OPTISENS CL 1100 Technical Datasheet

Free chlorine/chlorine dioxide/ozone sensor

- High quality and precise gold electrodes for usage in water analysis
- Membrane-free sensor for a wide application range
- Low maintenance costs and a long life cycle

The documentation is only complete when used in combination with the relevant documentation for the signal converter.

KROHNE

1.1 Free chlorine/chlorine dioxide/ozone sensor for water applications

The OPTISENS CL 1100 sensor is characterised by standardised design, easy handling and a long life cycle. In combination with the MAC 100 signal converter it is possible to create an extremely reliable and low-cost measurement system, which is suitable for a wide range of water analysis measurement tasks.

Designed as a membrane free sensor with gold electrodes, the sensor can be easily adapted to various application requirements and it is extremely service friendly and durable.

Highlights

- Unique combination of a membrane-free sensor with 2 gold electrodes for long-term stability and easy maintenance
- Suitable for measuring free chlorine, chlorine dioxide or ozone
- Special mounting assemblies for easy installation and reliable measuring results
- Suitable for connection to the MAC 100 converter with ASR - Automatic Sensor Cleaning feature for reliable measurement

Industries

- Water industry

Applications

- Monitoring drinking water quality
- Disinfection control
- Process water treatment
- Emergency chlorination for drinking water

1.2 Design and options

MAC 100 Multiparameter signal converter for liquid analytical measurements

A complete measuring system consists of:

- MAC 100 Multiparameter signal converter
- 1 or 2 sensors
- Mounting assemblies

Up to two sensors (for identical or different parameters) can be connected to the signal converter.

The signal converter MAC 100 can be adapted perfectly for your requirements: you specify the number and type of signal inputs and outputs, you define the complexity of the measuring point and the number of parameters. The standardised user interface also speeds up commissioning of the device and opens access to a wide range of diagnostic functions for devices and processes.

OPTISENS CL 1100

The OPTISENS CL 1100 is a single rod sensor with integrated reference electrode. This potentiostatic sensor with 2 gold electrodes is in combination with our instruments suitable for measuring free chlorine, chlorine dioxide or ozone.

In addition to excellent measurement accuracy this leads to a high chemical and mechanical resistance of the sensor and therefore to a long service life with stable measurement performance.

Made to Fit

Mounting assemblies to SENSOFIT 1000

As a complete provider for water analysis, we naturally offer a complete range of assemblies. In addition to immersion assemblies, there is also a range of flow-through assemblies and adapters for process connections in a wide range of materials. Special versions for special operating conditions are available on request.

For the OPTISENS CL 1100 sensor type the following individual assemblies are available:

- SENSOFIT FLOW 1000 flow-through holder

For further information please consider the technical datasheets.

1.3 Measuring principle

Free chlorine measurement

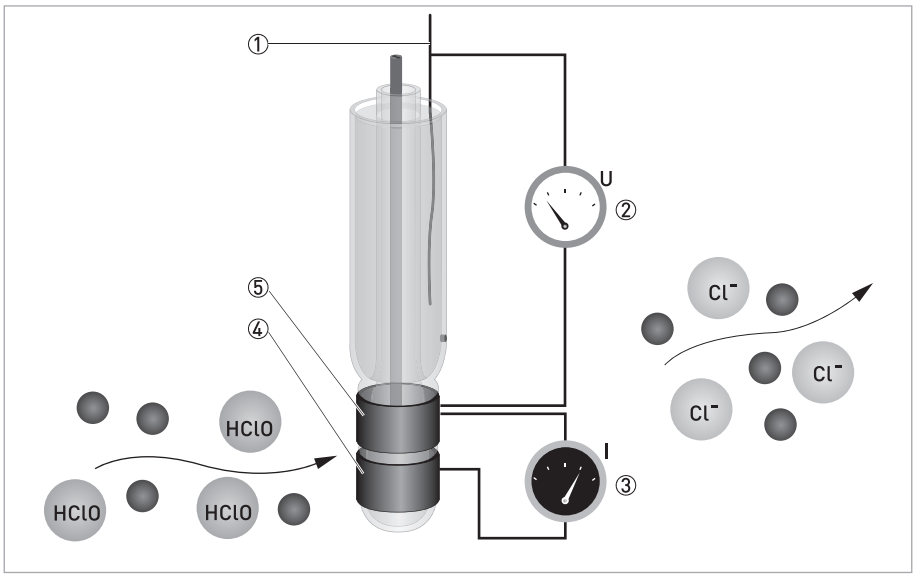


Figure 1-1: Free chlorine measurement

① Reference electrode
② Applied chlorine specific potential
③ Current needed to maintain the constant potential
④ Counter electrode
⑤ Measuring electrode

The sensor has three electrodes: a measuring electrode (gold), a counter electrode (gold), and a reference electrode (Ag/AgCl). A precise potential is built up between the measuring and the reference electrode. The measuring electrode starts polarising, i.e. ions collect close to the electrode to neutralize the electrical field. After polarisation the electrical current decreases to 0 mA as long as the polarising layer is not changed.

Free chlorine molecules that hit the surface of the measuring electrode take a defined portion of the charge with them, changing the measuring potential. The signal converter constantly measures the potential between measuring and reference electrode and immediately readjusts the potential as soon as it begins to change. The current needed to maintain a constant potential is directly correlated to the free chlorine concentration in the measuring medium.

Free chlorine (chlorine dissolved in water) changes its chemical composition depending on the pH value of the water. The pH value has consequences for the disinfection strength: with increasing pH the disinfection strength decreases.

- below pH3: Chlorine gas (Cl_2)
- between pH3 and pH8: Hypochlorous acid (HClO)
- above pH8: Hypochlorite (ClO^-)

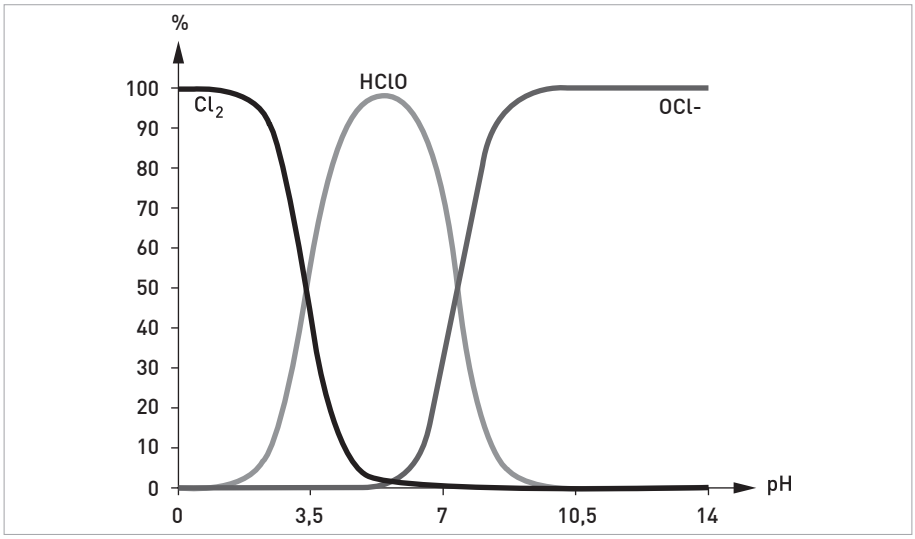


Figure 1-2: Composition of free chlorine depending on pH value

In order to obtain a reliable free chlorine measurement you should either control or compensate the pH value of the measuring medium. Because the pH measurement is temperature dependent, it also makes sense to measure the temperature. For further information on installing a pH sensor with temperature measurement, refer to the pH sensor manual.

Chlorine dioxide measurement

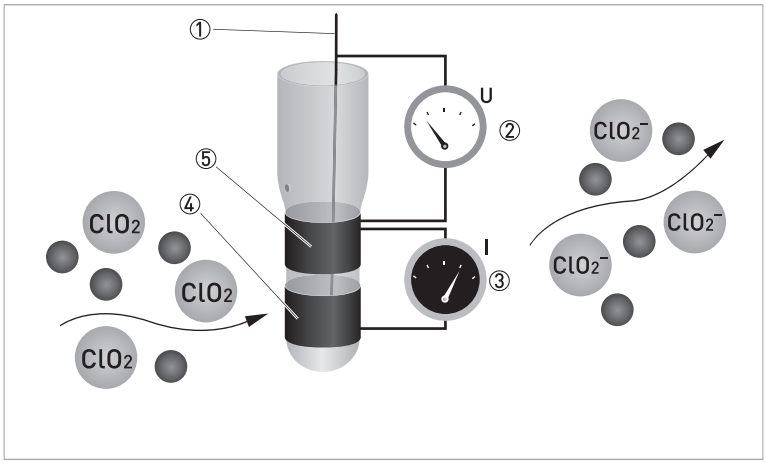


Figure 1-3: Chlorine dioxide measurement

① Reference electrode
② Applied chlorine dioxide specific potential
③ Current needed to maintain the constant potential
④ Counter electrode
⑤ Measuring electrode

Chlorine dioxide measurement

Chlorine dioxide (ClO_2) is an instable, non-storable, toxic gas with a characteristic scent. The molecule consists of one chlorine atom and two oxygen atoms – represented in the chemical formula ClO_2. It is very reactive. To avoid the risk of spontaneous explosions of gaseous chlorine dioxide or concentrated solutions, it is generally handled in dilution with low concentrations. ClO_2 is soluble in water, but tends to evaporate quickly. Typically it is prepared on site, for example from hydrochloric acid and sodium chlorite. The procedure provides solutions with approx. 2 g/l ClO_2 that can be safely handled and stored for several days.

The disinfection effect of ClO_2 is due to the transfer of oxygen instead of chlorine, so that no chlorinated byproducts are formed. ClO_2 is used as disinfectant against biofilm, bacteria, spores, and viruses. Today it is believed that the molecule´s unpaired electron is transferred to the DNA of the microorganism which cracks and causes cell necrosis. ClO_2 has a long-term effect of several days. In contrast to chlorine, the disinfection strength of ClO_2 does not depend on pH, and neither does the measurement show a pH influence in the range of pH 6 to pH 9.

ClO_2 is measured potentiostatic with measuring and counter electrodes of pure gold and an Ag/AgCl reference. The measurement shows high selectivity towards ClO_2. A precise potential is built up between the measuring and the reference electrode. The measuring electrode starts polarising, i.e. ions collect close to the electrode to neutralise the electrical field. ClO_2 molecules that hit the surface take a defined portion of the charge with them. The controller measures the potential between measuring and reference electrode and readjusts the charge on the electrode surface. The current needed to maintain a constant potential is directly correlated to the dissolved chlorine dioxide concentration in the measuring medium.

Ozone measurement

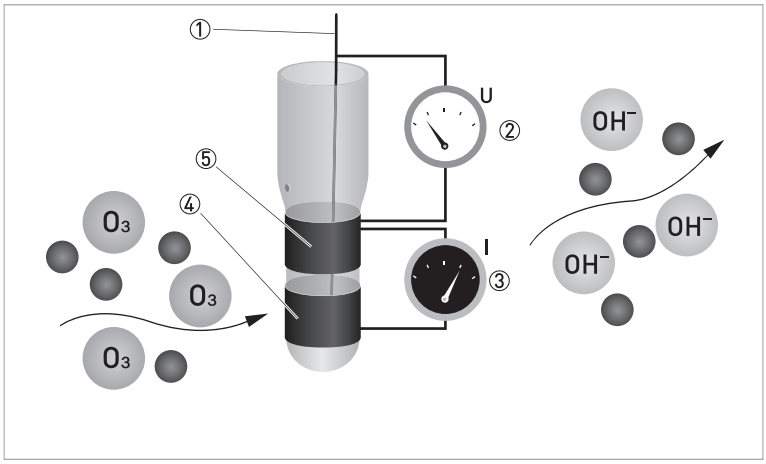


Figure 1-4: Ozone measurement

① Reference electrode
② Applied ozone specific potential
③ Current needed to maintain the constant potential
④ Counter electrode
⑤ Measuring electrode

Ozone measurement

Ozone (O_3) is an instable molecule of three oxygen atoms and a very strong oxidizing agent. At room temperature it is a gas. Due to its instability it cannot be stored in pressurised cylinders and has to be prepared on site.

O_3 is an eco-friendly disinfectant. However, its great disinfection strength can only be used to good advantage in suitable reactors with a reaction time of at least 3 minutes. The long-term effect of O_3 is only a few minutes.

O_3 is measured potentiostatic with measuring and counter electrodes of pure gold and an Ag/AgCl reference. The measurement shows high selectivity towards ozone. A precise potential is built up between the measuring and the reference electrode. The measuring electrode starts polarising, i.e. ions collect close to the electrode to neutralize the electrical field. O_3 molecules that hit the surface take a defined portion of the charge with them. The controller measures the potential between measuring and reference electrode and readjusts the charge on the electrode surface. The current needed to maintain a constant potential is directly correlated to the dissovled ozone concentration in the measuring medium. The sensor design with 3 electrodes in a single rod enables us to use our patented cleaning procedure ASR (patent Dr. A. Kuntze) providing you with a low-maintenance measuring setup.

2.1 Technical data for the sensor

- *The following data is provided for general applications. If you require data that is more relevant to your specific application, please contact us or your local sales office.*
- *Additional information (certificates, special tools, software,...) and complete product documentation can be downloaded free of charge from the website (Downloadcenter).*

For further information about the technical data please consider the MAC 100 converter manual.

OPTISENS CL 1100	Cl_2	ClO_2	O_3

Measuring system

Measuring principle	Potentiostatic with double gold electrodes		
Application range	Continuous measurement of free chlorine in water applications.	Continuous measurement of chlorine dioxide in water applications.	Continuous measurement of ozone in water applications.
Measuring range	Cl_2: 0.03...20 mg/l	ClO_2: 0.05...5 mg/l	O_3: 0.05...5 mg/l

Design

Construction	Glass sensor
Shaft diameter	12 mm / 0.47"
Length	120 mm / 4.72"
Process connection	PG 13.5
Sensor cap	M12

Measuring accuracy

Reference conditions	Medium: water
	Temperature: 20°C / 68°F
	Pressure: 1 bar / 14.5 psi (absolute)
	Transmitter: MAC 100
Maximum measuring error	0.1 mg/l
	Temperature: 1.0% full scale
Repeatability	0.01 mg/l
Resolution	0.01 mg/l
Long-term stability	24 hours: tested within accuracy definition
Temperature drift	Tested within accuracy definition
Response time (t90)	<20 seconds

Operating conditions

Operating temperature	-5…+70°C / +23…+158°F
Max. operating pressure	6 bar / 87 psi
Flow rate	> 30 l/h / 7.93 gal/h
Conductivity	> 200 µS/cm

Materials

Sensor shaft	Glass
Measuring electrodes	Gold
Reference electrode	Ag/AgCl/Tepox gel
Diaphragm	Ceramic
Gasket	EPDM

Electrical connection

Connector	M12

2.2 Dimensions for the sensor

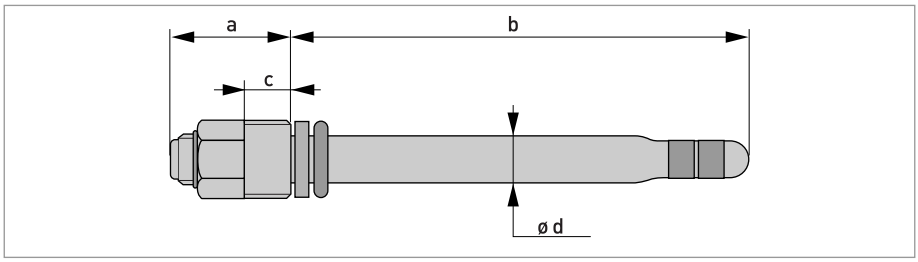


Figure 2-1: Dimensions of OPTISENS CL 1100

	Dimensions	
	[mm]	[inch]
a	31	1.2
b	120	4.7
c	10	0.4
d	Ø12	Ø0.5

2.3 Combination sensor/signal converter

Sensor type	Measured parameter	Measuring principle	Signal converter	
			Input A	Input B
pH	pH value	Potentiometric	X	X
ORP	ORP value	Potentiometric	X	X
Cl_2	Free chlorine	Amperometric	X	-
ClO_2	Chlorine dioxide	Amperometric	X	-
O_3	Ozone	Amperometric	X	-
DO	Dissolved oxygen	Amperometric ①	X	-
		Optical ①	X	-
COND	Conductivity/ specified resistance	Conductive	X	X
IND	Toroidal conductivity	Inductive	X	X
TUR	Turbidity	Optical ①	X	-

① only for single channel version

3.1 General notes on installation

Inspect the packaging carefully for damages or signs of rough handling. Report damage to the carrier and to the local office of the manufacturer.

Do a check of the packing list to make sure that you have all the elements given in the order.

Look at the device nameplate to ensure that the device is delivered according to your order. Check for the correct supply voltage printed on the nameplate.

3.2 Intended use

Responsibility for the use of the measuring devices with regard to suitability, intended use and corrosion resistance of the used materials against the measured fluid lies solely with the operator.

The manufacturer is not liable for any damage resulting from improper use or use for other than the intended purpose.

The intended use of the OPTISENS CL 1100 sensor is the measurement of free chlorine, chlorine dioxide or ozone in water applications. The sensor is suitable for connection to the MAC 100 signal converter and to be integrated into the OPTISYS CL 1100 measuring system.

This device is a Group 1, Class A device as specified within CISPR11:2009. It is intended for use in industrial environment. There may be potential difficulties in ensuring electromagnetic compatibility in other environments, due to conducted as well as radiated disturbances.

3.3 Pre-installation requirements

- *Do not touch or scratch the gold electrodes of the sensor.*
- *Make sure that the gold electrodes are clean and dust-free. If necessary, clean the tip as described in the manual of the OPTISENS CL 1100 sensor.*

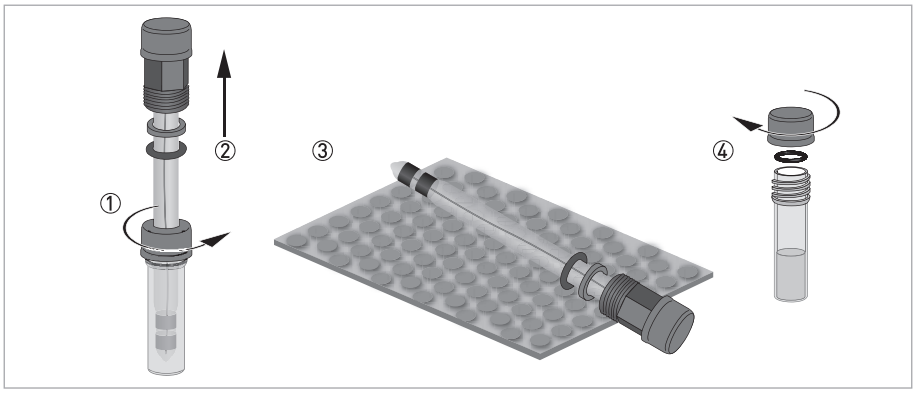


Figure 3-1: Handling the sensor

Unpacking the sensor

- Loosen the storage cap which is screwed on to the plastic tube ①.
- Gently pull the sensor out of the plastic tube ②.
- Lay the sensor on a soft mat/tissue ③.
- Screw the provided sealing cap on to the plastic tube, using O-ring and washer as pictured in the drawing ④. Keep the storage cap (the one with the hole in it) in the original packing.

3.4 Installing the sensor

3.4.1 General installation instructions

To achieve reliable measuring results, note the following items:

- *Always install the sensor in the designated flow-through assembly or in the OPTISYS CL 1100 measuring system.*
- *The gold electrodes must always have full contact with the measuring medium.*
- *Assure that at least 30 litres / 7.93 gal of the measuring medium flow past the electrodes per hour. In any case try to keep the flow as stable as possible.*

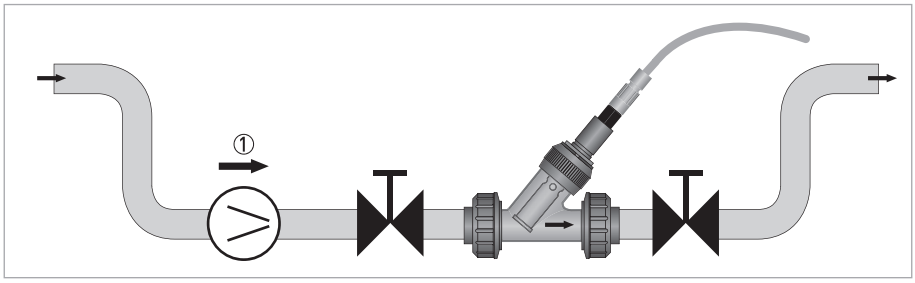


Figure 3-2: Installation requirements for the sensor

① Flow ≥ 30 l/h / 7.93 gal/h

3.4.2 Mounting to a flow-through assembly

Ensure that the pipe is without pressure before installing or removing a sensor!

The flow-through assembly is an optional accessory and not part of the standard scope of delivery. It has to be installed horizontally in pump or sample lines or directly in the process.

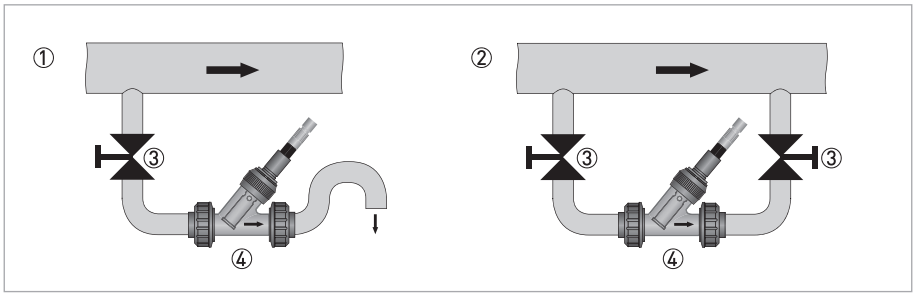


Figure 3-3: Possible mounting positions of the flow-through assembly

① Mounting in an outlet pipe
② Mounting in a bypass pipe
③ Valve
④ Flow-through assembly

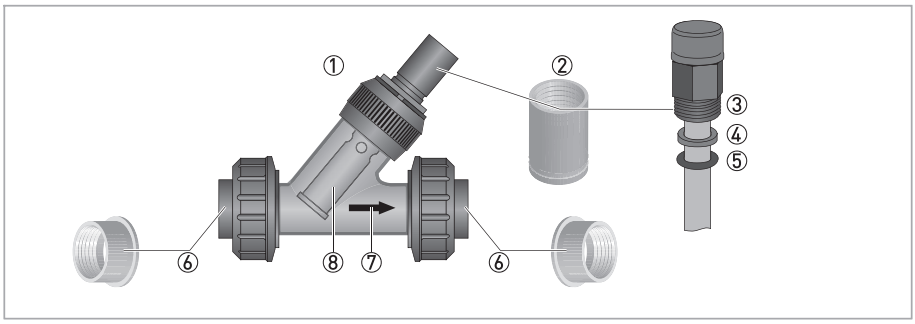


Figure 3-4: Installing the sensor into the flow-through assembly

① Flow-through assembly
② Female thread
③ Sensor thread
④ Washer
⑤ O-ring
⑥ Process connection
⑦ Flow direction
⑧ Protective cage

Installing a new sensor

- Make sure that the O-ring ⑤ and the washer ④ on the sensor are assembled in the sequence indicated in the drawing.
- Screw the sensor into the female thread ② of the flow-through assembly ①. Tighten the sensor by hand.
- If you have not yet established the electrical connection to the signal converter, leave the protective cap on the sensor until you establish the electrical connection.

3.4.3 Mounting to OPTISYS CL 1100 measuring system

The OPTISYS CL 1100 is a preconfigured free chlorine, chlorine dioxide or ozone measuring system.

The sensors are delivered with protective caps, which have to be removed before mounting into the flow-through cells.

Installing a new sensor

- Make sure that the O-ring and the washer on the sensor are assembled in the correct order.
- Screw the sensor into the female thread of the flow-through cell. Tighten the sensor by hand.
- If you have not yet established the electrical connection to the signal converter, leave the protective cap on the sensor until you establish the electrical connection.

4.1 Safety instructions

All work on the electrical connections may only be carried out with the power disconnected. Take note of the voltage data on the nameplate!

Observe the national regulations for electrical installations!

Observe without fail the local occupational health and safety regulations. Any work done on the electrical components of the measuring device may only be carried out by properly trained specialists.

Look at the device nameplate to ensure that the device is delivered according to your order. Check for the correct supply voltage printed on the nameplate.

4.2 Connecting the cable to the sensor

Moisture on the sensor connector must be avoided! Moisture may cause a short-circuit and a malfunction of the sensor!
If moisture has entered the connector dry it with air (e.g. hot air gun).

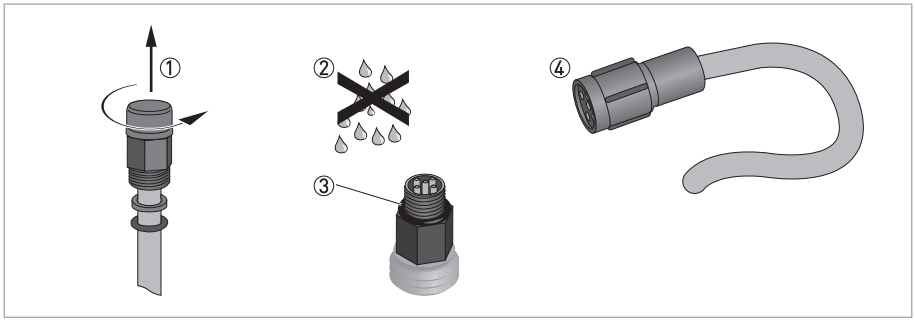


Figure 4-1: Connecting the cable to the sensor

- Unscrew the protective cap from the sensor connector and keep it for future use ①.
- Ensure that both cable and sensor connector are dry ②.
- Make sure that the O-ring is positioned on the sensor connector ③.
- Push the cable connector ④ on to the sensor.
- Screw the cable connector to the sensor and tighten it by hand.

4.3 Connecting the sensor cable to the signal converter

All work on the electrical connections may only be carried out with the power disconnected. Take note of the voltage data on the nameplate!

The sensor cables are prewired to signal converter by the manufacturer.

Look at the device nameplate to ensure that the device is delivered according to your order. Check for the correct supply voltage printed on the nameplate.

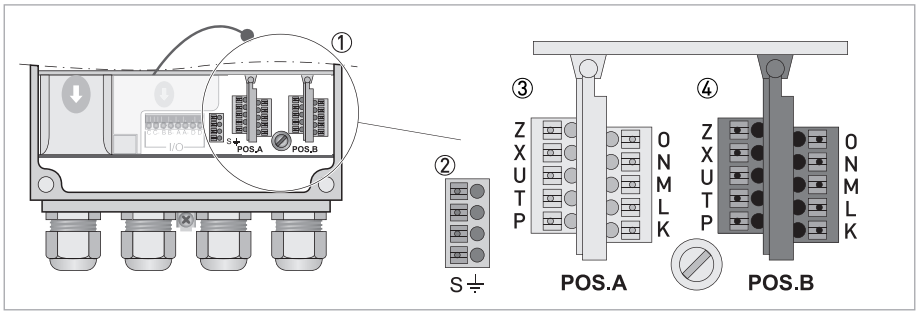


Figure 4-2: Sensor connection terminals on the signal converter

① Sensor connection terminals
② Terminal block S (protective earth)
③ Terminal block Pos.A: terminal for OPTISENS CL 1100 sensor and temperature
④ Terminal block Pos.B: terminal for pH sensor and temperature

The sensors for free chlorine, chlorine dioxide or ozone are always connected to terminal block Pos.A of the signal converter. Depending on the configuration of the signal converter, a pH sensor may be connected to terminal block Pos.B. An external temperature sensor may be connected to terminal block Pos.A. (For detailed information how to install and configure a pH and/or a temperature sensor please refer to the pH sensor documentation.)

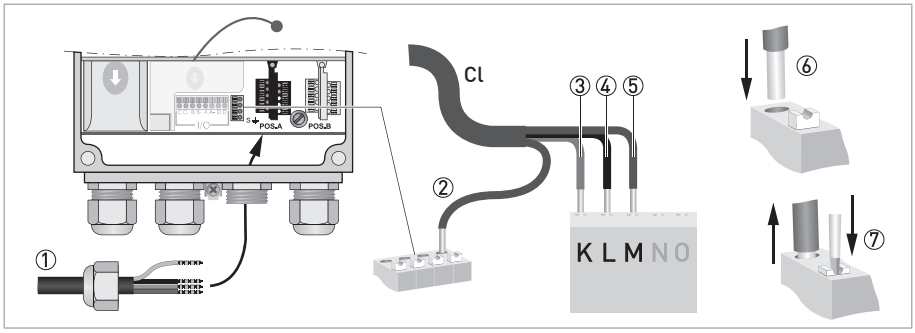


Figure 4-3: Connecting the 4-wire coax cable

Connecting the sensor cable to the signal converter

- Thread the sensor cable through the middle right cable gland ①.
- Push the coax shield cable ⑥ into one of the terminals of terminal block S ②.
- Push the blue ③, white ④, and brown ⑤ wire into the terminals of terminal block Pos.A as described in the previous drawing/table.
- To remove a cable, press down the white clip ⑦ on the corresponding terminal and pull the cable out.

4.4 Connecting the external temperature sensor

Connect an external Pt100 or Pt1000 sensor to terminal block Pos.A/B of the signal converter according to the following drawings:

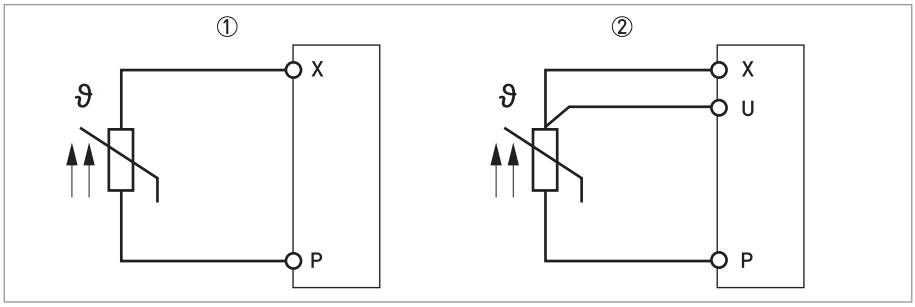


Figure 4-4: Connection of an external Pt100/1000 temperature sensor to the signal converter (2-wire connection)

① 2-wire connection
② 3-wire connection

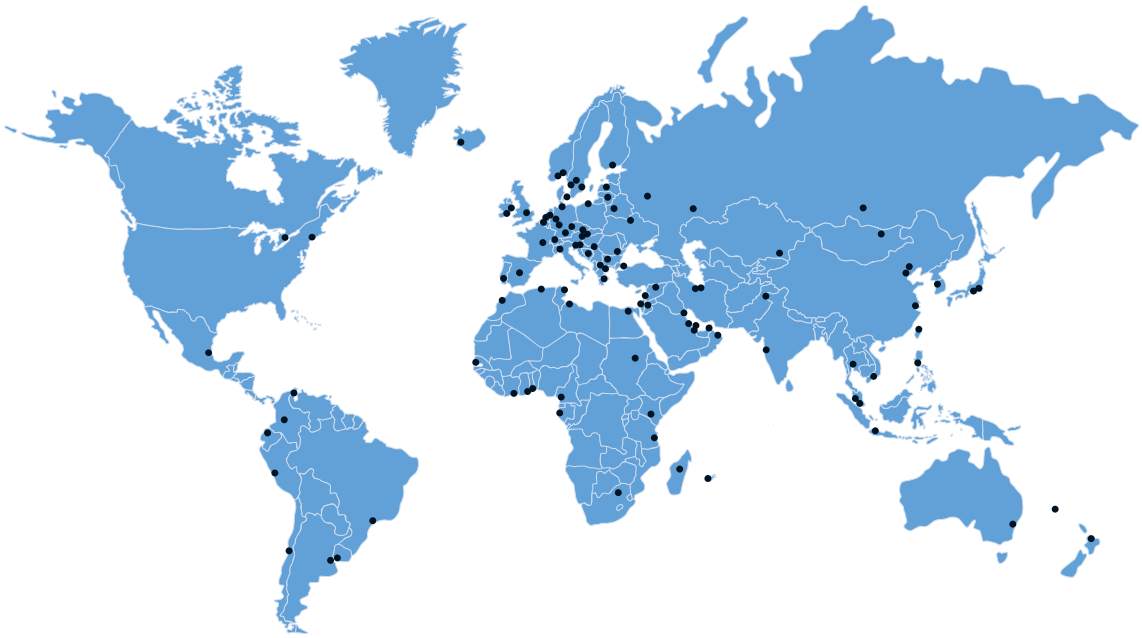
5.1 Order code

The characters of the order code highlighted in light grey describe the standard.

VGA E	**4**	**Sensor type**											
		5	OPTISENS CL 1100										
			Parameter										
			4	ClO_2, Cl_2 or O_3									
				Sensor features									
				2	Body: glass Electrodes: gold								
					Process conditions								
					1	-5...+70°C at 6 bar / 32...158°F at 87 psi							
						Process connection							
						1	PG 13,5						
							Sensor option						
							0	none					
								Sensor cable connection					
								7	M 12 connector				
									Cable				
									0	none			
										Cable features			
										0	none		
											Cable length		
											0	none	
												Cable options	
												0	none
													Documentation
													0 none
													1 English
													2 German
													3 French
													4 Spanish
VGA E	**4**												

5.2 Spare parts, consumables and accessories

Accessories	Order code
SENSOFIT FLOW 1000 flow-through holder	VGAV 422BB1000
Cable CL-W-1100-5	XGA W 0 52221
Cable CL-W-1100-10	XGA W 0 52231



KROHNE – Process instrumentation and measurement solutions

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- Level
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- Process Analysis
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