

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 and bidirectional communication with smart meters, are indispensable.

To understand how current utilities work in the Electrical Grids, EDIBON offers the Final User Smart Grid - Smart Meter Application (AEL-FUSG-M), a real Smart Grid System where the user can manage an actual Smart Meter.

GENERAL DESCRIPTION

The Final User Smart Grid - Smart Meter Application (AEL-FUSG-M) is an application that reflects the real operation of current Smart Grids. The purpose of the AEL-FUSG-M is to make the user understand how utilities work in a real smart grid environment.

The complete system consists of:

- a) AEL-FUSG-M. Final User Smart Grid - Smart Meter Application.
- b) Required accessories.
- c) Optional accessories.

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

N-ALI01. Industrial Main Power Supply.

This module is used to simulate the electrical grid and supply the data concentrator (N-CTT) and other possible elements.

N-CTT. Data Concentrator.

This module is a communications concentrator that belongs to a remote management system with automatic meter reading (AMR). The reading is performed through the power line (power line communication or PLC).

This module can communicate with one or more smart meters. Once the user is communicating with the smart meter from the data concentrator, a platform web can be open. The platform web is integrated in the data concentrator and we can see all electrical parameters of the smart meters that are connected to the power line. It is an important advance, because we can monitor in real time the behaviour of the loads like the utilities do. Besides we can meter the most important electrical parameters, for example: voltages, currents, positive active power, negative active power, positive reactive power, negative reactive power, power factors, positive and negative active energy, positive and negative reactive energy...

N-SM. Smart Meter.

This "smart" meter let us know which the consumption of the final customer is at any time. This meter is similar to conventional meters but has the advantage that can send all the electrical parameters of the load (customer) to the utility (data concentrator) in real time. Thus, the utility can know exactly the energy needs of each customer at all times.

Configuration and control software (platform web).

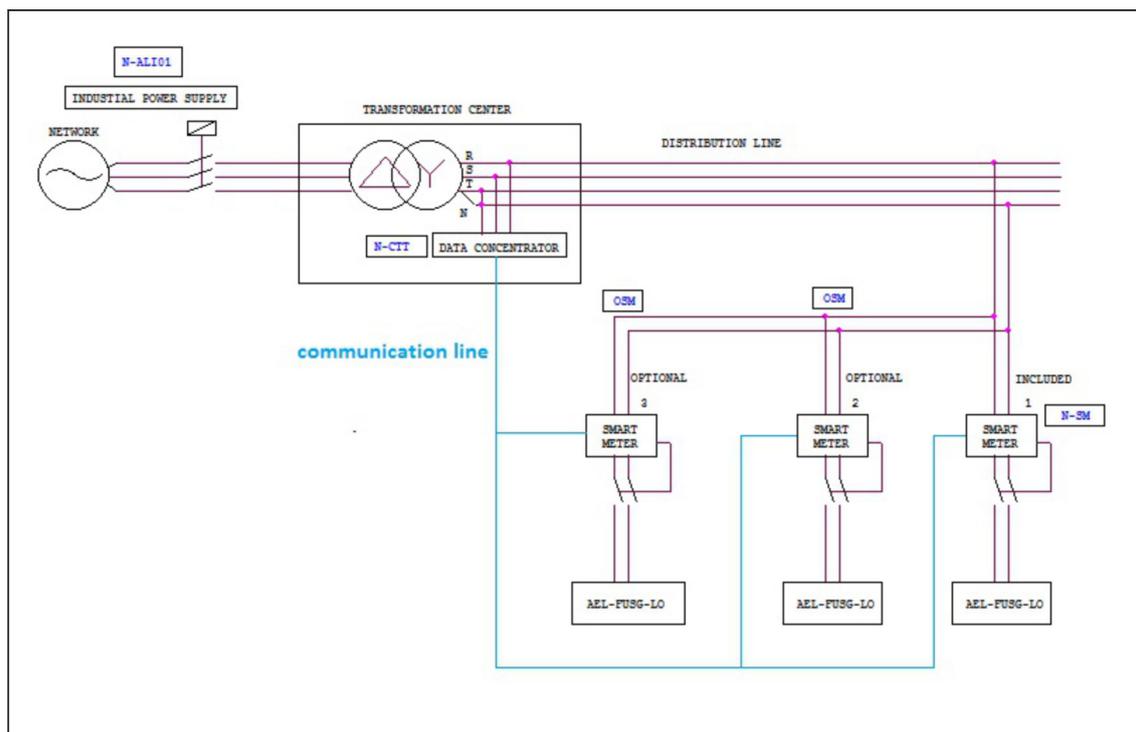
The N-CTT module includes a platform web to control the Smart Meter.

So, the user can perform the following functions:

Real time monitoring, remote management and verification of the network quality.

Relay breaker to limit the maximum consumed power by the final user.

Bidirectional communication between the Utility (the student) and the Smart Meter: the student can control and monitoring the loads state and limit the maximum power required.



General description

b) Required accessories:

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

AEL-FUSG-LO. Final User Smart Grid - 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. Incandescent lamp.

This module is used to simulate a reactive energy consumption.

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

This module is used to simulate a reactive energy compensation.

N-LAM32. LED Lamp.

This module is used to simulate a low consumption light.

N-WCC/M. Controlador de Motores CC (opción intermedia).

N-REF. Single Phase Fixed Resistor. (4 units)

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 module is used to simulate a conventional electric heating.

c) Optional accessories:

For AEL-FUSG-M. Final User Smart Grid-Smart Meter Application:

OSM. Additional Smart Meter with FUSG-LO Smart Grid Loads.

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

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

SPECIFICATIONS

The complete system consists of:

- a) AEL-FUSG-M. Final User Smart Grid - Smart Meter Application.
- b) Required accessories.
- c) Optional accessories.

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

N-ALI01. Industrial Main Power Supply.

This module is used to simulate the electrical grid and supply the data concentrator (N-CTT) and other possible elements.

Three-phase differential protection.

Three-phase output: 380 VAC.

Single-phase output: 230 VAC.

Safety key.

Emergency stop button.

Required power supply: three-phase 380 VAC.

N-CTT. Data Concentrator.

The communications concentrator consists of:

- A metering system formed by a number of smart meters (on our case, there is one residential smart meter). The data concentrator communicates with the smart meter by means of a power line.
- Remote control System. It is a web platform that let us have access to the data concentrator, visualize all the smart meters connected to the power line and configure different parameters, visualize all the electrical parameters of the load connected to each smart meter, etc.

Configuration and control software (platform web).

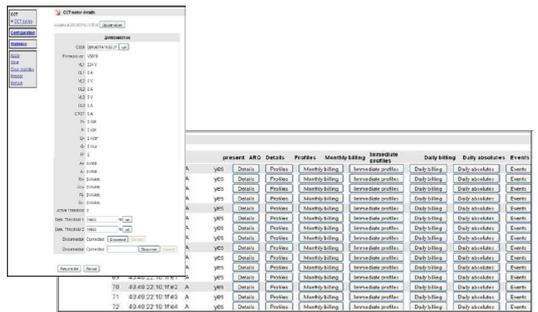
The N-CTT module includes a platform web to control the Smart Meter.

So, the user can perform the following functions:

Real time monitoring, remote management and verification of the network quality.

Relay breaker to limit the maximum consumed power by the final user.

Bidirectional communication between the Utility (the student) and the Smart Meter: the student can control and monitoring the loads state and limit the maximum power required.



N-SM. Smart Meter.

The N-SM Module can carry out the following measurements and controls:

- Current measurements.
- Voltage measurements.
- Active and reactive power measurement in four quadrants.
- Bidirectional measurements of the active and reactive energy in four quadrants.
- Power factor measurements.
- Smart Relay to be controlled from the data concentrator platform web.

Cables and Accessories, for normal operation.

Manuals.

Specifications

b) Required accessories:

In order to simulate different real consumptions and to carry out all the practical possibilities proposed AEL-FUSG-M application 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. Final User Smart Grid - 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 230 VAC.

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 commutable Capacitors.

Nominal voltage: 230 Vac.

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

Commutator.

N-LAM32. LED Lamp.

Nominal voltage: 230 VAC.

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

Adjustable voltage: up to 320 VDC.

Maximum current: 2 A.

N-REF. Single Phase Fixed Resistor. (4 units)

Nominal current: 2 A.

Nominal power: 500 W.

EMT12. Universal Motor (single-phase).

Power: 230 W.

Speed: 5000/9000 r.p.m.

Frequency: 50Hz/60 Hz.

V.Armatore.: 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 braking 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 module can be used for different purposes.

Load purpose: this module 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.



EMT12 + FRECP



EH

c) Optional accessories:

For AEL-FUSG-M. Final User Smart Grid-Smart Meter Application:

OSM. Additional Smart Meter with AEL-FUSG-LO. Final User Smart Grid - Smart Grid Loads.

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

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

EXERCISES AND PRACTICAL POSSIBILITIES

- 1.- Communication process with the data concentrator.
 - 2.- Remote control of the smart meter relay.
 - 3.- Real time monitoring of the energy consumed by the loads.
 - 4.- Power factor comparison with different load combinations using the data concentrator web server.
 - 5.- Comparison of the energy consumption from the utility point of view (with the platform integrated in the data concentrator) and from the final user point of view (using the smart meter display).
 - 6.- Power factor correction using capacitor banks. The student can configure different loads and analyze the quality of energy in real time.
 - 7.- Instantaneous measurement of the current, voltage, active power and power factor.
- NOTE: All practical exercises can be done remotely, as actual utilities do with real Smart Grids.

REQUIRED SERVICES

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

DIMENSIONS AND WEIGHTS

AEL-FUSG-M. Final User Smart Grid - Smart Meter Application:

- Dimensions: 640 x 320 x 670 mm approx.
(25.19 x 12.59 x 26.37 inches approx.)
- Weight: 20 Kg approx.
(44 pounds approx.)

Required accessory:

AEL-FUSG-LO. Final User Smart Grid - 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.)
- Weight: 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.)
- Weight: 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.)
- Weight: 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-E. Final User Smart Grid - Smart Energy Application.

- The user can increase the knowledge about the influence of the load demand through smart devices.
- Management of a real Home Energy Management System.
- Development of different automation programs to get an efficient consumption.

- 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.

SOME SOFTWARE SCREENS

Measurement details, load profiles, monthly billing, immediate profiles, daily billing.

#	serial	mac	present	ARO	Details	Profiles	Monthly billing	Immediate profiles	Daily billing	Daily absolute	Events
58	40.40.22.10.1f.d6	A	yes		Details	Profiles	Monthly billing	Immediate profiles	Daily billing	Daily absolute	Events
59	40.40.22.10.1f.d7	A	yes		Details	Profiles	Monthly billing	Immediate profiles	Daily billing	Daily absolute	Events
60	40.40.22.10.1f.d8	A	yes		Details	Profiles	Monthly billing	Immediate profiles	Daily billing	Daily absolute	Events
61	40.40.22.10.1f.d9	A	yes		Details	Profiles	Monthly billing	Immediate profiles	Daily billing	Daily absolute	Events
62	40.40.22.10.1f.da	A	yes		Details	Profiles	Monthly billing	Immediate profiles	Daily billing	Daily absolute	Events
63	40.40.22.10.1f.db	A	yes		Details	Profiles	Monthly billing	Immediate profiles	Daily billing	Daily absolute	Events
64	40.40.22.10.1f.dc	A	yes		Details	Profiles	Monthly billing	Immediate profiles	Daily billing	Daily absolute	Events
65	40.40.22.10.1f.dd	A	yes		Details	Profiles	Monthly billing	Immediate profiles	Daily billing	Daily absolute	Events
66	40.40.22.10.1f.de	A	yes		Details	Profiles	Monthly billing	Immediate profiles	Daily billing	Daily absolute	Events
67	40.40.22.10.1f.df	A	yes		Details	Profiles	Monthly billing	Immediate profiles	Daily billing	Daily absolute	Events
68	40.40.22.10.1f.e0	A	yes		Details	Profiles	Monthly billing	Immediate profiles	Daily billing	Daily absolute	Events
69	40.40.22.10.1f.e1	A	yes		Details	Profiles	Monthly billing	Immediate profiles	Daily billing	Daily absolute	Events
70	40.40.22.10.1f.e2	A	yes		Details	Profiles	Monthly billing	Immediate profiles	Daily billing	Daily absolute	Events
71	40.40.22.10.1f.e3	A	yes		Details	Profiles	Monthly billing	Immediate profiles	Daily billing	Daily absolute	Events
72	40.40.22.10.1f.e4	A	yes		Details	Profiles	Monthly billing	Immediate profiles	Daily billing	Daily absolute	Events

Instantaneous measurements, power demand threshold.

CCT

- [CCT cycles](#)
- [Configuration](#)
- [Statistics](#)
- [Apply](#)
- [Save](#)
- [Clear statistics](#)
- [Reboot](#)
- [Refresh](#)

CCT meter details

updated at 201/007/14,11:55:46 Update values

ZIV0034603144

Clock: 201/007/14 11:55:37 set

Firmware ver: V0019

VL1: 224 V

CL1: 0 A

VL2: 0 V

CL2: 0 A

VL3: 0 V

CL3: 0 A

CTOT: 0 A

P+: 0 kW

P-: 0 kW

Q+: 0 kVar

Q-: 0 kVar

PF: 0

A+: 0 kWh

A-: 0 kWh

Ri+: 0 kVAh

Rc+: 0 kVAh

Ri-: 0 kVAh

Rc-: 0 kVAh

Active Threshold: 2

Dem. Threshold 1: 15000 W set

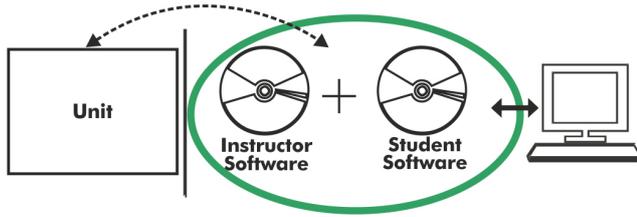
Dem. Threshold 2: 15000 W set

Disconnector: Connected Disconnect Connect

Disconnector: Connected - Disconnect Connect

Return to list Reload

AEL-FUSG/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.

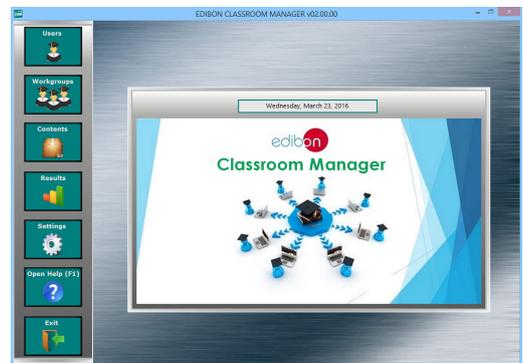
Instructor Software

- ECM-SOF. EDIBON Classroom Manager (Instructor Software).

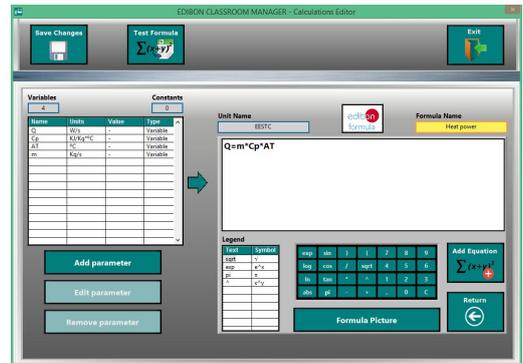
ECM-SOF is the application that allows the Instructor to register students, manage and assign tasks for workgroups, create own content to carry out Practical Exercises, choose one of the evaluation methods to check the Student knowledge and monitor the progression related to the planned tasks for individual students, workgroups, units, etc... so the teacher can know in real time the level of understanding of any student in the classroom.

Innovative features:

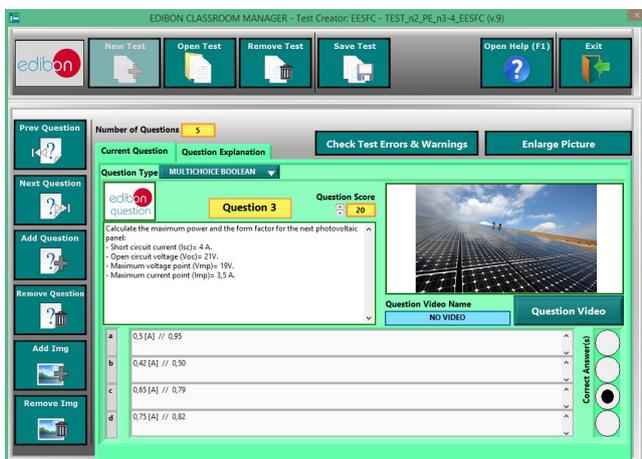
- User Data Base Management.
- Administration and assignment of Workgroup, Task and Training sessions.
- Creation and Integration of Practical Exercises and Multimedia Resources.
- Custom Design of Evaluation Methods.
- Creation and assignment of Formulas & Equations.
- Equation System Solver Engine.
- Updatable Contents.
- Report generation, User Progression Monitoring and Statistics.



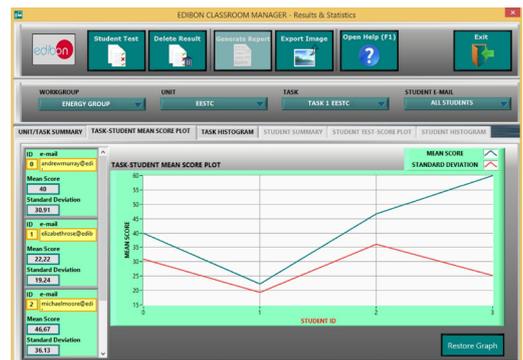
ECM-SOF. EDIBON Classroom Manager (Instructor Software) Application Main Screen



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

Optional
Student Software

- 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:

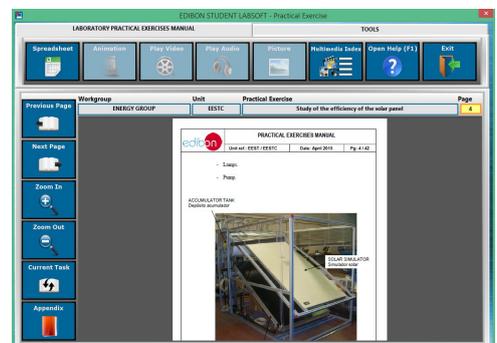
- Student Log-In & Self-Registration.
- Existing Tasks checking & Monitoring.
- Default contents & scheduled tasks available to be used from the first session.
- Practical Exercises accomplishment by following the Manual provided by EDIBON.
- Evaluation Methods to prove your knowledge and progression.
- 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:

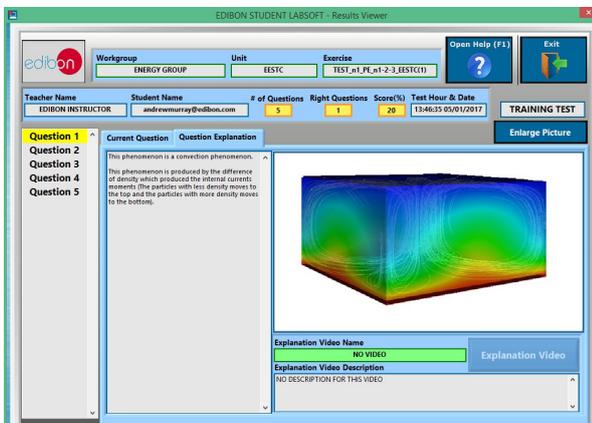
www.edibon.com/en/files/expansion/ICAI/catalog



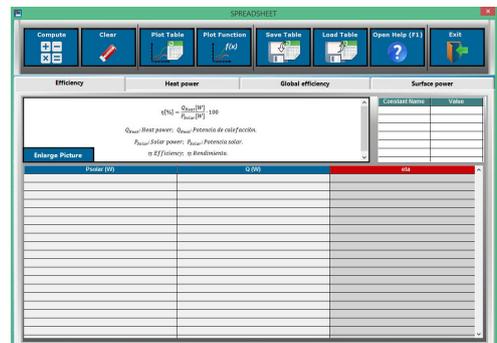
ESL-SOF. EDIBON Student LabSoft (Student Software) Application Main Screen



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.



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REPRESENTATIVE:

