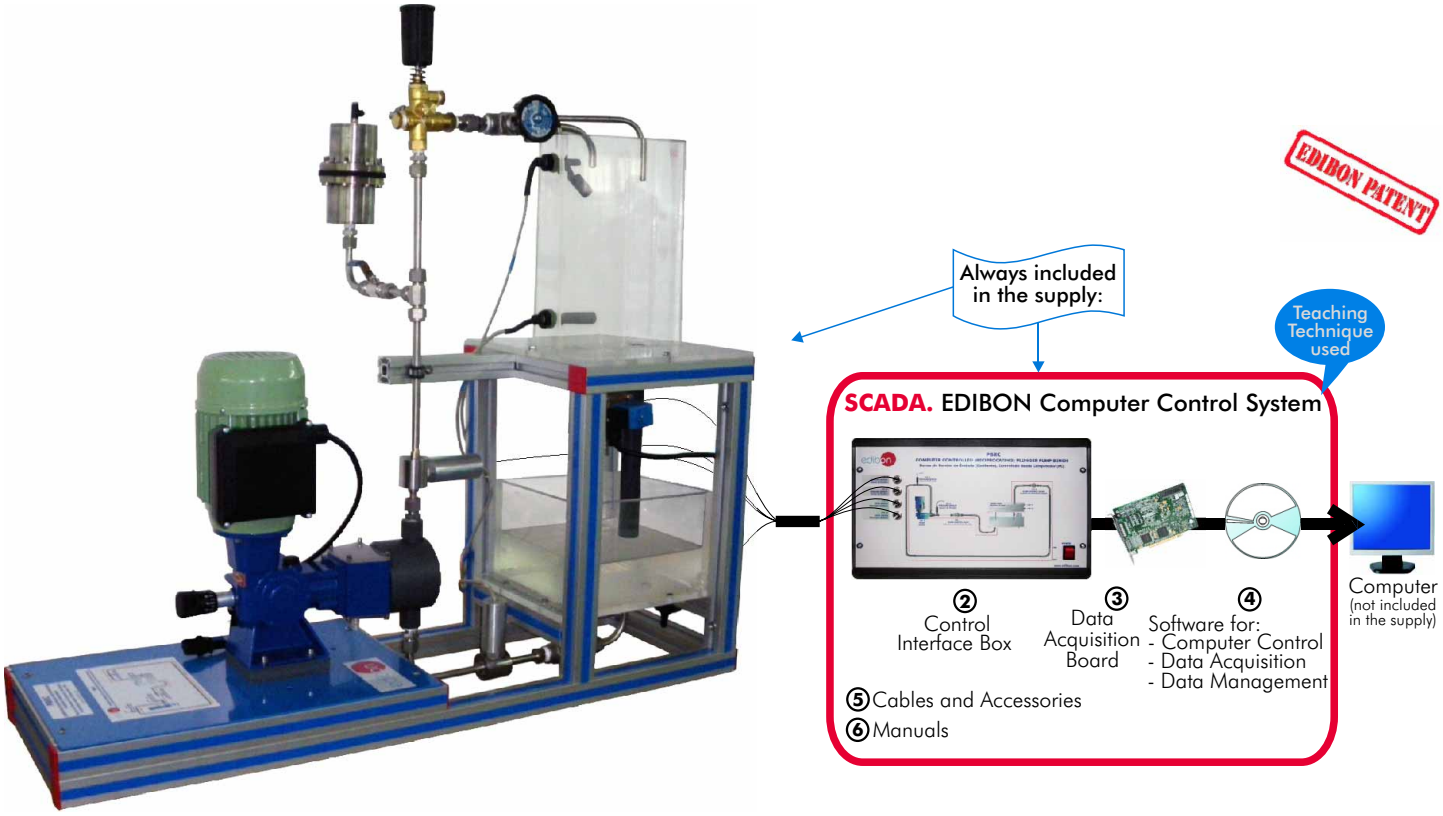
edibon
Technical Teaching Equipment

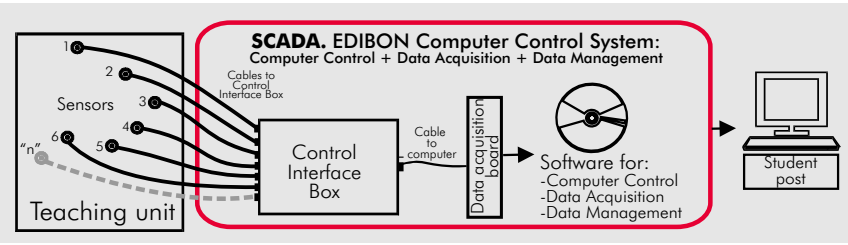
Computer Controlled **Piston Pump Bench**

PBRC



①Unit: PBRC. Piston Pump Bench

OPEN CONTROL
+
MULTICONTROL
+
REAL TIME CONTROL



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DESCRIPTION

The piston pump is a positive displacement pump and is used in dosage applications in order to feed exact small quantities of liquid at different pressures.

"PBRC" is a bench-top unit consists of a feed tank, flow meter tank calibrated for taking flow measurements, circulation pipes, valves at the pump inlet and outlet, as well as the enough control elements for the pump experiments: 2 pressure sensors and two level switches.

A frequency inverter for the pump, computer controlled, provides the possibility of regulation and measuring the pump motor speed, as well as the measurement of the torque transferred.

The pump is installed in a pipes system which avoids the permanent water spending during the operation because it is a closed circuit.

PBRC unit has instrumentation and sensors to allow the measurement, from the computer (PC), of most representative parameters of the piston pump:

- Motor speed (n).
- Pressure in a point next to the pump admission.
- Pressure in a point next to the pump discharge.
- Torque motor (F).
- Total flow driven (Q).

Adjustable parameters, as:

- Motor speed (n) and flow.
- Position of the valve 2 (open/close).

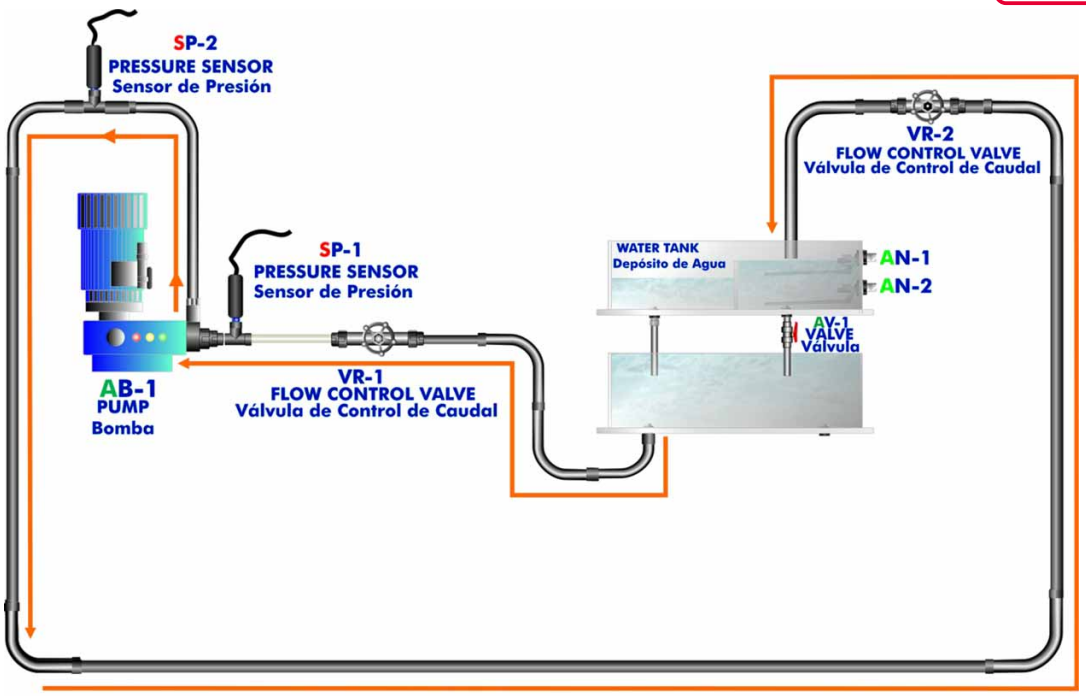
The unit includes the typical items a piston pump should have, such as: relief valve and damping chamber. So one of the most important objetives of this unit is to study the influence that the presence of the damping chamber has.

The reading of the measured magnitudes is carried out in the Computer Control and Data Adquisition Software (SCADA), which is supplied with the unit and allows to control the pump turn velocity, as well as the graphic representation of the pump characteristics.

This Computer Controlled Unit is supplied with the EDIBON Computer Control System (SCADA), including: Control interface Box + Data Acquisition Board + Computer Control and Data Acquisition Software, for controlling the process and the parameters involved.

PROCESS DIAGRAM AND ELEMENTS ALLOCATION

OPEN CONTROL
+
MULTICONTROL
+
REAL TIME CONTROL



Note:

AN= Level switch.

Items supplied as standard

① PBRC. Unit:

Bench top unit.
Anodized aluminium structure and panel in painted steel (epoxy paint).
Main metallic elements in stainless steel.
Diagram in the front panel with similar distribution to the elements in the real unit.
Piston pump, whose main characteristics are:
- Transparent pump head for visibility.
- Flow: 50 l/hour.
- Pressure: 9 bar.
- ∅ Piston: 38 mm.
- Stroke: 12.5 mm.
- Possibility of piston stroke regulation.
- Impulses: 58 impulses/min.

A.C. single-phase motor:
- Power: 0.25 kW.
- Velocity: 1.340 rpm (at 50 Hz).

The pump velocity, adjustable with a frequency inverter, controlled from the computer (PC).
2 Regulation valves to control the process.
2 Pressure sensors of 0-10 bar.
Flow meter tank calibrated for taking flow measurements (upper tank).
Feed tank (lower tank).
2 Level switches to measure the flow, located in the flow meter tank.
Damping chamber.
Solenoid valve, computer controlled, to discharge the flow meter tank (upper tank).
Relief valve.
Pipes and accessories in stainless steel.

PBRC. Unit

② PBRC/CIB. Control Interface Box :

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 its 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.
Simultaneously visualization in the computer of all parameters involved int 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 placed in only one computer screen.
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.
Open control allowing modifications, at any time and in a real time, of parameters involved in the process simultaneously.
Three safety levels, one mechanical in the unit, other electronic in control interface and the third one in the control software.

PBRC/CIB

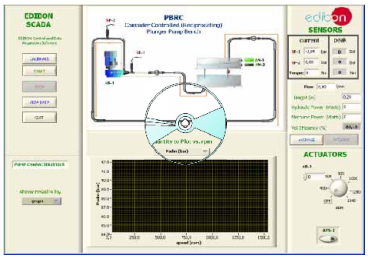
③ DAB. Data Acquisition Board:

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. Number of DMA channels=6.
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: **Counter/timers=2.** Resolution: Counter/timers: 32 bits.

DAB

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

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 simultaneously way.
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 250,000 data per second guaranteed. 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 to 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 at different work levels.
This unit allows that 30 students of the classroom can visualize simultaneously all results and manipulation of the unit, during the process, by using a projector.



PBRC/CCSOF

⑤Cables and Accessories, for normal operation.

⑥Manuals: 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: PBRC + DAB + PBRC/CCSOF + Cables and Accessories + Manuals are included in the minimum supply, enabling a normal operation.

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Complementary items to the standard supply

PLC. Industrial Control using PLC (7 and 8):

⑦PLC-PI. PLC Module:

Circuit diagram in the 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 (-10V. to + 10V.)(through SCSI connector).

Analog outputs block:

4 Analog outputs (-10V. to + 10V) (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.

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.
Free input AC voltage (100 to 240 V AC).
DC input: 16 (24 V DC).
Relay output: 14 (250 V A AC/2 A).
Program capacity: 32 ksteps.
High-speed counter.
Multi-point PID control.

Digital inputs/outputs and analog inputs/outputs Panasonic modules.

Communication RS232 wire, to computer (PC).

PLC-PI

⑧PBRC/PLC-SOF. PLC Control Software:

For this particular unit, always included with PLC supply.

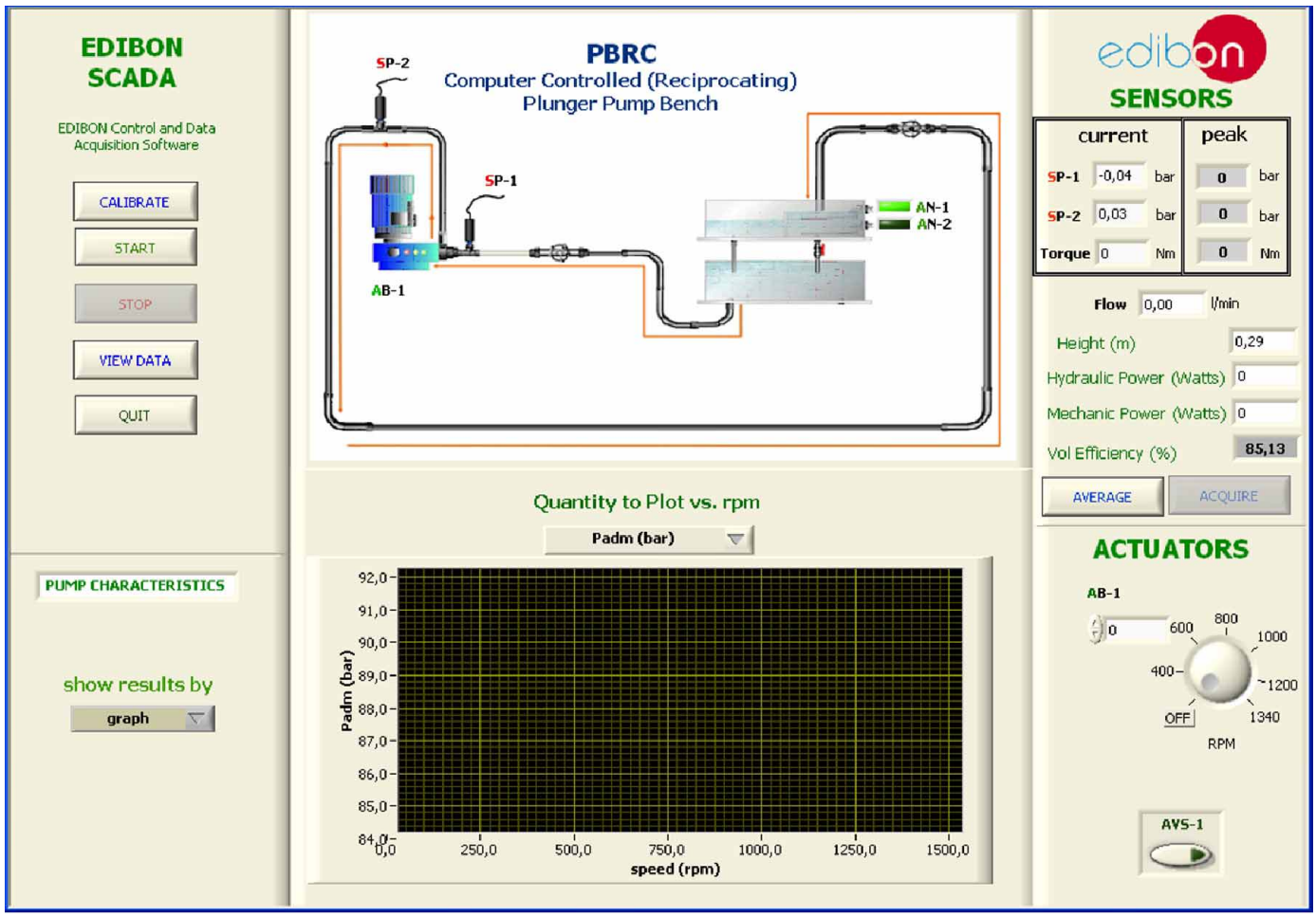
Items available on request

⑨PBRC/CAL. Computer Aided Learning Software (Results Calculation and Analysis).

⑩PBRC/FSS. Faults Simulation System.

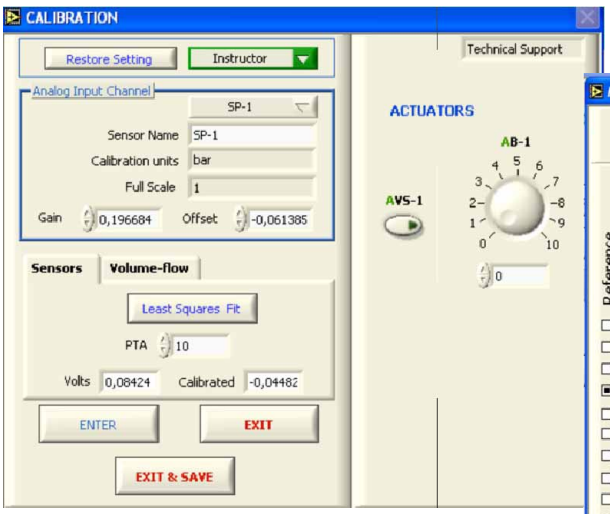
Software Main Screens

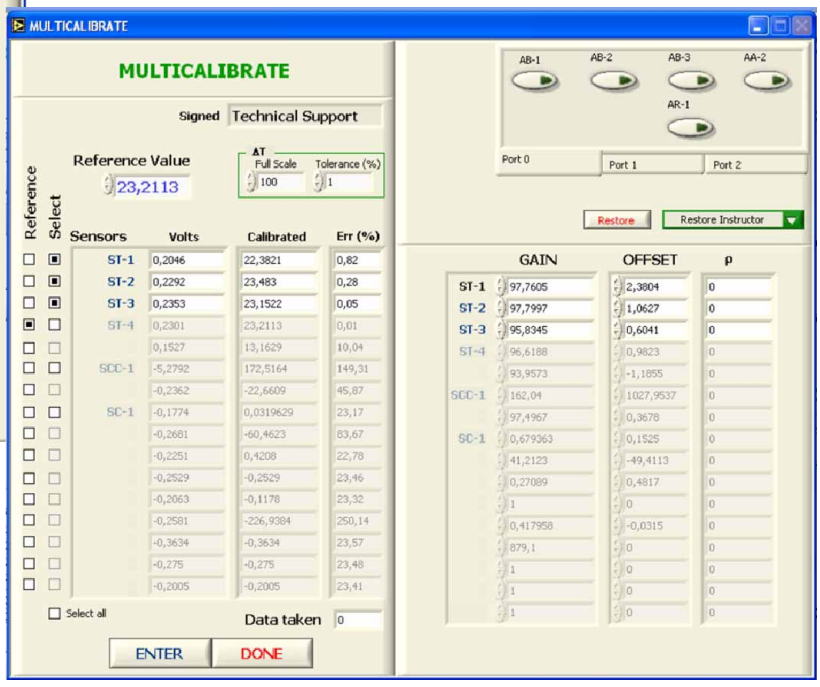
Main screen



Note: SP= Pressure sensor. AB= Pump. AN= Level switch. AVS= Solenoid valve.

Examples of Sensors Calibration screens





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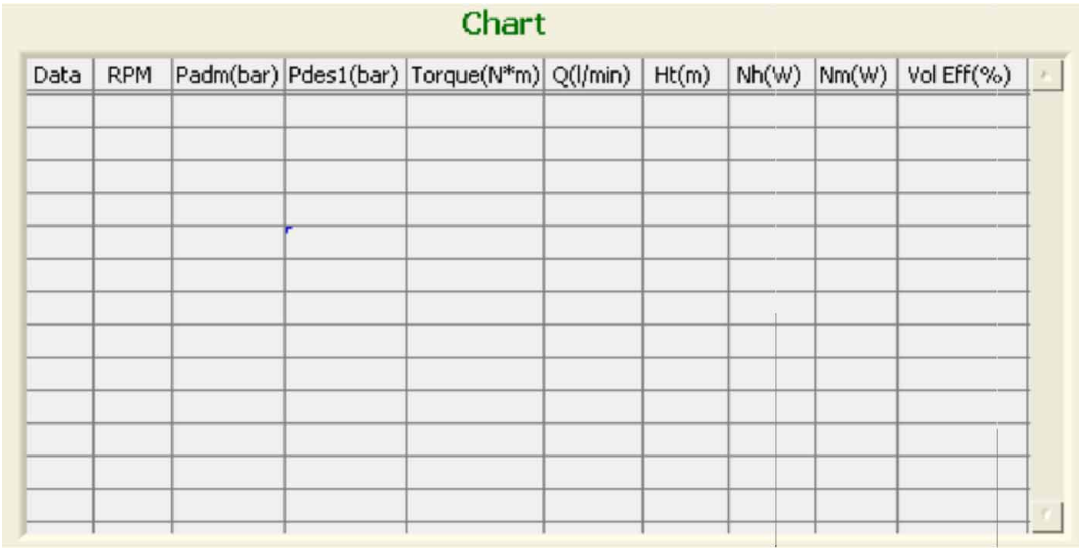
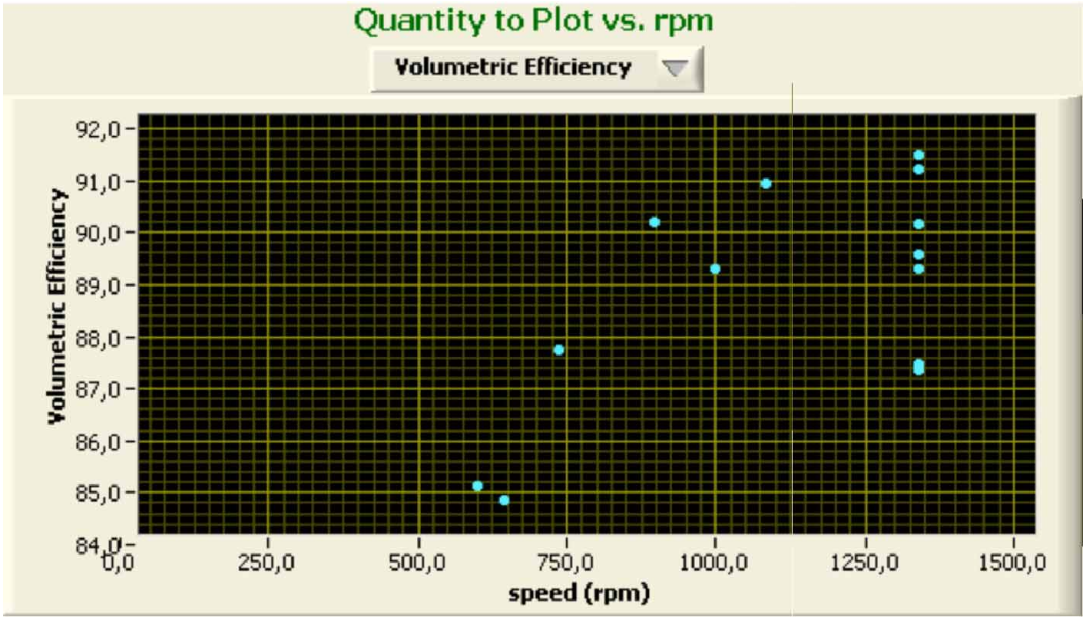
Software Main Screens

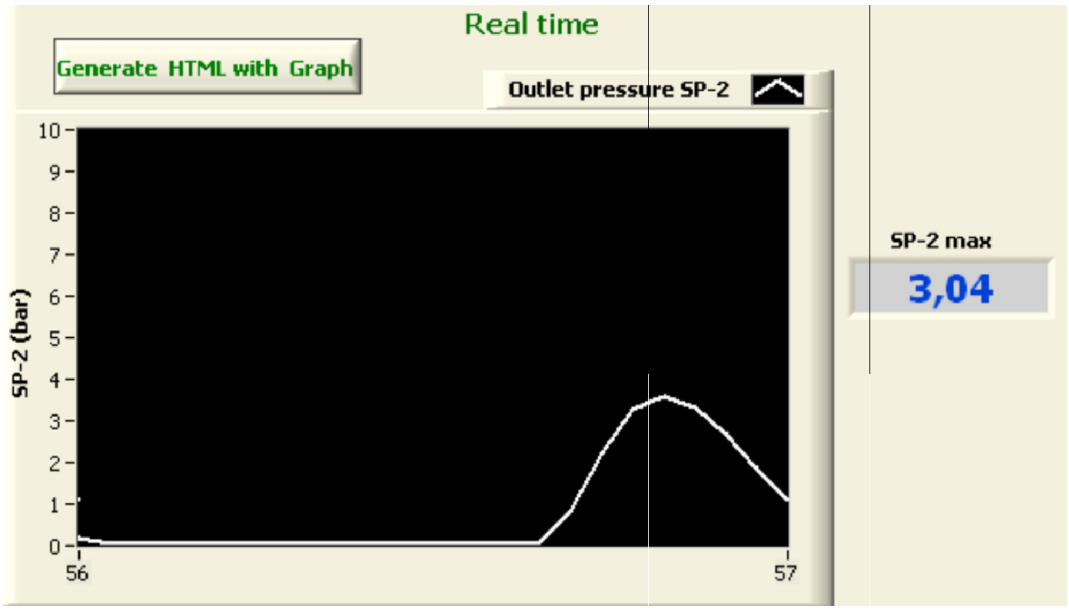
Examples of the three ways to show results:



Values chart.
The automatic data adquisition is registered in this chart.

Graph of volumetric efficiency in relation to the speed of pump.





Graph of pressure representation in real time.

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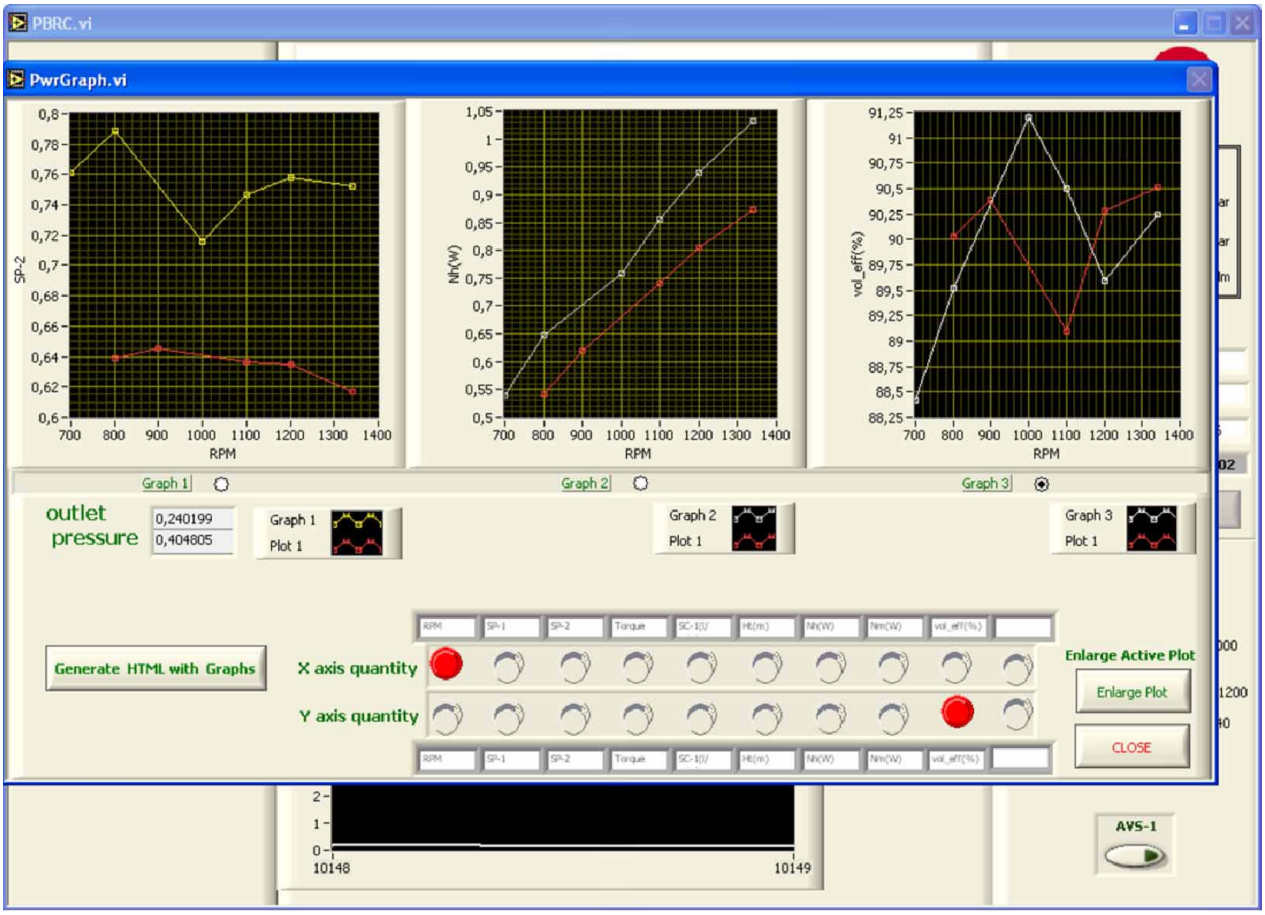
Some typical exercises results

Operating characteristics of a piston pump for different pressures.

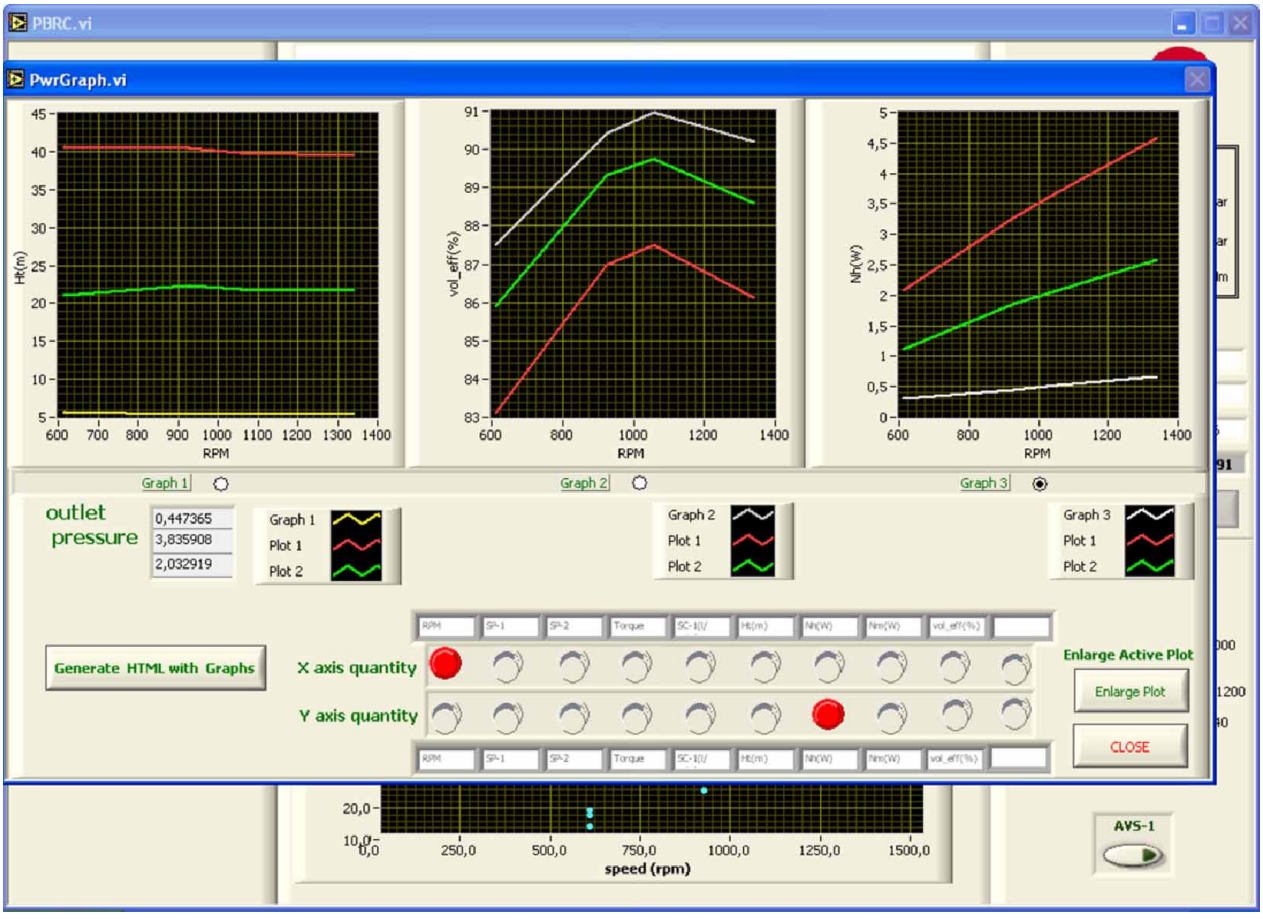


Operating characteristic of a piston pump:

1st. Representation of Total Head (m) in relation to RPM.

2nd. Representation of Volumetric Efficiency in relation to RPM.

3rd. Representation of Hydraulic Power in relation to RPM.



EXERCISES AND PRACTICAL POSSIBILITIES

Some Practical Possibilities of the Unit:

1.- Demonstration of a piston pump in operation.

2.- Measurement of plunger displacement.

3.- Measurement of cylinder pressure.

4.- Measurement of pump outlet pressure.

5.- Measurement of the volumetric efficiency.

6.- Obtain the curves of the pump H(n), N(n).

7.- Obtain the pump map.

8.- Study of safety valve for overpressure in operation.

9.- Study of the pressures influence at the exit when the piston pump works with a damping chamber.

10.- Pump efficiency calculation.

11.- Study of the effect to incorporate the damping chamber.

Other possible practices:

12.- Sensors calibration.

Practices to be done by PLC Module (PLC-PI) + PLC Control Software:

13.- Control of the PBRC unit process through the control interface box without the computer.

14.- Visualization of all the sensors values used in the PBRC unit process.

15.- Calibration of all sensors included in the PBRC unit process.

16.- Hand on of all the actuators involved in the PBRC unit process.

17.- Realization of different experiments, in automatic way, without having in front the unit. (This experiment can be decided previously).

18.- Simulation of outside actions, in the cases do not exist hardware elements. (Example: test of complementary tanks, complementary industrial environment to the process to be studied, etc).

19.- PLC hardware general use and manipulation.

20.- PLC process application for PBRC unit.

21.- PLC structure.

22.- PLC inputs and outputs configuration.

23.- PLC configuration possibilities.

24.- PLC program languages.

25.- PLC different programming standard languages.

26.- New configuration and development of new process.

27.- Hand on an established process.

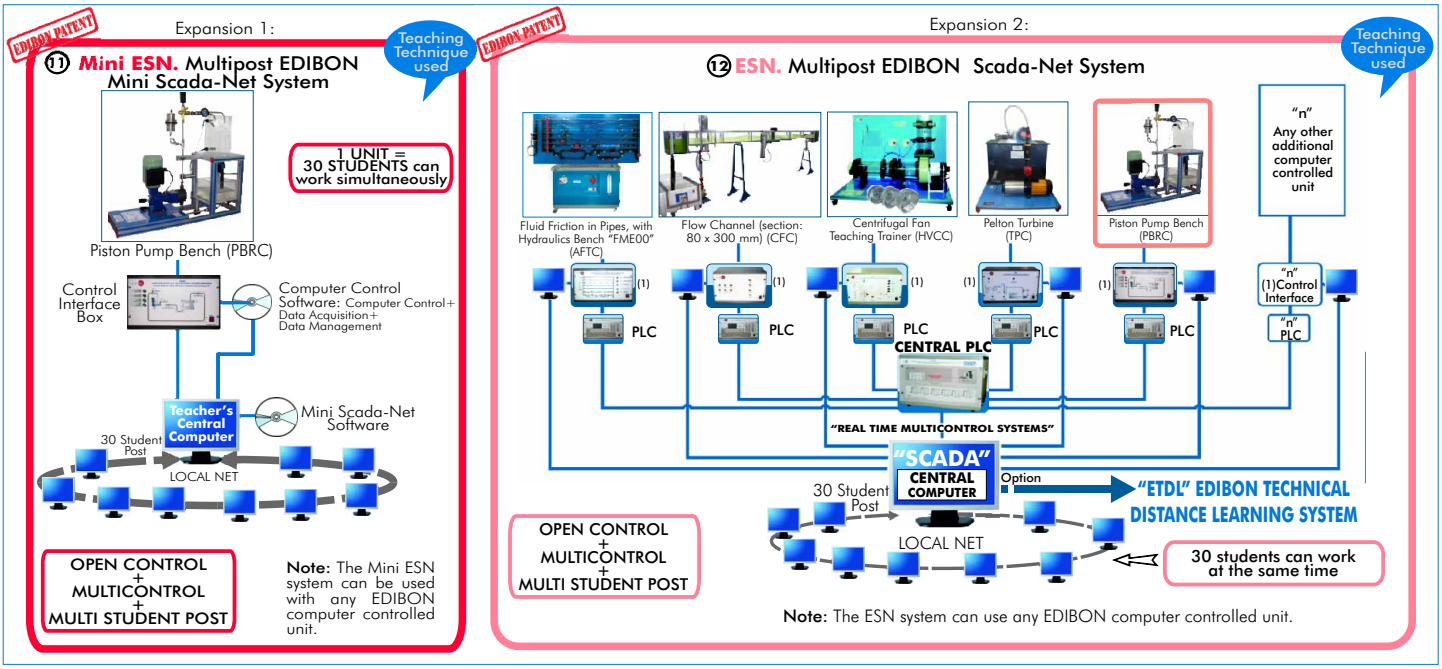
28.- To visualize and see the results and to make comparisons with the PBRC unit process.

29.- Possibility of creating new process in relation with the PBRC unit.

30.- PLC Programming Exercises.

31.- Own PLC applications in accordance with teacher and student requirements.

POSSIBILITIES OF OTHER AVAILABLE EXPANSIONS



ORDER INFORMATION

Items supplied as standard

Minimum configuration for normal operation includes:

① **Unit: PBRC. Piston Pump Bench.**

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

③ **DAB. Data Acquisition Board.**

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

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

⑥ **Manuals.**

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

Complementary items to the standard supply

PLC. Industrial Control using PLC (7 and 8):

⑦ PCL-PI.PLC Module.

⑧ PBRC/PLC-SOF. PLC Control Software.

⑨ PBRC/CAL. Computer Aided Learning Software (Results Calculation and Analysis). (Available on request).

⑩ PBRC/FSS. Faults Simulation System. (Available on request).

Expansions

⑪ Mini ESN. Multipost EDIBON Mini Scada-Net System.

⑫ ESN. Multipost EDIBON Scada-Net System.

REQUIRED SERVICES

-Electrical supply: single-phase, 220V./50Hz or 110V./60Hz.

-Water supply.

-Computer (PC).

DIMENSIONS & WEIGHTS

PBRC Unit:	-Dimensions: 1000 x 350 x 900 mm. approx.
	-Weight: 50 Kg. approx.
Control Interface Box:	-Dimensions: 490 x 330 x 310 mm. approx.
	-Weight: 10 Kg. approx.
PLC Module (PLC-PI):	-Dimensions: 490 x 330 x 310 mm. approx.
	-Weight: 30 Kg. approx.

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

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