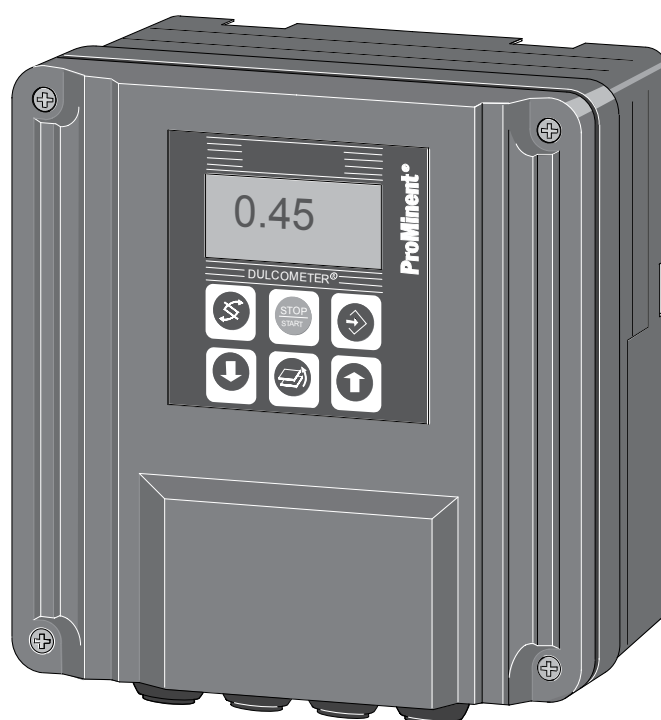


Instructions for assembly and use

DULCOMETER® D1Cb

All Measured Variables - Potentiometrically / Amperometrically



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

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1 Introduction

These operating instructions provide information on the technical data and functions of the DULCOMETER.® control series D1Cb.

1.1 Explanation of the Safety Information

Introduction

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

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



DANGER!

Nature and source of the danger

Consequence: Fatal or very serious injuries.

Measure to be taken to avoid this danger.

Danger!

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



WARNING!

Nature and source of the danger

Possible consequence: Fatal or very serious injuries.

Measure to be taken to avoid this danger.

Warning!

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



CAUTION!

Nature and source of the danger

Possible consequence: Slight or minor injuries. Material damage.

Measure to be taken to avoid this danger.

Caution!

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

**NOTICE!****Nature and source of the danger**

Damage to the product or its surroundings.

Measure to be taken to avoid this danger.

Note!

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

**Type of information**

Hints on use and additional information.

Source of the information. Additional measures.

Information!

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

1.2 Users' Qualifications

**WARNING!****Danger of injury with inadequately qualified personnel!**

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

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

Activity	Training
Assembly / Installation	trained qualified personnel
Commissioning	technical experts
Operation	instructed personnel
Maintenance / Repair	Customer service department
Decommissioning / Disposal	technical experts
Troubleshooting	instructed personnel

Explanation of the terms:

- A technical expert is deemed to be a person who is able to assess the tasks assigned to him and recognise possible hazards based on his/her technical training and experience, as well as knowledge of pertinent regulations.

Note: A technical qualification is typically proven by the required completion of a technical training course. The assessment of a person's technical training can also be based on several years of work in the relevant field.

- A qualified employee is deemed to be a person who is able to assess the tasks assigned to him and recognise possible hazards based on his/her technical training, knowledge and experience, as well as knowledge of pertinent regulations.

Note: The assessment of a person's technical training can also be based on several years of work in the relevant field.

- An instructed person is deemed to be a person who has been instructed and, if required, trained in the tasks assigned to him/her and possible dangers that could result from improper behaviour, as well as having been instructed in the required protective equipment and protective measures.

- Customer service department refers to service technicians, who have received proven training and have been authorised by ProMinent to work on the system.



Note for the system operator

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

1.3 General Safety Information



WARNING!

Live parts!

Possible consequence: Fatal or very serious injuries

- Measure: Disconnect the mains power supply prior to opening the housing
- De-energise damaged, defective or manipulated units by disconnecting the mains plug



WARNING!

Unauthorised access!

Possible consequence: Fatal or very serious injuries

- Measure: Ensure that there can be no unauthorised access to the unit



WARNING!

Operating errors!

Possible consequence: Fatal or very serious injuries

- The unit should only be operated by adequately qualified and technically expert personnel
- Please also observe the operating instructions for controllers and fittings and any other component groups, such as sensors, measuring water pumps ...
- The operator is responsible for ensuring that personnel are qualified



CAUTION!

Electronic malfunctions

Possible consequence: Material damage to destruction of the unit

- The mains connection cable and data cable should not be laid together with cables that are prone to interference
- Measure: Take appropriate interference suppression measures



NOTICE!

Correct and proper use

Damage to the product or its surroundings

- The unit is not intended to measure or regulate gaseous or solid media
- The unit may only be used in accordance with the technical details and specifications provided in these operating instructions and in the operating instructions for the individual components



NOTICE!

Correct sensor operation / Run-in time

Damage to the product or its surroundings

- Correct measuring and dosing is only possible if the sensor is working perfectly
- It is imperative that the run-in times of the sensors are adhered to
- The run-in times should be allowed for when planning initial operation
- It may take a whole working day to run-in the sensor
- Please read the operating instructions for the sensor



NOTICE!

Correct sensor operation

Damage to the product or its surroundings

- Correct measuring and dosing is only possible if the sensor is working perfectly
- Check and calibrate the sensor regularly

**NOTICE!****Compensation of control deviations**

Damage to the product or its surroundings

- This controller cannot be used in control circuits which require rapid compensation (< 30 s)

1.4 ID Code

Device identification / Identity code

DULCOMETER® control series D1Cb									
D1Cb									
	Type of mounting								
	W	Wall mounted (IP 65)							
		Version							
		00	with LCD and keypad / with ProMinent logo						
			Operating voltage						
			6	90...253 V, 50/60 Hz (wide voltage power unit)					
				Certification					
				01	CE mark				
					Hardware extension I				
					0	none			
						Hardware extension II			
						0	none		
						1	Protective RC circuit for power relay		
							External connection		
							0	none	
								Software default setting	
							U	Default setting	
							V	Software preset	
								Default setting - measured variable	
							0	Universal	P pH
							A	Peracetic acid	R Redox
							B	Bromine	S 0/4...20 mA standard signal general
							C	Chlorine	T Temperature
							D	Chlorine dioxide	X Dissolved oxygen
							F	Fluoride	Z Ozone
							H	Hydrogen peroxide	L Conductivity
							I	Chlorite	

DULCOMETER® control series D1Cb												
											Connection of measured variable	
											1	Standard signal 0/4-20 mA, all measured variables
											5	mV input for pH/redox via guard terminal
											Correction variable	
											0	none
											2	Temperature Pt 100/PT1000 (for pH and conductivity)
											4	Manual temperature input (for pH and conductivity)
											Control input	
											0	none
											1	Pause
											2	Pause or interference variable flow via frequency
											Signal output	
											0	none
											1	Analogue signal output 0/4...20 mA
											Power activation	
											G	Alarm and 2 limit relays or 2 timer relays
											M	Alarm and 2 solenoid valve relays or 2 timer relays
											Pump activation	
											0	none
											2	2 pumps via pulse frequency
Control behaviour												
0	none											
1	Proportional control											
2	PID control											

2 Functional Description

Brief functional description

The DULCOMETER® D1Cb 4-wire measuring transducer/control is a device designed to measure/control a measured variable and its concentration.

In measuring version mA, the measured variable can be switched in the device menu. In measuring version mV it is possible to select between pH and redox in the DULCOMETER® D1Cb

Depending on the measured variable, single-rod measuring chains for pH or redox potential or amperometric sensors with the aforementioned measured variables or separate versions (glass sensors with separate reference electrodes) can be connected. The temperature measurement serves as a correction variable and can be measured using a Pt 100/1000. This means that automatic temperature compensation is possible with pH-value and conductivity measured variables. Temperature compensation is performed in the sensor with amperometric measured variables (chlorine etc.). The DULCOMETER® D1Cb is operated by means of menu keys and an illuminated LCD display. The LCD display ensures that the reading, correction variable, actuating variable and fault messages can be clearly read.

2.1 Wall Mounted/Control Panel Mounted

The DULCOMETER® D1Cb W is suitable both for wall-mounting, as well as for mounting on a control panel (with additional control panel fixing set).

The plastic housing comprises a housing upper section and lower section. The LCD display and membrane keypad are accommodated in the upper section of the housing.

The lower section of the housing accommodates the processor and power units and any optional assemblies. A ribbon cable connects to the LCD display and the membrane keypad.

The electrical connection is made through originally sealed, push-out cable cut-outs on the underside of the lower section of the housing. On devices with an SN 6 input (depending on the identity code), the standard SN 6 socket is located on the left-hand side.

A wall bracket for straightforward wall mounting is located on the rear of the lower section of the housing.

2.2 Electrical Design

The device does not have a mains power switch. It is therefore immediately ready for operation once connected to the power supply.

The control processes an input signal whilst taking into consideration operator inputs. The result is displayed and made available to other devices via a standard signal. When equipped with actuators, the device can also provide control functions. It is designed to activate metering pumps, solenoid valves, as well as an mA standard signal output. The activation variable is recalculated every second.

2.2.1 Block circuit diagram

**NOTICE!****Connection of mV or mA sensors**

The DULCOMETER® D1Cb is suitable for the connection of mV or mA sensors. It is not possible to connect mV and mA sensors simultaneously.

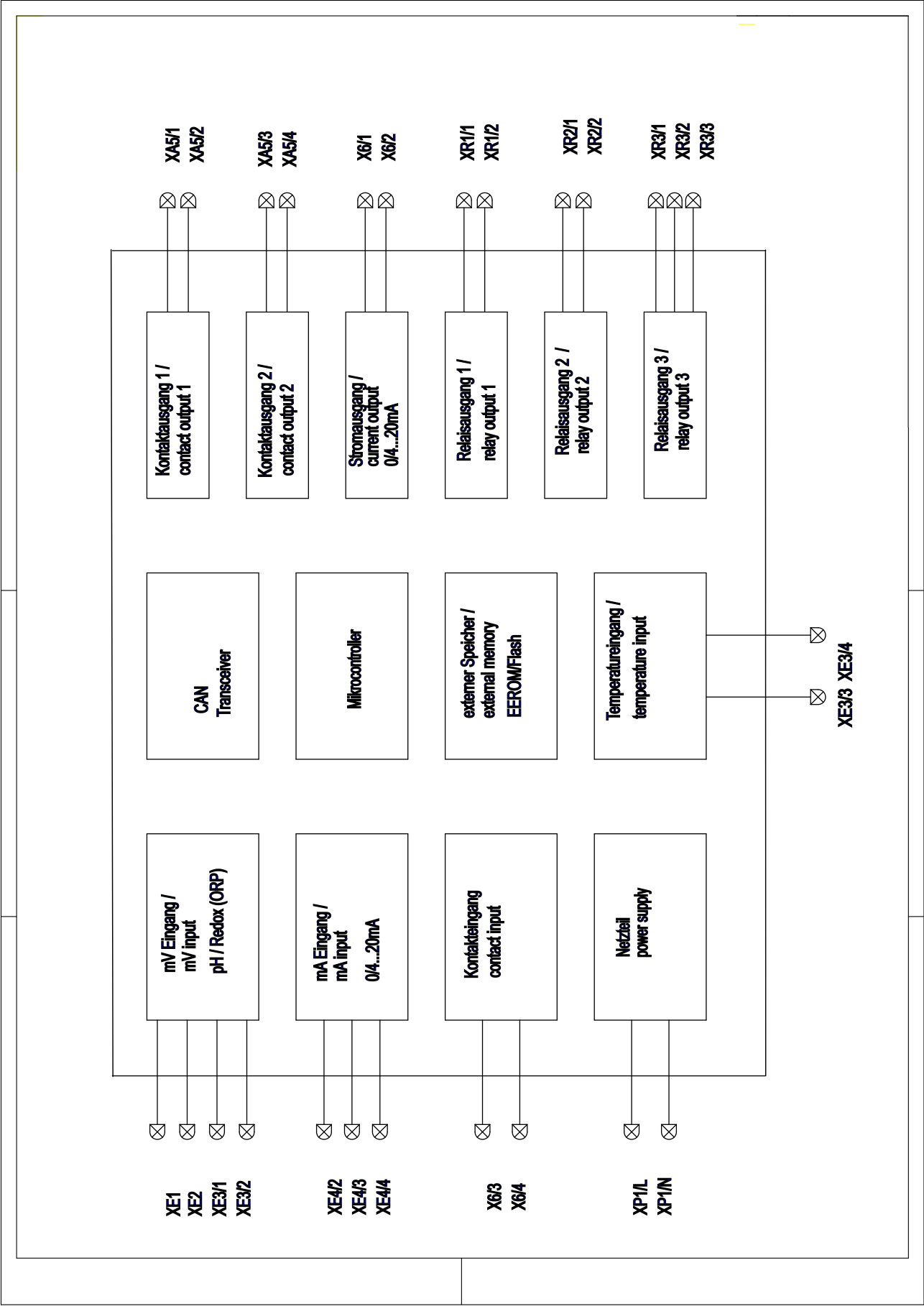


Fig. 1: Block circuit diagram

3 Installation



NOTICE!

Installation position and conditions

- Ensure that there is unimpeded access for operation
- Secure, low-vibration fixing
- Avoid direct sunlight
- Permissible ambient temperature at fixing position: 0 ... 50°C at max. 95% relative air humidity (non-condensing)



Reading and operating position

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



Installation position

- *Provide adequate clearance for the cable*
- *Allow at least 120 mm clearance above the control in its "parked position"*

3.1 Scope of Delivery

The following components are included as standard with a DULCOMETER® control series D1Cb.

Description	Quantity
Assembled device	1
Half screw connection, complete	1
M12 x 1.5 screw connection, complete	1
Assembly material, complete, 3P Universal	1
Check kit (only with conductivity measured variable)	1
Measured variable labels D1C/D2C	1
Drilling template for wall mounting	1
Punched template for control panel installation, drawing number 3140-3	1
Operating instructions	1
General safety instructions	1
CD-ROM with additional information and instructions	1

3.2 Installation (Wall Mounted)

The device can be installed directly on the wall with the aid of the wall mounting bracket. A drilling template is provided.

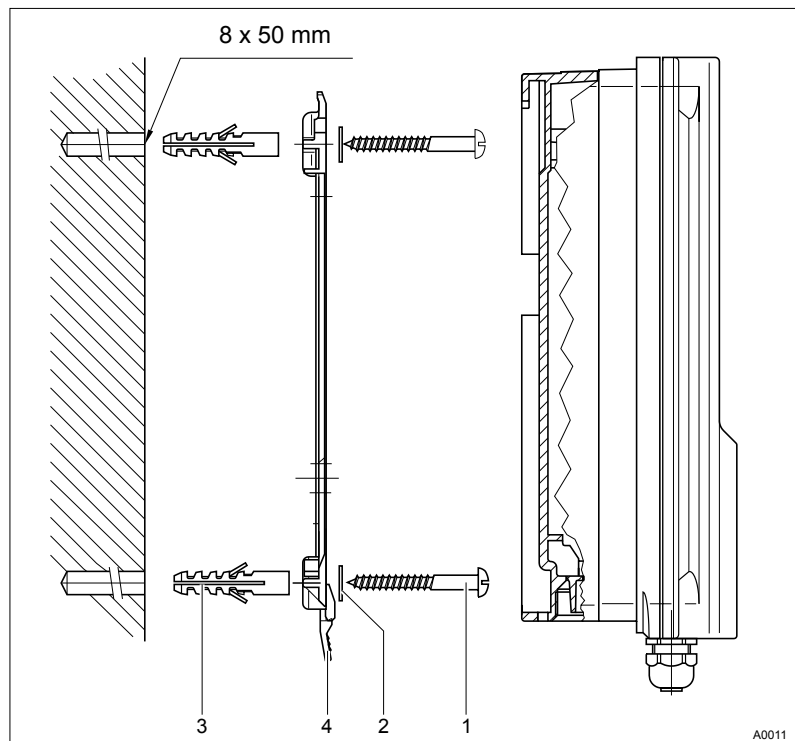


Fig. 2: Fixing material for wall mounting

1. 3 x Round head screws 5x45	2. 3 x Washers 5.3
3. 3 x Plastic wall plugs d8	4. Wall bracket

1. ➤ Mark and drill the holes (using the drilling template)
2. ➤ Insert wall plugs
3. ➤ Secure wall bracket in place with washers and round head screws
4. ➤ Place the device from above onto the wall bracket
5. ➤ Press the device gently against the wall bracket and slide it approx. 4 mm upwards until you hear it engage in position

3.3 Installation - Control Panel Mounted (Optional)



CAUTION!

Dimensional variations

Possible consequence: material damage

- Photocopying the punched template can result in dimensional deviations
- Only use original punched templates



CAUTION!

Material thickness of control panel

Possible consequence: material damage

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

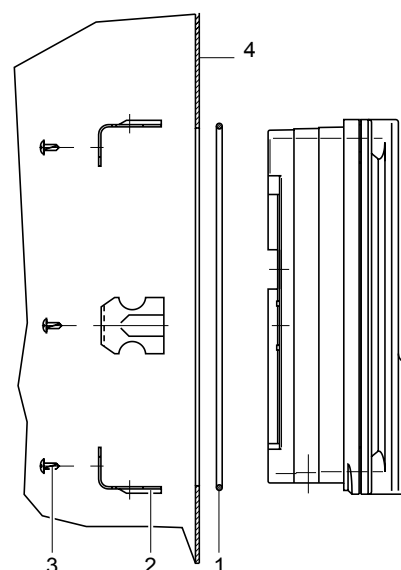


Fig. 3: The material thickness of the control panel must be at least 2 mm to ensure secure fixing

1. 1 x Foam rubber caulk strip d3	2. 6 x Galvanised steel retaining brackets
3. 6 x Galvanised PT cutting screws	4. Control panel

1. ➤ Determine the precise position of the device on the control panel using the template
2. ➤ Mark the corner points and drill (drill diameter 12 - 13 mm)
3. ➤ With a punching tool or jigsaw make the opening as per the template
4. ➤ Press the caulk strip evenly into the groove running around the device
5. ➤ Place the device into the control panel and fix in place at the rear by means of the retaining brackets and PT cutting screws
 - ⇒ The device should project approx. 35 mm from the control panel

3.3.1 Control Panel Mounting with an SN6 Socket



NOTICE!

Incorrect fitting of the O-ring

Damage to the device

- Ensure that the O-ring is correctly positioned

The SN6 socket (optional) must firstly be removed before the device can be mounted on the control panel. To do so, open the unit.

1. ➤ Unscrew the SN6 socket complete with O-ring (WAF 24)
2. ➤ Remove the SN6 socket with cable assembly

Once the device has been installed in the control panel, refit the SN6 socket and connecting cable and O-ring into the device.

3.4 Wall Mounted Installation of D1Cb (Electrical)



WARNING!

Electrical voltage

Possible consequence: Fatal or very serious injuries

- The electrical connection to the device should only be made once it has been fitted to the wall or control panel
- The device must be electrically disconnected before it is opened
- Ensure that the device cannot be reconnected accidentally



NOTICE!

Opening the device

Damage to the product or its surroundings

- The device may only be opened by qualified personnel
- The device should only be opened when fitted to the wall or control panel

3.4.1 Opening the device

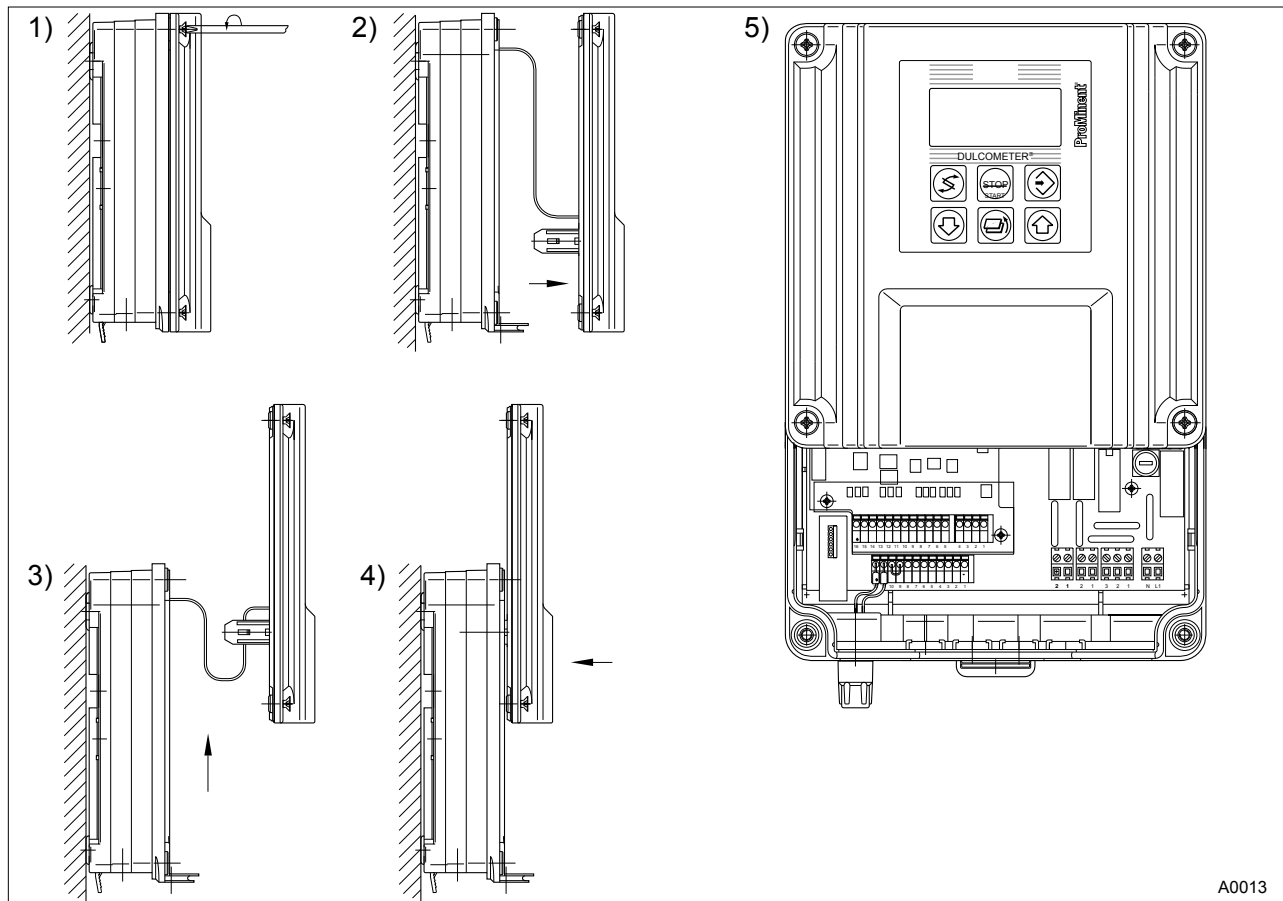


Fig. 4: Opening the device

1. ➡ Loosen the 4 captive screws (1).
2. ➡ Lift the upper section of the device from the lower section (2).
A wide flathead screwdriver may be of assistance.
3. ➡ Insert the upper section with both guide rails into the lower section (3 and 4) (parked position)

3.4.2 Electrical Installation (Wall Mounted)

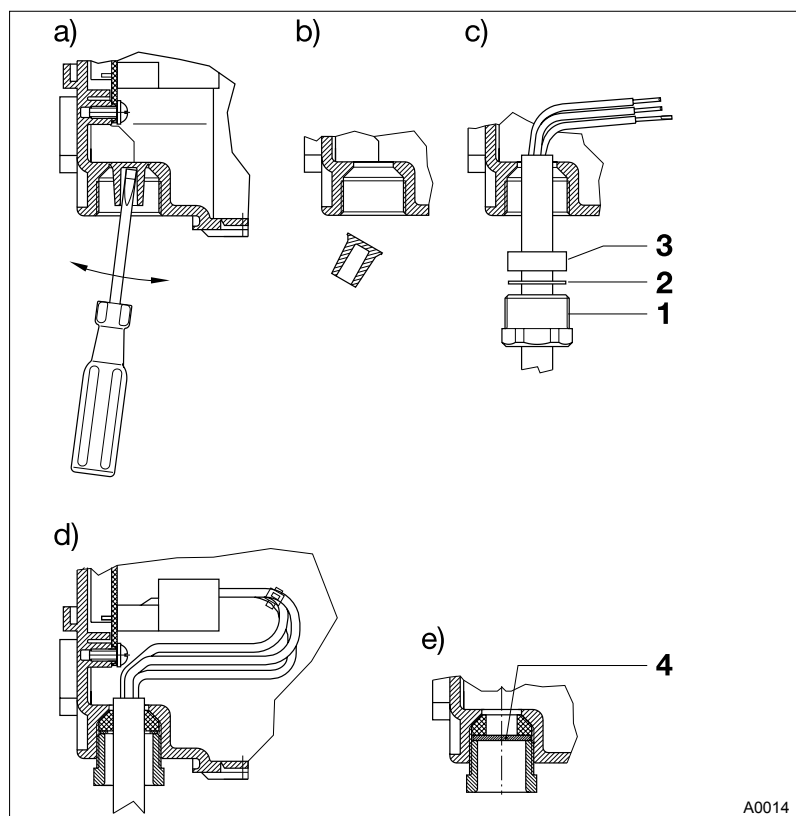


NOTICE!

Threaded holes

Using a suitable tool, punch out the threaded holes according to the number of cables

- Punch aids are provided to punch out the threaded holes



A0014

Fig. 5: Punching out threaded holes

- | | |
|-------------------------------|----------------------|
| 1. Screw connection M20 x 1.5 | 2. Pressure ring M20 |
| 3. Pressure ring M20 | 4. Dummy washer M20 |

1. ➤ Remove cable sheathing over a sufficient length
2. ➤ Fit screw connection (1), pressure ring (2) and seal (3) onto cable
3. ➤ Insert cable and fittings into the threaded hole
4. ➤ Align the cable and push in until enough cable is in the control housing
5. ➤ Screw in screw connection and tighten firmly
6. ➤ Shorten cable wires to the precise overall length and strip off approx. 8 mm insulation
7. ➤ Fit cable end sleeves to the ⚡ on page 21 wires
8. ➤ Connect up the wires to the terminals according to Fig. 9 the electrical wiring diagram

Punched out threaded holes can be resealed with the M20 dummy washers (4) provided.

The 4 openings in the front row can be used for conventional M12 x 1.5 screw connections (enclosure class IP 65 with lock nut).

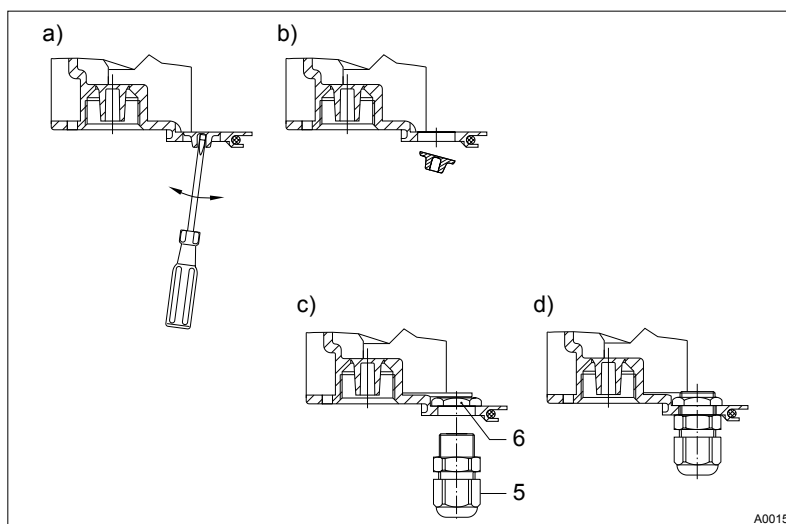


Fig. 6: M12x1.5 screw connections

5. Screw connection M12 x 1.5 6. Lock nut M12x1.5

1. ➤ Fit lock nut M12x1.5 (6) on the inside
2. ➤ Fit screw connection M12x1.5 from the outside and tighten firmly

3.4.3 Electrical Installation (Control Panel Mounted)

Proceed as described under "Electrical Installation (Wall Mounted)". ⚡ Chapter 3.4.2 "Electrical Installation (Wall Mounted)" on page 19

Only the rear row of threaded holes (M20x1.5) should be used when the device is mounted in a control panel. The front row (M12x1.5) is outside of the control panel.

Connect up in line with the electrical terminal wiring diagram. ⚡ Chapter 3.4.7 "Terminal Wiring Diagram" on page 23

3.4.4 Installation of Coaxial Cable to Guard Terminal XE1

Installation of coaxial cable

When installing the coaxial cable for the guard terminal XE 1, the allowances shown on the diagram for stripping insulation from the coaxial cable should be adhered to.

The guard terminal should be tightened until "hand-tight".

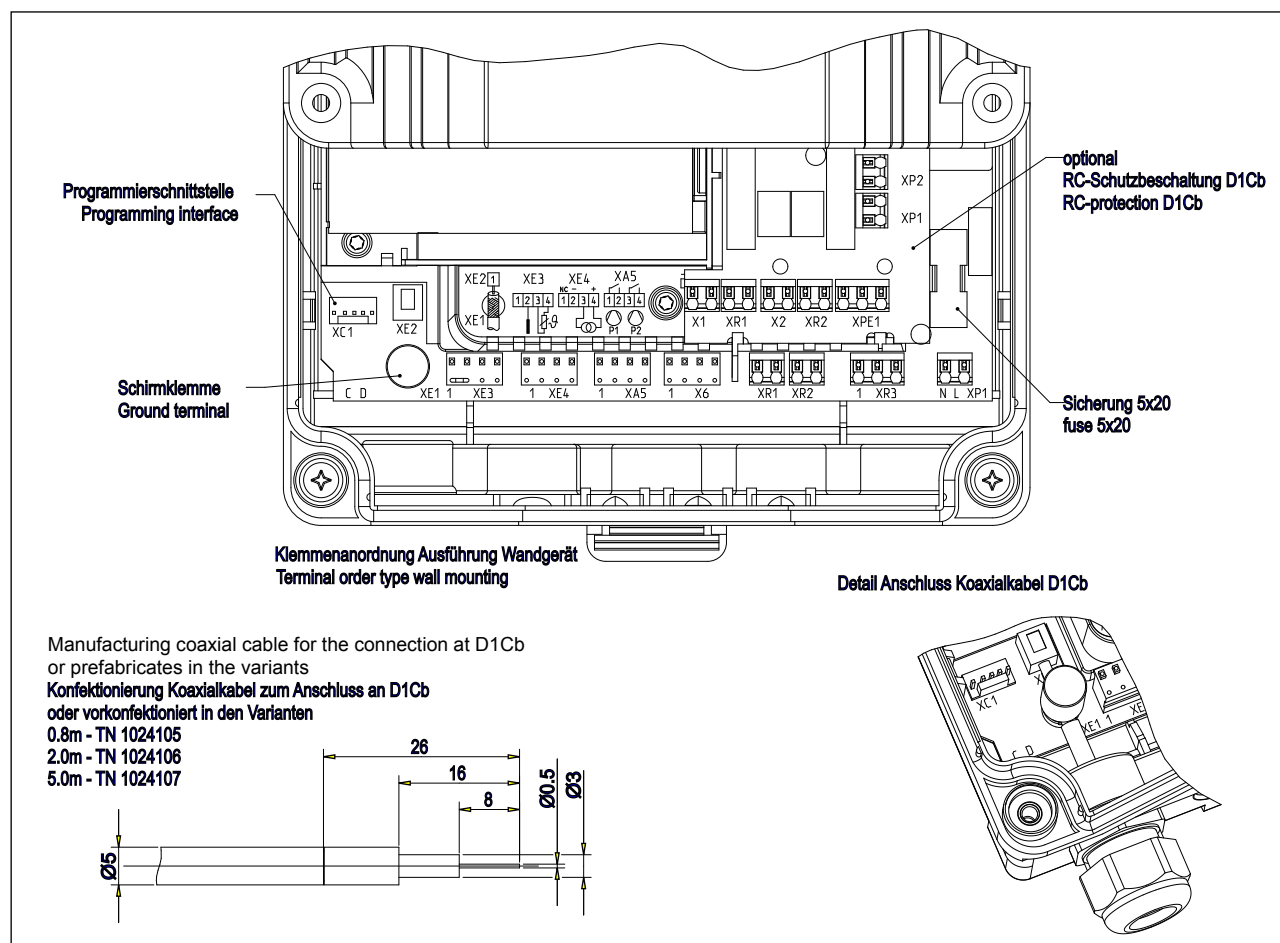


Fig. 7: Preparation of coaxial cable

3.4.5 Cable Cross-Sections and Cable End Sleeves

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

3.4.6 Protective RC Circuit (Optional)

A protective RC circuit is recommended for operation with consumers, which present an inductive load. In these applications a protective RC circuit prevents wear and tear of the relay contacts.

3.4.7 Terminal Wiring Diagram

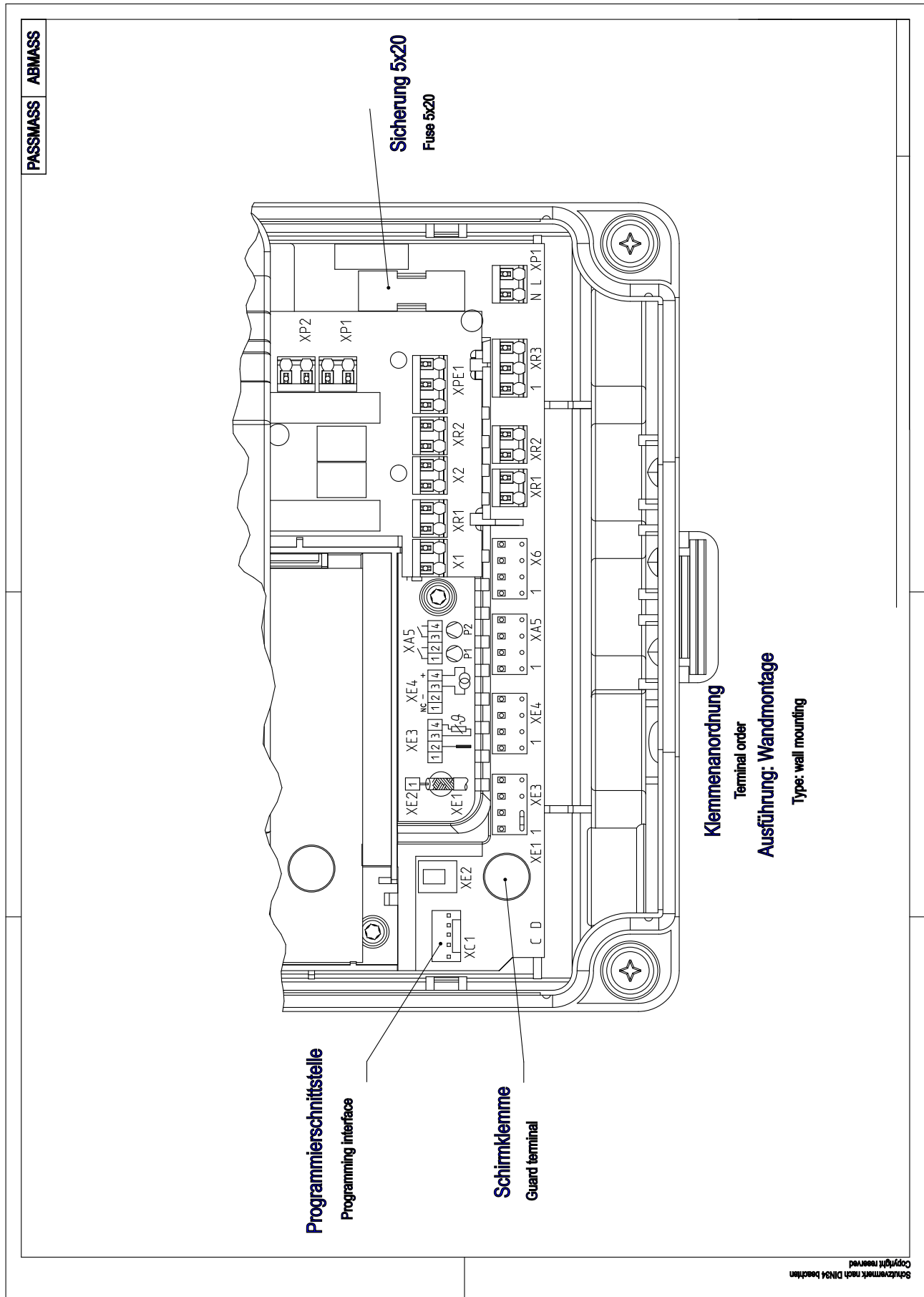


Fig. 8: Terminal layout

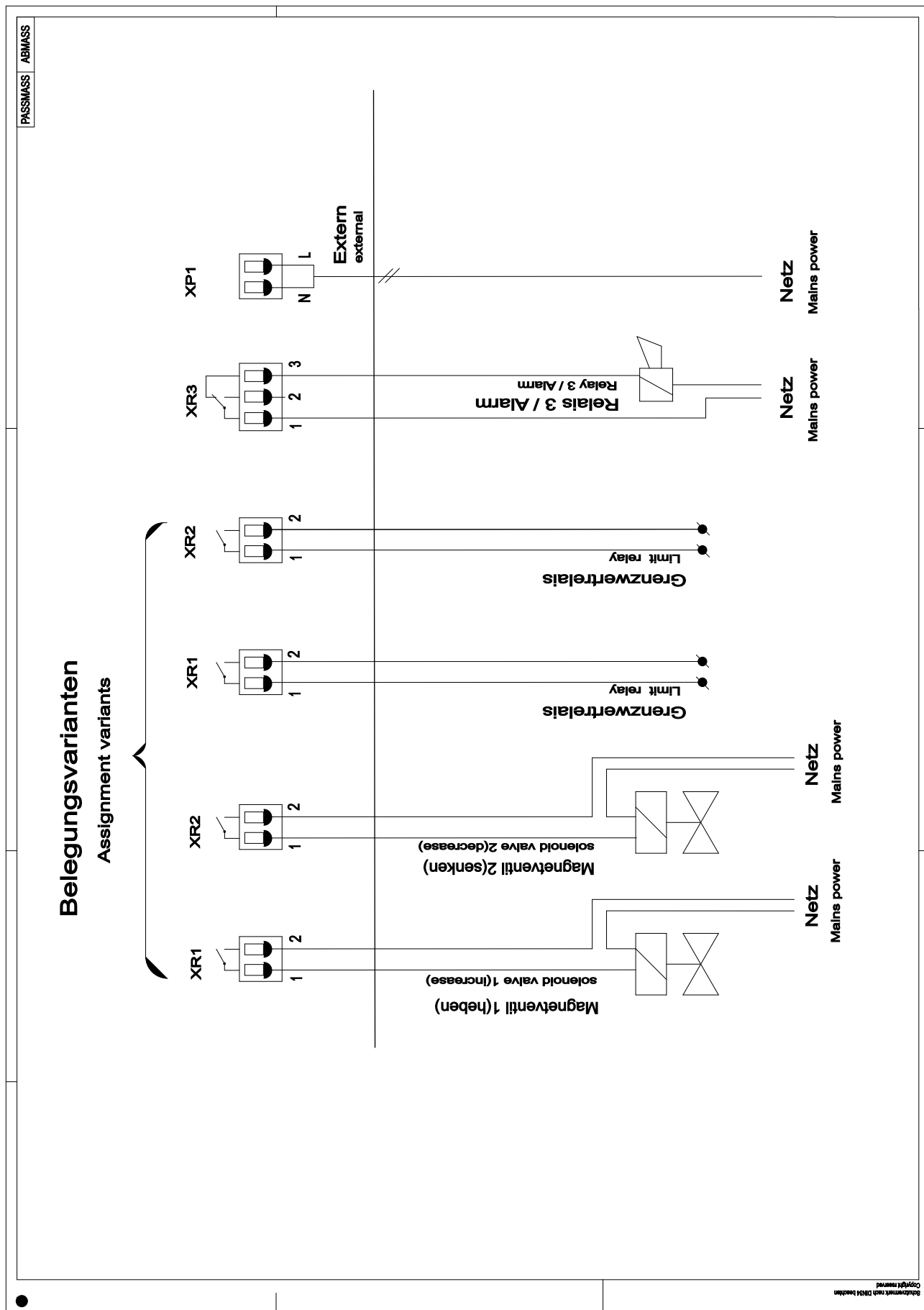


Fig. 9: Terminal diagram - Assignment options



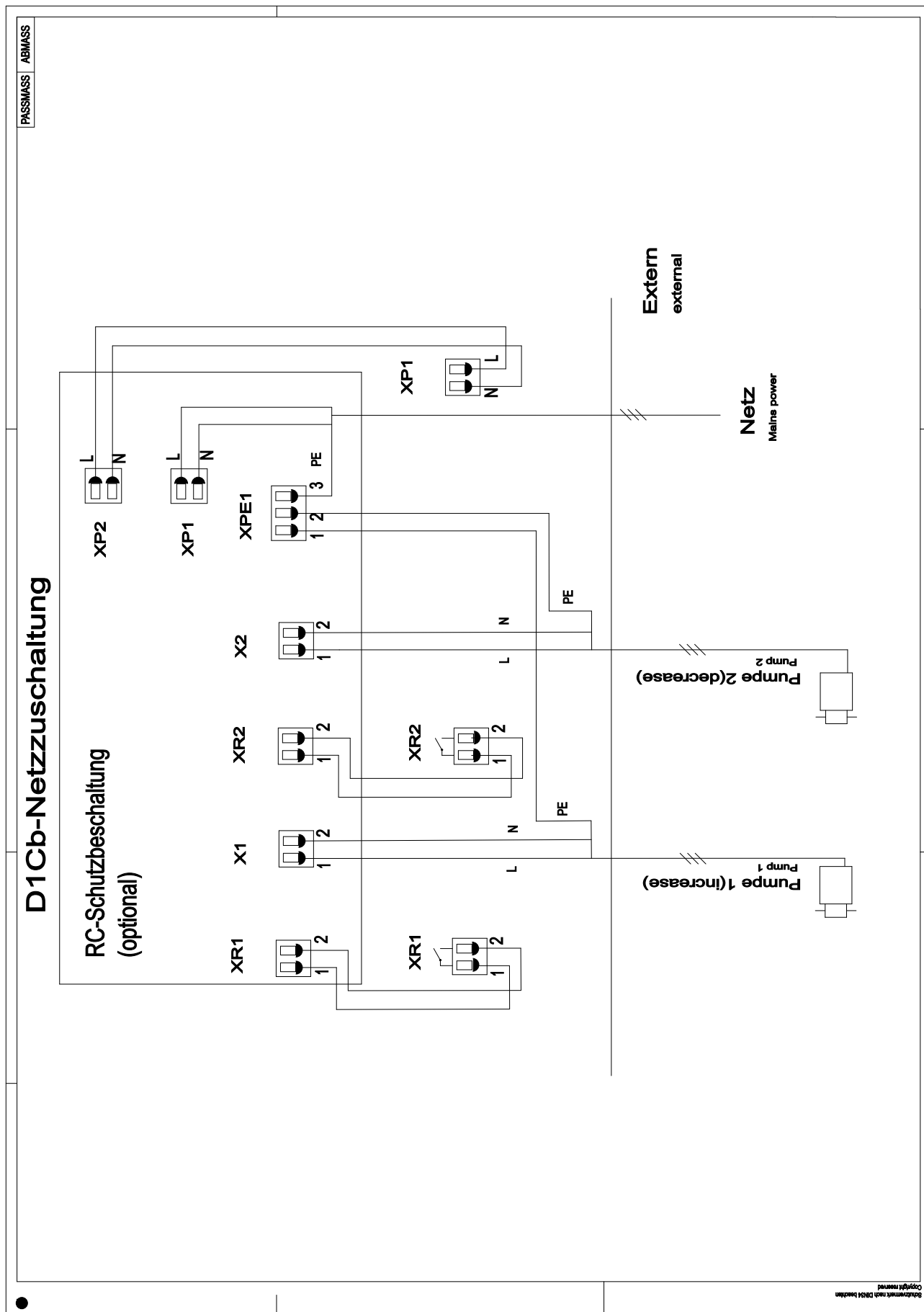


Fig. 11: Terminal diagram - Mains power connection

4 Commissioning



NOTICE!

Run-in time of sensors

Damage to the product or its surroundings

Take into consideration run-in times when commissioning

- Correct measuring and metering is only possible if the sensor is working perfectly
- It is imperative that the run-in times of the sensors are adhered to
- The run-in times should be allowed for when planning initial operation
- It may take a whole working day to run-in the sensor
- Please read the operating instructions for the sensor

Following completion of mechanical and electrical assembly, the control should be integrated into the measuring point.

4.1 Initial Commissioning

During initial commissioning the device will display in "English". The display will show "language english". The exception to this is if the language has been factory-preset to the customer's requirement.



Input of numerical values

Numerical values are inputted one position at a time

- Key increases the value
- Key decreases the value
- Key moves the decimal point to the right

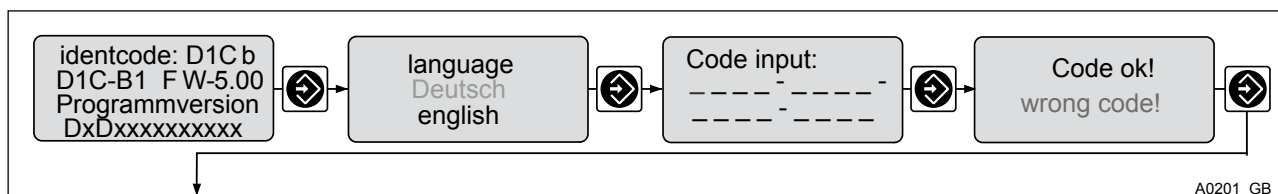


Fig. 12: Initial commissioning of display

This is followed by the selection of the measured variable and the measuring range.

4.1.1 Selection of Operating Language

With devices, which have not been preconfigured to the customer's specific requirement, the operating language required has to be selected in the "General Settings / Operating Menu" menu.

🔗 Chapter 6.15 "General settings" on page 52

4.1.2 Selection of Measured Variable and Measuring Range

With devices, which have not been preconfigured to the customer's specific requirement, the measured variable required has to be selected in the complete operating menu "General Settings / Change Measured Variable". The DULCOMETER® D1Cb then has to be labelled with the label corresponding to the measured variable selected. The relevant labels are enclosed with the DULCOMETER® D1Cb .

The measuring range required has to be selected and set in the full operating menu "General Settings / Change Measured Variable/"
 ↳ Chapter 6.15.1 "Measured Variable/Measuring Range" on page 52 once the measured variable has been selected.

4.2 Calibration of the Measuring Point

Following commissioning, the DULCOMETER® D1Cb must be calibrated
 ↳ Chapter 6.5 "Amperometric calibration of all measured variables" on page 41
 ↳ Chapter 7.5 "Calibration" on page 60 .
 When doing so, the operating instructions for the respective sensor should also be noted. The run-in times for the sensor should be scheduled as part of the commissioning process. These run-in times can take up to 24 hours.

4.3 Activation Code for Extended Functions



Activation code

Access to further functions can optionally be provided by means of an activation code

Should you require additional operating literature for these functions, this can be obtained on the homepage of ProMinent Dosiertechnik, Heidelberg.

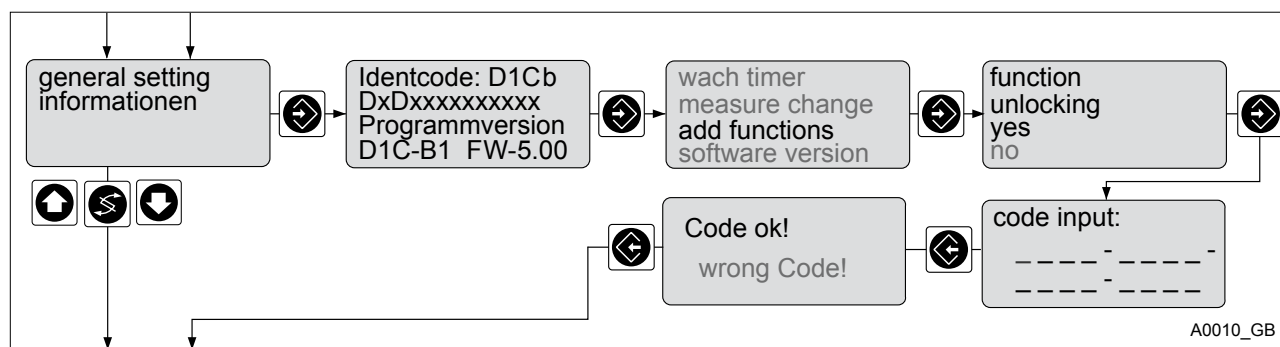


Fig. 13: Activation code / Serial number / Equipment number

The activation code is entered one digit at a time using the and key. Move to the next position with the key. The new functions can be calibrated and adjusted as described for the individual measured variables in the chapter entitled "Complete Operating Menu" ↳ Chapter 6.5 "Amperometric calibration of all measured variables" on page 41 ↳ Chapter 7.5 "Calibration" on page 60 .

4.3.1 Extended Functions Obtainable with the Activation Code

Extended functions

The DULCOMETER® D1Cb control unit can be extended or modified by means of a 16-digit activation code. Functions can be enabled several times.



D1Cb Software upgrade

To provide an activation code, ProMinent requires the 10-digit equipment number and the required and current software upgrade identity code, which can be found in the table below.



NOTICE!

Activation code

When ordering the activation code, it is imperative that you ensure that the serial number / equipment number (Eqnr.) corresponds exactly to that of the DULCOMETER® D1Cb to be extended. Otherwise a chargeable activation code will be provided, which will not work.



NOTICE!

"Incorrect code" message

If the code has been entered incorrectly then the "Incorrect code" message will appear. You can enter the activation code as many times as you need to. If this is still not successful, then check the serial number of the control.

DULCOMETER® D1Cb Software upgrade		
D1Ub	Software default setting	
V	Software preset	
	Default setting - measured variable	
	0	Universal
	A	Peracetic acid
	B	Bromine
	C	Chlorine
	D	Chlorine dioxide
	F	Fluoride
	H	Hydrogen peroxide
	I	Chlorite
	P	pH
	R	Redox
* = chargeable option		

Commissioning

DULCOMETER® D1Cb Software upgrade

S	0/4-20 mA standard signal general	
T	Temperature	
X	Oxygen	
Z	Ozone	
L	Conductivity	
	Connection of measured variable	
1*	Standard signal 0/4-20 mA, all measured variables	
5	mV input for pH/redox via guard terminal	
	Correction variable	
0	none	
2*	Temperature Pt100/PT1000 (for pH and conductivity)	
4*	Manual temperature input (for pH and conductivity)	
	Control input	
0	none	
1*	Pause	
2*	Pause or interference variable flow via frequency	
	Signal output	
0	none	
1*	Analogue signal output 0/4-20 mA	
	Power activation	
G	Alarm and 2 limit relays or 2 timer relays	
M*	Alarm and 2 solenoid valve relays or 2 timer relays	
	Pump activation	
0	none	
2*	2 pumps via pulse frequency	
	Control behaviour	
0	none	
1*	Proportional control	
2*	PID control	
	Language	
00	no default setting	

* = chargeable option

5 Operating Schematics / Display Symbols

5.1 Overview of device /Operating elements

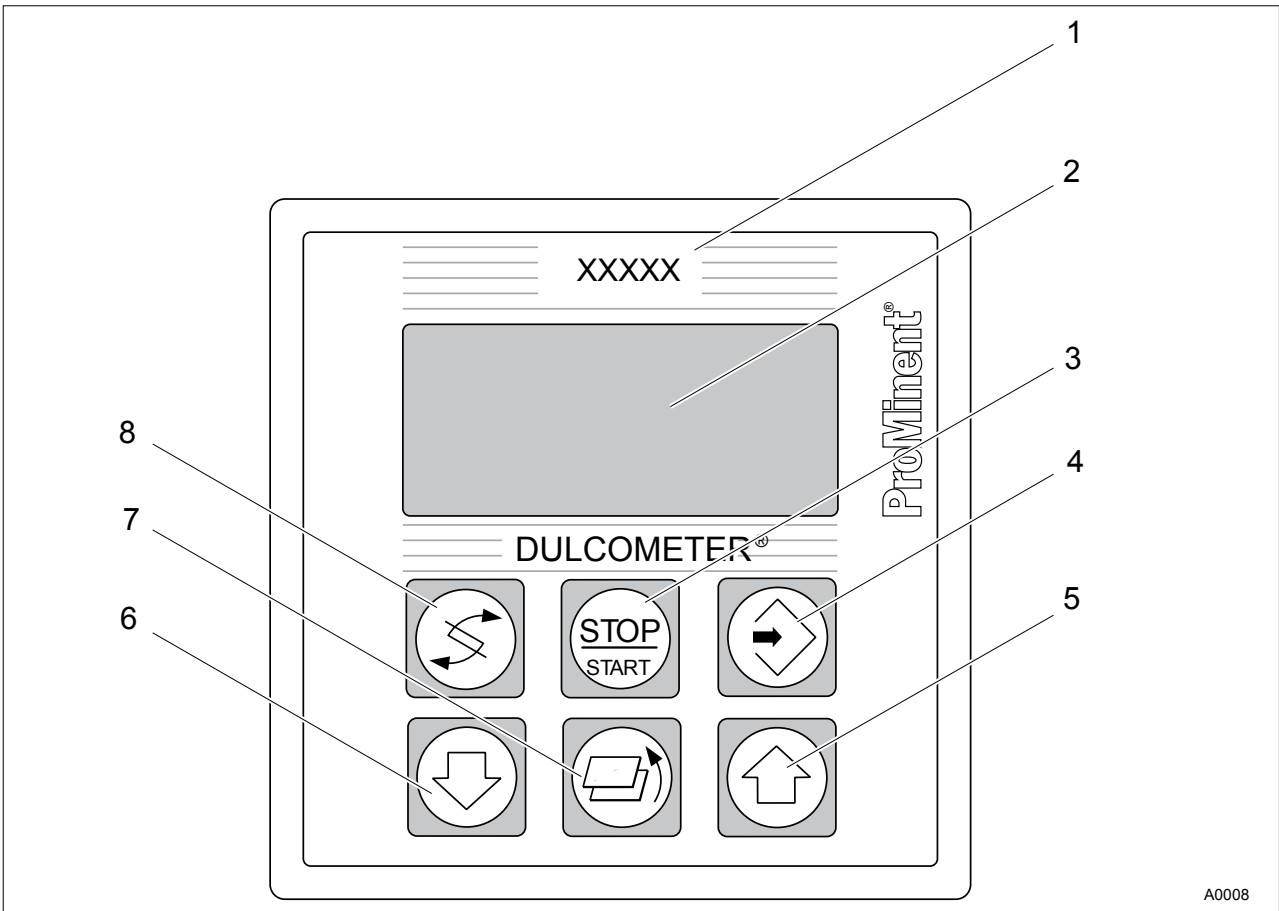


Fig. 14: Overview of device /Operating elements

Function	Description
1. Measured variable	Affix the measured variable label here
2. Display	
3. START/STOP key	Start/Stop the control and metering functions
4. INPUT key	To apply, confirm or save a displayed value or status or to acknowledge alarm
5. UP key	To increase a displayed numerical value and to change the variables (flashing display) and to move up in the operating menu
6. DOWN key	To lower a displayed numerical value and to change the variables (flashing display) and to move down in the operating menu
7. BACK KEY	Back to the permanent display or to the start of the respective setting menu
8. CHANGE key	To change within a menu level and to move from a changeable variable to another changeable variable within a menu option. When inputting numerical values, the cursor moves one space on.

5.2 Display Symbols

The display of the DULCOMETER® D1Cb uses the following symbols:

Meaning	Comment	Symbol
Limit transgression - relay 1 upper	Symbol left	↑
Limit transgression - relay 1 lower	Symbol left	↓
Limit transgression - relay 2 upper	Symbol right	↑
Limit transgression - relay 2 lower	Symbol right	↓
Metering pump 1 activation off	Symbol left	■
Metering pump 1 activation on	Symbol left	□
Metering pump 2 activation off	Symbol right	■
Metering pump 2 activation on	Symbol right	□
Solenoid valve 1 activation off	Symbol left	▲
Solenoid valve 1 activation on	Symbol left	△
Solenoid valve 2 activation off	Symbol right	▲
Solenoid valve 2 activation on	Symbol right	△
Stop key pressed		O
Manual metering		M
Fault		ε
Reading rises very quickly	Trend of reading display	↑
Reading rises quickly	Trend of reading display	↑
Reading rises slowly	Trend of reading display	↑
Reading falls very quickly	Trend of reading display	↓
Reading falls quickly	Trend of reading display	↓
Reading falls slowly	Trend of reading display	↓
Reading steady	Trend of reading display	↕

5.3 Permanent Display 1

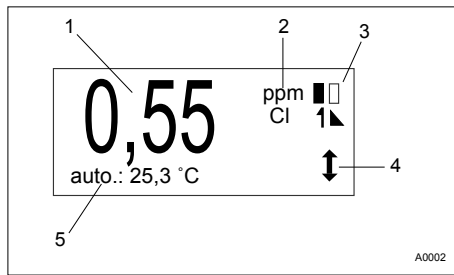


Fig. 15: Permanent Display 1

1. Reading

2. Measured variable

3. Status of actuators

4. Display of reading trend - falling / rising

5. Status line

Not all symbols are visible simultaneously in the permanent display 1. The scope of the symbols depends on what is required.

5.4 Permanent Display 2

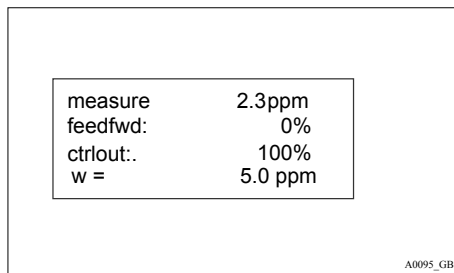


Fig. 16: Permanent Display 2

The permanent display 2 shows all information on the DULCOMETER® D1Cb that is needed at this time. Switch to other displays by pressing or or .

5.5 Permanent Display 3

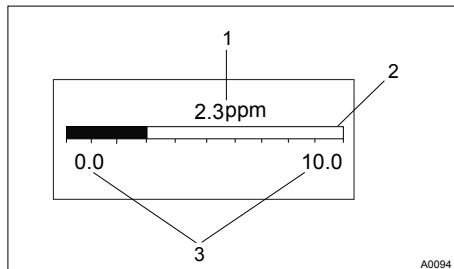


Fig. 17: Permanent Display 3

1. Current reading in plain text

2. Bar graph display shows the current reading in relation to the lower and upper reading limits

3. Displays the upper and lower limit of the display

Switch to other displays by pressing or or .

To set the lower and upper value (3) press . The left-hand value will flash and can be set using the or keys. Confirm the entry with . Switch between the left-hand and right-hand value (3) by pressing .

This setting only changes the display range of the bar graph, as it were "zooming in" to a smaller range to obtain a better resolution of the display in the main display range of the measurement.



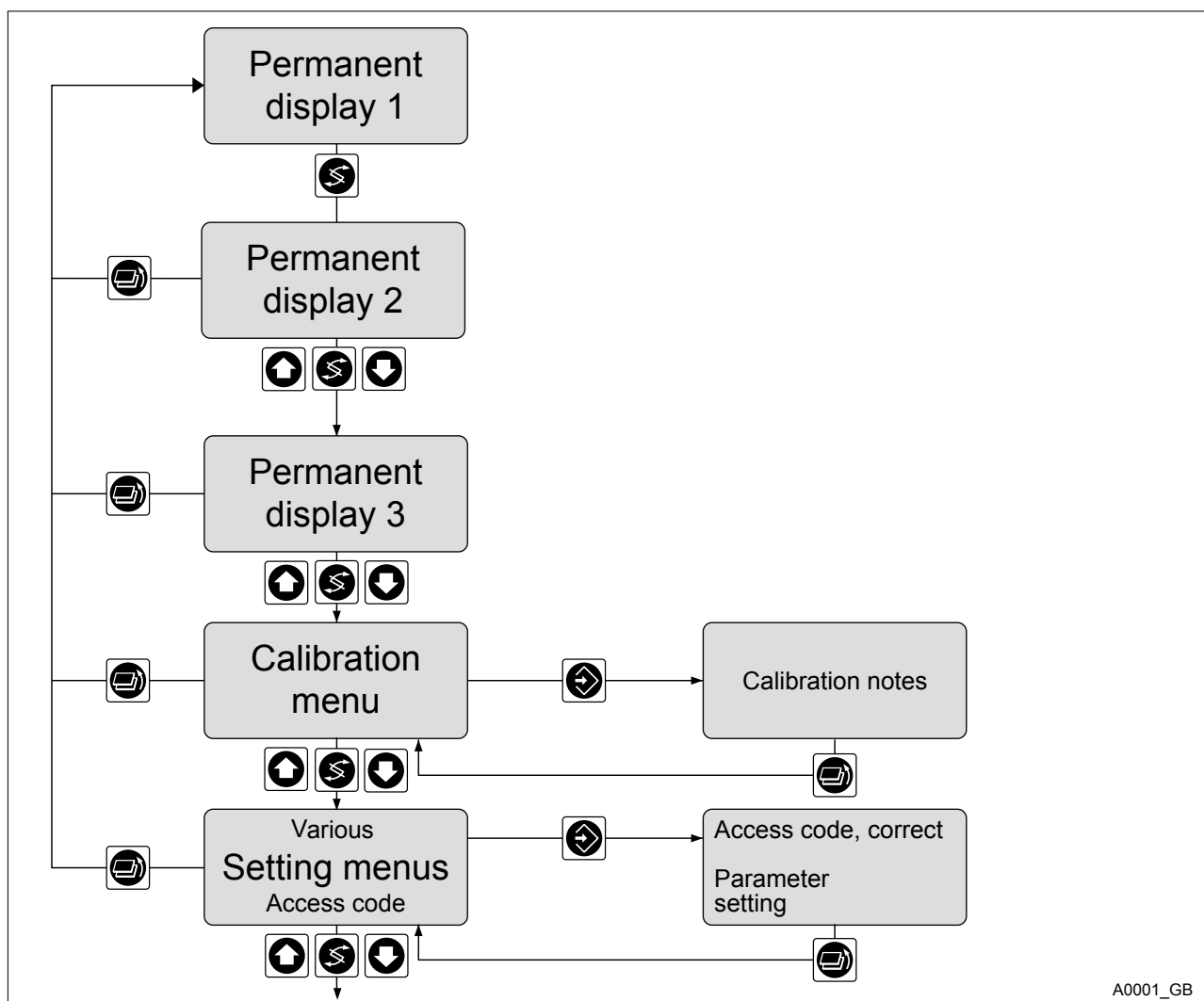
This setting only changes the display range of the bar graph! It is not possible to change the measured range of the DULCOMETER® D1Cb with this function.

5.6 Operating Schematics



Access code

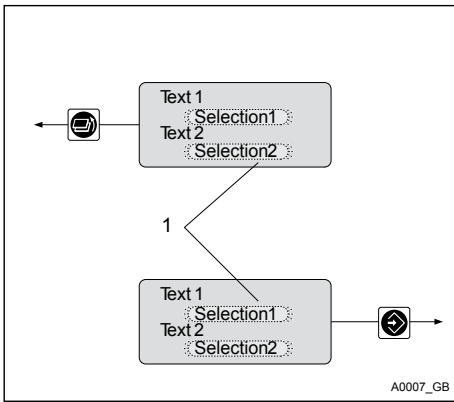
- Access to the setting menu can be blocked with an access code
- If the access code has been correctly selected for a setting menu, then all of the other setting menus are also accessible
- If no key is pressed within 10 seconds, the device will return to permanent display 1, the access code is re-enabled and access is restricted



A0001_GB

Fig. 18: Access code

The number and scope of the setting menus depends on the design of the device.



1. Settable values flash on and off

Fig. 19: Settable values flash on and off

5.7 Operating Menu

The DULCOMETER® D1Cb allows settings to be made in two different comprehensive menus. All of the parameters of the controller are preset and can be changed in the complete operating menu.

The controller is delivered with a reduced operating menu. If adjustments are necessary, the parameters can be accessed by switching to the complete operating menu.

5.8 Fault Messages

Any fault messages and notes which arise are shown in the bottom line of the permanent display 1. Faults which have to be acknowledged (acknowledging them switches the alarm relay off) are shown by the Σ symbol.

Faults/notes, which remain after acknowledgement, will be displayed alternately. If a correction variable is being processed, the value will be displayed in the same line as the faults/notes. Faults, which are rectified automatically by changing operating situations, are removed from the permanent display 1 without the need for acknowledgement.

5.8.1 Fault display

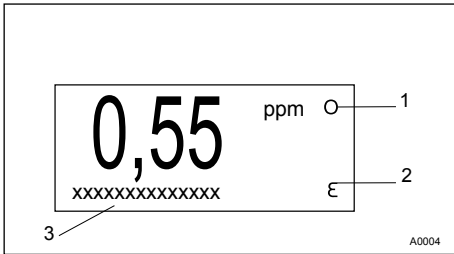


Fig. 20: Fault display

1. Stop function
2. Fault
3. Fault in plain text

5.9 General settings

5.9.1 Access code

Access to the setting menu can be prevented by an access code. The DULCOMETER® D1Cb is delivered with the access code "5000". Even if disabled by the access code, the calibration menu remains freely accessible.

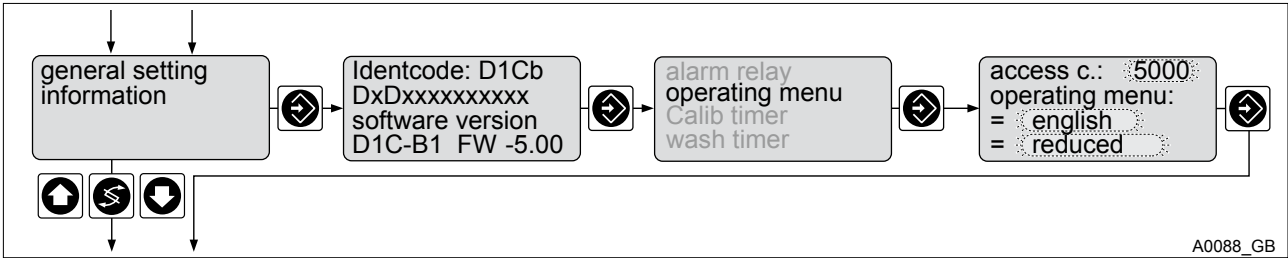


Fig. 21: Access code

		Possible values			
	Factory setting	Increment	Lower value	Upper value	Remarks
Access code	5000	1	0000	9999	

6 Amperometric Measured Variables and Operating Menus

6.1 Operating Menu

The DULCOMETER® D1Cb allows settings to be made in two different comprehensive menus. All of the parameters of the controller are preset and can be changed in the complete operating menu.

The controller is delivered with a reduced operating menu. If adjustments are necessary, the parameters can be accessed by switching to the complete operating menu.

6.2 Description of All Amperometric Measured Variables

Measured variable	Typical measuring range
Chlorine, chlorine dioxide, ozone	2 ppm
Bromine	10 ppm
Peracetic acid	2000 ppm
Hydrogen peroxide	200 ppm
Chlorite	0.5 ppm

The measuring ranges can be selected in the following ppm increments: 0,5, 2, 5, 10, 20, 50, 100, 200, 1000, 2000, 5000, 10000*, 20000*.

Measured variables	
Chlorine dioxide, chlorine, chlorite, bromine, ozone	
Measuring ranges	0.500 ppm
	2.00 ppm
	5.00 ppm
	10.00 ppm
	20.0 ppm
	50.0 ppm
	100 ppm
	200 ppm
Resolution	According to the above decimal places
Measured deviation of display	<0.5% of measuring range
Measured deviation of display 10000* ppm	<1.00% of measuring range
Measured deviation of display 20000* ppm	<2.00% of measuring range
Deviation of display/signal output, repeat accuracy	<0.25% of measuring range
* = only hydrogen peroxide and peracetic acid measured variables	

Amperometric Measured Variables and Operating Menus

Measured variables	
Deviation of display/signal output, repeat accuracy of measuring range 10000* ppm	<1.00% of measuring range
Deviation of display/signal output, repeat accuracy of measuring range 20000* ppm	<2.00% of measuring range
* = only hydrogen peroxide and peracetic acid measured variables	

6.3 Reduced operating menu

The reduced operating menu allows the key parameters to be operated. The following overview shows the settings that can be selected:

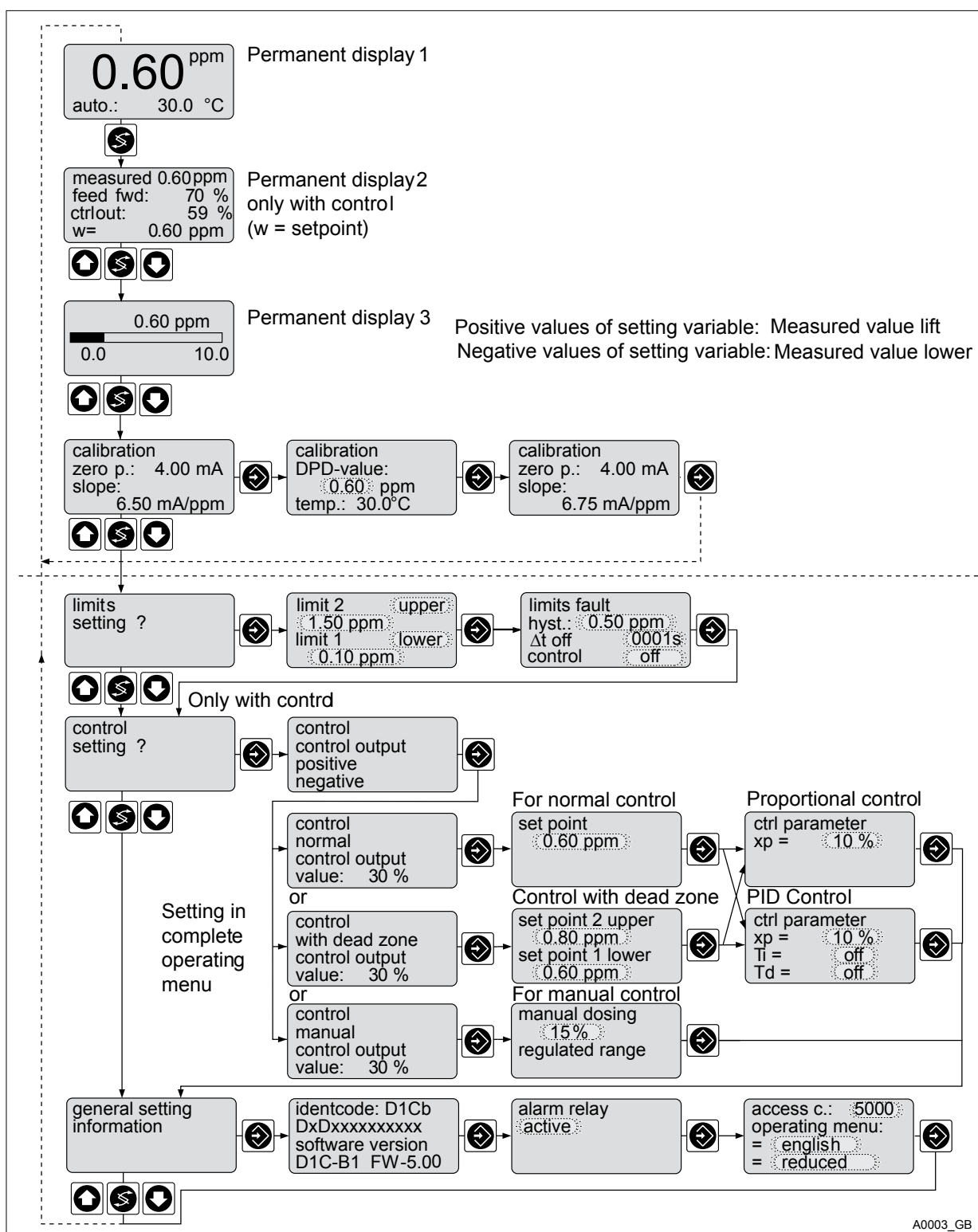


Fig. 22: Reduced operating menu

6.4 Complete Operating Menu / Description of All Measured Variables

The complete operating menu allows all controller parameters to be set. The following overview shows the settings that can be selected:

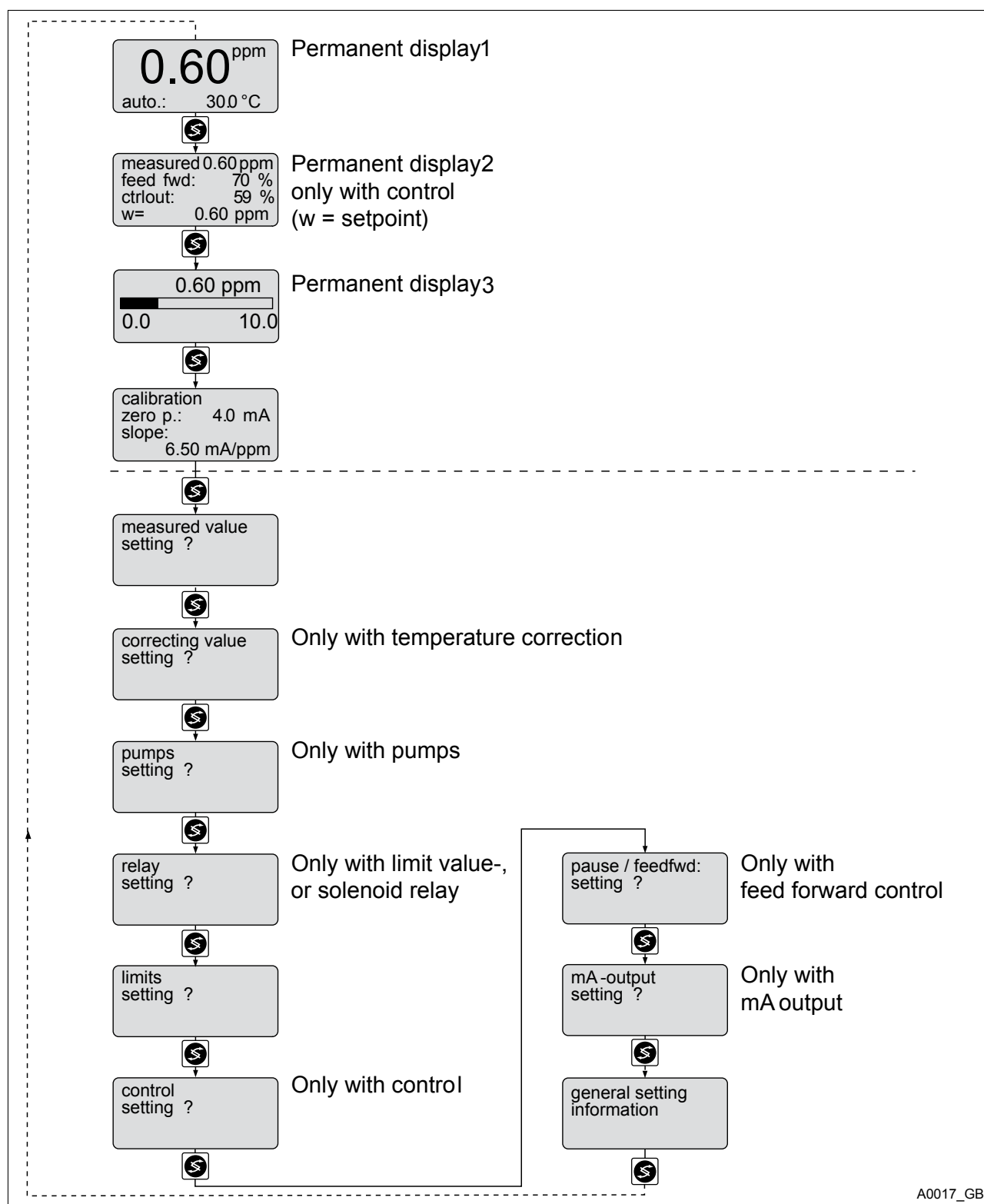


Fig. 23: Complete operating menu

6.5 Amperometric calibration of all measured variables

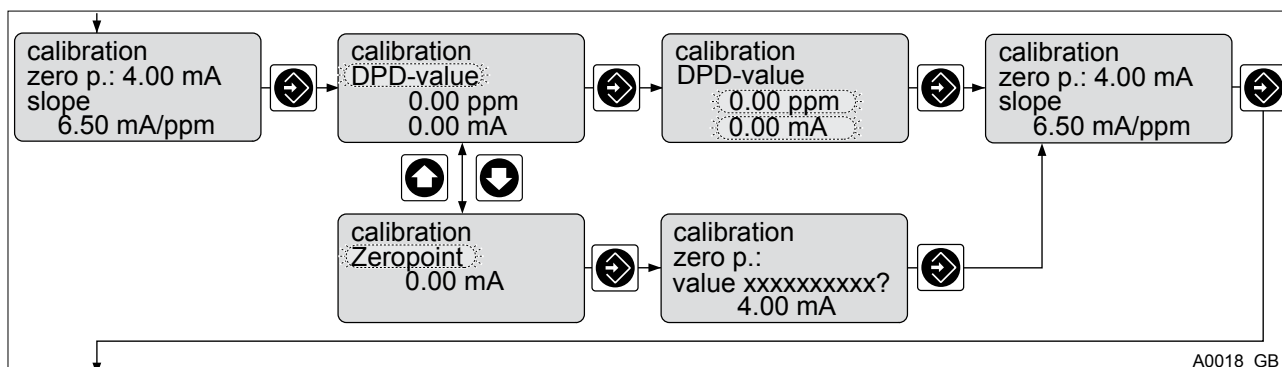


Fig. 24: Amperometric calibration of all measured variables

Fault message	Condition	Remarks
Calibration not possible! Gradient too low	Gradient too low ($< 20\%$ of standard gradient)	Repeat calibration
Calibration not possible! Gradient too high	Gradient too high ($> 300\%$ of standard gradient)	Repeat calibration
DPD value too low DPD $> x.xx$ ppm	DPD $< 2\%$ of measuring range	Repeat calibration after addition of metering medium or fit sensor suitable for the process
Calibration not possible! Zero point low	< 3 mA	Check sensor/cable Repeat calibration in water without metering medium
Calibration not possible! Zero point high	> 5 mA	Check sensor/cable Repeat calibration in water without metering medium

6.6 Calibration of Sensor - All Measured Variables

In the reduced operating menu The DULCOMETER® D1Cb stores the data for the gradient.

In the complete operating menu The DULCOMETER® D1Cb stores the data for the zero point and the gradient.

6.6.1 Preparation for Amperometric Calibration of the Sensor - All Measured Variables



CAUTION!

Correct sensor operation / Run-in time

Damage to the product or its surroundings

- Correct measuring and metering is only possible if the sensor is working perfectly
- Please read the operating instructions for the sensor
- It is imperative that the run-in times of the sensors are adhered to
- The run-in times should be allowed for when planning initial operation
- It may take a whole working day to run-in the sensor



Zero point calibration

Zero point calibration has to be performed under real conditions in water free from metering medium!

It is only required for the 0-0.5 ppm measuring range if measurements are to be made at the lower limit of the measuring range.

During calibration, the DULCOMETER® D1Cb sets the actuating outputs to "0". The exception to this is if the a basic load or a manual actuating variable has been set. This remains active. The mA standard signal outputs are frozen. The reading frozen at the start of calibration is suggested as a DPD value. The DPD values can be set using the arrow keys. Calibration is only possible if the DPD value is $\geq 2\%$ of the measuring range of the sensor. In the reduced operating menu The DULCOMETER® D1Cb stores the data for the gradient.

6.6.2 Calibration of Zero Point and Gradient



NOTICE!

Prerequisites








- The DPD method required by the metering medium employed will be used
- The run-in time for the sensor has been observed
- There is permitted and constant flow at the flow gauge
- There is temperature equalisation between the sensor and the sample water
- There is a constant pH value in the permitted range

Amperometric calibration: Gradient (in the reduced and complete operating menu)

The sensor is fitted, run in, flushed with sample water and connected electrically to the DULCOMETER® D1Cb .

There has to be adequate metering medium in the sample water for calibration (> 2% of the measuring range of the sensor).

Remove sample water directly at the measuring point and determine the content of metering medium in the sample water in "ppm" using an appropriate DPD measuring implement. Enter this value as follows into the DULCOMETER® D1Cb :

1. ➔ Select Calibration menu. Then press 
2. ➔ Select "DPD value" of unit to be calibrated using the  key
3. ➔ Then press 
4. ➔ If necessary adjust the flashing ppm value using keys ,  and  to the value determined using the DPD measuring method
 - ⇒ The mA value of the sensor shown in the display now corresponds to the DPD value in "ppm"
5. ➔ Then press the following key twice 
 - ⇒ The display now shows the value determined for the zero point and gradient. Refer to the Fault Message table should a fault be displayed ↗ *Table on page 41*











Necessity of calibrating the zero point

Calibration of the zero point is not generally necessary. 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.

Amperometric calibration: Zero point (only in the complete operating menu)

A container with distilled water, which is free of additives that could falsify the measured result, is needed for calibration. Immerse the dismantled sensor, which is nevertheless still electrically connected to the DULCOMETER® D1Cb in this water. Stir the sensor around the water for approx. 5 minutes until the reading on the DULCOMETER® D1Cb is displayed steady and close to 0".

1. ➔ Select Calibration menu. Then press 
2. ➔ Select "zero point" to be calibrated using the  key
3. ➔ Then press 
 - ⇒ A prompt is shown in the display
4. ➔ Confirm prompt with 
5. ➔ Then press 
6. ➔ Apply the "zero point" displayed during calibration with the  key
7. ➔ Then press 
 - ⇒ Display shows the values recorded
8. ➔ Then press 
 - ⇒ Refer to the Fault Message table should a fault be displayed ↗ *Table on page 41*



NOTICE!

Afterwards you must calibrate the gradient with the DPD value

6.7 Reading



WARNING!

Incorrect metering due to incorrect metering range

Possible consequence: Fatal or very serious injuries

- The measuring range of the sensor is essential for the measuring range!
- If the assignment of the measuring range is modified, the settings must be checked in all menus
- If the assignment of the measuring range is changed, the sensor must be recalibrated

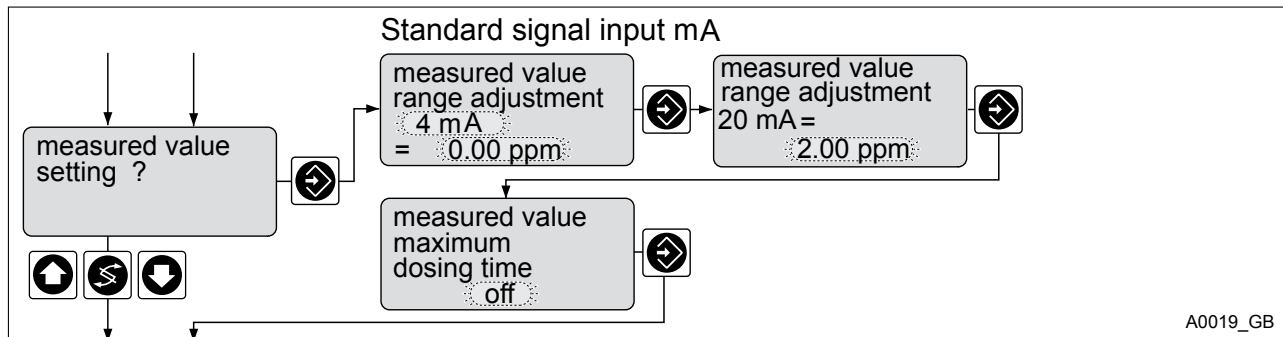


Fig. 25: Reading

This setting is used to adapt the DULCOMETER® D1Cb to sensors provided by third party providers. Sensors provided by third party providers may have measuring ranges, which deviate from the DULCOMETER® D1Cb standard specification.

6.7.1 Control Time - Control Variable



CAUTION!

Incorrect alarm by controller. Incorrect metering / Over-metering

Possible consequence: Slight or minor injuries, material damage

- Do not enable this function with applications where the reading does not change

This function checks whether the reading from the sensor changes within the "control time of the control variable". It is assumed that it does this for an intact sensor. If the reading does not change during this control time, the DULCOMETER® D1Cb changes the control variable to "0" and the alarm relay is released. A plain text message appears in the LCD display.

6.8 Correction value

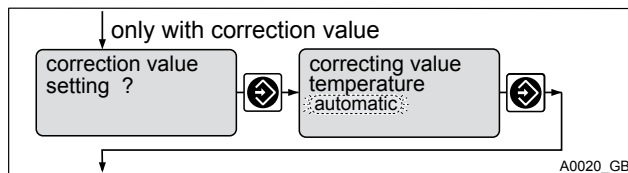


Fig. 26: Correction value

The correction variable compensates for the effect of the temperature of the medium on the reading. The correction variable is the temperature of the medium to be measured. The temperature of the medium affects the value to be measured. As the temperature rises, the gradient of the pH sensor rises, although the pH value of the water does not change with the temperature. By measuring the temperature it is possible to compensate for these effects with a calculation.

Operating modes

- Off: No temperature compensation takes place
 - For measurements which do not require temperature compensation
- Automatic: The DULCOMETER® D1Cb analyses the temperature signal from the sensor connected
 - For measurements with sensors, which supply a temperature signal that can be used by the DULCOMETER® D1Cb
- Manual: The temperature of the medium to be measured has to be measured by the user. Using keys and the value recorded can then be inputted into the DULCOMETER® D1Cb and saved with .
 - For measurements where the medium to be measured has a constant temperature which has to be taken into account in the control process

6.9 Pumps



NOTICE!

Maximum stroke rate of pump

The pumps are activated in accordance with the actuating variable up to the maximum frequency of the respective pump

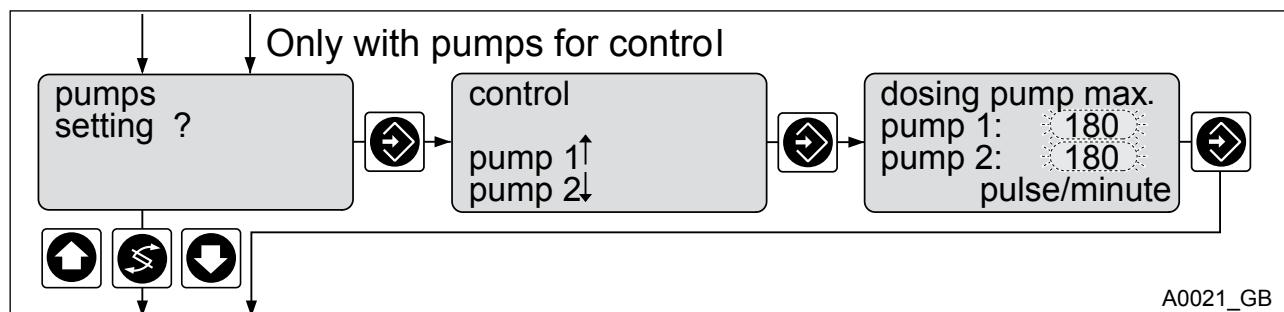


Fig. 27: Pumps

The minimum (0) and maximum (500) value of the pump strokes is specified by the controller. Critical when setting the stroke rate is the flow rate of the pump in relation to the respective process.

6.10 Relay for Activation



Limit relay used as an actuator

Extended functions

- The limit relays can also be defined in such a way that they react like an actuator. If, for example, a limit relay is activated, then it is deactivated if the pause contact is closed or for a subsequent time delay t_d (if $t_d > 0$ min is set under "General Settings").

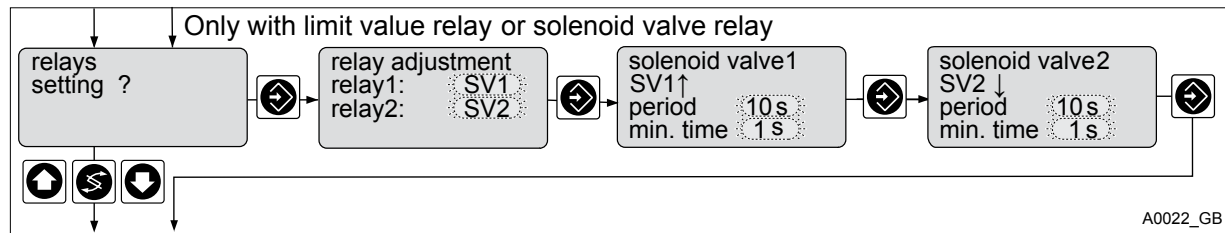


Fig. 28: Limit or solenoid valve relays

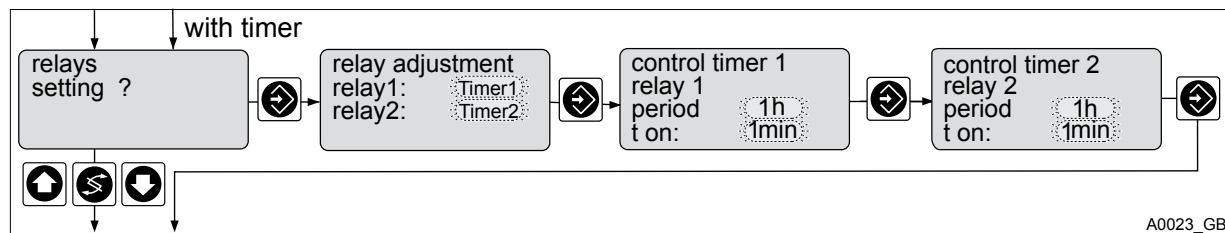


Fig. 29: With timer

		Possible values			
	Factory setting	Increment	Lower value	Upper value	Remarks
Relay assign- ment	As per identity code	Solenoid valve (MV1, MV2) Limit value (limit 1/2)* Actuator 1/2 Timer 1/2 Off			*At the limit, the relays remain activated even in the event of a malfunction
Cycle	10 s	1 s	10 s	9999 s	For solenoid valve
Min. time	1 s	1 s	1 s	Cycle/2	For solenoid valve: the smallest permis- sible switch-on period of the connected device should be set here
Cycle	Off	1 h	1 h/off	240 h	For timer
T On	1 minute	1 minute	1 minute	240 min	For timer

6.10.1 Timer relay



CAUTION!

The timer is reset when there is no supply voltage

Possible consequence: Slight or minor injuries, material damage

- Design the supply voltage in such a way that it cannot be interrupted
- With critical processes, the possible failure of the timer should be practically addressed

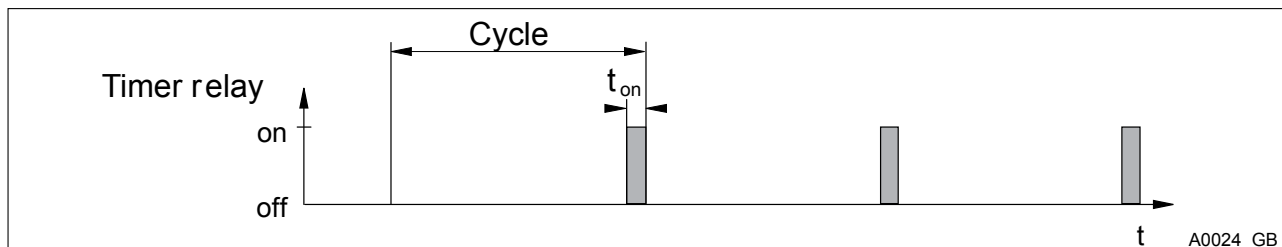


Fig. 30: Timer relay

At the end of the (timer) cycle time, the DULCOMETER® D1Cb closes the assigned timer relay for the duration of "t on" (timer). "Pause" interrupts the timer. If the clock is visible on the LCD display, then the timer can be reset to the beginning of the cycle using the input key. The % figure on the LCD display indicates the progress of the current cycle. % figure = remaining runtime.

6.10.2 Solenoid valves

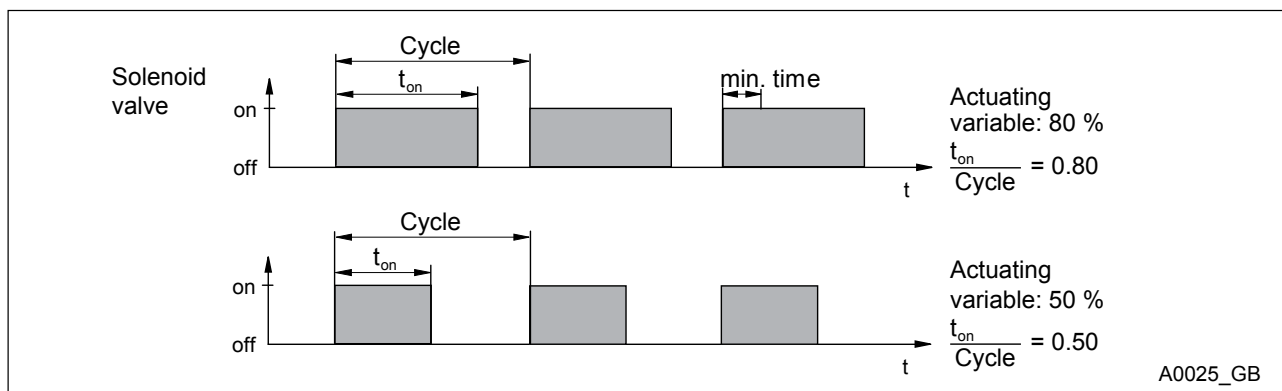


Fig. 31: Solenoid valves

6.10.3 Switching Times

The switching times of the DULCOMETER® D1Cb (solenoid valve) depend on the cycle time and on the "minimum time" (smallest permissible switching time of the connected device). The actuating variable determines the ratio $t_{on}/cycle$ and thus also the switching times. The "min. time" affects the switching times in two situations:

Theoretical switching time < min. time:

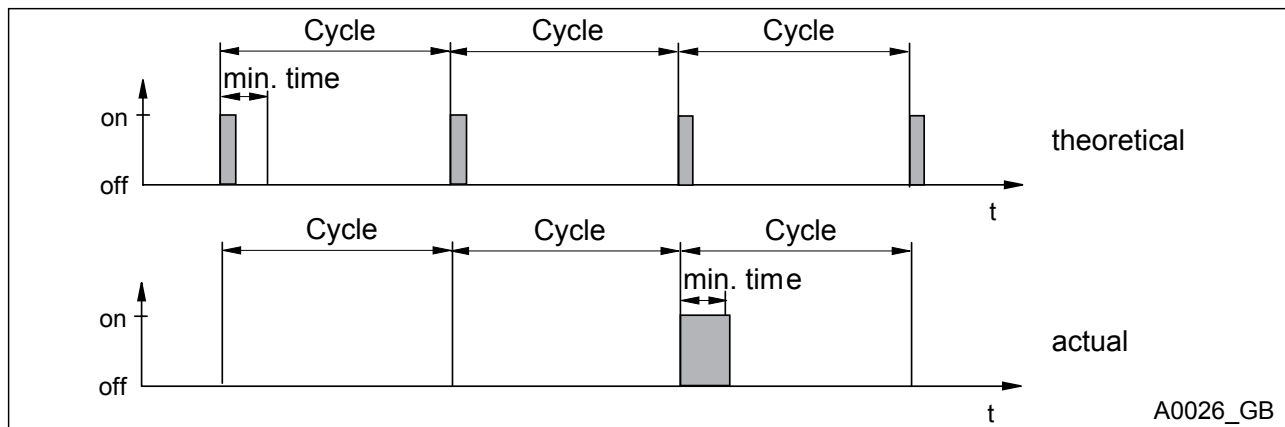


Fig. 32: Theoretical switching time < min. time

The DULCOMETER® D1Cb does not switch on for a certain number of cycles until the sum of the theoretical switching times exceeds the "min. time". Then it switches for the duration of this total time.

Theoretical switching time > (cycle - min. time):

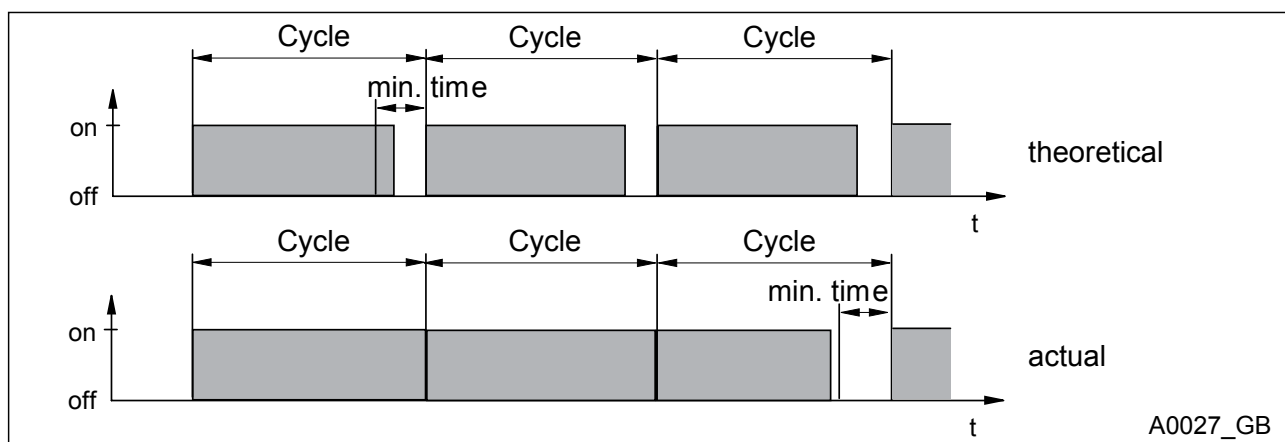


Fig. 33: Theoretical switching time > (cycle - min. time) and calculated switching time < cycle

The DULCOMETER® D1Cb does not switch off for a certain number of cycles until the differences between the cycle and the theoretical switching time exceed the "min. time".

6.11 Limit values

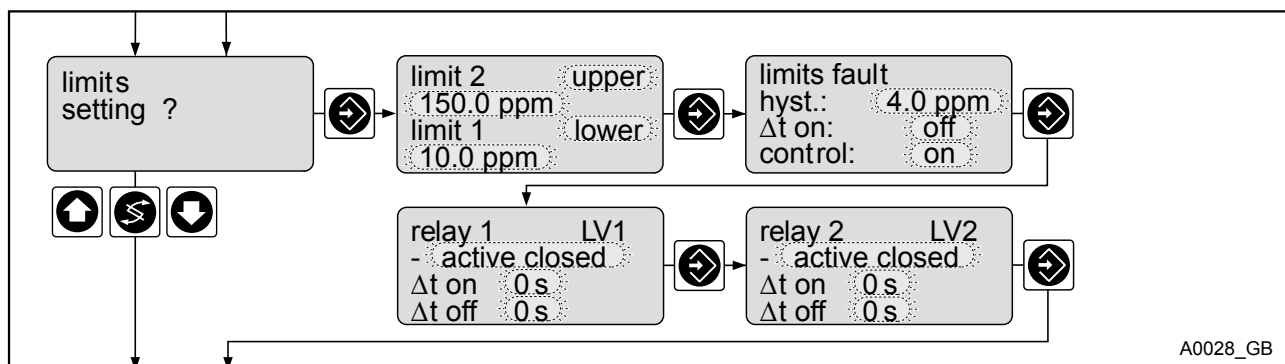


Fig. 34: Limit values

Amperometric Measured Variables and Operating Menus

		Possible values			
	Factory setting	Increment	Lower value	Upper value	Remarks
Type of limit transgression					Limit transgression by exceeding or dropping below limits
Limit 1	Lower	Lower / Upper / Off	Lower	Upper	
Limit 2	Upper	Lower / Upper / Off	Lower	Upper	
Limit value Limit 1	0.1 ppm	0.01 ppm	0 ppm	Upper limit of reading	
Limit value Limit 2	1.5 ppm	0.01 ppm	0 ppm	Upper limit of reading	
Hysteresis limit	0.04 ppm	0.01 ppm	0.02 ppm	Upper limit of reading	Effective in the direction of cancelling limit transgression
Control time limits t on	Off	1 s	1 s	9999 s	Results in message and alarm, Off = 0 s, function switched off No message, no alarm
Control	Normal	Normal / Dead zone / Manual			
Switching direction		Active			
Limit 1	Active closed	Active closed / Active open			Reacts like a closer
Limit 2		Active closed / Active open			Reacts like an opener
Switch-on delay on	0 s	1 s	0 s	9999 s	
Switch-off delay off	0 s	1 s	0 s	9999 s	

If the limit is exceeded for longer than the "Delay time of limits", then a fault message will be triggered that has to be acknowledged and the alarm relay is deactivated. If the "controller" is also set to "Off" then the control process is stopped.

Limit relay used as an actuator

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

6.12 Control

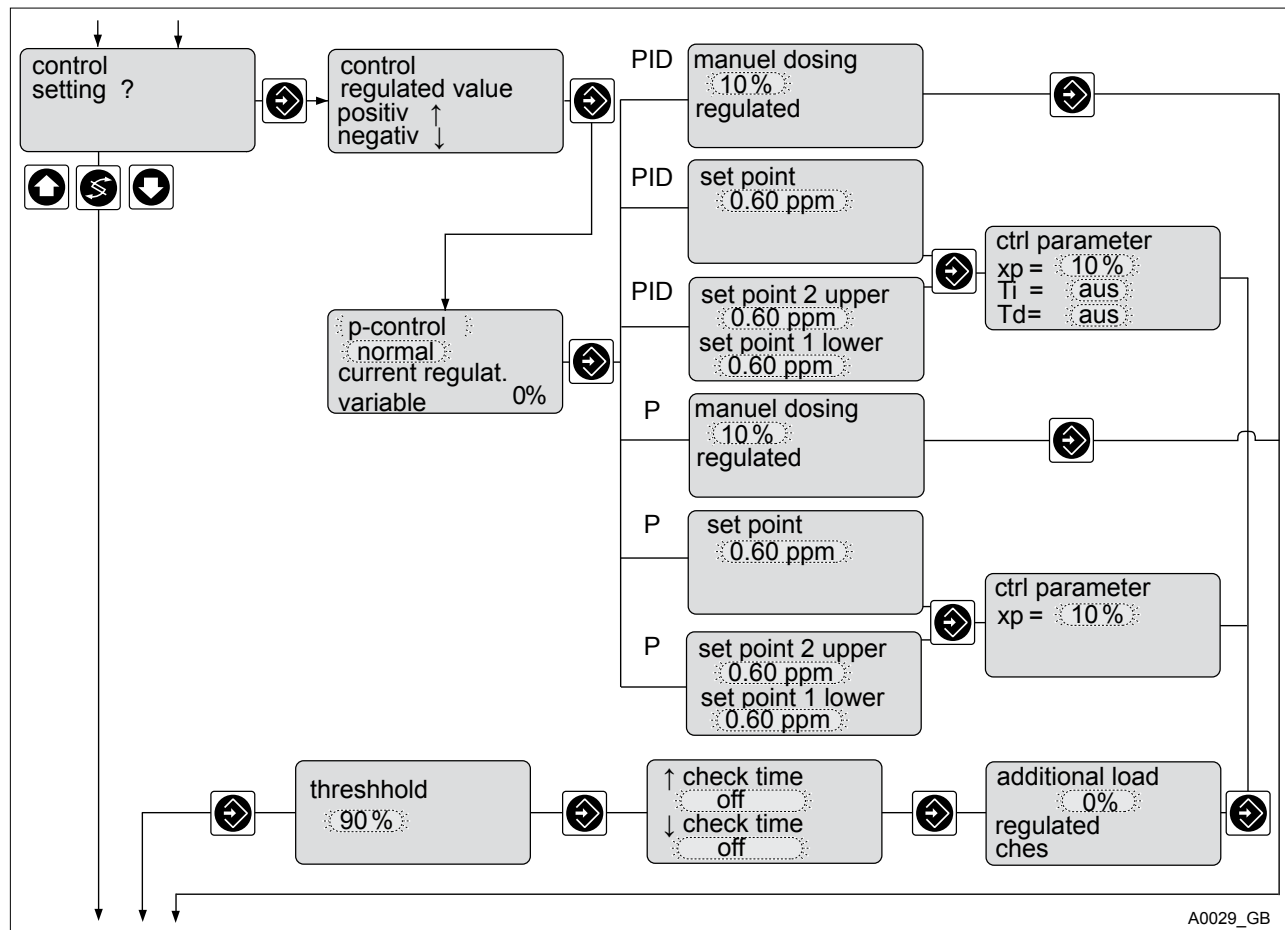


Fig. 35: Control

With control with a dead zone, the actuating variable does not change with readings within the dead zone. The setting ranges are specified by the DULCOMETER® D1Cb .

Explanations on this are provided in the glossary at the end of these assembly and operating instructions.

6.13 Interference variable

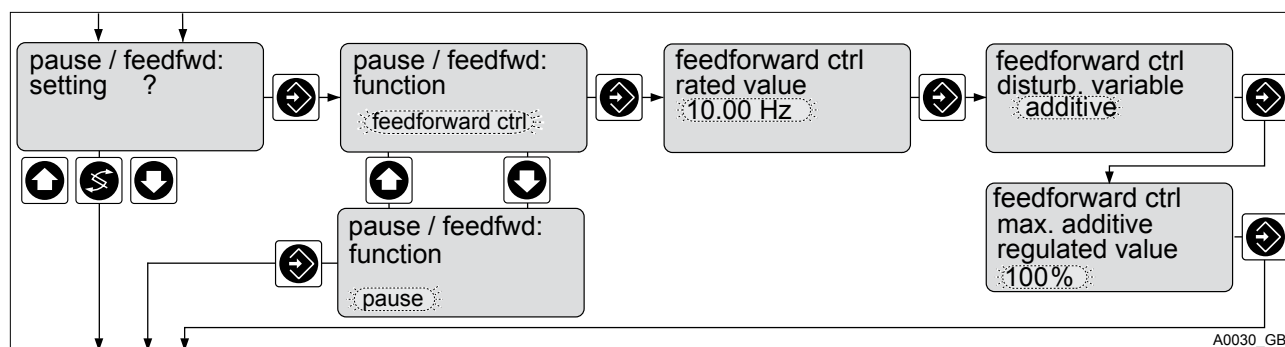


Fig. 36: Interference variable

Amperometric Measured Variables and Operating Menus

The DULCOMETER® D1Cb can, for example, process a signal from a flow measurement as an interference variable. This interference variable affects the actuating variable calculated by the DULCOMETER® D1Cb as a function of this external signal.

Depending of the nature of the effect on the actuating variable, it is referred to either as a

- multiplicative interference variable (flow-proportional effect) or an
- additive interference variable (interference variable-related effect)

The interference variable signal is in the form of a digital contact signal with a maximum frequency of up to 500 Hz (depending on the identity code and settings).

When "commissioning" the zero point signal of the flow gauge has to be checked without flow (must be ≥ 0).

		Possible values			
	Factory setting	Increment	Lower value	Upper value	Remarks
Interference variable (flow)	depending on identity code	none			Signal processing
Interference variable (flow)		1	1 Hz	500 Hz	Signal <0.02 Hz= no flow
Interference variable nominal value		1	0 Hz	500 Hz	Depending on signal type Maximum limit of range used
Interference variable: interference effect		Multiplicative Additive			
Max. additive actuating variable	100 %	1 %	0 %	+100 %	Only with additive actuating variable

6.14 Standard signal output

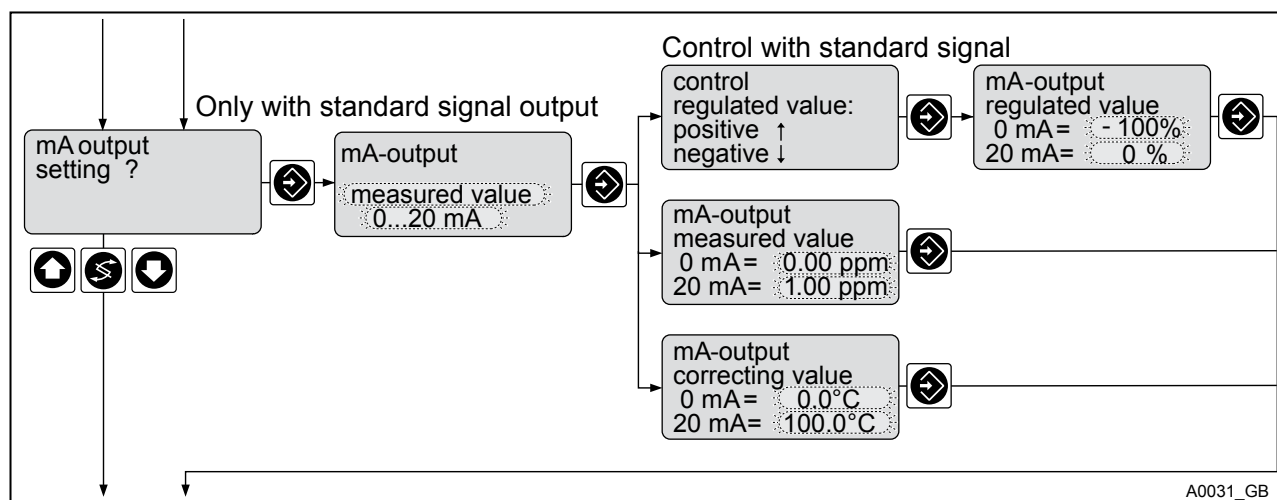


Fig. 37: Standard signal output

Amperometric Measured Variables and Operating Menus

		Possible values			
	Factory setting	Increment	Lower value	Upper value	Remarks
Assignment of variable	Reading	Reading Actuating variable Correction value			Possible if control unit present Only possible with correction variable
Starting range	0 – 20 mA	0-20 mA 4-20 mA 3.6/4-20 mA	0.1 Hz	10 Hz	Lower to 3.6 mA If alarm relay switches (not transgression of limit value)
Reading range	0 – 1 ppm	0.01 ppm	0 ppm	Upper limit of measuring range	Minimum range 0.1 ppm
Actuating variable range	-100 % - 0 %	1 %	-100 %	+ 100%	Minimum range 1 %
Correction value range	0 – 100 °C	0.1 °C	0 °C	100 °C	Minimum range 1 °C

6.15 General settings

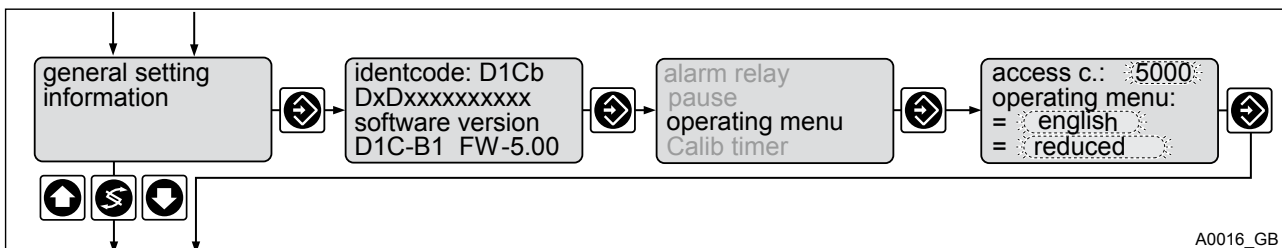


Fig. 38: General settings

6.15.1 Measured Variable/Measuring Range



WARNING!

Incorrect metering due to incorrect metering range

Possible consequence: Fatal or very serious injuries

- If the assignment of the measuring range is modified, the settings must be checked in all menus
- If the assignment of the measuring range is changed, the sensor must be recalibrated
- The measuring range of the sensor is essential for the measuring range!

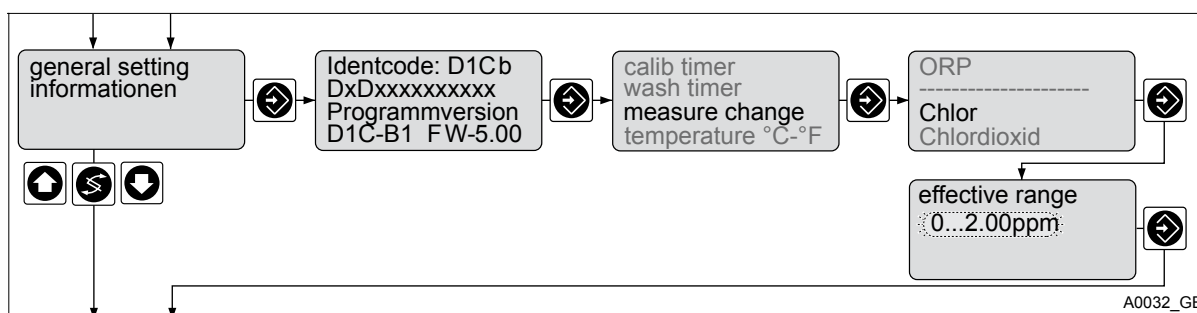


Fig. 39: Measuring range

In the "Change measured variable" setting range, it is possible to select the measured variable required for the respective process and suitable for the sensor. Depending on the measured variable, different setting windows have to be completed, which are provided by the DULCOMETER® D1Cb software. The values are set, selected and confirmed using keys , , and .

6.15.2 Sub-Functions - General Settings



Setting ranges

The setting ranges of the "General Settings" sub-functions are specified and limited by the DULCOMETER® D1Cb software

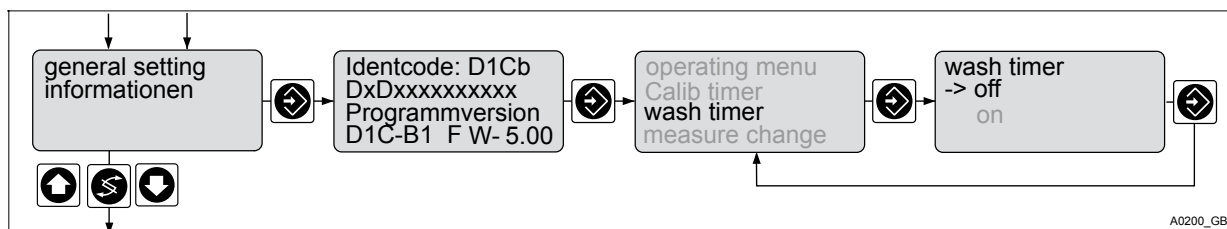


Fig. 40: Supplementary functions

The respective value required for the current measuring process can be set using the , , and keys.

The following sub-functions can be found in the "General Settings" menu item.

6.15.2.1 Operating Menu

Operating Menu

In the "Operating Menu" menu item, the language in which the operating menu is displayed can be selected and it is also possible to select between a "reduced" and "complete" operating menu. An access code is necessary for the complete operating menu.



↳ Chapter 5.6 "Operating Schematics" on page 34

6.15.2.2 Calibration Timer

The calibration timer reminds the user of a routinely necessary calibration. The calibration timer is activated by inputting a number of days. Recalibration is necessary at the end of this period.

The calibration timer serves to remind the device operator that the connected sensors need to be recalibrated. The time is thus not based directly on the state of the sensors but on the expiry of a period of time set by the operator. If the calibration timer is enabled, an interval of between 1 and 100 days can be entered. If the calibration timer is activated and if the menu is called up again, the remaining period of time until the timer runs out is shown by way of information. A remaining time of less than one day is shown in "hours".

Resetting the timer: The calibration timer is automatically reset to its initial value following a successful calibration. Any possible display message disappears.

"Snooze" mode: If the calibration timer has expired, the message on the display can be acknowledged for a period of 15 minutes by pressing the  button. The message "Calibration timer" will reappear. The  key has to be pressed for as long as the "Calibration timer" message is visible. If another message is shown alternately, it is necessary to wait until the "Calibration timer" message reappears. Any fault messages have priority.

6.15.2.3 Calibration Logbook

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


The following data is stored:

- Time of calibration (as per the operating hour counter)
- Zero point (without unit)
- Gradient (without unit)

6.15.2.4 Sensor Monitoring (pH Sensor mV Only)

With configured pH measured variables, it is possible to monitor a sensor connected to the potentiometric input for fault statuses. This check is disabled as standard.

Monitoring for sensor breakage: The sensor breakage check (glass breakage) can identify a defective sensor by means of its low internal resistance. Correctly functioning pH sensors are highly ohmic with internal resistances in the high MΩ range. The DULCOMETER® D1Cb is capable of recognising broken sensors by means of their internal resistance. This function should be deactivated if very low ohmic sensors are used.

Refer also to:  *Table on page 85*



Check for availability: The "Check for availability" identifies a disconnected sensor or a broken cable. This function should be disabled if pH sensors are used, which have a high internal resistance across their entire operating range.

6.15.2.5 Washing Timer

The washing timer serves to remind the operator of the DULCOMETER® D1Cb that the connected sensors require cleaning. The time is thus not based directly on the state of the sensors but on the expiry of a period of time set by the operator.

The "Washing timer" entry can be found in the system menu. The washing timer can be enabled and disabled in this menu. If the washing timer is enabled, an interval of between 1 and 100 days can be entered. If the washing timer is enabled and if the menu is called up again, the remaining period of time until the timer runs out is shown for information. A remaining time of less than one day is shown in "hours".

Resetting the timer: once the washing timer period has expired, it can be reset in the associated menu.

"Snooze" mode: if the washing timer has expired, the message on the display can be acknowledged for a period of 15 minutes by pressing the  button. The message "Washing timer" will reappear. The  key has to be pressed for as long as the "Washing timer" message is visible. If another message is shown alternately, it is necessary to wait until the "Washing timer" message reappears. Any fault messages have priority.

6.15.2.6 Operating Hour Counter

The DULCOMETER® D1Cb has a non-resettable operating hour counter.

"Operating hours" menu item. The operating hour counter has an accuracy of one minute and a maximum fault in the event of power failure of 5 minutes. The operating hour counter cannot be reset.

6.15.2.7 Pause

"Hold" and "Normal" pause functions

Detailed explanations on the ["Hold"] and ["Normal"] pause functions can be found in the glossary accompanying these instructions.

6.15.2.8 Software Version

Software Version

Under ["Software Version"], the version of the software currently installed and the revision of the DULCOMETER® D1Cb hardware is shown.

6.15.2.9 Additional Functions

Additional Functions

In the "Additional Functions" menu item, the scope of the DULCOMETER® D1Cb functions can be changed by inputting an optionally available enabling code. ↗ *"Extended functions" on page 29*

6.15.2.10 Temperature

Temperature

In the "Temperature" menu item, the unit in which the temperature is displayed can be switched between °C and °F.

6.15.2.11 Change Measured Variable

Change Measured Variable

In the "Change Measured Variable" menu item are listed all of the measured variables which can be enabled by the enabling code.
↳ *Chapter 6.15.1 "Measured Variable/Measuring Range" on page 52*

6.15.2.12 Alarm Relay

Alarm Relay

The alarm relay signals, together with the Σ and a fault message, that there is a fault. This may consist of a:

- general device fault
- power failure: the relay is activated if voltage is supplied to the control unit and there is no fault. If the voltage is disconnected, then the relay is deactivated
- upper and lower limits of measuring range breached
- limit transgression, even without limit relay, if the control time is set to "limit value > 0 s"
- sensor failure with pH (short circuit or no sensor connected)
- overload/short circuit at mA sensor input
- if the Pause input is enabled

7 Potentiometric Measured Variables and Operating Menus

7.1 Operating Menu

The DULCOMETER® D1Cb allows settings to be made in two different comprehensive menus. All of the parameters of the controller are preset and can be changed in the complete operating menu.

The controller is delivered with a reduced operating menu. If adjustments are necessary, the parameters can be accessed by switching to the complete operating menu.

7.2 Description of All pH/Redox Measured Variables

pH measured variable	Typical measuring range
Measuring range	- 500 mV ... + 500 mV
Display range	At least pH -1.45 ... 15.45
Reference temperature	+25°C
Resolution	0.01 pH
Measured deviation of display	<0.5% of measuring range
Deviation of display/signal output	<0.25% of measuring range
Repeat accuracy	<0.25% of measuring range

Redox measured variable	Typical measuring range
Measuring range	-1000 mV ... + 1000 mV
Resolution	1 mV
Measured deviation of display	<0.5% of measuring range
Deviation of display/signal output	<0.25% of measuring range
Repeat accuracy	<0.25% of measuring range

7.3 Reduced pH/redox operating menu

The reduced operating menu allows the key parameters to be operated. The following overview shows the settings that can be selected:

Potentiometric Measured Variables and Operating Menus

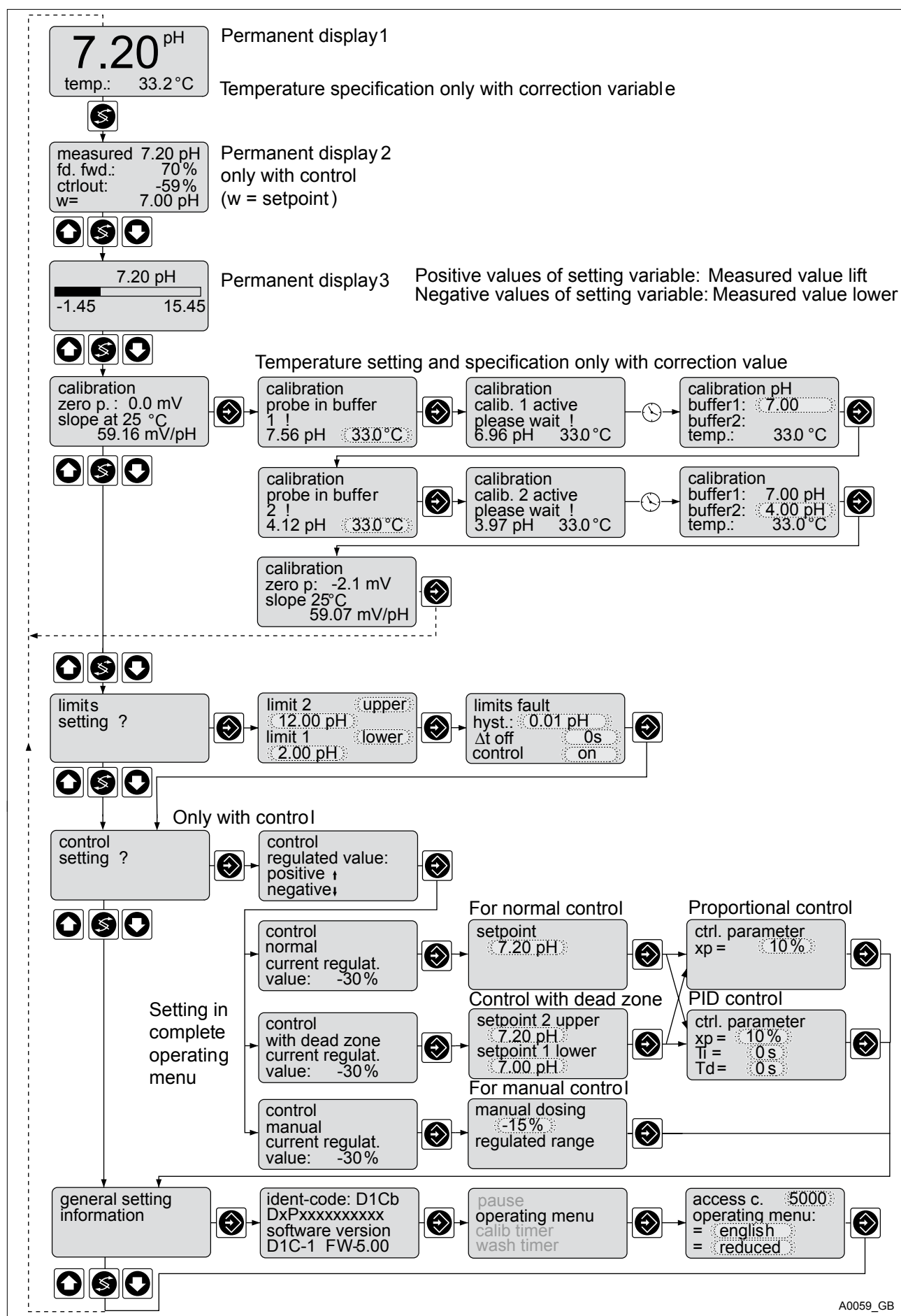


Fig. 41: Reduced pH/redox operating menu

7.4 Complete Operating Menu/Description of pH/Redox

The complete operating menu allows all parameters of the DULCOMETER® D1Cb. to be set. The following overview shows the settings that can be selected.

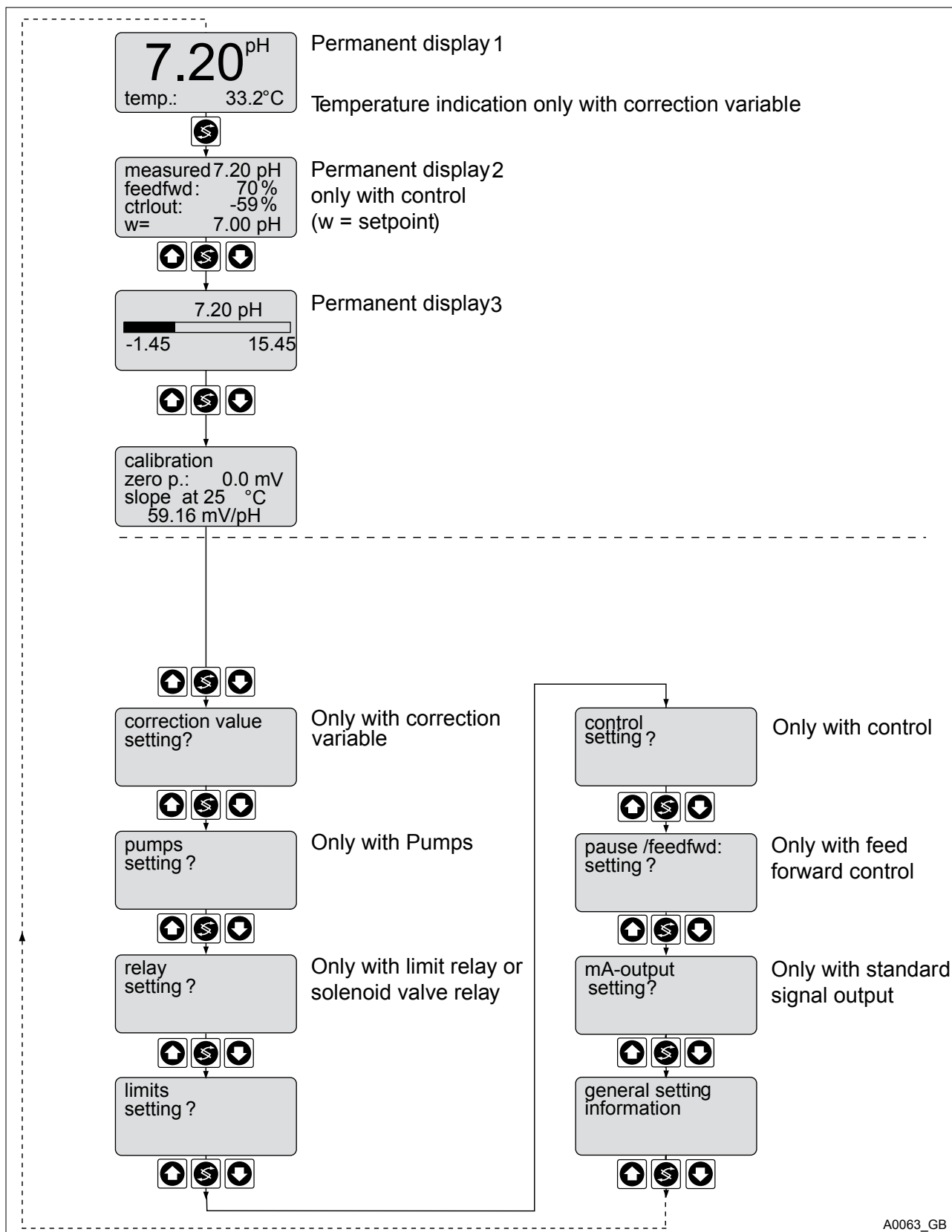


Fig. 42: Complete pH/redox operating menu

7.5 Calibration

pH / Redox



CAUTION!

Correct sensor operation / Run-in time

Damage to the product or its surroundings

- Correct measuring and metering is only possible if the sensor is working perfectly
- Please read the operating instructions for the sensor
- It is imperative that the run-in times of the sensors are adhered to
- The run-in times should be allowed for when planning initial operation
- It may take a whole working day to run-in the sensor

The DULCOMETER® D1Cb sets the actuating outputs to "0". The exception to this is if the a basic load or a manual actuating variable has been set. This remains active. The mA standard signal outputs are frozen.

When calibration/testing has been completed successfully, all of the fault checks relating to the reading are restarted. The DULCOMETER® D1Cb stores the recorded zero point and gradient data.

pH Calibration

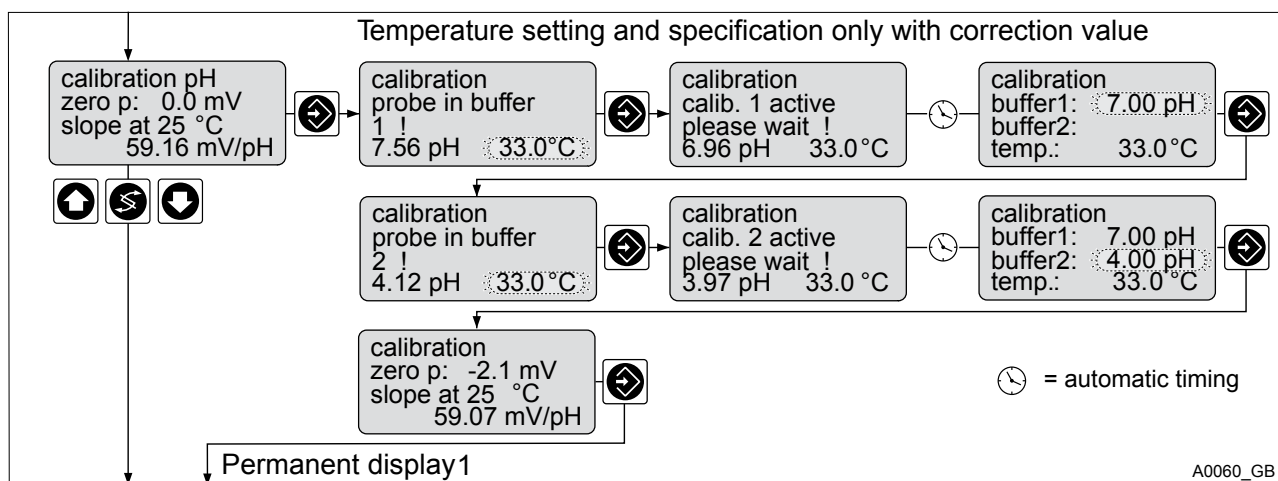


Fig. 43: pH Calibration

7.5.1 Description of pH Calibration

7.5.1.1 2-Point Calibration












2-Point Calibration

Recommended as the standard method

Description of pH calibration 2-point calibration

Two test containers with a buffer solution are required for calibration. The pH value of the buffer solutions should be at least 2 pH values apart. The sensor should be rinsed thoroughly with water when changing the buffer solution.

1. ➤ Select Calibration menu 
2. ➤ Immerse sensor in test container 1 with buffer solution (e.g. pH 7)
3. ➤ Move the sensor gently until the pH value displayed no longer changes
4. ➤ Then press 
 - ⇒ Calibration is running
5. ➤ If necessary adjust the pH value displayed using keys  and  to the value of the buffer solution in test container 1
6. ➤ Then press 
7. ➤ Remove the sensor, rinse thoroughly in water and then dry with a cloth (pad dry, don't rub!)
8. ➤ Immerse sensor in test container 2 with buffer solution (e.g. pH 4)
9. ➤ Move the sensor gently until the pH value displayed no longer changes
10. ➤ Then press 
 - ⇒ Calibration is running
11. ➤ If necessary adjust the pH value displayed using keys  and  to the value of the buffer solution in test container 2
12. ➤ Then press 
 - ⇒ The settings recorded will be displayed.

7.5.1.2 1-Point Calibration









1-Point Calibration

Recommended only for special applications e.g. swimming pool water

Description of pH calibration 1-point calibration

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

1. ➤ Select Calibration menu 
2. ➤ Immerse the sensor in the test container with buffer solution (e.g. pH 7)
3. ➤ Move the sensor gently until the pH value displayed no longer changes
4. ➤ Then press 
 - ⇒ Calibration is running
5. ➤ If necessary adjust the pH value displayed using keys  and  to the value of the buffer solution in the test container
6. ➤ Then press 
7. ➤ Then press 
 - ⇒ The settings recorded will be displayed.

7.5.2 pH Calibration Tables

Setting		Possible values			
	Starting value	Increment	Lower value	Upper value	Remarks
Calibration temperature	Reading	0.1 °C	0 °C	100 °C	
Buffer values	Reading (whole digit rounded up)	0.01 pH	-1.45 pH	15.45 pH	Fault message if the two buffers are too close (<2 pH values)

Fault message	Condition	Effect	
Buffer gap too small	$\Delta\text{buffer} < 2 \text{ pH}$	During the calibration process: recalibrate buffer 2!	
		Back to permanent display	
pH zero point low	$< -60 \text{ mV}$	Basic load metering	Note: old zero point and gradient remain
pH zero point high	$> +60 \text{ mV}$	Basic load metering	Note: old zero point and gradient remain
pH gradient low	$< 40 \text{ mV/pH}$	Basic load metering	Note: old zero point and gradient remain
pH gradient high	$> 65 \text{ mV/pH}$	Basic load metering	Note: old zero point and gradient remain
pH reading unsteady			Note: old zero point and gradient remain
°C reading unsteady			Note: old zero point and gradient remain

The following applies to all fault messages: eliminate the source of the fault and repeat calibration.

7.5.3 Testing Redox



NOTICE!

Testing redox sensor

With redox measured variables, the sensor is not calibrated but tested according to its design

Notification of abnormal behaviour

- Observe any notification of abnormal behaviour when testing the redox sensor
- Should the test not be successful then replace the redox sensor

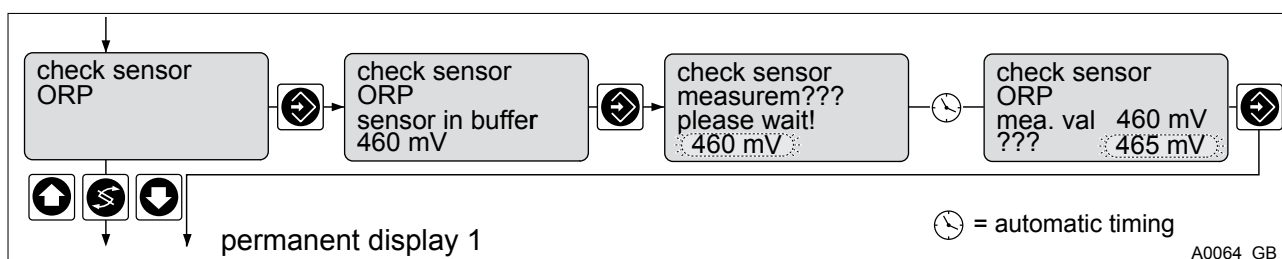


Fig. 44: Testing redox sensor

7.5.3.1 Description of Redox Sensor Test

Testing redox sensor

A container with a redox buffer solution (e.g. 465 mV) is needed for testing.

1. ➤ Select the Test menu
2. ➤ Immerse redox sensor in the test container with redox buffer solution (e.g. 465 mV)
3. ➤ Start test with
 - ⇒ Test is running
4. ➤ Adjust displayed value of "buffer" (flashing) using , and to the mV value of the redox buffer solution in the test container and confirm the value with
 - ⇒ The D1Cb displays the status message of the redox sensor in plain text. If the redox sensor is functioning correctly, permanent display 1 will be displayed directly
5. ➤ If the redox sensor is unclean or defective, the redox sensor should then be cleaned, as described in the redox sensor operating instructions, or alternatively replaced

7.5.3.2 Redox Test Tables

		Possible values			
Setting	Starting value	Increment	Lower value	Upper value	Remarks
Buffer values	Reading	1 mV	-1500 mV	+1500 mV	
185-265 mV	220 mV				
425-505 mV	465 mV				

Fault message	Condition	Effect
Reading high	Reading	Back to permanent display
	40 mV > buffer	Basic load metering
Reading low	Reading	Back to permanent display
	40 mV < buffer	Basic load metering

7.6 pH Redox Reading

7.6.1 pH Reading

pH Reading

		Possible values			
	Factory setting	Increment	Lower value	Upper value	Remarks
Assigned pH value	15.45 pH to -1.45 pH	0.01 pH	-3.13 pH	17.14 pH	

7.6.2 Redox Reading

Redox Reading

		Possible values			
	Factory setting	Increment	Lower value	Upper value	Remarks
Assigned sensor voltage	0 – 1 V	1 mV	-100 mV	+1100 mV	

7.7 pH / Redox correction value

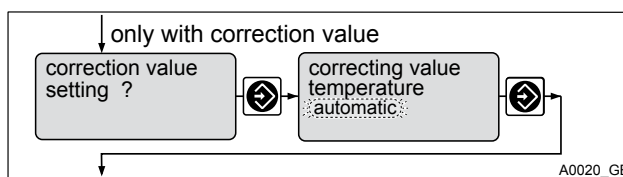


Fig. 45: pH / Redox correction value

Redox correction value:

There is no temperature compensation of the reading. Only the temperature is displayed or a temperature-proportional mA signal is generated.

pH correction value:		Possible values			
	Factory setting	Increment	Lower value	Upper value	Remarks
Nature of temperature compensation	As per identity code	Manual Automatic off			Switchover only if identity code = Automatic
Manual temperature compensation	25 °C	0.1 °C	0 °C	100 °C	

7.8 Pumps



NOTICE!

Maximum stroke rate of pump

The pumps are activated in accordance with the actuating variable up to the maximum frequency of the respective pump

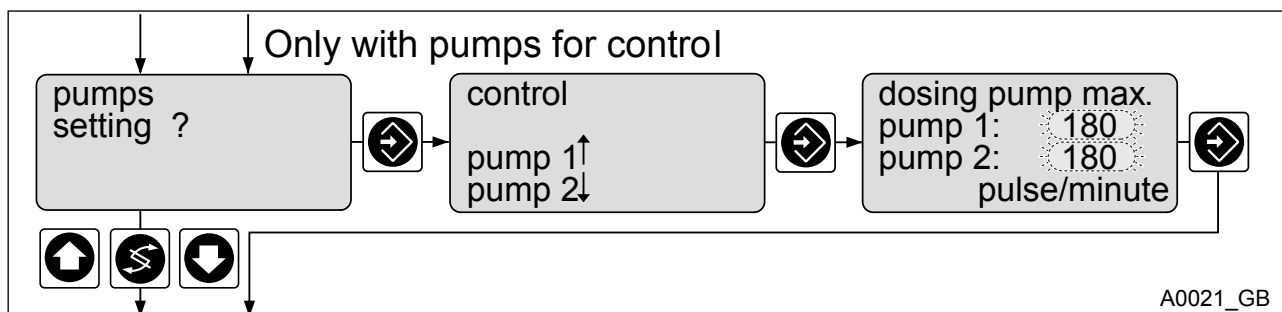


Fig. 46: Pumps

The minimum (0) and maximum (500) value of the pump strokes is specified by the controller. Critical when setting the stroke rate is the flow rate of the pump in relation to the respective process.

7.9 Relay for Activation



Limit relay used as an actuator

Extended functions

- The limit relays can also be defined in such a way that they react like an actuator. If, for example, a limit relay is activated, then it is deactivated if the pause contact is closed or for a subsequent time delay t_d (if $t_d > 0$ min is set under "General Settings").

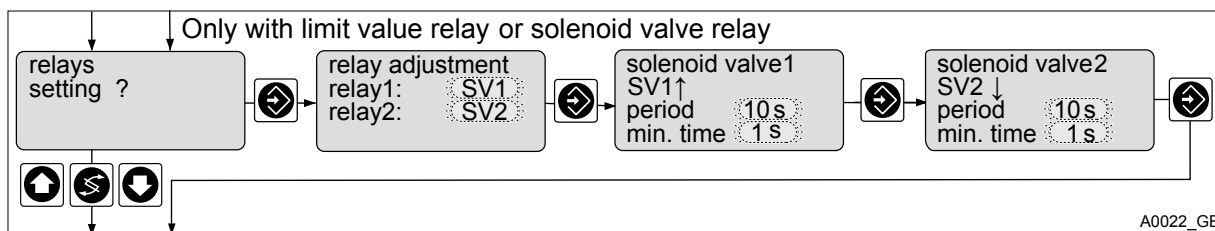


Fig. 47: Limit or solenoid valve relays

Potentiometric Measured Variables and Operating Menus

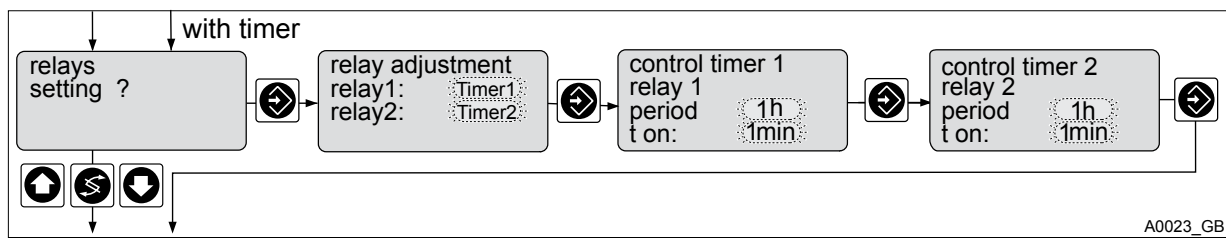


Fig. 48: With timer

		Possible values			
	Factory setting	Increment	Lower value	Upper value	Remarks
Relay assign- ment	As per identity code	Solenoid valve (MV1, MV2) Limit value (limit 1/2)* Actuator 1/2 Timer 1/2 Off			*At the limit, the relays remain activated even in the event of a malfunction
Cycle	10 s	1 s	10 s	9999 s	For solenoid valve
Min. time	1 s	1 s	1 s	Cycle/2	For solenoid valve: the smallest permis- sible switch-on period of the connected device should be set here
Cycle	Off	1 h	1 h/off	240 h	For timer
T On	1 minute	1 minute	1 minute	240 min	For timer

7.9.1 Timer relay



CAUTION!

The timer is reset when there is no supply voltage

Possible consequence: Slight or minor injuries, material damage

- Design the supply voltage in such a way that it cannot be interrupted
- With critical processes, the possible failure of the timer should be practically addressed

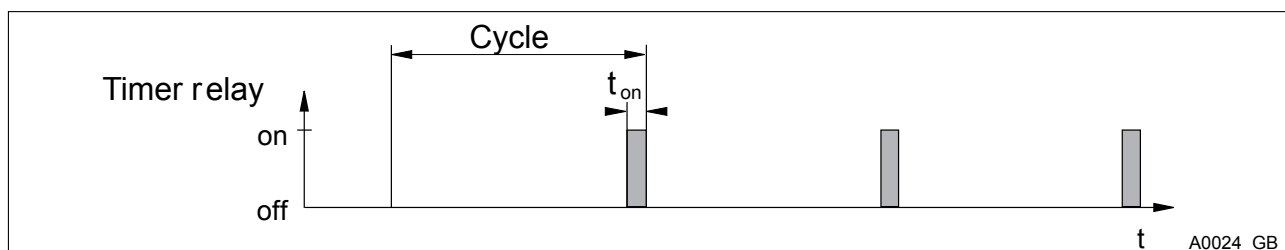


Fig. 49: Timer relay

At the end of the (timer) cycle time, the DULCOMETER® D1Cb closes the assigned timer relay for the duration of "t on" (timer). "Pause" interrupts the timer. If the clock is visible on the LCD display, then the timer can be reset to the beginning of the cycle using the input key. The % figure on the LCD display indicates the progress of the current cycle. % figure = remaining runtime.

7.9.2 Solenoid valves

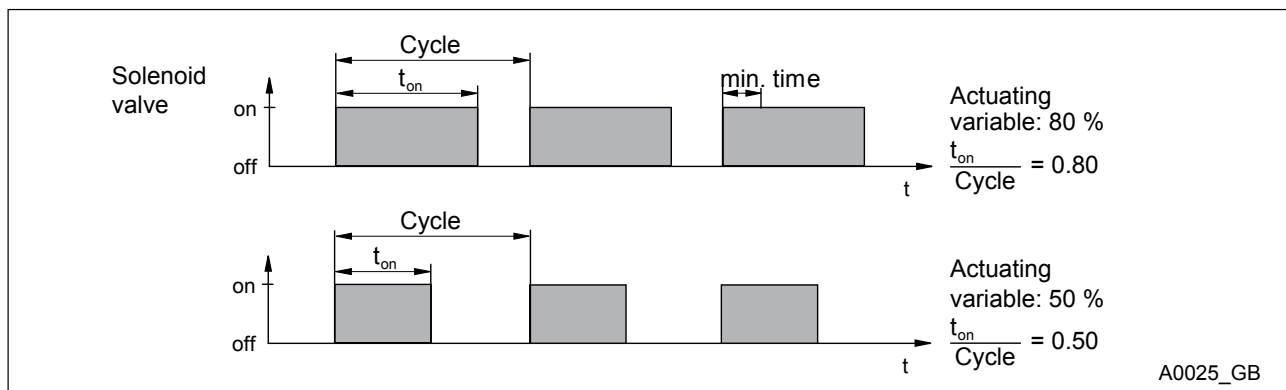


Fig. 50: Solenoid valves

7.9.3 Switching Times

The switching times of the DULCOMETER® D1Cb (solenoid valve) depend on the cycle time and on the "minimum time" (smallest permissible switching time of the connected device). The actuating variable determines the ratio $t_{on}/cycle$ and thus also the switching times. The "min. time" affects the switching times in two situations:

Theoretical switching time < min. time:

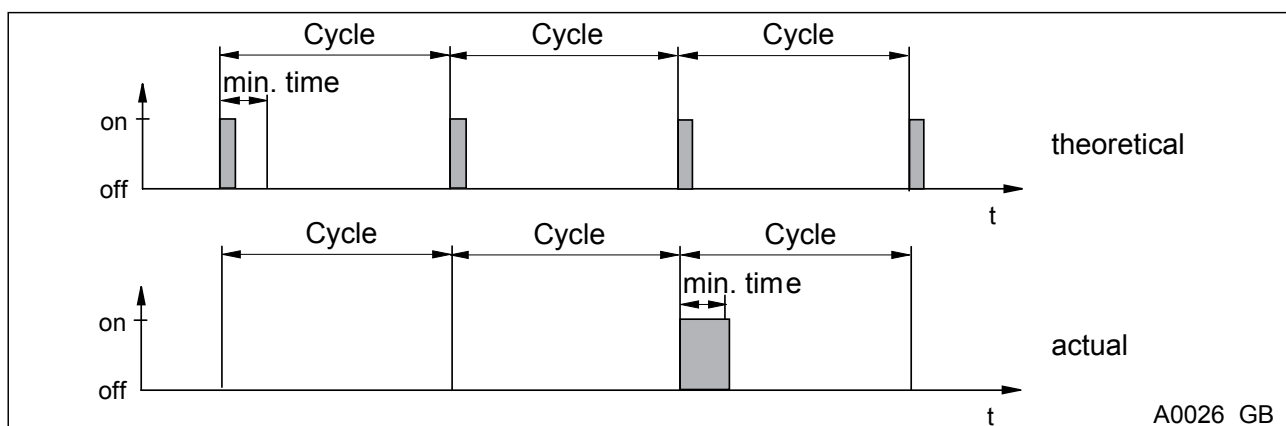


Fig. 51: Theoretical switching time < min. time

The DULCOMETER® D1Cb does not switch on for a certain number of cycles until the sum of the theoretical switching times exceeds the "min. time". Then it switches for the duration of this total time.

Theoretical switching time > (cycle - min. time):

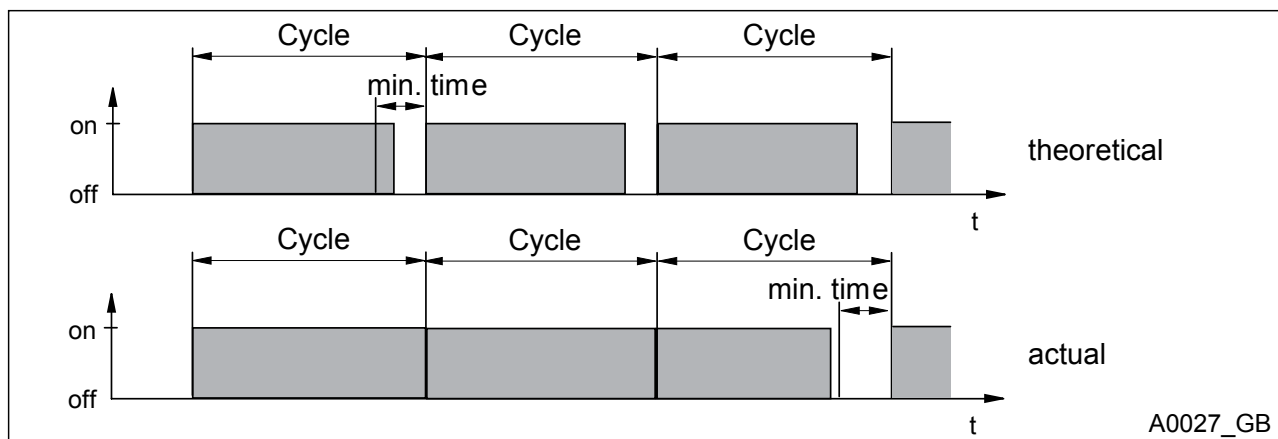


Fig. 52: Theoretical switching time > (cycle - min. time) and calculated switching time < cycle

The DULCOMETER® D1Cb does not switch off for a certain number of cycles until the differences between the cycle and the theoretical switching time exceed the "min. time".

7.10 pH / Redox limits

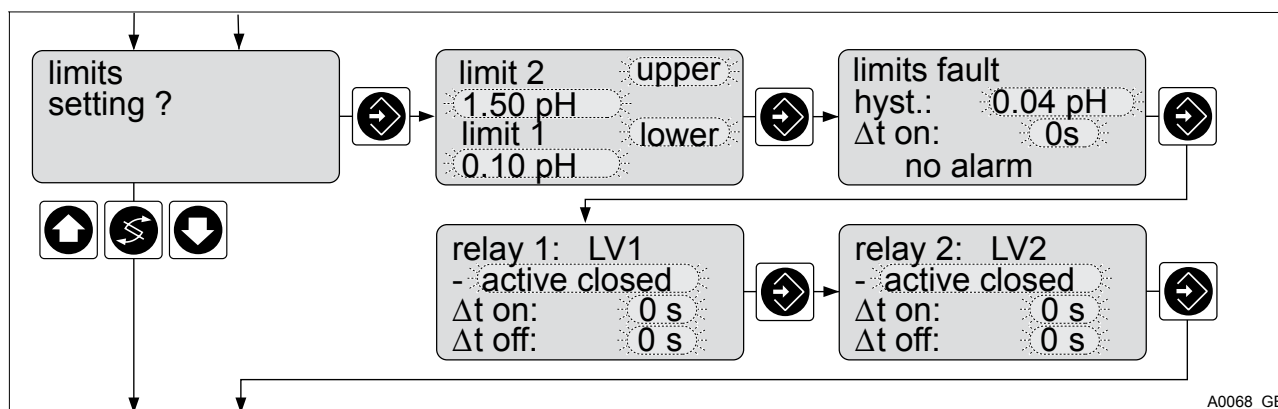


Fig. 53: pH / Redox limits

pH limits:		Possible values			Remarks
	Factory setting	Increment	Lower value	Upper value	
Type of limit transgression					Limit transgression by exceeding or dropping below limits
Limit 1	Lower	Lower / Upper / Off	Lower	Upper	
Limit 2	Upper	Lower / Upper / Off	Lower	Upper	
Limit value Limit 1	pH 1.93	pH 0.01	pH -3.13	pH 17.14	
Limit value Limit 2	pH 12.07	pH 0.01	pH -3.13	pH 17.14	
Hysteresis limit	pH 0.33	pH 0.01	pH 0.00	pH 20.27	Effective in the direction of cancelling limit transgression

Potentiometric Measured Variables and Operating Menus

pH limits:		Possible values			
	Factory setting	Increment	Lower value	Upper value	Remarks
Control time limits t on	Off	1 s	1 s	9999 s	Results in message and alarm, Off = 0 s, function switched off, no message, no alarm
Control	On	on off			
Switching direction limit 1	Active closed	Active closed / Active open			Reacts like a closer
Switching direction limit 2	Active closed	Active closed / Active open			Reacts like an opener
Switch-on delay on	0 s	1 s	0 s	9999 s	
Switch-off delay off	0 s	1 s	0 s	9999 s	

"Limit 1 lower" means that the limit criterion has been transgressed by dropping below the lower limit

"Limit 2 upper" means that the limit criterion has been transgressed by exceeding the upper limit

The DULCOMETER® D1Cb has the option of defining "hysteresis limits".

The "hysteresis" works towards rectifying the limit transgression, i.e. the "limit 1 upper" of pH 7.5 has been exceeded at a set hysteresis limit of pH 0.20, thus the criterion for limit transgression is redundant when the value drops below the lower limit of pH 7.3. The hysteresis behaviour for a "lower limit" functions in a similar way (the hysteresis value is added to the limit). In this way it is possible to forego an external relay in self-retaining mode. The control behaviour is not affected.

If the limit is exceeded for longer than the "Time delay - limit values", then a fault message will be triggered that has to be acknowledged and the alarm relay is deactivated; if "Control" is set to "Off" then the control process will stop.

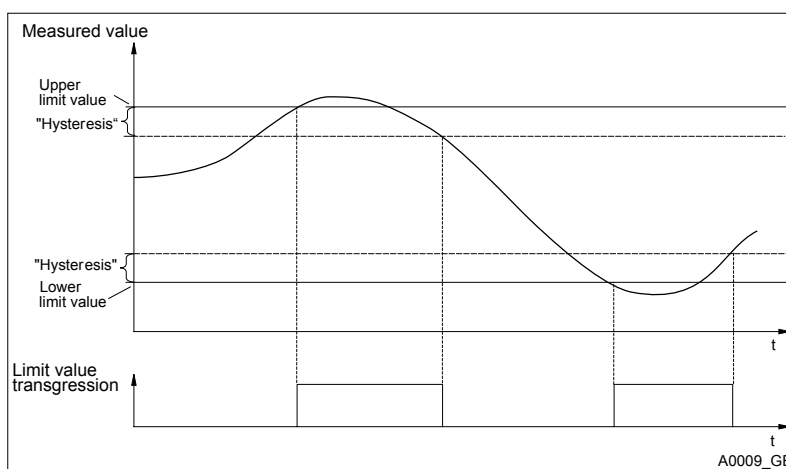


Fig. 54: Hysteresis

If there are limit relays, which are defined as limit relays, they will also switch to the alarm relay when a limit is transgressed and the direction of the limit transgression will be shown on the display by the \uparrow or \downarrow symbols.

Different on-delays (Δt On) and fall-delays (Δt Off) can be set as hystereses for the limit relays for limit 1 and limit 2. These prevent the limit relay from switching back and forward if the limit is only exceeded for a short time (damping function).

If there are no limit relays, the limits can nevertheless be entered. The DULCOMETER® D1Cb shows the reactions described when a limit is transgressed

Limit relay used as actuator:

If the limit relays are defined to react as actuators, then they react in the same way as actuating outputs. For example in the event of Pause being activated or in the event of an alarm, an activated limit relay will be deactivated.

Redox limit:		Possible values			
	Factory setting	Increment	Lower value	Upper value	Remarks
Type of limit transgression					Limit transgression at upper or lower limit
Limit 1	Lower	Lower / Upper / Off	Lower	Upper	
Limit 2	Upper	Lower / Upper / Off	Lower	Upper	
Limit value Limit 1	-600 mV	1 mV	-1200 mV	+1200 mV	
Limit value Limit 2	+600 mV	1 mV	-1200 mV	+1200 mV	
Hysteresis limit	40 mV	1 mV	0 mV	+2400 mV	Effective in the direction of cancelling limit transgression

Potentiometric Measured Variables and Operating Menus

Redox limit:		Possible values			
	Factory setting	Increment	Lower value	Upper value	Remarks
Control time limits t on	Off	1 s	1 s	9999 s	Results in message and alarm, Off = 0 s, function switched off No message, no alarm
Control	On	on off			
Switching direction limit 1	Active closed	Active closed / Active open			Reacts like a closer
Switching direction limit 2	Active closed	Active closed / Active open			Reacts like an opener
Switch-on delay on	0 s	1 s	0 s	9999 s	
Switch-off delay off	0 s	1 s	0 s	9999 s	

If the limit is exceeded for longer than the "Delay time of limits", then a fault message will be triggered that has to be acknowledged and the alarm relay is deactivated. If the "controller" is also set to "Off" then the control process is stopped.

7.11 Control of pH and redox variables

pH and Redox



NOTICE!

Compensation for control deviations

Damage to the product or its surroundings

- The DULCOMETER® D1Cb cannot be used in control circuits, which require quick compensation

Potentiometric Measured Variables and Operating Menus

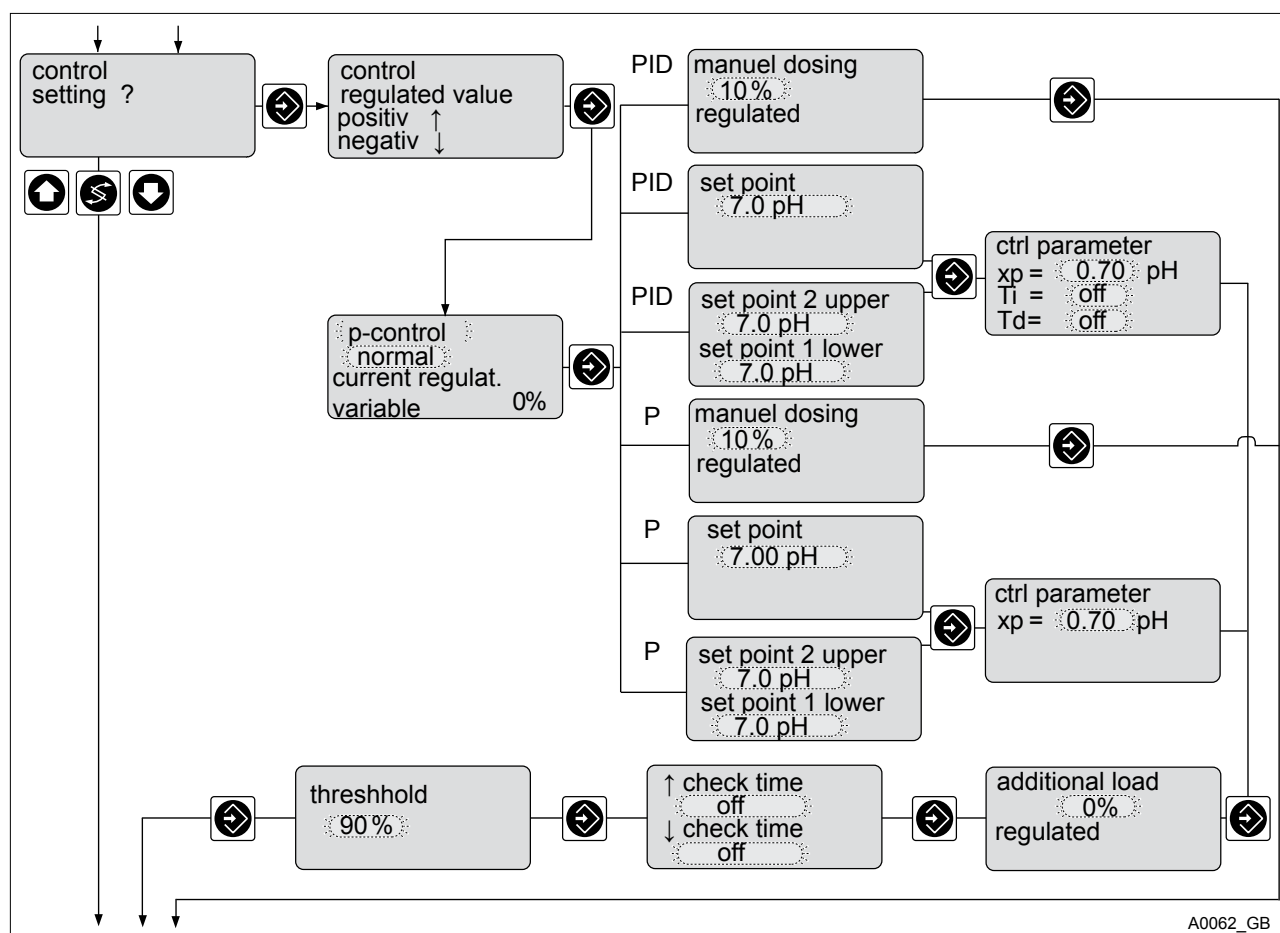


Fig. 55: Control of pH and redox variables

With control with a dead zone, the actuating variable does not change with readings within the dead zone. The setting ranges are specified by the DULCOMETER® D1Cb .

Explanations on this are provided in the glossary at the end of these assembly and operating instructions.

pH Control:					
	Factory setting	Possible values			Remarks
		Increment	Lower value	Upper value	
Set point	pH 7	0.01 pH	0 pH	14 pH	With control with dead zone 2 set points required Set point 1 < set point 2
Control parameter XP	pH 0.70	0,01%	-3.13 pH	17.14 pH	
Control parameter Tn	off	1 s	0 s	9999 s	Function off = 0 s

Potentiometric Measured Variables and Operating Menus

pH Control:					
	Possible values				
	Factory setting	Increment	Lower value	Upper value	Remarks
Control parameter Tv	off	1 s	0 s	2500 s	Function off = 0 s
Manual metering	0%	1 %	-100 %	100 %	
Redox control					
	Possible values				
	Factory setting	Increment	Lower value	Upper value	Remarks
Set point	750 mV	1 mV	-1200 mV	+1200 mV	With control with dead zone 2 set points required Set point 1 < set point 2
Control parameter XP	0 mV	1 mV	-1200 mV	+1200 mV	
Control parameter Tn	off	1 s	1 s	9999 s	Function off = 0 s
Control parameter Tv	off	1 s	1 s	2500 s	Function off = 0 s
Manual metering	0%	1 %	-100 %	100 %	

7.12 Interference variable

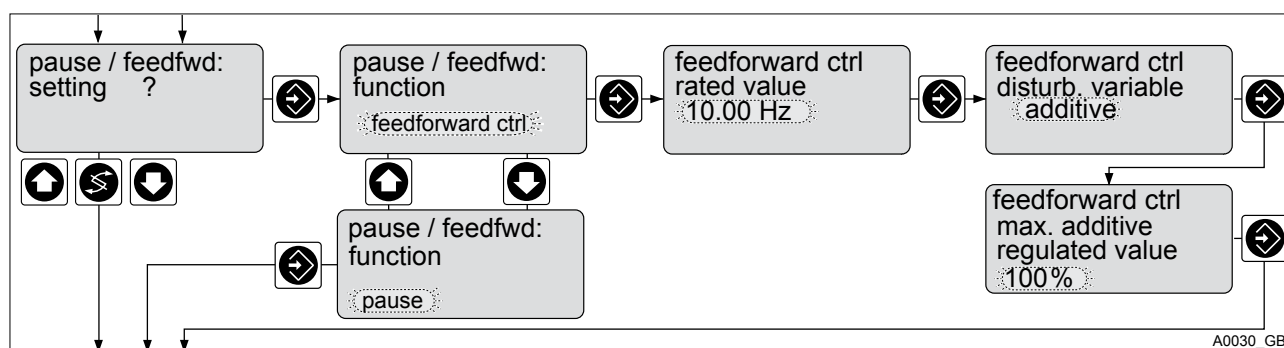


Fig. 56: Interference variable

The DULCOMETER® D1Cb can, for example, process a signal from a flow measurement as an interference variable. This interference variable affects the actuating variable calculated by the DULCOMETER® D1Cb as a function of this external signal.

Depending of the nature of the effect on the actuating variable, it is referred to either as a

Potentiometric Measured Variables and Operating Menus

- multiplicative interference variable (flow-proportional effect) or an
- additive interference variable (interference variable-related effect)

The interference variable signal is in the form of a digital contact signal with a maximum frequency of up to 500 Hz (depending on the identity code and settings).

When "commissioning" the zero point signal of the flow gauge has to be checked without flow (must be ≥ 0).

		Possible values			
	Factory setting	Increment	Lower value	Upper value	Remarks
Interference variable (flow)	depending on identity code	none			Signal processing
Interference variable (flow)		1	1 Hz	500 Hz	Signal <0.02 Hz= no flow
Interference variable nominal value		1	0 Hz	500 Hz	Depending on signal type Maximum limit of range used
Interference variable: interference effect		Multiplicative Additive			
Max. additive actuating variable	100 %	1 %	0 %	+100 %	Only with additive actuating variable

7.13 pH / Redox standard signal output

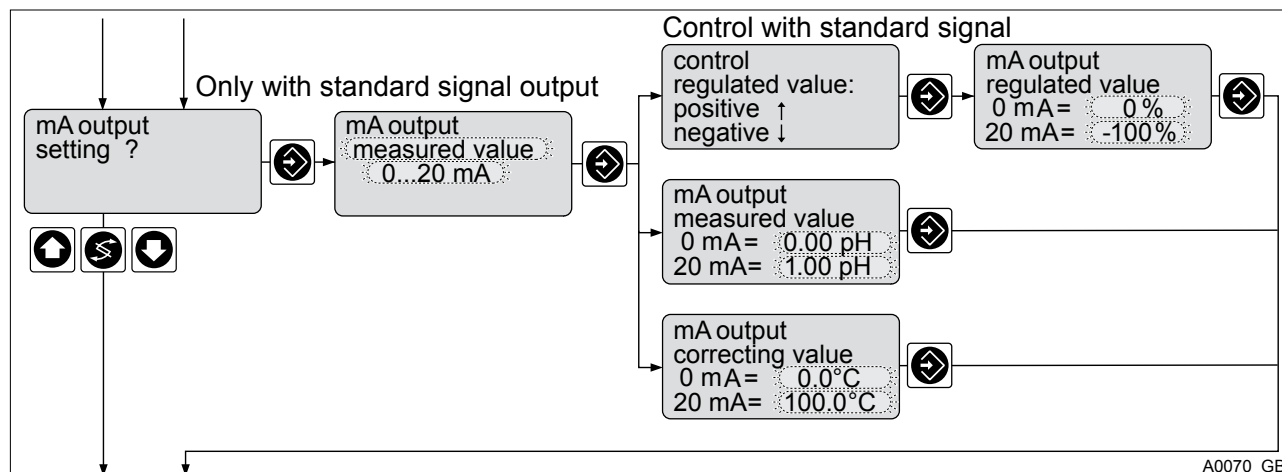


Fig. 57: pH / Redox standard signal output

pH Standard signal output:

		Possible values			
	Factory setting	Increment	Lower value	Upper value	Remarks
Assignment of variable	depending on identity code	Reading			

Potentiometric Measured Variables and Operating Menus

pH Standard signal output:					
		Possible values			
	Factory setting	Increment	Lower value	Upper value	Remarks
		Actuating variable Correction value			
Starting range	0 – 20 mA	0-20 mA 4-20 mA 3.6/4-20 mA			Reduction to 3.5 mA if alarm relay is switched (not limit transgression)
Reading range	pH -1.45 to pH 15.45	pH 0.01	pH -3.13	pH 17.14	Minimum range pH 0.1
Actuating variable range	-100 % - 0 %	1 %	-100 %	+100 %	Minimum range 1 %
Correction value range	0 – 100 °C	0.1 °C	0 °C	100 °C	Minimum range 1 °C

Redox standard signal output:					
		Possible values			
	Factory setting	Increment	Lower value	Upper value	Remarks
Assignment of variable	depending on identity code	Reading Actuating variable Correction value			
Starting range	0 – 20 mA	0-20 mA 4-20 mA 3.6/4-20 mA			Reduction to 3.5 mA if alarm relay is switched (not limit transgression)
Reading range	-1 to +1 V	1 mV	-1200 mV	+1200mV	
Actuating variable range	0%...+100%	1 %	-100 %	+100 %	Minimum range 1 %

7.14 General settings

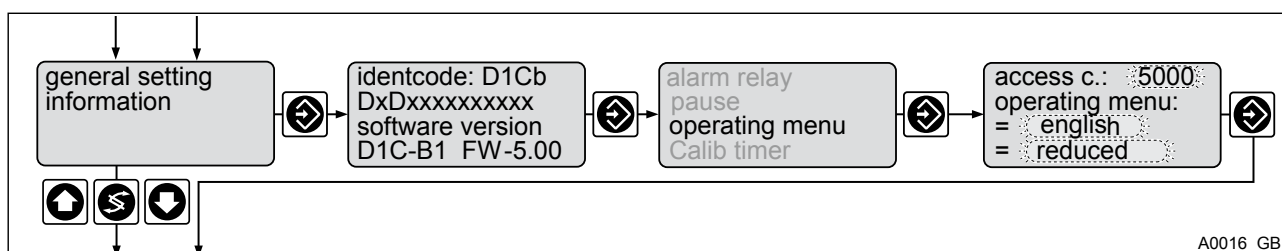


Fig. 58: General settings

7.14.1 Measured Variable/Measuring Range



WARNING!

Incorrect metering due to incorrect metering range

Possible consequence: Fatal or very serious injuries

- If the assignment of the measuring range is modified, the settings must be checked in all menus
- If the assignment of the measuring range is changed, the sensor must be recalibrated
- The measuring range of the sensor is essential for the measuring range!

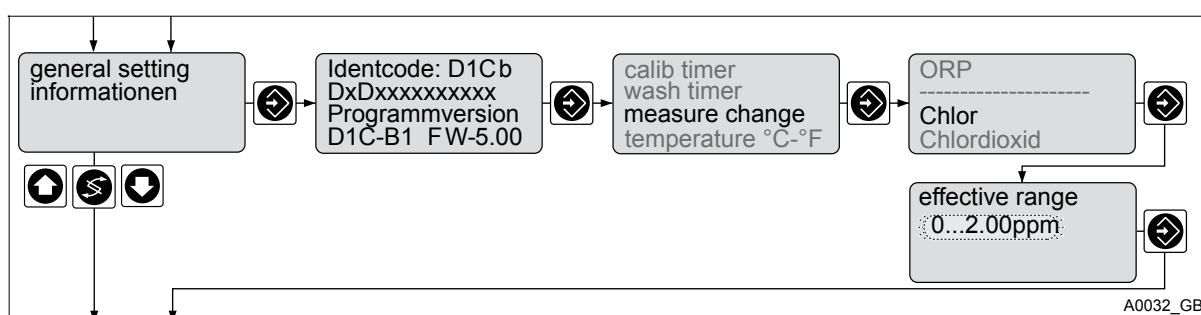






Fig. 59: Measuring range

In the "Change measured variable" setting range, it is possible to select the measured variable required for the respective process and suitable for the sensor. Depending on the measured variable, different setting windows have to be completed, which are provided by the DULCOMETER® D1Cb software. The values are set, selected and confirmed using keys , ,  and .

7.14.2 Sub-Functions - General Settings



Setting ranges

The setting ranges of the "General Settings" sub-functions are specified and limited by the DULCOMETER® D1Cb software

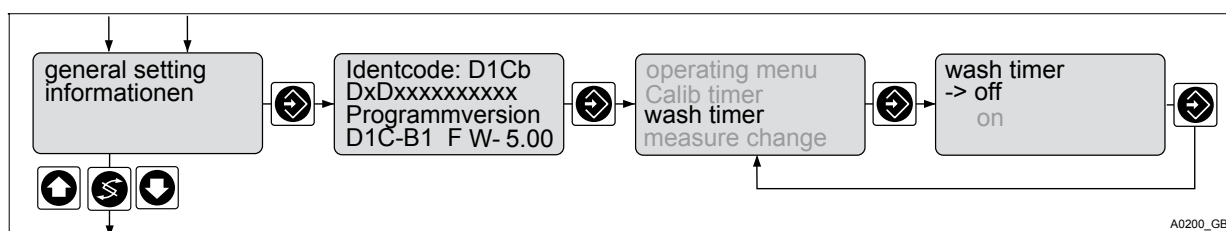


Fig. 60: Supplementary functions

The respective value required for the current measuring process can be set using the , ,  and  keys.

The following sub-functions can be found in the "General Settings" menu item.

7.14.2.1 Operating Menu

Operating Menu

In the "Operating Menu" menu item, the language in which the operating menu is displayed can be selected and it is also possible to select between a "reduced" and "complete" operating menu. An access code is necessary for the complete operating menu.



🔗 *Chapter 5.6 "Operating Schematics" on page 34*

7.14.2.2 Calibration Timer

The calibration timer reminds the user of a routinely necessary calibration. The calibration timer is activated by inputting a number of days. Recalibration is necessary at the end of this period.

The calibration timer serves to remind the device operator that the connected sensors need to be recalibrated. The time is thus not based directly on the state of the sensors but on the expiry of a period of time set by the operator. If the calibration timer is enabled, an interval of between 1 and 100 days can be entered. If the calibration timer is activated and if the menu is called up again, the remaining period of time until the timer runs out is shown by way of information. A remaining time of less than one day is shown in "hours".

Resetting the timer: The calibration timer is automatically reset to its initial value following a successful calibration. Any possible display message disappears.

"Snooze" mode: If the calibration timer has expired, the message on the display can be acknowledged for a period of 15 minutes by pressing the  button. The message "Calibration timer" will reappear. The  key has to be pressed for as long as the "Calibration timer" message is visible. If another message is shown alternately, it is necessary to wait until the "Calibration timer" message reappears. Any fault messages have priority.

7.14.2.3 Calibration Logbook

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

The following data is stored:

- Time of calibration (as per the operating hour counter)
- Zero point (without unit)
- Gradient (without unit)

7.14.2.4 Sensor Monitoring (pH Sensor mV Only)

With configured pH measured variables, it is possible to monitor a sensor connected to the potentiometric input for fault statuses. This check is disabled as standard.

Monitoring for sensor breakage: The sensor breakage check (glass breakage) can identify a defective sensor by means of its low internal resistance. Correctly functioning pH sensors are highly ohmic with internal resistances in the high MΩ range. The DULCOMETER® D1Cb is capable of recognising broken sensors by means of their internal resistance. This function should be deactivated if very low ohmic sensors are used.

Refer also to: 🔗 *Table on page 85*



Check for availability: The "Check for availability" identifies a disconnected sensor or a broken cable. This function should be disabled if pH sensors are used, which have a high internal resistance across their entire operating range.

7.14.2.5 Washing Timer

The washing timer serves to remind the operator of the DULCOMETER® D1Cb that the connected sensors require cleaning. The time is thus not based directly on the state of the sensors but on the expiry of a period of time set by the operator.

The "Washing timer" entry can be found in the system menu. The washing timer can be enabled and disabled in this menu. If the washing timer is enabled, an interval of between 1 and 100 days can be entered. If the washing timer is enabled and if the menu is called up again, the remaining period of time until the timer runs out is shown for information. A remaining time of less than one day is shown in "hours".

Resetting the timer: once the washing timer period has expired, it can be reset in the associated menu.

"Snooze" mode: if the washing timer has expired, the message on the display can be acknowledged for a period of 15 minutes by pressing the  button. The message "Washing timer" will reappear. The  key has to be pressed for as long as the "Washing timer" message is visible. If another message is shown alternately, it is necessary to wait until the "Washing timer" message reappears. Any fault messages have priority.

7.14.2.6 Operating Hour Counter

The DULCOMETER® D1Cb has a non-resettable operating hour counter.

"Operating hours" menu item. The operating hour counter has an accuracy of one minute and a maximum fault in the event of power failure of 5 minutes. The operating hour counter cannot be reset.

7.14.2.7 Pause

"Hold" and "Normal" pause functions

Detailed explanations on the *["Hold"]* and *["Normal"]* pause functions can be found in the glossary accompanying these instructions.

7.14.2.8 Software Version

Software Version

Under *["Software Version"]*, the version of the software currently installed and the revision of the DULCOMETER® D1Cb hardware is shown.

7.14.2.9 Additional Functions

Additional Functions

In the "Additional Functions" menu item, the scope of the DULCOMETER® D1Cb functions can be changed by inputting an optionally available enabling code. ↪ *"Extended functions" on page 29*

7.14.2.10 Temperature

Temperature

In the "Temperature" menu item, the unit in which the temperature is displayed can be switched between °C and °F.

7.14.2.11 Change Measured Variable

Change Measured Variable

In the "Change Measured Variable" menu item are listed all of the measured variables which can be enabled by the enabling code.
↳ *Chapter 6.15.1 "Measured Variable/Measuring Range" on page 52*

7.14.2.12 Alarm Relay

Alarm Relay

The alarm relay signals, together with the Σ and a fault message, that there is a fault. This may consist of a:

- general device fault
- power failure: the relay is activated if voltage is supplied to the control unit and there is no fault. If the voltage is disconnected, then the relay is deactivated
- upper and lower limits of measuring range breached
- limit transgression, even without limit relay, if the control time is set to "limit value > 0 s"
- sensor failure with pH (short circuit or no sensor connected)
- overload/short circuit at mA sensor input
- if the Pause input is enabled

8 Maintenance

The DULCOMETER® D1Cb is maintenance free.

8.1 Fuse Change on DULCOMETER® D1Cb



WARNING!

Danger from electrical voltage

Possible consequence: Fatal or very serious injuries

- The DULCOMETER® D1Cb does not have a mains power switch
- When working inside the control unit, disconnect the control unit from the mains power via an external switch or by removing the external fuse



WARNING!

Danger from electrical voltage

Possible consequence: Fatal or very serious injuries

- There may still be mains voltage on terminals XR1 - 3 even after removing the voltage supply
- These can be supplied externally separately with mains voltage
- Terminals XR1 - 3 should be disconnected separately from the mains power supply



NOTICE!

Use only 5 x 20 mm micro-fuses

Possible consequence: Damage to the product or its surroundings

- 100 – 240 V ⚡ *Table on page 87*

Fuse change

The mains fuse is located in a sealed fuse holder in the inside of the device

1. ➤ Open the control unit and put the upper section of the housing into its "parked position"
2. ➤ Remove cover of micro-fuse
3. ➤ Remove the micro-fuse using a suitable tool
4. ➤ Fit the micro-fuse using a suitable tool
5. ➤ Fit cover of micro-fuse
6. ➤ Replace upper section of housing and close the control unit

8.2 Troubleshooting

Fault	Fault text	Symbol	Effect on metering	Effect on control	Alarm with acknowledgement	Remarks	Remedy
Actuating variable Exceeds control time of reading	Check sensor	⌵	Basic load	Stop	Yes	Function can be switched off	Check sensor working, extend control time
Upper and lower limits of signal breached	Input	⌵	Basic load	Stop	Yes	Signal <3.0 ±0.2 mA or >23 ±0.2 mA	Check sensor, transducer and cable connection
Calibration Sensor has a fault	Compensation defective	⌵	Basic load	Stop	No	Metering continues with fault with unsteady readings	Check sensor, poss. replace, poss. recalibrate
Correction variable - upper/lower signal breached	Temp. input	⌵	Basic load	Stop	Yes	Pt100/ Pt1000 signal >138.5 Ω signal < 0 mA ±0.2 mA The last valid value will be reused	Check sensor, transducer and cable connection
Limit transgression After control time of limit value Control "on" Control "off"	Limit value 1 Limit value 2	⌵ ⌵	Stop or basic load	Stop	Yes Yes	Function can be switched off	Clarify cause and poss. set new values
Electronic fault	System fault	⌵ ⌵O	Stop	Stop	Yes	Electronic data defective	Notify service

Operating step	Message text	Symbol	Effect on metering	Effect on control	Alarm with acknowledgement	Remarks	Remedy
Pause contact	Pause	⌵ ⌵O	Stop	Stop	No/Yes*	No further fault check	
	Pause/Hold	⌵		PI frozen			
Stop key	Stop	⌵ ⌵O	Stop	Stop	No	Relays drop out	
During calibration of sensors			Basic load		No	No fault treatment of measured variable	

Maintenance

Operating step	Message text	Symbol	Effect on metering	Effect on control	Alarm with acknowledgement	Remarks	Remedy
Sensor gradient too low		⊗	Basic load		No	25%> sensor gradient	Check and poss. replace sensors
Sensor gradient too high		⊗	Basic load		No	> 300% of standard gradient	Check and poss. replace sensors
DPD < 2 % of measuring range	DPD value too small						Recalibrate after addition of metering agent
Zero point	Zero point low Zero point high	⊗				Signal <3 mA Signal >5 mA	Check sensor/cable Repeat compensation in water free of metering agent

*Dependent on whether "Alarm Off" or "Alarm On" in "General Settings"

9 Technical Data

9.1 DULCOMETER® D1Cb

Permissible ambient conditions:

Wall mounted:	0° C – 50° C
Control panel mounted:	0° C – 50° C

All versions: 10 to 95% relative air humidity (non-condensing)

Permissible storage conditions:

All versions:	-10° C – 60° C
---------------	----------------

All versions: < 95% relative air humidity (non-condensing)

9.2 Sound Pressure Level

No noise generation measurable

9.3 Material Data

Part	Material
Housing lower and upper section	PPE-GF10
Bracket on rear of housing lower section	PPE-GF20
Membrane keypad	Polyester PET membrane
Seal	CR foam rubber
Angle bracket and screws	Galvanically galvanised steel
M5 screws	Stainless steel A2

9.4 Chemical Resistance

The device is resistant to normal atmospheres in plant rooms

9.5 Dimensions and Weights

Complete device:	198 x 200 x 76 mm (W x H x D)
Packaging:	390 x 295 x 155 mm (W x H x D)
Weight of device without packaging:	approx. 1.2 kg
Gross weight of device with packaging:	approx. 2.0 kg

10 Electrical Data

Mains connection	
Nominal voltage range:	100 – 230 VAC $\pm 10\%$
Frequency	50 – 60 Hz
Current consumption	250 – 95 mA

The mains connection is isolated from other switching parts by reinforced insulation. The device has no mains switch; a fuse is fitted.

Power relay	
Loading of switching contacts:	5 A; no inductive loads
	Use protective RC circuit (optional) with inductive loads

Alarm Relay	
Loading of switching contacts:	5 A; no inductive loads
	Use protective RC circuit (optional) with inductive loads

Outputs galvanically isolated from other switching parts by reinforced insulation.

Digital input	
Open circuit voltage:	6 V DC max.
Short circuit current:	approx. 0.6 mA
Max. switching frequency:	500 Hz at 50% filling factor



NOTICE!
Do not supply with voltage

For the connection of an external semi-conductor or mechanical switch.

mA Output	
Current range:	0/3.8 – 20.5 mA
In the event of a fault:	3.6 or 21.5 mA
Max. apparent ohmic resistance:	450 Ω at 20.5 mA
Max. output voltage:	18 V DC
Overvoltage-resistant up to:	± 30 V
Output accuracy:	$\pm 0.25\%$ of range

Galvanically isolated from all other connections (500 V)

Pump activation	
Max. switching voltage	50 V (protective low voltage)
Max. switching current	50 mA
Max. residual current (open)	10 μ A
Max. resistance (closed)	60 Ω
Max. switching frequency (HW) at 50% filling factor	500 Hz

2 digital outputs isolated galvanically from each other and from all other connections via OptoMos relays.

mA Input	
Current measuring range	0..0.24 mA
Voltage output for passive transmitters:	approx. 21 V/max. 35 mA/ Ri max. 50 Ω
Measuring accuracy:	± 0.25 % of range up to 22 mA *
Overvoltage-resistant up to:	± 50 V
Short circuit-resistant	(no function)

* Values above 22 mA only have an informative character

For the connection of active and passive power transmitters in 2- and 3-wire systems. Not galvanically isolated from the temperature and mV inputs.

Do not connect mV and mA simultaneously. Values will be falsified.

Switch off supply and current measuring resistance in the event of a fault; reactivate cyclically by means of software.

mV Input	
Measuring range:	-1 V...+1 V
Measuring accuracy:	± 0.25 % of range
Sensor monitoring of input (low ohmic threshold) (can be switched off):	< approx. 500 k Ω (short circuit)
Sensor monitoring of input (high ohmic threshold) (can be switched off):	> approx. 1.2 G Ω
Overvoltage-resistant up to:	± 5 V (no function)

For the connection of potentiometric sensors. Short circuit monitoring provided by software.

Do not connect mV and mA simultaneously. Values will be falsified.

Electrical Data

Not galvanically isolated from the mA and temperature inputs.
Terminal for the connection of an electrode for compensating for the potential of the measuring liquid

Temperature input	
Temperature measuring range:	0...100 °C
Measuring flow:	approx. 0.96 mA
Measuring accuracy:	±0.5 % of measuring range
Overvoltage-resistant up to:	±5 V
Short circuit resistant (no function):	

For the connection of Pt100 or Pt1000 temperature sensors in 2-wire systems. A switch is automatically made between Pt100 / Pt1000.
Not galvanically isolated from the mA and mV inputs.

11 Spare Parts and Accessories

Spare Parts and Accessories DULC-OMETER® D1Cb

Spare parts	Part number
Micro-fuse 5x20 T 1.6A	732411
Screw connection M12x1.5 kpl. metric	1032245
Half screw connection kpl. metric	1031506

Accessories	Part number
Control panel assembly set (fitting set for installation on control panel)	792908

12 Protection Classes/Standards Complied With

12.1 Mechanical

Standards complied with

DIN EN ISO 12100-1 Safety of Machines, Basic Terminology, Methodology

DIN EN ISO 12100-2 Safety of Machines, Basic Terminology, Technical Principles for Design

12.2 Protection Against Contact and Humidity

Standards complied with

DIN EN 61010 Safety requirements for electrical units for measuring, control, regulating and laboratory use

12.3 Electrotechnical Safety / Radio Protection

Standards complied with

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

EC Low Voltage Directive (2006/95/EC)

EC EMC Directive (2004/108/EC)

DIN EN 61010 Laboratory devices

DIN EN 55014-1 EMC Requirements of household appliances Part 1 Emitted interference

DIN EN 55014-2 EMC Requirements of household appliances Part 2 Interference resistance

13 Disposal of Used Parts



NOTICE! Regulations

- Please observe the currently applicable local regulations (specifically with regard to electronic waste)!
- The membrane keypad should be classified and disposed of according to local guidelines!

For Germany: The cleaned used parts can be disposed of at municipal waste collection points.

14 Declaration of Conformity

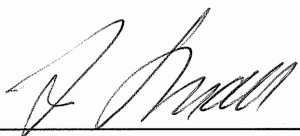
EC Declaration of Conformity	
We,	ProMinent Dosiertechnik GmbH Im Schuhmachergewann 5 - 11 D - 69123 Heidelberg
hereby declare that, on the basis of its functional concept and design and in the version brought into circulation by us, the product specified in the following complies with the relevant, fundamental safety and health stipulations laid down by EC directives. Any modification to the product not approved by us will invalidate this declaration.	
Product description :	<i>Measurement and control system, DULCOMETER</i>
Product type :	<i>D1Cb...</i>
Serial number :	<i>see type identification plate on device</i>
Relevant EC regulations :	<i>EC - low voltage directive (2006/95/EC) EC - EMC - directive (2004/108/EC)</i>
Harmonized standards used, in particular :	<i>EN 61010, EN 61326-1</i>
Date/manufacturer's signature :	<i>12.05.2009</i> 
The undersigned :	<i>Joachim Schall, director research and development</i>

Fig. 61: EC Declaration of Conformity

15 D1Cb Glossary

Additive basic load

A basic load is added to the current actuating variable.

The additive basic load means that, for example, constant attrition can be compensated for.

$$Y_{\text{Tot}} = Y_P + 15 \% \text{ (additive basic load = 15 \%)}$$

$$\text{Example 1: } Y_{\text{Tot}} = 85 \% + 15 \% \quad Y_{\text{Tot}} = -75 \% + 15 \%$$

$$\text{Example 2: } Y_{\text{Tot}} = 100 \% \quad Y_{\text{Tot}} = -60 \%$$

Additive interference variable

The additive interference variable switch is suitable for metering tasks, in which the metering volume is dependent in the first place on the interference variable (e.g. flow) and requires only minimal recorection. This nature of interference variable processing is used, for example, in the chlorination of water with approximately constant chlorine uptake.

A basic load metering, dependent on the interference variable, is added or subtracted from the "actuating variable recorded" initially by the DULCOMETER® D1C. The actuating variable can be a maximum of 100 %.

Actuating variable to actuator [%] = recorded actuating variable [%] + (max. additive actuating variable [%] * current interference variable [mA] / nominal interference variable [mA])

The maximum additive interference variable indicates which maximum interference variable is to be added (where current interference variable = nominal interference variable).

If there is no current interference variable (flow = 0), but a recorded actuating variable of the PID control, then the final actuating variable corresponds to the recorded actuating variable of the PID control.

If there is a current interference variable (flow > 0) and the recorded actuating variable of the PID control equals "0", then the final actuating variable corresponds to the 2nd term from the following formula:

$$\text{max. additive actuating variable} \times \text{current interference variable} / \text{nominal interference variable}$$

Hysteresis limit values

A "hysteresis" is a switching range that can be set. This switching range prevents excessive switching on and off in the area of the preset limits.

Manual

There is no control.

An actuating variable will be specified manually:

Actuating variable: 0...+100 % (actuating output rise active)

Actuating variable: -100...0 % (actuating output lower active)

This function is used to monitor actuators

Multiplicative interference variable

This type of interference variable processing is used, for example, with flow neutralisation. The "actuating variable recorded" initially by the DULCOMETER® D1C is multiplied by a factor F.

The factor lies in the range of $0 \leq F \leq 1$ ($0 \equiv 0 \%$, $1 \equiv 100 \%$). The actuating variable can therefore be a maximum of 100 %.

Actuating variable to actuator [%] = recorded actuating variable [%] * current interference variable [mA] / nominal interference variable [mA]

A "current interference variable" greater than or equal to the "nominal interference variable" does not affect the control variable.

The recorded actuating variable is the actuating variable, which is issued by the DULCOMETER® D1C without an interference variable.

The nominal interference variable limits the range that can be used.

Example: A flow meter is used, for example, which can measure a maximum flow of $Q=250 \text{ m}^3/\text{h}$. The analogue output of the flow meter issues a signal according to $4 \text{ mA} = 0 \text{ m}^3/\text{h}$, $20 \text{ mA} = 250 \text{ m}^3/\text{h}$. The maximum flow achievable in the application is, however, only $125 \text{ m}^3/\text{h}$. If the standard signal-output signal of the flow meter is now not adjusted to the 4...20 mA range of the D1C (possible with the majority of flow meters), then the standard signal at $125 \text{ m}^3/\text{h}$ is only 12 mA. Enter this value in the "Set Interference Variable?" under "Nominal Interference Variable".

The interference variable is the current analogue flow, which the flow meter supplies. The final actuating variable is transferred to the actuator.

Normal Pause

When the Pause contact is closed, the DULCOMETER® D1C sets the actuating outputs to "0" for as long as the Pause contact is closed or for a set time delay t_d (if $t_d > 0$). While the Pause contact is closed, the DULCOMETER® D1C records the P proportion in the background.

With PID control (identity code characteristic "control behaviour" = 2): the I-proportion present when the Pause contact is closed is stored (I-proportion generally only present if $T_n > 0$ has been set in the "Control Setting?" setting menu). The exception to this is if the standard signal outputs mA for the reading or correction value are unaffected by the Pause.

Once the Pause contact has been opened, the actuating outputs remain at "0" for the length of the time delay. The time delay t_d has to be set in such a way that, for example, during this time sample water with the current concentration relative to the process flows to the sensor.

With PID control (identity code characteristic "control behaviour" = 2): The control variable issued following the Pause and the expiry of the time delay t_d consists of the current P-proportion and (if $T_n > 0$ is set) the stored I-proportion.

Pause Hold

If the Pause contact is closed, the DULCOMETER® D1C freezes the actuating outputs at the most recent value for as long as the Pause contact is closed or for a set time delay t_d (if $t_d > 0$ is set). While the Pause contact is closed, the D1C records the P-proportion in the background.

With PID control (identity code characteristic "control behaviour" = 2): the standard signal outputs mA for the reading or correction value are also frozen. After the Pause contact has been opened, the actuating outputs remain frozen for the time delay t_d . The time delay t_d has to be set in such a way that, for example, during this time sample water with the current concentration relative to the process flows to the sensor.

With PID control (identity code characteristic "control behaviour" = 2): The actuating variable issued following the Pause and the expiry of the time delay t_d consists of the current P-proportion and (if $T_n > 0$ is set) the newly recorded I-proportion.

Symbols

X_p : 100%/Kp (reciprocal proportional coefficient)

T_N : Reset time of I-control [s]

T_D : Derivative time of D-control [s]

x: Control variable, actual value e.g. pH value)

KPR: Proportional coefficient

Xmax: Maximum actual value of control (e.g. pH 14)

y: Actuating variable (e.g. pulse frequency - pump)

Yh: Actuating range (e.g. 180 pulse/min)

yp: Actuating variable of proportional controller [%]

w: Primary variable or set point (e.g. pH 7.2)

e: Control difference, $e = w - x$ x_w : Control deviation, $x_w = x - w$

With dead zone

With dead zone control (neutral zone control) two set points have to be specified. If the reading is located within the dead zone, then no control variable will be issued. Set point 2 must be greater than set point 1!

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