Technical Teaching Equipment

Advanced Dissectable and Configurable Electrical Machines

AEL-EMT-KIT

Key features:

- **Many types of electrical motors can be built, configured and started up: AC Asynchronous Induction Motors, DC Motors/Generators, AC Synchronous Motors/Generators and Stepper Motor.**
- **Monitoring and analyzing waves shape of electrical machines.**
- **Data Acquisition System of electrical machines.**
- **Study of power factor.**
- **Measurement all electrical parameters.**
- **Testing of electrical machines magnetic field.**

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Products
Products range
Units
4.-Electricity

ISO 9000: Quality Management
(for Design, Manufacturing, Commercialization and After-sales service)

European Union Certificate
(total safety)

Certificates ISO 14000 and
ECO-Management and Audit Scheme
(environmental management)

Worlddidac Quality Charter Certificate and
Worlddidac Member

INTRODUCTION

The Advanced Dissectable and Configurable Electrical Machines (AEL-EMT-KIT) is a set of configurable electrical machines designed to study the basic principles of electrical machines:

Dissectible mechanical pieces.

Assembled and disassembled winding machines and mechanical pieces.

Construct and configure from zero and step by step a full range of rotational electrical machines.

Tests of rotational magnetic field with a compass.

Understand the differences between DC electrical motors, AC electrical motors, Stepper motors, reluctance motors, etc.

Different drivers for each type of electrical machines configuration to observe how the electrical machines work.

Analyze possible wiring mistakes with multimeter and analog instrumentation like ammeters, voltmeters, frequency meters, etc.

Using this application the student will clearly observe the components of the machines and how they must be interconnected, both electrically and mechanically.

It consists of mechanical pieces and electrical wirings.

The student will be able to make and test innumerable types of electrical machines.

The different machines have protected rotating parts and use low voltages, besides the machines characteristics are compatible with their equivalent industrial models.

GENERAL DESCRIPTION

AEL-EMT-KIT consists of:

a) AEL-EMT-KIT/B. Base Unit and common modules.

Kits:

b) AEL-EMT-KIT/AS. AC Asynchronous Induction Motors.

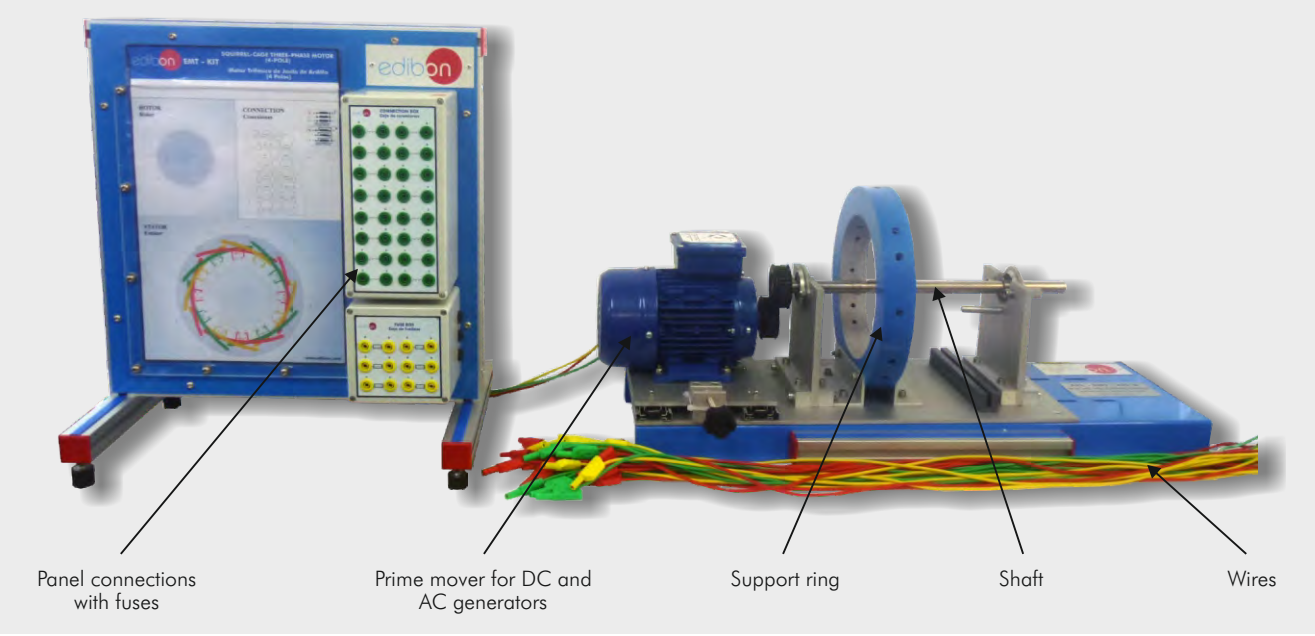
c) AEL-EMT-KIT/DC. DC Motors/Generators.

d) AEL-EMT-KIT/SMG. AC Synchronous Motors / Generators.

e) AEL-EMT-KIT/MPP. Stepper Motor.

a) **AEL-EMT-KIT/B. Base Unit and common modules.**

This base unit is required to construct any rotational machine:



Basic tools

Continue...

b) **AEL-EMT-KIT/AS. AC Asynchronous Induction Motors.**

The AEL-EMT-KIT/AS is designed to study AC asynchronous motors.

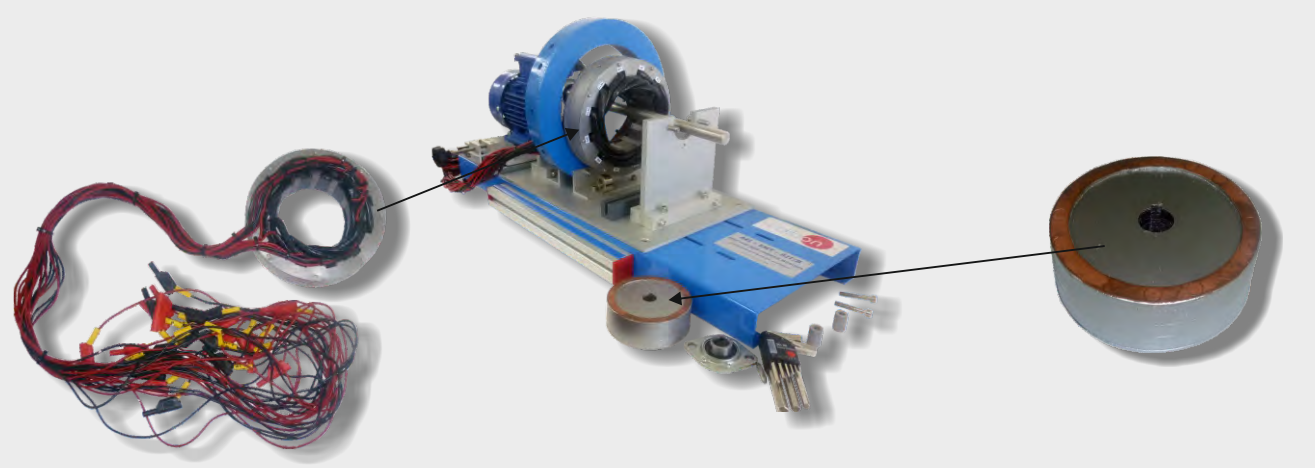
Required the AEL-EMT-KIT/B.

This kit consists of a set of mechanical pieces assembled among them in order to mount and operate different models of asynchronous induction machines. The objective of this kit is to study the operation of asynchronous induction machines, their parts, how the stator windings are distributed to configure the inductive poles and how, by means of a simple compass, the rotating magnetic field of these machines can be tested.

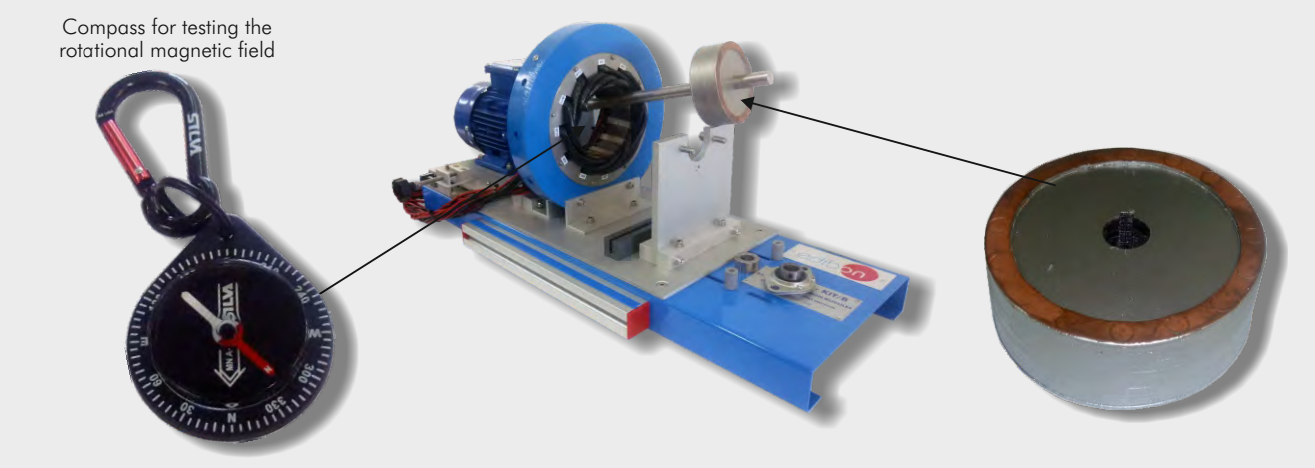
The user can construct and simulate the actual behavior of the following models of electrical machines with the AEL-EMT-KIT/AS:

- Three-phase AC induction motor of squirrel cage (2 pole).
- Three-phase AC induction motor of squirrel cage (4 pole).

Mounting of motor stator and rotor



Mounting the motor rotor



Toolbox to store the pieces

Continue...

c) **AEL-EMT-KIT/DC. DC Motors/Generators.**

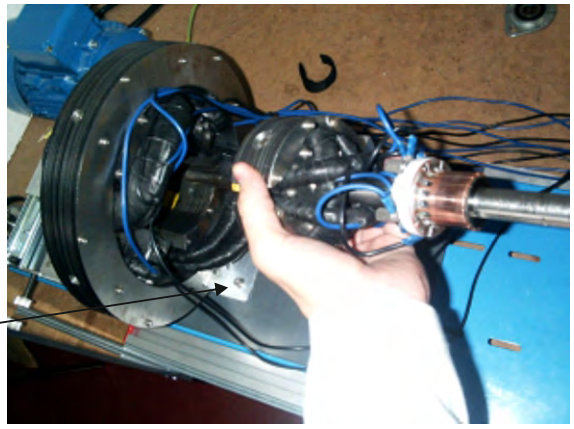
The AEL-EMT-KIT/DC has been designed to study DC motors/generators.

This kit consists of a set of mechanical pieces assembled among them in order to mount and operate different models of DC machines. The objective of this kit is to study the operation and different parts of a DC generator/motor and how independent, series, shunt and compound connections are done.

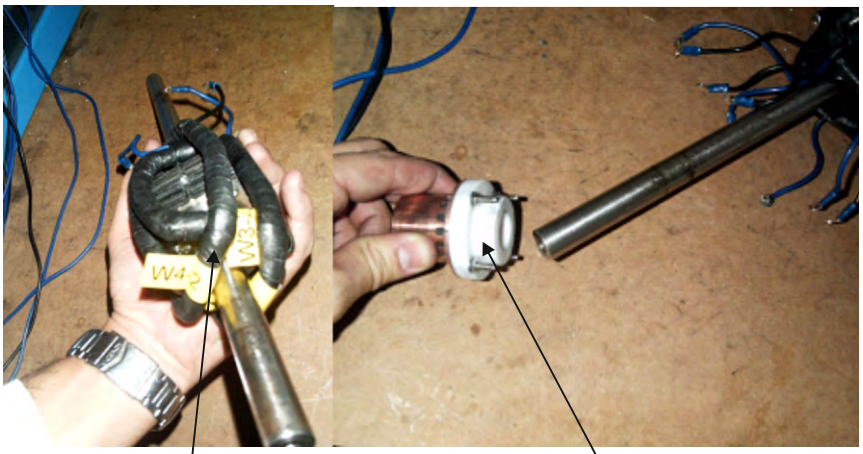
This kit will be able to work in two different modes: as a generator and as a motor.

With the AEL-EMT-KIT/DC, the user can construct and simulate the actual behavior of the following models of electrical machines:

- DC shunt motor (with and without interpoles).
- DC series motor (with and without interpoles).
- DC compound motor (with and without interpoles).
- DC shunt generator (with and without interpoles).
- DC series generator (with and without interpoles).
- DC compound generator (with and without interpoles).
- DC separately excited generator (with and without interpoles).



Mounting of DC Motor/Generator



Construction of DC rotor

Coupling of collector in the shaft

Coupling of poles

Continue...

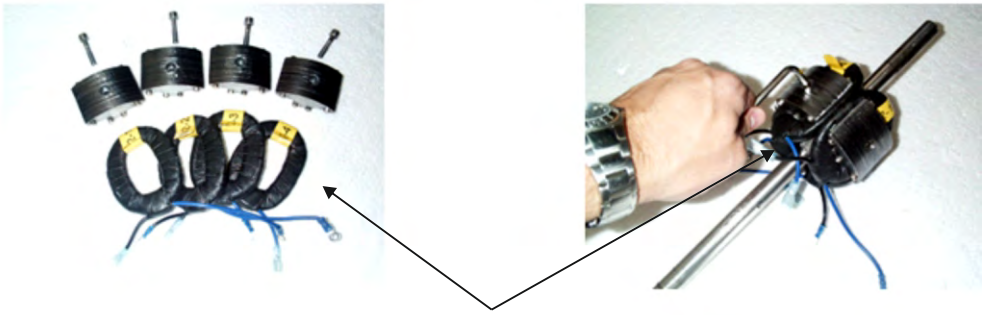
d) **AEL-EMT-KIT/SMG. AC Synchronous Motors / Generators.**

The AEL-EMT-KIT/SMG has been designed to study synchronous machines.

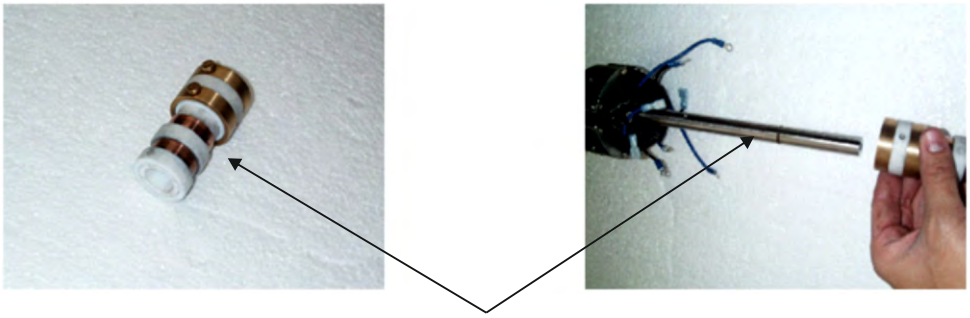
This Kit consists of a set of mechanical pieces assembled among them in order to mount and operate different models of synchronous machines. The aim of this kit is to demonstrate the operation of synchronous machines existing in the market, their parts, how the stator windings are distributed to configure the inductive poles, how the velocity control of these machines is performed and how, by means of a simple compass, the rotating magnetic field of these machines can be tested.

The user can construct and simulate the actual behavior of the following models of electrical machines with the AEL-EMT-KIT/SMG:

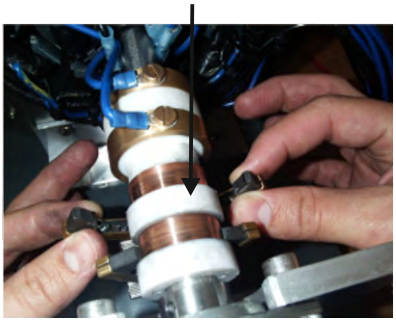
- Three-phase AC synchronous motor (2 pole).
- Three-phase AC synchronous generator (2 pole).
- Three-phase AC synchronous motor (4 pole).
- Three-phase AC synchronous generator (4 pole).

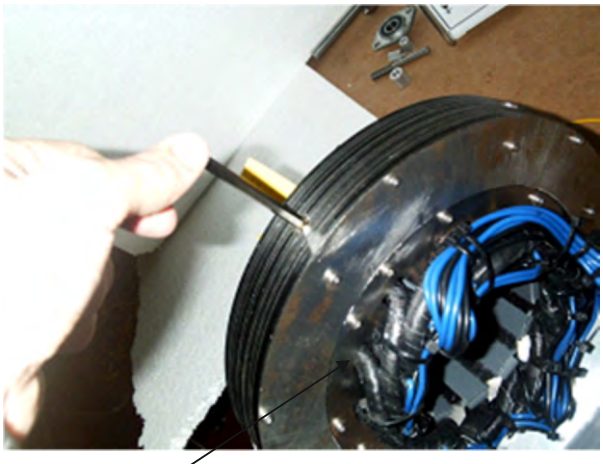


Rotor poles and windings

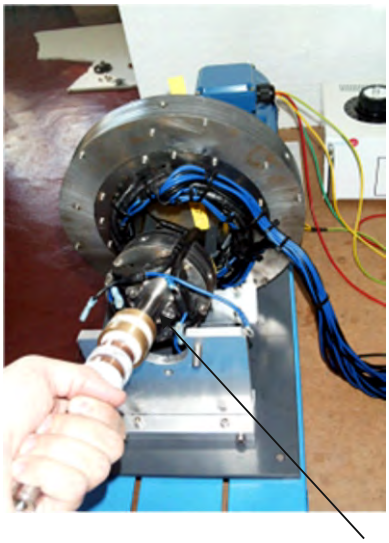


Slip rings mounting





Mounting of the stator



Mounting of the rotor

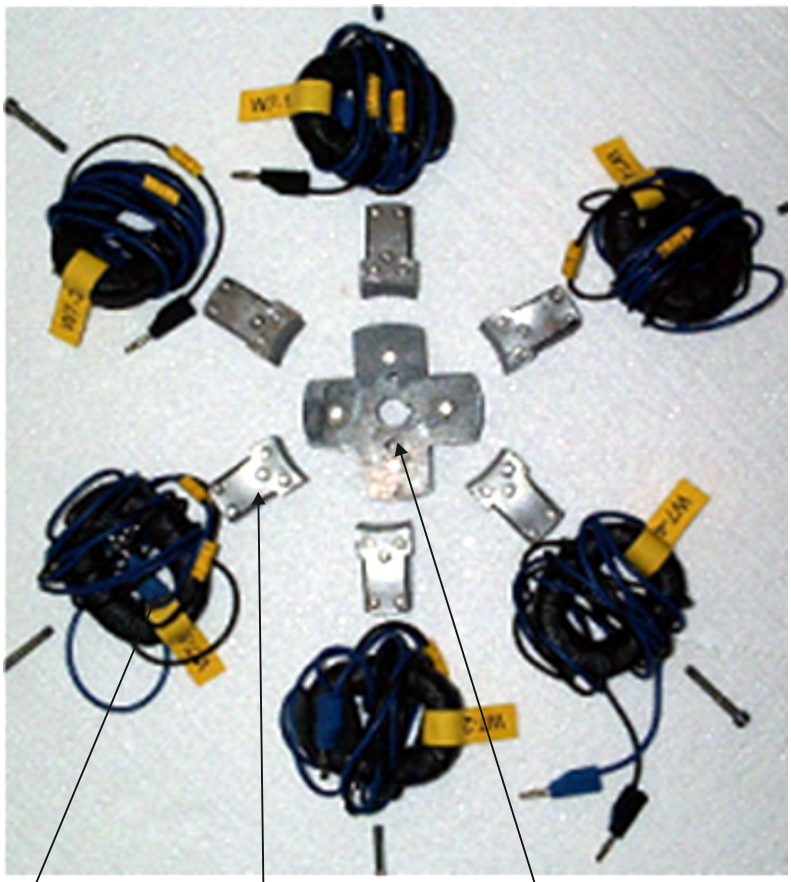
Continue...

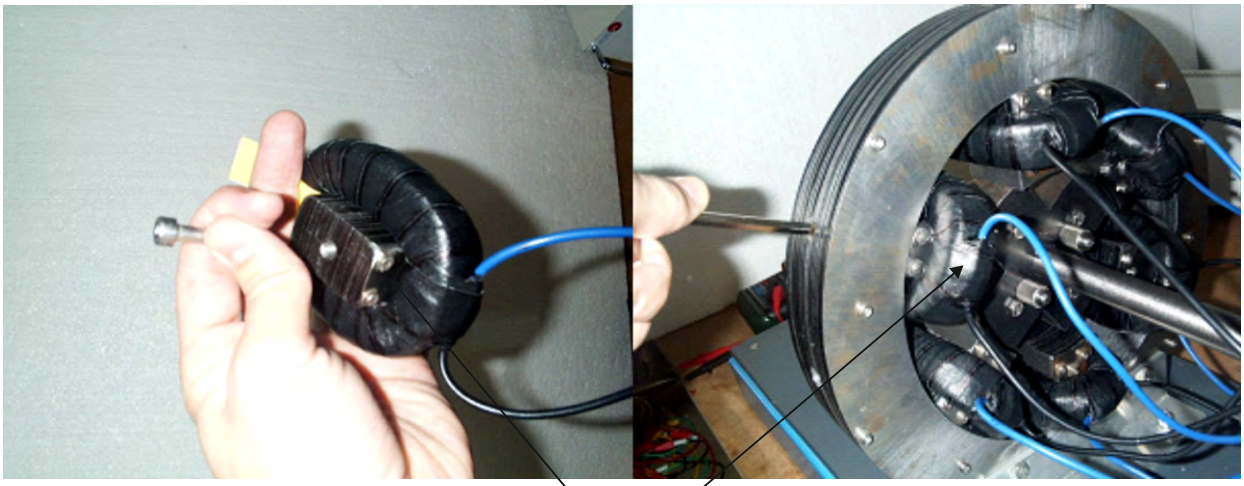
e) **AEL-EMT-KIT/MPP. Stepper Motor.**

The AEL-EMT-KIT/MPP has been designed to study stepper motors.

This Kit consists of a set of removable pieces assembled among them to make and operate a stepper motor.

The objective of this kit is to study the operation and different parts of a stepper motor. It includes a crosspiece rotor to make the shaft of the motor rotate through a rotating magnetic field controlled by a driver.





Mounting of poles and windings

AEL-EMT-KIT consists of:

a) AEL-EMT-KIT/B. Base Unit and common modules.

Kits:

b) AEL-EMT-KIT/AS. AC Asynchronous Induction Motors.

c) AEL-EMT-KIT/DC. DC Motors/Generators.

d) AEL-EMT-KIT/SMG. AC Synchronous Motors / Generators.

e) AEL-EMT-KIT/MPP. Stepper Motor.

f) Recommended Accessories.

a) **AEL-EMT-KIT/B. Base Unit and common modules.**

It includes:

- EMT-KIT/B. Base Unit:

  It is formed by:

  -Frame.
  -Support ring.
  -Bearings.
  -Shaft.
  -Axle bearings.
  -Other parts.

- EME/B. Electrical Machines Unit (Basic option).
- BRLA. Compass to observe the rotating magnetic field.
- TECNEL/TM. Optical Speed Meter.

  This meter is used to measure the rotation speed of electrical machines.

Recommended accessory:

- MUAD. Electric Power Data Acquisition System.

  It allows to monitor the waves shape of currents and voltages of electrical machines.

b) **AEL-EMT-KIT/AS. AC Asynchronous Induction Motors.**

It includes:

- Squirrel cage rotor.

  This element consists of a set of circular ferromagnetic sheets that make up the rotor of the induction machine. The squirrel cage, where electrical currents are induced, is inside.

- Crosspiece.

  Ferromagnetic element designed to distribute the magnetic fields of the machine stator in areas of minor reluctance, being able to simulate the behavior of an industrial reluctance motor.

- Stator.

  Slotted mechanical ferromagnetic element. Its aim is to hold the stator windings of the squirrel cage induction motor.

- Induction coils.

  These coils generate the rotating magnetic field of the three-phase induction motor, which can be configured to generate 2 or 4 poles.

Required modules:

- N-VVCA/M. AC Motor Speed Controller.

Recommended modules:

Measurement modules:

- N-MED22. AC Voltmeter (0-400 Vac).
- N-MED10. AC Ammeter (0-5 A).
- N-MED26. Frequency meter.

Recommended accessory:

- EAL. Network Analyzer Unit.

  This unit is used to perform analyses and measurements of the loads electrical parameters: Voltages, Currents, Active Power, Reactive Power, Apparent Power, Power Factor, and Frequency.

Continue...

c) AEL-EMT-KIT/DC. **DC Motors/Generators.**

This kit will be able to work in two different modes:

As a generator: the AEL-EMT-KIT/DC includes a drive motor or main energy source to work as a generator. It will make the DC generator turn to a velocity specified by the user. The excitation current of the generator can be controlled by a DC variable power supply or depending on the DC generator configuration (independent, in series, shunt, and compound), it can be auto-excited without the need of a DC variable source.

As a motor: to work as a motor, the user can control field and excitation currents depending on the configuration (independent, series, shunt and compound). Thus, apart from assembling the machine, both the velocity and torque of the machine can be controlled.

It includes:

- Rotor.

  This element consists of a set of ferromagnetic pieces that constitute the rotor of the two-pole synchronous generator. Such poles consist of sheets to reduce the parasitic currents of the machine.

- Commutator with segments.

  It is an essential element in this type of DC motors/generators DC, since its function is to transform the DC current it receives from the rotor winding into AC current. The user can control the current of the machine armature with a variable voltage supply (N-VVCC/M. DC Motor Speed Controller).

- Poles and interpoles.

  Ferromagnetic pieces located in the stator of the machine to generate the inductive magnetic field.

- Field winding.

  These windings generate the magnetic field of the DC motor. It includes a main winding and interpoles.

- Drive motor.

  When the AEL-EMT-KIT/DC works as a generator, a prime mover will make the DC machine rotate. The prime mover is controlled through a frequency variator that will allow the user to determine the turning rate of the generator.

Required modules:

- N-VVCA/M. AC Motor Speed Controller.
- N-VVCC/M. DC Motor Speed Controller. (2 units)
- N-REV. Variable Resistor. (2 units)

Recommended modules:

Measurement modules:

- N-MED17. DC Voltmeter (0-200 V). (2 units)
- N-MED05. DC Ammeter (0-1.5 A). (2 units)

Load module:

- N-REF. Resistor Load with commutator.

Continue...

d) AEL-EMT-KIT/SMG. **AC Synchronous Motors / Generators.**

It includes:

- Rotor.

  This element consists of a set of ferromagnetic pieces that constitute the rotor of the two-pole synchronous generator. Such poles consist of sheets to reduce the parasitic currents of the machine.

- Slip ring.

  The slip rings collector is an essential element in this type of synchronous generators, since its function is to excite the rotor of the machine by injecting a DC current. The user can control the excitation level of the machine through a variable voltage source (N-VVCC/M. DC Motor Speed Controlled).

- Stator.

  Slotted mechanical ferromagnetic element. Its aim is to hold the stator windings of the squirrel cage induction motor.

- Stator coils.

  These coils generate the electrical energy generated by the generator. 12 induction coils are configured in such a way that the result is a two pairs of poles generator.

- Induction coils.

  These coils generate the rotating magnetic field of the synchronous generator. 4 induction coils are configured to generate two pairs of magnetic poles that will induce the three-phase currents on the stator of the machine.

- Drive motor.

  Squirrel cage induction motor used to move the synchronous motor. This motor will enable to control the turning speed and mechanical power supplied to the synchronous generator.

Required modules:

- N-VVCA/M. AC Motor Speed Controller.
- N-VVCC/M. DC Motor Speed Controller.

Recommended modules:

Measurement modules:

- N-MED22. AC Voltmeter (0-400 Vac).
- N-MED10. AC Ammeter (0-5 A).
- N-MED26. Frequency meter.
- N-MED17. DC Voltmeter (0-200 V).
- N-MED05. DC Ammeter (0-1.5 A).

Load modules:

- N-REFT300. 300 Ohms Three-phase Fixed Resistor Module.
- N-CONT. Three-phase Variable Capacitor Load with commutator.

Continue...

e) AEL-EMT-KIT/MPP. **Stepper Motor.**

It includes:

- Crosspiece.

  This element includes a set of ferromagnetic pieces that make up the rotor of the DC motor.

- Poles.

  6 inductive poles geometrically located opposite each other to set a rotating magnetic field.

Required modules:

- N-VVCC/M. DC Motor Speed Controller.
- N-VVPP. Stepper Motor Controller. (manual and automatic control).

f) **Recommended Accessories.**

Optionally the AEL-EMT-KIT can be acquired with one of the following workbenches:

- AEL-WBR. Electrical Workbench (Rack).
- AEL-WBMG. Electrical Workbench (Mobile Big).
- AEL-WBMP. Electrical Workbench (Mobile Small).

EXERCISES AND PRACTICAL POSSIBILITIES

Some practical possiblities:

AEL-EMT-KIT/AS. AC Asynchronous Induction Motors:

1.- Recognition of the mechanical parts of a three-phase induction motor of squirrel cage.
2.- Construction of a three-phase induction motor of squirrel cage (2 pole), step by step.
3.- Construction of a three-phase induction motor of squirrel cage (4 pole), step by step.
4.- Measurement of the starting and running currents.
5.- Complete wiring of the stator wounds according to the electrical machines theory.

AEL-EMT-KIT/DC. DC Motors/Generators:

6.- Recognition of the mechanical parts of DC motors/generators .
7.- Construction of a DC shunt motor (with and without interpoles).
8.- Construction of a DC series motor (with and without interpoles).
9.- Construction of a DC compound motor (with and without interpoles).
10.- Construction of a DC shunt generator (with and without interpoles).
11.- Construction of a DC series generator (with and without interpoles).
12.- Construction of a DC compound generator (with and without interpoles).
13.- Construction of a DC separately excited generator (with and without interpoles).
14.- Complete wiring of all DC motors / generators according to theory.

AEL-EMT-KIT/SMG. AC Synchronous Motors / Generators:

15.- Recognition of the mechanical parts of synchronous motors/generators.
16.- Construction of a three-phase AC synchronous motor (2 pole).
17.- Construction of a three-phase AC synchronous generator (4 pole).
18.- Measurement of the current excitation.
19.- Measurement of the voltage generation in function of the speed of the generator.
20.- Measurement of the voltage generation in function of the current excitation.

AEL-EMT-KIT/MPP. Stepper Motor:

21.- Construction of a stepper motor.
22.- Speed control of the stepper motor.

REQUIRED SERVICES

- Electrical supply: three-phase, 380V./50Hz or 208V./60 Hz, 20 kW.

DIMENSIONS & WEIGHT

AEL-EMT-KIT:

-Dimensions: 1500 x 500 x 400 mm. approx.
(59.05 x 19.68 x 15.74 inches approx.)

-Weight: 40 Kg. approx.
(88.18 pounds approx.)

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

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REPRESENTATIVE: