Power Flux Protection Application

AEL-AE9

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↳PRODUCTS
↳4.- ELECTRICITY

INTRODUCTION

When we talk about power-system protection we are referring to the integrity of the facilities and infrastructure in which the electrical installation is located and the electrical systems that surround them. The importance of the power-system protection is innate to its design, since if the power supply and the integrity of equipment and people are not assured, it would be inconceivable the integration of a complex electrical system as it exists nowadays.

Protection devices are installed with the aims of protection of assets and ensuring continued supply of energy, as well as the protection of the people. In particular, the protection devices controlling the power flow of the network, as well as the power factor are important for detecting and dissipating electrical faults and analyzing how the power flow behaves in response to different events in an electrical system.

GENERAL DESCRIPTION

The Power Flux Protection Application, "AEL-AE9", has been designed to study the protection devices that deal with the resolution of network events involving reverse power flow and power factor alteration. This application allows the user to understand the operation of the protection devices during power factor detection below established limits and detection of a reverse power flow, as well as the incidents that may be caused.

The "AEL-AE9" application consists of a power factor protection relay and a reverse power flow protection relay, with their correspondent power switch, to study the operation of these protection devices when these circumstances are detected in the grid. Two squirrel-cage three-phase asynchronous motors are also included to produce a reverse power flow, creating the circumstances to study the protection devices operation.

One of the motor works as prime mover and it is controlled by a frequency controller. The second motor works as an electricity generator and it is coupled to the prime mover. Analog meters are included too to study the operation of the electrical machines. Additionally it is included a network analyzer which displays all the parameters involved in the grid. Finally, this application includes resistive, inductive and capacitive loads that cause different consumption conditions for the study of the influence of each one on the power factor, and the response of the correspondent protection devices.

The AEL-AE9 application includes the following elements:

- N-ALI01. Industrial Main Power Supply.

- N-EALD. Network Analyzer Unit with Data Acquisition.

- N-REL51. Reverse Power Relay.

- N-REL52. Power Factor Protection Relay.

- N-MED10. AC Ammeter (0-5 A).

- N-MED82. AC Voltmeter (0-500 V).

- N-PSM. Power Switch Module (2 units).

- EMT7. Asynchronous Three-Phase Motor of squirrel cage (2 units).

- N-VVCA/M. AC Motor Speed Controller (Intermediate option).

- N-REFT. Three- phase Commutable Resistor Load.

- N-INDT. Three-phase Commutable Inductive Load.

- N-CONT. Three- phase Commutable Capacitive Load (2 units).

The application AEL-AE9 can be mounted on rack (option A) or on rail (option B):

Option A:

This application needs the following racks:

- N-RACK-A.

- N-RACK-M.

Optionally the AEL-WBR. Electrical Workbench (Rack) can be supplied to place the rack/s.

Option B:

This application can be mounted on rail.

Optionally the AEL-WBC. Electrical Workbench (Rail) can be supplied to mount the modules.

The AEL-AE9 application includes the following elements:

- **N-ALI01. Industrial Main Power Supply.**

    Supply voltage: 400 VAC, 3PH+N+G.

    ON-OFF removable key.

    Output voltage connections:

    Three-Phase + Neutral: 400 VAC.

    Single-Phase: 230 VAC.

    Three-Phase supply hose with IP44 3PN+E 32A 400 V connecting plug.

    Differential magnetothermal, 4 poles, 25 A, 300 mA AC 6 KA.

    Emergency stop push button.

    GND terminal.

N-ALI01

- **N-EALD. Network Analyzer Unit with Data Acquisition.**

    The network analyzer module allows fulfilling measurements, displaying and analyzing all the parameters of the AC electrical networks. It has an LCD screen and push-buttons for the navigation through the different menus. It includes specific software for monitoring current and voltage curves, harmonics display, tariffs programming, alarms programming and electrical parameters storage.

    Features:

    Multifunctional three-phase power meter:

    Single and three-phase voltage. Up to 690 VAC L-L.

    Phase and line current. Current range up to 200%. Measurement from 0-10 A.

    Active, reactive and apparent power.

    Suitable frequencies: 25 Hz, 50 Hz, 60 Hz y 400 Hz.

    Display of the V-I vector diagram.

    Supply voltage: 85-265 VAC.

    Energy quality control:

    Current and voltage individual harmonics measurement. Up to the 40th harmonic.

    THD voltage and current, TDD and K-factor.

    Maximums and minimums display.

    Waveforms display, 128 samples/sec.

    Events and data storage.

    Harmonics analyzer:

    THD voltage and current, TDD current and K-factor, up to the 40th harmonic.

    Current and voltage harmonic spectrum and angles.

    Tariff programming:

    Class 0.5S IEC 62053-22, active and reactive power in four quadrants.

    Measurement of the total and per phase three-phase active, reactive and apparent powers.

    Usage time, 4 energy/demand records of total tariffs.

    8 tariffs, 4 seasons, 4 types of days.

    Automatic daily report of energy consumption maximums and minimums.

    Communications:

    Modbus TCP communication protocol with Ethernet interface.

N-EALD

- N-REL51. **Reverse Power Relay.**
    Supply voltage: 24 VDC.
    Input Voltage: 63 – 690 VAC.
    Nominal Current: 5 A.
    Maximum Current: 10 A.
    Frequency Permissible Range: 35 – 75 %.
    Set point current range:
        Reverse Power: (2 – 20 %, max. 2 – 50 %)
        Forward Power: (50 – 140 %, max. 50 – 150 %)
    Hysteresis: 1 – 10 % (max. 1 – 50 %).
    Delay: 3 – 30 sec. (max. 1 – 360 sec.)
    Auto Reset: Automatic/manual.
    Relay Output Contacts:
        Threshold contacts: 1NO/1NC.
        Trip contacts: 1NO/1NC.

N-REL51

- N-REL52. **Power Factor Protection Relay.**
    Supply Voltage: 90 - 690 VAC.
    Input Voltage: 90 - 690 VAC.
    Delay: 0.1 – 20 seg.
    Auto Reset: Automatic/manual.
    Relay Output Contacts:
        Trip contacts: 1NO/1NC.
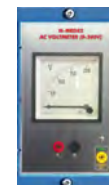

N-REL52

- N-MED10. **AC Ammeter (0-5 A).**
    Measuring range: 0-5 A.
    Terminals:
        Measurement terminal.
    GND terminal.

N-MED10

- N-MED82. **AC Voltmeter (0-500V).**
    Measuring range: 0-500 VAC.
    Terminals:
        Measurement terminal.
    GND terminal.

N-MED82

- N-PSM. **Power Switch Module (2 units).**
    Supply voltage: single-phase 230 VAC.
    Power terminals:
        Four power input terminals (3PH+N).
        Four power output terminals (3PH+N).
    Auxiliary contacts:
        One "NO" contact.
        One "NC" contact.
    Two push-buttons to open / close the power terminals and auxiliary contacts.
    Two control contacts of 24 VDC.
    Two voltage supply outputs of 24 VDC.
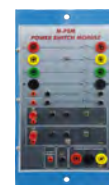
N-PSM

- EMT7. **Asynchronous Three-Phase Motor of squirrel cage (2 units).**
    Nominal power: 370 W.
    Nominal voltage: 3x 230/400 VAC Δ/Y
    Frequency: 50/60 Hz.
    Poles number: 2.
    RPM: 2730 rpm.
    Shaft height: 71 mm.

EMT7

- N-VVCA/M. **AC Motor Speed Controller (Intermediate option).**

    ON/OFF Switch.

    Supply voltage: 230 VAC.

    Nominal power: 750 W.

    PWM output voltage connections:

        Three-Phases: 230 VAC.

    10 K, potentiometer for the induction motor control speed.

    Setting and visualization display of the machine parameters.

    GND terminal.

N-VVCA/M

- N-REFT. **Three- phase Commutable Resistor Load.**

    Nominal voltage: 400 VAC.

    Resistance: 3x 150 Ohm.

    Nominal Current: 1.6 A.

    Manual switch to turn on / off resistors.

    Fuses: 3x 2 A.

    Terminals:

        Four Input Terminals (3PH+N).

        Four Output Terminals (3PH+N).

    GND terminal.

N-REFT

- N-INDT. **Three-phase Commutable Inductive Load.**

    Nominal voltage: 400 VAC.

    Inductance: 1.4 H.

    Nominal Current: 1.6 A.

    Manual switch to turn on / off inductances.

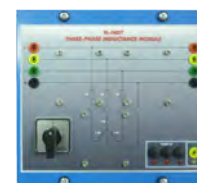   Fuses: 3x 2 A.

    Terminals:

        Four Input Terminals (3PH+N).

        Four Output Terminals (3PH+N).

    GND terminal.

N-INDT

- N-CONT. **Three- phase Commutable Capacitive Load (2 units)**.

    Nominal voltage: 400 VAC.

    Capacitance: 3x 7 μF

    Manual switch to turn on / off capacitors.

    Fuses: 3x 4 A.

    Terminals:

        Four Input Terminals (3PH+N).

        Four Output Terminals (3PH+N).

    GND terminal.

N-CONT

- **All necessary cables to realize the practical exercises are included.**

Cables and Accessories, for normal operation.

Manuals:

This unit is **supplied with the following manuals**: Required Services, Assembly and Installation, Starting-up, Safety, Maintenance & Practices Manuals.

EXERCISES AND PRACTICAL POSSIBILITIES

1.- Study of the starting of an asynchronous electric machine with starting capacitor.

2.- Manual regulation of the speed of an asynchronous electric machine to generate an over-slip and cause an inverse power flow. Operation both in generator mode and in motor mode.

3.- Analysis of active and reactive power and their influence on the operation of the protection relays to provoke a response from them.

4.- Setting of the Reverse Power protection.

5.- Testing of the reverse power protection response to a reverse power flow.

6.- Setting of the Power Factor protection.

7.- Testing of the power factor protection response to below established limits power factor.

8.- Calculation of the power factor when there is a resistive load variation and consequent response of the power factor protection.

9.- Calculation of the power factor when there is an inductive load variation and consequent response of the power factor protection.

10.- Calculation of the power factor when there is a capacitive load variation and consequent response of the power factor protection.

REQUIRED SERVICES

- Electrical supply: three-phase, 380 V/50 Hz or 220 V/60 Hz, 1 kW.

DIMENSIONS AND WEIGHTS

AEL-AE9:

- Dimensions: 640 x 320 x 920 mm approx.

  (25.19 x 12.59 x 32.22 inches approx.)

- Weight: 60 Kg approx.

  (132 pounds approx.)

# SOME **REAL** RESULTS OBTAINED WITH THE NETWORK ANALYSER

Waveform plot of the real time currents and voltages measured by the analyzer, showing the angular, maximum, minimum and RMS values, and the phasors corresponding to such electrical parameters.
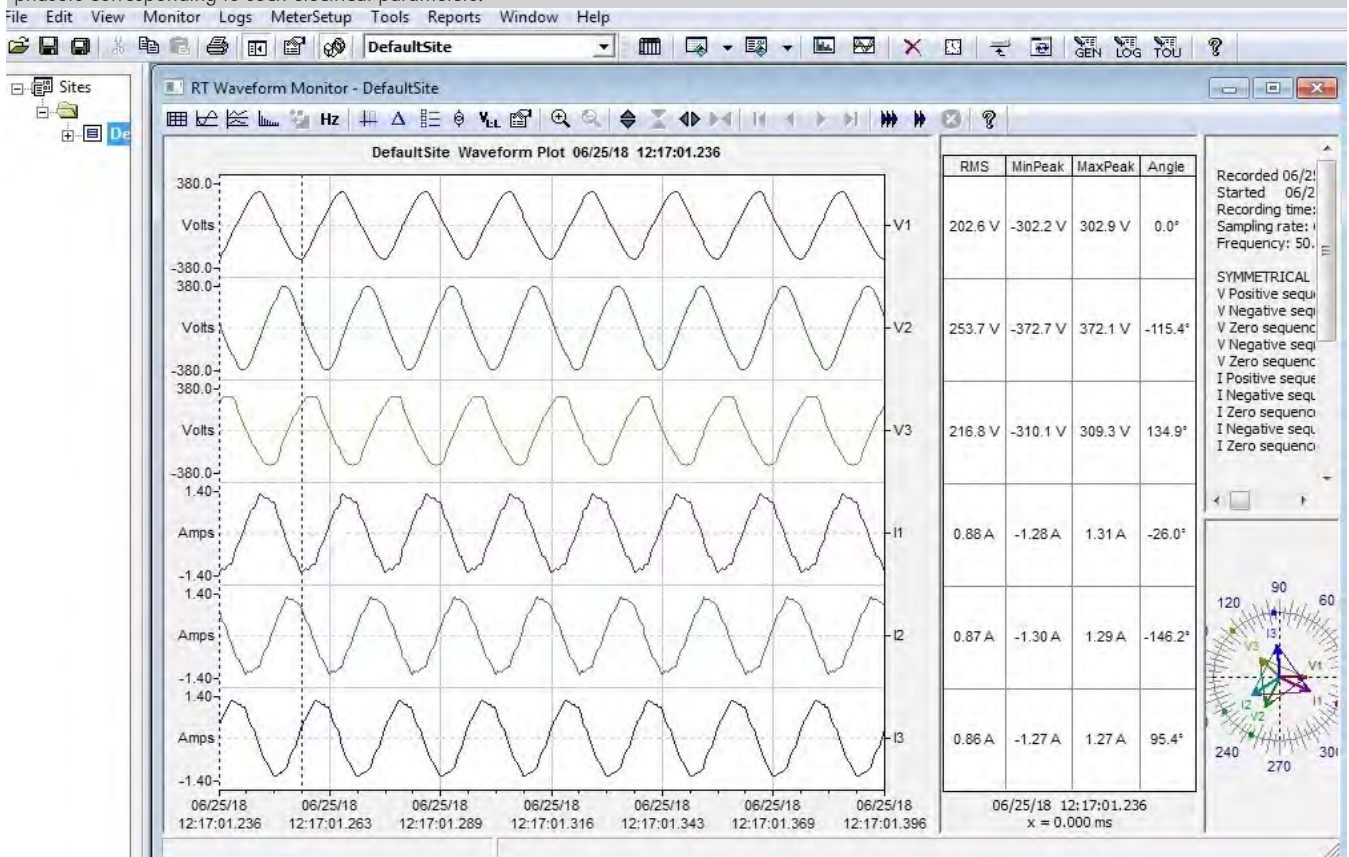
Representation of the torque-speed curve for the Three-Phase Asynchornous Squirrel Cage Motor. Notice that the motor nominal speed and the maximum torque can be appreciated.

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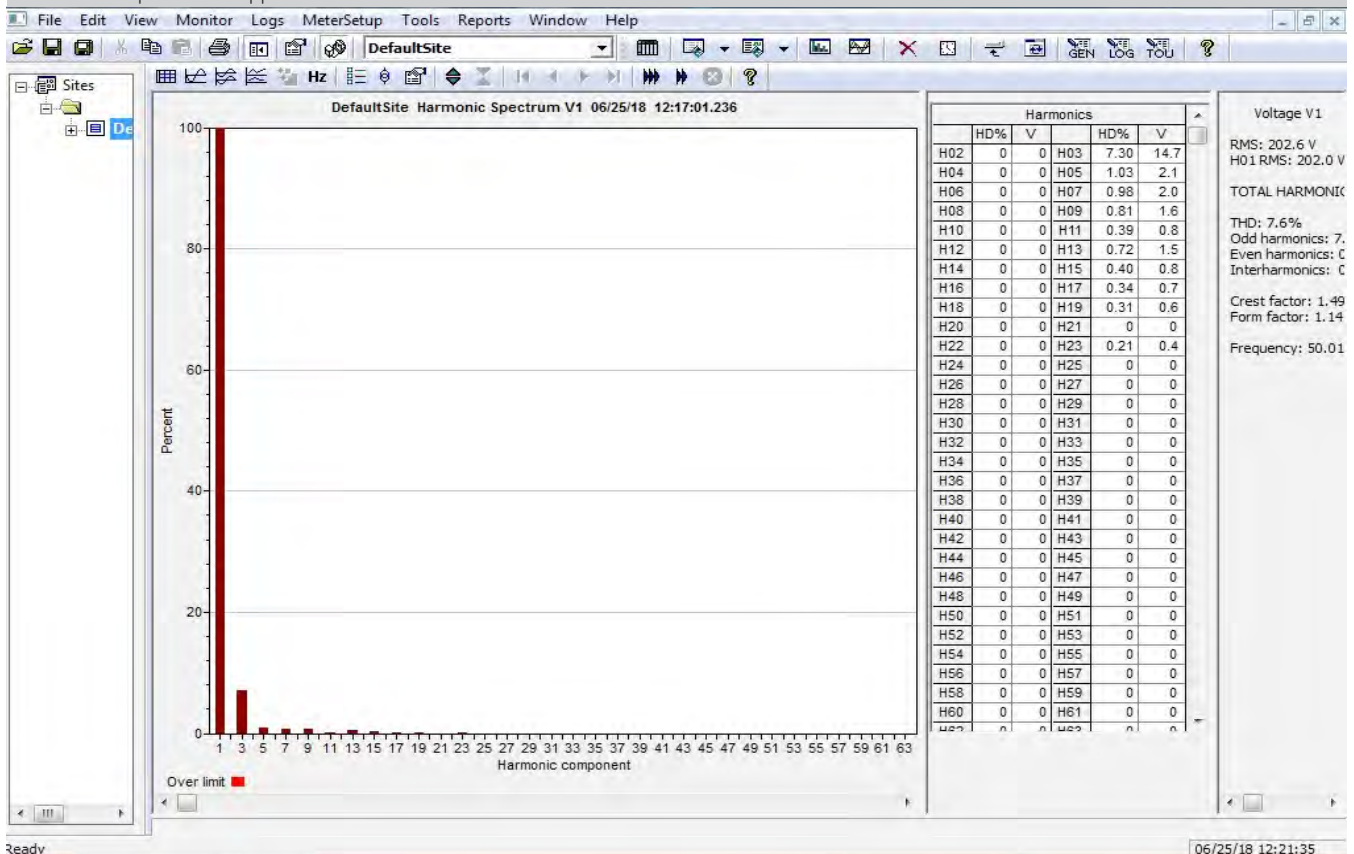
AEL-AE9/ICAI. Interactive Computer Aided Instruction Software System:
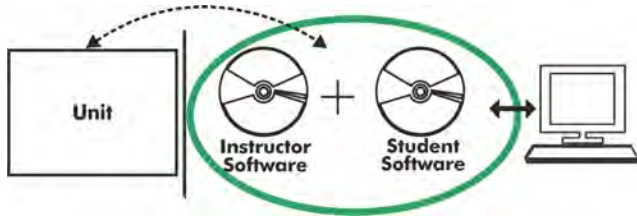
With no physical connection between unit and computer, **this complete software package consists of an Instructor Software (EDIBON Classroom Manager -ECM-SOF) totally integrated with the Student Software (EDIBON Student Labsoft -ESL-SOF).** Both are interconnected so that the teacher knows at any moment what is the theoretical and practical knowledge of the students.
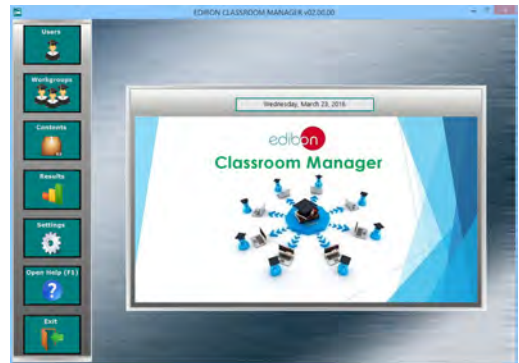
Instructor Software

**- 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.**

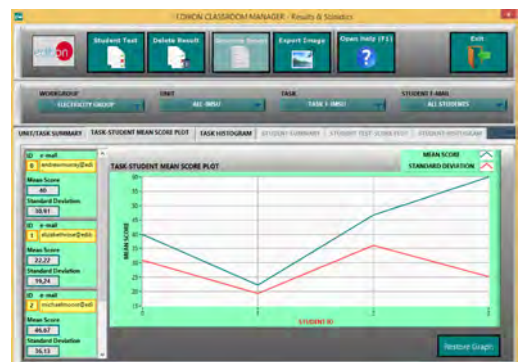
ECM-SOF. EDIBON Classroom Manager (Instructor Software) Application Main Screen
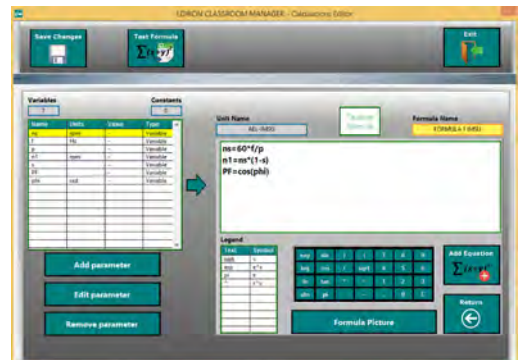
ECAL. EDIBON Calculations Program Package - Formula Editor Screen

ERS. EDIBON Results & Statistics Program Package - Student Scores Histogram
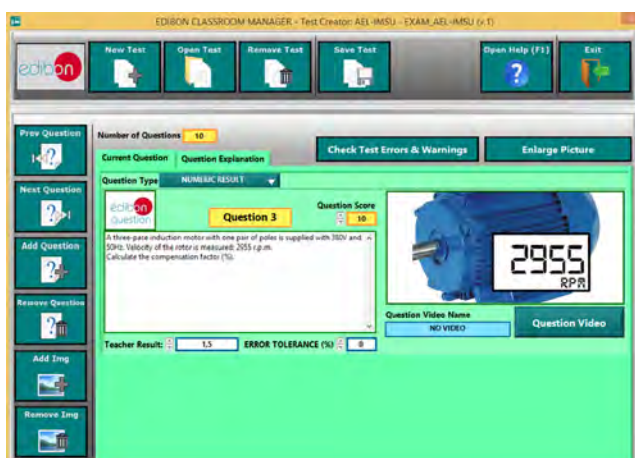
ETTE. EDIBON Training Test & Exam Program Package - Main Screen with Numeric Result Question

Optional

<u>Student Software</u>

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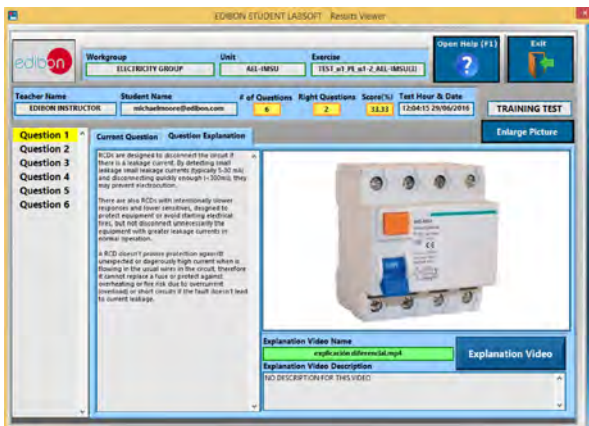
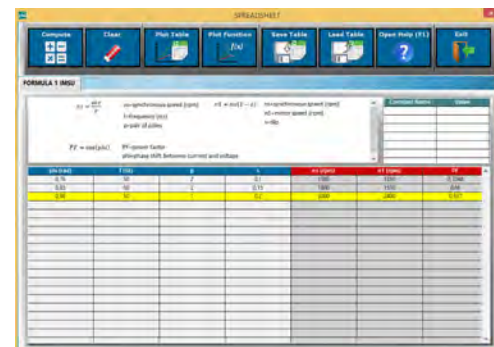www.edibon.com/en/files/expansion/ICAI/catalog

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.

INTERNATIONAL

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Edition: ED01/19
Date: January/2019