# AUTOMATION AND PROCESS CONTROL

## CRPH - pH Control and Regulation Study Unit


### 1. General

Thanks to the Didacta's CRPH the student is enabled to get a deep insight into the functioning of a control system in which the pH of a solution is the quantity to be controlled. In comparison with other quantities such as level or temperature, pH is not a linear function of the regulating variable and, as a consequence, particularly interesting to analyze.
The effects of the variation of process parameters on the efficiency of the regulation system and its stability, are fully investigated. Furthermore, the student can also achieve good knowledge of the components used in industrial applications, as the system is made up of equipment commonly used for industrial applications.

### 2. Composition

The unit is composed of:

- pH Regulation Module (code 916927);
- CRS/pH - Didactic Regulation Software (code 916989);
- MiniReg - On/Off and PID Electronic Regulator - Optional (code 916940);
- CRSS - Control and Regulation Simulation Software -Optional (code 914372).

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***Figure 1 – Process Control Equipment***

## 3. Description

### pH Regulation Module (code 916927)

The purpose of the process (see fig.2) is to control the pH of a solution initially held in tank (4), called "Main".
A solution flows, by falling, into mixing tank (1), where also a noise solution is sent by falling from tank (3) called "Noise".
Thanks to solenoid valves (8A) and (8B) and manual valves (9A) and (9B) the control the two flows is achieved , and measured directly by means of flow meters (15A) and (15B).
Stirrer (6) allows to get homogeneous solutions inside process tank (1).
From sampling tank (14) it is possible to take a sample of the controlled solution held in tank (1) in order to measure the pH with other gauges.

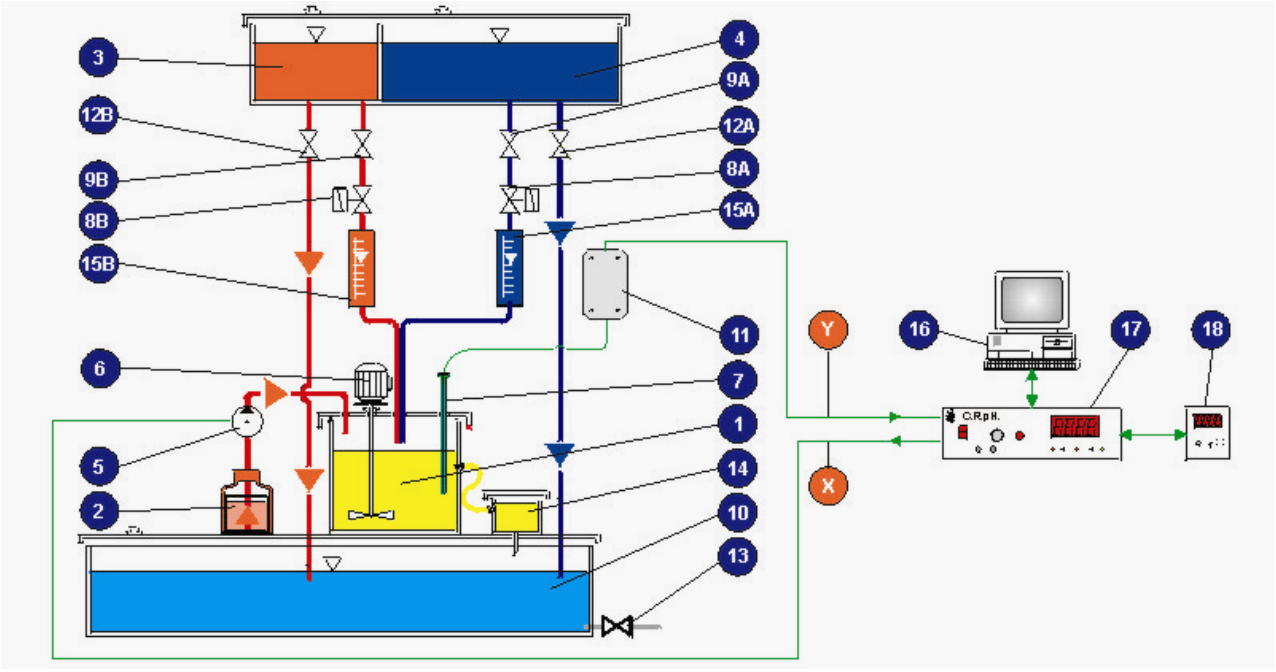


***Figure 2 – General synoptic***

The pH of the solution present in mixing tank (1) is measured by means of probe (7), converted into electrical signal (Y) and supplied to electrical unit (17) by means of signal transmitter (11).
The closed-loop control may occur in two different ways:

- via software, using the CRS Software (16);
- electronically, using Minireg optional electronic regulator (18).

In any case the control, of the PID (Proportional Integral Derivative) or On-Off type, occurs by comparing the signal corresponding to the pH with a Set-Point value set by the user.

As a function of the control logic, the regulator generates regulating signal (X) which acts on peristaltic pump (5), varying the flow coming from tank (2), containing a corrective solution.
The electrical equipment (17) includes the controls for the major electrical components of the unit, two timers enabling to set different opening times for solenoid valves (8A) and (8B), the AD/DA conversion board to interface the Personal Computer through the USB port, a digital indicator to display the pH value acquired by means of probe (7).

**CRS/pH - Control and Monitoring Software (code 916989)**

The control and monitoring software, running under MS-Windows, allows the fulfillment of a digital control via software, of PID or On-Off type. It is possible to set, independently and in real time, the regulation parameters and the Set-Point value for the pH of the solution to be controlled (see Fig.3),
The software allows monitoring the process in real time, showing on the video the diagram of the regulated quantity, of the regulating signal, and of the Set-Point in function of time (see Fig.4).
Such a diagram can be printed at any moment, while the signal samples and the control parameters can be saved in a file, in ASCII format, or printed

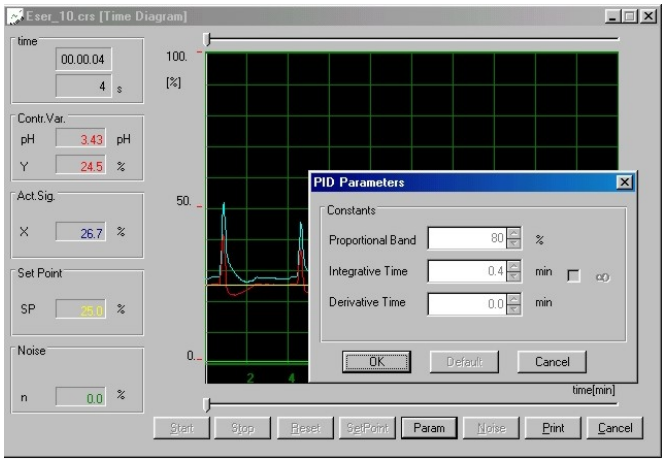


***Fig. 3 – CRS software: PID parameters setting window***

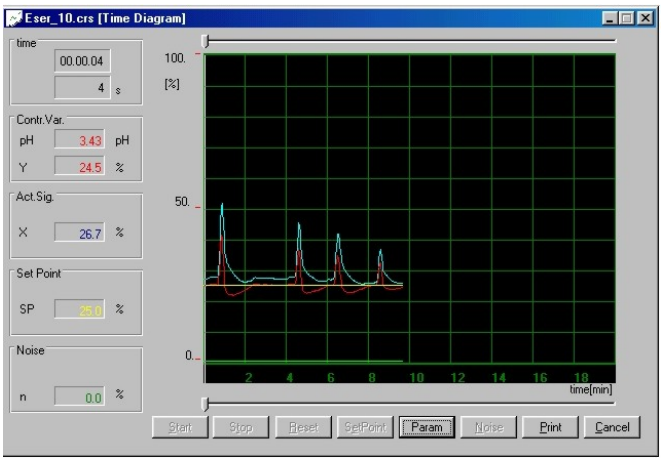


***Fig. 4 – CRS software: Real time signal diagram***

**MiniReg - Optional Electronic Regulator (code 916940)**

The MiniReg electronic regulator is equipped with microprocessor digital technology, capable of regulating any physical quantity acquired by transducers with standard electrical output.
The electronic regulator can programmed for a PID or On-Off regulation and includes a “Self Tuning” function for automatic determination of the optimal regulation parameters.

**CRSS - Optional Control and Regulation Simulation Software (code 914372)**

In addition to the CRS Software experiments, the CRSS software allows to simulate the process. The software is described in detail in a separate sheet.

## 4. Applications

- Analysis of pH control system of given solutions. The variable can be controlled either manually or electronically or by PC through purposely devised software.
- Study of open-loop control system characteristics.
- Study of closed-loop control system characteristics: effects of the three regulation modes, proportional, integral and derivative of PID regulation.
- Study of system stability in the various conditions and regulation of process parameters
- Determination of closed-loop system characteristics: On-Off regulation and effects of regulation parameters.
- Study of system response to different types of periodic and non periodic noises.
- Use of a local electronic regulator with remote Set-Point input. (Optional, supplied on request only)

## 5. Required PC Configuration

- PC minimum Pentium with HD >10Gb, CD drive, graphic card SVGA minimum, mouse, 32MB RAM, USB port
- Software: Windows XP or later versions.
- Graphic printer.

## 6. Required Services

- Electric Power Supply 220/240 V AC; 50/60 Hz single-phase; 0.2 kW.

## 7. Weight and Dimensions

- Dimensions: 800 x 650 x 1750 h mm
- Weight: 80 kg