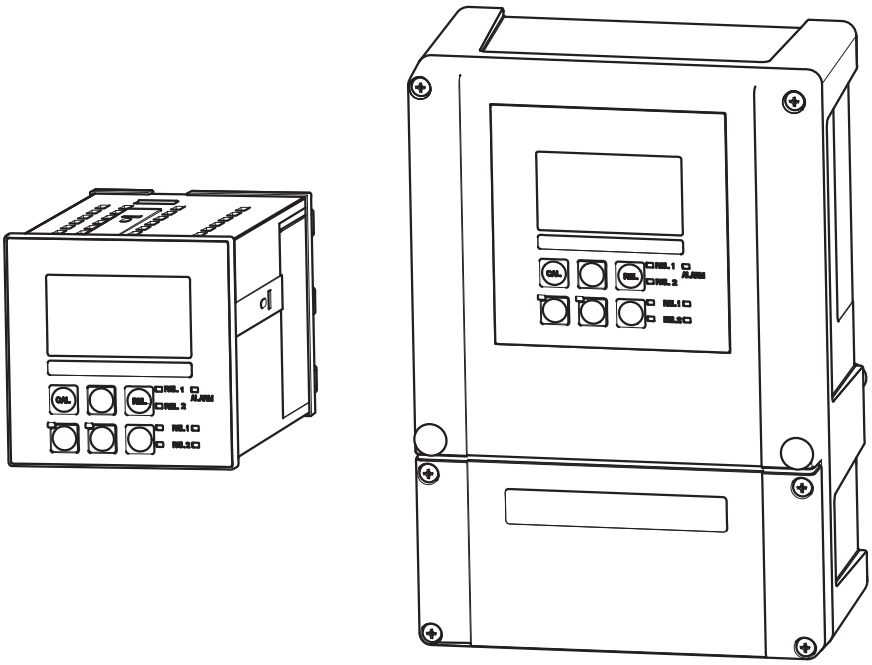
BA00246C/07/EN/14.13
71230976

valid as of:
software version 2.43

Operating Instructions
Liquisys M COM223F/253F
Transmitter for Dissolved Oxygen



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People for Process Automation

About this document

Safety messages

The structure, signal words and safety colors of the signs comply with the specifications of ANSI Z535.6 ("Product safety information in product manuals, instructions and other collateral materials").

Safety message structure	Meaning
⚠ DANGER **Cause (/consequences)** Consequences if safety message is not heeded ▶ Corrective action	This symbol alerts you to a dangerous situation. Failure to avoid the situation **will** result in a fatal or serious injury.
⚠ WARNING **Cause (/consequences)** Consequences if safety message is not heeded ▶ Corrective action	This symbol alerts you to a dangerous situation. Failure to avoid the situation **can** result in a fatal or serious injury.
⚠ CAUTION **Cause (/consequences)** Consequences if safety message is not heeded ▶ Corrective action	This symbol alerts you to a dangerous situation. Failure to avoid this situation can result in minor or medium injury.
NOTICE **Cause/situation** Consequences if safety message is not heeded ▶ Action/note	This symbol alerts you to situations that can result in damage to property and equipment.

Symbols

Additional information, tips

Permitted or recommended

Forbidden or not recommended

Table of contents

1 Basic safety instructions

1.1 Requirements for the personnel

- Installation, commissioning, operation and maintenance of the measuring system must only be carried out by trained technical personnel.
- The technical personnel must be authorized by the plant operator to carry out the specified activities.
- The electrical connection may only be performed by an electrical technician.
- The technical personnel must have read and understood these Operating Instructions and must follow the instructions they contain.
- Measuring point faults may only be rectified by authorized and specially trained personnel.

Repairs not described in the enclosed Operating Instructions may only be carried out directly at the manufacturer's or by the service organization.

1.2 Designated use

Liquisys M is a transmitter for determining the oxygen concentration of a liquid medium.

The transmitter is particularly suited for use in the following areas:
- Process control in enzyme production
- Control of culture preparation
- Biotechnological production

Any other use than the one described here compromises the safety of persons and the entire measuring system and is, therefore, not permitted.
The manufacturer is not liable for damage caused by improper or non-designated use.

1.3 Workplace safety

As the user, you are responsible for complying with the following safety conditions:
- Regulations for explosion protection
- Installation instructions
- Local standards and regulations

Electromagnetic compatibility
With regard to electromagnetic compatibility, this device has been tested in accordance with the applicable European standards for industrial applications.
The electromagnetic compatibility indicated only applies to a device that has been connected in accordance with the instructions in these Operating Instructions.

1.4 Operational safety

- Before commissioning the entire measuring point, make sure all the connections are correct. Ensure that electrical cables and hose connections are not damaged.
- Do not operate damaged products, and safeguard them to ensure that they are not operated inadvertently. Mark the damaged product as defective.
- If faults cannot be rectified, the products must be taken out of service and secured against unintentional commissioning.

1.5 Product safety

The product is designed to meet state-of-the-art safety requirements, has been tested and left the factory in a condition in which it is safe to operate. Relevant regulations and European standards have been observed.

1.6 Electrical symbols

Direct Current (DC)
A terminal at which DC is applied or through which DC flows.

Alternating Current (AC)
A terminal at which (sine-form) AC is applied or through which AC flows.

Ground connecting
A terminal which, from the user's point of view, is already grounded using a grounding system.

Protective ground terminal
A terminal which must be grounded before other connections may be set up.

Class II (isolated) device
Double insulation

Alarm relay

Input

Output

DC voltage source

Temperature sensor

2 Incoming acceptance and product identification

2.1 Incoming acceptance

- Make sure the packaging is undamaged!
- Inform the supplier about any damage to the packaging.
  Keep the damaged packaging until the matter has been settled.
- Make sure the contents are undamaged!
- Inform the supplier about damage to the contents. Keep the damaged products until the matter has been settled.
- Check that the order is complete and agrees with your shipping documents.
- The packaging material used to store or to transport the product must provide shock protection and humidity protection. The original packaging offers the best protection. Also, keep to the approved ambient conditions (see "Technical data").
- If you have any questions, please contact your supplier or your local sales center.

2.2 Scope of delivery

The delivery of the field instrument includes:
- 1 transmitter COM253F
- 1 plug-in screw terminal
- 1 cable gland Pg 7
- 1 cable gland Pg 16 reduced
- 2 cable glands Pg 13.5
- 1 Operating Instructions BA00246C/07/EN
- versions with HART communication:
  1 Operating Instructions Field Communication with HART, BA00208C/07/EN
- versions with PROFIBUS communication:
  1 Operating Instructions Field Communication with PROFIBUS PA/DP, BA00209C/07/EN

The delivery of the panel mounted instrument includes:
- 1 transmitter COM223F
- 1 set of plug-in screw terminals
- 2 tensioning screws
- 1 BNC-plug (solder-free)
- 1 Operating Instructions BA00246C/07/EN
- versions with HART communication:
  1 Operating Instructions Field Communication with HART, BA00208C/07/EN
- versions with PROFIBUS communication:
  1 Operating Instructions Field Communication with PROFIBUS PA/DP, BA00209C/07/EN

If you have any questions, please contact your supplier or your local sales center.

2.3 Product identification

2.3.1 Nameplate

The nameplate contains the following information:
- Manufacturer data
- Order code
- Extended order code
- Serial number
- Operating conditions
- Safety icons

Compare the order code on the nameplate with your order.

2.3.2 Identifying the product

The order code and serial number of your device can be found in the following locations:
- On the nameplate
- In the delivery papers

To find out the version of your device, enter the order code indicated on the nameplate in the search screen at the following address: www.products.endress.com/order-ident

2.4 Certificates and approvals

2.4.1 CE mark

Declaration of conformity
The product meets the requirements of the harmonized European standards. It thus complies with the legal requirements of the EC directives.
The manufacturer confirms successful testing of the product by affixing the CE symbol.

2.4.2 CSA general purpose

CSA General Purpose
The products listed below are eligible to bear the CSA Mark shown with adjacent indicators "C" and "US":

Version	Approval
COM253F-..2... COM253F-..3... COM253F-..7...	CSA Mark for Canada and USA
COM223F-..2... COM223F-..3... COM223F-..7...	CSA Mark for Canada and USA

3 Installation

3.1 Quick installation guide

Proceed as follows to completely install the measuring point:

- Install the transmitter (see "Installation instructions" section).
- If the sensor is not yet installed in the measuring point, install it (see Technical Information of the sensor).
- Connect the sensor to the transmitter as illustrated in the "Electrical connection" section.
- Connect the transmitter as illustrated in the "Electrical connection" section.
- Commission the transmitter as explained in the "Commissioning" section.

3.1.1 Measuring system

A complete measuring system comprises:

- The transmitter Liquisys M COM223F or COM253F in version HX or HS
- An oxygen sensor COS22 or COS21 with integrated NTC temperature sensor
- A measuring cable COK21
- An immersion, flow or retractable assembly e.g. CPA442 or CPA475

Options: extension cable CYK71, junction box VBM

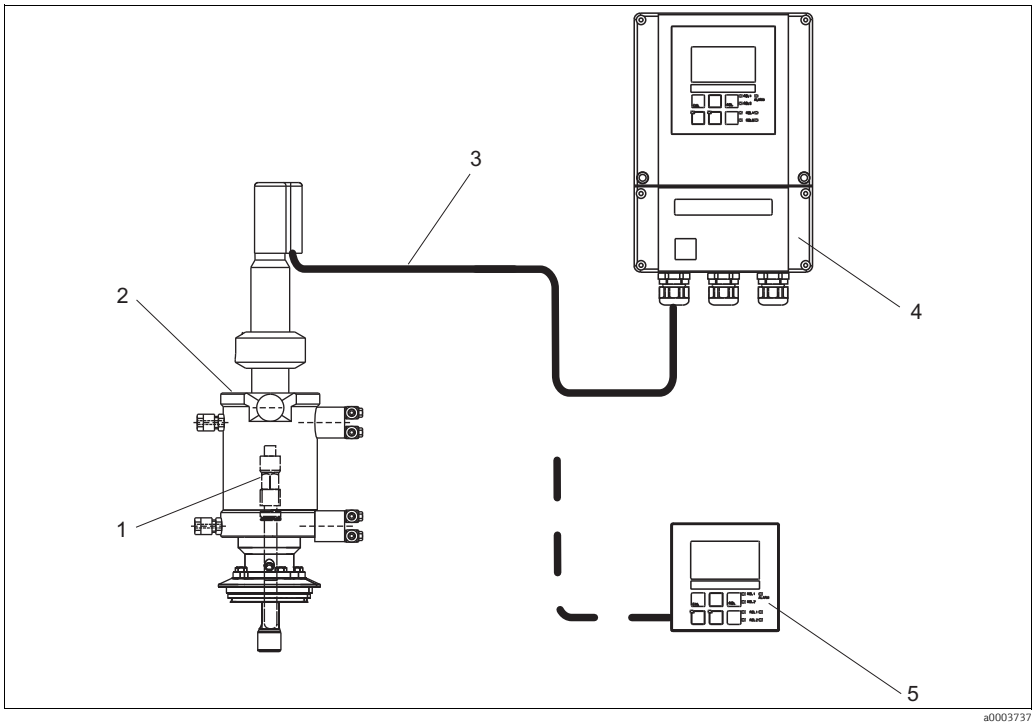


Fig. 1: Complete measuring system Liquisys M COM223F/253F

1 Oxygen sensor COS22
2 Retractable assembly CPA475
3 Measuring cable COK21
4 Liquisys M COM253F
5 Liquisys M COM223F

3.2 Installation conditions

3.2.1 Field instrument

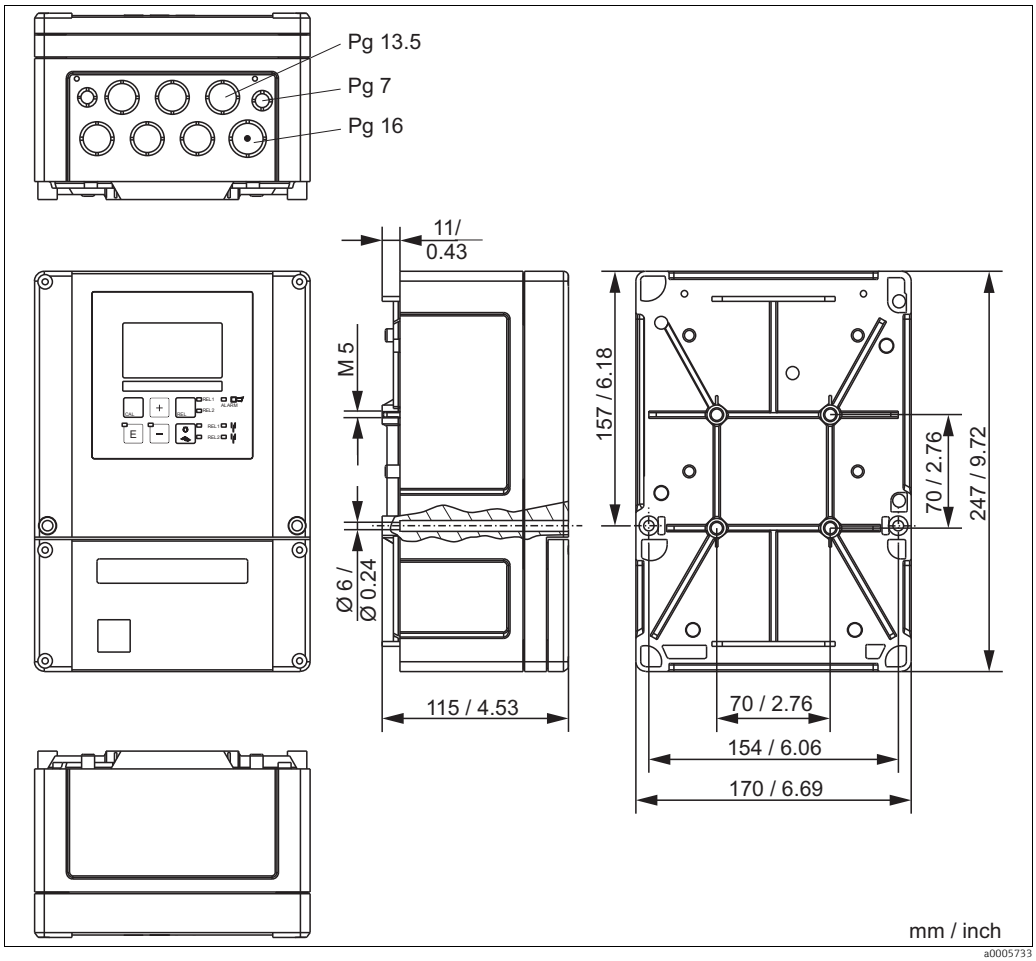


Fig. 2: Field instrument

There is a hole in the punching for the cable entry (connection of supply voltage). It serves as a pressure balance during air freight dispatching. Make sure no moisture penetrates the inside of the housing before the cable installation. The housing is completely air-tight after the cable installation.

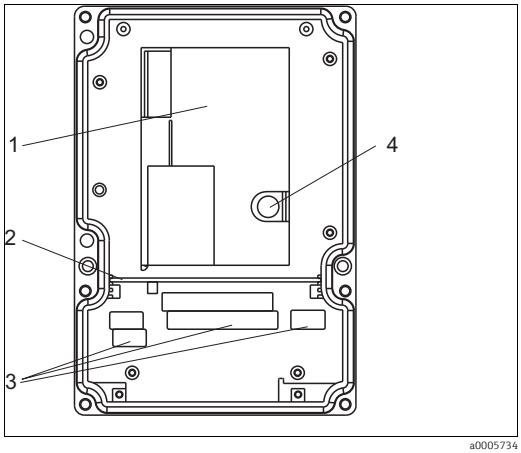


Fig. 3: View into the field housing

1 *Removable electronics box*
2 *Partition plate*
3 *Terminals*
4 *Fuse*

3.2.2 Panel-mounted instrument

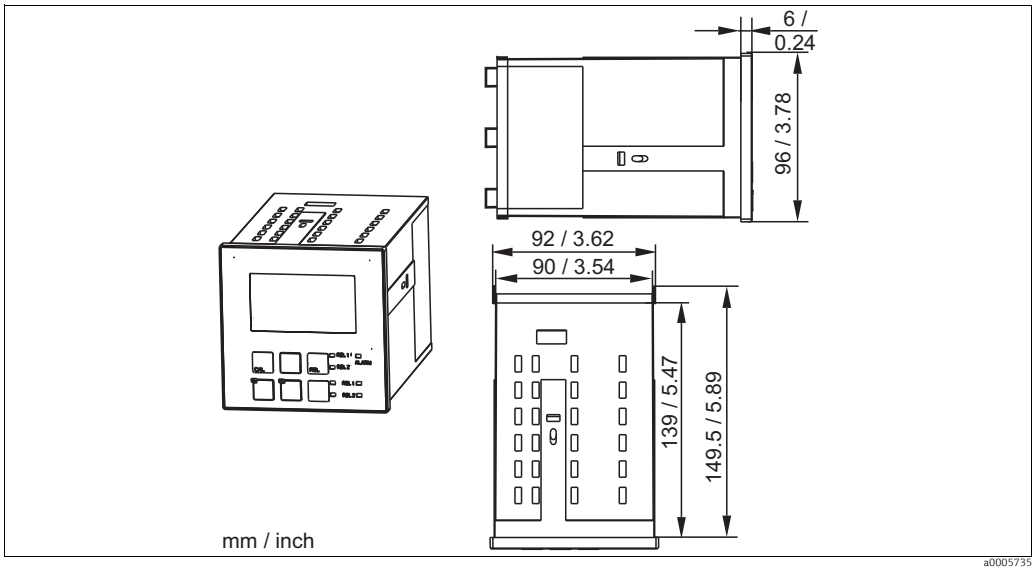


Fig. 4: Panel-mounted instrument

3.3 Installation instructions

3.3.1 Field instrument

There are several ways of securing the field housing:

- Wall mounting with fixing screws
- Post mounting to cylindrical pipes
- Post mounting to square securing masts

NOTICE

Effect of climate conditions (rain, snow, direct sun etc.)

Impaired operation to complete transmitter failure

▶ When installing outside, always use the weather protection cover (accessory).

Transmitter wall mounting

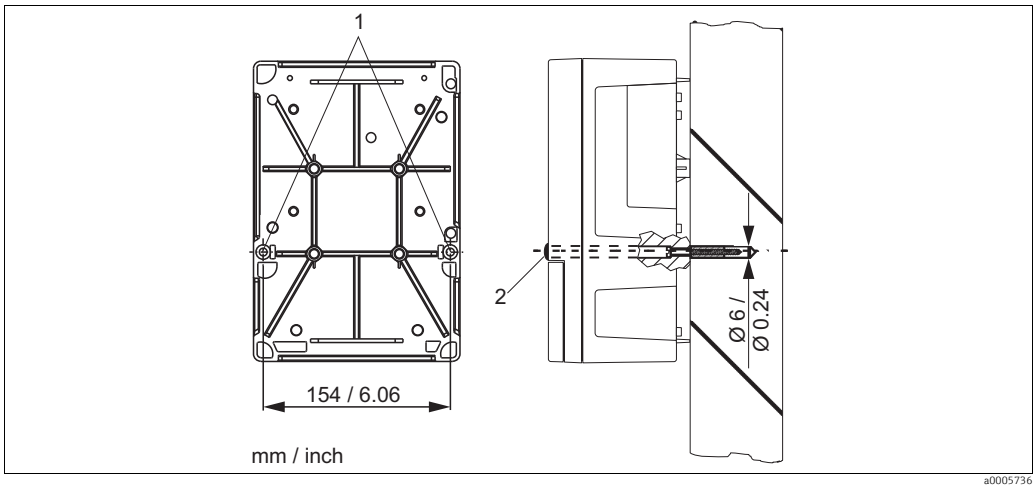


Fig. 5: Wall mounting field device

For wall mounting the transmitter, proceed as follows:

1. Drill the bores as shown in → 5.
2. Drive the two fixing screws through the securing bores (1) from the front.
3. Mount the transmitter on the wall as shown.
4. Cover the bores with plastic caps (2).

Transmitter post mounting

You require a post mounting kit to secure the field device to horizontal and vertical posts or pipes (max. Ø 60 mm (2.36")). The kit can be acquired as an accessory (see "Accessories" section).

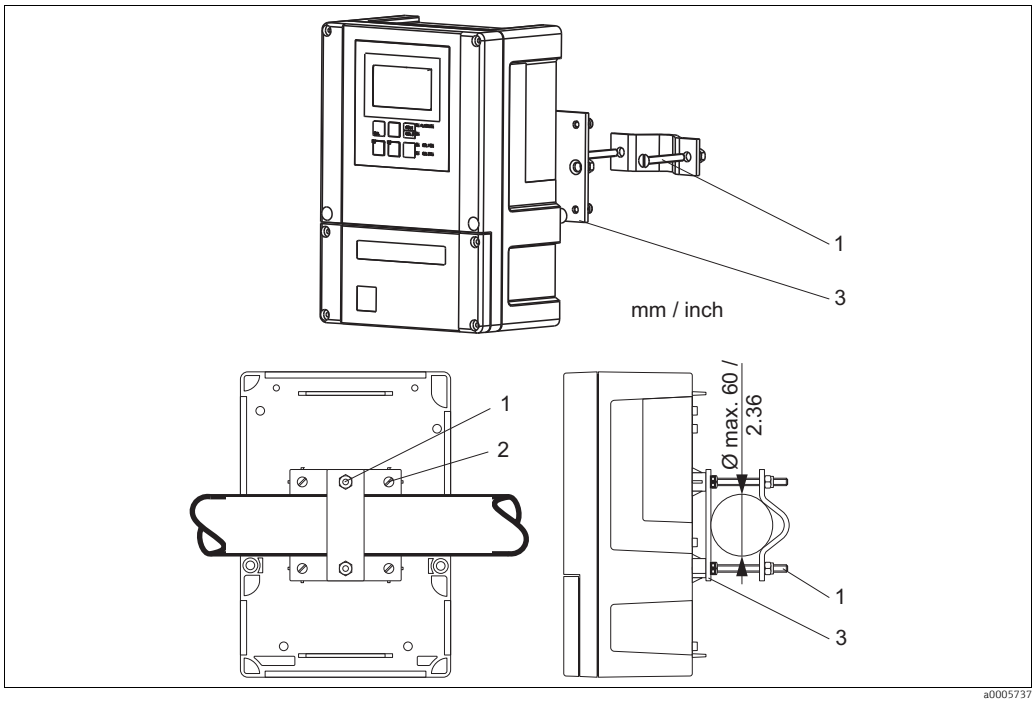


Fig. 6: Post mounting field device to cylindrical pipes

For post mounting the transmitter, proceed as follows:

1. Guide the two securing screws (1) of the mounting kit through the openings of the securing plate (3).
2. Screw the securing plate onto the transmitter using the four fixing screws (2).
3. Secure the retainer with the field device on the post or pipe using the clip.

You can also secure the field device to a square universal post in conjunction with the weather protection cover. These can be acquired as accessories, see "Accessories" section.

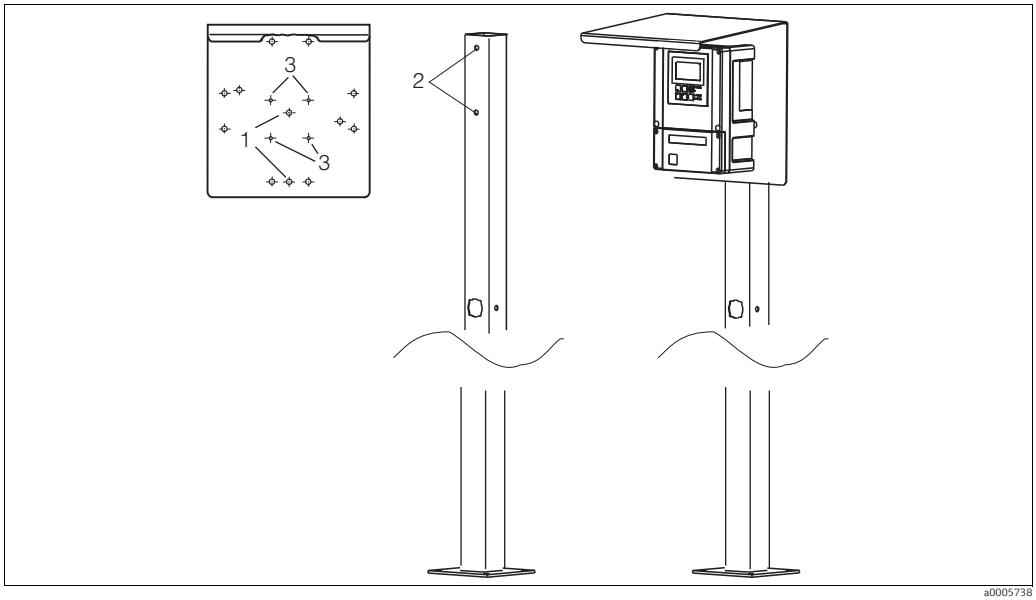


Fig. 7: Mounting field device with universal posts and weather protection cover

For mounting the weather protection cover, proceed as follows:

1. Screw the weather protection cover with 2 screws (bores 1) to the upright post (bores 2).
2. Secure the field device to the weather protection cover. To do so, use the bores (3).

3.3.2 Panel-mounted instrument

The panel-mounted instrument is secured with the clamping screws supplied (see → 8). The necessary installation depth is approx. 165 mm (6.50").

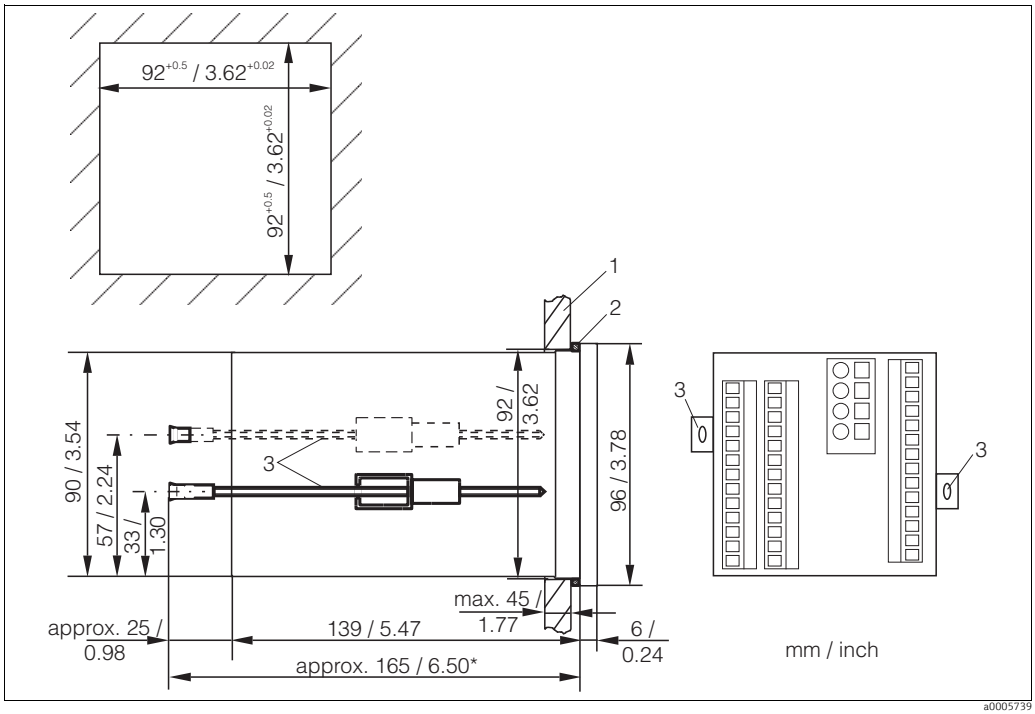


Fig. 8: Securing the panel-mounted instrument

1 Wall of the cabinet
2 Seal
3 Clamping screws
** Required installation depth*

3.4 Post-installation check

- After installation, check the transmitter for damage.
- Check whether the transmitter is protected against moisture and direct sunlight (e.g. by the weather protection cover).

4 Electrical Connection

⚠ WARNING

Device is energized

Improper connection can cause injury or death.

- The electrical connection must only be carried out by a certified electrician.
- Technical personnel must have read and understood the instructions in this manual and must adhere to them.
- **Prior to beginning** any wiring work, make sure voltage is not applied to any of the cables.

4.1 Wiring

NOTICE

The device does not have a power switch

- You must provide a protected circuit breaker in the vicinity of the device.
- This must be a switch or a power-circuit breaker and you must label it as the circuit breaker for the device.
- At the supply point, the power supply for the 24 V versions must be isolated from dangerous live cables by double or reinforced insulation.

4.1.1 Electrical connection

The wiring diagram depicted in → 9 shows the connections of the transmitter with all the options.

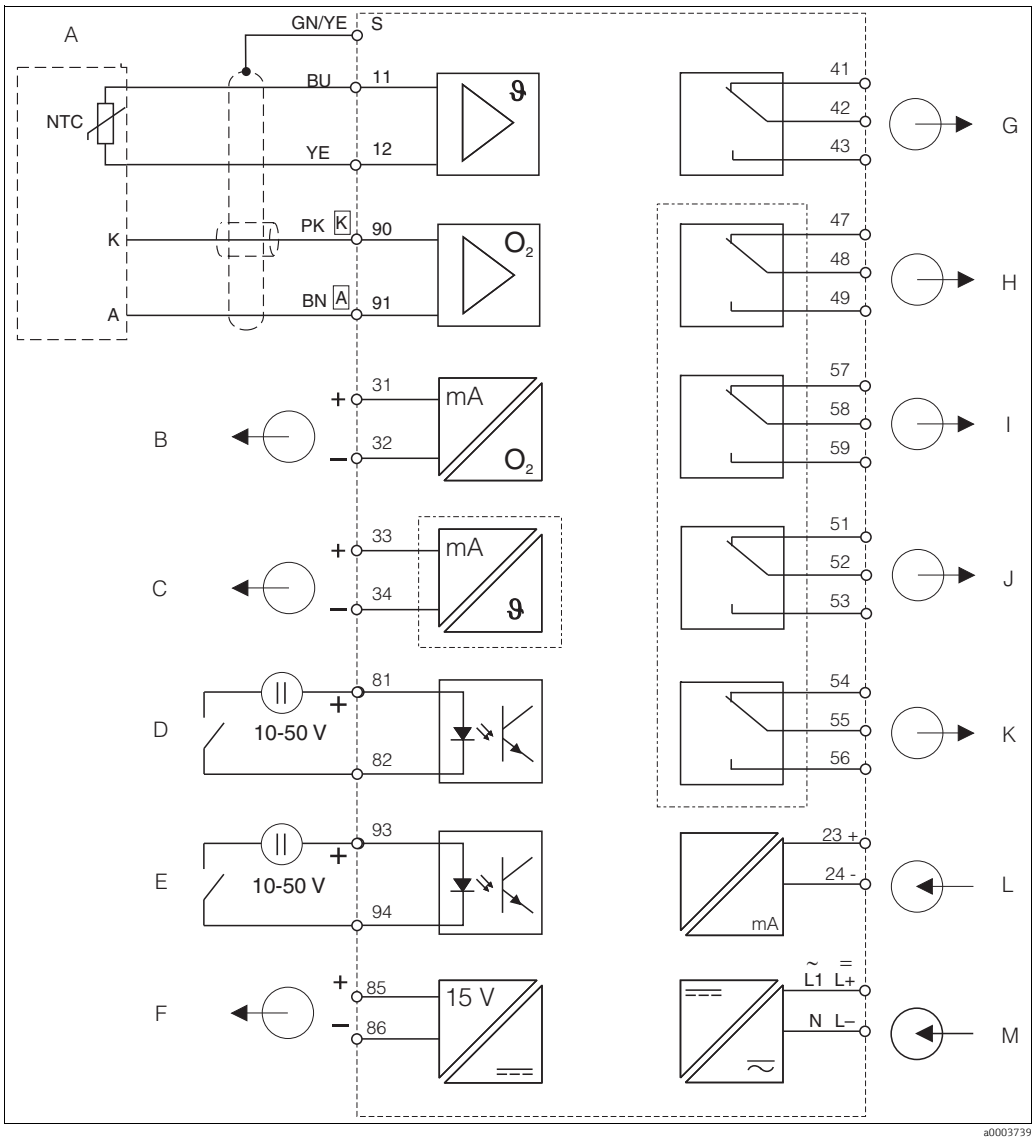


Fig. 9: Electrical connection of the transmitter

A	*Oxygen sensor COS21*	*G*	*Alarm (current-free contact position)*
B	*Signal output 1 oxygen*	*H*	*Relay 1 (current-free contact position)*
C	*Signal output 2 temperature/controller*	*I*	*Relay 2 (current-free contact position)*
D	*Binary input 1 (Hold)*	*J*	*Relay 3 (current-free contact position)*
E	*Binary input 2 (Chemoclean)*	*K*	*Relay 4 (current-free contact position)*
F	*Aux. voltage output*	*L*	*Current input 4 to 20 mA*
		M	*Power supply*

The device is approved for protection class II and is generally operated without a protective earth connection.
The circuits "C" and "F" are not galvanically isolated from each other.

Field instrument connection

To connect the field instrument proceed as follows:

1. Open the front cover to get access to the terminals.
2. Cut out the marked Pg gland hole of the housing. Mount a Pg gland and guide the measuring cable through the Pg gland into the housing.
3. Connect the measuring cable in accordance with the connection diagram.
4. Fix the Pg gland.

NOTICE

Nonobservance could cause incorrect measurement

- Always protect plugs, terminals and cables against humidity.
- Terminals marked NC may not be wired.
- Unmarked terminals may not be wired.

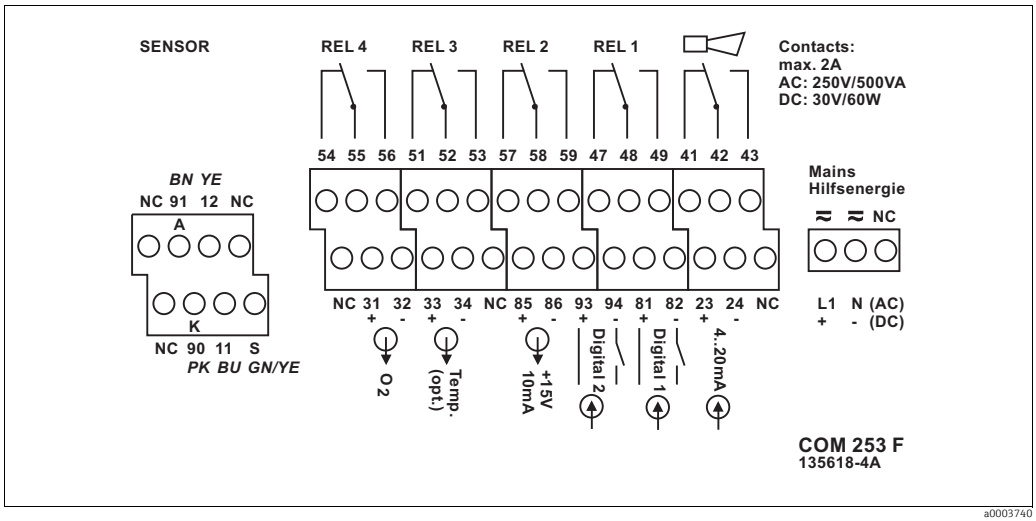


Fig. 10: Connection compartment sticker

Please label the sensor terminal block with the sticker provided.

Panel-mounted instrument connection
Connect the cables in accordance with the connection diagram.

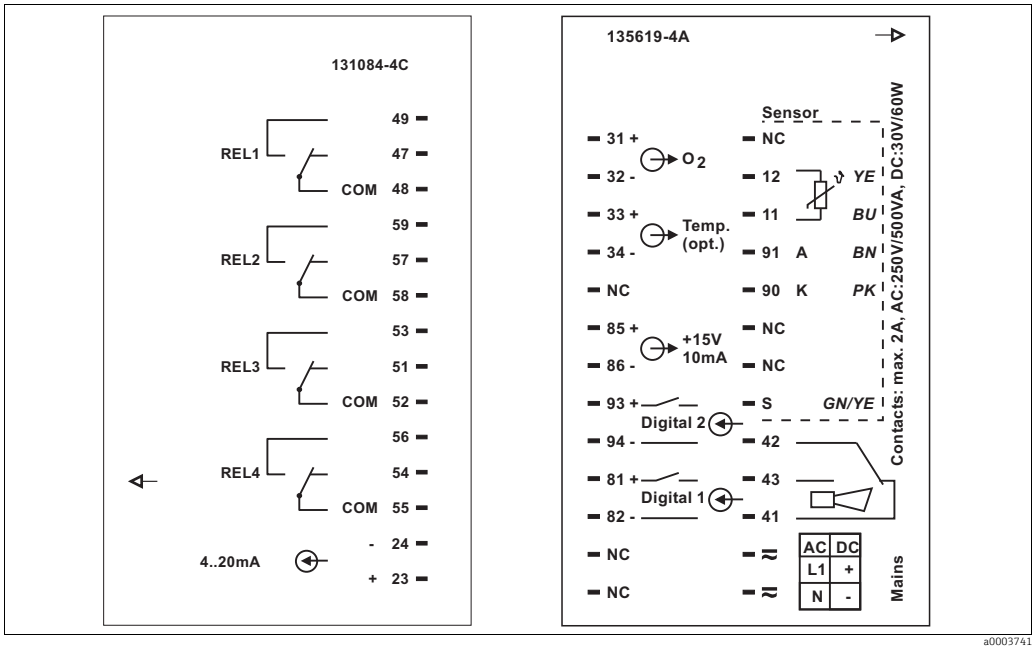


Fig. 11: Panel mounted instrument connection sticker

NOTICE
Nonobservance could cause incorrect measurement
- Always protect plugs, terminals and cables against humidity.
- Terminals marked NC may not be wired.
- Unmarked terminals may not be wired.

4.1.2 Measuring cable and sensor connection

You require screened special measuring cables to connect oxygen sensor COS21 to the transmitter. To extend the measuring cable, use junction box and extension cable:

Sensor	Sensor cablel	Extension
COS21	COK21	VBM junction box + CYK71 cable

Maximum cable length	
COS21	50 m (164 ft) with CYK71 cable

Structure of the measuring cable

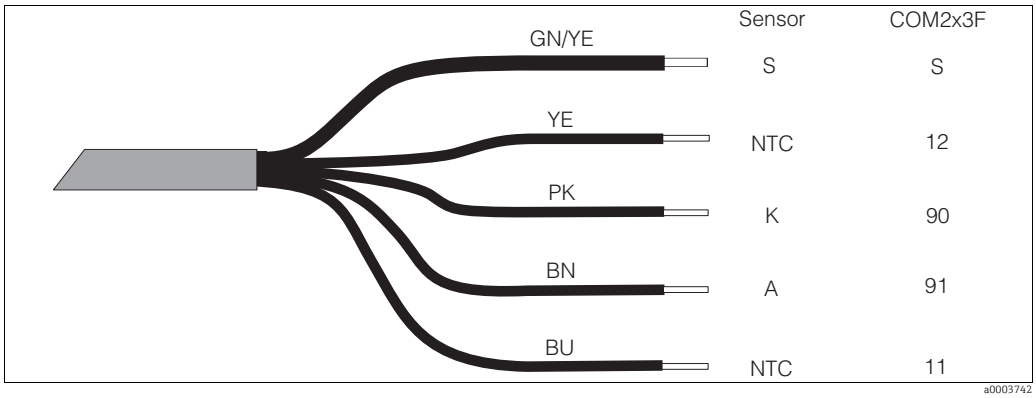


Fig. 12: Measuring cable COK21

For further information on cables and junction boxes refer to chapter "Accessories".

Example of connecting an oxygen sensor

Connection of the oxygen sensor COS21:

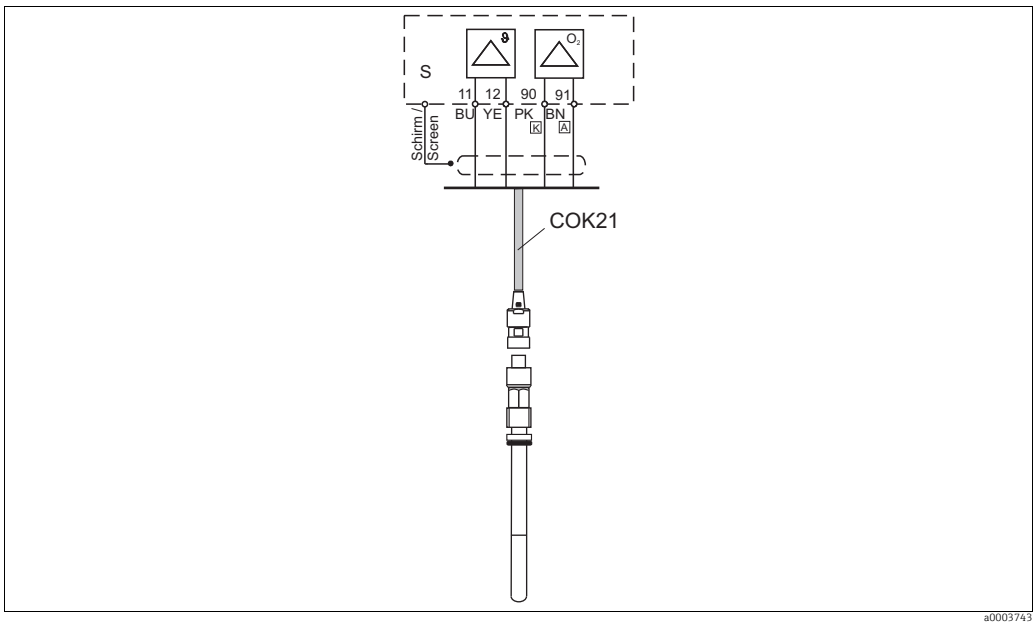


Fig. 13: Connection of COS21 with cable COK21

4.1.3 Alarm contact

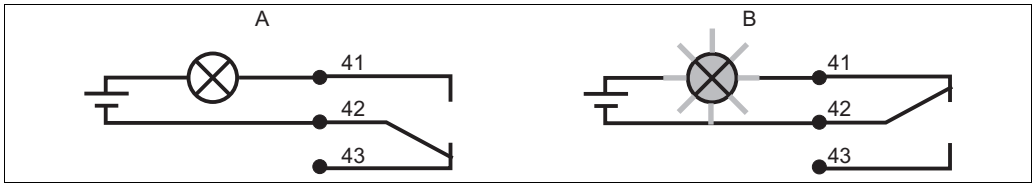


Fig. 14: Recommended fail-safe switching for the alarm contact
A Normal operating status *B Alarm condition*

Normal operating status:
Device in operation and no error message present (alarm LED off)

- Relay energized
- Contact 42/43 closed

Alarm condition
Error message present (alarm LED red) or device defective or voltage-free (alarm LED off)

- Relay de-energized
- Contact 41/42 closed

4.2 Post-connection check

After wiring up the electrical connection, carry out the following checks:

Device status and specifications	Remarks
Are the transmitter or the cable externally damaged?	Visual inspection
Do line voltage and power rate on the name plate match?	

Electrical connection	Remarks
Are the installed cables strain-relieved?	Bracket joint for cable ties at the rear plate
No loops and cross-overs in the cable run?	
Are all cables correctly connected acc. to the wiring diagram?	
Are all screw terminals tightened?	
Are all cable entries installed, tightened and sealed?	Field instrument only

5 Operability

5.1 Quick operation guide

You have the following ways of operating the transmitter:
- On site via the key field
- Via the HART interface (optional, with corresponding order version) per:
  – HART handheld terminal or
  – PC with HART modem and the FieldCare software package
- Via PROFIBUS PA/DP (optional, with corresponding order version) with:
  PC with corresponding interface and the FieldCare software package (see Accessories) or via a programmable logic controller (PLC)

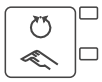
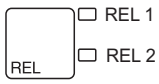
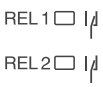
For operation via HART or PROFIBUS PA/DP, please read the relevant sections in the additional Operating Instructions:
- PROFIBUS PA/DP, field communication for Liquisys M CXM223/253, BA00209C/07/EN
- HART, field communication for Liquisys M CXM223/253, BA00208C/07/EN

The following section only explains operation via the keys.

5.2 Display and operating elements

5.2.1 Display

LED display

	Indicates the current operating mode, "Auto" (green LED) or "Manual" (yellow LED)
	Indicates the activated relay in the "Manual" mode (red LED)
	Indicates the working status of relay 1 and 2 LED green: measured value within the permitted limit, relay inactive LED red: measured value outside the permitted limit, relay active
	Alarm display, e.g. for continuous limit value overshoot, temperature sensor failure or system error (see error list)

LC display

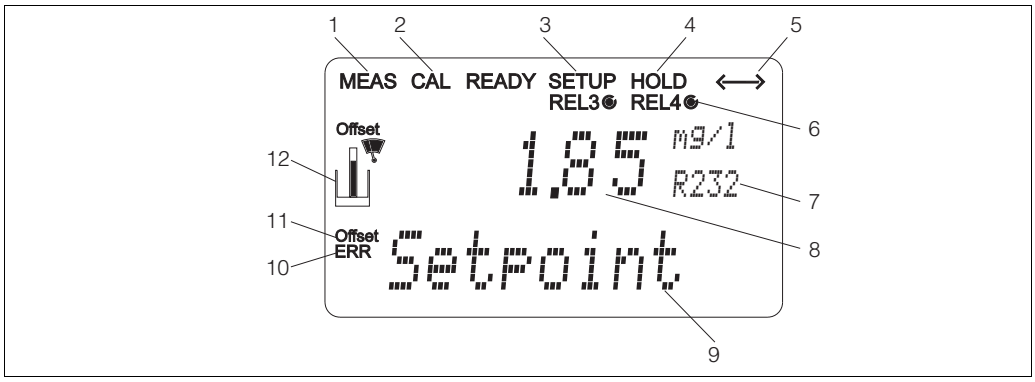


Fig. 15: LC display of transmitter

1 *Indicator for measuring mode (normal operation)*
2 *Indicator for calibration mode*
3 *Indicator for setup mode (configuration)*
4 *Indicator for "Hold" mode (current outputs remain at last current state)*
5 *Indicator for receipt of a message for devices with communication*
6 *Indicator of working status of relays 3/4: ○ inactive, ◉ active*
7 *Function code display*
8 *In measuring mode: measured variable*
In setup mode: configured variable
9 *In measuring mode: secondary measured value*
In setup/calibr. mode: e.g. setting value
10 *"Error": error display*
11 *Temperature offset*
12 *Sensor symbol*

5.2.2 Operating elements

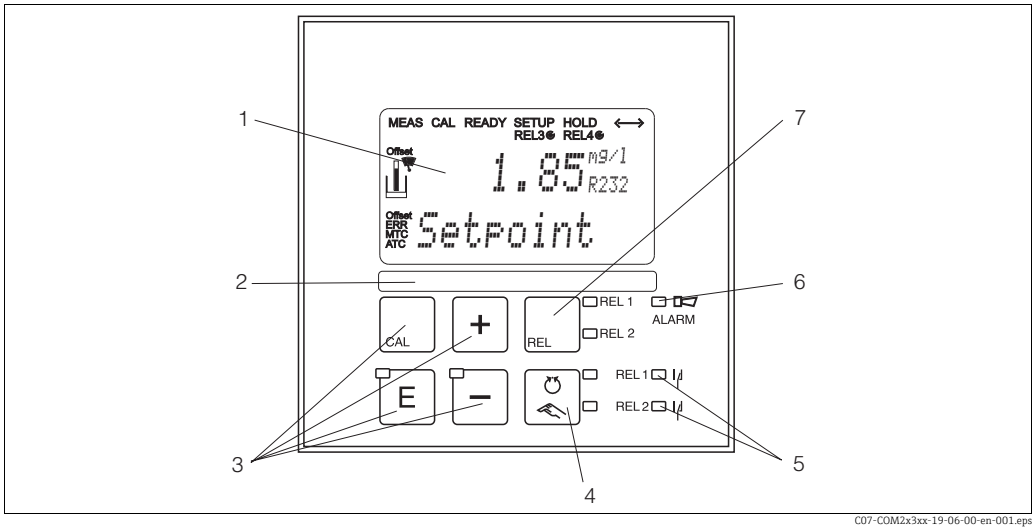
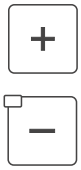
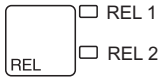
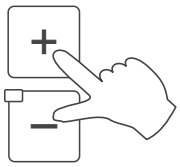
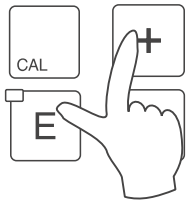
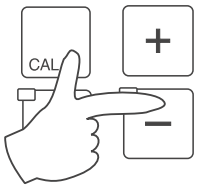


Fig. 16: Operating elements

1 *LC display for displaying the measured values and configuration data*
2 *Field for user labelling*
3 *4 main operating keys for calibration and device configuration*
4 *Changeover switch for automatic/manual mode of the relays*
5 *LEDs for limit contactor relay (switch status)*
6 *LED for alarm function*
7 *Display of the active contact and key for relay changeover in manual mode*

5.2.3 Key assignment

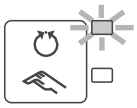
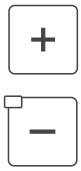
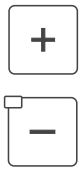
	**CAL key** When you press the CAL key, the device first prompts you for the calibration access code: ▪ Code 22 for calibration ▪ Code 0 or any other code for reading the last calibration data Use the CAL key to accept the calibration data or to switch from field to field within the calibration menu.
	**ENTER key** When you press the ENTER key, the device first prompts you for the setup mode access code: ▪ Code 22 for setup and configuration ▪ Code 0 or any other code for reading all configuration data. The ENTER key has several functions: ▪ Calls up the Setup menu from the measuring mode. ▪ Saves (confirms) data entered in the setup mode. ▪ Moves on within function groups.
	**PLUS key and MINUS key** In the setup mode, the PLUS and MINUS keys have the following functions: ▪ Selection of function groups. Press the MINUS key to select the function groups in the order given in the "System configuration" section. ▪ Configuration of parameters and numerical values ▪ Operation of the relay in manual mode In the measuring mode, you get the following sequence of functions by **repeatedly pressing the PLUS key**: 1. Temperature display in °F 2. Temperature display hidden 3. Measured value display in mg/l 4. Measured value display in %SAT 5. Measured value display in hPa 6. Sensor current in nA 7. Current input signal in % 8. Current input signal in mA 9. Return to standard measurement display In the measuring mode, the following is displayed in sequence by **repeatedly pressing the MINUS key:** 1. Current errors are displayed in rotation (max. 10). 2. Once all the errors have been displayed, the standard measurement display appears. In the function group F, an alarm can be defined separately for each error code.

	**REL key** In the manual mode, you can use the REL key to switch between the relay and the manual start of cleaning. In the automatic mode, you can use the REL key to read out the switch-on points (for limit contactor) or set points (for PID controller) assigned to the relay in question. Press the PLUS key to jump to the settings of the next relay. Use the REL key to get back to the standard measurement display (automatic return after 30 s).
	**AUTO key** You can use the AUTO key to switch between automatic mode and manual mode.
	**Escape function** If you press the PLUS and MINUS key simultaneously, you return to the main menu or are taken to the end of calibration if calibrating. If you press the PLUS and MINUS key again, you return to the measuring mode.
	**Locking the keyboard** Press the PLUS and ENTER key for at least 3 s to lock the keyboard against any unauthorized data entry. All the settings can continue to be read. The code prompt displays the code 9999.
	**Unlocking the keyboard** Press the CAL and MINUS key for at least 3 s to unlock the keyboard. The code prompt displays the code 0.

5.3 Local Operation

5.3.1 Automatic/manual mode

The transmitter normally operates in automatic mode. Here, the relays are triggered by the transmitter. In the manual mode, you can trigger the relays using the REL key or start the cleaning function.
How to change the operating mode:

	1. The transmitter is in **Automatic mode**. The top LED beside the AUTO key is lit.
	2. Press the AUTO key.
	3. To enable the manual mode, enter the code **22** via the PLUS and MINUS keys. The bottom LED beside the AUTO key lights up.
	4. Select the relay or the function. You can use the REL key to switch between the relays. The relay selected and the switch status (ON/OFF) is displayed on the second line of the display. In the manual mode, the measured value is displayed continuously (e.g. for measured value monitoring for dosing functions).
	5. Switch the relay. It is switched on with PLUS and switched off with MINUS. The relay remains in its switched state until it is switched over again.
	6. Press the AUTO key to return to the measuring mode, i.e. to the automatic mode. All the relays are triggered again by the transmitter.

Pay attention to the following:
- The selected operating mode remains in effect even after a power failure.
- The manual mode has priority over all automatic functions (Hold).
- Hardware locking is not possible in the manual mode.
- The manual settings are kept until they are actively reset.
- Error code E102 is signalled in the manual mode.

5.3.2 Operating concept

Operating modes

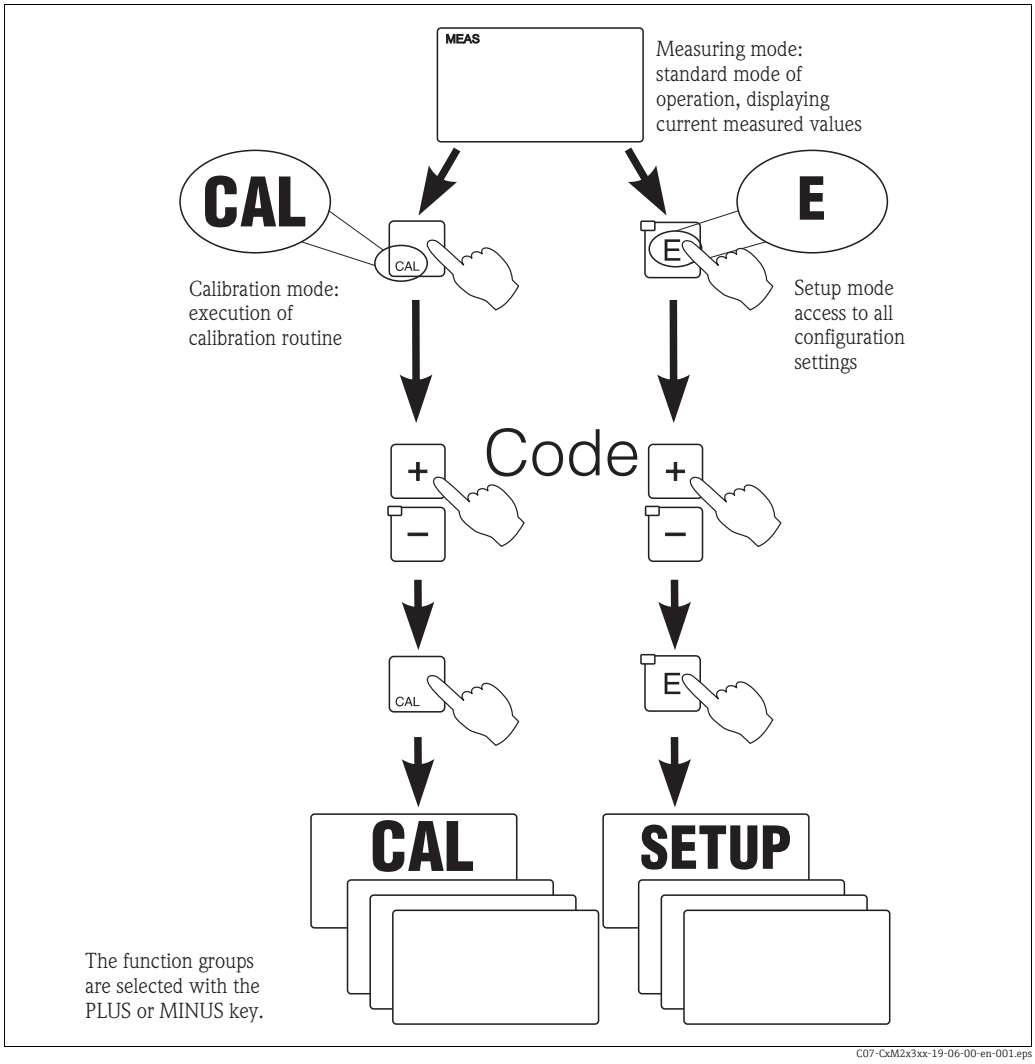


Fig. 17: Description of the possible operating modes

If no key is pressed in the setup mode for approx. 15 min, the device automatically returns to the measuring mode. Any active Hold (Hold during setup) is reset.

Access codes

All device access codes are fixed and cannot be altered. When the device requests the access code, it distinguishes between different codes.

- **Key CAL + Code 22:** access to Calibration and Offset menu
- **Key ENTER + Code 22:** access to the setup menus
- **Keys PLUS + ENTER:** locks the keyboard
- **Keys CAL + MINUS:** unlocks the keyboard
- **Key CAL or ENTER + any code:** access to read mode, i.e. all the settings can be read but not modified.
  The device continues measuring in the read mode. It does not shift to the Hold status. The current output and the controllers remain active.

Menu structure

The configuration and calibration functions are arranged in function groups.

- In setup mode, select a function group with the PLUS and MINUS keys.
- In the function group itself, switch from function to function with the ENTER key.
- Within the function, select the desired option with the PLUS and MINUS keys or edit the settings with these keys. Then confirm with the ENTER key and continue.
- Press the PLUS and MINUS keys simultaneously (Escape function) to exit programming (return to the main menu).
- Press the PLUS and MINUS simultaneously keys again to switch to the measuring mode.

If a modified setting is not confirmed with ENTER, the old setting is retained.
An overview of the menu structure is provided in the Appendix to these Operating Instructions.

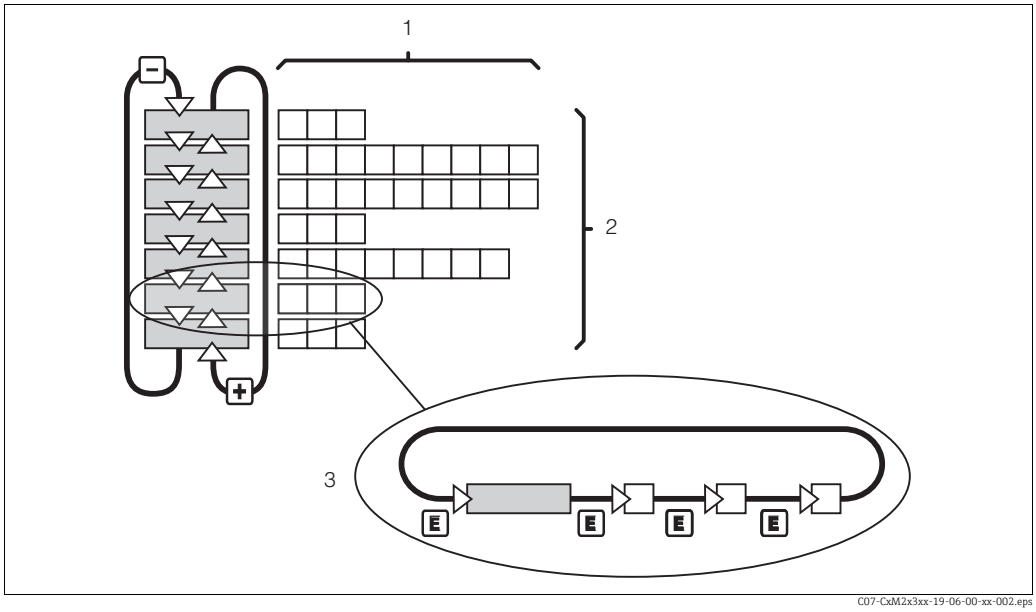


Fig. 18: Diagram of the menu structure

1 Functions (parameters selected, numbers entered)
2 Function groups, scroll backwards and forwards with the PLUS and MINUS keys
3 Switch from function to function with the ENTER key

Hold function: "freezing" of the outputs

During setup and calibration, the current output can be "frozen". It constantly retains its current status. "HOLD" appears on the display. If the controller actuating variable (steady control 4 to 20 mA) is output via current output 2, it is set to 0/4 mA in Hold.

Pay attention to the following:
- Hold settings can be found in the "Service" section.
- During Hold, all contacts will go to their normal positions.
- An active Hold has priority over all other functions.
- With every Hold, the I-component of the controller is set to zero.
- Any alarm delay is reset to "0".
- This function can also be activated externally via the Hold input (see Wiring diagram; binary input 1).
- The manual Hold (field S3) remains active even after a power failure.

6 Commissioning

6.1 Function check

⚠ WARNING

Incorrect connection, incorrect supply voltage

Safety risks for staff and incorrect operation of the device

- ▶ Check that all connections have been established correctly in accordance with the wiring diagram.
- ▶ Make sure that the supply voltage matches the voltage indicated on the nameplate.

6.2 Switching on

Familiarize yourself with the operation of the transmitter before it is first switched on. Please refer in particular to the "Safety instructions" and "Operation" sections.
After power-up, the device performs a self-test and then goes to the measuring mode.
Now calibrate the sensor in accordance with the instructions in the "Calibration" section.

During commissioning, the sensor must be calibrated so that the measuring system can return precise measurement data.

Then perform the first configuration in accordance with the instructions in the "Quick start-up" section. The values set by the user are kept even in the event of a power failure.
The following function groups are available in the transmitter (the groups only available in the Plus Package are marked accordingly in the functional description):

Setup mode

- SETUP 1 (A)
- SETUP 2 (B)
- CURRENT INPUT (Z)
- CURRENT OUTPUT (O)
- ALARM (F)
- CHECK (P)
- RELAY (R)
- SERVICE (S)
- E+H SERVICE (E)
- INTERFACE (I)

Calibration and offset mode

- CALIBRATION (C)

A detailed explanation of the function groups available in the transmitter can be found in the "System configuration" section.

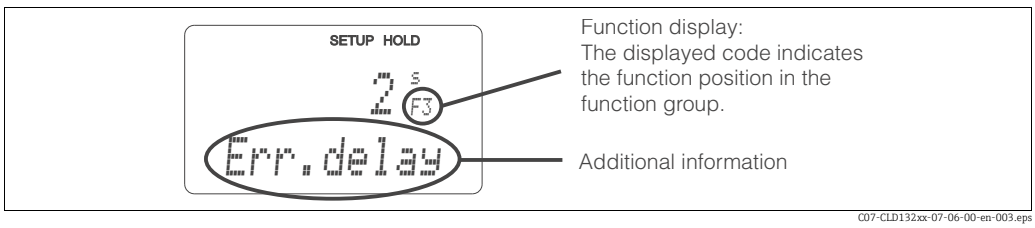


Fig. 19: Example for display in setup mode

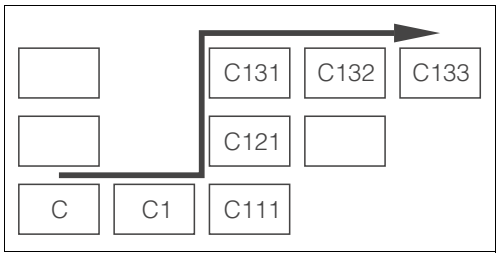


Fig. 20: Function coding

Selecting and locating functions is facilitated by a code displayed for each function in a special display field → 19.
The structure of this coding is given in → 20.
The first column indicates the function group as a letter (see group designations).
The functions in the individual groups are counted from the top to the bottom and from the left to the right.

Factory settings

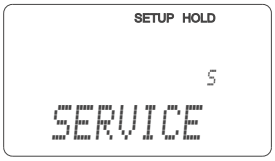
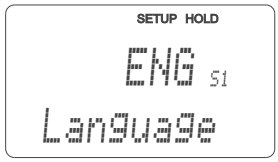
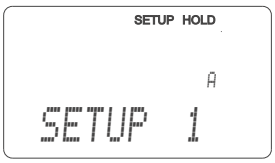
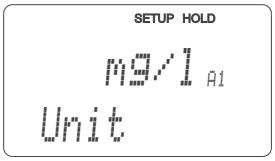
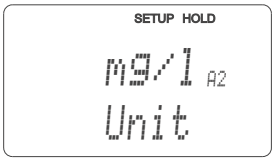
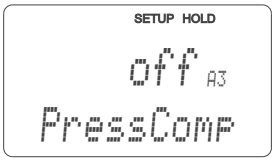
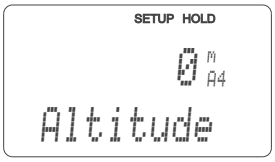
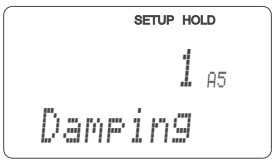
The first time it is switched on, the device has the factory setting for all functions. The table below provides an overview of the most important settings.
All other factory settings can be found in the description of the individual function groups in the "System configuration" section (the factory setting is highlighted in **bold**).

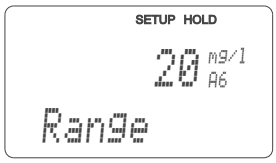
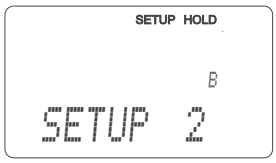
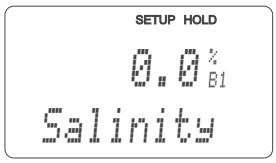
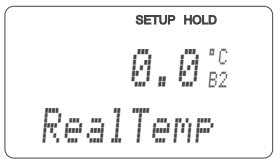
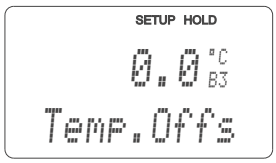
Function	Factory setting
Type of measurement	Oxygen concentration Temperature in °C
Altitude	0 m above sea level
Salinity	0.0 % salt concentration
Temperature offset	0.0 °C
Limit 1	20.00 mg/l
Contact function of limit contactor 1	Max contact without delay (switches when limit 1 is exceeded) contact not active
Limit 2	20.00 mg/l
Contact function of limit contactor 1	Max contact without delay (switches when limit 2 is exceeded) contact not active
Current outputs 1* and 2*	4 to 20 mA
Current output 1: measured value for 4 mA signal current*	0.00 mg/l
Current output 1: measured value for 20 mA signal current*	10.00 mg/l
Current output 2: temperature value for 4 mA signal current*	-10.0 °C (14 °F)
Current output 2: temperature value for 20 mA signal current*	60.0 °C (140 °F)
Language	English

* For corresponding version

6.3 Quick start-up

After power-up, you must make some settings to configure the most important functions of the transmitter which are required for correct measurement. The following section gives an example of this.

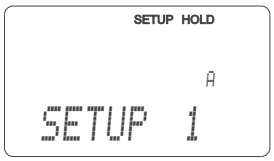
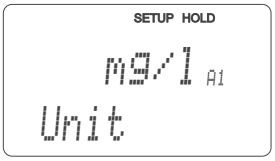
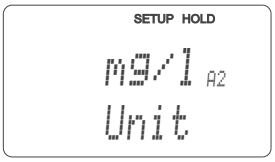
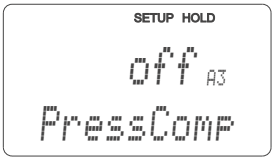
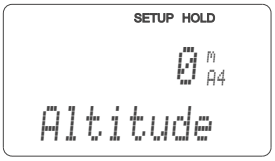
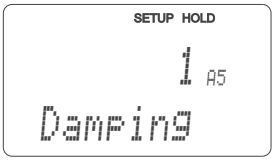
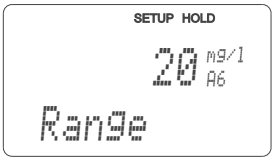
User input	Setting range (Factory settings, bold)	Display
1. Press the [E] key. 2. Enter the code 22 to edit the setup. Press [E].		
3. Press [−] until you get to the "Service" function group. 4. Press [E] to be able to make your settings.		
5. In S1, select your language, e.g. "ENG" for English. Press [E] to confirm.	**ENG = English** GER = German FRA = French ITA = Italian NEL = Dutch ESP = Spanish	
6. Press PLUS and MINUS key simultaneously to exit the "Service" function group.		
7. Press [−] until you get to the "Setup 1" function group. 8. Press [E] to be able to make your settings for "Setup 1".		
9. In A1, select the desired mode of operation, e.g. "mg/l" = oxygen concentration. Press [E] to confirm.	**mg/l** %SAT hPA	
10. In A2, select display unit and press [E] to confirm.	**mg/l** ppm ppb	
11. In A3, switch automatic pressure compensation on or off (version HS). Compensation takes account of both the altitude-dependent and the weather-dependent proportion of the air pressure. Press [E] to confirm.	**off** on	
12. In A4, enter altitude if automatic pressure compensation is not available (version HX) or switched off. Press [E] to confirm.	**0 m** 0 to 4000 m	
13. In A5, enter measured value damping. Measured value damping causes averaging over the specified number of individual measured values. This is used for example, to stabilize the display if the measurement is unstable. Enter "1" if no damping is required. Press [E] to confirm.	**1** 1 to 60	

User input	Setting range (Factory settings, bold)	Display
14. In A6, enter the oxygen measuring range: Press [E] to confirm. Display returns to "Setup 1".	**20 mg/l** 60 mg/l **200 %SAT** 600 %SAT **400 hPa** 1200 hPa	
15. Press [−] to go to the "Setup 2" function group. 16. Press [E] to edit "Setup 2".		
17. In B1, select the salinity of the medium. Press [E] to confirm.	**0.0 %** 0.0 to 4.0 %	
18. In B2, enter the the correct process temperature. Press [E] to confirm.	**current meas. value** -10 to 60 °C	
19. The difference between measured and entered temperature will be displayed. Press [E] . The display returns to "Setup 2".	**current meas. value** -5.0 to 5.0 °C	
20. Press PLUS and MINUS key simultaneously to switch to the measuring mode.		

6.4 System configuration

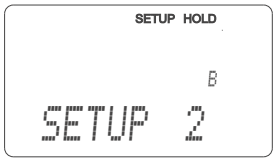
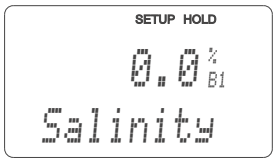
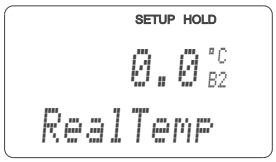
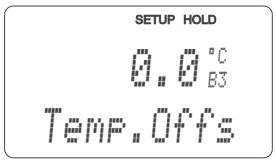
6.4.1 Setup 1 (Oxygen)

In the SETUP 1 function group, you can change the operating mode and the sensor settings.

Coding		Field	Selection or range (factory settings bold)	Display	Info
A		**Function group SETUP 1**			Basic settings.
	A1	Select operating mode	**mg/l** %SAT		mg/l = oxygen concentration %SAT = oxygen saturation index Any change in operating mode causes an automatic reset of user settings. If the oxygen value only needs **to be read** switch display using the PLUS key.
	A2	Select display unit	**mg/l** ppm ppb		
	A3	Switch automatic pressure compensation on or off	**off** on		Field only available with HS version. The **absolute** air pressure is measured. Compensation takes account of both the altitude-dependent and the weather-dependent proportion of the air pressure.
	A4	Enter altitude	**0 m** 0 to 4000m		Only available if the pressure compensation in A2 is switched off or not available.
	A5	Enter measured value damping	**1** 1 to 60		Measured value damping causes averaging over the specified number of individual measured values. It is used, for example, to stabilize the display with applications that fluctuate a great deal. There is no damping if "1" is entered.
	A6	Enter oxygen measuring range	**20 mg/l, 20 ppm, 20000 ppb** (depends on selected display unit) **200 % SAT** **400 hPa**		

6.4.2 Setup 2 (Salinity and temperature)

In the SETUP 2 function group, you can change the salinity and the temperature settings.

Coding		Field	Selection of range (factory settings bold)	Display	Info
B		**Function group SETUP 2**			Setups for salinity and temperature.
	B1	Enter salinity	**0.0 %** 0.0 to 4.0 %		Input of salinity.
	B2	Enter correct process temperature	**current meas. value** -10.0 to 60.0 °C		The display value can be edited. You can make an adjustment of max. ±5 °C. Due to the high accuracy, adjustment is not usually necessary.
	B3	Displays temperature difference (offset)	**Current offset** -5.0 to 5.0 °C		The offset is the difference between measured and entered temperature.

6.4.3 Current input

To use the "Current input" function group, you need a relay board with current input which is not part of the basic version. With this function group you can monitor process parameters and use these for feedforward control. For this purpose, you must connect the current output of an external measured variable (e.g. flowmeter) to the 4 to 20 mA input of the transmitter. The following assignment applies:

Flow in main stream	Current signal in mA	Current input signal in %
Flowmeter start of measuring range	4	0
Flowmeter end of measuring range	20	100

Monitoring of flow in main stream
This arrangement is particularly practical if the sample flow through a flow assembly in an open outlet is completely independent of the flow in the main stream.
This permits signalling of an alarm condition in the main stream (flow too low or has completely stopped) and triggers dosing switch-off even if the medium flow is retained due to the method of installation.

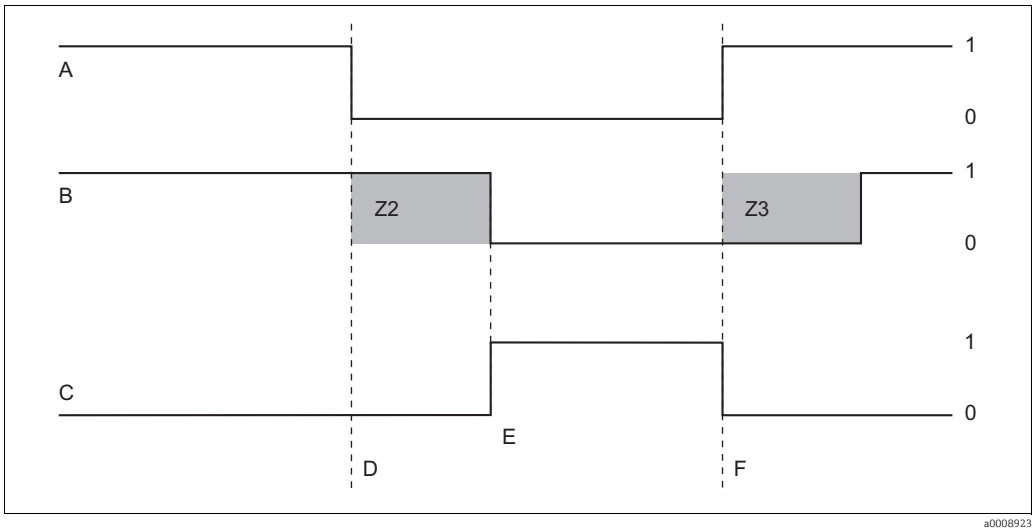


Fig. 21: Alarm signalling and dosing switch-off by the main stream

A Flow in main stream
B Relay contacts of PID controller
C Alarm relay
D Flow below switch-off limit Z4 or flow failure
E Flow alarm
F Flow restoration
Z2 Delay for controller switch-off, see field Z2
Z3 Delay for controller switch-on, see field Z3
0 Off
1 On

Feedforward control to PID controller

For control systems with very short reaction times, you can optimize the control. You measure the flow rate of the medium in addition to the oxygen concentration. This flow rate value (0/4 to 20 mA) you apply as feedforward control to the PID controller.

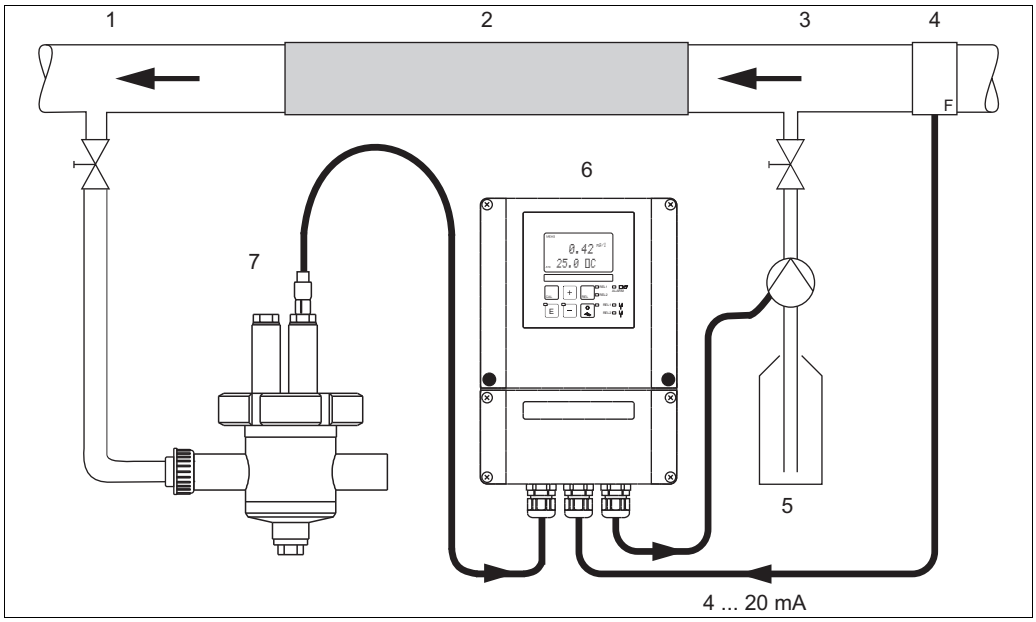


Fig. 22: Arrangement example for feed forward control of the flow rate in the main stream to the PID controller

1 *Measuring water extraction point*
2 *Static mixer*
3 *Injection points*
4 *Flowmeter*
5 *Injection medium*
6 *Liquisys M COM253F*
7 *CPA240 with COS21*

Feedforward control is a multiplying function as illustrated in the figure below (example with factory setting):

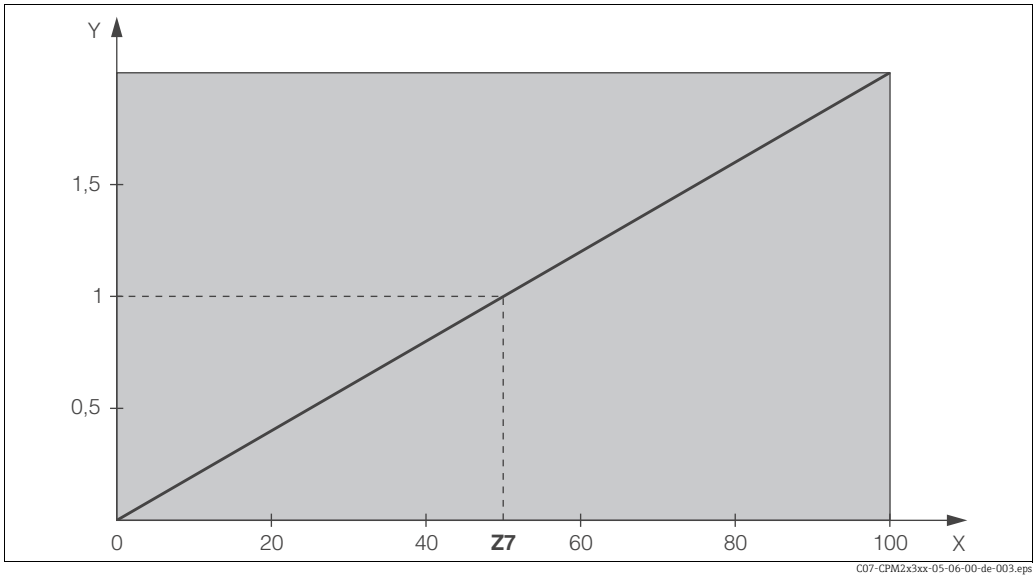
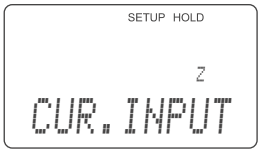
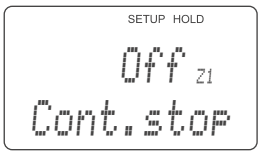
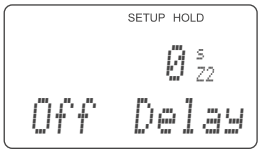
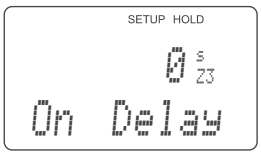
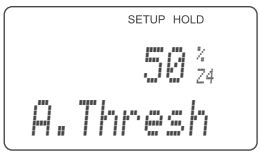
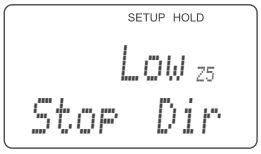
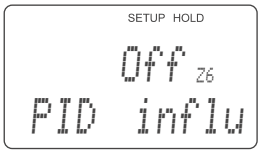
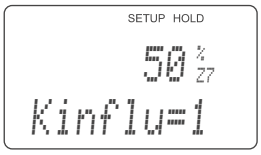


Fig. 23: Multiplying feedforward control

Y *Gain K_{infl}*
X *Current input signal [%]*
Z7 *Input value, when gain K_{infl} = 1*

The basic version does not include functions in *italic*.

Coding		Field	Setting range (Factory settings, bold)	Display	Info
Z		**CURRENT INPUT function group**			Current input settings.
	Z1	*Select flow monitoring of main stream (with controller switch-off)*	**Off** *On*		Flow monitoring may only be switched on if the flowmeter is connected in the main stream. If Z1 = off, fields Z2 to Z5 are not available.
	Z2	*Enter the delay for controller switch-off through current input*	**0 s** *0 to 2000 s*		Brief flow shortfalls can be suppressed by a delay and do not result in controller switch-off.
	Z3	*Enter the delay for controller switch-on through current input*	**0 s** *0 to 2000 s*		In the case of a controller, a delay until a representative measured value is received is useful if the flow fails for an extended period.
	Z4	*Enter the switch-off limit value for the current input*	**50%** *0 to 100%*		0 to 100% corresponds to 4 to 20 mA at the current input. Observe measured value assignment to the current output of the flowmeter.
	Z5	*Enter the switch-off direction for the current input*	**Low** *High*		The controller is switched off if the value entered in Z4 is undershot or overshot.
	Z6	*Select feedforward control to PID controller*	**Off** *Lin = linear* *Basic*		If Z6 = off, the field Z7 is not available. Z6 = basic: disturbance variable only affects the basic load (alternatively dosing in proportion to quantity can be used if usual PID controlling is not possible, due to a defective sensor, for example).
	Z7	*Enter value for feedforward control at which gain = 1 applies*	**50%** *0 to 100%*		When the value is set, the controller actuating variable is the same size when feedforward control is switched on as when feedforward control is switched off.

6.4.4 Current outputs

Use the "Current output" function group to configure the individual outputs. You can enter either a linear characteristic (O3 (1)) or a user-defined current output characteristic in conjunction with the Plus Package (O3 (3)). Exception: if you have chosen a "continuous controller" for current output 2, you cannot enter a user-defined current output characteristic for this current output.
In addition, you can simulate a current output value (O3 (2)) to check the current outputs. If a second current output is present, you can output the controller actuating variable in accordance with field R 237 via the current output.

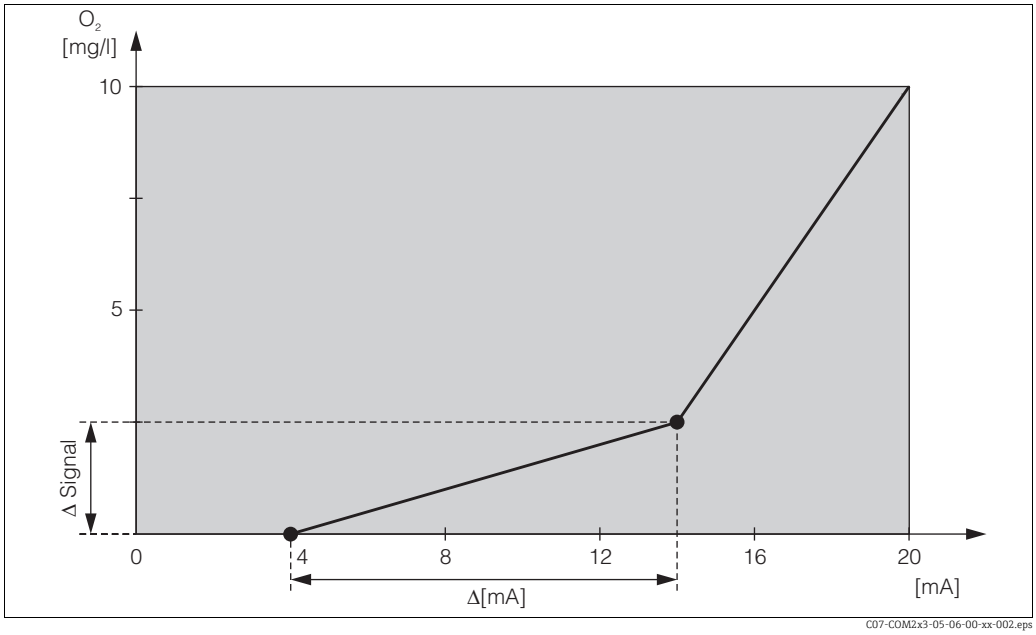


Fig. 24: User-defined current output characteristic (example)

The current output characteristic must be strictly monotonously increasing or strictly monotonously decreasing.
The distance per mA between two table value pairs must be greater than:

	Measuring range	Minimum distance per mA
Oxygen	0 to 20 mg/l	0.13 mg/l
	0 to 60 mg/l	0.38 mg/l
	0 to 200 % SAT	1.30 % SAT
	0 to 600 % SAT	3.80 % SAT
	0 to 400 hPa	2.50 hPa
	0 to 1200 hPa	7.50 hPa
Temperature	-10 to 60 °C (14 to 140 °F)	0.45 °C (0.81 °F)

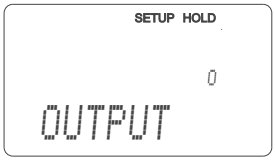
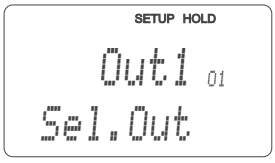
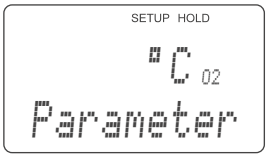
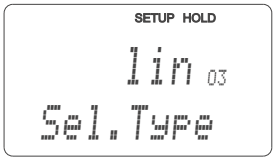
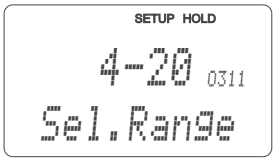
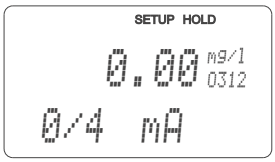
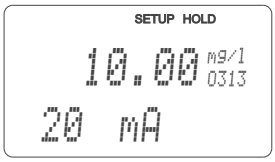
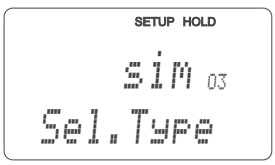
The values for the sample characteristic (→ 24) are entered in the following table. The distance per mA can be calculated from Δ signal / Δ mA.

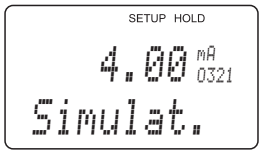
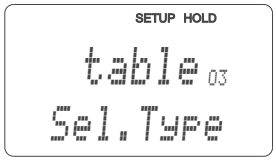
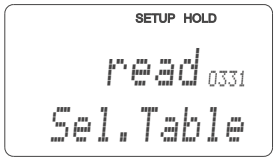
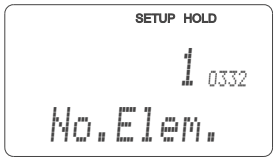
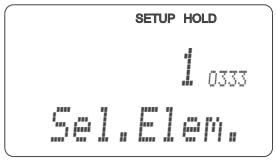
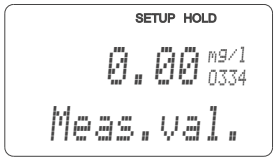
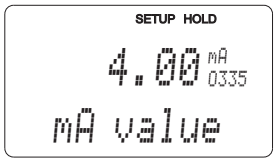
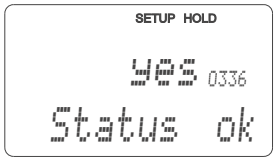
	Current output 1			Current output 2		
Value pair	**[mg/l; %SAT; hPa]**	**Current [mA]**	**Distance per mA**	**[mg/l; %SAT; hPa]**	**Current [mA]**	**Distance per mA**
1	0	4				
2	2.5	14	0.25			
3	10	20	1.25			

First enter the desired current output configuration into the following blank table with a pencil. Calculate the resulting signal distance per mA to observe the necessary minimum slope. Then enter the values in the device.

	Current output 1			Current output 2		
Value pair	**[mg/l; %SAT; hPa]**	**Current [mA]**	**Distance per mA**	**[mg/l; %SAT; hPa]**	**Current [mA]**	**Distance per mA**
1						
2						
3						
4						
5						
6						
7						
8						
9						

Basic version does not include functions in *italic*.

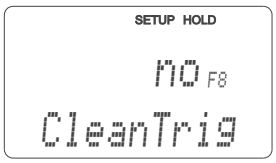
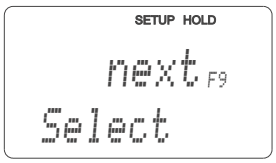
Coding	Field	Setting range (Factory settings, bold)	Display	Info
O	**CURRENT OUTPUT function group**			Configuration of the current output (does not apply for PROFIBUS).
O1	Select current output	**Out1** *Out 2*		A characteristic can be selected for every output.
O2	Select measured variable for 2nd current output	**°C** mg/l ppm *Contr*		R237 = curr (current output 2) can only be selected if O2 = Contr is selected (relay board required).
O3 (1)	Enter or output linear characteristic	**Lin = linear** (1) Sim = simulation (2) *Tab = table (3)*		The characteristic can have a positive or negative slope for the measured value output. In the case of actuating variable output (O2 = Contr), an increasing current corresponds to an increasing actuating variable.
O311	Select current range	**4 to 20 mA** 0 to 20 mA		
O312	0/4 mA value: Enter corresponding O_2 or temperature value	**0.00 mg/l*** 0.00 to 20.00 mg/l **0.0 %SAT** 0.0 to 200.0 %SAT **0 hPa** 0 to 400 hPa **0.0 °C** -10.0 to 130.0 °C		Here you can enter the O_2 or temperature value at which the min. current value (0/4 mA) is applied at the transmitter output. Minimum distance between 0/4 mA and 20 mA value: see field O313 * Display depends on setting in A2
O313	20 mA value: Enter corresponding O2 or temperature value	**10.00 mg/l*** 0.00 to 20.00 mg/l **100.0 %SAT** 0.0 to 200.0 %SAT **200 hPa** 0 to 400 hPa **40.0 °C** -10.0 to 130.0 °C		Here you can enter the O_2 or temperature value at which the max. current value (20 mA) is applied at the transmitter output. Minimum distance between 0/4 mA and 20 mA value must be: Oxygen: 0.2 mg/l / 2 %SAT / 4 hPa Temperature: 7 °C * Display depends on setting in A2
O3 (2)	Simulate current output	Lin = linear (1) **Sim = simulation** (2) *Tab = table (3)*		Simulation is not ended until (1) or (3) is selected. For further characteristics, see O3 (1), O3(3).

Coding			Field	Setting range (Factory settings, bold)	Display	Info
		O321	Enter simulation value	**Current value** 0.00 to 22.00 mA		Entering a current value results in this value being directly output at the current output.
	O3 (3)		*Enter current output table (only for Plus Package*)	Lin = linear (1) Sim = simulation (2) *Tab = table* (3)		Values can also be added or altered at a later stage. The values entered are automatically sorted by increasing current value. For further characteristics, see O3 (1), O3 (2).
		O331	*Select table options*	**Read** *Edit*		
		O332	*Enter number of table value pairs*	**1** *1 to 10*		Enter the number of pairs from the x and y value (measured value and current value) here.
		O333	*Select table value pair*	**1** *1 to No. elem.* *Assign*		The function chain O333 to O335 will run through as many times as correspond to the value in O332. "Assign" appears as the last step. After confirmation the system jumps to O336.
		O334	*Enter x value*	**0.00 mg/l*** 0.00 to 20.00 mg/l **0.0 %SAT** 0.0 to 200.0 %SAT **0 hPa** 0 to 400 hPa **0.0 °C** -10.0 to 60.0 °C		x value = measured value specified by user. * Display depends on setting in A2
		O335	*Enter y value*	**4.00 mA** *0.00 to 20.00 mA*		y value = current value belonging to O334 specified by user.
		O336	*Message as to whether table status is OK*	**yes** *no*		Back to O3. If status = no, correct table (all settings made up until now are retained) or back to measuring mode (table is deleted).

6.4.5 Monitoring functions

The monitoring functions are used to define various alarms and configure output contacts. Each individual error can be defined to be effective or not (at the contact or as an error current). An alarm condition can be defined to activate a cleaning function (F8)

Coding		Field	Setting range (Factory settings, bold)	Display	Info
F		**ALARM function group**		SETUP HOLD F ALARM	Alarm function settings.
	F1	Select contact type	**Latch = latching contact** Momen = momentary contact	SETUP HOLD Latch F1 Cont.Type	The contact type selected only applies to the alarm contact.
	F2	Select time unit	**s** min	SETUP HOLD S F2 Time Unit	
	F3	Enter alarm delay	**0 s (min)** 0 to 2000 s (min)	SETUP HOLD 0 s F3 Err.Delay	Depending on the option selected in F2, the alarm delay is entered in s or min.
	F4	Select error current	**22 mA** 2.4 mA	SETUP HOLD 22mA F4 Err.Curr	This selection must be made even if all error reporting is switched off in F5. If "0-20 mA" was selected in O311, "2.4 mA" may not be used.
	F5	Select error	**1** 1 to 255	SETUP HOLD 1 F5 Sel.error	Here you can select all the errors which should trigger an alarm. The errors are selected via the error numbers. Please refer to the table in section "System error messages" for the meaning of the individual error numbers. The factory settings remain in effect for all errors not edited.
	F6	Set alarm contact to be effective for the selected error	**yes** no	SETUP HOLD yes F6 Rel.Assg	If “no” is selected, all the other alarm settings are deactivated (e.g. alarm delay). The settings themselves are retained. This setting **only** applies to the error selected in F5.
	F7	Set error current to be effective for the selected error	**no** yes	SETUP HOLD no F7 Curr.Assg	The option selected in F4 is effective or ineffective in the event of an error. This setting **only** applies to the error selected in F5.

Coding		Field	Setting range (Factory settings, bold)	Display	Info
	F8	*Automatic cleaning function start*	**no** *yes*		This field is not available for certain errors, see "Trouble-shooting and fault elimination" section.
	F9	Select return to menu or next error	**next** = next error ←R		If ←R is selected, you return to F, if next is selected, you go to F5.

Check

The CHECK function group is only available for devices with a Plus Package.
In the CHECK function group, you can select different monitoring functions for the measurement.
All the monitoring functions are off in the factory setting. The Sensor Check System adapts to the current application conditions by adding and setting suitable functions.

Alarm threshold monitoring

For oxygen measurement without entry control (ventilation) sensor errors lead to a measured value error, but have no impact on the process medium (examples: monitoring measurement in surface waters or in water-works). Sensor errors normally cause high or low readings that are implausible. This is detected and signalled by user-definable alarm thresholds.

Controller monitoring

For oxygen measurement with simultaneous entry control, sensor errors not only lead to incorrect measured values but also have a direct impact on the state of the process medium. Particularly in the case of oxygenation control, the risk exists due to the control loop that there is no oxygen supply if the measured value is constantly too high. A too low oxygen supply creates a considerable risk for the microbiology. On the other hand, a measured value which is permanently too low leads to increased operating costs due to permanent oxygen supply. Such cases are recognised and signalled using freely settable monitoring times for the maximum permitted controller switch-on and switch-off periods.

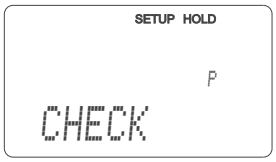
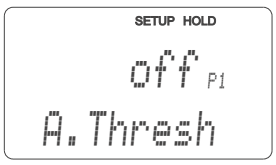
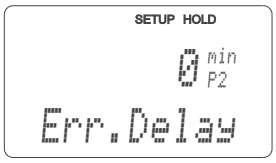
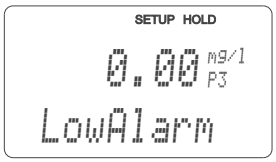
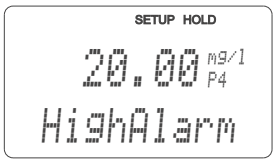
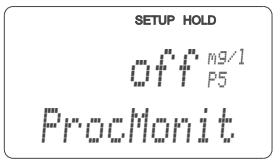
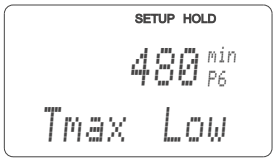
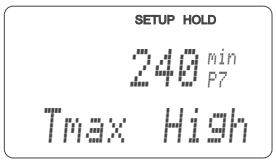
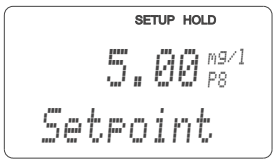
Sensor activity monitoring

The process medium can also have an effect on the sensor leading to incorrect measured values. The collection of solid matter at the sensor or a strong coating on the sensor membrane can lead to a strongly delayed or completely passive measuring signal. Constant monitoring of the signal activity recognizes and signals such passivity.

SCS monitoring functions at a glance

	Functional description	Setting possibility	Alarm event	Application
Alarm threshold monitoring (P1 to P4)	– Freely adjustable lower alarm threshold (AT) – Freely adjustable upper alarm threshold (AT)	off	–	Applications **with** or **without** oxygenation control
		only lower AT	Lower AT reached or dropped below	
		only upper AT	Upper AT reached or exceeded	
		lower and upper AT	Lower AT reached or dropped below or upper AT reached or exceeded	
Controller monitoring (CC: Controller Check, P5 to P8)	– Switch-on period monitoring – Switch-off period monitoring	off	–	Applications **with** oxygenation control
		on	Set maximum period for permanent switch-on or switch-off exceeded	
Sensor activity monitoring (AC: Alternation Check, P5 to P8)	Monitoring for signal change	off	–	Applications **with** or **without** oxygenation control
		on	Change within 1 hour < ±0.1 mg/l or ±1 %SAT or ±2 hPa	

The function group "Check" is used to monitor the lower und upper limits of the measured value and to initiate alarms.
Basic version does not include functions in *italic*.

Coding		Field	Setting range (Factory settings, bold)	Display	Info
P		**CHECK function group**			Settings for sensor and process monitoring
	P1	*Select alarm threshold monitoring*	**Off** *Low* *High* *Lo+Hi* *Low!* *High!* *Lo+Hi!*		Alarm signalling optionally with or without simultaneous controller switch-off. XXXX = without controller switch-off XXXX! = with controller switch-off
	P2	*Enter alarm delay*	**0 s (min)** *0 to 2000 s (min)*		Depending on your selection in F2, you can enter the error delay in min or s. Only after this delay does a high or low limit violation cause an alarm as per field P3/P4.
	P3	*Enter lower alarm threshold*	**0.00 mg/l*** *0.00 to 19.00 mg/l* **0.0 %SAT** *0.0 to190.0 %SAT* **0 hPa** *0 to 380 hPa*		* Display depends on setting in A2
	P4	*Enter upper alarm threshold*	**20.00 mg/l*** *1.00 to 20.00 mg/l* **200.0 %SAT** *0.0 to 200.0 %SAT* **400 hPa** *20 to 400 hPa*		* Display depends on setting in A2
	P5	*Select process monitoring (PCS alarm)*	**Off** *AC* *CC* *AC+CC* *AC!* *CC!* *AC+CC!*		AC = sensor activity check CC = controller check AC checking limits:. ±0.1 mg/l or ±1 %SAT or ±2 hPa in 1 h XXXX = without controller switch-off XXXX! = with controller switch-off
	P6	*Enter maximum permissible duration for lower CC setpoint limit violation* (field P8)	**480 min** *0 to 2000 min*		Only when P5 = CC or AC+CC
	P7	*Enter maximum permissible duration for upper CC setpoint limit violation* (field P8)	**240 min** *0 to 2000 min*		Only when P5 = CC or AC+CC
	P8	*Enter CC setpoint (for P6/P7)*	**5.00 mg/l*** *0.00 to 20.00 mg/l* **50.0 %SAT** *0.0 to 200.0 %SAT* **200 hPa** *0 to 400 hPa*		Setpoint for external controller (process control system) must match with setpoint in P8. * Display depends on setting in A2

6.4.6 Relay contact configuration

To use the RELAY function group, you need a relay board which is not part of the basic version.

The following relay contacts can be selected and configured as desired (max. four contacts, depending on options installed):
- Limit contactor for measured oxygen value: R2 (1)
- Limit contactor for temperature: R2 (2)
- PID controller: R2 (3)
- Timer for cleaning function: R2 (4)
- Chemoclean function: R2 (5)

Limit contactor for measured oxygen value and temperature

The transmitter has different ways of assigning a relay contact.
Switch-on and switch-off points and pick-up and drop-out delays can be assigned to the limit contactor. In addition, you can configure an alarm threshold to output an error message and to start a cleaning function in conjunction with this.
These functions can be used both for oxygen measurement and for temperature measurement.

Please refer to Fig. 25 for a clear illustration of the relay contact states.
- When the measured values increase (maximum function), the relay contact is closed as of t_2 after the switch-on point (t_1) has been overshot and the pick-up delay has elapsed (t_2 - t_1).
  The alarm contact switches if the alarm threshold (t_3) is reached and the alarm delay (t_4 - t_3) has also elapsed.
- When the measured values decrease, the alarm contact is reset when the alarm threshold (t_5) is undershot as is the relay contact (t_7) after the drop-out delay (t_7 - t_6).
- If the pick-up and drop-out delays are set to 0 s, the switch-on and switch-off points are also switch points of the contacts.

Settings can also be made for a minimum function in the same way as for a maximum function.

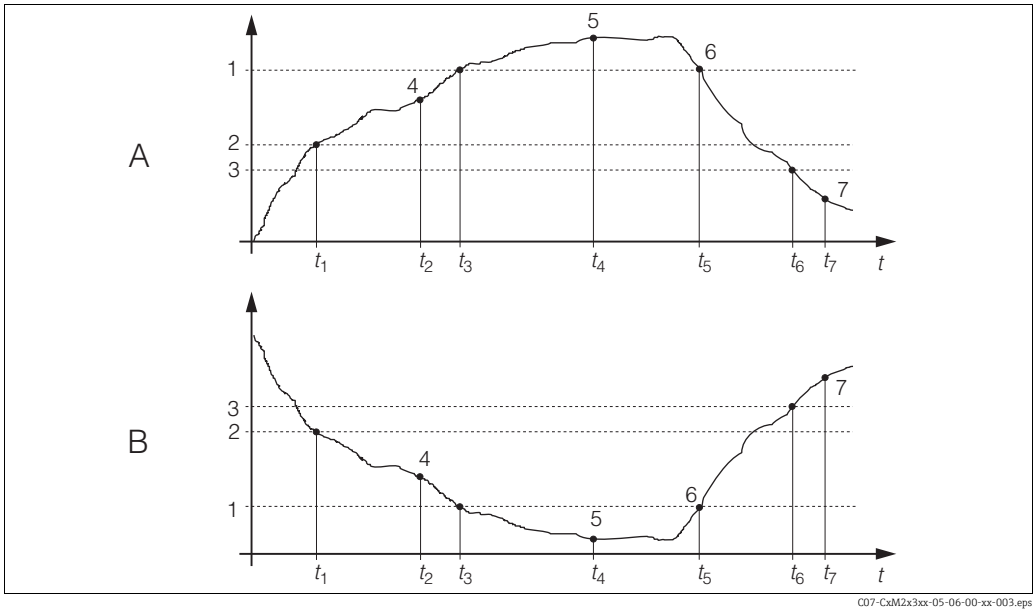


Fig. 25: Illustration of the alarm and limit value functions

A Switch-on point > switch-off point: Max. function
B Switch-on point < switch-off point: Min. function

1 Alarm threshold
2 Switch-on point
3 Switch-off point
4 Contact ON
5 Alarm ON
6 Alarm OFF
7 Contact OFF

P(ID) controller

You can define various controller functions for the transmitter. On the basis of the PID controller, P, PI, PD and PID controllers can be implemented. For an optimum control system, use the controller that best suits your application. Depending on the option selected in the R 237/R 266 field, the actuating signal can be output via relays or via current output 2 (if available).

- **P controller**
  Used for simple linear control purposes with small system deviations. Where major changes are to be controlled, overshooting may occur. In addition, a lasting control deviation is to be expected.
- **PI controller**
  Is used for control systems where overshooting is to be avoided and no lasting control deviation should occur.
- **PD controller**
  Is used for processes that require quick changes and where peaks are to be corrected.
- **PID controller**
  Is used for processes where a P, PI or PD controller does not control sufficiently.

Configuration options of the PID controller
The following configuration options are available for a PID controller:

- Change control gain K_p (P influence)
- Set integral action time T_n (I influence)
- Set derivative action time T_v (D influence)

Basic load dosing (Basic)
The basic load dosing (field R231) is used to set a constant dosage (field R2311)

PID controlling plus basic load dosing
If you select this function (PID + Basic) in field R231 the PID controlled dosage will not be lower than the basic load value entered in field R2311.

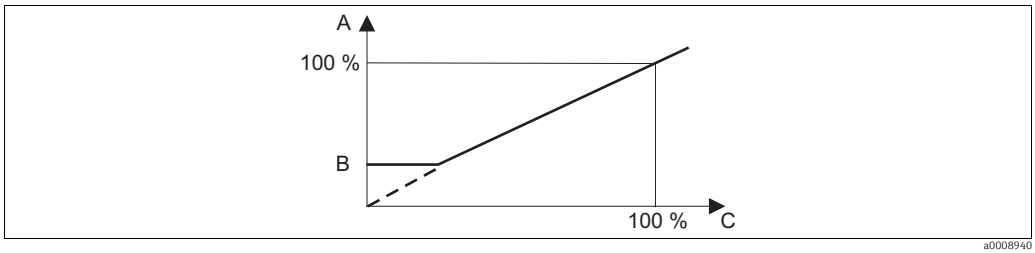


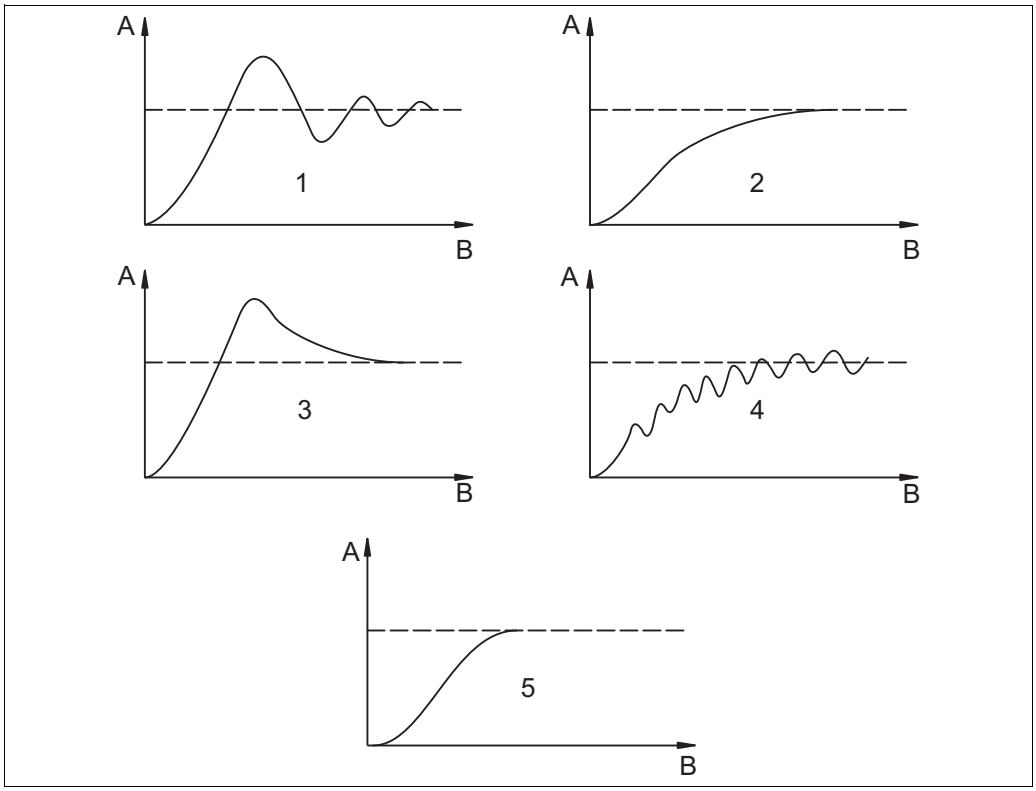
Fig. 26: Control characteristic PID controller with basic load dosing

A PID with basic load
B Basic load
C PID

Commissioning
If you do not yet have any experience for setting the control parameters, set the values that yield the greatest possible stability in the control circuit. Proceed as follows to optimize the control circuit further:

- Increase the control gain K_p until the controlled variable just starts to overshoot.
- Reduce K_p slightly and then reduce the integral action time T_n so that the shortest possible correction time without overshooting is achieved.
- To reduce the response time of the controller, also set the derivative action time T_v.

Control and fine optimization of the set parameters with a recorder



Optimization of settings T_n and K_p

A Actual value
B Time

1 *T_n too small*
2 *T_n too large*
3 *K_p too large*
4 K_p too small
5 Optimum setting

Actuating signal outputs (R237 to R2310)

Each control contact outputs a cyclical signal whose intensity corresponds to the controller's manipulated variable. A distinction is made according to the type of signal cycle:

- Pulse length modulation
  The bigger the calculated manipulated variable is, the longer the contact affected remains picked up. The period T can be adjusted between 0.5 and 99 s (field R238). Outputs with pulse length modulation are used to activate solenoid valves.
- Pulse frequency modulation
  The bigger the calculated manipulated variable is, the higher the switching frequency of the contact affected. The maximum switching frequency 1/T can be set between 60 and 180 min^{-1}. The on-time t_{ON} is constant. It depends on the set maximum frequency and is approx. 0.5 s for 60 min^{-1} and approx. 170 ms for 180 min^{-1}. Outputs with pulse frequency modulation are used to activate directly controlled solenoid dosing pumps.

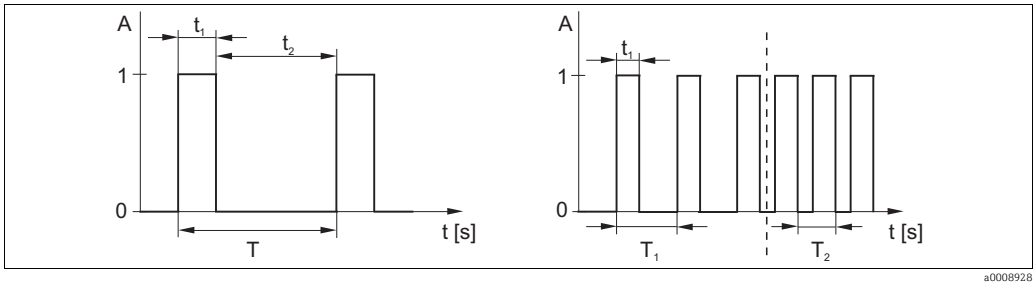


Fig. 27: Signal of a pulse-length modulated controller contact (left) and of a pulse-frequency modulated controller contact (right)

A Contact 1 = on, 0 = off
B Time [s] $t_1 = t_{on}$ $t_2 = t_{off}$
T Period length
T_1 T_2 Impulse period length (impulse freq. $1/T_1$ and $1/T_2$)

Constant controller
Via the current output 2, the minimum actuating variable (0 %) of the controller is output with 0/4 mA and the maximum actuating variable (100%) of the controller is output with 20 mA.

Control characteristic for direct and inverse control action
You can choose between two control characteristics in the R236 field:

- Direct control action = maximum function
- Inverse control action = minimum function

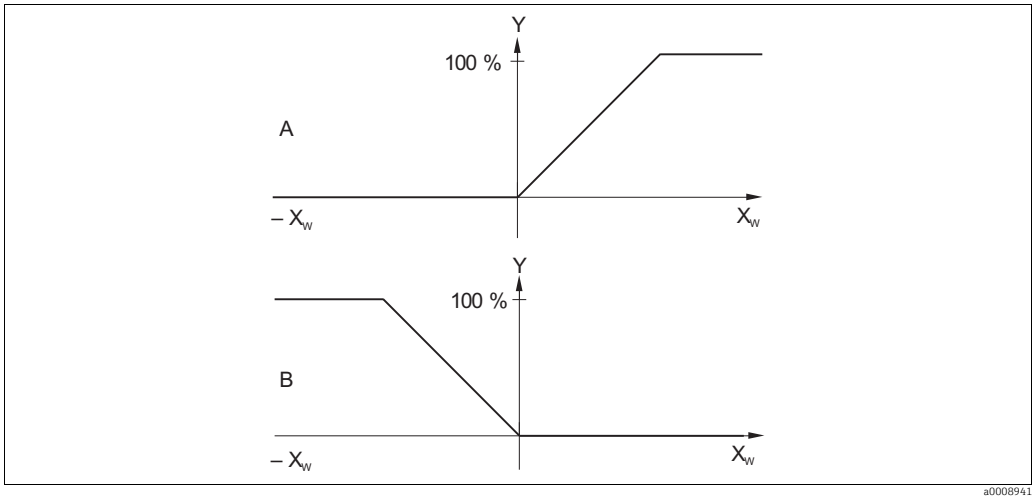


Fig. 28: Control characteristic of a proportional controller with direct and inverse control action

A Direct = max. function
B Inverse = min. function

Timer for cleaning function

This function includes a simple cleaning option. You can set the time interval after which cleaning should start. So you can only select a constant interval sequence.
Other cleaning functions are available for selection in conjunction with the Chemoclean function (version with four contacts, see "Chemoclean function" section).

Timer and Chemoclean do not work independently of one another. While one of the two functions is active, the other cannot be started.

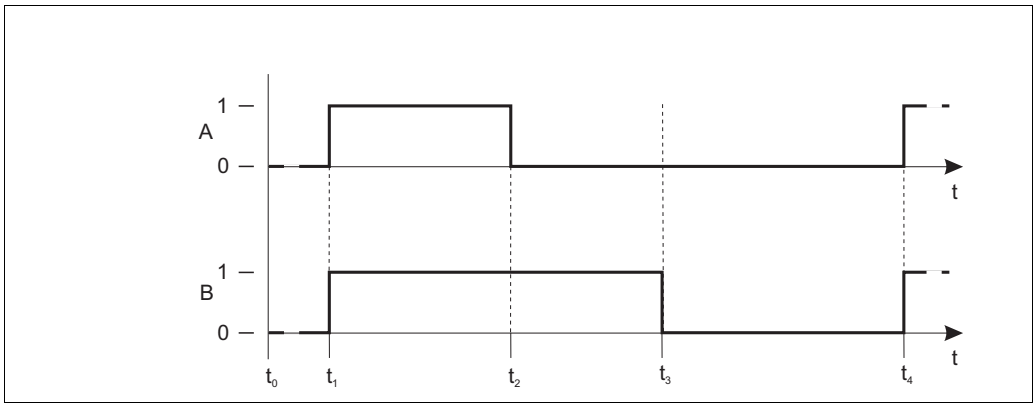


Fig. 29: Correlation of cleaning time, pause time and hold dwell period

A Wiper and/or spray cleaning system
B Hold function
0 Inactive
1 Active
t_0 *Normal mode*
t_1 *Cleaning start*
t_2-t_1 *Cleaning time*
t_3-t_2 *Clean hold dwell period (0 to 999 s)*
t_4-t_3 *Pause time between two cleaning intervals (1 to 7200 min)*

Chemoclean function

Just like the timer function, Chemoclean can also be used to start a cleaning cycle. However, Chemoclean also gives you the added option of defining different cleaning and rinsing intervals.
As a result, it is possible to clean irregularly with different repeat cycles and to separately set the cleaning times with post rinse times.

Pay attention to the following:
- To use the Chemoclean function the transmitter has to be equipped with a designated relay board (see product structure or chapter "accessories").
- Timer and Chemoclean do not work independently of one another. While one of the two functions is active, the other cannot be started.
- For the Chemoclean function, the relays 3 (water) and 4 (cleaner) are used.
- If cleaning is prematurely aborted, a post rinse time always follows.
- If the setting is "Economy", cleaning only takes place with water.

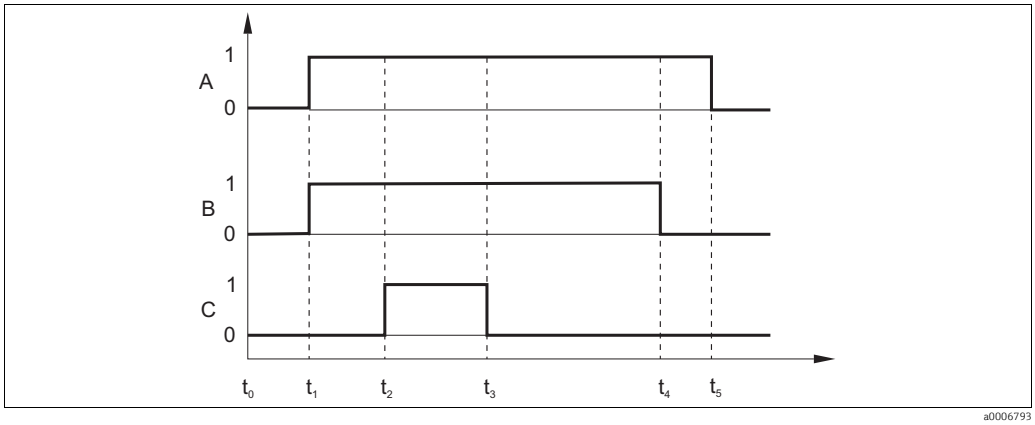


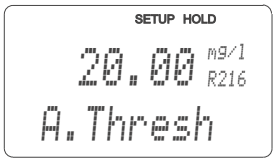
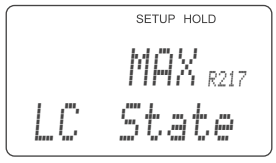
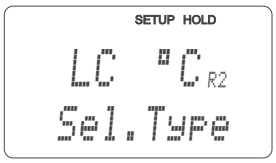
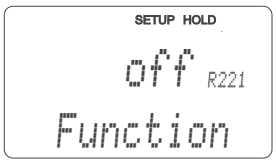
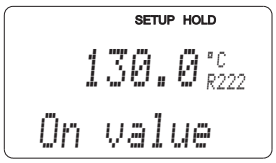
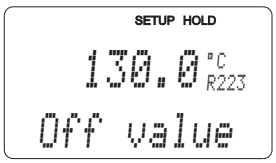
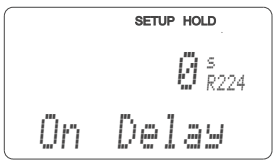
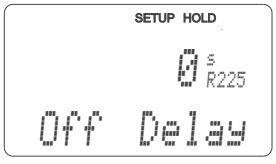
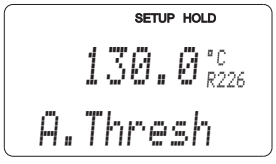
Fig. 30: Sequence of a cleaning cycle

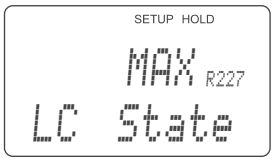
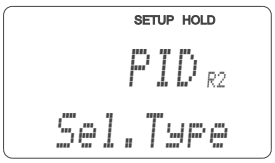
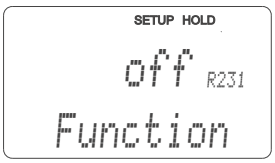
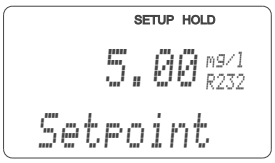
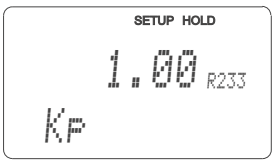
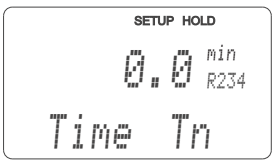
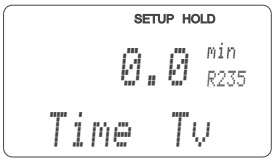
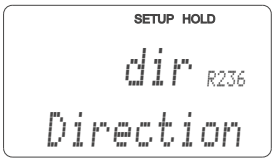
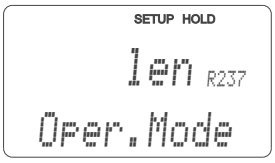
A Hold
B Water
C Cleaner
0 Contact on
1 Contact off

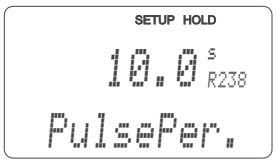
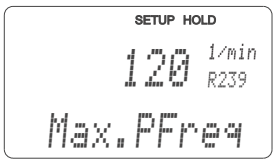
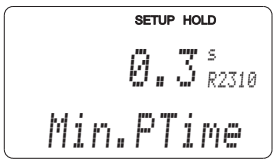
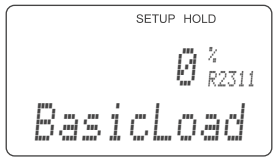
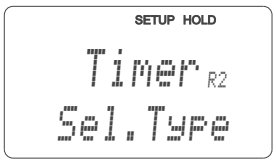
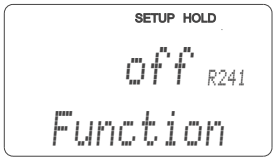
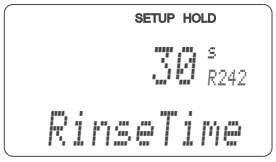
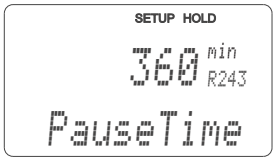
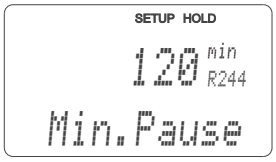
t_0 *Normal mode*
t_1 *Cleaning start*
$t_2 - t_1$ *Pre-rinse time*
$t_3 - t_2$ *Cleaning time*
$t_4 - t_3$ *Post rinse time*
$t_5 - t_4$ *Hold dwell period*

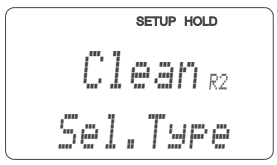
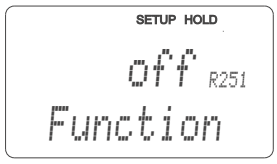
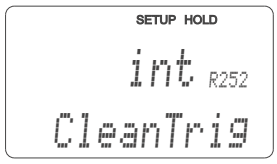
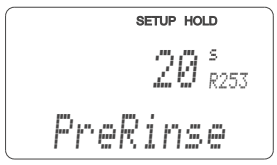
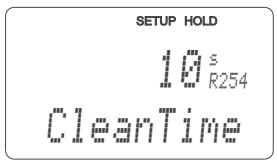
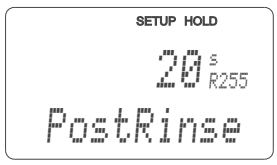
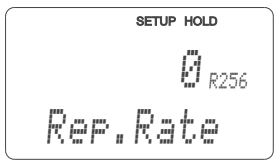
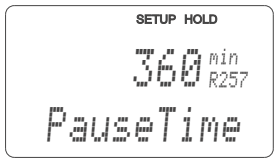
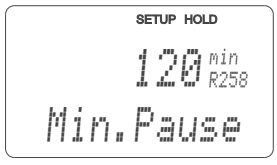
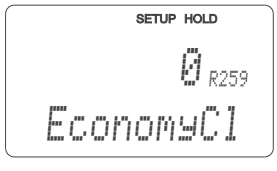
Basic version does not include functions in *italic*.

Coding			Field	Setting range (Factory settings, bold)	Display	Info
R			**RELAY function group**		SETUP HOLD R ATC RELAIS	Relay contact settings.
	R1		*Select contact to be configured*	**Rel1** *Rel2* *Rel3* *Rel4*	SETUP HOLD Rel1 R1 Sel.Relay	Rel3 (water) and Rel4 (cleaner) are only available with the relevant version of the transmitter. If Chemoclean is used as the cleaning method, Rel4 is not available.
	R2 (1)		Configuration limit contactor for O_2 measurement	**LC PV = limit contactor O_2** (1) LC °C = limit contactor T (2) PID controller (3) Timer (4) *Clean = Chemoclean (5)*	SETUP HOLD LC PV R2 Sel.Type	PV = process value If Rel4 is selected in the R1 field, Clean = Chemoclean cannot be selected. By confirming with ENTER, another relay function already switched on is switched off and its settings are reset to the factory settings.
		R211	Switch function of R2 (1) off or on	**Off** On	SETUP HOLD off R211 Function	All the settings are retained.
		R212	Enter the switch-on point of the contact	**20.00 mg/l*** 0.00 to 20.00 mg/l **200.0 %SAT** 0.0 to 200.0 %SAT **400 hPa** 0 to 400 hPa	SETUP HOLD 20.00 mg/l R212 On value	Never set the switch-on point and the switch-off point to the same value! (Only the operating mode selected in A1 is displayed.) * Display depends on setting in A2
		R213	Enter the switch-off point of the contact	**20.00 mg/l*** 0.00 to 20.00 mg/l **200.0 %SAT** 0.0 to 200.0 %SAT **400 hPa** 0 to 400 hPa	SETUP HOLD 20.00 mg/l R213 Off value	Entering a switch-off point selects either a Max contact (switch-off point < switch-on point) or a Min contact (switch-off point > switch-on point), thereby implementing a hysteresis that is constantly required (see "Illustration of the alarm and limit functions" figure). (Only the operating mode selected in A1 is displayed.) * Display depends on setting in A2
		R214	Enter pick-up delay	**0 s** 0 to 2000 s	SETUP HOLD 0 s R214 On Delay	
		R215	Enter drop-out delay	**0 s** 0 to 2000 s	SETUP HOLD 0 s R215 Off Delay	

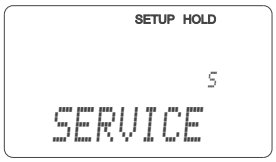
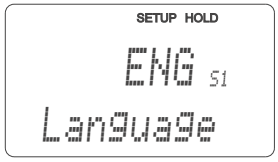
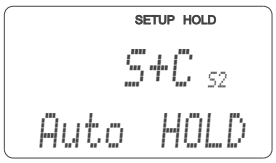
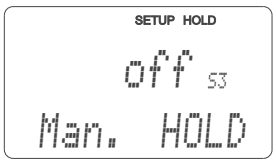
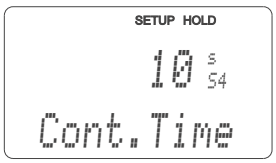
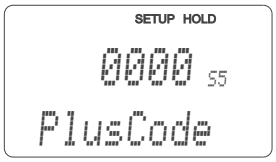
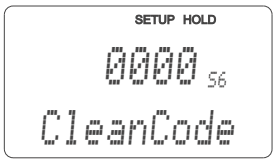
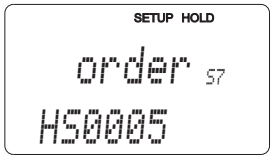
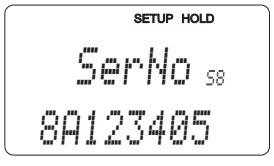
Coding			Field	Setting range (Factory settings, bold)	Display	Info
		R216	Enter alarm threshold	**20.00 mg/l*** 0.00 to 20.00 mg/l **200.0 %SAT** 0.0 to 200.0 %SAT **400 hPa** 0 to 400 hPa		If the alarm threshold is undershot/ overshot, this triggers an alarm with the error message and error current at the transmitter (note alarm delay in field F3). If defined as a Min contact, the alarm threshold must be < switch-off point. (Only the operating mode selected in A1 is displayed.) * Display depends on setting in A2
		R217	Display status for limit contactor	**MAX** MIN		Display only.
	R2 (2)		Configure limit contactor for temperature measurement	LC PV = limit contactor O_2 (1) **LC °C = limit contactor T (2)** PID controller (3) Timer (4) *Clean = Chemoclean (5)*		By confirming with ENTER, another relay function already switched on is switched off and its settings are reset to the factory settings.
		R221	Switch function of R2 (2) off or on	**Off** On		Settings made for the limit contactor are not deleted by switching the function off.
		R222	Enter switch-on temperature	**130.0 °C** -10.0 to 130.0 °C		Never set the switch-on point and the switch-off point to the same value!
		R223	Enter switch-off temperature	**130.0 °C** -10.0 to 130.0 °C		Entering a switch-off point selects either a Max contact (switch-off point < switch-on point) or a Min contact (switch-off point > switch-on point), thereby implementing a hysteresis that is constantly required (see "Illustration of the alarm and limit functions" figure).
		R224	Enter pick-up delay	**0 s** 0 to 2000 s		
		R225	Enter drop-out delay	**0 s** 0 to 2000 s		
		R226	Enter alarm threshold (as absolute value)	**130.0 °C** -10.0 to 130.0 °C		If the alarm threshold is undershot/ overshot, this triggers an alarm with the error message and error current at the transmitter (note alarm delay in field F3). If defined as a Min contact, the alarm threshold must be < switch-off point.

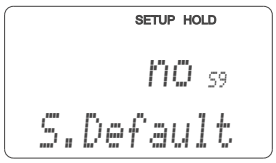
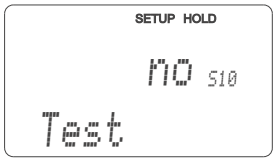
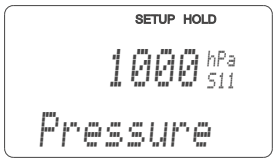
Coding	Field	Setting range (Factory settings, bold)	Display	Info
R227	Display status for limit contactor	**MAX** MIN		Display only.
R2 (3)	Configure P(ID) controller	LC PV = limit contactor O_2 (1) LC ˚C = limit contactor T (2) **PID controller (3)** Timer (4) *Clean = Chemoclean (5)*		By confirming with ENTER, another relay function already switched on is switched off and its settings are reset to the factory settings.
R231	Switch function of R2 (3) off or on	**Off** On Basic PID+B		On = PID controller Basic = basic load dosing PID+B = PID controller + basic load dosing
R232	Enter set point	**5.00 mg/l*** 0.00 to 20.00 mg/l **50.0 %SAT** 0.0 to 200.0 %SAT **200 hPa** 0 to 400 hPa		The set point is the value to be maintained by the control system. The control process restores this value when an upward or downward deviation occurs. (Only the operating mode selected in A1 is displayed.) * Display depends on setting in A2
R233	Enter control gain K_p	**1.00** 0.01 to 20.00		See "P(ID) controller" section.
R234	Enter integral action time T_n (0.0 = no I-component)	**0.0 min** 0.0 to 999.9 min		See "P(ID) controller" section. With every Hold, the I-component is set to zero. Although Hold can be deactivated in field S2, this does not apply for Chemoclean and timer!
R235	Enter derivative action time T_v (0.0 = no D-component)	**0.0 min** 0.0 to 999.9 min		See "P(ID) controller" section.
R236	Select controller characteristic	**dir = direct** inv = inverse		dir = Max. function inv = Min. function The setting is required depending on the control deviation (upward or downward deviation, see "P(ID) controller" section).
R237	Select pulse length or pulse frequency	**len = pulse length** freq = pulse frequency *curr = current output 2*		Pulse length e.g. for solenoid valve, pulse frequency e.g. for solenoid dosing pump, see "Actuating signal outputs" section. Curr = current output 2 can only be selected if O2 = Contr.

Coding			Field	Setting range (Factory settings, bold)	Display	Info
		R238	Enter pulse interval	**10.0 s** 0.5 to 999.9 s		This field only appears if pulse length is selected in R237. If pulse frequency is selected, R238 is skipped and entries continue with R239.
		R239	Enter maximum pulse frequency of the adjuster	**120 min^{-1}** 60 to 180 min^{-1}		This field only appears if pulse frequency is selected in R237. If pulse length is selected, R239 is skipped and entries continue with R2310.
		R2310	Enter minimum switch-on time t_{ON}	**0.3 s** 0.1 to 5.0 s		This field only appears if pulse length is selected in R237.
		R2311	Enter basic load	**0 %** 0 to 40 %		When you select the basic load, you enter the desired dosing quantity. 100% basic load would correspond to: – Constantly on for R237 = len – Fmax at R237 = freq (field R239) – 20 mA at R237 = curr
	R2 (4)		Configure cleaning function (timer)	LC PV = limit contactor O_2 (1) LC °C = limit contactor T (2) PID controller (3) **Timer (4)** *Clean = Chemoclean (5)*		Cleaning only takes place with one cleaning agent (usually water). By confirming with ENTER, another relay function already switched on is switched off and its settings are reset to the factory settings.
		R241	Switch function of R2 (4) off or on	**Off** On		Settings made for the timer are not deleted by switching the function off.
		R242	Enter rinsing/ cleaning time	**30 s** 0 to 999 s		Settings for Hold and relay are active for this time.
		R243	Enter pause time	**360 min** 1 to 7200 min		The pause time is the time between two cleaning cycles (see "Timer for cleaning function" section).
		R244	Enter minimum pause time	**120 min** 1 to R243 min		The minimum pause time prevents constant cleaning if a cleaning trigger is present.

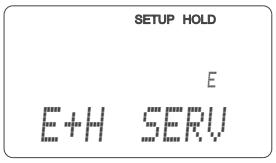
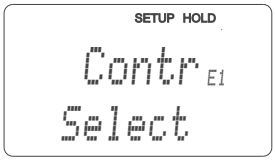
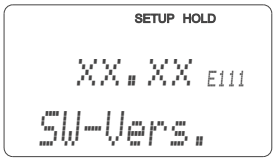
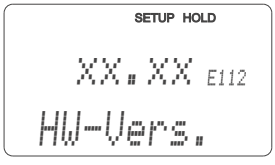
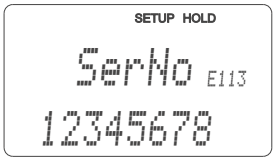
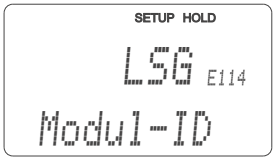
Coding			Field	Setting range (Factory settings, bold)	Display	Info
	R2 (5)		*Configure cleaning with Chemoclean (for version with four contacts , Chemoclean option and contacts 3 and 4 assigned)*	*LC PV = limit contactor O_2 (1)* *LC °C = limit contactor T (2)* *PID controller (3)* *Timer (4)* **Clean = Chemoclean (5)**		See "Chemoclean function" section. By confirming with ENTER, another relay function already switched on is switched off and its settings are reset to the factory settings.
		R251	*Switch function of R2 (5) off or on*	**Off** *On*		Settings made for the timer are not deleted by switching the function off.
		R252	*Select type of start pulse*	**Int = internal (time-controlled)** *Ext = external (digital input 2)* *I+ext = internal + external* *I+stp = internal, suppressed by external*		The cycle for the "int" function is started by the end of the pause time (R257). No real time clock is available. External suppression is required for irregular time intervals (e.g. weekends).
		R253	*Enter pre-rinse time*	**20 s** *0 to 999 s*		Rinsing with water takes place.
		R254	*Enter cleaning time*	**10 s** *0 to 999 s*		Cleaning with cleaning agent and water takes place.
		R255	*Enter post rinse time*	**20 s** *0 to 999 s*		Rinsing with water takes place.
		R256	*Enter number of repeat cycles*	**0** *0 to 5*		R253 to R255 is repeated.
		R257	*Enter pause time*	**360 min** *1 to 7200 min*		The pause time is the time between two cleaning cycles (see "Timer function" section).
		R258	*Enter minimum pause time*	**120 min** *1 to R257 min*		The minimum pause time prevents constant cleaning if an external cleaning start is present.
		R259	*Enter number of cleaning cycles without cleaning agent (economy function)*	**0** *0 to 9*		After cleaning with cleaner, up to 9 cleaning sessions can be carried out with water only until the next cleaning session with cleaner takes place.

6.4.7 Service

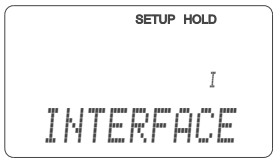
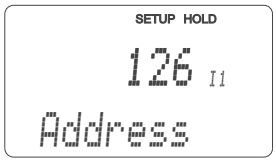
Coding		Field	Setting range (Factory settings, bold)	Display	Info
S		**SERVICE function group**			Service function settings.
	S1	Select language	**ENG = English** GER = German FRA = French ITA = Italian NL = Dutch ESP = Spanish		
	S2	Configure Hold	**S+C = Hold during configuration and calibration** Cal = Hold during calibration Setup = Hold during configuration None = no Hold		S = setup C = calibration
	S3	Manual Hold	**Off** On		The setting is retained even in the event of a power failure.
	S4	Enter Hold dwell period	**10 s** 0 to 999 s		
	S5	Enter SW upgrade release code (Plus Package)	**0000** 0000 to 9999		The code is located on the nameplate. If an incorrect code is entered, you are taken back to the measurement menu. The number is edited with the PLUS or MINUS key and confirmed with the ENTER key. "1" is displayed if the code is active.
	S6	Enter SW upgrade release code Chemoclean	**0000** 0000 to 9999		The code is located on the nameplate. If an incorrect code is entered, you are taken back to the measurement menu. The number is edited with the PLUS or MINUS key and confirmed with the ENTER key. "1" is displayed if the code is active.
	S7	Order number is displayed			If the device is upgraded, the order code is **not** automatically adjusted.
	S8	Serial number is displayed			

Coding		Field	Setting range (Factory settings, bold)	Display	Info
	S9	Reset the device to the basic settings 	**No** Sens = sensor data Facty = factory settings		Sens = last calibration is deleted and is reset to factory setting. Facty = all data (apart from A1 a. S1) are deleted and reset to the factory setting!
	S10	Perform device test	**No** Displ = display test		
	S11	Absolute air pressure will be displayed	**Current value**		Do not compare with the barometer. This shows the relative air pressure (related to sea level).

6.4.8 E+H Service

Coding			Field	Setting range (Factory settings, bold)	Display	Note
E			**E+H SERVICE function group**			Information on the device version
	E1		Select module	**Contr = controller** (1) Trans = transmitter (2) Main = power unit (3) Rel = relay module (4)		
		E111 E121 E131 E141	Software version is displayed			If E1 = contr: instrument software If E1 = trans, main, rel: module firmware
		E112 E122 E132 E142	Hardware version is displayed			Only display function
		E113 E123 E133 E143	Serial number is displayed			Only display function
		E114 E124 E134 E144	Module ID is displayed			Only display function

6.4.9 Interfaces

Coding		Field	Setting range (Factory settings, bold)	Display	Info
I		**INTERFACE function group**			Communication settings (only for device version HART or PROFIBUS).
	I1	Enter bus address	Address HART: **0** to 15 or PROFIBUS: 0 to **126**		Each address may only be used once in a network. If a device address ≠ 0 is selected, the current output is automatically set to 4 mA and the device is set to multi-drop operation.
	I2	Display of measuring point			

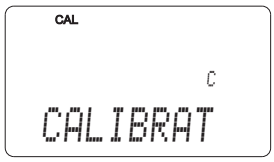
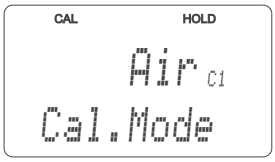
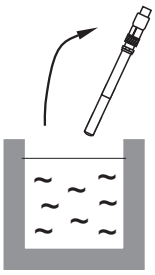
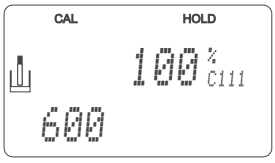
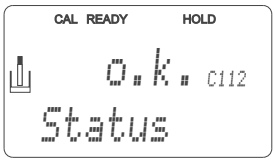
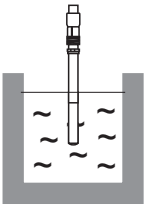
6.5 Communication

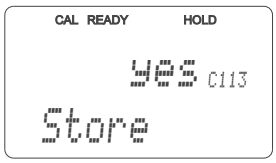
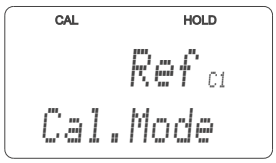
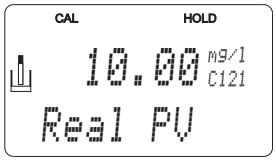
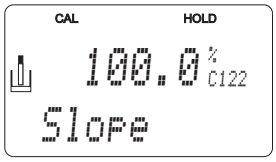
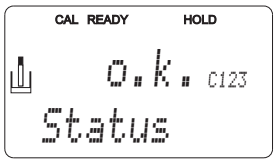
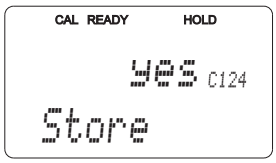
For devices with a communication interface, please also refer to the separate Operating Instructions BA00208C/07/EN (HART) or BA00209C/07/EN (PROFIBUS).

6.6 Calibration

To access the "Calibration" function group, press the CAL key.
This function group is used to calibrate and adjust the measuring point. The sensor is calibrated in air or in the medium.

Pay attention to the following:
- At first start-up, sensor calibration of amperometric sensors is absolutely required in order for the measuring system to be able to generate accurate measuring values.
- If the calibration procedure is aborted by pressing the PLUS and MINUS keys at the same time (return to C113 or C124) or if the calibration is faulty, then the previous calibration data are reinstated. A calibration error is indicated by the “ERR” message and flashing of the sensor symbol on the display.
  Repeat calibration!
- The instrument is automatically switched to hold during calibration (factory setting).
- After calibration, the system jumps back to the measuring mode. During the hold dwell period the hold symbol is displayed.

Coding			Field	Selection or range (factory settings bold)	Display	Info
C			**Function group CALIBRATION**	**Oxygen calibration**		Calibration settings.
	C1 (1)		Calibration in air	**Air** (1) Ref (3)		Calibration in air is only possible if air temperature is ≥-5 °C (≥23 °F).
	Remove sensor from the medium. Dry the membrane with a soft cloth.					
		C111	Start calibration	**Last sensor slope** Counter in second row counts down: 600 s → 0 s		The sensor slope is checked for 10 s after 530 s (permitted range 75 % to 140 %, outside range: error E032, calibration is aborted). The stability of the signal is checked during the last 60 s of the calibration (< 1%), if greater: error E044 and calibration is aborted.
		C112	Calibration status is displayed	o.k. E xxx		If the calibration status is not o.k., see chapter "System error messages".
		Immerse sensor in medium, if C112 = o. k.				.

Coding			Field	Selection or range (factory settings bold)	Display	Info
		C113	Store calibration results?	**yes** no new		If C112 = E xxx, then only no or **new**. If new, return to C. If yes/no, return to “Measurement”.
	C1 (2)		Single-point calibration in medium	Air (1) **Ref** (3)		The calibration value must be determined using an external method, e. g.: ▪ Oxygen handheld measuring device ▪ Winkler titration
		C121	Enter calibration value (value from external method)	**Current value**		Minimum value is 0.2 mg/l
		C122	Slope is displayed	**100.0 %** 75.0 to 140 %		
		C123	Calibration status is displayed	o.k. Exxx		If the calibration status is not o.k., see chapter "System error messages".
		C124	Store calibration results?	**yes** no new		If C123 = E xxx, then only no or **new**. If new, return to C. If yes/no, return to “Measurement”.

7 Diagnostics and troubleshooting

7.1 Troubleshooting instructions

The transmitter constantly monitors its functions itself. If an error occurs which the device recognizes, this is indicated on the display. The error number is shown below the display of the main measured value. If more than one error occurs, you can call these up with the MINUS key.
Refer to the "System error messages" table for the possible error numbers and remedial measures.
Should a malfunction occur without any transmitter error message, please refer to the "Process-specific errors" or the "Device-specific errors" tables to localize and rectify the error. These tables provide you with additional information on any spare parts required.

7.2 System error messages

The system error messages can be called up and selected with the MINUS key.

Error no.	Display	Tests and/or remedial measures	Alarm contact		Error current		Autom. cleaning start		PROFIBUS status	
			Facty	User	Facty	User	Facty	User	PV[1]	Temp
E001	EEPROM memory error	1. Switch device off and then on again.	Yes		No		—	—[2]	0C	0C
E002	Instrument not calibrated, calibration data invalid, no user data, user data invalid (EEPROM error), instrument software not suitable to hardware (controller)	2. Load device software compatible with the hardware (with optoscope, see "Optoscope service tool" section). 3. Load measurement-parameter specific device software. 4. If the error persists, send in the device for repair to your local service organisation or replace the device.	Yes		No		—	—[2]	0C	0C
E003	Download error	Invalid configuration. Repeat download, check optoscope.	Yes		No		No		0C	0C
E004	Instrument software version not compatible with module hardware version	Load software compatible with hardware. Load measurement-parameter specific device software.	Yes		No		No		0C	0C
E007	Transmitter malfunction, instrument software not compatible with transmitter version		Yes		No		—	—[2]	0C	0C
E008	Sensor or sensor connection faulty	Check sensor and sensor connection (Service).	Yes		Yes		—	—	0C	80
E010	Temperature sensor defective	Send in sensor for repair.	Yes		No		—	—	80	0C
E020	Signal range of sensor undershot	Check medium and sensor.	Yes		No		—	—	44	80
E022	Signal range of sensor exceeded	Check medium and sensor.	No		No		—	—	44	80
E032	During calibration signal outside permitted slope range 75 to 140 %	Check sensor and recalibrate.	Yes		No		—	—[2]	80	80
E044	During calibration sensor unstable	Check sensor and recalibrate.	No		No		No		80	80

Error no.	Display	Tests and/or remedial measures	Alarm contact		Error current		Autom. cleaning start		PROFIBUS status	
			Facty	User	Facty	User	Facty	User	PV[1)]	Temp
E057	Main parameter measuring range exceeded	Check measurement, control and connections.	Yes		No		No		44	80
E059	Below temperature measuring range		Yes		No		No		80	44
E061	Temperature measuring range exceeded		Yes		No		No		80	44
E063	Below current output range 1	Check configuration.	Yes		No		No		80	80
E064	Current output range 1 exceeded	Check measured value and current assignment.	Yes		No		No		80	80
E065	Below current output range 2		Yes		No		No		80	80
E066	Current output range 2 exceeded		Yes		No		No		80	80
E067	Alarm threshold limit contactor 1 exceeded	Check configuration.	Yes		No		No		80	80
E068	Alarm threshold limit contactor 2 exceeded		Yes		No		No		80	80
E069	Alarm threshold limit contactor 3 exceeded		Yes		No		No		80	80
E070	Alarm threshold limit contactor 4 exceeded		Yes		No		No		80	80
E080	Current output 1 range too small	Increase range in "Current outputs" menu.	Yes		No		–	—[2]	80	80
E081	Current output 2 range too small		Yes		No		–	—[2]	80	80
E082	Air pressure range undershot (<500 hPa)	Measurement only possible when uncompensated or with altitude data	Yes		No		No		80	80
E083	Air pressure range exceeded (>1100 hPa)		Yes		No		No		80	80
E085	Incorrect setting for error current	If the current range "0 to 20 mA" was selected in field O311, the error current "2.4 mA" may not be set.	Yes		No		No		80	80
E100	Current simulation active		No		No		–	—[2]	80	80
E101	Service function active	Switch off service function or switch device off and then on again.	No		No		–	—[2]	80	80
E102	Manual mode active		No		No		–	—[2]	80	80
E106	Download active	Wait for download to finish.	No		No		–	—[2]	80	80
E116	Download error	Repeat download.	Yes		No		–	—[2]	0C	0C
E152	Measuring signal of main parameter delayed or frozen (AC function / alternation check)	Inspect sensor and connection line, repair or replace.	Yes		No		No		44	44

Error no.	Display	Tests and/or remedial measures	Alarm contact		Error current		Autom. cleaning start		PROFIBUS status	
			Facty	User	Facty	User	Facty	User	PV[1]	Temp
E154	Below lower alarm threshold for period exceeding alarm delay	Perform manual comparison measurement if necessary. Service sensor and recalibrate.	Yes		No		No		-[3]	-
E155	Above upper alarm threshold for period exceeding alarm delay		Yes		No		No		-	-
E156	Actual value undershoots alarm threshold (CC setpoint) for longer than the set permissible maximum period		Yes		No		No		-	-
E157	Actual value exceeds alarm threshold (CC setpoint) for longer than the set permissible maximum period		Yes		No		No		-	-
E162	Dosage stop	Check settings in the CURRENT INPUT and CHECK function groups.	Yes		No		No		-	-
E171	Flow in main stream too low or zero	Restore flow.	Yes		No		No		-	-
E172	Switch-off limit for current input exceeded	Check process variables at sending measuring instrument. Change range assignment if necessary.	Yes		No		No		-	-
E173	Current input < 4 mA	Check process variables at sending measuring instrument.	Yes		No		No		-	-
E174	Current input > 20 mA	Check process variables at sending measuring instrument. Change range assignment if necessary.	Yes		No		No		-	-

1) PV = Process variable

2) If this error occurs, there is no possibility of starting a cleaning session (field F8 not applicable with this error).

3) Current error messages not applicable via PROFIBUS

7.3 Process specific errors

Use the following table to locate and correct errors.

Error	Possible cause	Tests and / or remedial measures	Equipment, spare parts, personnel
Value indicated 0.0	Sensor defective	– Test with new sensor. – Instrument test with sensor diagram. – Sensor current test.	Sensor type COS21 Sensor simulation see chapter "Maintenance of the entire measuring point".
	Sensor extension line interrupted	Check junction boxes and line.	Sensor simulation see chapter "Maintenance of the entire measuring point".
	Incorrect sensor connection	Check connection.	See chapter "Wiring".
	Instrument input defective	Replace module MKOH.	See spare parts list.
No or creeping display change	Sensor soiled	Clean sensor membrane.	See instructions for COS21. Heavily soiled media: use spray cleaning.
	Sensor installed in dead zone	Check installation conditions, move sensor to area with optimal flow conditions.	
Value indicated too small / sensor can probably not be calibrated	Membrane soiled	Clean sensor membrane.	See instructions for COS21. Heavily soiled media: use spray cleaning.
	Incorrect temperature measurement	Check temperature value.	Ref. measurement / thermometer.
	Incorrect altitude setting	Check altitude value.	
	Incorrect air pressure measurement	Check pressure value in field S11. sea level: approx. 1013 hPa. 500 m above sea level: approx. 950 hPa.	Only with version HS. Caution: display value = absolute atmospheric pressure.
	Electrolyte used up or soiled	Replace electrolyte.	See instructions for COS21.
	Flow rate too low	Check installation conditions, move sensor to area with optimal flow conditions.	
Value indicated too high / sensor can probably not be calibrated	Incorrect altitude setting	Check altitude value.	
	Incorrect air pressure measurement	Check pressure value in field S11. sea level: approx. 1013 hPa. 500 m above sea level: approx. 950 hPa.	Only with version HS. Caution: display value = absolute atmospheric pressure.
	Electrolyte or soiled	Replace electrolyte.	See instructions for COS21.
	Air cushion under membrane	Install new membrane cap.	For procedures and spare parts ordering see instructions for COS21.
Fixed incorrect measured value	Impermissible instrument operating state (no response to key actuation)	Switch instrument off and back on.	EMC problem: check line routing. If problem persists, check for possible sources of interference.
Incorrect temperature value	Incorrect sensor connection	Verify connections using connection diagram.	Connection diagram in chapter "Electrical connection".
	Measuring cable defective	Check cable for interruption/short circuit/ shunt.	Ohmmeter or on-site simulation.
	Temp. sensor defective	Measure resistance value in sensor (red and brown sensor lines).	Ohmmeter / values see chapter "Simulation temperature sensor".
Measured value variations	Faults on measuring cable	Connect cable screening according to circuit diagram.	See chapter "Wiring".
	Faults on signal output line	Check line routing, possibly route line separately.	Separate signal output, measuring input and power supply lines.
	Irregular flow/turbulences/large air bubbles	Select a better installation site or calm turbulences. Possibly use large measured value damping factor.	Measured value damping see field A5.
Controller or timer cannot be activated	No relay module available	Install module LSR1-2 or LSR1-4.	

Error	Possible cause	Tests and / or remedial measures	Equipment, spare parts, personnel
Controller/limit contact does not work	Controller switched off	Activate controller.	See fields R2xx.
	Controller in "Manual/Off" mode	Choose "Auto" or "Manual/On" mode.	Keyboard, REL-key
	Pickup delay setting too long	Disable or shorten pickup delay.	See fields R2xx.
	"Hold" function active	"Automatic Hold" during calibration, "Hold" input activated; "Hold" via keyboard active.	See fields S2 to S4.
Controller/limit contact works continuously	Controller in "Manual/On" mode	Set controller to "Manual/Off" or "Auto".	Keyboard, REL and AUTO keys.
	Dropout delay setting too long	Shorten dropout delay.	See field R2xx.
	Control loop interruption	Check measured value, current output, actuators, chemical supply.	
No O_2 current output signal	Line open or short-circuited	Disconnect line and measure directly on instrument.	mA meter 0–20 mA.
	Instrument with PROFIBUS PA/DP	PA/DP instruments have no current output.	
Fixed current output signal	Current simulation active	Switch off simulation.	See field O3.
	Impermissible operating state of processor system	Switch instrument off and back on.	EMC problem: check installation, screen, grounding if problem persists.
Incorrect current output signal	Incorrect current assignment	Check current assignment: 0–20 mA or 4–20 mA?	Field O311
	Total load in current loop excessive (> 500 Ω.)	Disconnect output and measure directly on instrument.	mA meter for 0–20 mA DC.
Current output table not accepted	Value interval too small	Select appropriate intervals.	
No temperature output signal	Instrument does not have 2nd current output	Refer to nameplate for variant; change LSCH-x1 module if necessary.	Module LSCH-x2, see chapter "Spare parts".
	Instrument with PROFIBUS PA	PA instrument has no current output!	
Chemoclean function not available	No relay module (LSR1-x) installed or only LSR1-2 available Additional function not enabled	Install LSR1-4 module. Chemoclean is enabled using the release code supplied by E+H in the Chemoclean retrofit kit.	Module LSR1-4, see chapter "Spare parts".
Plus package functions not available	Plus package not enabled (enable with code that depends on serial number and is received from E+H with order of extension package)	– When upgrading instrument with Plus package: code received from E+H ⇒ enter. – After replacing defective LSCH/LSCP module: first enter instrument serial number (s. nameplate) manually, then enter code.	For a detailed description, see chapter "Replacement of central module".

Error	Possible cause	Tests and / or remedial measures	Equipment, spare parts, personnel
No HART communication	No central HART module	Verify by looking at nameplate: HART = -xxx5xx and -xxx6xx.	Upgrade to LSCH-H1 / -H2.
	No or wrong DD (device description)	For further information see BA00208C/07/EN, “HART® - Field communication with Liquisys M CxM223/253”.	
	HART interface missing		
	Instrument not registered with HART server		
	Load too low (load > 230 Ω required)		
	HART receiver (e.g. FXA 191) not connected via load but via power supply		
	Incorrect device address (addr. = 0 for single operation, addr. > 0 for multi-drop operation)		
	Line capacitance too high		
	Line interferences		
	Several devices set to same address	Set addresses correctly.	Communication not possible with several devices set to same address.
No PROFIBUS® communication	No central PA/DP module	Verify by looking at nameplate: PA = -xxx3xx /DP = xxx4xx.	Upgrade to LSCP module, see chapter "Spare parts".
	Incorrect instrument software version (without PROFIBUS)	For further information, see BA00209C/07/EN "PROFIBUS PA/DP - Field communication with Liquisys M CxM223/253".	
	Commuwin (CW) II: Incompatible CW II and instrument software versions		
	No or incorrect DD/DLL		
	Incorrect baud rate setting for segment coupler in DPV-1 server		
	Incorrect station (master) addressed or duplicate address		
	Incorrect station (slaves) address		
	Bus line not terminated		
	Line problems (too long, cross section too small; not shielded, screen not grounded, wires not twisted)		
	Bus voltage too low (bus supply voltage typ. 24 V DC for non-Ex)	Voltage at instrument’s PA/DP connector must be at least 9 V.	

7.4 Instrument specific errors

The following table helps you with the diagnosis and points to any spare parts required.

Depending on the degree of difficulty and the measuring equipment present, diagnosis is carried out by:
- Trained operator personnel
- The user's trained electrical technicians
- Company responsible for system installation/operation
- Endress+Hauser Service

Information on the exact spare part designations and on how to install these parts can be found in the "Spare parts" section.

Error	Possible cause	Tests and/or remedial measures	Execution, tools, spare parts
Device cannot be operated, display value 9999	Operation locked	Press CAL and MINUS keys simultaneously.	See "Function of keys" section.
Display dark, no light-emitting diode active	No line voltage	Check whether line voltage is present.	Electrical technician/e.g. multimeter
	Supply voltage wrong/too low	Compare actual line voltage and nameplate data.	User (data for energy supply company or multimeter)
	Connection faulty	Terminal not tightened; insulation jammed; wrong terminals used.	Electrical technician
	Device fuse defective	Compare line voltage and the nameplate data and replace fuse.	Electrical technician/suitable fuse; see drawing in "Spare parts" section.
	Power unit defective	Replace power unit, note variant.	On-site diagnosis by Endress+Hauser Service, test module necessary
	Central module defective	Replace central module, note variant.	On-site diagnosis by Endress+Hauser Service, test module necessary
	COM253F: ribbon cable item 310 loose or defective	Check ribbon cable, renew if necessary.	See "Spare parts" section.
Display dark, light-emitting diode active	Central module defective (module: LSCH/LSCP)	Renew central module, note variant.	On-site diagnosis by Endress+Hauser Service, test module necessary
Display is on but – No change in display and/or – Device cannot be operated	Device or module in device not correctly mounted	COM223F: reinstall module. COM253F: reinstall display module.	Perform with the aid of the installation drawings in the "Spare parts" section.
	Operating system in unpermitted mode	Switch device off and then on again.	Poss. EMC problem: if this persists, check the installation.
Device gets hot	Voltage wrong/too high	Compare line voltage and nameplate data.	User, electrical technician
	Power unit defective	Replace power unit.	Diagnosis only by Endress+Hauser Service
Incorrect meas. O_2 and/or temperature	Transmitter module defective (module: MKOH), please first carry out tests and take measures as per the "Process errors without messages" section to make sure that the error is not in the cabling or in the sensor	Measuring input test MKOH: – Connect resistors for oxygen and temperature, see chapter "Simulation oxygen measurement".	If test negative: replace module (note variant). Perform with the aid of the exploded view drawings in the "Spare parts" section.
	Incorrect sensor current	Sensor current readable in the display in measurement mode by pressing PLUS key 3x.	Display in nA. Nominal value in air for 20 °C and 1013 hPa: 60 nA
Pressure value incorrect / unreadable	Defective pressure sensor	Module MKOH defective	Pressure readable in field S11 Caution: The absolute air pressure is displayed, do not compare with barometer!
	No pressure sensor available	Module MKOH without sensor installed	

Error	Possible cause	Tests and/or remedial measures	Execution, tools, spare parts
Current output, current value incorrect	Adjustment not correct	Check with installed current simulation, connect mA meter directly to current output.	If simulation value incorrect: adjustment in factory or new module LSCH required. If simulation value correct: check current loop for load and shunts.
	Load too big		
	Shunt/short to ground in current loop		
	Incorrect mode of operation	Check whether 0–20 mA or 4–20 mA is selected.	
No current output signal	Current output stage defective (module LSCH/LSCP)	For safety reasons, first completely disconnect the auxiliary power output. Check with installed current simulation, connect mA meter directly to current output.	If test negative: Renew central module LSCH (note variant).
No function of additional relay	COM253F: ribbon cable item 320 loose or defective	Check ribbon cable seating, renew cable if required.	See "Spare parts" section.
Only 2 additional relays can be triggered	Relay module LSR1-2 installed with 2 relays	Upgrade to LSR1-4 with 4 relays.	User or Endress+Hauser Service
Additional functions (Plus package) missing	No or incorrect release code used	If retrofitting: check whether the correct serial number was quoted when ordering the Plus package.	Handled by Endress+Hauser Sales
	Incorrect device serial number saved in LSCH/LSCP module	Check whether serial number on the nameplate matches SNR in LSCH/ LSCP (field S 8).	The serial number of the device is definitive for the Plus package.
Additional functions (Plus package and/or Chemoclean) missing after LSCH/LSCP module replaced	Replacement modules LSCH or LSCP have the **device** serial number 0000 when they leave the factory. The Plus package or Chemoclean are not enabled on leaving the factory.	In the case of LSCH/LSCP with SNR 0000, a **device** serial number can be entered once in fields E113 to E115. Then enter the release code for the Plus package and/or Chemoclean.	For a detailed description, see "Replacing central module" section.
No HART or PROFIBUS-PA/-DP interface function	Incorrect central module	HART: LSCH-H1 or H2 module, PROFIBUS-PA: LSCP-PA module, PROFIBUS-DP: LSCP-DP module, see field E112.	Replace central module; user or Endress+Hauser Service.
	Wrong software	SW version see field E111.	SW can be modified with optoscope.
	Bus problem	Remove some devices and repeat the test.	Contact Endress+Hauser Service.

8 Maintenance

Take all the necessary measures in time to guarantee the operational safety and reliability of the entire measuring system.

Maintenance work at the transmitter comprises:
- Calibration (see "Calibration" section)
- Cleaning of assembly and sensor
- Cable and connection check

When performing any work on the device, bear in mind any potential impact this may have on the process control system or on the process itself.

NOTICE
Electrostatic discharge (ESD)
Risk of damage to electronic components
- ▶ Take personal protective measures to avoid ESD, such as discharging beforehand at PE or permanent grounding with a wrist strap.
- ▶ For your own safety, use only genuine spare parts. With genuine spare parts, the function, accuracy and reliability are also guaranteed after repair.

8.1 Maintenance of the entire measuring point

8.1.1 Cleaning the transmitter

Clean the front of the housing with usual commercial cleaning agents.

In accordance with DIN 42 115, the front is resistant to:
- Ethanol (short periods)
- Diluted acids (max. 2% HCl)
- Diluted bases (max. 3% NaOH)
- Soap-based household cleaners

NOTICE
Prohibited cleaning agents
Damage to the housing surface or housing seal
- ▶ For cleaning purposes, never use concentrated mineral acids or bases.
- ▶ Never use organic cleaners such as benzyl alcohol, methanol, methylene chloride, xylene or concentrated glycerol cleaner.
- ▶ Never use high-pressure steam for cleaning purposes.

8.1.2 Transmitter check

Simulation of oxygen measurement
To perform a functional test of the instrument, the COS21 sensor can be simulated by resistors. Since the display value greatly depends on the sensor slope setting and on temperature, the following values should be considered as reference values:

Simulation resistance	Display value
∞ (open)	0 mg O_2/l
13 MΩ	7 to 13 mg O_2/l
With 13 MΩ and a temperature equivalent resistance of 27.0 kΩ after calibration	9.0 to 9.2 mg O_2/l
27.7 MΩ	3.3 to 6.1 mg O_2/l

Simulation temperature sensor
The COS21 sensor uses an NTC sensor (22.0 kΩ/25 °C) for temperature measurement. Use the following equivalent resistances to test the temperature measurement:

Simulation resistance	Display value
64.9 kΩ	0.0 °C (32 °F)
41.3 kΩ	10.0 °C (50 °F)
27.0 kΩ	20.0 °C (68 °F)
22.0 kΩ	25.0 °C (77 °F)
18.0 kΩ	30.0 °C (86 °F)

Test procedure

1. Connect the O_2 equivalent resistance (e.g. decade resistor) to terminals 90 and 91.
2. Connect the temperature equivalent resistance (e.g. decade resistor) to terminals 11 and 12.
3. Air pressure measurement:
   The air pressure measured can be checked in field S11 (absolute air pressure).

8.1.3 Maintenance oxygen sensors

Please refer to the technical information TI00244C/07/EN for your sensor with regard to sensor maintenance and trouble-shooting.

The technical information contains detailed information including:
- Sensor design and function
- Mounting and installation
- Electrical connection
- Calibration
- Maintenance and cleaning
- Accessories
- Technical data and ordering information

8.1.4 Maintenance assembly

Please refer to the corresponding assembly Operating Instructions for information on maintaining and trouble-shooting the assembly. Here you can find a description for assembling and disassembling, sensor replacement, seal replacement, as well as information on stability and spare parts and accessories.

8.1.5 Connecting lines and junction boxes

Since COS21 works with low measuring currents, shunts in connecting cables and junction boxes may cause considerable inaccuracy.

The following is to be assured:
- Intact gaskets on lids and cable glands
- Dry and clean inner compartment (if necessary dry, clean and insert a dehydrating bag)
- Lines ferrules, terminals and connectors must be free of corrosion
- Terminal screws must be tightened firmly
- Cables must enter junction boxes and instruments from below
- Make a downward cable loop in case of lateral cable entries to allow water to drip off

If the function test explained in the previous chapter is performed on a junction box instead of the instrument, the junction box, terminals and connecting line to the instrument are automatically included in the test.

9 Repair

9.1 Spare parts

Spare parts are to be ordered from your sales center responsible. Specify the order numbers listed in the chapter "Spare parts kits".

To be on the safe side, you should **always** specify the following data with your spare part orders:
- Instrument order code (order code)
- Serial number (serial no.)
- Software version where available

Refer to the nameplate for the order code and serial number.
The software version is displayed in the instrument software (see chapter "Instrument configuration") if the instrument processor system is functional.

9.2 Dismantling the panel-mounted instrument

Please note the effects on the process if the device is taken out of service!

Please refer to the diagram on the following page for the item numbers.

1. Disconnect the terminal block (item 424 b) from the rear of the device to de-energize the device.
2. Then remove the terminal blocks (item 424 a and pos. 430) from the rear of the device. Now you can disassemble the device.
3. Press in the latches of the end frame (item 340) and remove the frame from the rear.
4. Release the special screw (item 400) by turning it counter-clockwise.
5. Remove the entire electronics block from the housing. The modules are only mechanically connected and can be easily separated:
   – Simply remove the processor/display module from the front.
   – Pull out the brackets of the rear plate (item 320) slightly.
   – Now you can remove the side modules.
6. Remove the O_2 transmitter (item 270/280) as follows:
   – Using fine side-cutting pliers, nip off the heads of the synthetic distance holders.
   – Then remove the module from above.

Assembly is the reverse of the disassembly sequence. Tighten the special screw hand-tight without a tool.

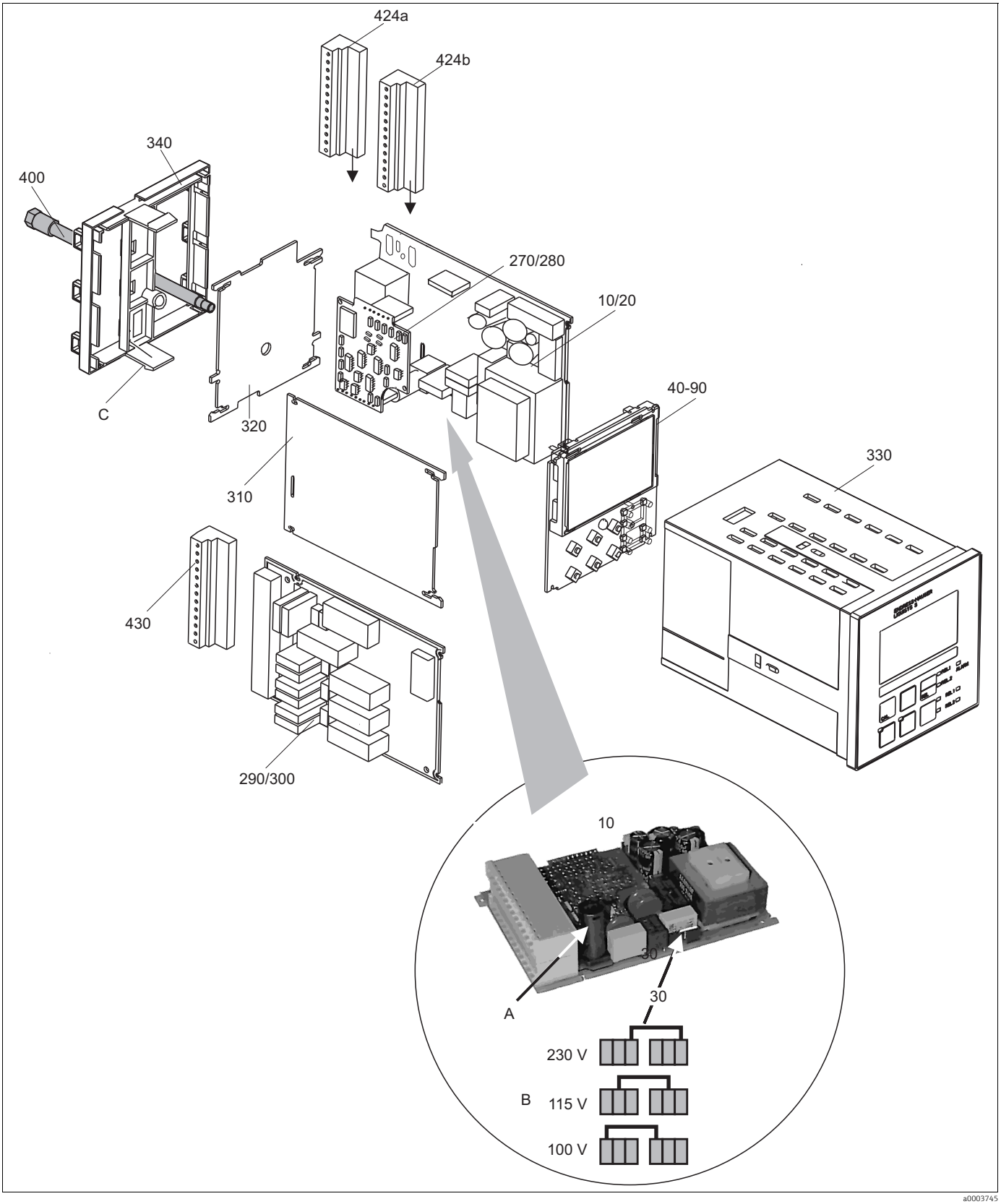


Fig. 31: Exploded view drawing of panel mounted instrument

The exploded view drawing contains the components and spare parts of the panel-mounted instrument. You can take the spare parts and the corresponding order number from the following section using the item numbers.

Item	Kit description	Name	Function/contents	Order number
10	Power unit (main module)	LSGA	100 / 115 / 230 V AC	51500317
20	Power unit (main module)	LSGD	24 V AC + DC	51500318
30	Jumper		Part of power unit item 10	
40	Central module (controller)	LSCH-S1	1 current output	51501225
50	Central module (controller)	LSCH-S2	2 current outputs	51501222
60	Central module (controller)	LSCH-H1	1 current output + HART	51501223
70	Central module (controller)	LSCH-H2	2 current outputs + HART	51501226
80	Central module (controller)	LSCP-PA	PROFIBUS PA/no current output	51501227
90	Central module (controller)	LSCP-DP	PROFIBUS DP/no current output	51502500
90	Kit COM2x3 Central module PROFIBUS DP	LSCP-DP	Central module PROFIBUS DP Relay module + 2 relays Current input and terminals valid of: hardware version 2.10	71134729
270	O_2 transmitter	MKOH	O_2 + temperature for COS21	51503352
280	O_2 transmitter	MKOH	O_2 + temperature + air pressure	51503353
290	Relay module	LSR1-2	2 relays	51500320
290	Relay module	LSR2-2i	2 relays + current input 4 to 20 mA	51504304
290	Kit CxM2x3 Relay module PROFIBUS DP	LRS2-DP	Relay module + 2 relays Current input and terminals DP valid of: hardware version 2.10	71134732
300	Relay module	LSR1-4	4 relays	51500321
300	Relay module	LSR2-4i	4 relays + current input 4 to 20 mA	51504305
310	Side panel		Kit with 10 parts	51502124
310, 320, 340, 400	Housing mechanical parts		Rear plate, side panel, end frame, special screw	51501076
330, 400	Housing module		Housing with front membrane, sensory tappets, gasket, special screw, tensioning dogs, connection plates and nameplates	51501075
340	End frame PROFIBUS-DP		Rear frame for PROFIBUS DP, with D-submin plug connector	51502513
424a, 424b	Terminal strip set Standard + HART / DX + DS		Complete terminal strip set, standard + HART	51501204
424a, 424b	Terminal strip set PROFIBUS PA / DX + DS		Complete terminal strip set, PROFIBUS PA	51502127
424a, 424b	Terminal strip set PROFIBUS DP / DX + DS		Complete terminal strip set, PROFIBUS DP	51502492
430	Terminal strip		Terminal strip for relay module	51501078
A	Fuse		Part of power unit, item 10	
B	Choice of line voltage		Position of jumper on power unit, item 10 depending on line voltage	
C	End frame latches		Part of the end frame	

9.3 Dismantling the field instrument

Please note the effects on the process if the device is taken out of service!

Please refer to the diagram on the following page for the item numbers.

To dismantle the field instrument you need the following tools:
- Standard set of screwdrivers
- Torx-screwdriver size TX 20

Proceed as follows:

1. Open and remove the cover of the connection compartment (item 420).
2. Disconnect the mains terminal (item 470) to de-energize the device.
3. Open the display cover (item 410) and loosen the ribbon cables (item 310/320) on the side of the central module (item 40 to 90).
4. To remove the central module (item 40), loosen the screw in the display cover (item 450 b).
5. Proceed as follows to remove the electronics box (item 330):
   – Release the screws in the housing base (item 450 a) with two revolutions.
   – Then push the entire box backwards and remove it from above.
   – Make sure that module locks do not open!
   – Loosen the ribbon cables (item 310/320).
   – Bend the module locks out and remove the modules.
6. To remove the docking module (item 340), remove the screws in the housing base (item 450 c) and remove the entire module from above.
7. Proceed as follows to remove the O_2 transmitter (item 270/280):
   – Using fine side-cutting pliers, nip off the heads of the synthetic distance sleeves.
   – Then remove the module from above.

To assemble, carefully push the modules into the trolley tracks of the electronics box and let them engage in the side box noses.

Incorrect mounting is not possible. Modules inserted in the electronics box incorrectly are not operable since the ribbon cables cannot be connected.
Make sure the cover seals are intact to guarantee IP 65 ingress protection.

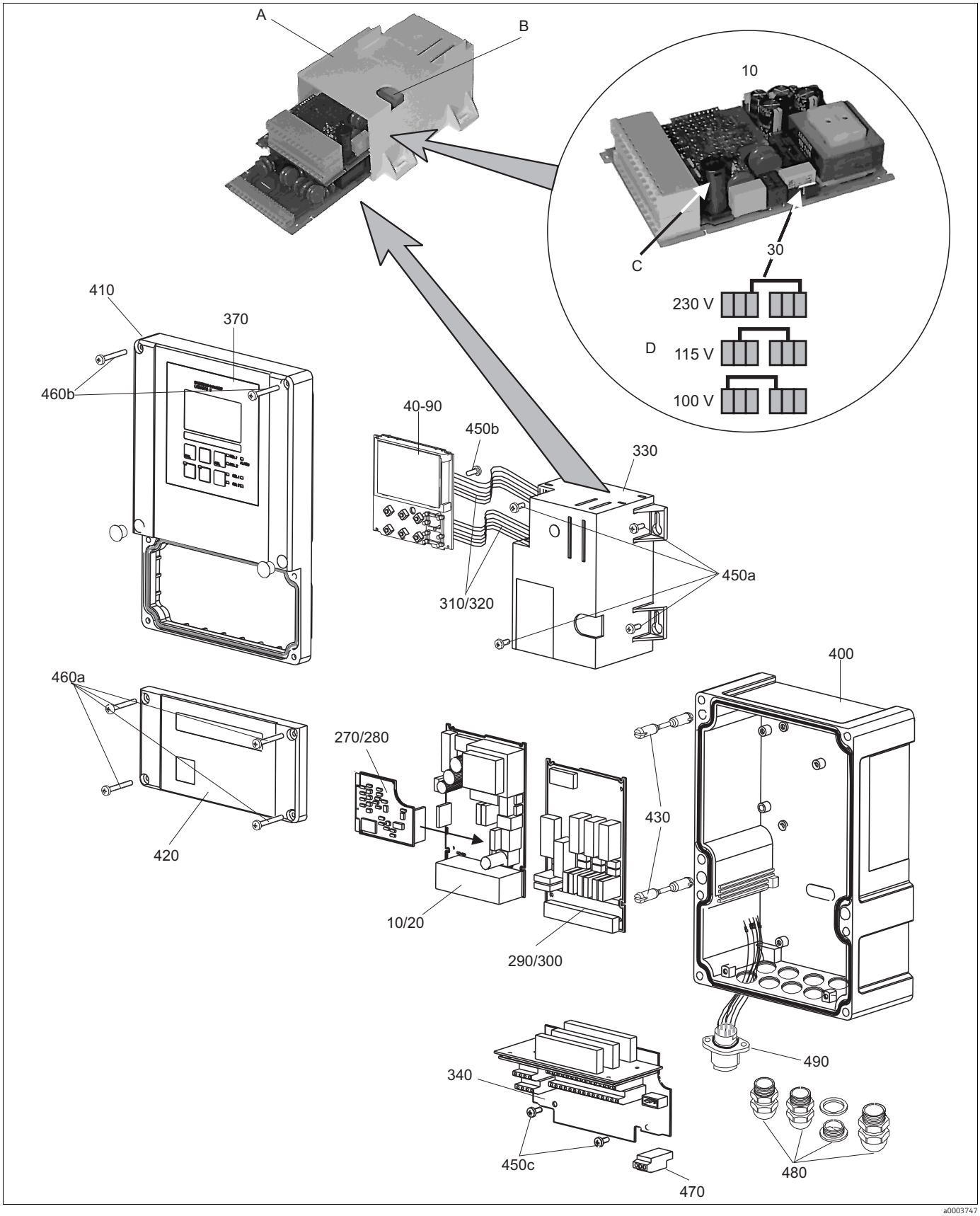


Fig. 32: Exploded view drawing of field instrument

The exploded view drawing contains the components and spare parts of the field device. You can take the spare parts and the corresponding order number from the following section using the item numbers.

Item	Kit description	Name	Function/contents	Order number
10	Power unit (main module)	LSGA	100 / 115 / 230 V AC	51500317
20	Power unit (main module)	LSGD	24 V AC + DC	51500318
30	Jumper		Part of power unit item 10	
40	Central module (controller)	LSCH-S1	1 current output	51501225
50	Central module (controller)	LSCH-S2	2 current outputs	51501222
60	Central module (controller)	LSCH-H1	1 current output + HART	51501223
70	Central module (controller)	LSCH-H2	2 current outputs + HART	51501226
80	Central module (controller)	LSCP	PROFIBUS PA/no current output	51501227
90	Central module (controller)	LSCP-DP	PROFIBUS DP/no current output	51502500
90	Kit COM2x3 Central module PROFIBUS DP	LSCP-DP	Central module PROFIBUS DP Relay module + 2 relays Current input and terminals valid of: hardware version 2.10	71134729
270	O_2 transmitter	MKOH	O_2 + temperature for COS21	51503352
280	O_2 transmitter	MKOH	O_2 + temperature + air pressure	51503353
290	Relay module	LSR1-2	2 relays	51500320
290	Relay module	LSR2-2i	2 relays + current input 4 to 20 mA	51504304
290	Kit CxM2x3 Relay module PROFIBUS DP	LSR2-DP	Relay module + 2 relays Current input and terminals DP valid of: hardware version 2.10	71134732
300	Relay module	LSR1-4	4 relays	51500321
300	Relay module	LSR2-4i	4 relays + current input 4 to 20 mA	51504305
310, 320	Ribbon cable lines		2 ribbon cable lines	51501074
330, 340, 450	Internal housing parts		Docking assembly, empty electronics box, small parts	51501073
450a, 450c	Torx screws K4x10		Internal housing parts	
450b	Torx screw for central module		Internal housing parts	
370, 410, 420, 430, 460	Housing cover		Display cover, connection compartment cover, front membrane, hinges, cover screws, small parts	51501068
460a, 460c	Screws for housing cover		Parts of housing cover	
400, 480	Housing base		Base, threaded joints	51501072
430	Hinges		2 pairs of hinges	51501069
470	Terminal strip		Terminal strip for connection to mains	51501079
A	Electronics box with relay module LSR1-x (bottom) and power unit LSGA/LSGD (top)			
B	Fuse also accessible if electronics box installed			
C	Fuse		Part of power unit, item 10	
D	Choice of line voltage		Position of jumper on power unit, item 10 depending on desired line voltage	

9.4 Replacing the central module

Generally, when a central module has been replaced, all data which can be changed are set to the factory setting.

Proceed as described below if a central module is replaced:

1. If possible, note the customized settings of the device, such as:
   - Calibration data
   - Current assignment, main parameter and temperature
   - Relay function selections
   - Limit value/controller settings
   - Cleaning settings
   - Monitoring functions
   - Interface parameters
2. Disassemble the device as explained in the "Dismantling the panel-mounted instrument" or "Dismantling the field instrument" section.
3. Use the part number on the central module to check whether the new module has the same part number as the previous module.
4. Assemble the device with the new module.
5. Start up the device again and check the basic functions (e.g. measured value and temperature display, operation via keyboard).
6. Enter the serial number:
   - Read the serial number (“ser-no.”) on the nameplate of the device.
   - Enter this number in the fields E115 (year, one-digit), E116 (month, one-digit), E117 (consecutive number, four-digit).
   - In the field E118, the complete number is displayed again so you can check it is correct.

     You can only enter the serial number for new modules with the serial number 0000. This can only be done **once**! For this reason, make sure the number entered is correct before you confirm with ENTER!
     Entry of an incorrect code will prevent the additional functions from being enabled. An incorrect serial number can only be corrected at the factory!

     Press ENTER to confirm the serial number or cancel the entry to enter the number again.
7. If available, enter the release codes for the Plus Package and/or Chemoclean in the "Service" menu.
8. Check the Plus Package release (e.g. by opening the function group CHECK / Code P) or the Chemoclean function.
9. Make the customer device settings again.

9.5 Return

The device must be returned if repairs or a factory calibration are required, or if the wrong device has been ordered or delivered. According to legal regulations, Endress+Hauser, as an ISO-certified company, is required to follow certain procedures when handling returned products that are in contact with medium.

To ensure swift, safe and professional device returns, please read the return procedures and conditions on the internet site:
www.services.endress.com/return-material

9.6 Disposal

The device contains electronic components and must therefore be disposed of in accordance with regulations on the disposal of electronic waste.
Please observe local regulations.

10 Accessories

10.1 Sensors

Oxymax H COS22D
- ▶ Sterilizable sensor for dissolved oxygen, with Memosens technology
- ▶ Ordering acc. to product structure, see Technical Information (TI00446C/07/EN)

10.2 Connection accessories

Special measuring cable COK21
- Cable length 3 m (9.8 ft)
  order no. 51505870
- Cable length 10 m (33 ft)
  order no. 51505868

CYK71 measuring cable
- non-terminated cable for the connection of sensors or the extension of sensor cables
- sold by the meter, order number: 50085333

Junction box VBM
- for cable extension for sensors COS41, COS4 (fixed cable versions)
- with 10 terminals, IP 65 / NEMA 4X
- Order numbers:
  - Cable entry Pg 13.5: 50003987
  - Cable entry NPT ½": 51500177

10.3 Mounting accessories

CYY101 weather protection cover for field devices, absolutely essential if operating the unit outdoors
- Material: stainless steel 1.4031 (AISI 304)
- Order No. CYY101-A

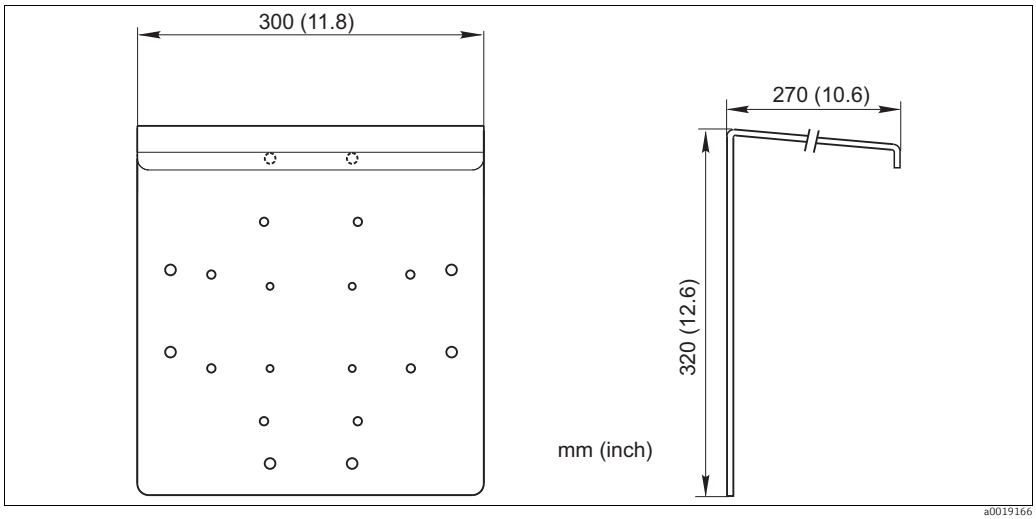


Fig. 33: Weather protection cover for field devices

CYY102 universal post
- Square pipe for mounting transmitters
- Material: stainless steel 1.4301 (AISI 304)
- Order No. CYY102-A

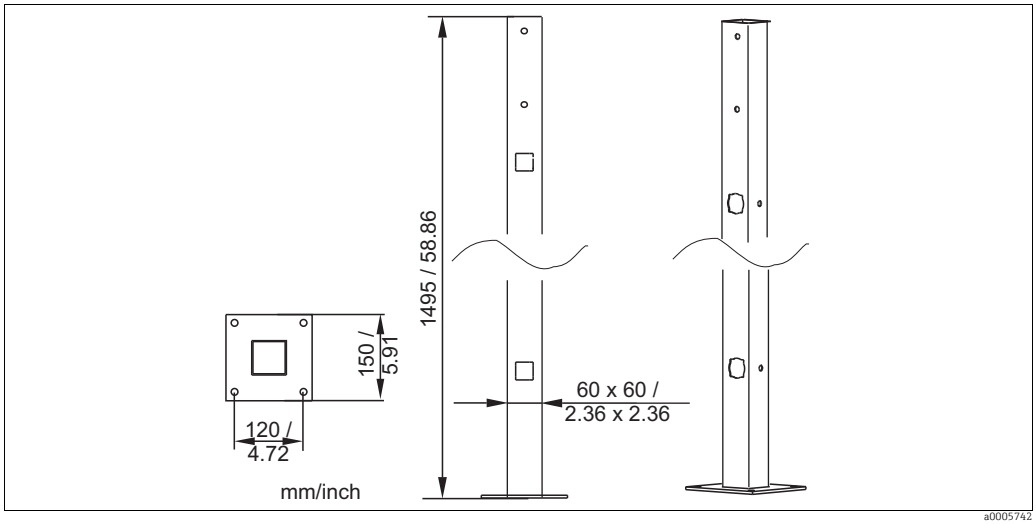


Fig. 34: Universal post

Post mounting kit
- For mounting of field housing on horizontal or vertical pipes (Ø max. 60 mm (2.36"))
- Material: stainless steel 1.4301
- order no. 50086842

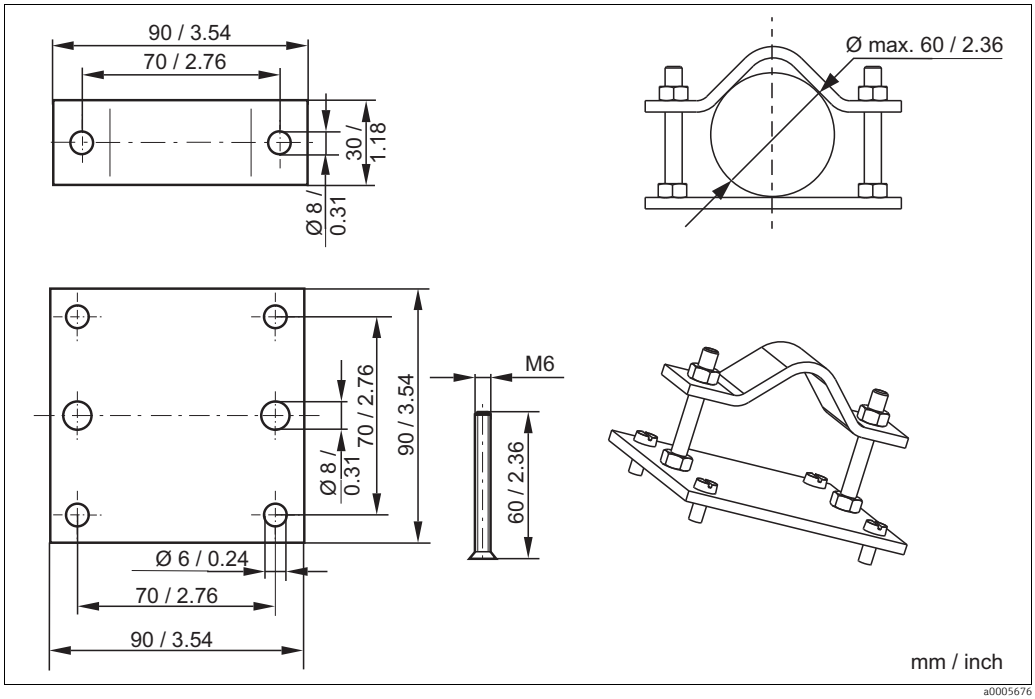


Fig. 35: Post mounting kit

10.4 Software and hardware add-ons

The add-ons can only be ordered by quoting the serial number of the device in question.

- Plus Package
  Order no. 51501679
- Chemoclean
  Order no. 51500963
- Two-relay card
  Order no. 51500320
- Four-relay card
  Order no. 51500321
- Two-relay card with current input
  Order no. 51504304
- Four-relay card with current input
  Order no. 51504305

11 Technical data

11.1 Input

Measured variables	Oxygen Temperature	
Measuring range	Oxygen measurement with COS22 (standard sensor): Oxygen concentration Saturation index Temperature:	 0.01 to 60 mg/l 0 to 600 % SAT -10 to 130 °C (+14 to 266 °F)
Cable specification	max. 50 m with COK21	
O_2 Signal input	Signal current:	0 to 650 nA
Binary inputs	Voltage: Power consumption:	10 to 50 V max. 10 mA
Current input	4 to 20 mA, galvanically separated Load: 260 Ω at 20 mA (voltage drop 5.2 V)	

11.2 Output

Output signal

0/4 to 20 mA, galvanically separated, active

HART	
Signal coding	Frequency Shift Keying (FSK) + 0.5 mA via current output signal
Data transfer rate	1200 Baud
Galvanic isolation	yes

PROFIBUS PA	
Signal coding	Manchester Bus Powered (MBP)
Data transfer rate	31.25 kBit/s, voltage mode
Galvanic isolation	yes (IO-Module)

PROFIBUS DP	
Signal coding	RS485
Data transfer rate	9.6 kBd, 19.2 kBd, 93.75 kBd, 187.5 kBd, 500 kBd, 1.5 MBd
Galvanic isolation	yes (IO-Module)

Signal on alarm

2.4 or 22 mA in case of an error

Load

maximum 500 Ω

Transmission range

COS22:
- Oxygen concentration: Δ 0.2 to Δ 60 mg/l
- Saturation index: Δ 2 to Δ 600 % SAT

Temperature: Δ 10 to Δ 140 K

Resolution

max. 700 digits/mA

Isolation voltage

max. 350 V_{RMS}/500 V DC

Overvoltage protection

according to EN 61000-4-5

Auxiliary voltage output

Output voltage: 15 V ± 0.6
Output current: max. 10 mA

Contact outputs

Switching current with ohmic load (cos φ = 1): max. 2 A
Switching current with inductive load (cos φ = 0.4): max. 2 A
Switching voltage: max. 250 V AC, 30 V DC
Switching power with ohmic load (cos φ = 1): max. 500 VA AC, 60 W DC
Switching power with inductive load (cos φ = 0.4): max. 500 VA AC, 60 W DC

Limit contactor

Pickup/dropout delay: 0 to 2000 s

Controller

Function (adjustable):	pulse length/pulse frequency controller
Controller response:	PID
Control gain K_p:	0.01 to 20.00
Integral action time T_n:	0.0 to 999.9 min
Derivative action time T_v:	0.0 to 999.9 min
Period for pulse length controller:	0.5 to 999.9 s
Frequency for pulse frequency controller:	60 to 180 min^{-1}
Basic load:	0 to 40% of max. set value

Alarm

Function (switchable):	latching/momentary contact
Alarm threshold adjustment range:	O_2 / temperature: entire measuring range, depending on sensor type
Alarm delay:	0 to 2000 s (min)
Monitoring time lower limit violation:	0 to 2000 min
Monitoring time upper limit violation:	0 to 2000 min

Protocol specific data

HART	
Manufacturer ID	11_h
Device type code	0094_h
Transmitter specific revision	0001_h
HART specification	5.0
DD files	www.products.endress.com/hart
Load HART	250 Ω
Device variables	None (dynamic variables PV, SV, only)
Features supported	-

PROFIBUS PA	
Manufacturer ID	11_h
Ident number	1518_h
Device revision	11_h
Profile version	2.0
GSD files	www.products.endress.com/profibus
GSD file version	
Output values	Main value, temperature value
Input values	Display value of PLC
Features supported	Device locking: The device can be locked by hardware or software.

PROFIBUS DP	
Manufacturer ID	11_h
Ident number	$151E_h$
Profile version	2.0
GSD files	www.products.endress.com/profibus
GSD file version	
Output values	Main value, temperature value
Input values	Display value of PLC
Features supported	Device locking: The device can be locked by hardware or software.

11.3 Power supply

Supply voltage

Depending on ordered version:
100/115/230 V AC +10/-15 %, 48 to 62 Hz
24 V AC/DC +20/-15 %

Fieldbus connection

HART	
Supply voltage	n/a, active current outputs
Integrated reverse voltage protection	n/a, active current outputs

PROFIBUS PA	
Supply voltage	9 V to 32 V, max. 35 V
Polarity sensitive	no
FISCO/FNICO compliant acc. to IEC 60079-27	no

PROFIBUS DP	
Supply voltage	9 V to 32 V, max. 35 V
Polarity sensitive	n/a
FISCO/FNICO compliant acc. to IEC 60079-27	no

Power consumption

max. 7.5 VA

Mains protection

Fine-wire fuse, medium-slow blow 250 V/3.15 A

11.4 Performance characteristics

Resolution	Oxygen	
	COS22 (standard sensor):	0.01 mg/l / 0.2 hPa / 0.02 Vol. % (gaseous media)
	Temperature:	0.1 °C
Maximum measured error[1)]	Display	
	Oxygen:	±0.03 mg/l, ±0.3 % SAT
	Temperature:	max. 1.0 % from -10 to +60 °C (+14 to 140 °F)
	Signal output	
	Oxygen:	max. 0.75 % of measuring range
	Temperature:	max. 1.25 % of measuring range
Repeatability	±0.05 mg/l, ±0.5 % SAT	
Temperature compensation range	0 to 50 °C (32 to 104 °F)	
Pressure compensation range	500 to 1100 hPa	
Altitude adjustment range	0 to 4000 m (0 to 13,000 ft)	
Salinity adjustment range	0 to 4 %	
Slope adjustment range	COS22:	75 to 140 % (nominal: 60 nA, in air, 20 °C, 1013 hPa)

1) acc. to IEC 746-1, for nominal operating conditions

11.5 Environment

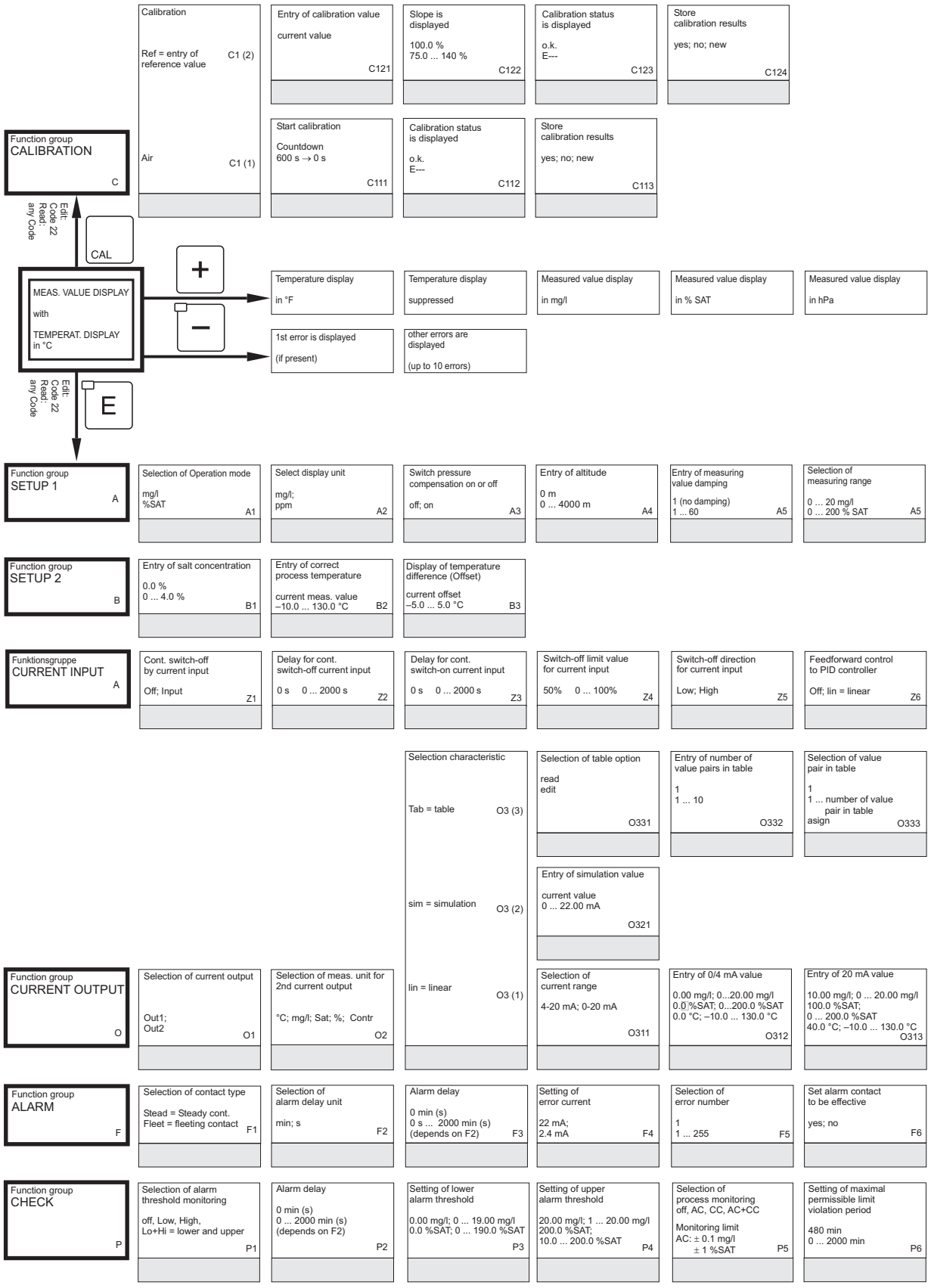
Ambient temperature	-10 to +55 °C (+14 to +131 °F)	
Storage temperature	–25 to +65 °C (-13 to +149 °F)	
Electromagnetic compatibility	Interference emission and interference immunity as per EN 61326-1:2006, EN 61326-2-3:2006	
Ingress protection	Panel mounted instrument: Field instrument:	IP 54 (front), IP 30 (housing) IP 65 / tightness acc. to NEMA 4X
Electrical safety	according EN/IEC 61010-1:2001, Installation Category II, for use up to 2000 m above sea level	
CSA	Apparatus with CSA General Purpose Approval are certified for indoor use.	
Relative humidity	10 to 95%, non-condensing	
Pollution degree	The product is suitable for pollution degree 2.	

11.6 Mechanical construction

Dimensions	Panel mounted instrument: Field instrument:	96 x 96 x 145 mm (3.78 x 3.78 x 5.71 inches) Installation depth: approx. 165 mm (6.50") 247 x 170 x 115 mm (9.72 x 6.69 x 4.53 inches)
Weight	Panel mounted instrument: Field instrument:	max. 0.7 kg (1.5 lb) max. 2.3 kg (5.1 lb)
Material	Housing of panel mounted instrument: Field housing: Front membrane:	Polycarbonate ABS PC Fr Polyester, UV-resistant
Terminals	Cross section	max. 2.5 mm^2

12 Appendix

Operating matrix COM223F/253F



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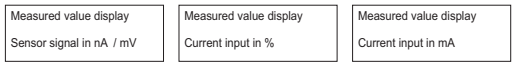
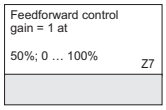
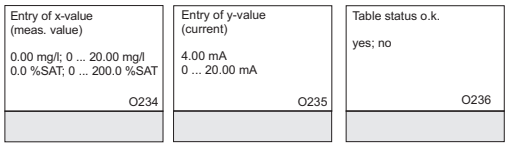
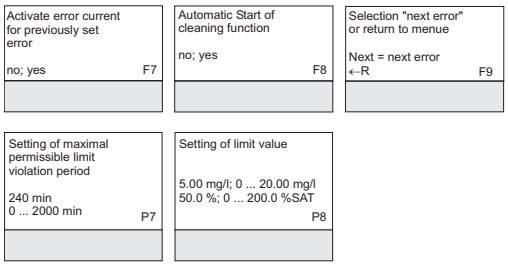

Measured value display
Sensor signal in nA / mV
Measured value display
Current input in %
Measured value display
Current input in mA


Feedforward control
gain = 1 at
50%; 0 … 100%
Z7


Entry of x-value
(meas. value)
0.00 mg/l; 0 ... 20.00 mg/l
0.0 %SAT; 0 ... 200.0 %SAT
O234
Entry of y-value
(current)
4.00 mA
0 ... 20.00 mA
O235
Table status o.k.
yes; no
O236


Activate error current
for previously set
error
no; yes
F7
Automatic Start of
cleaning function
no; yes
F8
Selection "next error"
or return to menue
Next = next error
←R
F9
Setting of maximal
permissible limit
violation period
240 min
0 ... 2000 min
P7
Setting of limit value
5.00 mg/l; 0 ... 20.00 mg/l
50.0 %; 0 ... 200.0 %SAT
P8

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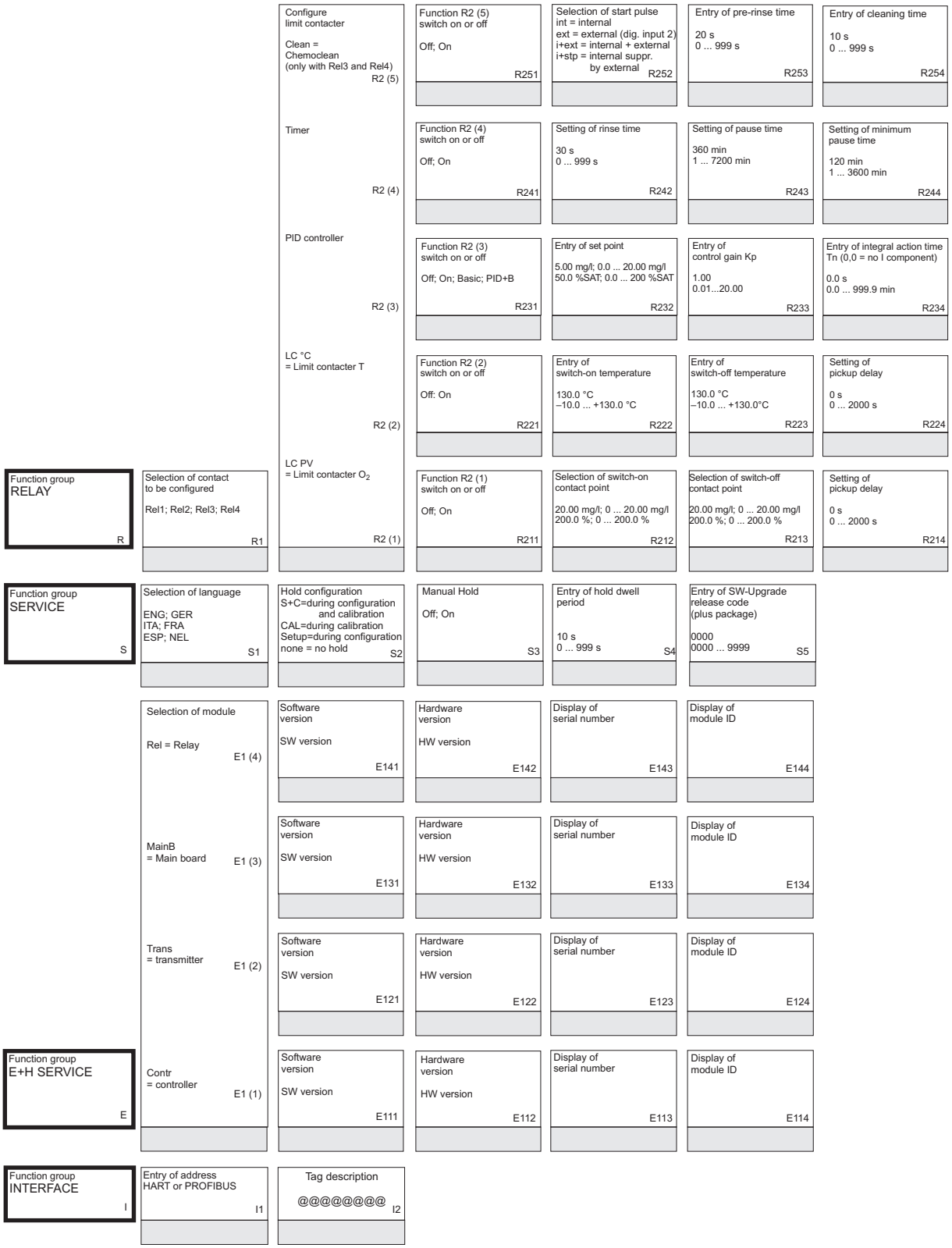
Function group
RELAY
R
Selection of contact to be configured
Rel1; Rel2; Rel3; Rel4
R1
Configure limit contacter
Clean = Chemoclean (only with Rel3 and Rel4)
R2 (5)
Timer
R2 (4)
PID controller
R2 (3)
LC °C = Limit contacter T
R2 (2)
LC PV = Limit contacter O2
R2 (1)
Function R2 (5) switch on or off
Off; On
R251
Selection of start pulse int = internal ext = external (dig. input 2) i+ext = internal + external i+stp = internal suppr. by external
R252
Entry of pre-rinse time
20 s
0 ... 999 s
R253
Entry of cleaning time
10 s
0 ... 999 s
R254
Function R2 (4) switch on or off
Off; On
R241
Setting of rinse time
30 s
0 ... 999 s
R242
Setting of pause time
360 min
1 ... 7200 min
R243
Setting of minimum pause time
120 min
1 ... 3600 min
R244
Function R2 (3) switch on or off
Off; On; Basic; PID+B
R231
Entry of set point
5.00 mg/l; 0.0 ... 20.00 mg/l
50.0 %SAT; 0.0 ... 200 %SAT
R232
Entry of control gain Kp
1.00
0.01...20.00
R233
Entry of integral action time Tn (0,0 = no I component)
0.0 s
0.0 ... 999.9 min
R234
Function R2 (2) switch on or off
Off: On
R221
Entry of switch-on temperature
130.0 °C
–10.0 ... +130.0 °C
R222
Entry of switch-off temperature
130.0 °C
–10.0 ... +130.0°C
R223
Setting of pickup delay
0 s
0 ... 2000 s
R224
Function R2 (1) switch on or off
Off; On
R211
Selection of switch-on contact point
20.00 mg/l; 0 ... 20.00 mg/l
200.0 %; 0 ... 200.0 %
R212
Selection of switch-off contact point
20.00 mg/l; 0 ... 20.00 mg/l
200.0 %; 0 ... 200.0 %
R213
Setting of pickup delay
0 s
0 ... 2000 s
R214
Function group
SERVICE
S
Selection of language
ENG; GER
ITA; FRA
ESP; NEL
S1
Hold configuration
S+C=during configuration and calibration
CAL=during calibration
Setup=during configuration
none = no hold
S2
Manual Hold
Off; On
S3
Entry of hold dwell period
10 s
0 ... 999 s
S4
Entry of SW-Upgrade release code (plus package)
0000
0000 ... 9999
S5
Function group
E+H SERVICE
E
Selection of module
Rel = Relay
E1 (4)
MainB = Main board
E1 (3)
Trans = transmitter
E1 (2)
Contr = controller
E1 (1)
Software version
SW version
E141
E131
E121
E111
Hardware version
HW version
E142
E132
E122
E112
Display of serial number
E143
E133
E123
E113
Display of module ID
E144
E134
E124
E114
Function group
INTERFACE
I
Entry of address HART or PROFIBUS
I1
Tag description
@@@@@@@@
I2

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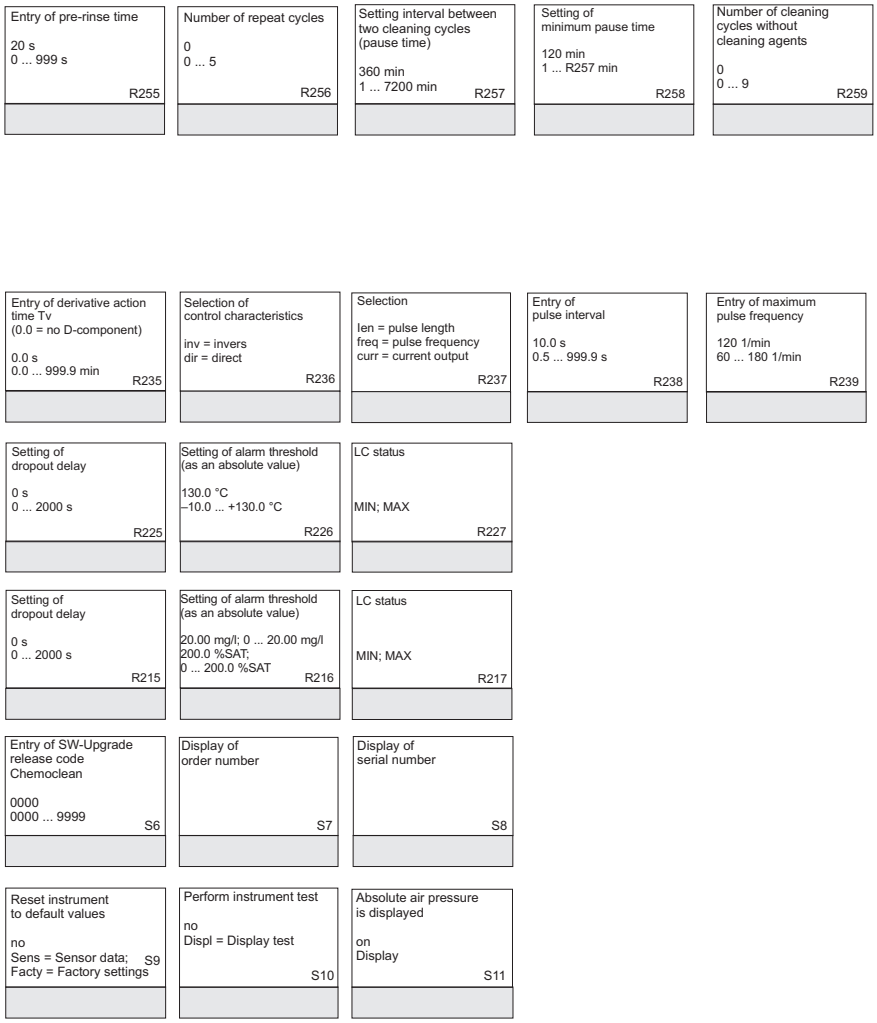
Entry of pre-rinse time
20 s
0 ... 999 s
R255
Number of repeat cycles
0
0 ... 5
R256
Setting interval between two cleaning cycles (pause time)
360 min
1 ... 7200 min
R257
Setting of minimum pause time
120 min
1 ... R257 min
R258
Number of cleaning cycles without cleaning agents
0
0 ... 9
R259
Entry of derivative action time Tv (0.0 = no D-component)
0.0 s
0.0 ... 999.9 min
R235
Selection of control characteristics
inv = invers
dir = direct
R236
Selection
Ien = pulse length
freq = pulse frequency
curr = current output
R237
Entry of pulse interval
10.0 s
0.5 ... 999.9 s
R238
Entry of maximum pulse frequency
120 1/min
60 ... 180 1/min
R239
Entry of minimum On-time t_{on}
0.3 s
0.1 ... 5.0 s
R2310
Entry of basic load
40%
0 ... 40%
R2311
Setting of dropout delay
0 s
0 ... 2000 s
R225
Setting of alarm threshold (as an absolute value)
130.0 °C
–10.0 ... +130.0 °C
R226
LC status
MIN; MAX
R227
Setting of dropout delay
0 s
0 ... 2000 s
R215
Setting of alarm threshold (as an absolute value)
20.00 mg/l; 0 ... 20.00 mg/l
200.0 %SAT;
0 ... 200.0 %SAT
R216
LC status
MIN; MAX
R217
Entry of SW-Upgrade release code Chemoclean
0000
0000 ... 9999
S6
Display of order number
S7
Display of serial number
S8
Reset instrument to default values
no
Sens = Sensor data;
Facty = Factory settings
S9
Perform instrument test
no
Displ = Display test
S10
Absolute air pressure is displayed
on
Display
S11

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