



Operating Instructions

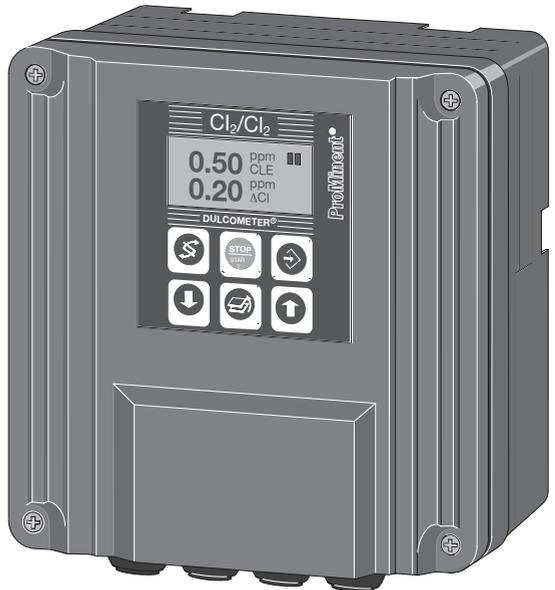
DULCOMETER® D2C

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

D2C2-001-chlorine/chlorine-GB



Typ D



Typ W

D2C A _____

Please enter the identity code of your device here!

Please completely read through operating instructions! · Do not discard!
The operator shall be liable for any damage caused
by installation or operating errors!

2 General User Information

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General User Information

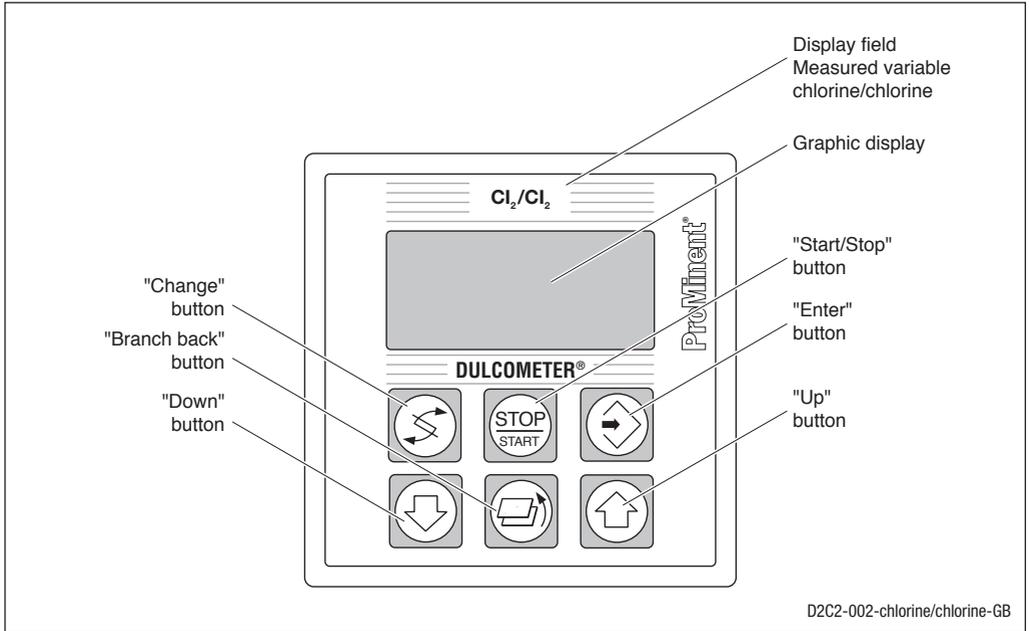
These operating instructions describe the technical data and function of the series DULCOMETER® D2C controller, provide detailed safety information and are divided into clear steps.



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!***

3 Device Overview / Controls



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

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

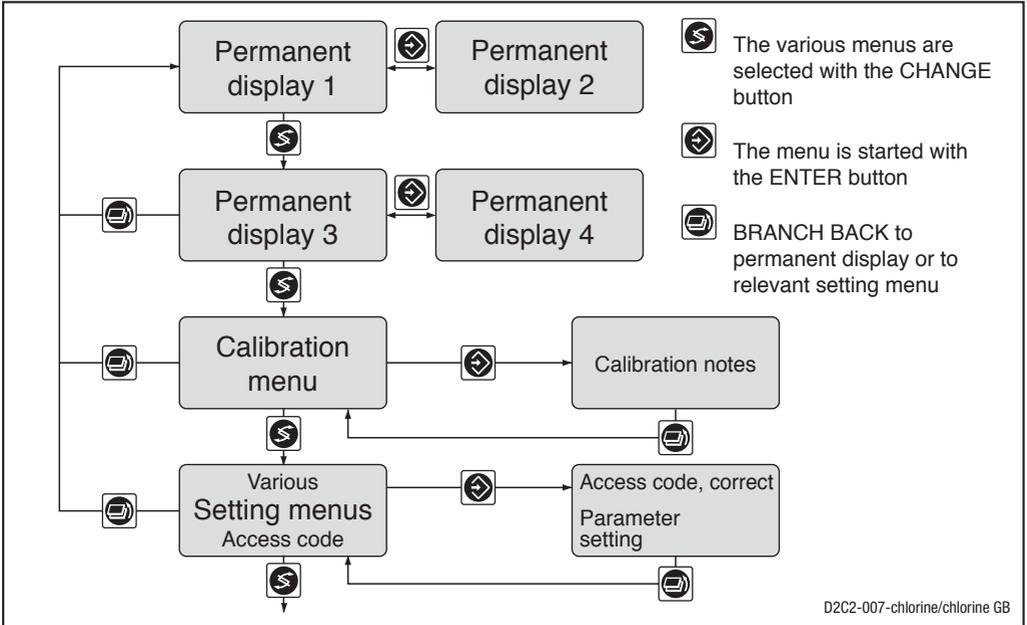
Faults to be acknowledged are shown in the permanent displays by the symbol "E". The corresponding fault messages and notes are shown in the permanent display 2. Faults/notes continuing after acknowledgement are shown alternatively. Faults automatically remedied through changing operating conditions 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"
⊖	Fault	

6 Operation



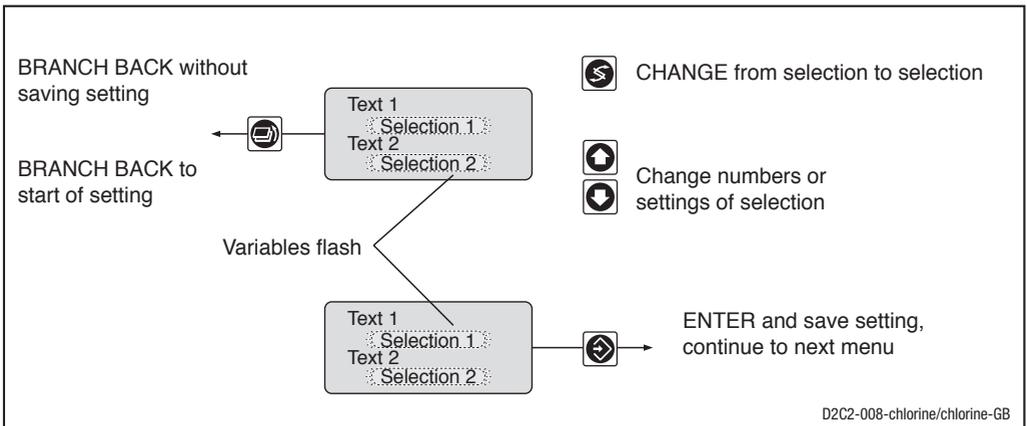
NOTE

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!

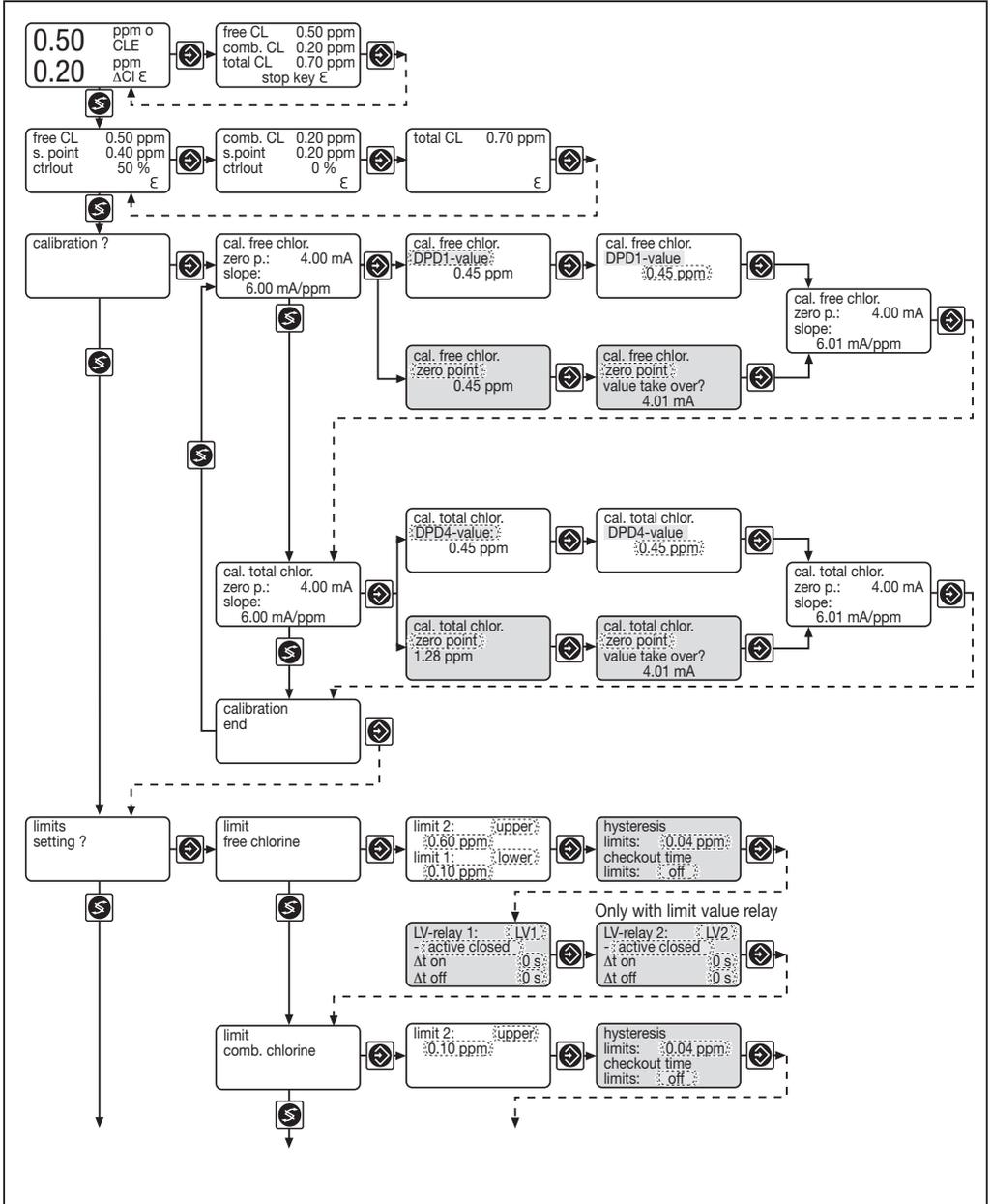
If the access code is selected correctly in a setting menu, then the following setting menus are also accessible!

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.

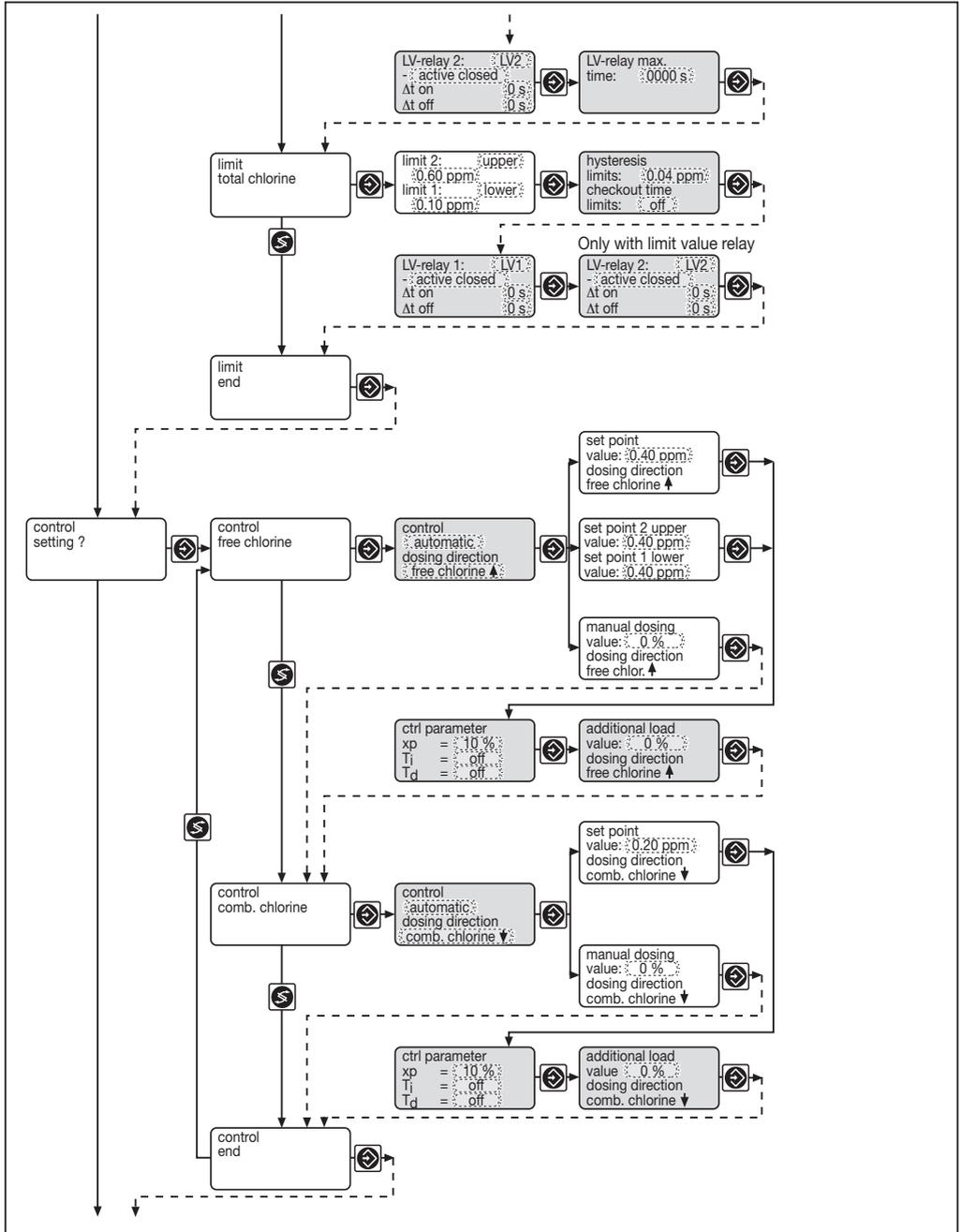


7 Operating Menu / Overview

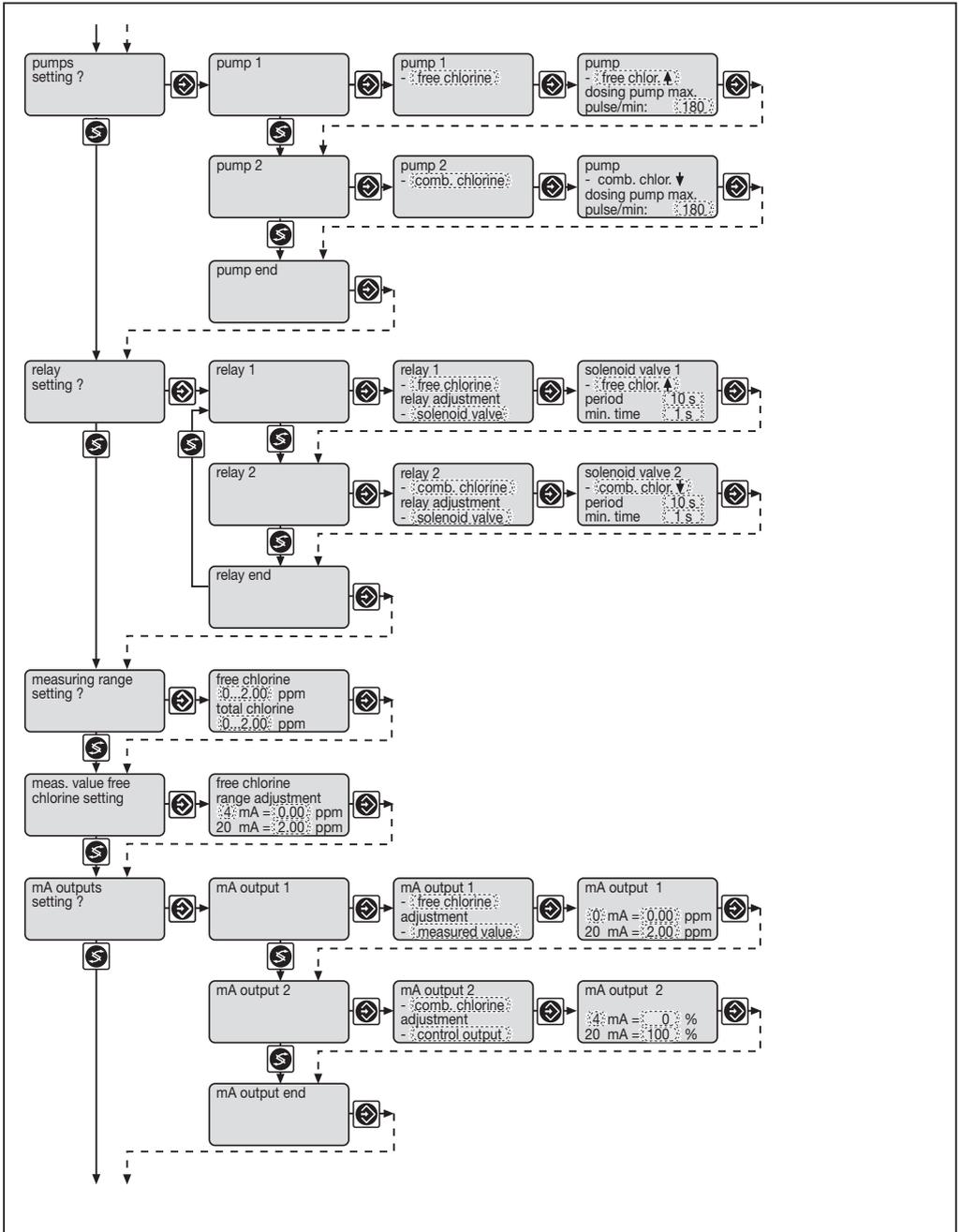
The setting menus highlighted in grey and the adjustable parameters are only visible in the complete operating menu.



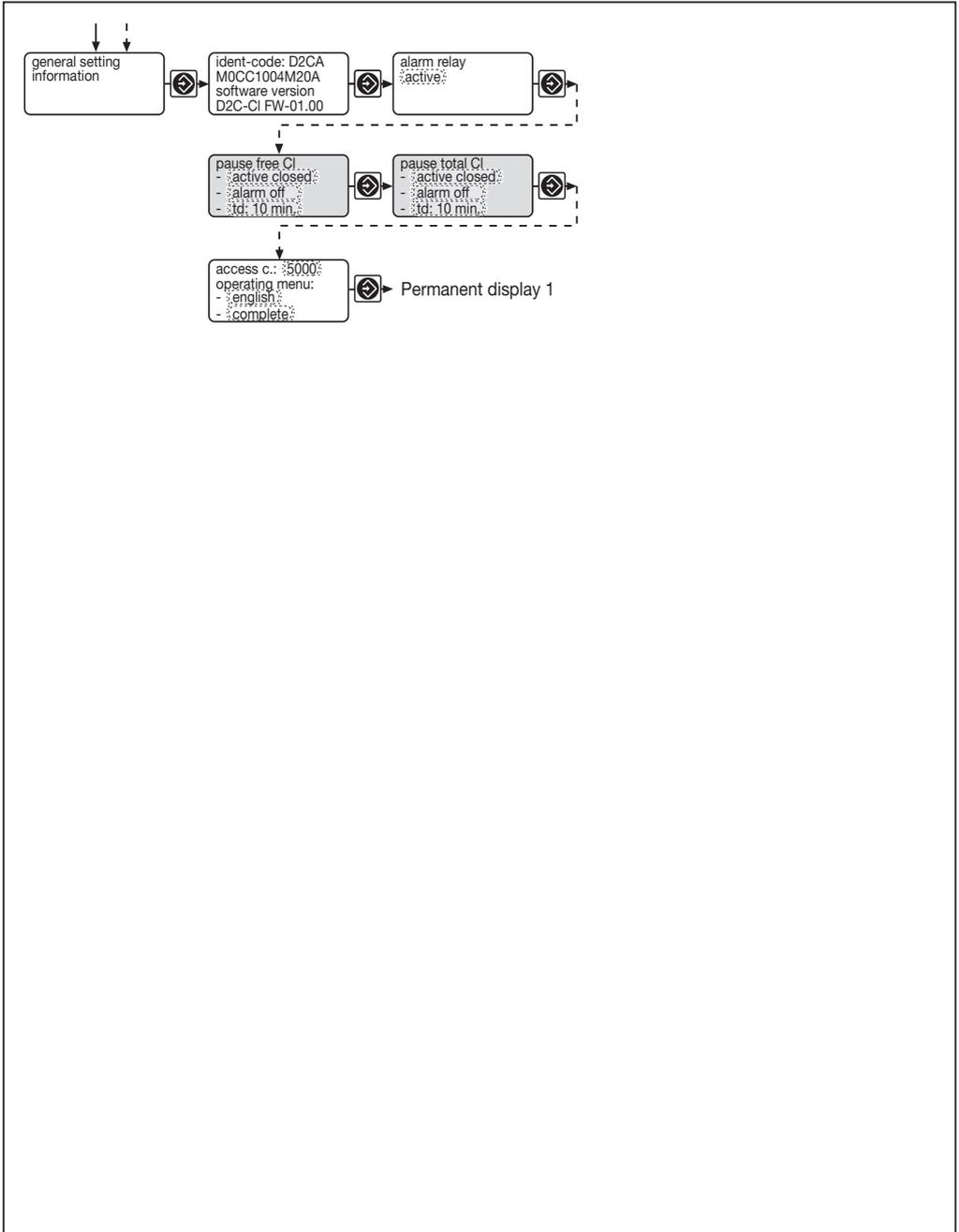
Operating Menu / Overview



Operating Menu / Overview

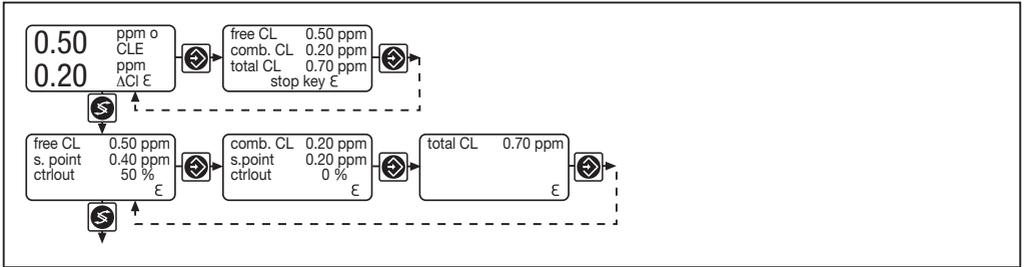


Operating Menu / Overview



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.

Calibrate

The chlorine probe is calibrated (slope adjustment) using the DPD method (free chlorine: DPD1, total chlorine: DPD1+3 or DPD4). The frozen measured value is suggested at the start of the calibration; this can be adjusted to the measured DPD value with the up / down keys. A calibration is only possible if the DPD value is $\geq 2\%$ of the range. The control function stops during the calibration and the dosing goes over to base load. After a successful calibration, the error diagnostics related to the measured value are restarted.

In the complete operating menu, the zero can be adjusted as well as the slope. The zero adjustment must be made under realistic operating conditions with **chlorine-free** water! In this case control is stopped and the dosing is reduced to the set base load.

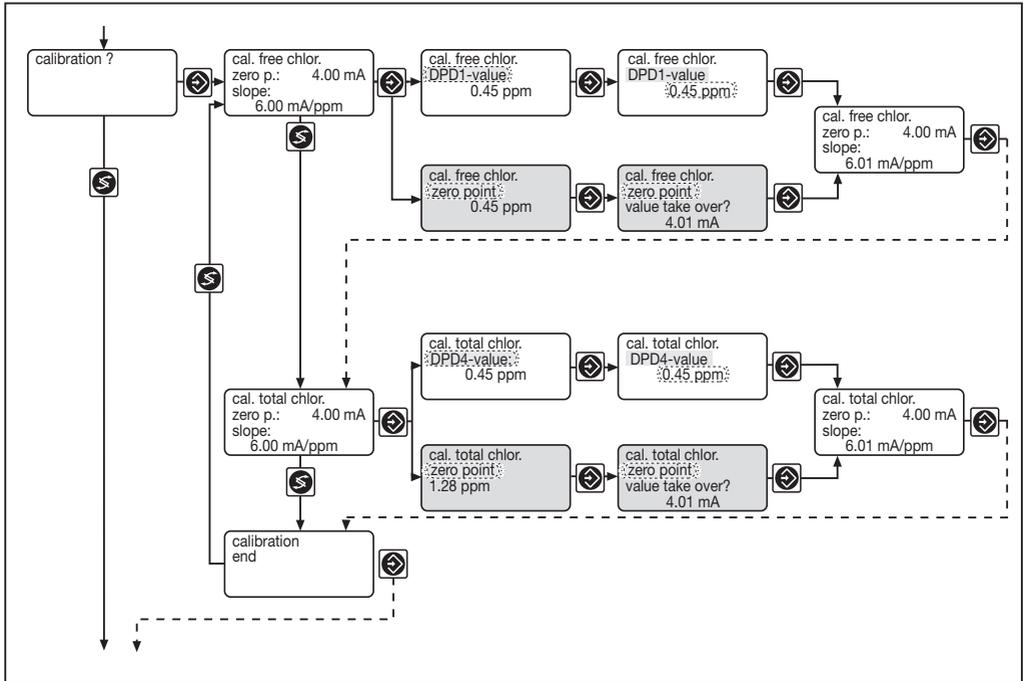
The 0/4 ... 20 mA output (measured value) is frozen at the start of the calibration.



ATTENTION

- **The range of the chlorine measuring cell must match the set range of the DULCOMETER® D2C (factory setting 0 - 2.00 ppm). Any range adjustment (see "Measuring ranges" and "Free chlorine measured value" sections, Page 19) must be made before the calibration. When the range is changed, all settings are reset to the factory settings.**
- **The D2C Cl₂/Cl₂ must only be operated in conjunction with a pH control system which maintains the pH at a constant value with a maximum deviation of $X_m = 0.05$ pH! Only then can the D2C Cl₂/Cl₂ control the chlorine concentration with sufficient accuracy, as the chlorine measured value is pH-dependent.**

Operating Menu / Description



	Initial value	Possible values		
		Increment	Lower value	Upper value
DPD value	Measured value	0.01 ppm 0.01 ppm 0.01 ppm	-0.20 ppm -0.50 ppm -1.00 ppm	2.20 ppm 5.50 ppm 11.00 ppm
Zero point	Measured value (mA)	-	-	-

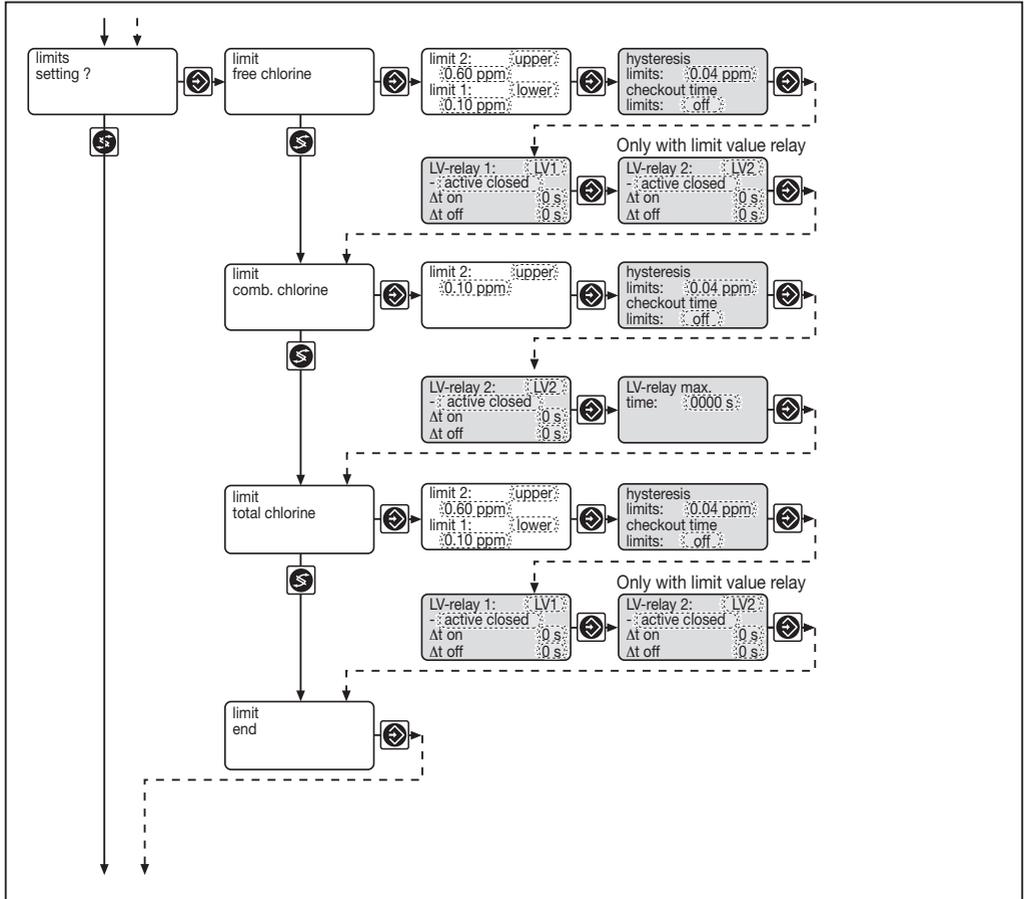
Error message	Condition	Remarks
Cl calibration not possible! Slope too low	Cl slope too low (<25 % of the standard slope)	Repeat calibration
Cl calibration not possible! Slope too high	Cl slope too high (>300 % of the standard slope)	Repeat calibration
DPD value too small! DPD > x.xx ppm	DPD <2 % of measuring range	Repeat calibration after addition of chlorine
Zero point high	Sensor signal > 5 mA	Repeat calibration in chlorine-free water
Zero point low	Sensor signal < 3 mA	Check sensor connection Possibly change sensor

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.

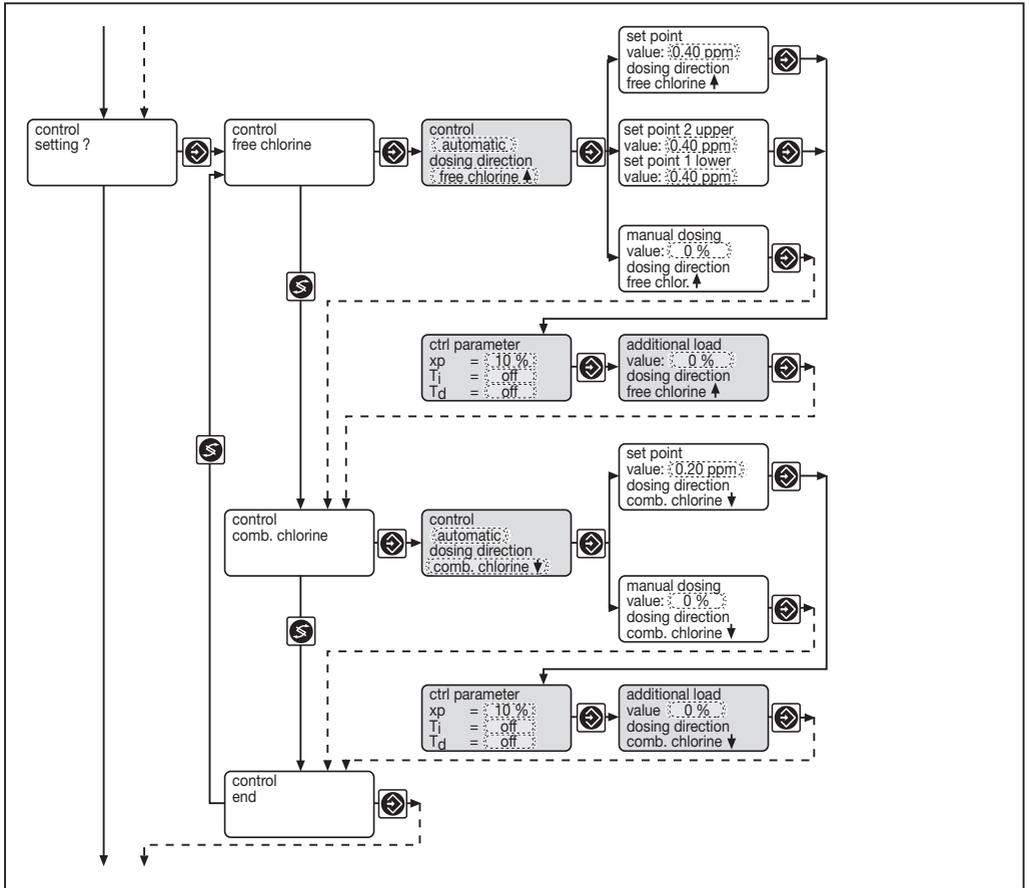


Operating Menu / Description

	Initial value	Possible values		Upper value	Remarks
		Step interval	Lower value		
Type of limit infringement					Limit infringement when value exceeds or falls below limit
Free chlorine	upper	upper lower			
Combined chlorine	lower	upper lower			
Total chlorine	upper	upper lower			
Limit value 1	0.10 ppm	0.01 ppm	-0.20 ppm	2.20 ppm	
	0.25 ppm	0.01 ppm	-0.50 ppm	5.50 ppm	
	0.50 ppm	0.01 ppm	-1.00 ppm	11.00 ppm	
Limit value 2	0.60 ppm	0.01 ppm	-0.20 ppm	2.20 ppm	
	1.50 ppm	0.01 ppm	-0.50 ppm	5.50 ppm	
	3.00 ppm	0.01 ppm	-1.00 ppm	11.00 ppm	
Hysteresis limit	0.04 ppm	0.01 ppm	0 ppm	2.20 ppm	Works towards clearing the infringement of the limit.
	0.10 ppm	0.01 ppm	0 ppm	5.50 ppm	
	0.20 ppm	0.01 ppm	0 ppm	11.00 ppm	
Checkout time limit	Off	1 s	1 s	9999 s	Leads to message and alarm and shutdown of the corresponding dosing. Off: function switched off, no message, no alarm.
Limit relay 1	LV-relay 1	LV-relay 1 LV-relay 2 Zone* Off			*With the "Zone" setting the gap between the limits must be ≥ 3 times the set hysteresis.
Limit relay 2	LV-relay 1	LV-relay 1 LV-relay 2 Zone* Off			
Limit relays 1, 2	active closed	active closed active open			
Turn-on delay Δt On	0 s	1 s	0 s	9999 s	
Turn-off delay Δt Off	0 s	1 s	0 s	9999 s	
Limit relay max. (turn-on) time	Off	1 s	1 s / Off	9999 s	Function can be switched off

Operating Menu / Description

Control



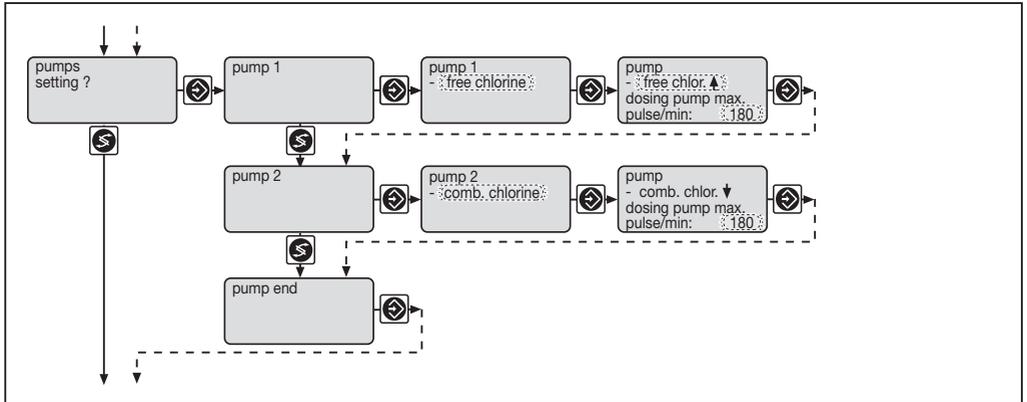
	Initial value	Possible values			Remarks
		Step interval	Lower value	Upper value	
Control	automatic	automatic auto with dead zone manual off			
Dosing direction	free chlorine ↑	free chlorine ↑ free chlorine ↓ free chlorine ↑/↓			
Setpoint 1/2	0.40 ppm 1.00 ppm 2.00 ppm	0.01 ppm 0.01 ppm 0.01 ppm	0 ppm 0 ppm 0 ppm	2.00 ppm 5.00 ppm 10.00 ppm	setpoint1 ≤ setpoint2

Operating Menu / Description

	Initial value	Possible values			Remarks
		Step interval	Lower value	Upper value	
Control parameter xp	10 %	1 %	1 %	500 %	xp relative to measuring range
Control parameter Ti	Off	1 s	1 s	9999 s	
Control parameter Td	Off	1 s	1 s	2500 s	
Additive base load	0 %	1 %	0 %	+100 %	
Manual dosing (free chlorine)	0 %	1 %	-100 %	+100 %	
Manual dosing (combined chlorine)	0 %	1 %	0 %	+100 %	

Pumps

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



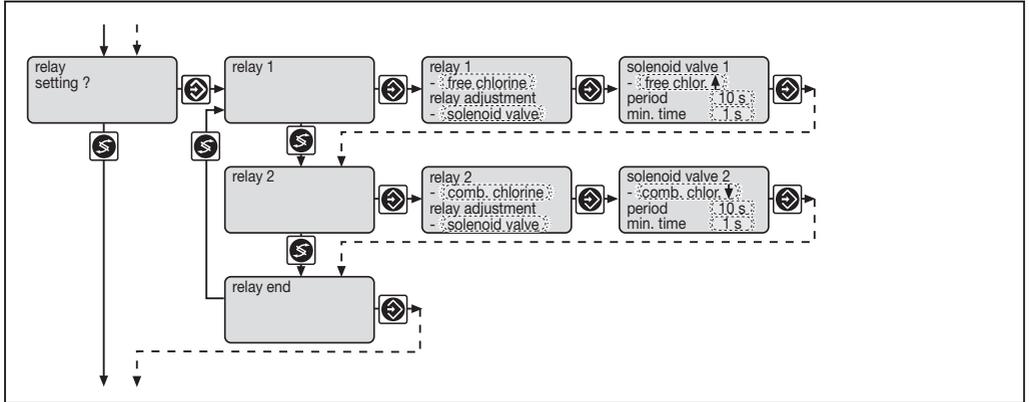
	Initial value	Possible values			Remarks
		Step interval	Lower value	Upper value	
Assignment of measured variables					
Pump 1	free chlorine	free chlorine combined chlorine Off			
Pump 2	combined chlorine	free chlorine combined chlorine Off			
Dosing direction	free chlorine ↑	free chlorine ↑ free chlorine ↓			
Pump					
Max. no. of strokes/min of pumps 1 and 2	180	1	1	500	Selection only available with free chlorine Off = 0 strokes/min

Operating Menu / Description

Relays

The two relays can be freely assigned with regard to function (limit, correcting element, solenoid valve). If the function is set to correcting element or solenoid valve, the relays are de-energised on fault to prevent faulty dosing.

Relay output 2 for combined chlorine is used to control devices for minimising combined chlorine.



	Initial value	Possible values Increment	Lower value	Upper value	Remarks
Measured variable assignment					
Relay 1	free chlorine	free chlorine comb. chlorine total chlorine Off			
Relay 2	comb. chlorine	free chlorine comb. chlorine total chlorine Off			
Function assignment	in accordance with Identity Code	limit value correcting element *			
Relay		solenoid valve ¹⁾			¹⁾ not with total chlorine measured variable * e.g. motor-driven pump Relay is de-energised on fault and during the calibration
Dosing direction	free chlorine ↑	free chlorine ↑ free chlorine ↓			Selection only available with free chlorine
Solenoid valve 1					
Cycle time	10 s	1 s	10 s	9999 s	
Minimum time	1 s	1 s	1 s	cycle/2	

Operating Menu / Description

Measuring ranges



ATTENTION

- The ranges (factory setting 0 – 2.00 ppm) must match the ranges of the chlorine measuring cells used.
- If the range is changed, all settings (limits, setpoints) are reset to the factory settings!



	Initial value	Possible values			Remarks
		Increment	Lower value	Upper value	
Measuring range	0...2 ppm	0...2 ppm 0...5 ppm 0...10 ppm			

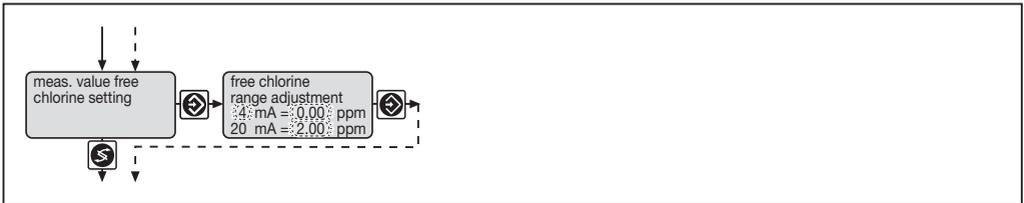
Free chlorine measured value

The measurement signal for free chlorine is connected to the standard signal input of X2. As the measurement signal can come from an external device or a D1C with a different range, you can adjust the range of this standard signal input separately in this setting menu.



ATTENTION

- If the range is changed, all setting values must be checked!
- If the measurement signal does not come directly from a sensor, but comes from a device such as a D1C, for example, only the ranges of the D2C and the device have to be matched to one another – do not calibrate the D2C for free chlorine!
- If the range changes, the controller range also changes with it!

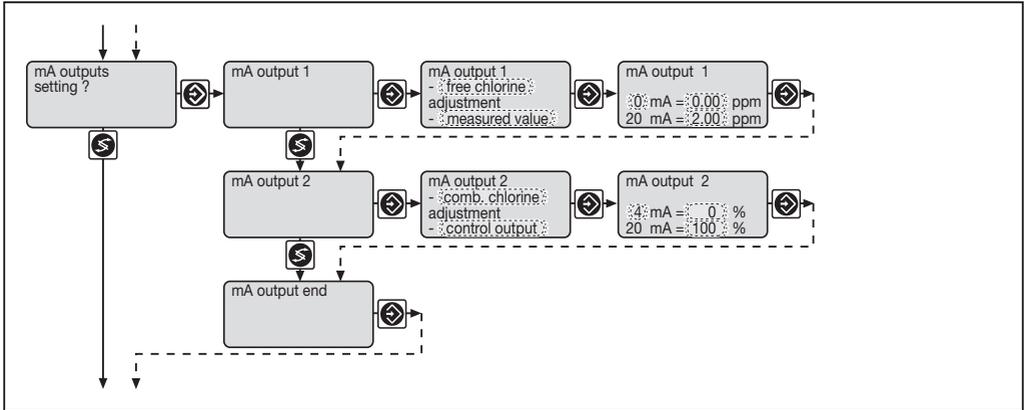


	Initial value	Possible values			Remarks
		Step interval	Lower value	Upper value	
Lower limit of standard signal range	4 mA	4 mA 0 mA			Upper limit is 20 mA
Range assigned to the standard signal	0...2.00 ppm 0...5.00 ppm 0...10.00 ppm	0.01 ppm 0.01 ppm 0.01 ppm	-0.20 ppm -0.50 ppm -1.00 ppm	2.20 ppm 5.50 ppm 11.00 ppm	

Operating Menu / Description

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!!



	Initial value	Possible values			Remarks
		Increment	Lower value	Upper value	
Measured variables assignment mA output 1	free chlorine	free chlorine comb. chlorine total Cl Off			
mA output 2	comb. chlorine	free chlorine comb. chlorine total Cl Off			
Functions assignment output1 → output2 →	measured value measured value	measured value control variable ¹⁾			¹⁾ not with total chlorine measured variable
Lower limit	4 mA	4 mA			Upper limit is 20 mA
Standard signal range		0 mA			
Measured value range	0...2 ppm	0.01 ppm	-1.00 ppm	11.00 ppm	Minimum range 0.1 ppm
Control variable range	0 %...+100 %	1 %	0 %	+100 %	Minimum range 1 %

Operating Menu / Description

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.

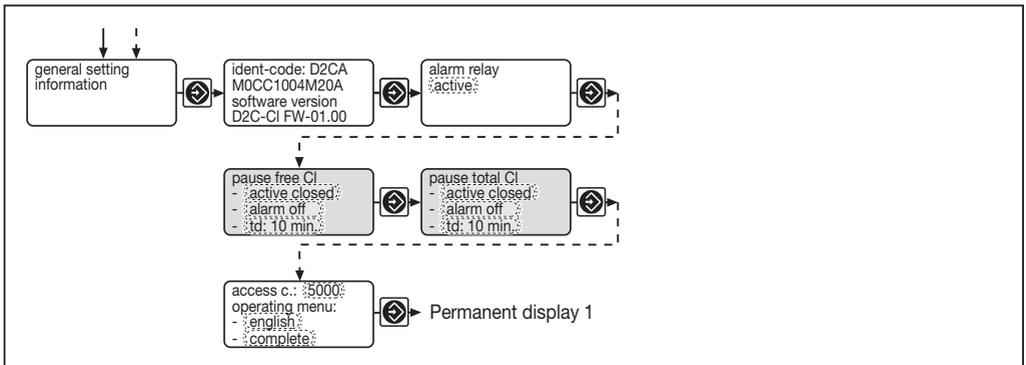
The mA output measuring value will be frozen when the pause function is activated.

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.



	Initial value	Possible values		Lower value	Upper value	Remarks
		Increment				
Alarm relay	active	active not active				
Pause	closed	closed open				
	Alarm off	Alarm off Alarm on				
td:	10 min	1 min	0 min	60 min		
Access code	5000	1	1	9999		
Language	as per identity code	German English French Spanish Swedish Dutch				
Operating menu	restricted	restricted 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 probes 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 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 (x_p , T_i , T_d) 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.
- x_p 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 x_p value of 10 %, for example, leads to a regulated value of 100 %. If the x_p 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 x_p value must be doubled.
- T_i (integral action time):** This value defines the integral (I) control behaviour. The greater T_i , the lower the I proportion.
- T_d (differential action time):** This value defines the differential (D) control behaviour. The lower T_i , 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 Faults / Notes / Troubleshooting

Error	Error text	Symbol	Effect on dosing	Effect on control	Alarm with acknowledge	Remarks	Remedy
Free chlorine signal too high /too low	free Cl input ↑↓	☹	base load ²⁾	stop ³⁾	Yes	3 mA>signal>23 mA	Check sensor, transmitter and connection
Limit infringement after check time	free Cl limit 1 ↓↑ free Cl limit 2 ↓↑	☹	none	stop ³⁾	Yes	Function can be switched off	
Faulty calibration	cal. free Cl not possible!	☹	base load ²⁾	stop ³⁾	No		Check sensor, clean, possibly renew. Repeat calibration
Total chlorine signal too high /too low	total Cl input ↑↓	☹	base load ²⁾	stop ³⁾	Yes	3 mA>signal>23 mA	Check sensor, transmitter and connection
Limit infringement after check time	total Cl limit 1 ↓↑ total Cl limit 2 ↓↑	☹	none	stop ³⁾	Yes	function can be switched off	
Faulty calibration	cal. total Cl not possible!	☹	base load ²⁾	stop ³⁾	No		Check sensor, clean, possibly renew. Repeat calibration
Combined chlorine negative value	comb Cl negativ	☹	continues		No	< -10 % of measuring range	Optimise pH controller, recalibrate free Cl and total Cl
Limit infringement after check time	comb Cl limit 2 ↓↑	☹	none	stop	Yes	Function can be switched off	

Operating step	Info text	Symbol	Effect on dosing	Effect on control	Alarm with acknowledge	Remarks	Remedy
Stop key ²⁾	stop key	☹	none	stop	No		Start device
Pause contact	pause	☹	none	stop	Yes, switchable	Delay time td adjustable:  shows current „td“	Deselect pause, delay time td
Electronics error	EEPROM faulty	☹	none	stop	Yes		Return device

²⁾ the dosing for combined chlorine goes onto base load as well (except for limit infringement)

³⁾ the control for combined chlorine stops as well (except for limit infringement)

⁵⁾ the delay period td of the pause function is deleted

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Operating Instructions DULCOMETER® D2C, Part 2, Chlorine/Chlorine
Subject to modifications · Printed in Germany

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