April 2016

E N G L I S H

Please carefully read this operating instructions completely before commissioning the sensor!
Do not discard!
The operator shall be liable for any damage caused by installation or operating errors!

	**Chlorine**	CL4.2 (analog-out/analog)	analog signal output Dual power supply ±5 - ±15 VDC Single power supply 10 - 30 VDC Analog signal processing No galvanical isolation
	Chlorine dioxide	CD4.2 (analog-out/analog)	
	Ozone	OZ1.2 (analog-out/analog)	
	Ozone	OZ1.2 (analog-out/digital)	analog signal output power supply 9-30 VDC digital internal signal processing galvanical isolation
		OZ1.2 (digital-out/digital)	Modbus-signaltransmitting power supply 9-30 VDC digital internal signal processing galvanical isolation
	Chlorine	CL4..21 4-20mA (analog-out/analog)	analog signal output Current supply 4…20 mA Analog signal processing No galvanical isolation
	Chlorine dioxide	CD4.2 4-20mA (analog-out/analog)	
	Ozone	OZ1.2 4-20mA (analog-out/analog)	

Content

1 General information

The area of application of these probes comprises pool water, drinking water or water qualities similar to that of drinking water. The water to be measured must not contain any surfactants (e.g. tensides) or abrasive particles. The measuring function is disturbed by surfactants (e.g. tensides).

This sensor is not suitable to check the absence of chlorine / chlorine dioxide /ozone.

A complete measuring and/or control system normally consists of the following components:
- sensor
- electrical leads and connectors
- probe housings and connections
- measuring and control device
- dosing equipment
- analysing instrumentation

This operating instructions primarily refers to the sensor. Please pay attention to the corresponding operating instructions of the peripheral devices!

Warning: *Do not touch the electrode finger and keep it clean!*
Do not remove the layer on the electrode finger!

1.1 Chlorine sensor CL4.2

The sensor measures the chlorine concentration resulting from the use of chlorine products (chlorine gas, sodium hypochlorite solution etc.).
The pH dependence of the different varieties of chlorine influences the measuring signal, so that it is necessary to keep the pH value at a constant level. Preferably, the pH value should lie between 7.2 and 7.4 (further information can be found in special technical literature and articles). The sensor can be used in a pH range from pH 6.0 to pH 8. It is essential to keep the pH value at a constant level as due to the dissociation curve of the hypochlorous acid (see fig. 7) shows different chlorine values although no change of the chlorine concentration can be recognised in the DPD-1 measuring values!
The sensor is designed for applications with water qualities complying with the DIN 19643 standard. When organic chlorine products or chlorine stabilisers are used, both based on (iso) cyanuric acid as a rule, there may be considerable differences between the DPD-1 measuring value and the signal of the chlorine sensor (please refer to specialist technical literature). For this application there is a special chlorine sensor whose measuring signal does not depend on the concentration of cyanuric acid.

1.2 Chlorine dioxide sensor CD4.2

The chlorine dioxide sensor is virtually insensitive to chlorine, i.e. it measures only approx. 3 % of the existing chlorine (at pH 7.2 and 15 °C) together with the other value. If the pH value rises or the temperature drops, respectively, the chlorine influence becomes even smaller. The sensor can be used in the pH range of up to <pH5 in alkaline fluids until the chlorine dioxide stability limit is reached. Precipitations (e.g. lime) may block the membrane!

1.3 Ozone sensor OZ1.2

The ozone sensor is virtually insensitive to chlorine, i.e. it measures only approx. 3 % of the existing chlorine (at pH 7.2 and 25 °C) together with the other value. The sensor can be used within the pH range of pH 1 to pH 14 (lime may block the membrane!).

2 Function

The sensor is a membrane covered amperometric 2-electrode system. The measuring electrode is membrane covered and is in the electrolyte area together with the reference electrode. This electrolyte area contains a special electrolyte and is separated from the measuring water.

In this measuring method the disinfectant diffuses out of the measuring water, through the membrane and causes in compound with the electrolyte an electrical signal at the measuring electrode. The electrical signal at the measuring electrode is proportional to the concentration of the disinfectant and is amplified by the electronics of the sensor. The measuring signal is independent from the temperature of the measuring water due to an integrated temperature compensation.

3 Intended use

The sensor has to be inserted in the probe housings type FLC according to this manual (see paragraph 6). The use of the sensor in other probe housings has to be released by the manufacturer of the sensor. Otherwise the liability for a proper function of the sensors and personal injury and damage to equipment resulting from that is disclaimed.
The maximum allowed operating pressure of the sensor is 1.0 bar / 10 mwc. The allowed temperature operating range of the sensor is 0 up to <45 °C. Further operating guidelines see paragraphs 13 + 14.
The sensors are to be used only for the measurement and control of the concentration of free chlorine / chlorine dioxide / ozone.
Only trained and authorised staff should operate the sensor.
Each application beyond this is a not intended use so the warranty becomes void and the liability is disclaimed.
We do not accept liability for injury to persons or damage to property if the operating instructions in this manual have not been followed, or the original state of the sensor has been changed, or the sensor has been used under conditions other than those specified.

If installing the sensor outside Germany, please comply with the corresponding local regulations.

4 Scope of supply

Keep the packaging for the sensor completely. In case of repair or warranty return the sensor in this package.
Check that the delivery is intact. In case of damage please contact your supplier.
Check that the delivery is complete by comparing with the below mentioned scope of supply.

4.1 Sensor with voltage supply – 4-20mA-output with 5-pole M12

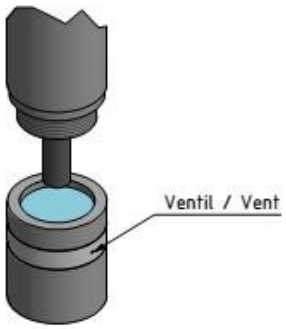
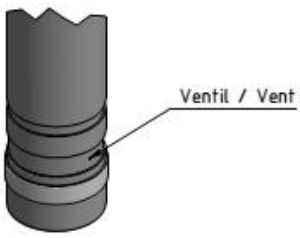
1 sensor with membrane cap M20.2
1 btl. 100 ml electrolyte ECL1 / ECD4/W●ECD7/W / EOZ1
1 piece of abrasive paper S1
1 manual

4.2 Sensor with 4-20 mA output with 2-pole terminal

1 sensor with membrane cap M20.2
1 mA-cap with o-ring 20 x 1.5
1 btl. 100 ml electrolyte ECL1 / ECD4/W●ECD7/W / EOZ1
1 piece of abrasive paper S1
1 manual

5 Preparation of the sensor for Start-up

Safety hint: *Some electrolytes contain diluted acids. Please heed the warnings on the electrolyte bottle.*
Do not swallow the electrolyte. Avoid contact of the electrolyte with skin and eyes. Otherwise wash with a lot of water. In case of eye inflammation, contact a doctor.

	The sensor is delivered with the membrane cap loosely screwed on the electrode shaft. Unscrew the membrane cap from the electrode shaft. Place the membrane cap onto a clean base. Fill up the membrane cap up to the edge with the enclosed electrolyte. Then replace it onto the base.
	Hold the electrode shaft upright and put it on the filled membrane cap. Then screw the membrane cap onto the electrode shaft. Turn it anti-clockwise until the thread engages, then screw slowly the electrode shaft clockwise (by hand) onto the membrane cap. Excess electrolyte will escape through a valve (located above the type marking) in the membrane cap. Do not close this vent (see arrow) with your finger. **Warning:** Electrolyte may spurt from the vent. Excess electrolyte or electrolyte which gets on your skin or in your eye wash up with water. Some electrolytes contain diluted acids. Please heed the warnings on the electrolyte bottle. Make sure that the membrane cap is tightly fastened to the electrode shaft! Wash up the excess electrolyte with water.
	**Important:** Check whether the membrane cap is completely screwed in up to the stop. The first screw-in resistance comes from the O-ring seal; however the screwing procedure of the cap must be continued until it hits the electrode shaft! When the membrane cap has been screwed on, the membrane is curved to the outside and must not be thumped any more, as this will damage the membrane and thus make it unusable. **Caution:** When the filled membrane cap is completely screwed onto the electrode shaft it is not allowed to touch or to adjoin the membrane!
	**Important:** When you unscrew the membrane cap do not forget to lift up the hose ring that covers the vent. So air is allowed to stream into the membrane cap. Otherwise the membrane will be destroyed because of the vacuum building up in the membrane cap.

6 Insertion of the sensor in the flow chambers FLC

Depressurise the system before inserting the sensor into the flow chamber type FLC-1 or FLC-3. Close the stop valves before and after the flow chamber.
Insertion of the sensor into the flow chamber should be carried out slowly.
The sensor is not allowed to be pushed against the bottom of the flow chamber!

Warning: A sudden failure of the sensor may lead to a very dangerous overdosing of the disinfectant – please provide preventative measures. Check the equipment for the smell of disinfectants, and the water for abnormal colour. In case of a very high overdose, the DPD-1 measuring may remain colourless, as the colorant will be bleached by the disinfectant.

Recommendations: Install a control unit with dosage time monitoring. Any dosage made for drinking water should only be made in proportion to the volume; the measuring value may be applied as a disturbance.

Safety hint: Please make sure that the sensor is tightly fastened in place!
Otherwise it may be pressed out of the flow chamber when it is under pressure.

Operating mode	**Flow chamber**	**Operating pressure max.**	**Operating temperature max.**	**Flow rate l/h**
IMPORTANT:	**!! Heed and comply with the max. allowed operating pressure / operating temperature of the sensor !!**			
Operation of the sensor **without** retaining ring	FLC-1	0.5 bar (5 mWS)	45 °C	15 (45)
	FLC-3		70 °C	45 (15)
Operation of the sensor **with** retaining ring	FLC-1	4.0 bar (40 mWS)	45 °C	15 (45)
	FLC-3	8.0 bar (80 mWS)	70 °C	45 (15)

6.1 Mounting with retaining ring

For the installation of the sensor in the flow chamber the sensor can be equipped with retaining ring, slide-ring and O-ring by the manufacturer (see fig. 1). For installation of the sensor in the flow chamber unscrew the 1 ¼" screw-connection from the flow chamber. Prepare the sensor according section 5. Make sure that retaining ring, slide-ring and O-ring are properly fixed according fig. 1.

Fig. 1:

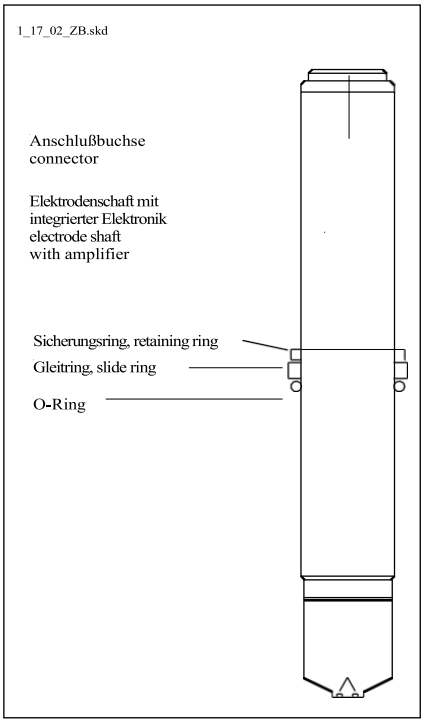
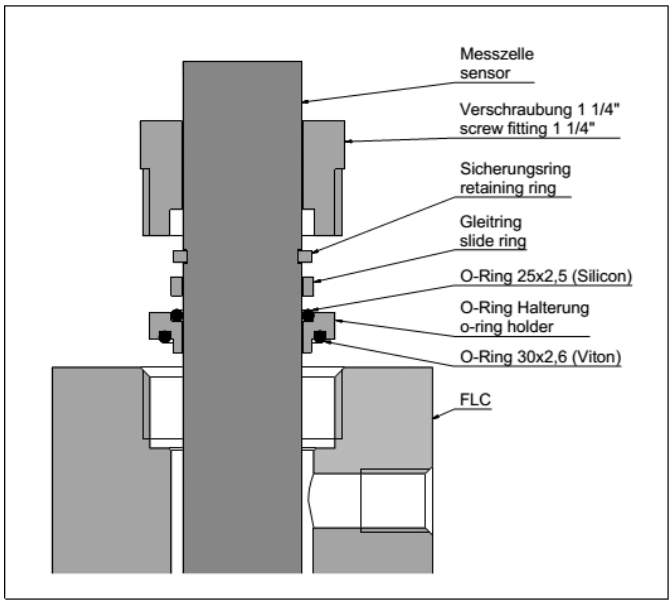


Fig. 2:



Insert the sensor according fig. 2 into the flow chamber. Push the earlier unscrewed 1 ¼" screw-connection carefully over the inserted sensor and fasten it tightly, otherwise leaks may occur.

First open the measuring water outlet. Then open slowly the measuring water supply.
Avoid installations that allow air bubbles to enter the measuring water.

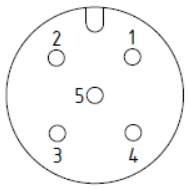
6.2 Mounting without retaining ring

If the sensor is not equipped with retaining ring, slide-ring and o-ring it can also be installed in the flow chamber by using an o-ring and 2 slide rings. The second slide ring has to be used instead of the retaining ring. Loosen the 1 ¼" screw-connection of the flow chamber. Insert the sensor (after preparation according section 5) into the flow chamber until the distance between the membrane and the inflow-opening is approx. 2 cm. Fasten the 1 ¼" screw-connection tightly. Please make sure that the sensor is tightly fastened in place, otherwise it may be pressed out of the flow chamber when it is under pressure and / or leaks may occur.

First open the measuring water outlet. Then open slowly the measuring water supply.
Avoid installations that allow air bubbles to enter the measuring water.

7 Startup of the sensor

Connect the sensor with the measuring device.

<table>
<tr><td>Connection of sensors with 0…+/-2000 mV signal output</td><td colspan="2">4 pole connector, reverse polarity protection,
symmetrical or unipolar power supply
pin configuration:
1 (socket) +U
2 (socket) -U or voltage GND
3 (PIN) GND or Signal GND
4 (PIN) signal output</td></tr>
<tr><td>Connection of sensors with modbus signal transmission</td><td>5 pole screw-connector, M12, reverse polarity protection
pin configuration: PIN 2 +9 - +30 V
PIN 3 GND
PIN 4 RS485 B
PIN 5 RS485 A
There are no termination resistors in the sensor!</td><td rowspan="2">  </td></tr>
<tr><td>Connection of mA-sensors with 5-pole M12 plug-on flange</td><td>5 pole screw-connector, M12, reverse polarity protection
pin configuration: PIN 2: +U
PIN 3: -U</td></tr>
<tr><td>Connection of mA-sensors with 2-pole terminal</td><td colspan="2">2-pole terminal clamp
Push the sensor cable through the black cable gland of the cap. Then fasten the wires in the terminals of the sensor electronics. By hand, screw the cap only now onto the sensor body/shaft until the o-ring seals. Now tighten the black cable gland (fixing the cable). For disconnection untighten the black cable gland first to release the cable.
Recommended cable: diameter approx. 4 mm, 2 x 0.25 mm².</td></tr>
</table>

As a rule, the sensor has run in after about 1 hour so that a first adjustment can be made. The run-in period of the OZ1.2 can take up to 2 hours. The adjustment has to be repeated after approx. one day. For proper function of the sensor the slope adjustment has to be repeated in regular intervals.

8 Control of the probe / Analytics

A balance or checking of the sensor using DPD-method should be performed regularly depending on utilization.
Recommendation: weekly check, if necessary more frequently.
The analytically determined value is adjusted by means of slope calibration function of the measuring and/or control device (see operation manual of the device).
It is recommended to replace the electrolyte every 3 - 6 months.

8.1 Analytics chlorine

The determination of the chlorine concentration should be performed by using DPD-1 method (“free chlorine”).

8.2 Analytics chlorine dioxide

Provided that there are no other oxidants, e. g. chlorine and ozone, chlorine dioxide can be determined in the same way as “free chlorine” (DPD-1). The result of this determination has to be multiplied by the factor 1.9, which shows the concentration in mg/l of chlorine dioxide.

8.3 Analytics ozone

Provided that there are no other oxidants, e. g. chlorine and chlorine dioxide, ozone can be determined by DPD-method. For this, a DPD total chlorine determination has to be done (DPD-4 or DPD-1 + DPD-3). The measuring value obtained has to be multiplied by a factor of 0.68, which shows the ozone concentration in mg/l. This method can be used for ozone concentrations of up to 1 mg/l.

8.4 Sensors with digital internal signal processing

The fixation of the connector is transparent. Through this two LEDs (orange and green) can be seen:

Green LED	*Continuous light*:	Power supply ok., program in processor is working.
	Flickering or *no light:*	indicates that the voltage is too low with the result in a malfunction of the processor.
Orange LED	*No light*:	everything ok, sensor signal has the right polarity
	Continuous light:	indicates wrong polarity of the sensor signal. The displayed output signal is to multiply with -1.
	Regular flickering:	The electrochemical cell is overdriven. Cause: chlorine concentration is too high. (Due to the different sensitivities/slopes of the electrochemical cells an overdrive may occur although the maximum measuring range is not reached yet.)

8.5 Sensors with 2-pole-terminal + CE-mark (4-20 mA)

Factory provided the potentiometer sideways to the 2-pole-connector is adjusted on the measuring range which is specified on the label. This adjustment is secured by a sealing wax. The setting of the potentiometer should not be changed.

9 Disassembling of the sensor

Switch of secondary measuring and/or control systems or switch them to manual operation before dismantling the sensor. A disassembled sensor results in an incorrect measuring value, which may cause an uncontrolled dosing within a control system.
Lock the measuring water supply and the outlet. Disconnect the sensor from the device.

Disconnection of sensors with 2-pole terminal: First untighten the PG screw-connection so that the cable is released. Unscrew the cap from the sensor. Then disconnect the wires from the 2-pole-terminal.

Untighten the screw-connection and pull out the sensor carefully.

10 Maintenance of the sensor

***Caution**: The brown coating of the electrode finger must not be emeried!!*

Check the sensor regularly for dirt, algae and bubbles. As far as possible avoid contamination of the membrane with solid particles, deposits etc. Bubbles on the outside of the membrane can be eliminated by increasing the flow rate temporary.
A slope adjustment has to be made after a change of the membrane cap or the electrolyte.

10.1 Change of electrolyte

Recommendation: change the electrolyte every 3 – 6 months. And also, if an adjustment is impossible due to unstable or too low values displayed.

Lift the hose ring on the membrane cap above the type marking sealing the vent sideways so that the opening is free (see fig. 3). The membrane cap is unscrewed and then air streams into the uncovered vent. The electrode finger is cleaned with a clean, dry paper towel. With the special abrasive paper supplied just the tip of the dry electrode finger (= working electrode) is cleaned. Place the special abrasive paper on paper towel, hold it at one corner and rub the electrode tip of the perpendicularly held sensor two or three times across the abrasive paper (see fig. 4). Then replace the hose ring onto the vent and fill with electrolyte (see section 5).
If the sensor still displays unstable or too low values, a new membrane cap must be used.

10.2 Change of membrane cap

Recommendation: change of the membrane cap once a year. And also, if an adjustment is impossible due to unstable or too low values displayed.

Lift the hose ring on the membrane cap above the type marking sealing the vent sideways so that the opening is free (see fig. 3). The membrane cap is unscrewed and then air streams into the uncovered vent. The electrode finger is cleaned with a clean, dry paper towel. With the special abrasive paper supplied just the tip of the dry electrode finger (= working electrode) is cleaned. Place the special abrasive paper on paper towel, hold it at one corner and rub the electrode tip of the perpendicularly held sensor two or three times across the abrasive paper (see fig. 4). Take a new membrane cap and fill with electrolyte (see paragraph 5).
If the sensor still displays unstable or too low values, a check / reconditioning by the manufacturer has to be done.

Fig. 3:

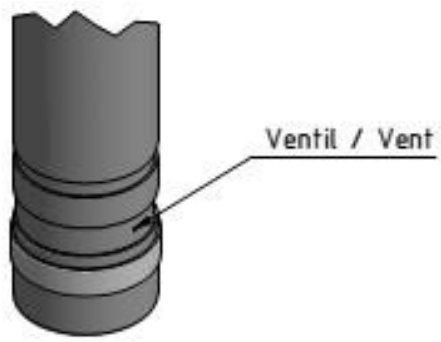
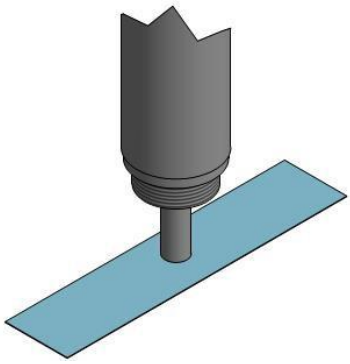


Fig. 4:



11 Storage

To store the sensor the membrane cap is unscrewed. Membrane cap and electrode finger are rinsed in clean water and dried in a place free of dust. The dry membrane cap is then loosely screwed onto the electrode shaft to protect the electrode finger. The membrane must not rest against the measuring electrode.
When putting the sensor back into use after storage, the electrode tip must be cleaned with the special abrasive paper and a new membrane cap must be used (see paragraph 5).
Used membrane caps which have been in operation for at least 1 day cannot be stored and reused.

12 Electrical specifications

The sensors have to be operated potentialfree. A current flow between the sensors and the measuring water is not allowed. Therefore, the measuring and control devices must be supplied with a galvanical isolation. When a 4-20 mA current loop is present a galvanical isolation can be achieved by using a isolating amplifier.

The sensors are only allowed to be operated with the specified voltage supply.
Ensure that the supply voltage of the measuring and/or control device is stable. Too low a voltage supply can cause incorrect measuring values, which may result in dangerous overdosing within a control system.

NOTE: A potential-free electrical connection is necessary as the sensor electronic is not equipped with a galvanical isolation.

Type	**N / DW / H / L**		**Up / HUp**	**MA-x**
CE	EMC-Testing DIN EN 61326-1 RoHS compliant			
Voltage supply	9-30 VDC	±5 … ±15 V DC	+10 …+30 V DC	12 V DC (load resistor: max. 50Ω) Up to 30 V DC (load resistor: 50Ω until 900Ω)
Power consumption	approx. 56-20 mA	approx. 10 mA		approx. 4 mA (max. current by overloading: approx. 30 mA)
Signal transmission	Analog signal output (mV per mg/l) or Modbus RTU	Analog signal output (mV per mg/l) **N:** appr. -100 **DW:** appr. -300 **H:** appr. -1000 **L:** appr. -10	Analog signal output (mV per mg/l) **Up:** appr. +100 **HUp:** appr. +1000	Analog signal output 4 – 20 mA (uncalibrated) (16 mA/measuring range in ppm = nominal slope in mA/ppm)
Internal signal processing	digital	analog		
Measuring range (mg/L)	**N:** 0.05…20.00 **DW:** 0.005…5.000 **H:** 0.005…2.000 **L:** 0.5…200.0		**Up:** 0.05…20.00 **HUp:** 0.005…2.000	x = Measuring range in mg/L (e. g. CD4.2MA2: Measuring range up to 2 mg/L ClO_2)
Connection information	– analog: 4-pole screw connector Modbus: 5-pole M12 plug-in flange – power supply is gal vanically isolated – output signal is galvanically isolated – Anschlüsse verpolungsgeschützt	– 4-pole screw connector – Ground power supply and ground signal are the same – connections are protected against polarity reversal	– 4-pole screw connector – power supply is galvanically isolated – connections are protected against polarity reversal	– 2-pole terminal or 5-pole M12 plug-on flange – connection is pro tected against polarity reversal – the 4-20 mA connection to the device also supplies the sensor with current – slope adjustment at the device necessary

(Subject to technical changes!)

13 Technical data

Data sheets are available for each type of sensor!

13.1 Chlorine sensor CL4.2

Application	Swimming pool water, drinking water, service water, process water The water must not contain any surfactants (tensides)! pH-value must be constant.
Chlorination agents	inorganic chlorine compounds: NaOCl (=sodium hypochlorite), $Ca(OCl)_2$, chlorine gas, chlorine electrolysis with membrane cell (unsuitable: chlorine electrolysis without membrane cell)
Measuring system	Membrane covered, amperometric 2-electrode system with electronic inside
Electronic	Analog version: - voltage output - not galvanically isolated electronics - analog internal data processing - output signal: analog (analog-out/analog) Digital version: - electronic is completely galvanically isolated - digital internal data processing - output signal: analog (analog-out/digital) or digital (digital-out/digital) mA-version: - current output analog - not galvanically isolated electronics - output signal: analog (analog-out/analog) - only valid for sensors with 2-pole-terminal & CE-mark: poti for (restricted) adjustment of measuring range
Information about the measuring range of sensors with 4-20 mA	Slope of a sensor can vary production-related or application-related between 65% and 150% of the nominal slope -> Recommendation to determine the suitable measuring range or the suitable sensor: Concentration to be measured x factor 1.5 = measuring range of the sensor Example: Concentration to be measured 1.6 ppm x 1.5 = 2.4 -> recommended sensor with a measuring range of 5 ppm
Slope drift At repeatability conditions (25 °C, pH 7,2 in drinking water)	approx. <-1% per month
indicator	Free chlorine
Working temperature	0 – <45 °C (no ice crystals in the measuring water)
Temperature compensation	Automatically, by an integrated temperature sensor
Max. allowed working pressure	1,0 bar, no pressure impulses and/or vibrations
Flow rate	approx. 15-30 l/h (in FLC-1), small flow rate dependence is given
pH-range	pH 6 – pH 8, pay attention to the dissociation equilibrium HOCL!
Run-in time	First start-up approx. 1 h
Response time	T_{90}: approx. 30 sec.
Zero point adjustment	Not necessary
Slope calibration	At the device, by analytical determination DPD-1-Method

Interferences	ClO_2: factor 9 O_3 Electrolytically generated chlorine with a cell without membrane can produce trouble
Connection	analog-out/analog version: 4-pole plug adapter analog-out/digital version: 4-pole plug adapter digital-out/digital version: 5-pole M12, plug-on flange 4-20 mA version: 2-pole terminal (2 x 1 mm²) or 5-pole M12, plug-on flange (PIN2: +U, PIN3: -U)
material	Semipermeable membrane, PVC-U
Size	Diameter: approx. 25 mm Length: analog-out/analog version approx. 175 mm analog-out/digital version approx. 195 mm digital-out/digital version approx. .205 mm 4-20 mA version approx. 220 mm (2-pol-terminal) or approx. 190 mm (5-pol-M12)
storage	Probe: Frost-protected, dry and without electrolyte no limit at >5 - <40 °C Membrane cap: Used membrane caps cannot be stored! Electrolyte: in original bottle protected from sunlight min. 1 year at >10 - <35 °C
maintenance	Regularly control of the measuring signal, min. once a week The following specifications depend on the water quality: Change of the membrane cap: once a year Change of the electrolyte: every 3 - 6 months

13.2 Chlorine dioxide CD4.2

Application	Swimming pool water, drinking water, service water, process water The water must not contain any surfactants (tensides)!
Measuring system	Membrane covered, amperometric 2-electrode system with electronic inside
Electronic	Analog version: - voltage output - not galvanically isolated electronics - analog internal data processing - output signal: analog (analog-out/analog) Digital version: - electronic is completely galvanically isolated - digital internal data processing - output signal: analog (analog-out/digital) or digital (digital-out/digital) mA-version: - current output analog - not galvanically isolated electronics - output signal: analog (analog-out/analog) - only valid for sensors with 2-pole-terminal & CE-mark: poti for (restricted) adjustment of measuring range
Information about the measuring range of sensors with 4-20 mA	Slope of a sensor can vary production-related or application-related between 65% and 150% of the nominal slope -> Recommendation to determine the suitable measuring range or the suitable sensor: Concentration to be measured x factor 1.5 = measuring range of the sensor Example: Concentration to be measured 1.6 ppm x 1.5 = 2.4 -> recommended sensor with a measuring range of 5 ppm
indicator	Chlorine dioxide
Working temperature	0 – <45 °C (no ice crystals in the measuring water)

Temperature compensation	Automatically, by an integrated temperature sensor
Max. allowed working pressure	1.0 bar, no pressure impulses and/or vibrations
Flow rate	approx. 15-30 l/h (in FLC-1), small flow rate dependence is given
pH-range	pH 1 – pH 11
Run-in time	First start-up approx. 1 h
Response time	T_{90}: approx. 15 sec.
Zero point adjustment	Not necessary
Slope calibration	At the device, by analytical determination
interferences	Cl_2: factor 0.03 O_3
Connection	analog-out/analog version: 4-pole plug adapter analog-out/digital version: 4-pole plug adapter digital-out/digital version: 5-pole M12, plug-on flange 4-20 mA version: 2-pole terminal (2 x 1 mm²) or 5-pole M12, plug-on flange (PIN2: +U, PIN3: -U)
material	Semipermeable membrane, PVC-U
Size	Diameter: approx. 25 mm Length: analog-out/analog version approx. 175 mm analog-out/digital version approx. 195 mm digital-out/digital version approx. .205 mm 4-20 mA version approx. 220 mm (2-pol-terminal) or approx. 190 mm (5-pol-M12)
storage	Probe: Frost-protected, dry and without electrolyte no limit at >5 - <40 °C Membrane cap: Used membrane caps cannot be stored! Electrolyte: in original bottle protected from sunlight min. 1 year at >10 - <35 °C
maintenance	Regularly control of the measuring signal, min. once a week The following specifications depend on the water quality: Change of the membrane cap: once a year Change of the electrolyte: every 3 - 6 months

13.3 Ozone sensor OZ1.2

Application	Swimming pool water, drinking water, service water, process water The water must not contain any surfactants (tensides)!
Measuring system	Membrane covered, amperometric 2-electrode system
Electronic	Analog version: - voltage output - not galvanically isolated electronics - analog internal data processing - output signal: analog (analog-out/analog) Digital version: - electronic is completely galvanically isolated - digital internal data processing - output signal: analog (analog-out/digital) or digital (digital-out/digital) mA-version: - current output analog - not galvanically isolated electronics - output signal: analog (analog-out/analog) - only valid for sensors with 2-pole-terminal &

	CE-mark: poti for (restricted) adjustment of measuring range
Information about the measuring range of sensors with 4-20 mA	Slope of a sensor can vary production-related or application-related between 65% and 150% of the nominal slope -> Recommendation to determine the suitable measuring range or the suitable sensor: Concentration to be measured x factor 1.5 = measuring range of the sensor Example: Concentration to be measured 1.6 ppm x 1.5 = 2.4 -> recommended sensor with a measuring range of 5 ppm
Slope drift At repeatability conditions (25 °C, pH 7,2 in drinking water)	approx. <-1% per month
indicator	ozone
Working temperature	0 – <45 °C (no ice crystals in the measuring water)
Temperature compensation	Automatically, by an integrated temperature sensor
Max. allowed working pressure	1.0 bar, no pressure impulses and/or vibrations
Flow rate	approx. 15-30L/h in FLC-1, small flow rate dependence is given
pH-range	pH 2 – pH 11
Run-in time	First start-up approx. 2 h
Response time	T_{90}: approx. 15 sec.
Zero point adjustment	Not necessary
Slope calibration	At the device, by analytical determination
interferences	Cl_2: factor 0.03 ClO_2: factor 0.7
Connection	analog-out/analog version: 4-pole plug adapter analog-out/digital version: 4-pole plug adapter digital-out/digital version: 5-pole M12, plug-on flange 4-20 mA version: 2-pole terminal (2 x 1 mm²) or 5-pole M12, plug-on flange (PIN2: +U, PIN3: -U)
material	Semipermeable PTFE (=Teflon) membrane, PVC-U
Size	Diameter: approx. 25 mm Length: analog-out/analog version approx. 175 mm analog-out/digital version approx. 195 mm digital-out/digital version approx. .205 mm 4-20 mA version approx. 220 mm (2-pol-terminal) or approx. 190 mm (5-pol-M12)
storage	Probe: Frost-protected, dry and without electrolyte no limit at >5 - <40 °C Membrane cap: Used membrane caps cannot be stored! Electrolyte: in original bottle protected from sunlight min. 1 year at >10 - <35 °C
maintenance	Regularly control of the measuring signal, min. once a week The following specifications depend on the water quality: Change of the membrane cap: once a year (depending on the water quality) Change of the electrolyte: every 3 - 6 months

14 General operating guidelines

- The sensor has to be operated in an upright position, so that the incoming flow comes from the bottom up to the membrane.
- During unpressurised operation with free outflow of the measuring water gas bubbles have no disturbing effect unless they cover the membrane. Gas bubbles at the membrane obstruct the inflow of the disinfectant, which leads to incorrect measuring signals.
- The flow rate must be constant.
- The signal of the chlorine sensors depends on the dissociation equilibrium of the hypochlorous acid (see fig.7).
- The membrane life is typically one year, but can vary considerably depending on the water quality. Heavy contamination of the membrane should be avoided.
- Each sensor has been tested and the results are documented.
- During interval operation of the measuring system / plant the sensor is not allowed to be disconnected from the power supply. The sensor must be connected to the power supply all the time. The sensor must not be allowed to stand dry.
- The sensor is not allowed to be operated in water that is free of a disinfectant for a longer period (>1 day). Danger: built up of sediments/contaminations (e. g. biological) on the membrane. This can interfere or block a later measurement of the disinfectant. After any operation without disinfectant, run-in periods must be reckoned with. If required, switch on metering unit time-delayed. If no chlorine is dosed for a longer period of time, the sensor must be disconnected from the device, disassembled and stored dry (see section 11).
- The presence of reducing-, oxidising reagents and corrosion inhibitors may interfere with the measurement.

15 Spare parts

type	Electrolyte	membrane cap
chlorine sensor CL4.2	ECL1, 100 mL (Art. No. 11001)	M20.2 (Art. No. 11027)
chlorine dioxide sensor CD4.2	ECD4/W ● ECD7/W, 100 mL (Art. No. 11030)	
ozone sensor OZ1.2	EOZ1, 100 mL (Art. No. 11101)	

16 Trouble Shooting

Trouble shooting must take account of the whole measuring circuit system from the extraction point to drain. In general, the measuring system consists of:

- sensor
- electrical leads and its connectors
- measuring and control device
- probe housings with hose connections / pipe connections

16.1 General Troubleshooting

Fault	Possible Cause	Action
Sensor cannot be calibrated / deviation of the measuring value from DPD-measurement	Run-in time too short	See paragraph 5, repeat calibration after several hours
	Membrane cracked	Replace membrane cap, see paragraph 10.2
	Membrane cap damaged	Replace membrane cap, see paragraph 10.2
	Interfering substances in the measuring water	Examine the measuring water for interfering substances and remedy, if necessary consult supplier
	Short-circuit / damage in the signal lead	Locate and eliminate short-circuit / defect, if necessary change the measuring cable
	Distance between working electrode and membrane is too great	Screw the membrane cap tightly onto the shaft until it hits the shaft
	DPD-chemicals spent	Use new DPD-chemicals, repeat calibration
	Deposits on the membrane	Replace membrane cap, see paragraph 10.2
	Gas bubbles on the outside of the membrane	Increase the flow rate temporary, if necessary check installation and revise it
	Sensor defective	Return the sensor to the manufacturer for check/reconditioning
	No electrolyte in the membrane cap	Fill membrane cap with electrolyte and follow the instructions of paragraph 5
	Chlorine concentration exceeds the upper limit of the measuring range	Check the whole system, remedy fault, repeat calibration

Measuring signal is not stable	Membrane cracked	Replace membrane cap, see paragraph 10.2
	Gas bubbles on the outside of the membrane	Increase the flow rate temporary, if necessary check installation and revise it
	Pressure fluctuations in the measuring water	Check installation, if necessary revise it
	Reference electrode exhausted and/or contaminated	Return sensor for reconditioning to the manufacturer
Only for sensors with digital electronics:		
green LED		
Flickering or no light	Voltage too low -> malfunction of the Microcontroller	Provide correct power supply to the sensor
	Sensor defective	Return sensor for reconditioning to the manufacturer
orange LED		
continuous light	wrong polarity of the sensor signal -> displayed output signal is to multiply with -1	Maintain sensor according to section 10 Return sensor for reconditioning to the manufacturer
regular flickering	electrochemical cell is overdriven -> level of concentration of the disinfectant is too high	Check installation, if necessary revise it, calibrate or maintain sensor if necessary
Only for MA-sensors: Output signal is 0	Sensor is connected to the measuring and/or control device with wrong polarity	Correctly connect the sensor to the measuring and/or control device
	Signal lead is broken	Replace signal lead
	Sensor defective	Return the sensor to the manufacturer for check/reconditioning
	Measuring and/or control device defective	Check the measuring and/or control device

16.2 Special Troubleshooting for sensor

When the electrode finger turns shiny silver or white the sensor must be reconditioned by the manufacturer.

Tightness check of membrane cap	Membrane cap M20.2 1. Thoroughly dry the outside of the membrane cap to be checked 2. Prepare membrane cap according to instruction manual and fill with electrolyte or clean water 3. Dry the outside of the membrane cap again if necessary 4. Slowly and carefully screw membrane cap on sensor according to the instruction manual 5. When screwing the membrane cap on, check if liquid leaks through the membrane CAUTION: Thoroughly check if liquid leaks through the membrane or exits at the designated points. If necessary, repeat tightness check. -> If dripping can be observed at the membrane, the membrane is damaged and a new membrane cap must be used. -> Check if the reference electrode was damaged by the exchange from measuring water to electrolyte. If it is not intact anymore, the sensor must be send back to the manufacturer for testing.
Check of the electronic system (dry test)	1. Unscrew membrane cap 2. Thoroughly rinse off electrode finger and dry carefully using clean cloth 3. Connect sensor to measurement/control device and wait for approx. 5 min. 4. Take readings of original sensor signal from measurement/control device or measure using a digital multimeter A) Sensor (mV): approx. +/- 0 mV B) Sensor (mA): approx. 4 mA C) Sensor (µA): approx. 0 µA -> If the sensor signal approximately corresponds to the above mentioned values, the electronic system is likely to be ok. -> If the measured value significantly deviates from the above mentioned values, the sensor must be send back to the manufacturer for testing.
Zero point check	After the check of the electronic system 1. Prepare sensor for start-up according to section 5 of the instruction manual 2. Connect sensor to measurement/control device 3. Place sensor carefully into a beaker filled with clean tab water (free from disinfectant!) 4. Stir for approx. 30 sec. using sensor in beaker (without causing air bubbles) 5. Then leave the sensor in the beaker and wait until the run-in time has passed (at least for 1 hour) 6. Take readings of original sensor signal from measurement/control device or measure using a digital multimeter 7. The sensor signal should approach zero. -> If the sensor signal approaches zero, the zero point is likely to be ok. -> If the measured value deviates significantly from zero, maintenance must be carried out on the sensor according to section 10 of the instruction manual and the zeropoint check must be repeated. It has to be taken into account that a freshly cleaned working electrode (measuring electrode) has a relatively high zero point. The sensor needs a few days to reach its lowest zero point again.

	-> If the measured value does not approach zero even after maintenance was carried out, the sensor must be send back to the manufacturer for testing. Note: For sensors with very limited measurement ranges or high sensitivity, the zero points are always slightly above those of sensors with larger measurement ranges or low sensitivity.
Signal check	<u>After zero point check</u> 1. Add some disinfectant to the beaker filled with clean tab water from section “zero point check“ 2. Stir as steadily as possible using the sensor connected to the measurement device for at least 5 min. 3. During this time, you should observe an increase of the measuring signal -> If the sensor signal increases, the sensor is likely to be ok. If the sensor does not react to the disinfectant, maintenance must be carried out on the sensor according to section 10 of the operating instructions and the “signal check” must be repeated. -> If the sensor still does not react to the disinfectant, the sensor must be send back to the manufacturer for testing.
Periphery check	e. g. 1. Check flow 2. Check measuring cable 3. Check measurement/control device 4. Check proper calibration 5. Check dosing unit 6. Check concentration of disinfectant in the dosing tank 7. Check suitability of sensor for measuring the dosed disinfectant 8. Check concentration of disinfectant in the measuring water (analytics) 9. Check pH value of the measuring water 10. Check temperature of measuring water 11. Check pressure in the flow fittings 12. Check analytics

17 Warranty

We grant a manufacturer's warranty of two years on the electrode body including the electronics subject to appropriate application. The warranty does not apply to the membrane cap (wearing part), electrolyte (expendable material) and service work to be performed.
(Cleaning of the parts in contact with the electrolyte, renewing the silver chloride coating of the electrode finger and cleaning of the electrode tip with special abrasive paper). Should there be mechanical damage or should the serial number be illegible, the warranty becomes void.
Return of a sensor for check/reconditioning: Only shipments are accepted that are returned with carriage paid. Otherwise they will be returned to the sender.

On checked/reconditioned sensors we grant a warranty of one year on the electrode body including the electronics subject to appropriate application from the date of check/reconditioning. Should there be mechanical damage or should the serial number be illegible, this warranty becomes void.

18 Liability disclaimer

The sensors are manufactured with the greatest care and is subjected to a documented function test. Should any malfunctions occur in the sensor despite this, no liability claims may be lodged against the manufacturer in case of damage resulting from this malfunction.

Subject to technical changes!!

Abb. / Fig. 6:

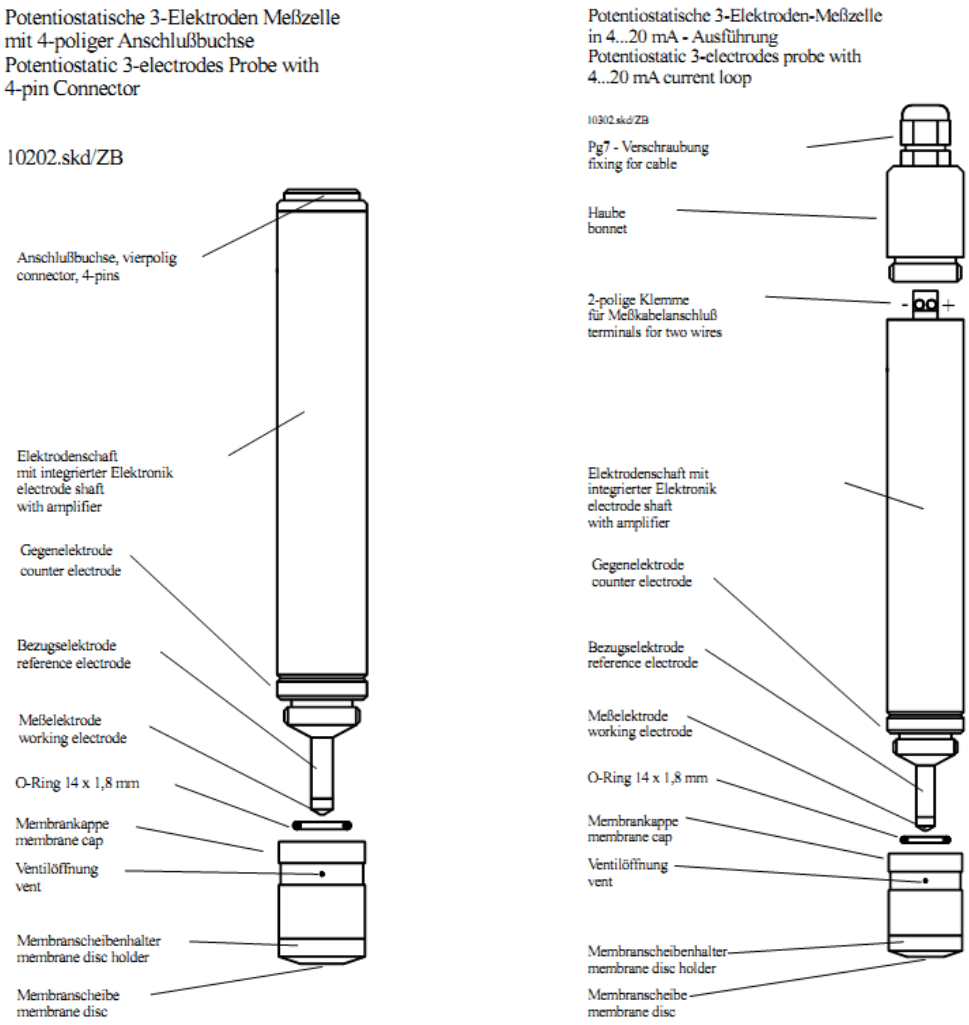


Abb. / Fig. 7: