The electric motors are devices capable of transforming electrical energy into mechanical energy. The squirrel cage motors are very used in industrial installations due to its great robustness, reliability and low cost. The starting current consumed by these motors is very high, being harmful to the machine and the protections. The soft starters aim at reducing these currents close to the nominal values. For this purpose it is very important to know several operations carried out with these electrical machines.
The Application of AC Three-Phase Induction Motor of Squirrel Cage, “AEL-ACINA”, is designed for the study of the main operations performed in the industrial field with three-phase squirrel cage induction motors. The student will learn the most important operations of these electrical machines faithfully by using commutators, timers and contactors.

The AEL-ACINA includes the following modules:

- N-ALI01. Industrial Main Power Supply Module.
- N-PUL48. 3 Double Chamber PushButtons.
- N-LAM02. Auxiliary Lamps.
- N-CON01. 3-pole Contactor (24 VAC). (4 units)
- N-REL30. Synchronization Relay. (3 units)
- N-ALI03. AC Auxiliary Power Supply.
- EMT7. 3PH Squirrel-Cage Motor.
- N-TRANS03. Three-phase Autotransformer.
- FLYW. Flywheel.

Recommended elements:

- N-EALD. Network Analyzer Module with Oscilloscope and Data Acquisition.
- EM-SCADA. Control and Data Acquisition System Software for Electrical Machines.
- N-MED10. AC Ammeter (0-5 A).
- N-MED22. AC Voltmeter (0-400 VAC).
- N-MED33. 3-phase balance Wattmeter 440 V.
- N-MED31. 3-Phase Phasemeter 400 V.
- N-MED39. 3-Phase Balanced Varmeter 440 V.

If the Option A (modules mounted on rack) is chosen, the rack/s required will depend on the optional modules requested by the customer.

The application AEL-ACINA 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.

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.
• **N-ALI01. Industrial Main Power Supply Module.**
  Supply voltage: 400 VAC, 3 PH+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, 25 A, 300 mA AC 6 KA.

• **N-PUL48. 3 Double Chamber Push-Buttons.**
  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. Auxiliary Lamps.**
  Nominal voltage: 24 VAC.
  Three lamps (red, yellow and green).
  Ground terminal.

• **N-CON01. 3-poles Contactor (220 VAC). (4 units)**
  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 Normally Open Contacts (NO) for control circuit.
  - Two Normally Close Contacts (NC) for control circuit.
  Ground terminal.

• **N-ARR01. Manual Star-Delta starter.**
  Nominal voltage: 400 VAC.
  Maximum contacts current: 10 A.
  Star-Delta three positions commutator:
  - 0: Open circuit.
  - Y: Star connection.
  - Δ: Delta connection.

• **N-REL30. Synchronization Relay Module. (3 units)**
  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-ALI03. AC Auxiliary Power Supply.**
  Supply voltage (Single-Phase): 230 VAC PH+N+G.
  Output voltage:
  - Single-Phase 24 VAC/12 VAC.
  - 24 VDC.
  - 0-24 VDC through potentiometer.
Specifications

• **EMT7. 3PH Squirrel-Cage Motor.**
  Nominal power: 370 W.
  Nominal voltage: 3 x 230/400 VAC Δ/Y.
  Frequency: 50/60 Hz.
  Number of poles: 2.
  RPM: 2730 rpm.
  Nominal current: 1,67/0,97 A.

• **N-TRANS03. Three-Phase Autotransformer Module.**
  Three-phase autotransformer.
  Nominal supply voltage: 400 VAC (3PH).
  Nominal output voltage: 3 x 230 VAC (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.

• **FLYW. Flywheel.**
  Weight: 2 kg.
  Maximum recommended speed: 4000 rpm.
  Moment of inertia: 0,0025 kgm²

• **N-ARR13. Direct starter with inversion.**
  Nominal voltage: 400 VAC.
  Maximum contacts current: 10 A.
  Three positions commutator:
  0: Open circuit.
  1: Direct connection.
  2: Reverse connection.

• **N-EALD. Network Analyzer Module with Oscilloscope and 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.
Specifications

• **EM-SCADA. Control and Data Acquisition System Software for Electrical Machines.**
  
  Power supply: 230 VAC.
  
  Input Signals:
  
  - Current signal (x2).
  - RMS current signal (x2).
  - Voltage signal (x2).
  - RMS voltage signal (x2).
  - Torque and speed signals.
  
  Output Signals:
  
  - Torque and speed control signal for the servomotor control.
  
• **N-MED10. AC Ammeter (0-5 A).**
  
  Measurement range: 0-5 A.
  
  Terminals:
  
  - Measurement Terminals.
  - Ground Terminal.
  
• **N-MED22. AC Voltmeter (0-400 VAC).**
  
  Measurement range: 0-400 VAC.
  
  Terminals:
  
  - Measurement Terminals.
  - Ground Terminal.
  
• **N-MED33. 3-Phase Wattmeter 440 V.**
  
  Nominal voltage 440 VAC.
  
  Terminals:
  
  - Measurement Terminals.
  - Ground Terminal.
  
• **N-MED31. 3-Phase Phasemeter 400 V.**
  
  3 phasemeter.
  
  400 VAC.
  
  CAP 0.5-1-0.5 IND.
  
  Accuracy 1.5 % of 90º.
  
  50 or 60 Hz.
  
• **N-MED39. 3-Phase Balanced Varometer 440 V.**
  
  3 phase balanced varmeter.
  
  440 VAC.
  
  Range: 0 - 300 Var.
  
  Scale 90º.
  
  Accuracy 1.5%.
  
  50 or 60 Hz.

• **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.
<table>
<thead>
<tr>
<th>EXERCISES AND PRACTICAL POSSIBILITIES</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.- Checking the Industrial Main Power Supply (N-ALI01).</td>
</tr>
<tr>
<td>2.- Checking the AC Auxiliary Main Power Supply (N-ALI03).</td>
</tr>
<tr>
<td>3.- Checking the lamps.</td>
</tr>
<tr>
<td>4.- Study of the control elements of alternating current motors.</td>
</tr>
<tr>
<td>7.- Automatic star-delta starter of three-phase induction motor.</td>
</tr>
<tr>
<td>8.- Automatic star-delta reversing circuit of three-phase induction motor.</td>
</tr>
<tr>
<td>9.- Use of the flywheel.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>REQUIRED SERVICES</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Electrical supply: three-phase, 380 VAC – 400 VAC/50 Hz or 190 VAC – 240 VAC/60 Hz, 1 kW.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>DIMENSIONS AND WEIGHTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>AEL-ACINA:</td>
</tr>
<tr>
<td>- Dimensions: 640 x 320 x 920 mm approx.</td>
</tr>
<tr>
<td>- Weight: 35 Kg approx.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SIMILAR UNITS AVAILABLE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Offered in this catalog:</td>
</tr>
<tr>
<td>- AEL-ACINA. Application of AC Three-Phase Induction Motor of Squirrel Cage.</td>
</tr>
<tr>
<td>Offered in other catalog:</td>
</tr>
<tr>
<td>- AEL-ACEMA. AC Electrical Motors Application.</td>
</tr>
<tr>
<td>- AEL-ACEMT. Advanced AC Electrical Motors Application.</td>
</tr>
<tr>
<td>- AEL-DCEMA. D.C. Electrical Motors Application.</td>
</tr>
<tr>
<td>- AEL-DCEMT. DC Electrical Motors Applications.</td>
</tr>
</tbody>
</table>
1. Main menu. Start-up, stop, view data, save data and quit.
2. RMS voltages and currents measurements. It shows RMS values for the real time measured voltages and currents.
3. Real voltages and currents measurements. It shows the exact values for the real time measured voltages and currents.
4. Torque and speed measurements. It shows the machine torque and speed real time values.
5. Interface ON pilot light indicator. The green pilot means the right operation of the control-interface box.
6. SCADA control switch. To enable the actuators control from the software.
7. Emergency stop button.
8. Speed actuator. In order to set the desired speed value through the potentiometer or entering the exact value.
9. Torque actuator. In order to set the desired torque value through the potentiometer or entering the exact value.
10. Screen selector.
Signal vs Time chart for the RMS value of the starting current for the Three-Phase Asynchronous Squirrel Cage Motor, with 10%, 20% and 30% applied torque.

1. Type of graph selector. Simple or several signals overlapping.
2. Parameters selection. It allows choosing the parameters to be displayed and the setting for its display.
3. Starting current for 10% of brake torque.
4. Starting current for 20% of brake torque.
5. Starting current for 30% of brake torque.

Representation of the torque-speed curve for the Three-Phase Asynchronous Squirrel Cage Motor.

1. Axis signal selector. It allows selecting the parameter to be monitored in each axis.
2. Type of graph selector.
3. Acquire points. It allows displaying in the graph the point corresponding to the time when it is pressed.
4. Save acquired points. It allows saving the acquired points, which will start erasing automatically after 500 samples.
Some test results with **EM-SCADA** (recommended)

Representation and display of the stored data.

Waveform chart for the real time voltages measured by the interface.

1. **Parameters selector.** It allows choosing the parameters whose waveforms want to be displayed.
Some test results with **EM-SCADA** (recommended)

Waveform chart for the real time currents measured by the interface.

Representation of the torque-speed curve for the manual braking test with the Three-Phase Asynchronous Motor of two speeds, no load speed (1500 rpm). Notice that the motor nominal speed and the maximum torque can be appreciated, as well as the motor complete braking.

1. **Axis signal selector.** It allows selecting the parameter to be monitored in each axis.
2. **Run.** It allows starting the manual braking test.
Some test results with **EM-SCADA** (recommended)

**1. Axis signal selector.** It allows selecting the parameter to be monitored in each axis.

**2. Type of test selector.** It allows selecting the type of automatic braking test to be fulfilled; linear, constant or exponential slope.

**3. Iniciar test.**

**4. Save data.** It allows saving the obtained test results.

**5. Compare data.** It allows comparing in the same graph up to three different test.

**6. Time (seconds).** It allows selecting the length of the test to be fulfilled.

**7. Points.** It shows the number of points that will define the resulting plot.

**8. Start point.** It allows selecting (as a percentage) the start point for the test to be fulfilled.

**9. End point.** It allows selecting (as a percentage) the end point of the test to be fulfilled.
Obtained results for the automatic braking test with the Three-Phase Asynchronous Squirrel Cage Motor, with delta connection, from 0 to 100 % and linear braking slope. Notice that the motor nominal speed and the maximum torque can be seen, as well as the motor complete braking.

Obtained results for the automatic braking test with the Three-Phase Asynchronous Squirrel Cage Motor, with star-delta starting, from 0 to 80 % and linear braking slope. Notice that the condenser operating point condenser can be appreciated, as well as the motor nominal speed and its complete braking.

Some test results with **EM-SCADA** (recommended)
Obtained results for the automatic braking test with the Single-Phase Asynchronous Motor with starting and running capacitor, from 0 to 100% linear braking slope. The capacitor operating point and the effects on the machine parameters can be appreciated, as well as the motor nominal speed and its complete braking.

Purchase of two previously performed and stored tests.

Some test results with **EM-SCADA** (recommended)
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-ACINA/ICAI. Interactive Computer Aided Instruction Software System:**

With 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
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:

Specifications subject to change without previous notice, due to the convenience of improvement of the product.