PH AMPLIFIER[1]
0 .. 14 pH
Description D030i

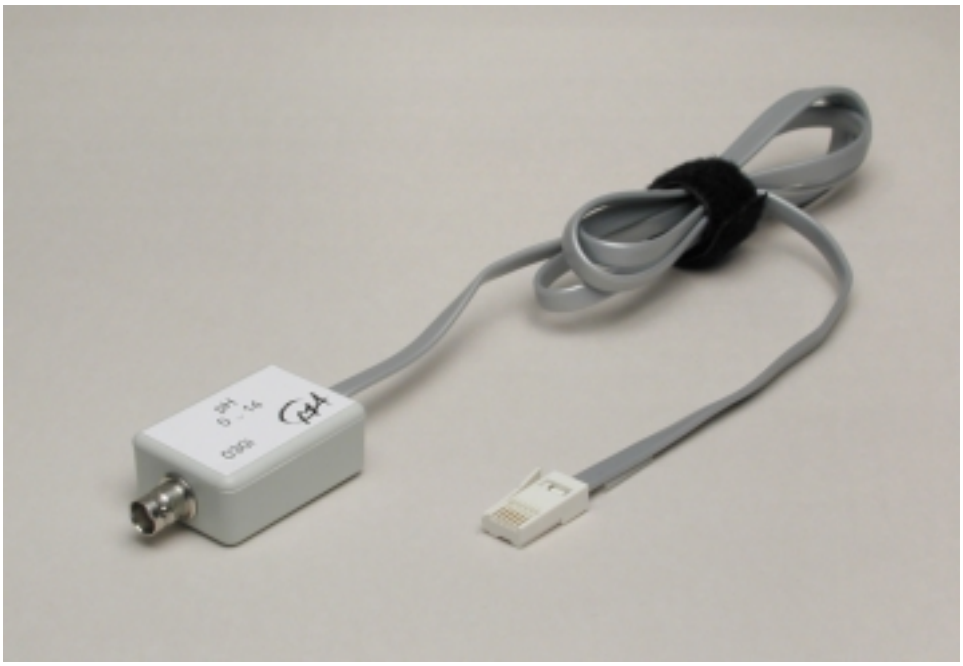

Figure 1. The pH amplifier (030i)

Short description

The pH system is a general-purpose pH measurement system that allows measuring the degree of acidity/pH value of a solution. The system consists of a pH amplifier (030i) and pH electrode (031). The pH electrode (031) has to be ordered separately.
The pH electrode is a gel-filled Ag-AgCl combination-electrode in a plastic tube. The electrode can not be refilled.
The amplifier has been built into a separate box and uses the 5 V power supplied by a lab interface. The sensor can be used in the range between 0 to 14 pH.

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[1] To use the new intelligent sensors in the Coach 5 program you need to update the Coach library. This update can be found at http://www.cma.science.uva.nl/english section Support > Coach 5.

The pH amplifier is equipped with a BT-plug and can be connected to the following CMA interfaces:

- **U**LAB
- CoachLab
- CoachLab II
- UIA/UIB through Measuring console (via 0520 adapter[2]).

Furthermore the sensor can be used in combination with other interfaces, like Texas Instruments CBL™, CBL2™ and Vernier LabPro without the need of an adapter.

pH amplifier

The pH amplifier is a circuit, which allows a standard combination pH electrode (such as the pH electrode (031)) to be monitored by a lab interface.
The pH electrode is connected to the BNC connector on one end of the box. The cable from the pH amplifier ends in a BT plug for connection to an interface.
The pH amplifier adjusts the voltage produced by the pH electrode to a range between 0 to 5 V, which can be measured by an interface.

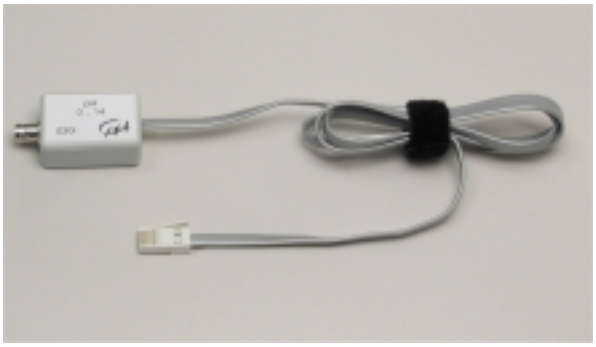

Figure 2. The pH amplifier (030i)

pH electrode

The pH electrode is designed to make measurements in the pH range of 0 to 14.
It has a coax cable, with a BNC connector.
The electrode (made from glass) is built in a plastic tube with an opening at the bottom side. It is supplied in a bottle filled with a protective solution. When the pH electrode is not being used, it must be kept in this liquid. Do not place the electrode in base solution (pH >10) for longer than few hours. This can affect the glass of the electrode. The pH electrode has a limited operational life and can be ordered separately.

Figure 3. The pH electrode (031)

During a measurement the end of the plastic tube of the electrode has to be held

[2] The CMA adapter art. nr 0520 allows connecting sensors with BT-plugs to 4-mm inputs.

approximately 1 cm in the liquid.

Intelligent sensor[3]

The pH Sensor is an intelligent sensor. The sensor has a memory chip with information about the sensor. Through a simple protocol (I^2C) the sensor communicates with **U**LAB and transfers its data (name, quantity, unit and calibration) to the datalogger. **U**LAB automatically displays the calibrated values on its screen. Also **U**LAB communicates the information to the Coach software. The sensor is delivered with a standard calibration.

Suggested experiments

The pH system can be used for various experiments in biology, chemistry and environmental science such as:
- measurements of pH of different acids and bases
- acid-base titration experiments
- monitoring pH during chemical reactions
- investigations of acid rains and of water quality in streams and lakes.

Calibration

The output of the pH sensor is linear with respect to the pH values. To collect data you can:
1. Use the calibration supplied in the standard sensor library of the Coach program.
2. Use the calibration supplied by the sensor EEPROM memory (only for the **U**LAB datalogger).
3. Calibrate the pH sensor (the best accuracy). User calibration can be performed in the Coach software (for details see 'Guide to Coach 5').
   Use the two-point calibration. Rinse the tip of the electrode in distilled water. Place the electrode into one of the buffer solutions. When the voltage reading stabilizes, enter the pH value.
   For the next calibration point, rinse the electrode and place it into second buffer solution. When the voltage reading stabilizes, enter the second pH value.
   Test your calibration in different known pH buffer solutions.

Changing of the default calibration in EEPROM of the sensor

In the near future a special program will be available to enable replacing of the default calibration in EEPROM of the sensor by a calibration done by the user. This will be done while the sensor is connected to the **U**LAB datalogger.

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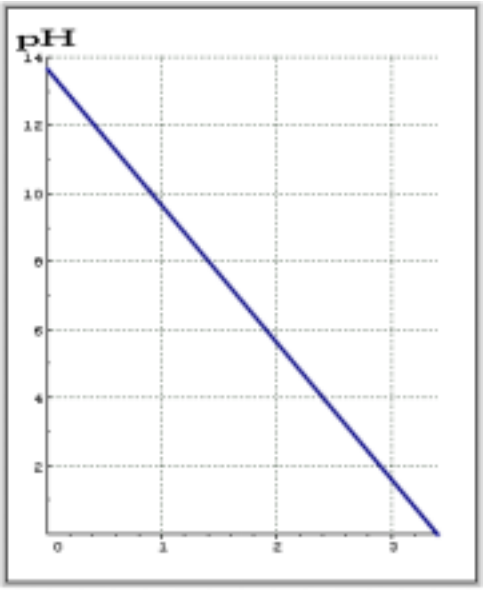
[3] At this moment only for CMA **U**LAB datalogger.



In this way the sensor can have its own, precise calibration.

The name of the pH sensor in the sensor library of the Coach 5 program is **pH sensor (030i) (CMA).**

Figure 4.
Default calibration graph of the pH sensor (used in the standard Coach library and sensor memory)
pH = -4.04 * V_{out} (V) + 13.68

Coefficients of the calibration function:
a= -4.04; b= 13.68.

Technical data

pH range	0 – 14 pH
Voltage output range	0 - 3.5V
Calibration function	pH = -4.04 * V_{out} (V)+ 13.68
Resolution using 12bit A/D converter	0.005 pH
Temperature range	5 to 80°
Isopotential pH	pH 7 (point at which temperature has no effect on output)
Connection	 BT (British Telecom) plug
When the system is not functioning properly you can test the electrode. Without amplification, the pH electrode should give off a voltage of 0.41 V at a pH value of 7 (plus or minus 0.06 V per pH unit). This can be measured with the help of a voltmeter with a very high input resistance. When the pH electrode does not give off the required voltage any more, it must be replaced.	

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