



OPTISENS PH 8390 Handbook

pH sensor

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1.1 Intended use

**CAUTION!**

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.

**INFORMATION!**

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

The intended use of OPTISENS PH 8390 sensor is the measurement of pH value in water applications. The sensor is suitable for connection to the MAC 100 signal converter.

1.2 Safety instructions from the manufacturer

1.2.1 Copyright and data protection

The contents of this document have been created with great care. Nevertheless, we provide no guarantee that the contents are correct, complete or up-to-date.

The contents and works in this document are subject to copyright. Contributions from third parties are identified as such. Reproduction, processing, dissemination and any type of use beyond what is permitted under copyright requires written authorisation from the respective author and/or the manufacturer.

The manufacturer tries always to observe the copyrights of others, and to draw on works created in-house or works in the public domain.

The collection of personal data (such as names, street addresses or e-mail addresses) in the manufacturer's documents is always on a voluntary basis whenever possible. Whenever feasible, it is always possible to make use of the offerings and services without providing any personal data.

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We hereby expressly prohibit the use of the contact data published as part of our duty to publish an imprint for the purpose of sending us any advertising or informational materials that we have not expressly requested.

1.2.2 Disclaimer

The manufacturer will not be liable for any damage of any kind by using its product, including, but not limited to direct, indirect or incidental and consequential damages.

This disclaimer does not apply in case the manufacturer has acted on purpose or with gross negligence. In the event any applicable law does not allow such limitations on implied warranties or the exclusion of limitation of certain damages, you may, if such law applies to you, not be subject to some or all of the above disclaimer, exclusions or limitations.

Any product purchased from the manufacturer is warranted in accordance with the relevant product documentation and our Terms and Conditions of Sale.

The manufacturer reserves the right to alter the content of its documents, including this disclaimer in any way, at any time, for any reason, without prior notification, and will not be liable in any way for possible consequences of such changes.

1.2.3 Product liability and warranty

The operator shall bear responsibility for the suitability of the device for the specific purpose. The manufacturer accepts no liability for the consequences of misuse by the operator. Improper installation and operation of the devices (systems) will cause the warranty to be void. The respective "Standard Terms and Conditions" which form the basis for the sales contract shall also apply.

1.2.4 Information concerning the documentation

To prevent any injury to the user or damage to the device it is essential that you read the information in this document and observe applicable national standards, safety requirements and accident prevention regulations.

If this document is not in your native language and if you have any problems understanding the text, we advise you to contact your local office for assistance. The manufacturer can not accept responsibility for any damage or injury caused by misunderstanding of the information in this document.

This document is provided to help you establish operating conditions, which will permit safe and efficient use of this device. Special considerations and precautions are also described in the document, which appear in the form of underneath icons.

1.2.5 Warnings and symbols used

Safety warnings are indicated by the following symbols.



DANGER!

This information refers to the immediate danger when working with electricity.



DANGER!

This warning refers to the immediate danger of burns caused by heat or hot surfaces.



DANGER!

This warning refers to the immediate danger when using this device in a hazardous atmosphere.



DANGER!

These warnings must be observed without fail. Even partial disregard of this warning can lead to serious health problems and even death. There is also the risk of seriously damaging the device or parts of the operator's plant.



WARNING!

Disregarding this safety warning, even if only in part, poses the risk of serious health problems. There is also the risk of damaging the device or parts of the operator's plant.



CAUTION!

Disregarding these instructions can result in damage to the device or to parts of the operator's plant.



INFORMATION!

These instructions contain important information for the handling of the device.



LEGAL NOTICE!

This note contains information on statutory directives and standards.



• **HANDLING**

This symbol designates all instructions for actions to be carried out by the operator in the specified sequence.

➞ **RESULT**

This symbol refers to all important consequences of the previous actions.

1.3 Safety instructions for the operator



WARNING!

*In general, devices from the manufacturer may only be installed, commissioned, operated and maintained by properly trained and authorized personnel.
This document is provided to help you establish operating conditions, which will permit safe and efficient use of this device.*

2.1 Scope of delivery

**INFORMATION!**

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

**INFORMATION!**

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

**INFORMATION!**

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 2-1: Standard scope of delivery

- ① Ordered sensor
- ② Documentation

Optional accessories

- SENSOFIT FLOW 1000 - flow through holder (in preparation)
- SENSOFIT IMM 1000/2000 - immersion holder (in preparation)
- SENSOFIT RET 1000/2000 - retractable holder (in preparation)
- Cable pH/ORP-W US style sensor 4 pin connector to hanked 7.62 m (25ft.) / 10 m (33ft.)

Consumables/Spare parts available

- 250 ml pH buffer solutions pH4/pH7

OPTISENS PH 8390

- with 23 mm (0.91") / 44 mm (1.75") length and attached cable 7.62 m (25 ft.) / 10 m (33 ft.)
- with 23 mm (0.91") / 44 mm (1.75") length and 4-pin connector

**INFORMATION!**

For further Information ask your local sales representer.

2.2 Device description

2.2.1 pH electrodes

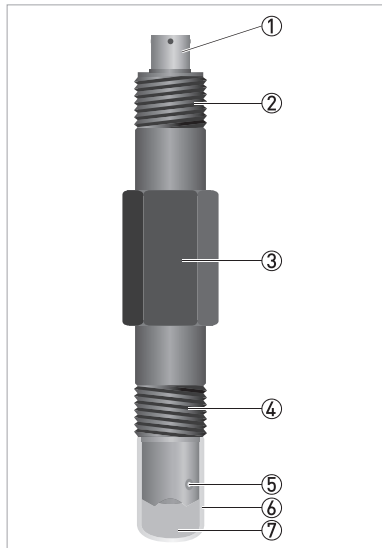


Figure 2-2: Sensor type

- ① attached cable or 4-pin connector
- ② MNPT 3/4"
- ③ CPVC Body
- ④ MNPT 3/4"
- ⑤ PTFE diaphragm
- ⑥ Protection cap
- ⑦ KCl Solution

The OPTISENS PH 8390 is manufactured using a pH sensitive special glass which can be used in almost all standard water applications due to its wide measuring range.

The pH electrodes are available with different diaphragms:

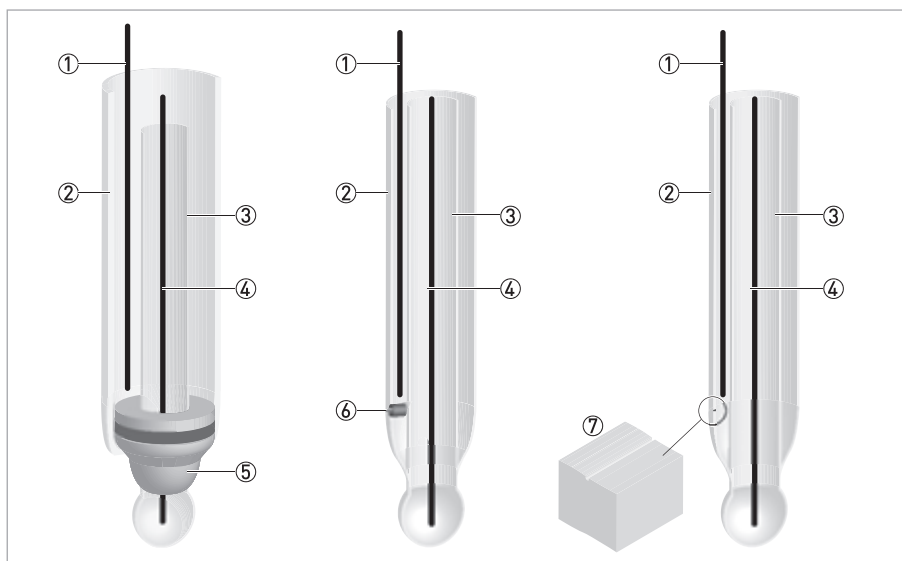


Figure 2-3: Diaphragm types

- ① Reference electrode
- ② KCl solution
- ③ Inner pH 7 buffer solution
- ④ Measuring electrode
- ⑤ PTFE diaphragm
- ⑥ Ceramic diaphragm
- ⑦ open diaphragm

pH electrode with open diaphragm and Pt100

open diaphragm (microscopically small hole in the glass); integrated Pt100 temperature measurement; suitable for cooling water, waste water and chemical industry applications.

pH electrode with ceramic diaphragm

Ceramic diaphragm; suitable for drinking water and pool industry applications.

pH electrode with PTFE diaphragm

Dirt-repellent Teflon diaphragm; suitable for waste water, surface water and process water applications.

2.3 Nameplate



INFORMATION!

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.

The sensor type is specified on the labelling of the sensor package and on the sensor itself.

3.1 Notes on installation

**INFORMATION!**

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

**INFORMATION!**

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

**INFORMATION!**

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 Storage and transport

**CAUTION!**

Do not store the electrode tip dry. This will shorten lifetime considerably.

Always store the pH electrode tip wet in a 3 molar KCl solution when not in use. Saltless water must be avoided since this would leak the KCl ions. The original packing in which the electrode tip was delivered contains a plastic tube with KCl solution and therefore is suitable for storage and transport (see following drawing).

- Since the pH electrode is made out of glass it is very fragile. Avoid shocks of any kind.
- Do not touch or scratch the pH sensitive glass tip of the electrode.
- Store the electrode in its original packaging in a dry, dust-free location. Keep it away from dirt. If necessary, clean it as described on page 35.

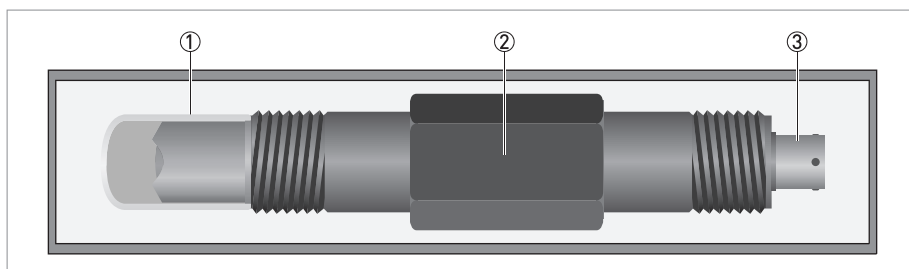


Figure 3-1: pH electrode in its original packaging

- ① Protection cap filled with 3 molar KCl Solution
- ② pH electrode
- ③ attached cable or 4-pin connector



Storing the electrode in the provided plastic tube

- Take the protection cap from the packaging.
- Fill the protection cap with 3 molar KCl solution.
- Insert the electrode tip into the protection cap until it is fully covered with KCl solution.
- Store the electrode in its original packaging.

3.3 Installation procedure

Because a new pH electrode needs to be calibrated before it is installed into its final measuring location, it is important to follow the installation order:

1. Unpack the electrode.
2. Connect the electrode to the signal converter.
3. Calibrate the electrode.
4. Install the electrode into its final measuring location.

The required steps are explained in the following sections.

3.4 Pre-installation requirements

**CAUTION!**

- *Never touch or scratch the pH sensitive glass tip of the electrode.*
- *Make sure that the glass tip is clean and dust-free. If necessary, clean the tip as described on page 35*

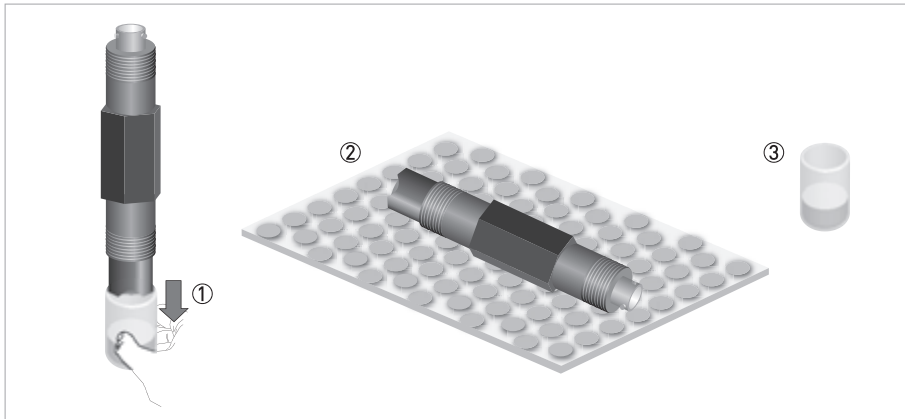


Figure 3-2: Handling the electrode

**Unpacking the electrode**

- Gently pull the protection cap from the electrode ①.
- Lay the electrode on a soft mat/tissue ②.
- Keep the protection cap in the original packaging ③.

3.5 Electrical connection

**DANGER!**

Observe the national regulations for electrical installations!

**WARNING!**

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.

3.5.1 Connecting the sensor cable to the signal converter

**DANGER!**

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

**INFORMATION!**

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.

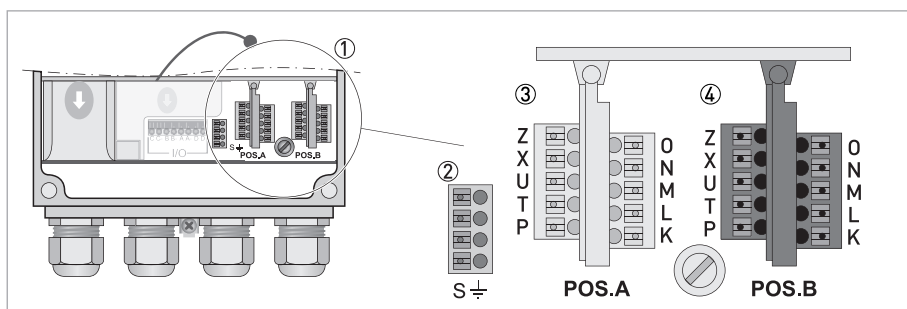


Figure 3-3: Sensor connection terminals on the signal converter dual channel version with terminal block A+B

- ① Sensor connection terminals
- ② Terminal block S (protective earth) and, to the right, terminal block A
- ③ Terminal block A: terminals for sensor and temperature
- ④ Terminal block B: terminals for sensor and temperature

When ordering the single channel version, only the interface "Pos.A" is populated. In the version with dual channel the interfaces "Pos.A" and "Pos.B" are populated.

Wire	Terminal block Pos.A/B
OPTISENS PH 8390 with 4-wire double coax cable	
Inner coax shield (black)	N (ref.)
Coax core (transparent)	O (pH)
Pt100 (white)	P
Pt100 (red)	X

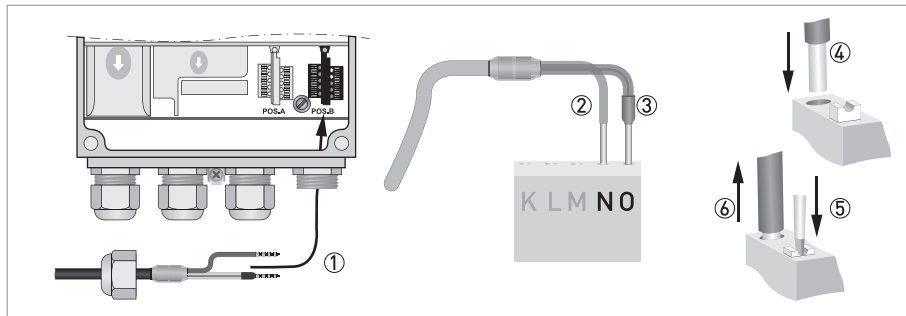


Figure 3-4: Connecting the sensor cable

The following instructions describe the connection of the different sensor cables.



Connecting the sensor cable to the signal converter

- Thread the sensor cable through the outer right cable gland ①.
- Push the coax shield ④ into terminal N ② and the coax core into terminal O ③.
- To remove a cable, press down the white clip ⑤ on the corresponding terminal and pull the cable out ⑥.

3.5.2 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:

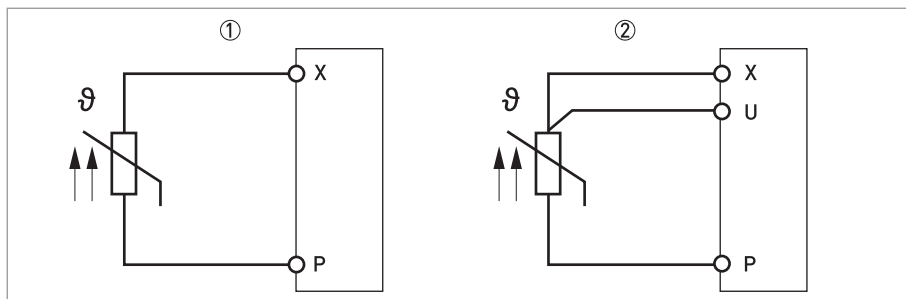


Figure 3-5: Connection of an external Pt100/1000 temperature sensor to the signal converter

- ① 2-wire connection
- ② 3-wire connection

3.5.3 Connecting the cable to the sensor

**CAUTION!**

Moisture inside the sensor connector must be avoided! Moisture will shortcut the mV signal between the electrodes and deliver erratic readings!

If moisture has entered the connector, clean it with pure water and then dry it with air (e.g. hair blower).

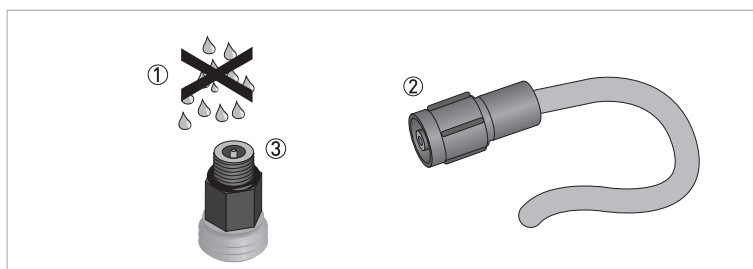


Figure 3-6: Connecting the cable to the sensor

**Connecting the cable to the sensor**

- Ensure that the cable and the electrode connector are absolutely dry ①.
- Screw the cable connector ② on to the sensor ③ and tighten it by hand .

3.6 Calibrating the electrode

Before the electrode is installed, it has to be calibrated. Proceed as described on page 25. Then continue with the installation procedure.

3.7 Installing the sensor

3.7.1 General installation instructions

The electrode tip must always have full contact with the measuring medium.

The mounting position of the electrode should not deviate more than 75° from vertical position (electrode tip pointing downwards). Doing otherwise might cause internal air bubbles to float into the electrode's glass tip. This would interrupt the electrical contact between the inner buffer solution and the glass surface.

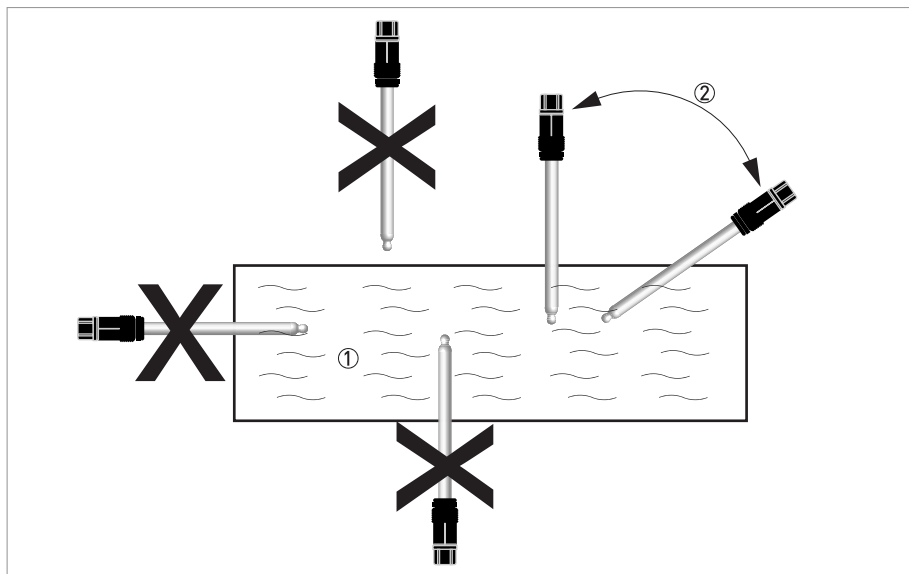


Figure 3-7: Installation requirements

- ① Measuring medium
- ② Maximum deviation of 75° from vertical position

3.8 Installing an external temperature sensor

Since the slope of the pH electrode is temperature-dependent, a temperature compensation makes sense if the temperature of your measuring medium varies.

If the pH electrode does not have an internal Pt100/1000 temperature sensor, you should use an external temperature sensor. There are various different possibilities of adding an external temperature sensor to your pH measurement installation. They can not be explain in detail in this document. Nevertheless, you should follow the general guidelines.

General guidelines for external temperature sensor installation

- The temperature sensor should be calibrated using a reference thermometer. For further information refer to *Temperature compensation* on page 25.
- The temperature should be measured close to the pH electrode in the same medium to avoid temperature differences. For example, surface water may have a different temperature than deeper water.

Suitable external temperature sensors are

- Pt100 in 2-wire or 3-wire connection
- Pt1000 in 2-wire or 3-wire connection

4.1 Menu mode structure



INFORMATION!

The following table just presents an overview. When programming the device, always consult the function tables additionally as they contain further information!

Only the sensor relevant menus are shown in the following tables. For detailed information about the general setting refer to the MAC 100 signal converter manual.

Measuring mode	Main menu	Submenu			Parameter
3 or 4 pages, scrolling with ↓ or ↑	> 2.5 s ←	A quick setup	> ← A9 pH cal. B process input A pH calibration (for dual channel version; refer to pH/ORP sensor documentation for further information)	> ← A9.1 temp.comp.	> ← For further information see function tables.
			A12 REDOX calibration B Only if switched to ORP! process input B REDOX calibration (for dual channel version; refer to pH/ORP sensor documentation for further information)		
			A13 pH cal. B process input B pH calibration (for dual channel version; refer to pH/ORP sensor documentation for further information)	A13.1 temp.comp.	

Measuring mode	Main menu		Submenu				Parameter		
3 or 4 pages, scrolling with ↓ or ↑	> 2.5 s ↶	B test	> ↶	B1 sim.process inp.A	> ↶	B1.1 temperature	> ↶	For further information see function tables.	
						B1.5 REDOX/ORP Only if switched to ORP! (for dual channel version; refer to pH/ORP sensor documentation for further information)			
									B1.7 pH (for dual channel version; refer to pH/ORP sensor documentation for further information)
				B2 sim.process inp.B		B 2.1 temperature			
						B2.5 REDOX/ORP Only if switched to ORP! (for dual channel version; refer to pH/ORP sensor documentation for further information)			
						B2.7 pH (for dual channel version; refer to pH/ORP sensor manual for further information)			
				B3 simulation I/O		B3.1 current out A			
						B3.2 current out B			
						B3.3 current out C			
						B3.6 simulation R3 off			
				B4 actual values		B4.1 operating hours			
						B4.2 process input A			
						B4.2.1 temperature			
						B4.2.2 pH/ORP			
						B4.2.9 CPU temp. (depends on V number)			
						B4.2.11 electrode current (µA)			
						B4.3 process input B			
						B4.3.1 temperature			
						B4.3.2 pH/ORP			
						B4.3.9 CPU temp. (depends on V number)			
						B4.3.11 elctrode current (µA)			
				B5 logbooks		B5.1 status log			
						B5.2 calibration log			
				B6 information		B6.1 C number			
						B6.2 process input A			
						B6.3 process input B			
						B6.4 SW.REV.MS			
	B6.5 SW.REV.UIS								
	B6.6 Electronic Revision ER								
	↕		↕		↕		↕		

Measuring mode	Main menu	Submenu			Parameter
3 or 4 pages, scrolling with ↓ or ↑	> 2.5 s ←	C setup	> ← C1 process input A	> ← C1.1 parameter (pH/REDOX)	> ← For further information see function tables.
				← C1.7 inner buffer (only pH)	
				C1.8 zero point	
				C1.9 slope	
				C1.10 calibration buffer	
				C1.14 time constant	
				C1.15 temperature	
				C1.16 REDOX cal.	
				C1.17 pH cal.	
			C2 process input B (for dual channel version; refer to pH/ORP sensor manual for further information)	C2.1 parameter (pH/REDOX)	
				C2.7 inner buffer (only pH)	
				C2.8 zero point	
				C2.9 slope	
				C2.10 calibration buffer	
				C2.14 time constant	
				C2.15 temperature	
				C2.16 REDOX cal.	
				C2.17 pH cal.	
		↓↑	↓↑	↓↑	↓↑

4.2 Function tables

4.2.1 Menu A, quick setup



INFORMATION!

Note that the appearance of some sub-menus depends on the hardware setting and the used sensor(s). Also only the sensor relevant menus and submenus are shown here in detail. For all other menu functions refer to the MAC 100 signal converter manual.

A9, ph cal. B

For single or dual channel version: Settings for sensor calibration

A12, process input B REDOX calibration

For dual channel version; refer to pH/ORP sensor manual for further information.
Only if switched to ORP!

A13, process input B pH calibration

For dual channel version; refer to pH/ORP sensor manual for further information.

4.2.2 Menu B, test

**INFORMATION!**

Note that the appearance of some sub-menus depends on the hardware setting and the used sensor(s). Also only the sensor relevant menus and sub-menus are shown here in detail. For all other menu functions refer to the MAC 100 signal converter manual.

The procedure to start the simulation process is the same for all functions:



- Choose the function with the help of ↓ or ↑ and press ↵.
- ☞ You see the two options "set value" (opens the editor to enter the simulation value) and "break" (exits the menu without simulation).
- Choose the desired option with the help of ↑ or ↓ and press ↵.
- ☞ If you chose "set value", the device asks "start simulation" and offers the options "no" (exits the menu without simulation) or "yes" (starts the simulation finally).
- Choose the desired option with the help of ↑ or ↓ and press ↵.
- ☞ If you chose "yes", the simulation starts.

B1,sim.process inp.A**B2,sim.process inp.B**

Level	Designation / function	Settings / descriptions
B1.1 B2.1	temperature	In this menu the temperature can be simulated.
B1.5 B2.5	REDOX/ORP ONLY if switched to ORP! (for dual channel version only; refer to pH/ORP sensor manual for further information)	In this menu the relative concentration of Redox/ORP can be simulated. For dual channel version only; refer to pH/ORP sensor manual for further information. ONLY if switched to ORP!
B1.7 B2.7	pH (for dual channel version only; refer to pH/ORP sensor manual for further information)	In this menu the relative concentration of pH can be simulated. For dual channel version only; refer to pH/ORP sensor manual for further information.

B4, actual values

Level	Designation / function	Settings / descriptions
This menu groups several functions which allow to display the corresponding actual reading. The shown measurements are depending on the device configuration.		
B4.1	operating hours	This menu shows the operating time of the devices in hours.
B4.2	process input A	In this menu the measurements from process input A can be read.
B4.3	process input B	In this menu the measurements from process input B can be read. For dual channel version only; refer to pH/ORP sensor manual for further information.

4.2.3 Menu C, setup


INFORMATION!

The signal converter has a dual process input, A and B. Each process input has an own submenu in this main menu. Process input A is always present, i.e. there is always a board in the interface "Pos.A" in the connection area. The interface of process input B only has a board with the dual channel signal converter. Be aware that the definition which kind of measurement a process input can do is defined when ordering the device. The configuration cannot be changed later.


INFORMATION!

Note that the appearance of some submenus depends on the hardware setting and the used sensor(s).

C1, process input A
C2, process input B

Level	Designation / function	Settings / descriptions
Process input A and B can be either a sensor 1 or a sensor 2. Further information about the type of sensor 1 or 2 please refer to MAC 100 manual "Sensor input combinations". Process input A is always present, process Input B can be present. Note: The exchange of a sensors 1 with a sensor 2, or vice versa, can only be done by the manufacturer! Depending on the sensor which is connected to a slot A or B the menu changes.		
C1.1 C2.1	parameter pH parameter REDOX	This menu item is for selecting the probe which is connected to process input A/B. The entries of this selection depends on the chosen device configuration. The device configuration is customer specific and set during production.
C1.7 C2.7	inner buffer	setting for inner buffer of the pH sensor
C1.8 C2.8	zero point	this menu item shows the actual zero point to the calibrated pH/ORP sensor
C1.9 C2.9	slope	this menu item shows the actual slope point to the calibrated pH/ORP sensor
C1.10 C2.10	calibration buffer	this menu item shows the used buffer concentration for the last calibration
C1.15 C2.15	temperature	Menu for temperature measurement. Available for sensor 1 and sensor 2.
C1.15.1 C2.15.1	probe	Options: • manual: used if no internal or external temperature sensor is connected to the signal converter • Pt100: used if the pH electrode has an integrated Pt temperature measurement or if an external Pt100 temperature sensor is connected to the signal converter • Pt1000: used if an external Pt1000 temperature sensor is connected to the signal converter • process input A: choose this option if there is a temperature sensor connected to input A of the signal converter
C1.15.2 C2.15.2	manual	Only available if C1.15.1 or C2.15.1 is set to "manual".
C1.15.3 C2.15.3	correction	Offset correction for temperature measurement. Not available if C1.15.1 or C2.15.1 is set to "manual".
C1.15.4 C2.15.4	limitation	Measuring ranges for temperature measurement.

Level	Designation / function	Settings / descriptions
C1.15.5 C2.15.5	temp. comp.	Menu for activating the temperature compensation parameters for the measurement. Options: • Linear: linear temperature compensation. • Off: temperature compensation is disabled.
C1.16 C2.16	REDOX cal.	menu item for calibrating the ORP sensor
C1.16.1 C2.16.1	prepare calibration	view actual redox value
C1.16.2 C2.16.2	ref. value Redox	Enter the reference value of the probe in mV
C1.16.3 C2.16.3	start calibration	Start calibration procedure.
C1.16.4 C2.16.4	stored value	View stored value of calibration.
C1.17 C2.17	pH cal.	menu item for calibration the pH sensor
C1.17.1 C2.17.1	temp.comp	Menu for activating the temperature compensation parameters for the calibration Options: • off: temperature measurement is disabled • manual: temperature value has to be entered manually • automatic: temperature measurement is performed as configured
C1.17.2 C2.17.2	start calibration in buffer 1	Start calibration procedure.
C1.17.3 C2.17.3	stored value	View stored value of calibration.
C1.17.4 C2.17.4	reference	Enter the reference value of the probe in pH
C1.17.6 C2.17.6	start calibration in buffer 2	Start calibration procedure.
C1.17.7 C2.17.7	stored value	View stored value of calibration
C1.17.8 C2.17.8	reference	Enter the reference value of the probe in pH

**CAUTION!**

If you choose for measurement the temperature compensation "linear" than choose between "automatic" or "manual" for the temperature compensation during calibration. If you choose for measurement the temperature compensation "off" than choose also "off" for the temperature compensation during calibration.

4.3 Calibration

4.3.1 Temperature compensation

There are three basic options for temperature compensation:

- **automatic:** the signal converter will automatically compensate temperature influences using the information of a Pt100 or Pt1000 temperature sensor.
- **manual:** the signal converter will compensate temperature influences using a manually entered value; this option only makes sense if the temperature of the measured medium is quite constant.
- **off:** temperature compensation is disabled.



INFORMATION!

If you choose no compensation, the measured pH value will most likely deviate from the actual pH value. The reason is that the pH value of a specific medium varies depending on the temperature of the medium.

The menu for the type of temperature compensation offers the following options:

- **Pt1000:** choose this option if there is an external Pt1000 temperature sensor connected to the signal converter.
- **Pt100:** choose this option if the electrode has an integrated Pt100 temperature measurement or if there is an external Pt100 temperature sensor connected to the signal converter.
- **manual:** choose this option if there is no internal or external temperature sensor connected to the signal converter.
- **process input A:** choose this option if there is a temperature sensor connected to input A of the signal converter.



INFORMATION!

In the basic configuration the setting of the temperature compensation is Pt100. If you use a pH sensor without Pt100/1000 then select the temperature compensation "manual" and enter the value. Otherwise an error will be displayed.

After starting-up the signal converter, the measuring screen appears. This is the standard screen which is displayed automatically in the normal operating mode. If you are in this mode and you want to adjust the temperature compensation, you have to perform the following steps:

Step 1: activating the temperature compensation for measurement

- Press > for more than 2.5 seconds, then release the button. You are on the main menu level. In the upper line of the display "A" appears, beneath the main menu quick setup is highlighted. - Press ▼ or ▲ until the main menu setup is highlighted.			
MAIN MENU			
A quick setup B test > C setup D service			
Press > to enter the chosen menu.			
You are on the first submenu level. In the upper line of the display "setup" and "c1" appears, beneath the submenu process input A is highlighted.			
Press ▼ or ▲ to select process input A or process input B. Choose process input A or B where ever pH is configured.			
Press > to enter the chosen menu.			
You are on the second submenu level. The submenu parameter is highlighted.			
Press > to enter the chosen menu.			
You are on the third submenu level. In the upper line of the display "parameters" appears - Press ▼ or ▲ to select pH - Press ↵ to confirm the entered value			
You are on the second submenu level. The submenu parameter is highlighted. Press ▼ or ▲ to select temperature			
Press > to enter the chosen menu.			
You are on the third submenu level. In the upper line of the display "temperature" and "C1.15.1" or "C2.15.1" appears, beneath the option probe is highlighted - Press ▼ or ▲ to select temp.comp - Press > to enter the chosen menu.			
You are on the fourth submenu level. In the upper line of the display "temp.comp" appears Now you can setup the temperature compensation - Press ▼ or ▲ to choose between automatic or off - Press ↵ to confirm the entered value			
You are on the third submenu level. If you have chosen the option automatic, you can select the type of temperature compensation now. - Press ▼ or ▲ to choose probe - Press > to enter the chosen menu.			
You are on the fourth submenu level. Press ▼ or ▲ to choose between Pt100, Pt1000, manual or process input A. - Press ↵ to confirm the entered value - Press ↵ several time until you reach the measuring mode again. Choose yes to safe and confirm your selection			



INFORMATION!

When ordering the dual channel version, the interface "Pos A" and "Pos B" are populated. A separate temperature sensor has to be connected to "Pos A" and configured on **process input A**. To connect a electrode with integrated Pt100/Pt1000 the temperature sensor has to be connected on the same terminal block as the electrode.

Step 2: Configure /adjust the temperature sensor

Step 2a: probe Pt100/1000			
Read the currently measured temperature of the Pt100/1000 temperature sensor from the measurement screen and write it down. Measure the temperature with a reference thermometer and check if it deviates from the temperature measured by the Pt100/1000. - Press > for more than 2.5 seconds, then release the button. You are on the main menu level. In the upper line of the display "A" appears, beneath the main menu setup is highlighted. - Press ▼ or ▲ until the main menu setup is highlighted.			
MAIN MENU			
A quick setup B test > C setup D service			
Press > to enter the chosen menu.			
You are on the first submenu level. In the upper line of the display "setup" and "c1" appears, beneath the submenu process input A is highlighted. Choose process input A or B where ever pH is configured.			
Press ▼ or ▲ to select process input A or process input B.			
Press > to enter the chosen menu process input A/B.			
You are on the second submenu level. Press ▲ or ▼ until the submenu temperature is highlighted.			
Press > to enter the chosen menu. The submenu probe Pt100/1000 is highlighted.			
- Press ▼ or ▲ until the submenu correction is highlighted. - Press ↵ to enter the chosen menu			



- If necessary, enter the temperature correction in Kelvin so that the signal converter shows the same temperature as the reference thermometer. Press ↵ to confirm the entered value. The temperature sensor has been adjusted.

Step 2b: probe manual			
Measure the temperature of the measuring medium.			
- Press > for more than 2.5 seconds, then release the button. You are on the main menu level. In the upper line of the display "A" appears, beneath the main menu setup is highlighted. - Press ▼ or ▲ until the main menu setup is highlighted.			
	MAIN MENU		
	A quick setup B test > C setup D service		
	Press > to enter the chosen menu.		
	You are on the first submenu level. In the upper line of the display "setup" and "c1" appears, beneath the submenu process input A is highlighted. Choose process input A or B where ever pH is configured.		
	- Press ▼ or ▲ to select process input A or process input B. - Press > to enter the chosen menu process input A/B.		
	You are on the second submenu level. Press ▲ or ▼ until the submenu temperature is highlighted.		
	Press > to enter the chosen menu. The submenu probe manual is highlighted.		
	- Press ▼ or ▲ until the submenu manual is highlighted. - Press ↵ to enter the chosen menu		



- Enter the measured temperature. Press **↵** to confirm the entered value. The manually measured temperature will now be used for temperature compensation.



- Step 2c: **probe process sensor A**
The temperature sensor connected to input A of the signal converter is used for temperature compensation.
The temperature sensor **probe process sensor A** has to configured in submenu **process input A**. If you use a Pt100/1000 follow the instruction in step 2.1. If you use manually entered value, follow the instruction in step 2.2.

4.3.2 Calibrating pH measurement

A pH calibration is necessary in regular intervals or when installing a new pH electrode.

In an intact electrode, the optimal slope is 59 mV for each pH unit and the optimal zero point is 0 mV at pH 7. The slope should at least have a value between 50...65 mV per pH unit. Re-calibrate the electrode if the slope does not approximate those limits.

The pH electrode ages, the slope gets flatter and the zero error increases. When one or both of these values exceed certain limits, the converter displays a message indicating that the electrode has to be exchanged.



CAUTION!

- *Never touch or scratch the pH sensitive glass tip of the electrode.*
- *Make sure that the glass tip is clean and dust-free. If necessary, clean the tip as described on page 35.*



CAUTION!

Moisture inside the sensor connector must be avoided! Moisture will shortcut the mV signal between the electrodes and deliver erratic readings!

If moisture has entered the connector, clean it with pure water and then dry it with air (e.g. hair blower).

To avoid alarms on the process control system when temporarily removing the sensor (i.e. for maintenance), the converter has a hold function. This function "freezes" all outputs (i.e. the display and the current outputs) of the last measured value.



INFORMATION!

As an indication that the manual hold function is active, the "warning sign" in the upper left corner of the display appears. Meanwhile the status messages show "checks in progress". For more details about how to select the manual hold function refer to the converter manual.

After starting-up the converter, the measuring screen appears. This is the standard screen which is displayed automatically in the normal operating mode. If you are in this mode and you want to initiate a calibration, you have to activate the manual hold function in the first step.

Step 1: activating the manual hold function

- Press > for more than 2.5 seconds, then release the button. You are on the main menu level. In the upper line of the display "A" appears, beneath the main menu quick setup is highlighted. - Press ▼ or ▲ until the main menu quick setup is highlighted.	
MAIN MENU > A quick setup B test C setup D service	
Press > to enter the chosen menu.	
	You are on the first submenu level. In the upper line of the display "quick setup" and "A1" appears, beneath the submenu language is highlighted. - Press ▼ or ▲ until the submenu manual hold is highlighted. - Press > to enter the chosen menu.
	You are on the second submenu level. In the upper line of the display "manual hold" appears, beneath the option off is highlighted
	Press ▼ or ▲ to choose the option on
	Press ↵ to confirm the entered value.



- You have activated the manual hold function. Go to the next step and prepare the calibration procedure. You have to return to the measuring mode.
- Press ↵ until you reach the measuring mode again



Step 2: preparing the calibration procedure

- If you re-calibrate an existing electrode, remove the electrode from its respective assembly and refer to *Calibrating pH measurement* on page 29.
- If you calibrate a new electrode, make sure that the electrode is correctly connected to the converter.
- Check the electrode for damages, check the diaphragm for coating and rinse the electrode tip with tap water and gently swipe it with a soft tissue.
- Provide two buffer solutions with the same known temperature: pH 4 and pH 7.

After activating the manual hold function and the preparative measures, you can get access to the calibration procedure from the measuring mode in two different ways. Either you go via the main menu **setup** (step 3a) or via the main menu **quick setup** (step 3b).

Step 3a: accessing the calibration menu via the main menu **setup**

- Press > for more than 2.5 seconds, then release the button. You are on the main menu level. In the upper line of the display "A" appears, beneath the main menu quick setup is highlighted. - Press ▼ or ▲ until the main menu setup is highlighted.	
MAIN MENU A quick setup B test > C setup D service	
Press > to enter the chosen menu.	
You are on the first submenu level. In the upper line of the display "setup" and "c1" appears, beneath the submenu process input A is highlighted.	
Press ▼ or ▲ to select process input A or process input B is highlighted. Choose process input A or B where ever pH is configured.	
Press > to enter the chosen menu.	
You are on the second submenu level. In the upper line of the display "process input A" and "C1.1" appears, beneath the submenu parameter (Cl2) is highlighted.	
Press ▼ or ▲ until the submenu pH cal. is highlighted.	
Press > to enter the chosen menu.	



- You can start the calibration procedure now as described in "Step 4".

Step 3b: accessing the calibration menu via the main menu **quick setup**

Press > for more than 2.5 seconds, then release the button. You are on the main menu level. In the upper line of the display "A" appears, beneath the main menu quick setup is highlighted.	
MAIN MENU > A quick setup B test C setup D service	
Press > to enter the chosen menu.	
You are on the first submenu level. In the upper line of the display "quick setup" and "a" appears, beneath the submenu language is highlighted.	
Press ▼ or ▲ until the submenu pH cal. A or B is highlighted, wherever pH is configured	
Press > to enter the chosen menu.	



- You can start the calibration procedure now as described in "Step 4".



Figure 4-1: Calibration procedure



Step 4: calibration procedure

- After choosing the submenu **pH cal.** (step 3a) or **pH cal. A or B** (step 3b) in the previous steps, continue by pressing **>**.
- ➡ The signal converter demands to choose the kind of temperature compensation for the calibration. You have the options "off", "automatic" and "manual" (for detailed information refer to *Temperature compensation* on page 25). Please select the same kind of temperature compensation for the calibration as for the measurement.
- If you chose "automatic", just press **↵**. If you chose "manual", first enter the temperature of the buffer solutions using **▼** or **▲** and then press **↵**.
- ➡ On the screen the message **calib. buffer 1** appears.
- Submerge the sensor tip into the pH 7 buffer solution ①.
- ➡ The currently measured value is shown on the display.
- Wait until a steady value is displayed, then press **↵**.
- Press **↵** to finally start the calibration procedure.
- ➡ The message **pH 1 set value** and the pH value of the first buffer solution are displayed on the screen.
- Press **↵** to confirm the settings.
- After 25 seconds the calibration step is completed and **calib. buffer 2** appears. Otherwise, if the shown value deviates from the buffer solution, enter the correct value using **▼** or **▲**.
- Press **↵** to confirm the entered value.
- ➡ On the screen the message **calib. buffer 2** appears.
- Rinse the sensor tip with tap water ② and clean it with a soft tissue.
- Submerge the sensor tip into the pH 4 buffer solution ③.
- ➡ The currently measured value is shown on the display.
- Wait until a steady value is displayed.
- Press **↵** to continue the calibration procedure.
- ➡ The message **pH 2 set value** and the pH value of the second buffer solution are displayed on the screen.
- Press **↵** to confirm the setting.
- After 25 seconds the calibration step is completed. Otherwise, if the shown value deviates from the buffer solution, enter the correct value using **▼** or **▲**.
- Press **↵** to confirm the entered value.
- ➡ The zero point of the electrode is displayed (should be near 0 mV in an intact electrode).

- Press  to confirm.
- ➡ The slope of the electrode is displayed (should be near 59 mV in an intact electrode).
- Press  to confirm.
- ➡ The message store cal. value is displayed on the screen. The converter asks if the new calibration values should be stored.
- Choose **yes** to store the calibration values. Choose **no** to discard the results.
- Press  to confirm.
- ➡ Prior returning to the measuring display, you are asked if the configuration should be stored.
- Choose **yes** using  or  to store the new calibration values.
- ➡ You have completed the pH calibration.
- If you want to return to the measuring mode, press  several times until you reach this mode.

**INFORMATION!**

*If an error occurs during the calibration procedure, the display shows an error message.
Possible causes for an error are:*

- *Slope too flat.*
- *Wrong buffer solution.*
- *Wrong electrical connection.*
- *Moisture in the sensor connector.*

**Step 5: re-installing the electrode**

- After the calibration procedure, rinse the electrode with tap water.
- Reinstall the electrode into its assembly, refer to *Installing the sensor* on page 17.

**Step 6: switching back to measurement**

- Deactivate the function "manual hold" again.

4.3.3 Calibration log



INFORMATION!

In order to show the history of the calibrations, the converter has a calibration logbook function. Up to 64 entries of the calibration history are stored including date and time.

Accessing the calibration log

- Press **>** for more than 2.5 seconds, then release the button. You are on the main menu level. In the upper line of the display "A" appears, beneath the main menu **quick setup** is highlighted.
- Press **▼** or **▲** until the main menu **test** is highlighted.

MAIN MENU A quick setup > B test C setup D service	
Press > to enter the chosen menu.	
	You are on the first submenu level. In the upper line of the display "test" and "B1" appears, beneath the submenu sim.process input A is highlighted.
	Press ▲ or ▼ until the submenu logbooks is highlighted.
	Press > to enter the chosen menu.
	You are on the second submenu level. In the upper line of the display "logbooks" and "B1" appears, beneath the submenu status log is highlighted.
	Press ▼ or ▲ until the submenu calibration log is highlighted.
	Press > to enter the chosen menu.



- You are on the data level and you see the calibration history. With the help of **▼** or **▲** you can scroll through the different entries.
- If you want to return to the measuring mode press **↶** several times until you reach this mode.

4.4 Troubleshooting

Problem	Possible cause	Remedy
The pH electrode does not deliver a signal.	Mechanical damage of the glass bulb, e.g. small cracks. This will shortcut the ion exchange and deliver a pH7 reading.	Exchange electrode.
	Moisture inside the electrode connector. This will shortcut the signal between pH glass half cell and reference half cell and deliver a reading of pH7.	Clean the connector (electrode/cable) with pure water and dry with air (e.g. hair blower).
The pH electrode delivers an unstable signal.	The diaphragm in the reference half cell does not provide good contact to the process medium due to drying up or coatings.	• Clean the diaphragm with hot soap or acid using a soft tissue (details on page 35). • Submerge electrode in water and increase the temperature to 50...60°C / 122...140°F. • Submerge electrode in 3 molar KCl solution at ambient temperature. The decrease in temperature will cause the reference half cell to suck in KCl solution through the diaphragm and regenerate the diaphragms functionality.

5.1 Maintenance

5.1.1 Cleaning



- Slight dirt residues or dust: Rinse the sensor tip with tap water and clean it with a soft tissue.
- Oily and greasy coatings: Remove with a warm soap solution and rinse with water.
- Hardness deposits or metal hydroxide deposits: Remove with 10% citric acid or hypochloric acid and rinse with water.

5.1.2 Aging and re-calibration

During operation, but already during storage, pH electrodes age due to poisoning effects of the inner buffer system. Therefore it is important to re-calibrate the electrode in regular intervals as described on page 29.

When the electrode becomes too old to provide reliable measurements, the signal converter displays an error message after the calibration procedure. In this case, the electrode has to be exchanged.

Aging effects pH electrodes:

- **Decrease of slope** due to abrasion, drying, corrosion of glass bulb coating and leaching: The slope should be $> 50 \text{ mV/pH}$. An optimal value is 59 mV/pH at $25^\circ\text{C} / 77^\circ\text{F}$. When the slope drops below 50 mV/pH , an error message is displayed and the electrode has to be exchanged. The slope of the electrode is displayed after each calibration procedure.
- **Shift of zero point** due to leaching / contamination of reference half cell or increased resistance between glass bulb and reference half cell: The zero point should lie between $-58...+58 \text{ mV}$ at pH 7. An optimal value is 0 mV at pH 7. The zero point of the electrode is displayed after each calibration procedure.

The following figure shows the aging effects:

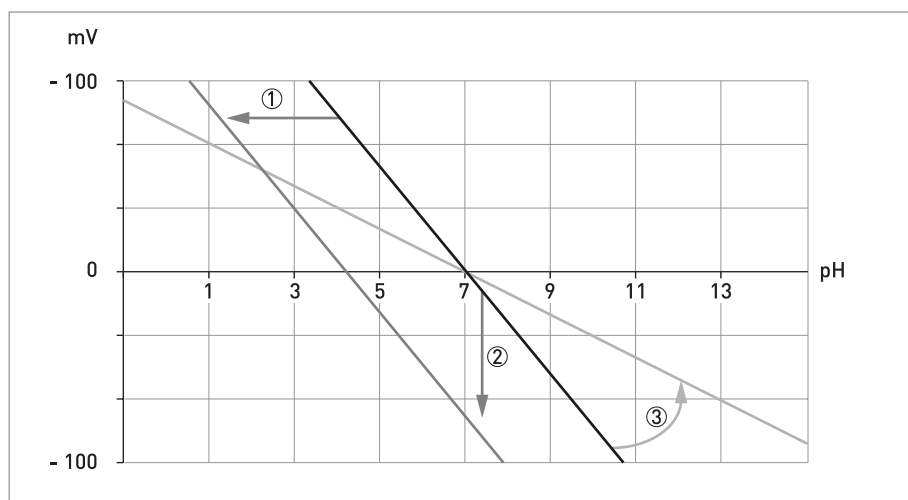


Figure 5-1: Aging effects of electrode

- ① Horizontal shift of slope
- ② Vertical shift of slope
- ③ Decrease of slope



INFORMATION!

The life time of a pH electrode can lie anywhere between 6 weeks and 2 years. The life time expectation depends heavily on the application. The right choice of the electrode type is very important.

5.2 Spare parts availability

The manufacturer adheres to the basic principle that functionally adequate spare parts for each device or each important accessory part will be kept available for a period of 3 years after delivery of the last production run for the device.

This regulation only applies to spare parts which are subject to wear and tear under normal operating conditions.

5.3 Availability of services

The manufacturer offers a range of services to support the customer after expiration of the warranty. These include repair, maintenance, technical support and training.



INFORMATION!

For more precise information, please contact your local representative.

5.4 Returning the device to the manufacturer

5.4.1 General information

This device has been carefully manufactured and tested. If installed and operated in accordance with these operating instructions, it will rarely present any problems.



CAUTION!

Should you nevertheless need to return a device for inspection or repair, please pay strict attention to the following points:

- *Due to statutory regulations on environmental protection and safeguarding the health and safety of our personnel, manufacturer may only handle, test and repair returned devices that have been in contact with products without risk to personnel and environment.*
- *This means that the manufacturer can only service this device if it is accompanied by the following certificate (see next section) confirming that the device is safe to handle.*



CAUTION!

If the device has been operated with toxic, caustic, flammable or water-endangering products, you are kindly requested:

- *to check and ensure, if necessary by rinsing or neutralizing, that all cavities are free from such dangerous substances,*
- *to enclose a certificate with the device confirming that is safe to handle and stating the product used.*

5.4.2 Form (for copying) to accompany a returned device

Company:		Address:	
Department:		Name:	
Tel. no.:		Fax no.:	
Manufacturer's order no. or serial no.:			
The device has been operated with the following medium:			
This medium is:		water-hazardous	
		toxic	
		caustic	
		flammable	
		We checked that all cavities in the device are free from such substances.	
		We have flushed out and neutralized all cavities in the device.	
We hereby confirm that there is no risk to persons or the environment through any residual media contained in the device when it is returned.			
Date:		Signature:	
Stamp:			

5.5 Disposal

**CAUTION!**

Disposal must be carried out in accordance with legislation applicable in your country.

6.1 Measuring principle

6.1.1 pH measurement

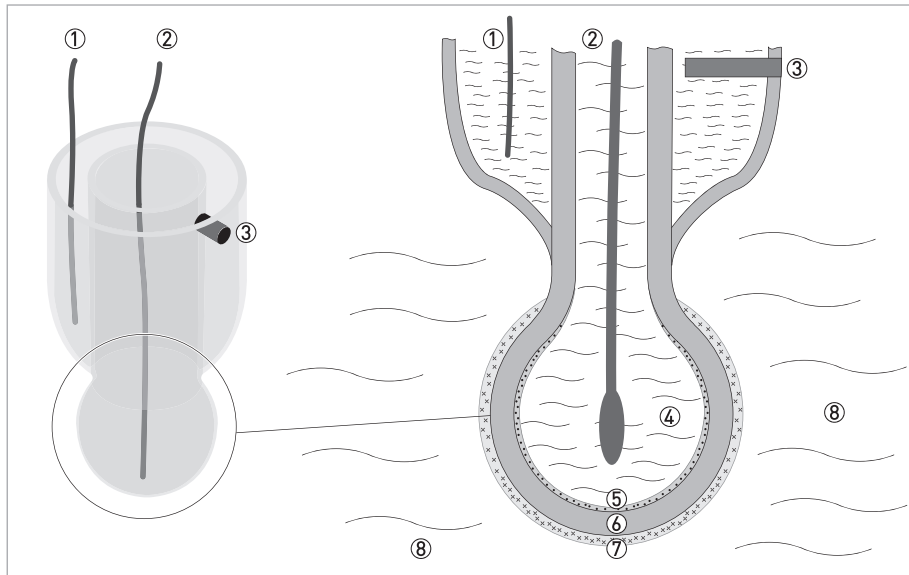


Figure 6-1: Measuring principle for pH measurement

- ① Reference electrode
- ② Measuring electrode
- ③ Diaphragm in contact with KCl solution and measuring medium
- ④ Inner pH 7 buffer solution
- ⑤ Surface potential on the inside (contact with buffer solution)
- ⑥ pH sensitive glass
- ⑦ Surface potential on the outside (contact with measuring medium)
- ⑧ Measuring medium

The measuring principle of a pH electrode is based on a pH sensitive glass. When the pH sensitive glass gets into contact with a liquid, a thin layer of hydrated gel develops on the surface, enabling an ion exchange between the glass surface and the liquid. The so-called Nernst potential builds up on the glass surface. If both sides of the glass are in contact with liquids, a voltage may be detected between the two surface potentials. The voltage correlates to the difference in H^+ ion concentration and thus to the difference of pH values in both liquids.

The pH measuring electrode contains an internal buffer solution with a known pH value. If the pH value of the measuring medium on the outside of the electrode is equal to the pH value of the inner buffer, the resulting voltage is 0 V.

If the pH value of the medium differs from the internal pH value, a voltage between the internal and the external layer can be measured. From the resulting voltage, the pH difference of the two liquids can be calculated.

The voltage is measured using a measuring electrode and a reference electrode; both are built into the sensor. The measuring electrode is in contact with the known buffer solution in the pH sensitive glass bulb. The reference electrode is immersed into a saturated solution of potassium chloride (KCl). The KCl solution itself is in electrical contact with the measuring medium by means of a diaphragm. The diaphragm prevents the measuring medium from penetrating into the reference system but still allows electrical contact with the measuring medium.

The voltage change of a pH electrode at 25°C / 77°F is around 59 mV for each pH unit. This is also called the slope of the pH electrode. The slope is temperature dependent and decreases over life time of the electrode.

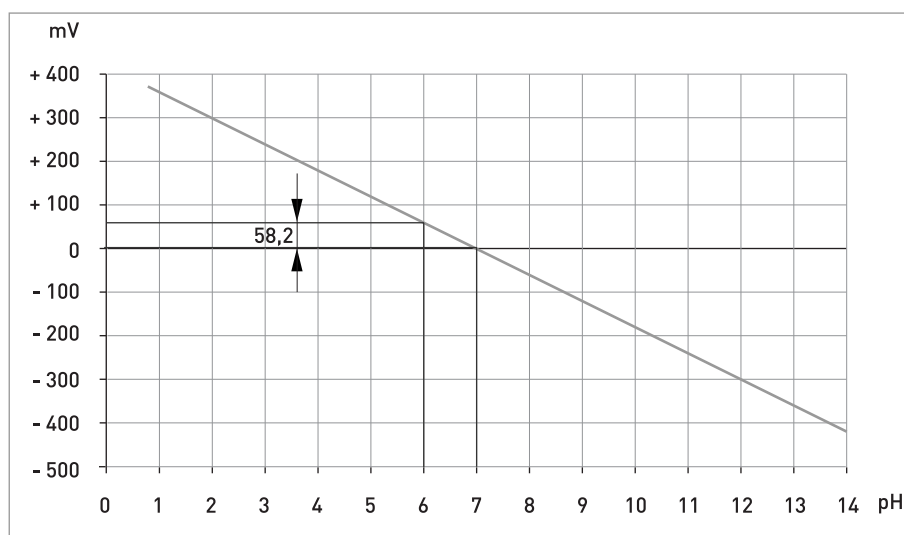


Figure 6-2: Optimal slope of the electrode at 25°C / 77°

To compensate for the temperature dependency of the pH measurement, the temperature of the medium can be measured and automatically compensated in the signal converter.

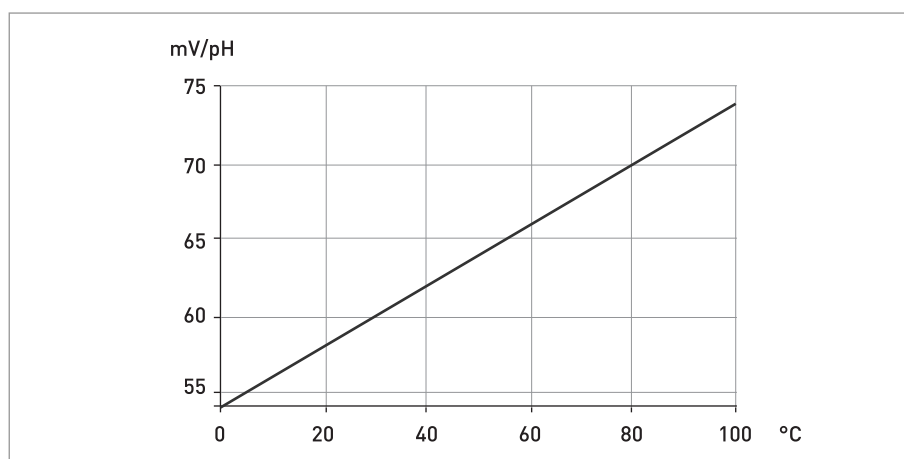


Figure 6-3: Temperature dependency of the electrode slope

6.2 Technical data



INFORMATION!

- 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 representative.
- Additional information (certificates, special tools, software,...) and complete product documentation can be downloaded free of charge from the website (Download Center).

pH electrodes

OPTISENS	PH 8390
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Measuring system

Measuring principle	Potentiometric
Measuring range	0...14 pH

Design

Construction	CPVC Body with Tuff Tip®
Shaft diameter	20 mm / 0.79"
insertion length	23 mm / 0.91" or 44 mm / 1.74"
Process Connection	3/4" MNPT
Temperature sensor	Pt 100
Sensor Cap	attached cable or 4-pin connector
Type of diaphragm	PTFE

Measuring accuracy

Reference conditions	Medium: water
	Temperature: 20°C / 68°F
	Pressure: max. 1 bar / 14.5 psi (absolute)
Maximum measuring error	pH: 0.2% full scale
	Temperature: 1.0% full scale
Repeatability	0.2% full scale
Resolution	0.1 (or 0.01 in extended mode)
Long-term stability	24 hours: tested within accuracy definition
Temperature drift	Tested within accuracy definition
Cable length variation	Tested within accuracy definition

Operating conditions

Temperature range	0...+80°C / +23...+176°F
Max. operating pressure	6.9 barg / 100 psig at 60°C/140°F
Minimum conductivity	> 150µS/cm

Installation conditions

Process connection	3/4" MNPT
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Materials

Electrode shaft	CPVC
Measuring electrode	Glass
Inner buffer	pH 7.0
Reference	double junction
Diaphragm	PTFE
Gasket	Viton®

Electrical connection

Connector	attached cable or 4-pin connector
Cable	only for 4-pin connector: Cable pH/ORP-W US style sensor 4-pin connector to hancked
Cable length	7.26 m / 25 ft; 10 m / 33 ft.

**INFORMATION!**

For further information ask your local sales representer.

6.3 Dimensions

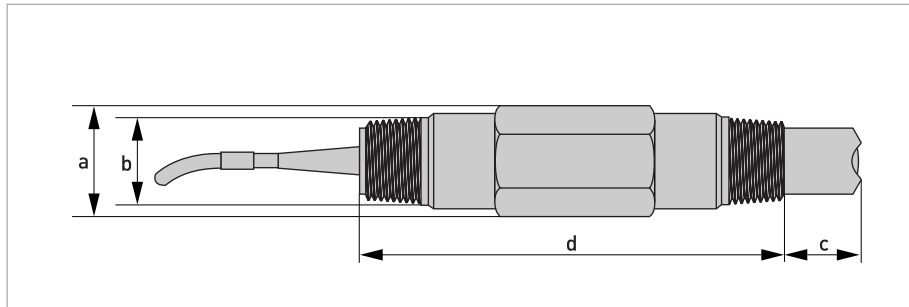


Figure 6-4: Dimensions OPTISENS PH 8390

	Dimensions [mm]	Dimensions [inch]
a	28.57	1 1/8"
b	3/4" MNPT thread	
c	23 / 44	0.91" / 1.74"
d	171	6.73"

7.1 pH as a function of mV

The pH-value is the negative decadative logarithm of the hydrogen ion concentration, and it is directly related to the proportion of hydrogen ions H^+ to hydroxide ions OH^- in the media. The pH-electrode measures excess or deficit of the hydrogen ions and gives a proportional millivolt signal as output. The signal is 59.16 mV per 1 pH at 25°C / 77°F. In clean water there is a total balance between hydrogen ions and hydroxide ions, the output from the electrode is 0.0 mV and pH is 7. The millivolt signal is measured by the pH sensor and the corresponding pH value is calculated in the signal converter.

mV	pH	H^+ ions [mol/l]	OH^- ions [mol/l]	Example
414	0	1	0.000000000000001	
355	1	0.1	0.00000000000001	
296	2	0.01	0.00000000000001	Coca Cola
237	3	0.001	0.00000000000001	
177	4	0.0001	0.00000000000001	Orange juice
118	5	0.00001	0.00000000000001	
59	6	0.000001	0.00000000000001	Milk
0	7	0.0000001	0.00000001	Clean water
-59	8	0.00000001	0.0000001	Blood
-118	9	0.000000001	0.000001	
-177	10	0.0000000001	0.00001	
-237	11	0.00000000001	0.0001	
-296	12	0.000000000001	0.01	
-355	13	0.00000000000001	0.1	
-414	14	0.000000000000001	1	Sulfa

7.2 pH temperature dependency

The output from a pH-electrode varies with the temperature in a predictable way. The size of the variation depends on both the temperature and the pH being measured.

°C	°F	pH	pH	pH	pH	pH	pH	pH	pH	pH	pH	pH	pH
5	41	2.30	3.24	4.18	5.12	6.06	7.00	8.06	9.12	10.18	11.24	12.30	13.36
15	59	2.15	3.12	4.09	5.06	6.03	7.00	8.03	9.06	10.09	11.12	12.15	13.18
25	77	2.00	3.00	4.00	5.00	6.00	7.00	8.00	9.00	10.00	11.00	12.00	13.00
35	95	1.85	2.88	3.91	4.94	5.97	7.00	7.97	8.94	9.91	10.88	11.85	12.82
45	113	1.70	2.76	3.82	4.88	5.94	7.00	7.94	8.88	9.82	10.76	11.70	12.64
55	131	1.55	2.64	3.73	4.82	5.91	7.00	7.91	8.82	9.73	10.64	11.55	12.46
65	149	1.40	2.52	3.64	4.76	5.88	7.00	7.88	8.76	9.64	10.52	11.40	12.28
75	167	1.25	2.40	3.55	4.70	5.85	7.00	7.85	8.70	9.55	10.40	11.25	12.10
85	185	1.10	2.28	3.46	4.64	5.82	7.00	7.82	8.64	9.46	10.28	11.10	11.92
95	203	0.95	2.16	3.37	4.58	5.79	7.00	7.79	8.58	9.37	10.16	10.95	11.74

At pH 7 and 25°C / 77°F the temperature error is zero. If temperature or pH changes the temperature error is calculated using the following formula:

0.03 pH-difference / pH or 0.03 pH-difference / K







KROHNE product overview

- Electromagnetic flowmeters
- Variable area flowmeters
- Ultrasonic flowmeters
- Mass flowmeters
- Vortex flowmeters
- Flow controllers
- Level meters
- Temperature meters
- Pressure meters
- Analysis products
- Products and systems for the oil & gas industry
- Measuring systems for the marine industry

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