ProMinent®

Assembly and operating instructions

DULCOMETER® Multi-parameter controller diaLog DACb

Part 2 – Operation and settings

EN

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.
The latest version of the operating instructions are available on our homepage.

Table of contents

1 Structure of the operating instructions

These operating instructions are divided into two parts.

- Part 1: Assembly and installation (part number 990458)
- Part 2: Operation and settings (part number 990459)

2 Operating concept

2.1 Display and keys

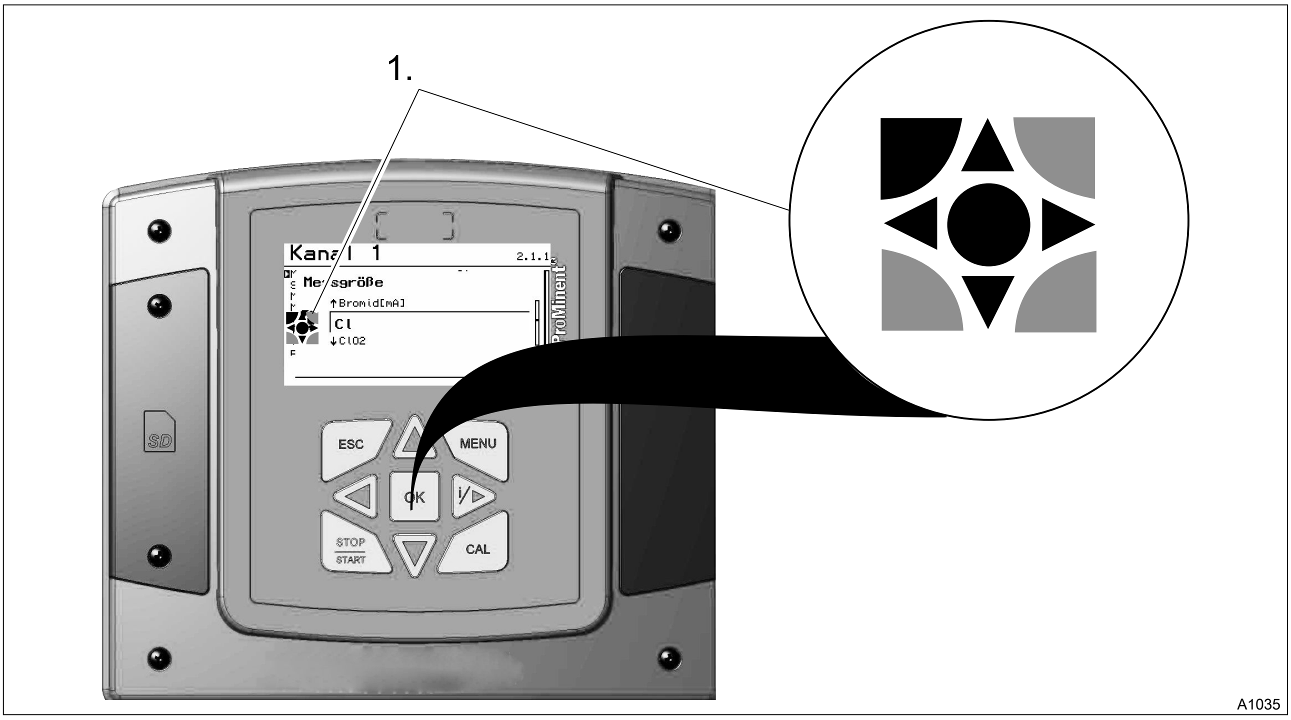


Fig. 1: Operating cross (1) / Active keys are displayed in [black] in the display; inactive keys in [grey].

The following path is shown as an example:

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

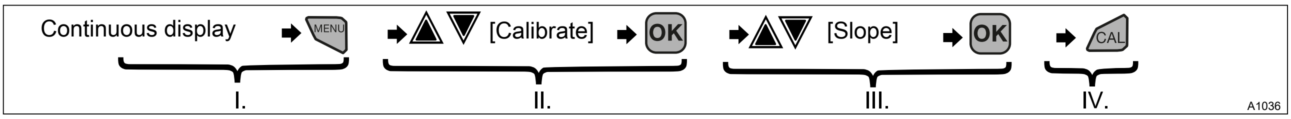


Fig. 2: A display change is made within a sequence of actions.

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

The function of the keys is described in the table *Chapter 2.2 ‘Functions of the keys ’ on page 9*.

➡ = 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.

Additional information can be obtained via the i/▷ key.

> ***Illumination of the display***
> *In the event 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.*

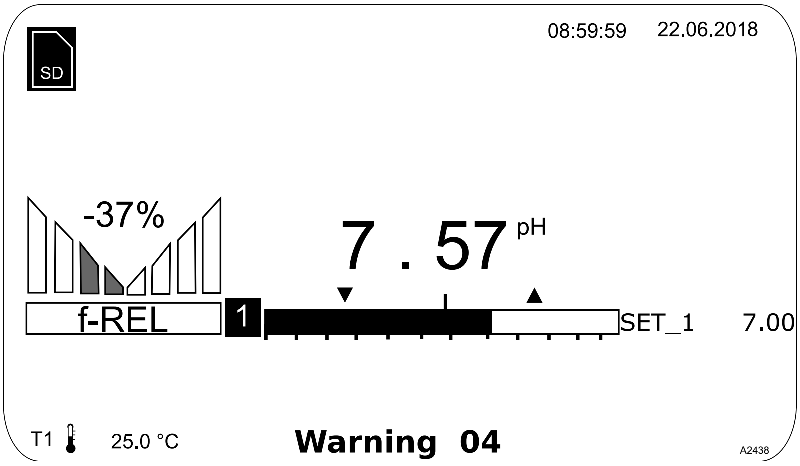


Fig. 3: Example of a continuous display when used with one measuring channel (e.g. pH).

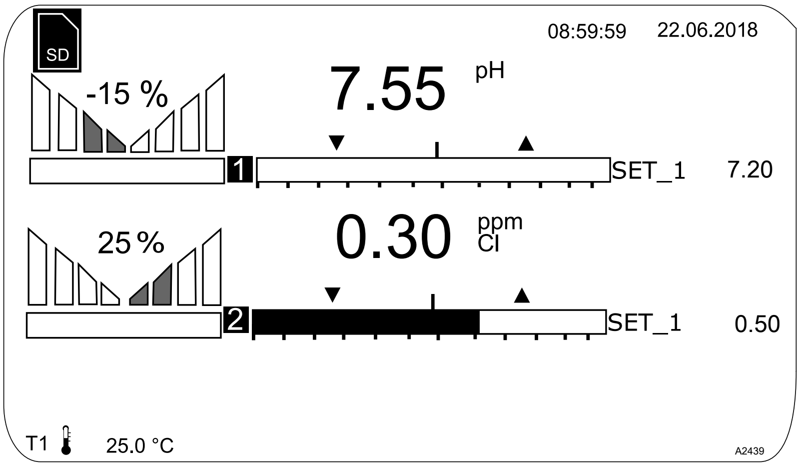


Fig. 4: Example of a continuous display when used with two measuring channels (e.g. pH/chlorine).

If you are using 3 measuring channels, select the desired measuring channel in the display using ▲ or ▼.

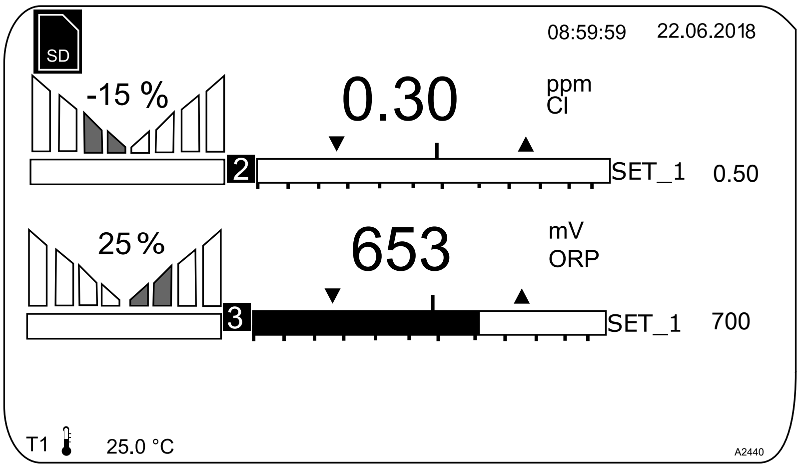


Fig. 5: Example of a continuous display when used with 3 measuring channels (e.g. pH/chlorine/ORP).

If you are using 3 measuring channels, you can use ▲ or ▼ to display the overall view of the measuring channels as the fourth view, see .

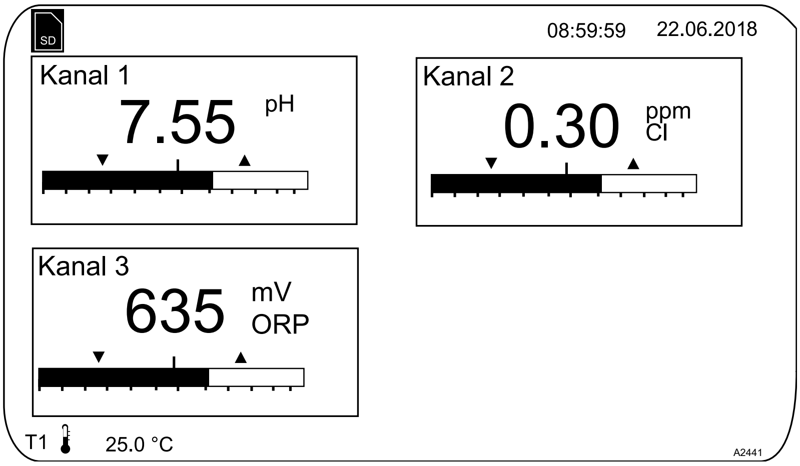


Fig. 6: Example of a continuous display when used with 3 measuring channels (e.g. pH/chlorine/ORP) and the display of all 3 measuring channels

Parameters in the adjustable menus

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.*

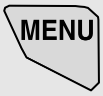
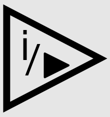
1. Select the desired parameter in the display using ▲ or ▼.
   ⇨ There is an arrow tip in front of the selected parameter, which indicates the selected parameter.
2. Press OK.
   ⇨ You are now in the setting menu for the desired parameter.
3. You can adjust the desired value in the setting menu using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

   The controller returns to the menu once OK has been pressed.

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

2.2 Functions of the keys

Tab. 1: 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.
	To decrease a displayed number value and to jump down in the operating menu.
	Moves the cursor to the left.

2.3 Changes the set operating language

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

Fig. 7: 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.

2.4 Acknowledge fault or warning message

If the controller recognises an error *[Error]*, the 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 this process, the controller indicates all errors and warnings. The pending alarm messages can be selected and, if required, acknowledged/confirmed. 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 sensor has not been calibrated yet, 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 no sensor is connected, then after acknowledgement of the message, no further processing is possible using the controller. You must now rectify the error - for this see the chapter on Diagnostics and Troubleshooting.

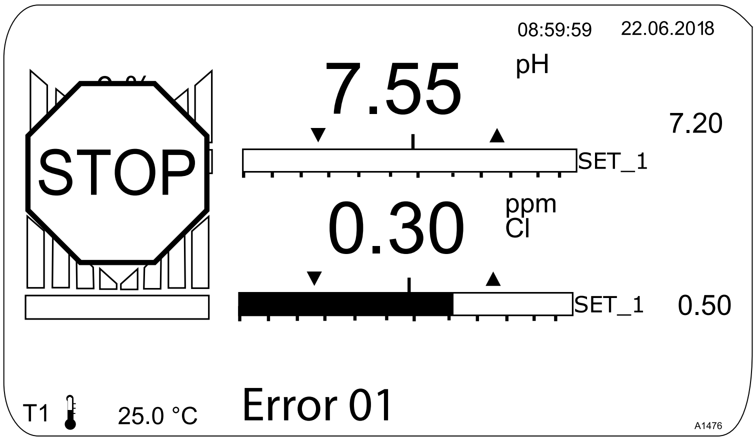


Fig. 8: Alarm message, controller stops control

2.5 Key Lock

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

2.6 Measured variables and measuring inputs

Measured variable	Measuring input	Modul type	
pH (mV) Temperature (mV) ORP (mV)	mV	VA VV	mV/mA measuring input or mV/mV measuring input
pH (mA) ORP (mA) mA general Bromine Chlorine Chlorine dioxide Chlorite Fluoride Oxygen Ozone Peracetic acid Hydrogen peroxide Conductivity (mA) Temperature (mA)	mA	VA AA	mV/mA measuring input or mA/mA measuring input
Conductivity (conductive)		L3	Conductive conductivity

3 Functional description

The DULCOMETER Multi-parameter Controller diaLog DACb is a ProMinent controller platform. In the remainder of this document, the term *'controller'* is consistently used for the DULCOMETER. The controller has been developed for the continuous measurement and control of liquid analysis parameters. For water treatment processes in environmental technology and industry. The controller is available in a version with 2 or 3 measuring channels. The controller can operate together with conventional analogue sensors and actuators.

Typical applications:

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

3.1 Standard equipment

- 1 measuring channel with 14 freely selectable measured variables (via mV or mA input) – depending on the identity code.
- PID controller with frequency-based metering pump control for 2 metering pumps.
- 2 analogue outputs for measured value, correction value or control variable (depending on the optional equipment).
- 4 digital inputs for sample water fault detection, pause and parameter switch-over.
- 2 relays with limit value function, timer and non-continuous control (depending on the optional equipment).
- Power supply for sensors 20 V DC, 70 mA
- Measured variables and language selection during commissioning.
- Compensation for the influence of temperature on the pH and fluoride measured variables.
- 22 operating languages.
- Saving and transfer of device parametrisation to an SD card.
- Subsequent upgrade of the software function by means of an activation key or firmware update.
- Interference variable processing (flow) via frequency (digital input), or
- Interference variable processing (flow) via mA (VA and AA module) as standard, or
- pH compensation for chlorine (VA and AA module).
- Measured value trend display via the controller display.

3.2 Optional equipment

- Third complete measuring and control channel with 14 freely selectable measured variables (via mV or mA input).
- Data and event logger with an SD card.
- Interference variable processing (flow) additionally via mA, if the mA inputs of channel 1 and 2 (VA or AA module) are assigned or not available (VV module).
- External remote setpoint for channel 1.
- 3 additional digital inputs, e.g. for level monitoring.
- PROFIBUS®-DP *.

- Modbus-RTU.
- PROFINET®.
- Visualisation via LAN/Wi-Fi web access.

4 Subsequent extension of functions

- **User qualification, subsequent extension of functions:** trained user, see Part 1 of the Operating Instructions, the *Safety and responsibility*and *User qualification sections*.

Requirement: The hardware for channel 3 must be available in the controller. The data logger can be enabled without the need for extension of the hardware. Missing hardware can only be retro-fitted in the manufacturer's factory. Channel 2 can be enabled from upgrade package 2 or upgrade package 3. The upgrade packages correspond to the upgrade packages also described in the identity code. The data logger function can always be enabled.

Validity of the enable code
An enable code is only valid and can only be used for the relevant controller with the specified serial number.

The enable code can be sent by email and is then read into the controller from the SD card (maximum 32 GB) or entered using the controller keypad. The enabled function is then available and simply needs to be activated and parametrised.

The following information is required to determine the enable code:

- the serial number of the controller in question, see the operating menu under *[Diagnostics]*, *[Device information,]*.
- the upgrade package required.

Present	Required	Order number
Package 2	Upgrade: Package 2 to package 3.	1047874
	Upgrade: Package 2 to package 4.	1047875
Package 3	Upgrade: Package 3 to package 4.	1047876
Package 0=no data logger	Upgrade: data logger.	1047877

Manual entry of the enable code:

1. Press MENU.
2. Use ▲ and ▼ to select *[Setup]*.
3. Press OK.
4. Use ▲ and ▼ to select *[Enable code]*.
5. Press OK.
6. Select *[Manual input]*.
7. Press OK.
8. Use the 4 arrow keys to enter the enable code.
9. Press OK.
10. Use ▲ and ▼ to select *[Double check]*.
11. Press OK.

⇨ The controller is now restarted.

5 Functions for Backing Up the Controller Settings

- **User qualification, backing up settings:** trained user, see Part 1 of the Operating Instructions, the User qualification section.

The following functions are available:

- Save device configuration as a text file.
- Save device configuration to an SD card.
- Load device configuration file from the SD card into the DAC.

Saving the device configuration as a text file

Maximum SD card size:	32 GB

This function enables you to save the device configuration to the SD card (maximum 32 GB) for documentation purposes and to print it out or document it using a PC and printer. The file that is written has the name `CONFIG.TXT` and is in ASCII format. An SD card with free space must be inserted in the controller card reader.

Proceed as follows to save the configuration to the SD card as a plain text file:

1. Press MENU.
2. Use ▲ and ▼ to select *[Setup]*.
3. Press OK.
4. Use ▲ and ▼ to select *[Extended configuration]*.
5. Press OK.
6. Use ▲ and ▼ to select *[Load or save device configuration]*.
7. Press OK.
8. Use ▲ and ▼ to select *[Save device configuration to the SD card as a plain text file]*.
9. Press OK.
   ⇨ The configuration is now saved, which takes approx. 5 minutes.
10. Next, press OK.
11. You can now remove the SD card and process the file, if necessary, or simply leave it on the SD card. This file cannot be read back by the controller.

Copying the device configuration file to the SD card:

The *[Copy device configuration file to SD card]* function can be used for documentation or backup purposes. You can use this file to distribute a recurring device configuration to different controllers. You can save the device configuration set on one controller as a unit configuration file on the SD card. Saving creates the `CONFIG` directory on the SD card and the file `CONFIG.BIN` is saved to this directory. This file stores all the user-specific controller settings data. Sensor calibration data is not copied as this data has to be defined separately for each measuring point. An SD card with free space must be inserted in the controller card reader.

1. Press MENU.
2. Use ▲ and ▼ to select *[Setup]*.
3. Press OK.
4. Use ▲ and ▼ to select *[Extended configuration]*.
5. Press OK.

6. Use ▲ and ▼ to select *[Load or save device configuration]*.
7. Press OK.
8. Use ▲ and ▼ to select *[Save device configuration file to the SD card]*.
9. Press OK.
   ⇨ The configuration is now saved, which takes approx. 3 minutes.
10. Next, press OK.
11. You can now remove the SD card and process the file, if necessary, or simply leave it on the SD card.

> ***Existing configuration accidentally overwritten***
>
> *If there is a configuration file on an SD card and another configuration file is loaded, the existing configuration file is renamed* `CONFIG.BAK`*. The new configuration file is then called* `CONFIG.BIN`*. If you wish to use* `CONFIG.BAK` *again, you must delete* `CONFIG.BIN` *and rename* `CONFIG.BAK` *to* `CONFIG.BIN`*. You can then use the configuration file again.*

Loading the device configuration file from the SD card

> ***Different identity codes***
>
> *If the identity codes of the source and destination controllers differ, only the settings that are common to both controllers will be transferred.*

If you have copied a configuration file to an SD card using the *[Copy device configuration file to SD card]*, you can use this function to load the device configuration file from the SD card into a DACa controller or transfer it to another DACa controller (cloning). The source and destination controllers must have the same identity code. This function saves you from having to manually set up the device configuration. Always check that you can use the settings for your intended application.

1. An SD card with a `CONFIG` directory and a valid `CONFIG.BIN` file must be inserted in the controller's card reader.
2. Press MENU.
3. Use ▲ and ▼ to select *[Setup]*.
4. Press OK.
5. Use ▲ and ▼ to select *[Extended configuration]*.
6. Press OK.
7. Use ▲ and ▼ to select *[Load or save device configuration]*.
8. Press OK.
9. Use ▲ and ▼ to select *[Load device configuration file from SD card]*.
10. Press OK.
    ⇨ The configuration now loads, which can take around 1 minute.

11. Apply with OK.

⇨ The controller now irrevocably applies the configuration from the SD card and deletes the existing configuration on the controller.

12. The following prompt appears: *[Are you sure?]* If you confirm by pressing OK, the configuration is transferred.

⇨ The controller then restarts, initialises itself and starts up with the new configuration.

6 Information on fieldbus products

You will find further information on our fieldbus products, including GSD files, operating instructions etc. at:
www.prominent.com/fieldbus

7 Commissioning

- **User qualification:** trained user, see Part 1 of the Operating Instructions, the User qualification section

WARNING!

Sensor run-in periods

Risk of hazardous incorrect metering.

Take the sensor run-in periods into account when commissioning:

– The sample water must contain sufficient feed chemical for your application (e.g. 0.5 ppm chlorine).
– Correct measurement and metering is only possible if the sensor is working perfectly.
– It is essential to observe the sensor run-in periods.
– Calculate the run-in period when scheduling commissioning.
– It may take an entire working day to run in the sensor.
– Refer to the sensor's 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 Steps

Installation and function control

– *Check that all the connections have been made correctly*
– *Ensure that the supply voltage matches the voltage indicated on the nameplate*

1. Switch the supply voltage on
2. The controller displays a menu in which you can set the language with which you wish to operate the controller

3. Wait for the controller's module scan

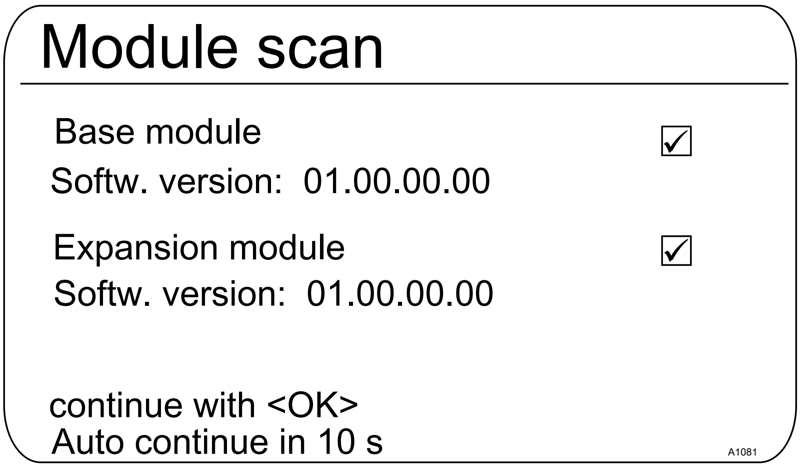


Fig. 9: Module scan

⇨ The controller indicates the controller modules installed and identified.

4. Press OK

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

7.2 Adjusting the backlight and contrast of the controller display

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

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

7.3 Resetting the operating language

Resetting the operating language

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

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

7.4 Defining metering and control processes

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

Define the following parameters to set up a controller:

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

7.5 Calibrating conductive conductivity, sensor parameter adjustment

> **!** NOTICE!
>
> **The sensor must be dry**
>
> Do not allow the conductivity sensor to come into contact with liquid. Only allow the conductivity sensor to come into contact with liquid once the conductivity sensor has been connected, configured and calibrated. The sensor parameters (zero point) of a moist or wet conductivity sensor can no longer be properly calibrated.
>
> If the conductivity sensor has come into contact with liquid prior to calibration, there is an option to dry the conductivity sensor. A dry conductivity sensor can be successfully recalibrated to the sensor parameters.

If *[Sensor not dry]* continues to be displayed despite the conductivity sensor having been dried, then you will have to wait some time until the controller has detected the sensor as dry.

Once you have selected the sensor type, the prompt automatically appears asking whether the sensor parameters (zero point) have to be determined. You can initiate this prompt manually as follows:

Continuous display ➨ Menu ➨ ▲ or ▼ *[Measurement]* ➨ OK ➨ ▲ or ▼ *[Measuring channel X Conductivity]* OK ➨ ▲ or ▼ *[Sensor parameter adjustment]* ➨ OK.

1. Use the arrow keys to select *[Automatically determine sensor parameters]*.
2. Continue with OK.
   ⇨ You will see the display showing *[Sensor dry]* and *[Automatically determine sensor parameters]*.
3. Continue with OK.
   ⇨ You will see the display with the message *[Sensor parameters are automatically determined]*.

   The sensor parameters are automatically carried over.

8 Setting measured variables

- **User qualification:** trained user, see Part 1 of the Operating Instructions, the User qualification section

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

Measuring channel settings

This descriptions of [Channel 1] apply correspondingly to the settings in all other measuring channels. The procedure for entering the settings for the channel in question is identical, however the parameters to be set may differ. Your attention is drawn to the differences, which are also described.

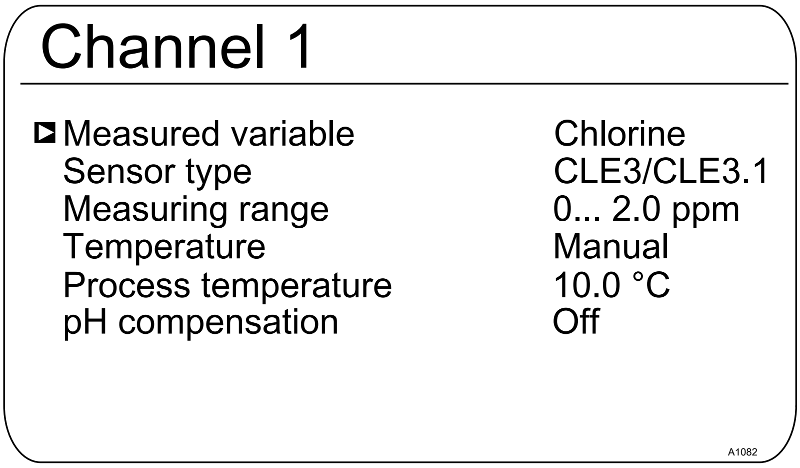


Fig. 10: Setting measured variables, using the example of [Channel 1] and the measured variable [Chlorine].

Tab. 2: You can set the following measured variables on the controller:

Measured variable	Meaning	Unit
[None]	The controller does not perform a 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]*
[mA general]		■ *[Freely selectable]* ■ *[%]* ■ *[mA]* ■ *[m]* ■ *[bar]* ■ *[psi]* ■ [m^3/h] ■ *[gal/h]* ■ *[ppm]* ■ *[%RH]* ■ *[NTU]*

Measured variable	Meaning	Unit
[Bromine]	Bromine	*[ppm]*
[Chlorine]	Chlorine	*[ppm]*
[Chlorine dioxide]	Chlorine dioxide	*[ppm]*
[Chlorite]	Chlorite	*[ppm]*
[Fluoride [mA]]	Fluoride	*[ppm]*
[Dissolved O2]	Oxygen	*[ppm]*
[Ozone]	Ozone	*[ppm]*
[Peracetic acid]	Peracetic acid	*[ppm]*
[Hydrogen per.]	Hydrogen peroxide with a sensor type *[PER]*	*[ppm]*
[Cond. [mA]]	Conductivity sensor with mA signal	*[µS]*
[Conductivity]	Conductive conductivity	*[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]*

INFORMATION: If you are measuring the pH with potential equalisation, you must set this procedure as a parameter when selecting the measured variable.

8.1 Information on the measured variables

Available measured variables

INFORMATION: All measured variables are available and can be used in the controller.

8.1.1 Measured variable pH [mV]

The measured variable pH [mV]

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

Decimal places

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

Factory setting: 2 decimal places

Glass break detection

[ON] / *[OFF]*: Switches the pH sensor's glass break detection *[ON]* or *[OFF]*. The factory setting is *[OFF]*. The controller displays an error message if an error is detected in the *[ON]* setting.

The internal resistance of the sensor falls significantly in the event of a glass break. This status is detected and an error message is issued.

The internal resistance of the sensor also falls at media temperatures of > 50 °C and a glass break is incorrectly detected.

The *[glass break detection]* function works up to a sensor cable length of approx. 2 m. External factors, such as the medium to be measured, can also affect glass break detection and lead to an incorrect interpretation. In these cases, glass break detection must be switched off to avoid an incorrect interpretation.

Cable break detection

[ON] / *[OFF]*: Switches the cable break detection of the coaxial cable *[ON]* or *[OFF]*. The factory setting is *[OFF]*. The controller displays an alarm message when an error is detected in the *[ON]* setting.

The resistance of an open cable end is measured in the event of a cable break or if no sensor is connected. This resistance is very high. This status is detected and an error message is issued.

Depending on the type of sensor, the resistance can also fall below the trigger threshold at media temperatures of < 10 °C and a glass break is incorrectly detected.

The *[cable break detection]* function works up to a sensor cable length of approx. 2 m. External factors, such as the medium to be measured, can also affect cable break detection and lead to an incorrect interpretation. In these cases, cable break detection needs to be switched off to avoid an incorrect interpretation.

8.1.2 Temperature

Temperature

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

Temperature compensation

This function is used for compensation of the temperature influence on the measurement. This is only necessary with pH and fluoride measurement and when chlorine dioxide is measured using a CDP sensor.

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

- *[Off]* switches the process temperature setting off
- *[Manual]* enables the process temperature to be manually specified, which makes sense with constant temperatures
- *[Automatic]* uses a measured process temperature. Automatic measurement of the temperature using the temperature sensor, e.g. Pt1000. With pH, temperature compensation can be switched *[ON]* or *[OFF]* in the menu.

8.1.3 Measured variable pH [mA]

Measured variable pH [mA]:

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

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

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

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

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

Temperature compensation

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

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

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

8.1.4 ORP [mV], ORP [mA]

Measured variables ORP [mV], ORP [mA]

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

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

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

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

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

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

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

Measurement of chlorine with pH compensation

INFORMATION: The pH compensation function is only possible with the measured variables VA (pH as an mV signal) and AA (pH as an mA signal) and is included as standard with these measured variables. Channel 3 does not have this function.

Chlorine used in water disinfection comes in various forms, e.g. as liquid sodium hypochlorite, as dissolved calcium hypochlorite, or as chlorine gas. All of these forms can be measured with chlorine sensors. After adding chlorine to water, the chlorine splits into two fractions depending on the pH value:

- 1. Into hypochlorous acid (also known as subchlorous 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 takes a long time to kill off organisms.

The sensors for measuring free chlorine selectively measure the very effective hypochlorous acid (HOCl), but not 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 the change. If the pH value now decreases again, it can lead to significant overmetering of chlorine, even though no additional chlorine has been metered. The use of a pH-compensated chlorine measurement can prevent this.

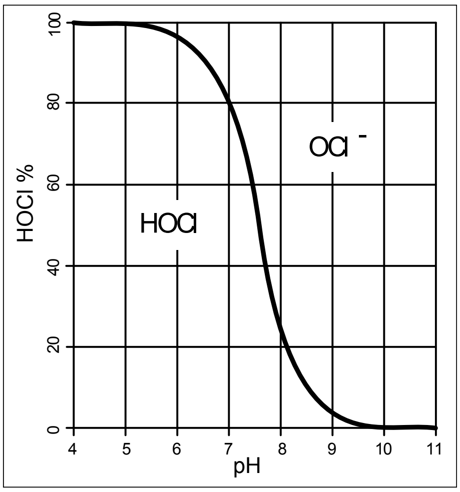


Fig. 11: HOCl/OCL$^-$ equilibrium

As the graph shows, with pH values of > 8.5, less than 10% of the HOCl is contained in the water and hence the disinfecting power is lower. The chlorine value shown after compensation is a mathematically calculated chlorine value. The mathematically calculated chlorine value does not change the effective disinfection effect in the water. Nevertheless, the above overmetering is avoided. The recognised reference method DPD 1 (for free chlorine) is used as a comparison method to calibrate the amperometric sensors. The reference method is pH-independent (or buffers the pH value to approx. 6.5) and therefore determines the free chlorine almost as 100% HOCl. The pH influence on the chlorine value measured by the sensor can be compensated by the controller so that the concentration value measured by the amperometric chlorine measuring system corresponds to this free chlorine value. 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. Nonetheless, it is also essential to measure the sample water temperature, as it has a significant influence on the pH measurement. If this influence were not compensated, then the pH value would be measured incorrectly and the chlorine value would then also be incorrectly compensated.

No calibration is possible with high pH values without pH compensation, as the difference between the measurement with the chlorine sensor and the comparison DPD 1 reference method is too great.

The working range of pH compensation: pH 4.00 ... 8.50, Temperature: 5 ... 45 °C

Measurement of dissolved oxygen: You need to enter the following correction variables in the event of exacting requirements relating to measuring accuracy (see specification of sensor types): Air pressure, Higher than NNI, Salinity or Conductivity. The temperature correction variable is corrected in the sensor with sensor types DO1, DO2 and DO3. If you switch the temperature to "OFF" for these sensor types, then you need to update the values of the correction variable at least prior to each calibration.

> ***Calibration of the chlorine sensor with active pH compensation***
> *It is essential that you always calibrate the pH sensor first and only then the chlorine sensor. Whenever the pH sensor is calibrated in future, the chlorine sensor always needs to be calibrated afterwards. Otherwise the chlorine measurement will be incorrect.*

Sensor type:

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

Measuring range of the sensors

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

Temperature

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

8.1.6 Measured variable fluoride

Fluoride Measured Variable

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

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

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

Measuring range of the measuring transducer

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

Temperature compensation

This function is used for compensation of the temperature influence on the measurement. This is only necessary with pH and fluoride measurement and when chlorine dioxide is measured using a CDP sensor.

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

- *[Off]* switches the process temperature setting off
- *[Manual]* enables the process temperature to be manually specified, which makes sense with constant temperatures
- *[Automatic]* uses a measured process temperature. Automatic measurement of the temperature using the temperature sensor, e.g. Pt1000. With pH, temperature compensation can be switched *[ON]* or *[OFF]* in the menu.

8.1.7 Peracetic acid

Peracetic acid measured variable

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

Measuring range of the sensors

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

Temperature

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

8.1.8 Hydrogen peroxide

Hydrogen peroxide as a measured variable [mA]

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

Measuring range of the sensors

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

Temperature

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

8.1.9 Conductivity [mA]

Measured variable conductivity [mA]

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

Measuring range:

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

Temperature:

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

8.1.10 Conductive *[conductivity]*

Temperature compensation and reference temperature

> **NOTICE!**
>
> **The sensor must be dry**
>
> Do not allow the conductivity sensor to come into contact with liquid. Only allow the conductivity sensor to come into contact with liquid once the conductivity sensor has been connected, configured and calibrated. The sensor parameters (zero point) of a moist or wet conductivity sensor can no longer be properly calibrated.
>
> If the conductivity sensor has come into contact with liquid prior to calibration, there is an option to dry the conductivity sensor. A dry conductivity sensor can be successfully recalibrated to the sensor parameters.

Set the temperature compensation and reference temperature for correct display of the conductive conductivity and resistance.

Non-adjustable values are specified by the controller for the display of *[TDS]* and *[SAL]*.

Tab. 3: Temperature compensation and reference temperature

Variable	Description	Type of temperature compensation	Area	Reference temperature (°C)
Specific conductivity / Electrical resistance	off	none		
	lin	linear, 0 … 9.99%/K	- 20 °C…150 °C	15 °C … 30 °C adjustable
	nLF	non-linear for natural water (DIN EN 27888)	0 °C…35 °C	20 °C or 25 °C selectable
		extended nLF function	35 °C … 120 °C	20 °C or 25 °C selectable
TDS	---	linear	0 °C…40 °C	25 °C, fixed
SAL	---	non-linear according to PSS-78	0 °C…35 °C	15 °C, fixed according to PSS-78

The conductive conductivity measured at the fluid temperature is converted to the reference temperature *[TREF]*.

> *Changing the reference temperature*
>
> *The temperature coefficient must be recalibrated if the reference temperature is changed.*
>
> *Adjustable process for temperature compensation*
>
> – *[off]*
>   – *Temperature compensation is switched off. It is measured based on the set reference temperature.*
> – *[lin]*
>   – *Linear temperature compensation via the temperature range permitted for the sensors. The reference temperature can be set between 15 °C ... 30 °C.*
> – *[nLF]*
>   – *Non-linear temperature compensation according to DIN EN 27888 for natural water, between 0 °C ... 35 °C. The reference temperature can be switched, 20 °C / 25 °C.*

Measured variable: TDS value

Symbol displayed in the controller's display: *[TDS]* (total dissolved solids)

Unit of measurement: ppm (mg/l)

Physical variable: Total of all inorganic and organic substances dissolved in a solvent

Display range: 0 …. 9999 ppm

Temperature range: 0 … 35 °C

[TLIMIT↑]: ≤ 40 °C

Setting the TDS value displayed: You can set a multiplicative factor *[TDS]* in the menu, with which the TDS value displayed can be changed:

Displayed TDS value *[ppm]* = K (25 °C) *[uS/cm]* * TDS factor

Setting range of TDS factor: 0.400 … 1.000 (Default: 0.640)

Temperature compensation is always linear on the TDS display with a reference temperature of 25 °C.

Measured variable: Salinity (SAL)

Symbol displayed in the controller's display: *[SAL]* units: ‰ (g/kg)

Physical variable: Mass of salts in one kg of water given in PSU (practical salinity units).

The salinity is derived from the conductivity measured, with a specified non-linear temperature compensation and a reference conductivity (KCL).

Display range: 0 …. 70.0 ‰

Temperature range: 0 … 35 °C

[TLIMIT↑]: ≤ 35 °C

The salinity *[SAL]* is calculated based on the *[Practical Salinity Scale 1978 (PSS-78)]*

8.1.11 Temperature *[mA]*, (as main measured variable)

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

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

8.1.12 mA general

Measured variable [mA general]

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

8.1.13 Features of the two-channel version

Two channel version

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

Two channel version with two identical measured variables

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

9 Calibration

- **User qualification:** instructed personnel, see Part 1 of the Operating Instructions, the User qualification section

> *Measuring channel settings*
> *This descriptions of [Channel 1] apply correspondingly to the settings in all other measuring channels. The procedure for entering the settings for the channel in question is identical, however the parameters to be set may differ. Your attention is drawn to the differences, which are also described.*

> *Display tolerances*
> *The display tolerances between the sensor and/or measuring equipment and controller must be calibrated with sensors and/or with output signals from measuring equipment that does not require calibration or where calibration is performed in the sensor/measuring equipment. See the respective operating instructions for the sensor or measuring equipment for more information.*

> *Cancelling the calibration process with ESC*
> *The ESC key can be used to cancel an ongoing calibration process at any stage. The controller then continues to work with the last valid calibration result.*

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

or

Continuous display ➨ CAL.

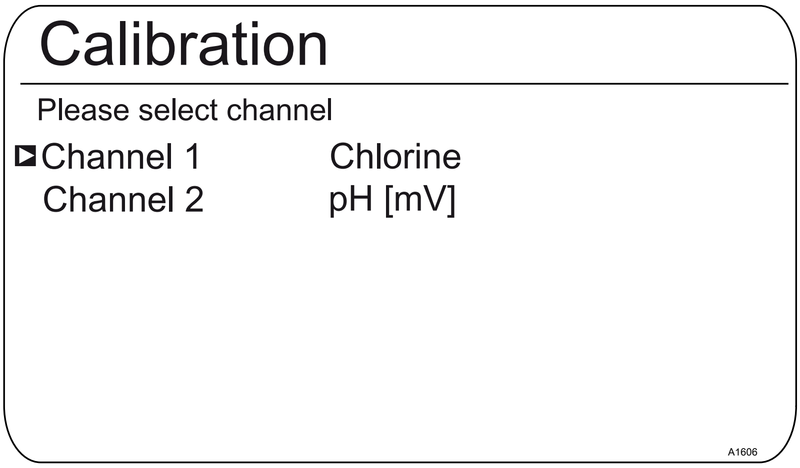


Fig. 12: Please select the channel.

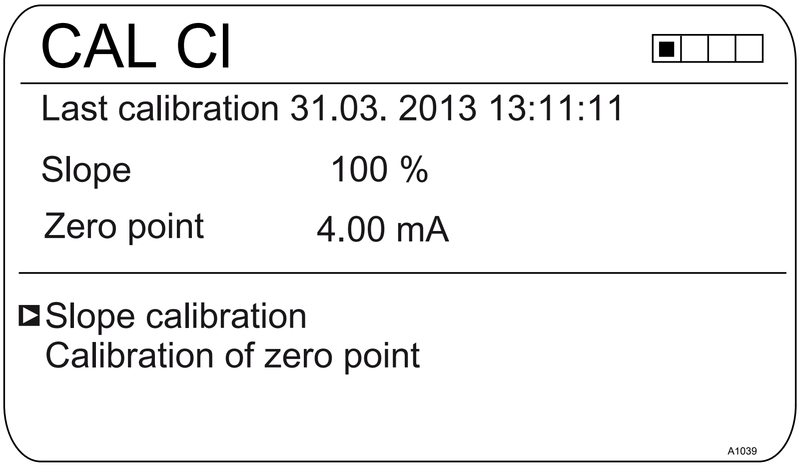


Fig. 13: [Calibration] display using [Chlorine] as an example.

> ***Calibrating the measuring channels***
> *The calibration processes are identical for all measuring channels. However, it is necessary to calibrate each measuring channel separately.*

9.1 Calibrating the pH Sensor

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

Tab. 4: Valid calibration values

Evaluation	Zero point	Slope
Good	-30 mV … +30 mV	-55 mV/pH ... -62 mV/pH
Acceptable	-60 mV ... -30 mV	- 40 mV/pH ... -55 mV/pH
	+30 mV ... +60 mV	-62 mV/pH ... - 65 mV/pH

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

> ***Calibrate the pH-sensor for the function: pH compensation for chlorine measurement***
> *It is mandatory that the pH measurement is always calibrated first and then the chlorine measurement. All other calibration of the pH measurement must always be followed by calibration of the chlorine measurement. Otherwise the chlorine measurement will be inaccurate.*

Selecting the calibration process

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

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

Buffer temperature dependencies

Buffer temperature

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

Buffer temperature dependencies

An incorrectly entered buffer temperature can lead to incorrect calibration.

Each buffer has different temperature dependencies. You have various choices in terms of compensating for these temperature dependencies, so that the controller can correctly process the buffer temperature.

- *Buffer temperature [Manual]: Ensure that the buffer temperature is identical for both buffers. Enter the buffer temperature in the [CAL Setup] menu item in the controller.*
- *Buffer temperature [Automatic]: Then immerse the temperature sensor connected to the controller together with the pH sensor into the buffer. Wait for a sufficiently long period of time until the pH and temperature sensor have recorded the buffer temperature.*
- *Buffer temperature [Off]: this setting is not recommended. Please use another setting.*

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

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

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

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

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

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

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

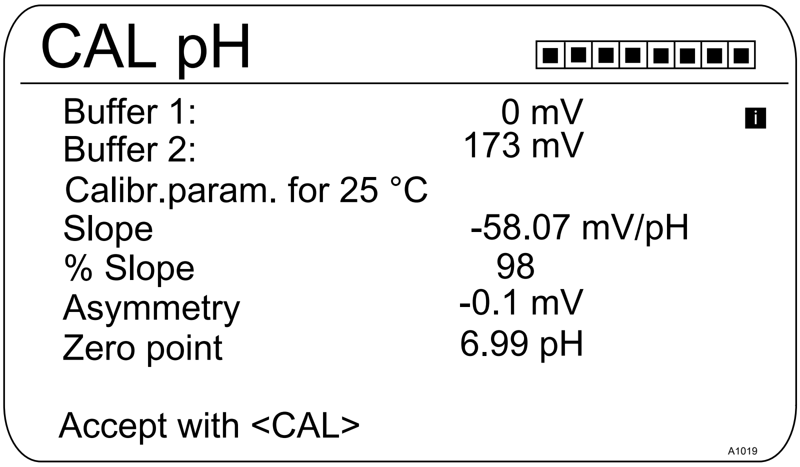


Fig. 14: Display of the calibration result

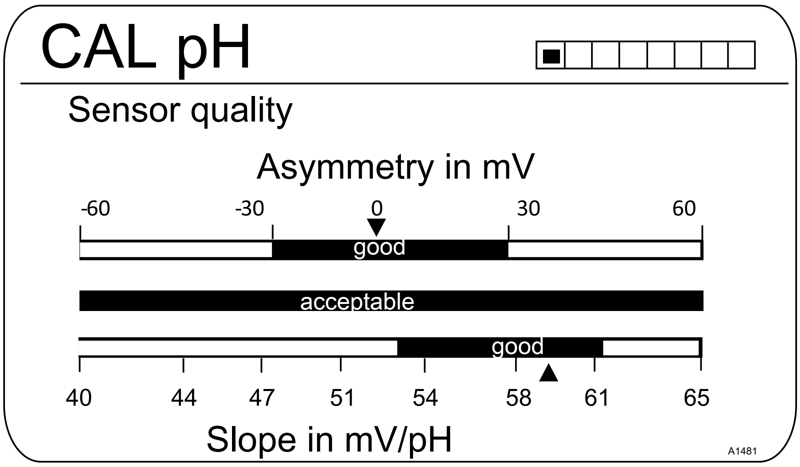


Fig. 15: Displayed after the ▷ key has been pressed

9.1.1 Selecting the Calibration Process for pH

To calibrate the controller there are three available calibration processes:

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

Selecting the calibration process

1. Continuous display ➨ CAL

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

2. Press OK

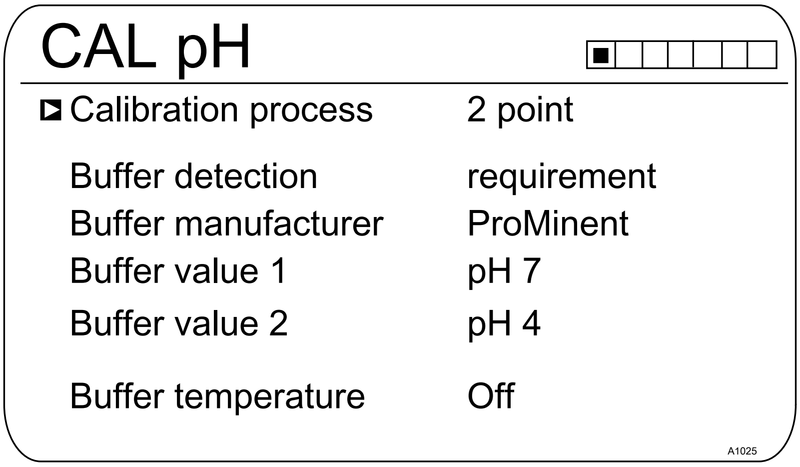


Fig. 16: Selecting the calibration process

⇨ The menu for selecting the calibration process appears.

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

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

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

5. Continue with CAL

⇨ You can now start your chosen calibration process.

9.1.2 2-Point Calibration of the pH Sensor (CAL)

Correct sensor operation

- *Correct measuring and metering is only possible if the sensor is working perfectly.*
- *Refer to the sensor's operating instructions.*
- *2-point calibration is strongly recommended and is preferable to other methods.*
- *The sensor needs to be removed and refitted in the in-line probe housing for calibration. Refer to the operating instructions for your in-line probe housing.*

> ***Defining buffer detection***
>
> *There are 2 buffer detection options with 2-point calibration.*
>
> *[Presetting]: select 2 buffers from the 4 possible buffer sets. During calibration, adhere to the selected order e.g. Buffer value 1: pH 7 and Buffer value 2: pH 4:*
>
> - *ProMinent® (pH 4; 7; 9; 10). (default setting)*
> - *NBS/DIN 19266 (pH 1; 4; 7, ; 9).*
> - *DIN 19267 (pH 1;4; 7; 9; 13).*
> - *Merck + Riedel® (pH 2; 4; 7; 9; 12).*
>
> *The buffer sets differ in their pH values and temperature dependencies set in the controller. The pH values at the different temperatures are also printed on the buffer containers.*
>
> *[Manual]: enter the buffer value with the associated temperature into the controller.*
>
> - *The pH values of the buffer solution, at temperatures other than 25°C, are printed in a table on the label of the buffer bottle.*
>
> *Select the available buffer.*

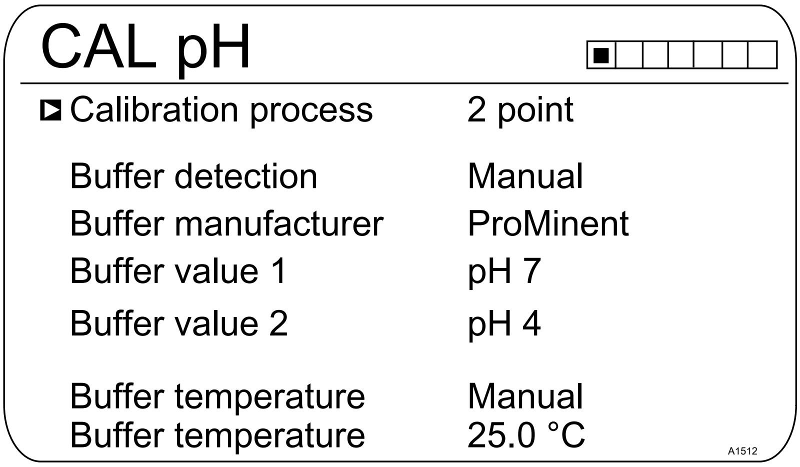


Fig. 17: Example: Display in [CAL-Setup]]

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

> ***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 2 pH values apart. Thoroughly rinse the sensor with water when changing the buffer solution.

Continuous display ➨ CAL.

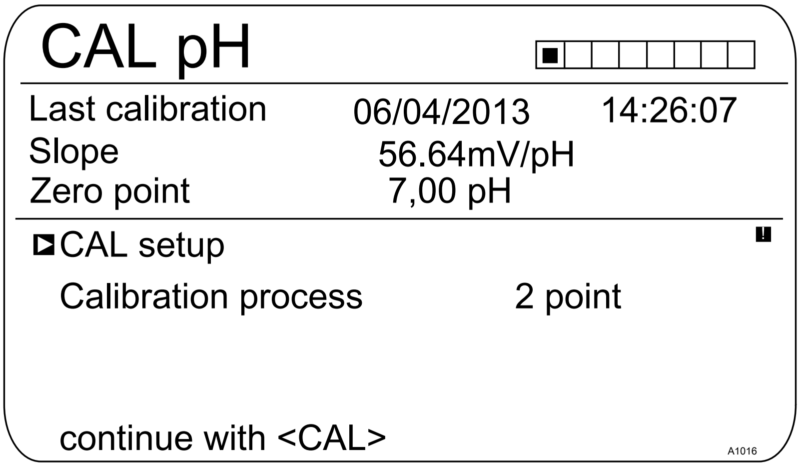


Fig. 18: pH sensor calibration (CAL)

1. Continue with CAL.
2. Rinse the sensor thoroughly with water and dry with a cloth (pat dry, don't rub).
3. Immerse the sensor in test container 1 which contains the buffer solution (e.g. pH 7). Gently move the sensor.
4. Continue with CAL.

> *Do not move the sensor cable during calibration as this can lead to signal variations.*

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

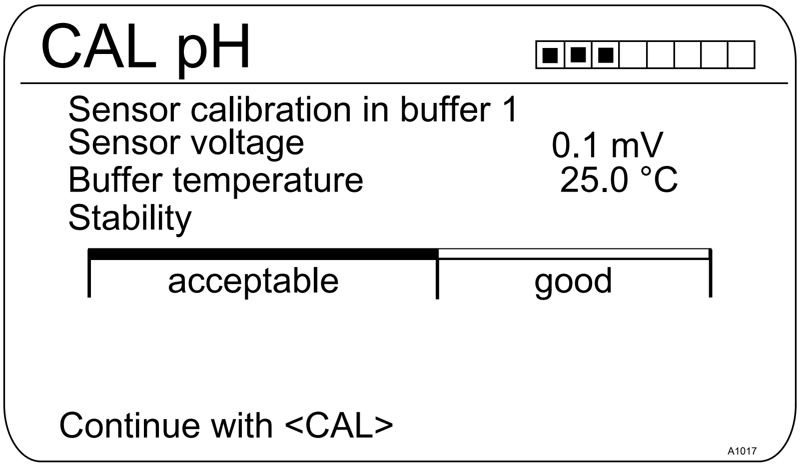


Fig. 19: Display of the sensor stability achieved

5. The range *[acceptable / good / very good]* is displayed.
   ⇨ The black part of the horizontal bar indicates the determined range.
6. As soon as the black bar appears, the display changes from *[Please wait!]* to continue with CAL.

> *The black bar does not need to be at [very good].*

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

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

9. Continue with .

10. Immerse the sensor in test container 2 which contains the buffer solution (e.g. pH 4). Gently move the sensor.

11. Continue with .

> *Do not move the sensor cable during calibration as this can lead to signal variations.*

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

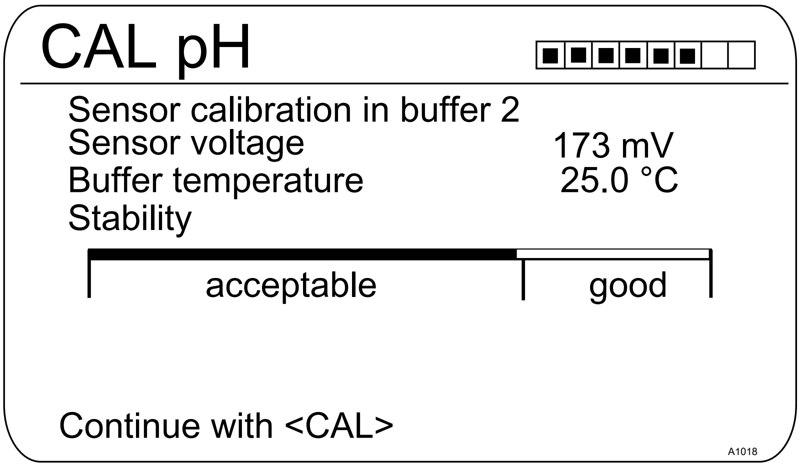


Fig. 20: Display of the sensor stability achieved

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

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

13. As soon as the black bar appears, the display changes from *[Please wait!]* to continue with .

> *The black bar does not need to be at [very good].*

14. *[Puffer detection] [Manual]*: Press and, using the four arrow keys, set the buffer value for buffer 2 to the value of the buffer you are using. Press to confirm input of the value.

15. Continue with .

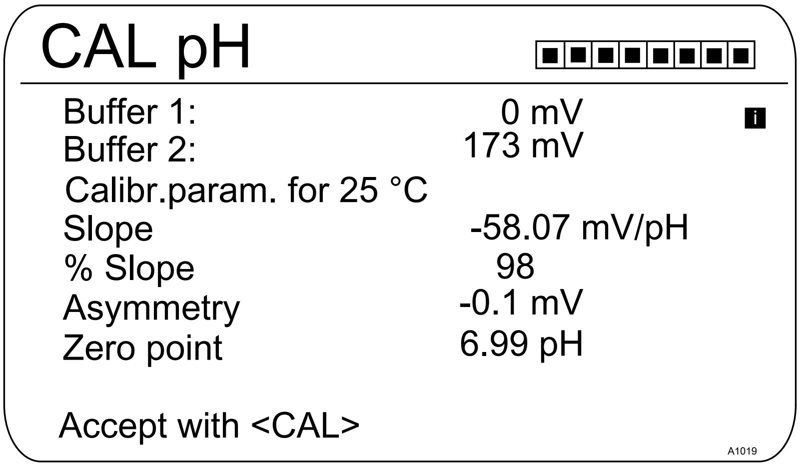


Fig. 21: Display of the calibration result

16.

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

> ***Cleaning and care of pH and ORP sensors***
>
> *Please note the separate instructions supplied with the pH and ORP sensors for cleaning and care of pH and ORP sensors.*
>
> *After cleaning, the sensor must be conditioned in 3-molar potassium chloride solution for 60 minutes before it can be reused for calibration.*

Carry over the result of the calibration into the controller memory by pressing CAL.

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

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

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

NOTICE!

Poor sensor operation and fluctuating pH values during the process

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

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

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

Correct sensor operation

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

Tab. 5: Valid calibration values

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

Continuous display ➨ CAL

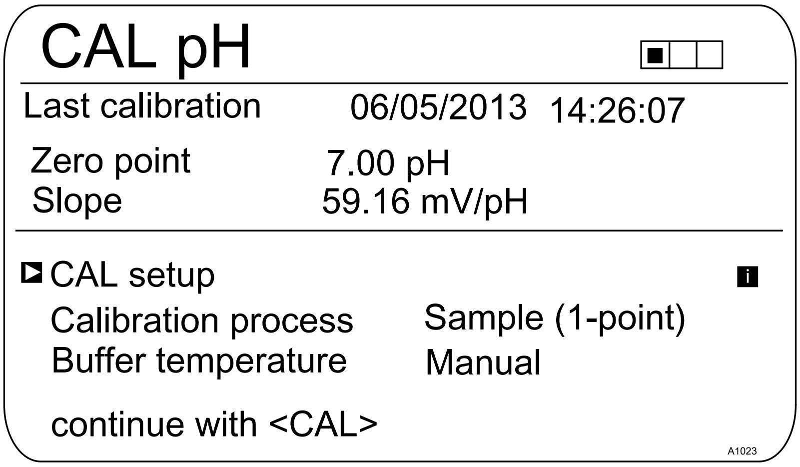


Fig. 22: pH sensor calibration (CAL)

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

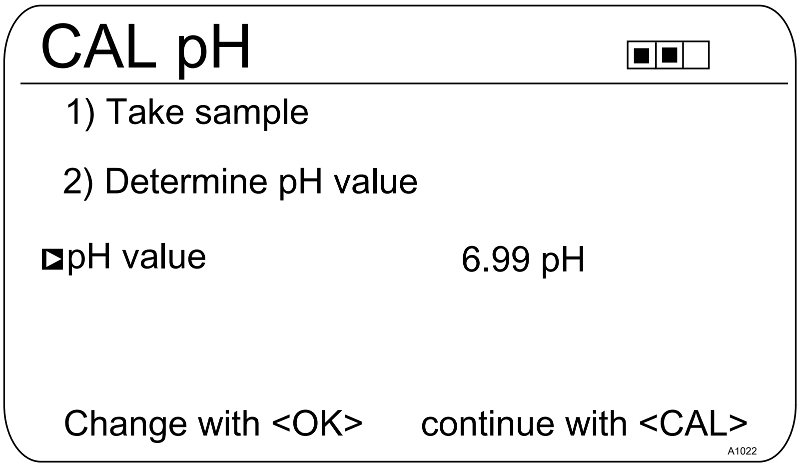


Fig. 23: Instructions for determining the pH value using the [Sample] method

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

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

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

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

Data input
With the [Data input] calibration method, the known data of the sensor is entered in the controller. Calibration by data input is only as accurate and reliable as the method with which the data was determined.

The sensor data must have been determined 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.*
- *Refer to the sensor's operating instructions.*

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

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

Tab. 6: Valid calibration values

Evaluation	Zero point	Slope
Good	-30 mV … +30 mV	-55 mV/pH ... -62 mV/pH
Acceptable	-60 mV ... -30 mV or +30 mV ... +60 mV	- 40 mV/pH ... - 65 mV/pH

Continuous display ➨ CAL

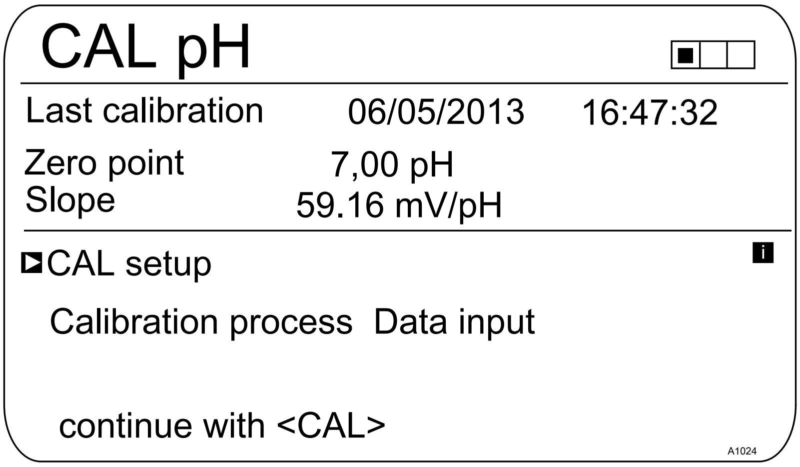


Fig. 24: pH sensor calibration (CAL)

1. Continue with CAL.

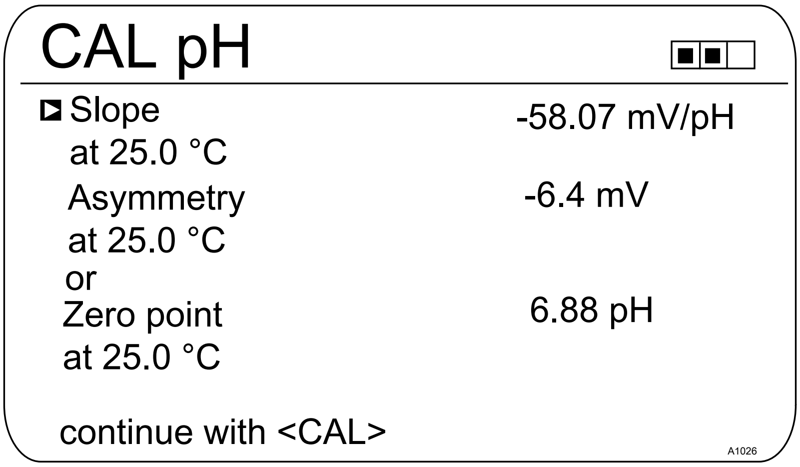


Fig. 25: Selection of the settable parameters

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

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

5. Carry over the result of the calibration into the controller memory by pressing CAL.
   ⇨ The controller shows the continuous display again and operates with the results of the calibration.

9.2 Calibrating the ORP Sensor

9.2.1 Selecting the calibration process for ORP

Selecting the calibration process

There are two calibration processes available for calibrating the controller:

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

1. Continuous display ➨ CAL

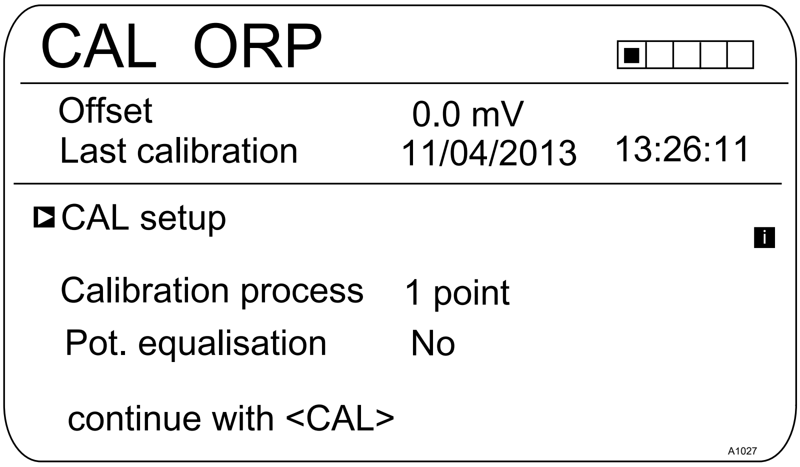


Fig. 26: [ORP] calibration menu

⇨ The calibration menu is displayed.

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

Selecting the calibration process

3. *[CAL Setup]*: Press OK

⇨ The menu for selecting the calibration process appears.

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

⇨ The input window appears.

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

6. Continue with CAL

⇨ You can now start your chosen calibration process.

9.2.2 1-point calibration of ORP sensor (CAL)

Correct sensor operation

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

ORP sensor calibration

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

Measuring and control behaviour of the controller during calibration

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

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

Buffer used

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

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

Continuous display ➨ CAL

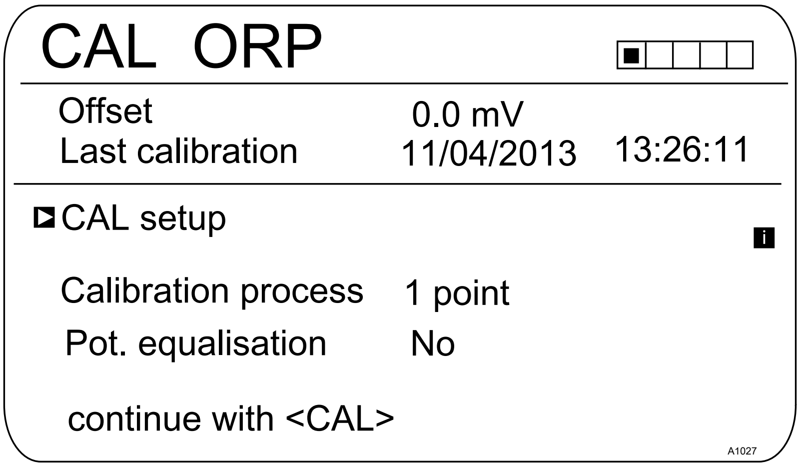


Fig. 27: 1-point calibration of ORP sensor (CAL)

1. Continue with CAL

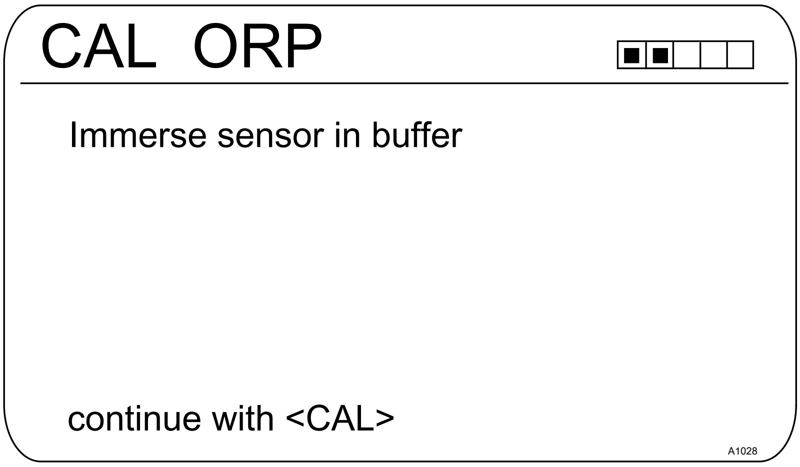


Fig. 28: 1-point calibration of ORP sensor (CAL)

2. Carry out the instructions and then press CAL
   ⇨ Calibration is running. *[Please wait!]* flashes.

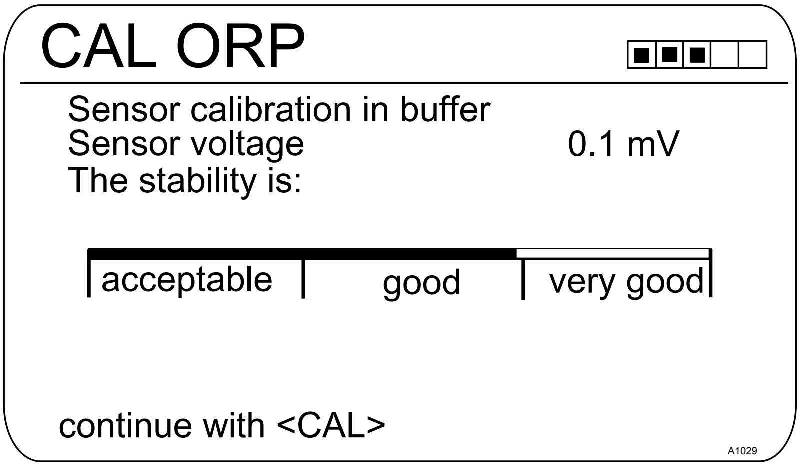


Fig. 29: Display of the sensor stability achieved

3. The *[acceptable / good / very good]* range is displayed
   ⇨ The black part of the horizontal bar indicates the range detected.
4. Continue with CAL

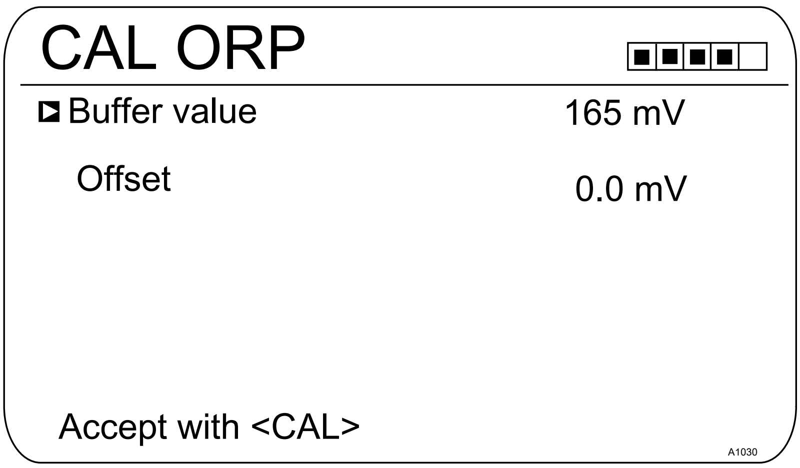


Fig. 30: Adjusting the buffer value

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

6. Press OK
7. Transfer the result of the calibration into the controller memory by pressing CAL
   ⇨ The controller operates with the calibration results.

9.2.3 Calibration data for ORP sensor (CAL)

Correct sensor operation

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

ORP sensor calibration

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

Measuring and control behaviour of the controller during calibration

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

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

Continuous display ➡ CAL

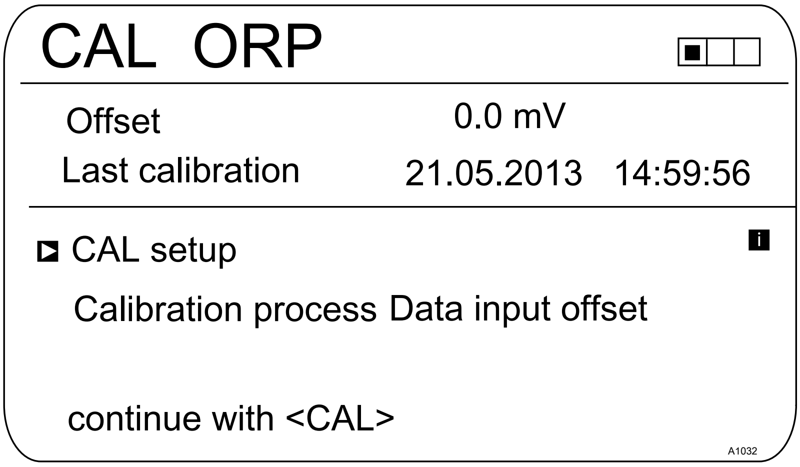


Fig. 31: Data input, ORP sensor calibration (CAL)

1. Continue with CAL

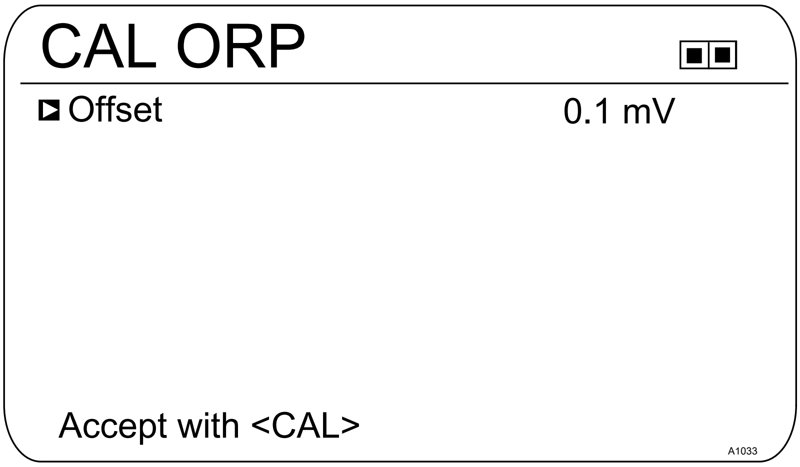


Fig. 32: Adjusting the [Offset]

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

9.3 Calibrating the Fluoride Sensor

9.3.1 Selection of the calibration process for fluoride

To calibrate the controller there are two available calibration processes:

- 1 point
- 2 point

Calibration process selection

1. Continuous display ➨ CAL

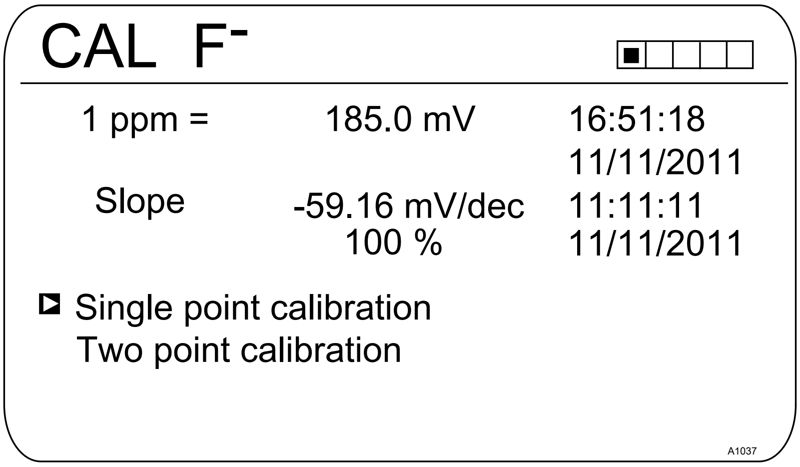


Fig. 33: Calibration menu [Fluoride]

⇨ 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

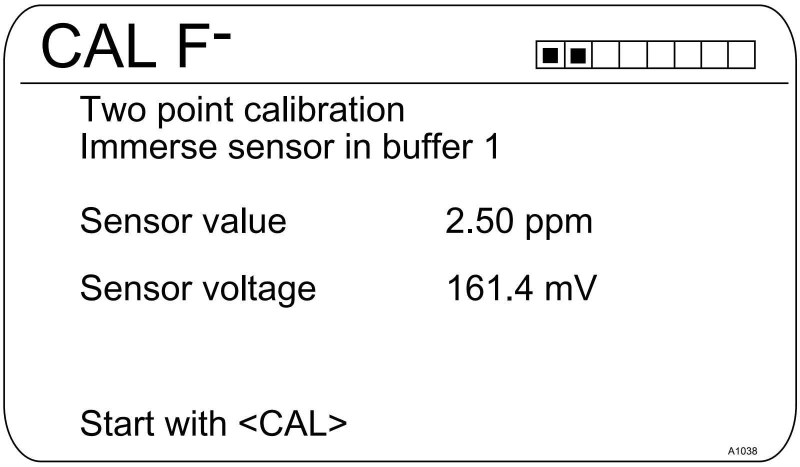


Fig. 34: Fluoride sensor calibration (CAL)

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]*.

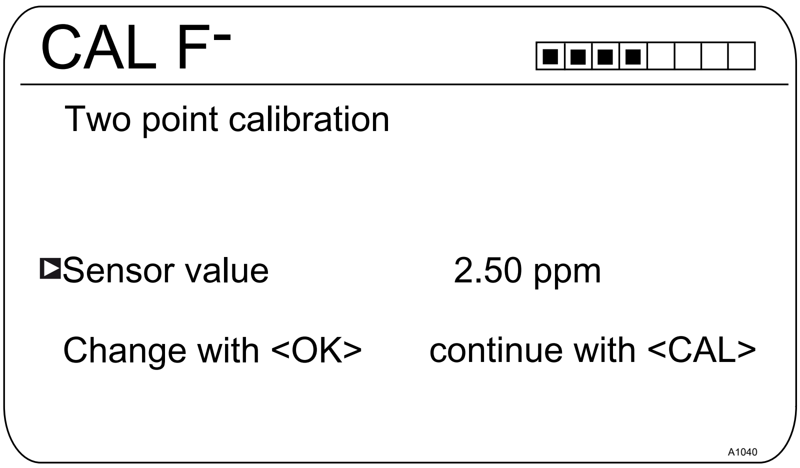


Fig. 35: Fluoride sensor calibration (CAL)

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

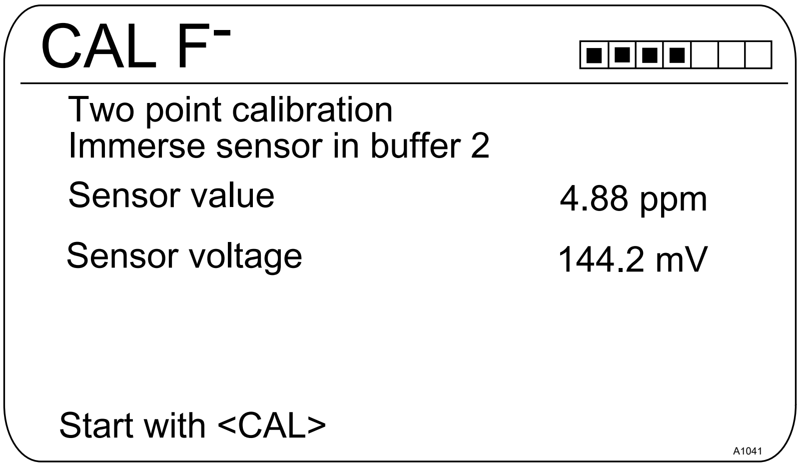


Fig. 36: Fluoride sensor calibration (CAL)

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

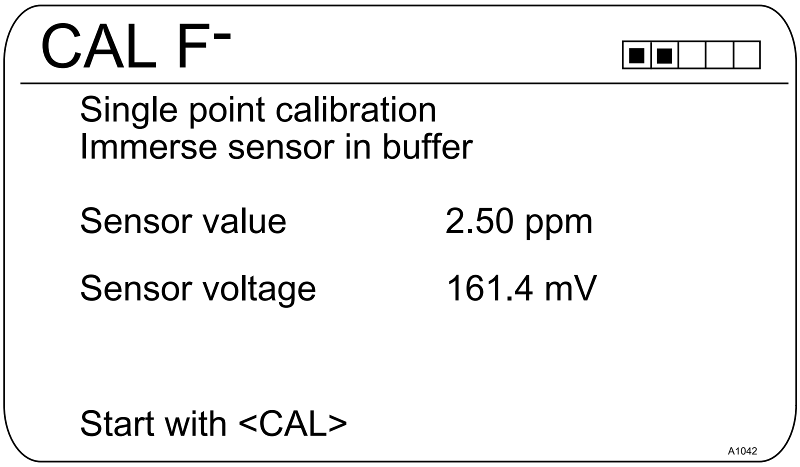


Fig. 37: Fluoride sensor calibration (CAL)

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

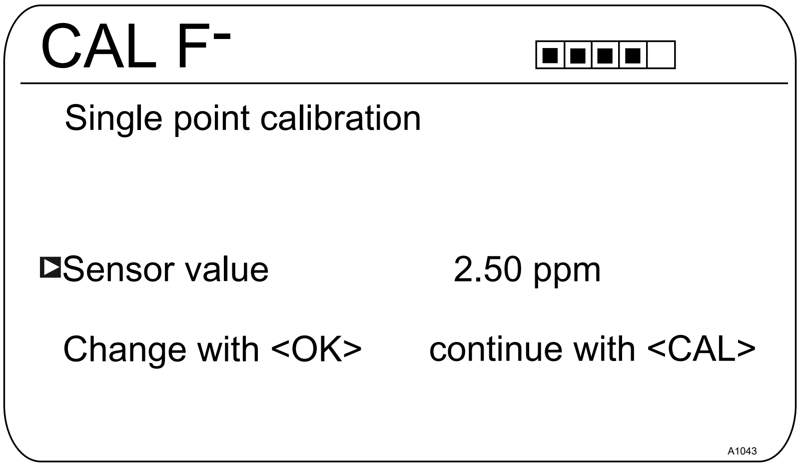


Fig. 38: Fluoride sensor calibration (CAL)

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 Calibration of Amperometric Sensors

> ***Calibration of Amperometric Sensors***
>
> *The calibration procedure for amperometric sensors 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. All other calibration of the pH measurement must always be followed by calibration of the chlorine measurement. Otherwise the chlorine measurement will be inaccurate.

Free chlorine or total available chlorine
Calibration of the zero point is not necessary.

Slope: Possible calibration in the range: 20% ... 300%.

A slope below 70% indicates a blockage of the diaphragm. Refer to the operating instructions for your sensor.

A slope of over 150% with sensors CLE3/CLE1 indicates surface-active components (surfactants) in the sample water. Replacing the diaphragm only delivers short-term improvement. It is important to prevent the occurrence of surfactants in the water. If surfactants cannot be avoided, then use an appropriate sensor, for example sensor type CBR.

9.4.1 Selecting the calibration process for amperometric measured variables

There are two calibration processes available for calibrating the controller:

- Calibrating the slope
- Calibrating the zero point

Selecting the calibration process

1. Continuous display ➨ CAL

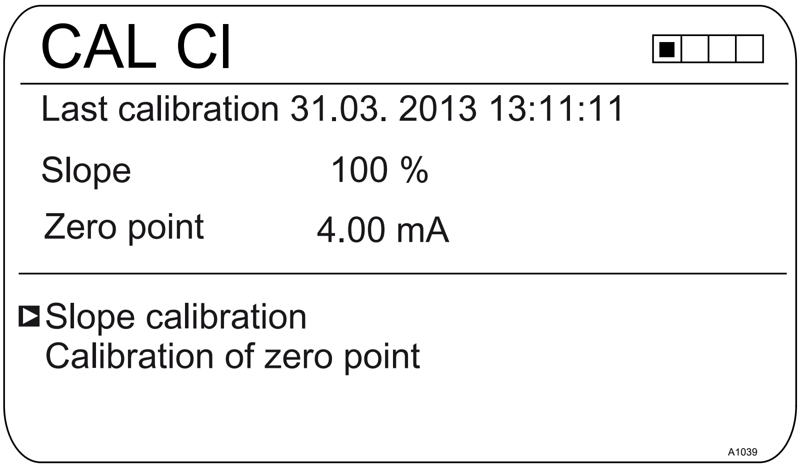


Fig. 39: [Chlorine] calibration menu

⇨ The calibration menu is displayed.

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

⇨ You can now start your chosen calibration process.

9.4.2 Calibrating the slope

CAUTION!

Correct sensor operation / Run-in period

Damage to the product or its surroundings

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

Measuring and control behaviour of the controller during calibration

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

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

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

NOTICE!

Prerequisites for correct calibration of the sensor slope

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

Material required for calibration of amperometric sensors:

- A reference method suitable for the measured variable in question

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

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

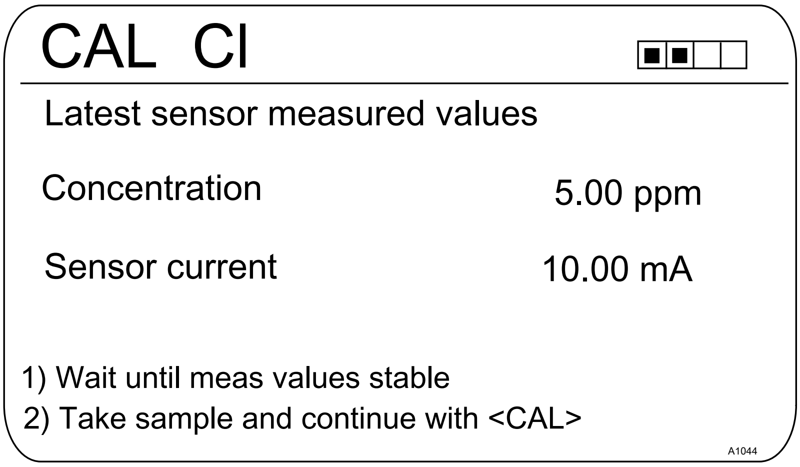


Fig. 40: Reference value calibration shows the actual sensor values

4. Continue with CAL

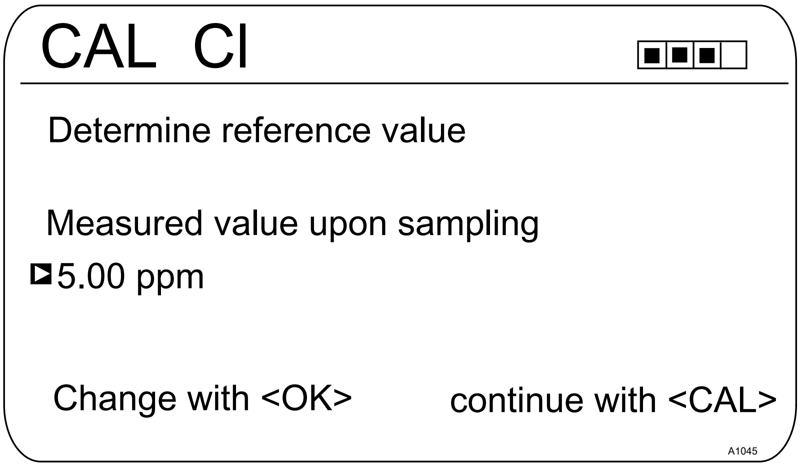


Fig. 41: Reference value calibration, the sensor value is frozen here; now take the sample and measure using DPD, for example

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

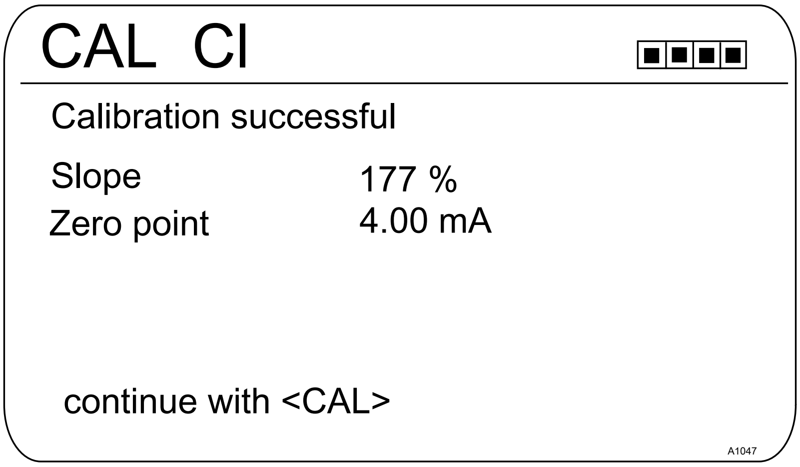


Fig. 42: Calibrating the reference value

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

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

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

> ***Permitted calibration range***
>
> *The permitted calibration range is 20 ... 300% of the sensor's rated value.*
>
> *Example of a shallow slope: Blocking of the sensor membrane leads to a low slope (low slope = low sensor sensitivity)*
>
> *Example of a steep slope: Surfactants make the sensor membrane more permeable, leading to a steeper slope (steep slope = high sensor sensitivity)*

9.4.3 Calibration of zero point

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

CAUTION!

Correct sensor operation / Run-in period

Damage to the product or its surroundings

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

Measuring and control behaviour of the controller during calibration

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

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

NOTICE!

Prerequisites for a correct calibration of the sensor zero point

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

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

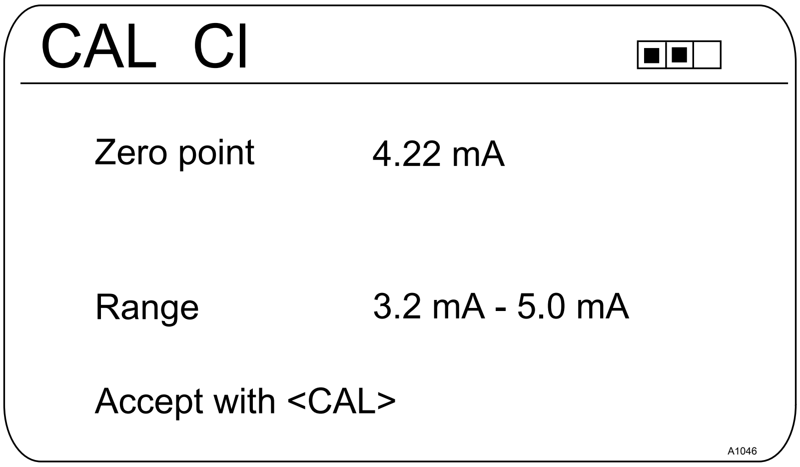


Fig. 43: Calibration of zero point

4. Then press CAL

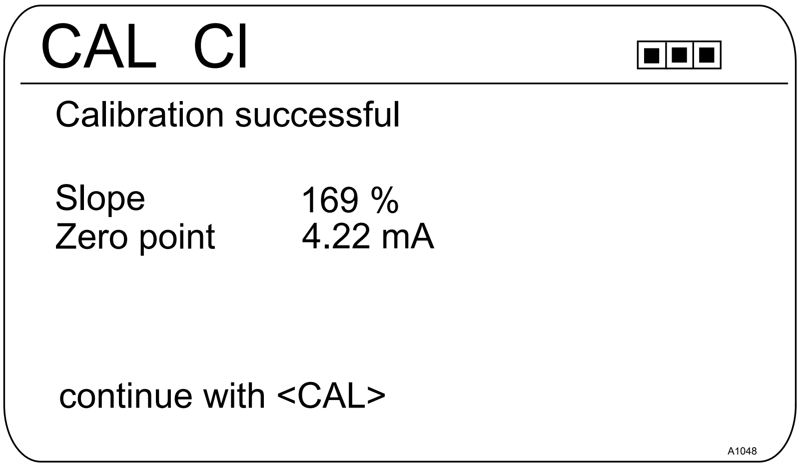


Fig. 44: Calibration of zero point

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 oxygen sensor

9.5.1 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 depending on the result:

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

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

> ***Sensor manufacturer's calibration specifications***
> *When determining the calibration interval, consider the sensor operating instructions as they may specify additional and/or deviating calibration intervals.*

9.5.2 Selection of the calibration process for the measured variable O_2

Different calibration modes are offered depending on the sensor type.

9.5.2.1 Calibration of the slope in air

1. Press the CAL key in the continuous display.
2. Use OK to select the measuring channel.
   ⇨ The display appears as follows:

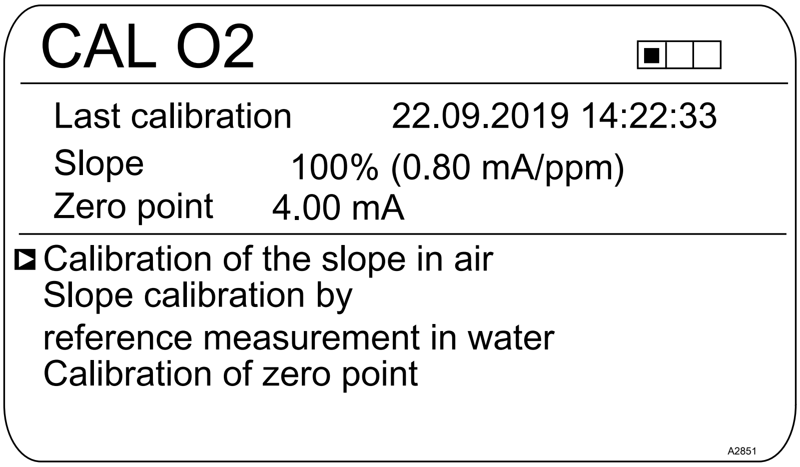


Fig. 45: Calibration of the slope in air

3. Use OK to select the calibration process: Calibration of the slope in air.

   ⇨ The display appears as follows:

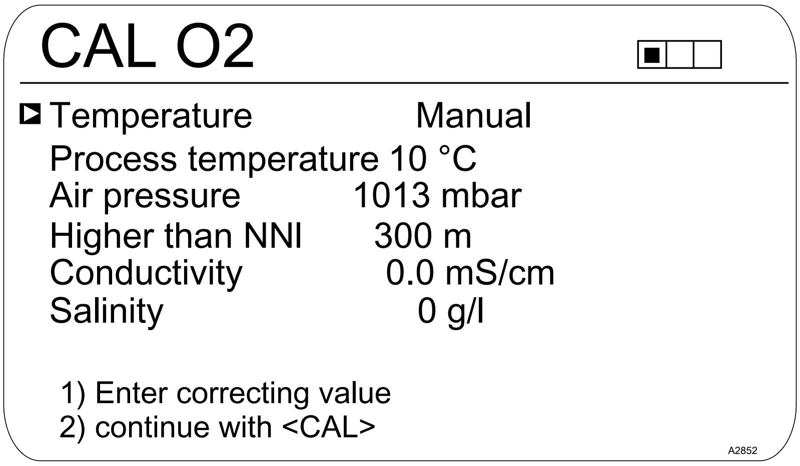


Fig. 46: Correction variable values

4. Enter the current values for the correction variables: Use OK to select the correction variable. Use the arrow keys to enter the values.
5. Use CAL to continue.

   ⇨ The display appears as follows:

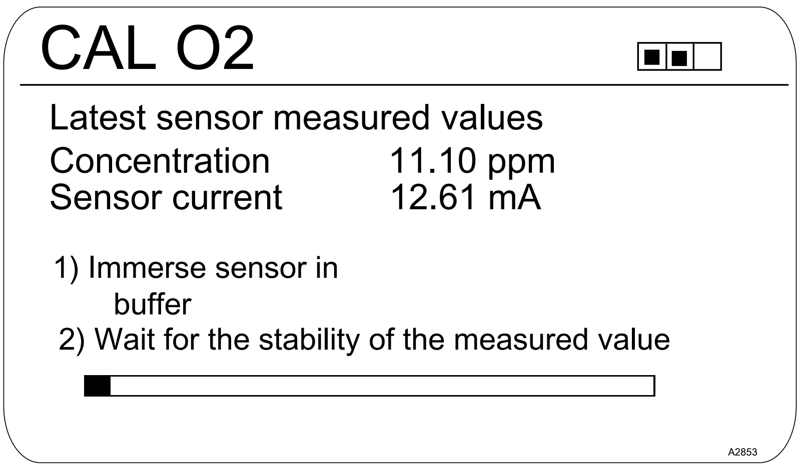


Fig. 47: Keeping the sensor in air saturated with water vapour

6. Keep the sensor in air saturated with water vapour.

7. Wait for the stability of the measured values.

8. The display appears as follows if calibration is successful:

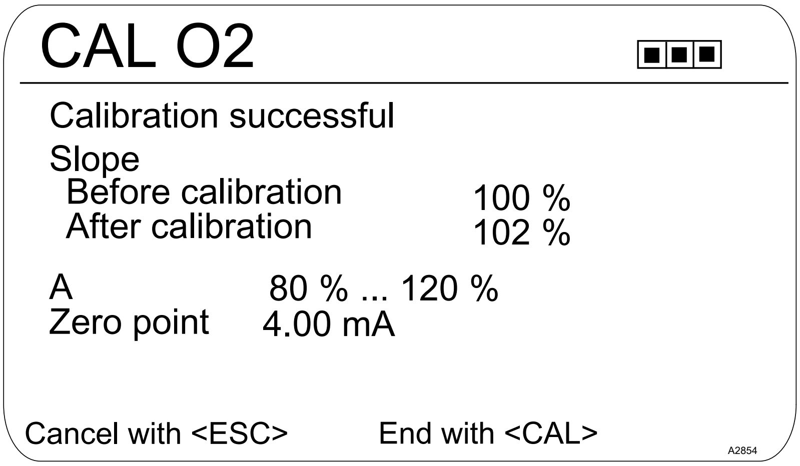


Fig. 48: Successful calibration

9. - Use CAL to confirm.
   - Press ESC to cancel.

10. The display appears as follows if calibration is unsuccessful:

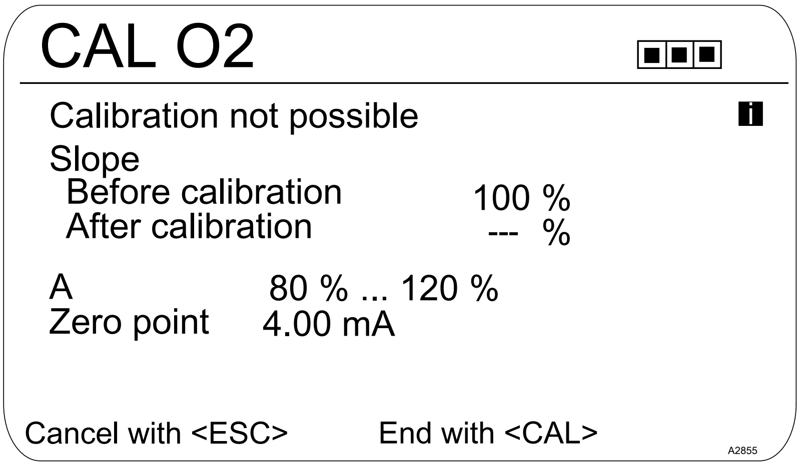


Fig. 49: Unsuccessful calibration

11. - Use CAL to end.
    - Press ESC to cancel.

12. Check the sensor and installation once again and repeat the calibration procedure.

9.5.2.2 Calibrating the slope using a reference measurement in water

1. Press the CAL key in the continuous display.

2. Use OK to select the measuring channel.

   ⇨ The display appears as follows:

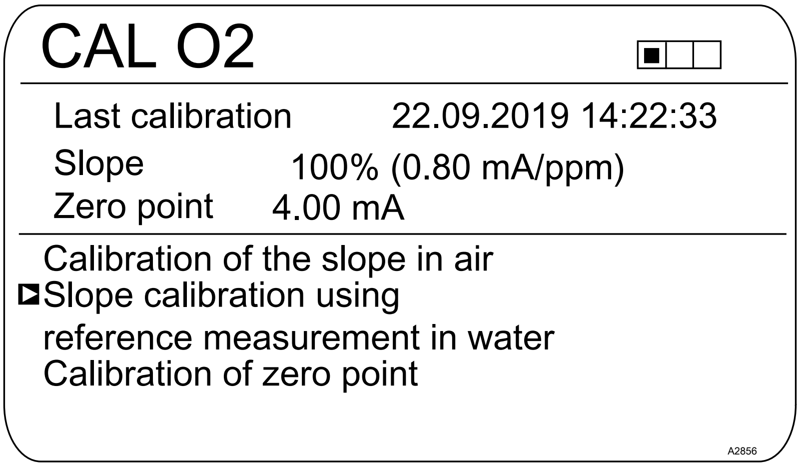


Fig. 50: Calibrating the slope using a reference measurement in water

3. Use OK to select the calibration process: Calibrate the slope using a reference measurement in water.
   ⇨ The display appears as follows:

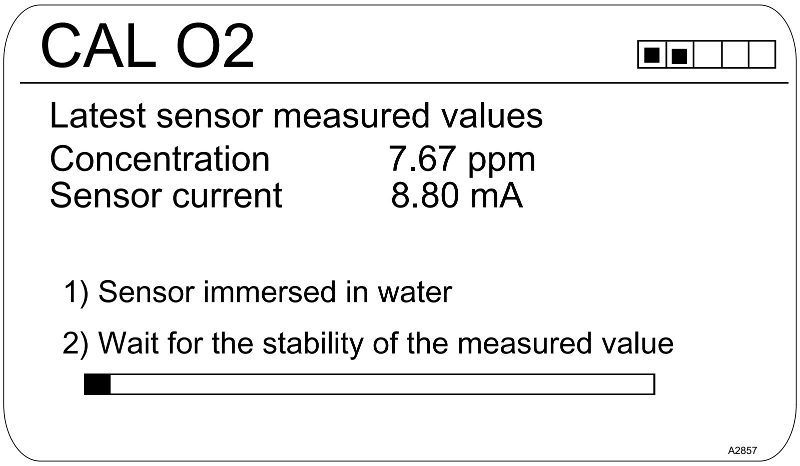


Fig. 51: Latest sensor measured values

4. Install the sensor in water.
5. Wait for the stability of the measured values.
   ⇨ The display appears as follows:

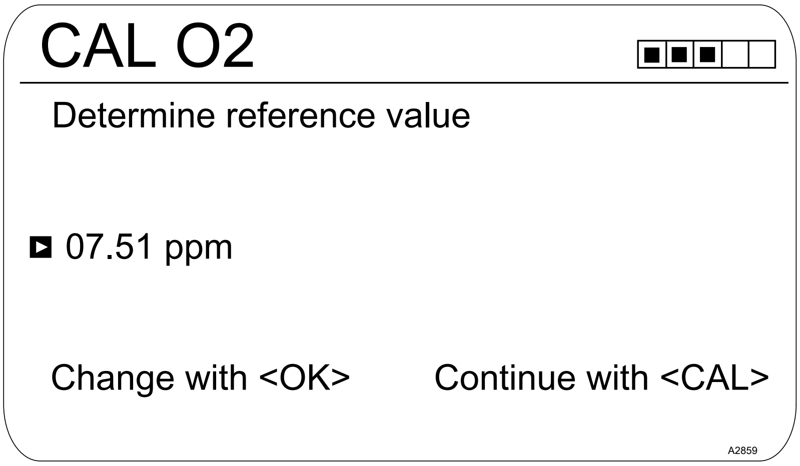


Fig. 52: Reference value

6. Use OK and the arrow keys to enter the reference value
   ⇨ The display appears as follows:

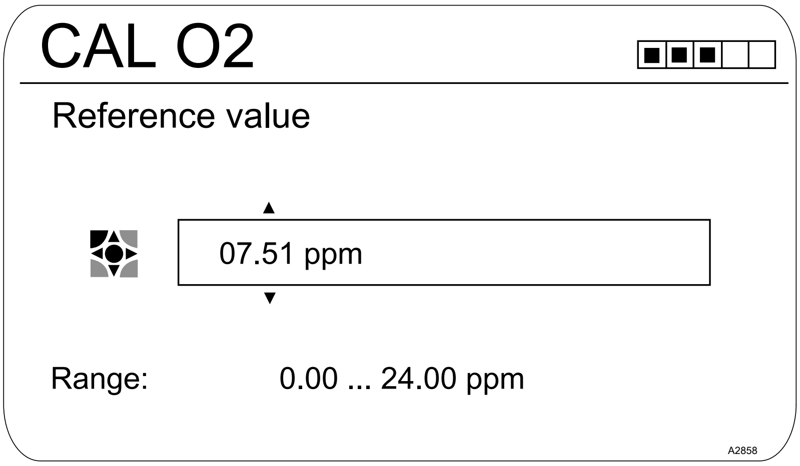


Fig. 53: Reference value

7. Continue with CAL.
8. The display appears as follows if calibration is successful:

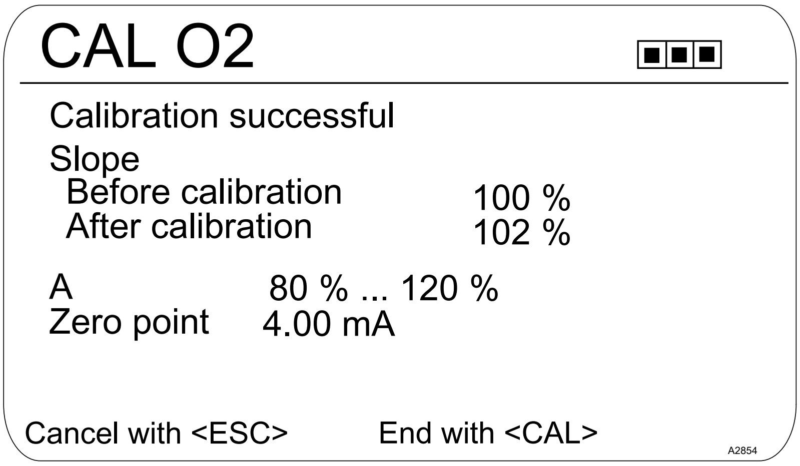


Fig. 54: Successful calibration

9. - Use CAL to confirm
   - Press ESC to cancel
10. The display appears as follows if calibration is unsuccessful:

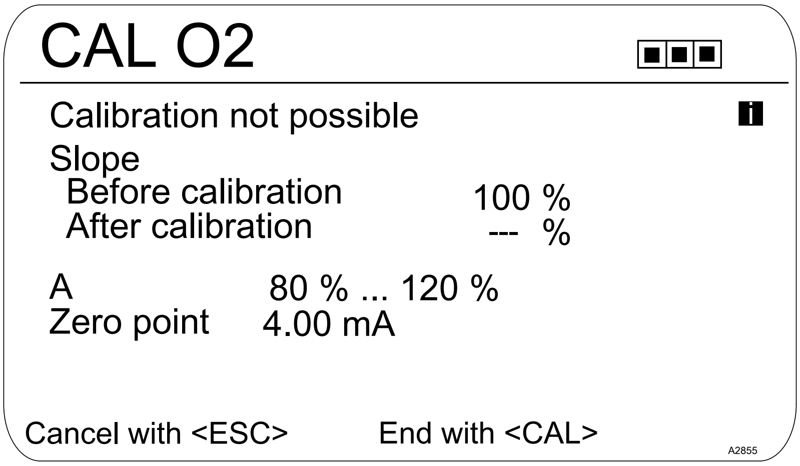


Fig. 55: Unsuccessful calibration

11. - Use CAL to end
    - Press ESC to cancel
12. Check the sensor and installation once again and repeat the calibration procedure.

9.5.2.3 Calibration of the zero point

Calibration of the zero point is only needed for precise measurements at the lower end of the measuring range (< 5% of the measuring range).

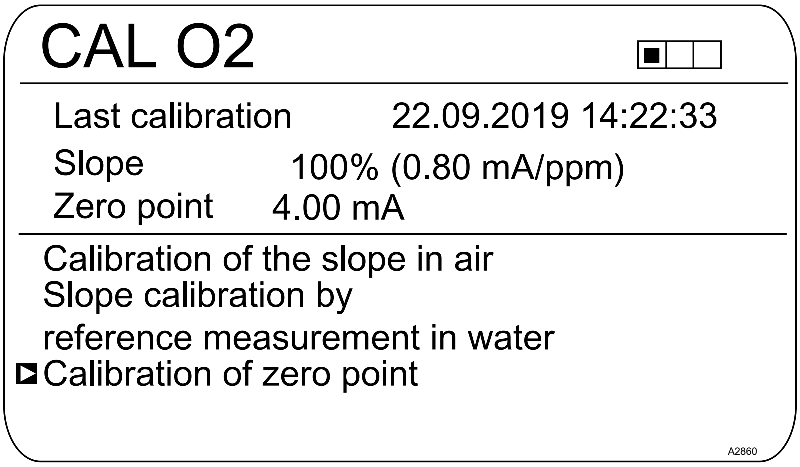


Fig. 56: Introduction: Calibration of the zero point

1. Use OK to select the calibration process: Calibration of the zero point.
   ⇨ The display appears as follows:

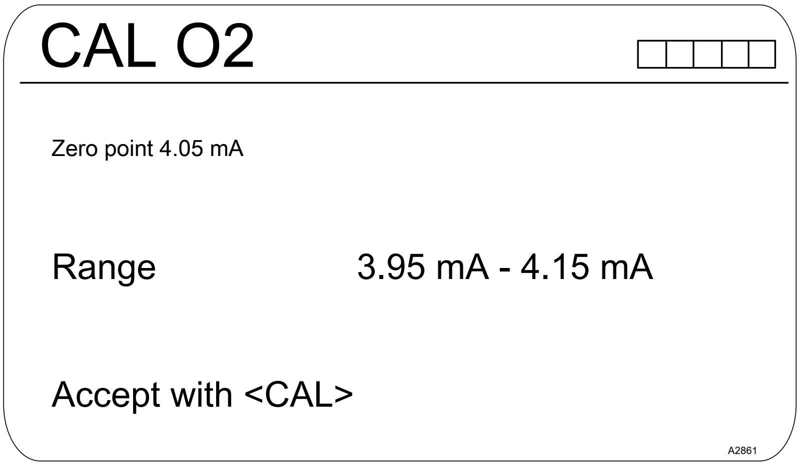


Fig. 57: Zero point

2. Position the sensor in an oxygen-free environment e.g. in water with a slight excess of sodium hydrogen sulfite and wait until the signal is stable
3. Use CAL to accept
4. The display appears as follows if calibration is successful:

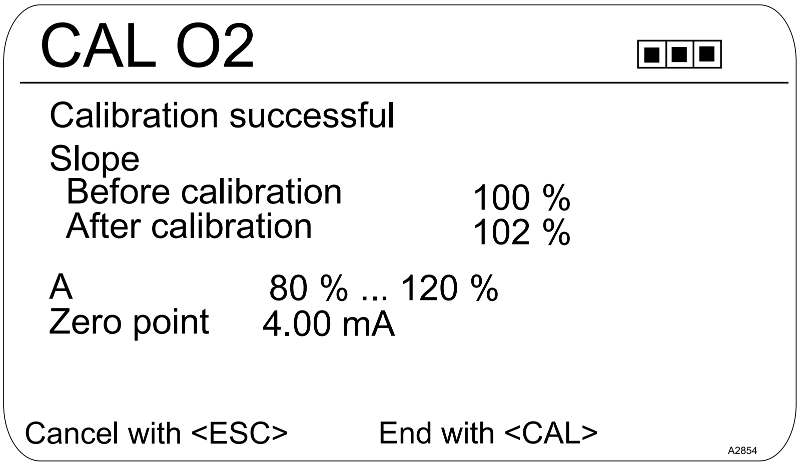


Fig. 58: Successful calibration

5.
   - Use CAL to confirm
   - Press ESC to cancel
6. The display appears as follows if calibration is unsuccessful:

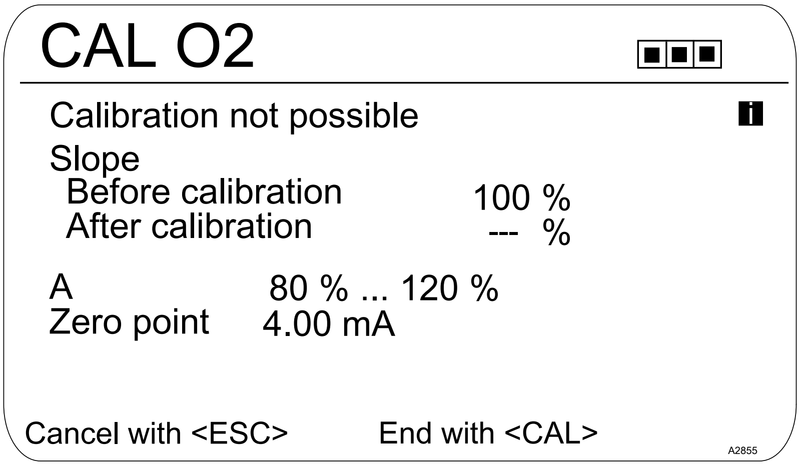


Fig. 59: Unsuccessful calibration

7. - Use CAL to end
   - Press ESC to cancel
8. Check the sensor and installation once again and repeat the calibration procedure.

9.6 Measured value [mA general] calibration

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

9.7 Calibrating Conductivity *[mA]*

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

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

1. Press CAL in the continuous display.
2. Use the arrow keys to select *[Slope calibration]*.
3. Continue with OK.
4. Follow the instructions in the controller display and perform calibration.

5. Continue with CAL.

6. Then press OK to adjust the µS/cm value or press CAL to continue with calibration.

7. Carry over the result of the calibration into the controller memory by pressing CAL.

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

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

9.8 Calibrating conductive conductivity

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

9.8.1 Calibrating conductive conductivity, sensor parameter adjustment

> NOTICE!
>
> The sensor must be dry
>
> Do not allow the conductivity sensor to come into contact with liquid. Only allow the conductivity sensor to come into contact with liquid once the conductivity sensor has been connected, configured and calibrated. The sensor parameters (zero point) of a moist or wet conductivity sensor can no longer be properly calibrated.
>
> If the conductivity sensor has come into contact with liquid prior to calibration, there is an option to dry the conductivity sensor. A dry conductivity sensor can be successfully recalibrated to the sensor parameters.

If *[Sensor not dry]* continues to be displayed despite the conductivity sensor having been dried, then you will have to wait some time until the controller has detected the sensor as dry.

Once you have selected the sensor type, the prompt automatically appears asking whether the sensor parameters (zero point) have to be determined. You can initiate this prompt manually as follows:

Continuous display ➨ Menu ➨ ▲ or ▼ *[Measurement]* ➨ OK ➨ ▲ or ▼ *[Measuring channel X Conductivity]* OK ➨ ▲ or ▼ *[Sensor parameter adjustment]* ➨ OK.

1. Use the arrow keys to select *[Automatically determine sensor parameters]*.
2. Continue with OK.
   ⇨ You will see the display showing *[Sensor dry]* and *[Automatically determine sensor parameters]*.
3. Continue with OK.
   ⇨ You will see the display with the message *[Sensor parameters are automatically determined]*.

   The sensor parameters are automatically carried over.

9.8.2 Calibrating conductive conductivity, cell constant

Prerequisite for calibration. The conductivity sensor is connected. The conductivity sensor is in a conductivity calibration solution, the conductivity of which is known.

Material	Order number
Conductivity calibration solution, 1413 µS/cm, 250 ml.	1027655
Conductivity calibration solution, 1413 µS/cm, 1000 ml.	1027656
Conductivity calibration solution, 12.88 mS/cm, 250 ml.	1027657
Conductivity calibration solution, 12.88 mS/cm, 1000 ml.	1027658

All parameters for the conductivity sensor are correctly entered in the *[Measurement]* menu item.

1. Press CAL in the continuous display.
2. Use the arrow keys to select the channel which should be calibrated.
3. Then press OK
   ⇨ You will see the display with the menu for selection of *[Cell constant]* or *[Temp. coefficient]*.

Calibration of the cell constant

4. Use the arrow keys to select *[Cell constant]*.
5. Continue with OK.
   ⇨ You will see the current data for the *[Cell constant]*. Enter the temperature coefficient of the calibration solution here.
6. Continue with calibration with CAL.
7. Continue with OK.
8. Enter the known conductance of your conductivity calibration solution.
9. Accept with OK.
10. Continue with CAL.

11. Apply the result of the calibration into the controller memory by pressing CAL or cancel the process with ESC.

   ⇨ The controller shows the calibration menu again and operates with the results of the calibration.

> *Incorrect calibration*
>
> *Cell constant, valid range: 0.005 ... 15 1/cm*
>
> *An error message appears if the result of the calibration lies outside the specified tolerance limits. In this case, the current calibration is not carried over.*
>
> *Check the prerequisites for calibration and eliminate the error. Then repeat calibration.*

9.8.3 Calibrating conductive conductivity, temperature coefficient

Prerequisite for calibration. The conductivity sensor is connected. The conductivity sensor is in a suitable liquid, e.g. a sample from the bypass fitting.

1. Press CAL in the continuous display.
2. Use the arrow keys to select the channel which should be calibrated.
3. Then press OK

   ⇨ You will see the display with the menu for selection of *[Cell constant]* or *[Temp. coefficient]*.

Check the *[Temp. coefficient]*

4. Use the arrow keys to select *[Temp. coefficient]*.
5. Continue with OK.

   ⇨ You will see the current data for the *[Temp. coefficient]*.

6. Continue with CAL.

   ⇨ The sensor signal stability will be displayed – the temperature values relate to the temperature difference of the medium:

   - low (< 10 °C is too low),
   - good (> 10 °C is good),
   - very good (> 15 °C is very good).

   CAL is displayed if the bar graph is in the "good" area.

7. Warm up the conductivity calibration solution by at least 10 °C but better by 15 °C while the conductivity sensor is in the conductivity calibration solution.

   ⇨ The *[Sensor signal stability]* bar moves now to the right.

   If *[low]* is displayed, then repeat the process at a temperature of 1 ... 2 °C higher. If *[low]* continues to be displayed, then the sensor is faulty. With *[good]* and *[very good]*, continue with CAL.

8. Apply the result of the calibration by pressing [CAL].

   ⇨ The controller shows the calibration menu again and operates with the results of the calibration.

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

9.9 Calibrating temperature

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

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

1. Press [CAL] in the continuous display.
2. Then press [OK]
3. Follow the instructions in the controller display and perform calibration
4. Then press [CAL]
5. Then press [OK] to adjust the value or press [CAL] to continue with calibration
6. Import the result of the calibration into the controller memory by pressing [CAL]

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

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

10 Setting up the *[Control]*

- **User qualification:** trained user, see Part 1 of the Operating Instructions, the User qualification section

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

Measuring channel settings

This descriptions of [Channel 1] apply correspondingly to the settings in all other measuring channels. The procedure for entering the settings for the channel in question is identical, however the parameters to be set may differ. Your attention is drawn to the differences, which are also described.

NOTICE!

Possible data loss

If you change the measured variable in the *[Measurement]* menu, see *Chapter 8 'Setting measured variables' on page 22*, all settings in the *[Measurement]* and *[Control]* menus are reset to their factory settings (default values). You then have to re-enter the settings in the *[Measurement]* and *[Control]* menus. The operator is responsible for the correct set-up of the controller.

Requirements for setting up the [Control]:

The following settings are required to set up the [Control]: Enter the settings if you have not yet done so.

- *Specify the measured variable and all the necessary settings in the [Measurement] menu, see* *Chapter 8 'Setting measured variables' on page 22*
- *Specify the actuators to be used for the control task: Information about electrical connections and settings can be found in the following menus*
  - *[Pumps], see* *Chapter 13 'Setting the [Pumps]' on page 96.*
  - *[Relays], see* *Chapter 14 'Setting the [Relays]' on page 98.*
  - *[mA outputs], see* *Chapter 16 'Setting the [mA outputs]' on page 104.*

Actuators (control elements) can include, for example, metering pumps, solenoid valves, motorised valves etc.

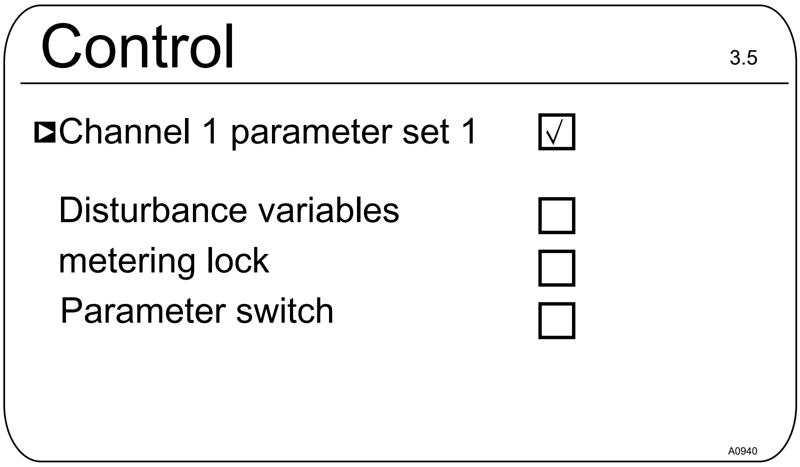


Fig. 60: Continuous display ➨ MENU ➨ ▲ or ▼ [Control] ➨ OK [Control]

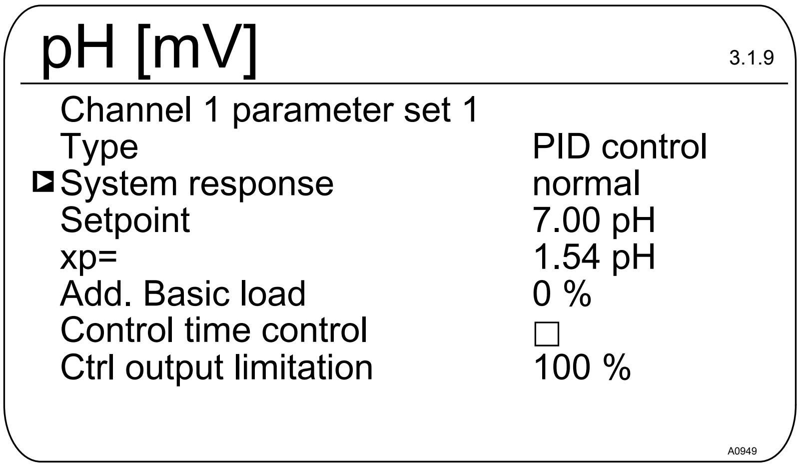


Fig. 61: using the example pH [mV]: Continuous display ➨ MENU ➨ ▲ or ▼ [Control] ➨ OK [Control] ➨ ▲ or ▼ [Channel 1 parameter set 1] ➨ OK [Channel 1 parameter set 1]

Parameter level 1	Function	Parameter
[Channel 1 parameter set 1]	*[Type]*	none
		P-control
		PID control
	[System response]	normal
		manual
		with dead zone
	[Setpoint]	The adjustable range of the setpoint is specified by the device.
	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.

Parameter level 1	Function	Parameter
	[Checkout time control]	Checkout time ↑ (upper)
		Checkout time ↓ (lower)
		Control variable threshold
	[Control variable limitation]	The adjustable range of the maximum control variable is specified by the device.
[Interference variables]	Interference variable input	Off
		On
[Remote setpoint]	Channel 1, 2 or 3	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 monodirectional or bidirectional controller. Two parameter sets are available for each controller. The second parameter set is activated when 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, ensure that the actuator which raises the measured value is connected to the corresponding *[Raise measured value]* output and the actuator which lowers the measured value is connected to the *[Lower measured value]* output, see Part 1 of the Operating Instructions, the Electrical installation section.

Example: A medium with an actual value of pH 3 should have its pH raised to the setpoint pH 7 using a sodium hydroxide solution (pH >14). To do this, connect the actuator to the *[Raise measured value]* control output.

Effective direction of the [control], bidirectional or monodirectional

You can vary the *[control]* based on various characteristics.

Function: A bidirectional *[control]* operates in two possible directions (raise AND lower measured value).

Application: Acidic or alkaline waste water is produced alternately in a neutralisation process in an industrial waste water system. Before the water can be fed into the sewage system, the pH value must be set, for example, to a value between pH 6.8 and 7.5. A bidirectional controller with two metering pumps for metering acid and alkali is used for this purpose. The pH value can be both lowered or raised to come within the required setpoint range.

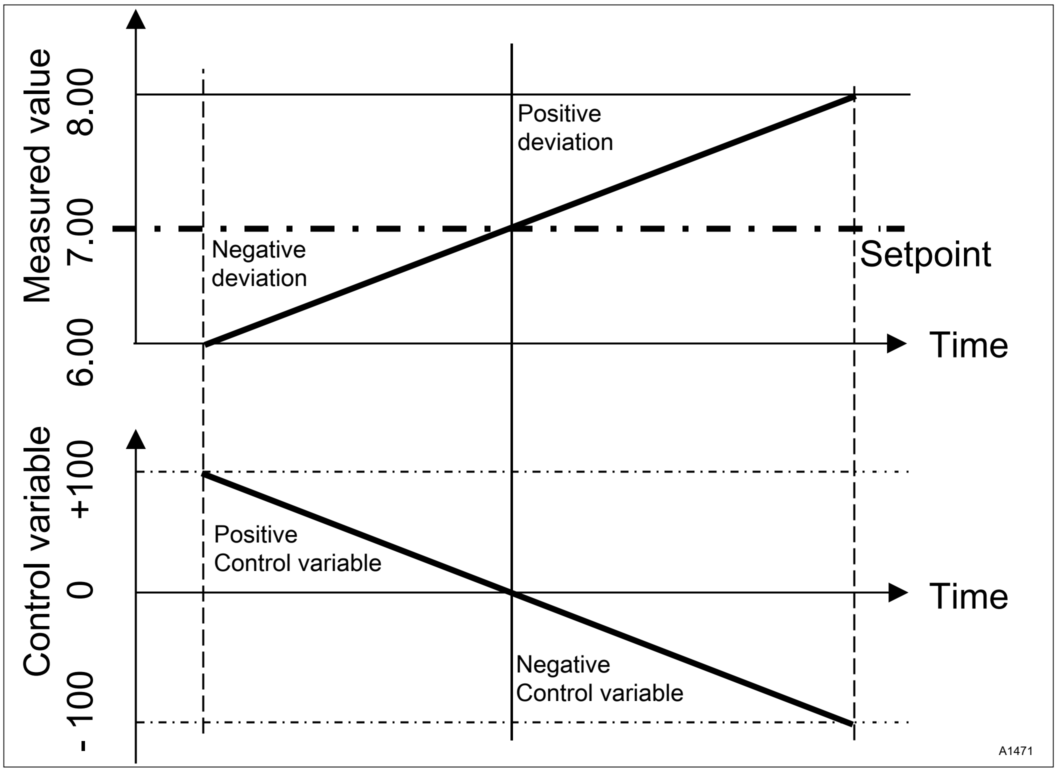


Fig. 62: PID bidirectional control type. Control characteristic without dead zone

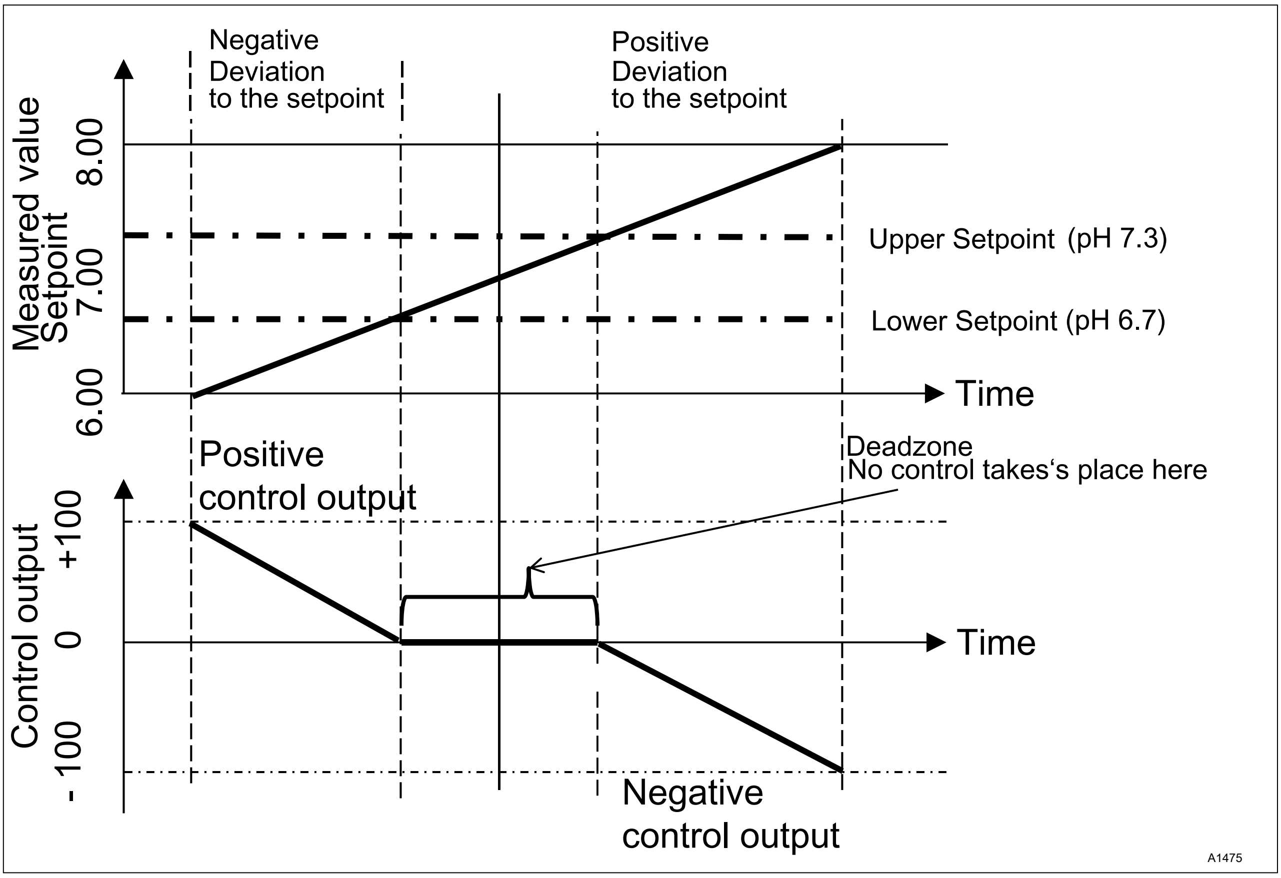


Fig. 63: PID bidirectional control type, with dead zone

Function: A monodirectional *[control]* operates in only one of two possible directions (raise OR lower measured value).

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

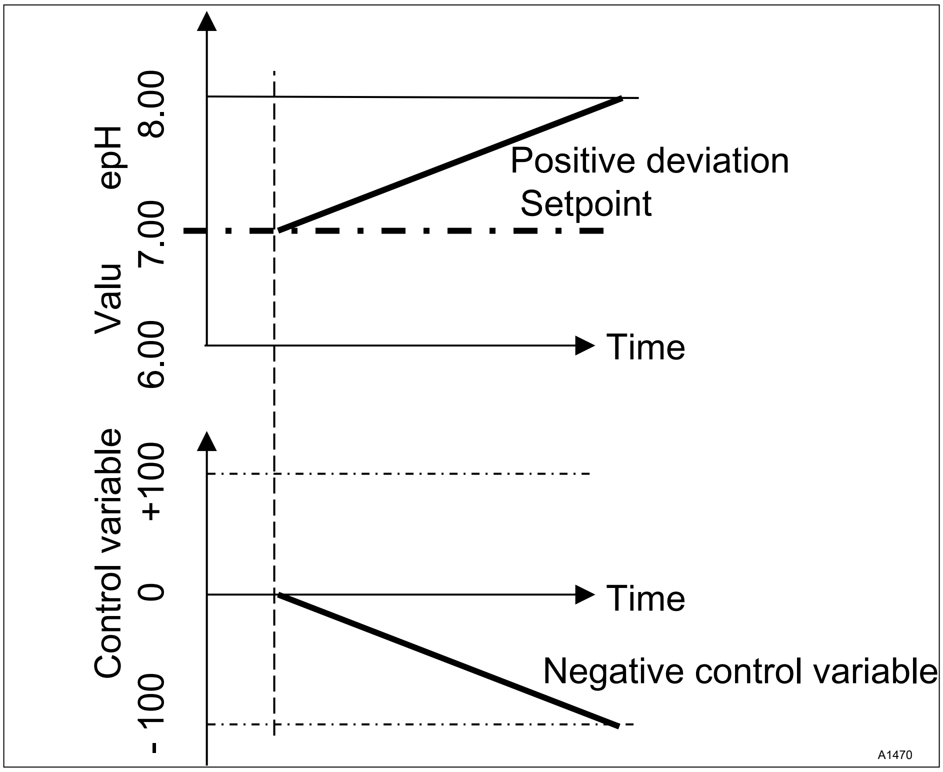


Fig. 64: PID monodirectional control type, pH-lowering

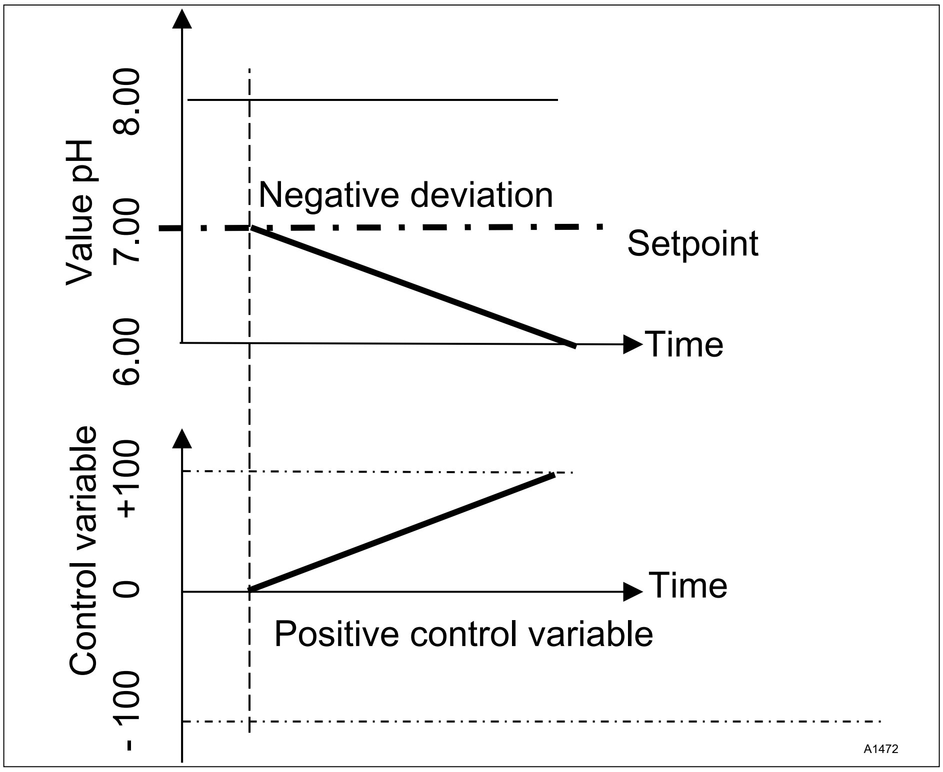


Fig. 65: PID monodirectional control type, pH-raising

Adjustable parameters in the [Control] menu

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 80*.

[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.

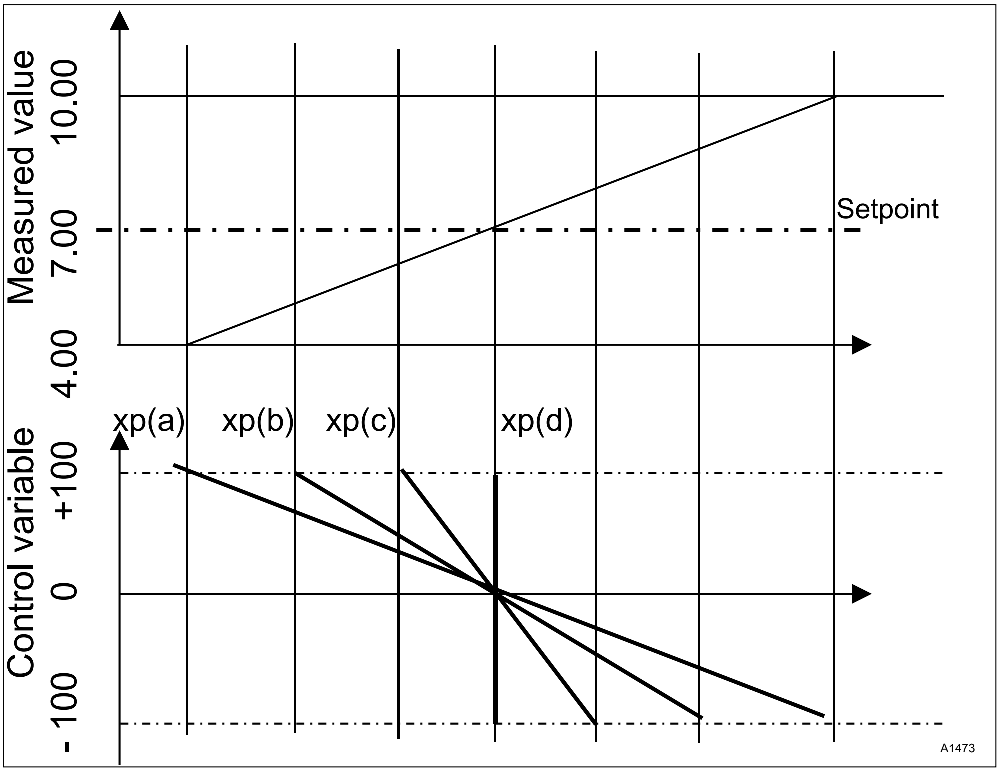


Fig. 66: The smaller the xp value, the more "forcefully" the control reacts.

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 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 equals

‘

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

10.8 Control parameter [Checkout time]

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

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

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

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

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

10.9 Control parameter [max. ctrl var.]

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

10.10 Interference variable

Steady control of flow processes using a feed forward control.

10.10.1 Additive and multiplicative feed forward control

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

The signal source of the interference variable can be supplied to the controller via an analogue signal or a pulse frequency from a flow meter.

The following options are available in the basic version of the controller with measured variables VA and AA:

- Pulse frequency interference variable,
- mA interference variable,
- pH compensation for chlorine.

If both channels of the VA or AA module are used for measured variables, then you will need equipment package 4 to process the interference variable as an analogue signal.

A pulse frequency signal can be connected to digital input 2 and an analogue signal, depending on the identity code, to mA input 2 or 3.

With equipment package 4, the multiplicative interference variable can act on channel 1 and channel 2.

An additive interference variable can only act on channel 1 or 2.

e.g. Identity code: …VA0

- mV input, channel 1: pH measurement
- mA input, channel 2: chlorine measurement
- Correction functions included:
  - pH compensation for chlorine
  - Temperature for pH

e.g. Identity code: …VA0

- mV input, channel 1: pH measurement
- mA input, channel 2: mA interference variable
- Correction functions included:
  - Flow interference variable for channel 1
  - Temperature for pH

e.g. Identity code: …AA0

- mA input, channel 1: chlorine measurement
- mA input, channel 2: mA interference variable
- Correction functions included:
  - Flow interference variable for channel 1

e.g. Identity code: …VA4

- mV input, channel 1: pH measurement
- mA input, channel 2: chlorine measurement

- mA input, channel 3: mA interference variable
- Correction functions included:
  - pH compensation for chlorine
  - Additive interference variable for channel 2
  - Temperature for pH

Applicational example of additive interference variable

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

Applicational example:

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

Set the following in the menu of the control:

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

[Effect]: *[additive]*

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

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

10.10.2 Multiplicative interference variable

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

Tab. 7: Interference variable

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

10.11 Remote setpoint via a 0/4 ... 20 mA analogue 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 analogue signal. The analogue signal can originate as an active signal from a PLC Programmable Logic Controller or also be specified using a 1 kOhm precision potentiometer.

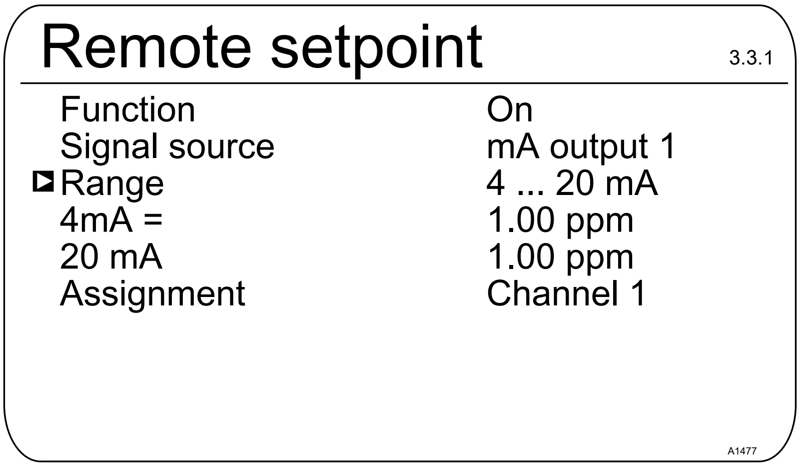


Fig. 67: Remote setpoint via a 0/4 ... 20 mA analogue signal

Description	Factory setting	Setting options
Function	Off	On/Off
Signal source	Fixed, mA input 2	

Description	Factory setting	Setting options
Area	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	

Applicational 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 Programmable Logic Controller. The PLC Programmable Logic Controller indicates the required standard signals to the controller via an analogue mA output. The controller automatically regulates based on the setpoint. The controller can report the current pH value to the PLC Programmable Logic Controller via an analogue mA output.

> *Electrical connection*
> *The 0/4 ... 20 mA analogue signal specifies the setpoint and is connected to terminals XE8 3 (-) and 4 (+) of the extension unit.*

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

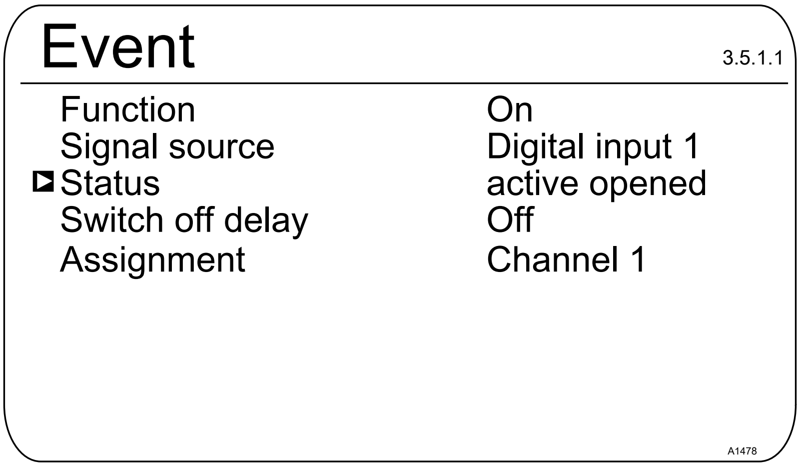


Fig. 68: Event controlled

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

Time controlled

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

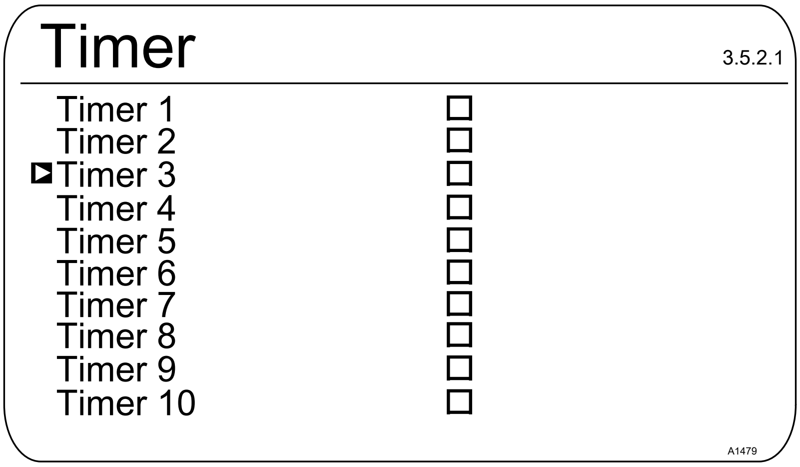


Fig. 69: [Timer control] = [Timer]

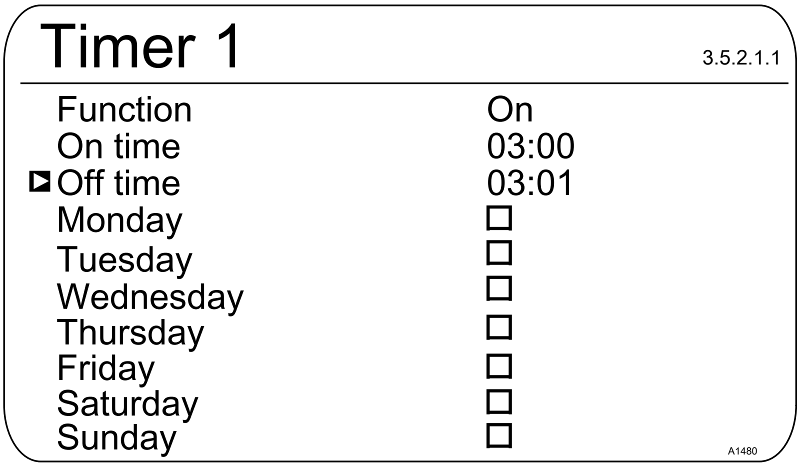


Fig. 70: Example: Timer 1

11 Setting the *[Limit values]*

- **User qualification:** trained user, see Part 1 of the Operating Instructions, the User qualification section

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

> ***Measuring channel settings***
>
> *This descriptions of [Channel 1] apply correspondingly to the settings in all other measuring channels. The procedure for entering the settings for the channel in question is identical, however the parameters to be set may differ. Your attention is drawn to the differences, which are also described.*

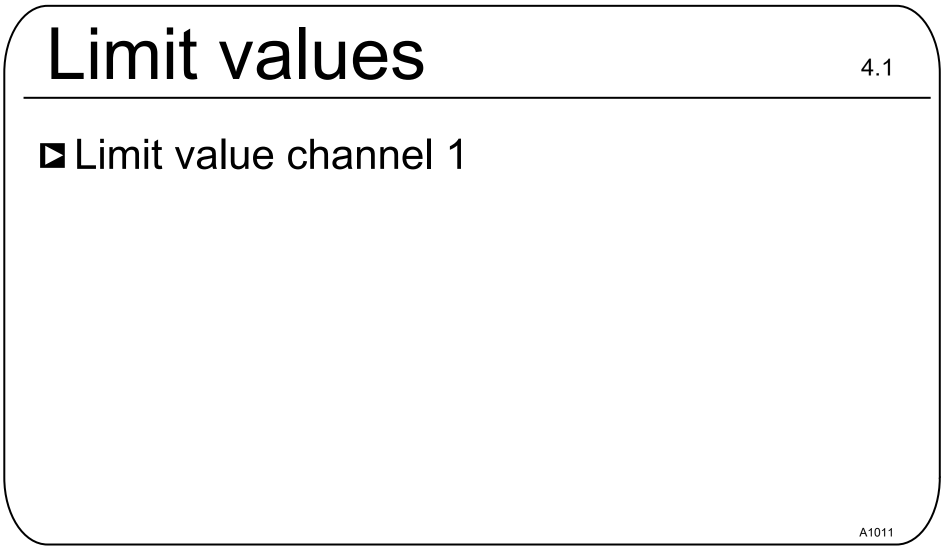


Fig. 71: Setting the [Limit values]

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 is triggered that has to be acknowledged and the alarm relay is deactivated. If the *[controller]* is also set to *[OFF]* then the control process stops.

[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 value). 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 limit values (∆t on)]*, then an acknowledgeable fault message is triggered and the alarm relay is deactivated. If the *[controller]* is also set to *[OFF]* then the control process stops.

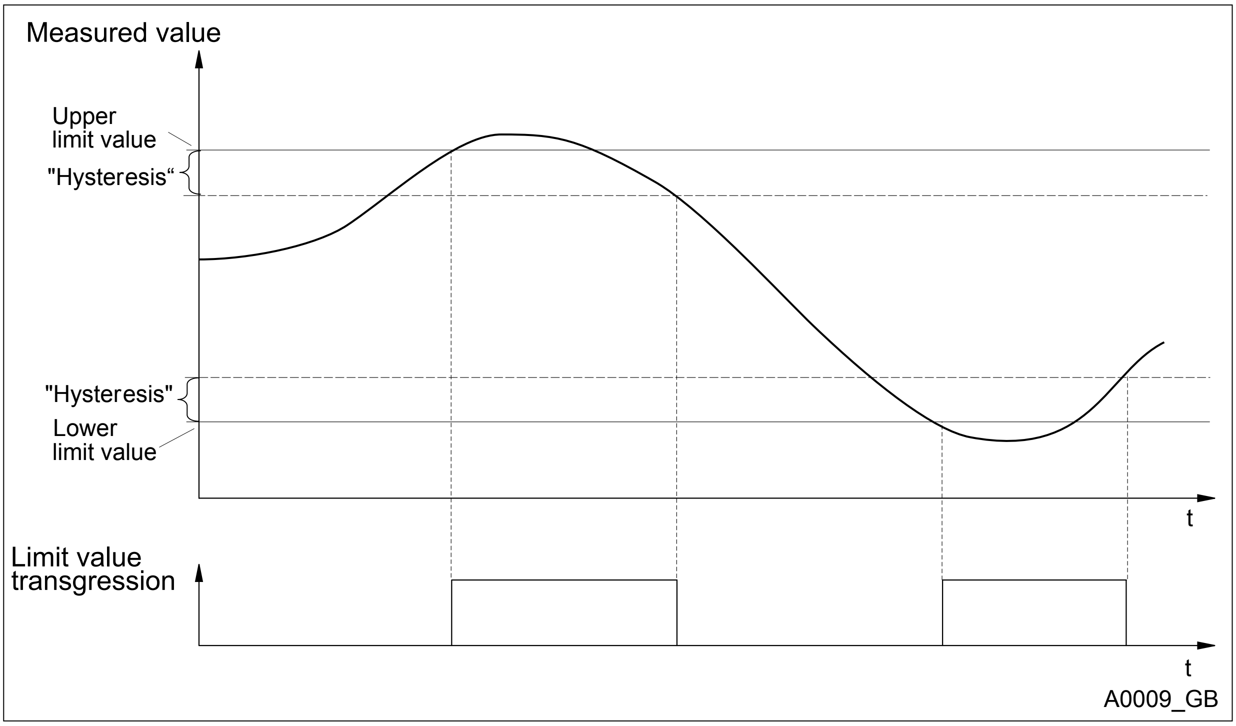


Fig. 72: Hysteresis

If the relays are defined as limit value relays, when a limit value transgression occurs they also switch 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]*. They prevent the limit value relay from switching back and forward if the limit value 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 control outputs. Example: In the event of Pause being activated, or in the event of an alarm, an activated limit value relay is deactivated.

Existing limit value error with alarm

You can manually reset an existing limit value error with alarm, for instance to enable a controlled restart of a system to ensure that the limit value situation can be left.

If an alarm is pending, you can call up the *[System alerts]* menu from the continuous display by pressing OK. Select the alarm in question and use OK to reset. Resetting the alarm cancels the limit value error/alarm. Checking of the limit value criterion restarts in line with the delay periods set. Metering is started if necessary.

11.2 Setting limit values channel 1

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

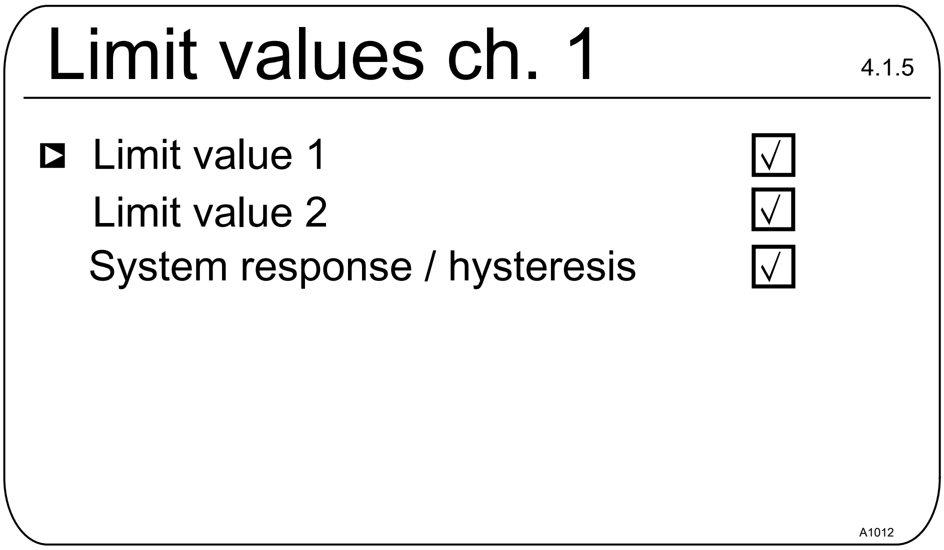


Fig. 73: Setting limit values channel 1

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]*

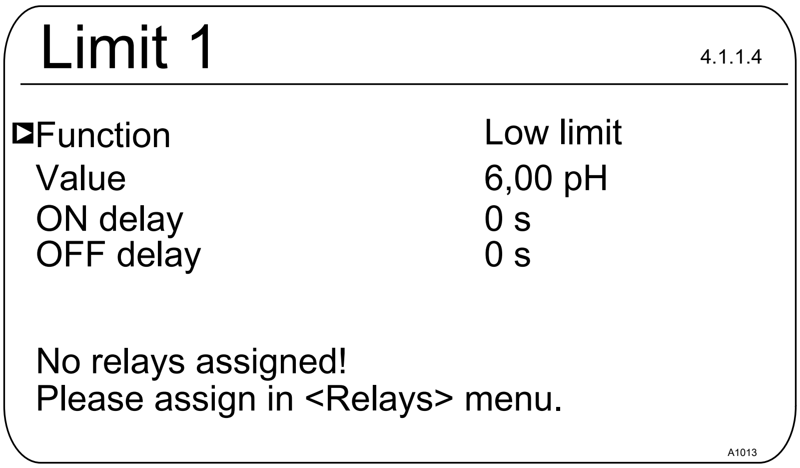


Fig. 74: Setting Limit 1

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]*

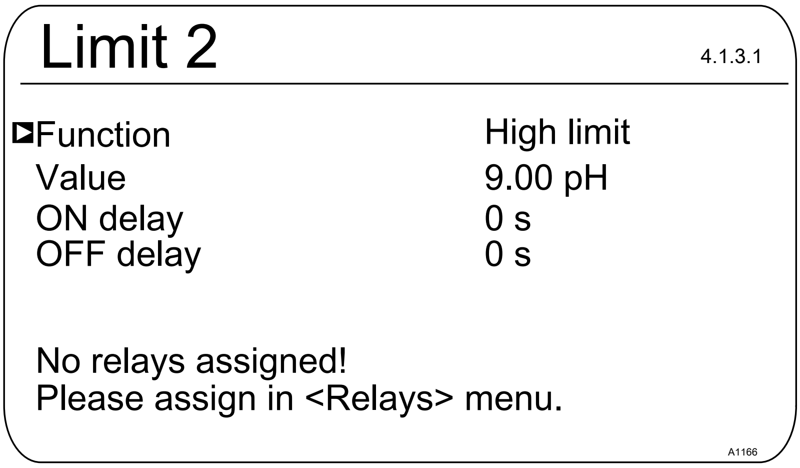


Fig. 75: Setting [Limit 2]

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]

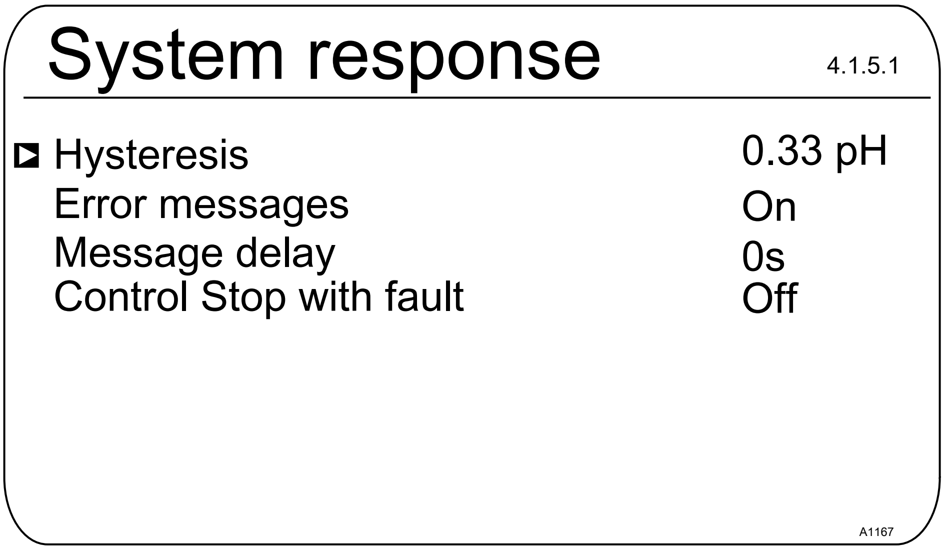


Fig. 76: Setting [System response]

You can select which control channel is stopped with a limit value transgression in the *[Limit values]* ➨ *[System behaviour]* ➨ *[Hysteresis]* menu.

The selection options are *[Control stop]*:

- Off
- Channel 1
- Channel 2

Example 1: If the pH value of channel 1 is so high that chlorine metering in channel 2 could become dangerous, then the metering of channel 2 is stopped when the pH value of channel 1 is too high and an alarm is triggered.

Example 2: The ORP value of channel 2 does not match the chlorine dioxide concentration of channel 2 and vice versa. Metering of chlorine dioxide can stop in these cases.

12 Digital input functions that can be set

Digital input	Off	Sample water fault	Pause	Pause Hold	Level in tank 1	Level in tank 2	Level in tank 3
1 Basic, module A	X	X	X	X			
2 Basic, module A	X	X	X	X			
3 Basic, module A	X	X	X	X	X		
4 Basic, module A	X	X	X	X		X	
5 Extension, module C	X	X	X	X	X		
6 Extension, module C	X	X	X	X		X	
7 Extension, module C	X	X	X	X			X

Description of the functions:

Measuring channels 1 and 2 are located on the basic module (module A). Channel 3 is optional and is located on the extension module (module C)

The digital inputs 1, 2, 3 and 4 are located on the basic module (module A).

The digital inputs 5, 6 and 7 are on the optional extension module (module C).

Sample water error:

If a sample water error is pending, then metering of the selected channels is immediately stopped. An alarm is emitted, the display lights up red, an alarm relay is activated, and the alarm relay drops out. Once the sample water error has been rectified, then the error status is reset, and the controllers restart according to the switch-off delay set.

Pause:

When the Pause input is set, then metering immediately stops and all the control outputs are set to 0%. When the Pause input has been reset, then the controllers restart according to the switch-off delay set. The last current I-factor has been saved and the I-factor is added to the P-factor currently calculated.

Pause Hold:

When the Pause Hold input is set, then the control outputs are frozen in the status prior to “Pause Hold”. When the Pause Hold input has been reset, then the controller restarts according to the switch-off delay set. The last current I-factor has been saved and the I-factor is added to the P-factor currently calculated.

mA outputs

You can configure the mA outputs as a measured value in such a way that the mA outputs either switch to the actual measured value before Pause/Pause Hold or to a fixed value when Pause/Pause Hold is enabled.

Level of tank 1 ... 3	If a level switch input is set, then metering of the selected channels is immediately stopped. An alarm is emitted, the display lights up red, an alarm relay is activated, and the alarm relay drops out.
'active opened' / *'active closed'* status:	*'active opened'* means that the function to be controlled is enabled when the input is open or not actuated. This status represents a safe status, a status that also occurs in the event of a line rupture. *'active closed'* means that the function to be controlled is activated when the input is closed or actuated. This status represents a potentially unsafe status, a status that does not remain in the event of a line rupture.
Switch-off delay 0 ... 1800 s:	This means that when activation is removed, the function is delayed by the time set.
Assignment of channel 1, channel 2, channel 3, channel 1+2, channel 1+3, channel 2+3, channel 1+2+3:	The function can either be applied only on 1 channel, on 2 channels or on all 3 channels.

13 Setting the *[Pumps]*

- **User qualification:** trained user, see Part 1 of the Operating Instructions, the User qualification section

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

> ***Measuring channel settings***
> *This descriptions of [Channel 1] apply correspondingly to the settings in all other measuring channels. The procedure for entering the settings for the channel in question is identical, however the parameters to be set may differ. Your attention is drawn to the differences, which are also described.*

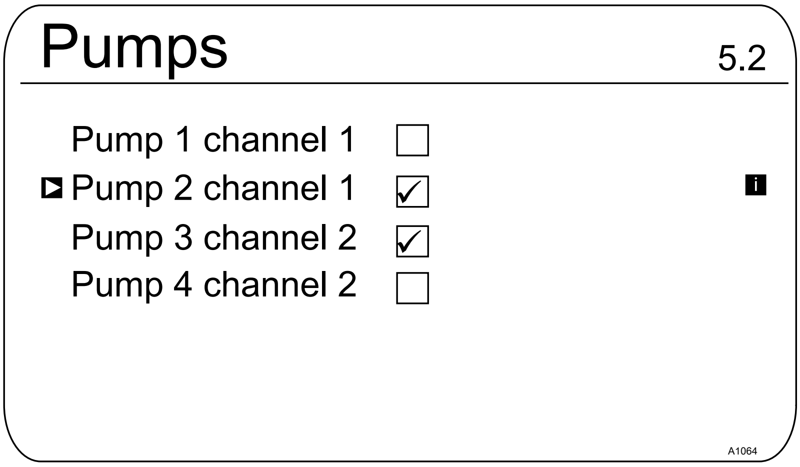


Fig. 77: Setting the [Pumps]

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

13.1 Setting [Pump 1]

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

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

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

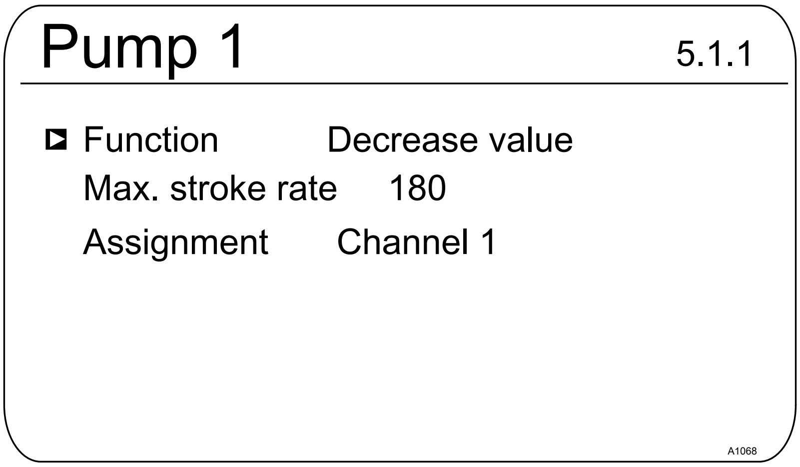


Fig. 78: Setting [Pump 1]

Use the ▲ or ▼ keys to select the menu and confirm with OK

⇨ The relevant setting menu appears.

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

14 Setting the *[Relays]*

- **User qualification:** trained user, see Part 1 of the Operating Instructions, the User qualification section.

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

> ***Measuring channel settings***
> *This descriptions of [Channel 1] apply correspondingly to the settings in all other measuring channels. The procedure for entering the settings for the channel in question is identical, however the parameters to be set may differ. Your attention is drawn to the differences, which are also described.*

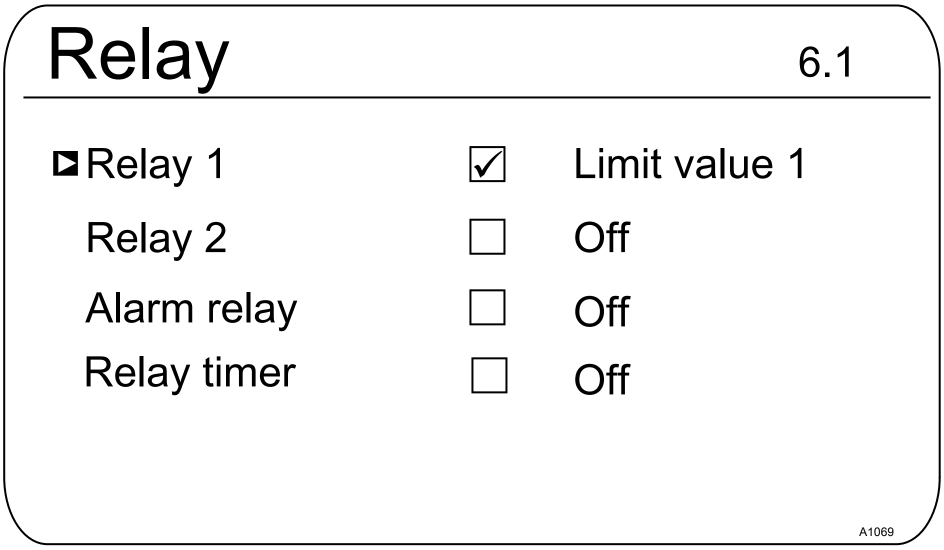


Fig. 79: Setting the [relays]

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

14.1 Setting Relay 1

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

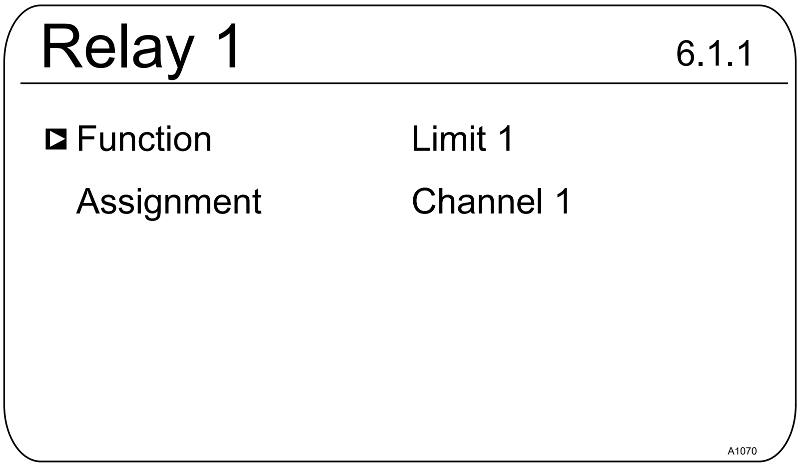


Fig. 80: Setting Relay 1

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

Tab. 8: Settable parameters of Relay 1 and Relay 2

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

Tab. 9: Settable alarm relay parameters

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

Changeable scope of the menus

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

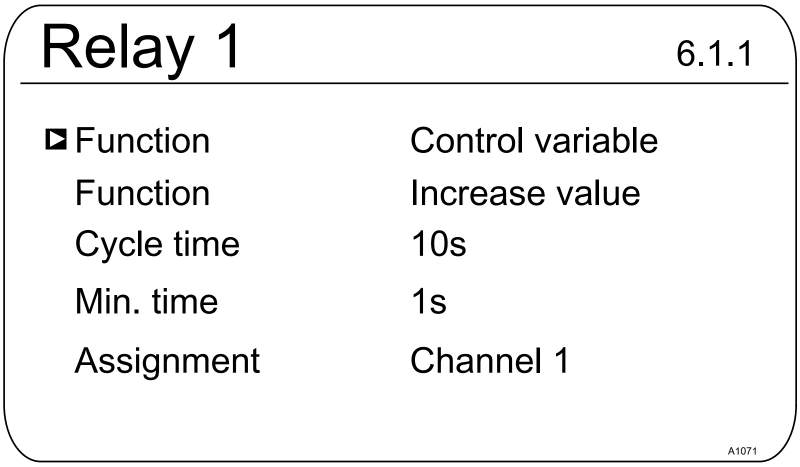


Fig. 81: Possible adjustable parameters with [Function] include, for example, [Control variable]

14.1.1 Function description [Off]

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

14.1.2 Functional description of *[Relay timer]*

The *[Relay timer]* is a real-time timer based on relay 1 and 2. The *[Relay timer]* lets you perform recurring weekday and time-dependent metering processes. Timer 1 is for relay 1 / Timer 2 is for relay 2.

14.1.3 Function description *[Limit 1]* or *[Limit 2]*

[Relay 1] and/or *[Relay 2]* can be operated as limit value relays. The limit values can be set in the menu ➪ *Chapter 11 'Setting the [Limit values]' on page 89*.

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).*

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

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

14.1.5 Function description of *[Cycle]*

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

CAUTION!

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

Possible consequence: slight or minor injuries. Material damage.

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

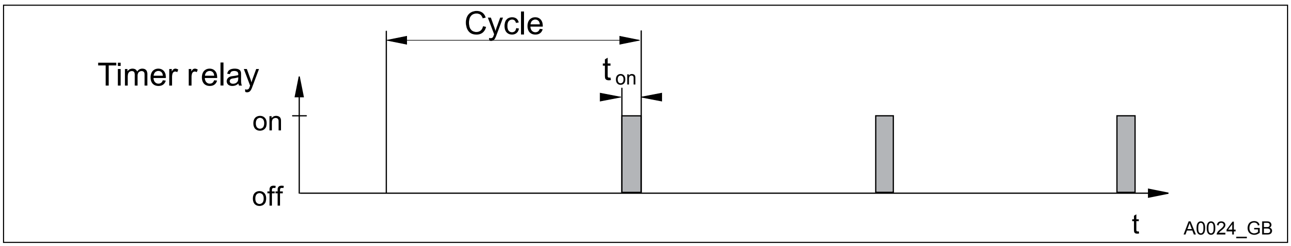


Fig. 82: Timer relay

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

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

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

15 Setting *[digital inputs]*

- **User qualification:** trained user, see Part 1 of the Operating Instructions, the User qualification section

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

> ***Measuring channel settings***
> *This descriptions of [Channel 1] apply correspondingly to the settings in all other measuring channels. The procedure for entering the settings for the channel in question is identical, however the parameters to be set may differ. Your attention is drawn to the differences, which are also described.*

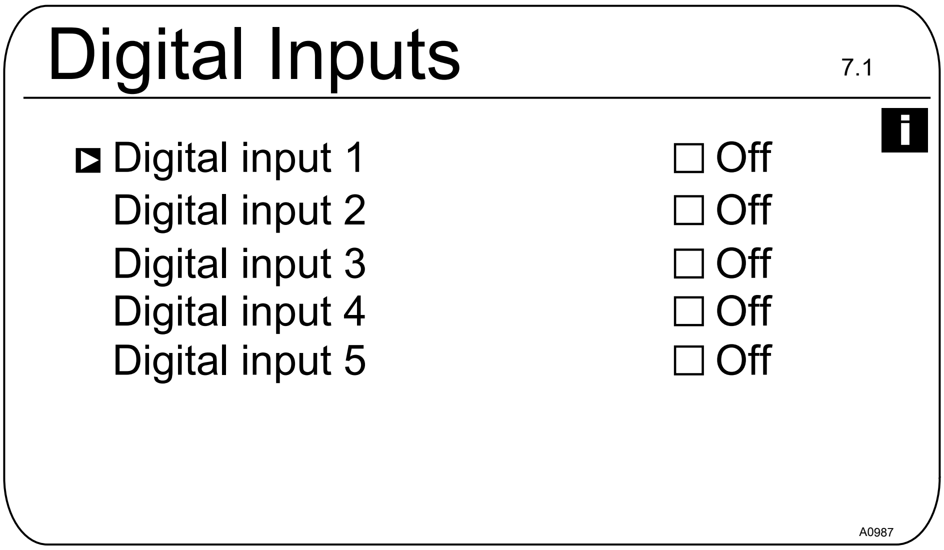


Fig. 83: Setting digital inputs [Dig. inputs]

The inputs 5– 7 are optional and thus not available with every device.

15.1 Setting *[Digital input 1]*

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

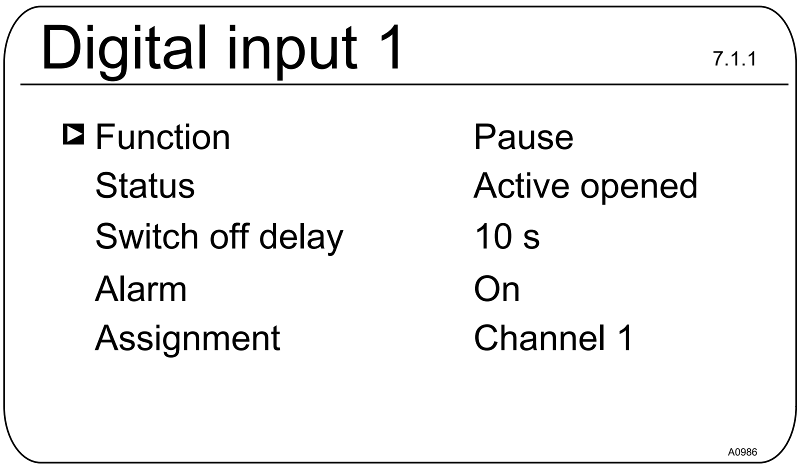


Fig. 84: Setting [Digital input 1]

Tab. 10: Pause

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

Setting [Digital input 2]

Tab. 11: Sample water fault

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

Setting [Digital input 3]

Tab. 12: Level of storage tank 1

Parameter	Adjustment range
Function	Off / Pause Hold / Pause / Level of storage tank 1
Status	Active open / Active closed
Switch off delay	0 ... 1800 s
Assignment	Channel 1, channel 2

Setting [Digital input 4]

Tab. 13: Level of storage tank 2

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

Setting [Digital input 5]

Tab. 14: Level of storage tank 3

Parameter	Adjustment range
Function	Off / Level of storage tank 3
Status	Active open / Active closed
Switch off delay	0 ... 1800 s
Assignment	Channel 1, channel 2, channel 1+2

16 Setting the *[mA outputs]*

- **User qualification:** trained user, see Part 1 of the Operating Instructions, the User qualification section

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

Settings for *[Channel 2]* and *[Channel 3]*

- The 2-channel version of the controller has 2 mA outputs, and the 3-channel version has 3 mA outputs. The descriptions for *[Channel 1]* also apply to the settings for *[Channel 2]* and *[Channel 3]*. The procedure for setting each mA output channel is identical, however the parameters to be set may differ. Any differences are noted and described.

> **CAUTION!**
>
> **Destruction of the monitors**
>
> Only connect passive monitors to the mA outputs. For example, if the mA outputs are connected to a PLC, then a 4-wire connection type must be selected on the PLC. A 2-wire connection type will result in a malfunction and possible destruction of the monitors.

In its basic version, the controller has 2 active mA outputs, meaning that the mA outputs actively supply an output current, without an external supply voltage. The mA outputs are galvanically isolated.

[Pause Hold] system response: *[Pause Hold]* determines the system response of the mA outputs when *[Pause Hold]* is active.

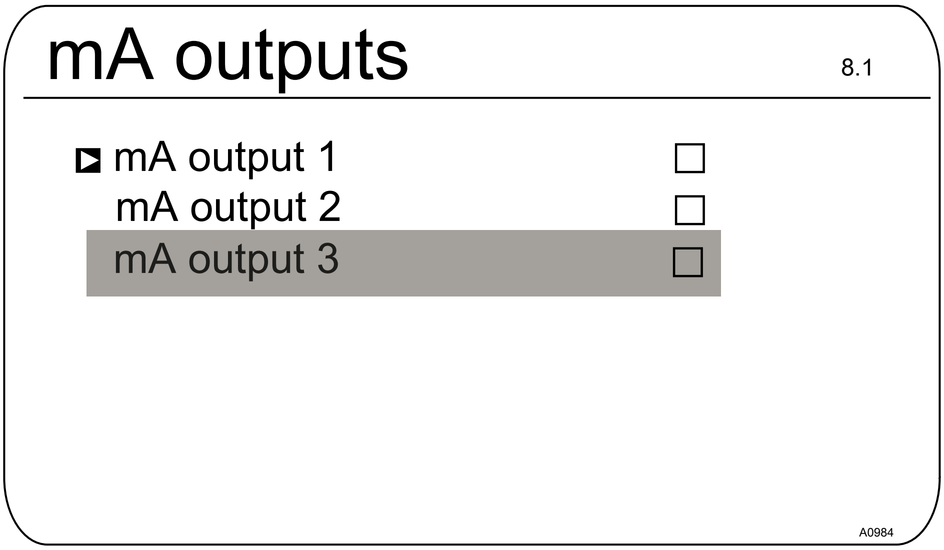


Fig. 85: Setting the [mA outputs].

Optional mA outputs

- The menu items for the optional mA outputs have the same setting options as the *[mA output 1]* menu item. A separate description is not provided.

16.1 Setting the *[mA outputs]*

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

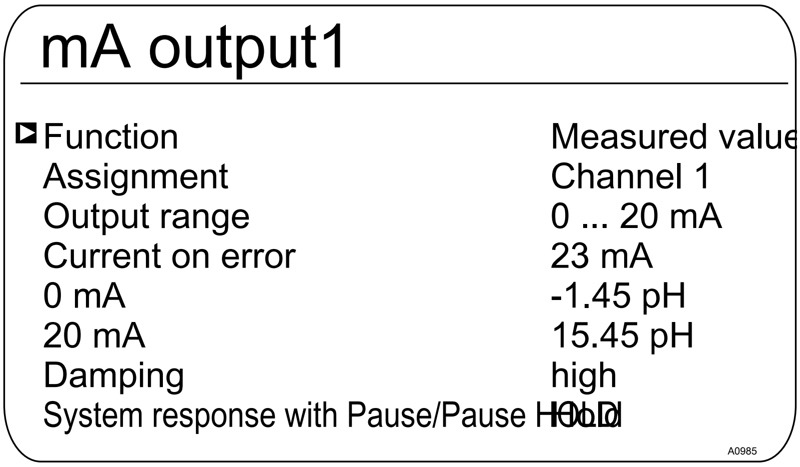


Fig. 86: Setting [mA output 1]

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

The mA output is frozen at the mA output value before *[Pause / Pause Hold]*.

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

[Function]	Adjustable value	Adjustable ranges or numerical values
[Measured value] *[Control variable]* *[Correcting value]*	*[Output range]*	0 ... 20 mA Assignment to the required measuring range start and end value.
		4 ... 20 mA Assignment to the required measuring range start and end value.
	[Error current]	*[Off]*
		23 mA
	[0 mA]	- 100% ... + 100%
	[20 mA]	- 100% ... + 100%
	[Damping]	*[high]*
		[medium]
		[weak]

[Function]	Adjustable value	Adjustable ranges or numerical values
	[System response with Pause / Pause Hold]	*[None]* The mA output changes with the measured value
		[Fixed] The mA output is set to a fixed mA output value, which is always issued at *[Pause Hold]*
		[Hold]

17 Care and maintenance

- **User qualification:** instructed personnel, see Part 1 of the Operating Instructions, the User qualification section

The device does not require regular care and maintenance. If necessary, you can wipe down the surface of the device with a damp micro-fibre cloth.

18 Function: Data logger

Data backup / limited service life

There is a possibility of data loss with all types of data storage. This data loss can be caused by damage to hardware, software, or unauthorised access, etc. The operator of the device is responsible for backing up the data recorded by the data logger. This must be done in accordance with the national and international requirements, regulations and legal standards applicable to the operator of the device. This data backup procedure must be defined and documented in a backup and recovery plan.

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

SD cards only have a limited service life. This service life is based, for example, on the general ageing of the SD card and depends on the storage technology (flash storage) used of the fundamentally limited number of write processes. Bear this in mind with your data backup strategy and ensure that you regularly replace your SD card.

18.1 Activating, reading and deleting log books

The controller supports the following log books as standard:

- Calibration log book
- Error log book

Access flap to the SD card slot

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

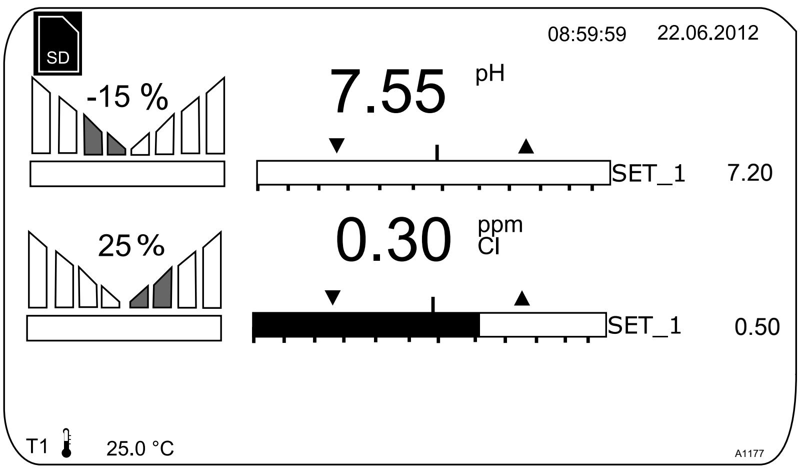


Fig. 87: Display showing symbol for the presence of an SD card (top right)

The data log book (optional)

The data log book is an optional feature. This option is currently supplied as an industrial 512 MB SD card. The SD card provided has a recording capacity of around 20 years based on a recording interval of 10 seconds. SD cards with a capacity of up to 32 GB can be used. They can therefore record approximately 1280 years.

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

18.2 Configuring log books

- **User qualification:** instructed user, see

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

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

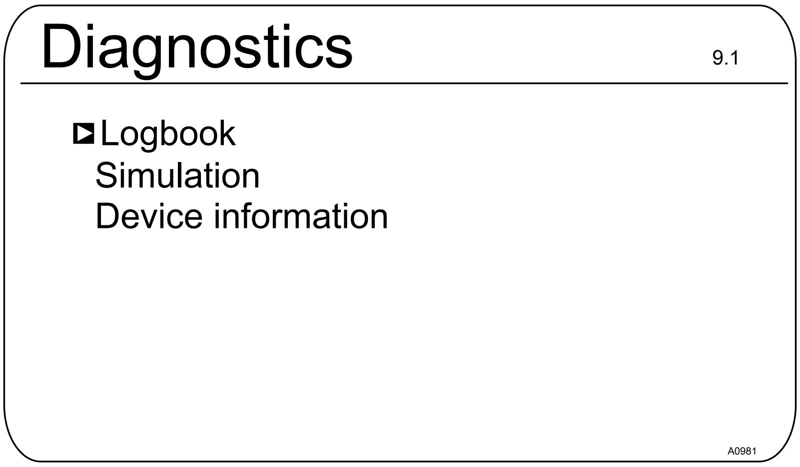


Fig. 88: [Diagnostics] > [Log books]

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

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

18.2.1 Using the *[calibration log book]*

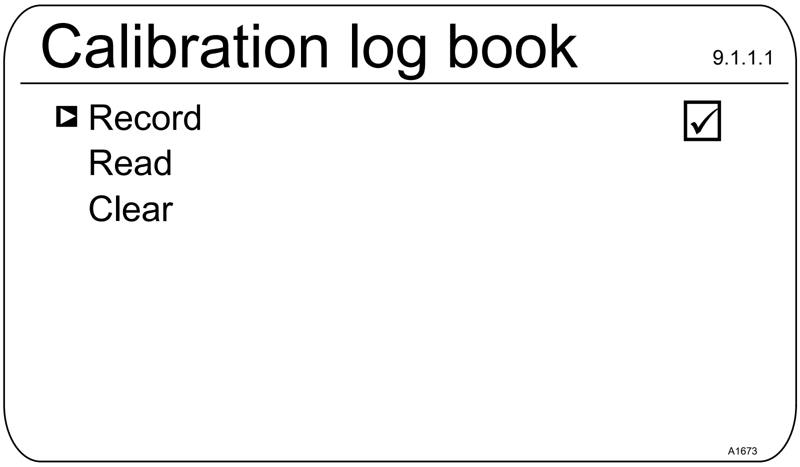


Fig. 89: Using the [calibration log book]

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

Reading calibrations

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

Deleting the *[calibration log book]*

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

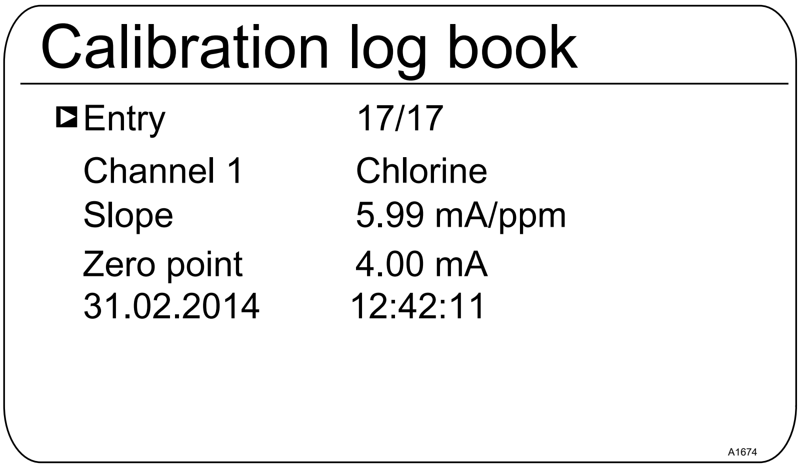


Fig. 90: Reading the [calibration log book]

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

18.2.2 Using the *[error log book]*

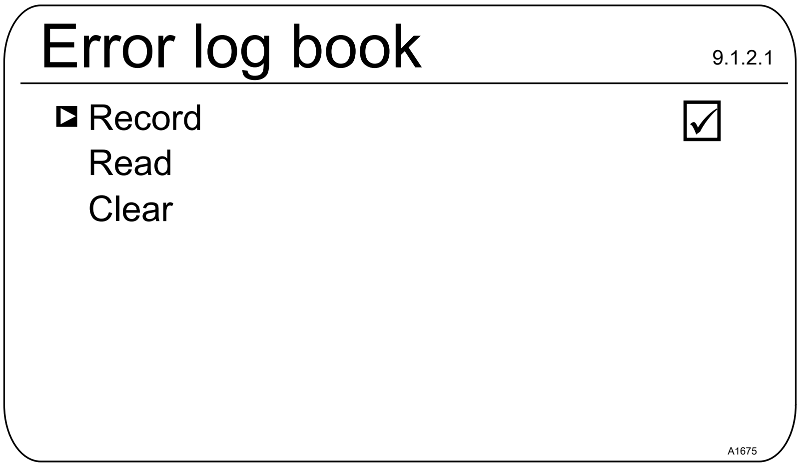


Fig. 91: Using the [error log book]

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

Reading messages

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

Deleting the *[error log book]*

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

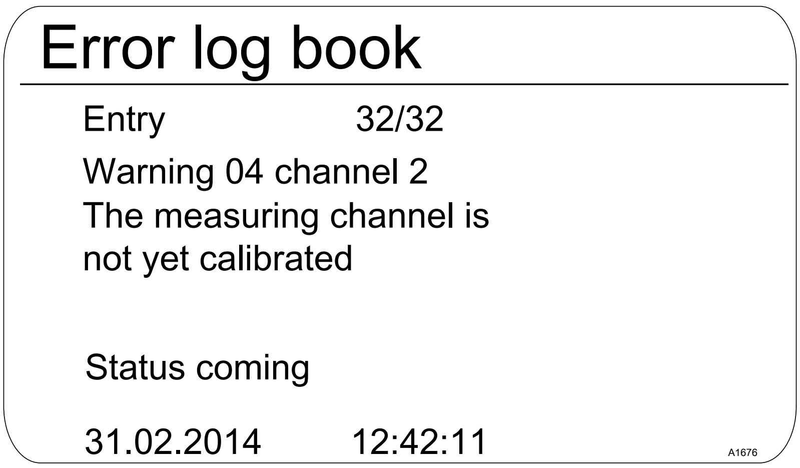


Fig. 92: Reading the [Error log book]

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

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

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

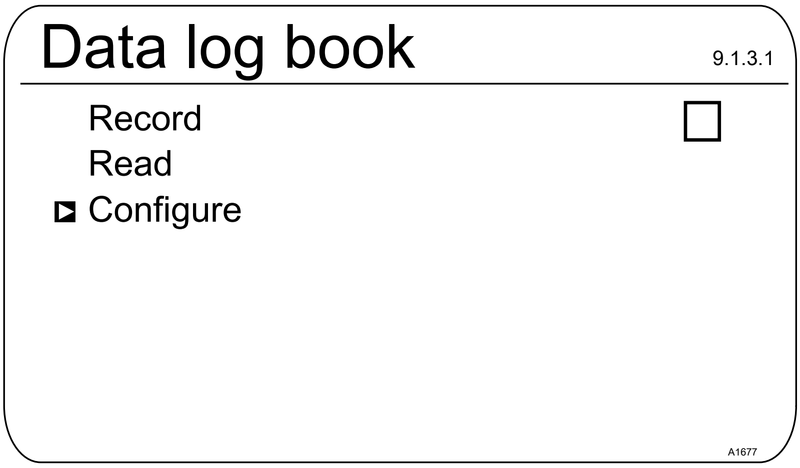


Fig. 93: Configuring the [Data log book]

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

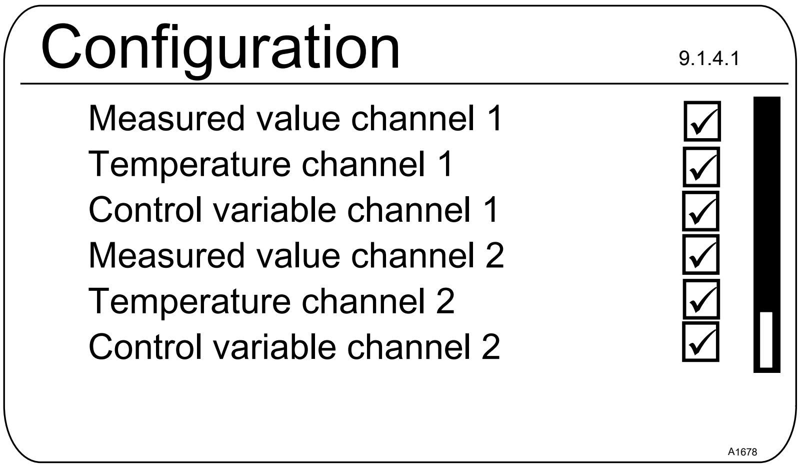


Fig. 94: [Configuration] of the data log book

[Configuration] of the data log book

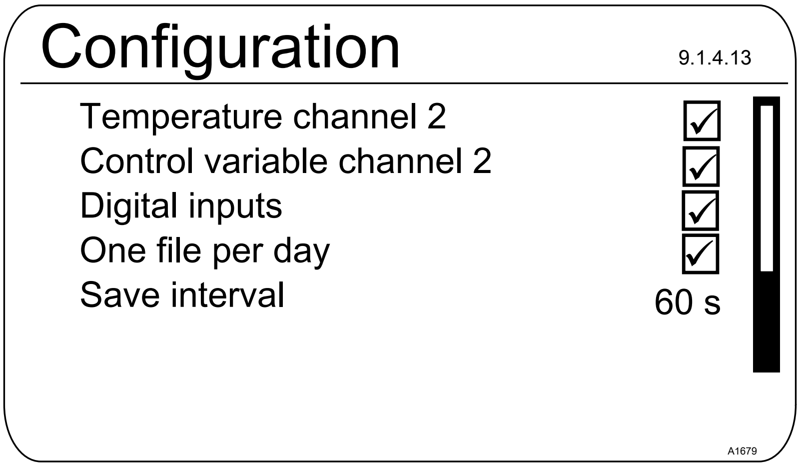


Fig. 95: [One file per day] checked

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

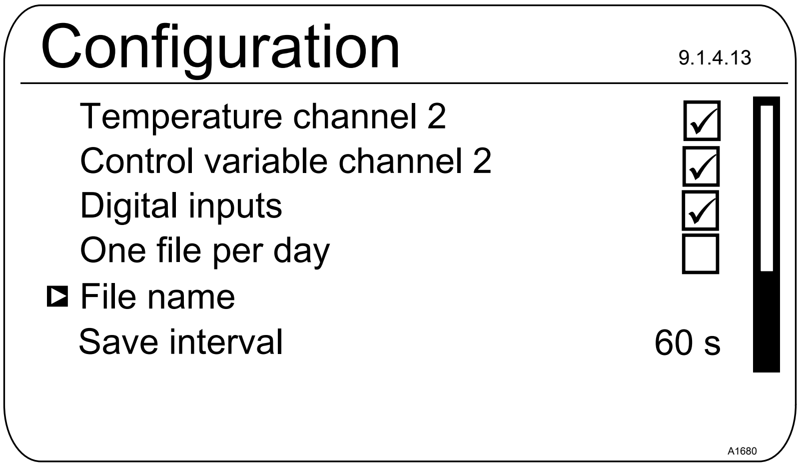


Fig. 96: [One file per day] unchecked

1. If you wish to specify a file name, then place the cursor on *[File name]* and press OK
   - ⇨ *[New]* appears.
2. Place the cursor on *[New]* and press OK
   - ⇨ You can now enter a random name with a maximum of 8 digits name as well as the proposed *[DATALOG0.CSV]* and/or set from 0 to 1 ... n.

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

Fig. 97: Check the file to write it to an existing file, here [DATALOG0.CSV]

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

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

19 *[Diagnostics]*

- **User qualification:** instructed personnel, see Part 1 of the Operating Instructions, the User qualification section

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

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

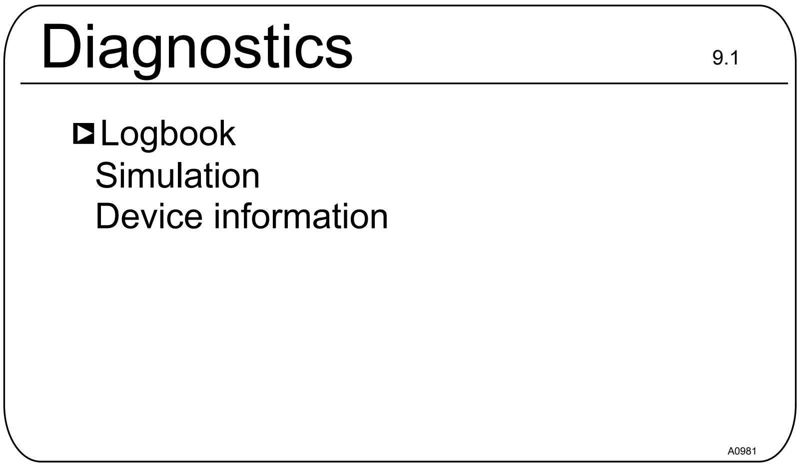


Fig. 98: Diagnostics

19.1 Displaying *[logbooks]*

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

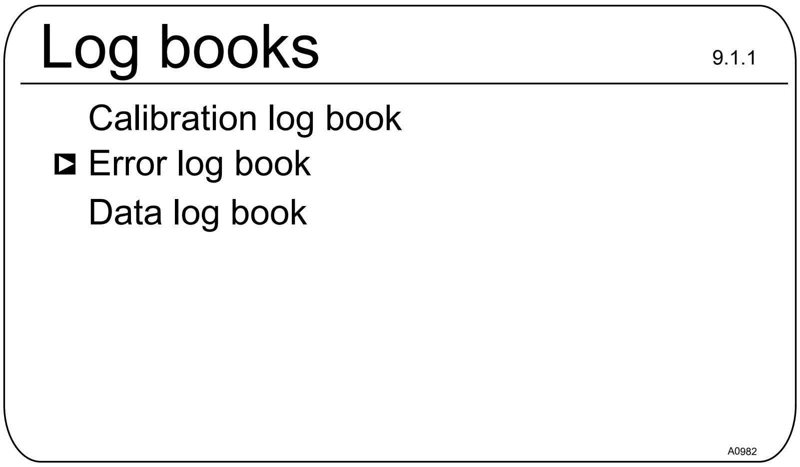


Fig. 99: Displaying [Log books]

19.1.1 Displaying the *[Calibration Log Book]*

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

The following data is stored:

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

Deleting entries in the*[Calibration log book]*

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

19.1.2 Reading the *[Error Log Book]*

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

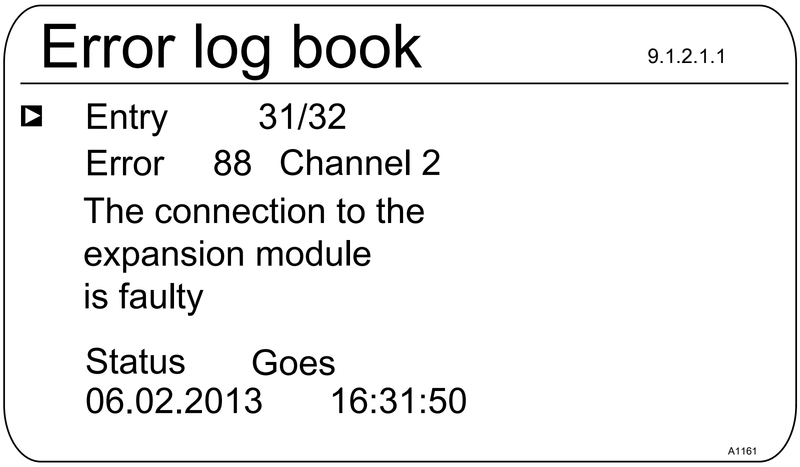


Fig. 100: [Error log book]

Deleting entries in the *[Error log book]*

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

19.2 Displaying *[simulation]*

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

WARNING!

Uncontrolled response

Cause: A controller operates uncontrolled in *[Simulation]* mode under full load and thus so do the connected actuators.

Possible consequence: Fatal or very serious injuries

Measure: Never leave a controller and its installed functional modules unsupervised if the simulation function is active.

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

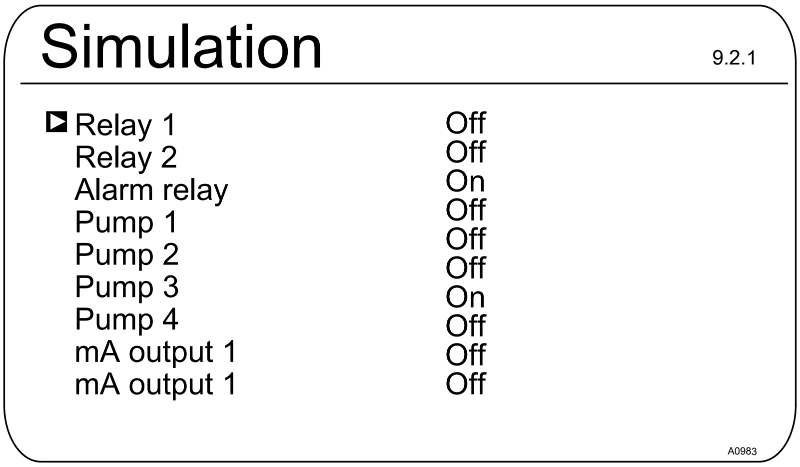


Fig. 101: Displaying simulation

19.3 Display *[Device information]*

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

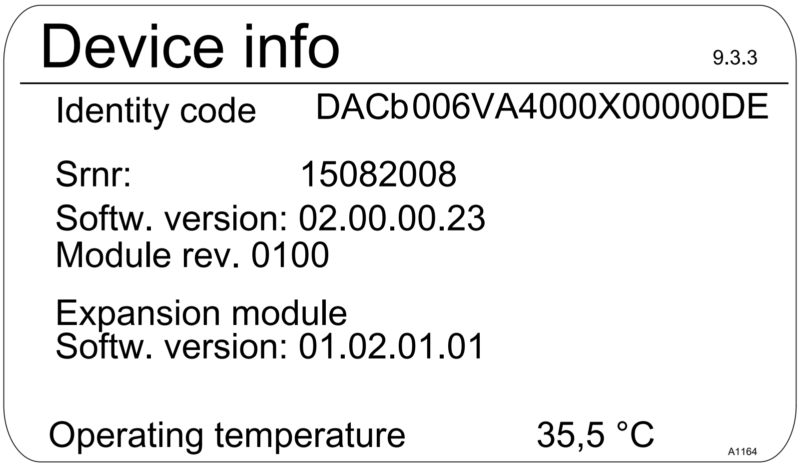


Fig. 102: Device information

19.4 Error messages and warning messages

19.4.1 Error messages

Tab. 15: Error messages

Error	Error message text	Cause	Remedy
01	The mV input voltage is too low.	Coaxial cable connection disconnected.	Check that the coaxial cable connection is fitted correctly and re-connect.
			Check the coaxial cable connection for corrosion and moisture and replace with a new cable, if necessary.

Error	Error message text	Cause	Remedy
		pH/ORP sensor is faulty	Replace the sensor.
02	The mV input voltage is too high.	The connected signal does not come from a pH sensor. A disturbance signal is picked up.	Check the origin of the sensor signal. Check the raw signal by pressing ▷. The sensor raw value is shown here in mV. If the value with pH is greater than ± 500 mV, or with ORP is greater than ± 1500 mV, then these are wrong sensor values. Check once again the cabling and origin of the sensor signal. Ensure that the measuring lines are not laid parallel to power cables.
03	The temperature is too low.	Incorrect sensor connected.	Check the type of sensor connected. Only Pt 100 and Pt 1000 sensors work.
04	The temperature is too high.	No sensor or incorrect sensor connected.	Check the sensor connection
			Check the type of sensor connected. Only Pt 100 and Pt 1000 sensors work.
05	A calibration error is pending.	With amperometric analysis (e.g. chlorine): The calculated reference value deviates too much from the real value or the sensor value.	With amperometric analysis (e.g. chlorine): Check the correctness of the reference method, e.g. DPD1.
		With pH and ORP: the buffers used differ from the nominal value, are outdated or watered down.	With pH and ORP: replace the buffer with new buffer.
06	No sensor detected, please check the connection.	Measuring cable connection disconnected.	Check the correct connection of the measuring cable connection. Connect the sensor correctly.
		No sensor is connected.	
		Cable faulty or not connected.	
		Sensor is suspended in the air.	Install the sensor correctly in the bypass fitting.
		Incorrect interpretation of cable break detection.	Switch off cable break detection, as described in the operating instructions for the controller.
07	Check the mechanical state of the sensor. Glass breakage is possible.	Diaphragm glass broken.	Replace sensor. Check the reason for the broken glass e.g. solids, too high a flow velocity.
		Incorrect interpretation of glass break detection.	Switch off glass break detection, as described in the operating instructions for the controller.
08	The checkout time was transgressed.	In the *[Control]* menu, the set control variable has exceeded the threshold for a longer time than the checkout time control variable.	The control section needs a longer time to regulate itself than the selected checkout time.
			The control section needs a greater control variable threshold to regulate itself than the selected one.
			The metering chemical is empty or has a too low/high a concentration.

Error	Error message text	Cause	Remedy
			The dosing line is disconnected or the point of injection is blocked.
09	The mA input current is too high.	The current is greater than the maximum permitted current of 23 mA.	Check the origin of the current.
			Check the raw value in mA in the Information menu by pressing ▷. If the value is >23 mA, then it is not a correct sensor signal. Replace the sensor with a new sensor.
10	The mA input current is too low.	The power circuit is disconnected.	Check the 2-wire connection between the sensor/transmitter and controller and check the raw value in mA in the Information menu by pressing ▷. If the value is 0 mA, then the connection is disconnected.
11	A limit value error still exists after the delay time has elapsed.	The measured value lies above the limit value for a period longer than the set delay time.	Check whether the choice of the limit value matches the application and adjust the limit value if necessary.
			Check whether the choice of the delay period matches the application and adjust the delay time if necessary.
			Check the design of the actuator. Is the actuator selected too large?
			Check the concentration of the metering chemical – is the concentration too high?
			Check the control parameters. Does the control tend to over/undershoot?
12	There is a sample water fault e.g. no flow.	The sample water limit contact of the in-line probe housing e.g. DGMa was triggered by the float dropping.	Check the routing of the sample water line.
			Check the sample water discharge. Is it blocked?
			Check if a sample water filter is fitted and clean it if necessary.
13	The controller is in *'Pause'* status.	The Pause input (digital input) was activated externally.	Check whether the Pause signal received matches the expected operating mode of the system.
			Check whether the *'NO/NC'* actuating direction matches the choice in the controller.
14	The controller is in *'Pause (Hold)'* status.	The Pause input (digital input) was activated externally.	Check whether the Pause signal received matches the expected operating mode of the system. Check whether the *'NO/NC'* actuating direction matches the choice in the controller.
15	The mA input supply is overloaded.	The sensor input of Channel 1 or 2 is used in 2-wire connection mode, e.g. together with chlorine sensor CLE3. The polarity was not noted or there is a short circuit between the two poles.	Check the polarity against the terminal diagram. Make sure that the two wires do not touch (shorten the stripped length, use insulated end sleeves, use heat-shrink tubing).

Error	Error message text	Cause	Remedy
16	The mA input is overloaded.	The sensor input of Channel 1 or 2 is used in 2-wire connection mode, but the signal is an active signal carrying voltage.	Use a multimeter to check the measuring signal. If it is an active / driven signal (voltage is measurable), then the type of connection has to be selected for active signals; refer to the terminal diagram in the operating instructions. This type of connection is not shown on the enclosed terminal assignment diagrams.
17	The level in tank 1 is too low.	The chemical in tank 1 is used up.	Top up the corresponding chemical.
18	The level in tank 2 is too low.	The chemical in tank 2 is used up.	Top up the corresponding chemical.
19	The level in tank 3 is too low.	The chemical in tank 3 is used up.	Top up the corresponding chemical.
21	The conductivity is too low.	This liquid cannot be measured with this sensor.	Use a suitable sensor, if necessary.
22	The conductivity is too high	This liquid cannot be measured with this sensor.	Use a suitable sensor, if necessary.
34	The correction variable is faulty.	One or more correction variables have been incorrectly entered and/or the correction variable has been incorrectly recorded.	Check the correction variable and all connected components.
85	The external power supply is faulty.	The external power supply has been incorrectly designed or is faulty.	Return the external power supply to its correct working order.
86	The communication is faulty.		
87	The connection to the communication module is faulty.	The connection elements have been incorrectly installed or are faulty.	Return the controller to the factory for inspection.
88	The connection to the extension module is faulty.	The connection cable has slipped out of the socket.	Check the connection cable and tighten.
		Connection problems between the main and extension module.	Return the controller to the factory for inspection.
99	There is a system error.	System components have failed.	Return the controller to the manufacturer for inspection.

19.4.2 Warning messages

Tab. 16: Warning messages

#	Warning message text	Cause	Remedy
01	The limit value was undershot	The measured value is below the limit value	Check whether the choice of the limit value matches the application and adjust if necessary.
			Check the design of the actuator: has too small an actuator been selected?
			Check the concentration of the feed chemical: is the concentration too low?
			Check the control parameters: does the control tend to over/undershoot?
02	The limit value was exceeded	The measured value is above the limit value	Check whether the choice of the limit value matches the application and adjust if necessary.
			Check the design of the actuator: has too large an actuator been selected?
			Check the concentration of the metering chemical – is the concentration too high?
			Check the control parameters: does the control tend to over/undershoot?
03	The wash timer has timed out. Maintenance is necessary	The wash timer activates a relay. The sensor is cleaned with cleaning fluid. A visual check may be necessary as outline in your maintenance schedule	Clean and check the sensor.
04	The measuring channel is not yet calibrated	The sensor connected to a measuring channel has not yet been calibrated	Calibrate the sensor.
05	Not yet calibrated.	The system has not yet been calibrated.	Calibrate the system e.g. the sensor.
71	The battery needs to be replaced	The battery has a service life of about 10 years, but this can be reduced by environmental factors	Replace the battery or inform Service. Battery BR 2032, Part no. 732829.
72	Check the time	The time has changed when replacing the battery	Reset the time.
73	The fan has a fault	The internal fan is no longer rotating	Please check to see whether an object has become trapped in the impeller otherwise return the controller to the manufacturer for inspection.
85	A fault in the external power supply.	The external power supply has been incorrectly designed or is faulty.	Return the external power supply to its correct working order.

#	Warning message text	Cause	Remedy
87	The connection to the communication module is faulty.	The connection elements have been incorrectly installed or are faulty.	Check the connection, repair it or replace faulty components.
89	System warning 1	A system error exists	Return the controller to the manufacturer for inspection.

19.5 Help texts

Content of the help texts	Cause	Remedy
The DPD value is too small, DPD value > MRS + 2 %	If the calculated reference value (e.g. DPD1) for calibrating a sensor is less than 2 % of the measuring range, then calibration is not possible.	Increase the concentration of the chemical to be measured in the process/ sample water and determine the reference value again (e.g. DPD1) after the run-in period.
The slope is too shallow, < 20 % of the MR	The sensor can no longer detect the chemicals to be measured	Replace the membrane cap and replace the electrolyte for new material
The slope is too steep, > 300 % of the MR	The sensor has been permanently affected by for example surface-active substances (surfactants).	Make sure that none of these substances are present in the water. Replace the membrane cap and replace the electrolyte for new material
The zero point is too low, < 3.2 mA	The sensor delivers a measured signal that is less than 3.2 mA. This value is outside of the specification.	Check the raw value in mA in the Information menu, by pressing ▷ in the main display. If the value is < 3.2 mA, then this is not the correct sensor signal. Check the cabling and replace the sensor with a new sensor.
The zero point is too high, > 5 mA	You would like to calibrate the zero point but the sensor is still detecting the chemical to be measured	Rinse the sensor with water containing no chemicals that are to be measured before zero point calibration. The water with which the zero point is determined should also not contain traces of this chemical. Use mineral water without carbon dioxide for this purpose.
An unknown calibration error		
In the residual period parameter set 1 is used	If parameter set 2 is not active, then parameter set 1 is activated	Check the control signals/lines that switch the parameter set or check the timer settings.

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