Assembly and operating instructions

DULCOMETER®
Multi-parameter Controller diaLog DACa

ProMinent®

A1111

Please carefully read these operating instructions before use! · Do not discard!
The operator shall be liable for any damage caused by installation or operating errors!
Technical changes reserved.

Part no. 985250

BA DM 203 04/14 EN

General non-discriminatory approach

In order to make it easier to read, this document uses the male form in grammatical structures but with an implied neutral sense. It is aimed equally at both men and women. We kindly ask female readers for their understanding in this simplification of the text.

Supplementary information

Read the following supplementary information in its entirety!

The following are highlighted separately in the document:

- Enumerated lists

▶ Instructions

⇨ Results of the instructions

Information

This provides important information relating to the correct operation of the system or is intended to make your work easier.

Safety information

Safety information are provided with detailed descriptions of the endangering situation, see ↪ *Chapter 4.1 'Explanation of the safety information' on page 18*

Table of contents

1 Operating Concept

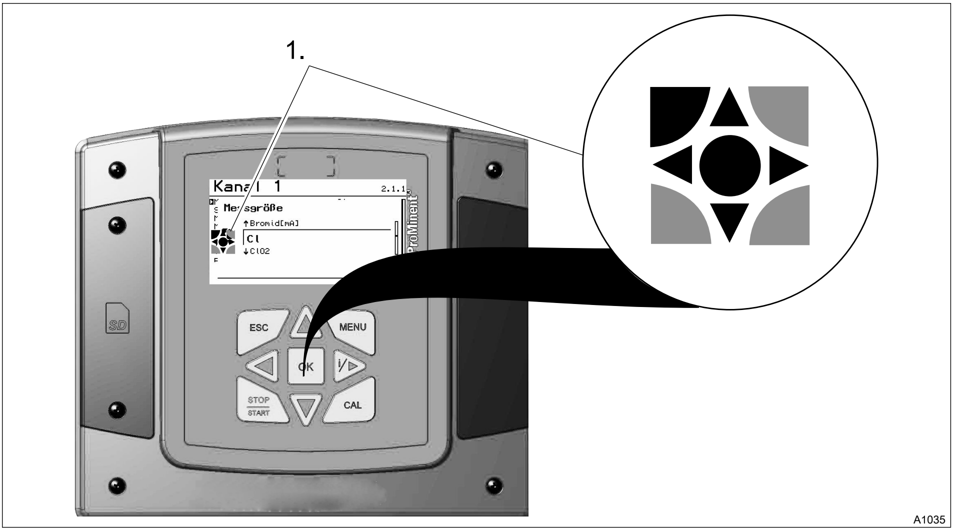


Fig. 1: Operating cross (1) / Active keys appear [black] in the display; inactive keys appear [grey].

For example, the following path is illustrated:

Continuous display ➨ [MENU] ➨ ▲ or ▼ *[Calibrate]* ➨ [OK] ➨ ▲ or ▼ *[Slope]* ➨ [OK] ➨ [CAL]

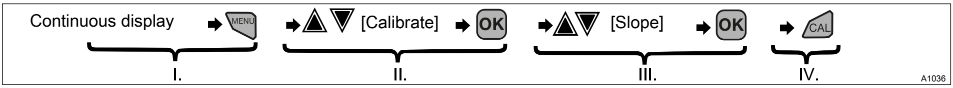


Fig. 2: The display changes throughout an action.

I. Continuous display 1
II. Display 2
III. Display 3
IV. Display 4

The function of the keys is described in table *Chapter 1.1 'Functions of the keys ' on page 11*.

➨ = describes as a symbol an action by the operator, that leads to a new possibility for an action.

[Named in the display] = square brackets contain the name that appears identically worded in the controller's display.

Use the ▷ key to call up further information.

Display lighting

In the event of an error with the [ERROR] status, the display's backlight changes from ‘white’ to ‘red’. This makes it easier for the operator to detect and react to an error.

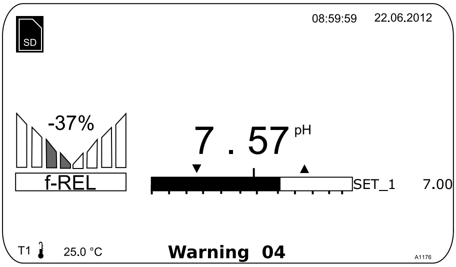


Fig. 3: Example of a continuous display when used with one measuring channel (e.g. pH)

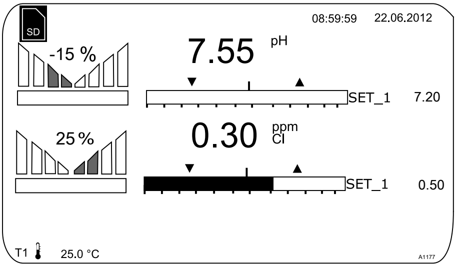


Fig. 4: Example of a continuous display when used with two measuring channels (e.g. pH/chlorine)

Setting of the various parameters in the adjustable menus

> *No time-controlled menu items*
>
> *The controller does not leave any menu item time-controlled, the controller remains at one menu item until this menu item has been exited by the user.*

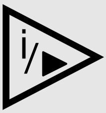
1. Select the parameter you require in the display using ▲ or ▼
   ⇨ An arrow is located in front of the selected parameter, which marks the selected parameter.
2. Press [OK]
   ⇨ You are now in the setting menu for the required parameter.
3. You can adjust the required value in the setting menu using the four arrow keys and then save it using [OK]
   ⇨
   > *Range error*
   >
   > *If you enter a value that is outside the possible setting range, the message [Range error] appears once you have pressed [OK]. Pressing [OK] or [ESC] returns you to the value to be set.*

   Pressing [OK] returns the controller to the menu

   > *Cancelling the setting process*
   >
   > *Pressing [ESC] returns you to the menu without a value being saved.*

1.1 Functions of the keys

Functions of the keys

Key	Function
OK	Confirmation in the setting menu: Confirms and saves the input values. Confirmation in the continuous display: Displays all information about saved errors and warnings.
ESC	Back to the continuous display or to the start of the respective setting menu, in which you are currently located.
MENU	Enables direct access to all of the controller's setting menus.
CAL	Enables direct access to the controller's calibration menu from the continuous display.
STOP START	Start/Stop of the controller's control and metering function from any display.
	To increase a displayed number value and to jump upwards in the operating menu.
	Confirmation in the setting menu: Moves the cursor to the right. Confirmation in the continuous display: Displays further information about the controller input and output values.

Key	Function
▼	To decrease a displayed number value and to jump down in the operating menu.
◀	Moves the cursor to the left.

1.2 Changes the set operating language

1. Simultaneously press the keys [ESC] and ▲
   ⇨ The controller changes to the menu for setting the operating language.

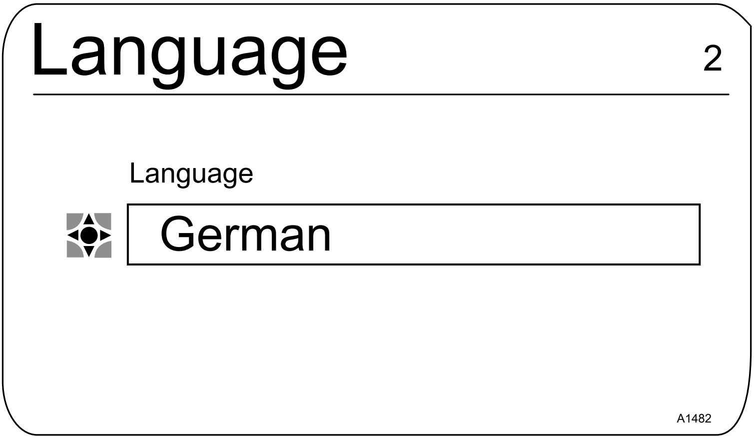


Fig. 5: Menu for setting the operating language

2. Now using keys ▲ and ▼ you can set the desired operating language
3. Confirm your selection by pressing the key [OK]
   ⇨ The controller changes back to the continuous display and indicates the selected operating language.

1.3 Acknowledging Error or Warning Messages

If the controller detects an error *[Error]*, the controller is stopped, the backlight switches to red and the alarm relay is deactivated. Acknowledge the message by pressing OK. The controller displays all the errors and warnings. You can select and acknowledge the pending alarm messages if necessary. When you acknowledge an error, the alarm relay is activated and the backlight switches on again with white light. The error that has occurred or the warning message continue to appear in the lower part of the display, e.g. *[Error 01]*, until the cause has been eliminated.

With a warning, for example the controller signals that a sensor has not yet been calibrated, it is possible to continue working with the controller with or without acknowledging the message.

With an error message *[Error]*, *[for example]* the controller signals that no sensor has been connected, it is not possible to continue working with the controller once the message has been acknowledged. You now have to eliminate the error, see ↬ *Chapter 17 '[Diagnostics]' on page 146*.

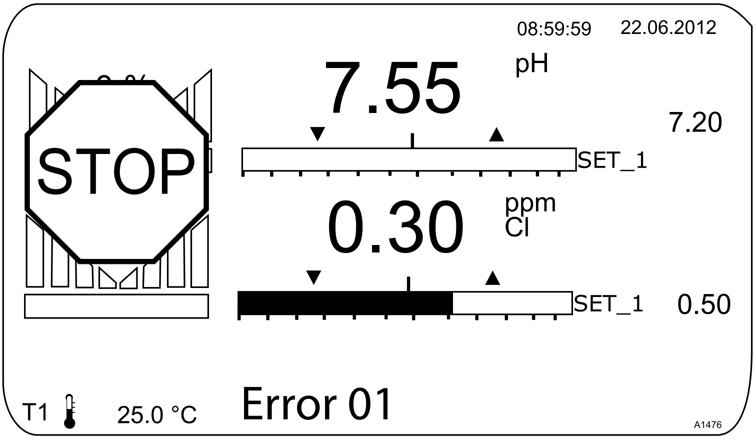


Fig. 6: Alarm message, controller stops the control

1.4 Key Lock

The controller has a key lock. If the key lock is activated, the keys cannot be pressed. The key lock can be activated or deactivated by simultaneously pressing ▲ and ▼. An activated key lock is indicated by the 🔑 symbol.

2 Entries in the *[Menu]* display

Name of menu item	Jump to chapter
[Measurement]	*Chapter 8 'Setting measured variables' on page 52*
[Limit values]	*Chapter 11 'Setting the [Limit values]' on page 120*
[Control]	*Chapter 10 'Setting the [Control]' on page 101*
[Calibration]	*Chapter 9 'Calibration' on page 61*
[Pumps]	*Chapter 12 'Setting the [Pumps]' on page 125*
[Relays]	*Chapter 13 'Setting the [Relays]' on page 128*
[Digital inputs]	*Chapter 14 'Setting [Digital inputs]' on page 133*
[mA-outputs]	*Chapter 15 'Setting the [mA outputs]' on page 136*
[Diagnostics]	*Chapter 17 '[Diagnostics]' on page 146*
[Service]	*Chapter 18 '[Service] ' on page 157*
[Setup]	*Chapter 19 ' Setting [Device setup]' on page 158*

3 ID Code

Device identification / Identity code

DULCOMETER®, Multi-parameter Controller diaLog DACa						
DACa	Design					
	00	With ProMinent® logo				
	S0	With fitting kit for control cabinet				
		Operating voltage				
		6	90 ... 253 V, 48/63 Hz			
			Channel 1*			
			1	Measurement + control, 2 pumps, 2 control inputs, 2 mA outputs		
				Channel 2**		
				0	No second channel	
				2	Package 2: Interference variable (mA) or external setpoint via mA or pH compensation for chlorine with pH control (all acting on channel 1). Additionally an mA output.	
				3	Package 3: 2nd measurement + control, additionally 2 pumps, 3 control inputs, one mA output	
				4	Package 4: 2nd measurement + control, additionally 2 pumps, 3 control inputs, one mA output, interference variable (mA or frequency), pH compensation for chlorine	
					Software default settings	
					0	no default settings
					1	Batch neutralisation 2 x pH measurements with 1-2-way controller and final inspection
					2	Flow neutralisation 2 x pH measurements with 1-2-way controller, interference variable and final inspection
					3	pH/ORP measurement/control (pH 2-way, ORP 1-way)

DULCOMETER®, Multi-parameter Controller diaLog DACa							
4	pH/Cl_2 measurement/control (pH 2-way, chlorine 1-way)						
5	pH/ClO_2 measurement/control (pH 2-way, chlorine dioxide 1-way)						
6	pH/Cl_2 measurement/control with interference variable (pH 2-way, chlorine 1-way)						
7	ClO_2/ORP measurement/control (chlorine dioxide 1-way, ORP for monitoring)						
	Channel connectors						
	0	Channel 1 / 2 via terminals (mA and mV)					
	1	Channel 1 via SN 6 coaxial connector (only with pH and ORP via mV)					
	2	Channel 2 via SN 6 coaxial connector (only with pH and ORP via mV)					
	3	Channel 1 and 2 via SN 6 coaxial connector (only with pH and ORP via mV)					
		Digital sensor / actuator connectors					
		0	none				
			Communication				
			0	none			
				Data logger			
				0	No data logger		
				1	Data logger with measured value visualisation with SD card		
					Hardware extension		
					0	None	
					1	Protective RC circuit for output relay	
						Certifications	
						01	None (CE standard)

DULCOMETER®, Multi-parameter Controller diaLog DACa		
Certificates		
0	None	
	Documentation language***	
	DE	German
	EN	English
	FR	French
	ES	Spanish

Footnotes concerning the identity code

** Selection of the measured variable during initial commissioning*

*** The measured variable is selected during initial commissioning or via the default software setting.*

**** Other languages are available on request.*

3.1 A complete measuring station may comprise the following:

- Measuring transducer / Controller DACa (see identity code)
- Fitting: DGMa..., DLG III ...
- pH sensor (dependent upon the application)
- ORP sensor (dependent upon the application)
- e.g. chlorine, chlorine dioxide, chlorite, bromine, dissolved oxygen sensor
- Transducer for pH or ORP (dependent on the set evaluation, pH [mA], ORP [mA])
- Sensor cable

4 Safety and Responsibility

4.1 Explanation of the safety information

Introduction

These operating instructions provide information on the technical data and functions of the product. These operating instructions provide detailed safety information and are provided as clear step-by-step instructions.

The safety information and notes are categorised according to the following scheme. A number of different symbols are used to denote different situations. The symbols shown here serve only as examples.

DANGER!

Nature and source of the danger

Consequence: Fatal or very serious injuries.

Measure to be taken to avoid this danger

Danger!

– Denotes an immediate threatening danger. If this is disregarded, it will result in fatal or very serious injuries.

WARNING!

Nature and source of the danger

Possible consequence: Fatal or very serious injuries.

Measure to be taken to avoid this danger

Warning!

– Denotes a possibly hazardous situation. If this is disregarded, it could result in fatal or very serious injuries.

CAUTION!

Nature and source of the danger

Possible consequence: Slight or minor injuries, material damage.

Measure to be taken to avoid this danger

Caution!

– Denotes a possibly hazardous situation. If this is disregarded, it could result in slight or minor injuries. May also be used as a warning about material damage.

! NOTICE!

Nature and source of the danger

Damage to the product or its surroundings

Measure to be taken to avoid this danger

Note!

– Denotes a possibly damaging situation. If this is disregarded, the product or an object in its vicinity could be damaged.

Type of information

Hints on use and additional information

Source of the information, additional measures

Information!

– *Denotes hints on use and other useful information. It does not indicate a hazardous or damaging situation.*

4.2 General safety notes

WARNING!

Live parts!

Possible consequence: Fatal or very serious injuries

– Measure: Before opening the housing or before carrying out installation work, ensure the devices are voltage-free.
– Disconnect damaged, defective or tampered-with devices from the power supply.

WARNING!

Danger from hazardous substances!

Possible consequence: Fatal or very serious injuries.

Please ensure when handling hazardous substances that you have read the latest safety data sheets provided by the manufacture of the hazardous substance. The actions required are described in the safety data sheet. Check the safety data sheet regularly and replace, if necessary, as the hazard potential of a substance can be re-evaluated at any time based on new findings.

The system operator is responsible for ensuring that these safety data sheets are available and that they are kept up to date, as well as for producing an associated hazard assessment for the workstations affected.

WARNING!

Unauthorised access!

Possible consequence: Fatal or very serious injuries.

– Measure: Ensure that there can be no unauthorised access to the device

WARNING!

Operating faults!

Possible consequence: Fatal or very serious injuries.

– The unit should only be operated by adequately qualified and technically expert personnel
– Please also observe the operating instructions for sensors and fittings and any other units which may be fitted, such as sample water pumps ...
– The operator is responsible for ensuring that personnel are qualified

NOTICE!

Correct sensor operation

Damage to the product or its surroundings

– Correct measuring and metering is only possible if the sensor is working perfectly
– Check and calibrate the sensor regularly

4.3 Intended Use

Intended Use

The device is intended for measuring and regulating liquid media. The designated measured variables appear on the device's display and are absolutely binding.

Only use the device in accordance with the technical data and specifications outlined in these operating instructions and in the operating instructions for the individual components (such as sensors, fittings, calibration devices, metering pumps, etc.).

Any other uses or modifications are prohibited.

Time constant of > 30 seconds

– *The controller can be used in processes, which require a time constant of > 30 seconds.*

4.4 Users' qualifications

WARNING!

Danger of injury with inadequately qualified personnel!

The operator of the plant / device is responsible for ensuring that the qualifications are fulfilled.

If inadequately qualified personnel work on the unit or loiter in the hazard zone of the unit, this could result in dangers that could cause serious injuries and material damage.

– All work on the unit should therefore only be conducted by qualified personnel.
– Unqualified personnel should be kept away from the hazard zone

Training	Definition
Instructed personnel	An instructed person is deemed to be a person who has been instructed and, if required, trained in the tasks assigned to him/her and possible dangers that could result from improper behaviour, as well as having been instructed in the required protective equipment and protective measures.
Trained user	A trained user is a person who fulfils the requirements made of an instructed person and who has also received additional training specific to the system from ProMinent or another authorised distribution partner.
Trained qualified personnel	A qualified employee is deemed to be a person who is able to assess the tasks assigned to him and recognize possible hazards based on his/her training, knowledge and experience, as well as knowledge of pertinent regulations. The assessment of a person's technical training can also be based on several years of work in the relevant field.

Training	Definition
Electrician	Electricians are deemed to be people, who are able to complete work on electrical systems and recognize and avoid possible hazards independently based on his/her technical training and experience, as well as knowledge of pertinent standards and regulations. Electricians should be specifically trained for the working environment in which the are employed and know the relevant standards and regulations. Electricians must comply with the provisions of the applicable statutory directives on accident prevention.
Customer Service department	Customer Service department refers to service technicians, who have received proven training and have been authorised by ProMinent to work on the system.

Note for the system operator

The pertinent accident prevention regulations, as well as all other generally acknowledged safety regulations, must be adhered to!

5 Functional description

The DULCOMETER®
Multi-parameter Controller diaLog DACa is a controller platform from ProMinent. In the remainder of this document, the term *'controller'* is consistently used for the DULCOMETER®. The controller has been developed for continuous measurement and control of liquid analysis parameters. For water treatment processes in environmental technology and industry. The controller is available in versions with one and two measurement channels. The controller can operate together with conventional analog sensors and actuators. The controller is equipped to communicate with digital sensors and actuators via the CANopen sensor/actuator bus.

Typical applications:

- Potable water treatment
- Waste water treatment
- Industrial and process water treatment
- Swimming pool water treatment

Standard equipment:

- One measuring channel with 14 freely selectable measured variables (via mV or mA input)
- PID controller with frequency-based metering pump control for 2 metering pumps
- Two analog outputs for measured value, correcting value, or control variable (dependent on the optional equipment)
- Two digital inputs for sample water error identification, pause and parameter switching
- Two relays with limit value function, timer and discontinuous control, 3-point stepper control (dependent on the optional equipment)
- Measured variables and language selection during commissioning
- Temperature compensation for the pH and fluoride measured variables
- 22 operating languages
- Saving and transfer of device parametrisation using an SD card
- Retrospective upgrading of the software function using activation key or firmware update
- Disturbance variable processing (flow) via frequency
- Measured value trend display via the controller display

Optional accessories:

- Second, complete measuring and control channel with 14 freely selectable measured variables (via mV or mA input)
- PC configuration software
- Data and event logger with an SD card
- Disturbance variable processing (flow) via mA
- Compensation of the pH influence on chlorine measurement
- 3 additional inputs, e.g. for level monitoring
- PROFIBUS®-DP *.
- Modbus-RTU
- Visualisation via LAN/WLAN web access

6 Assembly and installation

- **User qualification, mechanical installation:** trained qualified personnel, see *Chapter 4.4 'Users' qualifications' on page 21*
- **User qualification, electrical installation:** Electrical technician, see *Chapter 4.4 'Users' qualifications' on page 21*

! NOTICE!

Installation position and conditions

– The controller meets the requirements for IP 67 degree of protection (wall-mounted) or IP 54 (mounted on the control panel) and NEMA 4X (leak-tightness). These standards are only met if all seals and threaded connectors are correctly fitted.

– The (electrical) installation should only take place after (mechanical) installation

– Ensure that there is unimpeded access for operation

– Ensure safe and low-vibration fixing

– Avoid direct sunlight

– Permissible ambient temperature of the controller at the installation position: -20 ... 60°C at max. 95 % relative air humidity (non-condensing)

– Take into consideration the permissible ambient temperature of the sensors connected and other components

– The controller is only suitable for operation in closed rooms. If operating outside, use a suitable protective enclosure to protect the controller from the environment

Read-off and operating position

- *Install the device in a favourable position for reading and operating (preferably at eye level).*

Mounting position

- *As standard the controller is wall-mounted.*
  - *Nevertheless you can fit the controller in a control panel using the optional fitting kit.*
- *Always install the controller so that the cable entries point downwards.*
- *Leave sufficient free space for the cables.*

6.1 Scope of supply

The following components are included as standard:

Description	Quantity
Controller DAC	1
Assembly material, complete, 2P Universal (set)	2
Operating Manual	1
General safety notes	1

6.2 Mechanical Installation

6.2.1 Wall mounting

Mounting materials (contained in the scope of supply)

- 1 x wall bracket
- 4 x PT screws 5 x 35 mm
- 4 x washers 5.3
- 4 x rawl plug Ø 8 mm, plastic

Wall mounting

Take the wall bracket out of the housing

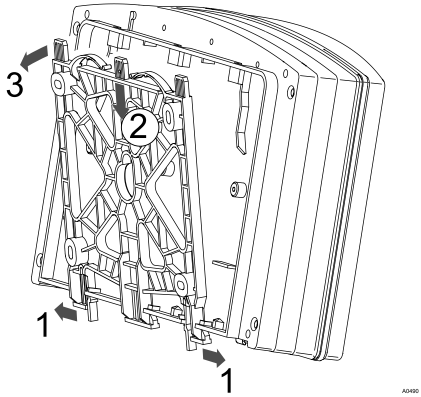


Fig. 7: Removing the wall bracket

1. Pull the two snap hooks (1) outwards

   ⇨ The wall brackets snaps slightly downwards.

2. Push the wall bracket downwards (2) from the housing and fold (3) it out

3. Use the wall bracket as a drilling template to mark the positions of four drill holes

4. Drill the holes: Ø 8 mm, d = 50 mm

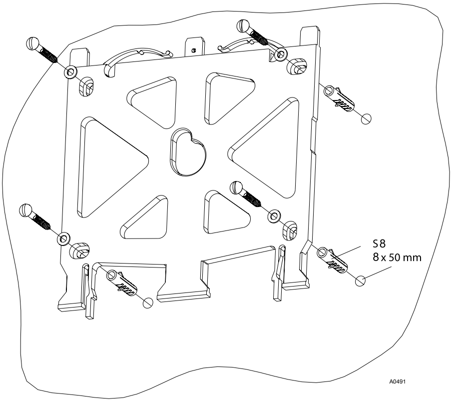


Fig. 8: Fitting the wall bracket

5. Screw the wall bracket into position using the washers.

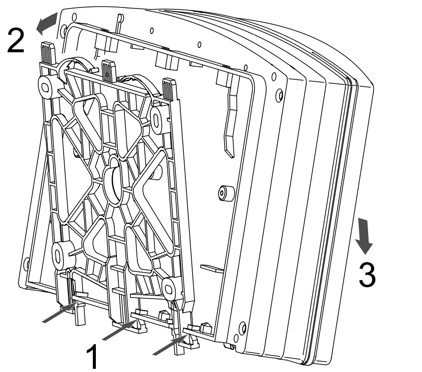


Fig. 9: Fitting the wall bracket

6. Hook the bottom of the housing (1) into the wall bracket

7. Lightly press the housing at the top (2) against the wall bracket

8. Then check that the housing is hooked in at the top and press down (3) until it audibly engages

6.2.2 Control Panel Installation

CAUTION!

Dimensional variations

Possible consequence: material damage

– Photocopying the punched template can result in dimensional deviations
– Use the dimensions shown in Fig. 11 and mark on the control panel

CAUTION!

Material thickness of control panel

Possible consequence: material damage

– The material thickness of the control panel must be at least 2 mm to ensure secure fixing

The perimeter of the housing has a 4 mm wide edge that acts as a stop for the control panel, with an additional perimeter groove to accommodate a caulking strip. When mounted in the control panel, the entire front face projects about 35 mm from the control panel. Install the controller from the outside into a cut-out provided in the control panel for this purpose. Fix the device to the control panel from the inside using the fittings.

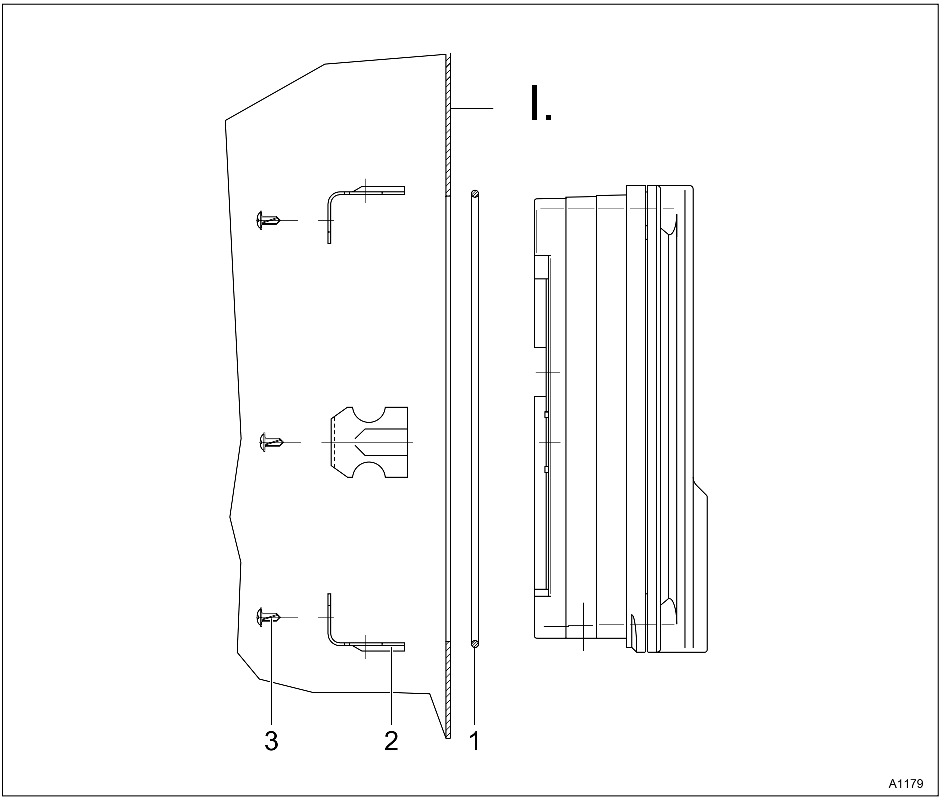


Fig. 10: Order number for the DAC control panel fitting kit (included with the scope of supply): 1041095.

I. Control panel
1. 1 x foam rubber caulking strip ∅3
2. Galvanised steel retaining brackets (6 off)
3. Galvanised PT cutting screws (6 off) Punched template

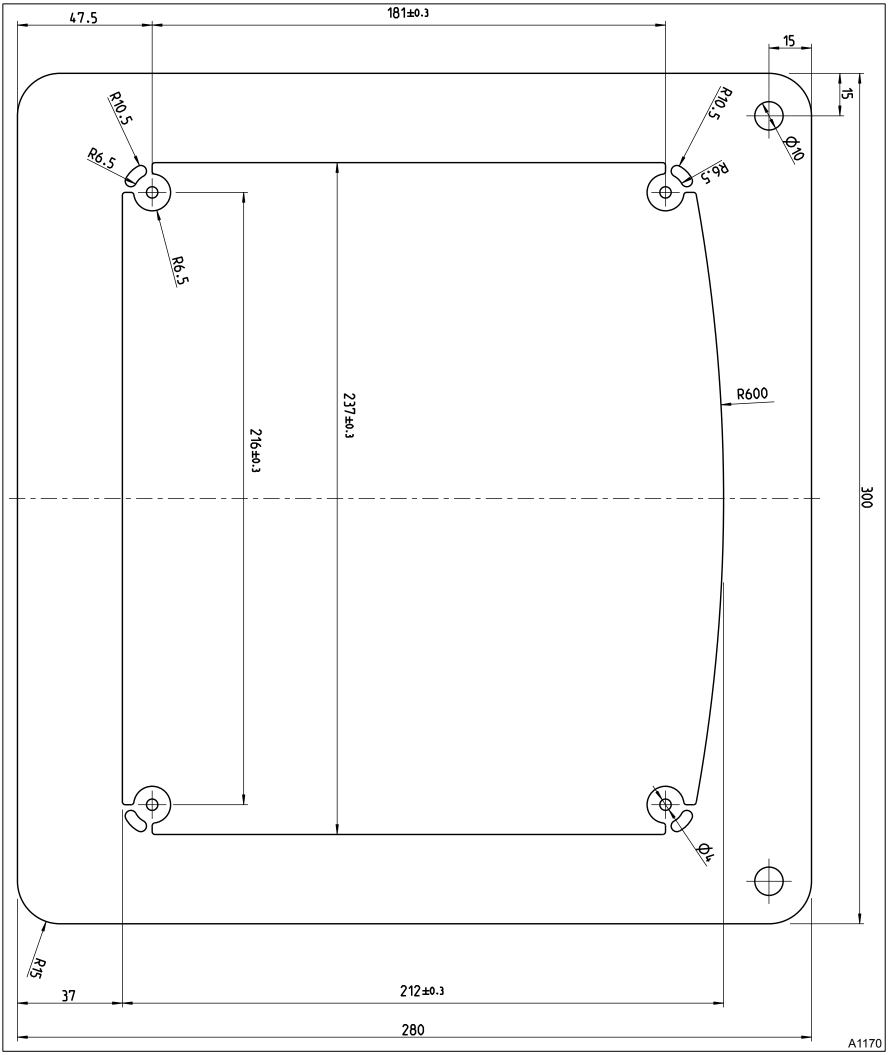


Fig. 11: The drawing is not true to scale and will not be revised as part of these operating instructions. The drawing is for information only.

1. Determine the precise position of the device on the control panel using the drilling template
2. Mark the corner points and drill (drill diameter 12 - 13 mm)
3. Using a punching tool or jigsaw, match the opening to the punched template drawing
4. Chamfer the cut edges and check whether the sealing surfaces are smooth for the caulking strip
   ⇨ Otherwise the seal cannot be guaranteed.
5. Press the caulking strip evenly into the groove running around the device
6. Place the device into the control panel and fix in place at the rear by means of the retaining brackets and PT cutting screws
   ⇨ The device should project approx. 35 mm from the control panel

6.3 Electrical installation

- **User qualification, electrical installation:** Electrical technician, see *Chapter 4.4 'Users' qualifications' on page 21*

NOTICE!

Moisture at the contact points

Use appropriate structural and technical measures to protect the connecting plugs, cables and terminals from moisture. Moisture at the contact points can adversely affect the operation of the device.

6.3.1 Specification of the threaded connectors

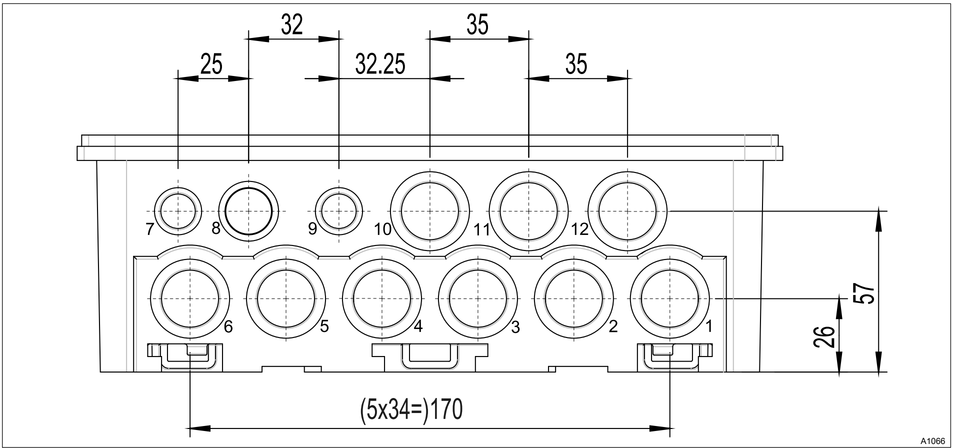


Fig. 12: All dimensions in millimetres (mm)

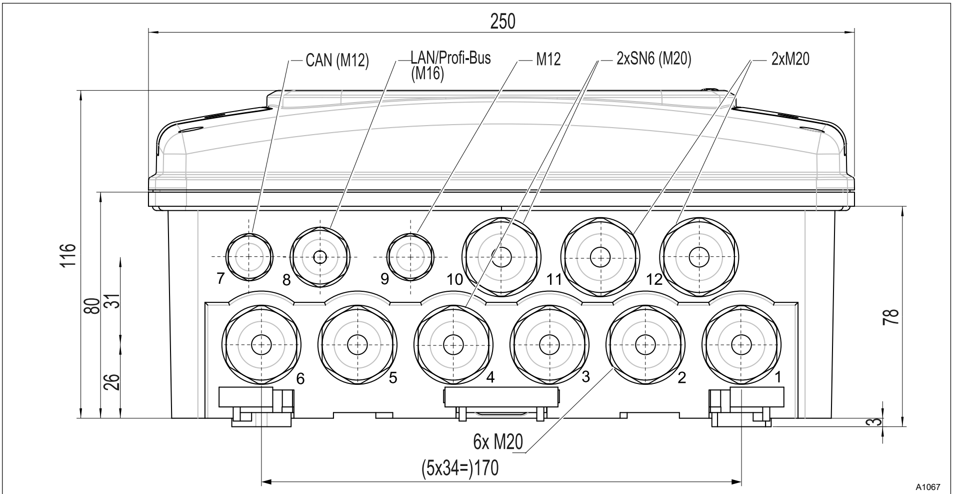


Fig. 13: All dimensions in millimetres (mm)

6.3.2 Terminal diagram

The controller is supplied with terminal diagrams showing 1:1 assignment.

Only one sensor per unit

Only one sensor can be connected to each of the main unit and extension unit. For example, you can connect a chlorine sensor to the main unit (channel 1) and a pH sensor or an interference variable to the extension unit (channel 2).

Connecting the chlorine sensor with controllers with two channels

Note the following when connecting the sensors when measuring chlorine with pH compensation. Connect the chlorine sensor on the extension unit (channel 2) to the terminals XE8.3 (-) and XE8.4 (+).

Connect the pH sensor on the extension unit (channel 1) as follows:

- *When using a coaxial cable on terminals XE1 (shield), XE 2 (internal conductor)*
- *When using a transmitter pHV1 (mA) on terminals XE4.3 (-) and XE4.4 (+)*

The pH value also needs to be temperature-compensated to ensure correct pH compensation. Therefore, connect the temperature sensor to terminals XE7.3 and XE7.4.

Depending on the identity code of the controller (channel 2 = Package 4), now connect the interference variable on the mA input to the extension unit XE8.2(-) and XE8.3 (+), if not already occupied by the transmitter pHV1 (mA).

The interference variable influences the pH and chlorine control.

pH measurement using a transmitter

If a pH measurement is connected to the controller via a transmitter DULCOMETER® DMTa or another manufacturer's pH measuring device, then assign mA-pH in the DMTa and/or in the other manufacturer's pH measuring device as follows:[4 mA = pH 15.45] and [20 mA = pH -1.45]

Connection of the transmitter DTMa

A DMTa is connected to the controller as a 2-wire transmitter:

- *Terminal DACa, channel 1: XE4.3 minus pole and XE4.4 plus pole*
- *Terminal DACa, channel 2: XE8.3 minus pole and XE8.4 plus pole*
- *refer to: ➜ 'Main unit (channel 1) terminal diagram with assignment options ' on page 36 and ➜ 'Extension unit (channel 2) terminal diagram with assignment options ' on page 38*

An external manufacturer's transmitter

Connect an external manufacturer's transmitter as follows to the controller if the transmitter delivers an active signal:

- *Terminal DACa, channel 1: XE4.3 plus pole and XE4.4 minus pole*
- *Terminal DACa, channel 2: XE8.3 plus pole and XE8.4 minus pole*
- *refer to: ➜ 'Main unit (channel 1) terminal diagram with assignment options ' on page 36 and ➜ 'Extension unit (channel 2) terminal diagram with assignment options ' on page 38*

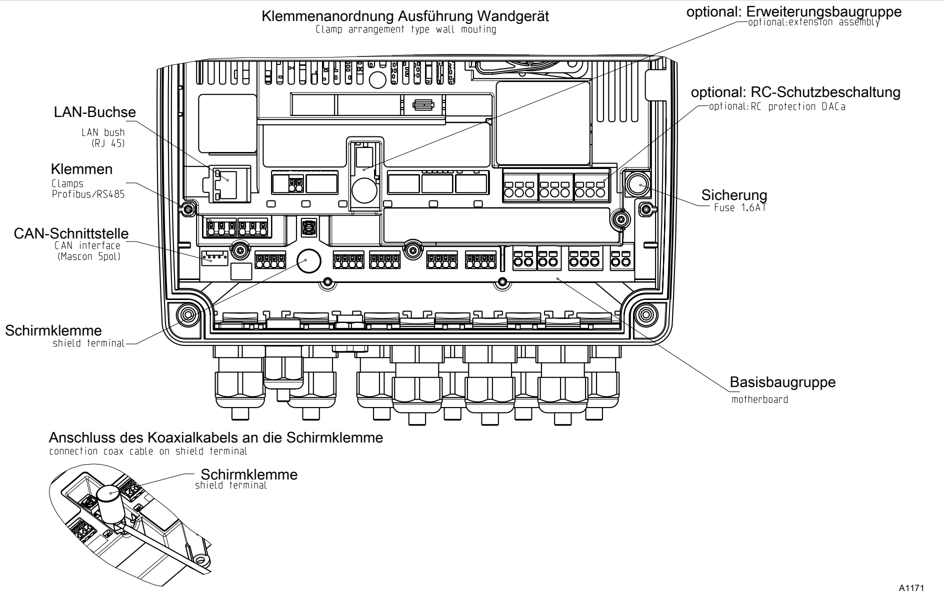


Fig. 14: Terminal layout

Main unit (channel 1) terminal diagram with assignment options

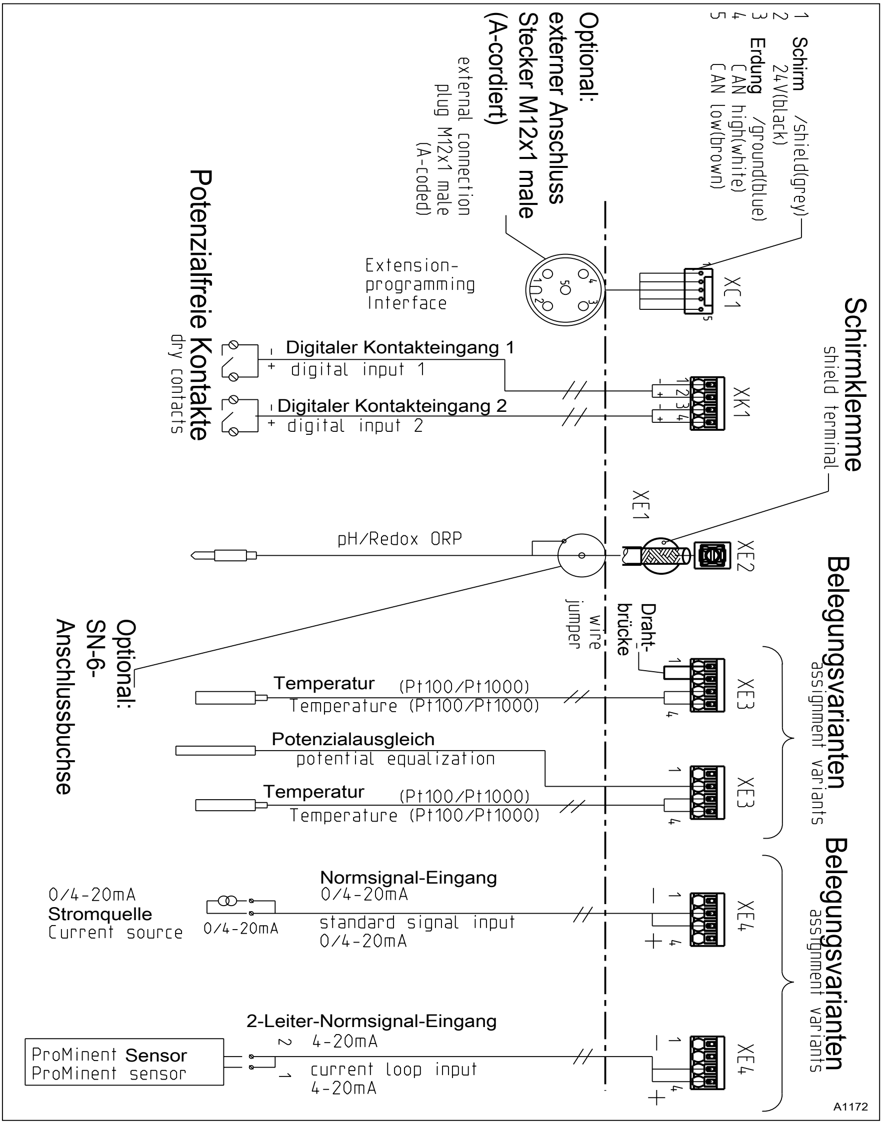


Fig. 15: Terminal diagram with assignment options. Main unit, channel 1, there can only be one main measured variable, e.g. chlorine sensor, connected to a unit.

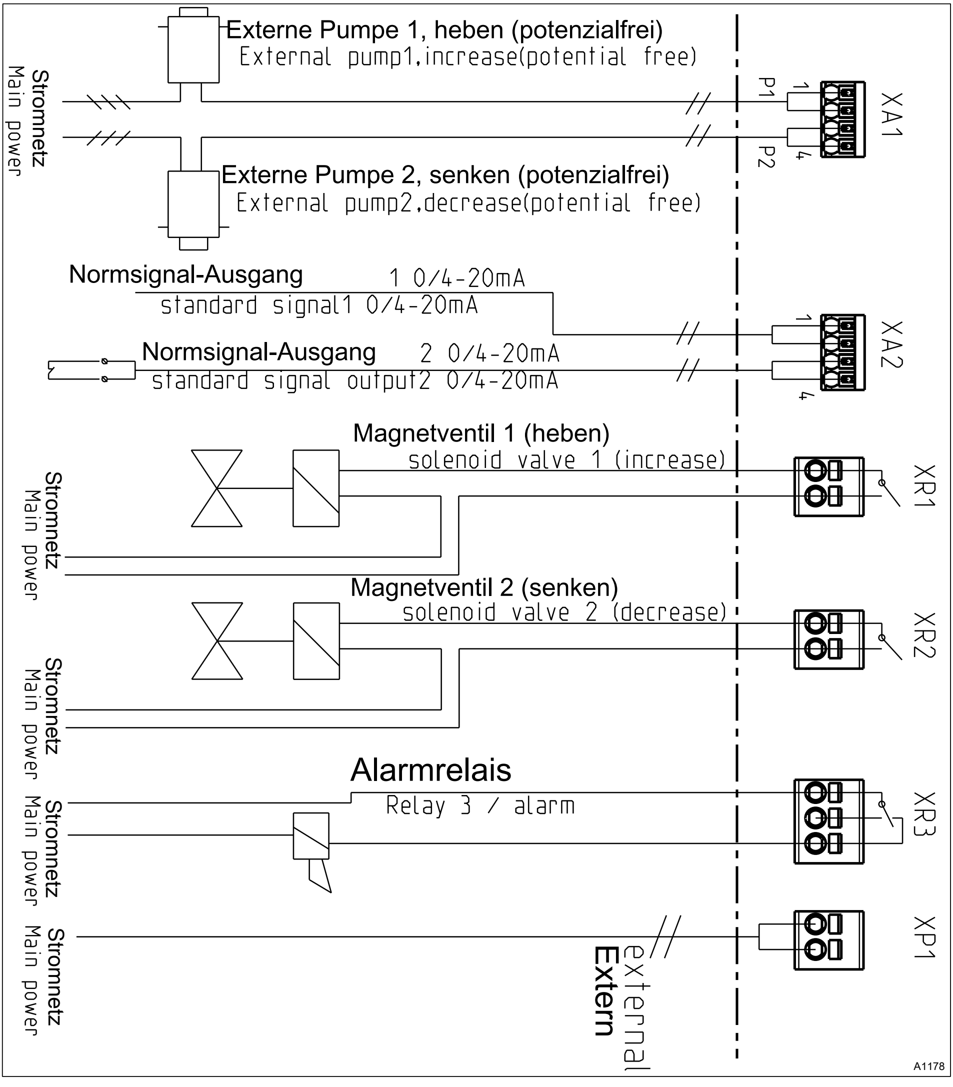


Fig. 16: Terminal diagram with assignment options

Extension unit (channel 2) terminal diagram with assignment options

Extension unit, channel 2, there can only be one main measured variable, e.g. pH, connected to a unit. In addition, the mA -signal of a magnetically inductive flow meter can be connected depending on the ID code.

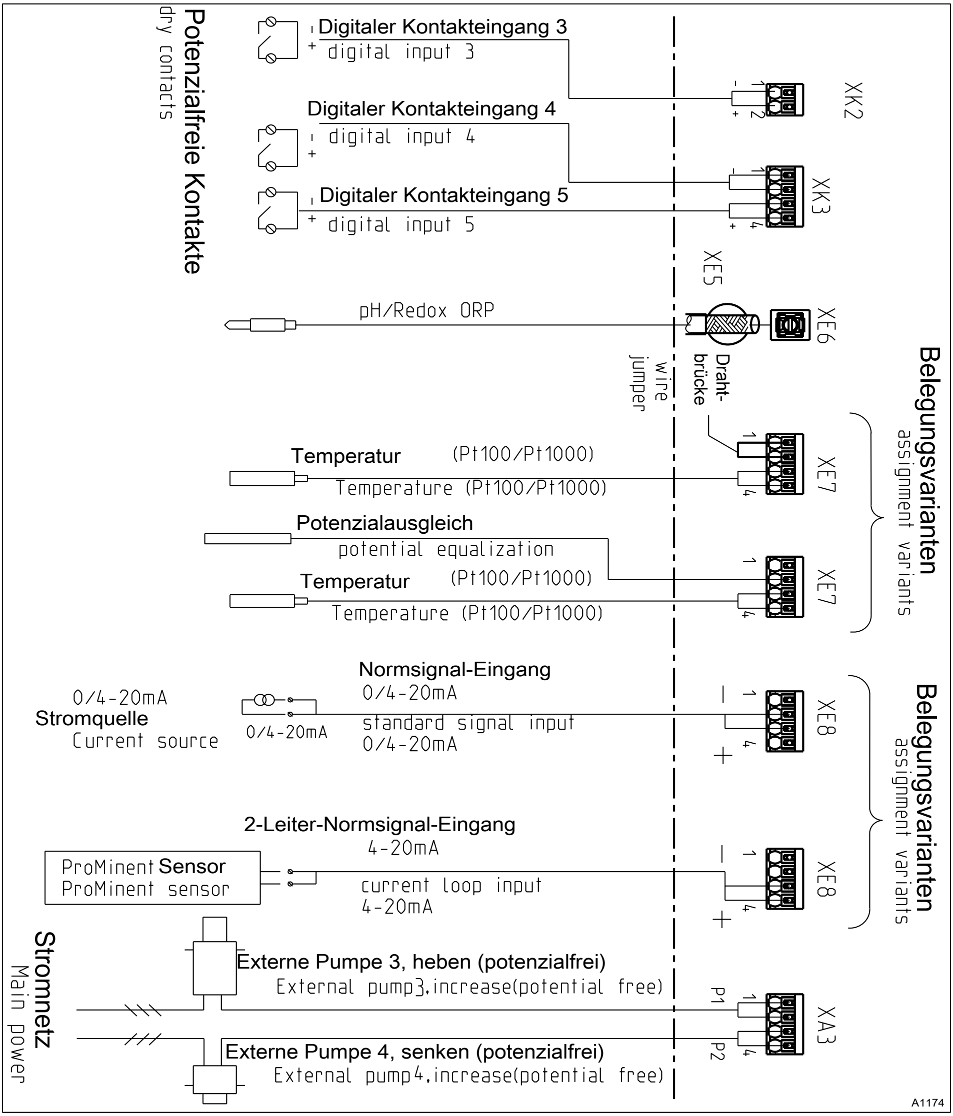


Fig. 17: Terminal diagram with assignment options

Terminal diagram with protective RC circuit (optional)

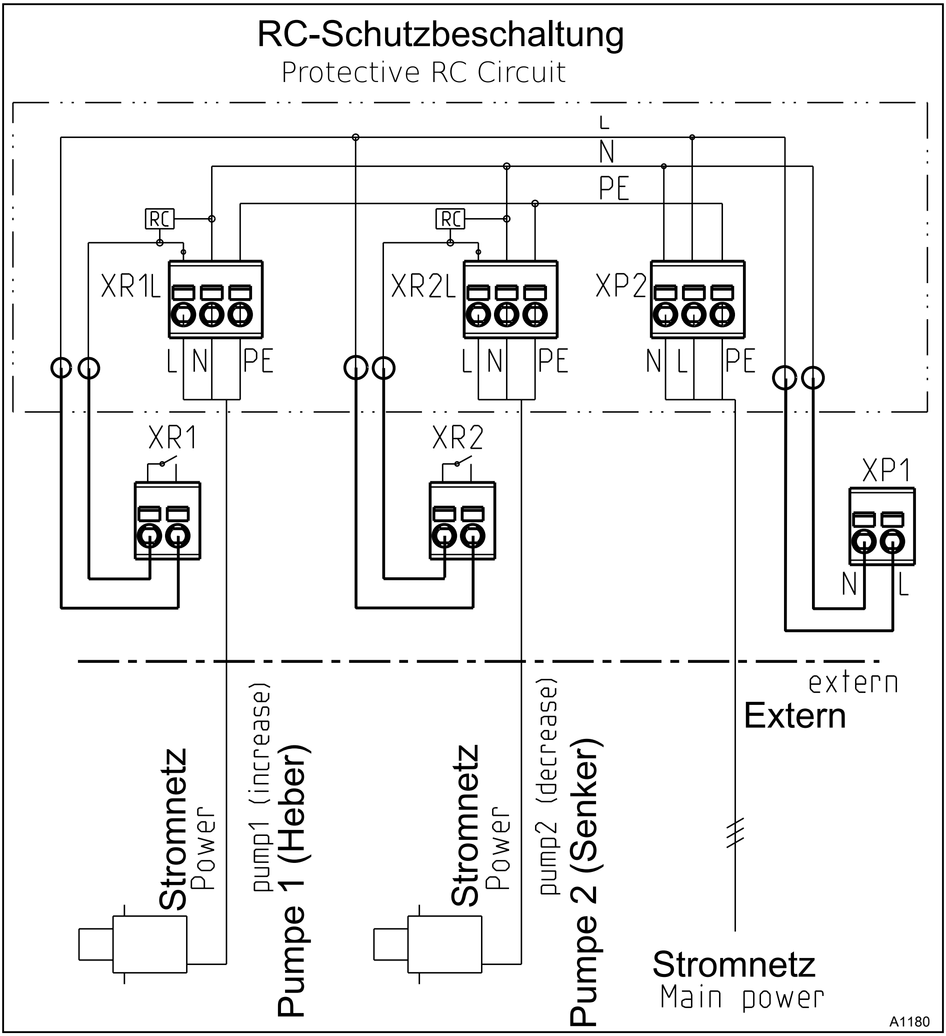


Fig. 18: Terminal diagram with protective RC circuit (optional)

Terminal diagram of the DAC "communication unit"

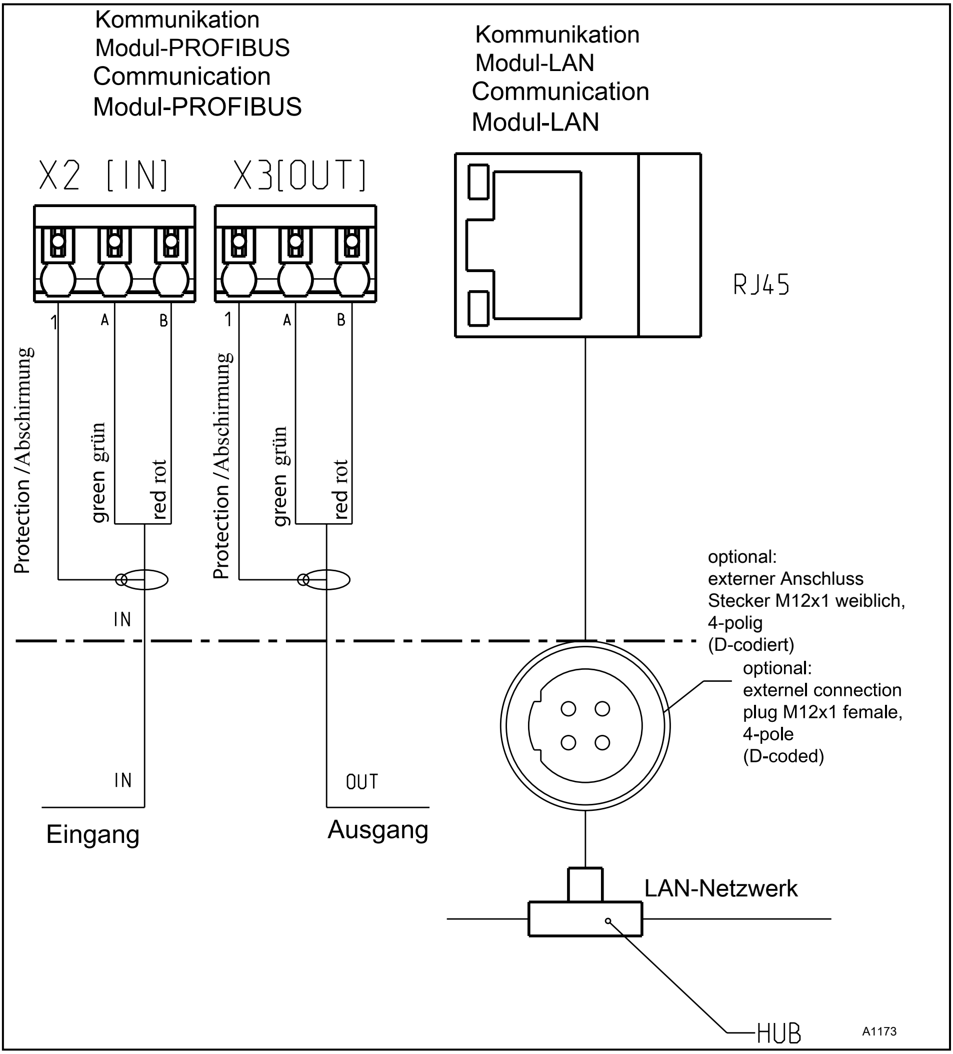


Fig. 19: Terminal diagram of the DAC communication unit

Service interfaces

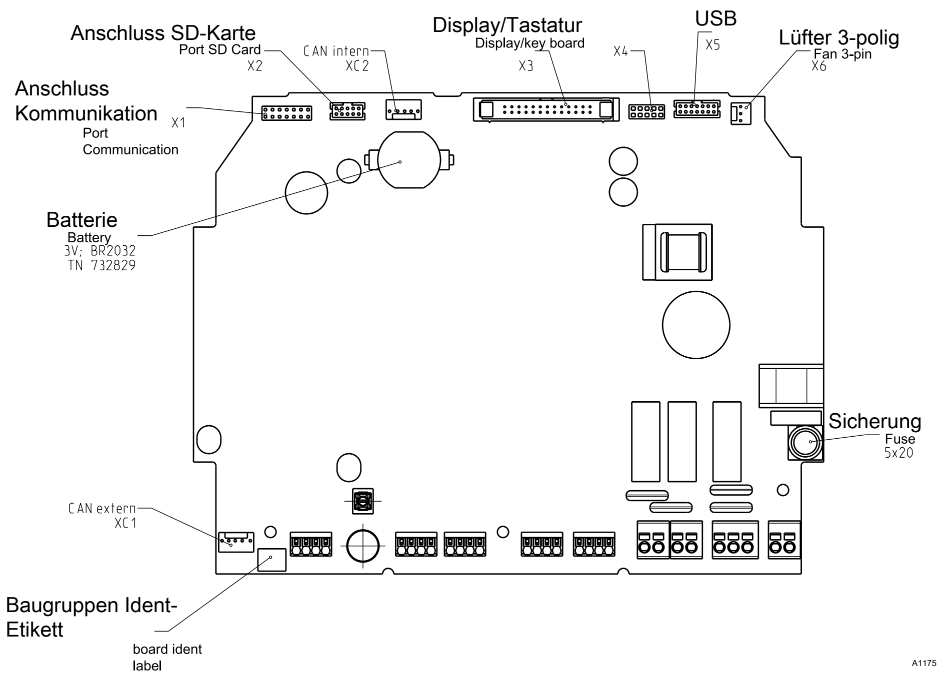


Fig. 20: Service interfaces

6.3.3 Cable Cross-Sections and Cable End Sleeves

	Minimum cross-section	Maximum cross-section	Stripped insulation length
Without cable end sleeve	0.25 mm^2	1.5 mm^2	
Cable end sleeve without insulation	0.20 mm^2	1.0 mm^2	8 - 9 mm
Cable end sleeve with insulation	0.20 mm^2	1.0 mm^2	10 - 11 mm

6.3.4 Wall mounting and control panel installation

Seals and terminal diagram

Select the correctly fitting seals for the controller's cable openings. Seal the open holes with blanking plugs. This is the only way to ensure an acceptable air-tightness.

Moisture in the controller can lead to operational abnormalities.

Note the instructions on the terminal diagrams provided.

Sets, mounting fittings, part number 1045171, contains the following components

Description	Part number	Quantity
Seal (M 20 x 1.5), 4xØ5	1045172	2
Seal (M 20 x 1.5), 2xØ4	1045173	2
Seal (M 20 x 1.5), 2xØ6	1045194	2
Sealing stopper, Ø10, polyamide, grey RAL 7035	1042417	5
Protective plug, IL4-073	140448	5
Plug, IL4-044	140412	5
Threaded cable connector (M 20 x 1.5) (5-13), polyamide, black	1040788	1
Threaded cable connector (M 12 x 1.5) (4-6), black	1009734	1
Counter-nut (M 12 x 1.5), width across flats 15), brass, nickel-plated	1018314	1

Ensure that the cable is not under tension.

1. Loosen the four housing screws

2. Slightly lift the top section of the housing forwards and plug the housing top section in the park position in the housing bottom section.

3. *Large threaded connection (M 20 x 1.5)*

   Small threaded connection (M 12 x 1.5)

4. Guide the cable into the controller.

5. Connect the cable as indicated on the terminal diagram

6. Tighten the clamping nuts of the threaded connections so that they are properly sealed

7. Place the upper section of the housing onto the lower section of the housing.

8. Manually tighten the housing screws

9. Check once again that the seal is properly fitted. The degree of protection IP 67 (wall/pipe-mounted) or IP 54 (control pane-mounted) can only be assured if the mounting is correct.

6.3.5 Switching of inductive loads

If you connect an inductive load, i.e. a consumer which uses a coil (e.g. an alpha motorised pump), then you must protect your controller with a protective circuit. If in doubt, consult an electrical technician for advice.

The RC member protective circuit is a simple, but nevertheless very effective, circuit. This circuit is also referred to as a snubber or Boucherot member. It is primarily used to protect switching contacts.

When switching off, the connection in series of a resistor and capacitor means that the current can be dissipated in a damped oscillation.

Also when switching on, the resistor acts as a current limiter for the capacitor charging process. The RC member protective circuit is highly suitable for AC voltage supplies.

The magnitude of the resistance R of the RC member is determined according to the following equation:

$R=U/I_L$

(Where U= Voltage across the load and I_L = current through the load)

The magnitude of the capacitor is determined using the following equation:

$C=k * I_L$

k=0,1...2 (dependent on the application).

Only use capacitors of class X2.

Units: R = Ohm; U = Volt; I_L = Ampere; C = µF

If consumers are connected which have a high starting current (e.g. plug-in, switched mains power supplies), then a means of limiting the starting current must be provided.

The switching-off process can be investigated and documented using an oscilloscope. The voltage peak at the switch contact depends on the selected RC combination.

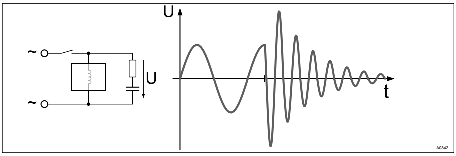


Fig. 21: Switching-off process shown on the oscillogram.

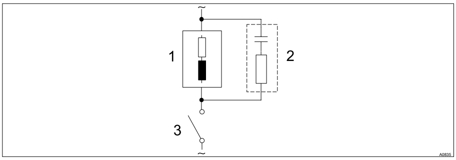


Fig. 22: RC protective circuit for the relay contacts

Typical AC current application with an inductive load:

- 1) Load (e.g. alpha motor-driven pump)
- 2) RC-protective circuit
  - Typical RC protective circuit at 230 V AC:
  - Capacitor *[0.22µF/X2]*
  - Resistance *[100 Ohm / 1 W]* (metal oxide (pulse resistant))
- 3) Relay contact (XR1, XR2, XR3)

6.3.6 Connect the sensors electrically to the controller

User qualification, electrical installation: Electrical technician, see *Chapter 4.4 ‘Users' qualifications’ on page 21*

Ready-made coaxial cable

If possible, only use ready-made coaxial cables that you can select from the Product Catalogue.

- *Coaxial cable 0.8 mm, ready-made, order no. 1024105*
- *Coaxial cable 2 m-SN6, ready-made, order no.*
- *Coaxial cable 5 m-SN6, ready-made, order no.*

6.3.6.1 Connection of pH or ORP sensors using a coaxial cable

! NOTICE!

Possible incorrect measurement due to poor electrical contact

Only use this type of connection if you do not wish to use ready-made coaxial cables. Note the following with this type of connection:

Remove the black plastic layer from the inner coaxial cable. This is present on all types of cable. In doing so, ensure that individual threads of the shielding do not come into contact with the inner conductor.

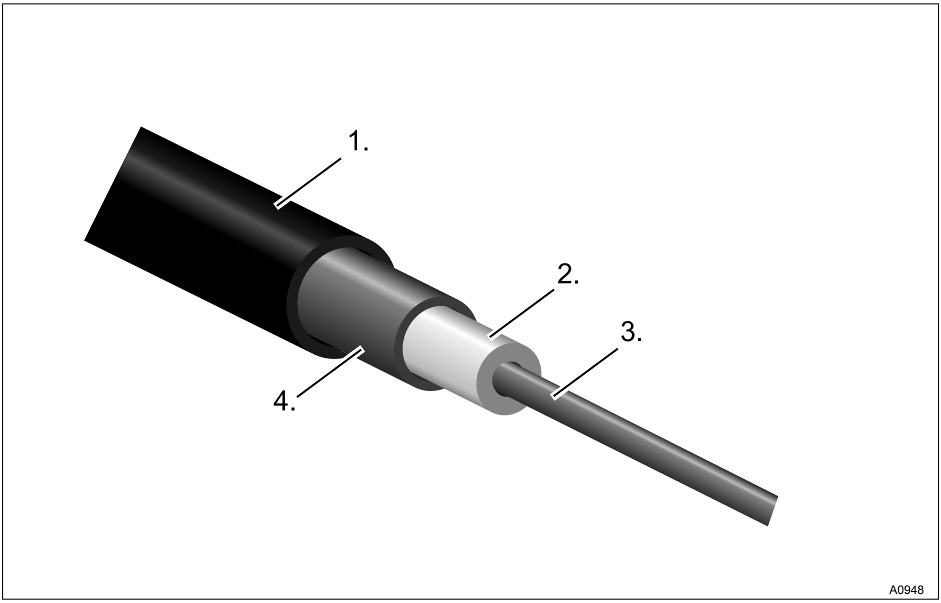


Fig. 23: Coaxial cable:

1. Protective sleeve
2. Insulation
3. Inner conductor
4. Outer conductor and shielding

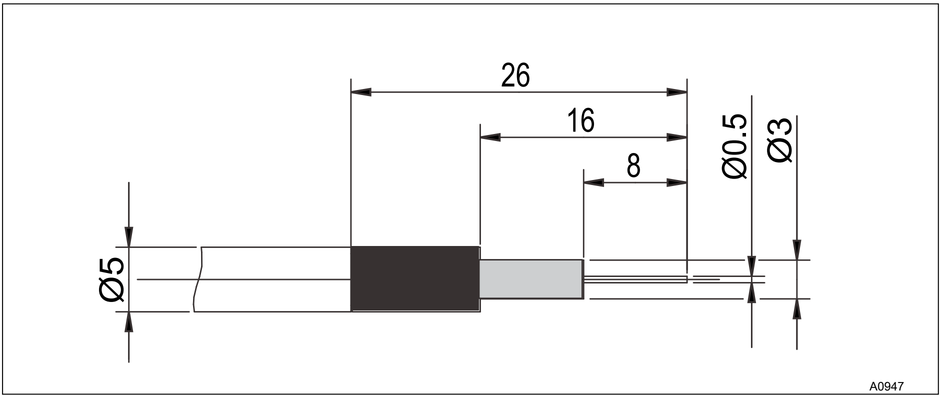


Fig. 24: Coaxial cable construction

Connect pH or ORP sensors using a coaxial line (this relates to pH/ORP connection via mV) directly via the controller's electrical terminal.

The controller can measure the pH/ ORP value once or twice, depending on the design (1- or 2-channel) .

There are two types of connection:

There is a connection without potential equalisation (unsymmetrical connection type) or a connection with potential equalisation (symmetrical connection type).

When is potential equalisation used?

Potential equalisation is used if the pH/ORP measurement is interfered with by disturbance potential from the measurement media. For example disturbance potential can be caused by electric motors with incorrect interference suppression or due to insufficient galvanic insulation of electrical conductors etc. Potential equalisation does not remove this disturbance voltage, however it does reduce its effect on the measurement. Therefore ideally remove the source of the disturbance potential.

Switch the controller to measurement with potential equalisation

! NOTICE!

Wire jumper with connected potential equalisation

A measurement with a wire jumper and connected potential equalisation delivers incorrect measured values.

Please note the following differences:

The controller is factory-preset for measurements without potential equalisation (unsymmetrical measurement).

When measuring with potential equalisation (symmetrical measurement), the setting in the [Measurement] menu has to be changed accordingly.

With a symmetrical connection, remove the wire jumper and connect the potential equalisation conductor (PA) to the terminal XE3_2 (channel 1) or XE7_2 (channel 2) of the controller.

1. In the *[Measurement]* channel 1 or 2 menu change the entry under *[Potential equalisation]* to *[Yes]*
2. Open the controller and remove the wire jumper
   - Terminal XE3_1, XE3_2 for channel 1
   - Terminal XE7_1, XE7_2 for channel 2

Sensor connection without potential equalisation

The sensor is connected to the controller, as marked on the terminal diagram. Do not remove the wire jumper in the controller.

Sensor connection with potential equalisation

! NOTICE!

Error sources when measuring with potential equalisation

A measurement without a wire jumper and/or unconnected potential equalisation delivers incorrect measured values.

With a symmetrical connection, connect the line for potential equalisation to terminal XE3_2 (channel 1) or XE7_2 (channel 2) in the controller. Before doing so, remove the respective wire jumper from these terminals.

Potential equalisation always has to be in contact with the measuring medium. A special potential equalisation plug (Order No. 791663) and a cable (Order No. 818438) are necessary with fitting DGMa. The potential equalisation pin is always fitted with fitting DLG, only the cable (Order No. 818438) is necessary.

Peculiarities when calibrating with potential equalisation

When calibrating, immerse the potential equalisation pin in the respective buffer solution, or use the calibration receptacle which forms part of the scope of supply of the DGMa fitting. This calibration receptacle incorporates an inbuilt potential equalisation pin to which you can connect the potential equalisation line.

6.3.6.2 Connection of amperometric sensors

Connect the sensor, as described in the sensor operating instructions, to the corresponding terminals of the controller, see ↳ *Chapter 6.3.2 ‘Terminal diagram’ on page 33*.

6.4 Priming to bleeding

The pump is working at 100% performance

Note any installation work in your surroundings, as feed chemical can uncontrollably escape into the environment in the event of open pipes etc.

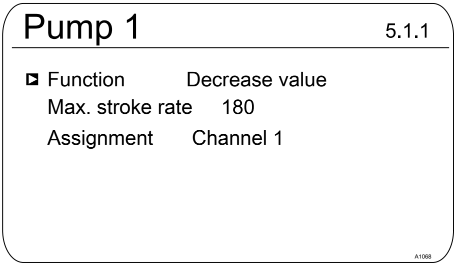


Fig. 25: [Prime with <OK>] e.g. to bleed a pump

If you select the function *[Prime with <OK>]* when the pumps are connected and operable, the pumps continue to operate at 100% power for as long as you press and hold down the OK key.

You can use this function, for example, to transport the feed chemical to the pump, thereby bleeding the metering line.

7 Commissioning

- **User qualification:** trained user, see ↳ *Chapter 4.4 'Users' qualifications' on page 21*

> ⚠ **WARNING!**
>
> **Sensor run-in period**
>
> This can result in hazardous incorrect metering
>
> Take into consideration the sensor's run-in period during commissioning:
>
> – There has to be adequate feed chemical in the sample water for your application (e.g. 0.5 ppm chlorine)
> – Correct measuring and metering is only possible if the sensor is working perfectly.
> – It is imperative that you adhere to the sensor's run-in periods.
> – Calculate the run in period when planning commissioning.
> – It may take a whole working day to run in the sensor.
> – Refer to the sensor's operating instructions.

After mechanical and electrical installation, integrate the controller into the measuring point.

7.1 Switch-on behaviour during commissioning

Switching On - First Steps

> *Installation and function control*
>
> – *Check that all the connections have been made correctly*
> – *Ensure that the supply voltage matches the voltage indicated on the nameplate*

1. Switch the supply voltage on
2. The controller displays a menu in which you can set the language with which you wish to operate the controller
3. Wait for the controller's module scan

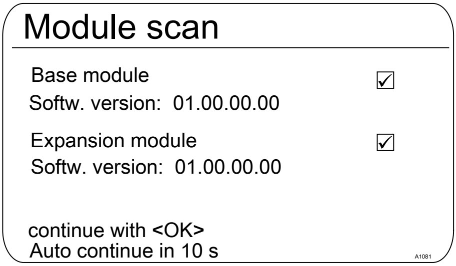


Fig. 26: Module scan

⇨ The controller indicates the controller modules installed and identified.

4. Press [OK]

⇨ The controller now changes to its continuous display. From the continuous display, you can access all the controller's functions using MENU.

7.2 Adjusting the backlight and contrast of the controller display

Continuous display ➨ MENU ➨ ▼ *[Setup]* ➨ OK *[Device setup]* ➨ ▲ or ▼ *[Device configuration]* ➨ OK *[Backlight]*

Under this menu item you can set the brightness and contrast of your controller display to match the ambient conditions at your installation location.

7.3 Resetting the operating language

Resetting the operating language

In the event that a foreign and hence incomprehensible operating language has been set, the controller can be reset to the basic setting. This is implemented by the simultaneous pressing of the ESC and ▲ keys.

If you no longer know whereabouts you are in the operator menu, you must press the ESC key as often as necessary until the continuous display becomes visible again.

7.4 Defining metering and control processes

Set the controller once you have integrated it into the control circuit. Setting the controller adapts it to your process.

Define the following parameters to set up a controller:

- What type of a process is planned?
- Which measured variables are there?
- Is there an in-line, batch or circulation process planned?
- Should the controller operate as a one-way or two-way control?
- Which control variables are there?
- What control parameters are necessary?
- What should the controller do in *[HOLD]*?
- How should the actuators be controlled?
- How should the mA-outputs be set?

8 Setting measured variables

- **User qualification:** trained user, see ➾ *Chapter 4.4 'Users' qualifications' on page 21*

Continuous display ➨ MENU ➨ ▲ or ▼ *[Measurement]* ➨ OK *[Measurement]* ➨ ▲ or ▼ *[Meas. channel 1]* OK ➨ ▲ or ▼ *[Measured variable]* OK

> *Settings for [Channel 2]*
>
> *In its 2-channel version, the controller has two measurement channels. This description for [Channel 1] applies correspondingly for the settings in [Channel 2]. The procedure for making the settings for the channel in question is identical, however the parameters to be set may be different. Differences are pointed out and are also described.*

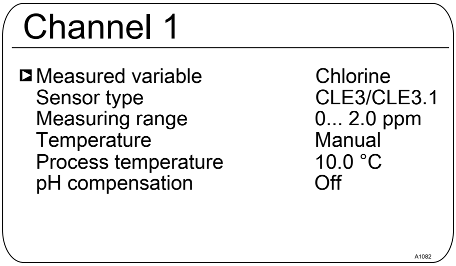


Fig. 27: Setting measured variables, using the example of [Channel 1] and the measured variable [Chlorine]

The following measured variables can be set at the controller:

Measured variable	Meaning	Unit
[None]	The controller does not carry out any measurement.	
[pH [mV]]	pH sensor with mV signal	*[pH]*
[pH [mA]]	pH sensor with mA signal	*[pH]*
[ORP [mV]]	ORP sensor with mV signal	*[mV]*
[ORP [mA]]	ORP sensor with mA signal	*[mV]*

Measured variable	Meaning	Unit
[mA general]		■ *[Freely selectable]* ■ *[%]* ■ *[mA]* ■ *[m]* ■ *[bar]* ■ *[psi]* ■ [m³/h] ■ *[gal/h]* ■ *[ppm]* ■ *[%RF]* ■ *[NTU]*
[Bromine]	Bromine	*[ppm]*
[Chlorine]	Chlorine	*[ppm]*
[Chlorine dioxide]	Chlorine dioxide	*[ppm]*
[Chlorite]	Chlorite	*[ppm]*
[Fluoride [mA]]	Fluoride	*[ppm]*
[Oxygen]	Oxygen	*[ppm]*
[Ozone]	Ozone	*[ppm]*
[Peracetic acid]	Peracetic acid	*[ppm]*
[Hydrogen per.]	Hydrogen peroxide with a *[PER]* sensor type	*[ppm]*
[Cond. (mA)]	Conductivity sensor with mA signal	*[µS]*
[Temp. [mA]]	Temperature sensor with mA signal	*[°C]* or *[°F]*
[Temp.[Pt100x]]	Temperature with a Pt 100 or Pt 1000 sensor type	*[°C]* or *[°F]*

When you perform the measurement of the pH value with potential equalisation, you have to set this procedure when selecting the measured variable as a parameter.

8.1 Information on the measured variables

> *Existing measured variables*
>
> *All possible measured variables are available in the controller and can be used.*

8.1.1 Measured Variable pH [mV]

The measured variable pH [mV]

The pH sensor of the measured variable pH [mV] is connected using a coaxial cable via which the mV signal is transmitted to the controller. This measurement can be used if the cable is less than 10 metres in length.

Decimal places

The function shows the pH value in the display with one or two decimal places. An adaptation of the display to one decimal place makes sense if a change in the 1/100 value is unimportant or if the value is unsteady.

Factory setting: 2 decimal places

Glass break detection

[ON] / *[OFF]* : Switches glass break detection of the pH sensor *[ON]* or *[OFF]*. The factory setting is *[OFF]*. If the controller has the setting *[ON]*, it displays an error message if an error is detected.

The function *[Glass break detection]* increases the safety of the measuring point.

Cable break detection

[ON] / *[OFF]* : Switches cable break detection of the coaxial cable *[ON]* or *[OFF]*. The factory setting is *[OFF]*. If the controller has the setting *[ON]*, it displays an alarm message if an error is detected.

The function *[Cable break detection]* increases the safety of the measuring point.

8.1.2 Temperature

Temperature

With amperometric measured variables, the temperature influence on the measurement is automatically compensated in the sensor. A separate temperature measurement is only used, if necessary, to display and issue the temperature values via an mA-output. Separate temperature compensation is only needed with a chlorine dioxide sensor type CDP.

Temperature compensation

This function is used for compensation of the temperature influence of the process on measurement.

Temperature: [Off] / [Manual] / [Automatic]

- *[Off]* switches the process temperature setting off
- *[Manual]* makes possible a manual specification of the process temperature
- *[Automatic]* uses a measured process temperature. Automatic measurement of the temperature using the temperature sensor, e.g. Pt1000. For pH, CDP and fluoride, temperature compensation can be switched *[ON]* or *[OFF]* in the menu.

8.1.3 Measured variable pH [mA]

Measured variable pH [mA]:

If the measured variable *'pH [mA]'*, i.e. pH measurement using a mA signal, is selected, then the possibility of sensor monitoring for cable or glass breaks is no longer available.

For a pH measurement using a mA signal, either a DMTa or a pH-V1 measuring transducer is connected to the pH sensor. A 2-conductor connection cable is used between the DMTa-/pH-V1 measuring transducer and the controller. The connection cable supplies the DMTa-/pH-V1 measuring transducer and routes the measured value as a 4 ... 20 mA signal to the controller.

When using the DMTa measuring transducer or the measuring transducer of another supplier, the measuring range allocation must be set to the following values:

- 4 mA = 15.45 pH
- 20 mA = -1.45 pH

With a pH-V1 measuring transducer, the setting of the measuring range allocation is automatically specified.

Temperature compensation

This function is used to compensate for the temperature influence on the measurement. The process temperature is set in the DMTa measuring transducer when using a DMTa measuring transducer

Temperature: [Off] / [Manual] / [Automatic]

- *[Off]* switches the process temperature setting off
- *[Manual]* permits manual process temperature setting
- *[Automatic]* uses a measured process temperature

8.1.4 ORP [mV], ORP [mA]

Measured variables ORP [mV], ORP [mA]

If the measured variable *' ORP [mV]'* or *'ORP [mA]'* is selected, measurement of the process temperature is only possible for information or recording purposes.

For the measured variable *'ORP [mV]'*, the measuring range is fixed in the range -1500 mV ... + 1500 mV.

For the measured variable *'ORP [mA]'*, the measuring range is dependent on the RH-V1 measuring transducer and is 0 ... +1000 mV.

8.1.5 Chlorine, bromine, chlorine dioxide, chlorite, dissolved oxygen and ozone

Measured variable chlorine, bromine, chlorine dioxide, chlorite, dissolved oxygen and ozone:

The measured variables chlorine , bromine, chlorine dioxide, chlorite, dissolved oxygen and ozone are always measured using a mA signal because the measuring transducer is located in the sensor.

The temperature compensation takes place automatically inside the sensor (exception: CDP, chlorine dioxide sensor). For further information see the operating instructions of the sensor used.

Measurement of chlorine with pH compensation

Chlorine for disinfecting water is available in different forms, for example as liquid sodium-calcium hypochlorite, as dissolved calcium hypochlorite or as chlorine gas. All these forms can be measured with DULCOTEST chlorine sensors. After chlorine has been added to water, the chlorine splits into two parts depending on the pH value:

- 1. into hypochlorous acid (also known as HOCl) – a strongly oxidising disinfectant that destroys most organisms in a very short time.
- 2. into the hypochlorite anion (OCl) – with a weak disinfectant effect that takes a very long time to destroy organisms.

The sensors for measuring free chlorine selectively measure the very effective hypochlorous acid (HOCl), but not the hypochlorite anion. If the pH value in the process changes, then the ratio of the two chlorine parts changes and thus also the sensitivity (slope) of the chlorine sensor. The HOCl concentration measured is lower as the pH value increases. If a control is integrated, the control tries to compensate for this. If the pH value becomes lower again, this could result in a significant overdosing of chlorine, although there was no further metering. The use of a pH-compensated chlorine measurement can prevent this.

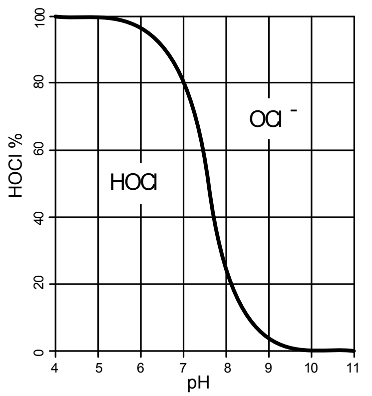


Fig. 28: HOCl/OCL equilibrium $^{-}$

As the diagram shows, less than 10% of the HOCl is contained in the water with pH values of > 8.5 and the disinfectant effect is therefore lower. The chlorine value displayed after compensation is a mathematically calculated chlorine value. The mathematically calculated chlorine value does not alter the effective disinfectant effect present in the water. However, the aforementioned overdosing is avoided. The recognised DPD 1 reference method (for free chlorine) is used as a comparative method to calibrate the amperometric sensors. The reference method is pH-independent (or buffers the pH value to approximately 6.5) and therefore records the free chlorine as almost 100 % HOCI. To ensure that the concentration value measured by the amperometric chlorine measuring system corresponds to this free chlorine value, the pH influence on the chlorine value measured by the sensor can be compensated by the controller. The controller can either perform this pH compensation automatically, via an integrated pH-measurement, or manually based on a fixed pH value. We recommend the automatic version. In doing so, it is imperative that you also measure the sample water temperature, which has a significant influence on the pH measurement. If this influence has not been compensated, the pH value would be measured incorrectly and the chlorine value would therefore also be incorrectly compensated.

No calibration is possible at high pH values without pH compensation, because the difference between the measurement using the chlorine sensor and the comparative DPD 1 reference method is too great.

The operational pH calibration range is: pH 4.00 ... 8.50, Temperature: 5 ... 45 °C

Calibration of the chlorine sensor with activated pH compensation

It is imperative that you always calibrate the pH sensor first before the chlorine sensor. The chlorine sensor always needs to be calibrated any further time the pH sensor has to be calibrated. Otherwise the chlorine measurement will be incorrect.

Sensor type:

First select the sensor type. The sensor type is given on the sensor nameplate. This sensor selection is necessary and activates the sensor-specific data in the controller.

Measuring range of the sensors

Select the measuring range. The measuring range is given on the sensor nameplate. An incorrect measuring range leads to an incorrect measurement.

Temperature

The temperature measurement is used only for information and recording purposes, but not for temperature compensation. Temperature compensation is performed in the sensor. If the measured variable *[Chlorine dioxide]* and the *[CDP]* type of sensor have been selected, then a separate temperature measurement is needed for temperature compensation.

8.1.6 Fluoride Measured Variable

Fluoride Measured Variable

When measuring fluoride as the measured variable, the sensor signal is converted into a 4 - 20 mA signal by a FPV1 or FP100V1 measuring transducer, depending on the measuring range. The measuring transducer is connected to the controller's mA input. The REFP-SE reference sensor is connected to the measuring transducer using a coaxial cable with an SN 6 plug.

FPV1 measuring transducer: Measuring range 0.05 ...10 mg/l.

FP100V1 measuring transducer: Measuring range 0.5 ... 100 mg/l.

Measuring range of the measuring transducer

Select the measuring range. The measuring range is printed on the nameplate of the measuring transducer. An incorrect measuring range will lead to an incorrect measurement.

Temperature compensation

This function is used for compensation of the temperature influence of the process on measurement.

Temperature: [Off] / [Manual] / [Automatic]

- *[Off]* switches the process temperature setting off
- *[Manual]* makes possible a manual specification of the process temperature
- *[Automatic]* uses a measured process temperature. Automatic measurement of the temperature using the temperature sensor, e.g. Pt1000. For pH, CDP and fluoride, temperature compensation can be switched *[ON]* or *[OFF]* in the menu.

8.1.7 Peracetic Acid

Peracetic acid measured variable

Peracetic acid as a measured variable is measured via one of the two mA sensor inputs. Temperature compensation is performed in the sensor. An additionally connected temperature sensor is only used for display and data recording with a data logger and can be issued on a mA-output via field bus or web server.

Measuring range of the sensors

Select the measuring range. The measuring range is given on the sensor nameplate. An incorrect measuring range leads to an incorrect measurement.

Temperature

The temperature measurement is used only for information or recording purposes, but not for temperature compensation. Temperature compensation is carried out in the sensor.

8.1.8 Hydrogen Peroxide

Hydrogen peroxide as a measured variable [mA]

Hydrogen peroxide as a measured variable is measured via one of the two mA sensor inputs. Temperature compensation is performed in the sensor. An additionally connected temperature sensor is only used for display and data recording with a data logger and can be issued on a mA-output via field bus or web server.

Measuring range of the sensors

Select the measuring range. The measuring range is given on the sensor nameplate. An incorrect measuring range leads to an incorrect measurement.

Temperature

The temperature measurement is used only for information or recording purposes, but not for temperature compensation. Temperature compensation is carried out in the sensor.

8.1.9 Conductivity [mA]

Measured variable conductivity [mA]

When measuring conductivity [mA], use of a measuring transducer is a prerequisite, e.g. a measuring transducer DMTa conductivity. A conductivity sensor cannot be directly connected to the controller.

Measuring range:

- Select the measuring range corresponding to the measuring range of the measuring transducer used. An incorrect measuring range leads to an incorrect measurement.

Temperature:

- The temperature measurement is used only for information or recording purposes, but not however for temperature compensation. Temperature compensation is carried out in the measuring transducer.

8.1.10 Temperature [mA], (as main measured variable)

Measured variable temperature [mA], (as main measured variable):

For the measured variable *'Temperature [mA]'* use of a DMTa temperature measuring transducer or a Pt100V1 measuring transducer is prerequisite. The measuring range is: 0 ... 100 °C. A temperature sensor cannot be connected directly to the controller.

8.1.11 mA General

Measured variable [mA general]

With the *[mA general]* measured variable, various preselected measured variable can be selected and/or one measured variable can also be freely edited with its unit of measure. The temperature measurement cannot be used for compensation purposes, because the influence of the temperature measurement on the measured value is not known. In principle, the settings are performed in the same way as with the other measured variable. A standardised calibrated signal is expected by the controller from each connected device

8.1.12 Features of the Two-channel Version

Two channel version

If a second measuring channel is available (dependent on the identity code, channel 2), then this second measuring channel can be configured according to the descriptions of the first measuring channel.

Two channel version with two identical measured variables

If the measured variables of measuring channel 1 and measuring channel 2 are chosen identically, then the menu item *[Differential meas]*appears in the *[Measurement]* menu. The *[Differential meas]* function is switched off "ex works". The function *[Differential meas]* can be activated and the calculation *[K1-K2]* executed. The result of the calculation is displayed in the main display 2 by pressing the ▼ key or ▲ key. By pressing the ▼ or ▲ key again you jump back to the main display 1. The limit value criteria for the *[Differential meas]* can be set in the menu *[Limit values]*.

9 Calibration

- **User qualification:** instructed user, see ↳ *Chapter 4.4 'Users' qualifications' on page 21*

> ***Settings for [Channel 2]***
>
> *In its 2-channel version, the controller has two measurement channels. This description for [Channel 1] applies correspondingly for the settings in [Channel 2]. The procedure for making the settings for the channel in question is identical, however the parameters to be set may be different. Differences are pointed out and are also described.*

> ***Display tolerances***
>
> *Display tolerances between the sensor and/or measuring device and controller have to be calibrated with sensors and/or with output signals of measuring devices that do not require calibration or where calibration is performed in the sensor/measuring device. The relevant information for this is contained in the respective operating instructions for the sensor or measuring device.*

Continuous display ➨ Menu ➨ ▲ or ▼ *[Calibration]* ➨ OK

or

Continuous display ➨ CAL

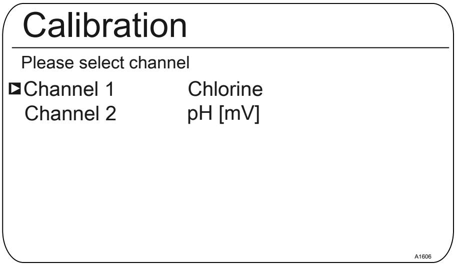


Fig. 29: Please select channel

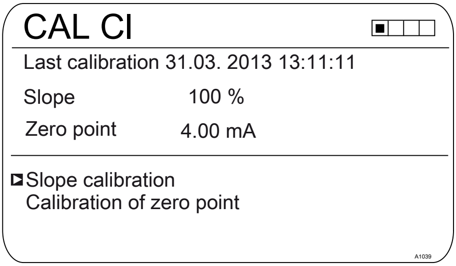


Fig. 30: Display [Calibration] with the example of [Chlorine]

> ***Calibrating measuring channel 1 and measuring channel 2***
>
> *The calibration processes are identical for measuring channel 1 and measuring channel 2. However, it is necessary to calibrate each measuring channel separately*

9.1 Calibrating the pH sensor

To ensure a high level of measuring accuracy, adjust the pH sensor at set time intervals. This calibration interval seriously depends on the application of the pH sensor and on the required measurement accuracy and reproducibility. The calibration interval can vary between daily and every few months.

Valid calibration values

Assessment	Zero point	Slope
Very good	-30 mV … +30 mV	56 mV/pH … 60 mV/pH
Good	-45 mV … +45 mV	56 mV/pH … 61 mV/pH
Acceptable	-60 mV … +60 mV	55 mV/pH … 62 mV/pH

If you measure the pH with potential equalisation, set this [Potential equalisation] procedure as a parameter when selecting the measured variable as a parameter.

Calibrate the pH-sensor for the function: pH compensation for chlorine measurement

It is mandatory that the pH measurement is always calibrated first, followed by the chlorine measurement. Calibration of the chlorine measurement should always follow every further calibration of the pH measurement, otherwise the chlorine measurement will be inaccurate.

Selecting the calibration process

Select the calibration process prior to initial calibration. This selection is saved until you select a new process.

- 2-point calibration: This is the recommended calibration process because it evaluates the sensor characteristic data: asymmetric potential, slope and response speed. 2 buffer solutions are needed for 2-point calibration, e.g. pH 7 and pH 4 if subsequent measurement is to be performed in an acidic medium or pH 7 and pH 10, if subsequent measurement is to be performed in an alkaline medium. The buffer gap should be at least 2 pH units.
- Samples (1-point) calibration: There are two options here. Samples (1-point) calibration is only recommended with reservations. From time to time check the sensor with 2-point calibration.
  - The pH sensor remains in the sample medium and you should calibrate a sample of the medium to be measured against an external comparison measurement. Perform the comparison measurement using an electrochemical method. Deviations of up to ± 0.5 pH units can occur using the phenol red method (photometer).
  - Calibration solely using a pH 7 buffer. This only calibrates the zero point. The sensor is not checked for an acceptable slope.
- Data input: With this calibration method, using a comparison measuring device, determine in advance the characteristic data of the pH sensor (asymmetry and slope) at standard temperature and enter this data into the controller. The comparative calibration should not be more than one week old because the pH sensor's characteristic data changes if the data is saved for longer.

Buffer temperature dependencies

> *Buffer temperature*
>
> *At temperatures that differ by 25 °C in the process, adjust the pH of the buffer solution by entering the reference values printed on the buffer solution bottle into the controller prior to calibration.*

> *Buffer temperature dependencies*
>
> *An incorrectly entered buffer temperature can lead to incorrect calibration.*
>
> *Each buffer has different temperature dependencies. You have various choices in terms of compensating for these temperature dependencies, so that the controller can correctly process the buffer temperature.*
>
> – *Buffer temperature [Manual]: Ensure that the buffer temperature is identical for both buffers. Enter the buffer temperature in the [CAL Setup] menu item in the controller.*
> – *Buffer temperature [Automatic]: Then immerse the temperature sensor connected to the controller together with the pH sensor into the buffer. Wait for a sufficiently long period of time until the pH and temperature sensor have recorded the buffer temperature.*
> – *Buffer temperature [Off]: this setting is not recommended. Please use another setting.*

The sensor stability information displayed during calibration, *[acceptable]*, *[good]* and *[very good]*, indicates to what extent the sensor signal fluctuates during calibration. At the start of calibration, the waiting time for stabilising of the measured value is 30 seconds; during this waiting time, *[Please wait!]* flashes in the display. You cannot continue with calibration during this waiting time.

If the pH sensor is cold, e.g. < 10 °C, then the pH sensor responds slowly and you have to wait a few minutes until the sensor signal has stabilised.

The controller has no waiting time limit. You will see the actual [sensor voltage] in mV and can identify high fluctuations and assign influences to them, such as the movement of the sensor cable.

Calibration is impossible if the sensor signal is very unsteady and the sensor signal is disrupted by external influences, or if the sensor cable has a cable break or the coaxial cable is damp. Rectify any fault or cable break.

You can only continue with calibration once the signal bar has reached the *[acceptable]* range and remains there or moves towards *[good]* or *[very good]*. Changes to the signal within the ranges *[acceptable]*, *[good]* and *[very good]* are permitted.

The signal fluctuation width within the ranges is specified as follows:

- first 30 seconds wait time, then evaluation of the sensor signal
  – Acceptable: 0.5 mV/30s
  – Good: 0.3 mV/30s
  – Very good: 0.1mV/30s

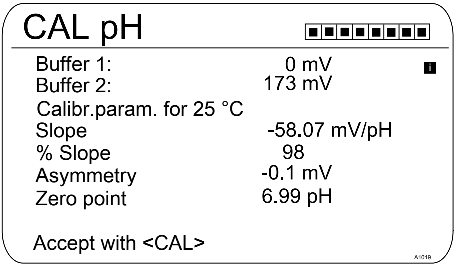


Fig. 31: Display of the calibration result

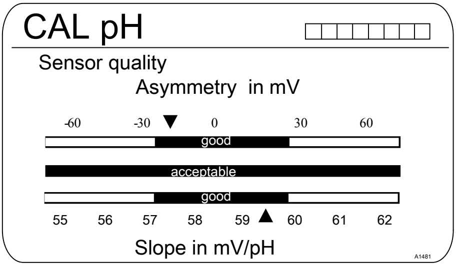


Fig. 32: Displayed after the ▷ key has been pressed

9.1.1 Selecting the Calibration Process for pH

To calibrate the controller there are three available calibration processes:

- 2-point
- Sample (1-point)
- Data input

Selecting the calibration process

1. Continuous display ➡ CAL

   ⇨ The Calibration menu is displayed, you may need to select *[Channel 1]* or *[Channel 2]*, depending on the measuring channel on which the pH measurement is performed.

2. Press OK

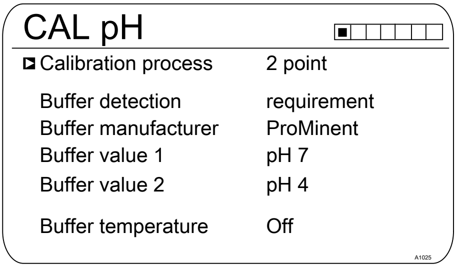


Fig. 33: Selecting the calibration process

   ⇨ The menu for selecting the calibration process appears.

3. Use the arrow keys to select the required menu item and press OK

   ⇨ The input window appears and you can make the necessary settings for your process

4. Use the arrow keys to select the calibration process and press OK
5. Continue with CAL

   ⇨ You can now start your chosen calibration process.

9.1.2 2-point pH sensor calibration (CAL)

Correct sensor operation

- *Correct measuring and metering is only possible if the sensor is working perfectly*
- *Refer to the sensor's operating instructions*
- *2-point calibration is strongly recommended and is preferable to other methods*
- *Remove the sensor from the in-line probe housing and re-fit it for calibration. To do this, refer to the operating instructions for your in-line probe housing*

Determining buffer detection

There are 2 methods of buffer detection with 2-point calibration.

[Requirement]: you have to select 2 buffers from the 4 possible buffer sets for this. Adhere to the selected order, e.g. buffer value 1: pH 7 and buffer value 2: pH 4 for calibration.

- *ProMinent® (pH 4; 7; 9; 10)*
- *NBS/DIN 19266 (pH 1; 4; 7, ; 9)*
- *DIN 19267 (pH 1;4; 7; 9; 13)*
- *Merck + Riedel® (pH 2; 4; 7; 9; 12)*

The buffer sets vary with regard to their pH values and temperature dependencies configured in the controller. The pH values for the different temperatures are also printed on the buffer containers.

[Manual]: enter the buffer value with the associated temperature into the controller.

- *The pH values of the buffer solution at temperatures that deviate from 25 °C are displayed in a table on the label of the buffer bottle.*

Select the buffer you require.

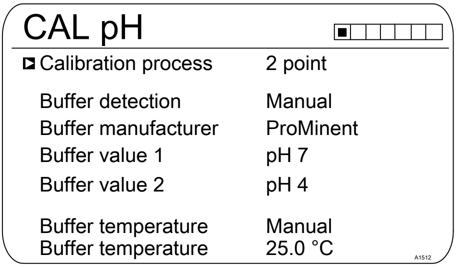


Fig. 34: Example: Display in[CAL Setup]

> ***Buffer used***
>
> *Dispose of the used buffer solution. For more information: refer to the buffer solution safety data sheet.*

> ***Valid calibration values***
>
> *Valid calibration:*
>
> – *Zero point -60mV…+60 mV*
> – *Slope 55 mV/pH…62 mV/pH*

You need two test containers with buffer solution for calibration. The pH values of the buffer solutions should be at least 2 pH values apart. Thoroughly rinse the sensor with water when changing the buffer solution.

Continuous display ➨ CAL

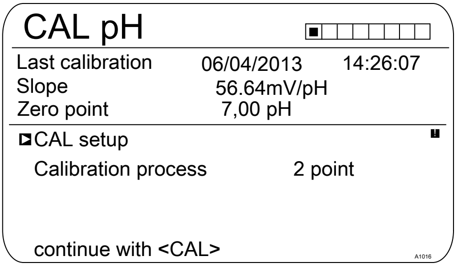


Fig. 35: pH sensor calibration (CAL)

1. Then press CAL
2. Rinse the sensor thoroughly with water before drying with a cloth (pad dry, don't rub)
3. Immerse the sensor in test container 1 containing buffer solution (e.g. pH 7). When doing so, move the sensor gently

4. Continue with CAL

   ⇨ Calibration is running. *[Please wait!]* flashes.

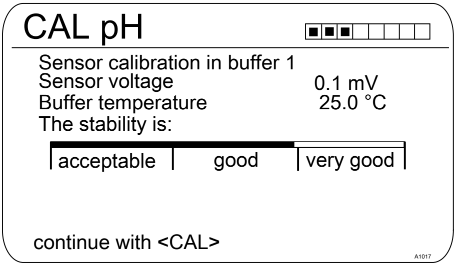


Fig. 36: Display of the sensor stability achieved

5. The *[acceptable / good / very good]* range is displayed

   ⇨ The black part of the horizontal bar indicates the range detected.

6. Continue with CAL

7. *[Buffer detection]* e.g. *[Manual]*: Press OK and set the buffer value for buffer 1 to the value of the buffer you are using with the four arrow keys. Confirm the input of the value with OK

8. Remove the sensor from the buffer solution, rinse thoroughly in water and then dry with a cloth (pad dry, don't rub!)

9. Continue with CAL

10. Immerse the sensor in test container 2 containing buffer solution (e.g. pH 4). When doing so, move the sensor gently

11. Continue with CAL

   ⇨ Calibration is running. *[Please wait!]* flashes.

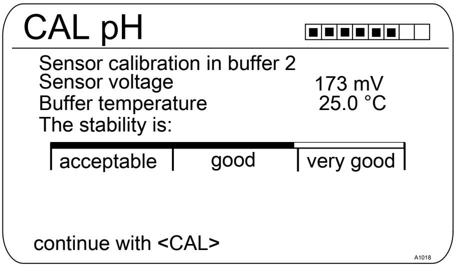


Fig. 37: Display of the sensor stability achieved

12. The *[acceptable / good / very good]* range is displayed

   ⇨ The black part of the horizontal bar indicates the range detected.

13. Continue with CAL

14. *[Buffer detection] [Manual]*: Press OK and set the buffer value for buffer 2 to the value of the buffer you are using with the four arrow keys. Confirm input of the value by pressing OK

15. Continue with CAL

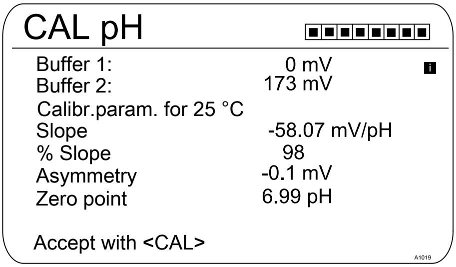


Fig. 38: Display of the calibration result

16. *Incorrect calibration*

An error message appears should the result of the calibration lie outside the specified tolerance limits. In this case the current calibration will not be applied.

Check the prerequisites for calibration and clear the error. Then repeat calibration.

Transfer the result of the calibration into the controller memory by pressing CAL

⇨ The controller displays the continuous display again and operates with the results of the calibration.

9.1.3 pH sensor calibration (CAL) with an external sample (1-point)

Measuring and control behaviour of the controller during calibration

During calibration the actuating outputs are deactivated. Exception: a basic load or a manual control variable has been set. This remains active. The measured value output [standard signal output mA] is frozen, corresponding to its settings in the mA output menu.

When calibration/testing has been completed successfully, all of the error checks relating to the measured value are restarted. The controller saves all the determined data for zero point and slope upon a successful calibration.

NOTICE!

Poor sensor operation and fluctuating pH values during the process

The calibration method with an external sample has a number of disadvantages compared with the buffer solution calibration method. If the pH value fluctuates significantly during the process, then the pH value may change by a variable amount in the period between sampling, sample measurement and entry of the pH value into the controller. This could mean that the pH value entered into the controller does not correspond to the actual pH value in the process. Consequently the result is a linear displacement of the pH value across the entire measuring range.

If the pH sensor no longer reacts to changes in the pH value and only gives out a constant uniform mV signal, this cannot be detected using the calibration method with an external sample. With the calibration method with two buffers (e.g. pH 7 and pH 4), this becomes apparent if the pH sensor does not detect any changes in the pH value.

The calibration method with an external sample should only be used with installations where there is poor access to the pH sensor and the identical or very uniform pH values are used in the process. In addition the pH sensor should be regularly serviced or replaced.

Correct sensor operation

- *Correct measuring, control and metering is only possible if the sensor is working perfectly*
- *Refer to the sensor's operating instructions*

Valid calibration values

Evaluation	Zero point	Slope
Very good	-30 mV … +30 mV	56 mV/pH … 60 mV/pH
Good	-45 mV … +45 mV	56 mV/pH … 61 mV/pH
Acceptable	-60 mV … +60 mV	55 mV/pH … 62 mV/pH

Continuous display ➨ CAL

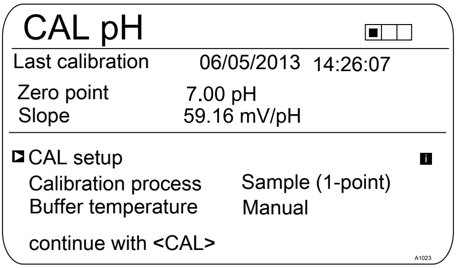


Fig. 39: pH sensor calibration (CAL)

1. Continue with CAL
2. Take a water sample at the in-line probe housing and, using a suitable method (measuring strips, hand measuring instrument), measure the pH value of the sample

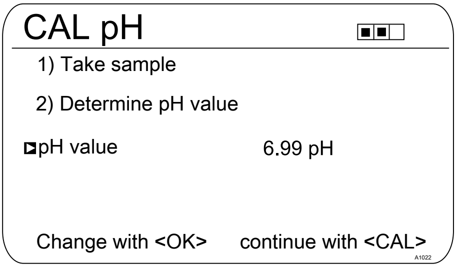


Fig. 40: Instructions for determining the pH value using the [Sample] method

3. Press OK
4. Use the arrow keys to enter the pH value you have determined in the controller
5. Press OK
6. Accept the pH value by pressing CAL
   ⇨ All the values of the calibration result are shown in the display.

> *Incorrect calibration*
>
> *An error message appears if the result of the calibration lies outside the specified tolerance limits. In this case, the current calibration is not applied.*
>
> *Check the prerequisites for calibration and clear the error. Then repeat calibration.*

7. Transfer the result of the calibration into the controller memory by pressing CAL
   ⇨ The controller displays the continuous display again and operates with the results of the calibration.

9.1.4 Calibration of the pH Sensor (CAL) by *[Data Input]*

Data input

Using the [Calibration of the pH sensor (CAL) by data input] calibration method, the sensor's known data is entered into the controller. Calibration by data input is only as accurate and reliable as the method with which the data was determined.

The sensor data must have been determined in real-time. The more up-to-date the sensor data is, the more reliable is this calibration method.

Correct sensor operation

- *Correct measuring and metering is only possible if the sensor is working perfectly*
- *Refer to the sensor's operating instructions*

Measuring and control behaviour of the controller during calibration

During calibration the actuating outputs are deactivated. Exception: a basic load or a manual control variable has been set. This remains active. The measured value output [standard signal output mA] is frozen, corresponding to its settings in the mA output menu.

When calibration/testing has been completed successfully, all of the error checks relating to the measured value are restarted. The controller saves all the determined data for zero point and slope upon a successful calibration.

Valid calibration values

Evaluation	Zero point	Slope
Very good	-30 mV … +30 mV	56 mV/pH … 60 mV/pH
Good	-45 mV … +45 mV	56 mV/pH … 60,5 mV/pH
Acceptable	-60 mV … +60 mV	55 mV/pH … 62 mV/pH

Continuous display ➡ CAL

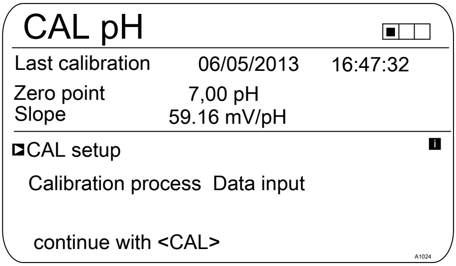


Fig. 41: pH sensor calibration (CAL)

1. Continue with CAL

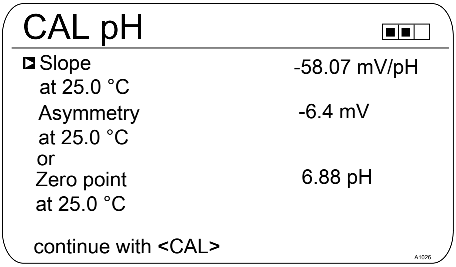


Fig. 42: Selection of the settable parameters

2. Use the arrow keys to select the required menu item and press OK
   ⇨ The entry window appears.
3. Enter the values for your sensor using the arrow keys and press OK
4. Continue with CAL

Incorrect calibration

An error message appears if the result of the calibration lies outside the specified tolerance limits. In this case, the current calibration is not applied.

Check the prerequisites for calibration and clear the error. Then repeat calibration.

5. Transfer the result of the calibration into the controller memory by pressing CAL

⇨ The controller displays the continuous display again and operates with the results of the calibration.

9.2 Calibrating the ORP Sensor

9.2.1 Selecting the calibration process for ORP

Selecting the calibration process

There are two calibration processes available for calibrating the controller:

- 1-point (with buffer solution)
- Data input

1. Continuous display ➡ CAL

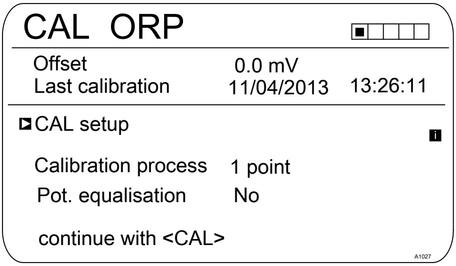


Fig. 43: [ORP] calibration menu

⇨ The calibration menu is displayed.

2. Use OK to select the Setup menu or start calibration by pressing CAL

Selecting the calibration process

3. *[CAL Setup]*: Press OK

⇨ The menu for selecting the calibration process appears.

4. Using the arrow keys select the required menu item *[Calibration process]* and press OK

⇨ The input window appears.

5. Use the arrow keys to select the calibration process and press OK

6. Continue with CAL

⇨ You can now start your chosen calibration process.

9.2.2 1-point calibration of ORP sensor (CAL)

Correct sensor operation

– *Correct measuring and metering is only possible if the sensor is working perfectly*
– *Refer to the sensor's operating instructions*
– *Remove the sensor from the in-line probe housing and re-fit it for calibration. To do this, refer to the operating instructions for your in-line probe housing*

ORP sensor calibration

The ORP sensor cannot be calibrated. Only an [OFFSET] deviation of magnitude ± 40 mV can be set and thus compensated. If the ORP sensor deviates by more than ± 40 mV from the reference value, then it must be checked in accordance with the requirements of the sensor operating instructions.

Measuring and control behaviour of the controller during calibration

During calibration the actuating outputs are deactivated. Exception: a basic load or a manual control variable has been set. This remains active. The measured value output [standard signal output mA] is frozen, corresponding to its settings in the mA output menu.

When calibration/testing has been completed successfully, all of the error checks relating to the measured value are restarted. The controller saves all the determined data for zero point and slope upon a successful calibration.

Buffer used

Dispose of the used buffer solution. For more information: refer to the buffer solution safety data sheet.

You need one test container with a buffer solution for calibration.

Continuous display ➨ CAL

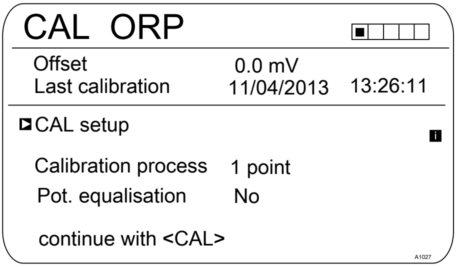


Fig. 44: 1-point calibration of ORP sensor (CAL)

1. Continue with CAL

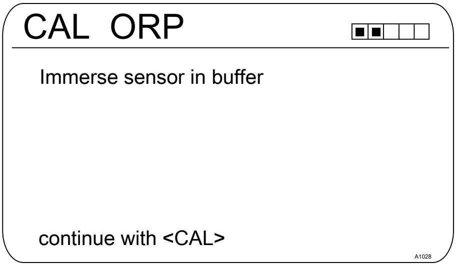


Fig. 45: 1-point calibration of ORP sensor (CAL)

2. Carry out the instructions and then press CAL

   ⇨ Calibration is running 🕐. *[Please wait!]* flashes.

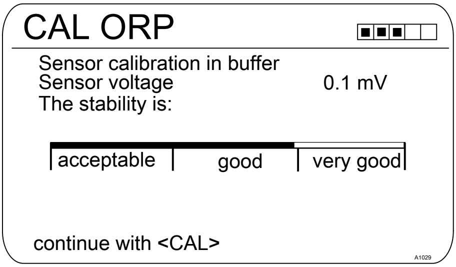


Fig. 46: Display of the sensor stability achieved

3. The *[acceptable / good / very good]* range is displayed

   ⇨ The black part of the horizontal bar indicates the range detected.

4. Continue with [CAL]

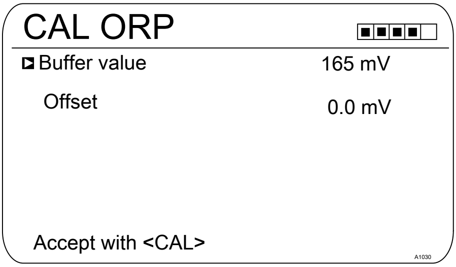


Fig. 47: Adjusting the buffer value

5. Press [OK] and use the four arrow keys to adjust the mV value of the buffer you are using

6. Press [OK]

7. Transfer the result of the calibration into the controller memory by pressing [CAL]

   ⇨ The controller operates with the calibration results.

9.2.3 Calibration data for ORP sensor (CAL)

> ***Correct sensor operation***
>
> – *Correct measuring and metering is only possible if the sensor is working perfectly*
> – *Refer to the sensor's operating instructions*
> – *Remove the sensor from the in-line probe housing and re-fit it for calibration. To do this, refer to the operating instructions for your in-line probe housing*

> ***ORP sensor calibration***
>
> *The ORP sensor cannot be calibrated. Only an ‘OFFSET’ deviation of magnitude ± 40 mV can be set and thus compensated. If the ORP sensor deviates by more than ± 40 mV from the reference value, then it must be checked in accordance with the requirements of the sensor operating instructions.*

> ***Measuring and control behaviour of the controller during calibration***
>
> *During calibration the actuating outputs are deactivated. Exception: a basic load or a manual control variable has been set. This remains active. The measured value output [standard signal output mA] is frozen, corresponding to its settings in the mA output menu.*
>
> *When calibration/testing has been completed successfully, all of the error checks relating to the measured value are restarted. The controller saves all the determined data for zero point and slope upon a successful calibration.*

Continuous display ➨ CAL

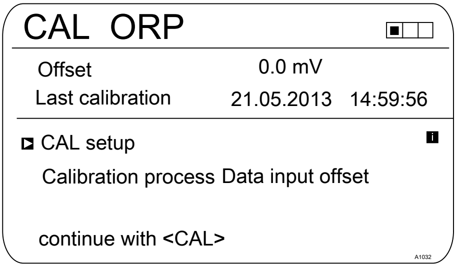


Fig. 48: Data input, ORP sensor calibration (CAL)

1. Continue with CAL

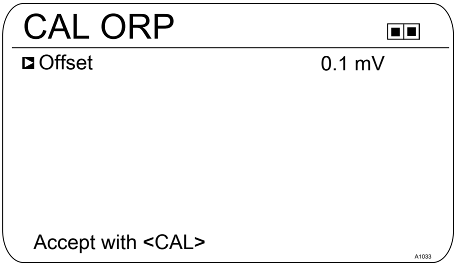


Fig. 49: Adjusting the [Offset]

2. Press OK and use the four arrow keys to adjust the mV value of the buffer you are using
3. Press OK
4. Transfer the result of the calibration into the controller memory by pressing CAL

   ⇨ The controller operates with the calibration results.

9.3 Calibrating the Fluoride Sensor

9.3.1 Selection of the calibration process for fluoride

To calibrate the controller there are two available calibration processes:

- 1 point
- 2 point

Calibration process selection

1. Continuous display ➨ CAL

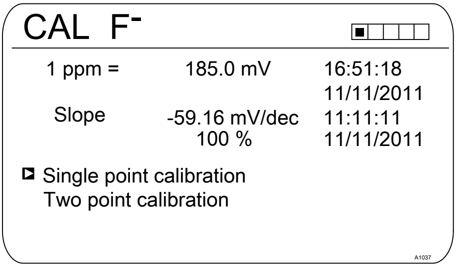


Fig. 50: Calibration menu [Fluoride]

⇨ The calibration menu is displayed.

2. Using the arrow keys select the desired menu item. Press the OK key

⇨ You can now start the selected calibration process.

9.3.2 2-point fluoride sensor calibration (CAL)

> *Correct sensor operation*
>
> – *Correct measuring and metering is only possible if the sensor is working perfectly*
> – *Observe the sensor operating instructions*
> – *The carrying out of a 2-point calibration is strongly recommended and is to be preferred to other methods*
> – *For calibration the sensor must be removed and refitted in the in-line probe housing. To do this, observe the operating instructions of your in-line probe housing*

Material required for calibration of fluoride sensors:

- Two test containers with calibrating solution

Measuring and control behaviour of the controller during calibration

During calibration the actuating outputs are deactivated. Exception: a basic load or a manual control variable has been set. This remains active. The measured value output [standard signal output mA] is frozen, corresponding to its settings in the mA output menu.

When calibration/testing has been completed successfully, all of the error checks relating to the measured value are restarted. The controller saves all the determined data for zero point and slope upon a successful calibration.

Used calibration solution

Dispose of the used calibration solution. For more information: see calibration solution safety data sheet.

Two test containers with a calibration solution are required for calibration. The fluoride content of the calibrating solutions should be at least 0.5 ppm F^- apart from each other. The sensor should be rinsed thoroughly with fluoride-free water when changing the calibrating solution.

1. Press the CAL key in the continuous display.
2. Using the arrow keys select *[Two point calibration]*
3. Then press OK

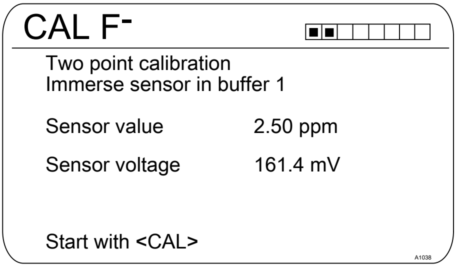


Fig. 51: Fluoride sensor calibration (CAL)

4. Immerse the sensor in test container 1 with calibration solution. When doing so gently move the sensor
5. Then press CAL
   ⇨ *[Calib. in progress]* (clock).

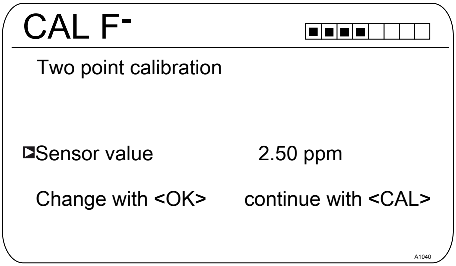


Fig. 52: Fluoride sensor calibration (CAL)

6. Then press OK to change the ppm value or press CAL to continue with the calibration
7. Then press CAL

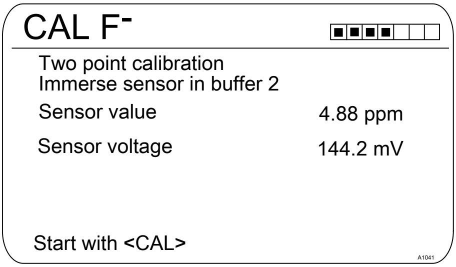


Fig. 53: Fluoride sensor calibration (CAL)

8. Immerse the sensor in test container 2 with calibration solution. When doing so gently move the sensor
9. Then press CAL
   ⇨ *[Calib. in progress]*.
10. Then press OK to adjust the ppm value or press CAL to continue with the calibration
11. Then press CAL
12. Import the result of the calibration into the controller memory by pressing the CAL key
    ⇨ The controller displays the continuous display again and operates with the results of the calibration.

> ***Incorrect calibration***
>
> *Should the result of the calibration lie outside the specified tolerance limits, an error message appears. In this case the current calibration will not be applied.*
>
> *Check the prerequisites for the calibration and clear the error. Then repeat the calibration*

9.3.3 1-point fluoride sensor calibration (CAL)

> ***Correct sensor operation***
>
> – *Correct measuring and metering is only possible if the sensor is working perfectly*
> – *Observe the sensor operating instructions*
> – *The carrying out of a 2-point calibration is strongly recommended and is to be preferred to other methods*
> – *For calibration the sensor must be removed and refitted in the in-line probe housing. To do this, observe the operating instructions of your in-line probe housing*

Material required for calibration of fluoride sensors:

- One test container with calibration solution

__Measuring and control behaviour of the controller during calibration__

During calibration the actuating outputs are deactivated. Exception: a basic load or a manual control variable has been set. This remains active. The measured value output [standard signal output mA] is frozen, corresponding to its settings in the mA output menu.

When calibration/testing has been completed successfully, all of the error checks relating to the measured value are restarted. The controller saves all the determined data for zero point and slope upon a successful calibration.

__Used calibration solution__

Dispose of the used calibration solution. For more information: see calibration solution safety data sheet.

One test container with calibration solution are required for calibration.

1. Press the CAL key in the continuous display.
2. Using the arrow keys select *[Single point calibration]*
3. Then press OK

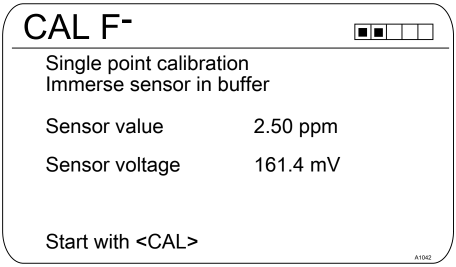


Fig. 54: Fluoride sensor calibration (CAL)

4. Immerse the sensor in test container 1 with calibration solution. When doing so gently move the sensor
5. Then press CAL
   ⇨ *[Calib. in progress]* 🕐.

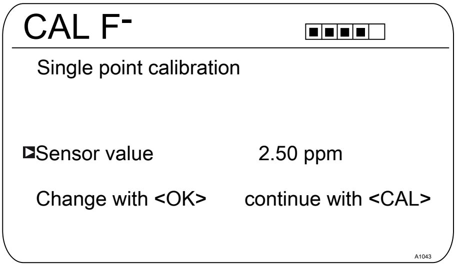


Fig. 55: Fluoride sensor calibration (CAL)

6. Then press OK to change the ppm value or press CAL to continue with the calibration
7. Then press CAL

8. Import the result of the calibration into the controller memory by pressing the CAL key

⇨ The controller displays the continuous display again and operates with the results of the calibration.

> *Incorrect calibration*
>
> *Should the result of the calibration lie outside the specified tolerance limits, an error message appears. In this case the current calibration will not be applied.*
>
> *Check the prerequisites for the calibration and clear the error. Then repeat the calibration*

9.4 Calibrating Amperometric Sensors

> *Calibrating Amperometric Sensors*
>
> *The process for calibrating amperometric sensors is identical with all amperometric measured variables.*
>
> *The process for calibrating amperometric measured variables is described throughout based on the measured variable chlorine [Cl]. All other measured variables require the same process as the measured variable chlorine [Cl].*
>
> *The following measured variables can be calibrated using the process described here:*
>
> – *Chlorine*
> – *Chlorine dioxide*
> – *Bromine*
> – *Chlorite*
> – *Ozone*
> – *Peracetic acid (PES)*
> – H_2O_2

> *Calibration combining pH and chlorine*
>
> *It is imperative that you always calibrate the pH measurement first before the chlorine measurement. The chlorine measurement always needs to be calibrated any further time the pH measurement is calibrated. Otherwise the chlorine measurement will be inaccurate.*

9.4.1 Selecting the calibration process for amperometric measured variables

There are two calibration processes available for calibrating the controller:

- Calibrating the slope
- Calibrating the zero point

Selecting the calibration process

1. Continuous display ➡ CAL

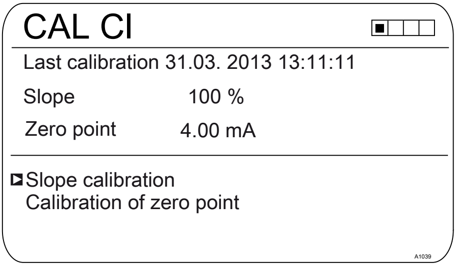


Fig. 56: [Chlorine] calibration menu

⇨ The calibration menu is displayed.

2. Use the arrow keys to select the chosen menu item. Press OK

⇨ You can now start your chosen calibration process.

9.4.2 Calibrating the slope

CAUTION!

Correct sensor operation / Run-in period

Damage to the product or its surroundings

- Correct measuring and metering is only possible if the sensor is working perfectly
- Please read the operating manual for the sensor
- Please also read the operating manuals for the fittings and other components used
- It is imperative that the run in periods of the sensors are adhered to
- The run in periods should be allowed for when planning commissioning
- It may take an entire working day to run in the sensor

Measuring and control behaviour of the controller during calibration

During calibration the actuating outputs are deactivated. Exception: a basic load or a manual control variable has been set. This remains active. The measured value output [standard signal output mA] is frozen, corresponding to its settings in the mA output menu.

When calibration/testing has been completed successfully, all of the error checks relating to the measured value are restarted. The controller saves all the determined data for zero point and slope upon a successful calibration.

The measured value frozen at the start of calibration is suggested as a reference value. The reference value can be set using the arrow keys. Calibration is only possible if the reference value is ≥ 2 % of the measuring range of the sensor.

NOTICE!

Prerequisites for correct calibration of the sensor slope

– The reference method needed is used, depending on the feed chemical used (e.g. DPD 1 for free chlorine).
– The run-in period for the sensor has been complied with; refer to the operating instructions for the sensor.
– There is permitted and constant flow at the in-line probe housing
– There is temperature balance between the sensor and the sample water
– There is a constant pH value in the permitted range

Material required for calibration of amperometric sensors:

- A reference method suitable for the measured variable in question

Remove sample water directly at the measuring point and determine the content of the feed chemical in the sample water in *[ppm]* using an appropriate reference method (e.g. DPD, titration etc.). Enter this value into the controller as follows:

1. Press CAL in the continuous display.
2. Use the arrow keys to select *[Slope calibration]*
3. Continue with OK

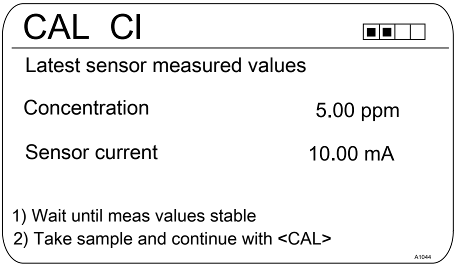


Fig. 57: Reference value calibration shows the actual sensor values

4. Continue with CAL

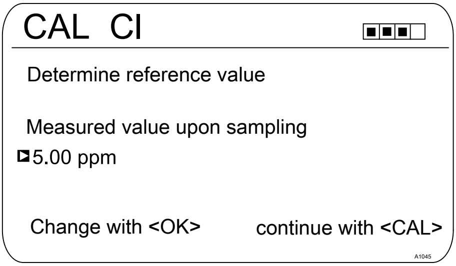


Fig. 58: Reference value calibration, the sensor value is frozen here; now take the sample and measure using DPD, for example

5. Then press OK to adjust the ppm value or press CAL to continue with the calibration

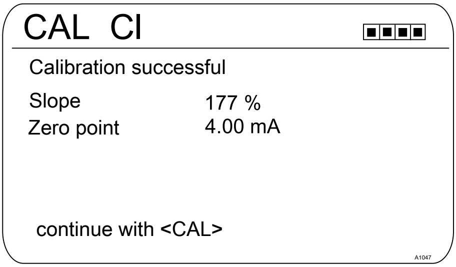


Fig. 59: Calibrating the reference value

6. Transfer the result of the calibration into the controller memory by pressing CAL

   ⇨ The controller displays the continuous display again and operates with the results of the calibration.

> ***Incorrect calibration***
>
> *An error message appears if the result of the calibration lies outside the specified tolerance limits. In this case, the current calibration is not applied.*
>
> *Check the prerequisites for calibration and clear the error. Then repeat calibration*

Permitted calibration range

The permitted calibration range is 20 ... 300% of the sensor's rated value.

Example of a shallow slope: Blocking of the sensor membrane leads to a low slope (low slope = low sensor sensitivity)

Example of a steep slope: Surfactants make the sensor membrane more permeable, leading to a steeper slope (steep slope = high sensor sensitivity)

9.4.3 Calibration of zero point

Necessity for calibrating the zero point

Calibration of the zero point is not generally necessary. A calibration of the zero point is only necessary if the sensor is operated at the lower limit of the measuring range or if the 0.5 ppm sensor version is used.

CAUTION!

Correct sensor operation / Run-in period

Damage to the product or its surroundings

- Correct measuring and metering is only possible if the sensor is working perfectly
- Please read the operating manual for the sensor
- Please also read the operating manuals for the fittings and other components used
- It is imperative that the run in periods of the sensors are adhered to
- The run in periods should be allowed for when planning commissioning
- It may take a whole working day to run-in the sensor

Measuring and control behaviour of the controller during calibration

During calibration the actuating outputs are deactivated. Exception: a basic load or a manual control variable has been set. This remains active. The measured value output [standard signal output mA] is frozen, corresponding to its settings in the mA output menu.

When calibration/testing has been completed successfully, all of the error checks relating to the measured value are restarted. The controller saves all the determined data for zero point and slope upon a successful calibration.

NOTICE!

Prerequisites for a correct calibration of the sensor zero point

- The run in period for the sensor has been adhered to
- There is permitted and constant flow at the in-line probe housing
- There is temperature balance between the sensor and the sample water
- There is a constant pH value in the permitted range

1. Press the CAL key in the continuous display.
2. Using the arrow keys select the *[Zero point]*
3. Then press OK

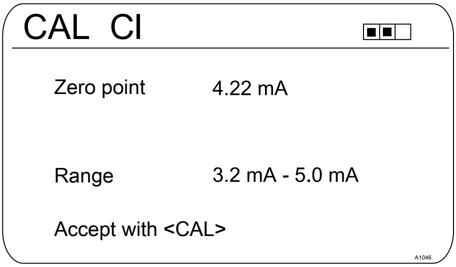


Fig. 60: Calibration of zero point

4. Then press CAL

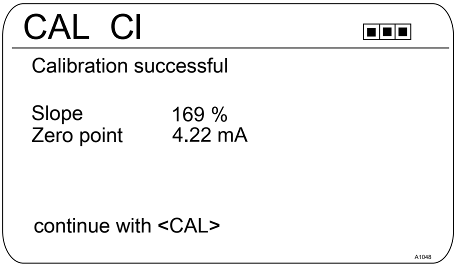


Fig. 61: Calibration of zero point

5. Import the result of the calibration into the controller memory by pressing the CAL key
   ⇨ The controller displays the continuous display again and operates with the results of the calibration.

> *Incorrect calibration*
>
> *Should the result of the calibration lie outside the specified tolerance limits, an error message appears. In this case the current calibration will not be applied.*
>
> *Check the prerequisites for the calibration and clear the error. Then repeat the calibration*

9.5 Calibrating Oxygen Sensors

Specifying the calibration interval

The calibration interval depends heavily on:

- the application
- the installation location of the sensor

If you wish to calibrate a sensor for a special application and/or a special installation location, then you can determine the calibration intervals using the following method. Check the sensor, e.g. one month after commissioning:

1. Remove the sensor from the medium
2. Clean the outside of the sensor with a damp cloth
3. Then gently dry the sensor membrane for example using a paper towel
4. After 20 minutes measure the oxygen saturation index in the air
5. Protect the sensor from external influences, such as sunlight and wind

   ⇨ Now decide depending on the expected result:

   Amperometric sensor: Calibrate the sensor if the measured value is not 102 ± 2 %SAT.

   If the value is within the set-point range, then you can extend the calibration interval. Repeat this process monthly and determine the optimum calibration interval for your application from the results.

> *Calibration specifications of the sensor manufacturer*
>
> *When determining the calibration interval, also take into consideration the operating instructions for the sensor, which may offer additional and/or different calibration intervals.*

9.5.1 Selection of the calibration process for the measured variable O_2

To calibrate the controller there are three available calibration processes:

- automatic
- DO value
- Zero point

Calibration process selection

1. Continuous display ➨ CAL

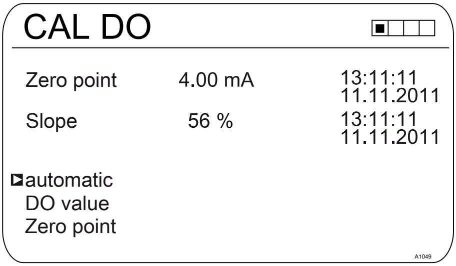


Fig. 62: Calibration menu [DO]

⇨ The calibration menu is displayed.

2. Using the arrow keys select the desired menu item. Press the OK key

⇨ You can now start the selected calibration process.

9.5.2 Selection of the calibration process for the measured variable DO

CAUTION!

Correct sensor operation / Run-in period

Damage to the product or its surroundings

– Correct measuring and metering is only possible if the sensor is working perfectly
– Please read the operating manual for the sensor
– Please also read the operating manuals for the fittings and other components used
– It is imperative that the run in periods of the sensors are adhered to
– The run in periods should be allowed for when planning commissioning
– It may take a whole working day to run-in the sensor

Measuring and control behaviour of the controller during calibration

During calibration the actuating outputs are deactivated. Exception: a basic load or a manual control variable has been set. This remains active. The measured value output [standard signal output mA] is frozen, corresponding to its settings in the mA output menu.

When calibration/testing has been completed successfully, all of the error checks relating to the measured value are restarted. The controller saves all the determined data for zero point and slope upon a successful calibration.

1. Press the CAL key in the continuous display.
2. Using the arrow keys select *[automatic]*
3. Then press OK

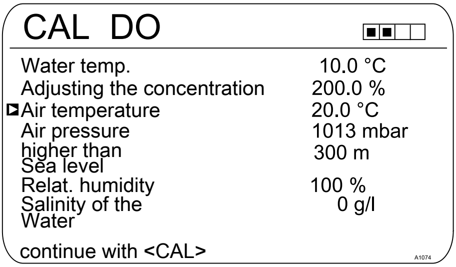


Fig. 63: Selection of the calibration process for the measured variable DO

4. Then press OK to adjust the values or press CAL to continue with the calibration

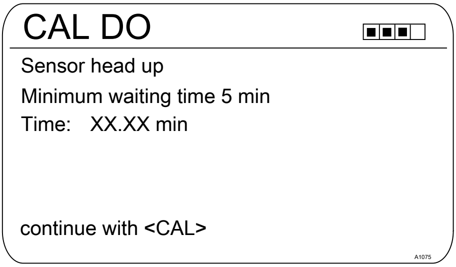


Fig. 64: Selection of the calibration process for the measured variable DO

5. Hold the DO sensor head up in the ambient air.

   ⇨ The calibration takes place. The elapsed time is displayed. The minimum waiting time for a correct calibration is 5 minutes

6. Press the CAL key to import the result of the calibration into the memory of the controller

   ⇨ The controller changes back to the continuous display and operates with the results of the calibration.

> ***Incorrect calibration***
>
> *Should the result of the calibration lie outside the specified tolerance limits, an error message appears. In this case the current calibration will not be applied.*
>
> *Check the prerequisites for the calibration and clear the error. Then repeat the calibration*

9.5.3 Zero point calibration for the measured variable DO

CAUTION!

Correct sensor operation / Run-in period

Damage to the product or its surroundings

- Correct measuring and metering is only possible if the sensor is working perfectly
- Please read the operating manual for the sensor
- Please also read the operating manuals for the fittings and other components used
- It is imperative that the run in periods of the sensors are adhered to
- The run in periods should be allowed for when planning commissioning
- It may take a whole working day to run-in the sensor

Measuring and control behaviour of the controller during calibration

During calibration the actuating outputs are deactivated. Exception: a basic load or a manual control variable has been set. This remains active. The measured value output [standard signal output mA] is frozen, corresponding to its settings in the mA output menu.

When calibration/testing has been completed successfully, all of the error checks relating to the measured value are restarted. The controller saves all the determined data for zero point and slope upon a successful calibration.

1. Press the CAL key in the continuous display.
2. Using the arrow keys select *[Zero point]*
3. Then press OK

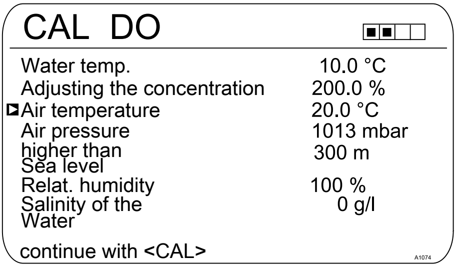


Fig. 65: Zero point calibration for the measured variable DO

4. Then press OK to adjust the values or press CAL to continue with the calibration

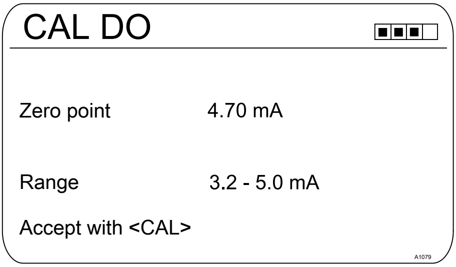


Fig. 66: Zero point calibration for the measured variable DO

5. Then press CAL

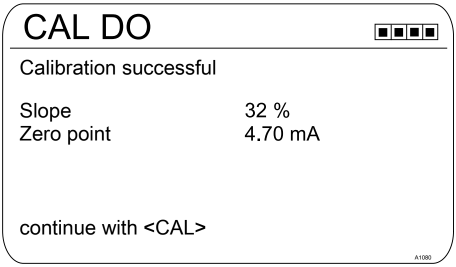


Fig. 67: Zero point calibration for the measured variable DO

6. Press the CAL key to import the result of the calibration into the memory of the controller

⇨ The controller changes back to the continuous display and operates with the results of the calibration.

The controller displays the continuous display again and operates with the results of the calibration.

> ***Incorrect calibration***
>
> *Should the result of the calibration lie outside the specified tolerance limits, an error message appears. In this case the current calibration will not be applied.*
>
> *Check the prerequisites for the calibration and clear the error. Then repeat the calibration*

9.5.4 DO value calibration for the measured variable DO

CAUTION!

Correct sensor operation / Run-in period

Damage to the product or its surroundings

- Correct measuring and metering is only possible if the sensor is working perfectly
- Please read the operating manual for the sensor
- Please also read the operating manuals for the fittings and other components used
- It is imperative that the run in periods of the sensors are adhered to
- The run in periods should be allowed for when planning commissioning
- It may take a whole working day to run-in the sensor

Measuring and control behaviour of the controller during calibration

During calibration the actuating outputs are deactivated. Exception: a basic load or a manual control variable has been set. This remains active. The measured value output [standard signal output mA] is frozen, corresponding to its settings in the mA output menu.

When calibration/testing has been completed successfully, all of the error checks relating to the measured value are restarted. The controller saves all the determined data for zero point and slope upon a successful calibration.

1. Press the CAL key in the continuous display.
2. Using the arrow keys select *[DO value]*
3. Then press OK

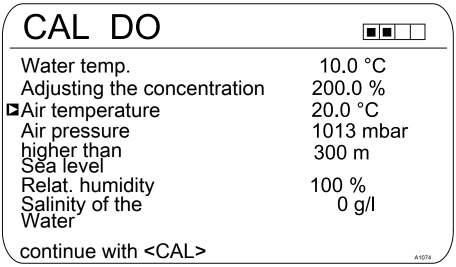


Fig. 68: DO value calibration for the measured variable DO

4. Then press OK to adjust the values or press CAL to continue with the calibration

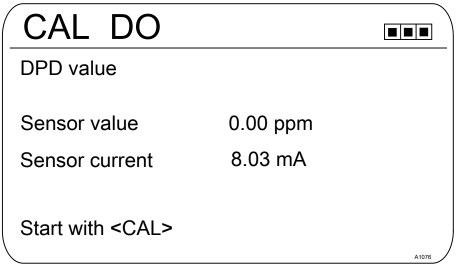


Fig. 69: DO value calibration for the measured variable DO

5. Then press CAL

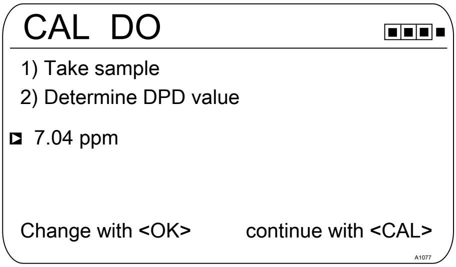


Fig. 70: DO value calibration for the measured variable DO

6. Take a water sample and determine the DPD value with a suitable measuring instrument.
7. Then press OK to adjust the values or press CAL to continue with the calibration

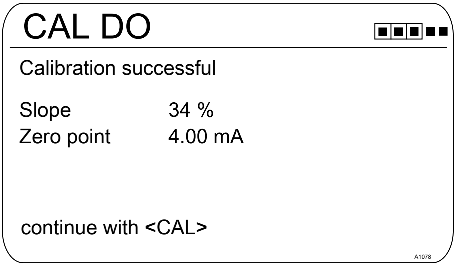


Fig. 71: DO value calibration for the measured variable DO

8. Import the result of the calibration into the controller memory by pressing the CAL key
   ⇨ The controller displays the continuous display again and operates with the results of the calibration.

> *Incorrect calibration*
>
> *Should the result of the calibration lie outside the specified tolerance limits, an error message appears. In this case the current calibration will not be applied.*
>
> *Check the prerequisites for the calibration and clear the error. Then repeat the calibration*

9.6 Measured value [mA general] calibration

> *Measured value [mA general] calibration*
>
> *The measured value [mA general] cannot be calibrated, this menu item is shown 'greyed out' and has no purpose.*

9.7 Calibrating conductivity

> *Measuring and control behaviour of the controller during calibration*
>
> *During calibration the actuating outputs are deactivated. Exception: a basic load or a manual control variable has been set. This remains active. The measured value output [standard signal output mA] is frozen, corresponding to its settings in the mA output menu.*
>
> *When calibration/testing has been completed successfully, all of the error checks relating to the measured value are restarted. The controller saves all the determined data for zero point and slope upon a successful calibration.*

You may need a manual measuring instrument for the conductivity measured variable. This manual instrument should measure and display sufficiently accurately to guarantee successful calibration.

1. Press CAL in the continuous display.
2. Use the arrow keys to select *[Calibrate slope]*
3. Then press OK
4. Follow the instructions in the controller display and perform calibration
5. Then press CAL
6. Then press OK to adjust the µS/cm value or press CAL to continue with calibration

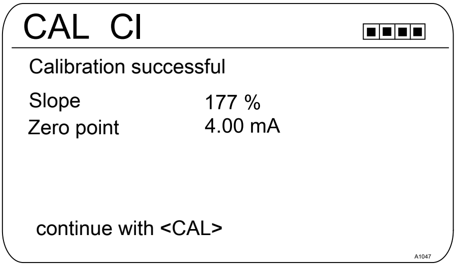


Fig. 72: Calibrating the reference value

7. Import the result of the calibration into the controller memory by pressing CAL
   - ⇨ The controller shows the continuous display again and operates with the results of the calibration.

> ***Incorrect calibration***
>
> *An error message appears if the result of the calibration lies outside the specified tolerance limits. In this case the current calibration is not carried over.*
>
> *Check the prerequisites for calibration and eliminate the error. Then repeat calibration.*

9.8 Calibrating temperature

> ***Measuring and control behaviour of the controller during calibration***
>
> *During calibration the actuating outputs are deactivated. Exception: a basic load or a manual control variable has been set. This remains active. The measured value output [standard signal output mA] is frozen, corresponding to its settings in the mA output menu.*
>
> *When calibration/testing has been completed successfully, all of the error checks relating to the measured value are restarted. The controller saves all the determined data for zero point and slope upon a successful calibration.*

You may need a manual measuring instrument for the temperature measured variable. This manual instrument should measure and display sufficiently accurately to guarantee successful calibration.

1. Press CAL in the continuous display.
2. Then press OK
3. Follow the instructions in the controller display and perform calibration
4. Then press CAL
5. Then press OK to adjust the value or press CAL to continue with calibration
6. Import the result of the calibration into the controller memory by pressing CAL
   - ⇨ The controller shows the continuous display again and operates with the results of the calibration.

Incorrect calibration

An error message appears if the result of the calibration lies outside the specified tolerance limits. In this case the current calibration is not carried over.

Check the prerequisites for calibration and eliminate the error. Then repeat calibration.

10 Setting the *[Control]*

- **User qualification:** trained user, see ↳ *Chapter 4.4 'Users' qualifications' on page 21*

Continuous display ➨ MENU ➨ ▲ or ▼ *[Control]* ➨ OK *[Control]*

Settings for [Channel 2]

In its 2-channel version, the controller has two measurement channels. This description for [Channel 1] applies correspondingly for the settings in [Channel 2]. The procedure for making the settings for the channel in question is identical, however the parameters to be set may be different. Differences are pointed out and are also described.

NOTICE!

Possible data loss

If you change measured variables in the *[Measurement]* menu, see ↳ *Chapter 8 'Setting measured variables' on page 52*, all settings in the *[Measurement]* and *[Control]* menus are reset to their factory settings (default values). You then have to re-enter the settings in the *[Measurement]* and *[Control]* menus. The operator is responsible for the correct set-up of the controller.

Prerequisites for set up of the [Control]:

The following settings are necessary for the [Control] set-up: If you have not yet made the settings, do this now.

- *Specify the measured variables and all the necessary settings in the [Measurement] menu, see ↳ Chapter 8 'Setting measured variables' on page 52*
- *Specify all the actuators planned for the control task: You can find specifications for the relevant electrical connections and settings in the following menus*
  - *[Pumps], see ↳ Chapter 12 'Setting the [Pumps]' on page 125*
  - *[Relays], see ↳ Chapter 13 'Setting the [Relays]' on page 128*
  - *[mA outputs], see ↳ Chapter 15 'Setting the [mA outputs]' on page 136*

Actuators (regulator control elements) are, for example, metering pumps, solenoid valves, motorised butterfly valves etc.

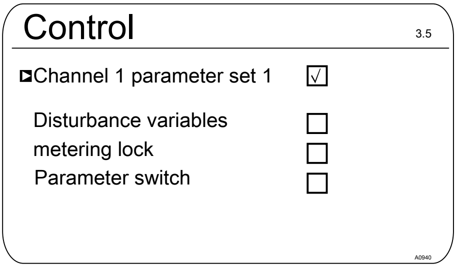


Fig. 73: Continuous display ➨ MENU ➨ ▲ or ▼ [Control] ➨ OK [Control]

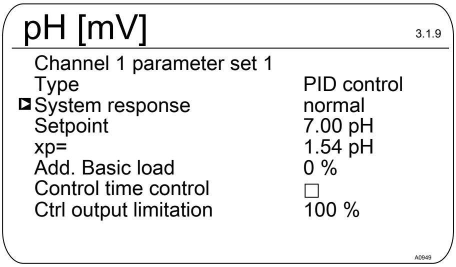


Fig. 74: for the example of pH [mV]: Continuous display ➨ MENU ➨ ▲ or ▼ [Control] ➨ OK [Control] ➨ ▲ or ▼ [Channel 1 parameter set 1] ➨ OK [Channel 1 parameter set 1]

Parameter level 1	Function	Parameter
[Channel 1 parameter set 1]	*[Type]*	none
		P-control
		PI control
		PI control
	[System response]	Normal
		Manual
		With dead zone
	[Setpoint]	The adjustable range of the setpoint is specified by the device.

Parameter level 1	Function	Parameter
	xp=	The adjustable range of the xp-value is specified by the device.
	Ti=	The adjustable range of the Ti-value is specified by the device.
	Td=	The adjustable range of the Td-value is specified by the device.
	[Additive basic load]	The adjustable range of the additive basic load is specified by the device.
	[Control checkout time]	Checkout time (up)
		Checkout time ↓ (down)
		Control variable threshold
	[Control variable limitation]	The adjustable range of the maximum control variable is specified by the device.
[Interference variables]	Interference variable input	Off
		On
[Setpoint]	Channel 1/2	Off
		On
[Parameter switch-over]	*[Event control]*	Off
		On
	[Time control]	Timer 1 ... 10: Off
		Timer 1 ... 10: On

Each controller can be configured as a 1-way or 2-way controller. Two parameter sets are available for each controller. The 2nd parameter set is activated if the digital input 2 is set as the *[Control parameter switch-over]*. In this case *[Parameter set 2]* can be configured in the menu.

When connecting the actuator, ensure that the actuator which increases the measured value is connected to the corresponding output *[Increase measured value]*, and the actuator which decreases the measured value is connected to the output *[Decrease measured value]*, see *Chapter 6.3 ‘Electrical installation’ on page 31*.

Example: A medium with an actual value pH 3 is to be have its pH increased to the setpoint pH 7 using a sodium hydroxide solution (pH >14). Therefore connect the actuator to the control output *[Increase measured value]*.

Direction of action of the [Control], 2- or 1-way

You can vary the *[Control]* based on various features.

Function: A 2-way *[Control]* operates in two possible directions (Increase AND decrease measured value).

Application: In a neutralisation process in an industrial waste water system, acidic or alkaline waste water is produced alternately. Before the water can be fed into the sewerage system, the pH value should, for example, be set to a value between pH 6.8 and 7.5. A 2-way controller with two metering pumps for metering acid and alkali is used for this purpose. The pH value can be both decreased or increased to come within the necessary setpoint range.

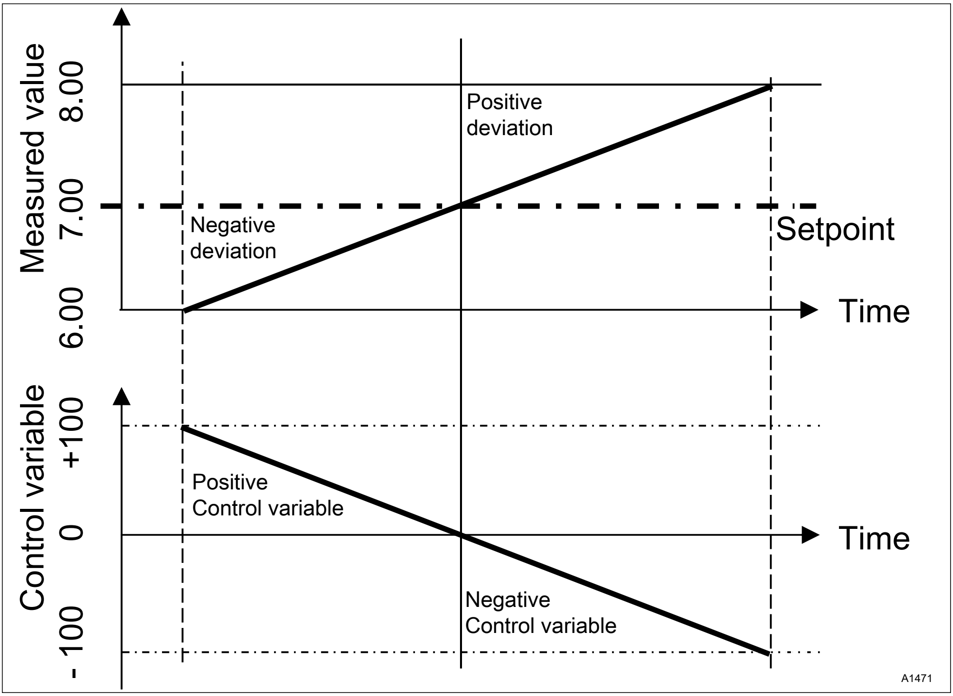


Fig. 75: Control type two-way PID. Control characteristic without dead zone

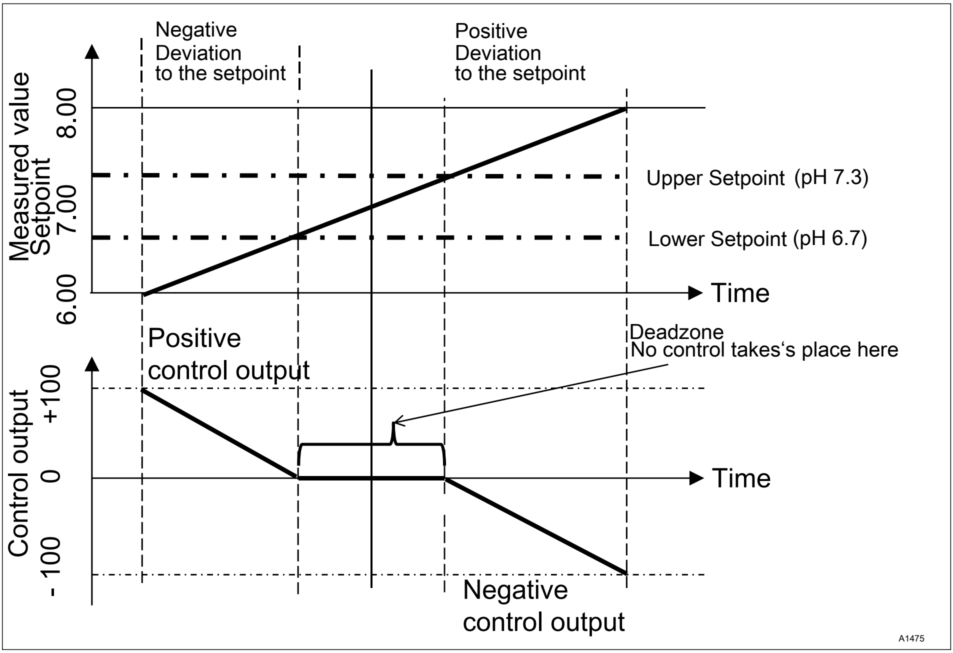


Fig. 76: Control type two-way PID, with dead zone

Function: A 1-way *[Control]* operates in only one of two possible directions (Increase OR decrease measured value).

Application: This affects, for example, a disinfection process, in which chlorine is added to water. The incoming water has a chlorine concentration of 0 ppm and is to be adjusted to 0.5 ppm by the addition of sodium-calcium hypochlorite. The addition of sodium-calcium hypochlorite increases the measured value.

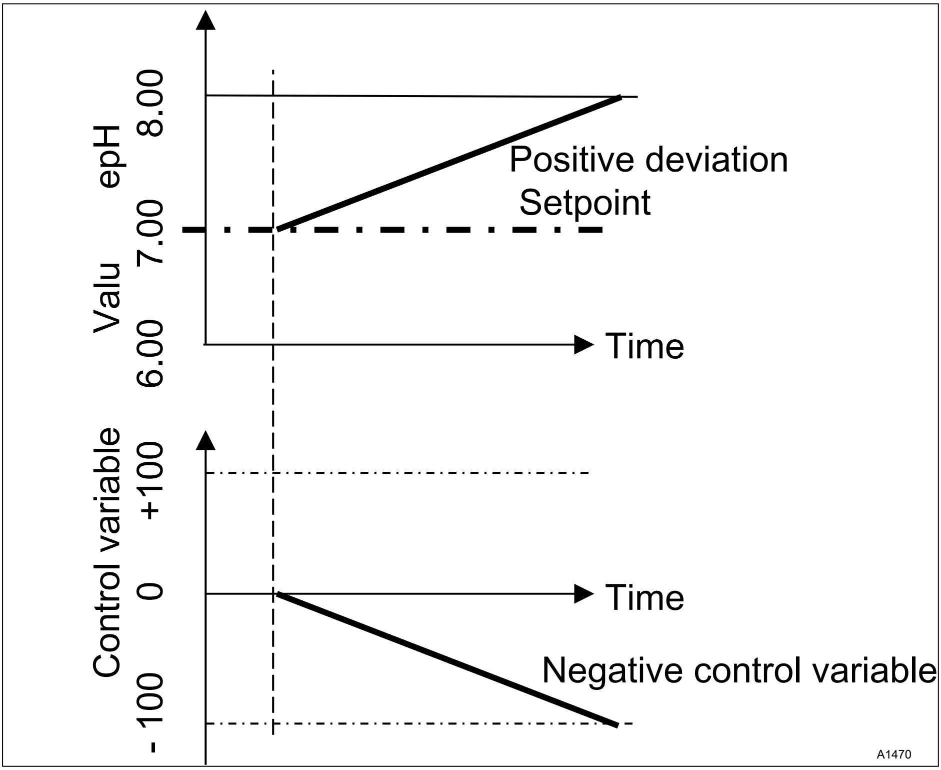


Fig. 77: Control type 1-way PID, pH-lowering direction

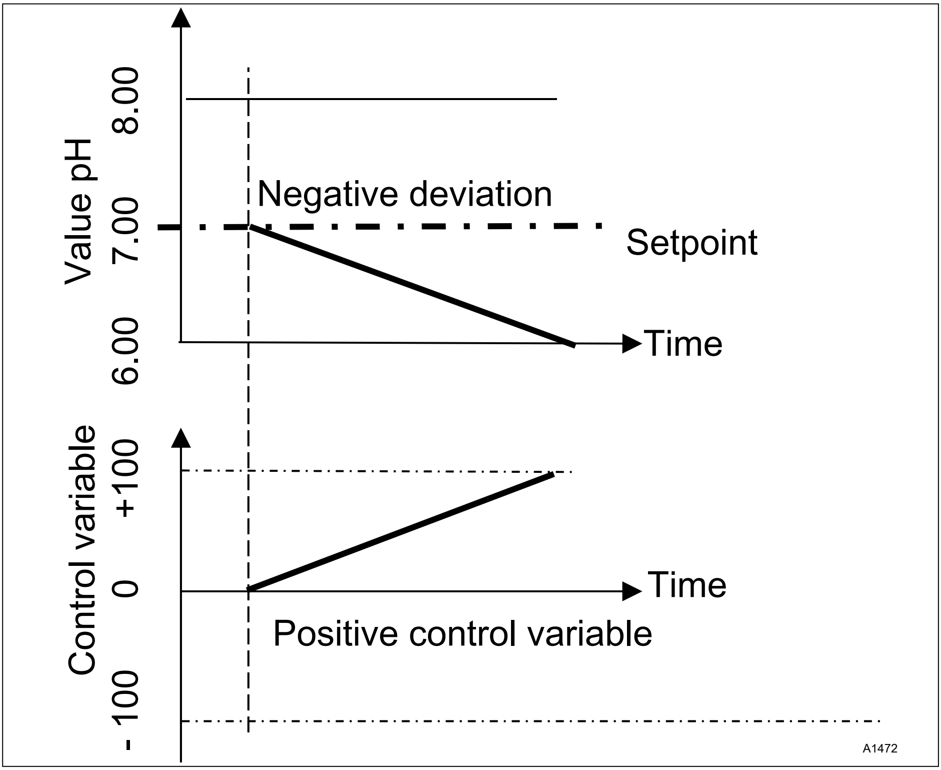


Fig. 78: Control type 1-way PID, pH-increasing direction

Adjustable parameters in the [Control] menu

You have to make the following selection in the Control menu:

10.1 Control parameter [Type]

You set the controller type under the menu option *[Type]*. You can set the *[Type]* as *[1-way]* or *[2-way]*.

P, PI, PID controllers are continuous controllers. The control variables can take any value in the control range from -100 % … +100 %.

P controller:

This controller type is used with an integrating control path (e.g. *[Batch Neutralisation]*). If the control deviation becomes small then the control (actuation) of the actuator becomes smaller (proportional relationship). If the setpoint is nearly reached, then the control output is nearly 0 %. However the setpoint is never exactly reached. Consequently a permanent control deviation results. When stabilizing large changes, excess oscillations may occur.

PI controller:

This controller type is used with a non-integrating control path (e.g. flow neutralisations). Here excess fluctuation must be avoided. No permanent control deviation must occur. The setpoint must always be adhered to. A constant addition of metering chemicals is required. It is not a malfunction when the controller does not stop metering when the setpoint is reached.

PID controller:

This controller type has the properties of a PI controller. Due to the differentiating control part *[D]*, it also offers a certain level of foresight and can react to forthcoming changes. It is used when measurement spikes occur in the measurement curve and these must be quickly regulated out.

10.2 Control parameter [System response]

You can set the system response of the controller under the menu option *[System response]*.

Standard

The controller reacts with its P, PI or PID system response as described in ↻ *Chapter 10.1 'Control parameter [Type]' on page 108*.

[Standard] is the selection for *[1-way]* controlled processes.

[Dead zone]

The *[Dead zone]* is defined by an upper and lower setpoint. The *[dead zone]* only operates with a *[2-way] [control]*, if an actuator is available for each direction.

The *[dead zone]* should have the effect of preventing the control path from starting to oscillate. If the measured value lies within both the setpoints, then no control of the actuators takes place. In this case even a PI/PID controller does not activate its actuators. The *[dead zone]* is used with a *[2-way]* neutralisation.

10.3 Control parameter [Setpoint]

The setpoint specifies the target value for control. The controller attempts to maintain the deviation between the setpoint and the actual value (measured value) as close to *'0'* as possible.

10.4 Control parameter [xp]

The xp value is the controller amplification factor. The xp value relates to the measuring range end of a controller and is entered as an absolute value. For pH for example xp=1.5.

For measured variables such as chlorine, the sensor measuring range is selected. The sensor measuring range corresponds to the measuring range end.

For pH, the measuring range end is 15.45. Here the default xp value is 1.54 (corresponds to ± 1.54 pH). The xp value states that for a deviation of ± 1.54 from the setpoint, the control variable equals ± 100%. The smaller the xp value, the more *'forcefully'* the control reacts, however the control also moves slightly into the over-control range.

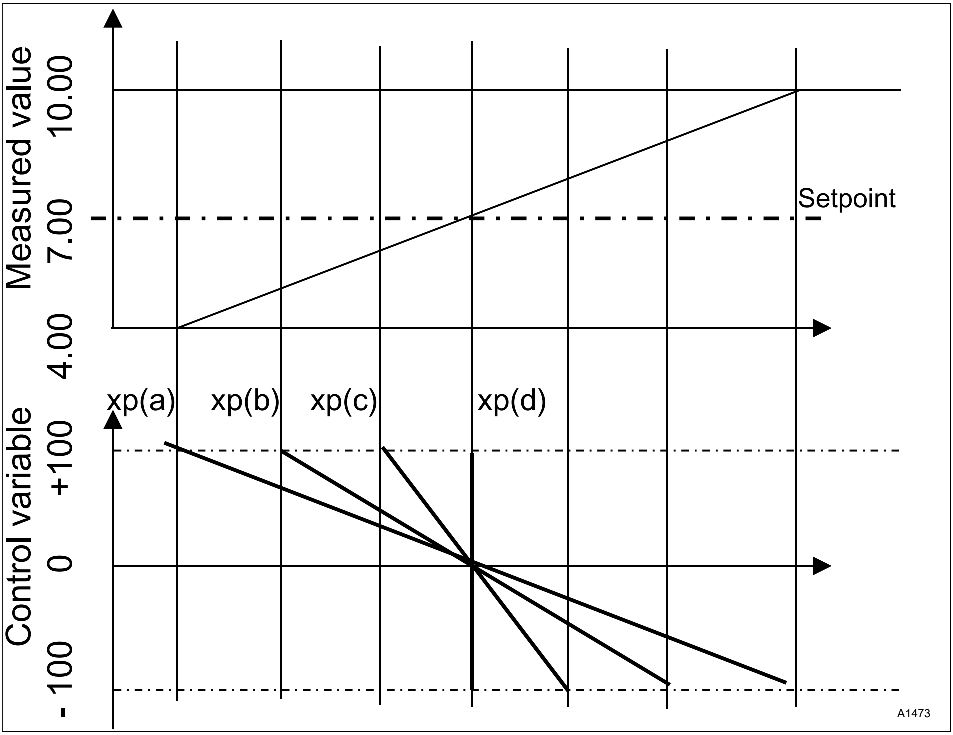


Fig. 79: The smaller the xp value, the more "forcefully" the control reacts.

10.5 Control parameter [Ti]

The time *[Ti]* is the integral time of the I-controller (integral controller) in seconds. The time *[Ti]* defines the time integration of the control deviation from the control variable. The smaller the time *[Ti]*, the greater the effect on the control variable. An infinitely long time *[Ti]* results in a pure proportional control.

10.6 Control parameter [Td]

The time *[Td]* is the differentiation time of the D-controller (differential controller) in seconds. The D-controller reacts to the rate of change of the measured value.

10.7 Control parameter [Add. Basic load]

[Add. Basic load] is the additive basic load. The additive basic load should balance out a continuous requirement for feed chemical in order to maintain the set-point.

The additive basic load can be set in the range -100 % … +100 %.

The additive basic load is added to the control variable determined by the controller and is effective in both control directions. E.g., if the control variable calculated by the controller equals

‘

➔ y= -10 % and the add. basic load equals +3 %, then the resulting control variable = Y= -10 % + (+3 %)= -7 %
➔ y= 10 % and the add. basic load equals +3 %, then the resulting control variable = Y= 10 % + (+3 %)= 13 %
➔ y= 0% and the add. basic load equals +3%, then the resulting control variable = Y= 0 % + (+3 %)= 3 %’

10.8 Control parameter [Checkout time]

The *[checkout time]* should prevent overdosing as a result of a malfunction.

During the *[checkout time]* the control variable is compared with an adjustable *[threshold]* (= control variable threshold). Depending on the control direction, you can set different values for the *[checkout times] [Checkout time “ up]* for increasing and *[Checkout time ” down]* for reducing.

The thresholds depend on the concentration of the metered feed chemical. If the threshold is exceeded, time recording starts *[(checkout time)]*.

If during the *[checkout time]* the variable again falls below the threshold, then the time is again reset to *‘0’* s.

If the control variable remains exceeded for longer than is permitted by the *[checkout time]*, then control stops immediately. This function (Control stop) resets automatically once the threshold is again undershot.

10.9 Control parameter [max. ctrl var.]

The *[max. ctrl var.]* specifies the maximum control variable to be output. This makes sense if an actuator is over-dimensioned and must not be opened to 100 %.

10.10 Interference variable

Steadier control of flow processes using a feedforward control.

Additive and multiplicative feedforward control

Alongside information relating to the actual measured variable, e.g. the chlorine concentration, the interference variable is a further source of information for the controller that makes it easier for the controller to provide stable control during flow processes. During flow processes, both the above parameters change frequently within wide ranges. If one parameter variable is not known, then it is impossible to achieve stable control of the other parameter variable. If processing of an interference variable is active, then the processing of the interference variable is signalled on the controller's continuous display under *[NAME OF INTERFERENCE VARIABLE]* and *[UNIT]* with the letter *[Q]*. Depending on the configuration, an interference variable can be effective for one or both measuring channels

The signal source of the interference variable can be supplied to the controller via an analog signal or a frequency (incorporated in the basic design of the controller). Channel 2 should be equipped with equipment package 2 (one main measured variable, e.g. chlorine) or equipment package 4 (2 main measured variables, e.g. pH and chlorine) to process an analog signal.

A frequency signal is connected to digital input 2 and an analog signal to mA input 2. The interference variable can act on both channels with accessory package 4, e.g.:

- mA input at channel 1: chlorine measurement
- mV input at channel 2: pH measurement
- Channel 2 analog input: flow signal

Applicational example of additive interference variable

If the addition of a chemical is largely only dependent on the flow (proportional dependency), then the addition of an additive interference variable proportional to the interference variable (flow), adds a proportion of the control variable to the control variable of the setpoint controller (setpoint control, that is the comparison, setpoint: actual value). It is also possible to completely switch off control of the setpoint and only provide flow-proportional metering. The measurement of the main measured value can be used together with the limit values as a monitoring function.

Applicational example:

You are to chlorinate drinking water. The required setpoint is 0.3 mg/l (ppm) chlorine. The volumetric flow of the drinking water is measured with a flow meter. The measuring signal of the flow meter is routed to the controller via a 4 ... 20 mA signal. A chlorine sensor CLE3 continuously measures the chlorine. The volumetric flow alters within a wide flow range from 0 ... 250 m³/h. The chlorine concentration of 0.3 mg/l is achieved using the proportionality between the water flow and the added volume of chlorine (the correct design of the metering pump according to the chlorine concentration is a prerequisite). If the chlorine requirement were now to increase, caused by a higher flow or greater depletion (higher temperature, more germs), then an additional positive fraction of the setpoint control would be added to the flow-proportional control variable. If by contrast, too much chlorine is metered, caused by a too high proportionality, then a negative control variable would be issued and added to the flow-proportional control variable and the resulting control variable would fall.

Set the following in the controller's menu:

[Menu], *[Control]*, *[Interference variable]*, *[On]*, *[Signal source]* = *[mA input 2]*

[Effect]: *[additive]*

[Assignment]: *[0…20 mA]* or *[4…20 mA]*

[Nominal value]: enter the maximum expected analog current here, e.g. 18 mA

Multiplicative interference variable

The multiplicative interference variable can influence the control variable of the setpoint controller over the entire control range proportionately to the interference variable. This corresponds to a proportionality factor of 0.00 = 0% and 1.00 = 100 %, including all intermediate values.

Interference variable

Parameter	Default setting	Possible values	Minimum value	Maximum value	Remark
Function	Off	On/Off			Switches the interference variable function on or off
Signal source	Frequency DI 2	Frequency DI 2 / mA input 2			Specifies the signal source from which the interference signal originates
Effect	additive	Additive / multiplicative			Specifies the effect of the interference variable
Nominal value	10 Hz	1…500 Hz	1 Hz	500 Hz	Specifies the maximum frequency of the contact water meter at maximum flow

10.11 Remote setpoint via a 0/4 ... 20 mA analog signal

Continuous display ➨ MENU ➨ ▲ or ▼ *[Control]* ➨ OK *[Control]* ➨ ▲ or ▼ *[Remote setpoint (mA)]* ➨ OK *[Remote setpoint]*

> *Availability of the remote setpoint*
>
> *The menu [Remote setpoint (mA)] is only available with the 1-channel control of the controller.*

The function *[Remote setpoint]* makes it possible for you to change the setpoint within a to be specified range for all measured variables of the controller channel 1 using an external 0/4 ... 20 mA analog signal. The analog signal can originate as an active signal from a PLC or also be specified using a 1 kOhm precision potentiometer.

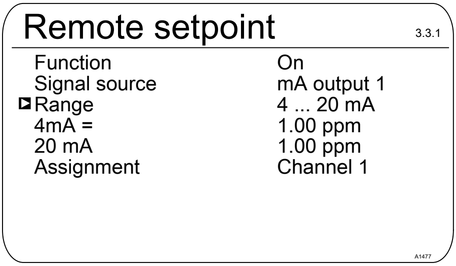


Fig. 80: Remote setpoint via a 0/4 ... 20 mA analog signal

Description	Factory setting	Adjustment Options
Function	Off	On/Off
Signal source	Fixed, mA input 2	
Range	4…20 mA	0…20mA/4…20mA
4 mA	Dependent on the measured variable and measuring range	Dependent on the measured variable and measuring range
20 mA	Dependent on the measured variable and measuring range	Dependent on the measured variable and measuring range
Assignment	Fixed, channel 1	

Application example:

In a process control system, several different pH setpoints must be reached in steps and then maintained. The system is controlled using a PLC. The PLC indicates the required standard signals to the controller via an analog mA output. The controller automatically regulates based on the setpoint. The controller can report the current pH value to the PLC via an analog mA output.

Required controller configuration:

You require package 2 for channel 2. You can find the corresponding information under *↳ Chapter 3 'ID Code' on page 15*

The function is available for all channel 1 measured variables. Channel 2 is used for processing the remote setpoint.

Electrical connection

The 0/4 ... 20 mA analog signal specifies the setpoint and is connected to terminals XE8 3 (-) and 4 (+) of the expansion module.

10.12 [Parameter switch] via the digital input or [Timer]

Continuous display ➨ MENU ➨ ▲ or ▼ *[Control]* ➨ OK *[Control]* ➨ ▲ or ▼ *[Parameter switch]* ➨ OK *[Parameter switch]*

An *[Event controlled]* or *[Time controlled]* *[Parameter switch]* allows you to activate an external potential-free switching signal for each alternative parameter set for all of the measured variables of channel 1 and channel 2 of the controller. Alternatively you can activate this switchover in a time dependent manner using 10 *[Timers]*. The existing active signal is valid, either *[Time controlled]* or *[Event controlled]*.

If *[Parameter switch]* is activated, then menu 3.1 also includes the parameterisation option for the respective parameter set 2. The selection option within the parameter set is identical to parameter set 1. If parameter set 2 is not active, then parameter set 1 is automatically activated.

Application example:

In a process control system, two different pH setpoints with different control parameters must be reached and maintained. The system is controlled using a PLC. The PLC indicates the required event signal to the controller via a digital output. The controller then switches from *[Channel 1 parameter set 2]* to *[Channel 2 parameter set 2]* and then maintains the relevant setpoint automatically. *[Parameter set 2]* must always be activated from 22:00 to 05:00 Monday to Friday irrespective of the PLC setting. This is a combination of *[Event controlled]* and *[Time controlled]* operation.

Electrical connection

The external release signal can be processed from digital input 2 (terminal XK1_3 and 4) or digital input 5 (terminal XK3_3 and 4).

Event controlled

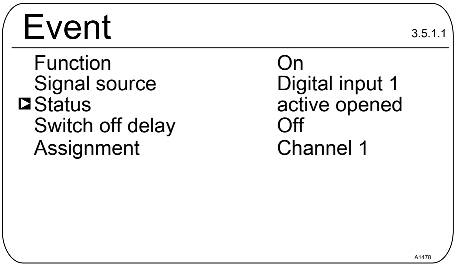


Fig. 81: Event controlled

Description	Factory setting	Adjustment Options
Function	Off	On/Off
Signal source	Digital input 2	Digital input 2, digital input 5
Status	Active opened	Active opened, Active closed
Switch off delay	Off	0=Off…1800s
Assignment	Channel 1	Dependent on device configuration, channel 1, channel 2, channel 1+2

Time controlled

For use of a [Timer] function, a [Timer] 1 ... 10 must be switched on. The On time and Off time must be specified within the [Timer]. If the off time (e.g. 11:00) is before the on time (e.g. 12:00), then the [Timer] is activated over two days.

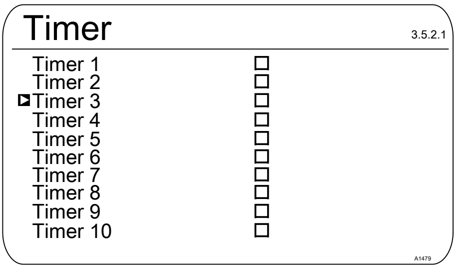


Fig. 82: [Timer control] = [Timer]

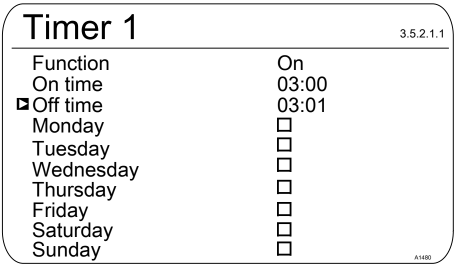


Fig. 83: Example: Timer 1

11 Setting the *[Limit values]*

- **User qualification:** trained user, see ↳ *Chapter 4.4 ‘Users' qualifications’ on page 21*

Continuous display ➨ MENU ➨ ▲ or ▼ *[Limit values]* ➨ OK *[Limit values]*

> ***Settings for [Channel 2]***
>
> *In its 2-channel version, the controller has two measurement channels. This description for [Channel 1] applies correspondingly for the settings in [Channel 2]. The procedure for making the settings for the channel in question is identical, however the parameters to be set may be different. Differences are pointed out and are also described.*

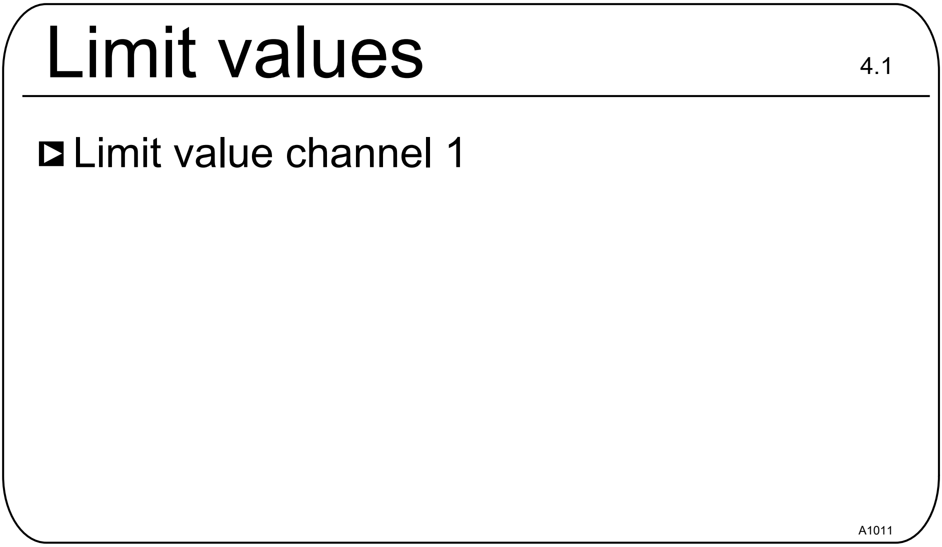


Fig. 84: Setting the [Limit values]

11.1 Function of the limit values

The limit values are not related to the control setpoint.

The limit values are continuously compared with the measured value.

The limit values are values that can be set within the measuring range of a measured variable. For each measuring channel a Limit *[1]* can be set for exceeding, i.e. the measured value is greater than the limit value and a Limit *[2]* can be set for undershooting, i.e. the measured value is less than the limit value. As the controller only has two limit value relays, there is an option of selecting a limit value *'range'*. An upper and lower limit are set as a limit value *'range'*. If the measured value is above or below the *'range'*, then a limit value transgression exists.

If the limit is exceeded for longer than *[the Control time lim. val. (Δt on)]*, then an error message will be triggered that has to be acknowledged and the alarm relay is deactivated. If the *[controller]* is also set to *[OFF]* then the control process is stopped.

[Lower lim] means that the limit criterion has been transgressed by undershooting of the lower limit

[High limit] means that the limit criterion has been transgressed by exceeding of the upper limit.

The controller has the option of defining *[Hysteresis limit values]*.

[Hysteresis] works towards rectifying the limit transgression, i.e. if the *[limit 1 upper]* of, for example, pH 7.5 has been exceeded by a set hysteresis limit of, for example, pH 0.20, then the criterion for limit transgression is redundant when the value drops below the lower limit of pH 7.3. The hysteresis behaviour for undershooting a *[Low limit]* functions in a similar way (here the hysteresis value is added to the limit). In this way it is possible to forego an external relay in self-retaining mode.

If the limit is exceeded for longer than the *[Delay period limitsΔt on]*, then an acknowledgeable fault message will be triggered and the alarm relay is deactivated. If the *[controller]* is also set to *[OFF]* then the control process is stopped.

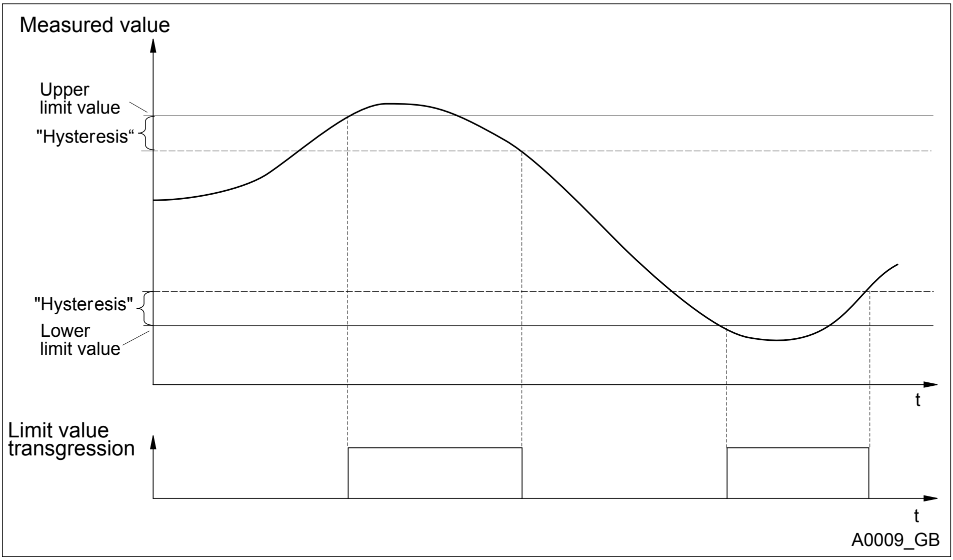


Fig. 85: Hysteresis

If the relays are defined as limit value relays, then when a limit value transgression occurs they also will switch in addition to the alarm relay.

Different switch on-delays (∆t On) and Switch off delays (∆t Off) can be set for the limit value relays for *[Limit 1]* and *[Limit 2]*. These prevent the limit value relay from switching back and forward if the limit values is only exceeded for a short time (damping function).

If there are no limit value relays, the limit values can nevertheless be entered. The controller displays the reactions described when a limit value transgression occurs

Limit value relay used as an actuator

If the relays are defined as actuators, then they react like actuating outputs. Example: in the event of Pause being activated or in the event of an alarm, an activated limit value relay will be deactivated.

11.2 Setting limit value channel 1

Continuous display ➨ MENU ➨ ▲ or ▼ *[Limit values]* ➨ OK *[Limit values]* ➨ ▲ or ▼ *[Limit value channel 1]* ➨ OK *[Limit value channel 1]*

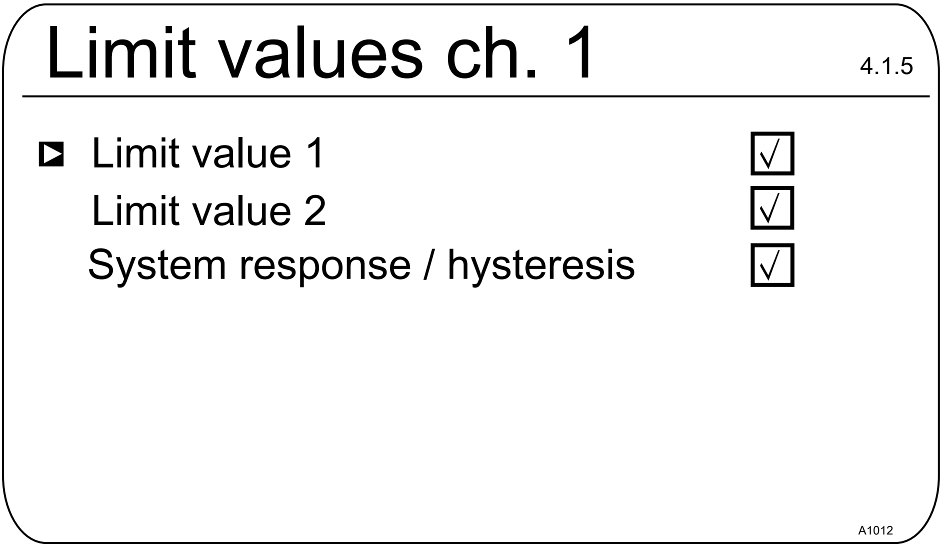


Fig. 86: Setting Limit value channel 1

11.2.1 Setting [Limit 1]

Continuous display ➨ MENU ➨ ▲ or ▼ *[Limit values]* ➨ OK *[Limit values]* ➨ ▲ or ▼ *[Limit value channel 1]* ➨ OK *[Limit ch. 1]* ➨ ▲ or ▼ *[Limit ch. 1]* ➨ OK *[Limit 1]*

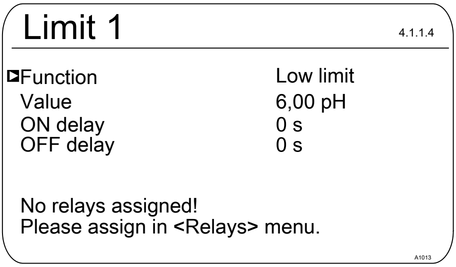


Fig. 87: Setting Limit 1

11.2.2 Setting [Limit 2]

Continuous display ➨ MENU ➨ ▲ or ▼ *[Limit values]* ➨ OK *[Limit values]* ➨ ▲ or ▼ *[Limit value channel 1]* ➨ OK *[Limit value channel 1]* ➨ ▲ or ▼ *[Limit 2]* ➨ OK *[Limit 2]*

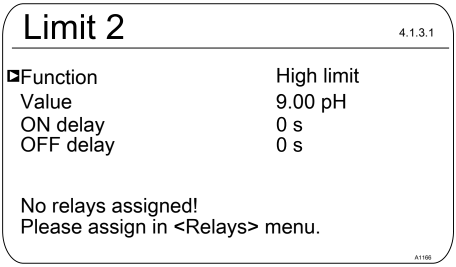


Fig. 88: Setting [Limit 2]

11.2.3 Setting [System response]

Continuous display ➨ MENU ➨ ▲ or ▼ *[Limit values]* ➨ OK *[Limit values]* ➨ ▲ or ▼ *[Limit value channel 1]* ➨ OK *[Limit value channel 1]* ➨ ▲ or ▼ *[System response]* ➨ OK *[System response]*

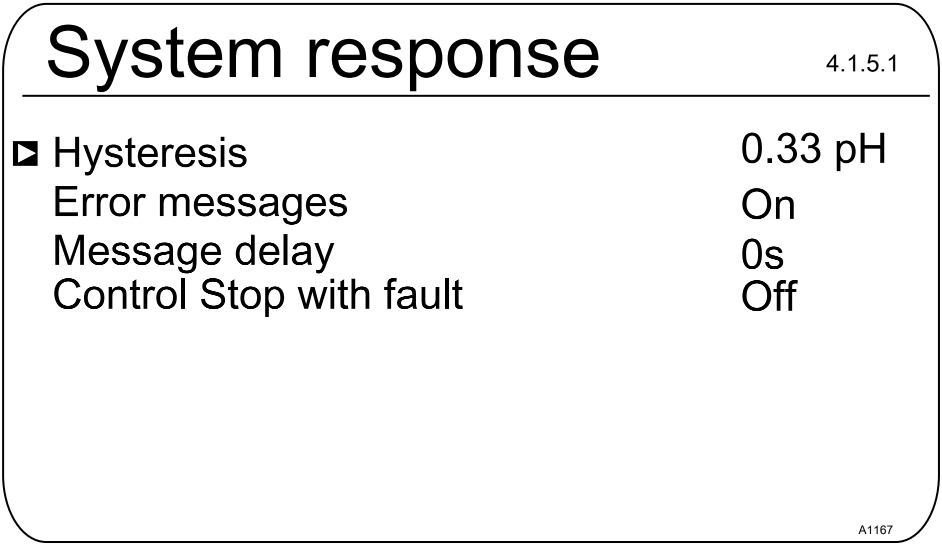


Fig. 89: Setting [System response]

12 Setting the [Pumps]

- **User qualification:** trained user, see *Chapter 4.4 'Users' qualifications' on page 21*

Continuous display ➨ MENU ➨ ▲ or ▼ *[Pumps]* ➨ OK *[Pumps]*

> ***Settings for [Channel 2]***
>
> *In its 2-channel version, the controller has two measurement channels. This description for [Channel 1] applies correspondingly for the settings in [Channel 2]. The procedure for making the settings for the channel in question is identical, however the parameters to be set may be different. Differences are pointed out and are also described.*

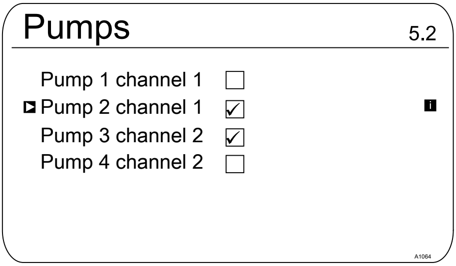


Fig. 90: Setting the [Pumps]

> ***Setting [Pump 1] or [Pump 2]***
>
> *Only the process for[Pump 1] is described. The set-up process for [Pump 2], [Pump 3] or [Pump 4] is the same as for [Pump 1].*

12.1 Setting [Pump 1]

> **CAUTION!**
>
> **Refer to the operating manual for the pump**
>
> Possibility of damaging the pump.
> Faults in the process.
>
> – Set the pump to *[External Contact]* operating status
> – Observe the maximum stroke rate for the pump
> – Switch off any stored stroke settings in the pump control
> – The maximum stroke rate for the pump can be found in the pump operating manual
>   – Setting a stroke rate on the controller, which is higher than the pump's actual possible maximum stroke rate, can lead to hazardous operating statuses

> ***Maximum pump frequency***
>
> *The pumps are activated according to the control variable up to the pump's respective maximum stroke rate.*

Continuous display ➡ MENU ➡ ▲ or ▼ *[Pumps]* ➡ OK *[Pumps]* ➡ ▲ or ▼ *[Pump 1 channel 1]* ➡ OK

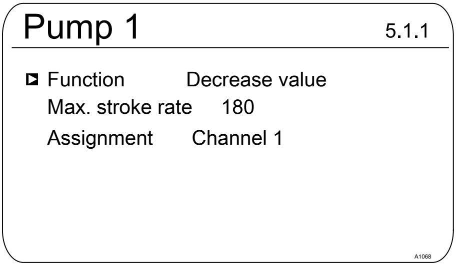


Fig. 91: Setting [Pump 1]

- Use the ▲ or ▼ keys to select the menu and confirm with OK
  - ⇨ The relevant setting menu appears.

Parameter	Settable function
[Function]	Set the pump to: ■ *[Increase value]* ■ *[Decrease value]* ■ *[Off]*
[Max. stroke rate]	The maximum stroke rate can be set freely between 0 ... 500 /min. The factory setting is 180/min
[Assignment]	Assign the pump to the relevant measuring channel: ■ Channel 1: Pump 1 and pump 2 ■ Channel 2: Pump 3 and pump 4

13 Setting the [Relays]

- **User qualification:** trained user, see *Chapter 4.4 'Users' qualifications' on page 21*

Continuous display ➨ MENU ➨ ▲ or ▼ *[Relays]* ➨ OK *[Relays]*

> ***Settings for [Channel 2]***
>
> *In its 2-channel version, the controller has two measurement channels. This description for [Channel 1] applies correspondingly for the settings in [Channel 2]. The procedure for making the settings for the channel in question is identical, however the parameters to be set may be different. Differences are pointed out and are also described.*

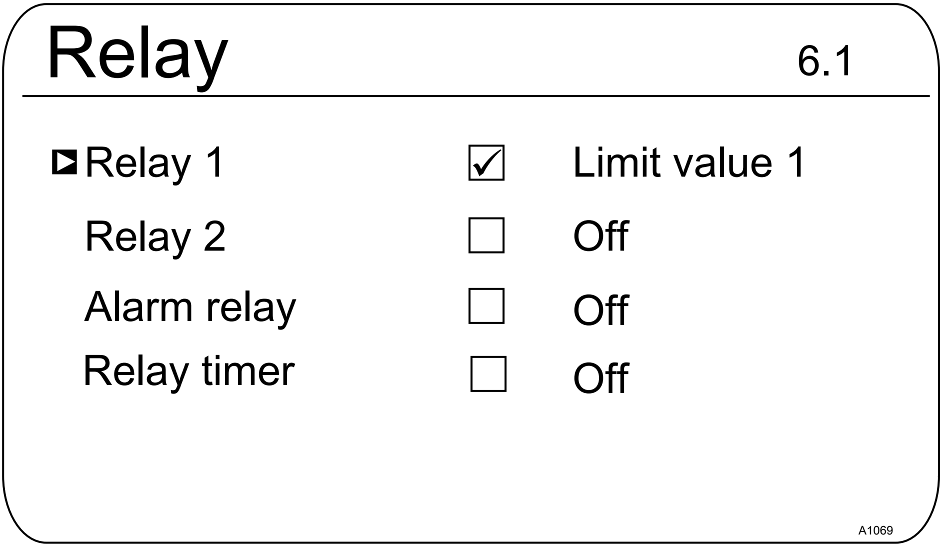


Fig. 92: Setting the [Relays]

> ***Setting [Relay 1], [Relay 2], [Alarm relay] or [Relay timer]***
>
> *Only the process for [Relay 1] is described. The setting process for [Relay 2], the [Relay timer] or the [Alarm relay] is the same as when setting [Relay 1].*

13.1 Setting Relay 1

Continuous display ➨ MENU ➨ ▲ or ▼ *[Relays]* ➨ OK *[Relays]* ➨ ▲ or ▼ *[Relay 1]* ➨ OK

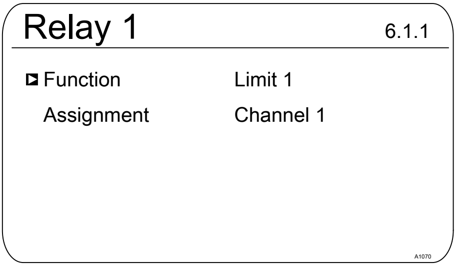


Fig. 93: Setting Relay 1

- Use the ▲ or ▼ keys to select the respective menu and confirm with OK
  - ⇨ The relevant setting menu appears.

Settable parameters of Relay 1 and Relay 2

Parameter	Settable function
[Function]	Set relay as: ■ *[Off]* ■ *[Limit value 1]* ■ *[Limit value 2]* ■ *[Limit value 1 <Control variable>]* ■ *[Limit value 2 <Control variable>]* ■ *[Cycle]* ■ *[Pulse length (PWM)]*
[Assignment]	Assign the relay to the relevant measuring channel: ■ *[Channel 1]* ■ *[Channel 2]* ■ *[Channel 3]* ■ *[channel 1+2]* ■ *[Channel 1+2+difference]*

Settable alarm relay parameters

Parameter	Settable function
[Function]	Set relay as: ■ *[Off]* ■ *[Alarm]* ■ *[Limit value 1]* ■ *[Limit value 2]* ■ *[Limit value 1+2]* ■ *[Pause]*

> ***Changeable scope of the menus***
>
> *The number of adjustable parameters may differ depending on the type and scope of the [Function]. The controller provides you with the possible, adjustable parameters. Use the ▲ or ▼ keys to select them and confirm with OK. The possible adjustment ranges are specified by the controller.*

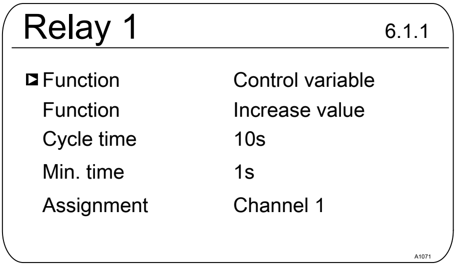


Fig. 94: Possible adjustable parameters with [Function] include, for example, [Control variable]

13.1.1 Function description [Off]

If the setting is *[Off]*, the relay does not accept any functions or allow any actions.

13.1.2 Functional description of *[Relay timer]*

The *[Relay timer]* is a real-time timer based on relay 2. The *[Relay timer]* enables you to perform recurring weekday and time-dependent metering processes.

13.1.3 Function description [Limit 1] or [Limit 2]

[Relay 1] and/or *[Relay 2]* can be operated as limit value relays. The limit values can be set in the menu ↳ *Chapter 11 'Setting the [Limit values]' on page 120*.

> ***Limit value relay used as an actuator***
>
> *Extended functions*
>
> – *The limit value relays can also be defined in such a way that they react like an actuator. If, for example, a limit value relay is activated, then it is deactivated if the pause contact is closed and for a subsequent delay period t_d (if t_d > 0 min is set).*

13.1.4 Functional description of *[Limit value 1/2 (control variable)]*

With the *[Limit value 1/2 (control variable)]* setting, the limit value relay reacts to faults and to Pause like an actuator

13.1.5 Function description of *[Cycle]*

With the *[Cycle]* setting, the assigned relays are activated cyclically independently of the time. The Cycle timer can, for example, be used with shock metering, if the timing of the metering does not matter. Use what is known as the *[Relay timer]* if it is important to perform metering at a specific time.

CAUTION!

The *[Cycle]* is reset when there is no supply voltage

Possible consequence: slight or minor injuries. Material damage.

– Configure the power supply so that it cannot be interrupted
– With critical processes, practically address the possible failure of the timer when designing your application

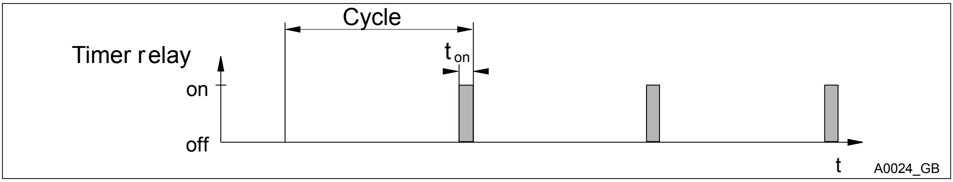


Fig. 95: Timer relay

At the end of the (Timer) cycle time, the controller closes the assigned timer relay for a period of *[t on]*. *[Pause]* interrupts the timer. If the clock is visible in the LCD display, then the OK key can be used to reset the *[Cycle]* to the beginning of the cycle. The % figure in the LCD display indicates the remaining runtime.

13.1.6 Functional description of *[Pulse length (PWM)]*

If the output relays are configured as *[Pulse length (PWM)]*, then these output relays emit the pulse length determined by the controller, to control an actuator (e.g. motor-driven metering pump, solenoid valve).

14 Setting [Digital inputs]

- **User qualification:** trained user, see ↳ *Chapter 4.4 'Users' qualifications' on page 21*

Continuous display ➨ MENU ➨ ▲ or ▼ *[Digital inputs]* ➨ OK *[Digital inputs]*

> *Settings for [Channel 2]*
>
> *In its 2-channel version, the controller has two measurement channels. This description for [Channel 1] applies correspondingly for the settings in [Channel 2]. The procedure for making the settings for the channel in question is identical, however the parameters to be set may be different. Differences are pointed out and are also described.*

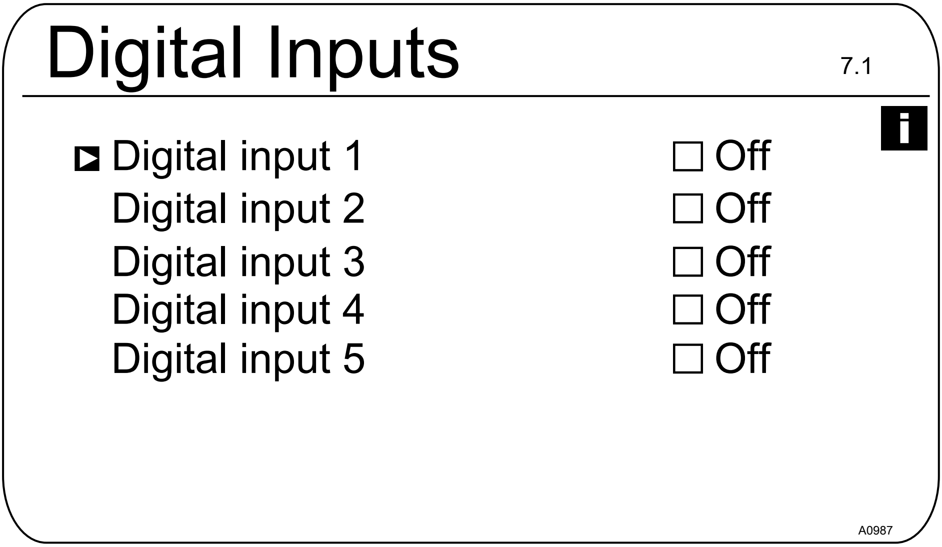


Fig. 96: Setting digital inputs [Dig. inputs]

14.1 Setting [Digital input 1]

Continuous display ➨ MENU ➨ ▲ or ▼ *[Digital inputs]* ➨ OK *[Digital Inputs]* ➨ ▲ or ▼ *[Digital input 1]* OK

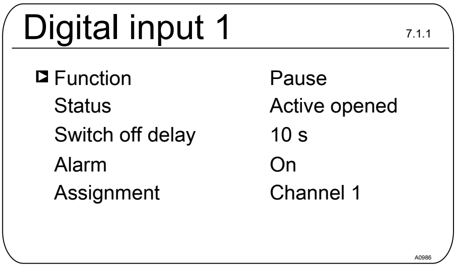


Fig. 97: Setting [Digital input 1]

Pause

Parameter	Adjustment range
Function	Pause / Off / Pause Hold
Status	Active opened / Active closed
Switch off delay	0 ... 1800 s
Alarm	On/Off
Assignment	Channel 1, channel 1+2

Setting [Digital input 2]

Sample water fault

Parameter	Adjustment range
Function	Off / Sample water fault
Status	Active open / Active closed
Switch off delay	0 ... 1800 s
Assignment	Channel 1, channel 1+2

Setting [Digital input 3]

Level of storage tank 1

Parameter	Adjustment range
Function	Off / Pause Hold / Pause / Level of storage tank 1
Status	Active open / Active closed
Switch off delay	0 ... 1800 s
Assignment	Channel 1

Setting [Digital input 4]

Level of storage tank 2

Parameter	Adjustment range
Function	Off / Sample water fault / Level of storage tank 2
Status	Active open / Active closed
Switch off delay	0 ... 1800 s
Assignment	Channel 1

Setting [Digital input 5]

Level of storage tank 3

Parameter	Adjustment range
Function	Off / Level of storage tank 3
Status	Active open / Active closed
Switch off delay	0 ... 1800 s
Assignment	Channel 1

15 Setting the *[mA outputs]*

- **User qualification:** trained user, *Chapter 4.4 'Users' qualifications' on page 21*

Continuous display ➨ MENU ➨ ▲ or ▼ *[mA outputs]* ➨ OK *[mA outputs]*

Settings for [Channel 2]

The 1-channel version of the controller has two mA outputs and the 2-channel version has three mA outputs. These descriptions of [Channel 1] correspondingly apply to the setting of [Channel 2] and [Channel 3]. The procedure for setting the respective mA output channels is identical, however the parameters to be set may differ. Your attention is drawn to the differences, which are also described.

CAUTION!

Destruction of the monitors

Only passive monitors should be connected to the mA outputs. For example, if the mA outputs are connected to a PLC Programmable Logic Controller, then a 4-wire connection type has to be selected on the PLC. The 2-wire connection type can result in incorrect operation and, possibly, the destruction of the monitors.

In its basic version, the controller has two active mA outputs, meaning that the mA outputs actively supply an output current, without an external supply voltage being provided. The mA outputs are galvanically isolated.

Response with *[Pause Hold]*: *[Pause Hold]* determines the response of the mA outputs if *[Pause Hold]* is active.

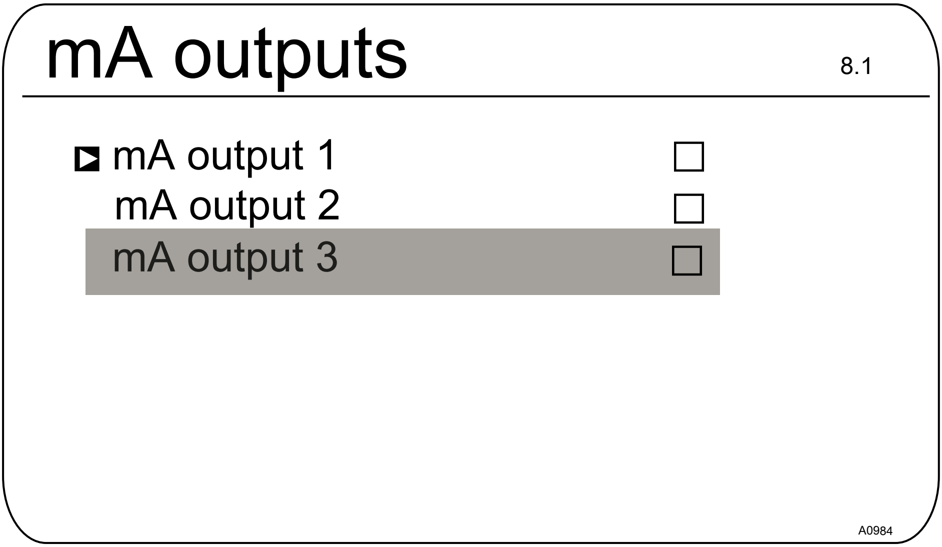


Fig. 98: Setting the [mA outputs] / [mA output 3] as an option on the extension module

15.1 Setting the *[mA outputs]*

Continuous display ➨ MENU ➨ ▲ or ▼ *[mA outputs]* ➨ OK *[mA outputs]* ➨ ▲ or ▼ *[mA output 1]* OK *[Function]* OK Set function

> ***mA output 2 / mA output 3***
>
> *Menu items [mA output 2] and [mA output 3] have the same setting options as menu item [mA output 1]. A separate description is not provided. [mA output 3] is located on the extension module and is only available if packages 2, 3 or 4 have been selected with channel 2 in the identity code.*

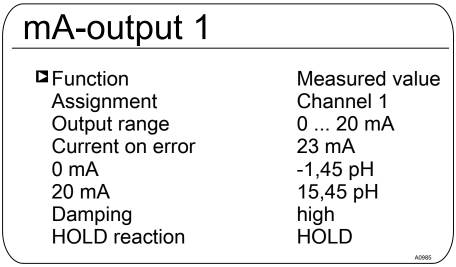


Fig. 99: Setting [mA output 1]

[Func- tion]	Adjustable value	Explanation
[Function]	*[Off]*	The mA output has no function
	[Measured value]	
	[Control variable]	
	[Correction value]	Temperature

The mA output is held at the valid mA output value upstream of *[Pause Hold]*.

The following adjustable parameters are available when selecting the *[Measured value]*, *[Control variable]* and *[Correction value]* functions:

[Function]	Adjustable value	Adjustable ranges or counter values
[Measured value] *[Control variable]* *[Correction value]*	*[Output range]*	0 ... 20 mA Assignment to the required measuring range start and end value.
		4 ... 20 mA Assignment to the required measuring range start and end value.
	[Error current]	*[Off]*
		23 mA
	[0 mA]	- 100 % ... 100 %
	[20 mA]	- 100 % ... 100 %
	[Filtering]	*[high]*
		[medium]
		[weak]
	[Response with Pause Hold]	*[None]* The mA output changes with the measured value
		[Fixed] The mA output is set to a fixed mA output value, which is always issued at *[Pause Hold]*
		[Hold]

16 Function: Data logger

Data backup / limited service life

There is a possibility of loss of data with all types of data storage. Data loss can be caused by damage to hardware, software, or unauthorised access etc. The operator of the device is responsible for backing up data, which is recorded by a data logger. This has to be done in accordance with the national and international requirements, regulations and norms applicable to the operator of the device. Define and document this data backup in a backup or recovery plan.

The manufacturer of the device is not responsible for backup or recovery of data.

SD cards have only a limited service life. This service life is based, for example, on the general ageing of the SD card and due to the memory type (Flash Memory) from the fundamentally limited number of write processes. Bear this in mind with your data backup strategy and ensure that you regularly use your SD card.

Access flap to SD card slot

Always keep the access flap to the SD card slot closed during operation. If the access flap is open, extraneous matter, like dust and moisture, can enter and cause damage to the controller.

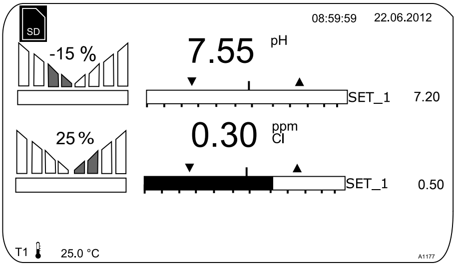


Fig. 100: Display showing symbol for the presence of an SD card (top right)

16.1 Activating, reading and deleting log books

The controller supports the following log books by default:

- Calibration log book
- Error log book

The data log book (optional)

The data log book is an optional feature. This option is currently supplied as an industrial 512MB SD card. Unlike *'consumer'* cards, industrial SD cards have an operating temperature of up to 85 °C and the data is filed twice in the SD card's memory for security reasons. The SD card provided has a recording capacity of around 20 years based on a recording interval of 10 seconds. SD cards with a capacity of up to 32 GB can be used and can therefore record approximately 1,280 years.

If the SD card is in the controller, this is displayed on the display in the top-left corner by the *[SD]* symbol. If the SD card is 80% full, then this level also appears on the screen as *[80% full]*. If the SD card is full, then the data is stored in the controller's internal memory. If this internal memory is full, then the oldest data is overwritten.

16.2 Configuring log books

- **User qualification:** instructed user, see *Chapter 4.4 'Users' qualifications' on page 21*

Continuous display ➨ [MENU] ➨ ▲ or ▼ *[Diagnostics]* ➨ [OK] *[Diagnostics]*

It is possible to look through log books, perform a simulation of outputs or view device information in this menu.

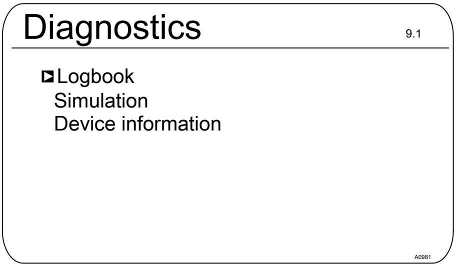


Fig. 101: [Diagnostics] > [Log books]

The calibration log book stores all calibrations of measured variables with a time stamp.

1. Press [MENU] in the continuous display
2. Use the arrow keys to select *[Diagnostics]*
3. Press [OK]
4. Use the arrow keys to select *[Log books]*
5. Press [OK]
6. Use the arrow keys to select *[Calibration log book]*
7. Press [OK]

16.2.1 Using the *[calibration log book]*

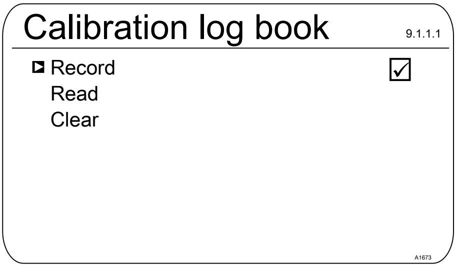


Fig. 102: Using the [calibration log book]

1. Use the arrow keys to move the cursor to *[Record]*
2. Press OK
   ⇨ The activation symbol (tick) appears in the selection boxes. Now all calibrations performed are recorded.

Reading calibrations

3. Use the arrow keys to move the cursor to *[Read]*
4. Press OK
   ⇨ This automatically removes the activation symbol. If you wish to record further calibrations after *[Reading]*, then it is necessary to reactivate the *[Calibration log book]*. The tick re-appears.

Deleting the *[calibration log book]*

5. Use the arrow keys to move the cursor to *[Delete]*
6. Press OK
   ⇨ This will irrevocably delete the calibration log book file on the SD card.

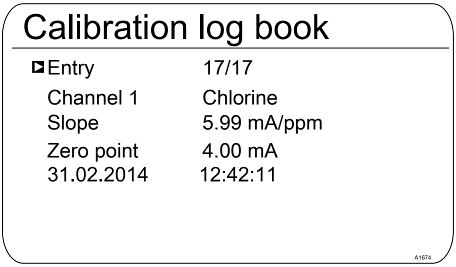


Fig. 103: Reading the [calibration log book]

Use the arrow keys to browse through the entries in the calibration log book. Press ESC to return to the continuous display.

16.2.2 Using the *[error log book]*

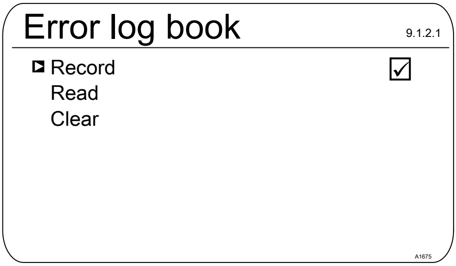


Fig. 104: Using the [error log book]

1. Use the arrow keys to select *[Error log book]*
2. Press OK
3. Use the arrow keys to move the cursor to *[Record]*
4. Press OK
   ⇨ The activation symbol (tick) appears in the selection boxes. Now all warnings and error messages are recorded.

Reading messages

5. Use the arrow keys to move the cursor to *[Read]*
6. Press OK
   ⇨ This automatically removes the activation symbol. If you wish to record further errors after *[Reading]*, then it is necessary to reactivate the *[Error log book]*. The tick reappears.

Deleting the *[error log book]*

7. Use the arrow keys to move the cursor to *[Delete]*
8. Press OK
   ⇨ This will irrevocably delete the error log book file on the SD card.

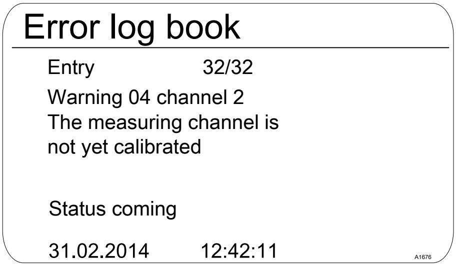


Fig. 105: Reading the [Error log book]

Use the arrow keys to browse through the entries in the error log book. Press ESC to return to the continuous display.

16.2.3 Using the *[Data log book]* (optional)

> ***The statuses of the digital inputs***
>
> *The [Data log book] saves all measured values, correction variables, control variables and the status of the digital inputs.*

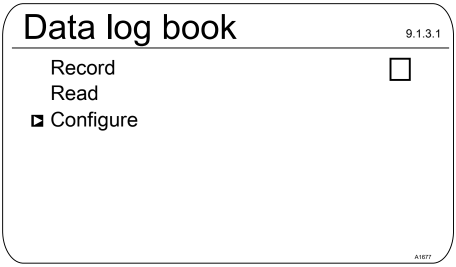


Fig. 106: Configuring the [Data log book]

First configure the *[Data log book]* before you activate it. You can select which data is to be recorded. All data is selected by default. You can specify at what interval the data is to be saved. For example, if one file is to be created each per day, from 00.00 to 24.00. Then the file name is = YYMMDD.CSV. You can also record an endless file and give it a random name. Data is always saved in CSV format. CSV stands for *C*omma-*s*eparated *v*alues. This format can be, for example, read and edited with MS Excel.

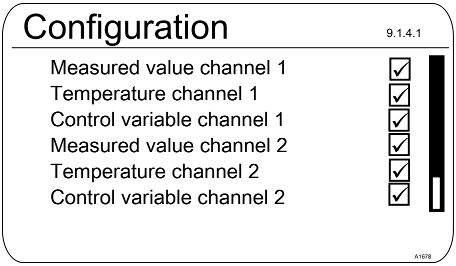


Fig. 107: [Configuration] of the data log book

[Configuration] of the data log book

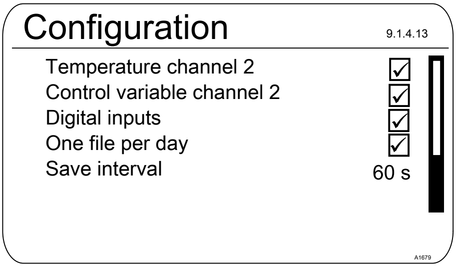


Fig. 108: [One file per day] checked

If you uncheck *[One file per day]*, then a new input option appears: *[File name]*.

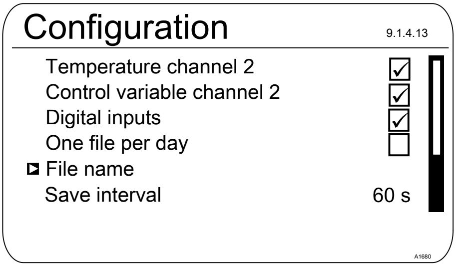


Fig. 109: [One file per day] unchecked

1. If you wish to specify a file name, then place the cursor on *[File name]* and press OK

   ⇨ *[New]* appears.

2. Place the cursor on *[New]* and press OK

   ⇨ You can now enter a random name with a maximum of 8 digits name as well as the proposed *[DATALOG0.CSV]* and/or set from 0 to 1 ... n.

> *The maximum file size is 2 GB*
>
> *The maximum file size is 2 GB. The SD card needs to be the same size.*

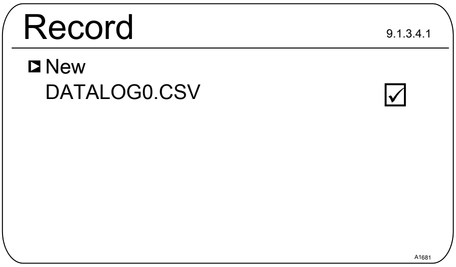


Fig. 110: Check the file to write it to an existing file, here [DATALOG0.CSV]

3. If you wish to attached measured data to an existing file, then check this file and the data will be written to this file

If the SD card is removed, then data can be recorded for a maximum of 24 hours in the controller's internal memory with a storage interval of 10 seconds. Around six times as long with an interval of 60 seconds. When the SD card is re-inserted into the controller, then the data from the internal memory is backed up to the SD card. This can take up to 20 minutes if 24 hours of data has been recorded. The green LED on the SD card reader flashes red/orange during this time.

17 *[Diagnostics]*

- **User qualification:** instructed user, see ➪ *Chapter 4.4 ‘Users' qualifications’ on page 21*

Continuous display ➨ MENU ➨ ▲ or ▼ *[Diagnostics]* ➨ OK *[Diagnostics]*

It is possible to look through log books, perform a simulation of outputs or view device information in this menu.

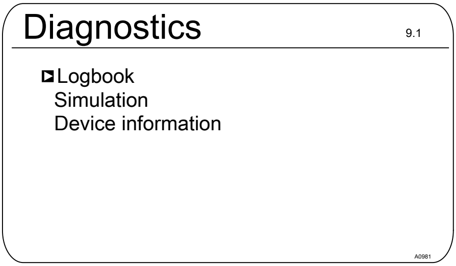


Fig. 111: Diagnostics

17.1 Displaying *[logbooks]*

Continuous display ➨ MENU ➨ ▲ or ▼ *[Diagnostics]* ➨ OK *[Diagnostics]* ➨ ▲ or ▼ *[Calibration log book]* OK *[Calibration log book]*

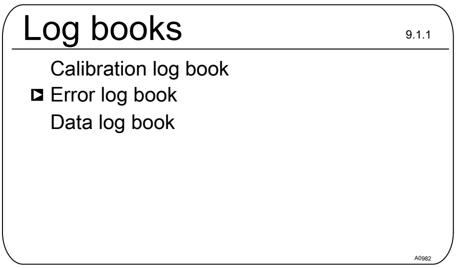


Fig. 112: Displaying [Log books]

17.1.1 Displaying the *[Calibration Log Book]*

The data on the sensor calibrations successfully completed are stored in the internal *[Calibration log book]*. Up to 30 calibrations can be stored. Thereafter the oldest entry is overwritten with the most recent entry.

The following data is stored:

- Name of the measuring channel
- Measured variable
- Time of calibration
- Zero point
- Slope

Deleting entries in the*[Calibration log book]*

You can also delete entries in the Calibration log book. Deleting the entries does not affect the calibrations stored in the controller.

17.1.2 Reading the *[Error Log Book]*

The error message data is stored in the *[Error log book]*. Up to 30 error messages can be stored. Thereafter the oldest entry is overwritten with the most recent entry.

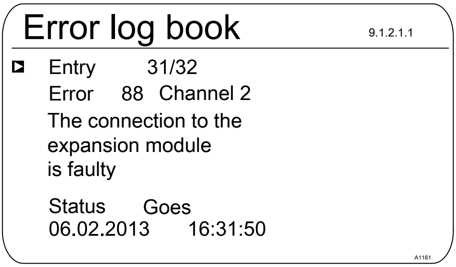


Fig. 113: [Error log book]

Deleting entries in the *[Error log book]*

You can also delete entries in the Error log book. Deleting the entries does not affect the errors stored in the controller.

17.2 Displaying *[simulation]*

Continuous display ➨ MENU ➨ ▲ or ▼ *[Diagnostics]* ➨ OK *[Diagnostics]* ➨ ▲ or ▼ *[Simulation]* OK *[Simulation]*

> **⚠ WARNING!**
>
> **Uncontrolled response**
>
> Cause: A controller operates uncontrolled in *[Simulation]* mode under full load and thus so do the connected actuators.
>
> Possible consequence: Fatal or very serious injuries
>
> Measure: Never leave a controller and its installed functional modules unsupervised if the simulation function is active.

The *[Simulation]* menu item enables you to activate all outputs for test purposes during commissioning. A simulated output remains activated until you quite the *[Simulation]* menu item. It is also possible to prime a peristaltic pump, for example, with *[Simulation]* mode. A

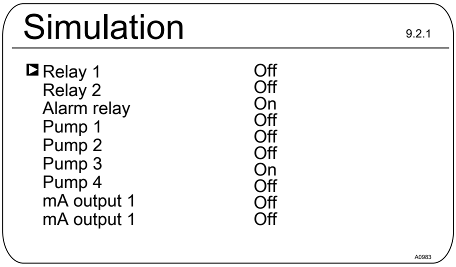


Fig. 114: Displaying simulation

17.3 Displaying *[Device Information]*

Continuous display ➨ MENU ➨ ▲ or ▼ *[Diagnostics]* ➨ OK *[Diagnostics]* ➨ ▲ or ▼ *[Device information]* OK *[Device information]*

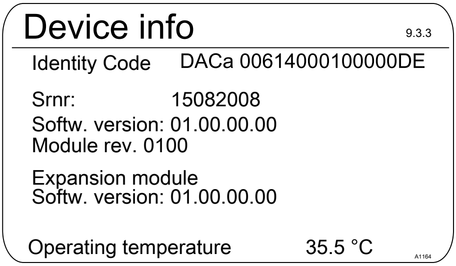


Fig. 115: Device Information

17.4 Error messages and warning alerts

Error messages

Error	Error message text	Cause	Remedy
88	The connection to the extension module is faulty	The connection cable has slipped out of the socket	Check the connection cable and tighten
		Connection problems between the main and extension unit	Return to the factory for checking
01	The mV input voltage is too low	Coaxial cable connection disconnected	Check that the coaxial cable connection is fitted correctly and re-connect
			Check the coaxial cable connection for corrosion and moisture and replace with a new cable, if necessary
		pH/ORP sensor is faulty	Replace the sensor
02	The mV input voltage is too high	The connected signal does not come from a pH sensor An interference signal is being picked up	Check the origin of the sensor signal. Check the raw signal by pressing ▷. The sensor raw value is shown here in mV. If the value with pH is greater than ± 500 mV or with ORP is greater ± 1500 mV, then these are wrong sensor values. Check once again the cabling and origin of the sensor signal. Ensure that the measuring lines are not laid parallel to power cables.
03	The temperature is too low	Incorrect sensor connected	Check the type of sensor connected. Only Pt 100 and Pt 1000 sensors work
04	The temperature is too high	No sensor or incorrect sensor connected	Check the sensor connection
			Check the type of sensor connected. Only Pt 100 and Pt 1000 sensors work

Error	Error message text	Cause	Remedy
05	There is a calibration error	With amperometric analysis (e.g. chlorine): the calculated reference value deviates too much from the real value or the sensor value.	With amperometric analysis (e.g. chlorine): Check the correctness of the reference method, e.g. DPD1
		With pH and ORP: the buffers used differ from the nominal value, are outdated or watered down	With pH and ORP: replace the buffer with new buffer
06	No sensor is fitted	Coaxial cable connection disconnected	Check the correct connection of the coaxial cable connection
		No sensor is connected	
07	Check the mechanical state of the sensor. Glass breakage is possible.	Membrane glass broken	Replace sensor Check the reason for the broken glass e.g. solids, too high a flow velocity
08	The checkout time was infringed	In the *[Control]* menu, the set control variable has exceeded the threshold for a longer time than the checkout time control variable	The control section needs a longer time to regulate itself than the selected checkout time.
			The control section needs a greater control variable threshold to regulate itself than the selected one.
			The metering chemical is empty or has a too low/high a concentration
			The metering line is disconnected or the point of injection blocked.
09	The mA input current is too high	The current is greater than the maximum permitted current of 23 mA	Check the origin of the current.

Error	Error message text	Cause	Remedy
			Check the raw value in mA in the Information menu by pressing ▷. If the value is >23 mA, then it is not a correct sensor signal. Replace the sensor with a new sensor.
10	The mA input current is too low	The power circuit is disconnected	Check the 2-wire connection between the sensor/transmitter and controller and check the raw value in mA by pressing ▷. If the value is 0 mA, then the connection is disconnected
11	After elapse of the delay period, a limit value error still exists.	The measured value lies above the limit value for a period longer than the set delay period	Check whether the choice of the limit value matches the application and adjust the limit value if necessary.
			Check whether the choice of the delay period matches the application and adjust the delay period if necessary.
			Check the design of the actuator. Is the actuator selected too large?
			Check the concentration of the metering chemical – is the concentration too high?
			Check the control parameters. Does the control tend to over/undershoot?
12	There is a sample water fault e.g. no flow	The in-line probe housing's sample water limit contact e.g. DGMa was triggered by the float dropping.	Check the routing of the sample water line
			Check the sample water discharge point. Is it blocked?
			Check if a sample water filter is fitted and clean it if necessary

Error	Error message text	Cause	Remedy
13	The controller is in *'Pause'* mode	The Pause input (digital input) was activated externally	Check whether the Pause signal received matches the system's expected operating mode. Check whether the *'NO/NC'* actuating direction matches the choice in the controller.
14	The controller is in *'Pause (Hold)'* mode	The Pause input (digital input) was activated externally	Check whether the Pause signal received matches the system's expected operating mode. Check whether the *'NO/NC'* actuating direction matches the choice in the controller.
15	The mA input supply is over-loaded	The sensor input of channel 1 or 2 is used in 2-wire connection mode, e.g. together with chlorine sensor CLE3. The polarity was not noted or there is a short circuit between the two poles.	Check the polarity against the terminal diagram. Make sure that the two wires do not touch (shorten the bared length, use insulated end sleeves, use heat-shrink tubing)
16	The mA input is overloaded	The sensor input of channel 1 or 2 is used in 2-wire connection mode, but the signal is an active signal carrying voltage.	Use a multimeter to check the measuring signal. If it is an active / driven signal (voltage is measurable), then the type of connection has to be selected for active signals, refer to the terminal diagram in the operating instructions. This type of connection is not shown on the enclosed ter-minal assignment diagram.
17	The level in the storage tank 1 is too low	The chemical in storage tank 1 is used up	Add the corresponding chem-ical

Error	Error message text	Cause	Remedy
18	The level in storage tank 2 is too low	The chemical in storage tank 2 is used up	Add the corresponding chemical
19	The level in storage tank 3 is too low	The chemical in storage tank 3 is used up	Add the corresponding chemical
99	There is a system error	System components have failed	Return the controller to the manufacturer for inspection

Warning alerts

Warnin g	Warning alert text	Cause	Remedy
01	The limit value was undershot	The measured value is below the limit value	Check whether the choice of the limit value matches the application and adjust if necessary.
			Check the design of the actuator: has too small an actuator been selected?
			Check the concentration of the feed chemical: is the concentration too low?
			Check the control parameters: does the control tend to over/ undershoot?
02	The limit value was exceeded	The measured value is above the limit value	Check whether the choice of the limit value matches the application and adjust if necessary.
			Check the design of the actuator: has too large an actuator been selected?
			Check the concentration of the metering chemical – is the concentration too high?
			Check the control parameters: does the control tend to over/ undershoot?
03	The wash timer has timed out. Maintenance is necessary	The wash timer activates a relay. The sensor is cleaned with cleaning fluid. A visual check may be necessary as per your maintenance schedule	Clean and check the sensor.

Warnin g	Warning alert text	Cause	Remedy
04	The measuring channel is not yet calibrated	The sensor connected to a measuring channel has not yet been cali- brated	Calibrate the sensor
71	The battery needs to be replaced	The battery has a service life of about 10 years, but this can be reduced by environ- mental factors	Replace the battery or inform Service Battery BR 2032, Part No. 732829
72	Check the time	The time has changed when replacing the bat- tery	Reset the time
73	The fan has a fault	The internal fan is no longer rotating	Please check to see whether an object has become trapped in the impeller otherwise return the controller to the manufac- turer for inspection
89	System warning 1	There is a system error	Return the controller to the manufacturer for inspection

17.5 Help texts

Content of the help texts	Cause	Remedy
The DPD value is too small, DPD value > MRS + 2 %	If the calculated reference value (e.g. DPD1) for calibrating a sensor is less than 2 % of the measuring range, then calibration is not possible.	Increase the concentration of the chemical to be measured in the process/ sample water and determine the reference value again (e.g. DPD1) after the run-in period.
The slope is too shallow, < 20 % of the MR	The sensor can no longer detect the chemicals to be measured	Replace the membrane cap and replace the electrolyte for new material
The slope is too steep, > 300 % of the MR	The sensor has been permanently affected by for example surface-active substances (surfactants).	Make sure that none of these substances are present in the water. Replace the membrane cap and replace the electrolyte for new material
The zero point is too low, < 3.2 mA	The sensor delivers a measured signal that is less than 3.2 mA. This value is outside of the specification.	Check the raw value in mA in the Information menu, by pressing ▷ in the main display. If the value is < 3.2 mA, then this is not the correct sensor signal. Check the cabling and replace the sensor with a new sensor.
The zero point is too high, > 5 mA	You would like to calibrate the zero point but the sensor is still detecting the chemical to be measured	Rinse the sensor with water containing no chemicals that are to be measured before zero point calibration. The water with which the zero point is determined should also not contain traces of this chemical. Use mineral water without carbon dioxide for this purpose.

Content of the help texts	Cause	Remedy
An unknown calibration error		
In the residual period parameter set 1 is used	If parameter set 2 is not active, then parameter set 1 is activated	Check the control signals/ lines that switch the parameter set or check the timer settings.

18 *[Service]*

- **User qualification:** instructed user, see ➨ *Chapter 4.4 ‘Users' qualifications’ on page 21*

Continuous display ➨ MENU ➨ ▲ or ▼ *[Service]* ➨ OK *[Service]*

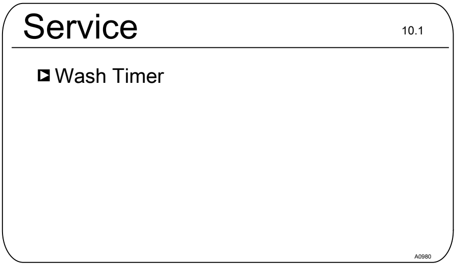


Fig. 116: [Service]

18.1 Setting the *[Wash Timer]*

Continuous display ➨ MENU ➨ ▲ or ▼ *[Service]* ➨ OK *[Service]* ➨ ▲ or ▼ *[Wash timer]* OK *[Simulation]*

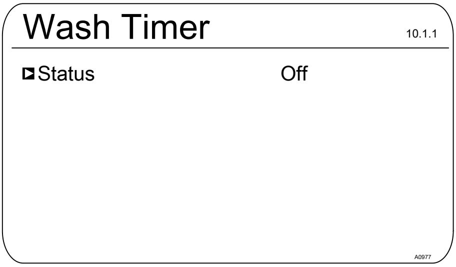


Fig. 117: [Wash Timer]

The *[status]* of the *[wash timer]* can be adjusted. Here the *[status]* *[On]* or *[Off]* is possible.

The setting is for *[Timer 1]* and *[Timer 2]* is possible.

19 Setting *[Device setup]*

- **User qualification:** instructed user, see ➪ *Chapter 4.4 'Users' qualifications' on page 21*

Continuous display ➨ MENU ➨ ▲ or ▼ *[Setup]* ➨ OK *[Device setup]*

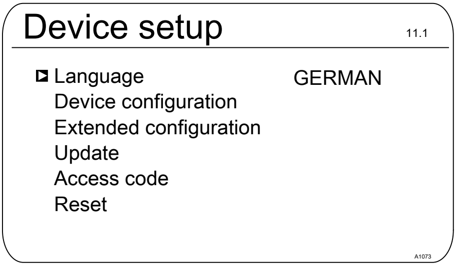


Fig. 118: Setting [Device setup]

19.1 Setting the [Language]

Continuous display ➨ MENU ➨ ▲ or ▼ *[Setup]* ➨ OK *[Device setup]* ➨ ▲ or ▼ *[Language]* ➨ OK *[Language selection]*

Available languages for output in the controller display*		
German	Greek	Romanian
Arabic	Hebrew	Russian
Bulgarian	Italian	Swedish
Chinese	Japanese	Slovakian
Danish	Korean	Thai
English_GB	Dutch	Czech
English_US	Norwegian	Turkish
Finnish	Polish	Hungarian
French	Portuguese	
* Additional languages are planned.		

19.2 Setting *[Device configuration]*

Continuous display ➨ MENU ➨ ▲ or ▼ *[Setup]* ➨ OK *[Device setup]* ➨ ▲ or ▼ *[Device configuration]* ➨ OK *[Device conf.]*

Device configuration	Range
[Time]	00:00 - 23:59
[Time mode]	24 h / 12 h
[Date]	All available values possible.
[Date mode]	DD.MM.YYYY / MM.DD.YYYY
[Temperature unit]	°C / °F
[Concentration in]	ppm / mg/l / mg/L
[Display refresh]	stable / medium / fast
[Contrast]	0 ... 127
[Backlight]	0 ... 100 %

19.3 Setting the [Extended configuration]

Continuous display ➨ MENU ➨ ▲ or ▼ *[Setup]* ➨ OK *[Device setup]* ➨ ▲ or ▼ *[Extended configuration]* ➨ OK *[Device conf.]*

Messages	range
SD card	

19.4 Update

Continuous display ➨ MENU ➨ ▲ or ▼ *[Setup]* ➨ f OK *[Device setup]* ➨ ▲ or ▼ *[Update]* ➨ OK *[Update]*

A software update may be necessary if:

- New functions or new operating languages are available and the software is to be upgraded with them
- A software modification is necessary. In this case you will be informed by ProMinent or its plant engineer / dealer about it.

A software update does not change the current device settings.

The following are required for a software update:

- A PC with internet access, so that you can download the necessary software
- A PC with an SD card reader
- An SD memory card, maximum size 16 GB, for software transfer

You can download the latest software from the link on the ProMinent homepage:

http://www.prominent.de/desktopdefault.aspx/tabid-12145/1485_read-67006/, the *[Firmware DACa]* can be found under the link Info/Downloads. ➢ Create a directory called `Update` on the memory card.

Under the above link you will find a ZIP file containing 4 files:

- DACa_Lan.plf
- EXTa_up.mhx
- DACa_up.mhx
- info.txt

You can find out the latest software version in the file *'info.txt'*. Copy all four files into the *'Update'* directory of the SD card.

An update is carried out in 3 steps:

- Update of the main module = *[Base board]*
- Update of the expansion module = *[Ext board]*
- Update of the language file = *[Language]*

1. To do this access the following menu in the controller and carry out the following 3 steps:

   ⇨ The controller reads in the respective data, thereafter the display goes out for approximately 30 seconds and then the controller reboots. The steps must be carried out manually.

2. Main module: ➨ MENU ➨ ▲ or ▼ *[Setup]* ➨ OK *[Device setup]* ➨ ▲ or ▼ *[Update]* ➨ OK ▲ or ▼ *[Base board]* ➨ OK

   ⇨ Updating starts

3. Expansion module: ➨ MENU ➨ ▲ or ▼ *[Setup]* ➨ OK *[Device setup]* ➨ ▲ or ▼ *[Update]* ➨ OK ▲ or ▼ *[Ext board]* ➨ OK

   ⇨ Updating starts

4. Language file: ➨ MENU ➨ ▲ or ▼ *[Setup]* ➨ OK *[Device setup]* ➨ ▲ or ▼ *[Update]* ➨ OK ▲ or ▼ *[Language]* ➨ OK

⇨ Updating starts

> *You can see the latest software version of the controller upon boot-up and at the following point in the controller menu*
>
> *[Menu] ➨ [Diagnostics] ➨ [Device information].*

19.5 Setting the [Access code]

Continuous display ➨ MENU ➨ ▲ or ▼
[Setup] ➨ OK *[Device setup]* ➨ ▲ or ▼
[Access code] ➨ OK *[Access code]*

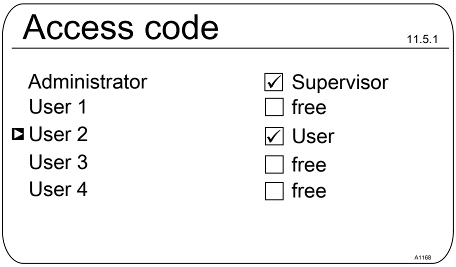


Fig. 119: Setting the [Access code]

20 Controller technical data

	Measuring range/Measured value
Measuring range connection type mV:	pH: 0.00 ... 14.00
	ORP voltage: -1500 ... +1500 mV
Connection type mA (amperometric measured variables, measuring ranges according to the sensors):	Chlorine
	Chlorine dioxide
	Chlorite
	Bromine
	Ozone
	Hydrogen peroxide (PER sensor)
	Hydrogen peroxide (PEROX sensor with transducer)
	Peracetic acid
	Dissolved oxygen
Connection type mA (potentiometric measured variables, measuring ranges according to the transmitters):	pH
	ORP voltage
	Fluoride
Conductivity (measuring ranges according to the transmitters):	via transmitter 0/4 ... 20 mA
Temperature:	via Pt 100/Pt 1000, measuring range 0 ... 150 °C

Technical Data

Description	Technical Data
pH resolution:	0.01
ORP voltage:	1 mV
Temperature:	0.1 °C
Amperometric analysis (chlorine etc.):	0.001/0.01 ppm, 0.01 Vol. %, 0.1 Vol. %
Precision:	0.3 % based on the full-scale reading
pH/ORP measuring input:	Input resistance > 0.5 x 1012 Ω
Correction variable:	Temperature via Pt 100/Pt 1000
Temperature compensation range:	0 … 100 °C
pH compensation range for chlorine:	6.5 … 8.5
Disturbance variable:	Flow via mA or frequency
Control characteristic:	P/PID control
Control:	2 bidirectional controllers
mA-output signal:	2 x 0/4 ... 20 mA electrically isolated, max. load 450 Ω, range and assignment (measured, correction, control variable) can be set
Control output:	2 x 2 pulse frequency outputs for control of metering pumps
	2 relays (limit value, 3-point step or pulse length control)
	2 x 0/4 ... 20 mA
Alarm relay:	250 V ~3 A, 700 VA type of contact: changeover contact
Electrical connection:	100 ... 240 V, 50/60 Hz, 27 W
Ambient temperature:	Ambient temperature -20 ... 60 °C (for inside installation or with a protective enclosure)
Degree of protection:	Wall mounted: IP 67

Description	Technical Data
	Control cabinet mounted: IP 54
	In accordance with NEMA 4X (air-tightness)
Tests and certifications:	CE, MET (corresponding to UL as per IEC 61010)
Material:	Housing PC with flame-proofed configuration
Dimensions:	250 x 220 x 122 mm (WxHxD)
Weight:	Net 2.1 kg

21 Spare parts and accessories

21.1 Spare parts

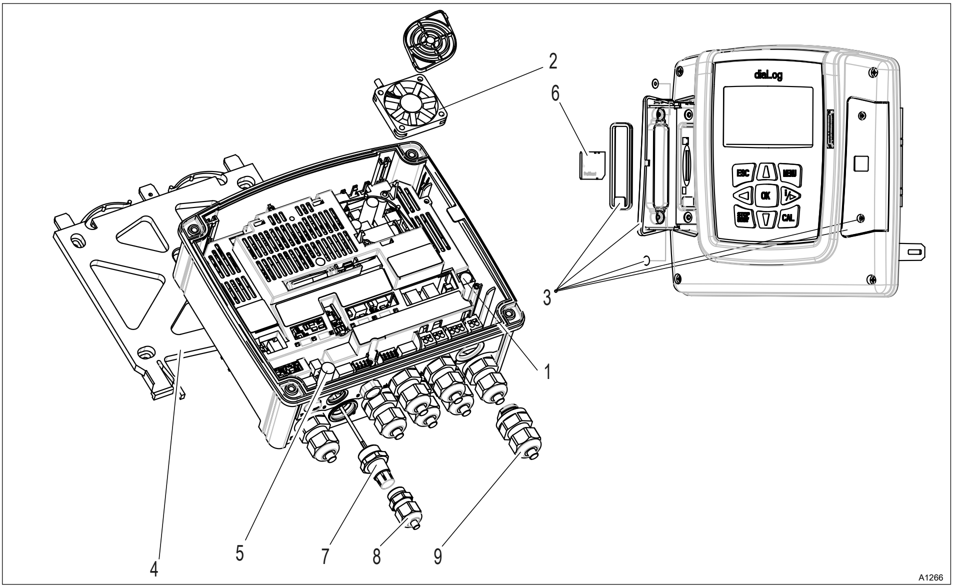


Fig. 120: Spare parts

Item	Spare parts	Order number
1	Fine fuse 5x20 T 1.6A	732411
2	Housing fan with speed signal, 5VDC, 50x50x10 mm	733328
3	Interface cover, spare parts package ■ Cover, left ■ Cover, right ■ Fastenings, complete	1044187
4	Wall bracket	1039767
5	Guard terminal, top part	733389

Item	Spare parts	Order number
6	SD card, industrial quality	1030506
7	SN6 socket	1036885
8	Cable threaded connector, M16x1.5	1043577
9	Cable threaded connector, M20x1.5	1040788
10	Counter nut, M20x1.5	1021016

21.2 Accessories

Accessories	Order number
Coaxial cable combination 0.8 m, pre-assembled	1024105
Coaxial cable combination 2 m-SN6 - pre-assembled	1024106
Coaxial cable combination 5 m-SN6 - pre-assembled	1024107
SN6 socket, retrofitting	1036885
Installation kit - DAC - control panel installation	1041095

22 Required formalities

22.1 Disposal of used parts

- **User qualification:** instructed user, see ↳ *Chapter 4.4 'Users' qualifications' on page 21*

> **NOTICE!**
>
> **Regulations governing the disposal of used parts**
>
> – Note the current national regulations and legal standards which apply in your country

The manufacturer will take back decontaminated used units providing they are covered by adequate postage.

Decontaminate the device before sending it for repair. To do so, remove all traces of hazardous substances. Refer to the material safety data sheet for your feed chemical.

The current decontamination declaration is available to download: *http://www.prominent.de/Service/Download-Service.aspx*

22.2 Standards complied with and conformity declaration

You can find the EC Declaration of Conformity for the controller as a download under *http://www.prominent.de/Service/Download-Service.aspx*

EN 60529 Specification for degrees of protection provided by enclosures (IP-Code)

EN 61000 Electromagnetic compatibility (EMC)

EN 61010 Safety requirements for electrical equipment for measurement, control and laboratory use - Part 1: General requirements

EN 61326 Electrical equipment for measuring, control and laboratory use - EMC requirements (for class A and B devices)

23 Glossary

Slope of the pH sensor

The slope or sensitivity of a pH sensor is defined as the quotient of the voltage emitted in mV per pH level. In theory, a pH sensor should generate a voltage of +59.16 mV per pH level at 25 °C. In time, the slope flattens off, initially slowly but later more quickly. That is why it is important that this change is compensated for during calibration. As with zero point compensation, slope compensation has to be repeated at specific intervals depending on the application.

Zero point of the pH sensor

The zero point of the pH sensor is the pH-value at which the sensor potential is 0 mV.

Asymmetric potential of a pH sensor

The asymmetric potential of a pH sensor is the potential difference that occurs when the pH sensor is immersed in a solution, which corresponds to the internal electrolytes. Ideally the potential difference is 0 mV.

Glass break detection

[ON] / *[OFF]* : Switches the pH sensor's glass break detection *[ON]* or *[OFF]*. The factory setting is *[OFF]*. The controller shows a fault message when a fault is detected when the setting is *[ON]*.

The glass break detection monitors the pH sensor to detect whether the pH sensor's pH-sensitive glass membrane is broken. In the event of the glass membrane breaking, the pH sensor's resistance becomes smaller, approx. 2 mega-Ω . The controller can analyse this change in resistance. The controller emits a fault message and control is stopped. This fault cannot be acknowledged.

The pH sensor's glass membrane also has low resistance when the process temperature increases. If the process temperature is approximately > 60°C, the detection threshold of 2 mega-Ω has been reached. At process temperatures of > 60°C, glass breakage is detected although no glass has broken. In order to avoid a false alarm, switch off glass break detection at process temperatures of > 60 °C .

Cable break detection

[ON] / *[OFF]* : Switches cable break detection of the coaxial cable *[ON]* or *[OFF]*. The factory setting is *[OFF]*. If the controller has the setting *[ON]*, it displays an alarm message if an error is detected.

The cable break detection device monitors a pH sensor with a coaxial connection cable to determine whether a break exists in the coaxial connection cable. If a break exists in the coaxial connection cable, the resistance increases enormously to approximately 1 giga-Ω. The controller can interpret this resistance change. The controller generates an error message and control is stopped. This error cannot be acknowledged.

The glass membrane of the pH sensor becomes highly resistant when the process temperature falls. Once the process temperature is approx. < 15 °C the detection threshold of 1 gig-Ω is reached. For process temperatures < 15 °C a cable break is detected even though no cable break exists. So that an error alarm is avoided, cable break detection must be switched off at process temperatures < 15 °C.

Measuring range of the measuring transducer

Select the measuring range. The measuring range is printed on the nameplate of the measuring transducer. An incorrect measuring range will lead to an incorrect measurement.

Measuring range of the sensors

Select the measuring range. The measuring range is given on the sensor nameplate. An incorrect measuring range leads to an incorrect measurement.

Measured variable chlorine, bromine, chlorine dioxide, chlorite, dissolved oxygen and ozone:

The measured variables chlorine , bromine, chlorine dioxide, chlorite, dissolved oxygen and ozone are always measured using a mA signal because the measuring transducer is located in the sensor.

The temperature compensation takes place automatically inside the sensor (exception: CDP, chlorine dioxide sensor). For further information see the operating instructions of the sensor used.

Measured variable conductivity [mA]

When measuring conductivity [mA], use of a measuring transducer is a prerequisite, e.g. a measuring transducer DMTa conductivity. A conductivity sensor cannot be directly connected to the controller.

Measuring range:

- Select the measuring range corresponding to the measuring range of the measuring transducer used. An incorrect measuring range leads to an incorrect measurement.

Temperature:

- The temperature measurement is used only for information or recording purposes, but not however for temperature compensation. Temperature compensation is carried out in the measuring transducer.

Measured variable pH [mA]:

If the measured variable *'pH [mA]'*, i.e. pH measurement using a mA signal, is selected, then the possibility of sensor monitoring for cable or glass breaks is no longer available.

For a pH measurement using a mA signal, either a DMTa or a pH-V1 measuring transducer is connected to the pH sensor. A 2-conductor connection cable is used between the DMTa-/pH-V1 measuring transducer and the controller. The connection cable supplies the DMTa-/pH-V1 measuring transducer and routes the measured value as a 4 ... 20 mA signal to the controller.

When using the DMTa measuring transducer or the measuring transducer of another supplier, the measuring range allocation must be set to the following values:

- 4 mA = 15.45 pH
- 20 mA = -1.45 pH

With a pH-V1 measuring transducer, the setting of the measuring range allocation is automatically specified.

Measured variables ORP [mV], ORP [mA]

If the measured variable *' ORP [mV]'* or *'ORP [mA]'* is selected, measurement of the process temperature is only possible for information or recording purposes.

For the measured variable *'ORP [mV]'*, the measuring range is fixed in the range -1500 mV ... + 1500 mV.

For the measured variable *'ORP [mA]'*, the measuring range is dependent on the RH-V1 measuring transducer and is 0 ... +1000 mV.

Measured variable temperature [mA], (as main measured variable):

For the measured variable *'Temperature [mA]'* use of a DMTa temperature measuring transducer or a Pt100V1 measuring transducer is prerequisite. The measuring range is: 0 ... 100 °C. A temperature sensor cannot be connected directly to the controller.

Measured variable temperature [Pt100X], (as main measured variable)

The temperature sensor Pt100 or Pt1000 can be directly connected to the measurement input of the controller. The measuring range is: 0 ... 150 °C

Temperature measurement for the measured variable ORP

If the measured variable ORP [mV] or ORP [mA] is selected, measurement of the process temperature is only possible for information or recording purposes. For the measured variable ORP [mV], the measuring range is fixed in the range - 1500 mV ... + 1500 mV. For the measured variable ORP [mA], the measuring range is dependent on the RH-V1 measuring transducer and is 0 ...+ 1000 mV.

The measured variable pH [mV]

The pH sensor of the measured variable pH [mV] is connected using a coaxial cable via which the mV signal is transmitted to the controller. This measurement can be used if the cable is less than 10 metres in length.

Sensor type:

First select the sensor type. The sensor type is given on the sensor nameplate. This sensor selection is necessary and activates the sensor-specific data in the controller.

Temperature compensation

This function is used to compensate for the temperature influence on the measurement. The process temperature is set in the DMTa measuring transducer when using a DMTa measuring transducer

Temperature: [Off] / [Manual] / [Automatic]

- *[Off]* switches the process temperature setting off
- *[Manual]* permits manual process temperature setting
- *[Automatic]* uses a measured process temperature

Temperature compensation

This function is used for compensation of the temperature influence of the process on measurement.

Temperature: [Off] / [Manual] / [Automatic]

- *[Off]* switches the process temperature setting off
- *[Manual]* makes possible a manual specification of the process temperature
- *[Automatic]* uses a measured process temperature. Automatic measurement of the temperature using the temperature sensor, e.g. Pt1000. For pH, CDP and fluoride, temperature compensation can be switched *[ON]* or *[OFF]* in the menu.

Temperature: Off / Manual / Automatic

For the *'Off'* setting, the temperature influence of the process water on the pH measurement is calculated at the fixed temperature value of 25 °C. A temperature measurement does not take place.

For the *'Manual'* setting, the previously determined process temperature must be manually entered in the controller. The *'Manual'* function only makes sense if the process temperature is stable (± 2 °C). If the process temperature changes quickly > ± 5 °C, then the *'Automatic'* setting is required.

For the *'automatic'* setting, a type *[Pt100]* or *[Pt1000]* temperature sensor must be connected. The controller automatically detects which type of temperature sensor is connected. To achieve accurate temperature compensation, the temperature sensor must be in the same process water as the sensor used for the measured variable.

Further input options are shown under the *'Automatic'* setting:

Temperature

The temperature measurement is used only for information and recording purposes, but not for temperature compensation. Temperature compensation is performed in the sensor. If the measured variable *[Chlorine dioxide]* and the *[CDP]* type of sensor have been selected, then a separate temperature measurement is needed for temperature compensation.

The temperature offset

The setting *'Temperature offset'* makes it possible to match the measured temperature to a reference value. An offset of -10.0 ... +10.0 °C is possible.

Additive basic load

The additive basic load should balance out a continuous requirement for a chemical in order to maintain the setpoint. The additive basic load can be set in the range -100 % … +100 %. The additive basic load is added to the control variable determined by the controller and is effective in both control directions. E.g., if the control variable calculated by the controller

- y= -10 % and the additive basic load equals +3 %, then the resulting control variable = Y= -10 % + (+3 %)= -7 %
- y= 10% and the additive basic load equals +3 %, the resulting control variable = Y= 10 % + (+3 %)= 13 %
- y= 0 % and the additive basic load equals +3 %, the resulting control variable = Y= 0 % + (+3 %)= 3 %

Control time control

The checkout time should prevent overdosing as a result of a malfunction. During the checkout time the control variable is compared with an adjustable *[threshold]* (= control variable threshold). Depending on the control direction, you can set different values for the checkout times *[Checkout time up]* to increase and *[Checkout time down]* to decrease the value. The checkout times depend on the concentration of the metered chemicals. If the *[threshold]* is exceeded, time recording starts (checkout time). If during the checkout time the variable again falls below the threshold, then the time is again reset to *[0]* s.

However if the disturbance variable remains above the threshold for longer than the checkout time, then the reaction of the controller can be selected *[Checkout time reset]* = *[Normal]* this selection stops the control immediately. To enable restarting, an operator must acknowledge the fault once the cause of the fault has been cleared.
[Checkout time reset] = *[Auto]* this selection automatically resets the function, if the threshold is again undershot and the control restarts automatically.

Dead zone

The dead zone is defined by an upper and lower setpoint. The dead zone only functions with a 2-way control and only if an actuator is available for each direction. The dead zone should have the effect of preventing the control path from starting to oscillate. If the measured value lies within both the setpoints, then no control of the actuators takes place even with a PI / PID controller. Application 2-way neutralisation.

Controller type

- P mono-directional
- P bidirectional
- PID mono-directional
- PID bidirectional
- Manual
- Off

P controller: This is used with integrating control paths (for example batch neutralisation). If control deviation becomes less, then the control of the actuator becomes less (proportional relationship). Once the setpoint is reached, then the control output is 0 %. However, the setpoint is never exactly reached, thereby creating a constant control deviation. Oscillations can occur when stabilising large changes.

PI controller: This is used with non-integrating control paths (for example in-line neutralisation), where oscillation has to be avoided and where no remaining control deviation may occur, i.e. the setpoint always has to be maintained. A constant addition of metering chemicals is required. It is not a malfunction if the controller does not stop when the setpoint is reached.

PID controller: This controller type has the properties of a PI controller. Due to the differentiating control part, it also offers a certain level of foresight and can react to forthcoming changes. It is used when measurement spikes occur in the measurement curve and these have to be quickly regulated out.

P, PI and PID controllers are continuous controllers. The control variable can have any value within the control range from -100 % … +100 %.

Manual: If *[Manual]* controller type is selected, then a control variable within a range of -100 % … 100 % can be entered. This function is used to test the cabling and the actuator.

Off: The control function is deactivated. The device works only as a measuring transducer.

Setpoint

The setpoint specifies the target value for control. The controller attempts to keep the deviation between the setpoint and measured value as small as possible.

Ctrl output limitation (control variable limitation)

Ctrl output limitation specifies the maximum control variable to be output. This makes sense if an actuator is over-dimensioned and must not be opened to 100%.

[Ti]

The time *[Ti]* is the integral action time of the I-controller (integral controller) in seconds. The time *[Ti]* defines the time integration of the control deviation from the control variable. The smaller the time *[Ti]*, the greater the effect on the control variable. An infinitely long time *[Ti]* results in a pure proportional control.

The time *[Ti]* is the time that an I-control needs to reach the equal size of control variable change that a P controller, although a P controller achieves this change immediately.

Td

The time Td is the differentiation time of the D-controller (differential controller) in seconds. The D-controller reacts to the rate of change of the measured value.

System response

The system response of the controller is set under the menu item *[System response]*. *[Normal]* is the selection for 1-way controlled processes.

[xp]

The *[xp]* value indicates the controller's proportional range. The *[xp]* value relates to the measuring range limit of a controller and is given as an absolute value, for example with pH *[xp]*=1.5. With measured variables *[such as]* chlorine, the sensor's measuring range, and thus the measuring range limit, is selected. For pH, the measuring range end is 15.45. The default is thus *[xp]* value 1.54 . The *[xp]* value states that with a deviation of ± 1.54 pH from the setpoint, the control variable is ± 100% . The smaller the xp value, the more sensitively and faster the control reacts, however the control also moves slightly into the over-control range.

Temperature filtering

In the *[Temperature filtering]* setting, the temperature measurement can be calmed, if the measured temperature is subject to rapid fluctuations. Only the measured temperature value shown in the display is affected by *[Temperature filtering]*. The measured temperature value, with which temperature compensation, is performed is fundamentally filtered *[medium]* and is unaffected by the *[Temperature filtering]* setting.

The following filter stages are possible:

- *'stable'*
  - *'Stable'* temperature filtering heavily calms the measured value.
- *'medium'*
  - *'Medium'* temperature filtering shows the real changes measured.
- *'fast'*
  - *'Fast'* temperature filtering quickly calms the measured value.

Decimal places

The function shows the pH value in the display with one or two decimal places. An adaptation of the display to one decimal place makes sense if a change in the 1/100 value is unimportant or if the value is unsteady.

Factory setting: 2 decimal places

Fluoride Measured Variable

When measuring fluoride as the measured variable, the sensor signal is converted into a 4 - 20 mA signal by a FPV1 or FP100V1 measuring transducer, depending on the measuring range. The measuring transducer is connected to the controller's mA input. The REFP-SE reference sensor is connected to the measuring transducer using a coaxial cable with an SN 6 plug.

FPV1 measuring transducer: Measuring range 0.05 ...10 mg/l.

FP100V1 measuring transducer: Measuring range 0.5 ... 100 mg/l.

Peracetic acid measured variable

Peracetic acid as a measured variable is measured via one of the two mA sensor inputs. Temperature compensation is performed in the sensor. An additionally connected temperature sensor is only used for display and data recording with a data logger and can be issued on a mA-output via field bus or web server.

Hydrogen peroxide as a measured variable [mA]

Hydrogen peroxide as a measured variable is measured via one of the two mA sensor inputs. Temperature compensation is performed in the sensor. An additionally connected temperature sensor is only used for display and data recording with a data logger and can be issued on a mA-output via field bus or web server.

Measured variable [mA general]

With the *[mA general]* measured variable, various preselected measured variable can be selected and/or one measured variable can also be freely edited with its unit of measure. The temperature measurement cannot be used for compensation purposes, because the influence of the temperature measurement on the measured value is not known. In principle, the settings are performed in the same way as with the other measured variable. A standardised calibrated signal is expected by the controller from each connected device

Two channel version

If a second measuring channel is available (dependent on the identity code, channel 2), then this second measuring channel can be configured according to the descriptions of the first measuring channel.

Two channel version with two identical measured variables

If the measured variables of measuring channel 1 and measuring channel 2 are chosen identically, then the menu item *[Differential meas]*appears in the *[Measurement]* menu. The *[Differential meas]* function is switched off "ex works". The function *[Differential meas]* can be activated and the calculation *[K1-K2]* executed. The result of the calculation is displayed in the main display 2 by pressing the ▼ key or ▲ key. By pressing the ▼ or ▲ key again you jump back to the main display 1. The limit value criteria for the *[Differential meas]* can be set in the menu *[Limit values]*.

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