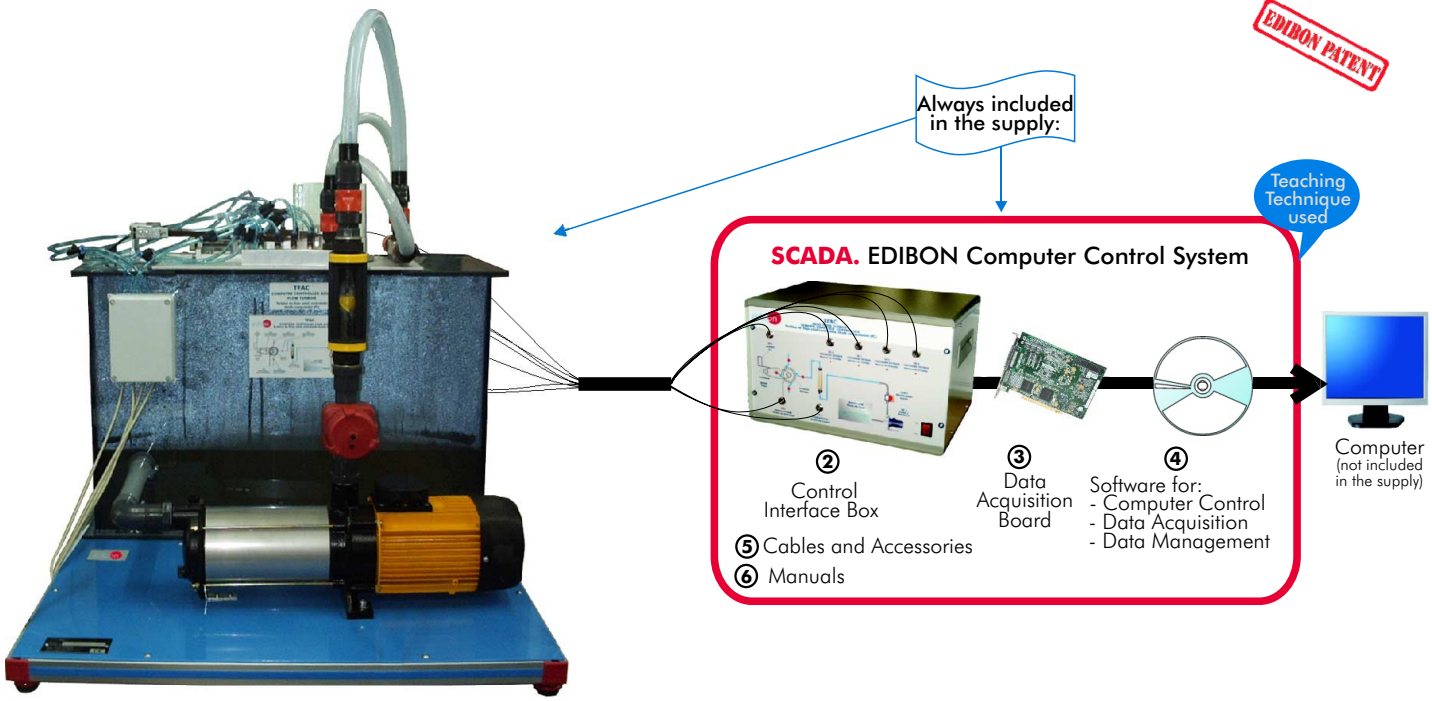
edibon

Technical Teaching Equipment

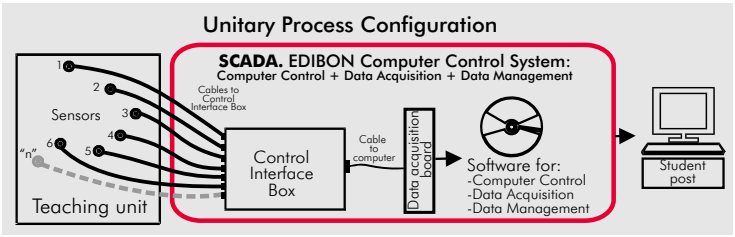
Computer Controlled **Axial Flow Turbine**

TFAC

EDIBON PATENT



① Unit: TFAC. Axial Flow Turbine



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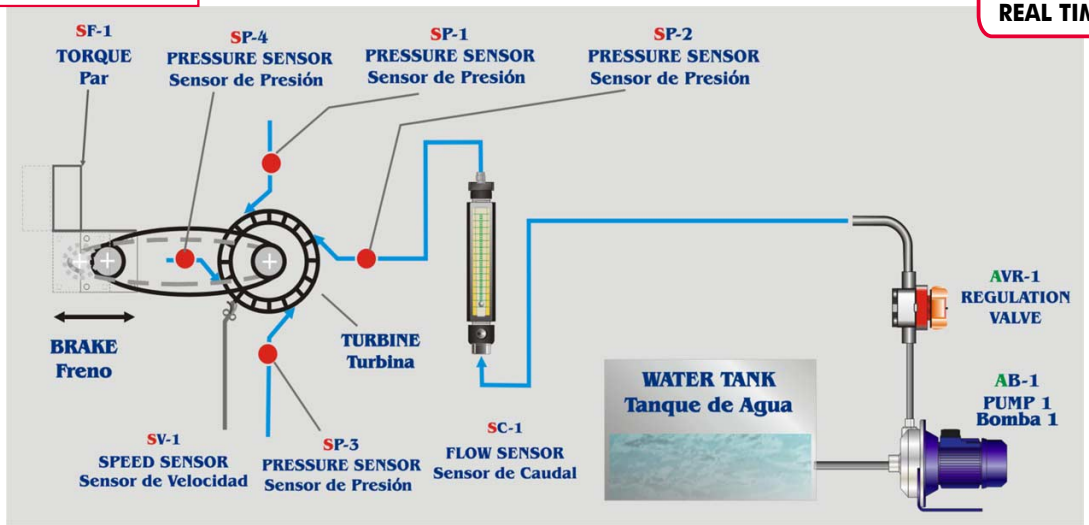
Products
Products range
Units
8.-Fluid Mechanics & Aerodynamics

PROCESS DIAGRAM AND ELEMENTS ALLOCATION

1 actuator and 7 sensors controlled from any computer, and working simultaneously

OPEN CONTROL + MULTICONTROL + REAL TIME CONTROL



ISO:9001-2000 Certificate of Approval. Reg. No. E204034

European Union Certificate

Certificates ISO 14001: 2004 and ECO-Management and Audit Scheme (environmental management)

Worlddidac Quality Charter Certificate
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DESCRIPTION

"TFAC" unit consists of an Axial Turbine, with 8 inclined nozzles at 20° and 30° degreed respect to the perpendicular direction at the rotating axis.

The pallets of turbine runner are clearly visible through the transparent tank.

It has four pressure sensors placed at the nozzle input, allowing to measure the input pressure in that point (water discharge pressure for each nozzle).

A band brake connected to one load cell allows varying the load given to the turbine by means of a connection device. A sensor determines the turbine velocity.

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

SPECIFICATIONS

Items supplied as standard

① TFAC. Unit:

Bench-top unit.
Anodized aluminium structure.
Panels and main metallic elements in stainless steel.
Diagram in the front panel with similar distribution that the elements in the real unit.
Nozzle:
Throat inlet diameter: 2.5 mm. Throat outlet diameter: 2.5 mm.
Discharge angle: 20° and 30°.
Turbine Rotor:
External diameter: 53mm. Internal diameter: 45mm. Number of blades: 40.
Inlet angle of the blades: 40°. Outlet angle of the blades: 40°.
Used material: brass.
Brake:
Pulley diameter: 60 mm. Effective radio: 50mm.
4 Pressure Sensors: 0 to 100 psi (0 to 6.7 bar).
Load cell: 0-2 Kg. Force Sensor (Torque): 0-20 N (maximum).
Flow Sensor: 0 to 150 l./min.
Speed Sensor: 0 to 20000 r.p.m.
Water Pump, computer controlled: maximum pressure: 7 bar, maximum water flow: 116 l./min. at 2.4 bar, electrical power: single-phase 220 V.
Water transparent tank, capacity: 100 l. approx.

TFAC Unit

② TFAC/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 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. **Simultaneously 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 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.

TFAC/CIB

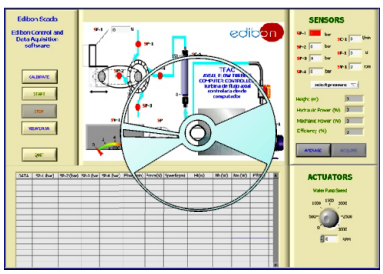
③ DAB. Data Acquisition Board:

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)=±10V. 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)=±10V. Data transfers=DMA, interrupts, programmed I/0.
Digital Input/Output: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 TFAC/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. Student calibration system for all 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 the 30 students of the classroom can visualize simultaneously all results and manipulation of the unit, during the process, by using a projector.



TFAC/CCSOF

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

Continue...

Complementary items to the standard supply

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

⑦ PLC-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).
High-speed counter.
Multi-point PID control.
Digital inputs/outputs and analog inputs/outputs Panasonic modules.

Communication RS232 wire, to computer (PC).

PLC-PI

⑧ TFAC/PLC-SOF. PLC Control Software:

For this particular unit, always included with PLC supply.

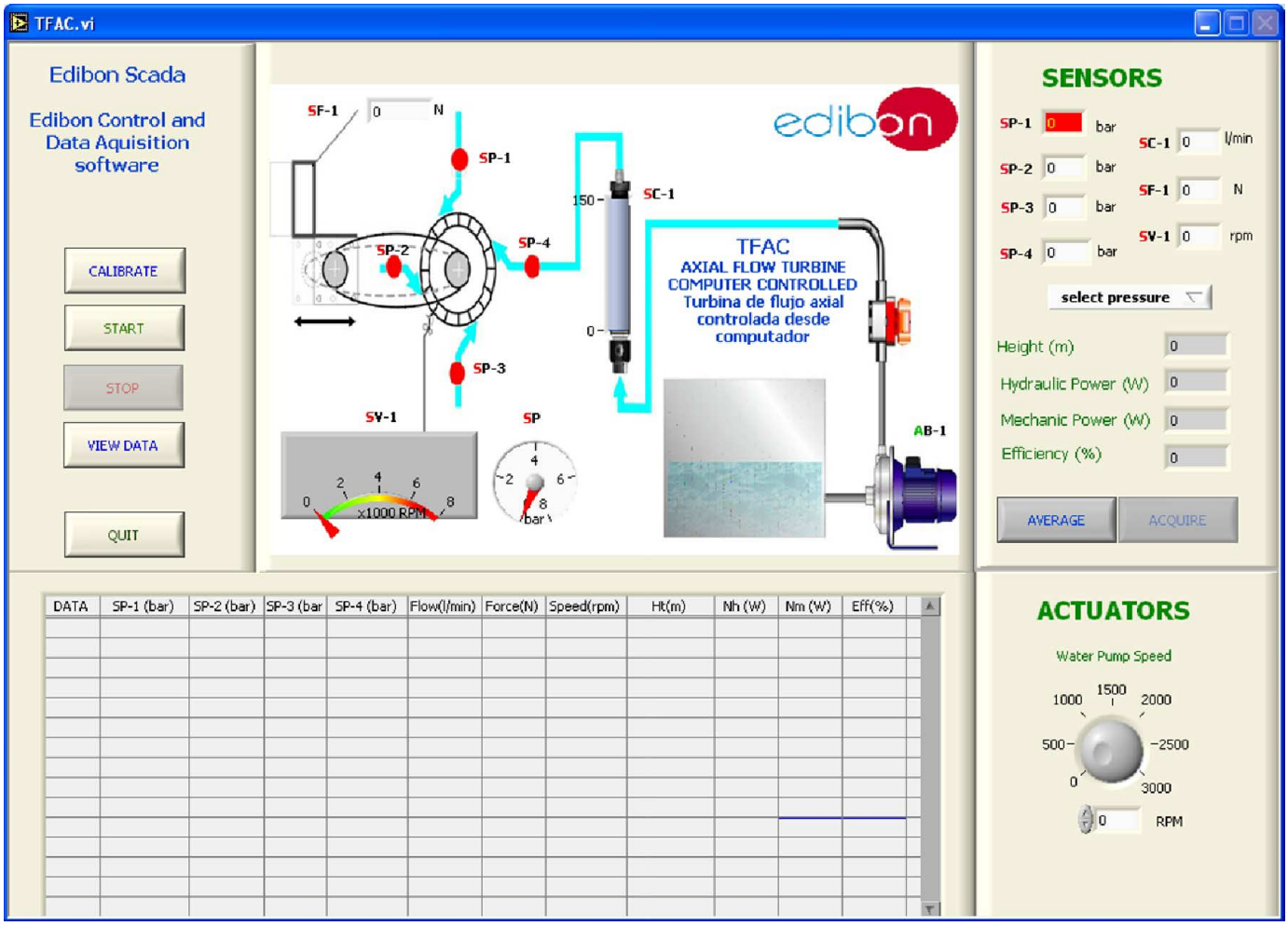
Items available on request

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

⑩ TFAC/FSS. Faults Simulation System.

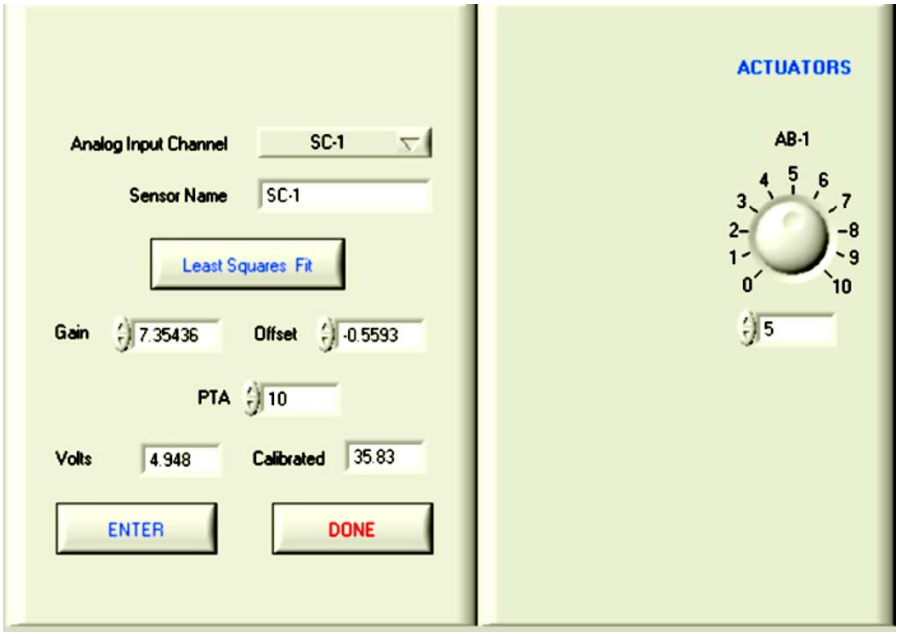
Software Main Screens

Main screen



Note: SP= Pressure sensor. SC= Flow sensor. SF= Force sensor. SV= Speed sensor.

Example of Sensors Calibration screen



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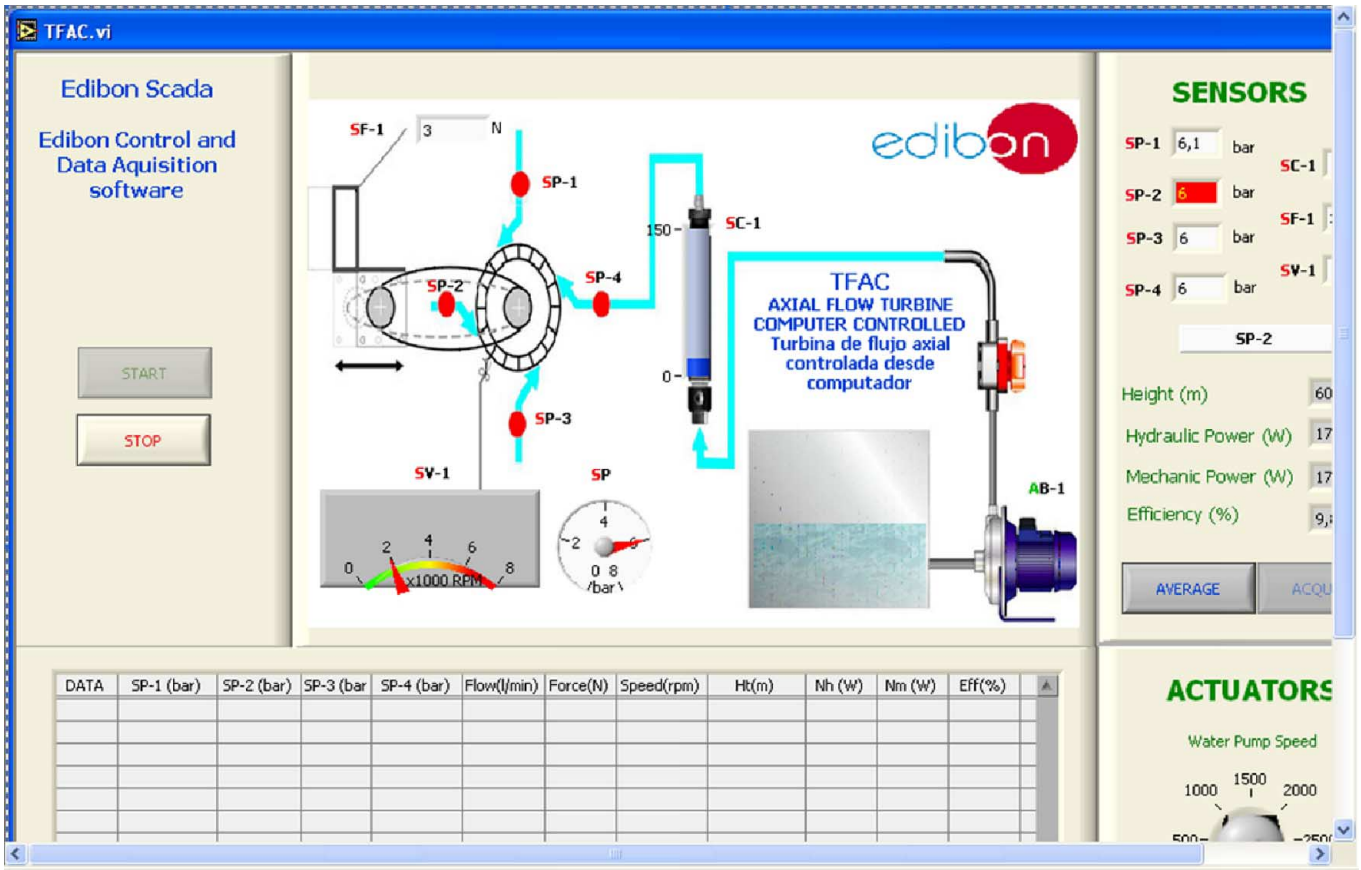
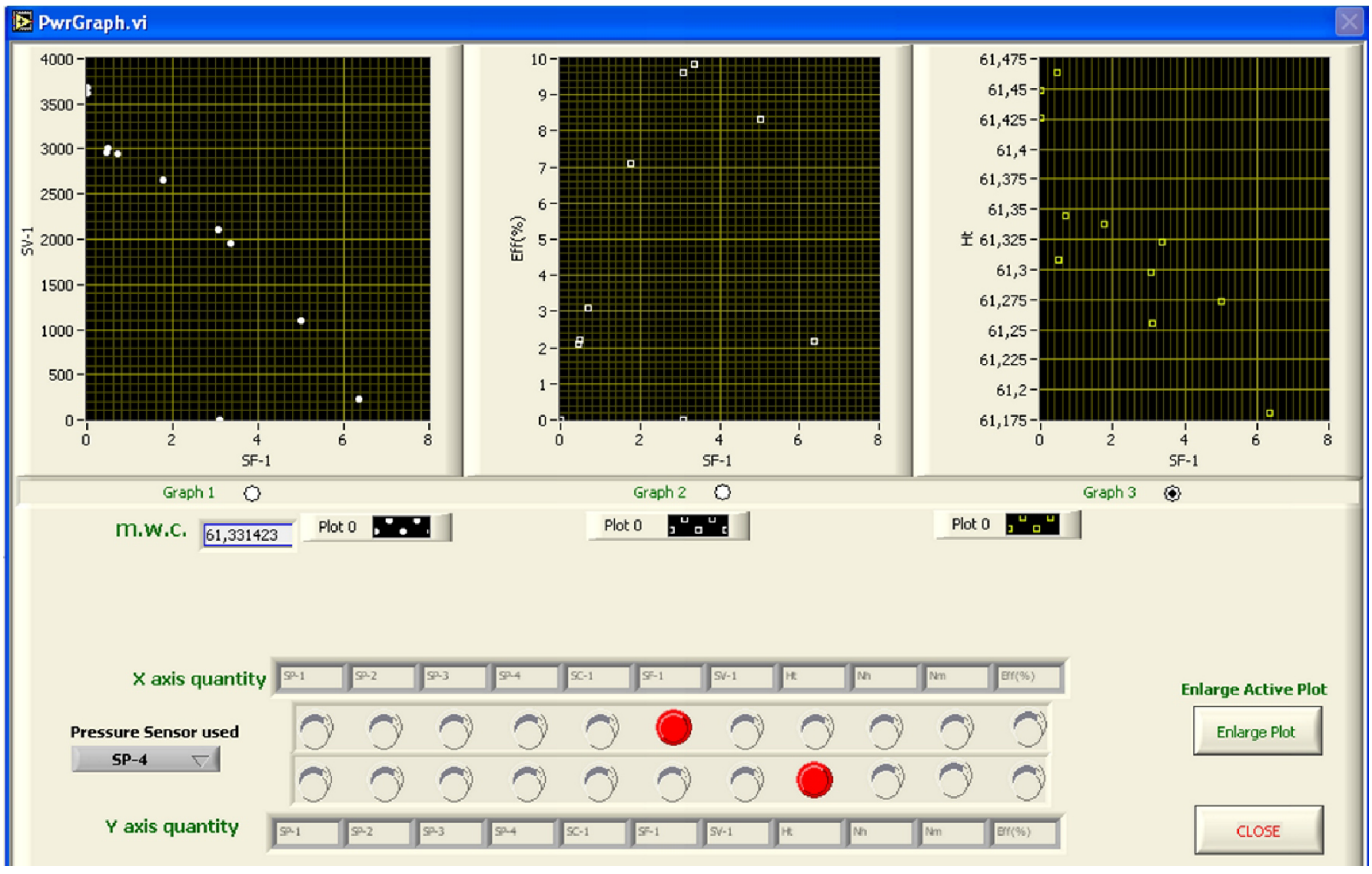
Some typical exercises results





EXERCISES AND PRACTICAL POSSIBILITIES

Some Practical Possibilities of the Unit:

1.- Determination of the nozzle discharge coefficient.
2.- Determination of operating characteristics of the Axial Turbine at different speed values (20° nozzle).
3.- Determination of operating characteristics of the Axial Turbine at different speed values (30° nozzle).
4.- Determination of the Axial Turbine characteristic curves (20° nozzle).
5.- Determination of the Axial Turbine characteristic curves (30° nozzle).
6.- Determination of torque, efficiency and power curves at a constant value (20° nozzle).
7.- Determination of torque, efficiency and power curves at a constant value (30° nozzle).
8.- Determination of curves in relation to the turning speed (20° nozzle).
9.- Determination of curves in relation to the turning speed (30° nozzle).
10.- Determination of curves in relation to the flow (20° nozzle).
11.- Determination of curves in relation to the flow (30° nozzle).
12.- Adimensionalization.
13.- Flow calculation.

Other possible practices:

14.- Pressure Sensors Calibration.
15.- Flow Sensor Calibration.

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

16.- Control of the TFAC unit process through the control interface box without the computer.
17.- Visualization of all the sensors values used in the TFAC unit process.
18.- Calibration of all sensors included in the TFAC unit process.
19.- Hand on of all the actuators involved in the TFAC unit process.
20.- Realization of different experiments, in automatic way, without having in front the unit. (This experiment can be decided previously).
21.- 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).
22.- PLC hardware general use and manipulation.
23.- PLC process application for TFAC unit.
24.- PLC structure.
25.- PLC inputs and outputs configuration.
26.- PLC configuration possibilities.
27.- PLC program languages.
28.- PLC different programming standard languages.
29.- New configuration and development of new process.
30.- Hand on an established process.
31- To visualize and see the results and to make comparisons with the TFAC unit process.
32.- Possibility of creating new process in relation with the TFAC unit.
33.- PLC Programming Exercises.
34.- Own PLC applications in accordance with teacher and student requirements.

POSSIBILITIES OF OTHER AVAILABLE EXPANSIONS

Expansion 1:

EDIBON PATENT

Teaching Technique used

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

1 UNIT = 30 STUDENTS can work simultaneously

Axial Flow Turbine (TFAC)

Control Interface Box

Computer Control Software: Computer Control + Data Acquisition + Data Management

Teacher's Central Computer

Mini Scada-Net Software

30 Student Post

LOCAL NET

OPEN CONTROL + MULTICONTROL + MULTI STUDENT POST

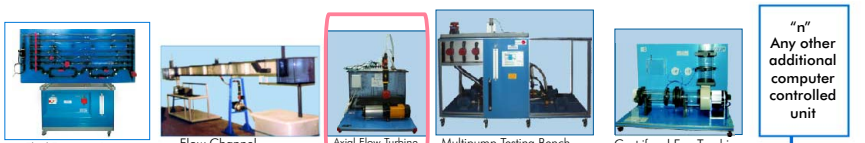
Note: The Mini ESN system can be used with any EDIBON computer controlled unit.

Expansion 2:

EDIBON PATENT

Teaching Technique used

⑫ **ESN.** Multipost EDIBON Scada-Net System



Fluid Friction in Pipes, with Hydraulics Bench "FME00" (AFTC)

Flow Channel (CFC)

Axial Flow Turbine (TFAC)

Multipump Testing Bench (PBOC)

Centrifugal Fan Teaching Trainer (HVCC)

"n" Any other additional computer controlled unit

(1) Control Interface

PLC

CENTRAL PLC

"REAL TIME MULTICONTROL SYSTEMS"

"SCADA" CENTRAL COMPUTER

Option

"ETDL" EDIBON TECHNICAL DISTANCE LEARNING SYSTEM

30 Student Post

LOCAL NET

30 students can work at the same time

OPEN CONTROL + MULTICONTROL + MULTI STUDENT POST

Note: The ESN system can use any EDIBON computer controlled unit.

ORDER INFORMATION

Items supplied as standard

Minimum configuration for normal operation includes:

① **Unit: TFAC. Axial Flow Turbine.**
② **TFAC/CIB.Control Interface Box.**
③ **DAB.Data Acquisition Board.**
④ **TFAC/CCSOF. Computer Control + Data Acquisition + Data Management Software.**
⑤ **Cables and Accessories,** for normal operation.
⑥ **Manuals.**

*** IMPORTANT: Under TFAC 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 TFAC/PLC-SOF. PLC Control Software.
⑨ TFAC/CAL. Computer Aided Learning Software (Results Calculation and Analysis). (Available on request).
⑩ TFAC/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 110./60Hz.
- Water supply and drainage.
- Computer (PC).

DIMENSIONS & WEIGHTS

TFAC Unit:	-Dimensions: 800 x 900 x 800 mm. approx. -Weight:80 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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