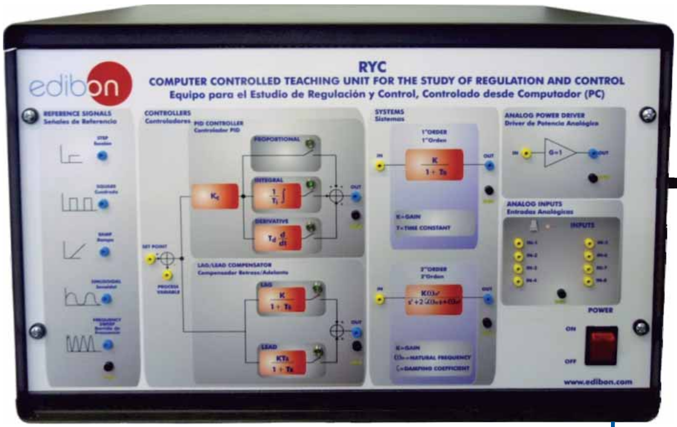
Computer Controlled **Teaching Unit for the Study of Regulation and Control,** with SCADA and PID Control

RYC

edibon
Technical Teaching Equipment



① Unit: RYC. Teaching Unit for the Study of Regulation and Control

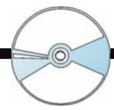
Teaching Technique used

EDIBON PATENT

EDIBON **SCADA** System and **PID CONTROL** included

Control Interface included in the Unit

② Data Acquisition Board



③ Software for:
- Computer Control
- Data Acquisition
- Data Management

Computer (not included in the supply)

④ Cables and Accessories

⑤ Manuals

*Minimum supply always includes: 1 + 2 + 3 + 4 + 5
(Computer not included in the supply)

⑥ Additional applications for working with the RYC Unit

- 6.1 RYC-SM. DC Servo Motor Module
- 6.2 RYC-BB. Ball and Beam Module
- 6.3 RYC-TAR. Air Flow Temperature Control Module
- 6.4 RYC-TAG. Water Flow Temperature Control Module
- 6.5 RYC-T. Temperature Control Module
- 6.6 RYC-P. Pressure Control Module
- 6.7 RYC-N. Level Control Module
- 6.8 RYC-C. Flow Rate Control Module
- 6.9 RYC-I. Luminosity Control Module
- 6.10 RYC-pH. pH Control Module
- 6.11 RYC-CP. Position Control Module
- 6.12 RYC-PI. Inverted Pendulum Control Module
- 6.13 RYC-CLM. Magnetic Levitation Control Module

OPEN CONTROL + MULTICONTROL + REAL TIME CONTROL

Key features:

- **Advanced Real-Time SCADA and PID Control.**
- **Open Control + Multicontrol + Real-Time Control.**
- **Specialized EDIBON Control Software based on Labview.**
- **National Instruments Data Acquisition board (250 KS/s , kilo samples per second).**
- **Projector and/or electronic whiteboard compatibility allows the unit to be explained and demonstrated to an entire class at one time.**
- **Capable of doing applied research, real industrial simulation, training courses, etc.**
- **Remote operation and control by the user and remote control for EDIBON technical support, are always included.**
- **Totally safe, utilizing 4 safety systems (Mechanical, Electrical, Electronic & Software).**
- **Designed and manufactured under several quality standards.**
- **Optional CAL software helps the user perform calculations and comprehend the results.**
- **This unit has been designed for future expansion and integration. A common expansion is the EDIBON Scada-Net (ESN) System which enables multiple students to simultaneously operate many units in a network.**
- **Wide range of applications for working with RYC.**

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Products
Products range
Units
2.-Electronics and
6.-Mechatronics & Automation

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

European Union Certificate (total safety)

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

Worlddidac Quality Charter Certificate (Worlddidac Member)

INTRODUCTION

Nowadays, the regulation and control engineering has an essential role in a wide range of control systems. A system can be mechanic, electric, chemical, etc. and the mathematical modeling, analysis and controller design uses control theory in time, frequency and complex-s domains, depending on the nature of the design problem.

The "RYC" is the Regulation and Control trainer unit designed by EDIBON. It allows students to learn the most important concepts about Regulation and Control in an easy and comprehensive way.

The unit is provided with a set of practices, through which the user will understand how to characterize first order systems and second order systems, and how the PID controller and the Lead & Lag controller work.

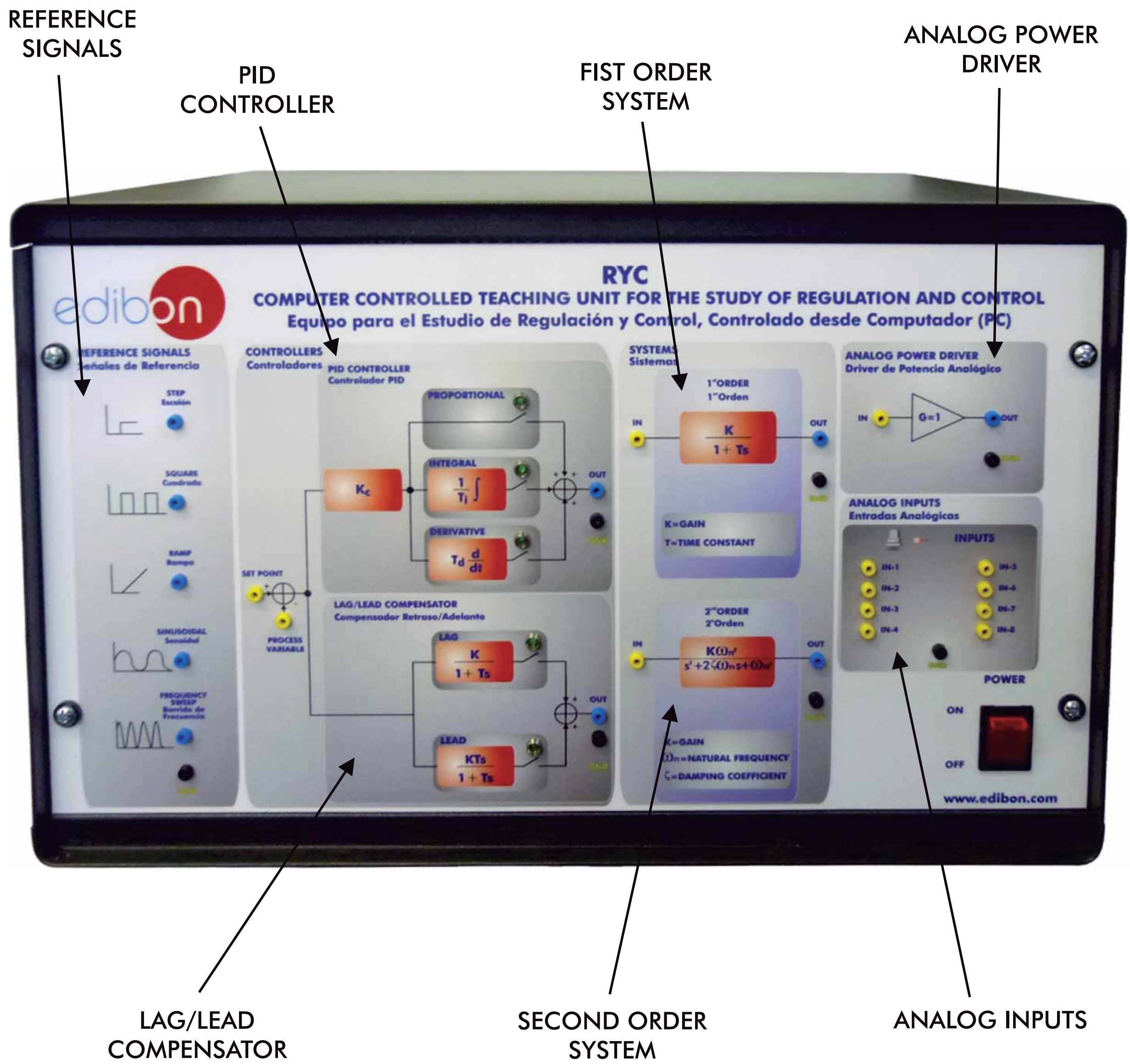
GENERAL DESCRIPTION

Regulation and control theory is divided into two major divisions in, namely, classical and modern. The implementation of classical controller designs as compared to systems designed using modern control theory is easier and these controllers are preferred in most industrial applications. The most common controllers designed using classical control theory, are PID controllers.

The "RYC" unit allows the students to simulate a first order system and second order system and regulate them with a PID controller or Lead & Lag compensator.

A wide range of applications (DC Servo Motor Module, Ball and Beam Module, etc.) for working with the "RYC" unit are available to study a real process response to complement the Study of regulation and control in real time.

PROCESS DIAGRAM AND UNIT ELEMENTS ALLOCATION



With this unit there are several options and possibilities:
- Main items: 1, 2, 3, 4 and 5.
- Additional Applications for working with RYC Unit: 6.
- Optional items: 7, 8, 9 and 10.

Let us describe first the main items (1 to 5):

① RYC. Unit:

Unit:

Metallic box.

Diagram in the front panel with similar distribution to the elements in the real unit.

Reference signals module:

This module allows to generate four different types of signals: step, square, ramp and sine. The frequency and amplitude of the signals can be adjusted through the computer (PC).

Step output. Square output. Ramp output. Sine output.

Step: amplitude: 0 V to 5 V, frequency: signal of low frequency with a fixed valve.

Square: amplitude: ±10 V, frequency: 0Hz to 200Hz.

Ramp: amplitude: ±10 V, frequency: 0Hz to 200Hz.

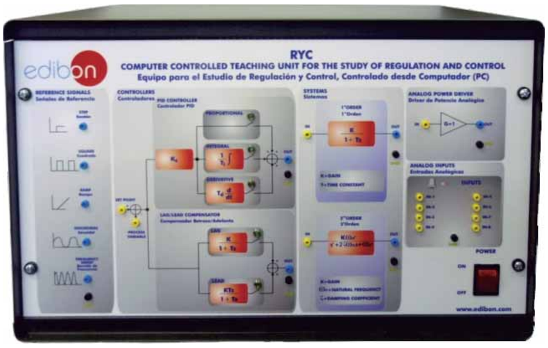
Sine: amplitude: ±10 V, frequency: 0Hz to 200Hz.

Frequency sweep: this module performs a frequency sweep needed for calculating the Bode plot.

PID controller module:

This module is subdivided into proportional, integrative and derivative blocks. The module allows to adjust each parameter independently from the computer (PC).

P controller: Kc: 1 to 20. I controller: Ti: 1 to 100ms. D controller: Td: 1 to 100ms. Sample time: 0.1 to 100ms.



RYC. Unit

Lead/Lag compensator:

This module represents a compensator system in the Laplace domain. The system allows to modify the zero, the pole and the gain of the compensator through the computer (PC).

(K lead): 1 to 100ms. (K lag): 1 to 100ms. Gain: 1 to 10. Sample time: 0.1 to 100ms.

First order system:

This module represents a first order system in the Laplace domain. The system allows to modify the time constant of the system through the computer (PC). The gain can be also adjusted using the computer (PC).

Time constant T: 1ms to 100 ms. Gain: 1 to 10.

Second order system:

This module represents a second order system in Laplace domain. The system allows to modify through the computer (PC) the three parameters of the system: gain, damping coefficient and the natural frequency.

Damping coefficient ξ: 0 to 1.5 in steps of 0.1.

Natural frequency (ω n): 1Hz to 2 π*100 rad/s (100Hz).

Gain: 1 to 10.

Analog power driver:

This module consists of a power amplifier that can be used as the last stage when an application requires high power supply (for example a DC Motor, pump, etc).

Analog Inputs:

This module is provided with 8 analog inputs. The inputs are used to visualize different signals in the computer (PC).

On/Off switch.

Fuse.

Connector to computer (PC).

Control Interface included.

Wide range of applications for working with RYC (not included in the minimum supply). (see pages from 5 to 9).

The complete unit includes as well:

Advanced Real-Time SCADA and PID Control.

Open Control + Multicontrol + Real-Time Control.

Specialized EDIBON Control Software based on Labview.

National Instruments Data Acquisition board (250 KS/s , kilo samples per second).

Projector and/or electronic whiteboard compatibility allows the unit to be explained and demonstrated to an entire class at one time.

Capable of doing applied research, real industrial simulation, training courses, etc.

Remote operation and control by the user and remote control for EDIBON technical support, are always included.

Totally safe, utilizing 4 safety systems (Mechanical, Electrical, Electronic & Software).

Designed and manufactured under several quality standards.

Optional CAL software helps the user perform calculations and comprehend the results.

This unit has been designed for future expansion and integration. A common expansion is the EDIBON Scada-Net (ESN) System which enables multiple students to simultaneously operate many units in a network.

Continue...

② DAB. Data Acquisition Board:

The Data Acquisition board is part of the SCADA system.

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

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)= ±10 V.

Data transfers=DMA, interrupts, programmed I/0. DMA channels=6.

DAB

Analog output:

Number of **channels=2**.

Resolution=16 bits, 1 in 65536.

Maximum output rate up to: 900 KS/s.

Output range(V)= ±10 V.

Data transfers=DMA, interrupts, programmed I/0.

Digital Input/Output:

Number of **channels=24 inputs/outputs**.

D0 or DI Sample Clock frequency: 0 to 100 MHz.

Timing:

Counter/timers=4.

Resolution: Counter/timers: 32 bits.

③ RYC/CCSOF. PID Computer Control +Data Acquisition+Data Management Software:

The three softwares are part of the SCADA system.

Compatible with actual Windows operating systems.

Graphic and intuitive simulation of the process on the computer screen.

Compatible with the industry standards.

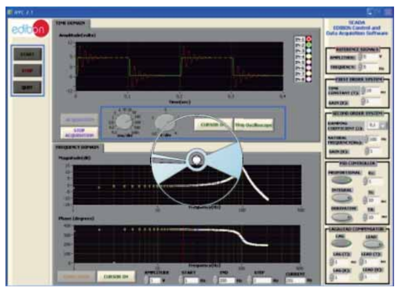
The software allows to modify all parameters of system simulators (first and second order) and controllers (PID and Lead/Lag Compensator).

Registration, visualization and control of all process variables in an automatic and simultaneous way.

Flexible, open and multicontrol software, developed with actual windows graphic systems, acting simultaneously on all process parameters.

PID menu and set point selection required in the whole work range.

Management, processing, comparison and storage of data.



RYC/CCSOF

Sampling velocity up to 250 KS/s (kilo samples per second).

Comparative analysis of the obtained data, after the process and modification of the conditions during the process.

Open software, allowing the teacher to modify texts, instructions. **Teacher's and student's passwords** to facilitate the teacher's control on the student, and allowing the access to different work levels.

This unit allows the 30 students of the classroom to visualize simultaneously all the results and the manipulation of the unit, during the process, by using a projector or an electronic whiteboard.

④ Cables and Accessories, for normal operation.

⑤ Manuals:

This unit is **supplied with the following manuals**: Required Services, Assembly and Installation, Interface and Control Software, Starting-up, Safety, Maintenance & Practices Manuals.

* References 1 to 5 are the main items: RYC + DAB + RYC/CCSOF + Cables and Accessories + Manuals are included in the minimum supply for enabling normal and full operation.

⑥ **Additional Applications** for working with the RYC Unit:

6.1 RYC-SM. **DC Servo Motor Module:**

This module has been designed to study a practical control system, through the control of the position and speed of a DC Servo Motor.

The RYC-SM module is conformed of DC servo motor, tachometer and potentiometer. The elements are used in conjunction with the RYC unit to control the motor position and the motor speed.

Specifications:

Painted steel box.

Diagram on the front panel with similar distribution to the elements in the real unit.

DC Servo Motor:

Motor supply: 10Vdc.

Motor speed: 3600 rpm max.

Tachometer:

Tachometer output: 10Vdc.

Tachometer speed: 3600 rpm max.

360 degrees potentiometer:

The potentiometer is connected to the axis of rotation to measure the position motor.

Dimensions: 300 x 200 x 200 mm. approx. (11.81 x 7.87 x 7.87 inches approx.).

Weight: 10 Kg. approx. (22 pounds approx.).

RYC-SM

6.2 RYC-BB. **Ball and Beam Module:**

This module has been designed to study a practical control system, through the study of a classical control system; the Ball and Beam system.

The RYC-BB module is conformed of DC servo motor, potentiometer, resistive wires and metallic ball. The sensors are used in conjunction with the RYC unit to control the position of the ball over the resistive wires.

Specifications:

Painted steel box.

Steel ball.

DC Servo Motor:

For modification the angle of the beam.

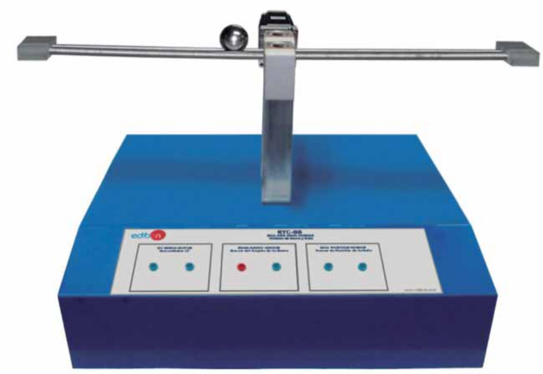
Sensors:

Potentiometer for detection the angle of beam.

Resistive wires (the ball rolls on them) and sensor to detect the different electrical resistances depending on the position of the ball.

Dimensions: 1000 x 350 x 430 mm. approx. (39.37 x 13.78 x 16.93 inches approx.).

Weight: 15 Kg. approx. (33 pounds approx.).



RYC-BB

6.3 RYC-TAR. **Air Flow Temperature Control Module:**

This module has been designed to study a practical control system, through the control of the air flow temperature.

The RYC-TAR module main components are a cylindrical duct with a heater element and fan at the beginning of the duct and three selectable temperature measuring devices along the cylinder.

The signal from each temperature measuring device is used by the RYC unit to control the air flux through the control of the power of the fan.

Specifications:

Painted steel box.

Diagram in the front panel with similar distribution to the elements in the real unit.

Fan:

Motor speed: 1200 rpm max.

Dimensions: 120mm x 12mm.

Three selectable thermocouples, distributed along the duct.

Dimensions: 400 x 300 x 300 mm. approx. (15.74 x 11.81 x 11.81 inches approx.).

Weight: 7 Kg. approx. (15.4 pounds approx.).

Continue...

⑥ **Additional Applications for working with the RYC Unit**: (continuation)

6.4 RYC-TAG. **Water Flow Temperature Control Module:**

This module has been designed to study a practical control system, through the control of water flow temperature.

The RYC-TAG module is composed by two different water circuits: one of them is used for the hot water and the other one is used for the cold water. Both circuits are connected by a heat exchanger.

The temperature sensor is used in conjunction with the RYC unit to control the temperature of the water exit flux of the cold water circuit, through the regulation of the hot water flow.

Specifications:

Diagram in the front panel with similar distribution to the elements in the real unit.

The unit is conformed of two separated circuits:

Hot water circuit, it is a closed circuit and the main elements are the pump, the water tank with a heater resistance and the electronic proportional control valve for control of the hot water recirculation flux.

Cold water circuit, it is an open circuit and the main element is the temperature measurement device (temperature sensor).

Both circuits exchange heat through a heat exchanger.

Dimensions: 500 x 450 x 600 mm. approx. (19.68 x 17.71 x 23.62 inches approx.).

Weight: 18 Kg. approx. (39.68 pounds approx.).

6.5 RYC-T. **Temperature Control Module:**

This module has been designed to study a practical control system, through the control of a water tank temperature.

The RYC-T main components are a transparent tank with a heater element, a thermocouple and two manual valves to fill and empty the tank. The thermocouple is used in conjunction with the RYC unit to control of the temperature of the water through the control of the heater element.

Specifications:

Painted steel box.

Diagram in the front panel with similar distribution to the elements in the real unit.

Water transparent tank.

Thermocouple.

Heater element.

Dimensions: 400 x 300 x 500 mm. approx. (15.74 x 11.81 x 19.68 inches approx.).

Weight: 8 Kg. approx. (18 pounds approx.).

6.6 RYC-P. **Pressure Control Module:**

This module has been designed to study a practical control system, through the control of the pressure level of a pressured tank.

The RYC-P module is conformed of a pressure tank, air pump and pressure sensor. The pressure sensor is used in conjunction with the RYC unit to control and monitoring the pressure level of the pressure chamber.

Specifications:

Painted steel box.

Diagram in the front panel with similar distribution to the elements in the real unit.

Air pump.

Analog manometer.

Pressure sensor.

Pressure tank with security valve.

Electronic valve regulated with a button on the front panel.

Dimensions: 400 x 350 x 300 mm. approx. (15.74 x 13.78 x 11.81 inches approx.).

Weight: 12 Kg. approx. (26.4 pounds approx.).

Continue...

⑥ **Additional Applications for working with the RYC Unit**: (continuation)

6.7 RYC-N. **Level Control Module:**

This module has been designed to study a practical control system, through the control of the water level of a tank.

The RYC-N module is conformed of a transparent tank, a pressure sensor, water pump and electronic proportional control valve. The pressure sensor is used in conjunction with the RYC unit to control the water level of the tank through the control of the incoming water flow with the electronic proportional control valve.

Specifications:

Painted steel box.

Diagram in the front panel with similar distribution to the elements in the real unit.

Transparent tank.

Pressure sensor to measure the water level.

Water pump.

Electronic proportional control valve.

Dimensions: 400 x 300 x 550 mm. approx. (15.74 x11.81x 21.65 inches approx.).

Weight: 15 Kg. approx. (33 pounds approx.).

6.8 RYC-C. **Flow Rate Control Module:**

This module has been designed to study a practical control system, through the control of the flow rate module in a closed circuit.

The RYC-C module is conformed of a closed circuit with a transparent tank, a flow sensor, a rotameter, a water pump and an electronic proportional control valve. The flow sensor is used in conjunction with the RYC unit to control the flow rate in the circuit through the electronic proportional control valve.

Specifications:

Diagram in the front panel with similar distribution to the elements in the real unit.

Transparent tank.

Flow sensor.

Rotameter.

Water pump.

Electronic proportional control valve.

Dimensions: 400 x 300 x 550 mm. approx. (15.74 x 11.81 x 21.65 inches approx.).

Weight: 13 Kg. approx. (28.6 pounds approx.).

6.9 RYC-I. **Luminosity Control Module:**

This module has been designed to study a practical control system and study the different light sensors, through the luminosity control with three different light sensors.

The RYC-I module is conformed of an adjustable lamp and three selectables sensors: a photoresistor (LDR), a phototransistor and a photodiode.

The signal from each light sensor is used by the RYC unit to control the power of the lamp.

Specifications:

Painted steel box.

Diagram in the front panel with similar distribution to the elements in the real unit.

Adjustable lamp.

Photodiode:

This sensor converts light into either current or voltage, depending upon the mode of operation.

Phototransistor:

It also consists of a photodiode with internal gain.

Light Dependent Resistor:

A LDR is a resistor whose resistance decreases with increasing incident light intensity.

Dimensions: 400 x 300 x 300 mm. approx. (15.74 x 11.81 x 11.81 inches approx.).

Weight: 7 Kg. approx. (15.4 pounds approx.).

Continue...

⑥ **Additional Applications for working with the RYC Unit**: (continuation)

6.10 RYC-pH. **pH Control Module:**

This module has been designed to study a practical control system through the pH dissolution control in a stirred tank.

The RYC-pH module allows the students learn the continuous control of a pH value. The module consists of two circuits, one of them for the acid solution supply and the other one for the basic solution supply. Both circuits send their solution to a tank with a pH meter.

The circuit for the acid solution has a pump to keep the circuit flow constant. The circuit for the basic solution has a pump and an electronic proportional control valve controlled by the RYC unit for reach a controlled system.

Specifications:

- Diagram in the front panel with similar distribution to the elements in the real unit.
- Pump to send acid solution to the tank.
- Pump to send basic solution to the tank.
- Stirred metallic tank:
  - Capacity: 2 l.
  - pH meter.
  - Stirring element.
- Electronic proportional control valve.

Dimensions: 600 x 400 x 550 mm. approx. (23.62 x 15.74 x 21.65 inches approx.).

Weight: 24 Kg. approx. (52.8 pounds approx.).

6.11 RYC-CP. **Position Control Module:**

This module has been designed to study a practical control system, through the control of a linear position system.

The RYC-CP module consist of a cart moved by a controlled DC servo motor through a toothed belt, the position sensor is a shaft encoder.

The RYC-CP allows the students to set the cart position, the shaft encoder output signal is connect to the RYC to control the cart position through the control of the DC servo motor.

Specifications:

- Diagram in the front panel with similar distribution to the elements in the real unit.
- Movable cart.
- DC servo motor.
- 2 limit switches to the beginning and ending of the linear movement.
- Shaft encoder for cart position measuring.
- Linear structure with a toothed belt, communicating the shaft encoder with the DC servo motor.

Dimensions: 700 x 350 x 300 mm. approx. (27.55 x 13.78 x 11.81 inches approx.).

Weight: 22 Kg. approx. (48.4 pounds approx.).

6.12 RYC-PI. **Inverted Pendulum Control Module:**

This module has been designed to study a practical control system. The RYC-PI allows the student to learn the principles of a classical control problem; the inverted pendulum in 2D. The parameters of the model are the deviation angle of the pendulum from the vertical position (as input) and the horizontal force applied to the cart (as output).

The RYC-PI module consist of a movable cart over elevated rails by a controlled DC servo motor through a toothed belt, the cart is attached with a pendulum. For measure the angle of the pendulum the cart has an angle encoder potentiometer in axis of rotation of the pendulum.

To measure the position of the cart the module has a shaft encodes in the axis of rotation of the DC motor.

The cart is connected with a pendulum with a small load, this load destabilizes the cart when the cart makes a move.

This module allows setting the position of the cart, and in conjunction with the RYC unit, the module automatically controls the pendulum position, holding it in a vertical position through the correct control of the movement of the cart.

Specifications:

- Linear structure with rails on the top.
- Movable cart.
- Pendulum attached with the movable cart.
- DC servo motor.
- Toothed belt, communicating the cart with the DC servo motor.
- Angle encoder for measure the cart position.
- Shaft encoder for measure the angle of the pendulum.
- 2 limit switches to the beginning and ending of the linear movement.

Dimensions: 1700 x 350 x 550 mm. approx. (66.92 x 13.78 x 21.65 inches approx.).

Weight: 19 Kg. approx. (41.8 pounds approx.).

Continue...

⑥ **Additional Applications for working with the RYC Unit**: (continuation)

6.13 RYC-CLM. **Magnetic Levitation Control Module:**

This module has been designed to study a practical control system.

The RYC-CLM allows the student to learn the principles of the position control of a levitating metallic ball.

The RYC-CLM module consist of electromagnet and position sensor made of a photo emitter and photo detector. The position sensor that detect the position of the metallic ball, work in conjunction with the RYC unit to control the vertical position of the metallic ball through the control of the feeder current for the electromagnet.

Specifications:

Painted steel box.

Diagram in the front panel with similar distribution to the elements in the real unit.

Electromagnet.

Current sensor for the feed current for the electromagnet

Coil feed driver circuit, which convert differential of potential (from the RYC unit) in current (for feed the electromagnet).

Steel ball

Position sensor conformed of:

Photo emitter.

Photo detector.

Dimensions: 400 x 400 x 400 mm. approx. (15.74 x15.74 x 15.74 inches approx.).

Weight: 12 Kg. approx. (26.4 pounds approx.).

Some Practical Possibilities

Practical possibilities to be done with the Regulation and Control Unit (RYC):

1.- Response of a first order system in time domain. (Step-response).

2.- Response of a first order system in time domain. (Ramp-response).

3.- Response of a first order system in time domain. (Sine-response).

4.- Response of a first order system in frequency domain (Sine-response).

5.- Response of a second order system in time domain (Step-response).

6.- Response of a second order system in time domain. (Ramp-response).

7.- Response of a second order system in time domain. (Sine-response).

8.- Response of a second order system in frequency domain (Sine-response).

9.- Phase Lead Compensator experiment.

10.- Phase Lag Compensator experiment.

11.- Structure of a PID controller (Proportional-Integrative-Derivative blocks).

12.- PID control of a first order system in open-loop.

13.- PID control of a second order system in open-loop.

14.- PID control of a first order system in closed- loop. (Mathematical tuning).

15.- PID control of a first order system in closed- loop. (Experimental tuning).

16.- PID control of a first order system in closed- loop. (Ziegler-Nichols tuning).

17.- PID control of a second order system in closed-loop. (Mathematical tuning).

18.- PID control of a second order system in closed- loop. (Experimental tuning).

19.- PID control of a second order system in closed- loop. (Ziegler - Nichols tuning).

Practical possibilities to be done with the Additional Applications, for working with RYC Unit:

- DC Servo Motor Module (RYC-SM):

20.- Familiarization with the main module components.

21.- Study a potentiometer used for the position measuring.

22.- Study a Tachometer used for the speed measuring.

23.- Analyze of the DC motor transient Response.

24.- Analyze the time constant of the DC motor in open loop.

25.- Analyze the time constant of the DC motor in closed loop.

26.- Study of the stability of the system to gain changes.

27.- Position control of DC motor with a PID controller and the potentiometer.

28.- Analysis of the different responses of the system to modifications of PID parameters for the position control.

29.- Speed control of DC motor with P, PI, PD and PID controllers.

30.- Analysis of the different responses of the system to modifications of PID parameters for the speed control.

- Ball and Beam Module (RYC-BB):

31.- Familiarization with the main module components.

32.- Estimate the ball velocity and the ball position.

33.- Analyze the transient Response of the system.

34.- Analyze the time constant of the system in closed loop.

35.- Study of the Ball position control with a PID controller.

36.- Analysis of the different responses of the system to modifications of PID parameters.

- Air Flow Temperature Control Module (RYC-TAR):

37.- Familiarization with the main module components.

38. -Analyze the transient response of the system.

39.- Analyze the system response in open loop.

40.- Analyze the system response in closed loop.

41.- Air temperature control with P, PI, PD and PID controllers.

42.- Setting and optimizing the parameters of the PID control.

43.- Analysis of the different responses of the system to modifications of PID parameters.

44.- Study of the disturbances in a controlled system with a PID controller.

- Water Flow Temperature Control Module (RYC-TAG):

45.- Familiarization with the main module components.

46.- Analyze the transient response of the system.

47.- Analyze the system response in open loop.

48.- Analyze the system response in closed loop.

49.- Water flow temperature control with a P, PI, PD and PID controller.

50.- Setting and optimizing the parameters of the PID control.

51.- Analysis of the different responses of the system to modifications of PID parameters.

52.- Study of the disturbances in a controlled system with a PID controller.

Continue...

Some Practical Possibilities

- Temperature Control Module (RYC-T):

53. -Familiarization with the main module components.

54. -Analyze the transient response of the system.

55.- Analyze the system response in open loop.

56.- Analyze the system response in closed loop.

57.- Air temperature control with a P, PI, PD and PID controller.

58.- Setting and optimizing the parameters of the PID control.

59.- Analysis of the different responses of the system to modifications of PID parameters.

- Pressure Control Module (RYC-P):

60.- Familiarization with the main module components.

61.- Analyze the transient response of the system.

62.- Analyze the system response in open loop.

63.- Analyze the system response in closed loop.

64.- Pressure control with a P, PI, PD and PID controller.

65.- Setting and optimizing the parameters of the PID control.

66.- Analysis of the different responses of the system to modifications of PID parameters.

67.- Study of the disturbances in a controlled system with a PID controller.

- Level Control Module (RYC-N):

68. -Familiarization with the main module components.

69.- Analyze the transient response of the system.

70.- Analyze the system response in open loop.

71.- Analyze the system response in closed loop.

72.- Level control with a P, PI, PD and PID controller.

73.- Setting and optimizing the parameters of the PID control.

74.- Analysis of the different responses of the system to modifications of PID parameters.

75.- Study of the disturbances in a controlled system with a PID controller.

- Flow Rate Control Module (RYC-C):

76.- Familiarization with the main module components.

77.- Analyze the transient response of the system.

78.- Analyze the system response in open loop.

79.- Analyze the system response in closed loop.

80.- Flow rate control with a P, PI, PD and PID controller.

81.- Setting and optimizing the parameters of the PID control.

82.- Analysis of the different responses of the system to modifications of PID parameters.

83.- Study of the disturbances in a controlled system with a PID controller.

- Luminosity Control Module (RYC-I):

84.- Familiarization with the main module components.

85.- Study the photoresistor characteristics.

86.- Study the phototransistor characteristics.

87.- Study the photodiode characteristics.

88.- Analyze the transient response of the system.

89.- Analyze the system response in open loop.

90.- Analyze the system response in closed loop.

91.- Luminosity control with a P, PI, PD and PID controller.

92.- Setting and optimizing the parameters of the PID control.

93.- Analysis of the different responses of the system to modifications of PID parameters.

94.- Study of the disturbances in a controlled system with a PID controller.

- pH Control Module (RYC-pH):

95.- Familiarization with the main module components.

96.- Analyze the transient response of the system.

97.- Analyze the system response in open loop.

98.- Analyze the system response in closed loop.

99.- pH level control with a P, PI, PD and PID controller.

100.- Setting and optimizing the parameters of the PID control.

101.- Analysis of the different responses of the system to modifications of PID parameters.

102.- Study of the disturbances in a controlled system with a PID controller.

-Position Control Module (RYC-CP):

103.- Familiarization with the main module components.

104.- Analyze the transient response of the system.

105.- Analyze the system response in open loop.

106.- Analyze the system response in closed loop.

107.- Position control with a P, PI, PD and PID controller.

108.- Setting and optimizing the parameters of the PID control.

109.- Analysis of the different responses of the system to modifications of PID parameters.

Continue...

Some Practical Possibilities

- Inverted Pendulum Control Module (RYC-PI):

110.- Familiarization with the main module components.

111.- Control of the cart position.

112.- Analyze the transient response of the system.

113.- System stabilization.

114.- Study the position control with PID controller.

115.- Setting and optimizing the parameters of the PID control.

116.- Analysis of the different responses of the system to modifications of PID parameters.

117.-Study the swing of the pendulum with the correct PID parameters.

- Magnetic Levitation Control Module (RYC-CLM):

118.-Familiarization with the main module components.

119.-Study the linear model system.

120.-Study the Non-linear model system.

121.-Control of the ball position.

122.-Analyze the transient response of the system.

123.-Study the control of the ball position through a PD and PID controller.

124.-Setting and optimizing the parameters of the PID control.

125.- Analysis of the different responses of the system to modifications of PID parameters.

Other possibilities to be done with this RYC Unit:

126.- Many students view results simultaneously.

To view all results in real time in the classroom by means of a projector or an electronic whiteboard.

127.- Open Control, Multicontrol and Real Time Control.

This unit allows intrinsically and/or extrinsically to change the span, gains; proportional, integral, derivate parameters; etc, in real time.

128.- The Computer Control System with SCADA and PID Control allow a real industrial simulation.

129.- This unit is totally safe as uses mechanical, electrical and electronic, and software safety devices.

130.- This unit can be used for doing applied research.

131.- This unit can be used for giving training courses to Industries even to other Technical Education Institutions.

132.- Control of the RYC unit process through the control interface box without the computer.

133.- Visualization of all the sensors values used in the RYC unit process.

- Several other exercises can be done and designed by the user.

REQUIRED SERVICES

-Electrical supply: single-phase, 220 V/50 Hz. or 110 V/60 Hz.

-Computer (PC).

DIMENSIONS & WEIGHTS

RYC. Unit: -Dimensions: 490 x 330 x 310 mm. approx. (19.29 x 12.99 x 12.20 inches approx.).

-Weight: 10 Kg. approx. (22 pounds approx.).

ADDITIONAL APPLICATIONS

- RYC-SM. DC Servo Motor Module.
- RYC-BB. Ball and Beam Module.
- RYC-TAR. Air Flow Temperature Control Module.
- RYC-TAG . Water Flow Temperature Control Module.
- RYC-T. Temperature Control Module.
- RYC-P. Pressure Control Module.
- RYC-N. Level Control Module.
- RYC-C. Flow Rate Control Module.
- RYC-I. Luminosity Control Module.
- RYC-pH. pH Control Module.
- RYC-CP. Position Control Module.
- RYC-PI. Inverted Pendulum Control Module.
- RYC-CLM. Magnetic Levitation Control Module.

AVAILABLE VERSIONS

Offered in this catalogue:

- RYC. Computer Controlled Teaching Unit for the Study of Regulation and Control.

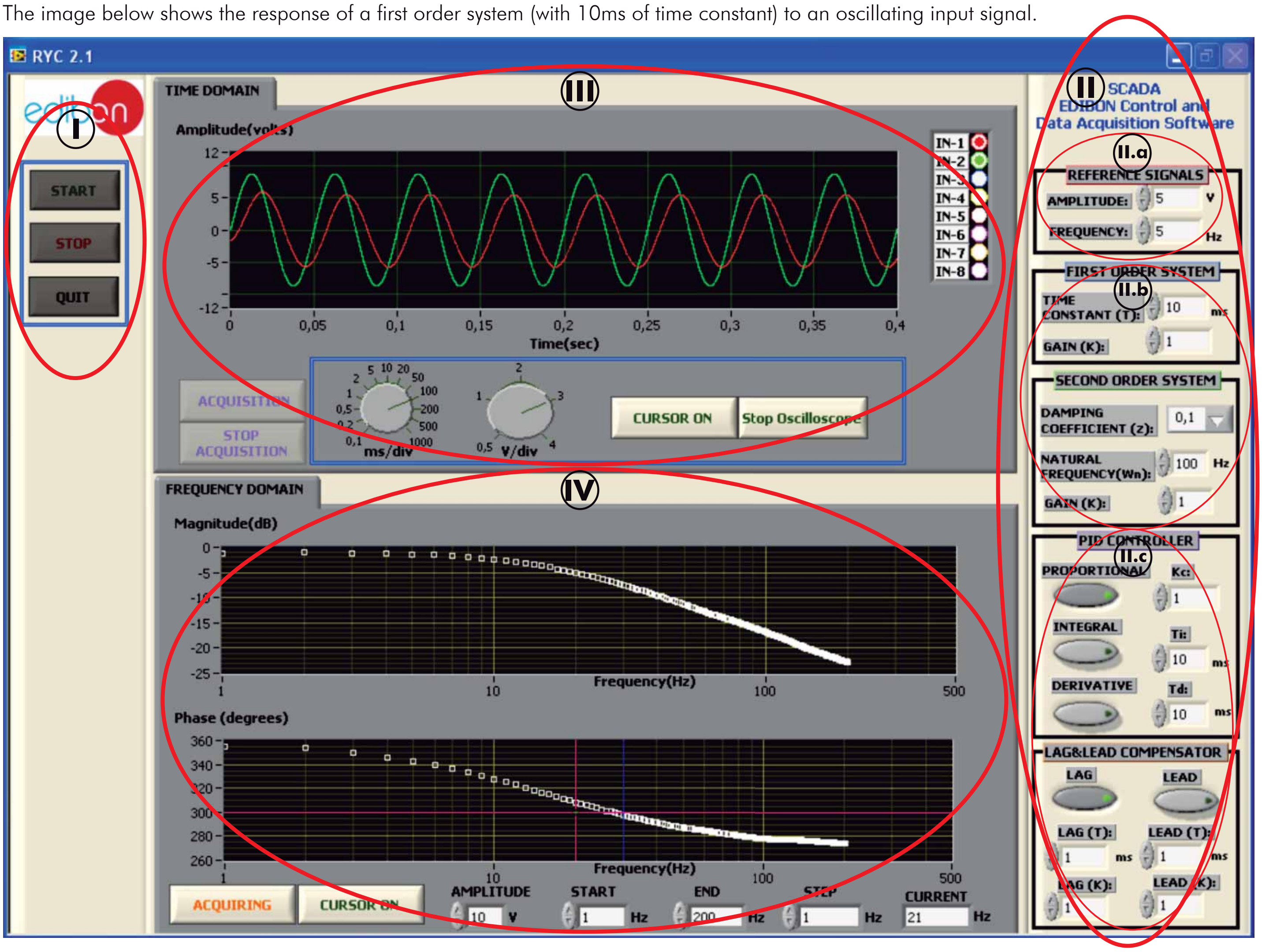
Offered in other catalogue:

- RYC/B. Basic Teaching Unit for the Study of Regulation and Control.

SCADA and PID Control

Typical Software screen

The image below shows the response of a first order system (with 10ms of time constant) to an oscillating input signal.



(I) Main software operation possibilities.

(II) System blocks with configurable parameters:

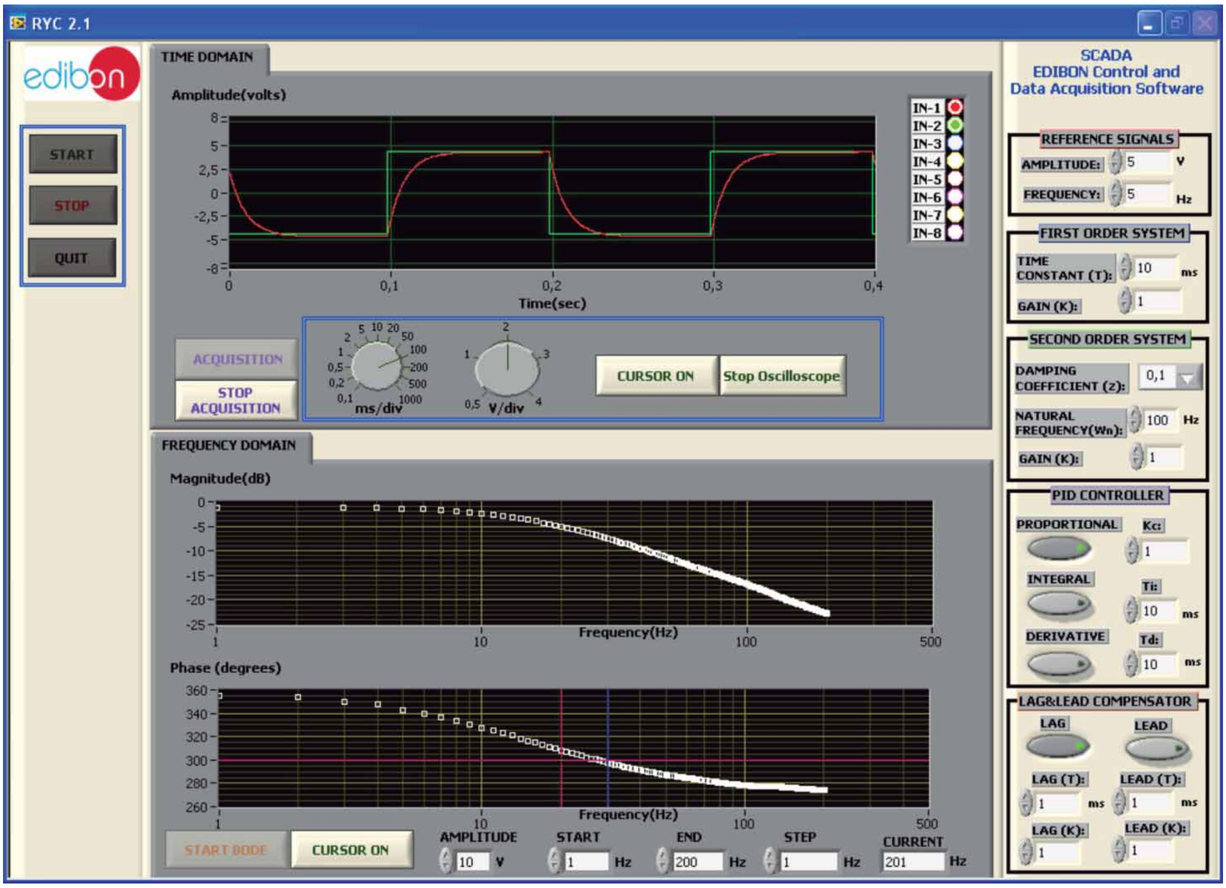
- (II.a) Reference signals parameters.
- (II.b) Parameters of system simulators (First order system and Second order system).
- (II.c) Parameters of PID controller and Lag and Lead compensator.

(III) Graph of system results in time domain, with the scale parameters for the complete configuration of the graph.

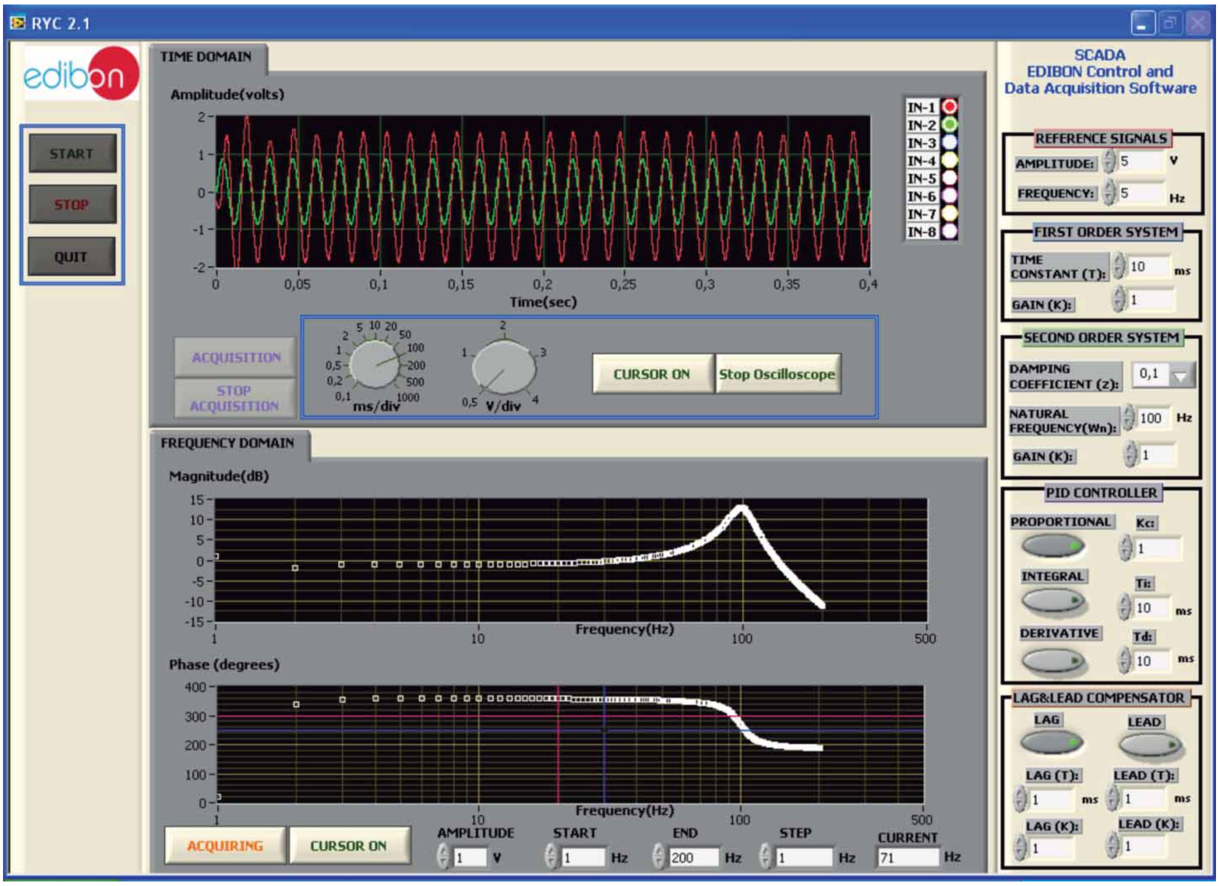
(IV) Bode plot (system results in frequency domain), with the scale parameters for the complete configuration of the graph.

- For improve the understandable of the trainer, when the students turn on an option in the software, the corresponding LED in the hardware, switches on automatically.

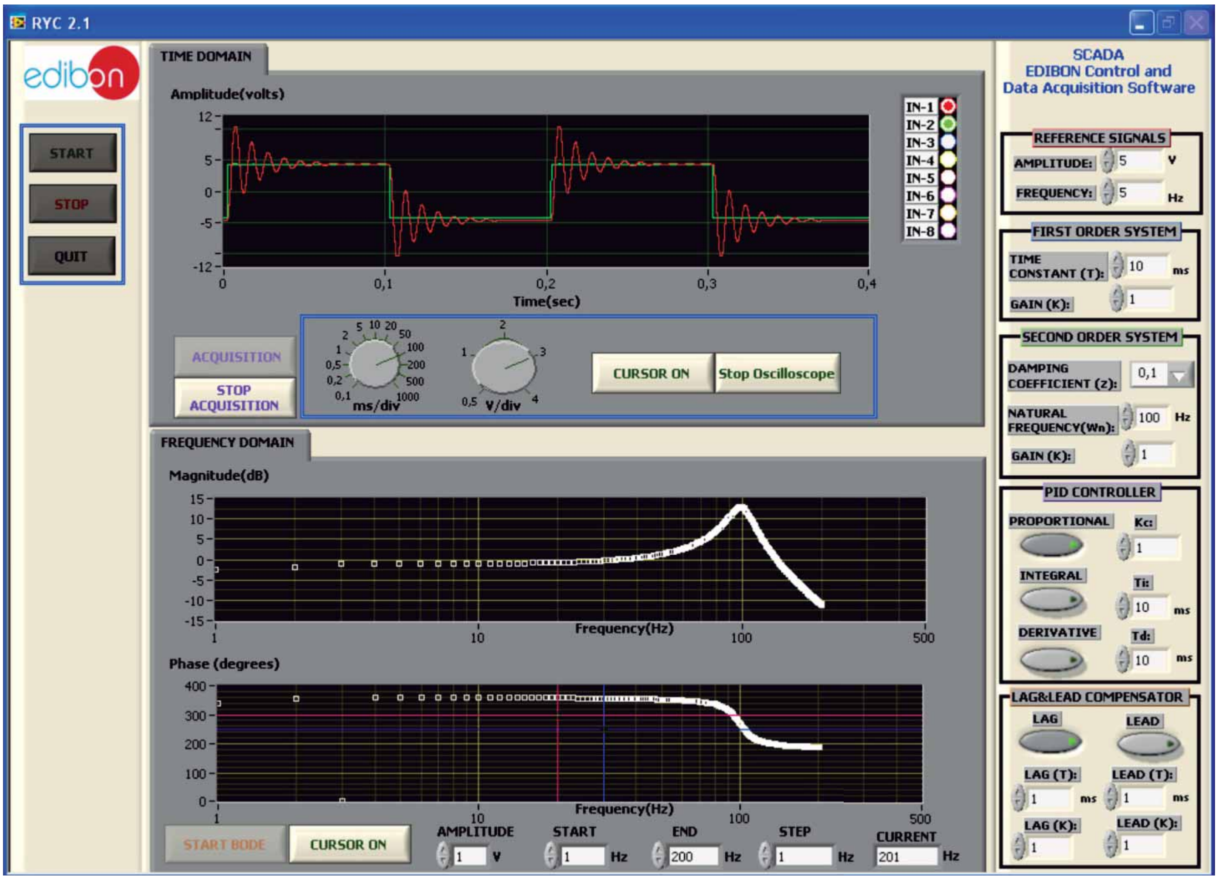
The image below shows the response of a open loop first order system (with 10ms of time constant) to a step input signal.



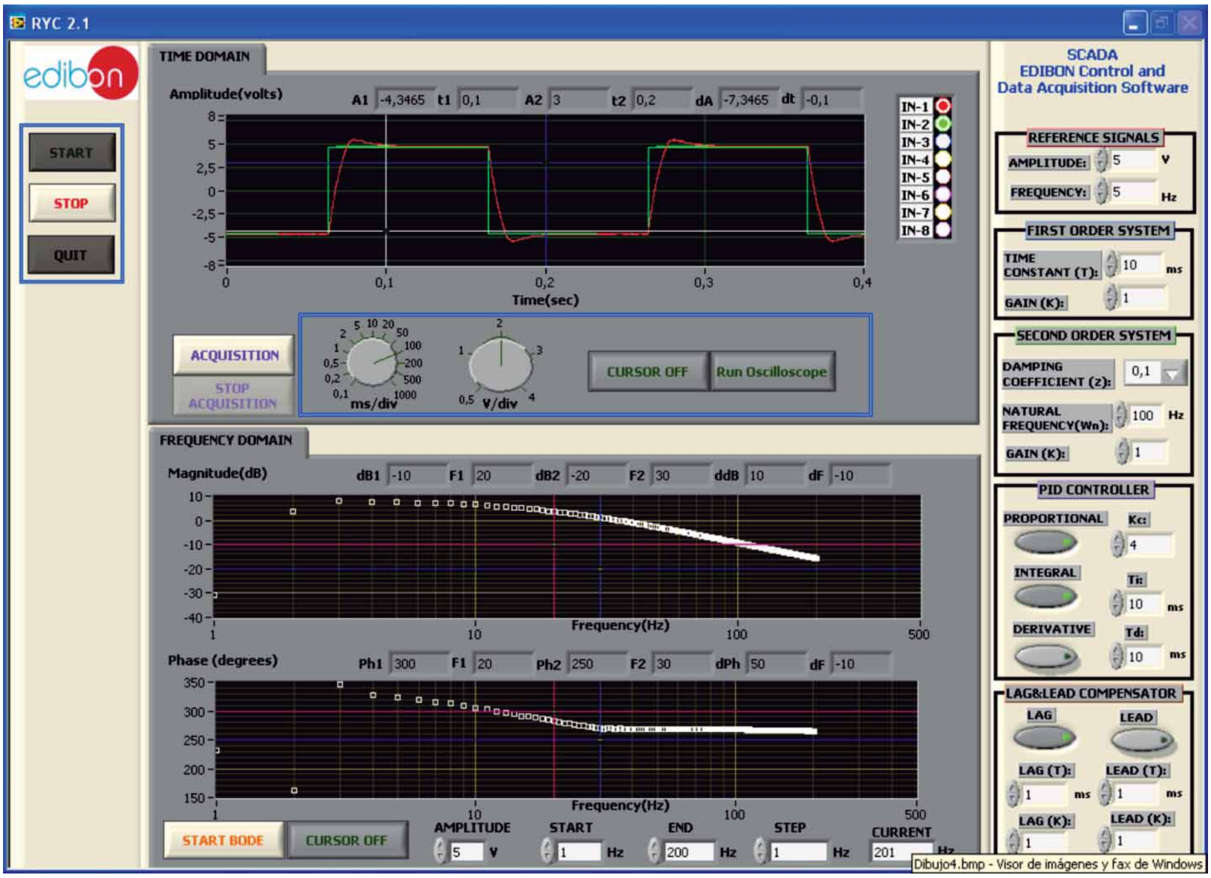
The image below shows the response of a open loop second order system (with 0.1 of damping coefficient and 100Hz of natural frequency) to an oscillating input signal.



The image below shows the response of a open loop second order system (with 0.1 of damping coefficient and 100Hz of natural frequency) to a step input signal.



The image below shows the response of a closed loop first order system (with 10ms of time constant) with PI controller (with 4 of proportional parameter and 10ms of integrative parameter) to a step input signal.



Additionally to the main items described, we can offer, as optional, other items from 7 to 10.
All these items try to give more possibilities for:

a) Technical and Vocational Education configuration. (CAI)
b) Higher Education and/or Technical and Vocational Education configuration. (CAL)
c) Multipost Expansions options. (Mini ESN and ESN)

a) Technical and Vocational Education configuration

⑦ RYC/CAI. Computer Aided Instruction Software System.

This complete software package includes two Softwares: the INS/SOF. Classroom Management Software (Instructor Software) and the RYC/SOF. Computer Aided Instruction Software (Student Software).

This software is optional and can be used additionally to items (1 to 5).

This complete software package consists on an Instructor Software (INS/ SOF) totally integrated with the Student Software (RYC/SOF). Both are interconnected so that the teacher knows at any moment what is the theoretical and practical knowledge of the students.

- INS/SOF. Classroom Management Software (Instructor Software):

The Instructor can:

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.

Generate and print reports.

Detect student's progress and difficulties.

...and many other facilities.

Instructor Software

- RYC/SOF. Computer Aided Instruction Software (Student Software):

It explains how to use the unit, run the experiments and what to do at any moment.

This Software contains:

Theory.

Exercises.

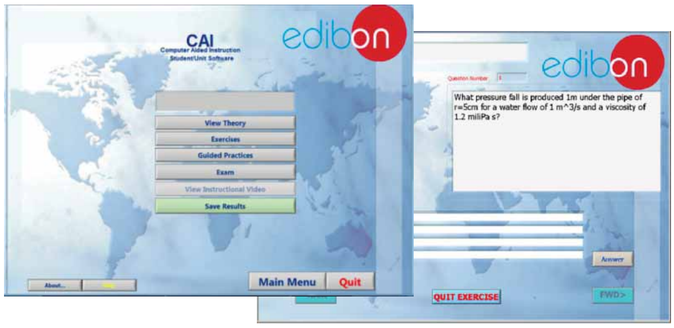
Guided Practices.

Exams.

For more information see **CAI** catalogue. Click on the following link:

www.edibon.com/products/catalogues/en/CAI.pdf

Student Software



b) Higher Education and/or Technical and Vocational Education configuration

⑧ RYC/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. It is very useful for Higher Education level.

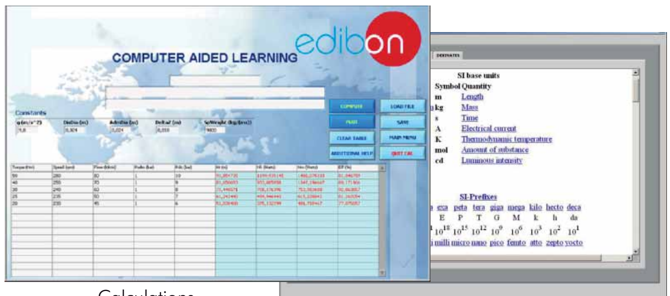
CAL is a class assistant that helps in doing the necessary calculations to extract the right conclusions from data obtained during the experimental practices.

CAL computes the value of all the variables involved and performs the calculations.

It allows to plot and print the results. Within the plotting options, any variable can be represented against any other.

Different plotting displays.

It has a wide range of information, such as constant values, unit conversion factors and integral and derivative tables.

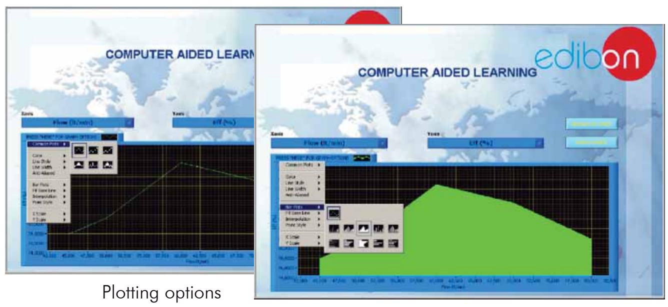


Calculations

Information of constant values, unit conversion factors and integral and derivative tables

For more information see **CAL** catalogue. Click on the following link:

www.edibon.com/products/catalogues/en/CAL.pdf



Plotting options

c) Multipost Expansions options

⑨ Mini ESN. EDIBON Mini Scada-Net System.

Mini ESN. EDIBON Mini Scada-Net System allows up to 30 students to work with a Teaching Unit in any laboratory, simultaneously. It is useful for both, Higher Education and/or Technical and Vocational Education.

The Mini ESN system consists on the adaptation of any EDIBON Computer Controlled Unit with SCADA and PID Control integrated in a local network.

This system allows to view/control the unit remotely, from any computer integrated in the local net (in the classroom), through the main computer connected to the unit. Then, the number of possible users who can work with the same unit is higher than in an usual way of working (usually only one).

Main characteristics:

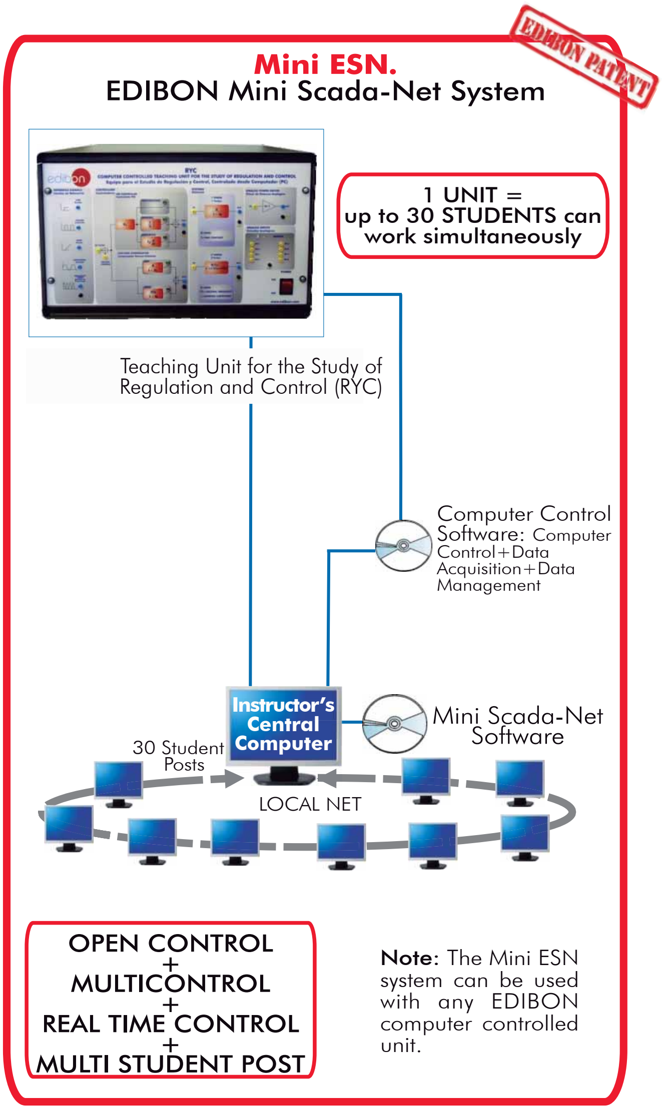
- **It allows up to 30 students to work simultaneously with the EDIBON Computer Controlled Unit with SCADA and PID Control, connected in a local net.**
- **Open Control + Multicontrol + Real Time Control + Multi Student Post**.
- **Instructor controls and explains to all students at the same time.**
- **Any user/student can work doing "real time" control/multicontrol and visualisation.**
- **Instructor can see in the computer what any user/student is doing in the unit.**
- **Continuous communication between the instructor and all the users/ students connected.**

Main advantages:

- **It allows an easier and quicker understanding.**
- **This system allows you can save time and cost.**
- **Future expansions with more EDIBON Units.**

For more information see **Mini ESN** catalogue. Click on the following link:

www.edibon.com/products/catalogues/en/Mini-ESN.pdf



⑩ ESN. EDIBON Scada-Net System.

This unit can be integrated, in the future, into a Complete Laboratory with many Units and many Students.

For more information see **ESN** catalogue. Click on the following link:

www.edibon.com/products/catalogues/en/units/electronics/esn-electronicscommunications/ESN-ELECTRONICS_COMMUNICATIONS-ADVANCED.pdf

ORDER INFORMATION

Main items (always included in the supply)

Minimum supply always includes:

① **Unit: RYC. Teaching Unit for the Study of Regulation and Control.**

② **DAB. Data Acquisition Board.**

③ **RYC/CCSOF. PID Computer Control + Data Acquisition + Data Management Software.**

④ **Cables and Accessories**, for normal operation.

⑤ **Manuals.**

* IMPORTANT: Under RYC we always supply all the elements for immediate running as 1, 2, 3, 4 and 5.

⑥ Additional **Applications** for working with RYC Unit: (to choose)

- 6.1 RYC-SM. DC Servo Motor Module.
- 6.2 RYC-BB. Ball and Beam Module.
- 6.3 RYC-TAR. Air Flow Temperature Control Module.
- 6.4 RYC-TAG . Water Flow Temperature Control Module.
- 6.5 RYC-T. Temperature Control Module.
- 6.6 RYC-P. Pressure Control Module.
- 6.7 RYC-N. Level Control Module.
- 6.8 RYC-C. Flow Rate Control Module.
- 6.9 RYC-I. Luminosity Control Module.
- 6.10 RYC-pH. pH Control Module.
- 6.11 RYC-CP. Position Control Module.
- 6.12 RYC-PI. Inverted Pendulum Control Module.
- 6.13 RYC-CLM. Magnetic Levitation Control Module.

Optional items (supplied under specific order)

a) Technical and Vocational configuration

⑦ RYC/CAI. Computer Aided Instruction Software System.

b) Higher Education and/or Technical and Vocational Education configuration

⑧ RYC/CAL. Computer Aided Learning Software (Results Calculation and Analysis).

c) Multipost Expansions options

⑨ Mini ESN. EDIBON Mini Scada-Net System.

⑩ ESN. EDIBON Scada-Net System.

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

edibon INTERNATIONAL

C/ Del Agua, 14. Polígono Industrial San José de Valderas.
28918 LEGANÉS. (Madrid). SPAIN.
Phone: 34-91-6199363 FAX: 34-91-6198647
E-mail: edibon@edibon.com WEB site: **www.edibon.com**

Issue: ED01/14
Date: January/2014

REPRESENTATIVE: