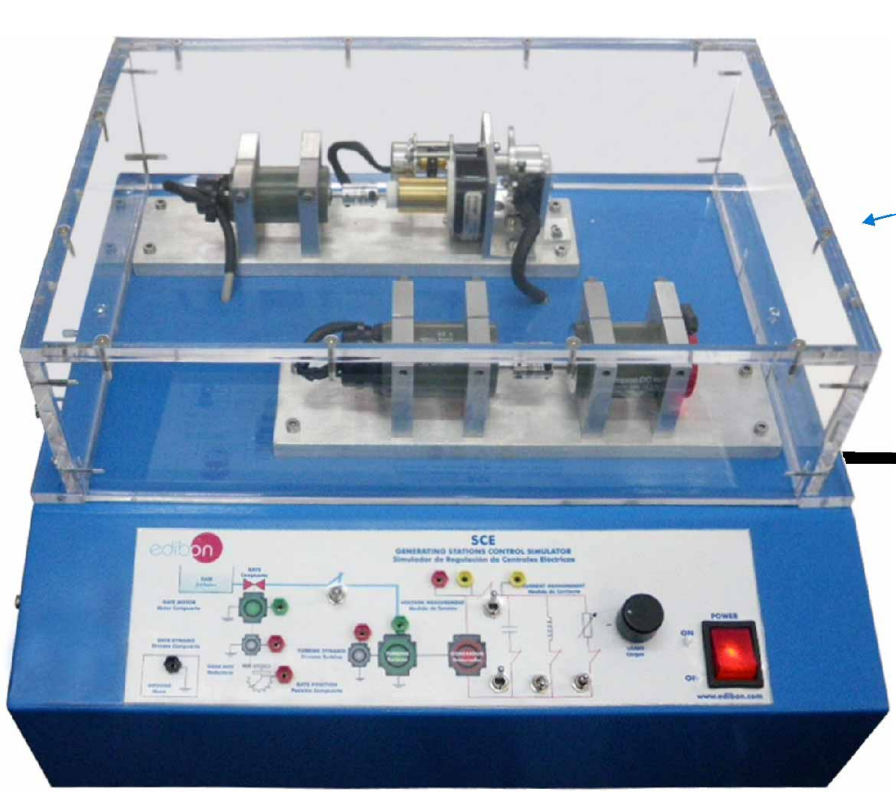
# Computer Controlled **Generating Stations Control and Regulation Simulator**

**SCE**

Technical Teaching Equipment




EDIBON PATENT

Always included in the supply:

Teaching Technique used

**SCADA.**
EDIBON Computer Control System

② Data Acquisition Board

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

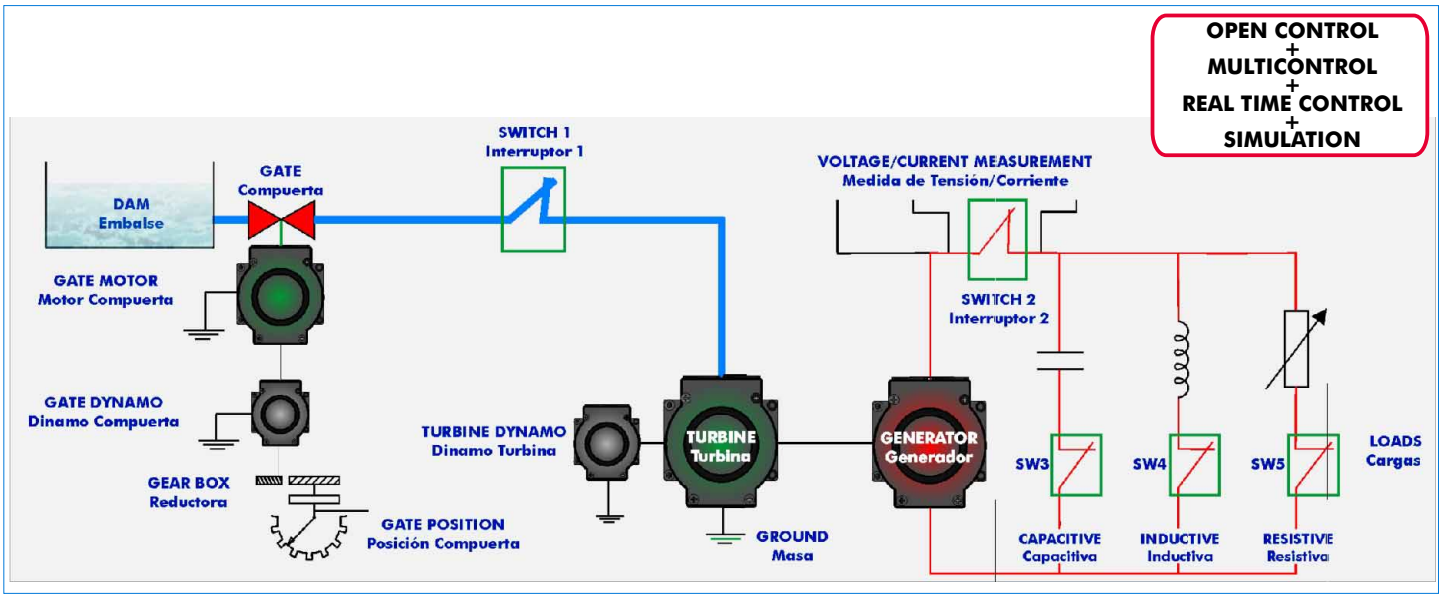
④ Cables and Accessories
⑤ Manuals

Computer (not included in the supply)

① Unit: SCE. Generating Stations Control and Regulation Simulator, including control interface

**www.edibon.com**
Products
Products range
Units
6.- Systems & Automatics
or
5.- Energy

## PROCESS DIAGRAM AND ELEMENTS ALLOCATION




ISO 9001:2000
Certificate of Approval

European Union Certificate

Certificates ISO 14001: 2004 and
ECO-Management and Audit Scheme
(environmental management)

Worlddidac Quality Charter
Certificate
Worlddidac Member

## 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.

## SPECIFICATIONS

**Items supplied as standard**

**① SCE. Unit:**

SCE. Unit

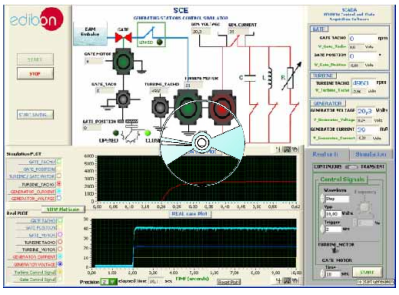
Bench-top unit.
Metallic box and main metallic elements in stainless steel.
Diagram in the front panel with similar distribution to the elements in the real unit.
It is possible to work with this unit in 2 ways:
-REAL mode (continuous or transient analysis).
-SIMULATED mode.
The unit consists mainly 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.
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).
Control interface.

**② DAB. Data Acquisition Board:**

DAB

PCI Data acquisition board (National Instruments) to be placed in a computer slot. Bus PCI.
Analog input: **Channels= 16** single-ended or 8 differential. **Resolution=16 bits**, 1 in 65536. **Sampling rate up to: 250 KS/s** (Kilo samples per second). Input range (V)=±10V. Data transfers=DMA, interrupts, programmed I/0. DMA channels=6.
Analog output: **Channels=2**. **Resolution=16 bits**, 1 in 65536. Max. output rate up to: 833 KS/s. Output range(V)=±10V. Data transfers=DMA, interrupts, programmed I/0.
**Digital Input/Output: Channels=24 inputs/outputs**. D0 or DI Sample Clock frequency: 0 to 1 MHz.
Timing: **Counter/timers=2**. Resolution: Counter/timers: 32 bits.

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



SCE/CCSOF

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 simultaneously 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 250,000 data per second guaranteed. Calibration system for the sensors involved in the process.**
**It allows the graphic representation in real time.**
Comparative analysis of the obtained data and modification of the conditions during the process.
**Open software, allowing to 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 at 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 that the 30 students of the classroom can visualize simultaneously all results and manipulation of the unit, during the process, by using a projector.**

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

**⑤ Manuals:** This unit is **supplied with 8 manuals:** Required Services, Assembly and Installation, Interface and Control Software, Starting-up, Safety, Maintenance, Calibration & Practices Manuals.

**✱ References 1 to 5: SCE + DAB + SCE/CCSOF + Cables and Accessories + Manuals are included in the minimum supply, enabling a normal operation.**

Continue...

## Complementary items to the standard supply

PLC. Industrial Control using PLC (7 and 8):

**⑦PLC-PI. PLC Module:**

Circuit diagram in the front panel.

Front panel:

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

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

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

**Analog inputs block:**

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

**Analog outputs block:**

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

**Touch screen:**

High visibility and multiple functions.
Display of a highly visible status.
Recipe function.
Bar graph function.
Flow display function.
Alarm list.
Multi language function.
True type fonts.

Back panel:

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

Inside:

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

**Panasonic PLC:**

**High-speed scan of 0.32 μsec.** for a basic instruction.
**Program capacity of 32 Ksteps**, with a sufficient comment area.
Free input AC voltage (100 to 240 V AC).
DC input: 16 (24 V DC).
Relay output: 14 (250 V A AC/2 A).
Program capacity: 32 ksteps.
**High-speed counter.**
**Multi-point PID control.**

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

Communication RS232 wire, to computer (PC).

**⑧SCE/PLC-SOF. PLC Control Software:**

For this particular unit, always included with PLC supply.

PLC-PI

## Items available on request

**⑨ SCE/CAL. Computer Aided Learning Software (Results Calculation and Analysis).**

**⑩SCE/FSS. Faults Simulation System.**

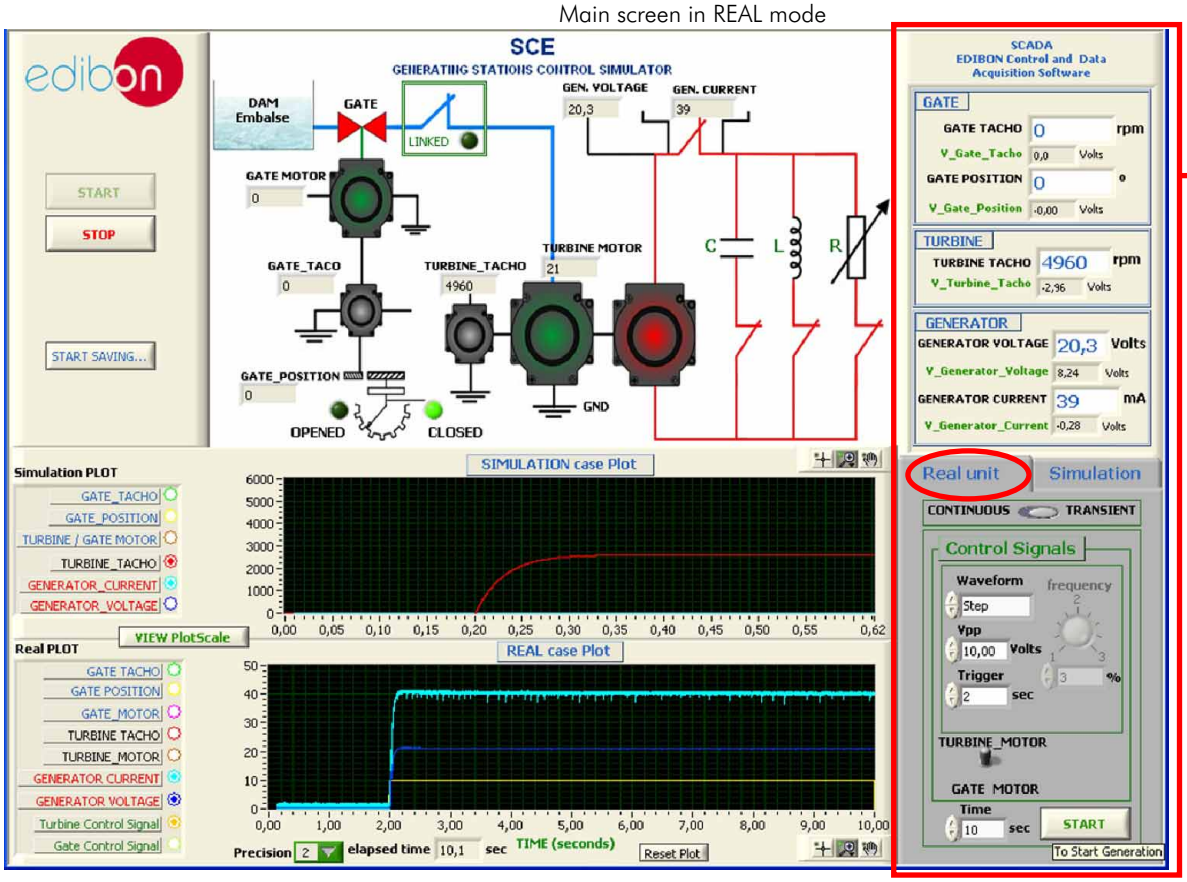
## Software Main Screens

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.

Main screen in REAL mode

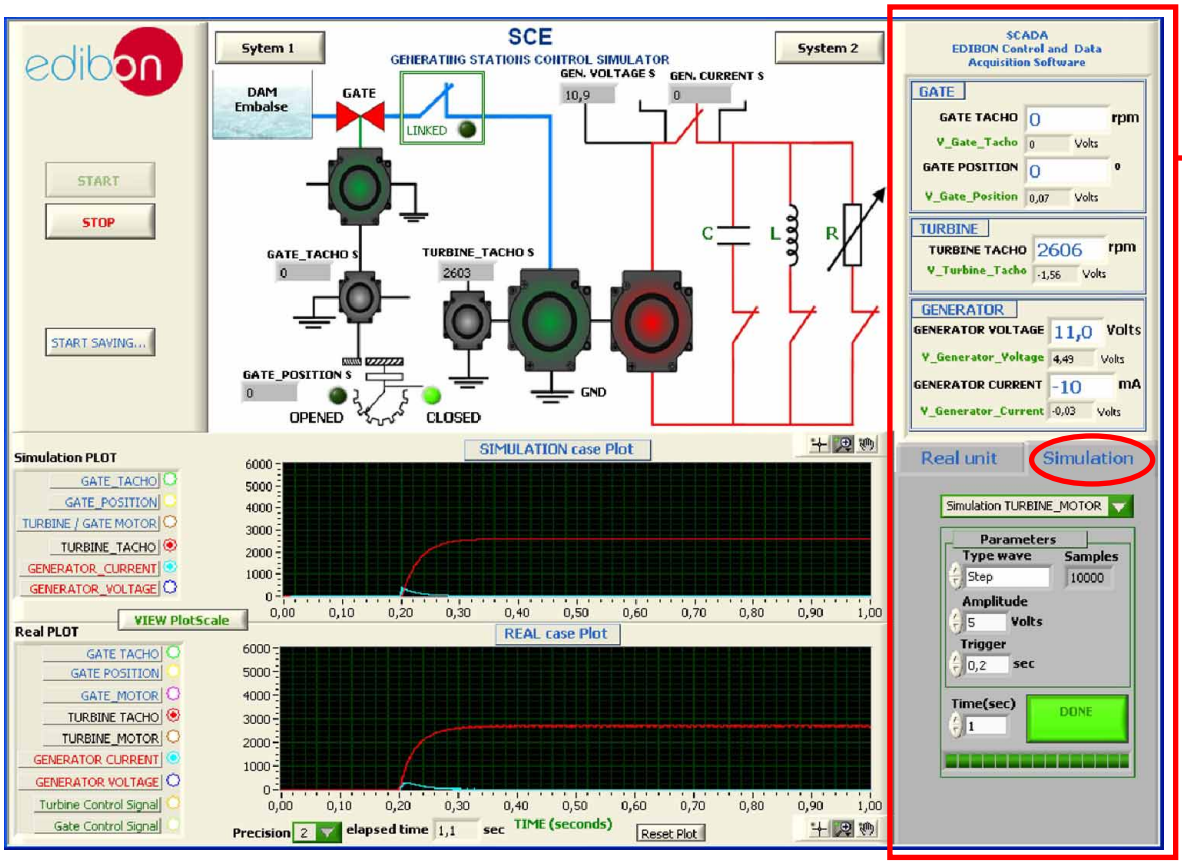



A set of sensors and actuators are available.

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

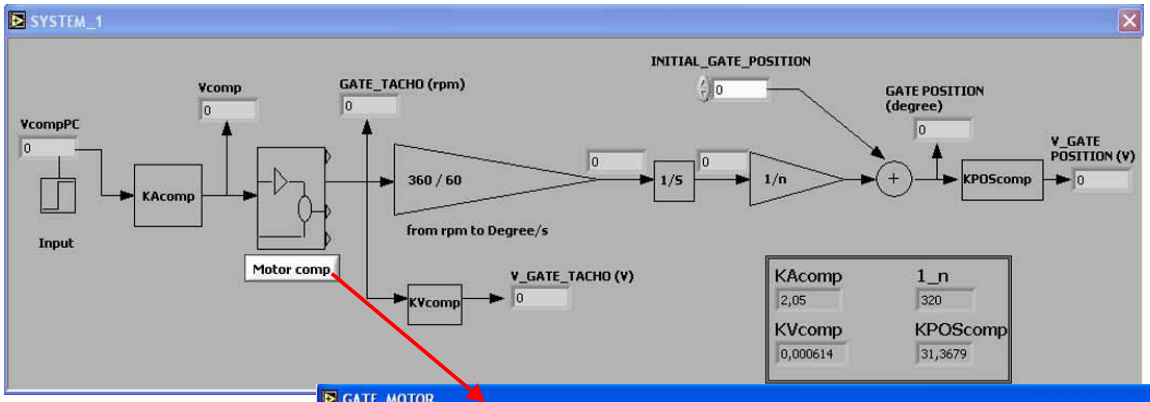



A set of virtual actuators and sensors are available, by which, throught the matemathical model of the system, we obtain the simulated response of the system.

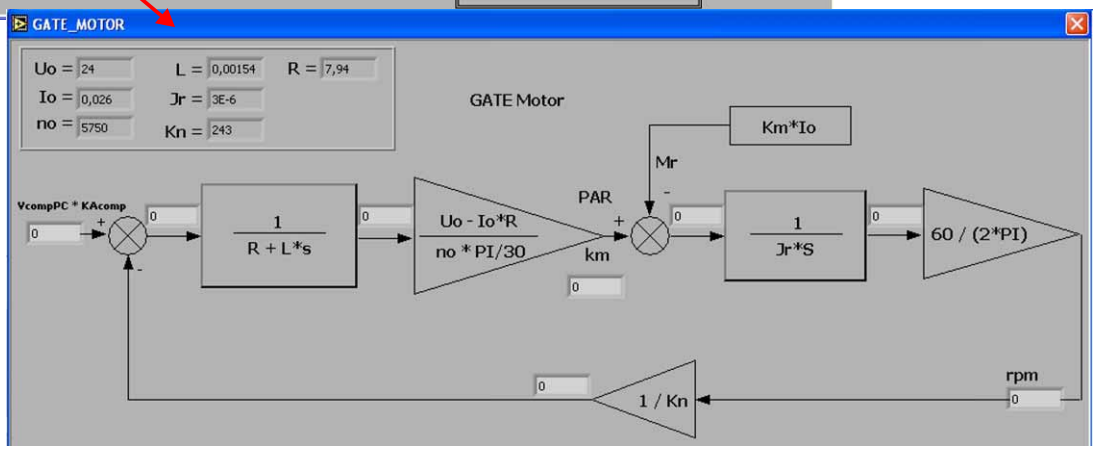
Continue...

Mathematical modelization screens (in SIMULATED mode)

Modelization of the Subsystem 1:

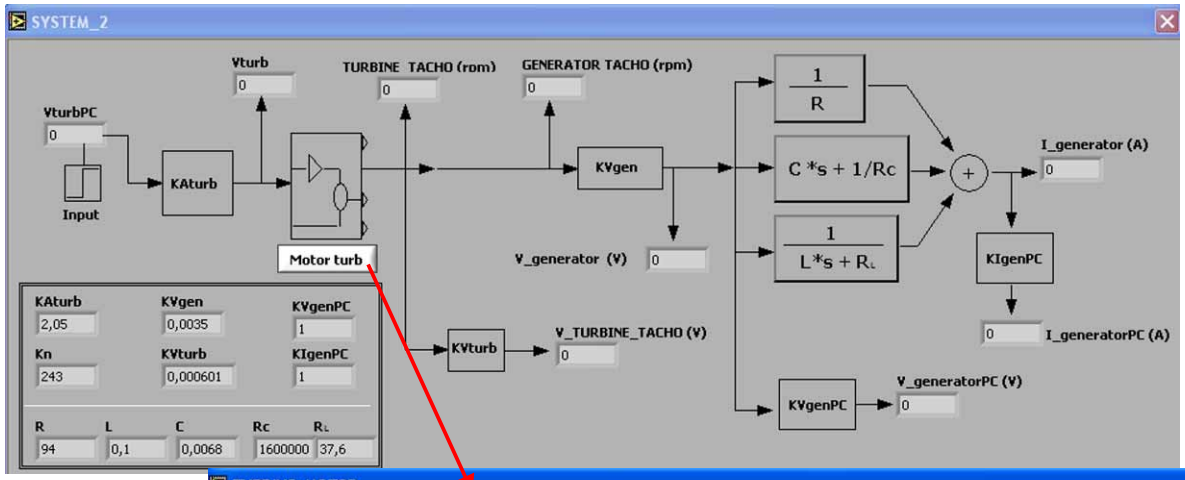



Modelization of the gate subsystem.

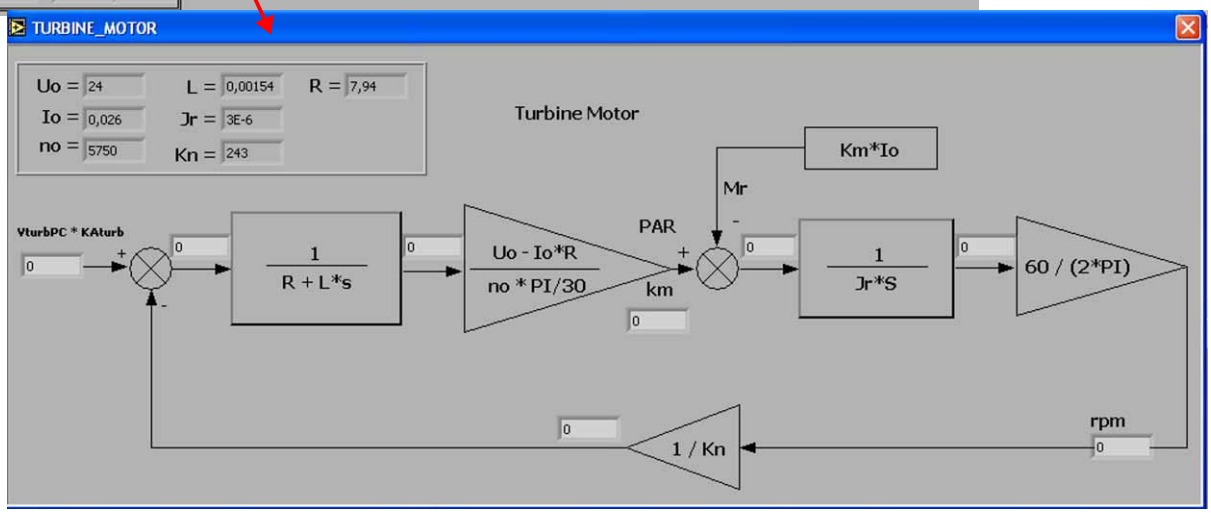



Modelization of the gate motor.

Modelization of the Subsystem 2:




Modelization of the generator subsystem.

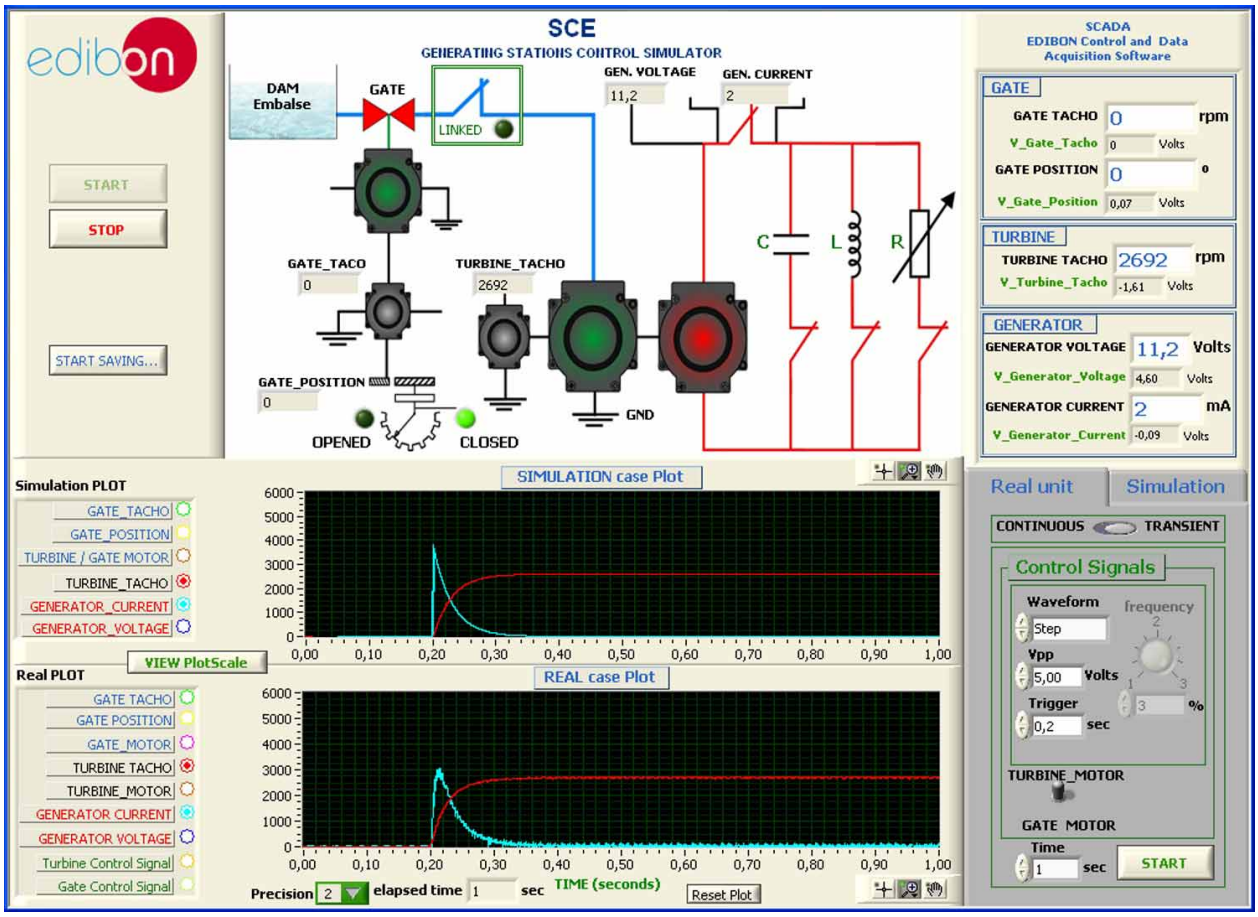



Modelization of the turbine motor.

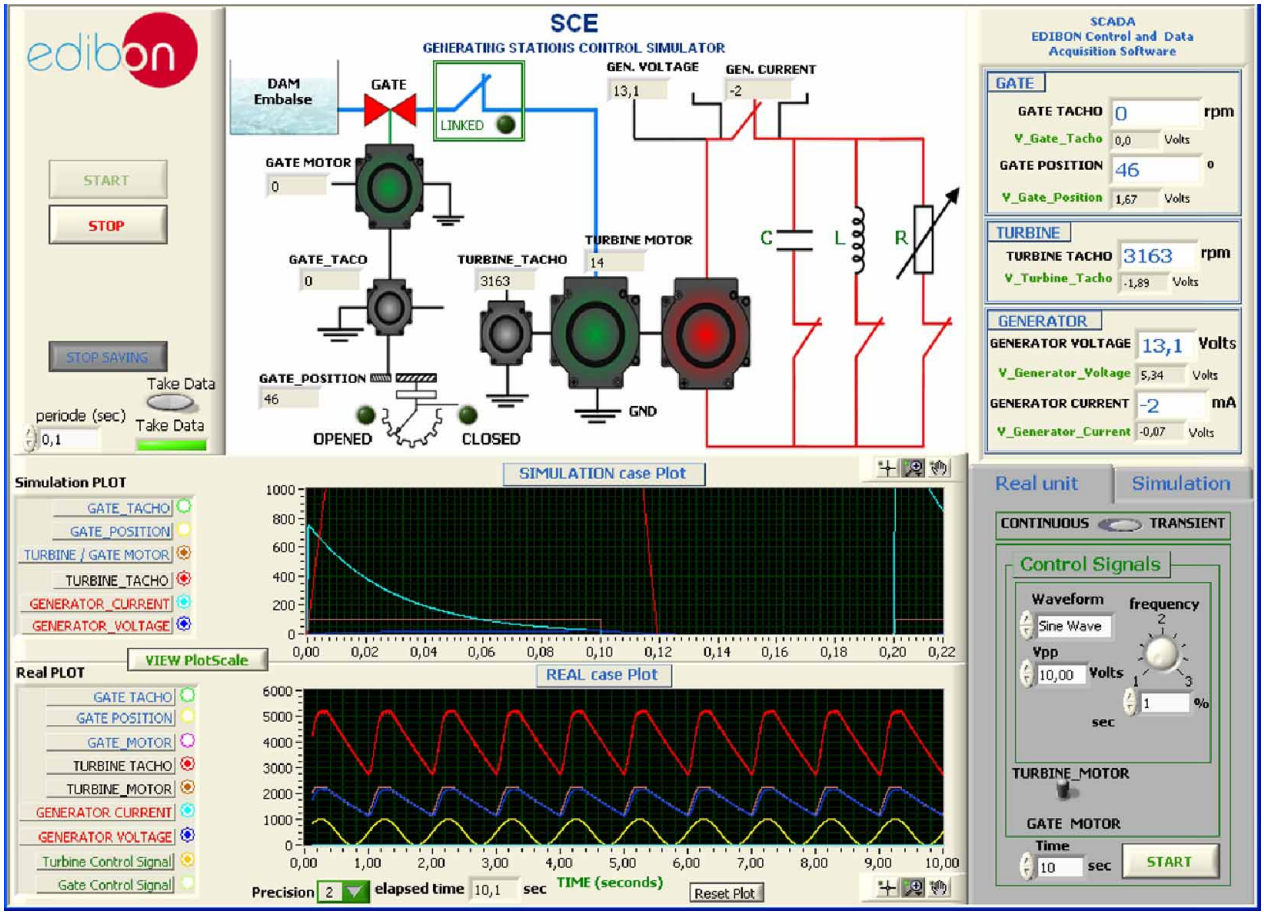
Continue...

## Some typical results screens

Step response of the generator with capacitive load.




Turbine response and generator response for sine control signal.




Continue...

## Some typical results screens

Generator transient response for step control signal.

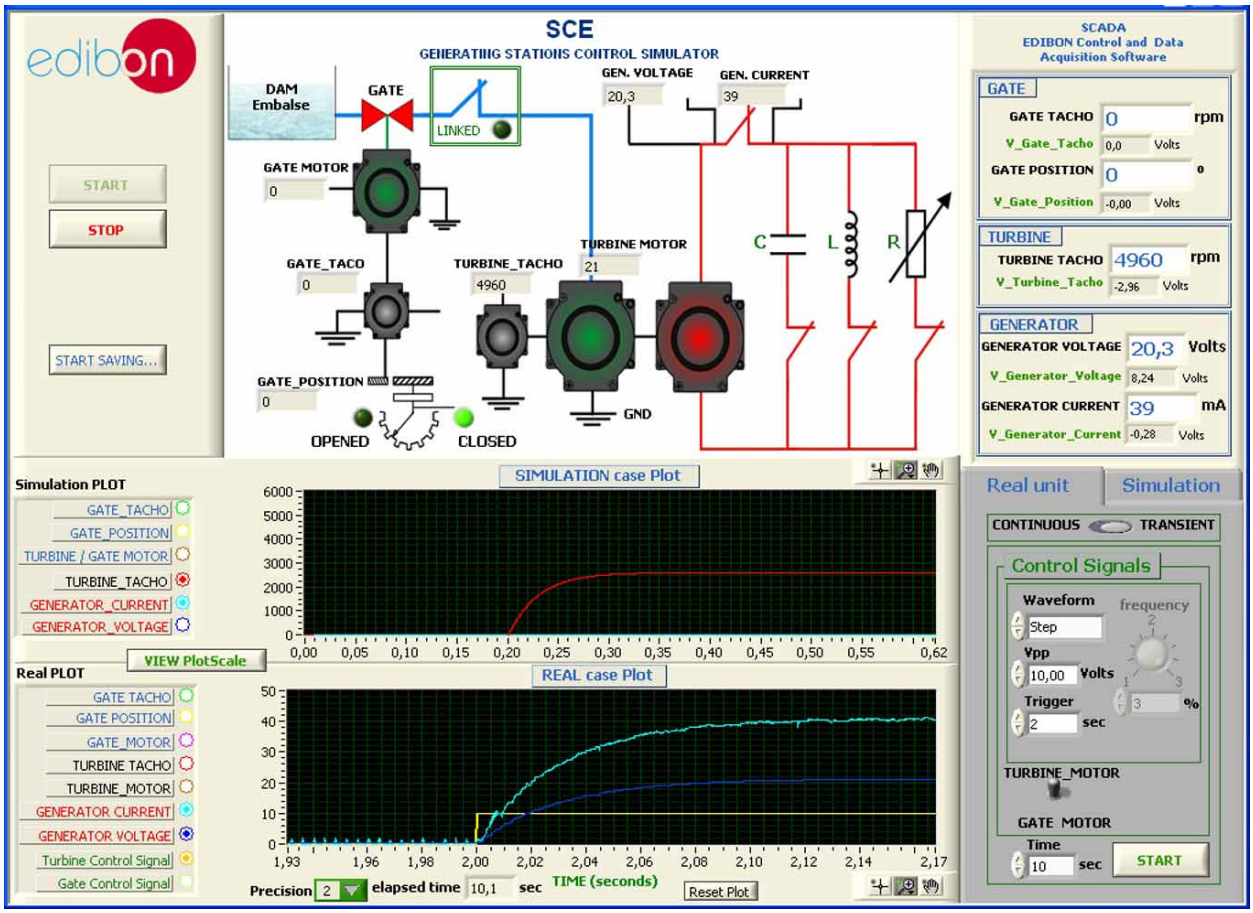
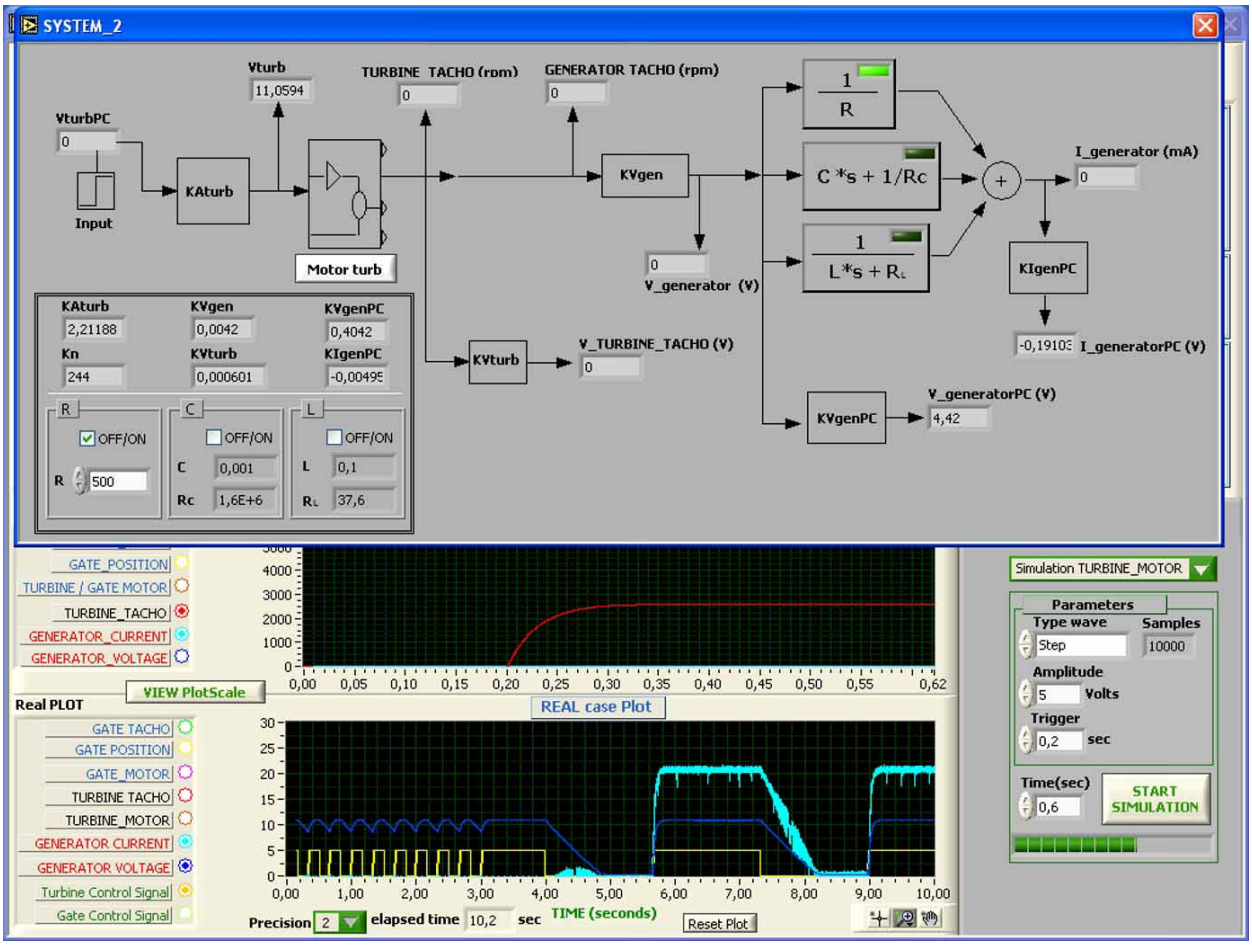



Diagram of the mathematical modelization of the turbine.



## EXERCISES AND PRACTICAL POSSIBILITIES

Some Practical Possibilities of the Unit:

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.

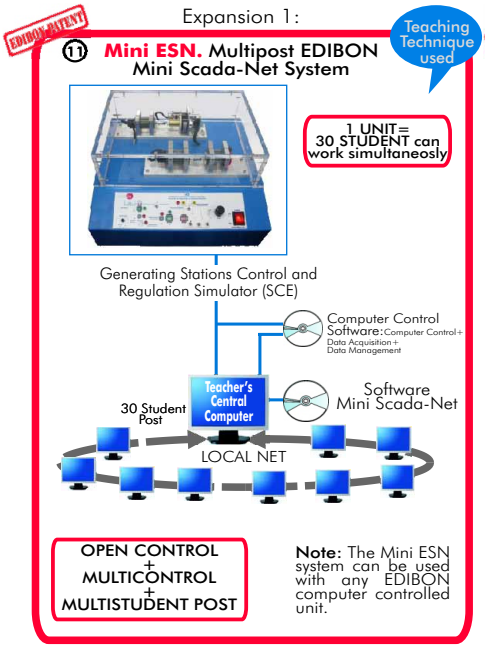
13.- Comparative analysis of the response of the gate real motor vs the response of the gate simulated motor for square control signals.

14.- Comparative analysis of the response of the gate real motor vs the response of the gate simulated motor for triangular control signals.

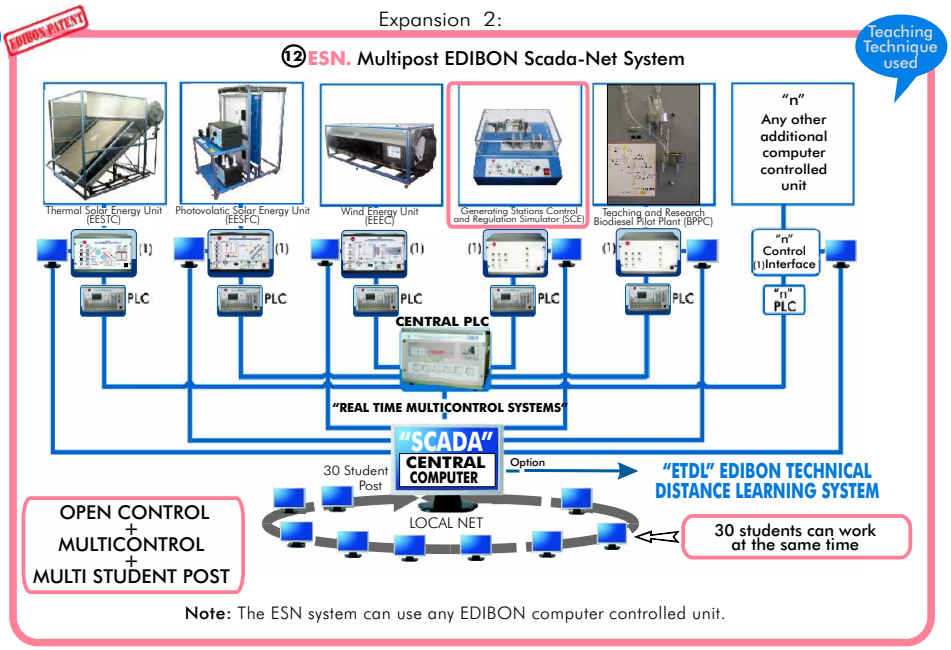
15.- Comparative analysis of step response between real motor and simulated motor (gate or turbine).

## POSSIBILITIES OF OTHER AVAILABLE EXPANSIONS

Expansion 1:




Expansion 2:




## ORDER INFORMATION

### Items supplied as standard

**Minimum configuration** for normal operation includes:

① **Unit: SCE. 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.**

### Complementary items to the standard supply

PLC. Industrial Control using PLC (7 and 8):

⑥ PCL-PI. PLC Module.

⑦ SCE/PLC-SOF. PLC Control Software.

⑧ SCE/CAL. Computer Aided Learning Software (Results Calculation and Analysis). (Available on request).

⑨ SCE/FSS. Faults Simulation System. (Available on request).

Expansions

⑩ Mini ESN. Multipost EDIBON Mini Scada-Net System.

⑪ ESN. Multipost EDIBON Scada-Net System.

## REQUIRED SERVICES

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

-Computer (PC).

## DIMENSIONS & WEIGHT

| | |
|---|---|
| SCE. Unit: | -Dimensions: 405 x 350 x 250 mm. approx. |
| | -Weight: 15 Kg. approx. |
| PLC Module (PLC-PI): | -Dimensions: 490 x 330 x 310 mm. approx. |
| | -Weight: 30 Kg. approx. |

✱ 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: ED02/10
Date: June/2010

REPRESENTATIVE: