Wind Power Plants with Double Feed Induction Generator Application, with SCADA

AEL-WPP
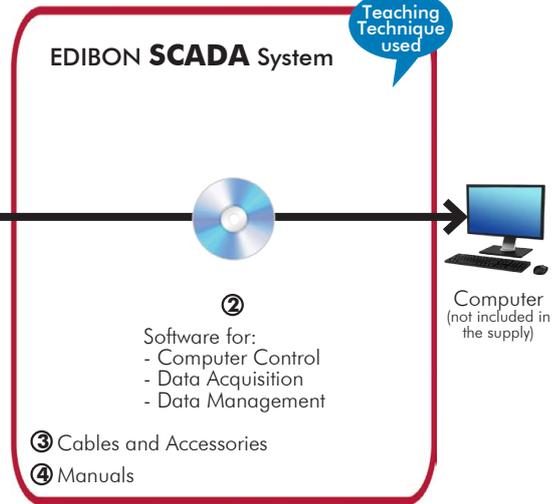
EDIBON **SCADA** System

Teaching Technique used

② Software for:
- Computer Control
- Data Acquisition
- Data Management

③ Cables and Accessories

④ Manuals

Computer
(not included in the supply)

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

① Unit: AEL-WPP. Wind Power Plants with Double Feed Induction Generator Application

Key features:

➤ **Advanced Real-Time SCADA.**

➤ **Open Control + Multicontrol + Real-Time Control.**

➤ **Specialized EDIBON Control Software based on LabVIEW.**

➤ **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 knowwledge 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,
   5.- ENERGY AND
   6.- MECHATRONICS,
      AUTOMATION &
      COMPUMECHATRONICS

For more information about Key Features, click here

INTRODUCTION

The doubly-fed induction generator (DFIG) system is a popular system in which the power electronic interface controls the rotor currents to achieve the variable speed necessary for maximum energy capture in variable winds. Because the power electronics only process the rotor power, typically less than 25% of the overall output power, the DFIG offers the advantages of speed control with reduced cost and power losses.

The DFIG can change the speed of the generator rotor by means of controlling the frequency of the rotor field current. When a fault occurs on the grid side and the rotor is accelerated, it can keep the speed of the rotor rotating magnetic field at the synchronous speed via reducing the frequency of the rotor field current.

GENERAL DESCRIPTION

The Wind Power Plants with Double Feed Induction Generator Application, "AEL-WPP", is used to investigate the design and operation of modern wind power stations. The "AEL-WPP" consists of a prime motor that moves a double-feed induction generator (as a generator for the wind power plant).

This power station includes a SCADA Control Systems which allows the following:

In one hand the SCADA allows the user to configure the desired wind curve for the experiment. Once the wind curve is configured and the user starts the experiment, the software controls automatically the "AEL-SERIN/CA-1K" motor to generate the same wind curve configured by the user.

In the other hand the SCADA allows to visualize the most important signals of the systems (rotor current, stator current, line voltage, dc bus voltage of the back to back inverter…) and allows to visualize the most important measurements of the system (value of the rotor active power and reactive power, stator active power and reactive power, total active and reactive power, speed of the generator shaft…).

The software also allows the user to save the experiment data, to analyze the results after the test, through a data visualizer included with the software. The data format of the saved files are compatible with Microsoft excel.

Finally, the SCADA software allows simulations of voltage dips in the electrical network supplying the doubly fed induction generator. It is possible to simulate dips of 20%, 40% and 60% as well as to specify the voltage dip injection time. Thanks to this simulation it is possible to understand, in a safe and efficient way, the different phenomena to which these types of wind turbines are subjected. The great advantage of being able to simulate voltage dips is that in no case will the machine be subjected to any damage.

The "AEL-WPP" application includes the following elements:

- EMT8B/1.5K. 3PH Wound Motor, 1.5 kW, 4 Poles.
- N-DFGC. Double-feed Generator Control Module.
- N-FRT. Fault Ride Trough Module.
- N-BTBINV. Back to Back Inverter.
- N-SERIN/CA-1K. Advanced Industrial Servosystems Module for AC Motors.

Required elements (Not included):

- AEL-PC. Touch Screen and Computer.
- AEL-WBR. Electrical Workbench (Rack).

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

With this unit there are several options and possibilities:

- Main items: 1, 2, 3 and 4.

- Optional items: 5, 6 and 7.

Let us describe first the main items (1 to 4):

① AEL-WPP. Unit.

- EMT8B/1.5K. **3PH Wound Motor, 1.5 kW, 4 Poles.**

  Servomotor:

    Nominal power: 1 kW.

    Nominal voltage: 3 x 400/230 VAC Y/ Δ.

    Number of poles: 2.

    Frequency: 50/60 Hz.

    RPM: 3000 rpm.

    Nominal current: 1.7/3 A, Y/ Δ.

  Asynchronous three-phase generator with double feed:

    Nominal power: 1.5 kW.

    Nominal voltage: 3 x 400/230 VAC Y/ Δ.

    Frequency: 50/60 Hz

    Number of poles: 4.

    RPM: 1500 rpm.

    Nominal current: 2.5/4.4 A, Y/ Δ.

EMT8B/1.5K

- N-DFGC. **Double-feed Generator Control Module.**

  Operation of the double-feed asynchronous generator in subsynchronous and supersynchronous operating mode.

  Autonomous control of reactive and active power, frequency, voltage, etc.

  Automatic mains synchronisation.

  Connection to control the back to back inverter (N-BTBINV).

  Connection to control the main motor (AEL-SERIN/CA-1K).

  Connection voltage: 3 x 400 V, 50…60 Hz.

N-DFGC

- N-FRT. **Fault Ride Trough Module.**

  Voltage dips simulation module. This module allows the simulation of different levels of voltage dips:

    0%, 20%, 40% and 60%.

  Configurable parameters for fault simulation:

    Adjustable power failure durations from 50 ms to 500 ms.

    Adjustable voltage drop, four levels, for all phases.

    Touch screen.

N-FRT

- N-BTBINV. **Back to Back Inverter.**

  This module integrates a back to back inverter used to extract power from the double-feed induction generator rotor. Besides, it integrates a braking chopper to protect the DC BUS.

  The back to back inverter is controlled by the "N-DFGC" module.

N-BTBINV

• N-SERINCA1K. **Advanced Industrial Servosystems Module for AC Motors.**

The "N-SERINCA1K" allows to generate wind curves configured by the user through the AEL-WPP/CCSOF software.

The "N-SERINCA1K" consists of a control interface module connected to a three-phase motor and a computer (AEL-PC). The control interface has a 20-bit incremental encoder that controls the speed, position and torque of the motor.

The USB communication between the control interface and the PC gives the "N-SERINCA1K" the possibility to control the motor from the PC and to display the most important motor signals: torque, position and speed control.

Control Interface module:

Three digital outputs:

Each output has a green LED that indicates if the output is active or not.

Encoder outputs:

Two pairs of outputs (CH A Out, CH B Out and their respective denied outputs) that are TTL signals of incremental position generated by the encoder feedback. These signals indicate the direction of rotation of the motor.

One pair of outputs (CH Z Out and their denied) that TTL works as marker of pulses. This signal indicates the motor speed.

Relay output: this output is a relay, and it belongs together with the output 4 that it can be in the software inside the I/O digital label.

Three analog outputs: can be controlled by software to be a certain valve of the internal variables.

Six digital inputs: digital inputs for those signals that are introduced to enable the different available functions in the software.

Six buttons: they are good to enable the digital inputs. When the button is pressed, the digital Input will be activated, making what has been defined by the software.

Six switches: they have the same function as the buttons, but with the only difference that they are switches and, therefore, maintain the position fixed (open or closed).

Switch outfitter of digital inputs: there is a switch that enables the digital inputs. When the green LED is on, the inputs will be enabled.

Analog input: this input allows an analog use directly of the user. It is an A/D input.

Potentiometer. Digital encoder.

Reset button: this button is used to reset the motor driver after setting a new configuration.

Motor:

3PH AC motor, 2 kW, 5 A, 5000 rpm, 400 VAC, 19.1 Nm, IP67, 20 bits (1048576 resolution) incremental encoder.

N-SERINCA1K/CCSOF: Data Management Software + Data Acquisition + Computer Control:

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

N-SERINCA1K

N-SERINCA1K/CCSOF

Required elements (Not included):

• AEL-PC. **Touch Screen and Computer.**

Touch Screen:

Energy efficiency class: A.

Screen diagonal: 68.6 cm (27 inch (s)).

Power consumption (operating): 26 watts.

Annual energy consumption: 38 kWh.

Power consumption (standby / off) 0.49 watts.

Screen resolution: 1920 x 1080 pixels

Computer:

Processor Number: Intel Core i7-6600U Processor (4M Cache, up to 3.40 GHz).

Cache: 4 MB Intel Smart Cache.

Clock speed: 2.6 GHz.

Of cores/# of threads: 2/4.

Max. TDP/Power: 15 W.

Memory types: DDR4-2133, LPDDDR3-1866, DDR3L-1600.

Graphics: Intel HD Graphics 530.

Slot for PCI Express.

AEL-PC

• AEL-WBR. **Electrical Workbench (Rack).**

Anodized aluminum frame.

Melamine board, 19 mm.

Four wheels for an easy movement of the bench, two of them with safety brakes.

Fluorescent tube, 58 W.

ON/OFF selector switch.

AEL-WBR

• **All necessary cables to realize the practical exercises are included.**

The complete unit includes as well:

Advanced Real-Time SCADA.

Open Control + Multicontrol + Real-Time Control.

Specialized EDIBON Control Software based on LabVIEW.

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 knowwledge 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 **AEL-WPP/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.

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 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.
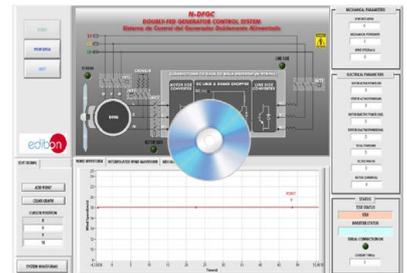
AEL-WPP/CCSOF

③ **Cables and Accessories**, for normal operation.

④ **Manuals:**

This unit is **supplied with 8 manuals**: Required services, Assembly and Installation, Control software, Starting-up, Safety, Maintenance & Practices manuals.

∗ References 1 to 4 are the main items: AEL-WPP + AEL-WPP/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.- Identifying elements and devices.

2.- Supply and modules signals wiring.

3.- Commissioning of application.

4.- Analyzing the system states: starting and loading the DC bus.

5.- Identifying modulation inverter start back to back.

6.- Stop sequence double feed induction generator.

7.- Study of the double-feed asynchronous machine with subsynchronous speed.

8.- Study of the double-feed asynchronous machine with supersynchronous speed.

9.- Study of the system behavior during the simulation of voltage dips in the network ("fault ride-through").

Other possibilities to be done with this unit:

10.- Many students view results simultaneously.

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

11.- 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.

12.- The Computer Control System with SCADA allows a real industrial simulation.

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

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

15.- 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: three-phase, 380 VAC- 400 VAC/50 Hz o 190 VAC-240/60 Hz, 2 kW.

REQUIRED ELEMENTS (Not included)

- AEL-PC. Touch Screen and Computer.
- AEL-WBR. Electrical Workbench (Rack).

DIMENSIONS AND WEIGHTS

AEL-WPP:
- Dimensions: 2000 x 400 x 2000 mm approx.
             (78.74 x 15.75 x 78.74 inches approx.)
- Weight: 100 Kg approx.
             (220 pounds approx.)

SIMILAR UNITS AVAILABLE

Offered in this catalog:
- AEL-WPP. Wind Power Plants with Double Feed Induction Generator Application.

Offered in other catalogs:
- AEL-WPT. Wind Power Application with Permanent Magnets Synchronous Generator.
- AEL-WPPI. Wind Power Plants with Induction Generator Application.
- AEL-WPTC. Wind Power Application with Permanent Magnets Synchronous Generator, with SCADA.
- EEEC. Computer Controlled Wind Energy Unit.
- EEE. Wind Energy Unit.
- MINI-EEE. Wind Energy Basic Unit.
- MINI-EEEC. Computer Controlled Wind Energy Basic Unit.
- AEL-WPPIC. Computer Controlled Wind Power Plants Application with Induction Generator.
- AEL-EPP. Energy Power Plants Application.
- AEL-SWT. Stand-Alone Wind Turbine Application.
- EESFC. Computer Controlled Photovoltaic Solar Energy Unit.
- EESFB. Photovoltaic Solar Energy Unit.
- MINI-EESF. Photovoltaic Solar Energy Modular Unit (Complete Version).
- MINI-EESF/B. Photovoltaic Solar Energy Modular Unit (Basic Version).
- MINI-EESF/M. Photovoltaic Solar Energy Modular Unit (Intermediate Version).

SCADA
Main screen
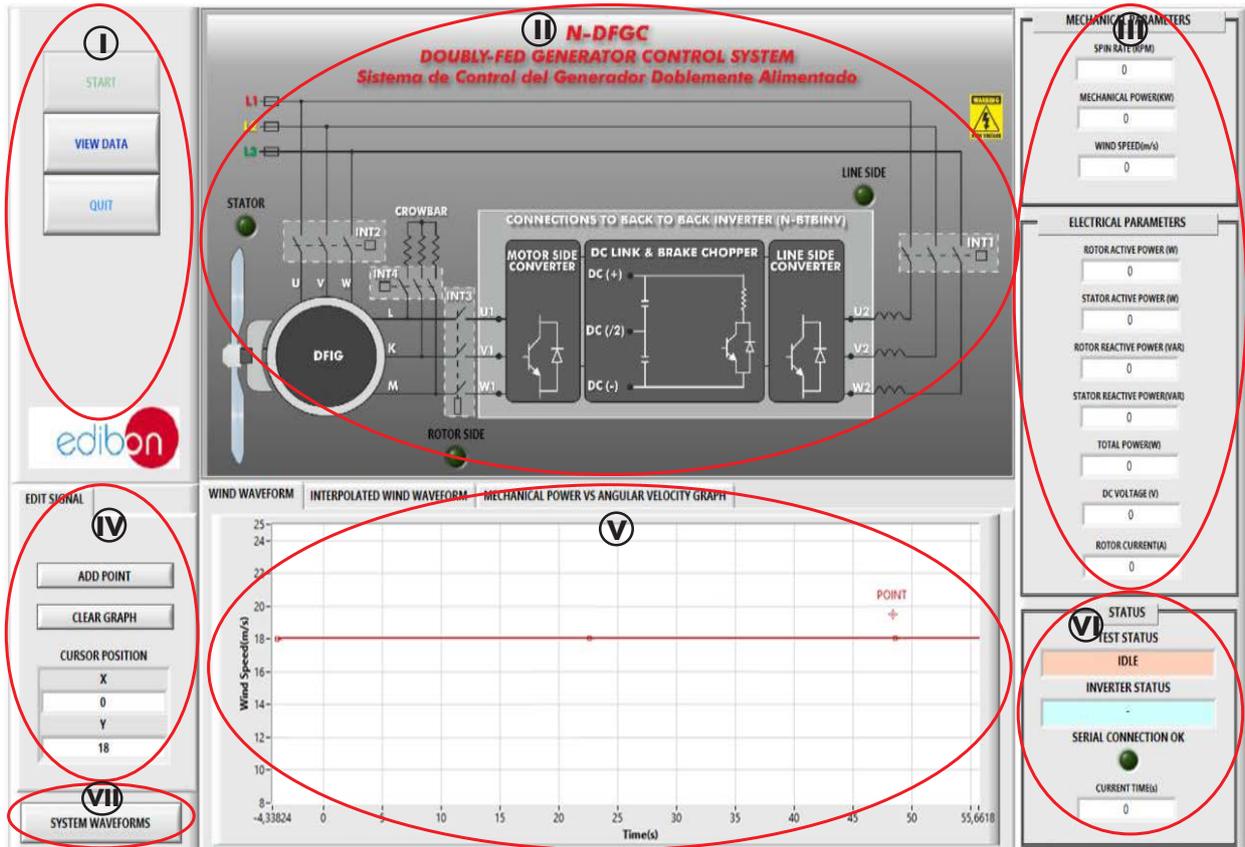
(I) Main controls.

(II) Contactors status diagram.

(III) Menu indicating the machines mechanical and electrical parameters.

(IV) Menu to edit the wind profile of point 5 in the WIND WAVEFORM tab.

(V) Graphical editing and visualisation of the wind profile to which the turbine is subjected as well as the optimum power curve as a function of the angular speed of the turbine.

(VI) Menu of test status and serial communication with the unit.

(VII) Menu to display the date logging of signals adquired during the machine test.

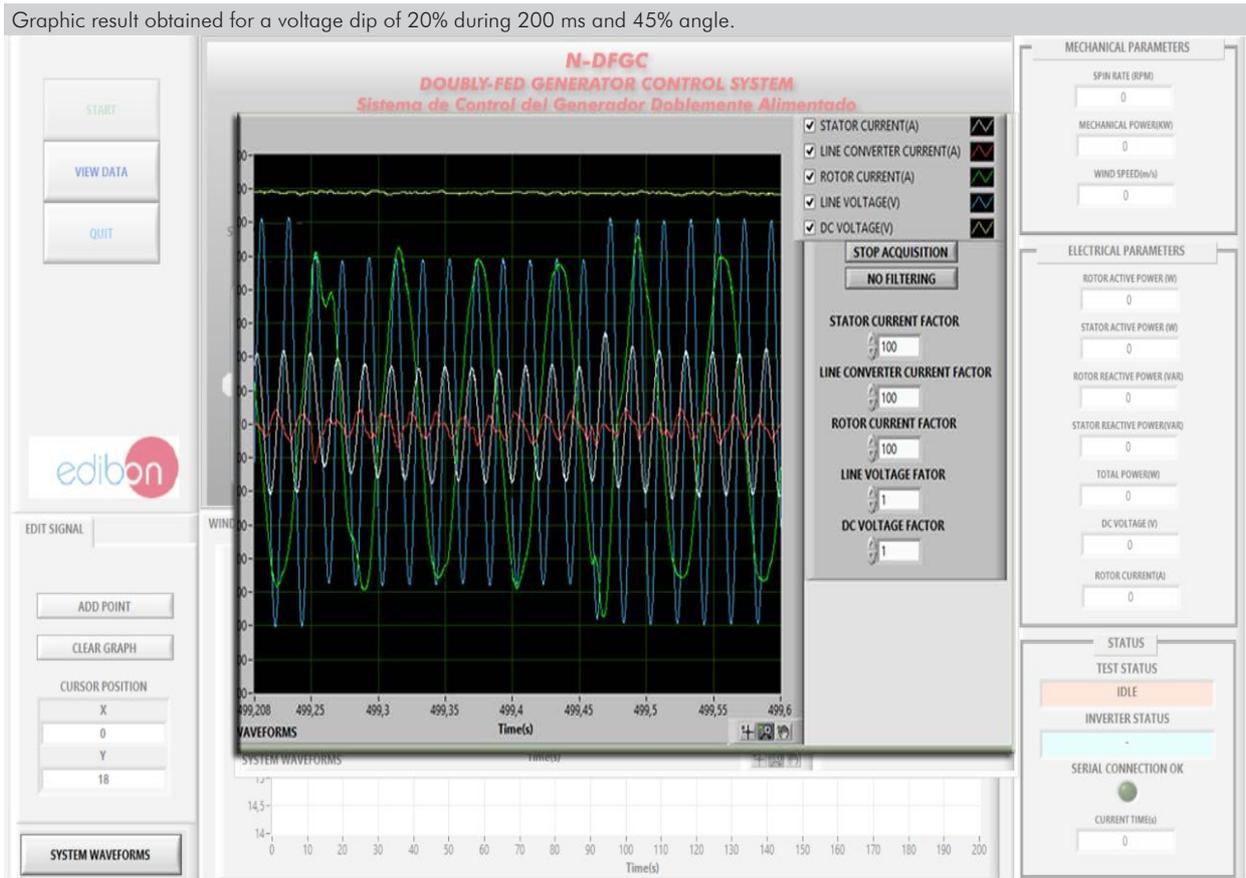Edition screen of the wind curve points.
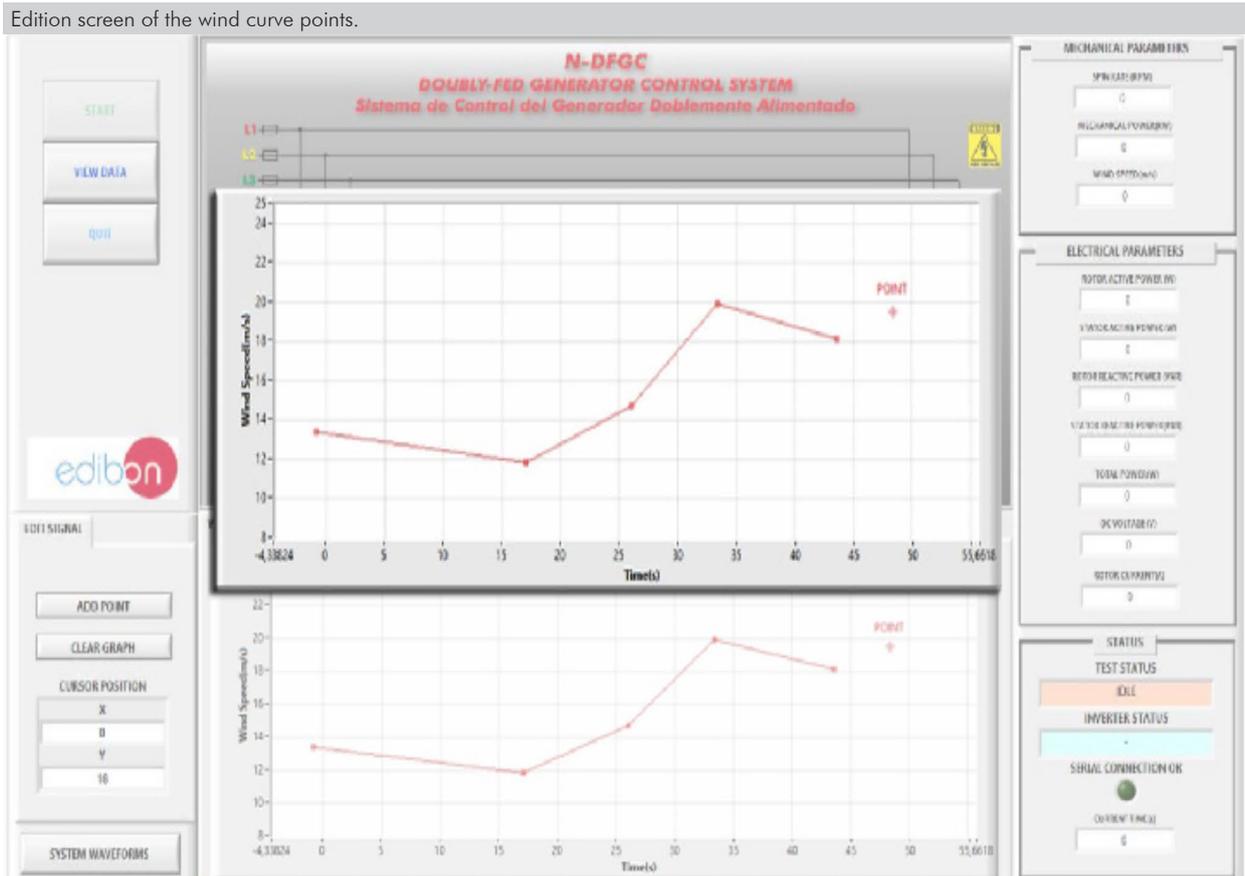
Wind turbine speed curve.
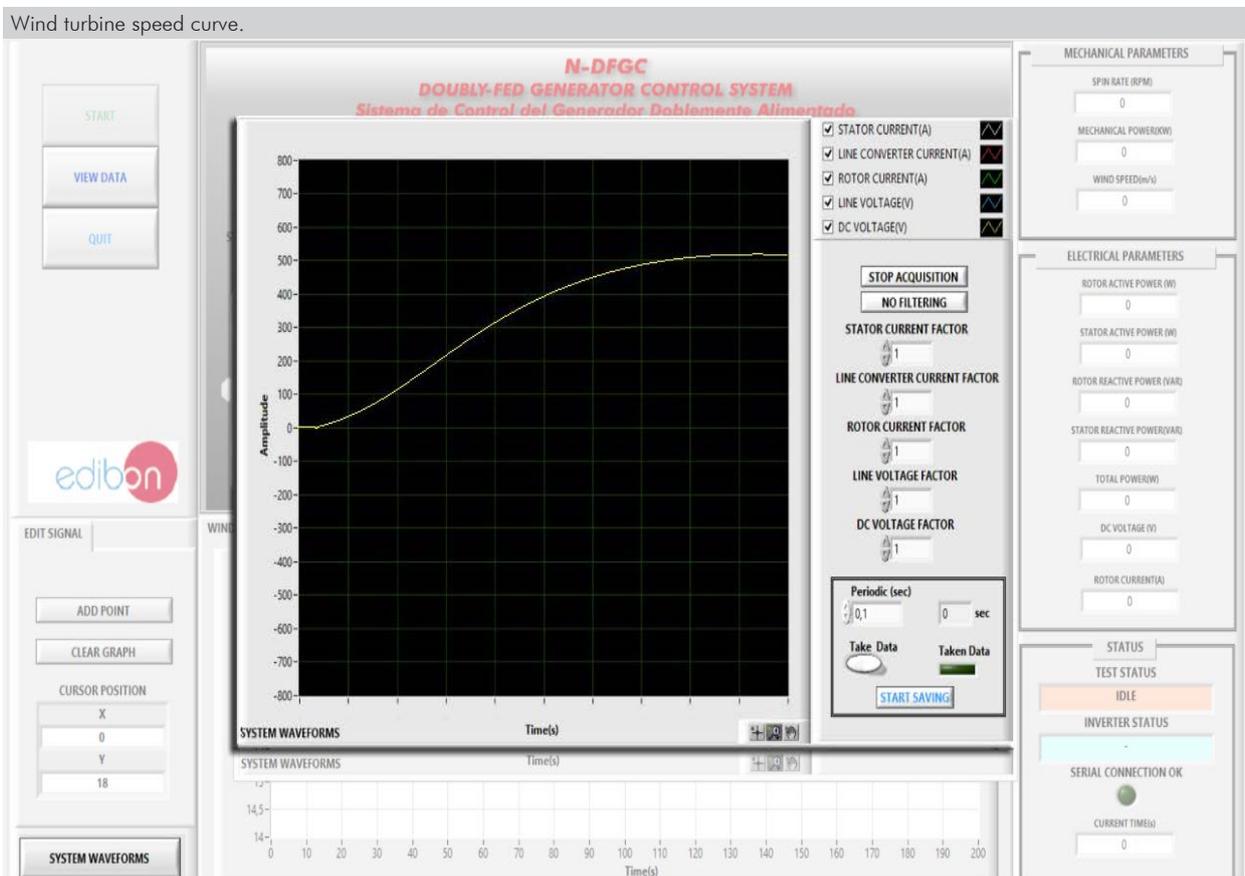
Some **real** results obtained from this unit

Graphic result obtained for a voltage dip of 20% during 200 ms and 45% angle.

Additionally to the main items (1 to 4) described, we can offer, as optional, other items from 5 to 7.

All these items try to give more possibilities for:

a) Technical and Vocational Education configuration. (ICAI)

b) Multipost Expansions options. (Mini ESN and ESN)

a) Technical and Vocational Education configuration

⑤ **AEL-WPP/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 4).

- 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.**

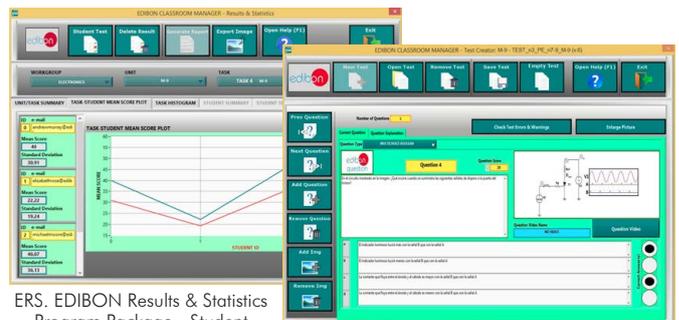For more information see **ICAI** catalogue. Click on the following link:

www.edibon.com/en/interactive-computer-aided-instruction-software

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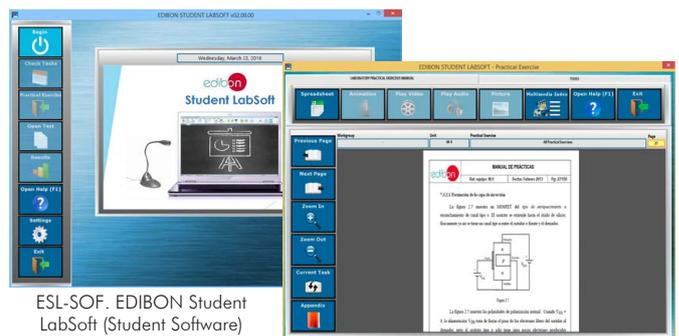
ESL-SOF. EDIBON Student LabSoft (Student Software) Application Main Screen

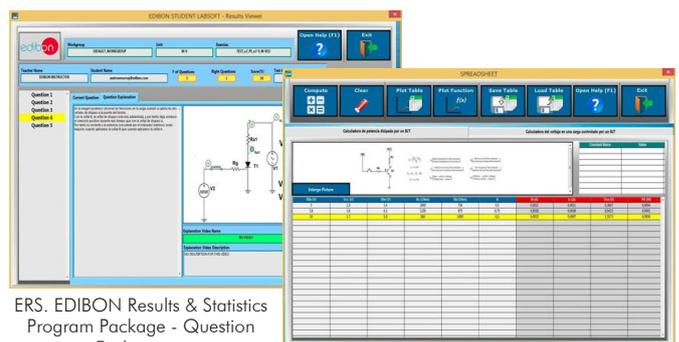EPE. EDIBON Practical Exercise Program Package Main Screen

ERS. EDIBON Results & Statistics Program Package - Question Explanation

ECAL. EDIBON Calculations Program Package Main Screen

b) Multipost Expansions options

⑥ MINI ESN. EDIBON Mini Scada-Net System for being used with EDIBON Teaching Units.

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 of the adaptation of any EDIBON Computer Controlled Unit with SCADA 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, 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/en/edibon-scada-net

MINI ESN.
EDIBON Mini Scada-Net System

1 UNIT= up to 30 STUDENTS can work simultaneously

Wind Power Plants with Double Feed Induction Generator Application (AEL-WPP)

Control Interface Box

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

Instructors' Central Computer

Mini Scada-Net Software

LOCAL NET FOR 30 STUDENTS

OPEN CONTROL
+
MULTICONTROL
+
REAL TIME CONTROL
+
MULTI STUDENT POST
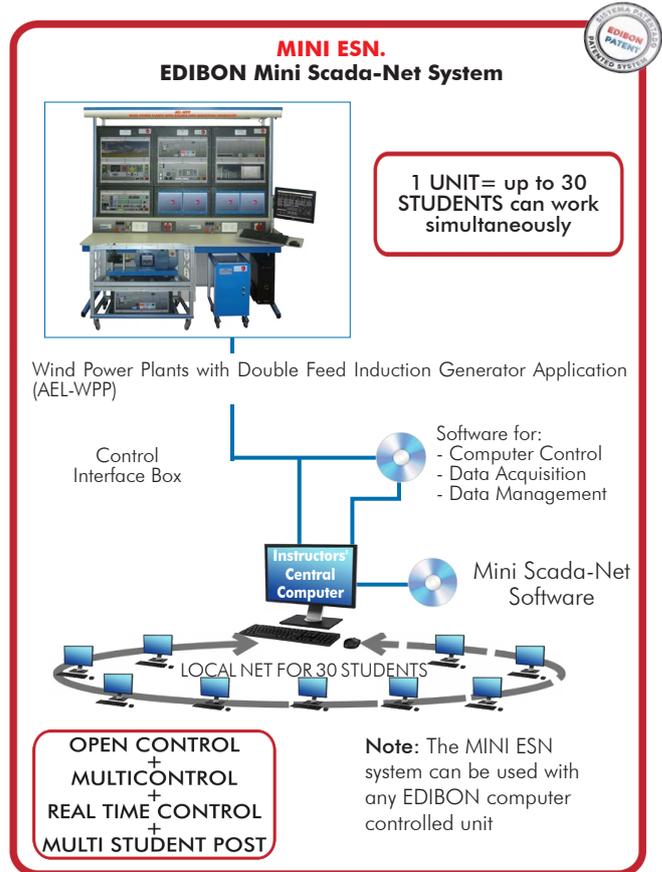
Note: The MINI ESN system can be used with any EDIBON computer controlled unit

⑦ ESN. EDIBON Scada-Net Systems.

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/en/edibon-scada-net

Main items (always included in the supply)

Minimum supply always includes:

① Unit: AEL-WPP. Wind Power Plants with Double Feed Induction Generator Application.

② AEL-WPP/CCSOF. Computer Control + Data Acquisition + Data Management Software.

③ Cables and Accessories, for normal operation.

④ Manuals.

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

Optional items (supplied under specific order)

a) Technical and Vocational Education configuration

⑤ AEL-WPP/ICAI. Interactive Computer Aided Instruction Software.

b) Multipost Expansions options

⑥ MINI ESN. EDIBON Mini Scada-Net System for being used with EDIBON Teaching Units.

⑦ ESN. EDIBON Scada-Net Systems.

① AEL-WPP. Unit.

- EMT8B/1.5K. 3PH Wound Motor, 1.5 kW, 4 Poles.

  Servomotor:

    Nominal power: 1 kW.

    Nominal voltage: 3 x 400/230 VAC Y/ Δ.

    Number of poles: 2.

    Frequency: 50/60 Hz.

    RPM: 3000 rpm.

    Nominal current: 1.7/3 A, Y/ Δ.

  Asynchronous three-phase generator with double feed:

    Nominal power: 1.5 kW.

    Nominal voltage: 3 x 400/230 VAC Y/ Δ.

    Frequency: 50/60 Hz

    Number of poles: 4.

    RPM: 1500 rpm.

    Nominal current: 2.5/4.4 A, Y/ Δ.

- N-DFGC. Double-feed Generator Control Module.

    Operation of the double-feed asynchronous generator in subsynchronous and supersynchronous operating mode.

    Autonomous control of reactive and active power, frequency, voltage, etc.

    Automatic mains synchronisation.

    Connection to control the back to back inverter (N-BTBINV).

    Connection to control the main motor (AEL-SERIN/CA-1K).

    Connection voltage: 3 x 400 V, 50…60 Hz.

- N-FRT. Fault Ride Trough Module.

    Voltage dips simulation module. This module allows the simulation of different levels of voltage dips:

      0%, 20%, 40% and 60%.

    Configurable parameters for fault simulation:

      Adjustable power failure durations from 50 ms to 500 ms.

      Adjustable voltage drop, four levels, for all phases.

      Touch screen.

- N-BTBINV. Back to Back Inverter.

    This module integrates a back to back inverter used to extract power from the double-feed induction generator rotor. Besides, it integrates a braking chopper to protect the DC BUS.

    The back to back inverter is controlled by the N-DFGC module.

- N-SERINCA1K. Advanced Industrial Servosystems Module for AC Motors.

    The "N-SERINCA1K" allows to generate wind curves configured by the user through the AELWPP/CCSOF software.

    The "N-SERINCA1K" consists of a control interface module connected to a three-phase motor and a computer (AEL-PC). The control interface has a 20-bit incremental encoder that controls the speed, position and torque of the motor.

    The USB communication between the control interface and the PC gives the "N-SERINCA1K" the possibility to control the motor from the PC and to display the most important motor signals: torque, position and speed control.

  Control Interface module:

    Three digital outputs:

      Each output has a green LED that indicates if the output is active or not.

    Encoder outputs:

      Two pairs of outputs (CH A Out, CH B Out and their respective denied outputs) that are TTL signals of incremental position generated by the encoder feedback. These signals indicate the direction of rotation of the motor.

      One pair of outputs (CH Z Out and their denied) that TTL works as marker of pulses. This signal indicates the motor speed.

    Relay output: this output is a relay, and it belongs together with the output 4 that it can be in the software inside the I/O digital label.

    Three analog outputs: can be controlled by software to be a certain valve of the internal variables.

    Six digital inputs: digital inputs for those signals that are introduced to enable the different available functions in the software.

    Six buttons: they are good to enable the digital inputs. When the button is pressed, the digital Input will be activated, making what has been defined by the software.

    Six switches: they have the same function as the buttons, but with the only difference that they are switches and, therefore, maintain the position fixed (open or closed).

    Switch outfitter of digital inputs: there is a switch that enables the digital inputs. When the green LED is on, the inputs will be enabled.

    Analog input: this input allows an analog use directly of the user. It is an A/D input.

    Potentiometer. Digital encoder.

    Reset button: this button is used to reset the motor driver after setting a new configuration.

  Motor:

    3PH AC motor, 2 kW, 5 A, 5000 rpm, 400 VAC, 19.1 Nm, IP67, 20 bits (1048576 resolution) incremental encoder.

  N-SERINCA1K/CCSOF: Data Management Software + Data Acquisition + Computer Control:

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

Required elements (Not included):

• AEL-PC. Touch Screen and Computer.

    Touch Screen:

        Energy efficiency class: A.

        Screen diagonal: 68.6 cm (27 inch (s)).

        Power consumption (operating): 26 watts.

        Annual energy consumption: 38 kWh.

        Power consumption (standby / off) 0.49 watts.

        Screen resolution: 1920 x 1080 pixels

    Computer:

        Processor Number: Intel Core i7-6600U Processor (4M Cache, up to 3.40 GHz).

        Cache: 4 MB Intel Smart Cache.

        Clock speed: 2.6 GHz.

        # Of cores/# of threads: 2/4.

        Max. TDP/Power: 15 W.

        Memory types: DDR4-2133, LPDDDR3-1866, DDR3L-1600.

        Graphics: Intel HD Graphics 530.

        Slot for PCI Express.

• AEL-WBR. Electrical Workbench (Rack).

    Anodized aluminum frame.

    Melamine board, 19 mm.

    Four wheels for an easy movement of the bench, two of them with safety brakes.

    Fluorescent tube, 58 W.

    ON/OFF selector switch.

•All necessary cables to realize the practical exercises are included.

The complete unit includes as well:

    Advanced Real-Time SCADA.

    Open Control + Multicontrol + Real-Time Control.

    Specialized EDIBON Control Software based on LabVIEW.

    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, as well as remote support from 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**AEL-WPP/CCSOF. Computer Control +Data Acquisition+Data Management Software:**

    The three softwares are part of the SCADA system.

    Compatible with the industry standards.

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

    Management, processing, comparison and storage of data.

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

    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.

③**Cables and Accessories**, for normal operation.

④**Manuals:**

    This unit is supplied with 8 manuals: Required services, Assembly and Installation, Control software, Starting-up, Safety, Maintenance & Practices manuals.

Exercises and Practical Possibilities to be done with the Main Items

1.- Identifying elements and devices.

2.- Supply and modules signals wiring.

3.- Commissioning of application.

4.- Analyzing the system states: starting and loading the DC bus.

5.- Identifying modulation inverter start back to back.

6.- Stop sequence double feed induction generator.

7.- Study of the double-feed asynchronous machine with subsynchronous speed.

8.- Study of the double-feed asynchronous machine with supersynchronous speed.

9.- Study of the system behavior during the simulation of voltage dips in the network ("fault ride-through").

Other possibilities to be done with this unit:

10.- Many students view results simultaneously.

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

11.- 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.

12.- The Computer Control System with SCADA allows a real industrial simulation.

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

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

15.- 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.

<u>a) Technical and Vocational Education configuration</u>

⑤ AEL-WPP/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.

<u>b) Multipost Expansions options</u>

⑥ MINI ESN. EDIBON Mini Scada-Net System for being used with EDIBON Teaching Units.
MINI ESN. EDIBON Mini Scada-Net System allows up to 30 students to work with a Teaching Unit in any laboratory, simultaneously.
The MINI ESN system consists of the adaptation of any EDIBON Computer Controlled Unit with SCADA 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.
Main characteristics:
- It allows up to 30 students to work simultaneously with the EDIBON Computer Controlled Unit with SCADA, 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.
The system basically will consist of:
This system is used with a Computer Controlled Unit.
- Instructor's computer.
- Students' computers.
- Local Network.
- Unit-Control Interface adaptation.
- Unit Software adaptation.
- Webcam.
- MINI ESN Software to control the whole system.
- Cables and accessories required for a normal operation.

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

REPRESENTATIVE: