



M I C R O S E N S

Product Data Sheet

MAES 2402

MICROSENS Chlorine (HOCl) Sensor



- The integrated chlorine sensor is realized on silicon using microelectronic compatible processes.
- The working and counter electrodes thin platinum films and the silver/silver chloride reference-electrode are deposited on an electrically insulating silicon nitride layer.

Features:

- PolyHEMA membrane on working electrode (WE) to limit diffusion for an improved signal-to-noise ratio
- Range: 0.01 mg/l - 5 mg/l
- Sensitivity S: 10 nA/(mg/l)
- Module dimension:
50 mm x 5 mm x 2 mm

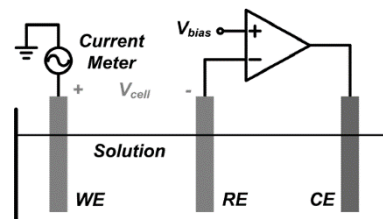
Applications:

- Water quality control
- Drinking water security
- Swimming pool water quality
- Industrial process control

Sensing principle:

The device is a miniaturized electrochemical cell consisting of a working-electrode (WE), a counter-electrode (CE) and a reference-electrode (RE).

The HOCl concentration measurement is based on the electrical current generated by the reduction of HOCl at the working electrode at a fixed polarization voltage V_{cell} .



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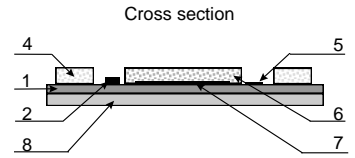
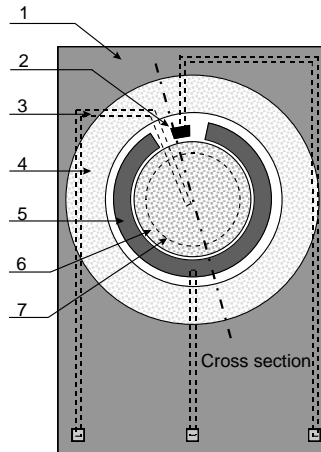
EPFL Innovation Park, Batiment D, 1015 Lausanne, Switzerland, Tel.: +41-21-353 91 35

e-mail : info@microsens.ch, www.microsens.ch

MAES Integrated Sensor

Base structure

- Sensor base materials: Silicon, Polysilicon
- Technology: 4" planar CMOS
- Electrode material: Platinum
- WE membrane: PolyHEMA
- Reference electrode: Ag/AgCl



- Material List**
- 1 Silicon nitride layer
 - 2 Silver/silver chloride (RE)
 - 3 Polysilicon tracks
 - 4 Polysiloxane membrane
 - 5 Platine layer (CE)
 - 6 PolyHEMA membrane
 - 7 Platin layer (WE)
 - 8 Silicon support

Sensor dimensions (chip):

Width	Length	Height	Unit
4.0	6.0	0.3	mm

HOCl Sensor Characteristics

Electrochemical Specifications

	Symbol	Value			Unit
		min	typical	max	
Polarisation voltage	U_{WR}	170.0	175.0	180.00	mV
Sensitivity (linear over given conc. range)	S	5.0	10.0	15.0	nA/(mg/l)
Current at zero HOCl conc.	I_0	-0.3		0.3	nA
Noise level	I_n			0.15	nA

The MAES 2402 exhibits a signal response, which is linear over a wide HOCl-concentration range. Its sensitivity is independent on convection properties of the analyte solution such as flow rate.

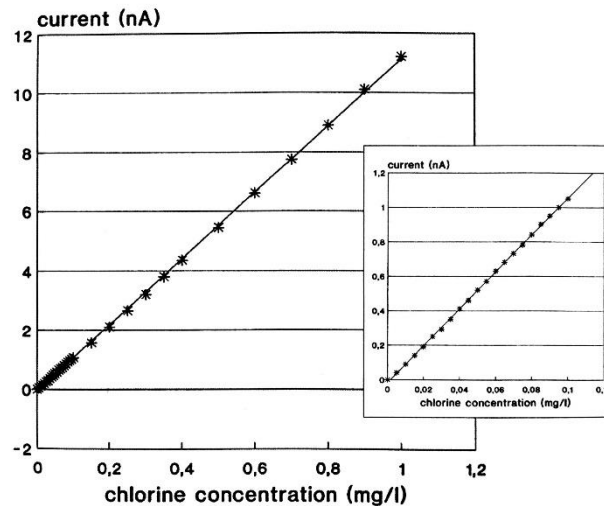


Figure 1: Chlorine sensitivity ($V_{pol}=150mV$)

Sensor Specifications

- Measured species: hypochlorous acid (HOCl)
- Concentration range: 0.01 mg/l - 5 mg/l
- Detection limit¹: 10^{-3} mg/l (1 ppb)
- Response time: < 30 sec
- Temperature range: 0 – 80°C
- Life time: > 6 month (continuous use)

Sensor packaging and connections

Connections of the packaged sensor



Dimensions of the packaged sensor

Width	Length	Height	Unit
5.0	50.0	2.0	mm

Handling Recommendations

Sensor Preparation

Before the first use, the HOCl sensor needs to be conditioned. The conditioning consists of two steps:

- 1) Hydration of the hydrogel membrane. 12h in a bath of 1mM KCl adjusted to pH6
- 2) Conditioning treatment. This procedure consists of measuring the sensor response repeatedly in the background solution (no free chlorine) and in the background solution with 2-5mg/l free chlorine (HOCl). When the sensitivity no longer increases, the sensor is considered ready for use.

After the initial hydration of the membrane repetitive drying and rehydration can be realized rapidly (within several minutes).

Important precautions:

- Avoid any electrostatic discharge at the sensor connections when handling in air. As a precaution the sensor module should be powered down, when the sensor is removed from the solution.
- Switch off the sensor electronics before disconnecting the sensor.
- Store the sensor under dry conditions. Avoid excessive illumination.

¹ under laboratory conditions

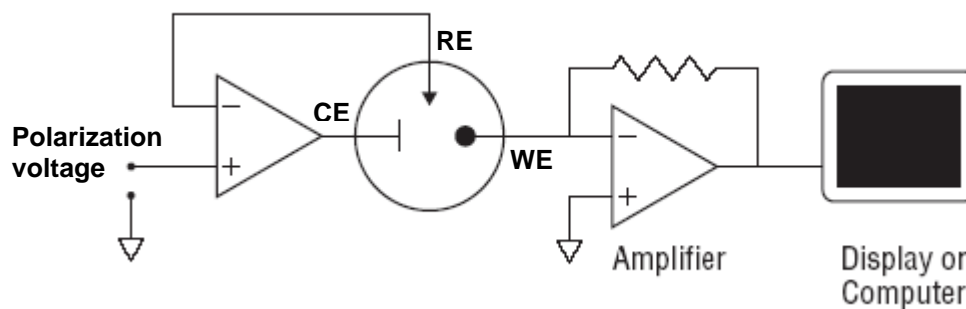
- Since the sensing area of the HOCl sensor is constituted of thin membranes any mechanical contact with the sensor surface should be avoided.

Sensor cleaning:

In case the sensor surface needs to be cleaned the procedure should be as follows:

- Rinse the sensor with DI water (using an ultrasonic bath is also an option)
- Let the sensor dry in air (dust free environment)
 - o Alternative: blow dry the sensor softly
- **Avoid:**
 - o Rinsing with solvents (acetone, ethanol, isopropanol)
 - o Rinsing with detergents
 - o Drying with blotting paper

Measurement circuit recommendation



The potential V_{cell} between WE and RE is held constant by an operational amplifier. The current flowing from the WE to the virtual mass is converted into a voltage and measured. This current is proportional to the HOCl concentration.

Circuit considerations:

In order to measure the small current at the sensor, the amplifier connected to WE should have a near-zero bias current.