



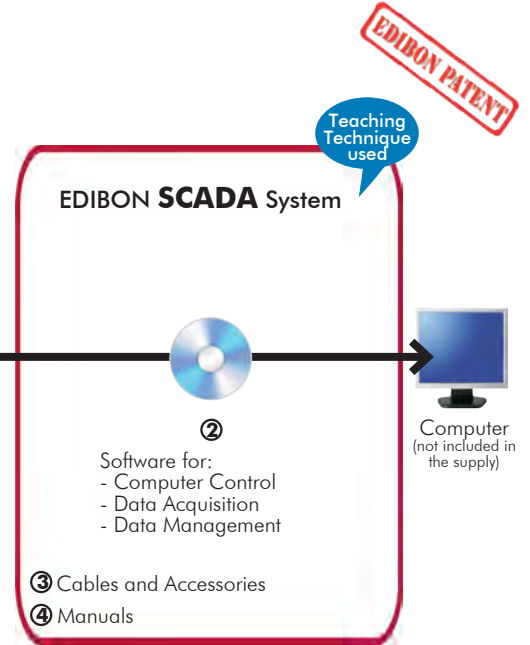
Engineering and Technical Teaching Equipment

Wind Power Application with Permanent Magnets Synchronous Generator, with SCADA

AEL-WPTC



Configuration example of the AEL-WPTC application



* Minimum supply always includes: 1 + 2 + 3 + 4 (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.**
- **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



www.edibon.com
↳ PRODUCTS
↳ 4.- ELECTRICITY

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

Wind energy is one of the most used alternative energy due to its competitiveness regarding costs, but it is also one of the most challenging regarding energy efficiency and its impact on the electrical systems. In this context, wind turbines based on permanent magnet synchronous generators provide flexibility for the exploitation of the maximum possible energy, specifically at low wind speeds, along with a great reduction in mechanical losses on account of its design.

GENERAL DESCRIPTION

The Wind Power Application with Permanent Magnets Synchronous Generator, with SCADA, "AEL-WPTC", has been designed to study the conversion of wind energy into electricity by means of a permanent magnet synchronous generator. This application allows the user to understand the structure and working of the different control, regulation and storage devices used in real wind systems.

The "AEL-WPTC" application includes a three-phase permanent magnet synchronous generator together with a servomotor and its control module, with the goal of studying electrical energy generation through the simulation of a real wind turbine. For that purpose, the application also includes an inverter and a regulator, as control and regulating devices, a battery, as storage device, and a series of AC and DC loads, as consumption elements of the generated power.

In order to carry out advanced tests with the permanent magnet generator, it is recommended to acquire the Control and Data Acquisition System Software for Electrical Machines, "EM-SCADA", which allows monitoring the operation mechanical parameters (torque, rotational speed) and the electrical parameters (voltage, current, powers, power factor...) to obtain the characteristic curves and operation points of the electrical machine under study.

Lastly, it is offered the opportunity to acquire a real small-size permanent magnets wind turbine to gain more experience in the study of the wind turbines and its working.

The "WPTC-UB" includes the following elements:

- N-ALI01. Industrial Main Power Supply.
- EMT6B. Permanent Magnets Synchronous Three-Phase Generator (24 VAC).
- N-SERV1K. 1 kW Servomotor Module.
- BAT6. Lead - Acid Battery 6.
- N-EALD. Network Analyzer Unit with Data Acquisition.
- N-REG02. Current Electronic Regulator Module 2.
- N-INV01. Power Inverter (300 W).
- N-REV01. Single-Phase Variable Resistor Module 0-1 kOhm.
- N-LAM34. 3 AC Lamps Module.
- N-LAM35. 2 DC Lamps Module.

Recommended elements for a greater functionality of the "WPTC-UB" unit:

- EM-SCADA. Control and Data Acquisition System Software for Electrical Machines.
- PMSWG. Permanent Magnet Small Wind Turbine.

Required elements to work with the EM-SCADA software:

- AEL-PC. Computer and touch screen.

This Computer Controlled 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 y 7.

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

① **AEL-WPTC Application.**

• **N-ALI01. Industrial Main Power Supply.**

Supply voltage: 400 VAC, 3PH+N+G.

ON-OFF removable key.

Output voltage connections:

Three-Phase + Neutral: 400 VAC.

Single-Phase: 230 VAC.

Three-Phase supply hose with IP44 3PN+E 32A 400 V connecting plug.

Differential magnetothermal, 4 poles, 25 A, 300 mA AC 6 KA.



N-ALI01

• **EMT6B. Permanent Magnets Synchronous Three-Phase Generator (24 VAC).**

Nominal power: 0,6 kVA.

Nominal voltage: 24 V.

Synchronous speed: 1000 rpm.



EMT6B

• **N-SERV1K. 1 kW Servomotor Module.**

Dynamic and static four-quadrant operation.

Speed and torque displays.

Testing for the presence of a shaft cover.

Connection voltage: 400 V.

Frequency: 50 Hz.

Maximum power output: 10 kVA.

Maximum speed: 4000 rpm.

Maximum torque 30 Nm.

Temperature monitoring.



N-SERV1K

• **BAT6. Lead - Acid Battery 6.**

Battery voltage: 12 V.

Charge and discharge current: 23 A.

Battery capacity: 7 Ah.



BAT6

• **N-EALD. Network Analyzer Unit with Data Acquisition.**

The network analyzer module allows fulfilling measurements, displaying and analyzing all the parameters of the AC electrical networks. It has an LCD screen and push-buttons for the navigation through the different menus. It includes specific software for monitoring current and voltage curves, harmonics display, tariffs programming, alarms programming and electrical parameters storage.

Features:

Multifunctional three-phase power meter:

Single and three-phase voltage. Up to 690 VAC L-L.

Phase and line current. Current range up to 200%. Measurement from 0-10 A.

Active, reactive and apparent power.

Suitable frequencies: 25 Hz, 50 Hz, 60 Hz y 400 Hz.

Display of the V-I vector diagram.

Supply voltage: 85-265 VAC.

Energy quality control:

Current and voltage individual harmonics measurement. Up to the 40th harmonic.

THD voltage and current, TDD and K-factor.

Maximums and minimums display.

Waveforms display, 128 samples/sec.

Events and data storage.

Harmonics analyzer:

THD voltage and current, TDD current and K-factor, up to the 40th harmonic.

Current and voltage harmonic spectrum and angles.

Tariff programming:

Class 0.5S IEC 62053-22, active and reactive power in four quadrants.

Measurement of the total and per phase three-phase active, reactive and apparent powers.

Usage time, 4 energy/demand records of total tariffs.

8 tariffs, 4 seasons, 4 types of days.

Automatic daily report of energy consumption maximums and minimums.

Communications:

Modbus TCP communication protocol with Ethernet interface.



N-EALD

• **N-REG02. Current Electronic Regulator Module 2.**

Automatic detection of operating voltage of 12V or 24V.

Monitoring of parameters:

- Voltage.
- Current.
- Charge level of the battery.
- Charging current.
- State.

Devices with self-protection, battery and loads.



N-REG02

• **N-INV01. Power Inverter (300W).**

ON/OFF switch.

Power: 300 W.

Output voltage: 230 VAC.

Efficiency: 90%.

Safety functions:

- Cut out for excess battery voltage.
- Over temperature and overload protection.

Short-circuit protection.

Pole reversal protection.



N-INV01

• **N-REV01. Single-Phase Variable Resistor Module 0-1 kOhm.**

Variable resistance: 0- 1 kOhm.

Maximum current: 6 A.



N-REV01

• **N-LAM34. 3 AC Lamps Module.**

Lamps voltage: 230 VAC (PH+N).

Conventional lamp: 25 W.

Low consumption lamp: 4 W.

LED lamp: 2 W.

Three switches.



N-LAM34

• **N-LAMP35. 2 DC Lamps Module.**

Lamps voltage: 12 VDC.

Halogen lamp: 25 W.

LED lamp: 2 W.

Two switches.



N-LAMP35

• **PMSWG. Permanent Magnet Small Wind Turbine.**

Output power: 200 W.

Nominal speed: 11,5 m/s.

Rotor diameter: 1 m.



PMSWG

• **EM-SCADA. Control and Data Acquisition System Software for Electrical Machines.**

Power supply: 230 VAC.

Input Signals:

- Current signal (x2).
- RMS current signal (x2).
- Voltage signal (x2).
- RMS voltage signal (x2).
- Torque and speed signals.

Output Signals:

- Torque and speed control signal for the servomotor control.
- Speed control signal for the servomotor.

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.



EM-SCADA

• **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, LPDDR3-1866, DDR3L-1600.
- Graphics: Intel HD Graphics 530.



AEL-PC

• **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 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-WPTC/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.

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AEL-WPTC/CCSOF

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

④ **Manuals:**

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

References 1 to 4 are the main items: AEL-WPTC + AEL-WPTC/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.- Start-up and working of the permanent magnets synchronous generator.
 - 2.- Structure and operation of a wind power plant.
 - 3.- Study of the energy storage and system optimization.
 - 4.- Operation and working characteristics with different wind speeds and load.
 - 5.- Design and operation of a wind power plant in island mode for the generation of AC current.
- Some possible practices with optional Data Acquisition Software, EM-SCADA:
- 6.- Real time torque monitoring.
 - 7.- Real time speed monitoring.
 - 8.- Real time monitoring of current, voltage and power values.
 - 9.- Real time monitoring of current and voltage waveforms.
 - 10.- Electrodynamics study of the motor/generator.
 - 11.- Obtaining characteristic curves (torque-velocity curve, torque-current curve, etc.) and working points for operating conditions.
 - 12.- Real time monitoring of the results.
 - 13.- Obtaining stored results.
- Other possibilities to be done with this Unit:
- 14.- Many students view results simultaneously.
To view all results in real time in the classroom by means of a projector or an electronic whiteboard.
 - 15.- The Computer Control System with SCADA allows a real industrial simulation.
 - 16.- This unit is totally safe as uses mechanical, electrical/electronic, and software safety devices.
- 17.- This unit can be used for doing applied research.
 - 18.- 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 V/50 Hz o 208 V/60 Hz, 1 kW.
- Computer.

DIMENSIONS AND WEIGHTS

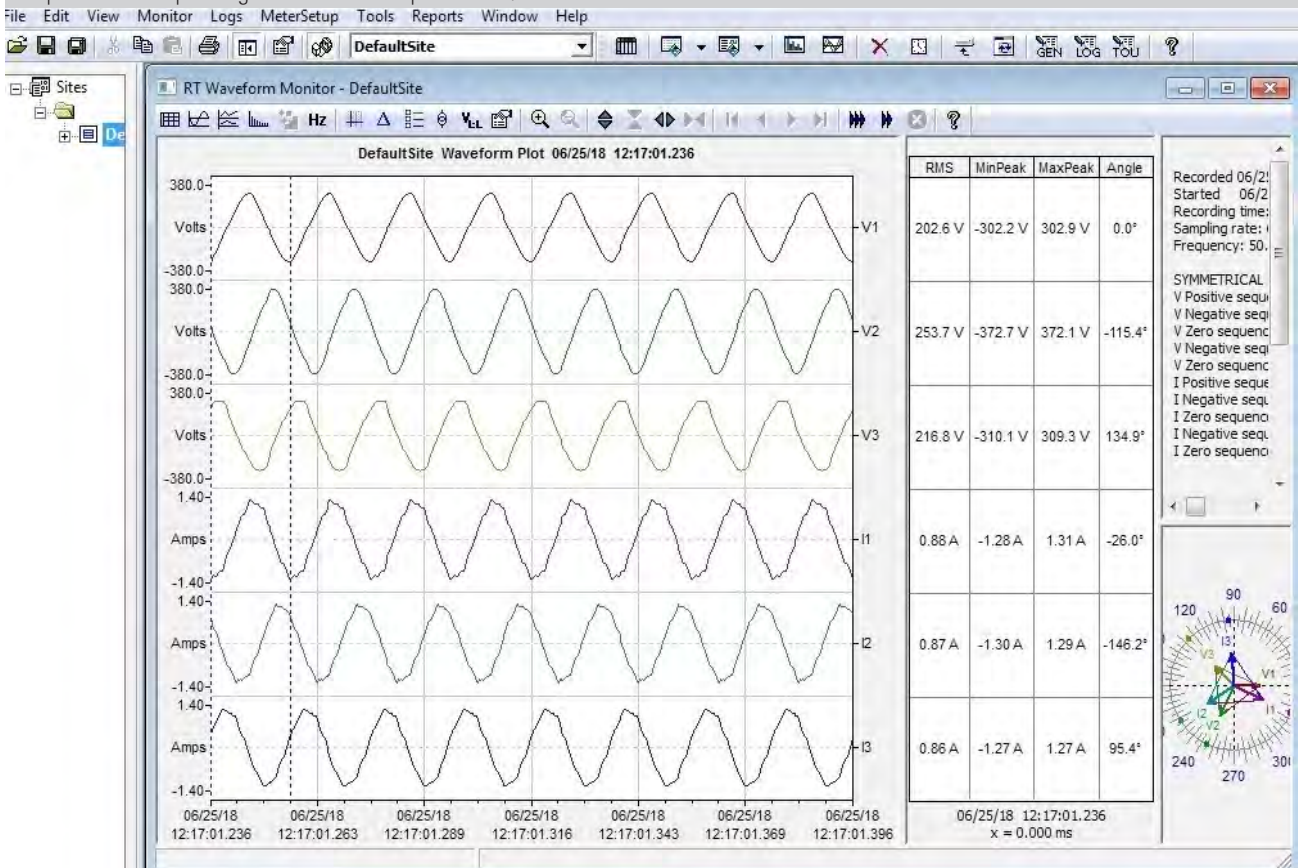
- AEL-WPTC:
- Dimensions: 1600 x 550 x 2000 mm approx.
(62,99 x 21,65 x 78,74 inches approx).
 - Weight: 180 kg approx.
(396 pounds approx).

RECOMMENDED SOFTWARE

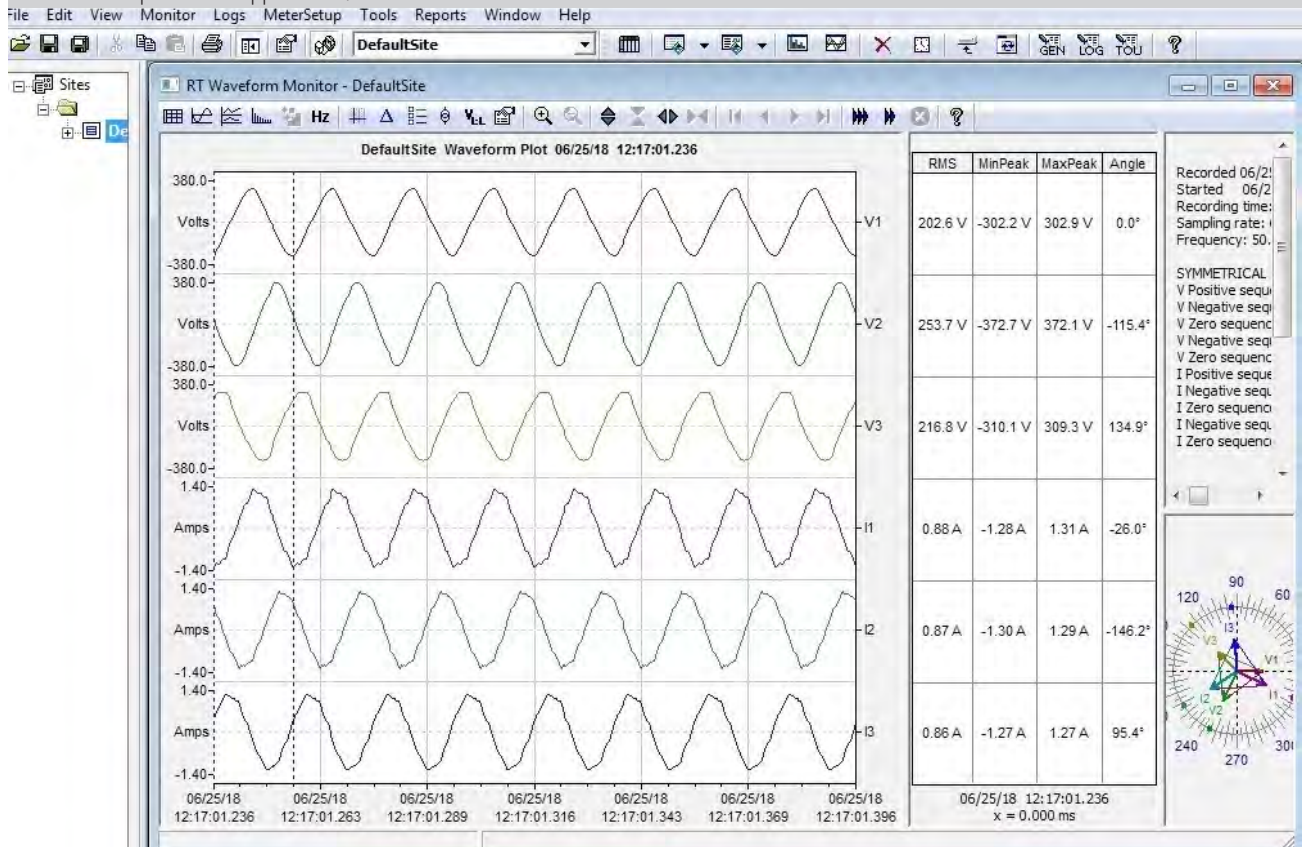
- EM-SCADA. Control and Data Acquisition System Software for Electrical Machines, with SCADA. (For more information see catalogue. Click on the following link: <http://www.edibon.com/en/files/equipment/EM-SCADA/catalog>)

SOME REAL RESULTS OBTAINED FROM THIS UNIT

Waveform plot of the real time currents and voltages measured by the analyzer, showing the angular, maximum, minimum and RMS values, and the phasors corresponding to such electrical parameters.



Representation of the torque-speed curve for the Three-Phase Asynchronous Squirrel Cage Motor. Notice that the motor nominal speed and the maximum torque can be appreciated.



COMPLETE TECHNICAL SPECIFICATIONS (for optional items)

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-WPTC/ICAI. Interactive Computer Aided Instruction Software System.

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 6).

- 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

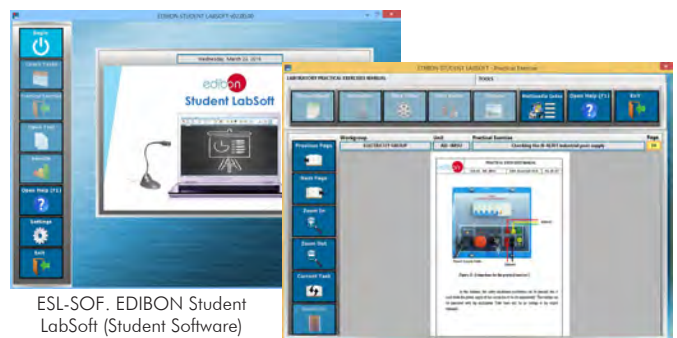
ECAL. EDIBON Calculations Program Package - Formula Editor Screen



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

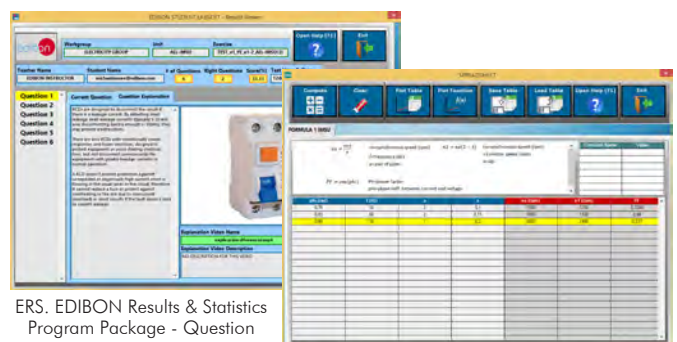
ETTE. EDIBON Training Test & Exam Program Package - Main Screen with Numeric Result Question

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

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:

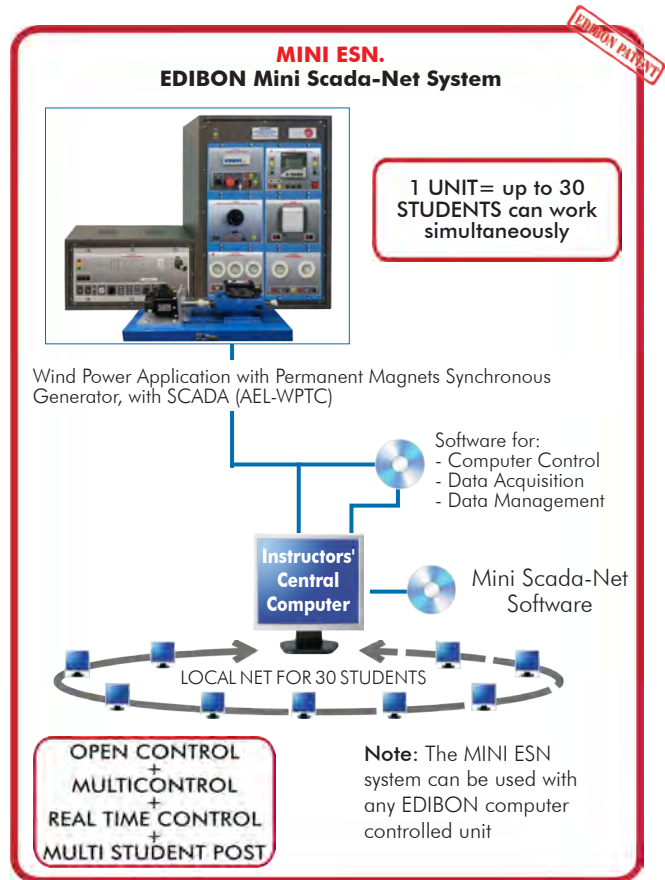
www.edibon.com/en/files/expansion/MINI-ESN/catalog

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/files/expansion/ESN/catalog



ORDER INFORMATION

Main items (always included in the supply)

Minimum supply always includes:

- ① **Unit: AEL-WPTC. Wind Power Application with Permanent Magnets Synchronous Generator, with SCADA.**
- ② **AEL-WPTC/CCSOF. Computer Control + Data Acquisition + Data Management Software.**
- ③ **Cables and Accessories**, for normal operation.
- ④ **Manuals.**

***IMPORTANT:** Under AEL-WPTC 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-WPTC/ICAI. Interactive Computer Aided Instruction Software System.

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-WPTC Application.**

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Supply voltage: 400 VAC, 3PH+N+G.
ON-OFF removable key.
Output voltage connections:
Three-Phase + Neutral: 400 VAC.
Single-Phase: 230 VAC.
Three-Phase supply hose with IP44 3PN+E 32A 400 V connecting plug.
Differential magnetothermal, 4 poles, 25 A, 300 mA AC 6 KA.
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Nominal power: 0,6 kVA.
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Features:
Multifunctional three-phase power meter:
Single and three-phase voltage. Up to 690 VAC L-L.
Phase and line current. Current range up to 200%. Measurement from 0-10 A.
Active, reactive and apparent power.
Suitable frequencies: 25 Hz, 50 Hz, 60 Hz y 400 Hz.
Display of the V-I vector diagram.
Supply voltage: 85-265 VAC.
Energy quality control:
Current and voltage individual harmonics measurement. Up to the 40th harmonic.
THD voltage and current, TDD and K-factor.
Maximums and minimums display.
Waveforms display, 128 samples/sec.
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Class 0.5S IEC 62053-22, active and reactive power in four quadrants.
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ON/OFF switch.
Power: 300 W.
Output voltage: 230 VAC.
Efficiency: 90%.
Safety functions:
Cut out for excess battery voltage.
Over temperature and overload protection.
Short-circuit protection.
Pole reversal protection.
- N-REV01. Single-Phase Variable Resistor Module 0-1 kOhm.
Variable resistance: 0- 1 kOhm.
Maximum current: 6 A.
- N-LAM34. 3 AC Lamps Module.
Lamps voltage: 230 VAC (PH+N).
Conventional lamp: 25 W.
Low consumption lamp: 4 W.
LED lamp: 2 W.
Three switches.

- N-LAMP35. 2 DC Lamps Module.
Lamps voltage: 12 VDC.
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LED lamp: 2 W.
Two switches.
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Output power: 200 W.
Nominal speed: 11,5 m/s.
Rotor diameter: 1 m.
- EM-SCADA. Control and Data Acquisition System Software for Electrical Machines.
Power supply: 230 VAC.
Input Signals:
Current signal (x2).
RMS current signal (x2).
Voltage signal (x2).
RMS voltage signal (x2).
Torque and speed signals.
Output Signals:
Torque and speed control signal for the servomotor control.
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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, LPDDR3-1866, DDR3L-1600.
Graphics: Intel HD Graphics 530.
- All necessary cables to realize the practical exercises are included.

The complete unit includes as well:

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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 7 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.- Start-up and working of the permanent magnets synchronous generator.
- 2.- Structure and operation of a wind power plant.
- 3.- Study of the energy storage and system optimization.
- 4.- Operation and working characteristics with different wind speeds and load.
- 5.- Design and operation of a wind power plant in island mode for the generation of AC current.

Some possible practices with optional Data Acquisition Software, EM-SCADA:

- 6.- Real time torque monitoring.
- 7.- Real time speed monitoring.
- 8.- Real time monitoring of current, voltage and power values.
- 9.- Real time monitoring of current and voltage waveforms.
- 10.- Electrodynamics study of the motor/generator.
- 11.- Obtaining characteristic curves (torque-velocity curve, torque-current curve, etc.) and working points for operating conditions.
- 12.- Real time monitoring of the results.
- 13.- Obtaining stored results.

Other possibilities to be done with this Unit:

- 14.- Many students view results simultaneously.
To view all results in real time in the classroom by means of a projector or an electronic whiteboard.
 - 15.- The Computer Control System with SCADA allows a real industrial simulation.
 - 16.- This unit is totally safe as uses mechanical, electrical/electronic, and software safety devices.
 - 17.- This unit can be used for doing applied research.
 - 18.- 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

⑤ **AEL-WPTC/ICAI. Interactive Computer Aided Instruction Software System.**

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.

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.

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.



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