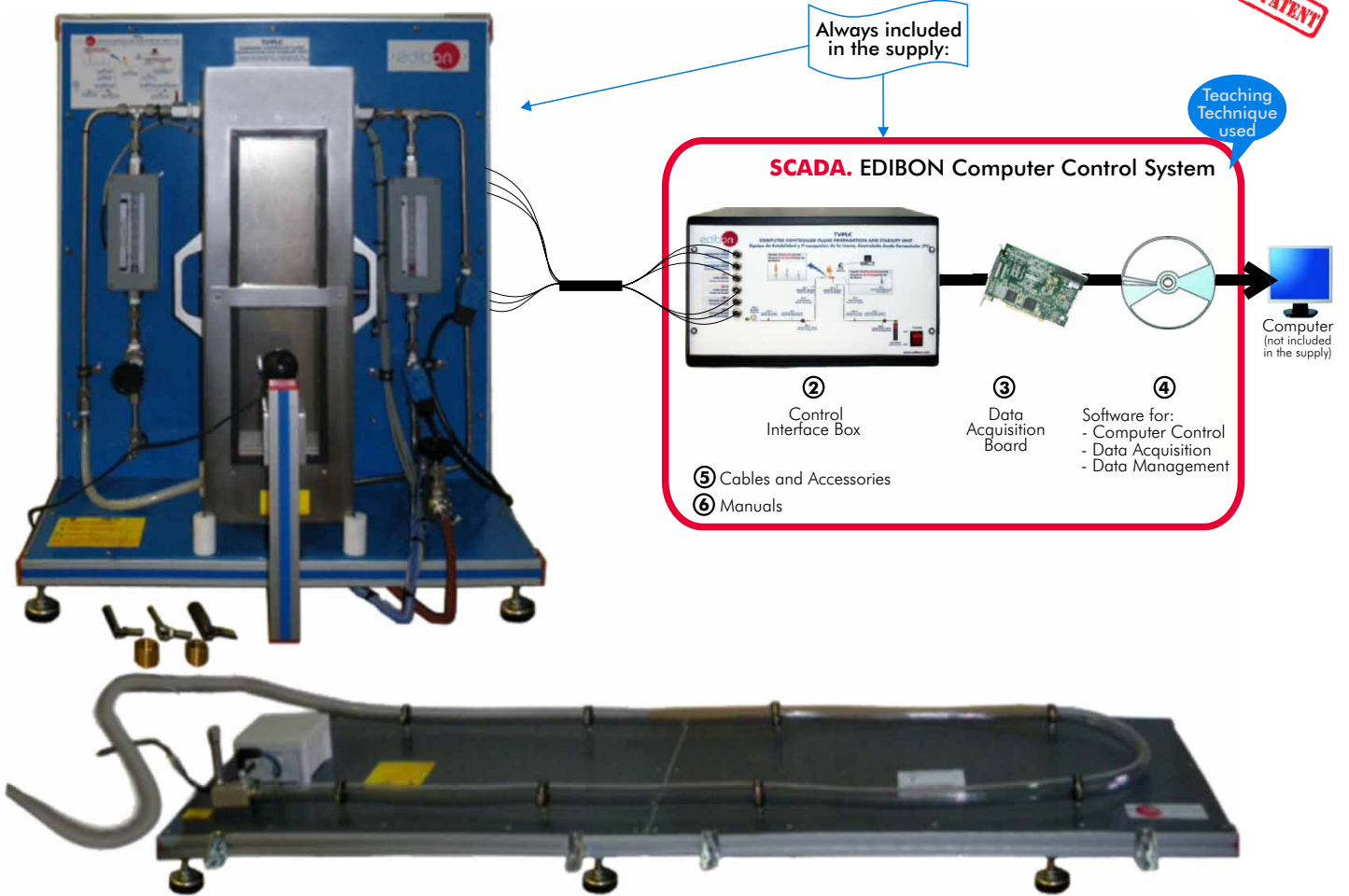
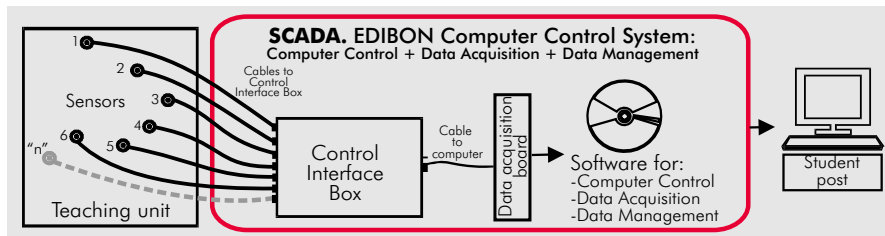


**EDIBON PATENT**



① Unit: TVPLC. Flame Propagation and Stability Unit

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



**www.edibon.com**

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



**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)

## DESCRIPTION

The Flame Propagation and Stability Unit (TVPLC), developed by EDIBON, is a teaching equipment which has been designed to allow students to investigate the behaviour characteristics of flames and understanding of flame control techniques employed for designing combustion systems.

With this unit we can determine the relationship between primary air/fuel ratios and flame speed or burner energy densities.

This unit allows to obtain and study the different flames changing the quantities of the fuel - comburent mix.

The unit is prepared to use different gaseous fuels, what allows to study the differences between them.

The TVPLC unit is composed by a vertical burner, which will be light by a lighter, and different installations or circuits and elements following described:

**Circuit of air,** which supplies the burner the necessary comburent for the combustion process. It is composed by a fan and a normally opened electrovalve. To adjust the required air flow there is a manual regulation valve. The circuit is made of flexible tube for easy coupling to the burner.

**Circuit of fuel gas:** composed by circuit of metallic tube, fuel feed system and two normally closed electrovalves for safety. Circuit made in stainless steel tube. To adjust the required gas flow there is a manual regulation valve.

**Safety elements.** The burner is protected by a box made in stainless steel which acts as physic barrier between combustion process and the users.

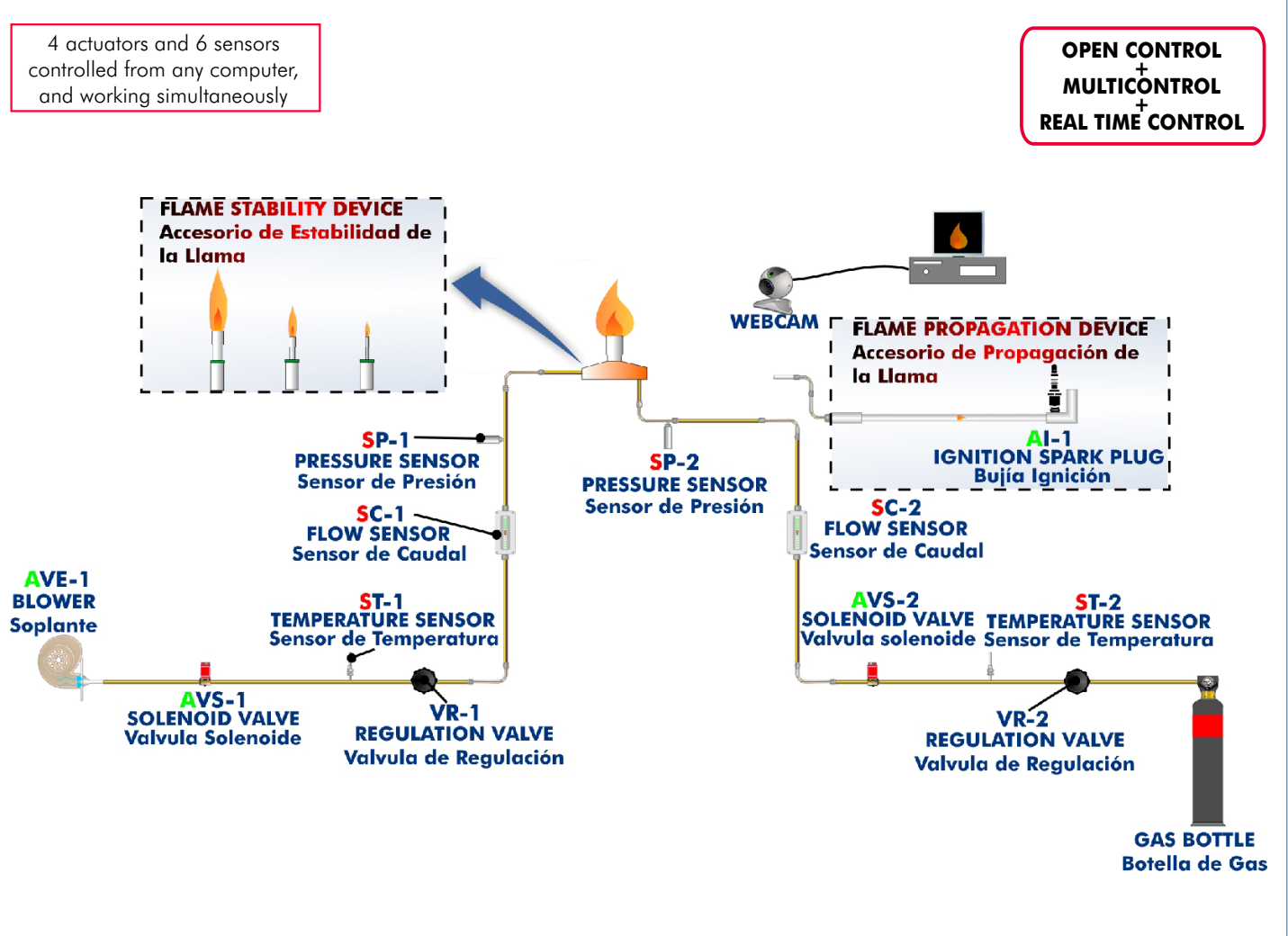
**Flame Propagation Accessory.** Structure made of aluminum profiles and with panels in PVC in order to lighten the unit. It is composed by a 5 m. tube in transparent PVC to be able to observe the experiment. The ignition process is carried out by a spark plug installed at one end.

**Instrumentation and sensors** for the correct study of a combustion process flame. Mainly, the flows, temperatures and pressures of air and gas circuits are studied.

A camera is provided with the unit to use with the Computer (PC), and so be able to get photographs of the different flames.

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 **TVPLC. Unit:**

Bench-top unit.

Anodized aluminium structure and panels of 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.

Burner with protective metallic box, with transparent window which ensure operation safety and complete experiment visibility.

Manual lighter.

Circuit of air, to supply the necessary oxygen to the combustion process. It is composed by:

Pressure fan, computer controlled, maximum flow:  $6\text{m}^3/\text{h}$ .

Electrovalve (solenoid valve), computer controlled, to control the air in flame propagation experiments.

Air flow regulation manual valve.

Circuit of flexible tube for easy coupling to the burner.

Circuit of gas:

Circuit of stainless steel tube.

Fuel supply system, computer controlled.

Gas flow regulation manual valve.

Double solenoid electrovalve.

Ignition system, computer controlled, implemented for the Flame Propagation Accessory. It is composed by a spark plug which is supplied by an ignition transformer.

Four flame tubes, easily interchangeable, with four different sections: 9, 12, 17 and 20 mm.

Flame stabilizers cones. They are placed at the upper part of the flame tube which corresponds. Its aim is to increase the mixes range for the flame keeps stable.

Flame Propagation Accessory, formed by:

5 meters transparent tube for visualizing the experiment.

Ignition spark plug.

Sensors:

2 Temperature sensors, "J" type, to measure:

Temperature of the inlet air.

Temperature of the inlet gas.

2 Pressure sensors to measure:

Air pressure.

Gas pressure.

2 Flow sensors to measure:

Air flow. Range: 0-0.6 l./s.

Gas flow. Range: 0-0.09 l./s.

Unit protected by magnethothermal and differential switches.

All electrical components connected to common earth/ground points.

Gas circuit safety valve.



TVPLC Unit

② **TVPLC/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.

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.

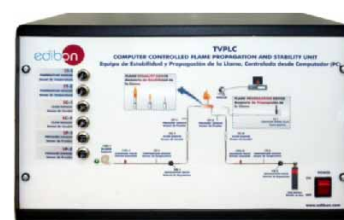
Shield and filtered signals to avoid external interferences.

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.

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

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



TVPLC/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)= $\pm 10V$ .
- 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)= $\pm 10V$ .
- Data transfers=DMA, interrupts, programmed I/O.

**Digital Input/Output:**

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

**Timing:**

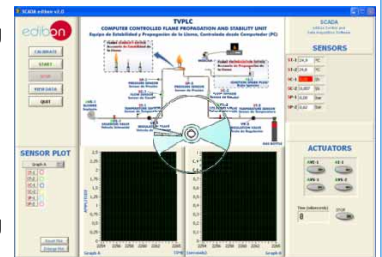
- Counter/timers=2**.
- Resolution: Counter/timers: 32 bits.



DAB

**④ TVPLC/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 simultaneous 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 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 the 30 students of the classroom to visualize simultaneously all results and manipulation of the unit, during the process, by using a projector.**



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

**Additional and optional 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 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 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 TVPLC/PLC-SOF. PLC Control Software:**

For this particular unit, always included with PLC supply.



PLC-PI

**Items available on request**

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

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



Software Main Screens

Main screen

The main screen displays the TVPLC (Computer Controlled Flame Propagation and Stability Unit) interface. It includes a schematic diagram of the equipment with various sensors and actuators labeled. On the left, there are control buttons: CALIBRATE, START, STOP, VIEW DATA, and QUIT. The top right shows the SCADA logo and version information. The right side features a 'SENSORS' panel with real-time data for ST-1, ST-2, SC-1, SC-2, SP-1, and SP-2. Below this is an 'ACTUATORS' panel with controls for AVE-1, AVS-1, AVS-2, and AI-1, along with a 'Time (milliseconds)' display and a STOP button. The bottom section contains two 'SENSOR PLOT' graphs, Graph A and Graph B, showing amplitude over time for selected sensors.

Nota: ST=Temperature sensor. SP=Pressure sensor. SC=Flow sensor. AVE=Blower. AVS=Solenoid valve. AI=Ignition spark plug.

Examples of Sensors Calibration screens

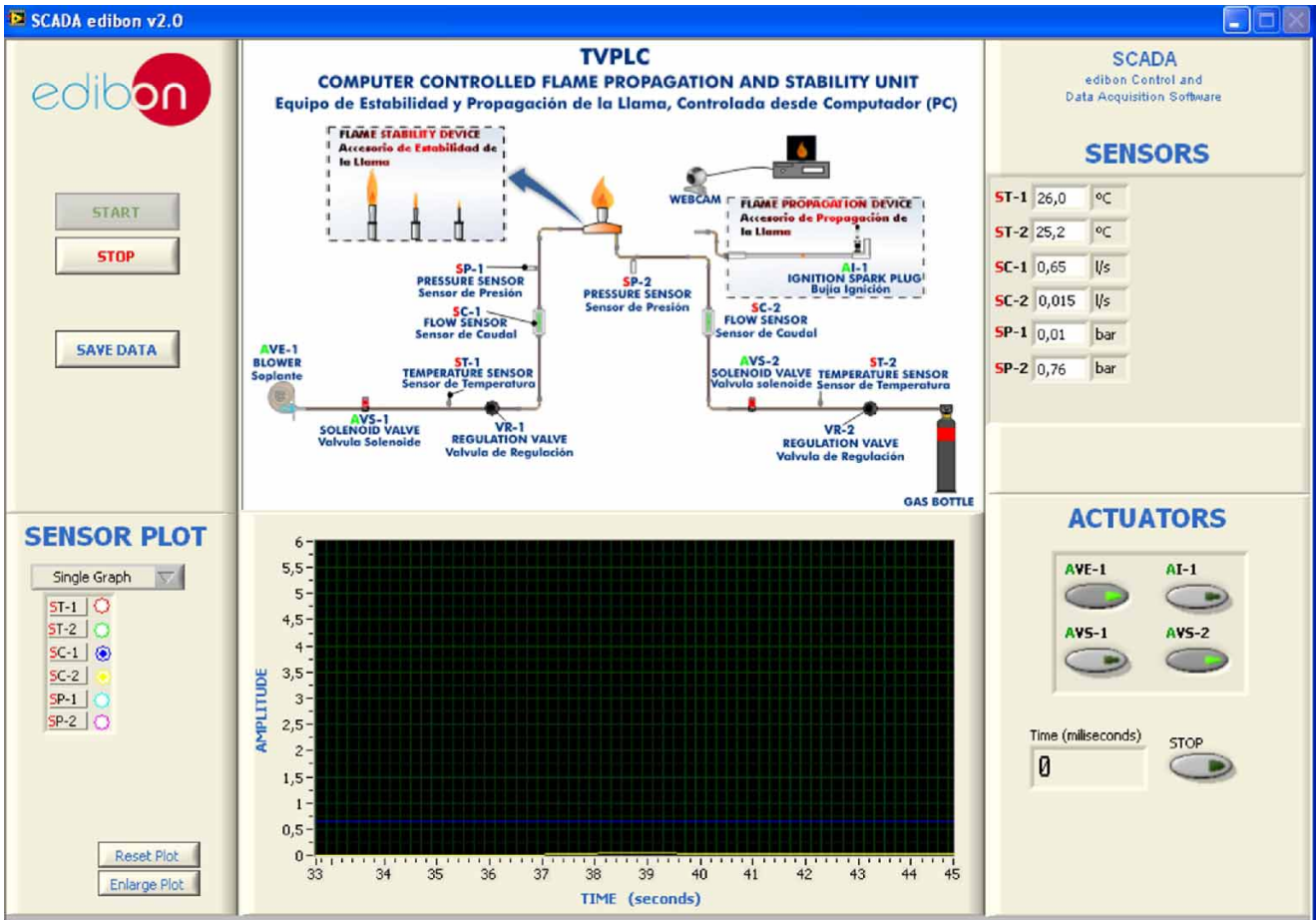
The image shows two calibration screens. The 'CALIBRATION' screen on the left allows for setting sensor parameters for a selected channel (ST-8), including sensor name, units, full scale, gain, and offset. It also features a 'Least Squares Fit' button and a 'PTA' (Proportional Temperature Adjustment) control. The 'MULTICALIBRATE' screen on the right provides a comprehensive view of multiple sensors, listing their reference values, calibrated values, and error percentages. It includes a table of calibration data and buttons for 'ENTER' and 'DONE'.

Reference Select	Sensors	Volts	Calibrated	Err (%)
<input checked="" type="checkbox"/>	ST-1	0,2046	22,3821	0,82
<input checked="" type="checkbox"/>	ST-2	0,2292	23,493	0,28
<input checked="" type="checkbox"/>	ST-3	0,2353	23,1522	0,05
<input checked="" type="checkbox"/>	ST-4	0,2301	23,2113	0,01
<input type="checkbox"/>	ST-4	0,1527	13,1529	10,04
<input type="checkbox"/>	SCC-1	-5,2792	172,5164	149,31
<input type="checkbox"/>	SCC-1	-0,2362	-22,0609	45,87
<input type="checkbox"/>	SD-1	-0,1774	0,0319629	23,17
<input type="checkbox"/>		-0,2681	-60,4623	83,67
<input type="checkbox"/>		-0,2251	0,4208	22,78
<input type="checkbox"/>		-0,2529	-0,2529	23,46
<input type="checkbox"/>		-0,2063	-0,1176	23,32
<input type="checkbox"/>		-0,2581	-226,9384	280,14
<input type="checkbox"/>		-0,3634	-0,3634	23,57
<input type="checkbox"/>		-0,275	-0,275	23,48
<input type="checkbox"/>		-0,2005	-0,2005	23,41

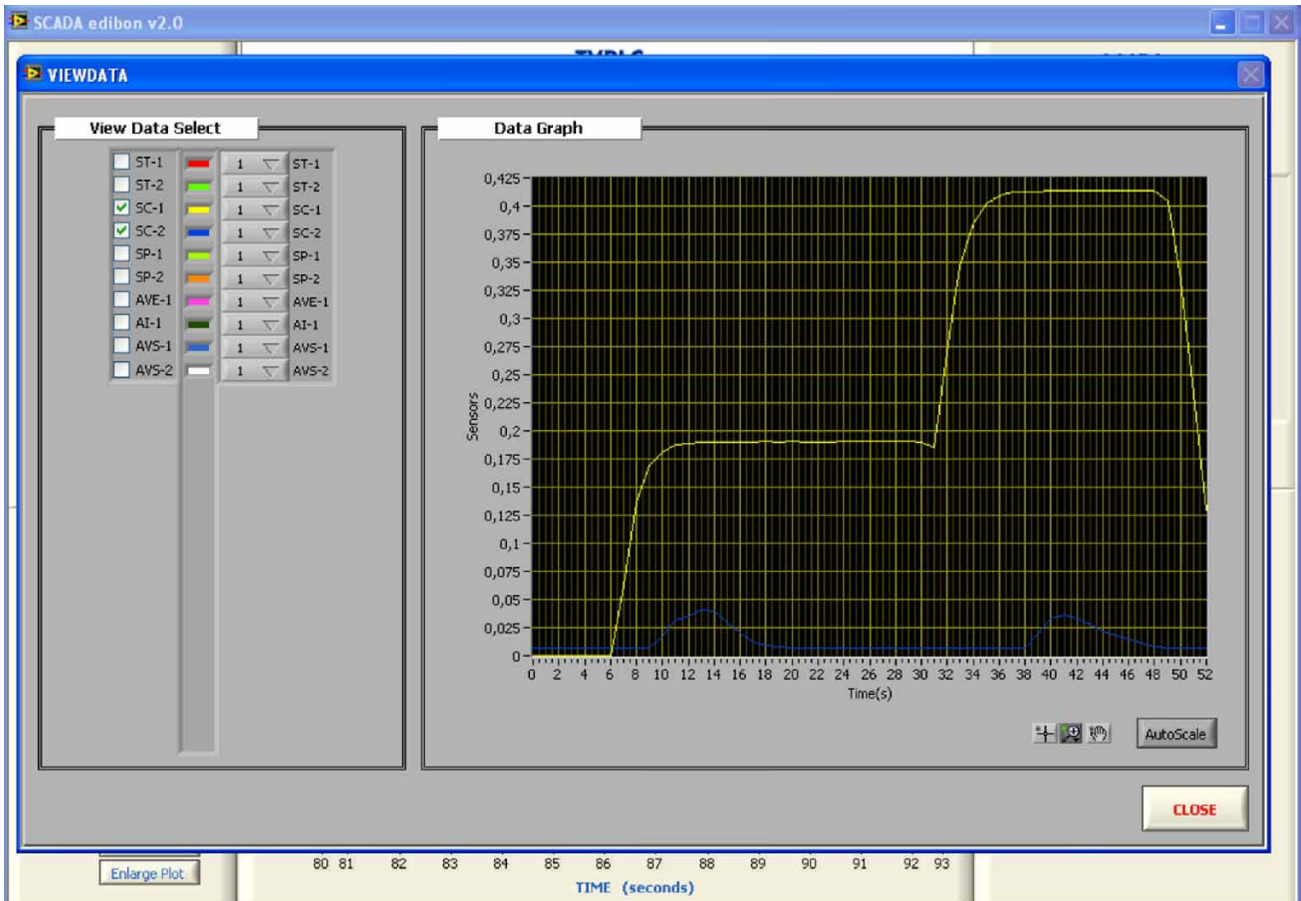
Continue...

Some typical exercises results

We see the sensors values in real time.



VIEWDATA= Graphic visualization for the saved data in a file.



## EXERCISES AND PRACTICAL POSSIBILITIES

### Some Practical Possibilities of the Unit:

- 1.- Study of the flame stability of a burner.
- 2.- Study of the flame stability with stabilizer devices.
- 3.- Demonstration of the process of flame lift off.
- 4.- Demonstration of the process of flame light back.
- 5.- To investigate and to study methods of improving flame stability limits.
- 6.- Study of the data for the construction of flames stability diagrams.
- 7.- To investigate the relationship between flame speed and air/fuel ratio for a variety of gaseous fuels.
- 8.- Study of flame propagation.
- 9.- Practice of Smithells flame propagation.
- 10.- To investigate the vertical and horizontal flame movement.
- 11.- To study the effect of changing cross-section of the burner on flame speed.
- 12.- Effect of directional change on flame speed.
- 13.- To study methods of arresting of moving flames in the flame speed tube.

Other possible practices:

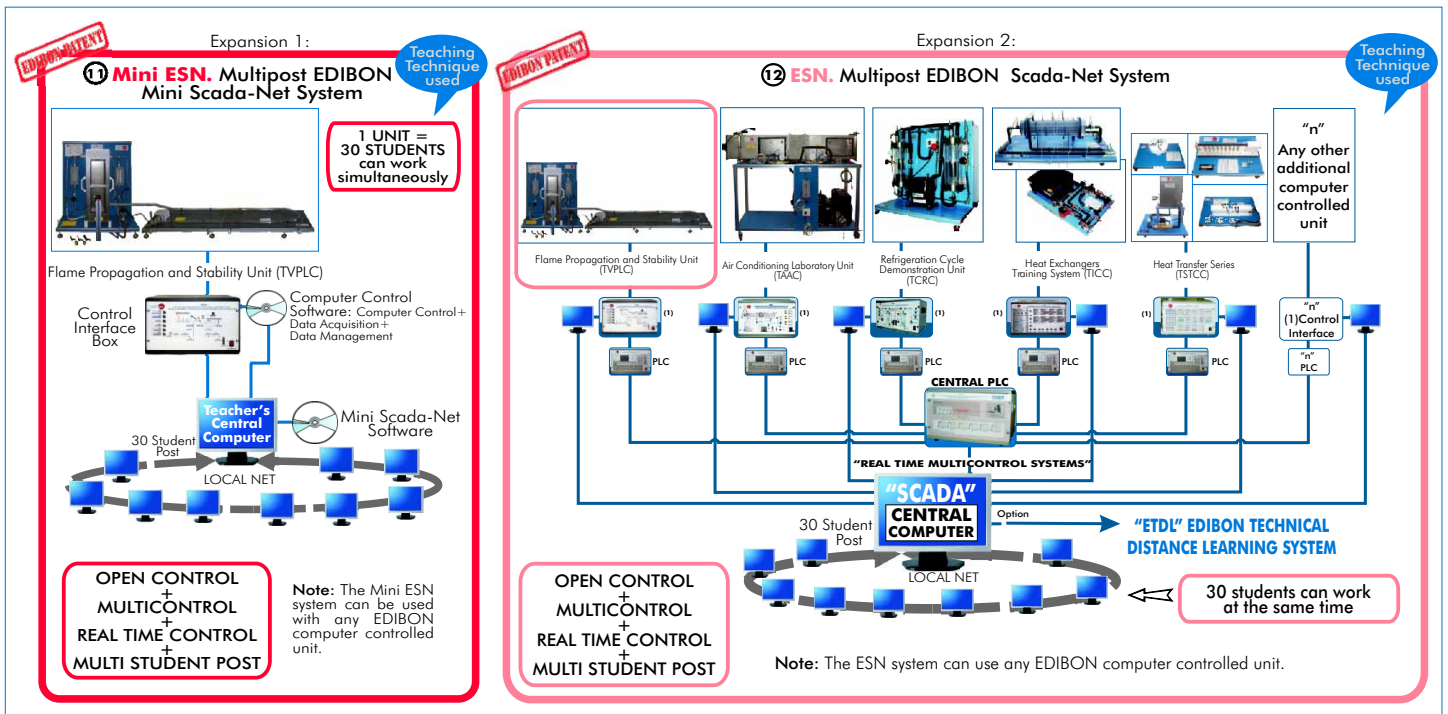
- 14.- Sensors calibration.

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

- 15.- Control of the TVPLC unit process through the control interface box without the computer.
- 16.- Visualization of all the sensors values used in the TVPLC unit process.

- 17.- Calibration of all sensors included in the TVPLC unit process.
- 18.- Hand on of all the actuators involved in the TVPLC unit process.
- 19.- Realization of different experiments, in automatic way, without having in front the unit. (This experiment can be decided previously).
- 20.- 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).
- 21.- PLC hardware general use and manipulation.
- 22.- PLC process application for TVPLC unit.
- 23.- PLC structure.
- 24.- PLC inputs and outputs configuration.
- 25.- PLC configuration possibilities.
- 26.- PLC program languages.
- 27.- PLC different programming standard languages.
- 28.- New configuration and development of new process.
- 29.- Hand on an established process.
- 30.- To visualize and see the results and to make comparisons with the TVPLC unit process.
- 31.- Possibility of creating new process in relation with the TVPLC unit.
- 32.- PLC Programming Exercises.
- 33.- 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: TVPLC. Flame Propagation and Stability Unit.
- ② TVPLC/CIB. Control Interface Box.
- ③ DAB. Data Acquisition Board.
- ④ TVPLC/CCSOF. Computer Control + Data Acquisition + Data Management Software.
- ⑤ Cables and Accessories, for normal operation.
- ⑥ Manuals.

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

#### Additional and optional items to the standard supply

- PLC. Industrial Control using PLC (7 and 8):
- ⑦ PCL-PI. PLC Module.
- ⑧ TVPLC/PLC-SOF. PLC Control Software.
- ⑨ TVPLC/CAL. Computer Aided Learning Software (Results Calculation and Analysis). (Available on request).
- ⑩ TVPLC/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.
- Exhaust gases extractor.
- Computer (PC).

## DIMENSIONS & WEIGHTS

### TVPLC Unit:

- Unit: -Dimensions: 700 x 500 x 800 mm. approx.
- Weight: 80 Kg. approx.

### -Flame Propagation Accessory:

- Dimensions: 2000 x 500 x 150 mm. approx.
- Weight: 30 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.



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](http://www.edibon.com)

Issue: ED01/11  
Date: July/2011

REPRESENTATIVE: