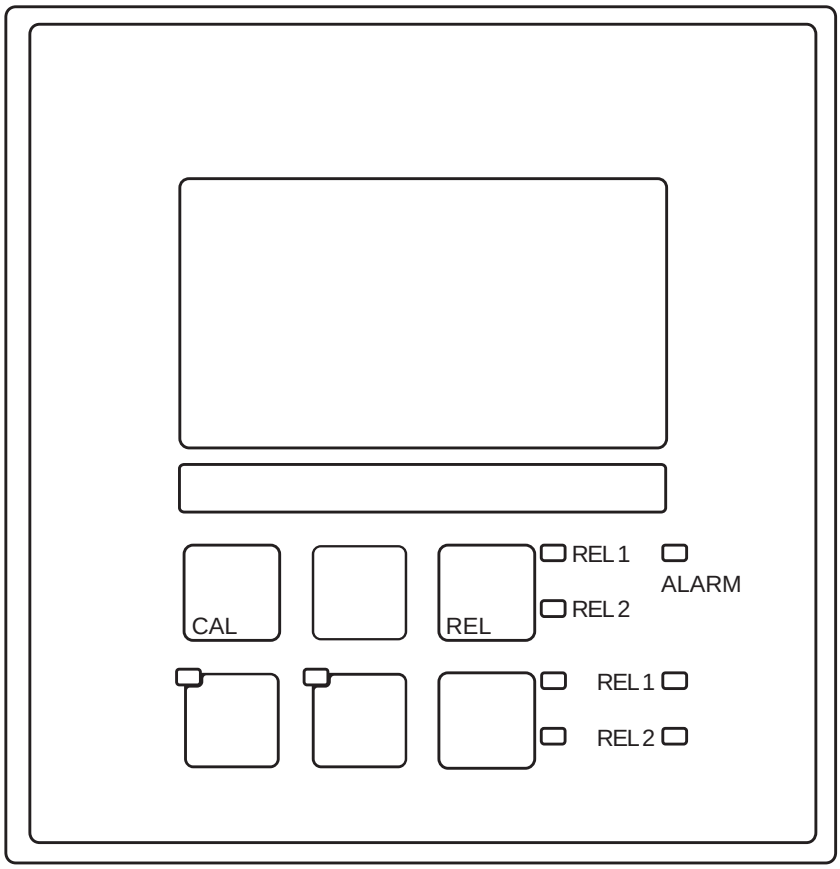
BA 199e00/10.00
51504769

Software version:
2.10 or higher

OOM 223
Transmitter for Dissolved Oxygen

Operating Instructions



Need information on the instrument?
Please read the following chapters:

You wish to install the instrument. The required steps are described in this chapter:

You wish to operate or reconfigure the instrument.
The operating concept is explained in these chapters:

Need help with problems or maintenance?
Please refer to these chapters:

OOM223E00.CHP

TABLE OF CONTENTS

1 General information

1.1 Symbols used

Warning:

This symbol alerts to hazards which may cause serious injuries as well as damage to equipment if ignored.

Note:

This symbol indicates important items of information.
Ignoring this information may result in malfunction.

1.2 Storage and transport

The packaging material used to store or transport the transmitter must provide shock protection. Optimal protection is provided by the original packaging materials.

Conformance with the ambient conditions (see Technical data) must be assured.

1.3 Unpacking

Verify that the packaging and contents are undamaged! Inform the post office or freight carrier of any damage.
Damaged merchandise must be retained until the matter has been settled.

Check that the delivery is complete and agrees with the shipping documents and your order (refer to nameplate for type and version).

The delivery includes:

- Transmitter OOM 223
- Operating instructions 199e00
- Panel-mounted instrument:
  – 1 set of plug-in screw terminals
  – 2 fastening clips

Keep the original packaging materials for future storage or shipping of the instrument.

If you have any questions, consult your supplier or the Endress+Hauser sales agency in your area (see back cover of these operating instructions for addresses).

1.4 Packaging and disposal

Package the assembly properly for reuse at a later point in time. Optimal protection is provided by the original packaging materials. Observe local regulations for disposal.

1.5 Product structure

You can identify the instrument version by the order code on the nameplate.

“Code” listsherelease code for software upgrades forthe Plus package.

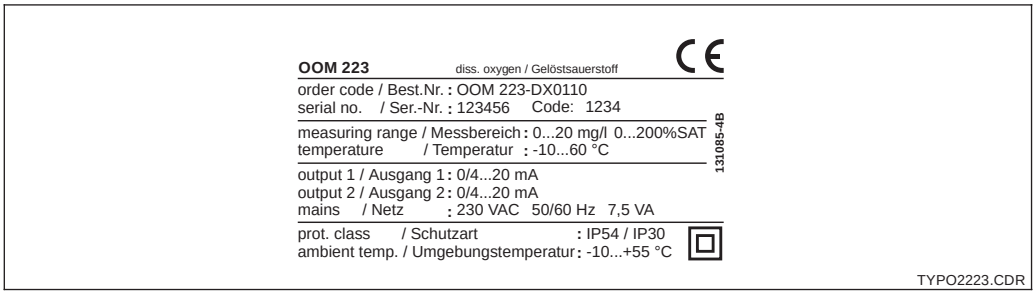


Fig. 1.1 Nameplate of OOM 223

OOM 223 / 253

Version

DX Oxygen measurement with OOS 4 / OOS 4HD
DS Oxygen measurement with OOS 4 / OOS 4HD, additional functions (Plus package)

Power supply

0 230 V AC
1 115 V AC
5 100 V AC
8 24 V AC/DC

Measurement output

0 Oxygen
1 Oxygen and temperature

Contacts

05 No additional contacts
10 2 contacts (limits / PID / timer)
16 4 contacts (limits / PID / timer)

OOM223-				

complete order code

Additional functions of the Plus Package (version DS)

- Automatic correction of air pressure for concentration measurement, field A2
- Current output table, fields O23x
- Monitoring of sensor and process, function group P
- Automatic start of cleaning function, field F8

2 Safety

2.1 Intended application

The Transmitter OOM 223 is a field-tested and reliable transmitter used to determine the oxygen concentration of liquid media.

The OOM 223 is particularly suitable for use in the following areas of application:

- Sewage treatment plants
- Wastewater treatment
- Drinking water
- Water conditioning and monitoring
- Surface water (rivers, lakes, oceans)
- Fish farming

2.2 General safety instructions

This device has been manufactured for safe operation according to the state of the art in engineering and conforms to the applicable regulations and European standards (see Technical data). It has been designed according to EN 61010-1 and has left the manufacturer's works in perfect condition.

However, if used improperly or for purposes other than the intended purpose, it may be dangerous, e.g. due to incorrect connection.

Warning:

- Operating this instrument in any way other than as described in these instructions may compromise the safety and function of the measuring system and is therefore impermissible.
- The notes and warnings in these installation and operating instructions must be strictly adhered to!

2.3 Installation, start-up, operation

Warning:

- This device may only be installed, connected electrically, commissioned, operated and serviced by properly trained personnel authorized by the system operator.
- The personnel must be familiar with these operating instructions and must adhere to the instructions described therein.
- Make sure that the power supply ratings match the data specified on the nameplate before you connect the instrument to a power source.
- A clearly identified mains disconnecting device must be installed close to the instrument.
- Live components can be touched through the vent slots in the housing and the openings on the rear of the housing. Do not insert tools, wires, etc., in these slots (OOM 223 only).
- Check that all connections have been properly made before powering up the system!
- Damaged equipment that may be dangerous must not be operated and should be clearly identified as being defective.
- Any troubleshooting of the measuring system is to be performed exclusively by authorized, trained personnel.
- If faults cannot be remedied, the instrument must be removed from service and secured to prevent accidental start-up.
- Repairs not described in these operating instructions may only be performed at the manufacturer's works.

2.4 Monitoring and safety features

Safety features

The transmitter is protected against external influences and damage by the following design measures:

- Rugged housing
- UV resistance

Monitoring features

In the event of a system error or power failure, an alarm condition is signalled via a fault-signalling contact.

2.5 Immunity to interference

This instrument has been tested according to the applicable European standards for industrial applications with regard to electromagnetic compatibility. It is carefully protected against electromagnetic interference by design measures.

Warning:

The specified immunity to interference only applies for devices connected as outlined in these operating instructions.

2.6 Declaration of conformity

The transmitterOOM 223 has been developed and manufactured in accordance with currently valid European standards and directives.

3 Installation

The following procedure should be followed for a complete measuring system installation:

- Installation or attachment of transmitter (see chpt. 3.1.1)
- Connection of cable and sensor (see chpt. 8)
- Installation is followed by start-up (see chpt. 5).

3.1 Measuring system

The complete measuring system comprises:

- The OOM 223 transmitter
- An oxygen sensor OOS 4 or OOS 4HD with an integrated NTC temperature sensor
- An immersion, flow or retractable assembly

Options:

- Extension cable OMK
- Junction box VBM

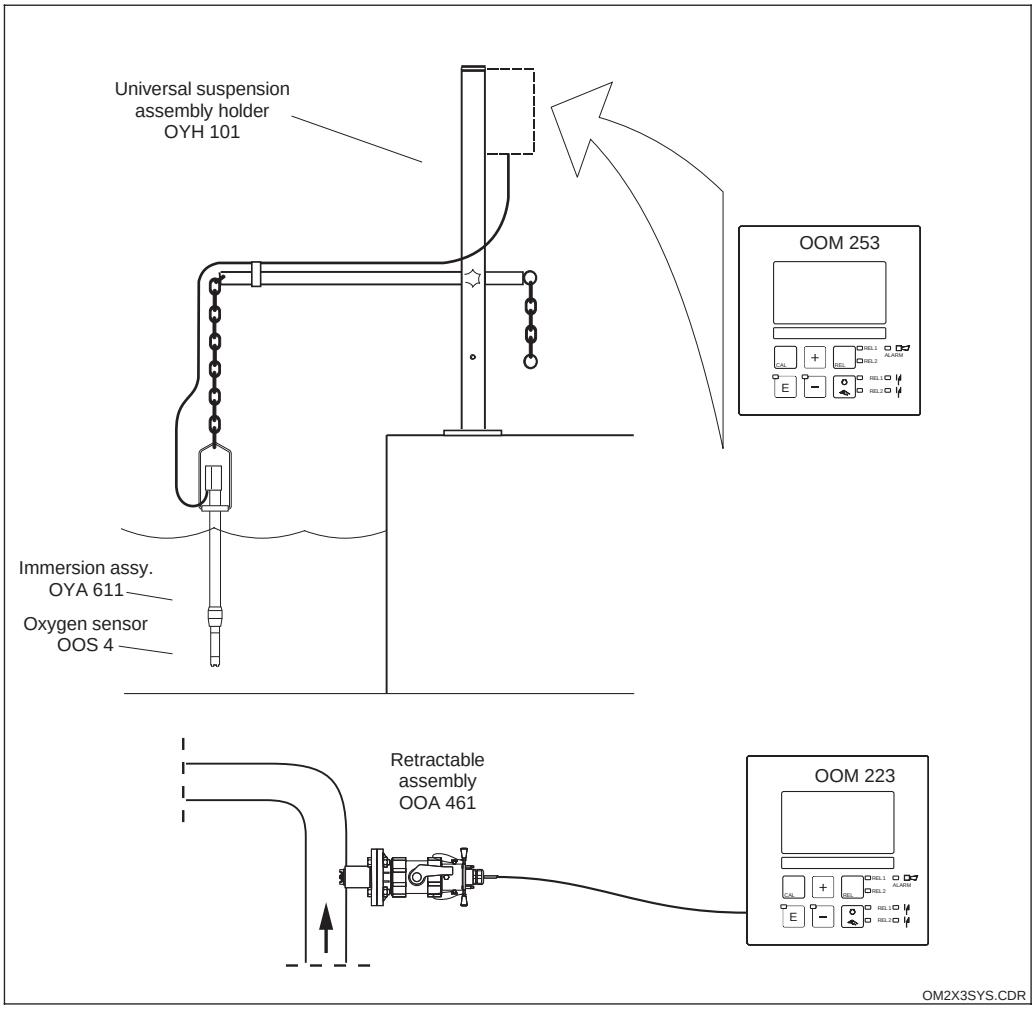
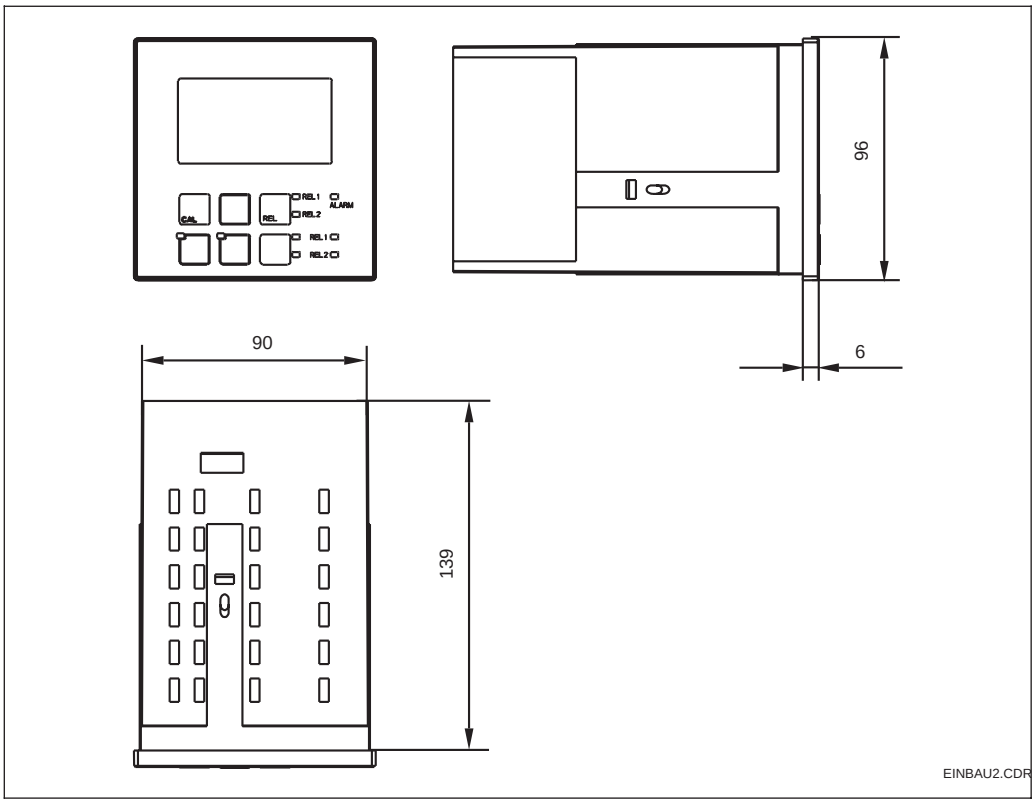


Fig. 3.1 Complete measuring systems consisting of OOM 223 with measuring cable, assembly and oxygen sensor

3.2 Dimensions



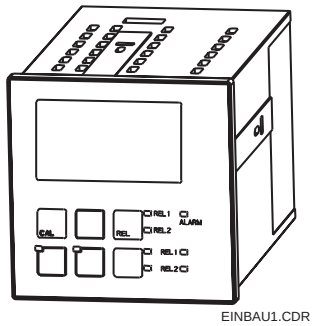
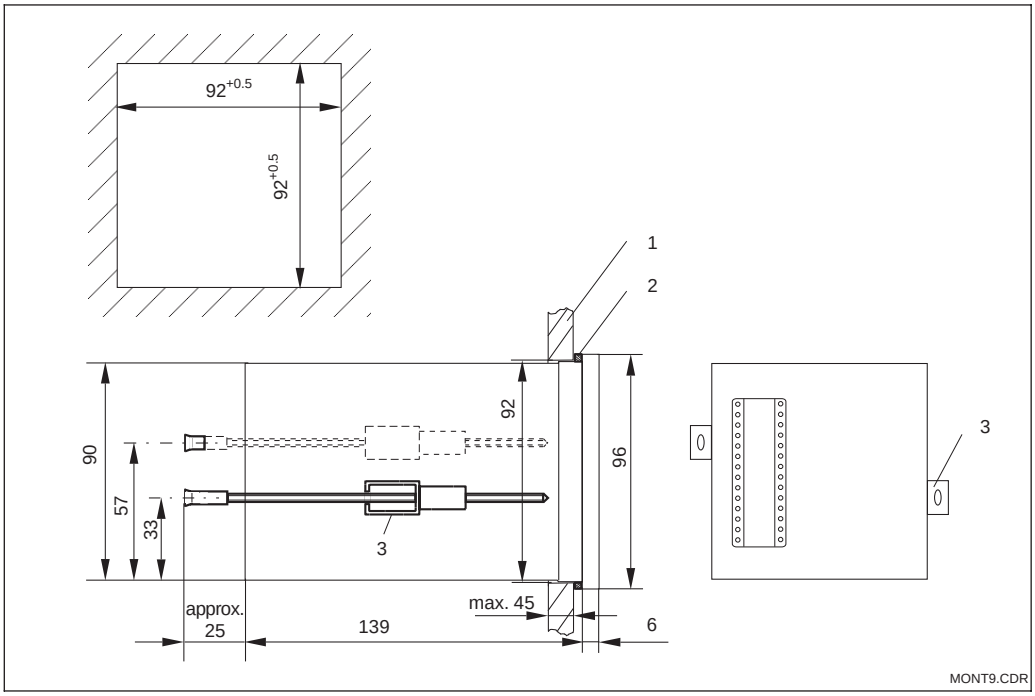


Fig. 3.2 OOM 223, panel-mounted version

3.2.1 Panel-mounted instrument

The instrument is attached using the supplied tensioning screws (see Fig. 3.3).

The required overall installation depth is approx. 165 mm.



Attachment of panel-mounted instrument
1 Wall of control cabinet
2 Gasket
3 Tensioning screws

Fig. 3.3

3.3 Electrical connection

Connection diagram

The connection diagram depicted in Fig. 3.4 shows the instrument connections for an oxygen sensor. The sensor connection is shown in more detail in Fig. 3.Fig. 3.66 and 3.7.

Note:

The instrument has protection class II and is generally operated without protective earth connection.

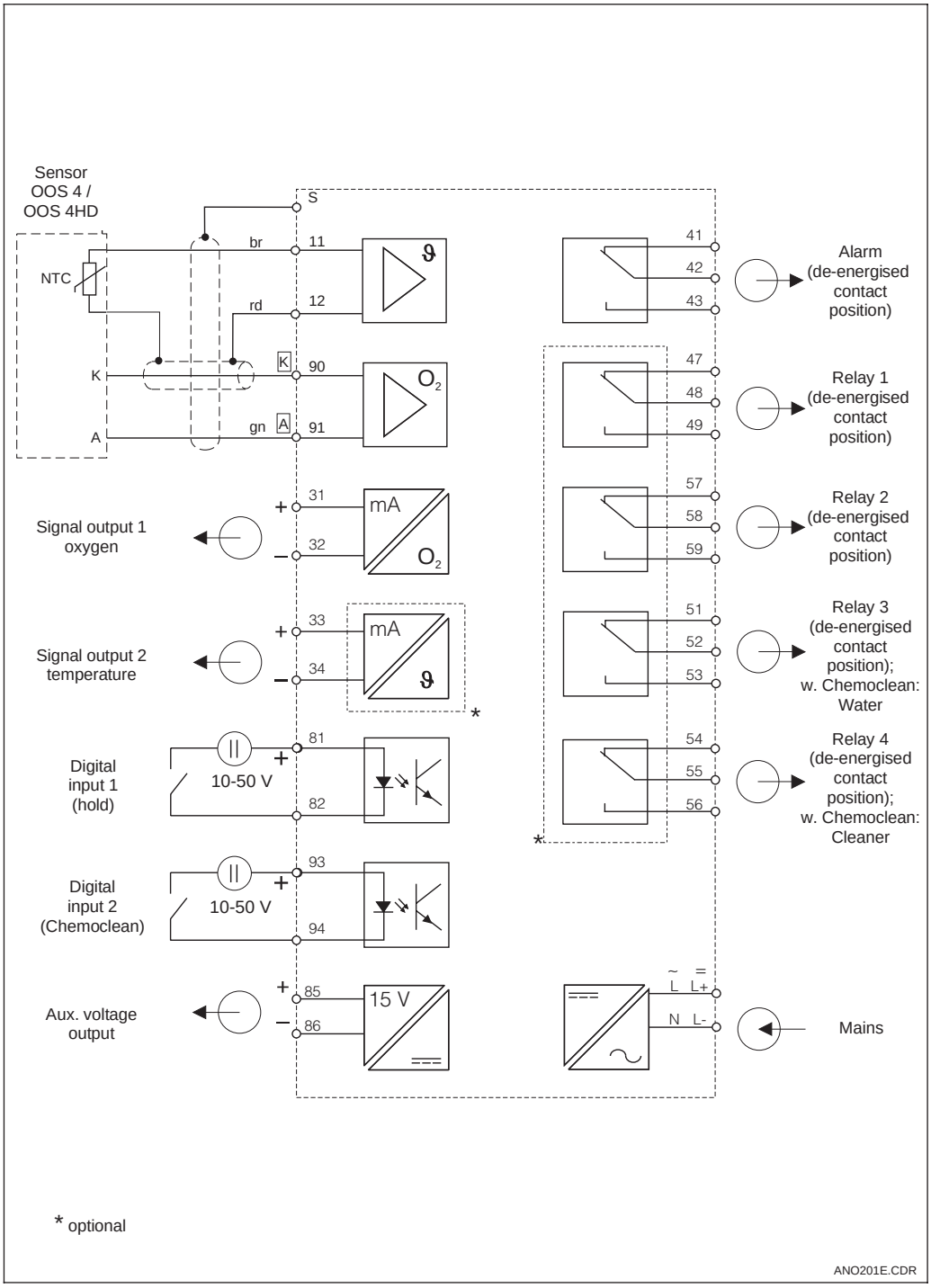


Fig. 3.4 Electrical connection of transmitter OOM 223 (all inputs and outputs connected)

Connections of panel-mounted instrument

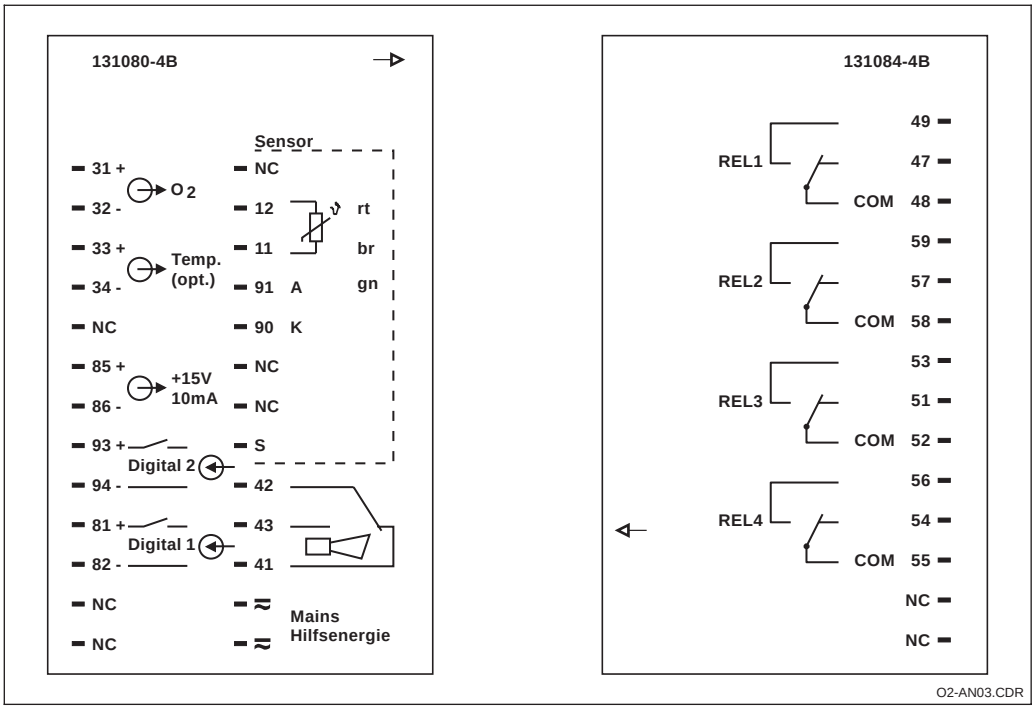


Fig. 3.5 Connection compartment stickers for panel-mounted instrument OOM 223

3.4 Sensor installation and measuring cable connection

Measuring cable connection

The oxygen sensor is connected via a special screened, multi-core cable which is completely terminated and permanently connected to the sensor.

Use junction box VBM and extension cable CMK (see chpt. 8) to extend the measuring cable.

Special measuring cable required for oxygen sensor connection		
Sensor type	**Sensor cable**	**Extension**
OOS 4 / OOS 4HD	OMK	VBM box + OMK
Maximum cable length		
OOS 4 / OOS 4HD	50 m with OMK	

Structure and termination of sensor cable

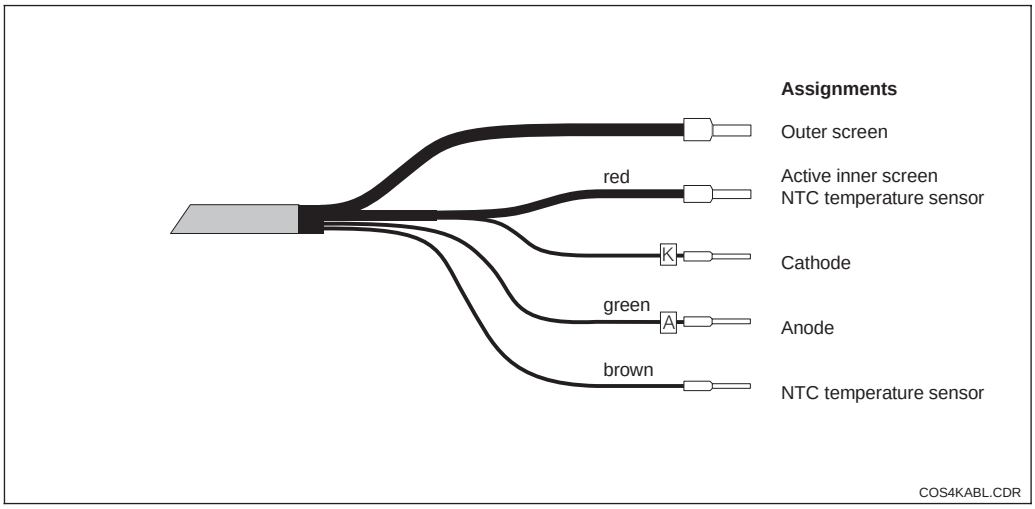


Fig. 3.6 Structure of special measuring cable OMK

Connection example

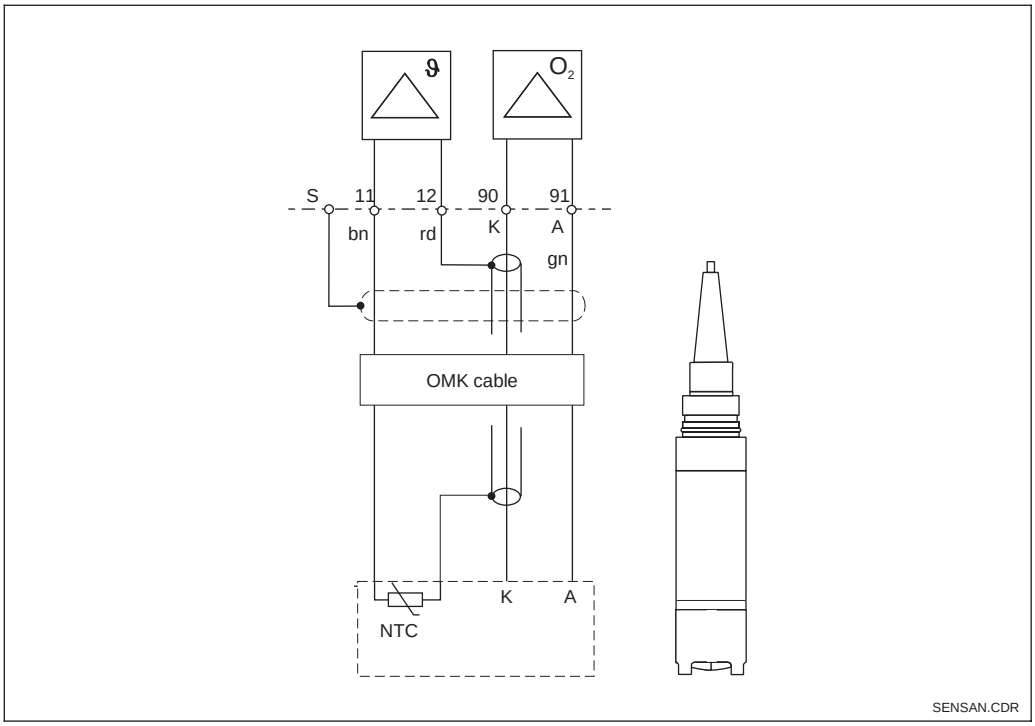


Fig. 3.7 Connection of sensor OOS 4 / OOS 4HD

4 Operation

4.1 Operator interface

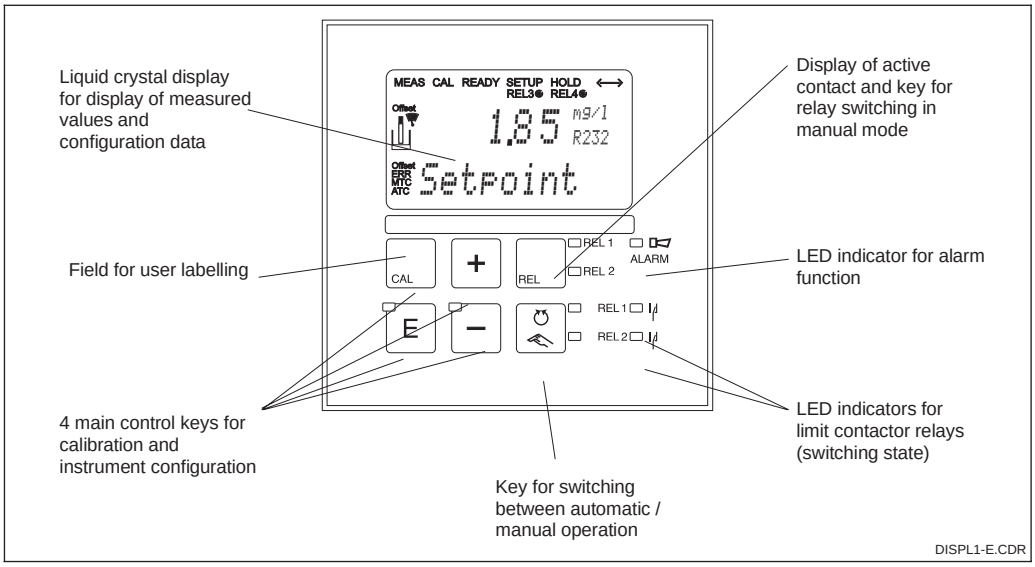


Fig. 4.1 Operating elements of OOM 223

4.2 Display

LED indicators

Indication of current operating mode: “auto” (green LED) or “manual” (yellow LED)

Indication for relay controlled in “manual” mode (red LED)

Indicates the state of relays 1 and 2.
LED green: measured value is within permissible limits, relay is inactive.
LED red: measured value is outside permissible limits, relay is active.

Alarm indication for continuous limit violation, temperature sensor failure or system errors (see error list in chpt. 6)

Liquid crystal display

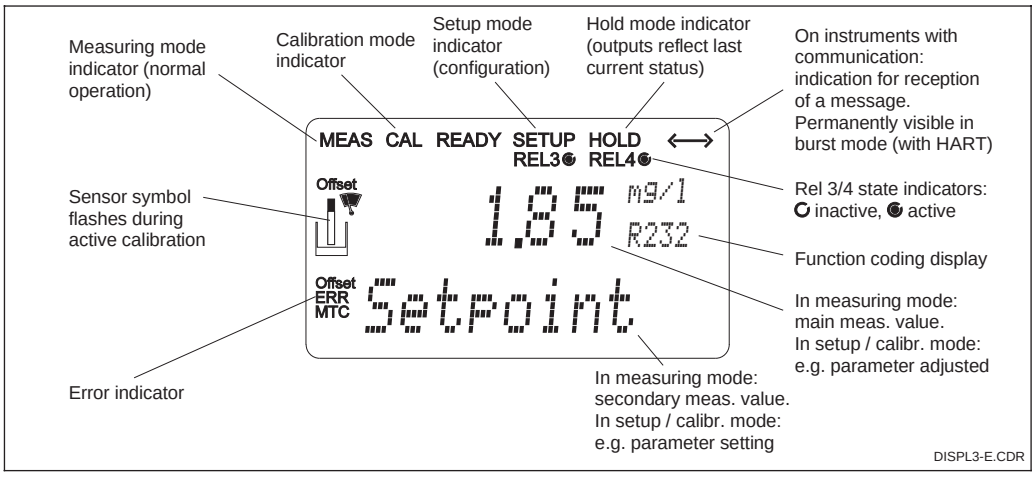


Fig. 4.2 Liquid crystal display

4.3 Key functions

CAL key

When the CAL key is pressed, the instrument prompts for the calibration access code (fixed setting: 22 for calibration; any other number to view the calibration data). Acknowledge with the CAL key to proceed. Use the CAL key to continue through the calibration process.

Note:

The calibration data set in function group C are used for calibration.

ENTER key

The ENTER key has several functions:
- Calling up the setup menu from the measuring mode
- Storage (acknowledgement) of data entered in the setup mode
- Starting calibration (same function as CAL key)
- Switching to the next function within the function groups.

PLUS key

MINUS key

The PLUS and MINUS keys have the following functions:
- Selection of function groups
- Setting parameters and numeric values (the setting speed increases when the key is held down)
- Relay operation in manual mode (s. chpt. 4.4).

In the measuring mode, the functions of the PLUS and MINUS keys are (s. chpt. 4.7):
- Temperature display in °F (PLUS)
- Suppression of temperature display (PLUS)
- Display of sensor current in nA (PLUS)
- Selection of error display (MINUS).

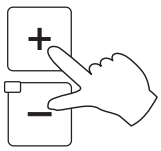
REL key

The REL key is used in manual mode to switch between the relays and the manual start cleaning function.

AUTO key

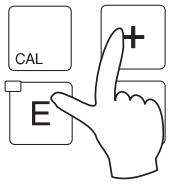
This key is used to toggle between the automatic and manual modes of operation.

Escape function



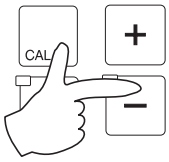
Press the PLUS and MINUS keys simultaneously to return to the main menu (in calibration mode: at the end of calibration). Press the PLUS and MINUS keys simultaneously again to return to the measuring mode.

Locking the hardware



Press the PLUS and ENTER keys simultaneously to lock the instrument. The code prompt displays the code 9999.

Unlocking the hardware



To unlock, press the CAL and MINUS keys simultaneously. The code prompt displays the code 0.

4.4 Auto / manual mode of operation

Auto mode

In this mode of operation, the relays are controlled by the transmitter.

Manual mode

In this mode all relays can be controlled manually.

Switching to manual mode

The instrument is switched to the manual mode by pressing the following keys:

1. Press AUTO key.
2. Enter code 22.
3. Select relay or function. Press REL key to toggle between the relays. The display shows the selected relay in the second line.
4. Set the relays. Switch on with PLUS, switch off with MINUS. The relay state remains in effect until it is actively reset.
5. Press AUTO key for returning to the measuring mode.

Note:

- Enable the manual mode by entering access code 22.
- The operating mode remains in effect even after a power failure.
- The manual mode takes precedence over any other automatic function (hold).
- Hardware locking in the manual mode is not possible.
- The manual settings remain in effect until they are actively reset.
- Error code E102 is signalled in the manual mode.

4.5 Operating concept

Operating modes

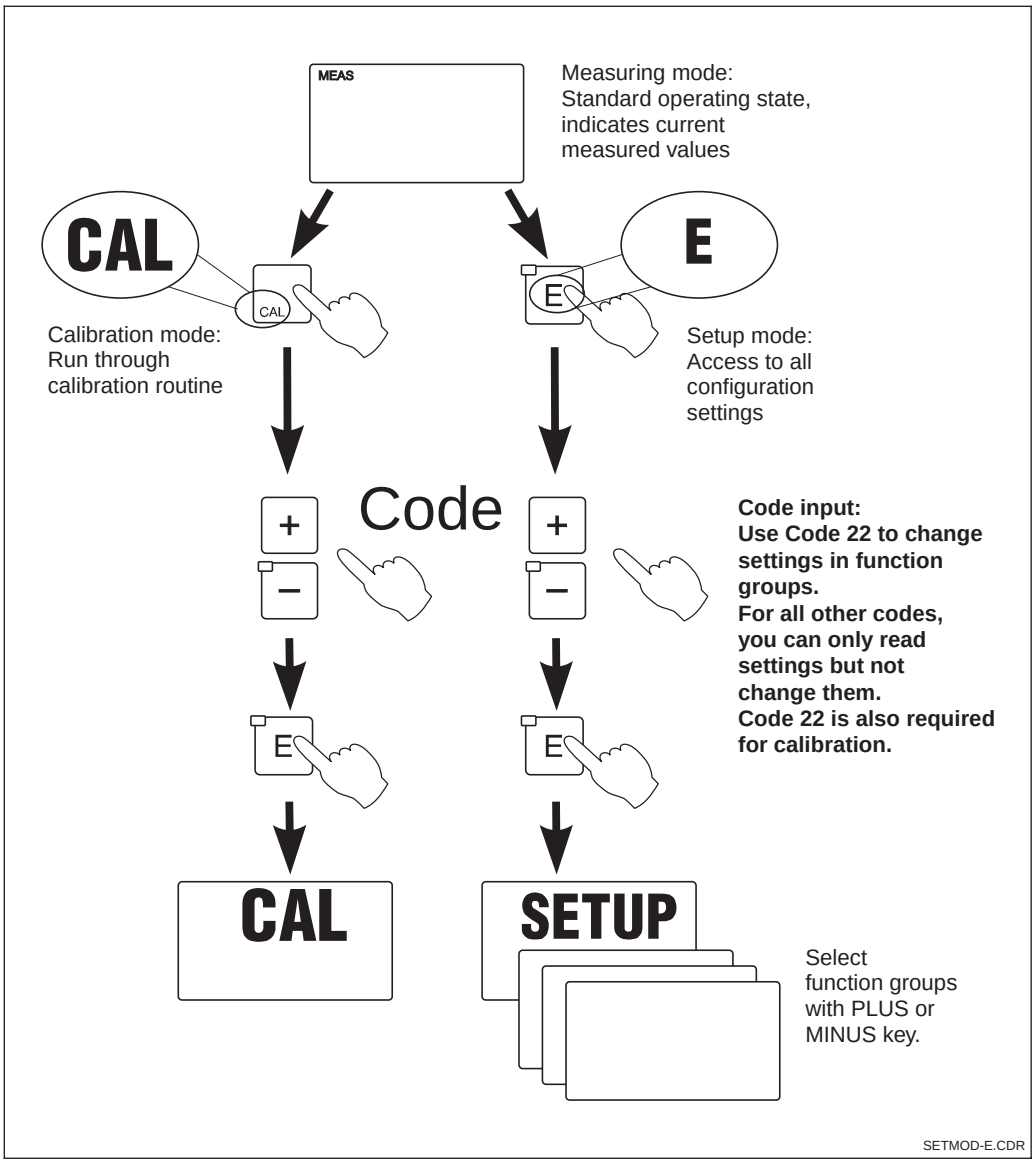


Fig. 4.3 Description of operating modes

Note:

- The user can put the functions and contacts on hold during calibration and configuration (see chpt. 5.6, function S2); the duration of the hold period may also be changed.
- If you do not press a key in setup mode for approx. 15 min, then the LCD returns automatically to measuring mode. An active hold function (hold at setup) is then reset.

Menu structure

The configuration and calibration functions are arranged in a menu structure by function groups.

The function groups are selected in the setup mode with the PLUS and MINUS keys. The ENTER key is used to move from one function to the next within a function group. The PLUS and MINUS keys are used for option selection and editing. Selections must be confirmed by pressing the ENTER key. This also moves the cursor to the next function.
Pressing the PLUS and MINUS keys at the same time terminates programming (return to main menu).

Note:

- If a change is made but not confirmed by pressing the ENTER key, the previous setting is retained.
- See the appendix of these operating instructions for an overview of the Liquisys S menu structure.

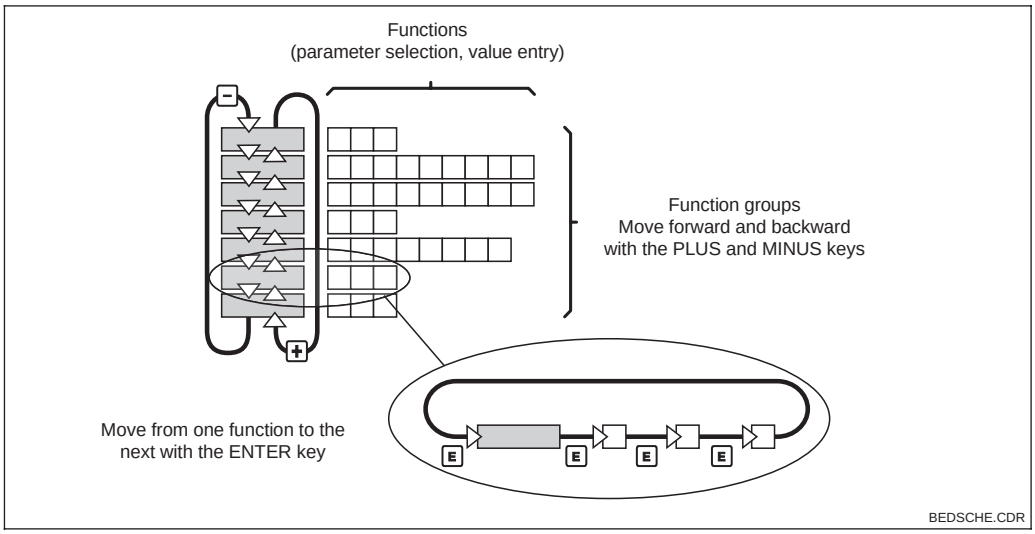


Fig. 4.4 Schematic representation of OOM 223 menu structure

Hold function: “freezes” the outputs

The current output is “frozen” in the setup mode and during calibration, i.e. the last current value is constantly output. The display shows the “HOLD” message (see chpt. 5.6 for hold settings).

Note:

- During hold, all contacts will go to their normal positions.
- An active hold has priority over all other functions.
- During each hold the I component of the controller is set to zero.
- Any alarm delay accumulated will be set to zero.
- The hold function can also be activated externally via the hold input (see connection diagram in Fig. 3.4; digital input 1).
- The manual hold (field S3) remains active even after a power failure.

4.6 Access codes

The instrument access code is fixed, i.e. it cannot be modified. The following access codes are distinguished (cf. Fig. 4.4):

- Any code: Read mode access, i.e. all settings can be viewed but not modified (access with ENTER/CAL key, see Fig. 4.4).
- Code 22: Access to calibration and offset menus (access with CAL key, see Fig. 4.4).
- Code 22: Access to configuration menus for instrument configuration and user settings (access with ENTER key, see Fig. 4.4).
- See chpt. 4.3 for hardware locking and unlocking.

4.7 Display during measurement

The measurement display has several possibilities of indication.

Settings accessed with PLUS key:

- Press the PLUS key to display the temperature in °F instead of °C.
- Press the PLUS key a second time to suppress the temperature display.
- Press the PLUS key a third time to display the sensor current in nA.
- Press the PLUS key a fourth time to return to the standard display.

Settings accessed with MINUS key:

- Press the MINUS key to display the first error message.
- Press the MINUS key repeatedly to display the following error messages (up to ten). If no further errors exist, the display returns to the measuring mode.

Note:

Function group F (alarm, see chpt. 5.4.1) can be used to define the alarm functions for each individual error code.

4.8 Calibration

Please refer to chpt. 5.8 for the calibration procedure.

5 Instrument configuration

After power-up (connection to power), the instrument performs a self-test and then enters the measuring mode.

Now it can be configured and calibrated for the first time.

The following function groups are available on the Liquisys S (the groups that are only available on the Plus package are marked accordingly in the function descriptions):

Setup mode

➜ SETUP 1 (A) see chpt. 5.2.1
➜ SETUP 2 (B) see chpt. 5.2.2
➜ CURRENT OUTPUT (O) see chpt. 5.3
➜ ALARM (F) see chpt. 5.4.1
➜ CHECK (P) see chpt. 5.4.2
➜ RELAY (R) see chpt. 5.5
➜ SERVICE I see chpt. 5.6
➜ SERVICE II see chpt. 5.7

Calibration mode

➜ CALIBRATION (C) see chpt. 5.8

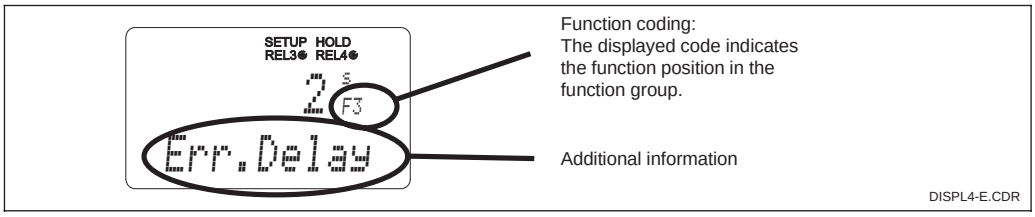


Fig. 5.1 Example of display in the setup mode

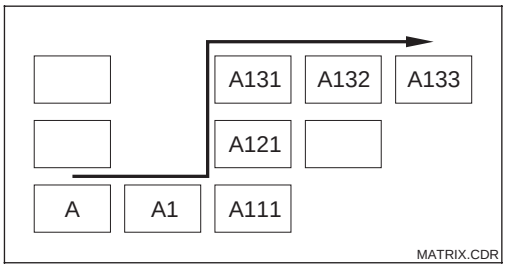


Fig. 5.2 Function coding

Selecting and locating functions is facilitated by a code displayed for each function in a special display field. The structure of this coding is shown in Fig. 5.2.
The first column indicates the function group as a letter (see group designations). The functions in each of the groups increment in each column and row.

Factory settings

When the instrument is switched on for the first time, the factory settings are in effect. The following table provides an overview of all major settings.

Please refer to the description of the individual functions in chpt. 5 for all other factory settings (the factory settings are printed in **bold** face there).

Type of measurement	oxygen concentration, temperature* in °C or °F
Temperature offset	0.0 °C
Limit 1	20.00 mg/l
Contact function of limit contactor 1	min contact without delay (switches when limit 1 is exceeded)
Limit 2	20.00 mg/l
Contact function of limit contactor 2	max contact without delay (switches when limit 2 is exceeded)

Current outputs 1 and 2*	4 ... 20 mA
Current output 1: meas. value for 4 mA signal current	0.00 mg/l
Current output 1: meas. value for 20 mA signal current	20.00 mg/l
Current output 2*: temperature value for 4 mA signal current	–10.0 °C
Current output 2*: temperature value for 20 mA signal current	60.0 °C
Altitude	0 m above sea level
Salinity	0.0 % salt concentration

* If equipped accordingly

Alarm contact

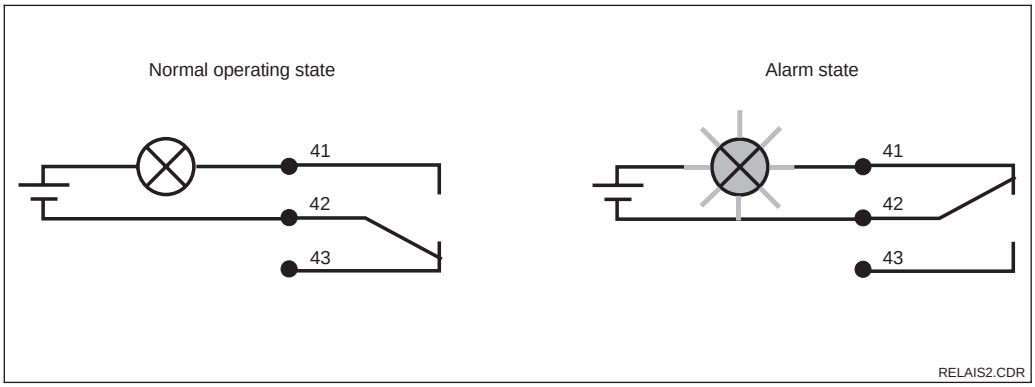


Fig. 5.3 Recommended fail-safe circuit for an alarm contact

Normal operating state:

- Instrument in operation
- No error message present (alarm LED green)

→ Relay energised
→ Contact 42/43 closed

Alarm state:

- Error message present (alarm LED red) or
- Instrument defective or dead (alarm LED off)

→ Relay de-energised
→ Contact 41/42 closed

5.1 Start-up

After power-up (connection to power supply established), the user must make the following selections in the specified function groups:

- **Function group SERVICE (S)**
  S1: Select language and exit function group.
- **Function group SETUP 1 (A)**
  Adjust all the parameters in this group; see chpt. 5.2.1.
- **Function group SETUP 2 (B)**
  Adjust all the parameters in this group; see chpt. 5.2.2.

Other configuration options are explained in the chapters to follow for each menu.

5.2 System configuration

The system is configured using the function groups SETUP 1 and SETUP 2. The measurement type and electrode are selected here, and the settings for temperature measurement are made.

All the parameters in these two function groups are to be configured to avoid measuring errors or failure to measure at all.

5.2.1 Setup 1

Coding		Field	Selection or range Factory setting	Display	Info
A		Function group SETUP 1		SETUP HOLD A SETUP 1	Initial display in function group SETUP 1.
	A1	Selection of operating mode	**mg/l** %SAT	SETUP HOLD mg/l A1 Unit	
	A2	*Switch automatic pressure compensation on or off*	***off*** *on*	SETUP HOLD off A2 PressComp	Plus package only.

Factory settings are printed in **bold** face;
base version does not include functions in *italics*.

Coding		Field	Selection or range Factory setting	Display	Info
	A3	Enter altitude	**0 m** 0 ... 4000 m	SETUP HOLD 0 m A3 Altitude	Only exists if pressure compensation in A2 has been switched off.
	A4	Enter measured value damping	**1** 1 ... 60	SETUP HOLD 1 A4 Damping	Measured value damping causes averaging over the specified number of individual measured values. It is used, for example, to stabilise the display with applications that fluctuate a great deal. There is no damping if “1” is entered.

5.2.2 Setup 2

Coding		Field	Selection or range Factory setting	Display	Info
B		Function group SETUP 2		SETUP HOLD B SETUP 2	Initial display in function group SETUP 2.
	B1	Salinity	**0.0 %** 0.0 ... 4.0 %	SETUP HOLD 0.0 % B1 Salinity	
	B2	Enter correct process temperature	**current meas. value** –10 ... 60.0 °C	SETUP HOLD 0.0 °C B2 RealTemp	The display value can be edited.
	B3	Enter temperature difference (offset)	**current offset** –5.0 ... 5.0 °C	SETUP HOLD 0.0 °C B3 Temp.Offs	The offset is the difference between the temperatures measured and entered.

Factory settings are printed in **bold** face;
base version does not include functions in *italics*.

5.3 Current outputs

The function group CURRENT OUTPUT is used to configure the individual outputs. Either a linear (O2 (1)) or, in conjunction with the Plus package, a user-defined current output characteristic (O2 (3)) can be entered. Furthermore, a current output value can be simulated to check the current outputs (O2 (2)).

Coding	Field	Selection or range Factory setting	Display	Info
O	Function group CURRENT OUTPUT		SETUP HOLD 0 OUTPUT	Initial display in function group CURRENT OUTPUT.
O1	Selection of current output	**Out1** *Out2*	SETUP HOLD Out1 01 Sel.Out	A different characteristic can be selected for each output.
O2 (1)	Enter linear characteristic	**lin** = **linear** (1) sim = simulation (2) *table (3)*	SETUP HOLD lin 02 Sel.Type	The slope of the characteristic may be positive or negative. See O2 (2), O2 (3) for the simulation and table characteristics.
O211	Selection of current range	**4–20** 0–20	SETUP HOLD 4-20 0211 Sel.Range	
O212	0/4 mA value; enter corresponding O_2 or temperature value	**0.00 mg/l** 0.00 ... 20.00 mg/l **0.0 %SAT** 0.0 ... 200.0 %SAT **0.0 °C** –10.0 ... 60.0 °C	SETUP HOLD 0.00 mg/l 0212 0/4 mA	Enter the O_2 or temperature value corresponding to the minimum current value (0/4 mA) at the transmitter output.
O213	20 mA value; enter corresponding O_2 or temperature value	**10.00 mg/l** 0.00 ... 20.00 mg/l **100.0 %SAT** 0.0 ... 200.0 %SAT **40.0 °C** –10.0 ... 60.0 °C	SETUP HOLD 10.00 mg/l 0213 20 mA	Enter the O_2 or temperature value corresponding to the maximum current value (20 mA) at the transmitter output.

Factory settings are printed in **bold** face;
base version does not include functions in *italics*.

Coding			Field	Selection or range Factory setting	Display	Info
	O2 (2)		Current output simulation	lin = linear (1) **sim** = **simulation** (2) *table (3)*	SETUP HOLD sim 02 Sel.Type	The simulation is terminated by selecting (1) or (3). See O2 (1), O2 (3) for other characteristics.
		O221	Simulation value	**current value** 0.00 ... 22.00 mA	SETUP HOLD 4.00 mA 0221 Simulat.	The current value entered here is output through the current output.
	O2 (3)		Current output table (Plus package only)	lin = linear (1) sim = simulation (2) ***table*** *(3)*	SETUP HOLD table 02 Sel.Type	Values may also be added or changed at a later point in time. The values entered are automatically sorted in ascending order by current value.
		O231	Selection of table option	**read** edit	SETUP HOLD read 0231 Sel.Table	
		O232	Enter number of value pairs	**1** 1 ... 10	SETUP HOLD 1 0232 No.Elem.	Enter the number of x and y value pairs (measured value and associated current value).
		O233	Selection of table value pair	**1** 1 ... number of table value pairs asign	SETUP HOLD 1 0233 Sel.Elem.	The functional chain O233 ... O235 is automatically passed as often as set in O232. “asign” is displayed as the last step. After confirmation, the display jumps to O236.
		O234	x value	**0.00 mg/l** 0.00 ... 20.00 mg/l **0.0 %SAT** 0.0 ... 200.0 %SAT	SETUP HOLD 0.00 µS/cm 0234 Meas.val.	x value = measured value determined by user (O_2 value).
		O235	y value	**4.00 mA** 0.00 ... 20.00 mA	SETUP HOLD 4.00 mA 0235 mA value	y value = current determined by user to be associated with O234.
		O236	Enter whether or not the table status is okay	**yes** no	SETUP HOLD yes 0236 Status ok	Return to O2. If no, then set table correctly (all previous settings are retained) or back to measuring mode (then the table is invalid).

Factory settings are printed in **bold** face;
base version does not include functions in *italics*.

5.4 Monitoring functions

The monitoring functions are used to define various alarms and to set output contacts. Each individual error can 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).

5.4.1 Alarm

Coding		Field	Selection or range Factory setting	Display	Info
F		Function group ALARM		SETUP HOLD F ALARM	Alarm function settings.
	F1	Selection of contact type	**Stead** = **steady contact** Fleet = fleeting contact	SETUP HOLD Stead F1 Cont.Type	The contact type selected here only applies to the alarm contact.
	F2	Selection of time unit	**min** s	SETUP HOLD min F2 Time Unit	
	F3	Enter alarm delay	**0 min (s)** 0 ... 2000 min (s)	SETUP HOLD 0 s F3 Err.Delay	Depending on the unit selected in F2, the alarm delay is entered in min or s.
	F4	Selection of error current	**22 mA** 2.4 mA	SETUP HOLD 22mA F4 Err.Curr	This selection must be made even if all errors are suppressed in F5. If “0–20 mA” was selected in O211, then “2.4 mA” must not be used.
	F5	Selection of error	**1** 1 ... 255	SETUP HOLD 1 F5 Sel.Error	This is where the errors are selected that are to trigger an alarm signal. The errors are selected via the error number. Please refer to the table in chpt. 6.4 for the error numbers. The factory settings remain in effect for all errors not edited.

Factory settings are printed in **bold** face;
base version does not include functions in *italics*.

Coding		Field	Selection or range Factory setting	Display	Info
	F6	Set alarm contact to be effective for selected error	**yes** (up to E070, see chpt. 6.4) no	SETUP HOLD yes F6 Rel.Assg	If set to “no”, all the other alarm settings (e.g. alarm delay) are also deactivated. The settings themselves are retained. This setting **only** applies to the error selected in F5.
	F7	Set error current to be effective for selected error	**no** yes	SETUP HOLD no F7 Curr.Assg	The error current selected in F4 becomes effective or is suppressed in case of error. This setting **only** applies to the error selected in F5.
	F8	Automatic start of cleaning function?	**no** yes	SETUP HOLD no F8 CleanTrig	This field does not exist for some errors; see chpt. 6.4.
	F9	Select next error or return to menu	**next** = **next error** <—-R	SETUP HOLD next F9 Select	If next is selected, the display returns to F5. If <—-R is selected, the display returns to F.

Factory settings are printed in **bold** face;
base version does not include functions in *italics*.

5.4.2 Check

This function group is used to select and set the monitoring functions.

Note:

All monitoring functions are disabled when the factory settings are in effect.

The Sensor Check System is adapted to the conditions at hand by enabling and adjusting appropriate functions.

Alarm threshold monitoring
In oxygen measurement **without** oxygen transfer control (aeration), sensor errors result in incorrect measurement but this does not have any effect on the process medium (examples: measurement in surface waters or in water works for monitoring purposes). Sensor errors usually result in implausibly high or low measured values. Such implausible values can be detected and signalled by means of a user-defined alarm threshold.

Controller monitoring
In oxygen measurement **with** oxygen transfer control, sensor errors not only result in incorrect measurement but also directly influence the process medium.
Particularly in the case of oxygen transfer control in sewage treatment plants, there is a risk that the aeration will not be reactivated at all if the measured value is permanently too high due to the control loop. Inadequate oxygen transfer poses a considerable danger to the microbiology and its clarification performance. Conversely, measured values that are permanently too low can cause higher operating expenses because the aeration equipment works continuously. These cases are detected and signalled by means of user-selectable monitoring times for maximum permissible controller ON or OFF times.

Sensor activity monitoring
The process medium may also affect the sensor, and this in turn may result in incorrect measurement. Braid formation on the sensor from solids floating in the medium or coatings on the sensor membrane result in a very sluggish or totally passivated measuring signal. Passivation can be detected and signalled by means of permanent signal activity monitoring.

Overview of SCS monitoring functions

	Function	Settings	Alarm event	Application
Alarm threshold monitoring	User-selectable lower alarm threshold (AT) User-selectable upper alarm threshold (AT)	Off	—	Applications **with** or **without** oxygen transfer control
		Lower AT only	Lower AT reached or fallen below	
		Upper AT only	Upper AT reached or exceeded	
		Upper and lower AT	Lower A: reached or fallen below or upper AT reached or exceeded	
Controller monitoring (PCS: Controller Check)	ON period monitoring OFF period monitoring	Off	—	Applications **with** oxygen transfer control
		On	Maximum setting for permanent ON or OFF period exceeded	
Sensor activity monitoring (PCS: Alternation Check)	Monitoring for signal change	Off	—	Applications **with** or **without** oxygen transfer control
		On	Change within 1 hour < ±0.1 mg/l or ±1%SAT	

Troubleshooting
Refer to chpt. 6.3 and 6.4 for further information on troubleshooting when sensor or process alarms have been detected.

Coding		Field	Selection or range Factory setting	Display	Info
P		Function group CHECK (Plus package only)		SETUP HOLD P CHECK	Settings for sensor and process monitoring.
	P1	Selection of alarm threshold monitoring	**off** Low High Lo+Hi = lower and upper	SETUP HOLD off P1 A.Thresh	
	P2	Alarm delay	**0 min (s)** 0 ... 2000 min (s)	SETUP HOLD 0 min P2 Err.Delay	Depending on the unit selected in F2, the alarm delay is entered in min or s. This alarm delay is valid if P5 = AC or AC+CC.
	P3	Lower alarm threshold	**0.00 mg/l** 0.00 ... 20.00 mg/l **0.0 %SAT** 0.0 ... 200.0 %SAT	SETUP HOLD 0.00 mg/l P3 LowAlarm	Omitted if P1 = off.
	P4	Upper alarm threshold	**20.00 mg/l** 0.00 ... 20.00 mg/l **200.0 %SAT** 0.0 ... 200.0 %SAT	SETUP HOLD 20.00 mg/l P4 HighAlarm	Omitted if P1 = off.
	P5	Selection of process monitoring	**off** AC CC AC+CC	SETUP HOLD off mg/l P5 ProcMonit	AC = sensor activity monitoring CC = controller monitoring Monitoring limits for AC: ±0.1 mg/l bzw. ±1 %SAT in 1 h
	P6	Maximum permissible duration for limit violation (lower limit)	**480 min** 0 ... 2000 min	SETUP HOLD 480 min P6 Tmax Low	Only if P5 = CC.
	P7	Maximum permissible duration for limit violation (upper limit)	**240 min** 0 ... 2000 min	SETUP HOLD 240 min P7 Tmax High	Only if P5 = CC.
	P8	Limit	**5.00 mg/l** 0.00 ... 20.00 mg/l **50.0 %SAT** 0.0 ... 200.0 %SAT	SETUP HOLD 5.00 mg/l P8 Setpoint	

Factory settings are printed in **bold** face.

5.5 Relay contact configuration

The relay contacts described below can be selected and configured as required (up to four times with four contacts depending on options installed).

- Limit contactor for measured oxygen value: R2 (1)
- Limit contactor for temperature: R2 (2)
- P(ID) controller: R2 (3)
- Timer for cleaning function: R2 (4)

5.5.1 Limit contactor for measured oxygen value and temperature

The relay contacts in the transmitter OOM 223 can be assigned different functions.
Switch-on and switch-off points and pickup and dropout delays can be defined for the limit contactor. Moreover, an alarm threshold can be set to issue an error message and to start a cleaning function.
These functions may be used for oxygen and temperature measurement.

Please refer to Fig. 5.4 for a graphic representation of the contact states of any relay or alarm contact.

When the measured value increases (max function), the relay contact is closed at time t_2 when the switch-on point (t_1) has been exceeded and the pickup delay ($t_2 – t_1$) has expired. When the alarm threshold (t_3) is reached and the alarm delay ($t_4 – t_3$) also has expired, the alarm contact is switched. When the measured value decreases, the alarm contact is reopened when the measured value drops below the alarm threshold (t_5), and the relay contact also opens (t_7, after the dropout delay $t_7 – t_6$).
When the pickup and dropout delays are set to 0 s, the switch-on and switch-off points are identical to the contact switching points.
Settings analogous to the max function can also be made for a min function.

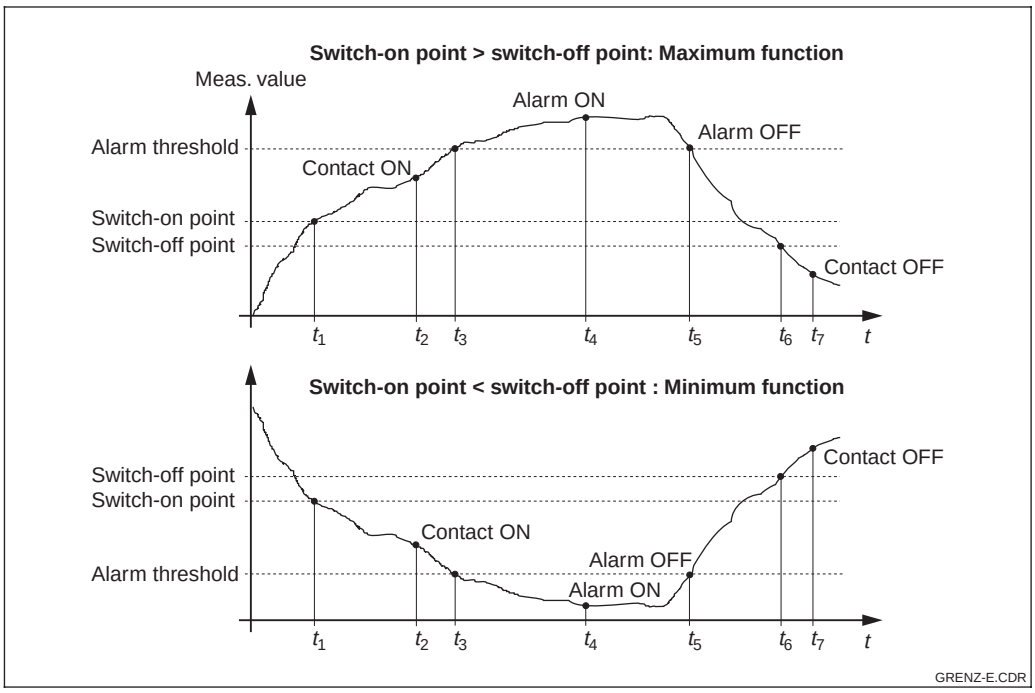


Fig. 5.4 Relationships between switch-on and switch-off points and pickup and dropout delays

5.5.2 P(ID) controller

The transmitter OOM 223 supports the definition of various controller functions. On the basis of the PID controller, P, PI, PD and PID controllers can be implemented. The best control response is obtained using the controller best suited to the application in question:

P controller: Used for simple linear control purposes with small system deviations. Where major changes are to be controlled, overshooting may occur. A control offset is to be expected.

PI controller: Used for processes where overshooting is to be avoided and permanent offsets are not allowed.

PD controller: Used for processes that require quick response and where peaks are to be corrected.

PID controller: Used for processes for which the type of control provided by a P, PI or PD controller is inadequate.

Adjustments of P(ID) controller

Three parameters can be adjusted in the case of a PID controller:

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

Step response of process

y = set value
y_h = control range
T_u = delay time [s]
T_g = recovery time [s]

$$V_{max} = \frac{X_{max}}{T_g} = \frac{\Delta x}{\Delta t}$$

= max. slew rate of control variable [K/s]
X_{max} = maximum process value
X_h = controller adjustment range

Controller characteristics

$$K = \frac{V_{max}}{X_h} \cdot T_u$$

$$y_\ell = K_p \cdot \left[e_\ell^* + \underbrace{\frac{1}{T_n} \cdot \sum_i e_i^*}_{\text{I comp.}} + \underbrace{T_v\left(e_\ell^* - e_{\ell-1}^*\right)}_{\text{D comp.}} \right],$$

$$e^* = \frac{\textit{set point} - \textit{actual value}}{MAX - MIN},$$

where *set point* = set point from R232,

MAX, MIN = upper and lower range values.

Recommendable settings for all types

Contr. response	K_p	T_v [s]	T_n [s]
P	1·K	0*	0*
PI	2.6·K	0*	6 T_u
PD	0.5·K	T_u	0*
PID	1.7·K	2 T_u	2 T_u

* T_v = 0: component is not calculated
T_n = 0: component is not calculated

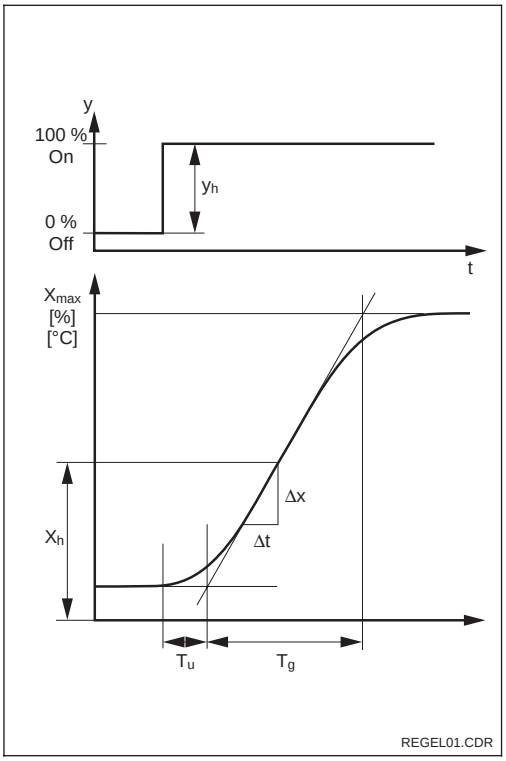


Fig. 5.5 Control characteristic

Start-up

If there is no previous experience for the control parameter settings, values should be used which guarantee maximum control loop stability (see table).

For optimisation, the control gain K_p is reduced until the control variable overshoots slightly. Then K_p is increased somewhat, and the T_n setting is reduced (shorter times) to obtain the shortest possible correction time without overshooting.
T_v must also be adjusted in the case of fast correction times.

Checking and fine tuning of parameter settings using a recorder

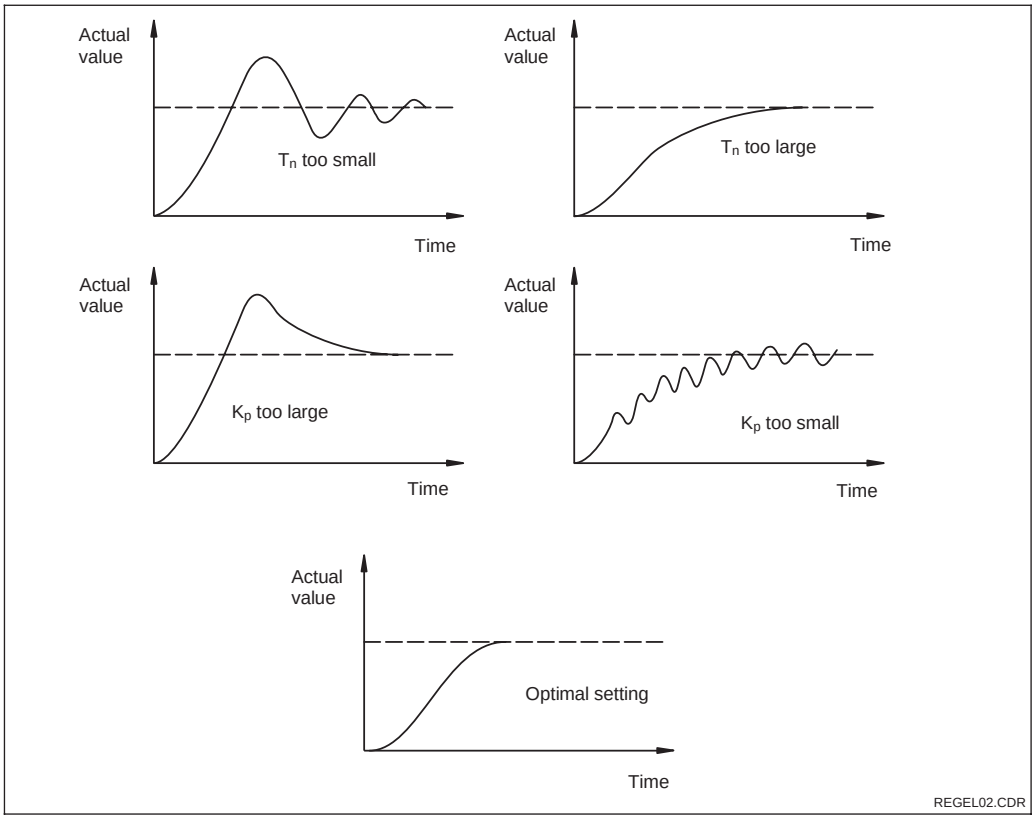


Fig. 5.6 Optimisation of settings for T_n and K_p

Actuating signal outputs (R237 ... R2310)

The control contact in question outputs a switched signal. The intensity of this signal is proportional to the controller's control output.

- *Pulse-length controller*
  The greater the calculated control output, the longer the contact in question remains picked up. The period can be adjusted between 0.5 and 99 s. Pulse-length outputs are used to control solenoid valves.

- *Pulse-frequency controller*
  The greater the calculated control output, the higher the switching frequency of the contact. The maximum switching frequency 1/T can be adjusted between 60 and 180 min^{-1}. The ON period t_{ON} is constant. Pulse-frequency outputs are used to control solenoid-operated metering pumps.

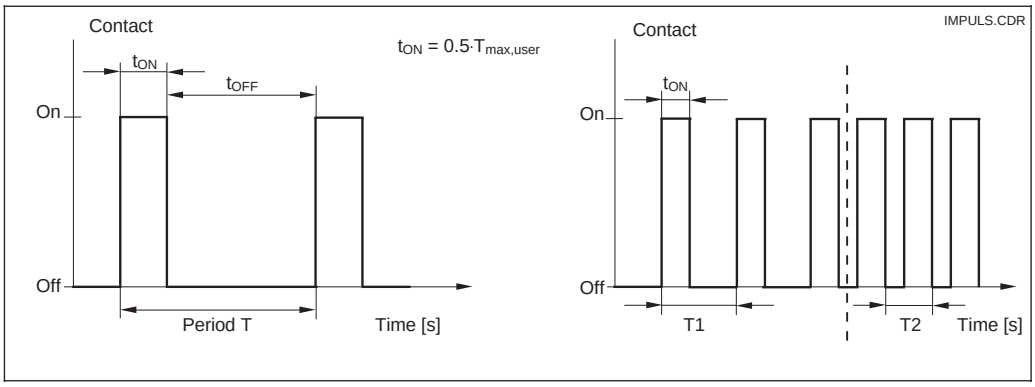


Fig. 5.7 Signal of a pulse-length (left) and a pulse-frequency control contact (right)

Control characteristic for direct and inverted control action

Field R236 offers two control characteristics for selection which have the effects shown in the following diagram.

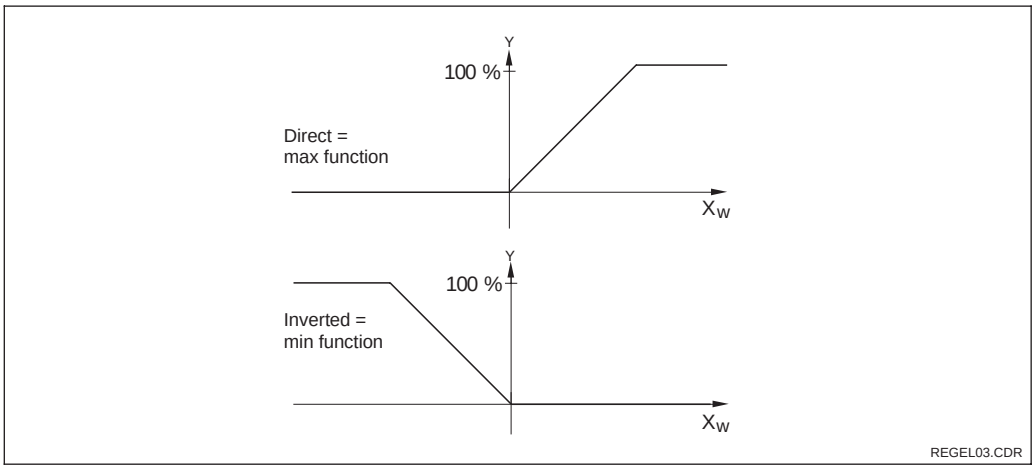


Fig. 5.8 Control characteristic of a proportional controller with direct and inverted control action

5.5.3 Timer for cleaning function

This function can be used to implement a simple cleaning routine. The user can specify a time interval after which cleaning is to start; i.e. only constant intervals can be defined.

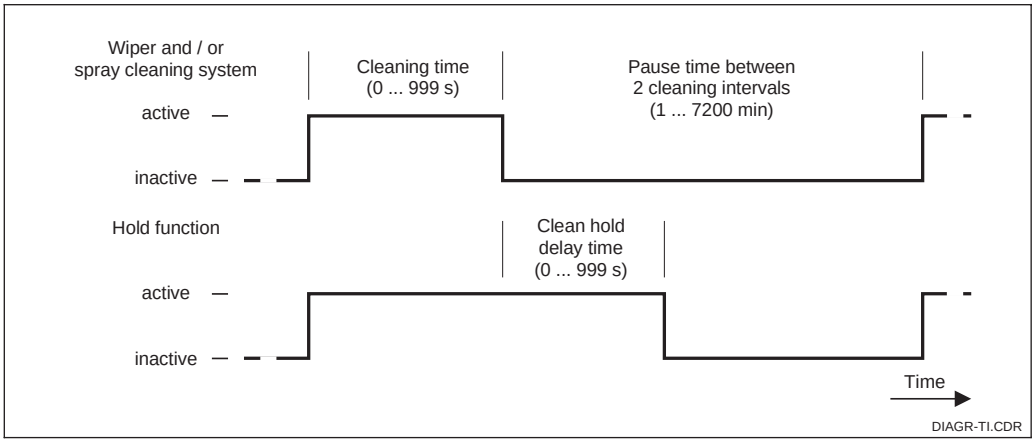


Fig. 5.9 Relationships among cleaning time, pause time and hold delay time

Note:

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

Coding			Field	Selection or range Factory setting	Display	Info
R			Function group RELAY		SETUP HOLD R RELAY	Relay contacts can be selected and adjusted.
	R1		Selection of contact to be configured	***Rel1*** *Rel2* *Rel3* *Rel4*	SETUP HOLD Rel1 R1 Sel.Relay	Rel3 and Rel4 are only available on instrument equipped accordingly.
	R2 (1)		Configuration of limit contactor for O_2	**LC PV** = **limit contactor O_2** (1) LC °C = limit contactor T (2) PID controller (3) Timer (4)	SETUP HOLD LC PV R2 Sel. Type	PV = process value
		R211	Switch function of R2 (1) off or on	**Off** On	SETUP HOLD Off R211 Function	All settings are retained.
		R212	Enter switch-on point of contact	**20.00 mg/l** 0.00 ... 20.00 mg/l **200.0 %SAT** 0.0 ... 200.0 %SAT	SETUP HOLD 20.00 mg/l R212 On value	Never set switch-on point and switch-off point to the same value! (The unit selected in A1 appears.)
		R213	Enter switch-off point of contact	**20.00 mg/l** 0.00 ... 20.00 mg/l **200.0 %SAT** 0.0 ... 200.0 %SAT	SETUP HOLD 20.00 mg/l R213 Off value	The switch-off point entry selects a max contact (switch-off point < switch-on point) or a min contact (switch-off point > switch-on point), thereby implementing an always required hysteresis function (see Fig. 5.4).
		R214	Enter pickup delay	**0 s** 0 ... 2000 s	SETUP HOLD 0 s R214 On Delay	
		R215	Enter dropout delay	**0 s** 0 ... 2000 s	SETUP HOLD 0 s R215 Off Delay	

Factory settings are printed in **bold** face;
base version does not include functions in *italics*.

Coding			Field	Selection or range Factory setting	Display	Info
		R216	Enter alarm threshold (as an absolute value)	**20.00 mg/l** 0.00 ... 20.00 mg/l **200.0 %SAT** 0.0 ... 200.0 %SAT	SETUP HOLD 20.00 mg/l R216 A.Thresh	When the alarm threshold is violated, the measuring transmitter issues an alarm with an error message and error current (note alarm delay). If you define a min contact, then you must set the alarm threshold to a less value than the switch-off point! R216 is not displayed on instruments equipped with Plus package.
	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)	SETUP HOLD LC °C R2 Sel. Type	
		R221	Switch function of R2 (2) off or on	**Off** On	SETUP HOLD Off R221 Function	
		R222	Enter switch-on temperature	**60.0 °C** –10.0 ... 60.0 °C	SETUP HOLD 60.00 °C R222 On value	Never set switch-on point and switch-off point to the same value!
		R223	Enter switch-off temperature	**60.0 °C** –10.0 ... 60.0 °C	SETUP HOLD 60.00 °C R223 Off value	The switch-off point entry selects a max contact (switch-off point < switch-on point) or a min contact (switch-off point > switch-on point), thereby implementing an always required hysteresis function (see Fig. 5.4).
		R224	Enter pickup delay	**0 s** 0 ... 2000 s	SETUP HOLD 0 s R224 On Delay	
		R225	Enter dropout delay	**0 s** 0 ... 2000 s	SETUP HOLD 0 s R225 Off Delay	

Factory settings are printed in **bold** face;
base version does not include functions in *italics*.

Coding			Field	Selection or range Factory setting	Display	Info
		R226	Enter alarm threshold	**60.0 °C** –10.0 ... 60.0 °C	SETUP HOLD 60.0 s R226 A.Thresh	When the alarm threshold is violated, the transmitter issues an alarm with an error message and error current. If you define a min contact, then you must set the alarm threshold to a less value than the switch-off point!
R2 (3)			P(ID) controller configuration	LC PV = limit contactor O_2 (1) LC °C = limit contactor T (2) **PID controller** (3) Timer (4)	SETUP HOLD PID R2 Sel. Type	
		R231	Switch function of R2 (3) off or on	**Off** On	SETUP HOLD Off R231 Function	
		R232	Enter set point	**5.00 mg/l** 0.00 ... 20.00 mg/l **50.0 %SAT** 0.0 ... 200.0 %SAT	SETUP HOLD 5.00 mg/l R232 Setpoint	The set point is the value to be maintained by the control. This value is to be re-established by the control in the event of any deviation (up or down).
		R233	Enter control gain K_p	**1.00** 0.01 ... 20.00	SETUP HOLD 1.00 R233 Kp	See chpt. 5.5.2.
		R234	Enter integral action time T_n (0.0 = no I comp.)	**0.0 min** 0.0 ... 999.9 min	SETUP HOLD 0.0 min R234 Time Tn	See chpt. 5.5.2. Each hold resets the I component to zero. Hold can be deactivated in S2, but not for timer!
		R235	Enter derivative action time T_v (0.0 = no D comp.)	**0.0 min** 0.0 ... 999.9 min	SETUP HOLD 0.0 min R235 Time Tv	See chpt. 5.5.2.
		R236	Selection of controller characteristic	**inv** = **inverted** dir = direct	SETUP HOLD inv R236 Direction	Setting may or may not be required depending on control deviation (up or down deviation, see chpt. 5.5.2).

Factory settings are printed in **bold** face;
base version does not include functions in *italics*.

Coding			Field	Selection or range Factory setting	Display	Info
		R237	Selection of pulse length or pulse frequency	**len** = **pulse length** freq = pulse frequency	SETUP HOLD len R237 Oper.Mode	Pulse length e.g. for solenoid valve, pulse frequency e.g. for solenoid-operated metering pump (see chpt. 5.5.2).
		R238	Enter pulse interval	**10.0 s** 0.5 ... 999.9	SETUP HOLD 10.0 s R238 PulsePer.	This field only appears if pulse length is selected in R237. When pulse frequency is selected, R238 is skipped and input continues in R239.
		R239	Enter maximum pulse frequency of actuator	**120 min^{-1}** 60 ... 180 min^{-1}	SETUP HOLD 120 1/min R239 Max.PFreq	This field only appears if pulse frequency is selected in R237. When pulse length is selected, R239 is skipped, and input continues in R2310.
		R2310	Minimum ON time t_{ON}	**0.3 s** 0.1 ... 5.0 s	SETUP HOLD 0.3 s R2310 Min.PTime	This field only appears if pulse length is selected in R237.
	R2 (4)		Configure cleaning function (timer)	LC PV = limit contactor O_2 (1) LC °C = limit contactor T (2) PID controller (3) **Timer** (4)	SETUP HOLD Timer R2 Sel. Type	Cleaning is performed using only one cleaning agent (usually water); see Fig. 5.9.
		R241	Switch function of R2 (4) off or on	**Off** On	SETUP HOLD Off R241 Function	
		R242	Enter rinse / cleaning time	**30 s** 0 ... 999 s	SETUP HOLD 30 s R242 RinseTime	The hold and relay settings are activated for the period of time specified here.
		R243	Enter pause time	**360 min** 1 ... 7200 min	SETUP HOLD 360 min R243 PauseTime	The pause time is the time between two cleaning cycles (see chpt. 5.5.3).
		R244	Enter minimum pause time	**120 min** 1 ... 3600 min	SETUP HOLD 120 min R244 Min.Pause	The minimum pause time prevents continuous cleaning when the external cleaning trigger is present.

Factory settings are printed in **bold** face;
base version does not include functions in *italics*.

5.6 Service I

Coding		Field	Selection or range Factory setting	Display	Info
S		Function group SERVICE I		SETUP HOLD S SERVICE I	
	S1	Selection of language	**ENG** = **English** GER = German FRA = French ITA = Italian NEL = Dutch ESP = Spanish	SETUP HOLD ENG S1 Language	This field must be configured once during start-up. Then you can exit S1 and continue.
	S2	Hold configuration	**S+C** = **during setup + calibration** CAL = during calibration Setup = during setup none = no hold	SETUP HOLD S+C S2 Auto HOLD	S = setup, C = calibration.
	S3	Manual hold	**Off** On	SETUP HOLD Off S3 Man. HOLD	The setting remains active even after a power failure.
	S4	Enter hold delay time	**10 s** 0 ... 999 s	SETUP HOLD 10 s S4 Cont.Time	
	S5	SW upgrade: Enter release code for Plus package	**0000** 0000 ... 9999	SETUP HOLD 0000 S5 PlusCode	The code is on the nameplate (see Fig. 1.1 and 1.2). Entry of an incorrect code returns you to the measurement menu. The number is edited with the PLUS or MINUS key and confirmed with the ENTER key.
	S6				Spare field without function
	S7	Order number is displayed		SETUP HOLD order S7 DX0005	The order code is not changed after an upgrade. The delivery state will be displayed.

actory settings are printed in bold face;
base version does not include functions in *italics*.

Coding		Field	Selection or range Factory setting	Display	Info
	S8	Serial number is displayed		SETUP HOLD SerNo S8 12345678	
	S9	Reset of instrument (restore default values) ⚠	**no** Sens = sensor data Facty = factory settings	SETUP HOLD no S9 S.Default	Facty = All data except for the language (field S1) are erased and reset to the factory settings! Sens = The sensor data are erased. ⚠
	S10	Perform instrument test	**no** Displ = display test	SETUP HOLD no S10 Test	
	S11	Absolute air pressure is displayed	**current value**	SETUP HOLD 1000 hPa S11 Pressure	

Factory settings are printed in **bold** face;
base version does not include functions in *italics*.

5.7 Service II

Coding	Field	Selection or range Factory setting	Display	Info
E	Function group SERVICE II		SETUP HOLD E SERVICE II	
E1	Selection of module	**Contr** = **central module** (1) Trans = transmitter (2) Main = power supply unit (3) Rel = relay (4)	SETUP HOLD Contr E1 Select	
E111 E121 E131 E141	Software version is displayed		SETUP HOLD xx.xx E111 SW-Vers.	Cannot be edited.
E112 E122 E132 E142	Hardware version is displayed		SETUP HOLD xx.xx E112 HW-Vers.	Cannot be edited.
E113 E123 E133 E143	Serial number is displayed		SETUP HOLD SerNo E113 12345678	Cannot be edited.

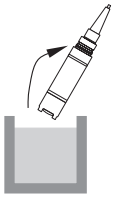
actory settings are printed in bold face;
base version does not include functions in *italics*.

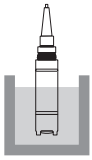
5.8 Calibration

This function group is used to calibrate the transmitter. The sensor is calibrated in air or in the medium.

Note:

- If the calibration procedure is aborted by pressing the PLUS and MINUS keys simultaneously (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. In this case, repeat the calibration!
- The end of calibration is followed by a return to the measuring mode. During the hold delay time (field S4), the hold symbol is displayed.

Coding	Field	Selection or range Factory setting	Display	Info
C	Function group CALIBRATION		CAL HOLD C CALIBRAT	
C1 (1)	Calibration in air	**Air** Ref	CAL HOLD Air C1 Calibrat	
Remove sensor from the medium.				
C111	Start calibration	**last sensor slope** countdown in second line: 600 s → 0 s	CAL HOLD 100 % C111 600	The sensor slope is checked for 10 s after 530 s (desired range 75 % ... 140 %, outside range: error 32, calibration is aborted). The stability of the signal is checked during the last 60 s of the calibration (< 1 %), if greater: error 45 and calibration is aborted.

Coding			Field	Selection or range Factory setting	Display	Info
		C112	Calibration status is displayed	o.k. E xxx	CAL READY HOLD o.k. C112 Status	
Immerse sensor into the medium again if C112 = o.k.						
		C113	Store calibration results?	**yes** no new	CAL READY HOLD yes C113 Store	If C112 = E xxx, then only no or **new.** If new, return to C. If yes/no, return to "Measurement".
	C1 (2)		One-point calibration in medium	Air **Ref**	CAL HOLD Ref C1 Calibrat	
		C121	Calibration value	**current value**	CAL HOLD 10.00 mg/l C121 Real PV	
		C122	Slope is displayed	**100.0 %** 75.0 ... 140.0 %	CAL HOLD 100.0 % C122 Slope	
		C123	Calibration status is displayed	o.k. E xxx	CAL READY HOLD o.k. C123 Status	
		C124	Store calibration results?	**yes** no new	CAL READY HOLD yes C124 Store	If C123 = E xxx, then only no or **new.** If new, return to C. If yes/no, return to "Measurement".

Factory settings are printed in **bold** face;
base version does not include functions in *italics*.

6 Maintenance and troubleshooting

6.1 Definition of terms

Maintenance means that all measures which will guarantee the safety of operation and reliability of the entire measuring system are taken in due time.

Maintenance on the OOM 223 includes:
- Calibration (see chpt. 5.8)
- Cleaning of assembly and sensor
- Checking of cables and connections

Troubleshooting means that the cause of the problem is determined and eliminated. Troubleshooting refers to measures that can be performed without intervention in the instrument (refer to chpt. 7, Corrective maintenance, for defects of the instrument).

Troubleshooting of the OOM 223 and the measuring system is performed with the aid of the troubleshooting table in chpt. 6.36.3.

6.2 Safety instructions

Warning:

Please be aware of effects work performed on the instrument might have on the process control system or the process itself.

Warning:

When removing the sensor during maintenance or calibration, please consider potential hazards due to pressure, high temperatures and contamination.

6.3 Troubleshooting common problems

Problem	Possible cause	Remedy	Equipment needed, spare parts
Instrument cannot be operated, display value 9999	– Operation locked	Press CAL and MINUS keys simultaneously	
	– Sensor defective	– Test with new sensor – Test instr. with sensor simulation – Sensor current check	Sensor OOS 4 / OOS 4HD Sensor simulation: s. chpt. 8.8.1 Current measurement: s. chpt. 8.3
Display value 0.0	– Break in sensor extension line	Check junction boxes and line	Simulation: s. chpt. 8.8.1
	– Incorrect sensor connection	Check connection	Connection: s. chpt. 3.4
	– Instrument input defective	Contact service	
No or creeping change of display	– Sensor soiled	Clean sensor membrane	s. instructions for OOS 4 / OOS 4HD. Heavily soiled media: use spray cleaning.
	– Sensor installed in “dead zone”	Check installation conditions, move sensor to area with optimal flow conditions	
Display value too low / sensor calibration may not be possible	– Membrane soiled	Clean sensor membrane	s. instructions for OOS 4 / OOS 4HD. 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 mbar 500 m above sea level: approx. 950 mbar	Plus package only. Caution: display value = absolute atmospheric pressure.
	– Electrolyte used up or soiled	Replace electrolyte	s. instructions for OOS 4 / OOS 4HD
	– Flow rate too low	Check installation conditions, move sensor to area with optimal flow conditions	

Problem	Possible cause	Remedy	Equipment needed, spare parts
Display value too high / sensor calibration may not be possible	– Polarisation incomplete	Wait for sensor to polarise after start-up (incl. interruptions in operation)	Polarisation is complete when meas. value is stable; max. approx. 60 min
	– Incorrect altitude setting	Check altitude value	
	– Incorrect air pressure measurement	Check pressure value in field S11. Sea level: approx. 1013 mbar 500 m above sea level: approx. 950 mbar	Plus package only Caution: display value = absolute atmospheric pressure.
	– Electrolyte soiled	Replace electrolyte	s. instructions for OOS 4 / OOS 4HD
	– Air cushion under membrane	Install new membrane cap	Procedure and spare parts: see instructions for OOS 4 / OOS 4HD
	– Anode coating worn off (silver-coloured)	Sensor regeneration at factory	Normal anode colour is brownish
	– “S” membrane on standard sensor	Install correct membrane cap	“S” cap can be distinguished by embossed “S”.
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: s. chpt. 3.3 and 3.5
	– Measuring cable defective	Check cable	Ohmmeter or field simulation
	– Temp. sensor in sensor defective	Measure sensor resistance (brown and red sensor lines)	Ohmmeter / s. chpt. 8.8.1 for values. Replace sensor if defective
Measured value fluctuates	– Measuring cable interference	Connect cable screen acc. to connection diagram	s. chpt. 3.4 and 3.5
	– Signal output line interference	Check line routing, try separate line routing	Separate signal output, meas. input and supply lines
	– Irregular flow rate / turbulence / big air bubbles	Choose better place of installation or eliminate turbulence. Possibly use large meas. value damping factor.	Meas. value damping s. field A4
Controller or timer cannot be activated	– No relay module installed	Contact dealer	
Controller / limit contact does not work	– Controller switched off	Activate controller	s. chpt. 5.5 or 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	s. fields R2xx
	– “Hold” function active	“Autom. hold” during calibration, “hold” input activated; “hold” via keyboard active	s. fields S2 to S4

Problem	Possible cause	Remedy	Equipment needed, spare parts
Controller / limit contact works continuously	– Controller in “Manual / On” mode – Dropout delay setting too long – Control loop interruption	Set controller to “Manual / Off” or “Auto” Shorten dropout delay Check measured value, current output or relay contacts, actuators, chemical supply.	Keyboard, REL and AUTO keys s. fields R2xx
No O_2 current output signal	– Line open or short-circuited – Output defective	Disconnect line and measure directly on instrument See chpt. 7.3	mA meter 0–20 mA DC
Fixed current output signal	– Current simulation active – Processor system out of sync	Switch off simulation Switch instrument off and back on	s. field O2 EMC problem: check installation if problem persists
Incorrect current output signal	– Incorrect current assignment – Total load in current loop excessive (> 500 Ω)	Check current assignment: 0–20 mA or 4–20 mA? Disconnect output and measure directly on instrument	Field O211 mA meter for 0–20 mA DC
No temperature output signal	– Instrument only has one current output	Refer to nameplate for variant; Contact dealer	
S package functions not available	– S package not enabled (enable with code that depends on serial number and is received from your dealer order of S package)	– S package upgrade; code received from your dealer ⇒ enter	

6.4 Problem elimination based on error messages

Error no.	Cause	Measures	Contact		Error current		Autom. cleaning trigger	
			Fact.	User	Fact.	User	Fact.	User
E001	EEPROM memory error	Switch instrument off and back on, return instrument to your local dealer for repair or replace instrument. Load software compatible with hardware. Load instrument software specific to parameter measured. On E003: invalid configuration, download attempt was performed with invalid parameter set. Repeat download, check Optoscope.	yes		no		—	—*
E002	Instrument not calibrated, calibration data invalid, no user data or user data invalid (EEPROM error)		yes		no		—	—*
E003	Download error		yes		no		—	—*
E004	Instrument software version incompatible with hardware version of module		yes		no		—	—*
E007	Transmitter malfunction Software does not match hardware (transmitter)		yes		no		—	—*
E032	Below slope range or range exceeded	Service sensor and recalibrate.	yes		no		—	—*
E044	Measured value unstable (during calibration)	Service sensor and recalibrate.	yes		no		no	
E057	Measuring range of main parameter exceeded	Check measurement, control and connections.	yes		no		no	
E059	Below temperature value measuring range		yes		no		no	
E061	Temperature value measuring range exceeded		yes		no		no	
E063	Below current output range 1	Check configuration.	yes		no		no	
E064	Current output range 1 exceeded	Check measured value and current assignment.	yes		no		no	
E065	Below current output range 2		yes		no		no	
E066	Current output range 2 exceeded		yes		no		no	
E067	Alarm threshold for limit contactor 1 exceeded	Check configuration in “limit contactor” menu.	yes		no		no	
E068	Alarm threshold for limit contactor 2 exceeded		yes		no		no	
E069	Alarm threshold for limit contactor 3 exceeded		yes		no		no	
E070	Alarm threshold for limit contactor 4 exceeded		yes		no		no	
E080	Distance between 0/4 mA and 20 mA values at output 1 too short	Adjust spreading for current output 1.	no		no		—	—*
E081	Distance between 0/4 mA and 20 mA values at output 2 too short	Adjust spreading for current output 2.	no		no		—	—*
E082	Below air pressure range	Only uncompensated measurement is possible.	yes		no		no	
E083	Air pressure range exceeded		yes		no		no	
E100	Current simulation active		no		no		—	—*
E101	Service function yes	Switch off service function or switch instrument off and back on.	no		no		—	—*

Error no.	Cause	Measures	Contact		Error current		Autom. cleaning trigger	
			Fact.	User	Fact.	User	Fact.	User
E102	Manual mode active		no		no		—	—*
E106	Download yes	Wait for download to end.	no		no		—	—*
E116	Download error	Repeat download.	no		no		—	—*
E152	Meas. signal of main parameter sluggish or frozen	Check sensor and connecting line, service or replace.	yes		no		no	
E154	Below lower alarm threshold for period exceeding alarm delay	Perform manual reference measurement if required. Service sensor and recalibrate.	yes		no		no	
E155	Lower alarm threshold exceeded for period exceeding alarm delay		yes		no		no	
E156	Actual value below set point for more than permissible maximum period		yes		no		no	
E157	Actual value exceeds set point for more than permissible maximum period		yes		no		no	

*When this error is present, the cleaning function cannot be started.
(Field F8 does not exist for this error.)

7 Diagnosis and corrective maintenance

7.1 Definition of terms

Diagnosis refers to the identification of instrument malfunctions and defects.

Corrective maintenance means
- replacement of parts diagnosed to be defective
- testing of instrument and measuring system function
- restoration of complete functionality.

Diagnosis based on the error table below and depending on difficulty and measuring equipment at hand is to be performed by
- trained operator personnel
- operator's electricians
- company responsible for system installation/ operation
- Dealer.

Please refer to the tables in chpt. 7.4 and 7.5 for identification of spare parts required.

7.2 Safety instructions

Warning:

- Disconnect the instrument from the power source before opening it up.
  Work under tension may only be performed by trained electricians.

- Switched contacts may be supplied from separate circuits. These circuits must also be de-energized before work on the terminals is performed.

- Caution: ESD!
  Electronic components are sensitive to electrostatic discharges. Personal protective measures, such as discharge via PE or permanent grounding using a wrist strap, are to be taken.

- For your own safety, use only original spare parts. Original parts will guarantee functionality, accuracy and reliability after repairs.

7.3 Diagnosis

The table below will help you diagnose.

Problem	Possible cause	Tests and/or remedial measures	Equipment, spare parts, personnel
Display dark, no LEDs active	– No mains voltage	Check if mains voltage is available	Electrician / e.g. multimeter
	– Wrong supply voltage / voltage too low	Compare mains voltage and rating on nameplate	Operator (utility company specification or multimeter)
	– Connection fault	Terminal not tightened; insulation clamped in terminal; wrong terminal used	Electrician
	– Fuse blown	Replace fuse, first compare mains voltage and rating on nameplate	Electrician / see drawings
	– Power supply unit defective	Replace power supply unit using correct variant	Return instrument
	– Central module defective	Replace central module using correct variant	
Display dark, LED(s) active	Central module defective	Replace central module	

Problem	Possible cause	Tests and/or remedial measures	Equipment, spare parts, personnel
Display shows measured value but – value does not change and/or – instrument cannot be operated	– Instrument, or module not properly installed in instrument – Impermissible operating system state	OOM 223: Reinstall module OOM 253: Reinstall display module Switch instrument off and back on	Return instrument Possible EMC problem: if problem persists, call Service to have installation checked.
Instrument gets hot	– Incorrect voltage / too high – Power supply unit defective	Compare mains voltage and rating on nameplate Replace power supply unit	Correct voltage setting Can only be diagnosed by factory
Incorrect meas. O_2 and/or temperature value	– Transmitter module defective (module: MKO1). Please perform tests and take measures according to chpt. 6.3 to eliminate the sensor or wiring as the cause of the problem. – Incorrect sensor current	Test measuring inputs: – connect equivalent resistances for oxygen and temperature, see chpt. 8.8.1 Sensor current can be displayed in meas. mode by pressing the PLUS key 3 times	If test fails: replace module. Return instrument If module tests out OK: check peripherals once more. Display in nA. Nominal value in air for 20 °C and 1013 mbar: 290 nA (COS 4 / COS 4HD)
Pressure value incorrect / cannot be read	– Pressure sensor defective – Pressure sensor does not exist	MKO1 module defective MKO1 module without sensor installed (instrument without Plus package)	Pressure can be read in field S11. Caution: The absolute air pressure is displayed. Upgrade to Plus package if required. Contact your dealer!
Current output, incorrect current	– Not calibrated correctly – Load excessive – Shunt / short-circuit to frame in current loop – Incorrect mode of operation	Test with built-in current simulation, connecting mA meter directly to current output. Chek whether 0–20 mA or 4–20 mA has been selected.	If simulation value is incorrect: recalibration at factory. If simulation value is correct: check current loop for load and shunts.
No current output signal	– Current output stage defective	Test with built-in current simulation, connecting mA meter directly to current output. First disconnect current output line completely for safety.	If test fails: Return instrument
Additional relays do not work	– OOM 253: ribbon cable item 320 loose or defective	Make sure ribbon cable is properly connected, replace cable if req.	
Only 2 additional relays can be used	– Relay module LSR1-2 with 2 relays installed	Convert to LSR1-4 with 4 relays	Return instrument
Enhanced functions (Plus package) not available	– No or incorrect release code used – Incorrect instrument serial number stored in LSCH/LSCP module	If upgraded: verify that correct serial number has been used to order Plus package Check whether serial number on nameplate matches serial number of LSCH/LSCP (field S8)	Handled by your dealer Instrument serial number is required to enable Plus package.

7.4 “Optoscope” service equipment with “Scopeware”

The Optoscope in conjunction with the “Scopeware” software opens the following possibilities **without** removing or opening the the transmitter and **without** making an electrical connection to the instrument:

- Documentation of the instrument settings in conjunction with Commuwin II
- Software update by the service technician
- Upload/download a hex dump to duplicate configurations.

The Optoscope acts as an interface between the transmitter and PC / Laptop. Information is transferred via the optical interface on the Liquisys S and via the RS 232 interface on the PC / Laptop.

Handling and operation are described in the Optoscope operating instructions. The required Windows “Scopeware” software comes in the scope of supply.

Order number of the Optoscope: 51500650

7.5 Corrective maintenance of measuring system

7.5.1 Oxygen measuring instrument

Simulation of oxygen measurement
To perform a functional test of the instrument, the OOS 4 / OOS 4HD sensors 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
1.9 MΩ	7 ... 13 mg O_2/l
With 1.9 MΩ and temp. equivalent resistance of 37.3 kΩ after calibration	9.0 ... 9.2 mg O_2/l
4.06 MΩ	3.3 ... 6.1 mg O_2/l

Simulation of temperature sensor
The OOS 4 / OOS 4HD sensors use an NTC sensor 30.0 kΩ/25 °C for temperature measurement.
Use the following equivalent resistances to test the temperature measurement:

Simulation resistance	Display value
95.0 kΩ	0.0 °C
58.7 kΩ	10.0 °C
37.3 kΩ	20.0 °C
30.0 kΩ	25.0 °C
24.3 kΩ	30.0 °C

Test procedure

- Connect the O_2 equivalent resistance (e.g. decade resistor) to terminals 90 and 91.
- Connect the temperature equivalent resistance (e.g. decade resistor) to terminals 11 and 12.
- Air pressure measurement:
  On instruments equipped with the Plus package, the air pressure measured can be checked in field S11.
  Caution: The absolute pressure is displayed (a normal barometer indicates the relative pressure referred to sea level and cannot be used to evaluate the air pressure measurement).

7.5.2 Oxygen sensors OOS 4 / OOS 4HD

Please refer to the operating instructions for OOS 4 / OOS 4HD with regard to sensor maintenance and troubleshooting!
The operating instructions contain detailed information including:

- Sensor design and function
- Mounting and installation
- Electrical connection
- Start-up and calibration
- Calculation examples and tables for verification of measured values
- Maintenance, regeneration, cleaning
- Troubleshooting table
- Accessories and spare parts
- Technical data and ordering information

7.5.3 Assembly

Refer to the assembly operating instructions for maintenance and troubleshooting! The following assemblies can be used for OOS 4 / OOS 4HD:

- Suspension assembly holder OYH 101-A with immersion pendulum assembly OYA 611
- Flow assembly OOA 250
- Float assembly OOA 110-50

7.5.4 Connecting lines and junction boxes

Since OOS 4 / OOS 4HD work with low measuring currents, shunts in connecting cables and junction boxes may introduce considerable inaccuracy.
The following is to be assured:

- Intact gaskets on lids and cable glands
- Dry and clean inside (dry, clean and use desiccant bag as necessary)
- Lines, ferrules, terminals and connectors are to be free of corrosion
- Terminal screws are to be tightened firmly
- Cables are to enter junction boxes and instruments from below
- Make a downward cable loop in the case of lateral cable entries to allow water to drip off.

If the functional test explained in chpt. 8.8.1 is performed on the junction box instead of the instrument, then the junction box with terminals and connecting line to the instrument is automatically included in the test.

8 Accessories

Connection accessories

- Junction box VBM
  Junction box for extension of measuring cable connection between sensor and instrument.
  Material: cast aluminium
  Ingress protection: IP 65
  Order no.: 50003987

Note:

The desiccant bag in the junction box must be checked and replaced at regular intervals which depend on ambient conditions in order to prevent inaccurate measurement due to moisture bridges in the measuring line.

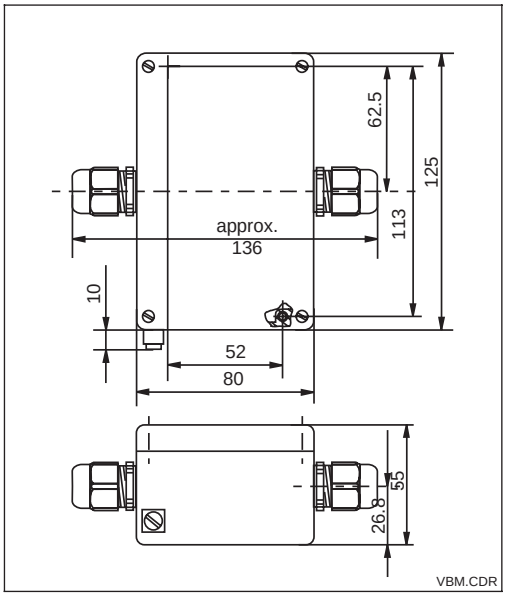


Fig. 8.1 Dimensions of junction box VBM

- Extension cable OMK
  Non-terminated measuring cable for oxygen sensors (by the metre)
  Order no.: 50005374

Sensors

- Oxygen sensor OOS 4
- Oxygen sensor OOS 4HD

Software upgrade

(serial number of instrument to be specified with order)

- Plus package
  Order no.: 51501679
- Field housing IP 65
  Order no.: 51503573

9 Technical data

General specifications

Product designation	OOM 223

Input

Measured variables	O_2, temperature

O_2 measurement with OOS 4 / OOS 4HD

Display and measuring range	0 ... 20 mg/l or 0 ... 200 % SAT
Temperature compensation range	0 ... 50 °C
Pressure compensation range (optional)	0 ... 1200 hPa
Altitude adjustment range	0 ... 4000 m
Salinity adjustment range	0 ... 4.0 %

O_2 signal input

Signal current	0 ... 3000 nA
Slope adaptation	75 ... 140 % of nominal slope
Nominal slope (sensor in air, 20 °C, 1013 mbar)	290 nA
Maximum cable length to sensor	50 m

Temperature measurement with OOS 4 / OOS 4HD

Temperature sensor	NTC, 30 kΩ at 25 °C
Display range	–10 ... +60 °C

Digital inputs 1 and 2

Voltage	10 ... 50 V
Current consumption	max. 10 mA

Output

O_2 signal output

Current range	0 / 4 ... 20 mA, galvanically isolated; error current 2.4 / 22 mA
Load	max. 500 Ω
Maximum resolution	700 digits/mA
Output range	Δ 2 ... Δ 20 mg/l or Δ 20 ... Δ 200 % SAT
Separation voltage	max. 350 V_{rms} / 500 V DC
Overvoltage protection	acc. to EN 61000-4-5:1995

Temperature signal output (optional)

Current range	0 / 4 ... 20 mA, galvanically isolated
Load	max. 500 Ω
Maximum resolution	700 digits/mA
Output range	Δ 2 ... Δ 20 mg/l or Δ 20 ... Δ 200 % SAT
Separation voltage	max. 350 V_{rms} / 500 V DC
Overvoltage protection	acc. to EN 61000-4-5:1995

Output (continued)

Auxiliary voltage output

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

Contact outputs (potential-free changeover contacts)

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

Limit adjustment range	0 ... 20 mg/l or 0 ... 200 % SAT
Pickup / dropout delay	0 ... 7200 s

Controller

Function (adjustable)	pulse-length / pulse-frequency controller
Controller response	P, PI, PD, PID
Control gain K_p	0.01 ... 20.00
Integral action time T_n	0.0 ... 999.9 min
Derivative action time T_v	0.0 ... 999.9 min
Period for pulse-length controller	0.5 ... 999.9 s
Maximum frequency for pulse-frequency controller	60 ... 180 min^{-1}

Alarm

Function (switchable)	steady / fleeting contact
Alarm threshold adjustment range	0 ... 20.00 mg/l or 0 ... 200.0 % SAT
Alarm delay	0 ... 2000 min (s)
Monitoring time for lower limit violation	0 ... 2000 min (s)
Monitoring time for upper limit violation	0 ... 2000 min (s)

Accuracy

O_2 measurement with OOS 4 / OOS 4HD

Measured value resolution	0.01 mg/l or 0.1 % SAT
Display deviation[1]	max. 0.5 % of measuring range
Repeatability	max. 0.2 % of measuring range
Measurement deviation[1], O_2 signal output	max. 0.75 % of measuring range

Temperature measurement with OOS 4 / OOS 4HD

Measured value resolution	0.1 °C
Display deviation[1]	max. 1.0 % of measuring range
Measurement deviation[1], temperature signal output	max1.25 %ÿÿÿoutputrange

Ambient conditions

Ambient temperature (nominal operating conditions)	–10 ... +55 °C
Ambient temperature (limit operating conditions)	–20 ... +60 °C
Storage and transport temperature	–25 ... +65 °C
Relative humidity (nominal operating conditions)	10 ... 95 %, non-condensing
Ingress protection of panel-mounted unit	IP 54 (front), IP 30 (housing)
Ingress protection of field housing	IP 65
Electromagnetic compatibility	interference emission and interference immunity acc. to EN 61326:1997 / A1:1998

Physical data

Dimensions of panel-mounted unit (H × W × D)	96 × 96 × 145 mm
Installation depth	approx. 165 mm
Weight of panel-mounted unit	max. 0.7 kg
Measured value display	LC display, two lines, five and nine digits, with status indicators

Materials

Housing of panel-mounted unit	polycarbonate
Front membrane	polyester, UV-resistant

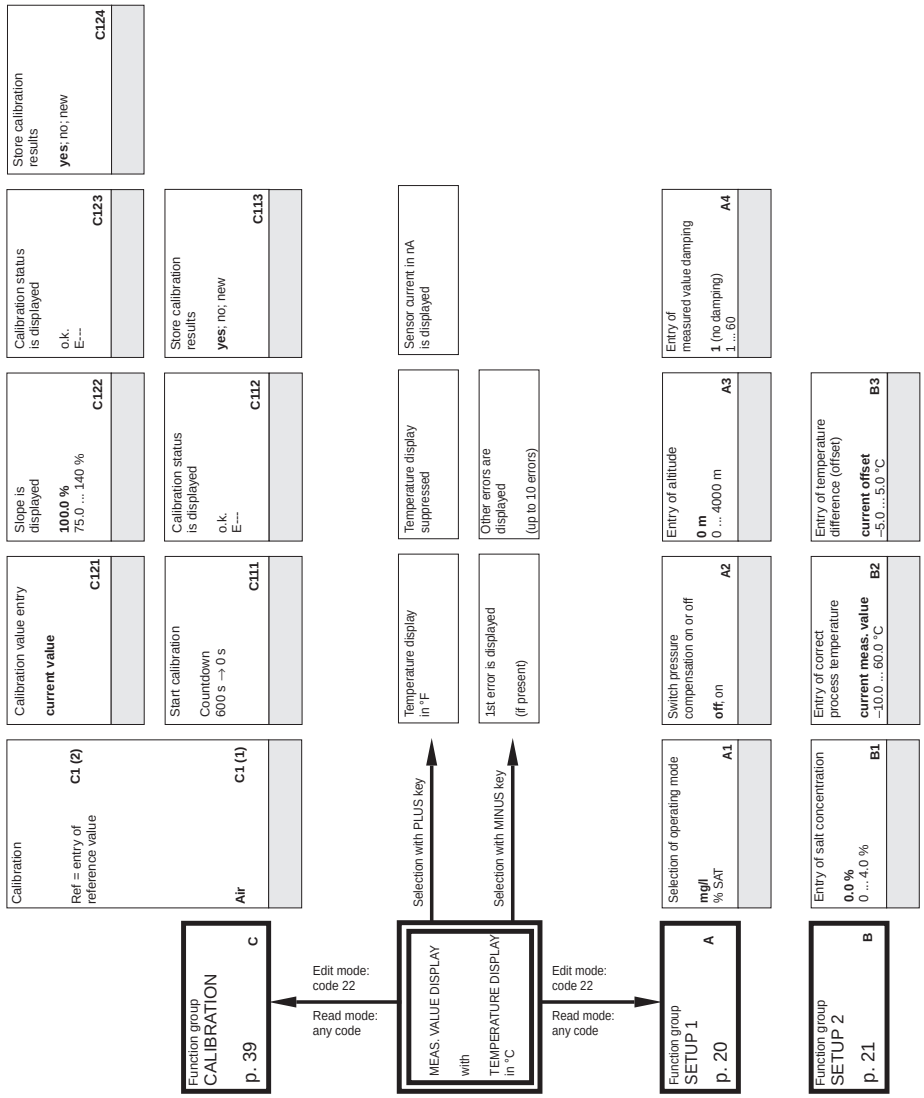
Power supply

Supply voltage	100 / 115 / 230 V AC +10 / –15 %, 48 ... 62 Hz 24 V AC/DC +20 / –15 %
Power consumption	max. 7.5 VA
Mains fuse	fine-wire fuse, medium time-lag, 250 V / 3.15 A

[1]According to IEC 746-1, for nominal operating conditions

Subject to modifications.

10 Appendix


Function group
CALIBRATION
p. 39
C
Calibration
Ref = entry of reference value
C1 (2)
Air
C1 (1)
Calibration value entry
current value
C121
Slope is displayed
100.0 %
75.0 ... 140 %
C122
Calibration status is displayed
o.k.
E---
C123
Store calibration results
yes; no; new
C124
Start calibration
Countdown
600 s → 0 s
C111
Calibration status is displayed
o.k.
E---
C112
Store calibration results
yes; no; new
C113
Edit mode: code 22
Read mode: any code
MEAS. VALUE DISPLAY
with
TEMPERATURE DISPLAY in °C
Selection with PLUS key
Temperature display in °F
Temperature display suppressed
Sensor current in nA is displayed
Selection with MINUS key
1st error is displayed
(if present)
Other errors are displayed
(up to 10 errors)
Edit mode: code 22
Read mode: any code
Function group
SETUP 1
p. 20
A
Selection of operating mode
mg/l
% SAT
A1
Switch pressure compensation on or off
off, on
A2
Entry of altitude
0 m
0 ... 4000 m
A3
Entry of measured value damping
1 (no damping)
1 ... 60
A4
Function group
SETUP 2
p. 21
B
Entry of salt concentration
0.0 %
0 ... 4.0 %
B1
Entry of correct process temperature
current meas. value
–10.0 ... 60.0 °C
B2
Entry of temperature difference (offset)
current offset
–5.0 ... 5.0 °C
B3
Field for entry of user setting

Function group CURRENT OUTPUT (p. 22, O)

- Current output selection — **Out1**; Out2 — O1
  - Characteristic selection
    - table — O2 (3)
      - Table option selection — **read**, edit — O231
      - O232
      - Selection of value pair in table — **1**, 1 … number of table value pairs, asign — O233
      - x value entry (measured value) — **0.00 mg/l;** 0 ... 20.00 mg/l, **0.0 %SAT;** 0 ... 200.0 %SAT — O234
      - y value entry (current value) — **4.00 mA**, 0 ... 20.00 mA — O235
      - Table status o.k. — **yes;** no — O236
    - sim = simulation — O2 (2)
      - Simulation value entry — **current value**, 0 … 22.00 mA — O221
    - **lin = linear** — O2 (1)
  - Current range selection — **4-20 mA;** 0-20 mA — O211
  - 0/4 mA value entry — **0.00 mg/l;** 0 ... 20.00 mg/l, **0.0 %SAT;** 0 ... 200.0 %SAT, **0.0°C;** –10.0 ... 60.0 °C — O212
  - 20 mA value entry — **10.00 mg/l;** 0 ... 20.00 mg/l, **100.0 %SAT;** 0...200.0 %SAT, **40.0 °C;** –10.0 ... 60.0 °C — O213

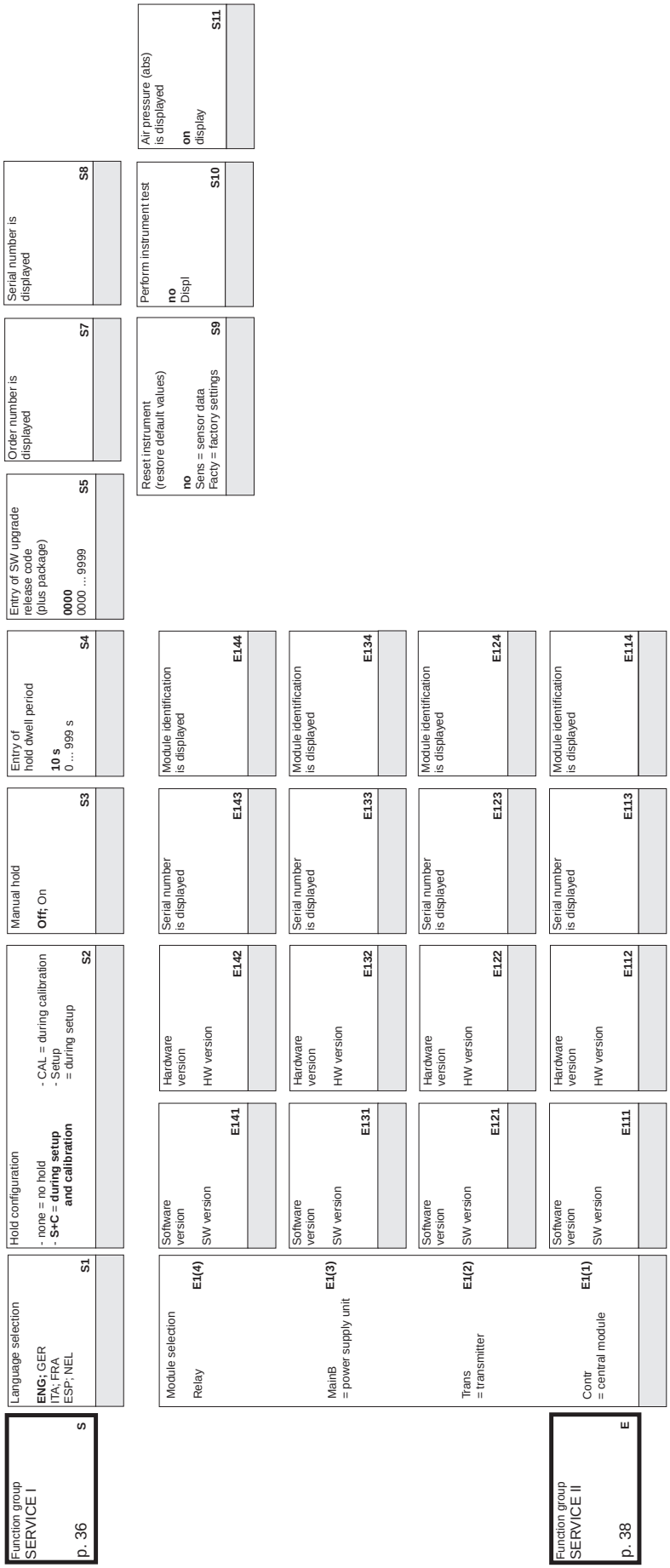
Function group ALARM (p. 24, F)

- Contact type selection — **Stead = steady contact;** Fleet = fleeting contact — F1
- Select alarm delay unit — **min**; s — F2
- Alarm delay — **0 min (s)**, 0 s... 2000 min (s) (depends on F2) — F3
- Error current setting — **22 mA**, 2.4 mA — F4
- Error number selection — **1**, 1… 255 — F5
- Set alarm contact to be effective — **yes**; no — F6
- Activate error current for previously set error — **no;** yes — F7
- Automatic start of cleaning function — **no**; yes — F8
- Select "next error" or return to menu — **next = next error**, ←R — F9

Function group CHECK (p. 27, P)

- Alarm threshold monitoring selection — **off**, Low, High, Lo+Hi = lower and upper — P1
- Alarm delay — **0 min (s)**, 0 … 2000 min (s) (depends on F2) — P2
- Setting of lower alarm threshold — **0.00 mg/l;** 0 ... 19.00 mg/l, **0.0 %SAT;** 0 ... 190.0 %SAT — P3
- Setting of upper alarm threshold — **20.00 mg/l;** 1 … 20.00 mg/l, **200.0 %SAT;** 10.0 ... 200.0 %SAT — P4
- Process monitoring selection — **off**, AC, CC, AC+CC; Monitoring limit AC: ± 0.1 mg/l, ± 1 %SAT (in 1 h) — P5
- Setting of maximum permissible limit violation period (below limit) — **480 min**, 0 … 2000 min — P6
- Setting of maximum permissible limit violation period (above limit) — **240 min**, 0 … 2000 min — P7
- Limit setting — **5.00 mg/l;** 0 … 20.00 mg/l, **50.0 %;** 0 ... 200.0 %SAT — P8

Function group	Select contact to be configured									
RELAY p. 32 R	**Rel1;** Rel2; Rel3; Rel4 R1	**LC PV** = **O_2 limit contactor**	R2 (1)	Function **R2 (1)** Switch off or on **Off**; On R211	Select contact switch-on point **20.00 mg/l;** 0 ... 20.00 mg/l **200.0 %;** 0 ... 200.0 % R212	Select contact switch-off point **20.00 mg/l;** 0 ... 20.00 mg/l **200.0 %;** 0 ... 200.0 % R213	Pickup delay setting **0 s** 0 ... 2000 s R214	Dropout delay setting **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 °C = T limit contactor	R2 (2)	Function **R2 (2)** Switch off or on **Off**; On R221	Entry of switch-on temperature **60.0 °C** –10.0 ... +60.0 °C R222	Entry of switch-off temperature **60.0 °C** –10.0 ... +60.0 °C R223	Pickup delay setting **0 s** 0 ... 2000 s R224	Dropout delay setting **0 s** 0 ... 2000 s R225	Setting of alarm threshold (as an absolute value) **60.0 °C** –10.0 ... +60.0 °C R226	
		PID controller	R2 (3)	Function **R2 (3)** Switch off or on **Off**; On 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	Entry of derivative action time Tv (0.0 = no D component) **0.0 s** 0.0 ... 999.9 min R235	Selection of control characteristic **inv = inverted;** dir = direct R236	Selection **len = pulse length** freq = pulse frequency R237
								Entry of pulse interval **10.0 s** 0.5 ... 999.9 s R238	Entry of max. 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
		Timer	R2 (4)	Function **R2 (4)** Switch off or on **Off**; On R241	Rinse time setting **30 s** 0 ... 999 s R242	Pause time setting **360 min** 1 ... 7200 min R243	Set minimum pause time **120 min** 1 ... 3600 min R244			


Function group
SERVICE I
S
p. 36
Language selection
ENG; GER
ITA; FRA
ESP; NEL
S1
Hold configuration
- none = no hold
- S+C = during setup
and calibration
- CAL = during calibration
- Setup
= during setup
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
Order number is
displayed
S7
Serial number is
displayed
S8
Reset instrument
(restore default values)
no
Sens = sensor data
Facty = factory settings
S9
Perform instrument test
no
Displ
S10
Air pressure (abs)
is displayed
on
display
S11
Module selection
Relay
E1(4)
MainB
= power supply unit
E1(3)
Trans
= transmitter
E1(2)
Contr
= central module
E1(1)
Software
version
SW version
E141
E131
E121
E111
Hardware
version
HW version
E142
E132
E122
E112
Serial number
is displayed
E143
E133
E123
E113
Module identification
is displayed
E144
E134
E124
E114
Function group
SERVICE II
E
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Distributed by:

51504769

BA 199e00/10.00
Printed in Germany / CV 5 / DT