



Configuration example of AEL-TI with AEL-TI-01 application included

[www.edibon.com](http://www.edibon.com)  
↳ PRODUCTS  
↳ 40.- ELECTRICITY

## INTRODUCTION

Power line is a structure used in electric power transmission and distribution to transmit electrical energy along large distances. It consists of a three-phase set of conductors (one of more than one by phase) suspended by towers or poles. Since most of the insulation is provided by air, overhead power lines are generally the lowest-cost method of power transmission for large quantities of electric energy.

Electricity is transmitted at high voltages to reduce the energy losses in long-distance transmission. Power is usually transmitted through overhead power lines. Underground power transmission has a significantly higher cost and greater operational limitations but is sometimes used in urban areas, extreme weather places or submarine interconnections.



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 Analysis of Three-phase Power Lines Application, "AEL-TI-01", includes a series of modules which allow the study of the most important characteristics of aerial lines, among them we can find: the aerial line module, which is configurable with different values of resistors, inductances and capacitances; the resistive, inductive and capacity loads modules to analyze the voltage drop of the lines in function of the power factor of the load; network analyzer module to measure in real time values of voltage, current, power flows, power factor, etc. a three pole power switch and an overcurrent protection relay.

This application allows the students carry out important investigations about power transmission and distribution lines: capacitive effects between the lines and the ground, energy losses depending on the load, power factor compensation and electrical values comparison, phase shifts in a line, etc.

In addition, this application has been designed to be combined with the rest of AEL-TI- and AEL-SST- applications in order to form a system in which the user can study concepts about generation, transmission, distribution and power consumption.

This application can work remotely through SCADA software AEL-TI-07/CCSOF included in the application of Transmission Application with Synchronous Generator, "AEL-TI-07".

The AEL-TI-01 application includes the following elements:

- N-AE1. Transmission Lines Simulation Module.
- N-REFT/3C. 3 x 300 W Three-Phase Configurable Resistors Module.
- N-INDT/3C. 3 x 300 VAr Three-Phase Configurable Inductances Module.
- N-CAR19T/3C. 3 x 300 VAr Three-Phase Configurable Capacitors Module.
- N-EALD. Network Analyzer Unit with Data Acquisition (2 units).
- N-PSM. Power Switch Module.
- N-RELO9. Time Electronic Relay against Overcurrents (1.2 - 7 A).

Required elements:

- N-VPS01. AC 3PH Variable Power Supply.

Recommended elements:

- AEL-TI-02. Distribution Transformer with Motor Regulation Application.  
<http://www.edibon.com/en/files/equipment/AEL-TI-02/catalog>
- AEL-TI-03. Arc Suppression Coil Application.  
<http://www.edibon.com/en/files/equipment/AEL-TI-03/catalog>
- AEL-TI-04. Underground Transmission Lines Application.  
<http://www.edibon.com/en/files/equipment/AEL-TI-04/catalog>
- AEL-TI-05. Parallel and Series Transmission Lines Application.  
<http://www.edibon.com/en/files/equipment/AEL-TI-05/catalog>
- AEL-TI-06. Analysis of Power Flows in Transmission Lines Application.  
<http://www.edibon.com/en/files/equipment/AEL-TI-06/catalog>
- AEL-TI-07. Power Transmission Application with Synchronous Generator + AEL-TI-07/CCSOF. Computer Control + Data Acquisition + Data Management Software.  
<http://www.edibon.com/en/files/equipment/AEL-TI-07/catalog>
- AEL-SST-01. Switching in Transmission and Distribution Substations Application.  
<http://www.edibon.com/en/files/equipment/AEL-SST-01/catalog>
- AEL-SST-02. Switching Substation Protection Application.  
<http://www.edibon.com/en/files/equipment/AEL-SST-02/catalog>

The application AEL-TI-01 can be mounted on rack (option A) or on rail (option B):

Option A:

This application needs the following racks.

- N-RACK-M.
- N-RACK-B (4 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-TI-01 application includes the following elements:

- **N-AE1. Transmission Line Simulation Module.**

Four capacitors banks of 1 $\mu$ F by capacitor to simulate capacitance between lines.

Two capacitors of 1 and 2 $\mu$ F by phase to simulate capacitances between the line and earth.

Two resistors of 15 and 30 Ohm by phase.

One inductance by phase with 33, 78, 140, 193 and 236 mH terminals.

One neutral resistor of 10 Ohm.



N-AE1

- **N-REFT/3C. 3x300 W Three-Phase Configurable Resistors Module.**

Configurable Star and Delta connections.

Three banks with three three-phase resistors of 1600  $\Omega$ .

Nominal voltage: 400V AC.

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



N-REFT/3C

- **N-INDT/3C. 3x300 VAR Three-Phase Configurable Inductances Module.**

Configurable Star and Delta connection.

Three banks with three three-phase inductances of 5 H.

Nominal voltage: 400V AC.

Nominal power: 3 x (3x300) VAR.



N-INDT/3C

- **N-CAR19T/3C. 3x300 VAR Three-Phase Configurable Capacitors Module.**

Configurable Star and Delta connection.

Three banks with three three-phase capacitors of 2  $\mu$ F.

Nominal voltage: 400V AC.

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



N-CAR19T/3C

- **N-EALD. Network Analyzer Unit with Data Acquisition (2 units).**

ON-OFF switch.

Supply voltage: 400V AC.

Input terminals: Input connection with the measurement point.

Output terminals: Output connection with the measurement point.

Digital outputs: Three digital outputs are used for pulses or alarms, or for combining both.

RS-485 Communication port.

Fuses: 3 x 10 A.

Network Analyzer Display. It shows:

Active, reactive and apparent power.

Active, reactive and apparent energies.

Lines and phase currents.

Line and phase voltages.

Frequencies.

Power Factor.



N-EALD

## Specifications

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

Supply voltage: single-phase 230V AC.

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 24V DC.

Two voltage supply outputs of 24V DC.



N-PSM

- **N-REL09. Time Electronic Relay against Overcurrents (1.2 - 7 A).**

Electronic thermal relay.

Overload protection.

Range 1.2 – 7A.

Reset and test function.

1 NONC contact.

Temporization.



N-REL09

Required elements:

- **N-VPS01. AC 3PH Variable Power Supply.**

3PH+N+GND male connector with cable.

200V DC fixed output terminals.

0-200V DC variable output terminals.

230/400V AC fixed output terminals.

0-230/400V AC variable output terminals.

Three positions voltage regulation commutator: this commutator allows to control the AC and DC output voltage terminals with a motorized autotransformer. Central position keep actual voltage. Right position increase slowly the output voltage. Left position reduce slowly the output voltage up to zero volts. By releasing the commutator, it will return to its initial position.

ON/OFF switch.

DC Ammeter.

DC Voltmeter.

AC Ammeter.

AC Voltmeter.

Adjustable three phase thermal protection.

Fuses.

GND terminal.



N-VPS01

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

**Cables and Accessories**, for normal operation.

**Manuals:**

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

## EXERCISES AND PRACTICAL POSSIBILITIES

- 1.- Study of line overvoltages in transmission lines.
- 2.- Study of drop voltages in transmission lines with different lengths and loads.
- 3.- Study of drop voltage in transmission lines with different power factors.
- 4.- Energy losses in transmission lines in function of U and I.
- 5.- Study of phase lost in transmission lines.
- 6.- Power factor compensation in transmission lines.
- 8.- This application is totally safe as uses mechanical, electric and electronic, and software safety devices.
- 9.- This application can be used for doing applied research.
- 10.- This application can be used for giving learning courses to industries even to other Technical Education Institutions.
- Several other exercises can be done and designed by the user.

Other possibilities to be done with this application:

- 7.- Many students view results simultaneously.  
To view all results in real time in the classroom it can be used a projector or an electronic whiteboard.

### REQUIRED SERVICES

- Electrical supply: three-phase, 380 V/50 Hz or 208 V/60 Hz, 3 kW.

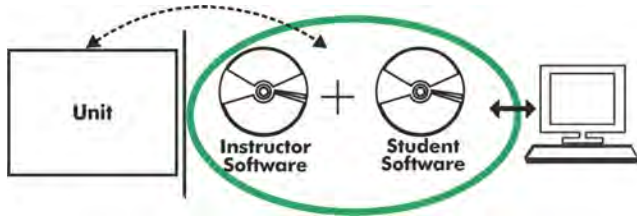
### DIMENSIONS AND WEIGHTS

- AEL-TI-01:
- Dimensions: 3000 x 450 x 1000 mm approx.  
(118.10 x 17.71 x 39.37 inches approx.)
  - Weight: 100 Kg approx.  
(220 pounds approx.)

### AVAILABLE VERSIONS

- Offered in this catalogue:
- AEL-TI-01. Analysis of Three-phase Power Lines Application.
- Offered in other catalogue:
- AEL-TI-02. Distribution Transformer with Motor Regulation Application.
  - AEL-TI-03. Arc suppression Coil Application.
  - AEL-TI-04. Underground Transmission lines Application.
  - AEL-TI-05. Parallel and Series Transmission Lines Application.
  - AEL-TI-06. Analysis of flow power on Transmission Lines Application.
  - AEL-TI-07. Transmission Application with Synchronous Generator.
  - AEL-SST-01. Switching and Distribution Power Substations Application.
  - AEL-SST-02. Switching Substation Protection Application.

**AEL-TI-01/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.

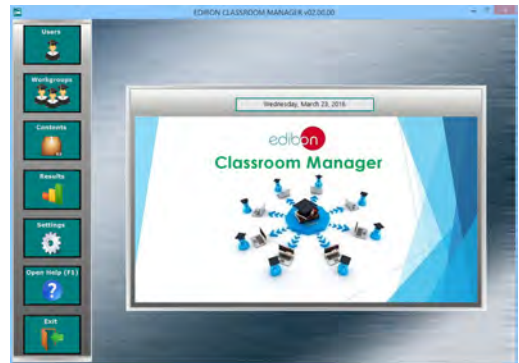
**Instructor Software**

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

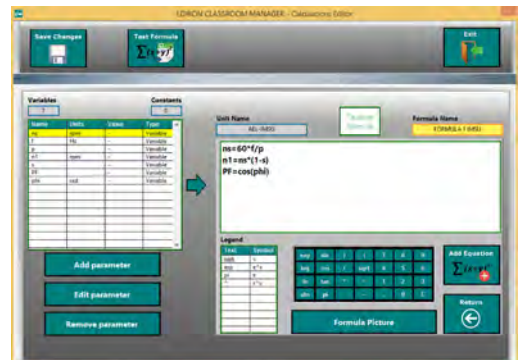
ECM-SOF is the application that allows the Instructor to register students, manage and assign tasks for workgroups, create own content to carry out Practical Exercises, choose one of the evaluation methods to check the Student knowledge and monitor the progression related to the planned tasks for individual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

Innovative features:

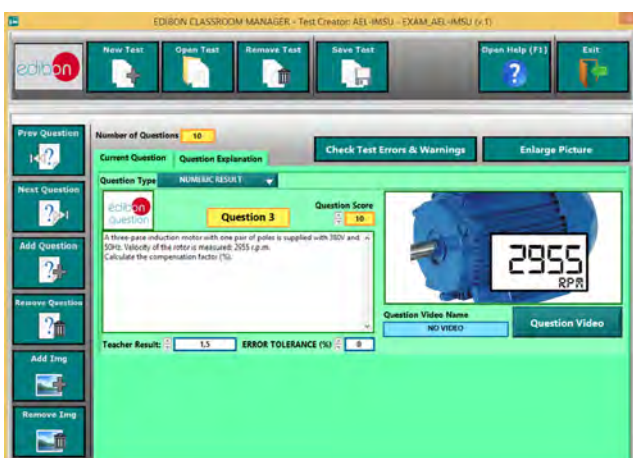
- User Data Base Management.
- Administration and assignment of Workgroup, Task and Training sessions.
- Creation and Integration of Practical Exercises and Multimedia Resources.
- Custom Design of Evaluation Methods.
- Creation and assignment of Formulas & Equations.
- Equation System Solver Engine.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

