Computer Controlled
Saturation Pressure Unit,
with SCADA

TSPC

EDIBON PATENT

Teaching Technique used

EDIBON **SCADA** System

① Unit: TSPC. Computer Controlled Saturation Pressure Unit

② Control Interface Box

③ Data Acquisition Board

④ Software for:
- Computer Control
- Data Acquisition
- Data Management

⑤ Cables and Accessories

⑥ Manuals

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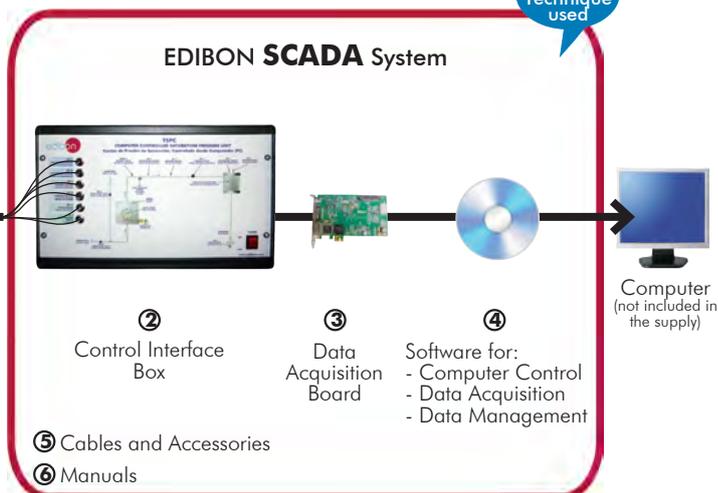
* Minimum supply always includes: 1 + 2 + 3 + 4 + 5 + 6
(Computer not included in the supply)

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 ICAI software to create, edit and carry out practical exercises, tests, exams, calculations, etc. Apart from monitoring user's knowledge and progress reached.**

➢ **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

POWERED BY NATIONAL INSTRUMENTS
LabVIEW™

www.edibon.com
⤷PRODUCTS
⤷9.- THERMODYNAMICS & THERMOTECHNICS

For more information about Key Features, click here

INTRODUCTION

When energy increases in water, an increment of the activity between molecules is generated. This causes an increase of the number of molecules that escape from the surface, until the equilibrium state is reached.

Such equilibrium state depends on the pressure between the water surface and the vapor. Molecules found in the water surface can escape more easily at a low pressure, requiring a smaller amount of energy to reach the equilibrium state (boiling point). The temperature at a given pressure at which the equilibrium is reached is known as saturation temperature. There is a single saturation temperature value for a saturation pressure and vice versa.

The Computer Controlled Saturation Pressure Unit, "TSPC", is a unit designed to demonstrate the water temperature behavior, as well as the change of the boiling point when there is a variation in pressure. Saturation curves can be obtained with this unit. Besides, the content of water in the wet steam generated by a throttling calorimeter can be determined (steam quality).

GENERAL DESCRIPTION

The Computer Controlled Saturation Pressure Unit, "TSPC", consists of a water boiler, including a computer controlled immersion heating element, and a sight glass to observe the boiling patterns in the water surface and control the water level in the boiler.

The saturated steam formed in the boiler passes through a throttle valve and is expanded to atmospheric pressure in a throttling calorimeter with the purpose of determining the dryness fraction of the saturated steam.

The temperature and pressure are measured after the boiler to determine the properties of the saturated steam, and after the expansion in the throttling calorimeter. In addition, a force sensor measures the weight of the condensed water.

The unit includes all the safety measures required for a safe operation, such as relief valve and pressure switch to limit the working pressure, and transparent protection panels.

TSPC detail

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, Data Acquisition and Data Management Software Packages, for controlling the process and all parameters involved in the process.
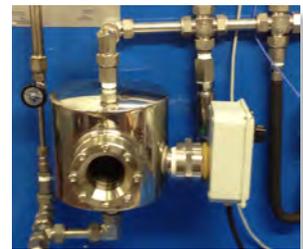
PROCESS DIAGRAM AND UNIT ELEMENTS ALLOCATION
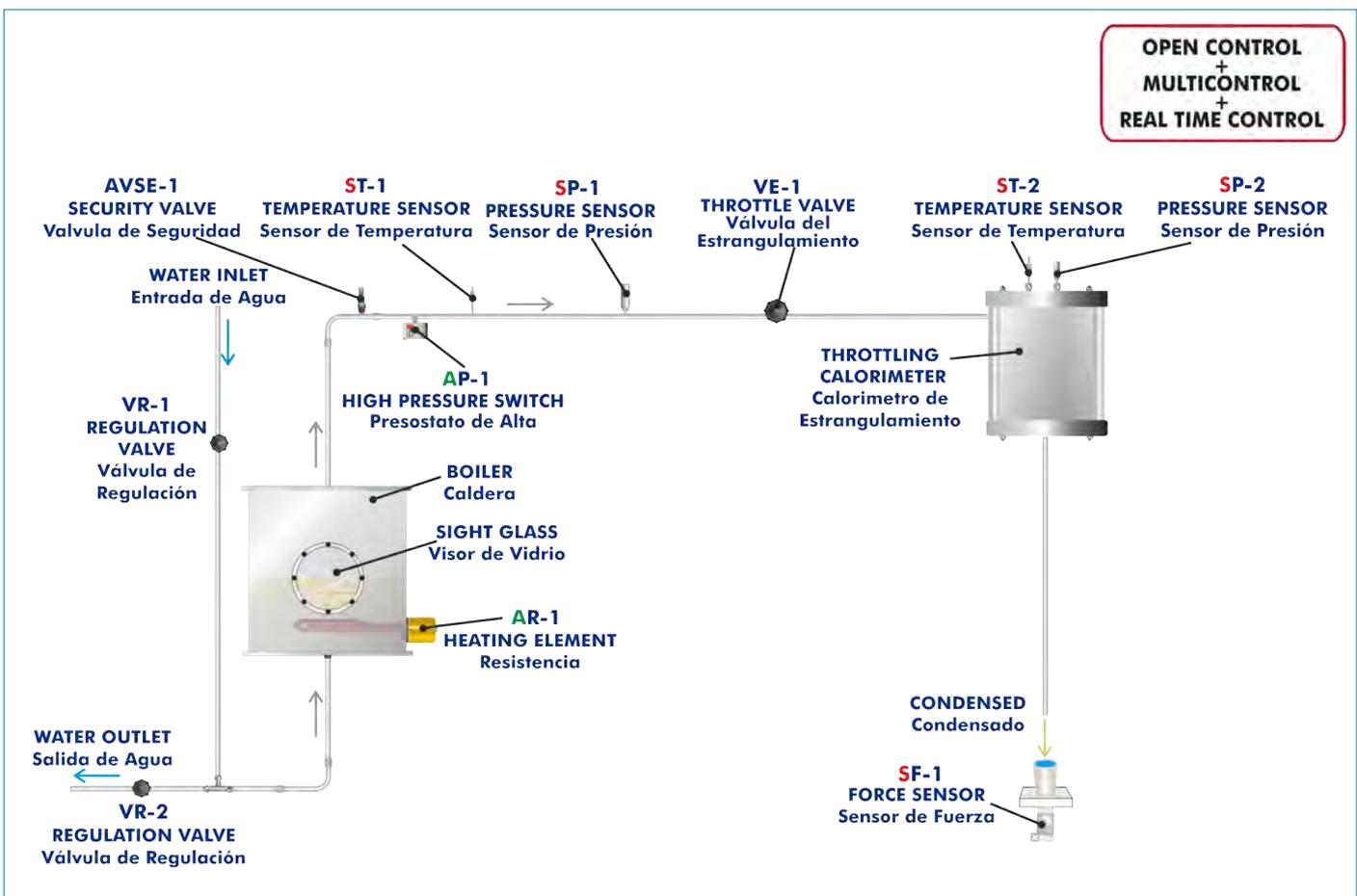
With this unit there are several options and possibilities:

  - Main items: 1, 2, 3, 4, 5 and 6.

  - Optional items: 7, 8, 9 and 10.

Let us describe first the main items (1 to 6):

① **TSPC. Unit:**

Unit: TSPC

Bench-top unit.

Anodized aluminum structure and panels of painted steel.

Main metallic elements of stainless steel.

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

Water boiler including:

  Computer controlled immersion heating element, power: 1000 W.

  Sight glass to observe the boiling patterns at the surface and control the water level.

Throttling calorimeter with throttling valve.

Water filling valve in the boiler.

Valve for emptying the water.

Two "J type" temperature sensors to measure the steam temperature at the boiler's outlet and the steam temperature in the throttling calorimeter.

Two pressure sensors to measure the steam pressure at the boiler's outlet and the steam pressure in the throttling calorimeter, range: 0 - 10 bar.

Force sensor to measure the weight of condensed water, range: 0 - 2 kg.

Safety valve to limit the working pressure to 8 bars.

High pressure switch.

Graduated glass beaker, capacity: 1 l.

This unit is protected by methacrylate sheets with orifices to allow handling the valves and collecting the condensed steam in a glass beaker.

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 ICAI software to create, edit and carry out practical exercises, tests, exams, calculations, etc. Apart from monitoring user's knowledge and progress reached.

  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 **TSPC/CIB. Control Interface Box:**

The Control Interface Box is part of the SCADA system.

<u>Control interface box with process diagram in the front panel</u> 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, heating elements, 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.

TSPC/CIB

③ **DAB. Data Acquisition Board:**

The Data Acquisition board is part of the SCADA system.

PCI Express Data acquisition board (National Instruments) to be placed in a computer slot. Bus PCI Express.

Analog input:

Number of **channels= 16** single-ended or 8 differential. **Resolution=16 bits**, 1 in 65536.

Sampling rate up to: <u>250 KS/s (kilo samples per second)</u>.

Input range (V)=±10 V. Data transfers=DMA, interrupts, programmed I/0. DMA channels=6.

Analog output:

Number of **channels=2**. **Resolution=16 bits**, 1 in 65536.

Maximum output rate up to: 900 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 100 MHz.

Timing: Number of **Counter/timers=4**. Resolution: Counter/timers: 32 bits.

DAB

④ **TSPC/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.

Management, processing, comparison and storage of data.

**Sampling velocity up to <u>250 KS/s (kilo samples per second)</u>.**

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.
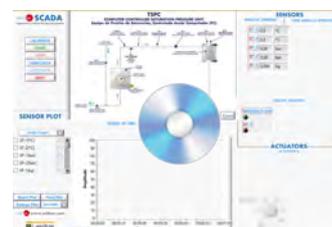
TSPC/CCSOF

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 are the main items: TSPC + TSPC/CIB + DAB + TSPC/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 THE MAIN ITEMS

1.- Measurement of the relationship between temperature and pressure of the saturated vapour in the outlet of the boiler.

2.- Understanding the origin and use of steam tables.

3.- Understanding saturation curves.

4.- To study the characteristics of a two phase fluid.

5.- Using a throttling calorimeter to determine the quality of wet steam.

Saturation Loop: (6 to 15)

6.- Observation of the patterns of boiling at the surface of the water.

7.- Measurement of the temperature of saturated steam over the range of pressures 0 to 8 bar gauge.

8.- Comparison of the saturation curves obtained with those published in steam tables.

9.- Determination of the describing equation and linearisation.

10.- Study the concept of the saturation line.

11.- Determination of the percentage of error between experimental and theoretical data.

12.- Effect of the rate of response on the accuracy of the measurement.

13.- To study the characteristic behavior of a two phase fluid.

14.- Gauge and absolute pressures.

15.- Temperature scales.

Throttling Calorimeter: (16 to 19)

16.- Determination of the dryness fraction (quality of the steam) produced by the saturation pressure unit at different operating pressure.

17.- Use of steam tables.

18.- Use of the steady flow energy equation.

19.- Study the difference in enthalpy between phases - enthalpy of vaporization.

Additional practical possibilities:

20.- Sensors calibration.

Other possibilities to be done with this Unit:

21.- Many students view results simultaneously.

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

22.- Open Control, Multicontrol and Real Time Control.

This unit allows intrinsically and/or extrinsically to change the span, gains; proportional, integral, derivative parameters; etc, in real time.

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

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

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

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

27.- Control of the TSPC unit process through the control interface box without the computer.

28.- Visualization of all the sensors values used in the TSPC unit process.

- Several other exercises can be done and designed by the user.

REQUIRED SERVICES

- Electrical supply: single-phase, 220V/50 Hz or 110V/60 Hz.
- Water supply and drain.
- Computer (PC).

DIMENSIONS AND WEIGHTS

TSPC:

Unit:

- Dimensions: 1000 x 450 x 800 mm approx.
  (39.36 x 17.71 x 31.49 inches approx.)
- Weight: 50 Kg approx.
  (110 pounds approx.).

Control Interface Box:

- Dimensions: 490 x 330 x 310 mm approx.
  (19.29 x 12.99 x 12.20 inches approx.)
- Weight: 10 Kg approx.
  (22 pounds approx.).

SCADA
Main screen
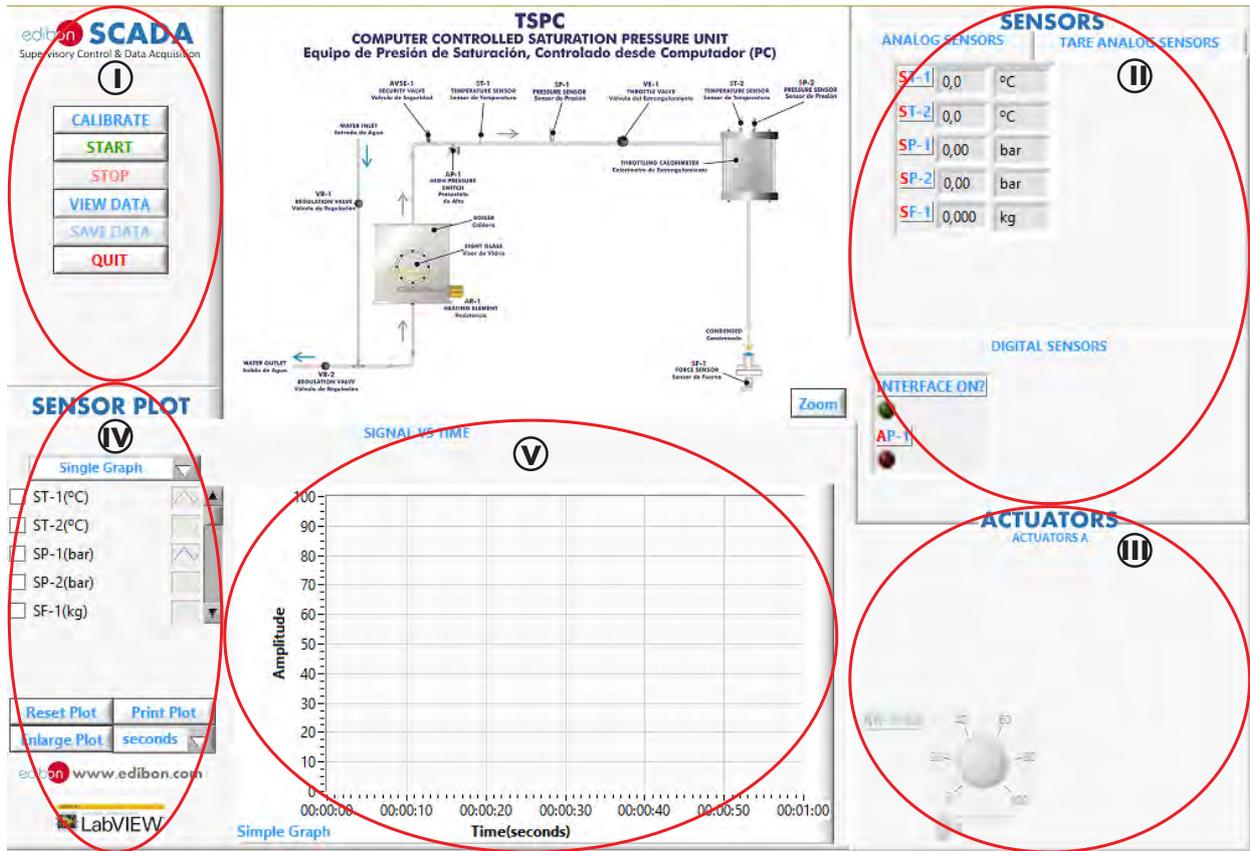
ⓘ Main software operation possibilities.

ⓘⓘ Sensors displays, real time values, and extra output parameters. Sensors: ST=Temperature sensor.   SP=Pressure sensor.   SF=Force sensor.

ⓘⓘⓘ Actuators controls. Actuator: AR=Heating element. AP= High pressure switch.

ⓘⓥ Channel selection and other plot parameters.

ⓥ Real time graphics displays.

Software for Sensors Calibration
Example of screen
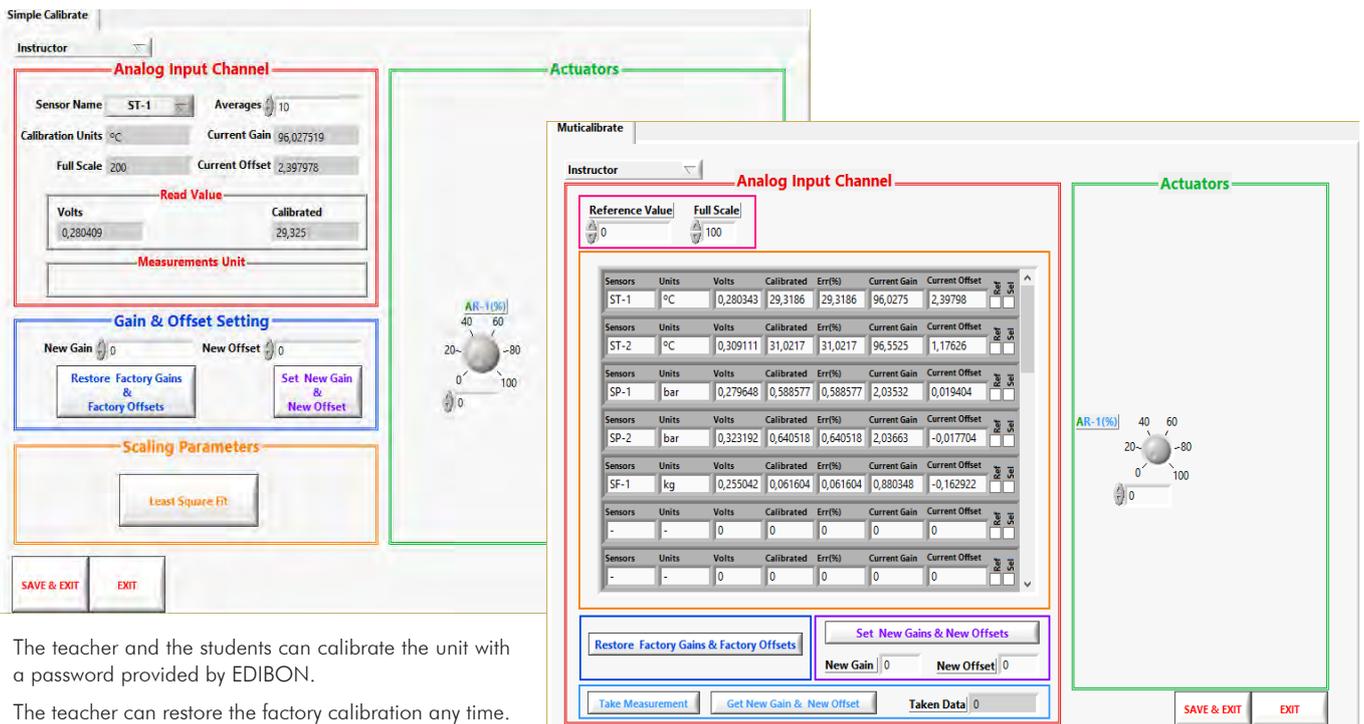
The teacher and the students can calibrate the unit with a password provided by EDIBON.

The teacher can restore the factory calibration any time.

Representation in real time of the measured magnitudes. It can be seen on the screen the starting of the pure water heating by using an immersion heating element (in the boiler) with power control.
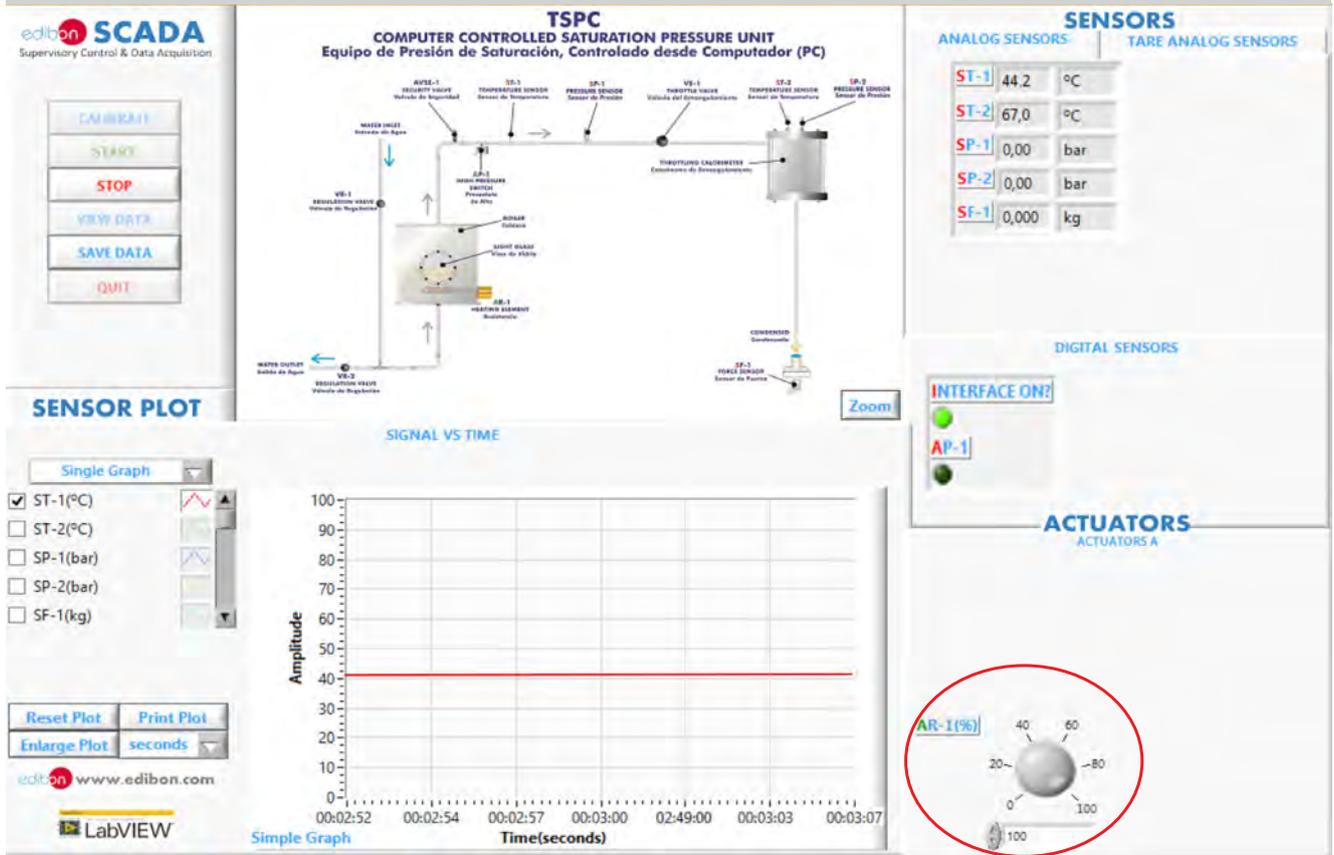
Representation in real time of the measured magnitudes. The properties of the saturated vapour (sensors ST-1 and SP-1) at the maximum working pressure, without passing through the throttling valve, can be seen in this screen. A security valve and a high pressure switch limit the working pressure to 8 bars.
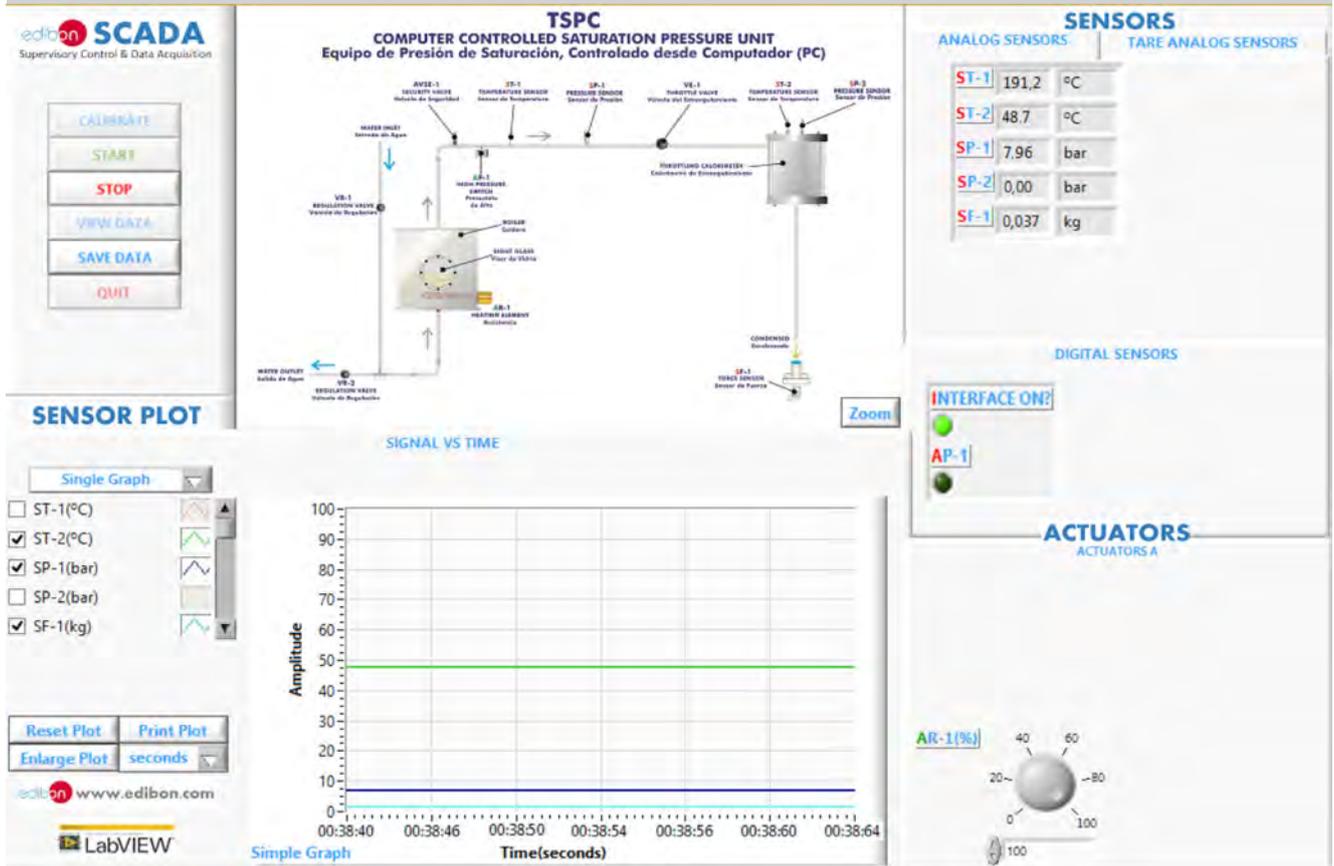
Some **real** results obtained from this Unit

Representation in real time of the measured magnitudes. This screen shows the properties of the saturated vapour generating in the boiler.
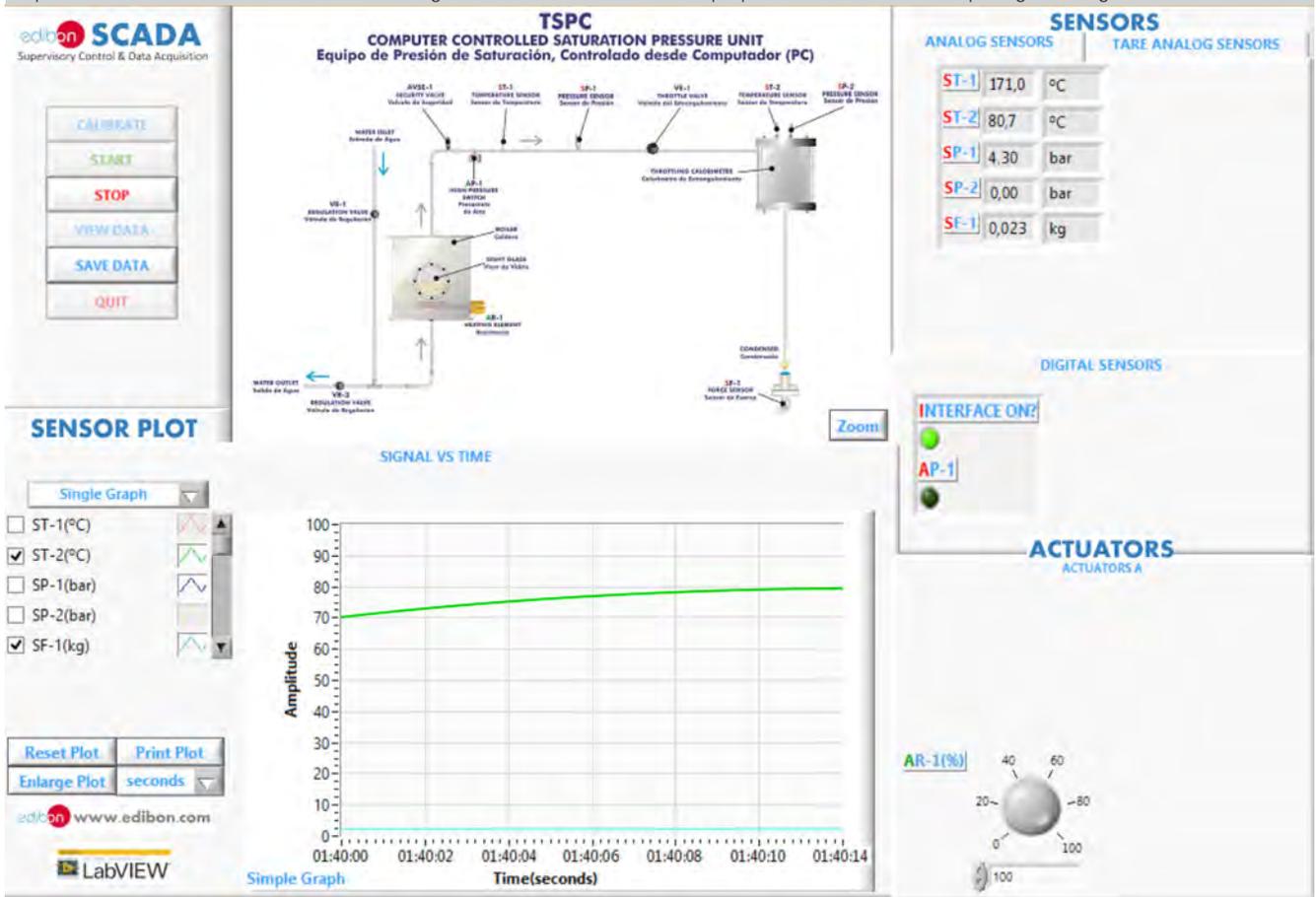
Additionally to the main items (1 to 6) described, we can offer, as optional, other items from 7 to 10.

All these items try to give more possibilities for:

   a) Technical and Vocational Education configuration. (ICAI and FSS)

   b) Multipost Expansions options. (MINI ESN and ESN)

<u>a) Technical and Vocational Education configuration</u>

⑦ **TSPC/ICAI. Interactive Computer Aided Instruction Software System.**

This complete software package consists of an Instructor Software (EDIBON Classroom Manager - ECM-SOF) totally integrated with the Student Software (EDIBON Student Labsoft - ESL-SOF). Both are interconnected so that the teacher knows at any moment what is the theoretical and practical knowledge of the students.

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

- ECM-SOF. EDIBON Classroom Manager (Instructor Software).

ECM-SOF is the application that allows the Instructor to register students, manage and assign tasks for workgroups, create own content to carry out Practical Exercises, choose one of the evaluation methods to check the Student knowledge and monitor the progression related to the planned tasks for individual students, workgroups, units, etc... so the teacher can know in real time the level of understanding of any student in the classroom.

Innovative features:

• **User Data Base Management.**

• **Administration and assignment of Workgroup, Task and Training sessions.**

• **Creation and Integration of Practical Exercises and Multimedia Resources.**

• **Custom Design of Evaluation Methods.**

• **Creation and assignment of Formulas & Equations.**

• **Equation System Solver Engine.**

• **Updatable Contents.**

• **Report generation, User Progression Monitoring and Statistics.**

- ESL-SOF. EDIBON Student Labsoft (Student Software).

ESL-SOF is the application addressed to the Students that helps them to understand theoretical concepts by means of practical exercises and to prove their knowledge and progression by performing tests and calculations in addition to Multimedia Resources. Default planned tasks and an Open workgroup are provided by EDIBON to allow the students start working from the first session. Reports and statistics are available to know their progression at any time, as well as explanations for every exercise to reinforce the theoretically acquired technical knowledge.

Innovative features:

• **Student Log-In & Self-Registration.**

• **Existing Tasks checking & Monitoring.**

• **Default contents & scheduled tasks available to be used from the first session.**

• **Practical Exercises accomplishment by following the Manual provided by EDIBON.**

• **Evaluation Methods to prove your knowledge and progression.**

• **Test self-correction.**

• **Calculations computing and plotting.**

• **Equation System Solver Engine.**

• **User Monitoring Learning & Printable Reports.**

• **Multimedia-Supported auxiliary resources.**

For more information see **ICAI** catalogue. Click on the following link:

www.edibon.com/en/files/expansion/ICAI/catalog

Instructor Software

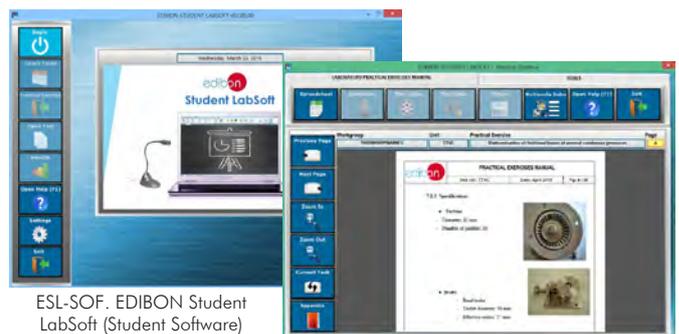ECM-SOF. EDIBON Classroom Manager (Instructor Software) Application Main Screen

ECAL. EDIBON Calculations Program Package - Formula Editor Screen

ERS. EDIBON Results & Statistics Program Package - Student Scores Histogram
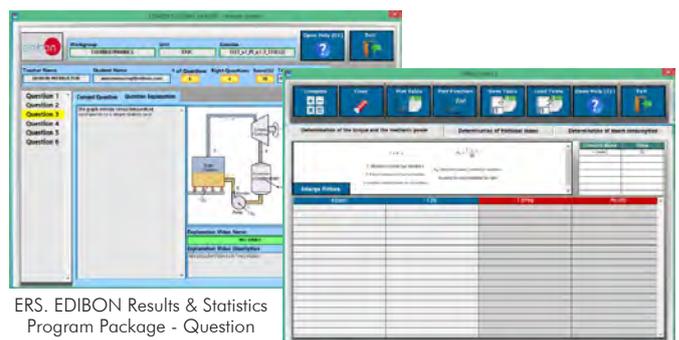
ETTE. EDIBON Training Test & Exam Program Package - Main Screen with Numeric Result Question

Student Software

ESL-SOF. EDIBON Student LabSoft (Student Software) Application Main Screen

EPE. EDIBON Practical Exercise Program Package Main Screen

ERS. EDIBON Results & Statistics Program Package - Question Explanation

ECAL. EDIBON Calculations Program Package Main Screen

⑧ **TSPC/FSS. Faults Simulation System.**

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 in 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 channels 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.

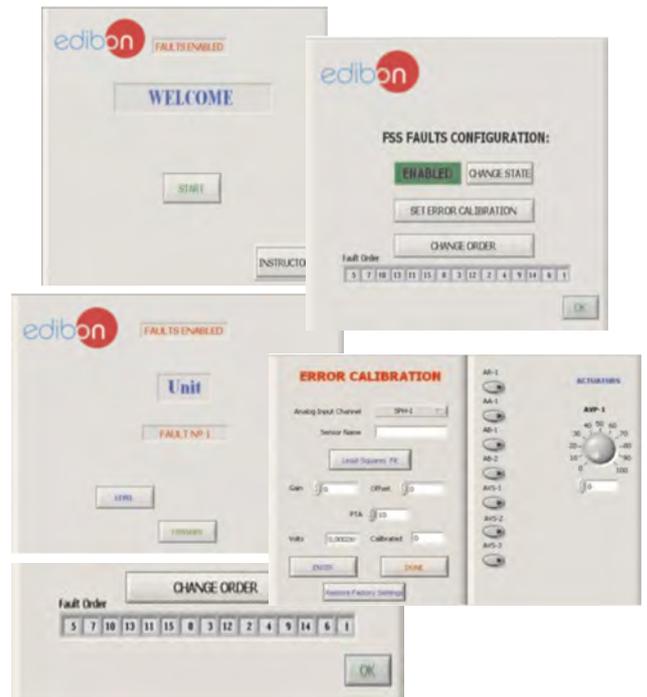- The action of some controls is annulled.

On/off faults:

- Several on/off faults can be included.

For more information see **FSS** catalogue. Click on the following link:

www.edibon.com/en/files/expansion/FSS/catalog

Example of some screens

b) Multipost Expansions options

⑨ **MINI ESN. EDIBON Mini Scada-Net System for being used with EDIBON Teaching Units.**

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 of 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 save time and cost.

- Future expansions with more EDIBON Units.

For more information see **MINI ESN** catalogue. Click on the following link:

www.edibon.com/en/files/expansion/MINI-ESN/catalog

MINI ESN.
EDIBON Mini Scada-Net System

1 UNIT= up to 30 STUDENTS can work simultaneously

Computer Controlled Saturation Pressure Unit (TSPC)

Control Interface Box

Software for:
- Computer Control
- Data Acquisition
- Data Management

Instructors' Central Computer

Mini Scada-Net Software

LOCAL NET FOR 30 STUDENTS

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

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

⑩ **ESN. EDIBON Scada-Net Systems.**

This unit can be integrated, in the future, into a Complete Laboratory with many Units and many Students.

For more information see **ESN** catalogue. Click on the following link:

www.edibon.com/en/files/expansion/ESN/catalog
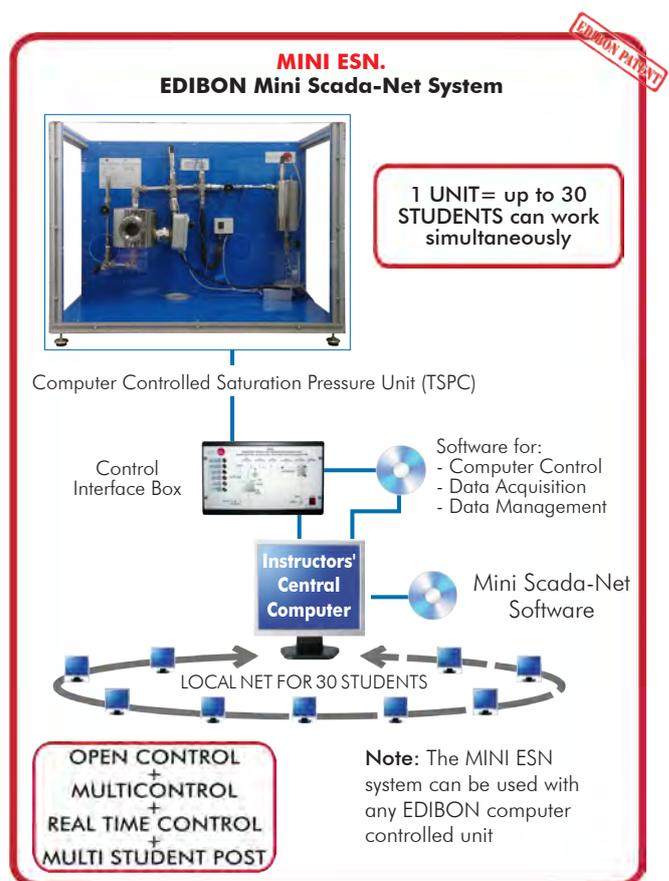
Main items (always included in the supply)

Minimum supply always includes:

① Unit: TSPC. Computer Controlled Saturation Pressure Unit.

② TSPC/CIB. Control Interface Box.

③ DAB. Data Acquisition Board.

④ TSPC/CCSOF. Computer Control + Data Acquisition + Data Management Software.

⑤ Cables and Accessories, for normal operation.

⑥ Manuals.

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

Optional items (supplied under specific order)

a) Technical and Vocational Education configuration

⑦ TSPC/ICAI. Interactive Computer Aided Instruction Software System.

⑧ TSPC/FSS. Faults Simulation System.

b) Multipost Expansions options

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Water filling valve in the boiler.
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High pressure switch.
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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.
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Analog output: Channels=2. Resolution=16 bits, 1 in 65536.
Digital Input/Output: Channels=24 inputs/outputs.

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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 the Main Items

1.- Measurement of the relationship between temperature and pressure of the saturated vapour in the outlet of the boiler.

2.- Understanding the origin and use of steam tables.

3.- Understanding saturation curves.

4.- To study the characteristics of a two phase fluid.

5.- Using a throttling calorimeter to determine the quality of wet steam.

Saturation Loop: (6 to 15)

6.- Observation of the patterns of boiling at the surface of the water.

7.- Measurement of the temperature of saturated steam over the range of pressures 0 to 8 bar gauge.

8.- Comparison of the saturation curves obtained with those published in steam tables.

9.- Determination of the describing equation and linearisation.

10.- Study the concept of the saturation line.

11.- Determination of the percentage of error between experimental and theoretical data.

12.- Effect of the rate of response on the accuracy of the measurement.

13.- To study the characteristic behavior of a two phase fluid.

14.- Gauge and absolute pressures.

15.- Temperature scales.

Throttling Calorimeter: (16 to 19)

16.- Determination of the dryness fraction (quality of the steam) produced by the saturation pressure unit at different operating pressure.

17.- Use of steam tables.

18.- Use of the steady flow energy equation.

19.- Study the difference in enthalpy between phases - enthalpy of vaporization.

Additional practical possibilities:

20.-Sensors calibration.

Other possibilities to be done with this Unit:

21.- Many students view results simultaneously.

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

22.- Open Control, Multicontrol and Real Time Control.

This unit allows intrinsically and/or extrinsically to change the span, gains; proportional, integral, derivative parameters; etc, in real time.

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

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

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

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

27.- Control of the TSPC unit process through the control interface box without the computer.

28.- Visualization of all the sensors values used in the TSPC unit process.

- Several other exercises can be done and designed by the user.

<u>a) Technical and Vocational Education configuration</u>

⑦ TSPC/ICAI. Interactive Computer Aided Instruction Software System.

This complete software package consists of an Instructor Software (EDIBON Classroom Manager - ECM-SOF) totally integrated with the Student Software (EDIBON Student Labsoft - ESL-SOF). Both are interconnected so that the teacher knows at any moment what is the theoretical and practical knowledge of the students.

- ECM-SOF. EDIBON Classroom Manager (Instructor Software).

ECM-SOF is the application that allows the Instructor to register students, manage and assign tasks for workgroups, create own content to carry out Practical Exercises, choose one of the evaluation methods to check the Student knowledge and monitor the progression related to the planned tasks for individual students, workgroups, units, etc...so the teacher can know in real time the level of understanding of any student in the classroom.

Innovative features:

• User Data Base Management.

• Administration and assignment of Workgroup, Task and Training sessions.

• Creation and Integration of Practical Exercises and Multimedia Resources.

• Custom Design of Evaluation Methods.

• Creation and assignment of Formulas & Equations.

• Equation System Solver Engine.

• Updatable Contents.

• Report generation, User Progression Monitoring and Statistics.

- ESL-SOF. EDIBON Student Labsoft (Student Software).

ESL-SOF is the application addressed to the Students that helps them to understand theoretical concepts by means of practical exercises and to prove their knowledge and progression by performing tests and calculations in addition to Multimedia Resources. Default planned tasks and an Open workgroup are provided by EDIBON to allow the students start working from the first session. Reports and statistics are available to know their progression at any time, as well as explanations for every exercise to reinforce the theoretically acquired technical knowledge.

Innovative features:

• Student Log-In & Self-Registration.

• Existing Tasks checking & Monitoring.

• Default contents & scheduled tasks available to be used from the first session.

• Practical Exercises accomplishment by following the Manual provided by EDIBON.

• Evaluation Methods to prove your knowledge and progression.

• Test self-correction.

• Calculations computing and plotting.

• Equation System Solver Engine.

• User Monitoring Learning & Printable Reports.

• Multimedia-Supported auxiliary resources.

⑧ TSPC/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 in 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 channels 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.

⑨ **MINI ESN. EDIBON Mini Scada-Net System for being used with EDIBON Teaching Units.**

MINI ESN. 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 of 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.

- 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 save 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 improvement of the product.

REPRESENTATIVE:

C/ Julio Cervera, 10-12-14. Móstoles Tecnológico.
28935 MÓSTOLES. (Madrid). ESPAÑA - SPAIN.
Tel.: 34-91-6199363   Fax: 34-91-6198647
E-mail: edibon@edibon.com   Web: **www.edibon.com**

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