ProMinent®

Operating Instructions
DULCOMETER® D1C
Part 2: Adjustment and Operation,
Measured Variable Conductive Conductivity

TÜV SÜD
ISO 9001

Conductivity

100 µS/cm

DULCOMETER®

ProMinent®

Type D

Conductivity

100 µS/cm

DULCOMETER®

ProMinent®

STOP START
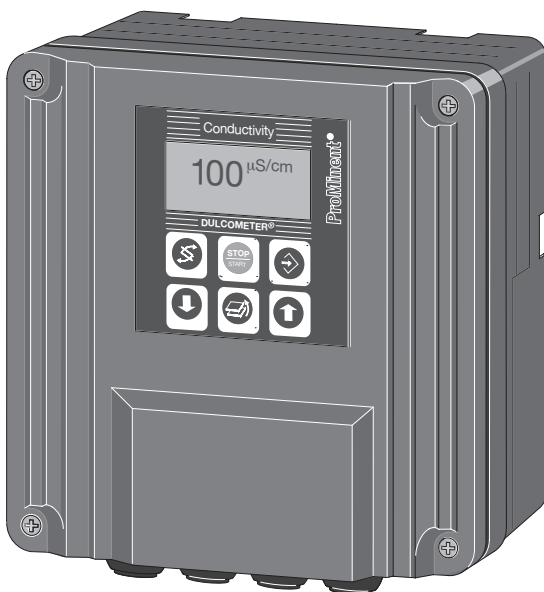
Type W

D1C A ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___

Please enter the identity code of your device here!

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

1 Device Identification / Identity Code

D1C A		DULCOMETER® Controller Series D1C / Version A	
		Type of mounting	
	D	Control panel installation 96 x 96 mm	
	W	Wall mounting	
		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	
	L	Conductivity	
		Connection of measured variable	
	1	Terminal, standard signal 0/4-20 mA	
	3	Terminal, conductive conductivity (0-20/200/2000 µS/cm; 0-20/200 mS/cm)	
		Correction variable	
	0	None	
	2	Temperature via terminal (PT 100)	
	3	Temperature via standard signal	
	4	Manual temperature entry	
		Feed forward control	
	0	None	
	1	As standard signal 0/4-20 mA	
	2	As frequency 0-500 Hz	
	3	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 correction variable	
	4	2 standard signal 0/4-20 mA outputs, free 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	

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 series 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 metering 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

D1C2-Leit.-002-GB
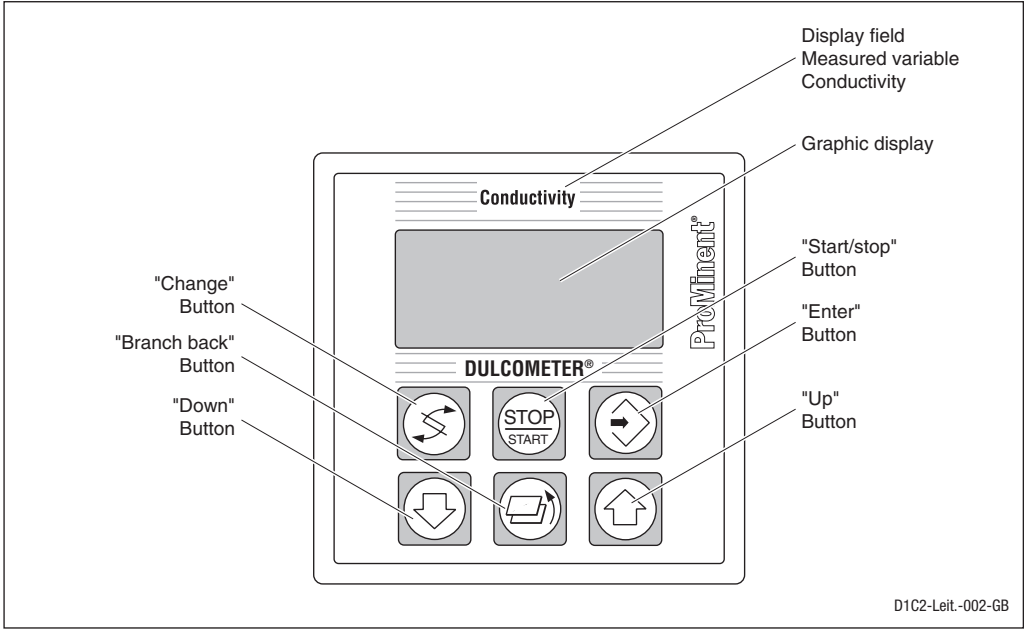
	CHANGE button		UP button
	To change over within a menu level and to change from one variable to another within a menu point.		To increase a displayed numerical value and to change variables (flashing display)
	START/STOP button		BRANCH BACK button
	Start/stop of control and metering function.		Back to permanent display or to start of relevant setting menu.
	ENTER button		DOWN button
	To accept, confirm or save a displayed value or status. For alarm acknowledgement.		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.

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 - depending 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 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 controlled variable:

Controlled 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 controlled variable:

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

4.5 Error Messages

Error messages and information are indicated on the bottom line in the permanent display 1. Errors to be acknowledged (acknowledgement switches off the alarm relay) are indicated by the symbol „Ɛ". Errors/notes which still apply after acknowledgement are indicated alternately. 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 Relay 1, upper	Symbol left		1
Relay 1 lower	Symbol left		↓
Relay 2 upper	Symbol right		1
Relay 2 lower	Symbol right		↓
Metering pump 1 (Increase conductivity) Control off	Symbol left		▮
Control on	Symbol left		▯
Metering pump 2 (Reduce conductivity) Control off	Symbol right		▮
Control on	Symbol right		▯
Solenoid valve 1 (Increase conductivity) Control off	Symbol left		◣
Control on	Symbol left		◺
Solenoid valve 2 (Reduce conductivity) Control off	Symbol right		�
Control on	Symbol right		◹
Servomotor Control, open relay			◣ ◹
Control, close relay			◺ ◢
Without control			◣ ◢
Position feedback	Thickness of bar increases from left to right during opening		▬▬▬
Stop button pressed			O
Manual metering			M
Fault			Ɛ

6

6   Operation diagram

The various menus are selected with the CHANGE button

The menu is started with the ENTER button

BRANCH BACK to permanent display or to relevant setting menu

D1C2-Leit.-007-GB
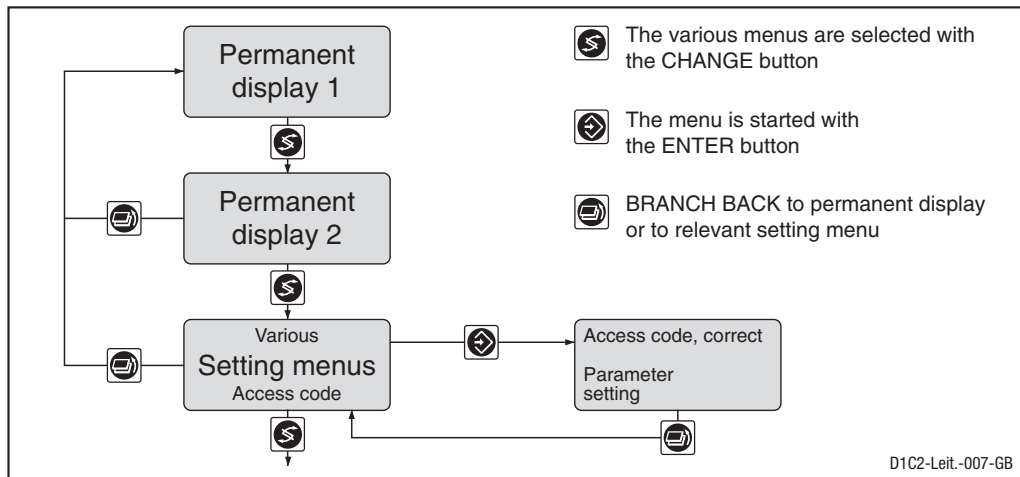
NOTE

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

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

If the access code is selected correctly in a setting menu, 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.

BRANCH BACK without saving setting

BRANCH BACK to start of setting

Variables flash

CHANGE from selection to selection

Change numbers or settings of selection

ENTER and save setting, continue to next menu

D1C2-Leit.-008-GB
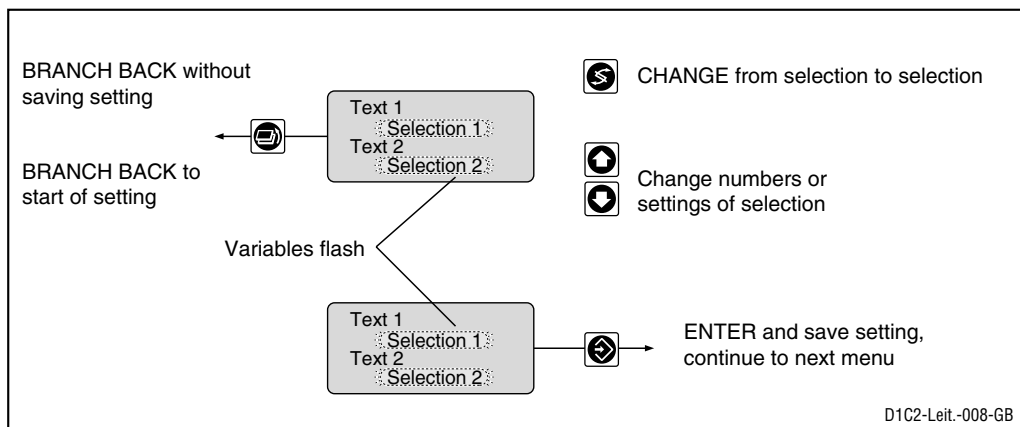
7 Restricted Operating Menu / Overview

The restricted operating menu permits simple operation of the most important parameters. The following overview shows the settings which can be selected:
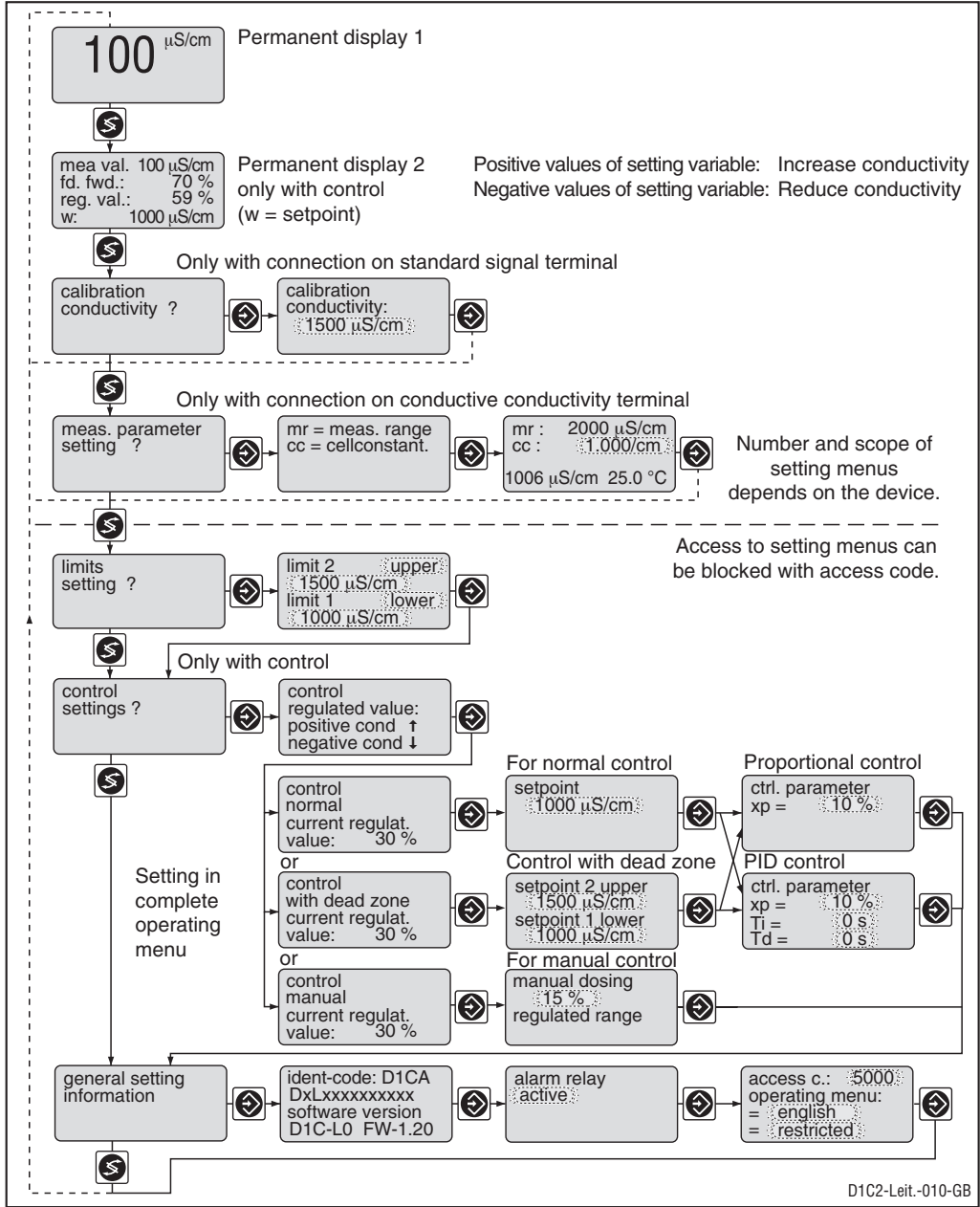
D1C2-Leit.-010-GB

Restricted Operating Menu / Description

100 µS/cm	Permanent display 1

Positive values of setting variable:
Increase conductivity
Negative values of setting variable:
Reduce conductivity

mea val. 100 µS/cm
fd. fwd.   70 %
reg. val.   59 %
w: 1000 µS/cm

Permanent display 2
only with control
(w = setpoint)

D1C2-Leit.-011-GB

Calibration conductivity (only for connected terminal standard signal)

calibration
conductivity ?

calibration
conductivity:
1500 µS/cm

D1C2-Leit.-029-GB

During calibration, the D1C sets the command outputs to "0". Exception: if a basic load or a manual control output were set, these are maintained during calibration. The standard signal outputs mA (measuring value or correction value) are frozen.

The actually measured value will be proposed; this value is adjustable (arrow keys). On successful completion of calibration, all error checks which refer to the measured value are restarted.

		Possible values		
	Initial value	Increment	Lower value	Upper value
Calibration conductivity	measured value	as per measuring range	as per measuring range	as per measuring range

Error message	Condition effect	Remarks
Measured value too low Value > xx mS/cm Check measuring range	Value < 2 % of measuring range	Check measuring range
Measured value too high Value < xx mS/cm Check measuring range	Value > 100 % of measuring range	Check measuring range

Restricted Operating Menu / Description

Calibration conductivity (only for connected terminal conductive conductivity)

Measuring parameter


```
Access to all setting menus can be blocked with an access code !

meas. parameter        mr = meas. range        mr :   2000 µS/cm
setting   ?            cc = cellconstant.       cc :    1.120/cm

                                                1538 µS/cm  23.8 °C
```
D1C2-Leit.-030-GB

	Initial value	Possible values			Remarks
		Increment	Lower value	Upper value	
Cell constant cc	1.000/cm	0.0001/cm	0.0060/cm	0.1499/cm	cc can be adjusted
		0.001/cm	0.150/cm	1.499/cm	for all mr
		0.01/cm	1.50/cm	12.00/cm	over the complete area

The measured value can be adjusted to the actual conductivity value by changing the cell constants (arrow keys).

> *NOTE*
>
> ***The following menus apply generally!***

Limit values


```
Access to all setting menus can be blocked with an access code !

limits                 limit 2        upper
setting  ?              1500 µS/cm
                       limit 1        lower
                        1000 µS/cm
```
D1C2-Leit.-014-GB

		Initial value	Possible values			Remarks
			Increment	Lower value	Upper value	
Type of limit transgression	Limit 1:	lower	lower			
	Limit 2:	upper	upper			
			off**			**only with limit value relay
Limit value	Limit 1:	10 µS/cm	0.01 µS/cm	-1 µS/cm	21 µS/cm	Measuring range 20 µS/cm
	Limit 2:	15 µS/cm				
	Limit 1:	25 µS/cm	0.01 µS/cm	-2.5 µS/cm	52.5 µS/cm	Measuring range 50 µS/cm*
	Limit 2:	37.5 µS/cm				
	Limit 1:	100 µS/cm	0.1 µS/cm	-10 µS/cm	210 µS/cm	Measuring range 200 µS/cm
	Limit 2:	150 mS/cm				

Restricted Operating Menu / Description

	Initial value	Possible values			Remarks
		Increment	Lower value	Upper value	
Limit 1:	250 μS/cm	0.1 μS/cm	-25 μS/cm	525 μS/cm	Measuring range 500 μS/cm*
Limit 2:	375 μS/cm				
Limit 1:	1000 μS/cm	1 μS/cm	-100 μS/cm	2100 μS/cm	Measuring range 2000 μS/cm
Limit 2:	1500 μS/cm				
Limit 1:	2500 μS/cm	1 μS/cm	-250 μS/cm	5250 μS/cm	Measuring range 5000 μS/cm*
Limit 2:	3750 μS/cm				
Limit 1:	10 mS/cm	0.01 mS/cm	-1 mS/cm	21 mS/cm	Measuring range 20 mS/cm
Limit 2:	15 mS/cm				
Limit 1:	100 mS/cm	0.1 mS/cm	-10 mS/cm	210 mS/cm	Measuring range 200 mS/cm
Limit 2:	150 mS/cm				
Limit 1:	500 mS/cm	1 mS/cm	-50 mS/cm	1050 mS/cm	Measuring range 1000 mS/cm*
Limit 2:	750 mS/cm				

*only for connected terminal standard signal

Control

Access to all setting menus can be blocked with an access code !

Note: The controlled variable is recalculated every second. Only suitable for processes with time constants greater than 30 s !

Only with control option

Positive values of setting variable: Increase conductivity
Negative values of setting variable: Reduce conductivity

control settings ?

control regulated value: positive cond ↑ negative cond ↓

Setting in complete operating menu

For normal control

control normal current regulat. value: 30 %

setpoint 1000 μS/cm

Proportional control

ctrl. parameter xp = 10 %

or

Control with dead zone

control with dead zone current regulat. value: 30 %

setpoint 2 upper 1500 μS/cm setpoint 1 lower 1000 μS/cm

PID control

ctrl. parameter xp = 10 % Ti = 0 s Td = 0 s

or

For manual control

control manual current regulat. value: 30 %

manual dosing 15 % regulated range

D1C2-Leit.-015-GB

	Initial value	Possible values			Remarks
		Increment	Lower value	Upper value	
Setpoint	10 μS/cm	0.01 μS/cm	-1 μS/cm	21 μS/cm	Measuring range 20 μS/cm
	15 μS/cm	0.01 μS/cm	-2.5 μS/cm	52.5 μS/cm	Measuring range 50 μS/cm*
	100 μS/cm	0.1 μS/cm	-10 μS/cm	210 μS/cm	Measuring range 200 μS/cm
	250 μS/cm	0.1 μS/cm	-25 μS/cm	525 μS/cm	Measuring range 500 μS/cm*
	1000 μS/cm	1 μS/cm	-100 μS/cm	2100 μS/cm	Measuring range 2000 μS/cm
	2500 μS/cm	1 μS/cm	-250 μS/cm	5250 μS/cm	Measuring range 5000 μS/cm*
	10 mS/cm	0.01 mS/cm	-1 mS/cm	21 mS/cm	Measuring range 20 mS/cm
	100 mS/cm	0.1 mS/cm	-10 mS/cm	210 mS/cm	Measuring range 200 mS/cm
	500 mS/cm	1 mS/cm	-50 mS/cm	1050 mS/cm	Measuring range 1000 mS/cm*

Restricted Operating Menu / Description

		Possible values			
	Initial value	Increment	Lower value	Upper value	Remarks
					2 setpoints necessary for control with dead zone. Setpoint 1 < setpoint 2
					Adjustment of measuring range on page 15/18
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 %	

*only for connected terminal standard signal

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]

General settings
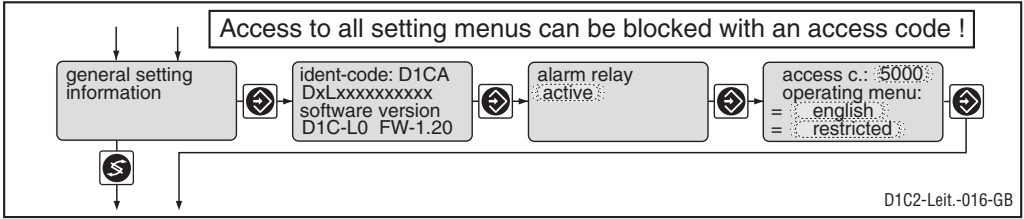
Access to all setting menus can be blocked with an access code !

general setting information → ident-code: D1CA DxLxxxxxxxxxx software version D1C-L0 FW-1.20 → alarm relay active → access c.: 5000 operating menu: = english = restricted

D1C2-Leit.-016-GB

		Possible values			
	Initial value	Increment	Lower value	Upper value	Remarks
Alarm relay	active	active not active			
Access code	5000	1	1	9999	
Language	as per identity code	as per identity code			
Operating menu	restricted	restricted 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 when 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:

D1C2-Leit.-017-GB

Complete Operating Menu / Description

100 μS/cm ⓢ mea val. 100 μS/cm fd. fwd.: 70 % reg. val.: 59 % w: 1000 μS/cm ⓢ	Permanent display 1 Permanent display 2 only with control (w = setpoint)

Positive values of setting variable: Increase conductivity
Negative values of setting variable: Reduce conductivity

D1C2-Leit.-018-GB

With connection on terminal standard signal see page 18

With connection on terminal conductive conductivity:

Measuring parameter (only for connected terminal conductive conductivity)

Access to all setting menus can be blocked with an access code !

meas. parameter setting ?	⬦	mr = meas. range cc = cellconstant. α = temperature- coefficient	⬦	mr : 2000 μS/cm cc : 1.120/cm α : 2.10%/ °C 1538 μS/cm 23.8 °C	⬦
ⓢ					

D1C2-Leit.-036-GB

		Possible values			
	Initial value	Increment	Lower value	Upper value	Remarks
Measuring range mr	0....2000 μS/cm	0....20 μS/cm 0....200 μS/cm 0....2000 μS/cm 0....20 mS/cm 0....200 mS/cm			Setpoints and limit values are switched to the corresponding startup values
Cell constant cc	1,000/cm	0.0001/cm 0.001/cm 0.01/cm	0.0060/cm 0.150/cm 1.50/cm	0.1499/cm 1.499/cm 12.00/cm	cc can be adjusted for all mr over the complete area
Temperature coefficient α	1.90 %/°C	0.01 %/°C	0 %/°C	10 %/°C	

The measured value can be adjusted to the actual conductivity value by changing the cell constants (arrow keys). Prerequisite is a known temperature coefficient and a constant temperature.

⚠ **IMPORTANT**
When changing the measuring range, metering and control are stopped, the setpoints, limit values, and the standard signal output are set to the corresponding startup values! Check these settings in all menus!
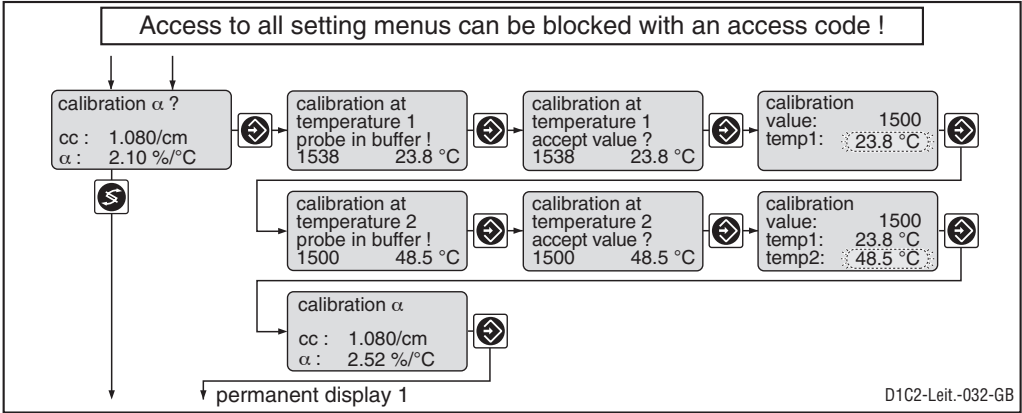
Complete Operating Menu / Description

Calibrating temperature coefficient α (only for connected terminal conductive conductivity)

The temperature coefficient α is newly determined by a 2-point calibration. During calibration, the D1C sets the command outputs to "0". Exception: if a basic load or a manual control output were set, these are maintained during calibration. The standard signal outputs mA (measuring value or correction value) are frozen.

⚠️ **ATTENTION**
The conductivity values you enter must be based on 25 °C. You must use the same solution when calibrating both temperatures!
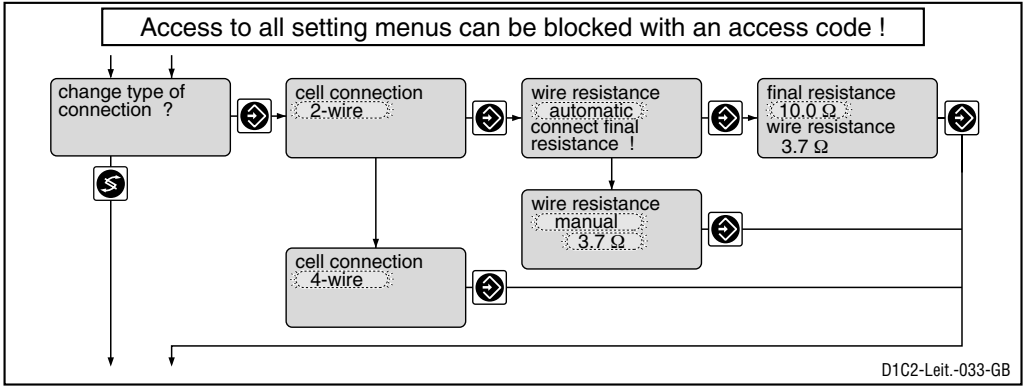

Access to all setting menus can be blocked with an access code !

calibration α ?
cc : 1.080/cm
α : 2.10 %/°C

calibration at
temperature 1
probe in buffer !
1538   23.8 °C

calibration at
temperature 1
accept value ?
1538   23.8 °C

calibration
value: 1500
temp1:   23.8 °C

calibration at
temperature 2
probe in buffer !
1500   48.5 °C

calibration at
temperature 2
accept value ?
1500   48.5 °C

calibration
value: 1500
temp1:   23.8 °C
temp2:   48.5 °C

calibration α
cc : 1.080/cm
α : 2.52 %/°C

permanent display 1

D1C2-Leit.-032-GB

		Possible values			
	Initial value	Increment	Lower value	Upper value	Measuring range
Set sensor	Measuring value	0.01 μS/cm 0.1 μS/cm 1 μS/cm 0.01 mS/cm 0.1 mS/cm	-1 μS/cm -10 μS/cm -100 μS/cm -1 mS/cm -10 mS/cm	21 μS/cm 210 μS/cm 2100 μS/cm 21 mS/cm 210 mS/cm	20 μS/cm 200 μS/cm 2000 μS/cm 20 mS/cm 200 mS/cm
Set temperature	Correction value	0.1 °C	0 °C	100 °C	

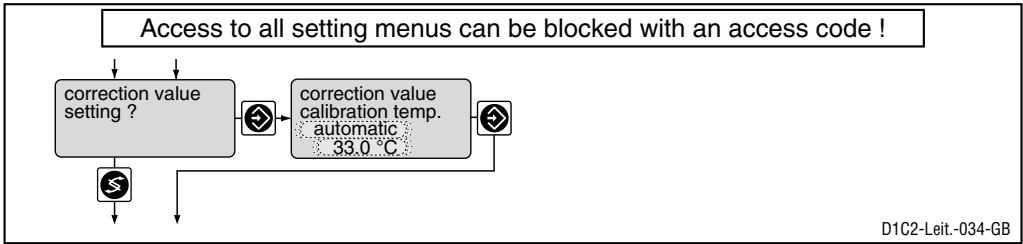| Error message/Warning	Condition	Remarks
Temperature range restricted xx – 100 °C		For the chosen temperature coefficient α, a correct reading can only be obtained for the displayed temperature range.
Temperature distance wrong	Δ temperature $\geq$ 10.0 °C Δ temperature $\leq$ 50.0 °C	

Complete Operating Menu / Description

Sensor connection (only for connected terminal conductive conductivity)

Access to all setting menus can be blocked with an access code !

change type of connection ?

cell connection 2-wire

wire resistance automatic connect final resistance !

final resistance 10.0 Ω wire resistance 3.7 Ω

wire resistance manual 3.7 Ω

cell connection 4-wire

D1C2-Leit.-033-GB

		Possible values			
	Initial value	Increment	Lower value	Upper value	Remarks
Sensor connection	2-wire 4-wire	2-wire			
Determine wire resistance	manual	manual automatic			
Manual entry wire resistance	0.5 Ω	0.1 Ω	0 Ω	50 Ω	
Final resistance	10.0 Ω	0.1 Ω	10 Ω	50 Ω	

Correction value (only for connected terminal conductive conductivity)

Access to all setting menus can be blocked with an access code !

correction value setting ?

correction value calibration temp. automatic 33.0 °C

D1C2-Leit.-034-GB

		Possible values			
	Initial value	Increment	Lower value	Upper value	Remarks
Type of temperature compensation	as per identity code	manual automatic off			
Manual temperature	25 °C	0.1 °C	0 °C	100 °C	
Automatic temperature	Correction value	0.1 °C	0 °C	100 °C	

Complete Operating Menu / Description

Calibration conductivity (only for connected terminal standard signal)


D1C2-Leit.-029-GB

During calibration, the D1C sets the command outputs to "0". Exception: if a basic load or a manual control output were set, these are maintained during calibration. The standard signal outputs mA (measuring value or correction value) are frozen.

The actually measured value will be proposed; this value is adjustable (arrow keys). On successful completion of calibration, all error checks which refer to the measured value are restarted.

| | Initial value | Possible values | | | Remarks |
		Increment	Lower value	Upper value	
Calibration conductivity	Measured value	depending on measuring range	depending on measuring range	depending on measuring range	

Error message	Condition effect	Remarks
Measured value too low value > xx mS/cm Check measuring range	Value < 2 % of measuring range	Check measuring range
Measured value too high value < xx mS/cm Check measuring range	Value > 100 % of measuring range	Check measuring range

Measuring range (only for connected terminal standard signal)

Access to all setting menus can be blocked with an access code !

D1C2-Leit.-019-GB
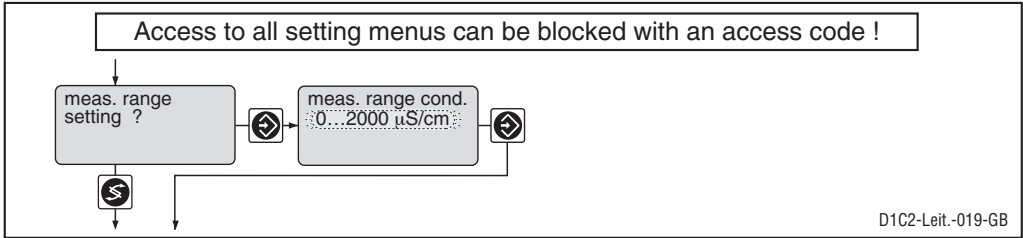
⚠️ *IMPORTANT*
When changing the measuring range, setpoints and limit values are switched over to their respective initial values. The settings must be checked in all menus!

17

Complete Operating Menu / Description

		Possible values			
	Initial value	Increment	Lower value	Upper value	Remarks
Measuring range	0....2000 μS/cm	0....1000 mS/cm* 0....200 mS/cm 0....20 mS/cm 0....5000 μS/cm* 0....2000 μS/cm 0....500 μS/cm* 0....200 μS/cm 0....50 μS/cm* 0....20 μS/cm			Setpoints and limit values are switched over to their respective initial values *only with connection on standard signal

Measured value (only for connected terminal standard signal)

D1C2-Leit.-020-GB
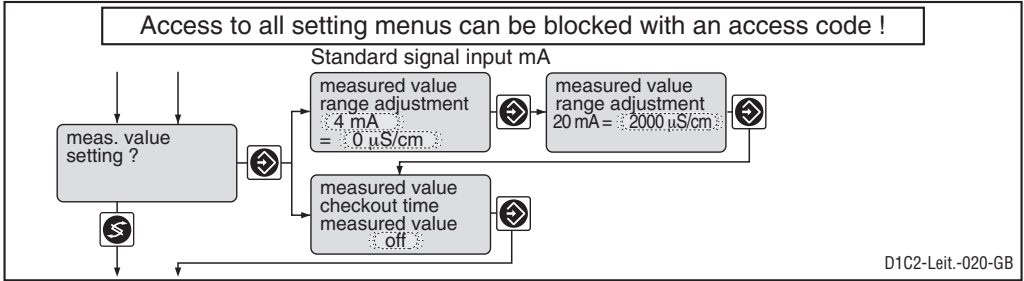
⚠️ **IMPORTANT**

When changing the range adjustment, the adjustments in all menus have to be checked!

		Possible values			
	Initial value	Increment	Lower value	Upper value	Remarks
Standard signal input lower signal limit	4 mA	0 mA 4 mA			
Allocated special voltage	0–2000 μS/cm	depending on measuring range	-5 % of final value	+5 % of final value	
Checkout time	off	1 s	1 s	9999 s	Constant measurement signal results in message and alarm. Function off = 0 s

Control time measuring value

⚠️ **IMPORTANT**

This function may not be activated for applications where it can be assumed that the measuring value does not change.
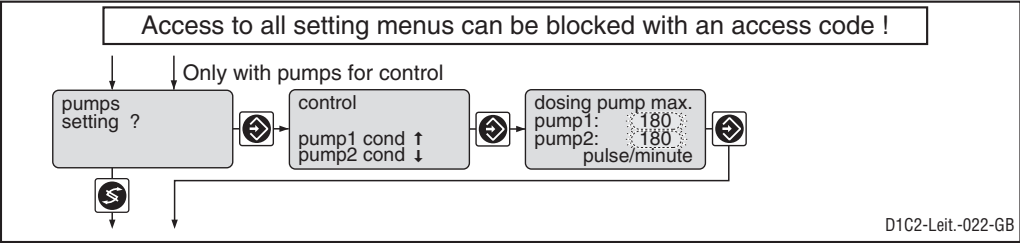
This function checks whether the measuring value from the sensor (measuring value input) changes within the "control time measuring value". It is assumed that the value does not change for an intact sensor.

If the measuring value does not change during this control time, the DULCOMETER® D1C sets the control output to "0" and the alarm relay drops out. The LCD display shows e.g. the message "check mS-probe".
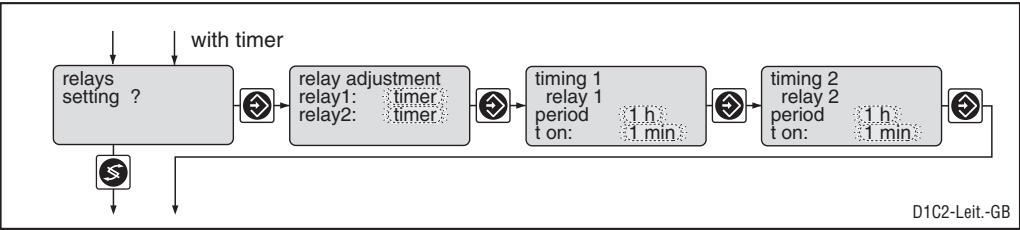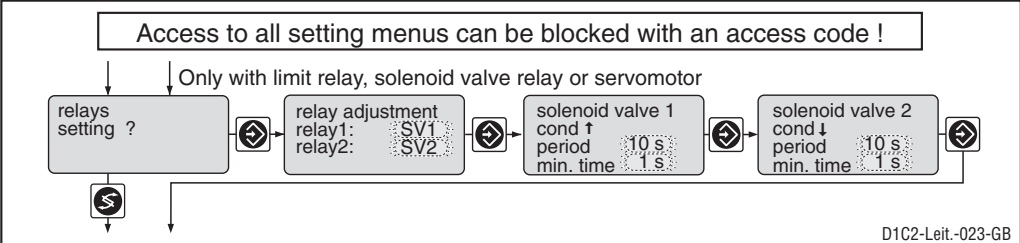
Complete Operating Menu / Description

NOTE

The following menus apply generally.

Pumps

Access to all setting menus can be blocked with an access code !

Only with pumps for control

| pumps setting ? | | control pump1 cond ↑ pump2 cond ↓ | | dosing pump max. pump1: 180 pump2: 180 pulse/minute | |

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		Possible values			
	Initial value	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 control

Access to all setting menus can be blocked with an access code !

Only with limit relay, solenoid valve relay or servomotor

| relays setting ? | | relay adjustment relay1: SV1 relay2: SV2 | | solenoid valve 1 cond ↑ period 10 s min. time 1 s | | solenoid valve 2 cond ↓ period 10 s min. time 1 s | |

D1C2-Leit.-023-GB

with timer

| relays setting ? | | relay adjustment relay1: timer relay2: timer | | timing 1 relay 1 period 1 h t on: 1 min | | timing 2 relay 2 period 1 h t on: 1 min | |

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Complete Operating Menu / Description

		Possible values			
	Initial value	Increment	Lower value	Upper value	Remarks
Relay adjustment	as per identity code				
Relay 1		Solenoid valve 1 Limit value 1* Actuator 1 Timer 1 Servomotor off			*For "limit value", the relays remain active, even in the event of a fault.
Relay 2		Solenoid valve 2 Limit value 2* Actuator 2 Timer 2 off			
Cycle	10 s	1 s	10 s	9999 s	for solenoid valve
min. time	1 s	1 s	1 s	Cycle/2	for solenoid valve Set here the smallest permitted operating factor of the connected device.
Period (Cycle)	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").

Timer relay

Cycle t_{on} on off t
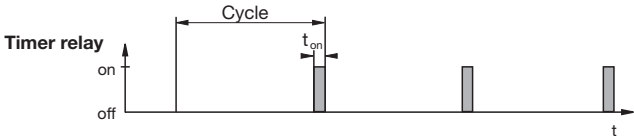
IMPORTANT

**The timer will be reset if there is a drop in the power supply.**

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.
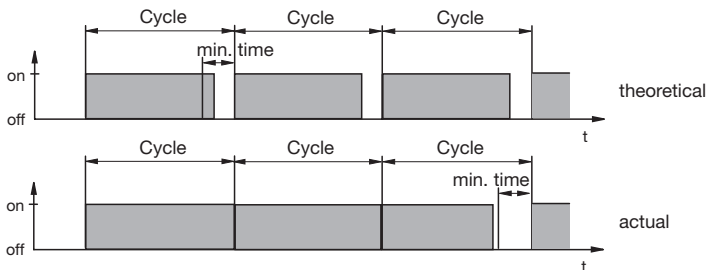
Complete Operating Menu / Description

Solenoid valve

Control variable: 80 %

$$\frac{t_{on}}{Cycle} = 0.80$$

Control variable: 50 %
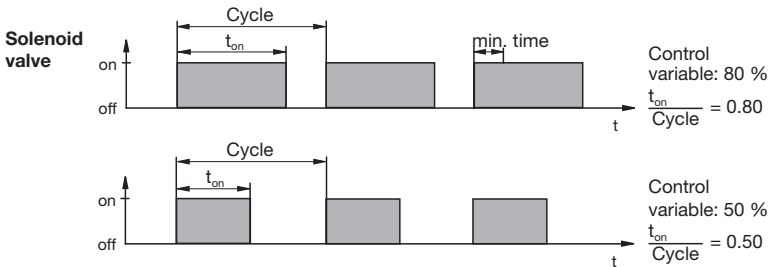
$$\frac{t_{on}}{Cycle} = 0.50$$

The switching time of the DULCOMETER® D1C (solenoid valve) depends on the actuating variable and the "min. time" (smallest permitted operating factor of the connected device).
The actuating 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:
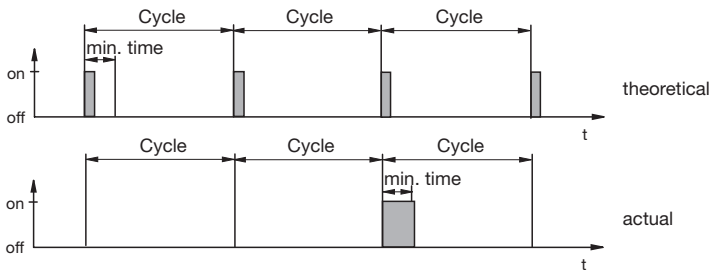
The DULCOMETER® D1C does not switch for a certain number of cycles until the sum of the theoretical switching times exceeds the "min. time". Then the DULCOMETER® D1C switches for the duration of this total time.
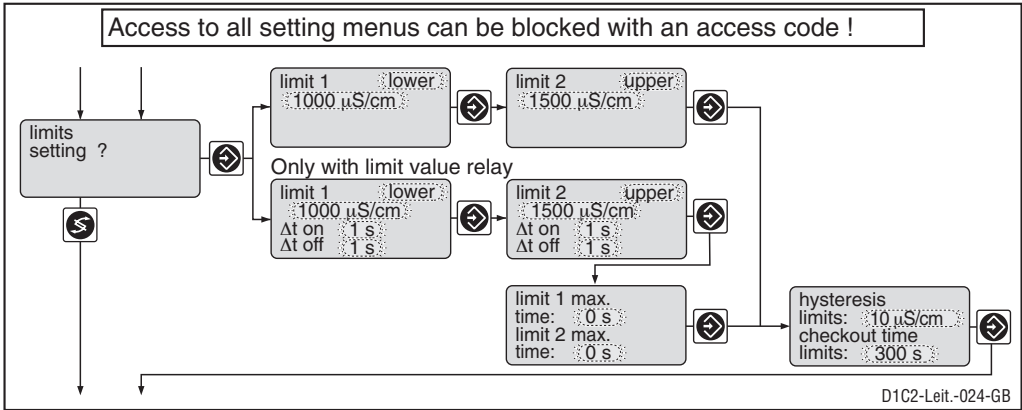
b) theoretical switching time > (cycle - min. time)   and   calculated switching time < cycle

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".

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Complete Operating Menu / Description

Limit values

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	Possible values				
	Initial value	Increment	Lower value	Upper value	Remarks
Type of limit Limit 1: transgression Limit 2:	lower upper	upper lower off*			Limit transgression when exceeding or dropping below value *only with limit value relay
Limit value 1 Limit value 2	500; 750 mS/cm 100; 150 mS/cm 10; 15 mS/cm 2500; 3750 μS/cm 1000; 1500 μS/cm 250; 375 μS/cm 100; 150 μS/cm 25; 37 μS/cm 10; 15 μS/cm	1 mS/cm 0.1 mS/cm 0.01 mS/cm 1 μS/cm 1 μS/cm 0.1 μS/cm 0.1 μS/cm 0.01 μS/cm 0.01 μS/cm	-50 mS/cm -10 mS/cm -1 mS/cm -250 μS/cm -100 μS/cm -25 μS/cm -10 μS/cm -2.5 μS/cm -1 μS/cm	1050 mS/cm 210 mS/cm 21 mS/cm 5250 μS/cm 2100 μS/cm 525 μS/cm 210 μS/cm 52.5 μS/cm 21 μS/cm	Meas. range 1000 mS/cm** Meas. range 200 mS/cm Meas. range 20 mS/cm Meas. range 5000 μS/cm** Meas. range 2000 μS/cm Meas. range 500 μS/cm** Meas. range 200 μS/cm Meas. range 50 μS/cm** Meas. range 20 μS/cm
Hysteresis limits	5 mS/cm** 1 mS/cm 0.1 mS/cm 25 μS/cm** 10 μS/cm 2.5 μS/cm** 1.0 μS/cm 0.25 μS/cm** 0.10 μS/cm	1 mS/cm 0.1 mS/cm 0.01 mS/cm 1 μS/cm 1 μS/cm 0.1 μS/cm 0.1 μS/cm 0.01 μS/cm 0.01 μS/cm	-2 mS/cm -0.4 mS/cm -0.04 mS/cm -10 μS/cm -4 μS/cm -1 μS/cm -0.4 μS/cm -0.1 μS/cm -0.04 μS/cm	1050 mS/cm 210 mS/cm 21 mS/cm 5250 μS/cm 2100 μS/cm 525 μS/cm 210 μS/cm 52.5 μS/cm 21 μS/cm	Effective in direction of "cancelling limit transgression"
Checkout time limits	off	1 s	1 s/off	9999 s	Result in message and alarm. off = 0 s: Function switched off, no message, no alarm

Complete Operating Menu / Description

	Possible values				
	Initial value	Increment	Lower value	Upper value	Remarks
Controlling	on	on off			
Actuating direction limit value 1; limit value 2	active closed	active closed active open			Reacts as make contact Reacts as break contact
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	

**only for connected terminal connection on standard signal

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 is broken. If "Controller" is also set to "off" the control process stops.

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**.

⚠ *ATTENTION*

- *Activation of the servomotor must be carried out with the same meticulous care as taken when calibrating a measuring sensor.*

- *To ensure correct operation, the activation time of the actuator used should not be less than 25 seconds for the control range from 0…100 %!*
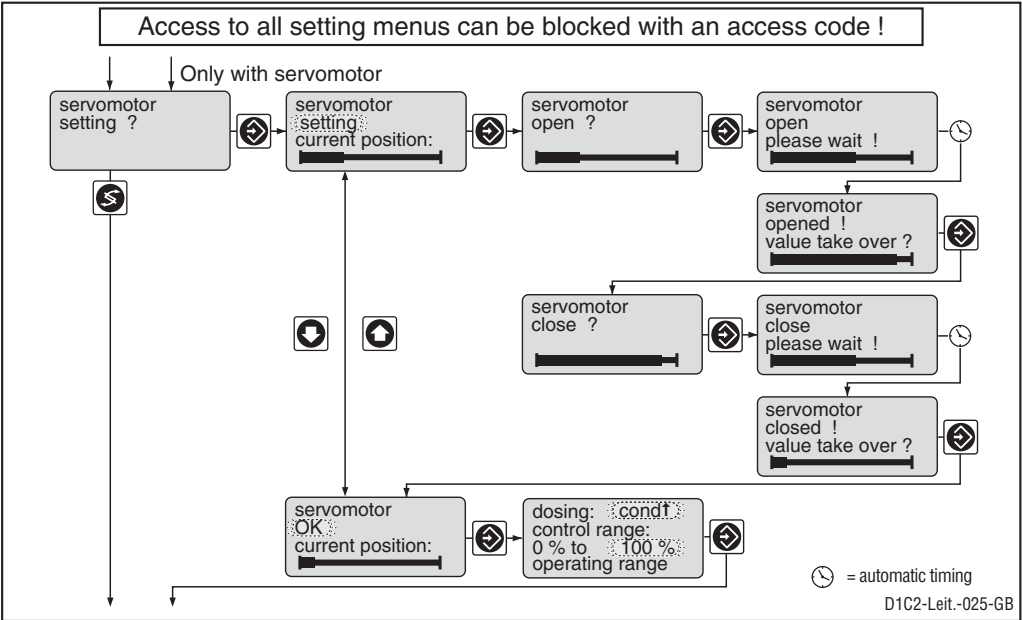
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Complete Operating Menu / Description

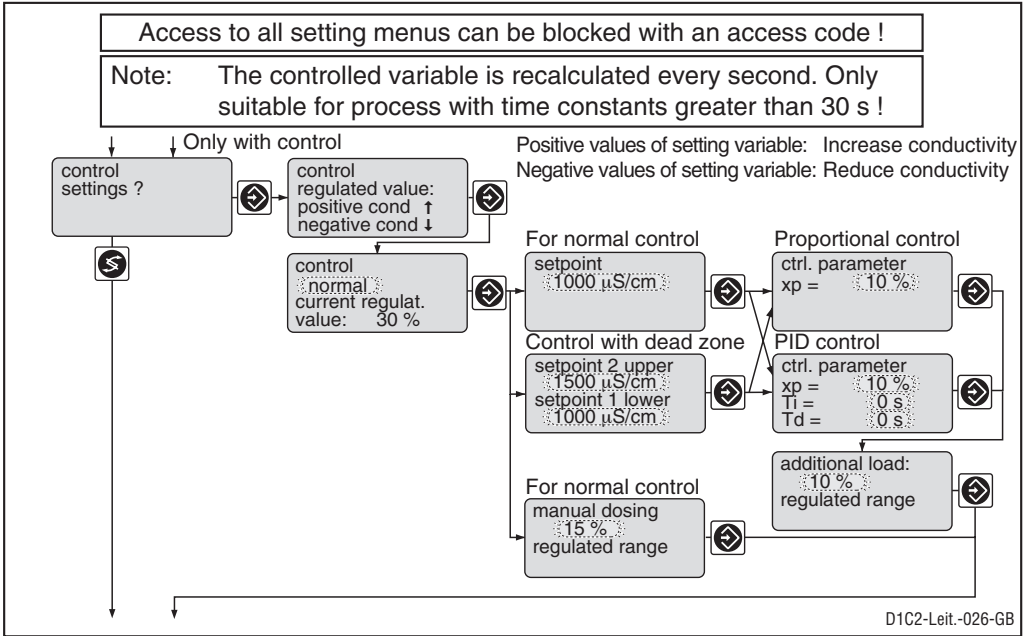|	Initial value	Possible values Increment	Lower value	Upper value	Remarks
Servomotor	Setting	Setting ok off			
Control direction	cond. ↑	cond. ↑ cond. ↓			
Control range	100 %	1 %	10 %	100 %	in % of operating range

NOTE

- *If the broad bar is to the far right, the stroke adjustment motor is fully open.*
- *The continuous display shows the degree in % to which it is open (the greater the percentage, the more open the stroke adjustment motor).*

Control

Access to all setting menus can be blocked with an access code !

Note: The controlled variable is recalculated every second. Only suitable for process with time constants greater than 30 s !

Only with control

Positive values of setting variable: Increase conductivity
Negative values of setting variable: Reduce conductivity

control settings ?

control regulated value:
positive cond ↑
negative cond ↓

control
normal
current regulat.
value: 30 %

For normal control
setpoint
1000 µS/cm

Control with dead zone
setpoint 2 upper
1500 µS/cm
setpoint 1 lower
1000 µS/cm

Proportional control
ctrl. parameter
xp =   10 %

PID control
ctrl. parameter
xp =   10 %
Ti =   0 s
Td =   0 s

For normal control
manual dosing
15 %
regulated range

additional load:
10 %
regulated range

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Complete Operating Menu / Description

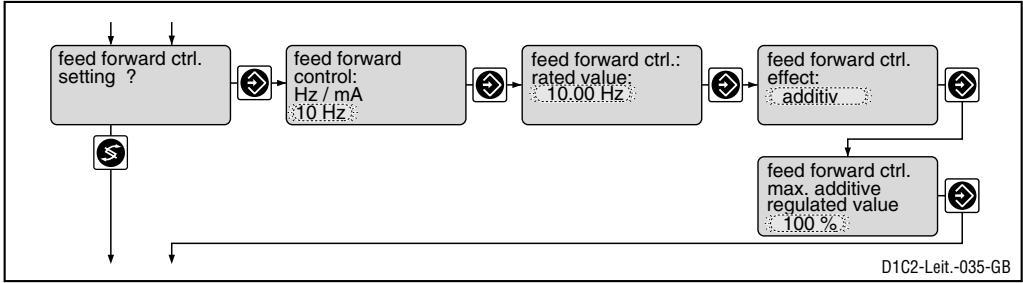|		Possible values			
	Initial value	Increment	Lower value	Upper value	Remarks
Control	normal	normal with dead zone manual			When controlling with dead zone, the feed forward control is not used for measured values within the dead zone
Setpoint setting	500 mS/cm 100 mS/cm 10 mS/cm 2500 μS/cm 1000 μS/cm 250 μS/cm 100 μS/cm 15 μS/cm 10 μS/cm	1 mS/cm 0.1 mS/cm 0.01 mS/cm 1 μS/cm 1 μS/cm 0.1 μS/cm 0.1 μS/cm 0.01 μS/cm 0.01 μS/cm	-50 mS/cm -10 mS/cm -1 mS/cm -250 μS/cm -100 μS/cm -25 μS/cm -10 μS/cm -2.5 μS/cm -1 μS/cm	1050 mS/cm 210 mS/cm 21 mS/cm 5250 μS/cm 2100 μS/cm 525 μS/cm 210 μS/cm 52.5 μS/cm 21 μS/cm	Meas. range 1000 mS/cm* Meas. range 200 mS/cm Meas. range 20 mS/cm Meas. range 5000 μS/cm* Meas. range 2000 μS/cm Meas. range 500 μS/cm* Meas. range 200 μS/cm Meas. range 50 μS/cm* Meas. range 20 μS/cm Setpoint 2 ≥ setpoint 1
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 %	

*only with connection on terminal standard signal

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]
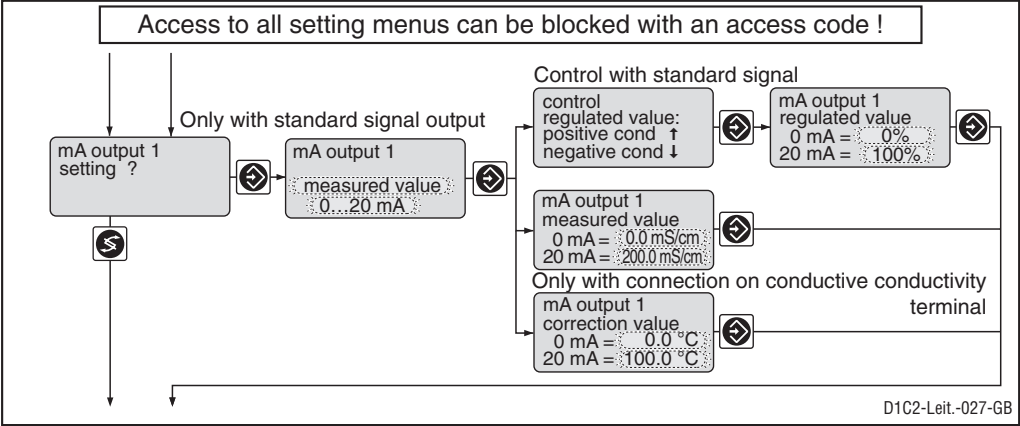
Complete Operating Menu / Description
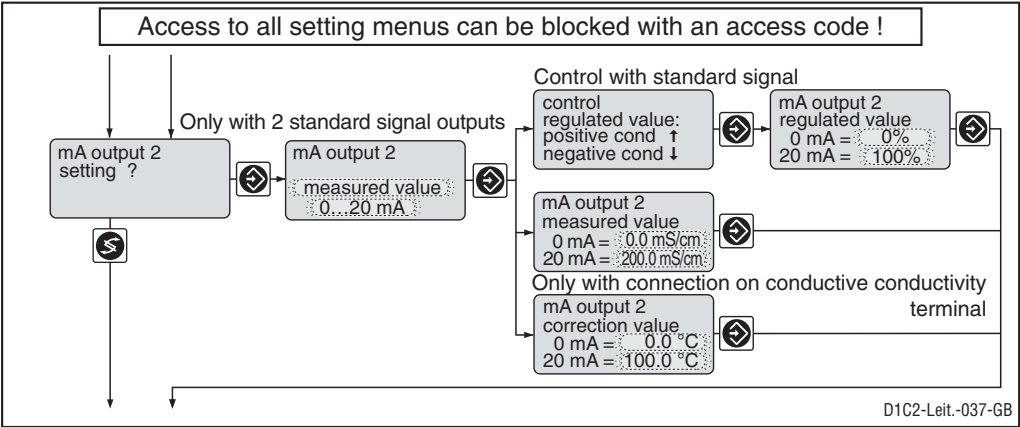
Feed forward control

D1C2-Leit.-035-GB

		Possible values			
	Initial value	Increment	Lower value	Upper value	Remarks
Feed forward control (Flow)	as per identity code with standard signal: 4–20 mA	None 10 Hz 500 Hz 0…20 mA 4…20 mA			Signal processing: Signal <0.02 Hz = no flow Signal <0.2 Hz = no flow Signal <0.2 mA = no flow Signal <4.2 mA = no flow
Feed forward control rated value	10 Hz 500 Hz 20 mA	0.01 Hz 1 Hz 0.01 mA	0.1 Hz 5 Hz 0/4 mA	10 Hz 500 Hz 20 mA	Dependent on signal type. Maximum limitation of range used.
Feed forward control effect	multiplicative	multiplicative additive			
Max. add. regulated value	100 %	1 %	-500 %	+500 %	Only with additive feed forward control

Complete Operating Menu / Description

Standard signal output 1

Access to all setting menus can be blocked with an access code !

Only with standard signal output

mA output 1 setting ?

mA output 1
measured value
0…20 mA

Control with standard signal

control
regulated value:
positive cond ↑
negative cond ↓

mA output 1
regulated value
0 mA =   0%
20 mA = 100%

mA output 1
measured value
0 mA =   0.0 mS/cm
20 mA = 200.0 mS/cm

Only with connection on conductive conductivity terminal

mA output 1
correction value
0 mA =   0.0 °C
20 mA = 100.0 °C

D1C2-Leit.-027-GB

Standard signal output 2

Access to all setting menus can be blocked with an access code !

Only with 2 standard signal outputs

mA output 2 setting ?

mA output 2
measured value
0…20 mA

Control with standard signal

control
regulated value:
positive cond ↑
negative cond ↓

mA output 2
regulated value
0 mA =   0%
20 mA = 100%

mA output 2
measured value
0 mA =   0.0 mS/cm
20 mA = 200.0 mS/cm

Only with connection on conductive conductivity terminal

mA output 2
correction value
0 mA =   0.0 °C
20 mA = 100.0 °C

D1C2-Leit.-037-GB

	Initial value	Possible values			Remarks
		Increment	Lower value	Upper value	
Variable allocation	as per identity code	Measured value Controlled variable Correction value			If control applicable Only with correction variable
Output range	0…20 mA	0…20 mA 4…20 mA 3.6/4-20 mA			Reduction to 3.6 mA when alarm relay switches (not limit-value violation)

Complete Operating Menu / Description

		Possible values			
	Initial value	Increment	Lower value	Upper value	Remarks
Range measured value	0–20 μS/cm	0.01 μS/cm	-1 μS/cm	21 μS/cm	Meas. range 20 μS/cm
	0–50 μS/cm	0.01 μS/cm	-2.5 μS/cm	52.5 μS/cm	Meas. range 50 μS/cm*
	0–200 μS/cm	0.1 μS/cm	-10 μS/cm	210 μS/cm	Meas. range 200 μS/cm
	0–500 μS/cm	0.1 μS/cm	-25 μS/cm	525 μS/cm	Meas. range 500 μS/cm*
	0–2000 μS/cm	1 μS/cm	-100 μS/cm	2100 μS/cm	Meas. range 2000 μS/cm
	0–5000 μS/cm	1 μS/cm	-250 μS/cm	5250 μS/cm	Meas. ranges 5000 μS/cm*
	0–20 mS/cm	0.01 mS/cm	-1 mS/cm	21 mS/cm	Meas. range 20 mS/cm
	0–200 mS/cm	0.1 mS/cm	-10 mS/cm	210 mS/cm	Meas. range 200 mS/cm
	0–1000 mS/cm	1 mS/cm	-50 mS/cm	1050 mS/cm	Meas. range 1000 mS/cm*
Range controlled variable	0 %…+100 %	1 %	-100 %	+100 %	Minimum range 1 %
Range correction value	0….100 °C	0.1 °C	0.0 °C	100 °C	Minimum range 1 °C

*only with connection on standard signal

General setting

D1C2-Leit.-028-GB

		Possible values			
	Initial value	Increment	Lower value	Upper value	Remarks
Alarm relay	active	active not active			
Pause	normal	normal hold			
Control input pause	active closed	active closed active open			Reacts as make contact Reacts as break contact
Alarm pause	off	off 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	restricted complete			

Complete Operating Menu / Description

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-proportion and (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.

9 Fault / Remarks / Troubleshooting

Fault	Fault text	Symbol	Effect On metering	On control	Alarm with acknowledgement	Remarks	Remedy
Measured value Signal exceeds/drops below value*	mS-meas. range ↑↓ Check mS-input	Ɛ Ɛ	Basic load Basic load	Stop Stop	Yes Yes	Measured value out of measuring range. Signal <3.0 ±0.2 mA or >23 ±0.2 mA	Check range adjustment Check sensor, transducer and cable connection
Checkout time meas. value exceeded*	Check mS-probe	Ɛ	Basic load	Stop	Yes	Function detachable	Check function of sensor, Extend checkout time
Correction measured variable Signal exceeds/drops below value*	Check te-input	Ɛ	Basic load	Stop	Yes	Signal <3.0 ±0.2 mA or >23 ±0.2 mA $\alpha \geq 4\ \%/°C$	Check sensor, transducer and cable connection
upper limit temperature exceeded	te-limit ↑	Ɛ	Basic load	Stop	Yes	Signal <3.0 ±0.2 mA or >23 ±0.2 mA	Check sensor, transducer and cable connection
Feed forward control Signal exceeds/drops below value*	Check feed forward input	Ɛ Ɛ		Stop	Yes	Value last valid is used	
Signal drops below multiplicative		Ɛ				Function detachable	Define cause, reset values if necessary
Limit value violation after checkout time limits Control "on" Control "off"	mS-limit 1 ↑↓ mS-limit 2 ↑↓	Ɛ Ɛ		Stop Stop	Yes Yes		
Servomotor	Servomotor defective	Ɛ	Stop or basic load	Stop	Yes	Servomotor closes	Check servomotor
Electronics error Position not reached	System error	Ɛ O	Stop	Stop	Yes	Electronic data defective	Call in service

Operation	Note text	Symbol	Effect On metering	On control	Alarm with acknowledgement	Remarks	Remedy
Pause contact	Pause Pause/Hold	Ɛ O Ɛ	Stop	Stop PI part frozen	No/Yes** No	No further fault check	–
Stop button	Stop	Ɛ O	Stop	Stop	No	Relay drops out	–
Calibration* Calibration with error	Check meas. range	Ɛ	Basic load	Stop	–	–	Repeat calibration Check sensor/buffer
During servomotor setting Position feedback wrong Upper position <40 % max. value Lower position >30 % range	Direction check Final value too small/ Final value too big		Basic load	Stop	–	Without correct adjustment the last valid values are still used	Check connection of relay, potentiometer Adjust the operation region of the servomotor correctly

* only with connection on standard signal
** Depends on whether "alarm off" or "alarm on" in "General Settings".