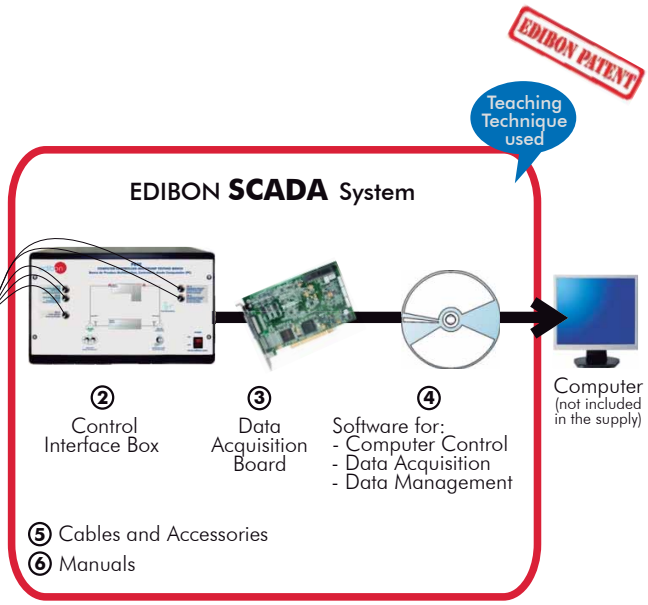
edibon
Technical Teaching Equipment

Computer Controlled **Multipump Testing Bench**
(2 types of pumps), with SCADA

PB2C



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

① Unit: PB2C. Multipump Testing Bench

OPEN CONTROL
+
MULTICONTROL
+
REAL TIME CONTROL

Key features:

- **Advanced Real-Time SCADA.**
- **Open Control + Multicontrol + Real-Time Control.**
- **Specialized EDIBON Control Software based on Labview.**
- **National Instruments Data Acquisition board (250 KS/s , kilo samples per second).**
- **Calibration exercises, which are included, teach the user how to calibrate a sensor and the importance of checking the accuracy of the sensors before taking measurements.**
- **Projector and/or electronic whiteboard compatibility allows the unit to be explained and demonstrated to an entire class at one time.**
- **Capable of doing applied research, real industrial simulation, training courses, etc.**
- **Remote operation and control by the user and remote control for EDIBON technical support, are always included.**
- **Totally safe, utilizing 4 safety systems (Mechanical, Electrical, Electronic & Software).**
- **Designed and manufactured under several quality standards.**
- **Optional CAL software helps the user perform calculations and comprehend the results.**
- **This unit has been designed for future expansion and integration. A common expansion is the EDIBON Scada-Net (ESN) System which enables multiple students to simultaneously operate many units in a network.**

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

For more information about Key Features, click here:

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 (PB2C) allows the students to study the operating characteristics of the centrifugal and gear pumps. It allows to control and to measure the most representative parameters of the pumps.

The measurements that can be taken using the unit are: admission and discharge pressure of the pump, impelled water flow, torque and turning speed of the pump and it can determine the manometric height, the hydraulic and mechanic power and the efficiency.

The unit is mounted on a structure with a working surface covered by a plastic sheet. Two different parts can be distinguished in the unit: the pumps, with their motors, connections and flexible hoses and the tanks to store and recycle water, with their measuring elements.

The minimum supply includes two types of pumps: one centrifugal pump and one gear pump. There are several optional pumps (not included in the minimum supply) that can be connected to the unit through valves and flexible hoses in order to demonstrate the operating behaviour of these pumps.

Each pump is activated by a separate motor which allows the direct measurement of the torque. The speed is changed by a frequency converter, located in the control interface box, and computer controlled.

The pump under study impels water in a closed circuit. There are two pressure tappings in each pump, one at the admission and other at the discharge of the pump, to determine the manometric head of the different pumps. These tappings are connected to their corresponding pressure sensor.

The pumps included in the minimum supply are connected through flexible hoses to the volumetric tank and to the storage tank. The connection of the optional pumps to the volumetric tank and the storage tank are done through valves, connections and flexible hoses.

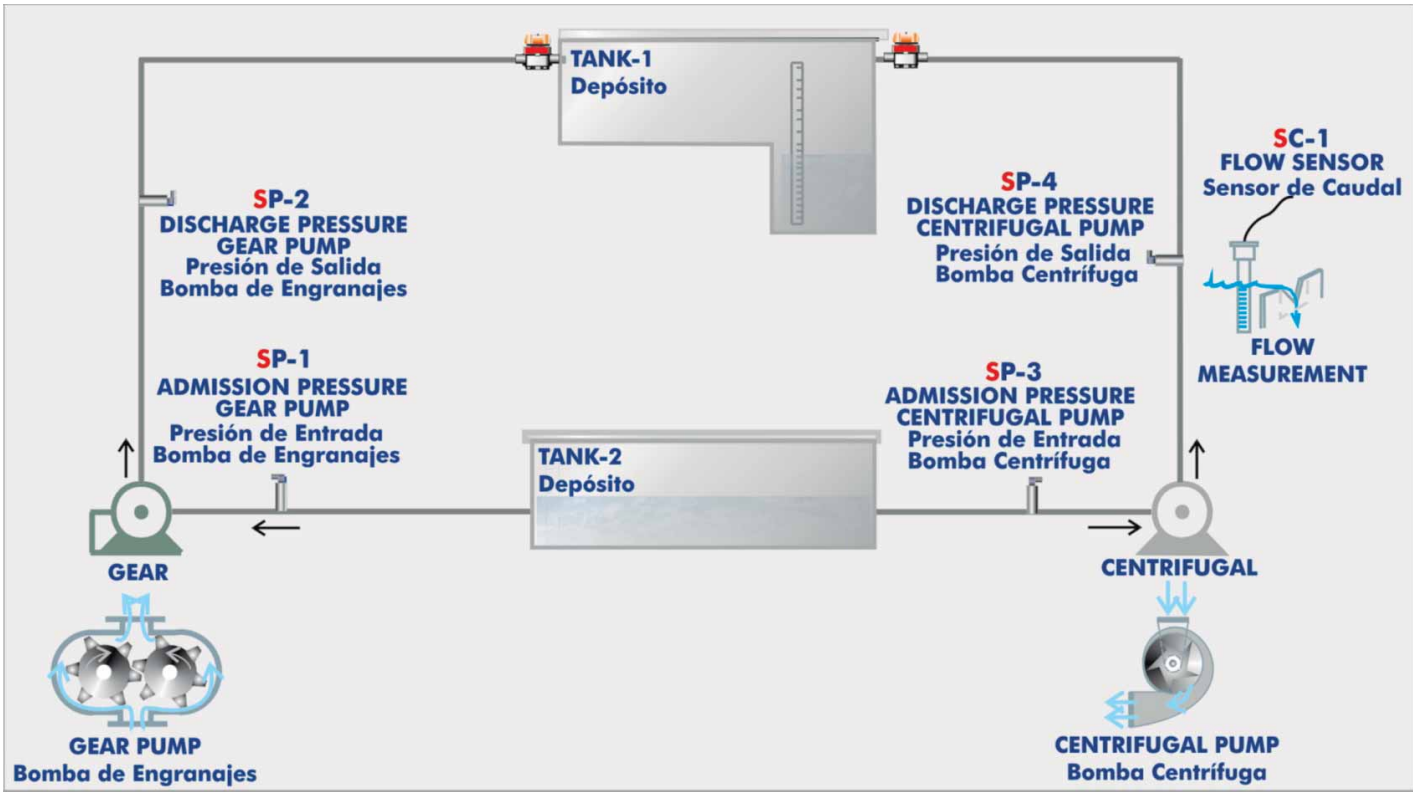
The unit includes two tanks, located at different levels, to recycle the water. The upper volumetric tank, located just over the water storage tank, is equipped with two weirs and two stilling baffles and includes a discharge valve and an activator.

The volumetric tank has been designed to accommodate low or high flows and it includes a level sensor to determine the water flow and the water level in the volumetric tank, an indicating transparent tube and a graduated scale. It has a safety overflow system that directly pours water into the storage tank if an incorrect use is made. The storage tank includes an indicating transparent tube.

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, Data Acquisition and Data Management 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 PB2C. Unit:

Unit designed to demonstrate the operating characteristics of the centrifugal and gear 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.

The unit is mounted on a structure with a work surface covered by a plastic sheet.

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

PB2C. Unit

2 Pumps (computer controlled):

Centrifugal pump: pedestal or of free axis type, made of brass.

- Maximum flow: 80 l./min.
- Maximum height: 20 mwc (meters of water column).
- Efficiency: 35%.

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%.

Motor for each pump, with independent operating.

Variation of speed by frequency converter, located in the control interface box, computer controlled.

There are two pressure tappings in each pump, one at the admission and other at the discharge of the pump.

Admission pressure sensor and discharge pressure sensor for each pump (4 sensors).

Reading of speed (r.p.m.) and torque (Nm) of the pump. The software can determine the pump manometric height, the hydraulic and mechanic power and the efficiency.

Calibrated volumetric tank of 0-10 l. for low flows and of 0-45 l. for high flows. It includes a level sensor to determine the water flow and the water level in the volumetric tank, an indicating transparent tube and a graduated scale.

Water storage tank, with capacity of 160 l. approx. It includes an indicating transparent tube.

2 "U" Shape weirs.

2 Stilling baffles.

Valves for centrifugal and gear pumps.

The complete unit includes as well:

Advanced Real-Time SCADA.

Open Control + Multicontrol + Real-Time Control.

Specialized EDIBON Control Software based on Labview.

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

Calibration exercises, which are included, teach the user how to calibrate a sensor and the importance of checking the accuracy of the sensors before taking measurements.

Projector and/or electronic whiteboard compatibility allows the unit to be explained and demonstrated to an entire class at one time.

Capable of doing applied research, real industrial simulation, training courses, etc.

Remote operation and control by the user and remote control for EDIBON technical support, are always included.

Totally safe, utilizing 4 safety systems (Mechanical, Electrical, Electronic & Software).

Designed and manufactured under several quality standards.

Optional CAL software helps the user perform calculations and comprehend the results.

This unit has been designed for future expansion and integration. A common expansion is the EDIBON Scada-Net (ESN) System which enables multiple students to simultaneously operate many units in a network.

Optional Pumps: (NOT included in the minimum supply). See section "Optional Pumps" in page 5.

-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.

② PB2C/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.

PB2C/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 Express Data acquisition board (National Instruments) to be placed in a computer slot. Bus PCI Express.

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: 900 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 100 MHz.

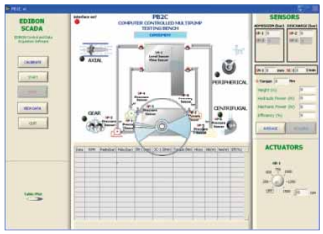
Timing: **Counter/timers=4**. Resolution: Counter/timers: 32 bits.

④ PB2C/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.



PB2C/CCSOF

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.

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 whiteboard.

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: PB2C + PB2C/CIB + DAB + PB2C/CCSOF + Cables and Accessories + Manuals are included in the minimum supply for enabling normal and full operation.

Optional Pumps

All the optional pumps are mounted on a structure with wheels to facilitate its movement. They include the required connections and hoses to connect them to the PB2C unit, and the pressure tappings to measure the admission and discharge pressure of the pumps.
The connection of the pumps to the PB2C unit allows the measurement of impelled water flow, torque and turning speed of the pump. Besides, the pump manometric heights, hydraulic and mechanic power and efficiency can be determined.

-PBOC-2BC. Second Centrifugal pump, and including the additional valves required to perform a Series/Parallel pump demonstration.

Maximum flow of 80 l./min at a maximum height (approx.) of 20 m.w.c. (metres of water column).

-PBOC-BIF. Flexible impeller pump.

Maximum flow of 66 l./min. at a maximum pressure of 2 bar.

-PBOC-BD. Diaphragm pump.

Maximum flow of 8.3 l./min. at a maximum pressure of 3 bar.

-PBOC-BE. Plunger pump.

Maximum flow of 10.6 l./min. at a maximum pressure of 25 bar.

-PBOC-VA. Vane pump.

Maximum flow of 9 l./min. at a maximum pressure of 1 bar.

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 the discharge coefficient of a weir of thin wall in U-shape.

3.- Determination of the curve Q vs r.p.m. of the centrifugal pump.

4.- Determination of the curve Q vs r.p.m. of the gear pump.

5.- Determination of the curve H vs Q for different r.p.m. of the centrifugal pump.

6.- Determination of the curve H vs Q for different r.p.m. of the gear pump.

7.- Determination of the mechanical power vs flow for different r.p.m. of the centrifugal pump.

8.- Determination of the mechanical power vs flow for different r.p.m. of the gear pump.

9.- Determination of the curve η vs the flow for different r.p.m. of the centrifugal pump.

10.- Determination of the curve η vs the flow for different r.p.m. of the gear pump.

11.- Determination of the map of a centrifugal pump.

12.- Determination of the map of a gear pump.

13.- Determination of the adimensional characteristic curves for the different type of pumps.

14.- Determination of the specific speed of the different pumps.

15.- Verification of the similarity rules for pumps of different geometry.

Additional practical possibilities:

16.- Sensors calibration.

Additional practical possibilities to be done with the Optional Pumps:

Second Centrifugal pump, and including the additional valves required to perform a Series/Parallel pump demonstration (PBOC-2BC):

17.- Coupling in series of two centrifugal pumps of different characteristics.

18.- Coupling in series of two centrifugal pumps with the same characteristics.

19.- Parallel coupling of two centrifugal pumps with similar characteristics.

20.- Parallel coupling of two centrifugal pumps of different characteristics.

Flexible impeller pump (PBOC-BIF):

21.- Determination of the curve Q vs r.p.m. of the flexible impeller pump.

22.- Determination of the curve H vs Q for different r.p.m. of the flexible impeller pump.

23.- Determination of the mechanical power vs flow for different r.p.m. of the flexible impeller pump.

24.- Determination of the curve η vs the flow for different r.p.m. of the flexible impeller pump.

25.- Determination of the map of a flexible impeller pump.

Diaphragm pump (PBOC-BD):

26.- Determination of the curve Q vs r.p.m. of the diaphragm pump.

27.- Determination of the curve H vs Q for different r.p.m. of the diaphragm pump.

28.- Determination of the mechanical power vs flow for different r.p.m. of the diaphragm pump.

29.- Determination of the curve η vs the flow for different r.p.m. of the diaphragm pump.

30.- Determination of the map of a diaphragm pump.

Plunger pump (PBOC-BE):

31.- Determination of the curve Q vs r.p.m. of the plunger pump.

32.- Determination of the curve H vs Q for different r.p.m. of the plunger pump.

33.- Determination of the mechanical power vs flow for different r.p.m. of the plunger pump.

34.- Determination of the curve η vs the flow for different r.p.m. of the plunger pump.

35.- Determination of the map of a plunger pump.

Vane pump (PBOC-VA):

36.- Determination of the curve Q vs r.p.m. of the vane pump.

37.- Determination of the curve H vs Q for different r.p.m. of the vane pump.

38.- Determination of the mechanical power vs flow for different r.p.m. of the vane pump.

39.- Determination of the curve η vs the flow for different r.p.m. of the vane pump.

40.- Determination of the map of a vane pump.

Other possibilities to be done with this Unit:

41.- Many students view results simultaneously.

To view all results in real time in the classroom by means of a projector or an electronic whiteboard.

42.- 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.

43.- The Computer Control System with SCADA allows a real industrial simulation.

44.- This unit is totally safe as uses mechanical, electrical and electronic, and software safety devices.

45.- This unit can be used for doing applied research.

46.- This unit can be used for giving training courses to Industries even to other Technical Education Institutions.

47.- Control of the PB2C unit process through the control interface box without the computer.

48.- Visualization of all the sensors values used in the PB2C 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./60Hz.

-Water supply and drainage.

-Computer (PC).

-Chronometer.

DIMENSIONS & WEIGHTS

PB2C:

Unit:	-Dimensions:	1650 x 800 x 1850 mm. approx. (64.96 x 31.49 x 72.83 inches approx.)
	-Weight:	200 Kg. approx. (441 pounds approx.)
Control-Interface Box:	-Dimensions:	490 x 330 x 310 mm. approx. (19.29 x12.99x12.20 inches approx.)
	-Weight:	10 Kg. approx. (22 pounds 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:

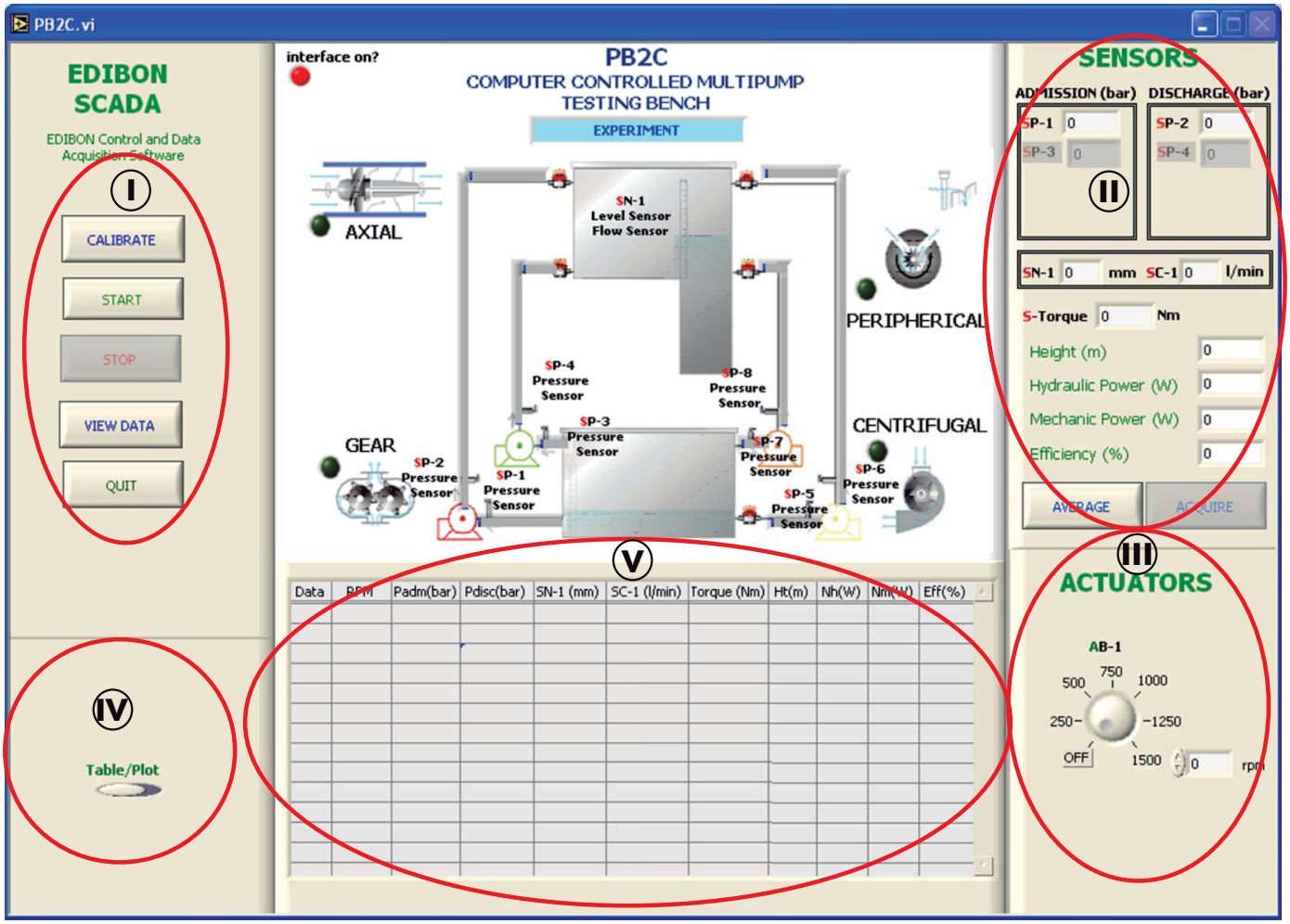
-PB2C. Computer Controlled Multipump Testing Bench (2 types of pumps).

Offered in other catalogue:

-PBOC. Computer Controlled Multipump Testing Bench.

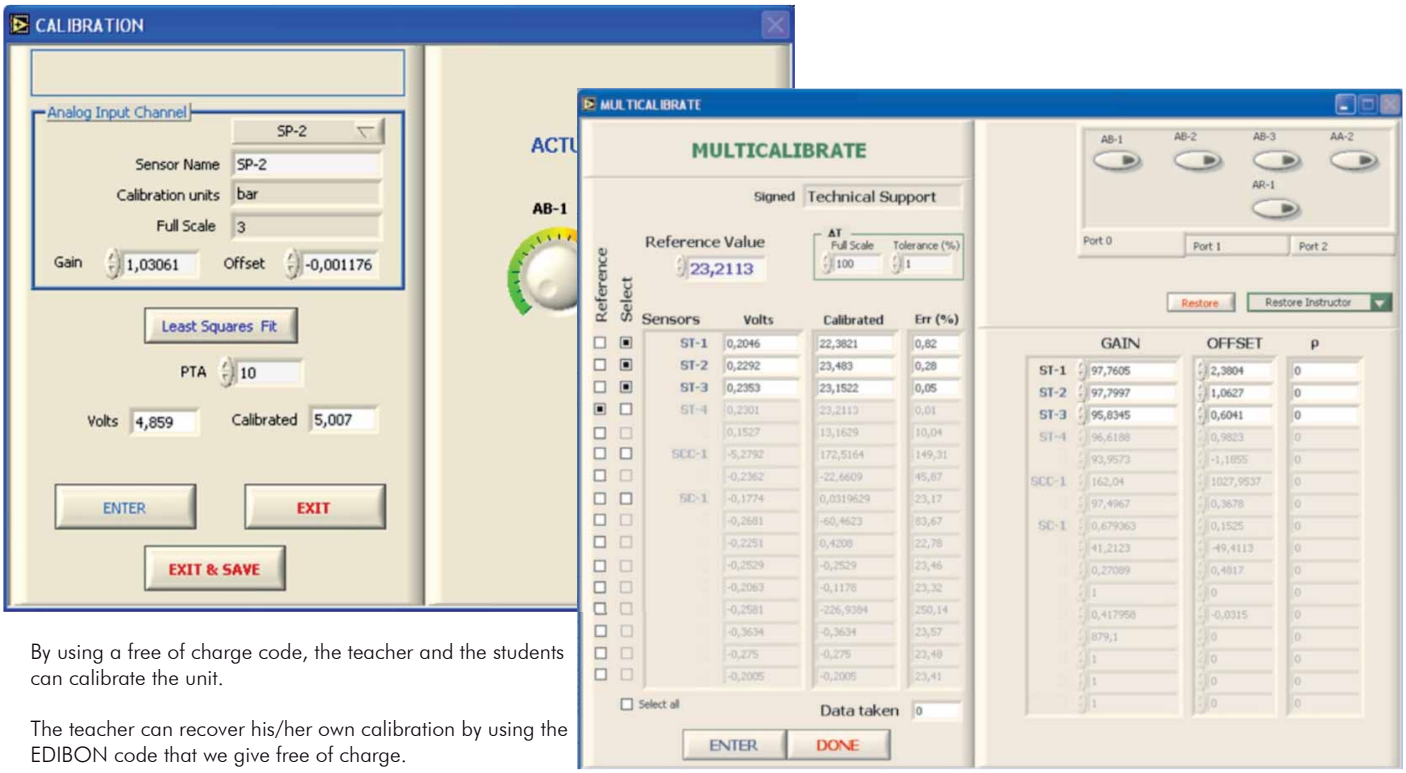
SCADA

Main screen



Ⓘ Main software operation possibilities.
Ⓘ Ⓘ Sensors displays, real time values, and extra output parameters. **Sensors:** SP=Pressure sensor. SC=Flow sensor. SN=Level sensor.
Ⓘ Ⓘ Ⓘ Actuators controls. **Actuators:** AB=Pump.
Ⓥ Channel selection and other plot parameters.
Ⓥ Real time graphics and tables displays.

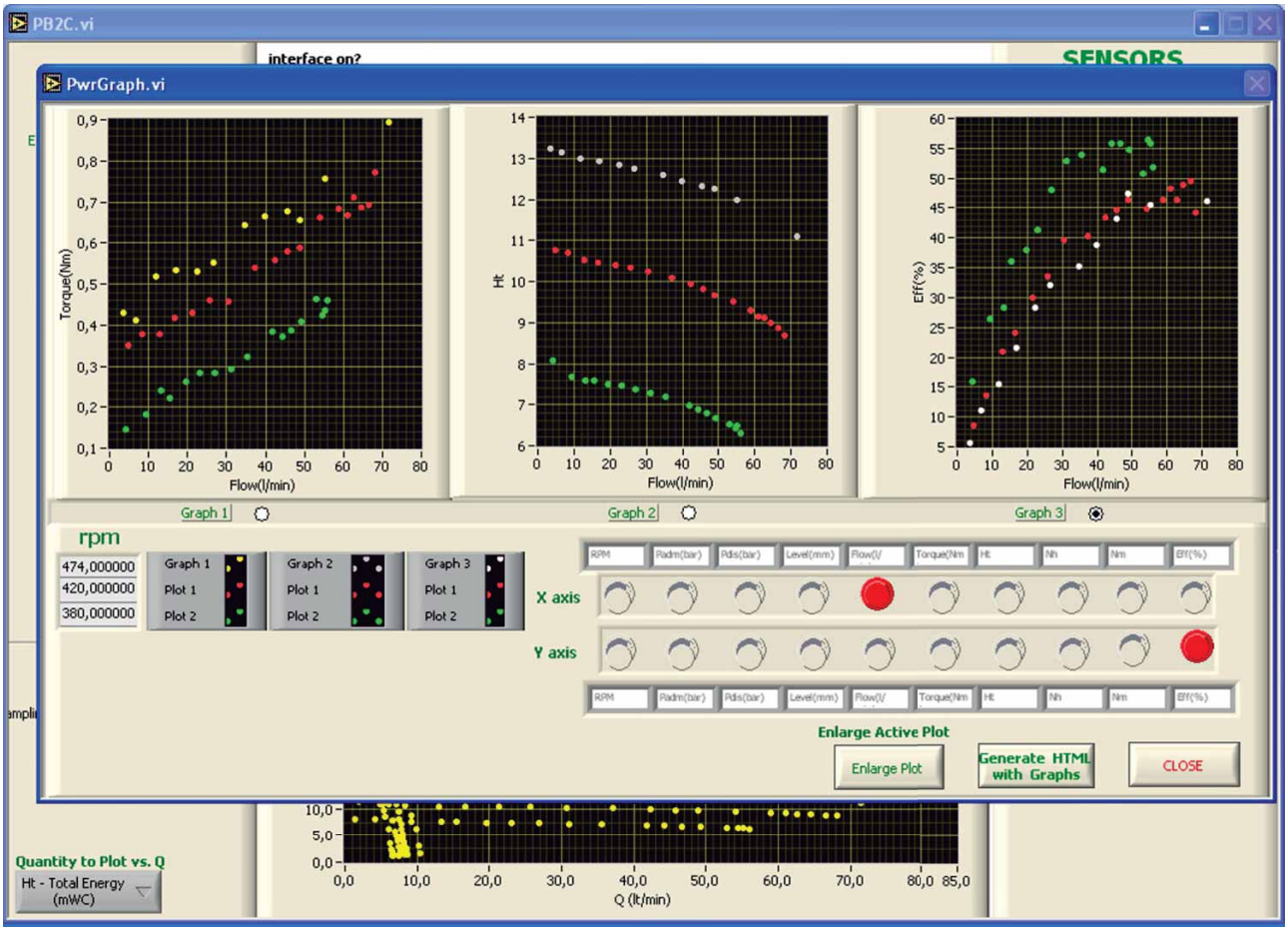
Software for Sensors Calibration



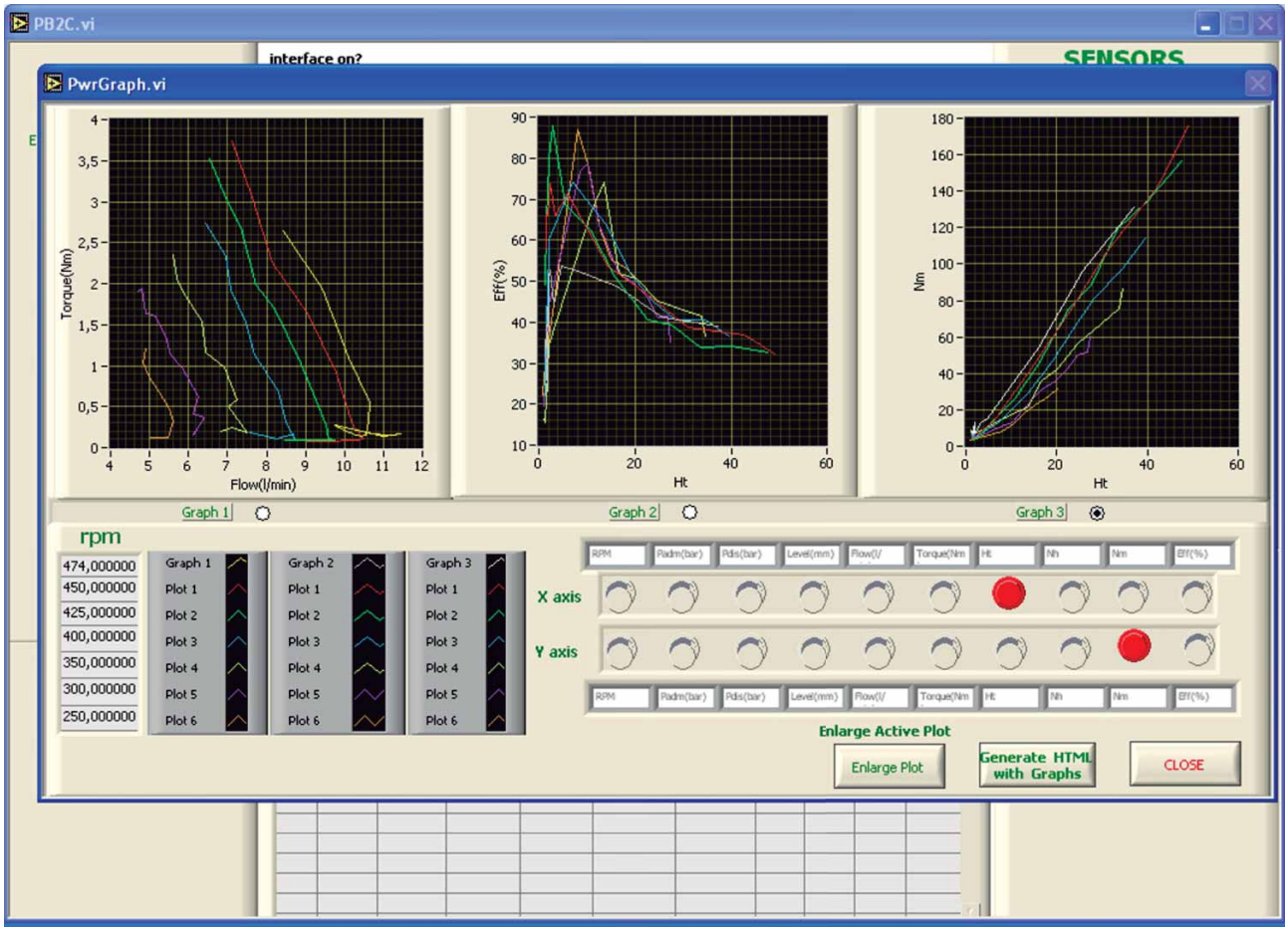
By using a free of charge code, the teacher and the students can calibrate the unit.

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

Data representation of the centrifugal pump after doing an experiment.



Data representation of the gear pump after doing an experiment.



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:

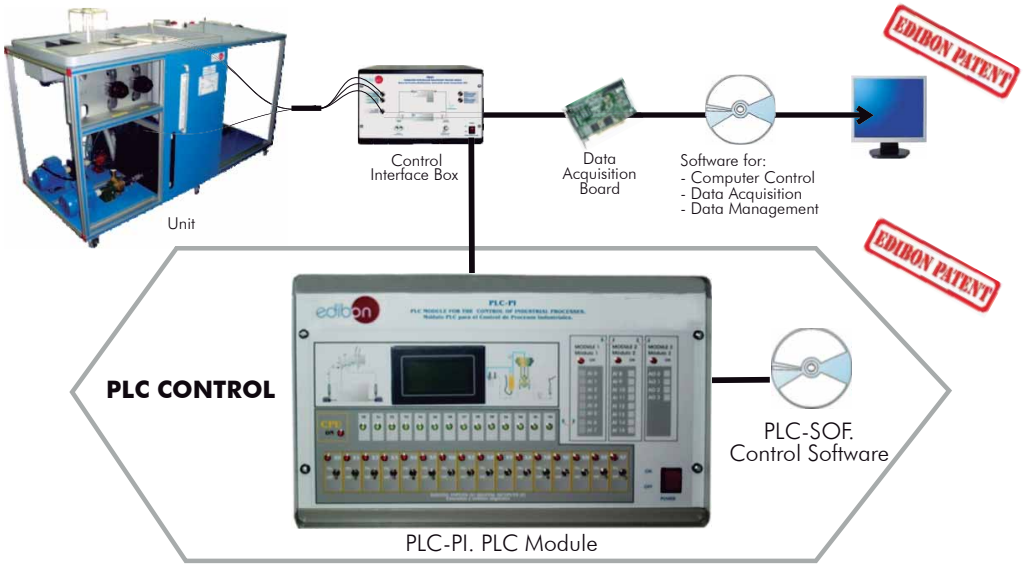
a) Industrial configuration. (PLC)
b) Technical and Vocational Education configuration. (CAI and FSS)
c) Higher Education and/or Technical and Vocational Education configuration. (CAL)
d) Multipost Expansions options. (Mini ESN and ESN)

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. (19.29 x 12.99 x 12.20 inches approx.) Weight: 30 Kg. approx. (66 pounds approx.)

-**PB2C/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 (PB2C).



Practices to be done with PLC-PI:

1.- Control of the PB2C unit process through the control interface box without the computer.
2.- Visualization of all the sensors values used in the PB2C unit process.
3.- Calibration of all sensors included in the PB2C unit process.
4.- Hand on of all the actuators involved in the PB2C 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 PB2C 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 PB2C unit process.
17.- Possibility of creating new process in relation with the PB2C unit.
18.- PLC Programming exercises.
19.- Own PLC applications in accordance with teacher and student requirements.

b) Technical and Vocational Education configuration

⑧ PB2C/CAI. Computer Aided Instruction Software System.

This complete software package includes two Softwares: the INS/SOF. Classroom Management Software (Instructor Software) and the PB2C/SOF. Computer Aided Instruction Software (Student Software).

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

This complete software package consists on an Instructor Software (INS/SOF) totally integrated with the Student Software (PB2C/SOF). Both are interconnected so that the teacher knows at any moment what is the theoretical and practical knowledge of the students.

- 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.

Generate and print reports.

Detect student's progress and difficulties.

...and many other facilities.

Instructor Software

- PB2C/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:

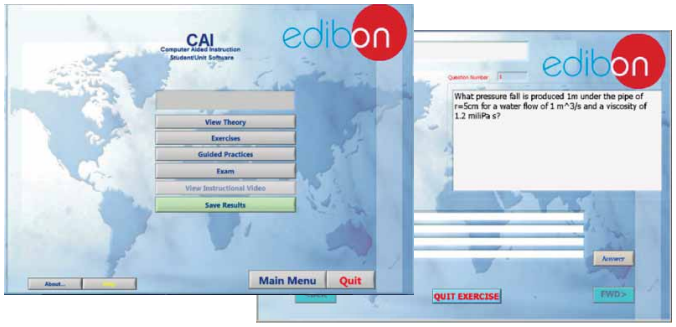
Theory.

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 PB2C/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 channels interchange at any time during the program execution.**
- **Response reduction of an actuator.**

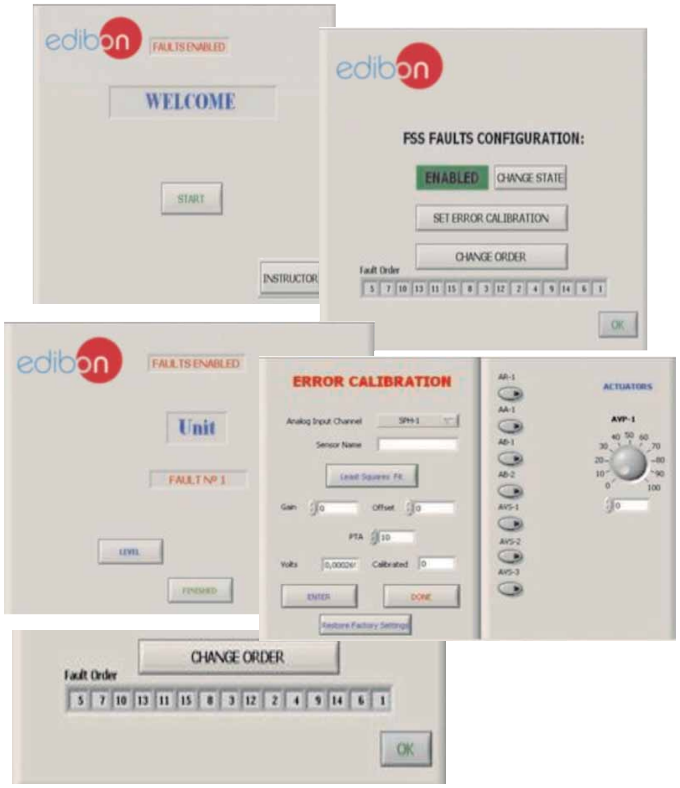
Faults in the controls execution:

- **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 PB2C/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 doing the necessary calculations to extract the right conclusions from data obtained during the experimental practices.

CAL computes the value of all the variables involved and performs the calculations.

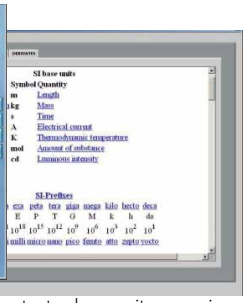
It allows to plot and print the results. Within the plotting options, any variable can be represented against any other.

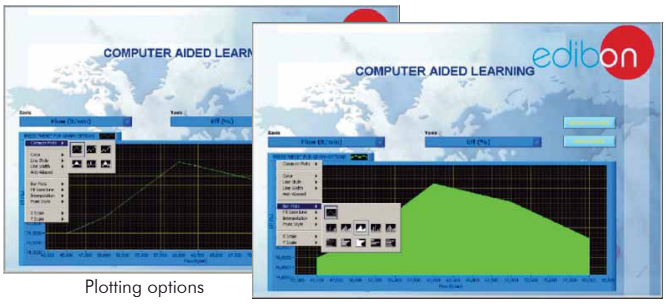
Different plotting displays.

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 up to 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).

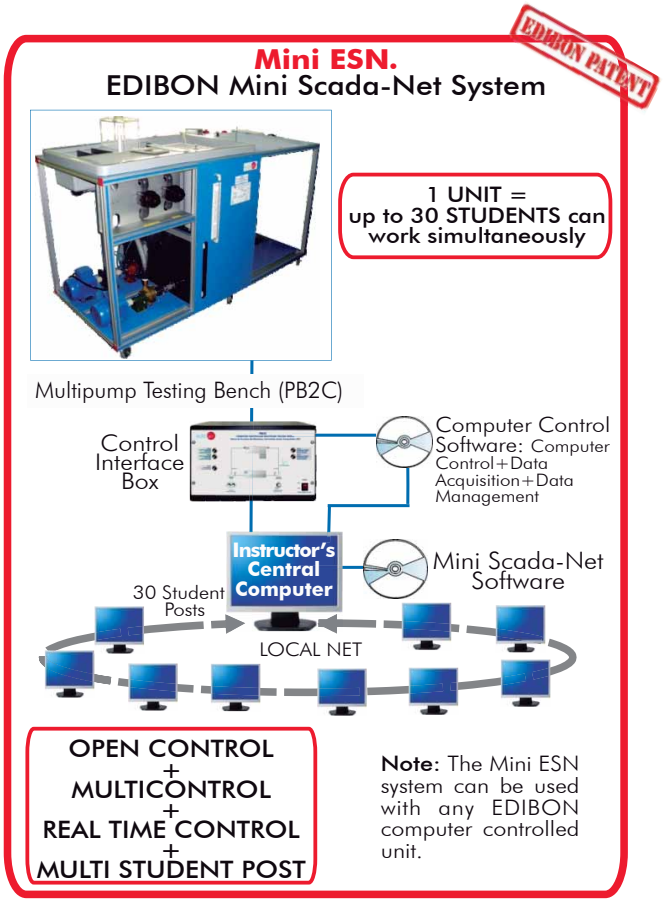
Main characteristics:

- **It allows up to 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.**
- **Instructor controls and explains to all students at the same time.**
- **Any user/student can work doing "real time" control/multicontrol and visualisation.**
- **Instructor can see in the computer what any user/student is doing in the unit.**
- **Continuous communication between the instructor and all the users/ students connected.**

Main advantages:

- **It allows an easier and 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 the future, into 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: PB2C. Multipump Testing Bench.**

② **PB2C/CIB. Control Interface Box.**

③ **DAB. Data Acquisition Board.**

④ **PB2C/CCSOF. Computer Control + Data Acquisition + Data Management Software.**

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

⑥ **Manuals.**

* IMPORTANT: Under PB2C 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.
- PB2C/PLC-SOF. PLC Control Software.

b) Technical and Vocational configuration

⑧ PB2C/CAI. Computer Aided Instruction Software System.

⑨ PB2C/FSS. Faults Simulation System.

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

⑩ PB2C/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 PB2C. Unit:

Unit designed to demonstrate the operating characteristics of the centrifugal and gear 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.
The unit is mounted on a structure with a work surface covered by a plastic sheet.
It is equipped with rubber wheels to provide mobility and with brake to immobilize the unit during the practices.
2 Pumps (computer controlled):
Centrifugal pump: pedestal or of free axis type, made of brass.
- Maximum flow: 80 l./min.
- Maximum height: 20 mwc (meters of water column).
- Efficiency: 35%.

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%.

Motor for each pump, with independent operating.
Variation of speed by frequency converter, located in the control interface box, computer controlled.
There are two pressure tappings in each pump, one at the admission and other at the discharge of the pump.
Admission pressure sensor and discharge pressure sensor for each pump (4 sensors).
Reading of speed (r.p.m.) and torque (Nm) of the pump. The software can determine the pump manometric height, the hydraulic and mechanic power and the efficiency.
Calibrated volumetric tank of 0-10 l. for low flows and of 0-45 l. for high flows. It includes a level sensor to determine the water flow and the water level in the volumetric tank, an indicating transparent tube and a graduated scale.
Water storage tank, with capacity of 160 l. approx. It includes an indicating transparent tube.
2 "U" Shape weirs.
2 Stilling baffles.
Valves for centrifugal and gear pumps.
The complete unit includes as well:
Advanced Real-Time SCADA.
Open Control + Multicontrol + Real-Time Control.
Specialized EDIBON Control Software based on Labview.
National Instruments Data Acquisition board (250 KS/s , kilo samples per second).
Calibration exercises, which are included, teach the user how to calibrate a sensor and the importance of checking the accuracy of the sensors before taking measurements.
Projector and/or electronic whiteboard compatibility allows the unit to be explained and demonstrated to an entire class at one time.
Capable of doing applied research, real industrial simulation, training courses, etc.
Remote operation and control by the user and remote control for EDIBON technical support, are always included.
Totally safe, utilizing 4 safety systems (Mechanical, Electrical, Electronic & Software).
Designed and manufactured under several quality standards.
Optional CAL software helps the user perform calculations and comprehend the results.
This unit has been designed for future expansion and integration. A common expansion is the EDIBON Scada-Net (ESN) System which enables multiple students to simultaneously operate many units in a network.

Optional Pumps: (NOT included in the minimum supply).
-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.

② PB2C/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 Express 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 PB2C/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 whiteboard.

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 the discharge coefficient of a weir of thin wall in U-shape.
3.- Determination of the curve Q vs r.p.m. of the centrifugal pump.
4.- Determination of the curve Q vs r.p.m. of the gear pump.
5.- Determination of the curve H vs Q for different r.p.m. of the centrifugal pump.
6.- Determination of the curve H vs Q for different r.p.m. of the gear pump.
7.- Determination of the mechanical power vs flow for different r.p.m. of the centrifugal pump.
8.- Determination of the mechanical power vs flow for different r.p.m. of the gear pump.
9.- Determination of the curve η vs the flow for different r.p.m. of the centrifugal pump.
10.- Determination of the curve η vs the flow for different r.p.m. of the gear pump.
11.- Determination of the map of a centrifugal pump.
12.- Determination of the map of a gear pump.
13.- Determination of the adimensional characteristic curves for the different type of pumps.
14.- Determination of the specific speed of the different pumps.
15.- Verification of the similarity rules for pumps of different geometry.

Additional practical possibilities:

16.- Sensors calibration.

Additional practical possibilities to be done with the Optional Pumps:

Second Centrifugal pump, and including the additional valves required to perform a Series/Parallel pump demonstration (PBOC-2BC):

17.- Coupling in series of two centrifugal pumps of different characteristics.
18.- Coupling in series of two centrifugal pumps with the same characteristics.
19.- Parallel coupling of two centrifugal pumps with similar characteristics.
20.- Parallel coupling of two centrifugal pumps of different characteristics.

Flexible impeller pump (PBOC-BIF):

21.- Determination of the curve Q vs r.p.m. of the flexible impeller pump.
22.- Determination of the curve H vs Q for different r.p.m. of the flexible impeller pump.
23.- Determination of the mechanical power vs flow for different r.p.m. of the flexible impeller pump.
24.- Determination of the curve η vs the flow for different r.p.m. of the flexible impeller pump.
25.- Determination of the map of a flexible impeller pump.

Diaphragm pump (PBOC-BD):

26.- Determination of the curve Q vs r.p.m. of the diaphragm pump.
27.- Determination of the curve H vs Q for different r.p.m. of the diaphragm pump.
28.- Determination of the mechanical power vs flow for different r.p.m. of the diaphragm pump.
29.- Determination of the curve η vs the flow for different r.p.m. of the diaphragm pump.
30.- Determination of the map of a diaphragm pump.

Plunger pump (PBOC-BE):

31.- Determination of the curve Q vs r.p.m. of the plunger pump.
32.- Determination of the curve H vs Q for different r.p.m. of the plunger pump.
33.- Determination of the mechanical power vs flow for different r.p.m. of the plunger pump.
34.- Determination of the curve η vs the flow for different r.p.m. of the plunger pump.
35.- Determination of the map of a plunger pump.

Vane pump (PBOC-VA):

36.- Determination of the curve Q vs r.p.m. of the vane pump.
37.- Determination of the curve H vs Q for different r.p.m. of the vane pump.
38.- Determination of the mechanical power vs flow for different r.p.m. of the vane pump.
39.- Determination of the curve η vs the flow for different r.p.m. of the vane pump.
40.- Determination of the map of a vane pump.

Other possibilities to be done with this Unit:

41.- Many students view results simultaneously.
To view all results in real time in the classroom by means of a projector or an electronic whiteboard.
42.- 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.
43.- The Computer Control System with SCADA allows a real industrial simulation.
44.- This unit is totally safe as uses mechanical, electrical and electronic, and software safety devices.
45.- This unit can be used for doing applied research.
46.- This unit can be used for giving training courses to Industries even to other Technical Education Institutions.
47.- Control of the PB2C unit process through the control interface box without the computer.
48.- Visualization of all the sensors values used in the PB2C 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.

-**PB2C/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 PB2C unit process through the control interface box without the computer.
2.- Visualization of all the sensors values used in the PB2C unit process.
3.- Calibration of all sensors included in the PB2C unit process.
4.- Hand on of all the actuators involved in the PB2C 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 PB2C 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 PB2C unit process.
17.- Possibility of creating new process in relation with the PB2C unit.
18.- PLC Programming exercises.
19.- Own PLC applications in accordance with teacher and student requirements.

b) Technical and Vocational Education configuration

⑧ PB2C/CAI. Computer Aided Instruction Software System.

This complete software package consists on an Instructor Software (INS/SOF) totally integrated with the Student Software (PB2C/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.
Generate and print reports.
Detect student's progress and difficulties.
-PB2C/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 PB2C/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 channels 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

⑩PB2C/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 doing the necessary calculations to extract the right conclusions from data obtained during the experimental practices.
CAL computes the value of all the variables involved and performs the calculations.
It allows to plot and print the results. Within 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

⑪Mini ESN. EDIBON Mini Scada-Net System.

EDIBON Mini Scada-Net System allows up to 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 up to 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.
-Instructor controls and explains to all students at the same time.
-Any user/student can work doing "real time" control/multicontrol and visualisation.
-Instructor can see in the computer what any user/student is doing in the unit.
-Continuous communication between the instructor and all the users/students connected.

Main advantages:

-It allows an easier and 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 is used with a Computer Controlled Unit.
-Instructor's computer.
-Students' computers.
-Local Network.
-Unit-Control Interface adaptation.
-Unit Software adaptation.
-Webcam.
-Mini ESN Software to control the whole system.
-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: ED01/13
Date: November/2013