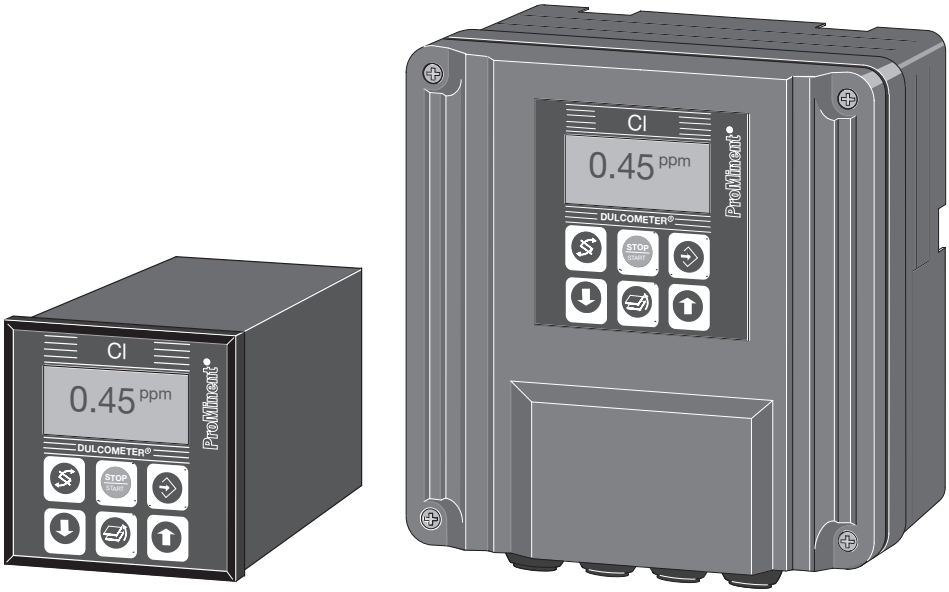
# Operating Instructions

## DULCOMETER® D1C

Part 2: Adjustment and Operation,
Measured Variable Chlorine

D1C2-Cl-001-GB




**Type D** **Type W**

**D1C 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!**

Part No. 987905 **ProMinent Dosiertechnik GmbH · 69123 Heidelberg · Germany** BA DM 161 01/08 GB

# 1 Device Identification / Identity Code

| D1C A | DULCOMETER® Controller Series D1C / Version A |
|---|---|
| | **Type of mounting** |
| D | Control panel installation 96 x 96 mm (IP 54) |
| W | Wall mounting (IP 65) |
| | **Operating voltage** |
| 0 | 230 V 50/60 Hz |
| 1 | 115 V 50/60 Hz |
| 2 | 200 V 50/60 Hz (only with control panel installation) |
| 3 | 100 V 50/60 Hz (only with control panel installation) |
| 4 | 24 V AC/DC |
| | **Measured variable** |
| C | Chlorine (0-0.5/2/5/10/20/50/100 ppm) |
| | **Connection of measured variable** |
| 1 | Terminal, standard signal 0/4-20 mA |
| | **Correction variable** |
| 0 | None |
| 1 | pH for chlorine via standard signal 0/4-20 mA |
| | **Feed forward control** |
| 0 | None |
| 1 | Flow as standard signal 0/4-20 mA |
| 2 | Flow as frequency 0-500 Hz |
| 3 | Flow as frequency 0-10 Hz |
| | **Control input** |
| 0 | None |
| 1 | Pause |
| | **Signal output** |
| 0 | None |
| 1 | Standard signal 0/4-20 mA measured value |
| 2 | Standard signal 0/4-20 mA control variable |
| 3 | Standard signal 0/4-20 mA correcting variable |
| 4 | 2 standard signal 0/4-20 mA outputs, freely programmable |
| | **Power control** |
| G | Alarm and 2 limit value/timer relays |
| M | Alarm and 2 solenoid valve relays |
| R | Alarm relay and servomotor with feedback |
| | **Pump control** |
| 0 | None |
| 2 | Two pumps |
| | **Control characteristic** |
| 0 | None |
| 1 | Proportional control |
| 2 | PID control |
| | **Log output** |
| 0 | None |
| | **Language** |
| D | German |
| E | English |
| F | French |
| I | Italian |
| N | Dutch |
| S | Spanish |
| P | Polish |
| A | Swedish |
| B | Portuguese |
| U | Hungarian |
| G | Czech |

| D1C A | ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ |
|---|---|

**Please enter the identity code of your device here!**

# 2 General User Information



## General User Information

These operating instructions describe the technical data and function of the DULCOMETER® D1C controller, provide detailed safety information and are divided into clear steps.

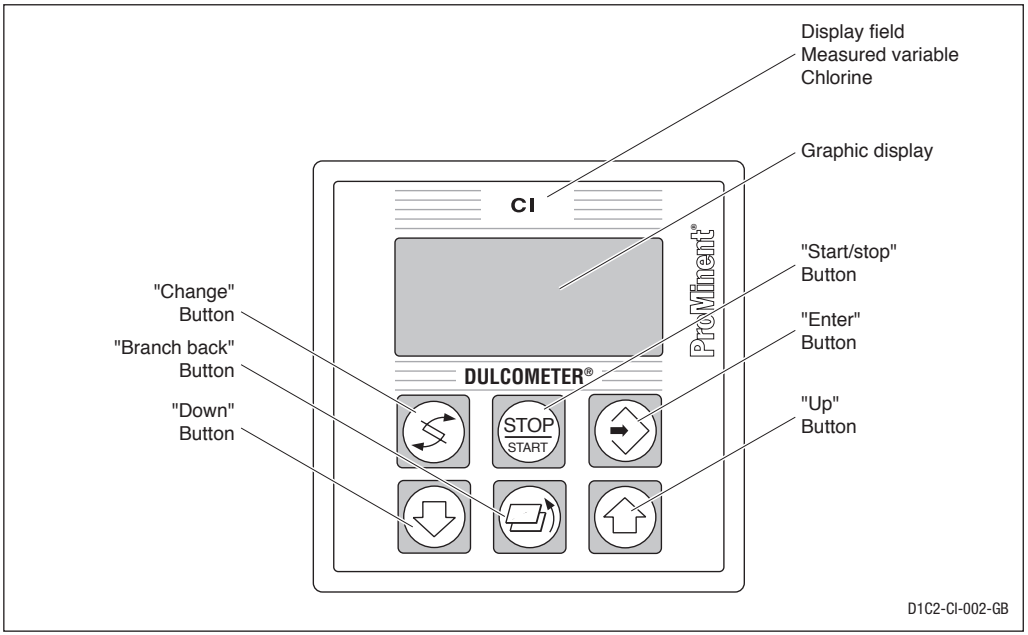
***IMPORTANT***

- ***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 sensor. The sensor has to be calibrated / checked regularly!***

***NOTE***

***A form "Documentation of controller settings type D1C" is available under www.prominent.com/documentation_D1C for the purpose of documenting the controller settings.***

# 3 Device Overview / Controls




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

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

# 4 Functional Description

***NOTE***

***Please refer to the description of the complete operating menu in Section 8 for a detailed description of the individual characteristics of the DULCOMETER® D1C controller!***

## 4.1 Operating Menu

The D1C 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 D1C 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 (see “General settings”).

## 4.2 Access Code

Access to the setting menu can be prevented by setting up an access code. The D1C controller is supplied with the access code 5000 which permits free access to the setting menu. The calibration menu remains freely accessible even if access to the setting menu is blocked by the code.

## 4.3 Control

The D1C 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 required rapid correction of setpoint deviations (less than approx. 30 seconds) cannot be processed with this controller. The cycle times must be taken into consideration when activating solenoid valves (pulse length) in the same way as their running times when activating servomotors (3-point).

Via the control input pause, the control function (selection of controlled variable) can be switched off. The calculation of the controlled variable starts again after cessation of “pause”.

## 4.4 Feed Forward Control

The D1C controller can process a signal of a feed forward control. Depending on the device version (see identity code) and the setting, this signal can be obtained in any form of a 0–20 mA or 4–20 mA signal or as a digital contact signal with the maximum frequencies 10 Hz or 500 Hz.

This signal can be used, for example, for flow-proportional metering (multiplicative effect) or feed forward-dependent basic load metering (additive effect). The result of control variable calculation from the proportional or PID control is multiplied by or added to the feed forward signal. A multiplicative feed forward variable at the level of the set rated value carries over the calculated control variable unchanged into the control variable:

*Control variable = Feed forward variable/rated value x calculated control variable*

During start-up, the zero point has to be checked. The multiplicative feed forward control is not designed for switching off permanently the actuating variable (signal ≈ 0).

An additive feed forward variable at the level of the rated value results in maximum control variable:

*Control variable (max. 100 %) = Feed forward variable/rated value x max. control variable + calculated control variable*

## 4.5 Error Messages

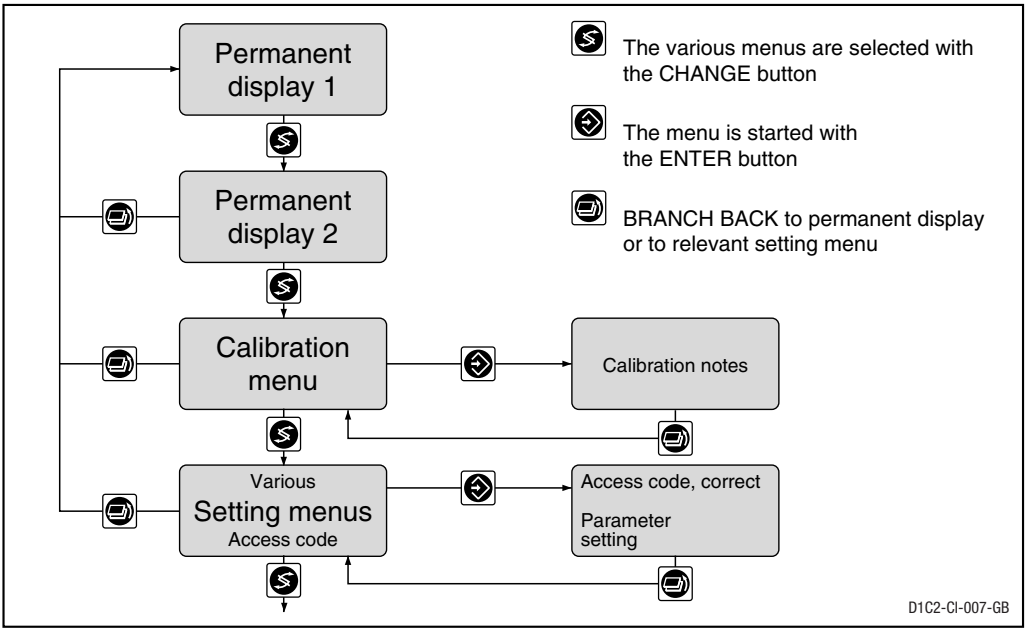
Error messages and information are indicated in the bottom line in the permanent display 1. Errors to be acknowledged (acknowledgement switches off the alarm relay) are indicated by the “Ϛ”. Errors/notes which still apply after acknowledgement are indicated alternately. During correction variable processing (temperature for correction of pH-value), the value is indicated in the same line as the error/note. Faults which are rectified of their own accord due to changed operating situations are removed from the permanent display without the need for acknowledgement.

# 5 Display Symbols

The display of the DULCOMETER® D1C controller uses the following symbols:

| Description | Comment | Symbol |
|---|---|---|
| Limit value transgression<br>Relay 1, upper | Symbol<br>left |  |
| Relay 1, lower | Symbol<br>left |  |
| Relay 2, upper | Symbol<br>right |  |
| Relay 2, lower | Symbol<br>right |  |
| Metering pump 1 (chlorine)<br>Control off | Symbol<br>left |  |
| Control on | Symbol<br>left |  |
| Metering pump 2 (dechlorine)<br>Control off | Symbol<br>right |  |
| Control on | Symbol<br>right |  |
| Solenoid valve 1 (chlorine)<br>Control off | Symbol<br>left |  |
| Control on | Symbol<br>left |  |
| Solenoid valve 2 (dechlorine)<br>Control off | Symbol<br>right |  |
| Control on | Symbol<br>right |  |
| Servomotor<br>Control, open relay | |  |
| Control, close relay | |  |
| Without control | |  |
| Position feedback | Thickness of bar<br>increases from left to right<br>during opening |  |
| Stop button pressed | |  |
| Manual metering | |  |
| Fault | |  |

# 6 Operation



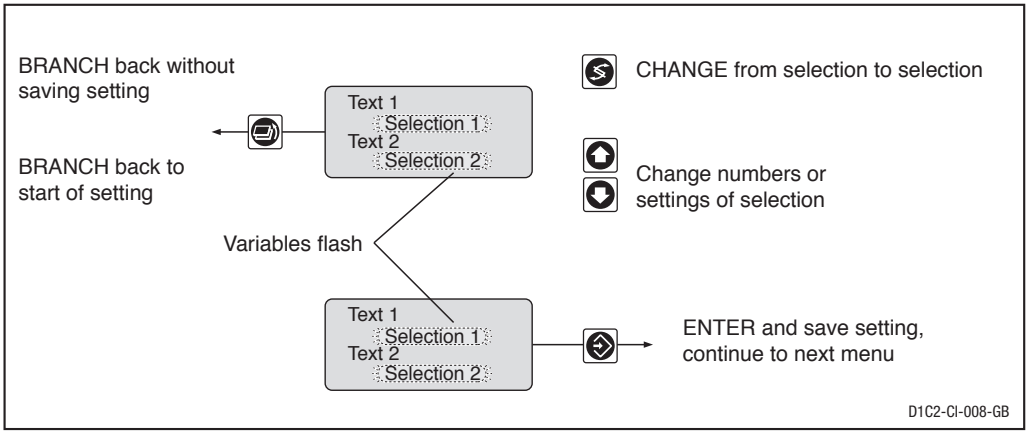

***NOTE***

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

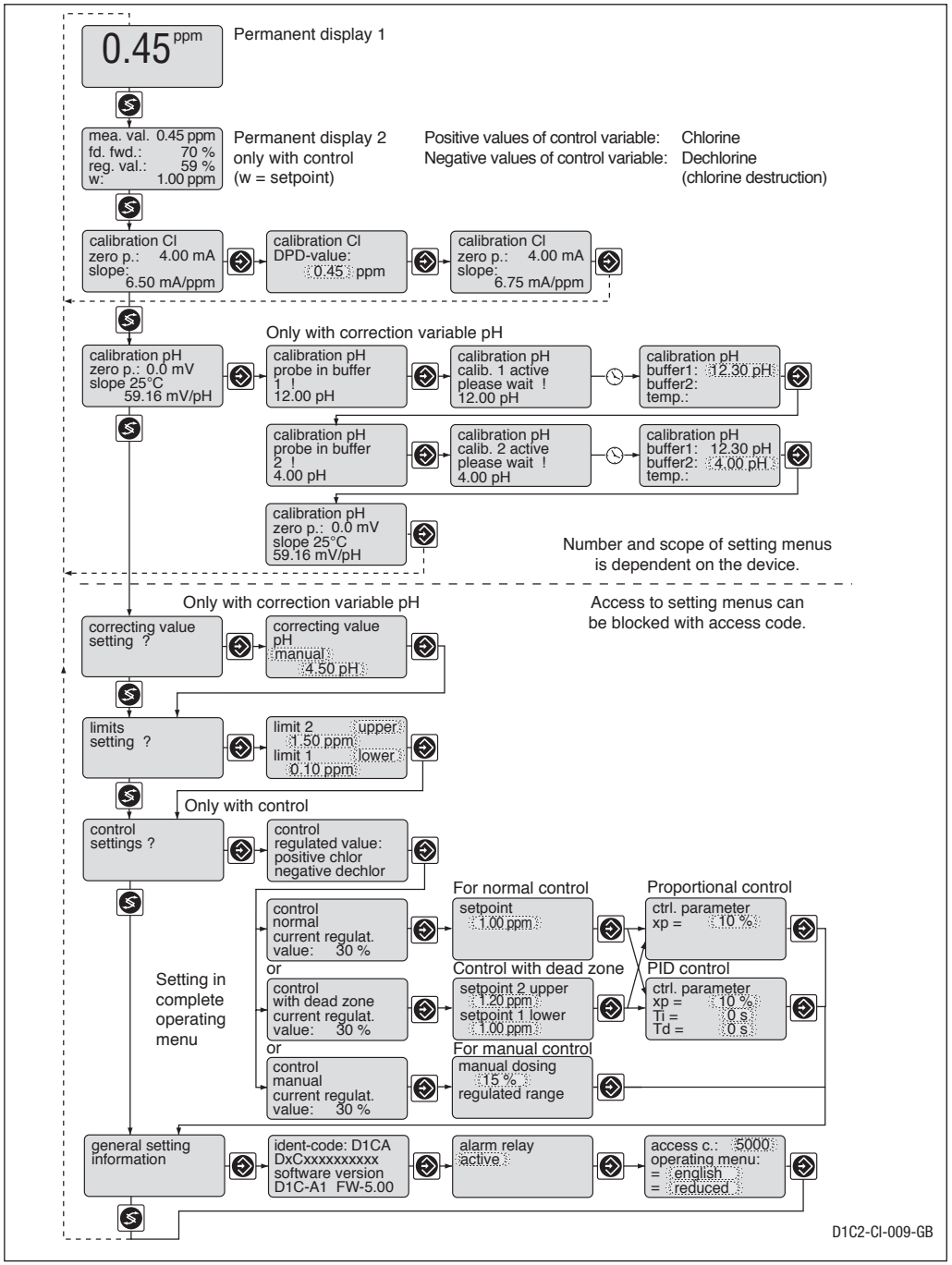
***The number and scope of setting menus is dependent on the device version!***

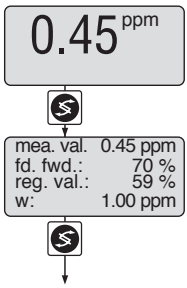
***If the access code is selected correctly in a setting menu, then the following setting menus are also accessible!***

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



# 7 Restricted Operating Menu / Layout






Permanent display 1

Permanent display 2
only with control
(w = setpoint)

Positive values of control variable: Chlorine
Negative values of control variable: Dechlorine (chlorine destruction)

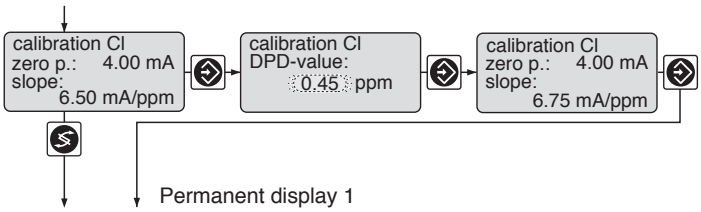
D1C2-Cl-011-GB

**Calibration of the Chlorine sensor**

During the calibration, the D1C sets the controller outputs to “0”. Exception: If a base load or manual controller output was set, these are maintained during the calibration. The standard signal outputs mA (measured value or correction value) are frozen. The measured value registered during the start of the calibration is proposed as the DPD value; this value is adjustable (arrow keys!). Calibration is only possible if the DPD value is ≥2 % of the measuring range. On successful completion of calibration, all error checks which refer to the measured value are restarted.

***IMPORTANT***

***The measuring range of the chlorine sensor must correspond to the adjusted measuring range (factory setting: 0–2 ppm). A change of the measuring range (see page 17) must be done before calibration!***



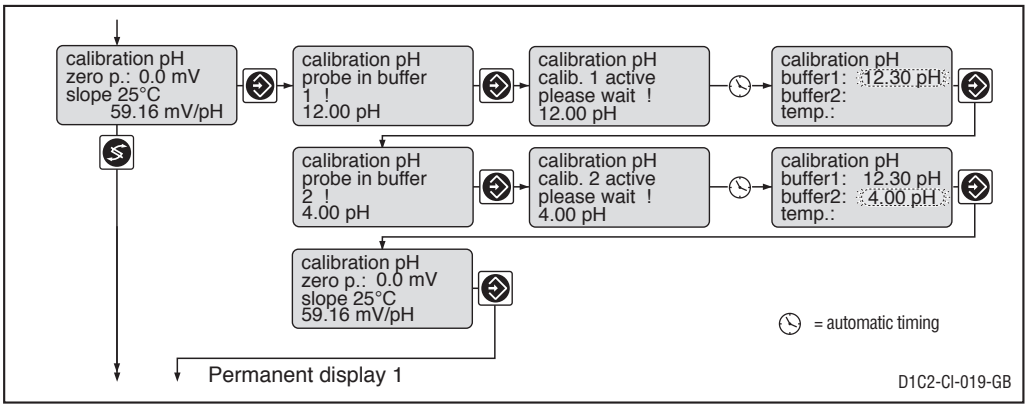

D1C2-Cl-012-GB

| | | Possible values | | | |
|---|---|---|---|---|---|
| | Initial value | Increment | Lower value | Upper value | Remarks |
| | Measured value | 0.01 ppm | 0 ppm | 100 ppm | |

| Error message | Condition | Effect |
|---|---|---|
| Calibration Cl not possible!<br>Sensor slope too low<br>(<25 % of norm slope) | Cl slope too low | Calibrate again |
| Calibration Cl not possible!<br>Sensor slope too high<br>(>300 % of norm slope) | Cl slope too high | Calibrate again |
| DPD value too low!<br>DPD > x.xx ppm | DPD <2 % of measuring range | Calibrate again after adding chorine |

**Calibrating the pH sensor (only possible with correcting variable pH)**

The pH sensor is calibrated with the aid of two-point calibration (zero point/slope). Buffer self-detection at pH 7 (zero point calibration) and at pH 4 (calibration of slope). The measured pH value of the buffer is proposed as the buffer value and can be changed manually (arrow keys). The control is stopped during calibration and reduced to the set basic load. The measured value is frozen. The errors relating to the corresponding measured variable are reset after successful calibration. The current data of the pH sensor (zero point and slope) are displayed.




| | Initial value | Possible values Increment | Lower value | Upper value | Remarks |
|---|---|---|---|---|---|
| Buffer values | Rounded-off whole number measured value | pH 0.01 | pH -2 | pH 16 | Error messages when both buffers too close (<2 pH values).<br>In order to operate perfectly, the pH sensor must be checked and calibrated regularly (weekly), since deviations of ±0.1 pH may cause errors of measurement. Further more, when using a CLE sensor, a slope calibration adjustment of the chlorine sensor should always be done after a pH calibration. |

***IMPORTANT***

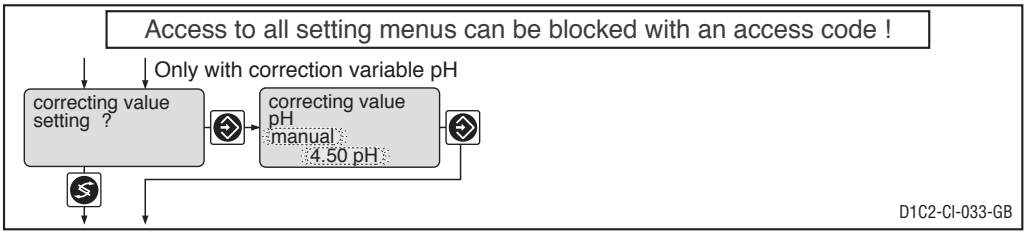
***pH correction is not possible if there are oxidating substances in the sample water! When a CLE measuring sensor is used:***

- ***The temperature must be between 10 °C and 15 °C***
- ***The pH value must be between 5 and 8***
- ***The corrective sensor current is limited to 25 mA***

# Restricted Operating Menu / Description

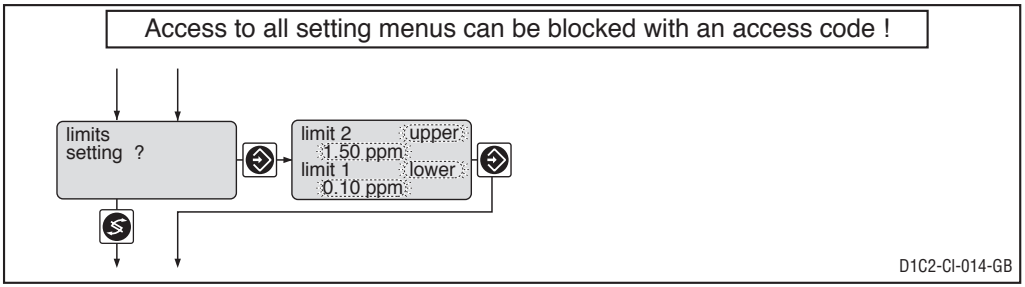
| Error message | Condition | Comment |
|---|---|---|
| Buffer distance too small | ΔBuffer < pH 2 | During calibration procedure:<br>Recalibrate buffer 2! |
| | | Return to permanent display: |
| Zero point low | < -60 mV | Basic metering load |
| Zero point high | > +60 mV | " |
| Slope low | <40 mV/pH | " |
| Slop high | >65 mV/pH | " |
| Measured value pH unstable | ΔU > 3 mV to t > 60 s | Standard metering |
| Measurde value °C unstable | | |

**pH correction**




| | Inital value | Possible values Increment | Lower value | Upper value | Remarks |
|---|---|---|---|---|---|
| Correction value | off<br>manual<br>automatic | off | | | When selecting manual pH correction, the pH value must not change more than ±0.1 pH units |

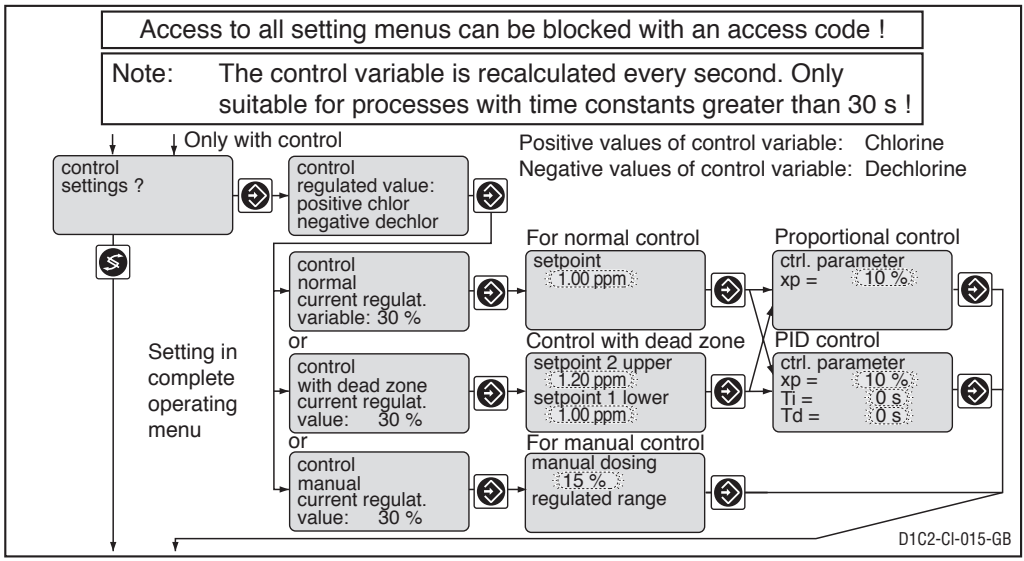
**Limits**




| | | Initial value | Possible values Increment | Lower value | Upper value | Remarks |
|---|---|---|---|---|---|---|
| Type of limit transgression | Limit 1: | lower | upper<br>lower | | | Limit transgression when exceeding or dropping below value |
| | Limit 2: | upper | off* | | | |
| Limit value | Limit 1: | 0.5 ppm | 0.01 ppm | 0.00 ppm | 100.00 ppm | *only with limit relay |
| | Limit 2: | 1.5 ppm | 0.01 ppm | 0.00 ppm | 100.00 ppm | |

# Restricted Operating Menu / Description

**Control**



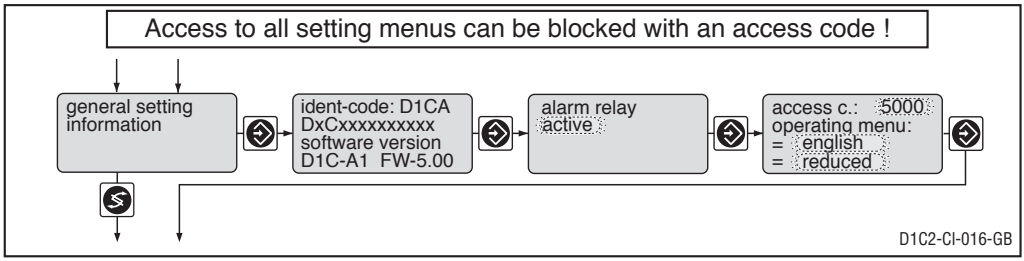

| | Initial value | Possible values Increment | Lower value | Upper value | Remarks |
|---|---|---|---|---|---|
| Setpoint | 1.00 ppm | 0.01 ppm | lower limit measuring range | upper limit measuring range | 2 setpoints necessary for control with dead zone. Setpoint 1 < setpoint 2<br>See page 17 for setting measuring range |
| Control parameter xp | 10 % | 1 % | 1 % | 500 % | xp referred to measuring range |
| Control parameter Ti | off | 1 s | 1 s | 9999 s | Function off = 0 s |
| Control parameter Td | off | 1 s | 1 s | 2500 s | Function off = 0 s |
| Manual metering | 0 % | 1 % | -100 % | +100 % | |

**Abbreviations for control variables:**

$x_p$ = 100 %/Kp (inverse proportional coefficient)
$T_i$ = I controller integration time [s]
$T_d$ = D controller differential time [s]

# Restricted Operating Menu / Description

**General Settings**



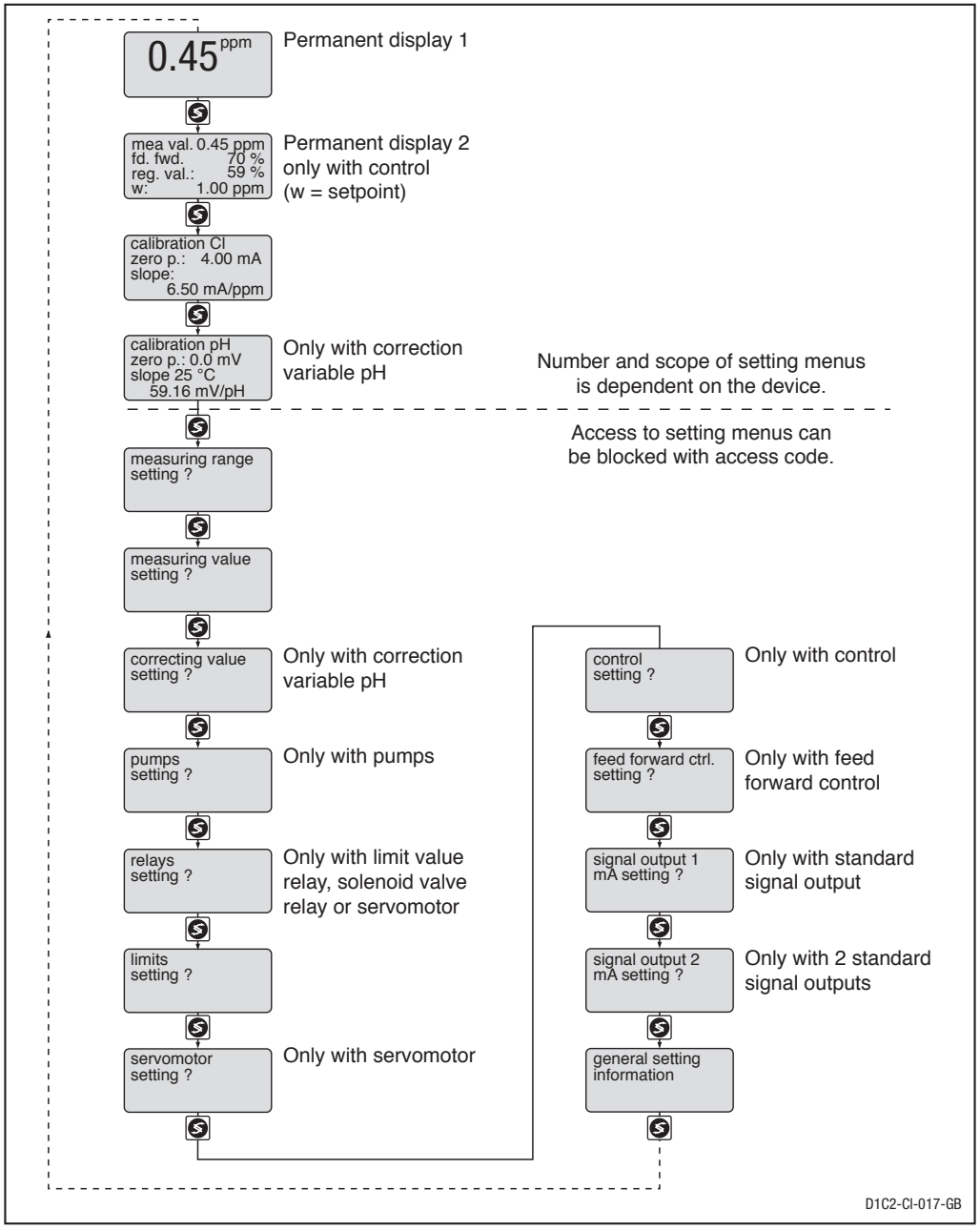

| | Initial value | Possible values Increment | Lower value | Upper value | Remarks |
|---|---|---|---|---|---|
| Alarm relay | active | active<br>not active | | | |
| Access code | 5000 | 1 | 1 | 9999 | |
| Language | as per identity code | as per identity code | | | |
| Operating menu | restricted | restricted<br>complete | | | |

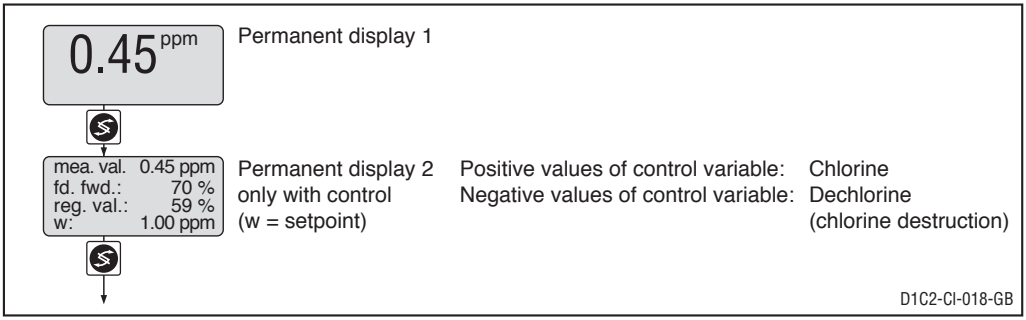
**Access Code**

Access to the setting menu can be prevented by setting up an access code. The DULCOMETER® D1C controller is supplied with the access code 5000 which permits free access to the setting menu. The calibration menu remains freely accessible even if access to the setting menu is blocked by the code.

# 8 Complete Operating Menu / Overview

All parameters of the controller can be set in the complete operating menu (access see previous page). The following overview shows the settings which can be selected:





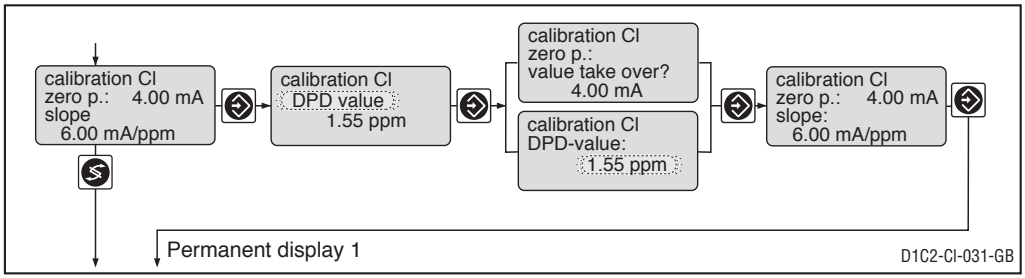

**Calibration of the Chlorine sensor (Zero point and slope)**

During the calibration, the D1C sets the controller outputs to “0”. Exception: If a base load or manual controller output was set, these are maintained during the calibration. The standard signal outputs mA (measured value or correction value) are frozen. The measured value frozen at the start of calibration is offered as the DPD value; this value is adjustable (arrow keys!). Calibration is only possible if the DPD value is ≥2 % of the measurement range. Once calibration has been successfully completed, all fault tracing procedures which refer to the measured value are restarted.

Zero point calibration must be carried out under real conditions in water free of chlorine dioxide. Calibration is normally only necessary for the measuring range 0 – 0.5 ppm when measuring at the lower limit of the measuring range.

***IMPORTANT***

***The measuring range of the sensor must agree with the set measuring range (factory setting: 0–2 ppm). The measuring range must be reset prior to calibration (see page 17).***



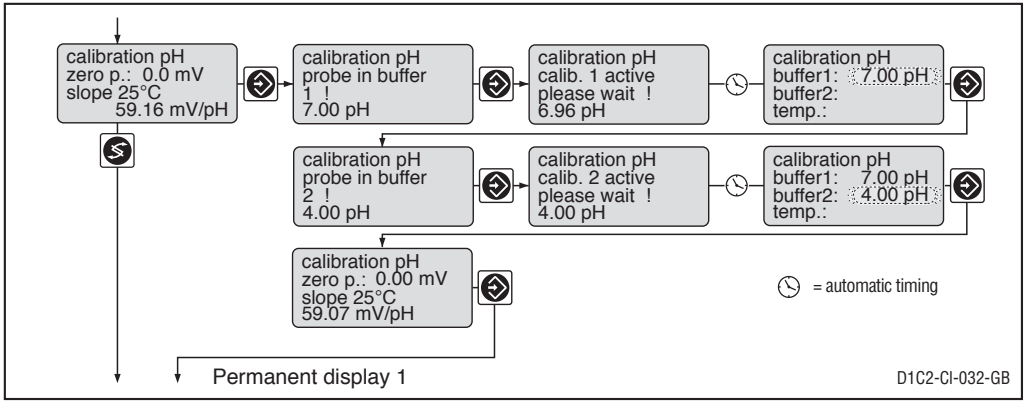

| | Initial value | Possible values Increment | Lower value | Upper value | Remarks |
|---|---|---|---|---|---|
| | Measured value | 0.01 ppm | 0 ppm | 100 ppm | |

| Error message | Condition | Comment |
|---|---|---|
| Calibration Cl not possible!<br>Zero point too low | Zero point < 3 mA | Repeat calibration in sample water without chlorine! |
| Calibration Cl not possible!<br>Zero point too high | Zero point > 5 mA | Repeat calibration in sample water without chlorine! |

| Error message | Condition | Effect |
|---|---|---|
| Calibration Cl not possible!<br>Slope low | Slope Cl too low<br>(<25 % of norm slope) | Calibrate again! |
| Calibration Cl not possible!<br>Slope high | Slope Cl too high<br>(>300 % of norm slope) | Calibrate again! |
| DPD value too low<br>DPD > x.xx ppm | DPD <2 % measuring range | Calibrate again after adding chlorine |

**Calibrating the pH sensor (only possible with correcting variable pH)**

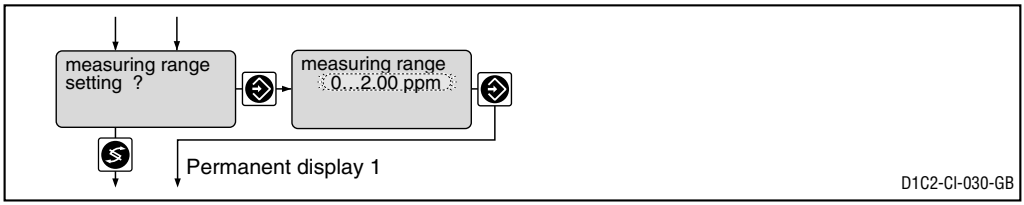
The pH sensor is calibrated with the aid of two-point calibration (zero point/slope). Buffer self-detection at pH 7 (zero point calibration) and at pH 4 (calibration of slope). The measured pH value of the buffer is proposed as the buffer value and can be changed manually (arrow keys). The control is stopped during calibration and reduced to the set basic load. The measured value is frozen. The errors relating to the corresponding measured variable are reset after successful calibration. The current data of the pH sensor (zero point and slope) are displayed.




| | Initial value | Possible values<br>Increment | Lower value | Upper value | Remarks |
|---|---|---|---|---|---|
| Buffer values | Rounded off whole number measured value | pH 0.01 | pH -2 | pH 16 | Error messages when both buffers too close (<2 pH values).<br>In order to operate perfectly, the pH sensor must be checked and calibrated regularly (weekly), since deviations of ±0.1 pH may cause errors of measurement. Further more, when using a CLE sensor, a slope calibration adjustment of the chlorine sensor should always be done after a pH calibration. |

| Error message | Condition | Comment | |
|---|---|---|---|
| Buffer distance too small | ΔBuffer < pH 2 | During calibration procedure:<br>Recalibrate buffer 2! | |
| | | Return to permanent display: | |
| Zero point low | < -60 mV | Basic metering load | Warning, old zero point and slope retained |
| Zero point high | > +60 mV | " | " |
| Slope low | < 45 mV/pH | " | " |
| Slop high | > 65 mV/pH | " | " |
| Measured value pH unstable | | | " |
| Measurde value °C unstable | | | " |

**Measuring range**

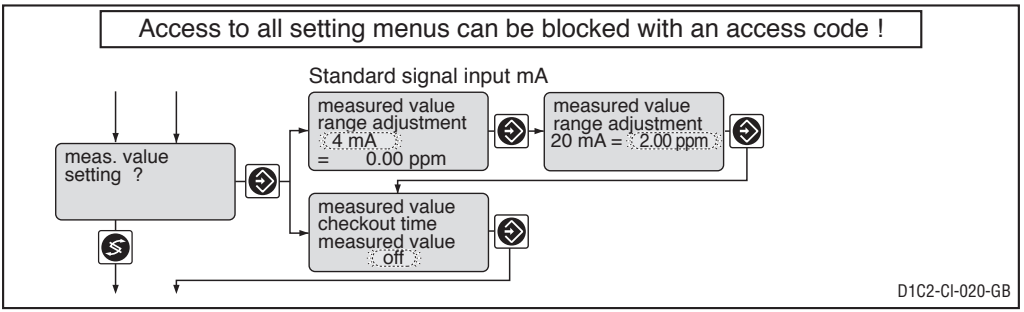



***IMPORTANT***

***The chlorine sensor must be recalibrated and the settings checked in all menus after changing the range allocation!***

| | Initial value | Possible values<br>Increment | Lower value | Upper value | Remarks |
|---|---|---|---|---|---|
| Measuring range | 0…2 ppm | 0…0.5 ppm<br>0…2 ppm<br>0…5 ppm<br>0…10 ppm<br>0…20 ppm<br>0…50 ppm<br>0…100 ppm | | | |

**Measured value**




***IMPORTANT***

***The chlorine sensor must be recalibrated and the settings checked in all menus after changing the range allocation!***

**Measured value checkout time**

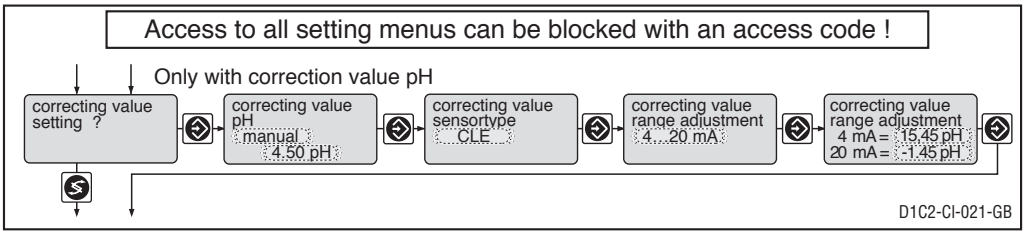
***IMPORTANT***

***This function may not be activated for applications in which it can be assumed that the measured value will not change.***

This function tests whether the measured value varies from that of the sensor (at the measured value input) within the “Measured value checkout time”. It is assumed that it will do so for an intact sensor.
If the measuring value does not change during this checkout time, the DULCOMETER® D1C sets the control variable to “0” and the alarm relay drops out. The LCD display shows e.g. the message “Check Cl probe”.

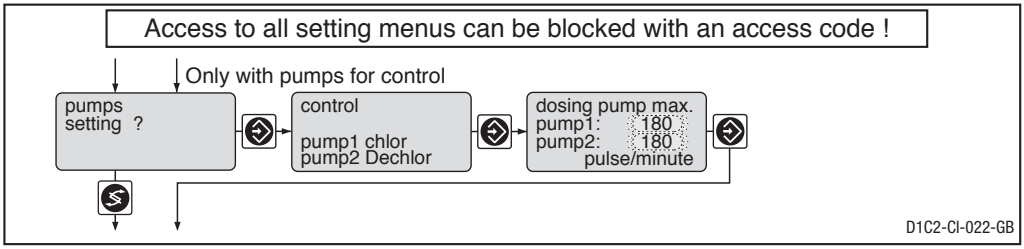
| | | Possible values | | | |
|---|---|---|---|---|---|
| | Initial value | Increment | Lower value | Upper value | Remarks |
| Standard signal input lower signal limit | 4 mA | 0 mA<br>4 mA | | | |
| Allocated measured value | | | | | |
| lower | 0 ppm | | | | |
| upper | 2 ppm | 0.01 ppm | 0.00 ppm | 100.00 ppm | |
| Checkout time | off | 1 s | 1 s | 9999 s | Constant measurement signal results in message and alarm. Function off = 0 s |

**Correction value pH**



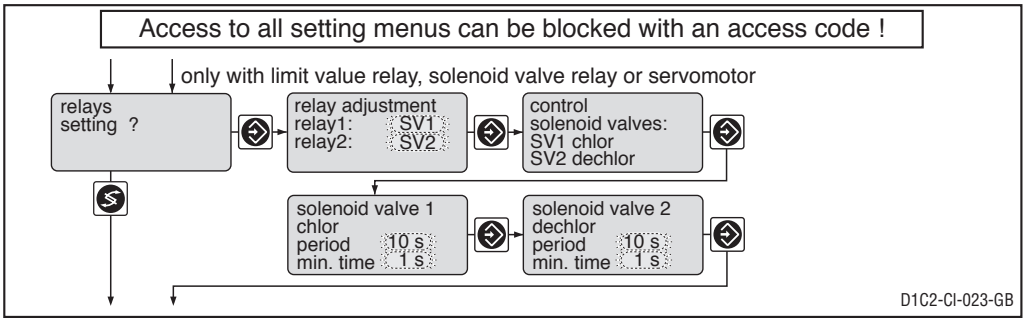

| | | Possible values | | | |
|---|---|---|---|---|---|
| | Initial value | Increment | Lower value | Upper value | Remarks |
| Correcting value | off<br>manual<br>automatic | off | | | A pH change < pH 0.1 must remain at “manual” |
| Type of sensor | CLE | CLE<br>CGE/CTE | | | |
| Standard signal input | 4 mA | 4 mA | | | |
| Lower signal limit | | 0 mA | | | |
| Scheduled measuring range | pH 15.45 ...<br>pH -1.45 | pH 0.01 | pH -2 | pH 16 | |

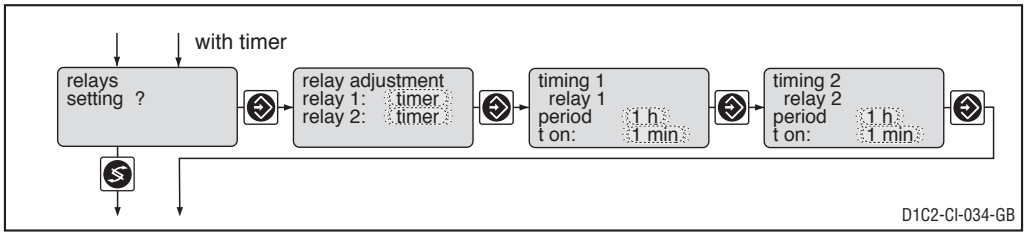
**Pumps**




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

**Relay for power activation**



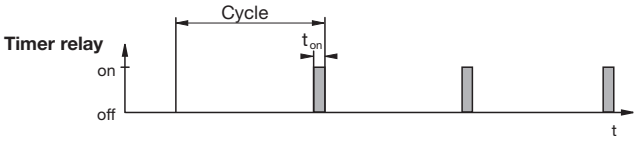




| | Initial value | Possible values Increment | Lower value | Upper value | Remarks |
|---|---|---|---|---|---|
| Relay adjustment | as per identity code | Motor<br>Solenoid valve (SV1, SV2)<br>Limit value (Limit 1/2)*<br>Actuator 1,2<br>Timer 1, 2<br>Servomotor<br>off | | | * In the case of “Limit value” - relays remain active even in the event of an error.<br><br>only with servomotor |

| | Initial value | Possible values Increment | Lower value | Upper value | Remarks |
|---|---|---|---|---|---|
| Period | 10 s | 1 s | 10 s | 9999 s | for solenoid valve |
| min. time | 1 s | 1 s | 1 s | period/2 | for solenoid valve Set here the smallest permitted operating factor of the connected device. |
| Period | off | 1 h | 1 h / off | 240 h | for timer |
| t on | 1 min | 1 min | 1 min | 60 min | for timer |

***NOTE***

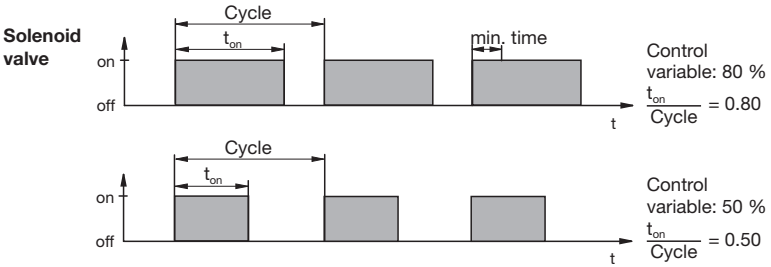
***The limit value relay can be defined in such a way as to respond as a control element, i.e. if a limit value relay closes a circuit, it opens when a pause contact is activated and/or for a subsequent delay period $t_d$ (if $t_d$ is set to > 0 min in "General settings").***




***IMPORTANT***

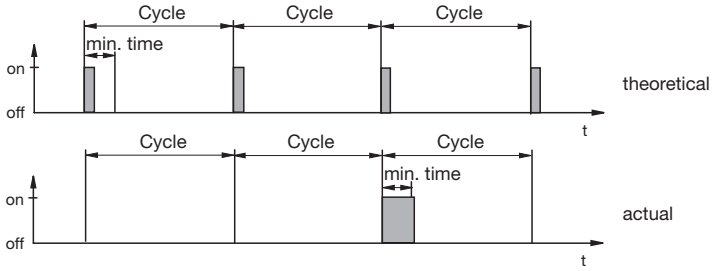
***The timer will reset in the event of a power failure.***

At the end of the (timer) cycle time the DULCOMETER® D1C closes the assigned relay for the duration of "t on" (timer). "Pause" interrupts the timer.
When the clock is shown in the LC display the timer can be reset to the start of the cycle at precisely this point using the enter button.
The % figure in the LC display indicates the progress of the current cycle.
Timer relays may be used, e.g. for shock metering or sensor cleaning.



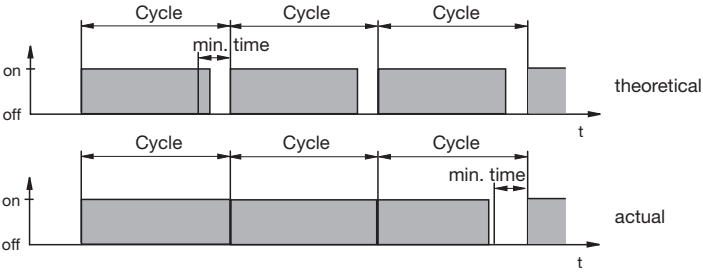

The switching time of the DULCOMETER® D1C (solenoid valve) depends on the control variable and the "min. time" (smallest permitted operating factor of the connected device).
The control variable determines the ratio $t_{on}$/cycle and thus the switching times (see fig. above).
The "min. time" influences the switching times in two situations:

a) theoretical switching time < min. time:



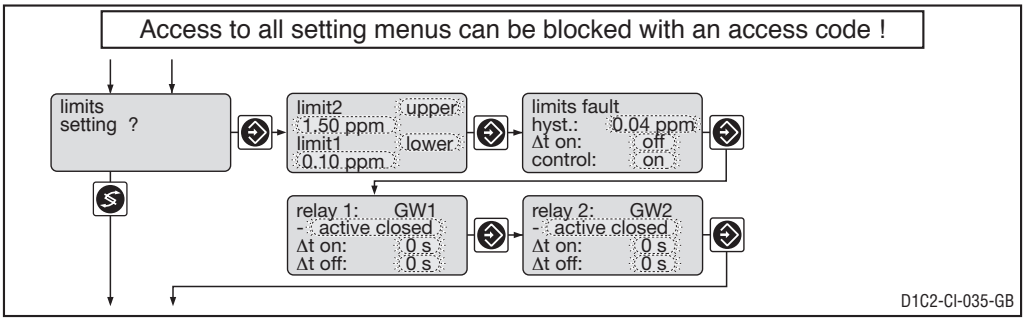

The DULCOMETER® D1C does not switch for a certain number of cycles until the sum of the theoretical switching times exceeds the “min. time”. Then the DULCOMETER® D1C switches for the duration of this total time.

b) theoretical switching time > (cycle - min. time) and calculated switching time < cycle




The DULCOMETER® D1C does not deactivate for a certain number of cycles until the differences between cycle and theoretical switching time exceed the “min. time”.

**Limits**




| | | Initial value | Possible values: Increment | Lower value | Upper value | Remarks |
|---|---|---|---|---|---|---|
| Type of limit transgression | Limit 1: | lower | upper<br>lower<br>off* | | | Limit transgression when exceeding or dropping below value |
| | Limit 2: | upper | | | | |
| Limit value | Limit 1: | 0.10 ppm | 0.01 ppm | 0.00 ppm | 20.00 ppm | *only with limit value relay |
| | Limit 2: | 1.50 ppm | 0.01 ppm | 0.00 ppm | 20.00 ppm | |
| Hysteresis limits | | 0.04 ppm | 0.01 ppm | 0.02 ppm | 20 ppm | Effective in direction of cancelling limit transgression. |
| Checkout time limits Δt 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<br>off | | | |
| Switching direction Limit value 1, Limit value 2 | | active closed | active closed<br>active open | | | Acts as N/O<br>Acts as N/C |
| 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 | |

If the limit is exceeded for longer than the “Delay time limit values” an error message is given, which must be acknowledged, and the alarm relay circuit drops out. If “Controller” is also set to “off” the control process stops.

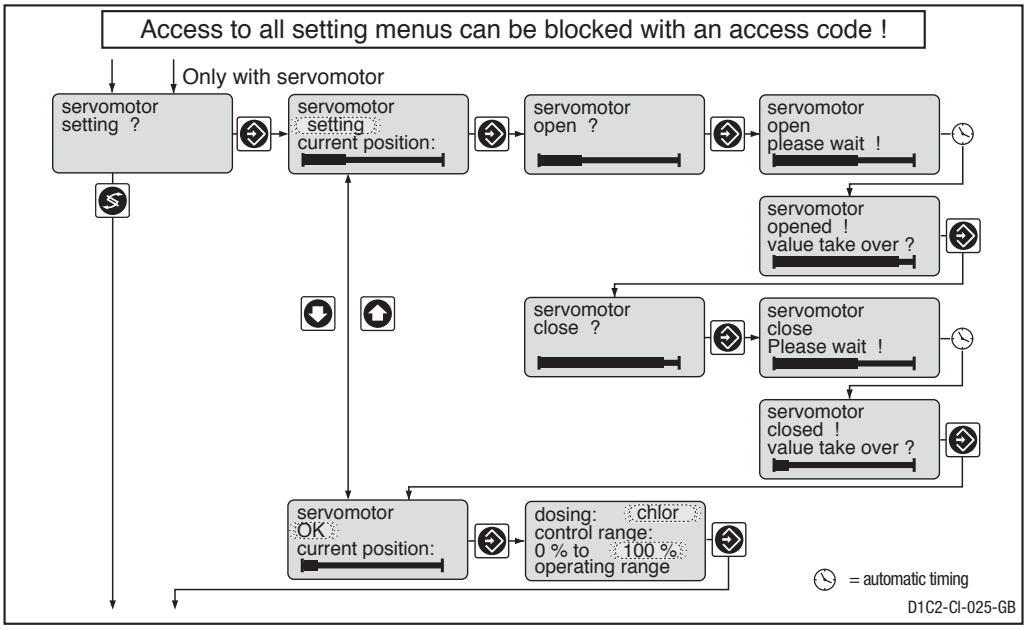
# Complete Operating Menu / Description

**Servomotor**

The **operating range** is defined by the total resistance range of the feedback potentiometer. The maximum limit of the range actually used is set by defining the **control range**.

***IMPORTANT***

- ***To ensure correct function, the set duration of the stroke position motor should be more than 25 sec for 0…100 % of setting range.***
- ***Stroke adjustment motor actuation must be carried out with the same care as the calibration of a sensor!***

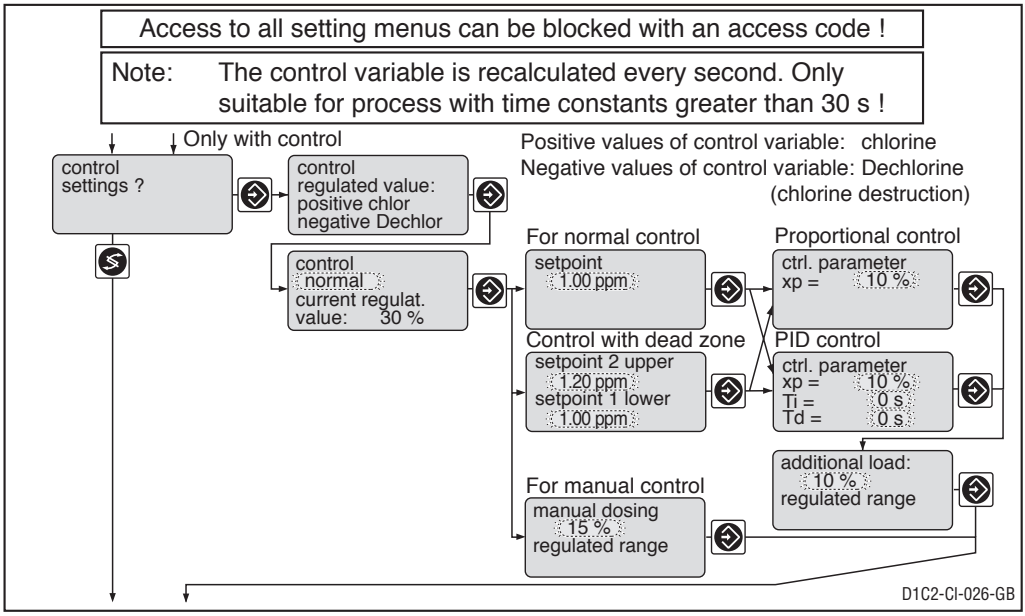



| | Initial value | Possible values Increment | Lower value | Upper value | Remarks |
|---|---|---|---|---|---|
| Servomotor | Setting | Setting<br>ok<br>off | | | |
| Control direction | Chlorine | Chlorine<br>Dechlorine | | | |
| Control range | 100 % | 1 % | 10 % | 100 % | in % of operating range |

***NOTE***

- ***When the wide bar is as right as it will go the stroke adjustment motor is fully open.***
- ***The permanent display shows to what degree the motor has opened in % (the greater the percentage, the farther open the stroke adjustment motor).***

**Control**

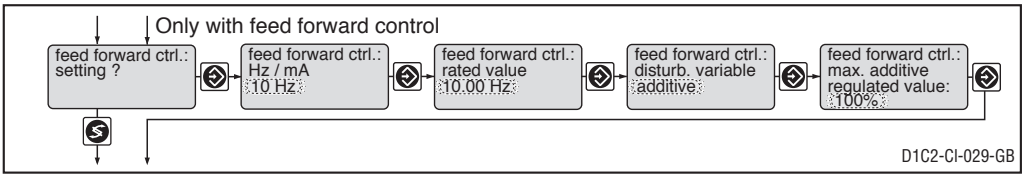



| | Initial value | Possible values: Increment | Lower value | Upper value | Remarks |
|---|---|---|---|---|---|
| Control | normal | normal<br>with dead zone<br>manual | | | When controlling with dead zone, the feed forward control is not used for measured values within the dead zone. |
| Setpoint | 1.00 ppm | 0.01 ppm | Lower measure-ment range limit | Upper measure-ment range limit | 2 setpoints necessary for control with dead zone. Setpoint 1 < setpoint 2 |
| Control parameter xp | 10 % | 1 % | 1 % | 500 % | xp referred to measuring range |
| Control parameter Ti | off | 1 s | 1 s | 9999 s | Function off = 0 s |
| Control parameter Td | off | 1 s | 1 s | 2500 s | Function off = 0 s |
| Additional load | 0 % | 1 % | -100 % | +100 % | |
| Manual metering | 0 % | 1 % | -100 % | +100 % | |

**Abbreviations for control variables:**

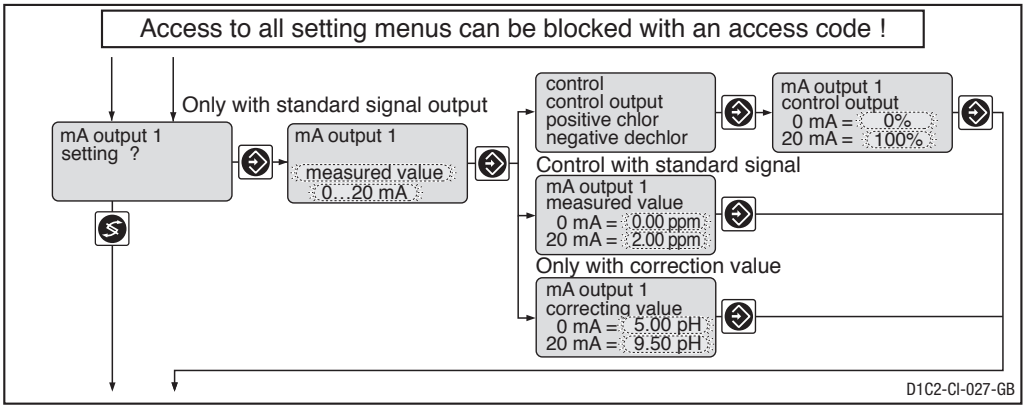
$x_p$ = 100 %/Kp (inverse proportional coefficient)
$T_i$ = I controller integration time [s]
$T_d$ = D controller differential time [s]

### Feed forward control

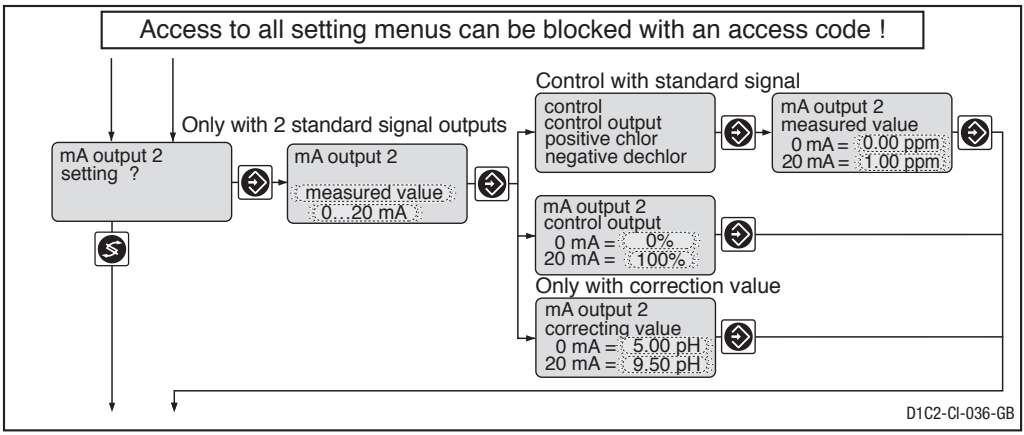



| | Initial value | Possible values Increment | Lower value | Upper value | Remarks |
|---|---|---|---|---|---|
| Feed forward control (Flow) | as per identity code | None | | | Signal processing: |
| | | 10 Hz | | | Signal <0,02 Hz = No flow |
| | | 500 Hz | | | Signal <0,2 Hz = No flow |
| | Standard signal | 0…20 mA | | | Signal <0,2 mA = No flow |
| | 4...20 mA | 4…20 mA | | | Signal <4,2 mA = No flow |
| Feed forward control | 10 Hz | 0.01 Hz | 0.1 Hz | 10 Hz | Dependent on signal type. |
| rated value | 500 Hz | 1 Hz | 5 Hz | 500 Hz | Maximum limitation |
| | 20 mA | 0.1 mA | 0/4 mA | 20 mA | of range used. |
| Feed forward control effect | multiplicative | multiplicative additive | | | |
| Max. add. regulated value | 100 % | 1 % | -500 % | +500 % | only with additive feed forward control |

### Standard signal output 1



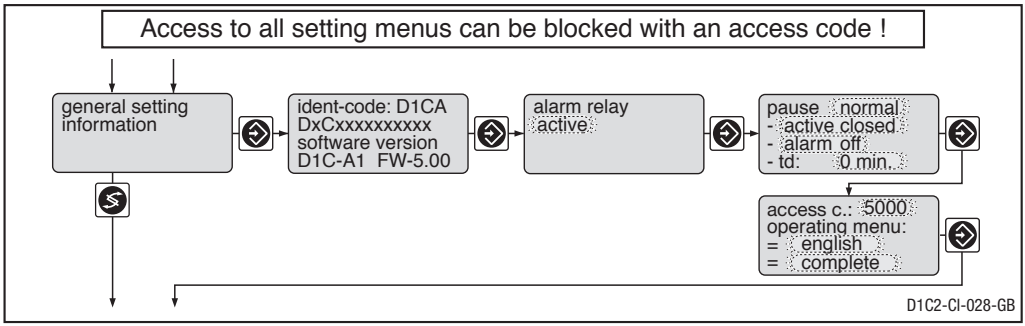
**Standard signal output 2**




| | Initial value | Possible values<br>Increment | Lower value | Upper value | Remarks |
|---|---|---|---|---|---|
| Variable allocation | as per identity code | Measured value<br>Control variable<br>Correction value | | | If control applicable only with correction variable |
| Output range | 0…20 mA | 0…20 mA<br>4…20 mA<br>3.6/4 -20 mA | | | Reduction to 3.6 mA when alarm relay switches (not limit-value violation) |
| Range measured value | Measuring range | 0.01 ppm | 0 ppm | 100 ppm | Minimum range 0.1 ppm |
| Range control variable | 0 %…+100 % | 1 % | -100 % | +100 % | Minimum range 1 % |
| Range correction value | pH 5…9.5 | pH 0.01 | pH -2 | pH 16 | |

# Complete Operating Menu / Description

**General setting**




| | Initial value | Possible values<br>Increment | Lower value | Upper value | Remarks |
|---|---|---|---|---|---|
| Alarm relay | active | active<br>not active | | | |
| Control input pause | closed | closed<br>open | | | |
| Pause | Pause | Pause/Hold*<br>Pause | | | |
| Control input pause | active closed | active closed<br>active open | | | Acts as N/O<br>Acts as N/C |
| Pause with alarm | alarm off | alarm off<br>alarm on | | | Alarm relay can be triggered by pause contact. |
| td | 0 min | 1 min | 0 min | 60 min | |
| Access code | 5000 | 1 | 1 | 9999 | |
| Language | as per identity code | as per identity code | | | |
| Operating menu | complete | reduced<br>complete | | | |

**Pause Normal**

If the pause-switch is off, the DULCOMETER® D1C sets the operating outputs to “0” for as long as the pause-switch is off or for a set time-delay $t_d$ (if $t_d$ is set to > 0 min). Whilst the pause-switch is off, the D1C establishes the P-proportion in the background.
With PID-control (Identity code characteristics “control characteristic” = 2): the I-proportion is stored when the pause is switched off (I-proportion then usually only present if Tn > 0 has been selected in the “Control setting?” setting menu).
Exception: the standard signal outputs mA for the measured value or correction value are not affected by the pause.
After pause is activated the operating outputs remain at “0” for the length of the time-delay $t_d$. The time-delay $t_d$ must be set up in such a way that, in this time e.g. sample water (process-specific current concentration) flows to the sensor.
With PID-control (Identity code characteristics “control characteristic” = 2): The control variable output resulting from the pause and the expiry of the time-delay $t_d$ is reconciled jointly with the current P-component and (if Tn is set > 0) with the stored I-component.

**Pause Hold**

If the pause-switch is off, the DULCOMETER® D1C freezes the operating output at the most recent value for as long as the pause-switch is off or for a set time-delay $t_d$ (if $t_d$ is set to > 0 min). Whilst the pause-switch is off, the D1C establishes the P-proportion in the background.
With PID-control (Identity code characteristics “control characteristic” = 2):
Even the mA standard signal outputs for measured value or correction value are frozen.
After pause is activated the operating outputs remain frozen for the length of the time delay $t_d$. The time delay $t_d$ must be set up in such a way that, in this time e.g. sample water (process-specific current concentration) flows to the sensor.
With PID-control (Identity code characteristics “control characteristic” = 2): The control variable output resulting from the pause and the expiry of the time-delay $t_d$ is reconciled jointly with the current P-proportionand (if Tn is set > 0) with the newly established I-proportion.

**Access Code**

Access to the setting menu can be prevented by setting up an access code. The DULCOMETER® D1C 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.

| Fault | Fault text | Symbol | Effect on metering | Effect on control | Alarm with acknowledgement | Remarks | Remedy |
|---|---|---|---|---|---|---|---|
| **Measured value**<br>Checkout time exceeded | *Check CI probe* | ε | Basic load | Stop | Yes | Function detachable | Check function of sensor, exceed checkout time |
| Signal exceeded/drops below value | *Check CI input* | ε | Basic load | Stop | Yes | Signal <3.0 ±0.2 mA or >23 ±0.2 mA | Check sensor, transducer and cable connection |
| Calibration sensor with error | *CI calib. defective* | ε | Basic load | Stop | No | Metering continues in case of error with unstable measured values | Check sensor, replace if necessary, recalibrate if necessary |
| **Correction variable**<br>Signal exceeded/drops below value | *Check feed forward input* | ε | Basic load | Stop | Yes | Signal <3.0 or >23 mA Value last valid is used | Check sensor, transducer and cable connection |
| Calibration pH with error | *pH calibration faulty* | ε | Basic load | Stop | Yes | | |
| Limit CLE | *pH limit 1/2* | ε | Basic load | Stop | Yes | pH <5 >8.5 | |
| Limit CGE/CTE | *pH limit 1/2* | ε | Basic load | Stop | Yes | pH <5 >9.5 | |
| **Feed forward control**<br>Signal exceeded/drops below value | *Check feed forward input* | ε | | | Yes | Signal <3.0 ±0.2 mA or >23 ±0.2 mA | Check sensor, transducer and cable connection |
| Signal exceeded, multiplicative | | ε | | Stop | | Value last valid is used | Value last valid is used |
| **Limit transgression**<br>after checkout time limits | *CI limit 1*<br>*CI limit 2* | | | | | Function detachable | Determine cause, reset values if necessary |
| Control “on” | | ε | | | Yes | | |
| Control “off” | | ε | Stop or Basic load | Stop | Yes | | |
| **Servomotor**<br>Position not reached | *Servomotor defective* | ε | | | Yes | Servomotor closes | Check servomotor |
| **Electronics error** | *System error* | ε O | Stop | Stop | Yes | Electronic data faulty | Call in service |

| Operation | Note text | Symbol | Effect on metering | Effect on control | Alarm with acknowledgement | Remarks | Remedy |
|---|---|---|---|---|---|---|---|
| **Pause contact** | *Pause* | Ɛ O | Stop | Stop | No/Yes* | No further fault check | – |
| | *Pause/Hold* | Ɛ | Unchanged | ** | No | – | – |
| **Stop button** | *Stop* | Ɛ O | Stop | Stop | No | Relay drops out | – |
| **During calibration** | | | Basic load | Stop | No | No error processing of measured variable | – |
| Probe slope too low<br>Probe zero point too high | *Slope Cl low*<br>*Slope Cl high* | Ɛ | Basic load | Stop | No | 25 % > sensor slope<br>> 200 % of norm slope | Check sensor, replace if necessary |
| Zero point too low<br>Zero point too high | *Zero point low*<br>*Zero point high* | Ɛ | Basic load | Stop | No | Zero point <3 mA<br>Zero point >5 mA | Recalibrate in sample water without chlorine |
| DPD-value <2 % measuring range | *DPD > x.xx ppm* | | | | No | 25 % > sensor slope<br>> 200 % of norm slope | Recalibrate |
| Buffer distance too small | *Buffer distance too small !*<br>*Δ buffer >2 pH !* | | | | | | Recalibrate |
| Probe zero point too low<br>Probe zero point too high<br>Probe slope too low<br>Probe slope too high | *pH zero point low*<br>*pH zero point high*<br>*pH slope low*<br>*pH slope high* | Ɛ | Basic load | Stop | No | | Check sensor, replace if necessary |
| Probe signal too unstable | *Measured value unstable* | | | | | | |
| **During servomotor setting**<br>Position feedback wrong<br>Upper position <40 % max. value<br>Lower position >30 % range | *Direction check*<br>*Final value small*<br>*Final value big* | | | | | Without correct adjustment the last valid values are still used | Check connection of relay, potentiometer<br>Adjust the operation region of the servomotor correctly |

* depending on whether “Alarm on” or “Alarm off” set in “General settings”

** Function PI stable

Operating Instructions DULCOMETER® D1C, Part 2/Chlorine
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