Computer Controlled **Test Bench for Hybrid Engine,**
with SCADA

TMHC

Engineering and Technical Teaching Equipment

EDIBON **SCADA** System

Teaching Technique used

② Control Interface Box

③ Data Acquisition Board

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

Computer
(not included in the supply)

⑤ Cables and Accessories

⑥ Manuals

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

① Unit: TMHC. Computer Controlled Test Bench for Hybrid Engine

Key features:

➤ **Advanced Real-Time SCADA.**

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

➤ **Specialized EDIBON Control Software based on LabVIEW.**

➤ **National Instruments Data Acquisition board (250 KS/s, kilo samples per second).**

➤ **Calibration exercises, which are included, teach the user how to calibrate a sensor and the importance of checking the accuracy of the sensors before taking measurements.**

➤ **Projector and/or electronic whiteboard compatibility allows the unit to be explained and demonstrated to an entire class at one time.**

➤ **Capable of doing applied research, real industrial simulation, training courses, etc.**

➤ **Remote operation and control by the user and remote control for EDIBON technical support, are always included.**

➤ **Totally safe, utilizing 4 safety systems (Mechanical, Electrical, Electronic & Software).**

➤ **Designed and manufactured under several quality standards.**

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

➤ **This unit has been designed for future expansion and integration. A common expansion is the EDIBON Scada-Net (ESN) System which enables multiple students to simultaneously operate many units in a network.**

**OPEN CONTROL
+
MULTICONTROL
+
REAL TIME CONTROL**

POWERED BY

NATIONAL INSTRUMENTS
LabVIEW™

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

For more information about Key Features, click here

INTRODUCTION

Due to the predictable depletion of the existing oil reservoirs, accelerated by the increasing global consumption, and to the effect that the emissions typical of combustion have on the global warming, some alternatives are required.

Current technology about internal combustion motors seems to be stagnated with regards to the consumption and emissions reduction, so that the introduction in the market of a new fuel to substitute petroleum will be slow.

A technology that enables to alleviate this situation until the arrival of alternative fuels is needed. This solution can be the hybrid vehicle.

A hybrid vehicle is that vehicle that combines at least two power transformers and two different energy storage systems (in the vehicle) with the aim of propelling the vehicle.

GENERAL DESCRIPTION

The Computer Controlled Test Bench for Hybrid Engine, "TMHC", is a teaching unit that allows to study and analyze the power source of a hybrid vehicle, consisting on a combination of an electrical motor and an internal combustion engine.

These two power sources are highly compatible, thus the hybrid vehicle makes the most of the advantages of each power source and, at the same time, it compensates for the disadvantages of the other.

The "TMHC" unit includes a dynamometer brake that introduces the load torque to the motor. The load torque is measured with the aid of the brake, which is coupled to the hybrid motor by the shaft. The torque is measured by the reaction generated on a load cell at the end of the arm (force sensor).

The speed of the hybrid motor is measured directly from the shaft of the motor with the aid of an optical sensor.

Besides, this unit includes a series of temperature, pressure, flow, speed and force sensors at different points of the unit.

This Computer Controlled Unit is supplied with the EDIBON Computer Control System (SCADA), and includes: The unit itself + a Control Interface Box + a Data Acquisition Board + Computer Control, Data Acquisition and Data Management Software Packages, for controlling the process and all parameters involved in the process.

PROCESS DIAGRAM AND UNIT ELEMENTS ALLOCATION
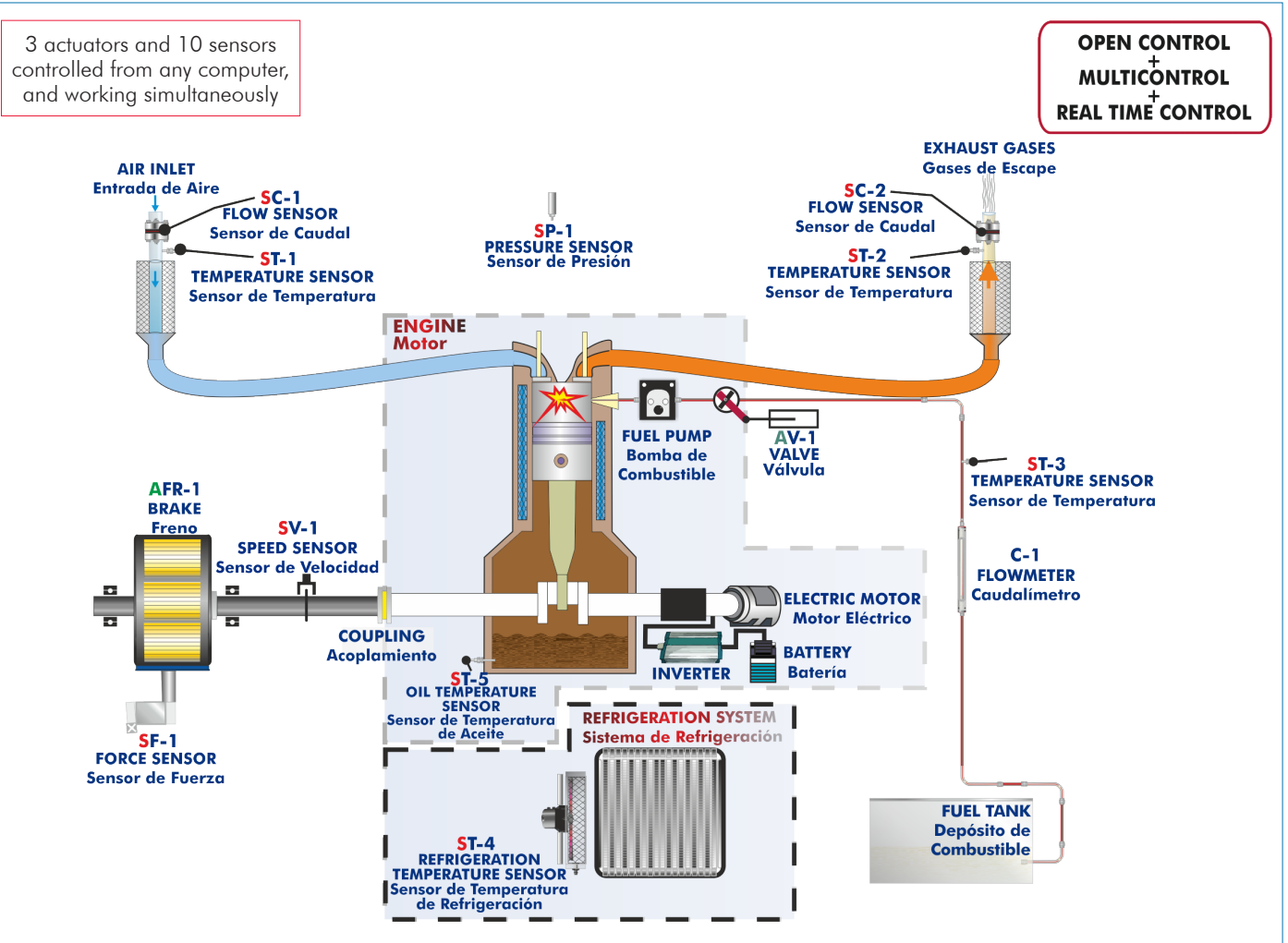
With this unit there are several options and possibilities:
  - Main items: 1, 2, 3, 4, 5 and 6.
  - Optional items: 7, 8, 9 and 10.
Let us describe first the main items (1 to 6):

① TMHC. 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.

Hybrid motor (four-stroke combustion engine + electric motor):

  Combustion engine: 4 cylinders, max. power: 62 kW approx. at 5800 rpm.

  Electric motor-generator: 10 kW approx.

Control and load unit for Hybrid Motor composed by four-stroke combustion engine+electric motor. Maximum power output of: 75 kW.

Eddy Current brake for generating the engine load, computer controlled:

  Braking torque: 120 Nm.

  Maximum speed: 5800 rpm.

Force transmission from the engine to the brake unit be means the use of an elastic claw coupling.

Coupling cover.

Adjustment of the braking torque and the speed by means of an inverter, computer controlled.

Quietening vessel for intake air, with air filter and air hose.

Vibration insulated base plate for the test engine installation.

Engine acceleration by means of the fuel valve, computer controlled (acceleration/deacceleration).

Quick and easy exhaust gas connection.

Fuel tank with pump.

Voltmeter: 0 – 200 V.

Ammeter: 0 – 100 A.

Wattmeter.

Battery.

Speed sensor to measure the speed (rpm) of the motor.

Temperature sensors, "J" type, for the measurement of air temperature, fuel temperature, oil temperature, exhaust gas temperature, etc.

Force sensor (torque).

Flow meter to measure the fuel consumption, range: 0 – 42 ml/min.

Flow sensor to measure the air intake quantity, range: 0 – 100 m³/h.

Flow sensor to measure the exhaust gas, range: 0 – 100 m³/h.

Pressure sensor necessary for obtain the corrected power of an engine, range: 900 – 1100 mbar.

By the previous sensors we can make measurement of the most representative parameters, as:

  Speed. Power. Torque. Air intake quantity. Fuel consumption. Air temperature. Fuel temperature. Exhaust gas temperature. Etc.

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: TMHC

② **TMHC/CIB. Control Interface Box:**

The Control Interface Box is part of the SCADA system.

<u>Control interface box with process diagram in the front panel</u> and with the same distribution that the different elements located in the unit, for an easy understanding by the student.

All sensors, with their respective signals, are properly manipulated from -10V. to +10V. computer output.

Sensors connectors in the interface have different pines numbers (from 2 to 16), to avoid connection errors.

Single cable between the control interface box and computer.

The unit control elements are permanently computer controlled, without necessity of changes or connections during the whole process test procedure.

Simultaneous visualization in the computer of all parameters involved in the process.

Calibration of all sensors involved in the process.

Real time curves representation about system responses.

Storage of all the process data and results in a file.

Graphic representation, in real time, of all the process/system responses.

All the actuators' values can be changed at any time from the keyboard allowing the analysis about curves and responses of the whole process.

All the actuators and sensors values and their responses are displayed on only one screen in the computer.

Shield and filtered signals to avoid external interferences.

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

Real time computer control for pumps, compressors, heating elements, control valves, etc.

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

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

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

TMHC/CIB

③ **DAB. Data Acquisition Board:**

The Data Acquisition board is part of the SCADA system.

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

Analog input:

Number of **channels= 16** single-ended or 8 differential. **Resolution=16 bits**, 1 in 65536.
Sampling rate up to: <u>250 KS/s (kilo samples per second)</u>.
Input range (V)=±10 V. Data transfers=DMA, interrupts, programmed I/0. DMA channels=6.

Analog output:

Number of **channels=2**. **Resolution=16 bits**, 1 in 65536.
Maximum output rate up to: 900 KS/s.
Output range (V)=±10 V. Data transfers=DMA, interrupts, programmed I/0.

Digital Input/Output:

Number of **channels=24 inputs/outputs**. D0 or DI Sample Clock frequency: 0 to 100 MHz.
Timing: Number of **Counter/timers=4**. Resolution: Counter/timers: 32 bits.

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

DAB

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

The three softwares are part of the SCADA system.

Compatible with actual Windows operating systems. Graphic and intuitive simulation of the process in screen. **Compatible with the industry standards.**

Registration and visualization of all process variables in an automatic and simultaneous way.

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

Management, processing, comparison and storage of data.

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

Calibration system for the sensors involved in the process.

It allows the registration of the alarms state and the graphic representation in real time.

Comparative analysis of the obtained data, after the process and modification of the conditions during the process.

Open software, allowing the teacher to modify texts, instructions. Teacher's and student's passwords to facilitate the teacher's control on the student, and allowing the access to different work levels.

This unit allows the 30 students of the classroom to visualize simultaneously all the results and the manipulation of the unit, during the process, by using a projector or an electronic whiteboard.

TMHC/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: TMHC + TMHC/CIB + DAB + TMHC/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.- Familiarisation with hybrid motors (combustion engine+electric motor).

2.- Determination of specific fuel consumption (combustion engine).

3.- Torque curves (combustion engine+electric motor).

4.- Power curves (combustion engine+electric motor).

5.- Determination of volumetric efficiency.

6.- Measurement of the most important parameters involved in the process: temperature, torque, speed, pressure, etc.

7.- Determination of engine friction loss.

8.- Determination of fuel-air ratio.

9.- Determination of the frictional power (in passive mode).

10.- Measurement of power delivered by the battery.

11.- Measurement of power produced by the electric generator.

12.- Curves of electric consumption.

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 TMHC unit process through the control interface box without the computer.

21.- Visualization of all the sensors values used in the TMHC 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

TMHC:
  Unit:
    -Dimensions: 1600 x 900 x 1600 mm approx.
              (62.99 x 35.43 x 62.99 inches approx.)
    -Weight: 300 Kg approx.
              (661.3 pounds approx.)
  Control Interface Box:
    -Dimensions: 490 x 330 x 310 mm approx.
              (19.29 x 12.99 x 12.2 inches approx.)
    -Weight: 10 Kg approx.
              (22 pounds approx.)

SIMILAR UNITS AVAILABLE

Offered in this catalog:
- TMHC. Computer Controlled Test Bench for Hybrid Engine.
Offered in other catalog:
- AEL-EHV. Computer Controlled Hybrid and Electric Vehicles Application.

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 10.

All these items try to give more possibilities for:

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

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

a) Technical and Vocational Education configuration

⑦ **TMHC/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.**

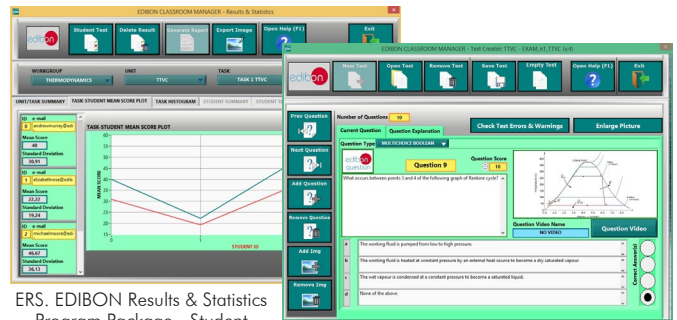For more information see **ICAI** catalogue. Click on the following link:

www.edibon.com/en/interactive-computer-aided-instruction-software

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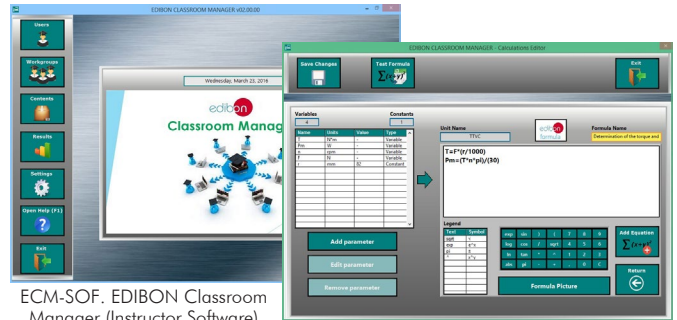
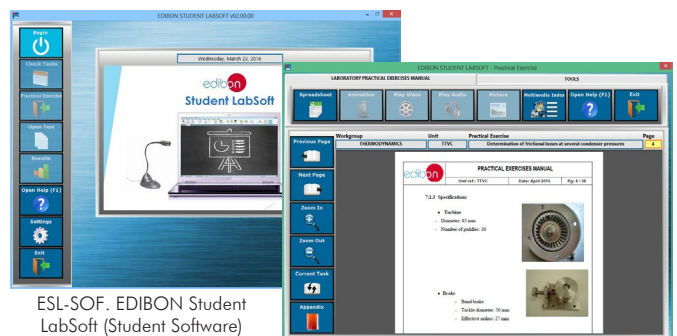ECM-SOF. EDIBON Classroom Manager (Instructor Software) Application Main Screen

ECAL. EDIBON Calculations Program Package - Formula Editor Screen

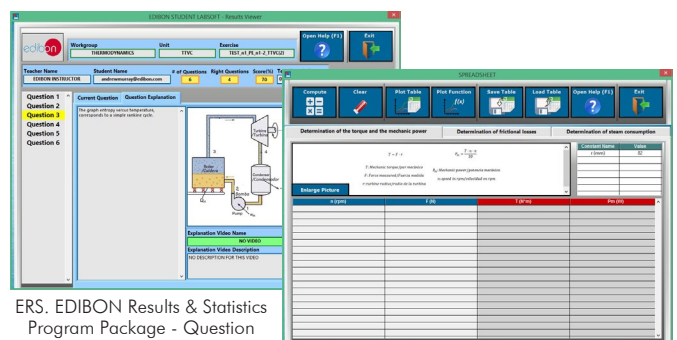ERS. EDIBON Results & Statistics Program Package - Student Scores Histogram

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

Student Software

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

EPE. EDIBON Practical Exercise Program Package Main Screen

ERS. EDIBON Results & Statistics Program Package - Question Explanation

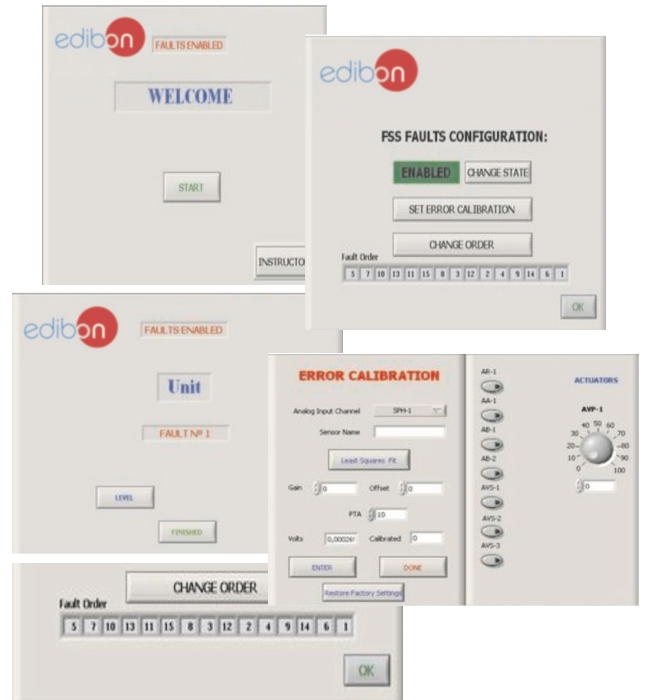ECAL. EDIBON Calculations Program Package Main Screen

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

Faults Simulation System (FSS) is a Software package that simulates **several faults** in any EDIBON Computer Controlled Unit. It is useful for Technical and Vocational level.

The "FAULTS" mode consists in causing several faults in the unit normal operation. The student must find them and solve them. There are several kinds of faults that can be grouped in the following sections:

Faults affecting the sensors measurement:
- An incorrect calibration is applied to them.
- Non-linearity.

Faults affecting the actuators:
- Actuators channels interchange at any time during the program execution.
- Response reduction of an actuator.

Faults in the controls execution:
- Inversion of the performance in ON/OFF controls.
- Reduction or increase of the calculated total response.
- The action of some controls is annulled.

On/off faults:
- Several on/off faults can be included.

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

www.edibon.com/en/fault-simulation-system

Example of some screens

b) Multipost Expansions options

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

MINI ESN. EDIBON Mini Scada-Net System allows up to 30 students to work with a Teaching Unit in any laboratory, simultaneously. It is useful for both, Higher Education and/or Technical and Vocational Education.

The MINI ESN system consists of the adaptation of any EDIBON Computer Controlled Unit with SCADA integrated in a local network.

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

Main characteristics:

- It allows up to 30 students to work simultaneously with the EDIBON Computer Controlled Unit with SCADA, connected in a local net.

- Open Control + Multicontrol + Real Time Control + Multi Student Post.

- Instructor controls and explains to all students at the same time.

- Any user/student can work doing "real time" control/multicontrol and visualisation.

- Instructor can see in the computer what any user/student is doing in the unit.

- Continuous communication between the instructor and all the users/students connected.

Main advantages:

- It allows an easier and quicker understanding.

- This system allows you can save time and cost.

- Future expansions with more EDIBON Units.

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

www.edibon.com/en/edibon-scada-net

MINI ESN.
EDIBON Mini Scada-Net System

1 UNIT= up to 30 STUDENTS can work simultaneously

Computer Controlled Test Bench for Hybrid Engine (TMHC)

Control Interface Box

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

Instructors' Central Computer

Mini Scada-Net Software

LOCAL NET FOR 30 STUDENTS

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

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

⑩ **ESN. EDIBON Scada-Net Systems.**

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

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

www.edibon.com/en/edibon-scada-net
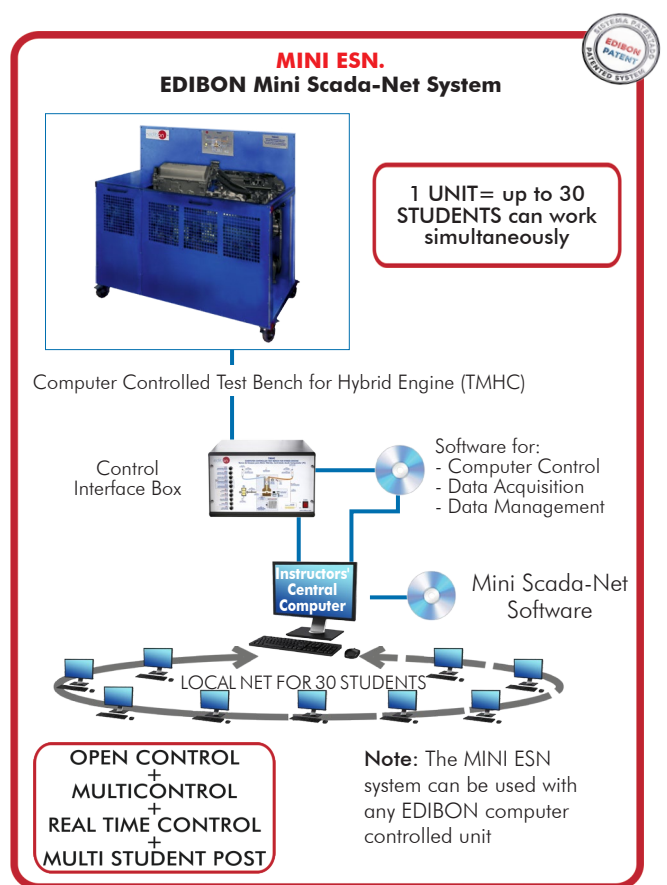
Main items (always included in the supply)

Minimum supply always includes:

① Unit: TMHC. Computer Controlled Test Bench for Hybrid Engine.

② TMHC/CIB. Control Interface Box.

③ DAB. Data Acquisition Board.

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

⑤ Cables and Accessories, for normal operation.

⑥ Manuals.

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

⑧ TMHC/FSS. Faults Simulation System.

b) Multipost Expansions options

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

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    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.
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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.

③DAB. Data Acquisition Board:
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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.

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Flexible, open and multicontrol software, developed with actual windows graphic systems, acting simultaneously on all process parameters.
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⑤Cables and Accessories, for normal operation.

⑥Manuals:
This unit is supplied with 8 manuals: Required Services, Assembly and Installation, Interface and Control Software, Starting-up, Safety, Maintenance, Calibration & Practices Manuals.

Exercises and Practical Possibilities to be done with the Main Items

1.- Familiarisation with hybrid motors (combustion engine+electric motor).

2.- Determination of specific fuel consumption (combustion engine).

3.- Torque curves (combustion engine+electric motor).

4.- Power curves (combustion engine+electric motor).

5.- Determination of volumetric efficiency.

6.- Measurement of the most important parameters involved in the process: temperature, torque, speed, pressure, etc.

7.- Determination of engine friction loss.

8.- Determination of fuel-air ratio.

9.- Determination of the frictional power (in passive mode).

10.-Measurement of power delivered by the battery.

11.-Measurement of power produced by the electric generator.

12.-Curves of electric consumption.

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.

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20.-Control of the TMHC unit process through the control interface box without the computer.

21.-Visualization of all the sensors values used in the TMHC unit process.

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

TENDER SPECIFICATIONS (for optional items)

⑦ TMHC/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.

⑧ TMHC/FSS. Faults Simulation System.

Faults Simulation System (FSS) is a Software package that simulates several faults in any EDIBON Computer Controlled Unit.

The "FAULTS" mode consists in causing several faults in the unit normal operation. The student must find them and solve them.

There are several kinds of faults that can be grouped in the following sections:

    Faults affecting the sensors measurement:

    - An incorrect calibration is applied to them.

    - Non-linearity.

    Faults affecting the actuators:

    - Actuators channels interchange at any time during the program execution.

    - Response reduction of an actuator.

    Faults in the controls execution:

    - Inversion of the performance in ON/OFF controls.

    - Reduction or increase of the calculated total response.

    - The action of some controls is annulled.

    On/off faults:

    - Several on/off faults can be included.

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

MINI ESN. EDIBON Mini Scada-Net System allows up to 30 students to work with a Teaching Unit in any laboratory, simultaneously.

The MINI ESN system consists of the adaptation of any EDIBON Computer Controlled Unit with SCADA integrated in a local network.

This system allows to view/control the unit remotely, from any computer integrated in the local net (in the classroom), through the main computer connected to the unit.

Main characteristics:

- It allows up to 30 students to work simultaneously with the EDIBON Computer Controlled Unit with SCADA, connected in a local net.

- Open Control + Multicontrol + Real Time Control + Multi Student Post.

- Instructor controls and explains to all students at the same time.

- Any user/student can work doing "real time" control/multicontrol and visualisation.

- Instructor can see in the computer what any user/student is doing in the unit.

- Continuous communication between the instructor and all the users/students connected.

Main advantages:

- It allows an easier and quicker understanding.

- This system allows you can save time and cost.

- Future expansions with more EDIBON Units.

The system basically will consist of:

This system is used with a Computer Controlled Unit.

- Instructor's computer.

- Students' computers.

- Local Network.

- Unit-Control Interface adaptation.

- Unit Software adaptation.

- Webcam.

- MINI ESN Software to control the whole system.

- Cables and accessories required for a normal operation.

✱ Specifications subject to change without previous notice, due to the convenience of improvement of the product.

REPRESENTATIVE: