

PH AMPLIFIER

DESCRIPTION D030



Figure 1. The pH System (Amplifier and Electrode)

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 electrode and a pH amplifier.

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 between pH = 0 and pH = 14.

The pH sensor is delivered with a BT-plug and can be connected to the following interfaces:

- UIA/UIB through Measuring console (via 0520 adapter)
- CoachLab
- CoachLab II
- SMI (via 0520 adapter)
- Texas Instruments CBL™ data-logger.

There is an adapter (art. 0520) to connect sensors with the BT-plug to 4-mm input.

Suggestion for experiments

- 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.

How the pH Amplifier works

The pH amplifier is a circuit which allows a standard combination pH electrode (such as the CMA 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 does three primary tasks:

1. It steps up the voltage produced by the pH electrode to a range where it can be monitored by the lab interface. A fairly common op-amp circuit is used.
2. It offsets the voltage so it is always in the range 0 to 3.5 volts. There is a potentiometer inside the pH amplifier that allows this offset to be adjusted.
3. It provides the negative voltage required for the amplifier circuit. One of the ICs on the circuit board converts the +5V power supplied by the lab interface to -5V.

When the pH electrode is connected, the pH amplifier will produce a voltage of 1.75V in a pH 7 buffer. The voltage will increase by about 0.25-volts/pH number for every pH number decrease. The voltage will decrease by about 0.25-volts/pH number as the pH increases.

pH electrode

The pH electrode is designed to make measurements in the pH range of 0 to 14 and it has been built into 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. The pH electrode has a limited operational life and can be ordered separately (article 031). The electrode has a coax cable, which can be linked to the amplifier with a BNC connector.

During a measurement the end of the plastic tube of the electrode has to be held approximately 1 cm in the liquid.



Figure 2. The pH electrode.

Calibration

The calibration is provided in the software. For the best accuracy, you may want to calibrate your pH system.

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.

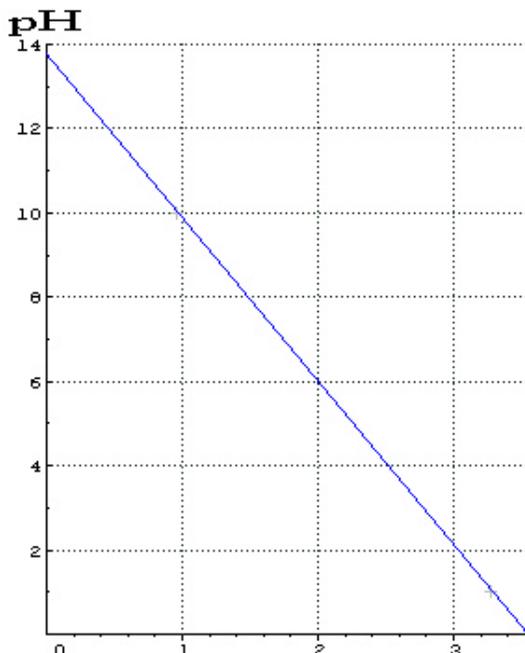


Figure 3.

Calibration of the pH sensor

Coefficients of the calibration function:

$a = -3.8716$; $b = 13.7553$

The name of the pH sensor in the sensor library of Coach 5 program is **pH sensor (030&bt+031) (CMA)**.

Checking the sensor when it is malfunctioning

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.

Technical data

| | |
|------------------------------------------|---------------------------------------------------------------------------------------------------------------|
| Sensitivity | - 0.25 V per pH unit |
| Output voltage | 0 - 3.5V |
| pH range | 0 - 14 pH |
| Resolution using 12 bit 5V 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 |

This product is to be used for educational purposes only. It is not appropriate for industrial, medical, research, or commercial applications.

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