Assembly and operating instructions

DULCOMETER®, Compact Controller
Measured variable: Chlorine

ProMinent®

EN

A1000

Please carefully read these operating instructions before use. · Do not discard.
The operator shall be liable for any damage caused by installation or operating errors.
The latest version of the operating instructions are available on our homepage.

Part no.: 985626

BA DM 208 08/15 EN

General non-discriminatory approach

In order to make it easier to read, this document uses the male form in grammatical structures but with an implied neutral sense. It is aimed equally at both men and women. We kindly ask female readers for their understanding in this simplification of the text.

Supplementary information

Please read the supplementary information in its entirety.

Information

This provides important information relating to the correct operation of the unit or is intended to make your work easier.

Safety Information

The safety information includes detailed descriptions of the hazardous situation, see
↳ *Chapter 2.1 'Explanation of the safety information' on page 8*

The following symbols are used to highlight instructions, links, lists, results and other elements in this document:

More symbols

Symbol	Description
1. ▶	Action, step by step
⇨	Outcome of an action
↳	Links to elements or sections of these instructions or other applicable documents
■	List without set order
[Button]	Display element (e.g. indicators) Operating element (e.g. button, switch)
'Display /GUI'	Screen elements (e.g. buttons, assignment of function keys)
`CODE`	Presentation of software elements and/or texts

Table of contents

1 Identity code

DCCa	DULCOMETER® Compact,									
	Mounting type									
	E	Spare part units								
	W	Wall/pipe mounting IP 67								
	S	With fitting kit for control panel mounting IP 54								
		Design								
		00	With ProMinent® logo							
		E1	Spare part unit, controller housing lower part (processor/PCB), fully assembled							
		E2	Spare part unit, controller housing top part (processor/PCB), fully assembled							
			Operating voltage							
			6	90 … 253 V, 48/63 Hz						
				Measured variable						
				C0	Free chlorine					
				NG	pH/ORP (switchable)					
				L3	Conductive conductivity (designation: COND_C)					
				L6	Inductive conductivity (designation: COND_I)					
					Hardware extension					
					0	None				
					Approvals					
					01	CE (Standard)				
						Certificates				
						0	None			
							Operating instructions language			
							EN	German	KR	Korean

DCCa	DULCOMETER® Compact,									
							EN	English	LT	Lithuanian
							ES	Spanish	LV	Latvian
							IT	Italian	NL	Dutch
							FR	French	PL	Polish
							FI	Finish	PT	Portuguese
							BG	Bulgarian	RO	Romanian
							ZH	Chinese	SV	Swedish
							CZ	Czech	SK	Slovakian
							EL	Greek	SL	Slovenian
							HU	Hungarian	RU	Russian
							YES	Japanese	TH	Thai

2 Introduction

Data and functions

These operating instructions describe the technical data and functions of the DULCOMETER® Compact Controller, measured variable chlorine.

2.1 Explanation of the safety information

Introduction

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

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

DANGER!

Nature and source of the danger

Consequence: Fatal or very serious injuries.

Measure to be taken to avoid this danger

Danger!

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

WARNING!

Nature and source of the danger

Possible consequence: Fatal or very serious injuries.

Measure to be taken to avoid this danger

Warning!

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

CAUTION!

Nature and source of the danger

Possible consequence: Slight or minor injuries, material damage.

Measure to be taken to avoid this danger

Caution!

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

! NOTICE!

Nature and source of the danger

Damage to the product or its surroundings

Measure to be taken to avoid this danger

Note!

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

Type of information

Hints on use and additional information

Source of the information, additional measures

Information!

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

2.2 Users' qualifications

WARNING!

Danger of injury with inadequately qualified personnel!

The operator of the plant / device is responsible for ensuring that the qualifications are fulfilled.

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

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

Training	Definition
Instructed personnel	An instructed person is deemed to be a person who has been instructed and, if required, trained in the tasks assigned to him/her and possible dangers that could result from improper behaviour, as well as having been instructed in the required protective equipment and protective measures.
Trained user	A trained user is a person who fulfils the requirements made of an instructed person and who has also received additional training specific to the system from ProMinent or another authorised distribution partner.
Trained qualified personnel	A qualified employee is deemed to be a person who is able to assess the tasks assigned to him and recognize possible hazards based on his/her training, knowledge and experience, as well as knowledge of pertinent regulations. The assessment of a person's technical training can also be based on several years of work in the relevant field.

Training	Definition
Electrician	Electricians are deemed to be people, who are able to complete work on electrical systems and recognize and avoid possible hazards independently based on his/her technical training and experience, as well as knowledge of pertinent standards and regulations. Electricians should be specifically trained for the working environment in which the are employed and know the relevant standards and regulations. Electricians must comply with the provisions of the applicable statutory directives on accident prevention.
Customer Service department	Customer Service department refers to service technicians, who have received proven training and have been authorised by ProMinent to work on the system.

Note for the system operator

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

3 Safety and responsibility

3.1 General Safety Information

WARNING!

Live parts!

Possible consequence: Fatal or very serious injuries

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

WARNING!

Unauthorised access!

Possible consequence: Fatal or very serious injuries

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

WARNING!

Operating errors!

Possible consequence: Fatal or very serious injuries

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

CAUTION!

Electronic malfunctions

Possible consequence: Material damage to destruction of the unit

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

NOTICE!

Correct and proper use

Damage to the product or its surroundings

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

NOTICE!

Correct sensor operation / Run-in time

Damage to the product or its surroundings

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

NOTICE!

Correct sensor operation

Damage to the product or its surroundings

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

NOTICE!

Compensation of control deviations

Damage to the product or its surroundings

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

3.2 Correct and proper use

NOTICE!

Correct and proper use

The device is intended to measure and regulate liquid media. The designated measured variable is detailed on the controller and is absolutely binding.

The unit may only be used in accordance with the technical details and specifications provided in this operating manual and in the operating manuals for the individual components (such as, for example, sensors, fittings, calibration devices, metering pumps etc.).

Any other uses or modifications are prohibited.

NOTICE!

Compensation for control deviations

Damage to the product or its surroundings

– The controller can be used in processes, which require compensation of > 30 seconds

Permissible sensors

The controller may only be operated with the following sensors:

– *DULCOTEST® Sensor for Free Chlorine CLB2 (Order Number 1038902) with temperature sensor*

– *DULCOTEST® Sensor for Free Chlorine CLB3 (Order Number 1041696) without temperature sensor*

4 Functional description

Brief functional description

The controller for chlorine measured variables provides basic functions for water treatment applications. The controller has a fixed configuration with the following features:

- Language independent operation. Use of abbreviations, such as:
  - *[INPUT]*
  - *[OUTPUT]*
  - *[CONTROL]*
  - *[ERROR]*
- Illuminated display
- 3 LEDs indicate the operating states:
  - *[f-REL]*, active
  - *[P-REL]*, active
  - Error
- Control characteristics:
  - P, or
  - PID
- Selectable control direction:
  - Raise measured value, or
  - lower measured value
- Impulse frequency relay *[f-REL]* for metering pump control
- Output relay *[P-REL]*, configurable as:
  - Alarm
  - limit value
  - PWM control output for metering pumps
- Analog output 0/4…20 mA, configurable:
  - Measured value, or
  - Correction variable
- Suction function for all actuators
- Digital input to switch off the control or to process a sample water limit contact by remote control
- Temperature sensor input (Pt100 or Pt 1000) for temperature compensation
- Degree of protection
  - IP67 (wall / pipe mounting)
  - IP54 (control panel mounting)

Applications:

- Treatment of drinking water
- Swimming pool water treatment

4.1 Overview of the first level menu

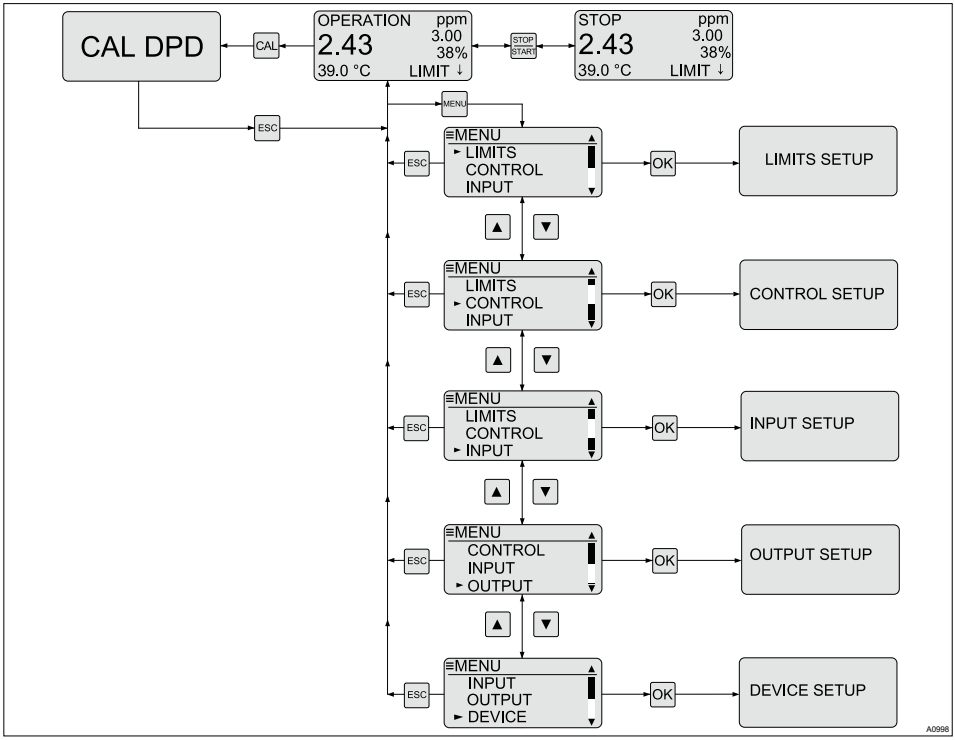
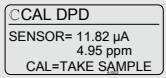
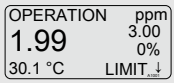
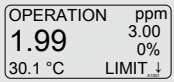
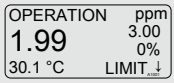
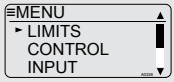
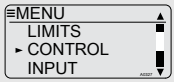
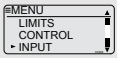
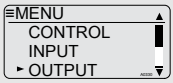
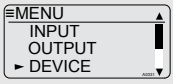


Fig. 1: Overview of the first level menu

Display view	Selection with:	Reference	Function
OPERATION ppm 1.99 3.00 0% 30.1 °C LIMIT ↓		*Chapter 7 'Operating diagram' on page 42*	
CAL			Changes to the calibration menu.

Display view	Selection with:	Reference	Function
		*Chapter 8.1 'Calibrating (CAL) the chlorine sensor ' on page 46*	The calibration menu enables calibration between the reference method (DPD1) and sensor.
			
			Stop/Start the control and metering function.
		*Chapter 9.2 'STOP/START key' on page 68*	By pressing the STOP key, the control is stopped. The STOP key can be pressed independently of the currently displayed menu. However the STOP state is only shown in the continuous display.
		*Chapter 7.3 'Continuous display' on page 43*	Changes from the continuous display to the setting menu.
		*Chapter 8.2 'Setting limit values [LIMITS] ' on page 53*	Enables the setting of the limit value for limit value monitoring.
			
		*Chapter 8.3 'Setting the control [CONTROL] ' on page 55*	Enables parameter setting for the control.
			

Display view	Selection with:	Reference	Function
	OK	*Chapter 8.4 'Input setting (INPUT)' on page 58*	Enables setting of the measured value input parameter.
			
	OK	*Chapter 8.5 'Output setting (OUTPUT)' on page 61*	Enables setting of the mA output parameter.
			
	OK	*Chapter 8.6 'DEVICE setting' on page 65*	Enables setting of the password and the *[RESTART]* and *[FACTORY RESET]* function on the controller.

5 Assembly and installation

- **User qualification, mechanical installation:** trained qualified personnel, see *Chapter 2.2 'Users' qualifications' on page 10*
- **User qualification, electrical installation:** Electrical technician, see *Chapter 2.2 'Users' qualifications' on page 10*

CAUTION!

Possible consequence: Material damage.

The hinge between the front and rear part of the housing cannot absorb high levels of mechanical loading. When working on the controller, hold the top section of the controller housing firmly.

NOTICE!

Mounting position and conditions

- The (electrical) installation should only take place after (mechanical) installation
- Ensure that there is unimpeded access for operation
- Ensure safe and low-vibration fastening
- Avoid direct sunlight
- Permissible ambient temperature of the controller at the installation location: - 10 ... 60°C at max. 95 % relative air humidity (non-condensing)
- Take into consideration the permissible ambient temperature of the connected sensors and other components

Read-off and operating position

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

Mounting position

- *Leave sufficient free space for the cables*

Packaging material

Dispose of packaging material in an environmentally responsible way. All packaging components carry the corresponding recycling code.

5.1 Scope of delivery

The following parts belong to the standard scope of delivery of a DULCOMETER® Compact Controller.

Description	Quantity
Assembled device	1
Cable connection set DMTa/DXMa (metr.)	1
Operating instructions	1

5.2 Mounting (mechanical)

The DULCOMETER® Compact Controller is suitable for mounting on a wall, pipe or control panel.

Mounting materials (contained in the scope of supply):

Description	Quantity
Wall/tube retaining bracket	1
Round head screws 5x45 mm	2
Washer 5.3	2
Rawlplug Ø 8 mm, plastic	2

5.2.1 Wall mounting

Mounting (mechanical)

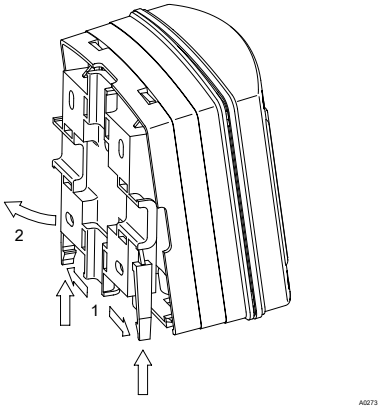


Fig. 2: Removing the wall/pipe bracket

1. Remove the wall/pipe bracket. Pull the two snap-hooks (1) outwards and push upwards
2. Fold out the wall/pipe bracket (2) and pull out in a downwards direction
3. Mark two drill holes diagonal to each other by using the wall/pipe bracket as a drilling template
4. Drill holes: Ø 8 mm, d = 50 mm

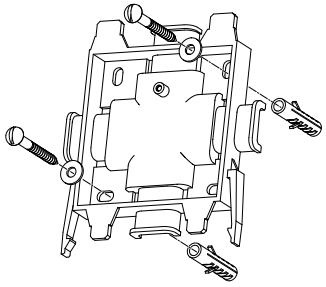


Fig. 3: Screwing on the wall/pipe bracket using washers

5. Screw on the wall/pipe bracket using the washers
6. Suspend the DULCOMETER® Compact Controller at the top in the wall/pipe bracket and push using light pressure at the bottom against the wall/pipe bracket. Then press upwards until the DULCOMETER® Compact Controller audibly snaps into position.

5.2.2 Pipe mounting

Mounting (mechanical)

Pipe diameter

Pipe diameter: 25 mm to 60 mm.

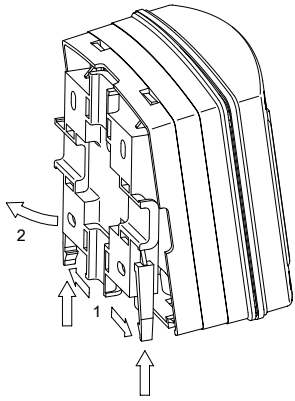


Fig. 4: Removing the wall/pipe bracket

1. Remove the wall/pipe bracket. Pull the two snap-hooks (1) outwards and push upwards
2. Fold out the wall/pipe bracket (2) and pull out in a downwards direction
3. Secure the wall/pipe bracket using cable ties (or pipe clips) to the pipe

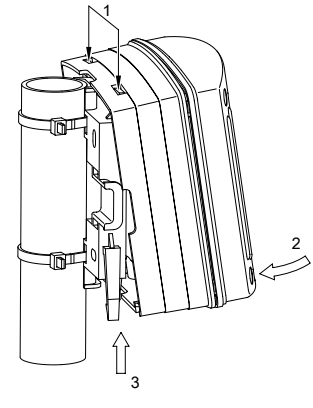


Fig. 5: Suspend and secure the DULCOMETER® Compact Controller

4. Suspend the DULCOMETER® Compact Controller at the top (1) in the wall/pipe bracket and push using light pressure at the bottom (2) against the wall/pipe bracket. Then press upwards (3) until the DULCOMETER® Compact Controller audibly snaps into position

5.2.3 Control panel mounting

Mounting kit for control panel installation of the DULCOMETER® Compact Controller: Order number 1037273

Description	Quantity
Drilling template sheet 3872-4	1
PT screw (3.5 x 22)	3
Profile seals	2
Strain relief strip DF3/DF4	1
PT screw (3.5 x 10)	2
Individual parts packed in transparent cover / Mounting kit is not contained in the standard scope of supply	

CAUTION!

Material thickness of control panel

Possible consequence: material damage

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

In the mounted state, the DULCOMETER® Compact Controller extends approx. 30 mm from the control panel.

Preparing the control panel

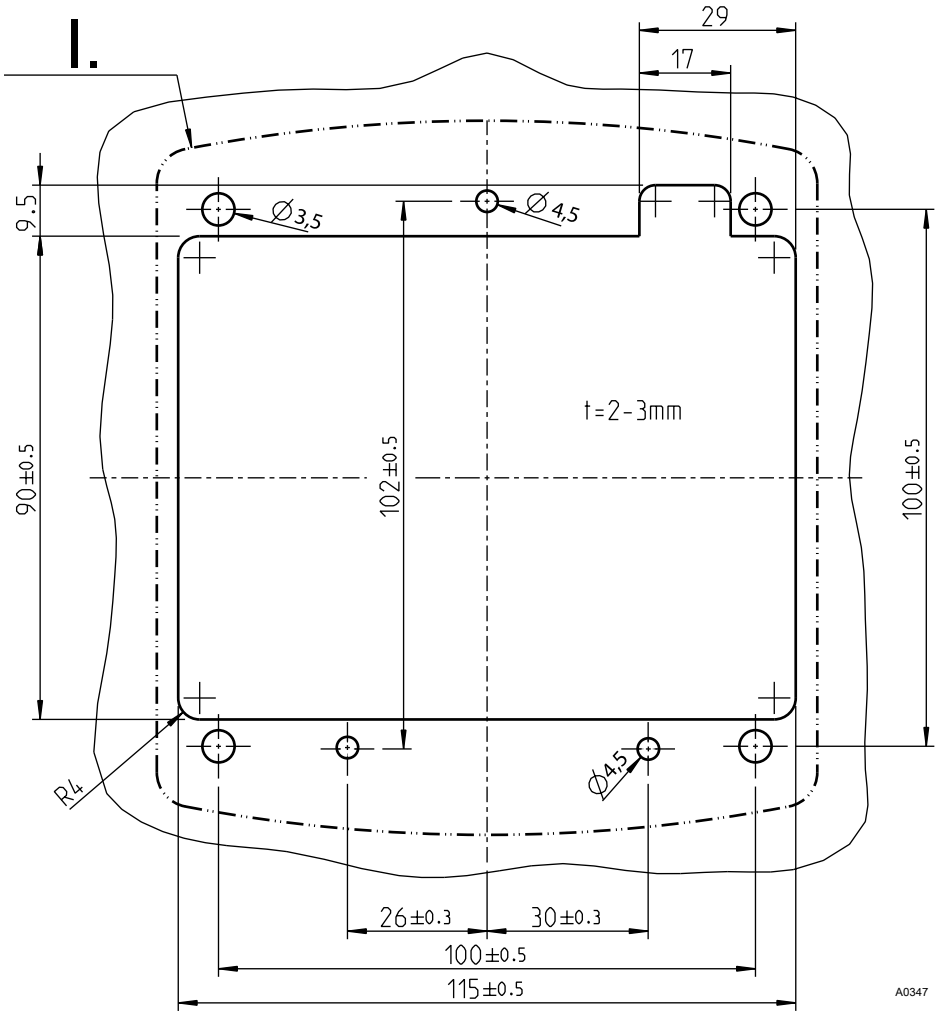


Fig. 6: The drawing is not to scale and is intended for information purposes only.

I. Outline contour of the DULCOMETER® Compact Controller housing

1. Mark the exact position of the DULCOMETER® Compact Controller on the control panel using the drilling template

2.

Core hole

Adhere to the 3.5 mm Ø as the core hole diameter for screwing in the fixing bolts.

Drill four holes for the bolts for the top section of the controller housing using a 3.5 mm Ø drill bit

3. Drill three holes for the bolts for the bottom section of the controller housing using a 4.5 mm Ø drill bit

4. Drill four holes using an 8 mm Ø drill bit and use a jigsaw to cut the cut-out

⇨ Deburr all the edges.

Fitting the DULCOMETER® Compact Controller into the cut-out in the control panel

NOTICE!

Ribbon cable base

The base for the ribbon cable is firmly soldered onto the PCB. The base cannot be removed. Open the base lock (3) to loosen the ribbon cable, see Fig. 7

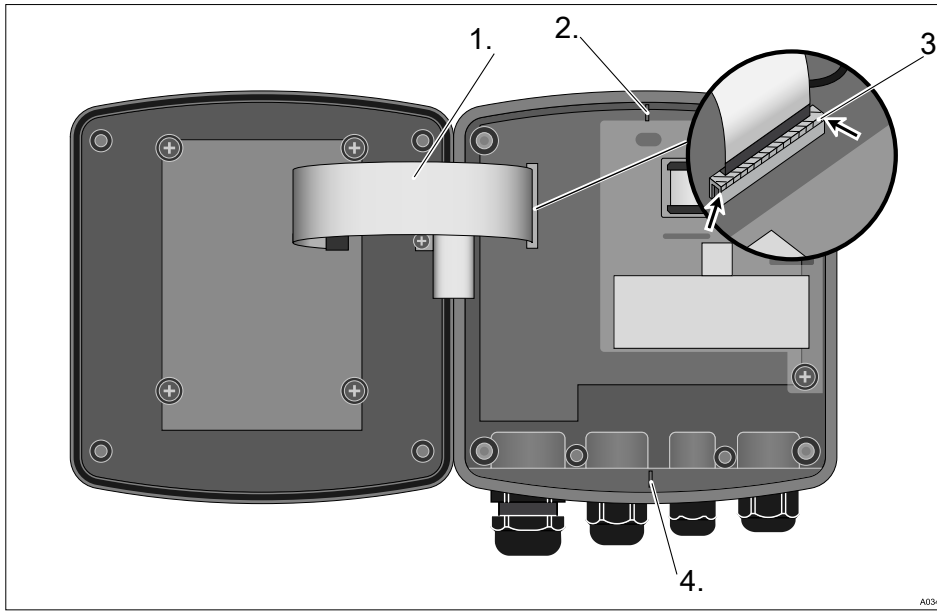


Fig. 7: Loosening the ribbon cable

1. Undo four screws and open the DULCOMETER® Compact Controller
2. Open the right and left lock (3) (arrows) on the base and pull the ribbon cable (1) out of the socket
3. Use pliers to break off the catches (2 and 4). These are not needed for control panel installation

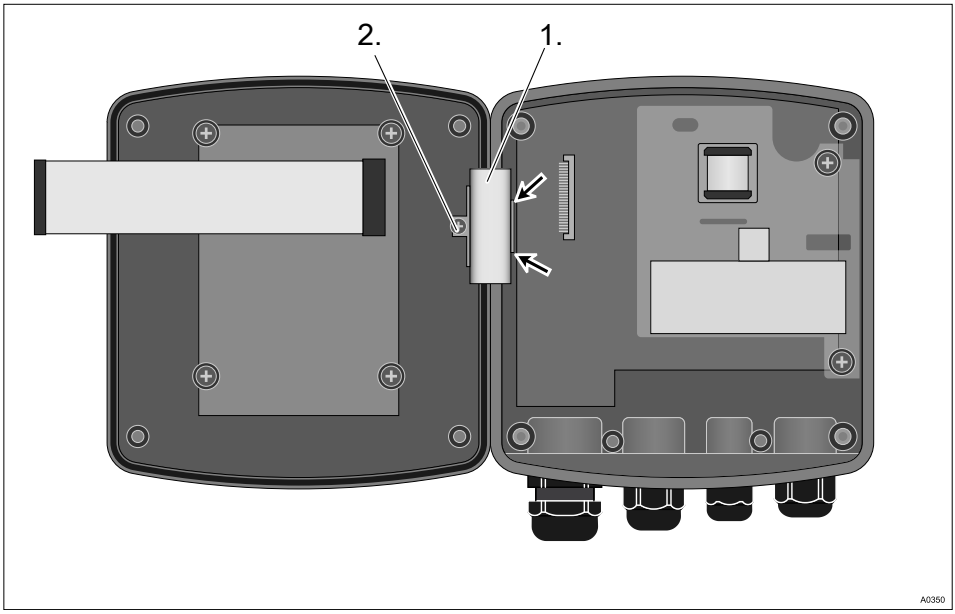


Fig. 8: Dismantle the hinge

4. Remove the screw (2), unclip the hinge (1) on the bottom section of the controller housing (arrows) and remove the hinge

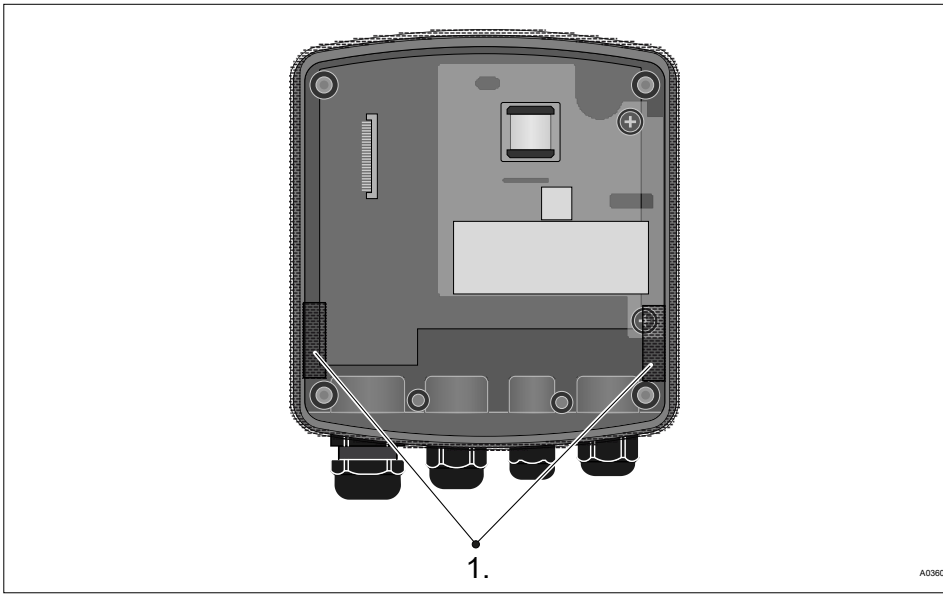


Fig. 9: Fitting the profile seal on the bottom section of the controller housing

5. Position the profile seal evenly around the upper edge of bottom section of the DULCOMETER® Compact Controller housing. Arrange the clips (1) as shown in the figure

   ⇨ Ensure that the profile seal evenly surrounds the upper edge of the housing.

6. Insert the bottom section of the DULCOMETER® Compact Controller housing with the profile seal from behind into the cut-out and use three screws to secure it in place

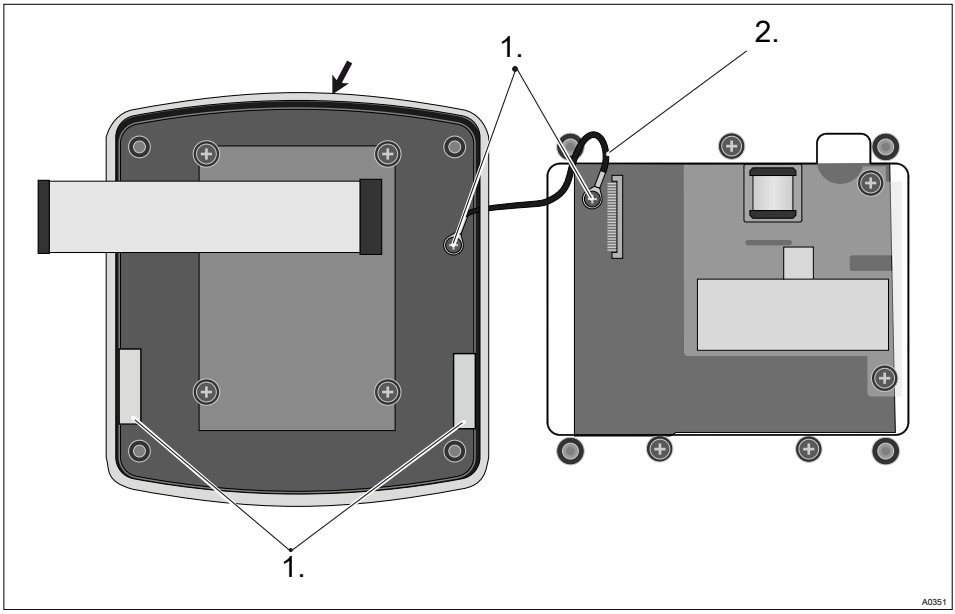


Fig. 10: Fitting the profile seal onto the top section of the controller housing

7. Position the profile seal (arrow) evenly into the groove in the top section of the DULCOMETER® Compact Controller housing. Arrange the clips (3) as shown in the figure

8. Secure the strain relief (2) using two screws (1)

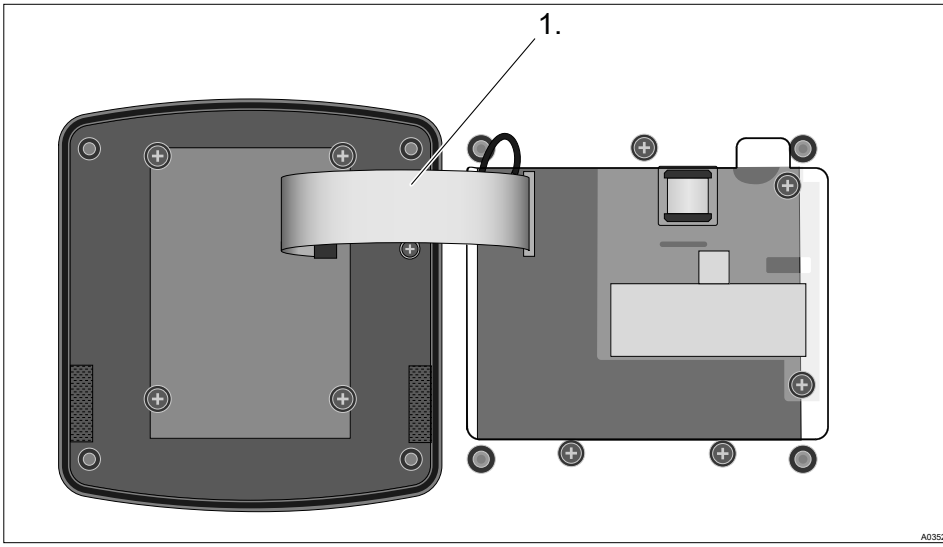


Fig. 11: Push and lock the ribbon cable in its base

9. Push and lock the ribbon cable (1) in its base
10. Screw the top section of the controller housing onto the bottom section of the DULCOMETER® Compact Controller housing
11. Once again check that the profile seals are fitted properly

    ⇨ IP 54 degree of protection can only be provided if the control panel is mounted correctly

5.3 Installation (electrical)

WARNING!

Live parts!

Possible consequence: Fatal or very serious injuries

- Measure: Disconnect the electrical power supply to the device before opening the housing and secure to prevent unintentional reconnection
- Disconnect damaged or defective devices or devices that have been tampered with and prevent unintended reconnection
- The provision of a suitable isolating device (emergency-off switch, etc.) is the responsibility of the plant operator

The signal leads of the controller may not be routed alongside interference-prone cabling. This could lead to controller malfunctions.

5.3.1 Cable Cross-Sections and Cable End Sleeves

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

5.3.2 Electrical connection of the chlorine sensor

CAUTION!

Length of sensor cable

The sensor is supplied with a fixed cable.

Possible consequence: Slight or minor injuries. Material damage.

Modifying the cable (lengthening, shortening, etc.) is impermissible.

5.3.3 Terminal diagram / wiring

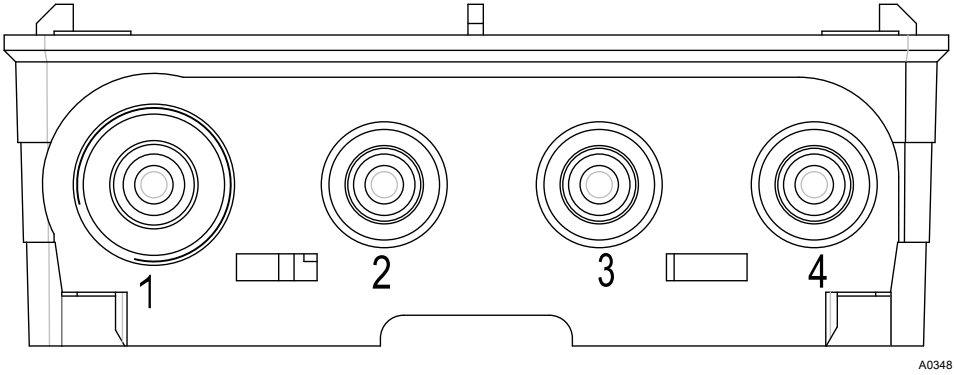


Fig. 12: Threaded connector number

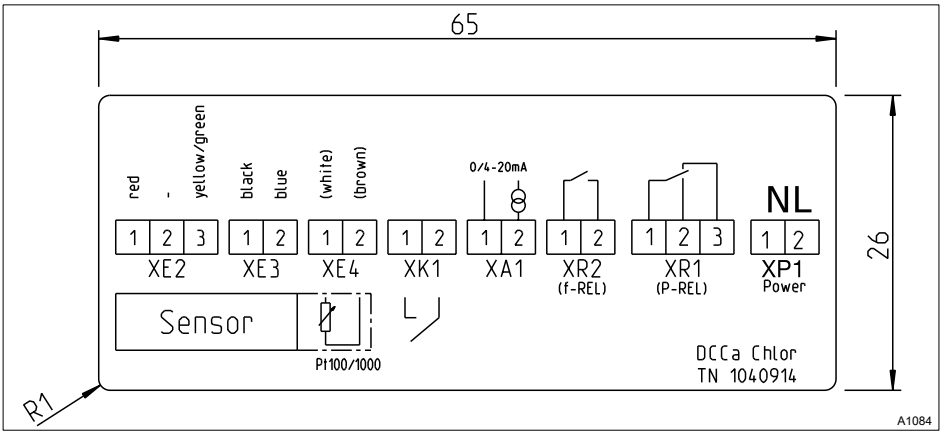


Fig. 13: Label terminal plan for Compact Controller Chlorine

Wiring

Threaded connector no. Size	Description	Terminals Description	Terminals number	Colour Info	Function	Remarks
1 / M20	Sensor without Pt element (sensor cable 4-core)	XE 2	1	red	Shielding	Guide cable through multiple seal inserts M20 / 2x**4.5** mm. Close the open bushing with the supplied seal insert
			2	-	free	
			3	Yellow/ green	RE	
		XE 3	1	black	WE	
			2	blue	CE	
	Sensor with Pt element (sensor cable 6-core)	XE 2	1	red	Shielding	
			2	-	free	
			3	Yellow/ green	RE	
		XE 3	1	black	WE	
			2	blue	CE	
		XE 4	1	white	Pt100 or Pt1000 Sensor	
			2	brown		
	Temp. input Pt 100 / Pt 1000	XE 4	1	+	Pt100 or Pt1000 Sensor	
			2	-		
2 / M16	Standard signal output	XA 1	1	+ 15 V	e.g. recorder / actuator	Guide cable in each case with 4-core through multiple seal insert M16 / 2x**4.5** mm.
			2	-		
	Contact input	XK 1	1	+	Pause	
			2	-		

Threaded connector no. Size	Descrip-tion	Terminals Description	Terminals number	Colour Info	Function	Remarks
	Relay output (f-relay)	XR 2	1		Fre-quency controlled metering pump	
			2			
*** To achieve protection class IP 67, please use original Prominent cable, part number 1036759**						
3 / M16	Relay output **or** Relay output	XR1	1	COM	Solenoid valve / metering pump ** raise / lower	Guide cable through single M16 seal insert
			2	NO		
	or Relay output (P-relay)	XR1	1	COM	Limit relay	
			2	NO		
		XR1	1	COM	Alarm relay	
			3	NC		
**** An RC suppressor must be connected (not part of the scope of delivery)** *Chapter 5.4 'Switching of inductive loads' on page 39*						
4 M16	Mains connector	XP 1	1	N	85 ... 253 V eff.	Guide cable through single M16 seal insert
			2	L		

Legend to the "Wiring" table

Abbreviation	Meaning
Colour	Cable colour
Info	Further information about the sensor
f-relay	Pump frequency relay
P-relay	Output relay
COM	Common relay contact (root)
NO	Contact *'normally opened'*
NC	Contact *'normally closed'*
RE	Reference sensor
WE	Working sensor
CE	Counter sensor

Recommended cable diameter

Cable identifier	Diameter in mm
Mains Cable	6.5
Temperature sensor cable	5.0
External signal cable	4.5

Terminal diagram

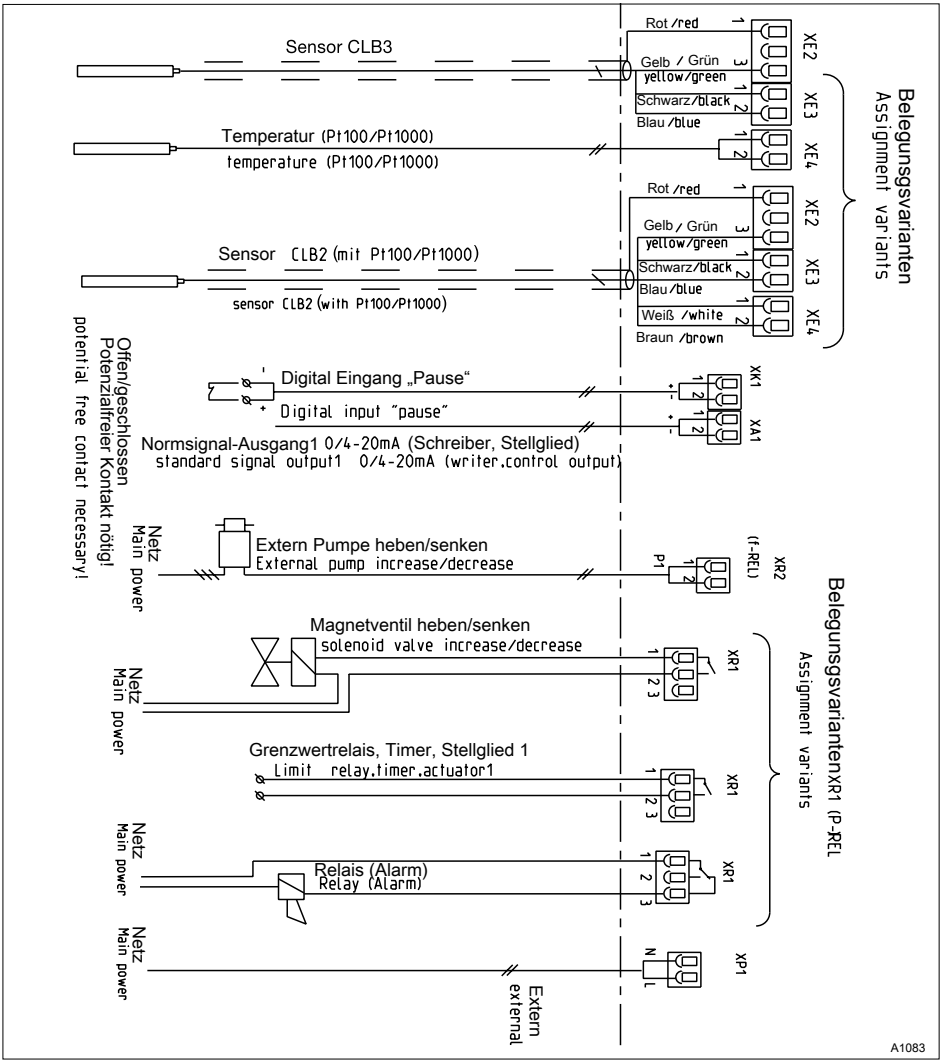


Fig. 14: Terminal diagram

5.3.4 Installation (electrical)

The cable must be routed in a site-provided cable duct to ensure strain relief

1. Undo the four housing screws
2. Slightly lift the controller housing top section forwards and fold it to the left

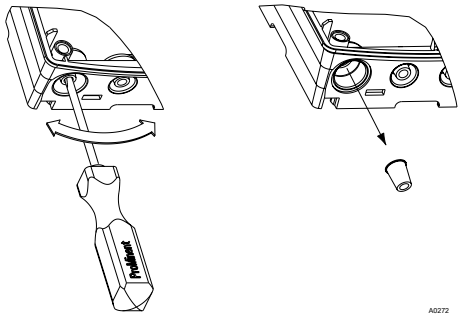


Fig. 15: Punch out threaded holes

3.

Large threaded connection (M 20 x 1.5)

Small threaded connection (M 16 x 1.5)

Punch out as many threaded connections on the bottom side of the controller housing bottom section as required

4. Guide the cable into the respective reducing inserts.
5. Insert the reducing inserts into the threaded connectors
6. Guide the cable into the controller.
7. Connect the cable as indicated in the terminal diagram
8. Screw the required threaded connections in and tighten
9. Tighten the clamping nuts of the threaded connections so that they are properly sealed
10. Click the controller housing top section on to the controller housing bottom section
11. Manually tighten the housing screws
12. Once again check the seating of the seal. Only if the mounting is correct, is protection class IP 67 (wall/pipe mounting) or IP 54 (control panel mounting) achieved

5.4 Switching of inductive loads

If you connect an inductive load, i.e. a consumer which uses a coil (e.g. an alpha motorised pump), then you must protect your controller with a protective circuit. If in doubt, consult an electrical technician for advice.

The RC member protective circuit is a simple, but nevertheless very effective, circuit. This circuit is also referred to as a snubber or Boucherot member. It is primarily used to protect switching contacts.

When switching off, the connection in series of a resistor and capacitor means that the current can be dissipated in a damped oscillation.

Also when switching on, the resistor acts as a current limiter for the capacitor charging process. The RC member protective circuit is highly suitable for AC voltage supplies.

The magnitude of the resistance R of the RC member is determined according to the following equation:

$R=U/I_L$

(Where U= Voltage across the load and I_L = current through the load)

The magnitude of the capacitor is determined using the following equation:

$C=k * I_L$

k=0,1...2 (dependent on the application).

Only use capacitors of class X2.

Units: R = Ohm; U = Volt; I_L = Ampere; C = µF

If consumers are connected which have a high starting current (e.g. plug-in, switched mains power supplies), then a means of limiting the starting current must be provided.

The switching-off process can be investigated and documented using an oscilloscope. The voltage peak at the switch contact depends on the selected RC combination.

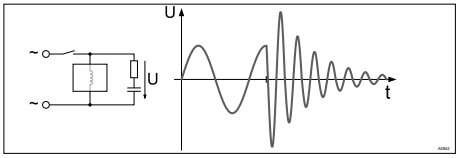


Fig. 16: Switching-off process shown on the oscillogram.

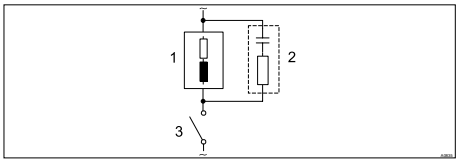


Fig. 17: RC protective circuit for the relay contacts

Typical AC current application with an inductive load:

- 1) Load (e.g. alpha motor-driven pump)
- 2) RC-protective circuit
  - Typical RC protective circuit at 230 V AC:
  - Capacitor *[0.22µF/X2]*
  - Resistance *[100 Ohm / 1 W]* (metal oxide (pulse resistant))
- 3) Relay contact (XR1, XR2, XR3)

6 Commissioning

- **User qualification:** trained user, see *Chapter 2.2 'Users' qualifications' on page 10*

WARNING!

Sensor run in periods

This can result in hazardous incorrect metering

- Correct measuring and dosing is only possible if the sensor is working perfectly
- Please read the operating manual for the sensor
- The sensor must be calibrated after commissioning

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

6.1 Initial commissioning

When the controller is first switched on, the controller is in STOP state.

Subsequently the control settings and setting of the various, process-dependent parameters is undertaken.

6.2 Setting the controller during commissioning

NOTICE!

Reset to factory settings

When switching over the metering direction, all actuators in the controller are reset to the factory settings for the selected metering direction.

For safety reasons, all actuators are deactivated. The base load is reset to 0 %. All parameters relating to the actuator, are reset to the factory setting.

Consequently all parameters relating to the actuator, must be reset.

The controller only controls *'one-way'*. Only one position or one negative control variable can be calculated. The direction of the control variable is set in the *'PUMP'* menu. There is no dead zone. In this sense, control cannot be *'deactivated'* (except with *'STOP'* or *'PAUSE'*).

The value of the P-proportion of the control (Xp) is specified for the controller in the corresponding measured variable unit.

For pure P-control and a separation between the set and actual values, which corresponds to the Xp value, the calculated control variable is +100% (with setting *'raise'*) and -100% (with setting *'lower'*).

7 Operating diagram

7.1 Overview of equipment/Control elements

- **User qualification:** instructed user, see *Chapter 2.2 'Users' qualifications' on page 10*

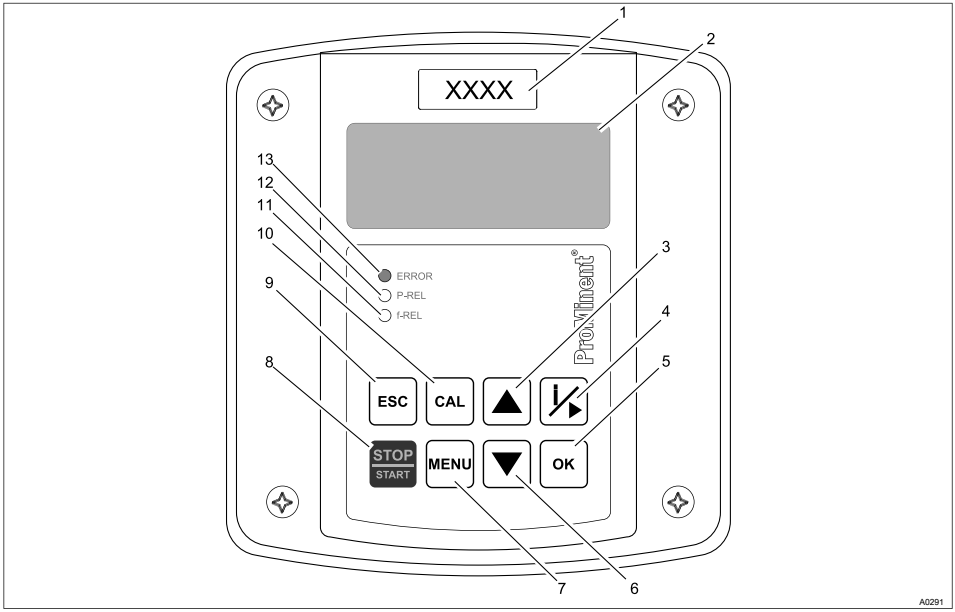


Fig. 18: Overview of equipment/Control elements

Function	Description
1st respective measured variable	Affix the measured variable label here
2. LCD display	
3. UP key	Too increase a displayed number value and to jump upwards in the operating menu
4. INFO/RIGHT key	Opens the info menu or moves the cursor one place to the right

Function	Description
5. OK key	To apply, confirm or save a displayed value or status or to acknowledge an alarm
6. DOWN key	Too decrease a displayed number value and to jump down in the operating menu
7. MENU key	Accesses the controller operating menu
8. STOP/START key	Starts and stops control and metering function
9. ESC key	Jumps a level back in the operating menu, without storage or changing entries or values
10. CAL key	For accessing the calibration menu and navigating within the calibration menu.
11. f-REL LED	Shows the activated state of the f-relay
12. P-REL LED	Shows the activated state of the P-relay
13. ERROR LED	Indicates a controller error state. A text message is displayed simultaneously in the LCD continuous display

7.2 Adjusting display contrast

If the DULCOMETER® Compact Controller is set to *'continuous display'* , you can set the contrast of the LCD-display. By pressing the ▲ key you can adjust the LCD display contrast so it is darker. By pressing the ▼ key you can adjust the LCD display contrast so it is lighter. Here each key press represents a contrast level. I.e. the key must be pressed once for each contrast level.

7.3 Continuous display

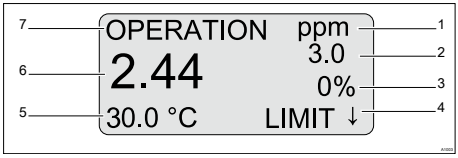


Fig. 19: Continuous display

1 Measured variable unit
2 Setpoint
3 Control variable
4 Possible error text: e.g.: "Limit↓" (direction of limit value transgression e.g. in this case, undershoot)
5 Temperature (Correction variable)
6 Measured value (actual value)
7 Operating status

7.4 Info display

In the info display, the most important parameters for each menu item of the first menu level are displayed.

Access to the info display from the continuous display is undertaken by pressing the key. Pressing the key again toggles to the next info display. Pressing the ESC key recalls the continuous display again.

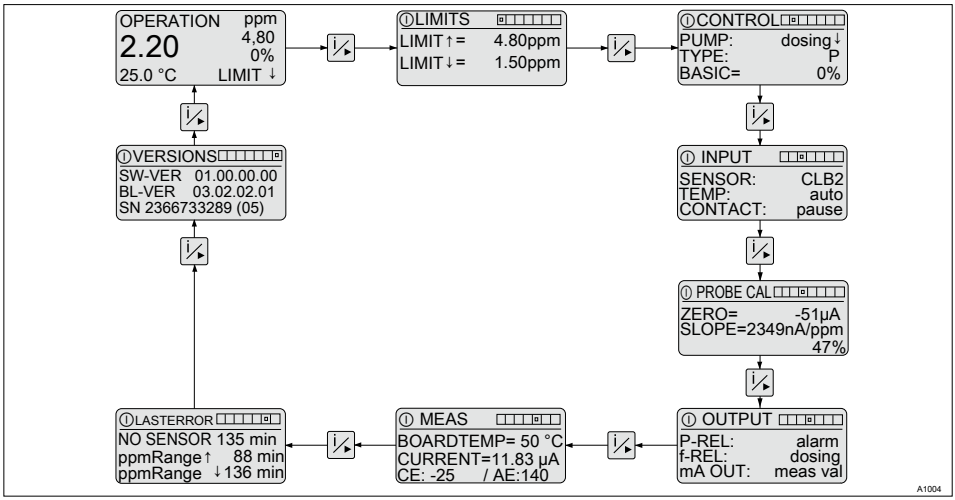


Fig. 20: Info display

By pressing the OK key, you can jump from the currently displayed info display directly to the selection menu of this info display.

Pressing the ESC key brings you straight back to the info display.

Info display [MEAS]

The info display [MEAS] shows the following measured values:

- *[BOARDTEMP]: Current housing interior temperature*
- *[CURRENT]: Current value flowing through the sensor in µA.*
- *[CE: xxxx / AE: xxxx], internal status variable (only for service engineer)*

These values are for information purposes only and cannot be changed.

7.5 Password

Access to the setting menu can be limited using a password. The DULCOMETER® Compact Controller is supplied with the password *'5000'*. Using the preset password *'5000'* the DULCOMETER® Compact Controller is setup so that all menus can be accessed without any limitations.

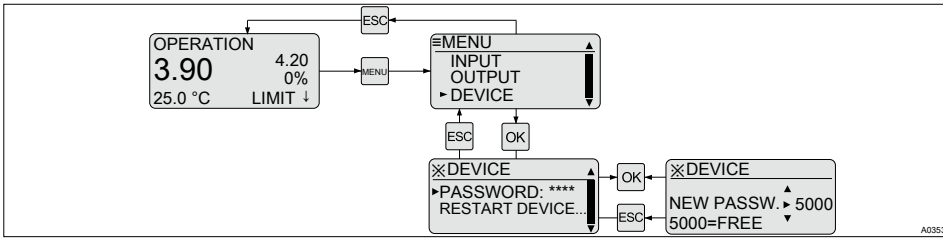


Fig. 21: Password setting

Password	Possible values			
Factory setting	**Increment**	**Lower value**	**Upper value**	**Remarks**
5000	1	0000	9999	5000 = *[FREE]*

8 Operating menus

- **User qualification:** instructed user, see *Chapter 2.2 'Users' qualifications' on page 10*

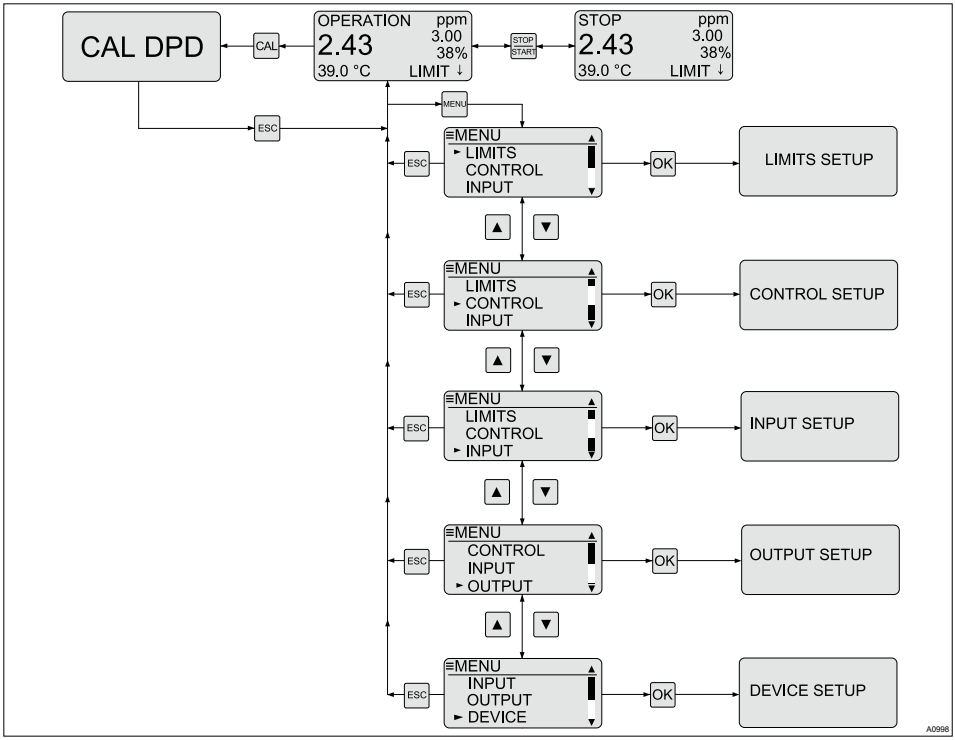


Fig. 22: Overview of the first level menus

8.1 Calibrating (CAL) the chlorine sensor

WARNING!

Danger from hazardous substances!

Possible consequence: Fatal or very serious injuries.

Please ensure when handling hazardous substances that you have read the latest safety data sheets provided by the manufacture of the hazardous substance. The actions required are described in the safety data sheet. Check the safety data sheet regularly and replace, if necessary, as the hazard potential of a substance can be re-evaluated at any time based on new findings.

The system operator is responsible for ensuring that these safety data sheets are available and that they are kept up to date, as well as for producing an associated hazard assessment for the workstations affected.

Sensor slope / sensor zero point

Only the sensor slope can be calibrated.

The sensor zero point can be balanced using the function [CHECK ZERO].

Correct sensor operation

- *Correct measuring and metering is only possible if the sensor is working perfectly*
- *Observe the sensor operating instructions*

Incorrect calibration

Should the result of the calibration lie outside the specified tolerance limits, an error message appears 'ERR'. In this case the current calibration will not be applied.

Check the prerequisites for the calibration and clear the error. Then repeat the calibration

In the event of repeated calibration failure, observe the notes given in the sensor operating instructions.

Pressing the CAL key twice sets the control outputs for the controller to *'0'*. Exception: a basic load or a manual control variable has been set. This remains active. The *[mA]* standard signal output is frozen.

When calibration has been completed successfully, all of the error checks relating to the measured value are restarted. The controller saves all the determined data for sensor slope when the calibration is successful.

8.1.1 Sensor slope calibration

Prerequisites for correct calibration of the sensor slope

- *Only calibration method DPD1 is permissible for both sensor types.*
- *Wait until the run in period for the sensor has elapsed so that the measured value has stabilised*
- *Constant flow 20 l/h - 60 l/h for in-line probe housing present*
- *There is temperature balance between the sensor and the sample water*
- *There is a constant pH value in the permitted sensor range*

The sensor is fitted, flushed with sample water, connected electrically to the controller and run-in.

There has to be adequate feed chemical in the sample water for calibration.

Remove sample water directly at the measuring point and determine the chemical content in the sample water in *[ppm]*. Enter this value into the controller as follows:

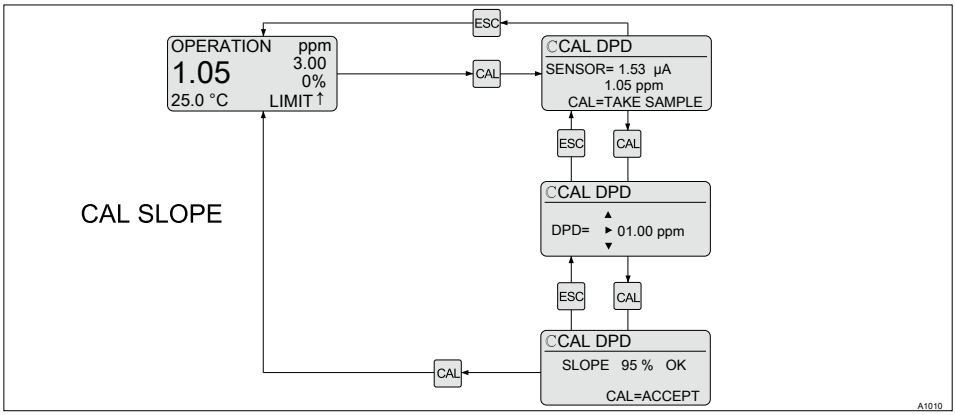


Fig. 23: Slope calibration

1. Press the CAL key

   ⇨ The menu *[CAL DPD]* appears.

2. Press the CAL key

⇨

At the time of taking the sample, you must have navigated to this point [CAL=TAKE SAMPLE] and then press the CAL key so that the current measured value is frozen.

The menu for entering the determined DPD value appears.

3. Take a water sample from the in-line probe housing and carry out the *[DPD]* reference measurement within no more than 15 minutes. The shorter this period of time, the greater the accuracy of the measurement.

The precision of the calibration can be checked by carrying out repeated measurements and observing the range of results. Determining the permissible precision is the responsibility of the plant operator

4. Enter the determined value into the controller using the ▲, ▼ and 1/x keys.
5. After entering the value, press the CAL key.
   ⇨ The display indicating the calculated slope in *[%]* appears.
6. Press the CAL key
   ⇨ The calculated sensor slope is accepted by the controller and the continuous display is shown again.

Sensor status

Display	Meaning	Status
[OK]	In order	20 % ... 300% of the sensor's rated slope
[WRN]	Warning	5 % ... 20 % *[LOW SLOPE]* or 300 % ... 1000 % *[HIGH SLOPE]* of the sensor's rated slope[1.]
[ERR]	Error	< 5% or > 1000% of the sensor's rated slope[2.]

1 = Sensor slope accepted. A warning is shown which can be acknowledged with the OK key. The sensor is still usable, but should be cleaned.

2 = Sensor slope cannot be accepted. Error display *[CAL ERROR]*. The controller will continue to operate with the previously calibrated value. The sensor must be cleaned and possibly replaced.

8.1.2 Calibrate sensor zero point [CHECK ZERO]

The sensor has been removed and is connected electrically to the controller.

For calibration hold the sensor in the air.

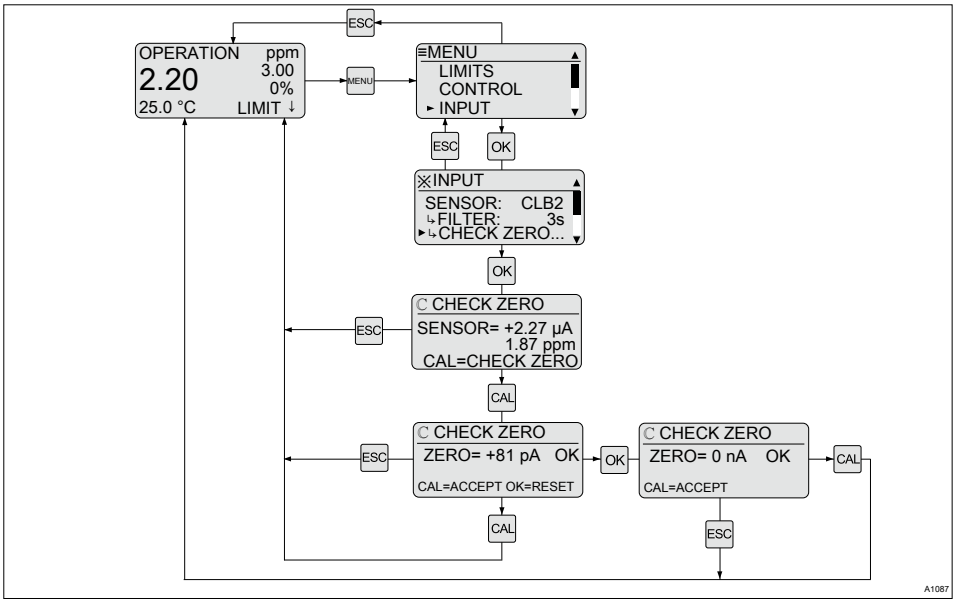


Fig. 24: Calibrate sensor zero point [CHECK ZERO]

1. Press the MENU key
   ⇨ The menu *[MENU]* appears.
2. Using ▲ or ▼ select the entry *[INPUT]* and press the OK key
   ⇨ The menu *[INPUT]* appears.
3. Using ▲ or ▼ select the entry *[CHECK ZERO]* and press the OK key
   ⇨ The menu *[CHECK ZERO]* appears.
4. Wait until the displayed value, for example *[µA]*, no longer changes, or changes only slightly

Sensor status

- *[OK] = - 500 nA ... + 500 nA*
- *[WRN] Warning = - 500 to - 1000 nA[LOW ZERO] or + 500 to + 1000 nA[HIGH ZERO]*
- *[ERR] error: ≦ - 1001 nA or ≧ + 1001 nA*

5. Press the CAL key

   ⇨ *[CAL=ACCEPT]*: The calibrated value for the sensor is transferred to the controller. The continuous display appears again.

   [OK=RESET]: The controller is reset to factory-determined zero point. This is useful, for example, when connecting a new sensor.

   [ESC]: The calibration process is cancelled. The controller will continue to operate with the old values. The continuous display appears again.

6. Only with *[OK=RESET]*: Press the CAL key

   ⇨ The calibrated value for the sensor is transferred to the controller. The continuous display appears again.

8.1.3 Commissioning a new sensor

1. Carry out the *[CHECK ZERO]* process and *Chapter 8.1.2 'Calibrate sensor zero point [CHECK ZERO]' on page 51* in doing so, use *[OK=RESET]* to set the zero point to *[0]* or calibrate the zero point with *[CAL=ACCEPT]* .

2. Now calibrate the sensor slope. *Chapter 8.1.1 'Sensor slope calibration' on page 48*

   ⇨ The menu *[INPUT]* appears.

3. Only for *[OK=RESET]*: Press the CAL key

   ⇨ The calibrated value for the sensor is transferred to the controller. The continuous display appears again.

8.2 Setting limit values *[LIMITS]*

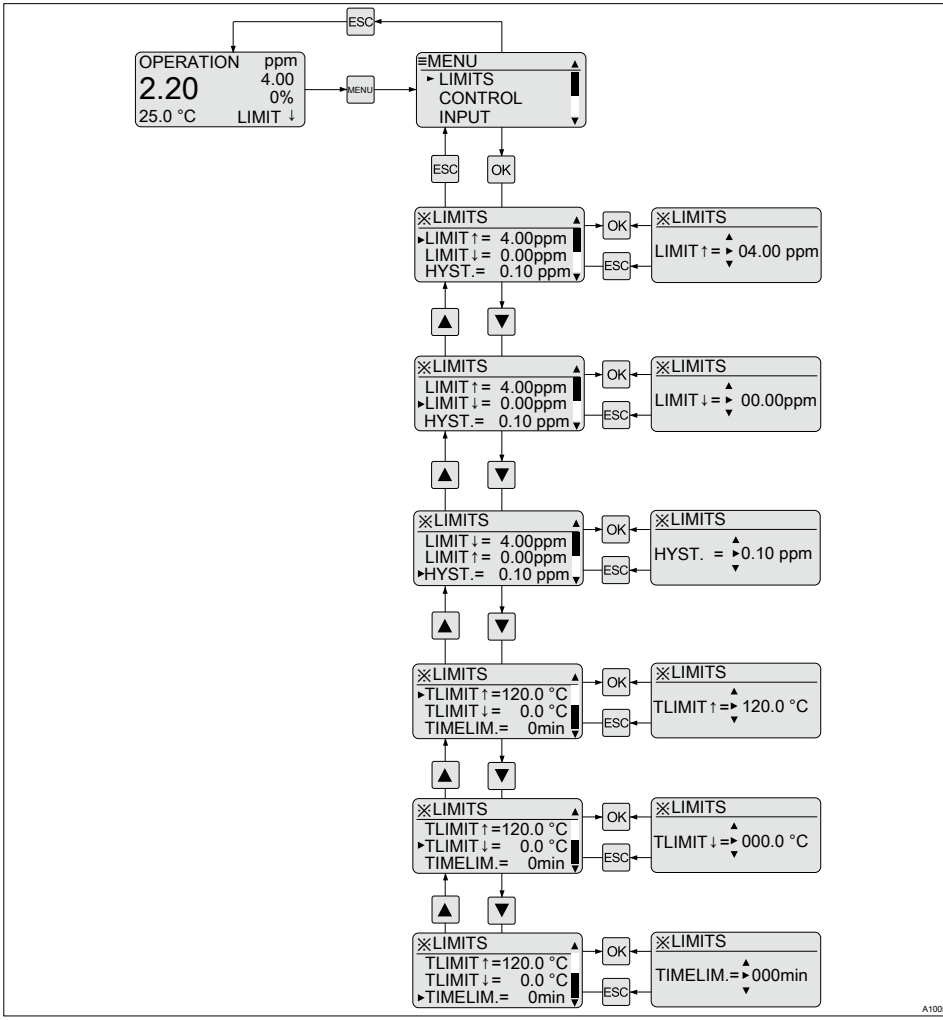


Fig. 25: Setting limit values [LIMITS]

Setting		Possible values			
Display	Starting value	Increment	Lower value	Upper value	Remark
[LIMIT ↑] ppm	0.80 ppm	0.01 ppm	0.00 ppm	5.00 ppm	upper limit value
[LIMIT ↓] ppm	0.00 ppm	0.01 ppm	0.00 ppm	5.00 ppm	lower limit value
[HYST.]	0.1 ppm	0.01 ppm	0.01 ppm	1.00 ppm	hysteresis of limit values
[TLIMIT ↑] °C	30.0 °C	0.1 °C	0.0 °C	120.0 °C	upper limit correction value °C
[TLIMIT ↓] °C	10.0 °C	0.1 °C	0.0 °C	120.0 °C	lower limit correction value °C
[TLIMIT ↑] °F	86.0 °F	0.1 °F	32.0 °F	248.0 °F	upper limit correction value °F
[TLIMIT ↓] °F	50.0 °F	0.1 °F	32.0 °F	248.0 °F	lower limit correction value °F
[TIMELIM.]	0 min = OFF	1 min	0	999	Checktime after a limit value has been exceeded or undershot

Hysteresis = *[HYST.]*

If the value has fallen below a limit value, then the limit value criteria are reset when the measured value has reached the value of the limit value plus hysteresis.

If the value has fallen below a limit value, then the limit value criteria are reset when the measured value has reached the value of the limit value minus hysteresis.

If the limit value criteria no longer exist on expiry of *[TIMELIM]* , then the control is automatically reactivated.

8.3 Setting the control *[CONTROL]*

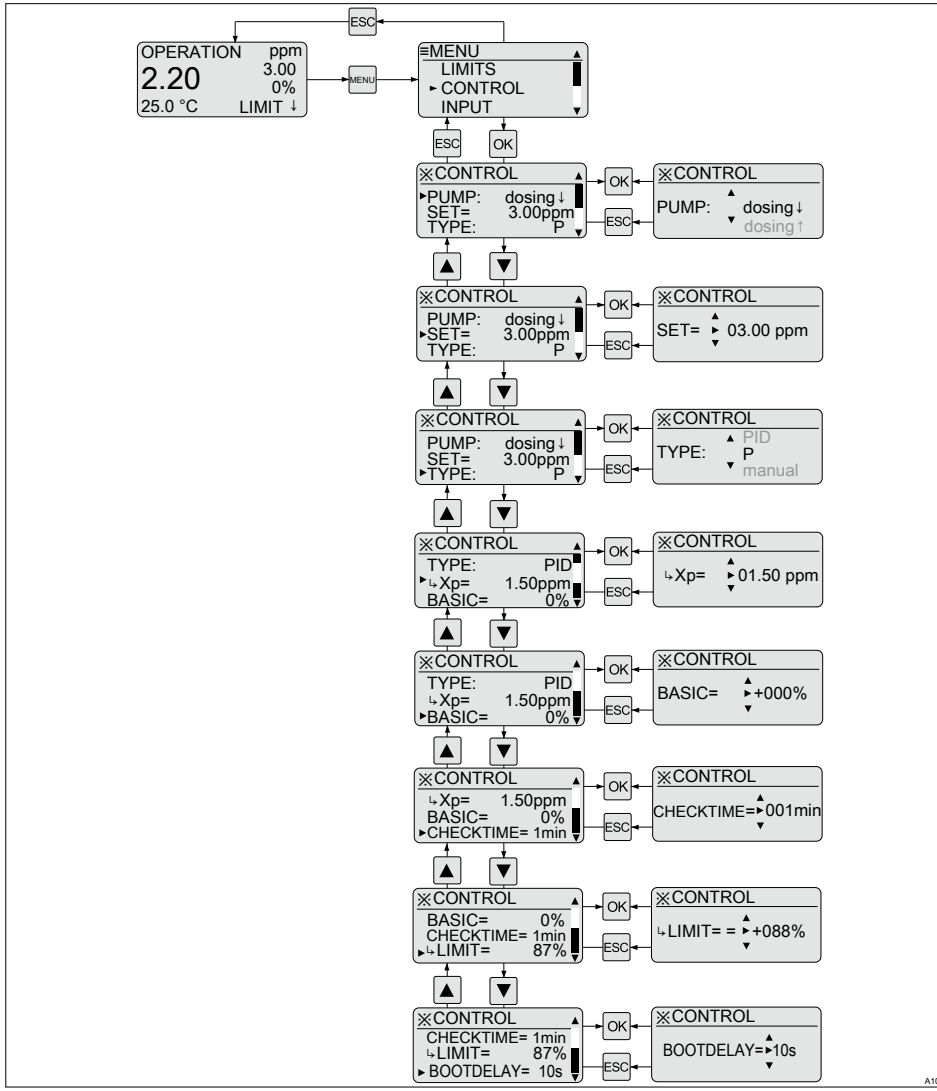


Fig. 26: Setting the control [CONTROL]

Setting		Possible values			
	Starting value	Increment	Lower value	Upper value	Remark
[PUMP]	dosing ↑	dosing ↓ dosing ↑			Mono-directional control direction [2]
[SET]	0.50 ppm	0.01 ppm	0.00 ppm	5.00 ppm	Setpoint in ppm
[TYPE]	P	P Manual PID			Controller type
[↳Xp]	0.20 ppm	0.01 ppm	0.01 ppm	5.00 ppm	P-proportion of control variable
[↳Ti]	0 s	1 s	0 s	9999 s	PID control integral action time (0 seconds = no I-proportion)
[↳Td]	0 s	1 s	0 s	2500 s	PID control derivative action time (0 seconds = no D-proportion)
[BASIC] [1]	0%	1%	- 100%	100%	Basic load
[↳MANUAL] [1]	0%	1%	- 100%	100%	Manual control value
[CHECK-TIME]	0 min	1 min	0 min	999 min	Control checktime 0 minutes = off

Setting		Possible values			
	Starting value	Increment	Lower value	Upper value	Remark
[↳LIMIT][1]	0%	1%	- 100%	100%	Checktime limit. No basic load, only PID control value
[BOOT DELAY]	0 s	1 s	0 s	9999 s	Control delay period after the start of the measuring point. After it is switched on, the unit only measures but does not control during this period.

1 = in an upwards direction with mono-directional control: 0 ...+ 100% (setting with PUMP: dosing↑), in a downwards direction: - 100 ... 0% (setting with PUMP: dosing↓).

2 = When switching over the metering direction, all actuators in the controller are reset to the factory settings for the selected metering direction.

8.4 Input setting (INPUT)

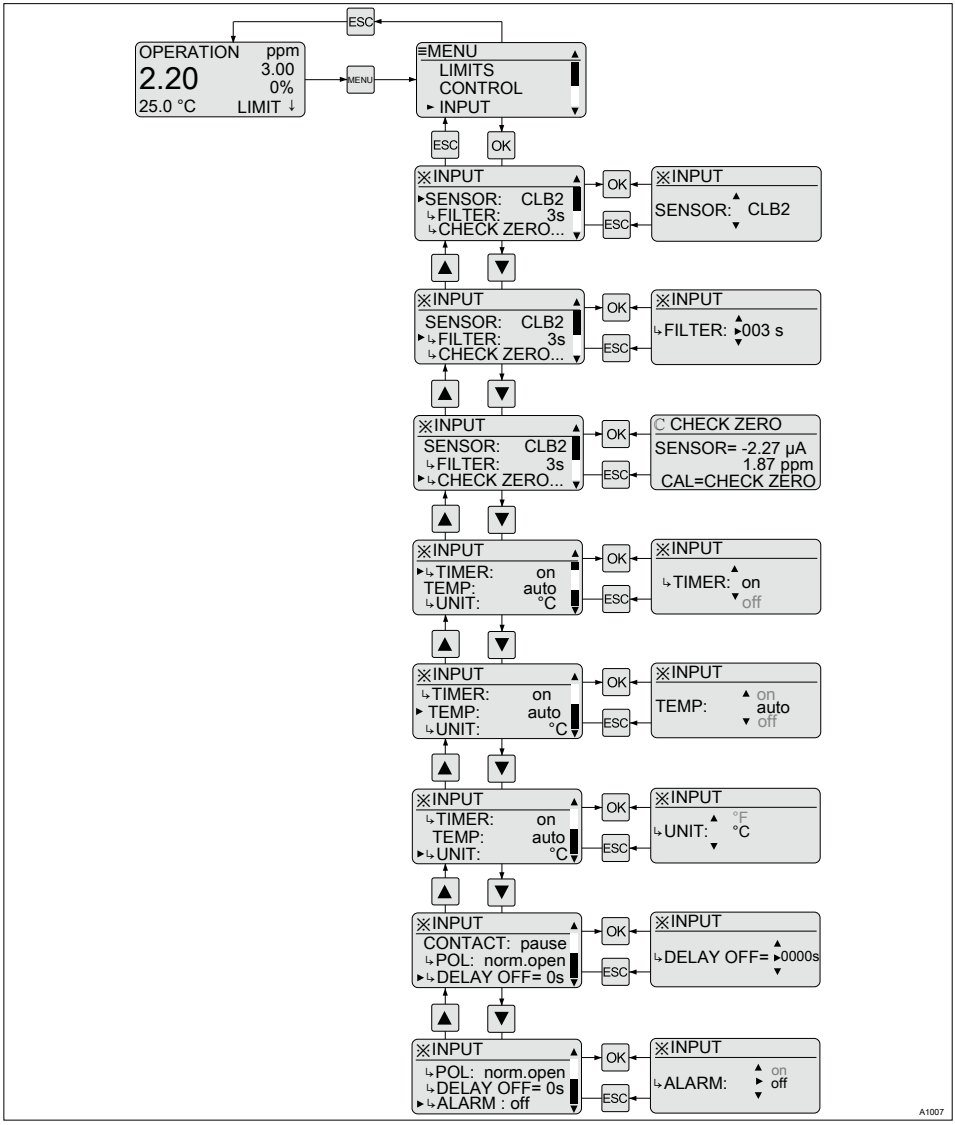


Fig. 27: Input setting (INPUT)

Setting		Possible values			
Display	Starting value	Increment	Lower value	Upper value	Remarks
SENSOR	CLB2	CLB2 CLB3			
↳FILTER	60 s	1 s	1 s	200 s	If the sensor signal is unsteady, then the average value accumulation can be adapted with [FILTER]. ■ 1 s = low filter effect ■ 100 s = large filter effect ■ 20 s = recommended value The filter constants influence the control behaviour.
↳CHECK ZERO ...					*Chapter 8.1.2 'Calibrate sensor zero point [CHECK ZERO]' on page 51*
↳TIMER	on	on off	on	off	Timer alarm for *[CHECKZERO]* Message after approx. 8 weeks. If *[CHECK ZERO]* has been carried out, then *[TIMER]* is reset. *[TIMER]* only counts the time that the controller has been in operation.
TEMP	auto	auto			Pt100/Pt1000

Setting		Possible values			
Display	Starting value	Increment	Lower value	Upper value	Remarks
		manual			Manual temperature adjustment
↳UNIT	°C	°C °F			Correction variable unit
↳VALUE	25 °C				Display only for *[TEMP] = [manual]*
CON-TACT	pause	pause hold			Configuration digital contact input
↳POL	norm.open	norm.open norm.closed			Change actuating direction between the contacts
↳DELAY OFF	0 s	1 s	0 s	1000 s	Contact input switch-off delay. Switching off of the contact input is delayed by this period.
↳ALARM	OFF	ON OFF			Switch on and off use of the alarm relay in *'PAUSE/HOLD'*

8.5 Output setting (OUTPUT)

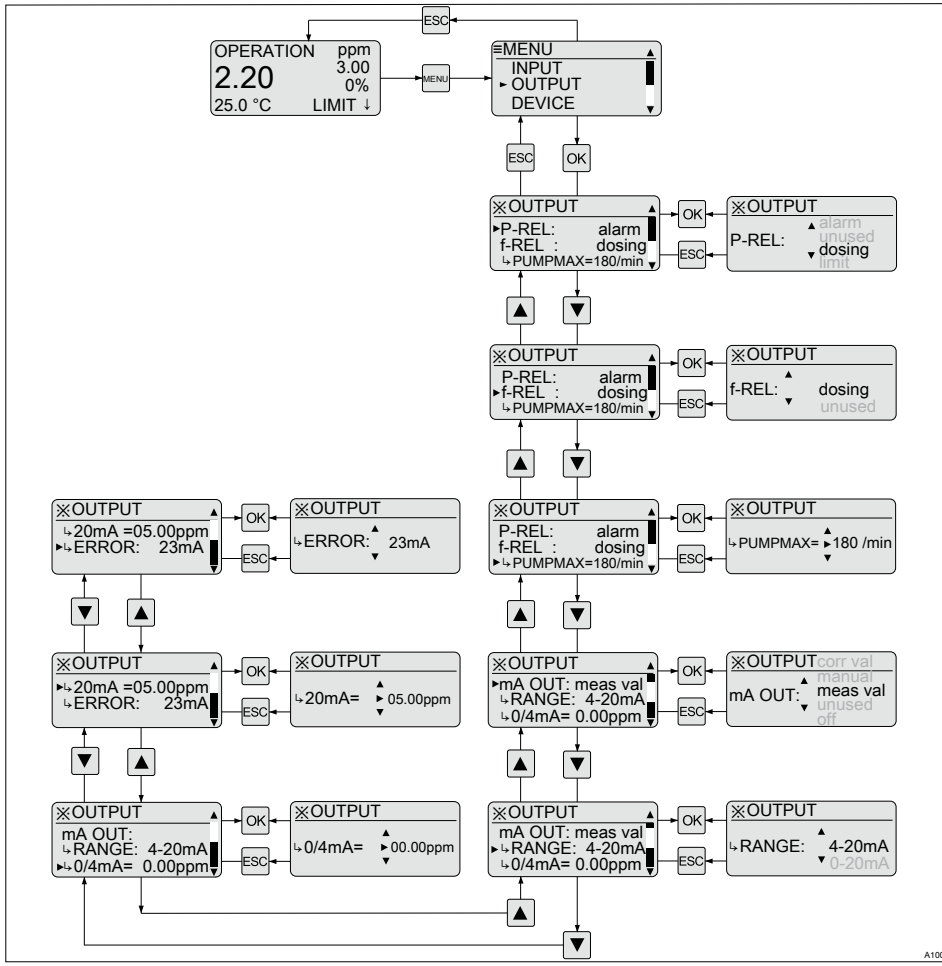


Fig. 28: Output setting (OUTPUT)

Setting		Possible values			
	Starting value	Increment	Lower value	Upper value	Remarks
P-REL (Power relay)	alarm	alarm			Alarm relay
		unused			off
		dosing			PWM relay (pulse width modulation)
		limit			Limit relay
↳PERIOD	60 s	1 s	30 s	6000 s	Cycle time of the PWM control (P-REL = dosing)
↳MIN ON [1]	10 s	1 s	5 s	PERIOD/4 or 999	Minimum switch on period using PWM control (P-REL = dosing)
↳DELAY ON	0 s	1 s	0 s	9999 s	Switch-on delay limit value relay (P-REL = limit)
↳DELAY OFF	0 s	1 s	0 s	9999 s	Switch-off delay limit value relay (P-REL = limit)
f-REL	dosing	dosing			Activation of the low power relay (frequency relay)
		unused			

Setting		Possible values			
	Starting value	Increment	Lower value	Upper value	Remarks
↳PUMPMAX	180 RPM	1	1	500	Maximum stroke rate of the low power relay (frequency relay)
mA OUT (Output value of the mA standard signal output)	meas val	off			off
		meas val			meas val
		corr val			corr val
		dosing			dosing = control value
		manual			manual
↳RANGE	4 - 20 mA	0 - 20 mA			Range of the mA standard signal output
		4 - 20 mA			
↳0/4 mA	0.00 ppm	0.01 ppm	0.00 ppm	10.00 ppm	ppm value assigned 0/4 mA
↳20 mA	5.00 ppm	0.01 ppm	0.00 ppm	10.00 ppm	ppm value assigned 20 mA
↳0/4 mA	0.0 °C	0.1 °C	0.0 °C	120.0 °C	Temp value assigned 0/4 mA
↳20 mA	100.0 °C	0.1 °C	0.0 °C	120.0 °C	Temp value assigned 20 mA
↳0/4 mA	32.0 °F	0.1 °F	32.0 °F	248.0 °F	Temp value assigned 0/4 mA
↳20 mA	212.0 °F	0.1 °F	32.0 °F	248.0 °F	Temp value assigned 20 mA

Setting		Possible values			
	Starting value	Increment	Lower value	Upper value	Remarks
↳20 mA [2]	100 %	1 %	10 % / - 10 %	100 % / - 100 %	Control value assigned 20 mA (0/4 mA is fixed as 0 %)
↳VALUE	4.00 mA	0.01 mA	0.00 mA	25.00 mA	Manual output current value
↳ERROR	off	23 mA			Output current value upon fault, 23 mA
		0/3.6 mA			Output current value upon fault, 0/3.6 mA
		off			off = no fault current is output

1 = The parameter maximum occurs at PERIOD/4 or 999, whichever is smaller

2 = dependent on metering direction, the limits are either -10% and -100% or +10% and +100%

8.6 DEVICE setting

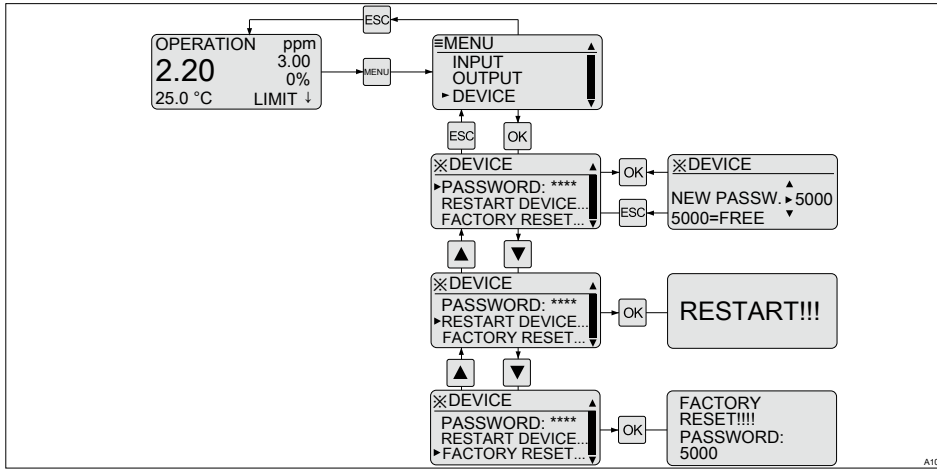


Fig. 29: [DEVICE] .

Setting		Possible values			
	Starting value	Increment	Lower value	Upper value	Remarks
PASS-WORD	5000	1	0000	9999	5000 = no password protection
RESTART DEVICE					Controller is restarted
FACTORY RESET...	no	yes no	yes = FAC-TORY RESET!	no = FAC-TORY RESET!	All parame-ters relating to the con-troller are reset to the factory set-tings.

9 Control parameters and functions

- **User qualification:** trained user, see ↳ *Chapter 2.2 'Users' qualifications' on page 10*

9.1 DULCOMETER® Compact Controller function states

DULCOMETER® Compact Controller function states have the following priority:

- 1. *'STOP'*
- 2. *'PAUSE/HOLD'*
- 3. *'CAL'* (calibration)
- 4. *'OPERATION'* (normal mode)

"CAL" (calibration) peculiarities

- Control goes to basic load, mA measurement outputs are frozen
- New faults are detected, however they have no effect on the alarm relay or the mA output
- Detection of measurement variable relevant faults during *'CAL'* (calibration process) are suppressed (e.g. LIMIT↑)

"PAUSE" peculiarities

- Control is switched to 0% control variable. The I-proportion is saved
- New faults are detected, however they have no effect on the alarm relay or the mA output
- Special case alarm relay in *'PAUSE'*: If activated the output relay switches to *'PAUSE'* (error message CONTACTIN)

"HOLD" peculiarities

- Control and all other outputs are frozen
- New faults are detected, however they have no effect on the alarm relay or the mA output. However the effect of already existing faults (e.g. fault current) remains
- Special case alarm relay: Activation of the frozen alarm relay is permitted (= no alarm), if all faults have been acknowledged or have disappeared
- Special case alarm relay in *'HOLD'*: If activated the output relay switches to *'HOLD'* (error message CONTACTIN)

"STOP" peculiarities

- Control OFF
- New faults are detected, however they have no effect on the alarm relay or the mA output
- The alarm relay is switched off in *'STOP'*

Peculiarities of the "START" event, i.e. switching from "STOP" to "OPERATION" (normal mode)

- Fault detection starts afresh, all existing faults are deleted

Generally applicable information

- If the cause of a fault disappears, then the fault message in the LCD footer disappears.
- A previously existing *'PAUSE/HOLD'* state is not influenced by starting a *'CAL'* (calibration) process. If during *'CAL'* (calibration) the functional state *'PAUSE/HOLD'* is released, then all states will remain frozen until the end of the *'CAL'* (calibration) process.

- If *'CAL'* (calibration) is started while functional state *'OPERATION'* (normal mode) is active, then the functional state *'PAUSE/HOLD'* is ignored until *'CAL'* (calibration) completes. However STOP/START is possible at any time
- An alarm can be acknowledged or removed as follows: By clearing all faults by pressing the STOP/START key and the OK key while the continuous display is visible

9.2 STOP/START key

The control function is started / stopped by pressing the STOP/START key. The STOP/START key can be pressed independently of the currently displayed menu. However, the [STOP]state is only shown in the continuous display.

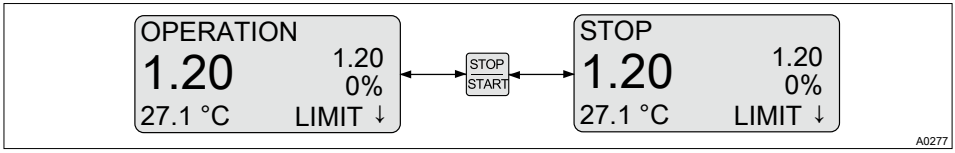


Fig. 30: STOP/START-Key

When the controller is first switched on, the controller is in *[STOP]*status.

Upon certain defined fault conditions, the controller switches to the *[STOP]*status. The control is then off (= 0 % control variable).

To differentiate between the fault-related *[STOP]* and the operating status *[STOP]* by pressing the STOP/START key, instead of *[STOP]*the identifier *[ERROR STOP]* is displayed.

Pressing the STOP/START key causes operating status *[ERROR STOP]* to change to operating status *[STOP]* . Pressing STOP/START once more causes the controller to be started again.

In *[STOP]*state, the controller must be started manually by pressing the STOP/START key.

[STOP] of the controller causes the following:

- Control is stopped
- The P-relay functioning as a limit value relay and a PWM relay are switched to the de-energised state
- The P-relay acting as an alarm relay activates (no alarm)

Restarting of the controller causes the following:

- If a *[STOP]*state existed, then the controller must be manually started after being switched back on.
- Fault detection starts afresh, all existing faults are deleted

9.3 Priming (PRIME)

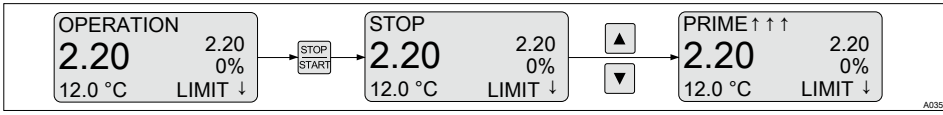


Fig. 31: Priming, e.g. to vent a pump

While the continuous display is visible and the states *'STOP'* or *'OPERATION'* are active, simultaneously pressing ▲ and ▼ causes the priming function *'PRIME'* to be started.

At the same time, dependent on the configuration of the controller, the output relay (P-REL) is actuated at 100 %, the frequency relay (f-REL) is actuated at 80 % of "PUMPMAX" and 16 mA is output at the mA output. However this is only the case if these outputs are set as actuator *'dosing'*.

The power relay (P-REL) starts after priming in an activated state.

You can use this function, for example, to transport the feed chemical up to the pump to vent the metering line.

9.4 Hysteresis limit

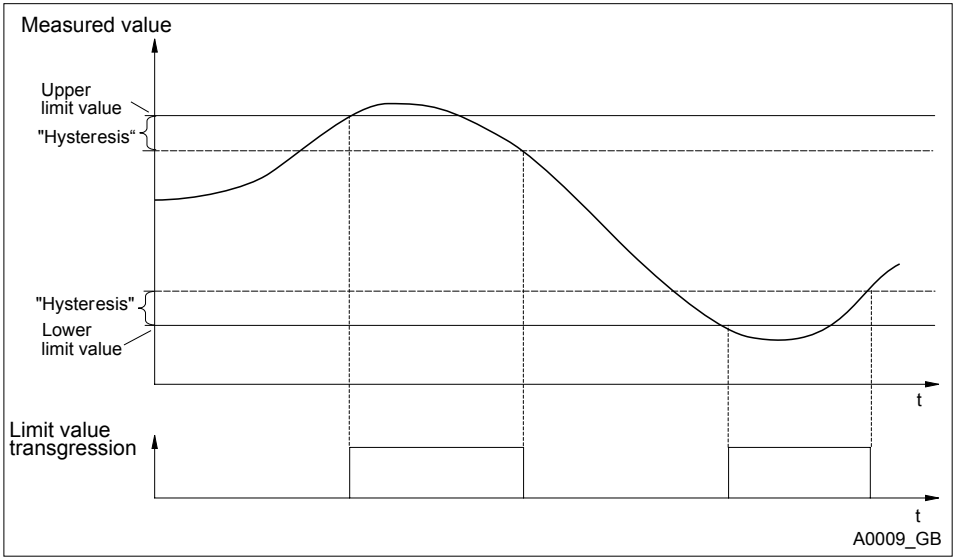


Fig. 32: Hysteresis

Upper lim. value = LIMIT↑ Lower lim. value = LIMIT↓

The range between LIMIT↑ and LIMIT↓ is the **valid measuring range.**

The controller has a configurable *'hysteresis'* of 0.01 ppm ... 1.00 ppm.

The *'hysteresis'* works towards rectifying the limit value transgression, i.e. if the *'Limit↑'* of, for example, 3.00 ppm has been exceeded, then the criterion for limit value transgression is redundant until the value drops below 2.80 ppm. The hysteresis behaviour for a *'Limit↓'* works analogously, (the hysteresis value is in this case is added to Limit ↓) e.g. *'Limit ↓'*2.50 ppm, hysteresis 0.20 ppm, then the criterion for limit value transgression is redundant until the value exceeds 2.70 ppm.

9.5 Temperature correction variable

The correction variable compensates for the effect of the temperature of the medium on the measured value. The correction variable is the temperature of the medium to be measured.

Operating modes

- *[off]*: No temperature compensation takes place
  - For measurements which do not require temperature compensation
- *[auto]*: The controller analyses the temperature signal from the temperature sensor connected

  - For measurements using a temperature sensor (0 -120 °C)

- *[manual]*: The temperature of the medium to be measured has to be measured by the user. The measured value is then entered using the keys: ▼ and ▲ in parameter *'VALUE'* on the controller and saved by pressing the OK key.
  - For measurements where the medium to be measured has a constant temperature, which has to be taken into account in the control process

9.6 Checkout time for measured variable and correction variable

Error text	Description
LIMIT ERR	Checkout time of the measured variable
TLIMITERR	Checkout time of the correction variable

If upon the expiry of the checkout time, the valid measuring range is not reached, then the DULCOMETER® Compact Controller exhibits the following behaviour:

- **LIMIT ERR:** The control is switched off. An error current is emitted, provided the output is configured as a measured variable output
- **TLIMITERR:** The control is switched off. An error current is emitted, provided the output is configured as a correction variable output or a measured variable output

Initially the transgression of a limit is only a limit value transgression. This leads to a *'WARNING'*. Switching on the control time *'TIMELIM'* (> 0 minutes), creates an alarm from the limit value transgression. In the event of a *[TLIMITERR]* a, the control switches to *[STOP]*.

9.7 Checkout time control

Monitoring of the control path

The checkout time monitors the control path. The checkout time mechanism permits detection of possible defective sensors.

Dead time determination

Each control path has a dead time. The dead time is the time, which the control path requires to detect a change or addition of metered chemicals using its own instrumentation.

You must select the checkout time so that it is greater than the dead time. You can determine the dead time, by operating the metering pump in manual mode and, for example, dosing acid.

NOTICE!

Dead time determination

You should only determine the dead time if the current process cannot be negatively influenced by the manual metering.

You must determine the time, which the control path (i.e. the entirety of controllers, sensors, measurement water, flow gauges, etc.) requires to detect a first change in the measured value starting from the beginning of dosing. This time is the *'dead time'*. A safety margin, e.g. 25%, must be added to this dead time. You must allocate an appropriate safety margin for your own particular process.

The parameter *'LIMIT'* can be used to set a limit for the control variable. If the control variable exceeds this limit value, the CHECKTIME fault is triggered (checkout time of the control has elapsed). The control is switched to basic load and a fault current output.

9.8 Power relay "P-REL" as limit value relay

The power relay *'P-REL'* can be configured as a limit value relay. It always act only on the measurement variable, whereby the limits are set in *'LIMITS'* . The relay is activated upon infringement of either the top or lower limit values.

Constant checking is carried out to determine whether a limit has been infringed and if this is interrupted with the power relay configured *'P-REL= limit'* for at least *'DELAY ON'* seconds, then the relay is activated. If the limit value transgression disappears for at least *'DELAY OFF'* seconds, then the limit value relay is again deactivated.

The limit value relay is deactivated immediately upon: *'STOP'*, user calibration, *'PAUSE'* and *'HOLD'*.

9.9 Setting and functional description of "Relay Used as a Solenoid Valve"

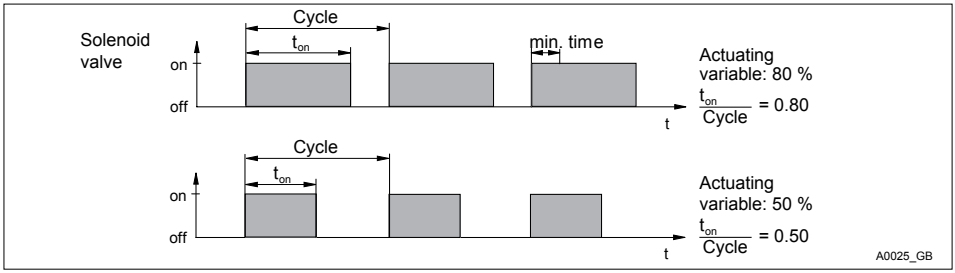


Fig. 33: Solenoid valve (= P-REL: dosing)

min. time *[MIN ON]* Cycle = *[PERIOD]* (in seconds)

Solenoid valve switching times

The switching times of the relay (solenoid valve) depend on the cycle time, the control variable and the 'min. time' (smallest permissible switch-on time for the connected device). The actuating variable determines the ratio t_{on}/cycle and thus also the switching times.

The 'min. time' affects the switching times in two situations:

1. Theoretical switching time < min. time

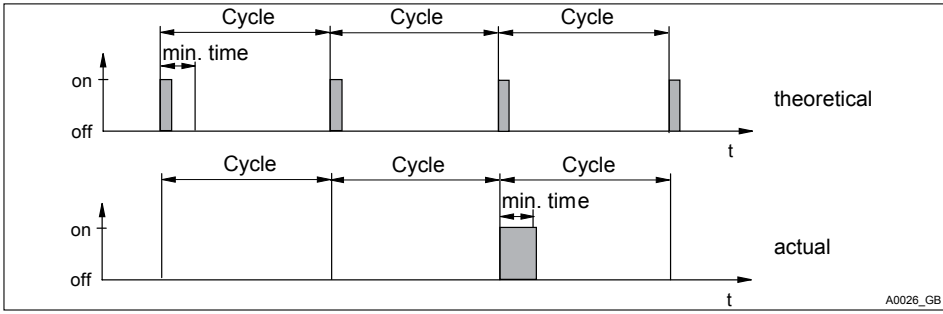


Fig. 34: Theoretical switching time < min. time

min. time *[MIN ON]*
Cycle = *[PERIOD]* (in seconds)

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

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

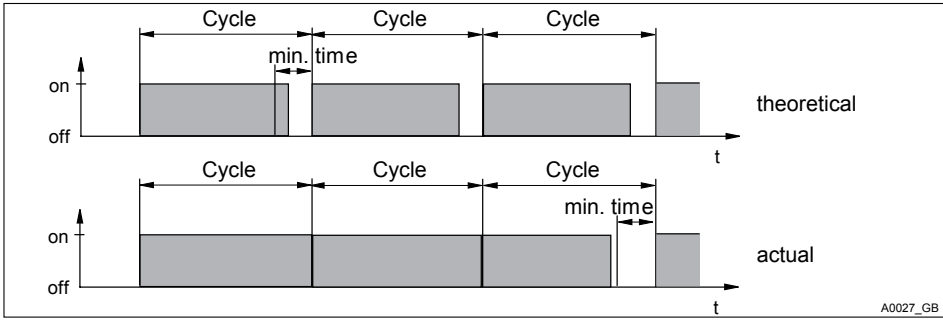


Fig. 35: Theoretical switching time > (cycle - min. time) and calculated switching time < cycle

min. time *[MIN ON]*
Cycle = *[PERIOD]* (in seconds)

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

9.10 Alarm relay

The alarm relay triggers in *'OPERATION'* (normal mode) if an error occurs which has been defined as *'ERROR'* and not just as *'WARNING'*.

The error message *'ALARM'* in the continuous display is marked with a ✻ (star) and can be acknowledged with the OK key. The alarm and the ✻ will then disappear.

9.11 "Error logger" operating mode

The last three errors are displayed. Also displayed is how long ago (in minutes) they occurred. When a new fault occurs, the oldest fault is deleted.

Faults are only shown which occur in operating status *'OPERATION'*, i.e. not in operating status *'STOP'*, *'CAL'* (user calibration), *'HOLD'* or *'PAUSE'*.

Only *'ERRORs'* are shown, not *'WARNINGS'*, e.g. a *'LIMIT ERR'* is shown, but not *'LIMIT↑'*.

A fault, whose display has lasted for 999 minutes is automatically deleted from the *'Error Logger'*. The *'Error Logger'* is neither saved nor backed up in the event of power loss.

10 Maintenance

- **User qualification: trained user, see** *Chapter 2.2 'Users' qualifications' on page 10*

The controller is maintenance free.

10.1 Changing the fuse, DULCOMETER® Compact Controller

WARNING!

Danger from electrical voltage

Possible consequence: Fatal or very serious injuries.

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

NOTICE!

Use only 5 x 20 mm micro-fuses

Possible consequence: Damage to the product or its surroundings

- 5x20 T 0.315 A
- Part number 732404

Fuse change

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

1. Disconnect the controller from the mains power
2. Open the controller and fold the controller housing top section to the left
3. Remove the PCB cover
4. Remove the micro-fuse using a suitable tool
5. Fit the micro-fuse using a suitable tool
6. Refit the PCB cover
7. Replace controller housing top section and close the controller

10.2 Error messages

- **User qualification for diagnosis:** trained user, see *Chapter 2.2 'Users' qualifications' on page 10*. Further qualifications depend on the type and scope of possible troubleshooting measures to be carried out.

Error display delay

Various errors are only displayed after approx. 10 seconds after switching on the controller.

Error messages

Display	Description / cause	Status[1]	Mode[2]	Measured variable output[3]	Correction variable output[4]
RANGE ↓	Sensor current insufficient	Error	Basic load	Error current	-
RANGE↑	Sensor current excessive	Error	Basic load	Error current	-
T RANGE ↓	Measured temperature beneath measuring range	Error	Basic load	Error current	Error current
T RANGE ↑	Measured temperature above measuring range	Error	Basic load	Error current	Error current
CAL ERROR	No valid user calibration exists	Error	-	-	-
CHECK-TIME	Control checkout time elapsed	Error	Basic load	Error current	-
mA RANGE ↑	mA output current has an upper limit	Error	-	-	-
mA RANGE ↓	mA output current has a lower limit	Error	-	-	-

Display	Description / cause	Status[1]	Mode[2]	Measured variable output[3]	Correction variable output[4]
LIMIT ↑	Measured variable exceeds upper set limit	Warning	-	-	-
LIMIT ↓	Measured variable falls below lower set limit	Warning	-	-	-
T LIMIT ↑	Correction variable exceeds upper set limit	Warning	-	-	-
T LIMIT ↓	Correction variable falls below lower set limit	Warning	-	-	-
LIMIT ERR	Set checkout time for monitoring the measurement variable limits has elapsed	Error	Stop	Error current	-
TLIMITERR	Set checkout time for monitoring the correction variable limits has elapsed	Error	Stop	Error current	Error current
_ _ _ . _ °C	No temperature sensor is connected	-[5]	-	-	-
NO CAL	No valid user calibration exists	Warning	-	-	-
CONTACTIN	If activated: Power relay is activated in *'PAUSE/HOLD'*	Error	-	-	-

Display	Description / cause	Status[1]	Mode[2]	Measured variable output[3]	Correction variable output[4]
CHECK ZERO	The timer alarm for zero point calibration elapses after approx. 8 weeks of operation.	Warning	-	-	By executing *[CHECK ZERO…]*, the reminder timer is reset.
LOW SLOPE	Slope is too low, but still permissible	Warning	-	-	Can be acknowledged by *[OK]*.
HI SLOPE	Slope is very high, but still permissible	Warning	-	-	Can be acknowledged by *[OK]*.
LOW ZERO	Zero point is very low, but still permissible	Warning	-	-	Can be acknowledged by *[OK]*.
HI ZERO	Zero point is very high, but still permissible	Warning	-	-	Can be acknowledged by *[OK]*.

1 = *[Status]* Error status after occurrence of the error (error means: Alarm-relay drops, *"*"* is displayed before the error message, can be acknowledged with OK).

2 = *[Mode]* Resulting controller mode (relates to control variable and thus, as necessary, mA output).

3 = *[Measured variable output]* Consequence for the current output, if this is set as *'measured variable output'*.

4 = *[Correction variable output]* Consequence for the current output, if this is set as *'correction variable output'*.

5 = Directly set the temperature at the controller as a fixed value.

11 Technical data DULCOMETER® Compact Controller

11.1 Permissible ambient conditions

Degree of protection (IP)

The controller fulfils the IP 67 degree of protection requirements (wall/pipe mounting) or IP 54 (control panel mounting). This degree of protection is only achieved if all seals and threaded connectors are correctly fitted.

Permissible ambient operating conditions

Temperature	-10 °C ... 60 °C
Air humidity	< 95 % relative air humidity (non-condensing)

Permissible ambient storage conditions

Temperature	-20 °C ... 70 °C
Air humidity	< 95 % relative air humidity (non-condensing)

11.2 Sound Pressure Level

No noise generation measurable

11.3 Material data

Part	Material
Housing lower and upper section	PC-GF10
Bracket rear side housing bottom section	PPE-GF20
Operating film	Polyester PET membrane
Seal	Expanded PUR
Cover screws	Stainless steel A2
Profile seal (control panel mounting)	Silicone

11.4 Chemical Resistance

The device is resistant to normal atmospheres in plant rooms

11.5 Dimensions and weights

Complete device:	128 x 137 x 76 mm (W x H x D)
Packaging:	220 x 180 x 100 mm (W x H x D)
Weight of device without packaging:	approx. 0.5 kg
Gross weight of device with packaging:	approx. 0.8 kg

12 Electrical data

Mains connection	
Nominal voltage range	100 ... 230 VAC ± 10 %
Frequency	50 ... 60 Hz
Power consumption	50 ... 100 mA

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

Power relay (P-relay)	
Loading of switching contacts	5 A; no inductive loads

Outputs galvanically isolated from other switching parts by reinforced insulation.

Digital input	
Open circuit voltage	22 V DC max.
Short circuit current	6.5 mA
Max.switching frequency	Static. For switching processes such as *'PAUSE'*, *'HOLD'*, etc.

NOTICE!

Do not supply with voltage

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

mA-output	0 ... 20 mA	4 ... 20 mA	manual
Current range	0 ... 20.5 mA	3.8 ... 20.5 mA	0 ... 25 mA
In the event of a fault	0 or 23 mA	3.6 or 23 mA	
Max. load	480 Ω at 20.5 mA		
Max. output voltage	19 V DC		
Overvoltage-resistant up to:	± 30 V		
Output accuracy	0.2 mA		

The Ma output is galvanically isolated from all other connections (500 V)

Connection data sensor	
Sensor	several selectable (2/3 sensors)
Measuring principle	potentiostatic
Temperature compensation via	Pt100/Pt1000
Sensor control	- 2000 mV ... + 2000 mV ± 10 mV
Measuring range	20 pA ... 10 mA
Electrical precision	1 nA ... 10 mA: ± 2 % of measured value
	< 1 nA: ± 3 % of measuring range
Sensor monitoring slope	5 % ... 1000 % of standard slope
Short circuit-proof	yes

Pump control (f-relay)	
Max. switching voltage:	50 V (protective low voltage)
Max. switching current:	50 mA
Max. residual current (open):	10 µA
Max. resistance (closed):	60 Ω
Max. switching frequency (HW) at 50 % filling factor	100 Hz

Digital output galvanically isolated from all other connections via OptoMos relay.

Temperature input	
Temperature measuring range:	0...120 °C
Measuring flow:	approx. 1.0 mA
Measuring accuracy:	Pt1000: ±0.5 % of the measuring range
	Pt100: ±1.0 % of the measuring range
Overvoltage-resistant up to:	±5 V
Short circuit-proof	Yes
For connection of a Pt100 or Pt1000 temperature sensor using a 2-wire system. Not galvanically isolated from the sensor connection	

13 Spare parts and accessories

Spare parts	Part number
Fine fuse 5x20 T 0.315 A	732404
Wall/tube retaining bracket	1002502
Guard terminal top part (nut)	733389
Measured variable labels	1002503
DMT fixing strap	1002498
Cable connection set DMTa/DXMa (metric)	1022312
Controller housing lower part (processor/PCB), fully assembled	Identity code DCCA_E_E1 ...
Controller housing top part (display/operating part), fully assembled	Identity code DCCA_E_E2 ...

Accessories	Part number
Mounting kit for control panel installation	1037273
Strain relief strap 130	1039762

14 Replacing spare part units

- **User qualification, mechanical installation:** trained qualified personnel, see *Chapter 2.2 'Users' qualifications' on page 10*
- **User qualification, electrical installation:** Electrical technician, see *Chapter 2.2 'Users' qualifications' on page 10*

CAUTION!

Check strap for strain relief

Possible consequence: Material damage.

The ribbon cable and its base cannot be mechanically stressed. Hence it is essential when mounting the controller in the control panel, that the check strap (part number 1035918) is fitted for strain relief and mechanical fixing. Without the check strap, the ribbon cable or its base could be damaged if they were to fall out of the top part of the controller housing.

14.1 Replacing the top part of the housing

NOTICE!

Ribbon cable base

The base of the ribbon cable is firmly soldered onto the PCB. The base cannot be removed. Open the base lock (3) to loosen the ribbon cable, see Fig. 36

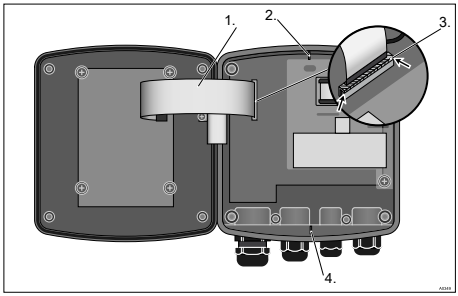


Fig. 36: Loosening the ribbon cable

1. Undo four screws and open the DULCOMETER® Compact Controller
2. Open the right and left lock (3) (arrows) on the base and pull the ribbon cable (1) out of the socket
3. The catches (2 and 4) are not needed with units for control panel installation.

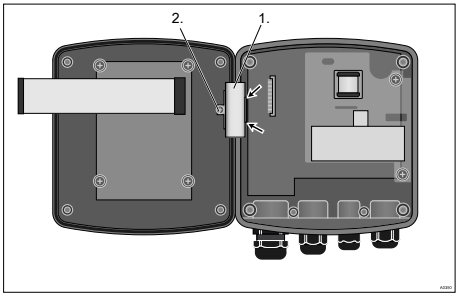


Fig. 37: Dismantling the hinge

4. Remove the screw (2), unclip the hinge (1) on the lower part of the controller housing (arrows) and remove the hinge

5. With control panel installation: Remove the two screws and remove the strain relief

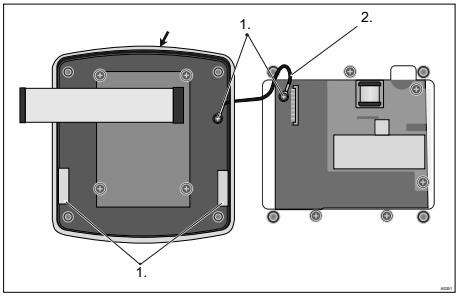


Fig. 38: With control panel installation: Fit the profile seal onto the top part of the controller housing

6. With control panel installation: Position the profile seal (arrow) evenly into the groove in the top part of the DULCOMETER® Compact Controller housing. Arrange the flaps (3) as shown in the figure

7. With control panel installation: Secure the strain relief (2) using two screws (1)

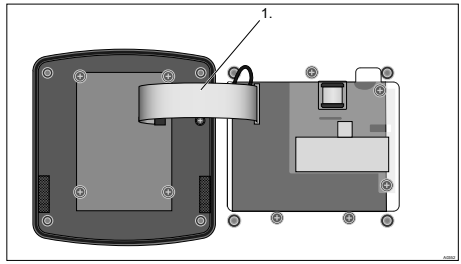


Fig. 39: Pushing and locking the ribbon cable in its base

8. Push and lock the ribbon cable (1) in its base

9. Fit the hinge

10. Screw the top part of the controller housing onto the lower part of the DULCOMETER® Compact Controller housing

11. With control panel installation: Re-check that the profile seals are fitted properly

    ⇨ Re-check that the seal is seated properly. Only if the mounting is correct, can IP 67 (wall/pipe mounting) or IP 54 (control panel mounting) degree of protection be achieved

14.2 Replacing the lower part of the housing (wall/tube retaining bracket)

Complete commissioning of the controller

Once the lower part of the housing has been replaced, it is necessary to fully commission the measuring and control point, as the new lower part of the housing does not have specific settings, only factory settings.

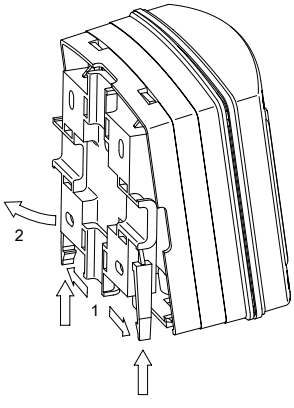


Fig. 40: Removing the wall/tube retaining bracket

1. Remove the wall/tube retaining bracket. Pull the two snap-hooks (1) outwards and push upwards

NOTICE!

Ribbon cable base

The base of the ribbon cable is firmly soldered onto the PCB. The base cannot be removed. Open the base lock (3) to loosen the ribbon cable, see Fig. 36

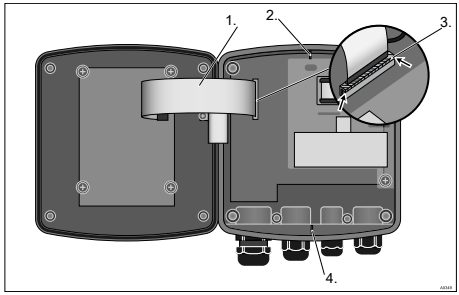


Fig. 41: Loosening the ribbon cable

2. Undo four screws and open the DULCOMETER® Compact Controller

3. Open the right and left lock (3) (arrows) on the base and pull the ribbon cable (1) out of the base. The catches (2 and 4) are used to aligned the two halves of the housing.

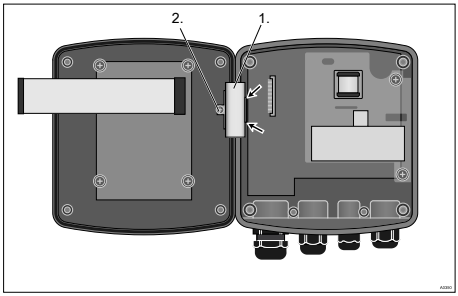


Fig. 42: Dismantling the hinge

4. Remove the screw (2), unclip the hinge (1) on the lower part of the controller housing (arrows) and remove the hinge

5. Label the cable connectors fitted to distinguish them and remove the cables from the lower part of the controller

Preparing the new lower part of the controller housing

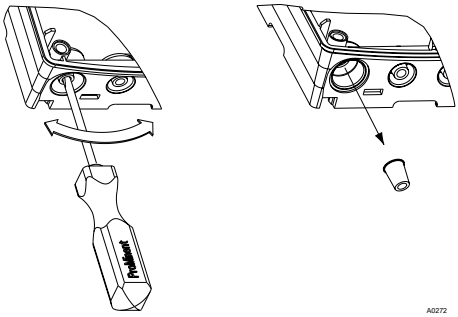


Fig. 43: Punching out the threaded holes

6.

Large threaded connection (M 20 x 1.5)

Small threaded connection (M 16 x 1.5)

Punch out as many threaded holes on the bottom of the lower part of the controller housing as required

Fit the cable and threaded connectors

7. Guide the cable into the respective reducing inserts

8. Insert the reducing inserts into the threaded connectors

9. Guide the cable into the controller

10. Connect the cable as indicated in the terminal diagram

11. Screw in the required threaded connectors and tighten

12. Tighten the threaded connector clamping nuts so that they are properly sealed

Refit the controller

13. Fit the hinge

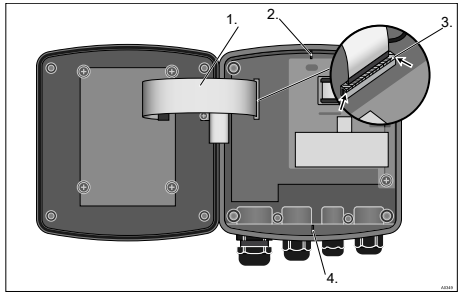


Fig. 44: Fix the ribbon cable

14. Push and lock the ribbon cable (1) in its base. The catches (2 and 4) are used to aligned the two halves of the housing.

15. Screw the top part of the controller housing onto the lower part of the DULCOMETER® Compact Controller housing

16. Re-check that the seal is seated properly. IP 67 degree of protection (wall/pipe-mounting) can only be provided if the installation is correct

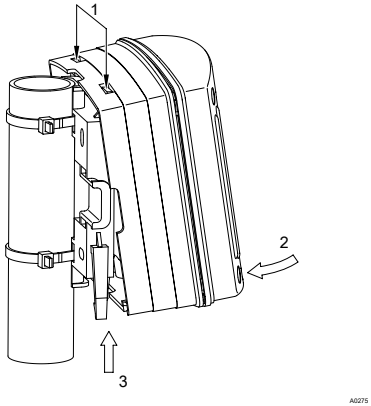


Fig. 45: Suspend and secure the DULCOMETER® Compact Controller

17. Suspend the DULCOMETER® Compact Controller at the top (1) in the wall/tube retaining bracket and push using light pressure at the bottom (2) against the wall/pipe retaining bracket. Then press upwards (3) until the DULCOMETER® Compact Controller audibly snaps into position

14.3 Replacing the lower part of the housing (control panel installation)

Complete commissioning of the controller

Once the lower part of the housing has been replaced, it is necessary to fully commission the measuring and control point, as the new lower part of the housing does not have specific settings, only factory settings.

NOTICE!

Ribbon cable base

The base of the ribbon cable is firmly soldered onto the PCB. The base cannot be removed. Open the base lock (3) to loosen the ribbon cable, see Fig. 36

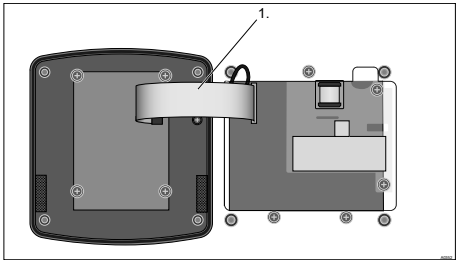


Fig. 46: Loosen the ribbon cable from the base

1. Undo four screws and open the DULCOMETER® Compact Controller

2. Open the right and left lock on the base and pull the ribbon cable (1) out of the base.

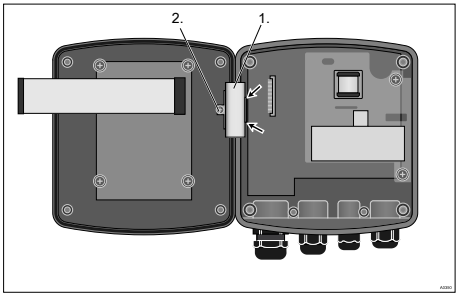


Fig. 47: Dismantling the hinge

3. Remove the screw (2), unclip the hinge (1) on the lower part of the controller housing (arrows) and remove the hinge

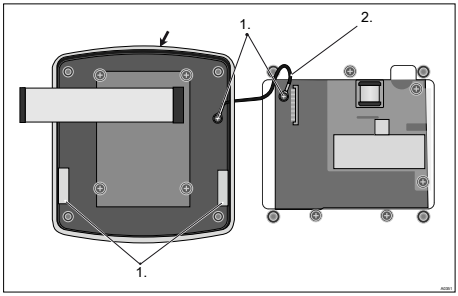


Fig. 48: Removing the strain relief

4. Remove the strain relief (2). Remove the screws (1) to do so.

5. Check the profile seal (arrow), then position the profile seal evenly into the groove in the top part of the DULCOMETER® Compact Controller housing. Arrange the flaps (3) as shown in the figure

6. Remove the top part of the controller housing (3 fixing bolts)

7. Label the cable connectors fitted to distinguish them and remove the cables from the lower part of the controller

Preparing the new lower part of the controller housing

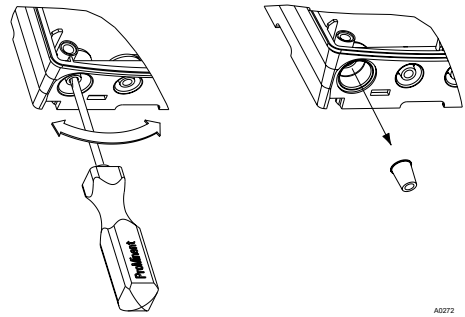


Fig. 49: Punching out the threaded holes

8.

Large threaded connection (M 20 x 1.5)

Small threaded connection (M 16 x 1.5)

Punch out as many threaded holes on the bottom of the lower part of the controller housing as required

Fit the cable and threaded connectors

9. Guide the cable into the respective reducing inserts

10. Insert the reducing inserts into the threaded connectors

11. Guide the cable into the controller

12. Connect the cable as indicated in the terminal diagram

13. Screw in the required threaded connectors and tighten

14. Tighten the threaded connector clamping nuts so that they are properly sealed

Refit the controller

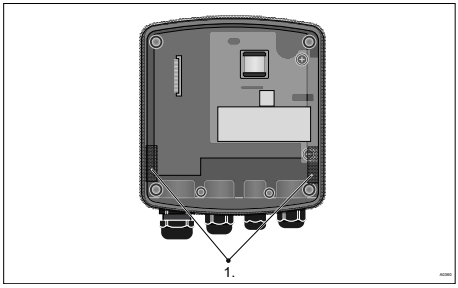


Fig. 50: Fitting the profile seal on the lower part of the controller housing

15. Use pliers to break off the catches. They are not needed for control panel installation

    Position the profile seal evenly around the top edge of the lower part of the DULCOMETER® Compact Controller housing. Arrange the flaps (1) as shown in the figure

    ⇨ Ensure that the profile seal evenly surrounds the top edge of the housing.

16. Insert the lower part of the DULCOMETER® Compact Controller housing with the profile seal from behind into the cut-out and use three screws to secure it in place

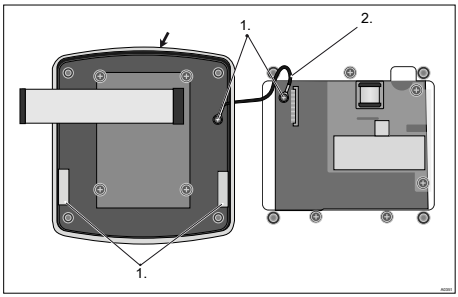


Fig. 51: Fit the profile seal onto the top part of the controller housing

17. Position the profile seal (arrow) evenly into the groove in the top part of the DULCOMETER® Compact Controller housing. Arrange the flaps (3) as shown in the figure

18. Secure the strain relief (2) using two screws (1)

19. Fit the hinge

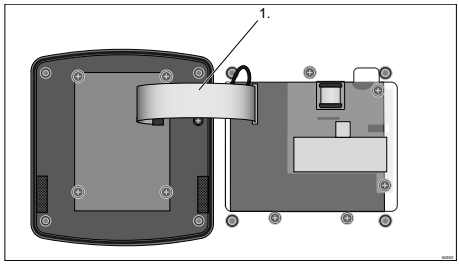


Fig. 52: Pushing and locking the ribbon cable in its base

20. Push and lock the ribbon cable (1) in its base

21. Screw the top part of the controller housing onto the lower part of the DULCOMETER® Compact Controller housing

22. Re-check that the profile seals are fitted properly

    ⇨ IP 54 degree of protection can only be provided if the control panel is mounted correctly

15 Standards complied with and Declaration of Conformity

The EC Declaration of Conformity for the controller is available to download on our homepage.

EN 60529 Specification for degrees of protection provided by housings (IP code)

EN 61000 Electromagnetic Compatibility (EMC)

EN 61010 Safety requirements for electrical equipment for measurement, control and laboratory use - Part 1: General requirements

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

16 Disposal of Used Parts

- **User qualification:** instructed user, see *Chapter 2.2 'Users' qualifications' on page 10*

NOTICE!

Regulations governing the disposal of used parts

– Note the current national regulations and legal standards which apply in your country

The manufacturer will take back decontaminated used units providing they are covered by adequate postage.

Decontaminate the unit before returning it for repair. To do so, remove all traces of hazardous substances. Refer to the Material Safety Data Sheet for your feed chemical.

A current Declaration of Decontamination is available to download on the ProMinent website.

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