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↳ PRODUCTS  
↳ 4. - ELECTRICITY

## INTRODUCTION

In the power supply points of the electrical distribution grids to which big industries are connected there are important reactive energy consumptions which means electrical and economic inefficiency, as distribution lines may get overloaded or oversized. For this reason reactive energy consumption is penalized by the electric operators. In order to solve this problem, different power factor compensation systems are installed in industries.



ISO 9001: Quality Management (for Design, Manufacturing, Commercialization and After-sales service)



European Union Certificate (total safety)



Certificates ISO 14001 and ECO-Management and Audit Scheme (environmental management)



"Worlddidac Quality Charter" and Platinum Member of Worlddidac

## GENERAL DESCRIPTION

The Reactive Power Compensation Application, "AEL-RPC", has been designed to study the reactive power effects in AC circuits, due to reactive loads, and its compensation procedures.

Reactive power can be described as the quantity of "unused" power that is developed by reactive components, such as inductors or capacitors in an AC circuit or system. The power factor (PF) is defined as the ratio between the active power in watts and the apparent power in volt-amperes and indicates how effectively electrical power is being used, so the closer the power factor is to 1 the more efficient use of the electrical power.

The "AEL-RPC" application includes all types of variable loads (resistive, inductive and capacitive) to study the power factor correction. In real power systems almost all circuits are inductive so the compensation procedure is done by placing capacitive loads through many different configurations. A network analyzer is also included to measure the electrical parameters (currents, voltages, frequency, powers or the power factor) that the user must know for the previously mentioned purpose. In addition an overcurrent relay and a power switch are included as protection devices.

The AEL-RPC includes the following elements:

- N-ALI01. Industrial Main Power Supply.
- N-REVT/1K. 1kW Three-Phase Variable Resistors Module.
- N-CAR19T/3C. 3 x 300 VAR Three-Phase Configurable Inductances Module.
- N-INDT/3C. 3 x 300 VAR Three-Phase Configurable Capacitors Module.
- N-EALD. Network Analyzer Unit with Computer Data Acquisition.
- N-PSM. Power Switch Module.
- N-REL09. Time Electronic Relay against Overcurrents (1.2 - 7 A).

This application can be extended with the following applications:

- AEL-ARPC. Automatic Reactive Power Compensation.
- AEL-EECFP. Advanced Reactive Power Compensation.

Recommended software:

- EM-SCADA. Control and Data Acquisition System Software for Electrical Machines, with SCADA.

The application AEL-RPC 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-B (3 units)

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.

## SPECIFICATIONS

The AEL-RPC includes the following elements:

- **N-ALI01. Industrial 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 400V connecting plug.

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



N-ALI01

- **N-REVT/1K. 1kW Three-Phase Variable Resistors Module.**

Resistance: 3 x 150-500 Ohm.

Fuses: 3 x 2 A.



N-REVT/1K

- **N-CAR19T/3C. 3 x 300 VAr Three-Phase Configurable Inductances Module.**

Configurable Star and Delta connection.

Three benches with three-phase capacitors of 2  $\mu$ F each one.

Nominal voltage: 400 VAC.

Nominal power: 3 x (3 x 300) VAr.



N-CAR19T/3C

- **N-INDT/3C. 3 x 300 VAr Three-Phase Configurable Capacitors Module.**

Configurable Star and Delta connection.

Three benches with three-phase inductances of 5 H each one.

Nominal voltage: 400 VAC.

Nominal power: 3 x (3x300) VAr.



N-INDT/3C

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

ON-OFF switch.

Supply voltage: 230 VAC+N+GND.

Input terminals: Input connection with the measurement point.

Output terminals: Output connection with the measurement point.

RS-485 Communication port.

Fuses: 3x10 A.

Network Analyzer Display. It shows:

Voltages (phase-phase, phase-neutral, angles, frequency, unbalance, THD)

Currents (max. demand, unbalance, TDD, THD)

Active, reactive and apparent power

Power factor (inductive and capacitive load)

Maximum demand (import, export, voltages, currents, PF).

MAX/MIN values.

V and I individual harmonics and their spectrums.

Voltages and currents phasors diagrams.

Waveforms of voltages and currents and THD values.

State of digital signals, external pulse counters or installation point counters

Relay output status.

Load bar graph displays the amount, in percent with respect of the nominal defined by the user.



N-CAR32

## Specifications

- **N-PSM. Power Switch Module.**

The voltage can be switched on and off manually or automatically.

Nominal voltage: 230 VAC+N+GND.

Frequency: 50/60Hz.

Control voltage: 24 VDC.

Nominal operating current: 15 A.

Functions: 2 pushbutton switches and remote control for switch-off relay.

Contacts:

- Three normally open contacts.

- Two auxiliary normally open contacts.



N-PSM

- **N-RELO9. Time Electronic Relay against Overcurrents (1.2 - 7 A).**

Electronic thermal relay.

Overload protection.

Range 1.2 - 7 A.

Reset and test function.

1 NONC contact.

Temporization.



N-RELO9

- **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.- Wiring star and delta connection with capacitive and inductive loads.
  - 2.- Overcurrent relay and power switch configuration and testing.
  - 3.- Measurement of the active power consumed by a receiver in a pure resistive circuit.
  - 4.- Measurement of the reactive power consumed by a receiver in a pure inductive circuit.
  - 5.- Measurement of the reactive power consumed by a receiver in a pure capacitive circuit.
  - 6.- Measurement of the apparent, active and reactive powers consumed by a receiver in a RL circuit.
  - 7.- Measurement of the power factor of a receiver in a RL circuit.
  - 8.- Computation and wiring of the capacitive load needed to carry out the appropriate power factor correction.
  - 9.- Comparison of the active energy consumed after the compensation.
  - 10.- Comparison of the reactive energy consumed after the compensation.
  - 11.- Measurement of power factor after the compensation.
  - 12.- Determination of the first and second power maxima.
  - 13.- Determination of the power maximum in the event of an asymmetric load.
- Practical exercises with the recommended Control and Data Acquisition System Software for Electrical Machines, with SCADA, "EM-SCADA":
- 14.- Real time current and voltage RMS values monitoring.
  - 15.- Real time current and voltage waveforms measurement.
  - 16.- Real time monitoring of the results.
  - 17.- Obtaining the saved results.
- Several other exercises can be done and designed by the user.

### REQUIRED SERVICES

- Electrical supply: three-phase, 380V/50 Hz. or 208V/60 Hz., 2 kW.

### DIMENSIONS AND WEIGHTS

#### AEL-RPC:

- Dimensions: 1380 x 840 x 600 mm approx.  
(54.33 x 33.07 x 23.62 inches approx.).
- Weight: 80 Kg approx.  
(176 pounds approx.).

### RECOMMENDED SOFTWARE

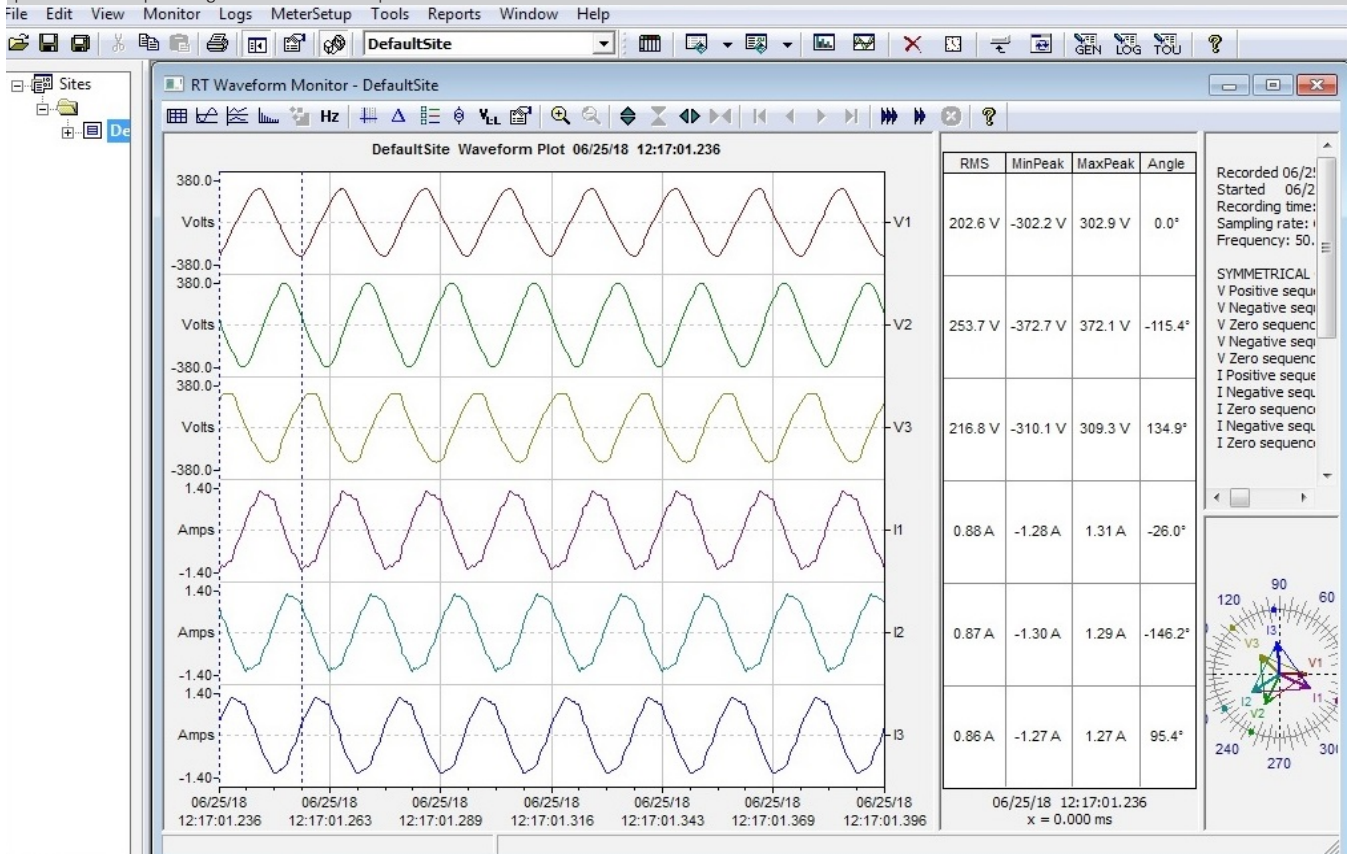
- EM-SCADA. Control and Data Acquisition System Software for Electrical Machines, with SCADA. (For more information see catalogue. Click on the following link: <http://www.edibon.com/en/files/equipment/EM-SCADA/catalog>)

### AVAILABLE VERSIONS

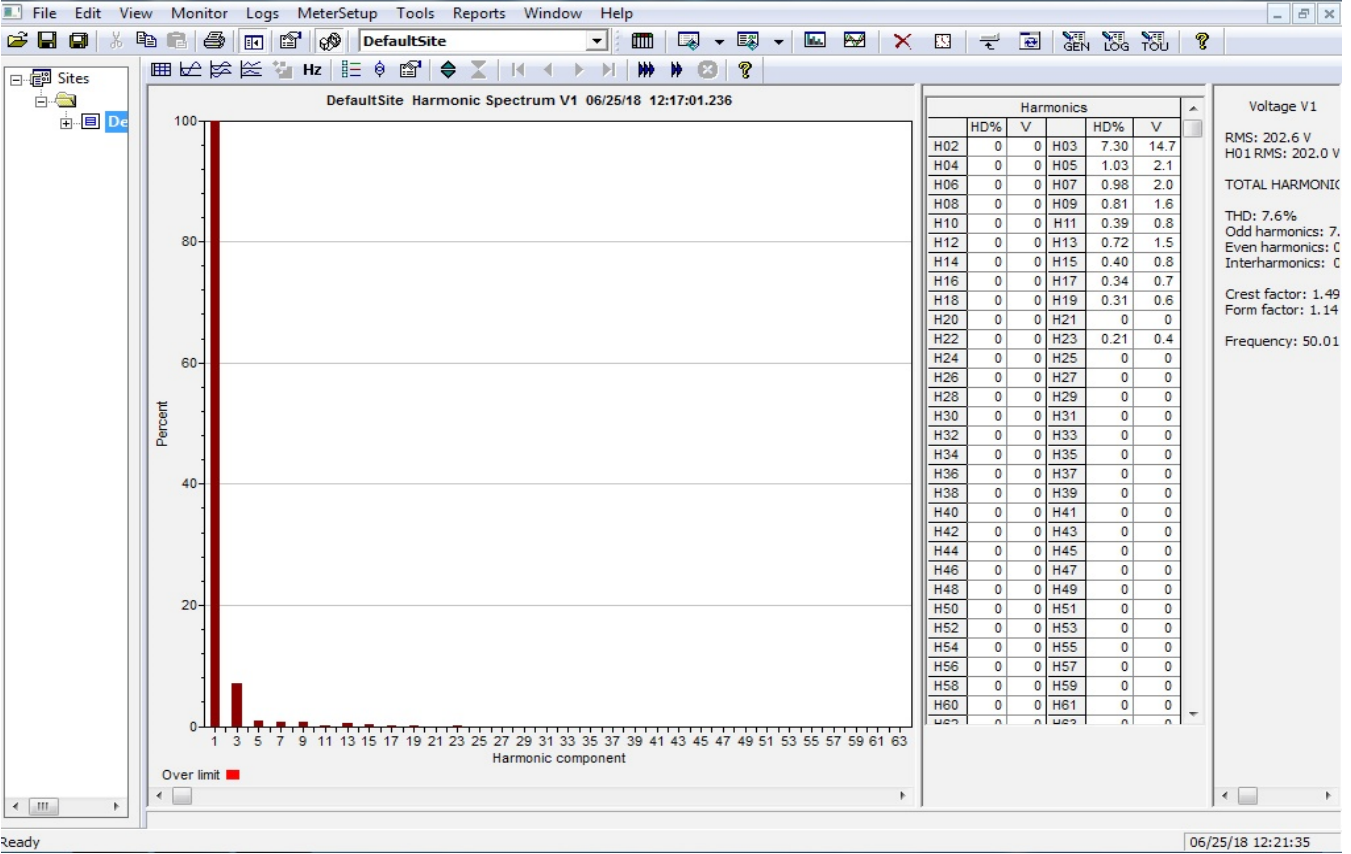
- AEL-RPC. Reactive Power Compensation Application.  
Offered in this catalogue:
- AEL-ARPC. Automatic Reactive Power Compensation Application.  
Offered in other catalogue:
- AEL-EECFP. Advanced Power Factor Compensation Application.

## SOME REAL RESULTS OBTAINED WITH THE NETWORK ANALYSER

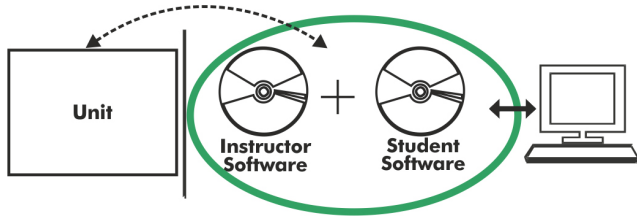
Waveform plot of the real time currents and voltages measured by the analyzer, showing the angular, maximum, minimum and RMS values, and the phasors corresponding to such electrical parameters.



Representation of the torque-speed curve for the Three-Phase Asynchronous Squirrel Cage Motor. Notice that the motor nominal speed and the maximum torque can be appreciated.



**AEL-RPC/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.

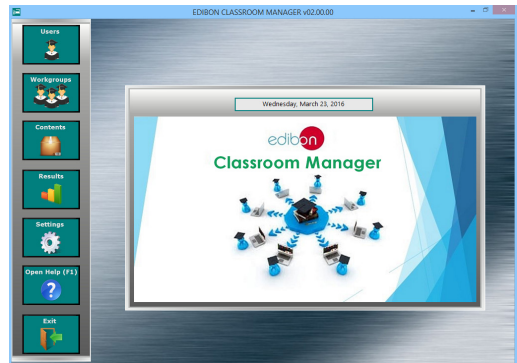
**Instructor Software**

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

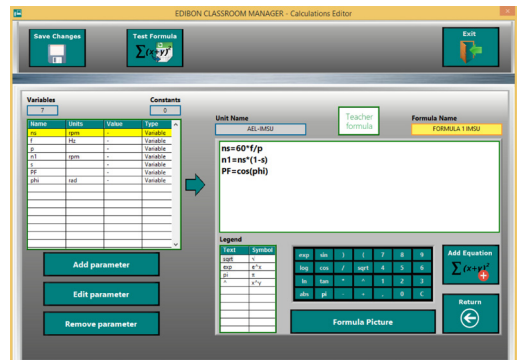
ECM-SOF is the application that allows the Instructor to register students, manage and assign tasks for workgroups, create own content to carry out Practical Exercises, choose one of the evaluation methods to check the Student knowledge and monitor the progression related to the planned tasks for individual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

Innovative features:

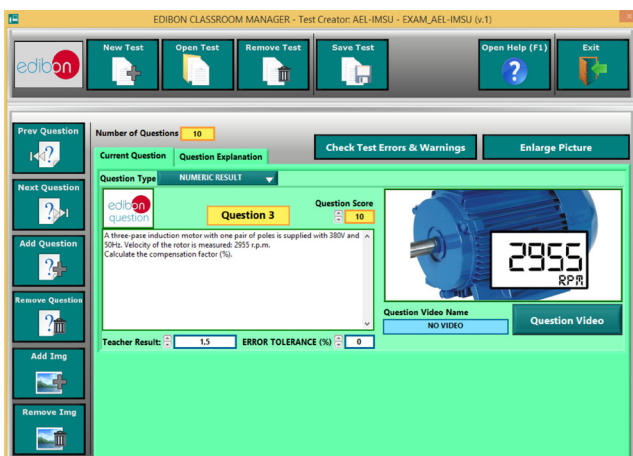
- User Data Base Management.
- Administration and assignment of Workgroup, Task and Training sessions.
- Creation and Integration of Practical Exercises and Multimedia Resources.
- Custom Design of Evaluation Methods.
- Creation and assignment of Formulas & Equations.
- Equation System Solver Engine.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



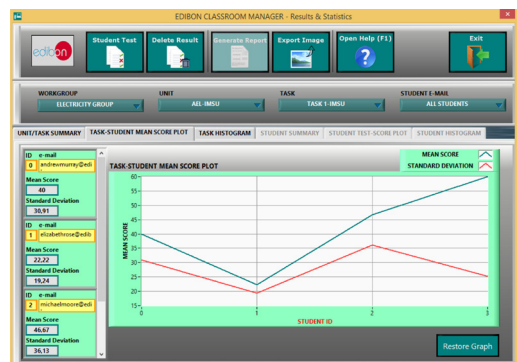
ECM-SOF. EDIBON Classroom Manager (Instructor Software) Application Main Screen



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:

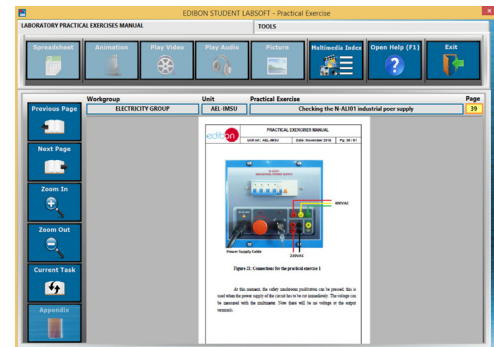
- Student Log-In & Self-Registration.
- Existing Tasks checking & Monitoring.
- Default contents & scheduled tasks available to be used from the first session.
- Practical Exercises accomplishment by following the Manual provided by EDIBON.
- Evaluation Methods to prove your knowledge and progression.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

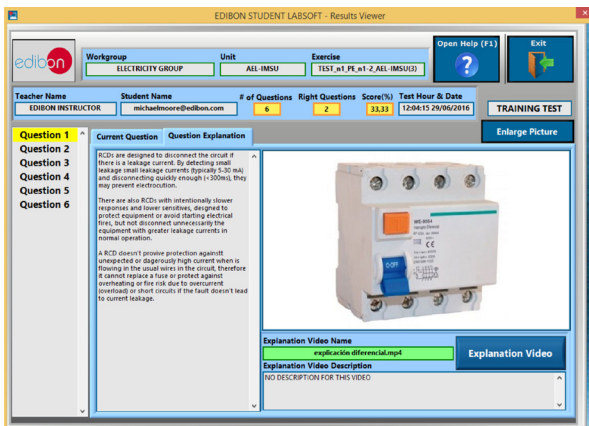
[www.edibon.com/en/files/expansion/ICAI/catalog](http://www.edibon.com/en/files/expansion/ICAI/catalog)



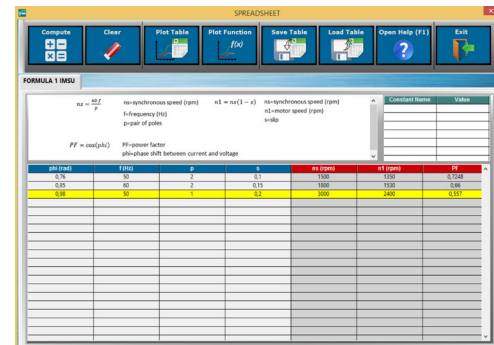
ESL-SOF. EDIBON Student LabSoft (Student Software) Application Main Screen



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:

