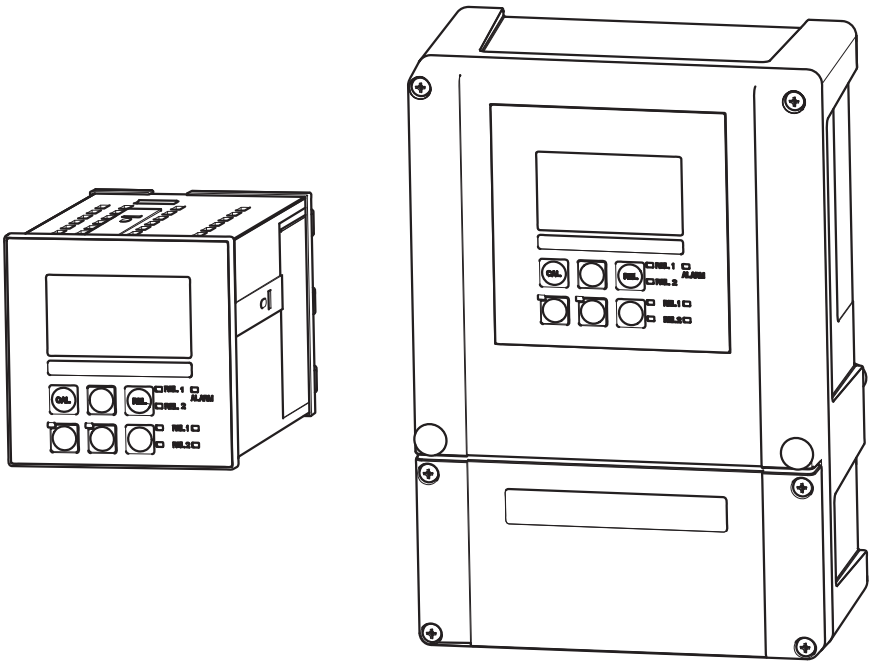
BA00214C/07/EN/14.13
71212626

valid as of:
Software-version 2.40

Operating Instructions
Liquisys M CCM223/253

Transmitter for Free Chlorine, Chlorine Dioxide and Total Chlorine



Endress+Hauser
People for Process Automation

About this document

Safety messages

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

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

Symbols

Additional information, tips

Permitted or recommended

Forbidden or not recommended

Table of contents

1 Basic safety instructions

1.1 Requirements for the personnel

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

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

1.2 Designated use

Liquisys M is a field-tested and reliable transmitter which determines the amount of free chlorine, chlorine dioxide or total chlorine dissolved in water.

The transmitter is particularly suited for use in the following areas:
- Drinking water
- Water treatment
- Cooling water
- Gas scrubbers
- Reverse osmosis
- Food processing
- Swimming pool and bathing pool water.

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

1.3 Workplace safety

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

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

1.4 Operational safety

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

1.5 Product safety

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

1.6 Electrical symbols

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

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

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

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

Class II (isolated) device
Double insulation

Alarm relay

Input

Output

DC voltage source

Temperature sensor

2 Incoming acceptance and product identification

2.1 Incoming acceptance

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

2.2 Scope of delivery

The delivery of the field instrument includes:
- 1 transmitter CCM253
- 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 BA00214C/07/EN
- 1 Operating Instructions
- versions with HART communication:
  1 Operating Instructions Field Communication with HART, BA00208C/07/EN
- versions with PROFIBUS communication:
  1 Operating Instructions Field Communication with PROFIBUS PA/DP, BA00209C/07/EN

The delivery of the panel-mounted instrument includes:
- 1 transmitter CCM223
- 1 set of plug-in screw terminals
- 2 tensioning screws
- 1 Operating Instructions
- 1 Operating Instructions BA00214C/07/EN
- versions with HART communication:
  1 Operating Instructions Field Communication with HART, BA00208C/07/EN
- versions with PROFIBUS communication:
  1 Operating Instructions Field Communication with PROFIBUS PA/DP, BA00209C/07/EN

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

2.3 Product identification

2.3.1 Nameplate

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

Compare the order code on the nameplate with your order.

2.3.2 Identifying the product

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

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

2.4 Certificates and approvals

2.4.1 CE mark

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

2.4.2 CSA general purpose

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

Version	Approval
CCM253-..2... CCM253-..3... CCM253-..7...	CSA Mark for Canada and USA
CCM223-..2... CCM223-..3... CCM223-..7...	CSA Mark for Canada and USA

3 Mounting

3.1 Quick installation guide

Proceed as follows to completely install the measuring point:

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

3.1.1 Measuring system

A complete measuring system comprises:

Version 1 (free chlorine and chlorine dioxide)
- The transmitter Liquisys M CCM223 or CCM253
- A membrane covered sensor CCS140/141 for Cl_2 or CCS240/241 for ClO_2 or an open sensor 963 for Cl_2
- A flow assembly CCA250 (not necessary for sensor 963)

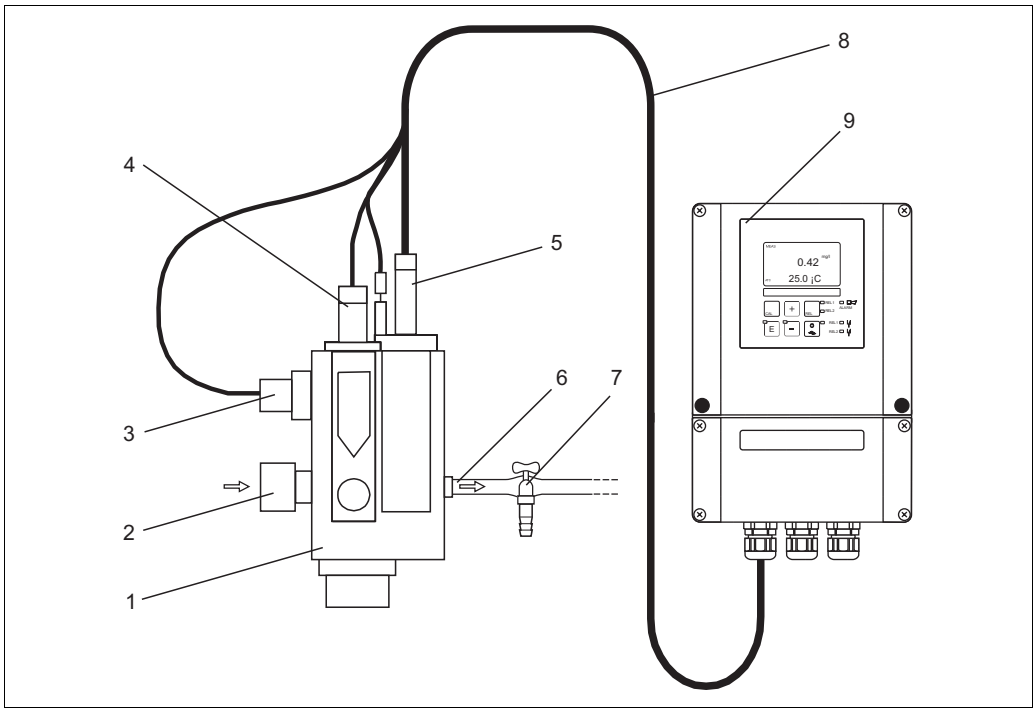
and optional:

- A pH or ORP sensor
- An INS proximity switch for flow monitoring (omitted with 963 sensor)
- CMK extension cable for chlorine measurement if required
- CYK71 extension cable for pH/ORP measurement if required
- MK extension cable for INS proximity switch if required
- VBC junction box

Version 2 (total chlorine)
- The transmitter Liquisys M CCM223 or CCM253
- A sensor for total chlorine CCS120
- A flow assembly CCA250 or immersion assembly CYA611
- A special measuring cable CPK9, PM wire internally

and optional:

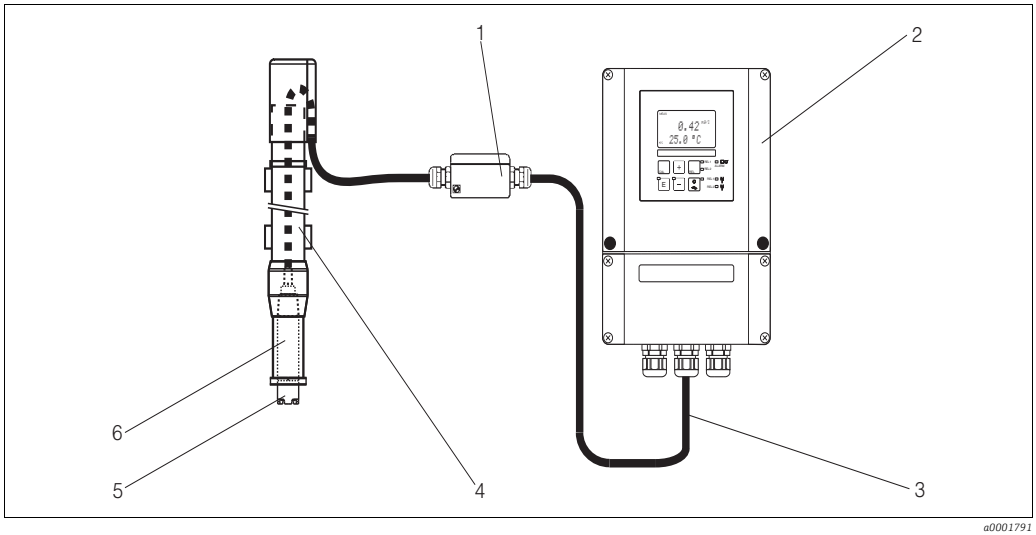
- A pH or ORP sensor
- An INS proximity switch for flow monitoring (omitted with immersion assembly)
- CMK extension cable (PM wire internally) for chlorine measurement if required
- CYK71 extension cable for pH/ORP measurement if required
- MK extension cable for INS proximity switch if required
- VBC junction box



a0001691

Fig. 1: Measuring system with flow assembly (example)

1	*Flow assembly CCA250*	*6*	*Medium outlet*
2	*Medium inlet*	*7*	*Sampling tap*
3	*Proximity switch for flow monitoring*	*8*	*Measuring cable*
4	*Mounting place for pH/redox sensor*	*9*	*Transmitter*
5	*Chlorine sensor*		



a0001791

Fig. 2: Measuring system with immersion assembly (example)

1	*Junction box*	*4*	*Immersion assembly CYA611*
2	*Transmitter*	*5*	*Chlorine sensor CCS120*
3	*Measuring cable*	*6*	*Assembly adapter G1*

3.2 Installation conditions

3.2.1 Field instrument

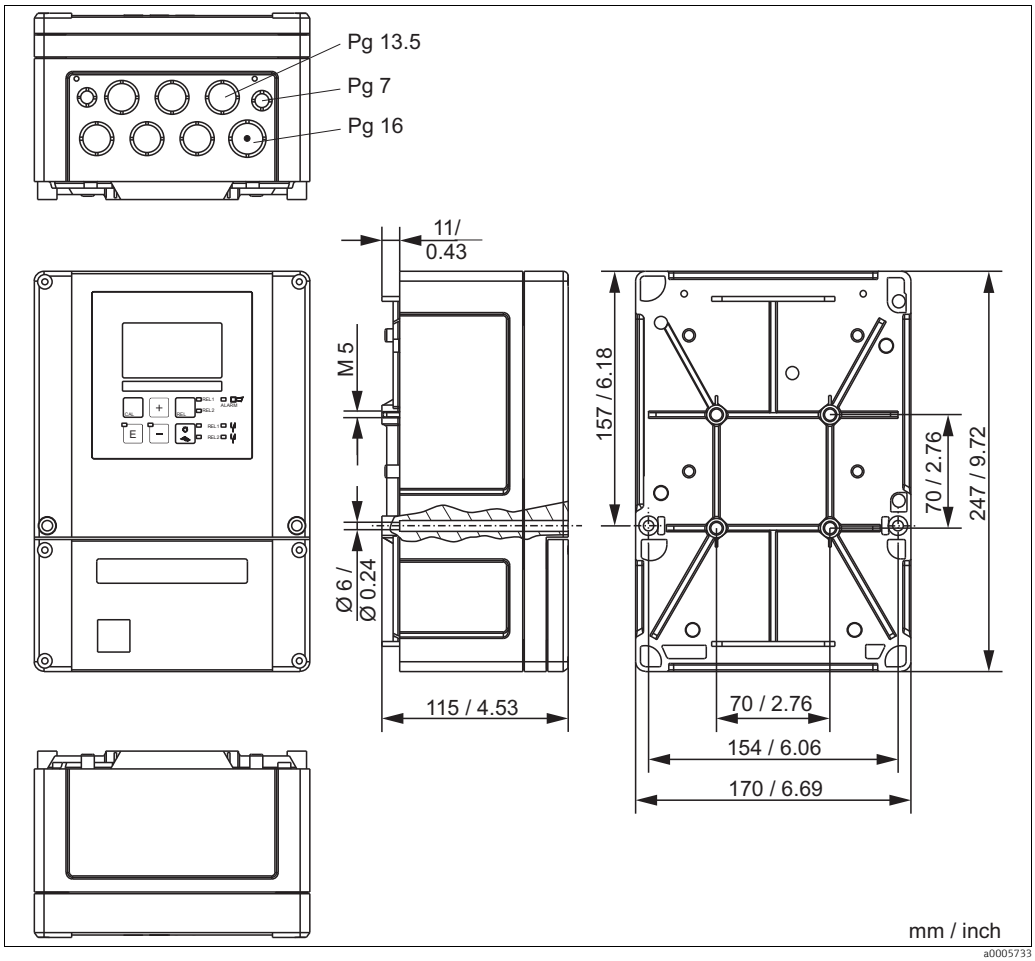


Fig. 3: Field instrument

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

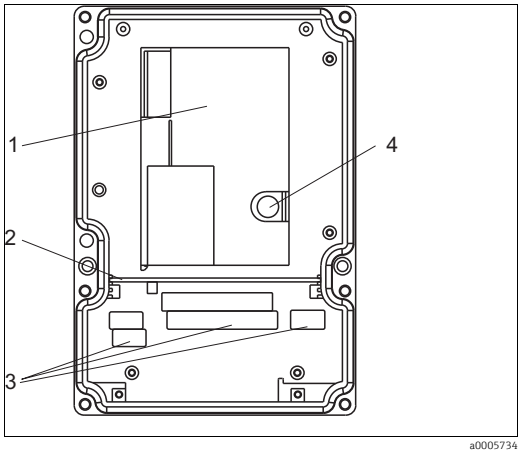


Fig. 4: View into the field housing

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

3.2.2 Panel-mounted instrument

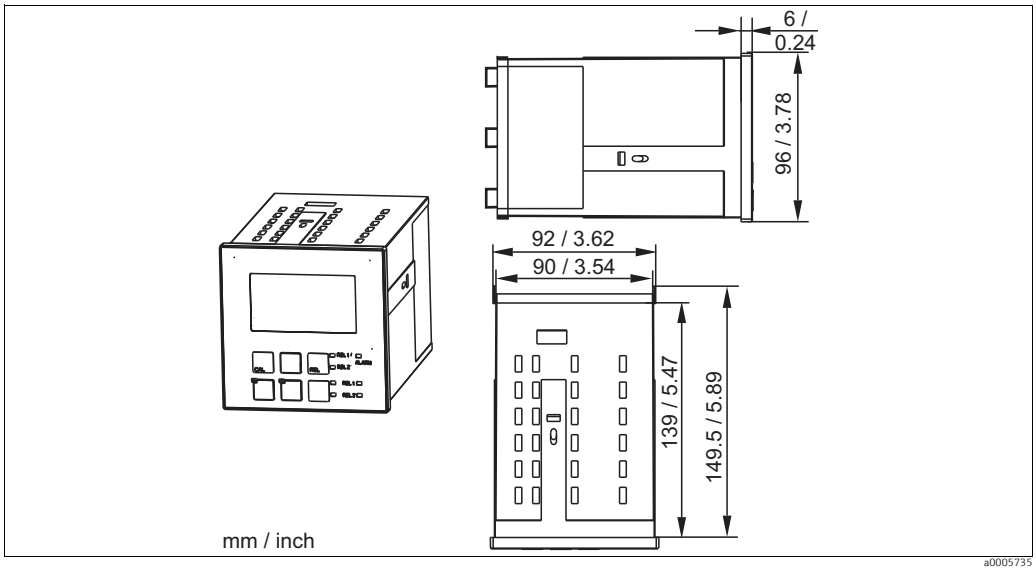


Fig. 5: Panel-mounted instrument

3.3 Installation instructions

3.3.1 Field instrument

There are several ways of securing the field housing:

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

NOTICE

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

Impaired operation to complete transmitter failure

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

Transmitter wall mounting

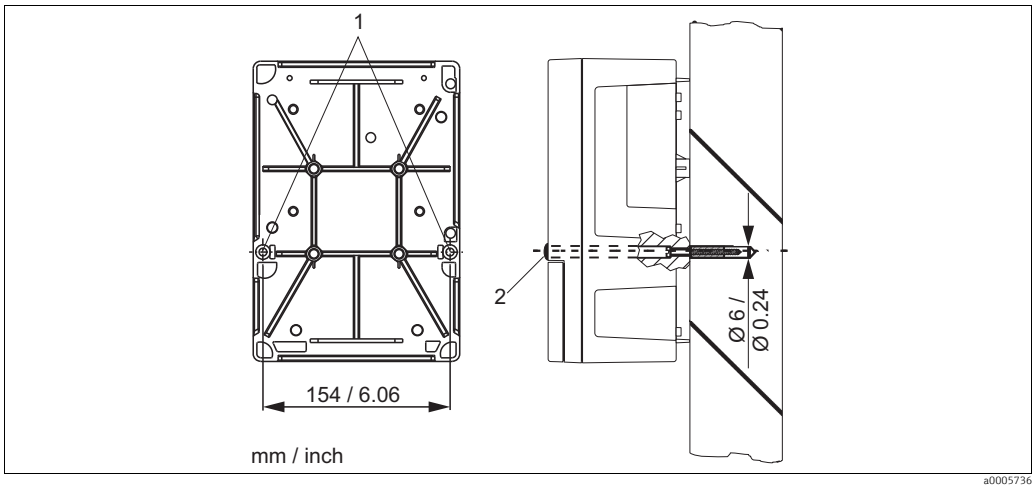


Fig. 6: Wall mounting field device

For wall mounting the transmitter, proceed as follows:

1. Drill the bores as shown in → 6.
2. Drive the two fixing screws through the securing bores (1) from the front.
3. Mount the transmitter on the wall as shown.
4. Cover the bores with plastic caps (2).

Transmitter post mounting

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

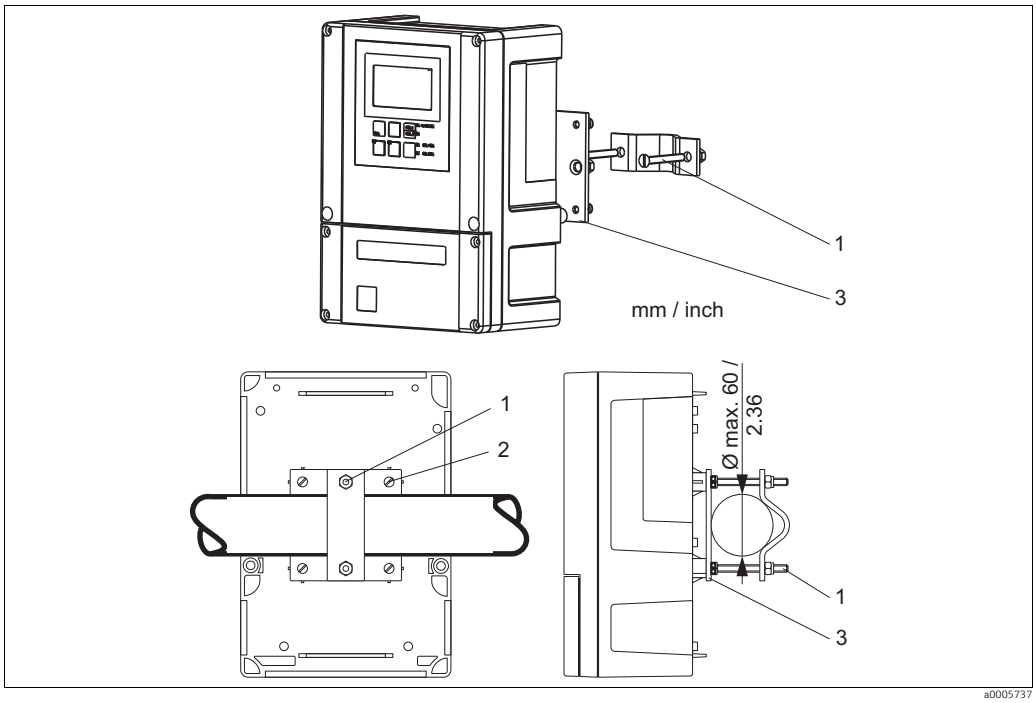


Fig. 7: Post mounting field device to cylindrical pipes

For post mounting the transmitter, proceed as follows:

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

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

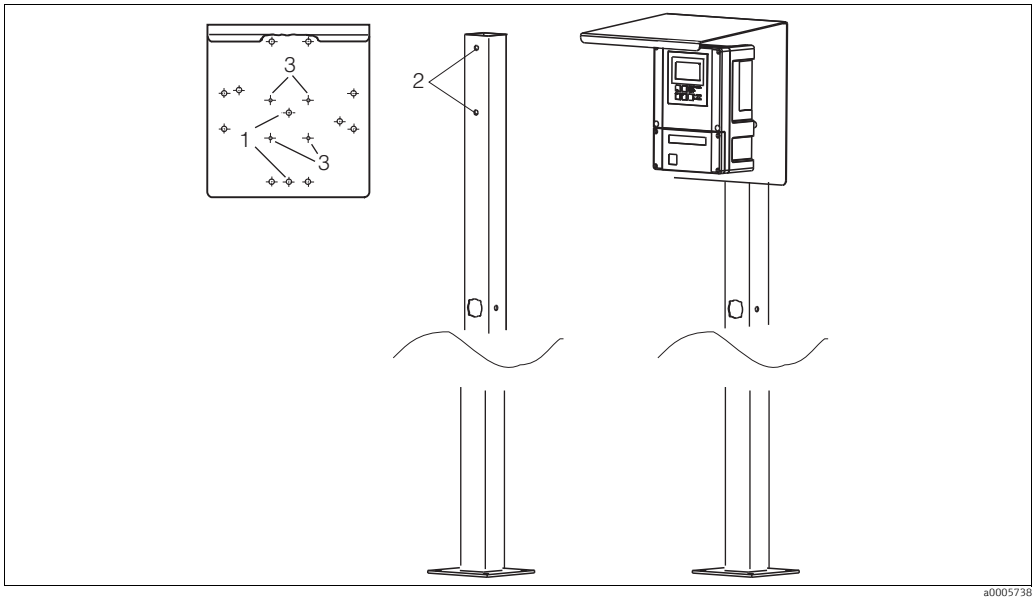


Fig. 8: Mounting field device with universal posts and weather protection cover

For mounting the weather protection cover, proceed as follows:

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

3.3.2 Panel-mounted instrument

The panel-mounted instrument is secured with the clamping screws supplied (see → 9). The necessary installation depth is approx. 165 mm (6.50").

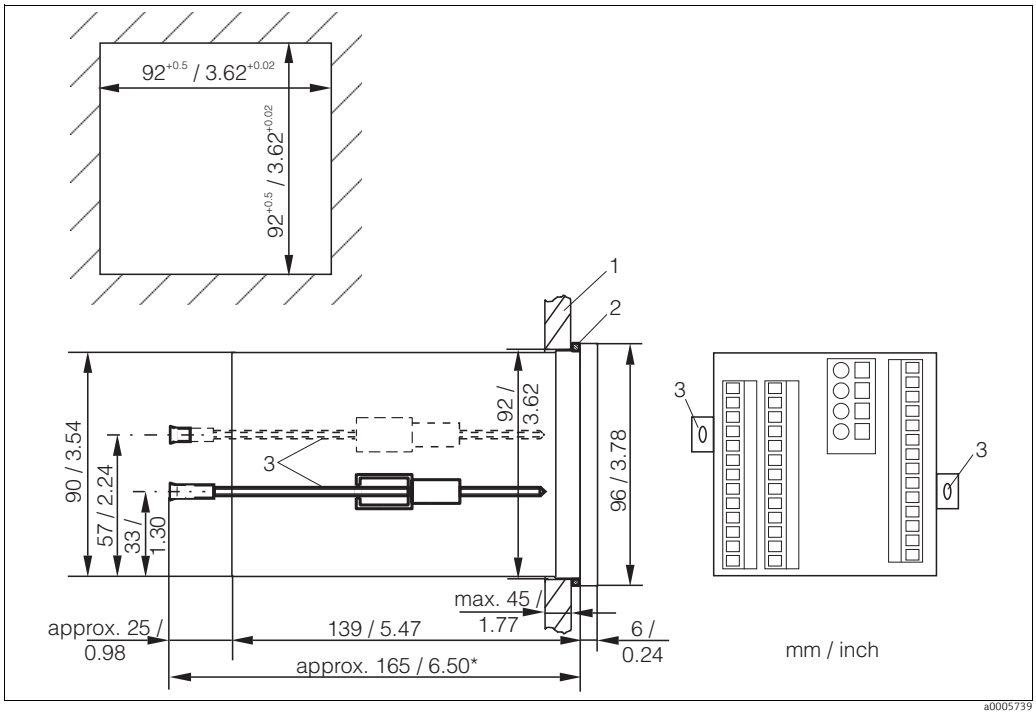


Fig. 9: Securing the panel-mounted instrument

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

3.4 Post-installation check

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

4 Electrical Connection

⚠ WARNING

Device is energized

Improper connection can cause injury or death.

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

The electrical connection of the transmitter differs depending on the sensor:

- If you are using the membrane-covered sensor CCS140 / 141 / 240 / 241 or the open sensor 963, please read the instructions in the "Electrical connection version 1" section.
- If you are using the total chlorine sensor CCS120, please read the instructions in the "Electrical connection version 2" section.

4.1 Wiring

4.1.1 Connecting supply voltage

NOTICE

The device does not have a power switch

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

4.1.2 Electrical connection version 1

The wiring diagram shows the connections of the transmitter with all options

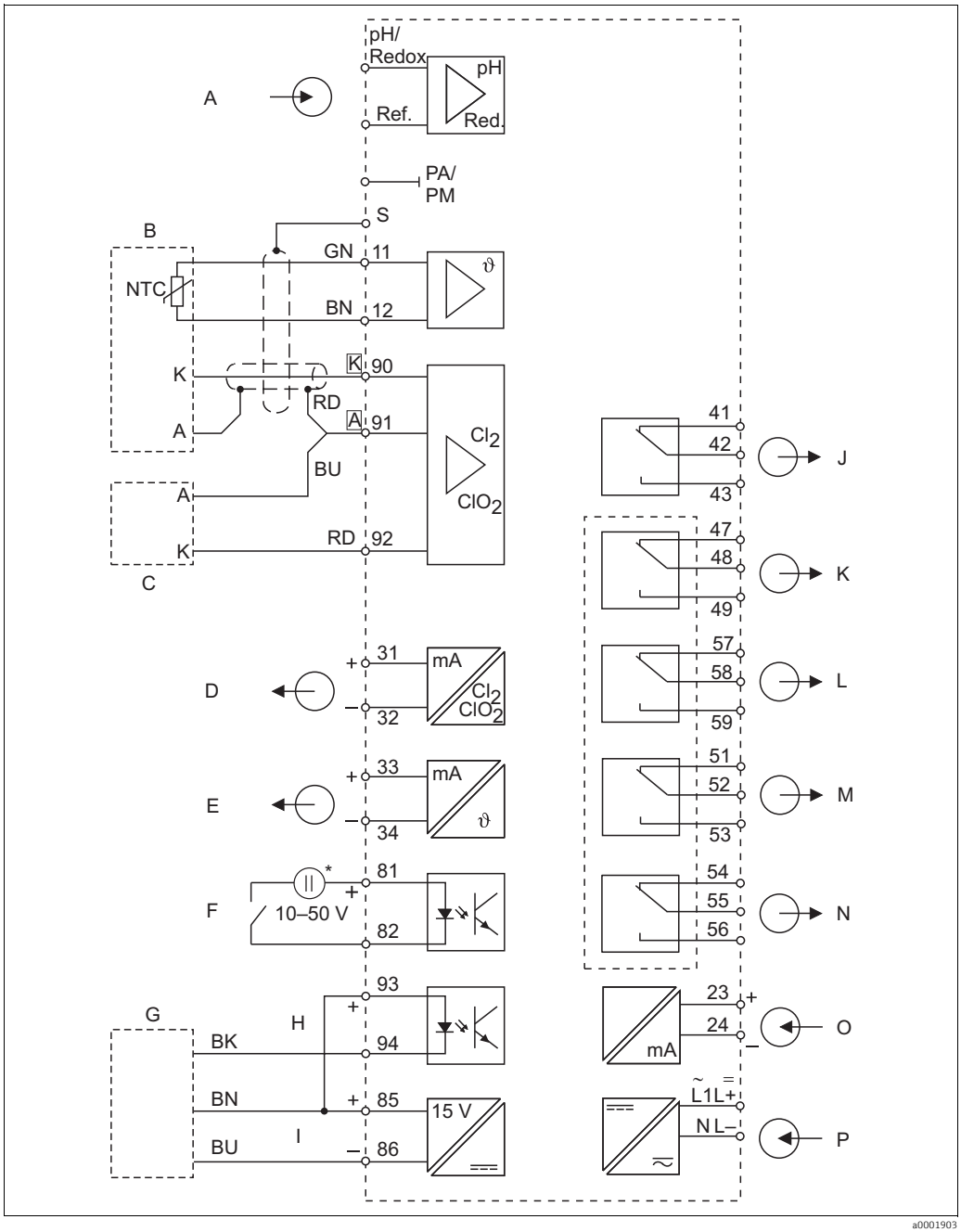


Fig. 10: Electrical connection of the transmitter (version 1)

A	*pH / ORP input (optional)*	*I*	*Aux. voltage output*
B	*Sensor CCS140/141/240/241*	*J*	*Alarm (current-free contact position)*
C	*Sensor 963 (alternative)*	*K*	*Relay 1 (current-free contact position)*
D	*Signal output 1 chlorine / chlorine dioxide*	*L*	*Relay 2 (current-free contact position)*
E	*Signal output 2 temperature, pH or ORP*	*M*	*Relay 3 (current-free contact position)*
F	*Binary input 1 (hold / cleaning)*	*N*	*Relay 4 (current-free contact position)*
G	*Proximity switch INS*	*O*	*Current input 4 to 20 mA*
H	*Binary input 2*	*P*	*Power supply*
*	*Aux. voltage output terminal 85/86 applicable*		

The device is approved for protection class II and is generally operated without protective ground connection.
The circuits "E" and "I" are not galvanically separated from each other.

4.1.3 Electrical connection version 2

The wiring diagram shows the connections of the transmitter with all options

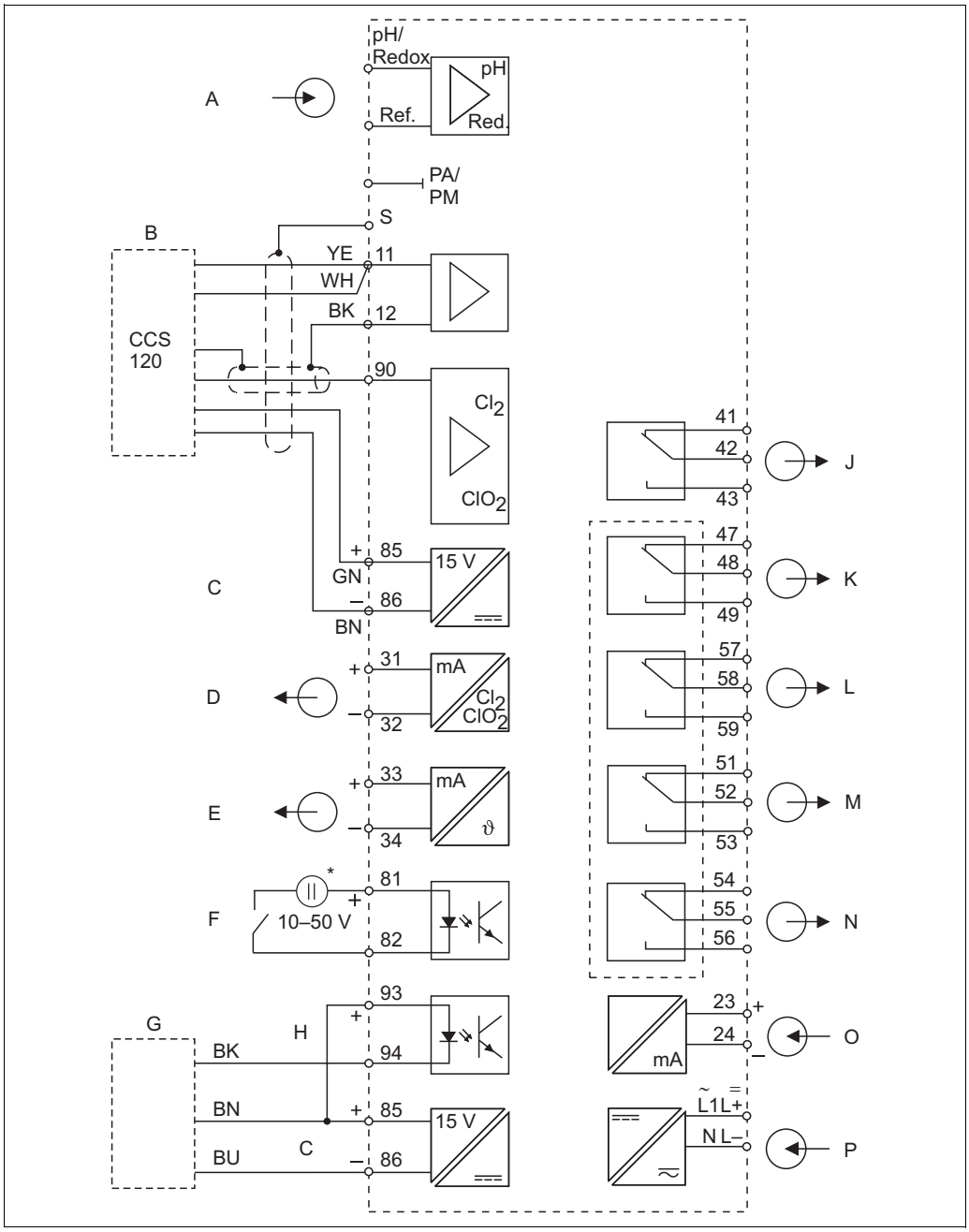


Fig. 11: Electrical connection of the transmitter (version 2)

A	*pH / ORP input (optional)*	*J*	*Alarm (current-free contact position)*
B	*Sensor CCS120*	*K*	*Relay 1 (current-free contact position)*
C	*Aux. voltage output*	*L*	*Relay 2 (current-free contact position)*
D	*Signal output 1 total chlorine*	*M*	*Relay 3 (current-free contact position)*
E	*Signal output 2 temperature, pH or ORP*	*N*	*Relay 4 (current-free contact position)*
F	*Binary input 1 (hold / cleaning)*	*O*	*Current input 4 to 20 mA*
G	*Proximity switch INS*	*P*	*Power supply*
H	*Binary input 2*		
*	*Aux. voltage output terminal 85/86 applicable*		

The device is approved for protection class II and is generally operated without protective ground connection.
The circuits "E" and "C" are not galvanically separated from each other.

4.1.4 Device connection

Field instrument connection

Proceed as follows to connect 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 cable gland and guide the cable through this cable gland.
3. Connect the cable in accordance with the terminal assignment (→ 12).
4. Tighten the cable gland.

NOTICE

Nonobservance could cause incorrect measurement

- Make sure to protect the connectors, cable ends and terminals against moisture.
- Terminals marked NC may not be wired.
- Unmarked terminals may not be wired.

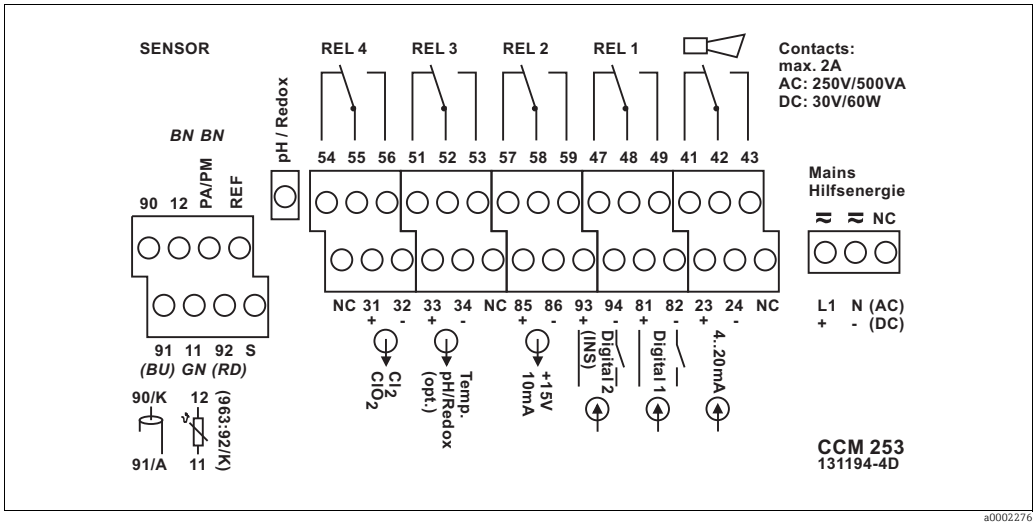


Fig. 12: Field instrument connection compartment sticker

Please label the sensor terminal block with the sticker provided.

Panel-mounted instrument connection

Connect the cable in accordance with the terminal assignment (→ 13)

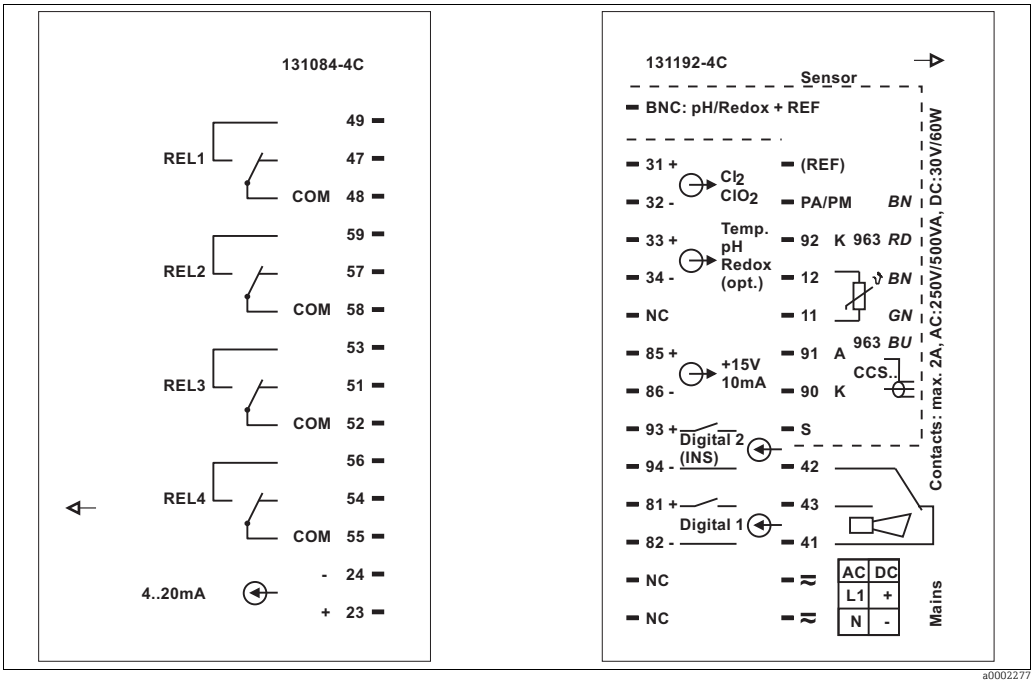


Fig. 13: Panel-mounted instrument connection sticker

NOTICE

Nonobservance could cause incorrect measurement

- Make sure to protect the connectors, cable ends and terminals against moisture.
- Terminals marked NC may not be wired.
- Unmarked terminals may not be wired.

Please label the sensor terminal block with the sticker provided.

4.1.5 Measuring cable and sensor connection

Type of sensor	Cable	Extension
Chlorine / chlorine dioxide sensors CCS140 / 141 / 240 / 241	3 m (9.8 ft) CMK, fixed cable	VBC junction box + CMK
Chlorine sensor 963	–	VBC junction box + MK
Temperature sensor for sensor 963	CPK1	
Total chlorine sensor CCS120	CPK9-N*A1B	VBC junction box + CYK71
pH or ORP sensor without temperature sensor	CPK1 for sensors with GSA plug-in head CPK9 for sensors with ESA plug-in head	VBC junction box + CYK71

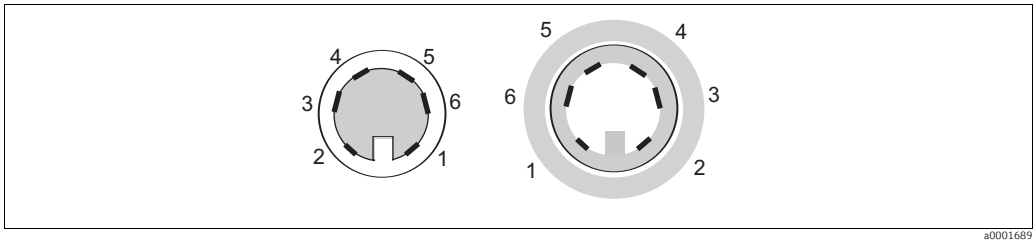
Connection of the sensors CCS140 / 141 / 240 /241
The sensors are equipped with a 3 m (9.8 ft) fixed cable. Connect the sensor to the transmitter as follows:

Sensor with 3 m (9.8 ft) fixed cable		Transmitter
Pin assignment	**Wire**	**Terminal**
Outer screen		S
Anode	[A] red	91
Cathode	[K]	90
NTC temperature sensor	green	11
NTC temperature sensor	brown	12

Connection of the total chlorine sensor CCS120
Connect the sensor with the measuring cable l CPK9-N*A1B (with internal PML) as follows:

Cable with TOP68 plug connection			Transmitter
Pin	**Assignment**	**Wire**	**Terminal**
1	TC signal	coax inside (white)	90
2	AGND	coax outside(black)	12
3			
4	+UB (15 V)	green	85
5	NTC1	yellow*	11
	NTC1	white*	11
6	NTC2/AGND	brown	86
S	screen	S	S

* The white and the yellow wire are interconnected inside of the TOP68 plug.



a0001689

Fig. 14: TOP68 plug connection; pin assignment of plug, male and female (shown from contact side)

Connection of the sensors 963
The sensor 963 is supplied without temperature sensor ex factory. Connect the sensor to the transmitter as follows:

- Without temperature measurement:
  Connect the supplied resistor10 kΩ to the terminals 11 and 12. The measured value display will constantly indicate 25 °C (77 °F).
- With temperature measurement:
  Install the NTC temperature sensor10 kΩ / 25 °C (77 °F) (120 mm installation version TSP 3692) into the sensor 963. Use the measuring cable CPK1 to connect the temperature sensor to the terminals 11 and 12 of the transmitter.
- Chlorine sensor:
  Connect the red wire to terminal 92 (cathode) and the blue wire to the terminal 91 (anode).

Connection of pH or ORP sensors
Connect the pH or ORP sensor **always symmetrically** to prevent a mutual interference of several sensors mounted in the CCA250 assembly.
Symmetrical connection requires a potential matching pin. It is integrated as standard in the CCA250 flow assembly and is connected to the PA/PM terminal by a potential matching line.

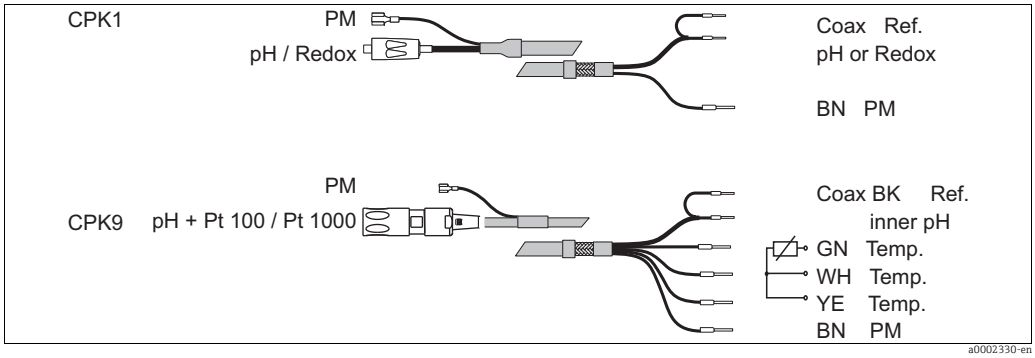


Fig. 15: Connection of the pH or ORP sensor to the field instrument with the cables CPK1 or CPK9

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 (→ 16).

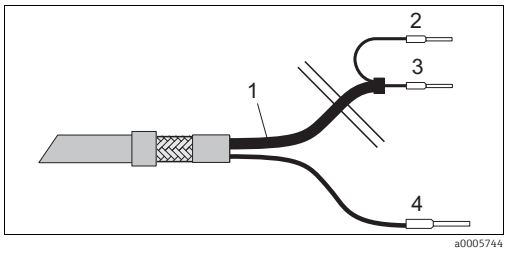


Fig. 16: Cable CPK1: device connection

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

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.
   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 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.
6. Remove the inner insulation (4 mm (0.16")).
7. Position the end sleeve 13 onto the stripped inner conductor and secure the end sleeve with crimping pliers.
8. Push the BNC connector housing 9 over the cable. The inner conductor must be located on the 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.

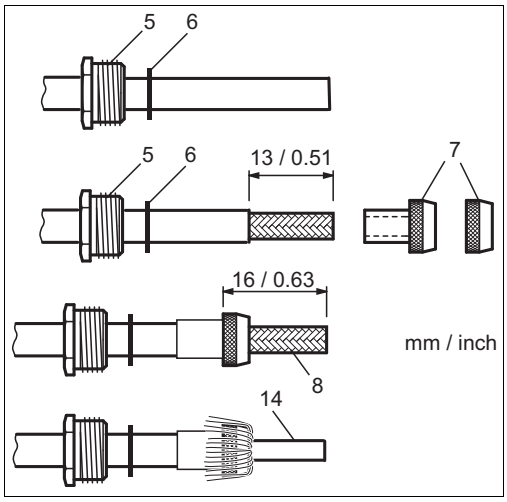


Fig. 17: Terminating the pH connecting cable for mounting the BNC elbow plug

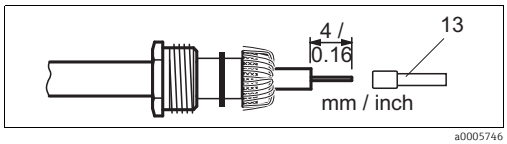


Fig. 18: Terminating the pH connecting cable for mounting the BNC elbow plug

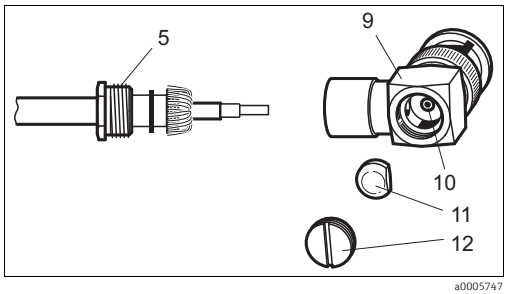


Fig. 19: Mounting the pH connecting cable in the BNC elbow plug

Cable extension

Maximum cable lengths	
Sensors CCS140/141/240/241	max. 30 m (98.4 ft) with cable CMK
Chlorine sensor 963	max. 30 m (98.4 ft) with cable MK
Total chlorine sensor CCS120	max. 15 m (49.2 ft) with cable CYK71
pH or ORP measurement	max. 50 m (164 ft) with cable CYK71

To extend the measuring cable use the junction box VBC and the corresponding extension cable.

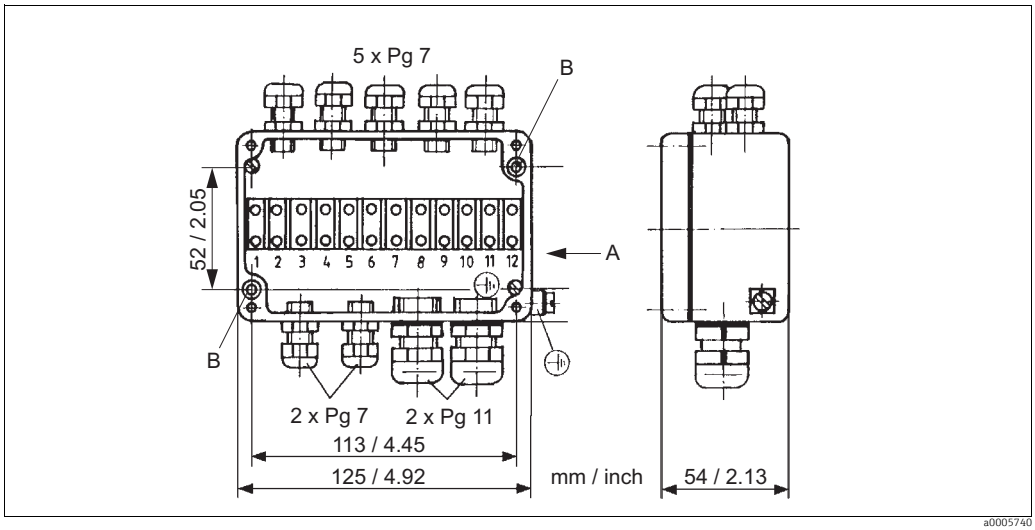


Fig. 20: VBC junction box with grounding point

A View in arrow direction
B 2 fixing holes Ø 4.5 mm / 0.18"

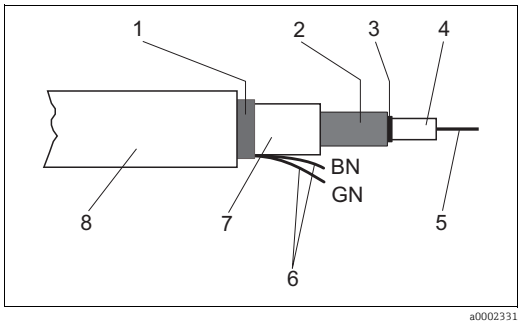


Fig. 21: CMK cable

1 Outer screen
2 Inner screen, anode
3 Semiconductor layer
4 Inner insulation
5 Inner conductor, measuring signal
6 Temperature sensor connection
7 2nd insulation
8 Outer insulation

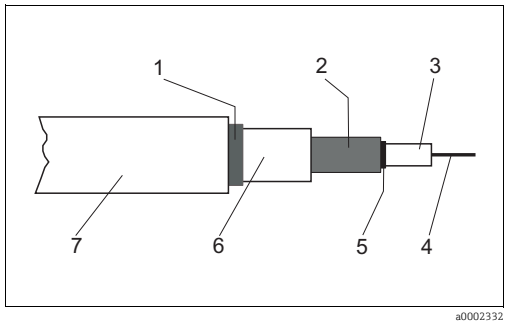


Fig. 22: CYK71 cable

1 Outer screen
2 Inner screen, reference signal
3 Inner insulation
4 Inner conductor, measuring signal
5 Semiconductor layer
6 2nd insulation
7 Outer insulation

NOTICE

Incorrect measurement due to short-circuit

▶ Make sure to remove the black semiconductor layer up to the inner screen when performing termination work!

4.1.6 Three-point step controller for Cl_2 / ClO_2 / total chlorine

Connect the continuously variable motor valves as follows:

- Connect the "closing" contact of the motor valve to relay 3.
- Connect the "opening" contact of the motor valve to relay 4.

4.1.7 Alarm contact

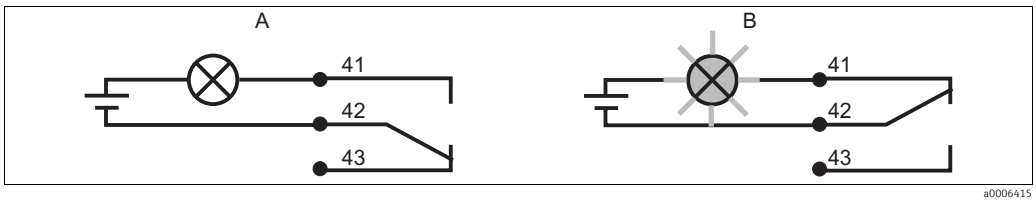


Fig. 23: Recommended fail-safe switching for the alarm contact
A Normal operating status *B Alarm condition*

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

- Relay energized
- Contact 42/43 closed

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

- Relay de-energized
- Contact 41/42 closed

4.2 Post-connection check

After the electrical connection, carry out the following checks:

Device condition and specifications	Notes
Are the transmitter and cables damaged on the outside?	Visual inspection

Electrical connection	Notes
Are the mounted cables strain relieved?	
Cable run without loops and cross-overs?	
Are the signal lines correctly connected in accordance with the wiring diagram?	
Are all screw terminals tightened?	
Are all cable entries installed, tightened and sealed?	

5 Operability

5.1 Quick operation guide

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

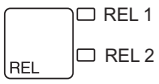
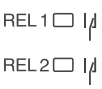
For operation via HART or PROFIBUS PA/DP, please read the relevant sections in the additional Operating Instructions:
- PROFIBUS PA/DP, field communication for Liquisys M CXM223/253, BA00209C/07/EN
- HART, field communication for Liquisys M CXM223/253, BA00208C/07/EN

The following section only explains operation via the keys.

5.2 Display and operating elements

5.2.1 Display

LED display

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

LC display

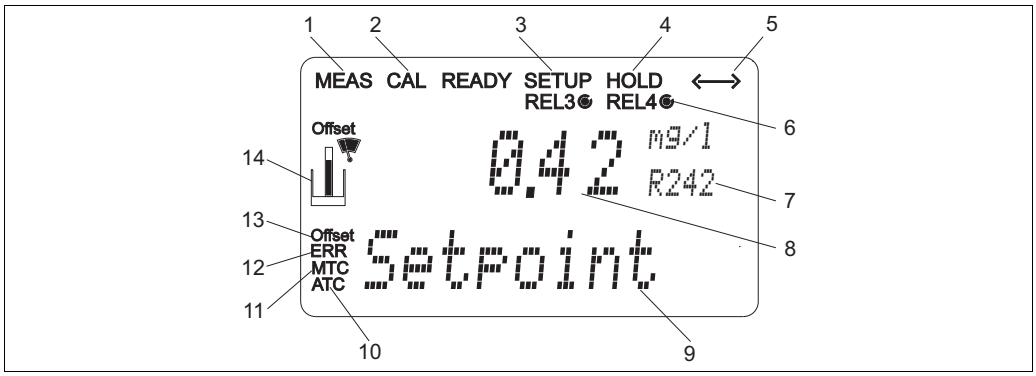


Fig. 24: Liquid crystal display

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

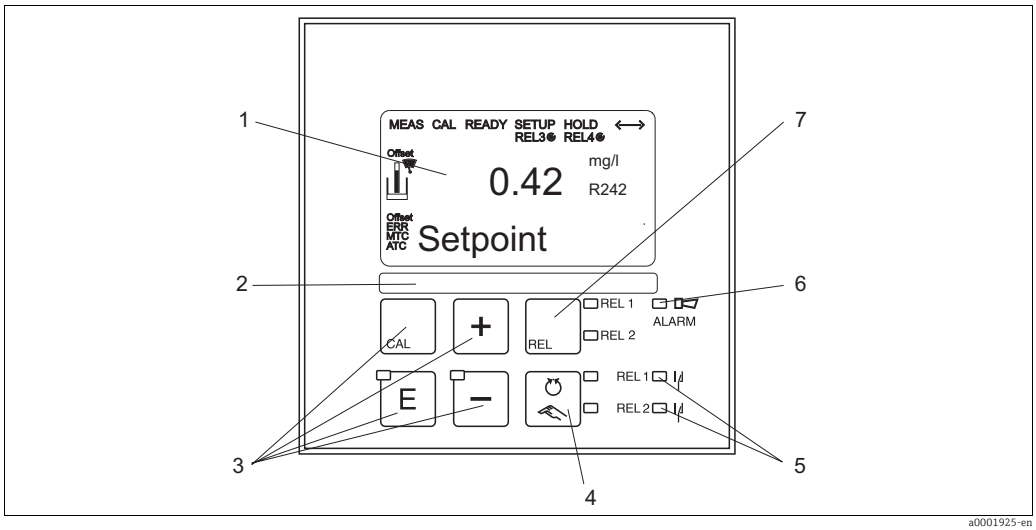
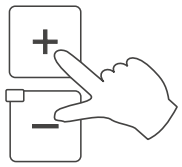
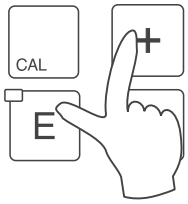
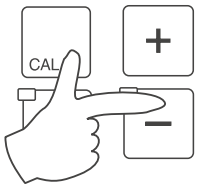


Fig. 25: Operating elements

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

5.2.3 Key assignment

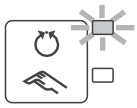
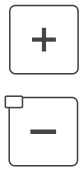
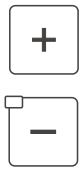
	**CAL key** When you press the CAL key, the device first prompts you for the calibration access code: ▪ Code 22 for calibration ▪ Code 0 or any other code for reading the last calibration data Use the CAL key to accept the calibration data or to switch from field to field within the calibration menu.
	**ENTER key** When you press the ENTER key, the device first prompts you for the setup access code: ▪ Code 22 for setup and configuration ▪ Code 0 or any other code for reading all configuration data. The ENTER key has several functions: ▪ Calls up the Setup menu from the measuring mode. ▪ Saves (confirms) data entered in the setup mode. ▪ Moves on within function groups.
 	**PLUS key and MINUS key** In setup mode, the PLUS and MINUS keys have the following functions: ▪ Selection of function groups. Press the MINUS key to select the function groups in the order given in the "System configuration" section. ▪ Configuration of parameters and numerical values ▪ Operation of the relay in manual mode In 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. pH measuring value or ORP potential (only on EP version) 4. pH sensor signal in mV (only on EP version) 5. Measured value display of Cl_2 / ClO_2 in nA 6. Zero current of the sensor CCS120 7. Measured value display of current input in % 8. Measured value display of current input in mA 9. Return to basic settings In 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 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 manual mode, you can use the REL key to switch between the relay and the manual start of cleaning. In 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 unauthorized data entry. All the settings can continue to be read. The code prompt displays the code 9999.
	**Unlocking the keyboard** Press the CAL and MINUS key for at least 3 s to unlock the keyboard. The code prompt displays the code 0.

5.3 Local Operation

5.3.1 Automatic/manual mode

The transmitter normally operates in automatic mode. Here, the relays are triggered by the transmitter. In the manual mode, you can trigger the relays using the REL key. You can also start the cleaning function with the REL key.
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) are displayed on the second line of the display. In 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. **Three-point step controller** Closing the motor valve is assigned to relay 3, opening the motor valve is assigned to relay 4. The PLUS button activates the selected relay. The MINUS button deactivates the selected relay. The transmitter controls that not both relays are activated at the same time. Example: If relay 3 is activated and you try to activate relay 4, then relay 3 will automatically be deactivated first.
	6. Press the AUTO key to return to the measuring mode, i.e. to the automatic mode. All the relays are triggered again by the transmitter.

Pay attention to the following:
- The 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 manual mode.

5.3.2 Operating concept

Operating modes

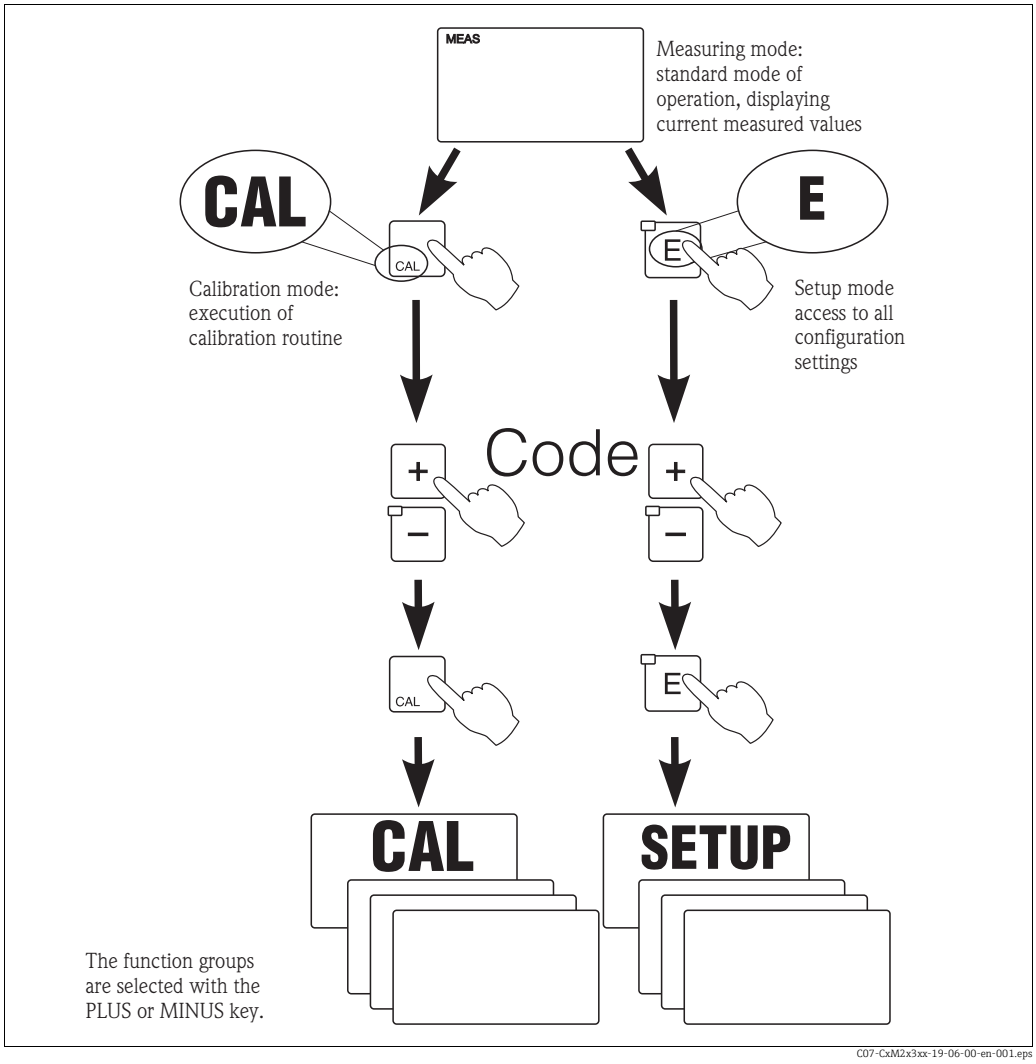


Fig. 26: Description of the possible operating modes

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

Access codes

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

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

Menu structure

The configuration and calibration functions are arranged in function groups.

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

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

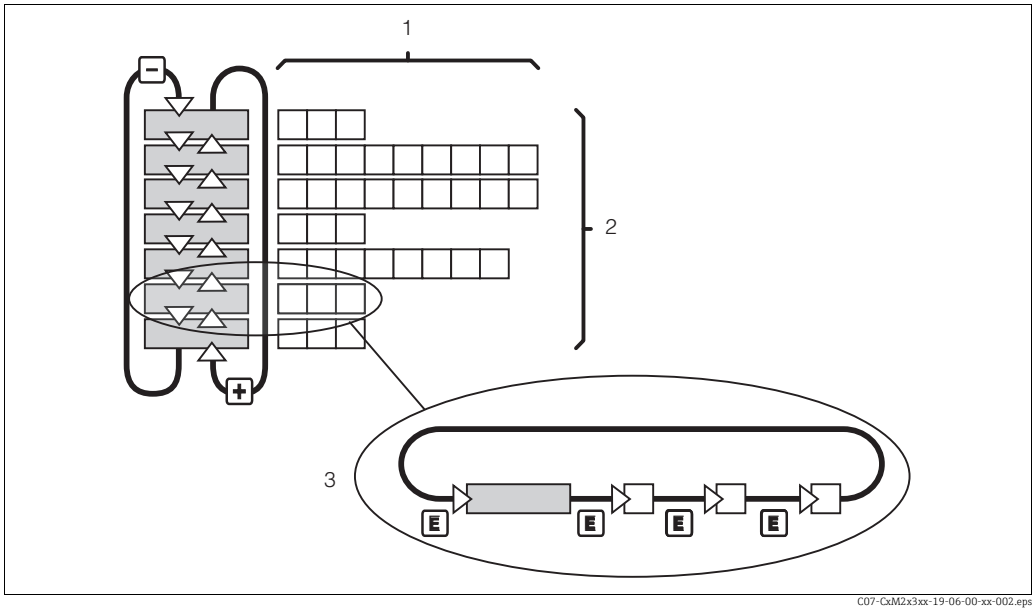


Fig. 27: Diagram of the menu structure

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

Hold function: "freezing" of the outputs

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

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

6 Commissioning

6.1 Function check

⚠ WARNING

Incorrect connection, incorrect supply voltage

Safety risks for staff and incorrect operation of the device

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

6.2 Switching on

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

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

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

Setup mode

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

Calibration mode

- CALIBRATION (C)

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

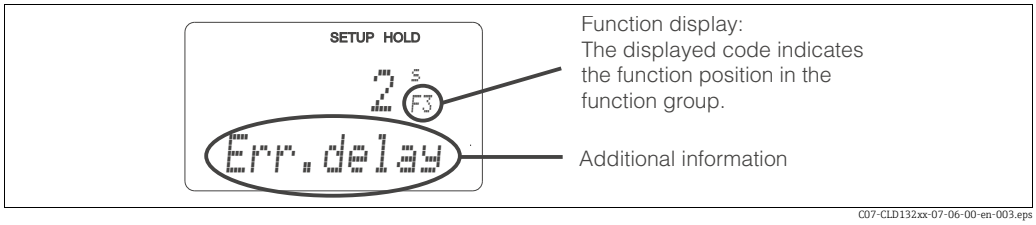


Fig. 28: Example for display in setup mode

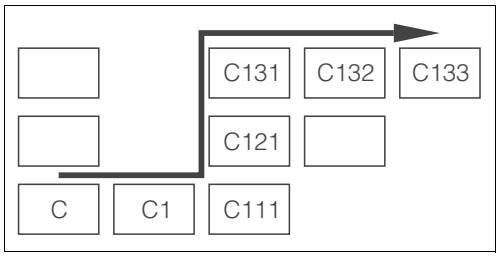


Fig. 29: Function coding

Selecting and locating functions is facilitated by a code displayed for each function in a special display field → 28.
The structure of this coding is given in → 29.
The first column indicates the function group as a letter (see group designations).
The functions in the individual groups are counted from the top to the bottom and from the left to the right.

Factory settings

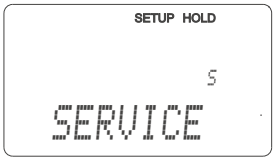
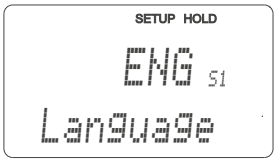
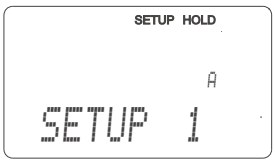
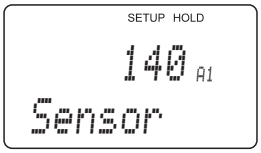
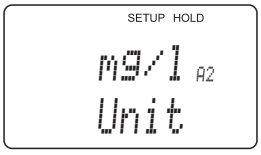
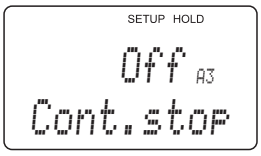
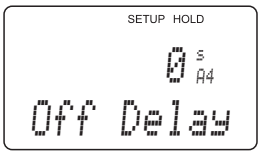
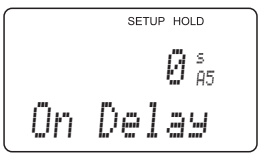
The first time it is switched on, the device has the factory setting for all functions. The table below provides an overview of the most important settings.
All other factory settings can be found in the description of the individual function groups in the "System configuration" section (the factory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

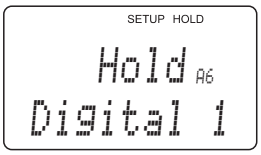
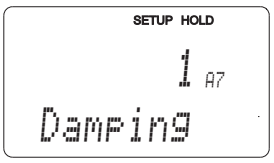
Function	Factory setting
Type of measurement	Content of free chlorine or total chlorine in mg/l Temperature measurement in °C pH value (EP version)
Sensor setting	CCS140 for free chlorine
Alarm contact	Steady contact
Alarm delay	Setting in minutes
Error current for alarm	22 mA
Check functions*	Off; can be switched on one by one as required
Limits 1 and 2 for chlorine / chlorine dioxide	0.5 mg/l
Limits 1 and 2 for pH*	pH 7.2
Limits 1 and 2 for redox*	750 mV
Limits 1 and 2 for temperature	50 °C
Current outputs 1 and 2	4 to 20 mA
Current output 1: measured value for 4 mA signal current	0.00 mg/l
Current output 1: measured value for 20 mA signal current	2.0 mg/l
Current output 2: temperature value for 4 mA signal current	0 °C
Current output 2: temperature value for 20 mA signal current	50 °C

* For corresponding version

6.3 Quick start-up

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

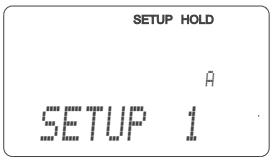
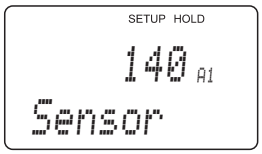
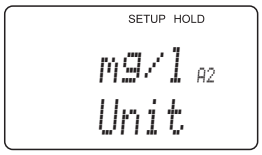
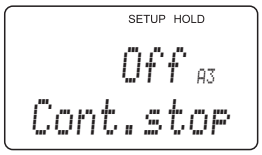
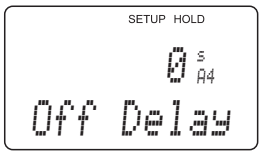
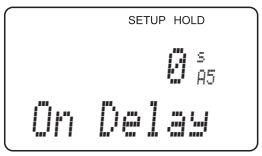
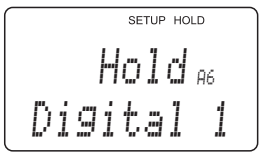
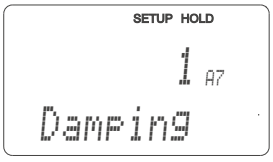
User input	Setting range (Factory settings, bold)	Display
1. Press the E key. 2. Enter the code 22 to edit the setup. Press E.		
3. Press − until you get to the "Service" function group. 4. Press E to be able to make your settings.		
5. In S1, select your language, e.g. "ENG" for English. Press E to confirm.	**ENG = English** GER = German FRA = French ITA = Italian NEL = Dutch ESP = Spanish	
6. Press PLUS and MINUS 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 type of sensor. Press E to confirm.	120 = CCS120 **140 = CCS140** 141 = CCS141 240 = CCS240 241 = CCS241 963	
10. Select the desired display unit in A2, press E to confirm.	**mg/l** ppm ppb	
11. If the proximity switch INS is connected, you can switch on flow monitoring of the sample stream assembly CCA250 in A3. Press E to confirm.	**Off** INS	
12. In A4, enter a delay time to suppress controller switch-off in case of short-term flow-rate undershoots. Press E to confirm your input.	**0 s** 0 to 2000 s	
13. In A5, enter the delay for controller switch-on. With chlorine / chlorine dioxide control, a delay until the reception of a representative measured value is recommended after a long flow rate failure.	**0 s** 0 to 2000 s	

User input	Setting range (Factory settings, bold)	Display
14. In A6, select digital input 1. Press [E] to confirm.	**Hold = external hold** Clean = Cleaning trigger	
15. If you need to stabilise the display, enter the required damping factor in A7. Press [E] to confirm. The display returns to the initial display of "Setup 1"	**1** 1 to 60	
16. Press PLUS and MINUS simultaneously to switch to the measurement mode.		

6.4 System configuration

6.4.1 Setup 1 (chlorine/chlorine dioxide)

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

Coding		Field	Selection or range (factory settings bold)	Display	Info
A		**Function group SETUP 1**			Basic settings.
	A1	Select connected sensor type	120 = CCS120 **140 = CCS140** 141 = CCS141 240 = CCS240 241 = CCS241 963		**Sensor type setting is not changed in field S9 when the instrument is reset.**
	A2	Select display unit	**mg/l** ppm ppb		
	A3	Select flow monitoring of sample stream assembly CCA250 (with controller switch-off)	**Off** INS		Only switch on when proximity switch INS is connected.
	A4	Enter delay for controller switch-off by sample stream	**0 s** 0 to 2000 s		Enter a delay time to suppress controller switch-off in case of short-term flow-rate undershoots.
	A5	Enter delay for controller switch-on by sample stream	**0 s** 0 to 2000 s		With chlorine / chlorine dioxide control, a delay until the reception of a representative measured value is recommended after a long flow rate failure.
	A6	Select digital input 1	**Hold = external hold** Clean = cleaning trigger		
	A7	Enter measured value damping	**1** 1 to 60		Measured value damping causes averaging over the specified number of individual measured values. It is used, for example, to stabilize the display with applications that fluctuate a great deal. There is no damping if “1” is entered.

Flow monitoring in sample stream

If a flow rate drops below 30 l/h or there is a total flow failure in the sample stream through the CCA250 assembly, an alarm is triggered if the INS proximity switch is installed. The alarm becomes active on expiry of the switch-off delay time (field A4).
The alarm signal stops as soon as the required flow rate is restored.While the alarm period lasts, the instrument automatically stops chemical dosing and the Chemoclean cleaning function. All relays assigned to PID controllers or cleaning functions revert to normal position; for the three-point step controller the "closing" contact closes. Dosing and cleaning resume once the switch-on delay time expires (field A5).The LCD reading flashes for the period of controller switch-off so that you can immediately recognize the situation.

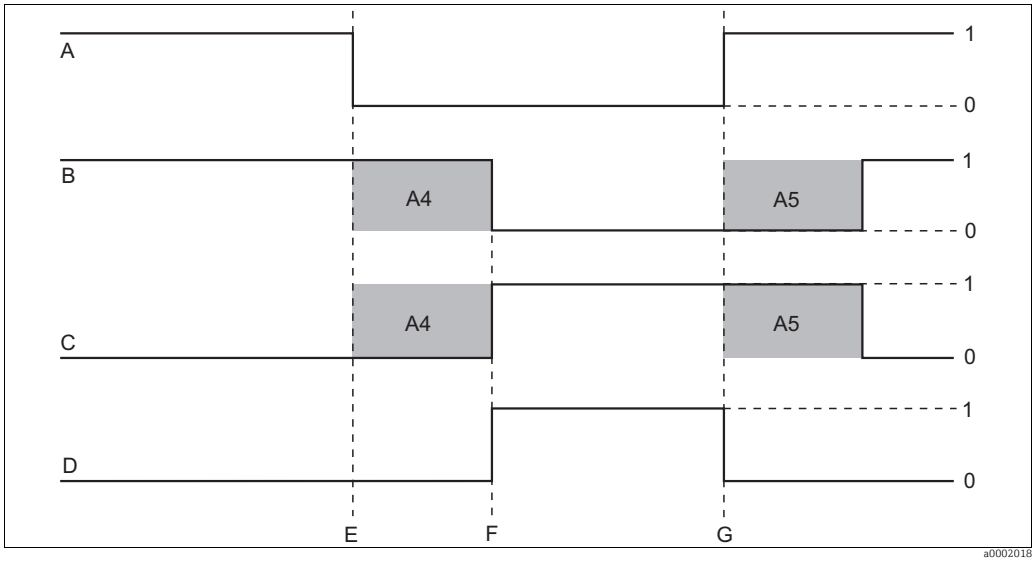
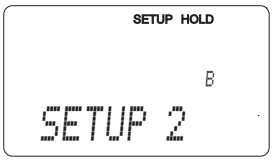
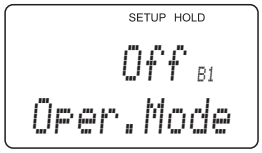
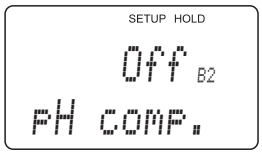
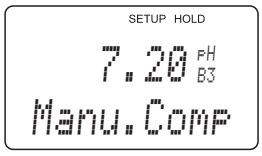
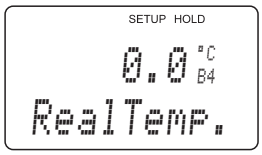
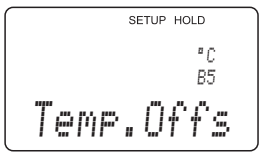


Fig. 30: Alarm signalling and dosing switch-off by the sample stream

A	*Flow in sample stream*	*G*	*Flow restored*
B	*Relay contacts of PID controller*	*0*	*off*
C	*"Closing" contact on three-point step controller*	*1*	*on*
D	*Alarm relay*	*A4*	*Field A4 (delay for controller switch-off)*
E	*Flow < 30 l/h or flow failure*	*A5*	*Field A5 (delay for controller switch-on)*
F	*Flow alarm*		

6.4.2 Setup 2 (pH/ORP and temperature)

In the SETUP 2 function group, you can change the settings for temperature and pH / ORP measurement.
Basic version does not include functions in *italic*.

Coding		Field	Selection or range (factory settings bold)	Display	Info
B		**Function group SETUP 2**			Initial display in function group SETUP 2.
	B1	*Select operating mode*	***Off*** *pH* *ORPmV*		*Field only exists in EP version.ORPmV = redox potential in mV (**O**xidation-**R**eduction **P**otential).* *If the operation mode changes, all user settings are automatically reset to the basic settings.* ***The operating mode setting is not changed in field S9 when the instrument is reset.***
	B2	*Select pH compensation*	***Off*** *Manu* *Auto*		*Field only exists in ES and EP versions (operation with CCS141/142).*
	B3	*Enter value for manual pH compensation*	***last compensation value*** *pH 4.00 to 9.00*		*Field only exists if you selected "manual" (Manu) in field B2.* *The secondary value shows the **measured** pH value.*
	B4	Enter correct process temperature	**current measured value** 0 to 50 °C		You can edit the displayed value. An adjustment of maximum ±5 °C is possible. Due to high accuracy, an adjustment is usually not required.
	B5	Enter temperature difference (offset)	**Curent offset** -5.0 to 5.0 °C		The offset is the difference between the entered actual value and the measured temperature.

Forms of chlorine

A distinction is made between free chlorine and combined chlorine.

Free chlorine

Free chlorine refers to the sum of elementary chlorine (Cl_2), hypochlorous acid (HOCl) and hypochlorite ions (OCl^-).These forms of chlorine are capable of killing bacteria, deactivating viruses and oxidizing organic substances within a short period of time.

Combined chlorine

Combined chlorine refers to the forms of chlorine in water and consists of chemical compounds made up of chlorine and ammonia (NH_3) or ammonium (NH_4^+).

Total chlorine
The sum of free and combined chlorine is referred to as total chlorine.

Measurement of free chlorine with the sensors CCS140 and CCS141
Molecular chlorine (Cl_2) has pH values of < 4. Hypochlorous acid (HOCl) and hypochlorite (OCl^-) remain within the range of pH 4 to 11 as components of free chlorine. As hypochlorous acid dissociates with an increasing pH value to form hypochlorite ions (OCl^-) and hydrogen ions (H^+), the amounts of the individual components in free chlorine change with the pH value (→ 31). For example, if the amount of hypochlorous acid is 97 % at pH 6, it drops to about 3 % at pH 9.
Hypochlorous acid has a highly disinfecting effect in an aqueous solution but the disinfecting effect of hypochlorite is extremely low. Therefore, chlorine is not suitable as a disinfecting agent at high pH values.

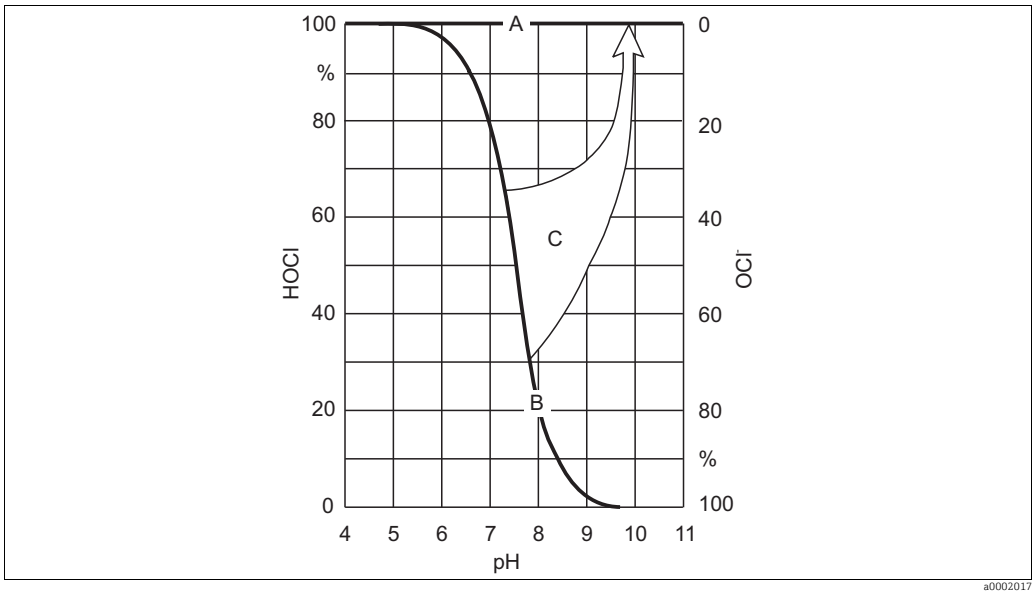


Fig. 31: Schematic diagram of pH compensation

*A Measured value **with** pH compensation*
*B Measured value **without** pH compensation*
C pH compensation

The CCS140 or CCS141 chlorine sensors selectively measure the amount of hypochlorous acid in amperometric measurement. They do not measure the amount of hypochlorite ions because these ions do not permeate through the sensor membrane.

Measurement of total chlorine with the sensor CCS120
If ammonium is present in the medium - preferably water - in addition to free chlorine, chloramines are formed (Cl_nNH_m). The chloramine compounds form in various dimerization degrees. They are called "combined chlorine". Combined chlorine has a lower disinfecting effect but it forms larger depots compared to free chlorine. This means:

- Slower elimination of existing germs
- Disinfecting effect over considerably longer periods
- Disinfecting effect over considerably longer transport distances

The amperometric sensor CCS120 measures the total chlorine content, i.e. free chlorine as well as chloramine components.
This type of measurement is only slightly pH dependent.

pH compensation of chlorine sensor signal for free chlorine
(only on ES and EP versions, for CCS140/141 sensors)
To calibrate and inspect the chlorine measuring system, a colorimetric reference measurement must be carried out using the DPD method. Free chlorine reacts with diethyl-p-phenylenediamine and forms a red dye. The intensity of the red pigmentation increases

proportionally to the chlorine content. In the DPD method the measuring water is constantly buffered to a pH value of about 6.3. Therefore, the pH value of the measuring water is not included in the DPD measurement. Due to the buffer function in the DPD method, all components of free chlorine are detected and thus the total free chlorine is measured.
If you select pH compensation in fields B2 or B3, the sum of hypochlorous acid and hypochlorite corresponding to the DPD measurement is calculated from the hypochlorous acid measured by the sensor and the pH value in the region of pH 4 to 9. For this calculation, the curve shown in → 31 is stored in the transmitter.

When free chlorine is measured with the pH compensation function on, always perform calibration in the pH-compensated operating mode.

When you use pH compensation, the measured chlorine value displayed and applied to the instrument output corresponds to the DPD measured value even if the pH values fluctuate. If you do not use pH compensation, the measured chlorine value only corresponds to the DPD measurement if the pH value remains unchanged compared with the calibration. Without pH compensation the chlorine measuring system must be recalibrated when the pH value changes.
pH compensation can take place both automatically using the connected pH electrode (EP version) or manually (ES version) by entering the current pH value in field B3.
Measuring chlorine dioxide is not pH-dependent, therefore, it requires no pH compensation.

Accuracy of pH compensation
The accuracy of the pH compensated measured chlorine value depends on the sum of several single measured deviations (chlorine, pH, Temperature, DPD measurement etc.).
High amounts of hypochlorous acid (HOCl) during chlorine calibration have positive effects on the accuracy whereas low amounts of hypochlorous acid have negative effects.
Inaccuracy of the pH compensated chlorine value increases the bigger the pH difference between operation and calibration gets or the more inaccurate the single measured values are.

Calibration of free chlorine measurement taking into account the pH value
The reference measurement (DPD method, photometer) determines the complete free chlorine by buffering to pH 6.2. In contrast to this, amperometric measurement only determines the HOCl components.
The pH compensation causes the HOCl value to be increased to the actual value of free chlorine. During operation, pH compensation is active up to a pH value of 9. Since there is hardly any HOCl left at this pH value and the measured current is very low. Calibration of the complete measuring system makes sense only up to a pH value of the medium of 8 or 8.2.

Sensor	pH value	HOCl content	uncompensated value	compensated value
CCS141	8.2	15 %	12 nA	80 nA
CCS140	8	20 %	4 nA	20 nA

Above these pH values the total measured error of the measuring system is inacceptable.

6.4.3 Current input

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

	Flow in main stream	**Current signal in mA**	**Current input signal in %**
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
Flow monitoring in the main stream is particularly practical if the sample flow through the flow assembly CCA250 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 sample flow is retained due to the method of installation.
This monitoring method corresponds to monitoring the flow rate in the sample stream (see SETUP 1).

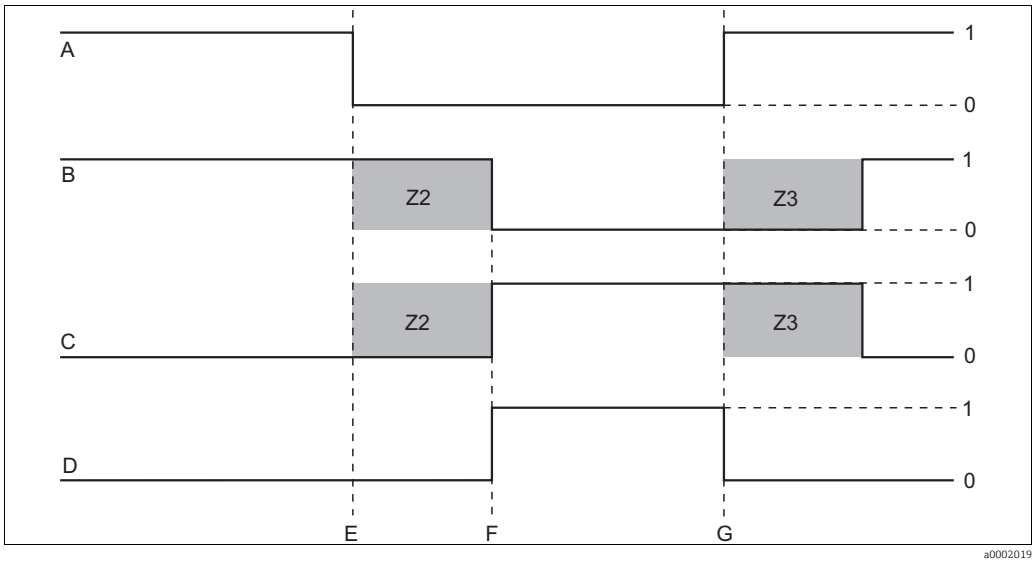


Fig. 32: Alarm signalling and dosing switch-off by the main stream

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

Feedforward control to PID controller

To optimize control systems with very short reaction times, measure the medium flow rate in addition to the chlorine content. Then apply this flow rate value (0/4 to 20 mA) as feedforward control to the PID controller.

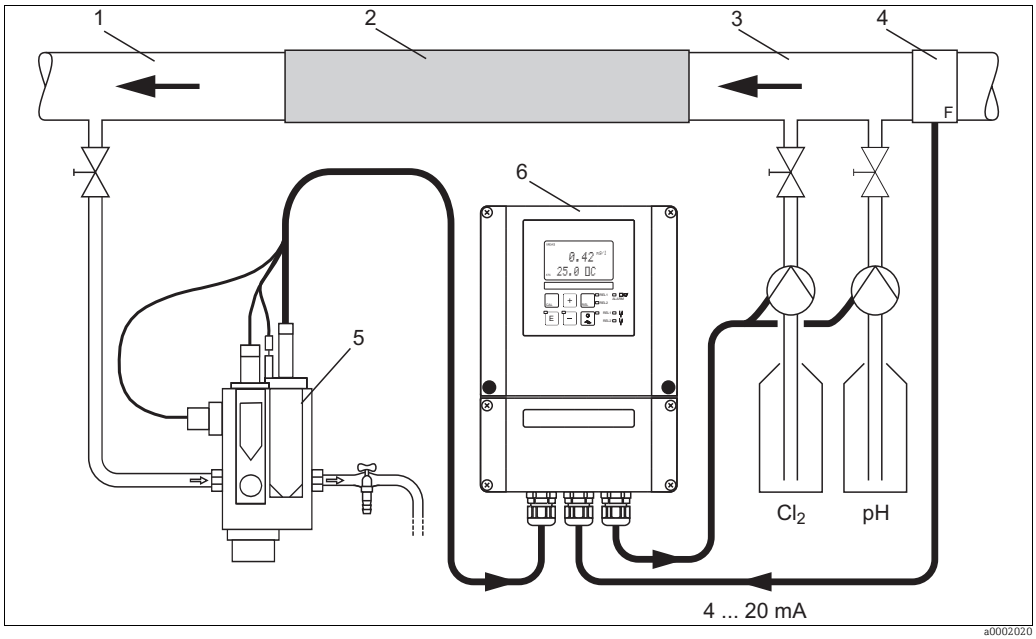


Fig. 33: Arrangement example for feedforward control oft the flow rate in the main stream to the PID controller(s)

1 Measuring water extraction point
2 Static mixer
3 Injection points
4 Flow meter
5 Flow assembly CCA250
6 Liquisys M CCM253

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

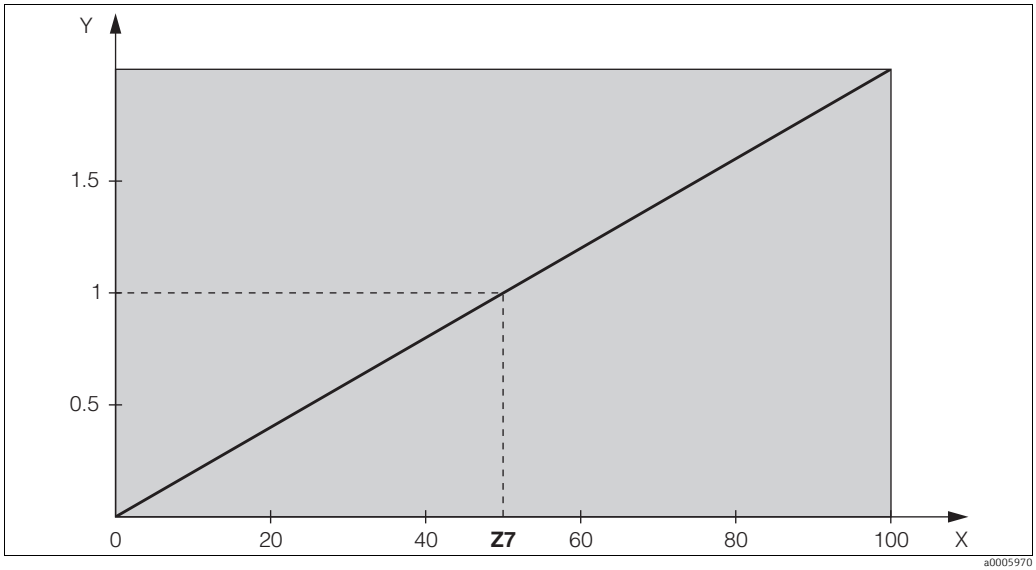
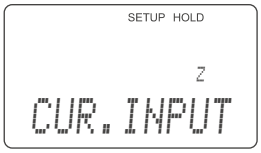
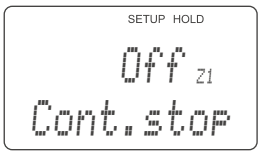
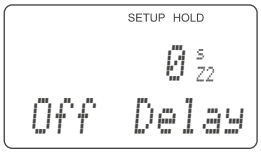
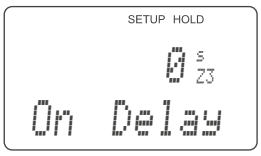
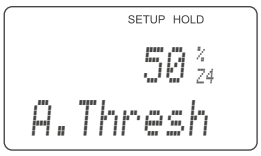
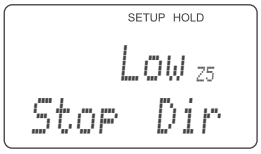
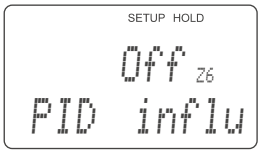
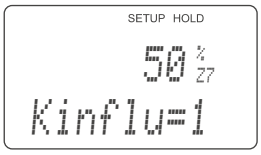


Fig. 34: Multiplying feedforward control

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

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

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

6.4.4 Current outputs

Use the "Current output" function group to configure the individual outputs. You can enter either a linear characteristic (O3 (1)) or, on the ES and EP versions, a user-defined current output characteristic (O3 (3)). Exception: if you have chosen a "continuous controller" for current output 2, you cannot enter a user-defined current output characteristic for this current output.
In addition, you can simulate a current output value (O3 (2)) to check the current outputs.

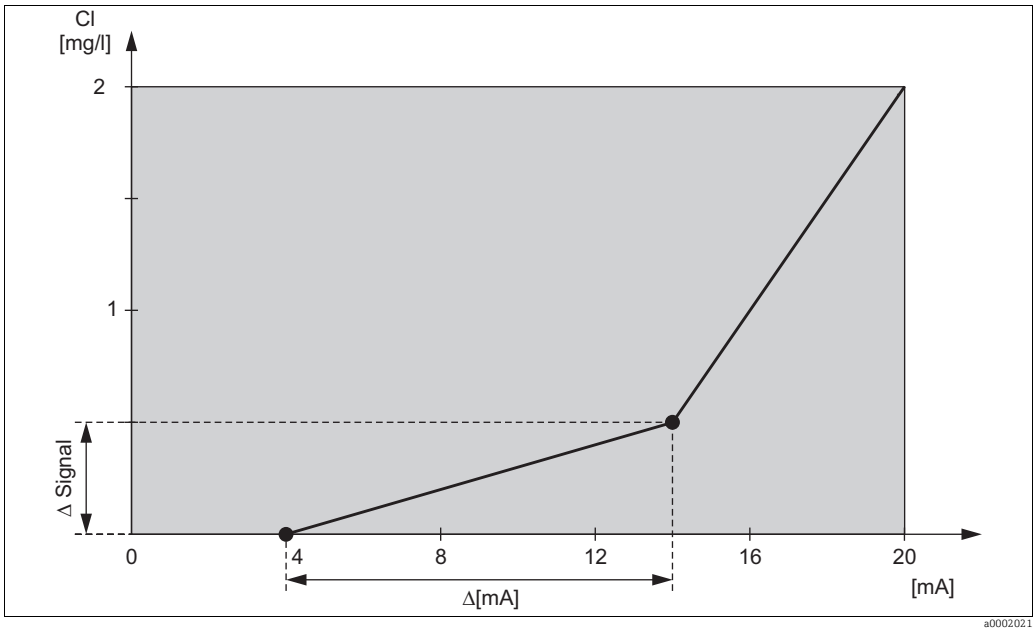


Fig. 35: User-defined current output characteristic (example)

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

Sensor / measuring parameter	Minimum distance per mA
CCS120	0.005 mg/l
CCS140/141	0.01 mg/l
CCS240/241	0.003 mg/l
pH	pH 0.03
ORP	5 mV
Temperature	0.25 °C

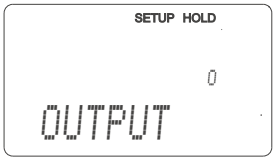
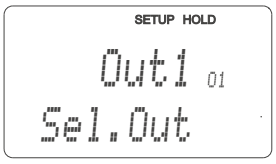
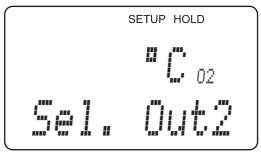
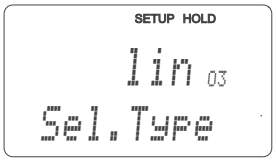
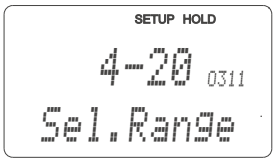
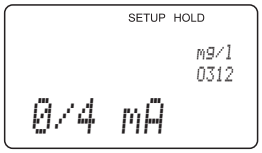
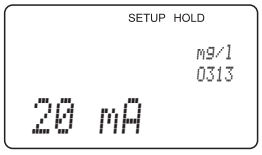
The values for the sample characteristic (→ 35) are entered in the following table. The distance per mA can be calculated from Δ signal / Δ mA.

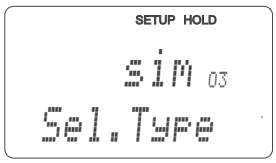
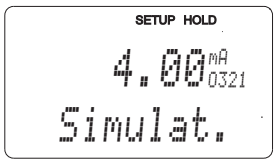
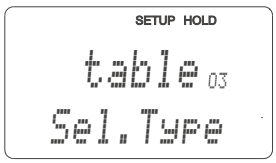
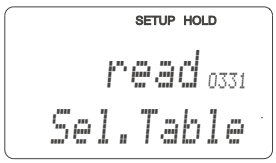
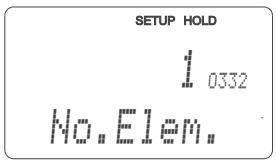
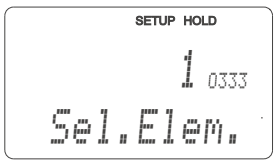
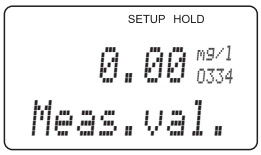
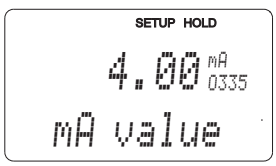
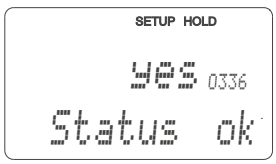
Current output 1				Current output 2		
Value pair	**Cl [mg/l]**	**Current [mA]**	**Distance per mA**	**..... [ ]**	**Current [mA]**	**Distance per mA**
1	0	4				
2	0.5	14	0.05			
3	2	20	0.25			

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

Current output 1				Current output 2		
Value pair	**..... [ ]**	**Current [mA]**	**Distance per mA**	**..... [ ]**	**Current [mA]**	**Distance per mA**
1						
2						
3						
4						
5						
6						
7						
8						
9						

Basic version does not include functions in *italic*.

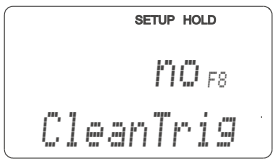
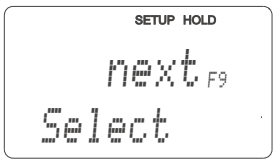
Coding	Field	Setting range (Factory settings, bold)	Display	Info
O	**CURRENT OUTPUT function group**			Configuration of the current output (does not apply for PROFIBUS).
O1	Select current output	**Out1** *Out 2*		A characteristic can be selected for every output. You can select a separate characteristic for each output.
O2	Select measured variable for 2nd current output	**°C** mg/l ppm ppb pH ORPmV Contr		pH or ORPmV only on EP version and depending on selection in B1. Selection of Curr (=current output 2) in R247 or R 257 is only possible, if O2 = Contr is selected.
O3 (1)	Enter or output linear characteristic	**Lin = linear** (1) Sim = simulation (2) *Tab = table (3)*		The characteristic can have a positive or negative slope for the measured value output. In case of actuating variable output (O2 = Contr), an increasing current corresponds to an increasing actuating variable.
O311	Select current range	**4 to 20 mA** 0 to 20 mA		
O312	0/4 mA value: Enter corresponding measured value	**0 ppb** 0 to 20000 ppb **0.00 ppm** 0 to 20 ppm **0.00 mg/l** 0 to 20 (5) mg/l **pH 4.00** pH 4 to 9 **0 mV** 0 to 1500 mV **0 °C** 0 to 50 °C		Here enter the measured value at which the minimum current value (0/4 mA) is applied to the transmitter output. Minimum distance between 0/4 mA and 20 mA value: see field O313. This field is not available if O2= Contr is selected.
O313	20 mA value: Enter corresponding measured value	**2000 ppb** 0 to 20000 ppb **2.00 ppm** 0 to 20 ppm **2.00 (0.50) mg/l** 0 to 20 (5) mg/l **pH 9.00** pH 4 to 9 **1000 mV** 0 to 1500 mV **50 °C** 0 to 50 °C		Here enter the measured value at which the maximum current value (20 mA) is applied to the transmitter output. Minimum distance between 0/4 mA and 20 mA value must be: ▪ 140/240: 0.2 mg/l ▪ 141/241/963: 0.05 mg/l ▪ 120: 0.1 mg/l ▪ pH: pH 0.5 ▪ Redox: 100 mV ▪ Temperature: 5 °C This field is not available if O2= Contr is selected.

Coding		Field	Setting range (Factory settings, bold)	Display	Info
O3 (2)		Simulate current output	Lin = linear (1) **Sim = simulation** (2) Tab = table (3)		Simulation is not ended until (1) or (3) is selected.
	O321	Enter simulation value	**Current value** 0.00 to 22.00 mA		Entering a current value results in this value being directly output at the current output.
O3 (3)		*Enter current output table (only for ES and EP versions*)	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.
	O331	*Select table options*	**read** *Edit*		
	O332	*Enter number of table value pairs*	**1** *1 to 10*		Enter the number of pairs from the x and y value (measured value and current value) here.
	O333	*Select table value pair*	**1** *1 to No. elem.* *assign*		The function chain O333 to O335 will run through as many times as correspond to the value in O332. "Assign" appears as the last step. After confirmation the system jumps to O336.
	O334	*Enter x value*	**0 ppb** 0 to 20000 ppb **0.00 ppm** 0 to 20 ppm **0.00 mg/l** 0 to 20 (5) mg/l **pH 4.00** pH 4 to 9 **0 mV** 0 to 1500 mV **0 °C** 0 to 50 °C		x value = measured value specified by user.
	O335	*Enter y value*	**4.00 mA** *0.00 to 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 until now are retained) or back to measuring mode (table is deleted).

6.4.5 Monitoring functions

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

Coding		Field	Setting range (Factory settings, bold)	Display	Info
F		**ALARM function group**		SETUP HOLD F ALARM	Alarm function settings.
	F1	Select contact type	**Latch = latching contact** Momen = momentary contact	SETUP HOLD Latch F1 Cont.Type	The contact type selected only applies to the alarm contact.
	F2	Select time unit	**min** s	SETUP HOLD min F2 Time Unit	
	F3	Enter alarm delay	**0 min (s)** 0 to 2000 min (s)	SETUP HOLD 0 min F3 Err.Delay	Depending on the option selected in F2, the alarm delay is entered in s or min.
	F4	Select error current	**22 mA** 2.4 mA	SETUP HOLD 22mA F4 Err.Curr	This selection must be made even if all error reporting is switched off in F5. If "0-20 mA" was selected in O311, "2.4 mA" may not be used.
	F5	Select error	**1** 1 ... 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 other alarm settings are deactivated (e.g. alarm delay). The settings themselves are retained. This setting **only** applies to the error selected in F5.
	F7	Set error current to be effective for the selected error	**no** yes	SETUP HOLD no F7 Curr.Assg	The option selected in F4 is effective or ineffective in the event of an error. This setting **only** applies to the error selected in F5.

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

6.4.6 Check

Check

The CHECK function group is only available for devices with a Plus Package (versions ES and EP).
In the CHECK function group, you can select different monitoring functions for the measurement.
By default all monitoring functions are off. The Sensor Check System is adapted to the current application conditions by adding and setting suitable functions.

Alarm threshold monitoring

When you perform a chlorine or chlorine dioxide measurement **without** chemical entrainment control, sensor errors lead to a measured value error, but have no impact on the process medium (examples: monitoring measurement in water-works). Sensor errors normally cause high or low readings that are implausible. This is detected and signalled by user-definable alarm thresholds.

Controller monitoring

When you perform chlorine or chlorine dioxide measurements **with** simultaneous chemical entrainment control, sensor errors do not result in incorrect measured values but have direct impact on the state of the process medium.
In particular in case of controlled water disinfection, there is a process-related risk that chemical dosing is not switched on due to a permanently high measured value. This causes considerable danger to process stability, or even a serious health hazard for humans. On the other hand a measured value that is permanently too low leads to uninterrupted chemical dosing and thus to higher operating costs and a risk of corrosion.
These cases are detected and signalled thanks to user-definable monitoring times for maximum permitted controller switch-on and switch-off times.

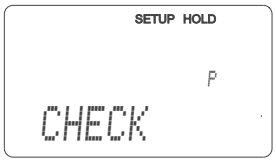
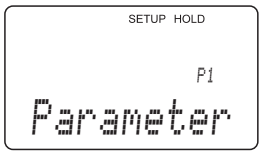
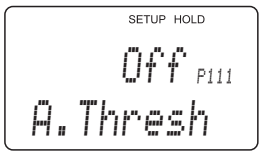
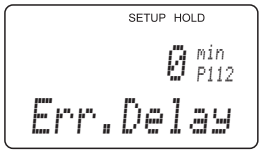
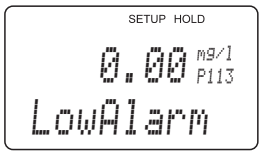
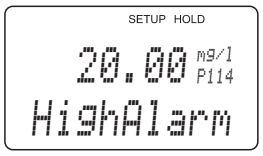
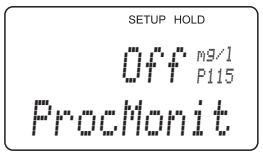
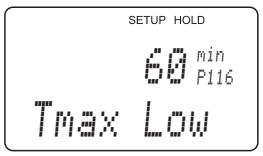
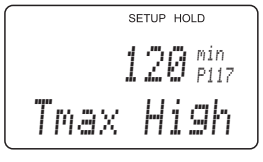
Sensor activity monitoring

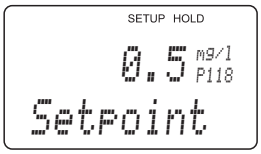
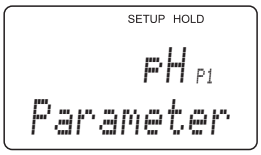
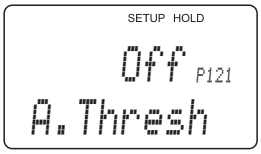
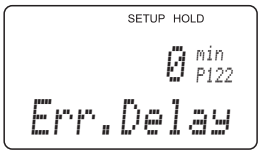
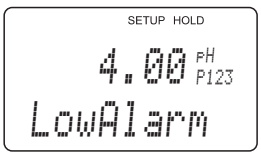
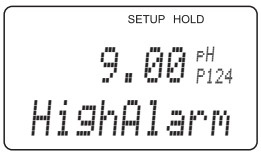
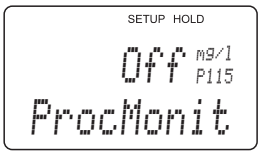
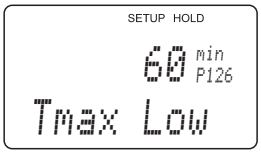
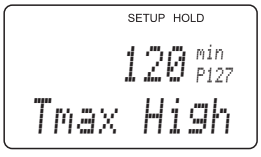
Impacts of the process medium on the sensor can also result in incorrect measured values. For example, a strong deposit on the sensor membrane can lead to a highly sluggish or even a constant measuring signal. This is detected and signalled by continuously monitoring the signal.

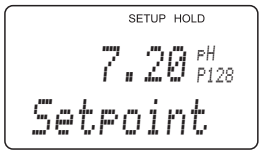
SCS monitoring functions at a glance

	Functional description	Setting possibility	Alarm event	Application
Alarm threshold monitoring (P111 to P114) (P111 to P114)	– freely adjustable lower alarm threshold (AT) – freely adjustable upper alarm threshold (AT)	off	–	Applications **with** or **without** chemical entrainment control
		only lower AT	lower AT reached or dropped below	
		only upper AT	upper AT reached or exceeded	
		lower and upper AT	lower AT reached or dropped below or upper AT reached or exceeded	
Controller monitoring (CC: Controller Check, P115 to P118 P125 to P128)	– Switch-on period monitoring – Switch-off period monitoring	off	–	Applications **with** chemical entrainment control
		on	Set maximum period for permanent switch-on or switch-off exceeded	
Sensor activity monitoring (AC: Alternation Check, P115 to P118 P125 to P128)	Monitoring for signal change	off	–	Applications **with** or **without** chemical entrainment control
		on	Change within 1 hour less than ±0.1 mg/l or ±1 %SAT or ±2 hPa ▪ ±0.01 mg/l (CCS140/240, Sensor 963) ▪ ±0.005 mg/l (CCS141/241) ▪ pH ±0.01 ▪ ±1 mV	

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

Coding	Field	Setting range (Factory settings, bold)	Display	Info
P	**CHECK function group**			Settings for sensor and process monitoring
P1(1)		**Cl2** ClO2		Cl_2 at A1 = "120", "140", "141", "963" ClO_2 at A1 = "240", "241"
P111	*Select alarm threshold monitoring*	**Off** *Low* *High* *Lo+Hi* *Low!* *High!* *Lo+Hi!*		Alarm signalling optionally with or without simultaneous controller switch-off. XXXX = without controller switch-off XXXX! = with controller switch-off
P112	*Enter alarm delay*	**0 min (s)** *0 to 2000 min (s)*		Depending on your selection in F2, you can enter the error delay in min or s. Only after this delay a high or low limit violation causes an alarm as per field P113/P114.
P113	*Enter lower alarm threshold*	**0 ppb** *0 to 20000 ppb* **0.00 ppm** *0 to 20 ppm* **0.00 mg/l** *0 to 20 (5) mg/l*		Omitted when P111 = Off
P114	*Enter upper alarm threshold*	**20000 ppb** *0 to 20000 ppb* **20.00 ppm** *0 to 20 ppm* **20.00 (5.00) mg/l** *0 to 20 (5) mg/l*		Omitted when P111 = Off
P115	*Select process monitoring (PCS alarm)*	**Off** *AC* *CC* *AC+CC* *AC!* *CC!* *AC+CC!*		AC = sensor activity check CC = controller check Alarm signalling optionally with or without simultaneous controller switch-off. XXXX = without controller switch-off XXXX! = with controller switch-off
P116	*Enter maximum permissible duration for lower violation*	**60 min** *0 to 2000 min*		Only when P115 = CC or AC+CC
P117	*Enter maximum permissible duration for upper limit violation*	**120 min** *0 to 2000 min*		Only when P115 = CC or AC+CC

Coding	Field	Setting range (Factory settings, bold)	Display	Info
P118	*Enter limit*	**500 ppb** *0 to 20000 ppb* **0.5 ppm** *0 to 20 ppm* **0.5 (0.1) mg/l** *0 to 20 (5) mg/l*		Limit for monitoring according to fields P116 and P117. When using external control by a process control system, make sure that the value set in field P118 corresponds to the value external set.
P1(2)		**pH** ORPmV		Only on EP version. Depending on the operating mode you selected in field B1, pH or ORPmV appears.
P121	*Select alarm threshold monitoring*	**Off** *Low* *High* *Lo+Hi* *Low!* *High!* *Lo+Hi!*		Alarm signalling optionally with or without simultaneous controller switch-off. XXXX = without controller switch-off XXXX! = with controller switch-off
P122	*Enter alarm delay*	**0 min (s)** *0 to 2000 min (s)*		Depending on your selection in F2, you can enter the error delay in min or s. Only after this delay a high or low limit violation causes an alarm as per field P123/P124.
P123	*Enter lower alarm threshold*	**pH 4.00** *pH 4 to 8.9* **0 mV** *0 to 1490 mV*		Omitted when P121 = Off
P124	*Enter upper alarm threshold*	**pH 9.00** *pH 4 .1 to 9* **1500 mV** *10 to 1500 mV*		Omitted when P121 = Off
P125	*Select process monitoring (PCS alarm)*	**Off** *AC* *CC* *AC+CC* *AC!* *CC!* *AC+CC!*		AC = sensor activity check CC = controller check Alarm signalling optionally with or without simultaneous controller switch-off. XXXX = without controller switch-off XXXX! = with controller switch-off Select CC, AC+CC, CC! and AC+CC! only if you selected pH in field P1(2).
P126	*Enter maximum permissible duration for lower violation*	**60 min** *0 to 2000 min*		Only when P125 = CC or AC+CC
P127	*Enter maximum permissible duration for upper limit violation*	**120 min** *0 to 2000 min*		Only when P125 = CC or AC+CC

Coding			Field	Setting range (Factory settings, bold)	Display	Info
		P128	*Enter limit*	**pH 7.20** *pH 4 to 9*		Limit for monitoring according to fields P126 and P127. When using external control by a process control system, make sure that the value set in field P118 corresponds to the value external set.

6.4.7 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 contact for chlorine / chlorine dioxide measured value: R2 (1)
- Limit contact for pH / ORP measured value: R2 (2)
- Limit contact for temperature: R2 (3)
- PID controller for chlorine / chlorine dioxide: R2 (4)
- PID controller for pH: R2 (5)
- Timer for cleaning function: R2 (6)
- Chemoclean function: R2 (7)
- Three-point step controller for chlorine / chlorine dioxide: R2 (8)

Only one function can be assigned to each relay. If a relay function is already switched on (R211 to R281), it is switched off when you select another function and confirm with ENTER (R2(1) to R2(8)).

Pressing the REL key allows you to display the corresponding setpoint of every relay function.

Limit contactor for measured value

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 for chlorine / chlorine dioxide measurement or for temperature or pH or ORP measurement.

Please refer to Fig. 36 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) (field F3) has also elapsed (error E067 to E070).
- 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.

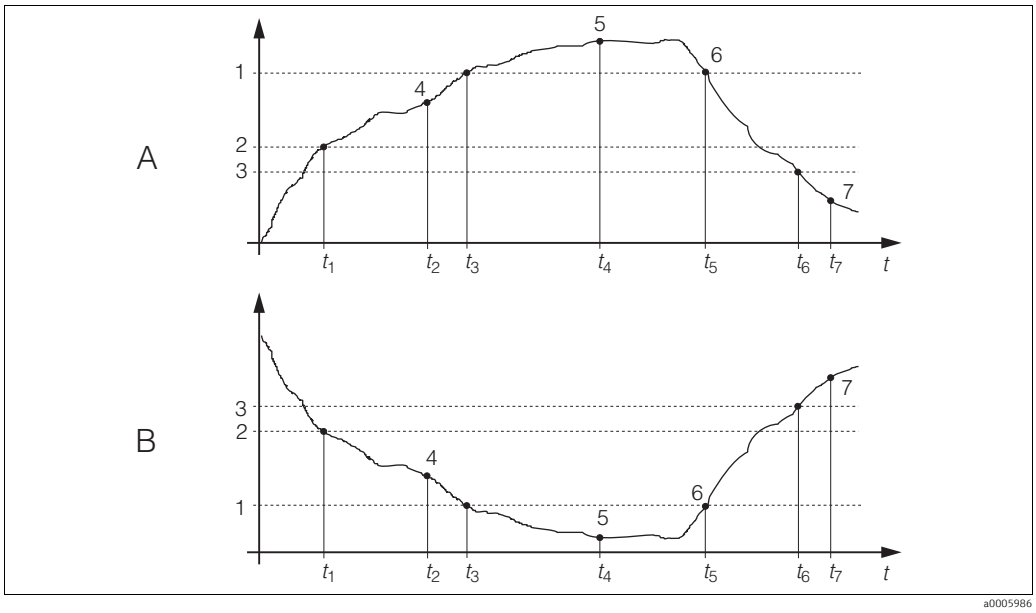


Fig. 36: Illustration of the alarm and limit value functions

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.

- **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 R241 the PID controlled dosage will not be lower than the basic load value entered in field R2411.

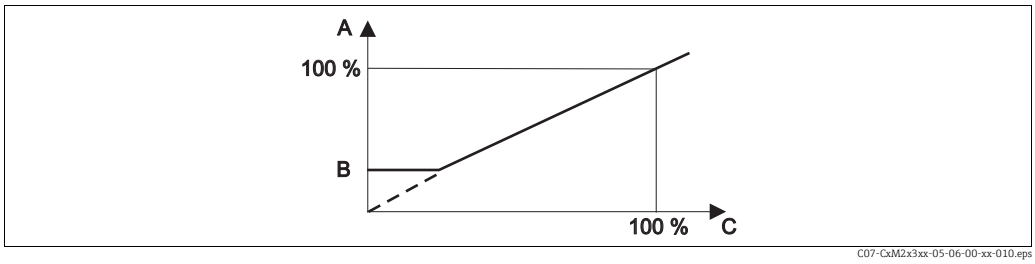


Fig. 37: Control characteristic PID controller with basic load dosing

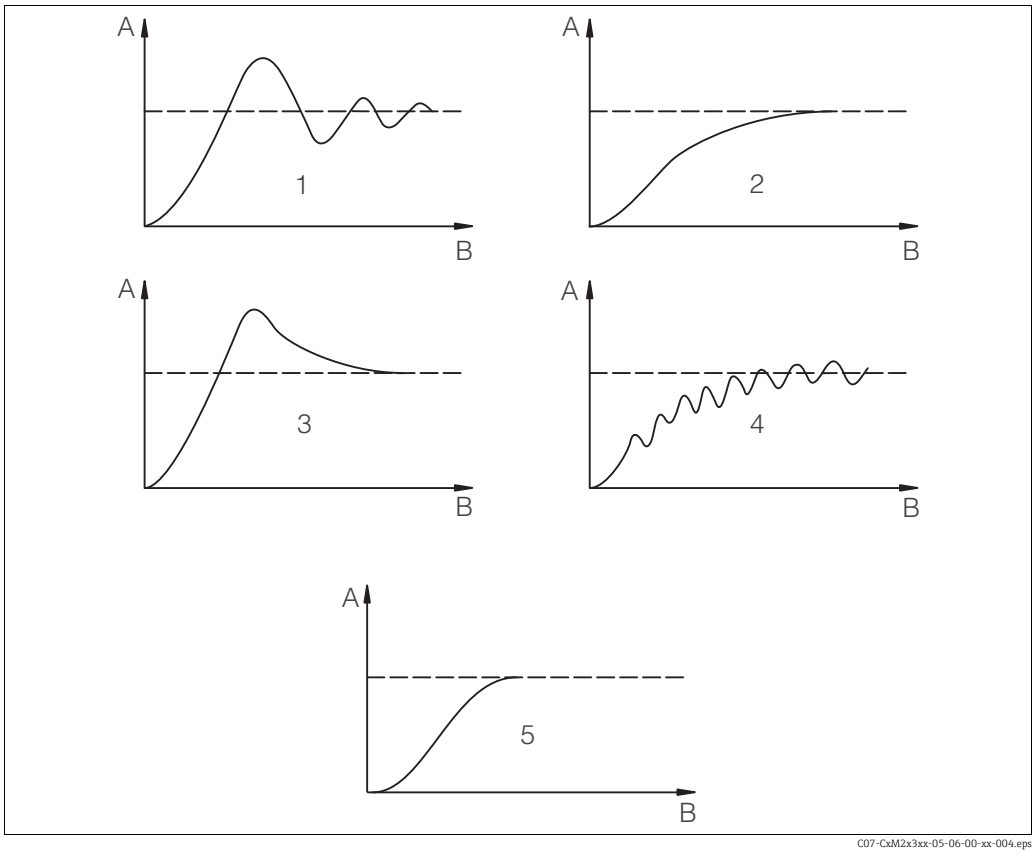
A PID with basic load
B Basic load
C PID

Commissioning

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

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

Control and fine optimization of the set parameters with a recorder



Optimization of settings T_n and K_p

A Actual value
B Time

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

Actuating signal outputs (R247 to R2410 and R257 to R2510)

Each control contact outputs a cyclical signal whose intensity corresponds to the controller's actuating 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 R248 or R258). 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.

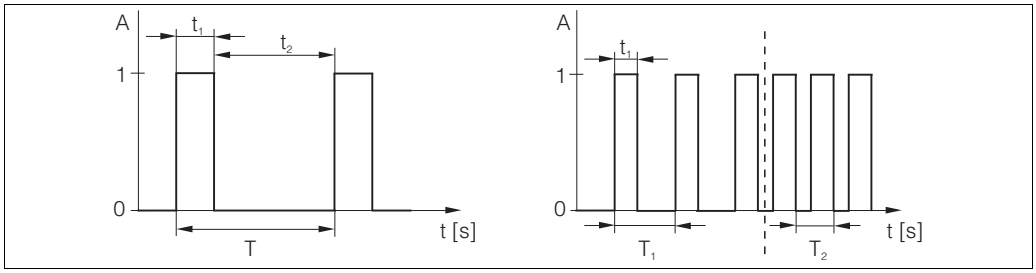


Fig. 38: Signal of a pulse-length modulated controller contact (left) and of a pulse-frequency modulated controller contact (right)

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. You can configure the constant controller in the fields R247 or R257 and O2

Control characteristic for direct and inverse control action

You can choose between two control characteristics in the R246 or R256 fields:

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

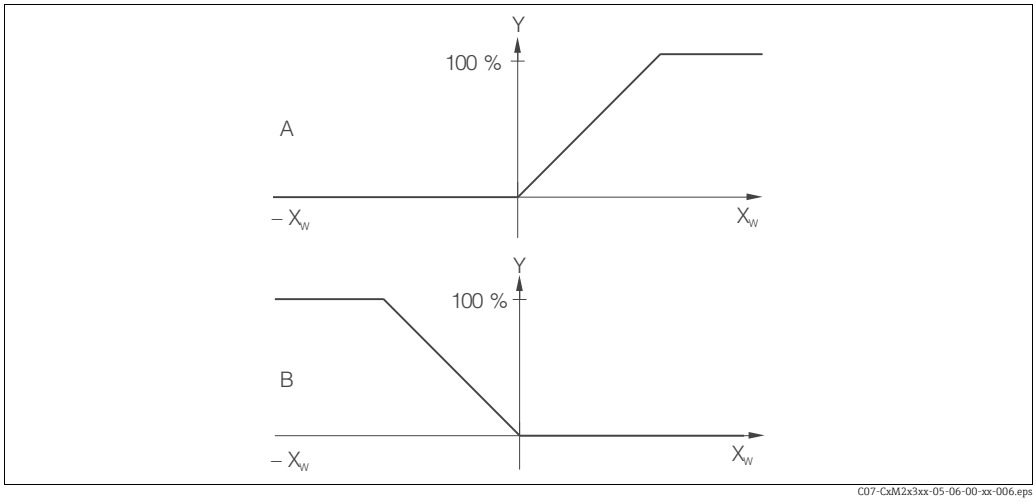


Fig. 39: Control characteristic of a proportional controller with direct and inverse control action

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

Timer for cleaning function

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

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

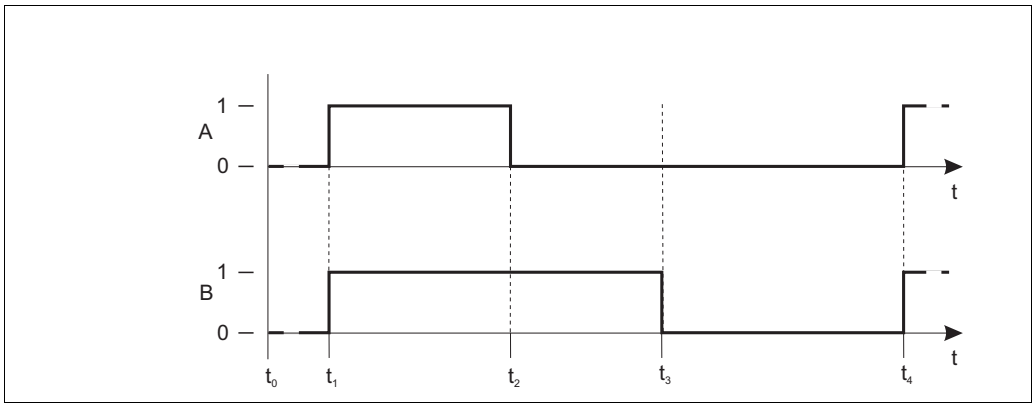


Fig. 40: Correlation of cleaning time, pause time and hold dwell period

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

Chemoclean function

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

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

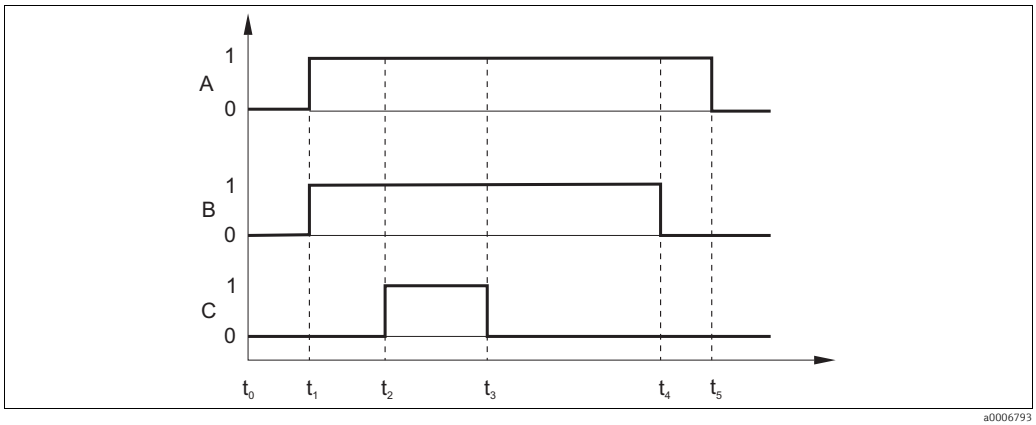


Fig. 41: Sequence of a cleaning cycle

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

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

Three-point step controller

This controller is used for triggering motor valves for chlorine dosing.

- When the controller activates relay 3, the motor valve closes.
- When the controller activates relay 4, the motor valve opens.

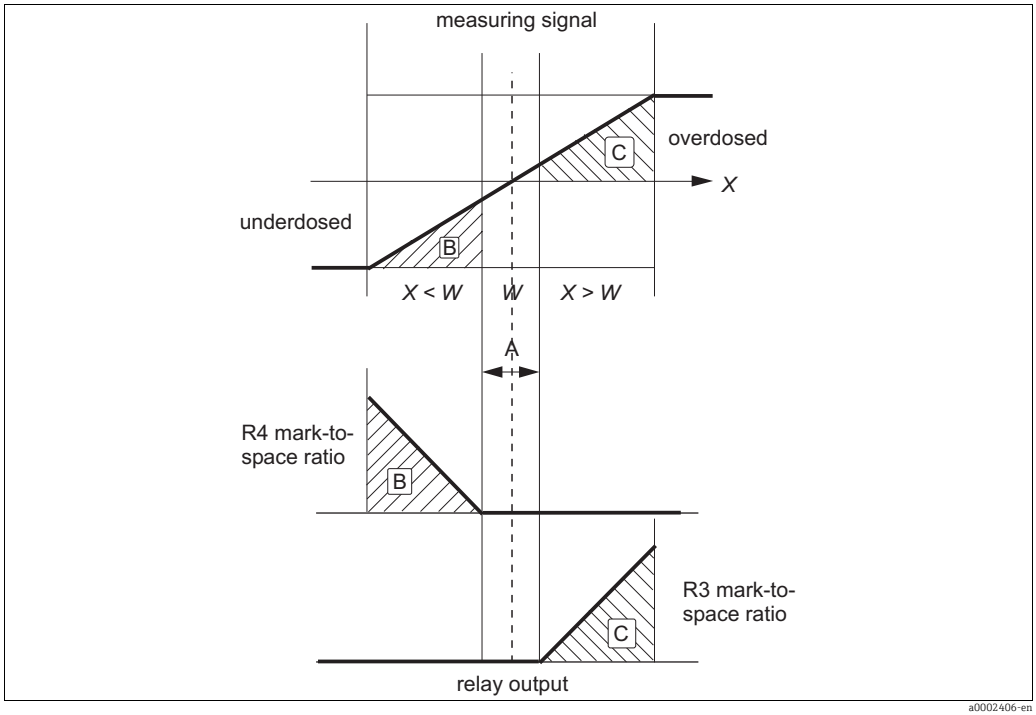


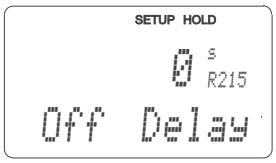
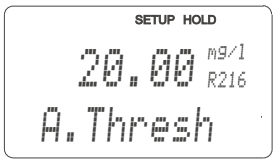
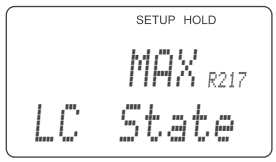
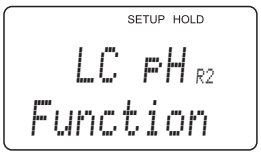
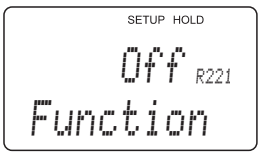
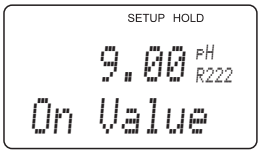
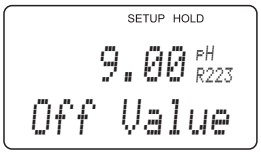
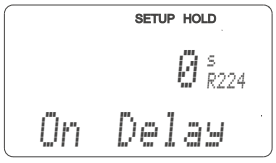
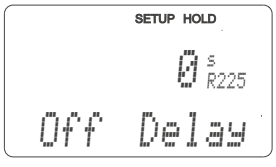
Fig. 42: Function of the three-point step controller

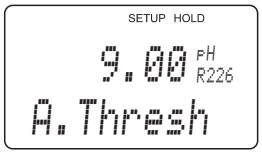
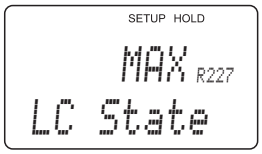
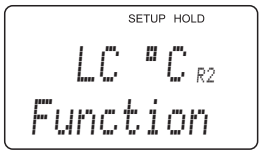
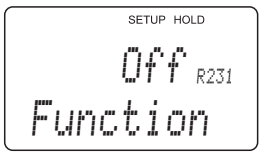
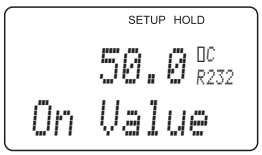
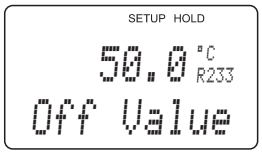
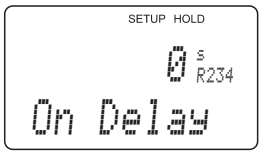
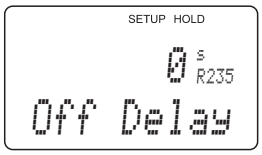
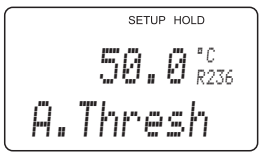
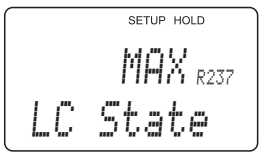
A Measured value is inside of the set point window
B Measured value is smaller than the set point
C Measured value is larger than the set point
W Set point
X Measured value

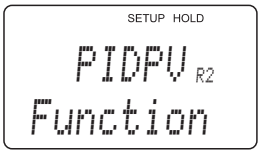
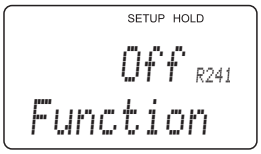
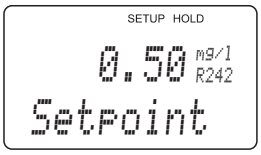
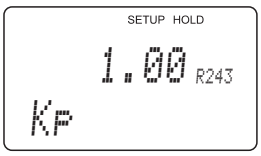
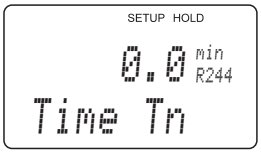
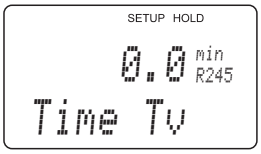
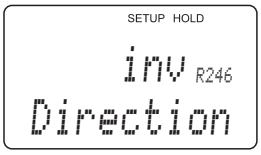
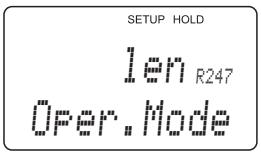
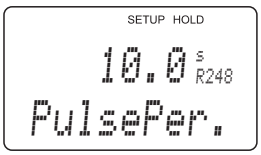
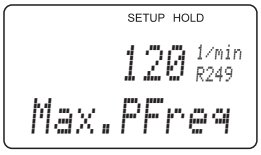
- Measured value is inside of the set point window (A)
  Relays 3 and 4 are **not** activated. The motor valve will not change.
- Measured value is smaller than the set point (B)
  The chlorine dosing is too low. The controller activates relay 4. The motor valve opens and increases the chlorine dosing.
- Measured value is larger than the set point (C)
  The chlorine dosing is too high. The controller activates relay 3. The motor valve closes and decreases the chlorine dosing.

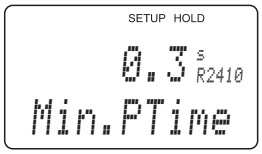
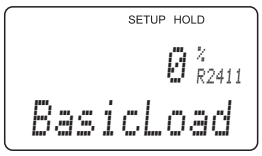
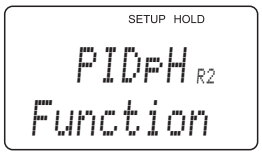
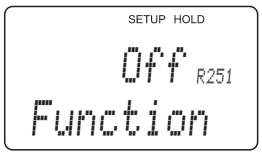
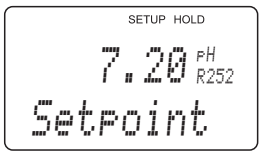
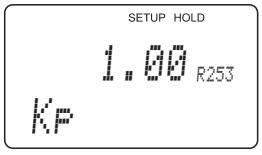
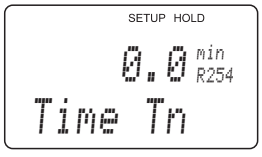
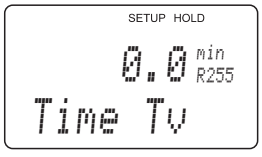
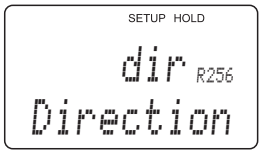
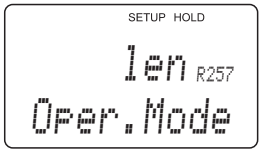
Basic version does not include functions in *italic*.

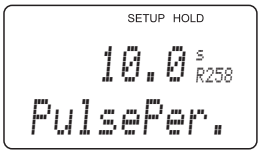
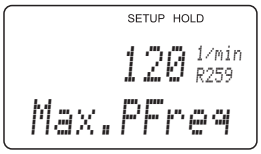
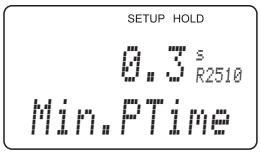
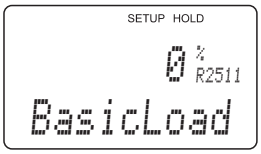
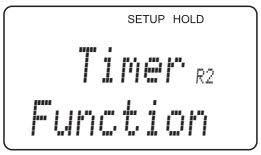
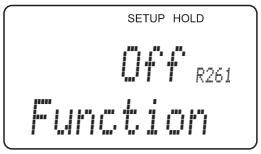
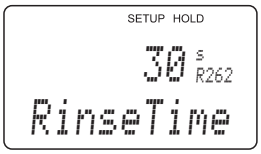
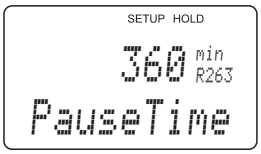
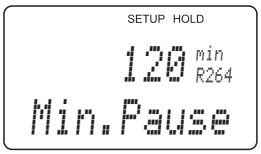
Coding			Field	Setting range (Factory settings, bold)	Display	Info
R			**RELAY function group**		SETUP HOLD R ATC RELAIS	Relay contact settings.
	R1		*Select contact to be configured*	**Rel1** *Rel2* *Rel3* *Rel4*	SETUP HOLD Rel1 R1 Sel.Relay	Rel3 (water) and Rel4 (cleaner) are only available with the relevant version of the transmitter. If Chemoclean is used as the cleaning method, Rel4 is not available.
	R2 (1)		Configure limit contact for Cl_2/ClO_2	**LC PV = limit contactor Cl_2/ClO_2** (1) *LC pH = limit contactor pH (2)* LC °C = limit contactor T (3) PID controller Cl_2/ClO_2 (4) PID controller pH (5) Timer (6) *Clean = Chemoclean (7)* *3PSt = step controller (8)*	SETUP HOLD LC PV R2 Sel.Type	PV = process value If Rel4 is selected in the R1 field, Clean = Chemoclean cannot be selected. By confirming with ENTER, another relay function already switched on is switched off and its settings are reset to the factory settings.
		R211	Switch function of R2 (1) off or on	**Off** On	SETUP HOLD off R211 Function	All the settings are retained.
		R212	Enter the switch-on point of the contact	**20000 ppb** 0 to 20000 ppb **20 ppm** 0 to 20 ppm **20 (5) mg/l** 0 to 20 (5) mg/l	SETUP HOLD 20.00 mg/l R212 On value	Never set the switch-on point and the switch-off point to the same value! (Only the operating mode selected in A1 is displayed.)
		R213	Enter the switch-off point of the contact	**20000 ppb** 0 to 20000 ppb **20 ppm** 0 to 20 ppm **20 (5) mg/l** 0 to 20 (5) mg/l	SETUP HOLD 20.00 mg/l R213 Off value	Entering a switch-off point selects either a Max contact (switch-off point < switch-on point) or a Min contact (switch-off point > switch-on point), thereby implementing a hysteresis that is constantly required (see "Illustration of the alarm and limit functions" figure). (Only the operating mode selected in A1 is displayed.)
		R214	Enter pick-up delay	**0 s** 0 to 2000 s	SETUP HOLD 0 s R214 On Delay	

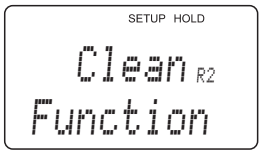
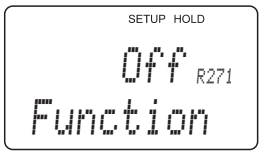
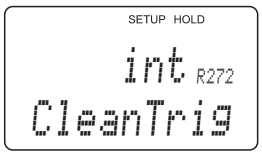
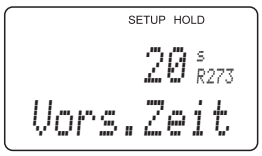
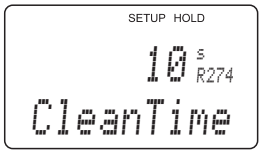
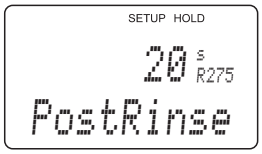
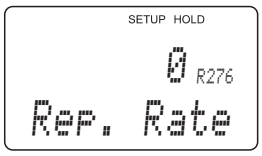
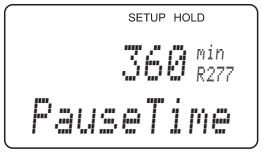
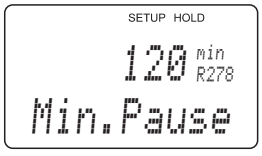
Coding	Field	Setting range (Factory settings, bold)	Display	Info
R215	Enter drop-out delay	**0 s** 0 to 2000 s		
R216	Enter alarm threshold	**20000 ppb** 0 to 20000 ppb **20 ppm** 0 to 20 ppm **20 (5) mg/l** 0 to 20 (5) mg/l		If the alarm threshold is undershot/ overshot, this triggers an alarm with the error message and error current at the transmitter (note alarm delay in field F3). If defined as a Min contact, the alarm threshold must be < switch-off point. (Only the operating mode selected in A1 is displayed.)
R217	Display status for limit contactor	**MAX** MIN		Display only.
R2 (2)	*Configure limit contactor for pH or Redox mV*	**LC pH = limit contactor pH (2)** *LCORP = limit contactor Redox mV*		Only on EP version. Depending on operating mode selected in field B1 you configure for pH or redox. By confirming with ENTER, another relay function already switched on is switched off and its settings are reset to the factory settings.
R221	*Switch function of R2 (2) off or on*	**Off** *On*		Settings made for the limit contactor are not deleted by switching the function off.
R222	*Enter switch-on point*	**pH9** *ph 4 to 9* **1500 mV** *0 to 1500 mV*		Never set the switch-on point and the switch-off point to the same value!
R223	*Enter switch-off point*	**pH9** *ph 4 to 9* **1500 mV** *0 to 1500 mV*		Entering a switch-off point selects either a Max contact (switch-off point < switch-on point) or a Min contact (switch-off point > switch-on point), thereby implementing a hysteresis that is constantly required (see "Illustration of the alarm and limit functions" figure).
R224	*Enter pick-up delay*	**0 s** *0 to 2000 s*		
R225	*Enter drop-out delay*	**0 s** *0 to 2000 s*		

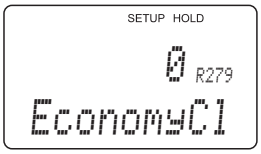
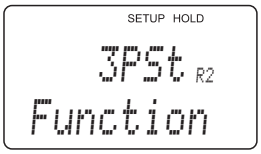
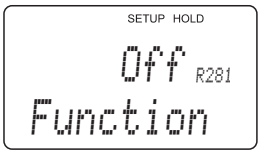
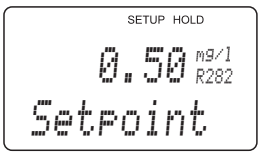
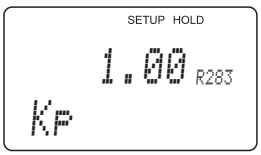
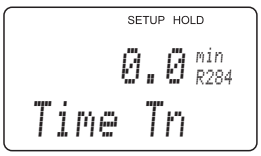
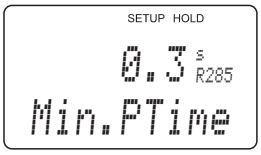
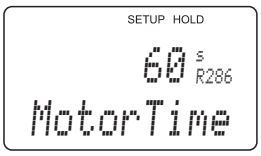
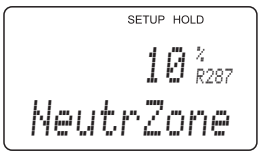
Coding			Field	Setting range (Factory settings, bold)	Display	Info
		R226	*Enter alarm threshold (as absolute value)*	**pH 9.00** *ph 0 to 9* **1500 mV** *0 to 1500 mV*		If the alarm threshold is undershot/ overshot, this triggers an alarm with the error message and error current at the transmitter (note 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 limit contactor for temperature measurement	**LC °C = limit contactor T (3)**		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 (2) off or on	**Off** On		Settings made for the limit contactor are not deleted by switching the function off.
		R232	Enter switch-on temperature	**50.0 °C** 0 to 50.0 °C		Never set the switch-on point and the switch-off point to the same value!
		R233	Enter switch-off temperature	**50.0 °C** 0 to 50.0 °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).
		R234	Enter pick-up delay	**0 s** 0 to 2000 s		
		R235	Enter drop-out delay	**0 s** 0 to 2000 s		
		R236	Enter alarm threshold (as absolute value)	**50.0 C** 0 to 50.0 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.
		R237	Display status for limit contactor	**MAX** MIN		Display only.

Coding			Field	Setting range (Factory settings, bold)	Display	Info
R2 (4)			Configure P(ID) controller for Cl_2/ ClO_2	**PIDPV**		PV = process value of main measuring parameter 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 Basic PID+B		On = PID controller Basic = basic load dosing PID+B = PID controller + basic load dosing
	R242		Enter set point	**500 ppb** 0 to 20000 ppb **0.5 ppm** 0 to 20 ppm **0.5 (0.1) mg/l** 0 to 20 (5) mg/l		The set point is the value to be maintained by the control system. Using the control process, this value is restored upwards or downwards when a deviation occurs.
	R243		Enter control gain K_p	**1.00** 0.01 to 20.00		See "P(ID) controller" section.
	R244		Enter integral action time T_n (0.0 = no I-component)	**0.0 min** 0.0 to 999.9 min		See "P(ID) controller" section. With every Hold, the I-component is set to zero. Although Hold can be deactivated in field S2, this does not apply for Chemoclean and timer!
	R245		Enter derivative action time T_v (0.0 = no D-component)	**0.0 min** 0.0 to 999.9 min		See "P(ID) controller" section.
	R246		Select controller characteristic	**inv = inverted (default for sodium hypochlorite)** dir = direct		The setting is required depending on the desired dosing direction (dosing above or below setpoint, see "P(ID) controller" section).
	R247		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.
	R248		Enter pulse interval	**10.0 s** 0.5 to 999.9 s		This field only appears if pulse length is selected in R247. If pulse frequency is selected, R248 is skipped and entries continue with R249.
	R249		Enter maximum pulse frequency of the adjuster	**120 min^{-1}** 60 to 180 min^{-1}		This field only appears if pulse frequency is selected in R247. If pulse length is selected, R249 is skipped and entries continue with R2410.

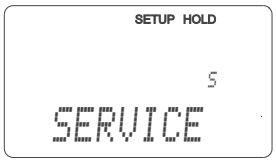
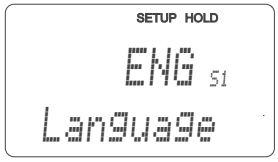
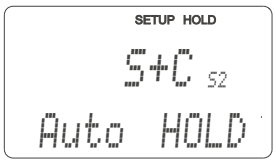
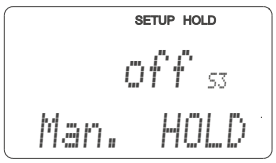
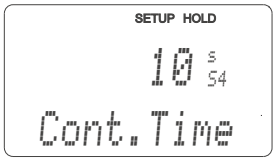
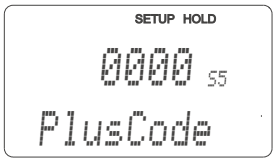
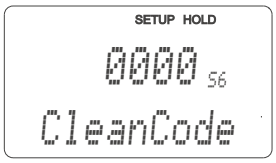
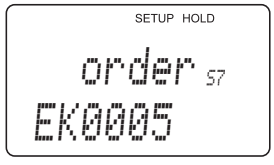
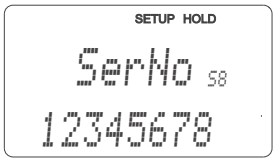
Coding	Field	Setting range (Factory settings, bold)	Display	Info
R2410	Enter minimum switch-on time t_{ON}	**0.3 s** 0.1 to 5.0 s		This field only appears if pulse length is selected in R247.
R2411	Enter basic load	**0 %** 0 to 40 %		When you select the basic load, you enter the desired dosing quantity. 100% basic load would correspond to: – Constantly on for R247 = len – F_{max} at R247 = freq (field R249) – 20 mA at R247 = curr
R2 (5)	Configure P(ID) controller for pH	**PIDpH**		By confirming with ENTER, another relay function already switched on is switched off
R251	Switch function of R2 (5) off or on	**Off** On Basic PID+B		On = PID controller Basic = basic load dosing PID+B = PID controller + basic load dosing
R252	Enter set point	**pH 7.20** pH 4 to 9		The set point is the value to be maintained by the control system. Using the control process, this value is restored upwards or downwards when a deviation occurs.
R253	Enter control gain K_p	**1.00** 0.01 to 20.00		See "P(ID) controller" section.
R254	Enter integral action time T_n (0.0 = no I-component)	**0.0 min** 0.0 to 999.9 min		See "P(ID) controller" section. With every Hold, the I-component is set to zero. Although Hold can be deactivated in field S2, this does not apply for Chemoclean and timer!
R255	Enter derivative action time T_v (0.0 = no D-component)	**0.0 min** 0.0 to 999.9 min		See "P(ID) controller" section.
R256	Select controller characteristic	inv = inverted **dir = direct** (default for acid)		The setting is required depending on the desired dosing direction (dosing above or below setpoint, see "P(ID) controller" section).
R257	Select pulse length or pulse frequency	**len = pulse length** freq = pulse frequency *curr = current output 2*		Pulse length e.g. for solenoid valve, pulse frequency e.g. for solenoid dosing pump, see "Actuating signal outputs" section. Curr = current output 2 can only be selected if O2 = Contr.

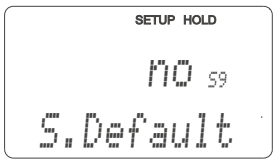
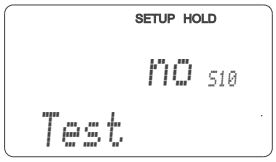
Coding	Field	Setting range (Factory settings, bold)	Display	Info
R258	Enter pulse interval	**10.0 s** 0.5 to 999.9 s		This field only appears if pulse length is selected in R257. If pulse frequency is selected, R258 is skipped and entries continue with R259.
R259	Enter maximum pulse frequency of the adjuster	**120 min^{-1}** 60 to 180 min^{-1}		This field only appears if pulse frequency is selected in R257. If pulse length is selected, R259 is skipped and entries continue with R2510.
R2510	Enter minimum switch-on time t_{ON}	**0.3 s** 0.1 to 5.0 s		This field only appears if pulse length is selected in R257.
R2511	Enter basic load	**0 %** 0 to 40 %		This field only appears with version EP. When you select the basic load, you enter the desired dosing quantity. 100% basic load would correspond to: – Constantly on for R257 = len – F_{max} at R257 = freq (field R259) – 20 mA at R257 = curr
R2 (6)	Configure cleaning function (timer)	**Timer**		Cleaning only takes place with one cleaning agent (usually water). By confirming with ENTER, another relay function already switched on is switched off and its settings are reset to the factory settings.
R261	Switch function of R2 (6) off or on	**Off** On		
R262	Enter rinsing/ cleaning time	**30 s** 0 to 999 s		Settings for Hold and relay are active for this time.
R263	Enter pause time	**360 min** 1 to 7200 min		The pause time is the time between two cleaning cycles (see "Timer for cleaning function" section).
R264	Enter minimum pause time	**120 min** 1 to 3600 min		The minimum pause time prevents constant cleaning if a cleaning trigger is present.

Coding			Field	Setting range (Factory settings, bold)	Display	Info
R2 (7)			*Configure cleaning with Chemoclean (for version with four contacts , Chemoclean option and contacts 3 and 4 assigned)*	**Clean = Chemoclean**		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.
	R271		*Switch function of R2 (7) off or on*	**Off** *On*		
	R272		*Select type of start pulse*	**int = internal (time-controlled)** *ext = external (digital input 2)* *I+ext = internal + external* *I+stp = internal, suppressed by external*		The cycle for the "int" function is started by the end of the pause time (R277). No real time clock is available. External suppression is required for irregular time intervals (e.g. weekends).
	R273		*Enter pre-rinse time*	**20 s** *0 to 999 s*		Rinsing with water takes place.
	R274		*Enter cleaning time*	**10 s** *0 to 999 s*		Cleaning with cleaning agent and water takes place.
	R275		*Enter post rinse time*	**20 s** *0 to 999 s*		Rinsing with water takes place.
	R276		*Enter number of repeat cycles*	**0** *0 to 5*		R273 to R275 is repeated.
	R277		*Enter pause time*	**360 min** *1 to 7200 min*		The pause time is the time between two cleaning cycles (see "Timer function" section).
	R278		*Enter minimum pause time*	**120 min** *1 to R257 min*		The minimum pause time prevents constant cleaning if an external cleaning start is present.

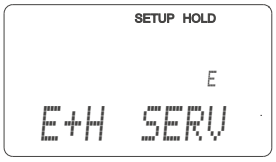
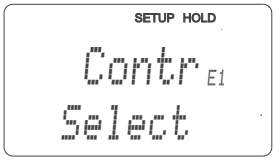
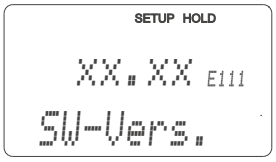
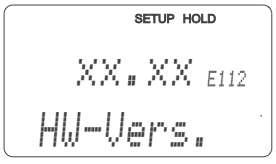
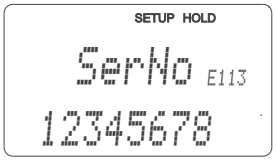
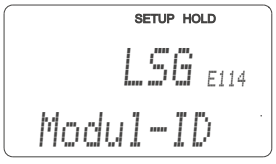
Coding			Field	Setting range (Factory settings, bold)	Display	Info
		R279	*Enter number of cleaning cycles without cleaning agent (economy function)*	**0** *0 to 9*		After cleaning with cleaner, up to 9 cleaning sessions can be carried out with water only until the next cleaning session with cleaner takes place.
	R2 (8)		Configure 3-point step controller for Cl_2/ClO_2	**3PSt**		Only with relays 3 and 4 By confirming with ENTER, another relay function already switched on is switched off
		R281	Switch function of R2 (8) off or on	**Off** On		
		R282	Enter set point	**500 ppb** 0 to 20000 ppb **0.5 ppm** 0 to 20 ppm **0.5 (0.1) mg/l** 0 to 20 (5) mg/l		The set point is the value which the controller has to hold. The controller will restore this value if there is a deviation up or down.
		R283	Enter control gain K_p	**1.00** 0.01 to 20.00		See "P(ID) controller" section.
		R284	Enter integral action time T_n (0.0 = no I-component)	**0.0 min** 0.0 to 999.9 min		See "P(ID) controller" section.
		R285	Enter minimum switch-on time T_{ON}	**0.3 s** 0.1 to 5.0 s		
		R286	Enter motor run time	**60 s** 10 to 999 s		Actuator motor run time from "fully closed" state to "fully open" state.
		R287	Enter neutral zone	**10 %** 0 to 40 %		

6.4.8 Service

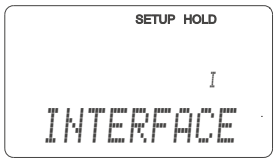
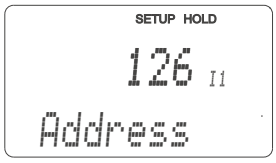
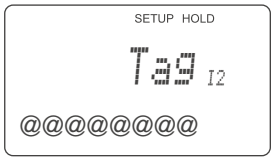
Coding		Field	Setting range (Factory settings, bold)	Display	Info
S		**SERVICE function group**			Service function settings.
	S1	Select language	**ENG = English** GER = German FRA = French ITA = Italian NL = Dutch ESP = Spanish		
	S2	Configure Hold	**S+C = Hold during configuration and calibration**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

Coding		Field	Setting range (Factory settings, bold)	Display	Info
	S9	Reset the device to the basic settings 	**No** Sens = sensor data Facty = factory settings		Sens = last calibration is deleted and is reset to factory setting. Facty = all data (apart from A1 and S1) are deleted and reset to the factory setting!
	S10	Perform device test	**No** Displ = display test		

6.4.9 E+H Service

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

6.4.10 Interfaces

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

6.5 Communication

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

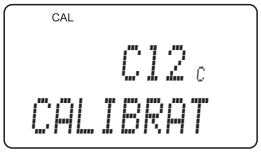
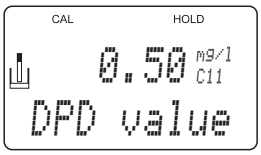
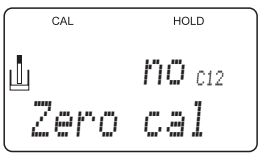
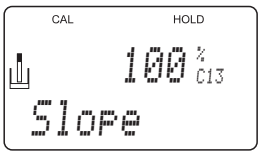
6.6 Calibration

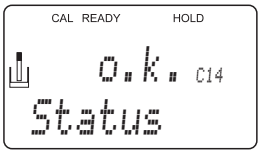
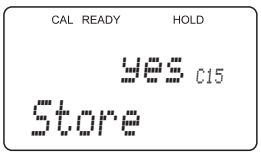
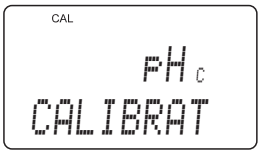
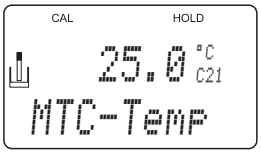
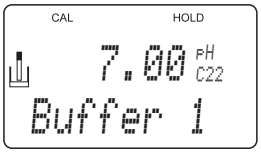
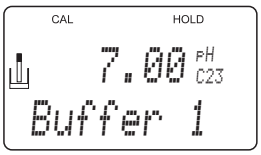
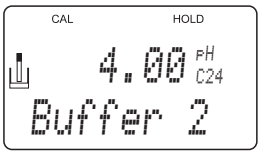
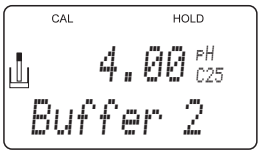
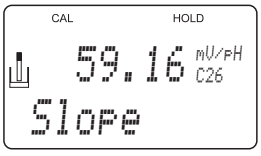
To access the "Calibration" function group, press the CAL key.
This function group is used to calibrate and adjust the measuring point.

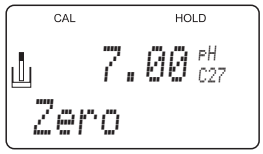
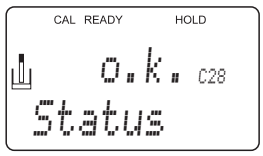
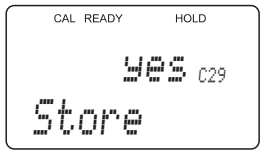
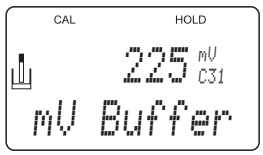
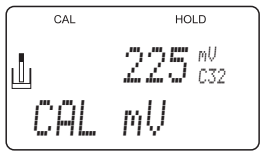
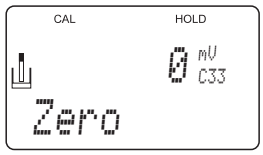
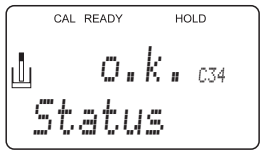
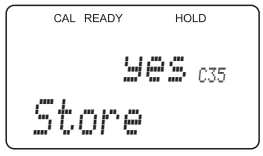
For the calibration of the "free chlorine" measurement you have to consider the pH value and the temperature of the medium. You will find the limit values in the following table:

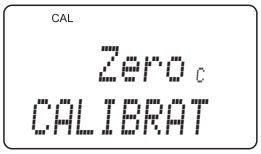
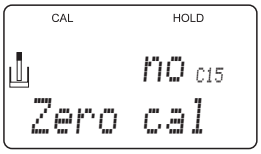
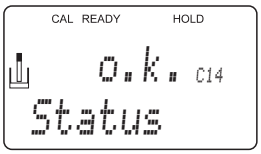
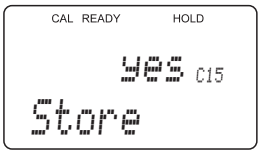
Sensor	pH_{min}	pH_{max}	T_{min}	T_{max}
CCS140	4	8	10 °C (50 °F)	45 °C (113 °F)
CCS141	4	8.2	2 °C (36 °F)	45 °C (113 °F)
CCS240	-	-	2 °C (36 °F)	45 °C (113 °F)
CCS241	-	-	2 °C (36 °F)	45 °C (113 °F)
CCS120	5.5	9.5	5 °C (41 °F)	45 °C (113 °F)

Pay attention to the following:
- For chlorine and chlorine dioxide calibration you need a photometer, e.g. CCM 182 (see "Accessories"). To calibrate chlorine and chlorine dioxide for trace detection (< 0.1 mg/l), use a photometer with higher accuracy and lower detection limits.
- If the calibration is aborted by pressing the PLUS and MINUS keys at the same time (return to C15, C29 or C35) or if the calibration is faulty, the original calibration data will continue to be used. A calibration error is indicated by an “ERR” and a flashing sensor symbol on the display.
  In this case, repeat the calibration!
- The instrument is automatically switched to Hold during calibration (factory setting).
- After calibration, the system jumps back to the measuring mode. During the dwell period the Hold symbol is displayed.

Coding		Field	Selection or range (factory settings bold)	Display	Info
C(1)		**Function group CALIBRATION: Calibration Cl_2/ClO_2**	**Cl2** ClO2		Cl2 at A1 = 120/140/141/963 ClO2 at A1 = 240/241
	C11	Enter DPD calibration value	**Value of previous calibration**		Minimum values for calibration: ▪ for CCS120/140/240 and sensor 963: **0.05 mg/l** ▪ for CCS141/241: **0.01 mg/l**
	C12	Zero point calibration?	**no** yes		Only for A1 = 963 Zero point calibration: 1. Send non-chlorinated water through the assembly. 2. Wait 10 min. 3. Adopt by selecting ENTER
	C13	Display slope	**100 %** minimum 25 % (3 %) maximum 500 %		Minimum permitted slope: ▪ for CCS140/141 with pH compensation and for CCS240/241: **25 %** ▪ for CCS120/140/141 without pH compensation and for sensor 963: **3 %**

Coding		Field	Selection or range (factory settings bold)	Display	Info
	C14	Calibration status is displayed	**o. k.** E xxx		
	C15	Store calibration result?	yes no new		If C14 = E xxx, then no or **new**. If new, then return to C. If yes/no, then return to "Measurement".
C(2)		**Function group CALIBRATION: Calibrate pH**	**pH**		
	C21	Enter calibration temperature	**25.0 °C** 0 to 50 °C		This field is only used for registration of the calibration temperature. Input not imperative.
	C22	Enter pH value of first buffer solution	**Buffer value of previous calibration** pH 3.50 to 9.50		Press the ENTER key to display the current measuring value. Press the ENTER key again as soon as the measuring value has approximated the buffer value.
	C23	Calibration takes place			Stability control: Adopt if stability ≤ pH ±0.05 for more than 10 s.
	C24	Enter pH value of second buffer solution	**Buffer value of previous calibration** pH 3.50 to 9.50		Buffer 2 must have a different value than buffer 1. Plausibility check takes place. Press the ENTER key and proceed as in field C22.
	C25	Calibration takes place			Stability control: Adopt if stability ≤ pH ±0.05 for more than 10 s.
	C26	Display slope	**59.16 mV/pH** 38.00 to 65.00 mV/pH		

Coding		Field	Selection or range (factory settings bold)	Display	Info
	C27	Zero point is displayed	**pH 7.00** pH 5.00 to 9.00		
	C28	Calibration status is displayed	**o. k.** E xxx		
	C29	Store calibration result?	**yes** no new		If C28 = E xxx, then only no or **new**. If new, then return to C. If yes/no, then return to "Measurement".
C(3)		**Function group CALIBRATION: Calibration ORP mV**	**ORPmV**		
	C31	Enter value of ORP buffe	**Buffer value of previous calibration** 0 to 1500 mV		Press the ENTER key to display the current measuring value. Press the ENTER key again as soon as the measuring value has approximated the buffer value.
	C32	Calibration takes place			Stability control: Adopt if stability ≤ ±1 mV for more than 10 s.
	C33	Zero point is displayed	-100 to +100 mV		
	C34	Calibration status is displayed	**o. k.** E xxx		
	C35	Store calibration result?	yes no new		If C34 = E xxx, then only no or **new**. If new, then return to C. If yes/no, then return to "Measurement".

Coding		Field	Selection or range (factory settings bold)	Display	Info
C(2)		**Function group CALIBRATION: Zero point CCS120**	**zero point**		
	C12	Zero point calibration?	**no** yes		Only for A1 = 120 Zero point calibration: 1. Send non-chlorinated water through the assembly. 2. Wait 10 min. 3. Adopt by selecting ENTER
	C14	Calibration status is displayed	**o. k.** E xxx		
	C15	Store calibration result?	yes no new		If C14 = E xxx, then no or **new**. If new, then return to C. If yes/no, then return to "Measurement".

7 Diagnostics and troubleshooting

7.1 Troubleshooting instructions

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

7.2 System error messages

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

Error no.	Display	Tests and/or remedial measures	Alarm contact		Error current		Autom. cleaning start		PROFIBUS status	
			Facty	User	Facty	User	Facty	User	PV[1]	Temp
E001	EEPROM memory error	1. Switch device off and then on again.	Yes		No		—	—[2]	0C	0C
E002	Instrument not calibrated, calibration data invalid, no user data, user data invalid (EEPROM error), instrument software not suitable for hardware (controller)	2. Load device software compatible with the hardware (with optoscope, see "Optoscope service tool" section). 3. Load measurement-parameter specific device software. 4. If the error persists, send in the device for repair to your local service organisation or replace the device.	Yes		No		—	—[2]	0C	0C
E003	Download error	Invalid configuration. Repeat download, check optoscope.	Yes		No		—		0C	0C
E004	Instrument software version not compatible with module hardware version	Load software compatible with hardware. Load measurement-parameter specific device software.	Yes		No		—		0C	0C
E007	Transmitter malfunction, instrument software not compatible with transmitter version		Yes		No		—	—[2]	0C	0C
E010	Temperature sensor defective	Check temperature sensor and connections; if necessary, check measuring cable using temperature simulator.	Yes		No		No	—	80	0C
E032	Upper or lower pH slope range exceeded	Repeat calibration and replace buffer solution; if necessary, replace electrode and check instrument and measuring cable using simulator.	No		No		—	—[2]	80	80
E033	pH value zero point too low or too high		No		No		—	—[2]	80	80
E034	Upper or lower ORP offset range exceeded		No		No		—	—[2]	80	80
E035	Sensor 963 zero point signal outside permitted range	▪ Service sensor (acc. to sensor instructions) ▪ Check connections. ▪ Check active charcoal filter.	No		No		—	—[2]	80	80

Error no.	Display	Tests and/or remedial measures	Alarm contact		Error current		Autom. cleaning start		PROFIBUS status	
			Facty	User	Facty	User	Facty	User	PV[1)]	Temp
E038	Cl sensor signal outside permitted range during slope calibration	▪ Service sensor (acc. to sensor instructions) ▪ Check connections. ▪ Check DPD measuring instrument. ▪ Do not use organic chlorination agent.	No		No		–	—[2]	80	80
E041	Calibration parameter calculation aborted	Repeat calibration and replace buffer solution; if necessary, replace sensor and check instrument and measuring cable.	No		No		–	—[2]	80	80
E042	Distance between buffer value and zero point (pH7) too small (single-point calibration)	For slope calibration, use a buffer solution which has at least a distance of ΔpH = 2 to the electrode zero point.	No		No		–	—[2]	80	80
E043	Distance between buffer 1 and buffer 2 calibration values too small (two-point calibration)	Use buffer solutions which differ by at least ΔpH = 2.	No		No		–	—[2]	80	80
E044	Stability factor not met during calibration	Repeat calibration and replace buffer solution; if necessary, replace sensor and check instrument and measuring cable using simulator.	No		No		–	—[2]	80	80
E045	Calibration aborted		No		No		–	—[2]	80	80
E055	Lower Cl/ClO_2 measuring range exceeded	Check measurement and connections; if necessary, check instrument and measuring cable using simulator.	Yes		No		No			80
E056	Lower pH/mV measuring range exceeded		Yes		No		No			80
E057	Upper Cl/ClO_2 measuring range exceeded		Yes		No		No			80
E058	Upper pH/mV measuring range exceeded		Yes		No		No			80
E059	Lower temperature measuring range exceeded		Yes		No		No		80	
E061	Upper temperature measuring range exceeded		Yes		No		No		80	
E063	Lower current output range1 exceeded	Check measured value and current assignment.	Yes		No		No		80	80
E064	Upper current output range1 exceeded		Yes		No		No		80	80
E065	Lower current output range2 exceeded		Yes		No		No		80	80
E066	Upper current output range2 exceeded		Yes		No		No		80	80
E067	Alarm threshold limit contactor 1 exceeded	Check configuration.	Yes		No		No		80	80
E068	Alarm threshold limit contactor 2 exceeded		Yes		No		No		80	80
E069	Alarm threshold limit contactor 3 exceeded		Yes		No		No		80	80
E070	Alarm threshold limit contactor 4 exceeded		Yes		No		No		80	80
E080	Current output 1 range too small	Increase range in "Current outputs" menu.	No		No		–	—[2]	80	80
E081	Current output 2 range too small		No		No		–	—[2]	80	80

Error no.	Display	Tests and/or remedial measures	Alarm contact		Error current		Autom. cleaning start		PROFIBUS status	
			Facty	User	Facty	User	Facty	User	PV[1)]	Temp
E085	Incorrect setting for error current	If the current range "0 to 20 mA" was selected in field O311, the error current "2.4 mA" may not be set.	No		No		—	—[2]	80	80
E100	Current simulation active		No		No		—	—[2]	80	80
E101	Service function yes	Switch off service function or switch device off and then on again.	No		No		—	—[2]	80	80
E102	Relay simulation yes	Check relay configuration.	No		No		—	—[2]	80	80
E106	Download yes	Wait for download to finish.	Yes		No		—	—[2]	80	80
E116	Download error	Repeat download.	Yes		No		—	—[2]	0C	0C
E152	Measuring signal of Cl/ClO_2 parameter delayed or frozen (AC function / alternation check)	▪ Inspect sensor and connection line, repair or replace. ▪ Check whether medium has really changed or not.	Yes		No		No		44	44
E153	Measuring signal of pH/mV parameter delayed or frozen (AC function / alternation check)		Yes		No		No		44	44
E154	Cl/ClO_2 below lower alarm threshold for period exceeding alarm delay	▪ Perform manual comparison measurement if necessary. ▪ Service sensor. ▪ Recalibrate measuring system. ▪ Check flow rate. ▪ Check chemical supply ▪ Check dosing devices	Yes		No		No		-[3)]	-
E155	Cl/ClO_2 above upper alarm threshold for period exceeding alarm delay		Yes		No		No		-	-
E156	Actual Cl/ClO_2 value undershoots alarm threshold (CC setpoint) for longer than the set permissible maximum period		Yes		No		No		-	-
E157	Actual Cl/ClO_2 value exceeds alarm threshold (CC setpoint) for longer than the set permissible maximum period		Yes		No		No		-	-
E158	pH/mV below lower alarm threshold for period exceeding alarm delay		Yes		No		No		-	-
E159	pH/mV above upper alarm threshold for period exceeding alarm delay		Yes		No		No		-	-
E160	Actual pH/mV value undershoots alarm threshold (CC setpoint) for longer than the set permissible maximum period		Yes		No		No		-	-
E161	Actual pH/mV value exceeds alarm threshold (CC setpoint) for longer than the set permissible maximum period		Yes		No		No		-	-
E162	Dosage stop	Check settings in the CURRENT INPUT and CHECK function groups.	Yes		No		No		-	-

Error no.	Display	Tests and/or remedial measures	Alarm contact		Error current		Autom. cleaning start		PROFIBUS status	
			Facty	User	Facty	User	Facty	User	PV[1)]	Temp
E163	Compensated chlorine value too imprecise since pH value > 9	Check pH value and adjust according to system requirements. For pH values > 9, the disinfection effect is questionable since the chlorine now exists as the less effective OCl^-.	Yes		No		No		-	-
E170	Flow through assembly too low or zero	Restore flow.	Yes		No		No		-	-
E171	Flow in main stream too low or zero	Restore flow.	Yes		No		No		-	-
E172	Switch-off limit for current input exceeded	Check process variables at sending measuring instrument. Change range assignment if necessary.	Yes		No		No		-	-
E173	Current input < 4 mA	Check process variables at sending measuring instrument.	Yes		No		No		-	-
E174	Current input > 20 mA	Check process variables at sending measuring instrument. Change range assignment if necessary.	Yes		No		No		-	-

1) PV = Process value

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

3) Current error messages not applicable via PROFIBUS

7.3 Process-specific errors

Use the following table to locate and correct errors.

Error	Possible cause	Tests and / or remedial measures	Equipment, spare parts, personnel
No instrument function	Instrument fuse defective	Replace fuse.	Fine-wire fuse, M 250 V / 3.15 A
	No power supply	Establish power supply.	Check with voltmeter.
Display flashes	Automatic controller switch-off due to alarm	Determine cause using error code Exxx and remedy.	
	Current output simulation	End simulation.	
Chlorine measurement: Slope too low	Sensor was in chlorine-free water or in air	Short conditioning above (not in!) chlorine bleach, wait for conditioning time in water before calibration.	Chlorine bleach / chlorine parent solution
No match with DPD check measurement	Measurement takes place without pH compensation, whereas DPD measurement is always buffered to pH 6.3	Measure chlorine value pH-compensated.	Select CCM223/253 with ES (manual compensation) or EP (automatic compensation) option.
DPD measured value much too high	Organic chlorination agent used (may also be used only at times or for shock chlorination). Here no correlation between actual free chlorine, DPD measurement and amperometric measurement. DPD value up to factor 5 too high.	Use free (gaseous) chlorine or chlorine of inorganic chlorine compounds.	If organic chlorination agent was used previously, the entire system must be evacuated and carefully cleaned!
Chlorine value too high	Membrane defective	Replace membrane cap.	Replacement cartridges CCY14-WP
	Polarisation incomplete	Wait until polarisation time ends.	Be patient
	Foreign oxidant	Analyze medium.	Detailed knowledge of the process
	Shunt in chlorine sensor	Replace sensor.	Replacement sensor

Error	Possible cause	Tests and / or remedial measures	Equipment, spare parts, personnel
Chlorine value too low	Measuring chamber not closed	Refill and carefully screw tight.	Electrolyte CCY14-F or CCY24-F
	Air cushion outside in front of membrane	Remove air bubble, possibly choose better installation position.	
	Air cushion under membrane	Refill and carefully screw tight bubble-free.	Electrolyte CCY14-F or CCY24-F
Chlorine value wrong / no calibration possible; zero current too large	Wrong polarisation voltage	Measure polarisation voltage, replace MKC1 module if required.	DVM (+) at S or 90, DVM (-) at 91 CCS140/141: -20 mV CCS240/241: +120 mV
	Wrong sensor type selected	Check sensor selection.	
pH/mV measurement: Measuring chain zero point not adjustable	Reference system poisoned	Test with new sensor.	pH/mV sensor
	Membrane blocked	Clean / grind membranes (not with TEFLON membranes).	HCl 3%, warding file (only file in one direction); new sensor
	Measuring line broken	Short-circuit pH input and connect to PM -> reading pH 7.	
	Asymmetrical voltage of sensor too high	Clean membranes or test with different sensor.	HCl 3%, file (only file in one direction); new sensor.
	Potential matching (PM) of Liquisys M -> medium incorrect	CCM223/253 always connect symmetrically to PM!	Connection diagram
No or slow change of readings	Sensor dirty	Clean sensor.	Cleaning agent
	Sensor aged	Replace sensor.	New sensor
	Sensor defective (reference outgoing lead)	Replace sensor.	New sensor
Measuring chain slope not adjustable / **Slope too low**	Connection not at high impedance (humidity, dirt)	Test cable, connector and junction boxes.	pH simulator, insulation tester
	Instrument input defective	pH measurement directly on the instrument.	pH simulator
	Sensor aged	Replace sensor.	pH sensor
Measuring chain slope not adjustable / **No slope**	Hairline crack in glass membrane	Replace sensor.	pH sensor.
	Connection not at high impedance	Test cable, connector and junction boxes.	pH simulator, insulation tester
Permanent, incorrect reading	Sensor not immersed or protective cap not removed	Check installation position, remove protective cap.	
	Air cushion in assembly	Check assembly and installation position.	
	Ground fault at or in the instrument	Test measurement in insulated vessel, possibly with buffer solution.	Plastic vessel, buffer solutions
	Hairline crack in glass membrane	Replace sensor.	pH sensor
	Instrument in impermissible operating state (no response to key actuation)	Switch instrument off and on.	Possibly EMC problem: If repeated, check grounding and wire routing
Incorrect temperature reading	Incorrect sensor connection	Check connections.	Connection diagrams
	Sensor or measuring cable defective	Test sensor and cable.	Ohmmeter
pH value in process incorrect	Flow rate too high	Reduce flow rate or measure in a bypass.	
	Potential in medium	Possibly ground with / at PM pin (connect PA/PM to PE).	Problem mainly occurs in plastic lines
	Sensor covered in dirt or deposits	Clean sensor.	For highly polluted media: Use spray cleaning

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

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

7.4 Instrument-specific errors

The following table helps you 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
- Endress+Hauser Service

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

Error	Possible cause	Tests and/or remedial measures	Execution, tools, spare parts
Device cannot be operated, display value 9999	Operation locked	Press CAL and MINUS keys simultaneously.	See "Function of keys" section.
Display dark, no light-emitting diode active	No line voltage	Check whether line voltage is present.	Electrical technician/e.g. multimeter
	Supply voltage wrong/too low	Compare actual line voltage and nameplate data.	User (data for energy supply company or multimeter)
	Connection faulty	Terminal not tightened; insulation jammed; wrong terminals used.	Electrical technician
	Device fuse defective	Compare line voltage and the nameplate data and replace fuse.	Electrical technician/suitable fuse; see drawing in "Spare parts" section.
	Power unit defective	Replace power unit, note variant.	On-site diagnosis by Endress+Hauser Service, test module necessary
	Central module defective	Replace central module, note variant.	On-site diagnosis by Endress+Hauser Service, test module necessary
	CCM253: ribbon cable loose or defective	Check ribbon cable, renew if necessary.	See "Spare parts" section.
Display dark, light-emitting diode active	Central module defective (module: LSCH/LSCP)	Renew central module, note variant.	On-site diagnosis by Endress+Hauser Service, test module necessary
Display is on but – No change in display and/or – Device cannot be operated	Device or module in device not correctly mounted	CCM223: reinstall module. CCM253: reinstall display module.	Perform with the aid of the installation drawings in the "Spare parts" section.
	Operating system in unpermitted mode	Switch device off and then on again.	Poss. EMC problem: if this problem persists, check the installation.
Device gets hot	Voltage wrong/too high	Compare line voltage and nameplate data.	User, electrical technician
	Power unit defective	Replace power unit.	Diagnosis only by Endress+Hauser Service
Incorrect Cl/ClO_2 measured value and/or temperature measured value	Transmitter module defective (module: MKC1). First carry out tests and action as per chapter "Process-specific errors"	Measuring input test: – Chlorine input open = reading 0.00mg/l – Resistance 10kΩ at terminals 11/12 and 13 = reading 25 °C (77 °F)	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 meter directly to current output.	If simulation value incorrect: adjustment in factory or new module LSCxx 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.	
	Incorrect assignment	Output 2 can be assigned to temperature or pH	Check which parameter is assigned to output.

Error	Possible cause	Tests and/or remedial measures	Execution, tools, spare parts
No current output signal	Current output stage defective (LSCH module only; LSCP module has no current output)	Check with installed current simulation, connect mA meter directly to current output.	If test negative: Renew central module (pay attention to variant).
No function of additional relay	CCM253: ribbon cable loose or defective	Check ribbon cable seating, renew cable if required.	See "Spare parts" section.
Only 2 additional relays can be triggered	Relay module LSR1-2 installed with 2 relays	Upgrade to LSR1-4 with 4 relays.	User or Endress+Hauser Service
Additional functions (Plus package) missing	No or incorrect release code used	If retrofitting: check whether the correct serial number was quoted when ordering the Plus package.	Handled by Endress+Hauser Sales
	Incorrect device serial number saved in LSCH/LSCP module	Check whether serial number on the nameplate matches SNR in LSCH/ LSCP (field S8).	The serial number of the device is definitive for the Plus package.
Additional functions (Plus package and/or Chemoclean) missing after replacement of LSCH/LSCP module	Replacement modules LSCH or LSCP have the **device** serial number 0000 when they leave the factory. The Plus package or Chemoclean are not enabled on leaving the factory.	In the case of LSCH/LSCP with SNR 0000, a **device** serial number can be entered once in fields E115 to E117. Then enter the release code for the Plus package and/or Chemoclean.	For a detailed description, see "Replacing central module" section.
No HART or PROFIBUS PA/ DP interface function	Incorrect central module	HART: LSCH-H1 or H2 module, PROFIBUS PA: LSCP-PA module, PROFIBUS DP: LSCP-DP module, see field E112.	Replace central module; user or Endress+Hauser Service.
	Wrong software	SW version see field E111.	SW can be modified with optoscope.
	Bus problem	Remove some devices and repeat the test.	Contact Endress+Hauser Service.

8 Maintenance

⚠ WARNING

Process pressure and temperature, contamination, electrical voltage

Risk of serious or fatal injury

- ▶ If the sensor has to be removed during maintenance work, avoid hazards posed by pressure, temperature and contamination.
- ▶ De-energize the device before opening it.
- ▶ Power can be supplied to switching contacts from separate circuits. De-energize these circuits before working on the terminals.

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

Maintenance work at the transmitter comprises:

- Calibration (see "Calibration" section)
- Cleaning of assembly and sensor
- Cable and connection check

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

NOTICE

Electrostatic discharge (ESD)

Risk of damage to electronic components

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

8.1 Maintenance of the entire measuring point

8.1.1 Cleaning the transmitter

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

In accordance with DIN 42 115, the front is resistant to:

- Ethanol (short periods)
- Diluted acids (max. 2% HCl)
- Diluted bases (max. 3% NaOH)
- Soap-based household cleaners

NOTICE

Prohibited cleaning agents

Damage to the housing surface or housing seal

- ▶ For cleaning purposes, never use concentrated mineral acids or bases.
- ▶ Never use organic cleaners such as benzyl alcohol, methanol, methylene chloride, xylene or concentrated glycerol cleaner.
- ▶ Never use high-pressure steam for cleaning purposes.

8.1.2 Maintenance of chlorine sensors

Corrective maintenance for chlorine sensors and assemblies is described in the operating instructions. Use and refer to the operating instructions relating to your measuring system:

CCS120	BA00388C/07/EN
CCS140/141	BA00058C/07/EN
CCS240/241	BA00114C/07/EN
963	BA00039C/07/EN

There you will find in detail:
- Function and system design of the sensor
- Installation
- Electrical connection
- Commissioning and calibration
- Calculation samples and tables to check the measured value
- Maintenance, regeneration, cleaning
- Error table
- Accessories and spare parts
- Technical data and order information

8.1.3 Maintenance of the assembly

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

8.1.4 Maintenance of pH/ORP sensors (version EP)

⚠ CAUTION
The cleaning system is not switched off during calibration or maintenance activities
Risk of injury due to medium or cleaning agent
- ▶ If a cleaning system is connected, switch it off before removing a sensor from the medium.
- ▶ If you are not switching off the cleaning system because you wish to test the cleaning function, wear protective clothing, goggles and gloves or take other appropriate measures.

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).

⚠ CAUTION
Risk of injury
- ▶ 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 desulphurizing 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.

- Fibres, suspended substances
  Water under pressure, poss. with surface-active agents.
- Light biological deposits
  Water under pressure.

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

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

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.

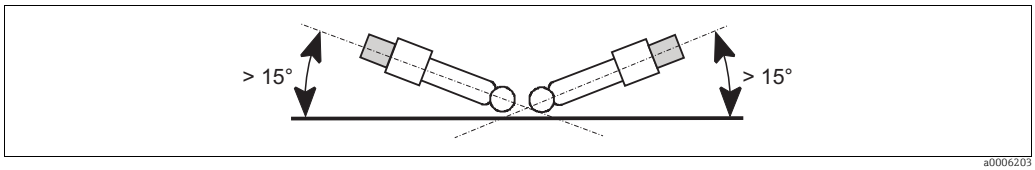


Fig. 43: Permitted installation angle of glass electrodes

Check for reference system reduction:
The inner metal lead of the reference system (Ag/AgCl) of a combination electrode or a separate reference electrode is usually light-brown and matt. A silver-coloured reference system is reduced and therefore defective. The cause is a current flowing through the reference element.

Possible causes for the current flow:
- Incorrect operating mode of the measuring instrument (PML pin connected, but operating mode without solution ground ("without PML") selected.
- Shunt in measuring cable (e. g. through humidity) between reference line and grounded screen or PM line.
- Measuring instrument defective (shunt in reference input or entire input amplifier downstream of PE).

8.1.5 Maintenance pH connecting lines and junction boxes (EP)

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

NOTICE

Faulty measurement due to moisture in the measuring cable

▶ 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, 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.

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

8.2 Test and simulation

8.2.1 Chlorine sensors

Chlorine sensors work according to the amperometric principle and supply very small direct current as measuring signals.
A chlorine sensor can be simulated by a DC source. Due to the small currents, however, the simulation is highly sensitive. Lines should be screened and the simulator earthed. You will find typical slope values in the table below.

Sensor	Typical slope value
CCS120	approx. 115 nA per mg Cl/l
CCS140	approx. 25 nA per mg Cl/l
CCS141	approx. 80 nA per mg Cl/l
CCS240	approx. 100 nA per mg ClO_2/l
CCS241	approx. 350 nA per mg ClO_2/l
963	approx. 20 µA per mg Cl/l

8.2.2 Temperature measurement

The transmitter uses the NTC sensor of the chlorine sensor to measure the temperature. Due to the relatively high sensor resistance, a two-wire connection is sufficient. Simulation can take place with a normal decade resistor. The table below contains some simulation values.

Temperature	NTC simulation value
0 °C (32 °F)	29.490 kΩ
10 ° C (50 °F)	18.787 kΩ
20 °C (68 °F)	12.268 kΩ
25 °C (77 °F)	10.000 kΩ
30 °C (86 °F)	8.197 kΩ
40 °C (104 °F)	5.594 kΩ

In case of a defective temperature sensor, measurement is automatically continued with 25 °C (77 °F).

8.2.3 pH/ORP measurement

Simulation takes place with a pH/mV simulator or an mV voltage source.

On the CCM223/253, pH or mV must always be measured symmetrically. For this reason, each simulation requires potential matching with the simulator. Connect the reference signal of the simulators (normal screen of the pH coaxial measuring line) to the PA/PM terminal of the transmitter.

Zero point rapid test
- On the CCM223 connect the BNC inner conductor to the BNC receptacle and the PM terminal.
- On the CCM253 connect the pH terminal, the Ref terminal and the PM terminal.
- For pH, the reading must be about 7, for ORP about 0 mV.

Test with DC voltage source

pH value	Simulation
2	295 mV
4	177 mV
7	0 mV
9	-118 mV
12	-295 mV

8.2.4 Flow monitoring

Flow is monitored by an inductive proximity switch (INS) in the CCA250 assembly. This switch is powered by 15 V from the auxiliary voltage output of the transmitter.

Function of the INS

Flow	INS	INS output
yes	damped	low impedance
no	not damped	high impedance

Test or emergency mode
If you connect terminal 93 to terminal 85 and terminal 94 to terminal 86, this simulates an active proximity switch and thus a correct flow.

Do not run the measuring system continuously in this state and switch the flow monitor back on as soon as possible!

9 Repair

9.1 Spare parts

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

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

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

9.2 Dismantling the panel-mounted instrument

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

Please refer to the following diagram for the item numbers.

1. Disconnect the terminal blocks (items 150 to 180) from the rear of the device to de-energise the device.
2. Press in the latches of the end frame (item 340) and remove the frame from the rear.
3. Release the special screw (item 400) by turning it counter-clockwise.
4. 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.
5. Remove the Cl transmitter (item 110/120) as follows:
   – Using fine side-cutting pliers, nip off the heads of the synthetic distance holders.
   – Then remove the module from above.

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

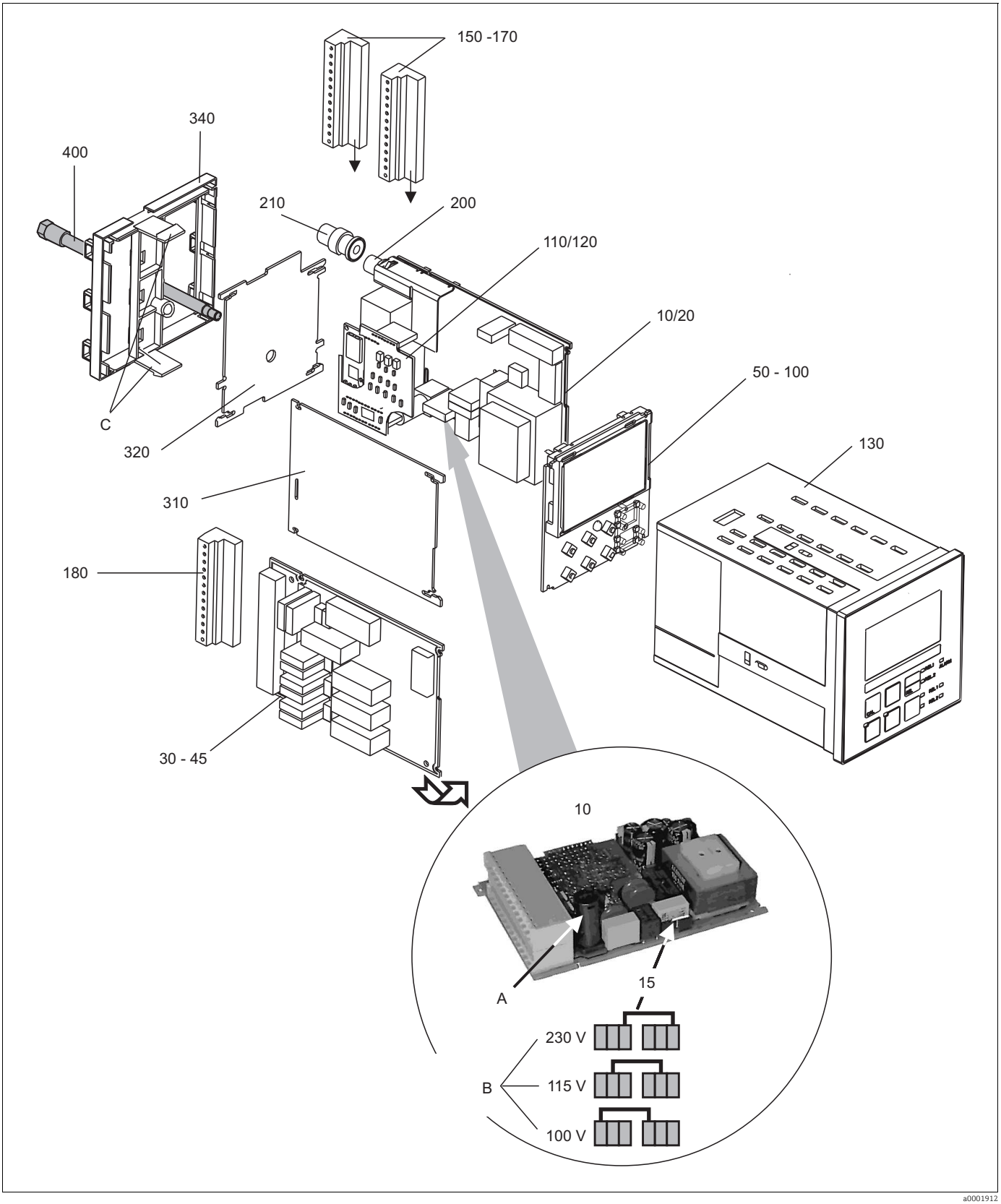


Fig. 44: Exploded view drawing of panel mounted instrument

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

Item	Kit description	Name	Function/contents	Order number
10	Power unit (main module)	LSGA	100 / 115 / 230 V AC	51500317
15	Jumper		Part of power unit item 10	
20	Power unit (main module)	LSGD	24 V AC + DC	51500318
30	Relay module	LSR1-2	2 relays	51500320
35	Relay module	LSR2-2i	2 relays + current input 4 to 20 mA	51504304
35	Kit CxM2x3 Relay module PROFIBUS DP	LSR2-DP	Relay module + 2 relays Current input and terminals DP valid of: hardware version 2.10	71134732
40	Relay module	LSR1-4	4 relays	51500321
45	Relay module	LSR2-4i	4 relays + current input 4 to 20 mA	51504305
50	Central module (controller)	LSCH-S1	1 current output	51502467
60	Central module (controller)	LSCH-S2	2 current outputs	51502468
70	Central module (controller)	LSCH-H1	1 current output + HART	51502497
80	Central module (controller)	LSCH-H2	2 current outputs + HART	51502496
90	Central module (controller)	LSCP-PA	PROFIBUS PA/no current output	51502495
100	Central module (controller)	LSCP-DP	PROFIBUS DP/no current output	51502498
100	Kit CCM2x3 Central module PROFIBUS DP	LSCP-DP	Central module PROFIBUS DP Relay module + 2 relays Current input and terminals valid of: hardware version 2.10	71134731
110	Cl transmitter	MKC1	Cl + temperature	51502466
120	Cl/pH transmitter	MKC1	Cl, pH/mV + temperature	51502465
130, 400	Housing module		Housing with front membrane, sensory tappets, gasket, special screw, tensioning dogs, connection plates and nameplates	51501075
150	Terminal strip set Standard + HART		Complete terminal strip set, standard + HART	51502463
160	Terminal strip set PROFIBUS PA		Complete terminal strip set, PROFIBUS PA	51502464
170	Terminal strip set PROFIBUS DP		Complete terminal strip set, PROFIBUS DP	51502490
180	Terminal strip		Terminal strip for relay module	51501078
200	pH input socket		Socket with screen plate	51501070
210	BNC connector		BNC easy solderless, angled	50074961
310, 320, 340, 400	Housing mechanical parts		Rear plate, side panel, end frame, special screw	51501076
340	End frame PROFIBUS DP		Rear frame for PROFIBUS DP, with D-submin plug connector	51502513
A	Fuse		Part of power unit, item 10	
B	Choice of line voltage		Position of jumper on power unit, item 10 depending on line voltage	
C	End frame latches		Part of the end frame	

9.3 Dismantling the field instrument

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

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

Proceed as follows:

1. Open and remove the cover of the connection compartment (item 420).
2. Disconnect the mains terminal (item 270) to de-energize the device.
3. Open the display cover (item 410) and loosen the ribbon cables (item 250) on the side of the central module (item 50 to 100).
4. To remove the central module (item 50), loosen the screw in the display cover (item 450 b).
5. Proceed as follows to remove the electronics box (item 230):
   – Release the screws in the housing base (item 450 a) with two revolutions.
   – Then push the entire box backwards and remove it from above.
   – Make sure that module locks do not open!
   – Loosen the ribbon cables (item 250).
   – Bend the module locks out and remove the modules.
6. To remove the docking module (item 240), remove the screws in the housing base (item 450 c) and remove the entire module from above.
7. Proceed as follows to remove the Cl transmitter (item 110/120) on instruments with pH/mV input:
   – Bend the screening plate up.
   – Disconnect the connected strand (pH input, strand comes from the BNC connection jack).
   – Using fine side-cutting pliers, nip off the heads of the synthetic distance sleeves.
   – Then remove the module from above.

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

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

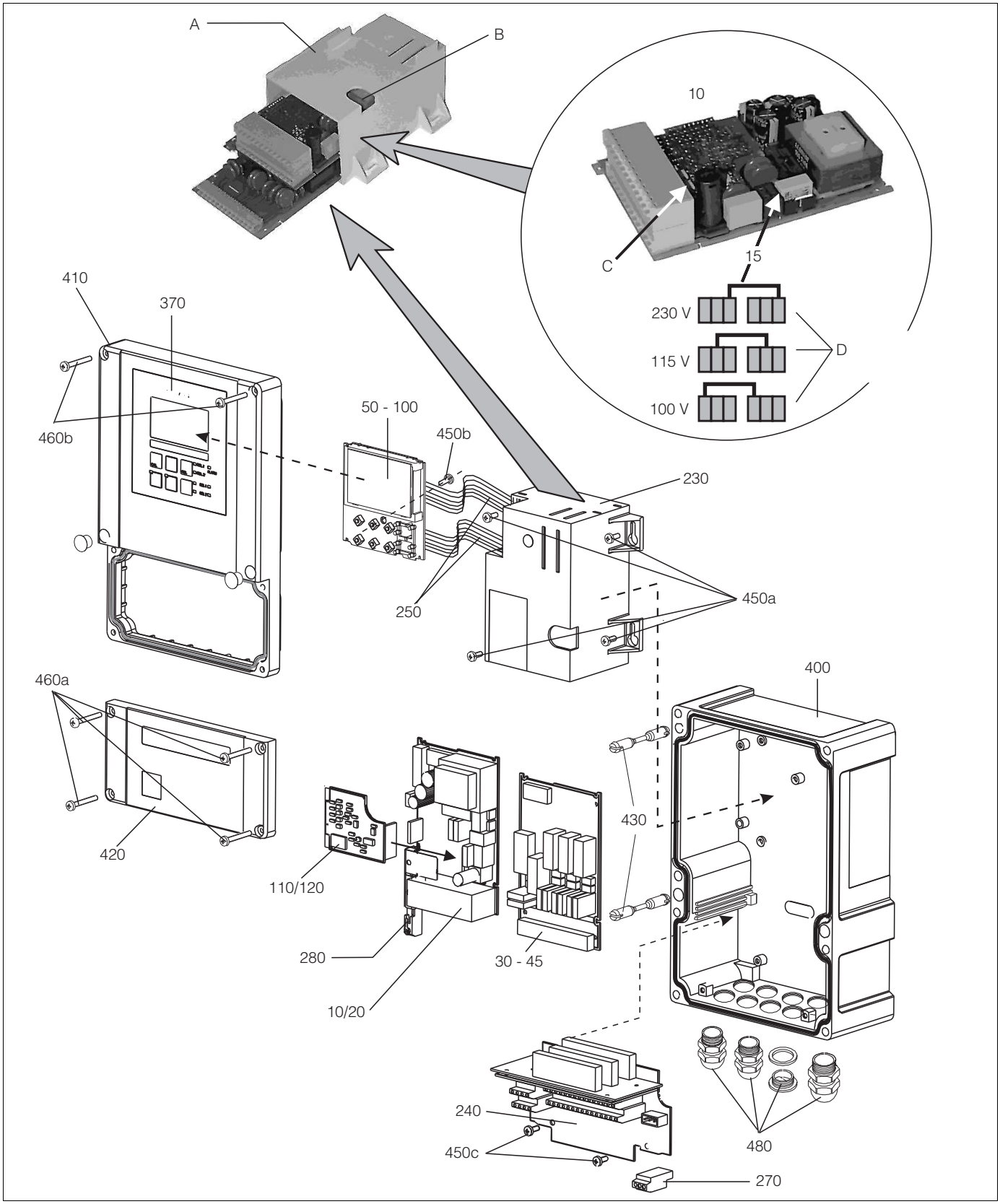


Fig. 45: Exploded view drawing of field instrument

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

Item	Kit description	Name	Function/contents	Order number
10	Power unit (main module)	LSGA	100 / 115 / 230 V AC	51500317
15	Jumper		Part of power unit item 10	
20	Power unit (main module)	LSGD	24 V AC + DC	51500318
30	Relay module	LSR1-2	2 relays	51500320
35	Relay module	LSR2-2i	2 relays + current input 4 to 20 mA	51504304
35	Kit CxM2x3 Relay module PROFIBUS DP	LSR2-DP	Relay module + 2 relays Current input and terminals DP valid of: hardware version 2.10	71134732
40	Relay module	LSR1-4	4 relays	51500321
45	Relay module	LSR2-4i	4 relays + current input 4 to 20 mA	51504305
50	Central module (controller)	LSCH-S1	1 current output	51502467
60	Central module (controller)	LSCH-S2	2 current outputs	51502468
70	Central module (controller)	LSCH-H1	1 current output + HART	51502497
80	Central module (controller)	LSCH-H2	2 current outputs + HART	51502496
90	Central module (controller)	LSCP-PA	PROFIBUS PA/no current output	51502495
100	Central module (controller)	LSCP-DP	PROFIBUS DP/no current output	51502498
100	Kit CCM2x3 Central module PROFIBUS DP	LSCP-DP	Central module PROFIBUS DP Relay module + 2 relays Current input and terminals valid of: hardware version 2.10	71134731
110	Cl transmitter	MKC1	Cl + temperature	51502466
120	Cl/pH transmitter	MKC1	Cl, pH/mV + temperature	51502465
230, 240	Internal housing parts		Docking assembly, empty electronics box, small parts	51501073
250	Ribbon cables		2 ribbon cables	51501074
270	Terminal strip		Terminal strip for connection to mains	51501079
280	pH terminal		pH terminal with screen plate	51501071
370, 410 420, 430 460	Housing cover		Display cover, connection compartment cover, front membrane, hinges, cover screws, small parts	51501068
400, 480	Housing base		Base, threaded joints	51501072
310, 320, 340, 400	Housing mechanical parts		Rear plate, side panel, end frame, special screw	51501076
A	Electronics box with relay module LSR1-x (bottom) and power unit LSGA/LSGD (top)			
B	Fuse also accessible if electronics box installed			
C	Fuse		Part of power unit, item 10	
D	Choice of line voltage		Position of jumper on power unit, item 10 depending on line voltage	

9.4 Replacing the central module

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

Proceed as described below if a central module is replaced:

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

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

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

9.5 Return

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

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

9.6 Disposal

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

10 Accessories

10.1 Sensors

CCS120
- Amperometric sensor for total chlorine
- Measuring range 0.1 to 10 mg/l
- Ordering acc. to product structure, www.products.endress.com/ccs120
- Technical Information TI00388C/07/EN

CCS140
- Membrane-covered amperometric sensor for free chlorine
- Measuring range 0.05 to 20 mg/l
- Ordering acc. to product structure, www.products.endress.com/ccs140
- Technical Information TI00058C/07/EN

CCS141
- Membrane-covered amperometric trace sensor for free chlorine
- Measuring range 0.01 to 5 mg/l
- Ordering acc. to product structure, www.products.endress.com/ccs141
- Technical Information TI00058C/07/EN

CCS240
- Membrane-covered amperometric sensor for chlorine dioxide
- Measuring range 0.05 to 20 mg/l
- Ordering acc. to product structure, www.products.endress.com/ccs240
- Technical Information (TI00114C/07/EN)

CCS241
- Membrane-covered amperometric trace sensor for chlorine dioxide
- Measuring range 0.01 to 5 mg/l
- Ordering acc. to product structure, www.products.endress.com/ccs241
- Technical Information (TI00114C/07/EN)

10.2 Connection accessories

CYK71 measuring cable
- Non-terminated cable for the connection of sensors (e.g. conductivity sensors) or the extension of sensor cables
- Sold by the meter, order numbers:
  - non-Ex version, black: 50085333
  - Ex version, blue: 50085673

CMK measuring cable
- For cable extension between junction box and transmitter, non terminated, sold by the meter
- Order no. 50005374

CPK1 measuring cable
- For pH/ORP electrodes with GSA plug-in head
- Ordering acc. to product structure, see Technical Information (TI00118C/07/EN)

CPK9 measuring cable
- For sensors with TOP68 plug-in head, for high-temperature and high-pressure applications, IP 68
- Ordering acc. to product structure, see Technical Information (TI00118C/07/EN)

MK extension cable
- Two-wire signal cable with additional screen and PVC insulation.
- Particularly for the transmission of output signals of transmitters or input signals of controllers and for temperature measurement.
- Order no. 50000662

Junction box VBC
- Metallic junction box for cable extension,
- Dimensions (W x D x H): 125 x 80 x 54 mm / 4.92 x 3.15 x 2.13 inches
- Order no. 50005181

Junction box VBM
- For cable extension
- 10 terminals
- Cable entries: 2 x Pg 13.5 or 2 x NPT ½"
- Material: aluminum
- Ingress protection: IP 65 (≙ NEMA 4X)
- Order numbers:
  - cable entries Pg 13.5: 50003987
  - cable entries NPT ½": 51500177

10.3 Mounting accessories

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

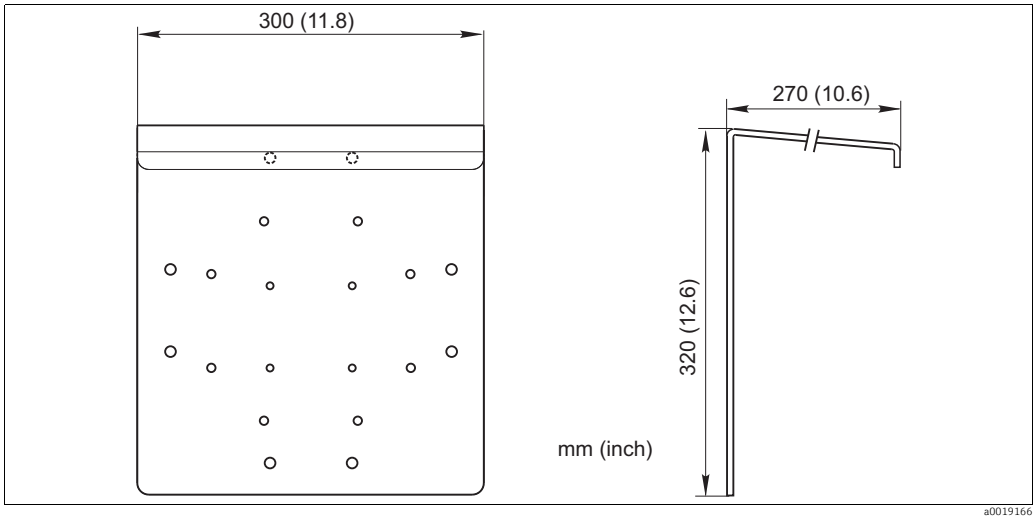


Fig. 46: Weather protection cover for field devices

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

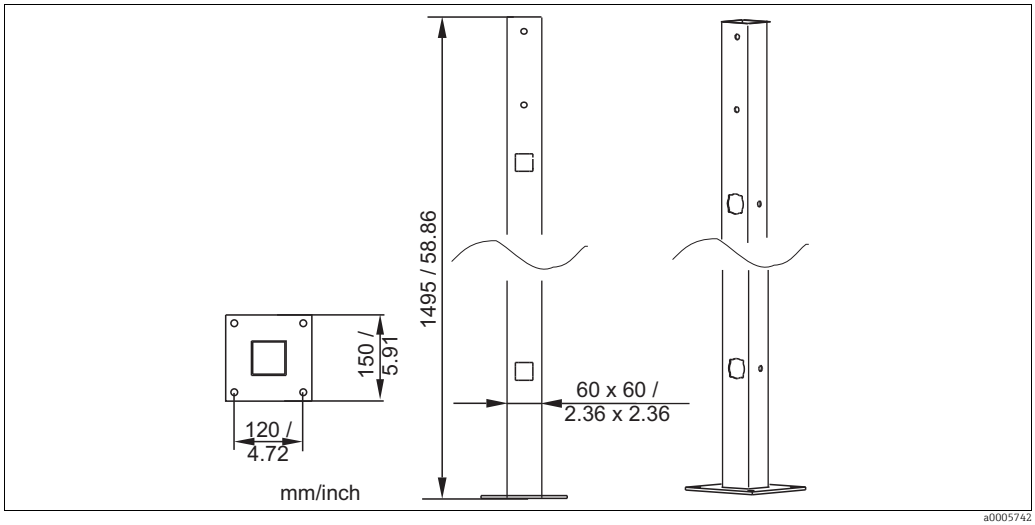


Fig. 47: Universal post

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

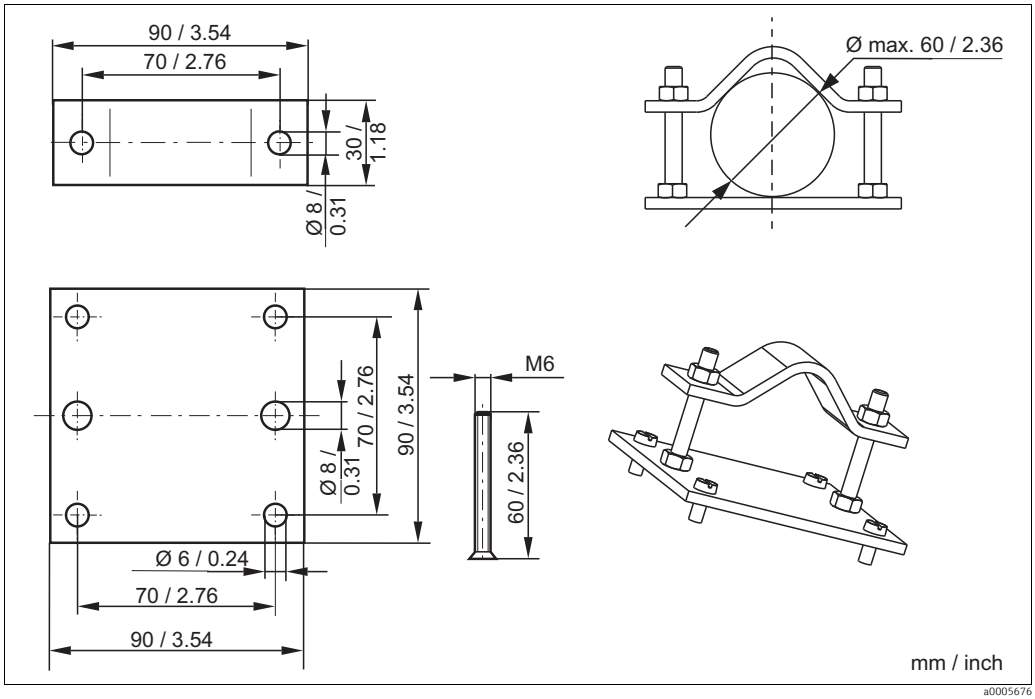


Fig. 48: Post mounting kit

10.4 Measuring system

Compact measuring station CCE10/CCE11
- Panel mounted ready for connection for holding one transmitter, with flow assembly CCA250
- Ordering acc. to product structure, s. Technical Information TI00440C/07/EN

10.5 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. 51502242
- Chemoclean
  Order no. 51502871
- 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
- pH package for EK version
  Order no. 51502460
- pH package for ES version
  Order no. 51503526

10.6 Calibration accessories

CCM182
- Microprocessor-controlled photometer for determining chlorine and pH value
- Measuring range for chlorine: 0.05 - 6 mg/l
- Measuring range for pH value: 6.5 - 8.4
- Order no.: CCM182-0

11 Technical data

11.1 Input

Measured variables	Total chlorine, free chlorine, chlorine dioxide, temperature pH or ORP (optional)	
Measuring range	Display and measuring range	0 to 5 / 0 to 20 mg/l
	Application measuring range	
	CCS120	0.1 to 10 mg/l
	CCS140/240	0.05 to 20 mg/l
	CCS141/241	0.01 to 5 mg/l
	963	0.05 to 5 mg/l
	Temperature compensation range	
	CCS140/240/141/241 and 963	2 to 45 °C (36 to 113 °F)
	CCS120	5 to 45 °C (41 to 113 °F)
	pH compensation range for free chlorine	pH 4 to 9
	Calibration range	pH 4 to 8
	Reference point for nominal slope	25 °C (77 °F) / pH 7.2
Cable specification	Chlorine/chlorine dioxide sensors CCS140/141/240/241:	max. 30 m (98 ft) with CMK cable
	Chlorine sensor 963:	max. 30 m (98 ft) with MK cable
	Total chlorine sensor CCS120:	max. 15 m (49 ft) with CPK9 cable
	pH/ORP measurement:	max. 50 m (164 ft) with CYK71 cable
Cl_2/ClO_2 signal input	CCS120/140/141/240/241:	0 to 5000 nA
	Sensor 963:	-100 to 500 µA
Binary inputs	Voltage:	10 to 50 V
	Power consumption:	max. 10 mA
Current input	4 to 20 mA, galvanically separated Load: 260 Ω at 20 mA (voltage drop 5.2 V)	

11.2 Output

Output signal

0/4 ... 20 mA, galvanically separated, active

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

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

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

Signal on alarm

2.4 or 22 mA in case of an error

Load

maximum 500 Ω

Transmission range

Cl_2/ClO_2:	0 to 10 mg/l for CCS120 0 to 20 mg/l for CCS140/240 0 to 5 mg/l for CCS141/241 and 963
Cl_2/ClO_2:	0 to 10 mg/l for OCS120 0 to 20 mg/l for OCS140/240 0 to 5 mg/l for OCS141/241 and 963
Temperature:	0 to 50 °C (32 to 122 °F)
pH:	pH 4 to 9
ORP:	0 to 1500 mV

Resolution

max. 700 digits/mA

Isolation voltage

max. 350 V_{RMS}/500 V DC

Overvoltage protection

according to EN 61000-4-5

Auxiliary voltage output

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

Contact outputs

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

Limit contactor

Pickup/dropout delay:	0 to 2000 s

Controller

Function (adjustable):	Pulse-length/pulse-frequency controller, three-point step controller for Cl_2/ClO_2
Controller response:	P, PI, PD, PID, basic load dosing
Controller gain K_p:	0.01 to 20.00
Integral action time T_n:	0.0 to 999.9 min
Derivative action time T_v:	0.0 to 999.9 min
Period length of pulse-length controller:	0.5 to 999.9 s
Frequency for pulse-frequency controller:	60 to 180 min^{-1}
Basic load:	0 to 40% of max. set value
Motor run time for three-point step controller:	10 to 999 s
Neutral zone for three-point step controller:	0 to 40 %

Alarm

Function (switchable):	Latching/momentary contact
Alarm threshold adjustment range:	Cl_2/ClO_2/pH/ORP/temperature: total measuring range
Alarm delay:	0 to 2000 s (min)
Monitoring time lower limit violation:	0 to 2000 min
Monitoring time upper limit violation:	0 to 2000 min

Protocol specific data

HART	
Manufacturer ID	11_h
Device type code	0096_h
Transmitter specific revision	0002_h
HART specification	5.0
DD files	www.products.endress.com/hart
Load HART	250 Ω
Device variables	None (dynamic variables PV, SV, only)
Features supported	-

PROFIBUS PA	
Manufacturer ID	11_h
Ident number	1519_h
Device revision	11_h
Profile version	2.0
GSD files	www.products.endress.com/profibus
GSD file version	
Output values	Main value, temperature value
Input values	Display value of PLC
Features supported	Device locking: The device can be locked by hardware or software.

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

11.3 Power supply

Supply voltage

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

Fieldbus connection

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

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

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

Power consumption

max. 7.5 VA

Sensor connection

Type of sensor	Cable	Extension
Chlorine / chlorine dioxide sensors CCS140 / 141 / 240 / 241	3 m (9.8 ft) CMK, fixed cable	VBC junction box + CMK
Chlorine sensor 963	–	VBC junction box + MK
Temperature sensor for sensor 963	CPK1	
Total chlorine sensor CCS120	CPK9-N*A1B	VBC junction box + CYK71
pH or ORP sensor without temperature sensor	CPK1 for sensors with GSA plug-in head CPK9 for sensors with ESA plug-in head	VBC junction box + CYK71

Mains protection

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

11.4 Performance characteristics

Cl_2/ClO_2 measurement

Measured value resolution	
CCS120/140/240 and 963:	0.01 mg/l
CCS141/241:	0.001 mg/l
Measurement deviation[1] display (pH, T = const.)	
CCS140/141/240/241:	max. 0.5 % of measured value ±4 digits
CCS120 and 963:	max. 1 % of measured value ±4 digits
Repeatability:	max. 0.2 % of measuring range
Measurement deviation[1] of signal output	max. 0.75 % of current output range

Temperature measurement

Measured value resolution:	0.1 °C
Measurement deviation[1] of display:	±0.3 K
Measurement deviation[1] signal output:	max. 1.25 % of current output range

pH and ORP measurement

pH measured value resolution:	pH 0.01
ORP measured value resolution:	1 mV
Measurement deviation[1)] of display pH:	pH 0.03
Measurement deviation[1)] of display ORP:	3 mV
Measurement deviation[1)] of pH signal output:	max. 1.25 % of current output range
Measurement deviation[1)] of ORP signal output:	max. 1.25 % of current output range

1) acc. to IEC 60746-1, at nominal operating conditions

11.5 Environment

Ambient temperature

-10 to +55 °C (+14 to +131 °F)

Storage temperature

–25 to +65 °C (-13 to +149 °F)

Electromagnetic compatibility

Interference emission and interference immunity as per EN 61326-1:2006, EN 61326-2-3:2006

Ingress protection

Panel mounted instrument:	IP 54 (front), IP 30 (housing)
Field instrument:	IP 65 / tightness acc. to NEMA 4X

Electrical safety

according EN/IEC 61010-1:2001, Installation Category II, for use up to 2000 m above sea level

CSA

Apparatus with CSA General Purpose Approval are certified for indoor use.

Relative humidity

10 to 95%, non-condensing

Pollution degree

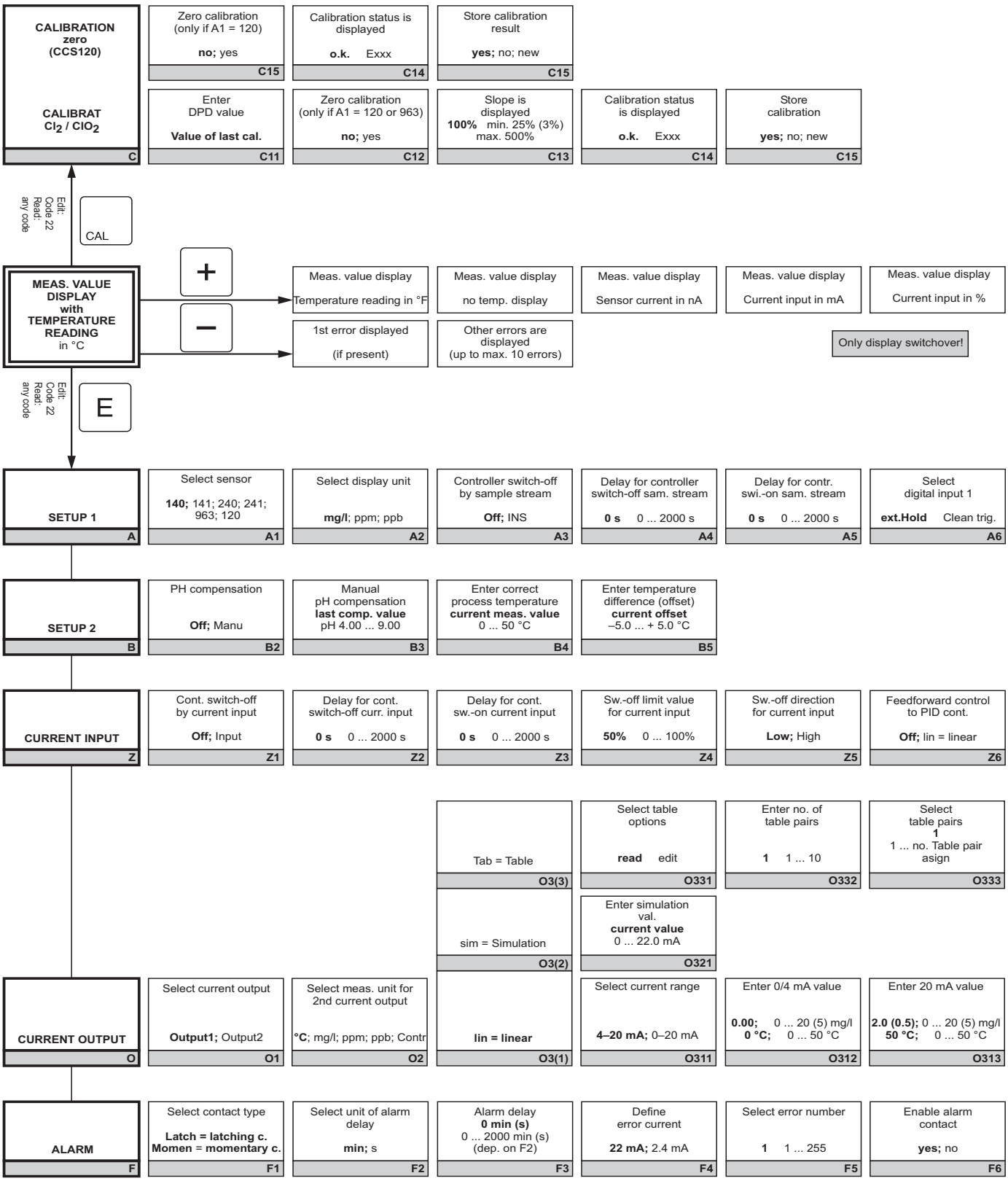
The product is suitable for pollution degree 2.

11.6 Mechanical construction

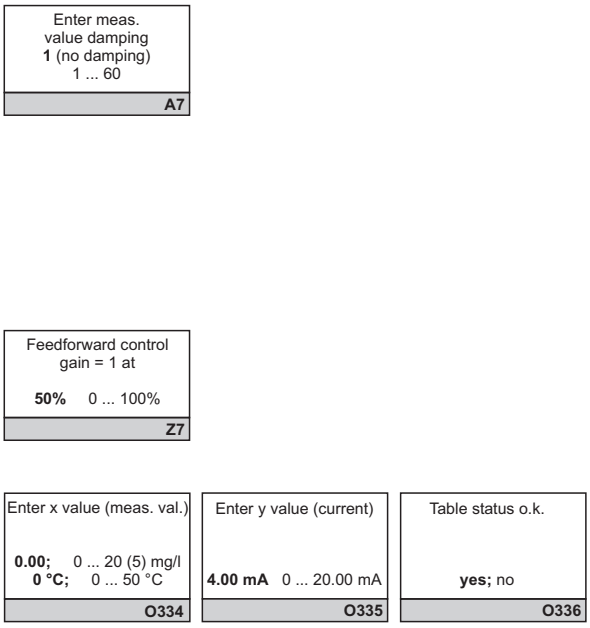
Dimensions	Panel-mounted instrument:	96 x 96 x 145 mm (3.78 x 3.78 x 5.71 inches) Installation depth: approx. 165 mm (6.50")
	Field instrument:	247 x 170 x 115 mm (9.72 x 6.69 x 4.53 inches)
Weight	Panel-mounted instrument:	max. 0.7 kg (1.5 lb)
	Field instrument:	max. 2.3 kg (5.1 lb)
Material	Housing of panel-mounted instrument:	Polycarbonate
	Field housing:	ABS PC Fr
	Front membrane:	Polyester, UV-resistant
Terminals	Cross section	max. 2.5 mm^2 (14 AWG)

12 Appendix

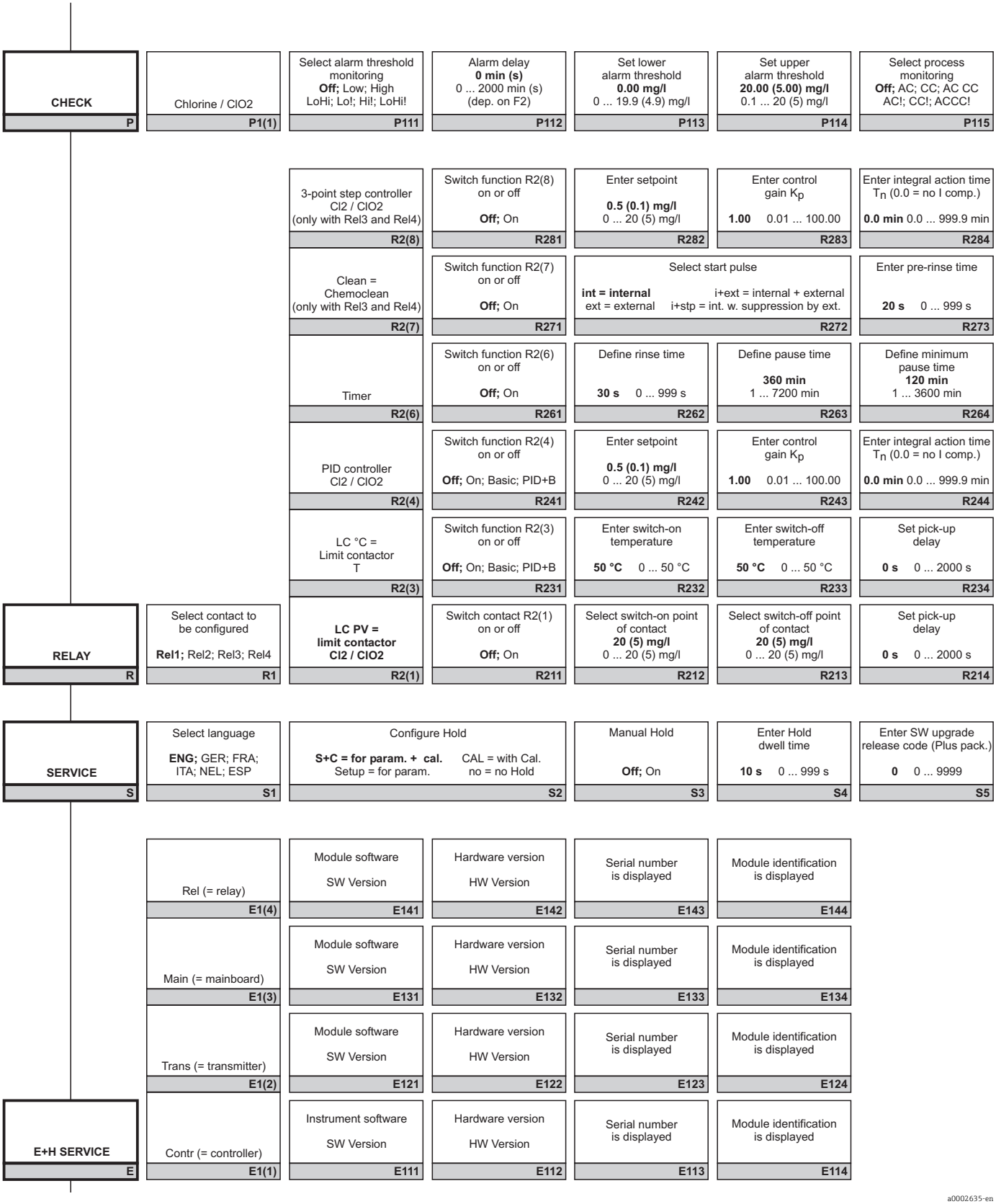
Operating matrix CCM223/253 - versions EK and ES



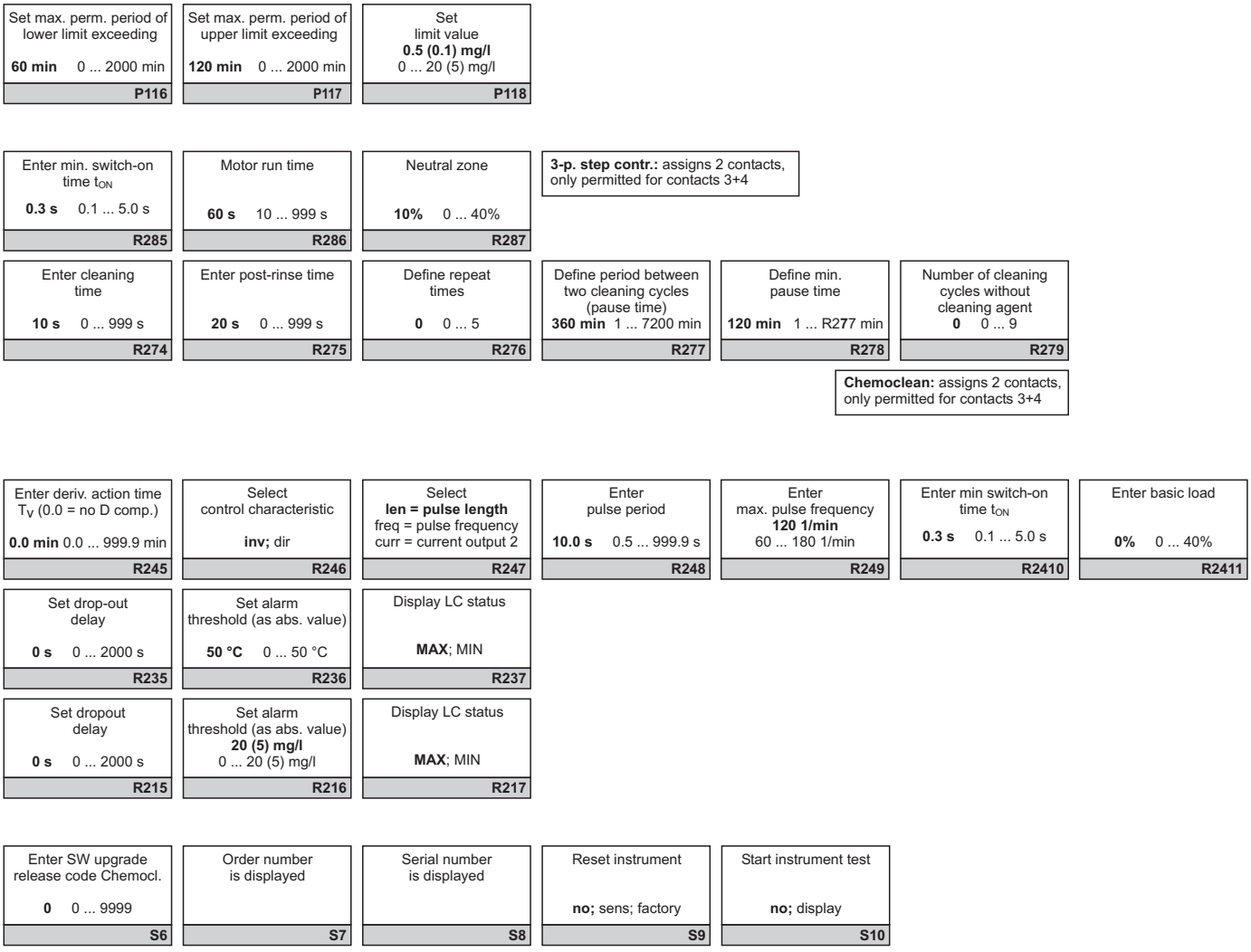
a0002633-en


Enter meas.
value damping
1 (no damping)
1 ... 60
A7
Feedforward control
gain = 1 at
50% 0 ... 100%
Z7
Enter x value (meas. val.)
0.00; 0 ... 20 (5) mg/l
0 °C; 0 ... 50 °C
O334
Enter y value (current)
4.00 mA 0 ... 20.00 mA
O335
Table status o.k.
yes; no
O336
Enable error current
for error just entered
no; yes
F7
Automatic start
of cleaning function
no; yes
F8
Select “next error”
or return to menu
next = next error
<---R
F9

a0002634-en

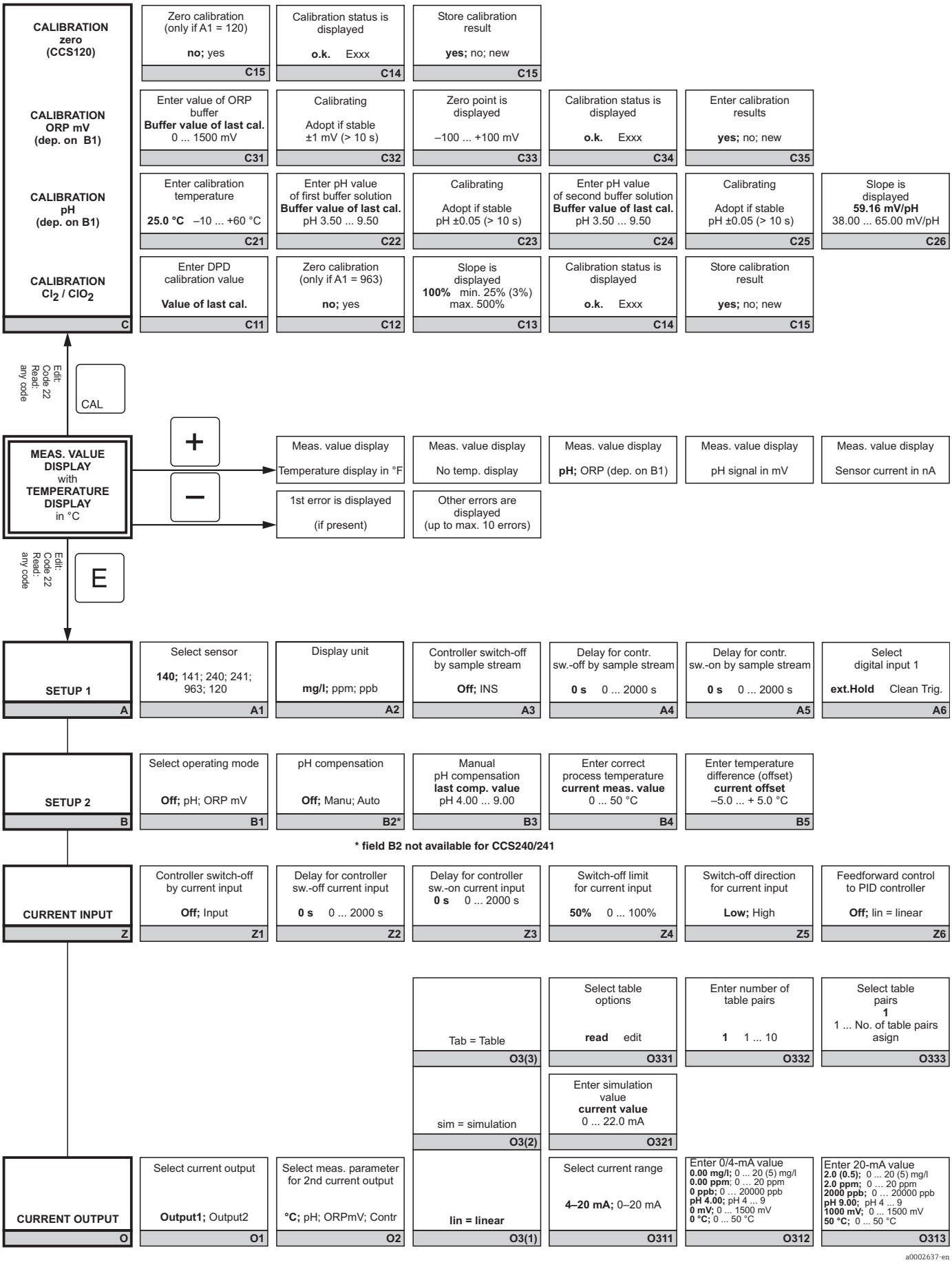

CHECK
P
Chlorine / ClO2
P1(1)
Select alarm threshold monitoring
Off; Low; High
LoHi; Lo!; Hi!; LoHi!
P111
Alarm delay
0 min (s)
0 ... 2000 min (s)
(dep. on F2)
P112
Set lower alarm threshold
0.00 mg/l
0 ... 19.9 (4.9) mg/l
P113
Set upper alarm threshold
20.00 (5.00) mg/l
0.1 ... 20 (5) mg/l
P114
Select process monitoring
Off; AC; CC; AC CC
AC!; CC!; ACCC!
P115
3-point step controller Cl2 / ClO2 (only with Rel3 and Rel4)
R2(8)
Switch function R2(8) on or off
Off; On
R281
Enter setpoint
0.5 (0.1) mg/l
0 ... 20 (5) mg/l
R282
Enter control gain Kp
1.00 0.01 ... 100.00
R283
Enter integral action time Tn (0.0 = no I comp.)
0.0 min 0.0 ... 999.9 min
R284
Clean = Chemoclean (only with Rel3 and Rel4)
R2(7)
Switch function R2(7) on or off
Off; On
R271
Select start pulse
int = internal i+ext = internal + external
ext = external i+stp = int. w. suppression by ext.
R272
Enter pre-rinse time
20 s 0 ... 999 s
R273
Timer
R2(6)
Switch function R2(6) on or off
Off; On
R261
Define rinse time
30 s 0 ... 999 s
R262
Define pause time
360 min
1 ... 7200 min
R263
Define minimum pause time
120 min
1 ... 3600 min
R264
PID controller Cl2 / ClO2
R2(4)
Switch function R2(4) on or off
Off; On; Basic; PID+B
R241
Enter setpoint
0.5 (0.1) mg/l
0 ... 20 (5) mg/l
R242
Enter control gain Kp
1.00 0.01 ... 100.00
R243
Enter integral action time Tn (0.0 = no I comp.)
0.0 min 0.0 ... 999.9 min
R244
LC °C = Limit contactor T
R2(3)
Switch function R2(3) on or off
Off; On; Basic; PID+B
R231
Enter switch-on temperature
50 °C 0 ... 50 °C
R232
Enter switch-off temperature
50 °C 0 ... 50 °C
R233
Set pick-up delay
0 s 0 ... 2000 s
R234
RELAY
R
Select contact to be configured
Rel1; Rel2; Rel3; Rel4
R1
LC PV = limit contactor Cl2 / ClO2
R2(1)
Switch contact R2(1) on or off
Off; On
R211
Select switch-on point of contact
20 (5) mg/l
0 ... 20 (5) mg/l
R212
Select switch-off point of contact
20 (5) mg/l
0 ... 20 (5) mg/l
R213
Set pick-up delay
0 s 0 ... 2000 s
R214
SERVICE
S
Select language
ENG; GER; FRA; ITA; NEL; ESP
S1
Configure Hold
S+C = for param. + cal. CAL = with Cal.
Setup = for param. no = no Hold
S2
Manual Hold
Off; On
S3
Enter Hold dwell time
10 s 0 ... 999 s
S4
Enter SW upgrade release code (Plus pack.)
0 0 ... 9999
S5
Rel (= relay)
E1(4)
Module software SW Version
E141
Hardware version HW Version
E142
Serial number is displayed
E143
Module identification is displayed
E144
Main (= mainboard)
E1(3)
Module software SW Version
E131
Hardware version HW Version
E132
Serial number is displayed
E133
Module identification is displayed
E134
Trans (= transmitter)
E1(2)
Module software SW Version
E121
Hardware version HW Version
E122
Serial number is displayed
E123
Module identification is displayed
E124
E+H SERVICE
E
Contr (= controller)
E1(1)
Instrument software SW Version
E111
Hardware version HW Version
E112
Serial number is displayed
E113
Module identification is displayed
E114

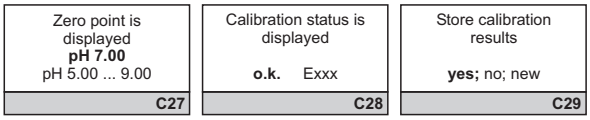
a0002635-en

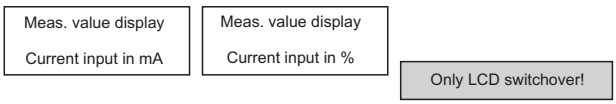

Set max. perm. period of lower limit exceeding
60 min 0 ... 2000 min
P116
Set max. perm. period of upper limit exceeding
120 min 0 ... 2000 min
P117
Set limit value
0.5 (0.1) mg/l
0 ... 20 (5) mg/l
P118
Enter min. switch-on time t_{ON}
0.3 s 0.1 ... 5.0 s
R285
Motor run time
60 s 10 ... 999 s
R286
Neutral zone
10% 0 ... 40%
R287
3-p. step contr.: assigns 2 contacts, only permitted for contacts 3+4
Enter cleaning time
10 s 0 ... 999 s
R274
Enter post-rinse time
20 s 0 ... 999 s
R275
Define repeat times
0 0 ... 5
R276
Define period between two cleaning cycles (pause time)
360 min 1 ... 7200 min
R277
Define min. pause time
120 min 1 ... R277 min
R278
Number of cleaning cycles without cleaning agent
0 0 ... 9
R279
Chemoclean: assigns 2 contacts, only permitted for contacts 3+4
Enter deriv. action time T_V (0.0 = no D comp.)
0.0 min 0.0 ... 999.9 min
R245
Select control characteristic
inv; dir
R246
Select
len = pulse length
freq = pulse frequency
curr = current output 2
R247
Enter pulse period
10.0 s 0.5 ... 999.9 s
R248
Enter max. pulse frequency
120 1/min
60 ... 180 1/min
R249
Enter min switch-on time t_{ON}
0.3 s 0.1 ... 5.0 s
R2410
Enter basic load
0% 0 ... 40%
R2411
Set drop-out delay
0 s 0 ... 2000 s
R235
Set alarm threshold (as abs. value)
50 °C 0 ... 50 °C
R236
Display LC status
MAX; MIN
R237
Set dropout delay
0 s 0 ... 2000 s
R215
Set alarm threshold (as abs. value)
20 (5) mg/l
0 ... 20 (5) mg/l
R216
Display LC status
MAX; MIN
R217
Enter SW upgrade release code Chemocl.
0 0 ... 9999
S6
Order number is displayed
S7
Serial number is displayed
S8
Reset instrument
no; sens; factory
S9
Start instrument test
no; display
S10

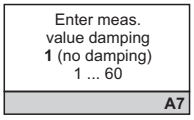
a0002636-en

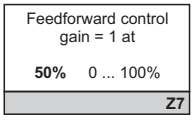
Operating matrix - version EP

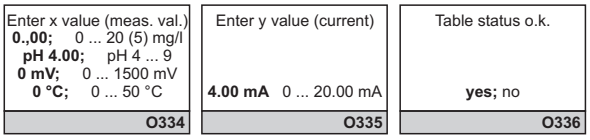



Zero point is displayed
pH 7.00
pH 5.00 ... 9.00
C27
Calibration status is displayed
o.k. Exxx
C28
Store calibration results
yes; no; new
C29

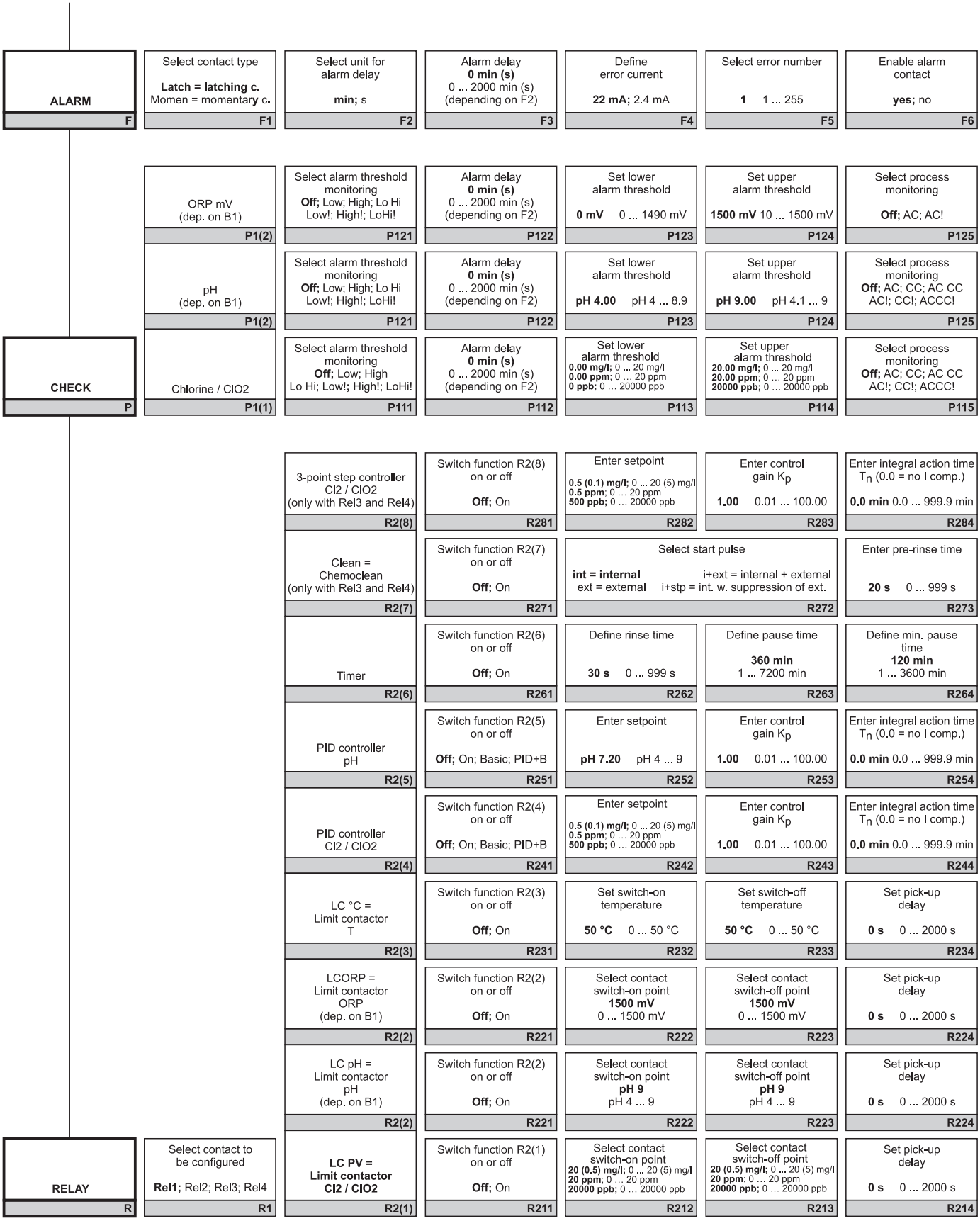

Meas. value display
Current input in mA
Meas. value display
Current input in %
Only LCD switchover!


Enter meas. value damping
1 (no damping)
1 ... 60
A7


Feedforward control gain = 1 at
50% 0 ... 100%
Z7


Enter x value (meas. val.)
0.,00; 0 ... 20 (5) mg/l
pH 4.00; pH 4 ... 9
0 mV; 0 ... 1500 mV
0 °C; 0 ... 50 °C
O334
Enter y value (current)
4.00 mA 0 ... 20.00 mA
O335
Table status o.k.
yes; no
O336

a0002638-en


ALARM
F
Select contact type
Latch = latching c.
Momen = momentary c.
F1
Select unit for alarm delay
min; s
F2
Alarm delay
0 min (s)
0 ... 2000 min (s)
(depending on F2)
F3
Define error current
22 mA; 2.4 mA
F4
Select error number
1 1 ... 255
F5
Enable alarm contact
yes; no
F6
CHECK
P
ORP mV (dep. on B1)
P1(2)
Select alarm threshold monitoring
Off; Low; High; Lo Hi
Low!; High!; LoHi!
P121
Alarm delay
0 min (s)
0 ... 2000 min (s)
(depending on F2)
P122
Set lower alarm threshold
0 mV 0 ... 1490 mV
P123
Set upper alarm threshold
1500 mV 10 ... 1500 mV
P124
Select process monitoring
Off; AC; AC!
P125
pH (dep. on B1)
P1(2)
Select alarm threshold monitoring
Off; Low; High; Lo Hi
Low!; High!; LoHi!
P121
Alarm delay
0 min (s)
0 ... 2000 min (s)
(depending on F2)
P122
Set lower alarm threshold
pH 4.00 pH 4 ... 8.9
P123
Set upper alarm threshold
pH 9.00 pH 4.1 ... 9
P124
Select process monitoring
Off; AC; CC; AC CC
AC!; CC!; ACCC!
P125
Chlorine / ClO2
P1(1)
Select alarm threshold monitoring
Off; Low; High
Lo Hi; Low!; High!; LoHi!
P111
Alarm delay
0 min (s)
0 ... 2000 min (s)
(depending on F2)
P112
Set lower alarm threshold
0.00 mg/l; 0 ... 20 mg/l
0.00 ppm; 0 … 20 ppm
0 ppb; 0 … 20000 ppb
P113
Set upper alarm threshold
20.00 mg/l; 0 ... 20 mg/l
20.00 ppm; 0 … 20 ppm
20000 ppb; 0 … 20000 ppb
P114
Select process monitoring
Off; AC; CC; AC CC
AC!; CC!; ACCC!
P115
RELAY
R
Select contact to be configured
Rel1; Rel2; Rel3; Rel4
R1
LC PV = Limit contactor Cl2 / ClO2
R2(1)
Switch function R2(1) on or off
Off; On
R211
Select contact switch-on point
20 (0.5) mg/l; 0 ... 20 (5) mg/l
20 ppm; 0 … 20 ppm
20000 ppb; 0 … 20000 ppb
R212
Select contact switch-off point
20 (0.5) mg/l; 0 ... 20 (5) mg/l
20 ppm; 0 … 20 ppm
20000 ppb; 0 … 20000 ppb
R213
Set pick-up delay
0 s 0 ... 2000 s
R214
3-point step controller Cl2 / ClO2 (only with Rel3 and Rel4)
R2(8)
Switch function R2(8) on or off
Off; On
R281
Enter setpoint
0.5 (0.1) mg/l; 0 ... 20 (5) mg/l
0.5 ppm; 0 … 20 ppm
500 ppb; 0 … 20000 ppb
R282
Enter control gain Kp
1.00 0.01 ... 100.00
R283
Enter integral action time Tn (0.0 = no I comp.)
0.0 min 0.0 ... 999.9 min
R284
Clean = Chemoclean (only with Rel3 and Rel4)
R2(7)
Switch function R2(7) on or off
Off; On
R271
Select start pulse
int = internal i+ext = internal + external
ext = external i+stp = int. w. suppression of ext.
R272
Enter pre-rinse time
20 s 0 ... 999 s
R273
Timer
R2(6)
Switch function R2(6) on or off
Off; On
R261
Define rinse time
30 s 0 ... 999 s
R262
Define pause time
360 min
1 ... 7200 min
R263
Define min. pause time
120 min
1 ... 3600 min
R264
PID controller pH
R2(5)
Switch function R2(5) on or off
Off; On; Basic; PID+B
R251
Enter setpoint
pH 7.20 pH 4 ... 9
R252
Enter control gain Kp
1.00 0.01 ... 100.00
R253
Enter integral action time Tn (0.0 = no I comp.)
0.0 min 0.0 ... 999.9 min
R254
PID controller Cl2 / ClO2
R2(4)
Switch function R2(4) on or off
Off; On; Basic; PID+B
R241
Enter setpoint
0.5 (0.1) mg/l; 0 ... 20 (5) mg/l
0.5 ppm; 0 … 20 ppm
500 ppb; 0 … 20000 ppb
R242
Enter control gain Kp
1.00 0.01 ... 100.00
R243
Enter integral action time Tn (0.0 = no I comp.)
0.0 min 0.0 ... 999.9 min
R244
LC °C = Limit contactor T
R2(3)
Switch function R2(3) on or off
Off; On
R231
Set switch-on temperature
50 °C 0 ... 50 °C
R232
Set switch-off temperature
50 °C 0 ... 50 °C
R233
Set pick-up delay
0 s 0 ... 2000 s
R234
LCORP = Limit contactor ORP (dep. on B1)
R2(2)
Switch function R2(2) on or off
Off; On
R221
Select contact switch-on point
1500 mV
0 ... 1500 mV
R222
Select contact switch-off point
1500 mV
0 ... 1500 mV
R223
Set pick-up delay
0 s 0 ... 2000 s
R224
LC pH = Limit contactor pH (dep. on B1)
R2(2)
Switch function R2(2) on or off
Off; On
R221
Select contact switch-on point
pH 9
pH 4 ... 9
R222
Select contact switch-off point
pH 9
pH 4 ... 9
R223
Set pick-up delay
0 s 0 ... 2000 s
R224

a0002639-en

Enable error current for error just selected **no;** yes	Automatic start of clean function **no;** yes	Select "next error" or return to menu **next = next error** <---R
F7	**F8**	**F9**

Set max. perm. period for lower alarm threshold **60 min** 0 ... 2000 min	Set max. perm. period for upper alarm threshold **120 min** 0 ... 2000 min	Set limit value **pH 7.20** pH 4 ... 9
P126	**P127**	**P128**
Set max. perm. period for lower limit exceeding **60 min** 0 ... 2000 min	Set max. perm. period for lower limit exceeding **120 min** 0 ... 2000 min	Set limit value **0.5 (0.1) mg/l;** 0 ... 20 (5) mg/l **0.5 ppm**; 0 ... 20 ppm **500 ppb;** 0 ... 20000 ppb
P116	**P117**	**P118**

Enter min. switch-on time t_{ON} **0.3 s** 0.1 ... 5.0 s	Motor run time **60 s** 10 ... 999 s	Neutral zone **10%** 0 ... 40%	**3-p. step controller:** assigns 2 contacts, only permitted for contacts 3+4
R285	**R286**	**R287**	

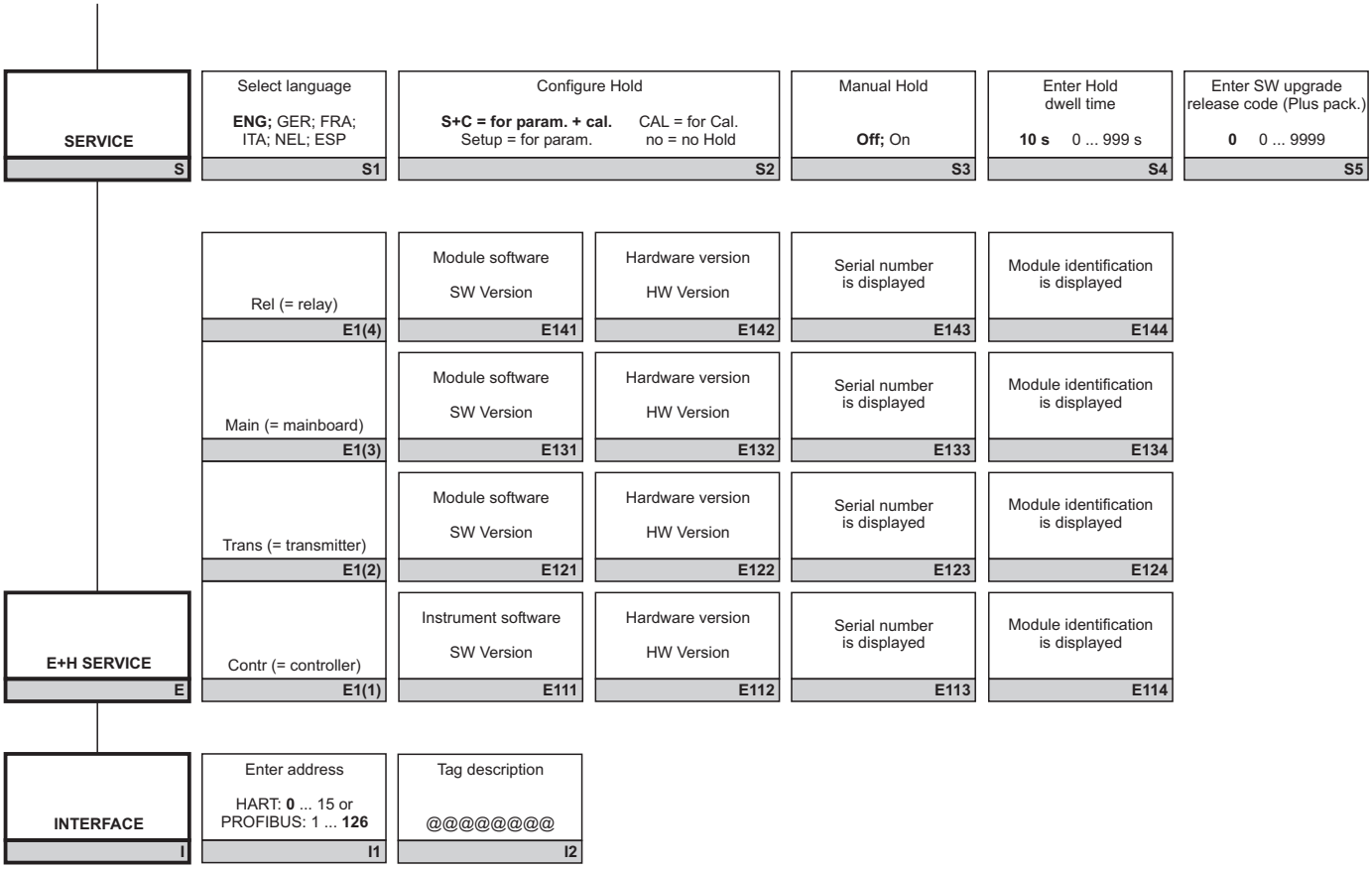
Enter cleaning time **10 s** 0 ... 999 s	Enter post-rinse time **20 s** 0 ... 999 s	Define repeat cycles **0** 0 ... 5	Define period between two cleaning cycles (pause time) **360 min** 1 ... 7200 min	Define minimum pause time **120 min** 1 ... R277 min	Number of cleaning cycles without cleaning agent **0** 0 ... 9
R274	**R275**	**R276**	**R277**	**R278**	**R279**

Chemoclean: assigns 2 contacts, only permitted for contacts 3 (+4)

Enter deriv. action time T_V (0.0 = no D comp.) **0.0 min** 0.0 ... 999.9 min	Select control characteristic **dir**; inv	Select **len = pulse length** freq = pulse frequency curr = current output 2	Enter pulse period **10.0 s** 0.5 ... 999.9 s	Enter max. pulse frequency **120 1/min** 60 ... 180 1/min	Enter min. switch-on time t_{ON} **0.3 s** 0.1 ... 5.0 s	Enter basic load **0%** 0 ... 40%
R255	**R256**	**R257**	**R258**	**R259**	**R2510**	**R2511**
Enter deriv. action time T_V (0.0 = no D comp.) **0.0 min** 0.0 ... 999.9 min	Select control characteristic **inv;** dir	Select **len = pulse length** freq = pulse frequency curr = current output 2	Enter pulse period **10.0 s** 0.5 ... 999.9 s	Enter max. pulse frequency **120 1/min** 60 ... 180 1/min	Enter min. switch-on time t_{ON} **0.3 s** 0.1 ... 5.0 s	Enter basic load **0%** 0 ... 40%
R245	**R246**	**R247**	**R248**	**R249**	**R2410**	R2411

Set drop-out delay **0 s** 0 ... 2000 s	Set alarm threshold **50 °C** 0 ... 50 °C	Display of LC status **MAX**; MIN
R235	**R236**	**R237**
Set drop-out delay **0 s** 0 ... 2000 s	Set alarm threshold **1500 mV** 0 ... 1500 mV	Display of LC status **MAX**; MIN
R225	**R226**	**R227**
Set drop-out delay **0 s** 0 ... 2000 s	Set alarm threshold **pH 9.00** pH 0 ... 9	Display of LC status **MAX**; MIN
R225	**R226**	**R227**
Set drop-out delay **0 s** 0 ... 2000 s	Set alarm threshold **20 (5) mg/l;** 0 ... 20 (5) mg/l **20 ppm**; 0 ... 20 ppm **20000 ppb;** 0 ... 20000 ppb	Display of LC status **MAX**; MIN
R215	**R216**	**R217**

a0002640-en


SERVICE
S
Select language
ENG; GER; FRA; ITA; NEL; ESP
S1
Configure Hold
S+C = for param. + cal. CAL = for Cal.
Setup = for param. no = no Hold
S2
Manual Hold
Off; On
S3
Enter Hold dwell time
10 s 0 ... 999 s
S4
Enter SW upgrade release code (Plus pack.)
0 0 ... 9999
S5
E+H SERVICE
E
Rel (= relay)
E1(4)
Module software SW Version
E141
Hardware version HW Version
E142
Serial number is displayed
E143
Module identification is displayed
E144
Main (= mainboard)
E1(3)
Module software SW Version
E131
Hardware version HW Version
E132
Serial number is displayed
E133
Module identification is displayed
E134
Trans (= transmitter)
E1(2)
Module software SW Version
E121
Hardware version HW Version
E122
Serial number is displayed
E123
Module identification is displayed
E124
Contr (= controller)
E1(1)
Instrument software SW Version
E111
Hardware version HW Version
E112
Serial number is displayed
E113
Module identification is displayed
E114
INTERFACE
I
Enter address
HART: 0 ... 15 or PROFIBUS: 1 ... 126
I1
Tag description
@@@@@@@@
I2

a0002641-en

Control SW upgrade release code Chemocl.	Order number is displayed	Serial number is displayed	Reset instrument	Start instrument test
0 0 ... 9999			**no;** sens; factory	**no;** display
S6	**S7**	**S8**	**S9**	**S10**

Index

www.addresses.endress.com

Endress+Hauser

People for Process Automation