edibon
Technical Teaching Equipment

Computer Controlled **Multipump Testing Bench,** with SCADA

PBOC

EDIBON PATENT

Teaching Technique used

EDIBON **SCADA** System

② Control Interface Box

③ Data Acquisition Board

④ Software for:
- Computer Control
- Data Acquisition
- Data Management

⑤ Cables and Accessories

⑥ Manuals

Computer (not included in the supply)

① Unit: PBOC. Multipump Testing Bench

*Minimum supply always includes: 1 + 2 + 3 + 4 + 5 + 6
(Computer not included in the supply)

OPEN CONTROL
+
MULTICONTROL
+
REAL TIME CONTROL

Key features:

- **Advanced Real Time SCADA.**
- **Open Control + Multicontrol + Real Time Control.**
- **Own Control Software based on Labview.**
- **National Instruments Data Acquisition board (250 KS/s (kilo samples per second)).**
- **Calibration exercises included.**
- **Students multipost (an entire class) by using a projector.**
- **Ready for doing applied research, real industrial simulation, training courses possibilities, etc.**
- **Unit is totally safe (Mechanical, Electronic/Electrical and Software safety devices included).**
- **Results calculation and analysis software (CAL).**
- **Several future expansions, as ESN. EDIBON Scada-Net System (many students working simultaneously), and more.**
- **Designed and manufactured under several quality standards.**

www.edibon.com
Products
Products range
Units
8.- Fluid Mechanics & Aerodynamics

ISO 9000: Quality Management
(for Design, Manufacturing, Commercialization and After-sales service)

European Union Certificate
(total safety)

Certificates ISO 14000 and
ECO-Management and Audit Scheme
(environmental management)

Worlddidac Quality Charter Certificate
(Worlddidac Member)

GENERAL DESCRIPTION

The Multipump Testing Bench (PBOC) allows the students to study the operating characteristics of several types of pumps (Centrifugal pump, Axial flow pump, Gear pump and Peripherical pump, included in the minimum supply, and other optional pumps). It allows to control and to measure the most representative parameters of these types of pumps.

Some measures that can be taken using this unit are: pump manometric height, flow, torque and turning speed.

Each pump is activated by a motor which allows the direct measurement of the torque as well as the turning speed. A frequency converter carries out the speed variation.

In each pump there are two pressure tappings, one for the admission and other for the discharge. The tappings are connected to their corresponding pressure sensors.

The valves and pipes arrangement allows a quick selection of any of the pumps to be tested.

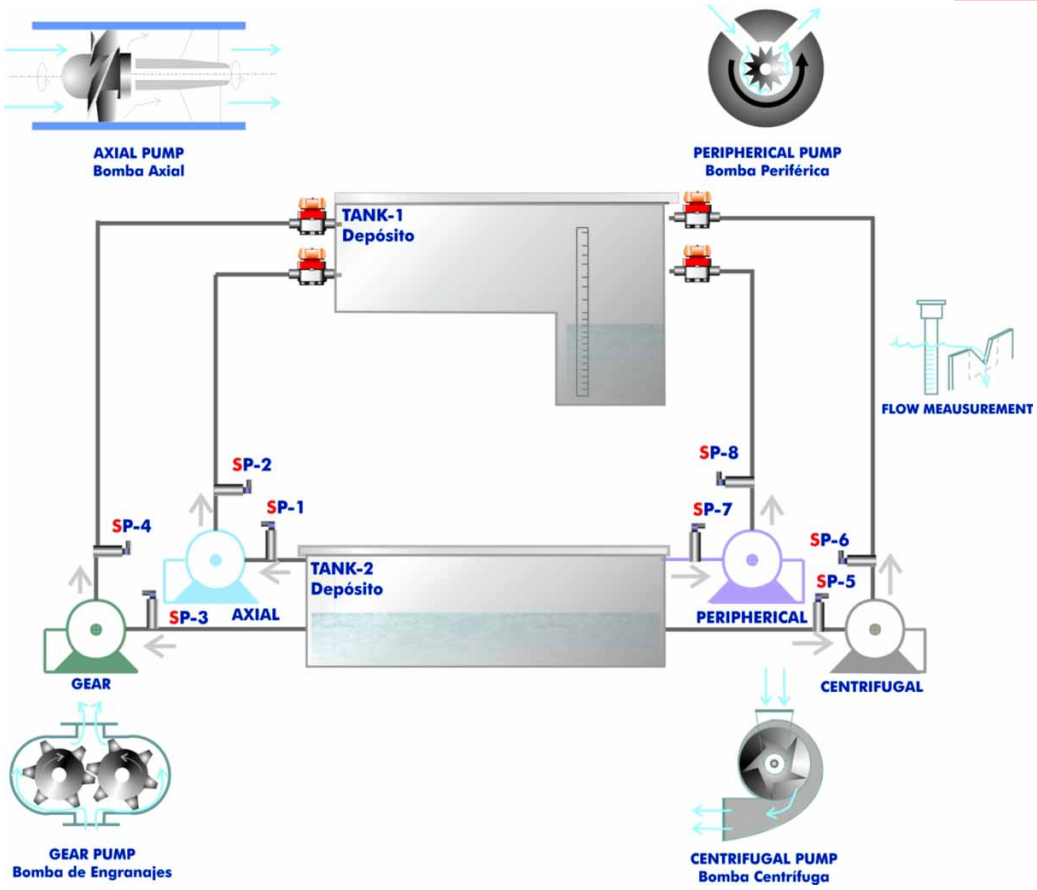
The volumetric tank is equipped with a stilling baffle and incorporates a discharge valve and an activator. The tank is located at the outlet of the water channel, just over the water storage tank.

The volumetric tank has been designed to accommodate low or high flows and it incorporates a vision tube and a graduated scale. It has a safety overflow system, directly pouring water into the storage tank, in case an incorrect use has been made.

This Computer Controlled Unit is supplied with the EDIBON Computer Control System (SCADA), and includes: The unit itself + a Control Interface Box + a Data Acquisition Board + Computer Control and Data Acquisition Software Packages, for controlling the process and all parameters involved in the process.

PROCESS DIAGRAM AND UNIT ELEMENTS ALLOCATION

OPEN CONTROL
+
MULTICONTROL
+
REAL TIME CONTROL



COMPLETE TECHNICAL SPECIFICATIONS (for main items)

With this unit there are several options and possibilities:

- Main items: 1, 2, 3, 4, 5 and 6.
- Optional items: 7, 8, 9, 10, 11 and 12.

Let us describe first the main items (1 to 6):

① PBOC. Unit:

Unit designed to demonstrate the operating characteristics of different types of pumps.

Anodized aluminium structure and panels in painted steel.

Main metallic elements in stainless steel.

Diagram in the front panel with similar distribution to the elements in the real unit.

Fully instrumented self-contained unit.

It is equipped with four rubber wheels to provide mobility and with brake to immobilize the unit during the practices.

PBOC.Unit

4 Pumps (computer controlled): Centrifugal pump, Axial flow pump, Gear pump and Peripherical pump:

Centrifugal pump: pedestal or of free axis type, with a reinforced runner that works in an extension of the main head and held by a double ball bearing.

- Maximum flow: 50 l/min.
- Maximum height: 11 mwc (meters of water column).
- Efficiency: 35%.

Axial flow pump: with propeller, which works in an acrylic casing with thin interstices between the propeller and the casing.

- Maximum flow: 50 l/min.
- Maximum height: 2 mwc (meters of water column).
- Efficiency: 15%.

Gear pump: of positive displacement, with casing of a melted piece and two rotors in form of a straight cylindrical gear.

- Maximum flow: 35 l/min.
- Maximum height: 45 mwc (meters of water column).
- Efficiency: 75%.

Peripherical pump: also known as Regenerator or Turbine pump, with an runner of straight blades inside an annular casing and an axis of activation on two lubricated ball bearings.

- Maximum flow: 40 l/min.
- Maximum height: 22 mwc (meters of water column).
- Efficiency: 30%.

Motor for each pump, with independent operating.

Admission pressure sensor and discharge pressure sensor for each pump (8 sensors).

Control software for the direct reading of speed (r.p.m.) and torque (Nm).

Variation of speed by frequency converter, computer control.

Calibrated volumetric tank of 0-10 litres for low flows and of 0-45 litres for high flows.

Flow sensor.

"U" Shape weir.

2 Stilling baffles in the open channel.

Water storage tank, with capacity of 160 litres approx.

Valves for centrifugal , peripherical and gear pumps. Control valve for axial pump.

The complete unit includes as well:

Advanced Real Time SCADA.

Open Control + Multicontrol + Real Time Control.

Own Control Software based on Labview.

National Instruments Data Acquisition board (250 KS/s (kilo samples per second)).

Calibration exercises included.

Students multipost (an entire class) by using a projector.

Ready for doing applied research, real industrial simulation, training courses possibilities, etc.

Unit is totally safe (Mechanical, Electronic/Electrical and Software safety devices included).

Results calculation and analysis software (CAL).

Several future expansions, as ESN. EDIBON Scada-Net System (many students working simultaneously), and more.

Designed and manufactured under several quality standards.

② PBOC/CIB. Control Interface Box:

The Control Interface Box is part of the SCADA system.

Control interface box with process diagram in the front panel and with the same distribution that the different elements located in the unit, for an easy understanding by the student.

All sensors, with their respective signals, are properly manipulated from -10V. to +10V. computer output. Sensors connectors in the interface have different pines numbers (from 2 to 16), to avoid connection errors.

Single cable between the control interface box and computer.

The unit control elements are permanently computer controlled, without necessity of changes or connections during the whole process test procedure.

PBOC/CIB

Simultaneous visualization in the computer of all parameters involved in the process.

Calibration of all sensors involved in the process.

Real time curves representation about system responses.

Storage of all the process data and results in a file.

Graphic representation, in real time, of all the process/system responses.

All the actuators' values can be changed at any time from the keyboard allowing the analysis about curves and responses of the whole process.

All the actuators and sensors values and their responses are displayed on only one screen in the computer.

Shield and filtered signals to avoid external interferences.

Real time computer control with flexibility of modifications from the computer keyboard of the parameters, at any moment during the process.

Real time computer control for pumps, compressors, resistances, control valves, etc.

Real time computer control for parameters involved in the process simultaneously.

Open control allowing modifications, at any moment and in real time, of parameters involved in the process simultaneously.

Three safety levels, one mechanical in the unit, another electronic in the control interface and the third one in the control software.

③ DAB. Data Acquisition Board:

The Data Acquisition board is part of the SCADA system.

PCI Data acquisition board (National Instruments) to be placed in a computer slot. Bus PCI.

Analog input:

Number of **channels= 16** single-ended or 8 differential. **Resolution=16 bits**, 1 in 65536.

Sampling rate up to: 250 KS/s (kilo samples per second).

Input range (V)=±10 V. Data transfers=DMA, interrupts, programmed I/0. DMA channels=6.

DAB

Analog output:

Number of **channels=2. Resolution=16 bits**, 1 in 65536. Maximum output rate up to: 833 KS/s.

Output range(V)=±10 V. Data transfers=DMA, interrupts, programmed I/0.

Digital Input/Output:

Number of **channels=24 inputs/outputs**. D0 or DI Sample Clock frequency: 0 to 1 MHz.

Timing: Number of **Counter/timers=2**. Resolution: Counter/timers: 32 bits.

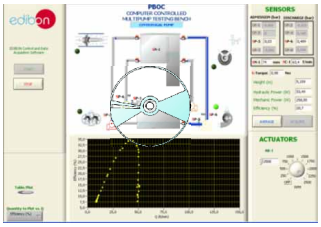
④ PBOC/CCSOF. Computer Control +Data Acquisition+Data Management Software:

The three softwares are part of the SCADA system.

Compatible with actual Windows operating systems. Graphic and intuitive simulation of the process in screen. **Compatible with the industry standards.**

Registration and visualization of all process variables in an automatic and simultaneous way.

Flexible, open and multicontrol software, developed with actual windows graphic systems, acting simultaneously on all process parameters.



PBOC/CCSOF

Management, processing, comparison and storage of data.

Sampling velocity up to 250 KS/s (kilo samples per second).

Calibration system for the sensors involved in the process.

It allows the registration of the alarms state and the graphic representation in real time.

Comparative analysis of the obtained data, after the process and modification of the conditions during the process.

Open software, allowing the teacher to modify texts, instructions. Teacher's and student's passwords to facilitate the teacher's control on the student, and allowing the access to different work levels.

This unit allows the 30 students of the classroom to visualize simultaneously all the results and the manipulation of the unit, during the process, by using a projector or an electronic blackboard.

⑤ Cables and Accessories, for normal operation.

⑥ Manuals: This unit is **supplied with 8 manuals:** Required Services, Assembly and Installation, Interface and Control Software, Starting-up, Safety, Maintenance, Calibration & Practices Manuals.

* References 1 to 6 are the main items: PBOC + PBOC/CIB + DAB + PBOC/CCSOF + Cables and Accessories + Manuals are included in the minimum supply for enabling normal and full operation.

EXERCISES AND PRACTICAL POSSIBILITIES TO BE DONE WITH MAIN ITEMS

1.- Determination of the flow by a weir of thin wall in U-shape.
2.- Determination of unloading coefficient of a weir of thin wall in a U-shape.
3.- Determination of the curve Q vs r.p.m. for the centrifugal pump.
4.- Determination of the curve Q vs r.p.m. for the peripherical pump.
5.- Determination of the curve Q vs r.p.m. for the gear pump.
6.- Determination of the curve Q vs r.p.m. for the axial pump.
7.- Determination of the curve H vs Q for different r.p.m. for the centrifugal pump.
8.- Determination of the curve H vs Q for different r.p.m. for the peripherical pump.
9.- Determination of the curve H vs Q for different r.p.m. for the gear pump.
10.- Determination of the curve H vs Q for different r.p.m. for the axial pump.
11.- Determination of the mechanical power vs flow for different r.p.m. for the centrifugal pump.
12.- Determination of the mechanical power vs flow for different r.p.m. for the gear pump.
13.- Determination of the mechanical power vs flow for different r.p.m. for the peripherical pump.
14.- Determination of the mechanical power vs flow for different r.p.m. for the axial pump.
15.- Determination of the curve η vs the flow for different r.p.m. for the centrifugal pump.
16.- Determination of the curve η vs the flow for different r.p.m. for the peripherical pump.
17.- Determination of the curve η vs the flow for different r.p.m. for the gear pump.
18.- Determination of the curve η vs the flow for different r.p.m. for the axial pump.
19.- Determination of the map of a centrifugal pump.
20.- Determination of the map of a peripherical pump.
21.- Determination of the map of a gear pump.
22.- Determination of the map of an axial pump.
23.- Determination of the adimenssional characteristic curves for different types of pumps.
24.- Determination of the specific speed of different types of pumps.
25.- Verification of the similarity rules for pumps of different geometry.

Additional practical possibilities:

26.- Sensors calibration.

Other possibilities to be done with this Unit:

27.- Many students view results simultaneously.
To view all results in real time in the classroom by means of a projector or an electronic blackboard.
28.- Open Control, Multicontrol and Real Time Control.
This unit allows intrinsically and/or extrinsically to change the span, gains; proportional, integral, derivate parameters; etc in real time.
29.- The Computer Control System with SCADA allows a real industrial simulation.
30.- This unit is totally safe as uses mechanical, electrical and electronic, and software safety devices.
31.- This unit can be used for doing applied research.
32.- This unit can be used for giving training courses to Industries even to other Technical Education Institutions.
33.- Control of the PBOC unit process through the control interface box without the computer.
34.- Visualization of all the sensors values used in the PBOC unit process.

- By using PLC-PI additional 19 more exercises can be done.
- Several other exercises can be done and designed by the user.

REQUIRED SERVICES

-Electrical supply: single-phase, 220V./50Hz or 110V./60 Hz.
-Water supply.
-Drainage system.
-Computer (PC).

DIMENSIONS & WEIGHTS

PBOC Unit:	- Dimensions: 1650 x 800 x 1850 mm. approx.
	- Weight :240 Kg. approx.
Control Interface Box:	- Dimensions: 490 x 330 x 310 mm. approx.
	- Weight: 10 Kg. approx.

OPTIONAL PUMPS

-PBOC-2BC. Second Centrifugal pump, and including the additional valves required to perform a Series/Parallel pump demonstration.
-PBOC-BIF. Flexible impeller pump.
-PBOC-BD. Diaphragm pump.
-PBOC-BE. Plunger pump.
-PBOC-VA. Vane pump.

AVAILABLE VERSIONS

Offered in this catalogue:

- PBOC. Computer Controlled Multipump Testing Bench.

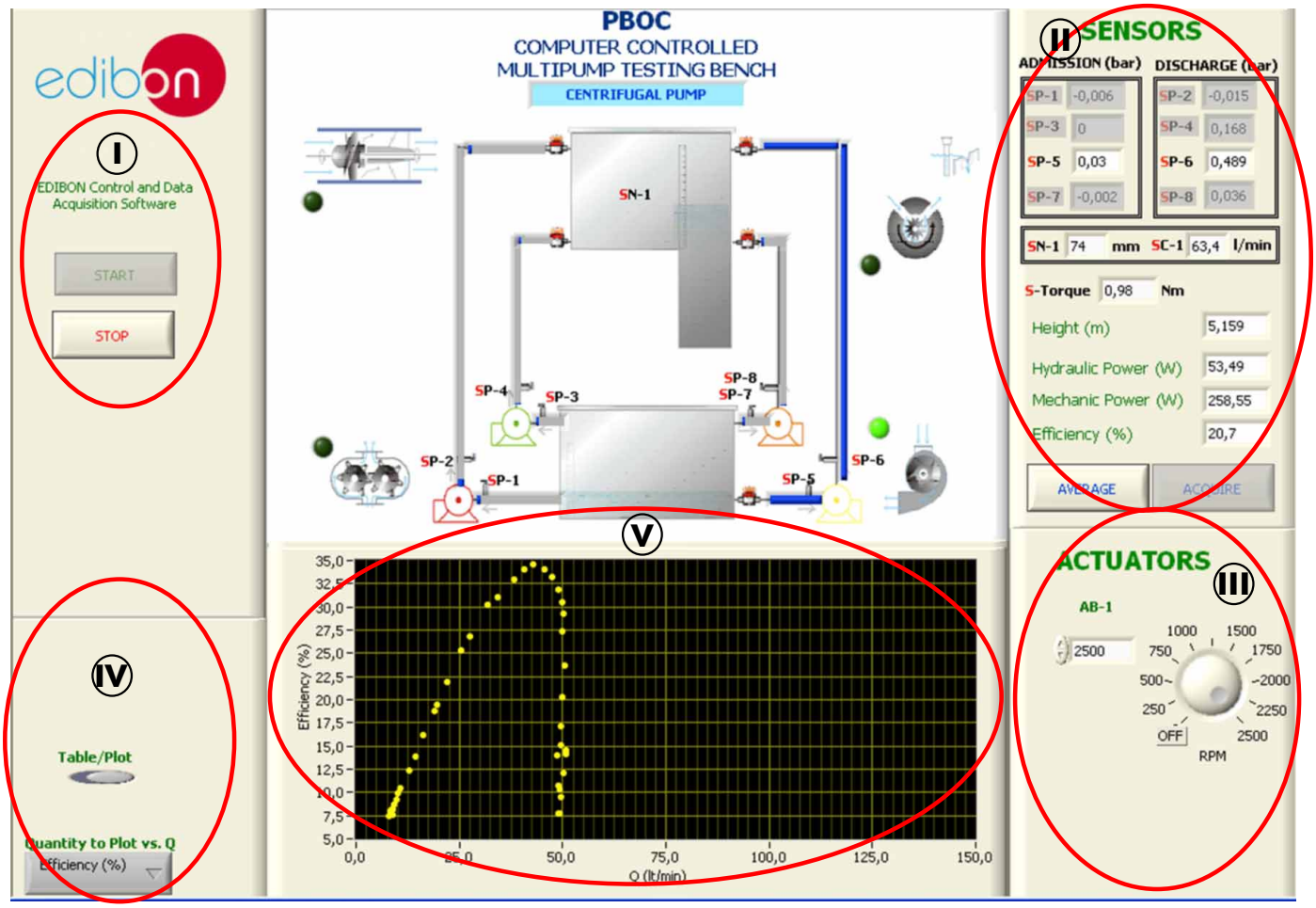
Offered in other catalogue:

- PB2C. Computer Controlled Multipump Testing Bench.

SCADA

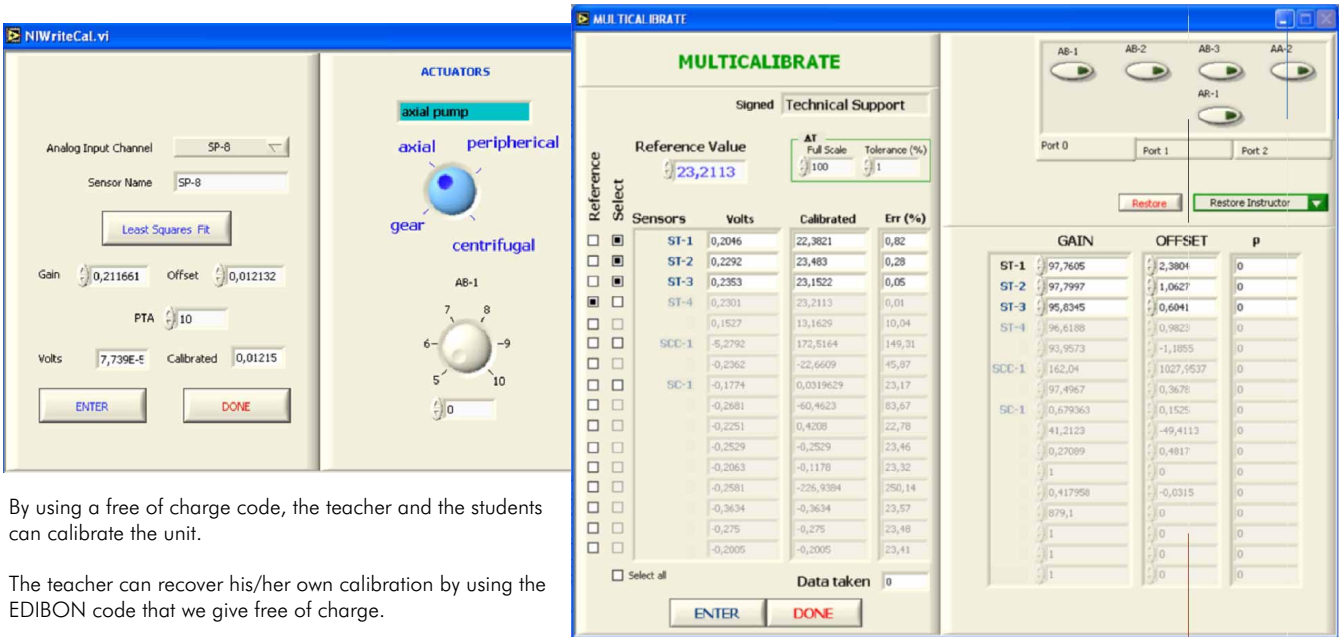
Main screen

Main screen of the "PBOC" computer control software.
The water circuit is shown depending on the pump selected in the interface.
All the sensors and calculations are shown on the upper right side. Eight pressure sensors are shown, corresponding to the inlet and outlet of each pump. Depending on the pump selected, we will have the sensors enabled or not.
We have an actuator, which works on the selected pump.
Data can be represented in a table or in a graph. Data aquisition can be made point by point, after changing the pressure conditions. In order to minimize measurement oscillations, we can average the data before taking the resultant point.



(I) Main Controls.
(II) **Sensors displays and extra output parameters. Sensors:** SP=Pressure sensor. SN=Level sensor. SC=Flow sensor.
(III) **Actuators controls. Actuators:** AB=Pump.
(IV) Channel selection and other plot parameters.
(V) Graphical Display.

Software for Sensors Calibration

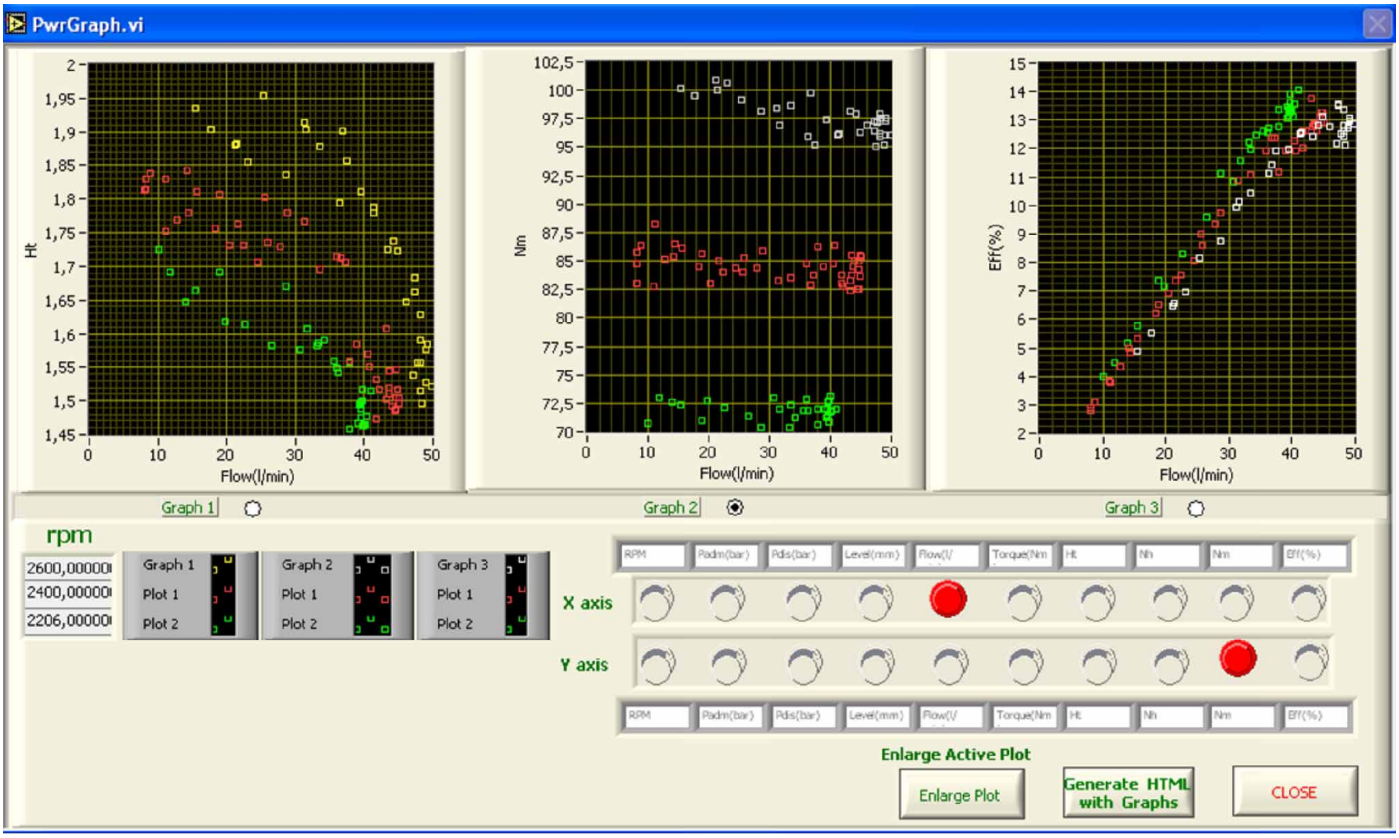


By using a free of charge code, the teacher and the students can calibrate the unit.

The teacher can recover his/her own calibration by using the EDIBON code that we give free of charge.

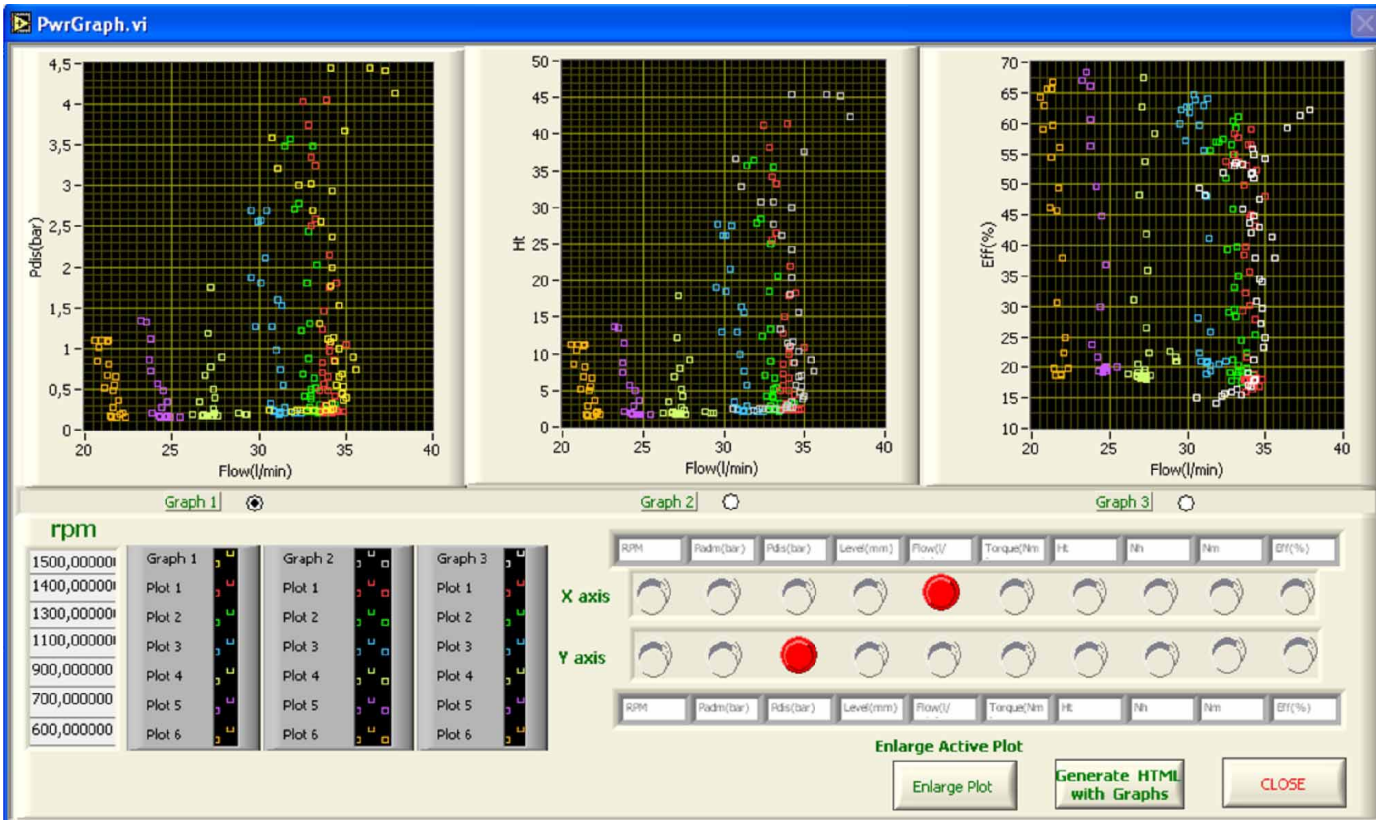
Axial pump

Data representation of the **axial pump** after making an experiment. Height pumped, mechanic power and efficiency are shown in the graphs, for different pump speeds. As it is expected, axial pumps are not able to pump water reaching big heights.



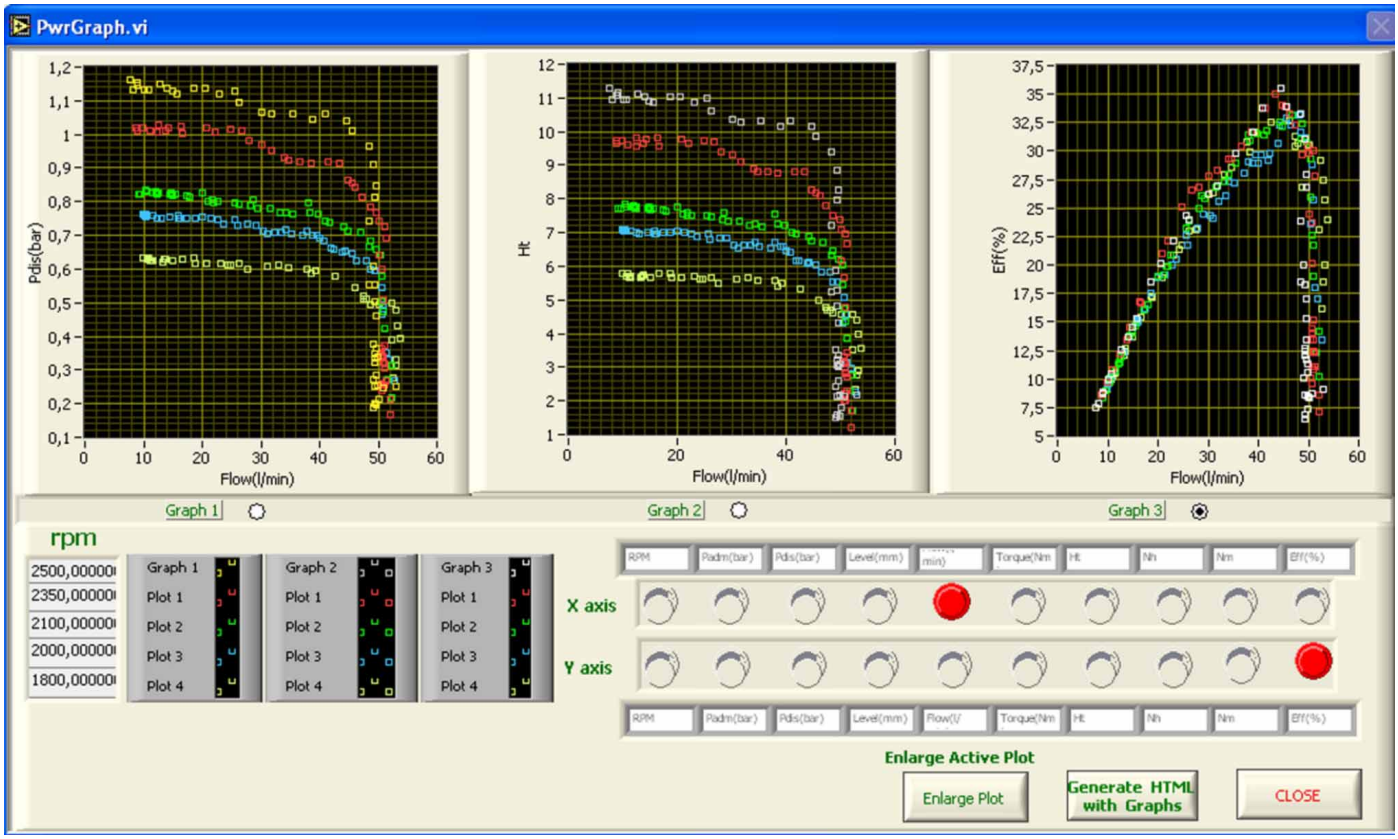
Gear pump

Data representation of the **gear pump** after making an experiment. Discharge pressure, height and efficiency are shown in the graphs, for different pump speeds. As we can see, when outlet valve is closing, discharge pressure and height increase in a linear way. The gear pump gives high discharge pressure values, as it was expected.



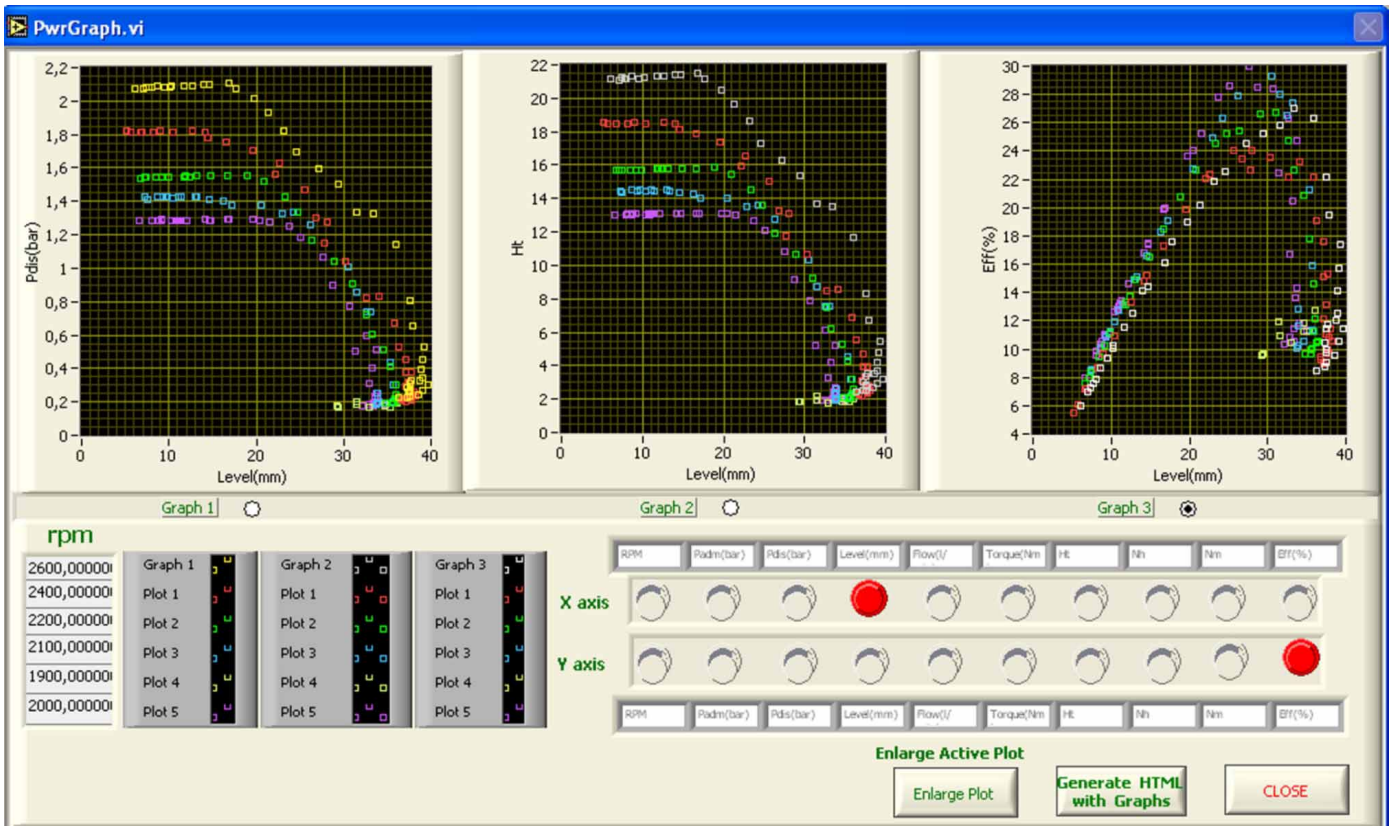
Centrifugal pump

Data representation of the **centrifugal pump** after making an experiment. Discharge pressure, height and efficiency are shown in the graphs, for different pump speeds. As we can see, a typical pump map is obtained, reaching the higher pressure given by the pump.With flows similar to axial, centrifugal is able to give a higher pressure than axial.



Peripherical pump

Data representation of the **peripherical pump** after making an experiment. Discharge pressure, height and efficiency are shown in the graphs, for different pump speeds. As we can see, a typical pump map is obtained, reaching the higher pressure given by the pump. Althouhg it can pump water to higher heights than the centrifugal one, it is not able to move flows as bigger as the centrifugal does.



COMPLETE TECHNICAL SPECIFICATIONS (for optional items)

Additionally to the main items (1 to 6) described, we can offer, as optional, other items from 7 to 12.
All these items try to give more possibilities for:

a) Industrial configuration. (PLC)
b) Technical and Vocational Education configuration. (CAI and FSS)
c) Higher Education and/or Technical and Vocational Education configuration. (CAL)
d) Multipost Expansions options. (Mini ESN and ESN)

a) Industrial configuration

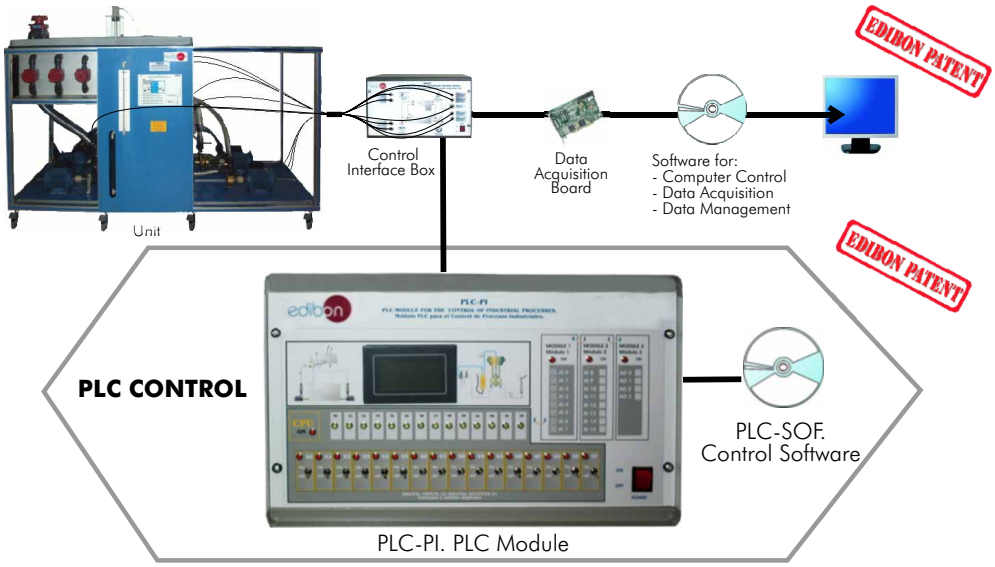
⑦ PLC. Industrial Control using PLC (it includes PLC-PI Module plus PLC-SOF Control Software):

-**PLC-PI. PLC Module:**

Metallic box.
Circuit diagram in the module front panel.
Front panel:
Digital inputs(X) and Digital outputs (Y) block:
16 Digital inputs, activated by switches and 16 LEDs for confirmation (red).
14 Digital outputs (through SCSI connector) with 14 LEDs for message (green).
Analog inputs block:
16 Analog inputs (-10 V. to + 10 V.) (through SCSI connector).
Analog outputs block:
4 Analog outputs (-10 V. to + 10 V.) (through SCSI connector).
Touch screen:
High visibility and multiple functions. Display of a highly visible status. Recipe function. Bar graph function. Flow display function. Alarm list. Multi language function. True type fonts.
Back panel:
Power supply connector. Fuse 2A. RS-232 connector to PC. USB 2.0 connector to PC.
Inside:
Power supply outputs: 24 Vdc, 12 Vdc, -12 Vdc, 12 Vdc variable.
Panasonic PLC:
High-speed scan of 0.32 µsec. for a basic instruction.
Program capacity of 32 Ksteps, with a sufficient comment area.
Power supply input (100 to 240 V AC).
DC input: 16 (24 V DC).
Relay output: 14.
High-speed counter.
Multi-point PID control.
Digital inputs/outputs and analog inputs/outputs Panasonic modules.
Communication RS232 wire to computer (PC).
Dimensions: 490 x 330 x 310 mm. approx. Weight: 30 Kg. approx.

-**PBOC/PLC-SOF. PLC Control Software:**

For this particular unit, always included with PLC supply.
The software has been designed using Labview and it follows the unit operation procedure and linked with the Control Interface Box used in the Computer Controlled Multipump Testing Bench (PBOC).



Practices to be done with PLC-PI:

1.- Control of the PBOC unit process through the control interface box without the computer.
2.- Visualization of all the sensors values used in the PBOC unit process.
3.- Calibration of all sensors included in the PBOC unit process.
4.- Hand on of all the actuators involved in the PBOC unit process.
5.- Realization of different experiments, in automatic way, without having in front the unit. (This experiment can be decided previously).
6.- Simulation of outside actions, in the cases hardware elements do not exist. (Example: test of complementary tanks, complementary industrial environment to the process to be studied, etc).
7.- PLC hardware general use and manipulation.
8.- PLC process application for PBOC unit.
9.- PLC structure.
10.- PLC inputs and outputs configuration.
11.- PLC configuration possibilities.
12.- PLC programming languages.
13.- PLC different programming standard languages.
14.- New configuration and development of new process.
15.- Hand on an established process.
16.- To visualize and see the results and to make comparisons with the PBOC unit process.
17.- Possibility of creating new process in relation with the PBOC unit.
18.- PLC Programming exercises.
19.- Own PLC applications in accordance with teacher and student requirements.

⑧ PBOC/CAI. Computer Aided Instruction Software System.

This complete package included two Softwares: the INS/SOF. Classroom Management Software (Instructor Software) and the PBOC/SOF. Computer Aided Instruction Software (Student Software).

This software is optional and can be used additionally to items (1 to 6).

This complete package consists on an Instructor Software (INS/ SOF) totally integrated with the Student Software (PBOC/SOF). Both are interconnected so that the teacher knows at any moment what is the theoretical and practical knowledge of the students. These, on the other hand, get a virtual instructor who helps them to deal with all the information on the subject of study.

- INS/SOF. Classroom Management Software (Instructor Software):

The Instructor can:

Organize Students by Classes and Groups.

Create easily new entries or delete them.

Create data bases with student information.

Analyze results and make statistical comparisons.

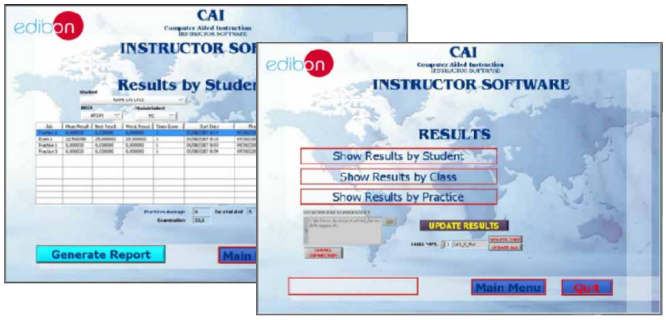
Print reports.

Develop own examinations.

Detect student's progress and difficulties.

...and many other facilities.

Instructor Software



- PBOC/SOF. Computer Aided Instruction Software (Student Software):

It explains how to use the unit, run the experiments and what to do at any moment.

This Software contains:

Theory.

Exercises.

Guided Practices.

Exams.

Student Software

For more information see **CAI** catalogue. Click on the following link:
www.edibon.com/products/catalogues/en/CAI.pdf

⑨ PBOC/FSS. Faults Simulation System.

Faults Simulation System (FSS) is a Software package that simulates several faults in any EDIBON Computer Controlled Unit. It is useful for Technical and Vocational level.

The "FAULTS" mode consists on causing several faults in the unit normal operation. The student must find them and solve them.

There are several kinds of faults that can be grouped in the following sections:

Faults affecting the sensors measurement:

- An incorrect calibration is applied to them.
- Non-linearity.

Faults affecting the actuators:

- Actuators canals interchange at any time during the program execution.
- Response reduction of an actuator.

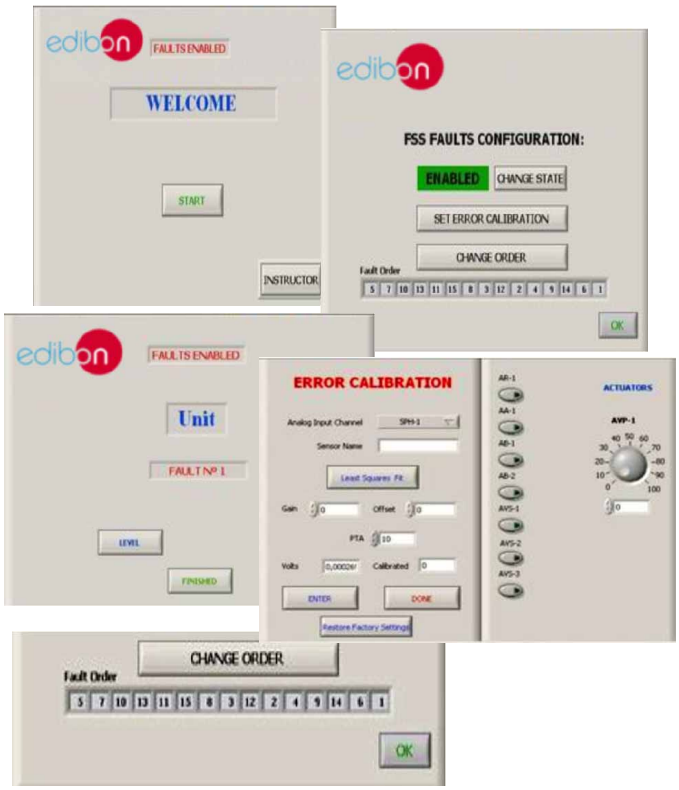
Faults in the controls execution:

- Inversion of the performance in ON/OFF controls.
- Reduction or increase of the calculated total response.
- The action of some controls is annulled.

On/off faults:

- Several on/off faults can be included.

Example of some screens



For more information see **FSS** catalogue. Click on the following link:
www.edibon.com/products/catalogues/en/FSS.pdf

c) Higher Education and/or Technical and Vocational Education configuration

⑩ PBOC/CAL. Computer Aided Learning Software (Results Calculation and Analysis).

This Computer Aided Learning Software (CAL) is a Windows based software, simple and very easy to use, specifically developed by EDIBON. It is very useful for Higher Education level.

CAL is a class assistant that helps in making the necessary calculations to extract the right conclusions from data obtained during the experimental practices.

CAL will perform the calculations.

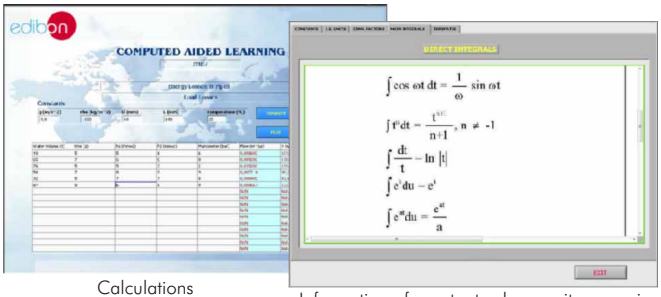
CAL computes the value of all the variables involved.

It allows to plot and print the results. Between the plotting options, any variable can be represented against any other.

Different plotting displays.

It has a wide range of information, such as constant values, unit conversion factors and integral and derivative tables.

For more information see **CAL** catalogue. Click on the following link:
www.edibon.com/products/catalogues/en/CAL.pdf



Calculations

Information of constant values, unit conversion factors and integral and derivative tables

Plotting options

d) Multipost Expansions options

⑪ Mini ESN. EDIBON Mini Scada-Net System.

Mini ESN. EDIBON Mini Scada-Net System allows 30 students to work with a Teaching Unit in any laboratory, simultaneously. It is useful for both, Higher Education and/or Technical and Vocational Education.

The Mini ESN system consists on the adaptation of any EDIBON Computer Controlled Unit with SCADA integrated in a local network.

This system allows to view/control the unit remotely, from any computer integrated in the local net (in the classroom), through the main computer connected to the unit. Then, the number of possible users who can work with the same unit is higher than in an usual way of working (usually only one).

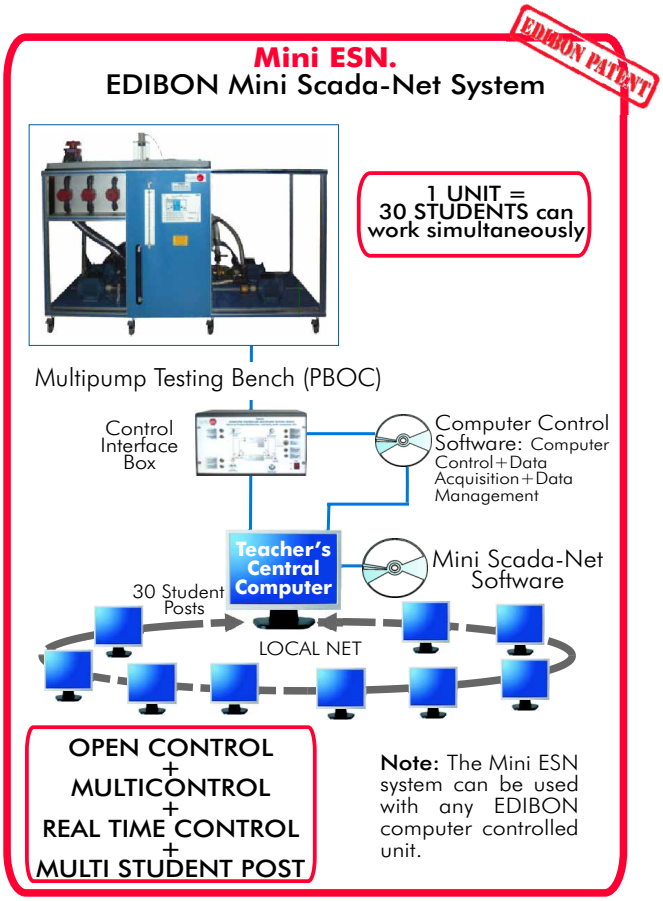
Main characteristics:

- **It allows 30 students to work simultaneously with the EDIBON Computer Controlled Unit with SCADA, connected in a local net.**
- **Open Control + Multicontrol + Real Time Control + Multi Student Post.**
- **Teacher controls and explains to all students at the same time.**
- **Any user/student can work doing "real time" control/multicontrol and visualisation.**
- **The manager/teacher can see in his/her computer what any user/student is doing in the unit.**
- **Continuous communication between the manager and all the users/students connected.**

Main advantages:

- **It allows an easier a quicker understanding.**
- **This system allows you can safe time and cost.**
- **Future expansions with more EDIBON Units.**

For more information see **Mini ESN** catalogue. Click on the following link:
www.edibon.com/products/catalogues/en/Mini-ESN.pdf



⑫ ESN. EDIBON Scada-Net System.

This unit can be integrated, in future, in a Complete Laboratory with many Units and many Students.

For more information see **ESN** catalogue. Click on the following link:
www.edibon.com/products/catalogues/en/units/fluidmechanicsaerodynamics/esn-fluidmechanics/ESN-FLUID_MECHANICS.pdf

ORDER INFORMATION

Main items (always included in the supply)

Minimum supply always includes:

① **Unit: PBOC. Multipump Testing Bench.**

② **PBOC/CIB. Control Interface Box.**

③ **DAB. Data Acquisition Board.**

④ **PBOC/CCSOF. Computer Control + Data Acquisition + Data Management Software.**

⑤ **Cables and Accessories**, for normal operation.

⑥ **Manuals.**

* IMPORTANT: Under PBOC we always supply all the elements for immediate running as 1, 2, 3, 4, 5 and 6.

Optional items (supplied under specific order)

a) Industrial configuration

⑦ PLC. Industrial Control using PLC (it includes PLC-PI Module plus PLC-SOF Control Software):

- PCL-PI. PLC Module.
- PBOC/PLC-SOF. PLC Control Software.

b) Technical and Vocational configuration

⑧ PBOC/CAI. Computer Aided Instruction Software System.

⑨ PBOC/FSS. Faults Simulation System.

c) Higher Education and/or Technical and Vocational Education configuration

⑩ PBOC/CAL. Computer Aided Learning Software (Results Calculation and Analysis).

d) Multipost Expansions options

⑪ Mini ESN. EDIBON Mini Scada-Net System.

⑫ ESN. EDIBON Scada-Net System.

① PBOC. Unit:

Unit designed to demonstrate the operating characteristics of different types of pumps.
Anodized aluminium structure and panels in painted steel.
Main metallic elements in stainless steel.
Diagram in the front panel with similar distribution to the elements in the real unit.
Fully instrumented self-contained unit.
It is equipped with four rubber wheels to provide mobility and with brake to immobilize the unit during the practices.
4 Pumps (computer controlled): Centrifugal pump, Axial flow pump, Gear pump and Peripherical pump:
Centrifugal pump: pedestal or of free axis type, with a reinforced runner that works in an extension of the main head and held by a double ball bearing.
- Maximum flow: 50 l/min.
- Maximum height: 11 mwc (meters of water column).
- Efficiency: 35%.

Axial flow pump: with propeller, which works in an acrylic casing with thin interstices between the propeller and the casing.
- Maximum flow: 50 l/min.
- Maximum height: 2 mwc (meters of water column).
- Efficiency: 15%.

Gear pump: of positive displacement, with casing of a melted piece and two rotors in form of a straight cylindrical gear.
- Maximum flow: 35 l/min.
- Maximum height: 45 mwc (meters of water column).
- Efficiency: 75%.

Peripherical pump: also known as Regenerator or Turbine pump, with an runner of straight blades inside an annular casing and an axis of activation on two lubricated ball bearings.
- Maximum flow: 40 l/min.
- Maximum height: 22 mwc (meters of water column).
- Efficiency: 30%.

Motor for each pump, with independent operating.
Admission pressure sensor and discharge pressure sensor for each pump (8 sensors).
Control software for the direct reading of speed (r.p.m.) and torque (Nm).
Variation of speed by frequency converter, computer control.
Calibrated volumetric tank of 0-10 litres for low flows and of 0-45 litres for high flows.
Flow sensor.
"U" Shape weir.
2 Stilling baffles in the open channel.
Water storage tank, with capacity of 160 litres approx.
Valves for centrifugal , peripherical and gear pumps. Control valve for axial pump.
The complete unit includes as well:
Advanced Real Time SCADA.
Open Control + Multicontrol + Real Time Control.
Own Control Software based on Labview.
National Instruments Data Acquisition board (250 KS/s (kilo samples per second)).
Calibration exercises included.
Students multipost (an entire class) by using a projector.
Ready for doing applied research, real industrial simulation, training courses possibilities, etc.
Unit is totally safe (Mechanical, Electronic/Electrical and Software safety devices included).
Results calculation and analysis software (CAL).
Several future expansions, as ESN. EDIBON Scada-Net System (many students working simultaneously), and more.
Designed and manufactured under several quality standards.

② PBOC/CIB. Control Interface Box:

The Control Interface Box is part of the SCADA system. Control interface box with process diagram in the front panel.
The unit control elements are permanently computer controlled.
Simultaneous visualization in the computer of all parameters involved in the process.
Calibration of all sensors involved in the process.
Real time curves representation about system responses.
All the actuators' values can be changed at any time from the keyboard allowing the analysis about curves and responses of the whole process.
Shield and filtered signals to avoid external interferences.
Real time computer control with flexibility of modifications from the computer keyboard of the parameters, at any moment during the process.
Real time computer control for parameters involved in the process simultaneously.
Open control allowing modifications, at any moment and in real time, of parameters involved in the process simultaneously.
Three safety levels, one mechanical in the unit, another electronic in the control interface and the third one in the control software.

③ DAB. Data Acquisition Board:

The Data Acquisition board is part of the SCADA system.
PCI Data acquisition board (National Instruments) to be placed in a computer slot.
Analog input: Channels= 16 single-ended or 8 differential. Resolution=16 bits, 1 in 65536. Sampling rate up to: 250 KS/s (kilo samples per second).
Analog output: Channels=2. Resolution=16 bits, 1 in 65536.
Digital Input/Output: Channels=24 inputs/outputs.

④ PBOC/CCSOF. Computer Control +Data Acquisition+Data Management Software:

The three softwares are part of the SCADA system.
Compatible with the industry standards.
Flexible, open and multicontrol software, developed with actual windows graphic systems, acting simultaneously on all process parameters.
Management, processing, comparison and storage of data.
Sampling velocity up to 250 KS/s (kilo samples per second).
Calibration system for the sensors involved in the process.
It allows the registration of the alarms state and the graphic representation in real time.
Open software, allowing the teacher to modify texts, instructions. Teacher's and student's passwords to facilitate the teacher's control on the student, and allowing the access to different work levels.
This unit allows the 30 students of the classroom to visualize simultaneously all the results and the manipulation of the unit, during the process, by using a projector or an electronic blackboard.

⑤ Cables and Accessories, for normal operation.

⑥ Manuals: This unit is supplied with 8 manuals: Required Services, Assembly and Installation, Interface and Control Software, Starting-up, Safety, Maintenance, Calibration & Practices Manuals.

Exercises and Practical Possibilities to be done with Main Items

1.- Determination of the flow by a weir of thin wall in U-shape.
2.- Determination of unloading coefficient of a weir of thin wall in aU-shape.
3.- Determination of the curve Q vs r.p.m. for the centrifugal pump.
4.- Determination of the curve Q vs r.p.m. for the peripherical pump.
5.- Determination of the curve Q vs r.p.m. for the gear pump.
6.- Determination of the curve Q vs r.p.m. for the axial pump.
7.- Determination of the curve H vs Q for different r.p.m. for the centrifugal pump.
8.- Determination of the curve H vs Q for different r.p.m. for the peripherical pump.
9.- Determination of the curve H vs Q for different r.p.m. for the gear pump.
10.- Determination of the curve H vs Q for different r.p.m. for the axial pump.
11.- Determination of the mechanical power vs flow for different r.p.m. for the centrifugal pump.
12.- Determination of the mechanical power vs flow for different r.p.m. for the gear pump.
13.- Determination of the mechanical power vs flow for different r.p.m. for the peripherical pump.
14.- Determination of the mechanical power vs flow for different r.p.m. for the axial pump.
15.- Determination of the curve η vs the flow for different r.p.m. for the centrifugal pump.
16.- Determination of the curve η vs the flow for different r.p.m. for the peripherical pump.
17.- Determination of the curve η vs the flow for different r.p.m. for the gear pump.
18.- Determination of the curve η vs the flow for different r.p.m. for the axial pump.
19.- Determination of the map of a centrifugal pump.
20.- Determination of the map of a peripherical pump.
21.- Determination of the map of a gear pump.
22.- Determination of the map of an axial pump.
23.- Determination of the adimenssional characteristic curves for different types of pumps.
24.- Determination of the specific speed of different types of pumps.
25.- Verification of the similarity rules for pumps of different geometry.

Additional practical possibilities:

26.- Sensors calibration.

Other possibilities to be done with this Unit:

27.- Many students view results simultaneously.
To view all results in real time in the classroom by means of a projector or an electronic blackboard.
28.- Open Control, Multicontrol and Real Time Control.
This unit allows intrinsically and/or extrinsically to change the span, gains; proportional, integral, derivate parameters; etc in real time.
29.- The Computer Control System with SCADA allows a real industrial simulation.
30.- This unit is totally safe as uses mechanical, electrical and electronic, and software safety devices.
31.- This unit can be used for doing applied research.
32.- This unit can be used for giving training courses to Industries even to other Technical Education Institutions.
33.- Control of the PBOC unit process through the control interface box without the computer.
34.- Visualization of all the sensors values used in the PBOC unit process.

- By using PLC-PI additional 19 more exercises can be done.
- Several other exercises can be done and designed by the user.

a) Industrial configuration

⑦ PLC. Industrial Control using PLC (it includes PLC-PI Module plus PLC-SOF Control Software):

-**PLC-PI. PLC Module:**

Metallic box.
Circuit diagram in the module front panel.
Digital inputs(X) and Digital outputs (Y) block: 16 Digital inputs. 14 Digital outputs.
Analog inputs block: 16 Analog inputs.
Analog outputs block: 4 Analog outputs.
Touch screen.
Panasonic PLC:
High-speed scan of 0.32 µsec. Program capacity of 32 Ksteps. High-speed counter. Multi-point PID control.
Digital inputs/outputs and analog inputs/outputs Panasonic modules.

-**PBOC/PLC-SOF. PLC Control Software:**

For this particular unit, always included with PLC supply.

Practices to be done with PLC-PI:

1.- Control of the PBOC unit process through the control interface box without the computer.
2.- Visualization of all the sensors values used in the PBOC unit process.
3.- Calibration of all sensors included in the PBOC unit process.
4.- Hand on of all the actuators involved in the PBOC unit process.
5.- Realization of different experiments, in automatic way, without having in front the unit. (This experiment can be decided previously).
6.- Simulation of outside actions, in the cases hardware elements do not exist. (Example: test of complementary tanks, complementary industrial environment to the process to be studied, etc).
7.- PLC hardware general use and manipulation.
8.- PLC process application for PBOC unit.
9.- PLC structure.
10.- PLC inputs and outputs configuration.
11.- PLC configuration possibilities.
12.- PLC programming languages.
13.- PLC different programming standard languages.
14.- New configuration and development of new process.
15.- Hand on an established process.
16.- To visualize and see the results and to make comparisons with the PBOC unit process.
17.- Possibility of creating new process in relation with the PBOC unit.
18.- PLC Programming exercises.
19.- Own PLC applications in accordance with teacher and student requirements.

b) Technical and Vocational Education configuration

⑧ PBOC/CAI. Computer Aided Instruction Software System.

This complete package consists on an Instructor Software (INS/ SOF) totally integrated with the Student Software (PBOC/SOF).
-INS/SOF. Classroom Management Software (Instructor Software):
The Instructor can:
Organize Students by Classes and Groups.
Create easily new entries or delete them.
Create data bases with student information.
Analyze results and make statistical comparisons.
Print reports.
Develop own examinations.
Detect student's progress and difficulties.
-PBOC/SOF. Computer Aided Instruction Software (Student Software):
It explains how to use the unit, run the experiments and what to do at any moment.
This Software contains:
Theory.
Exercises.
Guided Practices.
Exams.

⑨ PBOC/FSS. Faults Simulation System.

Faults Simulation System (FSS) is a Software package that simulates several faults in any EDIBON Computer Controlled Unit.
The "FAULTS" mode consists on causing several faults in the unit normal operation. The student must find them and solve them.
There are several kinds of faults that can be grouped in the following sections:
Faults affecting the sensors measurement:
- An incorrect calibration is applied to them.
- Non-linearity.

Faults affecting the actuators:
- Actuators canals interchange at any time during the program execution.
- Response reduction of an actuator.

Faults in the controls execution:
- Inversion of the performance in ON/OFF controls.
- Reduction or increase of the calculated total response.
- The action of some controls is annulled.

On/off faults:
- Several on/off faults can be included.

c) Higher Education and/or Technical and Vocational Education configuration

⑩ PBOC/CAL. Computer Aided Learning Software (Results Calculation and Analysis).

This Computer Aided Learning Software (CAL) is a Windows based software, simple and very easy to use.
CAL is a class assistant that helps in making the necessary calculations to extract the right conclusions from data obtained during the experimental practices.
CAL will perform the calculations.
CAL computes the value of all the variables involved.
It allows to plot and print the results. Between the plotting options, any variable can be represented against any other.
Different plotting displays.
It has a wide range of information, such as constant values, unit conversion factors and integral and derivative tables.

d) Multipost Expansions options

⑪ Mini ESN. EDIBON Mini Scada-Net System.

EDIBON Mini Scada-Net System allows 30 students to work with a Teaching Unit in any laboratory, simultaneously.
The Mini ESN system consists on the adaptation of any EDIBON Computer Controlled Unit with SCADA integrated in a local network.
This system allows to view/control the unit remotely, from any computer integrated in the local net (in the classroom), through the main computer connected to the unit.
Main characteristics:

-It allows 30 students to work simultaneously with the EDIBON Computer Controlled Unit with SCADA, connected in a local net.
-Open Control + Multicontrol + Real Time Control + Multi Student Post.
-Teacher controls and explains to all students at the same time.
-Any user/student can work doing "real time" control/multicontrol and visualisation.
-The manager/teacher can see in his/her computer what any user/student is doing in the unit.
-Continuous communication between the manager and all the users/students connected.

Main advantages:

-It allows an easier a quicker understanding.
-This system allows you can safe time and cost.
-Future expansions with more EDIBON Units.

The system basically will consist of:
This system can be used with Computer Controlled Unit.

-Manager/Teacher computer.
-Computers in a local net.
-Mini SCADA-NET system (Manager/Instructor Software + User/Student Software + Unit Software adaptation + Unit-Control Interface adaptation + Webcam + cables and accessories required for a normal operation).

✱Specifications subject to change without previous notice, due to the convenience of improvements of the product.

REPRESENTATIVE:

C/ Del Agua, 14. Polígono Industrial San José de Valderas.
28918 LEGANÉS. (Madrid). SPAIN.
Phone: 34-91-6199363 FAX: 34-91-6198647
E-mail: edibon@edibon.com WEB site: **www.edibon.com**

Issue: ED01/11
Date: December/2011