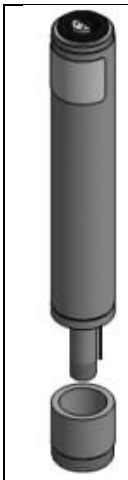
November 2015

E N G L I S H

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

Version AS2…:	***applicable up to 50 °C and 8 bar (application: cold water)***
Version AS3…:	***applicable up to 70 °C and 8 bar (application: warm water)***

	**Chlorine**	AS2 / AS3 (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		
	Chlorine	AS2 / AS3 (analog-out/digital)	analog signal output Power supply 12 VDC or 24 VDC Digital internal signal processing Galvanical isolation
	Chlorine	AS2 / AS3 (digital-out/digital)	Modbus-Signal transmission Power supply 12 VDC or 24 VDC Digital internal signal processing Galvanical isolation
	**Chlorine**	AS2 / AS3 4- 20mA (analog- out/analog)	analog signal output Current supply 4...20 mA Analog signal processing No galvanical isolation
	Chlorine Dioxide		

Content

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1 General Information

This chlorine / chlorine dioxide sensor AS is a special sensor designed to measure the concentration of chlorine / chlorine dioxide in drinking water at temperatures up to 50 °C or 70 °C respectively under pressure up to 8 bar (80 mws).
The area of application of these probes comprises drinking water or water qualities similar to that of drinking water.
For safe operation under pressure, the sensor is equipped with a retaining ring as a standard.
The measuring signal of the chlorine sensor AS follows the dissociation equilibrium of hypochlorous acid.

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

A complete measuring and/or control system normally consists of the following components:
- sensor
- electrical leads and connectors
- flow chambers 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 electrodes and keep them clean!*

2 Function

The sensors of the type AS are open (not-membrane covered) amperometric 3-electrode system. The measuring and counter electrode are in direct contact with the measuring water. The reference electrode is separated from the measuring water in a special electrolyte room which contains a special electrolyte. Together with the electrolyte an electrical signal is generated at the measuring electrode. The electrical signal at the measuring electrode is proportional to the concentration of the disinfectant and 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 flow chamber FLC-3 (max. 70 °C) according to this manual (see section 7). The use of the sensor in other flow chambers 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 8.0 bar / 80 mwc. The allowed temperature operating range of the sensor is 0 up to <50 °C (AS2) or 0 up to <70 °C (AS3) respectively. Further operating guidelines see sections 14 + 15. The sensor is to be used only for the measurement and control of the concentration of chlorine or chlorine dioxide respectively.
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 following mentioned scope of supply.

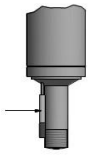
4.1 AS: analog-out - AS: digital-out - AS: 4-20mA with 5-pole M12

1 sensor ready for installation with protection cap and retaining ring, slide ring, o-ring 25 x 2.5 sil.
1 bottle gel-electrolyte EAS1/GEL, 50 ml
1 piece of abrasive paper S3
1 operating instructions

4.2 AS2/AS3: 4-20mA with 2-pole terminal

1 sensor ready for installation with protection cap and retaining ring, slide ring, o-ring 25 x 2.5 sil.
1 mA-cap with o-ring 20 x 1.5
1 bottle gel-electrolyte EAS1/GEL, 50 ml
1 piece of abrasive paper S3
1 manual

5 Preparation of the sensor for start-up

<table>
<tr><td>Attention</td><td colspan="2">GEL-electrolytes are not allowed to be shaked!</td></tr>
<tr><td>Safety hint</td><td colspan="2">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.</td></tr>
<tr><td rowspan="2">Caution</td><td colspan="2">Do not touch the electrodes or contaminate them otherwise!!</td></tr>
<tr><td colspan="2">Only for AS3-Type:
Do not remove the reservoir cartridge which is slid on the reference electrode!  </td></tr>
<tr><td> 
</td><td colspan="2">The grey protection cap contains liquid.
Hold the sensor at the hull and unscrew the dark grey protection cap.

If the hull is loosely then first fill up the electrolyte (see section 11.2) and then screw on the hull.
There must be no air bubbles in the electrolyte!</td></tr>
</table>

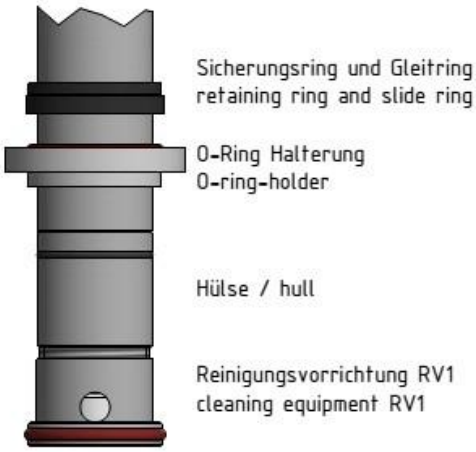
6 Option: Cleaning equipment RV1

The cleaning equipment RV1 can be ordered optionally and installed on the sensor. The cleaning effect of RV1 is moderate. That means light deposits on the electrodes will be removed, e. g. low rust films.
For a correct and reliable operation of sensor with cleaning equipment RV1 the flow chamber FLC-3 has to be used. The construction of RV1 is adapted to this flow chamber.
For a proper function of RV1 a flow rate of at least 45 l/h is recommended.
The AS-sensors can be upgraded with the cleaning equipment RV1 at any time.

6.1 Scope of supply of RV1

	RV1 2 bags with 3 cleaning balls Manual TARAsens AS

6.2 Assembling of RV1 on the sensor

	After the AS-sensor has been prepared for start-up according section 5 the cleaning equipment RV1 can be mounted on the sensor: Firstly remove the so called „O-ring-holder“ from flow chamber and slide it on the shaft beginning from the sensor side. The space for the red o-ring 25 x 2.5 should attach to this o-ring. Fill 3 pieces of the cleaning balls from one of the two bags into the cleaning equipment and screw it on the electrolyte hull (hull AS2 / AS3). The additional bag contains 3 cleaning balls for replacement.

7 Insertion of the sensor in the flow chamber

Depressurise the system before inserting the sensor into the flow chamber. 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 chlorine, 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	e. g. dosage volume monitoring, dosage time monitoring, limit value 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 in FLC-3	Sensor type	Operating pressure max.	Operating temperature max.	Flow rate l/h
IMPORTANT:	**!! Heed and comply with the max. allowed operating temperature of the sensor !!**			
Operation of the sensor **without** RV1	AS2	8.0 bar (80 mWS)	50 °C	45 (min. 15)
	AS3		70 °C	
Operation of the sensor **with** RV1	AS2		50 °C	min. 45
	AS3		70 °C	

7.1 without cleaning equipment RV1

For the installation of the sensor in flow chamber FLC-3 unscrew the 1 1/4“ screw-connection of the flow chamber. Insert the according section 5 prepared sensor (see fig. 1) according fig. 2 into FLC-3. Push the screw fitting over the sensor and fasten it 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 or leakages can 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.

7.2 with cleaning equipment RV1

For the installation of the sensor in flow chamber FLC-3 unscrew the 1 1/4“ screw-connection of the flow chamber. Insert the according section 5-6 prepared sensor (see fig. 1) according fig. 2 into FLC-3.
Insert the sensor with mounted RV1 carefully by turning it in clockwise direction into FLC-3 until the O-ring-holder gives resistance. Check if the big black O-ring 30 x 2.6 is located correctly between the „O-ring-holder“ and the flow chamber.

Push the screw fitting over the sensor and fasten it 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 or leakages can occur.

First open the measuring water outlet. Then open slowly the measuring water supply. For an optimal function of RV1 a flow rate of at least 45 l/h is recommended.
Avoid installations that allow air bubbles to enter the measuring water.

Advice: If the sensor is turned anticlockwise during assembling the electrolyte cap (hull AS2 / AS3) may become loosely. This can result in a malfunction of the sensor. Another risk of anticlockwise turning is that RV1 may remain in the flow chamber.

Fig. 1:

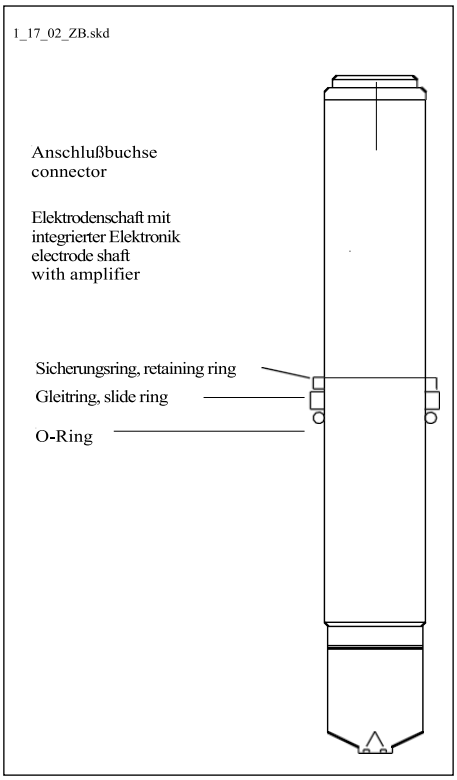
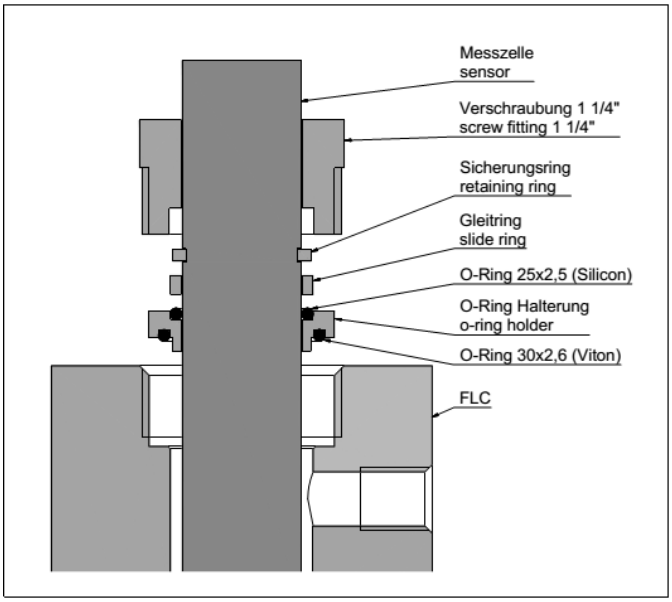
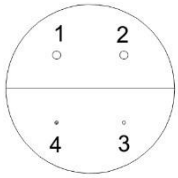
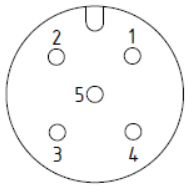


Fig. 2:



8 Start-up of the sensor

Connect the sensor with the measuring device.

Connection of sensors with 0…+/- 2000 mV signal output	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	
Connection of sensors with modbus signal transmission	5 pole screw-connector, M12, reverse polarity protection pin configuration: PIN 2 +12 V / +24 V PIN 3 GND PIN 4 RS485 B PIN 5 RS485 A There are no termination resistors in the sensor!	
Connection of mA-sensors with 5-pole M12 plug-on flange	5 pole screw-connector, M12, reverse polarity protection pin configuration: PIN 2: +U PIN 3: -U	
Connection of mA-sensors with 2-pole terminal	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.	

As a rule the sensor is run in after about 1 hour up to 1 day (depends on the water quality) so that a first adjustment can be made. The adjustment has to be repeated the next day.
For proper function of the sensor the slope adjustment has to be repeated in regular intervals.

9 Control of the probe / Analytics

A balance or checking of the probe 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 controller (see Operation Manual of the Controller).
It is recommended to change the electrolyte every 3-6 months.

9.1 Analytics chlorine

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

9.2 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.

9.3 Sensors with digital internal signal processing

The fixation of the electrical connector is transparent. Through this two illuminating diodes 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.)

9.4 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.

10 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 at first and after that the outlet. Disconnect the sensor from the device.

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

10.1 without cleaning equipment RV1

Remove the 1 ¼" screwing and carefully pull the sensor out of the flow chamber.

10.2 with cleaning equipment RV1

Remove the 1 ¼" screwing and turn the sensor in clockwise direction and carefully pull it out of the flow chamber.

Advice: If the sensor is turned anticlockwise during assembling or disassembling the electrolyte cap (hull AS2 / AS3) may become loosely. This can result in a malfunction of the sensor. Another risk of anticlockwise turning is that RV1 may remain in the flow chamber.

11 Maintenance of the sensor

Check the sensor regularly for dirt, algae and bubbles. As far as possible avoid contamination of the electrodes with solid particles, deposits etc, if necessary use RV1 (see section 6). Bubbles on the outside of the electrodes can be eliminated by increasing the flow rate temporary.
A slope adjustment has to be made after cleaning the electrodes or change of the electrolyte.

11.1 Cleaning of the electrodes

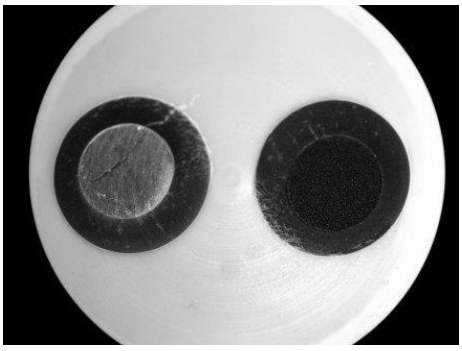
It is recommended to clean the electrodes every 4 – 12 weeks. Also, if an adjustment is impossible due to unstable or too low values displayed.

Disassemble the sensor according section 10 "Disassembling of the sensor". Dry the outside of the sensor with a clean paper towel. If necessary hold the electrolyte cap (hull AS2 / AS3) tight to remove RV1.

Use the S3 emery paper supplied to clean the electrodes. Therefore, hold the sensor in a position that both electrodes are parallelly pulled over the emery (not one after another!). Then put the sensor into operation again according to the instructions of sections 5-8.

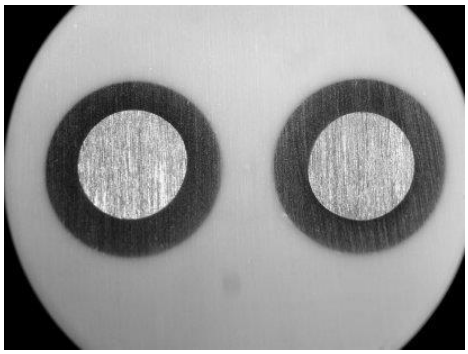
If the sensor still displays unstable or too low values, the electrolyte has to be changed.

Fig. 3:



electrodes after approx. 4 months operating time
in warm water, 50 °C, 6 bar,
good water quality (potable water)
dark: counter electrode, bright: working electrode

Fig. 4:



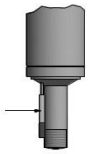
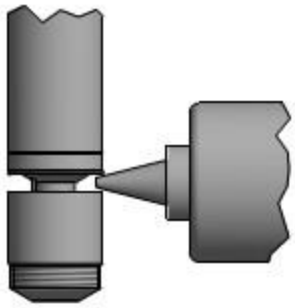
electrodes freshly abraded with emery S3

11.2 Change of electrolyte

It is recommended to change the electrolyte every 3 – 6 months. Also, if an adjustment is impossible due to unstable or too low values displayed.

Disassemble the sensor according to section 10 "Disassembling of the sensor". Dry the outside of the sensor with a clean paper towel. If necessary, hold the electrolyte cap (hull AS2 / AS3) tight to remove

RV1. Unscrew the electrolyte hull (hull AS2 / AS3) and rinse it with clean water. Rinse the electrode finger with clean water. Throw both dry like a clinical thermometer.

Only for AS3-type	Do not remove the reservoir cartridge which is slid on the reference electrode! 
	Screw on again the hull until there is a gap (approx. 5 mm) so that you can insert the spout of the electrolyte bottle. Fill in the electrolyte without bubbles until it overflows. Completely screw on the hull by hand tightly. Remove the excess electrolyte with a clean paper towel. There must be no air bubbles in the electrolyte!!

Then put the sensor into operation again according to the instructions of sections 5-8.

If the sensor still displays unstable or too low values, a check / reconditioning by the manufacturer has to be done.

11.3 Cleaning equipment RV1

Disassemble the sensor according to section 10 “Disassembling of the sensor”. Hold on electrolyte hull (hull AS2 / AS3) and unscrew RV1. When required perform the above mentioned maintenance steps 11.1 and 11.2.
If necessary, the used cleaning balls can be replaced by 3 new ones.
There must be no air bubbles in the electrolyte!!
Then put the sensor into operation again according to the instructions of sections 5-8.

12 Storage

To store the sensor the electrolyte hull is unscrewed. Electrolyte hull and electrode finger are rinsed in clean water and dried in a place free of dust. The dry electrolyte hull cap with screwed-on protection cap is then loosely screwed onto the electrode shaft to protect the electrodes.
For a short period (1-3 days) the sensor can be stored wet. I. e. the protection cap can be filled with clean water or electrolyte and screwed on the electrolyte hull.

When putting the sensor back into operation after storage, the electrodes must be cleaned with the special abrasive paper (see sections 5-8).

13 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.

13.1 AS2 / AS3 (analog output, analog internal signal processing)

analog-out / analog

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

13.1.1 Chlorine

	**Measuring range in ppm**	**resolution in ppm**	**Output Output resistance**	**Nominal slope** (at pH 7.2)	**Voltage supply**	**Connection**
	CE	EMC-Testing DIN EN 61326-1 RoHS compliant				
AS2H-CL	0.005… 2.000	0.001	analog 0…-2000 mV 1 kΩ	-1000 mV/ppm	±5 - ±15 VDC 10 mA	4-pole screw connector
AS2N-CL	0.03… 10.00	0.01		-100 mV/ppm		
AS2Up-CL	0.03… 10.00	0.01	analog 0…+2000 mV 1 kΩ	+100 mV/ppm	10 - 30 VDC 10 mA	
AS3H-CL	0.005… 2.000	0.001	analog 0…-2000 mV 1 kΩ	-1000 mV/ppm	±5 - ±15 VDC 10 mA	
AS3N-CL	0.03… 10.00	0.01		-100 mV/ppm		
AS3Up-CL	0.03… 10.00	0.01	analog 0…+2000 mV 1 kΩ	+100 mV/ppm	10 - 30 VDC 10 mA	

(Subject to technical changes!)

13.1.2 Chlorine dioxide

	**Measuring range in ppm**	**resolution in ppm**	**Output Output resistance**	**Nominal slope**	**Voltage supply**	**Connection**
	CE	EMC-Testing DIN EN 61326-1 RoHS compliant				
AS2H-CD	0.005…2.000	0.001	0…-2000 mV 1 kΩ	-1000 mV/ppm	±5 - ±15 VDC 10 mA	4-pole screw connector
AS2N-CD	0.03…10.00	0.01		-100 mV/ppm		
AS2Up-CD	0.03…10.00	0.01	0…+2000 mV 1 kΩ	+100 mV/ppm	10 - 30 VDC 10 mA	
AS3H-CD	0.005… 2.000	0.001	0…-2000 mV 1 kΩ	-1000 mV/ppm	±5 - ±15 VDC 10 mA	
AS3N-CD	0.03… 10.00	0.01		-100 mV/ppm		
AS3Up-CD	0.03… 10.00	0.01	0…+2000 mV 1 kΩ	+100 mV/ppm	10 - 30 VDC 10 mA	

(Subject to technical changes!)

13.2 AS (analog output, digital internal signal processing)

analog-out / digital

13.2.1 Chlorine

- The power supply is galvanically isolated inside of the sensor.
- The output signal is galvanically isolated too, that means potential-free.

	**Measuring range in ppm**	**Resolution in ppm**	**Output** **Output resistance**	**Nominal Slope** (at pH 7.2)	**Power supply**	**Connection**
	CE	EMC-Testing DIN EN 61326-1 RoHS compliant				
AS2H-CL-A12n	0.005… 2.000	0.001	analog 0…-2 V (max. -2.5 V) 1 kΩ	-1000 mV/ppm	12 VDC (11.5…13 VDC) approx. 40 mA	4-pole screw connector
AS2N-CL-A12n	0.03… 10.00	0.01		-100 mV/ppm		
AS3H-CL-A12n	0.005… 2.000	0.001		-1000 mV/ppm		
AS3N-CL-A12n	0.03… 10.00	0.01		-100 mV/ppm		
AS2H-CL-A12p	0.005… 2.000	0.001	analog 0…+2 V (max. +2.5 V) 1 kΩ	-1000 mV/ppm		
AS2N-CL-A12p	0.03… 10.00	0.01		-100 mV/ppm		
AS3H-CL-A12p	0.005… 2.000	0.001		-1000 mV/ppm		
AS3N-CL-A12p	0.03… 10.00	0.01		-100 mV/ppm		
AS2H-CL-A24n	0.005… 2.000	0.001	analog 0…-2 V (max. -2.5 V) 1 kΩ	-1000 mV/ppm	24 VDC (22.5…26 VDC) approx. 20 mA	4-pole screw connector
AS2N-CL-A24n	0.03… 10.00	0.01		-100 mV/ppm		
AS3H-CL-A24n	0.005… 2.000	0.001		-1000 mV/ppm		
AS3N-CL-A24n	0.03… 10.00	0.01		-100 mV/ppm		
AS2H-CL-A24p	0.005… 2.000	0.001	analog 0…+2 V (max. +2.5 V) 1 kΩ	-1000 mV/ppm		
AS2N-CL-A24p	0.03… 10.00	0.01		-100 mV/ppm		
AS3H-CL-A24p	0.005… 2.000	0.001		-1000 mV/ppm		
AS3N-CL-A24p	0.03… 10.00	0.01		-100 mV/ppm		

(Subject to technical changes!)

13.3 AS (digital output, digital internal signal processing)

digital-out / digital

- The power supply is galvanically isolated inside of the sensor.
- The output signal is galvanically isolated too, that means potential-free.

13.3.1 Chlorine

	**Measuring range in ppm**	**Resolution in ppm**	**Output Output resistance**	**Power supply**	**Connection**
	CE	EMC-Testing DIN EN 61326-1 RoHS compliant			
AS2H-CL-M1c-12	0.005… 2.000	0.001	Modbus RTU	12 VDC (11.5…13 VDC) approx. 40 mA	5-pole M12 plug-on flange
AS2N-CL-M1c-12	0.03… 10.00	0.01			
AS3H-CL-M1c-12	0.005… 2.000	0.001			
AS3N-CL-M1c-12	0.03… 10.00	0.01			
AS2H-CL-M1c-24	0.005… 2.000	0.001		24 VDC (22.5…26 VDC) approx. 20 mA	
AS2N-CL-M1c-24	0.03… 10.00	0.01			
AS3H-CL-M1c-24	0.005… 2.000	0.001			
AS3N-CL-M1c-24	0.03… 10.00	0.01			

(Subject to technical changes!)

13.4 AS 4-20 mA (analog output, analog internal signal processing)

analog-out / analog

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

13.4.1 Chlorine

13.4.1.1 Electrical Connection: 2-pole terminal

	**Measuring range in ppm**	**resolution in ppm**	**Output Output resistance**	**Nominal slope** (at pH 7.2)	**Voltage supply**	**Connection**
	CE	EMC-Testing DIN EN 61326-1 RoHS compliant				
AS2MA1-CL	0.03… 1.00	0.01	4…20 mA uncalibrated	16.0 mA/ppm	12…30 VDC R_L 50Ω…R_L 900Ω	2-pole terminal
AS2MA2-CL	0.03… 2.00	0.01		8.0 mA/ppm		
AS2MA5-CL	0.03… 5.00	0.01		3.2 mA/ppm		
AS2MA10-CL	0.03… 10.00	0.01		1.6 mA/ppm		
AS2MA20-CL	0.03… 20.00	0.01		0.8 mA/ppm		
AS3MA1-CL	0.03… 1.00	0.01		16 mA/ppm		
AS3MA2-CL	0.03… 2.00	0.01		8.0 mA/ppm		
AS3MA5-CL	0.03… 5.00	0.01		3.2 mA/ppm		
AS3MA10-CL	0.03… 10.00	0.01		1.6 mA/ppm		
AS3MA20-CL	0.03… 20.00	0.01		0.8 mA/ppm		

(Subject to technical changes!)

13.4.1.2 Electrical Connection: 5-pole M12 plug-on flange

	**Measuring range in ppm**	**resolution in ppm**	**Output Output resistance**	**Nominal slope** (at pH 7.2)	**Voltage supply**	**Connection**
	CE	EMC-Testing DIN EN 61326-1 RoHS compliant				
AS2MA1-CL-M12	0.03… 1.00	0.01		16.0 mA/ppm		
AS2MA2-CL-M12	0.03… 2.00	0.01		8.0 mA/ppm		
AS2MA5-CL-M12	0.03… 5.00	0.01		3.2 mA/ppm		
AS2MA10-CL-M12	0.03… 10.00	0.01		1.6 mA/ppm		
AS2MA20-CL-M12	0.03… 20.00	0.01	4…20 mA	0.8 mA/ppm	12…30 VDC	5-pole M12 plug-on flange
AS3MA1-CL-M12	0.03… 1.00	0.01	uncalibrated	16 mA/ppm	R_L 50Ω…R_L 900Ω	Function of wires: PIN2: +U PIN3: -U
AS3MA2-CL-M12	0.03… 2.00	0.01		8.0 mA/ppm		
AS3MA5-CL-M12	0.03… 5.00	0.01		3.2 mA/ppm		
AS3MA10-CL-M12	0.03… 10.00	0.01		1.6 mA/ppm		
AS3MA20-CL-M12	0.03… 20.00	0.01		0.8 mA/ppm		

(Subject to technical changes!)

13.4.2 Chlorine dioxide

13.4.2.1 Electrical Connection: 2-pole terminal

	**Measuring range in ppm**	**resolution in ppm**	**Output Output resistance**	**Nominal slope**	**Voltage supply**	**Connection**
	CE	EMC-Testing DIN EN 61326-1 RoHS compliant				
AS2MA1-CD	0.03… 1.00	0.01		16 mA/ppm		
AS2MA2-CD	0.03… 2.00	0.01		8.0 mA/ppm		
AS2MA5-CD	0.03… 5.00	0.01	4…20 mA	3.2 mA/ppm	12…30 VDC	2-pole terminal
AS3MA1-CD	0.03… 1.00	0.01	unkalibriert	16 mA/ppm	R_L 50Ω…R_L 900Ω	
AS3MA2-CD	0.03… 2.00	0.01		8.0 mA/ppm		
AS3MA5-CD	0.03… 5.00	0.01		3.2 mA/ppm		

(Subject to technical changes!)

13.4.2.2 Electrical Connection: 5-pole M12 plug-on flange

	**Measuring range in ppm**	**resolution in ppm**	**Output Output resistance**	**Nominal slope**	**Voltage supply**	**Connection**
	CE	EMC-Testing DIN EN 61326-1 RoHS compliant				
AS2MA1-CD-M12	0.03… 1.00	0.01	4…20 mA unkalibriert	16 mA/ppm	12…30 VDC R_L 50Ω…R_L 900Ω	5-pole M12 plug-on flange Function of wires: PIN2: +U PIN3: -U
AS2MA2-CD-M12	0.03… 2.00	0.01		8.0 mA/ppm		
AS2MA5-CD-M12	0.03… 5.00	0.01		3.2 mA/ppm		
AS3MA1-CD-M12	0.03… 1.00	0.01		16 mA/ppm		
AS3MA2-CD-M12	0.03… 2.00	0.01		8.0 mA/ppm		
AS3MA5-CD-M12	0.03… 5.00	0.01		3.2 mA/ppm		

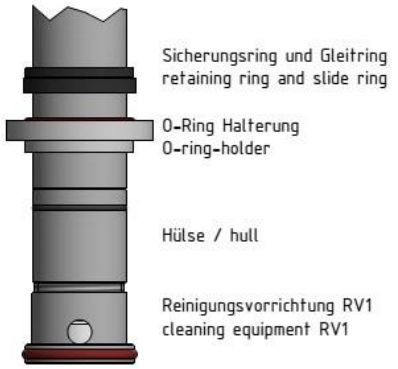
(Subject to technical changes!)

14 Technical data

A separate data sheet is available!

Application	drinking water cold, hot until max. 70 °C
Chlorination agents	inorganic chlorine compounds: NaOCl (=sodium hypochlorite), $Ca(OCl)_2$, chlorine gas, electrolytically generated chlorine
Chlorine dioxide agents	Chlorite / Chlorine, Chlorite / Acid, Chlorite / Peroxo
Measuring system	amperometric potentiostatic 3-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
indicator	Version -CL: Free chlorine Version –CD: Chlorine dioxide

Working temperature	AS2: 0 – <50 °C (no ice crystals in the measuring water) AS3: 0 – <70 °C (no ice crystals in the measuring water)
Temperature compensation	Automatically, by an integrated temperature sensor Response time t_{90} = approx. 10 min. Max. change in temperature: 30 °C per hour, quick changes in temperature should be avoided
Max. allowed working pressure	8 bar
Flow chamber	FLC-3 (separate data sheet available)
Flow rate	Without RV1: min. 15 l/h, in TARAflow FLC-3 With RV1: min. 45 l/h, in TARAflow FLC-3
pH-range	pH 5 – pH 9, pay attention to the dissociation equilibrium HOCL! Stability of the material: pH 1 – pH 12
Run-in time	First start-up approx. 1 h up to 2 days, depending on the water quality
Response time	T_{90}: approx. 30 sec.
Zero point adjustment	Not necessary
Slope calibration	Chlorine: At the device, by analytical determination, DPD-1-Method Chlorine dioxide: At the device, by analytical determination, (without chlorine) DPD-1-Method
Interferences chlorine sensor	Ozone, chlorine dioxide, chlorite are measured
Interferences chlorine dioxide sensor	Chlorine, chlorite are measured with less than 2 % of their value
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	AS2: PVC-U AS3: PEEK
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-pole-terminal) approx. 190 mm (5-pole-M12)
storage	Filled with electrolyte and protection –cap (also filled with electrolyte 1 year, frost-protected OR Frost-protected, dry and without electrolyte no limit
maintenance	Regularly control of the measuring signal, min. once a week The following specifications depend on the water quality: Cleaning of the gold electrodes: every 4 – 12 weeks Change of the electrolyte: every 3 - 6 months Maintenance at factory: once a year

Option	Cleaning equipment RV1-M – direct installation on the sensor – approaching flow to the sensor through RV1 – cleaning effect of RV1 is moderate, i. e. weak deposits on the electrodes will be removed, e. g. weak rust films – for a correct and proper operation of sensor with cleaning equipment RV1 flow chamber FLC-3 has to be used!! – flow rate min. 45 l/h – Sensor can be upgraded at any time	

15 General operating guidelines

- The sensor has to be operated in an upright position in flow chamber FLC-3, so that the incoming flow comes from the bottom up to the electrodes or RV1 respectively.
- According to experience the slope increases somewhat at increasing pressures. Outgasing measuring water interferes the measurement. During unpressurised operation with free outflow of the measuring water gas bubbles have no disturbing effect unless they cover the electrodes. Gas bubbles at the electrodes obstruct the access of the disinfectant, which leads to incorrect measuring signals.
- According to experience using RV1 with the chlorine sensors results in an approx. threefold slope, i. e. the specified measuring range can only be used by 1/3.
  e. g. AS3H-CL: specified measuring range 2.000 ppm, nominal slope approx. -1000 mV/ppm
  with RV1:
  slope approx. -3000 mV/ppm => actual measuring range approx. 0.600 ppm
- A minimum flow rate is required. The flow rate has to be constant.
- The signal of the chlorine sensors is subjected to the dissociation equilibrium of hypochlorous acid (see fig. 5).
- Each sensor has been tested and the test results have been 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 probe is not allowed to be operated in disinfectant-free water for a longer period (>1 day). Danger: build-up of sediments/contaminations (e. g. biological) on the electrodes. 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 12).
- The presence of reducing-, oxidising reagents and corrosion inhibitors may interfere with the measurement.

Cross sensitivities	
Chlorine sensor	Chlorine dioxide sensor
chlorine dioxide is measured with a sensitivity of 400 % (4 times higher signal than the chlorine signal), 1 ppm ClO_2 will result in approx. -400 mV signal	Chlorine is measured at approx. 2 %
Chlorite is disturbing by increasing the measuring signal, at pH 7.1 and 60 mg/l chlorite approx. -150 mV; the signal increases at decreasing pH values	Chlorite <1%

ozone is measured at 900 % (9 times higher signal than the chlorine signal), 1 ppm O_3 will result in approx. -900 mV	---

16 Spare parts

Description	Art. No.
electrolyte EAS1/GEL, 50 ml	11905
emery S3	11904
Spare part kit AS and PEF/FLC-3 including 1x slide ring, 1x retaining ring, 1x o-ring 30 x 2.6 (Viton), 1x o-ring 25 x 2.5 (silicone), 1x o-ring holder	11502
For cleaning equipment RV1-M Spare part kit RV1-M	11911

17 Accessories

Description	Art. No.
cleaning equipment RV1-M	12112

18 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
- flow chambers with hose connections / pipe connections

18.1 General Troubleshooting

Fault	Possible Cause	Action
Sensor cannot be calibrated / deviation of the measuring value from DPD measurement	Run-in time too short	See section 8, repeat calibration after several hours
	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
	Electrolyte hull is not screwed on completely	Screw on the electrolyte hull completely up to the limit stop
	Protection cap was not removed before installation	Deinstall the sensor, remove the protection cap, see section 5-8
	DPD chemicals spent	Use new DPD chemicals, repeat calibration

	Deposits on the electrodes	Clean the electrodes, see section 11.1
	Air bubbles on the outside of the electrodes	Increase the flow rate temporary, if necessary check installation and revise it
	Air entrapments in the electrolyte	Remove the electrolyte hull, empty it out and refill the electrolyte without any bubbles, see section 11.2
	Sensor defective	Return the sensor to the manufacturer for check/reconditioning
	No electrolyte in the electrolyte hull	Fill the electrolyte hull with electrolyte and follow the instructions of sections 5-8
	Cleaning equipment RV1 exhausted	Equip RV1 according to section 11.3 with new cleaning balls
	At operation under pressure: Too many air bubbles in the measuring water sample	Take a new measuring water sample, let it outgas and repeat analytics
	concentration of the disinfectant exceeds the upper limit of the measuring range	Check the whole system, remedy fault, repeat calibration
Measuring signal is not stable	Air bubbles on the outside of the electrodes	Increase the flow rate temporary, if necessary check installation and revise it
	Air entrapments in the electrolyte	Remove the electrolyte hull, empty it out and refill the electrolyte without any bubbles, see section 11.2
	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 MA-sensors (4-20 mA):		
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

Slope of the sensor is beyond the adjustment range of the measuring and/or control device	Measuring and/or control device defective Wrong adjustment of the potentiometer	Check the measuring and/or control device Re-adjustment of the potentiometer and repeat of the calibration Return the sensor for check / re-adjustment to the manufacturer

18.2 Special troubleshooting for sensor

Check of the electronic system (dry test)	1. Unscrew hull AS2 / AS3 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	<u>After the check of the electronic system</u> 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	After zero point check 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

19 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 electrolyte (consumable item) service work to be performed.
(Cleaning of the parts in contact with the electrolyte, renewing the reference electrode and cleaning of the electrode tips 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.

20 Liability disclaimer

The sensors are manufactured with the greatest care and are 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!!

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Fig. 5:

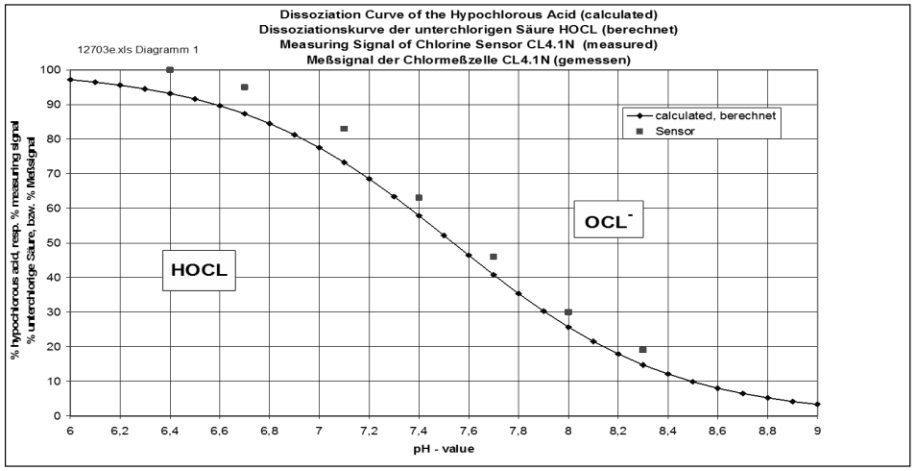
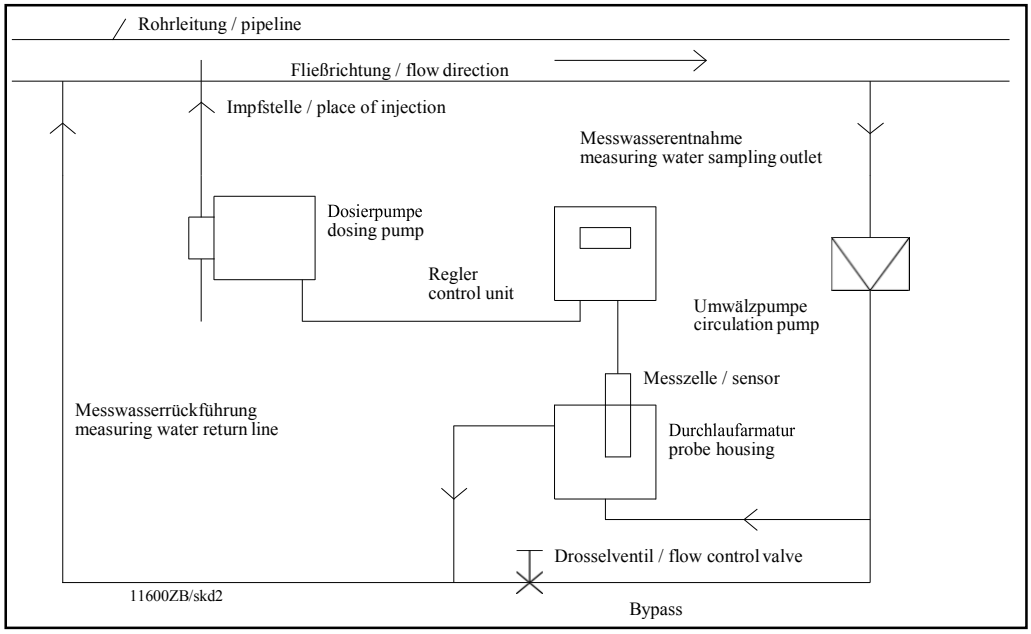


Fig. 6: Flow diagram of chlorine / chlorine dioxide measuring and dosage in continuous operation



There should be at least 2 to 3 m length of pipe to allow for mixing between the chlorine / chlorine dioxide injection place and the measuring water sampling outlet.
Measuring water recirculation located at about 0.2 m before the injection place.
Dosing should be effected into the middle of the water flow.
The quantity of water circulated by the circulation pump should at least be double the pipe volume between the measuring water sampling outlet and the measuring water recirculation line.

Example for assessing the circulation rate:
Diameter of the pipeline: 100 mm (r = 50 mm)
Distance between measuring water sampling outlet and recirculation line: L = 2.20 m
$V = r^2 * \pi * L$
$= 5{,}0^2\ cm^2 * 3{,}14 * 220\ cm$ = approx. 17 litres
i. e. the circulation volume should be at least 34 litres/hour.