



Configuration example of AEL-TI with AEL-TI-04 application included

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INTRODUCTION

Transmission and distribution lines have the purpose of transport the power from power generation centers up to final consumer.

There are two types of transmission lines: aerials and undergrounds.

The advantage of first one is that they are cheaper and require less maintenance. Thus, aerial transmission line have more overload capacity. On the other hand, underground transmission lines are used in limited areas such as urban centers or in the busiest areas.



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 Underground Transmission Lines Application, "AEL-TI-04", has been designed to study the most important characteristics of underground transmission lines such as critical length, capacitive, characteristic impedance, energy losses, etc. Thus, this application allows to compare both aerial and underground transmission lines, their interconnection and the response against different type of loads.

For it, this application includes an underground line module whose electrical parameters are configurable. It has different resistances, inductances and capacitors which allow to simulate different underground transmission lines.

In addition, this application includes a three phase autotransformer module for the stage of energy distribution. Thus, it is included a network analyser to monitor and measure the electrical parameters of the transmission line such as power factor, harmonics, drop voltages, energy losses, 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.

Additionally, 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-04 application includes the following elements:

- N-TRANS03. Module three-phase autotransformer.
- N-UTL. Underground transmission line module.
- N-EALD. Analyzer module of data by computer networks.

Required elements:

- AEL-TI-01. Analysis of Three-phase Power Lines Application.

<http://www.edibon.com/en/files/equipment/AEL-TI-01/catalog>

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

Recommended elements:

- N-RELT. Relay Test Module.

- 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-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-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-04 can be mounted on rack (option A) or on rail (option B):

Option A:

This application needs the following racks.

- N-RACK-B (2 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-04 application includes the following elements:

- **N-TRANS03. Three-Phase Autotransformer Module.**

Three-phase autotransformer.

Nominal supply voltage: 400V AC (3PH).

Nominal output voltage: 3 x 230V AC (3PH+N).

Nominal power: 1 kVA.

Transformer connection: YY0.

Start/stop commutator for instantaneous connection/disconnection of the grid transformer.

Fuses: 3 x 5 A.



N-TRANS03

- **N-UTL. Underground Transmission Line module.**

Resistance per phase: 0,5 Ohm, 1 Ohm, 2 Ohm.

Inductance per phase: 6 mH, 12 mH, 24 mH.

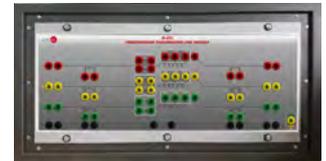
Capacity per phase: 2 x 2 μ F 7 μ F.

Max power consumption: 1kW.

Voltage: 230V AC.

Frequency: 50/60Hz.

Current: 2.5 A.



N-UTL

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

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

Required elements:

AEL-TI-01. Analysis of Three-phase Power Lines Application.

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

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

Four capacitors banks of 1 μ F by capacitor to simulate capacitance between lines.

Two capacitors of 1 and 2 μ 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 Ω .

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 μ 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-RELO9. **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-RELO9

Required element:

- 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 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 cable capacity.
 - 2.- Calculation of the cables critical length.
 - 3.- Determination of the characteristic impedance.
 - 4.- Study of the differences between aerial and underground electrical lines.
 - 5.- Energy losses calculation in underground lines.
 - 6.- Symmetric and asymmetric faults (N-RELT module required).
 - 7.- Analysis of faults with different system configurations of neutral (N-RELT module required).
 - 8.- Several students can see the results at the same time. A projector or electronic whiteboard can be used to see all the results in real time in class.
 - 9.- The Computer Control System with CCSOF Control system allows a real simulation.
 - 10.- This application is completely safe since it has mechanical, electrical, electronic security devices and Software.
 - 11.- This application may be used to carry out applied research.
 - 12.- This application may be used for teaching training to industries, even to other institutions of technical education.
- Several other exercises can be done and designed by the user.
- Other possibilities to be done with this application:

REQUIRED SERVICES

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

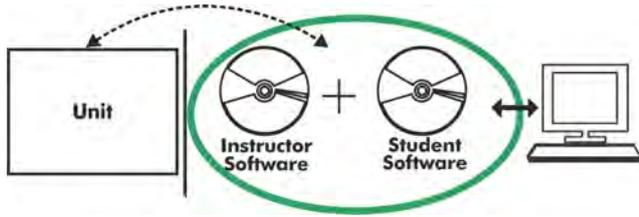
DIMENSIONS AND WEIGHTS

- AEL-TI-04:
- Dimensions: 600 x 300 x 700 mm approx.
(23.62 x 11.81 x 27.55 inches approx.)
 - Weight: 30 Kg approx.
(66 pounds approx.)

AVAILABLE VERSIONS

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

AEL-TI-04/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.

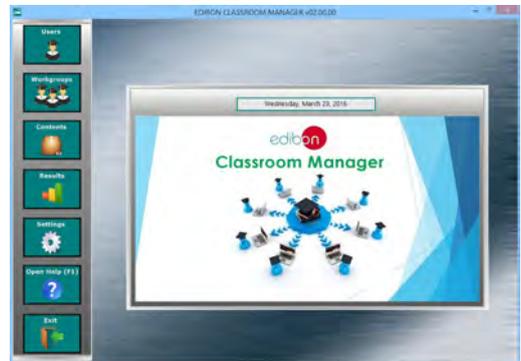
Instructor Software

- 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.



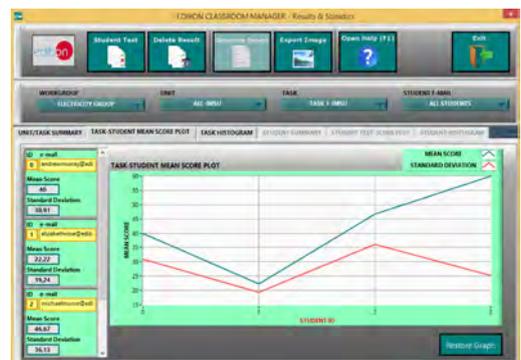
ECM-SOF. EDIBON Classroom Manager (Instructor Software) Application Main Screen



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



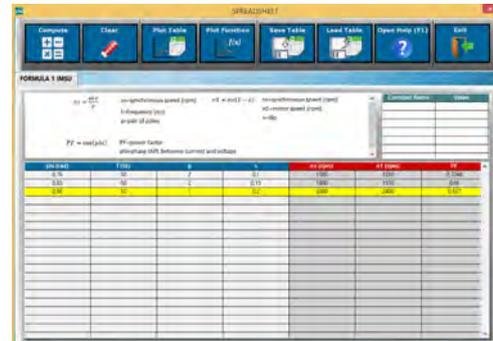
ESL-SOF. EDIBON Student LabSoft (Student Software)
Application Main Screen



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:

