



M I C R O S E N S

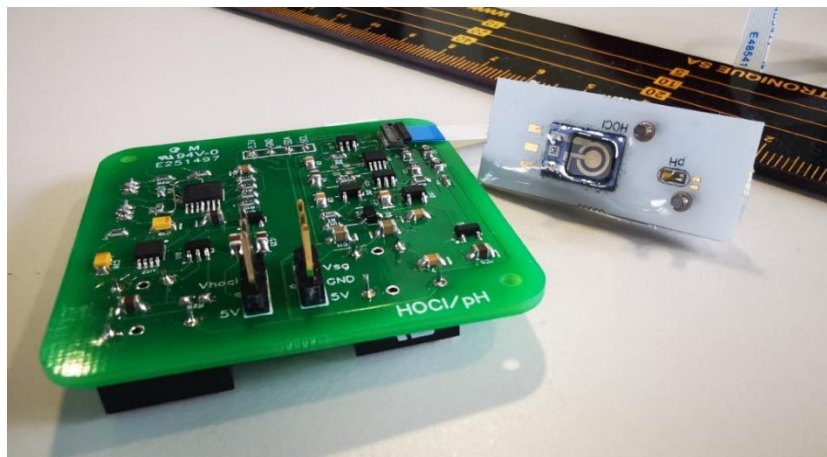


Preliminary
Product Data Sheet

HOCl-pH measurement system

MICROSENS Miniature HOCl and pH Sensing Element with control interface

Amperometric Pt-electrodes HOCl sensor in combination with Ta₂O₅ gate Ion Sensitive Field Effect transistor (ISFET) and their respective Ag/AgCl reference electrodes



- The sensorhead comprises an MSFET3330 pH sensor with Ag/AgCl reference electrode and a MAES HOCl amperometric sensor with Ag/AgCl reference electrode and circuitry
- The sensing devices are realized with microelectronic technology compatible with CMOS processes.
- The MSFET3330 with Ta₂O₅ insulating gate measures the pH value in a wide range from basic to acidic solutions
- The MAES HOCl sensor measures the HOCl content of the solution

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HOCl/pH Sensor head

Integrated elements:

- MSFET3330 with Ag/AgCl reference electrode for pH measurements
- MAES Pt-electrodes sensor with Ag/AgCl reference electrode and basic driver electronics for HOCl measurements

The sensors and reference electrodes are placed on the sensor head's front side, the circuitry and FFC connector are placed on the backside. Both sides are encapsulated to protect the electronic contacts from the liquid environment.



Sensor head dimensions:

- Width: 15mm
- Length: 35mm
- Height: determined by the FFC connector

MSFET 3330-2 Sensor

Base structure

- Sensor base materials: Silicon, Polysilicon
- Technology: 4" planar CMOS process

Selective membrane

- pH-sensitive material: Ta_2O_5

Sensor dimensions:

	Width	Length	Height	Unit
Chip dimensions	1.2	3	0.3	mm



pH Sensor Characteristics

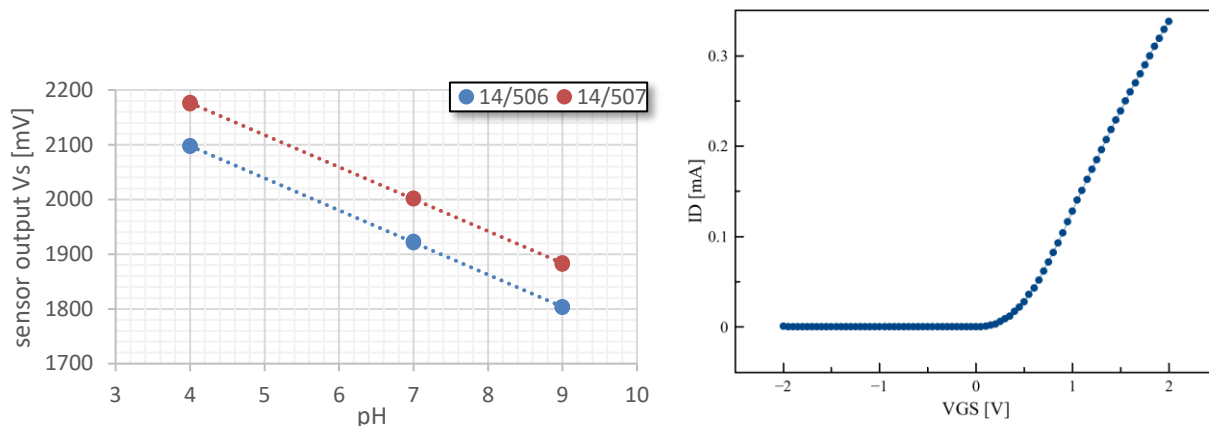
DC Specifications:

	min	typical	max	Unit
V_{ds}		0.5		V
I_{ds}	0.05	0.08	0.1	mA
Sensitivity ($\Delta V_s/pH$)	-50	-55.0	-59.2	mV/pH

pH Sensor Specifications

- Sensitivity: - 55 mV/pH unit
- Range: pH 1 ... pH 12
- Accuracy: 0.05 UpH

- Stability: -0.5 mV/day (± 0.01 UpH/day)
- Operating temperature: 0°C ... 80°C
- Temperature dependence: -0.2 mV/°C



HOCl sensor

The sensing element is a three-electrode set-up consisting of Working (WE), Counter (CE) and Reference (RE) electrode.

Base structure

- Sensor base materials: Silicon, Platinum, Polyimide
- Technology: 6" planar CMOS compatible process

Sensor dimensions:

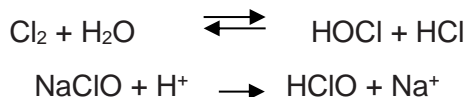
	Width	Length	Height	Unit
Chip dimensions	7	10	0.5	mm



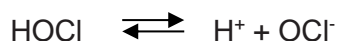
Technical Details

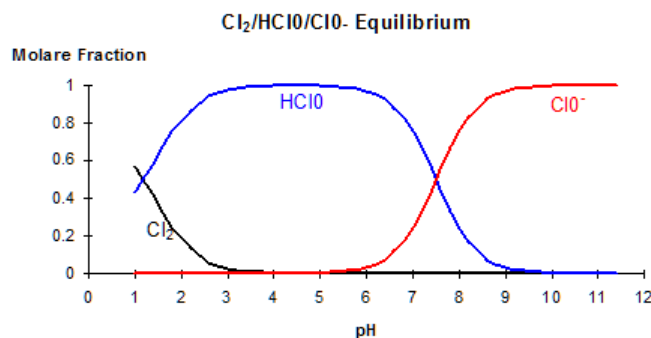
Measurement Principle

Many techniques are used for the chlorination of water either using dissolved chlorine (Cl₂ gas), sodium hypochlorite (NaOCl) or calcium hypochlorite (Ca(OCl)₂). Either way, hypochlorous acid is formed by hydrolysis of Cl₂ or acidification of hypochlorite.



The chlorinated compounds are separated into two groups the free chlorine and the bonded chlorine. Depending on the pH-value of the water, the free chlorine can be: dissolved chlorine Cl₂ (gas), hypochlorous acid HOCl or the hypochlorite ion OCl⁻.





Molar fractions of the three compositions of free chlorine in water as a function of pH

Electrochemical Specifications

	Symbol	Value			Unit
		min	typical	max	
Polarisation voltage	U_{WR}	220.0	250.0	280.00	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

Specifications (target):

- Measured species: hypochlorous acid (HOCl)
- Concentration range: 10⁻³ mg/l - 10 mg/l
- Detection limit: < 10⁻³ mg/l (1ppb)
- Sensitivity S^1 : 10 nA / mg/l
- Response time: < 30 sec
- Life time: > 9 month (continuous use)

Reference-electrodes

The MSFET3330 as well as the HOCl sensor require reference electrodes. The sensor head comprises two Ag/AgCl reference electrodes (one for each sensor).

Measurement circuit

The measurement circuit provides a combined control interface for the HOCl/pH measurement. It contains the drivers for the MSFET3330 and the HOCl sensor. The MSFET3330 requires a constant voltage V_{ds} and a constant drain current (I_{ds}) to the ISFET as well as a floating ground. The HOCl sensor driver provides the polarization voltage required for the HOCl reaction at the sensor surface.

¹ constant over the given concentration range

General specifications

- Power supply:
 - Option A (Jumper in place): 5V
 - Option B (Jumper removed): 5V for pH driver, 3.3V or 5V for HOCl driver
- Dimensions:
 - 50mm x 50mm x 15mm (interface)
- Communication:
 - I2C (ADS1115) with 5kOhm pull-up resistors
 - Address HOCl: 0x49
 - Address pH: 0x48
 - Set ADC input range to 2.5V for HOCl
 - Set ADC input range to 2.5V for pH
- Connection to HOCl/pH sensor head
 - FFC cable (**metallic side down**)
- HOCl driver
 - Sets polarization voltage (-250mV)
 - HOCl current conversion: 1nA = 1mV
- pH driver
 - Galvanic isolation, floating GND
 - ISFET working point ($V_{ds} = 0.5V$, $I_d = 80\mu A$)

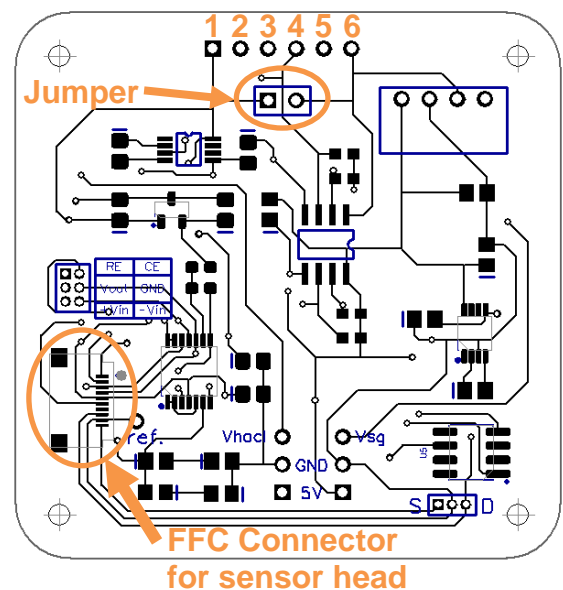
Connection Schematics

		Remark
1	Power (HOCl driver)	Can be 3.3V or 5V
2	GND (HOCl driver)	Internally connected to "5"
3	SDA	
4	SCL	
5	GND (pH driver)	Internally connected to "2"
6	Power (pH driver)	5V

IMPORTANT:

When the jumper is in place, the power lines are connected. Therefore, only one of the power lines should be used and power needs to be set to 5V.

The sensor head is connected via the FFC connector. The FFC cable needs to be installed with the metal side down.



Handling Recommendations

Cleaning recommendations:

- Rinse with DI water
- Let dry in air (dust free environment)
 - Alternatively: blow dry

- Avoid:
 - Rinsing with solvent (acetone, ethanol, isopropanol)
 - Rinsing with detergents
 - Drying with blotting tissues

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 head is removed from the solution.
- Store the sensor head under dry conditions. Avoid excessive illumination.
- Avoid contact with high concentrations of solvents (acetone, ethanol, isopropanol) or detergents.