Instruction manual

CO_2 Transmitter 5100 e

Order number: 52 121 170

Warranty
Defects occurring within 1 year from delivery date shall be remedied free of charge at our plant (carriage and insurance paid by sender).
Sensors, fittings, and accessories: 1 year.

Subject to change without notice.

Return of goods
Please contact your nearst Mettler-Toledo distributer. Return the goods well cleaned to Mettler-Toledo. If the goods were in contact with process media, please decontaminate the goods and enclose a corresponding confirmation.

Correct disposal of the unit
(Dircetion 2002/96/EG, dated 27.1.2003)
Wehen the unit is finally taken out of order, observe the local environmental regulations for correct disposal.

Mettler-Toledo GmbH, Process Analytics, Industrie Nord,
CH-8902 Urdorf, Tel. +41 (01) 736 22 11 Fax +41 (01) 736 26 36
Subject to technical changes. Mettler-Toledo GmbH, 07/03.
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Safety information

Be sure to read and observe the following instructions!

The device has been designed in accordance with the state of the art and complying with the applicable safety regulations. When operating the device, certain conditions may nevertheless lead to danger for the operator or damage to the device.

Caution!
Commissioning may only be carried out by trained experts. Whenever it is likely that protection has been impaired, the device shall be made inoperative and secured against unintended operation.

The protection is likely to be impaired if, for example:
- the device shows visible damage
- the device fails to perform the intended measurements
- after prolonged storage at temperatures above 70 °C (158 °F)
- after severe transport stresses

Before recommissioning the device, a professional routine test in accordance with EN 61010-1 must be performed. This test should be carried out by the manufacturer.

Caution!
Before commissioning it must be proved that the device may be connected with other equipment.

Intended use

The Model CO_2 5100 e is used to measure partial pressure CO_2 in biotechnological processes.
The rugged molded enclosure can be fixed into a control panel or mounted on a wall or at a post. The protective hood provides additional protection against direct weather exposure and mechanical damage.
The transmitter is designed to be used together with the Mettler-Toledo CO_2 sensor InPro 5000.

Trademarks

The following names are registered trademarks. For practical reasons they are shown without trademark symbol in this manual.

Sensocheck
Sensoface
Calimatic
GainCheck
EasyClean®
InPro®

EC Declaration of Conformity

Mettler-Toledo GmbH

Declaration of conformity
Konformitätserklärung
Déclaration de conformité

CE

We/Wir/Nous	Mettler-Toledo GmbH, Process Analytics Im Hackacker 15 8902 Urdorf Switzerland declare under our sole responsibility that the product, erklären in alleiniger Verantwortung, dass dieses Produkt, déclarons sous notre seule responsabilité que le produit,
Description **Beschreibung/Description**	**CO_2 5100 e** to which this declaration relates is in conformity with the following standard(s) or other normative document(s). auf welches sich diese Erklärung bezieht, mit der/den folgenden Norm(en) oder Richtlinie(n) übereinstimmt. auquel se réfère cette déclaration est conforme à la (aux) norme(s) ou au(x) document(s) normatif(s).
Low-voltage directve/Nieder-spannungs-Richtlinie/ Directive basse tension	**73/23/EWG**
Norm/Standard/Standard	**DIN EN 61010-1** **/ VDE 0411 Teil 1: 2008-08**
EMC Directive/EMV-Richtlinie Directive concernant la CEM	**89/336/EWG**
Norm/Standard/Standard	**DIN EN 61326** **/ VDE 0843 Teil 20: 1998-01** **DIN EN 61326/A1** **/ VDE 0843 Teil 20/A1: 1999-05**
Place and Date of issue **Ausstellungsort / - Datum** **Lieu et date d´émission**	Urdorf, August 20, 2003

Mettler-Toledo GmbH, Process Analytics

Waldemar Rauch
General Manager PO Urdorf

Christian Zwicky
Head of Marketing

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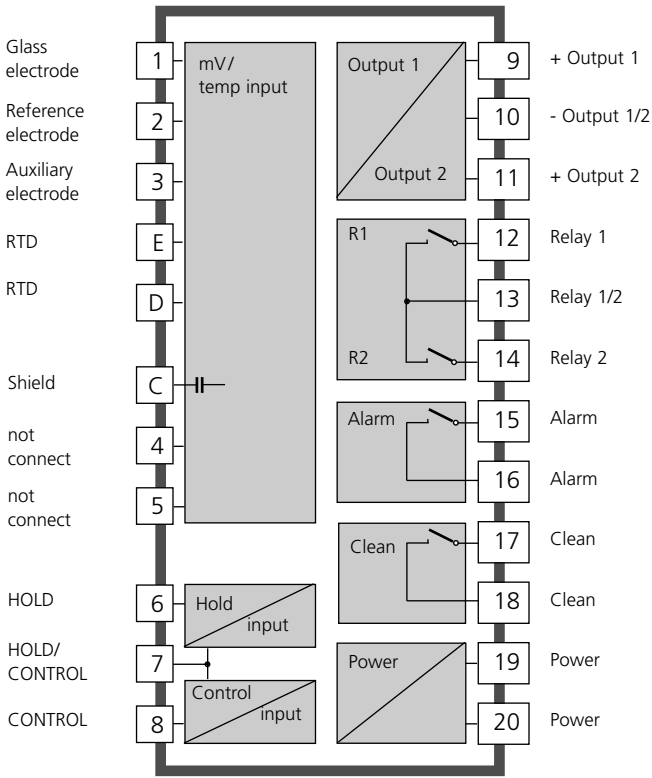
METTLER TOLEDO

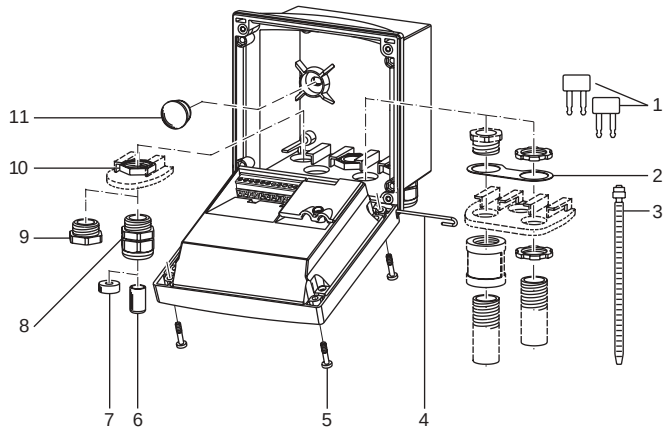
Overview of pH Transmitter CO_2 5100 e



Package contents

Check the shipment for transport damage and completeness.
The package should contain:

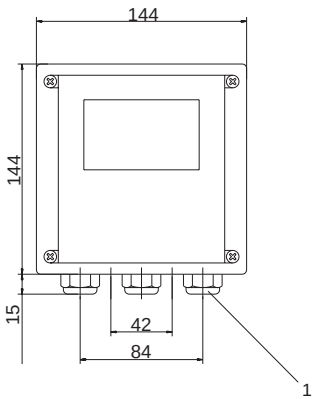
- Front unit
- Lower case
- Bag containing small parts
- Instruction manual
- Specific test report

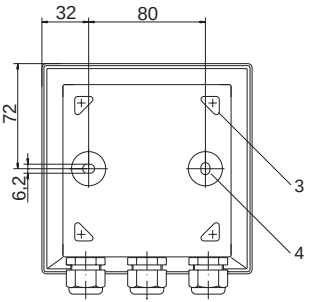


1 Jumper (2 pieces)
2 Washer (1 piece), for conduit mounting: Place washer between enclosure and nut
3 Cable ties (3 pieces)
4 Hinge pin (1 piece), insertable from either side
5 Enclosure screws (4 pieces)
6 Sealing inserts (1 piece)
7 Rubber reducer (1 piece)
8 Cable glands (3 pieces)
9 Filler plugs (3 pieces)
10 Hexagon nuts (5 pieces)
11 Sealing plugs (2 pieces), for sealing in case of wall mounting

Fig.: Assembling the enclosure

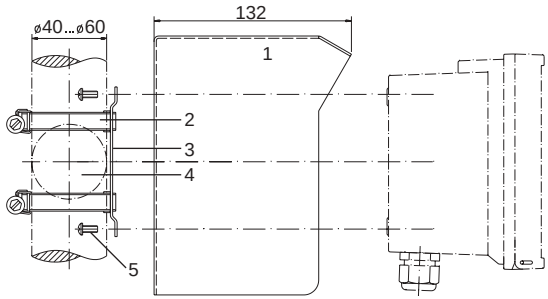
Pipe mounting, panel mounting





1 Cable gland (3 pieces)
2 Breakthroughs for cable gland or conduit 1/2", dia 21.5 mm (2 breakthroughs) Conduits not included!
3 Breakthroughs for pipe mounting (4 breakthroughs)
4 Breakthroughs for wall mounting (2 breakthroughs)

Fig.: Mounting plan



1 Protective hood (if required)
2 Hose clamps with worm gear drive to DIN 3017 (2 pieces)
3 Pipe-mount plate (1 piece)
4 For vertical or horizontal posts or pipes
5 Self-tapping screws (4 pieces)

Fig.: Pipe-mount kit

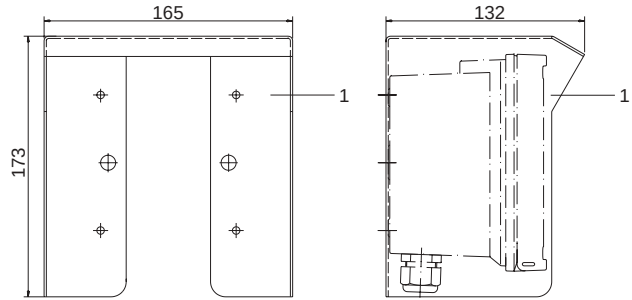
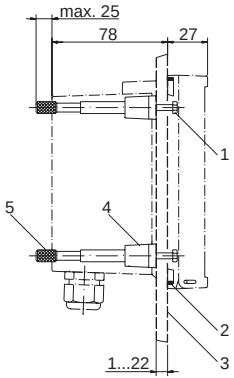


Fig.: Protective hood for wall and pipe mounting



1 Screws (4 pieces)
2 Gasket (1 piece)
3 Control panel
4 Span pieces (4 pieces)
5 Threaded sleeves (4 pieces)

Fig.: Panel-mount kit

Information on installation

Caution!

- Installation may only be carried out by trained experts in accordance with this instruction manual and as per applicable local and national codes.
- Be sure to observe the technical specifications and input ratings.
- Be sure not to notch the conductor when stripping the insulation.
- Before connecting the device to the power supply, make sure that its voltage lies within the range 20.5 to 253 V AC/DC.
- When commissioning, a complete configuration must be carried out by the system administrator.

The terminals are suitable for single wires and flexible leads up to 2.5 mm² (AWG 14).

Warning!

Additional safety precautions have to be taken for applications in hazardous locations to CSA (CLI DIV2 GPA,B,C,D T4, Ex nA IIC T4)!

Terminal assignments

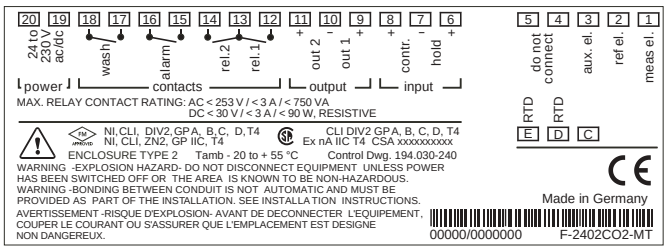
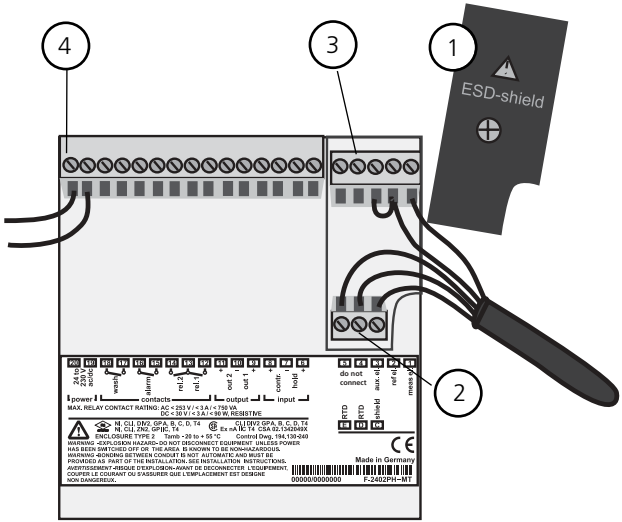


Fig.: Terminal assignments CO_2 5100 e



1 ESD shield covering the signal inputs (Screw off for assembly)
Note: The cable shield must end under the ESD shield.
(Cut lines if required)
2 Terminals for temperature probe and outer shield
3 Terminals for electrode
4 Connection of power supply

Fig.: Information on installation, rear side of device

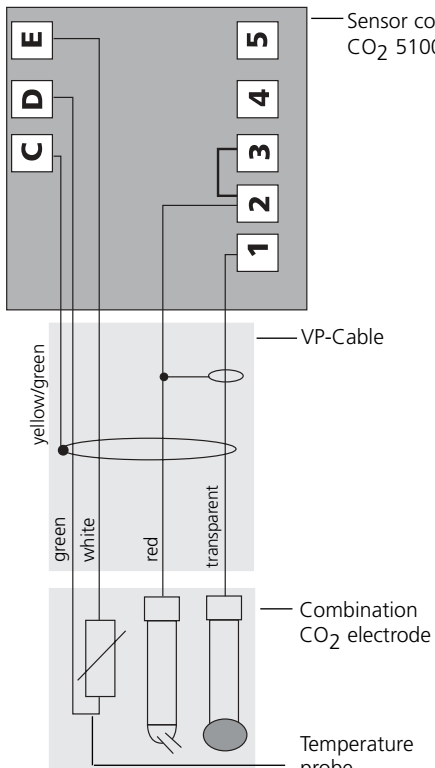
Division 2 wiring

FM

The connections to the Transmitter are incendive and must be installed in accordance with the National Electric Code (ANSI-NFPA 70) Division 2 hazardous (classified) location incendive wiring techniques.

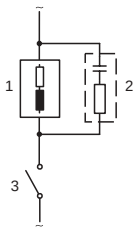
Wiring diagram

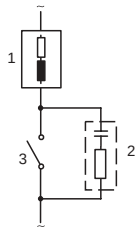
CO_2 measurement with monitoring of glass electrode. Connection with VP cable.



Protective wiring of switching contacts

Relay contacts are subjected to electrical erosion. Especially with inductive and capacitive loads, the service life of the contacts will be reduced. For suppression of sparks and arcing, components such as RC combinations, nonlinear resistors, series resistors and diodes should be used.

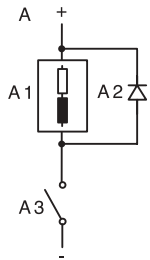


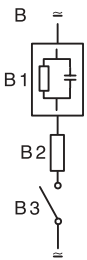


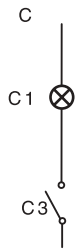
Typical AC applications with inductive load

1 Load
2 RC combination, e.g. RIFA PMR 209
Typical RC combinations
for 230 V AC:
Capacitor 0.1µF / 630V,
Resistor 100 Ohms / 1 W
3 Contact

Typical protective wiring measures





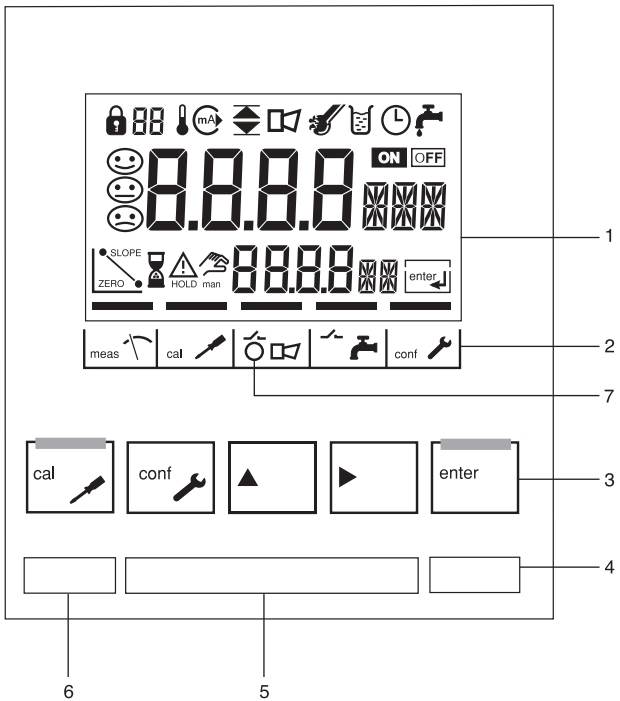


A: DC application with inductive load
B: AC/DC applications with capacitive load
C: Connection of incandescent lamps

A1	Inductive load
A2	Free-wheeling diode, e.g. 1N4007 (Observe polarity)
A3	Contact
B1	Capacitive load
B2	Resistor, e.g. 8 Ohms/1 W at 24 V / 0.3 A
B3	Contact
C1	Incandescent lamp, max 60 W / 230 V, 30 W / 115 V
C3	Contact

Warning!
Make sure that the maximum ratings of the relay contacts are not exceeded even during switching!

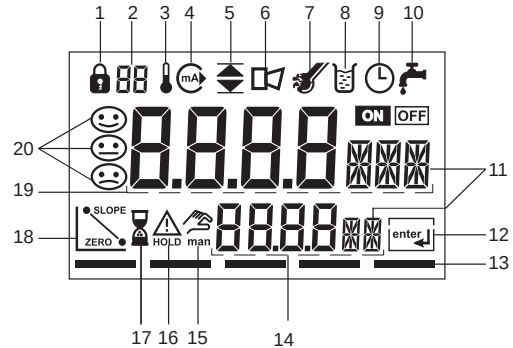
User interface



1 Display
2 Mode indicators (no keys), from left to right:
- Measuring mode
- Calibration mode
- Alarm
- Wash contact
- Configuration mode

3 Keypad
4 Coding
5 Rating plate
6 Model designation
7 Alarm LED

Display



1 Mode code entry
2 Display of measured variable*
3 Temperature
4 Current output
5 Limit values
6 Alarm
7 Sensocheck
8 Calibration
9 Interval/response time
10 Wash contact
11 Measurement symbols
12 Proceed with enter
13 Bar for identifying the device status, above mode indicators, from left to right:
- Measuring mode
- Calibration mode
- Alarm
- Wash contact
- Configuration mode

14 Lower display
15 Manual temp indicator
16 Hold mode active
17 Waiting time running
18 Electrode data
19 Main display
20 Sensoface

* Not in use

Operation: Keypad

cal	Start, end calibration
conf	Start, end configuration
▶	Select digit position (selected position flashes)
▲	Edit digit
enter	• Calibration: Continue in program sequence • Configuration: Confirm entries, next configuration step • Measuring mode: Display output current

cal ➔ enter	Cal Info, display of asymmetry potential and slope
conf ➔ enter	Error Info, display last error message
▶ + ▲	Start GainCheck device self-test

Safety features

Sensocheck, Sensoface sensor monitoring
Sensocheck continuously monitors the sensor and wirings. Sensocheck can be switched off (configuration p.45).

Sensoface provides information on the electrode condition. The asymmetry potential (zero), slope and response time during calibration are evaluated. The three Sensoface indicators provide the user with information about wear and required maintenance of the sensor.

GainCheck device self test
A display test is carried out, the software version is displayed and the memory and measured value transfer are checked.

Start GainCheck device self-test: ▶ + ▲

Automatic device self-test
The automatic device self-test checks the memory and measured-value transfer. It runs automatically in the background at fixed intervals.

Safety functions

Hold mode

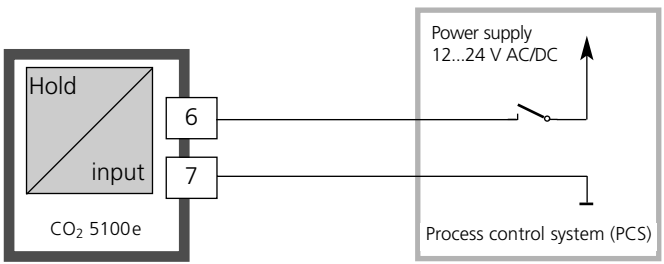
Display:

HOLD

The Hold mode is a safety state during configuration and calibration. Output current is frozen (Last) or set to a fixed value (Fix). Alarm and limit contacts are disabled.
If the calibration or configuration mode is exited, the Transmitter remains in the Hold mode for safety reasons.
This prevents undesirable reactions of the connected peripherals due to incorrect configuration or calibration. The measured value and "HOLD" are displayed alternately. The Transmitter only returns to measuring mode after **enter** is pressed and a waiting time of 20 s has passed.

To activate the Hold mode from outside

The Hold mode can be activated from outside by sending a signal to the Hold input (e.g. from the process control system).



Hold active	Hold inactive
10 ... 30 V AC/DC	0 ... 2 V AC/DC

Mode codes

The mode codes allow fast access to the functions.

Calibration

Key + Code	Description
cal 0000	**Cal Info** Display of asymmetry potential and slope
cal 1001	**Zero adjustment** of a nominal zero point
cal 1100	**Calibration** Adjustment of asymmetry potential and slope (electrode)
cal 1105	**Product calibration 1** Adjustment of asymmetry potential (ref.messurement)
cal 1106	**Product calibration 2** Adjustment of asymmetry potential (aeration)
cal 1015	**Adjusting temp probe**

Key + Code	Description
conf 0000	**Error Info** Display last error and erase
conf 1200	**Configuring**
conf 2222	**Sensor monitor** Display of uncorrected measured voltage (mV)
conf 7654	**Parameter set 1/2** Switchover internal / external
conf 5555	**Current source 1** Output current 1 specified
conf 5556	**Current source 2** Output current 2 specified
conf 5557	**Relay test** Manual test of contacts
conf 5559	**Manual controller** Manual specification of controller output

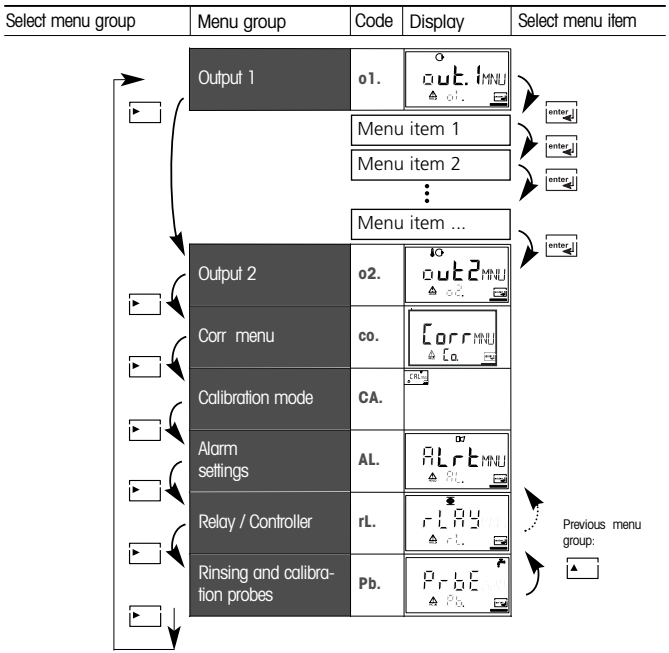
Configuration

In the Configuration mode you set the device parameters.

Activate	conf	Activate with **conf**
		Enter mode code "1200" Edit parameter with ► and ▲, confirm/continue with **enter**. (End with **conf enter**.)
Hold	HOLD HOLD icon	During configuration the Transmitter remains in the Hold mode for reasons of safety. The output current is frozen (at its last value or at a preset fixed value, depending on the configuration), limit and alarm contacts are inactive. The controller is in the configured state, Sensoface is off, mode indicator "Configuration" is on.
Input errors		The configuration parameters are checked during the input. In the case of an incorrect input "Err" is displayed for approx. 3 s. The incorrect parameters cannot be stored. Input must be repeated.
End	conf enter	End with **conf**. The measured value and Hold are displayed alternately, "**enter**" flashes. End Hold mode with **enter**. The display shows the measured value. The output current remains frozen for another 20 s (HOLD icon on, "hourglass" flashes).

Menu structure of configuration

The configuration steps are assigned to different menu groups.
With the arrow keys you can jump between the individual menu groups.
Each menu group contains menu items for setting the parameters.
Pressing **enter** opens a menu item. The values are edited using the arrow keys. Pressing **enter** confirms/stores the settings.
Return to measurement: Press **conf**.



Overview of configuration steps

Code	Menu	Selection / Default
out1	**Output 1**	
o1.	Select measured variable	hPa, mg/l, % CO_2, mV
	Select current range	0-20 mA / 4-20 mA
	Enter current beginning	xxxx
	Enter current end	xxxx
	Time constant of output filter	xxxx SEC
	22 mA signal in the case of error	ON / OFF
	Signal behavior during HOLD	Last / Fix
	Enter fixed value	xxx.x mA
out2	**Output 2**	
o2.	Select temperature unit	°C / °F
	Select temperature probe	Pt1000 / NTC30
	Select current range	0-20 mA / 4-20 mA
	Enter current beginning	xxx.x
	Enter current end	xxx.x
	Time constant of output filter	xxxx SEC
	22 mA signal in the case of temp error	ON / OFF
	Signal behavior during HOLD	Last / Fix
	Enter fixed value	xxx.x mA
co.	**Correction**	
co.	Select correction, pressure, unit	bar/kPa/psi
	Enter, correction, pressure	psi
	Enter conc. hydrogen carbonate	mol/l
CAL	**Calibration mode**	
CA.	Select calibration mode	aut/man/dat
	Enter cal timer interval	xxxx h

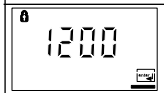
Code	Menu		Selection / Default
ALrt	**Alarm settings**		
AL.	Select Sensocheck		ON / OFF
	Enter alarm delay		xxxx s
	LED in HOLD mode		ON / OFF
rLAY	**Relay 1/2: Limit values, controller**		
rL.	Select limit function / controller		LiMIT / CtROL
	L1.	Select contact function	Lo / Hi
		Select contact response	N/O / N/C
		Enter switching point	xxxx
		Enter hysteresis	xxxx
		Enter delay	xxxx SEC
	L2.	Select contact function	Lo / Hi
		Select contact response	N/O / N/C
		Enter switching point	xxxx
		Enter hysteresis	xxxx
		Enter delay	xxxx SEC
	Ct.	Enter controller setpoint	xxxx
		Enter neutral zone	xxxx
		(P) Controller gain K_P	xxxx %
		(I) Reset time T_R	xxxx SEC
		(D) Rate time T_D	xxxx SEC
		Controller	PLC / PFC
		PLC: Pulse length	xxxx SEC
		PFC: Pulse frequency	xxxx /min
		Select HOLD behavior	Y Last / Y Off
PrbE	**Rinsing and cleaning probes**		
Pb.	Select cleaning / calibration probe		EASYCLN / rinse
	rinse	Rinsing interval	xxx.x h
		Rinse duration	xxxx SEC
		Contact response	N/O / N/C
	EASYCLN	Cleaning interval	xxx.x h
		Calibration interval	xxx.x h
	Lock cleaning / calibration interval		ON / OFF

Configuration

Output 1

Menu group	Code	Display	Select menu item
Output 1	o1.	out. MNU	Select measured variable
			Select 0-20 / 4-20 mA
			Enter current beginning
			Enter current end
			Set output filter
			22 mA in the case of error
			Hold mode

End:
Press **conf**, then **enter**

code	Display	Action	Choices
o1.		Select configuration (Press **conf**.)	
	 After correct input a welcome text is displayed for approx. 3 s	Enter mode code "1200" (Select position with ► key and edit number with ▲ key. When the display reads "1200", press **enter** to confirm.)	
		The Transmitter is in HOLD mode (HOLD icon is on).	
		Select measured variable Select with ► key Proceed with **enter**	%, hPa, mg/l, mV

Note: Characters represented in gray are flashing and can be edited.

Output 1

Output current range. Current beginning. Current end.

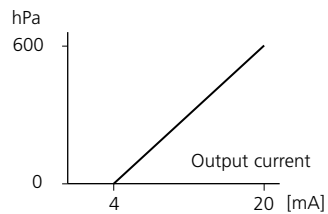
Menu group	Code	Display	Select menu item
Output 1	o1.		Select measured variable Select 0-20 / 4-20 mA Enter current beginning Enter current end Set output filter 22 mA in the case of error Hold mode

End:
Press **conf**, then **enter**

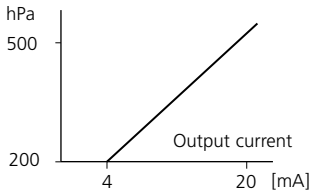
Code	Display	Action	Choices
o1.		Set output current range Select with ► key Proceed with **enter**	**4-20 mA** (0 - 20 mA)
		Current beginning Enter lower end of scale, depending on measured variable selected Select with ► key, edit number with ▲ key, proceed with **enter**	0%-160%, –999mV… +1500 mV 0-2000 hPa
		Current end Enter upper end of scale, depending on measured variable selected Select with ► key, edit number with ▲ key, proceed with **enter**	0%-160%, –999mV… +1500 mV 0-2000 hPa

Assignment of measured values: Current beginning and current end

Example 1: Range hPa



Example 2: Range 200-500 hPa
Advantage: Higher resolution in range of interest



Configuration

Output 1
Time constant of output filter.

Menu group	Code	Display	Select menu item
Output 1	o1.		Select measured variable
			Select 0-20 / 4-20 mA
			Enter current beginning
			Enter current end
			Set output filter
			22 mA in the case of error
			Hold mode

End:
Press **conf**, then **enter**

Code	Display	Action	Choices
o1.	0000 SEC o1.TCnF	Time constant of output filter Default setting: 0 s (inactive). To specify a time constant: Select with ► key, edit number with ▲ key, proceed with **enter**	**0 s** 0 - 120 s

Time constant of output filter

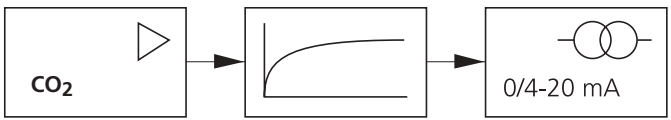
To smoothen the current output, a low-pass filter with adjustable filter time constant can be switched on. When there is a jump at the input (100 %), the output level is 63 % after the time constant has been reached.

The time constant can be set from 0 to 120 s.

If the time constant is set to 0 s, the current output follows the input.

Note:

The filter only acts on the current output, not on the display, the limit values, or the controller!



Time constant 0 to 120 s

Output 1

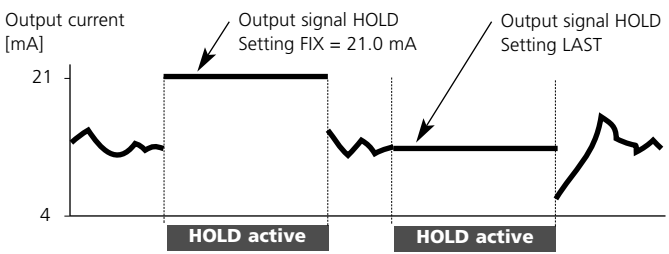
Output current during Error and HOLD.

Menu group	Code	Display	Select menu item
Output 1	**o1.**	out.1 MNU o1.	Select measured variable Select 0-20 / 4-20 mA Enter current beginning Enter current end Set output filter 22 mA in the case of error Hold mode

End:
Press **conf**, then **enter**

Code	Display	Action	Choices
o1.		22 mA signal for error message Select with ► key Proceed with **enter**	**OFF** **(ON)**
		Output signal during HOLD LAST: During HOLD the last measured value is maintained at the output. FIX: During HOLD a value (to be entered) is maintained at the output. Select with ► key Proceed with **enter**	**LAST** (FIX)
	 	Only with FIX selected: Enter current which is to flow at the output during HOLD Select position with ► key and edit number with ▲ key Proceed with **enter**	**21.0 mA** (00.0 to 21.0 mA

Output signal during HOLD:

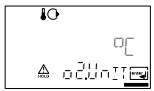
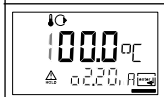


Output 2

Temperature unit and probe. Output current.

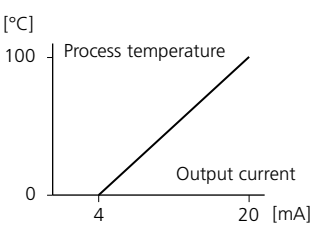
Menu group	Code	Display	Select menu item
Output 2	**o2.**		Select °C/°F
			Select 0-20 / 4-20 mA
			Enter current beginning
			Enter current end
			Set output filter
			22 mA for temp error
			Hold mode

End:
Press **conf**, then **enter**

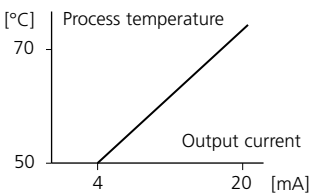
Code	Display	Action	Choices
o2.		Specify temperature unit Select with ► key Proceed with **enter**	**°C** (°F)
		Select temperature probe Select with ► key Proceed with **enter**	**Pt 1000** (PT1000, NTC30)
		Set output current range Select with ► key Proceed with **enter**	**4 - 20 mA** (0 - 20 mA)
		Current beginning: Enter lower end of scale. Select with ► key, edit number with ▲ key, proceed with **enter**	**000.0 °C**
		Current end: Enter upper end of scale. Select with ► key, edit number with ▲ key, proceed with **enter**	**100.0 °C**

Process temperature: Current beginning and current end

Example 1: Range 0 to 100 °C



Example 2: Range 50 to 70 °C.
Advantage: Higher resolution in range of interest



Output 2
Time constant of output filter.

Menu group	Code	Display	Select menu item
Output 2	**o2.**		Select °C/°F
			Select 0-20 / 4-20 mA
			Enter current beginning
			Enter current end
			Set output filter
			22 mA for temp error
			Hold mode

End:
Press **conf**, then **enter**

Code	Display	Action	Choices
o2.		Time constant of output filter Default setting: 0 s (inactive). To specify a time constant: Select with ► key, edit number with ▲ key, proceed with **enter**	**0 s** (0 - 120 s)

Time constant of output filter

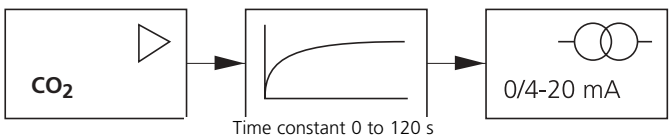
To smoothen the current output 2, a low-pass filter with adjustable filter time constant can be switched on. When there is a jump at the input (100 %), the output level is 63 % after the time constant has been reached.

The time constant can be set from 0 to 120 s.

If the time constant is set to 0 s (default), the current output follows the input.

Note:

The filter only acts on the current output, not on the display!



Output 2

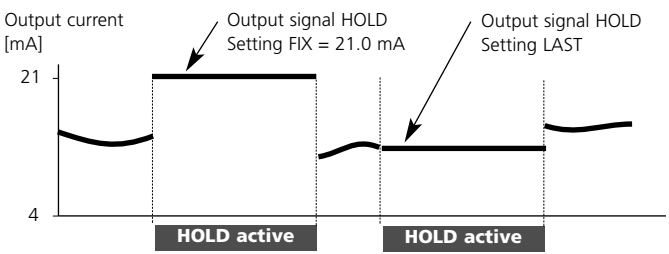
Temperature error. Output current during HOLD.

Menu group	Code	Display	Select menu item
Output 2	**o2.**		Select °C/°F
			Select 0-20 / 4-20 mA
			Enter current beginning
			Enter current end
			Set output filter
			22 mA for temp error
			Hold mode

End:
Press **conf**, then **enter**

Code	Display	Action	Choices
o2.		22 mA signal for error message Select with ► key. Proceed with **enter**	**OFF** (ON)
		Output signal during HOLD LAST: During HOLD the last measured value is maintained at the output. FIX: During HOLD a value (to be entered) is maintained at the output. Select with ► key. Proceed with **enter**	**LAST** (FIX)
	 	Only with FIX selected: Enter current which is to flow at the output during HOLD. Select position with ► key and edit number with key. Proceed with **enter**	**21.0 mA** (00.0 to 21.0 mA)

Output signal during HOLD:



Correction
Process pressure Hydrogencarbonate.

Menu group	Code	Display	Select menu item
Calibration mode	**co.**		Meas. unit (pressure) Process pressure Hydrogencarbonate

End:
Press **conf**, then **enter**

Code	Display	Action	Choices
CA.		Select pressure unit Select with ► key Proceed with **enter**	**bar** (kPa, psi)
		Enter process pressure. This value is used to convert partial pressure (pCO2) to % CO_2. Select with ► key, edit number with ▲ key, proceed with **enter**	**1.013 bar**
		Hydrogen carbonate. *Enter hydrogen carbonate concentration.* Select position with ► key and edit number with ▲ key Proceed with **enter**	**0.050 mol/l** (Electrolyte InPro 5000)

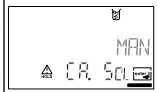
* ppt (parts per thousand) - corresponds to g/kg

Configuration

Calibration mode

Menu group	Code	Display	Select menu item
Calibration mode	CA.		Calibration mode Cal timer interval

End:
Press **conf**, then **enter**

Code	Display	Action	Choices
CA.		AUT: Calibration with Calimatic automatic buffer selection.	
		MAN: Calibration with manual buffer entry	
		DAT: Entry of asymmetry potential and slope of premeasured electrodes Select with ► key Proceed with **enter**	
		Enter calibration interval: Entry of time interval within which the Transmitter is to be calibrated. With a time interval of 0000 hrs the calibration timer is not active. Select with key, edit number with ▲ key, proceed with **enter**	**0000 h** (0000 to 9999 h)

Menu group	Code	Display	Select menu item
Alarm settings	AL.		Select Sensocheck Delay LED in HOLD mode

End:
Press **conf**, then **enter**

End:
Press **conf**, then **enter**

Code	Display	Action	Choices
AL.		Select Sensocheck (continuous monitoring of glass and reference electrode) Select with ► key Proceed with **enter**	ON / **OFF**
		Alarm delay Select with ► key, edit number with ▲ key, proceed with **enter**	**0010 s** (xxxx s)
		LED in HOLD mode Select with ► key Proceed with **enter**	ON / **OFF**

	Alarm	HOLD
LED HOLD:ON	on	flashes
LED HOLD:OFF	flashes	off

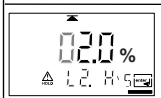
Menu group	Code	Display	Select menu item
Relay / Controller	**rL.**		**L1.** Contact function
			Contact response
			Enter switching point
			Enter hysteresis
			Delay
			L2. Relay 2 menu group
			Ct. Controller menu group

End:
Press **conf**, then **enter**

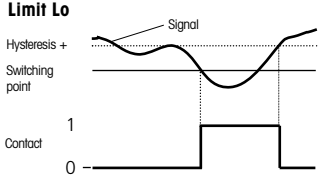
Code	Display	Action	Choices
rL.		Use of relays: • Limit function (LiMIT) • Controller (CtROL) Select with ► key Proceed with **enter** **Note:** Selecting CtROL leads to Controller menu group **Ct.**	**LiMIT** (CtROL)
L1.		For Limit 1 function, see Pg 53. Select with ► key Proceed with **enter**	**Lo** (Hi)
		Limit 1 contact response N/C: normally closed contact N/O: normally open contact Select with ► key Proceed with **enter**	**N/C** (N/O)
		Limit 1 switching point Select with ► key, edit number with ▲ key, proceed with **enter**	**100.0 %** (xx.xx%)
		Limit 1 hysteresis Select with ► key, edit number with ▲ key, proceed with **enter**	**0.5 %** (xx.x %)
		Limit 1 delay The contact is activated with delay (deactivated without delay) Select with ► key, edit number with ▲ key, proceed with **enter**	**0010 s** (0 to 9999 s)

Menu group	Code	Display	Select menu item	
Relay / Controller	rL.		**L1.**	Relay 1 menu group
			L2.	Contact function
				Contact response
				Enter switching point
				Enter hysteresis
				Delay
			Ct.	Controller menu group

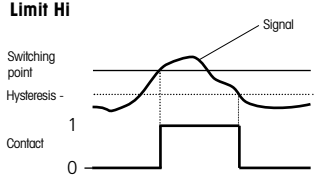
End:
Press **conf**, then **enter**

Code	Display	Action	Choices
L2.		Select Limit 2, see Fig. below. Select with ► key Proceed with **enter**	**Hi** (Lo)
		Limit 2 contact response N/C: normally closed contact N/O: normally open contact Select with ► key Proceed with **enter**	**N/C** (N/O)
		Limit 2 switching point Select with ► key, edit number with ▲ key, proceed with **enter**	**100.0 %** (xx.xx%)
		Limit 2 hysteresis Select with ► key, edit number with ▲ key, proceed with **enter**	**00.5 %**(xx.xx%)
		Limit 2 delay The contact is activated with delay (deactivated without delay) Select with ► key, edit number with ▲ key, proceed with **enter**	**0010 s** (0 to 9999 s)

Limit Lo



Limit Hi



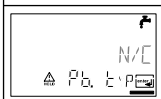
Controller
(for description see Pg 75 and the following)
Setpoint. Neutral zone

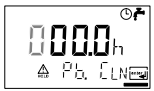
Menu group	Code	Display	Select menu item	
Relay / Controller	rL.		**L1.**	Relay 1 menu group
			L2.	Relay 2 menu group
			Ct.	Controller setpoint
				Enter neutral zone
				(P) Controller gain
				(I) Reset time T_R
				D) Rate time T_D
				Pulse length/Pulse frequency
				PLC: Pulse length
				PFC: Pulse frequency
				HOLD behavior

End:
Press **conf**, then **enter**

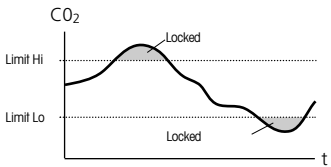
Code	Display	Action	Choices
Ct.		Setpoint Select with ► key, edit number with ▲ key, proceed with **enter**	**50.0 %**
		Neutral zone (dead band) Select with ► key, edit number with ▲ key, proceed with **enter**	**10.00 %**
		Controller: Proportional action Select with ► key, edit number with ▲ key, proceed with **enter**	**0100 %**
		Controller: Integral (reset time): Select with ► key, edit number with ▲ key, proceed with **enter**	**0000 s** (xxxx s)
		Controller: Derivative (rate time) Select with ► key, edit number with ▲ key, proceed with **enter**.	**0000 s** (xxxx s)
		Pulse length /Pulse frequency Select with ► key Proceed with **enter**	**PLC** (PFC)
		PLC: Pulse length Select with ► key, edit number with ▲ key, proceed with **enter**	**0010 s** (xxxx s)
		PFC: Pulse frequency Select with ► key, edit number with ▲ key, proceed with **enter**	**0060/min** (xxxx /min)
		Behavior during HOLD Select with ► key Proceed with **enter**	**Y Last** (Y Off)

Menu group	Code	Display	Select menu item
Rinsing and calibration probes	Pb.		Rinsing/calibration probe Rinsing interval Rinse duration Contact response Cleaning interval Calibration interval

Code	Display	Action (rinsing probe)	Selection
Pb.		Control of: • Rinsing probe (rinse) • Calibration probe (EasyClean) Select with ► key Proceed with **enter**	**rinse** (EASYCLN) EASYCLN: see opposite page →
		Rinsing interval Select with ► key, edit number with ▲ key, proceed with **enter**	**000.0 h** (xxx.x h)
		Rinse duration Select with ► key, edit number with ▲ key, proceed with **enter**	**0060 s** (xxxx s)
		Contact type Select with ► key Proceed with **enter**	**N/C** (N/O)

Code	Display	Action (calibration probe)	Selection
Pb.		Calibration probe (EasyClean) Select with ► key Proceed with **enter**	**EASYCLN** (rinse)
		Cleaning interval (EasyClean only) Select with ► key, edit number with ▲ key, proceed with **enter**	**000.0 h** (xxx.x h)
		Calibration interval (EasyClean only) Select with ► key, edit number with ▲ key, proceed with **enter**	**000.0 h** (xxx.x h)
		Lock cleaning (calibration) interval* **On**: The Transmitter only starts a cleaning (calibration) interval if the measured value lies within the tolerated range (Limit Lo/Limit Hi).	**Off** (On)

***"Lock cleaning (calibration) interval" function:**



The Transmitter only starts a cleaning (calibration) interval if the measured value lies within the tolerated range (Limit Lo/Limit Hi). (For limit setting, refer to pages 47-50)

Display	Action	Remark
	Switch between parameter sets Press **conf** key, enter code 7654 Select with ► key, edit number with ▲ key, proceed with **enter**	Wrong settings change the measurement properties! If an invalid code is entered, the Transmitter returns to measuring mode.
		Welcome text is displayed for approx. 3 sec
	Select parameter set 1 or 2. Select with ► key Proceed with **enter**	
 	Since the complete device configuration is changed in one step, there is a security prompt (No/Yes). When pressing **enter** directly, the selection is not stored.	

Default settings of parameter sets

Two complete parameter sets are stored in the EEPROM.
As delivered, the two sets are identical but can be edited.

Note:
Fill in your configuration data on the following pages.

Code. Parameter	Default setting
o1. Unit	hPa
o1. 0/4-20 mA	4-20 mA
o1. Current beginning	1 hPa
o1. Current end	1000 hPa
o1. Filter time	0 s
o1. 22mA signal	OFF
o1. Hold behavior	Last
o1. Fix current	021.0 mA
o2. Pt1000/NTC30	Pt1000
o2. Unit °C / °F	°C
o2. 0/4...20mA	4-20 mA
o2. Current beginning	000.0 °C
o2. Current end	100.0 °C
o2. Filter time	0 s
o2. 22mA signal	OFF
o2. Hold behavior	Last
o2. Fix current	021.0 mA
Co. Pression unit	bar
Co. Pression	1.013 bar
Co. Hydrogen carbonate	0.05
CA. Cal interval	0000 h
AL. Sensocheck	OFF
AL. Alarm delay	0010 s
AL. LED Hold	ott

Code. Parameter	Default setting
rL. Relay function	Limit
L1. Contact function	Lo
L1. Contact response	N/C
L1. Switching point	%
L1. Hysteresis	%
L1. Delay	0010 s
L2. Contact function	Hi
L2. Contact response	N/C
L2. Switching point	50 %
L2. Hysteresis	10 %
L2. Delay	0010 s
Ct. Setpoint	%
Ct. Neutral zone	%
Ct. P action	0100 %
Ct. I action	0000 s
Ct. D action	0000 s
Ct. PLC/PFC controller	PLC
Ct. Pulse length	0010 s
Ct. Pulse frequency	0060 /min
Ct. Hold behavior	Last
Pb. EasyCLN/Rinse	rinse
Pb. Rinsing interval	000.0 h
Pb. Rinse duration	0060 s
Pb. Cleaning interval	000..0 h

Parameter set – user settings

Code. Parameter Setting		
o1. Unit: %, hPa, mg/l, mV	_____	_____
o1. 0/4-20 mA	_____	_____
o1. Current beginning	_____	_____
o1. Current end	_____	_____
o1. Filter time	_____	_____
o1. 22mA signal	_____	_____
o1. Hold behavior	_____	_____
o1. Fix current	_____	_____
o2. Unit °C / °F	_____	_____
o2. 0/4...20mA	_____	_____
o2. Current beginning	_____	_____
o2. Pt 1000 / NTC30	_____	_____
o2. Current end	_____	_____
o2. Filter time	_____	_____
o2. 22mA signal	_____	_____
o2. Hold behavior	_____	_____
o2. Fix current	_____	_____
o2. Hydrogen carbonate	_____	_____
co. Pression unit	_____	_____
co. Pression	_____	_____
co. Hydrogen carbonate	_____	_____
CA. Cal interval	_____	_____

Code. Parameter Setting

AL. Sensocheck		
AL. Alarm delay		
AL. LED-Hold		
rL. Relay function		
L1. Contact function		
L1. Contact response		
L1. Switching point		
L1. Hysteresis		
L1. Delay		
L2. Contact function		
L2. Contact response		
L2. Switching point		
L2. Hysteresis		
L2. Delay		
Ct. Setpoint		
Ct. Neutral zone		
Ct. P action		
Ct. I action		
Ct. D action		
Ct. PLC/PFC controller		
Ct. Pulse length		
Ct. Pulse frequency		
Ct. Hold behavior		
Pb. EasyCLN/Rinse		

Calibration

Calibration adjusts the device to the electrode.

Activate

Activate with **cal**

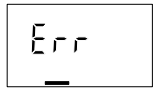
Enter mode code: 1100
Select with ► key, edit number with ▲ key, proceed with **enter**
(End with **cal enter**.)

Hold

HOLD icon

During calibration the Transmitter remains in the Hold mode for reasons of safety. Output current is frozen (last value or preset fixed value, depending on configuration), limit and alarm contacts are inactive. The controller is in the configured state, Sensoface is off, mode indicator "Configuration" is on.

Input errors



The calibration parameters are chekked during the input. In the case of an incorrect input "Err" is displayed for approx. 3 sec. The incorrect parameters cannot be stored. Input must be repeated.

End

End with **cal**.
The measured value and Hold are displayed alternately, "**enter**" flashes. Press **enter** to end the Hold mode. The measured value is displayed. The output current remains frozen for another 20 sec (HOLD icon on, "hourglass" flashes).

pH calibration

Calibration is used to adapt the device to the individual electrode characteristics, namely asymmetry potential and slope. Calibration can be performed with Calimatic automatic buffer recognition, with manual buffer input, by entering premeasured electrode data.

Caution

- All calibration procedures must be performed by trained personnel. Incorrectly set parameters may go unnoticed, but change the measuring properties.
- The response time of the electrode and temperature probe is considerably reduced if the electrode is first moved about in the buffer solution and then held still.

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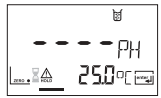
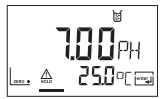
Automatic calibration with Calimatic

The Transmitter can only operate properly when the buffer solutions used correspond to the configured set. Other buffer solutions, even those with the same nominal values, may demonstrate a different temperature behavior. This leads to measurement errors.

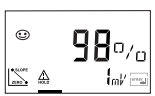
Display	Action	Remark
	Press **cal** key, enter code 1100. Select with ► key, edit number with ▲ key, proceed with **enter**	If an invalid code is entered, the Transmitter returns to measuring mode.
	Remove the electrode with temperature probe, clean it and immerse it in the first buffer solution (in any order).	Transmitter in Hold mode, measured value frozen. Sensoface inactive.
	Buffer recognition While the "hourglass" icon flashes, the electrode and temperature probe remain in the first buffer solution.	The response time of the electrode and temperature probe is considerably reduced if the electrode is first moved about in the buffer solution and then held still.
	Buffer recognition terminated, the nominal buffer value is displayed.	

Display	Action	Remark
	Stability check: The measured mV value is displayed.	To abort stability check: Press **cal**. (accuracy reduced)
	Calibration with the first buffer is terminated. Remove the electrode from the first buffer solution and rinse it thoroughly.	
	• Two-point calibration: Immerse electrode in the second buffer solution pH 9.21. Start with **enter**.	The calibration process runs again as for the first buffer.
	Retract electrode and temp probe out of second buffer, rinse off, re-install. Repeat calibration: **cal**, End calibration: **enter**.	Slope and asymmetry potential of electrode (related to 25 °C) are displayed. Hold is deactivated after 20 sec.

Manual calibration

For calibration with manual buffer specification, you must enter the pH value of the buffer solution used in the Transmitter for the proper temperature. This presetting enables calibration with any desired buffer solution. The MAN calibration mode in the configuration mode.

Display	Action	Remark
	Press **cal** key, enter code 1100 Select with ► key, edit number with ▲ key, proceed with **enter**	If an invalid code is entered, the Transmitter returns to measuring mode.
	Remove the electrode, clean and immerse it in the first buffer solution. Start with **enter**.	Transmitter in Hold mode, measured value frozen. Sensoface inactive.
	Enter the pH value of your buffer solution for the proper temperature. While the "hourglass" icon flashes, the electrode remains in the first buffer solution.	The response time of the electrode and temperature probe is considerably reduced if the electrode is first moved about in the buffer solution and then held still.

Display	Action	Remark
	Stability check: The measured mV value is displayed.	To abort stability check: Press **cal**. (accuracy reduced)
	Calibration with the first buffer is terminated. Remove the electrode from the first buffer solution and rinse it thoroughly.	
	• Two-point calibration: Immerse electrode in the second buffer solution. Enter the pH value of the second buffer solution. Start with **enter**.	The calibration process runs again as for the first buffer.
	Retract electrode out of second buffer, rinse off, re-install. Repeat calibration: **cal**, End calibration: **enter**.	Slope and asymmetry potential of electrode (related to 25 °C) are displayed. Hold is deactivated after 20 sec.

Data entry of premeasured electrodes

You can directly enter the values for slope and asymmetry potential of an electrode. The values must be known, e.g. determined beforehand in the laboratory. The DAT calibration mode must be preset in the configuration mode.

Display	Action	Remark
	Press **cal** key, enter code 1100 Select with ► key, edit number with ▲ key, proceed with **enter**	If an invalid code is entered, the Transmitter returns to measuring mode.
	Ready for calibration Start with **enter**.	Transmitter in Hold mode, measured value frozen. Sensoface inactive.
	Enter asymmetry potential [mV]. Select with ► key, edit number with ▲ key, proceed with **enter**	
	Enter slope [%]. Select with ► key, edit number with ▲ key, proceed with **enter**	
	The Transmitter displays the new slope and asymmetry potential (at 25 °C). Proceed with **enter**.	
	pCO_2 and Hold are displayed alternately. Proceed with **enter**. Hold is deactivated after 20 s.	Security prompt.

Converting slope [%] to slope [mV/pH] at 25 °C:

%	mV/pH
78	46.2
80	47.4
82	48.5
84	49.7
86	50.9
88	52.1
90	53.3
92	54.5
94	55.6
96	56.8
98	58.0
100	**59.2**
102	60.4

Converting asymmetry potential in electrode zero point:

$$ZERO = 7 - \frac{V_{AS}\,[mV]}{S\,[mV / pH]}$$

ZERO Electrode zero point
V_{AS} Asymmetry potential
S Slope

Process calibration 1
Calibration by sampling

The electrode remains in the measured media during the process calibration. The measuring process will be interrupted only during a short time.
Procedure: During the sampling the currently measured value is stored in the transmitter. The transmitter immediately returns to the measuring mode. The calibration mode indicator flashes and reminds that the calibration has not been terminated. The sample is now measured in the lab using a reference method. The measured sample value is then entered in the transmitter. The transmitter will now calculate the asymmetry potential from the difference between the stored value and the sample value (one point calibration).
If the sample value is invalid, you can take over the value stored during the sampling. In this case, the old calibration values are stored.
Afterwards, you can start a new process calibration.

Display	Action	Remark
	Product calibration, step 1: Press **cal** key, enter code 1105 (Select with ► key, edit number with ▲ key, proceed with **enter**	If an invalid code is entered, the Transmitter returns to measuring mode.
	Take sample and store value. Proceed with **enter**	Now the sample can be measured in the lab.

Display	Action	Remark
	Measuring mode: From the flashing CAL mode indicator you see that sample calibration has not been terminated.	While the sample value is determined, the Transmitter is in measuring mode.
	Product calibration, step 2: When the sample value has been determined, call up the product calibration once more (**cal**, code 1105).	Display (approx. 3 sec)
	Enter lab value. The new asymmetry potential is calculated.	
	Display of slope and new asymmetry potential (related to 25 °C). End calibration with **enter**.	New calibration: Press **cal**.
	The measured value is shown in the main display alternately with "Hold"; "enter" flashes. End with **enter**.	After end of calibration, the outputs remain in Hold mode for approx. 20 sec.

Process calibration 2
Aeration

The electrode remains in the process during the calibration with standard gas. The measuring process will be interrupted only during a short time.
Procedure: The system is exposed to a standard calibration gas with a defined CO_2 partial pressure (consider pressure dependence) and calibrated accordingly. This method allows two calibration possibilities. The aeration procedure may take place directly in the reactor, or in the flushing chamber of a retractable housing like InTrac 797. In both cases, it is important to flush the reactor or the flushing chamber with standard gas until a stable reading is displayed on the transmitter. The process calibration can be started as soon as the reading is stable. When a stable reading is displayed, proceed with entering the correct partial pressure, after the correction with the process pressure. The transmitter will calculate the new asymmetry potential of the CO_2 sensor.

Display	Aktion	Bemerkung
	Product calibration, step 2: Press **cal** key, enter code 1106 (Select with ► key, edit number with ▲ key, proceed with **enter**	If an invalid code is entered, the Transmitter returns to measuring mode.
	Store value. Proceed with **enter**	The value must be stable displayed.

Display	Action	Remark
	Manual input of the known CO_2 partial pressure. Calculation of the new asymetric potential.	
	Display of slope and new asymmetry potential (related to 25 °C). End calibration with **enter**.	New calibration: Press **cal**.
	The measured value is shown in the main display alternately with "Hold"; "enter" flashes. End with **enter**.	After end of calibration, the outputs remain in Hold mode for approx. 20 sec.

Temperature probe adjustment

Display	Action	Remark
	Activate calibration (Press **cal**, enter m, ode code 1015) Select with ► key, edit number with ▲ key, proceed with **enter**	Wrong settings change the measurement properties! If an invalid code is entered, the Transmitter returns to measuring mode.
	Measure the temperature of the process medium using an external thermometer	The Transmitter is in Hold mode.
	Enter measured temperature value. Select with ► key, edit number with ▲ key, proceed with **enter** End adjustment with **enter**. HOLD will be deactivated after 20 sec.	Default: Current value of secondary display.

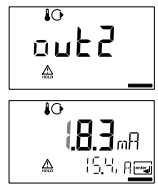
Measurement

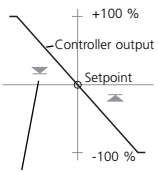
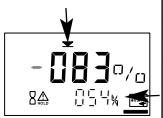
Display	Remark
	In the measuring mode the main display shows the configured process variable , the secondary display shows the temperature.. During calibration you can return to measuring mode by pressing the **cal**, during configuration by pressing **conf**. (Waiting time for meas. value stabilization approx. 20 s).

Diagnostics functions

Display	Remark
	Display of output currents Press **enter** while in measuring mode. The current at output 1 is shown in the main display, the current at output 2 in the secondary display. After 5 sec the Transmitter returns to measuring mode.
	Display of calibration data (Cal Info) Press **cal** while in measuring mode and enter code 0000. The slope is shown in the main display, the asymmetry potential in the secondary display. After 20 sec the Transmitter returns to measuring mode (immediate return at pressing **cal**).
	Display of electrode potential (Sensor monitor) Press **conf** while in measuring mode and enter code 2222. The (uncompensated) electrode potential is shown in the main display, the measuring temperature in the secondary display. Press **enter** to return to measurement.
	Display of last error message (Error Info) Press **conf** while in measuring mode and enter code 0000. The last error message is displayed for approx. 20 sec. After that the message will be deleted (immediate return to measurement at pressing **enter**).

These functions are used for testing the connected peripherals.

Display	Action / Remarks
	Specify current at output 1 • Press **conf**, enter code 5555 The current indicated in the main display for output 1 can be edited. Select with ► key, edit number with ▲ key, proceed with **enter** The actually measured current is shown in the secondary display. The Transmitter is in Hold mode. Press **enter** to return to measurement (Hold remains active for another 20 sec).
	**Specify current at output 2** • Press **conf**, enter code 5556 The current indicated in the main display for output 2 can be edited. Select with ► key, edit number with ▲ key, proceed with **enter.** The actually measured current is shown in the secondary display. The Transmitter is in Hold mode. Press **enter** to return to measurement.
 Select a relay Test 0/1 Return to measurement	**Relay test (manual test of contacts)** • Press **conf**, enter code 5557 The relays are frozen. This state is indicated in the display. The 4 digits in the display correspond to the 4 relays (as on terminal plate): 1st digit: R1 2nd digit: R2 3rd digit: AL 4th digit: CLN Function test using arrow keys – see left column. When exiting the function (**enter**), the relays are set corresponding to the measured value.

Display	Action / Remarks
   Controller characteristic  The arrows indicate which relay (valve) is active: ▲ Relay 2 active (Meas. value > setpoint) ▼ Relay 1 active (Meas. value < setpoint) 	**Controller test (manual specification of controller output)** • Press **conf**, enter code 5559 After function activation "Ctrl" is displayed for approx. 3 sec. With controller turned off, "OFF" is displayed in addition, then return to measuring mode. The function is used to start up control loops or check the actuators. For bumpless changeover to automatic operation (exiting this function), configure an I-action component (reset time). Specify value: Select with ► key, edit number with ▲ key, proceed with **enter** The Transmitter is in Hold mode. Press **enter** to return to measurement (Hold remains active for another 20 sec). Controller output -100 to 0 %: Relay 2 active Controller output 0 to +100 %: Relay 1 active Momentary controller output (adjusted value has not been stored yet)

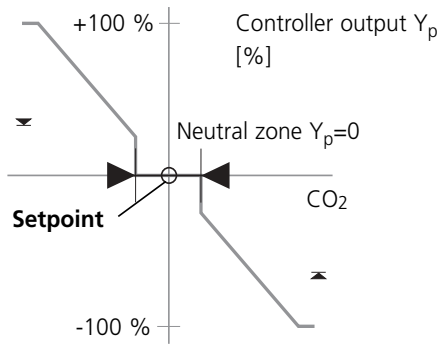
PID controller

P controller
Application in integrating systems
(e.g. closed tank, batch processes).

PI controller
Application in non-integrating systems
(e.g. drains).

PID controller
The additional derivative action compensates for measurement peaks.

Controller characteristic



Note:
In Hold mode the controller output acts as configured (Y = const. or Y = 0).

Controller equations

Controller output Y = $Y_P + \frac{1}{T_R}\int Y_P dt + T_D \frac{dY_P}{dt}$

P action I action D action

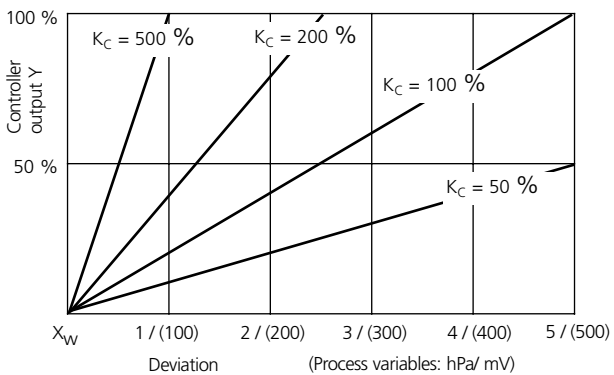
Proportional action Y_P

$Y_P = \frac{\text{Setpoint - Meas. value}}{\text{hPa}} * K_p$ $Y_P = \frac{\text{Setpoint - Meas. value}}{\text{500mV}} * K_p$

with:

Y_P	Proportional action	T_D	Rate time [s]
T_R	Reset time [s]	K_C	Controller gain [%]

Proportional action (Gradient K_C [%])



Neutral zone (Y=0)

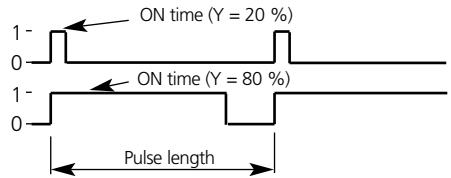
Tolerated deviation from setpoint.
The setting , for example, permits a deviation of ± 0.5 % from the desired value without activating the controller.

Pulse length / pulse frequency controller

Pulse length controller (PLC)

The pulse length controller is used to operate a valve as an actuator. It switches the contact on for a time that depends on the controller output. The period is constant. A minimum ON time of 0.5 sec is maintained even if the controller output takes corresponding values.

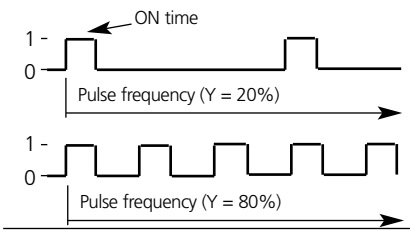
Output signal (switching contact)of pulse length controller



Pulse frequency controller (PFC)

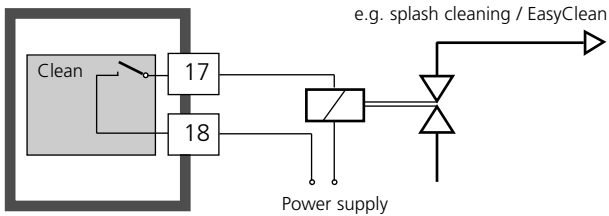
The pulse frequency controller is used to operate a frequency-controlled actuator. It varies the frequency with which the contacts are switched on. The maximum pulse frequency [pulses/ min] can be defined. It depends on the actuator.
The contact ON time is constant. It is automatically calculated from the user-defined maximum pulse frequency.

Output signal (switching contact) of pulse frequency controller

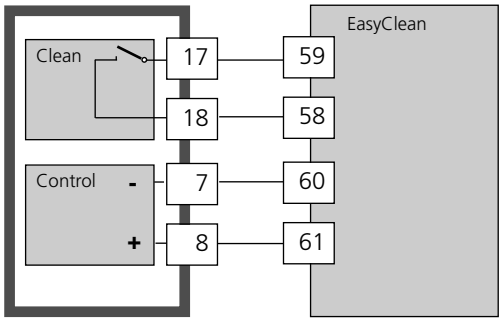


Connecting a rinsing system

The "Clean" contact can be used to connect a simple splash cleaning system. Rinse duration and rinsing interval are defined during configuration. (page 53)



Operation with automatic cleaning system
"EasyClean" is a separate automatic cleaning system. The cleaning cycle is activated according to the cleaning interval defined during configuration (Pg 56).
Also see EasyClean Manual.



Error messages (Error Codes)

Errors	Display	Problem Possible causes	Alarm contact	Red LED	Out 1 (22 mA)	Out 2 (22 mA)
ERR 01	Measured value flashes	**pH electrode** • Electrode defective • Too little electrolyte in electrode • Electrode not connected • Break in electrode cable • Incorrect electrode connected	x	x	x	
ERR 02	Measured value flashes	**Measure range** • >0.00 pH>14.00 • Electrode not connected • Break in electrode cable • Incorrect electrode connected • Electrode potential < 1500 mV	x	x	x	
ERR 98	"Conf" flashes	**System error** Configuration or calibration data defective; completely reconfigure and recalibrate the device. Memory error in device program (PROM defective)	x	x	x	x
ERR 99	"FAIL" flashes	**Factory settings** EEPROM or RAM defective This error message only occurs in the case of a complete defect. The Transmitter must be repaired and recalibrated at the factory.	x	x	x	x

Errors	Symbol (flashing)	Problem Possible causes	Alarm contact	Red LED	Out 1 (22 mA)	Out 2 (22 mA)
ERR 03		**Temperature probe** Open or short circuit Temperature range exceeded	x	x	x	x
ERR 11		**Current output 1** Current below 0 (3.8) mA	x	x	x	
ERR 12		**Current output 1** Current above 20.5 mA	x	x	x	
ERR 13		**Current output 1** Current span too small / too large	x	x	x	
ERR 21		**Current output 2** Current below 0 (3.8) mA	x	x		x
ERR 22		**Current output 2** Current above 20.5 mA	x	x		x
ERR 23		**Current output 2** Current span too small / too large	x	x		x
ERR 41 **ERR 42**		**Rinsing probe**: Communication Calibration error	x	x	x	x
ERR 33 **ERR 34**		**Sensocheck**: Glass electrode Reference electrode	x	x	x	Sensoface active
		• Zero error, Sensoface active, see Pg 84				
		• Slope error, Sensoface active, see Pg 84				
		• Response time exceeded, Sensoface active, see Pg 84				
		• Cal interval expired, Sensoface active, see Pg 84				

Error messages (during calibration)

Symbol flashes:	Problem Possible causes
	Asymmetry potential out of range (±60 mV) • Electrode worn out • Buffer solution contaminated • Buffer does not belong to buffer set • Nominal electrode zero point ≠ pH 7
	Electrode slope out of range (80 – 103 %) • Electrode worn out • Buffer solution contaminated • Buffer does not belong to buffer set • electrode used, has different nominal slope
	Problems during recognition of the buffer solution • Same or similar buffer solution was used for both calibration steps • Buffer solution used does not belong to buffer set device

Symbol flashes:	Problem Possible causes
	Problems during recognition of the buffer solution (continued) • During manual calibration the buffer solutions were not used in the specified order • Buffer solutions contaminated • Electrode defective • Electrode not connected • Electrode cable defective
	Calibration was canceled after approx. 2 min because the electrode drift was too large. • Electrode defective • Electrode dirty • No electrolyte in the electrode • Electrode cable insufficiently shielded or defective • Strong electric fields influence the measurement • Major temperature fluctuation of the buffer solution • No buffer solution or extremely diluted

Operating state	Out 1	Out 2	Rel.1/2 Controller	Rel.1/2 Limit value	Cleaning contact	Alarm contact	LED	Time out
Measurement								
Cal Info (cal) 0000								20 s
Error Info (conf) 0000								20 s
Calibration (cal) 1100								
Temp adjustment (cal) 1015								

Operating state	Out 1	Out 2	Rel.1/2 Controller	Rel.1/2 Limit value	Cleaning contact	Alarm contact	LED	Time out
Process cal 1 (cal) 1105								
Process cal 2 (cal) 1106								
Configuration (conf) 1200								20 min
Parameter set 1/2 (conf) 7654								20 min
Sensor monitor (conf) 2222								20 min
Current source 1 (conf) 5555								20 min
Current source 2 (conf) 5556								20 min
Relay test (conf) 5557								20 min
Manual controller (conf) 5559								20 min
Rinsing function								
HOLD input								

Explanation:

active

as configured (Last/Fix or Last/Off)

Sensoface

(Sensocheck must have been activated during configuration.)

The little smiley in the display (Sensoface) alerts for electrode problems (defective sensor, defective cable, maintenance required). The permitted calibration ranges and the conditions for a friendly, neutral, or sad Sensoface are summarized in the following chart. Additional icons refer to the error cause.

Sensocheck

Continuously monitors the electrodes and wires for short circuits or open circuits. Critical values make the Sensoface "sad" and the corresponding icon flashes:

The Sensocheck message is also output as error message Err 33. The alarm contact is active, the red LED is lighted, output current 1 is set to 22 mA (when configured correspondingly). Sensocheck can be switched off during configuration (then Sensoface is also disabled). Exception: After a calibration the "friendly" Smiley is always displayed for confirmation.

Note

The worsening of a Sensoface criterion leads to the devaluation of the Sensoface indicator (Smiley becomes "sad"). An improvement of the Sensoface indicator can only take place after calibration or removal of am electrode defect.

Display	Problem	Status
	Asymmetry potential and slope	Asymmetry potential (zero) and slope of the electrode are still okay, However, the electrode should be replaced soon. Asymmetry potential (zero point) and/or slope of the electrode have reached values which no longer ensure proper calibration. Replace the electrode.
	Calibration timer	Over 80 % of the calibration interval has already past. The calibration interval has been exceeded.
	Electrode defective	Check the electrode and its connections (also see error messages Err 33 and Err 34, Page 78.

Appendix

Specifications

pH/mV input	Input	Glass electrode
	Input	Reference electrode
	Input	Auxiliary electrode
Measuring range	pH: 0.00 ... 14.00	
Display range CO_2		
Saturation	0.0 ... 200.0 % (0 ... 60 °C / 32…140 °F)	
Concentration	0.0 ... 999.9 mg/l (0 ... 60 °C / 32…140 °F)	
	0000 ... 4000 mg/l (0 ... 60 °C / 32…140 °F)	
Partial pressure	0,0 ... 999.9 ... 2000 hPa	
	Input glass electrode1)	
Input resistance	> 0.5 x 10^{12} Ω	
Input current	< 2 x 10^{-12} A	
Input reference electrode1)	Input resistance > 1 x 10^{10} Ω	
	Input current < 1 x 10^{-10} A	
Measuring error1,2,3)	< 5 % of measured value +2 mg/l,	
	resp. 0.2 %, resp. 2 hPa	
Process pressure*)	0.000 ... 4.000 bar	
	Electrolytes concentration *)	
	0.000 ... 1.000 mol/l	
Electrode standardization pH/CO_2	pH-calibration	
	operating modes	
	AUT	Auto-calibration with buffer pH 7.00, 9.21
	MAN	manual calibration with input induvidual buffer values
	DAT	data input of premeasured sensors
	CO_2-calibration	
	Product calibration (with separat Mode-Code)	
	max. calibration range	
	asymmetry potential ±60 mV	
	slope	80 ... 103 % (47.5 ... 61 mV/pH)
	(possibly restrictive hints by Sensoface)	
Caltimer	0000 ... 9999 h	

Specifications

Sensocheck	Automatic monitoring of glass and reference electrode (can be disabled). Delay time approx. 30 s
Sensoface	Provides information on the electrode condition. Evaluation of zero/slope, response, calibration interval, Sensocheck
Temperature input	Pt 1000 / NTC 30
2-wire connection, adjustable	
Measurement range	–20.0 ... 150.0 °C / –4 ... 302 °F
Adjustment range	10 K
Resolution	0.1 °C / 1 °F
Meas. error1,2,3)	< 0.5 K
HOLD input	Galv. separated (OPTO coupler)
Function	Switches device to HOLD mode
Switching volatage	0 ... 2 V (AC/DC) inaktive 10 ... 30 V (AC/DC) HOLD aktive
CONTROL input	Galv. separated (OPTO coupler)
Function	Control input for automatic cleaning/ calibration system
Switching voltage	0 ... 2 V (AC/DC) inactive 10 ... 30 V (AC/DC) active
Output 1	0/4 ... 20 mA, max. 10 V, floating (galv. connected to output 2)
Measured variable *)	CO_2 value (%, mg/l, hPa)
Overrange *)	22 mA In the case of error messages
Output filter *)	PT1-filter, filter time constant 0 ... 120 s
Meas. error1)	< 0.3 % current value +0.05 mA
Start / end of scale	as desired within ranges
Adm. span	2 ... 200 % / 50 ... 4000 mg/l /50 ... 2000 hPa
Output 2	0/4 ... 20 mA, max. 10 V, floating (galv. connected to output 1)
Measured variable	Temperature
Overrange *)	22 mA In the case of error messages
Output filter *)	PT1-filter, filter time constant 0 ... 120 s

Meas. error1)	< 0.3 % current value +0.05 mA
Start / end of scaale*)	as desired within ranges
Adm. span	10 ... 100 K
Alarm contact	Relay contact, floating
Contact ratings	AC < 250 V / < 3 A / < 750 VA DC < 30 V / < 3 A / < 90 W
Contact response	N/C (fail-safe type)
Alarm delay	0000…0600 s
Limit values	Output via relay contacts R1, R2 (see PID process contoller) Contacts R1, R2 floating, but inter-connected
Contact ratings	AC < 250 V / < 3 A / < 750 VA DC < 30 V / < 3 A / < 90 W
Contact response *)	N/C or N/O Delay *) 0000 … 9999 s Switching points *)
As desired within range	
Hysteresis *)	max. 40 % of MR floating
PID-Process controller	Output via relay contacts R1, R2 (see limit values) R1 base valve, R2 acid valve specification *)
Set point specification*)	0 ... 100,0 % / 0 ... 1999 mg/l / 0 ... 999,9 hPa
Neutral zone *)	0 ... 20,0 % / 0 ... 400 mg/l / 0 ... 200,0 hPa
P-action *) controller gaine	Kr: 0010 ... 9999 %
I-action *) reset time	Tr: 0000 ... 9999 s (0000 s = no integral action)
D-action *) derivative time	Td: 0000 ... 9999 s (Os= no derivative action)
Controller type *)	pulse length controller or pulse frequency controller
Pulse periode *)	0001 ... 0600 s, min. ON time 0,5 s (pulse length controller)
max. pulse frequency *)	0001 ... 0180 min-1 (pulse frequency controller)
Cleaning function*)	Relay contact, floating for controlling a simple rinsing system or an automatic cleaning system
Contact ratings	AC < 250 V / < 3 A / < 750 VA

	DC < 30 V / < 3 A / < 90 W
Contact response *)	N/C or N/O
Rinsing interval *)	000.0 ... 999,9 h (000.0 h …= cleaning function switched off)
Cleaning interval *)	0000 ... 1999 s
Post-delay	20 s

Display	LC display, 7-segment with icons
Main display	Characters height 17 mm, unit symbols 10 mm Secondary display
Characters height 10 mm, unit symbols 7 mm	
Sensoface	3 status indicators (friendly, neutral, sad smily)
Mode indication	5 status bars: "meas", "cal", "alarm", "cleaning", "config" 18 further icons for configuration and messages
Alarm indication	red LED in case of alarm or HOLD, user defined

Keypad	5 keys: [cal] [conf] [►] [▲] [enter]

Service functions	
Current source	Current adjustable for output 1 and 2 00.00 to 22.00mA)
Manual controller	Controller output entered directly (startup of control process)
Device self-test	Automatic memory test (RAM, FLASH, EEPROM) Display test Display of all segments Last Error
Display of last error occurred	
	Sensor monitor Display of direct, uncorrected sensor signal (electrode) Relay test
Manual control of the four switching contacts	

Parameter sets *)	Two selectable parameter sets for different applications

Explosion protection	NI, Class I, Div 2, Group A, B, C, D (USA/Canada)

Data retention	Parameters and calibration > 10 years (EEPROM)
EMV	DIN EN 61326 VDE 0843 part 20 /01.98 DIN EN 61326/A1 VDE 0843 part 20/A1 /05.99
Lightning protection	DIN EN 61000-4-5, installation class 2

Protection against against electrical shock	Protective separation of all extra-low-voltage circuits mains by double insulation as per EN 61010-1

Power supply	24 (-15%) ... 230 (+15%) V AC/DC; ca. 2 VA AC: 45 ... 65 Hz Overvolatage category II, Class II

Nominal operatings condition	Ambient temperature –20 ... +55 °C (–4…131 °F)
Transport/Storage temp	–20 ... +70 °C (–4…158 °F)
Relative humidity	10 ... 95 % not condensing
Power supply	24 (–15%) ... 230 (+15%) V AC/DC
Frequency for AC	45 ... 65 Hz

Enclosure	Molded enclosure made of PBT (polybutylene terephtalate)
Color	bluish gray RAL 7031
Assembly	Wall mounting Pipe mounting: dia 40 to 60 mm, dia 30 to 45 mm Panel mounting, cutout to DIN 43 700 Sealed against panel
Dimensions	H 144 mm, W 144 mm, D 105 mm
Ingress protection	IP 65 / NEMA 4X (USA/Canada: interioer use)
Cable glands	3 breakthroughs for cable glands M20x1.5 2 breakthroughs for NPT 1/2" 1 and 2 or Rigid Metallic Conduit
Weight	Approx. 1 kg

*) User-defined
1) To IEC 746 Part 1, at nominal operating conditions
2) ± 1 count
3)Plus sensor error

Buffer table

Mettler-Toledo technical buffers

°C	pH	pH
0	7.12	9.52
5	7.09	9.45
10	7.06	9.38
15	7.04	9.32
20	7.02	9.26
25	**7.00**	**9.21**
30	6.99	9.16
35	6.98	9.11
40	6.97	9.06
45	6.97	9.03
50	6.97	8.99
55	6.98	8.96
60	6.98	8.93
65	6.99	8.90
70	7.00	8.88
75	7.02	8.85
80	7.04	8.83
85	7.06	8.81
90	7.09	8.79
95	7.12	8.77

Product line and accessories

Devices	**Order No.**
CO_2 Transmitter 5100 e	**52 121 105**
Mounting accessories	
Pipe-mount kit	52 120 741
Panel-mount kit	52 120 740
Protective hood	52 120 739

Asymmetry potential — The voltage which a pH electrode provides at a pH of 7. The asymmetry potential is different for each electrode and changes with age and wear.

Buffer set — Contains selected buffer solutions which can be used for automatic calibration with the Knick Calimatic.

Buffer solution — Solution with an exactly defined pH value for calibrating a pH meter.

Calibration — Adjustment of the transmitter to the current electrode characteristics. The asymmetry potential and slope are adjusted. You can conduct either a one or a two-point calibration. With one-point calibration only the asymmetry potential (zero point) is adjusted.

Calimatic — Automatic buffer recognition. The patented Calimatic then automatically recognizes the buffer solutions used during calibration.

Combination electrode — Combination of glass and reference electrode in one body.

Electrode slope — Is indicated in % of the theoretical slope (59.2 mV/pH at 25 °C). The electrode slope is different for every electrode and changes with age and wear.

Electrode zero point — See asymmetry potential

GainCheck — Device self-test which runs automatically in the background at fixed intervals. The memory and measured-value transmission are checked. You can also start the GainCheck manually. Then a display test is also conducted and the software version displayed.

Mode code — Preset four-digit number to select certain modes.

One-point calibration Calibration with which only the asymmetry potential (zero point) is taken into account. The previous slope value is retained. Only one buffer solution is required for a one-point calibration.

pH electrode system A pH electrode system consists of a glass and a reference electrode. If they are combined in one body, they are referred to as combination electrode.

Response time Time from the start of a calibration step to the stabilization of the electrode potential.

Sensocheck Sensocheck continuously monitors the glass and reference electrodes. The resulting information is indicated by the Sensoface smileys. Sensocheck can be switched off.

Sensoface Provides information on the electrode condition. The zero point, slope, and response time are evaluated. In addition, the Sensocheck information is indicated.

Slope See Electrode slope

Two-point calibration Calibration with which the electrode asymmetry potential (zero point) and slope are determined. Two buffer solutions are required for two-point calibration.

Zero point See asymmetry potential

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