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. 985217

BA DM 194 02/13 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*

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1 Operating concept

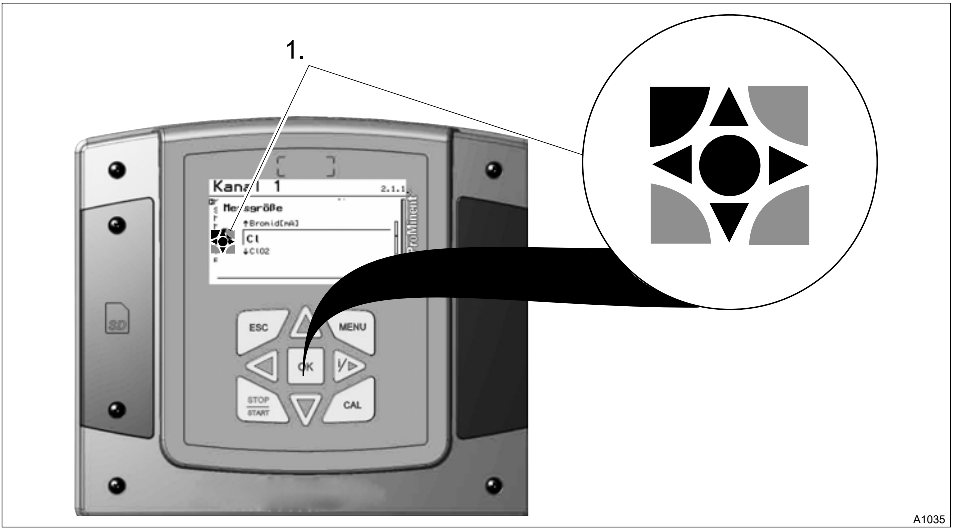


Fig. 1: Operating cross (1) / Active keys are displayed in [black] in the display; inactive keys in [grey].

For example, the following path is represented:

Continuous display ➨ MENU ➨ ▲ or ▼ *[calibrate]* ➨ OK ➨ ▲ or ▼ *[slope]* ➨ OK ➨ CAL

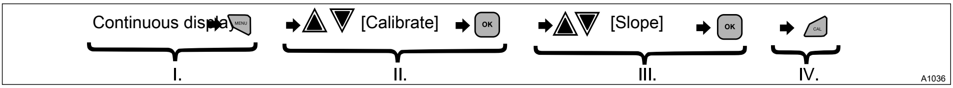


Fig. 2: A display change is made within a sequence of actions.

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 10*.

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

[Naming in the display] = square brackets contain the name that appears with the identical wording in the controller display.

You can query further information via the ▷ key, e.g. which current terminal the input was assigned to.

Illumination of the display

In the case of an error with the status [ERROR], the backlight of the display changes from 'white' to 'red'. This makes it easier for the operator to react to an error.

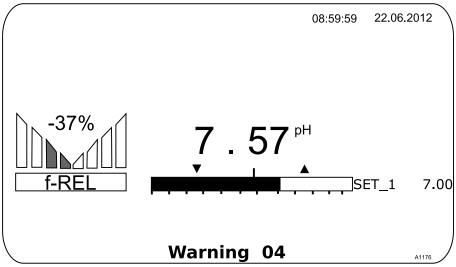


Fig. 3: This is the appearance of the continuous display when used with one measuring channel (e.g. pH)

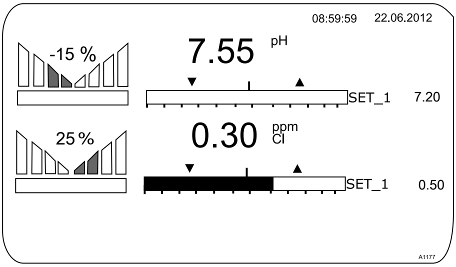


Fig. 4: This is the appearance of the continuous display when used with two measuring channels (e.g. pH/chlorine)

Setting of the various parameters in the adjustable menus

No time-controlled menu items

The controller does not exit any menu items in a time-controlled manner, the controller remains in a menu item until this menu item is exited by the user.

1. Select the desired parameter in the display using the keys ▲ or ▼.

   ⇨ In front of the selected parameter there is an arrow tip, which marks the selected parameter.

2. Press OK

   ⇨ You are now in the setting menu for the desired parameter.

3. You can adjust the desired value in the setting menu using the four arrow keys and then save it using the OK key

   ⇨

   Range error

   If you enter a value that is outside the possible setting range, the message [range error] appears. By pressing OK or ESC you return to the value to be set.

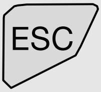
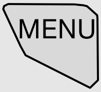
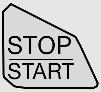
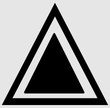
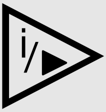
   Once the OK key is pressed, the controller returns to the menu

   Interrupting the setting process

   Pressing the ESC key returns to the menu without saving a value.

1.1 Functions of the keys

Functions of the keys

Key	Function
	Confirmation in the setting menu: Confirms and saves the input values. Confirmation in the continuous display: Displays all information about saved errors and warnings.
	Back to the continuous display or to the start of the respective setting menu, in which you are currently located.
	Enables direct access to all of the controller's setting menus.
	Enables direct access to the controller's calibration menu from the continuous display.
	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 Acknowledge fault or warning message

If the controller recognises an error, control is stopped, the backlight switches to red lighting and the alarm relay is deactivated. You can access the next value to be set by pressing the OK key. In doing so, the controller shows you all errors and warnings; you can select and, where necessary, acknowledge the current alarm messages. If you acknowledge an error, the alarm relay activates and the backlight switches back to white light. In the bottom part of the display, the error or warning message that has occurred remains displayed, such as *[Error 01]*, until the cause has been cleared.

In the event of a warning, e.g. the controller signals that a calibration is required, further processing using the controller is possible with or without acknowledgement of the message.

In the event of an error message *[Error]*, e.g. the controller signals that a sensor is missing, then after acknowledgement of the message, no further processing is possible using the controller. You must now clear the error - see *Chapter 18 'Diagnostics' on page 139*.

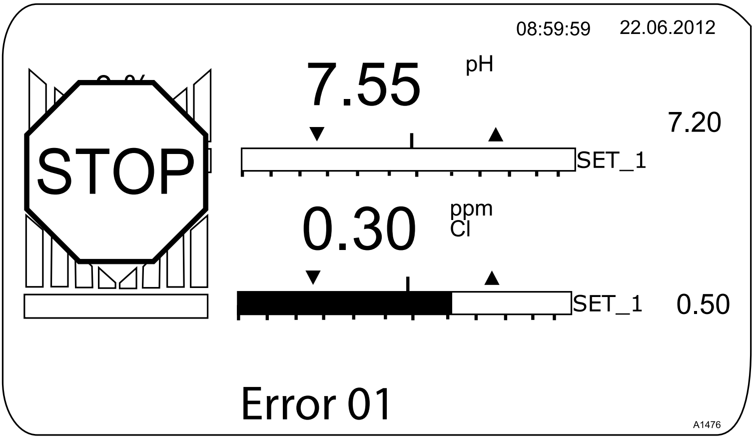


Fig. 6: Alarm message, controller stops control

1.4 The 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 simultaneous pressing of the ▲ and ▼ keys. Activation of the key lock is indicated by the 🔑 symbol in the display.

2 Entries in the display [menu]

Name of the menu item	Jump to chapter
[Measurement]	*Chapter 8 ‘Configuration of measured variables’ on page 50*
[Limits]	*Chapter 11 ‘Setting the [Limit values]’ on page 116*
[Control]	*Chapter 10 ‘Setting the [Control]’ on page 97*
[Calibration]	*Chapter 9 ‘Calibrating the controller’ on page 58*
[Pumps]	*Chapter 12 ‘Setting the [Pumps]’ on page 120*
[Relay]	*Chapter 13 ‘Setting the [Relays]’ on page 123*
[Digital inputs]	*Chapter 14 ‘Setting [Digital inputs]’ on page 127*
[mA outputs]	*Chapter 15 ‘Setting the [mA outputs]’ on page 130*
[Diagnostics]	*Chapter 18 ‘Diagnostics’ on page 139*
[Service]	*Chapter 16 ‘The [Service]’ on page 133*
[Setup]	*Chapter 17 ‘Setting [Device setup]’ on page 134*

3 ID Code

Device identification / identity code

DULCOMETER®, Multi-parameter Controller diaLog DACa						
DACa	Version					
	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: Disturbance variable (mA) or external remote setpoint via mA or pH compensation for chlorine (all acting on channel 1)	
				3	Package 3: 2nd measurement + control, additionally 2 pumps, additionally 3 control inputs	
				4	Package 4: 2nd measurement + control, additionally 2 pumps, additionally 3 control inputs, disturbance variable (mA or frequency), pH compensation for chlorine	
					Software default settings	
					0	no default settings
					1	Batch neutralisation 2 x pH measurement with 1-2-way controller and final inspection
					2	Flow neutralisation 2 x pH measurement with 1-2-way controller, disturbance variable and final inspection
					3	pH-/ORP measurement/control (pH 2 page, ORP 1-way)
					4	pH-/Cl_2 measurement/control (pH 2-way, chlorine 1-way)

DULCOMETER®, Multi-parameter Controller diaLog DACa	
5	pH-/ClO_2 measurement/control (pH 2-way, chlorine dioxide 1-way)
6	pH-/Cl_2 measurement/control with disturbance variable (pH 2-way, chlorine 1-way)
7	ClO_2/ORP measurement/control (chlorine dioxide 1-way, ORP for monitoring)
	Channel connections
0	Channel 1/2 via terminals (mA and mV)
1	Channel 1 via SN 6 coaxial connector (only for pH and ORP via mV)
2	Channel 2 via SN 6 coaxial connector (only for pH and ORP via mV)
3	Channel 1 and 2 via SN 6 coaxial connector (only for pH and ORP via mV)
	Connection of digital sensors / actuators
0	none
	Communication
0	none
	Data logger
0	no data logger
1	Data logger with measured value presentation with SD card
	Hardware expansion
0	none
1	Protective RC circuit for output relay
	Certifications
0	None (CE standard)
	Certificates

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

Footnotes concerning the identity code

** Selection of the measured variable upon initial commissioning*

*** Selection of the measured variable takes place upon initial commissioning or via software default setting. Higher order packages include the options of the preceding packages.*

**** Other languages can be supplied upon 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 to measure and regulate liquid media. The labelling of the measured variables is indicated in the controller display and is absolutely binding.

The unit may only be used in accordance with the technical details and specifications provided in this operating manual and in the operating manuals for the individual components (such as sensors, fittings, calibration devices, metering pumps, etc.).

Any other uses or modifications are prohibited.

Compensation for control deviations

Damage to the product or its surroundings

– *The controller can be used in processes, which require compensation 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 Mounting 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!

Mounting position and conditions

- The controller fulfils the IP 67 degree of protection requirements (wall mounting) or IP 54 (control panel mounting) and NEMA 4X (leak-tightness). These standards are only fulfilled if all seals and threaded connectors are correctly fitted.
- The installation (electrical) can only take place after mounting (mechanical)
- Ensure that there is unimpeded access for operation
- Secure, low-vibration fixing
- Avoid direct sunlight
- Permissible ambient temperature of the controller at the installation location: -20 ... 60°C at max. 95 % relative air humidity (non-condensing)
- The permissible ambient temperature of the connected sensors and other such components must be considered
- The controller is only suitable for operation in closed rooms. If operated outside, the controller must be protected against the environment by a suitable protective enclosure

NOTICE!

Material damage to electrostatically sensitive components

Components can be damaged or destroyed by electrostatic voltages.

– Before any work, on electrostatically sensitive components, disconnect the power supply.
– When working on electrostatically sensitive components, wear an earthed anti-static wrist band.
– Always hold components by their corners and never touch conductors, ICs, etc.
– Only place components on anti-static supports or the original packaging.

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 used for wall mounting.*
  – *Nevertheless you can fit the controller in a control panel using the optional fitting kit.*
– *You must always install the controller horizontally, so that the cable entries are directed 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 Mounting mechanical

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

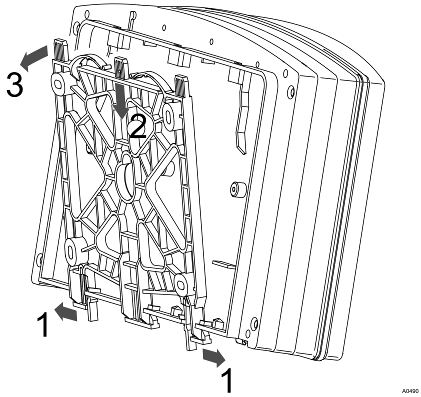


Fig. 7: Removing the wall bracket

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

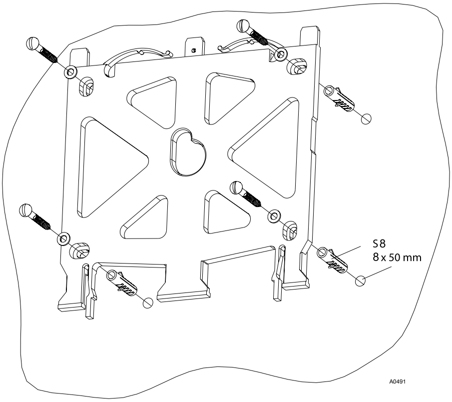


Fig. 8: Fitting the wall bracket

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

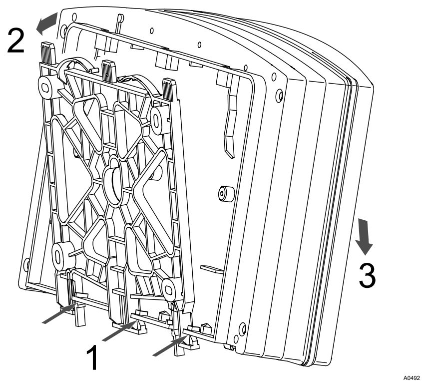


Fig. 9: Fitting the wall bracket

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 according to 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 circumference of the housing has a 4 mm wide projecting face as a stop for the control panel, with an additional circumferential groove to hold a caulking strip. When mounted in the control panel, the entire front elevation extends about 35 mm from the panel. Installation is from the outside into a control panel cut-out provided for this purpose. Using the fittings, the device can be secured to the control panel from the inside.

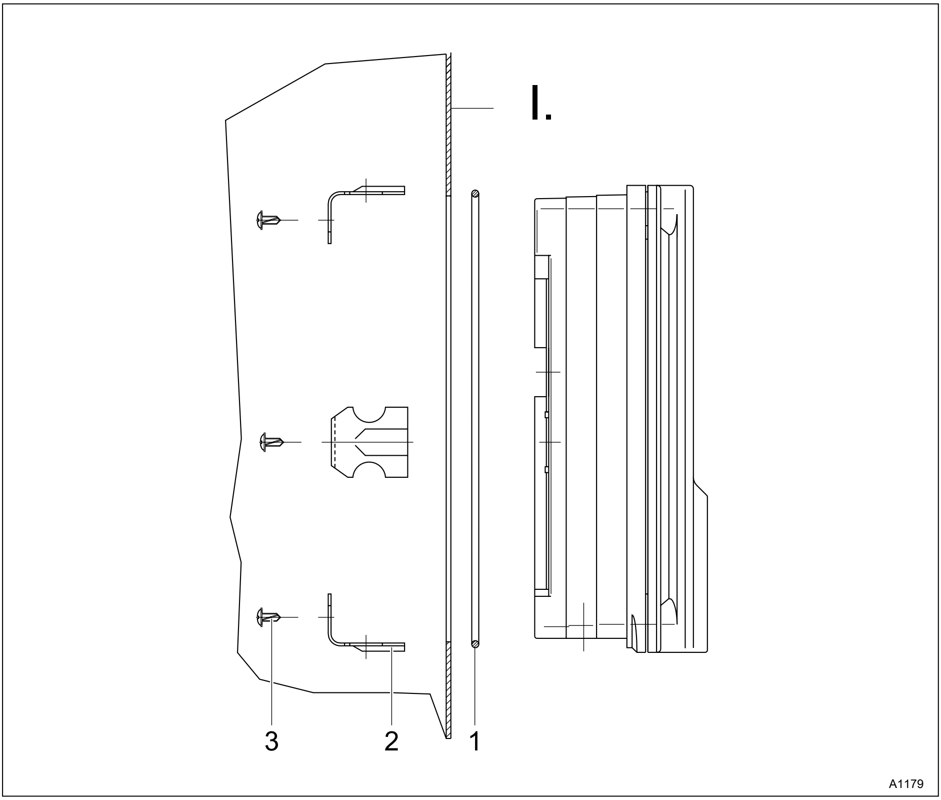


Fig. 10: Order number for the DAC control panel mounting kit: 1041095.

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

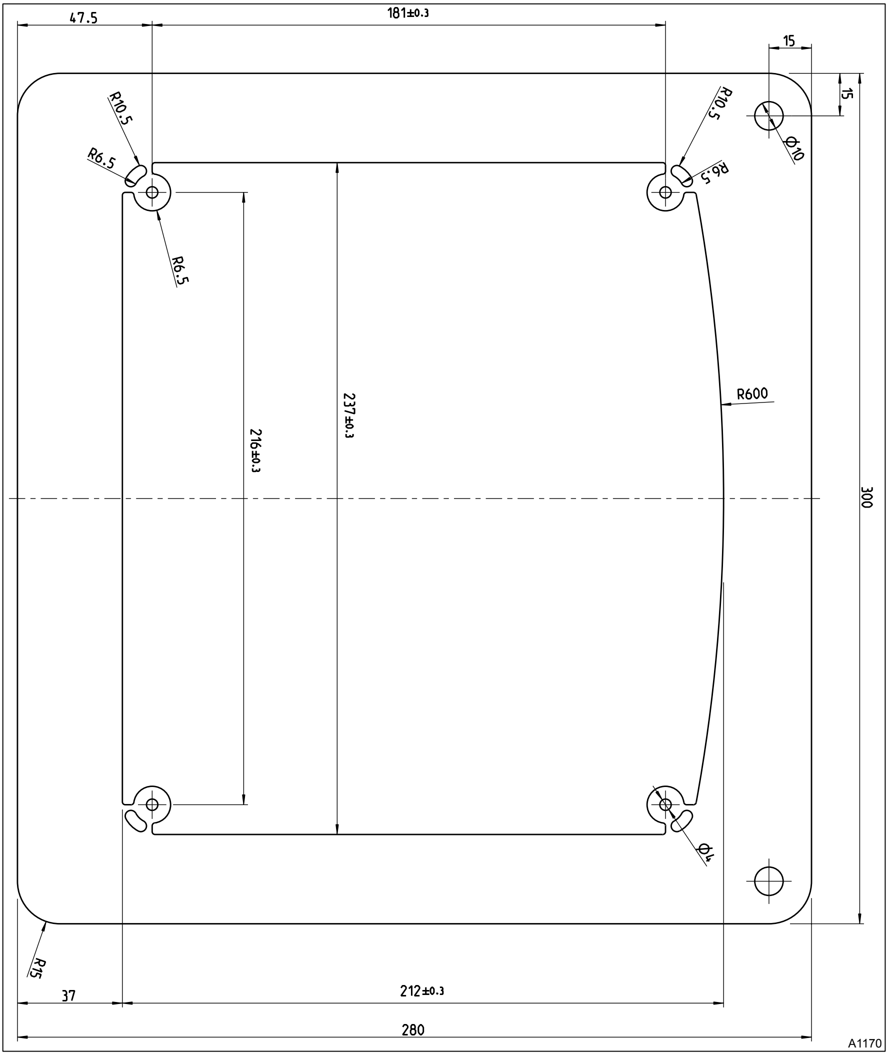


Fig. 11: The drawing is not true to scale and will not, as part of these operating instructions, be updated. The drawing is for information only.

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. With a punching tool or jigsaw make the opening as per the punched template drawing
4. Chamfer the cut edges and check whether the sealing surfaces are smooth for the caulk strip
   ⇨ Otherwise sealing cannot be guaranteed
5. Press the caulk 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 qualifications, electrical installation:** Electrical technician, see *Chapter 4.4 ‘Users' qualifications’ on page 21*

! NOTICE!

Moisture at the contact points

You must use suitable construction and technical measures to protect the connecting plug, cable and terminals against moisture. Moisture at the contact points of the electrical installation may falsify the measurement result.

6.3.1 Specification of the threaded connectors

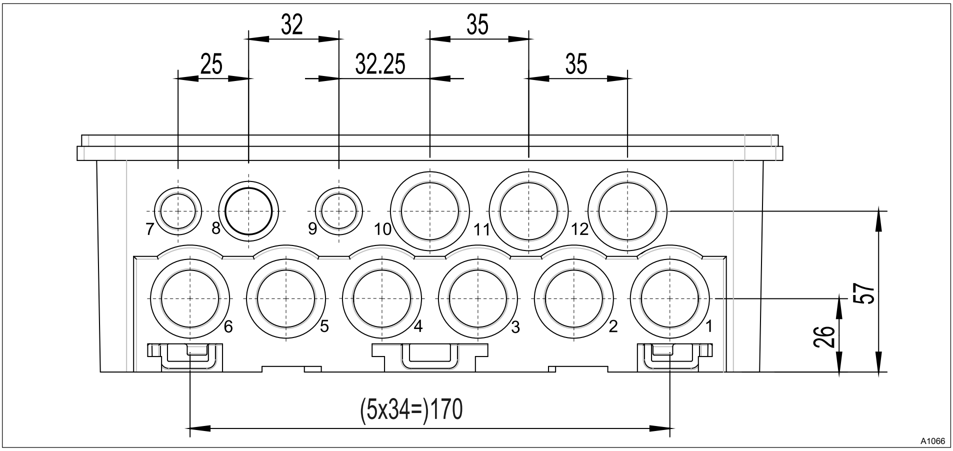


Fig. 12: All dimensions in millimetres (mm)

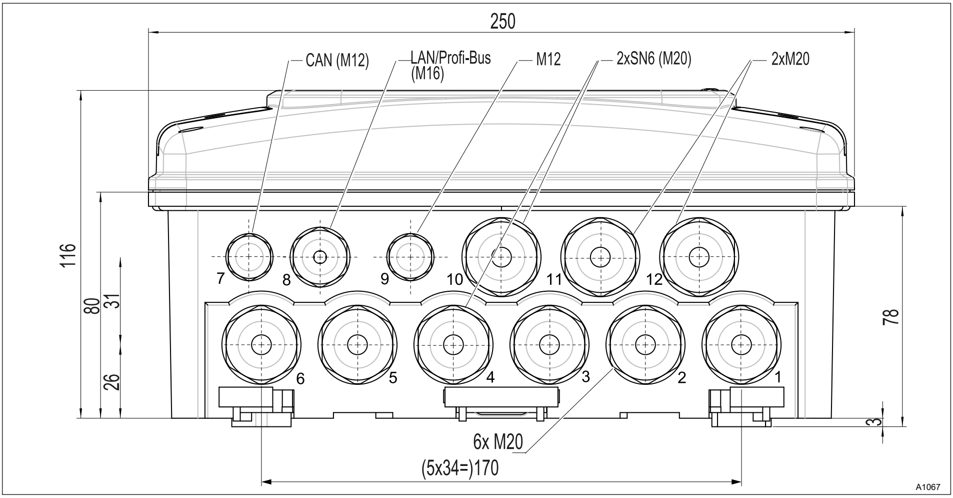


Fig. 13: All dimensions in millimetres (mm)

6.3.2 Terminal diagram

Terminal arrangement in the wall device design

The controller has terminal diagrams showing a 1:1 allocation.

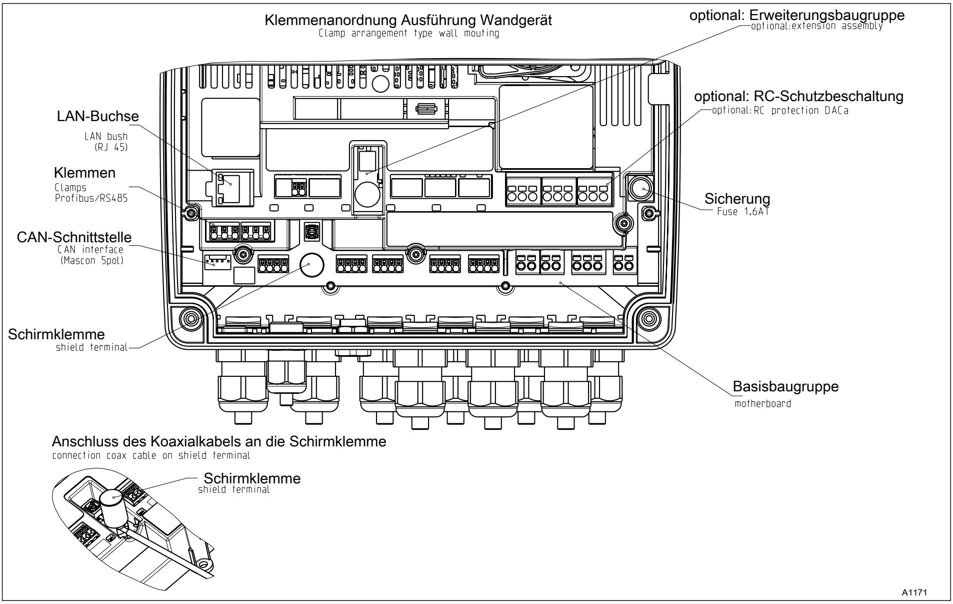


Fig. 14: Terminal arrangement in the wall device design

Terminal diagram with assignment variants

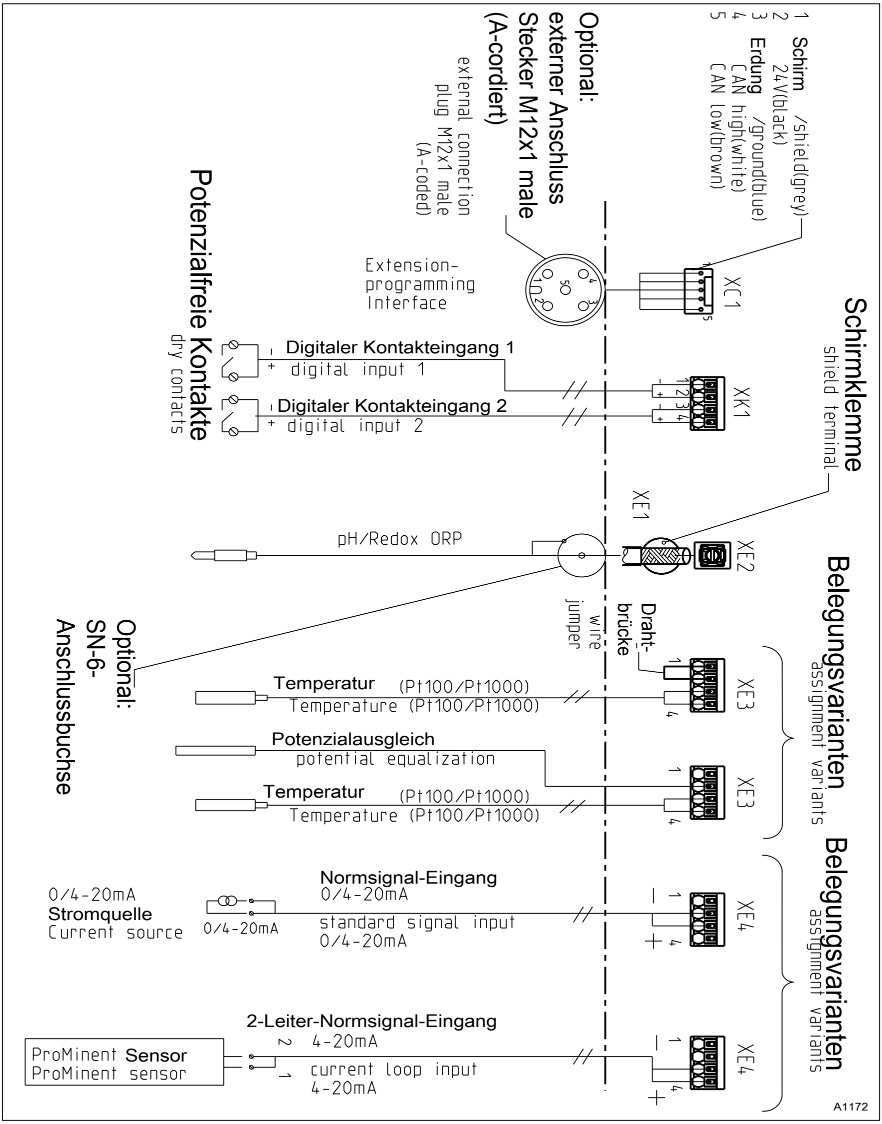


Fig. 15: Terminal diagram with assignment variants

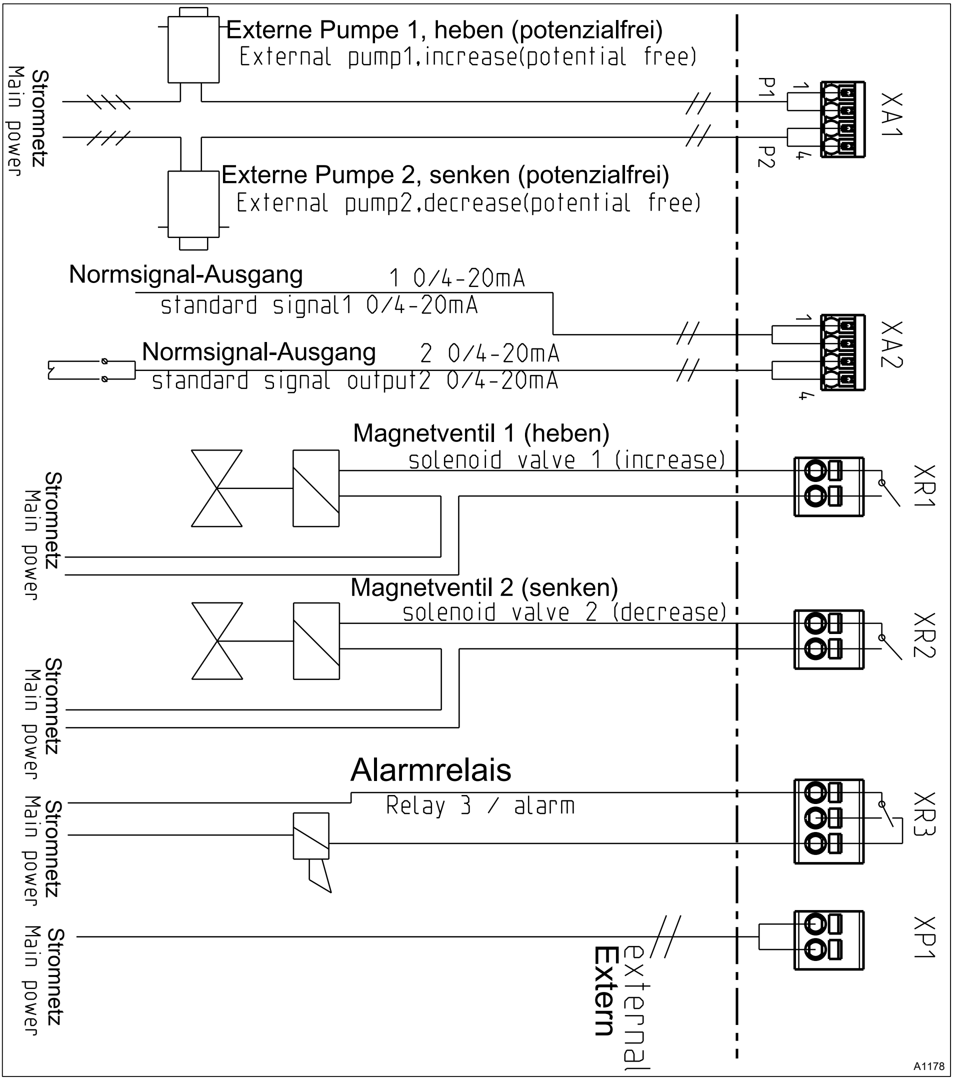


Fig. 16: Terminal diagram with assignment variants

Terminal diagram with extension modules

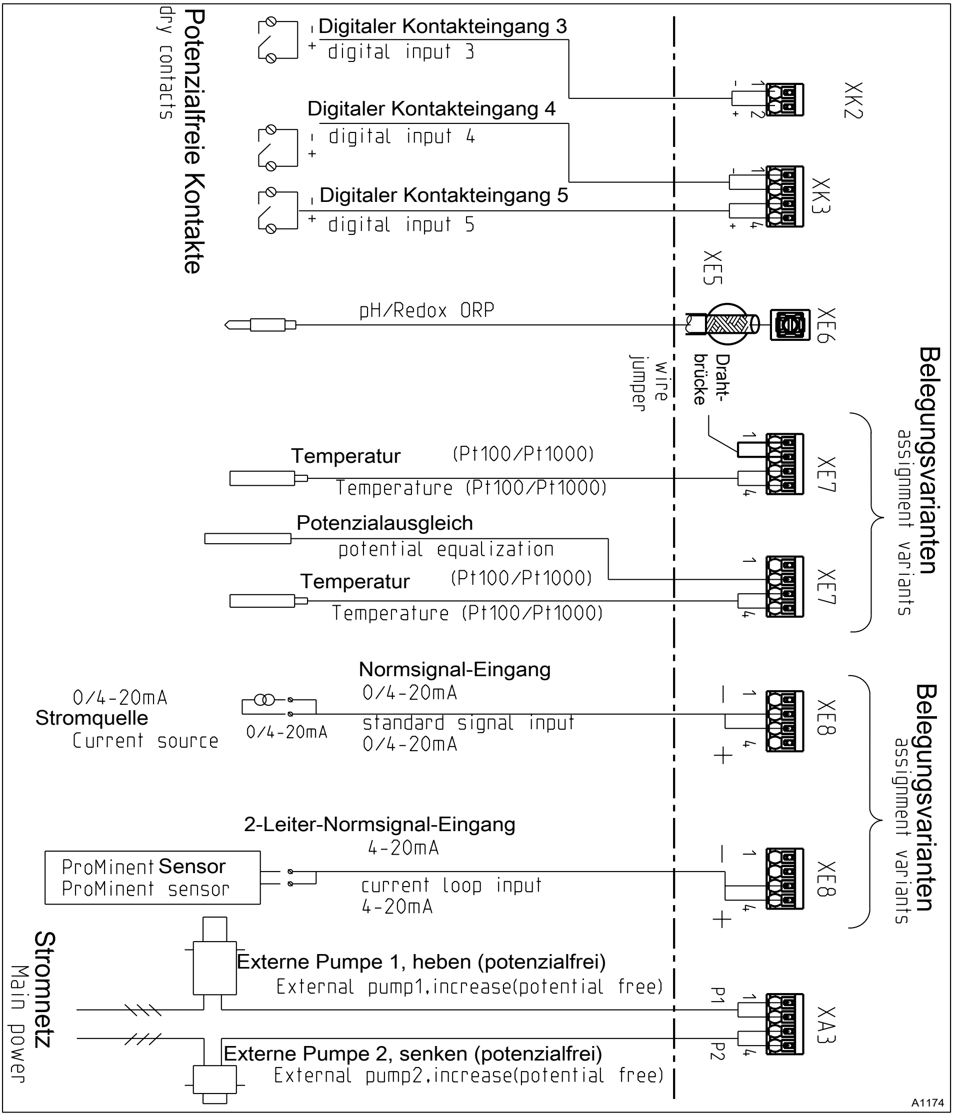


Fig. 17: Terminal diagram with assignment variants

Terminal diagram with protective RC circuit (option)

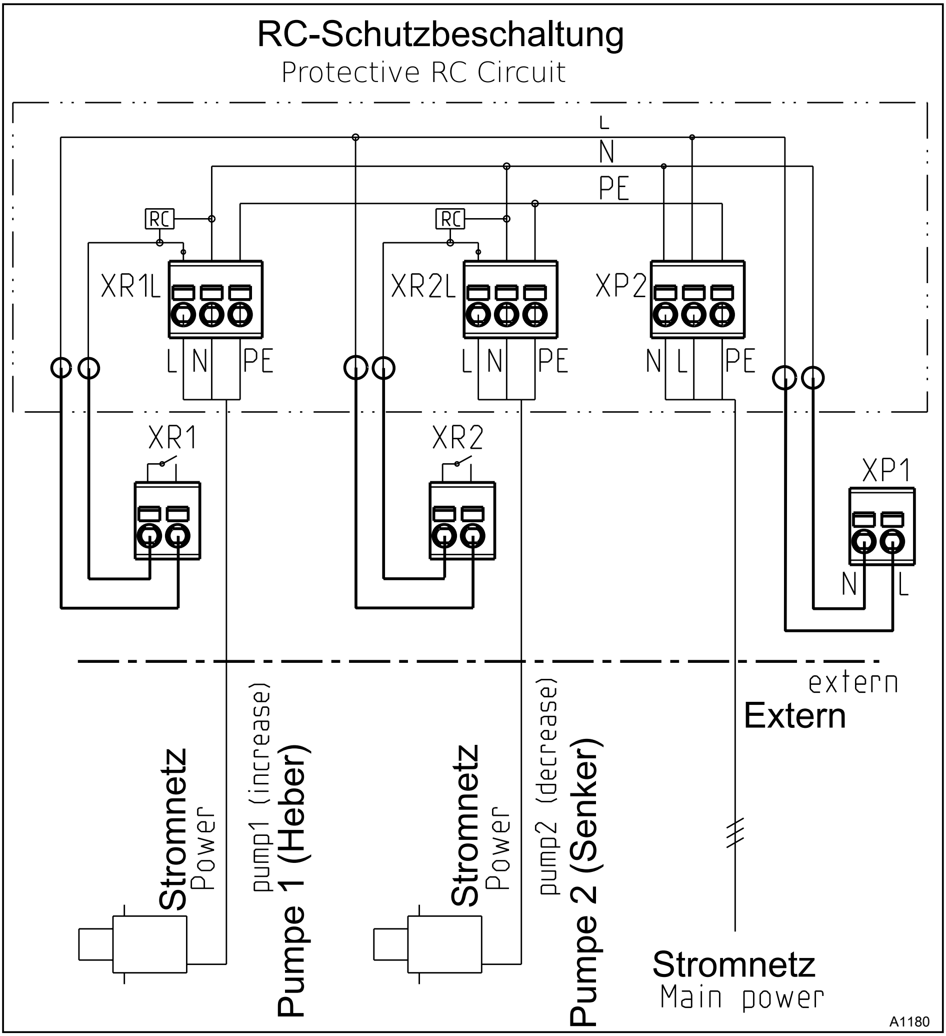


Fig. 18: Terminal diagram with protective RC circuit (option)

Terminal diagram DAC "communication module"

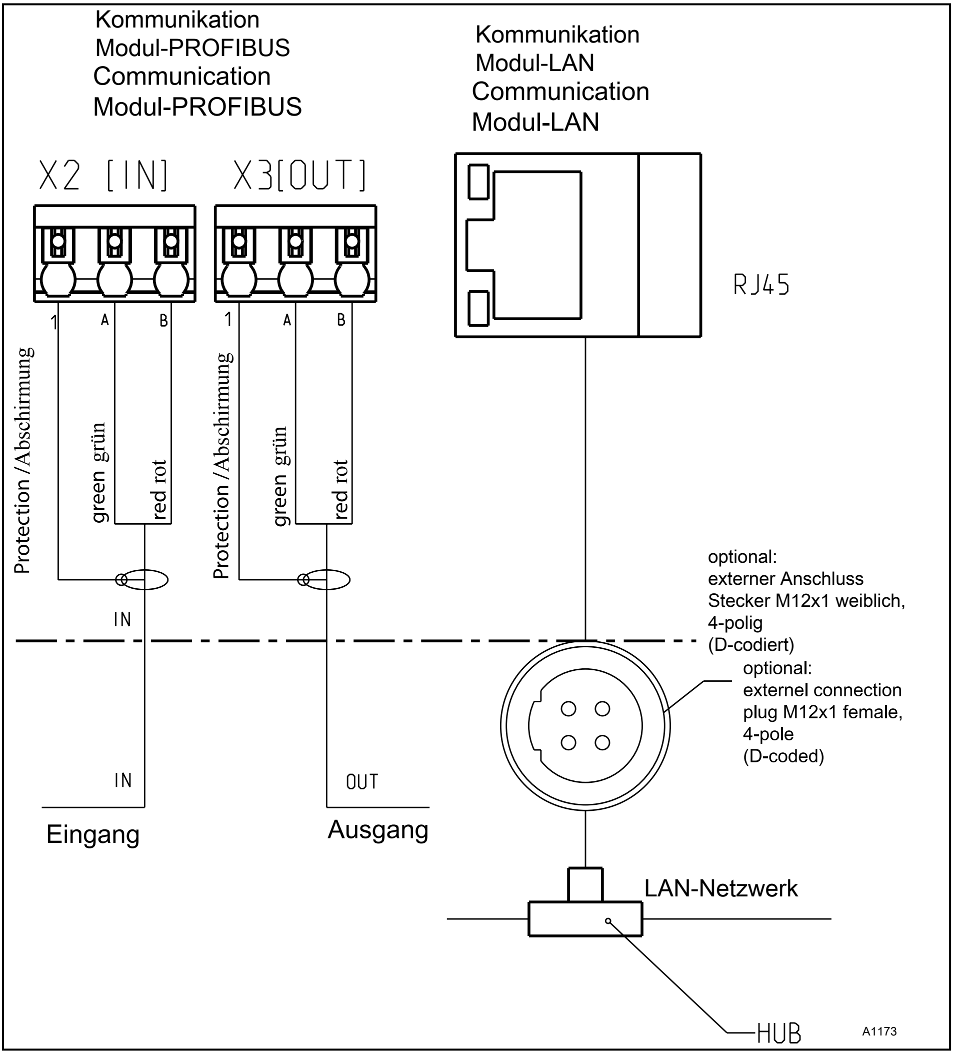


Fig. 19: Terminal diagram DAC "communication module"

Service interfaces

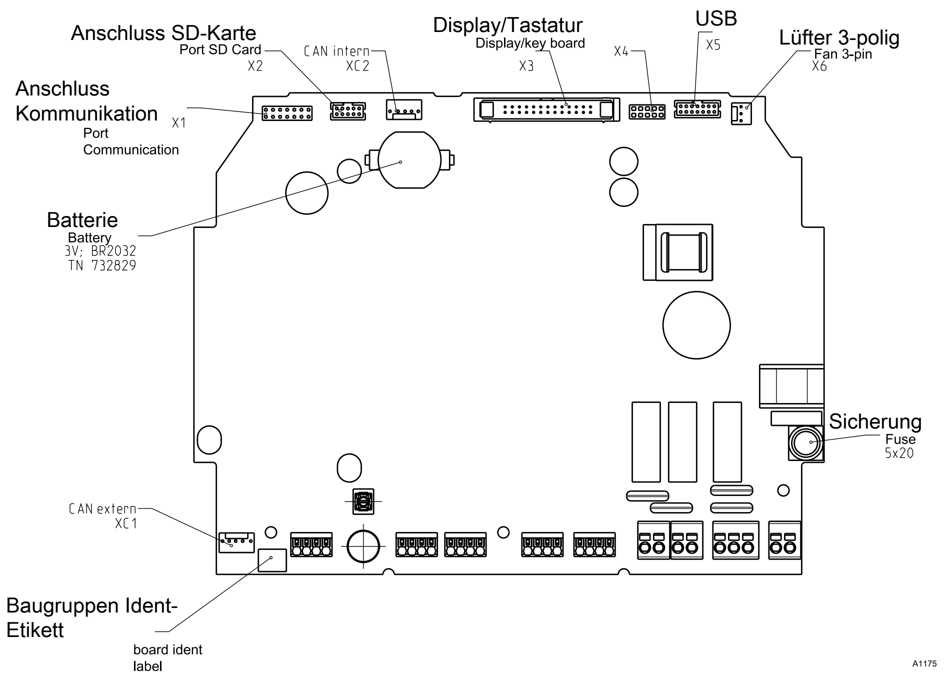


Fig. 20: Service interfaces

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 suitable seals to match the cable penetrations of the controller. Close open holes with blanking plugs. It is only in this way that sufficient sealing is ensured.

Observe the instructions on the enclosed terminal plans.

Kit, fitting accessories, part number 1045171, includes the following individual parts

Description	Part number	Quantity
Sealing ring (M 20 x 1.5), 4xØ5	1045172	2
Sealing ring (M 20 x 1.5), 2xØ4	1045173	2
Sealing ring (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
Cable threaded connector (M 20 x 1.5) (5-13), polyamide, black	1040788	1
SKINTOP® threaded connector (M 12 x 1.5), (4-6), black	1009734	1
Counter nut (M 12 x 1.5), 15 mm AF, brass, nickel plated	1018314	1

The cable must be routed in a site-provided cable duct to ensure strain relief

1. Undo the four housing screws
2. Slightly lift the controller housing top section 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 in the terminal diagram
6. Tighten the clamping nuts of the threaded connections so that they are properly sealed
7. Plug the controller housing top section on to the controller housing bottom section
8. Manually tighten the housing screws
9. Once again check the seating of the seal. Only if the mounting is correct, is the degree of protection IP 67 (wall/pipe mounting) or IP 54 (control panel mounting) achieved

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 fade out 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 suited to AC voltage supplies.

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

$R=U/I_L$

(U= Voltage divided by the load // I_L = load current)

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

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.

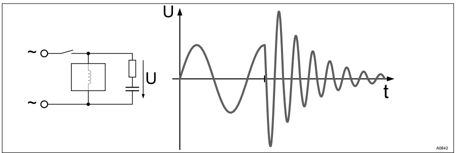


Fig. 21: Switching-off process shown on the oscillogram.

WARNING!

Mains voltage

Possible consequence: Fatal or very serious injuries

If mains voltage is connected to one of the terminals XR1-XR3 or XP, then no protective low voltage may be connected to any other of these terminals (SELV).

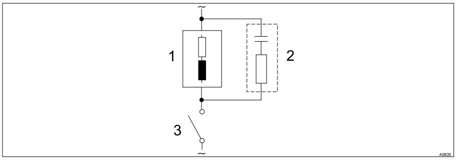


Fig. 22: RC protective circuit for the relay contacts

Typical AC current application with an inductive load:

- 1) Load (e.g. alpha motorised pump)
- 2) RC-protective circuit
  - Typical RC protective circuit at 230 V AC:
  - Capacitor *[0.22µF/X2]*
  - Resistor *[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 use only pre-assembled coaxial cables, which you can select from the product catalogue.*
>
> – *Coaxial cable 0.8 m, pre-assembled, 1024105*
> – *Coaxial cable 2 m-SN6, pre-assembled, 1024106*
> – *Coaxial cable 5 m-SN6, pre-assembled, 1024107*

6.3.6.1 Connection of pH or redox sensors via coaxial cable

NOTICE!

Possible incorrect measurement due to poor electrical contact

Observe the following for this type of connection:

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

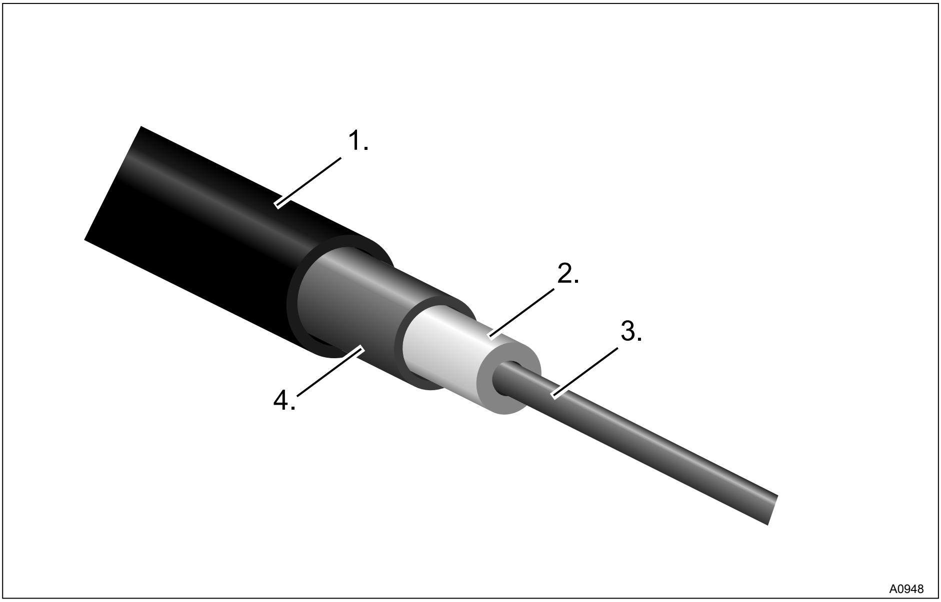


Fig. 23: Coaxial cable cutaway view:

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

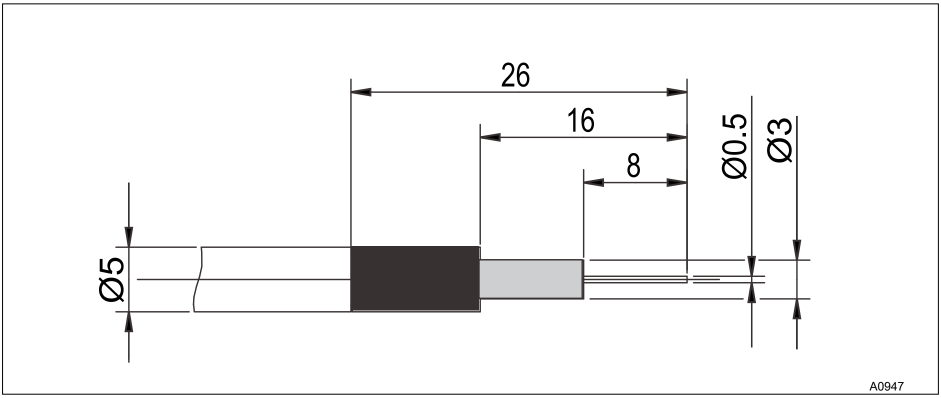


Fig. 24: Coaxial cable assembly

Connection of pH or redox sensors via a coaxial cable This relates to the connection type pH/redox via mV, directly via the electrical terminal of the controller or the controller SN6 connector.

The controller can, dependent on version (1 or 2 channel) measure the pH/ redox value once or twice.

There are two connection types:

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

When is potential equalisation used?

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

Measurements under difficult conditions are less problematic with potential equalisation. Difficult conditions include for example fast flowing or high-resistance measurement media, measurement media with low conductivity (< 100µS/cm) or a dirty sensor diaphragm.

Switch the controller to a 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:

In the factory the controller is preset for measurements without potential equalisation (unsymmetrical measurement).

In a measurement with potential equalisation (symmetrical measurement), the setting in the [Measurement] menu must be changed accordingly.

With a symmetrical connection you must 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 menu *[Measurement]* channel 1 or 2 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 in the terminal diagram. The wire jumper in the controller must not be removed.

Sensor connection with potential equalisation

> **NOTICE!**
>
> **Error sources when measuring with potential equalisation**
>
> A measurement without a wire jumper and/or non-connected potential equalisation delivers incorrect measured values.

> *With a symmetrical connection the line for potential equalisation must be connected to terminal XE3_2 (channel 1) or XE7_2 (channel 2) of the controller. Before this, the respective wire jumper at these terminals must be removed.*

> *The potential equalisation pin must always be in contact with the measurement medium. With the DGMa valve a special potential equalisation plug (Order No. 791663) and a cable (Order No. 818438) are necessary. With the DLG valve a potential equalisation pin is always fitted, only the cable (Order No. 818438) is necessary.*

> ***Peculiarities when calibrating when measuring with potential equalisation***
>
> *When calibrating you must 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 valve. 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*.

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
>
> Consider the run in period of the sensor during commissioning:
>
> – Correct measuring and metering is only possible if the sensor is working perfectly.
> – Adhere to the run in periods of the sensor without fail.
> – Calculate the run in period when planning commissioning.
> – It may take a whole working day to run-in the sensor.
> – Observe the sensor operating instructions.

After mechanical and electrical installation, the controller must be integrated into the measuring point.

7.1 Switch-on behaviour during commissioning

Switching on first step

> *Installation and function control*
>
> – *Check that all connections are made correctly*
> – *Make sure 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 would like to operate the controller
3. Wait for the controller's module scan

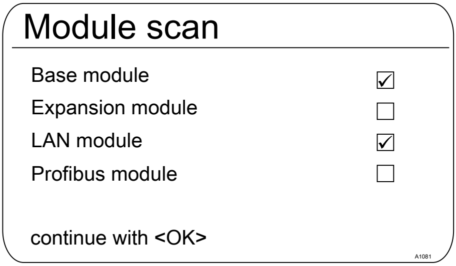


Fig. 25: Module scan

⇨ The controller indicates the installed and identified controller modules.

4. Press OK

⇨ The controller now changes into the continuous display. From the continuous display you can access all controller functionalities via the MENU key.

7.2 Adjusting the backlight and contrast of the controller display

Continuous display ➨ MENU ➨ ▲ or ▼ *[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 [English]. 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 the metering and control process

After you have integrated your controller in the control path, you must make the controller settings. Through the settings, your controller is matched to your process, so that it is rendered possible for the controller to effectively control the process.

To set up a controller, determine the following parameters:

- What type of a process is under consideration?
- Should the controller operate as a one-way or two-way control?
- Which control variables exist?
- Which control parameters are necessary?
- What should the controller do in *[HOLD]*?
- How should the actuators by controlled?
- How should the outputs be set?

8 Configuration of measured variables

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

Continuous display ➨ MENU ➨ ▲ or ▼ *[Measurement]* ➨ OK *[Measurement]* ➨ ▲ or ▼ *[Measurement 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.*

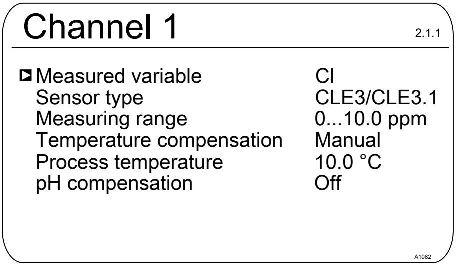


Fig. 26: Setting measured variables, using the example [Channel 1] and [Chlorine]

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]*
[Br]	Bromine	*[ppm]*
[Cl]	Chlorine	*[ppm]*
[ClO2]	Chlorine dioxide	*[ppm]*
[CLT]	chlorite	*[ppm]*
[Fluoride [mA]]	Fluoride	*[ppm]*
[DO]	Dissolved oxygen	*[ppm]*
[O3]	Ozone	*[ppm]*
[PES]	Peracetic acid	*[ppm]*
[H2O2 (PER)]	Hydrogen peroxide with a sensor type *[PER]*	*[ppm]*
[Cond. (mA)]	Conductivity sensor with mA signal	*[µS]*
[Temp. [mA]]	Temperature sensor with mA signal	*[°C]* or *[°F]*
[Temp.(Pt100x)]	Temperature with a sensor type Pt 100 or Pt 1000	*[°C]* or *[°F]*

8.1 Information about the measured variables

Available measured variables

All measured variables are available and useable in the controller.

The measured variable pH [mV]

Measurement of the measured variable pH [mV] takes place using a coaxial cable via the mV signal of the pH sensor. This measurement can be used if the cable length is less than 10 metres.

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.

Temperature

Where amperometric measured variables are concerned, the process temperature is measured for information only except for the CDP chlorine dioxide sensor where temperature compensation is implemented.

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.

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 for compensation of the temperature influence of the process on measurement. When using a DMTa measuring transducer, the process temperature setting is carried out within this DMTa measuring transducer

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

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

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 Cl (chlorine), Br (bromine), ClO_2 (chlorine dioxide), CLT (chlorite), DO (dissolved oxygen) and O_3 (ozone):

The measured variables Cl (chlorine), Br (bromine), ClO_2 (chlorine dioxide), CLT (chlorite), DO (dissolved oxygen) and O_3 (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 used in water disinfection comes in various forms, e.g. liquid sodium-calcium hypochlorite, dissolved calcium hypochlorite or chlorine gas. All of these forms can be measured using DULCOTEST chlorine sensors. After the addition of chlorine to water, the chlorine splits into two fractions dependent on the pH value:

- 1. Into hypochlorous acid (HOCl) a strongly oxidising, efficient, anti-bacterial agent that destroys most organisms very quickly.
- 2. Into the hypochlorite anion (OCl-) – with a weak anti-bacterial effect that requires a long time to kill off organisms.

The sensors for measuring free chlorine selectively measure the very effective hypochlorous acid (HOCl), but not however the hypochlorite anion. If the pH value changes during the process, then the ratio of the two chlorine fractions changes and hence the sensitivity (slope) of the chlorine sensor. If the pH value increases, the measured HOCL concentration decreases. If there is an integrated control, then the control tries to compensate for this. If the pH value now reduces, the result can be a considerable overdosing of chlorine, even though no extra dosing has taken place. Use of a pH compensated chlorine measurement can prevent this.

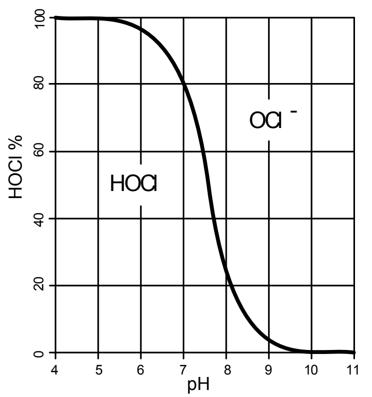


Fig. 27: HOCl/OCL equilibrium

As the graph shows, for pH values > 8.5, less than 10 % of the HOCl is contained in the water and hence the disinfecting power is less. The chlorine value shown after compensation is a calculated chlorine value. The calculated chlorine value does not change the effective disinfection effect acting in the water. Nevertheless the above described overdosing is avoided. To calibrate the amperometric sensors, the recognised reference method DPD 1 (for free chlorine) is used as a comparison method. The reference method is pH-independent (or buffers the pH value to 6.5) and therefore determines the free chlorine nearly completely as 100 % HOCl. So 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 carry out this compensation automatically either using an integrated pH measurement or manually relative to a fixed pH value. We recommend the automatic version. Here it is also essential to measure the sample water temperature, as it has a significant influence on the pH measurement. If this influence was not compensated, then the pH value would not be measured accurately and then the chlorine value would be incorrectly compensated.

Without pH compensation, no calibration is possible at high pH values, because the difference between the measurement with the chlorine sensor and the comparison DPD 1 reference method is too great.

The working range of the pH compensation is: 4.00 ... 8.50, temperature is: 5 ... 45 °C

Combined calibration of pH and chlorine

It is mandatory that the pH measurement is always calibrated first and then the chlorine measurement. Every other pH measurement calibration must always be followed by a chlorine measurement calibration. Otherwise chlorine measurement will be inaccurate.

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 or recording purposes, but not for temperature compensation. Temperature compensation is carried out in the sensor. If the measured variable ClO_2 (chlorine dioxide) and the sensor type CDP are selected, then temperature compensation is necessary.

Measured variable fluoride

The measured variable fluoride is measured using the mA interface. The measuring transducers are connected to this mA interface. The fluoride sensor FLEP-010-SE and the reference sensor REFP-SE are connected to this measuring transducer.

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

FP100V1 measuring transducer: Measured value 0.5 ... 100 mg/l.

Measuring range of the sensors

Select the measuring range. The measuring range is given on the measuring transducer nameplate. An incorrect measuring range leads 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.

Measured variable PAA

Peracetic acid (PAA):The strongly oxidising effect gives rise to its use as a bleach, amongst others for papers, textiles and starch and as a disinfectant (in approximately 1 % concentration) and sterilisation agent (e.g. for the bottling of drinks in plastic bottles)

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.

Measured variable H_2O_2 (PAA) [mA]

Hydrogen peroxide (H_2O_2) is a pale blue, in diluted form, colourless, largely stable liquid compound comprising hydrogen and oxygen. It works as a strong bleach and disinfectant.

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.

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 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 [mA general]

With the measured variable *[mA general]*, various preselected measured variables can be selected or a measured variable and its measurement unit can be freely edited. The temperature measurement cannot be used for compensation purposes, because the influence of the temperature measurement on the measured value is not known. In principal, the settings are made as with the other measured variables of the controller.

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 Calibrating the controller

- **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*
>
> *With sensors or with the output signals of measuring devices that do not require calibration or where calibration is carried out in the sensor/measuring device, display tolerances between the sensor or measuring device and the controller need be balanced. The relevant information hereto is contained in the respective operating instructions of the sensor or measuring device.*

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

or

Continuous display ➨ CAL

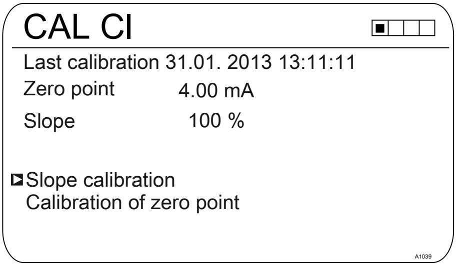


Fig. 28: Display [Calibrate] in the example [Cl] (chlorine)

> *Calibration of measuring channel 1 and measuring channel 2*
>
> *The calibration process is the same for measuring channel 1 and measuring channel 2. Each measuring channel must be calibrated independently, however the calibration procedure is the same for both measuring channels.*

9.1 Calibrating the pH measured value

To ensure high measuring accuracy, it is necessary that you adjust the pH sensor at set time intervals. This calibration interval depends strongly 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 carry out the pH value measurement using potential equalisation, then you must set this approach when selecting the measured variable as a parameter.

1. You must remove the wire jumper, see terminal diagram, XE3 1_2 for channel 1 and XE7 1_2 for channel 2
2. You must now connect the liquid potential equalisation kit (part number 818438) to the now free terminals.

   For the in-line probe housing DGMA, you also need a liquid potential equalisation plug (part number 791663)
3. Connect the liquid potential equalisation kit to the fitting (e.g. DGMa)
4. During calibration you must also immerse the liquid potential equalisation pin in the buffer solution. Otherwise the calibration will be inaccurate or not possible

Combined calibration of pH and chlorine

It is mandatory that the pH measurement is always calibrated first and then the chlorine measurement. Every other pH measurement calibration must always be followed by a chlorine measurement calibration. Otherwise chlorine measurement will be inaccurate.

You must select the calibration process before the first 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: asymmetry potential, slope and response speed. 2 buffer solutions are necessary for the 2-point calibration, e.g. pH 7 and pH 4 if later measurement is to take place in an acidic medium or pH 7 and pH 10, if later measurement is to take place in an alkaline medium. The buffer gap must be at least 2 pH units.
- Samples (1-point) calibration: There are two possibilities here. Samples (1-point) calibration is only recommended with reservations. From time to time the sensor must be checked with a 2-point calibration.
  - The pH sensor remains in the measurement medium and you must calibrate a sample of the measurement medium against an external comparison measurement. The comparison measurement must take place 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. Checking of the sensor for an acceptable slope does not take place.
- File input: with this calibration method you determine in advance, using a comparison measurement device, the characteristic data of the pH sensor (asymmetry and slope) at standard temperature and enter this data in the controller. The comparison calibration must not be more than a week old because the characteristic data of the pH sensor change if the data are saved for longer.

Buffer temperature

At process temperatures differing from 25 °C, you must adjust the pH value of the buffer solution by entering the reference values printed on the buffer solution bottle into the controller prior to calibration.

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

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

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

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, then calibration is not possible. You must rectify any fault or cable break.

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

The signal fluctuation width within the ranges is specified as follows: first 30 seconds wait time, then evaluation of the sensor signal

- 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

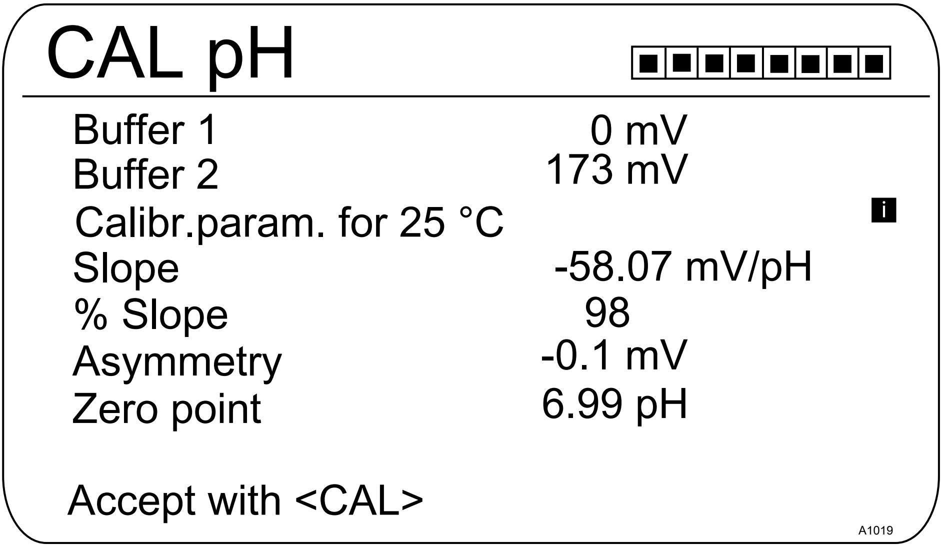


Fig. 29: Display of the calibration result

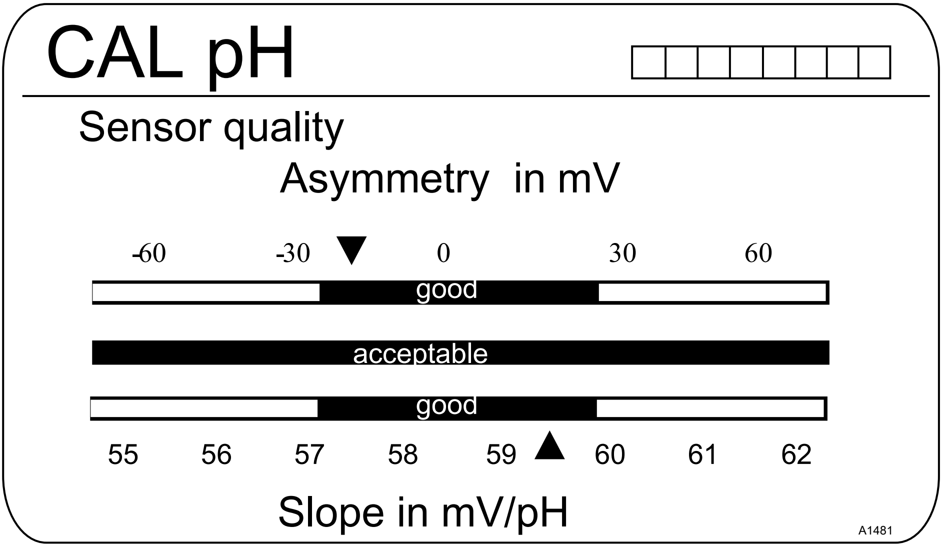


Fig. 30: Displayed after pressing the ▷ key

9.1.1 Selection of the pH calibration process

To calibrate the controller there are three available calibration processes:

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

Calibration process selection

1. Continuous display ➡ CAL
   - ⇨ The calibration menu is displayed
2. Press OK

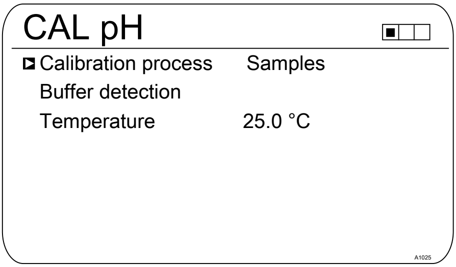


Fig. 31: Calibration process selection

   - ⇨ The menu for selecting the calibration process appears.
3. Using the arrow keys select the desired menu entry and press the OK key
   - ⇨ The entry window appears.
4. Using the arrow keys select the calibration process and press the OK key
5. Then press CAL
   - ⇨ You can now start the selected calibration process.

9.1.1.1 Setting the temperature

1. Continuous display ➡ CAL
   - ⇨ The calibration menu is displayed
2. Press OK

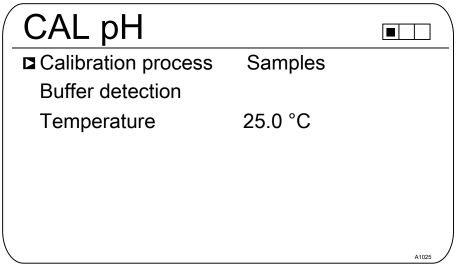


Fig. 32: Setting the temperature

   - ⇨ The menu for selecting the temperature for the calibration process appears.
3. Then press CAL
   - ⇨ You can now start the selected 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*
– *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*

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 buffer

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

Valid calibration values

Valid calibration:

– *Zero point -60mV…+60 mV*
– *Slope 55 mV/pH…62 mV/pH*

Two test containers with a buffer solution are required for calibration. The pH values of the buffer solutions must be at least 1.5 pH units apart. Thoroughly rinse the sensor with water when changing the buffer solution.

Continuous display ➨ CAL

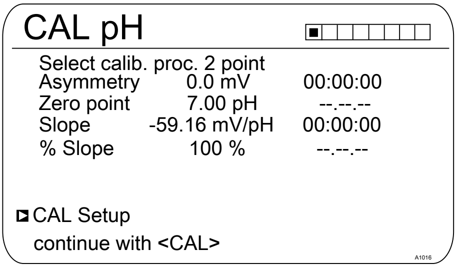


Fig. 33: pH sensor calibration (CAL)

1. Then press CAL
2. Immerse the sensor in test container 1 which contains the buffer solution (e.g. pH 7). When doing so gently move the sensor
3. Then press CAL

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

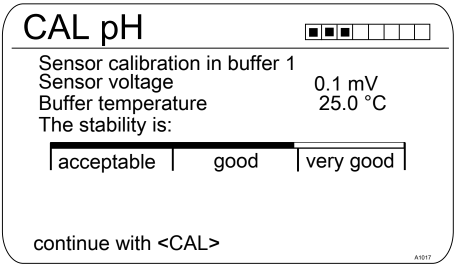


Fig. 34: Display of the attained sensor stability

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

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

5. Then press CAL

6. *[Puffer detection] [Manual]*: Press the OK key and set the buffer value for buffer 1 using the four arrow keys to the value of the buffer you are using. Confirm input of the value by pressing the OK key

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

8. Then press CAL

9. Immerse the sensor in test container 2 which contains the buffer solution (e.g. pH 4). When doing so gently move the sensor

10. Then press CAL

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

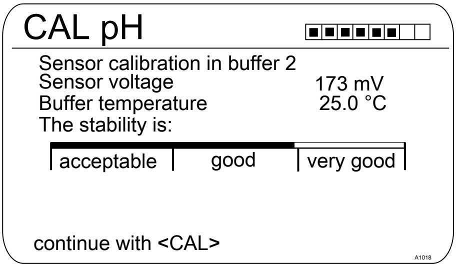


Fig. 35: Display of the attained sensor stability

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

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

12. Then press CAL

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

14. Then press CAL

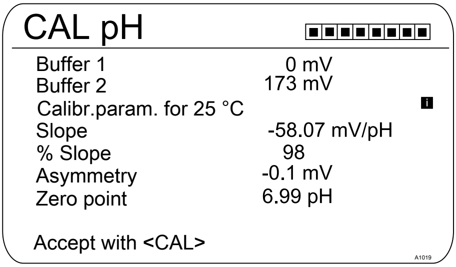


Fig. 36: Display of the calibration result

15. *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

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.

9.1.3 pH sensor calibration (CAL) with an external sample

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 few disadvantages in comparison with the buffer solution calibration method. If the pH value fluctuates considerably during the process, then in the period between sampling, sample measurement and entry of the pH value into the controller, the pH value may change by a variable amount. In this case, the result may be that the pH value entered in the controller does not correspond to the actual pH value. 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, then this cannot be detected by calibration using an external sample. In the calibration method with two buffers (e.g. pH 7 and pH 4) this becomes apparent if the pH sensor does not detect any change in the pH value.

The calibration method with an external sample should only be used with installations with difficult to access pH sensors and process pH values that are always the same or very uniform. 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*
- *Observe the sensor operating instructions*

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

Continuous display ➨ CAL

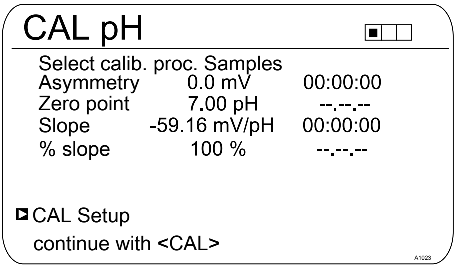


Fig. 37: pH sensor calibration (CAL)

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

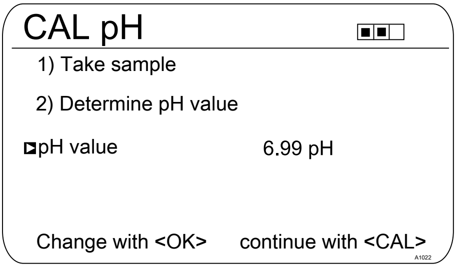


Fig. 38: Work instruction for determining the pH value using the [Sample] method

3. Press OK
4. Using the arrow keys, enter the pH value you determined into the controller
5. Press OK
6. Accept the pH value by pressing the CAL key
   ⇨ All the values of the calibration result are output to the display.

> *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*

7. Press the CAL key to import the result of the calibration into the memory of the controller
   ⇨ The controller displays the continuous display again and operates using the calibration results.

9.1.4 Calibration of the pH sensor (CAL) by data input

Data input

Using the calibration method [Calibration of the pH sensor (CAL) by data input], the known data of the sensor are entered in the controller. The calibration by data input is only as accurate and reliable as the method with which the data were determined.

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

Correct sensor operation

– *Correct measuring and metering is only possible if the sensor is working perfectly*
– *Observe 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.

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 … 60.5 mV/pH
Acceptable	-60 mV … +60 mV	55 mV/pH … 62 mV/pH

Continuous display ➨ CAL

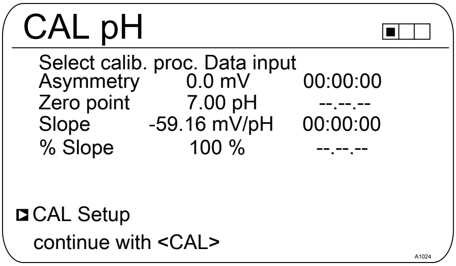


Fig. 39: pH sensor calibration (CAL)

1. Then press CAL

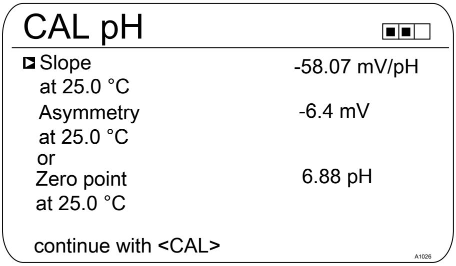


Fig. 40: Selection of the settable parameters

2. Using the arrow keys select the desired menu entry and press the OK key
   ⇨ The entry window appears.
3. Enter the values for your sensor using the arrow keys and press the OK key
4. Then press CAL

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

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.

9.2 Calibrating the ORP measured value

9.2.1 Selection of the calibration process for ORP

Calibration process selection

To calibrate the controller there are two available calibration processes:

- Single point calibration (with buffer solution)
- Data input

1. Continuous display ➡ CAL

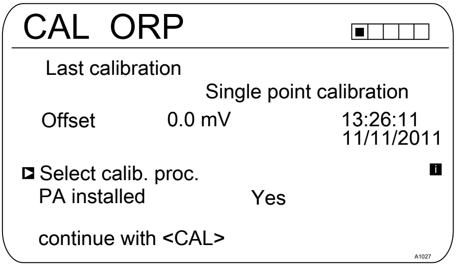


Fig. 41: Calibration menu [ORP]

⇨ The calibration menu is displayed.

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

⇨ The menu for selecting the calibration process appears.

3. Using the arrow keys select the desired menu entry *[Select calib. proc.]* and press the OK key

⇨ The entry window appears.

4. Using the arrow keys select the calibration process and press the OK key

5. Then press CAL

⇨ You can now start the selected calibration process.

9.2.2 Single point calibration ORP sensor (CAL)

Correct sensor operation

– *Correct measuring and metering is only possible if the sensor is working perfectly*
– *Observe the sensor operating instructions*
– *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*

ORP sensor calibration

The ORP sensor cannot be calibrated. Only a deviation [OFFSET] with a value in the range ± 40 mV can be set and thereby 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.

Used buffer

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

One test container with a buffer solution is required for calibration.

Continuous display ➨ CAL

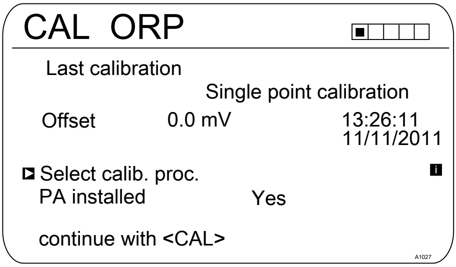


Fig. 42: Single point calibration ORP sensor (CAL)

1. Then press CAL

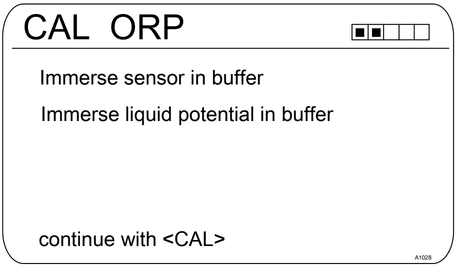


Fig. 43: Single point calibration ORP sensor (CAL)

2. Carry out the instructions and then press CAL

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

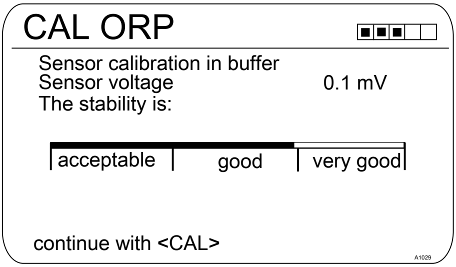


Fig. 44: Display of the attained sensor stability

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

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

4. Then press CAL

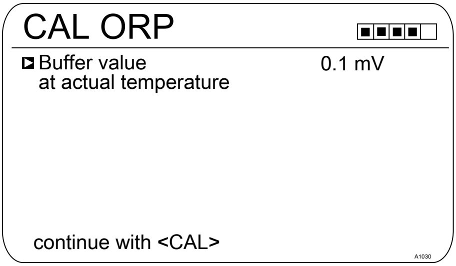


Fig. 45: Adjusting the buffer value

5. Press the OK key and set the mV value using the four arrow keys to the value of the buffer you are using.

6. Press OK

7. Then press CAL

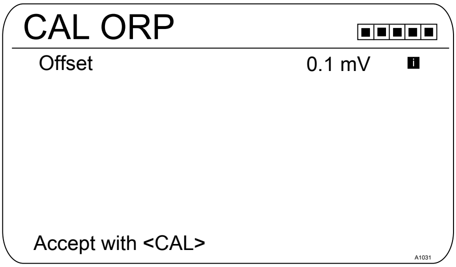


Fig. 46: Acceptance of the [Offset]

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

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

9.2.3 ORP sensor data calibration (CAL)

> ***Correct sensor operation***
>
> – *Correct measuring and metering is only possible if the sensor is working perfectly*
> – *Observe the sensor operating instructions*
> – *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*

ORP sensor calibration

The ORP sensor cannot be calibrated. Only a deviation ‘OFFSET’ of magnitude ± 40 mV can be set and thereby 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

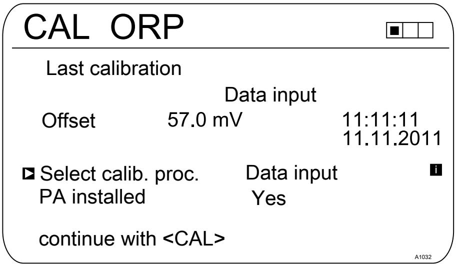


Fig. 47: Data input, ORP sensor calibration (CAL)

1. Then press CAL

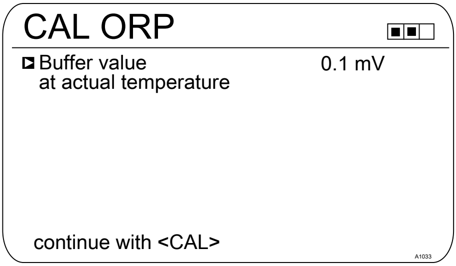


Fig. 48: Adjusting the buffer value

2. Press the OK key and set the mV value using the four arrow keys to the value of the buffer you are using.
3. Press OK
4. Then press CAL

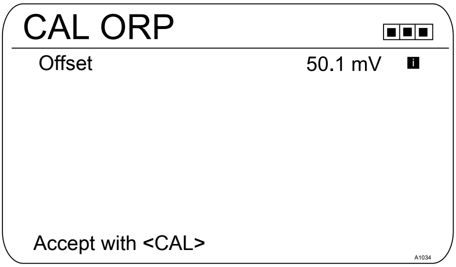


Fig. 49: Acceptance of the [Offset]

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

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

9.3 Calibrating fluoride (F^-) measured value [mA]

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

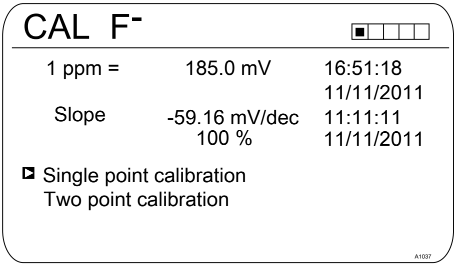


Fig. 50: Calibration menu [Fluoride]

⇨ 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

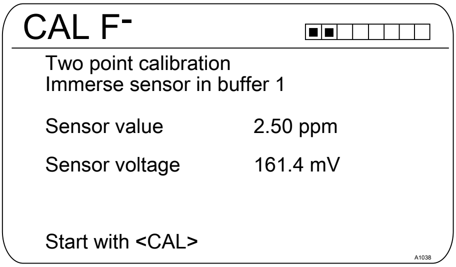


Fig. 51: Fluoride sensor calibration (CAL)

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]*.

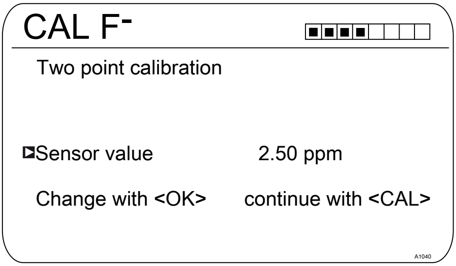


Fig. 52: Fluoride sensor calibration (CAL)

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

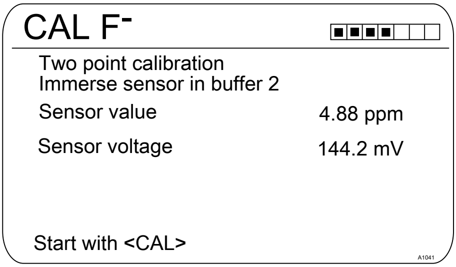


Fig. 53: Fluoride sensor calibration (CAL)

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

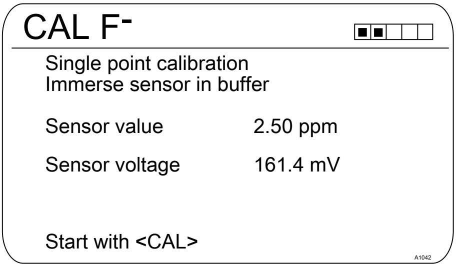


Fig. 54: Fluoride sensor calibration (CAL)

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]*.

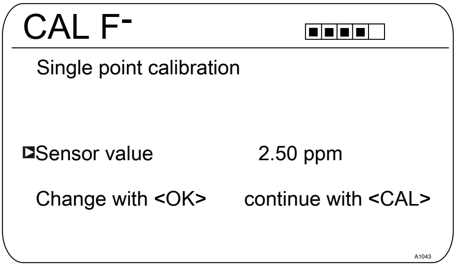


Fig. 55: Fluoride sensor calibration (CAL)

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 the measured value for amperometric measured variables

Calibrating amperometric measured variables

The calibration procedure for amperometric measured variables is the same for all amperometric measured variables.

The procedure for calibrating amperometric measured variables is described throughout based on the measured variable chlorine [Cl]. All other measured variables require the same procedure as the measured variable chlorine [Cl].

The following measured variables can be calibrated using the procedure described here:

- *Chlorine*
- *Chlorine dioxide*
- *Bromine*
- *chlorite*
- *Ozone*
- *Peracetic acid (PES)*
- H_2O_2

Combined calibration of pH and chlorine

It is mandatory that the pH measurement is always calibrated first and then the chlorine measurement. Every other pH measurement calibration must always be followed by a chlorine measurement calibration. Otherwise chlorine measurement will be inaccurate.

9.4.1 Selection of the calibration process for amperometric measured variables

To calibrate the controller there are two available calibration processes:

- Slope calibration
- Calibration of zero point

Calibration process selection

1. Continuous display ➨ CAL

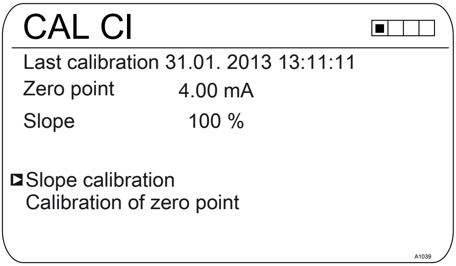


Fig. 56: Calibration menu [Chlorine]

⇨ The calibration menu is displayed.

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

⇨ You can now start the selected calibration process.

9.4.2 Slope calibration

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.

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

NOTICE!

Prerequisites for correct calibration of the sensor slope

- The DPD method required by the feed chemical employed will be used
- 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

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 metering medium 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 the CAL key in the continuous display.
2. Using the arrow keys select the *[DPD value]*
3. Then press OK

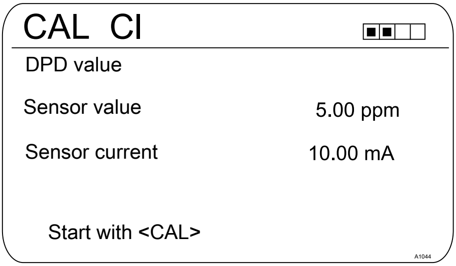


Fig. 57: DPD value calibration shows the actual sensor values

4. Then press CAL

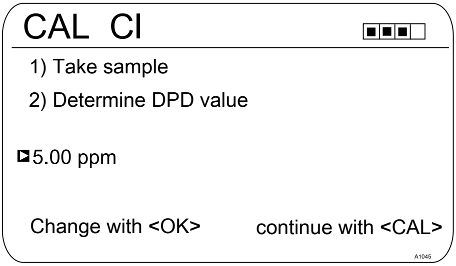


Fig. 58: DPD value calibration, here the sensor value is frozen; now take the sample and measure using DPD

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

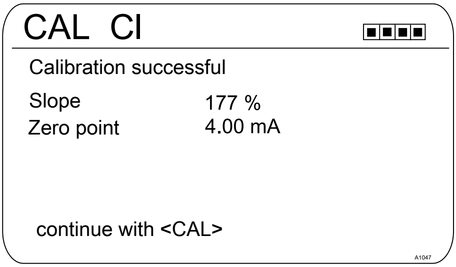


Fig. 59: DPD value calibration

6. 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*

Permitted calibration range

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

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

Example with a steep slope: Surfactants make the sensor diaphragm more permeable leading to a steeper slope (steep slope = high sensor sensitivity)

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

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.

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

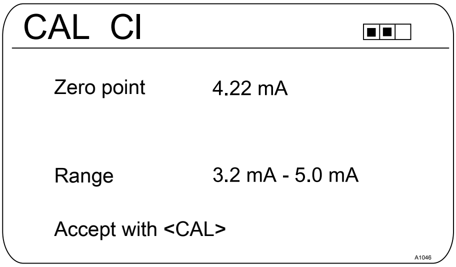


Fig. 60: Calibration of zero point

4. Then press CAL

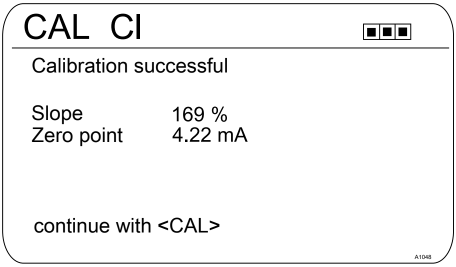


Fig. 61: Calibration of zero point

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 the measured value for the measured variable DO

Specify the calibration interval

The calibration interval depends strongly 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 its commissioning:

1. Take the sensor out of the medium
2. Clean the outside of the sensor with a damp cloth
3. Then gently dry the sensor diaphragm, e.g. using a paper towel
4. After 20 minutes, measure the oxygen saturation index in the air
5. Protect the sensor against external influences such as sunlight and wind

    ⇨ Now decide dependent on the result:

    Amperometric sensor: If the measured value does not lie with 102 ± 2 %SAT, you must calibrate the sensor.

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

> *Calibration specifications of the sensor manufacturer*
>
> *When determining the calibration interval also consider the sensor operating instructions as they may specify additional and/or deviating 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

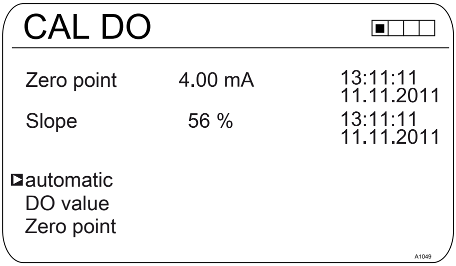


Fig. 62: Calibration menu [DO]

⇨ 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

CAL DO

Water temp.	10.0 °C
Adjusting the concentration	200.0 %
Air temperature	20.0 °C
Air pressure	1013 mbar
higher than Sea level	300 m
Relat. humidity	100 %
Salinity of the Water	0 g/l

continue with <CAL>

A1074

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

CAL DO

Sensor head up

Minimum waiting time 5 min

Time: XX.XX min

continue with <CAL>

A1075

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

CAL DO

Water temp.	10.0 °C
Adjusting the concentration	200.0 %
▶ Air temperature	20.0 °C
Air pressure	1013 mbar
higher than Sea level	300 m
Relat. humidity	100 %
Salinity of the Water	0 g/l

continue with <CAL>

A1074

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

CAL DO

Zero point	4.70 mA
Range	3.2 - 5.0 mA

Accept with <CAL>

A1079

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

5. Then press CAL

CAL DO

Calibration successful

Slope	32 %
Zero point	4.70 mA

continue with <CAL>

A1080

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

CAL DO

Water temp.	10.0 °C
Adjusting the concentration	200.0 %
◘ Air temperature	20.0 °C
Air pressure	1013 mbar
higher than Sea level	300 m
Relat. humidity	100 %
Salinity of the Water	0 g/l

continue with <CAL>

A1074

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

CAL DO

DPD value

Sensor value	0.00 ppm
Sensor current	8.03 mA

Start with <CAL>

A1076

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

5. Then press CAL

CAL DO

1) Take sample
2) Determine DPD value

◘ 7.04 ppm

Change with <OK> continue with <CAL>

A1077

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

CAL DO

Calibration successful

Slope	34 %
Zero point	4.00 mA

continue with <CAL>

A1078

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.

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 'Configuration of measured variables' on page 50*, all settings in the *[Measurement]* and *[Control]* menus are reset to their factory settings (default values). You then have to make the settings against in the *[Measurement]* and *[Control]* menus.

The operator is responsible for the correct set-up of the controller.

Prerequisites for the [Control] set-up:

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

- *Specify all the measured variables and the necessary settings in the [Measurement] menu, see ✎ Chapter 8 'Configuration of measured variables' on page 50*
- *Specify all the intended actuators for the control task: You can find specifications for the relevant electrical connections and settings in the menus*
  - *[Pumps], see ✎ Chapter 12 'Setting the [Pumps]' on page 120*
  - *[Relays], see ✎ Chapter 13 'Setting the [Relays]' on page 123*
  - *[mA outputs], see ✎ Chapter 15 'Setting the [mA outputs]' on page 130*

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

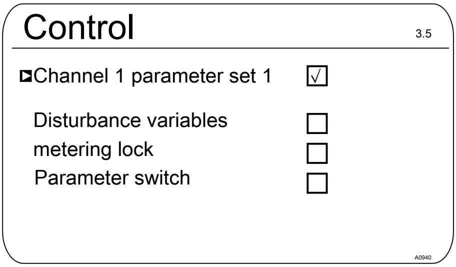


Fig. 72: Continuous display ➨ MENU ➨ ▲ or ▼ [Control] ➨ OK [Control]

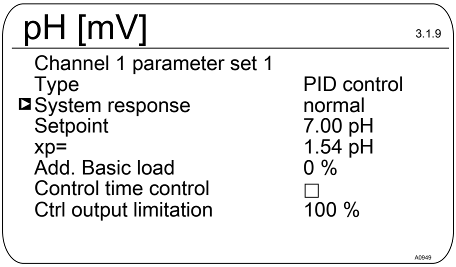


Fig. 73: In the example pH [mV]: Continuous display ➨ MENU ➨ ▲ or ▼ [Control] ➨ OK [Control] ➨ ▲ or ▼ [Channel 1 parameter set 1] ➨ OK [Channel 1 parameter set 1]

Parameter level 1	Function	Parameters
[Channel 1 parameter set 1]	*[Type]*	none
		Proportional 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	Parameters
	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.
	[Add. Basic load]	The adjustable range of the additive basic load is specified by the device.
	[Checkout time control]	Checkout time (up)
		Checkout time ↓ (down)
		Control variable threshold
	[Ctrl output limitation]	The adjustable range of the maximum threshold is specified by the device.
[Disturbance variables]	Disturbance variable input	Off
		On
[Remote set-point]	Channel 1/2	Off
		On
[Parameter switch]	*[Event controlled]*	Off
		On
	[Time controlled]	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]*. In this case *[Parameter set 2]* can be configured in the menu.

When connecting the actuator you must ensure that the actuator which increases the measured value is connected to the corresponding output *[Increase measured value]* and the actuator which is 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 set-point pH 7 using a sodium hydroxide solution (pH >14). Therefore you must connect the actuator to the control output *[Increase measured value]*.

The following chemicals increase the pH value:	e.g. chlorine, bromine, alkalis, chlorine dioxide... . The control variable is in this connection positive (+).
The following chemicals decrease the pH value:	e.g. acids and reducing agents (sodium bisulphite) ... . The control variable is in this connection negative (-).

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 arises in an alternating manner. Before the water can be fed into the sewerage system, the pH value must for example be set to an example between pH 6.8 and 7.5. Here a 2-way controller with two metering pumps is used for metering acid and alkali. The pH value can be both decreased or increased in order to come within the necessary setpoint range.

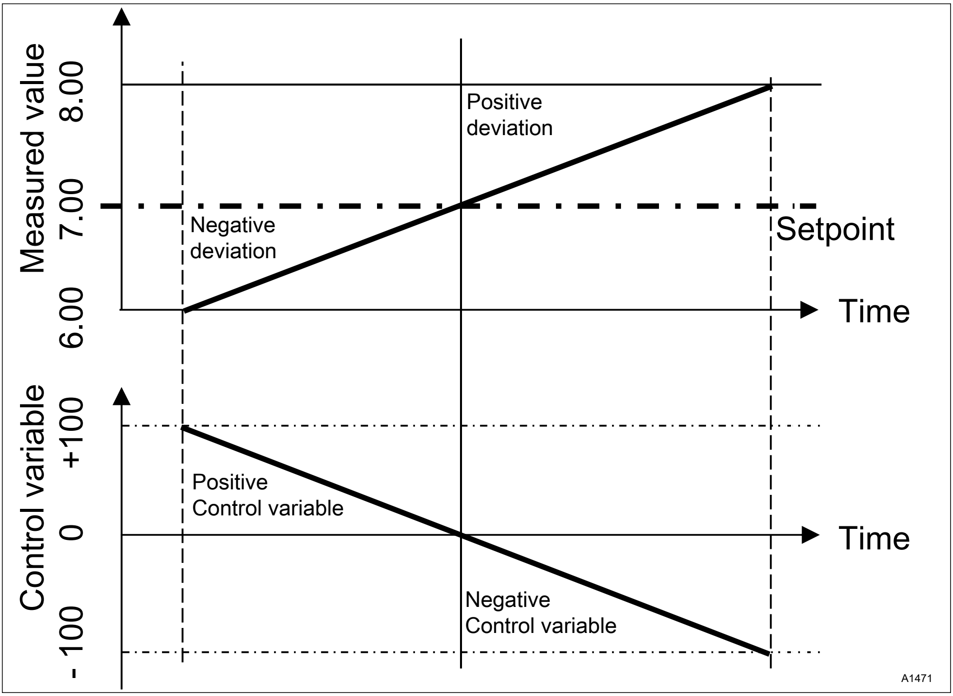


Fig. 74: Control type two-way PID. Control characteristic without dead zone

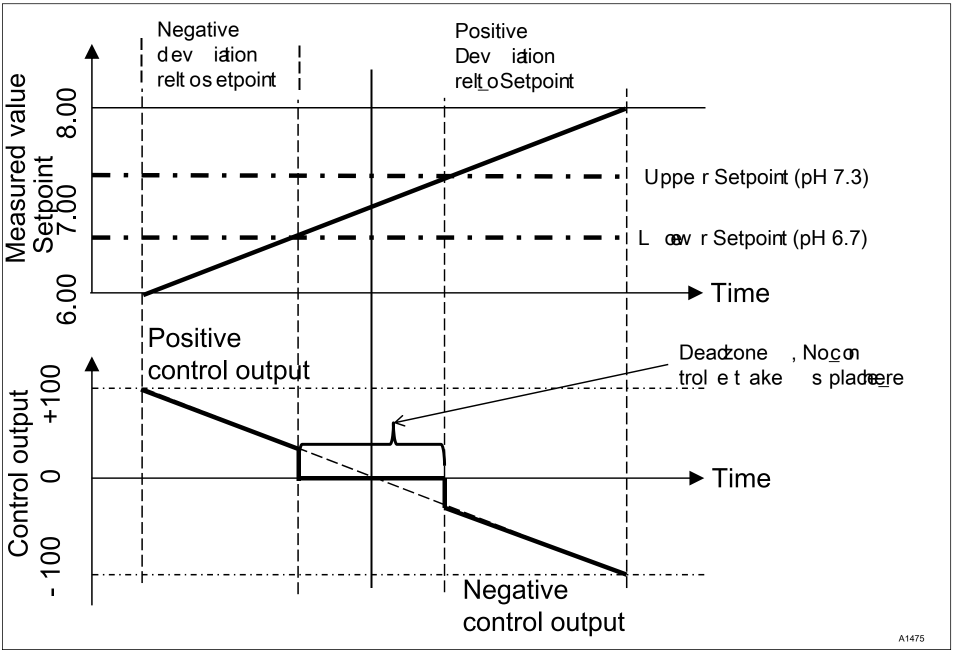


Fig. 75: Control type two-way PID, with dead zone

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

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

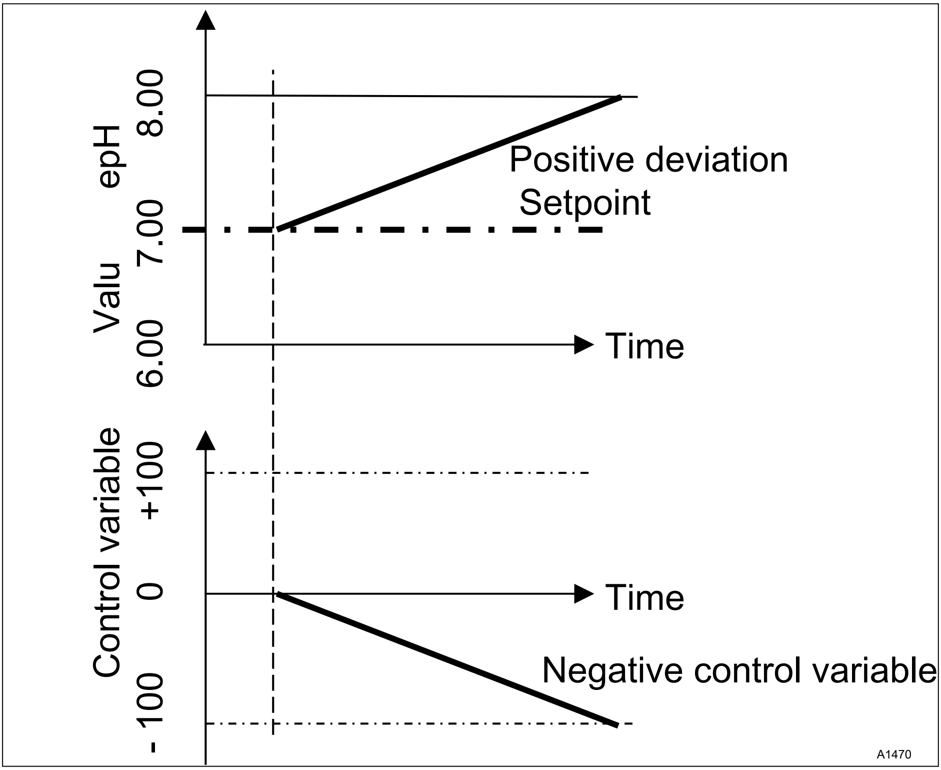


Fig. 76: Control type 1-way PID, direction pH decrease value

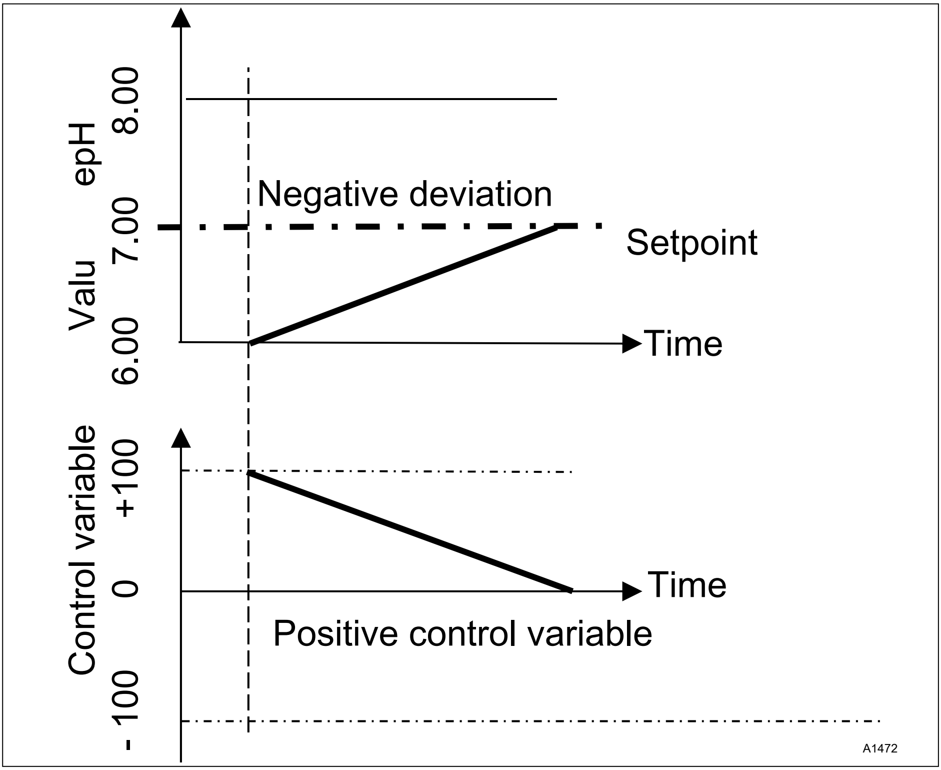


Fig. 77: Control type 1-way PID, direction pH increase value

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 104*.

[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.

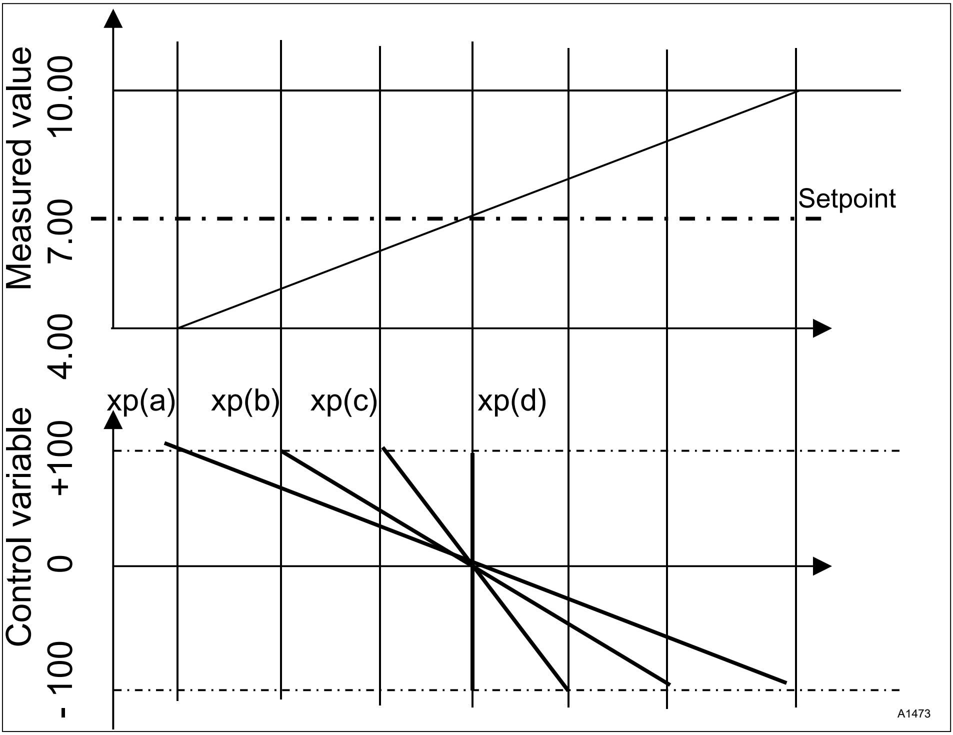


Fig. 78: The smaller the xp value, the more "forcefully" the control reacts.

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 over-dosing 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 Disturbance variable

More steady control of flow processes using a feedforward control.

Additive and multiplicative feedforward control

The disturbance variable is, alongside the information relating to the actual measured variable, e.g. the chlorine concentration, a further source of information for the controller that makes it easier for the controller to achieve stable control during flow processes. During flow processes, both parameters mentioned change frequently over wide ranges. If a parameter value is not recognised, then it is not possible to achieve stable control of the other parameter values

The signal source of the disturbance variable can be supplied to the controller via an analog signal or a frequency (included in the basic version of the controller). To process an analog signal, channel 2 must be equipped with equipment package 2 (a main measured variable, e.g. chlorine) or equipment package 4 (2 main measured variables, e.g. pH and chlorine).

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

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

Application example additive disturbance variable

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

Application example:

You have to chlorinate drinking water. The desired setpoint is 0.3 mg/l (ppm) chlorine. The volume flow of the drinking water is measured with a flow meter. The measurement signal of the flow meter is routed to the controller via a 4 ... 20 mA signal. The continual measurement of the chlorine is carried out using a CLE3 chlorine sensor. The volume flow changes in 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 specified chlorine quantity (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 flow-proportional control variable. If by contrast, caused by a too high proportionality, too much chlorine is metered, then a negative control variable is output and added to the flow-proportional control variable and the resulting control variable would fall.

You must set the following in the controller menu:

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

[Effect]: *[additive]*

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

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

Multiplicative disturbance variable

With the multiplicative disturbance variable, the disturbance variable of the setpoint controller can be influenced over the entire control range. Here a proportionality factor of 0.00 = 0% and 1.00 = 100 %, including all intermediate values.

Disturbance variable

Parameter	Default setting	Possible values	Minimum value	Maximum value	Remark
Function	Off	On/Off			Switches the disturbance 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 disturbance 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.

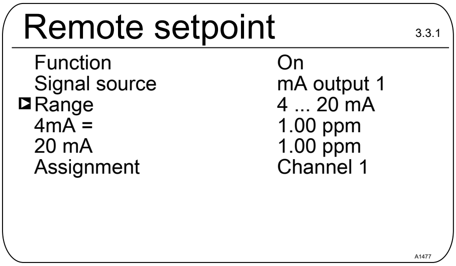


Fig. 79: Remote setpoint via a 0/4 ... 20 mA analog signal

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

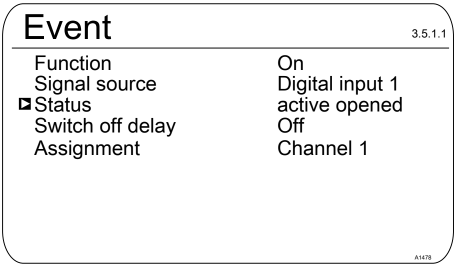


Fig. 80: Event controlled

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 configu-ration, 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.

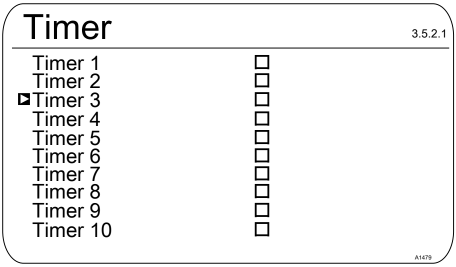


Fig. 81: [Timer control] = [Timer]

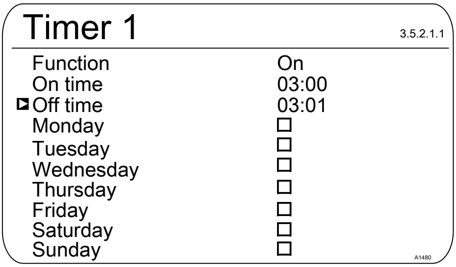


Fig. 82: Example: Timer 1

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.*

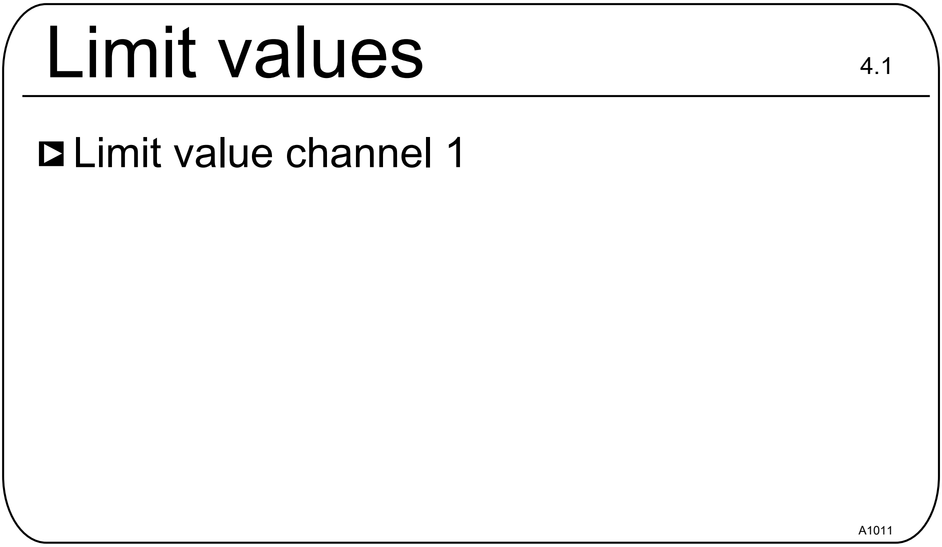


Fig. 83: Setting the [Limit values]

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.

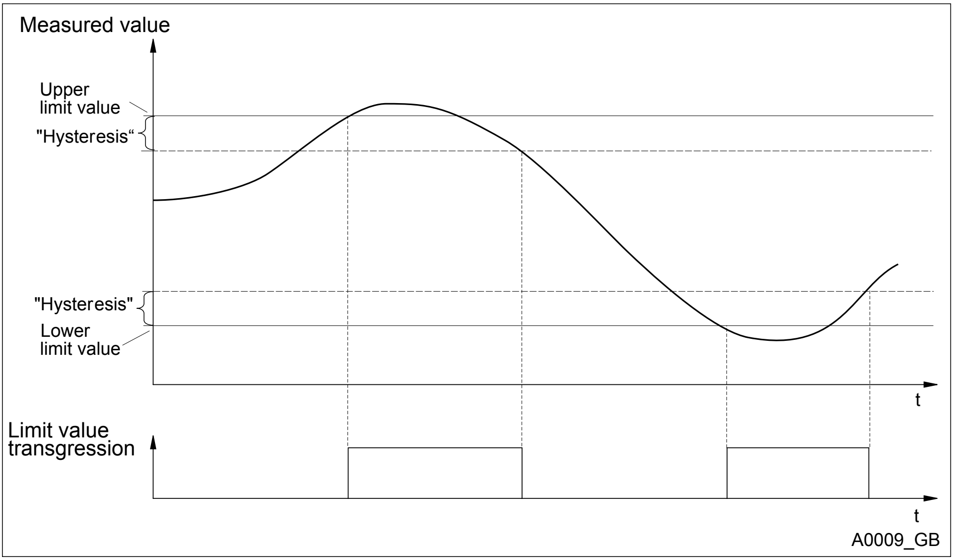


Fig. 84: Hysteresis

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]

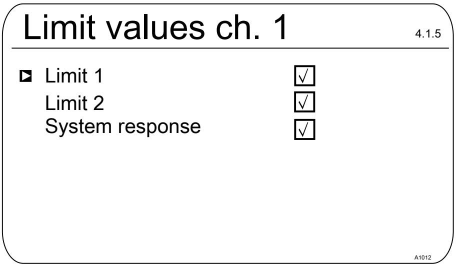


Fig. 85: Setting Limit value channel 1

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]*

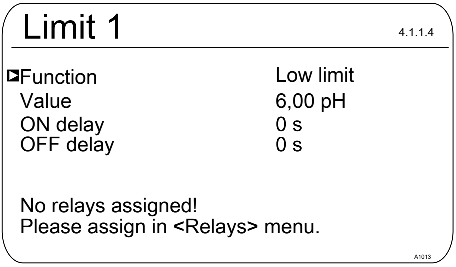


Fig. 86: Setting Limit 1

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]*

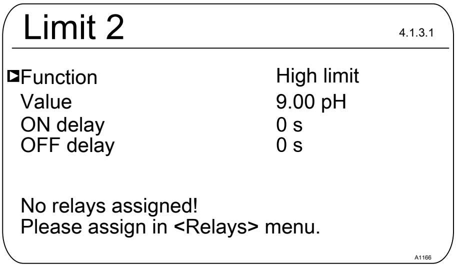


Fig. 87: Setting [Limit 2]

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]*

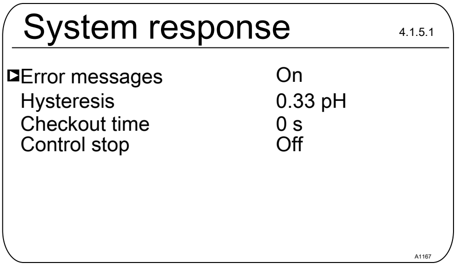


Fig. 88: Setting [System response]

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.*

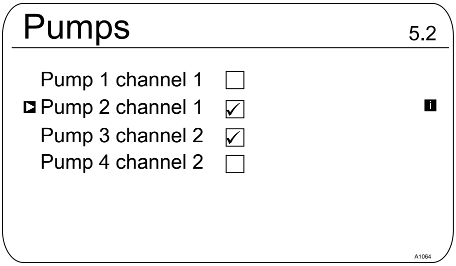


Fig. 89: Setting the [Pumps]

> ***Set-up of [Pump 1] or [Pump 2]***
>
> *Solely 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 up [Pump 1]

> **WARNING!**
>
> **Priming with OK**
>
> Cause: If you select the function *[Priming with <OK>]* when the pumps are connected and operable, the pumps continue to operate at 100 % power for as long as you press the OK key. This function is used to bleed the pump and the feed and drainage lines.
>
> Possible consequence: Death or serious injury may result from the uncontrolled transport of feed chemical.
>
> Measure:
>
> – Ensure that the function *[Priming with <OK>]* cannot result in the unregulated escaping of feed chemical.
> – Ensure that the function *[Priming with <OK>]* cannot supply any process in an unregulated manner with feed chemical.
> – Refer to the safety data sheets on your feed chemicals.

CAUTION!

Observe the operating manual for the pump

Possibility of damage to the pump.
Faults in the process.

- Set the pump in *[External Contact]* operating status
- Observe the maximum stroke rate for the pump
- Switch off any stroke memories which may be present in the pump control
- The maximum stoke rate for the pump can be found in the pump operating manual
  - Setting a stroke rate on the controller, which is higher than the actual possible maximum stroke rate of the pump, can lead to hazardous operating conditions

Maximum pump frequency

The pumps are activated in accordance with the control variable up to the respective maximum stroke rate of the pump.

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

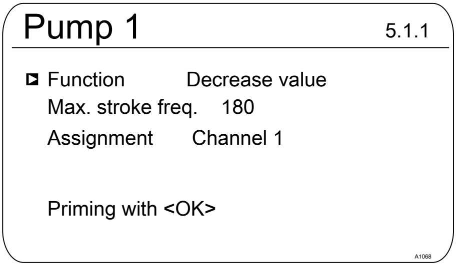


Fig. 90: Setting [Pump 1]

➨ Select the respective menu using the ▲- or ▼ keys and confirm by pressing the OK key.

⇨ The relevant setting menu appears.

Parameters	Settable function
[Function]	Set the pump as: ■ *[Increase value]* ■ *[Decrease value]* ■ *[Off]*
[Max. stroke freq.]	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
[Priming with <OK>]	If you select the function *[Priming with <OK>]* when the pumps are connected and operable, the pumps continue to operate at 100 % power for as long as you press the OK key. This function is used to bleed the pump and the feed and drainage lines.

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.*

Relay 6.1

▶ Relay 1	☑	Limit 1
Relay 2	☐	Off
Alarm relay	☐	Off

A1069

Fig. 91: Setting the [Relays]

> ***Setting [Relay 1], [Relay 2] or [Alarm relay]***
>
> *Solely the process for [Relay 1] is described. The set-up process for [Relay 2] or the [Alarm relay] is the same as for [Relay 1].*

13.1 Setting Relay 1

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

Relay 1 6.1.1

▶ Function	Limit 1
Assignment	Channel 1

A1070

Fig. 92: Setting Relay 1

➜ Select the respective menu using the ▲- or ▼ keys and confirm by pressing the OK key.

⇨ The relevant setting menu appears.

Settable parameters of Relay 1 and Relay 2

Parameters	Settable function
[Function]	Set relay as: ■ *[Off]* ■ *[Limit 1]* ■ *[Limit 2]* ■ *[Limit 1 <Actuator>]* ■ *[Limit 2 <Actuator>]* ■ *[Timer]* ■ *[Control variable]* ■ *[Wash relay*]* – * only for relay 2 and only if a timer is activated in the *[Service]* menu.
[Assignment]	Assign the relay to the relevant measuring channel: ■ *[Channel 1]* ■ *[Channel 2]* ■ *[Channel 3]* ■ *[channel 1+2]* ■ *[Channel 1+2+3]*

Settable parameters of the alarm relay

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

> *Changeable scope of the menus*
>
> *Dependent on the type and scope of the selected [Function], the number of adjustable parameters may be different. The controller provides you with the option of possible, adjustable parameters. You can select them with ▲- or ▼ keys and confirm by pressing the OK key. The possible adjustment ranges are specified to you by the controller.*

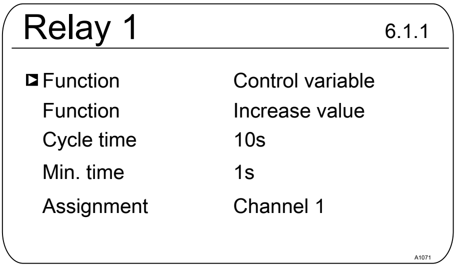


Fig. 93: Possible adjustable parameters for the [Function], for example [Control variable]

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 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 116*.

> ***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).*

13.1.3 Function description [Control variable]

In the setting *[Control variable]*,

13.1.4 Function description [Timer]

In the setting *[Timer]*, ...

CAUTION!

The [Timer] is reset when there is no supply voltage

Possible consequence: slight or minor injuries. Material damage.

– Configure the power supply in such a way that it cannot be interrupted
– With critical processes, the possible failure of the timer should be practically addressed when designing your application

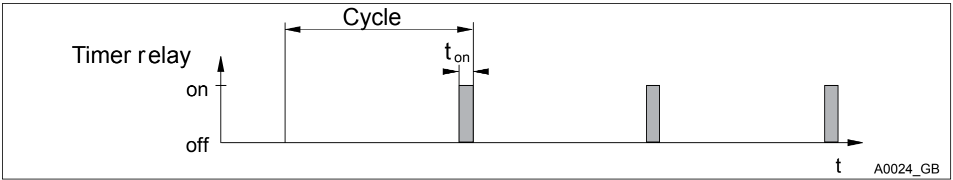


Fig. 94: Timer relay

At the end of the (Timer) cycle time, the controller closes the corresponding timer relay for the duration of *[t on]*. *[Pause]* interrupts the timer. If the clock is visible on the LCD display, then the *[Timer]* can be reset to the beginning of the cycle using the OK key. The % specification on the LCD display indicates the remaining runtime.

13.1.5 Function description [Control variable]

If the output relays are configured as a *[Control variable]*, then these output relays output the control variable 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.

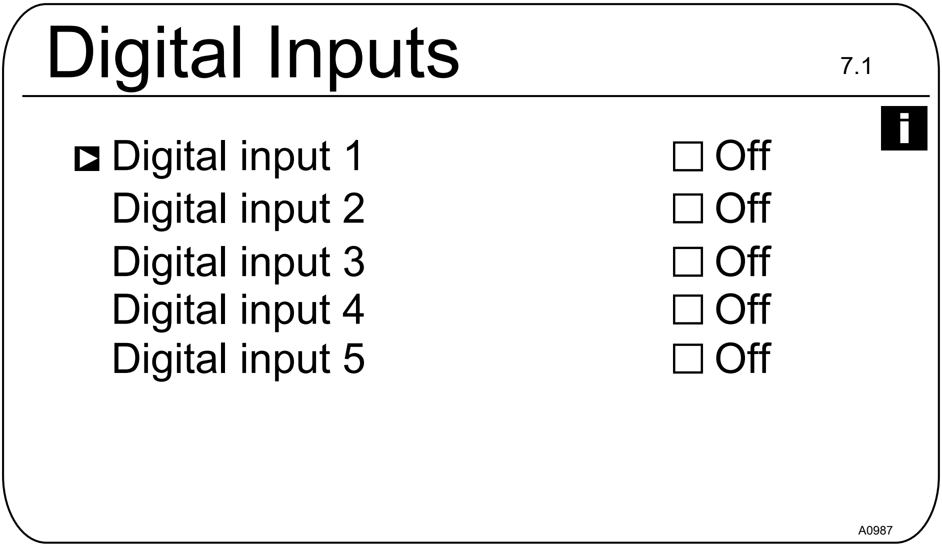


Fig. 95: Setting digital inputs [Dig. inputs]

14.1 Setting [Digital input 1]

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

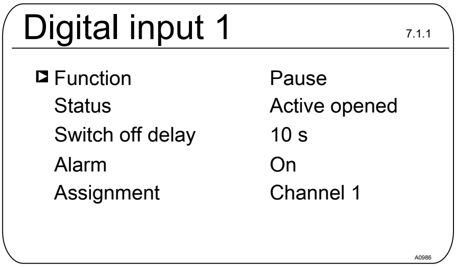


Fig. 96: Setting [Digital input 1]

Pause

Parameters	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]

Error sample water

Parameters	Adjustment range
Function	Off / Error sample water
Status	Active opened / Active closed
Switch off delay	0 ... 1800 s
Assignment	Channel 1, channel 1+2

Setting [Digital input 3]

Level pump 1

Parameters	Adjustment range
Function	Off / Pause Hold / Level pump 1
Status	Active opened / Active closed
Switch off delay	0 ... 1800 s
Assignment	Channel 1

Setting [Digital input 4]

Level pump 2

Parameters	Adjustment range
Function	Off / Pause Hold / Level pump 2
Status	Active opened / Active closed
Switch off delay	0 ... 1800 s
Assignment	Channel 1

Setting [Digital input 5]

Level pump 3

Parameters	Adjustment range
Function	Off / Pause Hold / Level pump 3
Status	Active opened / Active closed
Switch off delay	0 ... 1800 s
Assignment	Channel 1

15 Setting the [mA outputs]

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

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

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.

CAUTION!

Destruction of the monitors

Only passive monitors can be connected to the mA outputs. For example, if the mA outputs are connected to a PLC, then the connection type at the PLC must be selected as 4-wire. The connection type 2-wire leads to faulty operation and, as the case may be, to destruction of the monitors.

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

Behaviour upon *[Pause Hold]*:
[Pause Hold] determines the behaviour of the mA outputs if the function *[Pause Hold]* is active.

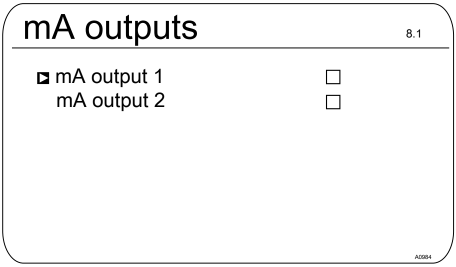


Fig. 97: Setting the [mA outputs]

15.1 Setting [mA outputs]

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

> *mA output 2*
>
> *The menu item [mA output 2] has the same setting options as the menu item [mA output 1]. A separate description is not provided.*

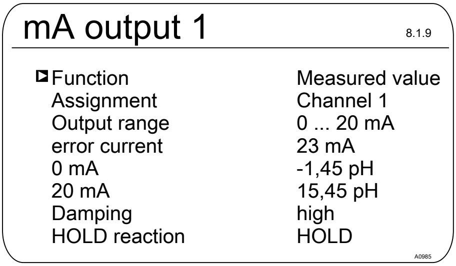


Fig. 98: Setting [mA output 1]

[Function]	Adjustable value	Explanation
[Function]	*[Off]*	The mA output has no function
	[Measured value]	
	[Control variable]	
	[Correcting value]	Temperature

In the function selection *[Measured value]*, *[Control variable]* and *[Correcting value]* the following adjustable parameters are available:

[Function]	Adjustable value	Adjustable ranges or counter values
[Measured value] *[Control variable]* *[Correcting value]*	*[Output range]*	0 ... 20 mA
		4 ... 20 mA
	[error current]	*[Off]*
		23 mA
	[0 mA]	- 100 % ... + 100 %
	[20 mA]	- 100 % ... + 100 %
	[Damping]	*[high]*
		[medium]
		[weak]
	[Behaviour upon Pause Hold]	*[None]*
		[Fixed]
		[HOLD]

16 The [Service]

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

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

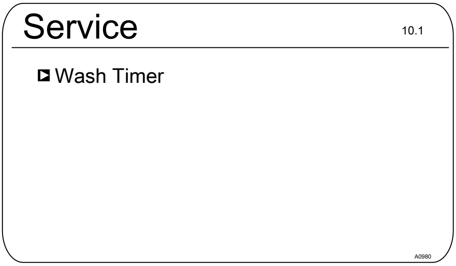


Fig. 99: [Service]

16.1 Setting the [Wash timer]

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

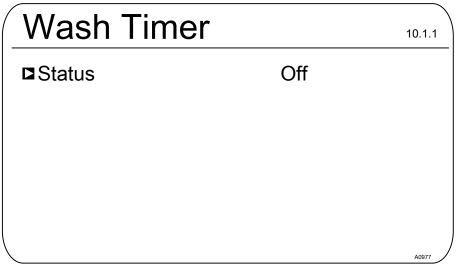


Fig. 100: [Wash Timer]

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

17 Setting [Device setup]

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

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

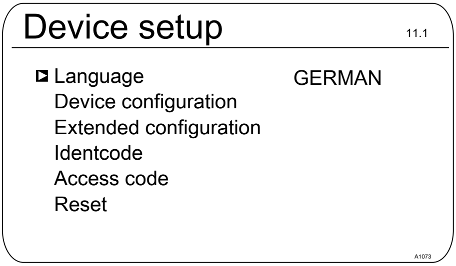


Fig. 101: Setting [Device setup]

17.1 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.		

17.2 Setting the [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

17.3 Setting the [Extended configuration]

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

Messages	range
SD card	

17.4 Update

Continuous display ➨ MENU ➨ ▲ or ▼ *[Setup]* ➨ fOK *[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].*

17.5 Setting the [Access code]

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

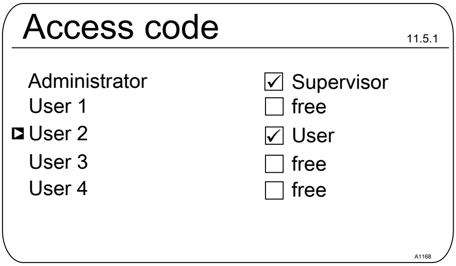


Fig. 102: Setting the [Access code]

18 Diagnostics

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

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

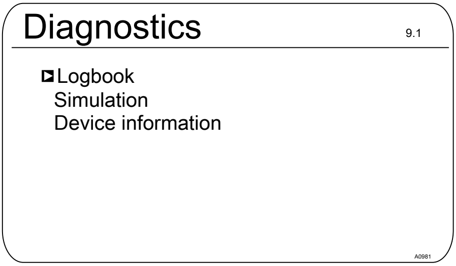


Fig. 103: Diagnostics

18.1 Display the [Logbook]

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

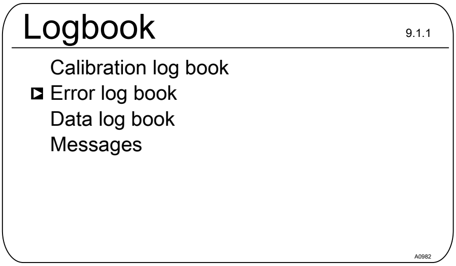


Fig. 104: Display the [Logbook]

18.1.1 Display the [Calibration log book]

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

The following data is stored:

- Time of calibration (as per the operating hour counter)
  - d = day
  - h = hour
  - m = minute
- Zero point (without measurement unit)
- Slope (without measurement unit)

18.1.2 Read [Error log book]

The error messages data are 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.

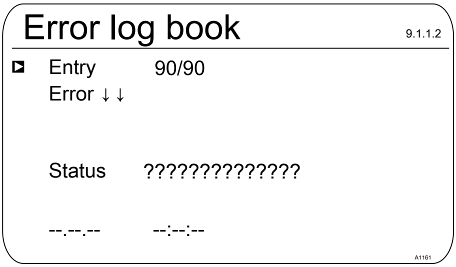


Fig. 105: [Error log book]

18.1.3 Read [Data log book]

The measurement data is stored in the internal *[Data log book]*. Up to 30 data records can be stored. Thereafter the oldest entry is overwritten with the most recent entry.

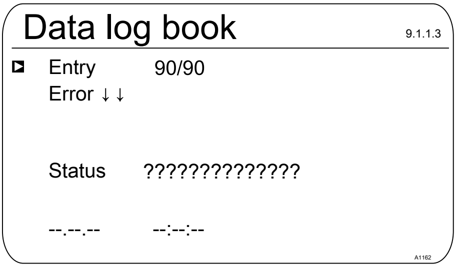


Fig. 106: [Data log book]

18.1.4 Read-off stored [Messages]

The messages are stored in the internal Messages log book. Up to 30 messages can be stored. Thereafter the oldest entry is overwritten with the most recent entry.

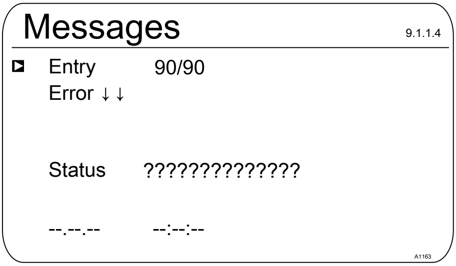


Fig. 107: Messages

18.2 Display [Simulation]

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

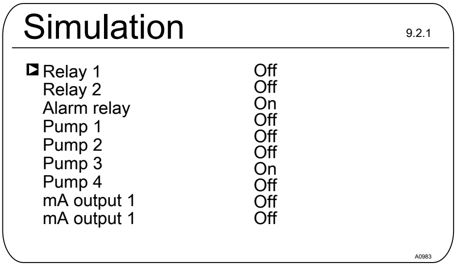


Fig. 108: Display Simulation

18.3 Display [Device information]

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

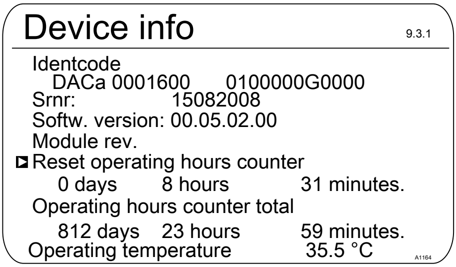


Fig. 109: Device information

18.4 Error messages

Error message text	Cause	Remedy
The connection to the expansion module is faulty		
The mV input voltage is too low		
The mV input voltage is too high		
The temperature is too low		
The temperature is too high		
A calibration error exists		
No sensor is available		
Check the mechanical status of the sensor. Glass break is possible.		
The checkout time was infringed		
The mA input current is too high		
The mA input current is too low		
After elapsing of the delay period a limit error still exists.		
Error sample water exists, e. g. no flow		
The controller is in the *'Pause'* state		
The controller is in the *'Pause (Hold)'* state		
The mA input supply is overloaded		
The mA input is overloaded		
The level in tank 1 is too low		
The level in tank 2 is too low		
The level in tank 3 is too low		

Error message text	Cause	Remedy
The connection to the expansion module is faulty		
A system error exists		
The limit was undershot		
The limit was exceeded		
The wash timer has timed out. Maintenance is necessary		
The measuring channel is not yet calibrated		
Placeholder warning 05		
Placeholder warning 06		
Placeholder warning 06		
Placeholder warning 07		
Placeholder warning 08		
Placeholder warning 10		
Placeholder warning 11		
Placeholder warning 12		
Placeholder warning 13		
Placeholder warning 14		
Placeholder warning 15		
The battery must be replaced.		
The time must be checked		
The fan has an error.		
System warning 1		

18.5 Help texts

Contents of the help texts	Cause	Remedy
Connection XK 1		
Connection XK 2		
Please connect digital input 3 to connection XK 3		
The DPD value is too big, DPD value < MRE -2%		
The DPD value is too small, DPD value > MRS +2%		
The slope is too shallow, < 20% of MR		
The slope is too steep, > 300% of MR		
The zero point is too low, < 3.2 mA		
The zero point is too high, > 5mA		
An unknown calibration error		
In the residual period parameter set 1 is used		
Please connect pump 1 to connection XA 2		
Please connect pump 1 to connection XA 2		
Please connect pump 2 to connection XA 3		
Please connect pump 2 to connection XA 4		
Please connect pump 4 to connection XA 5		

19 Communication and connection

There are various additional modules available to connect the controller to the IT infrastructure.

19.1 Profibus DP module

PROFIBUS DP (Decentralised Periphery) for control of sensors and actuators by a central control in production engineering. Here in particular the many standard diagnostic options also come to the fore. Further deployment areas are the connection of *‘distributed intelligence’*, i.e. the networking of a number of controls to each other (similar to PROFIBUS FMS). Data rates of up to 12 Mbit/s over twisted pair and/or fibre optic cables are possible.

19.2 Module for Modbus RTU

Modbus RTU (RTU: *[Remote Terminal Unit]*) transmits the data in binary format. This ensures a good data throughput, however the data can not be directly evaluated by humans, rather it must first be converted to a readable format.

19.3 LAN module

A *‘Local Area Network’*, shortened to *‘LAN’*, is a computer network. The physical extent of a *‘LAN’* is limited without additional measures to 500 m and is generally used for home networks or small companies.

19.4 WLAN module

Wireless Local Area Network (WLAN) refers to a local radio network and normally refers to a standard of the IEEE-802.11 family. In some countries (e.g. USA, Great Britain, Canada, Netherlands, Spain, France, Italy) the term Wi-Fi is widely applied to this narrower concept.

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. %
Accuracy:	0.3 % based on the full-scale reading
pH/ORP measurement 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 2-way controllers
Signal current output:	2 x 0/4 ... 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:	90-253 V, 50/60 Hz, 25 VA
Ambient temperature:	Ambient temperature 0 ... 55 °C (for inside deployment or with a protective enclosure)
Degree of protection:	Wall mounted: IP 67

Description	Technical Data
	Control panel mounted: IP 54
	NEMA 4X (leak-tightness)
Tests and certification:	CE, MET (corresponding to UL as per IEC 61010)
Material:	Housing PC with flame proofing configuration
Dimensions:	250 x 220 x 122 mm (WxHxD)
Weight:	net 2.1 kg

21 Spare parts and accessories

21.1 Spare parts

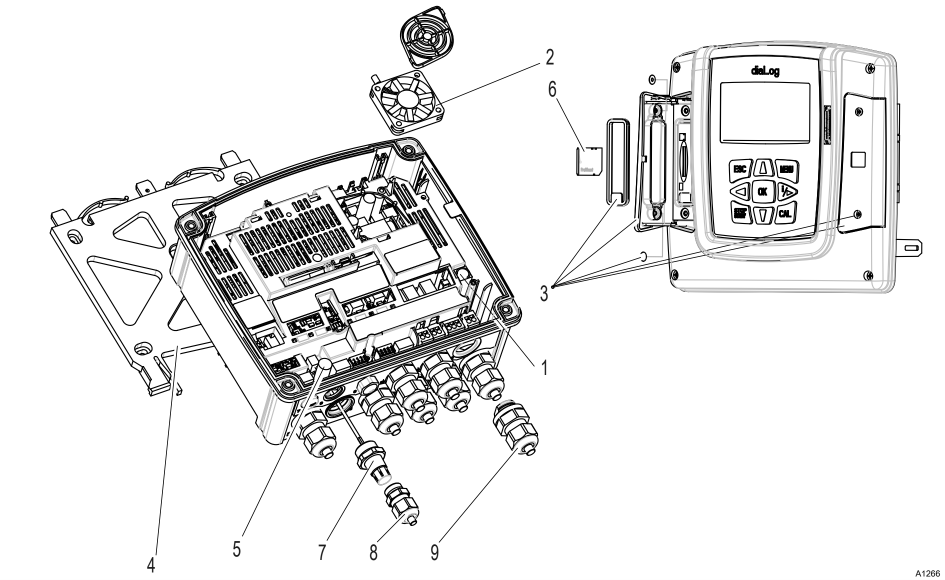


Fig. 110: Spare parts

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
Cable combination coaxial 0.8 m, pre-assembled	1024105
Cable combination coaxial 2 m-SN6 - pre-assembled	1024106
Cable combination coaxial 5 m-SN6 - pre-assembled	1024107
SN6-socket, retrofit	1036885
Coaxial cable, Ø 5 mm, 0.8 m – SS	305077
Coaxial cable, Ø 5 mm, 2.0 m – SS	304955
Coaxial cable, Ø 5 mm, 5.0 m – SS	304956
Installation kit - DAC - control panel installation	1041095

22 Necessary formalities

22.1 Disposal of used parts

- **Users' qualification:** instructed persons, see ↪ *Chapter 4.4 'Users' qualifications' on page 21*

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

ProMinent Dosiertechnik GmbH, Heidelberg will take back decontaminated used devices providing that they are covered by adequate postage.

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

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 glass break detection device monitors a pH sensor to detect whether the sensor's glass body is broken. If a break exists in the glass body, the resistance of the pH sensor falls below approximately 2 mega-Ω. The controller can interpret this resistance change. The controller generates an error message and control is stopped. This error cannot be acknowledged.

The resistance (ohms) of the pH sensor also falls if the process temperature increases. Once the process temperature is approx. > 60 °C the detection threshold of 2 mega-Ω is reached. For process temperatures > 60 °C a grass break is detected even though no glass break exists. So that an error alarm is avoided, glass break detection must be switched off at process temperatures > 60 °C.

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 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.

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.

Measuring range of the sensors

Select the measuring range. The measuring range is given on the measuring transducer nameplate. An incorrect measuring range leads 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 Cl (chlorine), Br (bromine), ClO_2 (chlorine dioxide), CLT (chlorite), DO (dissolved oxygen) and O_3 (ozone):

The measured variables Cl (chlorine), Br (bromine), ClO_2 (chlorine dioxide), CLT (chlorite), DO (dissolved oxygen) and O_3 (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]

Measurement of the measured variable pH [mV] takes place using a coaxial cable via the mV signal of the pH sensor. This measurement can be used if the cable length is less than 10 metres.

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 for compensation of the temperature influence of the process on measurement. When using a DMTa measuring transducer, the process temperature setting is carried out within this DMTa measuring transducer

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

- *[Off]* switches the process temperature setting off
- *[Manual]* enables manual setting of the process temperature
- *[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

Where amperometric measured variables are concerned, the process temperature is measured for information only except for the CDP chlorine dioxide sensor where temperature compensation is implemented.

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.

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. If the measured variable ClO_2 (chlorine dioxide) and the sensor type CDP are selected, then temperature compensation is necessary.

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 1 way
- P 2 way
- PID 1 way
- PID 2 way
- Manual
- Off

P controller: This controller type is used with integrating control paths (e.g. Batch Neutralisation). If the control deviation becomes smaller, 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 exists. When stabilising large changes, excess oscillations may exist.

PI controller: This controller type is used with non-integrating control paths (e.g. flow neutralisations) where excess fluctuations must be avoided and no permanent control deviation may occur, i.e. the setpoint must always be adhered to. Constant adding of metering chemicals is required. It is not a malfunction when the controller does not stop when the setpoint is reached.

PID controller: Has the properties of a PI controller. Due to the differentiating control part D, it also offers a certain prediction capability and can react to forthcoming changes. It is used when measurement spikes occur in the measurement curve and these must be quickly regulated out.

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

Manual: If *[manual]* controller type is selected, then the control variable can be entered in a range from -100 % … 100 %. This function is useful for testing 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 time of the I (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 controller.

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 is the controller amplification factor. XP relates to the measuring range end of a controller and is entered as an absolute value, e.g. with pH xp=1.5. For measured variables, such as chlorine, the sensor measuring range, and with it the measuring range end, is selected. For pH, the measuring range end is 15.45. Here the default xp value is 1.54. The XP value states that for a deviation of ± 1.54 pH from the setpoint, the control variable equals ± 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 dampening

Under the *‘Temperature dampening’* setting, *‘Temperature dampening’* can be carried out if the measured temperature is subject to rapid fluctuations. The temperature measurement shown in the display is influenced by *‘Temperature dampening’*. The temperature measurement with which the controller carries out calculations, is essentially *‘medium’* filtered and is not affected by the *‘Temperature dampening’*.

The following filter (damping) levels are possible:

- *‘stable’*
  - *‘Stable’* temperature dampening significantly smooths the measured value.
- *‘medium’*
  - The temperature dampening *‘fast’* shows the measured changes in real-time.
- *‘fast’*
  - *‘Medium’* temperature dampening smooths the measured value by a medium amount.

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

Measured variable fluoride

The measured variable fluoride is measured using the mA interface. The measuring transducers are connected to this mA interface. The fluoride sensor FLEP-010-SE and the reference sensor REFP-SE are connected to this measuring transducer.

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

FP100V1 measuring transducer: Measured value 0.5 ... 100 mg/l.

Measured variable PAA

Peracetic acid (PAA):The strongly oxidising effect gives rise to its use as a bleach, amongst others for papers, textiles and starch and as a disinfectant (in approximately 1 % concentration) and sterilisation agent (e.g. for the bottling of drinks in plastic bottles)

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.

Measured variable H_2O_2 (PAA) [mA]

Hydrogen peroxide (H_2O_2) is a pale blue, in diluted form, colourless, largely stable liquid compound comprising hydrogen and oxygen. It works as a strong bleach and disinfectant.

Measured variable [mA general]

With the measured variable *[mA general]*, various preselected measured variables can be selected or a measured variable and its measurement unit can be freely edited. The temperature measurement cannot be used for compensation purposes, because the influence of the temperature measurement on the measured value is not known. In principal, the settings are made as with the other measured variables of the controller.

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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