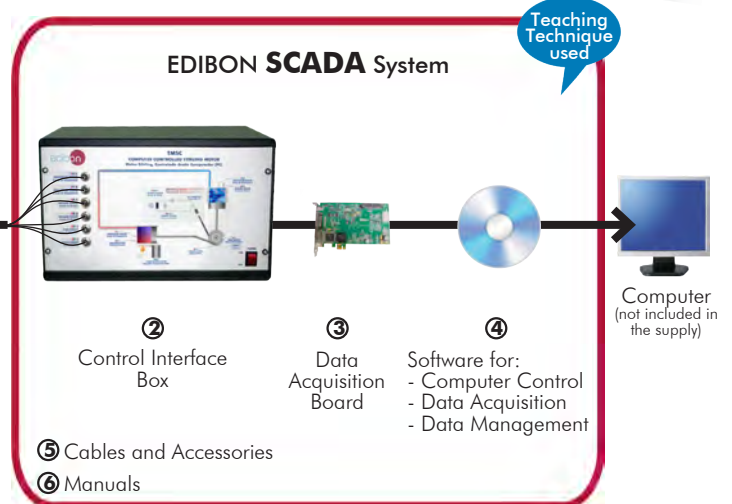




① Unit: TMS.C. Computer Controlled Stirling Motor



* 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**



www.edibon.com
PRODUCTS
↳ 5.- ENERGY
AND
9.- THERMODYNAMICS
& THERMOTECHNICS

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

A Stirling motor is a heat engine that operates by cyclic compression and expansion of air or other gas, the working fluid, at different temperature levels such that there is a net conversion of heat energy to mechanical work.

The motor is an external combustion unit like a steam engine in that all heat transfer takes place through the engine wall and the heat source is outside the engine. But unlike the steam engine, the working fluid used by the Stirling motor is a fixed quantity of gas either air or other type.

Similarly to other heat engines, the general cycle consists of compressing cool gas, heating the gas, expanding the hot gas, and finally cooling the gas again before repeating the cycle.

The Computer Controlled Stirling Motor, "TMSC", is noted for its high efficiency, quiet operation, and can be used with any type of heat source, such as renewable ones.

GENERAL DESCRIPTION

The Computer Controlled Stirling Motor, "TMSC", is used to demonstrate the operation of a thermodynamic machine for the conversion of energy. It converts thermal energy into mechanical energy and operates as a motor (heat engine). Additionally it can operate an electrical generator and load.

An ideal stirling cycle has four phases:

- Phase 1: Constant volume heating of the gas in the hot cylinder.
- Phase 2: Isothermal expansion at constant temperature in the hot cylinder.
- Phase 3: Constant volume working in the cold cylinder.
- Phase 4: Isothermal compression of the gas in the cold cylinder.

The Computer Controlled Stirling Motor, "TMSC", unit designed by EDIBON is an Alfa type engine. It consists of two power pistons located in separate cylinders (one for the cold source and another for the hot one). They are connected to a tube where the regenerator is located, which stores and transfers the heat, that enables the engine to reach a higher efficiency.

Gas moves between both cylinders in a close circuit. The external source provides energy to the hot cylinder, generating the expansion of the gas, and the subsequent motion of the piston, 90° out of phase from the other, and connected to it by a crankshaft.

The hot gas passes to the cold cylinder. During this time the cold cylinder piston compresses the cooled gas and forces it to move to the hot cylinder, where it receives the heat from the hot source and the cycle starts again.

The unit also includes a braking system with force sensor and an electrical generator with pulley to convert the mechanical energy into electrical energy, equipped with an electrical load and current and voltage measurement system.

This unit is supplied with the suitable sensors and instrumentation for the control and measurement of the most representative parameters, as:

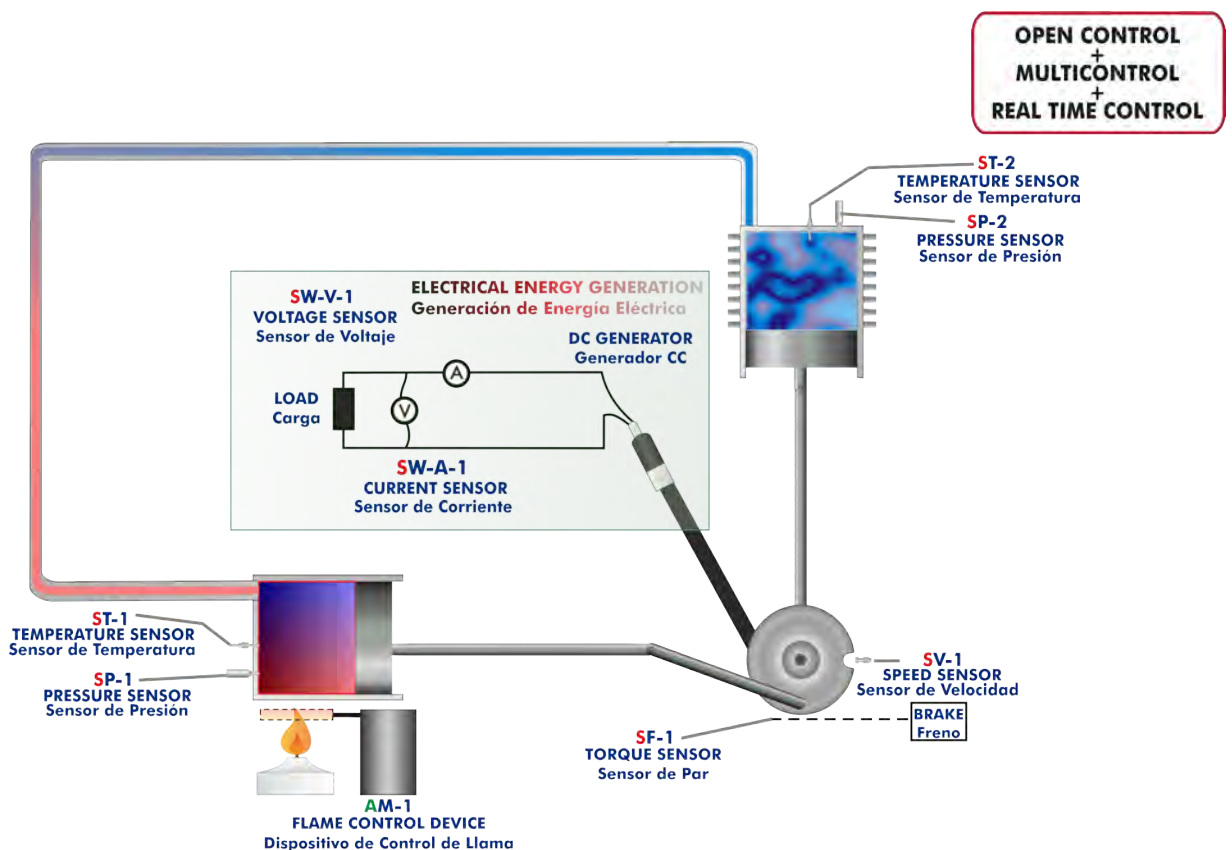
- Flame control. Temperatures measurement in the cylinders. Pressures measurement in the cylinders. Speed measurement (rpm). Torque measurement (force). Current and voltage measurement. Stirling motor power generated and efficiency calculation.

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.



TMSC detail

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, and 9.

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

① **TMSC. Unit:**

Bench-top unit.

Anodized aluminum structure and panels of painted steel.

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

Alpha type Stirling motor: hot and cold cylinders made of stainless steel and pistons made of bronze.

Device to control the flame of the heating element, to cover it and to release it.

Alcohol lamp as heating element.

Braking system.

Electrical generator with a pulley for converting the generated mechanical energy into electrical energy. Equipped with an electrical load and current and voltage measurement system.

Instrumentation:

Two temperature sensors "J" type, one in the hot cylinder and the other in the cold cylinder.

Two pressure sensors, one in the hot cylinder and the other in the cold cylinder, range: 0 - 5 PSI.

Speed sensor (rpm), range: 0 - 3000 r.p.m.

Current sensor.

Voltage sensor.

Torque measurement (force sensor), range: 0 - 1 N/m.

Generated power calculation.

Stirling motor efficiency calculation.

Overtemperature protection with the activation of the device to control the flame.

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.



Unit: TMSC

② TMSC/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 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.



TMSC/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/O. 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/O.

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.

The Data Acquisition board model may change at any moment, providing the same or better features than those required for the unit.



DAB

④ TMSC/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).

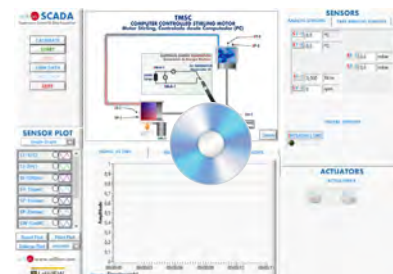
Calibration system for the sensors involved in the process.

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.



TMSC/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: TMSC + TMSC/CIB + DAB + TMSC/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.- Study of the conversion of thermal-mechanical-electrical energy.
 - 2.- Study of the relationship between the temperatures difference of the thermal machine and the speed generated.
 - 3.- Calculation of the "threshold" temperatures difference which generates motion.
 - 4.- Study of the mechanical power in relation to speed.
 - 5.- Study of the electrical power in relation to speed.
 - 6.- Mechanical efficiency calculation.
 - 7.- Electrical efficiency calculation.
 - 8.- Speed measurement (rpm).
 - 9.- Torque measurement.
 - 10.- Measurement of the generated electrical power.
 - 11.- Temperature measurements.
 - 12.- Pressure measurements.
- Additional practical possibilities:
- 13.- Sensors calibration.
- Other possibilities to be done with this Unit:
- 14.- Many students view results simultaneously.
To view all results in real time in the classroom by means of a projector or an electronic whiteboard.
- 15.- 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.
 - 16.- The Computer Control System with SCADA allows a real industrial simulation.
 - 17.- This unit is totally safe as uses mechanical, electrical/electronic, and software safety devices.
 - 18.- This unit can be used for doing applied research.
 - 19.- This unit can be used for giving training courses to Industries even to other Technical Education Institutions.
 - 20.- Control of the TMSC unit process through the control interface box without the computer.
 - 21.- Visualization of all the sensors values used in the TMSC unit process.
- Several other exercises can be done and designed by the user.

REQUIRED SERVICES

- Electrical supply: single-phase 200 VAC – 240 VAC/50 Hz or 110 VAC – 127 VAC/60 Hz.
- Computer.

DIMENSIONS AND WEIGHTS

- TMSC:
- Unit:
- Dimensions: 450 x 400 x 480 mm approx.
(17.71 x 15.74 x 18.89 inches approx.)
 - Weight: 35 Kg approx.
(77.16 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.).

REQUIRED CONSUMABLES (Not included)

- Alcohol or paraffin.

SIMILAR UNITS AVAILABLE

- TMSC. Computer Controlled Stirling Motor.
Offered in this catalogue:
- TMSB. Stirling Motor.
Offered in other catalogue:

SOFTWARE MAIN SCREENS

SCADA Main screen

The SCADA Main screen displays a central schematic of the 'TMSC COMPUTER CONTROLLED STIRLING MOTOR'. The schematic includes components like 'ELECTRICAL ENERGY GENERATION', 'DC GENERATOR', 'LOAD CARGO', and various sensors (ST-1, ST-2, SP-1, SP-2, SF-1, SV-1) and actuators (AM-1, AM-2). The interface is divided into several functional areas:

- Top Left:** A vertical menu with buttons for CALIBRATE, START, STOP, VIEW DATA, SAVE DATA, and QUIT.
- Top Right:** A 'SENSORS' panel showing real-time values for analog sensors (ST-1, ST-2, SP-1, SP-2, SF-1, SV-1) and digital sensors.
- Bottom Left:** A 'SENSOR PLOT' window with a 'Single Graph' view and a list of sensor channels (ST-1, ST-2, SF-1, SV-1, SP-1, SP-2, SW-1) for selection.
- Bottom Center:** A 'SIGNAL VS TIME' graph showing amplitude over time (00:00:00 to 00:00:15).
- Bottom Right:** An 'ACTUATORS' panel showing control elements for AM-1 and AM-2.

❶ Main software operation possibilities.

❷ Sensors displays, real time values, and extra output parameters. Sensors: ST= Temperature sensor. SP= Pressure sensor. SW-V= Voltage sensor. SW-A= Current sensor. SW= Power sensor. SF= Force sensor. SV= Speed sensor.

❸ Actuators controls. Actuator: AM= Flame control device.

❹ Channel selection and other plot parameters.

❺ Real time graphics displays.

Software for Sensors Calibration

Example of screen

The 'Calibrate Window' software interface is designed for sensor calibration. It features two main tabs: 'Simple Calibrate' and 'Mutlicalibrate'.

Simple Calibrate Tab:

- Analog Input Channel:** Fields for Sensor Name (ST-1), Averages (10), Calibration Units (°C), Current Gain (98,3837), Full Scale (100), and Current Offset (0,888826). It includes a 'Read Value' section with 'Volts' (0,405231), 'True Calibrated' (40,757), and 'Calibrated' (40,757) values.
- Measurements Unit:** A toggle for 'Enable Front Panel Limits'.
- Gain & Offset Setting:** Fields for 'New Gain' (0) and 'New Offset' (0), with buttons for 'Restore Factory Gains & Factory Offsets' and 'Set New Gain & New Offset'.
- Scaling Parameters:** A 'Least Square Fit' button.
- Buttons:** 'SAVE & EXIT' and 'EXIT'.

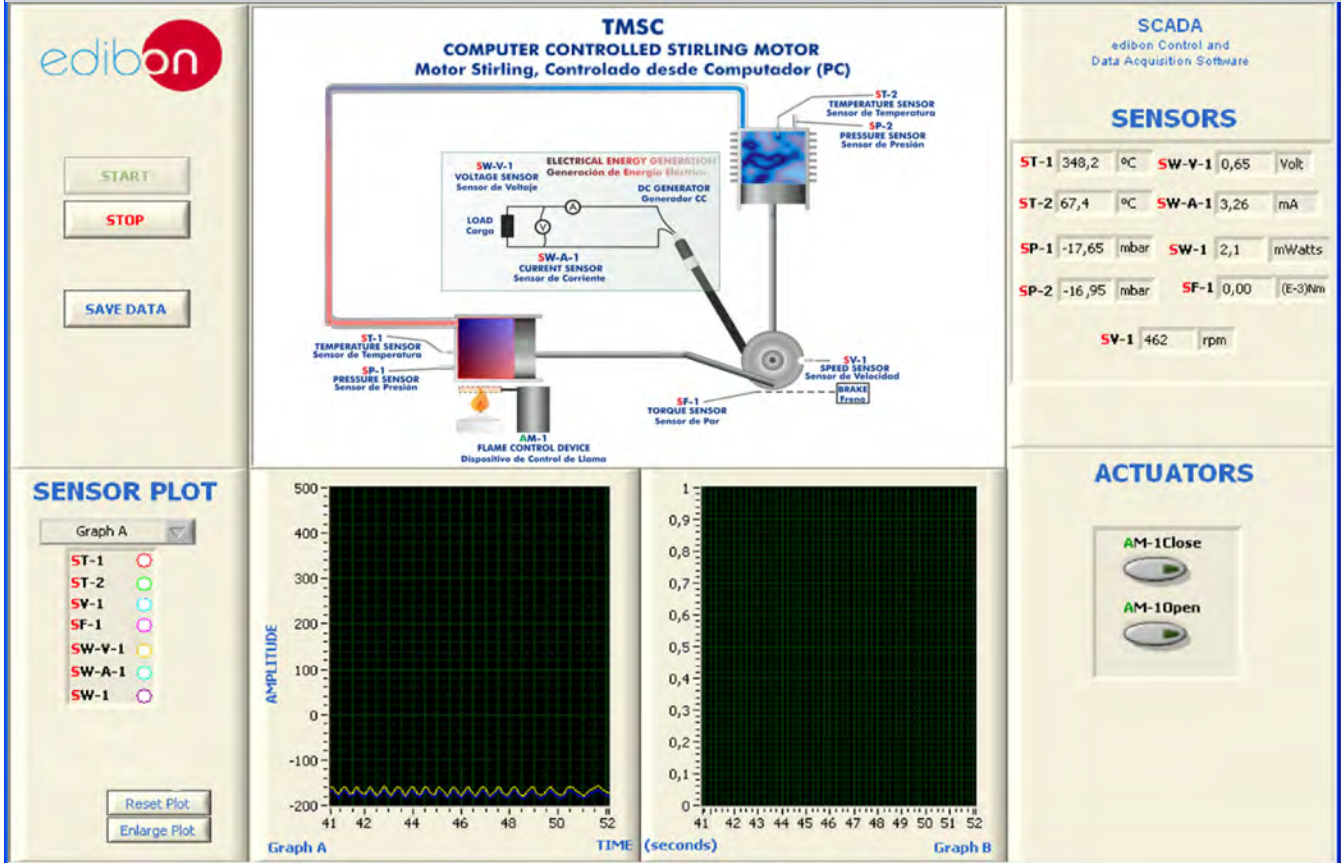
Mutlicalibrate Tab:

- Reference Value:** A field set to 0.
- Full Scale:** A field set to 100.
- Sensors Table:** A table for multiple sensors with columns for Volts, Calibrated, Err(%), Current Gain, and Current Offset. The table shows data for ST-1 and SP-2.
- Buttons:** 'Restore Factory Gains & Factory Offsets', 'Set New Gains & New Offsets', 'Take Measurement', 'Get New Gain & New Offset', and 'Taken Data' (0).
- Bottom Buttons:** 'SAVE & EXIT' and 'EXIT'.

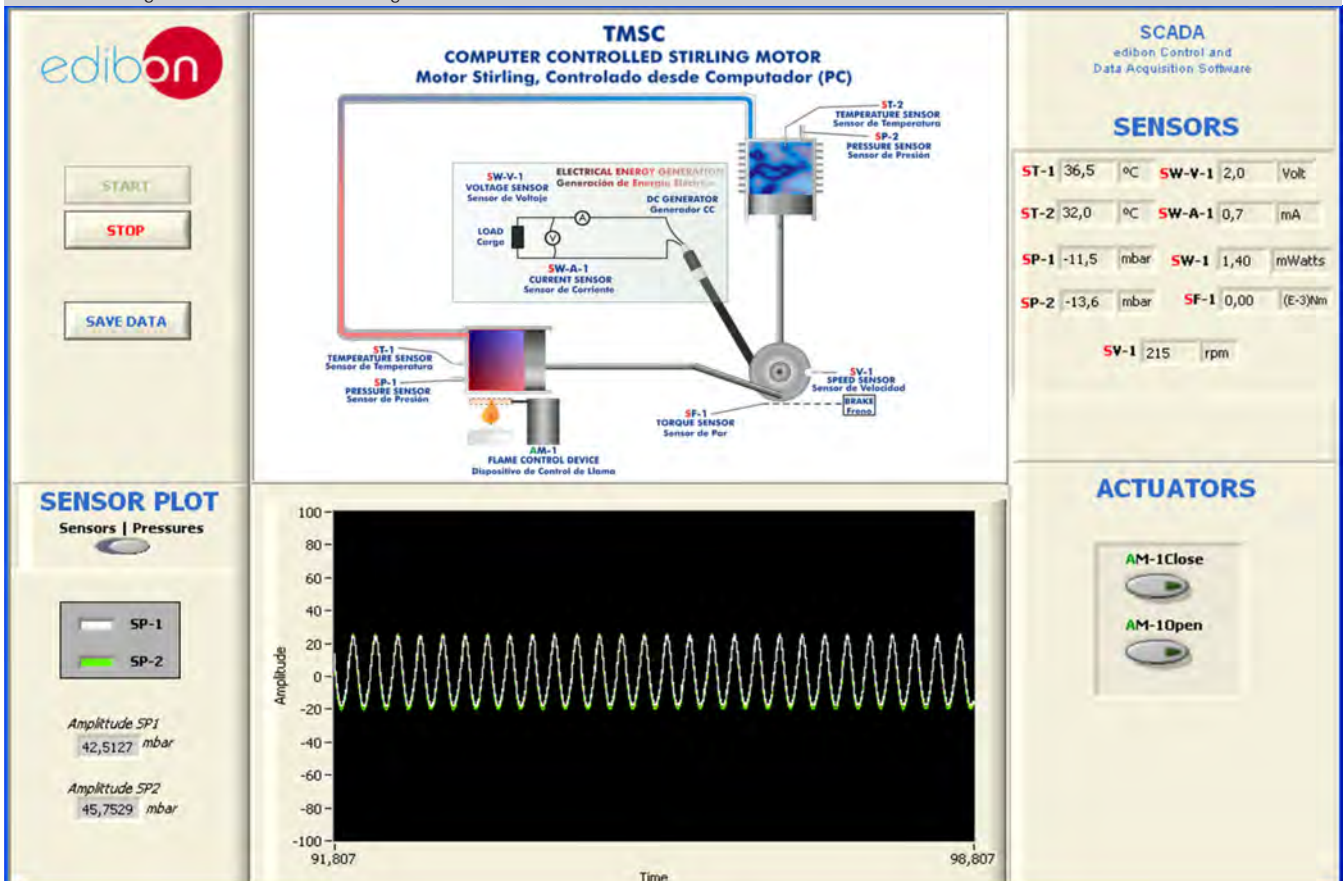
The teacher and the students can calibrate the unit with a password provided by EDIBON. The teacher can restore the factory calibration any time.

SOME REAL RESULTS OBTAINED FROM THIS UNIT

Plot where the temperature in the cylinders is visualized.

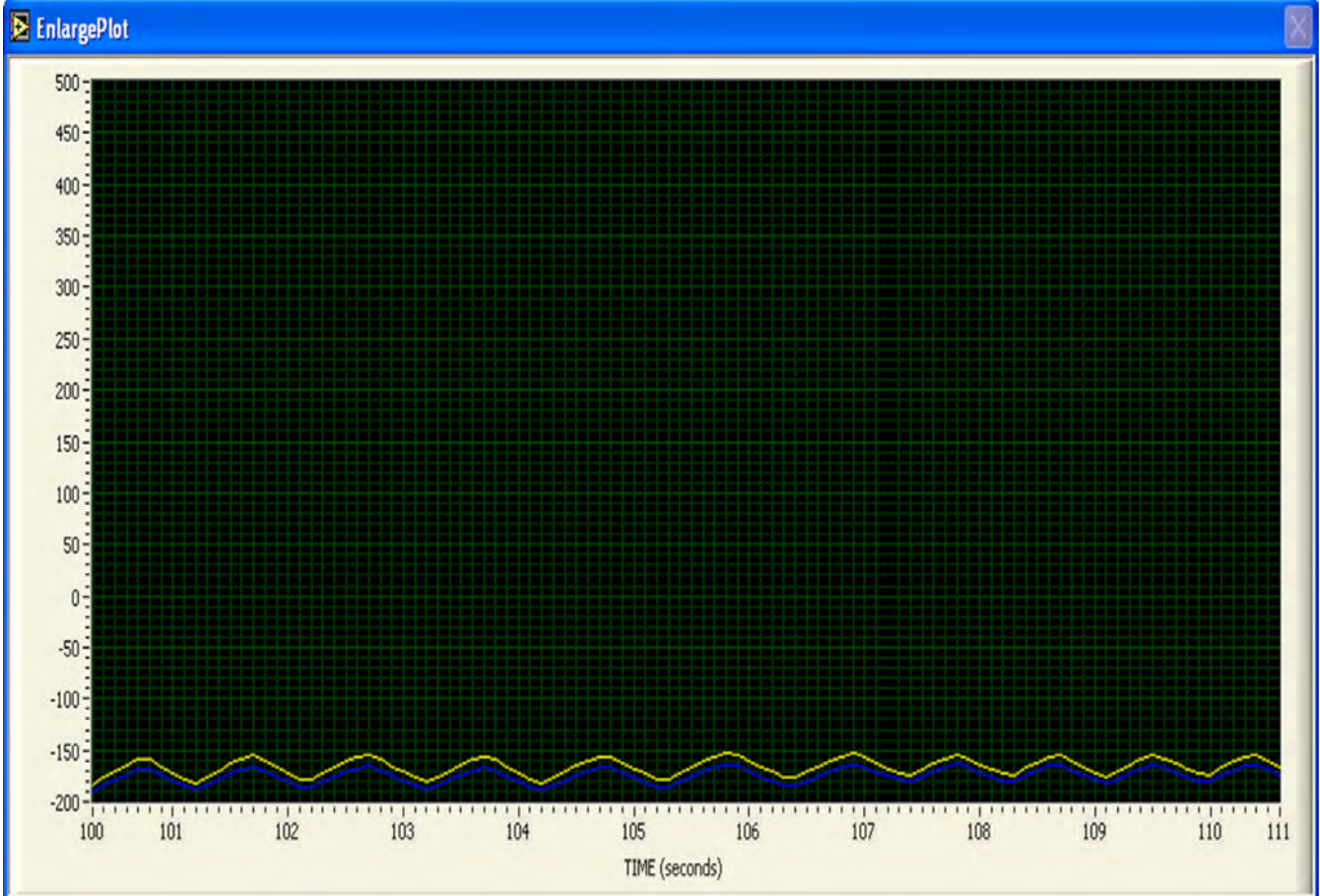


Plot where the generated current and voltage are visualized.



Some **real** results obtained from this Unit

Power versus velocity of the Stirling motor.



Representation in real time of pressure variations in the cylinders. Study with an oscilloscope.

START

STOP

SAVE DATA

TMSC

COMPUTER CONTROLLED STIRLING MOTOR

Motor Stirling, Controlado desde Computador (PC)

SCADA

edibon Control and Data Acquisition Software

SENSORS

| | | | |
|------|-------------|--------|--------------|
| ST-1 | 360,0 °C | SW-V-1 | 0,85 Volt |
| ST-2 | 68,6 °C | SW-A-1 | 0,41 mA |
| SP-1 | -16,48 mbar | SW-1 | 0,4 mWatts |
| SP-2 | -15,58 mbar | SF-1 | 0,25 (E-3)Nm |
| | | SV-1 | 631 rpm |

SENSOR PLOT

Graph B

- ST-1
- ST-2
- SV-1
- SF-1
- SW-V-1
- SW-A-1
- SW-1

Reset Plot

Enlarge Plot

Graph A

Graph B

ACTUATORS

AM-1Close

AM-1Open

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 9.

All these items try to give more possibilities for:

- a) Technical and Vocational Education configuration. (ICAI)
- b) Multipost Expansions options. (MINI ESN and ESN)

a) Technical and Vocational Education configuration

⑦ **TMSC/ICAI. Interactive Computer Aided Instruction Software.**

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.

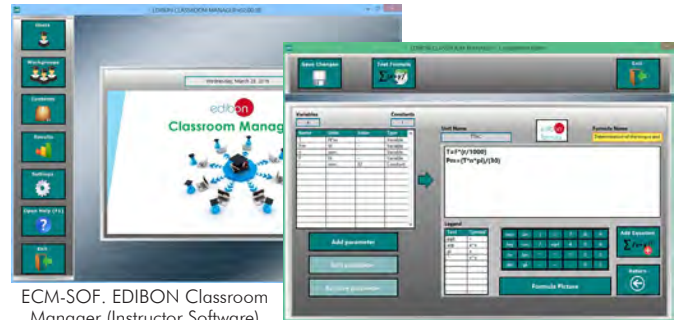
Innovative features:

- **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

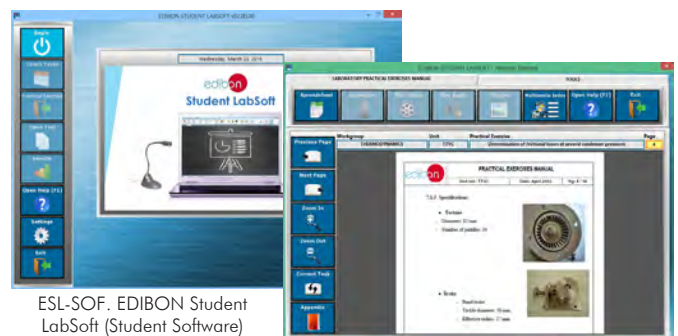
ECAL. EDIBON Calculations Program Package - Formula Editor Screen



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

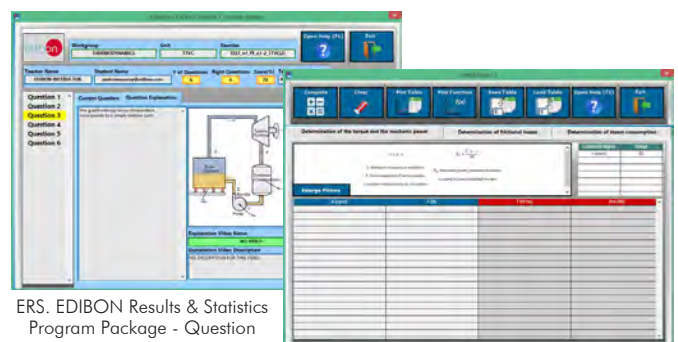
ETTE. EDIBON Training Test & Exam Program Package - Main Screen with Numeric Result Question

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

b) Multipost Expansions options

⑧ **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:

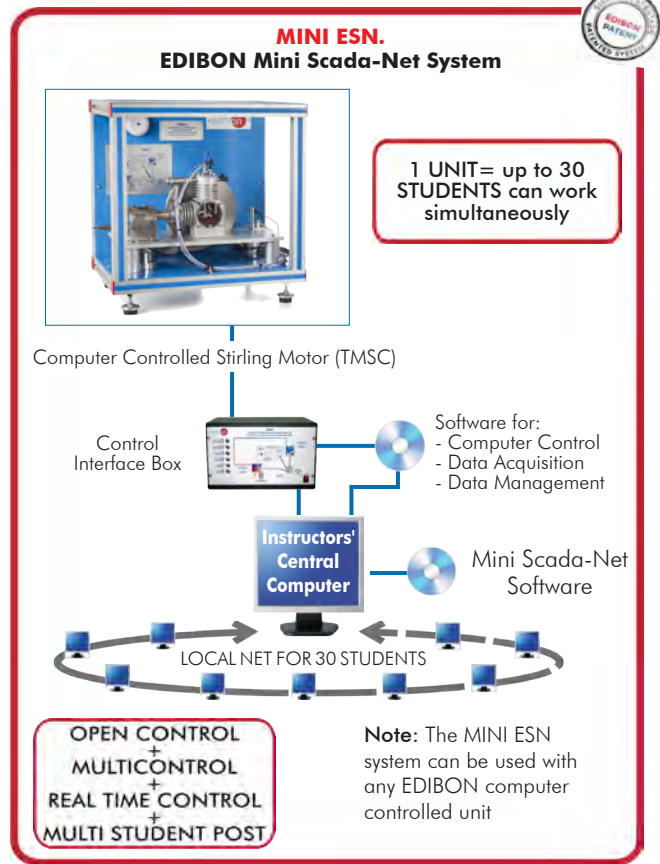
www.edibon.com/en/files/expansion/MINI-ESN/catalog

⑨ **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: TMSC. Computer Controlled Stirling Motor.**
- ② **TMSC/CIB. Control Interface Box.**
- ③ **DAB. Data Acquisition Board.**
- ④ **TMSC/CCSOF. Computer Control + Data Acquisition + Data Management Software.**
- ⑤ **Cables and Accessories**, for normal operation.
- ⑥ **Manuals.**

***IMPORTANT:** Under TMSC 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 **TMSC/ICAI. Interactive Computer Aided Instruction Software.**

b) Multipost Expansions options

- ⑧ **MINI ESN. EDIBON Mini Scada-Net System for being used with EDIBON Teaching Units.**
- ⑨ **ESN. EDIBON Scada-Net Systems.**

① TMSC. Unit:

Bench-top unit.
 Anodized aluminum structure and panels of painted steel.
 Diagram in the front panel with similar distribution to the elements in the real unit.
 Alpha type Stirling motor: hot and cold cylinders made of stainless steel and pistons made of bronze.
 Device to control the flame of the heating element, to cover it and to release it.
 Alcohol lamp as heating element.
 Braking system.
 Electrical generator with a pulley for converting the generated mechanical energy into electrical energy. Equipped with an electrical load and current and voltage measurement system.
 Instrumentation:
 Two temperature sensors "J" type, one in the hot cylinder and the other in the cold cylinder.
 Two pressure sensors, one in the hot cylinder and the other in the cold cylinder, range: 0 - 5 PSI.
 Speed sensor (rpm), range: 0 - 3000 r.p.m.
 Current sensor.
 Voltage sensor.
 Torque measurement (force sensor), range: 0 - 1 N/m.
 Generated power calculation.
 Stirling motor efficiency calculation.
 Overtemperature protection with the activation of the device to control the flame.
 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.

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The Control Interface Box is part of the SCADA system.
 Control interface box with process diagram in the front panel.
 The unit control elements are permanently computer controlled.
 Simultaneous visualization in the computer of all parameters involved in the process.
 Calibration of all sensors involved in the process.
 Real time curves representation about system responses.
 All the actuators' values can be changed at any time from the keyboard allowing the analysis about curves and responses of the whole process.
 Shield and filtered signals to avoid external interferences.
 Real time computer control with flexibility of modifications from the computer keyboard of the parameters, at any moment during the process.
 Real time computer control for parameters involved in the process simultaneously.
 Open control allowing modifications, at any moment and in real time, of parameters involved in the process simultaneously.
 Three safety levels, one mechanical in the unit, another electronic in the control interface and the third one in the control software.

③ DAB. Data Acquisition Board:

The Data Acquisition board is part of the SCADA system.
 PCI 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.
 The Data Acquisition board model may change at any moment, providing the same or better features than those required for the unit.

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

The three softwares are part of the SCADA system.
 Compatible with the industry standards.
 Flexible, open and multicontrol software, developed with actual windows graphic systems, acting simultaneously on all process parameters.
 Management, processing, comparison and storage of data.
 Sampling velocity up to 250 KS/s (kilo samples per second).
 Calibration system for the sensors involved in the process.
 It allows the registration of the alarms state and the graphic representation in real time.
 Open software, allowing the teacher to modify texts, instructions. Teacher's and student's passwords to facilitate the teacher's control on the student, and allowing the access to different work levels.
 This unit allows the 30 students of the classroom to visualize simultaneously all the results and the manipulation of the unit, during the process, by using a projector or an electronic whiteboard.

⑤ Cables and Accessories, for normal operation.

⑥ Manuals:

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

Exercises and Practical Possibilities to be done with the Main Items

- 1.- Study of the conversion of thermal-mechanical-electrical energy.
 - 2.- Study of the relationship between the temperatures difference of the thermal machine and the speed generated.
 - 3.- Calculation of the "threshold" temperatures difference which generates motion.
 - 4.- Study of the mechanical power in relation to speed.
 - 5.- Study of the electrical power in relation to speed.
 - 6.- Mechanical efficiency calculation.
 - 7.- Electrical efficiency calculation.
 - 8.- Speed measurement (rpm).
 - 9.- Torque measurement.
 - 10.- Measurement of the generated electrical power.
 - 11.- Temperature measurements.
 - 12.- Pressure measurements.
- Additional practical possibilities:
- 13.- Sensors calibration.
- Other possibilities to be done with this Unit:
- 14- Many students view results simultaneously.
To view all results in real time in the classroom by means of a projector or an electronic whiteboard.
 - 15.- 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.
 - 16.- The Computer Control System with SCADA allows a real industrial simulation.
 - 17.- This unit is totally safe as uses mechanical, electrical/electronic, and software safety devices.
 - 18.- This unit can be used for doing applied research.
 - 19.- This unit can be used for giving training courses to Industries even to other Technical Education Institutions.
 - 20.- Control of the TMSC unit process through the control interface box without the computer.
 - 21.- Visualization of all the sensors values used in the TMSC unit process.
- Several other exercises can be done and designed by the user.

TENDER SPECIFICATIONS (for optional items)

a) Technical and Vocational Education configuration

⑦ **TMSC/ICAI. Interactive Computer Aided Instruction Software.**

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.

b) Multipost Expansions options

⑧ **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.



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