Engineering and Technical Teaching Equipment

AEL-FUSG-E. Final User Smart Grid - **Smart Energy Application**

Configuration and programming software

AEL-FUSG-LO. Final User Smart Grid - Smart Grid Loads

Static Loads

Dynamic Loads

Key features:

➤ **Managing real Smart Grid devices used by prestigious utilities.**

➤ **The final customer can carry out an optimal consumption at home. Learning how to use an actual Home Energy Management System.**

➤ **Scheduling switching schemes, visualizing and comparing the consumption with different loads.**

➤ **Configuring virtual scenes with different sensors and actuators to achieve the optimal consumption and other possibilities to automate the consumption.**

➤ **Remote controlling of smart devices from programming software.**

➤ **Simulating electric heating and programming optimal consumption.**

➤ **This Trainer may be expanded with:** AEL-FUSG-M. Final User Smart-Grid - **Smart Meter Trainer** and/or AEL-FUSG-N. Final User Smart-Grid - **Net Metering Trainer.**

INTRODUCTION

Nowadays, the main goal of all major electric utilities is to achieve a perfect synchronization between power generation and consumption. For that purpose, some activities, such as real-time remote management and monitoring of the energy consumption by final customers, are essential.

Thus, in order to make it possible, Home Energy Management Systems are indispensable to control the load profile and program the energy consumption at home and at industrial environments.

GENERAL DESCRIPTION

Final User Smart Grid - Smart Energy Application, "AEL-FUSG-E", is a trainer that reflects the real operation of actual Home Energy Management Systems. The purpose of the "AEL-FUSG-E" trainer is to make the user understand how smart devices work in a smart home or industrial environment, controlling the most significant loads. Through the "AEL-FUSG-E" trainer the user will manage the monitoring, programming of consumptions and visualization of the load profile through smart devices. A great characteristic is that all smart devices use ZigBee communication protocol (wireless communication).

The complete system consists of:

a) AEL-FUSG-E. Final User Smart Grid - Smart Energy Application.

b) Required accessories.

c) Optional accessories.

a) AEL-FUSG-E. Final User Smart Grid - Smart Energy Application, consist of the following modules:

N-HPM. Home Power Module.

This module is used to share the electrical energy to other modules. Besides, it has a differential circuit breaker and a wireless smart energy meter. The wireless smart energy meter can communicate with other wireless devices and develop a mesh. Thus, the user can program different conditions from the software, for example, the smart energy meter can be programmed to limit the maximum consumed energy.

N-WLSM. Wireless Light Sensor.

This module is used to measure the luminance of a room and to send the measured parameters to the software. Through previous programming, we can associate luminance parameters to the smart relays and switch on/off the lights in function on the amount of light.

N-WSM. Wireless Switch Module.

This module is used to send commands of switching on/off to the "N-IOWM" (smart relays) with previews software programming. Besides, this module has a wireless temperature sensor. The temperature sensor can be programmed from the software to control the electric heating (EH module), so we can simulate different temperature control conditions.

N-IOWM. Wireless Output Module.

This module is used to supply different loads. This element receives commands by means of radio frequency and it used to supply contactors coil or other loads in function of the programming software.

N-CON02. 3-poles Contactor (220 Vac.).

These modules are contactors that receive orders of switching from the "N-IOWM" to supply energy to the loads.

Control and programming software.

The "AEL-FUSG-E" is provided with control and programming software.

The user can schedule switching schemes, visualize and compare the consumption with different loads, configure virtual scenes with different sensors and actuators to achieve the optimal consumption, among other possibilities to automate the consumption.

All these possibilities are programmed remotely through the software with the PC.

b) Required accessories:

In order to simulate different real consumptions and to carry out all the practical possibilities proposed "AEL-FUSG-E" trainer requires a set of static and dynamic loads. The following loads must be acquired:

AEL-FUSG-LO. Smart Grid Loads, formed by:

Static Loads:

N-REV. Single Phase Variable Resistor.

This module is used to limit the torque of the universal motor "EMT12".

N-LAM16. Incandescent Lamp.

N-IND. Single Phase Inductance.

This module is used to simulate a reactive energy consumption.

N-CAR19. Single-phase Bank of conmutable Capacitors.

This module is used to simulate a reactive energy compensation.

N-LAM32. 1 LED Lamp.

This module is used to simulate a low consumption light.

N-VVCC/M. DC Motor Speed Controller (intermediate option).

N-REF. Single Phase Fixed Resistor.

Dynamic Loads:

EMT12. Universal Motor (single-phase).

This motor is used to simulate a washing machine together the eddy current brake.

FRECP. Eddy Current Brake.

This brake is used to reduce the "EMT12" speed and to increase the energy consumed by him.

EH. Electric Heating Unit.

This unit is used to simulate a conventional electric heating.

c) Optional accessories:

For AEL-FUSG-E. Final User Smart Grid-Smart Energy Trainer:

It can be included a series of home automation modules to complete the knowledge about smart control systems.

The user can acquire three different modules:

AEL-HP-EM. Home Emergency Module.

AEL-HP-SE. Home Security Module.

AEL-HE-EN. Home Energy Module.

For AEL-FUSG-LO. Smart Grid Loads:

AEL-APFC. Single-phase Automatic Power Factor Compensation Application.

The complete system consists of:

    a) AEL-FUSG-E. Final User Smart Grid - Smart Energy Application.

    b) Required accessories.

    c) Optional accessories.

a) **AEL-FUSG-E. Final User Smart Grid - Smart Energy Application**, consist of the following modules:

N-HPM. Home Power Module.

This module is used to share the electrical energy to other modules. Besides, it has a differential circuit breaker and a wireless smart energy meter.

The wireless smart energy meter has a ZigBee communication protocol and it can be programmed to control the smart relays that supply the loads. When the consumed energy reaches a programmed value, the smart relay will be opened, so we can limit the energy consumption.

Power supply: 230 Vac.

Input terminal.

8 Outputs terminals.

Smart Energy Meter:

    2 x 1.5 V AAA batteries.

N-WLSM. Wireless Light Sensor.

This module is used to measure the luminance of a room and to send the measured parameters to the software. Through previous programming, we can associate luminance parameters to the smart relays and switch on/off the lights in function on the amount of light.

Wireless communication.

Button battery: 1.5 V.

Luminance sensor.

N-WSM. Wireless Switch Module.

This module is used to send commands of switching on/off to the "N-IOWM" (smart relays) with previews software programming. Besides this module has a temperature sensor to control the temperature with previously programming.

Wireless communication.

Button battery: 1.5 V.

N-HPM   N-WLSM

N-WSM

N-IOWN

Unit: AEL-FUSG-E   N-CON02

N-IOWM. Wireless Output Module.

This module is used to supply different loads. This element receives commands by mean of radio frequency and it used to supply contactors coil or other loads in function of the programming software.

Wireless communication.

Nominal current: 0.5 A.

Input voltage: 230 Vac.

2 Outputs relays.

N-CON02. 3-poles Contactor (220 Vac.).

These modules are contactors that receive orders of switching from the "N-IOWM".

Coil voltage: 230 Vac.

Contacts current: 20 A.

Control and Programming Software.

The AEL-FUSG-E is provided with control and programming software.

The user can schedule switching schemes, visualize and compare the consumption with different loads, configure virtual scenes with different sensors and actuators to achieve the optimal consumption, among other possibilities to automate the consumption.

All these possibilities are programmed remotely through the software with the PC.
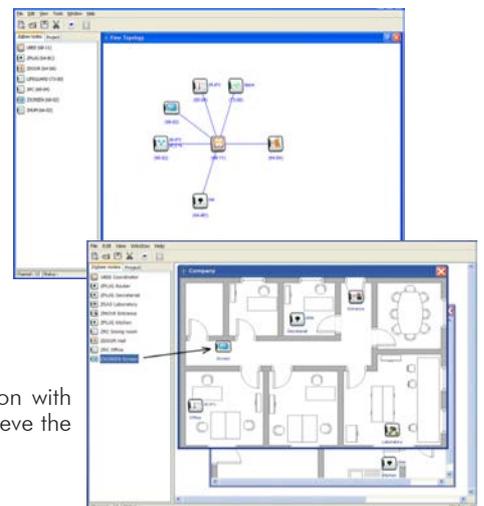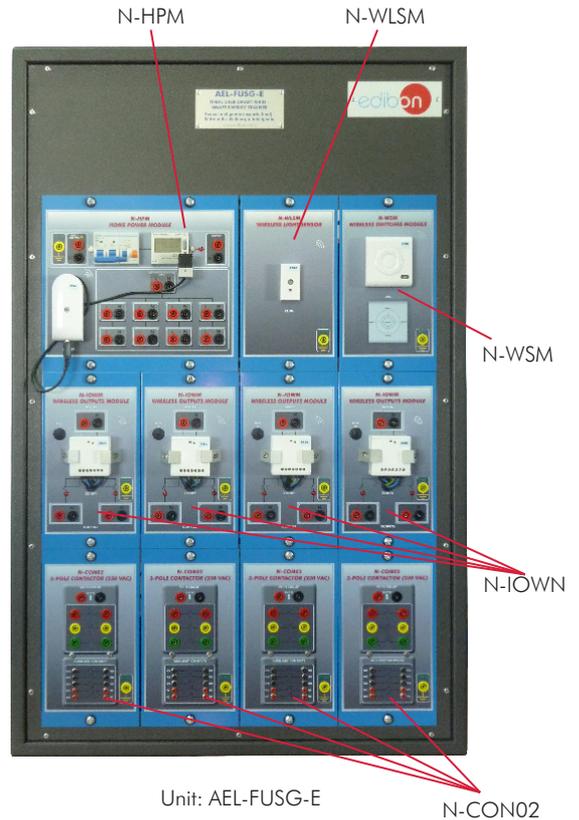
Cables and Accessories, for normal operation.

Manuals.

b) Required accessories:

In order to simulate different real consumptions and to carry out all the practical possibilities proposed "AEL-FUSG-E" trainer requires a set of static and dynamic loads that represent different consumption generally used at home, industries and other places.

The following loads must be acquired:

AEL-FUSG-LO. Smart Grid Loads:

It is formed by:

N-REV. Single Phase Variable Resistor.

Nominal current: 2 A.

Nominal power: 500 W.

N-LAM16. Incandescent Lamp.

Input voltage: 2 terminals of 230V.

Power: 60W.

N-IND. Single Phase Inductance.

Nominal current: 2 A.

Inductance: 33 mH; 78 mH; 140 mH; 236 mH.

Commutator.

N-CAR19. Single-phase Bank of Conmutable Capacitors.

Nominal voltage: 230 Vac.

Capacitance: 7 mF; 14 mF; 21 mF; 28 mF; 35 mF.

Commutator.

N-LAM32. 1 LED Lamp.

Nominal voltage: 230 Vac.

N-VVCC/M. DC Motor Speed Controller (intermediate option).

Adjustable voltage: up to 320 Vdc.

Maximum current: 2 A.

N-REF. Single Phase Fixed Resistor.

Nominal current: 2 A.

Nominal power: 500 W.

EMT12. Universal Motor (single-phase).

Power: 230 W.

Speed: 5000/9000 r.p.m.

Frequency: 50 Hz/60 Hz.

V. Armature.: 230 V.

FRECP. Eddy Current Brake.

FRECP is an unit designed to work as a magnetic brake by means of the induction of Foucault's parasitic currents.

The FRECP is similar to an electrical motor, since it has a stator winding, the inductor, that we will feed with a DC voltage. We will change the braking torque by means of this direct voltage.

The breaking torque is proportional to the current injected.

Nominal current: 1.67 A.

Maximum current: 1.8 A.

Maximum braking torque: 1.4 Nm.

Bench - support.

DC power supply.

EH. Electric Heating Unit.

This unit can be used for different purposes.

Load purpose: this unit is used like a resistive load of 700 W.

IMPORTANT!: These loads can be used simultaneously with AEL-FUSG-M. Final User Smart Grid - Smart Meter Application, AEL-FUSG-E. Final User Smart Grid - Smart Energy Application and AEL-FUSG-N. Final User Smart Grid - Net Metering Application.

N-REF

N-LAM16

N-IND

N-LAM32

N-CAR19

N-REV

N-VVCC/M

EMT12 + FRECP

EH

c) Optional accessories:

For AEL-FUSG-E. Final User Smart Grid - Smart Energy Application:

It can be included a series of home automation modules to complete the knowledge about smart control systems:

AEL-HP-EM. Home Emergency Module.

AEL-HP-SE. Home Security Module.

AEL-HE-EN. Home Energy Module.

-AEL-HP-EM. Home Emergency Module:

It consists of different sensors to detect emergency conditions like flooding, fire and gas. Each sensor is provided with a smart relay and they can be associated by programming.

It includes the following elements:

N-LEAK. Wireles Leakage Detector.

This module is used to detect water leaks. N-LEAK module has a sensor that is activated when a water leakage is detected and it sends a status signal to the software.

Wireless communication.

Button battery: 1.5 V.

N-GASD. Wireless Gas Detector.

This module is used to detect smoke and gas leaks. This device emits a sound signal when smoke or carbon monoxide is detected. Besides, it sends a status signal to the software.

Wireless communication.

Button battery: 1.5 V.

N-IOWM. Wireless Output Module.

This module is used to supply different loads. This element receives commands by mean of radio frequency and it is used to supply contactors coil or other loads in function of the programming software.

Wireless communication.

Nominal Current: 0.5 A.

Input Voltage: 230 VAC.

2 Outputs relays.

N-DET12. Gas Electro-valve.

This module is used to cut off the flow in case of alarm. This device receives orders of switching from the "N-IOWM".

Input voltage: 2 terminals of 220 Vac.

Power: 14 W.

Maximum working pressure: 500 mbar.

Closing period: 0.1 sec.

N-DET10. Water Electrovalve.

This module is used to cut off the flow in case of leak. This device receives orders of switching from the "N-IOWM".

Input voltage: 2 terminals of 220 Vac.

AEL-HP-EM

-AEL-HP-SE. Home Security Module:

It consists of different sensors to detect emergency intrusion situations. Each sensor is provided with smart relay and they can be associated by programming.

It includes the following elements:

N-WISM. Wireless Intrusion Sensor.

This module is used to detect when the door or windows is opened or closed. When the sensor detects that the door is opened, it sends a signal to the software. Through previous programming, we can associate status signal to the smart relays.

Wireless communication.

Button battery: 1.5 V.

N-WMSM. Wireless Motion Sensor.

This module is used to detect some movement. This element has a detector presence that contains an infrared sensor allowing to detect the movements in a maximum of 10 meter.

Wireless communication.

N-IOWM. Wireless Output Module.

This module is used to supply different loads. This element receives commands by mean of radio frequency and it used to supply contactors coil or other loads in function of the programming software.

Wireless communication.

Nominal Current: 0.5 A.

Input Voltage: 230 VAC.

2 Outputs relays.

N-LAM16. Incandescent Lamp.

Input voltage: 2 terminals of 230 VAC.

Power: 60 W.

N-TIM05. Bell + Buzzer.

Input voltage: 2 terminals of 230 VAC.

Bell decibel: 70 dB.

Buzzer decibel: 80dB.

AEL-HP-SE

-AEL-HE-EN. Home Energy Module:

It is formed by different environmental sensors, like light and temperature. It also includes smart switches and relays for general purpose. Each pair of sensor and switch is provided with a smart relay and they can be associated by programming.

It includes the following elements:

N-WSM. Wireless Switch Module.

This module is used to send commands of switching on/off to the "N-IOWM" (smart relays) with previews software programming. Besides this module has a temperature sensor to control the temperature with previously programming.

Wireless communication.

Button battery: 1.5 V.

N-IOWM. Wireless Output Module.

This module is used to supply different loads. This element receives commands by mean of radio frequency and it used to supply contactors coil or other loads in function of the programming software.

Wireless communication.

Nominal Current: 0.5 A.

Input Voltage: 230 VAC.

2 Outputs relays.

N-WLSM. Wireless Light Sensor.

This module is used to measure the luminance of a room and to send the measured parameters to the software. Through previous programming, we can associate luminance parameters to the smart relays and switch on/off the lights in function on the amount of luminance.

Wireless communication.

Button battery: 1.5 V.

Luminance sensor.

N-SEL04. Sound Element.

This module consists of two red lights and two green lights.

Input voltage of pilot lights: 2 terminals of 230VAC.

For AEL-FUSG-LO. Smart Grid Loads:

AEL-APFC. Single-phase Automatic Power Factor Compensation Application.

AEL-HP-SE

EXERCISES AND PRACTICAL POSSIBILITIES

1.- Studying the energy efficiency increase by using capacitor banks to compensate the reactive power of loads.

2.- Real time monitoring of local consumptions with induction, resistor or capacitive loads.

3.- Simulation of different consumptions and scheduling of the Home Energy Management System devices by the final customer.

4.- Study of the optimal load demand and programming the smart devices according to different programming schemes.

5.- Controlling and programming the loads maximum accumulated consumption.

6.- Programming the panel´s inputs and outputs

7.- Illumination control

8.- Temperature control system

9.- Programming the moment of the activating of washing machine.

10.-Remote scheduling of smart devices (Smart relays, thermostat, different sensors, etc.).

11.-Developing switching schemes for appliances connected to the smart relays or thermostat with the management platform.

Practical exercises of AEL-FUSG-E trainer with AEL-FUSG-M trainer:

12.-Measurement of energy consumption at home or by an industrial consumer and comparison of this measurement with the utility´s register (smart meter).

13.-Simulation of different consuming periods and scheduling of the Home Energy Management System devices.

14.-Telemetering of the energy consumed by the loads using the data concentrator platform.

REQUIRED SERVICES

- Electrical supply: single-phase, 220 V/50 Hz or 110 V/60 Hz.
- Computer.
- AEL-FUSG-LO. Final User Smart Grid - Smart Grid Loads.

DIMENSIONS AND WEIGHTS

AEL-FUSG-E. Final User Smart Grid - Smart Energy Application:
  -Dimensions: 640 x 320 x 920 mm approx.
          (25.19 x 12.59 x 36.22 inches approx.)
  -Weights: 35 Kg approx.
          (77 pounds approx.)
Required accessory:
AEL-FUSG-LO. Smart Grid Loads:
  Static Loads in Rack:
        - Dimensions: 640 x 320 x 920 mm approx.
                (25.19 x 12.59 x 36.22 inches approx.)
        -Weights: 30 Kg approx.
                (66 pounds approx.)
  EMT12:
        -Dimensions: 285 x 250 x 260 mm approx.
                (11.22 x 9.84 x 10.24 inches approx.)
        -Weights: 8 Kg approx.
                (17.6 pounds approx.)
  FRECP:
        -Dimensions: 285 x 250 x 270 mm approx.
                (11.22 x 9.84 x 10.63 inches approx.)
        -Weights: 8.25 Kg approx.
                (18.2 pounds approx.)
  EH:
        -Dimensions: 450 x 340 x 300 mm approx.
                (17.71 x 13.38 x 11.81 inches approx.)
        -Weight: 4 Kg approx.
                (8.81 pounds approx.)

ADDITIONAL APPLICATIONS

- AEL-FUSG-M. Final User Smart Grid - Smart Energy Application.

   To study a real Smart Meter used by Utilities.

- AEL-FUSG-N. Final User Smart Grid - Net Metering Application.

   The user will learn different simulations, such as selling electricity to the grid, Net Metering and measuring the input and output power flows generated by the Renewable Energy simulator.
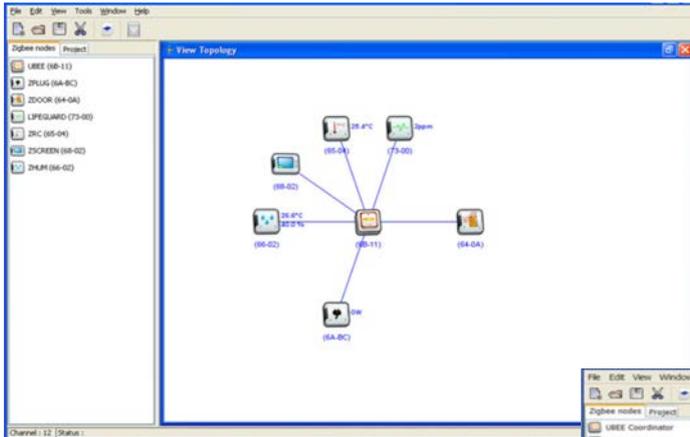
This screen shows the virtual devices programming.

This screen shows a home virtual plan with the devices distribution.
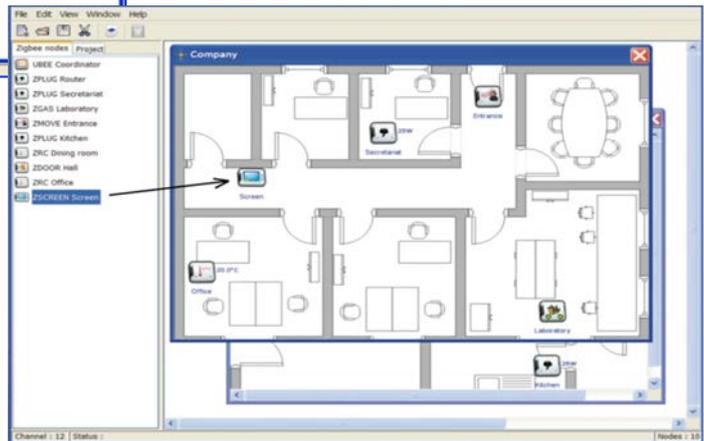
AEL-FUSG-E/ICAI. Interactive Computer Aided Instruction Software System:
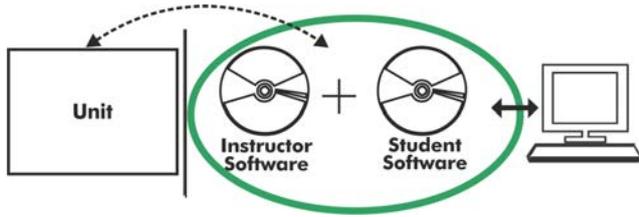
With no physical connection between unit and computer, **this complete software package consists of an Instructor Software (EDIBON Classroom Manager -ECM-SOF) totally integrated with the Student Software (EDIBON Student Labsoft -ESL-SOF).** Both are interconnected so that the teacher knows at any moment what is the theoretical and practical knowledge of the students.

<u>Instructor Software</u>

- 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.

ECM-SOF. EDIBON Classroom Manager (Instructor Software) Application Main Screen
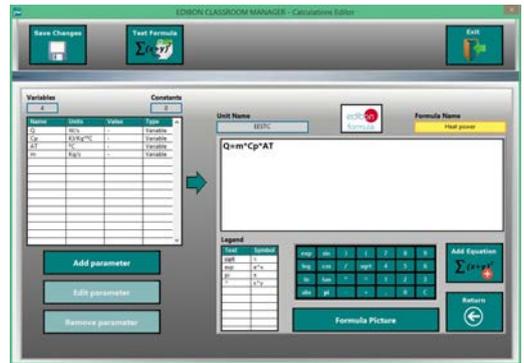
ECAL. EDIBON Calculations Program Package - Formula Editor Screen

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

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

- 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

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

EPE. EDIBON Practical Exercise Program Package Main Screen
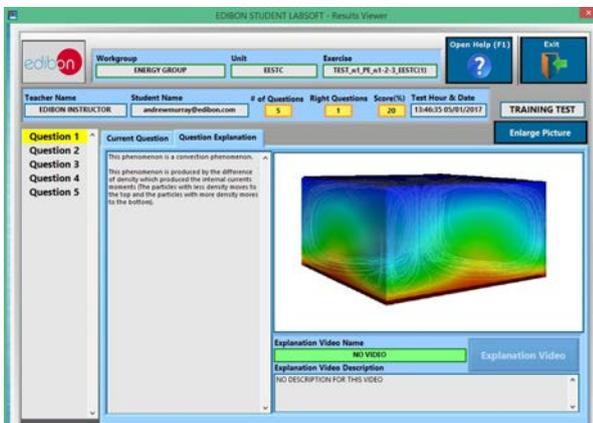
ERS. EDIBON Results & Statistics Program Package - Question Explanation
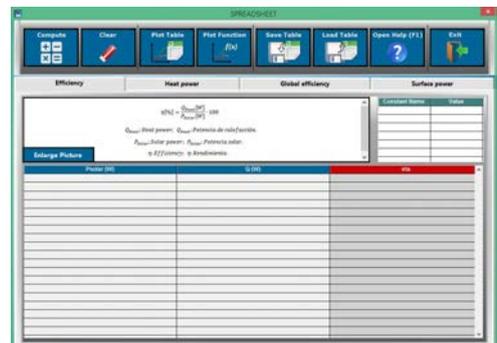
ECAL. EDIBON Calculations Program Package Main Screen

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

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

Edition: ED01/18
Date: October/2018

REPRESENTATIVE: