Basic Electronics and Electricity Integrated Laboratory

edibon
Technical Teaching Equipment

LIEBA

Laboratory structure

① Power Supply

FA-CO

or

EBC-100

② Modules
(power supply needed)

(M1)
(M2)
(M16)
(M17)
(M3)
(M4)
(M5)
(M6)
(M7)
(M8)

Other modules

② Modules
(power supply needed)

(M9)
(M10)
(M11)
(M12)
(M13)
(M14)
(M15)
(M31)
(M60)
(M65)

Expansion Board (M99)

③ CAI. Computer Aided Instruction Software System

Used Teaching Technique

INS/SOF. Instructor Software

M.../SOF. Student/Module Software

④ LIEBA/CAL. Computer Aided Learning Software
(Results Calculation and Analysis)

Used Teaching Technique

COMPUTED AIDED LEARNING

⑤ EDAS/VIS. EDIBON Data Acquisition System/ Virtual Instrumentation System

Used Teaching Technique

DAIB. Data acquisition interface box

DAB. Data acquisition board

EDAS/VIS-SOF. Data Acquisition and Virtual Instrumentation Software

The complete laboratory includes parts 1 to 5 and any part can be supplied individually or additionally. (Power supply + Module/s is the minimum supply).

Some available Modules

Basic Electricity:
- M1. Direct Current (D.C.) Circuits.
- M2. Alternating Current (A.C.)Circuits.
- M16. Electric Networks.
- M17. Electromagnetism.
- M18. Three-phase circuits.

Basic Electronics:
- M3. Semiconductors I.
- M4. Semiconductors II.
- M5. Power Supplies.
- M6. Oscillators.
- M7. Operational Amplifiers.
- M8. Filters.
- M9. Power Electronics.
- M10. Digital Systems & Converters.
- M11. Digital Electronics Fundamentals.
- M12. Basic Combinational Circuits.
- M13. Basic Sequential Circuits.
- M14. Optoelectronics.
- M15. Development Module.

Basic Electronics: Microprocessors:
- M30. 16 Bits Microprocessor.
- M31. Z80 Microprocessor.
- M-EB. Practical Expansion Boards.
- M32. 8051 Microcontroller.
- M33. 68000 Microprocessor.
- M34. DSP Microprocessor.

Basic Electronics: Transducers:
- M41. Resistance Transducers.
- M43. Applications of Temperature.
- M44. Applications of Light.
- M45. Linear Position and Force.
- M46. Environmental Measurements.
- M47. Rotational Speed & Position Control.
- M48. Sounds Measurements.
- M49. Applications of Temperature and Pressure.

Basic Electronics: Control Electronics:
- M60. Analog/Digital Converters.
- M61. Digital/Analog Converters.
- M65. Control and Regulation.

Basic Electronics: Any other possibilities:
- M99. Expansion Board.
  Some electronic sub-boards available:
  - M99-1. Analogical Commutator.
  - M99-2. Analogical Multiplier.
  - M99-3. Function Generator.
  - M99-4. AM Modulator.
  - M99-5. AM Demodulator.

* We can develop any electronic sub-board according to the application required by the customer.

INTRODUCTION

Present technology requires necessary knowledge of ELECTRONICS and ELECTRICITY in most fields.

Avionics, Autotronics, Domotics, Agrotronics, Physics, Process Chemistry, Health Services, etc., already employ components or even whole systems based on Electronics and Electricity. Thus there is an increasing number of professionals in these and many other fields who need adequate knowledge and training.

Taken this into account, EDIBON has developed the Basic Electronics and Electricity Integrated Laboratory, capable of covering different levels of difficulty. It is based on a series of self-taught modules, each one referring to a specific area of Electricity and Electronics (analog and digital electronics).

GENERAL DESCRIPTION

We present a flexible and modular-based system for learning basic electronics and circuit theory.
The advantage given by this learning and teaching system is that the student establishes his own rhythm, thus rendering unnecessary to keep pace with the rest of the class.
Any desired configuration can be chosen(see next page), according to working mode, areas of study and number of working posts.
Being a modular and open system, it is very economical and may be enlarged depending on required needs; all previously acquired systems are fully compatible and valid.

What are the parts included in the laboratory?:

① **Power supply:**
   There are two choices for supplying the modules:
   FA-CO. Power Supply:
   Using this system training and practices can be done conventionally. This is the most common power supply used.
   EBC-100. Base Unit :
   This unit is self-complete, it includes hardware, power supply and the necessary connections for supplying power and allocating the available modules.

② **Modules:**
   They consist on electronic boards which permit the student to do the exercises/practices corresponding to the target subject.
   On these modules the circuits to be designed are serigraphed. Real components are displayed to familiarize the student with them. There are many points where measures can be taken (voltage, current intensity, resistance, etc.).
   Moreover, circuit and electronic **component faults can be simulated too**.
   Every Module has its own manuals, that gives the theoretical knowledge and explains everything the student needs to carry out the exercise/practice. We provide eight manuals per module.
   Connectors and cables for completing the exercises and practices are included.

③ **CAI. Computer Aided Instruction Software System:**
   The best help in classroom for both teacher and students.
   Includes:
   3.1)   INSTRUCTOR SOFTWARE: **INS/SOF**. Classroom Management Software Package (Instructor Software).
           Only one package is needed per classroom.
           Helps creating databases, reports and statistical comparisons among many more features.
   3.2)   STUDENT SOFTWARE: **M../SOF**. Computer Aided Instruction Software Packages (Student/Module Software).
           Each module has its own package.
           Gives the students the proper assistance on theoretical knowledge as well as in practice, presenting exercises and questions.

④ **LIEBA/CAL. Computer Aided Learning Software (Results Calculation and Analysis):**
   Windows based software, simple and easy to use, specifically developed to use with M1 to M18 modules.
   Thought for Results Calculation and Analysis, this software computes and plots obtained data.

⑤ **EDAS/VIS. EDIBON Data Acquisition System/Virtual Instrumentation System:**
   EDIBON has developed this unique data acquisition interface, link between modules and PC, for an adequate visualization of the results yielded by the modules.
   The components together (hardware + software) makes the computer work as virtual instruments: Oscilloscope, Functions Generator, Spectrum Analyzer, Transient Analyzer, Multimeter, Logic Analyzer and Logic Generator, with all their features and applications.
   Includes:
   5.1)   Hardware: DAIB. Data Acquisition Interface Box + DAB. Data Acquisition Board.
   5.2)   Software: EDAS/VIS-SOF. Data Acquisition and Virtual Instrumentation Software.

**Complete LIEBA LABORATORY** includes: ① + ② + ③ + ④ + ⑤

Minimum configuration: ① Power supply + ② Modules (Every module needs power supply).

Some Working possibilities:

## A) CAI + EDAS/VIS + LIEBA/CAL working possibility (complete EDIBON system)

Power Supply + Modules + CAI. Computer Aided Instruction Software System + EDAS/VIS. EDIBON Data Acquisition System/ Virtual InstrumentationSystem + LIEBA/CAL. Computer Aided Learning Software (Results Calculation and Analysis)

INS/SOF Instructor Software
M./SOF Student/Module Software

DAIB. Data acquisition interface box
DAB. Data acquisition board
EDAS/VIS-SOF Data Acquisition and Virtual Instrumentation Software

COMPUTED AIDED LEARNING

B) CAI + EDAS/VIS working possibility

Power Supply + Modules + CAI. Computer Aided Instruction Software System + EDAS/VIS. EDIBON Data Acquisition System/ Virtual InstrumentationSystem

INS/SOF Instructor Software
M./SOF Student/Module Software

DAIB. Data acquisition interface box
DAB. Data acquisition board
EDAS/VIS-SOF Data Acquisition and Virtual Instrumentation Software

C) CAI working possibility

Power Supply + Modules + CAI. Computer Aided Instruction Software System

INS/SOF Instructor Software
M./SOF Student/Module Software

D) LIEBA/CAL working possibility

Power Supply + Modules + LIEBA/CAL. Computer Aided Learning Software (Results Calculation and Analysis)

COMPUTED AIDED LEARNING

E) EDAS/VIS working possibility

Power Supply + Modules + EDAS/VIS. EDIBON Data Acquisition System/ Virtual InstrumentationSystem

DAIB. Data acquisition interface box
DAB. Data acquisition board
EDAS/VIS-SOF Data Acquisition and Virtual Instrumentation Software

F) Simplest working possibility

Power Supply + Modules
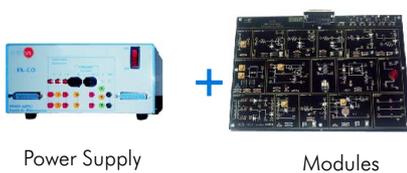
FA-CO. **Power Supply**

Fixed outputs: + 5 V, ± 12 V, 1 A.

Variable outputs: ± 12 V, 0.5 A.

AC output: 12V. or 24 V.

Outputs through either 2mm. contact terminals, or through 25 pin CENTRONICS connectors (2 outputs).

LED's voltage indicators.

Robust construction.

Supply: 110/220V A.C.

Frequency: 50/60 Hz.

FA-CO includes all the requirements for full working with any module from M1 to M99.

EBC-100. **Base Unit**

Hardware support and power supply.

Modules supporting unit.

Fixed outputs + 5V, + 12V, -12V.

Variable outputs ± 12 V.

AC output: 12 V. or 24 V.

Outputs through either 2mm. contact terminals, or through 25 pin CENTRONICS connector.

LED's voltage indicators.

Robust construction.

Supply: 110/220 V. A.C.

Frequency: 50/60 Hz.

EBC-100 includes all the requirements for full working with any module from M1 to M99.

<u>Main modules features:</u>

The Modules have been designed for making practices using either the FA-CO Power Supply or the EBC-100 Base Unit.

The Modules consist in a series of different circuits which shall allow performing the corresponding exercises separately.

All circuits are serigraphed on the surface of each module, thus permitting vision of their REAL components.

Almost all exercises/practices have special switches so that the teacher may SIMULATE CIRCUITRY FAILURE (faults), to be found by the Student.

Basic Electricity
<u>Available modules:</u>

M1. **Direct Current (D.C.)Circuits**
Practical possibilities:

<u>Measurement managing and checking instruments:</u>
1.- Electronic instrumentation operation. Use of multimeter.
2.- **Study of fault F1 in Resistance circuit.**
3.- **Study of fault F2 in Resistance circuit.**
4.- Theoretical/practical exercises.

<u>Ohm's Law:</u>
5.- Ohm's Law verification.
6.- Power calculation.
7.- Theoretical/practical exercises.

<u>Resistors: characteristics and types:</u>
8.- Resistor measurements. Color code. Ohmmeter.
9.- **Study of Fault F1 in Resistors circuit.**
10.- **Study of Fault F2 in Resistors circuit.**
11.- Theoretical/practical exercises.

<u>Resistors association and the Wheatstone Bridge:</u>
12.- Voltage and current measurement in a circuit with resistors connected in series.

13.- Series/Parallel configuration study.
14.- **The Wheatstone Bridge.**
15.- **Study of Fault in Series Resistors circuit.**
16.- **Study of Fault in Parallel Resistors circuit.**
17.- **Study of Fault F1 in Wheatstone Bridge circuit.**
18.- **Study of Fault F2 in Wheatstone Bridge circuit.**
19.- Theoretical/practical exercises.

<u>Kirchoff's laws:</u>
20.- **Kirchoff's first law.**
21.- **Kirchoff's second law.**
22.- **Fault study using Kirchoff's law.**
23.- Theoretical/practical exercises.

<u>Additional Possibilities:</u>
Voltage/Current dividers.
Batteries and Switches.
Power source in series and parallel.
The Rheostat and Potentiometer.

Circuit blocks:

Resistance Circuit.(Circuit #1).
Series/Parallel Resistors. (Circuit #2).
Series/Parallel Resistors Circuit with source. (Circuit #3).
Intensity regulation. (Circuit #4).
Wheatstone bridge. (Circuit #5).
Faults study. (Circuit #6).

Note: FA-CO or EBC-100 Units give all the supplies required for this module.
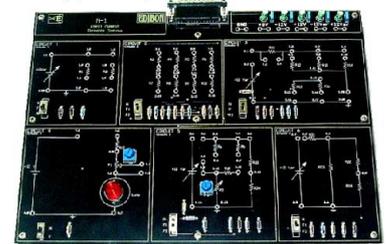
M2. **Alternating Current (A.C.) Circuits**
Practical possibilities:

<u>Alternating signal characteristics. Instruments:</u>
1.- Waveforms study in A.C.
2.- **Introduction of anomalies in the Wave form circuit.**
3.- **Study of Faults in the Waveform circuit.**
4.- Relation between peak values and RMS for sinusoidal waves.
5.- Resistance in a sinusoidal alternating current.
6.- Measurements using the oscilloscope.
7.- Voltage and current phase angles for resistors in sinusoidal alternating current.
8.- Sinusoidal A.C. resistors in series.
9.- Sinusoidal A.C. resistors in parallel.
10.- Exercises.

<u>Behaviour of A.C. capacitors and inductors:</u>
11.- Capacitance with square waveform and sinusoidal input current.
12.- Inductance with square waveform and a sinusoidal input voltage.
13.- Reactive reactance, Xc, variations with the frequency.
14.- **Study of faults in capacitors.**
15.- Reactive capacitance variations with the capacitance.
16.- A.C. capacitors in parallel.
17.- A.C. capacitors in series.
18.- A.C. capacitors as voltage dividers.
19.- Inductance in an A.C circuit.
20.- Inductive reactance variations with the inductance.
21.- Inductors in series in an A.C. circuit.
22.- Exercises.

<u>Basic theorems and capacitance and inductance circuits:</u>
23.- A.C. Resistor-Capacitor circuits in series.
24.- A.C. Resistor-Capacitor circuits in parallel.
25.- A.C. Resistor-Inductor circuits in series.
26.- Study of Fault 1 in the Circuit #3.
27.- Study of Fault 2 in the Circuit #3.
28.- A.C. Resistor-Inductor circuits in parallel.
29.- Exercises.

<u>RLC Circuits:</u>
30.- **Resistance-Capacitance Filters.**
31.- **Filters inductive resistance. Low-Pass and High- Pass filters.**
32.- Exercises.

<u>Resonance:</u>
33.- A.C. L-C Circuits in parallel with low impedance source.
34.- **Study of Fault 1 in the resonance circuit.**
35.- **Study of Fault 2 in the resonance circuit.**
36.- A.C. L-C Circuits in parallel with high impedance source.
37.- Circuit frequency response and bandwidth.
38.- A.C. R-L-C Circuits in series.
39.- **Study of Fault 1 in the resonance circuit.**
40.- Exercises.

<u>The transformer:</u>
41.- The transformer.
42.- **The transformer with load.**
43.- Current measurement in the secondary Transformer with charge.
44.- Exercises.

Circuit blocks:

Wave forms. (Circuit #1).
Transformers. (Circuit #2).
Reactive mixed circuits. (Circuit #3).
Channels.

Note: FA-CO or EBC-100 Units give all the supplies required for this module.
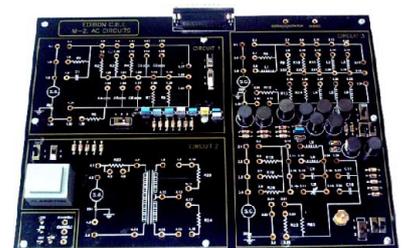
M16. **Electric Networks**

Practical possibilities:

Ohm's law:
1.- **Calculation of the internal resistance of a continuous source.**
2.- **Error study in an internal resistance.**
3.- **Internal resistance calculation of an alternating source.**
4.- Theoretical/practical exercises.

Electrical power:
5.- Power transferred by a DC source to load.
6.- Power transferred to a load by an AC source.
7.- Theoretical/practical exercises.

Power supplies combination:
8.- DC+DC assembly.
9.- Error study in the circuit, DC assembly.
10.- **DC+AC assembly.**
11.- Theoretical/practical exercises.

Thévenin's and Norton's theorems:
12.- Thévenin and Norton equivalent circuits. Conversion. Kirchoff's laws.
13.- Theoretical/practical exercises.

Superposition theorem:
14.- Application of the Superposition theorem.
15.- **Error study in the Superposition circuit.** Component values modifications.
16.- Theoretical/practical exercises.

Star-triangle transformation:
17.- Resistance measurement between terminals. Delta | Y configurations.
18.- Theoretical/practical exercises.

Wheatstone bridge:
19.- **Calibration of a Wheatstone bridge fed by a DC source.**
20.- **Error study in the Wheatstone bridge circuit.**
21.- **Wheatstone bridge calibration fed by an AC source.**
22.- Theoretical/practical exercises.

Additional Possibilities:
Millman's Theorem.

Circuit blocks:

Series/Parallel Connections. (Circuit#1).
AC/DC. (Circuit#2).
Superposition. (Circuit#3).
Triangle .Star. (Delta | Y)(Circuit#4).
Bridges. (Circuit#5).
Channels.

Note: FA-CO or EBC-100 Units give all the supplies required for this module.
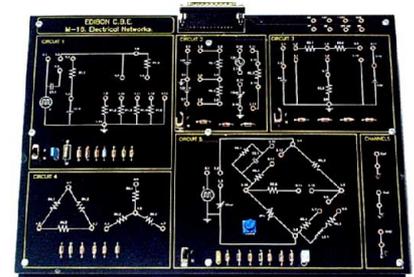
M17. **Electromagnetism**

Practical possibilities:

Magnetic fields:
1.- Magnetic fields measurement.
2.- Induced electromotive force. Coil Reactance calculation.
3.- Exercises.

Electromagnetic applications:
4.- Mutual Inductance.
5.- Basic operation of the transformer.
6.- Core effect in a transformer response.
7.- **Fault study in the Transformer.**
8.- Basic operation of the solenoid.
9.- **Fault study in the Solenoid circuit.**
10.- Basic operation of a relay.
11.- Self-holding of the position of the contacts.
12.- **Fault study in the Relay circuit.**
13.- Exercises.

Direct current motor:
14.- **Characteristic Speed/Voltage of a continuous current motor.**

15.- **Motor used as DC generator.**
16.- Cemf.
17.- Exercises.

Stepping Motor:
18.- **Stepper motor working.**
19.- **Fault study in Stepping motor circuit.**
20.- Exercises.

Circuit blocks:

Coils. Hall effect probe. Materials. (Circuit#1).
Solenoid. (Circuit#2).
Excitation. Relays. (Circuit#3).
Hall effect probe. DC Motor. (Circuit#4).
Stepping motor. (Circuit#5).
Channels.

Note: FA-CO or EBC-100 Units give all the supplies required for this module.

M18. **Three-phase Circuits**

Practical possibilities:

Generation of a three-phase system:
1.- Checking of the three-phase system.
2.- Calculation of the voltage values.

Three-phase loads in star and delta:
3.- Star-delta equivalence.
4.- Decompensation of the star.
5.- Out-phase between voltage and current (reactance).
6.- Measurement of the power factor.
7.- Correction of the power factor.

Synchronism detector:
8.- Out-phase generation between waves.
9.- Detection of out-phase between waves.

Phase-sequence detector:
10.- Waves in direct sequence.
11.- Waves in inverse sequence.

Three-phase rectifier:
12.- Half-wave three-phase rectifier.
13.- Full-wave three-phase rectifier.

Circuit blocks:

Three-phase generator.
Star-Delta (Y-Δ).
Phase-synchronism detector.
Current resistors.
Loads.
Phase-sequence detector.
Three-phase rectifiers:
   - Full wave three-phase rectifier.
   - Half wave three-phase rectifier.

Note: FA-CO or EBC-100 Units give all the supplies required for this module.
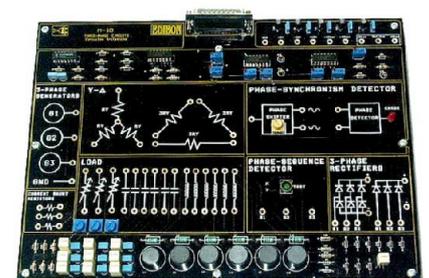
M3. **Semiconductors I**

Practical possibilities:

Characteristics of the PN junction:
1.- Study of the diode.
2.- **Fault Study in Diodes.**
3.- Exercises.

The diode as a rectifier element:
4.- Half wave rectifier.
5.- **Study of faults in Rectifier circuit.**
6.- Bridge rectifier.
7.- **Study of faults in bridge rectifier.**
8.- Exercises.

The Zener diode:
9.- Voltage regulator with a Zener diode.
10.- **Study of faults in Zener circuit.**
11.- Exercises.

Study and characteristics of the transistor:
12.- Study of the transistor.
13.- Study of the fault in the transistor.
14.- Exercises.

Transistor characteristics operating as a switch:
15.- **Study of the transistor as a switch.**
16.- Exercises.

Common emitter amplifier:
17.- **Study of the common emitter NPN amplifier.**
18.- **Fault Study in Amplifier circuit.**
19.- Study of the common emitter PNP amplifier.
20.- Exercises.

Additional Possibilities:
Voltage Doubler.
Power Supply filtering.

Circuit blocks:
Diode. (Circuit#1).
Signal filtration. (Circuit#2).
Diodes bridge. (Circuit#3).
Zener diode. (Circuit#4).
BJT transistor. (Circuit#5).
NPN and PNP as switch. (Circuit#6).
NPN amplification. (Circuit#7).
PNP amplification. (Circuit#8).
Sources.
Load.
Channels.

Note: FA-CO or EBC-100 Units give all the supplies required for this module.

M4. **Semiconductors II**

Practical possibilities:

Complementary transistors pair:
1.- Complementary transistors pair.
2.- **Transistors pair with alternating signal.**
3.- **Fault study of the complementary Transistor pair.**
4.- Exercises.

Darlington configuration:
5.- Darlington configuration.
6.- **Fault study of the Darlington configuration.**
7.- Exercises.

Differential amplifier:
8.- Differential amplifier.
9.- **Fault study in the differential amplifier.**
10.- Exercises.

Study and characteristics of the JFET transistor:
11.- JFET characteristics.
12.- **Fault study with the JFET transistor.**
13.- Exercises.

Analog switch:
14.- Analog switch.
15.- Exercises.

Multistage Amplifier. Direct coupling:
16.- Amplifier coupled directly.
17.- **Fault study of an amplifier coupled directly.**
18.- Exercises.

Circuit blocks:
Complementary transistors. (Circuit#1).
Darlington configuration. (Circuit#2).
Differential configuration. (Circuit#3).
JFET field-effect transistors. (Circuit#4).
Analog switch. (Circuit#5).
Direct coupling. (Circuit#6).

Note: FA-CO or EBC-100 Units give all the supplies required for this module.

M5. **Power Supplies**

Practical possibilities:

Rectification:
1.- Rectification.
2.- **Bridge rectifier.**
3.- Theoretical/practical exercises.

Fixed voltage sources:
4.- **Power supply with the Zener diode.**
5.- **Stabilization through Zener and Transistor.**
6.- **Fault study in "Stabilization through Zener and Transistor".**
7.- Protection against overcurrents.
8.- Protection against overvoltages.
9.- **Study of the fault "Protection against overcurrents".**
10.- Theoretical/practical exercises.

Symmetrical voltage power sources:
11.- **Symmetrical source; 78XX regulator.**
12.- **Symmetrical source; 79XX regulator.**
13.- Theoretical/practical exercises.

Voltage regulators with integrated circuits:
14.- **Adjustable regulator; LM317.**
15.- **Study of the fault in adjustable LM317 regulator.**
16.- **Adjustable L200 regulator.**
17.- **Fault Study in adjustable L200 Regulator.**
18.- Theoretical/practical exercises.

Introduction to switched power supplies:
19.- **Switching technique.**
20.- Switching technique. PWM.
21.- Switching technique. Boost.
22.- Theoretical/practical exercises.

Additional Possibilities:
Voltage Feedback.
DC-DC converter.

Circuit blocks:

Transformer. (Circuit#1).
Half wave rectifier. Full wave rectifier, center tap. (Circuit#2).
Full wave rectifier. (Circuit#3).
Filtering. (Circuit#4).
Zener limiting. (Circuit#5).
Regulation. (Circuit#6).
Overcurrent protection. (Circuit#7).
Overvoltage protection. (Circuit#8).
Voltage regulators. (Circuit#9).
LM317 adjustable Regulators. (Circuit#10).
L200 adjustable Regulator. (Circuit#11).
Switched source. (Circuit#12).
PWM switched source. (Circuit#13).
Boost switched source. (Circuit#14).
Load.
Channels.

Note: FA-CO or EBC-100 Units give all the supplies required for this module.

M6. **Oscillators**

Practical possibilities:

Oscillators. RC and LC Nets:
- 1.- **RC net oscillator.**
- 2.- **LC net oscillator.**
- 3.- **Faults study with RC and LC Net oscillators.**
- 4.- Exercises.

Wien bridge oscillator:
- 5.- **Wien Bridge.**
- 6.- **Fault study in the Wien bridge oscillator.**
- 7.- Exercises.

Colpitts oscillator. Hartley oscillator:
- 8.- **Colpitts oscillator.**
- 9.- **Hartley oscillator.**
- 10.- **Faults study with the Colpitts oscillator.**
- 11.- Exercises.

Astable multivibrator:
- 12.- **Astable multivibrator.**
- 13.- **Fault study with an Astable multivibrator.**
- 14.- Exercises.

555 TIMER:
- 15.- **555 timer.**
- 16.- **555 timer fault study.**
- 17.- Exercises.

Circuit blocks:

RC and LC oscillators. (Circuit#1).
Wien bridge. (Circuit#2).
Colpitts, Hartley oscillators. (Circuit#3).
Astable multivibrator. (Circuit#4).
555 Timer. (Circuit#5).

Note: FA-CO or EBC-100 Units give all the supplies required for this module.

M7. **Operational Amplifiers**

Practical possibilities:

Operational amplifier characteristics:
- 1.- Operational amplifier study.
- 2.- Closed-loop output compensation voltage.
- 3.- Operational amplifier fault study.
- 4.- Exercises.

The inverting amplifier:
- 5.- Inverting amplifier study.
- 6.- Inverting amplifier fault study.
- 7.- Exercises.

The non-inverting amplifier:
- 8.- Study of the non-inverting amplifier.
- 9.- Voltage follower.
- 10.- **Fault study in the non-inverting amplifier.**
- 11.- Exercises.

The adder amplifier:
- 12.- Adding amplifier study.
- 13.- **Fault study in the adding amplifier.**
- 14.- Exercises.

The differential amplifier:
- 15.- Differential amplifier study.
- 16.- **Differential amplifier fault study.**
- 17.- Exercises.

Comparators:
- 18.- Comparator study.
- 19.- Comparators fault study.
- 20.- Exercises.

Additional Possibilities:
Attenuator.
Voltage Divider.
Open-loop operation.

Circuit blocks:

Non-inverting amplifier. (Circuit#1).
Amplifier. (Circuit#2).
Voltage follower. (Circuit#3).
Adder. (Circuit#4).
Differential amplifier. (Circuit#5).
Comparator. (Circuit#6).
Channels.
Sources.

Note: FA-CO or EBC-100 Units give all the supplies required for this module.

M8. **Filters**

Practical possibilities:

RC and LC filter responses:
- 1.- Frequency response.
- 2.- Low-pass filter.
- 3.- High-pass filter.
- 4.- LC Circuit.
- 5.- **Study of Error in Low-pass filter.**
- 6.- **Study of Error in High-pass filter.**
- 7.- Exercises theoretical/practical.

T-shaped Filter:
- 8.- **Filter with double T link.**
- 9.- Generator circuit of the signal S1.
- 10.- **Study of Error in RC filter with double T.**
- 11.- Exercises theoretical/practical.

Active filters:
- 12.- Low-pass filter.
- 13.- Low-pass filter with load and operational amplifier.
- 14.- High-pass filter.
- 15.- High-pass filter with load and operational amplifier.
- 16.- The attenuation is cumulative.
- 17.- Use of Operational Amplifier.
- 18.- **Study of Faults in filters.**
- 19.- Exercises theoretical/practical.

Association of filters:
- 20.- Behaviour of the filter.
- 21.- **Filter of distorted signal.**
- 22.- **Filter in cascade; low pass filter and high pass filter.**
- 23.- **Filter in parallel.**
- 24.- **Study of Error in filters.**
- 25.- Exercises theoretical/practical.

Additional Possibilities:
Band-Pass and Band-Stop Filters.

Circuit blocks:

RC filters. (Circuit#1).
LC filter. (Circuit#2).
T-shaped filter. (Circuit#3).
Active filters. (Circuit#4).
Association of filters. Distorted signal filters. (Circuit#5 and Circuit#6).

Note: FA-CO or EBC-100 Units give all the supplies required for this module.
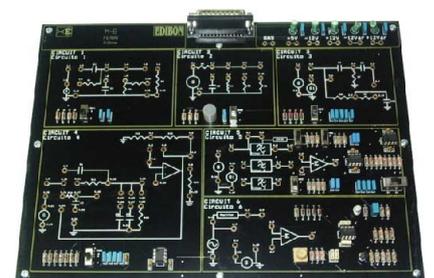
M9. **Power Electronics**

Practical possibilities:

<u>The bipolar power transistor:</u>
1.- Study of the power transistor.
2.- Study of faults in the power transistor.
3.- Exercises.
<u>The MOSFET transistor:</u>
4.- Study of the MOSFET transistor.
5.- Study of faults in the MOSFET transistor.
6.- Exercises.
<u>The thyristor:</u>
7.- Study of the thyristor.
8.- Study of the error of the thyristor.
9.- Exercises.
<u>The UJT transistor and trigger circuits of the thyristor:</u>
10.- Study of the trigger circuits of the thyristor.
11.- Study of insulation circuits.
12.- Exercises.
<u>The TRIAC:</u>
13.- Study of the TRIAC.
14.- Practical assembly of the TRIAC.
15.- Exercises.
<u>Additional Possibilities:</u>
Half/Full wave control.

Circuit blocks:

Variable source. (Circuit#1).
Power transistors. (Circuit#2).
MOSFET N. (Circuit#3).
MOSFET P. (Circuit#4).
Thyristores. (Circuit#5).
Pulse generator. (Circuit#6).
UJT. (Circuit#7).
Transformer. (Circuit#8).
Photodiode. (Circuit#9).
Lamp. (Circuit#10).
Rectification. (Circuit#11).
DIAC. (Circuit#12).
TRIAC. (Circuit#13).
DIAC tripping TRIAC. (Circuit#14).
Channels.

Note: FA-CO or EBC-100 Units give all the supplies required for this module.
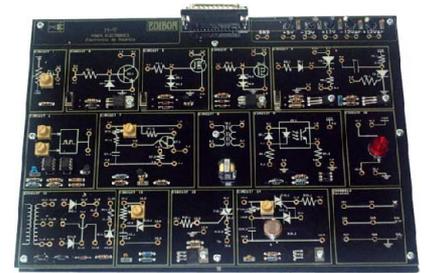
M10. **Digital Systems and Converters**

Practical possibilities:

<u>Analog switching. The bistable, astable and monostable family:</u>
1.- Characteristics of an analog switch chip.
2.- Study of the error F1 in the Analog Multiplexer.
3.- **Study of the errors in the Analog Multiplexer.**
4.- **Characteristics of an S-R type Latch Integrated circuit.**
5.- **Error Study in the bistable.**
6.- Characteristics of an integrated astable circuit.
7.- **Error Study in the astable.**
8.- Characteristics of an integrated Monostable circuit.
9.- Theoretical/practical exercises.
<u>Behaviour of Binary/BCD Counters & 7-segments Displays:</u>
10.- Characteristics of Binary UP/DOWN Counter 74LS193 and 7-Segment Display.
11.- **Error Study in the binary counter.**
12.- Characteristics of the BCD UP/DOWN counter and 7-Segment Display.
13.- **Error Study in the BCD counter.**
14.- Theoretical/practical exercises.
<u>Comparators and analog integrators:</u>
15.- Characteristics of an analog comparator.
16.- Analog integrator.
17.- **Error Study in the analog integrator.**
18.- Triangular wave generation.
19.- Theoretical/practical exercises.

<u>A/D and D/A conversion:</u>
20.- **D/A Converter.**
21.- **A/D Converter.**
22.- Theoretical/practical exercises.
<u>Applications:</u>
23.- **Random number generator.**
24.- Measuring the time between two events.
25.- Theoretical/practical exercises.

<u>Additional Possibilities:</u>
Synchronous/Asynchronous Counter.

Circuit blocks:

Potentiometer.
BCD counter.
Binary counter.
Logic monitors.
Display.
Shot Clocks.
Logic switches.
Flip Flop RS.
Analog multiplexer.
Analog integrator.
Monostable.
Logic gates.
Astable.
Analog comparator.
D/A converter.
Channels.

Note: FA-CO or EBC-100 Units give all the supplies required for this module.
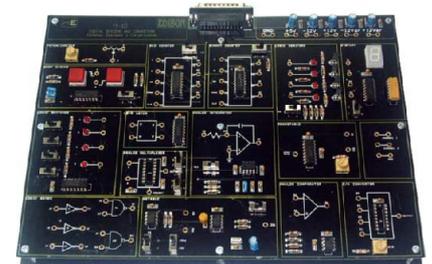
M11. **Digital Electronics Fundamentals**

Practical possibilities:

<u>Numbers systems:</u>
1.- **Voltage measurement in a circuit of sources.**
2.- **Fault study in the source circuit.**
3.- Exercises.
<u>Logical circuits:</u>
4.- **Logical Diode.**
5.- **Fault study in Sources.**
6.- **Logic with transistor and diodes.**
7.- **Fault study in transistor/diode circuit.**
8.- Exercises.
<u>TTL gates:</u>
9.- Basic function gates.
10.- **Fault study in TTL circuit.**
11.- **Fault study in Logic Gates.**
12.- Exercises.
<u>CMOS gates:</u>
13.- Basic function gates.
14.- **Fault study in CMOS circuit.**
15.- Exercises.
<u>Boolean Algebra and logical functions:</u>
16.- Study of use of Circuit #3.
17.- Exercises.
<u>Open collector gates:</u>
18.- Study of the use of Circuit #5.
19.- Exercises.

<u>Others types of integrated gates:</u>
20.- Study of simple operations with a Schmitt Trigger inverter.
21.- Operation study of a three-state buffer.
22.- Study of the fault in the Circuit #7.
23.- Exercises.

<u>Additional Possibilities:</u>
JK Flip-Flop.
Control of Data Bus.

Circuit blocks:

Logical source. (Circuit#1).
Sources. (Circuit#2).
TTL logical gates. (Circuit#3).
CMOS logical gates. (Circuit#4).
Open collector gates. (Circuit#5).
Schmitt trigger. (Circuit#6).
Three-states. (Circuit#7).
Channels.
Sources.
Indicators.

Note: FA-CO or EBC-100 Units give all the supplies required for this module.
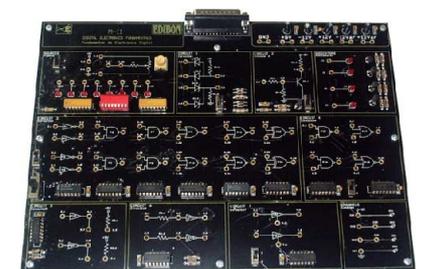
M12. **Basic Combinational Circuits**

Practical possibilities:

Encoders:
1.- Study of an encoder.
2.- **Fault study in the encoder.**
3.- Exercises.

Decoders:
4.- Study of a decoder.
5.- **Fault study in the decoder.**
6.- Exercises.

Multiplexers:
7.- Study of a multiplexer.
8.- **Study of the errors in the multiplexers.**
9.- Exercises.

Demultiplexers:
10.- Study of a demultiplexer.
11.- **Study of the errors in demultiplexers.**
12.- Exercises.

Digital Comparators:
13.- Study of a comparator.
14.- **Study of the errors in a comparator.**
15.- Exercises.

Arithmetic and logic operations:
16.- Study of an adder.
17.- Study of the error in the arithmetic and logic operations.
18.- Study of a parity generator.
19.- Study of the error in the Parity generator.
20.- Exercises.

Circuit blocks:

Encoder. (Circuit#1).
Decoder. (Circuit#2).
Multiplexer. (Circuit#3).
Demultiplexer. (Circuit#4).
Comparator. (Circuit#5).
Adder. (Circuit#6).
Parity. (Circuit#7).
Indicators.
Channels.
Sources.

Note: FA-CO or EBC-100 Units give all the supplies required for this module.
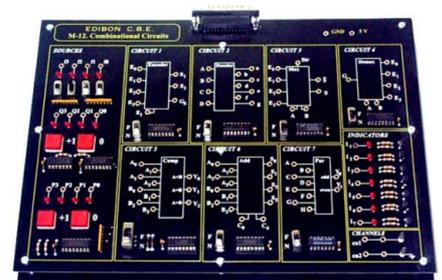
M13. **Basic Sequential Circuits**

Practical possibilities:

Bistables:
1.- Bistables.
2.- Bistable S-R using NAND gates.
3.- Practical performance.
4.- Study of error in the Bistables.
5.- Exercises.

Shift registers:
6.- Shift registers.
7.- Study of faults of the Shift registers.
8.- Exercises.

Counters:
9.- Practice of the Counters.
10.- Study of faults of the Counters.
11.- Exercises.

Synchronised sequential circuits:
12.- Practice of the Synchronised.

13.- Study of errors of the Synchronised sequential circuits.
14.- Exercises.

Memories:
15.- Exercises.

Circuit blocks:

Logic gates. (Circuit#1).
RS Bistable. (Circuit#2).
Shift registers. (Circuit#3).
Counters. (Circuit#4).
Logic displays.
Sources.
Signal generator.
Clock.

Note: FA-CO or EBC-100 Units give all the supplies required for this module.
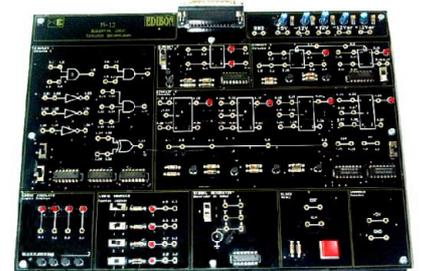
M14. **Optoelectronics**

Practical possibilities:

Light transmitters and liquid crystal display (LCD):
1.- **Light transmitters.**
2.- **Bar graph.**
3.- **LCD display** and 7-segment display.
4.- **Fault Study in light transmitters and liquid crystal display.**
5.- Exercises.

Photo-conducting cells:
6.- **Light dependent resistors.**
7.- Alarm.
8.- **Fault study on the photo-conducting cell.**
9.- Exercises.

Fibre optics:
10.- Fibre optics practice.
11.- Fault study using fibre optics.
12.- Exercises.

Infrared:
13.- **Circuit with infrared diodes.**
14.- **Fault study of the infrared diodes.**
15.- Exercises.

Circuit blocks:

Lamp. (Circuit#1).
Sources. (Circuit#2).
Bar graph. (Circuit#3).
LDR. (Circuit#4).
Photodiodes, optic fibre. (Circuit#5).
Converter. (Circuit#6).
Amplifier. (Circuit#7).
Differential amplifier. (Circuit#8).
Infrared Photodiodes. (Circuit#9).
LCD Display, 7 segment BCD. (Circuit#10).
Buzzer.

Note: FA-CO or EBC-100 Units give all the supplies required for this module.


M15. **Development Module**

This is a module to build and implement student's own circuits, it consists on:

Development board.
Power supply connector.
Digital visual display unit.
Logical source.
Set of potentiometers.
Pulse generator and inverters.
Interrupter.
Clock.

Circuit blocks:

Power.
Logic sources.
Logic displays.
Potentiometers.
Sources.
Clock.
Switch.

Note: FA-CO or EBC-100 Units give all the supplies required for this module.

Basic Electronics: Microprocessors
Available modules:
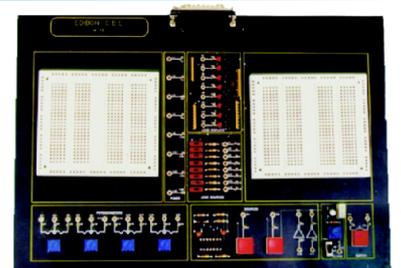
M30. **16 Bits Microprocessor** (EDILAB)

Main features:

It operates either with stand-alone keyboard and LCD or with host PC through its RS-232-C/RS 485 interface in serial mode.

Equally, it works with either 8086 or 8088 CPU in Max Mode at a frequency of 8 MHz.

Provision for on-board 8087 NDP.

Keyboard and serial monitor programs support the entry of user program, editing and debugging facilities like breakpoint, single-step and full speed execution of user program.

Built-in One Line Assembler, Dissembler in both serial and stand-alone modes of operation.

Provision for on-board memory of 1M bytes.

On-board parallel printer port.

On-board 8 bit DAC.

Provision for on-board 12 bit ADC.

48 I/O lines and there 16-bit programmable interval timers.

On-board Interrupt controller handles eight external interrupt sources. Provision for cascading through expansion connector.

Provision for system bus expansion through ribbon cable connectors.

Driver Software for file upload/download to/from host PC.

M31. **Z80 Microprocessor** (EDILAB)

Practical possibilities:

1. - Data transfer.
2. - Basic applications of arithmetic and logic operation instructions.
3. - Binary addition and subtraction.
4. - Branch instructions and program loops.
5. - Stack and subroutines.
6. - Rotate shift instructions and multiplication routines.
7. - Binary division routine.
8. - Binary to BCD conversion program.
9. - BCD-to-binary conversion program.
10. - Square root program.
11. - Clock (how to design a clock).
12. - Clock 2 (with CTC interrupt mode 2).
13. - Telephone tone.
14. - Music box.

Specifications:

Circuits board, containing:
- Z80 Microprocessor (8 bits).
- PIO input/output interface chip.

Z80 -CTC counter/timer chip.8Kx8 EPROM memory.

8Kx8 RAM memory.

7 LED to show the output digital port state.

8 switch to set the state of the input digital port.

Speaker provided on board for user's application.

Extension connectors: provide all buses of CPU for users expansion.

Programming Language development Software.

Manuals set.

Applications (optional):
- 1. - Applications Module:
 - Data acquisition by A/D converter (physical parameters control).
  - Relays and /or thyristors control.
  - 16 keys keyboard.
  - 4 displays of 7 segments.
  - LCD display of 2 lines and 16 characters.
- 2. - Micro-robot with 4 movements.
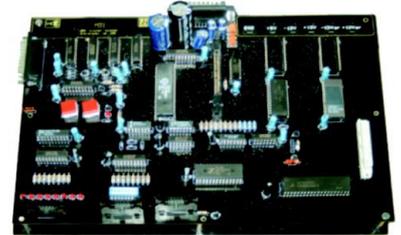
M-EB. **Practical Expansion Boards** (EDILAB)

Main features:

Cross by traffic light simulator.
Digital/Analog double converter.
8 channels analog/digital converter.
Stepping motor control.
DC motor control.
Solid-state relays.
EPROM memories programmer.
Universal controller.
Robotic trainer.
Centronics interface.

Printer.
Expansion for hardware applications.
Audio module.
Lifts simulator.
Practices basic module.
EPROM memories programmer.
Physical parameters sensors.
Teaching robot.
MODEM.
RS-232C interface.
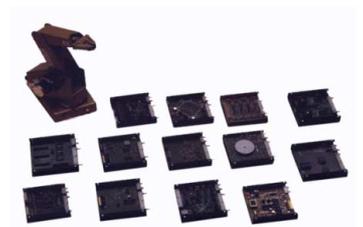
M32. **8051 Microcontroller** (EDILAB)

Main features:

It operates either in stand-alone mode using computer (PC) keyboard and LCD or with host PC through its RS-232-C/RS-485 interface in serial mode.

Keyboard and serial monitor programs support the entry of user programs, editing and debugging facilities like breakpoints (128K) single stepping and full speed execution of user programs.

Line Assembler and Disassembler in both modes.

Total on-board memory is 128K bytes of which 88K bytes RAM has battery backup provision.

On-board parallel printer port.

On-board 8 bit DAC.

Optional on-board 12 bit ADC.

48 I/O lines and four programmable interval timers.

13 port lines of the MCU are brought out to the connector including INT1, RXD & TXD pins (6 lines are shared for optional 12 bit ADC).

Buffered bus signals are available through ribbon cable connector for easy system expansion.

User friendly Window and DOS driver software for file upload/download to/from host PC.

M33. **68000 Microprocessor** (EDILAB)

Main features:

It operates with a PC compatible system through its RS 232 C serial communication interface.

Powerful system monitor permits entry of programs, debugging through breakpoint, trace and instruction step facilities.

Driver Software for PC compatibles with file upload download capability.

On-line Assembler, Disassembler.

This trainer has on board memory of 128K bytes of monitor firmware, 64K of RAM, expandable up to 256K bytes of optional ROM/RAM.

ABORT facility to recover gracefully from "STUCK" program.

Flexible and Powerful Interrupt system.

On board European standard G64 Bus interface.

Provision for multi-master design expansion.

Provision for Nickel cadmium battery for battery back-up of RAM.

Supported by variety of Interface Modules.

On board serial printer interface.

M34. **DSP Microprocessor** (EDILAB)

Practical possibilities:

1. - Sinewave Generation on Port A of 8255.
2. - Output Sinewave using D/A Converters.
3. - Transmit/Receive "READY" Signal from PC via Serial Port.
4. - Test Data Memory and Send the Results to Computer (PC).
5. - LCD Module Control.
6. - RTC (Real Time Clock) Display on LCD.
7. - Keypad Interface Control.
8. - Encoder Output and Display on LCD.
9. - External Interrupt Control.
10. - A/D Converter Control.
11. - PWM and Dead-Band Control and Setting.
12. - Capture Control.

Basic Electronics: Transducers

M41. Resistance Transducers

Practical possibilities:

1.- Linearly sliding potentiometer.
2.- Rotary carbon-track potentiometer.
3.- Rotary coil potentiometer.
4.- Precision servo-potentiometer.

Note: FA-CO or EBC-100 Units give all the supplies required for this module.
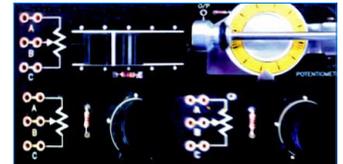
M43. Applications of Temperature

Practical possibilities:

The integrated circuit temperature transducer:
1.- Characteristics of an integrated temperature circuit.
2.- Construction of a digital thermometer.

The (T.D.R.) Platinum transducer:
3.- Characteristics of a platinum Temperature Dependent Resistance (T.D.R) transducer.

The N.T.C (Negative Temperature Coefficient) thermistor:
4.- Characteristics of an N.T.C thermistor.
5.- N.T.C Characteristics. Thermistor used in an alarm circuit (double thermistor).

The "K" type thermocouple temperature thermistor:
6.- Characteristics of a 'K' type thermopar.

Circuit blocks:

Counter/Timer.
Thermometric probes (Type 'K', IC, Thermistor, Platinum RTD).
Wheatstone bridge.
Carbon track.
Buzzer.
Electronic switch.
Voltage to frequency converter.
Differentiator.
AC Amplifier.
Amplifier (Adjust offset. Gain).
Comparator. Hyteresis.
Instrumental amplifier.
Buffer.
x100 amplifier.

Note: FA-CO or EBC-100 Units give all the supplies required for this module.

M44. Applications of Light

Practical possibilities:

1.- Photovoltaic Cell.
2.- Characteristics of a photovoltaic cell.
3.- Phototransistor.
4.- Characteristics of a phototransistor.
5.- Photodiode PIN.
6.- Characteristics of a PIN photodiode.
7.- Photoconductive Cell.
8.- Luminous intensity detector.

Note: FA-CO or EBC-100 Units give all the supplies required for this module.

## M45. Linear Position and Force

Practical possibilities:

1.- Characteristics of a Linear Variable Differential Transformer (LVDT).
2.- Characteristics of a Variable Resistance.
3.- The characteristics of a strain gauge transducer.

Note: FA-CO or EBC-100 Units give all the supplies required for this module.
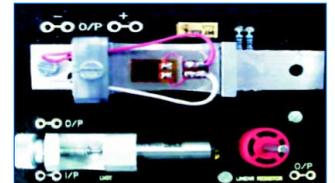
M46. Environmental Measurements

Practical possibilities:

1.- Characteristics of Air flow Sensor.
2.- Characteristics of Air pressure Sensor.
3.- Characteristics of Humidity Sensor.

Note: FA-CO or EBC-100 Units give all the supplies required for this module.

M47. Rotational Speed and Position Control

Practical possibilities:

1.- Characteristics of a slotted opto transducer and its applications for counting and speed measurement.
2.- Characteristics of the reflective opto-transducer.
3.- Characteristics of an inductive transducer.

4.- Characteristics of a half effect transducer.
5.- Characteristics of a D.C. Permanent magnet tachogenerator.

Note: FA-CO or EBC-100 Units give all the supplies required for this module.
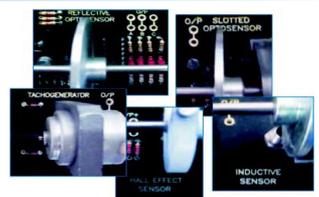
M48. Sounds Measurements

Practical possibilities:

1.- Characteristics of a Dynamic Microphone.
2.- Characteristics of an ultrasonic receiver.
3.- Theoretical/Practical questions.

Note: FA-CO or EBC-100 Units give all the supplies required for this module.

M49. Applications of Temperature and Pressure

Practical possibilities:

The integrated circuit temperature transducer:
1.- Characteristics of an integrated temperature circuit.
2.- Construction of a digital thermometer.

The (T.D.R.) Platinum transducer:
3.- Characteristics of a platinum Temperature Dependent Resistance (T.D.R) transducer.

The N.T.C (Negative Temperature Coefficient) thermistor:
4.- Characteristics of an N.T.C thermistor.
5.- N.T.C Characteristics. Thermistor used in an alarm circuit (double thermistor).

The "K" type thermocouple temperature thermistor:
6.- Characteristics of a 'K' type thermopar.

The Pressure transducer:
7.- Characteristic of a pressure transducer.

Circuit blocks:

Counter/Timer.
Thermometric probes (Type 'K', IC, Thermistor, Platinum RTD).
Wheatstone bridge.
Carbon track.
Buzzer.
Pressure transducer.
Electronic switch.
Voltage to frequency converter.
Differentiator.
AC Amplifier.
Amplifier (Adjust offset. Gain).
Comparator. Hyteresis.
Instrumental amplifier.
Buffer.
x100 amplifier.

Note: FA-CO or EBC-100 Units give all the supplies required for this module.

Basic Electronics: Control Electronics

Available modules:

M60. **Analog/Digital Converters**

Practical possibilities:

1.- Sampling theorem.

2.- Monopolar simple ramp converter.

3.- Monopolar double ramp converter.

4.- Monopolar binary ramp converter.

5.- A/D integrated converter. Monopolar assembly.

6.- A/D integrated converter. Bipolar assembly.

7.- Flash converter.

Circuit blocks:

Generators.
D/A converter.
A/D converter.
Adder.
Sample & Hold.
Leds.
Logic control.
Integrator.
Counter.
Flash converter.

Note: FA-CO or EBC-100 Units give all the supplies required for this module.
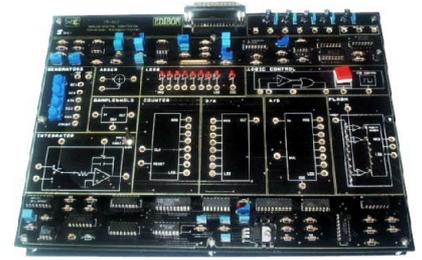
M61. **Digital/Analog Converters**

Practical possibilities:

1.- D/A converter of weighted divider resistors.

2.- Analog switches errors.

3.- D/A converter of R/2R ladder.

4.- Current division in R/2R ladder converter.

5.- D/A converter of inverted ladder.

6.- D/A integrated converter.

7.- Serial data input D/A converter.

8.- D/A converter of pulse width modulation.

Circuit blocks:

Generators.
R/2R converter.
Weighed converter.
D/A converter.
Serial converter.
Amplifier.
Adder.
Sample/Hold.
Frequency-voltage converter.

Note: FA-CO or EBC-100 Units give all the supplies required for this module.
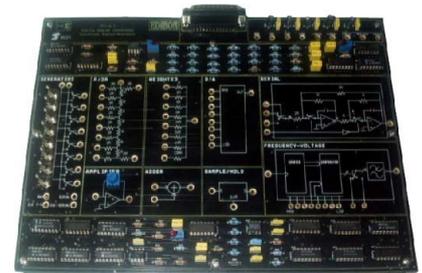
M65. **Control and Regulation**

Practical possibilities:

1.- Study in open loop N°1: Proportional block.

2.- Study in open loop N°2: Integrator block.

3.- Study in open loop N°3: Simple pole.

4.- Study in open loop N°4: 2nd order plant.

5.- Study in open loop N°5: Non lineal plants: Limitation and Hysteresis.

6.- Study in open loop N° 6: Block composition: Negative zero and Negative Pole.

7.- Study in closed loop N°1: Control by means of Optimum Quantitative.1st order system.

8.- Study in closed loop N°2: Control by means of Optimum Quantitative. 2nd order system.

9.- Potentiometer adjustment.

Note: FA-CO or EBC-100 Units give all the supplies required for this module.

Basic Electronics: Any other possibilities

Available modules:

M99. **Expansion Board**

The aim of the M99 Expansion Board is to provide generic support to up to 8 electronic sub-boards, each one with its own specific functionality, customized to client necessities.

The sub-boards have to be inserted in any of the eight 32-pin female connectors reserved for it on the M99 Board.

There are connectors, in both the sub-boards and on the M99, through which one can access the internal input/output data points, to take measures and get information about the practice. Thus, the student carries out the pedagogical aims.

In the upper right corner of the M99 board there are 14 connectors for power supply. Thanks to them, the sub-boards can be supplied with different voltage intensities. Either "FA-CO" Power Supply or "EBC-100" Base unit with built-in power supply, are required to work with the M99 Expansion Board, like with any other Module.

- Some electronic sub-boards already developed:

M99-1. Analogical Commutator.
M99-2. Analogical Multiplier.
M99-3. Function Generator.
M99-4. AM Modulator.
M99-5. AM Demodulator.

* We can design and include any electronic circuit or application on a sub-board according to customer requirements. This way, any Modules can be complemented with extra circuits, in extra sub-boards.

The sub-boards can also be purchased independently to the modules, thus giving total freedom to customers in the acquisition of circuits.

ANY SPECIFICATIONS CAN BE COVERED

Example of an electronic sub-board put in the M99 Board
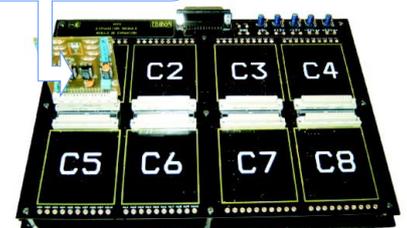
Note: FA-CO or EBC-100 Units give all the supplies required for this module.
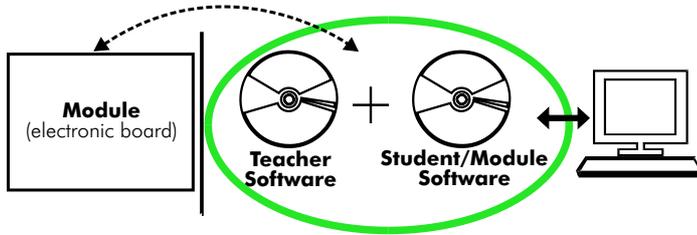
With no physical connection between module and computer, this complete package consists on an Instructor Software (INS/SOF) totally integrated with the Student/Module Software (M../SOF). Both are interconnected so that the teacher knows at any moment what is the theoretical and practical knowledge of 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 + M../SOF.

3.1) 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 modules, and working in network configuration, allows controlling all the students in the classroom.

3.2) **M../SOF. Computer Aided Instruction Software Packages (Student/Module Software).**
It explains how to use the module, run the experiments and what to do at any moment.
Each module 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 modules, showing how to complete the circuits and get the right information from them.
Exams: set of questions presented to test the obtained knowledge.
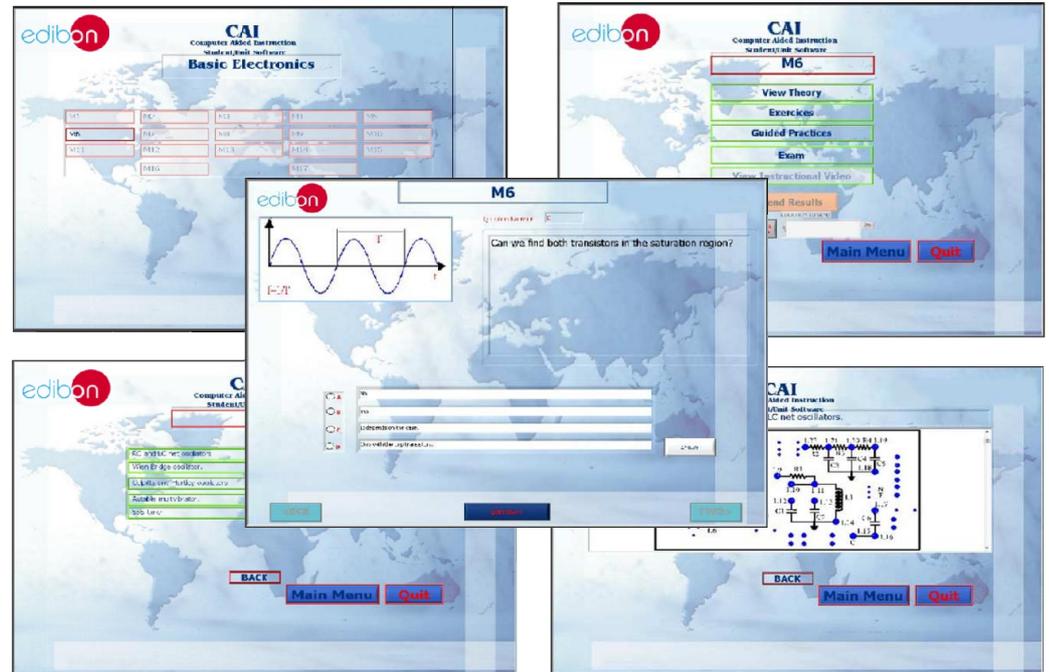
∗ Both Instructor Software and Student/Module Software are available in English and Spanish. Any other language available on request.

Available Student/Module Software Packages:

Basic electricity
- M1/SOF. Direct Current (D.C.) Circuits.
- M2/SOF. Alternating Current (A.C.) Circuits.
- M16/SOF. Electric Networks.
- M17/SOF. Electromagnetism.
- M18/SOF. Three-phase Circuits.

Basic Electronic:
- M3/SOF. Semiconductors I.
- M4/SOF. Semiconductors II.
- M5/SOF. Power Supplies.
- M6/SOF. Oscillators.
- M7/SOF. Operational Amplifiers.

- M8/SOF. Filters.
- M9/SOF. Power Electronics.
- M10/SOF. Digital Systems and Converters.
- M11/SOF. Digital Electronics Fundamentals.
- M12/SOF. Basic Combinational Circuits.
- M13/SOF. Basic Sequential Circuits.
- M14/SOF. Optoelectronics.
- M15/SOF. Development Module.

Basic Electronic: Transducers:
- M41/SOF. Resistance transducers.
- M43/SOF. Applications of Temperature.
- M44/SOF. Applications of light.

- M45/SOF. Linear Position and Force.
- M46/SOF. Environmental Measurement .
- M47/SOF. Rotational Speed and Position Control.
- M48/SOF. Sound Measurements.
- M49/SOF. Applications of Temperature and Pressure.

Basic Electronic: Control Electronics:
- M60/SOF. Analog/Digital Converters.
- M61/SOF. Digital/Analog Converters.
- M65/SOF. Control and Regulation.

This Computer Aided Learning Software (CAL) is a Windows based software, simple and very easy to use specifically developed by EDIBON. It has been designed to cover different areas of science: Basis Electronics, Communications, Basic Electricity, Mechanics, Basic Fluid Mechanics and General Fluid Mechanics*. **On the Basic Electronics Area, it can be used with the M1 to M18 modules.** These modules cover every subject in Basic Electricity and Electronics, both analog and digital. (See page 4 for Modules details).

*Although only the purchased areas will be activated and ready to use.

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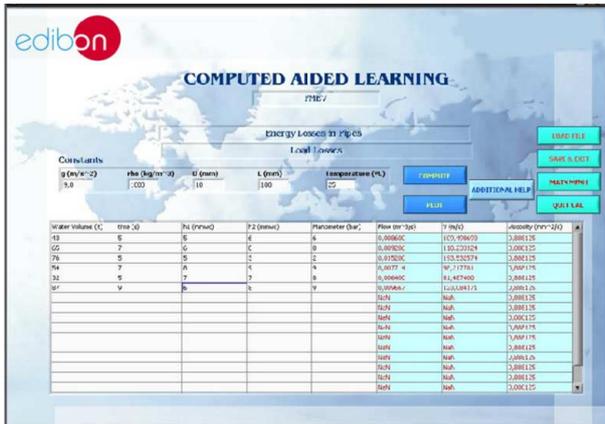
Simply insert the experimental data, with a single click CAL will perform the calculations.

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:
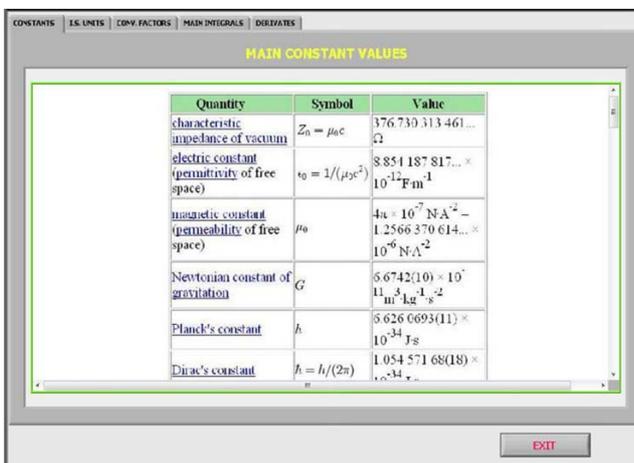
It provides a handy option to avoid using different reference sources while in progress. For example: the values of Physical constants, their symbols and right names, conversion factors...
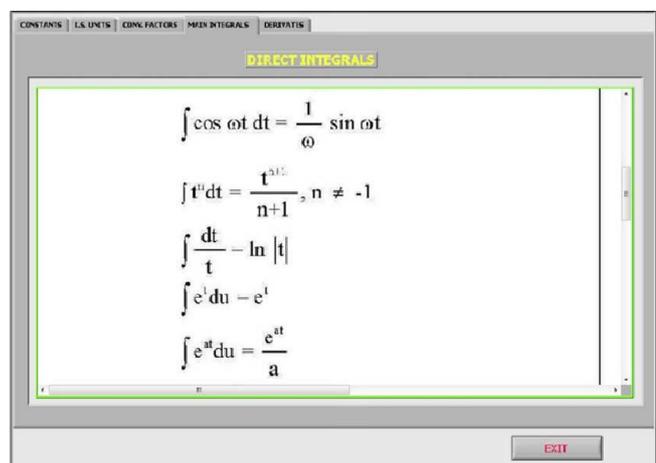
...and the very useful Integral and Derivative tables.

✱ Software available in English and Spanish. Any other language available on request.
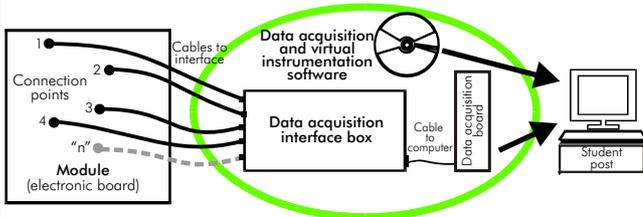
EDAS/VIS is the perfect link between the electronic modules and the PC. With the EDAS/VIS system, information from the modules is sent to the computer. There, it can be analyzed and represented.

We easily connect the Data Acquisition Interface Box (DAIB) to the modules with the supplied cables (connection points are placed in the modules). Like any other hardware, the DAIB is connected to the PC through the Data Acquisition Board (DAB), and by using the Data Acquisition and Virtual Instrumentation Software (specific for every module), the student can get the results from the undertaken experiment/practice, see them on the screen and work with them.

This EDAS/VIS System includes DAIB + DAB + EDAS/VIS-SOF:

5.1) Hardware:

5.1.1) **DAIB. Data Acquisition Interface Box:**
Metallic box. Dimensions: 310 x 220 x 145 mm. approx.
Front panel:
16 Analog inputs (1 block with **12 voltage channels** and 1 block with **2 current channels** (4 connections)).
Sampling velocity **1,250,000 samples per second** for **EDAS/VIS 1.25 Version.**
Sampling velocity **250,000 samples per second** for **EDAS/VIS 0.25 Version.**
2 Analog outputs.
24 Digital inputs/outputs, configurable as inputs or outputs, with 24 state led indicators.
These digital inputs/outputs are grouped in three ports of eight channels (P0, P1 and P3).
4 Digital signal switches 0-5V. 2 Analog signal potentiometers ±12V.
Main ON/OFF switch.
Inside: Internal power supply of 12 and 5 V. Potentiometer.
Back panel: Power supply connector. SCSI connector (for data acquisition board).
Connecting cables.

DAIB

5.1.2) **DAB. Data Acquisition Board:**
For EDAS/VIS 1.25 Version:
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: 1,250,000 S/s (samples per second). Input range (V)=±10V.
Data transfers=DMA, interrupts, programmed I/0. Number of DMA channels=6.
Analog output:
Number **channels=2. Resolution=16 bits**, 1 in 65536. **Max. output rate up to: 833KS/s.**
Output range(V)=±10V. Data transfers=DMA, interrupts, programmed I/0.
Digital Input/Output: Numbers of **channels=24 inputs/outputs. Port 0 up to 8 Mhz.**
Timing: **Counter/timers=2.** Resolution: Counter/timers: 32 bits.
For EDAS/VIS 0.25 Version:
Sampling rate up to: 250,000 S/s (samples per second).
Analog output: Max. output rate up to: 10 KS/s.
Digital Input/Output: Number of **channels=24 inputs/outputs. Port 0 up to 1 Mhz.**
Rest of characteristics are the same than EDAS/VIS 1.25 Version.

DAB

5.2) **EDAS/VIS-SOF. Data Acquisition and Virtual Instrumentation Software:**
Compatible with actual Windows operating systems. Amicable graphical frame.
Configurable software allowing the temporal/frequency representation of the different inputs and outputs. Visualization of a voltage of the circuits on the computer screen.
It allows data store in a file, print screens and reports of the signals at any time.
Measurement, analysis, visualization, representation and report of results.
Set of Virtual Instruments:
- Oscilloscope:
Channels: 12 simultaneous. Maximum input voltage:±10V.
All 12 input channels could be scaled to compare signal with different voltage levels.
"Math Menu" with operations as Addition, Subtraction, Multiplication and Division, between any of the 12 oscilloscope channels.
- Function Generator:
Two independent signal generators, for sinusoidal, triangular, saw tooth and square.
Channels: 2 (allowing working simultaneously). Maximum output voltage:±10V.
It includes a graph where an output signal for each channel is shown.
- Spectrum Analyzer:
Channels: 12 (simultaneous). Max. voltage:±10V. Spectrum analyzer: based on the FFT.
- Multimeter:
Voltmeter (**Channels: 12** (simultaneous). Max. voltage:±10V RMS).
Ammeter (**Channels: 2** (simultaneous). Max. Ampere: 500 mA rms per channel).
- Transient Analyzer.
- Logic Analyzer:
Number of Input channels: 8. TTL Voltage Level. **Clock Source: 3 different sources.**
This instrument allows receiving as far as 8 digital signal simultaneously at 1 or 8 Mbps (depending the version).
- Logic Generator:
Number of transmission channels: 8. TTL voltage level.
This instrument allows generating up to 8 digital simultaneous signals of 1 or 8 Mbps (depending of the version).
Sampling velocity 1,250,000 samples per second for EDAS/VIS 1.25 Version.
Sampling velocity 250,000 samples per second for EDAS/VIS 0.25 Version.
Manuals: This system **is supplied with the following manuals**: Required Services, Assembly and Installation, Interface and Software, Starting-up, Safety, Maintenance & Practices
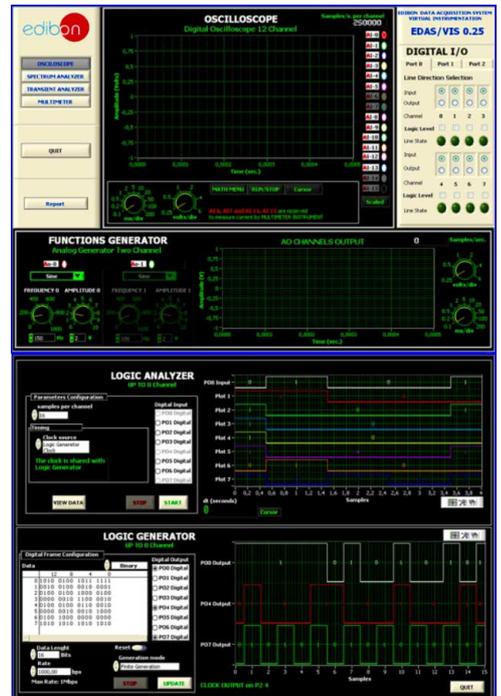
EDAS/VIS-SOF

Important! Only one EDAS/VIS is needed for all basic electronic boards. One EDAS/VIS is needed for each student work post. The EDAS/VIS allows to work with several basic electronic boards simultaneously.

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

Note: for more information see EDAS/VIS specific Catalogue: www.edibon.com/products/catalogues/en/units/electronics/basic/EDAS-VIS.pdf

- Electrical power supply needed for FA-CO and EBC-100: single-phase, 220V/50Hz or 110V/60 Hz.
- For using EDAS/VIS, CAI and/or LIEBA/CAL a Computer (PC) is required.

Each module: - Dimensions: 300 x 210 x 45 mm. approx.
　　　　　　　　- Weight: 300 gr. approx.
FA-CO:　　　　- Dimensions: 225 x 205 x 100 mm. approx.
　　　　　　　　- Weight: 2 Kg. approx.
EBC-100:　　　- Dimensions: 410 x 298 x 107 mm. approx.
　　　　　　　　- Weight: 2 Kg. approx.

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

REPRESENTATIVE: