



INTRODUCTION

An electrical motor is such an electromechanical device which converts electrical energy into a mechanical energy. In case of three phase AC motor operations, most widely used motor is three phase induction motor. This type of motor does not require any starting device because it has the capacity of self-starting. However, when it is required to control the induction motor, it is necessary to add different elements such as circuit breakers, timers, fuses, thermal relays, frequency controllers and many other devices which allow controlling and protecting these electrical machines.

The AEL-AI12 Modular application (AC Motors) has been designed by Edibon in order to instruct the students about the most important operations of alternating current motors.



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)



Certificate and Worlddidac Member

GENERAL DESCRIPTION

This application consisting of several modules which allows the user realize logic control circuits in order to manage the motors included in this unit: three-phase induction motor of squirrel cage, single-phase induction motor with starting and running capacitor and Dahlander motor.

At first, the student gets theory knowledge about how the motors described before work. After that, the student will be ready to wire logic control circuits to start the motors by different ways, working in forward and reverse speed of the machine, breaking the motors and study several protections.

Optionally several AC electrical machines are offered in this application such as three-phase induction motor with wound rotor, three-phase induction motor of squirrel cage with two speeds, single-phase induction motor with starting capacitor, single-phase motor with split shift, three-phase reluctance motor and single-phase shaded pole motor.

The AEL-AI12 includes the following modules:

- N-ALI01. Industrial Main Power Supply.
- N-ALI03. AC Auxiliary Power Supply.
- N-PUL48. 3 Double Chamber Pushbuttons. (2 units)
- N-LAM02. Auxiliary Lamps (3 lamps, 24 Vac).
- N-CON01. 3-pole Contactor (24 Vac). (4 units)
- N-VAR09. Frequency Variator.
- N-REL30. Synchronization Relay.
- N-REL47. Thermal Relay. (2 units)
- N-REL45. Module with Disjunctur.
- N-IAM31. 4-pole Magneto-thermal Automatic Switch, 4 A, Curve C.
- N-FUS10. Module with 3 fuse-holders and power fuses.
- TRA06. 3-Phase Power Transformer.
- N-MED60. Network Analyzer.
- N-CAR10. Capacitive Load.
- EMT7. Asynchronous three-phase motor of squirrel cage.
- EMT9. Dahlander three-phase motor.
- EMT16. Asynchronous single-phase motor with starting and running capacitor.

Optional electrical machines:

- EMT8. Asynchronous three- phase motor with wound rotor.
- EMT10. Asynchronous three-phase motor of two independent speeds.
- EMT11. Asynchronous single-phase motor with starting capacitor.
- EMT20. Asynchronous single-phase motor with split phase.
- EMT21. Three-phase reluctance motor.
- EMT22. Single-phase shaded pole motor.

Optional loads:

- N-REF/T. Three-Phase Resistor Load with commutator module.
- N-CON/T. Three-phase Capacitor module.
- N-IND/T. Three-phase Inductance module.

Optional learning software:

In addition, Edibon provides optional software (AEL-AI12/ICAI) to reinforce knowledge about this field. This software is formed by:

- ECM-SOF. EDIBON Classroom Manager (Instructor Software).
- ESL-SOF. EDIBON Student Labsoft (Student Software).

The application AEL-AI12 can be mounted on rack (option A) or on rail (option B):

Option A:

This application needs the following racks.

- N-RACK-A. (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.

The trainer includes the following modules:

- **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-ALI03. AC Auxiliary Power Supply.**
 Supply voltage (Single-Phase): 230VAC PH+N+G.
 Output voltage:
 Single-Phase 24 VAC/12 VAC.
 24 VDC.
 0-24VDC through potentiometer.
- **N-PUL48. Three Double Chamber Push-Buttons Module. (2 units).**
 Two independent chambers.
 Nominal voltage: 24 VAC.
 Three double chamber push-buttons (green and red).
 Contacts:
 Three Normally Open Contacts (NO) for green switch.
 Three Normally Close Contacts (NC) for red switch.
 Ground terminal.
- **N-LAM02. Three Auxiliary Lamps Module.**
 Nominal voltage: 24 VAC.
 Three lamps (red, yellow and green).
 Ground terminal.
- **N-CON01. Three-Pole Contactor Module. (4 units)**
 Nominal voltage for power contacts: 400 VAC.
 Nominal voltage for control contacts: 24 VAC.
 Nominal voltage for the control coil: 24VAC.
 Contacts:
 One three-phase Normally Open Contact (NO) for power circuit.
 Three Normally Open Contacts (NO) for control circuit.
 Two Normally Close Contacts (NC) for control circuit.
 Ground terminal.
- **N-VAR09. Electronic Frequency Variator.**
 Supply voltage: 230 VAC
 On/Off power switch
 PWM output voltage connections:
 Three-Phases: 230 VAC
 Wheel to regulate the frequency.
 Setting and visualization display of the machine parameters.
- **N-REL30. Synchronization Relay Module.**
 Nominal voltage for power contacts: 400 VAC.
 Nominal voltage for control contacts: 24 VAC.
 Nominal voltage for the control coil: 24 VAC.
 Contacts:
 One three-phase Normally Open Contact (NO) for power circuit.
 Three auxiliary contacts:
 One instantaneous Normally Open Contact (NO).
 One time Normally Open Contact (NO).
 One time Normally Close Contact (NC).
 Ground terminal.



N-ALI01



N-ALI03



N-PUL48



N-LAM02



N-CON01



N-VAR09



N-REL30

Specifications

- **N-REL47. Thermal Relay Module. (2 units).**

Nominal voltage for power contacts: 400 VAC.

Nominal voltage for the control coil: 24 VAC.

Contacts:

One three-phase Normally Open Contact (NO) for power circuit
Ground terminal.



N-REL47

- **N-REL45. Start-Stop Switch.**

Nominal voltage for power contacts: 400 VAC.

Three-phase relay:

Selecting wheel to make an adjustment: 6A and 10A.

Two switches:

START (ON): It closes the switch and allows the passage of the current through the terminals.

STOP (OFF): It opens the switch.

Contacts:

One three-phase Normally Open Contact (NO) for power circuit
Ground terminal.



N-REL45

- **N-IAM31. Magneto-thermal Switch.**

Nominal voltage: 400 VAC, 3PH+N.

Protection against overloads: 4 A.

Curve: C type.



N-IAM31

- **N-FUS10: Module with 3 fuse-holders and power fuses.**

Four fuseholders and their respective fuses:

3 fuses of 20 A.

1 fuse of 32 A.

Input terminals: 3PH+N.

Output terminals: 3PH+N.



N-FUS10

- **N-MED60. Network Analyzer.**

ON-OFF switch.

Supply voltage: 400 VAC.

Input terminals: Input connection with the measurement point.

Output terminals: Output connection with the measurement point.

Fuses: 3x10 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-MED60

- **TRA06. Three-Phase Power Transformer.**

Nominal supply voltage: 400 (3PH).

Nominal output voltage: 4230 (3PH+N).

Nominal power: 1 kVA.

Ground terminal.



TRA06

- **N-CAR10: Capacitive Load.**

Nominal voltage: 230 V

Inductances: 4x7uF.



N-CAR10

- **EMT7. Asynchronous Three-Phase Motor of Squirrel Cage.**

Nominal power: 370 W.
 Nominal voltage: 3x 230/400 VAC Δ/Y .
 Frequency: 50/60 Hz.
 Number of poles: 2.
 RPM: 2730 r.p.m.
 Nominal current: 1,67/ 0,97 A



EMT7

- **EMT9. Dahlander three-phase motor.**

Nominal power: 370 W.
 Nominal voltage: 3x 400 VAC.
 Frequency: 50/60 Hz.
 Number of poles: 4.
 RPM: 1400/2800 r.p.m.
 Nominal current: 1,2 / 1,55 A.



EMT9

- **EMT16: Single-phase capacitor motor.**

Supply voltage: 110-220 V.
 Power: 370 W.
 Speed: 2780 r.p.m.
 Frequency: 50/60 Hz.
 Armature current: 1,85 A.



EMT16

Optional electrical machines:

- **EMT8. Asynchronous three-phase motor with wound rotor.**

Nominal power: 300 W.
 Nominal voltage: 3 x 230/400 VAC Δ / Y .
 Frequency: 50/60 Hz.
 Pole number: 2.
 RPM: 2870 r.p.m.
 Nominal current: 1 / 0,5 A.



EMT8

- **EMT10. Asynchronous three-phase motor of two independent speeds.**

Nominal power: 240/370 W.
 Nominal voltage: 3x 400 VAC.
 Frequency: 50/60 Hz.
 RPM: 900/1420 r.p.m.
 Nominal current: 1,05 / 1,35 A.



EMT10

- **EMT11. Asynchronous single-phase motor with starting capacitor.**

Nominal power: 370 W.
 Nominal voltage: 3x 230 VAC.
 Frequency: 50/60 Hz.
 RPM: 2780 r.p.m.
 Nominal current: 2,53 A.



EMT11

- **EMT20. Asynchronous single-phase motor with split phase.**

Supply voltage: 220 V.
 Power: 370 W.
 Speed: 2780 r.p.m.
 Frequency: 50 Hz.
 Induced current: 2,53 A.



EMT20

Specifications

- **EMT21. Three-phase reluctance motor.**

Nominal power: 300 W.

Nominal voltage: 3 x 400 VAC.

Frequency: 50/60 Hz.

RPM: 3000 r.p.m.

Nominal current: 1,4 A.



EMT21

- **EMT22. Single-phase shaded pole motor.**

Power: 16 W.

Speed: 1550 r.p.m.

Frequency: 50/60 Hz.

V. Armadura: 230/240V.

I. Armadura: 0,42 A.



EMT22

Optional loads:

- **N-REF/T. Three-Phase Resistor Load with commutator module.**

Nominal voltage: 400 VAC.

Three-phase resistance: 3x150 Ohm.

Nominal current: 1,6 A.

Manual commutator to switch on/off the inductances.

Fuses: 3x2 A.

Terminals:

Four inputs terminals (3PH+N).

Four outputs terminals (3PH+N).

Ground terminal.



N-REF/T

- **N-CON/T. Three-phase Capacitor module.**

Capacitor value: 3x7 uF.

Nominal Voltage: 400 VAC.

Manual commutator to switch on/off the capacitors.

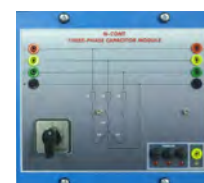
Fuses: 3x4 A.

Terminals:

Four inputs terminals (3PH+N).

Four outputs terminals (3PH+N).

Ground terminal.



N-CON/T

- **N-IND/T. Three-phase Inductance module.**

Nominal voltage: 400 VAC.

Inductance value: 1,4 H.

Nominal current: 1,6 A.

Manual commutator to switch on/off the inductances.

Fuses: 3x2 A.

Terminals:

Four inputs terminals (3PH+N).

Four outputs terminals (3PH+N).

Ground terminal.



N-IND/T

- **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

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| <p>1.- Identification of the element of the Main Power Supply.</p> <p>2.- Study of the elements in the control of AC motors.</p> <p>3.- Study of the protection elements for AC motors.</p> <p>4.- Direct starting of a three-phase motor through contactor, with some stop and start push-buttons.</p> <p>5.- Configuration of a magnetic protection system, with stop mush room button.</p> <p>6.- Direct starting of a three-phase motor with thermal relay with control coil.</p> <p>7.- Direct starting of a three-phase motor through impulses contactor.</p> <p>8.- Direct starting of a three-phase motor with thermal relay and with push-buttons and signalling.</p> <p>9.- Turning inverted starter of a three-phase motor stopping before turning in the opposite direction.</p> <p>10.- Turning inverted starter of a three-phase motor without stopping before turning in the opposite direction.</p> <p>11.- Turning inverted starter of a three-phase motor with microswitch and push-buttons box.</p> <p>12.- Star/delta starting with a turn inverter of a three-phase motor.</p> <p>13.- Automatic star-delta starting of a three phase motor.</p> <p>14.- Turning inverted starter of a three-phase motor with micro switch, with start pushbuttons, stop and function cycle. (Direct).</p> <p>15.- Manual star-delta starting of a three-phase motor.</p> <p>16.- Control of a single phase motor direct and, with time -delay connection and disconnection.</p> <p>17.- Starting of a three-phase motor with single phase voltage.</p> <p>18.- Motor speed control with a frequency variator.</p> <p>19.- Parameters of the motor.</p> | <p>20.- Starting and control of a two-speed Dahlander motor.</p> <p>21.- Measurement with digital measurement system of the voltage, current, power factor and active power parameters of electric motors and transformers.</p> <p>22.- Study of control systems with pushbuttons, lamps Signaling, relays, timers and contactors.</p> <p>Some practical possibilities with optional electric machines:</p> <p>23.- Direct start of the asynchronous three-phase motor with rotor Coiled.</p> <p>24.- Star/Delta starting of the asynchronous three-phase motor with wound rotor with pushers and contactors.</p> <p>25.- Start and reverse rotation of the asynchronous three-phase motor with wound rotor with pushers and contactors.</p> <p>26.- Direct start-up of the asynchronous three-phase motor with two independent speeds.</p> <p>27.- Direct start and motor speed switching of three-phase asynchronous with two independent speeds with push buttons and contactors.</p> <p>28.- Start and reverse rotation of the asynchronous three-phase motor with two independent speeds with pushers and contactors.</p> <p>29.- Direct starting of the asynchronous single-phase motor with capacitor.</p> <p>30.- Direct starting of the asynchronous single-divided phase.</p> <p>31.- Direct start of three-phase reluctance motor.</p> <p>32.- Star/delta starting of three-phase reluctance motor with pushers and contactors.</p> <p>33.- Direct starting with reluctance motor reversal three-phase with pushers and contactors.</p> <p>34.- Direct starting of single-phase motor with short-circuited winding auxiliary.</p> |
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REQUIRED SERVICES

- Electrical supply: single phase, 220 V./50 Hz. or 110 V./60 Hz.

DIMENSIONS AND WEIGHTS

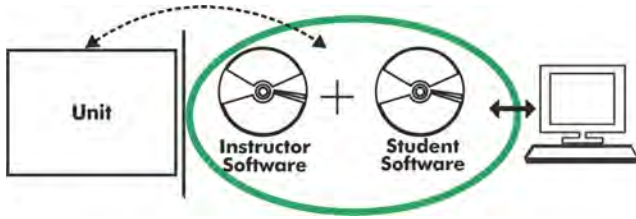
AEL-AI12:

-Dimensiones: 1380 x 840 x 2010 mm. approx.
(54.33 x 33.07 x 79.13 inches approx.).

-Weight: 90 Kg. approx.
(198 pounds approx.).

Optional

AEL-AI12/ICAI. Interactive Computer Aided Instruction Software System.



Without no physical connection between unit and computer (PC), 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.

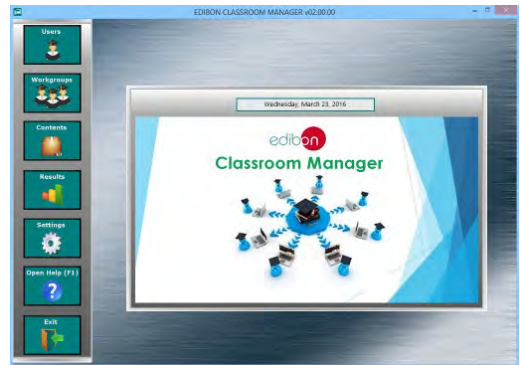
Instructor Software

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

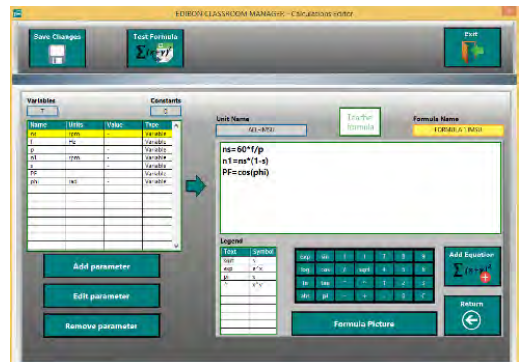
ECM-SOF is the application that allows the Instructor to register students, manage and assign tasks for workgroups, create own content to carry out Practical Exercises, choose one of the evaluation methods to check the Student knowledge and monitor the progression related to the planned tasks for individual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

Innovative features:

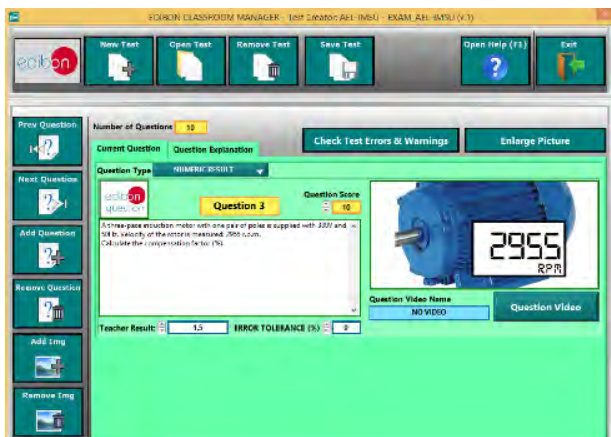
- User Data Base Management.**
- Administration and assignment of Workgroup, Task and Training sessions.**
- Creation and Integration of Practical Exercises and Multimedia Resources.**
- Custom Design of Evaluation Methods.**
- Creation and assignment of Formulas & Equations.**
- Equation System Solver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



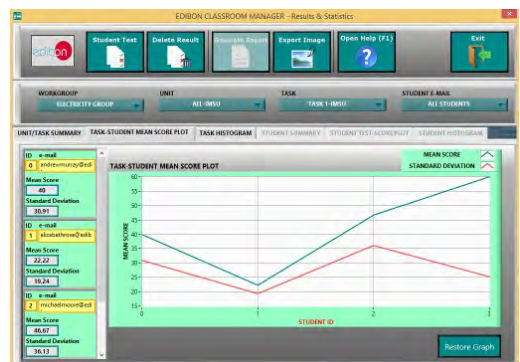
ECM-SOF. EDIBON Classroom Manager (Instructor Software) Application main screen



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:

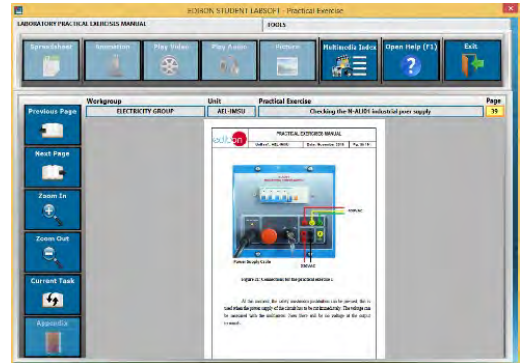
- Student Log-In & Self-Registration.**
- Existing Tasks checking & Monitoring.**
- Default contents & scheduled tasks available to be used from the first session.**
- Practical Exercises accomplishment by following the Manual provided by EDIBON.**
- Evaluation Methods to prove your knowledge and progression.**
- 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/products/catalogues/en/units/electricity/ICAI-Electricity/ICAI-Electricity.pdf



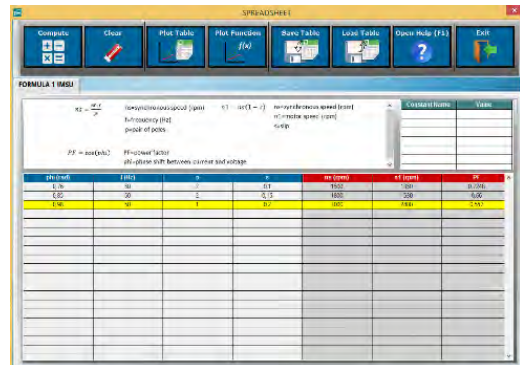
ESL-SOF. EDIBON Student LabSoft (Student Software) Application Main Screen



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:

