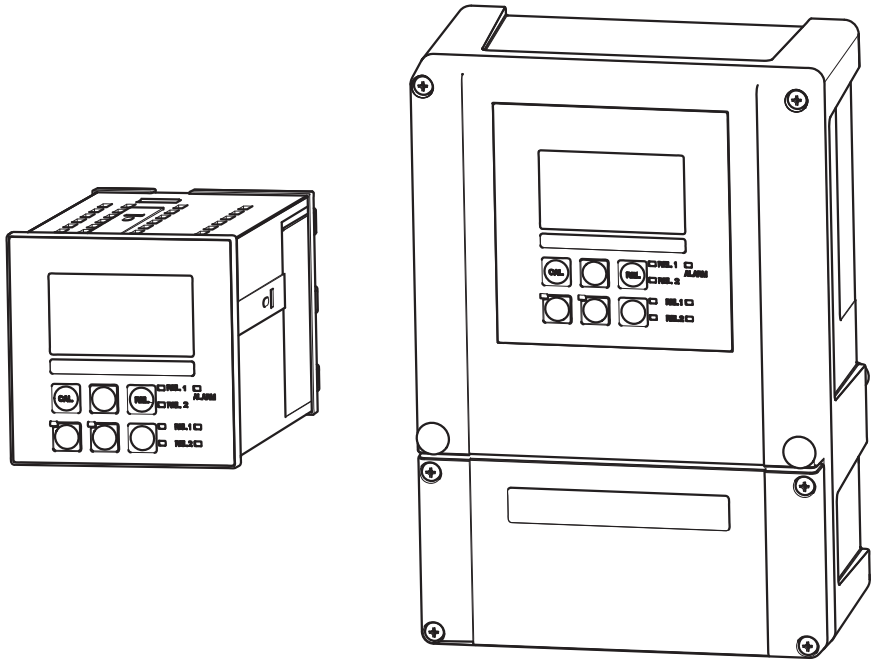
Operating Instructions

OPM223/253

Transmitter for pH and ORP



BA194e/00/07.09/
71106576
valid as of:
Software-version 2.50

Table of contents

1 Safety instructions

1.1 Designated use

OPM223/253 is a transmitter for determining the pH value and/or ORP.

The transmitter is particularly suited for use in the following areas:
- Chemical industry
- Pharmaceutical industry
- Food industry
- Drinking water treatment
- Condensate treatment
- Municipal sewage treatment plants
- Water treatment
- Electroplating

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.

1.2 Installation, commissioning and operation

Please note the following items:
- Installation, electrical connection, commissioning, operation and maintenance of the measuring system must only be carried out by trained technical personnel.
  The technical personnel must be authorised for the specified activities by the system operator.
- Technical personnel must have read and understood these Operating Instructions and must adhere to them.
- Before commissioning the entire measuring point, check all the connections for correctness. Ensure that electrical cables and hose connections are not damaged.
- Do not operate damaged products and secure them against unintentional commissioning. Mark the damaged product as being defective.
- Measuring point faults may only be rectified by authorised and specially trained personnel.
- If faults can not be rectified, the products must be taken out of service and secured against unintentional commissioning.
- Repairs not described in these Operating Instructions may only be carried out at the manufacturer’s or by the service organisation.

1.3 Operational safety

The transmitter has been designed and tested according to the state of the art and left the factory in perfect functioning order.
Relevant regulations and European standards have been met.

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

Ex systems have an additional Ex documentation which is part of the Operating Instructions (see also chapter "Scope of delivery").

EMC
This instrument has been tested for electromagnetic compatibility in industrial use according to applicable European standards.
Protection against interference as specified above is valid only for an instrument connected according to the instructions in these Operating Instructions.

1.4 Return

If the transmitter has to be repaired, please return it *cleaned* to the sales centre responsible. Please use the original packaging, if possible.

1.5 Notes on safety icons and symbols

Safety icons

Warning!
This symbol alerts you to hazards. They can cause serious damage to the instrument or to persons if ignored.

Caution!
This symbol alerts you to possible faults which could arise from incorrect operation. They could cause damage to the instrument if ignored.

Note!
This symbol indicates important items of information.

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

Alarm relay

Input

Output

DC voltage source

Temperature sensor

2 Identification

2.1 Device designation

2.1.1 Product structure

	Sensor input; software	
	IS	pH (glass/ISFET) / ORP; Plus package
	PR	pH (glass)/ORP; basic version
	PS	pH (glass)/ORP; Plus package

		Power supply; approval	
		0	230 V AC
		1	115 V AC
		2	230 V AC; CSA Gen. Purp.
		3	115 V AC; CSA Gen. Purp.
		4	230 V AC; ATEX II 3G [EEx nAL] IIC
		5	100 V AC
		6	24 V AC/DC; ATEX II 3G [EEx nAL] IIC for OPM223, EEx nA[L] IIC T4 for OPM253
		7	24 V AC; CSA Gen. Purp.
		8	24 V AC/DC

			Output	
			0	1 x 20 mA, pH/ORP
			1	2 x 20 mA, pH/ORP + selectable

				Additional contacts; analogue input	
				05	not selected
				10	2 x relay (limit/P(ID)/timer)
				15	4 x relay (limit/P(ID)/Chemoclean)
				16	4 x relay (limit/P(ID)/timer)
				20	2 x relay (limit/P(ID)/timer); 20 mA
				25	4 x relay (limit/P(ID)/Chemoclean); 20 mA
				26	4 x relay (limit/P(ID)/timer); 20 mA

OPM253-					complete order code
OPM223-					

2.1.2 Additional functions of the Plus Package

- Current output table to cover large areas with varying resolution
- Monitoring of sensor and process for safe operation
- Neutralisation controller to keep pH value constant by dosing acid and alkali
- Automatic cleaning function start

2.2 Scope of delivery

The delivery of the field instrument includes:
- 1 transmitter OPM253
- 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 BA194e00
- versions with explosion protection for hazardous area zone II (ATEX II 3G): Safety instructions for use in explosion-hazardous areas, XA194a300

The delivery of the panel mounted instrument includes:
- 1 transmitter OPM223
- 1 set of plug-in screw terminals
- 2 tensioning screws
- 1 BNC-plug (solder-free)
- 1 operating instructions BA194e00
- versions with explosion protection for hazardous area zone II (ATEX II 3G): Safety instructions for use in explosion-hazardous areas, XA194a300

If you have any questions, please contact your supplier or your sales centre responsible .

2.3 Certificates and approvals

Declaration of conformity
The product meets the legal requirements of the harmonised European standards.
The manufacturer confirms compliance with the standards by affixing the CE symbol.

Explosion protection for Zone 2

OPM253-..6...	ATEX II 3G EEx nA[L] IIC T4
OPM253-..4... OPM223-..4... OPM223-..6...	ATEX II 3G [EEx nAL] IIC

3 Installation

3.1 Quick installation guide

Warning!
If the measuring point or parts of the measuring point are in explosion-hazardous areas you have to follow the "Safety instructions for electrical apparatus certified for use in explosion-hazardous areas". These instructions (XA194a300) are part of the scope of delivery.

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 systems comprises:
- The transmitter OPM223 or OPM253
- A pH/ORP electrode with or without an integrated temperature sensor
- An immersible, flow or retractable assembly
- A measuring cable(e.g. OPK9)

Options: extension cable, junction box VBA or VBM

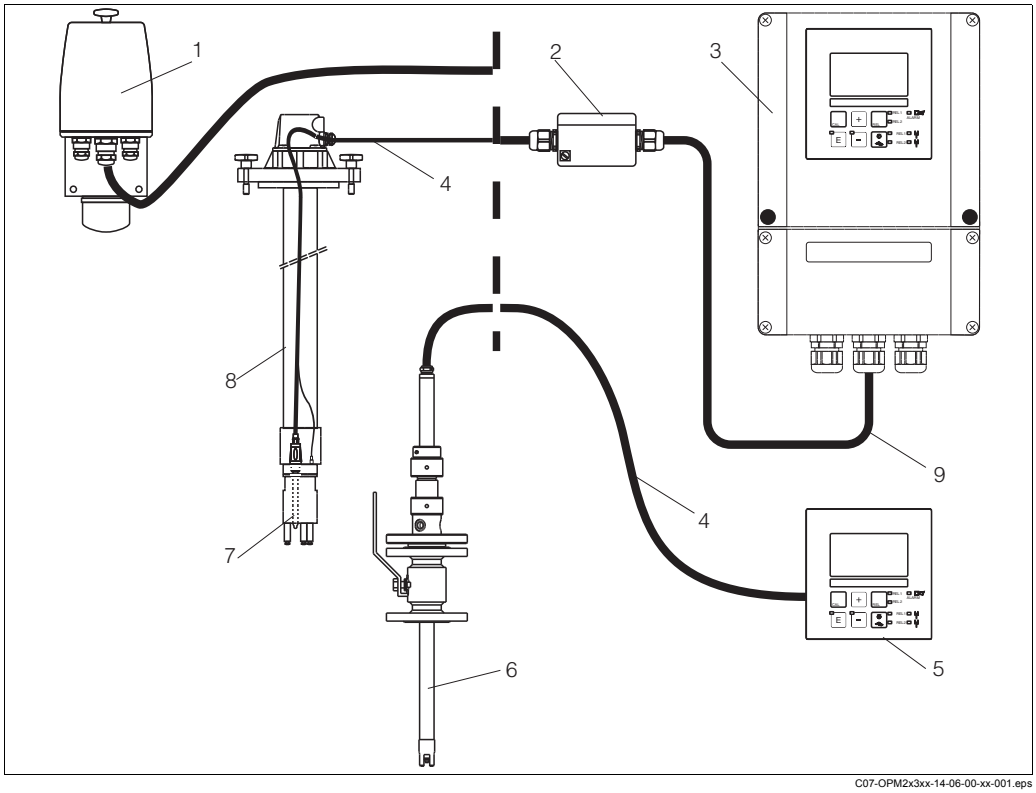


Fig. 1: Complete measuring system OPM223/253

1 Flow assembly OPA250
2 Junction box VBA
3 Transmitter OPM253
4 Measuring cable e.g. OPK9
5 Transmitter OPM223
6 Retractable assembly OPA450
7 Electrode, e.g OPS11
8 Immersion assembly OPA111
9 Extension cable

3.2 Incoming acceptance, transport, storage

- Make sure the packaging is undamaged!
  Inform the supplier about 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 delivery contents.
  Keep the damaged products until the matter has been settled.
- Check that the scope of delivery is complete and agrees with your order and the 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 sales centre responsible.

3.3 Installation conditions

3.3.1 Field instrument

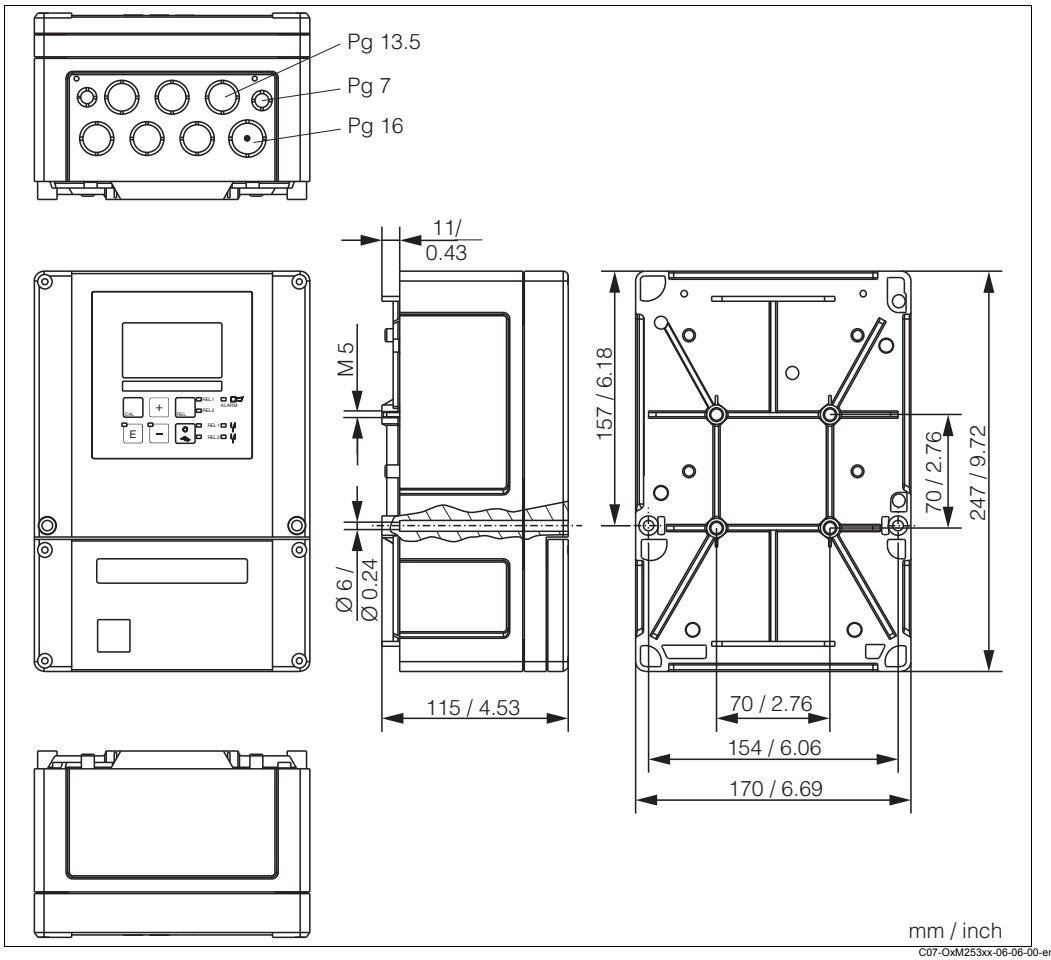
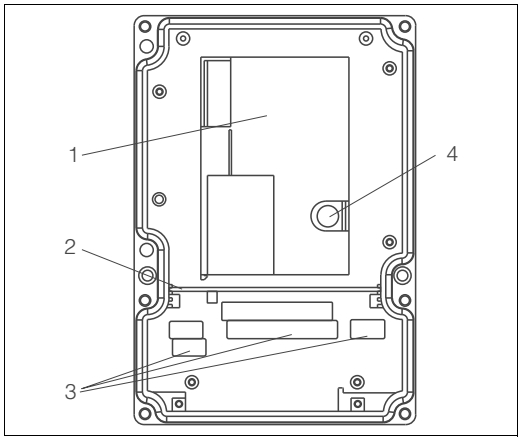


Fig. 2: Field instrument

Note!
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.



1 Removable electronics box
2 Partition plate
3 Terminals
4 Fuse

Fig. 3: View into the field housing

3.3.2 Panel-mounted instrument

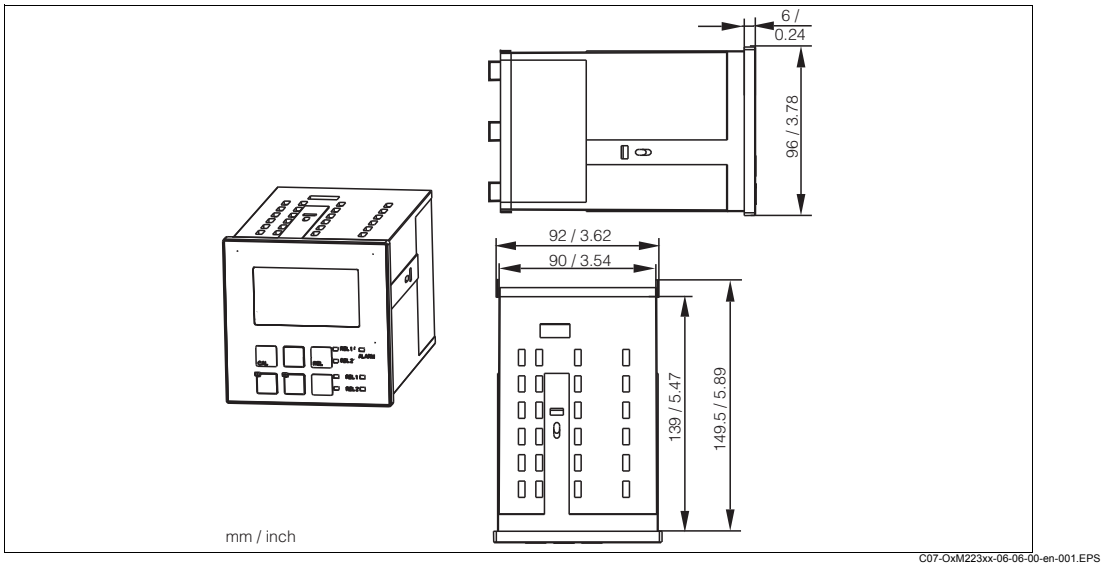


Fig. 4: Panel-mounted instrument

3.4 Installation instructions

3.4.1 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 mast

Note!
When mounting in the open air with unprotected exposure to weather conditions, a weather protection cover (see Accessories) is required.

Transmitter wall mounting

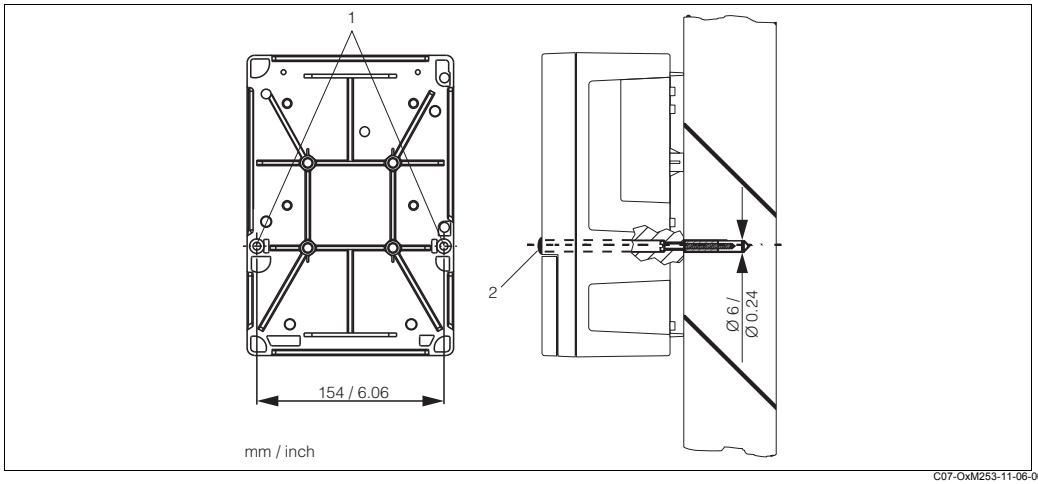


Fig. 5: Field instrument wall mounting

For wall mounting the transmitter, proceed as follows:

1. Drill the bores as shown in Fig. 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

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

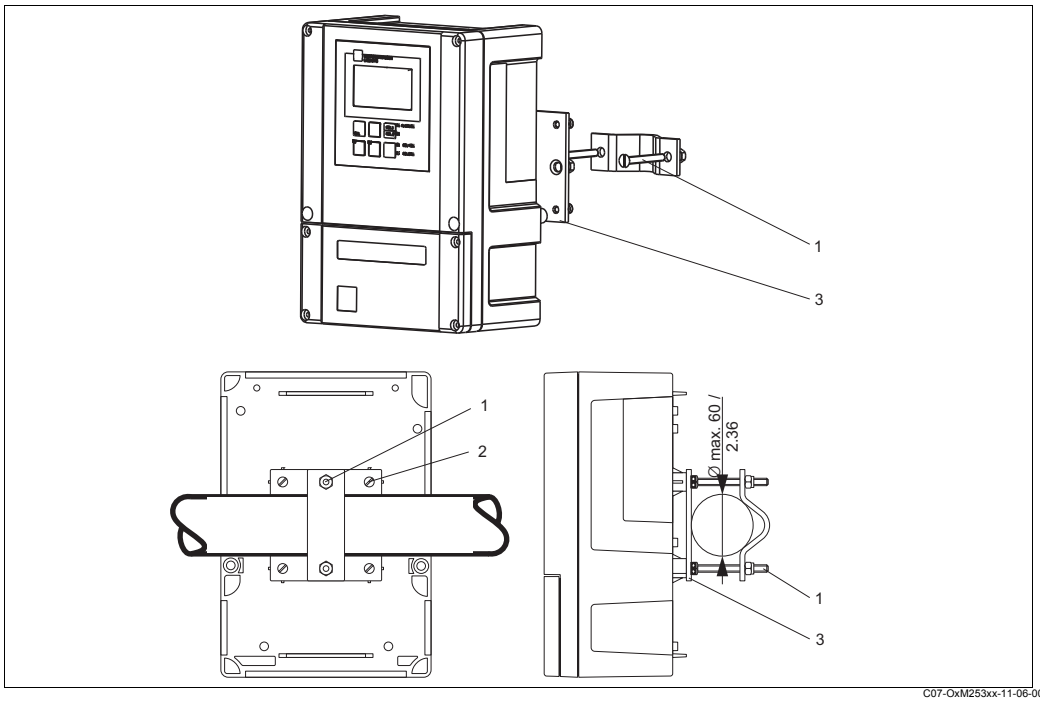


Fig. 6: Post mounting field device to cylindrical pipes

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 using the clip on the post or pipe.

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.

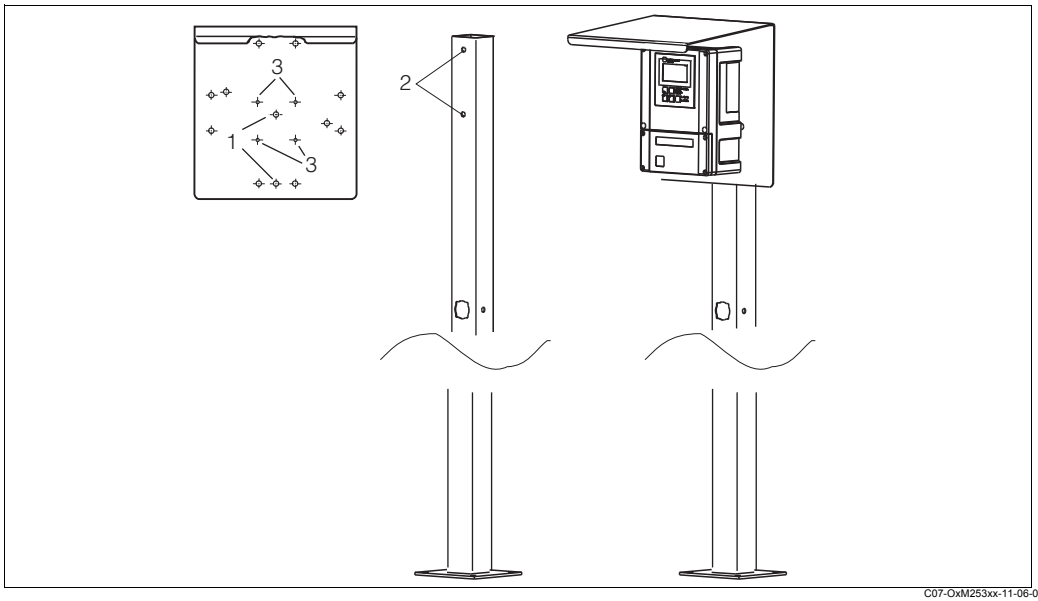


Fig. 7: Mounting field device with universal posts and weather protection cover

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).

3.4.2 Panel-mounted instrument

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

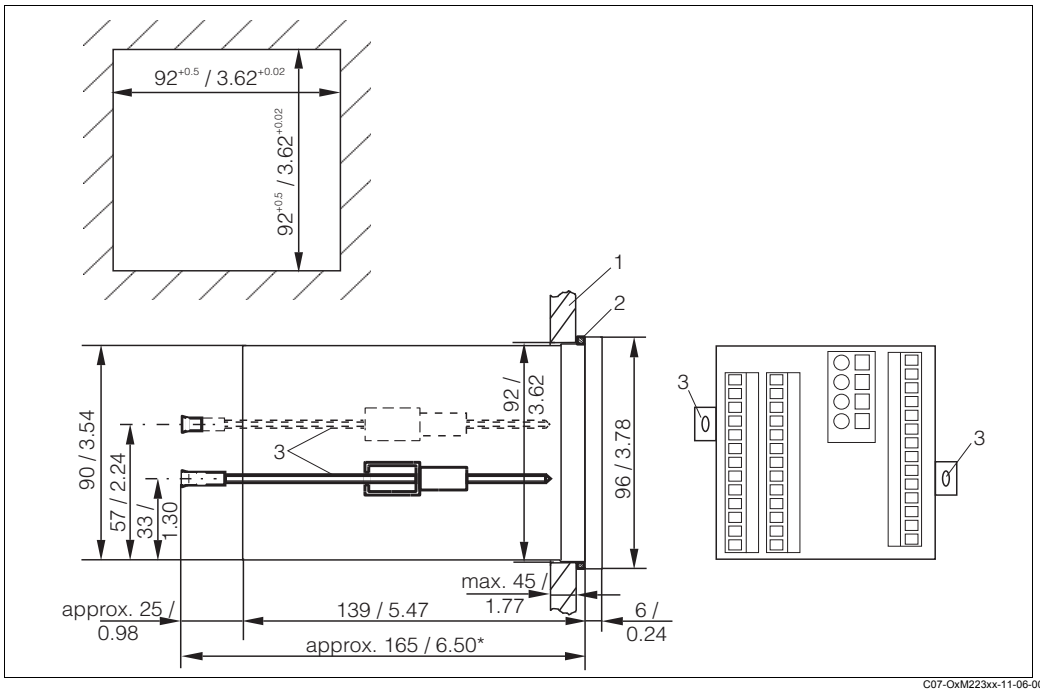


Fig. 8: Securing the panel-mounted instrument

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

3.5 Post-installation check

- After installation, check the transmitter for damage.
- Check whether the transmitter is protected against moisture and direct sunlight.

4 Wiring

Warning!
- The electrical connection must only be carried out by authorised technical personnel.
- Technical personnel must have read and understood the instructions in this manual and must adhere to them.
- Ensure that there is no voltage at the power cable before beginning the connection work.

4.1 Electrical connection

4.1.1 Connection diagram

The wiring diagram depicted in Fig. 9 shows the connections of an instrument equipped with all the options. Connecting the sensors to the various measuring cables is explained in more detail in the "Measuring cables and sensor connection" section.

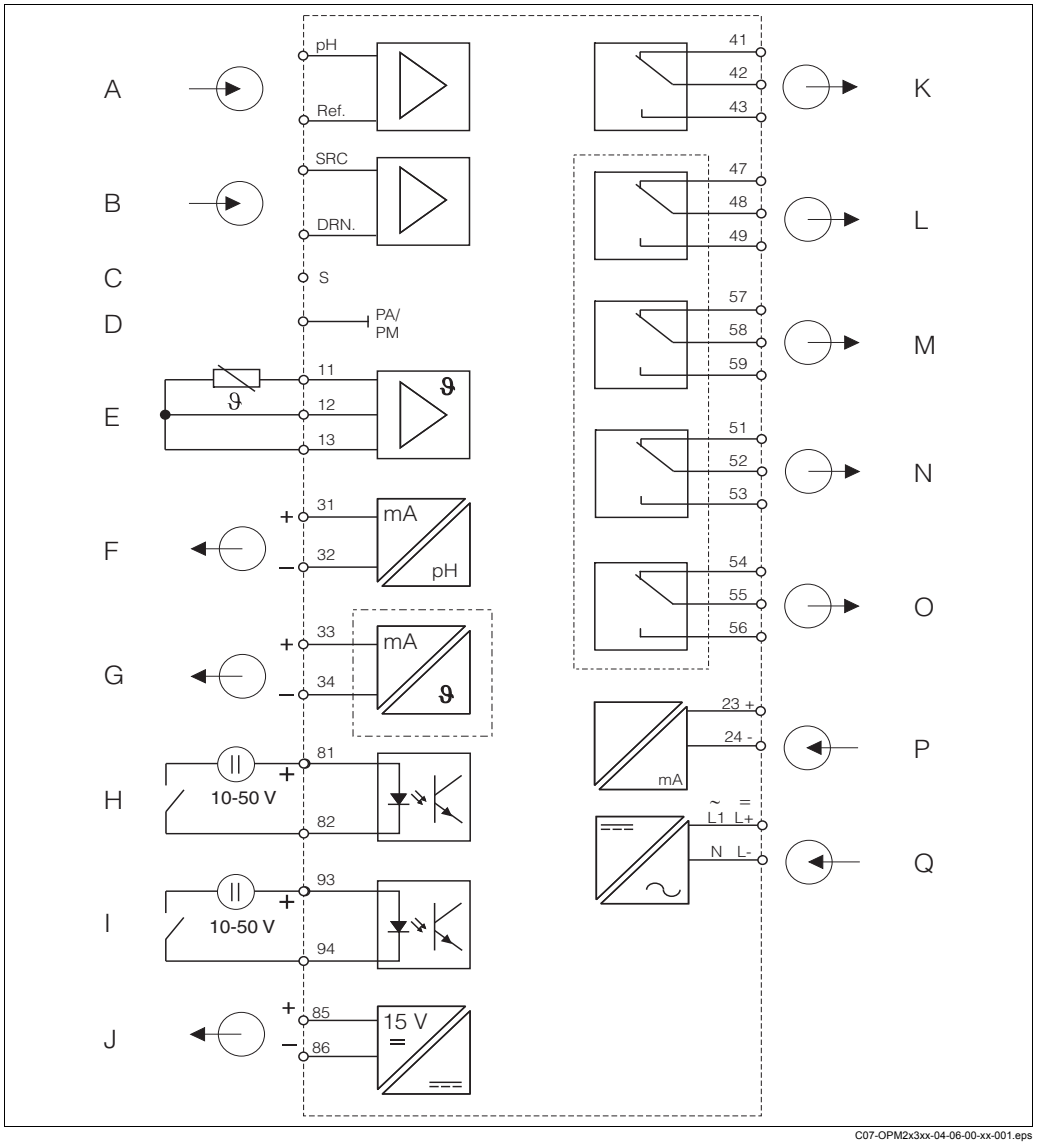


Fig. 9: Transmitter electrical connection

A	Standard sensor	J	Auxiliary voltage output
B	ISFET sensor	K	Alarm (contact position currentless)
C	Outer screen connection for glass electrodes	L	Relay 1 (contact position currentless)
D	Potential matching	M	Relay 2 (contact position currentless)
E	Temperature sensor	N	Relay 3 (contact position currentless)
F	Signal output 1 pH/ORP	O	Relay 4 (contact position currentless)
G	Signal output 2 temperature, pH/ORP or controller	P	Current input 4 ... 20 mA
H	Binary input 1 (Hold)	Q	Power supply
I	Binary input 2 (Chemoclean)		

Note!

- The device is approved for protection class II and is generally operated without a protective earth connection.
- To guarantee measuring stability and functional safety, you have to ground the outer screen of the sensor cable:
  – Glass electrodes (PR/PS device version): terminal "S"
  – ISFET sensors (IS device version): PE distributor rail
    This is on the cover frame for panel-mounted instruments and in the connection compartment for field devices.
- Ground the PE distributor rail or the ground terminal.

Field instrument connection

Guide the measuring cables through the PG glands into the housing. Connect the measuring cables in accordance with the terminal assignment (→ Fig. 10).

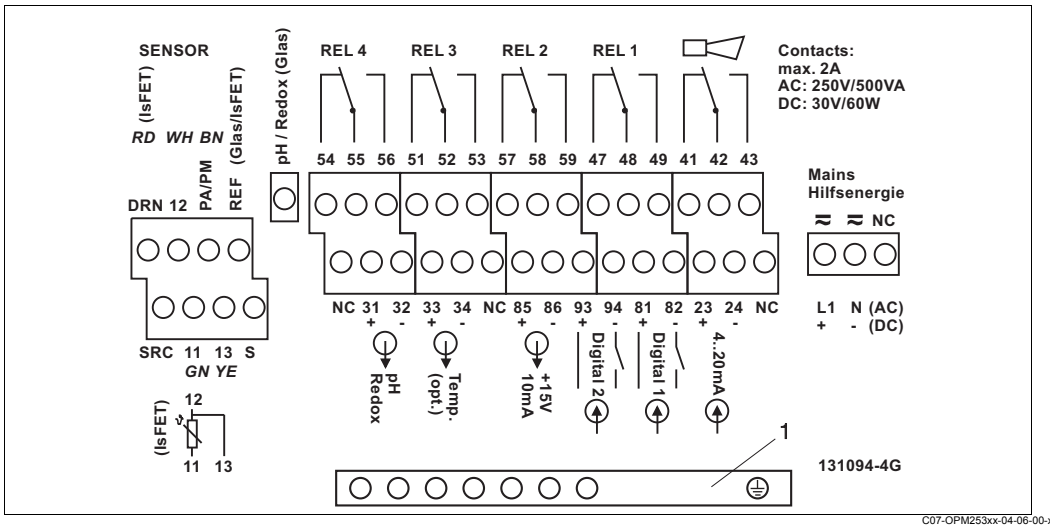


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Fig. 10: Field instrument connection compartment sticker

1 PE distributor rail for IS device version

Panel-mounted instrument connection

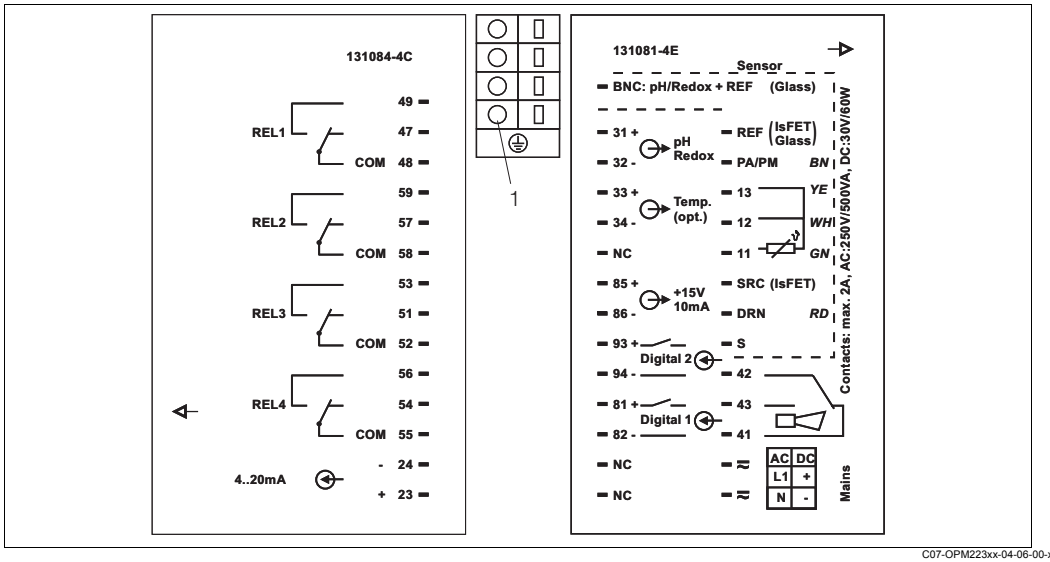

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Fig. 11: Panel-mounted instrument connection sticker

1 Ground terminal for IS device version

Caution!
- Terminals marked NC may not be wired.
- Unmarked terminals may not be wired.

Note!
Please label the sensor terminal block with the sticker provided.

4.1.2 Measuring cable and sensor connection

You require screened special measuring cables to connect pH and ORP electrodes to the transmitter. The following multi-core and ready-to-use cable types can be used:

Sensor type	Cable	Extension
Electrode without temperature sensor	OPK1	VBA / VBM box + OYK71 cable
Electrode with temperature sensor Pt 100 and TOP 68 plug-in head	OPK9	VBA / VBM box + OYK71 cable
ISFET sensor with temperature sensor Pt 100 / Pt 1000 and TOP 68 plug-in head	OPK12	VBA / VBM box + OYK12 cable
pH individual electrode with separate reference electrode and separate temperature sensor	OPK2	VBA / VBM box + PMK cable

Structure and termination of the measuring cables

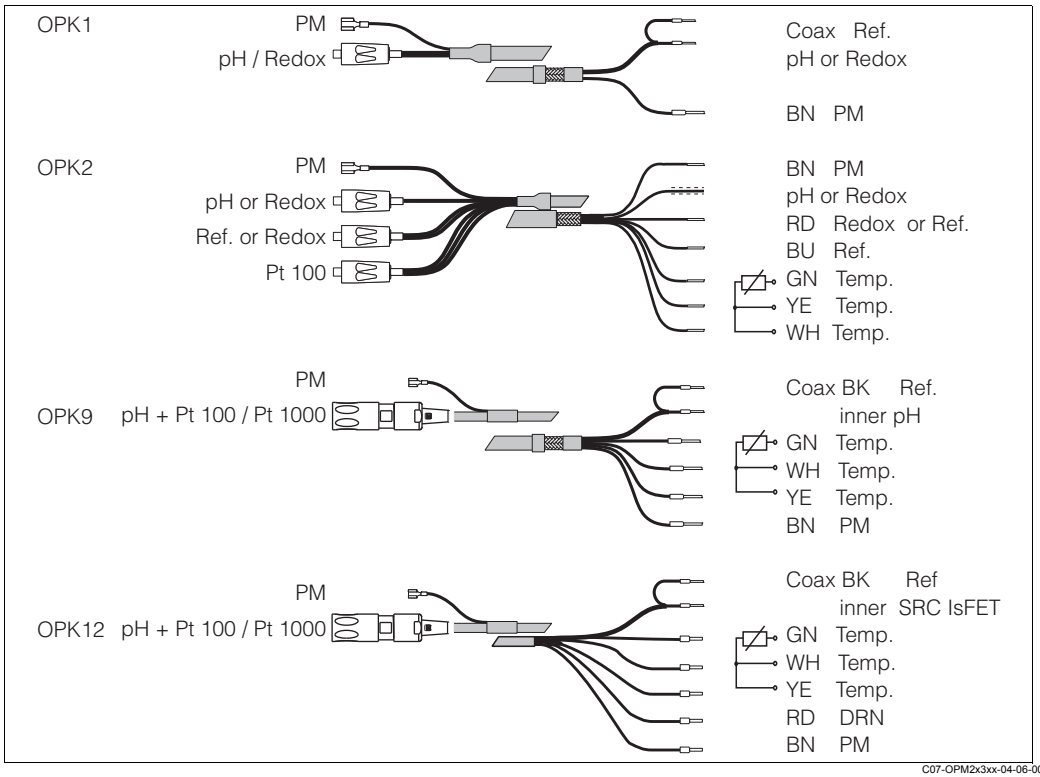


Fig. 12: Structure of the special measuring cables

Note!
For further information on the cables and junction boxes, please refer to the "Accessories" section.

Field instrument measuring cable connection
Proceed as follows to connect a pH-electrode to the field instrument:

1. Open the housing cover to access the terminal block in the connection compartment.
2. Break the punching of a cable gland from the housing, mount a PG gland and guide the cable through this Pg gland.
3. Connect the cable in accordance with the terminal assignment .
4. Tighten the Pg gland.

Caution!
Make sure to protect the connectors, cable ends and terminals against moisture as this could result in incorrect measurement!

Panel-mounted instrument measuring cable connection
To connect a pH electrode to the panel-mounted instrument, connect the cable in accordance with the terminal assignment to the terminals on the rear of the device.
If you are using glass electrodes with the panel-mounted instrument, you have to terminate the measuring cable with a BNC connector. A solder-free BNC connector is supplied with the device.
Proceed as follows:

1. Cut off end sleeves 2 and 3 of the coaxial cable (Fig. 13).

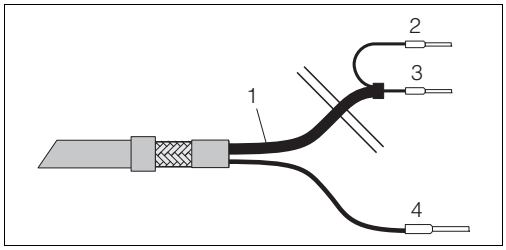


Fig. 13: Cable OPK1: device connection

1 Coaxial cable
2 Inner screen BK (ref.)
3 Inner coax (pH / mV)
4 Strand BN (PM)

2. Push the cable gland 5 and the washer 6 onto the coaxial cable.
3. Remove the insulation (13 mm(0.51")) and screw the clamping ring 7 onto the insulation.

   Note!
   Parts 5 to 7 are supplied with the BNC connector for cable diameters 3.2 mm (0.13") and 5 mm (0.20").
4. Fold the braided screen 8 of the screen over the clamping ring and cut off the excess material.
5. There is a semi-conductor layer 14 (conductive foil) between the inner insulation and the braided screen 8. Strip this semi-conductor layer to the braided screen.

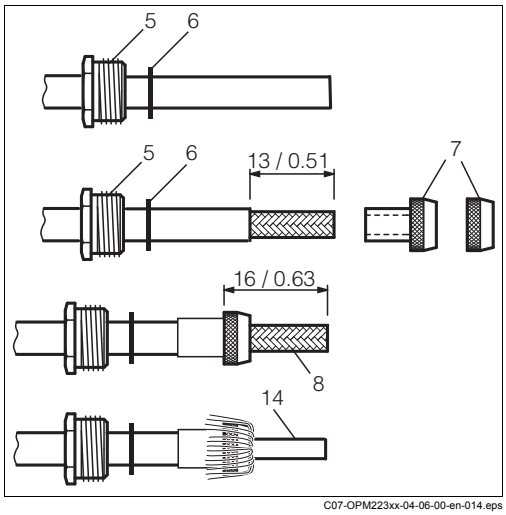


Fig. 14: Terminating the pH connecting cable for mounting the BNC elbow plug

6. Remove the inner insulation (4 mm (0.16")).
7. Position end sleeve 13 onto the stripped inner conductor and secure the end sleeve with a crimping pliers.
8. Push the BNC connector housing 9 over the cable. The inner conductor must be located at clamping surface 10 of the connector.
9. Tighten the cable gland 5.
10. Insert the clamp element 11 and screw in the connector cover 12. This creates a safe connection between the inner conductor and the connector pin.

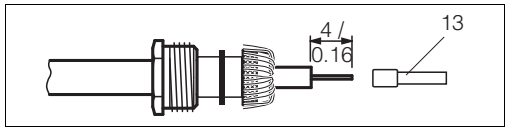


Fig. 15: Terminating the pH connecting cable for mounting the BNC elbow plug

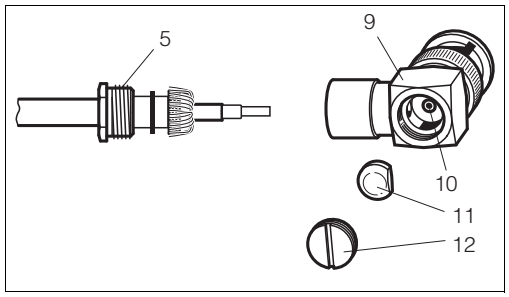


Fig. 16: Mounting the pH connecting cable in the BNC elbow plug

Examples for connecting pH and ORP sensors

The following diagrams show the connection of various pH and ORP sensors.

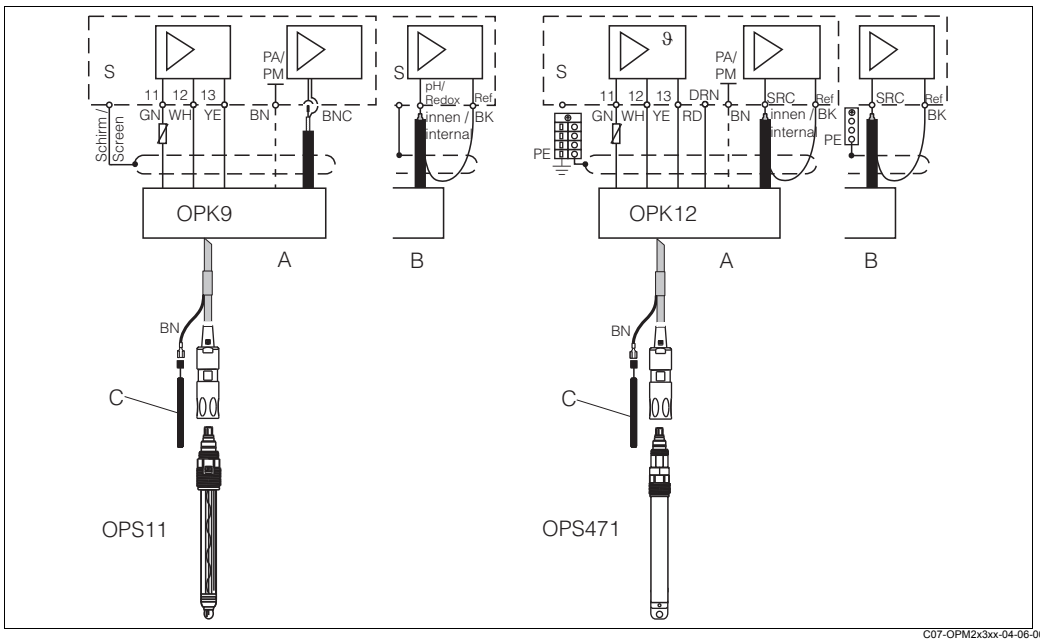


Fig. 17: Connecting glass electrode OPS11 with OPK9 (left) and ISFET sensor OPS471 with OPK12

A Panel-mounted instrument
B Field instrument
C Potential matching PM for symmetrical connection

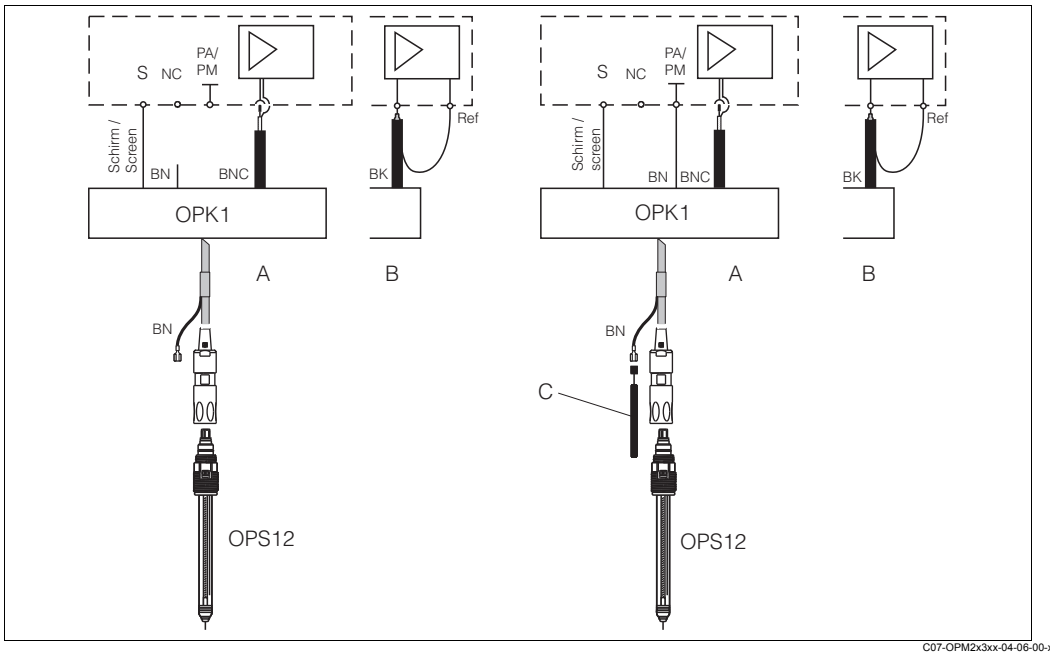


Fig. 18: Asymmetrical (without PML) and symmetrical (with PML) connection of ORP electrodes

A Panel-mounted instrument
B Field instrument
C Potential matching (PM) in the medium for symmetrical connection

The pH and ORP sensors can be connected both symmetrically and asymmetrically. Generally, the following applies:

- No potential matching connection present: asymmetrical connection
- Potential matching connection present: symmetrical connection

The decision can also depend on the operating conditions.

Note!
- OPM223/253 is pre-programmed for symmetrical measurement with potential matching. If you want asymmetrical measurement, you have to change the configuration in the A2 field.
- If the "asymmetrical" software setting was selected for a symmetrical connection, the operating time of the reference electrode is reduced.

Caution!
In the case of a symmetrical connection, the potential matching pin must be connected and always immersed in the medium.

Advantages of symmetrical vs. asymmetrical:
- Symmetrical measurement:
  – No leak current since the reference and the pH/ORP electrode is connected with high resistance
  – Safe measurement under difficult process conditions (strong flowing and high-resistance media, partially soiled diaphragm)
- Asymmetrical measurement:
  – Use of assemblies without potential matching possible

4.2 Alarm contact

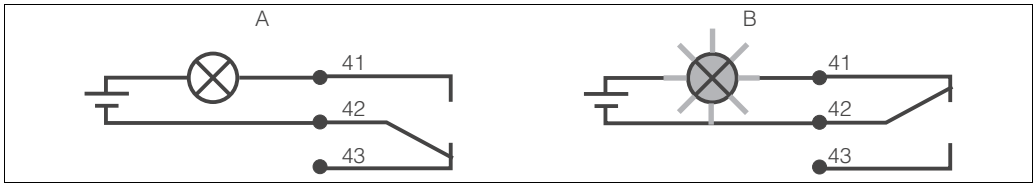


Fig. 19: Recommended fail-safe switching for the alarm contact
A Normal operating status *B Alarm condition*

Normal operating status:
- Device in operation
- No error message present (Alarm LED off)

› Relay energised
› Contact 42/43 closed

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

› Relay de-energised
› Contact 41/42 closed

4.3 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

Electrical connection	Remarks
Are the installed cables strain-relieved?	
No loops and cross-overs in the cable run?	
Are the signal cables correctly connected acc. to the wiring diagram?	
Are all screw terminals tightened?	
Are all cable entries installed, tightened and sealed?	
Are the PE distributor rails grounded (if present)?	Grounding at place of installation

5 Operation

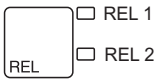
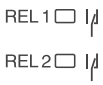
5.1 Quick operation guide

You have the following ways of operating the transmitter:
- On site via the key field

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

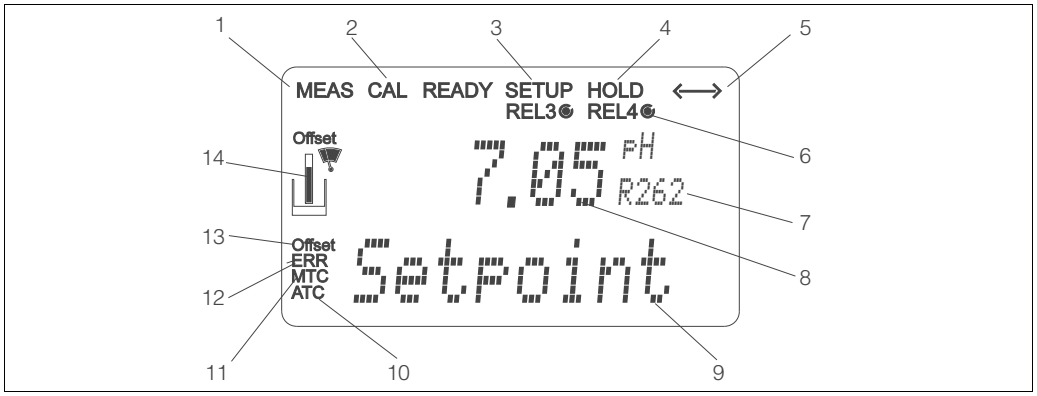


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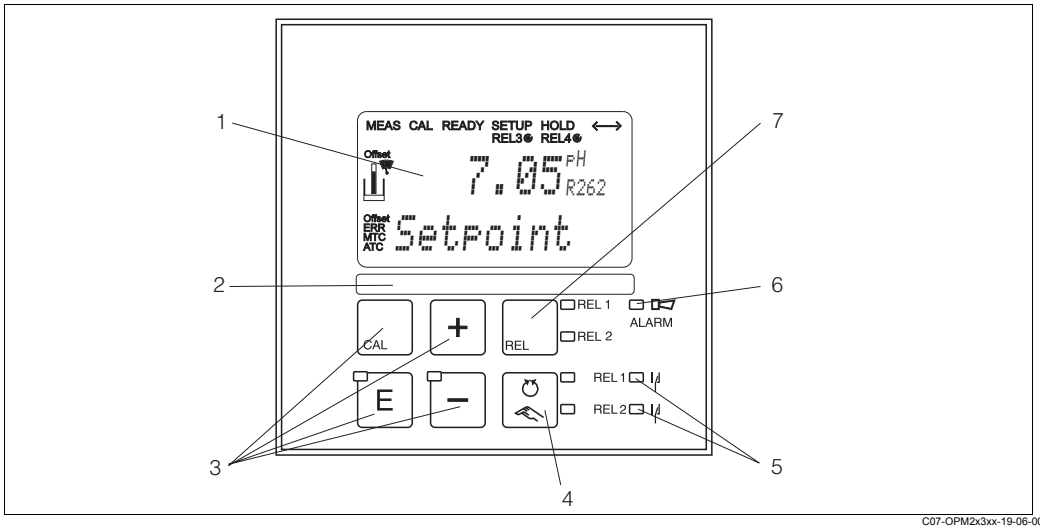
Fig. 20: Transmitter LC display

1 *Indicator for measuring mode (normal operation)*
2
3 *Indicator for calibration mode*
4 *Indicator for setup mode (configuration)*
5 *Indicator for "Hold" mode (current outputs remain at last current state)*
6 *Indicator for receipt of a message for devices with communication*
7 *Indicator of working status of relays 3/4: ○ inactive, ◉ active*
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 *Indicator for autom. temperature compensation*
11 *Indicator for man. temperature compensation*
12 *"Error": error display*
13 *Temperature offset*
14 *Sensor symbol*

5.2.2 Operating elements



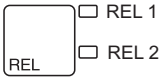
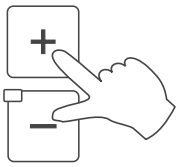
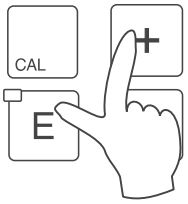
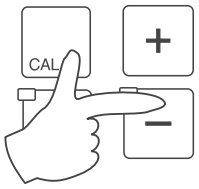
C07-OPM2x3xx-19-06-00-en-001.eps

Fig. 21: Operating elements

1 *LC display for displaying the measuring 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*
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

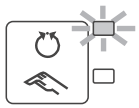
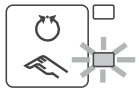
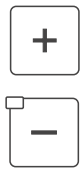
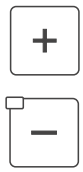
	**CAL key** When you press the CAL key, the device first prompts you for the calibration access code: • Code 22 for calibration • Code 0 or any other code for reading the last calibration data Use the CAL key to accept the calibration data or to switch from field to field within the calibration menu.
	**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 the 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. ✎ Note! 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 mV 4. Current input signal in % 5. Current input signal in mA 6. Return to basic settings 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 display mode (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 unauthorised 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. The bottom LED beside the AUTO key lights up.
	3. To enable the manual mode, enter the code **22** via the PLUS and MINUS keys.
	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.

Note!
- The operating mode remains in effect even after a power failure.
- The manual mode has priority over all other 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

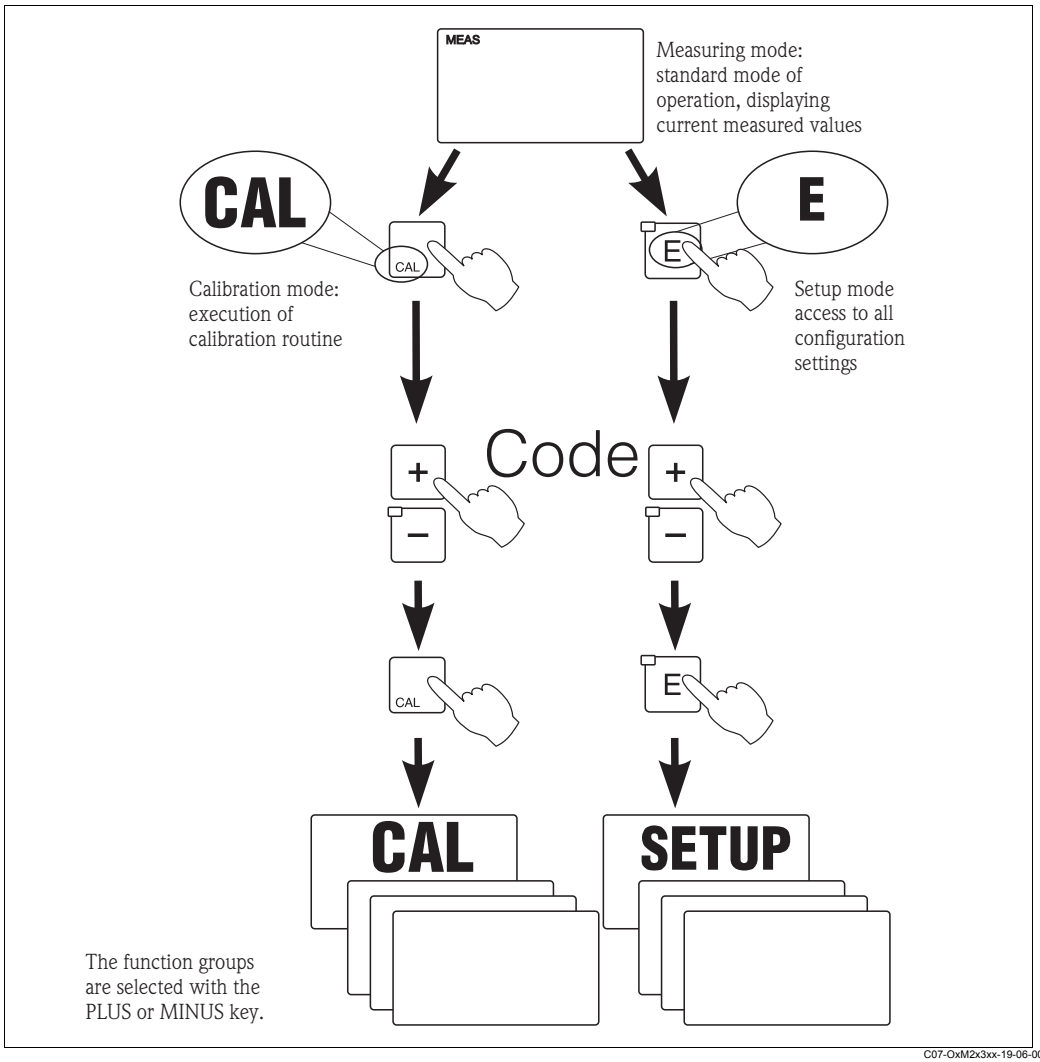


Fig. 22: Description of the possible operating modes

Note!
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.

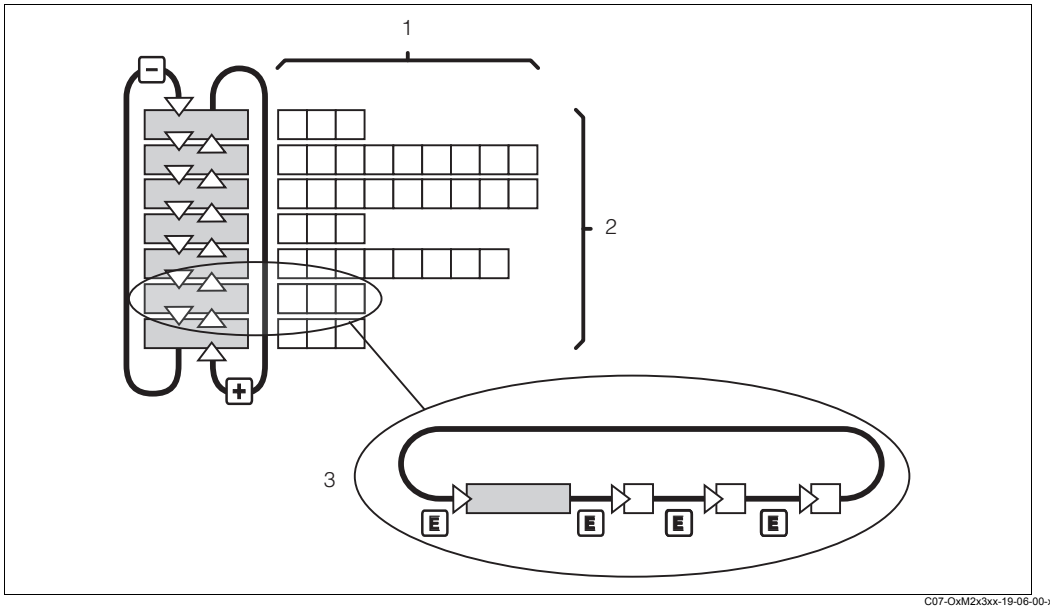
- **Key CAL + Code 22:** access to Calibration and Offset menu
- **Key ENTER + Code 22:** access to the menus for the parameters which make configuration and user-specific settings possible
- **Keys PLUS + ENTER:** locks the keyboard
- **Keys CAL + MINUS:** unlocks the keyboard
- **Key CAL or ENTER + 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 the 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.

Note!
- 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.



C07-OxM2x3xx-19-06-00-xx-002.eps

Fig. 23: 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

In both the setup mode and during 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 ... 20 mA) is output via current output 2, it is set to 0/4 mA in Hold.

Note!
- 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.

5.4 System configuration

5.4.1 Setup 1 (pH / ORP)

In the SETUP 1 function group, change the settings for the measuring mode and the sensor. All the settings in this menu are made during initial commissioning. However, you can change the settings at any time.

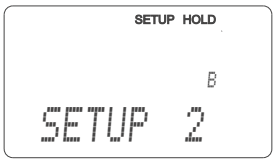
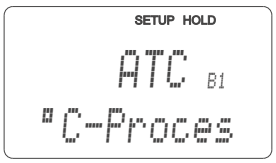
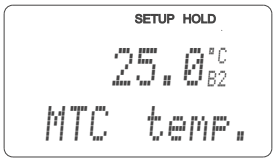
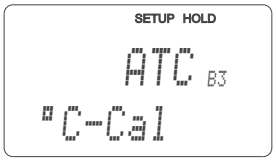
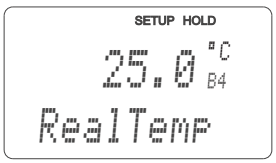
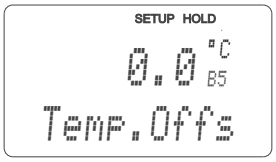
Note!
An error message (E010) is output if the temperature sensor is defective. Measuring continues at a process temperature of 25 C (77 °F).

Setup 1 for ISFET and standard sensors

Coding		Field	Setting range (Factory settings, bold)	Display	Info
A		**SETUP 1 function group**		SETUP HOLD A SETUP 1	Configuration of basic functions
	A1	Select operating mode	**pH** ORP mV ORP %	SETUP HOLD pH A1 Oper.Mode	Caution! When the operating mode is changed, all user settings are automatically reset to the factory settings.
	A2	Select connection mode	**Sym = symmetrical** Asym = asymmetrical	SETUP HOLD sym A2 Wiring	Detailed information on symmetrical or asymmetrical connections can be found in the "Sensor connection" section.
	A3	Enter measured value damping	**1** 1 ... 60	SETUP HOLD 1 A3 Damping	Measured value damping causes averaging over the number of individual measured values entered. This is used, for example, to stabilise the display if the measurement is unstable. There is no damping if “1” is entered.
	A4	Select sensor	**Glass** Antimony ISFET	SETUP HOLD Glass A4 Sensor	For glass electrodes: glass For ISFET sensors: ISFET Note! Glass electrodes may only be used with zero point pH 7.
	A5	Select temperature sensor	**Pt 100** Pt 1K NTC 30 K None	SETUP HOLD Pt100 A5 Temp	Field only available for version "IS" For ISFET sensors: Pt 1K (Pt 1000) For glass electrodes: Pt 100 NTC 30k not used No temperature sensor: Select MTC in B1

5.4.2 Setup 2 (temperature)

Use this function group to change the settings for temperature measurement.
You already made all the settings of this function group during initial commissioning. However, you can change the values chosen at any time.

Coding		Field	Setting range (Factory settings, bold)	Display	Info
B		**SETUP 2 function group**			Settings for temperature measurement.
	B1	Select the type of temperature compensation for the process	– For pH operating mode: **ATC** MTC – For ORP operating mode: **Off** On		For B1 = ATC: jump to B3. For B1 = MTC: in B2, enter the process temperature which is to be used for compensation.
	B2	Enter process temperature	**25,0 °C** -50,0 ... 150,0 °C		Only if A1 = pH and B1 = MTC. You can edit the displayed value. The value entered can only be in C.
	B3	Select the type of temperature compensation for the calibration	**ATC** MTC		For B1 = ATC: edit possible. For B1 = MTC: only display B3 = MTC, return to B. A separate temperature sensor must also be immersed in the buffer solution.
	B4	Enter temperature	**25 °C** -50,0 ... 150,0 °C		Only for B1 = ATC. You can edit the displayed value. The value entered can only be in C.
	B5	Temperature difference (offset) is displayed	**0,0 °C** -5,0 ... 5,0 °C		Only for B1 = ATC. The difference between the measured and entered temperature is displayed.

5.4.3 Current input

With the "Current input" 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 ... 20 mA input of the transmitter. The following assignment applies:

	Flow in main stream	Current signal in mA	Current input signal in %
Current input lower range limit	Flowmeter lower setting value	4	0
Current input upper range limit	Flowmeter upper setting value	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.

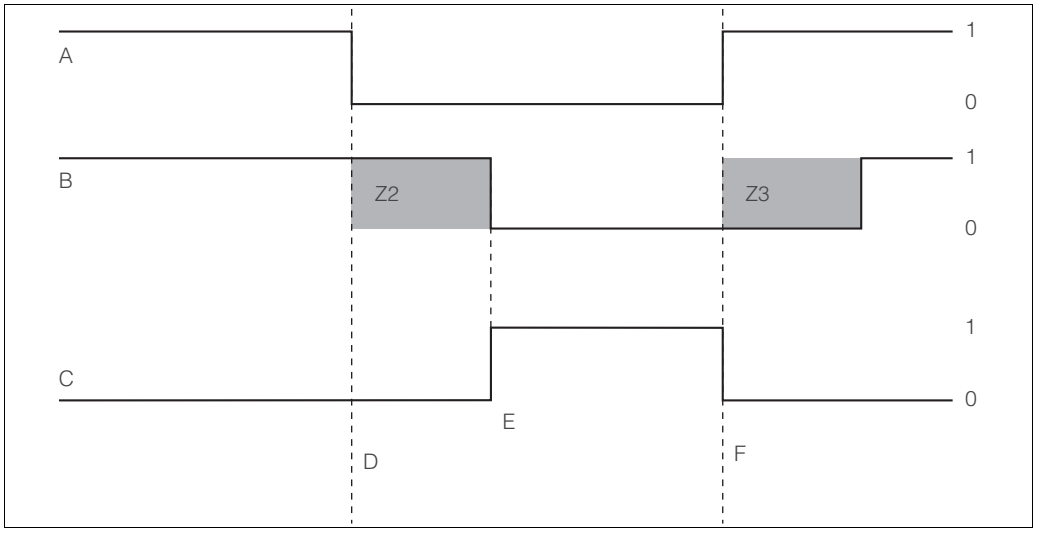


Fig. 24: Alarm signalling and dosing switch-off by the main stream

A Flow in main stream
B Relay contacts of PID controller
C Alarm relay
D Flow below switch-off limit Z 4 or flow failure
E Flow alarm
F Flow restoration
Z2 Delay for controller switch-off, see field Z2
Z3 Delay for controller switch-up, see field Z3
0 Off
1 On

Feedforward control to PID controller

For control systems with very short reaction times, it can be useful to also apply the flow rate, if it is fluctuating, to the controller to optimise the control process.

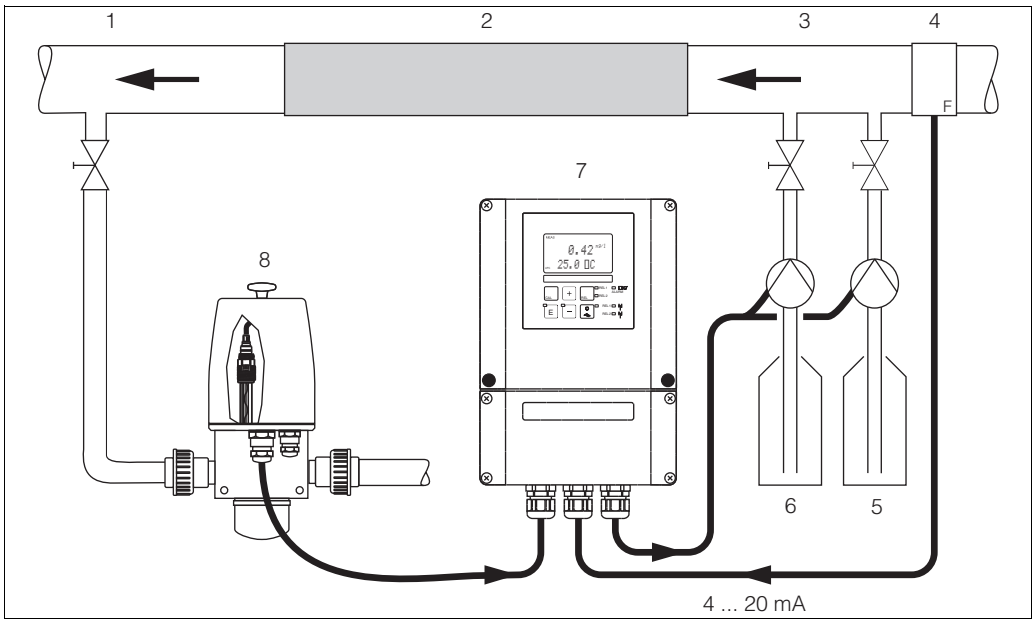


Fig. 25: Sample arrangement for feedforward control of the flow in the main stream to the PID controller

1	*Measuring water extraction point*	*5*	*Alkali*
2	*Static mixer*	*6*	*Acid*
3	*Injection points*	*7*	*Transmitter OPM253*
4	*Flowmeter*	*8*	*OPA250 with OPS11*

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

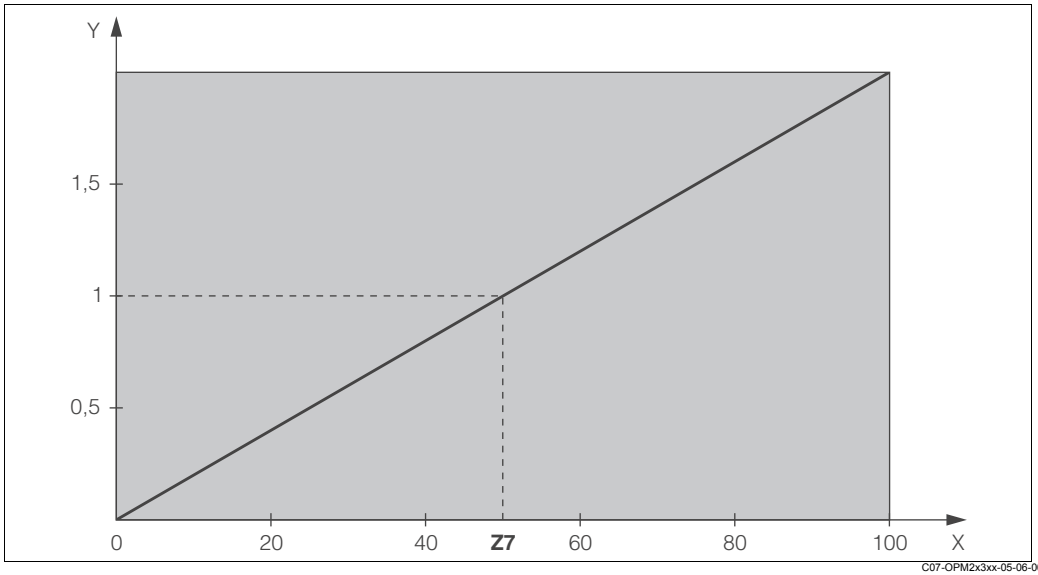
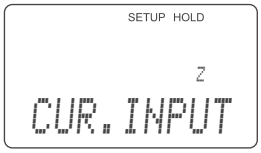
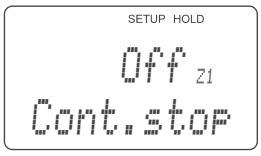
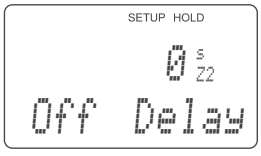
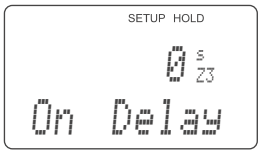
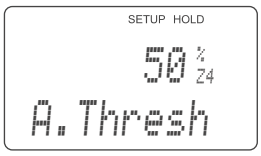
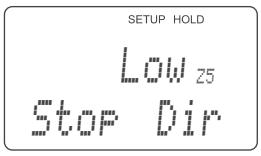
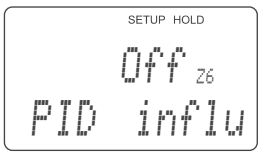
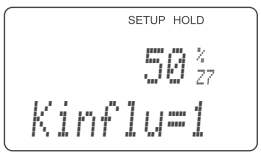


Fig. 26: Multiplying feedforward control

Y Gain K_{infl}
X Current input signal [%]

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 ... 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 ... 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 ... 100%		0 ... 100% corresponds to 4 ... 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, if usual PID controller not possible, e.g. defective sensor).
	Z7	Enter value for feedforward control at which gain = 1 applies	50% 0 ... 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.

5.4.4 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 also 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 / R 266 via the current output.

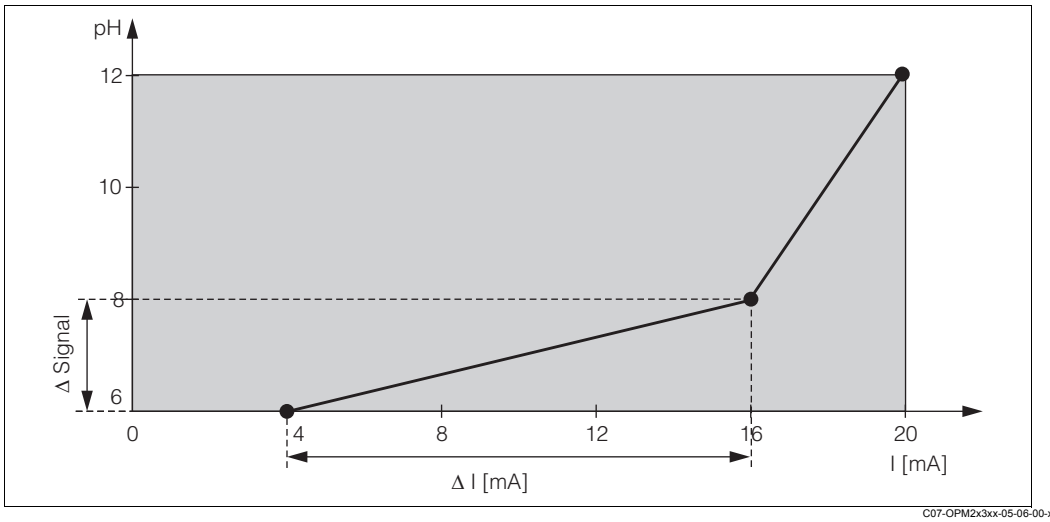


Fig. 27: User-defined current output characteristic (example)

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

- pH: 0.03
- ORP: 5 mV
- Temperature: 0.25 C

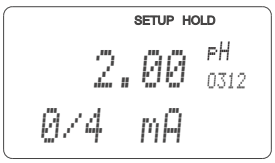
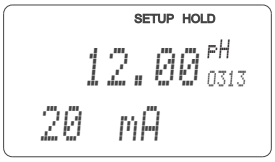
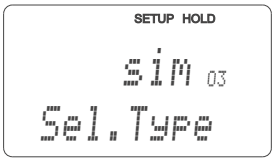
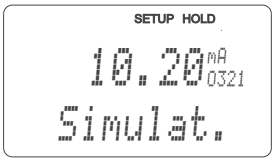
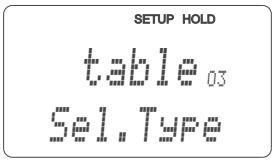
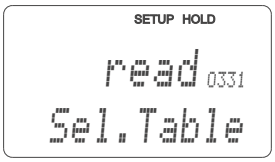
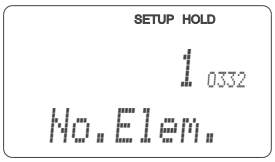
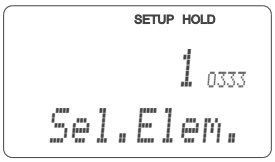
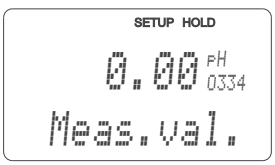
The values for the sample characteristic (Fig. 27) are entered in the following table. The distance per mA can be calculated from Δ signal / Δ mA.

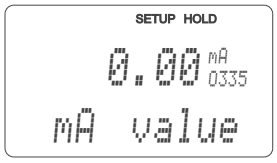
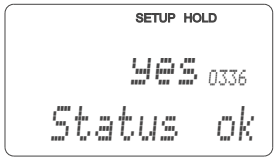
	Current output 1			Current output 2		
Value pair	**pH / mV / % / C**	**Current [mA]**	**Distance per mA**	**pH / mV / % / C**	**Current [mA]**	**Distance per mA**
1	6	4				
2	8	16	0,166			
3	12	20	1,000			

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	**pH / mV / % / C**	**Current [mA]**	**Distance per mA**	**pH / mV / % / C**	**Current [mA]**	**Distance per mA**
1						
2						
3						
4						
5						
6						
7						
8						
9						

Coding			**Field**	**Setting range (Factory settings, bold)**	**Display**	**Info**
O			**CURRENT OUTPUT function group**		SETUP HOLD 0 OUTPUT	Configuration of the current output.
O1			Select current output	**Out1** Out 2	SETUP HOLD Out1 01 Sel.Out	A characteristic can be selected for every output.
O2			Select measured variable for 2nd current output	**°C** pH mV Contr	SETUP HOLD °C 02 Parameter	R237/R 266 = curr (current output 2) can only be selected if O2 = Contr is selected (relay board required).
O3	O3 (1)		Enter or output linear characteristic	**Lin = linear** (1) Sim = simulation (2) Tab = table (3)	SETUP HOLD lin 03 Sel.Type	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 ... 20 mA** 0 ... 20 mA	SETUP HOLD 4-20 0311 Sel.Range	

Coding			Field	Setting range (Factory settings, bold)	Display	Info
		O312	0/4 mA value: Enter associated pH (ORP or temperature value	**pH 2.00** pH -2.00 ... 16.00 **-1500 mV** -1500 ... 1500 mV **0.0 %** 0.0 ...100.0 % **0.0 C** -20 ... 150.0 C		Here you can enter the measured value at which the min. current value (0/4 mA) is applied at the transmitter output. (Spreading: see Technical data.)
		O313	20 mA value: Enter associated pH (ORP) or temperature value	**pH 12.0** pH -2.00... 16.00 **1500 mV** -1500 mV ... 1500 mV **100.0 %** 0.0 ...100.0 % **100.0 C** -20.0 ... 150.0 C		Here you can enter the measured value at which the max. current value (20 mA) is applied at the transmitter output. (Spreading: see Technical data.)
	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).
		O321	Enter simulation value	**Current value** 0.00 ... 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 ... 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 ... No. elem. Assign		
		O334	Enter x value	**pH 0.00** pH -2.00 ... 16.00 **0 mV** -1500 ... 1500 mV **0.0 %** 0.0 ... 100.0 %		x value = measured value specified by user.

Coding			Field	Setting range (Factory settings, bold)	Display	Info
		O335	Enter y value	**0.00 mA** 0.00 ... 20.00 mA		y value = current value belonging to O334 specified by user. Return to O333 until all values are entered.
		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).

5.4.5 Monitoring functions

You can use the monitoring functions to define various alarms and configure output contacts. Each individual error can defined to be effective or not (at the contact or as an error current). Moreover, the electrode can be checked for glass breakage or leak current (P1, P2, P7). In the event of an alarm, a cleaning function can also be activated (F8).

Note!
You can only check for glass breakage or leak current and avail of the cleaning function in the Plus package.

Alarm

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 ... 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. Caution! If "0-20 mA" was selected in O311, "2.4 mA" may not be used.
	F5	Select error	**1** 1 ... 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.

Coding		Field	Setting range (Factory settings, bold)	Display	Info
	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.
	F8	*Automatic cleaning function start*	**no** *yes*	SETUP HOLD no F8 CleanTrig	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	SETUP HOLD next F9 Select	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 two different monitoring functions for the measurement:

SCS electrode monitoring
The Sensor Check System monitors the pH and reference electrode for incorrect measurement and complete failure.

SCS identifies the following reasons for incorrect measurement:
- Electrode glass breakage
- Fine short circuits in the pH measuring circuit, also e.g. moisture or dirt bridges at terminal points
- Contamination or clogging of the reference electrode
- Leak current for ISFET sensor

The following three monitoring methods are used:
- Monitoring the pH electrode for high resistance (alarm if a minimum impedance is undershot, approx. 500 kΩ).
  This function cannot be selected for antimony and ISFET electrodes (A4).
- Monitoring of impedance of the reference electrode (alarm if set threshold value overshot).
  This function can only be selected for symmetrically high-resistance measurement.
- Monitoring of leak current for ISFET sensors (pre-alert E168 at I_{LEAK} > 200 nA, error E008 at I_{LEAK} > 400 nA).

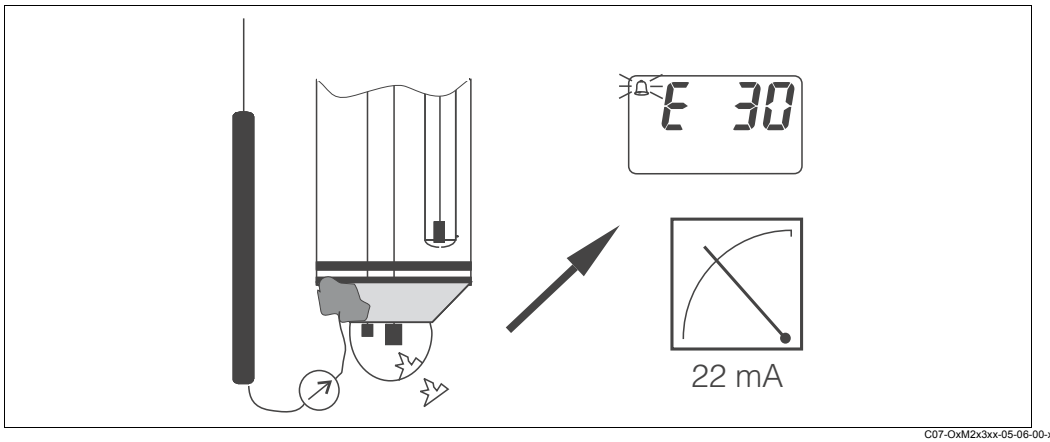


Fig. 28: SCS alarm

Caution!
Do not remove the standard electrode from the process without Hold! Since SCS is measured against PML, no contact between the inner conductor and PML triggers an alarm.

PCS alarm (Process Check System)
The function AC is used to check measuring signals for deviations. If the measuring signal change within an hour is smaller than 0.5% (of full scale value of the selected measuring range), an alarm (E152) is triggered . The reason for such sensor behaviour can be contamination, cable rupture or similar.
You can monitor the controller activity with the function CC. A malfunction of the controller is detected and reported thanks to freely adjustable monitoring times (E154 - E157).

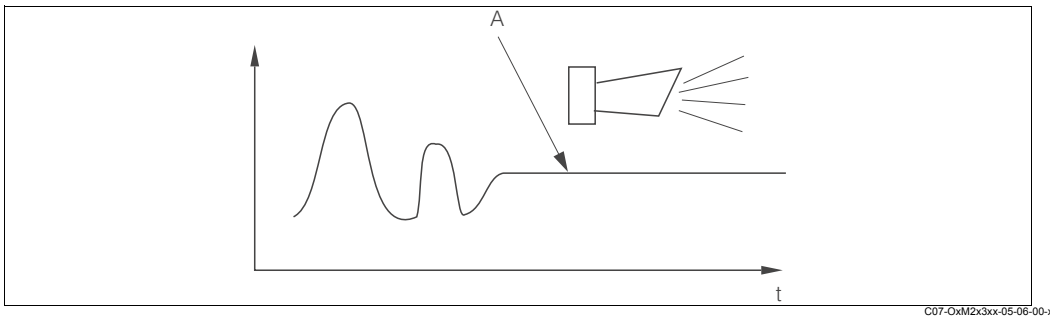
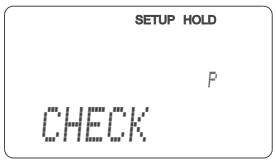
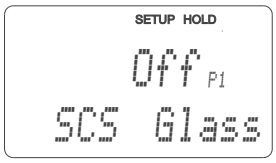
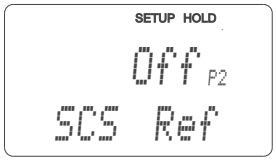
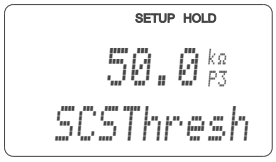
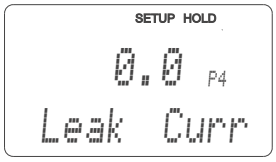
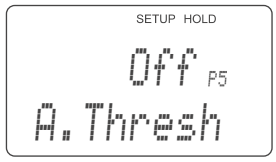
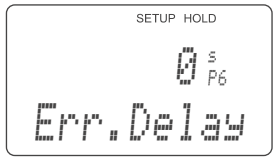
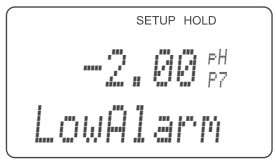
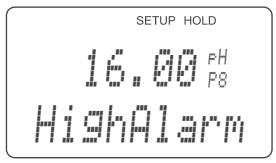


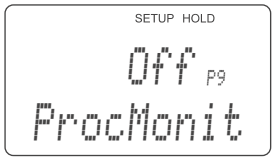
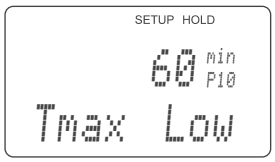
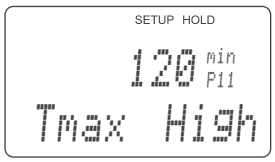
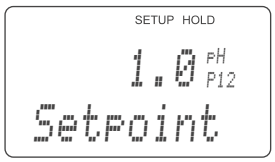
Fig. 29: PCS alarm (live check)

A Constant measuring signal = alarm triggered after PCS alarm time has elapsed

Note!
- The electrode must be symmetrically connected (with PML) to monitor the reference.
- Any PCS alarm pending is automatically deleted as soon as the sensor signal changes.
- Due to its semiconductor component, the ISFET sensor is sensitive to light and reacts with measured value fluctuations. For this reason, avoid direct sunlight when calibrating and operating. Normal ambient light does not have any effect on the measurement.

Alarm threshold monitoring
You can use this function to monitor the measured value for permissible upper and lower limits and trigger an alarm.

Coding		Field	Setting range (Factory settings, bold)	Display	Info
P		**CHECK function group**			Settings for electrode and process monitoring
	P1	Switch SCS alarm for the measuring electrode on or off	**Off** On		Monitoring of electrode for glass breakage (error no.: E008). Response time approx. 30 s SCS glass warning (error no.: E175) SCS monitoring is not active during calibration.
	P2	Switch SCS alarm for the reference electrode on or off	**Off** On		Monitoring of reference electrode for contamination or clogging (error no.: E030). Response time approx. 60 s SCS ref warning (error no.: E177) Only for A2 = sym.
	P3	Enter SCS alarm threshold for reference electrode	**50.0 kΩ** 0.0 ... 50 kΩ		The measurement result also contains the resistance of the medium. The impedance of the reference electrode increases with the degree of contamination.
	P4	Leak current display for ISFET sensor	0.0 ... 9.9 µA		Only if A4 = ISFET and P1 = on. Display only. Leak currents > 0.4 µA indicate damage to the ISFET sensor.
	P5	Select alarm threshold monitoring	**Off** Low High LoHi = low + high Low! High! LoHi!		Alarm possible with or without controller switch-off. xxxx = without controller switch-off xxxx! = with controller switch-off
	P6	Enter alarm delay	**0 s (min)** 0 ... 2000 s (min)		Depending on the option selected in F2, the alarm delay is entered in s or min. Only once this time has elapsed does undershooting/overshooting in accordance with field P7 / P8 result in an alarm.
	P7	Enter lower alarm threshold	**-2.00 pH** -2.00 ... 16.00 pH		Not applicable when P5 = off.
	P8	Enter upper alarm threshold	**16.00 pH** -2.00 ... 16.00 pH		Not applicable when P5 = off.

Coding		Field	Setting range (Factory settings, bold)	Display	Info
	P9	Select process monitoring (PCS alarm)	**Off** AC CC AC CC AC! CC! ACCC!		AC = sensor activity monitoring CC = controller monitoring Alarm possible with or without simultaneous controller switch-off. xxxx = without controller switch-off xxxx! = with controller switch-off
	P10	Enter maximum permissible duration for alarm threshold undershoot	**60 min** 0 ... 2000 min		Only for P9 = CC or AC CC.
	P11	Enter maximum permissible duration for alarm threshold overshoot	**120 min** 0 ... 2000 min		Only for P9 = CC or AC CC.
	P12	Enter alarm threshold (for P10 / P11)	**1.00 pH** -2.00 ... 16.00 pH		Set value is an absolute value. This function is primarily suited to batch operation and single-sided limit switches.

5.4.6 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 pH / ORP: R2 (1)
- Limit contactor for temperature: R2 (2)
- PID controller: R2 (3)
- Timer for cleaning function: R2 (4)
- Chemoclean function: R2 (5)
- Neutralisation controller: R2 (6) (for Plus Package)

Limit contactor for pH / ORP measured 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 pH/ORP measurement and for temperature measurement.

Please refer to Abb. 30 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.

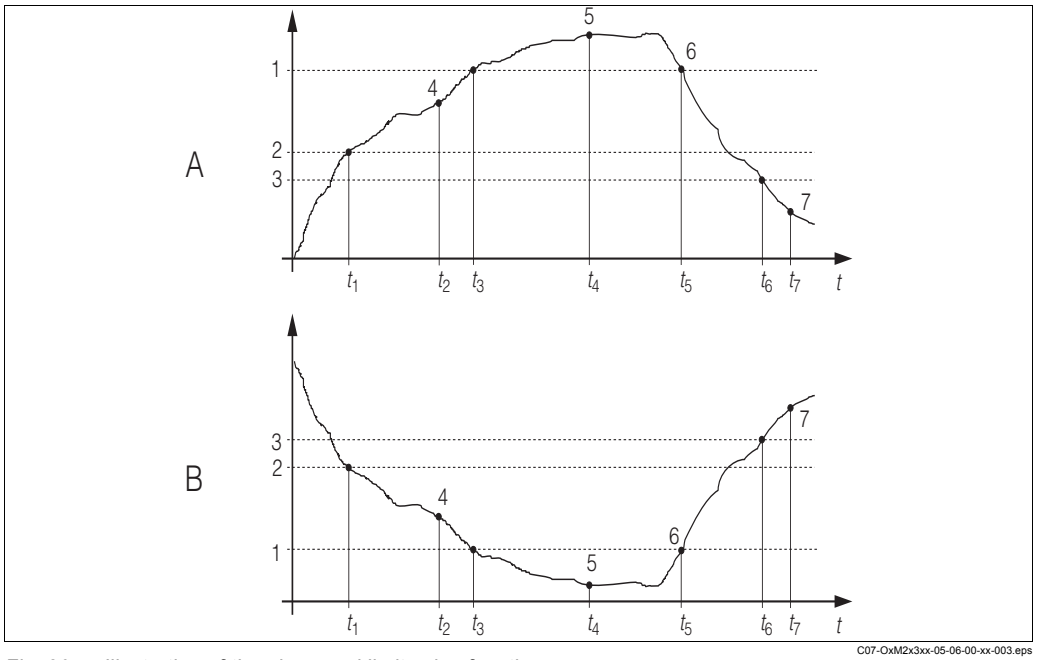


Fig. 30: Illustration of the alarm and limit value functions

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).

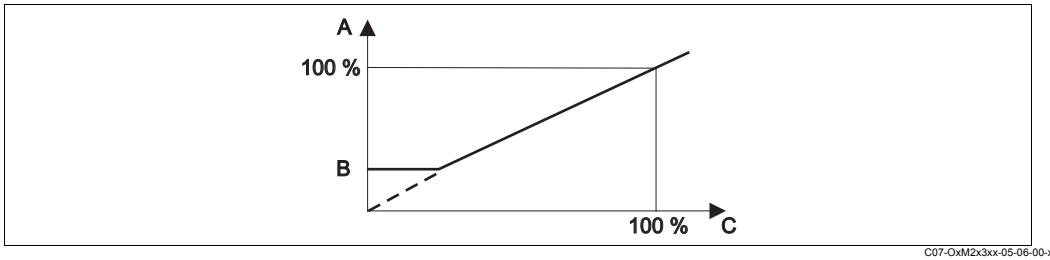
- **P controller**
  Used for simple linear control purposes with small system deviations. Where major changes are to be controlled, overshooting may occur. In addition, a lasting control deviation is to be expected.
- **PI controller**
  Is used for control systems where overshooting is to be avoided 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.



C07-OxM2x3xx-05-06-00-xx-010.eps

Fig. 31: 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 optimise 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 optimisation of the set parameters with a recorder

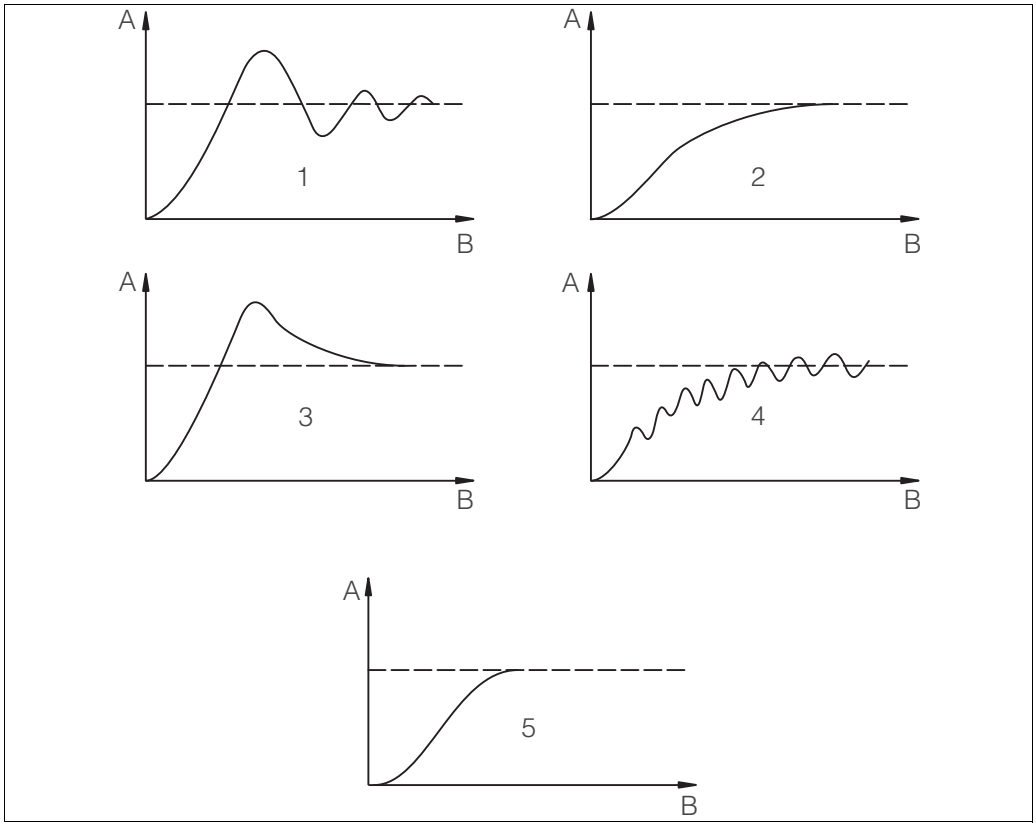


Fig. 32: Optimisation of settings T_n and K_p

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 ... 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.

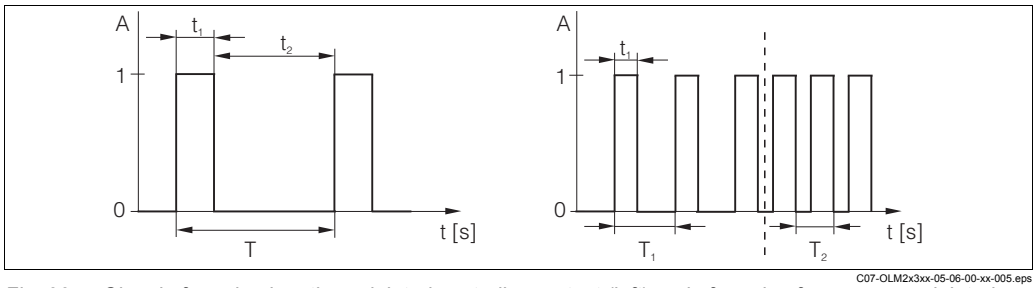


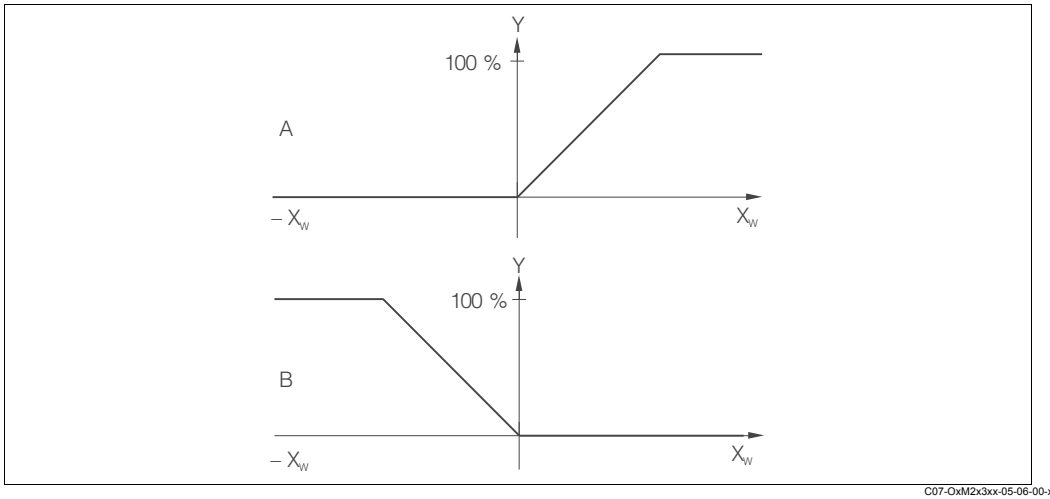
Fig. 33: Signal of a pulse-length modulated controller contact (left) and of a pulse-frequency modulated controller contact (right)

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



C07-OxM2x3xx-05-06-00-xx-006.eps

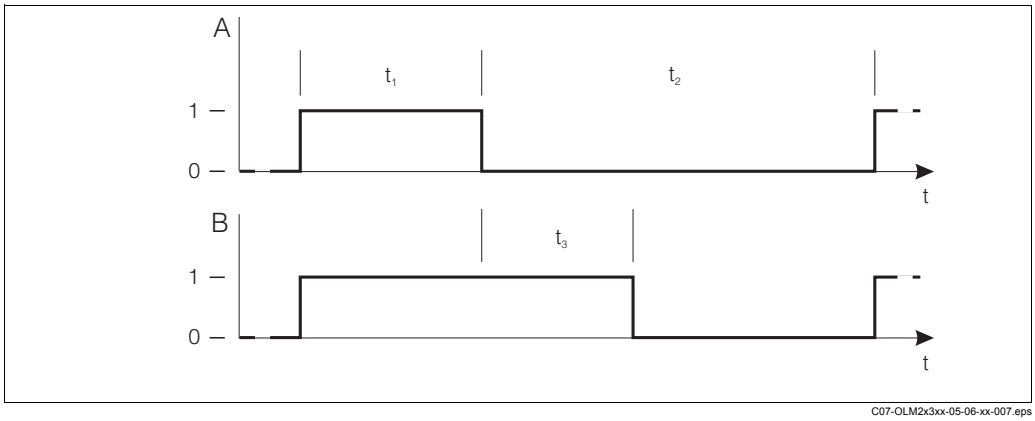
Fig. 34: Control characteristic of a proportional controller with direct and inverse control action

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).

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



C07-OLM2x3xx-05-06-xx-007.eps

Abb. 35: Connection between cleaning time, pause time and Hold dwell period

A Wiper and/or spray cleaning system
B Hold function
0 Inactive
1 Active
t_1 Cleaning time (0 ... 999 s)
t_2 Pause time between two cleaning intervals (1 ... 7200 min)
t_3 Clean Hold dwell period (0 ... 999 s)

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.

Note!
- 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 the cleaning is prematurely aborted, a post rinse time always follows.
- If the setting is "Economy", cleaning only takes place with water.

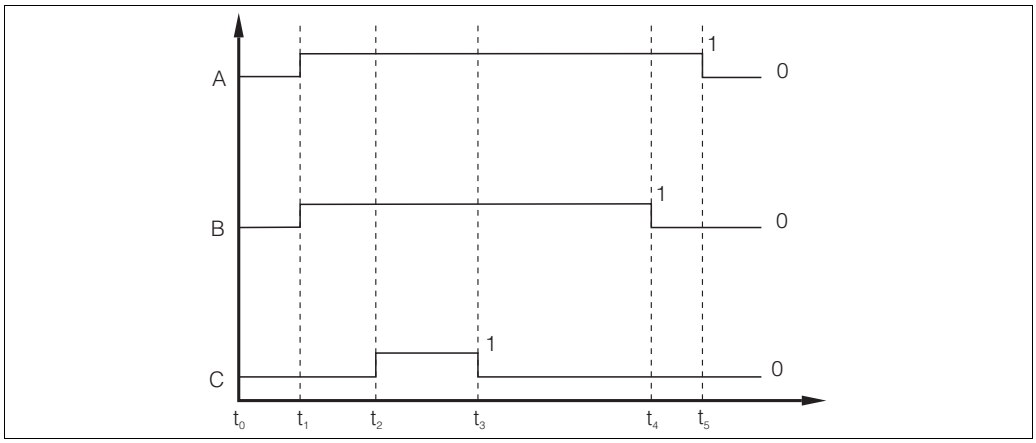


Fig. 36: Sequence of a cleaning cycle

A Hold
B Water
C Cleaner

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*

Neutralisation controller

During neutralisation control, the pH value of a medium is kept constant by dosing acid and alkali. Two separate actuating signals are required for this task, one for acid and one for alkali. The neutralisation controller is a controller with two relay contacts and is specially designed for this task. The P(ID) controller is available as the controller.
The values for the control gain K_p for acid and alkali can be set separately. Integral action time T_n and derivative action time T_v apply to both controllers (see "P(ID) controller" section).
The "neutral Zone" is located between the set values 1 and 2. There is no acid or alkali dosing (Y = 0, see Fig. 37) in the "neutral zone" with a controller without integral components (P, PD). In the case of a controller with an integral component (PI, PID), there is constant alkali/acid dosing ($Y_{new} = Y_{old}$). The behaviour of the I-component within the neutral zone depends on the process type (inline/batch).
The "neutral zone" can be shifted as desired in the X direction via set point 1 and 2.

Note!
Neutralisation control is only possible with relays 1 and 2.

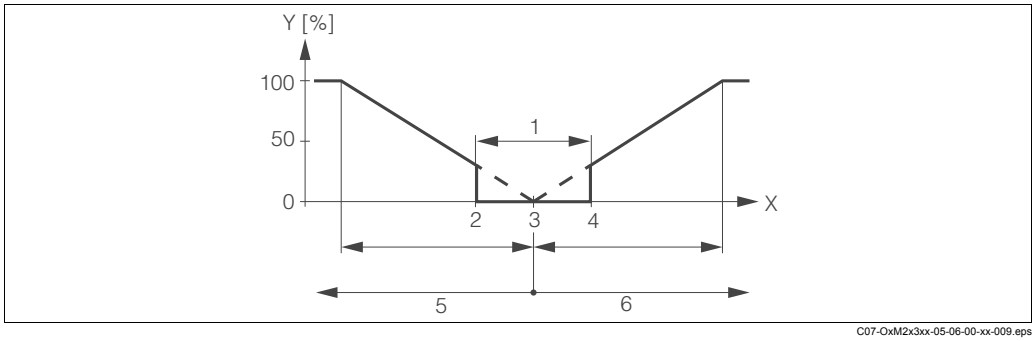
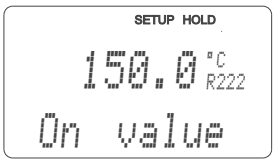
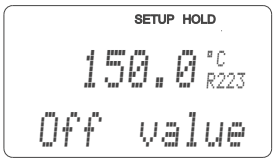
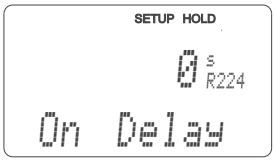
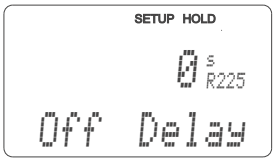
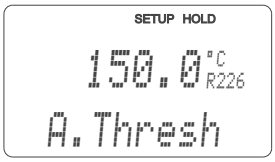
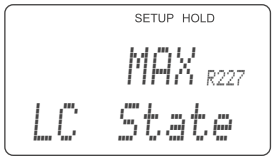
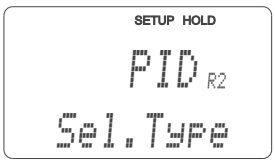
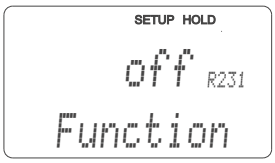
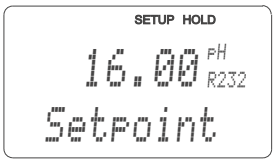


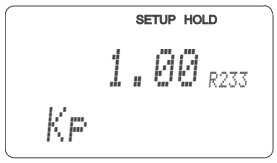
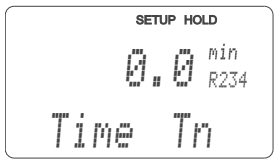
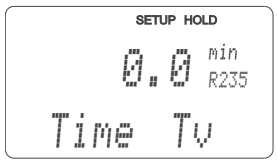
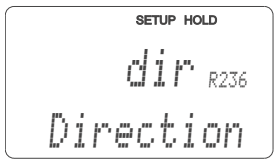
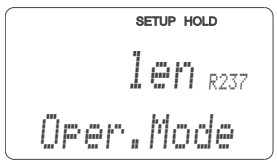
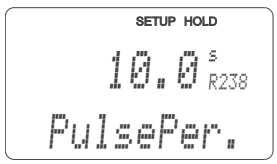
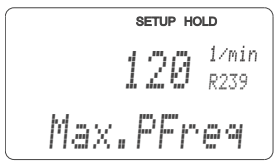
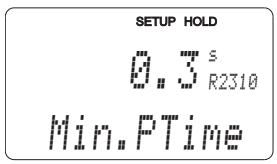
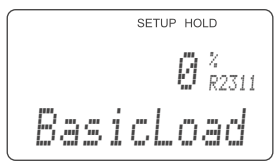
Fig. 37: Control characteristic of a proportional neutralisation controller

1 Neutral zone
2 Set point 1
3 Set point
4 Set point 2
5 Control contact 1 for alkali
6 Control contact 2 for acid

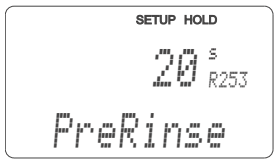
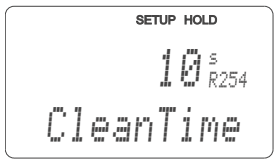
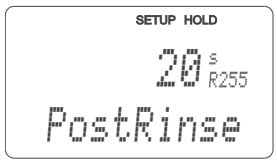
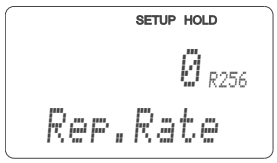
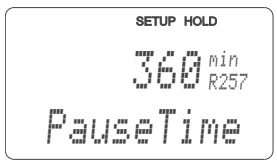
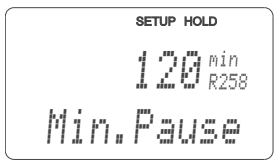
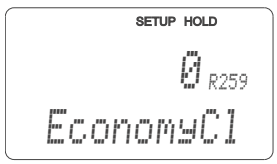
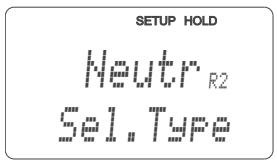
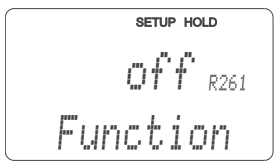
Coding		Field	Setting range (Factory settings, bold)	Display	Info
R		**RELAY function group**		SETUP HOLD R ATC RELAIS	Relay contact settings.
	R1	Select contact to be configured	**Rel1** Rel2 Rel3 Rel4	SETUP HOLD Rel1 R1 Sel.Relay	Rel3 (water) and Rel4 (cleaner) are only available with the relevant version of the transmitter. If Chemoclean is used as the cleaning method, Rel4 is not available.
	R2 (1)	Configure limit contactor for pH/ ORP measurement	**LC PV = limit contactor pH/ORP** (1) LC C = limit contactor T (2) PID controller (3) Timer (4) *Clean = Chemoclean (5)* *Neutra controller (6)*	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.

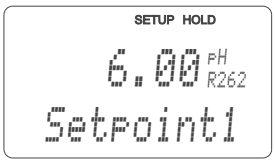
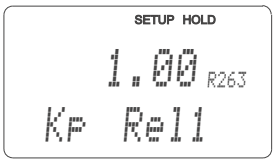
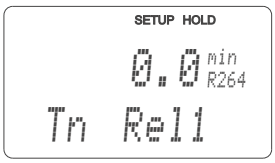
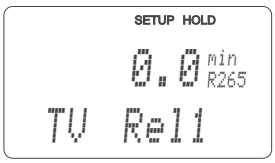
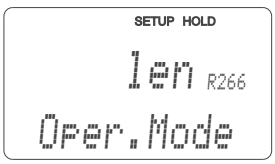
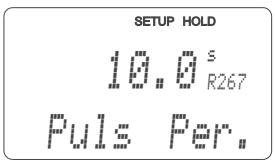
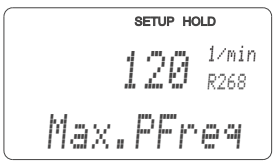
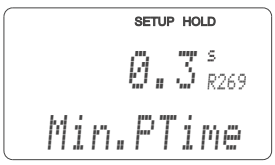
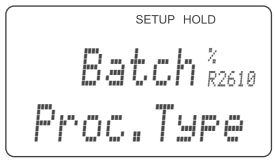
Coding	Field	Setting range (Factory settings, bold)	Display	Info
R211	Switch function of R2 (1) off or on	**Off** On	SETUP HOLD off R211 Function	All the settings are retained.
R212	Enter the switch-on point of the contact	**pH 16.00** pH -2.00 ... 16.00 **1500 mV** -1500 ... 1500 mV **100.0 %** 0.0 ... 100.0 %	SETUP HOLD 16.00 pH 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.)
R213	Enter the switch-off point of the contact	**pH 16.00** pH -2.00 ... 16.00 **1500 mV** -1500 mV ... 1500 mV **100.0 %** 0.0 ... 100.0 %	SETUP HOLD 16.00 pH 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).
R214	Enter pick-up delay	**0 s** 0 ... 2000 s	SETUP HOLD 0 s R214 On Delay	
R215	Enter drop-out delay	**0 s** 0 ... 2000 s	SETUP HOLD 0 s R215 Off Delay	
R216	Enter alarm threshold	**pH 16.00** pH -2.00... 16.00 **1500 mV** -1500 ... 1500 mV **100.0 %** 0.0 ... 100.0 %	SETUP HOLD 16.00 pH R216 A.Thresh	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.
R217	Display status for limit contactor	**MAX** MIN	SETUP HOLD MAX R217 LC State	Display only.
R2 (2)	Configure limit contactor for temperature measurement	LC PV = limit contactor pH/ ORP (1) **LC C = limit contactor T (2)** PID controller (3) Timer (4) *Clean = Chemoclean (5)* *Neutra controller*	SETUP HOLD LC °C R2 Sel.Type	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	SETUP HOLD off R221 Function	

Coding			Field	Setting range (Factory settings, bold)	Display	Info
		R222	Enter switch-on temperature	**150.0 C** -50.0 ... 150.0 C		Never set the switch-on point and the switch-off point to the same value!
		R223	Enter switch-off temperature	**150.0 C** -50.0 ... 150.0 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 ... 2000 s		
		R225	Enter drop-out delay	**0 s** 0 ... 2000 s		
		R226	Enter alarm threshold (as absolute value)	**150.0 C** -50.0 ... 150.0 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.
		R227	Display status for limit contactor	**MAX** MIN		Display only.
	R2 (3)		Configure P(ID) controller	LC PV = limit contactor pH/ ORP (1) LC C = limit contactor T (2) **PID controller (3)** Timer (4) *Clean = Chemoclean (5)* *Neutra controller*		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	**pH 16.00** pH -2.00 ... 16.00 **1500 mV** -1500 ... 1500 mV **0.0 %** 0.0 ... 100.0 %		The set point is the value to be maintained by the control system. Using this control process, this value is restored upwards or downwards when a deviation occurs.

Coding	Field	Setting range (Factory settings, bold)	Display	Info
R233	Enter control gain K_p	**1.00** 0.01 ... 20.00		See "P(ID) controller" section.
R234	Enter integral action time T_n (0.0 = no I-component)	**0.0 min** 0.0 ... 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 ... 999.9 min		See "P(ID) controller" section.
R236	Select controller characteristic	**dir = direct** Inv = inverse		The setting is required depending on the control deviation (upward or downward deviation, see "Chemoclean function" 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.
R238	Enter pulse interval	**10.0 s** 0.5 ... 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 ... 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 ... 5.0 s		This field only appears if pulse length is selected in R237.
R2311	Enter basic load	**0 %** 0 ... 40 %		When you select the basic load, you enter the desired dosing quantity. 100% basic load corresponds to: – Constantly on for R237 = len – Fmax at R237 = feq – 20 mA at R237 = curr

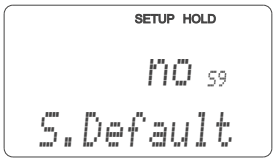
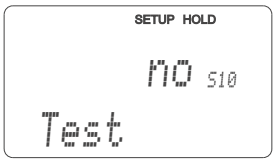
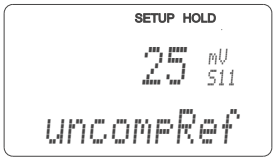
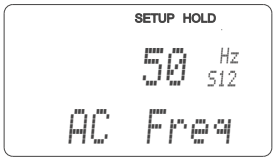
Coding	Field	Setting range (Factory settings, bold)	Display	Info
R2312	Enter process type	**Batch** Inlne	SETUP HOLD Batch % R2312 Proc.Type	Batch = discontinuous process Inlne = continuous process There is no further dosing in the setting range in batch mode. The I-component is decreased. Dosing continues in the setting range in inline mode. The I-component is effective.
R2 (4)	Configure cleaning function (timer)	LC PV = limit contactor pH/ ORP (1) LC C = limit contactor T (2) PID controller (3) **Timer** (4) *Clean = Chemoclean (5)* *Neutra controller (6)*	SETUP HOLD Timer R2 Sel.Type	Cleaning only takes place with a 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	SETUP HOLD off R241 Function	
R242	Enter rinsing/ cleaning time	**30 s** 0 ... 999 s	SETUP HOLD 30 s R242 RinseTime	Settings for Hold and relay are active for this time.
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 "Timer for cleaning function" section).
R244	Enter minimum pause time	**120 min** 1 ... R243 min	SETUP HOLD 120 min R244 Min.Pause	The minimum pause time prevents constant cleaning if a cleaning trigger is present.
R2 (5)	Configure cleaning with Chemoclean (for version with four contacts and contacts 3 and 4 assigned)	LC PV = limit contactor pH/ ORP (1) LC C = limit contactor T (2) PID controller (3) Timer (4) **Clean = Chemoclean (5)** *Neutra controller (6)*	SETUP HOLD Clean R2 Sel.Type	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	SETUP HOLD off R251 Function	
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	SETUP HOLD int R252 CleanTrig	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).

Coding			Field	Setting range (Factory settings, bold)	Display	Info
		R253	Enter pre-rinse time	**20 s** 0 ... 999 s		Rinsing with water takes place.
		R254	Enter cleaning time	**10 s** 0 ... 999 s		Cleaning with cleaning agent and water takes place.
		R255	Enter post rinse time	**20 s** 0 ... 999 s		Rinsing with water takes place.
		R256	Enter number of repeat cycles	**0** 0 ... 5		R253 ... R255 is repeated.
		R257	Enter pause time	**360 min** 1 ... 7200 min		The pause time is the time between two cleaning cycles (see "Timer function" section).
		R258	Enter minimum pause time	**120 min** 1 ... 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 ... 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.
	R2 (6)		Configure neutralisation controller	LC PV = limit contactor pH/ ORP (1) LC C = limit contactor T (2) PID controller (3) Timer (4) *Clean = Chemoclean (5)* **Neutra controller (6)**		Only for A1 = pH. If neutra controller is selected for Rel1, only neutra controller is offered for Rel2. By confirming with ENTER, another relay function already switched on is switched off and its settings are reset to the factory settings.
		R261	Switch function of R2 (6) off or on	**Off** On		

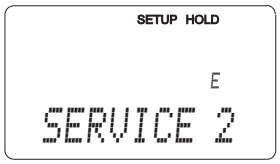
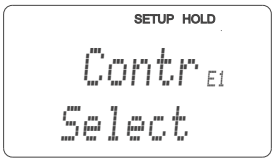
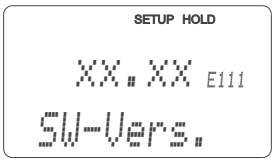
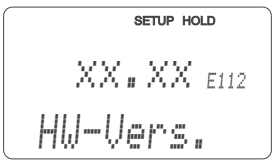
Coding			Field	Setting range (Factory settings, bold)	Display	Info
		R262	Enter set point 1 (or 2)	**pH 6.00** pH -2.00 ... 16.00		Relay assignment 1 and 2 for neutra controller: Rel1 = set point 1 Rel2 = set point 2
		R263	Enter relay switching capacity K_p1 (or K_p2)	**1.00** 0.10 ... 20.00		Relay assignment 1 and 2 for neutra controller: Rel1 = Kp1 Rel2 = Kp2
		R264	Enter integral action time T_n1 (or T_n2) (0.0 = no I-component)	**0.0 min** 0.0 ... 999.9 min		Relay assignment 1 and 2 for neutra controller: Rel1 = Tn1 Rel2 = Tn2
		R265	Enter derivative action time T_v1 (or T_v2) (0.0 = no D-component)	**0.0 min** 0.0 ... 999.9 min		Relay assignment 1 and 2 for neutra controller: Rel1 = Tv1 Rel2 = Tv2
		R266	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.
		R267	Enter pulse interval	**10.0 s** 0.5 ... 999.9 s		This field only appears if pulse length is selected in R266. If pulse frequency is selected, R267 is skipped and entries continue with R268.
		R268	Enter maximum pulse frequency of the adjuster	**120 min^{-1}** 60 ... 180 min^{-1}		This field only appears if pulse frequency is selected in R266. If pulse length is selected, R268 is skipped and entries continue with R269.
		R269	Enter minimum switch-on time t_{ON}	**0.3 s** 0.1 ... 5.0 s		This field only appears if pulse length is selected in R266.
		R2610	Enter process type	**Batch** Inlne		Batch = discontinuous process Inlne = continuous process There is no further dosing in the setting range in batch mode. The I-component is decreased. Dosing continues in the setting range in inline mode. The I-component is effective.

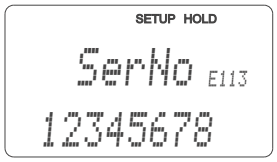
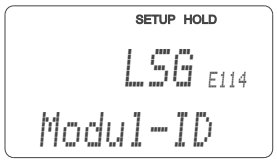
5.4.7 Service

Coding		Field	Setting range (Factory settings, bold)	Display	Info
S		**SERVICE function group**		SETUP HOLD S SERVICE	Service function settings.
	S1	Select language	**ENG = English** GER = German FRA = French ITA = Italian NL = Dutch ESP = Spanish	SETUP HOLD ENG S1 Language	This field has to be configured once during device configuration. Then you can exit S1 and continue.
	S2	Configure Hold	**S+C = Hold during configuration and calibration** Cal = Hold during calibration Setup = Hold during configuration 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 is retained even in the event of a power failure.
	S4	Enter Hold dwell period	**10 s** 0 ... 999 s	SETUP HOLD 10 s S4 Cont.Time	
	S5	Enter SW upgrade release code (Plus Package)	**0000** 0000 ... 9999	SETUP HOLD 0000 S5 PlusCode	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 ... 9999	SETUP HOLD 0000 S6 CleanCode	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		SETUP HOLD order S7 PR0005	If the device is upgraded, the order code is automatically adjusted.
	S8	Serial number is displayed		SETUP HOLD SerNo S8 12345678	

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	Reference voltage is displayed	Current value in mV		This is used to check the reference potential. Value > 50 mV indicates galvanic voltage in the medium. High values (> 1000 mV) may falsify the measured value.
	S12	Select AC frequency	**50 Hz** 60 Hz		Only select 60 Hz if the frequency of the voltage at the place of use is 60 Hz, the measured value is fluctuating or sporadic SCS errors are reported.

5.4.8 Service 2

Coding			Field	Setting range (Factory settings, bold)	Display	Note
E			**SERVICE 2 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 E151	Software version is displayed			If E1 = contr: instrument software If E1 = trans, main, rel: module firmware
		E112 E122 E132 E142 E152	Hardware version is displayed			Only display function

Coding			Field	Setting range (Factory settings, bold)	Display	Note
		E113 E123 E133 E143 E153	Serial number is displayed			Only display function
		E114 E124 E134 E144 E154	Module ID is displayed			Only display function

5.5 Calibration

Use the CAL key to access the calibration function group.
Use this function group to calibrate the sensor. The calibration can take place in a number of ways:

- By measuring in two calibration solutions with known pH value.
- By entering data for the slope and zero point
- In the case of ORP measurement, by entering the mV value or two different % values

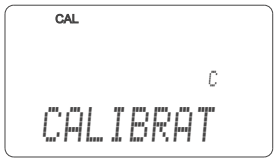
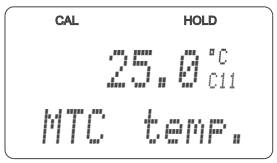
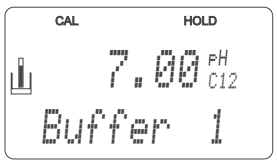
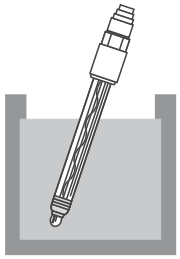
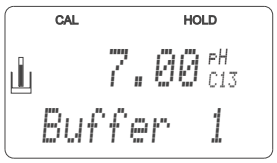
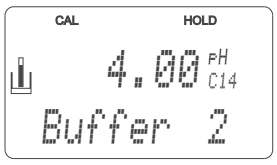
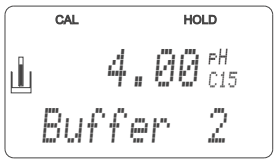
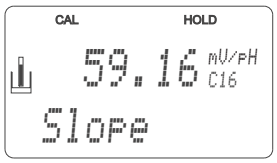
Note!

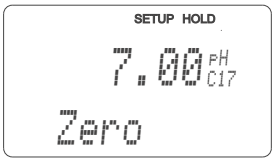
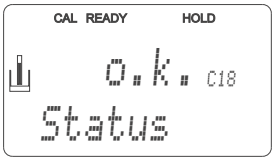
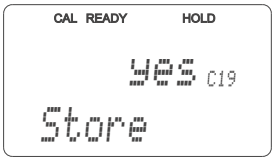
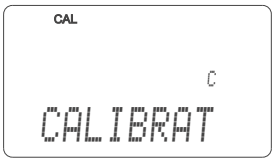
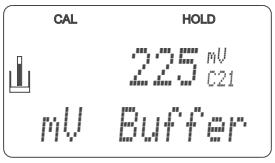
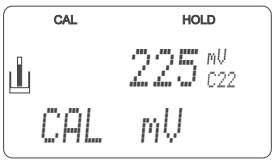
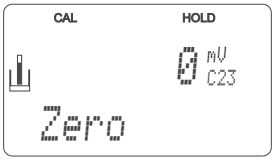
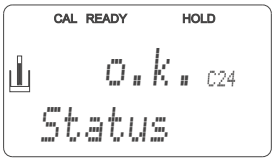
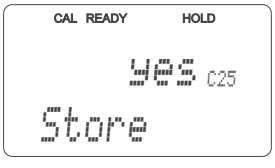
- During commissioning, calibration is absolutely essential so that the measuring system can return precise measurement data.
- If the calibration is aborted by simultaneously pressing the PLUS and MINUS keys (return to C19, C25 or C36), or if the calibration is faulty, the original calibration data are used again. A calibration error is indicated by “ERR” and the sensor symbol flashes on the display. Repeat calibration!
- For each calibration, the device automatically switches to Hold (factory setting).
- Any offset set is automatically deleted after the calibration is accepted.
- If the slope or zero point are outside the ranges given in C16 and C17, error 32 becomes active for slope or error 33 becomes active for zero point. The electrode must then be checked and replaced if necessary.

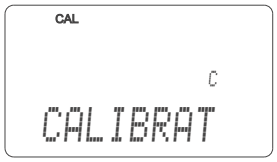
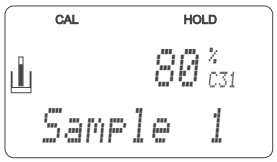
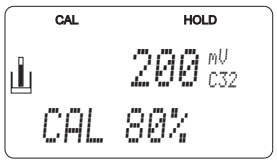
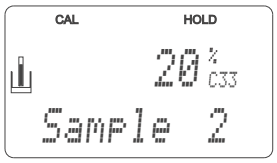
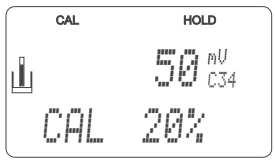
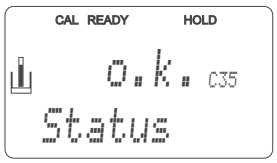
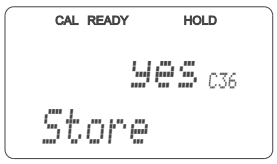
Things to note elements when calibrating ISFET sensors

Switch-on behaviour
A control circuit is created when the measuring system is switched on. During this time (approx. 5 ... 8 minutes), the measured value adjusts to the real value. This settling behaviour occurs every time the liquid film between the pH-sensitive semi-conductor and the reference lead is interrupted (e.g. caused by dry storage or intensive cleaning with compressed air). The settling time depends on the length of the interruption.

Sensitivity to light
Like all semi-conductor elements, the ISFET chip is sensitive to light (measured value fluctuations). However, this only affects the measured value if the sensor is directly exposed to sunlight. For this reason, avoid direct sunlight when calibrating. Normal ambient light does not have any effect on the measurement.

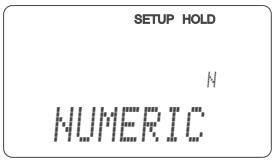
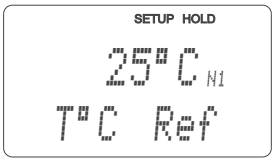
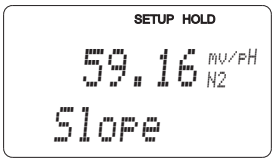
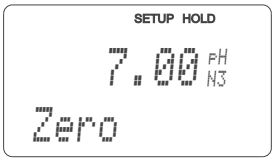
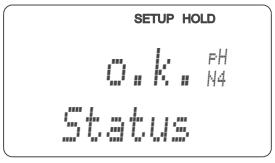
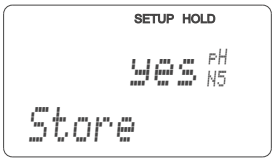
Coding		Field	Setting range (Factory settings, bold)	Display	Info
C (1)		**CALIBRATION function group**	**Calibration pH**		Only for A1 = pH. Calibration with two different buffer solutions.
	C11	Enter calibration temperature	**25.0 C** -50.0 ... 150.0 C		Only for B1 = MTC.
	C12	Enter pH value of the first buffer solution	**Buffer value of the last calibration** pH 0.00 ... 14.00		You can edit the displayed value. The value is given by the corresponding buffer solution.
Insert the electrode into the buffer indicated. In the case of ATC operation, the temperature sensor must also be immersed in the buffer solution. Then start the calibration with CAL. The current measured value is displayed. 1. **Manual continuation:** if the value becomes stable, you can accept the calibration for buffer solution 1 with the CAL key. 2. **Automatic continuation:** takes place if the value is stable (difference between measured values ≤ 0.05 and constant value over 10 s). If the value does not stabilise within 5 min, error 44 is set and the calibration is aborted.					**In the case of symmetrical measuring operation, the potential matching pin must also be immersed in the buffer.**
	C13	Calibration is performed			Stability check: The value is accepted in the event of stability ≤ ±pH 0.05 for more than 10 s.
	C14	Enter pH value of the second buffer solution	**Buffer value of the last calibration** pH 0.00 ... 14.00		The buffer must have another pH value than buffer 1. A plausibility check takes place.
Proceed with buffer 2 as with buffer 1.					
	C15	Calibration is performed			Accepted in the event of stability ≤ ±pH 0.05 for more than 10 s.
	C16	Slope is displayed	Glass: **59.16 mV/pH** 38.00 ... 65.00 mV/pH Antimony: **59.16 mV/pH** 25.00 ... 65.00 mV/pH ISFET: **59.16 mV/pH** 38.00 ... 65.00 mV/pH		

Coding		Field	Setting range (Factory settings, bold)	Display	Info
	C17	Zero point (zero point / U_is) is displayed	Glass: **pH 7.00** pH 5.00 ... 9.00 Antimony: **pH 1.00** pH -1.00 ... 3.00 ISFET: **current value** -500 ... +500 mV		For ISFET, the zero point is displayed in mV.
	C18	Calibration status is displayed	o.k. E xxx		
	C19	Store calibration result?	**yes** no New		If C18 = E xx, then only No or **New**. If New, return to C. If Yes/No, return to "Measurement".
The electrode can now be reinstalled in the process.					
C (2)		CALIBRATION function group: Calibration for ORP mV	**Calibration ORP mV**		Only for A1 = ORP (mV).
The measuring transmitter has a calibrated mV display range. An absolute mV value with a single buffer solution (adjustment of measuring chain offset) is set. Here, a buffer solution is used, preferably with 225 or 475 mV.					The maximum permitted calibration offset is ±100 mV.
	C21	Enter the mV value belonging to the ORP buffer used	**Current measured value** 1500 ... 1500 mV		**In the case of symmetrical measuring operation, the potential matching pin must also be immersed in the buffer.**
	C22	Calibration is performed	mV value		Stability check: The value is accepted in the event of stability ≤ ±1 mV for more than 10 s.
	C23	Zero point is displayed	-100 ... 100 mV		
	C24	Calibration status is displayed	o.k. E xxx		
	C25	Store calibration result?	**yes** no new		If C24 = E xxx, then only No or **New**. If New, return to C. If Yes/No, return to "Measurement".

Coding		Field	Setting range (Factory settings, bold)	Display	Info
	C (3)	CALIBRATION function group: Calibration for ORP %	**Calibration ORP %**		Sensor adjustment with compensation for wall effects.
For the calibration, a sample of the medium is placed in two containers. The contents of the first container is detoxified. The contents of the second container remains unchanged. A relative value of 80 % is set with the "toxic" sample. A relative value of 20 % is set with the "non-toxic" sample.				Default values: 0 % = -1000 mV 100 % = +1000 mV	The calibration range is ±1500 mV, the minimum difference should be 60 mV.
	C31	Determine 80% value of the "toxic" sample	**80%** 0 ... 100%		Start the calibration of the "toxic" sample by pressing the CAL key. The value is accepted provided it is stable or confirmed with the CAL key (see calibration pH).
	C32	Calibration is performed	mV value is displayed		Accepted in the event of stability ≤ ±5 mV for more than 10 s.
	C33	Determine 20% value of the "non-toxic" sample	**20%** 0 ... 100%		The procedure for C31 is repeated with the "non-toxic" sample to calibrate value 2.
	C34	Calibration is performed	mV value is displayed		Stability check: The value is accepted in the event of stability ≤ ±5 mV for more than 10 s.
	C35	Calibration status is displayed	o.k. E xxx		
	C36	Store calibration result?	**yes** no new		If C35 = E xxx, then only No or **New**. If New, return to C. If Yes/No, return to "Measurement".
The electrode can now be reinstalled in the process.					

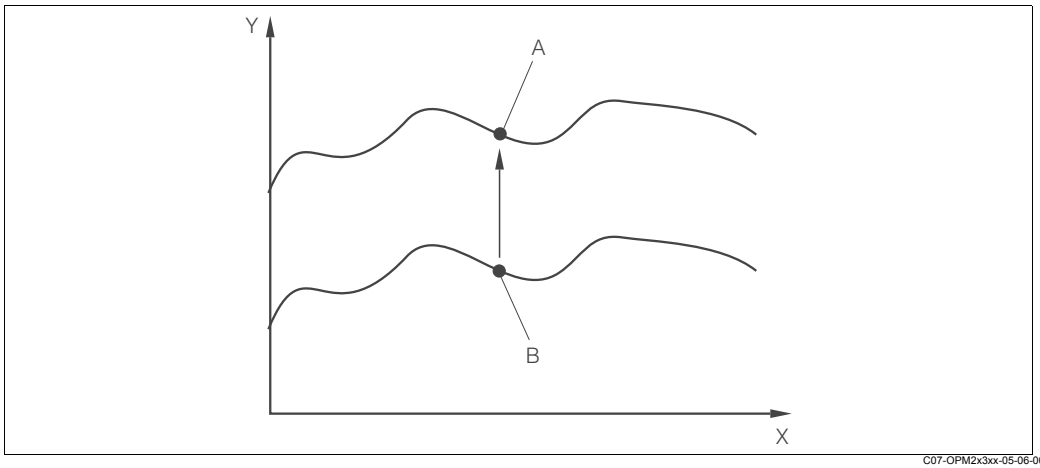
Numeric calibration

During numerical calibration, the slope and zero point can be corrected manually.

Coding		Field	Setting range (Factory settings, bold)	Display	Info
N		**NUMERIC CALIBRATION function group**			
	N1	Enter reference temperature	**25.0 C** -50.0 ... 150.0 C		
	N2	Enter slope	Glass: **59.16 mV/pH** 38.00 ... 65.00 mV/pH Antimony: **59.16 mV/pH** 25.00 ... 65.00 mV/pH ISFET: **59.16 mV/pH** 38.00 ... 65.00 mV/pH		For A4 = ISFET: enter the slope from the quality certificate.
	N3	Enter zero point	Glass: **7.00 pH** 5.00 ... 9.00 pH Antimony: **1.00 pH** -1.00 ... 3.00 pH ISFET: **0 mV** -500 ... +500 mV		For A4 = ISFET: enter the voltage U_{IS} from the quality certificate.
	N4	Calibration status is displayed	**o.k.** E xxx		
	N5	Store calibration result?	**yes** no new		

Offset

The settings in the OFFSET function group can be used to calibrate the measurement to a reference measurement. This requires a linear shift of all the measured values, i.e. the adjustment is determined
for one measured value, and all others are calculated using the same adjustment.



C07-OPM2x3xx-05-06-00-xx-005.eps

Fig. 38: Offset
X Time
Y Measured value
A Calibrated value
B Current measured value

Note!
Following a calibration, the offset is automatically set to zero.

Coding		Field	Setting range (Factory settings, bold)	Display	Info
V		**OFFSET function group for pH or ORP**		CAL V OFFSET	Depending on the operating mode selected, either pH or ORP appears (i.e. no direct selection can be made)
	V1	Enter desired measured value	**Current measured value** pH -2.00 ... 16.00 -1500 ... 1500 mV 0.0 ... 100.0 %	CAL HOLD 0.00 pH V1 Real PV	You can edit the display. The entry can differ from the actual value by max. ±2.0 pH / ±120 mV / ±50 %.
	V2	Current offset is displayed	**pH 0.00** pH -2.00 ... 2.00 **0 mV** -120 ... 120 mV **0.0 %** -50.0 ... 50.0 %	CAL HOLD 0.00 pH V2 PV Offset	
	V3	Calibration status is displayed	o.k. E xxx	CAL READY HOLD o.k. V3 Status	
	V4	Store calibration result?	**yes** no new	CAL READY HOLD yes V4 Store	If V3 = E xxx, then only No or New. If New, return to V. If Yes/No, return to "Measurement".

6 Commissioning

6.1 Things to note when commissioning ISFET sensors

Switch-on behaviour
A control circuit is created when the measuring system is switched on. During this time (approx. 5 ... 8 minutes), the measured value adjusts to the real value. This settling behaviour occurs every time the liquid film between the pH-sensitive semi-conductor and the reference lead is interrupted (e.g. caused by dry storage or intensive cleaning with compressed air). The settling time depends on the length of the interruption.

Sensitivity to light
Like all semi-conductor elements, the ISFET chip is sensitive to light (measured value fluctuations). However, this only affects the measured value if the sensor is directly exposed to sunlight. For this reason, avoid direct sunlight when calibrating. Normal ambient light does not have any effect on the measurement.

6.2 Function check

Warning!
- Check all connections for correctness.
- Make sure that the supply voltage is identical to the voltage written on the nameplate!

6.3 Switching on

Familiarise 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.

Note!
During commissioning, the sensors 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)
- SERVICE 2 (E)

Calibration and offset mode
- CALIBRATION (C)
- NUMERIC (N)
- OFFSET (V)

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

Factory settings

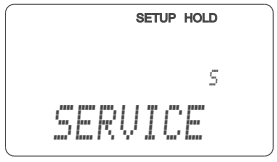
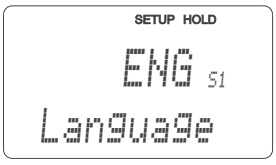
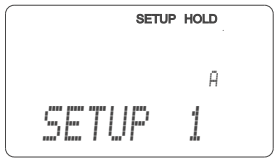
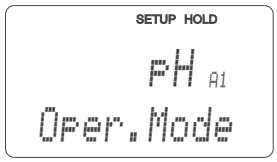
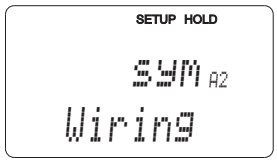
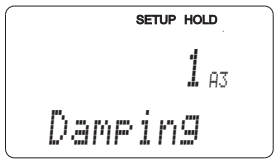
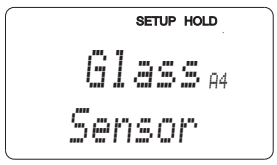
The first time it is switched on, the device has the factory setting for all functions. The table below provides an overview of the most important settings.
All other factory settings can be found in the description of the individual function groups in the "System configuration" section (the factory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

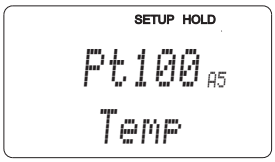
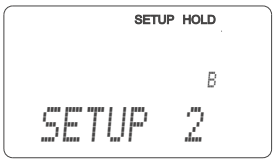
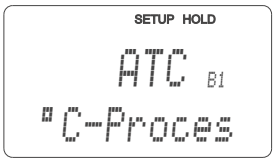
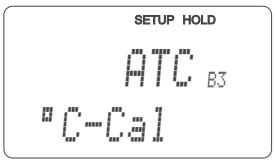
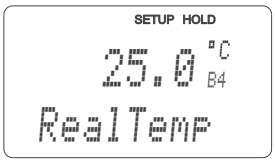
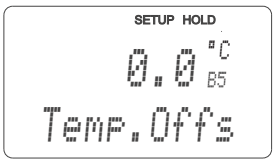
Function	Factory setting
Type of measurement	pH or ORP absolute, Temperature measurement in C
Type of measurement compensation	Linear with reference temperature 25 C (77 °F)
Temperature compensation	Automatic (ATC on)
Limit value for controller 1	pH 16 (ORP: -1500 mV or 0 %)
Limit value for controller 2	pH 16 (ORP: +1500 mV or 100 %)
Hold	Active during configuration and calibration
Contact 1 ... 4	Limit contactor pH, function off
Current outputs 1* and 2*	4 ... 20 mA
Current output 1: measured value for 4 mA signal current*	pH 2
Current output 1: measured value for 20 mA signal current*	pH 12
Current output 2: temperature value for 4 mA signal current*	0.0 C (32 °F)
Current output 2: temperature value for 20 mA signal current*	100.0 C (212 °F)

* For corresponding version

6.4 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 + and − 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. "pH". Press E to confirm.	**pH** ORP mV ORP %	
10. In A2, select the type of connection for your sensor. See the "Sensor connection" section for this. Press E to confirm.	**sym = symmetrical** asym = asymmetrical	
11. In A3, enter the damping factor. Measured value damping averages the individual measured values and serves to stabilise the display and the signal output. Enter "1" if no measured value damping is required. Press E to confirm.	**1** 1 ... 60	
12. In A4, specify the type of sensor that you are using, e.g. "Glass" for glass electrode. Press E to confirm.	**Glass** ISFET	

User input	Setting range (Factory settings, bold)	Display
13. In A5, select the temperature sensor the electrode used has, e.g. "Pt 100" for a glass electrode. Press [E] to confirm your entries. The display returns to the initial display of the "Setup 1" function group.	**Pt 100** Pt 1K NTC 30K None	
14. Press [−] to get to the "Setup 2" function group. 15. Press [E] to make your settings for "Setup 2".		
16. In B1, select the type of temperature compensation for the process, e.g. ATC for automatic temperature compensation. Press [E] to confirm. If you have chosen ATC, the menu jumps automatically to field B3.	**ATC** MTC	
17. In B3, select the type of temperature compensation for the calibration, e.g. ATC for automatic temperature compensation. Press [E] to confirm.	**ATC** MTC	
18. The current temperature is displayed in B4. If necessary, calibrate the temperature sensor to an external measurement. Press [E] to confirm.	Actual value displayed and entered -50.0 ... 150.0 C	
19. The difference between the measured and entered temperature is displayed. Press [E]. The display returns to the initial display of the "Setup 2" function group.	**0.0 C** -5.0 ... 5.0 C	
20. Press [+/-] simultaneously to switch to the measurement mode.		

7 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

Warning!
- When carrying out all work on the device, please observe any possible effects on the process control or the process itself.
- When removing the sensor during maintenance or calibration, please consider potential hazards due to pressure, high temperatures and contamination.
- Make sure the device is de-energised before you open it.
  If work must be carried out when the device is live, this may only be performed by an electrical technician!
- Switching contacts can be fed by separate circuits. These circuits must also be de-energised before work on the terminals is performed.

Caution ESD!
- Electronic components are sensitive to electrostatic discharge. Personal protective measures such as discharging at the PE beforehand or permanent grounding with a wrist strap are required.
- For your own safety, use only genuine spare parts. With genuine spare parts, the function, accuracy and reliability are also guaranteed after repair.

Note!
If you have any queries, please contact your local Sales Office.

7.1 Maintenance transmitter

7.1.1 Dismantling of panel mounted instrument

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

Note!
Please refer to the diagram in Section "Spare parts" for the item numbers.

1. Disconnect the terminal block (item 422 b) from the rear of the device to de-energise the device.
2. Then remove the terminal blocks (item 422 a and poss. 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 pH/mV transmitter (item 230) as follows:
   – Bend the screening plate up.
   – Disconnect the connected strand (pH input, strand comes from the BNC connection jack).
   – Using a 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.

7.1.2 Dismantling of field instrument

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

Note!
Please refer to the diagram in Section 9.5 for the item numbers.

1. Open and remove the cover of the connection compartment (item 420).
2. Disconnect the mains terminal (item 470) to de-energise the device.
3. Open the display cover (item 410) and loosen the ribbon cables (item 310 / 320) on the side of the electronics box (item 330).
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) in two revolutions.
   – Then push the entire box backwards and remove it from above.
   – Make sure that module locks do not open!
   – 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 pH/mV transmitter (item 230):
   – Bend the screening plate up.
   – Disconnect the connected strand (pH input, strand comes from the BNC connection jack).
   – Using a 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.

Note!
- 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.

7.1.3 Replacing the controller

Note!
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 customised 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.”) off the nameplate of the device.
   – Enter this number in the fields E115 (year, one-digit), E116 (month, one-digit), E117 (cons. number, four-digit).
   – In the field E118, the complete number is displayed again so you can check it is correct.

   ☝ Caution!
   You can only enter the serial number for modules fresh from the factory 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.

7.2 Maintenance of the entire measuring point

7.2.1 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:
- Isopropanol
- Diluted acids (max. 3%)
- Diluted alkalis (max. 5%)
- Esters
- Hydrocarbons
- Ketones
- Household cleaners

☝ Caution!
For cleaning purposes, never use:
- Concentrated mineral acids or alkalis
- Benzyl alcohol
- Methylene chloride
- High-pressure steam

7.2.2 Cleaning the pH/ORP sensors

Please clean **contamination on the glass electrodes** as follows:
- Oily and greasy films:
  Clean with detergent (grease dissolvers, such as alcohol, acetone, poss. washing-up liquids).

Warning!
When using the following cleaning agents, make sure to protect your hands, eyes and clothing!

- Lime and metal hydroxide layers:
  Dissolve layers with diluted hydrochloric acid (3 %) and then rinse carefully with a lot of clear water.
- Layers containing sulphide (from flue gas desulphurising or sewage treatment plants):
  Use mixture of hydrochloric acid (3 %) and thiocarbamide (usual commercial) and then rinse carefully with a lot of clear water.
- Layers containing proteins (e.g. food industry):
  Use mixture of hydrochloric acid (0.5 %) and pepsin (usual commercial) and then rinse carefully with a lot of clear water.

Clogged diaphragms can be cleaned mechanically (does not apply to Teflon diaphragms and open ring junction electrodes):
- Use a small warding file.
- Only file in one direction.

Air bubbles in the electrode:
- Air bubbles can indicate incorrect mounting. For this reason check the orientation.
- The range 15 to 165 to the horizontal is allowed.
- Not permitted: horizontal installation or installation with the plug-in head pointing downwards.

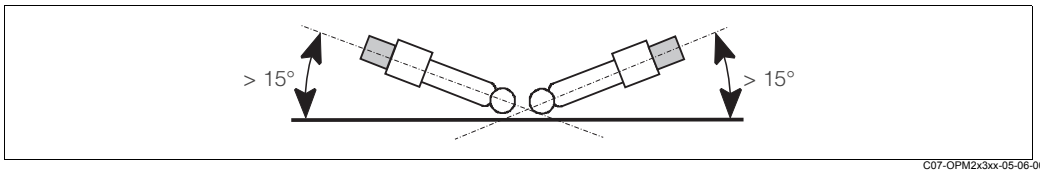


Fig. 39: Permitted angle of installation for glass electrodes

ORP electrodes:
Carefully clean the metal pins or surfaces mechanically.

Note!
After mechanical cleaning, the ORP sensor can require several hours conditioning time. For this reason, check the calibration after a day.

7.2.3 Liquid KCl supply

- The KCl must be free of bubbles. In the case of an unpressurised version, check whether the cotton thread is present in the hose.
- In the case of counterpressure, check whether the pressure in the KCl tank is min. 0.8 bar (11.6 psi) above the medium pressure.
- The KCl consumption should be low but noticeable. Approx. 1 ... 10 ml/day is typical.
- The opening for sensors with a KCl top-up opening at the glass shaft must be clear.

7.2.4 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, stability as well as information on spare parts and accessories.

7.2.5 Connecting lines and junction boxes

Check the cables and connections for moisture. Moisture is indicated by a sensor slope that is too small. If no more display is possible or if the display is fixed at pH 7, please check the following components:

- Sensor head
- Sensor connector
- pH measuring cable
- Junction box, if fitted
- Extension cable

Caution!
If there is moisture in the measuring cable, the cable must be replaced!

A shunt in the cable of > 20 MΩ can no longer be measured with normal multimeters but is damaging for the pH measurement. A reliable test can be carried out with a usual commercial insulation meter:

- Make sure to disconnect the pH measuring cable from the sensor and device!
- If you are using a junction box, you check check the infeed and outfeed measuring cable separately.
- Check the cable with 1000 V DC (at least with 500 V DC) testing voltage.
- If the cable is intact, the insulation resistance > 100 GΩ.
- If the cable is defective (moist), there is flashover.
  The cable must be replaced.

Note!
The sensor head and junction box can be cleaned and dried with a hot air dryer.

7.3 "Optoscope" service tool

The Optoscope together with the “Scopeware” software offers the following possibilities, without having to remove or open the transmitter and without galvanic 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 serves as an interface between the transmitter and PC / laptop. The information exchange takes place via the optical interface on the transmitter and via an RS 232 interface on the PC / laptop (see "Accessories").

8 Accessories

8.1 Sensors

- OPS11
  pH electrode for process applications, with PTFE diaphragm,
  Ordering acc. to product structure, see Technical Information (TI028e00)
- OPS12
  ORP electrode for process applications, with PTFE diaphragm,
  Ordering acc. to product structure, see Technical Information (TI367e00)
- OPS41
  pH electrode with ceramics diaphragm and liquid KCl electrolyte,
  Ordering acc. to product structure, see Technical Information (TI079e00)
- OPS42
  ORP electrode with ceramics diaphragm and liquid KCl electrolyte,
  Ordering acc. to product structure, see Technical Information (TI079e00)
- OPS71
  pH electrode with double chamber reference system and integrated bridge electrolyte,
  Ordering acc. to product structure, see Technical Information (TI245e00)
- OPS72
  ORP electrode with double chamber reference system and integrated bridge electrolyte,
  Ordering acc. to product structure, see Technical Information (TI374e00)
- OPS91
  pH electrode with open aperture for media with high dirt load,
  Ordering acc. to product structure, see Technical Information (TI375e00)
- OPS471
  Sterilisable and autoclavable ISFET sensor for food and pharmaceuticals, process technology, water treatment and biotechnology;
  Ordering acc. to product structure, see Technical Information (TI283e00)
- OPS441
  Sterilisable ISFET sensor for media with low conductivity, with liquid KCl electrolyte;
  Ordering acc. to product structure, see Technical Information (TI352e00)
- OPS491
  ISFET sensor with open aperture for media with high dirt load;
  Ordering acc. to product structure, see Technical Information (TI377e00)

8.2 Connection accessories

- Special measuring cable OPK9
  For pH/ORP electrodes with TOP68 plug-in head
  Order as per product structure, see Technical Information (TI118e00)
- Special measuring cable OPK1
  For pH/ORP electrodes with GSA plug-in head
  Order as per product structure, see Technical Information (TI118e00)
- Special measuring cable OPK2
  For pH/ORP electrodes with GSA plug-in head, with three electrode connectors
  Order as per product structure, see Technical Information (TI118e00)
- Special measuring cable OPK12
  For pH glass electrodes and ISFET sensors with TOP68 plug-in head
  Order as per product structure, see Technical Information (TI118e00)

- Junction box VBM
  for cable extension, with 10 terminals, IP 65 / NEMA 4X

Cable entry Pg 13.5	Order no. 50003987
Cable entry NPT ½"	Order no. 51500177

- Junction box VBA
  with 10 high-impedance terminals, protection class: IP 65; material: polycarbonate
  order no. 50005276

8.3 Mounting accessories

- Weather protection cover OYY101 for mounting of field housing, for outdoor installation
  material: stainless steel 1.4031;
  order no. OYY101-A

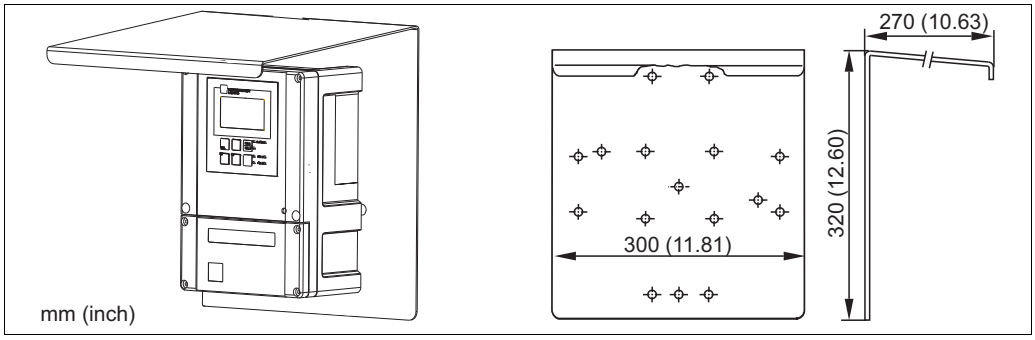


Fig. 40: Weather protection cover for field instrument

- Universal upright post OYY102
  Square post for mounting of field housing, material: stainless steel 1.4301;
  order no. OYY102-A

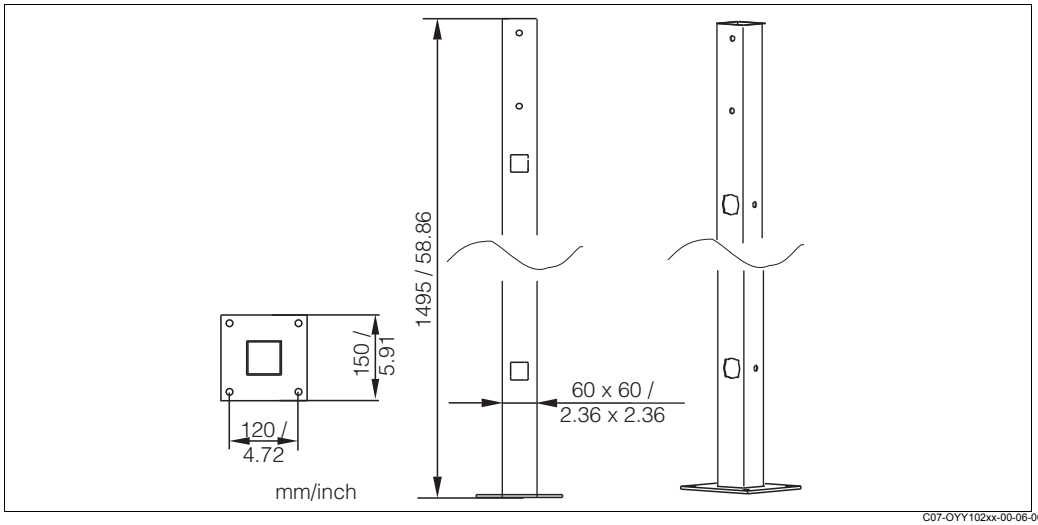


Fig. 41: Square post OYY102

- Kit for mounting of field housing on horizontal or vertical pipes (Ø max. 60 mm (2.36")) order no. 50086842

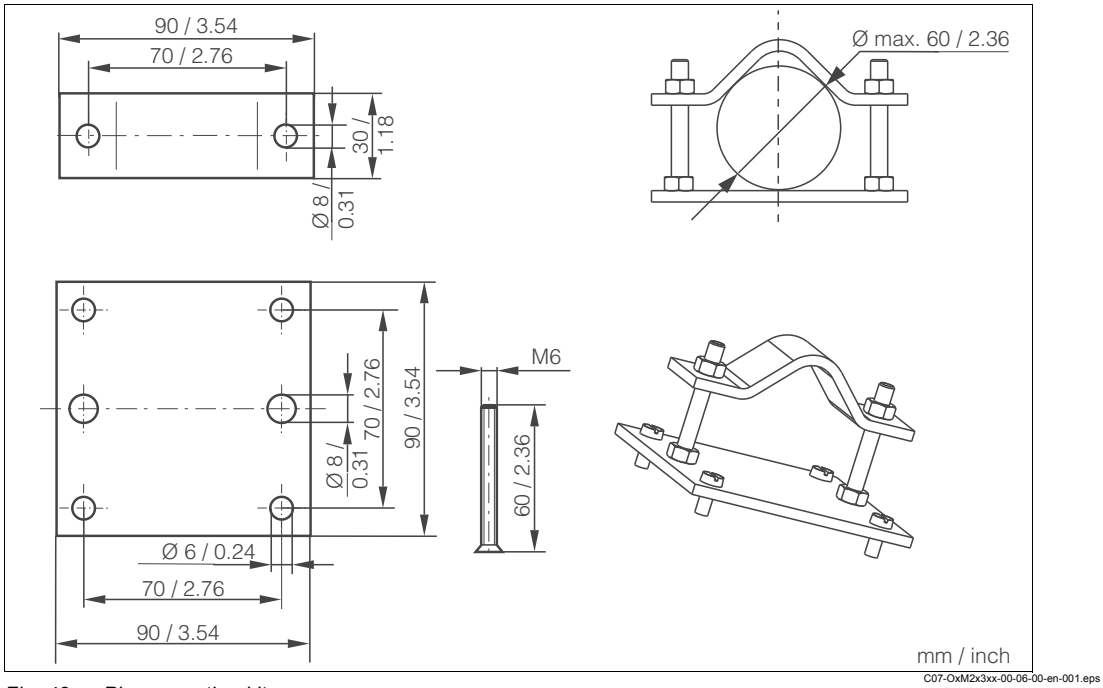


Fig. 42: Pipe mounting kit

8.4 Assemblies

- OPA451
  Manual retractable assembly made of stainless steel with ball valve shut-off for the pH/ORP electrodes OPF81/82,
  Order as per product structure, see Technical Information (TI343e00)
- OPA471
  Compact stainless steel retractable assembly for installation in tanks and pipes, for manual or pneumatically remote-controlled operation
  Order as per product structure, see Technical Information (TI217e00)
- OPA472
  Compact plastic steel retractable assembly for installation in tanks and pipes, for manual or pneumatically remote-controlled operation
  Order as per product structure, see Technical Information (TI223e00)
- OPA473
  Process retractable assembly made of stainless steel with ball valve shut-off for particularly safe separation of the process medium from the environment
  Order as per product structure, see Technical Information (TI344e00)
- OPA474
  Process retractable assembly made of plastic with ball valve shut-off for particularly safe separation of the process medium from the environment
  Order as per product structure, see Technical Information (TI345e00)
- OPA111
  Immersion and installation assembly made of plastic for open and closed tanks
  Order as per product structure, see Technical Information (TI112e00)
- OPA250
  Flow assembly for pH/ORP measurement
  Order as per product structure, see Technical Information (TI041e00)
- OYA611
  Immersion assembly for pH/ORP compact electrode OPF81
  Order as per product structure, see Technical Information (TI166e00)

8.5 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. 51500385
- 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

8.6 Calibration solutions

Technical buffer solutions, accuracy 0.02 pH, acc. to NIST/DIN
- pH 4.0 red, 100 ml (0.026 US gal.), order no. OPY 2-0
- pH 4.0 red, 1000 ml (0.264 US gal.), order no. OPY 2-1
- pH 7.0 green, 100 ml (0.026 US gal.), order no. OPY 2-2
- pH 7.0 green, 1000 ml (0.264 US gal.), order no. OPY 2-3

Technical buffer solutions for single use, accuracy 0.02 pH, acc. to NIST/DIN
- pH 4.0 20 x 20 ml (0.005 US gal.), order no. OPY 2-D
- pH 7.0 20 x 20 ml (0.005 US gal.), order no. OPY 2-E

Technical buffer solutions for ORP electrodes
- +220 mV, pH 7.0, 100 ml (3.4 fl.oz..); order no. OPY3-0
- +468 mV, pH 0.1, 100 ml (3.4 fl.oz.); order no. OPY3-1

KCl-electrolyte solutions for liquid filled electrodes
- 3.0 mol, T = -10 ... 100 °C (14 ... 212 °F), 100 ml (3.4 fl.oz.), order no. OPY4-1
- 3.0 mol, T = -10 ... 100 °C (14 ... 212 °F), 1000 ml (34 fl.oz.), order no. OPY4-2
- 1.5 mol, T = -30 ... 100 °C (-22 ... 266 °F), 100 ml (3.4 fl.oz.), order no. OPY4-3
- 1.5 mol, T = -30 ... 100 °C (-22 ... 266 °F), 1000 ml (34 fl.oz.), order no. OPY4-4

8.7 Optoscope

- Optoscope
  Interface between transmitter and PC / laptop for service purposes.
  The Windows software "Scopeware" required for the PC or laptop is supplied with the Optoscope. The Optoscope is supplied in a sturdy plastic case with all the accessories required.
  Order no. 51500650

9 Trouble-shooting

9.1 Trouble-shooting instructions

The transmitter constantly monitors its functions itself. If an error occurs which the device recognises, this is indicated on the display. The error number is under the unit 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 localise and rectify the error. These tables provide you with additional information on any spare parts required.

9.2 System error messages

You can display and select the error messages with the MINUS key.

Error no.	Display	Tests and/or remedial measures	Alarm contact		Error current		Autom. cleaning start	
			Facty	User	Facty	User	Facty	User
E001	EEPROM memory error	1. Switch device off and then on again.	Yes		No		—	—[1]
E002	Instrument not calibrated, calibration data invalid, no 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 supplier or replace the device.	Yes		No		—	—[1]
E003	Download error	Invalid configuration. Repeat download, check optoscope.	Yes		No		No	
E004	Instrument software version not compatible with module hardware version	Load software compatible with hardware Load measurement-parameter specific device software.	Yes		No		No	
E007	Transmitter malfunction, instrument software not compatible with transmitter version		Yes		No		—	—[1]
E008	SCS alarm: Glass electrode: glass breakage ISFET: leakage current > 400 nA	Check glass electrode for glass breakage or hair-line cracks; Inspect electrode plug-in head for moisture and dry if necessary; Check medium temperature. Replace ISFET.	Yes		No		No	
E010	Temperature sensor defective, not connected or short-circuited	Check temperature sensor and connections; check device and measuring cable with temperature simulator if necessary. Check correct option selected in field A5.	Yes		No		No	
E030	SCS reference electrode warning	Check reference electrode for contamination and damage; clean electrode.	No		No		No	
E032	Slope range exceeded or below range	Repeat calibration and renew buffer solution; replace electrode if necessary, check device and measuring cable with simulator.	Yes		No		—	—[1]
E033	pH value zero too low or too high		Yes		No		—	—[1]
E034	ORP offset range exceeded or below range		Yes		No		—	—[1]

Error no.	Display	Tests and/or remedial measures	Alarm contact		Error current		Autom. cleaning start	
			Facty	User	Facty	User	Facty	User
E041	Calculation of calibration parameters aborted	Repeat calibration and renew buffer solution; replace electrode if necessary, check device and measuring cable with simulator.	Yes		No		—	—[1]
E042	Distance of calibration value for buffer pH 2 from zero (pH 7) too short	Use buffer solution that is at least Δ pH = 2 from electrode zero point.	Yes		No		—	—[1]
E043	Distance between calibration values for pH 1 and pH 2 too short	Use buffer solutions that are at least Δ pH = 2 apart.	Yes		No		—	—[1]
E044	Stability requirement for calibration not fulfilled	Repeat calibration and renew buffer solution; replace electrode if necessary, check device and measuring cable with simulator.	Yes		No		—	—[1]
E045	Calibration aborted	Repeat calibration and renew buffer solution; replace electrode if necessary, check device and measuring cable with simulator.	Yes		No		—	—[1]
E055	Below main parameter measuring range	Check measurement and connections; check device and measuring cable with simulator if necessary.	Yes		No		No	
E057	Main parameter measuring range exceeded		Yes		No		No	
E059	Below temperature measuring range		Yes		No		No	
E061	Temperature measuring range exceeded		Yes		No		No	
E063	Below current output range 1	Check configuration in the "Current outputs" menu; check measurement and connections; check device and measuring cable with simulator if necessary.	Yes		No		No	
E064	Current output range 1 exceeded		Yes		No		No	
E065	Below current output range 2		Yes		No		No	
E066	Current output range 2 exceeded		Yes		No		No	
E067	Set point exceeded controller 1	Check configuration.	Yes		No		No	
E068	Set point exceeded controller 2		Yes		No		No	
E069	Set point exceeded controller 3		Yes		No		No	
E070	Set point exceeded controller 4		Yes		No		No	
E080	Current output 1 range too small	Increase range in "Current outputs" menu.	No		No		—	—[1]
E081	Current output 2 range too small		No		No		—	—[1]
E085	Incorrect setting for error current	If the current range "0 ... 20 mA" was selected in field O311, the error current "2.4 mA" may not be set.	?		?		?	?
E100	Current simulation active		No		No		—	—[1]
E101	Service function yes	Switch off service function or switch device off and then on again.	No		No		—	—[1]
E102	Manual mode active		No		No		—	—[1]
E106	Download yes	Wait for download to finish.	No		No		—	—[1]
E116	Download error	Repeat download.	No		No		—	—[1]
E147	Sensor communication faulty	Check that the sensor is correctly connected, the cable ends are correctly wired at the terminals and the cable is not damaged.	No		No		No	
E152	PCS alarm	Check sensor and connection.	No		No		No	

Error no.	Display	Tests and/or remedial measures	Alarm contact		Error current		Autom. cleaning start	
			Facty	User	Facty	User	Facty	User
E154	Below lower alarm threshold for period exceeding alarm delay	Perform manual comparison measurement if necessary. Service sensor and recalibrate.	Yes		No		No	
E155	Above upper alarm threshold for period exceeding alarm delay		Yes		No		No	
E156	Actual value undershoots alarm threshold for longer than the set permissible maximum period		Yes		No		No	
E157	Actual value exceeds alarm threshold 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	
E164	Dynamic range of pH converter exceeded	Check cable and sensor.	Yes		No		—	
E166	Dynamic range of reference converter exceeded	Check cable and sensor.	Yes		No		—	
E168	Warning: ISFET leakage current > 200 nA	Check ISFET for abrasion and air-tightness, replace as soon as possible.	No		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	
E175	SCS glass warning	Check electrode for glass breakage or hair-line cracks; Check medium temperature. Measurement can continue until the error occurs.	No		No		No	
E177	SCS reference electrode warning	Check electrode for contamination and damage; clean electrode; measuring can continue until the error occurs.	No		No		No	

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

9.3 Process specific errors

Use the following table to localise and rectify any errors occurring.

Errors	Possible cause	Tests and/or remedial measures	Tools, spare parts
Device cannot be operated, display value 9999	Operation locked	Press CAL and MINUS keys simultaneously	See "Function of keys" section.
Measuring chain zero-point cannot be adjusted	Reference system toxified	Test with new sensor	pH/ORP sensor
	Diaphragm clogged	Clean or grind down diaphragm	HCl 3 %, use file (only file in one direction)
	Measuring line open	Short-circuit pH input on instrument ⇒ display pH 7	
	Sensor asymmetry voltage too high	Clean diaphragm or test with another sensor	HCl 3 %, use file (only file in one direction); sensor
	Potential matching (PA/PM) transmitter ⇔ wrong medium	Asymm.: no PM or PM at PE Symm.: PM connection mandatory	See "Electrode installation and measuring cable connection" section
No or creeping change of display	Sensor contaminated	Clean sensor.	See "Cleaning pH/ORP electrodes" section.
	Sensor ageing	Replace sensor.	New sensor
	Sensor defective (reference lead)	Replace sensor.	New sensor
	No internal buffer	Check KCl supply (0.8 bar (11.6 psi) above medium pressure).	KCl (OPY 4-x)
Measuring chain slope not adjustable/slope too small	No high-impedance connection (moisture, dirt)	Check cable, plug connector and junction boxes.	pH simulator, insulation, see "Checking the connecting lines and boxes" section
	Device input defective	Check device directly.	pH simulator
	Sensor ageing	Renew sensor.	pH sensor
Measuring chain slope not adjustable/no slope	Hair-line crack in the glass membrane	Renew sensor.	pH sensor
	No high-impedance connection (moisture, dirt)	Check cable, plug connector and junction boxes.	pH simulator, insulation, see "Checking the connecting lines and boxes" section
Permanent, incorrect measured value	Sensor not immersing or protection cap not removed	Check installation position, remove protection cap.	
	Air cushion in assembly	Check assembly and orientation.	
	Ground connection at or in device	Perform test measurement in insulated vessel, poss. with buffer solution.	Plastic vessel, buffer solutions
	Hair-line crack in the glass membrane	Renew sensor.	pH sensor
	Impermissible device operating status (no reaction to key actuation)	Switch device off and then on again.	EMC problem: if this persists, check the grounding, screens and line routing or have checked by responsible service.
Incorrect temperature value	Incorrect sensor connection	Check connections using wiring diagram.	Wiring diagram "Electrical connection" section
	Measuring cable defective	Check cables for interruptions/short-circuit/shunt.	Ohmmeter
	Incorrect sensor type	Set type of temperature sensor at the device (field B1).	Glass electrode: Pt 100 ISFET: Pt 1000

Errors	Possible cause	Tests and/or remedial measures	Tools, spare parts
pH value in process wrong	No/incorrect temperature compensation	ATC: activate function. MTC: adjust process temperature.	
	Conductivity of medium too low	Select pH sensor with liquid KCl.	e.g. OPS41
	Flow too high	Reduce flow or measure in a bypass.	
	Potential in medium	Poss. ground with or at PM pin (connection PM/PE).	Problem occurs particularly in plastic lines.
	Sensor contaminated or assigned	Clean sensor (see "Cleaning pH/ORP sensors" section).	For heavily contaminated media: Use spray cleaning.
Measured value fluctuations	Interference on measuring cable	Connect cable as per wiring diagram.	See "Electrical connection" section.
	Interference on signal output line	Check line routing, lay line separately if necessary.	Signal output and measuring input lines
	Interference potential in medium	Measure symmetrically (with PML).	Poss. ground medium with PM/PE connection.
	No potential matching (PA/PM) for symmetrical input	Connect PM pin in assembly with devices PA/PM.	
Controller/limit contact does not work	Controller switched off	Activate controller.	See "Relay contact configuration" section or fields R2xx.
	Controller in operating mode "Manual/off"	Select "Auto" or "Manual on" mode.	Keyboard, REL key
	Pick-up delay set too long	Switch off or shorten pick-up delay time.	See fields R2xx.
	"Hold" function active	“Auto hold” for calibration, “Hold” input activated, “Hold” active via keyboard.	See fields S2 to S4.
Controller/limit contact works constantly	Controller in operating mode "Manual/on"	Set controller to "Manual/off" or "Auto".	Keyboard, REL and AUTO keys
	Drop-out delay set too long	Reduce drop-out delay time.	See fields R2xx.
	Control circuit interrupted	Check measured value, current output or relay contacts, adjusters, chemical supply.	
No pH/mV current output signal	Line open or short-circuited	Disconnect line and measure directly at the device.	mA metre 0–20 mA DC
	Output defective	See "Diagnosis" section.	
Fixed pH/mV current output signal	Current simulation active	Switch off simulation.	See field O2.
	Impermissible processor system operating status	Switch device off and then on again.	EMC problem: if it persists, check the installation.
Incorrect current output signal	Incorrect current assignment	Check current assignment: 0–20 mA or 4–20 mA?	Field O211
	Overall burden in the current loop too high (> 500 Ω)	Disconnect output and measure directly at the device.	mA metre for 0–20 mA DC
Current output table is not accepted	Value distance too small	Select practical distances.	
No temperature output signal	Device does not have a second current output	Check version using nameplate, if necessary, replace module LSCH-x1.	Module LSCH-x2, See "Spare parts" section.
Chemoclean function not available	No relay module (LSR1-x) installed or only LSR1-2 available	Install LSR1-4 module. The Chemoclean is enabled using the release code supplied by your supplier in the Chemoclean retrofit kit.	Module LSR1-4, see "Spare parts" section.

Errors	Possible cause	Tests and/or remedial measures	Tools, spare parts
No functions from Plus Package available	Plus Package not enabled (enable by entering a code which depends on the serial number and which is supplied by your supplier when a Plus Package is ordered)	– For Plus Package retrofit: enter code supplied by your supplier. – Following replacement of a defective module LSCH/LSCP: first enter device serial number (see nameplate) by hand, then enter existing code number.	For a detailed description, see "Replacing central module" section.

9.4 Instrument specific errors

The following table helps you during 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
- Responsible 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
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 responsible service, test module necessary
	Central module defective	Replace central module, note variant.	On-site diagnosis by responsible service, test module necessary
	OPM253: 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 responsible 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	OPM223: reinstall insert. OPM253: remount 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 or have checked by responsible service.
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 responsible service
Measured value pH/mV and/or temperature measured value incorrect	Transmitter module defective (module: MKIC), please first carry out tests and take measures as per the "Process errors without messages" section.	Measuring input test: – Connect pH, ref and PM directly at the device with wire jumpers = display pH 7 – Resistance 100 Ω at terminals 11 / 12 + 13 = display 0 C	If test negative: replace module (note variant). Perform with the aid of the exploded drawings in the "Spare parts" section.
Current output, current value incorrect	Adjustment not correct	Check with installed current simulation, connect mA metre directly to current output.	If simulation value incorrect: adjustment in factory or new module LSCH/LSCP 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)	Check with installed current simulation, connect mA metre directly to current output.	If test negative: Renew central module LSCH/LSCP (note variant).

Error	Possible cause	Tests and/or remedial measures	Execution, tools, spare parts
No function of additional relay	OPM253: 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 responsible service
Additional functions (S-package) missing	No or incorrect release code used	If retrofitting: check whether the correct serial number was quoted when ordering the S-package.	Handled by your supplier
	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 S-package.
Additional functions (S-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 S-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 E114 to E116. Then enter the release code for the S-package and/or Chemoclean.	For a detailed description, see "Replacing central module" section.

9.5 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 sofware (see chapter "Instrument configuration") if the instrument processor system is functional.

9.5.1 Panel mounted instrument

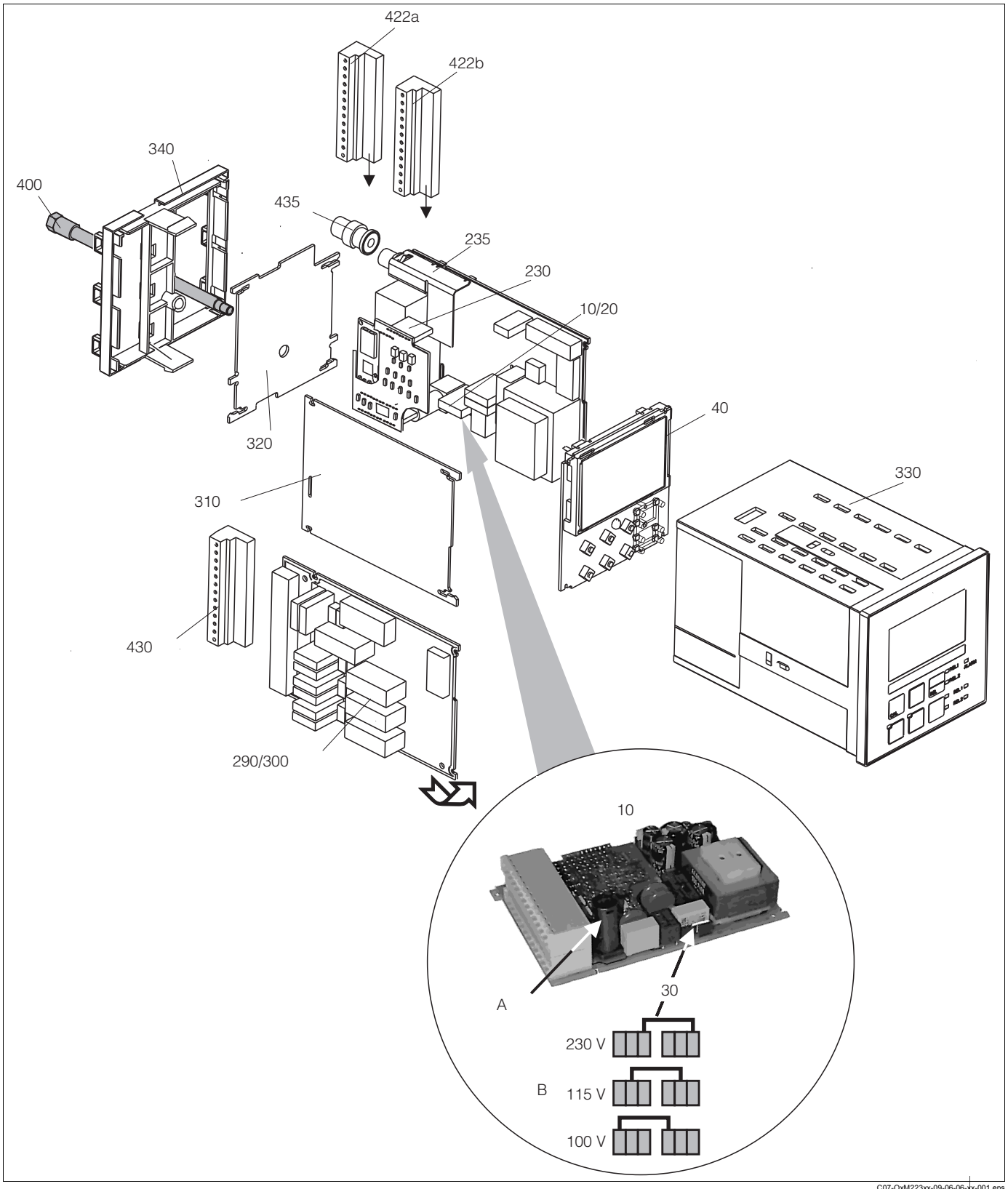


Fig. 43: Exploded drawing of panel-mounted instrument

The exploded 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	LSGA	100 / 115 / 230 V AC	51500317
20	Power unit	LSGD	24 V AC + DC	51500318
30	Jumper		Part of power unit, item 10	
40	Central module	LSCH-S1	1 current output	51501081
40	Central module	LSCH-S2	2 current outputs	51501082
230	pH/mV transmitter	MKP1	pH/mV + temperature input Glass electrode	51501080
230	pH/mV transmitter	MKP2	pH/mV + temperature input ISFET sensor	51507096
235	pH/mV input		BNC connection jack + screening plate	51501070
290	Relay module	LSR1-2	2 relays	51500320
290	Relay module	LSR2-2i	2 relays + current input 4 ... 20 mA	51504304
300	Relay module	LSR1-4	4 relays	51500321
300	Relay module	LSR2-4i	4 relays + current input 4 ... 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
zu 340	PE terminal		PE terminal for screen grounding for IS version	51501086
422a, 422b	Terminal strip set		Complete terminal strip set, standard	51501077
430	Terminal strip		Terminal strip for relay module	51501078
435	BNC connector, elbowed		pH/mV connection	50074961
A	Fuse		Part of power unit, item 10	
B	Choice of line voltage		Position of jumper item 30 on power unit, item 10 depending on line voltage	

9.5.2 Field instrument

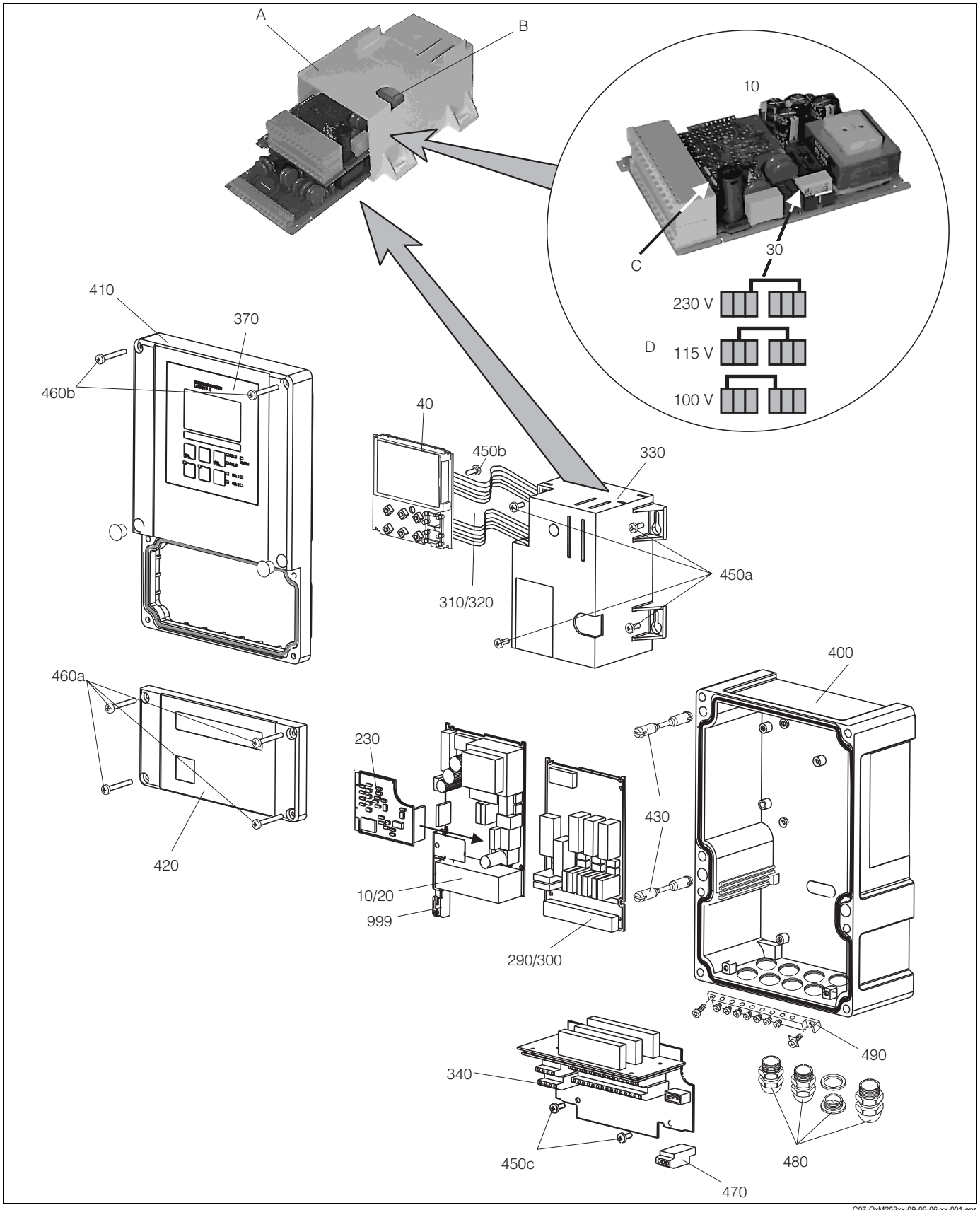


Fig. 44: Field device exploded drawing

The exploded 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.

Item	Kit description	Name	Function/contents	Order number
10	Power unit	LSGA	100 / 115 / 230 V AC	51500317
20	Power unit	LSGD	24 V AC + DC	51500318
30	Jumper		Part of power unit, item 10	
40	Central module	LSCH-S1	1 current output	51501081
40	Central module	LSCH-S2	2 current outputs	51501082
230	pH/mV transmitter	MKP1	pH/mV + temperature input Glass electrode	51501080
230	pH/mV transmitter	MKP2	pH/mV + temperature input ISFET sensor	51507096
290	Relay module	LSR1-2	2 relays	51500320
290	Relay module	LSR2-2i	2 relays + current input 4 ... 20 mA	51504304
300	Relay module	LSR1-4	4 relays	51500321
300	Relay module	LSR2-4i	4 relays + current input 4 ... 20 mA	51504305
310, 320	Ribbon cable lines		2 ribbon cable lines	51501074
340, 330, 450	Inner housing fittings		Docking module, empty electronics box, small parts	51501073
450a, 450c	Torx screws K4x10		Part of inner housing fittings	
450b	Torx screw for central module		Part of inner housing fittings	
410, 420, 370, 430, 460	Housing cover		Display cover, connection compartment cover, front membrane, hinges, cover screws	51501068
460a, 460b	Cover screws		Part of housing cover	
430	Hinges		2 pairs of hinges	51501069
400, 480	Housing base		Base, threaded joints	51501072
470	Terminal strip		Terminal strip for connection to mains	51501079
490	PE rail		PE connection rail for screen grounding for IS version	51501087
999	pH/mV terminal module		ph/mV terminal + screening plate	51501071
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 item 30 on power unit, item 10 depending on desired line voltage	

9.6 Return

If the transmitter has to be repaired, please return it *cleaned* to the sales centre responsible.
Please use the original packaging, if possible.

9.7 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 Technical data

10.1 Input

Measured variable	pH ORP Temperature	
Measuring range	pH	–2 ... 16
	ORP	–1500 ... +1500 mV / 0 ... 100 %
	Temperature – Pt 100, Pt 1000 – NTC 30K	 -50 ... +150 C (-58 ... +302 °F) -20 ... +100 C (-4 ... +212 °F)
Input impedance (glass electrodes)	> 10^{12} Ω (for nominal operating conditions)	
Cable specifications	Cable length:	Max. 50 m (164.05 ft)
Binary inputs 1 and 2	Voltage:	10 ... 50 V
	Current consumption:	Max. 10 mA
Current input	4 ... 20 mA, galvanically isolated	
	Load: 260 Ω for 20 mA (voltage drop 5.2 V)	

10.2 Output

Output signal	0/4 ... 20 mA, galvanically isolated	
Signal on alarm	2.4 or 22 mA in case of error	
Load	Max. 500 Ω (depending on operating voltage)	
Transmission range	pH:	Adjustable, min. Δ 1 pH
	ORP: – Absolute: – Relative:	 Adjustable, min. Δ 50 mV Fixed, 0 ... 100 %
	Temperature:	Adjustable, Δ 10 ... Δ 100 % of end of measuring range
	Continuous controller:	0 - 100 % Y-signal
Signal resolution	Max. 700 digits/mA	
Minimum spread 0 / 4 ... 20 mA signal	10 % of the measuring range span	
Insulation voltage	Max. 350 V_{eff} / 500 V DC	
Auxiliary voltage output	Output voltage:	15 V ± 0.6
	Output current:	Max. 10 mA
Contact outputs (floating 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 capacity with ohmic load (cos φ = 1):	Max. 1250 VA AC, 150 W DC
	Switching capacity with inductive load (cos φ = 0.4):	Max. 500 VA AC, 90 W DC
Limit contactor	Pick-up/drop-out delay	0 ... 7200 s

Controller	Function (adjustable):	Pulse length/pulse frequency controller
	Controller behaviour:	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 length for pulse length controller:	0.5 ... 999.9 s
	Frequency for pulse frequency controller:	60 ... 180 min^{-1}
	Basic load:	0 ... 40% of max. actuating variable
Alarm	Function (switchable):	Steady/fleeting contact
	Alarm threshold adjustment range:	pH/temperature: entire measuring range
	Alarm delay:	0 ... 2000 s

10.3 Power supply

Supply voltage	Depending on order version: 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, semi-delay 250 V/3.15 A

10.4 Environment

Ambient temperature range	-10 ... +55 C (+14 ... +131 °F)	
Ambient temperature limits	–20 ... +60 C (-4 ... +140 °F)	
Storage temperature	–25 ... +65 C (-13 ... +149 °F)	
Electromagnetic compatibility	Interference emission and interference immunity as per EN 61326: 1997 / A1: 1998	
Overvoltage protection	As per EN 61000-4-5:1995	For outputs, binary inputs and current input
Degree of protection	Panel-mounted instrument:	IP 54 (front), IP 30 (housing)
	Field device:	IP 65
Relative humidity	10 ... 95%, not condensating	

10.5 Performance characteristics

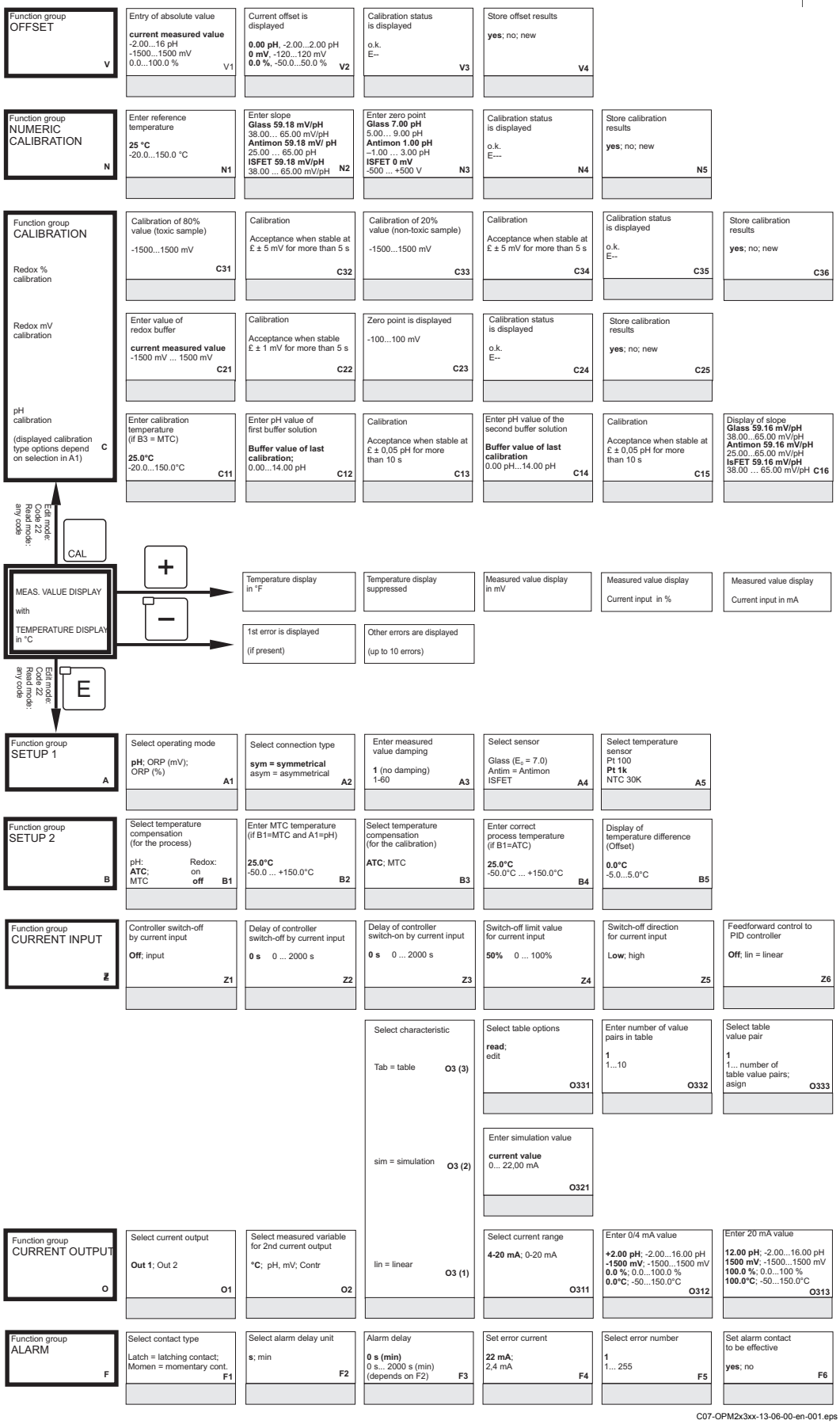
Reference temperature	25 C (77 °F)	
Measured value resolution	pH:	0.01 pH
	ORP:	1 mV/0.1 %
	Temperature:	0.1 C
Maximum measured error[1]	Display – pH: – ORP: – Temperature:	 Max. 0.5 % of scope of measuring range Max. 0.5 % of scope of measuring range Max. 1.0 % of scope of measuring range
	Signal output – pH: – ORP: – Temperature:	 Max. 0.75 % of scope of measuring range Max. 0.75 % of scope of measuring range Max. 1.25 % of scope of measuring range
Repeatability[1]	pH:	Max. 0.2 % of scope of measuring range
	ORP:	Max. 0.2 % of scope of measuring range
Zero point shift	Glass electrode:	pH 5.0 ... 9.0 (nominal pH 7.00)
	Antimony electrode:	pH –1.0 ... 3.0 (nominal pH 1.00)
	ISFET sensor	-500 ... +500 mV
Slope adjustment	Glass electrode:	38.00 ... 65.00 mV/pH (nominal 59.16 mV/pH)
	Antimony electrode:	25.00 ... 65.00 mV/pH (nominal 59.16 mV/pH)
	ISFET sensor	38.00 ... 65.00 mV/pH (nominal 59.16 mV/pH)
Offset	pH:	±2 pH units
	ORP:	±120 mV/±50 %
	Temperature:	±5 C

1) In accordance with IEC 746-1, for nominal operating conditions

10.6 Mechanical construction

Design/dimensions	Panel-mounted instrument:	L x W x D: 96 x 96 x 145 mm (3.78" x 3.78" x 5.71") Installation depth: approx. 165 mm (6.50")
	Field device:	L x W x D: 247 x 170 x 115 mm (9.72" x 1.70" x 4.53")
Weight	Panel-mounted instrument:	Max. 0.7 kg (1.5 lb)
	Field device:	Max. 2.3 kg (5.1 lb)
Material	Panel-mounted instrument housing:	Polycarbonate
	Field housing:	ABS PC Fr
	Front membrane:	Polyester, UV-resistant
Terminals	Cable cross-section:	2.5 mm^2

11 Appendix



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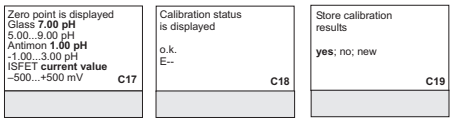

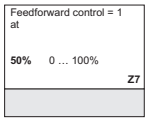

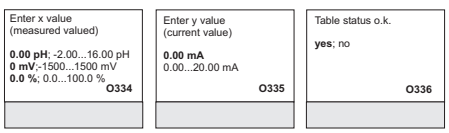

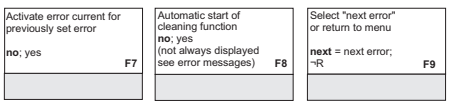

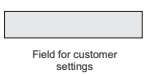

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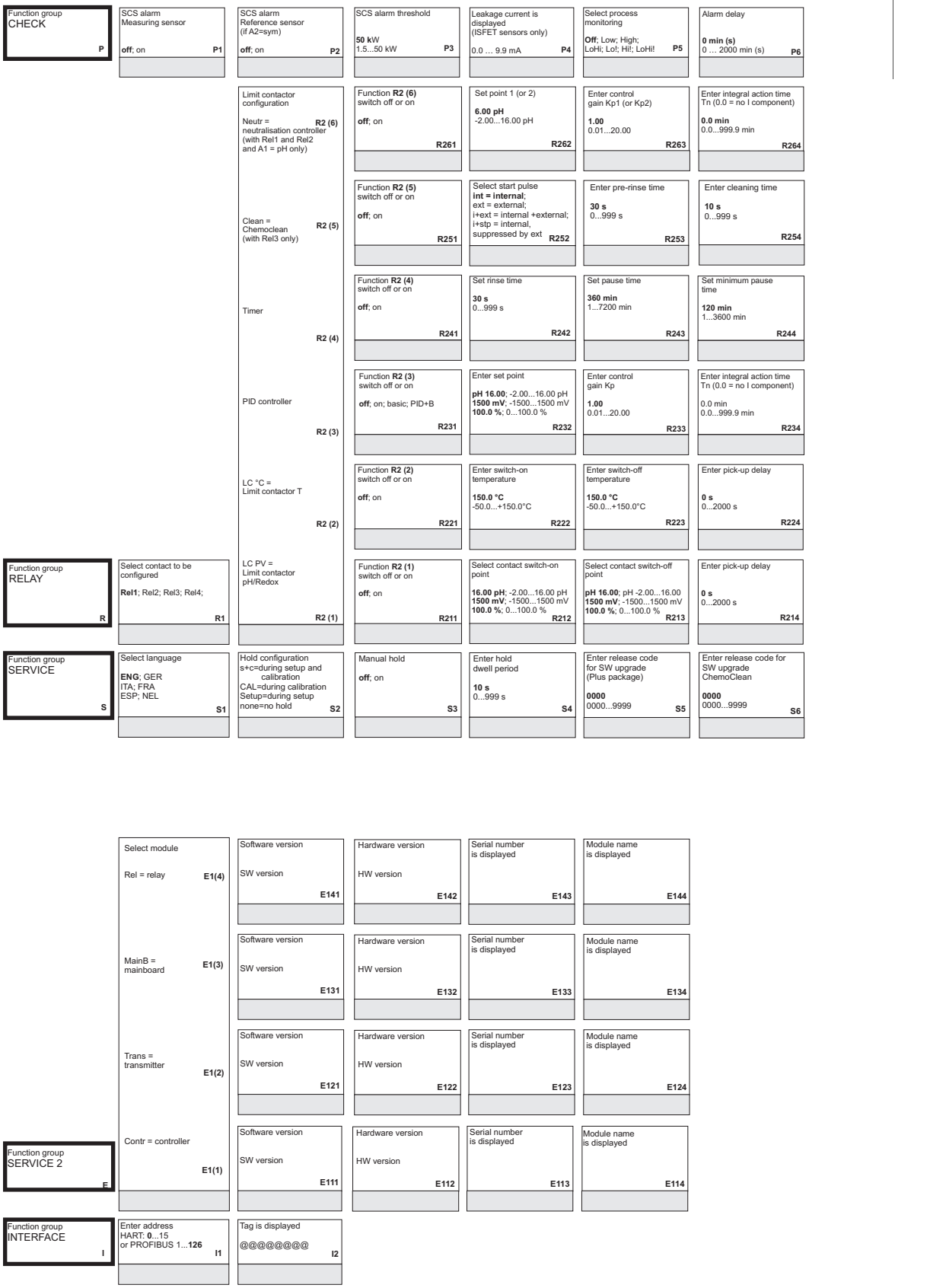

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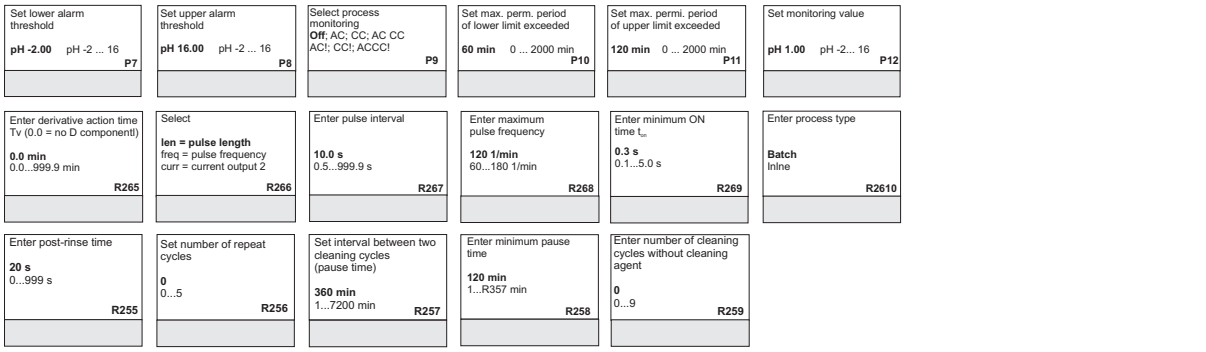

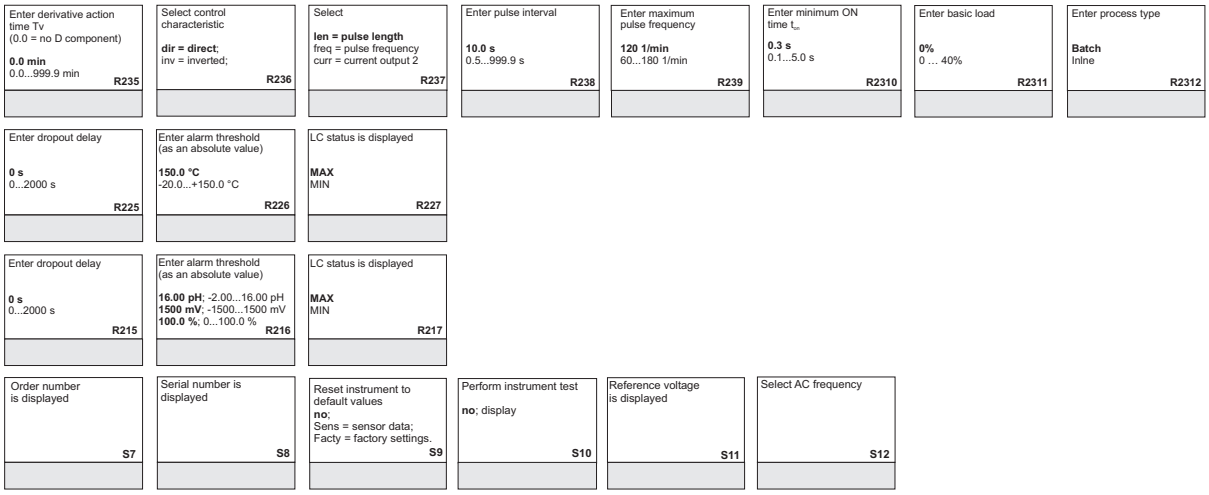

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