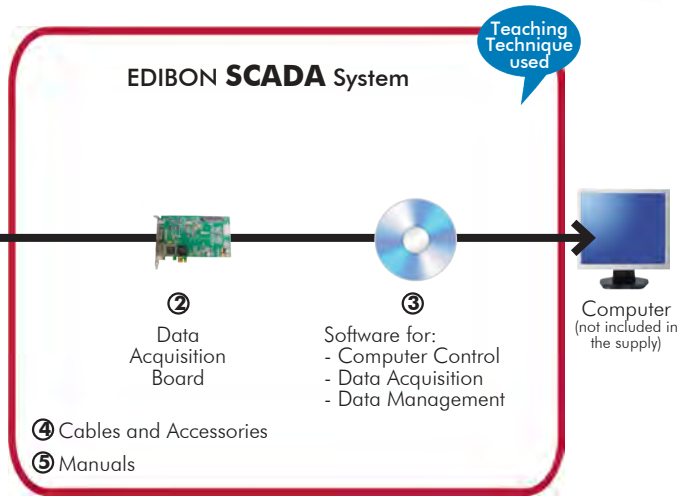
edibon

Engineering and Technical Teaching Equipment

Computer Controlled **Generating Stations Control and Regulation Simulator,** with SCADA

SCE

① Unit: SCE. Computer Controlled Generating Stations Control and Regulation Simulator



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

Key features:

- **Advanced Real-Time SCADA.**
- **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 ICAI software to create, edit and carry out practical exercises, tests, exams, calculations, etc. Apart from monitoring user's knowledge and progress reached.**
- **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.**

OPEN CONTROL + MULTICONTROL + REAL TIME CONTROL

POWERED BY NATIONAL INSTRUMENTS LabVIEW

www.edibon.com
PRODUCTS
2.- ELECTRONICS

For more information about Key Features, click here

ISO 9001: **Quality Management** (for Design, Manufacturing, Commercialization and After-sales service)

European Union Certificate (total safety)

Certificates ISO 14001 and ECO-Management and Audit Scheme (environmental management)

"Worlddidac Quality Charter" and Platinum Member of Worlddidac

INTRODUCTION

In many processes, considered as critical, such as, for example, the power generation system, possible errors in the adjustments of the control algorithms are not contemplated since any failure can entail enormous damages and / or losses. This is why obtaining a mathematical model that accurately reflects the behavior of a system is a fundamental task when designing the control algorithm for the system. This model allows optimally adjusting the algorithms without the need to work on the actual process.

The SCE equipment designed by EDIBON allows to study the modeling and simulation process of the electrical generation of a power plant as well as the verification of the model against the real system.

GENERAL DESCRIPTION

Unit designed to simulate the regulation behaviour of a hydroelectric generating station, as a didactic application with different aspects of regulation, control and simulation.

It is possible to work with this unit in 2 ways:

REAL mode (continuous or transient analysis).

SIMULATED mode.

The unit consists mainly of an interface for the conditioning of input and output signals. For its part, this one will be connected to the computer (through a SCSI wire and a data acquisition board) and to the two subsystems that we try to control:

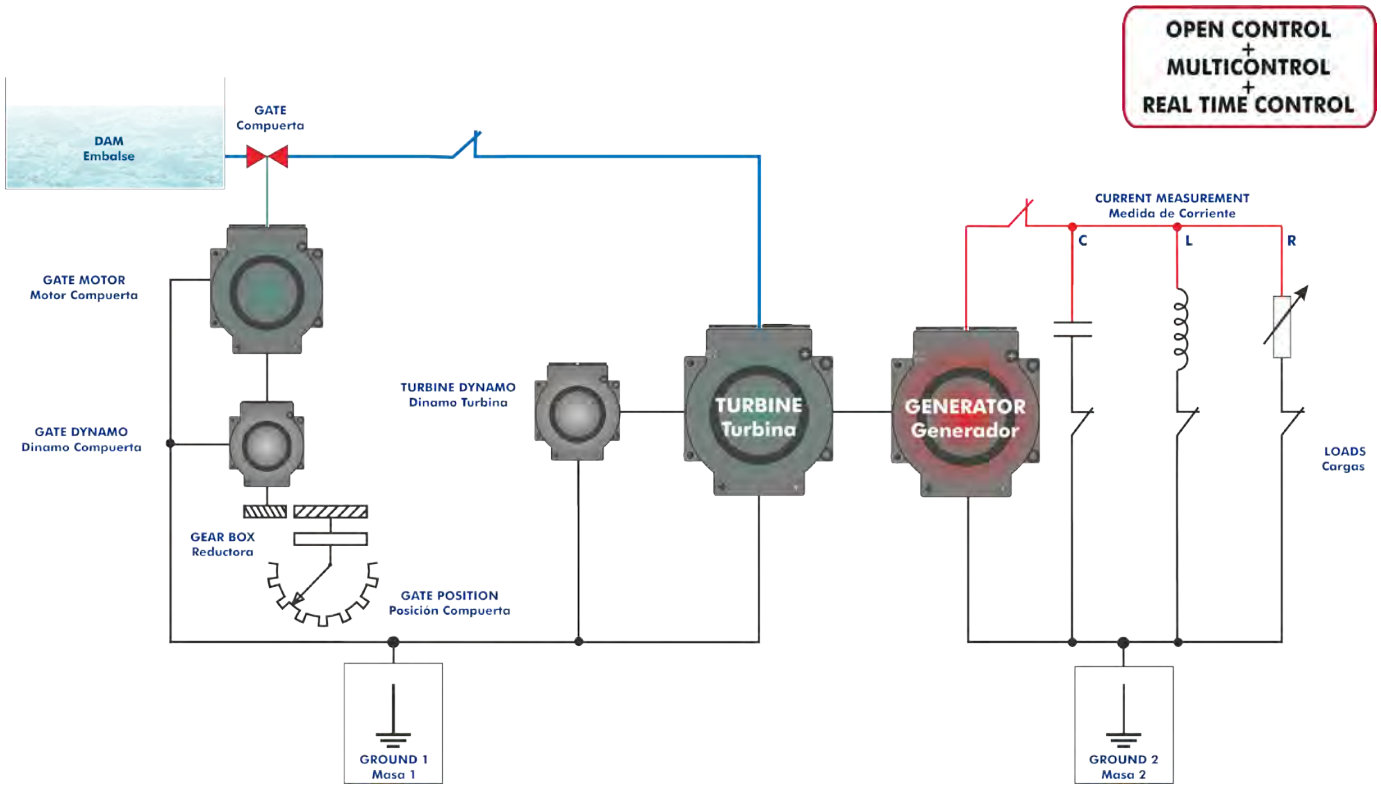
Gate subsystem.

Turbine-generator subsystem.

The unit has (in the interface) some switches to establish different loads to the generator output and different conditions of the real system.

This Computer Controlled Unit is supplied with the EDIBON Computer Control System (SCADA), and includes: The unit itself + a Data Acquisition Board + Computer Control, Data Acquisition and Data Management Software Packages, for controlling the process and all parameters involved in the process.

PROCESS DIAGRAM AND UNIT ELEMENTS ALLOCATION



With this unit there are several options and possibilities:

- Main items: 1, 2, 3, 4 and 5.
- Optional items: 6.

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

① SCE. Unit:

Bench-top unit.

Metallic box and main metallic elements in stainless steel.

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

It is possible to work with this unit in 2 ways:

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Unit: SCE

Gate subsystem:

It consists of a motor that controls the gate opening, and some mechanisms that emulate it.

The control tension to command the gate's motor will be range between 0 and 10 volts.

The gate's motor is coupled, by one side, to a dynamo, that will give us a signal proportional to its own rotating velocity, and by the other side to a reduction gear.

The dynamo (Dynamo Gate) gives us a voltage that is proportional to the motor's rotating velocity.

Near the output of the reduction gear there is a potentiometer that gives us an output in volts proportional to the position where it is located, simulating the opening degree of the gate.

Turbine-generator subsystem:

This subsystem will be analyzed separately or linked up with the previous one, achieving that the motor that simulates the turbine turns according to the gate opening percentage.

This turbine is connected with a generator system and with a system of different loads (inductive, capacitive and resistive).

Three loads in parallel are connected at the generator output, that simulate the consumption of the energy distribution system:

Variable resistance (270-770 Ω approx.).

Capacitance (1000 μF).

Inductance (100 mH).

The complete unit includes as well:

Advanced Real-Time SCADA.

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 ICAI software to create, edit and carry out practical exercises, tests, exams, calculations, etc. Apart from monitoring user's knowledge and progress reached.

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.

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.

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: Number of **Counter/timers=4**. Resolution: Counter/timers: 32 bits.

The Data Acquisition board model may change at any moment, providing the same or better features than those required for the unit.

DAB

③ SCE/CCSOF. 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 in screen. **Compatible with the industry standards.**

Registration and visualization 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.

Management, processing, comparison and storage of data.

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

It allows the registration of the alarms state and the graphic representation in real time.

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

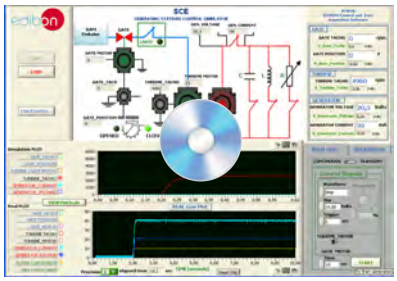
Open software, allowing the teacher to modify texts, instructions. Teacher's and student's passwords to facilitate the teacher's control on the student, and allowing the access to different work levels.

This software has got 2 operating modes:

REAL mode: Through motors, actuators and sensors that the unit includes (continuos, transient).

SIMULATED mode: through the mathematical modelization of the motors ,previously mentioned.

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.



SCE/CCSOF

④ Cables and Accessories, for normal operation.

⑤ Manuals:

This unit **is supplied with 7 manuals:** Required Services, Assembly and Installation, Control Software, Starting-up, Safety, Maintenance & Practices Manuals.

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

EXERCISES AND PRACTICAL POSSIBILITIES TO BE DONE WITH THE MAIN ITEMS

1.- Modelization of the motor as a standard motor.
2.- Modelization of the motor with the constants corrections of the mathematical model.
3.- Calculation of the dynamos speed constant.
4.- Obtaining of the transient responses of the gate motor.
5.- Obtaining of the transient response of the turbine motor.
6.- Obtaining of the transient response of the gate simulated motor.
7.- Obtaining of the transient response of the turbine simulated motor.
8.- Comparative analysis of the transient response of the turbine real motor vs the transient response of the simulated motor for resistive load.
9.- Comparative analysis of the transient response of the turbine real motor vs the transient response of the simulated motor for capacitive load.
10.- Comparative analysis of the transient response of the turbine real motor vs the transient response of the simulated motor for inductive load.
11.- Comparative analysis of the response of the gate real motor vs the response of the gate simulated motor for continuous (manually from the computer) control signals.
12.- Comparative analysis of the response of the gate real motor vs the response of the gate simulated motor for sinusoidal control signals.
13.- Comparative analysis of the response of the gate real motor vs the response of the gate simulated motor for square control signals.
14.- Comparative analysis of the response of the gate real motor vs the response of the gate simulated motor for triangular control signals.
15.- Comparative analysis of step response between real motor and simulated motor (gate or turbine).

Other possibilities to be done with this Unit:

16.- Many students view results simultaneously.
To view all results in real time in the classroom by means of a projector or an electronic whiteboard.
17.- Open Control, Multicontrol and Real Time Control.
This unit allows intrinsically and/or extrinsically to change the span, gains; proportional, integral, derivative parameters; etc, in real time.
18.- The Computer Control System with SCADA allows a real industrial simulation.
19.- This unit is totally safe as uses mechanical, electrical/electronic, and software safety devices.
20.- This unit can be used for doing applied research.
21.- This unit can be used for giving training courses to Industries even to other Technical Education Institutions.

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

REQUIRED SERVICES

- Electrical supply: single-phase 200 VAC – 240 VAC/50 Hz or 110 VAC – 127 VAC/60 Hz.
- Computer (PC).

DIMENSIONS AND WEIGHTS

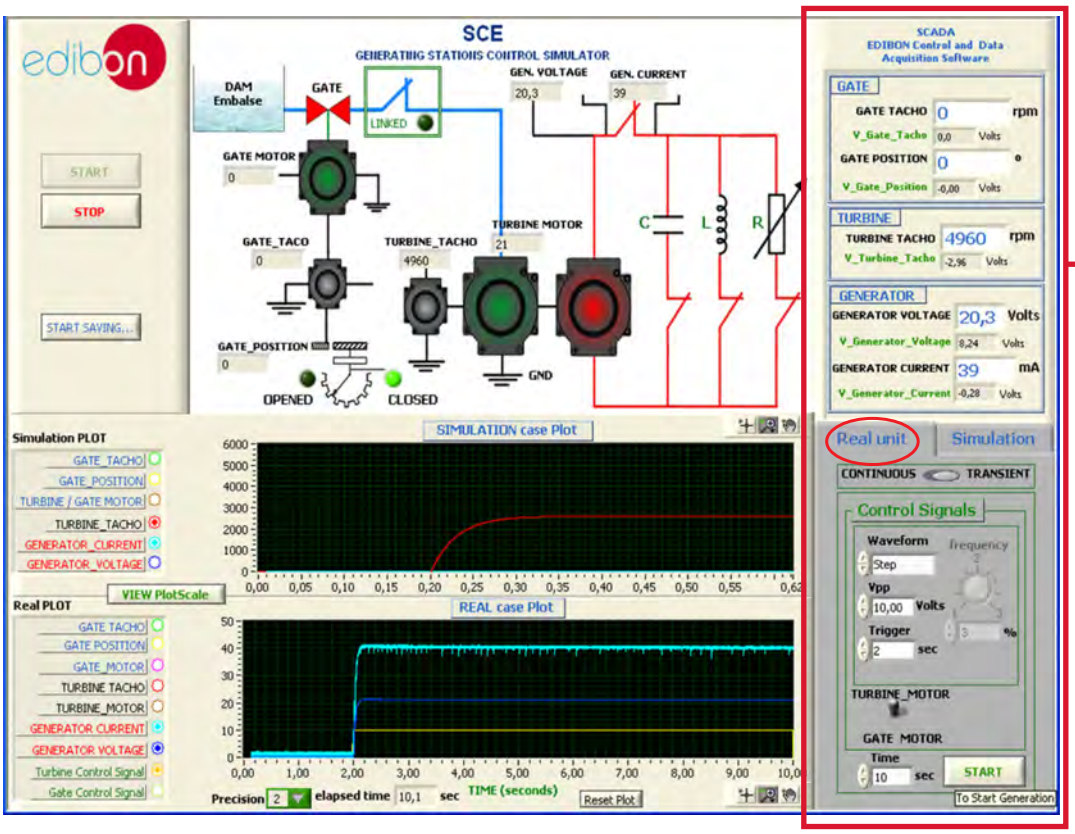
SCE. Unit: -
- Dimensions: 405 x 350 x 250 mm approx.
(15.94 x 13.77 x 9.84 inches approx.)
- Weight: 15 Kg approx.
(33 pounds approx.)

SCADA
Main screen

This software has 2 operating modes:

1.- REAL mode: We obtain the real response of the system.

2.- SIMULATED mode: We obtain the simulated response of the system.

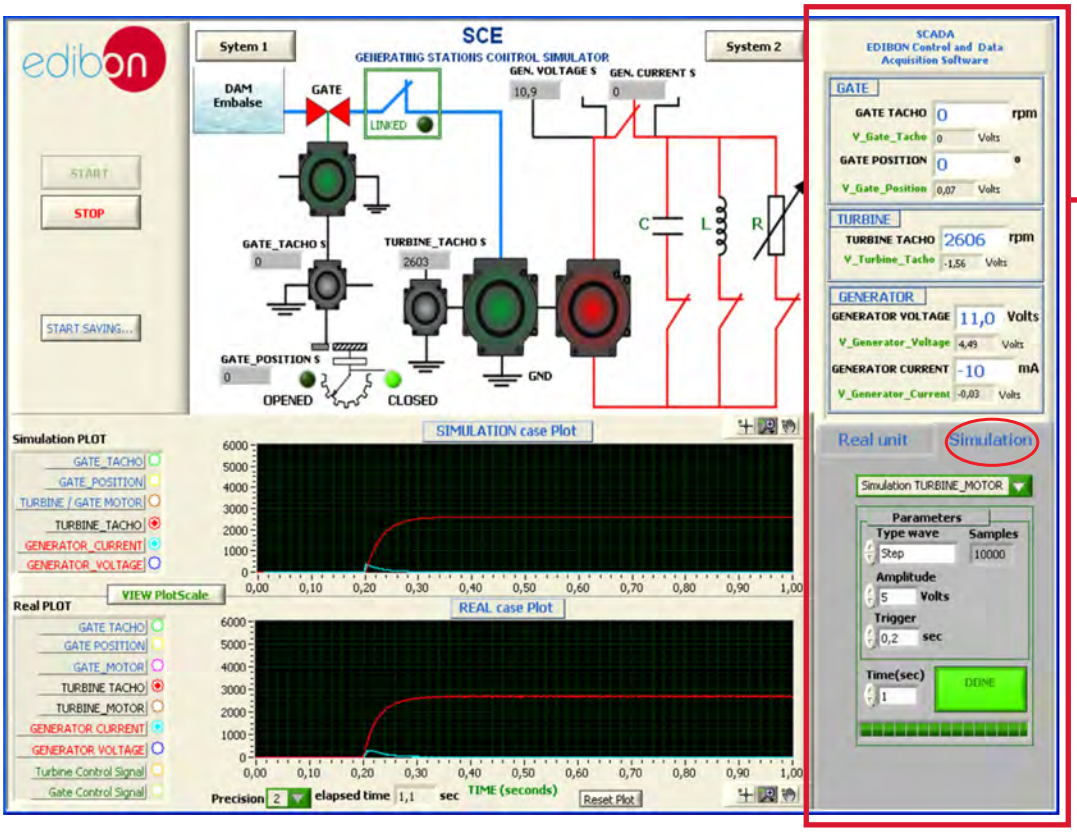


A set of sensors and actuators are available.

We excite the system through the actuators: by the functions generator (sinusoidal, triangular, square signals,...) or continuous signals.

We obtain the system response through the sensors: r.p.m.,voltages and current, given by the system itself.

Main screen in SIMULATED mode

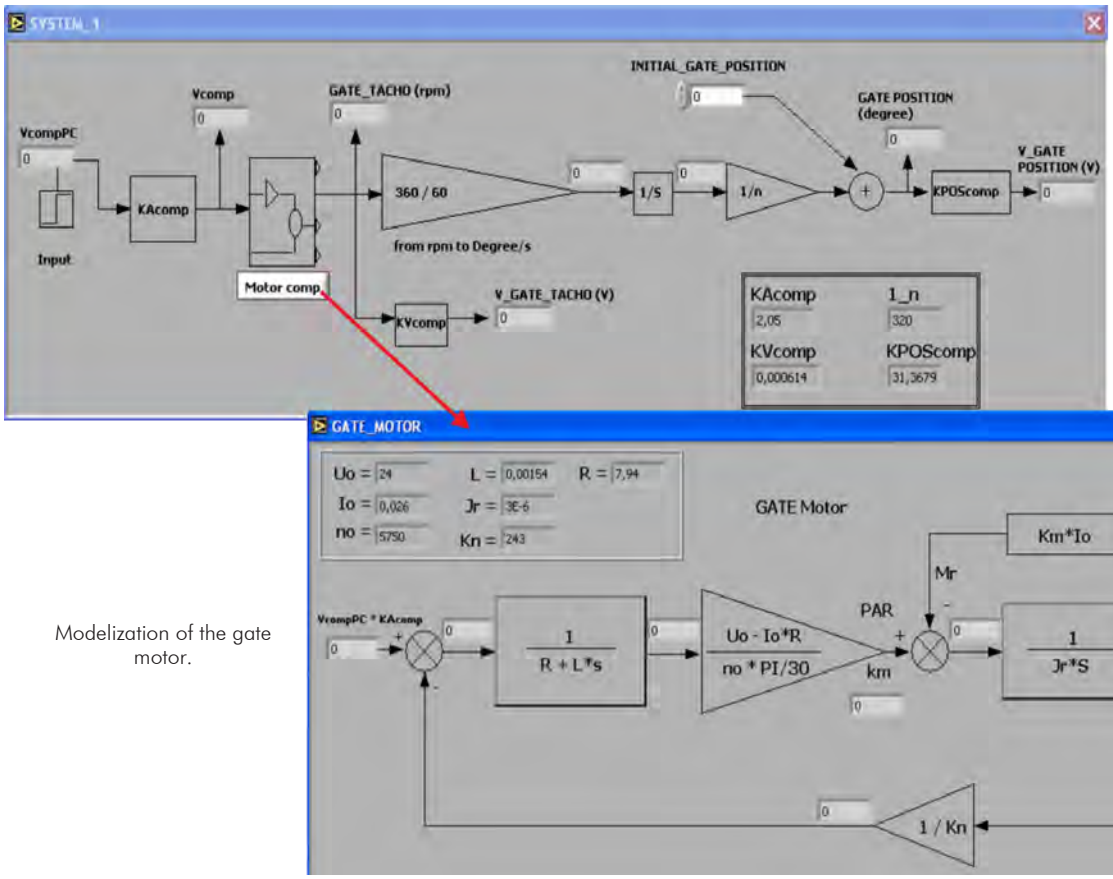


A set of virtual actuators and sensors are available, by which, throught the matemathical model of the system, we obtain the simulated response of the system.

Software Main screens

Mathematical modelization screens (in SIMULATED mode)

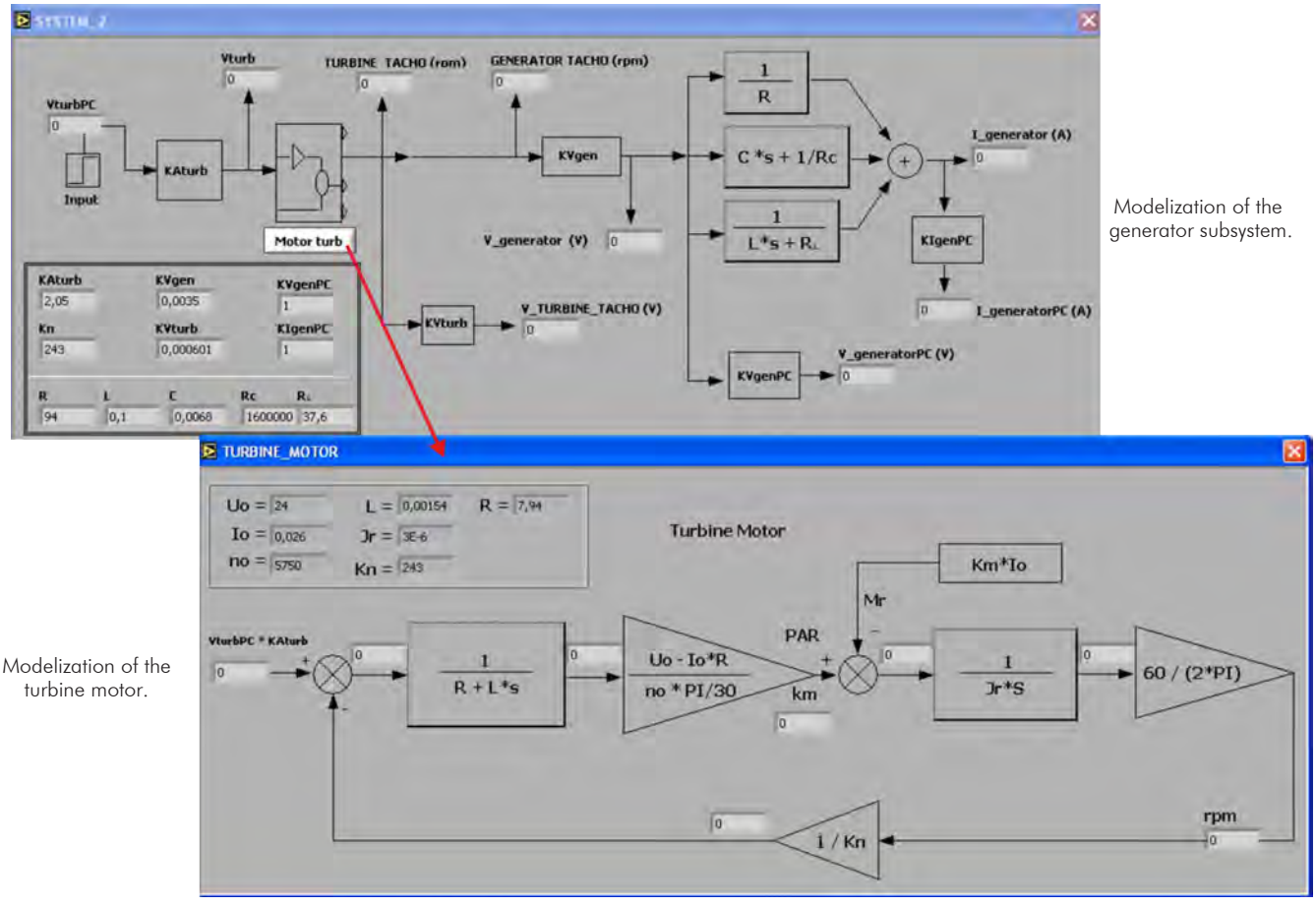
Modelization of the Subsystem 1:



Modelization of the gate subsystem.

Modelization of the gate motor.

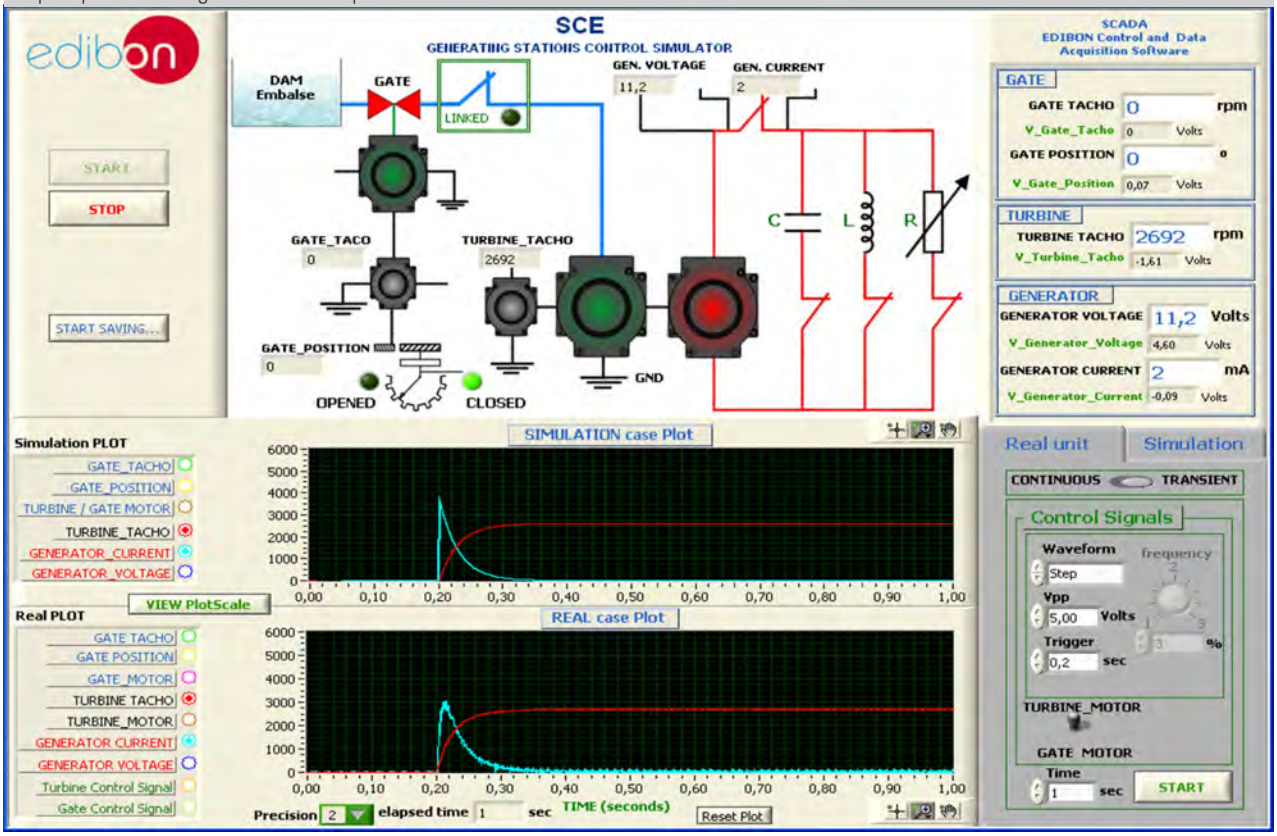
Modelization of the Subsystem 2:



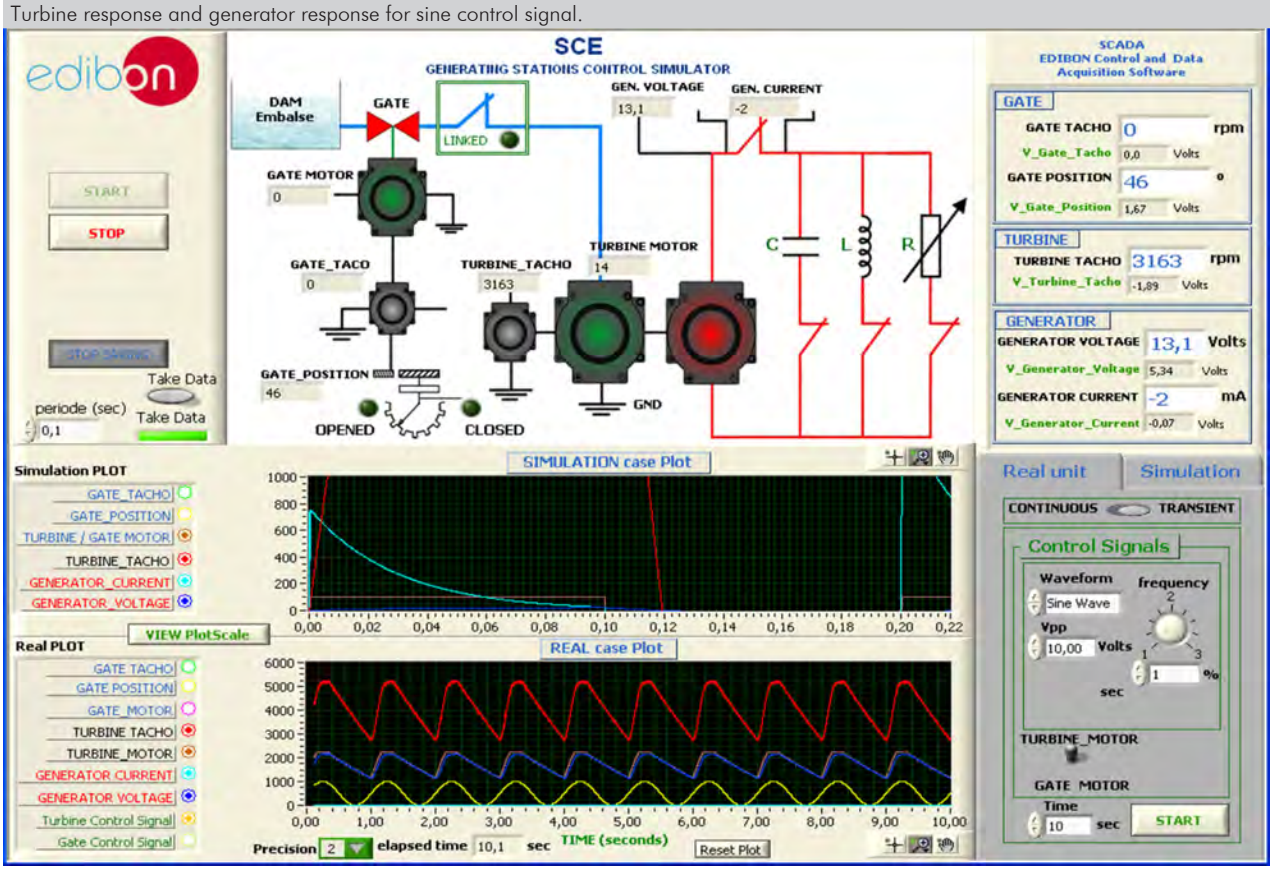
Modelization of the generator subsystem.

Modelization of the turbine motor.

Step response of the generator with capacitive load.



Turbine response and generator response for sine control signal.



Generator transient response for step control signal.

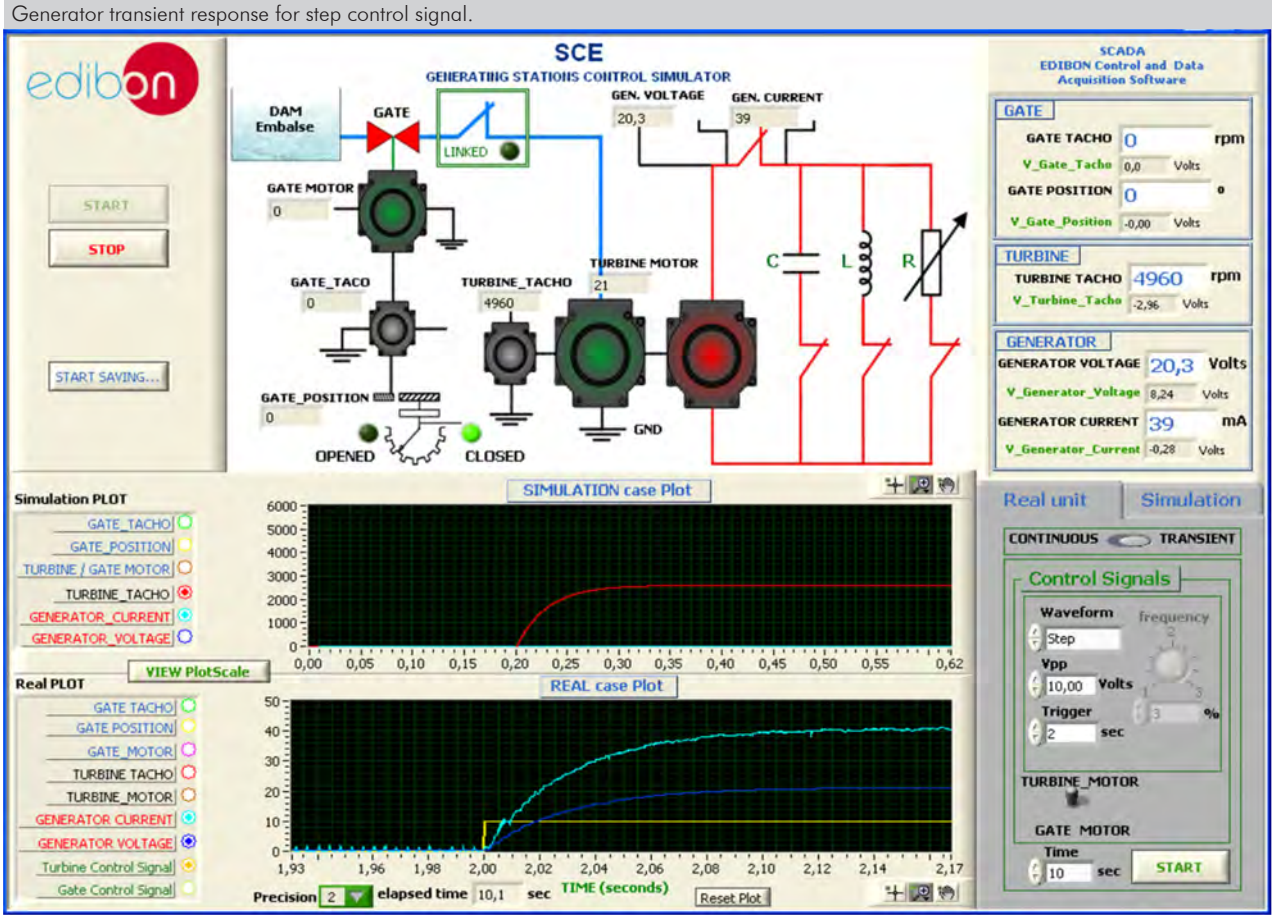
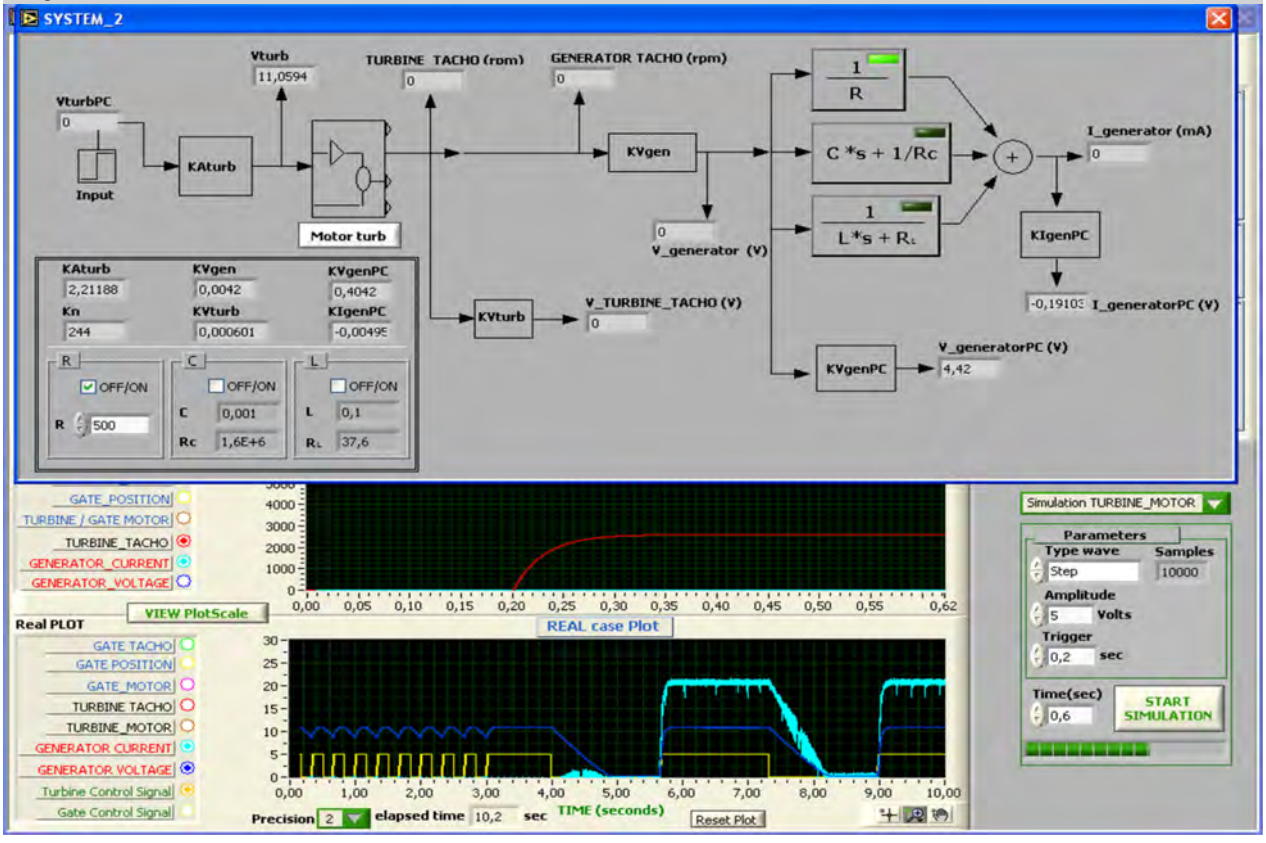


Diagram of the mathematical modelization of the turbine.



Additionally to the main items (1 to 5) described, we can offer, as optional, other items from 6 and 7.
All these items try to give more possibilities for:
a) Technical and Vocational Education configuration. (ICAI and FSS)

a) Technical and Vocational Education configuration

⑥ SCE/ICAI. Interactive Computer Aided Instruction Software.
This complete software package consists of an Instructor Software (EDIBON Classroom Manager - ECM-SOF) totally integrated with the Student Software (EDIBON Student Labsoft - ESL-SOF). Both are interconnected so that the teacher knows at any moment what is the theoretical and practical knowledge of the students.

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

- ECM-SOF. EDIBON Classroom Manager (Instructor Software).

ECM-SOF is the application that allows the Instructor to register students, manage and assign tasks for workgroups, create own content to carry out Practical Exercises, choose one of the evaluation methods to check the Student knowledge and monitor the progression related to the planned tasks for individual students, workgroups, units, etc... so the teacher can know in real time the level of understanding of any student in the classroom.

Innovative features:

- **User Data Base Management.**
- **Administration and assignment of Workgroup, Task and Training sessions.**
- **Creation and Integration of Practical Exercises and Multimedia Resources.**
- **Custom Design of Evaluation Methods.**
- **Creation and assignment of Formulas & Equations.**
- **Equation System Solver Engine.**
- **Updatable Contents.**
- **Report generation, User Progression Monitoring and Statistics.**

- ESL-SOF. EDIBON Student Labsoft (Student Software).

ESL-SOF is the application addressed to the Students that helps them to understand theoretical concepts by means of practical exercises and to prove their knowledge and progression by performing tests and calculations in addition to Multimedia Resources. Default planned tasks and an Open workgroup are provided by EDIBON to allow the students start working from the first session. Reports and statistics are available to know their progression at any time, as well as explanations for every exercise to reinforce the theoretically acquired technical knowledge.

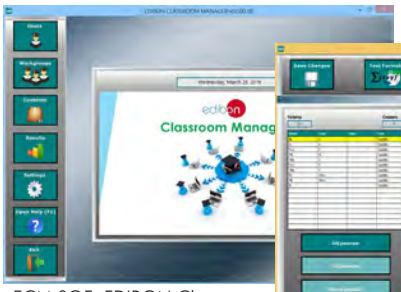
Innovative features:

- **Student Log-In & Self-Registration.**
- **Existing Tasks checking & Monitoring.**
- **Default contents & scheduled tasks available to be used from the first session.**
- **Practical Exercises accomplishment by following the Manual provided by EDIBON.**
- **Evaluation Methods to prove your knowledge and progression.**
- **Test self-correction.**
- **Calculations computing and plotting.**
- **Equation System Solver Engine.**
- **User Monitoring Learning & Printable Reports.**
- **Multimedia-Supported auxiliary resources.**

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

www.edibon.com/en/files/expansion/ICAI/catalog

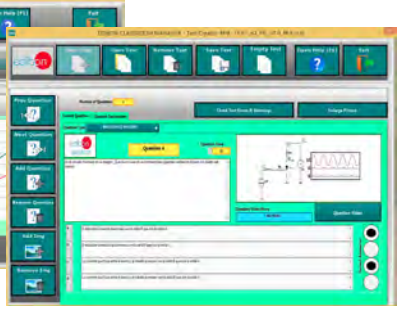
Instructor Software



ECM-SOF. EDIBON Classroom Manager (Instructor Software) Application Main Screen

ECAL. EDIBON Calculations Program Package - Formula Editor Screen

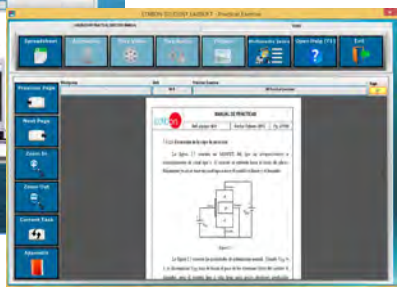
ERS. EDIBON Results & Statistics Program Package - Student Scores Histogram



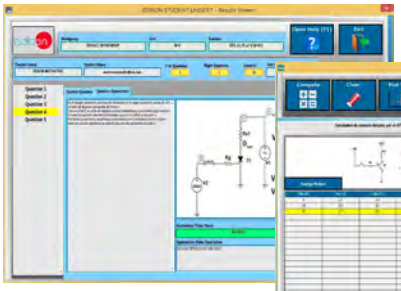
ETTE. EDIBON Training Test & Exam Program Package - Main Screen with Numeric Result Question

Student Software

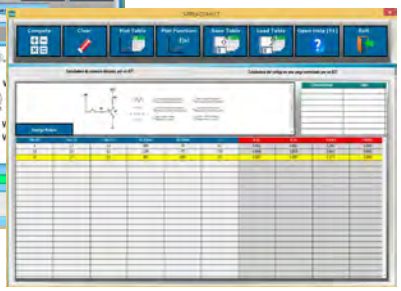
ESL-SOF. EDIBON Student LabSoft (Student Software) Application Main Screen



EPE. EDIBON Practical Exercise Program Package Main Screen



ERS. EDIBON Results & Statistics Program Package - Question Explanation



ECAL. EDIBON Calculations Program Package Main Screen

⑦ SCE/FSS. Faults Simulation System.

Faults Simulation System (FSS) is a Software package that simulates several faults in any EDIBON Computer Controlled Unit. It is useful for Technical and Vocational level.

The "FAULTS" mode consists in causing several faults in the unit normal operation. The student must find them and solve them. There are several kinds of faults that can be grouped in the following sections:

Faults affecting the sensors measurement:

- An incorrect calibration is applied to them.

- Non-linearity.

Faults affecting the actuators:

- Actuators channels interchange at any time during the program execution.

- Response reduction of an actuator.

Faults in the controls execution:

- Inversion of the performance in ON/OFF controls.

- Reduction or increase of the calculated total response.

- The action of some controls is annulled.

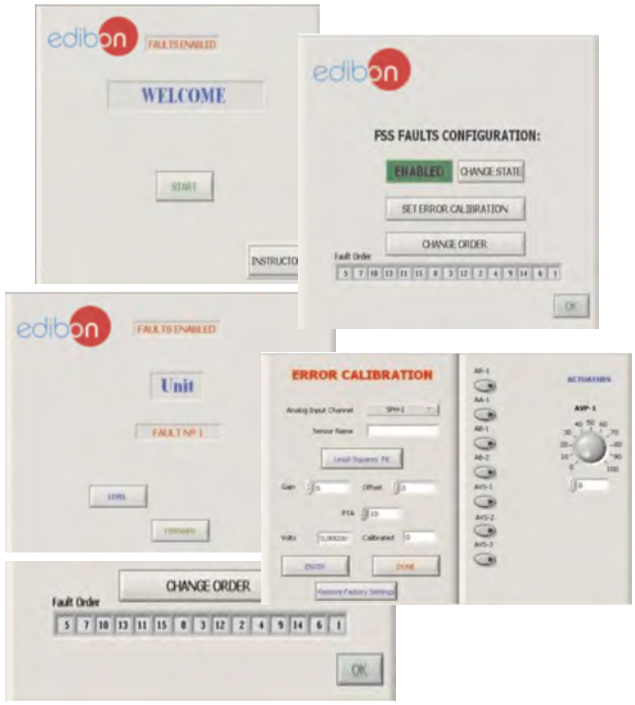
On/off faults:

- Several on/off faults can be included.

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

www.edibon.com/en/files/expansion/FSS/catalog

Example of some screens



ORDER INFORMATION

Main items (always included in the supply)

Minimum supply always includes:

①**Unit: SCE. Computer Controlled Generating Stations Control and Regulation Simulator.**

②**DAB. Data Acquisition Board.**

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

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

⑤ **Manuals.**

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

Optional items (supplied under specific order)

a) Technical and Vocational Education configuration

⑥ SCE/ICAI. Interactive Computer Aided Instruction Software.

⑦ SCE/FSS. Faults Simulation System.

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Metallic box and main metallic elements in stainless steel.

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Control interface.

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Analog output: Channels=2. Resolution=16 bits, 1 in 65536.

Digital Input/Output: Channels=24 inputs/outputs.

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

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9.- Comparative analysis of the transient response of the turbine real motor vs the transient response of the simulated motor for capacitive load.
10.- Comparative analysis of the transient response of the turbine real motor vs the transient response of the simulated motor for inductive load.
11.- Comparative analysis of the response of the gate real motor vs the response of the gate simulated motor for continuous (manually from the computer) control signals.
12.- Comparative analysis of the response of the gate real motor vs the response of the gate simulated motor for sinusoidal control signals.
13.- Comparative analysis of the response of the gate real motor vs the response of the gate simulated motor for square control signals.
14.- Comparative analysis of the response of the gate real motor vs the response of the gate simulated motor for triangular control signals.
15.- Comparative analysis of step response between real motor and simulated motor (gate or turbine).

Other possibilities to be done with this Unit:

16.- Many students view results simultaneously.
To view all results in real time in the classroom by means of a projector or an electronic whiteboard.
17.- Open Control, Multicontrol and Real Time Control.
This unit allows intrinsically and/or extrinsically to change the span, gains; proportional, integral, derivative parameters; etc, in real time.
18.- The Computer Control System with SCADA allows a real industrial simulation.
19.- This unit is totally safe as uses mechanical, electrical/electronic, and software safety devices.
20.- This unit can be used for doing applied research.
21.- This unit can be used for giving training courses to Industries even to other Technical Education Institutions.
- Several other exercises can be done and designed by the user.

a) Technical and Vocational Education configuration

⑥ SCE/ICAI. Interactive Computer Aided Instruction Software.

This complete software package consists of an Instructor Software (EDIBON Classroom Manager - ECM-SOF) totally integrated with the Student Software (EDIBON Student Labsoft - ESL-SOF). Both are interconnected so that the teacher knows at any moment what is the theoretical and practical knowledge of the students.

- ECM-SOF. EDIBON Classroom Manager (Instructor Software).

ECM-SOF is the application that allows the Instructor to register students, manage and assign tasks for workgroups, create own content to carry out Practical Exercises, choose one of the evaluation methods to check the Student knowledge and monitor the progression related to the planned tasks for individual students, workgroups, units, etc...so the teacher can know in real time the level of understanding of any student in the classroom.

Innovative features:

- User Data Base Management.
- Administration and assignment of Workgroup, Task and Training sessions.
- Creation and Integration of Practical Exercises and Multimedia Resources.
- Custom Design of Evaluation Methods.
- Creation and assignment of Formulas & Equations.
- Equation System Solver Engine.
- Updatable Contents.
- Report generation, User Progression Monitoring and Statistics.

- ESL-SOF. EDIBON Student Labsoft (Student Software).

ESL-SOF is the application addressed to the Students that helps them to understand theoretical concepts by means of practical exercises and to prove their knowledge and progression by performing tests and calculations in addition to Multimedia Resources. Default planned tasks and an Open workgroup are provided by EDIBON to allow the students start working from the first session. Reports and statistics are available to know their progression at any time, as well as explanations for every exercise to reinforce the theoretically acquired technical knowledge.

Innovative features:

- Student Log-In & Self-Registration.
- Existing Tasks checking & Monitoring.
- Default contents & scheduled tasks available to be used from the first session.
- Practical Exercises accomplishment by following the Manual provided by EDIBON.
- Evaluation Methods to prove your knowledge and progression.
- Test self-correction.
- Calculations computing and plotting.
- Equation System Solver Engine.
- User Monitoring Learning & Printable Reports.
- Multimedia-Supported auxiliary resources.

⑦ TTEC/FSS. Faults Simulation System.

Faults Simulation System (FSS) is a Software package that simulates several faults in any EDIBON Computer Controlled Unit.

The "FAULTS" mode consists in causing several faults in the unit normal operation. The student must find them and solve them.

There are several kinds of faults that can be grouped in the following sections:

Faults affecting the sensors measurement:
- An incorrect calibration is applied to them.
- Non-linearity.

Faults affecting the actuators:
- Actuators channels interchange at any time during the program execution.
- Response reduction of an actuator.

Faults in the controls execution:
- Inversion of the performance in ON/OFF controls.
- Reduction or increase of the calculated total response.
- The action of some controls is annulled.

On/off faults:
- Several on/off faults can be included.

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

edibon INTERNATIONAL

C/ Julio Cervera, 10-12-14. Móstoles Tecnológico.
28935 MÓSTOLES. (Madrid). ESPAÑA - SPAIN.
Tel.: 34-91-6199363 Fax: 34-91-6198647
E-mail: edibon@edibon.com Web: **www.edibon.com**

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