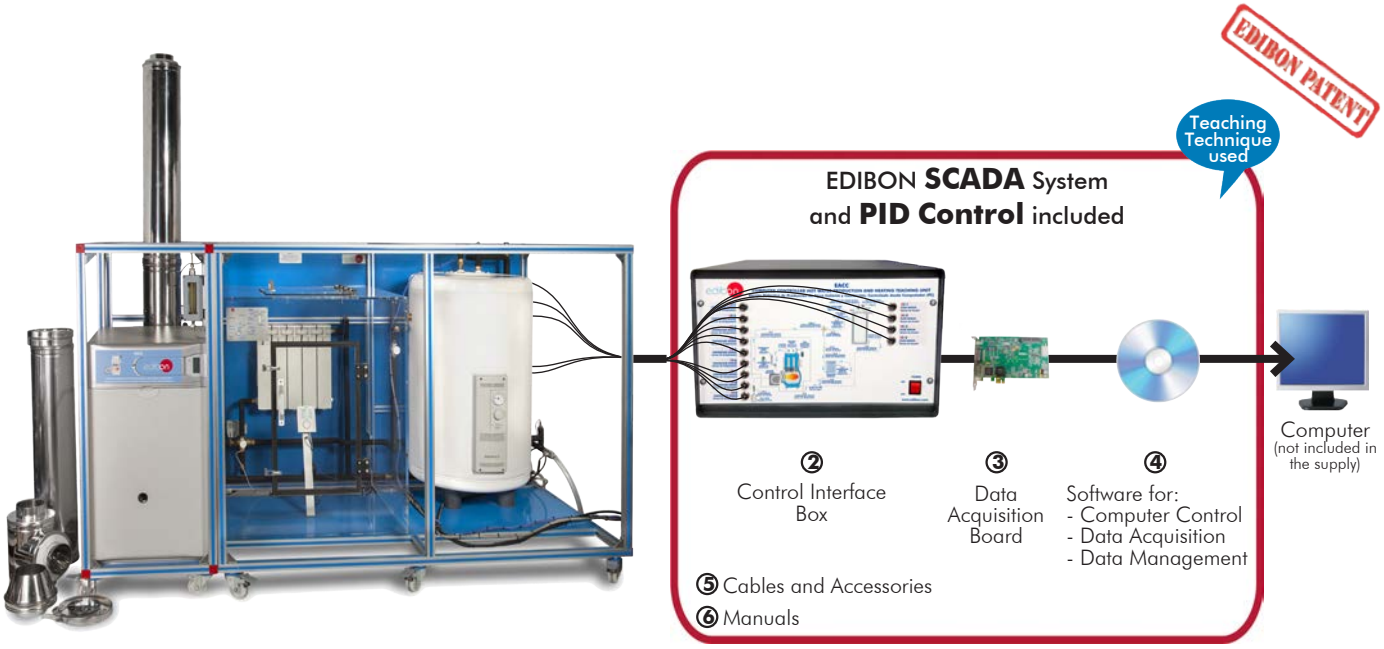
edibon

Engineering and Technical Teaching Equipment

Computer Controlled **Hot Water Production and Heating Teaching Unit,** with SCADA and PID Control

EACC



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

① Unit: EACC. Computer Controlled Hot Water Production and Heating Teaching Unit

Key features:

- **Advanced Real-Time SCADA and PID Control.**
- **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
↳5.- ENERGY

For more information about Key Features, click here

ISO 9001: **Quality Management** (for Design, Manufacturing, Commercialization and After-sales service)

European Union Certificate (total safety)

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

"Worlddidac Quality Charter" and Platinum Member of Worlddidac

INTRODUCTION

Almost half the energy spent by families is used to heat the house, whereas the Domestic Hot Water is the second energy consumer at our homes, involving a 26 % approximately of the total power consumption.

Energy is a limited natural resource whose generation as heat has quite important economic costs and environmental impact. For this reason, a study of the characteristics and operation of these installations, in such a way that it makes it easier for the user the knowledge of these aspects in detail, makes it possible to advance in a responsible use and contributes to a general wellfare.

The computer controlled hot water and heating generation unit, "EACC", developed by EDIBON, is a didactic equipment that the students can use to learn about heating installations and the production of domestic hot water, both for houses and colective blocks with a boiler in each dwelling.

GENERAL DESCRIPTION

The main element of the unit is the boiler. Its function is the heating of the water that will flow through the other elements transferring its heat. It is a low temperature boiler that works with gas-oil and it is suitable to work with pressurized burners for gas or gas-oil. The boiler includes an stage gas-oil burner, circulating pump, closed expansion tank, safety valve, air purger and drainage valve.

The burner has an On/Off operation. The mechanical atomization of gasoil at high pressure is made through a nozzle. Also, it allows to obtain combustion optimum values by means of the regulation of the combustive air (manually) and the deflector.

The unit includes an electronic three-ways valve, which distributes the water which has been previously heated by the boiler-burner group into two primary circuits. One of them is the double jacket of the hot water tank, to obtain domestic hot water, and the other is the radiator, to generate heating.

The hot water tank has a double jacket through which water previously heated in the boiler flows, constituting the primary circuit. There is a solenoid valve in the line that introduces tap water to the hot water tank to be heated. It will be opened or closed depending on the needs.

The part of the unit where the heating generation is studied is constituted by a fin radiator of five elements and a purger, which is inside a metacrylate receptacle, allowing to control the time spent on heating the receptacle until reaching the target temperature or the fuel flow required for that purpose. It is possible to control the temperature in such receptacle by means of a PID control through the software that acts on the three-ways solenoid valve. The receptacle has a room thermostat inside, which makes it possible to control the heating temperature.

The primary circuit is closed with the recirculation of both the circuit's water, that has already transferred its heat in the hot water tank, and the water from the radiator. Both lines converge and are connected to the boiler again, thus closing the primary circuit.

The unit includes a suitable chimney for the boiler for a correct installation of the unit.

There is a portable gas analyzer to analyze the combustion fumes that go out from the boiler. Measurements of CO, CO_2, O_2, combustion efficiency, excess of air and temperature of the combustion gases can be obtained with this device.

EACC detail

The sensors and instrumentation supplied with the unit makes it possible to know at any moment the measurement of:

Flows: the fuel flow consumed by the boiler depending on the needs, the water flow used for the primary circuit of the hot water tank, the water flow used for the primary circuit of the radiator to generate heating and the tap water inlet flow into the hot water tank.

Temperatures: the temperature of the hot water leaving the boiler, the temperature of the water outlet and inlet of the primary circuit of the hot water tank and the radiator, the temperature of the domestic hot water inside the hot water tank and the domestic hot water outlet and the temperature of the primary circuit´s water that recirculates to the boiler.

Measurement of CO, CO_2, O_2, combustion efficiency, air excess and temperature of combustion fumes.

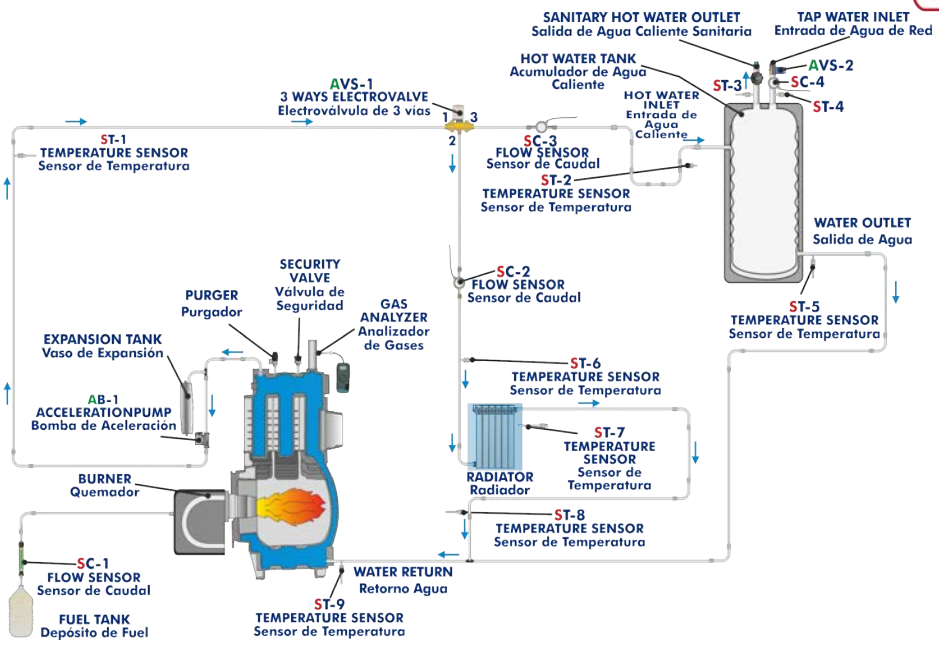
Signals of the burner´s operation process: ignition spark, ventilation, emergency stop alarm signal (safety thermostat), electrovalve, etc.

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

3 actuators and 13 sensors controlled from any computer, and working simultaneously

OPEN CONTROL + MULTICONTROL + REAL TIME CONTROL

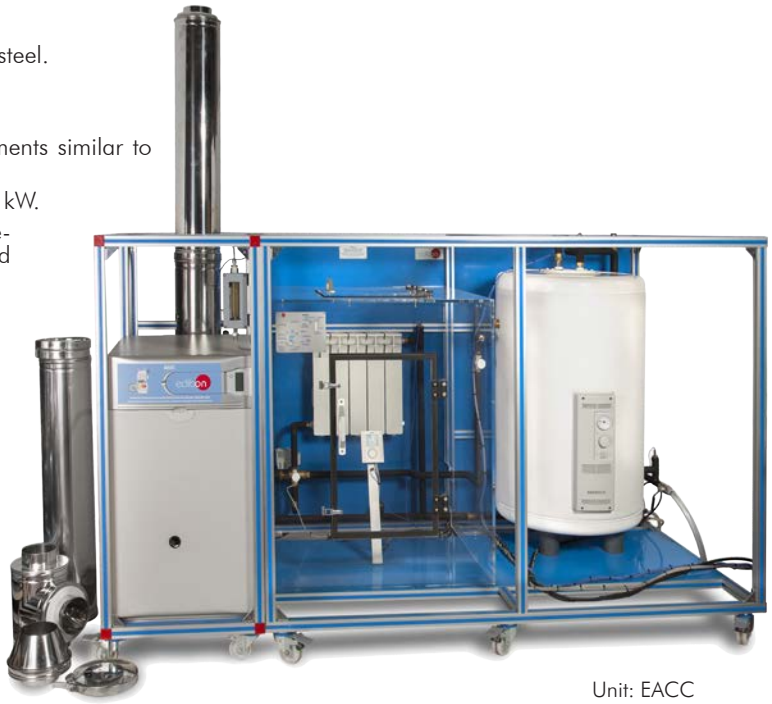


With this unit there are several options and possibilities:

- Main items: 1, 2, 3, 4, 5 and 6.
- Optional items: 7, 8, 9, 10 and 11.

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

① EACC. Unit:



Unit: EACC

Anodized aluminum frame and panels made of painted steel.

The unit includes wheels to facilitate its mobility.

Main metallic elements made of stainless steel.

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

Boiler, that works with gas-oil, with a useful power of 32 kW.

The body of the boiler is made of cast iron with a three-way fumes pass and it is suitable to work with pressurized burnes for gas or gas-oil. This boiler includes:

- Stage gas-oil burner (32 kW), computer controlled.
- Circulation pump, computer controlled.
- Closed expansion tank.
- Safety valve (3 bar).
- Air purger.
- Safety thermostat.
- Drain valve.

Portable tank for fuel (20 l).

Fuel filter.

Chimney made of stainless steel:

- Adapter at the outlet of the boiler.
- "T" of 90 °C. Two elbows of 45°. Two straight sections of 930 mm. Cone for free outlet. Two wall clamps.

Three-ways electronic valve, computer controlled, which distributes the water heated by the boiler-burner group into two primary circuits. One of them is the double jacket of the hot water tank to obtain domestic hot water, and the other is the radiator to generate heating.

Hot water tank with double jacket made of stainless steel with a capacity of 150 l.

Solenoid electrovalve, computer controlled, in the tap water inlet line to the hot water tank.

Fin radiator of five elements and purger. Methacrylate receptable where the radiator is located. It is possible to control the temperature in the receptacle by means of a PID control through the software that acts on the threeways solenoid valve. The receptacle has a room thermostat inside, which also makes it possible to control the heating temperature.

Nine temperature sensors "J" type, at the key points of the unit, to measure:

- Temperature of the hot water leaving the boiler.
- Temperature of the water outlet and inlet of the hot water tank primary circuit and the radiator.
- Temperature of the domestic hot water inside the hot water tank and the domestic hot water outlet.
- Temperature of the primary circuit´s water that recirculates to the boiler.

Gas-oil flow sensor to measure the fuel flow consumed by the boiler, range: 0.4 – 4 kg/h.

Three water flow sensors, range: 1.5 – 30 l/min, to measure:

- Water flow used for the primary circuit of the hot water tank.
- Water flow used for the primary circuit of the radiator to generate heating.
- Tap water inlet flow into the hot water tank.

Combustion gases analyzer for the measurement of CO, CO_2, O_2, air excess, temperature of the combustion fumes, combustion efficiency, etc.

The complete unit includes as well:

- **Advanced Real-Time SCADA and PID Control.**
- **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.**
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② EACC/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.

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

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

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

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

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

Possibility of automatization of the actuators involved in the process.

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

EACC/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: 250 KS/s (kilo samples per second).

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 EACC/CCSOF. PID 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.

Analog and digital PID control.

PID menu and set point selection required in the whole work range.

Management, processing, comparison and storage of data.

Sampling velocity up to 250 KS/s (kilo samples per second).

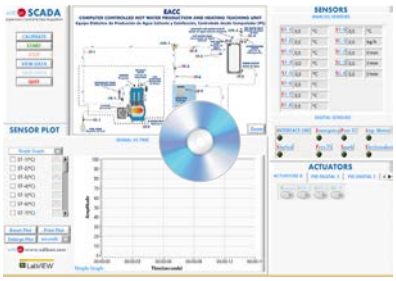
Calibration system for the sensors involved in the process.

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.



EACC/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: EACC + EACC/CIB + DAB + EACC/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.- Familiarization with the operation of a heating and domestic hot water (DHW) installation.

2.- Determination of the fuel flow and fuel consumption.

3.- Determination of the boiler's temperature.

4.- Determination of the heating water inlet and outlet temperature.

5.- Determination of the domestic hot water (DHW) temperature.

6.- Energy balance of the heating circuit.

7.- Energy balance of the domestic hot water (DHW) circuit.

8.- Calculation of the energy efficiency.

9.- Variation of the exhaust gases outlet in function of the combustion quality.

10.-Influence of the target heating of the domestic hot water (DHW) temperature on the constituents of the combustion fumes and on the combustion efficiency.

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, derivative parameters; etc, in real time.

14.-The Computer Control System with SCADA and PID Control allow a real industrial simulation.

15.-This unit is totally safe as uses mechanical, electrical/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 EACC unit process through the control interface box without the computer.

19.-Visualization of all the sensors values used in the EACC 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 and drain.
- Computer (PC).

REQUIRED CONSUMABLES (Not included)

- Gas-oil (working flows range: 1.5 kg/h – 4 kg/h).

DIMENSIONS AND WEIGHTS

EACC:

Unit:

-Dimensions: 2000 x 750 x 1500 mm approx.
(78.74 x 29.52 x 59.05 inches approx.)

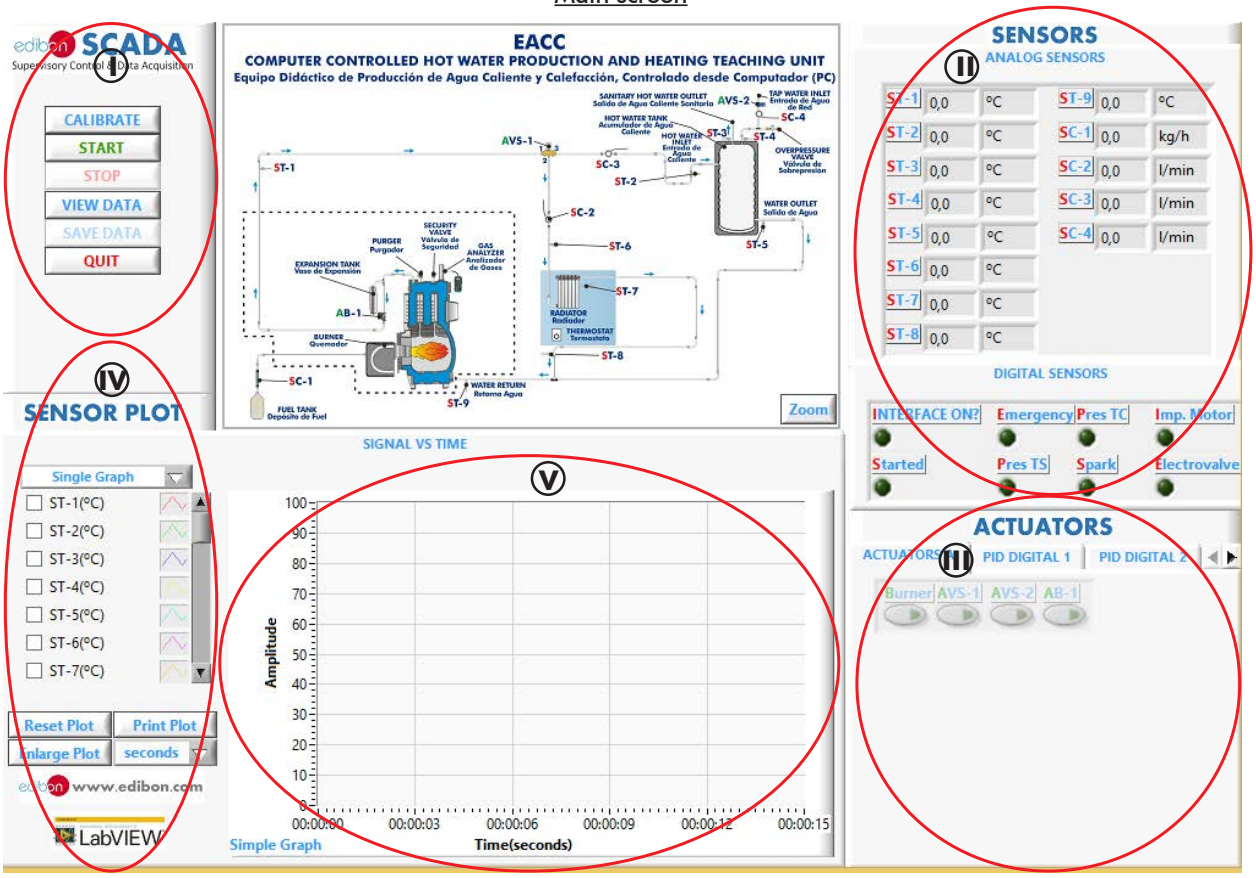
-Weight: 180 kg approx.
(396.83 pounds approx.)

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 and PID Control
Main screen



Ⓘ Main software operation possibilities.

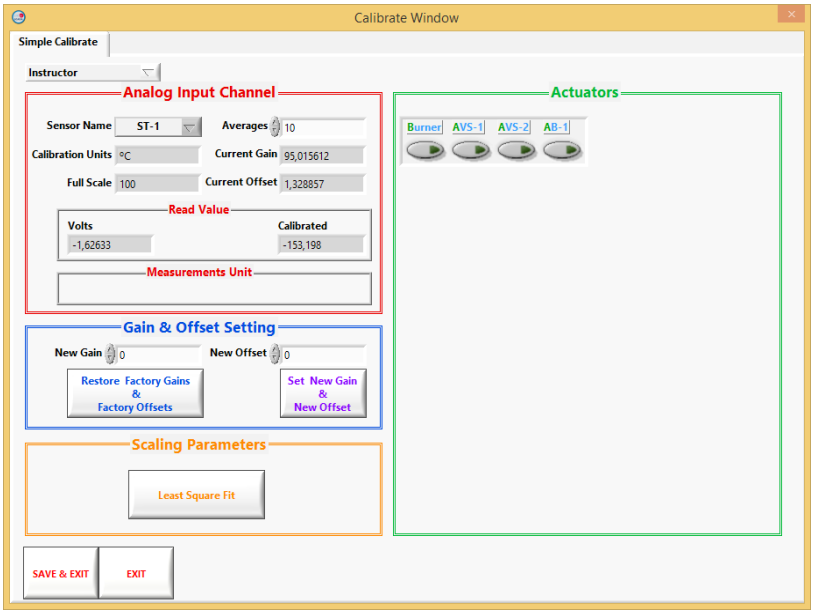
Ⓘ**Ⓘ Sensors displays, real time values, and extra output parameters. Sensors:** ST= Temperature sensor. SC= Flow sensor.

Ⓘ**Ⓘ Actuators controls. Actuators:** AVS= Solenoid valve. AB= Pump. Signals of the burner´s operation process.

Ⓘ Channel selection and other plot parameters.

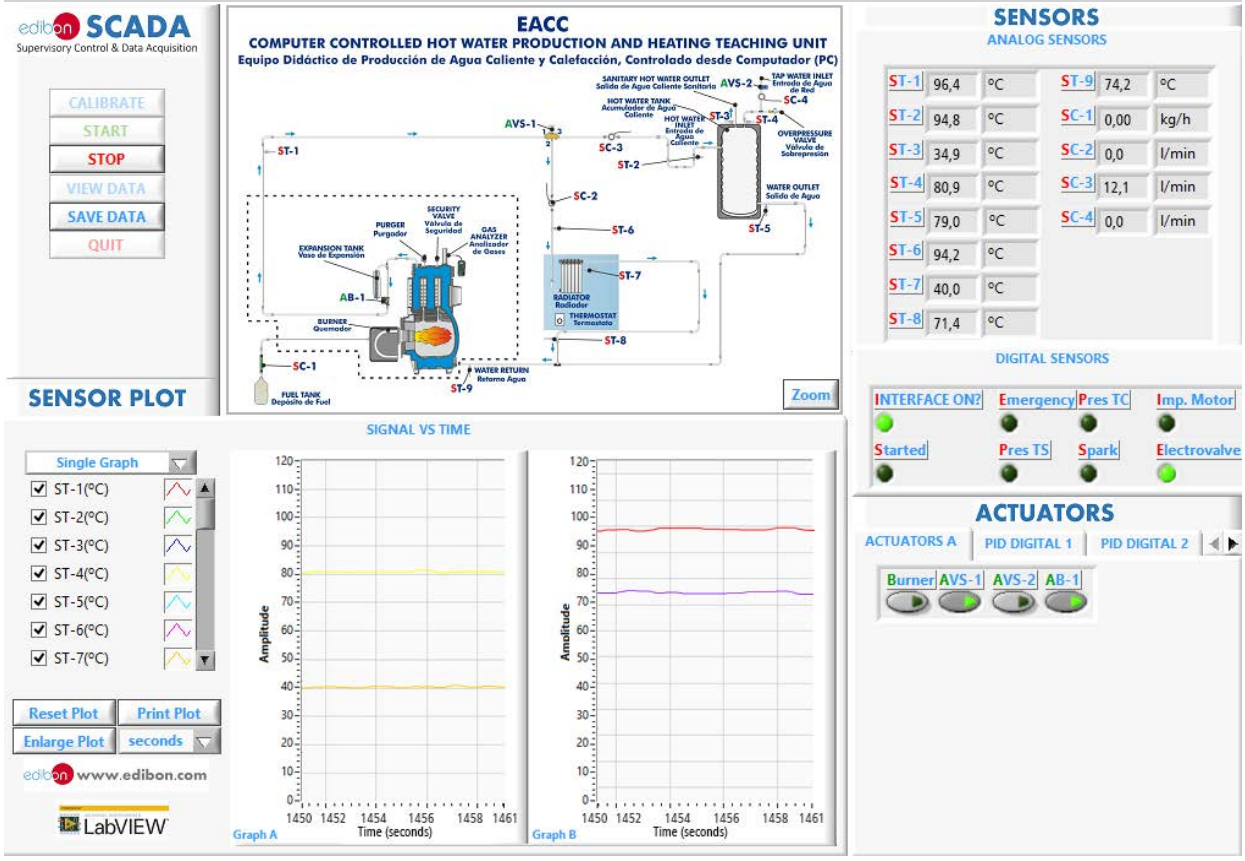
Ⓘ Real time graphics displays.

Software for Sensors Calibration
Example of screen

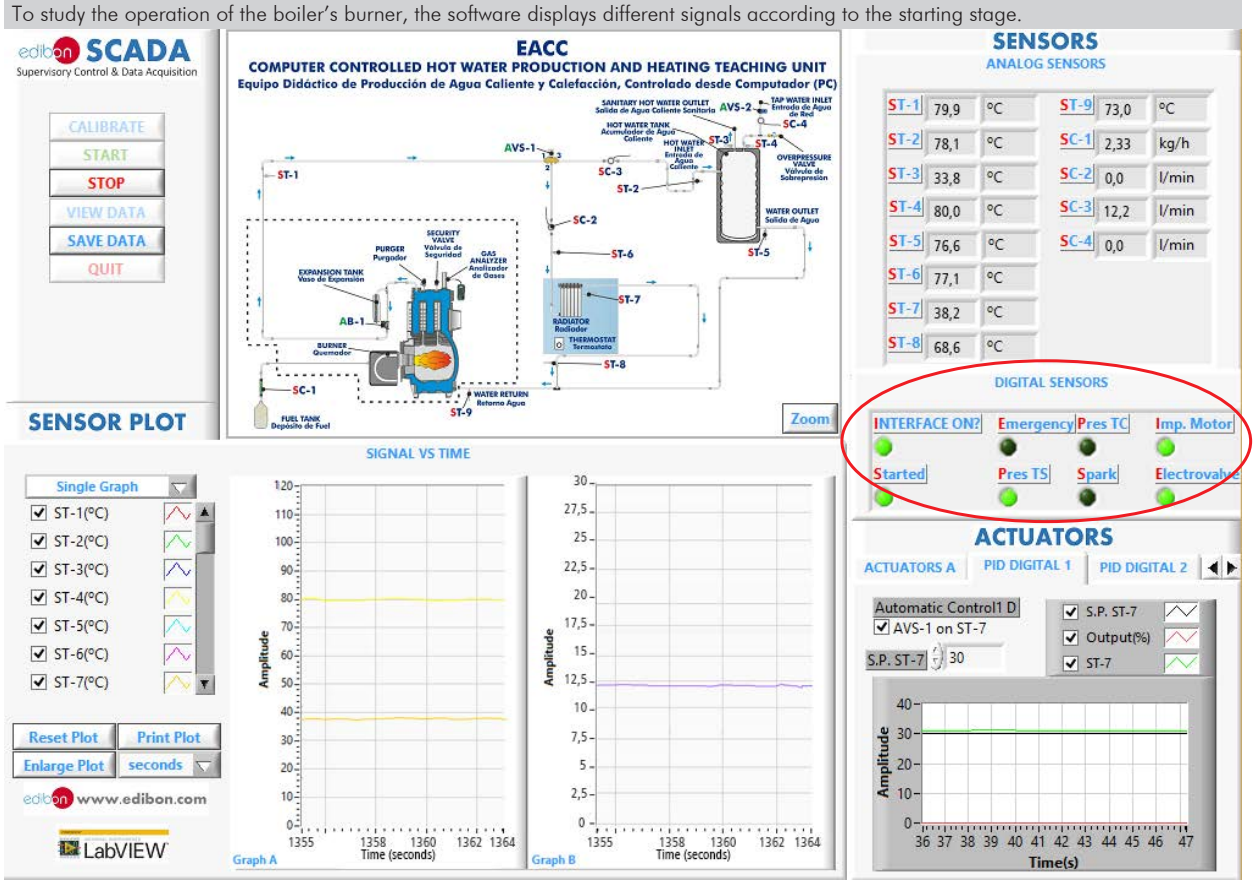


The teacher and the students can calibrate the unit with a password provided by EDIBON.
The teacher can restore the factory calibration any time.

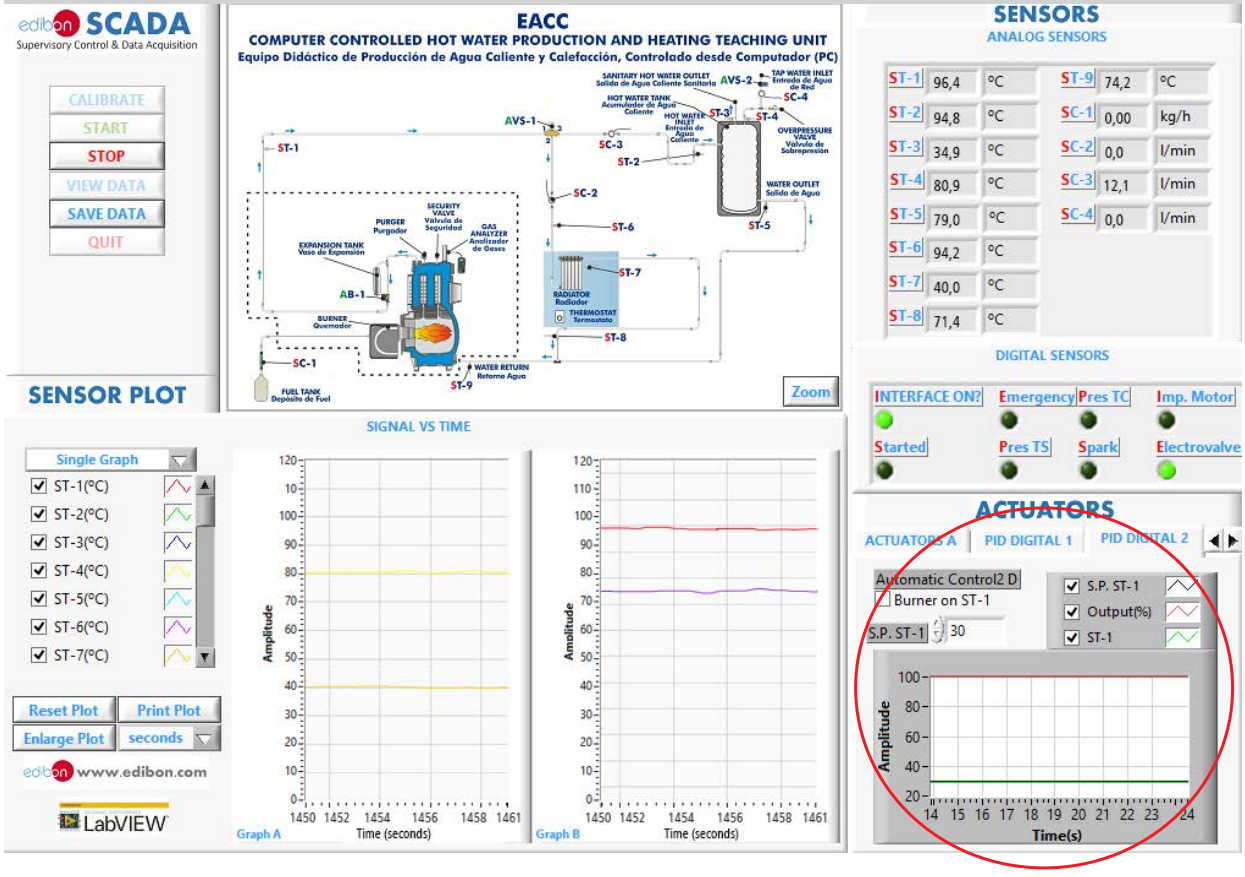
Representation in real time of the measured magnitudes.



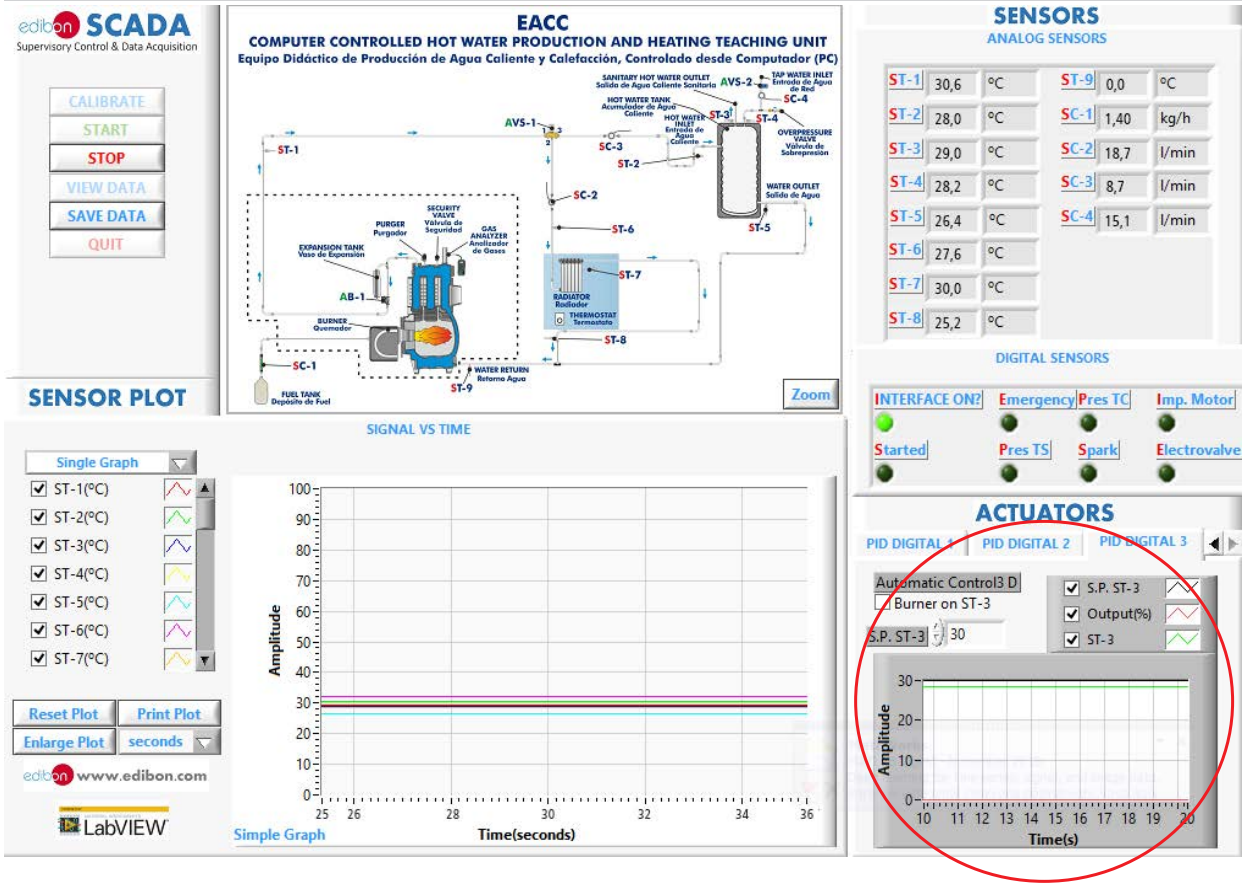
To study the operation of the boiler's burner, the software displays different signals according to the starting stage.



Heating temperature control is done through a PID control. When the target temperature is reached at the temperature sensor (ST-1), the boiler is turned off.



Heating temperature control is done through a PID control. When the target temperature is reached at the temperature sensor (ST-3), the boiler is turned off.



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 11.
All these items try to give more possibilities for:

a) Industrial configuration. (PLC)
b) Technical and Vocational Education configuration. (ICAI and FSS)
c) 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.

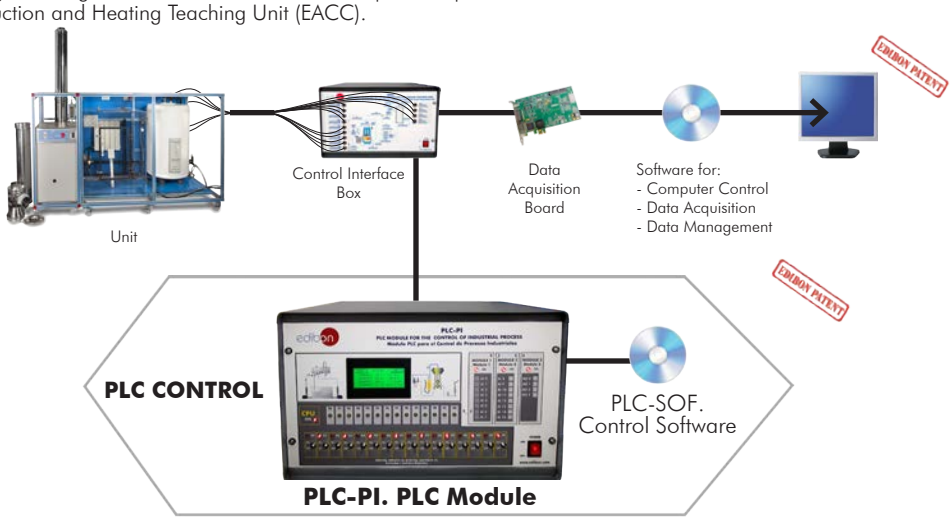
Communication RS232 wire to computer (PC).

Dimensions: 490 x 330 x 310 mm. approx. (19.29 x 12.99 x 12.20 inches approx.). Weight: 30 Kg. approx. (66 pounds approx.).

-EACC/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 Hot Water Production and Heating Teaching Unit (EACC).



Practices to be done with PLC-PI:

1.- Control of the particular unit process through the control interface box without the computer.
2.- Visualization of all the sensors values used in the particular unit process.
3.- Calibration of all sensors included in the particular unit process.
4.- Hand on of all the actuators involved in the particular unit process.
5.- Realization of different experiments, in automatic way, without having in front the particular unit. (These experiments can be decided previously).
6.- Simulation of outside actions, in the cases do not exist hardware elements. (Example: test of complementary tanks, complementary industrialenvironment to the process to be studied, etc).
7.- PLC hardware general use.
8.- PLC process application for the particular unit.
9.- PLC structure.
10.- PLC inputs and outputs configuration.
11.- PLC configuration possibilities.
12.- PLC program languages.
13.- PLC different programming standard languages (ladder diagram (LD), structured text (ST), instructions list (IL), sequential function chart (SFC), function block diagram (FBD)).
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 particular unit process.
17.- Possibility of creating new process in relation with the particular unit.
18.- PLC Programming Exercises.
19.- Own PLC applications in accordance with teacher and student requirements.

b) Technical and Vocational Education configuration

⑧ EACC/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

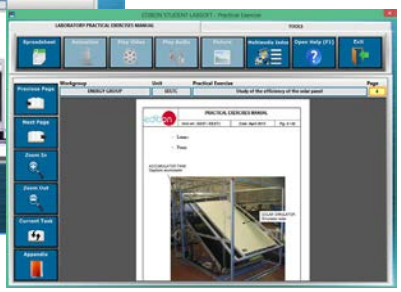
ECAL. EDIBON Calculations Program Package - Formula Editor Screen

ERS. EDIBON Results & Statistics Program Package - Student Scores Histogram

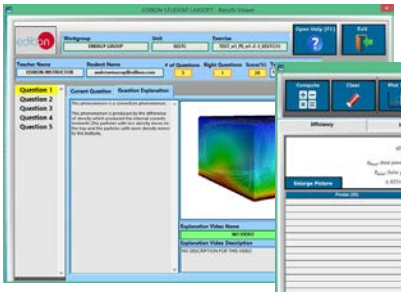
ETTE. EDIBON Training Test & Exam Program Package - Main Screen with Numeric Result Question

Student Software

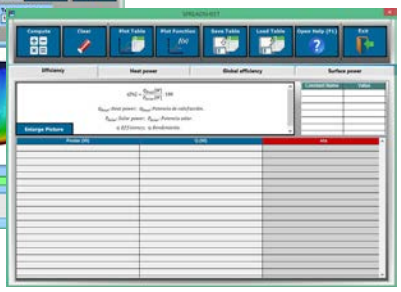
ESL-SOF. EDIBON Student LabSoft (Student Software) Application Main Screen



EPE. EDIBON Practical Exercise Program Package Main Screen



ERS. EDIBON Results & Statistics Program Package - Question Explanation



ECAL. EDIBON Calculations Program Package Main Screen

⑨ EACC/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.**

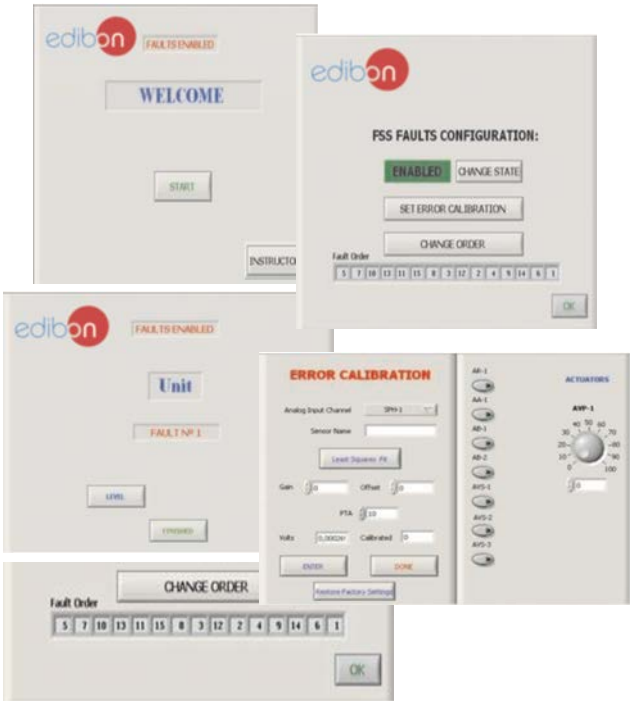
Faults in the controls execution:

- **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.**

Example of some screens



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

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

c) Multipost Expansions options

⑩ 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 and PID Control integrated in a local network.

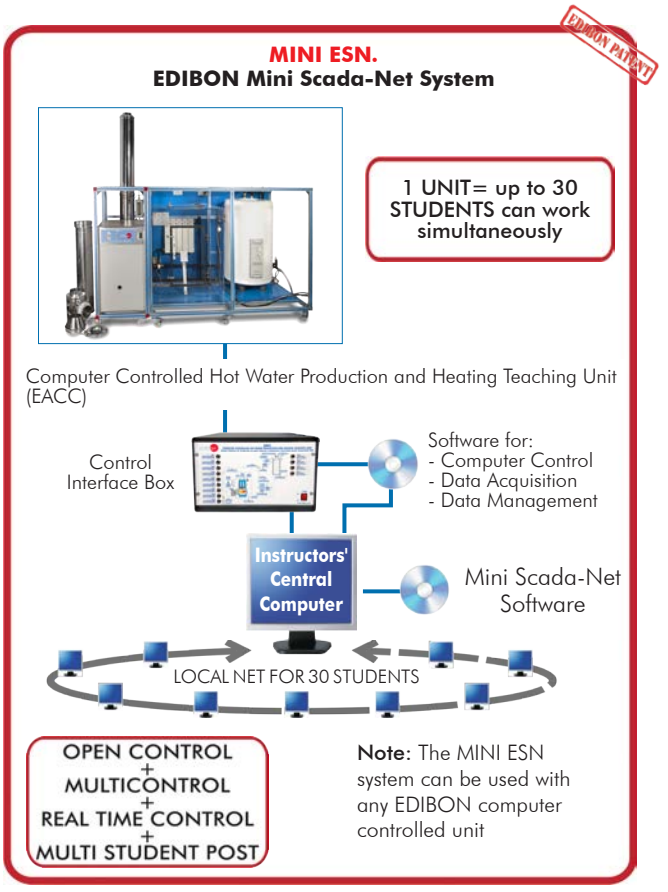
This system allows to view/control the unit remotely, from any computer integrated in the local net (in the classroom), through the main computer connected to the unit. Then, the number of possible users who can work with the same unit is higher than in an usual way of working (usually only one).

Main characteristics:

- **It allows up to 30 students to work simultaneously with the EDIBON Computer Controlled Unit with SCADA and PID Control, 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

⑪ 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

ORDER INFORMATION

Main items (always included in the supply)

Minimum supply always includes:

① **Unit: EACC. Computer Controlled Hot Water Production and Heating Teaching Unit.**

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

③ **DAB. Data Acquisition Board.**

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

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

⑥ **Manuals.**

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

b) Technical and Vocational Education configuration

⑧ EACC/ICAI. Interactive Computer Aided Instruction Software System.

⑨ EACC/FSS. Faults Simulation System.

c) Multipost Expansions options

⑩ MINI ESN. EDIBON Mini Scada-Net System for being used with EDIBON Teaching Units.

⑪ ESN. EDIBON Scada-Net Systems.

① EACC. Unit:
Anodized aluminum frame and panels made of painted steel.
The unit includes wheels to facilitate its mobility.
Main metallic elements made of stainless steel.
Diagram in the front panel with distribution of the elements similar to the real one.
Boiler, that works with gas-oil, with a useful power of 32 kW.
The body of the boiler is made of cast iron with a three-way fumes pass and it is suitable to work with pressurized burnes for gas or gas-oil. This boiler includes:
- Stage gas-oil burner (32 kW), computer controlled.
- Circulation pump, computer controlled.
- Closed expansion tank.
- Safety valve (3 bar).
- Air purger.
- Safety thermostat.
- Drain valve.

Portable tank for fuel (20 l).
Fuel filter.
Chimney made of stainless steel:
- Adapter at the outlet of the boiler.
- "T" of 90 °C. Two elbows of 45°. Two straight sections of 930 mm. Cone for free outlet. Two wall clamps.

Three-ways electronic valve, computer controlled, which distributes the water heated by the boiler-burner group into two primary circuits. One of them is the double jacket of the hot water tank to obtain domestic hot water, and the other is the radiator to generate heating.
Hot water tank with double jacket made of stainless steel with a capacity of 150 l.
Solenoid electrovalve, computer controlled, in the tap water inlet line to the hot water tank.
Fin radiator of five elements and purger. Methacrylate receptable where the radiator is located. It is possible to control the temperature in the receptacle by means of a PID control through the software that acts on the threeways solenoid valve. The receptacle has a room thermostat inside, which also makes it possible to control the heating temperature.
Nine temperature sensors "J" type, at the key points of the unit, to measure:
- Temperature of the hot water leaving the boiler.
- Temperature of the water outlet and inlet of the hot water tank primary circuit and the radiator.
- Temperature of the domestic hot water inside the hot water tank and the domestic hot water outlet.
- Temperature of the primary circuit´s water that recirculates to the boiler.

Gas-oil flow sensor to measure the fuel flow consumed by the boiler, range: 0.4 – 4 kg/h.
Three water flow sensors, range: 1.5 – 30 l/min, to measure:
- Water flow used for the primary circuit of the hot water tank.
- Water flow used for the primary circuit of the radiator to generate heating.
- Tap water inlet flow into the hot water tank.

Combustion gases analyzer for the measurement of CO, CO_2, O_2, air excess, temperature of the combustion fumes, combustion efficiency, etc.
The complete unit includes as well:
- Advanced Real-Time SCADA and PID Control.
- 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 EACC/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 PID control with flexibility of modifications from the computer keyboard of the PID parameters, at any moment during the process.
Real time PID control for parameters involved in the process simultaneously.
Proportional control, integral control and derivative control, based on the real PID mathematical formula, by changing the values, at any time, of the three control constants (proportional, integral and derivative constants).
Open control allowing modifications, at any 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 Express 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 EACC/CCSOF. PID 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.
Analog and digital PID control. PID menu and set point selection required in the whole work range.
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 the Main Items

1.- Familiarization with the operation of a heating and domestic hot water (DHW) installation.

2.- Determination of the fuel flow and fuel consumption.

3.- Determination of the boiler's temperature.

4.- Determination of the heating water inlet and outlet temperature.

5.- Determination of the domestic hot water (DHW) temperature.

6.- Energy balance of the heating circuit.

7.- Energy balance of the domestic hot water (DHW) circuit.

8.- Calculation of the energy efficiency.

9.- Variation of the exhaust gases outlet in function of the combustion quality.

10.-Influence of the target heating of the domestic hot water (DHW) temperature on the constituents of the combustion fumes and on the combustion efficiency.

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, derivative parameters; etc, in real time.

14.-The Computer Control System with SCADA and PID Control allow a real industrial simulation.

15.-This unit is totally safe as uses mechanical, electrical/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 EACC unit process through the control interface box without the computer.

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

-**EACC/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 particular unit process through the control interface box without the computer.
2.- Visualization of all the sensors values used in the particular unit process.
3.- Calibration of all sensors included in the particular unit process.
4.- Hand on of all the actuators involved in the particular unit process.
5.- Realization of different experiments, in automatic way, without having in front the particular unit. (These experiments can be decided previously).
6.- Simulation of outside actions, in the cases do not exist hardware elements. (Example: test of complementary tanks, complementary industrialenvironment to the process to be studied, etc).
7.- PLC hardware general use.
8.- PLC process application for the particular unit.
9.- PLC structure.
10.-PLC inputs and outputs configuration.
11.-PLC configuration possibilities.
12.-PLC program languages.
13.-PLC different programming standard languages (ladder diagram (LD), structured text (ST), instructions list (IL), sequential function chart (SFC), function block diagram (FBD)).
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 particular unit process.
17.-Possibility of creating new process in relation with the particular unit.
18.-PLC Programming Exercises.
19.-Own PLC applications in accordance with teacher and student requirements.

b) Technical and Vocational Education configuration

⑧ **EACC/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.

⑨ EACC/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.

c) Multipost Expansions options

⑩ 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 and PID Control 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 and PID Control, 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.

edibon INTERNATIONAL

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