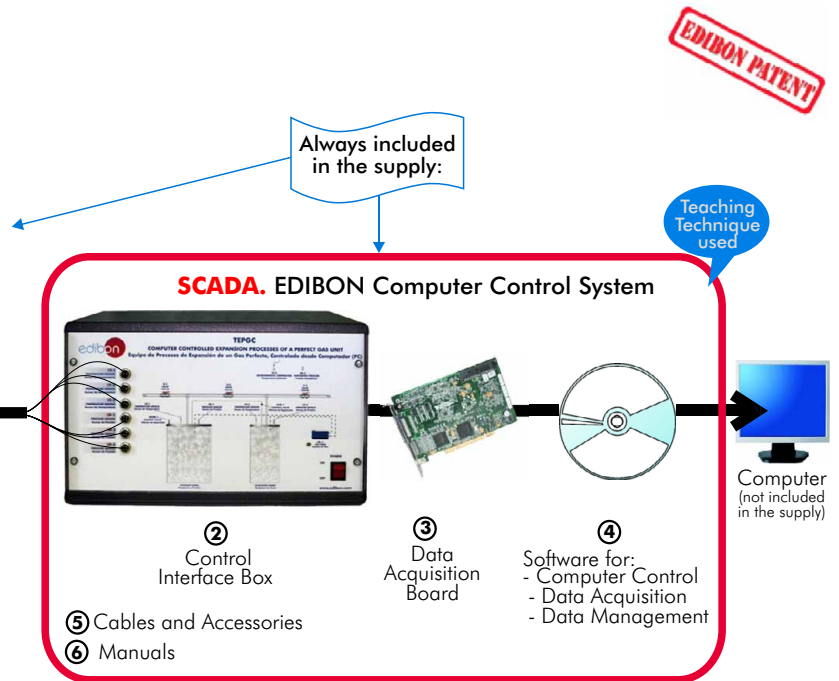
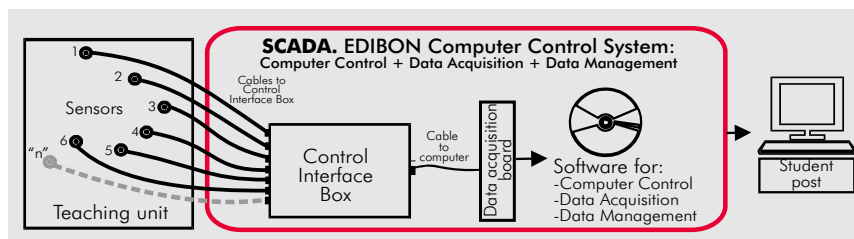




① Unit: TEPGC. Expansion Processes of a Perfect Gas Unit



**OPEN CONTROL
+
MULTICONTROL
+
REAL TIME CONTROL**



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- Products
- Products range
- Units
- 9.-Thermodynamics & Thermotechnics

DESCRIPTION

The "TEPGC" is a demonstration unit of expansion processes of a perfect gas. It uses the air to carry out the experiments and so to demonstrate the basic principles of Thermodynamics.

We can find continuously expansion and compression processes of different gases. The TEPGC unit allows the student to deepen in its knowledge to later understand other more complex units.

The TEPGC unit consists of two rigid vessels of methacrylate, connected between them. One of them operates under pressure and the other one operates under vacuum. Between them, there is an air pump and a set of valves which allow to carry out the different experiments. One of the tasks of the pump will be to pressurize the pressure vessel with air and to evacuate the air from the vacuum vessel.

The two vessels are made of methacrylate, what makes easier the experiments visualization and, at the same time, they thermally isolate their content from the external atmosphere.

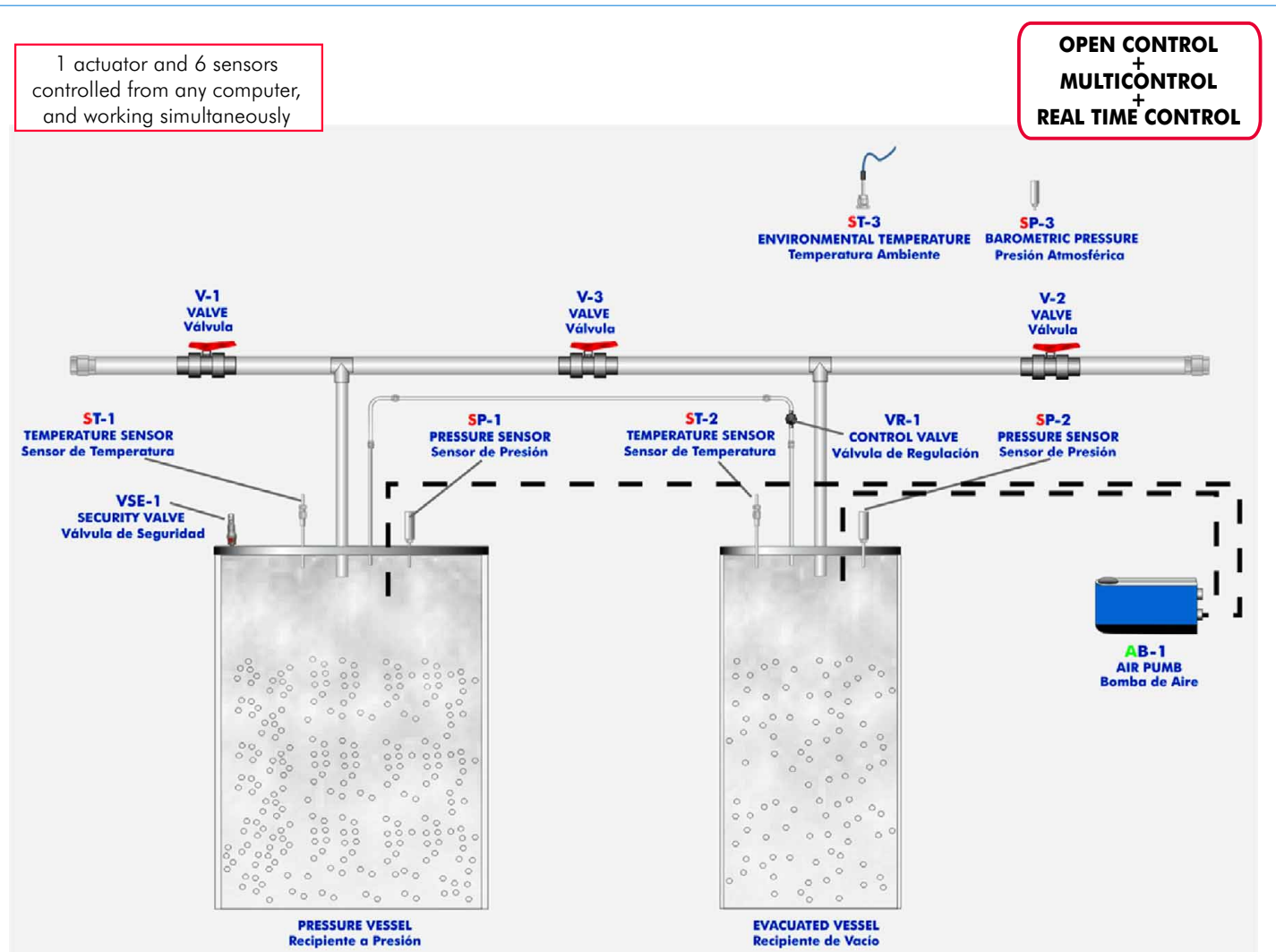
On the upper cover of the pressure vessel, a pressure sensor, a temperature sensor and a relief valve are mounted. It has a connection to the pump which allows it to pressurize the vessel.

On the upper cover of the evacuated vessel, a pressure sensor and a temperature sensor are mounted. It is directly connected to the pump which allows to evacuate its internal air.

Both vessels are interconnecting by two pipes of different sections: a large diameter pipe which separates both the vessels by a quick action valve, which will allow to carry out fast gas expansions, and a small diameter pipe which separates both vessels by a needle regulation valve, which makes easier the performance of slow expansions.

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



Items supplied as standard

① TEPGC. Unit:

Bench-top unit.

Anodized aluminium structure and panels 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.

2 Transparent (methacrylate) interconnected vessels, one operating under pressure and the other under vacuum.

The capacity of the pressurised vessel is 20 litres.

The capacity of the evacuated vessel is 12 litres.

Each vessel with the following features:

Interconnection between the two vessels via a large diameter pipe and valve (fast change) and small diameter pipe and regulation valve (gradual change).

Connection to a large diameter pipe and valve to allow depressurisation/pressurisation of the vessel to/from the atmosphere.

Connection to sensor to measure the pressure/vacuum inside the vessel.

Connection to the air pump via isolating valve to allow the vessel to be pressurised/evacuated.

Temperature sensor for measuring the air temperature inside the vessel.

Relief valve to avoid over-pressurisation in the pressurized vessel.

Air pump, computer controlled, power: 100 W. It allows the pressurisation or evacuation of the vessels.

This unit allows pressure and temperature changes to be controlled continuously using a computer (PC).

The vessels can be operated singly or in combination allowing processes whereby air flows from a pressurised vessel to atmosphere, from atmosphere to an evacuated vessel or from a pressurised vessel to an evacuated vessel.

Total sensors included:

2 Temperature sensors, "J" type, one in each vessel, range: 0-600° C.

2 Pressure sensors, one in each vessel, range: 0-5 psi.

1 Barometric pressure sensor, range: 700-1200 mbar.

1 Room temperature sensor, range: 0-600° C.

Maximum working temperature up to 100° C.

② TEPGC/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 PID control with flexibility of modifications from the computer keyboard of the PID parameters, at any moment during the process.

Real time PID and on/off control for pumps, compressors, resistances, control valves, etc.

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

Proportional control, integral control and derivative control, based on the real PID mathematical formula, by changing the values, at any time, of the three control constants (proportional, integral and derivative constants).

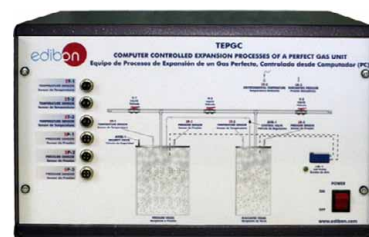
Open control allowing modifications, at any time and in a real time, of parameters involved in the process simultaneously.

Possibility of automatization of the actuators involved in the process.

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



TEPGC Unit.



TEPGC/CIB

Continue...

Items supplied as standard (continuation)

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/O.
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/O.

Digital Input/Output:

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

Timing: Counter/timers=2.

Resolution: Counter/timers: 32 bits.



DAB

④ TEPGC/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.

Analog and digital PID control. Menu for PID and set point selection required in the whole work range.

Management, processing, comparison and storage of data.

Sampling velocity up to 250,000 data per second guaranteed.

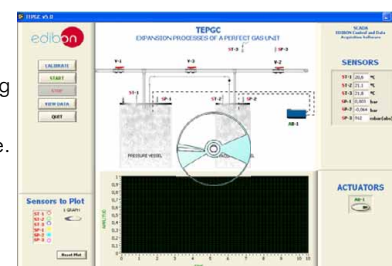
Calibration system for the sensors involved in the process.

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 the 30 students of the classroom can visualize simultaneously all results and manipulation of the unit, during the process, by using a projector.



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

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.

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 μ sec. 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 VDC).

Relay output: 14 (250 VA 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).

⑧ **TEPGC/PLC-SOF. PLC Control Software:**

For this particular unit, always included with PLC supply.



PLC-PI

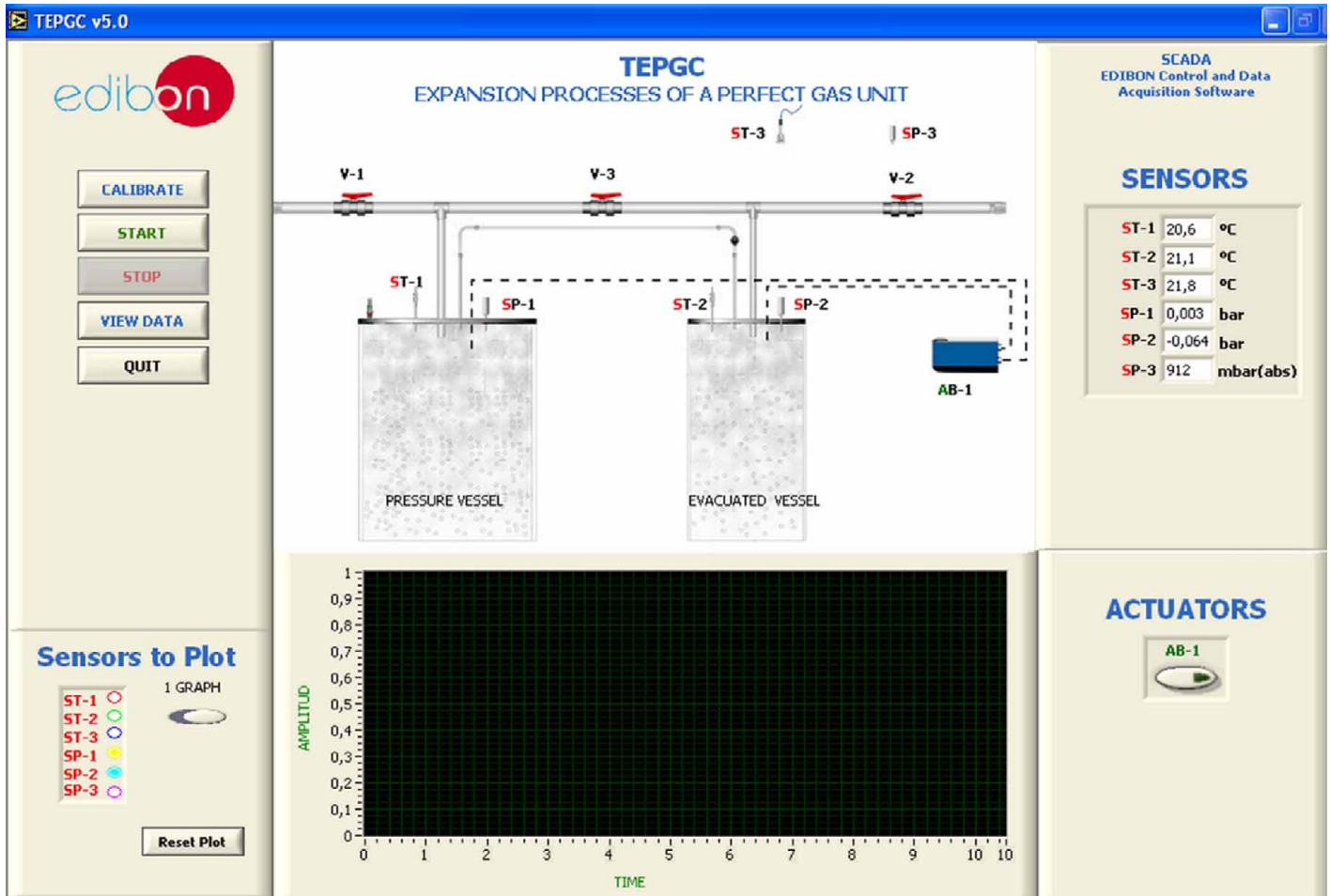
Items available on request

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

⑩ **TEPGC/FSS. Faults Simulation System.**

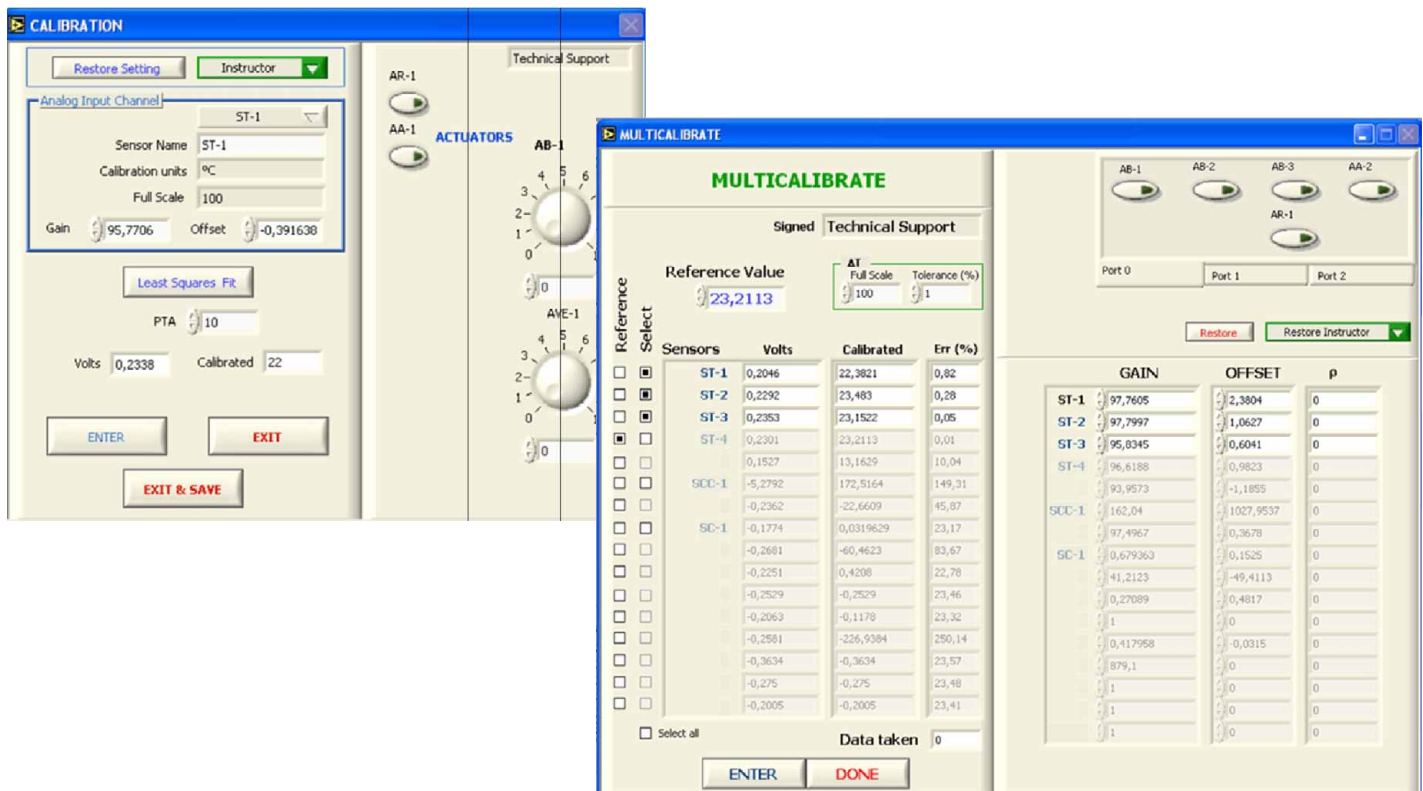
Software Main Screens

Main screen



Note: ST=Temperature sensor. SP=Pressure sensor. AB=Pump.

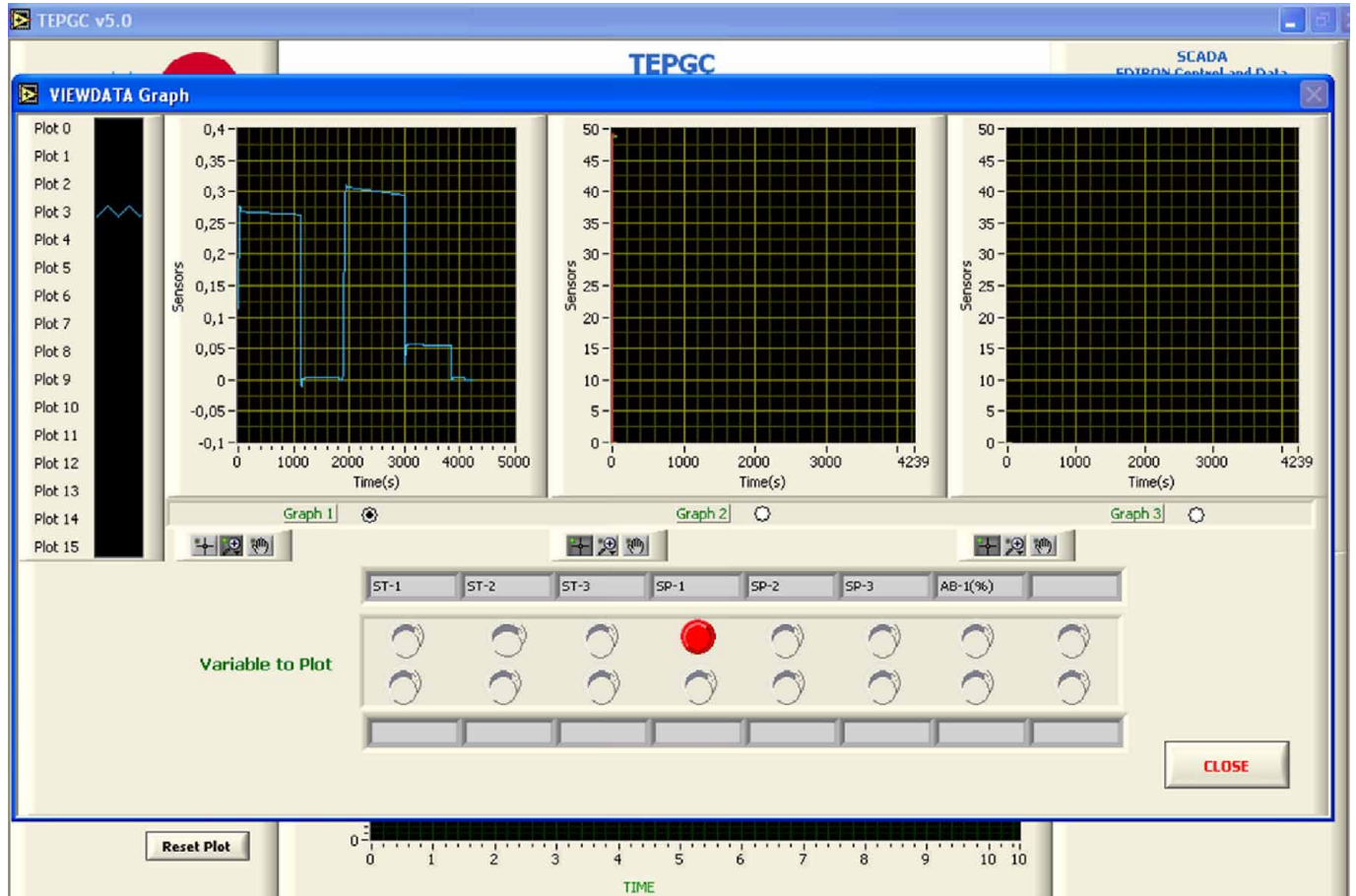
Examples of Sensors Calibration screens



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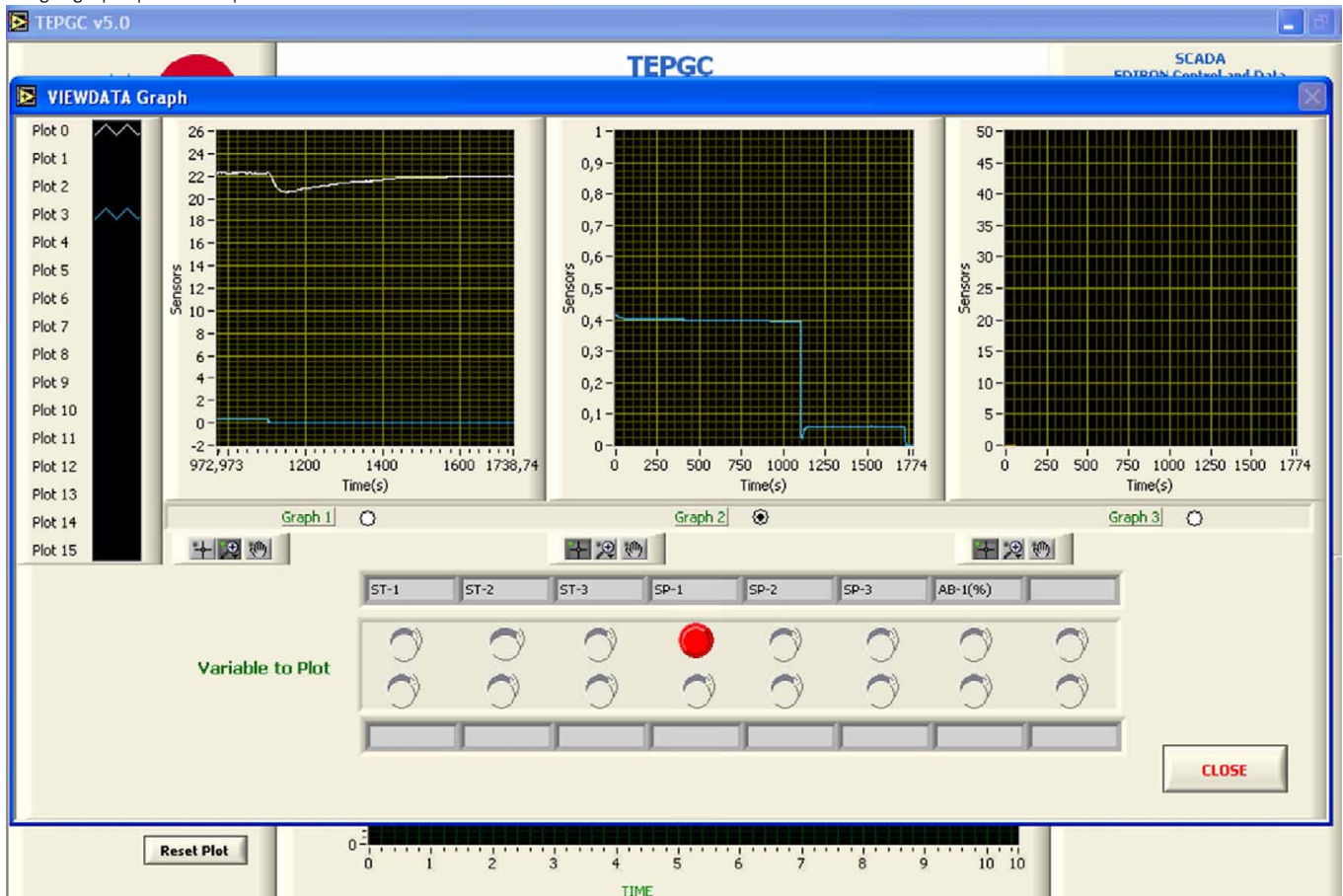
Some typical exercises results

Graphic representation, in real time, of different compression-expansion stages in the pressure vessel.



Analysis of the state variables of a fast expansion of the gases in the pressure vessel.

- Left graph: temperature representation.
- Right graph: pressure representation.

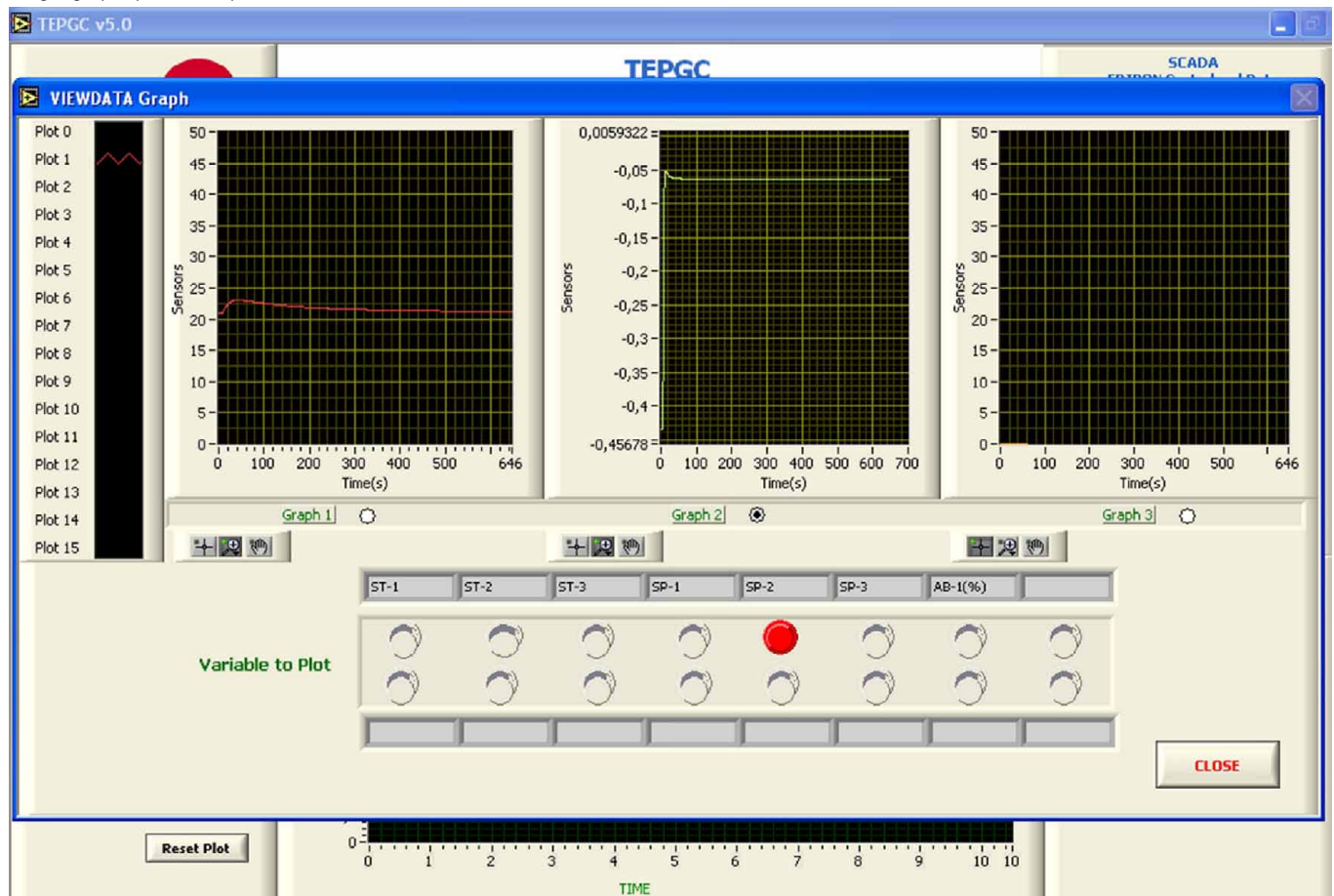


Continue...

Some typical exercises results

Study of the state variables in a practice of compression in the vacuum vessel.

- Left graph: temperature representation.
- Right graph: pressure representation.



Some Practical Possibilities of the Unit:

- Other possible practices:

16.- Sensors calibration.

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

- 17.- Control of the TEPGC unit process through the control interface box without computer.
- 18.- Visualization of all the sensors values used in TEPGC unit process.

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

Expansion 1:

11 Mini ESN. Multipost EDIBON Mini Scada-Net System

1 UNIT = 30 STUDENTS can work simultaneously

Expansion Processes of a Perfect Gas Unit (TEPGC)

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 + REAL TIME CONTROL + MULTI STUDENT POST

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

Expansion 2:

12 ESN. Multipost EDIBON Scada-Net System

Boiling Heat Transfer Unit (TICC)

Heat Exchangers Training System (TICC)

Expansion Processes of a Perfect Gas Unit (TEPGC)

Refrigeration Cycle Demonstration Unit (TDCG)

Air Conditioning Laboratory Unit (TAC)

"n" Any other additional computer controlled unit

"n" Control Interface

"n" PLC

PLC

CENTRAL PLC

"REAL TIME MULTICONTROL SYSTEMS"

"SCADA" CENTRAL COMPUTER

Option

"ETDI" EDIBON TECHNICAL DISTANCE LEARNING SYSTEM

30 Student Post

LOCAL NET

30 students can work at the same time

OPEN CONTROL + MULTICONTROL + REAL TIME CONTROL + MULTI STUDENT POST

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

Items supplied as standard

Minimum configuration for normal operation includes:

- ① Unit: TEPGC. Expansion Processes of a Perfect Gas Unit.
- ② TEPGC/CIB. Control Interface Box.
- ③ DAB. Data Acquisition Board.
- ④ TEPGC/SOF. Computer Control + Data Acquisition + Data Management Software.
- ⑤ Cables and Accessories, for normal operation.
- ⑥ Manuals.

* **IMPORTANT:** Under **TEPGC** 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 TEPGC/PLC-SOF. PLC Control Software.
- ⑨ TEPGC/CAL. Computer Aided Learning Software (Results Calculation and Analysis). (Available on request).
- ⑩ TEPGC/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.
Computer (PC).

DIMENSIONS & WEIGHTS

TEPGC unit:	-Dimensions: 705 x 570 x 1125 mm. approx. -Weight : 60 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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