



Level



Pressure



Flow



Temperature



Liquid  
Analysis



Registration



Systems  
Components



Services

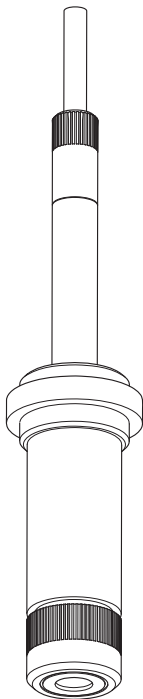


Solutions

## Operating Instructions

# CCS140/141





Sensors for free chlorine




# Document function


## 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
 <b>DANGER</b> <b>Cause (/consequences)</b> Possible consequences if ignored ▶ Preventive measures	This symbol alerts you to a dangerous situation. Failure to avoid the situation <b>will</b> result in a fatal or serious injury.
 <b>WARNING</b> <b>Cause (/consequences)</b> Possible consequences if ignored ▶ Preventive measures	This symbol alerts you to a dangerous situation. Failure to avoid the situation <b>can</b> result in a fatal or serious injury.
 <b>CAUTION</b> <b>Cause (/consequences)</b> Possible consequences if ignored ▶ Preventive measures	This symbol alerts you to a dangerous situation. Failure to avoid this situation can result in minor or medium injury.
 <b>NOTICE</b> <b>Cause/situation</b> Possible consequences if ignored ▶ Action/note	This symbol alerts you to situations that can result in damage to property and equipment.

## Used symbols

→  1 This symbol indicates a cross reference to a defined page (e.g. p. 1).

→  2 This symbol indicates a cross reference to a defined figure (e.g. fig. 2).


# Table of contents

<b>1</b>	<b>Safety instructions</b> . . . . .	<b>4</b>	<b>9</b>	<b>Troubleshooting</b> . . . . .	<b>29</b>
1.1	Requirements for personnel . . . . .	4	9.1	Troubleshooting instructions . . . . .	29
1.2	Designated use . . . . .	4	9.2	Return . . . . .	30
1.3	Workplace safety . . . . .	4	9.3	Disposal . . . . .	30
1.4	Operational safety . . . . .	5			
1.5	Product safety . . . . .	5	<b>10</b>	<b>Technical data</b> . . . . .	<b>31</b>
<b>2</b>	<b>Identification</b> . . . . .	<b>6</b>	10.1	Input . . . . .	31
2.1	Nameplate . . . . .	6	10.2	Performance characteristics . . . . .	31
2.2	Scope of delivery . . . . .	6	10.3	Environment . . . . .	31
<b>3</b>	<b>Installation</b> . . . . .	<b>7</b>	10.4	Process . . . . .	32
3.1	Incoming acceptance, transport, storage . . . . .	7	10.5	Mechanical construction . . . . .	32
3.2	Installation conditions . . . . .	8			
3.3	Installation . . . . .	9			
3.4	Post-installation check . . . . .	10			
<b>4</b>	<b>Wiring</b> . . . . .	<b>11</b>			
4.1	Direct connection to the transmitter . . . . .	11			
4.2	Connection via junction box . . . . .	13			
4.3	Post-connection check . . . . .	14			
<b>5</b>	<b>Function</b> . . . . .	<b>15</b>			
5.1	Sensor design . . . . .	15			
5.2	Operating principle . . . . .	16			
<b>6</b>	<b>Commissioning</b> . . . . .	<b>20</b>			
6.1	Installation and function check . . . . .	20			
6.2	Polarization . . . . .	20			
6.3	Calibration . . . . .	21			
<b>7</b>	<b>Maintenance</b> . . . . .	<b>22</b>			
7.1	Cleaning the sensor . . . . .	22			
7.2	Replacing the membrane . . . . .	23			
7.3	Refilling the electrolyte . . . . .	23			
7.4	Storing the sensor . . . . .	24			
7.5	Regenerating the sensor . . . . .	24			
7.6	Reconditioning the sensor . . . . .	25			
<b>8</b>	<b>Accessories</b> . . . . .	<b>27</b>			
8.1	Connection accessories . . . . .	27			
8.2	Installation accessories . . . . .	27			
8.3	Maintenance / calibration . . . . .	28			
				<b>Index</b> . . . . .	<b>34</b>

# 1 Safety instructions

## 1.1 Requirements for 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

Oxidizing agents such as chlorine or anorganic chlorine compounds are used for disinfection of water. Their dosing must be carefully controlled to suit the application. Too low a concentration makes the degree of disinfection questionable. Too high a concentration increases the costs and can result in corrosion effects, impairment of taste or skin irritation.

The sensor has been specially designed for this purpose. It is used for continuous measurement of free chlorine in water.

When used in connection with a measurement and control system, it permits the optimum disinfection status to be maintained.

Any other use than the one described here compromises the safety of persons and the entire measuring system and is not permitted.

The manufacturer is not liable for damage caused by improper or non-designated use.

### **NOTICE**

#### **Use in not specified applications**

Measurement errors and failures up to the breakdown of the measurement point possible

- ▶ Only use the product acc. to its specification.
- ▶ Observe the technical data of the nameplate.

## 1.3 Workplace safety

As the user, you are responsible for complying with the following safety conditions:

- Installation instructions
- Local standards and regulations

## 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.

## 2 Identification

### 2.1 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.

### 2.2 Scope of delivery

The scope of delivery comprises:

- 1 chlorine sensor
- 1 bottle filled with electrolyte (50 ml)
- 1 cap for protection and storage
- 1 replacement cartridge with pretensioned membrane
- Operating Instructions, English

## 3 Installation

### 3.1 Incoming acceptance, transport, storage

- ▶ 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.

### 3.2 Installation conditions

#### 3.2.1 Dimensions

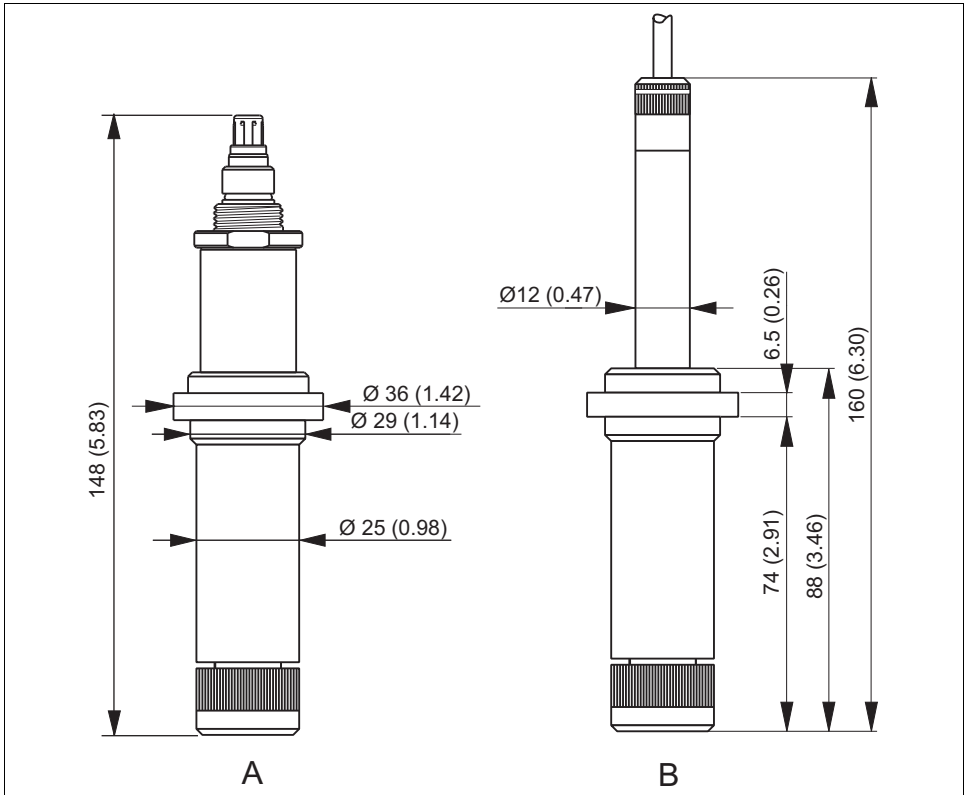


Fig. 1: Dimensions

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- A Version with TOP68 plug head
- B Version with fixed cable

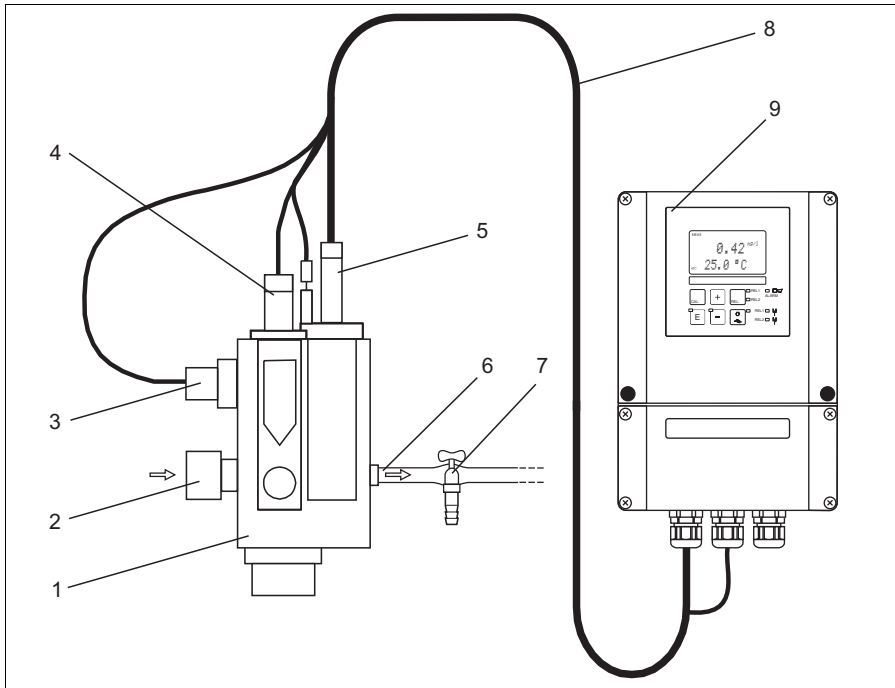


## 3.3 Installation

### 3.3.1 Measuring system

A complete measuring system comprises at least:

- Chlorine sensor
- Liquisys M CCM223/253 transmitter
- Special measuring cable
- Flow assembly
- Reference measuring instrument for determination of free chlorine according to the DPD method



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Fig. 2: Measuring system in the flow mode (example)

- |   |  |   |               |
|---|--|---|---------------|
| 1 | CCA250 flow assembly                           | 6 | Medium outlet |
| 2 | Medium inlet                                   | 7 | Sampling tap  |
| 3 | Inductive proximity switch for flow monitoring | 8 | Sensor cable  |
| 4 | Mounting places for pH/ORP sensors             | 9 | Transmitter   |
| 5 | Chlorine sensor                                |   |               |

### 3.3.2 Installation in CCA250 flow assembly

The flow assembly CCA250 is designed for on-site installation of the sensor. In addition to the chlorine or chlorine dioxide sensor, a pH and an ORP sensor can be installed. A needle valve regulates the flow within the range of 30 to 120 l/h (7.9 to 31.7 US.gal/h).

When installing the sensor, note the following:

- The flow must be at least 30 l/h (7.9 US.gal/h).  
If the flow drops below this value or stops completely, this can be detected by an inductive proximity switch and an alarm signal plus locking of the dosage pumps can be triggered.
- If the medium is fed back into a surge tank, pipeline or the like, ensure that the thus generated back pressure on the sensor does not exceed 1 bar (14.5 psi) and remains constant.
- Negative pressure at the sensor, e.g. by feedback of medium to the suction side of a pump, must be avoided.

For further installation instructions, see the Operating Instructions of the flow assembly.

### 3.3.3 Installation in other flow assemblies

When using other flow assemblies than the CCA250 ensure the following:

- The flow velocity against the membrane is at least 15 cm/s (0.49 ft/s).
- The flow direction is upward so that carried bubbles are removed and do not collect in front of the membrane.
- The membrane is directly struck by the flow.

## 3.4 Post-installation check

- Check the membrane for leak tightness und replace it if necessary.
- Is the sensor installed in an assembly and is not suspended from the cable?

## 4 Wiring

### **⚠ WARNING**

#### **Device is energized**

Improper connection can cause injury or death.

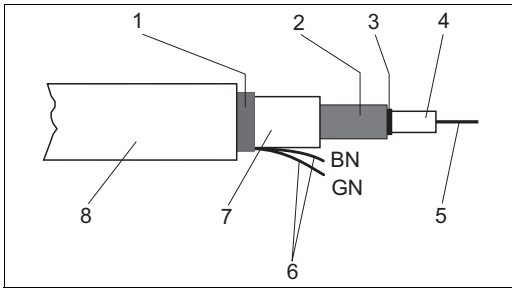
- ▶ The electrical connection must only be carried out by a certified electrician.
- ▶ Technical personnel must have read and understood the instructions in this manual and must adhere to them.
- ▶ **Prior to beginning** any wiring work, make sure voltage is not applied to any of the cables.

### 4.1 Direct connection to the transmitter

The sensors are equipped with a 3 m (9.8 ft) fixed cable. Connect the sensor to the transmitter according to the following table:

Sensor with 3 m fixed cable		Transmitter
Assignment	Core	Terminal
Outer screen		S
Anode	[A] red	91
Cathode	[K] uncolored	90
NTC temperature sensor	green	11
NTC temperature sensor	brown	12

### Structure of the sensor cable



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Fig. 3: Structure of 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

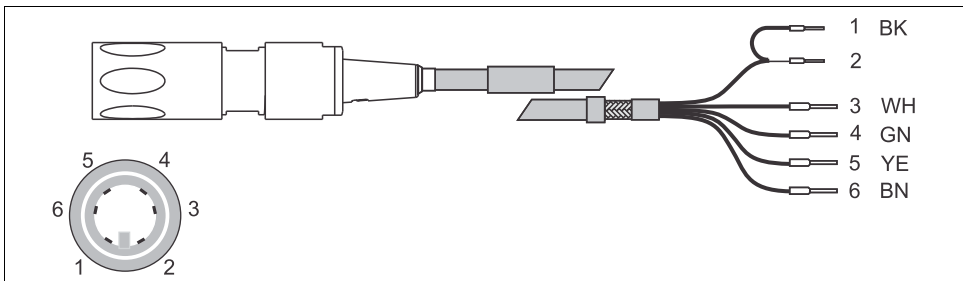
### NOTICE

#### Measuring error due to incorrect connection

- Make sure to remove the black semiconductor layer up to the inner screen when performing termination work.

#### Sensor with TOP68 plug

To connect the sensor use measuring cable CPK9 in the appropriate length (see chapter Accessories)



a0018301

Fig. 4: Measuring cable with internal potential match connection (CPK9-N\*A1B)

- 1 Signal (cathode) - coax black
- 2 Reference (anode) - coax screen
- 3 Not used - white
- 4 Temperature sensor - green
- 5 Temperature sensor - yellow
- 6 Not used - brown

## 4.2 Connection via junction box

To extend the sensor connection, use the VBC junction box.

Extend the connections as follows:

- For the chlorine sensor, use a CYK71 special measuring cable.
- For the pH and ORP sensors, also use CYK71 special measuring cables.
- For the inductive proximity switch, use the MK special measuring cable.

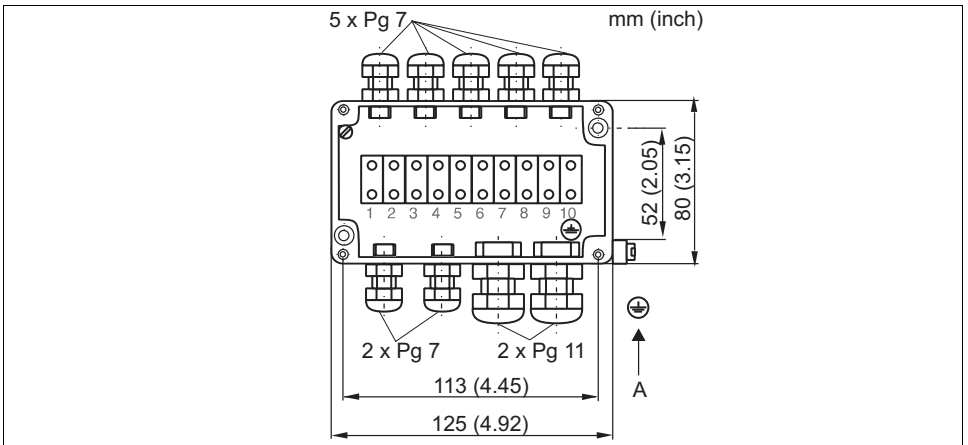


Fig. 5: VBC junction box with grounding point

### Structure of the CYK71 special measuring cable

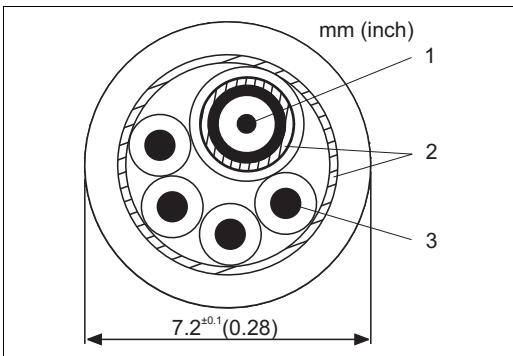


Fig. 6: Structure of CYK71 cable

- 1 Coax wire, e.g. pH or ORP
- 2 Screens
- 3 4 control wires YE/GN/WH/BN

### 4.3 Post-connection check

Instrument status and specifications	Remarks
Are the sensor, assembly, junction box or cable damaged?	Visual inspection
Electrical connection	Remarks
Does the supply voltage of the transmitter match the specifications on the nameplate?	110/230 V AC 24 V AC/DC
Are the installed cables strain-relieved and not twisted?	
Is the cable type route completely isolated?	Power cable/weak current cable
Are the power supply and signal cable correctly connected to the transmitter?	Use the connection diagram of CCM2x3.
Are all the screw terminals properly tightened?	
Are all the cable entries installed, tightened and sealed?	For lateral cable entries: cable loops downwards for water to be able to drip off.
Are all the cable entries installed downwards or lateral?	

## 5 Function

### 5.1 Sensor design

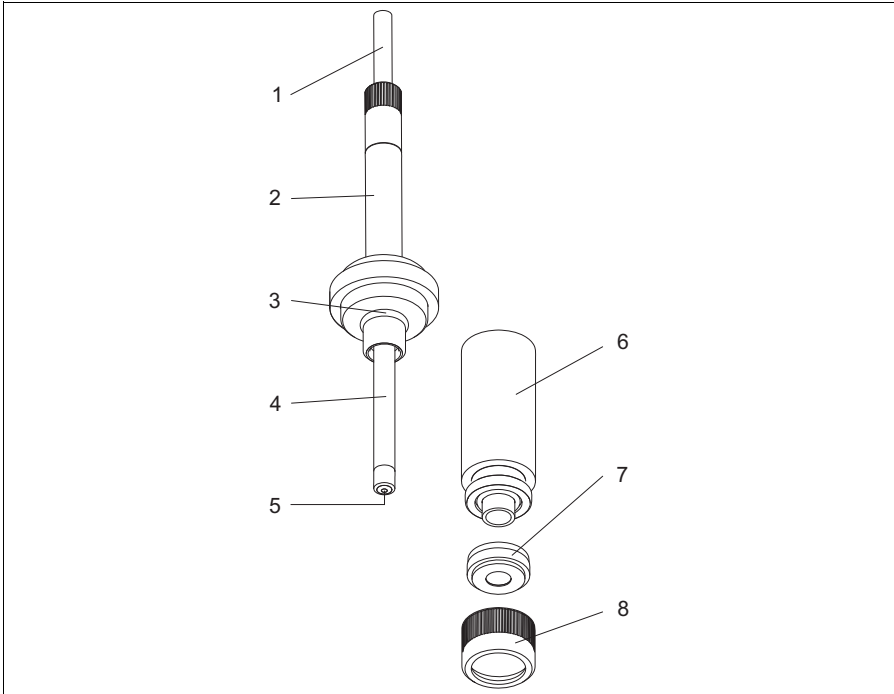


Fig. 7: Sensor design

1 Fixed cable

2 Sensor shaft

3 O-ring

4 Large anode, silver/silver chloride

5 Gold cathode

6 Measuring chamber

7 Membrane cap with dirt-repellent membrane

8 Screw cap for fixing the membrane cap

The sensor consists of the following function units:

- Measuring chamber
  - for protection of anode and cathode from medium
  - with large electrolyte volume guaranteeing a long service life in combination with the large anode and the small cathode
- Sensor shaft with
  - large anode
  - cathode embedded in plastic
  - optional temperature sensor

- Membrane cap with
  - robust PTFE membrane
  - special support grid between cathode and membrane for a specified and constant electrolyte film and thus a relatively constant indication even at varying pressures and flows

## 5.2 Operating principle

### 5.2.1 Measuring principle

The concentration of free chlorine is determined according to the amperometric measuring principle. The hypochlorous acid (HOCl) contained in the medium diffuses through the sensor membrane and is reduced to chloride ions ( $\text{Cl}^-$ ) on the gold cathode. On the silver anode, silver is oxidized to silver chloride. The electron release of the gold cathode and electron acceptance on the silver anode result in a current flow which is proportional to the free chlorine concentration in the medium under constant conditions. The concentration of hypochlorous acid in the medium depends on the pH value. This dependence can be compensated by measuring the pH value in the flow assembly. The transmitter transforms the current signal into the measuring unit concentration in mg/l.

### 5.2.2 Influences on the measuring signal

#### pH dependence of measurement of free chlorine

Molecular chlorine ( $\text{Cl}_2$ ) has pH values of < 4. Hypochlorous acid (HOCl) and hypochlorite ( $\text{OCl}^-$ ) 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 ( $\text{OCl}^-$ ) and hydrogen ions ( $\text{H}^+$ ), the amounts of the individual components in free chlorine change with the pH value (Fig. 8). 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.



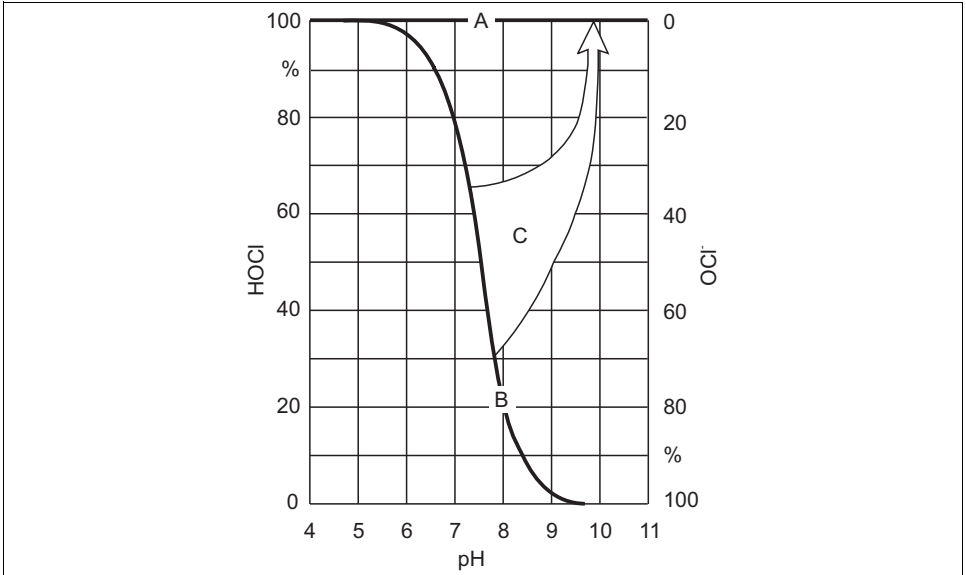


Fig. 8: Schematic diagram of pH compensation


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

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.

### pH compensation of chlorine sensor signal for free chlorine

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 the transmitter, 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 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.

### 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 6.3. 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 unacceptable.

### Flow

The membrane-covered sensor requires a minimum flow velocity of 15 cm/s (0.5 ft/s) in order to function properly. When using the CCA250 flow assembly, this value corresponds to a flow rate of 30 l/h (8 gal/h) (upper edge of float at level of red bar mark). At higher flow rates, the measuring signal is virtually flow independent. At lower flow rates, the measuring signal depends on the flow. If an INS proximity switch is installed in the assembly, too low flow rates can reliably be detected, allowing to signal an alarm or to block the dosage pumps if required.

**Temperature**

Changes in the medium temperature influence the measuring signal. A temperature increase causes the measured value to increase (approx. 4% per K), a temperature reduction causes it to decrease. Therefore the temperature should remain constant after calibration of the chlorine measuring point or a recalibration must be performed if the temperature has changed.

When using the sensor versions CCS140/141-N in combination with Liquisys M, an automatic temperature compensation is performed. In this case, the temperature does not need to remain constant and recalibrations after temperature changes are not required.

## 6 Commissioning

- Read also the instructions on commissioning and operation in the Operating Instructions of the used transmitter.
- The power supply of the transmitter and the sensor may not be interrupted. After longer power interruption (> 2 h), the sensor must be recommissioned (polarization time).
- After commissioning, the sensor must be kept permanently wet.
- Do not switch off the measuring system during interval operation! Dosing devices may be controlled by timer switches.  
However, if no disinfectant is dosed over a long period of time (several weeks), the sensor must be disconnected from the transmitter, opened, emptied and stored dry (see chapter "Storage").

### 6.1 Installation and function check

Before first commissioning, check if:

- the sensor is correctly installed
- the electrical connection is correct.

### 6.2 Polarization

The voltage applied between cathode and anode by the transmitter polarizes the surface of the gold electrode. Therefore, after switching on the transmitter with connected sensor, you have to wait until the polarization period has elapsed before you can start the calibration.

To achieve a stable display value, the sensors need the following polarization periods:

First commissioning:

CCS140:	60 min.
CCS141:	90 min.

Recommissioning:

CCS140:	30 min.
CCS141:	45 min.

## 6.3 Calibration

### Reference measurement according to the DPD method

The calibration of the measuring system requires a colorimetric reference measurement according to the DPD method. Chlorine reacts with diethyl-p-phenylenediamine (DPD) by producing a red dye, the intensity of the red color being proportional to the chlorine concentration.

The intensity of the red dye is measured by a photometer (e.g. CCM182, see accessories) and displayed as chlorine concentration.

### Requirements

The sensor reading is stable (no drifts or unsteady values for at least 5 minutes). This is normally fulfilled, when:

- The polarization period is finished.
- The flow is constant and within the correct range.
- The sample medium and the sensor are at the same temperature.
- The pH value is within the admissible range.

### Zero-point adjustment

A zero-point adjustment is not required thanks to the zero stability of the membrane-covered sensor. If you, however, wish to perform a zero-point adjustment, operate the sensor in chlorine-free water for at least 15 min.

### Slope calibration

For slope calibration, perform the following steps:

1. Ensure a constant pH value and temperature of the medium.
2. Take a sample for DPD measurement. The sampling location has to be close to the installed sensor. Use the sampling tap if available.
3. Determine the free chlorine content with a photometer (e.g. CCM182, see accessories) according to the DPD method. To do so, see the instructions on measurement of free chlorine in the Operating Instructions of the photometer.
4. Enter the measured value into the transmitter (see Operating Instructions of the transmitter).
5. After initial installation of the sensor, check the calibration by DPD measurement 24 hours later.

 Carry out a slope calibration every time the membrane or electrolyte is changed.

## 7 Maintenance

Check the measurement at regular intervals; depending on the respective conditions at least once a month.

Perform the following tasks:

- If the membrane is visibly soiled, clean the sensor (see section "Cleaning the sensor").
- Refill the sensor with electrolyte once per season or every 12 months. Depending on the chlorine content on site, this period can be reduced or extended (see section "Refilling the electrolyte").
- Calibrate the sensor when necessary (see section "Calibration").

### 7.1 Cleaning the sensor

#### **▲ CAUTION**

#### **Hydrochloric acid and surface tension reducing chemicals**

Diluted hydrochloric acid causes irritations when in contact with skin or eyes. Surface tension reducing chemicals can penetrate into the sensor membrane and cause measuring faults due to blocking.

- ▶ When using diluted hydrochloric acid, wear protective clothing like protective gloves and goggles. Avoid splashes.
- ▶ Do not use chemicals reducing the surface tension.

If the membrane is visibly soiled, proceed as follows:

1. Remove the sensor from the flow assembly.
2. Clean the membrane mechanically with a gentle water jet or put it for some minutes in 1 to 5 % hydrochloric acid without chemical additives.

## 7.2 Replacing the membrane

1. Unscrew the measuring chamber (pos. 1) from the shaft.
2. Unscrew the front screw cap (pos. 3).
3. Remove the membrane cap (pos. 2) and replace it by a CCY14-WP replacement cartridge.
4. Refill the measuring chamber with CCY14-F electrolyte (see section "Refilling the electrolyte").

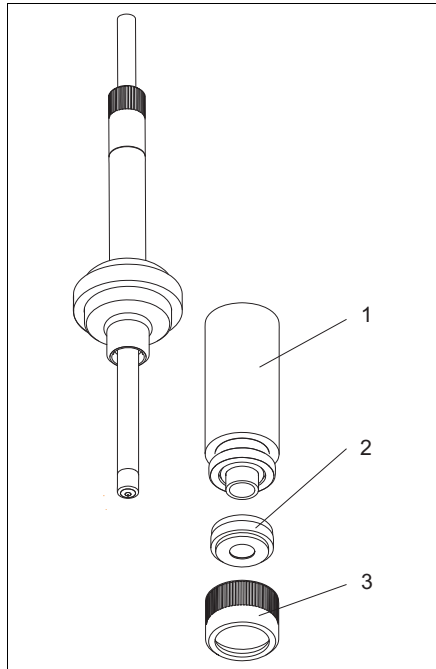


Fig. 9: Membrane replacement

- |   |                   |
|---|-------------------|
| 1 | Measuring chamber |
| 2 | Membrane cap      |
| 3 | Screw cap         |

## 7.3 Refilling the electrolyte

### NOTICE

#### Membrane or electrodes damaged, air bubbles

Measuring errors up to total failure of the measuring point

- ▶ Do not touch or damage the membrane or electrodes.
- ▶ The electrolyte is chemically neutral and not hazardous. However, do not swallow it and avoid contact with the eyes.
- ▶ Keep the electrolyte bottle closed after use. Do not transfer the electrolyte into other containers.
- ▶ Do not store the electrolyte for more than 1 year. The electrolyte may not show a yellow color (use by date, see label).
- ▶ Avoid forming air bubbles when pouring the electrolyte into the membrane cap.

Proceed as follows to fill in the electrolyte:

1. Unscrew the measuring chamber from the sensor shaft.
2. Hold the measuring chamber at an angle and fill in about 7 to 8 ml (0.24 to 0.27 fl.oz) electrolyte, up to the internal thread of the measuring chamber.
3. Tap the filled measuring chamber several times on a flat surface so that adherent air bubbles can detach and rise.
4. Insert the sensor shaft vertically from above into the measuring chamber.
5. Slowly tighten the measuring chamber to the stop. Excess electrolyte is pressed out at the sensor bottom during the tightening.

## 7.4 Storing the sensor

During short-term interruptions in measurement:

- If it is ensured that the assembly will not drain off, you can leave the sensor in the assembly.
- If the assembly might drain off, remove the sensor from the assembly. To keep the membrane of the uninstalled sensor wet, moisten the inner sponge of the protection cap and slide the cap onto the measuring chamber.

During long-term interruptions in measurement, particularly if dehydration is possible:

- Empty the sensor.
- Rinse the measuring chamber and electrode shaft with cold water and let them dry.
- Screw the sensor down loosely and not to the stop so that the membrane remains unstressed.
- Proceed according to chapter "Commissioning" when recommissioning the sensor.

## 7.5 Regenerating the sensor

During measurement, the electrolyte in the sensor is gradually exhausted by chemical reactions. The silver chloride layer, applied to the anode at the factory, continues to grow epitaxially during sensor operation. This has no effect on the reaction taking place at the cathode.

A change in color of the silver chloride layer, however, indicates effects on the reaction at the cathode. Therefore, ensure by visual inspection that the grey-brown color of the anode has not changed. If the anode color has changed, e.g. if it is spotted, white or silvery, the sensor must be regenerated. Send it to the manufacturer for this purpose.



## 7.6 Reconditioning the sensor

Long-term operation (> 3 months) in chlorine-free media, i.e. with very low sensor currents, may lead to a deactivation of the sensor.

This deactivation is a continuous process that results in a lower slope and longer response times. After long-term operation in a chlorine-free medium, the sensor must be reconditioned.

You need the following materials for reconditioning:

- Demineralized water
- Polishing sheet (see "Accessories")
- Beaker
- Approx. 100 ml (3.381 fl.oz) of chlorine bleaching lye NaOCl approx. 13 %, pharmaceutical quality (available at chemical stores or pharmacies)

### **▲ WARNING**

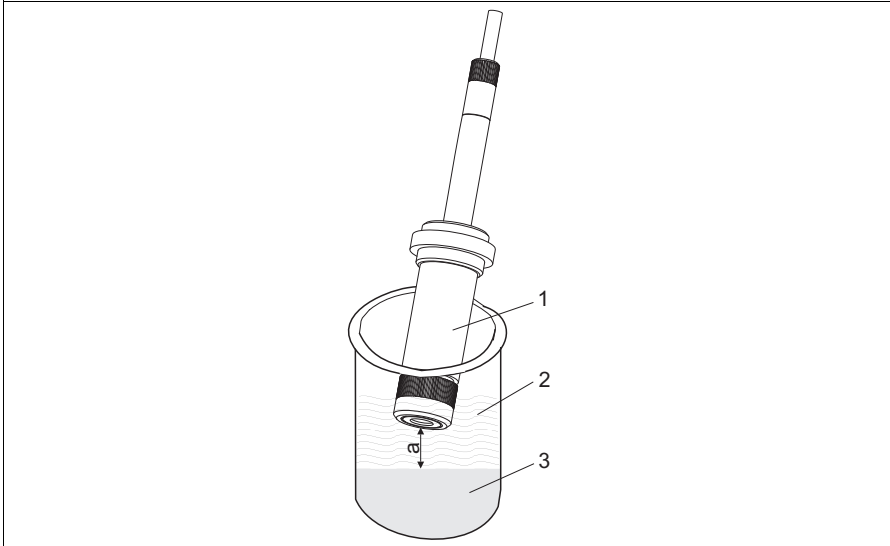
#### **Bleaching lye**

Bleaching lye is a corrosive substance and causes dangerous gases to develop if it comes in contact with acids.

- ▶ Wear suitable protective clothing such as safety gloves and protective goggles.
- ▶ Avoid contact with the eyes and skin.
- ▶ Avoid bleaching lye coming into contact with acids.
- ▶ Observe additional information on the safety data sheet.

Proceed as follows:

1. Close the medium inlet and outlet and make sure that no medium can squirt out of the assembly.
2. Remove the sensor from the assembly.
3. Unscrew the measuring chamber and put it aside.
4. Polish the gold cathode of the sensor using the polishing sheet:
  - Place a wetted strip of the sheet in your hand.
  - Polish the gold cathode by moving it circularly on the strip.
  - Rinse the sensor with demineralized water.
5. Top up the electrolyte if required (see chapter "Refilling the electrolyte") and screw the measuring chamber back into place.
6. Fill the beaker with chlorine bleach liquor to about 10 mm (0.39") and position it safely.
7. The sensor must not touch the liquid.  
Place the sensor in the gaseous phase about 5 to 10 mm (0.2" to 0.39") above the chlorine bleach liquor.



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Fig. 10: Reconditioning of the sensor above chlorine bleach liquor

1	Sensor	3	Chlorine bleach liquor
2	Gaseous phase of chlorine bleach liquor	a	Distance between sensor and liquid, 5 to 10 mm

8. The sensor current will now increase. The absolute value and the speed of increase depend on the temperature of the chlorine bleach liquor.
  - When the sensor current has reached a value of several hundred nA, leave the sensor under these conditions over a period of 20 min.
  - If the recommended current value cannot be reached, cover the beaker to avoid quick air change.
9. After the 20 min. have elapsed, re-install the sensor in the assembly.
10. Re-establish the medium flow. The sensor current will normalize.
11. After sufficient settling time (no noticeable drift), calibrate the measuring chain.

## 8 Accessories

### 8.1 Connection accessories

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

CYK71 measuring cable

- Non-terminated cable for the connection of sensors or the extension of sensor cables
- Sold by the meter, order numbers:
  - non-Ex version, black: 50085333
  - Ex version, blue: 51506616

CPK9 special 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 (TI118C/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

### 8.2 Installation accessories

Flowfit CCA250

- Flow assembly for chlorine, chlorine dioxide, pH and ORP sensors
- Ordering acc. to product structure (→ online Configurator, [www.products.endress.com/cca250](http://www.products.endress.com/cca250))
- Technical Information TI062C/07/EN

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 TI440C/07/EN

### 8.3 Maintenance / calibration

#### 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

#### Polishing sheets COY31-PF

- 10 pieces for cleaning of the gold cathode
- For oxygen and chlorine sensors
- Order no. 51506973

#### Service kit CCS14x

- For chlorine sensors CCS140/CCS141/CCS142D
- 2 replacement cartridges, filling electrolyte 50 ml, polishing sheets
- Order no. 71076921

## 9 Troubleshooting

### 9.1 Troubleshooting instructions

Troubleshooting must take account of the whole measuring system. The measuring system comprises:

- Transmitter
- Electrical connections and lines
- Assembly
- Sensor

The possible causes of failures listed in the following table primarily refer to the sensor. Make sure that the following operating conditions are met before commencing troubleshooting:

- Constant pH value after chlorine calibration, not required for measurement in the "pH compensated" mode of operation
- Constant temperature after calibration, not required for measurement in the "temperature compensated" mode of operation
- Minimum flow rate of 30 l/h (7.9 gal/h) (red bar mark when using the CCA250 assembly)
- No use of organic chlorination agents

If the value measured by the sensor differs significantly from that of the DPD method, first consider all possible malfunctions of the photometric DPD method (see Operating Instructions of the photometer). If necessary, repeat the DPD measurement several times.

Error	Possible cause	Remedy
No display, no sensor current	No supply voltage at the transmitter	Establish mains connection.
	Connection cable between sensor and transmitter interrupted	Establish cable connection.
	No electrolyte filled into the measuring chamber	Fill measuring chamber (see chapter "Refilling the electrolyte").
	No input flow of medium	Establish flow, clean filter.
Display value too high	Polarization of the sensor not yet completed	Wait for complete polarization (see chapter "Polarization").
	Membrane defective	Replace membrane cap.
	Shunt resistance (e.g. moisture contact) in the sensor, at the connections or in the connection cable	Open measuring chamber, rub gold cathode dry. If the display of the transmitter does not return to zero, there is a shunt.
	Interference of foreign oxidants on the sensor	Examine medium, check chemicals.

Error	Possible cause	Remedy
Display too low	Measuring chamber not completely tightened	Tighten measuring chamber or screw cap tight.
	Membrane soiled	Clean membrane.
	Air bubble in front of membrane	Release air bubble.
	Air bubble between cathode and membrane	Open measuring chamber, fill in some electrolyte, tap.
	Input flow of medium too low	Establish correct input flow (see chapter "Influences on measuring signal").
	Interference of foreign oxidants on the DPD reference measurement	Examine medium, check chemicals (see chapter "Operating principle").
	Use of organic chlorination agents	Use agents acc. to DIN 19643 (water replacement may be required).
Display fluctuates considerably	Hole in membrane	Replace membrane cap.
	External voltage in medium	Measure voltage between the PMC pin and the protective ground of the transmitter (both AC and DC ranges). For values exceeding approx. 0.5 V, find and eliminate external cause.
Temperature display too low	Supply line to NTC temperature sensor broken	Test the wires (fixed cable: green/brown, TOP68: green/yellow) and measure the NTC resistance, replace the sensor if necessary.
Temperature display too high	Supply line to NTC temperature sensor short-circuited	Test the wires (fixed cable: green/brown, TOP68: green/yellow) and measure the NTC resistance, replace the sensor if necessary.

## 9.2 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](http://www.services.endress.com/return-material)

## 9.3 Disposal

Please dispose of the device in accordance with the local regulations.

## 10 Technical data

### 10.1 Input

<b>Measured variable</b>	Free chlorine:	hypochlorous acid (HOCl)
<b>Measuring range</b>	CCS140 (for industrial water, pool water): CCS141 (for drinking water applications):	0.05 to 20 mg Cl <sub>2</sub> /l (25 °C (77 °F), pH 7.2) 0.01 to 5 mg Cl <sub>2</sub> /l (25 °C (77 °F), pH 7.2)
<b>Signal current</b>	CCS140: CCS141:	approx. 25 nA per mg Cl <sub>2</sub> /l (25 °C (77 °F), pH 7.2) approx. 80 nA per mg Cl <sub>2</sub> /l (25 °C (77 °F), pH 7.2)

### 10.2 Performance characteristics

<b>Response times</b>	T <sub>90</sub> < 2 min in applications involving mainly active chlorination	
<b>Polarization time</b>	CCS140: First polarization: Repolarization: CCS141: First polarization: Repolarization:	60 min 30 min 90 min 45 min
<b>Drift</b>	typically < 1.5 % per month	
<b>Recommended maintenance interval for electrolyte</b>	typically 12 months	

### 10.3 Environment

<b>Storage temperature</b>	Filled with electrolyte:	5 to 50 °C (41 to 122 °F)
	Without electrolyte:	-20 to 60 °C (-4 to 140 °F)
<b>Ingress protection</b>	IP 68 (membrane side up to the mounting collar Ø 36 mm (Ø 1.42"))	

## 10.4 Process

<b>Temperature range</b>	CCS140: CCS141:	10 to 45 °C (50 to 113 °F) 2 to 45 °C (36 to 113 °F)
<b>pH range</b>	CCS140: CCS141:	4 to 8 pH 4 to 8.2 pH  Note! Chlorine measurement in the range of pH 8.2 to pH 9 with limited accuracy.
<b>Pressure</b>	Medium in the CCA250 assembly: max. 1 bar (14.5 psi)	
<b>Flow volume</b>	in the CCA250 assembly: min. 30 l/h (8 US.gal./h)	
<b>Flow velocity</b>	min. 15 cm/s (0.5 ft/s)	

## 10.5 Mechanical construction

<b>Design, dimensions</b>	see chapter "Installation conditions"	
<b>Weight</b>	approx. 0.5 kg (1.1 lb.)	
<b>Materials</b>	Sensor shaft: Membrane: Membrane cap: Cathode: Anode:	PVC PTFE PBT (GF 30), PVDF Gold Silver / silver chloride
<b>Cable connection</b>	Version with fixed cable (3 m (9.84 ft)), four cores, double-screened, low noise Version with TOP68: To be used with CPK9-N*A1B (* = length of cable)	
<b>Cable length</b>	max. 30 m (98 ft) (cable extension included)	
<b>Temperature compensation</b>	NTC, 10 kΩ at 25 °C (77 °F)	





## Index

### A

Accessories	
Assemblies	27
Compact measuring station	27
Connection accessories	27
Maintenance materials	28
Photometer	28
Assemblies	27

### C

Cable connection	32
Cable length	32
Cables	27
Calibration	21
Check	
Electrical connection	14
Installation and function	20
Commissioning	20
Compact measuring station	27

### D

Depolarization current	31
Designated use	4
Dimensions	8
Disposal	30
Drift	31

### E

Electrical connection	11
Environment	31
Errors	29

### F

Flow operation	9
Flow velocity	32
Flow volume	32
Free chlorine	4
Function	15

### I

Incoming acceptance	7
Ingress protection	31
Input	31
Installation	7–9
Flow assembly	10

### J

Junction box	27
--------------	----

### M

Maintenance	22
Maintenance materials	28
Materials	32
Measured variable	31
Measuring principle	16
Measuring range	31
Measuring system	9
Mechanical construction	32

### N

Nameplate	6
-----------	---

### O

Operating principle	16
Operational safety	5

### P

Performance characteristics	31
pH range	32
Photometer	28
Polarization	20
Polarization time	31
Pressure	32
Process	32
Product safety	5

### R

Response time	31
Return	30

### S

Scope of delivery	6
Sensor	
Design	15
Storage	7
Storage temperature	31

**T**

Technical data . . . . .	31
Temperature compensation. . . . .	32
Temperature range . . . . .	32
Transport . . . . .	7
Troubleshooting . . . . .	29

**W**

Weight . . . . .	32
Wiring . . . . .	11
Cable extension . . . . .	13
Check . . . . .	14
Direct connection. . . . .	11
Workplace safety . . . . .	4

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