Computer Controlled **Thermal Conductivity of Building and Insulating Materials Unit,** with SCADA

TCMC

EDIBON PATENT

Teaching Technique used

EDIBON **SCADA** System

② Software for:
- Computer Control
- Data Acquisition
- Data Management

Computer
(not included in the supply)

③ Cables and Accessories

④ Manuals
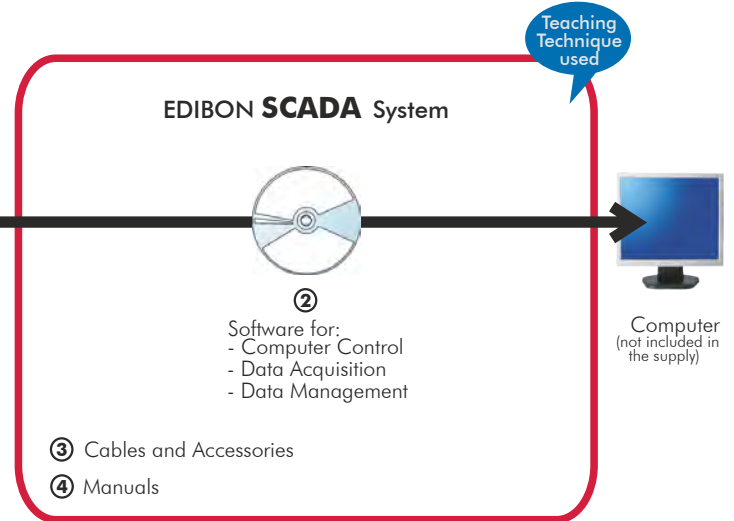
① Unit: TCMC. Thermal Conductivity of Building and Insulating Materials Unit

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

Key features:

▶ **Advanced Real-Time SCADA.**

▶ **Open Control + Multicontrol + Real-Time Control.**

▶ **Specialized EDIBON Control Software.**

▶ **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
      ↳7.-Mechanics & Materials
        and
      9.-Thermodynamics & Thermotechnics

For more information about Key Features, click here:

INTRODUCTION

Thermal conductivity is defined as the ability of a material to transfer heat. It is measured in watts per square meter of surface area for a temperature gradient of 1 K per unit thickness of 1 m. The main factors that affect thermal conductivity are the density of the material, moisture of the material and room temperature. With increasing density, moisture and temperature, the thermal conductivity increases too.

Energy efficiency is a priority for many areas of industry. One aspect of energy efficiency is the improved insulation of buildings by using materials of a low thermal conductivity.

There are a number of possibilities to measure thermal conductivity and they differ in technique, sample size, testing time, capability and methodologies of measurement. A heat flow meter (HFM) test is a steady-state measurement process in which a specimen is placed in contact with an upper and a lower plate, which are then stabilized at two different temperatures. Due to the temperature gradient thus imposed, heat flows vertically through the specimen, from the hot face to the cold face. Under steady-state conditions, the specimen thermal conductivity can be calculated.

The Computer Controlled Thermal Conductivity of Building and Insulating Material Unit "TCMC" is designed to determinate the thermal conductivity of a wide range of materials used in buildings and other insulating materials.

GENERAL DESCRIPTION

The Computer Controlled Thermal Conductivity of Building and Insulating Material Unit "TCMC" is an unit employed to measure thermal conductivity of low-conductivity materials, such as insulating materials.

This unit is a calibrated instrument that complies with the ISO 8301, ASTM C518, DIN EN 12667 and JIS A1412 standards.

With the TCMC unit, samples measuring 30.5 cm x 30.5 cm and of variable thicknesses, ranging from a few millimeters to 10 cm, are tested between two heat flux sensors in fixed or adjustable temperature gradients. After a few minutes for the system to reach equilibrium, the unit determines the thermal conductivity and thermal resistance of the sample.

The TCMC unit can operate as a stand-alone instrument, without the assistance of a computer. The unit includes a printer and produces a summary report, with the test results. The cooling system works with a Peltier cooling system and requires no external chiller or water supply, thereby improving reliability and avoiding maintenance cost and time.

Automatic plate movement and determination of the sample thickness facilitate tests preparation. The TCMC unit comes with a transducer, allowing the measurement of the actual specimen's thickness within few seconds.

The plate temperature control system and dual heat flux sensors quickly provide accurate data. The user places the sample between two plates and defines the mean sample temperature and temperature drop. The plate temperatures are controlled by bidirectional Heating/Cooling Peltier systems, coupled with a closed loop fluid flow and an integrated forced air heat exchanger.

This Computer Controlled Unit is supplied with the EDIBON Computer Control System (SCADA), and includes: The unit itself + 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
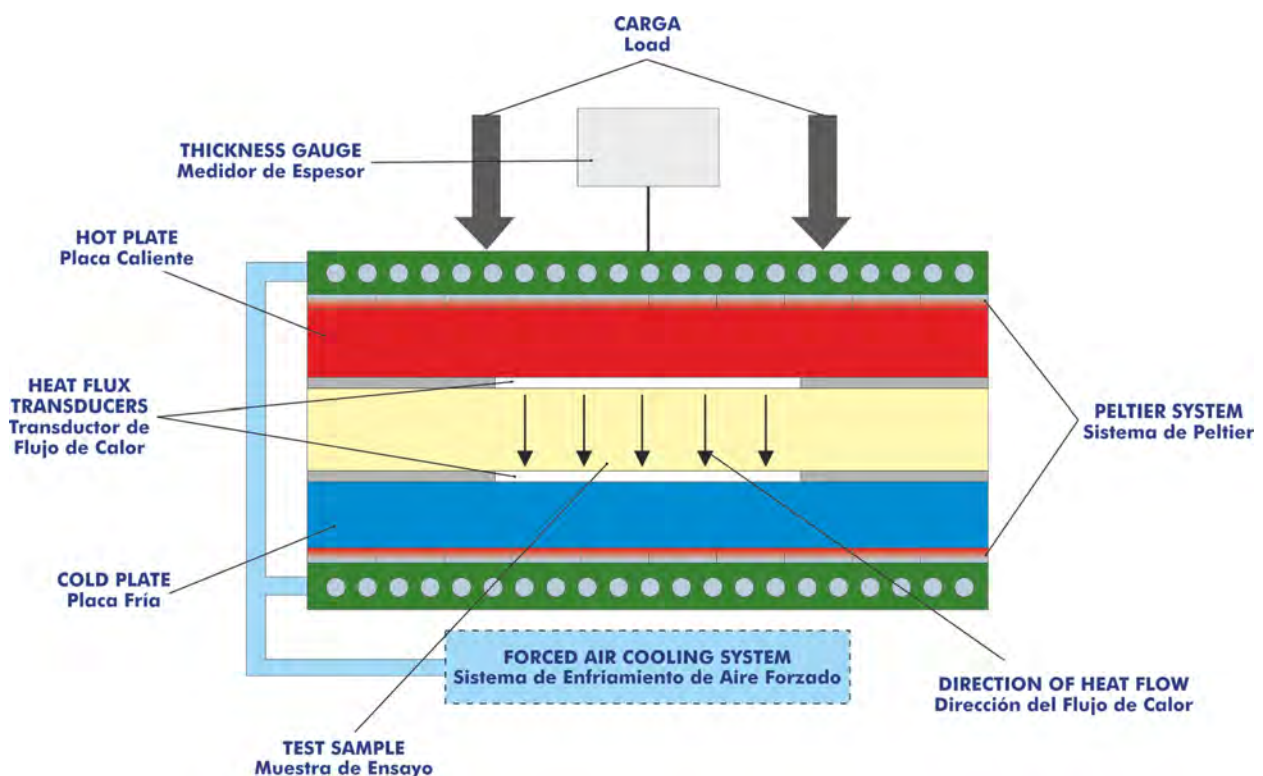
With this unit there are several options and possibilities:
- Main items: 1, 2, 3, and 4.
- Optional items: 5, 6, 7, 8 and 9.

Let us to describe the main items (1 to 4), first:

① TCMC. Unit:

Bench-top unit.

Thermallly insulated unit.

Plate temperature ranges: 0 to 40°C.

Cooling system: Forced Air.

Plate temperature control: Peltier system.

Specimens:

L x W: 300 x 300 mm.

Thickness: 5-100 mm.

It is recommended to use fibrous, granular and cellular materials and soft, rigid and semi-rigid materials.

Thermal resistance range: 0.1 to 8.0 $m^2 \cdot K/W$.

Thermal conductivity range: 0.002 to 1.0 $W/m \cdot K$.

A loading system ensures that the same force is applied to the specimens. Value: 21KPa.

Two heat flux sensors, situated in the cold and hot plate.

Six temperature sensors, located in different points of the unit: 3 sensors situated in the hot plate and 3 sensors situated in the cold plate.

Repeatability: 0.5%.

Accuracy: 1 to 3%.

Set of specimens:

Materials: black nitrile rubber, polyacetal, expanded polystyrene, PTFE, PMMA, PVC, glass fiber and glass fiber with resin.

The unit is connected with the computer via USB connection cable.

The complete unit includes as well:

Advanced Real-Time SCADA.

Open Control + Multicontrol + Real-Time Control.

Specialized EDIBON Control Software.

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.

TCMC Unit

② TCMC/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 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.

TCMC/CCSOF

③ Cables and Accessories, for normal operation.

④ Manuals: This unit is **supplied with 8 manuals:** Required Services, Assembly and Installation, Control Software, Starting-up, Safety, Maintenance, Calibration & Practices Manuals.

✱ References 1 to 4 are the main items: TCMC + TCMC/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 thermal conductivity of calibrated materials.

2.- Determination of the density of different materials.

3.- Determination of the thermal conductivity of different materials.

4.- Determination of the thermal resistance.

Additional practical possibilities:

5.- Sensors calibration.

Other possibilities to be done by this Unit:

6.- Many students view results simultaneously.

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

7.- 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.

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

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

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

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

12.- Control of the TCMC unit process through the control interface box without the computer.

13.- Visualization of all the sensors values used in the TCMC unit process.

- 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.

-Computer (PC).

DIMENSIONS & WEIGHT

-Dimensions: 630 x 700 x 520 mm. approx.
  (24.80 x 27.55 x 20.47 inches approx.).

-Weight: 64 Kg. approx.
  (141 pounds approx.).

Additionally to the main items (1 to 4) described, we can offer, as optional, other items from 5 to 9.

All these items try to give more possibilities for:

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

b) Higher Education and/or Technical and Vocational Education configuration. (CAL)

c) Multipost Expansions options. (Mini ESN and ESN)

a) Technical and Vocational Education configuration

⑤ TCMC/CAI. Computer Aided Instruction Software System.

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

This software is optional and can be used additionally to items (1 to 4).

This complete software package consists of an Instructor Software (INS/SOF) totally integrated with the Student Software (TCMC/SOF). Both are interconnected so that the teacher knows at any moment what is the theoretical and practical knowledge of the students.

- **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.

Generate and print reports.

Detect student's progress and difficulties.

…and many other facilities.

Instructor Software

- **TCMC/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.

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

www.edibon.com/products/catalogues/en/CAI.pdf

Student Software

⑥ TCMC/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 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 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.
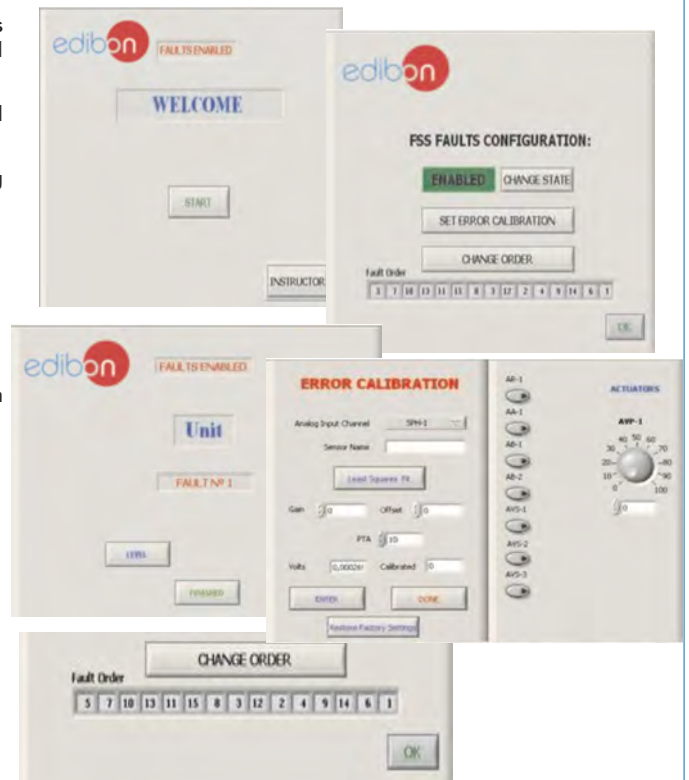
- The action of some controls is annulled.

On/off faults:

- Several on/off faults can be included.

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

www.edibon.com/products/catalogues/en/FSS.pdf

Example of some screens

b) <u>Higher Education and/or Technical and Vocational Education configuration</u>

⑦ **TCMC/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 doing the necessary calculations to extract the right conclusions from data obtained during the experimental practices.

CAL computes the value of all the variables involved and performs the calculations.

It allows to plot and print the results. Within 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

c) <u>Multipost Expansions Options</u>

⑧ **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).
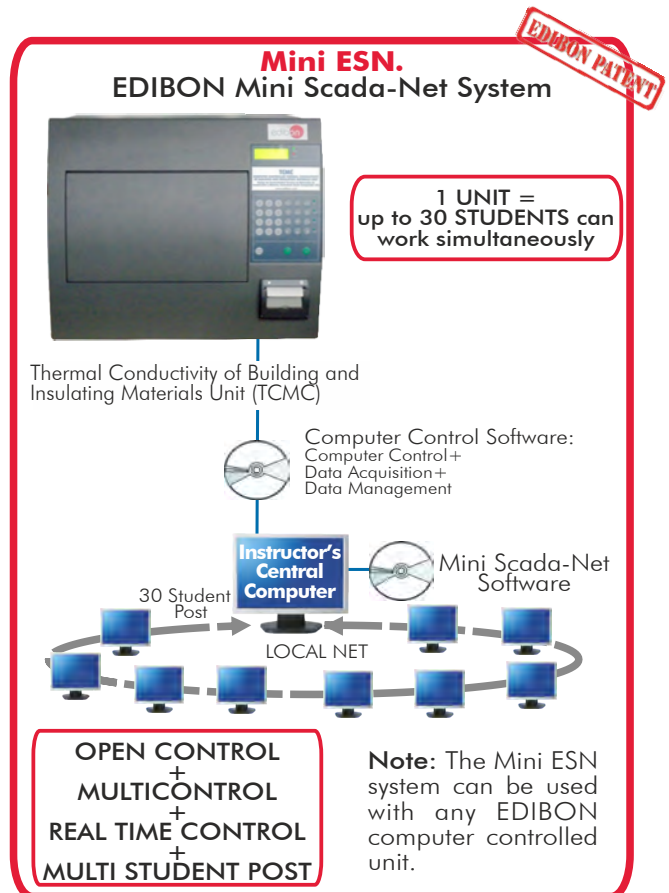
<u>Main characteristics:</u>

- **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.**

<u>Main advantages:</u>

- **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/products/catalogues/en/Mini-ESN.pdf

Mini ESN.
EDIBON Mini Scada-Net System

EDIBON PATENT

1 UNIT =
up to 30 STUDENTS can
work simultaneously

Thermal Conductivity of Building and Insulating Materials Unit (TCMC)

Computer Control Software:
Computer Control+
Data Acquisition+
Data Management

Instructor's Central Computer

Mini Scada-Net Software

30 Student Post

LOCAL NET

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

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

⑨ **ESN. EDIBON Scada-Net.**
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/products/catalogues/en/units/thermodynamicsthermotechnics/esn-thermodynamics/ESN-THERMODYNAMICS.pdf

Main items (always included in the supply)

Minimum supply always includes:

① **Unit: TCMC. Thermal Conductivity of Building and Insulating Materials Unit.**

② **TCMC/CCSOF. Computer Control + Data Acquisition + Data Management Software.**

③ **Cables and Accessories**, for normal operation.

④ **Manuals.**

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

Optional items (supplied under specific order)

a) Technical and Vocational configuration

⑤ TCMC/CAI. Computer Aided Instruction Software System.

⑥ TCMC/FSS. Faults Simulation System.

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

⑦ TCMC/CAL. Computer Aided Learning Software (Results Calculation and Analysis).

c) Multipost Expansions options

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Set of specimens:

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Exercises and Practical Possibilities to be done with Main Items

1.- Study of the thermal conductivity of calibrated materials.

2.- Determination of the density of different materials.

3.- Determination of the thermal conductivity of different materials.

4.- Determination of the thermal resistance.

Additional practical possibilities:

5.- Sensors calibration.

Other possibilities to be done by this Unit:

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Different plotting displays.

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c) <u>Multipost Expansions options</u>

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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.

-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 improvements of the product.

REPRESENTATIVE: