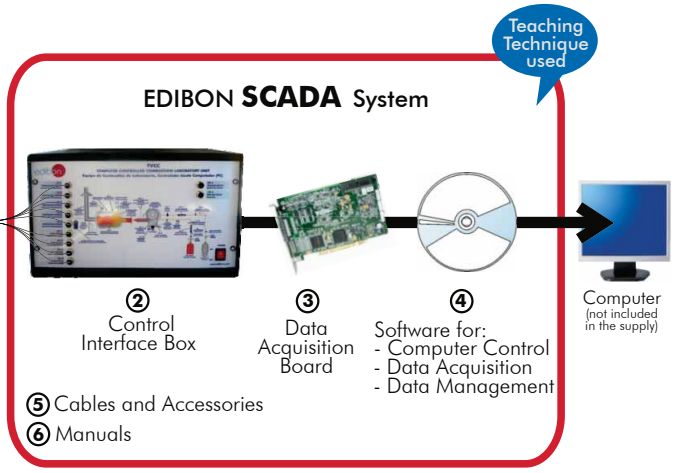
edibon
Technical Teaching Equipment

Computer Controlled **Combustion Laboratory Unit,** with SCADA

TVCC

EDIBON PATENT



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

① Unit: TVCC. Combustion Laboratory Unit

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.**

OPEN CONTROL
+
MULTICONTROL
+
REAL TIME CONTROL

www.edibon.com
Products
Products range
Units
9.-Thermodynamics & Thermotechnics

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 TVCC unit enables the students the study and understanding of many aspects related to combustion, using a small scale unit based on an industrial dual burner.

The TVCC combustion unit is mounted on a metallic structure that enables a safe access to the equipment and an easy handling and access to the burner, combustion chamber and all the accessories and control panels.

The burner starts the combustion with light-oil (diesel or gas-oil) or with gas (natural gas or LPG). The gas (either from a LPG cylinder or from the premises' supply) and fuel-oil stored in two tanks provided with the unit are fed to the burner through suitable ducts and valves. Both lines include their corresponding filter and the appropriate safety measures.

Prior to the combustion start, the burner begins with an air purge, later on it burns the corresponding fuel and, automatically, it is set to a safe working conditions.

The burner has an integrated fan that provides the air required for the combustion, a flame detection sensor and an ignition controller. This fan has a differential pressure sensor to measure the air flow provided, a thermocouple to determine its temperature and a regulator for the air flow to be introduced in the burner.

The flame burns inside a stainless steel combustion chamber cooled with water. Such chamber has 5 observation points (of 100 mm.) at their sides which allow to observe the flame.

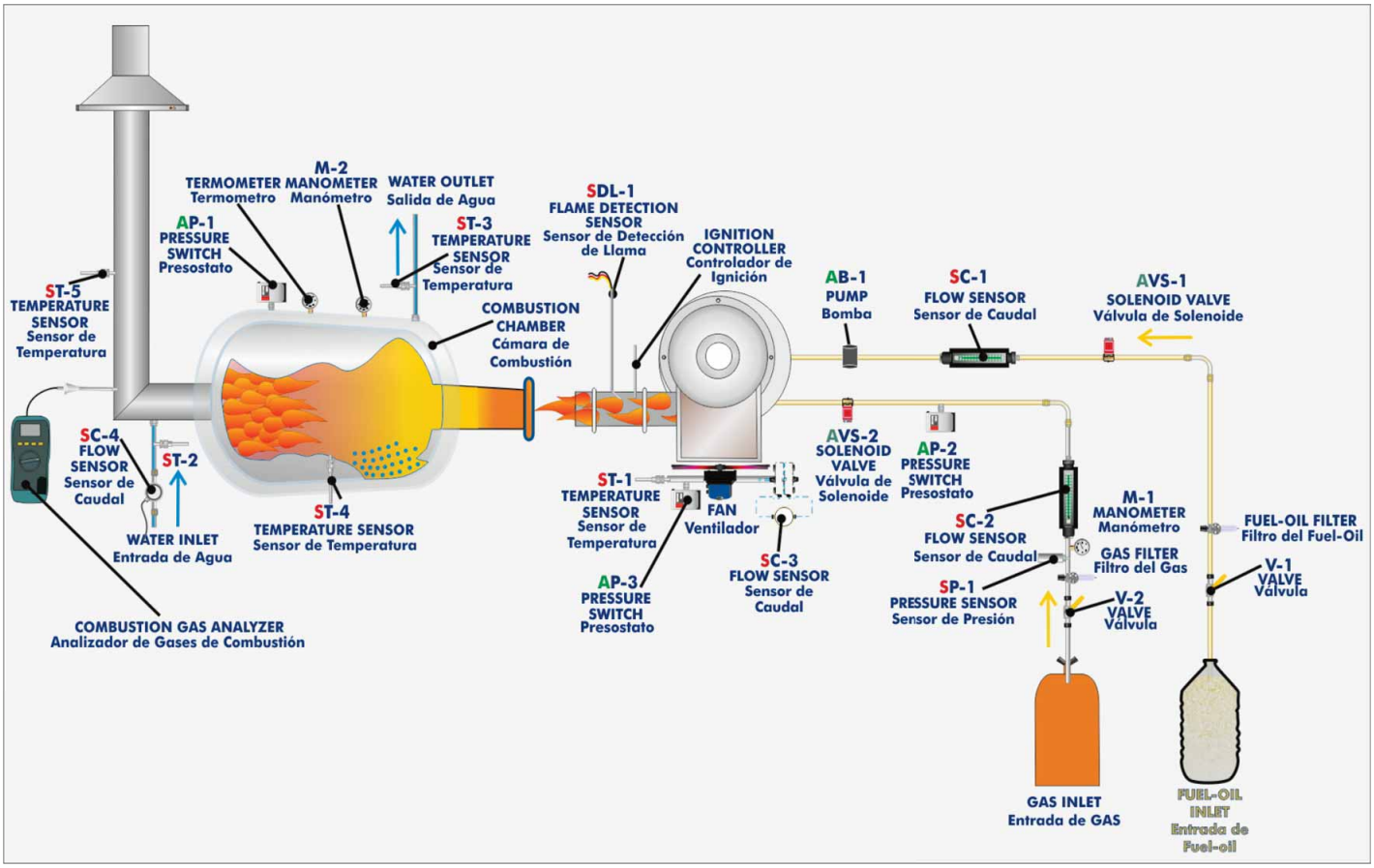
The unit also includes a manual digital analyzer for the combustion fumes. It allows to determine the composition of such gases, the air excess, content in O_2, CO, CO_2 and CO/CO_2 ratio.

This way, students can study the effect of the fuel/air ratio in the characteristics of the flame, in the efficiency of the combustion, in the constituents of the combustion fumes, etc., as well as the influence of all these aspects in the use of different fuels.

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 and Data Acquisition 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



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 TVCC. Unit:

Metallic structure that guarantees a good stability and resistance.

Diagram in the front panel with similar distribution to the elements in the real unit.

Stainless steel combustion chamber (700 mm. x 1100 mm.) with 5 pieces of 100 mm. diameter for the observation points.

Cooling jacket with thermometer, manometer and pressure switch to avoid overpressure in the jacket.

Dual burner of 150 kW to work both with natural gas (or other LPG) and fuel-oil.

Fan integrated in the burner with a regulating lever for the air flow.

The natural gas line includes:

- Manual valve.
- Gas filter.
- Pressure sensor, range: 0-10 bar.
- Pressure regulator, range: 0-3 bar.
- Manometer, range: 0 - 400 mbar.
- Electronic solenoid valve and safety pressure switch.
- Flow sensor, range: 3-21 m^3/h.
- Needle valve to regulate the gas inlet flow.

The fuel oil line includes:

- Manual valve.
- Electronic solenoid valve.
- Flow sensor, range: 4-38 Kg/h.
- Needle valve to regulate the liquid fuel inlet flow.
- 2 Storage and supply tanks for the fuel-oil.
- Suction pump of the fuel into the burner.

TVCC. Unit

Air ventilation, safety and drain valves.

5 Temperature sensors: combustion chamber, cooling water inlet and outlet, combustion fumes outlet and air inlet to the burner.

4 Flow sensors: natural gas inlet, light-oil inlet, cooling water flow inlet (range: 1.5 - 30 l./min.) and air inlet (by means of a differential pressure sensor, range: 0-1 PSI).

1 Pressure sensor: natural gas inlet, range: 0-10 bar.

Combustion gases analyzer: measurement of the content in O_2, CO and CO_2, efficiency of the combustion, air excess and CO/CO_2 ratio.

2 Solenoid valves, one for each working flow: gas or fuel-oil.

Flame detection sensor and ignition controller.

Safety measures. The feeding to the burner is cut off when:

- The outlet water temperature exceeds 80°C.
- The pressure of the cooling jacket exceeds 1 bar.
- A water flow higher than 5 l./min is not detected.

The unit includes wheels for its mobility.

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.

②TVCC/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.

TVCC/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.

③DAB. Data Acquisition Board:

The Data Acquisition board is part of the SCADA system.

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. DMA channels=6.

DAB

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

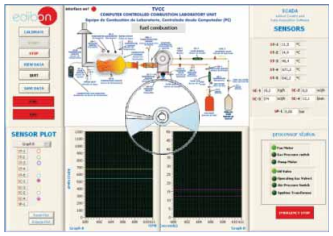
④TVCC/CCSOF. Computer Control +Data Acquisition+Data Management Software:

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.

Flexible, open and multicontrol software, developed with actual windows graphic systems, acting simultaneously on all process parameters.



TVCC/CCSOF

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.

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

EXERCISES AND PRACTICAL POSSIBILITIES TO BE DONE WITH MAIN ITEMS

1.- Study of the combustion process and the burner operation.

2.- Familiarisation of the adjustment and operation of an oil or gas burner.

3.- Effect of the air/fuel ratio both in the efficiency of the combustion and in the measuring of the combustion gases components and in the temperature.

4.- Effect of the air/fuel ratio on energy balance.

5.- Effect of the air/fuel ratio on heat transfer.

6.- Effect of the flame radiation on heat transfer and observed temperature.

7.- Comparison of flue gas analysis with theoretical predictions.

8.- Comparison of the performance of different fuels.

9.- Assessment of a burner, including:

Flame stability.

Flame shape.

Flame radiation.

Firing rate.

Turndown range.

Smoke emission.

10.- Comparison between a gas burner and a gas-oil burner.

Additional practical possibilities:

11.- Sensors calibration.

Other possibilities to be done with this Unit:

12.- Many students view results simultaneously.

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

13.- 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.

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

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

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

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

18.- Control of the TVCC unit process through the control interface box without the computer.

19.- Visualization of all the sensors values used in the TVCC 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, 220 V/50 Hz. or 110 V/60 Hz.
- Water supply.
- Gas: natural gas or LPG. Minimum flow of 7 m^3/h at a pressure of 2 bar.
- Gas-oil: kerosene, diesel or other light fuel (approximate density between 790-840 kg/m^3 and viscosity between 0.011-0.055 cm^2/s at 40°C). Minimum flow: 10 kg/h.
- Exhaust pipe for combustion fumes.
- Computer.

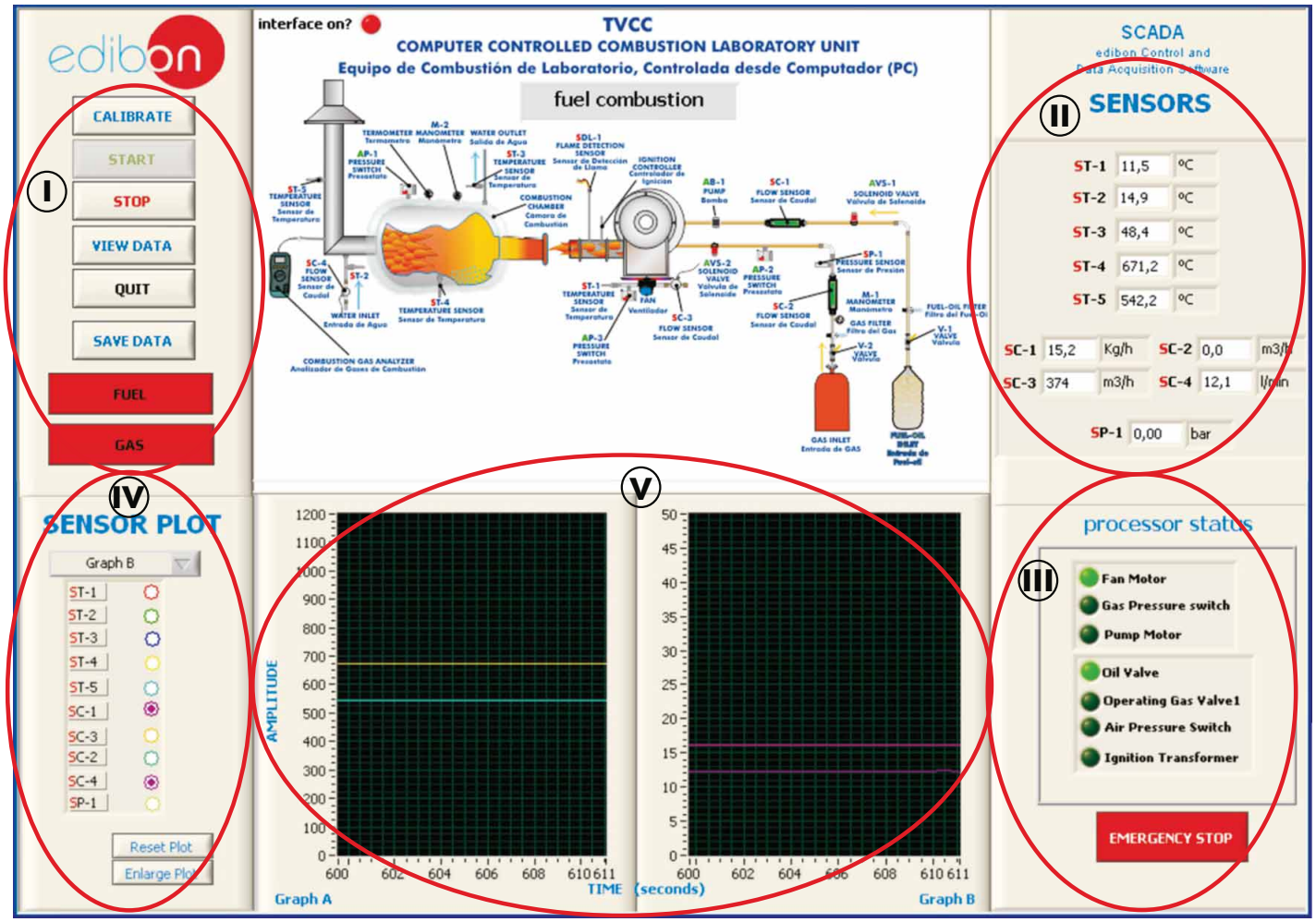
DIMENSIONS & WEIGHTS

TVCC:

Unit:	-Dimensions:	2200x1000x1900mm.approx. (86.61 x 39.37 x 74.80 inches approx.).
	-Weight:	400 Kg. approx. (881.8 pounds approx.).
Control Interface Box:	-Dimensions:	490 x 330 x 310 mm. approx. (19.29 x 13 x 12.20 inches approx.).
	-Weight:	10 Kg. approx. (22 pounds approx.).

SCADA

Main screen



Ⓘ Main software operation possibilities.

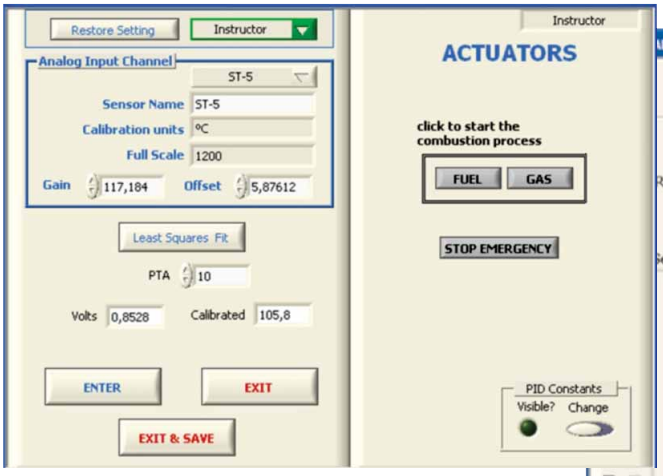
Ⓘ Ⓘ Sensors displays, real time values, and extra output parameters. **Sensors:** ST=Temperature sensor. SC=Flow sensor. SP=Pressure sensor.

Ⓘ Ⓘ Ⓘ Visualization of the actuator's operation and status.

Ⓘ Ⓥ Channel selection and other plot parameters.

Ⓥ Real time graphics displays.

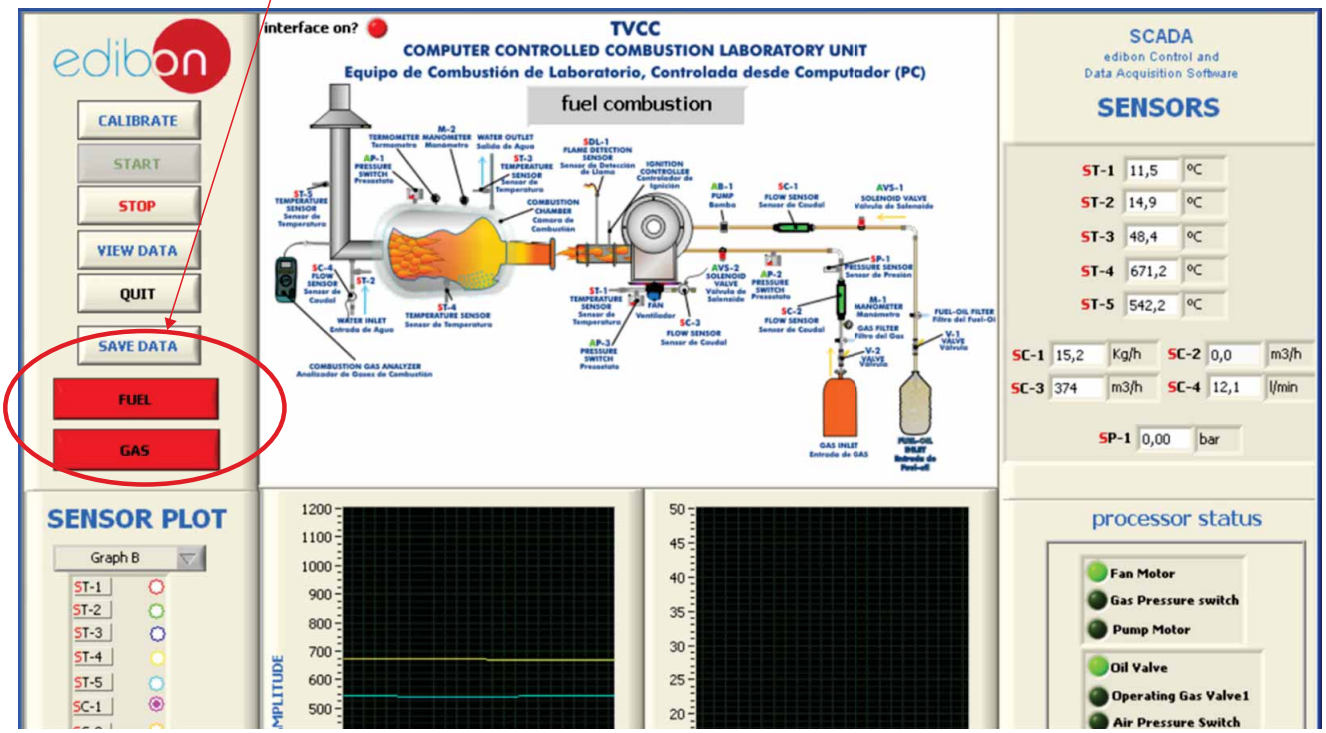
Software for Sensors Calibration



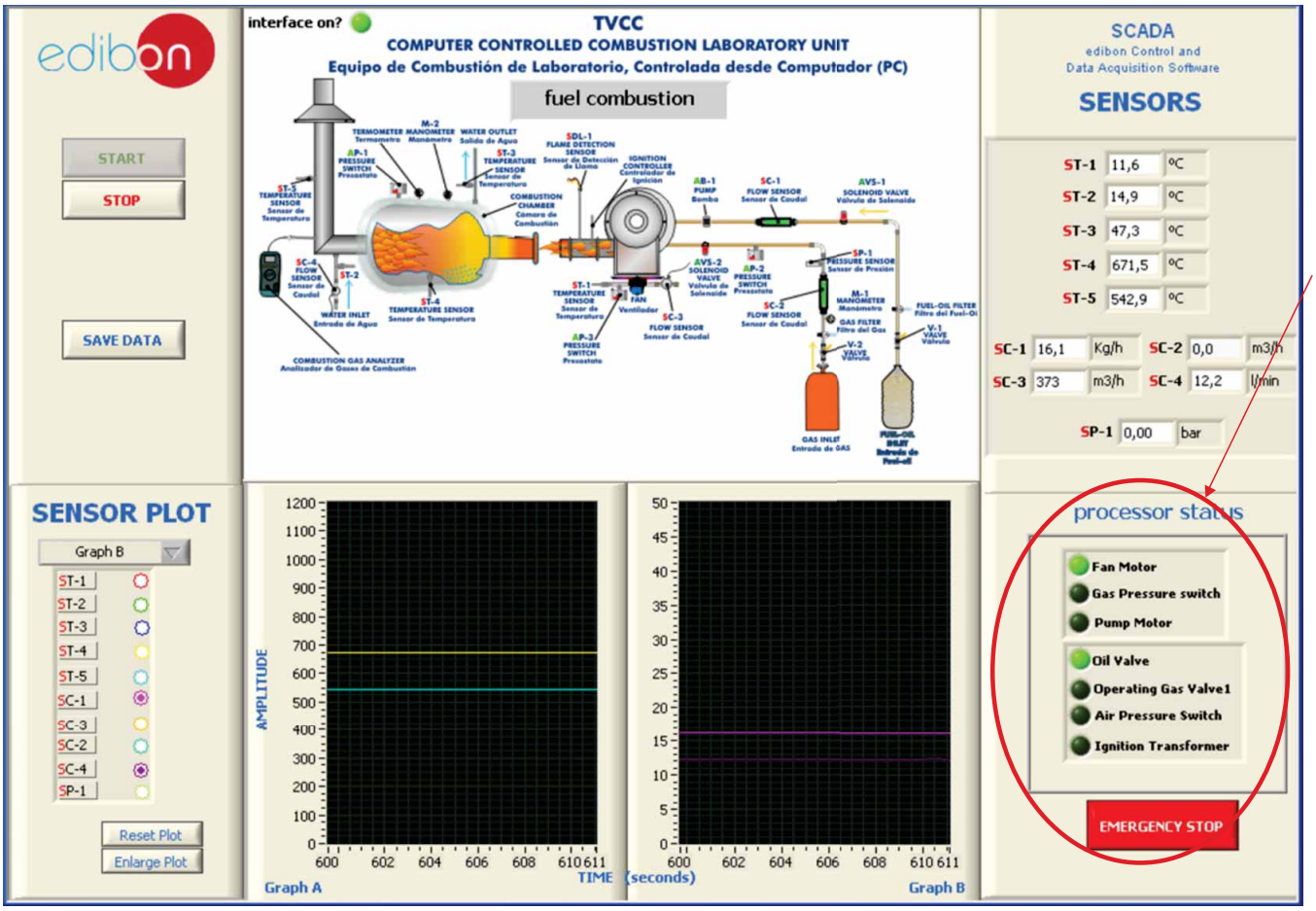
By using a free of charge code, the teacher and the students can calibrate the unit.

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

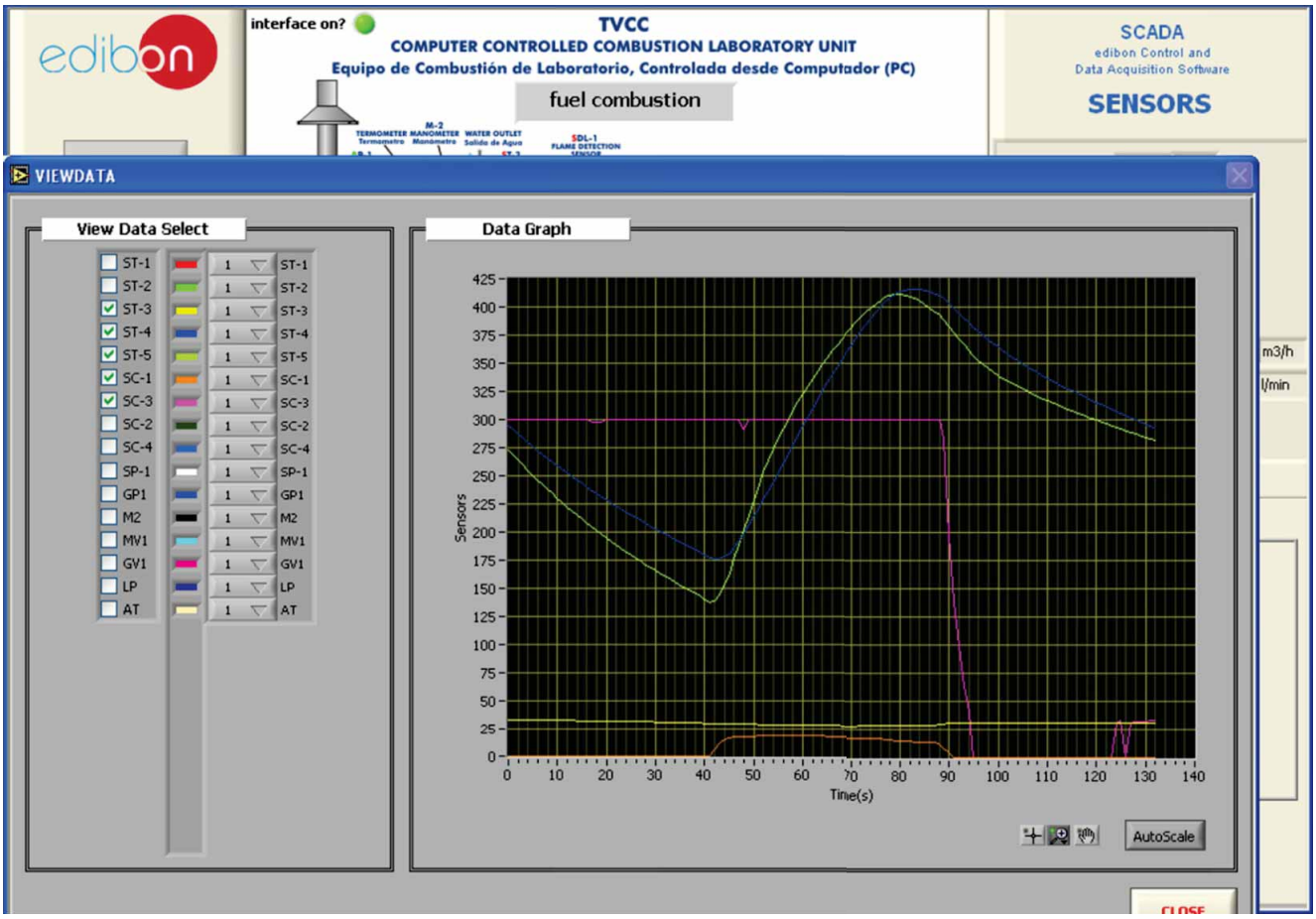
Running the software of the TVCC unit and pressing Start, the software gives the possibility to the user of choosing the fuel with which he/she wants to work: Fuel-oil or gas fuel.



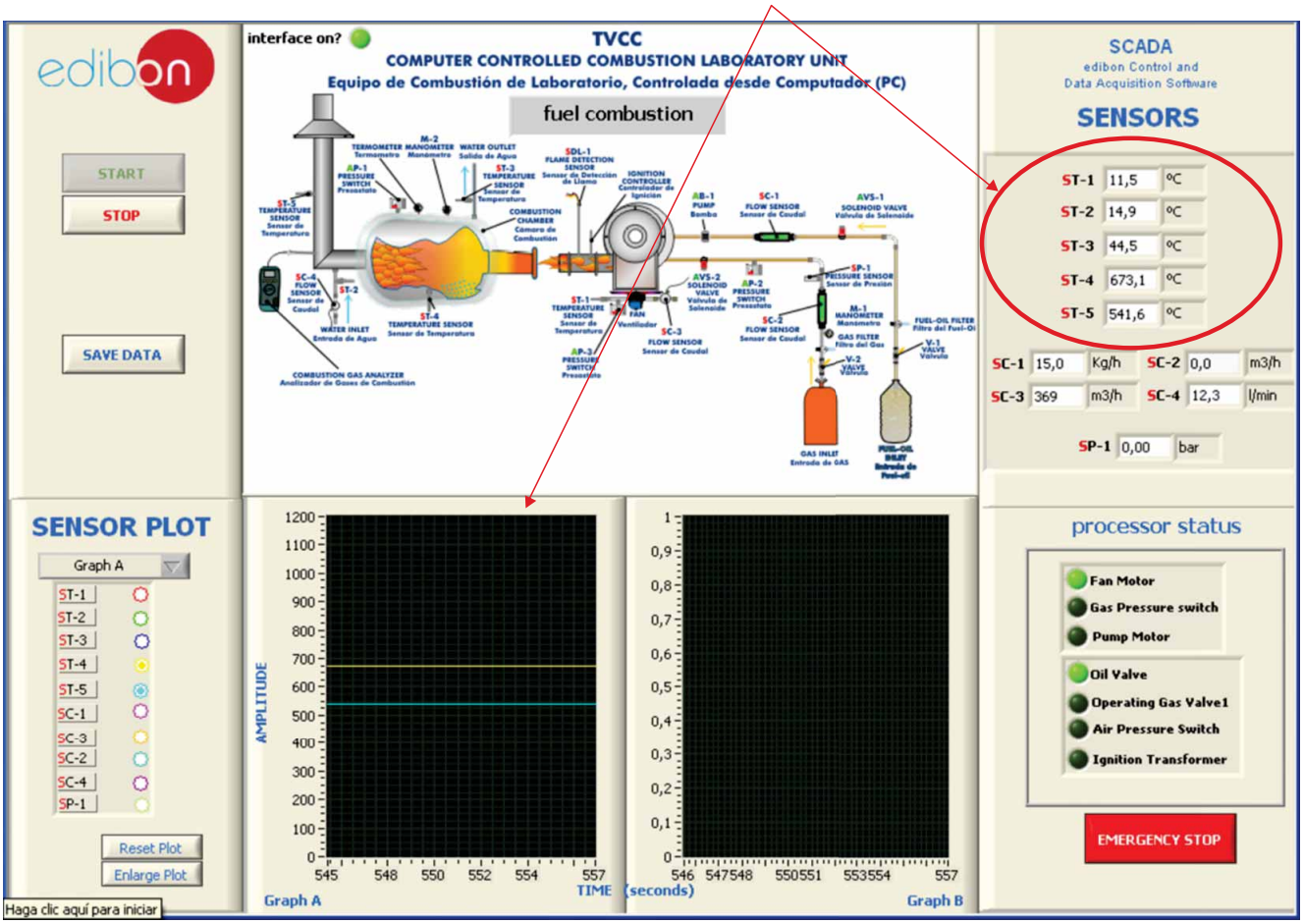
The state of the different elements of the unit (fan, solenoid valves, pressure switches, ignition controller, etc.) can be displayed in the software of the TVCC unit.



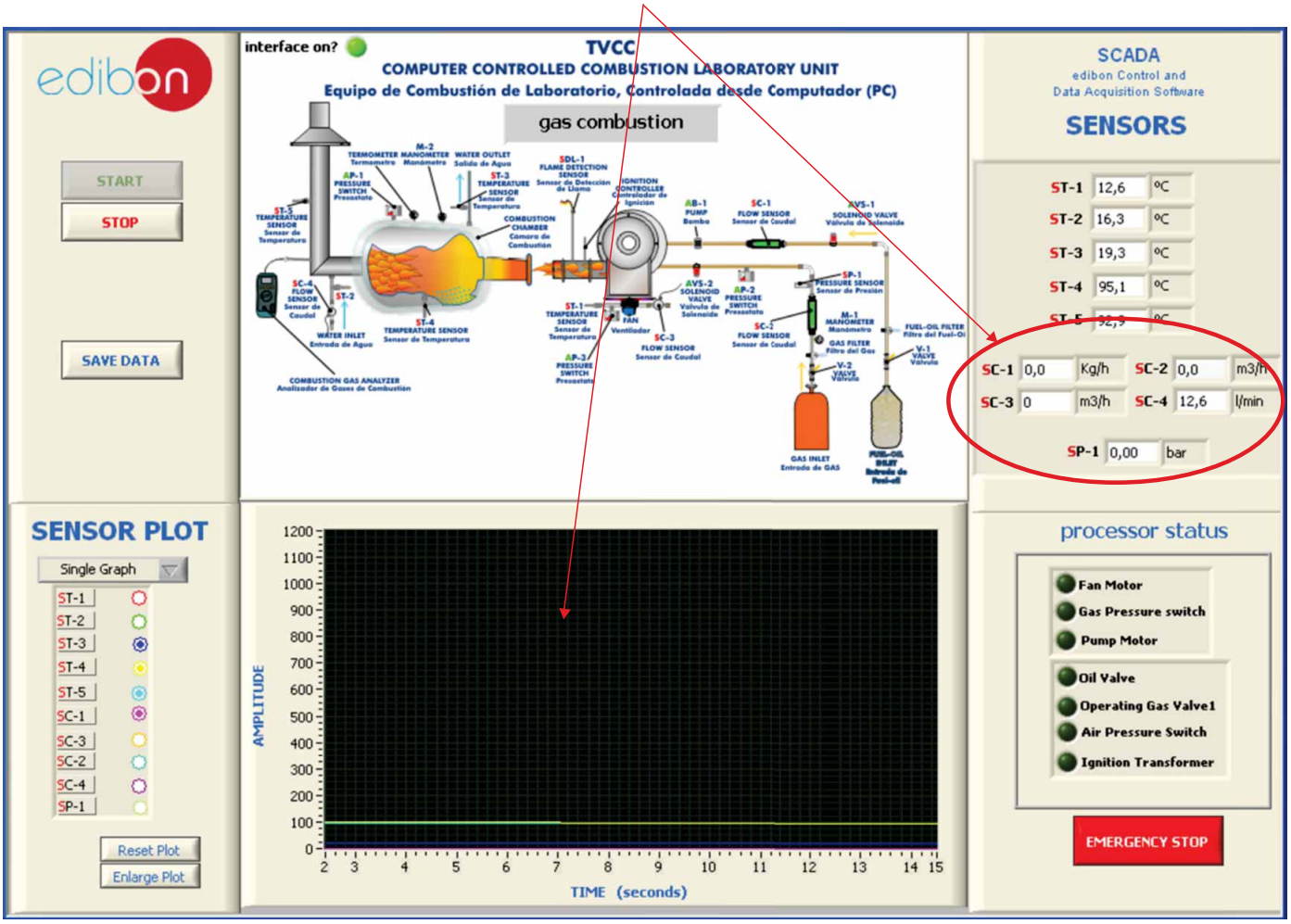
Data collected by sensors can be represented in function of time.



During the combustion process the software of the TVCC unit makes it possible to display the temperature at Key points of the unit (from ST-1 to ST-5). The evolution along the process can be seen either numerically or graphically, representing the data as they are collected.



During the main practical exercises with the unit, the fuel/air ratio is changed and the influence of this change in different parameters is studied. It is possible to display with the software every flow which have influence on the process: air, cooling water, fuel-oil, and fuel gas. They can be either numerically or graphically displayed.



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

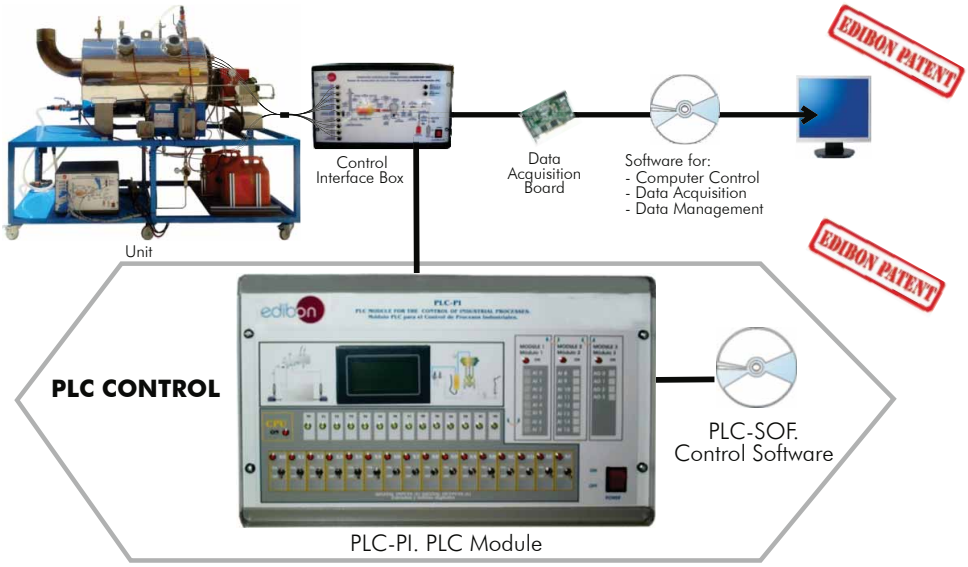
⑦ PLC. Industrial Control using PLC (it includes PLC-PI Module plus PLC-SOF Control Software):

-**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 13 x 12.20 inches approx.) Weight: 30 Kg. approx. (66 pounds approx.)

-**TVCC/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 Combustion Combustion Laboratory Unit (TVCC).



Practices to be done with PLC-PI:

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

b) Technical and Vocational Education configuration

⑧TVCC/CAI. Computer Aided Instruction Software System.

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

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

This complete package consists on an Instructor Software (INS/SOF) totally integrated with the Student Software (TVCC/SOF). Both are interconnected so that the teacher knows at any moment what is the theoretical and practical knowledge of the students. These, on the other hand, get a virtual instructor who helps them to deal with all the information on the subject of study.

- 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.

Print reports.

Develop own examinations.

Detect student's progress and difficulties.

...and many other facilities.

Instructor Software

- TVCC/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.

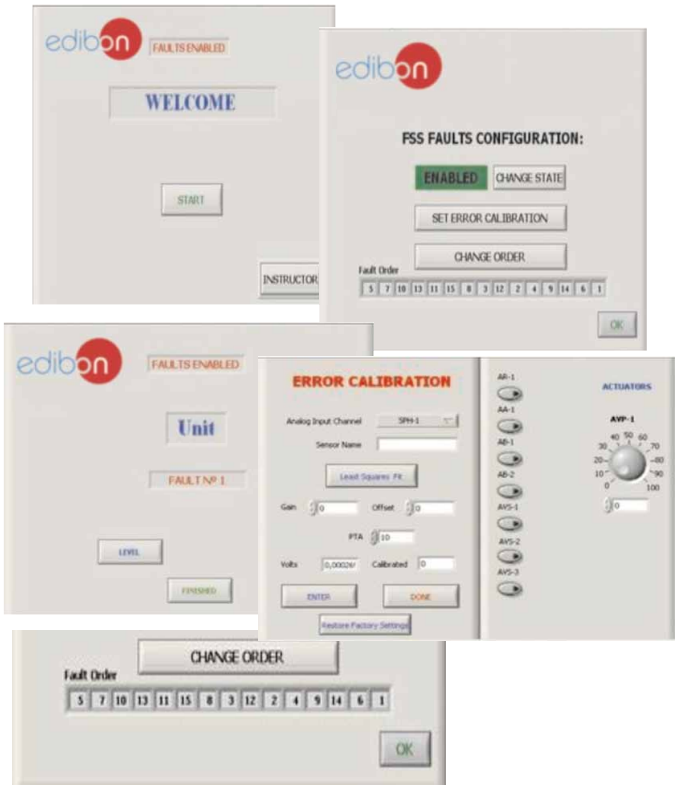
Exams.

Student Software

For more information see **CAI** catalogue. Click on the following link:
www.edibon.com/products/catalogues/en/CAI.pdf

⑨TVCC/FSS. Faults Simulation System.

Example of some screens



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 canals 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.

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

⑩TVCC/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 making the necessary calculations to extract the right conclusions from data obtained during the experimental practices.

CAL will perform the calculations.

CAL computes the value of all the variables involved.

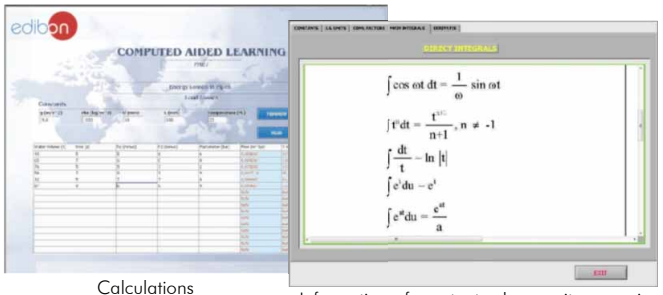
It allows to plot and print the results. Between the plotting options, any variable can be represented against any other.

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:

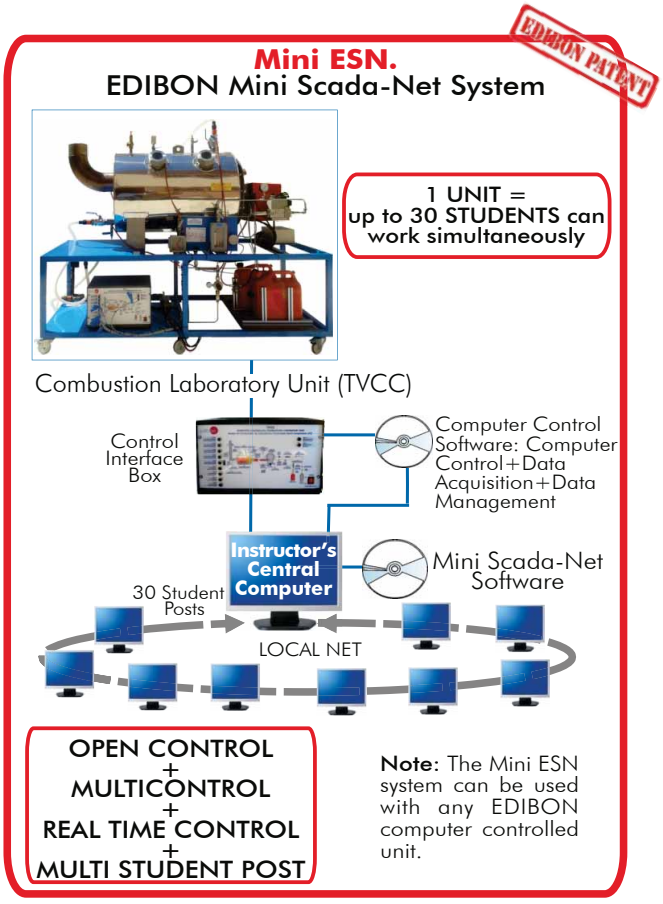
- **It allows up to 30 students to work simultaneously with the EDIBON Computer Controlled Unit with SCADA, connected in a local net.**
- **Open Control + Multicontrol + Real Time Control + Multi Student Post.**
- **Instructor controls and explains to all students at the same time.**
- **Any user/student 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



⑫ESN. EDIBON Scada-Net System.

This unit can be integrated, in future, in 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/thermodynamicsthermotechnics/esn-thermodynamics/ESN-THERMODYNAMICS.pdf

ORDER INFORMATION

Main items (always included in the supply)

Minimum supply always includes:

① **Unit: TVCC. Combustion Laboratory Unit.**

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

③ **DAB. Data Acquisition Board.**

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

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

⑥ **Manuals.**

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

b) Technical and Vocational configuration

⑧ TVCC/CAI. Computer Aided Instruction Software System.

⑨ TVCC/FSS. Faults Simulation System.

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

⑩ TVCC/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 TVCC. Unit:

Metallic structure that guarantees a good stability and resistance.
Diagram in the front panel with similar distribution to the elements in the real unit.
Stainless steel combustion chamber (700 mm. x 1100 mm.) with 5 pieces of 100 mm. diameter for the observation points.
Cooling jacket with thermometer, manometer and pressure switch to avoid overpressure in the jacket.
Dual burner of 150 kW to work both with natural gas (or other LPG) and fuel-oil.
Fan integrated in the burner with a regulating lever for the air flow.
The natural gas line includes:
- Manual valve. Gas filter.
- Pressure sensor, range: 0-10 bar. Pressure regulator, range: 0-3 bar. Manometer, range: 0 - 400 mbar.
- Electronic solenoid valve and safety pressure switch.
- Flow sensor, range: 3-21 m^3/h.
- Needle valve to regulate the gas inlet flow.

The fuel oil line includes:
- Manual valve. Electronic solenoid valve.
- Flow sensor, range: 4-38 Kg/h.
- Needle valve to regulate the liquid fuel inlet flow.
- 2 Storage and supply tanks for the fuel-oil.
- Suction pump of the fuel into the burner.

Air ventilation, safety and drain valves.
5 Temperature sensors: combustion chamber, cooling water inlet and outlet, combustion fumes outlet and air inlet to the burner.
4 Flow sensors: natural gas inlet, light-oil inlet, cooling water flow inlet (range: 1.5 - 30 l./min.) and air inlet (by means of a differential pressure sensor, range: 0-1 PSI).
1 Pressure sensor: natural gas inlet, range: 0-10 bar.
Combustion gases analyzer: measurement of the content in O_2, CO and CO_2, efficiency of the combustion, air excess and CO/CO_2 ratio.
2 Solenoid valves, one for each working flow: gas or fuel-oil.
Flame detection sensor and ignition controller.
Safety measures. The feeding to the burner is cut off when:
- The outlet water temperature exceeds 80ºC.
- The pressure of the cooling jacket exceeds 1 bar.
- A water flow higher than 5 l./min is not detected.

The unit includes wheels for its mobility.
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.

② TVCC/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 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 TVCC/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.- Study of the combustion process and the burner operation.

2.- Familiarisation of the adjustment and operation of an oil or gas burner.

3.- Effect of the air/fuel ratio both in the efficiency of the combustion and in the measuring of the combustion gases components and in the temperature.

4.- Effect of the air/fuel ratio on energy balance.

5.- Effect of the air/fuel ratio on heat transfer.

6.- Effect of the flame radiation on heat transfer and observed temperature.

7.- Comparison of flue gas analysis with theoretical predictions.

8.- Comparison of the performance of different fuels.

9.- Assessment of a burner, including:

- Flame stability.
- Flame shape.
- Flame radiation.
- Firing rate.
- Turndown range.
- Smoke emission.

10.- Comparison between a gas burner and a gas-oil burner.

Additional practical possibilities:

11.- Sensors calibration.

Other possibilities to be done with this Unit:

12.- Many students view results simultaneously.

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

13.- 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.

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

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

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

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

18.- Control of the TVCC unit process through the control interface box without the computer.

19.- Visualization of all the sensors values used in the TVCC 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.

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

b) Technical and Vocational Education configuration

⑧ TVCC/CAI. Computer Aided Instruction Software System.

This complete package consists on an Instructor Software (INS/ SOF) totally integrated with the Student Software (TVCC/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.
Print reports.
Develop own examinations.
Detect student's progress and difficulties.
-TVCC/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 TVCC/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 canals 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

⑩TVCC/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 making the necessary calculations to extract the right conclusions from data obtained during the experimental practices.
CAL will perform the calculations.
CAL computes the value of all the variables involved.
It allows to plot and print the results. Between 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.
-Intructor 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.

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