Integrated Laboratory for Electrical Machines

LIMEL

Laboratory structure

① Electrical Machines Units

EME. Electrical Machines Unit
(Advanced option)

EME/M. Electrical Machines Unit
(Intermediate option)

EME/B. Electrical Machines Unit
(Basic option)

② Measurement Units

MULT. Digital Multimeter

EAL. Network Analyzer Unit (AC)

or

Other Network Analyzers:
- EALD. with Computer Data Acquisition.
- EALDG. with Computer Data Acquisition + Oscilloscope Display.
- EAL-DC. Network Analyzer Unit (DC).

- EAM-VA. Analog Measurement Unit.
- MUAD. Electric Power Data Acquisition System.

③ Loads

RCL3R. Resistive, Inductive and Capacitive Loads Module

or

Individual elements:
- IND. Inductance Module.
- CON. Capacitors Module.
- REV. Variable Resistance Module.
- REV-T. Three-phase Variable Resistance Module.
- REF. Fixed Resistance Module.

④ Motors

⑤ Brakes

FRE-FE. Electronic Brake

or

- DI-FRE. Pendular Dynamo Brake.
- FREND. Dynamo Brake.
- FRENP. Magnetic Powder Brake.
- FREPR. Prony Brake.
- FRECP. Eddy Current Brake.

⑪ CAI. Computer Aided Instruction Software System

Teaching Technique used

INS/SOF. Instructor Software
+
EMT../SOF. Student/Motor Software

⑫ CAL. Computer Aided Learning Software (Results Calculation and Analysis)

COMPUTED AIDED LEARNING

Teaching Technique used

⑬ MUAD. Electric Power Data Acquisition System

Teaching Technique used

EPIB. Electric Power Interface Box
+
DAB. Data Acquisition Board
+
MUAD/SOF. Data Acquisition Software

PC

⑥ Transformers

ETT. Three-phase and single-phase Transformers Unit

or

- TPPT. Three-phase Power Transformer Unit.
- EMPTA. Auxiliary Transformer and Protection Module.
- AUTR. Variable Auto-Transformer.
Individual elements:
- TRANS. Single-phase Transformer.
- TRANS/3. Three-phase Transformer.

⑦ DC Motor Speed Control

VVCC. DC Motor Speed Controller

or

- VVCC/M. DC Motor Speed Controller (intermediate option).
Individual elements:
- VVCC/B. DC Motor Speed Controller, with no other elements.

⑧ AC Motor Speed Control

VVCA. AC Motor Speed Controller

or

- VVCA/M. AC Motor Speed Controller (intermediate option).
Individual elements:
- VVCA/B. AC Motor Speed Controller, with no other elements.

⑨ PLC

PLC-PI. PLC Module for the Control of Industrial Processes

or

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

⑩ Tachogenerator

TECNEL/T. Tachogenerator

or

- TECNEL/TM. Hand Tachometer.

Complete configuration

Main units:
① Electrical Machines Units.
② Measurement Units.
③ Loads.
④ Motors.
⑤ Brakes.

Additional possibilities:
⑪ CAI. Computer Aided Instruction Software System.
⑫ CAL. Computer Aided Learning Software (Results Calculation and Analysis).
⑬ MUAD. Electric Power Data Acquisition System.

* MINIMUM CONFIGURATION: ① + ②

Additional elements:
⑥ Transformers.
⑦ DC Motor Speed Control.
⑧ AC Motor Speed Control.
⑨ PLC (Programmable Logic Contoller).
⑩ Tachogenerator.

INTRODUCTION

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

GENERAL DESCRIPTION

MAIN UNITS

① **Electrical Machines Units:**
   EDIBON presents three alternatives with increasing complexity and practical possibilities.
   - **EME**. Electrical Machines Unit (Advanced option). It is a compact unit including the main electrical functions.
   - **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.** Digital Multimeter (simplest alternative).
   - **EAL.** Network Analyzer Unit (AC).
   - **EALD.** Network Analyzer Unit, with Computer Data Acquisition.
   - **EALDG.** Network Analyzer Unit, with Computer Data Acquisition + Oscilloscope Display.
   - **EAL-DC.** Network Analyzer Unit (DC).
   - **EAM-VA.** Analog Measurement Unit.
   - **MUAD.** Electric 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 elements. As a basic alternative, customers may select independent loads to be integrated in the system:
   - **IND.** Inductance Module.
   - **CON.** Capacitors Module.
   - **REV.** Variable Resistance Module.
   - **REV-T.** Three-phase Variable Resistance Module.
   - **REF.** Fixed Resistance Module.

④ **Motors:**
   EDIBON has a selection of 24 different motors, covering almost every educational need.

   Motors (D.C.):
   - **EMT1.** D.C. Independent excitation motor-generator.
   - **EMT2.** D.C. Series excitation motor-generator.
   - **EMT3.** D.C. Shunt excitation motor-generator.
   - **EMT4.** D.C. Compound excitation motor-generator.
   - **EMT5.** D.C. Shunt-series excitation motor-generator.
   - **EMT12.** Universal motor (single-phase).
   - **EMT15.** D.C. Permanent magnet motor.
   - **EMT18.** D.C. Brushless motor.
   - **EMT19.** Stepper motor.

   Motors (A.C.):
   - **EMT6.** A.C. Synchronous three-phase motor alternator.
   - **EMT6B.** Permanent magnets synchronous three-phase generator (24 Vac).
   - **EMT7.** Asynchronous three-phase motor of squirrel cage.
   - **EMT7B.** Asynchronous three-phase motor of squirrel cage (4 poles).
   - **EMT7C.** Asynchronous three-phase motor of squirrel cage (8 poles).
   - **EMT8.** Asynchronous three-phase motor with wound rotor.
   - **EMT9.** Dahlander three-phase (two-speeds).
   - **EMT10.** Asynchronous three-phase motor of two independent speeds.
   - **EMT11.** Asynchronous single-phase motor with starting capacitor.
   - **EMT12.** Universal motor (single-phase).
   - **EMT14.** Repulsion motor, single-phase with short-circuited brushes.
   - **EMT16.** Asynchronous single-phase motor with starting and running capacitor.
   - **EMT17.** Three-phase motor of squirrel cage with "Y" connection.
   - **EMT20.** Asynchronous single-phase motor with split phase.
   - **EMT21.** Three-phase reluctance motor.
   - **EMT22.** Single-phase shaded pole motor.

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 several type of brakes:
   - **FRE-FE.** Electronic Brake.
   - **DI-FRE.** Pendular Dynamo Brake.
   - **EMCC.** Load Cell Module.
   - **FREND.** Dynamo Brake.
   - **FRENP.** Magnetic Powder Brake.
   - **FREPR.** Prony Brake.
   - **FRECP.** Eddy Current Brake.

ADDITIONAL 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.
- **TPPT.** Three- phase Power Transformer Unit.
- **EMPTA**. Auxiliary Transformer and Protection Module.
- **AUTR.** Variable Auto-transformer.
Individual elements:
- **TRANS.** Single-phase Transformer.
- **TRANS/3.** Three-phase Transformer.

⑦ DC Motor Speed Control:
- **VVCC.** DC Motor Speed Controller.
- **VVCC/M.** DC Motor Speed Controller (intermediate option).
- **VVPP.** Velocity Control for Stepper Motor (Manual Control and Automatic Control).
- **VVPP/B.** Velocity Control for Stepper Motor (Manual Control).
Individual elements:
- **VVCC/B.** DC Motor Speed Controller, with no other elements.

⑧ AC Motor Speed Control:
- **VVCA.** AC Motor Speed Controller.
- **VVCA/M.** AC Motor Speed Controller (intermediate option).
Individual elements:
- **VVCA/B.** AC Motor Speed Controller, with no other elements.

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

⑩ Tachogenerator:
For measuring the motor speed.
- **TECNEL/T.** Tachogenerator.
- **TECNEL/TM.** Hand Tachometer.

ADDITIONAL POSSIBILITIES

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

Software:

⑪ CAI. Computer Aided Instruction Software System:
The best help in classroom for both teacher and students.
Includes:
- INS/SOF. Classroom Management Software (Instructor Software).
Only one package is needed per classroom.
Helps creating databases, reports and statistical comparisons among many more features.
- EMT../SOF. Computer Aided Instruction Softwares (Student Software).
Each Motor has its own package. Gives the students the proper assistance on theoretical knowledge as well as in practice, presenting exercises and questions.

⑫ CAL. Computer Aided Learning Software (Results Calculation and Analysis):
Windows based software, simple and easy to use.
Thought for Results Calculation and Analysis, this software computes display plots and obtained data.

Data Acquisition:

⑬ MUAD. Electric 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:
1) EPIB. Electric Power Interface Box.
2) DAB. Data Acquisition Board.
3) MUAD/SOF. Data Acquisition Software.

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 in correct.

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

    Two 24 Vac terminals.

 - 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.

    Single-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 unit: (see Section "2")

    EAL. Network Analyzer Unit.

EME

REQUIRED SERVICES

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

DIMENSIONS AND WEIGHT

- Dimensions: 490 x 450 x 470 mm. approx.
- Weight: 50 Kg. approx.

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PRACTICAL POSSIBILITIES

Some Practical Possibilities of the EME Unit:

The D.C.Machine (with motors EMT1/2/3/4/5/15)

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 EMT6)

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 EMT7/8/9/10/11/16/17)

22.- Mordey´s 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 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 EMT12)

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 EMT14)

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 EMT18)

39.- Brushless motor starting.

40.- Speed control and change of the turn sense.

The Dahlander motor (with motor EMT9)

41.- Dahlander motor starting.

42.- Different working speeds.

43.- Changing the different speeds of Dahlander motor while working.

The Stepper motor (with motor EMT19)

44.- Stepper motor starting.

45.- Steps control.

46.- Rotation sense change.

The Reluctance motor (with motor EMT21)

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 Vdc with fuses.

Connection Key.

Emergency stop push button.

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

    2 Digital Multimeters.

  Recommended measurement unit: (see Section "2")

    EAL. Network Analyzer Unit.

EME/M

REQUIRED SERVICES

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

DIMENSIONS AND WEIGHT

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

PRACTICAL POSSIBILITIES

Some Practical Possibilities of the EME/M 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.- Mordey's 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 three-phase motor.

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.

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

SPECIFICATIONS

Metallic box.

Diagram in the front panel.

Thermal Magnetic Circuit Breaker.

DC supply 200 Vdc with fuses.

Connection Key.

Emergency stop push button.

Two push buttons (1NO + 1NC).

One contactor, with three power connections, one control connection and supply control.

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

    2 Digital Multimeters.

  Recommended measurement unit: (see Section "2")

    EAL. Network Analyzer Unit.
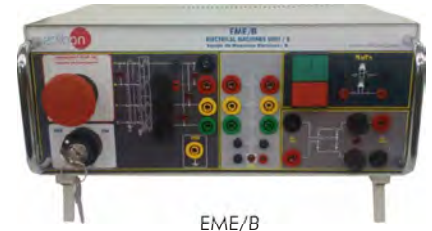
EME/B

REQUIRED SERVICES

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

DIMENSIONS AND WEIGHT

- Dimensions: 300 x 190 x 120 mm. approx.
- Weight: 5 Kg. approx.

PRACTICAL POSSIBILITIES

Some Practical Possibilities of the EME/B Unit:

The D.C.Machine:

1.- Preparation, regulation 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.

② Measurement Units

The measurement units let us extract information from the experimental units (EMEs), 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 Analyzers:**

2.2.1) EAL. **Network Analyzer Unit (AC)**

SPECIFICATIONS

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

Metallic box. Diagram in the front panel.

Measurements of current, voltage, power, power factor, frequency, energy, TRMS measurement of distorted waves (voltage, current) for each phase and average.

Display for instantaneous variables: 3 x 3 digits.

Display for energies: 8 + 1 digits.

Voltage: $V_{L-N} = 185\,V$ to $460\,V$. $V_{L-L} = 320\,V$ to $800\,V$.

Current: Phase current : 0.03 to 5A.

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

Power: Active, Reactive and Apparent.

Power Factor: Power factor for resistive, inductive and capacitive load types.

EAL

REQUIRED SERVICES

- Power supply: 220V, 50/60Hz.

DIMENSIONS & WEIGHT

- Dimensions: 300 x 190 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 easy parameter selection.

Metallic box. Diagram in the front panel.

Measurements of current, voltage, power, power factor, frequency, energy, TRMS measurement of distorted waves (voltage, current) for each phase and average.

Display for instantaneous variables: 3 x 3 digits.

Voltage: $V_{L-N} = 185\,V$ to $460\,V$. $V_{L-L} = 320\,V$ to $800\,V$.

Current: Phase current : 0.03 to 5A.

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

Power: Active, Reactive and Apparent.

Power Factor: Power factor for resistive, inductive and capacitive load types.

Connection RS232 to computer (PC) and Data Acquisition Software.

EALD

REQUIRED SERVICES

- Power supply: 220V, 50/60Hz.

DIMENSIONS & WEIGHT

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

2.2.3) EALDG. **Network Analyzer Unit, with Computer Data Acquisition + Oscilloscope Display**

SPECIFICATIONS

This unit shows the main electric parameters on the electric network through the interface and a 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 and oscilloscope display.

Voltage: Range 0 - 750 Vrms. Prec.: ±0.5%. Phase to phase - Phase to neutral.

Current: Range 0.01 - 5 Arms. Prec.: ±0.5%.

Frequency: Range 48 to 62 Hz. ±0.1Hz.

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

Power Factor: Power Factor for each phase and average. Range -0.5 to + 0.5. Prec.: ±1%.

Operating temperature 0 to +50°C.

Connection RS232 to computer (PC).

Data Acquisition Software.

EALDG

REQUIRED SERVICES

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

DIMENSIONS & WEIGHT

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

2.2.4) EAL-DC. **Network Analyzer Unit (DC)**

SPECIFICATIONS

This unit shows the main electric parameters on the electric loads throught the interface and a parameters selection.

Metallic box. Diagram in the front panel.

1 Current input.

1 Terminal voltage.

Visualization digital display:

Voltage: Range 0 - 450 Vdc without transformer.

Current: Range 0-5 A.

Power.

Power supply connection: 38 - 265 Vac/dc.

Resolution: 0.1 V; 0.01 A; 0.01 KW.

Energy total: 6 DGT (0.1 KWh).

EAL-DC

REQUIRED SERVICES

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

DIMENSIONS & WEIGHT

- Dimensions: 300 x 190 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 500 Vac.

- 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.

EAM-VA

DIMENSIONS & WEIGHT

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

- Weight: 40 Kg. approx.

2.4) MUAD. **Electric Power Data Acquisition System** (See "Section 13")

Electric Power Interface Box

Data Acquisition Board

Data Acquisition Software

VOLTAGE & CURRENT

POWER SPECTRUM

DC and RMS

Computer (not included in the supply)

➡ Sampling rate up to: **250,000 S/s (samples per second).**

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 fixed resistances.

    Single and Three-phase variable resistances.

    Single and Three-phase inductances.

    Single and Three-phase capacitors.

RCL3R

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:	$3 \times [\,0, 33, 78, 140, 193, 236\,mH\,]$.$(230V/2\,A)$
Capacitive loads:	$3 \times [\,4 \times 7\,\mu F\,]$. $(400V)$

DIMENSIONS & WEIGHT

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

3.2) **Individual elements:**

When a simpler and cheaper option is preferred when studying the use of loads in electrical machines, EDIBON gives the choice of acquiring single modules.

SPECIFICATIONS

IND. **Inductance Module**

    Metallic box. Diagram in the front panel.

    Inductance load: $[\,0, 33, 78, 140, 193, 236\,mH\,]$.

    Dimensions: 300 x 190 x 120 mm. approx.

IND

CON. **Capacitors Module**

    Metallic box. Diagram in the front panel.

    Capacitive load: $[\,4 \times 7\,\mu F\,]$.

    Dimensions: 300 x 190 x 120 mm. approx.

CON

REV. **Variable Resistance Module**

    Metallic box. Diagram in the front panel.

    Variable resistive load of 0-150Ω (500W).

    Dimensions: 300 x 190 x 120 mm. approx.

REV

REV-T. **Three-phase Variable Resistance Module**

    Metallic box. Diagram in the front panel.

    3 Variable resistive loads of 150Ω (500W).

    Dimensions: 490 x 330 x 310 mm. approx.

REV-T

REF. **Fixed Resistance Module**

    Metallic box. Diagram in the front panel.

    Resistive load of 150Ω (500W).

    Dimensions: 300 x 190 x 120 mm. approx.

REF

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

The motors supplied include connectors, couplings and motor support.

SPECIFICATIONS

Motors D.C.:

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

Power: 250W. Speed: 3400 r.p.m. V.excitation: 200 V.D.C. I.Excitation: 0.3A. V.Armature.: 200V D.C. I.Armature: 1.5A.

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

Power: 250W. Speed: 7500 r.p.m. V.Armature: 200V.D.C. I.Armature: 1.5A.

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

Power: 250W. Speed: 3400 r.p.m. V.Armature: 200V.D.C. I.Armature: 1.5A.

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

Power: 250W. Speed: 3400 r.p.m. I.Excitation:0.4A. V.Armature: 200V. I.Armature: 1.5A.

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

Power: 250W. Speed: 3400/7500 r.p.m. V.excitation: 230 V.D.C. I.Excitation: 0.4A. V.Armature.: 200V. D.C. I.Armature: 1.5A.

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

Power: 230W. Speed: 9000 r.p.m. Frequency: 50/60Hz. V.Armature.: 230V. I.Armature: 1A.

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

Power: 100W. Speed: 3000 r.p.m. V.Armature: 200V. I.Armature: 0.5A.

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

Power: 80W. Speed: 3250 r.p.m. V.Armature: 24V.D.C. I.Armature:3.3 A.

EMT19. **Stepper motor:**

Power: 2W. V.Armature: 12V. I.Armature: 0.16 A.

Note: Available as OPTIONAL: Velocity Control for Stepper Motor (VVPP) and Velocity Control for Stepper Motor (VVPP/B).

OPTIONAL for working with EMT19. Stepper motor:

- VVPP. **Velocity Control for Stepper Motor** (Manual Control and Automatic Control):

The VVPP is the stepper motor controller training module designed by EDIBON. It has a PLC which programmed for controlling the stepper motor and includes a software to program the PLC.

Technical data:

Number of inputs: 8. Voltage: 230 Vac. Number outputs: 4. Output type: Relay. Output capacity: 2 A. Single-phase: 220 V; 6.3 VA.

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

- VVPP/B. **Velocity Control for Stepper Motor** (Manual control):

Front panel:

DC input + ground connection. ON/OFF switch.

A, A', B, B' connections with 4 fuses.

Direction: clockwise/anticlockwise.

Manual control with 4 switches.

Electrical supply required: 220 Vac, single phase + ground.

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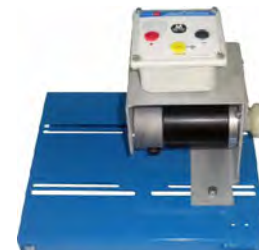

EMT1

EMT2

EMT3

EMT4

EMT5

EMT12

EMT15

EMT18

EMT19

VVPP

VVPP/B

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

Power: 300W. Speed: 3000 r.p.m. Frequency: 50/60 Hz. V.Armature: 400V. I.Armature: 1.4 A.

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

Power: 16W. Speed: 1550 r.p.m. Frequency: 50/60Hz. V. Armature: 230/240V. I.Armature: 0.42 A.

EMT21   EMT22

PRACTICAL POSSIBILITIES

Some Practical Possibilities:

The D.C. Machine (with motors EMT1/2/3/4/5/15)

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 EMT6)

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 EMT7/8/9/10/11/16/17)

22.- Mordey's 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 EMT12)

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 EMT14)

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 EMT18)

39.- Brushless motor starting.

40.- Speed control and change of the turn sense.

The Dahlander motor (with motor EMT9)

41.- Dahlander motor starting.

42.- Different working speeds.

43.- Changing the different speeds of Dahlander motor while working.

The Stepper motor (with motor EMT19)

44.- Stepper motor starting.

45.- Steps control.

46.- Rotation sense change.

The Reluctance motor (with motor EMT21)

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

The electronic brake FRE-FE is an unit that allows to regulate the braking torque of a motor.
The FRE-FE is constituted as a set of two elements:
   Control module:
      Front panel:
         Braking torque control.
         ON/OFF switch.
         Electrical parameters indicator.
         Display manipulation: Key "FUNC/DATA". Keys "RUN" / "STOP".
         Forward / Reverse switch.
   Braking motor mounted on a bench-support.
Cable to connect the two elements.
Power:370W. V. Armature: 220/240V.
The control of the braking torque is carried out by means of a control potentiometer placed on the front side of the control module.
The direction of the braking motor is controlled by a switch placed on the front panel of the control module.
Furthermore, the user will be able to visualize in a display different electrical parameters (as for example : current, frequency, active power…), as well as checking the voltage in the resistor that is used to produce the braking of the motor.

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: 300W.
Speed: 3000 rpm.
V.Excitation: 190 V.D.C. I.Excitation: 0.3A.
V.Armature: 200 V.D.C. I.Armature : 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.
- Variable power resistance (REV).

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.
Load cell.
Connection cable.

EMCC

REQUIRED SERVICES

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

DIMENSIONS & WEIGHT

- Dimensions: 300 x 190 x 120 mm. approx.
- Weight: 2 Kg. approx.

5.3) FREND. **Dynamo Brake**

SPECIFICATIONS

Power: 300W.

Speed: 3400 rpm.

I.Excitation: 0.4A.

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

Connectors.

Bench - support.

REQUIRED SERVICES

- Electrical supply: 200 Vdc.
- Variable power resistance (REV).

FREND

5.4) FRENP. **Magnetic Powder Brake**

SPECIFICATIONS

The FRENP 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.

Power: 400 W. V.Armature: 110/220V.

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

REQUIRED SERVICES

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

FRENP

5.5) FREPR. **Prony Brake**

SPECIFICATIONS

Prony brake with resistant ribbon.

Mechanical braking action and dynamometer.

Power: 500W.

Speed: 3000 rpm.

FREPR

5.6) FRECP. **Eddy Current Brake**

SPECIFICATIONS

FRECP is an unit designed to work as a magnetic brake by means of the induction of Foucault's parasitic currents.

The FRECP is similar to an electrical motor, since it has a stator winding, the inductor, that we will feed with a DC voltage. We will change the braking torque by means of this direct voltage.

The breaking torque is proportional to the current injected.

Nominal current: 1.67 A. Maximum current: 1.8 A. Maximum braking torque: 1.4 Nm.

Bench - support.

DC power supply.

REQUIRED SERVICES

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

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).

Max. 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).

Max. 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.
2.- Rehearsal of a single-phase transformer in open circuit.
3.- Rehearsal of a single-phase transformer in short circuit.
4.- Rehearsal of a single-phase transformer in load.
5.- Rehearsal of a three-phase transformer in open circuit.
6.- Rehearsal of a three-phase transformer in short circuit.
7.- Autotransformer tests.
8.- Connection modes tests: Start/delta/Zig-Zag/6-phase/triple star.
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 of 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

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 190 x 120 mm. approx.
- Weight: 3 Kg. 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) AUTR. **Variable Auto-transformer**

SPECIFICATIONS

This unit enables to carry out different practices related with variable auto-transformers.

The objective of the AUTR unit is to show techniques to measure the variable output and how the auto-transformer can be used with a load.

Metallic box. Diagram in the front panel.

It has two protection fuses in back part for controlling the output current is lower than 2A.

Input voltage: 240Vac, 50/60 Hz.

Output voltage: 0-240Vac, 50/60 Hz.

Maximum output current: 2 A.

AUTR

DIMENSIONS & WEIGHT

- Dimensions: 300 x 190 x 120 mm. approx.

6.5) **Individual elements:**

SPECIFICATIONS

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

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⑦ DC Motor Speed Control

7.1) VVCC. **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 terminals:

Connection with the excitation of the DC Motor.

Red Terminal / Positive Polarity. Black Terminal / Negative Polarity.

Rotor terminals:

Connection with the rotor of the DC Motor.

Red Terminal / Positive Polarity. Black Terminal / Negative Polarity.

Tachodynamo terminals:

Connection with an external DC Tachogenerator.

Red Terminal / Positive Polarity. Black Terminal / Negative Polarity.

Torque control: Control of the mechanical torque of the motor.

Speed control: Control of the speed of the motor.

Start/Stop switch to run or stop the motor. On/Off switch to turn the unit on.

Feedback switch: switch to control the feedback source (tachodynamo or internal).

LED indicators of the status of the unit.

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.
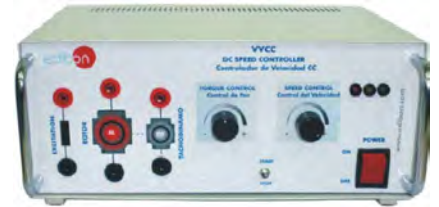
VVCC

REQUIRED SERVICES

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

DIMENSIONS & WEIGHT

- Dimensions: 300 x 190 x 120 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) VVCC/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.

Adjustable voltage: up to 320 Vdc. Maximum current: 2 A.

At the top of the unit there is a knob to adjust the DC voltage.

Front panel including:

Positive, negative and ground connections. ON/OFF switch.

VVCC/M

REQUIRED SERVICES

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

DIMENSIONS & WEIGHT

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

7.3) VVPP. **Velocity Control for Stepper Motor** (Manual Control and Automatic Control)

DESCRIPTION

The VVPP is the stepper motor controller training module designed by EDIBON. It has a PLC which programmed for controlling the stepper motor and includes a software to program the PLC.

VVPP

SPECIFICATIONS

Technical data:

Number of inputs: 8.

Voltage: 230 Vac.

Number outputs: 4.

Output type: Relay.

Output capacity: 2 A.

Single-phase: 220 V; 6.3 VA.

DIMENSIONS & WEIGHT

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

7.4) VVPP/B. **Velocity Control for Stepper Motor** (Manual control)

SPECIFICATIONS

Front panel:

DC input + ground connection. ON/OFF switch.

A, A', B, B' connections with 4 fuses.

Direction: clockwise/anticlockwise.

Manual control with 4 switches.

VVPP/B

REQUIRED SERVICES

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

DIMENSIONS & WEIGHT

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

7.5) **Individual elements:**

SPECIFICATIONS

VVCC/B. **DC Motor Speed Controller**, with no other elements

Maximum power: 550W.

Maximum torque: 2.6 N.m.

VVCC/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 Ω.

  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: 400 x 600 x 500 mm. approx.
- Weight: 30 Kg. approx.

PRACTICAL POSSIBILITIES

1.- Motor parameters adjustment.
2.- Working at a frequency given by the panel.
3.- Working at a frequency given by an analog input (potentiometer).
4.- Turn inversion.
5.- Display of analog output.
6.- Digital inputs configuration.
7.- Outputs from alarm to relay.
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.
Power: 3kVA. Frequency: 1-50 Hz. Phase voltage: 230 Vac. Maximum current: 8A.
Overcurrent thermal protection.
ON/OFF switch.
It has two blocks in the front panel:
  Speed control: Start/Stop switch and speed control potenciometer.
  Connections to motor: Three-phase connection to AC motor and ground connection.

VVCA/M

REQUIRED SERVICES

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

DIMENSIONS & WEIGHT

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

8.3) **Individual elements:**

SPECIFICATIONS

VVCA/B. **AC Motor 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 Units.

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. PLC Module:

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. 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. USB 2.0 connector to PC.

Inside:

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

Panasonic PLC:

High-speed scan of 0.32 μsec. for a basic instruction.

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

Power supply input (100 to 240 V AC).

DC input: 16 (24 V DC).

Relay output: 14.

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 module, 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. approx.
- Weight: 30 Kg. approx.

REQUIRED SERVICES

- Electrical supply: single-phase, 220 V. - 110 V.
- Computer (PC).

PRACTICAL POSSIBILITIES

1.- Control of the particular unit process through the control interface box without the computer (PC).

2.- PID control.

3.- Visualization of all the sensors values used in the particular unit process.

4.- Calibration of all sensors included in the particular unit process.

5.- Hand on of all the actuators involved in the particular unit process.

6.- Realization of different experiments, in automatic way, without having in front the particular unit. (This experiment can be decided previously).

7.- Simulation of outside actions, in the cases hardware elements do no exit.

8.- PLC hardware general use and manipulation.

9.- PLC process application for the particular unit.

10.- PLC structure.

11.- PLC inputs and outputs configuration.

12.- PLC configuration possibilities.

13.- PLC program languages.

14.- PLC different programming standard languages.

15.- New configuration and development of new process.

16.- Hand on an established process.

17.- Visualization and see the results and to make comparisons with the particular unit process.

18.- Possibility of creating new process in relation with the particular unit process.

19.- PLC Programming exercises.

20.- Own PLC applications in accordance with teacher and student requirements.

⑨ PLC (Programmable Logic Controller)

9.2) **Individual Elements:**

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

SPECIFICATIONS

Inputs: 8.

Output: 6. Output type: Relay 2A.

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: 16K .

Data memory: 12285.

Document memory: 64K and IEC1131 source code.

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

Timer/Counter: 1024.

Bit memory: 4096.

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

High Speed Counter: Single phase: 8ch, total 80KHz (max. 10KHz / channel).

Number of interruption programs: 15 programs (14 external, 1 internal). Constant time interrupt (0.5ms to 30sec). Interrupt subroutine jump time: 10 micro sec .

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

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).

Others: Step ladder : 1000 steps.   Subroutine: 500 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.

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

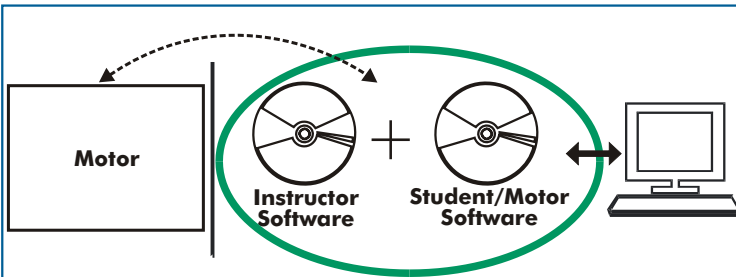Output voltage gradient: 60 +/- 5% V /1000 r.p.m.

TECNEL/T

10.2) TECNEL/TM. **Hand Tachometer**

DESCRIPTION

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

⑪ 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.

Instructor Software

With the **INS/SOF. Classroom Management Software** (**Instructor Software**), the Instructor 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.

Student Software

EMT../SOF. Computer Aided Instruction Softwares (Student Software)
It explains how to use the motor, run the experiments and what to do at any moment.
Each motor has its own Student Software.
- The options are presented by pull-down menus and pop-up windows.
- Each Software 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 with 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 Softwares:

Motors (D.C.):
-EMT1/SOF.   D.C. Independent excitation motor-generator.
-EMT2/SOF.   D.C. Series excitation motor-generator.
-EMT3/SOF.   D.C. Shunt excitation motor-generator.
-EMT4/SOF.   D.C. Compound excitation motor-generator.
-EMT5/SOF.   D.C. Shunt-series compound excitation motor.
-EMT12/SOF.   Universal motor (single-phase).
-EMT15/SOF.   D.C. Permanent magnet motor.
-EMT18/SOF.   D.C. Brushless motor.
-EMT19/SOF.   Stepper motor.

Motors (A.C.):
-EMT6/SOF.   A.C. Synchronous three-phase motor alternator.
-EMT6B/SOF.   Permanent magnets synchronous three-phase generator (24 Vac).
-EMT7/SOF.   Asynchronous three-phase motor of squirrel cage.
-EMT7B/SOF.   Asynchronous three-phase motor of squirrel cage (4 poles).
-EMT7C/SOF.   Asynchronous three-phase motor of squirrel cage (8 poles).
-EMT8/SOF.   Asynchronous three-phase motor with wound rotor.
-EMT9/SOF.   Dahlander three-phase (two-speeds).
-EMT10/SOF.   Asynchronous three-phase motor of two independent speeds.
-EMT11/SOF.   Asynchronous single-phase motor with starting capacitor.
-EMT12/SOF.   Universal motor (single-phase).
-EMT14/SOF.   Repulsion motor, single-phase with short-circuited brushes.
-EMT16/SOF.   Asynchronous single-phase motor with starting and running capacitor.
-EMT17/SOF.   Three-phase motor of squirrel cage with "Y" connection.
-EMT20/SOF.   Asynchronous single-phase motor with split phase.
-EMT21/SOF.   Three-phase reluctance motor.
-EMT22/SOF.   Single-phase shaded pole motor.

⑫ CAL. Computer Aided Learning Software (Results Calculation and Analysis)

This Computer Aided Learning Software (CAL) is a Windows based software, simple and very easy to use specifically developed by EDIBON.

CAL is a class assistant that helps in making the necessary calculations to extract the right conclusions from data obtained during the experimental practices.

With a single click, CAL computes the value of all the variables involved.

Also, CAL gives the option of plotting and printing the results.

Once the Area of study is selected, the right module can be chosen among a wide range, each one with its own set of lab. exercises.

Simply insert the experimental data, with a single click CAL will perform the calculations.
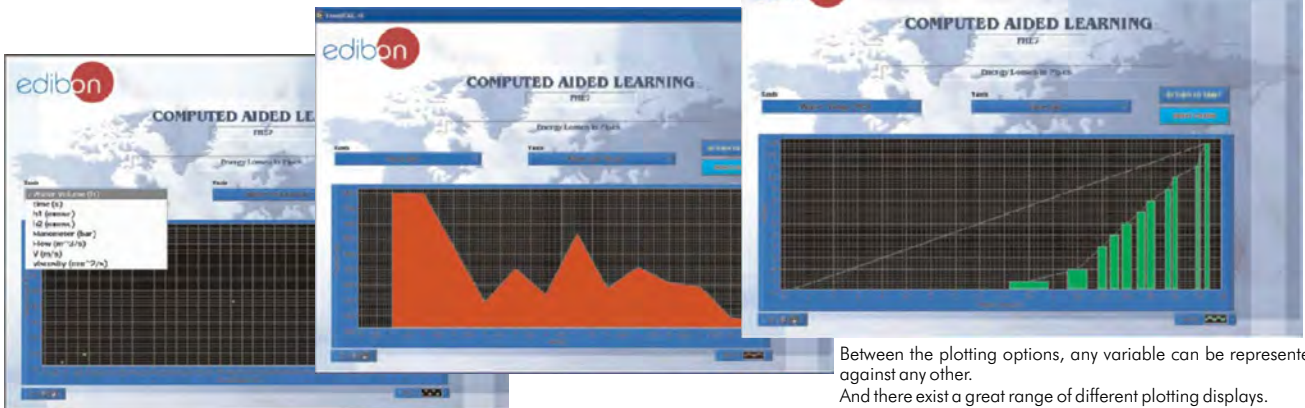

Between the plotting options, any variable can be represented against any other.
And there exist a great range of different plotting displays.

Among the given choices, an additional help button can be found, which offers a wide range of information, such as constant values, unit conversion factors and integral and derivative tables:
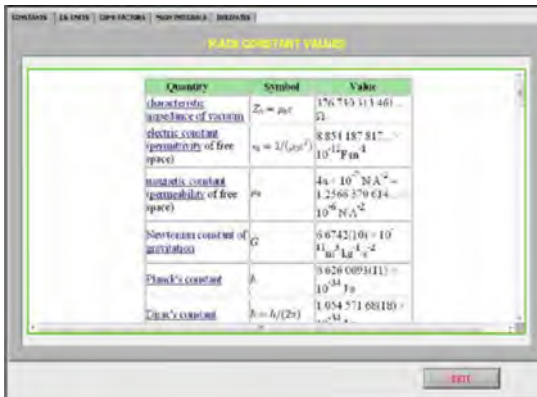
It provides a handy option to avoid using different reference sources while in progress. For example: the values of Physical constants, their symbols and right names, conversion factors…
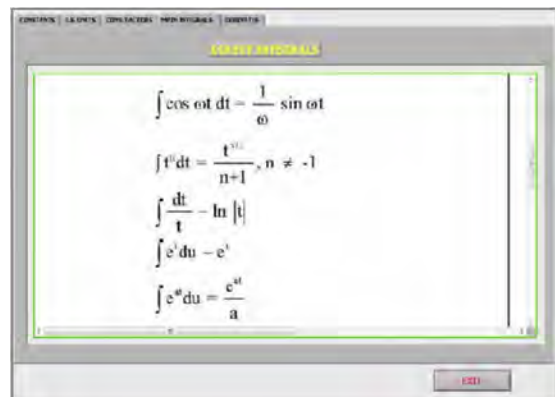
…and the very useful Integral and Derivative tables.

Available Softwares:

Motors (D.C.):
- EMT1/CAL. D.C. Independent excitation motor-generator.
- EMT2/CAL. D.C. Series excitation motor-generator.
- EMT3/CAL. D.C. Shunt excitation motor-generator.
- EMT4/CAL. D.C. Compound excitation motor-generator.
- EMT5/CAL. D.C. Shunt-series compound excitation motor.
- EMT12/CAL. Universal motor (single-phase).
- EMT15/CAL. D.C. Permanent magnet motor.
- EMT18/CAL. D.C. Brushless motor.
- EMT19/CAL. Stepper motor.

Motors (A.C.):
- EMT6/CAL. A.C. Synchronous three-phase motor alternator.
- EMT6B/CAL. Permanent magnets synchronous three-phase generator (24 Vac).
- EMT7/CAL. Asynchronous three-phase motor of squirrel cage.
- EMT7B/CAL. Asynchronous three-phase motor of squirrel cage (4 poles).
- EMT7C/CAL. Asynchronous three-phase motor of squirrel cage (8 poles).
- EMT8/CAL. Asynchronous three-phase motor with wound rotor.
- EMT9/CAL. Dahlander three-phase (two-speeds).
- EMT10/CAL. Asynchronous three-phase motor of two independent speeds.
- EMT11/CAL. Asynchronous single-phase motor with starting capacitor.
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- EMT16/CAL. Asynchronous single-phase motor with starting and running capacitor.
- EMT17/CAL. Three-phase motor of squirrel cage with "Y" connection.
- EMT20/CAL. Asynchronous single-phase motor with split phase.
- EMT21/CAL. Three-phase reluctance motor.
- EMT22/CAL. Single-phase shaded pole motor.

⑬ MUAD. Electric Power Data Acquisition System
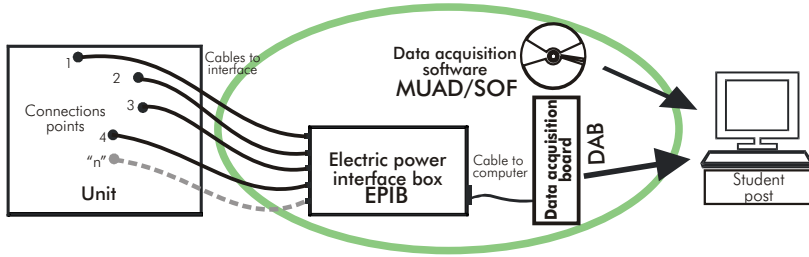
MUAD is the perfect link between the unit and the PC. MUAD is a continuous data acquisition system with virtual instrumentation, that measures, analyzes and represents the parameters involved in the process.

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 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) **EPIB. Electric Power Interface Box** (dimensions: 300 x 180 x 120 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.
- Sampling range: 250 KSPS (Kilo samples per second).
- 4 Tension sensors AC/DC, 400V.
- 4 Current sensors.

EPIB

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 KS/s (Kilo samples per second).
Input range (V)=± 10V.
Data transfers=DMA, interrupts, programmed I/0.
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)=±10.
Data transfers=DMA, interrupts, programmed I/0.
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

3) **MUAD/SOF. Data Acquisition Software**:
Data Acquisition Software with Graphic Representation:
Friendly 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).

MUAD/SOF

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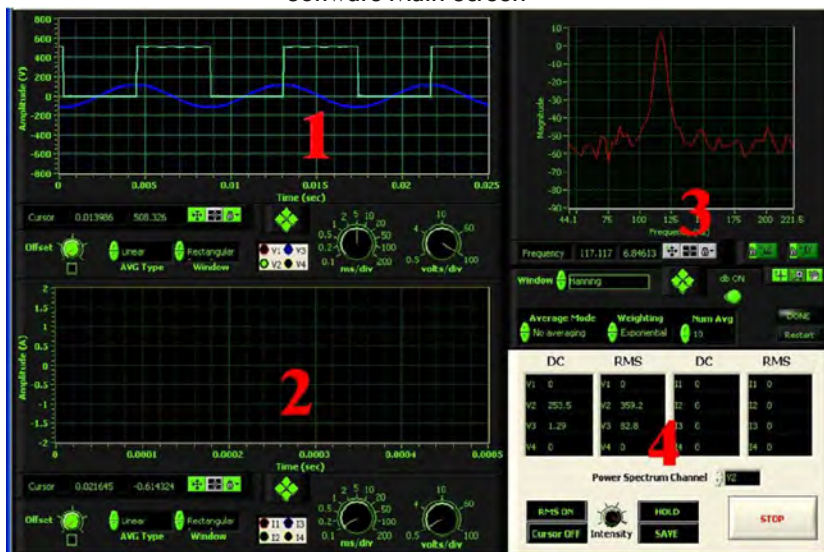
1.- Voltage channels section.
2.- Current channels section.
3.- Power spectrum section.
4.- General control panel section.

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

REPRESENTATIVE: