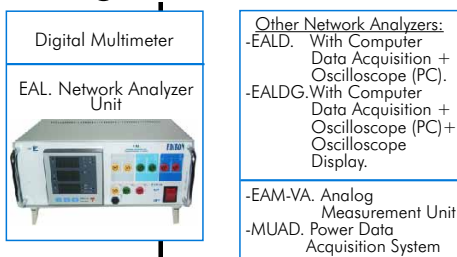


## Laboratory structure

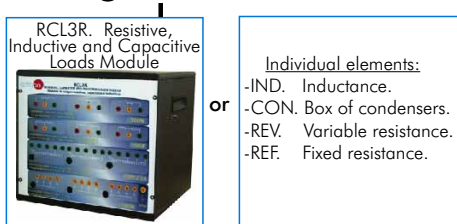
### ① Electrical Machines Units:



### ② Measurement Units



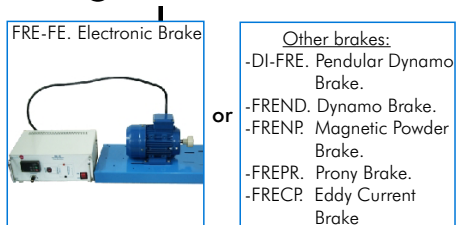
### ③ Loads:



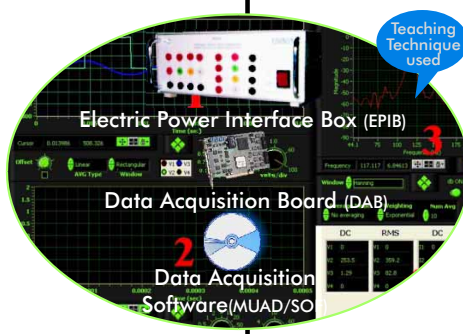
### ④ Motors:



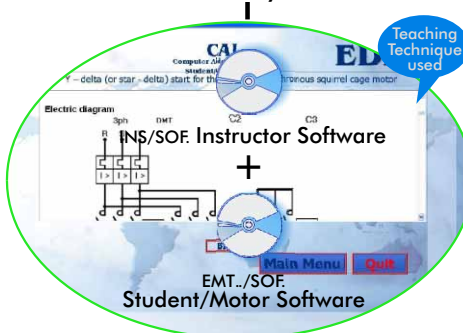
### ⑤ Brakes:



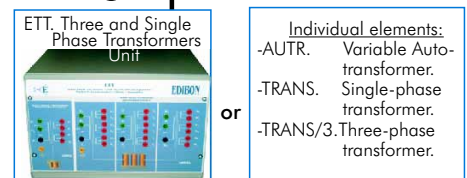
### ⑪ MUAD. Power Data Acquisition System



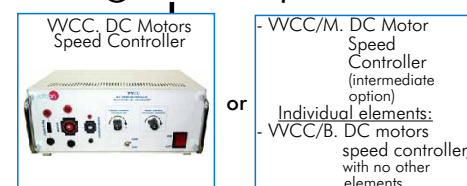
### ⑫ CAI. Computer Aided Instruction Software System



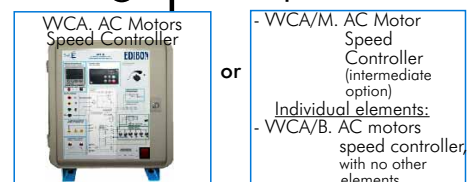
### ⑥ Transformers:



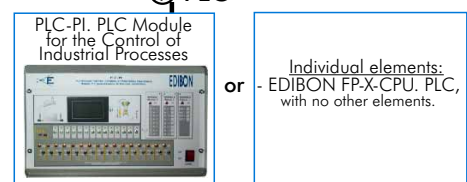
### ⑦ DC Motor Speed Control



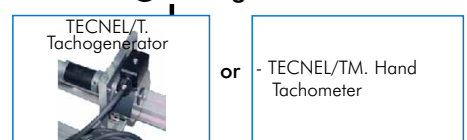
### ⑧ AC Motor Speed Control



### ⑨ PLC



### ⑩ Tachogenerator



## Complete configuration

### Main units:

- ① Common Electrical Machines Base Units.
- ② Measurement Units.
- ③ Loads.
- ④ Motors.
- ⑤ Brakes.

### Complementary possibilities:

- ⑪ MUAD. Power Data Acquisition System.
- ⑫ CAI. Computer Aided Instruction Software System.

\* MINIMUM CONFIGURATION: ① + ②

### Complementary elements:

- ⑥ Transformers.
- ⑦ DC Motor Speed Control.
- ⑧ AC Motor Speed Control.
- ⑨ PLC (Programmable Logic Controller).
- ⑩ Tachogenerator.

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## INTRODUCTION

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LIMEL, Electrical Machines Integrated Laboratory is a set of different elements that can be interconnected to form a complete learning and teaching center. From the minimum configuration to the most advanced one (always depending on the customer's choice) EDIBON offers a means of learning electric functions and those of its most useful appliances. This process is always carried out through real working devices.

Customer may choose the equipment that best adapt to her/his educational needs, always bearing in mind that all previously acquired elements are fully compatible and valid for future extensions.

EDIBON presents its range of products. We have divided them into main and complementary elements. As far as we are concerned, the main units constitute the basis for a good understanding of Electrical functions and equipment. The complementary elements help with a deeper knowledge on the subject, and EDIBON encourages to complement any laboratory configuration with MUAD and CAI systems, which have been designed to be the best teaching assistants.

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## DESCRIPTION

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### MAIN UNITS

#### ① Electrical Machines Units:

EDIBON presents three alternatives with increasing complexity and practical possibilities.

- **EME.** Electrical Machines Unit. It is a compact unit including the main electrical functions. It is EDIBON's most advanced option.
- **EME/M.** Electrical Machines Unit (intermediate option). Students can get a good grasp on the subject.
- **EME/B.** Electrical Machines Unit (basic option). It includes the most basic functions.

#### ② Measurement Units:

- **MULT.** Multimeter (simplest alternative).
- **EAL.** Network Analyzer Unit.
- **EALD.** Network Analyzer Unit, with Computer Data Acquisition.
- **EALDG.** Network Analyzer Unit, with Computer Data Acquisition + Oscilloscope (PC) + Oscilloscope Display.
- **EAM-VA.** Analog Measurement Unit.
- **MUAD.** Power Data Acquisition System. The most powerful data acquisition system and virtual instrumentation.

#### ③ Loads:

- **RCL3R.** Resistive, Inductive and Capacitive Loads Module. It is a compact box with resistive, capacitive and inductive loads already mounted and ready to use.
- Individual loads. As a basic alternative, customers may select independent loads to be integrated in the system by himself.

#### ④ Motors:

EDIBON has a selection of 21 different motors, covering almost every educational need.

#### ⑤ Brakes:

A brake should be considered a must-have in the laboratory, due to its applications with motors: torque measurement and speed control.

EDIBON offers 6 type of brakes:

- **FRE-FE.** Electronic Brake.
- **DI-FRE.** Pendular Dynamo Brake.
- **FREND.** Dynamo Brake.
- **FRENp.** Magnetic Powder Brake.
- **FREPR.** Prony Brake.
- **FRECP.** Eddy Current Brake.

### COMPLEMENTARY ELEMENTS

If we wished students to increase their knowledge on Electricity, it would be also recommended that they acquired some experience using the following devices.

#### ⑥ Transformers:

- **ETT.** Three-phase and single-phase Transformers Unit.
- **EMPTA.** Auxiliary Transformer and Protection Module.
- **TPPT.** Three-phase Power Transformer Unit.
- Individual Elements (variable auto-transformer, single-phase transformer and three-phase transformer).

#### ⑦ DC Motor Speed Control:

- **VVCC.** DC Motors Speed Controller.
- **VVCC/M.** DC Motor Speed Controller (intermediate option).

#### ⑧ AC Motor Speed Control:

- **VVCA.** AC Motors Speed Controller.
- **VVCA/M.** AC Motor Speed Controller (intermediate option).

#### ⑨ PLC. Programmable Logic Controller:

The PLC is a device for real time control of sequential processes in an industrial environment.

In this case, EDIBON has developed:

- **PLC-PI.** PLC Module for the Control of Industrial Processes. It is a module for controlling the Electrical Machines Unit "EME"

#### ⑩ Tachogenerator:

For measuring the motor speed.

### COMPLEMENTARY POSSIBILITIES:

EDIBON has designed and developed these two utilities to extract the maximum from the electric equipment.

#### ⑪ MUAD. Power Data Acquisition System:

Data acquisition system and virtual instrumentation.

EDIBON has developed this unique data acquisition interface, link between the equipment and PC, for an adequate visualization of the results yielded by the equipment.

These components together (hardware + Windows based software) makes the computer work as a virtual oscilloscope, with all its features and applications.

Includes:

- Hardware: MUAD. Data Acquisition Interface Box + DAB. Data Acquisition Board.
- Software. Data Acquisition and Virtual Instrumentation Software.

#### ⑫ CAI. Computer Aided Instruction Software System:

The best help in classroom for both teacher and students.

Includes:

- **INS/SOF.** INSTRUCTOR SOFTWARE. Classroom Management Software Package (Teacher software). Only one package is needed per classroom. Helps creating databases, reports and statistical comparisons among many more features.
- **EMT./SOF.** STUDENT SOFTWARE. Computer Aided Instruction Software Packages. Each Motor has its own package. Gives the students the proper assistance on theoretical knowledge as well as in practice, presenting exercises and questions.

## ① Electrical Machines Units

### 1.1) EME. Electrical Machines Unit (advanced option)

#### DESCRIPTION

The Electrical Machines Unit (EME) is a compact and robust box for the study of the main electrical functions. In its front side, you find standard electrical functions, divided in sections, for a better visualization of the different applications. In EME, you have all the main panels you need for analyzing an electrical machine, as measuring devices, supply systems, management systems, protection systems, synchronism and rectification systems, etc.  
This unit is prepared for working to a maximum power of 1 KW and all the components are located within a compact box.

#### SPECIFICATIONS

**Metallic box. Diagram in the front panel.**

Different modules included in the EME unit:

**-Connection terminals module:**

Connection terminals of three-phase: R, S and T and supply neutral with the corresponding signaling lamps which indicate the voltage.

There are 4 terminals in each phase.

Signaling lamp which will light up when the three-phase sequence is correct.

This module also has a signaling lamp and fuse, corresponding to the internal supply of the unit.

**-Operation module:**

3 Running switches.

3 Stop switches.

3 Three-pole contactors, power A, B and C, with control circuit in alternating current. Each contactor has 2 auxiliary terminals (NC) and 3 auxiliary terminals (NO).

3 Lamps that will light when the contactors are started.

2 Timing relays.

Indicating lamps.

**-Protection module:**

Thermal Magnetic Circuit Breaker.

Thermal relay.

3 Power contacts.

2 auxiliary contacts (NO and NC).

Signaling lamp.

**-Synchronizing and rectification module:**

3 lamps, as well as the inlet terminals for the three-phases with signaling for indicating its correct sequence.

One phase bridge rectifier, with 2 fuses with their corresponding fusion lamps.

**-Contactors module:**

3 Power takes, and the selected position closes the corresponding contact in the three phases.

**-Possibility of assemblies of control circuits with delay.**

\* Minimum recommended measurement units: (see Section "2")

2 Digital multimeters.

Recommended measurement units: (see Section "2")

EAL. Network Analyzer Unit.



EME

#### REQUIRED SERVICES

-Electrical supply: Three-phase with neutral and ground, 380V.

#### DIMENSIONS AND WEIGHT

-Dimensions: 490 x 450 x 470mm. approx.

-Weight: 50 Kg. approx.

#### PRACTICAL POSSIBILITIES

Some Practical Possibilities of the Unit:

The D.C. Machine (with motors EMT 1/2/3/4/5/15)

- 1.- Preparation, regulation and inversion in a dynamo with independent excitation.
  - 2.- The dynamo characteristic curve without load.
  - 3.- Dynamos with series and shunt excitation.
  - 4.- Dynamo external characteristic curve.
  - 5.- Dynamo characteristic regulation curve.
  - 6.- Speed variation, inversion and stop of D.C. motor with independent excitation.
  - 7.- Speed-armature current characteristic curves in a D.C. motor with shunt or independent excitation.
  - 8.- Torque-current characteristic curve in a D.C. motor with shunt or independent excitation.
  - 9.- Torque-speed characteristic curve in a D.C. motor with shunt or independent excitation.
  - 10.- Speed-excitation current characteristic curves in a D.C. motor with independent or shunt excitation. Operation in constant power.
  - 11.- Speed control at constant torque.
  - 12.- Series D.C. motor: starting, speed variation, inversion and braking.
  - 13.- Speed-intensity characteristic curve in a D.C. motor with series excitation.
  - 14.- Torque-current characteristic curve in a D.C. motor with series excitation.
  - 15.- The D.C. motor with series excitation as universal motor.
- The Synchronous Machine (with motor EMT 6)
- 16.- Starting, voltage and frequency regulation in a three-phase alternator.
  - 17.- Net coupling of a three-phase alternator.
  - 18.- Characteristic curve of an alternator without load.
  - 19.- Characteristic curve of an alternator in short circuit.
  - 20.- Characteristic curve of an alternator with load.
  - 21.- Synchronous motor starting.
- The Asynchronous Machine (with motors EMT 7/8/9/10/11/16/17).
- 22.- Morley diagrams.
  - 23.- Starting process of a three-phase asynchronous motor with rotor in short circuit.

- 24.- Test without load of an asynchronous motor with rotor in short circuit.
- 25.- Test with load of a three-phase asynchronous motor with rotor in short circuit.
- 26.- Starting of a three-phase asynchronous motor with the wound rotor.
- 27.- Test without load of a three-phase asynchronous motor with the wound rotor.
- 28.- Test with load of a three-phase asynchronous motor with wound rotor.
- 29.- Starting and turn sense inversion of a single-phase motor with capacitor.
- 30.- Test without load of a single-phase asynchronous motor.
- 31.- Test in load of the single-phase motor.
- The Universal motor (with motor EMT 12)
- 32.- The Universal motor with D.C. supply.
- 33.- Speed-current characteristic of an Universal motor with D.C. supply.
- 34.- Torque-intensity characteristic in the D.C. Universal motor.
- 35.- The universal motor with A.C. supply.
- The Repulsion motor (with motor EMT 14)
- 36.- Starting and inversion of a single-phase repulsion motor.
- 37.- Test of a single-phase repulsion motor without load.
- 38.- Test of a single-phase asynchronous repulsion motor in A.C.
- The Brushless motor (with motor EMT 18)
- 39.- Brushless motor starting.
- 40.- Speed control and change of the turn sense.
- The Dahlander motor (with motor EMT 9)
- 41.- Dahlander motor starting.
- 42.- Different working speeds.
- 43.- Changing the different speeds of Dahlander motor while working.
- The Stepper motor (with motor EMT 19)
- 44.- Stepper motor starting.
- 45.- Steps control.
- 46.- Rotation sense change.
- The Reluctance motor (with motor EMT 21)
- 47.- Star connection of the reluctance motor.
- 48.- Delta connection of the reluctance motor.
- 49.- Revolution sense and inversion of rotation.

## 1.2) EME/M. Electrical Machines Unit (Intermediate option)

### SPECIFICATIONS

Metallic box. Diagram in the front panel.  
Thermal Magnetic Circuit Breaker.  
Two double switches (1 NO + 1 NC in each one)  
Push Button (1 NC + 1 NO).  
Three contactors with 2 NO and 1 NC.  
DC supply 200 V dc with fuses.  
Connection Key  
Emergency stop push button.

\* Minimum recommended measurement units: (see Section "2")  
2 Digital multimeters.  
Recommended measurement units: (see Section "2")  
EAL. Network Analyzer Unit.

### REQUIRED SERVICES

-Electrical supply: Three-phase with neutral and ground, 380V.

### DIMENSIONS AND WEIGHT

-Dimensions: 490 x 330 x 310 mm. approx. -Weight: 25 Kg. approx.

### PRACTICAL POSSIBILITIES

Some Practical Possibilities of the Unit:

#### The D.C. Machine:

- 1.- Preparation, regulation and inversion in a dynamo with independent excitation.
- 2.- The dynamo characteristic curve without load.
- 3.- Dynamos with series and shunt excitation.
- 4.- Dynamo external characteristics curve.
- 5.- Characteristic regulation curve of a dynamo.
- 6.- Speed control at constant torque.
- 7.- Series D.C. motor: starting, speed variation, inversion and braking.

#### The Synchronous Machine:

- 8.- Starting, voltage and frequency regulation in a three-phase alternator.
- 9.- Characteristic curve of an alternator without load.
- 10.- Characteristic curve of an alternator in short circuit.
- 11.- Characteristic curve of an alternator with load.
- 12.- Synchronous motor starting.

#### The Asynchronous Machine:

- 13.- Morley diagrams.
- 14.- Starting process of a three-phase asynchronous motor with rotor in short circuit.
- 15.- Test without load of an asynchronous motor with rotor in short circuit.
- 16.- Test with load of a three-phase asynchronous motor with rotor in short circuit.

- 17.- Starting and turn sense inversion of a single-phase motor with capacitor.
- 18.- Test without load of a single-phase motor.
- 19.- Test in load of the single-phase motor.

#### The Universal motor:

- 20.- The universal motor with D.C. supply.
- 21.- Speed-current characteristic of an Universal motor with D.C. supply.
- 22.- Torque-intensity characteristic in the D.C. Universal motor.
- 23.- The Universal motor with A.C. supply.

#### The Repulsion motor:

- 24.- Starting and inversion of a single-phase repulsion motor.
- 25.- Test of a single-phase repulsion motor without load.
- 26.- Test of a single-phase asynchronous repulsion motor in A.C.

#### The Brushless motor:

- 27.- Brushless motor starting.
- 28.- Speed control and change of the turn sense.

#### The Dahlander motor:

- 29.- Dahlander motor starting.
- 30.- Different working speeds.

#### The Reluctance motor:

- 31.- Star connection of the reluctance motor.
- 32.- Delta connection of the reluctance motor.
- 33.- Revolution sense and inversion of rotation.



EME/M

## 1.3) EME/B. Electrical Machines Unit (Basic option)

### SPECIFICATIONS

Metallic box.  
Diagram in the front panel.  
Thermal Magnetic Circuit Breaker.  
DC supply 200 V dc with fuses.  
Connection Key.  
Emergency stop push button.  
Two push buttons (1 NO + 1 NC).

\* Minimum recommended measurement units: (see Section "2")  
2 Digital multimeters.  
Recommended measurement units: (see Section "2")  
EAL. Network Analyzer Unit.

### REQUIRED SERVICES

-Electrical supply: Three-phase with neutral and ground, 380V.

### DIMENSIONS AND WEIGHT

-Dimensions: 300 x 180 x 120 mm. approx. -Weight: 5 Kg. approx.

### PRACTICAL POSSIBILITIES

Some Practical Possibilities of the Unit:

#### The D.C. Machine:

- 1.- Preparation, regulation and inversion in a dynamo with independent excitation.
- 2.- Dynamos with series and shunt excitation.
- 3.- Speed control at constant torque.
- 4.- Series D.C. Motor: starting, speed variation, inversion and braking.

#### The Asynchronous Machine:

- 5.- Starting process of a three-phase asynchronous motor with rotor in short circuit.
- 6.- Test without load of an asynchronous motor with rotor in short circuit.

#### The Universal motor:

- 7.- The Universal motor with D.C. supply.



EME/B



## ② Measurement Units

### DESCRIPTION

The measurement units let us extract information from the experimental unit (EME), thus allowing further process of the data. We can get values of currents, voltages, resistance, etc. for further analysis.

### 2.1) MULT. Digital Multimeter

#### SPECIFICATIONS

Digital multimeter.  
Voltage and current meter.  
Resistances and capacitors.

\*Two units are needed to complete the practices.

### 2.2) Network Analyzer:

#### 2.2.1) EAL. Network Analyzer Unit

##### SPECIFICATIONS

This unit shows the main electric parameters on the electric network through the interface and an parameter selection.

**Metallic box.**

**Diagram in the front panel.**

**3 current inputs, for series intensity.**

**3 voltage terminals, for each phase measure (R,S,T) and another one for the neutral connection.**

**Control and visualization digital display.**

**Voltage:** Range 20 - 500 Vrms. Prec.:  $\pm 0.5\%$ . Phase to phase - Phase to neutral.

**Current:** Range 0.02 - 5 Arms. Prec.:  $\pm 0.5\%$ .

**Frequency:** Range 48 to 62 Hz.  $\pm 0.1$ Hz.

**Power:** Active, Reactive and Apparent. Range 0.01 to 9900 kW. Prec.:  $\pm 1\%$ .

**Power Factor:** Power Factor for each phase and average. Range -0.1 to + 0.1. Prec.:  $\pm 1\%$ .

**Operating temperature** 0 to +50°C.



EAL

##### REQUIRED SERVICES

- Power supply: 220 V. - 110 V, single -phase + ground.

##### DIMENSIONS & WEIGHT

- Dimensions: 300 x 180 x 120 mm. approx.

- Weight: 3 Kg. approx.

#### 2.2.2) EALD. Network Analyzer Unit, with Computer Data Acquisition

##### SPECIFICATIONS

This unit shows the main electric parameters on the electric network through the interface and an parameter selection.

**Metallic box.**

**Diagram in the front panel.**

**3 current inputs, for series intensity.**

**3 voltage terminals for each phase measure (R,S,T) and another one for the neutral connection.**

**Control and visualization digital display.**

**Voltage:** Range 20 - 500 Vrms. Prec.:  $\pm 0.5\%$ . Phase to phase - Phase to neutral.

**Current:** Range 0.02 - 5 Arms. Prec.:  $\pm 0.5\%$ .

**Frequency:** Range 48 to 62 Hz.  $\pm 0.1$ Hz.

**Power:** Active, Reactive and Apparent. Range 0.01 to 9900 kW. Prec.:  $\pm 1\%$ .

**Power Factor:** Power Factor for each phase and average. Range -0.1 to + 0.1. Prec.:  $\pm 1\%$ .

**Operating temperature** 0 to +50°C.

**Connection RS232 to computer (PC).**

**Data Acquisition Software.**



EALD

##### REQUIRED SERVICES

- Power supply: 220 V. - 110 V, single phase + ground.

##### DIMENSIONS & WEIGHT

- Dimensions: 300 x 180 x 120 mm. approx.

- Weight: 3 Kg. approx.

### 2.2.3) EALDG. Network Analyzer Unit, with Computer Data Acquisition + Oscilloscope (PC) + Oscilloscope Display.

#### SPECIFICATIONS

This unit shows the main electric parameters on the electric network through the interface and an parameter selection.

Steel box. Diagram in the front panel.

3 current inputs, for series intensity.

3 voltage terminals for each phase measure (R,S,T) and another one for the neutral connection.

Control and visualization digital display and oscilloscope display.

Voltage: Range 20 - 500 Vrms. Prec.:  $\pm 0.5\%$ . Phase to phase - Phase to neutral.

Current: Range 0.02 - 5 Arms. Prec.:  $\pm 0.5\%$ .

Frequency: Range 48 to 62 Hz.  $\pm 0.1$  Hz.

Power: Active, Reactive and Apparent. Range 0.01 to 9900 kW. Prec.:  $\pm 1\%$ .

Power Factor: Power Factor for each phase and average. Range -0.1 to +0.1. Prec.:  $\pm 1\%$ .

Operating temperature 0 to +50°C.

Connection RS232 to computer (PC).

Data Acquisition Software.



EALDG

#### REQUIRED SERVICES

- Power supply: 220 V. - 110 V, single phase + ground.

#### DIMENSIONS & WEIGHT

- Dimensions: 300 x 180 x 120 mm. approx.

- Weight: 3 Kg. approx.

### 2.3) EAM-VA. Analog Measurement Unit

#### DESCRIPTION

This unit allows to analyze the different voltages and currents involved in a circuit through a simple frontal panel that includes analog measurement instruments.

#### SPECIFICATIONS

Metallic box.

4 Voltmeters.

- A.C. Measuring Instruments with moving iron.
- Voltmeter with measuring range from 0 to 500Vac.
- Horizontal scale with precision grade of 1.5 (following norm BS89/IEC51).

2 Ammeters.

- A.C. Measuring Instruments with moving iron.
- Ammeter with measuring range of 0 to 5A.
- Horizontal scale with precision grade of 1.5 (following norm BS89/IEC51).

2 Analog inputs for each meter.

#### DIMENSIONS & WEIGHT

- Dimensions: 490 x 330 x 310 mm. approx.

- Weight: 40 Kg. approx.



EAM-VA

### 2.4) MUAD. Power Data Acquisition System (See "Section 11")



## 3.1) RCL3R. Resistive, Inductive and Capacitive Loads Module

### DESCRIPTION

When you brake an electrical machine, the electrical energy has to be dissipated. Loads provide this function, the dissipation of energy. Depending on the experiment, the dissipating load has to be resistive, inductive or capacitive. EDIBON recommends having the three kinds, if a good understanding on the subject is pursued.

Our Resistive, Capacitive and Inductive Loads Module (RCL3R) offers:

- Single and Three-phase resistances.
- Single and Three-phase inductances.
- Single and Three-phase capacitors.

### SPECIFICATIONS

Metallic box.

Diagram in the front panel.

Variable resistive loads:  $3 \times [150 \Omega (500 W)]$ .

Fixed resistive loads:  $3 \times [150 \Omega (500 W) + 150 \Omega (500 W)]$ .

Inductive loads:  $3 \times [0, 33, 78, 140, 193, 236 \text{ mH}] (230V / 2 A)$

Capacitive loads:  $3 \times [4 \times 7 \mu F] (400V)$



RCL3R

### DIMENSIONS & WEIGHT

- Dimensions: 490 x 450 x 470 mm. approx.
- Weight: 30 Kg. approx.

## 3.2) Individual elements:

### DESCRIPTION

When a simpler and cheaper option is preferred when studying the use of loads in electrical machines, EDIBON gives the choice of acquiring single components. They are offered as single independent components to be mounted by the student. They can be purchased separately in any desired amount.

### SPECIFICATIONS

IND. **Inductance:**

- From 33 to 236 mH, or similar.

CON. **Box of Condensers:**

- $7 \mu F$  or similar.

REV. **Variable Resistance:**

- $0-150 \Omega (500W)$ , or similar.

REF. **Fixed Resistance:**

- $150 \Omega (500W)$ , or similar.



IND



CON



REV



REF

## DESCRIPTION

EDIBON has a wide range of electric motors, trying to give an alternative to every educational need.

The motors supplied include connectors, couplings, standard motor support, etc.

## SPECIFICATIONS

### EMT1. **D.C. Independent excitation motor-generator:**

Power: 250-300W. Speed: 3000 r.p.m.  $V_{excitation}$ : 190 V.D.C.  $I_{Excitation}$  nominal: 0.3A.  $V_{Armature}$ : 200V D.C.  $I_{Armature}$  nominal: 1.5A.

### EMT2. **D.C. Series excitation motor-generator:**

Power: 250-300W. Speed: 3000 r.p.m.  $V_{excitation}$ : 220 V.D.C.  $I_{Excitation}$  nominal: 0.3A.  $V_{Armature}$ : 200V D.C.  $I_{Armature}$  nominal: 1.5A.

### EMT3. **D.C. Shunt excitation motor-generator:**

Power: 250-300W. Speed: 3000 r.p.m.  $V_{excitation}$ : 190 V.D.C.  $I_{Excitation}$  nominal: 0.3A.  $V_{Armature}$ : 200V D.C.  $I_{Armature}$  nominal: 1.5A.

### EMT4. **D.C. Compound excitation motor-generator:**

Power: 250-300W. Speed: 3000 r.p.m.  $V_{excitation}$ : 200 V.D.C.  $I_{Excitation}$  nominal: 0.3A.  $V_{Armature}$ : 200V D.C.  $I_{Armature}$  nominal: 1.5A.

### EMT5. **D.C. Shunt-series compound excitation motor:**

Power: 250-300W. Speed: 3000 r.p.m.  $V_{excitation}$ : 220 V.D.C.  $I_{Excitation}$  nominal: 0.3A.  $V_{Armature}$ : 200V D.C.  $I_{Armature}$  nominal: 1.5A.

### EMT6. **A.C. Synchronous alternator motor:**

Power: 250-300W. Speed: 3000 r.p.m. Frequency: 50Hz. Connections: Star/triangle.  $V_{excitation}$  nominal: 220V D.C.  $I_{Excitation}$  nominal: 0.59A.  $V_{Armature}$ : 3x220/380V.

### EMT7. **Asynchronous Three-phase motor of squirrel cage:**

Power: 250-300W. Speed: 2769 r.p.m. (50Hz), 3330 r.p.m. (60Hz). Connections: Star/triangle. Frequency: 50/60 Hz.  $V_{Armature}$ : 230/400V (50Hz), 250/440V (60Hz).  $I_{Armature}$  nominal: 1A-0.7A.

### EMT8. **Asynchronous Three-phase motor with wound rotor:**

Power: 300W. Speed: 1413 r.p.m. Frequency: 50Hz.  $V_{Armature}$ : 230/400V.  $I_{Armature}$  nominal: 1A-0.7A.

### EMT9. **Dahlander three-phase (two-speeds):**

Power: 350W. Speed: 2780/1390 r.p.m. Frequency: 50Hz. Voltage: 3 x 380 Vac.

### EMT10. **Asynchronous Three-phase motor of two independent speeds:**

Power: 250-375W. Frequency: 50Hz. Voltage: 3 x 380 Vac.

### EMT11. **Asynchronous Single-phase motor with starting capacitor:**

Power: 370W. Speed: 2800 r.p.m. Frequency: 50Hz.  $V_{Armature}$ : 230V.  $I_{Armature}$  nominal: 1.5A.

### EMT12. **Universal motor (single-phase):**

Power: 4-8W. Speed: 480/14000 r.p.m. Frequency: 50Hz.  $V_{Armature}$ : 230/240V.

Some available motors:



EMT1



EMT2



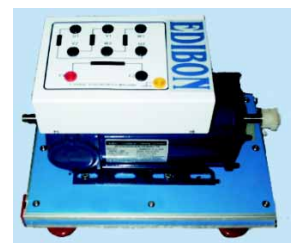
EMT3



EMT4



EMT5



EMT6



EMT7



EMT8



EMT9



EMT10



EMT11



EMT12

Continue...



## SPECIFICATIONS

### EMT14. **Repulsion motor, single-phase with short-circuited brushes:**

Power: 250W. Speed:  $\pm 3000$  r.p.m. Frequency: 50Hz. V.Armature.: 220/240V.  
I.Armature nominal: 2.7/3A.

### EMT15. **D.C. Permanent magnet motor:**

Power: 100W. Speed: 4000 r.p.m. Maximum terminal voltage: 100V.

### EMT16. **Asynchronous single-phase motor with starting and running capacitor:**

Power: 250W. Speed: 2800 r.p.m. Frequency: 50 Hz. V.Armature: 230V.

### EMT17. **Three-phase motor of squirrel cage with "Y" connection:**

Power: 250W. Speed: 2760 r.p.m. Frequency: 50 Hz. V.Armature: 3 x 380 Vac.  
I.Armature nominal: 2.3-1.3A.

### EMT18. **D.C. Brushless motor:**

Power: 80W. Speed: 4100 r.p.m. V.Armature: 24V D.C., with controller.

### EMT19. **Stepper motor:**

Various models from 50Ncm to 1000Ncm.

Note: Available as OPTIONAL: Stepper Motor Drive (VPP), Velocity Control for stepper motor (VPP/B) and a PLC for doing Position Control Practices with this motor.

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

Power: 350W. Speed: 3450 r.p.m. Frequency: 60Hz. V.Armature: 115/230V. I.Armature nominal: 3.5-2A.

### EMT21. **Three-phase Reluctance motor:**

Three-phase. 380 V. Power: 200W. Speed: 3000 r.p.m. Frequency: 50 Hz.

### EMT22. **Single-phase Shaded Pole motor:**

Power: 34W. Speed: 1350/1550 r.p.m. Frequency: 50/60Hz. Voltage: 230/240 Vac.

#### OPTIONAL for working with EMT19. Stepper Motor:

##### - VPP. **Stepper Motor Drive:**

- Running speed control: 4000 r.p.m.
- Base speed control: 3000 r.p.m.
- Full/half step.
- Direction: clockwise/counterclockwise.
- Single-phase: 220V - 110V.

##### - VPP/B. **Velocity Control for stepper motor:**

Metallic box.

Front panel:

- DC input + ground connection.
- ON/OFF switch.
- +A/-A, +B/-B, +C/-C connections with 3 fuses.
- 6-position selector with stop and 5 speeds.

Electrical supply required: 220 V a.c. - 110 V a.c., single phase + ground.

Dimensions: 300 x 180 x 120 mm. approx. Weight: 3 Kg. approx.

Some available motors:



EMT14



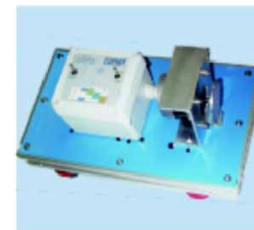
EMT15



EMT16



EMT17



EMT19



EMT20



VPP/B

PRACTICAL POSSIBILITIES

Some Practical Possibilities:

The D.C. Machine (with motors EMT 1/2/3/4/5/15)

- 1.- Preparation, regulation and inversion in a dynamo with independent excitation.
- 2.- The dynamo characteristic curve without load.
- 3.- Dynamos with series and shunt excitation.
- 4.- Dynamo external characteristic curve.
- 5.- Dynamo characteristic regulation curve.
- 6.- Speed variation, inversion and stop of D.C. motor with independent excitation.
- 7.- Speed-armature current characteristic curve in a D.C. motor with shunt or independent excitation.
- 8.- Torque-current characteristic curve in a D.C. Motor with shunt or independent excitation.
- 9.- Torque-speed characteristic curve in a D.C. Motor with shunt or independent excitation.
- 10.- Speed-excitation current characteristic curve in a D.C. Motor with independent or shunt excitation. Operation in constant power.
- 11.- Speed control at constant torque.
- 12.- Series D.C. Motor: starting, speed variation, inversion and braking.
- 13.- Speed-intensity characteristic curve in a D.C. Motor with series excitation.
- 14.- Torque-current characteristic curve in a D.C. Motor with series excitation.
- 15.- The D.C. Motor with series excitation as universal motor.

The Synchronous Machine (with motor EMT 6)

- 16.- Starting, voltage and frequency regulation in a three-phase alternator.
- 17.- Net coupling of a three-phase alternator.
- 18.- Characteristic curve of an alternator without load.
- 19.- Characteristic curve of an alternator in short circuit.
- 20.- Characteristic curve of an alternator with load.
- 21.- Synchronous motor starting.

The asynchronous Machine (with motors EMT 7/8/9/10/11/16/17)

- 22.- Morley diagrams.
- 23.- Starting process of a three-phase asynchronous motor with rotor in short circuit.
- 24.- Test without load of an asynchronous motor with rotor in short circuit.
- 25.- Test with load of a three-phase asynchronous motor with rotor in short circuit.
- 26.- Starting of a three-phase asynchronous motor with the wound rotor.
- 27.- Test without load of a three-phase asynchronous motor with the wound rotor.
- 28.- Test with load of a three-phase asynchronous motor with wound rotor.
- 29.- Starting and turn sense inversion of a single-phase motor with capacitor.
- 30.- Test without load of a single-phase motor.
- 31.- Test in load of the single-phase motor.

The Universal motor (with motor EMT 12)

- 32.- The universal motor with D.C. Supply.
- 33.- Speed-current characteristic of an Universal motor with D.C. Supply.
- 34.- Torque-intensity characteristic in the D.C. Universal motor.
- 35.- The universal motor with A.C. Supply.

The repulsion motor (with motor EMT 14)

- 36.- Starting and inversion of a single-phase repulsion motor.
- 37.- Test of a single-phase repulsion without load.
- 38.- Test of a single-phase asynchronous repulsion motor with A.C.

The Brushless motor (with motor EMT 18)

- 39.- Brushless motor starting.
- 40.- Speed control and change of the turn sense.

The Dahlander motor (with motor EMT 9)

- 41.- Dahlander motor starting.
- 42.- Different working speeds.
- 43.- Changing the different speeds of Dahlander motor while working.

The Stepper motor (with motor EMT 19)

- 44.- Stepper motor starting.
- 45.- Steps control.
- 46.- Rotation sense change.

The Reluctance motor (with motor EMT 21)

- 47.- Star connection of the reluctance motor.
- 48.- Delta connection of the reluctance motor.
- 49.- Revolution sense and inversion of rotation.

The importance of Brakes comes when we want to adjust the motor speed, measure the torque given, or stop the motor. EDIBON encourages selecting one of the following brakes.

### 5.1) FRE-FE. **Electronic Brake**

#### SPECIFICATIONS

This unit is based in two elements:

1.- Module -metallic box:

Power supply: 1 phase, 200-240V.

Rated output capacity: 0.75 KW.

Output frequency range: 0.2 to 400 Hz.

Display to visualize voltage (V), Current (A), and Frequency (Hz).

Brake resistance included.

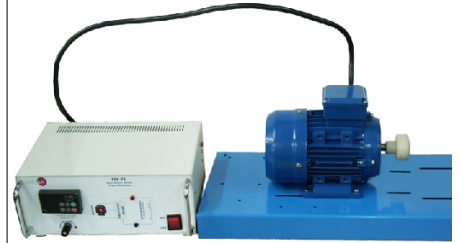
Torquemeter.

R.p.m. Meter.

Connectors.

2.- Braking motor mounted on a bench-support.

Connection wire between elements "1" and "2".



FRE-FE

#### REQUIRED SERVICES

- Electrical supply: 220 V a.c. - 110 V a.c., single - phase + ground.

### 5.2) DI-FRE. **Pendular Dynamo Brake**

#### SPECIFICATIONS

Power: 250-300W.

V.Excitation: 190 V.D.C. I.Excitation nominal: 0.3A.

V.Armature: 200 V.D.C. I.Armature nominal: 1.5A.

Torque measured with lever and weights, by combining the mechanical torque and electrical torque.

Security connectors.

Bench-support.



DI-FRE

#### REQUIRED SERVICES

- Electrical supply: 200 Vdc.

Available Accesory for working with DI-FRE:

### EMCC. **Load Cell Module**

#### SPECIFICATIONS

Metallic box.

Front panel:

Connector for cable to the load cell.

ON/OFF switch.

Digital display/Force N.

Connection cable.

Load cell.

#### REQUIRED SERVICES

- Power supply: 220 V. - 110 V, Single-phase + ground.

#### DIMENSIONS & WEIGHT

- Dimensions: 300 x 180 x 120 mm. approx.      - Weight: 2 Kg. approx.



EMCC

### 5.3) FREN. Dynamo Brake

#### SPECIFICATIONS

Power: 250-300W.

V.Excitation: 190 V.D.C. I.Excitation nominal: 0.3A.

V.Armatore: 200 V.D.C. I.Armatore nominal: 1.5A.

Connectors.

Bench - support.



FREN

#### REQUIRED SERVICES

- Electrical supply: 200 Vdc.

### 5.4) FREN. Magnetic Powder Brake

#### SPECIFICATIONS

The FREN is a unit designed for the study of a magnetic powder brake. The unit consists of a magnetic powder brake and a control module.

The control module allows setting the nominal torque of the brake through a potentiometer. It has two terminals to measure a voltage in direct proportion to the current supplied to the brake, therefore, to the exerted torque.

The unit also includes a fuse and a thermal relay to avoid eventual damages due to a over-intensity and/or to a over-temperature.

Max. power: 400 W, limited at 220W. Voltage: 24 Vac. Max. torque: 5 Nm. Max. R.P.M.: 3000.

It is equipped with temperature probe to stop the braking action (the motor would stay free).



FREN

#### REQUIRED SERVICES

- Electrical supply: 220 V a.c. - 110 V a.c.

### 5.5) FREPR. Prony Brake

#### SPECIFICATIONS

Prony brake with resistant ribbon.

Mechanical braking action and dynamometer.

Max. Power: 500W.

Max. Torque: 4Nm.

Max. R.P.M.: 3000.

Max. Time: 30 seconds.



FREPR

### 5.6) FRECP. Eddy Current Brake

#### SPECIFICATIONS

Max. Power: 500 W.

Voltage: 120 Vdc.

Max. Torque: 3Nm.

Max. R.P. M.: 3000.



FRECP



## ⑥ Transformers

### 6.1) ETT. Three-phase and Single-phase Transformers Unit

#### SPECIFICATIONS

Metallic box. Diagram in the front panel.

##### Single-phase transformer:

Nominal power: 500 VA.

Transformation ratio: 400 / 230 V.

Inlets: 400 V and 230 V (in the primary).

Number of secondary coils: 2.

Output voltage in the secondary: 115 (each one).

Maximum current in the primary: 1.5 A (for each voltage of 400 V). 3 A (for each voltage of 230 V).

##### Three-phase transformer in pillars:

Nominal power: 1000 VA.

Transformation ratio: 380/3 x 127 V.

Inlets: 220 V and 380 V (in the primary).

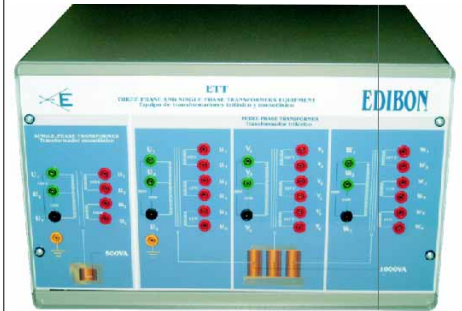
Outlet voltage in the secondary: 3 x 127 V (each phase).

Maximum current in the primary: 2 A (for a voltage of 380 V). 2 A (for a voltage of 220 V).

Connection modes:

Primary: Star, triangle.

Secondary: Star, triangle, zig-zag, six-phase and triple star.



ETT

#### REQUIRED SERVICES

Electrical supply:

For Single-phase transformer: 400-230 V / 50 Hz. or 60 Hz.

For Three-phase transformer: 380-220 V / 50 Hz. or 60 Hz.

#### DIMENSIONS & WEIGHT

- Dimensions: 490 x 330 x 310 mm. approx.

- Weight: 40 Kg. approx.

#### PRACTICAL POSSIBILITIES

- |  |  |
|--|--|
| 1. Measurement of the transformation ratio.                  | circuit.   |
| 2. Rehearsal of a single-phase transformer in open circuit.  | 6. Rehearsal of a three-phase transformer in short circuit.        |
| 3. Rehearsal of a single-phase transformer in short circuit. | 7. Autotransformer tests.  |
| 4. Rehearsal of a single-phase transformer in load           | 8. Connection modes tests: Star/delta/Zig-Zag/6-phase/triple star. |
| 5. Rehearsal of a three-phase transformer in open            | 9. Transformer ratio variation tests.                              |

### 6.2) TPPT. Three- phase Power Transformer Unit

#### SPECIFICATIONS

The "TPPT" unit is formed by a metallic box, which contains a three-phase power transformer. In the front panel of the box are located the terminals for both primary and secondary terminals for different power supply inputs and outputs. In the backside are located the fuses to protect the transformer.

Diagram in the front panel.

Power: 1000 VA.

##### Module 1: Primary winding

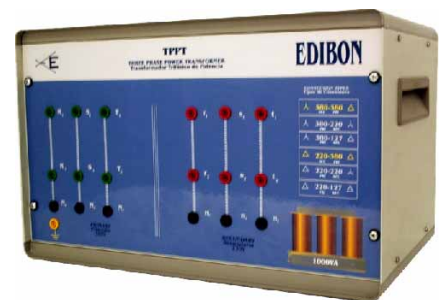
It is located at the left side of front panel. It includes a three-phase winding which can be connected externally in either star or triangle, each phase winding has a neutral terminal, a 146V a.c. intermediate terminal and 220V a.c. terminal.

##### Module 2: Secondary winding

It is located at the right side of the front panel. It includes a three-phase winding which can be connected externally in either star or triangle. Each phase winding has a neutral terminal, a 127V a.c. intermediate terminal and a 220V a.c. terminal.

This unit can be used to make 6 different a.c. connection types:

- Star (380V.) - Triangle (380V.).
- Star (380V.) - Star (220V.).
- Star (380V.) - Triangle (127V.).
- Triangle (220V.) - Triangle (380V.).
- Triangle (220V.) - Star (220V.).
- Triangle (220V.) - Triangle (127V.).



TPPT

#### REQUIRED SERVICES

Electrical supply: 380 - 220 V.

#### DIMENSIONS & WEIGHT

- Dimensions: 490 x 330 x 310 mm. approx.

- Weight: 30 Kg. approx.

## ⑥ Transformers (continuation)

### 6.3) EMPTA. Auxiliary Transformer and Protection Module

#### SPECIFICATIONS

Metallic Box.

Diagram in the front panel.

Input and output connectors.

Thermal magnetic unit 16 A., 2 poles.

Differential 25 A., 30 mV., 230 V.

Reversible auto-transformer 125-220 (1000 VA).

Conversion from 127V. 60Hz to 220V. 50Hz.

Conversion from 220V. 50Hz to 127V. 60Hz.

Differential electrical protection.

Thermal magnetic protection.

Required services: Input: 220V. 50Hz or 127V. 60Hz.



EMPTA

#### REQUIRED SERVICES

Electrical supply: 220 V a.c. - 127 V a.c.

#### DIMENSIONS & WEIGHT

- Dimensions: 300 x 120 x 190 mm. approx.
- Weight: 3Kg. approx.

#### PRACTICAL POSSIBILITIES

1. Conversion from 127V/60Hz to 220V/50Hz
2. Conversion from 220V/50Hz to 127V/60Hz
3. Differential electrical protection
4. Thermal magnetic protection

### 6.4) Individual elements:

#### SPECIFICATIONS

AUTR. Variable Auto-transformer.

TRANS. Single-phase transformer.

Input and output connectors.

Single phase transformer, 400 V a.c. - 230 V a.c., 400 VA.

Ground connector.



TRANS

TRANS/3. Three-phase transformer.

Input and output connectors.

Three phase transformer, 400 V a.c. - 230 V a.c., 1000 VA.



TRANS/3

## ⑦ DC Motor Speed Control

### 7.1) WVCC. DC Motor Speed Controller

#### DESCRIPTION

This unit varies the speed of a DC motor for control applications. It works with any DC motor available.

#### SPECIFICATIONS

Metallic box.

Front panel including:

- Excitation connection (2 connectors).
- Rotor connection (2 connectors).
- Tachodynamo connection (2 connectors).
- Parameters self adjustment (torque control and speed control):
  - Motor torque regulator.
  - Motor speed regulator.
- State leds indicators.
- START/STOP speed controller switch.
- ON/OFF main switch.

Maximum power: 550W.

Maximum torque: 2.6 Nm

Speed range: 130-2000 r.p.m.

Besides the motor speed controller, all the indicators, connecting cables and additional components are included.



WVCC

#### REQUIRED SERVICES

- Electrical supply: 220 V a.c. - 110 V a.c., single-phase + ground.

#### DIMENSIONS & WEIGHT

- Dimensions: 300 x 120 x 190 mm. approx. - Weight: 10 Kg. approx.

#### PRACTICAL POSSIBILITIES

1. Motor parameters adjustment
2. Working at a certain frequency.
3. Starting carrying out by defined ramp.
4. Braking possibility until a certain speed and recovery.

### 7.2) WVCC/M. DC Motor Speed Controller (intermediate option)

#### SPECIFICATIONS

This unit consists in a variable transformer followed by a rectifier bridge and an anti-ripple capacitor with a resistor to get discharged.

Metallic box.

Regulated voltage output up to  $\approx 320$  Vdc.

Maximum current output 2 A.

Front panel including:

- Connections:
  - Positive, negative and ground connections.
- ON/OFF switch.

The top side of the unit include a wheel to adjust the DC output voltage up to  $\approx 320$  Vdc.



WVCC/M

#### REQUIRED SERVICES

- Electrical supply: 220 V a.c. - 110 V a.c. , single-phase + ground.

#### DIMENSIONS & WEIGHT

- Dimensions: 300 x 120 x 190 mm. approx. - Weight: 3 Kg. approx.

### 7.3) Individual elements:

#### SPECIFICATIONS

WVCC/B. DC motors speed controller, with no other elements.

Maximum power: 550W.

Maximum torque: 2.6 N.m.



WVCC/B

## ⑧ AC Motor Speed Control

### 8.1) VVCA. AC Motor Speed Controller

#### DESCRIPTION

This is a unit for varying the speed of an AC motor for control applications. It works with any AC motor available.

#### SPECIFICATIONS

This unit enables to change the speed of an asynchronous motor, obtaining features which characterize a direct current motor. It consists basically on a rectifying phase coupled to another inverter phase, with a capacitor in parallel between them. By varying the shooting frequency of the IGBT, we obtain an alternating output at a variable frequency which is applied to the asynchronous motor.

**Metallic box.**

**Circuit diagram in front panel.**

It has a control panel in order to introduce the parameters of the motor that is going to be used and the output frequency.

In addition, through it, we can carry out several programming.

The unit also has a series of terminals where we connect the digital and analog inputs and the relay and transistor outputs.

**Maximum power: 750 W.**

**Parameter self adjustment.**

**Analog/digital parameter inlets through panel. Turn inversion while running.**

**Analog parameter visualization.**

**Voltage Input**

Frequency set according to external command: up to 50Hz. Reversible operation using +/- signal: 0 to +/-10 V. PID control. Input resistance: 22 K $\Omega$ .

**Current input**

Frequency set according to the analog input current command: up to 50 Hz. Reversible operation: 20 to 4mA. PID control. Input resistance: 250 Ohms.

**5 Digital inputs that can be configured by the user. 1 outlet to alarm relay.**

**2 transistor internal outlets**

Maximum load current: 50 mA. Leak current at OFF: 0.1 mA

**Speed range: 130-2000 r.p.m.**

Besides the motor speed controller, all the indicators, connecting cables and additional components are included.



VVCA

#### REQUIRED SERVICES

- Electrical supply: 220 V a.c. - 110 V a.c., single-phase + ground.

#### DIMENSIONS & WEIGHT

- Dimensions: 600 x 600 x 150 mm. approx. - Weight: 30 Kg. approx.

#### PRACTICAL POSSIBILITIES

- |  |                                       |
|--|---------------------------------------|
| 1.- Motor parameters adjustment.                                     | 5.- Display of analog output.         |
| 2.- Working at a frequency given by the panel.                       | 6.- Digital inputs configuration.     |
| 3.- Working at a frequency given by an analog input (potentiometer). | 7.- Outputs from alarm to relay.      |
| 4.- Turn inversion.  | 8.- Outputs from alarm to transistor. |

### 8.2) VVCA/M. AC Motor Speed Controller (intermediate option)

#### SPECIFICATIONS

This unit consist in a simple AC motor speed controller.

**Metallic box.**

**Output: 3 PH, 3.0 KVA, 220 V, 1-50 Hz., 8.0 A.**

**Overload current thermal protection.**

**ON/OFF switch.**

It has two blocks in the front panel:

**Speed control:**

Start/Stop switch.

Speed control potentiometer.

**Connections to motor:**

Three-phase connection to AC motor.

Ground connection.



VVCA/M

#### REQUIRED SERVICES

- Electrical supply: 220 V a.c. - 110 V a.c., single-phase + ground.

#### DIMENSIONS & WEIGHT

- Dimensions: 300 x 120 x 190 mm. approx. - Weight: 3 Kg. approx.

### 8.3) Individual elements:

#### SPECIFICATIONS

**VVCA/B. AC motors speed controller**, with no other elements.

Frequency from 0 to 60Hz.



VVCA/B



## ⑨ PLC (Programmable Logic Controller)

The Programmable Logic Controller is a device designed for real time control of sequential processes in an industrial environment. In this case, EDIBON has developed this PLC module for controlling the Electrical Machines Unit "EME"

### 9.1) PLC-PI. PLC Module for the Control of Industrial Processes

#### SPECIFICATIONS

This module has been designed for the Control of Industrial Processes. The application has been developed to be used with any individual electric machine.

#### PLC-PI. Unit:

Metallic box.

Circuit diagram in the front panel.

Front panel:

**Digital inputs(X) and Digital outputs (Y) block:**

16 Digital inputs, activated by switches and 16 LEDs for confirmation (red).

14 Digital outputs (through SCSI connector) with 14 LEDs for message (green).

**Analog inputs block:**

16 Analog inputs (-10V. to + 10V.) (through SCSI connector).

**Analog outputs block:**

4 Analog outputs (-10V. to + 10V) (through SCSI connector).

**Touch screen:**

High visibility and multiple functions.

Display of a highly visible status.

Dimensions: 110 x 72 mm.

Recipe function. Bar graph function. Flow display function.

Alarm list.

Multi language function.

True type fonts.

Back panel:

Power supply connector. 2 A Fuse. RS-232 connector to PC.

Inside:

Power supply outputs: 24 Vdc, 12 Vdc, -12 Vdc, 12 Vdc variable.

**Panasonic PLC:**

High-speed scan of 0.32  $\mu$ sec. for a basic instruction.

Program capacity of 32 Ksteps, with a sufficient comment area.

Free input AC voltage (100 to 240 VAC).

DC input: 16 (24 VDC).

Relay output: 14 (250 VAC/2 A).

Volume input: 2.

Equipped with a USB communication port.

High-speed counter.

Multi-point PID control.

Digital inputs/outputs and analog inputs/outputs Panasonic modules.

RS232 Communication wire, to computer (PC).

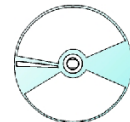
#### PLC-SOF. PLC Control Software:

The software package is always included with the PLC-PI unit, since it is the necessary application to program the PLC-PI from the computer.



PLC-PI

+



PLC-SOF

#### DIMENSIONS & WEIGHT

-Dimensions: 490 x 330 x 310 mm.

-Weight: 30 Kg. approx.

#### REQUIRED SERVICES

-Electrical supply: single-phase, 220 V. - 110 V.

-Computer (PC).

#### PRACTICAL POSSIBILITIES

- |   |  |
|---|--|
| <ol style="list-style-type: none"> <li>1.- Control of the particular unit process through the control interface box without the PC.</li> <li>2.- PID control.</li> <li>3.- Visualization of all the sensors values used in the particular unit process.</li> <li>4.- Calibration of all sensors included in the particular unit process.</li> <li>5.- Hand on of all the actuators involved in the particular unit process.</li> <li>6.- Realization of different experiments, in automatic way, without having in front the particular unit. (This experiment can be decided previously).</li> <li>7.- Simulation of outside actions, when there are not any hardware element present.</li> <li>8.- PLC hardware general use and manipulation.</li> <li>9.- PLC process application for the particular unit.</li> <li>10.- PLC structure.</li> </ol> | <ol style="list-style-type: none"> <li>11.- PLC inputs and outputs configuration.</li> <li>12.- PLC configuration possibilities.</li> <li>13.- PLC program languages.</li> <li>14.- PLC different programming standard languages (ladder diagram (LD), structures text (ST), instructions list (IL), sequential function chart (SFC), function diagram (FBD).</li> <li>15.- New configuration and development of new process.</li> <li>16.- Hand on an established process.</li> <li>17.- Visualization of results and comparisons with the particular unit process.</li> <li>18.- Possibility if creating new process in relation with the particular unit process.</li> <li>19.- PLC Programming exercises.</li> <li>20.- Own PLC applications in accordance with teacher and student requirements.</li> </ol> |
|---|--|

## ⑨ PLC (continuation)

### 9.2) Individual Elements:

**EDIBON FP-X-CPU. PLC**, with no other elements

#### SPECIFICATIONS

**Inputs: 8.**

**Input Commons: 1.**

**Output: 6.**

Output type: Relay 2A/pt Max 4.5A/common.

**Output commons: 4.**

Cassette Expansion: 2.

**Execution time: 0.32µs** on basic instruction sets. Super fast for high level instruction sets, including Floating point math.

Prog. mem. type: Flash ROM built-in (no battery backup required).

Program memory: 16KW.

Data memory: 12,285.

Document memory: 64KW and IEC1131 source code.

Retentive data: All registers with optional battery (AFPX-BATT).

Timer/Counter: 1024.

Bit memory: 4096.

**Dimension (w, h, d): 60 x 90 x 79mm.**

**High Speed Counter:** Single phase: 8ch, total 80KHz (max. 10KHz / channel). Counter range: -2, 147, 483,648 to +2,147,483,647 (each).

Interrupt: 8 input interrupt X0 to X7. Constant time interrupt (0.5ms to 30sec). Interrupt subroutine jump time: 10 micro sec.

**PID:** PID algorithm (with auto tuning). I-PD algorithm (with auto tuning). 10ms cycle to 100s cycle.

Prog port: MEWTOCOL. Default 9600bps, software configurable to 115.2Kbps. Modem communication support (Slave mode only). Master slave MEWTOCOL communication (up to 99 station).

Secondary port/ third port: Requires optional cassette. Master to master communication (Floating master), up to 16 stations. MEWTOCOL, ASCII mode, Binary mode software selectable. 300, 600, 1200, 2400, 4800, 9600, 19200bps, 38.4Kbps, 57.6Kbps. 115.2Kbps. Modem communication support (Slave mode and dial out).

Floating point: Trigonometric, log, root, and more instructions.

Others: Step ladder : 1000 steps. Subroutine: 100 subroutines. Jumps/Loops: 256 labels. Master Control Relay: 256 points. Index: 14 pointers (I0 to, ID).

Battery Back up: 55 word can be backed up without battery. Optional battery.

Volume pots: 2 points.

Calendar time clock: Optional.



EDIBON FP-X-CPU

## ⑩ Tachogenerator

### 10.1) TECNEL/T. Tachogenerator

#### DESCRIPTION

The Tachogenerator, as a speed transducer, provides a means of converting the rotational speed into an analog voltage signal. Thus, it is mainly used for measuring the motor speed. The TECNEL/T is an automatic unit, that could be permanently connected to the main rotor.

#### SPECIFICATIONS

Output voltage gradient: 30 +/- 3% V / 1000 r.p.m.

#### REQUIRED SERVICES

- Electrical supply: continuous d.c. output 0-100 V.

#### DIMENSIONS & WEIGHT

- Dimensions: 200 x 150 x 50 mm. approx.  
- Weight: 1 Kg. approx.



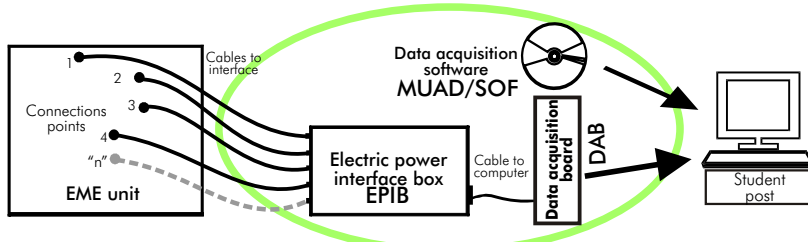
TECNEL/T

### 10.2) TECNEL/TM. Hand Tachogenerator

#### DESCRIPTION

This is a hand optical tachogenerator. It cannot be attached to the motor, what implies that the measurements have to be taken manually.

## ⑪ MUAD. Power Data Acquisition System



MUAD is the perfect link between the EME unit and the PC. MUAD is a continuous data acquisition system with virtual instrumentation, that measures, analyzes and represents the parameters involved in the process. MUAD allows voltage and current acquisition and measurement, data processing, frequency spectrum and all the functions of a digital oscilloscope. We easily connect the Electric Power Interface Box (EPIB) to the EME unit with the supplied cables (there are several connection points placed for it). The EPIB is connected to the PC through the Data Acquisition Board (DAB), and by using the Virtual Instrumentation Software, the student can get results from the undertaken experiment/practice, see them on the screen and work with them.

MUAD System includes EPIB + DAB + MUAD/SOF:

1) Hardware :

1.1) **EPIB. Electric power interface box** (dimensions: 300 x 120 x 180 mm. approx.):

Interface that carries out the conditioning of the diverse signals that can be acquired in a process, for their later treatment and visualisation.

Front panel separated in two: left-hand part for VOLTAGE sensors, and right-hand part for CURRENT sensors.

- 8 analog input channels.
- 4 Tension sensors AC/DC, 400V.
- Sampling range: 250 KSPS (Kilo samples per second).
- 4 Current sensors.



EPIB

+

1.2) **DAB. Data acquisition board :**

PCI Data acquisition board (National Instruments) to be placed in a computer slot. Bus PCI.

**Analog input:**

Number of channels= 16 single-ended or 8 differential.

Resolution=16 bits, 1 in 65536.

Sampling rate up to: 250 KSPS (Kilo samples per second).

Input range (V)= $\pm 10V$ .

Data transfers=DMA, interrupts, programmed I/O.

Number of DMA channels=6.

**Analog output:**

Number of channels=2.

Resolution=16 bits, 1 in 65536.

Maximum output rate up to: 833 KSPS.

Output range(V)= $\pm 10$ .

Data transfers=DMA, interrupts, programmed I/O.

**Digital Input/Output:**

Number of channels=24 inputs/outputs.

D0 or DI Sample Clock frequency: 0 to 1 MHz.

**Timing: Counter/timers=2.**

Resolution: Counter/timers: 32 bits.



DAB

+

2) **MUAD/SOF. Data acquisition software :**

Data Acquisition Software with Graphic Representation:

Amicable graphical frame.

Compatible with actual Windows operating systems.

Configurable software allowing the representation of temporal evolution of different signals.

Visualization of circuit tensions on the computer screen.

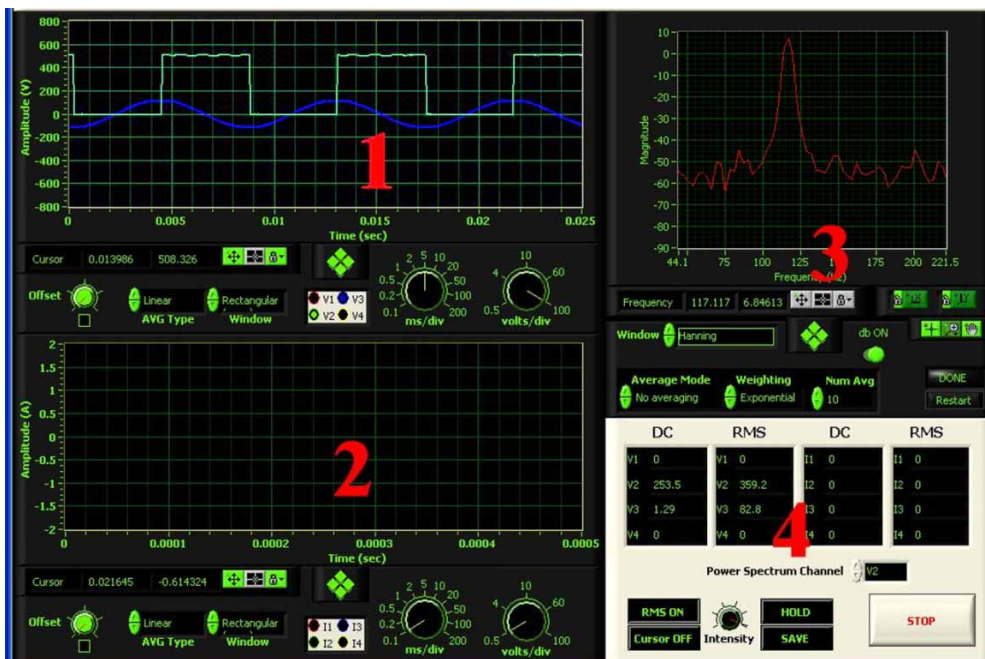
Sampling rate up to 250 KS/s (Kilo samples per second) guaranteed.

\* Software is available in English and Spanish. Any other language available on request.



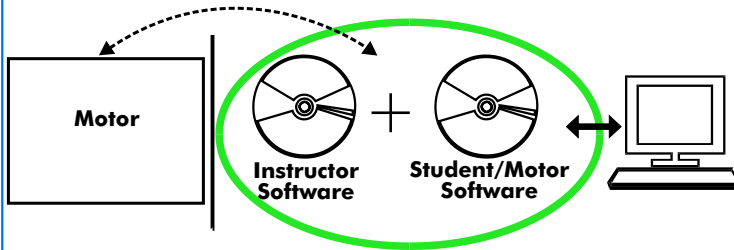
MUAD/SOF

Software Main Screen



- 1.- Voltage channels section
- 2.- Current channels section
- 3.- Power spectrum section
- 4.- General control panel section

## 12 CAI. Computer Aided Instruction Software System



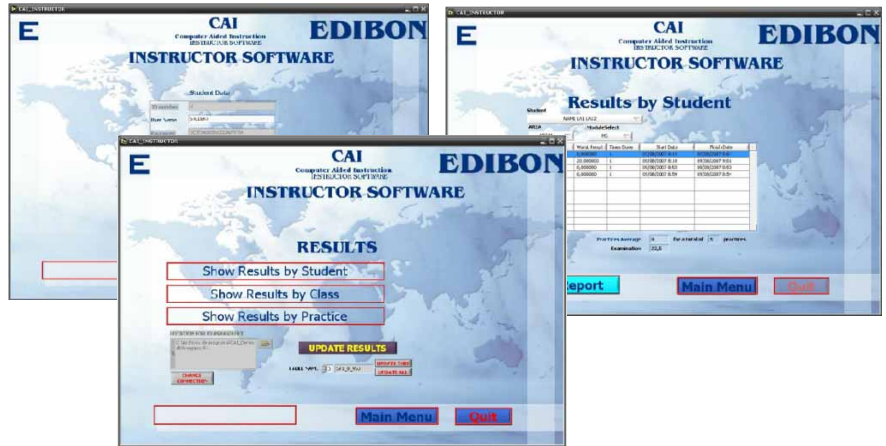
With no physical connection between motor and computer, this complete package consists on an Instructor Software (INS/SOF) totally integrated with the Student Software (EMT../SOF). Both are interconnected so that the teacher knows at any moment what is the theoretical and practical knowledge of the students. These, on the other hand, get a virtual instructor who helps them to deal with all the information on the subject of study.

This complete system includes INS/SOF + EMT../SOF.

With the INS/SOF. Classroom Management Software Package (Instructor Software), the Teacher has a whole range of options, among them:

- Organize Students by Classes and Groups.
- Create easily new entries or delete them.
- Create data bases with student information.
- Analyze results and make statistical comparisons.
- Print reports.
- Develop own examinations.
- Detect student's progress and difficulties.
- ...and many other facilities.

The Instructor Software is the same for all the motors, and working in network configuration, allows controlling all the students in the classroom.



### EMT../SOF. Computer Aided Instruction Software Packages (Student Software)

Explains how to use the motor and run the experiments and what to do at any moment.

Each motor has its own Student Software package.

- The options are presented by pull-down menus and pop-up windows.
- Each Software Package contains:

**Theory:** that gives the student the theoretical background for a total understanding of the studied subject.

**Exercises:** divided by thematic areas and chapters to check out that the theory has been understood.

**Guided Practices:** presents several practices to be done, alongside the motors, showing how to complete the circuits and get the right information from them.

**Exams:** set of questions presented to test the knowledge obtained.



#### Available Student Software Packages:

- |   |  |
|---|--|
| -EMT1/SOF. DC Independent excitation motor-generator.                   | -EMT14/SOF. Repulsion motor, single-phase with short-circuited brushes.          |
| -EMT2/SOF. DC Series excitation motor-generator.                        | -EMT15/SOF. DC Permanent magnet motor.   |
| -EMT3/SOF. DC Shunt excitation motor-generator.                         | -EMT16/SOF. Asynchronous single-phase motor with starting and running capacitor. |
| -EMT4/SOF. DC Compound excitation motor-generator.                      | -EMT17/SOF. Three-phase motor of squirrel cage with "Y" connection.              |
| -EMT5/SOF. DC Shunt-series compound excitation motor.                   | -EMT18/SOF. DC Brushless motor.  |
| -EMT6/SOF. AC Synchronous alternator motor.                             | -EMT19/SOF. Stepper motor.   |
| -EMT7/SOF. Asynchronous three-phase motor with squirrel cage.           | -EMT20/SOF. Asynchronous single-phase motor with split phase.                    |
| -EMT8/SOF. Asynchronous three-phase motor with wound rotor.             | -EMT21/SOF. Three-phase Reluctance motor.  |
| -EMT9/SOF. Dahlander three-phase (two-speeds).                          | -EMT22/SOF. Single-phase Shaded Pole motor.                                      |
| -EMT10/SOF. Asynchronous three-phase motor with two independent speeds. |  |
| -EMT11/SOF. Asynchronous single-phase motor with starting capacitor.    |  |
| -EMT12/SOF. Universal motor (single-phase).                             |  |

\* Both Instructor Software and Student Software are available in English and Spanish. Any other language available on request.

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

REPRESENTATIVE:



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