

Operating Instructions

DULCOMETER® D2C

Part 2: Adjustment and Operation,
Measured Variables pH/chlorine dioxide

D2C2-001-pH/ClO₂-GB



type D



type W

D2C A _____

Please enter the identity code of your device here!

**Please completely read through operating instructions! • Do not discard!
The warranty shall be invalidated by damage caused by operating errors!**

1 Device Identification / Identity Code

D2C A		DULCOMETER® controller Series D2C	
W	Wall mounting		
D	Panel mounting (96 x 96 mm)		
	Operating voltage		
0	230 V 50/60 Hz		
1	115 V 50/60 Hz		
4	24 V AC/DC		
	Measured variable 1/Measured variable 2		
PD	pH (0-14 pH) / Chlorine dioxide (0...0.5/2/5/10/20 ppm)		
	Connection of measured variable 1 (connection measured variable 2: 4-20 mA)		
1	Terminal standard signal 4-20 mA (signal converters are necessary)		
2	SN6 plug connector		
5	Terminal mV		
	Correction variable (Temperature for pH)		
0	None		
2	Automatically (Pt 100 via terminal)		
4	Manual		
	Disturbance variable connection		
0	None		
	Signal output		
0	None		
4	2 Standard signal outputs 0/4-20 mA, free programmable		
	Power control		
G	Alarm and 2 limit relay		
M	Alarm and 2 solenoid valve relays (pulse length control)		
	Control characteristic		
1	Proportional control		
2	PID control		
	Protocol output		
0	None		
	Language		
D	German		
E	English		
F	French		
S	Spanish		
A	Swedish		
N	Dutch		
P	Polish		
I	Italian		

D2C A	—	—	—	—	—	—	—	—	—
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Please enter the identity code of your device here!

2 Contents / General User Information

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General User Information

These operating instructions describe the technical data and function of the series DULCOMETER® D2C controller, provide detailed safety information and are divided into clear steps.



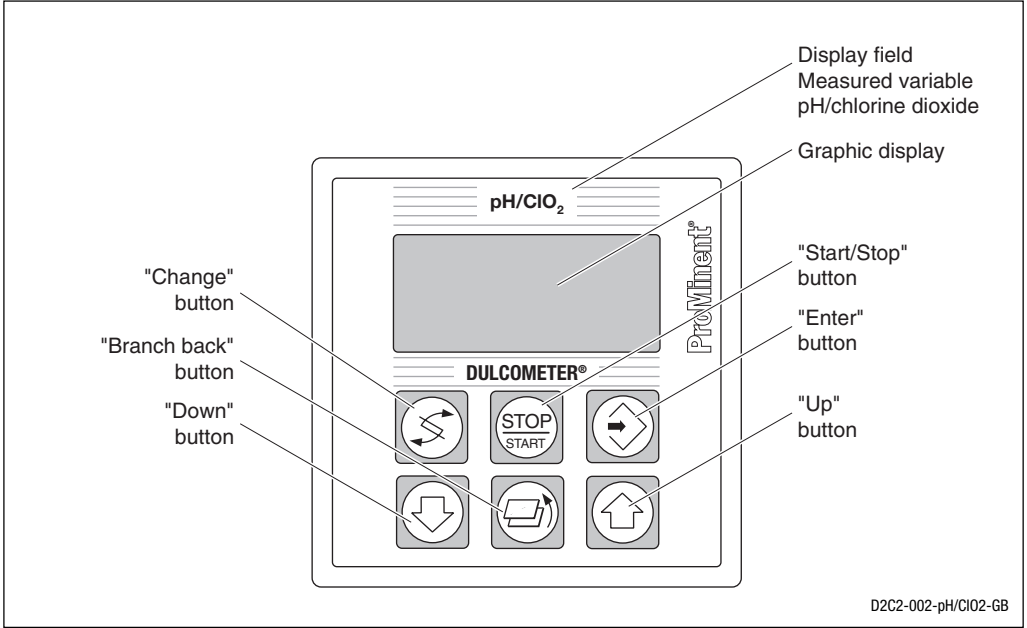
IMPORTANT




- ***Please observe the parts of these operating instructions applicable to your particular version! This is indicated in the Section “Device Identification/Identity Code”.***
- ***Correct measuring and dosing is only possible in the case of impeccable operation of the probe. The probe has to be calibrated/checked regularly!***
- ***In the event of a probe failure, uncontrolled chemicals addition may result. We therefore recommend urgently to activate “check out time limits” with automatic control shut-off!***




NOTE

A form “Documentation of controller settings Type D2C” is available under www.prominent.com/documentation_D2C for the purpose of documenting the controller settings.

3 Device Overview / Controls



	<p>CHANGE button</p> <p>To change over within a menu level and to change from one variable to another within a menu point.</p>
	<p>START/STOP button</p> <p>Start/stop of control and metering function.</p>
	<p>ENTER button</p> <p>To accept, confirm or save a displayed value or status. For alarm acknowledgement.</p>

	<p>UP button</p> <p>To increase a displayed numerical value and to change variables (flashing display)</p>
	<p>BRANCH BACK button</p> <p>Back to permanent display or to start of relevant setting menu.</p>
	<p>DOWN button</p> <p>To decrease a displayed numerical value and to change variables (flashing display).</p>

4 Functional Description

NOTE

Please refer to the description of the operating menu for a detailed description of the individual characteristics of the DULCOMETER® D2C controller!

4.1 Operating Menu

The DULCOMETER® D2C controller permits settings to be made in two different menus. All values are preset and can be changed in the complete operating menu.

The controller is delivered with a restricted operating menu so that the D2C controller can be used effectively in many applications from the very onset. If adaptations prove to be necessary, all relevant parameters can then be accessed by switching over to the complete operating menu.

4.2 Access Code

Access to the setting menu can be prevented by setting up an access code. The D2C controller is supplied with the access code 5000 which permits free access to the setting menu. The calibration menu remains freely accessible even when access to the setting menu is blocked by the code.

4.3 Control

The D2C can operate as a proportional controller or as a PID controller - dependent on the device version (see identity code) and the setting.

The controlled variable is recalculated every second. Control procedures which require rapid correction of setpoint deviations (less than approx. 30 seconds) cannot be processed with this controller. The solenoid valve control (pulse on-time) must take account of the cycle times.

The control function (reference variable output) can be switched off through the pause function and the water control input. The calculation of the regulated variable starts again with the cessation of the "pause" after expiry of the adjustable delay time "td". No fault treatment is performed with active "pause" function.

4.4 Fault messages

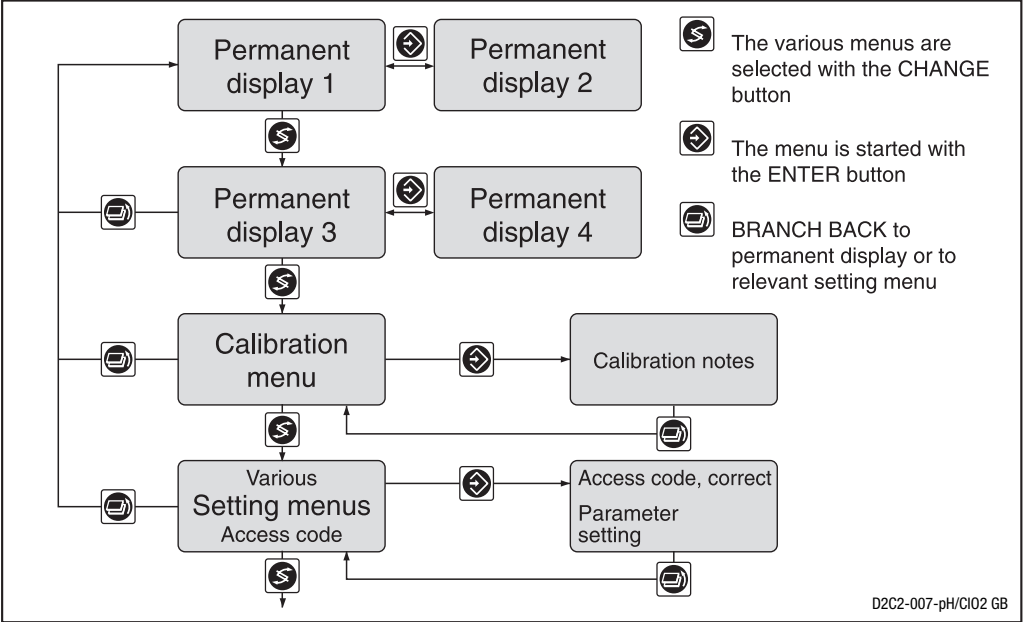
Faults to be acknowledged are shown in the permanent displays 1, 3 and 4 by the symbol "E". The corresponding fault messages and notes are shown in the permanent display 2. Faults/notes continuing after acknowledgement are shown alternatively. Faults automatically remedied through changing operating conditions are removed from the permanent display without necessitating acknowledgement. Chapter 10 includes an overview of fault messages and causes.

5 Display Symbols

The display of the DULCOMETER® D2C controller uses the following symbols:

Symbol	Description	Comment
↑	Limit value transgression measured value 1 Relay 1 upper or zone	Symbol left
↓	Relay 1 lower	Symbol left
↑	Limit value transgression measured value 2 Relay 2 upper or zone	Symbol right
↓	Relay 2 lower	Symbol right
■	Metering pump measured value 1 Control OFF	Symbol left
□	Control ON	Symbol left
■	Metering pump measured value 2 Control OFF	Symbol right
□	Control ON	Symbol right
▲	Solenoid valve measured value 1 Control OFF	Symbol left
△	Control ON	Symbol left
▼	Solenoid valve measured value 2 Control OFF	Symbol right
▽	Control ON	Symbol right
O	Stop button pressed	
M	Manual metering	
pause ⌚	Delay time "td"	Control starts after expiry of "td"
ε	Fault	

6 Operation



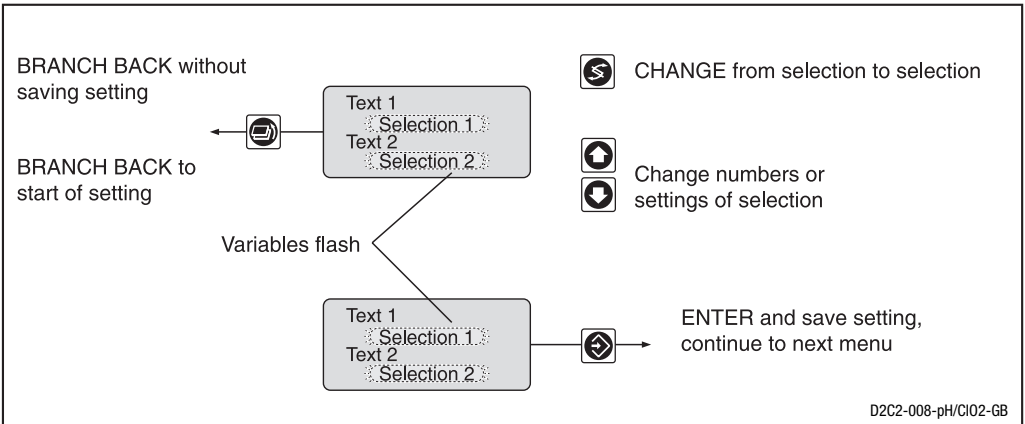
NOTE

Access to the setting menus can be barred with the access code!

The number and scope of setting menus is dependent on the device version!

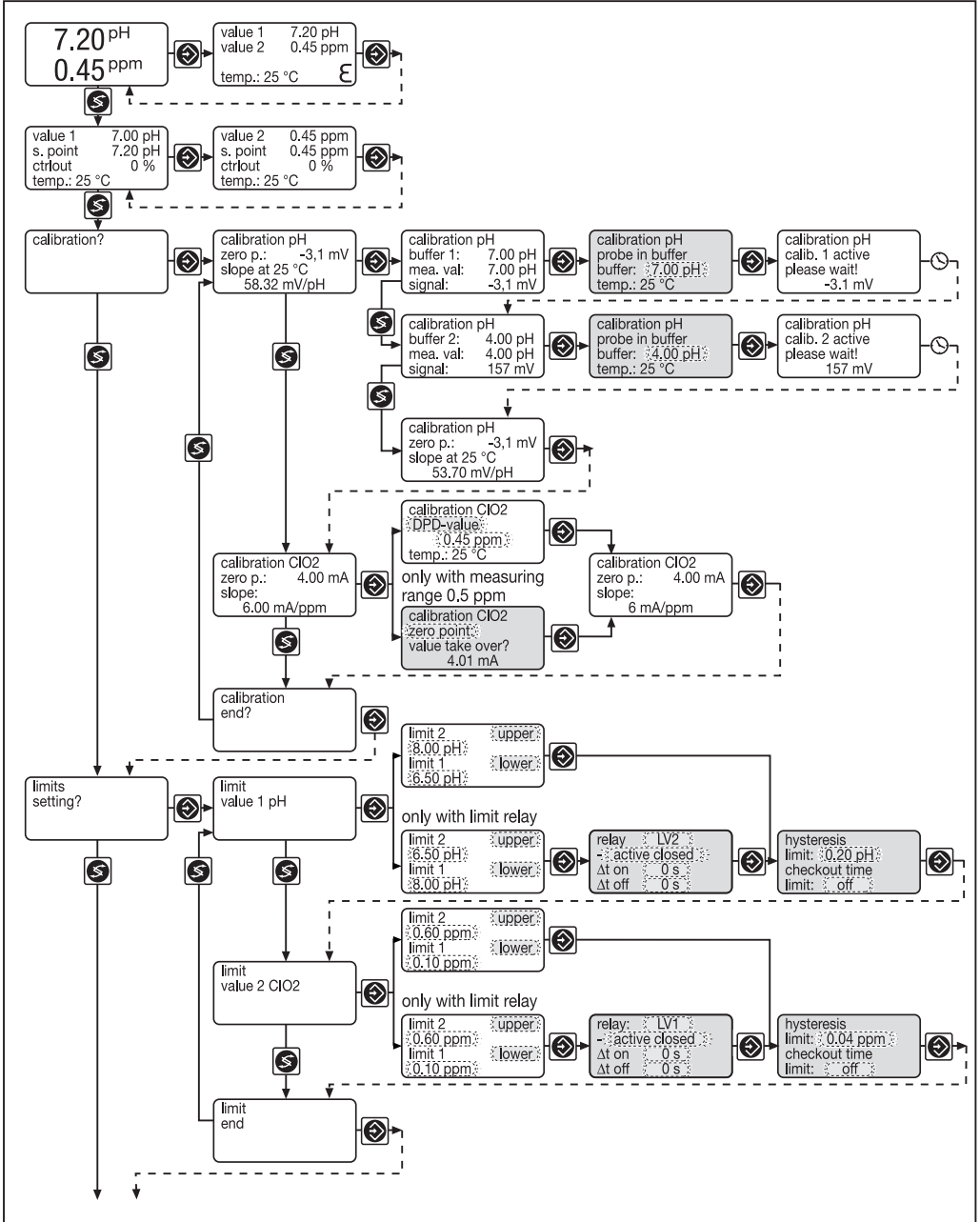
If the access code is selected correctly in a setting menu, then the following setting menus are also accessible!

If within a period of 10 minutes no button is pushed, the unit automatically branches back from the calibrating menu or a setting menu to the permanent display 1.

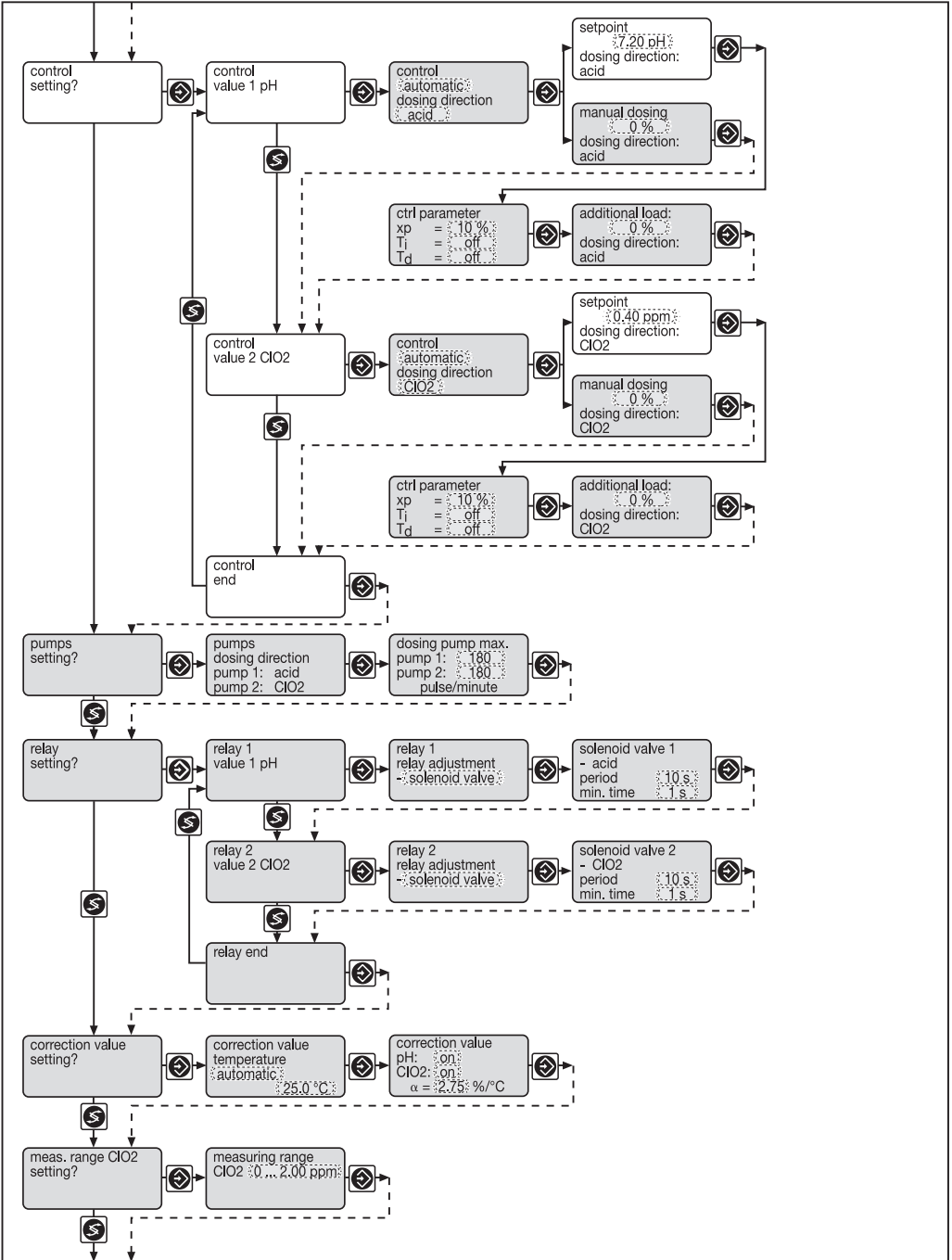


7 Operating Menu / Overview

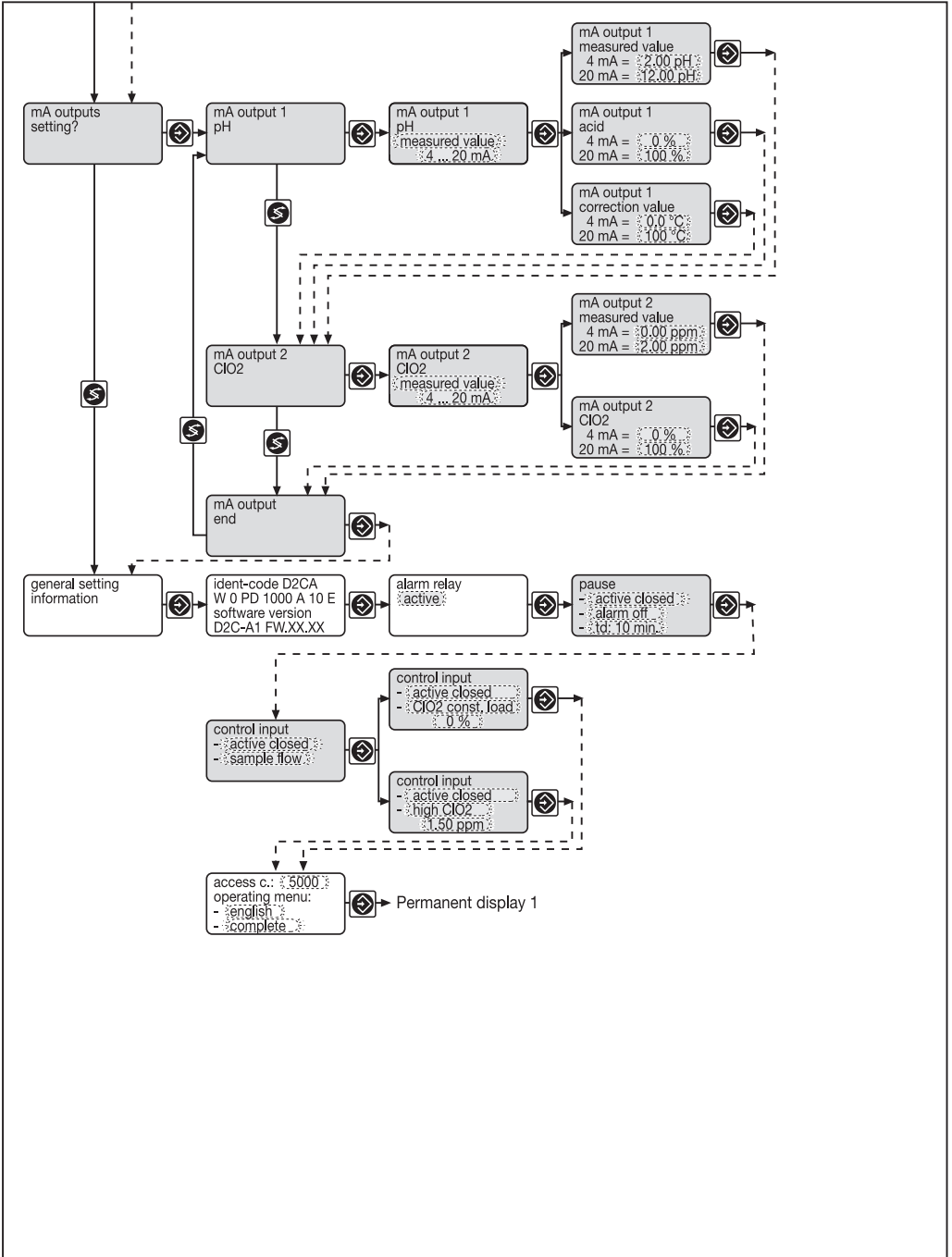
The setting menus highlighted in grey and the adjustable parameters are only visible in the complete operating menu.



Operating Menu / Overview

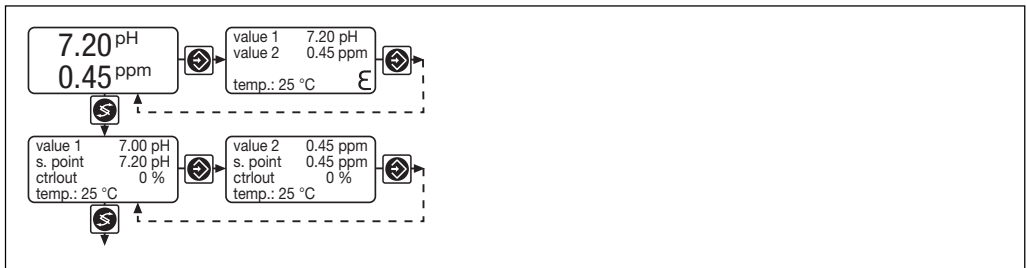


Operating Menu / Overview



8 Operating Menu / Description

Permanent displays

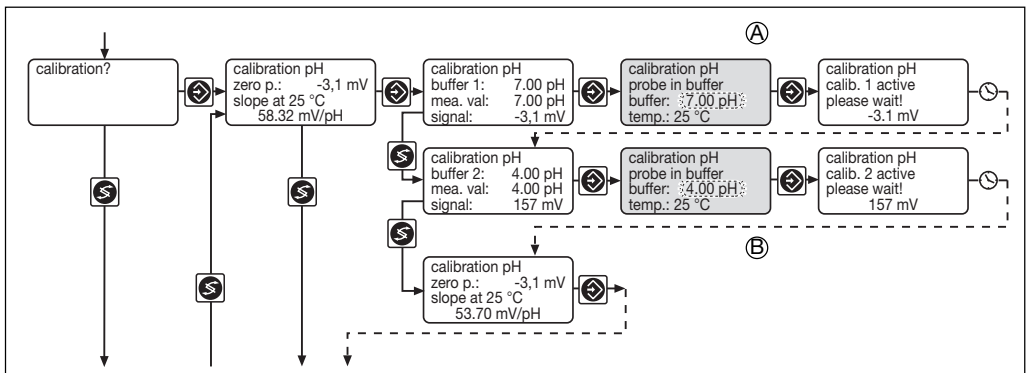


The permanent displays 1 to 4 serve information on fault messages/causes (see also table on page 23) as well as on operating values/settings.

Calibration

Calibration of pH probe:

The calibration of the pH probe uses a two-point calibration method (zero point, slope). As buffer pH 7 (zero point calibration) and pH 4 (slope calibration) are factory-set. If other buffers are to be used, the defaults in the complete operating menu (menu A, B) may be altered. During calibration control is stopped and metering is reduced to the set base load. The output 0/4...20 mA (measuring value) will be frozen. After successful calibration, all fault determinations relating to the measuring value are started again. The current probe data (zero point/slope) will be displayed.



Operating Menu / Description

	Initial value	Possible values			Remarks
		Increment	Lower value	Upper value	
Buffer values	pH 7 pH 4	0.01 pH	-2 pH	16 pH	Error messages when both buffers too close (<2 pH-values)
Temperature	Measured value	0.1 °C	0 °C	100.0 °C	

Error message	Condition	Effect
Buffer distance too small	Δ Buffer <2 pH	During calibration procedure: Recalibrate buffer 2!
pH zero point low pH zero point high pH slope low pH slope high Measured value pH unsteady Temp. measured value unsteady	< -60 mV < +60 mV < 45 mV/pH > 65 mV/pH	Return to permanent display: Basic metering load Warning, old zero point and slope retained " " " " " " " " Warning, old zero point and slope retained

Calibration of the chlorine dioxide probe

The calibration (slope calibration) of the chlorine probe uses the DPD method. When starting calibration, the frozen measuring value is proposed; this value may be adjusted to the measured DPD value using the Up and Down buttons. A calibration will only be possible if the DPD value is $\geq 2\%$ of the measuring range. During calibration, control function and metering are maintained. After successful calibration, all fault determinations relating to the measuring value are started again.

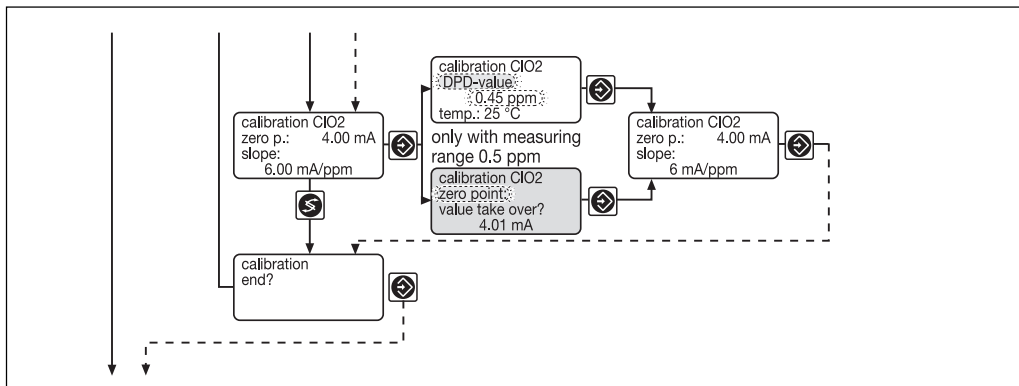
With a measuring range adjusted to 0 - 0.5 ppm, the zero point may be calibrated in the entire operating menu in addition to the slope. The zero point calibration should be performed under realistic conditions with **chlorine dioxide-free** water. In this case, control will be stopped and metering will be reduced to the set base load. The 0/4...20 mA output (measured value) is frozen at the start of the calibration.



IMPORTANT

The measuring range of the chlorine dioxide probe must correspond to the adjusted measuring range of the DULCOMETER® D2C (factory setting 0 - 2.00 ppm). A possible alteration of the measuring range (see page 19) must be done prior to calibration. If the measuring range is altered, all settings are reset to the factory settings.

Operating Menu / Description



	Initial value	Possible values		
		Increment	Lower value	Upper value
DPD-value	Measured value	0.001 ppm 0.01 ppm 0.01 ppm 0.01 ppm	-0.050 ppm -0.20 ppm -1.00 ppm -2.00 ppm	0.550 ppm 2.20 ppm 11.00 ppm 22 ppm
Zero point	Measured value (mA)	–	–	–

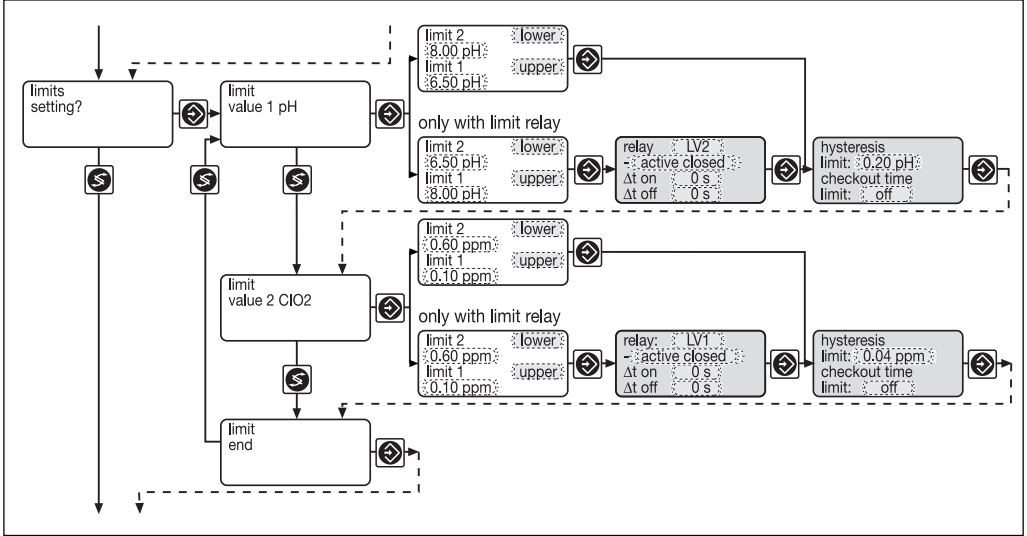
Error message	Condition	Effect
Calibration ClO ₂ not possible! Probe slope too low	ClO ₂ slope too low (<25% of standard slope)	Repeat calibration
Calibration ClO ₂ not possible! Probe slope too high	ClO ₂ slope too high (>300% of standard slope)	Repeat calibration
DPD value too low! DPD > x.xx ppm	DPD <2 % of measuring range	Repeat calibration after addition of chlorine dioxide
Zero point too high	Probe signal >5 mA	Repeat calibration in chlorine dioxide-free water
Zero point too low	Probe signal <3 mA	Check probe connection replace probe, if necessary

Operating Menu / Description

Limits

When setting the check out time, metering of the corresponding pump is stopped and an alarm is triggered through the alarm relay in the event of limit violations exceeding the set check out time.

For devices with limit relays, a limit value or a zone may be set for each measuring value, where the relay will switch.

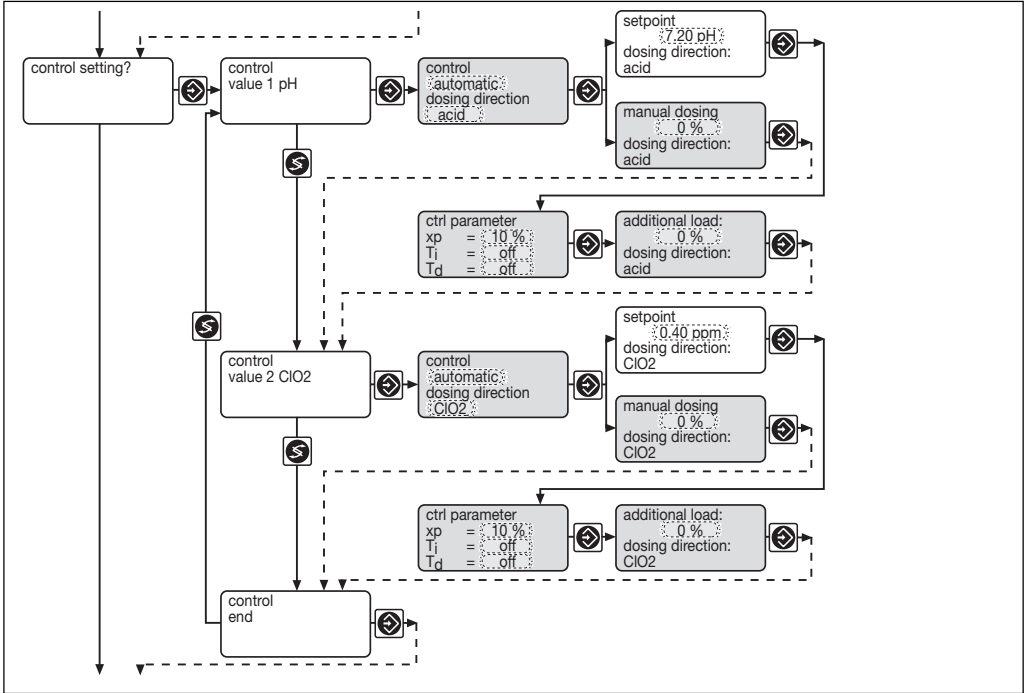


Operating Menu / Description

	Initial value	Possible values		Upper value	Remarks
		Increment	Lower value		
Type of limit transgression					
Measured value 1 pH	upper	upper lower			Limit transgression when exceeding or dropping below value
Measured value 2 chlorine dioxide	lower	upper lower			
Limit value					
Measured value 1 pH	pH 8 pH 6.5	pH 0.01 pH 0.01	pH -2 pH -2	pH 16 pH 16	
Measured value 2 chlorine dioxide	0.025 ppm 0.10 ppm	0.001 ppm 0.01 ppm	-0.050 ppm -0.20 ppm	upper limit measuring range	
Limit value 1	0.50 ppm 1.00 ppm	0.01 ppm 0.01 ppm	-1.00 ppm -2.00 ppm		
Limit value 2	0.375 ppm 1,50 ppm 7,50 ppm 15.00 ppm	0.001 ppm 0.01 ppm 0.01 ppm 0.01 ppm	-0.050 ppm -0.20 ppm -1.00 ppm -2.00 ppm	upper limit measuring range	
Limit relay 1 pH	LV 2	LV 1 LV 2 zone* off			*with regard to the setting "zone", the difference between the limits and the set hysteresis should be $\geq 3x$.
Limit relay 2 chlorine dioxide	LV 1	LV 1 LV 2 zone* off			
Limit relay 1,2	active closed	active closed active open			
Switch-on delay* Δt on	0 s	1 s	0 s	9999 s	
Switch-off delay* Δt off	0 s	1 s	0 s	9999 s	
Hysteresis limits					Is active in the direction of cancellation of limit violation.
Measured value 1	pH 0.2	pH 0.01	pH 0.02	pH 16	
Measured value 2	0.010 ppm 0.04 ppm	0.001 ppm 0.01 ppm	0 ppm 0 ppm	0.550 ppm 2.20 ppm	
	0.20 ppm 0.40 ppm	0.01 ppm 0.01 ppm	0 ppm 0 ppm	11.00 ppm 22.00 ppm	
Checkout time limits	off	1 s	1 s	9999 s	
					Results in message and alarm and shutting-off of the corresponding metering. Off: function off, no message, no alarm.

Operating Menu / Description

Control

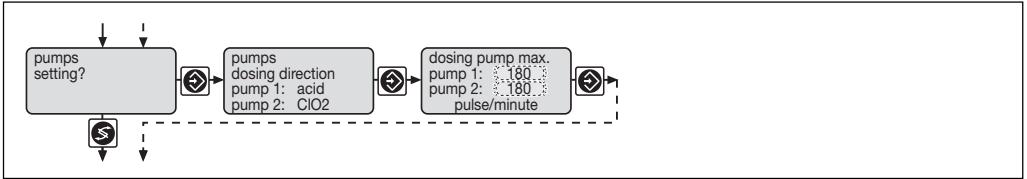


	Initial value	Possible values			Remarks
		Increment	Lower value	Upper value	
Control	normal	normal manual			xp referred to pH 14 (measured value 1) xp referred to measuring range (measured value 2)
Setpoint					
Measured value 1 pH	pH 7.20	pH 0.01	pH 0	pH 14	
Measured value 2 chlorine dioxide	0.150 ppm	0.001 ppm	0 ppm	0.500 ppm	
	0.60 ppm	0.01 ppm	0 ppm	2.00 ppm	
	3.00 ppm	0.01 ppm	0 ppm	10.00 ppm	
	6.00 ppm	0.01 ppm	0 ppm	20.00 ppm	
Control parameter xp	10 %	1 %	1 %	500 %	
Control parameter Ti	off	1 s	1 s	9999 s	
Control parameter Td	off	1 s	1 s	2500 s	
Additional load	0 %	1%	0 %	+100 %	
Manual metering	0 %	1%	0 %	+100 %	

Operating Menu / Description

Pumps

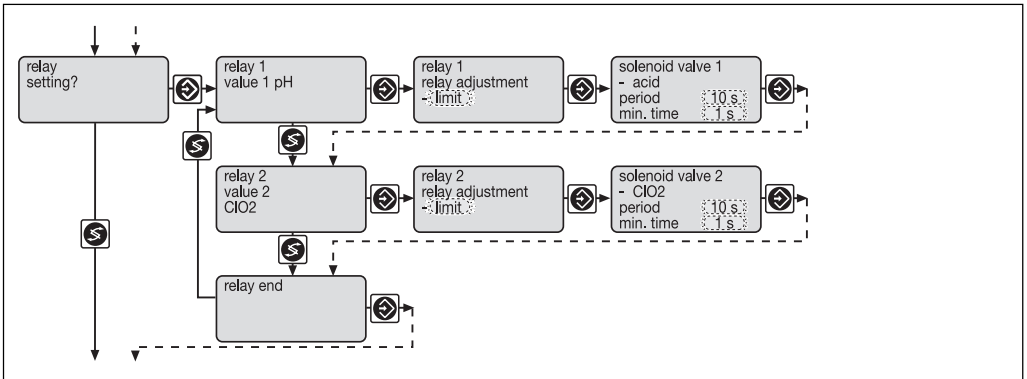
The maximum stroke value of the metering pumps should correspond to the stroke frequency of the metering pump used.



	Initial value	Possible values			Remarks
		Increment	Lower value	Upper value	
Max. stroke/minute of pumps 1 and 2	180	1	1	500	off = 0 strokes/min

Relays

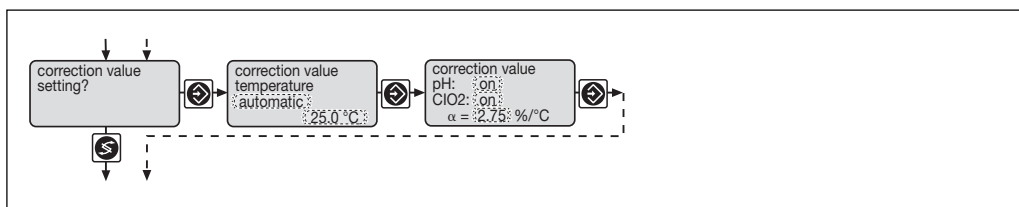
Allocation of the two relays with regard to the function (limit, actuator, solenoid valve) is freely selectable. If the function is set to actuator or solenoid valve, the relays will be set inactive in the case of fault in order to avoid faulty metering.



Operating Menu / Description

	Initial value	Possible values			Remarks
		Increment	Lower value	Upper value	
Relay 1 Measured value 1 pH Relay adjustment	Limit value	Limit value Actuator* Solenoid valve off			*e.g. motor pump Relay is deactivated in case of fault and during calibration
Relay 2 Measured value 2 chlorine dioxide Relay adjustment	Limit value	Limit value Actuator* Solenoid valve off			
Solenoid valve Cycle time	10 s	1 s	10 s	9999 s	
Min. time	1 s	1 s	1 s	Cycle/2	

Correction variable (measured value 1 pH)



	Initial value	Possible values			Remarks
		Increment	Lower value	Upper value	
Type of temperature compensation	as per identity code	manual automatic off			Change-over only if pursuant to identity code = automatic
Manual	25 °C	0.1 °C	0 °C	100 °C	Correctable via arrow keys
automatic	Measured value	0.1 °C	Measured value -5 °C	Measured value +5 °C	
Correction pH	yes	yes no			
Correction ClO ₂	yes	yes no			

Operating Menu / Description

Measuring range chlorine dioxide

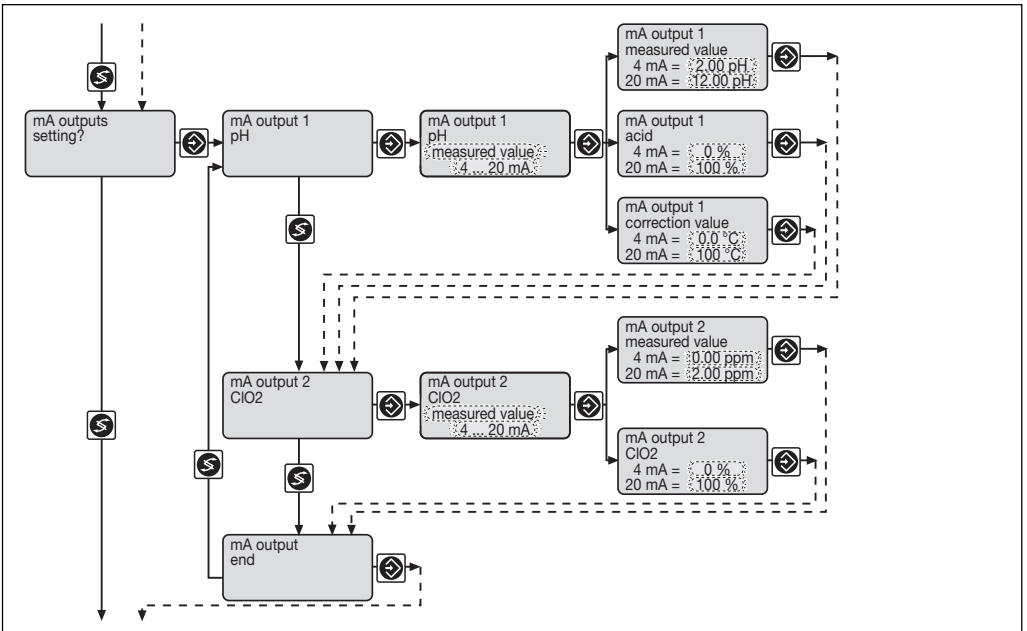
The measuring range (factory setting 0-2.00 ppm) must correspond to the chlorine dioxide measuring cell used. The factory setting (limits, setpoint...) is reset if the measuring range is altered.



	Initial value	Possible values			Remarks
		Increment	Lower value	Upper value	
Measuring range	0...2 ppm	0...0.5 ppm 0...2 ppm 0...10 ppm 0...20 ppm			

Outputs 0/4 - 20mA

The mA outputs may be used either for documentation of the measuring value or as regulated value. When the regulated value is set, the metering direction selected in "control" will be automatically used!



Operating Menu / Description

	Initial value	Possible values			Remarks
		Increment	Lower value	Upper value	
Variable allocation	Measured value	Measured value Regulated value Correcting value			
Output range	4...20 mA	0...20 mA 4...20 mA			
Range measured value 1 pH	pH 2...pH 12	pH 0.01	pH -2	pH 16	Minimum range pH 0.1
Range regulated variable	0 %...+100 %	1 %	0 %	+100 %	Minimum range 1 %
Range measured value 2 chlorine dioxide	0...0.500 ppm 0...2.00 ppm 0...10.00 ppm 0...20.00 ppm	0.001 ppm 0.01 ppm 0.01 ppm 0.01 ppm	-0.050 ppm -0.20 ppm -1.00 ppm -2.00 ppm	0.550 ppm 2,20 ppm 11.00 ppm 22.00 ppm	Minimum range 1 %
Range regulated variable	0 %...+100 %	1 %	0 %	+100 %	Minimum range 1 %

General settings

Alarm relay

The alarm relay may be activated / deactivated. When deactivated, no fault message is displayed.

Pause function

With regard to the pause, a delay time "td" may be set. The control will start again only after cessation of the pause contact and expiry of the preset delay time. When the delay time is elapsing, a clock symbol will be displayed. The pause function may be reset by pressing the start/stop button.

The mA output measuring value will be frozen when the pause function is activated.

Control input

The control input may be used for fault messages for sample water, ClO₂ shock dosing or base load metering ClO₂. In the event of fault message for sample water, control will be stopped, metering will be set to base load and the alarm relay will be activated. If ClO₂ shock dosing is set, the control signal sets metering to maximum frequency until the preset specified value for ClO₂ shock dosing is reached. This function will only be available if metering direction is set to chlorine dioxide. If base load is set, a control signal will apply a base load to the chlorine dioxide pump. This base load will be maintained for the duration of the control signal.

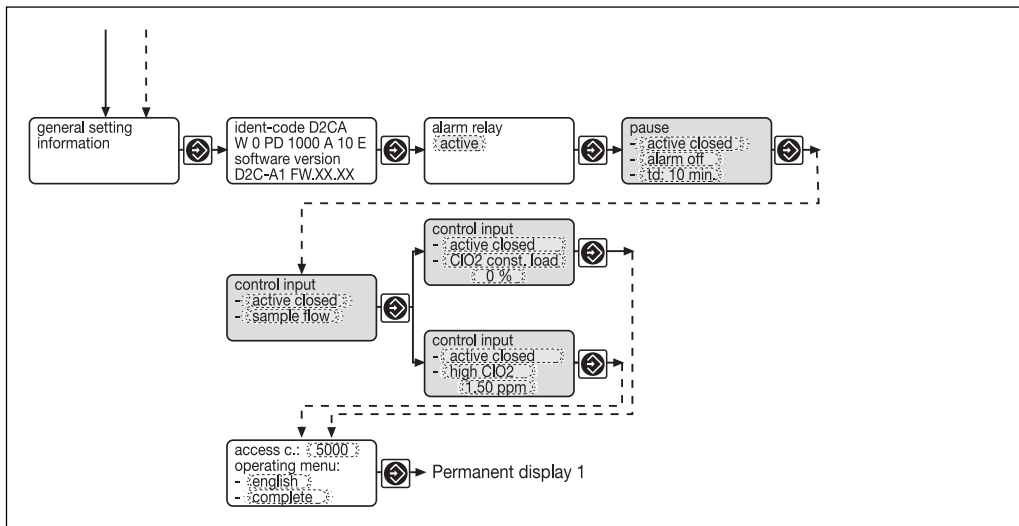
Operating menu

All setting menus may be accessed by switching from reduced to complete. We recommend to set the reduced menu again after commissioning.

Access code

If the access code (factory-set to 5000) is altered, no settings with the exception of calibration may be carried out without entering the correct code.

Operating Menu / Description



	Initial value	Possible values			Remarks
		Increment	Lower value	Upper value	
Alarm relay	active	active not active			
Pause	closed	closed open			
Control	Alarm off	Alarm off	0 min.	60 min.	
	td: 10 min. Sample water	Alarm on 1 min. Sample water High ClO ₂ (shock dosing) Base load ClO ₂ off			
Control	0.150 ppm	0.001 ppm	adjusted setpoint	0.500 ppm	only for dosing direction ClO ₂
	0.60 ppm	0.01 ppm		2.00 ppm	
	3.00 ppm	0.01 ppm		10.00 ppm	
	6.00 ppm	0.01 ppm		20.00 ppm	
High load ClO ₂ (shock dosing)	ClO ₂		ClO ₂	Measuring range	
Control base load ClO ₂	0 %	1 %	0 %	100 %	only for dosing direction ClO ₂
Access code	5000	1	1	9999	
Language	as per identity code	German English French Spanish Swedish Dutch Polish Italian			
Operating menu	reduced	reduced complete			

9 Technical Terms

- Calibration:** By calibrating (adjusting), the measuring value readout will be adjusted to the actual probe signal. Without calibration, a correct measurement is not possible. A calibration should be performed regularly (depending on application).
- Solenoid valve:** Activation of solenoid valves (motor-driven pumps) is defined by the cycle time and the minimum on-state interval (minimum time) (pulse length control). The on-state interval always corresponds to at least the minimum time. However, it is increased up to the cycle time at a maximum depending on the control deviation and the control response. The cycle time itself defines the maximum possible on-state operations. For instance, an actuator is switched on a maximum of 60 times per hour when the cycle time is at 60 seconds. The minimum time defines the minimum on-state interval duration. It should be selected as small as possible while, however, ensuring that metering is still possible within this time.
- Zero point:** The zero point of pH probes is theoretically 0 mV. In practice, for a good probe function a zero point of ± 25 mV is acceptable. The zero point of chlorine dioxide measuring cells is 4 mA. A calibration is not necessary.
- Slope:** The slope of pH probes should always be ≥ 50 (better ≥ 55) mV/pH. The slope of the chlorine dioxide measuring cell is given in mA/ppm. For a good probe function, the values accepted by the controller are sufficient.
- Set point:** The set point is the value which is to be continuously maintained stable throughout the process via controlling.
- Regulated value:** The regulated value is the value (e.g. frequency, mA signal) the controller sends to the final controlling element (e.g. metering pump) to reach again the set point.
- Control parameter:** The control parameters (xp, Ti, Td) determine the control characteristic (PID).
- Manual control:** In this setting, the controller produces a controlled variable corresponding to the entry. It is retained up to the next change. It is independent of the measured variable and the set control parameters. This setting can be used for determining the time response (e.g. dead time...) of the controlled system.
- xp value:** This value influences the proportional control behaviour. In case of a deviation of 1.4 pH (=10 % of 14 pH) or 0.2 ppm (=10 % of 2 ppm), a xp value of 10 %, for example, leads to a regulated value of 100 %. If the xp value has to be increased to 20 %, the deviation must be double the value in order to reach a regulated value of 100 %. In case of control overshooting, the set xp value must be doubled.
- Ti (integral action time):** This value defines the integral (I) control behaviour. The greater Ti, the lower the I proportion.
- Td (differential action time):** This value defines the differential (D) control behaviour. The lower Td, the lower the D proportion.
- Metering direction:** This value determines in which direction the controller is active. In case of the metering direction "acid", the controller generates a manipulated value when the specified value for pH is exceeded.
- Additive base load:** This results in the fact that the controller always generates a manipulated value corresponding to the additive base load. This load may only be reset to 0 using the stop button. This function should not be activated when using PI or PID controllers.
- Relay:** The relay (alarm, limit relay) switch when the corresponding prerequisites (e.g. alarm condition, limit violation) are given. The relay function can be set either as make contact (active closed) or break contact (active open). The relay may be reset pressing the stop button. (Exception: limit value).

10 Troubleshooting

Fault	Fault text	Symbol	Effect on metering	Effect on control	Alarm with acknowledgement	Remarks	Remedy
Measured variable 1 Signal exceeded/ drops below value	<i>pH input</i> ↑↓	☹	Basic load	Stop	yes	3 mA>signal>23 mA -499 mV>signal>499 mV	Check probe, transducer and cable connection
Calibration with error	<i>pH calibration defect</i>	☹	Basic load pH	Stop pH	no		Check probe, clean, replace if necessary, recalibrate if necessary
Measured variable 2 Signal exceeded/ drops below value	<i>CD input</i> ↑↓	☹	Basic load	Stop	no	3 mA>signal>23 mA	Check probe, transducer and cable connection
Calibration with error	<i>CD calibration defect</i>	☹	Basic load ClO ₂	Stop ClO ₂	no		Check probe, clean, replace if necessary, recalibrate if necessary
Limit transgression after checkout time	<i>pH limit value</i> <i>CD limit value</i>	☹	no metering	Stop	yes	Function may be deactivated	
Correcting variable Signal exceeded/ drops below value	°C input ↑↓	☹	Basic load	Stop	yes	Signal ~ 100 Ω or ~138.5 Ω	

Operating step	Note text	Symbol	Effect on metering	Effect on control	Alarm with acknowledgement	Remarks	Remedy
Stop button	<i>Stop button</i>	☹	no metering	Stop	no		Start unit, run-on time "td" stops, shock dosing stops
Pause contact	<i>Pause</i>	☹	no metering	Stop	yes, may be deactivated	delay time td adjustable, ☹ display elapsing "td"	Deselect pause, delay time "td"
Fault sample water	<i>Fault sample water</i>	☹	no metering	Stop	yes	Function switchable	
ClO₂ shock dosing	<i>High ClO₂</i>	☹	frequency adjustable	Stop	no	Function switchable	
Base load ClO₂	<i>Base load ClO₂</i>	☹	frequency adjustable		no	Function switchable	
Electronic fault	<i>EEPROM defective</i>	☹	no metering	Stop	yes		send in unit

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