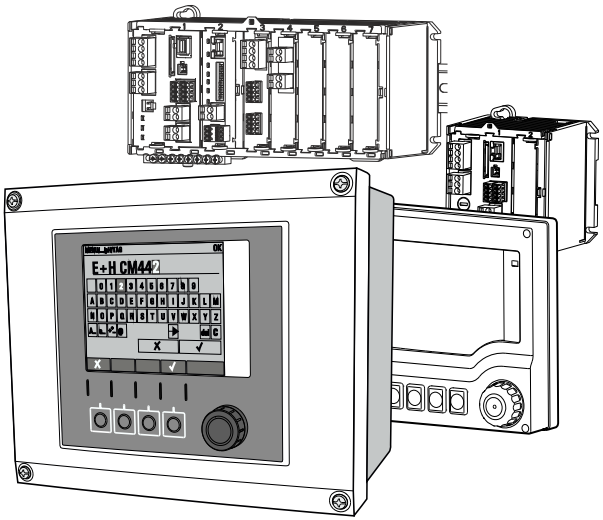
BA00450C/07/EN/17.13
71222845

Valid as of:
Softwareversion 01.04.00

Valid for:
CM442, CM444, CM448,
CM442R, CM444R, CM448R

Operating Instructions
Liquiline CM44x/CM44xR

Universal four-wire multichannel controller
Operation & settings



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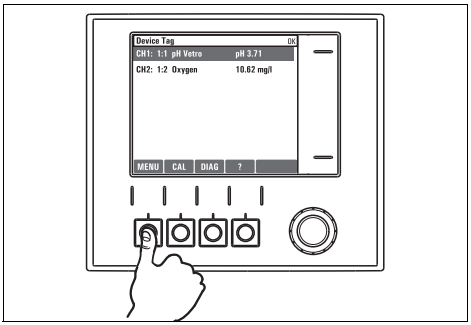
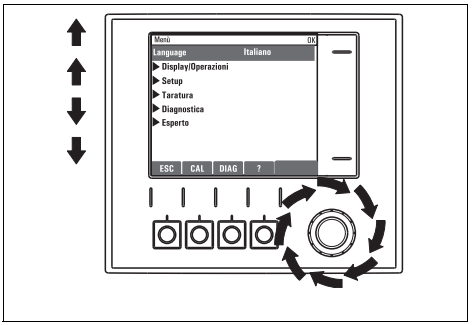
Operation concept

This operation concept is valid for CM44x (field device) and CM44xR (DIN rail device) alike. The figures below show the field device.



a0012790-en

Fig. 1: Pressing the soft key: selecting the menu directly



a0012791-en

Fig. 2: Turning the navigator: moving the cursor in the menu

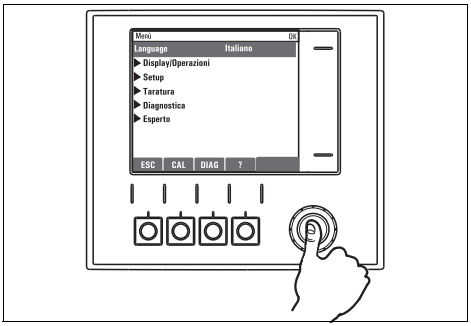


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Fig. 3: Pressing the navigator: launching a function

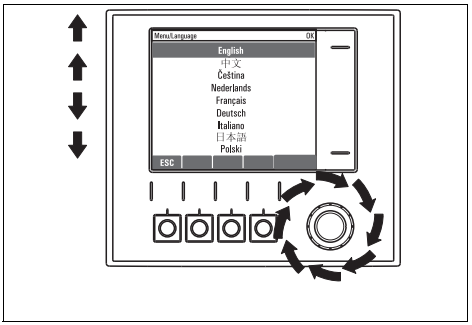

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Fig. 4: Turning the navigator: selecting a value (e.g. from a list)

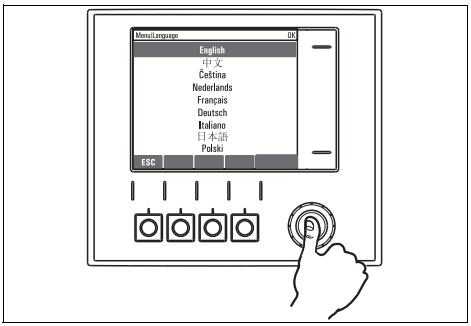

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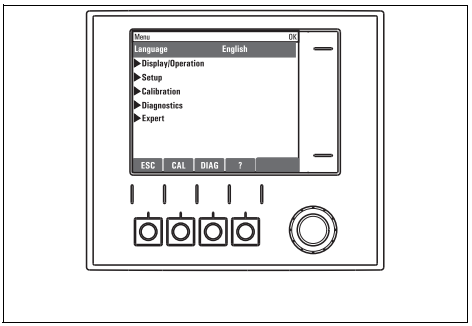
Fig. 5: Pressing the navigator: accepting the new value



a0012795-en

Fig. 6: Result: new setting is accepted

Table of contents

1 About this manual

This manual gives a detailed account of all the configuration options **in the menu "Setup"**.

A description of the following menus is provided here:
- Inputs
  - Input configuration
  - Split into separate sections based on the different types of sensor that can be connected
- Outputs
  - Output configuration
  - Split into separate sections based on the different output types
- Additional functions
  - Settings for alarm sensors and controllers
  - Cleaning program configuration
  - Mathematical functions
- Data management
  - Firmware updates
  - Saving and loading configurations
  - Enter activation codes for extended functions

This manual does not include the following:
- Setup/General settings
  --> Operating Instructions "Commissioning", BA00444C (CM44x) or BA01225C (CM44xR)
- Display/Operation
  --> Operating Instructions "Commissioning", BA00444C (CM44x) or BA01225C (CM44xR)
- Calibration
  --> Operating Instructions "Calibration", BA00451C
- Diagnostics
  --> Operating Instructions "Maintenance & Diagnostics", BA00445C (CM44x) or BA01227C (CM44xR)
- Expert
  --> Internal Service Manual

2 General settings

2.1 Basic settings

Path: Menu/Setup/General settings

Function	Options	Info
Device tag	Customized text, 32 characters	Select any name for your controller. Use the TAG name for example.
Temperature unit	Options ▪ °C ▪ °F ▪ K **Factory setting** °C	
Current output range	Options ▪ 0 to 20 mA ▪ 4 to 20 mA **Factory setting** 4 to 20 mA	In accordance with Namur NE43, the linear range is from 3.8 to 20.5 mA (Current output range="4 to 20 mA") or from 0 to 20.5 mA (Current output range="0 to 20 mA"). If the range is exceeded or undershot, the current value stops at the range limit and a diagnostics message (460 or 461) is output.
Error current	0.0 to 23.0 mA **Factory setting** 21.5 mA	The function meets NAMUR NE43. Set the current value that should be output at the current outputs in the event of an error.
The value for "Error current" should be outside the measuring range. If you decided that your Current output range = "-0 to 20 mA", you should set an error current between 20.1 and 23 mA. If the Current output range = "4 to 20 mA" you could also define a value < 4 mA as the error current. The device allows an error current within the measuring range. In such instances pay attention to possible affects this may have on your process.		
Alarm delay	0 to 9999 s **Factory setting** 0 s	The system only displays the errors that are present longer than the set delay time. This makes it possible to suppress messages that only occur briefly and are caused by normal process-specific fluctuations.
Device Hold	Options ▪ Disabled ▪ Enabled **Factory setting** Disabled	You can activate an immediate, general hold here. The function acts in the same way as the "HOLD" soft key in the measuring menus.

2.2 Date and time

Path: Menu/Setup/General settings/Date/Time

Function	Options	Info
Set date	Depends on the format	Editing mode: Day (two-digit): 01 to 31 Month (two-digit): 01 to 12 Year (four-digit): 1970 to 2106
Set time	Depends on the format	Editing mode: hh (hour): 00 to 23 / 0 am to 12 pm mm (minutes): 00 to 59 ss (seconds): 00 to 59
▶ Extended setup		
Date format	Options ▪ DD.MM.YYYY ▪ YYYY-MM-DD ▪ MM-DD-YYYY **Factory setting** DD.MM.YYYY	Decide which date format you want to use.
Time format	Options ▪ HH:MM am (12h) ▪ HH:MM (24h) ▪ HH:MM:SS (24h) **Factory setting** HH:MM:SS (24h)	Decide whether you want to use the 12-hour or 24-hour clock. Seconds can also be displayed with the latter version.
Time zone	Options ▪ None ▪ Choice of 35 time zones **Factory setting** None	If no time zone is selected, then Greenwich Mean Time is used (London).
DST	Options ▪ Off ▪ Europe ▪ USA ▪ Manual **Factory setting** Off	The controller adapts the summertime/normal time changeover automatically if you choose European or American daylight saving time. Manual means that you can specify the start and end of daylight saving time yourself. Here, two additional submenus are displayed in which you specify the changeover date and time.

2.3 Automatic hold

Path: Menu/Setup/General settings/Automatic hold

Function	Options	Info
▶ Device specific hold		
Setup menu Diagnostics menu	Options ▪ Disabled ▪ Enabled **Factory setting** Disabled	Decide whether a hold should be output at the current output when the particular menu is opened.
Calibration active	**Factory setting** Enabled	
Hold release time	0 to 600 s **Factory setting** 0 s	The hold is maintained for the duration of the delay time when you switch to the measuring mode.

If a device-specific hold is activated, any cleaning previously started is interrupted. When a hold is active you can only start manual cleaning.

2.4 Logbooks

Logbooks record the following events:
- Calibration/adjustment events
- Operator events
- Diagnostic events

Here you define how the logbooks should store the data.
In addition, you are also able to define individual data logbooks. Assign the logbook name and select the measured value to be recorded. You can set the scan time (Scan time) individually for every data logbook.
More information on the logbooks is provided in BA "Maintenance & Diagnostics", BA00445C (CM44x) or BA01227C (CM44xR), "Diagnostics menu" section.

Path: Menu/Setup/General settings/Logbooks

Function	Options	Info
Logbook ident	Free text	Part of the file name when exporting a logbook.
Event logbook	Options ▪ Off ▪ Ring buffer ▪ Fill up buffer **Factory setting** Ring buffer	All diagnostic messages are recorded **Ring buffer** If the memory is full, the most recent entry automatically overwrites the oldest entry. **Fill up buffer** If the memory is full, there is an overflow, i.e. no new values can be saved. The controller displays a corresponding diagnostic message. The memory then has to be cleared manually.
▶ Overflow warnings *Event logbook="Fill up buffer"*		
Calibration logbook	Options ▪ Off ▪ On **Factory setting** Off	Decide whether you want to receive a diagnostic message from the controller in the event of fill-up buffer overrun of the logbook in question.
Diagnostic logbook		
Configuration logbook		
▶ Data logbooks		
▶ New		You can create a maximum of 8 data logbooks.
Logbook name	Customized text, 20 characters	
Source of data	Options ▪ Sensor inputs ▪ Controller ▪ Current inputs ▪ Fieldbus signals ▪ Mathematical functions **Factory setting** None	Select a data source for the logbook entries. You can choose from connected sensors, available controllers, current inputs, fieldbus signals and mathematical functions.

Path: Menu/Setup/General settings/Logbooks

Function	Options	Info
Measured value	Options ▪ depend onSource of data **Factory setting** None	You can record different measured values depending on the data source.
Scan time	00:00:01 to 01:00:00 **Factory setting** 00:01:00	Minimum interval between two entries Format: HH:MM:SS
Data logbook	Options ▪ Off ▪ Ring buffer ▪ Fill up buffer **Factory setting** Off	**Ring buffer** If the memory is full, the most recent entry automatically overwrites the oldest entry. **Fill up buffer** If the memory is full, there is an overflow, i.e. no new values can be saved. The controller displays a corresponding diagnostic message. The memory then has to be cleared manually.
▷ Add another logbook	Action	*Only if you want to create another data logbook immediately.* You add a new data logbook at a later date using ▶ New.
▷ Finished	Action	This allows you to exit the menu ▶ New.
▷ Start/stop simultaneously	Action	Appears if you have created more than one data logbook. With one mouse click, you can start or stop recording all the data logbooks.
▶ "Logbook name"		The name of this submenu is based on the name of the logbook and only appears once you have created a logbook.
This menu appears several times if you have several data logbooks.		
Source of data Measured value	Read only	This is for information purposes only. If you want to record another value, delete this logbook and create a new data logbook.
Log time left *Data logbook="Fill up buffer"*	Read only	Displays the days, hours and minutes remaining until the logbook is full.
Log size *Data logbook="Ring buffer"*	Read only	Displays the number of entries remaining until the logbook is full.
Logbook name	Customized text, 20 characters	You can change the name here again.
Scan time	00:00:01 to 01:00:00 **Factory setting** 00:01:00	As above Minimum interval between two entries Format: HH:MM:SS

Path: Menu/Setup/General settings/Logbooks

Function	Options	Info
Data logbook	Options ▪ Off ▪ Ring buffer ▪ Fill up buffer **Factory setting** Off	**Ring buffer** If the memory is full, the most recent entry automatically overwrites the oldest entry. **Fill up buffer** If the memory is full, there is an overflow, i.e. no new values can be saved. The controller displays a corresponding diagnostic message. The memory then has to be cleared manually.
▶ Line plotter		Menu to define the graphic display
Axes	Options ▪ Off ▪ On **Factory setting** On	Should the axes (x, y) be displayed (On) or not (Off)?
Orientation	Options ▪ Horizontal ▪ Vertical **Factory setting** Horizontal	You can choose whether the value curves should be displayed from left to right ("Horizontal") or from top to bottom ("Vertical"). If you want to display two data logbooks simultaneously, make sure that both logbooks have the same settings here.
X-Description	Options ▪ Off ▪ On **Factory setting** On	Decide whether a description should be displayed for the axes and whether gridlines should be shown. In addition, you can also decide whether pitches should be displayed.
Y-Description		
Grids		
Pitches		
X Pitch/Grid distance	10 to 50% **Factory setting** 10 %	Specify the pitches.
Y Pitch/Grid distance		
▷ Remove	Action	This action removes the data logbook. Any data that have not been saved are lost.

Example for setting up a new data logbook

1. Menu/Setup/General settings/Logbooks/Data logbooks/New:
   a. Logbook name: Assign a name, e.g. "01".
   b. Source of data: Select a data source, e.g. the sensor connected to channel 1 (CH1).
   c. Measured value: Select the measured value that you want to record.
   d. Scan time: Specify the interval between two logbook entries.
   e. Data logbook: Activate the logbook. Specify the type of memory, "Ring buffer" or "Fill up buffer".
2. ../Finished: Execute this action.
   --> Your new logbook now appears in the list of data logbooks.
3. Select the data logbook with the name "01".
4. If you selected "Fill up buffer" you can also decide whether you want to receive a diagnostic message in the event of memory overrun.
5. Depending on the type of memory selected, you receive information about the memory space (for "Ring buffer") or the time remaining until memory overrun "Fill up buffer").
6. Define the graphic display mode in the "Line plotter" submenu.

2.5 Extended setup

2.5.1 Diagnostics settings

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.

Path: ... /Extended setup/Diagnostics settings/Diag. behavior

Function	Options	Info
List of diagnostic messages		Select the message to be changed. Only then can you make the settings for this message.
Diag. code	Read only	
Diagnostic message	Options ▪ On ▪ Off **Factory setting** Depends on the message	You can deactivate or reactivate a diagnostics message here. Deactivating means: ▪ No error message in the measuring mode ▪ No error current at the current output
Error current	Options ▪ On ▪ Off **Factory setting** Depends on the message	Decide whether an error current should be output at the current output if the diagnostic message display is activated.

Path: ... /Extended setup/Diagnostics settings/Diag. behavior

Function	Options	Info
Status signal	Options ▪ 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 you want to change a status signal assignment for your application.
Diag. output	Options ▪ None ▪ Alarm relay ▪ Relay 1 to n (depends on the device version) **Factory setting** None	You can use this function to select an output to which the diagnostic message should be assigned. Before you can assign the message to an output, you must first configure a relay output to "Diagnostics" (Menu/Setup/Outputs, assign the "Diagnostics" function and set the Operating mode to "as assigned").
An alarm relay is always available, regardless of the device version. Other relays are optional.		
Cleaning program	Options ▪ None ▪ Cleaning 1 ▪ Cleaning 2 ▪ Cleaning 3 ▪ Cleaning 4 **Factory setting** None	Decide whether the diagnostic message should trigger a cleaning program. You can define the cleaning programs under: Menu/Setup/Additional functions/Cleaning.
Detail information	Read only	Here you can find more information on the diagnostic message and instructions on how to resolve the problem.

2.5.2 HART bus address

If Multidrop is active (Bus address > 0), the current at current output 1 is fixed at 4 mA. Here, it does not matter what function has been assigned to the output (measured value/controller etc.). Current simulation is no longer possible.

Path: Menu/Setup/General settings/Extended setup/HART

Function	Options	Info
Bus address	0 to 63 **Factory setting** 0	You can change the device address to integrate several HART devices in a single network (Multidrop mode).

If you reset the device to the factory settings (Diagnostics/Systemtest/Reset/Factory default), the bus address is not reset. Your setting is retained.

2.5.3 PROFIBUS DP

Path: Menu/Setup/General settings/Extended setup/PROFIBUS

Function	Options	Info
Enable	Options ▪ Off ▪ On **Factory setting** Off	You can switch off PROFIBUS communication at this point. The software can then only be accessed via local operation.
Termination	Read only	If the device is the last in the bus, you can terminate via the hardware. --> BA00444C, "Wiring" section
Bus address	1 to 125	If you have addressed the bus via hardware (DIP switches on the module, --> BA00444C (CM44x) or BA01225C (CM44xR)), you can only read the address here. If an invalid address is set via the hardware, you have to assign a valid address for your device either here or via the bus.
Ident number	Options ▪ Automatic ▪ PA-Profile 3.02 (9760) ▪ Liquiline CM44x (155D) ▪ Liquiline CM44xR (155D) ▪ Liquistation CSFxx (155C) **Factory setting** Automatic	

2.5.4 Modbus

Path: Menu/Setup/General settings/Extended setup/Modbus

Function	Options	Info
Enable	Options ▪ Off ▪ On **Factory setting** Off	You can switch off Modbus communication at this point. The software can then only be accessed via local operation.
Termination	Read only	If the device is the last in the bus, you can terminate via the hardware. --> BA00444C or BA01225C, "Wiring" section
Settings		
Transmission Mode	Options ▪ TCP ▪ RTU ▪ ASCII	The transmission mode is displayed depending on the version ordered. In the case of RS485 transmission, you can choose between "RTU" and "ASCII".
Watchdog	0 to 999 s **Factory setting** 5 s	If no data transmission takes place for longer than the time set, this is an indicator that communication has been interrupted. After this time, input values received via the Modbus are considered to be invalid.

2.5.5 Ethernet

Path: Menu/Setup/General settings/Extended setup/Ethernet

Function	Options	Info
Enable	Options ▪ Off ▪ On **Factory setting** On	You can switch ethernet communication on and off at this point.
Settings		
Webserver	Options ▪ Off ▪ On **Factory setting** On	You can switch the internal Web server on and off at this point. **Off:** It is then not possible to access the device via the Web browser.
DHCP	Options ▪ Off ▪ On **Factory setting** Off	The Dynamic Host Configuration Protocol (DHCP) makes it possible to assign the network configuration to clients via a server. With DHCP, it is possible to automatically integrate the device into an existing network without the need for manual configuration. Normally, the client need only be configured for automatic retrieval of the IP addresses. During startup, the IP address, the netmask and the gateway are retrieved from a DHCP server.

Path: Menu/Setup/General settings/Extended setup/Ethernet

Function	Options	Info
IP-Address	xxx.xxx.xxx.xxx **Factory setting** 192.168.1.212	An IP address is an address in computer networks which are based on the Internet protocol (IP).
Netmask	xxx.xxx.xxx.xxx **Factory setting** 255.255.255.0	On the basis of the IP address of a device, the netmask specifies which IP addresses this device searches for in its own network and which addresses it could access in other networks via a router. It therefore divides the IP address into a network part (network prefix) and a device part. The network part must be identical for all devices in the individual network, and the device part must be different for every device within the network.
Gateway	x.x.x.x **Factory setting** 0.0.0.0	A gateway (protocol converter) enables communication between networks that are based on completely different protocols.
MAC-Address	Read only	The MAC address (Media Access Control address) is the hardware address of every individual network adapter which is used to uniquely identify the device in a computer network.
Modbus TCP port	Read only	The Transmission Control Protocol (TCP) is an arrangement (protocol) as to how data should be exchanged between computers. A port is a part of an address which assigns data segments to a network protocol.
Web server TCP port	Read only	

2.5.6 Data management

Firmware update

Please contact your local sales office for information on firmware updates available for your controller and its compatibility with earlier versions.
Your **current firmware version** can be found at: Menu/Diagnostics/System information/Software version.

First save your current setup on an SD card since a firmware update overwrites your settings with the factory settings. After updating the firmware, you can restore your setup by uploading it from the SD card.

To install a firmware update, you must have the update available on an SD card.

1. Insert the SD card into the controller card reader.
2. Go to: Menu/Setup/General settings/Extended setup/Data management/Firmware update.
   ↳ The update files on the SD card are displayed.
3. Select the desired update and select yes when the following question is displayed: The current firmware will be overwritten. After this the device will reboot. Do you want to proceed?
   ↳ The firmware is loaded and the device is then started with the new firmware.

Saving the setup

Saving the setup gives you the following advantages:
- Quick and easy to restore a setup following a firmware update
- Copying settings for other devices
- Quick and easy switching between various setups, e.g. for different user groups or for recurring sensor type change
- Restoring a tried-and-tested setup, e.g. if you have changed a lot of settings and no longer know what the original settings were

1. Insert the SD card into the controller card reader.
2. Go to: Menu/Setup/General settings/Extended setup/Data management/Save setup.
3. Assign a file name (Name).
4. Then select "Save".
5. If you have already assigned the file name, you will be asked whether you want to overwrite the existing setup.
6. Select "OK" to confirm, or cancel the action and give the file a new name.
   ↳ Your setup is stored on the SD card and you can upload it quickly to the device at a later date.

Loading the setup

You can load a setup you have saved quickly and easily

When you load a setup, the current configuration is overwritten. Note that cleaning and controller programs could be active. Do you want to continue anyway?

1. Insert the SD card into the controller card reader.
2. Go to: Menu/Setup/General settings/Extended setup/Data management/Load setup.
   ↳ A list of all the setups on the SD card is displayed.
3. Select the desired setup.
   ↳ The device then displays the following message:The current parameters will be overwritten and the device will reboot. Warning: Please note that cleaning and controller programs can be active. Do you want to proceed?
4. Select "OK" to confirm or cancel the action.
   ↳ The desired setup is restored after restarting the device.

Exporting the setup

Exporting the setup gives you the following advantages:
- Export in XML format with a stylesheet for formatted display in an XML-compatible application such as Microsoft Internet Explorer
- Importing the data (drag and drop the XML file into a browser window)

1. Insert the SD card into the controller card reader.
2. Go to: Menu/Setup/General settings/Extended setup/Data management/Export setup.
3. Assign a file name (Name).
4. Then select "Export".
5. If you have already assigned the file name, you will be asked whether you want to overwrite the existing setup.
6. Select "OK" to confirm, or cancel the action and give the file a new name.
   ↳ Your setup is saved on the SD card in a folder named "Device".

Activation code

You require activation codes for:
- Additional functions, e.g. fieldbus communication
- Software upgrades

If activation codes are available for your device, these codes are provided on the inner nameplate. The corresponding device functions are activated at the factory. You only require the codes if servicing the device.

1. Enter the activation code: Menu/Setup/General settings/Extended setup/Data management/Activation code.
2. Confirm your entry.

   ↳ Your new hardware or software function is activated and can be configured.

The table below tells you what functions an activation code enables:

Function	Activation code beginning with:
Second Memosens input (CM442 only)	062...
Two current outputs (BASE-E module only)	081...
HART	0B1...
PROFIBUS DP	0B3...
Modbus TCP	0B4...
Modbus RS485	0B5...
Measuring range switching, set 1	211...
Measuring range switching, set 2[1)]	212...
Feedforward control	220...

1) When you order the "Measuring range switching" option, you receive two activation codes. Enter both codes to have two sets for measuring range switching.

3 Information on sensors with the Memosens protocol

Sensors with the Memosens protocol have integrated electronics that save calibration data and other information. The sensor data are automatically communicated to the transmitter when the sensor is connected and are used to calculate the measured value.

Data digital sensors save include:
- Manufacturer data
  - Serial number
  - Order code
  - Date of manufacture
- Calibration data
  - Date of calibration
  - Calibration values
  - Number of calibrations
  - Serial number of the transmitter used to perform the last calibration
- Operating data
  - Date of initial commissioning
  - Hours of operation under extreme operating conditions
  - Sensor monitoring data

The specific data that are recorded and communicated to the transmitter depend on the sensor used. Differences can also occur within a sensor type.
This causes different menu items to be displayed or hidden depending on the sensor connected.
Pay attention to specific information in this manual.

Example:
The amperometric oxygen sensor COS51D cannot be sterilized. For this reason, you will not be able to define limit values for sterilization in the diagnostics settings for this sensor. On the other hand, these menu items are displayed for a sterilizable amperometric sensor, such as COS22D.

4 Inputs: General

4.1 Configuration

An input can be configured in one of two ways:

1. Configuration where a sensor is not connected
   - ▶ Select the appropriate channel.
   - ▶ From the list of sensor types, select the sensor which you want to configure.
   - ▶ Configure the channel as explained in following sections.
   - ▶ Connect the selected sensor type later on.
2. Configuration where a sensor is connected
   - ▶ Configure the channel as explained in following sections.

The following applies when configuring without a sensor:

- 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 (see "Data management" in the "General settings" section). This function might be a better option than performing a configuration when a sensor is not connected.

4.2 Frequently occurring functions

Some submenus are identical for all sensor types.
These submenus are explained below so you can find a description of these menus at one central place. Instead of repeating the description, the sensor-specific section then only contains a reference to this chapter.

4.2.1 Damping

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

Path: Menu/Setup/Inputs/<Sensor type>

Function	Options	Info
Damping <Sensor type>	0 to 600 s **Factory setting** 0 s	You specify the damping of the main measured value of the connected sensor and that of the integrated temperature sensor.
Damping temp.		

4.2.2 Manual hold

Path: Menu/Setup/Inputs/<Sensor type>

Function	Options	Info
Manual hold	Options ▪ On ▪ Off **Factory setting** Off	**On** You can use this function to set the channel manually to "Hold". **Off** No hold

4.2.3 Cleaning

Path: Menu/Setup/Inputs/<Sensor type>/Extended setup

Function	Options	Info
Cleaning	Options ▪ None ▪ Cleaning 1 ▪ Cleaning 2 ▪ Cleaning 3 ▪ Cleaning 4 **Factory setting** None	Select a cleaning program. This program is executed: ▪ In a specified interval To do so, the cleaning program must be started. ▪ If a diagnostic message is pending on the channel **and** a cleaning has been specified for this message (--> "Inputs/Diagnostics settings/Diag. behavior").

You define the cleaning programs in the "Setup/Additional functions/Cleaning" menu.

4.2.4 Calibration timer and calibration expiration date

You can specify the calibration interval for the sensor here.
Once the time configured elapses, the "Calibration timer" diagnostics message appears on the display.

The timer is reset automatically if you recalibrate the sensor.

Path: Menu/Setup/Inputs/<Sensor type>/Extended setup/Calib. settings

Function	Options	Info
Calibration timer	Options ▪ Off ▪ On **Factory setting** Off	Switches the function on or off
Calibration timer value *Calibration timer="On"*	14 to 365 d (chlorine sensor) 1 to 10000 h (all others) **Factory setting** 180 d (chlorine sensor) 1000 h (all others)	Specify the time after which the timer should have timed out. Once this time has elapsed, the "Calib. Timer" diagnostics message, along with the code 102, appears on the display.
Calib. expiration date	Options ▪ 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 much time has elapsed since the sensor was last calibrated. A diagnostics message is displayed if the time since the last calibration is longer than the predefined warning and alarm limit.
▶ Calib. expiration date		
Warning limit	**Factory setting** 11 months	Diagnostics message: 105 "Calib. validity"
Alarm limit	**Factory setting** 12 months	Diagnostics message: 104 "Calib. validity"
Warning and alarm limits mutually affect each other's possible ranges for adjustment. Range of adjustment which must include both limits: 1 to 24 months Generally the following applies: alarm limit > warning limit		

4.2.5 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 certain period (several measured values).

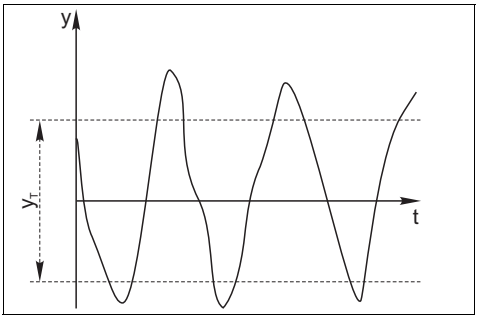


Fig. 7: Normal measuring signal, no alarm

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

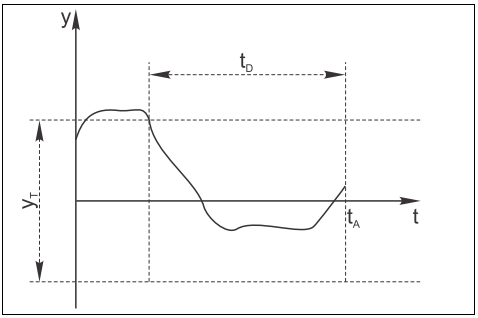


Fig. 8: Stagnating signal, alarm is triggered

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

The main causes of stagnating measured values are:
- Sensor fouled or outside the medium
- Sensor defective
- Process error (e.g. through control system)

Remedial action
- ▶ Clean the sensor.
- ▶ Check the position of the sensor in the medium.
- ▶ Check the measuring chain.
- ▶ Switch off the controller and switch it back on again.

Path: Menu/Setup/Inputs/<Sensor type>/Extended setup/Diagnostics settings

Function	Options	Info
▶ Process Check System		Diagnostics code and associated message text: 904 "Process check"
Function	Options ▪ On ▪ Off **Factory setting** Off	
Duration	1 to 240 min **Factory setting** 60 min	The measured value must change during this time. Otherwise the error message is triggered.

Path: Menu/Setup/Inputs/<Sensor type>/Extended setup/Diagnostics settings

Function	Options	Info
Tolerance width *Not available for pH/*ORP	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.

4.2.6 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.

Path: ... /Extended setup/Diagnostics settings/Diag. behavior

Function	Options	Info
List of diagnostic messages		Select the message to be changed. Only then can you make the settings for this message.
Diag. code	Read only	
Diagnostic message	Options ▪ On ▪ Off **Factory setting** Depends on the message	You can deactivate or reactivate a diagnostics message here. Deactivating means: ▪ No error message in the measuring mode ▪ No error current at the current output
Error current	Options ▪ On ▪ Off **Factory setting** Depends on the message	Decide whether an error current should be output at the current output if the diagnostic message display is activated.
Status signal	Options ▪ 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 you want to change a status signal assignment for your application.
Diag. output	Options ▪ None ▪ Alarm relay ▪ Relay 1 to n (depends on the device version) **Factory setting** None	You can use this function to select an output to which the diagnostic message should be assigned. Before you can assign the message to an output, you must first configure a relay output to "Diagnostics" (Menu/Setup/Outputs, assign the "Diagnostics" function and set the Operating mode to "as assigned").
An alarm relay is always available, regardless of the device version. Other relays are optional.		

Path: ... /Extended setup/Diagnostics settings/Diag. behavior

Function	Options	Info
Cleaning program	Options ▪ None ▪ Cleaning 1 ▪ Cleaning 2 ▪ Cleaning 3 ▪ Cleaning 4 **Factory setting** None	Decide whether the diagnostic message should trigger a cleaning program. You can define the cleaning programs under: Menu/Setup/Additional functions/Cleaning.
Detail information	Read only	Here you can find more information on the diagnostic message and instructions on how to resolve the problem.

4.2.7 Sterilizations

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

Path: Menu/Setup/Inputs/<Sensor type>/Extended setup/Diagnostics settings

Function	Options	Info
▶ Sterilizations	0 to 99	Specify the limit values for the number of sensor sterilizations.
Function	Options ▪ On ▪ Off **Factory setting** Off	
Warning limit	**Factory setting** 30[1)]	Diagnostics code and associated message text: 108 "Sterilization"

1) For oxygen: 25

4.2.8 Tag control

With this function, you specify which sensors are accepted at your device.

"Tag" stands for the name of a measuring point, and is used in many areas of process measuring technology.

Path: Menu/Setup/Inputs/<Sensor type>/Extended setup

Function	Options	Info
▶ Tag control		Additional information on the display: tag control currently used
Operating mode	Options ▪ Off ▪ Tag ▪ Group **Factory setting** Off	**Off** No tag control, all sensors are accepted. **Tag** Only sensors with the same tag are accepted. **Group** Only sensors in the same tag group are accepted.
Tag	Free text **Factory setting** EH_CM44_	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 tag.
Group	Numerical **Factory setting** 0	

4.2.9 Sensor replacement

When the sensor is replaced, the last measured value is retained via the "hold" function. A diagnostics message is not triggered.

4.2.10 Data processing factory setting

Here you can restore the factory settings for the sensor input. For this purpose, simply press the navigator button and select "OK" when the prompt for the device software appears.
Only the factory settings for this particular input are restored. All other settings remain unchanged.

4.2.11 Sensor factory setting

Here you can restore the sensor factory settings. For this purpose, simply press the navigator button and select "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.

5 Inputs: pH/ORP Incl. combi sensors

5.1 Basic settings

5.1.1 Sensor identification

Path: Menu/Setup/Inputs/<Sensor type>

Function	Options	Info
Channel	Options ▪ On ▪ Off **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

Path: Menu/Setup/Inputs/pH or Redox or pH/Redox

Function	Options	Info
Main value	Options ▪ pH(only pH sensor) ▪ mV ▪ % (only ORP sensor) ▪ Redox mV (only combi sensor) ▪ Redox % (only combi sensor) ▪ rH (only combi sensor) **Factory setting** pH (pH sensor and combi sensors) mV(ORP sensor)	Select how the main measured value should be displayed. You can display the main measured 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 combi sensor, you can also select the rH value. Subsequent configuration options depend on the option selected here.

5.1.3 Damping

--> "Inputs: General/Frequently occurring functions" section → 📄 21

5.1.4 Manual hold

--> "Inputs: General/Frequently occurring functions" section → 📄 21

5.2 Extended setup

5.2.1 Temperature and medium compensation (only pH)

Path: Menu/Setup/Inputs/pH or pH/Redox/Extended setup

Function	Options	Info
Temp. compensation	Options ▪ Off ▪ Automatic ▪ Manual **Factory setting** Automatic	Decide how you want to compensate the medium temperature: ▪ Automatically using the temperature sensor of your sensor (ATC) ▪ Manually by entering the medium temperature ▪ Not at all
This setting only refers to compensation during measurement. You enter the compensation for calibration in the calibration settings.		
Medium comp. *only pH sensor*	Options ▪ Off ▪ 2-point ▪ Table **Factory setting** Off	Take a sample from 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. You can balance out this effect with the "Medium compensation" function.		
Internal buffer *(only pH glass or combi sensor)*	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

Path: Menu/Setup/Inputs/pH or Redox or pH/Redox/Extended setup

Function	Options	Info
Main value format *(only pH)*	Options ▪ #.# ▪ #.## **Factory setting** #.#	Specify the number of decimal places for displaying the main measured value.
Temperature format	Options ▪ #.# ▪ #.## **Factory setting** #.#	Select how many decimal places should be used to display the temperature.

5.2.3 Cleaning

--> "Inputs: General/Frequently occurring functions" section → 📄 21

5.2.4 Calibration settings

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.

Path: Menu/Setup/Inputs/<Sensor type>/Extended setup/Calib. settings

Function	Options	Info
▶ Stability criteria		
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 range for measured value fluctuation should not be exceeded

Buffer recognition (only pH or combi sensor)

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 a pH of 9.00 for automatic buffer recognition.

Path: Menu/Setup/Inputs/pH or pH/Redox/Extended setup/Calib. settings

Function	Options	Info
Temp. compensation	Options ▪ Off ▪ Automatic ▪ Manual **Factory setting** Automatic	Decide how you want to compensate the buffer temperature: ▪ Automatically using the temperature sensor of your sensor (ATC) ▪ Manually by entering the buffer temperature ▪ Not at all

Path: Menu/Setup/Inputs/pH or pH/Redox/Extended setup/Calib. settings

Function	Options	Info
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. You perform the compensation in the measuring mode further down in the menu.		
Buffer recognition	Options ▪ Fixed ▪ Automatic*(only pH glass or combi sensor)* ▪ Manual **Factory setting** Fixed	**Fixed** You choose values from a list. This list depends on the setting for "Buffer manufacturer". **Automatic***(only pH glass or combi sensor)* The device recognizes the buffer automatically. The recognition depends on the setting for "Buffer manufacturer". **Manual** You enter any two buffer values. These must differ in terms of their pH value.
Buffer manufacturer	Options ▪ 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)* / 9.20 / 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
You have the possibility of defining two buffers of your own with the "Special buffer" option. For this purpose, two tables are displayed in which you can enter value pH value/temperature value pairs.		

Calibration timer and calibration expiration date

--> "Inputs: General/Frequently occurring functions" section → 21

5.2.5 Diagnostics settings

This menu branch is used for specifying warning limits, and for defining whether and how diagnostics tools should be used.
The associated diagnostics code is displayed for every setting.

Sensor check system (only pH glass or combi 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.

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

Path: Menu/Setup/Inputs/pH or pH/Redox/Extended setup/Diagnostics settings

Function	Options	Info
▶ Glass impedance (SCS)	0 to 10000 MΩ	Specify your limit values for monitoring the impedance of the pH glass.
Upper limit	Options ▪ On ▪ Off **Factory setting** On	**On** SCS operates with the following settings for the upper warning and alarm limits. **Off** SCS is switched off.
Upper alarm limit	**Factory setting** 2000 MΩ	Diagnostics code and associated message text: 124 "Sensor glass"
Upper warning limit	**Factory setting** 1600 MΩ	Diagnostics code and associated message text: 125 "Sensor glass"
Lower limit	Options ▪ On ▪ Off **Factory setting** On	**On** SCS operates with the following settings for the lower warning and alarm limits. **Off** SCS is switched off.
Lower warning limit	**Factory setting** 1 MΩ	Diagnostics code and associated message text: 123 "Sensor glass"
Lower alarm limit	**Factory setting** 0 MΩ	Diagnostics code and associated message text: 122 "Sensor glass"

The upper and lower limit values of the glass SCS value can be switched on or off independently of each other.

Slope (only pH or combi sensor)

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

Path: Menu/Setup/Inputs/pH or pH/Redox/Extended setup/Diagnostics settings

Function	Options	Info
▶ Slope	5.00 to 99.00 mV/pH	Specify your limit values for slope monitoring.
Warning limit	**Factory setting** 55.00 mV/pH	Associated diagnostics code and message text: 509 "Sensor calib."

Zero point (only pH glass or combi sensor) or Operating point (only 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.

Path: Menu/Setup/Inputs/pH or pH/Redox/Extended setup/Diagnostics settings

Function	Options	Info
▶ Zero point *(pH glass or combi sensor)* Operating point *(pH ISFET)*	**pH glass** -2.00 to 16.00 **pH ISFET** -950 mV to 950 mV	Specify your limit values for zero point or operating point monitoring.
Upper warning limit	**Factory setting** pH 8.00 / 300 mV	Associated diagnostics code and message text: 505 "Sensor calib." (pH glass) 515 "Sensor calib." (pH ISFET)
Lower warning limit	**Factory setting** pH 6.00 / -300 mV	Associated diagnostics code and message text: 507 "Sensor calib." (pH glass) 517 "Sensor calib." (pH ISFET)

Sensor condition check (only pH glass or combi sensor)

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

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

Remedial action
- ▶ Clean or regenerate the sensor.
- ▶ Replace the sensor if this does not have the desired effect.

Path: Menu/Setup/Inputs/pH or pH/Redox/Extended setup/Diagnostics settings

Function	Options	Info
▶ Sensor Condition Check		The function can only be switched on or off. It uses internal limit values
Function	Options ▪ On ▪ Off **Factory setting** On	Diagnostics code and associated message text: 127 "SCC sufficient" 126 "SCC bad"

Redox-Meas value (only ORP or combi sensor in ORP or rH mode)

You can specify limit values in order to monitor your process. A diagnostics message is displayed if the limits are exceeded or undershot.

Path: Menu/Setup/Inputs/Redox or pH/Redox/Extended setup/Diagnostics settings

Function	Options	Info
▶ Redox-Meas value		Specify your limit values for monitoring the measured 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"

Process check system

--> "Inputs: General/Frequently occurring functions" section → 📄 21

Limits operating hours

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 you specify warning limits for operating times under extreme conditions, you can guarantee the operation of your measuring point without any downtime by performing maintenance tasks in time.

Path: Menu/Setup/Inputs/pH or Redox or pH/Redox/Extended setup/Diagnostics settings

Function	Options	Info
▶ Limits operating hours		Specify your limit values for monitoring the number of operating hours under extreme conditions.
The range of adjustment for the operating hours alarm and warning limits is generally 1 to 50000 h.		
Function	Options ▪ On ▪ Off **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* or combi sensor
Warning limit	**Factory setting** 10000 h	Diagnostics code and associated message text: 180 "Operating time"
▶ Operation > 300 mV		*only pH* or combi sensor
Warning limit	**Factory setting** 10000 h	Diagnostics code and associated message text: 179 "Operating time"

Delta slope(only pH)

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.

Path: Menu/Setup/Inputs/pH or pH/Redox/Extended setup/Diagnostics settings

Function	Options	Info
▶ Delta slope	0.10 to 10.00 mV/pH	Specify your limit values for monitoring the slope differential.
Function	Options ▪ On ▪ Off **Factory setting** Off	
Warning limit	**Factory setting** 5.00 mV/pH	Diagnostics code and associated message text: 518 "Sensor calib."

Delta zero point (only pH glass or combi sensor) or Delta operating point (only pH 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.

Path: Menu/Setup/Inputs/pH or pH/Redox/Extended setup/Diagnostics settings

Function	Options	Info
▶ Delta zero point *(pH glass or combi sensor)* Delta operating point *(pH ISFET)*	**pH glass** pH 0.00 to 2.00 **pH ISFET** 0 to 950 mV	Specify your limit values for monitoring the zero point or operating point differential.
Function	Options ▪ On ▪ Off **Factory setting** Off	
Warning limit	**Factory setting** pH 0.50 / 25 mV	Diagnostics code and associated message text: 520 "Sensor calib." (pH glass) 522 "Sensor calib." (pH ISFET)

Sterilizations

--> "Inputs: General/Frequently occurring functions" section → 21

Diagnostic behavior

--> "Inputs: General/Frequently occurring functions" section → 21

5.2.6 Tag control

--> "Inputs: General/Frequently occurring functions" section → 21

5.2.7 Sensor replacement

--> "Inputs: General/Frequently occurring functions" section → 21

5.2.8 Data processing factory setting

--> "Inputs: General/Frequently occurring functions" section → 21

6 Inputs: Conductivity

6.1 Basic settings

6.1.1 Sensor identification

Path: Menu/Setup/Inputs/<Sensor type>

Function	Options	Info
Channel	Options ▪ On ▪ Off **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

--> "Inputs: General/Frequently occurring functions" section → 21

6.1.3 Manual hold

--> "Inputs: General/Frequently occurring functions" section → 21

6.1.4 Operating mode and cell constant

Path: Menu/Setup/Inputs/Conductivity

Function	Options	Info
Operating mode	Options ▪ Conductivity ▪ Resistance *(only Cond c)* ▪ Concentration *(only Cond i)* ▪ TDS *(only Cond c)* **Factory setting** Conductivity	Alternatively to the conductivity, you can also measure the resistivity and the total dissolved solids (TDS) parameter with a **conductive conductivity sensor**. Alternatively to the conductivity, you can determine the concentration of the medium with an **inductive conductivity sensor**. **TDS** TDS stands for all the organic and inorganic substances in the water in ionic, molecular or microgranular (<2 µm) form. Compared with laboratory methods (gravimetric analysis), TDS measurement via the conductivity value delivers a maximum measured error of less than 10%.
Cell constant	Read only (Only available if a sensor is connected)	The cell constant of the connected sensor is displayed (--> sensor certificate)

6.1.5 Installation factor (only inductive sensors)

Path: Menu/Setup/Inputs/Conductivity

Function	Options	Info
Inst. factor	Read only (Only available if a sensor is connected)	Displays the current value. Only changes with a calibration.

In confined installation conditions, the wall affects conductivity measurement in the liquid. The installation factor compensates for this effect. The transmitter corrects the cell constant by multiplying by the installation factor.
The size of the installation factor depends on the diameter and the conductivity of the pipe nozzle, as well as the distance between the sensor and the wall.
If there is a sufficient distance between the wall and the sensor (a > 15 mm (0.59"), from DN 80), the installation factor f does not have to be taken into consideration (f = 1.00).
If distances from the wall are smaller, the installation factor is bigger for electrically insulating pipes (f >1), and smaller for electrically conductive pipes (f < 1).
It can be measured using calibration solutions, or a close approximation determined from the following diagram.

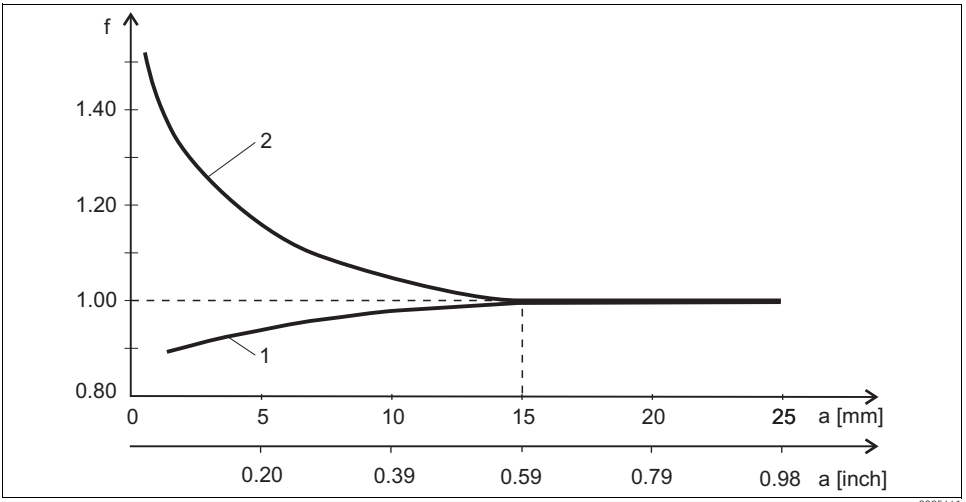


Fig. 9: Relation between the installation factor f and the wall distance

1 Electrically conductive pipe wall
2 Electrically insulating pipe wall

6.1.6 Concentration table (only inductive sensors)

Path: Menu/Setup/Inputs/Conductivity

Function	Options	Info
Conc. Table *(Operating mode=Concentration)*	Options ▪ NaOH 0..15% ▪ HCl 0..20% ▪ HNO3 0..25% ▪ HNO3 24..30% ▪ H2SO4 0..28% ▪ H2SO4 40..80% ▪ H2SO4 93..100% ▪ H3PO4 0..40% ▪ NaCl 0..26% ▪ User table 1 ▪ User table 2 ▪ User table 3 ▪ User table 4 **Factory setting** NaOH 0..15%	Concentration tables saved at the factory: NaOH: 0 to 15%, 0 to 100 °C (32 to 212 °F) HCl: 0 to 20%, 0 to 65 °C (32 to 149 °F) HNO_3: 0 to 25%, 2 to 80 °C (36 to 176 °F) H_2SO_4: 0 to 28%, 0 to 100 °C (32 to 212 °F) H_2SO_4: 40 to 80%, 0 to 100 °C (32 to 212 °F) H_2SO_4: 93 to 100%, 0 to 100 °C (32 to 212 °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 *(Operating mode=Concentration)*	Options ▪ with temp. comp ▪ without temp. comp **Factory setting** with temp. comp	Only select "without temp. comp" in very small temperature ranges. In all other cases, select "with temp. comp".
Table name *(Conc. Table=one of the user tables)*	Customized text, 16 characters	Assign a meaningful name to the selected table.
▶ Edit table *(Conc. Table=one of the user tables)*	3-column table	Assign conductivity and concentration value pairs for a specific temperature.
Conc. unit *(Operating mode=Concentration)*	**Read only** %	This is for information purposes only. No options are available.

Example of a concentration table:

Conductivity (uncompensated)	Concentration	Temperature
1.000 mS/cm	0.000 mg/l	0.00 °C
2.000 mS/cm	0.000 mg/l	100.00 °C
100.0 mS/cm	3.000 mg/l	0.00 °C
300.0 mS/cm	3.000 mg/l	100.00 °C

Values must be constantly increasing or decreasing.

6.1.7 Unit and format

Path: Menu/Setup/Inputs/Conductivity

Function	Options	Info
Main value format	Options ▪ Auto ▪ # ▪ #.# ▪ #.## ▪ #.### **Factory setting** Auto	Specify the number of decimal places.
Cond. unit *(Operating mode=Conductivity)* Unit *(Operating mode=Resistance)*	Options Conductivity/resistance ▪ Auto / Auto ▪ µS/cm / MΩm ▪ mS/cm / MΩcm ▪ S/cm / kΩcm ▪ µS/m / kΩm ▪ mS/m / Ωm ▪ S/m / Ωcm **Factory setting** Auto / Auto	The picklist depends on the operating mode. You can either choose from units for conductivity or units for resistivity. Since there are no options for concentration measurement, this function is not displayed for such measurements.

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.

Path: Menu/Setup/Inputs/Conductivity

Function	Options	Info
Temp. source	Options ▪ 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 °F)	Enter the temperature of your medium.

Path: Menu/Setup/Inputs/Conductivity

Function	Options	Info
Compensation *(Operating mode=Conductivity)*	Options ▪ None ▪ Linear ▪ NaCl (IEC 746-3) ▪ Water ISO7888 (20°C) ▪ Water ISO7888 (25°C) ▪ UPW NaCl ▪ UPW HCl ▪ User table 1 ▪ User table 2 ▪ User table 3 ▪ User table 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 thus measure uncompensated conductivity.

Linear temperature compensation

The change between two temperature points is taken to be constant, i.e. α = const. The value for alpha remains stored in the sensor and is recalculated for each calibration.

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

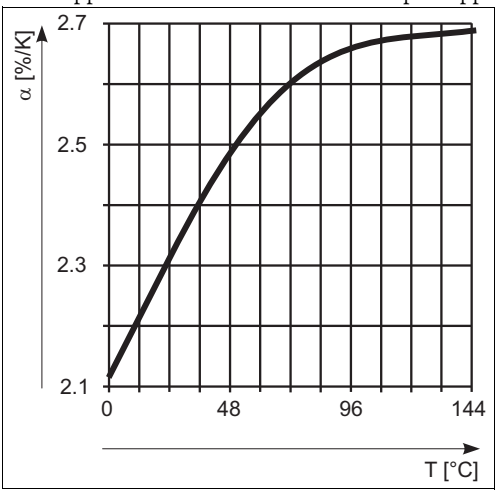
The alpha coefficients and alpha reference temperatures of your process medium must be known. Typical alpha coefficients at a reference temperature from 25 °C are:

- 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

Path: Menu/Setup/Inputs/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 conductivity 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 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 values up to approx. 100 µS/cm.

- UPW NaCl: Optimized for pH-neutral contamination.
- UPW HCl: Optimized for measuring the acid conductivity downstream of a cation exchanger. Also suitable for ammonia (NH_3) and caustic soda (NaOH).

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 κwith:
- $\kappa(T_0)$ for the reference temperature T_0
- $\kappa(T)$ for the temperatures that occur in the process

Use the following formula to calculate the αvalues 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.

Path: Menu/Setup/Inputs/Conductivity

Function	Options	Info
Temp. comp. mode *(Compensation=one of the user tables)*	Options ▪ 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 *(Compensation=one of the user tables)*	Customized text, 16 characters	Assign a meaningful name to the selected table.
▶ Edit table *(Compensation=one of the user tables)*	▪ Temperature ▪ Conductivity ▪ Temperature comp. cond. or ▪ Temperature ▪ Coefficient alpha	Maximum number of rows: 25 The type of table depends on the option under "Temp. comp. mode".

6.2 Extended setup

6.2.1 Temperature format

Path: Menu/Setup/Inputs/<Sensor type>/Extended setup

Function	Options	Info
Temperature format	Options ▪ #.# ▪ #.## **Factory setting** #.#	Select how many decimal places should be used to display the temperature.

6.2.2 Cleaning

--> "Inputs: General/Frequently occurring functions" section → 📄 21

6.2.3 Diagnostics settings

This menu branch is used for specifying warning limits, and for defining whether and how diagnostics tools should be used.
The associated diagnostics code is displayed for every setting.

Process check system

--> "Inputs: General/Frequently occurring functions" section → 📄 21

Limits operating hours

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 you specify warning limits for operating times under extreme conditions, you can guarantee the operation of your measuring point without any downtime by performing maintenance tasks in time.

Path: Menu/Setup/Inputs/Conductivity/Extended setup/Diagnostics settings

Function	Options	Info
▶ Limits operating hours		
The range of adjustment for the operating hours alarm and warning limits is generally 1 to 50000 h.		
Function	Options ▪ On ▪ Off **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** 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 > 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 sensors*
Warning limit	**Factory setting** 10000 h	Diagnostics code and associated message text: 198 "Operating time"

Path: Menu/Setup/Inputs/Conductivity/Extended setup/Diagnostics settings

Function	Options	Info
▶ 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"

Sterilizations

--> "Inputs: General/Frequently occurring functions" section → 21

Diagnostic behavior

--> "Inputs: General/Frequently occurring functions" section → 21

Polarization detection (only conductive 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 uses suitable compensation. You can view the measuring range limits of the sensor under Diagnostics/Sensor information/Sensor specifications.

Path: Menu/Setup/Inputs/Conductivity/Extended setup/Diagnostics settings/Polarization detetected

Function	Options	Info
Polarization detetected	Options ▪ On ▪ Off **Factory setting** Off	Diagnostics code and associated message text: 168 "Polarization"

6.2.4 Pharmaceutical water

Here you can make settings for monitoring pharmaceutical water in accordance with the United States Pharmacopeia (USP) or European Pharmacopeia (EP).
The uncompensated conductivity value and the temperature are measured for the limit functions. The measured values are compared with the tables defined in the standards. If the limit is exceeded, an alarm is triggered. Furthermore, you can also set a preliminary alarm (warning limit) which signals undesired operating states before they occur.

Path: Menu/Setup/Inputs/Conductivity/Extended setup/Diagnostics settings/Pharmacy-water

Function	Options	Info
Function	Options ▪ Off ▪ EP ▪ USP **Factory setting** Off	The alarm values are stored in the device in accordance with USP or EP specifications. You define the warning limit as a % of the alarm value.
Warning limit	10.0 to 99.9 % **Factory setting** 80.0 %	Diagnostics code and associated message text: 915 "USP / EP warning" If the value exceeds the USP or EP alarm values saved in the software, diagnostics message 914 "USP/ EP alarm" is displayed.

6.2.5 Tag control

--> "Inputs: General/Frequently occurring functions" section → 21

6.2.6 Sensor replacement

--> "Inputs: General/Frequently occurring functions" section → 21

6.2.7 Data processing factory setting

--> "Inputs: General/Frequently occurring functions" section → 21

6.2.8 Sensor factory setting (only CLS50D)

--> "Inputs: General/Frequently occurring functions" section → 21

7 Inputs: Oxygen

7.1 Basic settings

7.1.1 Sensor identification

Path: Menu/Setup/Inputs/<Sensor type>

Function	Options	Info
Channel	Options ▪ On ▪ Off **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

Path: Menu/Setup/Inputs/DO

Function	Options	Info
Main value	Options ▪ Concentration liquid ▪ Concentration gaseous ▪ Saturation ▪ Partial pressure ▪ Raw value nA (only Oxygen (amp.)) ▪ Raw value µs (only Oxygen (opt.)) **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.

7.1.3 Damping

--> "Inputs: General/Frequently occurring functions" section → 📄 21

7.1.4 Unit

Path: Menu/Setup/Inputs/DO

Function	Options	Info
Unit *Main value="Concentration liquid" or "Concentration gaseous"*	Options *(Main value="Concentration liquid")* ▪ mg/l ▪ µg/l ▪ ppm ▪ ppb Options *(Main value="Concentration gaseous")* ▪ %Vol ▪ ppmVol *(Main value="Concentration gaseous"* **Factory setting** mg/l %Vol	

7.1.5 Manual hold

--> "Inputs: General/Frequently occurring functions" section → 21

7.2 Extended setup

7.2.1 Temperature compensation (only amperometric sensors)

Path: Menu/Setup/Inputs/DO/Extended setup

Function	Options	Info
Temp. compensation	Options ▪ 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)*	0.0 to 80.0 °C (32.0 to 176.0 °F) **Factory setting** 20.0 °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

Path: Menu/Setup/Inputs/DO or Chlorine/Extended setup[1)]

Function	Options	Info
Main value format	Options ▪ #.# ▪ #.## ▪ #.### ▪ # **Factory setting** #.##	Specify the number of decimal places for displaying the main measured value.
Temperature format	Options ▪ #.# ▪ #.## **Factory setting** #.#	Select how many decimal places should be used to display the temperature.

1) In the case of chlorine, the sequence of the two menu functions is reversed

7.2.3 Medium compensation (in the process)

Path: Menu/Setup/Inputs/DO/Extended setup

Function	Options	Info
Medium pressure	Options ▪ Process pressure ▪ Air pressure ▪ Altitude **Factory setting** Air pressure	
Altitude *Medium pressure="Altitude"*	-300 to 4000 m **Factory setting** 0 m	Enter the altitude **or** the average air pressure (mutually dependent values). If you specify the altitude, the average air pressure is calculated from the barometric altitude formula and vice versa. If you are compensating using the process pressure, enter the pressure in your process here. The pressure is then independent of the altitude.
Air pressureorProcess pressure	*Medium pressure="Air pressure"* 500 to 1200 hPa *Medium pressure="Process pressure"* 500 to 9999 hPa **Factory setting** 1013 hPa	
Salinity	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).

7.2.4 Cleaning

Path: Menu/Setup/Inputs/<Sensor type>/Extended setup

Function	Options	Info
Cleaning	Options ▪ None ▪ Cleaning 1 ▪ Cleaning 2 ▪ Cleaning 3 ▪ Cleaning 4 **Factory setting** None	Select a cleaning program. This program is executed: ▪ In a specified interval To do so, the cleaning program must be started. ▪ If a diagnostic message is pending on the channel **and** a cleaning has been specified for this message (--> "Inputs/Diagnostics settings/Diag. behavior").

You define the cleaning programs in the "Setup/Additional functions/Cleaning" menu.

7.2.5 Calibration settings

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.

Path: Menu/Setup/Inputs/Oxygen/Extended setup/Calib. settings

Function	Options	Info
▶ Stability criteria		
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 partial pressure 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** 20 s	Timeframe within which the permitted range for measured value fluctuation should not be exceeded

Medium compensation (during calibration)

Path: Menu/Setup/Inputs/DO/Extended setup/Calib. settings

Function	Options	Info
Medium pressure	Options ▪ Process pressure ▪ Air pressure ▪ Altitude **Factory setting** Air pressure	
Altitude *Medium pressure="Altitude"*	-300 to 4000 m **Factory setting** 0 m	Enter the altitude **or** the average air pressure (mutually dependent values). If you specify the altitude, the average air pressure is calculated from the barometric altitude formula and vice versa. If you are compensating using the process pressure, enter the pressure in your process here. The pressure is then independent of the altitude.
Air pressureorProcess pressure	*Medium pressure="Air pressure"* 500 to 1200 hPa *Medium pressure="Process pressure"* 500 to 9999 hPa **Factory setting** 1013 hPa	
Rel. hum. (air variable)	0 to 100 % **Factory setting** 100 %	

Calibration timer and calibration expiration date

--> "Inputs: General/Frequently occurring functions" section → 21

7.2.6 Diagnostics settings

This menu branch is used for specifying warning limits, and for defining whether and how diagnostics tools should be used.
The associated diagnostics code is displayed for every setting.

Slope

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.

Path: Menu/Setup/Inputs/DO/Extended setup/Diagnostics settings

Function	Options	Info
▶ Slope	0.0 to 200.0 %	Specify the limit values for slope monitoring in your sensor.
Upper warning limit	**Factory setting** 140.0 %	Diagnostics code and associated message text: 511 "Sensor calib."
Lower warning limit	**Factory setting** 60.0 %	Diagnostics code and associated message text: 509 "Sensor calib."

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 diaphragm or electrolyte contamination. Replace the diaphragm and electrolyte as specified in the instructions in the sensor operating manual.

Path: Menu/Setup/Inputs/DO/Extended setup/Diagnostics settings

Function	Options	Info
▶ Delta slope	0.0 to 50.0 %	Specify the limit values for monitoring the slope differential.
Function	Options ▪ On ▪ Off **Factory setting** On	
Warning limit	**Factory setting** 5.0 %	Diagnostics code and associated message text: 518 "Sensor calib."

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.

Path: Menu/Setup/Inputs/DO/Extended setup/Diagnostics settings

Function	Options	Info
▶ Zero point	0.0 to 10.0 nA	Specify the limit values for zero point monitoring in your sensor.
Warning limit	**Factory setting** 3.0 nA	Diagnostics code and associated message text: 513 "Zero Warn"

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.

Path: Menu/Setup/Inputs/DO/Extended setup/Diagnostics settings

Function	Options	Info
▶ Delta zero point	0.0 to 10 nA	Specify your limit values for monitoring the zero point differential.
Function	Options ▪ On ▪ Off **Factory setting** Off	
Warning limit	**Factory setting** 1.0 nA	Diagnostics code and associated message text: 520 "Sensor calib."

Cap calibrations (only amperometric sensors)

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.

Path: Menu/Setup/Inputs/DO/Extended setup/Diagnostics settings

Function	Options	Info
▶ Number of cap calibrations		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.
Function	Options ▪ On ▪ Off **Factory setting** Off	
Warning limit	0 to 1000 **Factory setting** 6	Diagnostics code and associated message text: 535 "Sensor check"

Cap sterilizations (only sterilizable, amperometric sensors)

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

Path: Menu/Setup/Inputs/DO/Extended setup/Diagnostics settings

Function	Options	Info
▶ Number of cap sterilizations		Specify how many sterilizations 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.
Function	Options ▪ On ▪ Off **Factory setting** Off	
Warning limit	0 to 100 **Factory setting** 25	Diagnostics code and associated message text: 109 "Sterilizat. cap"

Sterilizations (only sterilizable sensors)

--> "Inputs: General/Frequently occurring functions" section → 21

Process check system

--> "Inputs: General/Frequently occurring functions" section → 21

Limits operating hours

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 you specify warning limits for operating times under extreme conditions, you can guarantee the operation of your measuring point without any downtime by performing maintenance tasks in time.

Path: Menu/Setup/Inputs/DO/Extended setup/Diagnostics settings

Function	Options	Info
▶ Limits operating hours		
The range of adjustment for the operating hours alarm and warning limits is generally 1 to 50000 h.		
Function	Options ▪ On ▪ Off **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** 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 optical sensors*
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"
▶ Operation > 40°C		*only COS22D, COS61D*
Warning limit	**Factory setting** 10000 h	Diagnostics code and associated message text: 192 "Operating time"

Path: Menu/Setup/Inputs/DO/Extended setup/Diagnostics settings

Function	Options	Info
▶ Operation > 80°C		*only COS22D*
Warning limit	**Factory setting** 10000 h	Diagnostics code and associated message text: 193 "Operating time"
▶ (Operation above first specified nA value)		*Only amperometric sensors, sensor-specific limit* – *COS22D: >15 nA* – *COS51D: >30 nA*
Warning limit	**Factory setting** 10000 h	Diagnostics code and associated message text: 183 "Operating time" (COS22D) 184 "Operating time" (COS51D)
▶ (Operation above second specified nA value)		*Only amperometric sensors, sensor-specific limit* – *COS22D: >50 nA* – *COS51D: >160 nA*
Warning limit	**Factory setting** 10000 h	Diagnostics code and associated message text: 185 "Operating time" (COS22D) 186 "Operating time" (COS51D)
▶ Operation < 25 µs		*Only optical sensors (µS = fluorescence decay time, raw value of optical measurement)*
Warning limit	**Factory setting** 10000 h	Diagnostics code and associated message text: 181 "Operating time"
▶ Operation > 40 µs		*Only optical sensors*
Warning limit	**Factory setting** 10000 h	Diagnostics code and associated message text: 182 "Operating time"

Diagnostic behavior

--> "Inputs: General/Frequently occurring functions" section → 📄 21

7.2.7 Tag control

--> "Inputs: General/Frequently occurring functions" section → 📄 21

7.2.8 Sensor replacement

--> "Inputs: General/Frequently occurring functions" section → 📄 21

7.2.9 Data processing factory setting

--> "Inputs: General/Frequently occurring functions" section → 📄 21

7.2.10 Sensor factory setting (only COS61D)

--> "Inputs: General/Frequently occurring functions" section → 📄 21

8 Inputs: Chlorine

8.1 Basic settings

8.1.1 Sensor identification

Path: Menu/Setup/Inputs/<Sensor type>

Function	Options	Info
Channel	Options ▪ On ▪ Off **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

8.1.2 Main value

Path: Menu/Setup/Inputs/Chlorine

Function	Options	Info
Main value	Options ▪ Concentration ▪ Sensor current (nA) **Factory setting** Concentration	Decide how you want to display the main value.

8.1.3 Damping

--> "Inputs: General/Frequently occurring functions" section → 21

8.1.4 Manual hold

--> "Inputs: General/Frequently occurring functions" section → 21

8.1.5 Unit

Path: Menu/Setup/Inputs/Chlorine

Function	Options	Info
Unit *Main value="Concentration liquid"*	Options ▪ mg/l ▪ µg/l ▪ ppm ▪ ppb **Factory setting** mg/l	

8.2 Extended setup

8.2.1 Measured value formats

Path: Menu/Setup/Inputs/DO or Chlorine/Extended setup[1)]

Function	Options	Info
Main value format	Options ▪ #.# ▪ #.## ▪ #.### ▪ # **Factory setting** #.##	Specify the number of decimal places for displaying the main measured value.
Temperature format	Options ▪ #.# ▪ #.## **Factory setting** #.#	Select how many decimal places should be used to display the temperature.

1) In the case of chlorine, the sequence of the two menu functions is reversed

8.2.2 Medium compensation (in the process)

Path: Menu/Setup/Inputs/Chlorine/Extended setup

Function	Options	Info
Medium comp. (pH)	Options ▪ Off ▪ On **Factory setting** On	**Off** The concentration measured value is calculated as HClO (=free available chlorine). **On** The pH value is used to calculate a cumulative concentration value from HClO and ClO^- (=total chlorine).
Mode *Medium comp. (pH)="On"*	Options ▪ Fixed value ▪ Measured value **Factory setting** Fixed value	Decide whether you want to specify a fixed pH value for calculating the total chlorine or whether the measured value of a pH sensor attached to another input should be used.
Fixed pH *Mode="Fixed value"*	4.00 to 9.00 pH **Factory setting** 7.20 pH	Useful for media with a constant pH value Enter the pH value of your medium which you determined with a reference measurement.
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. The measured value of the sensor is then continuously used to calculate the total chlorine.
Temp. compensation	Options ▪ Off ▪ Automatic ▪ Manual **Factory setting** Automatic	Decide whether and how you want to compensate the medium temperature: ▪ No compensation ▪ Automatically using the temperature sensor of your sensor ▪ Manually by entering the medium temperature
Medium 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 your medium.

8.2.3 Cleaning

--> "Inputs: General/Frequently occurring functions" section → 21

8.2.4 Calibration settings

Calibration timer and calibration expiration date

--> "Inputs: General/Frequently occurring functions" section → 21

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.

Path: Menu/Setup/Inputs/Chlorine/Extended setup/Calib. settings

Function	Options	Info
▶ Stability criteria		
Delta signal	0.1 to 5.0 % **Factory setting** 1 %	Permitted measured value fluctuation during calibration. (With reference to the raw value in nA)
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

8.2.5 Diagnostics settings

This menu branch is used for specifying warning limits, and for defining whether and how diagnostics tools should be used.
The associated diagnostics code is displayed for every setting.

Slope

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.

Path: Menu/Setup/Inputs/Chlorine/Extended setup/Diagnostics settings

Function	Options	Info
▶ Slope	3.0 to 500.0 %	Specify the limit values for slope monitoring in your sensor.
Upper warning limit	**Factory setting** 200.0 %	Diagnostics code and associated message text: 511 "Sensor calib."
Lower warning limit	**Factory setting** 25.0 %	Diagnostics code and associated message text: 509 "Sensor calib."

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 buildup on the sensor diaphragm or electrolyte contamination. Replace the diaphragm and electrolyte as specified in the instructions in the sensor operating manual.

Path: Menu/Setup/Inputs/Chlorine/Extended setup/Diagnostics settings

Function	Options	Info
▶ Delta slope	1 to 15 %	Specify the limit values for monitoring the slope differential.
Function	Options ▪ On ▪ Off **Factory setting** Off	
Warning limit	**Factory setting** 5 %	Diagnostics code and associated message text: 518 "Sensor calib."

Zero point

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

Path: Menu/Setup/Inputs/Chlorine/Extended setup/Diagnostics settings

Function	Options	Info
▶ Zero point	0.0 to 3.2 nA	Specify the limit values for zero point monitoring in your sensor.
Warning limit	**Factory setting** 2.0 nA	Diagnostics code and associated message text: 513 "Zero Warn"

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. Increasing differences indicate the formation of buildup on the cathode. Clean the cathode as specified in the instructions in the sensor operating manual.

Path: Menu/Setup/Inputs/Chlorine/Extended setup/Diagnostics settings

Function	Options	Info
▶ Delta zero point	0.0 to 3.2 nA	Specify your limit values for monitoring the zero point differential.
Function	Options ▪ On ▪ Off **Factory setting** On	
Warning limit	**Factory setting** 1.0 nA	Diagnostics code and associated message text: 520 "Sensor calib."

Number of cap calibrations

Path: Menu/Setup/Inputs/Chlorine/Extended setup/Diagnostics settings

Function	Options	Info
▶ Number of cap calibrations		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.
Function	Options ▪ On ▪ Off **Factory setting** Off	
Warning limit	1 to 20 **Factory setting** 6	Diagnostics code and associated message text: 535 "Sensor check"

Process check system

--> "Inputs: General/Frequently occurring functions" section → 21

Limits operating hours

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 you specify warning limits for operating times under extreme conditions, you can guarantee the operation of your measuring point without any downtime by performing maintenance tasks in time.

Path: Menu/Setup/Inputs/Chlorine/Extended setup/Diagnostics settings

Function	Options	Info
▶ Limits operating hours		
The range of adjustment for the operating hours alarm and warning limits is generally 1 to 100000 h.		
Function	Options ▪ On ▪ Off **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.

Path: Menu/Setup/Inputs/Chlorine/Extended setup/Diagnostics settings

Function	Options	Info
▶ 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°C		
Warning limit	**Factory setting** 10000 h	Diagnostics code and associated message text: 178 "Operating time"
▶ Operation > 30°C		
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"

Electrolyte counter

The electrolyte consumption is calculated on the basis of the amount of charge that penetrates the sensor diaphragm.

The following applies for the sensor CCS142D:
Half the chloride would be consumed and the entire dihydrogen phosphate would be converted to monohydrogen phosphate in an electrolyte filling (4 ml) at 20 000 000 µAs (=20 As). This would render the electrolyte and the sensor unusable.

With a view to predictive maintenance, you should replace the electrolyte at 10 000 000 µAs, and preferably at 5 000 000 µAs. 25%-50% of the dihydrogen phosphate is then consumed. The calculation presumes that the buffer of the electrolyte is only changed by the electrochemical conversion of hypochlorous acid. It does not take into account the penetration of acids or bases into the sensor.
Depending on the application it can be necessary to change the electrolyte before a charge of 5 As is reached.

Path: Menu/Setup/Inputs/Chlorine/Extended setup/Diagnostics settings

Function	Options	Info
▶ Electrolyte counter	0 to 2000000 µAs	
Function	Options ▪ On ▪ Off **Factory setting** On	
Warning limit	**Factory setting** 1000000 µAs	Diagnostics code and associated message text: 534 "Sensor calib."

Diagnostic behavior

--> "Inputs: General/Frequently occurring functions" section → 📄 21

8.2.6 Tag control

--> "Inputs: General/Frequently occurring functions" section → 📄 21

8.2.7 Sensor replacement

--> "Inputs: General/Frequently occurring functions" section → 📄 21

8.2.8 Data processing factory setting

--> "Inputs: General/Frequently occurring functions" section → 📄 21

9 Inputs: Turbidity and solids

9.1 Basic settings

9.1.1 Sensor identification

Path: Menu/Setup/Inputs/<Sensor type>

Function	Options	Info
Channel	Options ▪ On ▪ Off **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 calibration is based on a three-point calibration of a reference sample.
The factory calibration cannot be deleted and can be retrieved at any time. All other calibrations -
performed as customer calibrations - are referenced to this factory calibration.

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".

Path: Menu/Setup/Inputs/Turbidity

Function	Options	Info
Application type	Options ▪ Clear water ▪ Solid **Factory setting** Clear water	Preselection for saved calibration data records
Application	Depends on the sensor	Select a saved calibration data record

9.1.3 Damping

--> "Inputs: General/Frequently occurring functions" section → 21

9.1.4 Manual hold

--> "Inputs: General/Frequently occurring functions" section → 21

9.2 Extended setup

9.2.1 Measured value formats

Path: Menu/Setup/Inputs/Turbidity/Extended setup

Function	Options	Info
Temperature format	Options ■ #.# ■ #.## **Factory setting** #.#	Select how many decimal places should be used to display the temperature.
Main value format	Options ■ #.# ■ #.## ■ #.### ■ # **Factory setting** #.#	Specify the number of decimal places for the main value.
Unit	Options Application="Formacine" ■ FNU ■ NTU Options All apart from "Formacine" ■ g/l ■ ppm ■ %TS **Factory setting** FNU g/l	Select the unit for the main measured value.

9.2.2 Cleaning

--> "Inputs: General/Frequently occurring functions" section → 21

9.2.3 Calibration settings

Calibration timer and calibration expiration date

--> "Inputs: General/Frequently occurring functions" section → 21

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.

Path: Menu/Setup/Inputs/Turbidity/Extended setup/Calib. settings

Function	Options	Info
▶ Stability criteria		
Delta turbidity	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	0 to 100 s **Factory setting** 20 s	Timeframe within which the permitted range for measured value fluctuation should not be exceeded

9.2.4 Diagnostics settings

This menu branch is used for specifying warning limits, and for defining whether and how diagnostics tools should be used.
The associated diagnostics code is displayed for every setting.

Limits operating hours

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 you specify warning limits for operating times under extreme conditions, you can guarantee the operation of your measuring point without any downtime by performing maintenance tasks in time.

Path: Menu/Setup/Inputs/Turbidity/Extended setup/Diagnostics settings

Function	Options	Info
▶ Limits operating hours		Specify your limit values for monitoring the number of operating hours under extreme conditions.
The range of adjustment for the operating hours alarm and warning limits is generally 1 to 50000 h.		
Function	Options ▪ On ▪ Off **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** 10000 h	Diagnostics code and associated message text: 199 "Operating time"
The names of the subsequent menu functions in brackets depend on the sensor specification. For this reason, they cannot be specified here.		
▶ (Operation below specified temperature limit, e.g. < -5 °C)		
Warning limit	**Factory setting** 10000 h	Diagnostics code and associated message text: 935 "Process temp."
▶ (Operation above specified temperature limit, e.g. > 55 °C)		
Warning limit	**Factory setting** 10000 h	Diagnostics code and associated message text: 934 "Process temp."
▶ (Operation below specified limit value, e.g. < 0 FNU)		
Warning limit	**Factory setting** 10000 h	Diagnostics code and associated message text: 943 "Process value"
▶ (Operation above specified limit value, e.g. > 10000 FNU)		
Warning limit	**Factory setting** 10000 h	Diagnostics code and associated message text: 942 "Process value"

Process check system

--> "Inputs: General/Frequently occurring functions" section → 21

Sensor operating hours

The data displayed here are the current hours the device has been in operation under extreme conditions. You cannot make any changes. You can only read the values.
The same data can be found in the Diagnostics menu.

Diagnostic behavior

--> "Inputs: General/Frequently occurring functions" section → 21

9.2.5 Tag control

--> "Inputs: General/Frequently occurring functions" section → 21

9.2.6 Sensor replacement

--> "Inputs: General/Frequently occurring functions" section → 21

9.2.7 Data processing factory setting

--> "Inputs: General/Frequently occurring functions" section → 21

9.2.8 Sensor factory setting

--> "Inputs: General/Frequently occurring functions" section → 21

10 Inputs: SAC

10.1 Basic settings

10.1.1 Sensor identification

Path: Menu/Setup/Inputs/<Sensor type>

Function	Options	Info
Channel	Options ▪ On ▪ Off **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

Calibration data records are saved under an individual name in the sensor. A new sensor is calibrated at the factory and thus already has appropriate data records. You can add your own data records during each calibration. These are then available for selection under "Application".

Path: Menu/Setup/Inputs/SAC

Function	Options	Info
Basic application	Options ▪ SAC ▪ Transm. ▪ Absorption ▪ COD ▪ TOC ▪ DOC ▪ BOD **Factory setting** SAC	Preselection for saved calibration data records
Application	Options ▪ Factory calib. ▪ 5 other data records **Factory setting** Factory calib.	Select a saved calibration data record

10.1.3 Damping

--> "Inputs: General/Frequently occurring functions" section → 21

10.1.4 Manual hold

--> "Inputs: General/Frequently occurring functions" section → 21

10.2 Extended setup

10.2.1 Measured value formats

Path: Menu/Setup/Inputs/SAC/Extended setup

Function	Options	Info
Temperature format	Options ▪ #.# ▪ #.## **Factory setting** #.#	Select how many decimal places should be used to display the temperature.
Main value format	Options ▪ #.# ▪ #.## ▪ #.### ▪ # **Factory setting** #.#	Specify the number of decimal places for the main value.
Unit	Options ▪ None ▪ % ▪ mg/l ▪ ppm ▪ 1/m **Factory setting** Depends on "Basic application"	The unit of the main value depends on the basic application selected. Depending on this setting only certain units are available for selection.

10.2.2 Cleaning

--> "Inputs: General/Frequently occurring functions" section → 21

10.2.3 Calibration settings

Calibration timer and calibration expiration date

--> "Inputs: General/Frequently occurring functions" section → 21

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.

Path: Menu/Setup/Inputs/SAC/Extended setup/Calib. settings

Function	Options	Info
▶ Stability criteria		
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	0 to 100 s **Factory setting** 10 s	Timeframe within which the permitted range for measured value fluctuation should not be exceeded

10.2.4 Diagnostics settings

This menu branch is used for specifying warning limits, and for defining whether and how diagnostics tools should be used.
The associated diagnostics code is displayed for every setting.

Limits operating hours

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 you specify warning limits for operating times under extreme conditions, you can guarantee the operation of your measuring point without any downtime by performing maintenance tasks in time.

Path: Menu/Setup/Inputs/SAC/Extended setup/Diagnostics settings

Function	Options	Info
▶ Limits operating hours		Specify your limit values for monitoring the number of operating hours under extreme conditions.
The range of adjustment for the operating hours alarm and warning limits is generally 1 to 50000 h.		
Function	Options ▪ On ▪ Off **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** 10000 h	Diagnostics code and associated message text: 199 "Operating time"
The names of the menu functions in brackets depend on the sensor specification. For this reason, they cannot be specified here.		
▶ (Operation below specified temperature limit, e.g. < 5 °C)		
Warning limit	**Factory setting** 10000 h	Diagnostics code and associated message text: 935 "Process temp."
▶ (Operation above specified temperature limit, e.g. > 50 °C)		
Warning limit	**Factory setting** 10000 h	Diagnostics code and associated message text: 934 "Process temp."
▶ (Operation below specified limit value, e.g. < 50 mg/l)		
Warning limit	**Factory setting** 10000 h	Diagnostics code and associated message text: 170 "Process value"
▶ (Operation above specified limit value, e.g. > 200 mg/l)		
Warning limit	**Factory setting** 10000 h	Diagnostics code and associated message text: 169 "Process value"

Path: Menu/Setup/Inputs/SAC/Extended setup/Diagnostics settings

Function	Options	Info
▶ 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"
▶ Lamp life		
Warning limit	**Factory setting** 35040 h	Diagnostics code and associated message text: 171 "Lamp change"
Alarm limit	**Factory setting** 36500 h	Diagnostics code and associated message text: 71 "Lamp change"

Process check system

--> "Inputs: General/Frequently occurring functions" section → 📄 21

Sensor operating hours

The data displayed here are the current hours the device has been in operation under extreme conditions. You cannot make any changes. You can only read the values.
The same data can be found in the Diagnostics menu.

Diagnostic behavior

--> "Inputs: General/Frequently occurring functions" section → 📄 21

10.2.5 Tag control

--> "Inputs: General/Frequently occurring functions" section → 📄 21

10.2.6 Sensor replacement

--> "Inputs: General/Frequently occurring functions" section → 📄 21

10.2.7 Data processing factory setting

--> "Inputs: General/Frequently occurring functions" section → 📄 21

10.2.8 Sensor factory setting

--> "Inputs: General/Frequently occurring functions" section → 📄 21

11 Inputs: Nitrate

11.1 Basic settings

11.1.1 Sensor identification

Path: Menu/Setup/Inputs/<Sensor type>

Function	Options	Info
Channel	Options ▪ On ▪ Off **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 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".

Path: Menu/Setup/Inputs/Nitrate

Function	Options	Info
Application	Depends on the sensor	Select a saved calibration data record

11.1.3 Damping

--> "Inputs: General/Frequently occurring functions" section → 21

11.1.4 Manual hold

--> "Inputs: General/Frequently occurring functions" section → 21

11.2 Extended setup

11.2.1 Measured value formats

Path: Menu/Setup/Inputs/Nitrate/Extended setup

Function	Options	Info
Temperature format	Options ■ #.# ■ #.## **Factory setting** #.#	Select how many decimal places should be used to display the temperature.
Main value format	Options ■ #.# ■ #.## ■ #.### ■ # **Factory setting** #.#	Specify the number of decimal places.
Unit	Options ■ 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.

11.2.2 Cleaning

--> "Inputs: General/Frequently occurring functions" section → 21

11.2.3 Calibration settings

Calibration timer and calibration expiration date

--> "Inputs: General/Frequently occurring functions" section → 21

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.

Path: Menu/Setup/Inputs/Nitrate/Extended setup/Calib. settings

Function	Options	Info
▶ Stability criteria		
Delta nitrate	0.1 to 5.0 % **Factory setting** 2.0 %	Permitted measured value fluctuation during calibration
Delta temperature	0.10 to 2.00 °C 0.18 to 3.60 °F **Factory setting** 0.50 °C 0.90 °F	Permitted temperature fluctuation during calibration
Duration	0 to 100 s **Factory setting** 10 s	Timeframe within which the permitted range for measured value fluctuation should not be exceeded

11.2.4 Diagnostics settings

This menu branch is used for specifying warning limits, and for defining whether and how diagnostics tools should be used.
The associated diagnostics code is displayed for every setting.

Limits operating hours

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 you specify warning limits for operating times under extreme conditions, you can guarantee the operation of your measuring point without any downtime by performing maintenance tasks in time.

Path: Menu/Setup/Inputs/Nitrate/Extended setup/Diagnostics settings

Function	Options	Info
▶ Limits operating hours		Specify your limit values for monitoring the number of operating hours under extreme conditions.
The range of adjustment for the operating hours alarm and warning limits is generally 1 to 50000 h.		
Function	Options ▪ On ▪ Off **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** 10000 h	Diagnostics code and associated message text: 199 "Operating time"
The names of the menu functions in brackets depend on the sensor specification. For this reason, they cannot be specified here.		
▶ (Operation below specified temperature limit, e.g. < 5 °C)		
Warning limit	**Factory setting** 10000 h	Diagnostics code and associated message text: 935 "Process temp."
▶ (Operation above specified temperature limit, e.g. > 50 °C)		
Warning limit	**Factory setting** 10000 h	Diagnostics code and associated message text: 934 "Process temp."
▶ (Operation below specified limit value, e.g. < 50 mg/l)		
Warning limit	**Factory setting** 10000 h	Diagnostics code and associated message text: 943 "Process value"
▶ (Operation above specified limit value, e.g. > 200 mg/l)		
Warning limit	**Factory setting** 10000 h	Diagnostics code and associated message text: 942 "Process value"

Path: Menu/Setup/Inputs/Nitrate/Extended setup/Diagnostics settings

Function	Options	Info
▶ 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"
▶ Lamp life		
Warning limit	**Factory setting** 35000 h	Diagnostics code and associated message text: 171 "Lamp change"
Alarm limit	**Factory setting** 36500 h	Diagnostics code and associated message text: 71 "Lamp change"

Process check system

--> "Inputs: General/Frequently occurring functions" section → 21

Sensor operating hours

The data displayed here are the current hours the device has been in operation under extreme conditions. You cannot make any changes. You can only read the values.
The same data can be found in the Diagnostics menu.

Diagnostic behavior

--> "Inputs: General/Frequently occurring functions" section → 21

11.2.5 Tag control

--> "Inputs: General/Frequently occurring functions" section → 21

11.2.6 Sensor replacement

--> "Inputs: General/Frequently occurring functions" section → 21

11.2.7 Data processing factory setting

--> "Inputs: General/Frequently occurring functions" section → 21

11.2.8 Sensor factory setting

--> "Inputs: General/Frequently occurring functions" section → 21

12 Inputs: ISE

12.1 Basic settings

12.1.1 Sensor identification

Path: Menu/Setup/Inputs/<Sensor type>

Function	Options	Info
Channel	Options ▪ On ▪ Off **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 Main value

The main value can be any parameter which is returned by one of the electrodes in the ISE-sensor.

Path: Menu/Setup/Inputs/ISE

Function	Options	Info
Main value	Options ▪ 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.

12.1.3 Damping of the temperature value

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

Path: Menu/Setup/Inputs/ISE

Function	Options	Info
Damping temp.	0 to 300 s **Factory setting** 0 s	Specify the damping for the temperature measurement.

12.1.4 Manual hold

--> "Inputs: General/Frequently occurring functions" section → 21

12.2 Extended setup

12.2.1 Temperature format

Path: Menu/Setup/Inputs/<Sensor type>/Extended setup

Function	Options	Info
Temperature format	Options ▪ #.# ▪ #.## **Factory setting** #.#	Select how many decimal places should be used to display the temperature.

12.2.2 Cleaning

--> "Inputs: General/Frequently occurring functions" section → 21

12.2.3 Diagnostic behavior

--> "Inputs: General/Frequently occurring functions" section → 21

12.2.4 Tag control

--> "Inputs: General/Frequently occurring functions" section → 21

12.2.5 Sensor replacement

--> "Inputs: General/Frequently occurring functions" section → 21

12.2.6 Data processing factory setting

--> "Inputs: General/Frequently occurring functions" section → 21

12.3 Electrode slot menus

12.3.1 Electrode slot

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

Make settings:

- ▶ Define the parameter for the slot (only slots 2-4).
  The 1st slot is always designated to the pH electrode. It is not possible to select another parameter for this slot.
- ▶ You can complete and assign the other 3 slots as you prefer.
- ▶ Specify the measured variable that should be output. No options can be selected for pH which is why the "Measured variable" function is not available for this parameter.

Options displayed for "Measured variable" with the following parameters:				
pH	**Ammonium**	**Nitrate**	**Potassium**	**Chloride**
-	▪ NH4-N ▪ NH4	▪ NO3-N ▪ NO3	▪ K	▪ Cl

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 "Slot 2:1 (ISE)" software menu.

12.3.2 Damping

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

Path: Menu/Setup/Inputs/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.

12.3.3 Compensation

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 can 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 for compensation of the effect of interference ions are available only for ammonium and nitrate.

Path: Menu/Setup/Inputs/ISE/Electrode slot/Compensation

Function	Options	Info
Compensation	Options ▪ Off ▪ On **Factory setting** Off	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.
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 type	Options ▪ 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, in this function you have to define which electrode is used for compensation. Generally, you have a potassium or chloride electrode and Liquiline recognizes the right slot.
Selectivity coefficient	-10.00 to 10.00 **Factory setting** -2.00 (chloride) -0.85 (potassium)	The coefficients are empirical values.

Path: Menu/Setup/Inputs/ISE/Electrode slot/Compensation

Function	Options	Info
Mode	Options ■ + ■ - **Factory setting** -	The standard setting (-) corrects a measured value that is too high as a result of the effect of interference ions.

12.3.4 Extended setup

Main value format

If the measured variable of the electrode slot is not your main value for the ISE input, it will be displayed with all the measured values in the measuring mode.

Path: Menu/Setup/Inputs/ISE/Extended setup

Function	Options	Info
Main value format	Options ■ # ■ #.# ■ #.## **Factory setting** #.##	Specify the number of decimal places for the measured variable of the electrode slot.

Membrane timer

Path: Menu/Setup/Inputs/ISE/<Electrode slot>Extended setup

Function	Options	Info
Membrane timer	Options ■ Off ■ On **Factory setting** Off	Switches the timer on or off For sending a reminder to replace the sensor membrane
Membrane timer value	0 to 80 weeks **Factory setting** 26 weeks	After the time expires, diagnostic message M720, "Membrane change" appears. Then, replace the sensor diaphragm with a new one.

Calibration settings

Stability criteria

Path: Menu/Setup/Inputs/ISE/<Electrode slot>Extended setup/Calib. settings

Function	Options	Info
Stability criteria	Options ▪ Off ▪ Weak ▪ Medium ▪ Hard **Factory setting** Medium	In normal situations leave the stability criteria set to "Medium".

Buffer recognition (only pH)

Path: Menu/Setup/Inputs/ISE/<Electrode slot>Extended setup/Calib. settings

Function	Options	Info
Buffer recognition	Options ▪ Fixed ▪ Manual **Factory setting** Fixed	**Fixed** You choose values from a list. This list depends on the setting for "Buffer manufacturer". **Manual** You enter any two buffer values. These must differ in terms of their pH value.
Buffer manufacturer	Options ▪ 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)* / 9.20 / 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
You have the possibility of defining two buffers of your own with the "Special buffer" option. For this purpose, two tables are displayed in which you can enter value pH value/temperature value pairs.		

Standard addition (all except for pH)

The "Standard addition" calibration type is available only via the "Expert" menu, which is normally available to service personnel only.

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

Path: Menu/Setup/Inputs/ISE/<Electrode slot>Extended setup/Calib. settings

Function	Options	Info
▶ Standard addition		
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 steps	1 to 4 **Factory setting** 3	Number of addition steps (=measuring points of the calibration function)

Calibration timer

You can specify the calibration interval for the sensor here.
Once the time configured elapses, the "Calibration timer" diagnostics message appears on the display.

The timer is reset automatically if you recalibrate the sensor.

Path: Menu/Setup/Inputs/ISE/<Slot>/Extended setup/Calib. settings

Function	Options	Info
Calibration timer	Options ▪ Off ▪ On **Factory setting** Off	Switches the function on or off
Calibration timer *Calibration timer="On"*	1 to 10000 h **Factory setting** 1000 h	Specify the time after which the timer should have timed out. Once this time has elapsed, the "Calib. Timer" diagnostics message, along with the code 102, appears on the display.

Diagnostics settings

This menu branch is used for specifying warning limits, and for defining whether and how diagnostics tools should be used.
The associated diagnostics code is displayed for every setting.

Process check system

--> "Inputs: General/Frequently occurring functions" section → 21

Slope (only pH)

The slope characterizes the sensor condition. The bigger the deviation from the ideal value (100%, corresponds to -59 mV/pH) the poorer the condition of the sensor.

Path: Menu/Setup/Inputs/ISE/Extended setup/Diagnostics settings

Function	Options	Info
▶ Slope	80.00 to 100.00 %	Specify your limit values for slope monitoring.
Warning limit	**Factory setting** 90.00 %	Associated diagnostics code and message text: 509 "Sensor calib."

Zero point (only pH)

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.

Path: Menu/Setup/Inputs/ISE/Extended setup/Diagnostics settings

Function	Options	Info
▶ Zero point *(pH glass)*	-10.00 to 10.00	Specify your limit values for zero point or operating point monitoring.
Upper warning limit	**Factory setting** 2.50	Associated diagnostics code and message text: 505 "Sensor calib."
Lower warning limit	**Factory setting** -2.50	Associated diagnostics code and message text: 507 "Sensor calib."

Delta slope (only pH)

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.

Path: Menu/Setup/Inputs/ISE/Extended setup/Diagnostics settings

Function	Options	Info
▶ Delta slope	0.50 to 10.00 %	Specify your limit values for monitoring the slope differential.
Function	Options ▪ On ▪ Off **Factory setting** Off	
Warning limit	**Factory setting** 2.5 %	Diagnostics code and associated message text: 518 "Sensor calib."

Delta zero point (only pH)

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.

Path: Menu/Setup/Inputs/ISE/Extended setup/Diagnostics settings

Function	Options	Info
▶ Delta zero point	0.00 to 5.00	Specify your limit values for monitoring the zero point or operating point differential.
Function	Options ▪ On ▪ Off **Factory setting** Off	
Warning limit	**Factory setting** 1.00	Diagnostics code and associated message text: 520 "Sensor calib."

12.4 Limits operating hours

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 you specify warning limits for operating times under extreme conditions, you can guarantee the operation of your measuring point without any downtime by performing maintenance tasks in time.

Path: Menu/Setup/Inputs/ISE

Function	Options	Info
▶ Limits operating hours		Specify your limit values for monitoring the number of operating hours under extreme conditions.
The range of adjustment for the operating hours alarm and warning limits is generally 1 to 50000 h.		
Function	Options ▪ On ▪ Off **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** 36000 h	Diagnostics code and associated message text: 199 "Operating time"
▶ Operation > 30°C		
Warning limit	**Factory setting** 36000 h	Diagnostics code and associated message text: 191 "Operating time"
▶ Operation > 40°C		
Warning limit	**Factory setting** 36000 h	Diagnostics code and associated message text: 192 "Operating time"

13 Inputs: Interface

13.1 Basic settings

The CUS71DOUS71D is not detected automatically. It must be selected manually (Current sensor). During initial commissioning, data are recorded and calculated for 3 to 5 minutes before a measured value is displayed.

Path: Menu/Setup/Inputs/Ultrasonic interface

Function	Options	Info
Sensor operation	Options ▪ 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	Options ▪ Off ▪ On **Factory setting** On	Only for sensor version with wiper function
Wiper timing	1 to 240 min **Factory setting** 10 min	Only for sensor version with wiper function
Turbidity measurement	Options ▪ Off ▪ On **Factory setting** On	Only for sensor version with integrated turbidity measurement and wiper function
Turbidity unit	Options ▪ FNU ▪ NTU **Factory setting** FNU	Only for sensor version with integrated turbidity measurement and wiper function

13.2 Manual hold

--> "Inputs: General/Frequently occurring functions" section → 21

13.3 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.

Path: Menu/Setup/Inputs/Ultrasonic interface/Tank configuration

Function	Options	Info
Blanket definition	Options ▪ 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
Unit of measure	Options ▪ m ▪ cm ▪ ft ▪ inch **Factory setting** m	Any change to the unit is automatically accepted in all the displays.
Tank depth	0.4 to 10.0 m (1.4 to 32.8 ft) **Factory setting** 8.0 m (26.2 ft)	Distance from the water level to the tank floor
Zero adjust	0.4 to 10.0 m (1.4 to 32.8 ft) **Factory setting** 0.4 m (1.3 ft)	Distance from the water level to the sensor diaphragm
Blanking zone	Options ▪ Off ▪ On **Factory setting** Off	Permanent echo signals above and below a search window are masked out as interference signals.
Upper window limit	0.0 m to Lower window limit (1.4 ft ...) **Factory setting** 0.3 m (1.0 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	Upper window limit to 11.0 m (to 32.8 ft) **Factory setting** 3.3 m (10.8 ft)	Distance to the water line Permanent echo signals **below** this value are masked out as interference signals.

13.4 Sensor signal

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

Path: Menu/Setup/Inputs/Ultrasonic interface/Sensor signal

Function	Options	Info
Acoustic control	Options ▪ Manual ▪ Automatic **Factory setting** Automatic	Controls the graphic display of the echo signal **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. **Manual** You can enter a fixed gain value for diagnostics or test purposes.
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.		
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.
Gain control set point *Acoustic control="Automatic"*	1 to 50 **Factory setting** 20	Horizontal position of the intersection of the interface line with the echo peak. The factory setting "20" corresponds to 20 % of the maximum display height.
Refresh rate	▪ 2 s ▪ 4 s ▪ 6 s ▪ 8 s **Factory setting** 4 s	Time frame for data refresh
Damping	5 to 255 **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).

13.5 Extended setup

13.5.1 Sensor signal

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

Path: Menu/Setup/Inputs/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 speak to the manufacturer's service team before changing the setting for Speed of sound.		
▶ 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 0.5 **Factory setting** 0.1	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.

13.5.2 Calculation

Path: Menu/Setup/Inputs/Ultrasonic interface/Extended setup/Calculation

Function	Options	Info
Interface	Options ▪ 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	Options ▪ Off ▪ On **Factory setting** Off	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	0 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.

13.5.3 Diagnostics settings

This menu branch is used for specifying warning limits, and for defining whether and how diagnostics tools should be used.
The associated diagnostics code is displayed for every setting.

Alarm delay echo loss

Path: Menu/Setup/Inputs/Ultrasonic interface/Extended setup/Diagnostics settings

Function	Options	Info
Alarm delay echo loss	0 to 255 min **Factory setting** 10 min	Delay time for an error message if the echo is lost

Diagnostic behavior

--> "Inputs: General/Frequently occurring functions" section → 📄 21

13.5.4 Restart the sensor signal

The sensor is reinitialized with the "Restart sensor signal" 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.

13.5.5 Sensor replacement

--> "Inputs: General/Frequently occurring functions" section → 📄 21

13.5.6 Data processing factory setting

--> "Inputs: General/Frequently occurring functions" section → 📄 21

13.5.7 Sensor factory setting

--> "Inputs: General/Frequently occurring functions" section → 📄 21

14 Current inputs

The input can be used as the data source for limit switches and logbooks, for example. Furthermore, external values can be made available as set points for controllers.

Path: Menu/Setup/Inputs/Current input x:y[1)]

Function	Options	Info
Mode	Options ▪ Off ▪ 0 to 20 mA ▪ 4 to 20 mA **Factory setting** 4 to 20 mA	Select the same current range as in the data source (connected device).
Input mode	Options ▪ Parameter ▪ Current **Factory setting** Current	Select the input variable.
Meas. value format	Options ▪ # ▪ #.# ▪ #.## ▪ #.### **Factory setting** #.#	Specify the number of decimal places.
Parameter name *Input mode "Parameter"*	Free text	Assign a useful name, such as the parameter name, which the data source uses.
Unit of measure *Input mode "Parameter"*	Free text	You cannot choose the unit from a list. If you want to use a unit, you must enter it manually here.
Lower range value *Input mode "Parameter"*	-20.0 to Upper range value <engineering unit> **Factory setting** 0.0 <engineering unit>	Enter the measuring range. The lower and upper range values are assigned to the 0 or 4 mA value and the 20 mA value respectively. The system uses the engineering unit which you entered beforehand.
Upper range value *Input mode "Parameter"*	Upper range value to 10000.0 <engineering unit> **Factory setting** 10.0 <engineering unit>	
Damping	0 to 60 s **Factory setting** 0 s	The damping causes a floating average curve of the measured values over the time specified.

1) x:y = slot no. : input number

15 Outputs

15.1 Current outputs

The basic version of the device always has two current outputs.
You can configure additional current outputs with extension modules.
Under Menu/Setup/General settings set the current range of 0 to 20 mA or 4 to 20 mA.

Possible applications
- For outputting a measured value to a process control system or an external recorder
- For outputting a manipulated variable to connected actuators

The current output curve is always linear.

Path: Menu/Setup/Outputs/Current output x:y (slot:output number)

Function	Options	Info
Current output	Options ▪ On ▪ Off **Factory setting** Off	Use this function to activate or deactivate a variable being output at the current output
Source of data	Options ▪ None ▪ Connected inputs ▪ Controller **Factory setting** None	The sources of data on offer depend on your device version. All the sensors and controllers connected to inputs are available for selection.
Measured value	Options ▪ None ▪ Depends on theSource of data **Factory setting** None	The measured value you can select depends on the option selected under "Source of data".
The next table lists the measured values available depending on the data source. Apart from measured values from connected sensors, you can also select a controller as the data source. The best way to do so is by using the "Additional functions" menu. Here, you can also select and configure the current output for outputting the controlled variable.		
Range lower value	Selection range and factory settings depend on: "Measured value"	You can output the entire measuring range of the "Measured value" or just some of it at the current output. For this purpose, specify the upper and lower range values in accordance with your requirements.
Range upper value		

Path: Menu/Setup/Outputs/Current output x:y (slot:output number)

Function	Options	Info
Hold behavior	Options ▪ Freeze ▪ Fixed value ▪ None **Factory setting** Depends on the channel:output	**Freeze** The device freezes the last current value. **Fixed value** You define a fixed current value that is output at the output. **None** A hold does not affect this current output.
Hold current *Hold behavior="Fixed value"*	0.0 to 23.0 mA **Factory setting** 22.0 mA	Specify which current should be output at this current output in the event of a hold.

Measured valuedepending on theSource of data

Source of data	Measured value
pH Glass pH ISFET	Options ▪ Raw value mV ▪ pH ▪ Temperature
Redox	Options ▪ Temperature ▪ Redox mV ▪ Redox %
Oxygen (amp.) Oxygen (opt.)	Options ▪ Temperature ▪ Partial pressure ▪ Concentration liquid ▪ Saturation ▪ Raw value nA (only Oxygen (amp.)) ▪ Raw value µs (only Oxygen (opt.))
Cond i Cond c	Options ▪ Temperature ▪ Conductivity ▪ Resistance (only Cond c) ▪ Concentration (only Cond i)
Chlorine	Options ▪ Temperature ▪ Current ▪ Concentration
ISE	Options ▪ Temperature ▪ pH ▪ Ammonium ▪ Nitrate ▪ Potassium ▪ Chloride

Measured valuedepending on theSource of data

Source of data	Measured value
TU/TS	Options ▪ Temperature ▪ Turbidity g/l ▪ Turbidity FNU
Nitrate	Options ▪ Temperature ▪ NO3 ▪ NO3-N
Ultrasonic interface(interface measurement)	Options ▪ Interface ▪ Turbidity
SAC	Options ▪ Temperature ▪ SAC ▪ Transm. ▪ Absorption ▪ COD ▪ BOD
Controller 1	Options ▪ Bipolar(only current outputs) ▪ Unipolar+ ▪ Unipolar-
Controller 2	
Mathematical functions	All the mathematical functions can also be used as a data source and the calculated value can be used as the measured value.

Outputting the controller manipulated variable via the current output

Assign "Unipolar+" to the output to which an actuator that can increase the measured value is connected. Assign "Unipolar-" to the output to which an actuator that can decrease the measured value is connected.

To output the manipulated variable of a two-sided controller, positive manipulated variables and negative manipulated variables generally have to be output to different actuators, as most actuators are able to influence the process in one direction only (not in both). For this purpose, the instrument splits the bipolar manipulated variable y into two unipolar manipulated variables, y+ and y-.

Only the two unipolar manipulated variable parts are available for selection for outputting to modulated relays. If outputting the values via a current output, you also have the possibility of outputting the bipolar manipulated variable y to one current output only (split range).

15.2 Alarm relay and optional relays

The basic version of the device always has one alarm relay.
Additional relays are also available depending on the version of the device.

The following functions can be output via a relay

- Limit switch status
- Controller manipulated variable for controlling an actuator
- Diagnostics messages
- Status of a cleaning function in order to control a pump or a valve

You can assign a relay to multiple inputs in order to clean several sensors with just one cleaning unit, for example.

Path: Menu/Setup/Outputs/Alarm relay or relay at channel no.

Function	Options	Info
Function	Options ▪ Off ▪ LimitSwitch ▪ Controller ▪ Diagnostics ▪ Cleaning **Factory setting** Off	The following functions depend on the option selected. These versions are illustrated individually in the following section to provide a clearer understanding of the options. Function="Off" switches off the relay function and means no further settings are required.

15.2.1 Outputting the status of a limit switch

Function="LimitSwitch"

Function	Options	Info
Source of data	Options ▪ None ▪ Limit switch 1 ▪ Limit switch 2 ▪ Limit switch 3 ▪ Limit switch 4 ▪ Limit switch 5 ▪ Limit switch 6 ▪ Limit switch 7 ▪ Limit switch 8 **Factory setting** None	Select the limit switch via which the status of the relay is to be output. The limit switches are configured in the "Setup/Additional functions/Limit switches" menu.

15.2.2 Outputting the manipulated variable of a controller

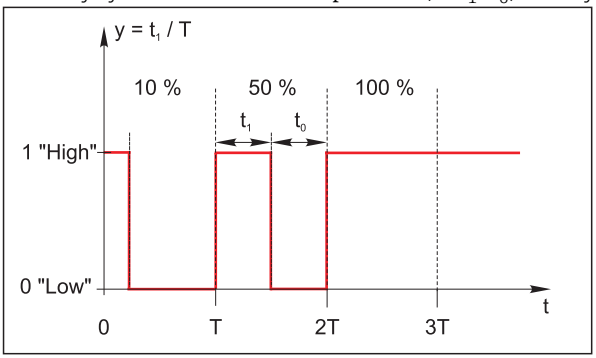
To output a controller manipulated variable via a relay, the relay is modulated. The relay is energized (pulse, t_1) and is then de-energized (interval, t_0).

Function="Controller"

Function	Options	Info
Source of data	Options ▪ None ▪ Controller 1 ▪ Controller 2 **Factory setting** None	Select the controller that should act as the data source.
Operating mode	Options ▪ PWM ▪ PFM **Factory setting** PWM	PWM=pulse width modulation PFM=pulse frequency modulation

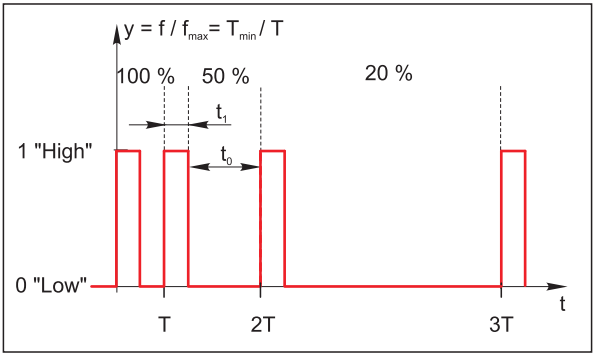
Types of modulation:

1. **PWM** (pulse width modulation):
   The duty cycle is varied within a period **T** ($T=t_1+t_0$). The cycle duration remains constant.



   Typical application: solenoid valve

2. **PFM** (pulse frequency modulation):
Here, pulses of a constant length (t_1) are output and the interval between the pulses varies (t_0). At a maximum frequency, $t_1 = t_0$.



Typical application: dosing pump

Function="Controller"

Function	Options	Info
Actuator type	Options ▪ None ▪ Unipolar- ▪ Unipolar+ **Factory setting** None	Here you specify what part of the controller should power the relay. "Unipolar+" is the part of the manipulated variable which the controller uses to increase the process value (e.g. for heating purposes). On the other hand, select "Unipolar-" if you want to connect an actuator to the relay that causes the controlled variable to drop (e.g. for cooling purposes).
Cycle duration *Operating mode="PWM"*	(Shortest turn-on time) to 999.0 s **Factory setting** 10.0 s	Specify the cycle duration within which the duty cycle should be varied (only PWM).
The settings for Cycle duration and Shortest turn-on time mutually affect one another. The following applies: Cycle duration ≥ Shortest turn-on time.		
Shortest turn-on time *Operating mode="PWM"*	0.3 s to (Cycle duration) **Factory setting** 0.3 s	Pulses that are shorter than this limit value are not output in order to conserve the actuator.
Maximum frequency *Operating mode="PFM"*	1 to 180 min^{-1} **Factory setting** 60 min^{-1}	Maximum number of pulses per minute The controller calculates the pulse duration based on this setting.

15.2.3 Outputting diagnostics messages via the relay

You can output two categories of diagnostics messages via the relay:
1. Diagnostics messages from one of the 4 Namur classes
   (--> BA00445C or BA01227C "Maintenance&Diagnostics" for more information on the Namur classes)
2. Diagnostics messages which you have individually assigned to the relay output

A message is individually assigned to the relay output at 2 specific points in the menu:
- Menu/Setup/General settings/Diagnostics/Device behavior
  (device-specific messages)
- Menu/Setup/Inputs/../Diagnostics settings/Diag. behavior
  (sensor-specific messages)

Before being able to assign the relay output to a special message in "Device behavior", you must first configure Outputs/relay x:y or /Alarm relay/Function="Diagnostics".

Function="Diagnostics"

Function	Options	Info
Operating mode	Options ▪ as assigned ▪ Namur M ▪ Namur S ▪ Namur C ▪ Namur F **Factory setting** as assigned	**as assigned** If this option is selected, the diagnostics messages which you have individually assigned to the relay are output via the relay. **Namur M ... F** If you decided to use one of the Namur classes, all the messages that are assigned to the individual class are output via the relay. You can also change the Namur class assignment for every diagnostics message. (Menu/Setup/General settings/Diagnostics/Device behavior or Menu/Setup/Inputs/../Diagnostics settings/Diag. behavior)
Attributed diagnostic messages *Operating mode="as assigned"*	Read only List of diagnostic messages	All the messages assigned to the relay output appear on the display. You do not have the option of editing the information here.

15.2.4 Outputting the status of a cleaning function

Function="Cleaning"

Function	Options	Info
Assignment	Options ▪ None ▪ Cleaning 1 - Water ▪ Cleaning 1 - Cleaner ▪ Cleaning 2 - Water ▪ Cleaning 2 - Cleaner ▪ Cleaning 3 - Water ▪ Cleaning 3 - Cleaner ▪ Cleaning 4 - Water ▪ Cleaning 4 - Cleaner **Factory setting** None	Here you can specify how a cleaning function should be displayed for the alarm relay. You can define the cleaning programs under: Menu/Setup/Additional functions/Cleaning.

15.3 HART

Specify which device variables should be output via HART communication.

You can define a maximum of 16 device variables:
- ▶ Define the data source. You can choose from the sensor inputs and the controllers.
- ▶ From the source, select the measured value that should be output.
- ▶ Define how the device should behave in the event of a "Hold".
- ▶ The configuration options for "Source of data", "Measured value" and "Hold behavior" are identical to those described in the "Outputs/Current outputs" section. Please refer to this section for more information.
- ▶ Please note that if you select Hold behavior="Freeze", the system not only flags the status but also actually "freezes" the measured value.

More information is provided in BA00486C "HART communication".

15.4 PROFIBUS DP

15.4.1 Device variables (device --> PROFIBUS)

Specify which process values should be mapped to the PROFIBUS function blocks and are thereby available for transmission via PROFIBUS communication.

You can define a maximum of 16 device variables (AI Blocks):
- ▶ Define the data source.
  Choose between sensor inputs, current inputs or mathematical functions whose measured values should be transmitted.
- ▶ From the data source, select the measured value to be transmitted.

In addition, you can define 8 binary variables (DI Blocks):
- ▶ Define the data source.
  Select the limit switch or relay whose status should be transmitted.

15.4.2 PROFIBUS variables (PROFIBUS --> device)

Not in the "Menu/Setup/Outputs" menu
- ▶ A maximum of 4 analog (AO) and 8 digital (DO) PROFIBUS variables are available as measured values in the controller, limit switch or current output menus.
- ▶ Example: Using an AO or DO value as the set point for the controller
  - "Menu/Setup/Additional functions/Controller 1" menu
  - In the menu mentioned, define PROFIBUS as the data source.
  - Select the desired analog output (AO) or digital output (DO) as the measured value.

More information is provided in the SD01188C document on the CD.

15.5 Modbus RS485 and Modbus TCP

Specify which process values should be output via Modbus RS485 communication or via Modbus TCP.
In the case of Modbus RS485, you can switch between the RTU and the ASCII protocol.

You can define a maximum of 16 device variables:
- ▶ Define the data source. You can choose from the sensor inputs and the controllers.
- ▶ From the source, select the measured value that should be output.
- ▶ Define how the device should behave in the event of a "Hold".
- ▶ The configuration options for "Source of data", "Measured value" and "Hold behavior" are identical to those described in the "Outputs/Current outputs" section. Please refer to this section for more information.
- ▶ Please note that if you select Hold behavior="Freeze", the system not only flags the status but also actually "freezes" the measured value.

More information is provided in the SD01189C document on the CD.

16 Binary inputs and outputs

The optional "DIO" hardware module with 2 digital inputs and 2 digital outputs enables the following

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

16.1 Application examples

16.1.1 Chlorine control with feedforward control

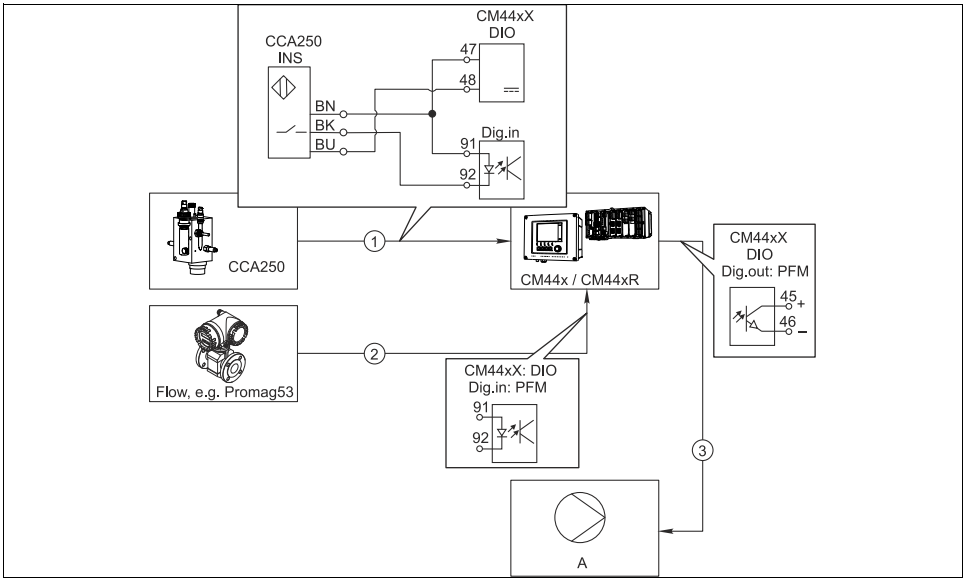


Fig. 10: Example of chlorine control with feedforward control

1 Connection of the inductive proximity switch INS of the CCA250 assembly at the digital input of the DIO module for enabling the controller
2 Connection of the signal from a flowmeter to the digital input of the DIO module using the pulse-frequency modulation (=PFM, setting in the CM44x software) for feedforward control
3 Activation of a (pulse) dosing pump via a digital output of the DIO module using the PFM
A Dosing pump

Chlorine control with feedforward control

Utilize the advantage of the effectively wear-free control with binary outputs versus a control system with relay. It is possible to achieve virtually continuous dosing using a dosing pump with higher input frequency through pulse frequency modulation (PFM).

1. Connect the proximity switch INS from assembly CCA250 to a digital input of the DIO module. Configure a controller in the software, selecting the binary input for the function "Controller Enable" which the proximity switch is connected to. Leave the "Signal type" in the inputs menu at the factory setting "Static signal" as the selected input.
2. Connect the flowmeter value to the second input of the DIO module. Set the "Signal type" for this input to "PFM" in the inputs menu and select the corresponding measured value.
   ↳ You can now use this input in the controller menu as the disturbance variable for your controller [1]. To do so, in the submenu "Disturbance variable" select the binary input to which you connected the flow measured value as the "Source of data."
3. You can activate a dosing pump through PFM via a digital output of the DIO module. In the outputs menu, set the "Signal type" of the corresponding binary output to "PFM" and use the previously configured controller as the "Source of data." Observe your dosing's direction of action, so that you correctly install the "Actuator type."

You must perform additional settings in the controller menu to fully customize the control to your process conditions.

1) An activation code, Order No. 71211288, is necessary for the "feedforward control" function.

16.1.2 CM44x as cleaning master

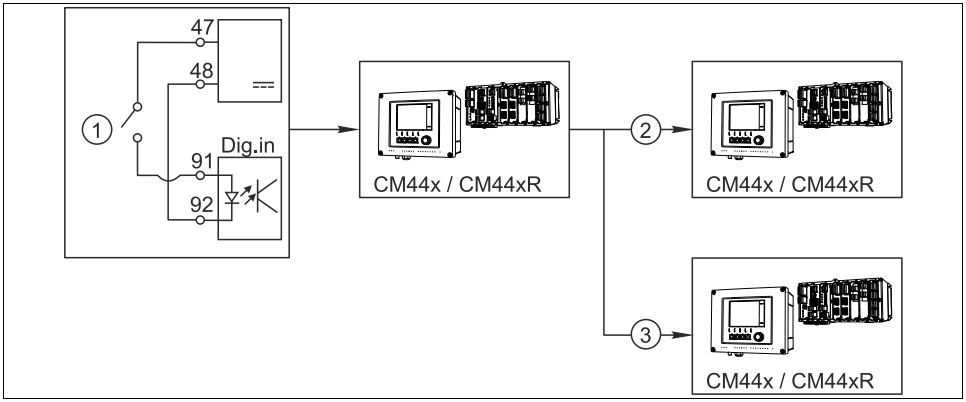


Fig. 11: Example of a central cleaning control

1 External cleaning trigger at the binary input
2 Transferring the external hold over binary output to other measuring devices without connected cleaning functions
3 Transferring the cleaning trigger over a binary output to other self-cleaning measuring points

CM44x as "cleaning master"

1. An external trigger actuates a cleaning at the master. A cleaning unit is connected over a relay or a binary output, for example.
2. The cleaning trigger is transferred to another device via a binary output. This does not have its own connected cleaning unit, but its sensors are installed in the medium affected by cleaning the master and are set to hold by the trigger.
3. The trigger is transferred via an additional binary output to another device, whose connected sensors have their own cleaning units. The signal can be used to simultaneously activate a self-cleaning with the master.

16.2 Binary input configuration

Path: Menu/Setup/Inputs/Binary input x:y[1)]

Function	Options	Info
Binary input	Options ▪ Off ▪ On **Factory setting** On	Switching the input on/off
Signal type	Options ▪ Static signal ▪ PFM **Factory setting** Static signal	Select the signal type. **Static signal** Use this setting to read out the position of, for example, an on/off switch, an inductive proximity switch or a PLC binary output. Signal application: for measuring range switching, acceptance of an external hold, as a cleaning trigger or for controller activation **PFM** The PFM setting produces a pulse-frequency-modulated signal that is subsequently available on the device as a quasi-continuous process value. Example: Measuring signal of a flowmeter
Signal type = "Static signal"		
Signal level	Options ▪ High ▪ Low **Factory setting** High	Determine which input signal levels should activate, for example, measuring range switching or a cleaning. **High** Input signals between 11 and 30 V DC **Low** Input signals between 0 and 5 V DC
Signal type = "PFM"		
Max. frequency	100.00 to 1000.00 Hz **Factory setting** 1000.00 Hz	Maximum frequency of the PFM input signal Is to equal the maximum possible upper limit of the measuring range. If the value selected is too small, higher frequencies will not be detected. If the value is too large, on the other hand, the resolution for small frequencies will be relatively inexact.
Meas. value format	Options ▪ # ▪ #.# ▪ #.## ▪ #.### **Factory setting** #.##	Specify the number of decimal places.

Path: Menu/Setup/Inputs/Binary input x:y[1)]

Function	Options	Info
Input mode	Options ▪ Frequency ▪ Parameter **Factory setting** Frequency	**Frequency** Display in Hz in the measuring menu **Parameter** You subsequently determine the parameter name and unit. These are then displayed in the measuring menu.
Parameter name *Input mode = "Parameter"*	Free text	Define a name for the parameter, e.g. "flow rate."
Unit of measure *Input mode = "Parameter"*	Free text	Determine the unit in which your parameter should be displayed, e.g." l/min."
Lower range value *Input mode = "Parameter"*	-2000.00 to 0.00 **Factory setting** 0.00	Your previously defined unit is additionally displayed. The start of measuring range corresponds to a frequency of 0 Hz.
Upper range value *Input mode = "Parameter"*	0.00 to 10000.00 **Factory setting** 0.00	The end of measuring range corresponds to the maximum frequency defined above. The displayed unit is the one predefined by you.
Damping	0 to 600 s **Factory setting** 0 s	The damping generates a floating average curve of the measured value over the specified time.

1) x:y = slot no. : input number

16.3 Configuration of binary outputs

Path: Menu/Setup/Outputs/Binary output x:y[1)]

Function	Options	Info
Binary output	Options ▪ Off ▪ On **Factory setting** On	Switching the output on/off
Signal type	Options ▪ Static signal ▪ PFM **Factory setting** Static signal	Select the signal type. **Static signal** Comparable to a relay: output of a diagnostic status or a limit contactor **PFM** You can output a measured value, e.g. the chlorine value or the manipulated variable of a controller. It functions as a "wear-free" switching contact that can be used to activate a dosing pump, for example.
Signal type = "PFM"		
Max. frequency	1.00 to 1000.00 Hz **Factory setting** 1000.00 Hz	Maximum frequency of the PFM output signal Is to equal the maximum possible upper limit of the measuring range.
Meas. value format	Options ▪ # ▪ #.# ▪ #.## ▪ #.### **Factory setting** #.##	Specify the number of decimal places.
Source of data	Options ▪ None ▪ Sensor inputs ▪ Binary inputs ▪ Controller ▪ Fieldbus signals ▪ Mathematical functions **Factory setting** None	Source, whose value should be read out as a frequency over the binary output.
Measuring value *Source of data = an input*	Selection dependent on "Source of data"	"Inputs" = everything except controllers

Path: Menu/Setup/Outputs/Binary output x:y[1)]

Function	Options	Info
Actuator type *Source of data = a controller*	Options ▪ None ▪ Bipolar ▪ Unipolar+ ▪ Unipolar- **Factory setting** None	Determines which controller component the connected actuator, e.g. the dosing pump, should trigger. **Unipolar+** Part of the manipulated variable that the controller uses to increase the process value **Unipolar-** For connected actuators that decrease the controlled variable **Bipolar** "Split range"
Hold behavior	Options ▪ Freeze ▪ Fixed value ▪ None **Factory setting** Freeze	**Freeze** The device freezes the last value. **Fixed value** You define a fixed current value that is transmitted at the output. **None** A hold does not affect this output.
Hold value *Hold behavior = "Fixed value"*	0 to 100 % **Factory setting** 0 %	
Error behavior	Options ▪ Freeze ▪ Fixed value **Factory setting** Fixed value	**Freeze** The device freezes the last value. **Fixed value** You define a fixed current value that is transmitted at the output.
Error value *Error behavior = "Fixed value"*	0 to 100 % **Factory setting** 0 %	

Path: Menu/Setup/Outputs/Binary output x:y[1)]

Function	Options	Info
Signal type = "Static signal"		
Function	Options ▪ None ▪ Limit switches ▪ Diagnostics message ▪ Cleaning **Factory setting** None	Source for the outputted switching state The following functions depend on the option selected. Function = "None" switches the function off without requiring any settings.
Assignments *Function = "Cleaning"*	Multiple selection ▪ Cleaning 1 - Water ... ▪ Cleaning 4 - Cleaner	Here you can decide which binary outputs should be used for activating the valves and pumps. Here you concretely assign a control signal to the binary output for the cleaner/water dosing of a cleaning program. You can define the cleaning programs under: Menu/Setup/Additional functions/Cleaning.
Data sources *Function = "Limit switches"*	Multiple selection ▪ Limit switch 1 ... ▪ Limit switch 8	Select the limit contactor to be transmitted over the binary output. The limit switches are configured in the "Setup/Additional functions/Limit switches" menu.
Operating mode *Function = "Diagnostics message"*	Options ▪ as assigned ▪ Namur M ▪ Namur S ▪ Namur C ▪ Namur F **Factory setting** as assigned	**as assigned** With this selection, the diagnosis messages are transmitted over the binary output that you individually allocated to it. **Namur M ... F** When you choose one of the Namur classes, all messages allocated to that respective class are output. You can also change the Namur class assignment for every diagnostics message. (Menu/Setup/General settings/Diagnostics/Device behavior or Menu/Setup/Inputs/../Diagnostics settings/Diag. behavior)

1) x:y = slot no. : input number

17 Additional functions

17.1 Limit switch

There are different ways of configuring a limit switch:
- Assigning a switch-on and switch-off point
- Assigning a switch-on and switch-off delay for a relay
- Setting an alarm threshold and also outputting an error message
- Starting a cleaning function

Path: Menu/Setup/Additional functions/Limit switches/Limit switches 1 to 8

Function	Options	Info
Source of data	Options ▪ None ▪ Connected sensors ▪ Controllers available **Factory setting** None	Specify the input or output which should be the source of data for the limit switch.
Measuring value	Options ▪ None ▪ Depends on theSource of data **Factory setting** None	The measured value you can select depends on the option selected under "Source of data".

Measured valuedepending on theSource of data

Source of data	Measured value
pH Glass pH ISFET	Options ▪ Raw value mV ▪ pH ▪ Temperature
Redox	Options ▪ Temperature ▪ Redox mV ▪ Redox %
Oxygen (amp.) Oxygen (opt.)	Options ▪ Temperature ▪ Partial pressure ▪ Concentration liquid ▪ Saturation ▪ Raw value nA (only Oxygen (amp.)) ▪ Raw value µs (only Oxygen (opt.))

Measured valuedepending on theSource of data

Source of data	Measured value
Cond i	Options ▪ Temperature ▪ Conductivity ▪ Resistance (only Cond c) ▪ Concentration (only Cond i)
Cond c	
Chlorine	Options ▪ Temperature ▪ Current ▪ Concentration
ISE	Options ▪ Temperature ▪ pH ▪ Ammonium ▪ Nitrate ▪ Potassium ▪ Chloride
TU/TS	Options ▪ Temperature ▪ Turbidity g/l ▪ Turbidity FNU
Nitrate	Options ▪ Temperature ▪ NO3 ▪ NO3-N
Ultrasonic interface(interface measurement)	Options ▪ Interface ▪ Turbidity
SAC	Options ▪ Temperature ▪ SAC ▪ Transm. ▪ Absorption ▪ COD ▪ BOD
Controller 1	Options ▪ Bipolar(only current outputs) ▪ Unipolar+ ▪ Unipolar-
Controller 2	
Mathematical functions	All the mathematical functions can also be used as a data source and the calculated value can be used as the measured value.

You can monitor the manipulated variable by assigning the controller manipulated variable to a limit switch (e.g. configure a dosing time alarm).

Path: Menu/Setup/Additional functions/Limit switches/Limit switches 1 to 8

Function	Options	Info
Cleaning program	Options ▪ None ▪ Cleaning 1 ▪ Cleaning 2 ▪ Cleaning 3 ▪ Cleaning 4 **Factory setting** None	Use this function to choose the cleaning instance which should be started when the limit switch is active.
Function	Options ▪ On ▪ Off **Factory setting** Off	Activating/deactivating the limit switch
Operating mode	Options ▪ Above limit check ▪ Below limit check ▪ In range check ▪ Out of range check ▪ Change rate **Factory setting** Above limit check	Type of limit value monitoring: ▪ Limit value overshoot or undershoot→ 12 ▪ Measured value within or outside a range → 13 ▪ aChange rate→ 15
Limit value	**Settings** Depends on the measured value	*Operating mode="Above limit check" or "Below limit check"*

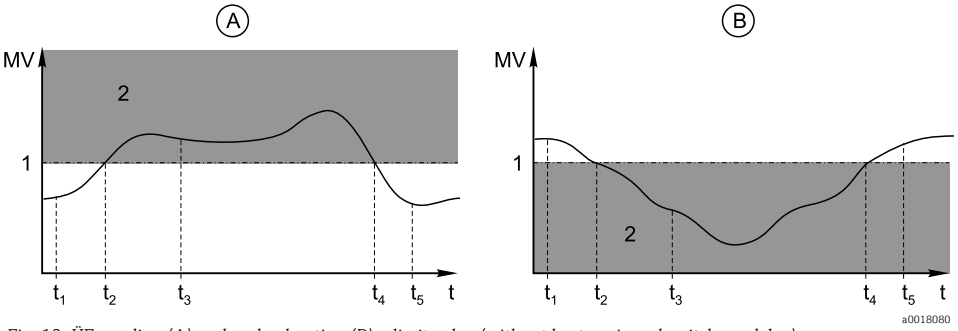


Fig. 12: ÜExceeding (A) and undershooting (B) a limit value (without hysteresis and switch-on delay)

1 Limit value
2 Alarm range
t_1,t_3,t_5 No action
t_2,t_4 An event is generated

- If the measured values (MV) are increasing, the relay contact is closed when the on-value is exceeded ("Limit value" + "Hysteresis") and the start delay has elapsed ("Start delay").
- If the measured values are decreasing, the relay contact is reset when the off-value is undershot ("Limit value" - "Hysteresis") and following the release delay ("Switch off delay").

Path: Menu/Setup/Additional functions/Limit switches/Limit switches 1 to 8

Function	Options	Info
Range lower value	**Settings** Depends on the measured value	*Operating mode="In range check" or "Out of range check"*
Range upper value		

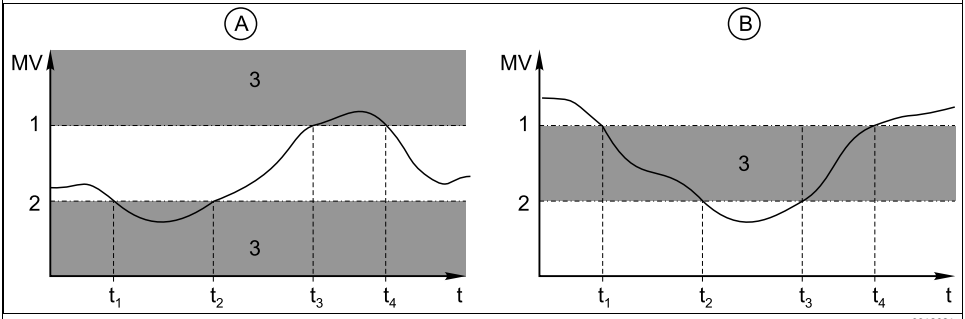
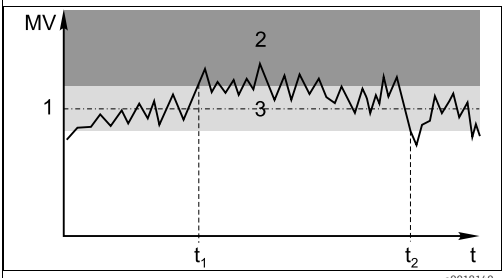


Fig. 13: Monitoring outside (A) and within (B) a range (without hysteresis and switch-on delay)

1 End of range
2 Start of range
3 Alarm range
$t_{1, 2, 3, 4}$ An event is generated

- If the measured values (MV) are increasing, the relay contact is closed when the on-value is exceeded ("Range lower value" + "Hysteresis") and the start delay has elapsed ("Start delay").
- If the measured values are decreasing, the relay contact is reset when the off-value is undershot ("Range upper value" - "Hysteresis") and following the release delay ("Switch off delay").

Hysteresis	**Settings** Depends on the measured value	*Operating mode="In range check", "Out of range check","Above limit check" or "Below limit check"*



The hysteresis is needed to ensure a stable switching behavior.

The device software adds or subtracts the value set here to/from the limit value (Limit value, Range lower value or Range upper value). This results in the double "Hysteresis" value for the hysteresis range around the limit value.
An event is then only generated if the measured value (MV) completely passes through the hysteresis range.
→ 14

Fig. 14: Hysteresis taking the example of limit value overshoot

1 Limit value
2 Alarm range
3 Hysteresis range
t_1, t_2 An event is generated

Path: Menu/Setup/Additional functions/Limit switches/Limit switches 1 to 8

Function	Options	Info
Start delay	0 to 9999 s **Factory setting** 0 s	*Operating mode="In range check", "Out of range check","Above limit check" or "Below limit check"* Synonyms: pick-up and drop-out delay
Switch off delay		
Delta value	**Settings** Depends on the measured value	*Operating mode="Change rate"* The slope of the measured value (MV) is monitored in this mode. An event is generated if, in the given timeframe (Delta time), the measured value increases or decreases by more than the specified value (Delta value). No further event is generated if the value continues to experience such a steep increase or decrease. If the slope is back below the limit value, the alarm status is reset after a preset time (Auto Confirm). Events are triggered by the following conditions in the example given: $t_2 - t_1$ < "Delta time" **and** ΔMV_1 > "Delta value" $t_4 - t_3$ > "Auto Confirm" **and** ΔMV_2 < "Delta value" $t_6 - t_5$ < "Delta time" **and** ΔMV_3 > ΔMV
Delta time	00:01 to 23:59 **Factory setting** 01:00	
Auto Confirm	00:01 to 23:59 **Factory setting** 00:01	

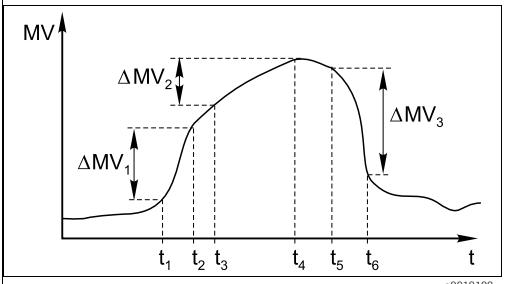


Fig. 15: Change rate

17.2 Controller

17.2.1 Controller structure in Laplace representation

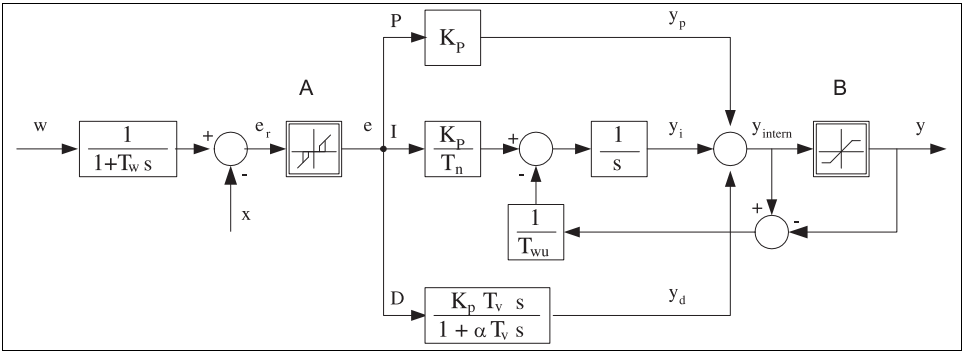


Fig. 16: Block diagram of the controller structure

A	*Neutral zone*
B	*Output limiting*
K_p	*Gain (P-value)*
T_n	*Integral action time (I-value)*
T_v	*Derivative action time (D-value)*
T_w	*Time constant for set point damping*
T_{wu}	*Time constant for anti-windup feedback*
P	*Proportional value*
I	*Integral value*
D	*Derivative value*
αT_v	*Damping time constant with α= 0 to 1*
e	*Control deviation*
w	*Set point*
x	*Controlled variable*
y	*Manipulated variable*

The controller structure of the device comprises set point damping at the input to prevent erratic changes in the manipulated variable if the set point changes. The difference between the set point w and the controlled variable (measured value) X results in the control deviation which is filtered by a neutral zone.
The neutral zone is used to suppress control deviations (e) that are too small. The control deviation thus filtered is now fed to the actual PID controller which divides into three parts based on the P (proportional), I (integral) and D (derivative) values (top-down). The integral section (middle) also comprises an anti-windup mechanism for limiting the integrator. A low-pass filter is added to the D-section to damp hard D-terms in the manipulated variable. The sum of the 3 sections results in the internal controller manipulated variable which is limited according to the settings (for PID-2s to -100% to +100%).
The graphic does not illustrate a downstream filter for limiting the rate of change of the manipulated variable (can be configured in the menu in "Max Y change rate /s").

In the menu do not configure the gain K_p. Instead configure the reciprocal value, the proportional band X_p (K_p=1/X_p).

17.2.2 Configuration

Make the following decisions when configuring a controller:

1. What type of process can your process be assigned to?
   -->Process type
2. Should it be possible to influence the measured variable (controlled variable) in one direction or in both directions?
   One-sided or two-sided controller, -->Controller type
3. What should be the controlled variable (sensor, measured value)? -->Controlled variable
4. Do you have a disturbance variable that should be active at the controller output? -->Disturbance variable
5. Define the parameters for the controller:
   - Setpoint, -->Setpoint
   - Neutral zone, -->Xn
   - Proportional band, -->Xp
   - Integral action time (I-value), -->Tn
   - Derivative action time (D-value), -->Tv
6. What should the controller do in the event of a hold (measured error, sensor replacement, cleaning etc.)?
   - Pause or continue with dosing?
   - At the end of a hold, continue or restart the control loop (affects I-value)?
7. How should the actuator be triggered?
   - Assign "Unipolar+" to the output for an actuator which can increase the measured value.
   - Assign "Unipolar-" to the output for an actuator which can decrease the measured value.
   - Select "Bipolar" if you want to output the manipulated variable via one current output only (split range).
8. Configure the outputs and switch on the controller.

Path: Menu/Setup/Additional functions/Controller 1 or Controller 2

Function	Options	Info
Control	Options ▪ Off ▪ Automatic ▪ Manual mode **Factory setting** Off	First configure the controller and leave the switch at "Off" during this time. Once you have made all the settings, you can assign the controller to an output and switch it on.
▶ Manual mode		
Y	-100 to 100 % **Factory setting** 0 %	Specify the manipulated variable that should be output in manual mode.
Y Actual output	Read only	Manipulated variable actually output.
Name	Free text	Give the controller a name so you can identify it later on.

Path: Menu/Setup/Additional functions/Controller 1 or Controller 2

Function	Options	Info
Controller Enable	Options ▪ None ▪ Binary inputs ▪ Limit switch ▪ Fieldbus variables **Factory setting** None	In connection with the DIO module, you can select a binary input signal, e.g. from an inductive proximity switch, as a source for enabling the controller.
Setup Level	Options ▪ Standard ▪ Advanced **Factory setting** Standard	The Setup Level changes the number of parameters that can be configured. If you choose "Standard" the other controller parameters are active nevertheless. The system uses the factory settings which usually suffice in most cases.
Process type	Options ▪ Inline ▪ Batch **Factory setting** Inline	Decide what type of process best describes your particular process (see the explanation below).

Batch process
The medium is in a closed system.
The task of the control system is to dose in such a way that the measured value (controlled variable) changes from its start value to its target value. No more dosing is needed once the setpoint has been reached and the system is stable. If the target value is overshot, a two-sided control system can compensate for this.
In the case of 2-sided batch control systems, a neutral zone is used/configured to suppress oscillations around the setpoint.

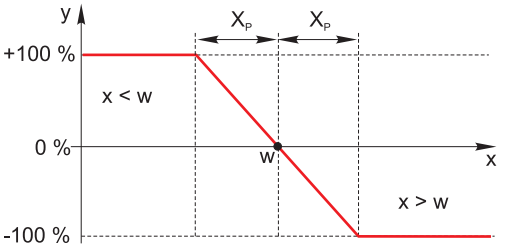
In-line process
In an in-line process, the control system works with the medium flowing by in the process. Here, the controller has the task of using the manipulated variable to set a mixture ratio between the medium and dosing agent such that the resulting measured variable corresponds to the setpoint. The properties and volume of the medium flow can change at any time and the controller has to react to these changes on a continuous basis. If the flow rate and medium remain constant, the manipulated variable can also assume a fixed value once the process has settled. Since the control process is never "finished" here, this type of control is also referred to as continuous control.

A mixture of both process types can often be found in practice: the semi-batch process. Depending on the ratio between the flow and the container volume, this arrangement behaves either like a batch process or an in-line process.

Path: Menu/Setup/Additional functions/Controller 1 or Controller 2

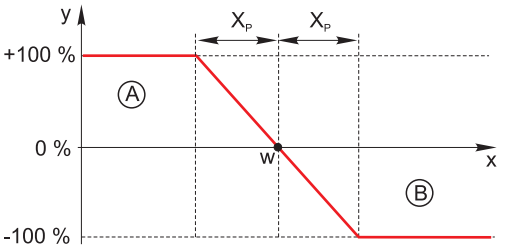
Function	Options	Info
Controller type	Options ▪ PID 1-sided ▪ PID 2-sided **Factory setting** PID 2-sided	Depending on the actuator connected, you influence the process in just one direction (e.g. heating) or in both directions (e.g. heating and cooling).

A 2-sided controller can output a manipulated variable in the range from -100% to +100%, i.e. the manipulated variable is bipolar. The manipulated variable is positive if the controller should increase the process value. In the case of a pure P-controller, this means that the value of the controlled variable x is smaller than the setpoint w. On the other hand, the manipulated variable is negative if the process value should be decreased. The value for x is greater than the setpoint w. The following graphic illustrates the relationship $y = (w-x)/X_p$:



Effective direction *Controller type="PID 1-sided"*	Options ▪ Direct ▪ Reverse **Factory setting** Reverse	In what direction should the controller influence the measured value? ▪ The measured value should increase as a result of dosing (e.g. heating) --> "Reverse" ▪ The measured value should decrease as a result of dosing (e.g. cooling) --> "Direct"

A 1-sided controller has a unipolar manipulated variable, i.e. it can only influence the process in one direction. If the controller should increase the process value, set "Reverse" as the effective direction. The controller then becomes active when the process value is too small (range A).
With the "Direct" effective direction, the controller acts as a "downwards controller". It becomes active when the process value (e.g. the temperature) is too high (range B).



The red curve shows overlap between the curves of the two 1-sided controllers.

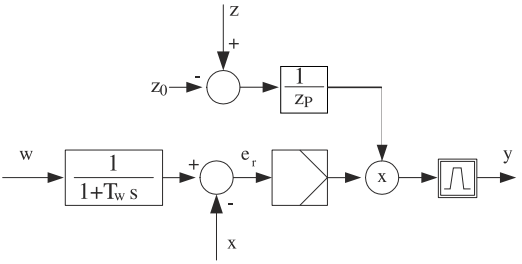
Path: Menu/Setup/Additional functions/Controller 1 or Controller 2

Function	Options	Info
▶ Controlled variable		
Source of data	Options ▪ Sensors ▪ Current inputs ▪ Fieldbus signals ▪ Binary inputs ▪ Mathematical functions **Factory setting** None	Specify the input or output which should be the source of data for the controlled variable.
Measured value	Options ▪ None ▪ Depends on theSource of data **Factory setting** None	Specify the measured value that should be your controlled variable. The measured value you can select depends on the option selected under "Source of data".
▶ Setpoint		Not available if a fieldbus has been selected as the "Source of data"
Setpoint	**Range of adjustment and factory setting** Depends on the "Source of data"	Specify the setpoint for the controlled variable.

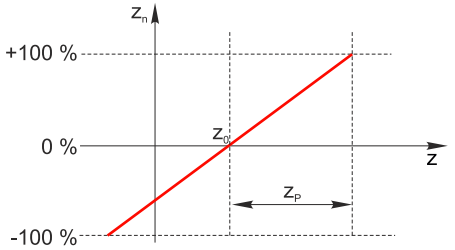
Path: Menu/Setup/Additional functions/Controller 1 or Controller 2

Function	Options	Info
▶ Disturbance variable		optional, activation code necessary

With "flowing medium" (inline) controls, it can happen that the flow rate is non-constant. In some circumstances, strong fluctuations are possible. In the case of a settled control system in which the flow rate is suddenly halved, it is desirable that the dosed quantity from the controller is also directly halved. In order to achieve this type of "flow-rate-proportional" dosing, this task is not left to the I-component of the controller, but rather one enters the (to be measured) flow rate as disturbance variable z multiplicative at the controller output.



Strictly speaking, feedforward control involves an open-loop control system, since its effect is not measured directly. That means that the feed flow is directed exclusively forward. Hence the designation "feedforward control."
For the additive feedforward control that is alternatively available in the device, the (standardized) disturbance variable is added to the controller actuating variable. This enables you to set up a type of variable base load dosing.
The standardization of the disturbance variable is required both for multiplicative and for additive feedforward control and is done using parameters Z_0 (zero point) and Z_p (proportional band): $z_n = (z - z_0)/z_p$



Example:
Flowmeter with measuring range 0 ... 200 m^3/ h
The controller would currently dose 100% without feedforward control.
The feedforward control should be configured such that at z = 200m^3/h, the controller still doses at 100% (z_n = 1). If the flow rate drops, the dosing rate should be reduced, and at a flow rate of less than 4 m^3/h, dosing should stop entirely (z_n = 0).
--> Select the zero point z_0 = 4 m^3/h and the proportional band Z_p= 196 m^3/h.

Function	**Options** ▪ Off ▪ Multiply ▪ Add **Factory setting** Off	Selecting multiplicative or additive feedforward control

Path: Menu/Setup/Additional functions/Controller 1 or Controller 2

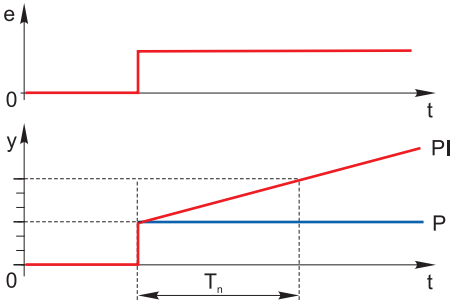
Function	Options	Info
Source of data	Options ▪ Sensors ▪ Current inputs ▪ Fieldbus signals ▪ Binary inputs ▪ Mathematical functions **Factory setting** None	Specify the input or output which should be the source of data for the disturbance variable.
Measured value	Options ▪ None ▪ Depends on theSource of data **Factory setting** None	Specify the measured value that should be your disturbance variable. The measured value you can select depends on the option selected under "Source of data".
Zp	Range of adjustment depending on the selection of the measured value	Proportional band -->
Z0		Zero point
▶ Parameters		

The Liquiline PID controller has been implemented in the serial structural form, i.e. it has the following parameters:
- Integral action time T_n
- Derivative action time T_v
- Proportional band X_p

You can also configure the following for Setup Level="Advanced":
- Time constant T_{wu}
- Time constant Alpha
- Width of the neutral zone X_n
- Width of the hysteresis range of the neutral zone X_{hyst}
- Cycle time of the controller

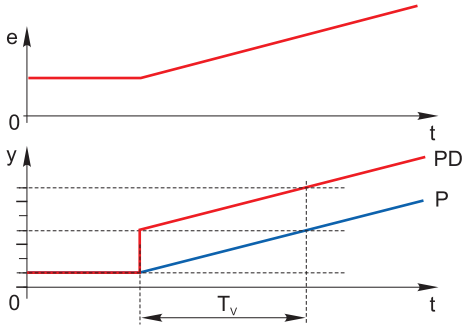
Tn	0.0 to 9999.0 s **Factory setting** 0.0 s	The integral action time specifies the effect of the I-value If Tn > 0, then the following holds true: Clock < Twu < 0.5(Tn + Tv)

The integral action time is the time needed in a step-function response to achieve a change in the manipulated variable - as a result of the I effect - which has the same magnitude as the P-value.

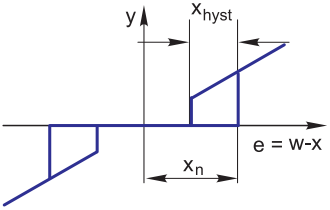


e = control deviation, e=w-x (setpoint controlled variable)

Path: Menu/Setup/Additional functions/Controller 1 or Controller 2

Function	Options	Info
Twu	0.1 to 999.9 s **Factory setting** 20.0 s	Time constant for anti-windup feedback The lower the value the greater the integrator inhibition. Exercise extreme caution when making changes. Clock < Twu < 0.5(Tn + Tv)
Tv	0.0 to 9999.0 s **Factory setting** 0.0 s	The derivative action time specifies the effect of the D-value
The derivative action time is the time by which the ramp response of a PD controller reaches a specific value of the manipulated variable at an earlier stage than it would solely as a result of its P-value.  		
alpha	0.0 to 1.0 **Factory setting** 0.3	Affects the additional damping filter of the D-controller. The time constant is calculated from alpha * T_v.
Process balance *Controller type="PID 2-sided"*	Options ▪ Symmetric ▪ Asymmetric **Factory setting** Symmetric	**Symmetric** There is only one control gain and this applies for both sides of the process. **Asymmetric** You can set the control gain individually for both sides of the process.
Xp *Process balance="Symmetric"*	**Range of adjustment and factory setting** Depends on the "Source of data"	Proportional band, reciprocal value of the proportional gain K_p As soon as X deviates more than X_p from the set point, Y reaches 100%.
Xp Low Xp High	**Range of adjustment and factory setting** Depends on the "Source of data"	*Process balance="Asymmetric"*

Path: Menu/Setup/Additional functions/Controller 1 or Controller 2

Function	Options	Info
Xn *Process balance="Symmetric"*	**Range of adjustment and factory setting** Depends on the "Source of data"	Tolerance range about the setpoint that prevents minor oscillations about the setpoint if using two-sided control loops.
XN Low XN High	**Range of adjustment and factory setting** Depends on the "Source of data"	*Process balance="Asymmetric"*
XHyst	0.0 to 99.9 % **Factory setting** 0.0 %	Width of the hysteresis range of the neutral zone, relative component of Xn
 The graphic illustrates the manipulated variable (with a pure P-controller) over the control deviation e (set point minus controlled variable). Very low control deviations are set to zero. Control deviations > X_n are processed "in the normal way". Via X_{hyst} it is possible to configure a hysteresis to suppress oscillations at the edges.		
Clock	0.333 to 100.000 s **Factory setting** 1.000 s	**Expert setting!** Only change the cycle time of the controller if you know exactly what you are doing! Clock < Twu < 0.5(Tn + Tv)
Max Y change rate /s	0.00 to 1.00 **Factory setting** 0.40	Limits the change of the output variable
▶ Hold behavior		Hold=measured value is no longer reliable
Manipulated Variable	Options ▪ Freeze ▪ Set to zero **Factory setting** Freeze	How should the controller react to a measured value that is no longer reliable? **Freeze** The manipulated variable is frozen at the current value **Set to zero** Manipulated variable is set to 0 (no dosing)
State	Options ▪ Freeze ▪ Reset **Factory setting** Freeze	Internal controller status **Freeze** No change **Reset** After a hold, the control system starts from scratch, and settling time takes place again.

Path: Menu/Setup/Additional functions/Controller 1 or Controller 2

Function	Options	Info
▶ Manual mode		
Y	-100 to 100 % **Factory setting** 0 %	Editable manipulated variable, which is output in the manual mode.
Y Actual output	Read only	Manipulated variable actually output: Input manually for "Control" = "Manual mode", calculated by the controller for Control" = "Automatic"
Setpoint	Read only	Configured setpoint (damped) If the controller is running and the set point is reconfigured, here you can see how the (effective) set point gradually moves towards the new value.
X		Current measured value
▶ Output selection		Goes to the "Outputs" menu --> "Outputs" section

17.3 Cleaning programs

⚠ CAUTION

The cleaning system is not switched off during calibration or maintenance activities

Risk of injury due to medium or cleaning agent

- ▶ If a cleaning system is connected, switch it off before removing a sensor from the medium.
- ▶ If you are not switching off the cleaning system because you wish to test the cleaning function, wear protective clothing, goggles and gloves or take other appropriate measures.

Path: Menu/Setup/Additional functions/Cleaning/Cleaning 1 to 4

Function	Options	Info
Cleaning type	Options ▪ Standard clean ▪ Chemoclean **Factory setting** Standard clean	
Cleaning time	5 to 600 s **Factory setting** 10 s	Cleaning time... Cleaning duration The cleaning duration and interval depend on the process and sensor. Determine the variables empirically or based on experience.
Cleaning interval	00-00:01 to 07-00:00 (DD-hh:mm) **Factory setting** 01-00:00	The interval value can be between 1 minute and 7 days. Example: You have set the value "01-00:00". Each day, the cleaning cycle starts at the same time you started the first cleaning cycle.
Hold	Options ▪ On ▪ Off **Factory setting** Off	Decide whether there should be a hold for the assigned sensor during the cleaning process.
▶ Output selection		Goes to the "Outputs" menu You can assign the cleaning program directly to one or more outputs. --> "Outputs" section
▷ Start cycle	Action	Start the cyclical cleaning process with the settings above
▷ Start manually	Action	Start an individual cleaning process If cyclical cleaning is enabled, there are times in which it is not possible to manually start the process.
▷ Stop	Action	End the cleaning process (cyclically or manually)
State of cleaning	Read only	Indicates whether cleaning is currently taking place or not
Time to next clean	Read only	Countdown to the next cleaning process (only if cyclical cleaning has been started)

17.4 Mathematical functions

In addition to "real" process values which are delivered by analog inputs or physical sensors connected to the device, you can also calculate a maximum of 6 "virtual" process values using mathematical functions.

The "virtual" process values can be:
- Output via a current output or a fieldbus
- Used as a controlled variable
- Assigned as a measured variable to a limit contactor
- Used as a measured variable to trigger cleaning
- Displayed in user-defined measuring menus

17.4.1 Difference

You can subtract the measured values of two sensors and use the result to detect incorrect measurements, for example.
To calculate a difference, you must use two measured values with the same engineering unit.

Path: Menu/Setup/Additional functions/Mathematical functions/MF 1 to 6/Mode/Difference

Function	Options	Info
Calculation	Options ▪ Off ▪ On **Factory setting** Off	On/off switch for the function
Y1	The options depend on the sensors connected	Select the sensors and the measured variables that should be used as the minuend (Y1) or subtrahend (Y2).
Measured value		
Y2		
Measured value		
Difference value	Read only	View this value in a user-defined measuring screen or output the value via the current output.

17.4.2 Redundancy

Use this function to monitor two or three sensors with redundant measurements. The arithmetic average of the two closest measured values is calculated and output as the redundancy value.

Path: Menu/Setup/Additional functions/Mathematical functions/MF 1 to 6/Mode/Redundancy

Function	Options	Info
Calculation	Options ▪ Off ▪ On **Factory setting** Off	On/off switch for the function
Y1	The options depend on the sensors connected	You can select different types of sensor that output the same measured value. **Example for temperature redundancy:** You have a pH sensor and an oxygen sensor at inputs 1 and 2. Select both as "Y1" and "Y2". For "Measured value" select the temperature.
Measured value		
Y2		
Measured value		
Y3 (optional)		
Measured value		
Deviation control	Options ▪ Off ▪ On **Factory setting** Off	You can monitor the redundancy. Specify an absolute limit value that may not be exceeded.
Deviation limit	Depends on the selected measured value	
Redundancy	Read only	View this value in a user-defined measuring screen or output the value via the current output.

17.4.3 rH value

To calculate the rH value, a pH sensor and an ORP sensor must be connected. It is irrelevant whether you are using a pH glass sensor, an ISFET sensor or the pH electrode of an ISE sensor.

Path: Menu/Setup/Additional functions/Mathematical functions/MF 1 to 6/Mode/rH calculation

Function	Options	Info
Calculation	Options ▪ Off ▪ On **Factory setting** Off	On/off switch for the function
pH source	Connected pH sensor	Set the input for the pH sensor and the input for the ORP sensor. Measured value interrogation is obsolete as you must select pH or ORP mV.
Redox source	Connected ORP sensor	
Calculated rH	Read only	View this value in a user-defined measuring screen or output the value via the current output.

17.4.4 Degassed conductivity

Carbon dioxide from the air can be a contributing factor to the conductivity of a medium. The degassed conductivity is the conductivity of the medium excluding the conductivity caused by carbon dioxide.

In the power station industry, for example, it is advantageous to use the degassed conductivity:
- The percentage of conductivity caused by corrosion products or fouling in the feed water can be determined as early as when the turbines are started. The system excludes the initially high conductivity values resulting from the ingress of air.
- If carbon dioxide is regarded as non-corrosive, the live steam can be directed to the turbine far earlier during startup.
- If the conductivity value increases during normal operation, it is possible to immediately determine an ingress of coolant or air by calculating the degassed conductivity.

Path: Menu/Setup/Additional functions/Mathematical functions/MF 1 to 6/Mode/Degassed conductivity

Function	Options	Info
Calculation	Options ▪ Off ▪ On **Factory setting** Off	On/off switch for the function
Cation conductivity	Connected conductivity sensor	"Cation conductivity" is the sensor downstream from the cation exchanger and upstream from the "degassing module", "Degassed conductivity" is the sensor at the outlet of the degassing module. Measured value interrogation is obsolete as you can only choose conductivity.
Degassed conductivity	Connected conductivity sensor	
CO2 concentration	Read only	View this value in a user-defined measuring screen or output the value via the current output.

17.4.5 Dual conductivity

You can subtract two conductivity values and use the result, for example, to monitor the efficiency of an ion exchanger.

Path: Menu/Setup/Additional functions/Mathematical functions/MF 1 to 6/Mode/Dual conductivity

Function	Options	Info
Calculation	Options ▪ Off ▪ On **Factory setting** Off	On/off switch for the function
Inlet	The options depend on the sensors connected	Select the sensors that should be used as the minuend (Inlet, e.g. sensor upstream from the ion exchanger) and subtrahend (Outlet, e.g. sensor downstream from the ion exchanger).
Measured value		
Outlet		
Measured value		
Main value format	Options ▪ Auto ▪ # ▪ #.# ▪ #.## ▪ #.### **Factory setting** Auto	
Cond. unit	Options ▪ Auto ▪ µS/cm ▪ mS/cm ▪ S/cm ▪ µS/m ▪ mS/m ▪ S/m **Factory setting** Auto	
Dual conductivity	Read only	View this value in a user-defined measuring screen or output the value via the current output.

17.4.6 Calculated pH value

The pH value can be calculated from the measured values of two conductivity sensors under certain conditions. Areas of application include power stations, steam generators and boiler feedwater.

Path: Menu/Setup/Additional functions/Mathematical functions/MF 1 to 6/Mode/pH calculation from conductivity

Function	Options	Info
Calculation	Options ▪ Off ▪ On **Factory setting** Off	On/off switch for the function
Method	Options ▪ NaOH ▪ NH3 ▪ LiOH **Factory setting** NaOH	The calculation is performed on the basis of Guideline VGB-R-450L of the Technical Association of Large Power Plant Operators (Verband der Großkesselbetreiber, (VGB)). **NaOH** $pH = 11 + \log \{(\kappa_v - 1/3\ \kappa_h)/273\}$ **NH3** $pH = 11 + \log \{(\kappa_v - 1/3\ \kappa_h)/243\}$ **LiOH** $pH = 11 + \log \{(\kappa_v - 1/3\ \kappa_h)/228\}$ κ_v ... "Inlet" ... direct conductivity κ_h ... "Outlet" ... acid conductivity
Inlet Outlet	Choice of conductivity sensor	Inlet Sensor upstream from the cation exchanger, "direct conductivity" Outlet Sensor downstream from the cation exchanger, "acid conductivity" The choice of measured value is obsolete since it must always be "Conductivity".
Calculated pH	Read only	View this value in a user-defined measuring screen or output the value via the current output.

17.5 Measuring range switch

A measuring range switching (MRS) configuration includes the following options for each of the four binary input states:
- Mode of operation (conductivity or concentration)
- Concentration table
- Temperature compensation
- Current output turndown
- Limit contactor range

If an MRS set is assigned to a channel and MRS is enabled for this set, the measuring range configuration selected via the binary inputs is used instead of the normal configuration of the linked sensor channel. So that the current outputs and limit contactors are controlled by the MRS, these must be linked with the MRS set, not with the measuring channel.
Current outputs and limit contactors that are connected to an MRS set receive the measured value corresponding to the mode of operation as well as the corresponding turndown or range for limit value monitoring. A limit contactor connected to an MRS set always uses the "Out of range check" mode, i.e. it switches if the value is outside the configured range. If a current output or limit contactor is connected to an MRS set, the turndown, monitoring range and limit contactor mode can no longer be configured manually. Therefore, these options are hidden in the current output menu and limit contactor menu.

Example: CIP cleaning in a brewery

	Beer	**Water**	**Base**	**Acid**
Binary input 1	0	0	1	1
Binary input 1	0	1	0	1
	Measuring range 00	Measuring range 01	Measuring range 10	Measuring range 11
Operating mode	Conductivity	Conductivity	Concentration	Concentration
Conc. Table	-	-	NaOH 0..15%	User table 1
Compensation	User table 1	Linear	-	-
Current output				
Range lower value	1.00 mS/cm	0.1 mS/cm	0.50 %	0.50 %
Range upper value	3.00 mS/cm	0.8 mS/cm	5.00 %	1.50 %
Limit switches				
Range lower value	2.3 mS/cm	0.5 mS/cm	2.00 %	1.30 %
Range upper value	2.5 mS/cm	0.7 mS/cm	2.10 %	1.40 %

Path: Menu/Setup/Additional functions/Measuring range switch

Function	Options	Info
▶ MRS set 1 ▶ MRS set 2		If you enter both activation codes, you have two independent parameter sets available for measuring range switching. The submenus are the same for both sets.
MRS	Options ▪ On ▪ Off **Factory setting** Off	Switches the function on or off
Sensor	Options ▪ None ▪ Connected, inductive conductivity sensors **Factory setting** None	This function can be used on inductive conductivity sensors only.
Binary input 1 Binary input 2	Options ▪ None ▪ Binary inputs ▪ Fieldbus signals ▪ Limit switch **Factory setting** None	Source of the switching signal, can be selected for input 1 and 2 in each case
Sensor = inductive conductivity sensor		
▶ Measuring range 00 ▶ Measuring range 01 ▶ Measuring range 10 ▶ Measuring range 11		Select the MRSs; a maximum of 4 are possible. The submenus are identical for each and thus are displayed only once.
Operating mode	Options ▪ Conductivity ▪ Concentration **Factory setting** Conductivity	

Path: Menu/Setup/Additional functions/Measuring range switch

Function	Options	Info
Conc. Table	Options ▪ NaOH 0..15% ▪ HCl 0..20% ▪ HNO3 0..25% ▪ HNO3 24..30% ▪ H2SO4 0..28% ▪ H2SO4 40..80% ▪ H2SO4 93..100% ▪ H3PO4 0..40% ▪ NaCl 0..26% ▪ User table 1 ▪ User table 2 ▪ User table 3 ▪ User table 4 **Factory setting** NaOH 0..15%	Concentration tables saved at the factory: NaOH: 0 to 15%, 0 to 100 °C (32 to 212 °F) HCl: 0 to 20%, 0 to 65 °C (32 to 149 °F) HNO_3: 0 to 25%, 2 to 80 °C (36 to 176 °F) H_2SO_4: 0 to 28%, 0 to 100 °C (32 to 212 °F) H_2SO_4: 40 to 80%, 0 to 100 °C (32 to 212 °F) H_2SO_4: 93 to 100%, 0 to 100 °C (32 to 212 °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)
Compensation	Options ▪ None ▪ Linear ▪ NaCl (IEC 746-3) ▪ Water ISO7888 (20°C) ▪ Water ISO7888 (25°C) ▪ UPW NaCl ▪ UPW HCl ▪ User table 1 ▪ User table 2 ▪ User table 3 ▪ User table 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 thus measure uncompensated conductivity.
▶ Current output		
Range lower value	0 to 100 %	*Operating mode = "Concentration"*
Range upper value		
Range lower unit	Options ▪ S/m ▪ µS/cm ▪ mS/cm ▪ S/cm ▪ µS/m ▪ mS/m **Factory setting** mS/cm	*Operating mode = "Conductivity"* Define the units and range limits for the output values.
Range lower value	Enter value	
Range upper unit	Enter value	
Range upper value	Enter value	

Path: Menu/Setup/Additional functions/Measuring range switch

Function	Options	Info
▶ Limit switches		
Range lower value	0 to 100 %	*Operating mode = "Concentration"*
Range upper value		
Range lower unit	Options ▪ S/m ▪ µS/cm ▪ mS/cm ▪ S/cm ▪ µS/m ▪ mS/m **Factory setting** mS/cm	*Operating mode = "Conductivity"* Define the units and range limits for the output values.
Range lower value	Enter value	
Range upper unit	Selection and factory setting as for "Range lower unit"	
Range upper value	Enter value	

18 Communication

18.1 Web server

18.1.1 Connection

▶ Connect the PC communication cable to the RJ45 port of module 485.

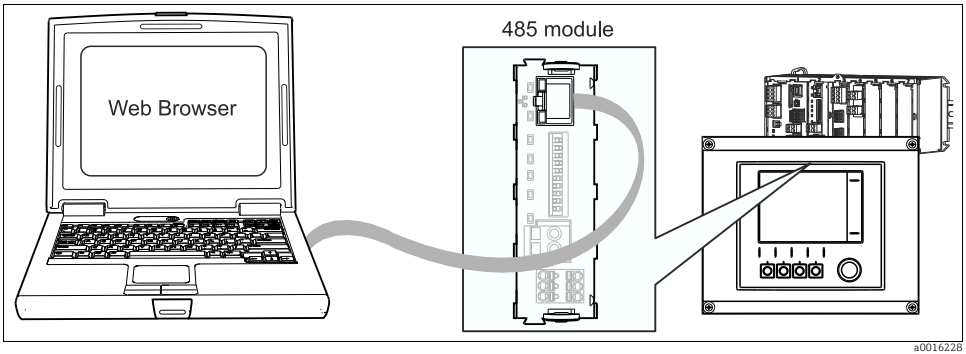


Fig. 17: Ethernet connection

18.1.2 Creating the data connection

1. Start your PC.
2. First, set a manual IP address in the network connection settings of the operating system.
   ↳ This address must be in the same subnetwork as the IP address of the device.

   Example:

   - IP address Liquiline: 192.168.1.212 (Diagnostics/System information/Ethernet/IP-Address)
   - IP address for the PC: 192.168.1.**213**
3. Start the Internet browser.

If you use a proxy server to connect to the Internet:

4. Disable the proxy (browser settings under "Connections/LAN settings").
5. Enter the IP address of your device in the address line.
   ↳ The system takes a few moments to establish the connection and then the CM44 web server starts.

- Enter the following address(es) to download logbooks:
  - 192.168.1.212/logbooks_csv.fhtml (for logbooks in CSV format)
  - 192.168.1.212/logbooks_fdm.fhtml (for logbooks in FDM format)

Downloads in FDM format can be securely transmitted, saved and visualized with Endress+Hauser's "Field Data Manager Software".
(--> www.products.endress.com/ms20)

18.1.3 Operation

The menu structure of the web server corresponds to the onsite operation.

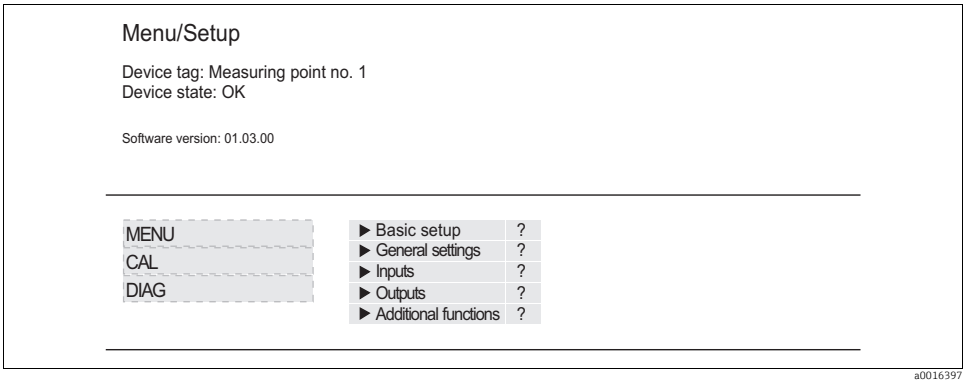


Fig. 18: Example of web server (menu/language=English)

- Clicking a menu name or a function corresponds to pressing the navigator.
- You can make your settings conveniently via the computer keyboard.

Instead of using an Internet browser, you can also use FieldCare for configuration via ethernet. The ethernet DTM required for this purpose can be downloaded from the product page.

18.2 Service interface

You can connect the device to a computer via the service interface and configure it using "Fieldcare". Furthermore, configurations can also be saved, transferred and documented.

18.2.1 Connection

- ▶ Connect the service connector to the interface on the Liquiline basic module and connect it to the Commubox.
- ▶ Via the USB port, connect the Commubox to the computer running the Fieldcare software.

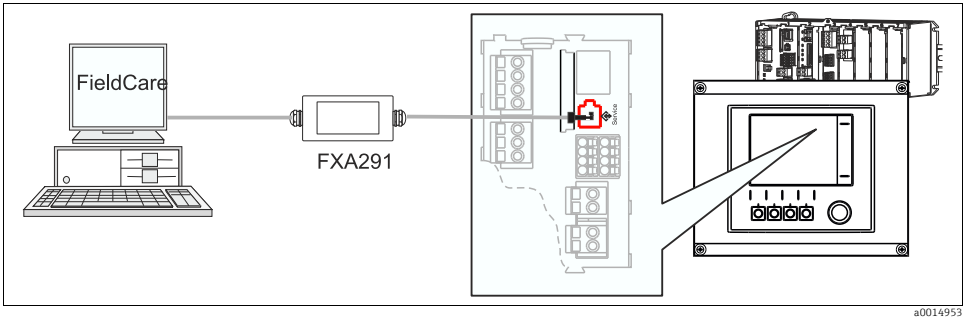


Fig. 19: Connection overview

18.2.2 Creating the data connection

1. Start Fieldcare.
2. Establish a connection to the Commubox. For this, select the ComDTM "CDI Communication FXA291"
3. Then select the DTM for CM442/CM444/CM448 and start the configuration.

You can now start online configuration via the DTM.
Online configuration competes with onsite operation, i.e. each of the two options blocks the other one. On both sides it is possible to take away access from the other side.

A video showing an example of how to set up a connection to CM44x is available on the CD.

18.2.3 Operation

- In the DTM the menu structure corresponds to the onsite operation. The functions of the Liquiline soft keys are found in the main window on the left.
- Clicking a menu name or a function corresponds to pressing the navigator.
- You can make your settings conveniently via the computer keyboard.
- Via Fieldcare, you can save logbooks, make backups of configurations and transfer the configurations to other devices.
- You can also print out configurations or save them as PDFs.

18.3 Fieldbuses

18.3.1 HART

You can communicate using the HART protocol via current output 1.

- ▶ Connect the HART modem or handheld to current output 1 (communication load 230 - 500 Ohm).
- ▶ Establish the connection via your HART device.
- ▶ Operate Liquiline via the HART device. To do so, follow the instructions in the manual.

All the information on HART communication is provided on the CD (BA00486C).

18.3.2 PROFIBUS-DP

With the fieldbus module 485 and the appropriate device version, you can communicate via PROFIBUS DP.
Connect the PROFIBUS data cable to the terminals of the fieldbus module as described (--> BA00444C "Commissioning").

All the information on PROFIBUS communication is provided on the CD (SD01188C).

18.3.3 Modbus

With the fieldbus module 485 and the appropriate device version, you can communicate via Modbus RS485 or Modbus TCP.
Connect the Modbus data cable to the terminals of the fieldbus module (RS 485) or to the RJ45 (TCP) port as described (--> BA00444C "Commissioning").

All the information on Modbus communication is provided on the CD (SD01189C).

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