edibon

Engineering and Technical Teaching Equipment

① Unit: AEL-EESD. Advanced Digital Synchronization Trainer

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: LabVIEW

www.edibon.com
⤷PRODUCTS
  ⤷40.- ELECTRICITY

For more information about Key Features, click here

PDF Adobe

You Tube

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)

Certificate and Worlddidac Member

The AEL-EESD Advanced Digital Synchronization Trainer has been designed by Edibon to study the procedure and need for synchronization of different power generation sources in the same grid. When different energy sources are generating power, it is extremely significant that theses work in synchronism. Frequencies, phase shift and voltages can vary substantially and the grid could be damage if these were not properly synchronized.

The AEL-EESD consists of several modules that allow step by step demonstrating the synchronization procedure of a synchronous generator with the grid. This trainer provides a complete program that extends training in generator synchronization manenvers, control and the most relevant protections used on theses systems. This trainer has a synchronous generator-motor group and several modules such as a professional synchronouscope module, excitation voltage regulator module of the synchronous generator, speed controller module of the turbine and a power analyzer that measures all electrical parameters of the synchronous generator (V, f, PF, Q, VAr, VA). Through these modules, the user could manually control the speed of the synchronous generator (generator frequency) and the output voltage according to the excitation current. With the synchronouscope module, the user could visualize the voltage, frequency and lags between the generator and the grid. Once synchronization conditions are achieved the synchronization module indicates that synchronization circuit breaker can be closed. Hence the user can give permission to synchronize the generator-motor group. When the generator is synchronized with the grid, the main purpose of the excitation and frequency controller is to inject more or less reactive and active power to the grid according to the required power factor.

Optionally, the AEL-EESD trainer provides a Supervisory Control and Data Acquisition Software (AEL-EESD/CCSOF) designed to carry out a remote control over the generator-motor group. Through the SCADA and the PC, the user can control the speed and torque of the turbine, the excitation current and frequency of the generator, enable/disable of the synchronization circuit breaker, monitoring the state of the alarms and protections of the generation group (it is necessary to acquire the optional Protection and Control Relay Unit). In addition, the optional SCADA System allows all the time acquire the electrical variables measured with the power analyzer and to monitor them numerically and graphically.

For further studies about generator control systems, this trainer has the following optional modules: generation protection and control relay unit, three-phase digital bank resistors module and three-phase digital bank of commutable inductances module.

• N-ERP-PGC01. Generator Protection and Control Relay Unit. In large industrial installations power generation systems require a special device to control automatically the frequency, voltage and power factor of the synchronous generators. This is the goal of the protection and control relay unit. Because constants load fluctuations occur in the demanded energy, it is necessary a precise control of the frequency, current excitation, torque and power factor of the generators and turbines. With this device, the user can realize a manual control of the generator and transfers, in any moment, the fully control to the protection and control relay unit (automatic control mode).

• N-CAR35T3D. Three-Phase Digital Bank of Resistors Module.

• N-CAR36T3D. Three-Phase Digital Bank of Commutable Inductances Module.

  These two three-phase resistive and inductive modules offer the possibility to study the synchronous generator in stand-alone mode. These circumstances occur, for instance in islands, because it is very expensive to interconnect the nearest power generation source and chose stand-alone power generation.

The AEL-EESD includes the following modules:

- N-ALI01.   Industrial Main Power Supply.

- N-AVR/P.   Automatic Voltage Regulator.

- N-ASY3PH.   Three-phase Automatic Synchronoscope.

- N-EALD.   Network Analyzer Unit with Computer Data Acquisition.

- N-VVCA5K.   5 kW Motor Speed Controller.

- GMG4.5K3PH.   4.5 kWA Generator-Motor Group.

Optional modules:

Optionally, the students can carry out advanced operations of synchronization and control of the generator-motor group including in the basic option the following optional modules:

- N-ERP-PGC01.   Generator Protection and Control Relay Unit.

- N-CAR35T3D.   Three-Phase Digital Bank Resistors Module.

- N-CAR36T3D.   Three-Phase Digital Bank of Commutable Inductances Module.

Optional SCADA software:

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

Optional learning software:

In addition, Edibon provides optional software (AEL-EESD/ICAI) to reinforce knowledge about this field. This software is formed by:

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

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

The application AEL-EESD can be mounted on rack (option A) or on rail (option B):

Option A:

This application needs the following racks:

- N-RACK-A.

- N-RACK-B. (3 units if optional modules are acquired)

Optionally the AEL-WBR. Electrical Workbench (Rack) can be supplied to place the rack/s.

Option B:

This application can be mounted on rail.

Optionally the AEL-WBC. Electrical Workbench (Rail) can be supplied to mount the modules.

Optionally 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-EESD. Unit.**
The trainer includes the following modules:
- N-ALI01. **Industrial 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 400V connecting plug.
    Differential magnetothermal, 4 poles, 25A, 300mA AC 6KA.

N-ALI01

- N-AVR/P. **Automatic voltage regulator.**
    Generator excitation regulator.
    Local/remote control switch.
    Manual/automatic control switch of the excitation in local mode.
    Excitation current manual control potentiometer.
    ON-OFF switch.
    Connection terminals.
    Communication connector SUB-D of 62 pins.

N-AVR/P

- N-ASY3PH. **Three-phase Automatic Synchronoscope.**
    Digital three-phase programmable synchronoscope.
    Display with indication of:
        Grid voltage.
        Generator voltage.
        Phase difference between grid and generator.
    Manual synchronization pushbutton.
    Synchronism deactivation pushbutton.
    Local/remote control switch.
    Indicating lamp of the synchronization contactor state.
    ON-OFF switch.
    Connection terminals.
    Safety fuses.
    Communication connector SUB-D of 62 pins.

N-ASY3PH

- N-EALD. **Network Analyzer Unit with Computer Data Acquisition.**
    ON-OFF switch.
    Supply voltage: 400 VAC.
    Input terminals: Input connection with the measurement point.
    Output terminals: Output connection with the measurement point.
    Digital outputs: Three digital outputs are used for pulses or alarms, or for combining both.
    RS-485 Communication port.
    Fuses: 3x10 A.
    Network Analyzer Display. It shows:
        Active, reactive and apparent power.
        Active, reactive and apparent energies.
        Lines and phase currents.
        Line and phase voltages.
        Frequencies.
        Power Factor.

N-EALD

- N-VVCA5K. **5 kW Motor Speed Controller.**
    AC 5KW motors control module.
    Three-phase supply voltage: 400 VAC + N.
    Rated power: 5 kW.
    Motor speed control potentiometer.
    ON-OFF control switch.
    Local/remote control switch.
    Signals connector SUB-D of 62 pins.
    ON-OFF switch.
    Connection terminals.

N-VVCA5K

- GMG4.5K3PH. **4.5 kWA Generator-Motor Group.**
    Motor-generator group coupled in an aluminum frame with wheels.
    Rated power of the generator: 4.5 KVA.
    Stator rated I: 6.5 A.
    Excitation rated I: 4 A.
    RPM: 3000 r.p.m.
    Motor rated power I: 5 KVA.
    Rated I: 7.2 A.
    RPM: 3000 r.p.m.

GMG4.5K3PH

Optional modules:

- N-ERP-PGC01. **Generator Protection and Control Relay Unit.**
    Generator protection relay module.
    Single-phase supply voltage: 230 VAC.
    "Island grid/parallel grid" control switch.
    "Local/remote" control switch.
    Manual control switches of the relay:
        SW1, emergency stop.
        SW2, automatic start of the motor-generator group.
        SW3, protections reset pushbutton.
        SW4, generator frequency control activation.
        SW5, 52G1 synchronization circuit breaker closure manual permission.
    State light indicators.
    Alarm light indicators.
    Synchronization safety key.
    Emergency stop pushbutton.
    SUB-D signals connector of 62 pins.
    ON-OFF switch.
    Connection terminals.
    The N-ERP-PGC-01 generator protection relay:
        Enables to connect up to 16 diesel generators in parallel-island with distribution of active and reactive load and start/stop in function of the load demand.
        Enables to connect one generator in parallel with the grid.
        Enables different switches control modes, such as opening, closing and synchronization.
        Includes analogical outputs to control voltage and frequency regulators available in the market.
        Three-phase measurement of the grid and generator voltage.
        Three-phase measurement of the generator intensity and power.
        Single-phase measurement of the grid intensity.
    Protections:
        - Generator protections: max/mín-voltage (59/27), max/min-frequency (81O/U), voltage asymmetry, dead bus detection, overload (32), unbalance load (46), reverse power/reduce (32R/F), overcurrent time define curve (50/51), inverse time overcurrent (IEC255), fault ground (50N/51N), phases, breakers fault.
        - Motor: over/sub speed (12).
        - Mains: max/min-voltage (59/27), max/min-frequency (81O/U), vector surge.

N-ERP-PGC01

- N-CAR35T3D. **Three-Phase Digital Bank Resistors Module.**
    Digital bank of commutable resistors module.
    Three sliding load switches.
    Three three-phase commutable banks of resistors of 150 ohm.
    Local/remote control switch.
    ON-OFF switch.
    Communications connector SUB-D of 62 pins.

N-CAR35T3D

- N-CAR36T3D. **Three-Phase Digital Bank of Commutable Inductances Module.**
    Digital banks of commutable inductances module.
    Three sliding load switches.
    Three three-phase commutable banks of inductances of 1.4 H.
    Local/remote control switch.
    ON-OFF switch.
    Communications connector SUB-D of 62 pins.

N-CAR36T3D

- **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.

    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 **AEL-EESD/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 <u>250 KS/s (kilo samples per second)</u>.

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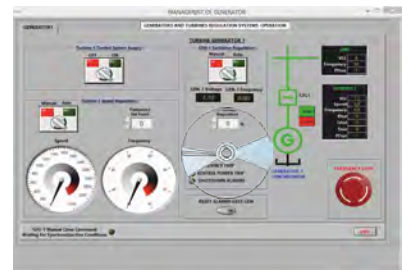
This unit allows the 30 students of the classroom to visualize simultaneously all the results and the manipulation of the unit, during the process, by using a projector or an electronic whiteboard.

AEL-EESD/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-EESD + AEL-EESD/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.- Commissioning of generation group and coupling to the electrical grid.

2.- Inductive reactive power generation.

3.- Capacitive reactive power generation.

4.- Coupling operations between generator and electrical grid.

5.- Monitoring of voltages and phase angles in order to carry out a correct coupling.

6.- Main connections for the synchronization module to perform the appropriate readings of the phases angles.

7.- Monitoring of the generator´s power flux before and after the synchronization.

8.- Search of the optimum point to couple the generator to the grid.

9.- Frequency and voltage manual control of the generator to carry out the synchronization to the grid.

Additional practical exercises possibilities with the optional modules:

10.- Island grid operations.

11.- Parallel grid operations.

12.- Manual and automatic voltage regulation operations.

13.- Manual and automatic frequency regulation operations.

14.- Transference of manual to automatic voltage regulation operations.

15.- Transference of manual to automatic frequency regulation operations.

16.- Studying of the power factor regulation of synchronous generator in parallel grid operation.

17.- Studying of turbine regulation (frequency control) in island mode.

18.- Studying of turbine regulation (frequency control) in parallel grid mode.

19.- Studying of excitation/voltage regulation in island mode.

20.- Studying of excitation/voltage regulation in parallel grid mode.

21.- Analysis of active and reactive power.

22.- Automatic control of active power.

23.- Automatic control of reactive power.

24.- Studying of the micro-grids.

25.- Setting of Overcurrent protection.

26.- Setting of Overvoltage and Undervoltage protection of the synchronous generator.

27.- Reverse power protection.

28.- Remote control operation with the SCADA Control System.

Other possibilities to be done with this Unit:

29.- Many students view results simultaneously.
    To view all results in real time in the classroom by means of a projector or an electronic whiteboard.

30.- The Computer Control System with SCADA allow a real industrial simulation.

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

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

33.- 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, 380V./50 Hz. or 208V./60 Hz., 20 Kw.
- Computer (PC).

DIMENSIONS AND WEIGHTS

AEL-EESD:

Modules in Rack: -Dimensions: 640 x 320 x 920 mm. approx.
                                (25.19x12.59x36.22 inches approx.)
                  -Weight: 100 Kg. approx.
                                (220 pounds approx.)

GMG4K: -Dimensions: 1180x700 x 740 mm. approx.
                                (46.45x27.55x29.13 inches approx.)
                  -Weight: 80 Kg. approx
   (176 pounds approx.)

SCADA
Main screen
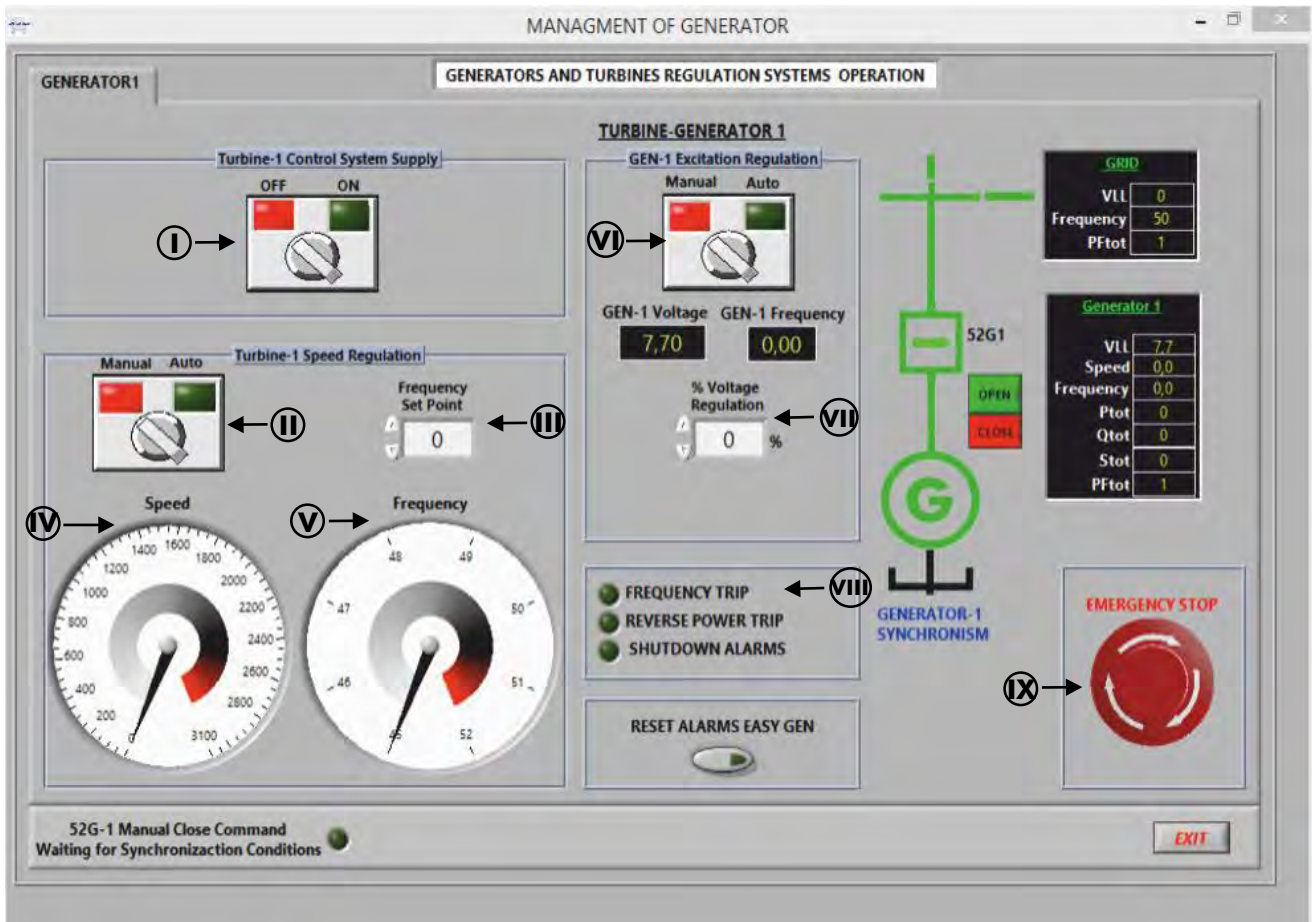
(I) Start/Stop turbine switch.

(II) Switch to set the speed control mode of the turbine-generator group (manual/automatic).

(III) Generator frequency manual set point.

(IV) Analog speed meter of the turbine.

(V) Analog frequency meter of the generator.

(VI) Switch to set the control mode of the current excitation of the synchronous generator (manual/automatic).

(VII) Generator excitation manual set point.

(VIII) Alarms lights indicators of the turbine-generator group.

(IX) Emergency stop push-button of the turbine-generator group.

Electrical variables monitoring screen of the synchronous generator with the optional SCADA.
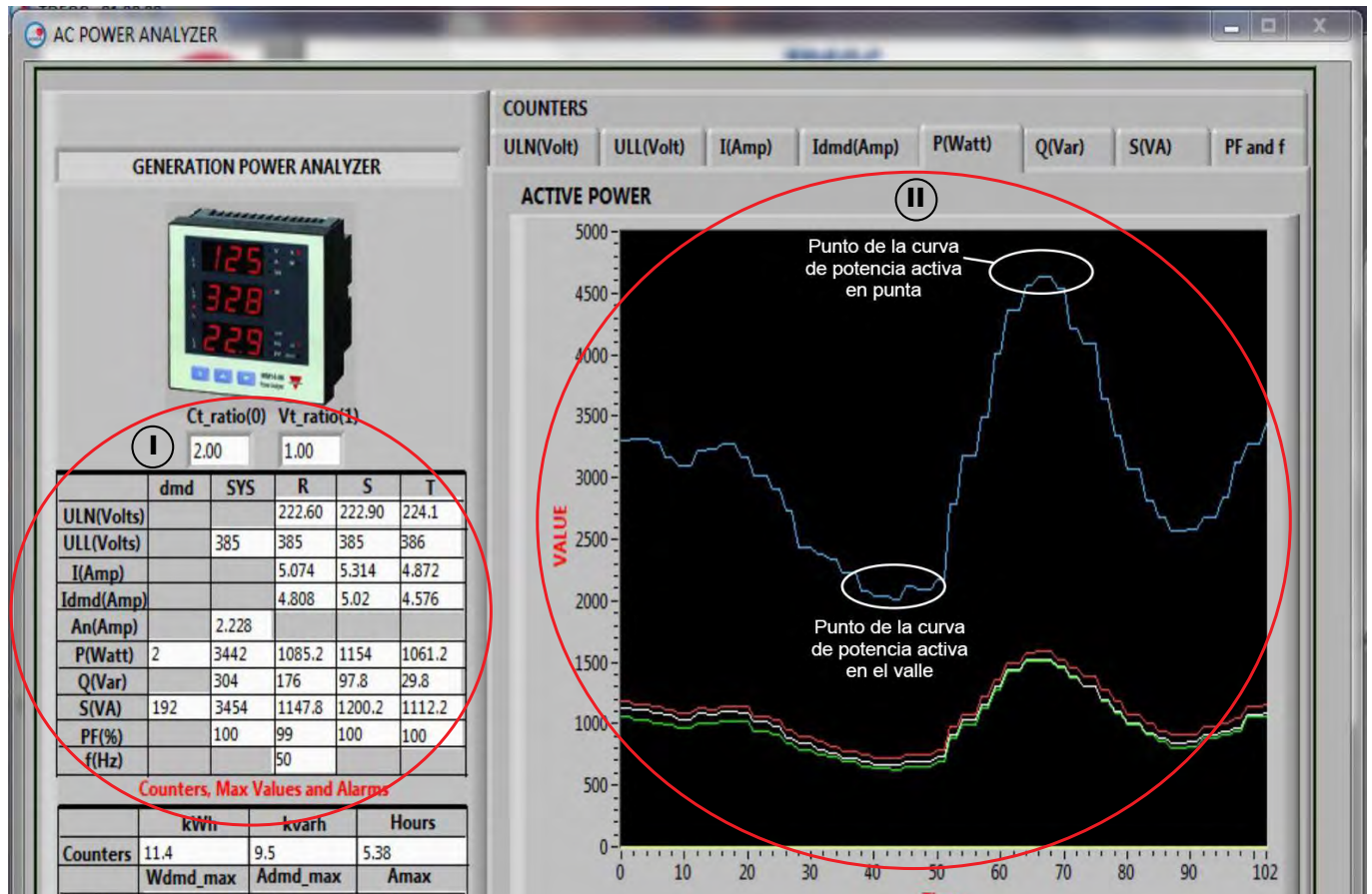
(I) Instantaneous values of the electrical measurements of the synchronous generator: phase and line voltages, line and total active powers, total and line reactive power, total and line apparent power, line and total power factors and generator frequency.

(II) The graph shows the active power curve evolution produced by the synchronous generator. This power is consumed by the national grid. In the power curve can distinguish two important points, which determine the whole daily demand energy curve of a country in a real power system: valley point or minimum demand point and pick point or maximum demand point. In addition, the SCADA software can show phase voltages, line voltages, line currents, reactive power, apparent power and power factor waves.

Additionally to the main items (1, 3, 4) described, we can offer, as optional, other items 2 and 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)

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

⑤ AEL-EESD/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 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 Workgroups, Tasks 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.

Instructor Software

ECM-SOF. EDIBON Class-room Manager Software Application main screen

ECAL. EDIBON Calculations Program Package - Formula Editor Screen
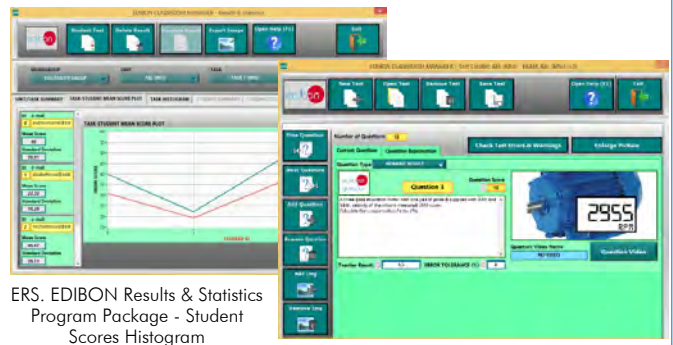
ERS. EDIBON Results & Statistics Program Package - Student Scores Histogram

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

-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.
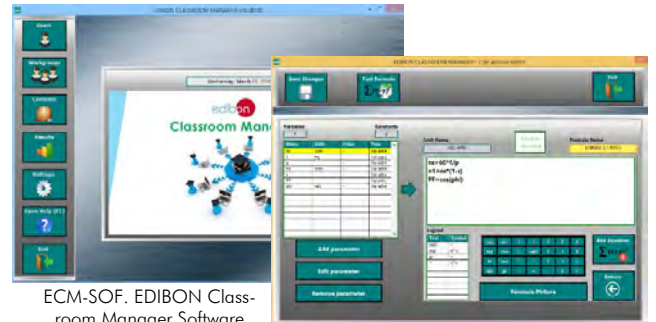
Innovative features:

   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.

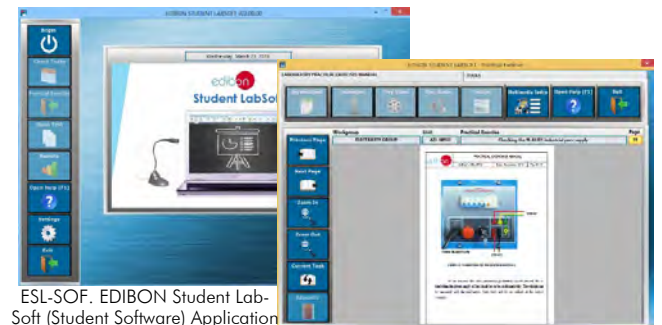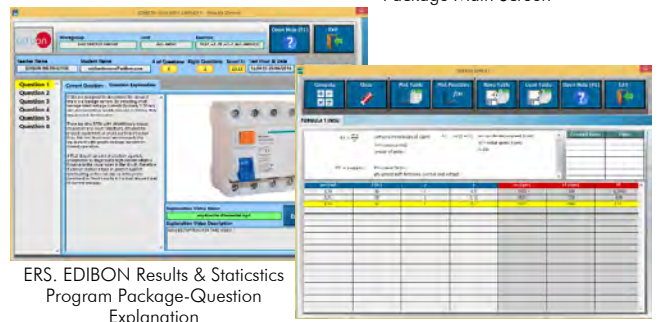For more information see **ICAI** catalogue. Click on the following link:

www.edibon.com/products/catalogues/en/units/electricity/ICAI-Electricity/ICAI-Electricity.pdf

Student Software

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

EPE. EDIBON Practical Exercise Program Package Main Screen

ERS. EDIBON Results & Staticstics Program Package-Question Explanation

ECAL. EDIBON Calculations ProgramPackage Main Screen

⑥ Mini ESN. EDIBON Mini Scada-Net System.

Mini ESN. EDIBON Mini Scada-Net System allows up to 30 students to work with a Teaching Unit in any laboratory, simultaneously.

It is useful for both, Higher Education and/or Technical and Vocational Education.

The Mini ESN system consists 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/products/catalogues/en/Mini-ESN.pdf

**Mini ESN.
EDIBON Mini Scada-Net System**

1 UNIT= up to 30 STUDENTS can work simultaneously

Advanced Digital Synchronization Trainer (AEL-EESD)

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 System.

This unit can be integrated, in the future, into a Complete Laboratory with many Units and many Students.
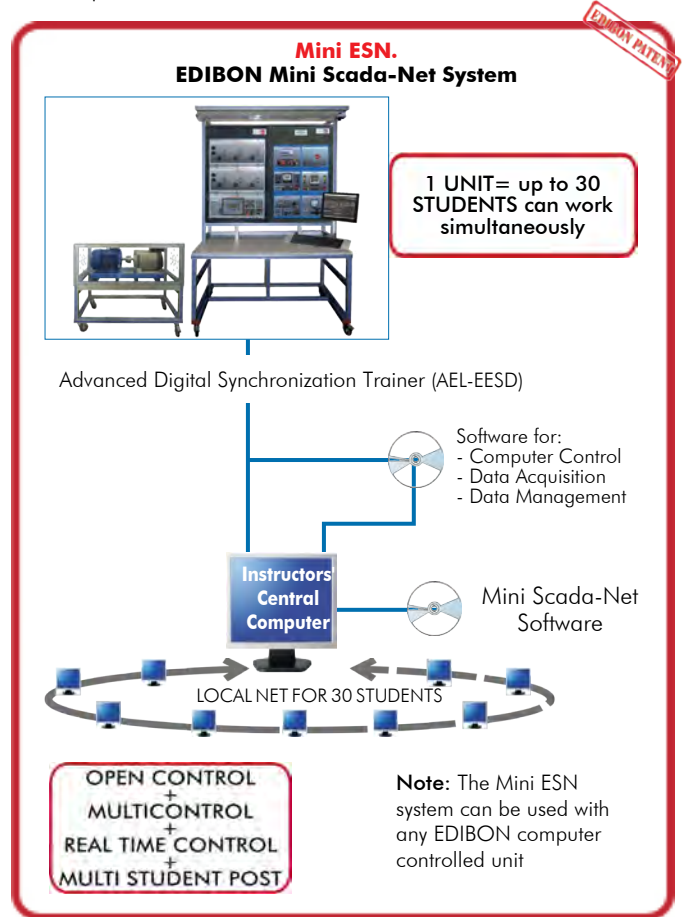
Main items (always included in the supply)

Minimum supply always includes:

① **Unit: AEL-EESD. Advanced Digital Synchronization Trainer.**

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

④ **Manuals.**

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

Optional items (supplied under specific order)

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

a) Technical and Vocational configuration

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

b) Multipost Expansions options

⑥ Mini ESN. EDIBON Mini Scada-Net System.

⑦ ESN. EDIBON Scada-Net System.

① AEL-EESD. Unit.

The trainer includes the following modules:

• **N-ALI01. Industrial 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 400V connecting plug.
   Differential magnetothermal, 4 poles, 25A, 300mA AC 6KA

• **N-AVR/P. Automatic voltage regulator.**
   Generator excitation regulator.
   Local/remote control switch.
   Manual/automatic control switch of the excitation in local mode.
   Excitation current manual control potentiometer.
   ON-OFF switch.
   Connection terminals.
   Communication connector SUB-D of 62 pins.

• **N-ASY3PH. Three-phase Automatic Synchronoscope.**
   Digital three-phase programmable synchronoscope
   Display with indication of:
      Grid voltage.
      Generator voltage.
      Phase difference between grid and generator.
   Manual synchronization pushbutton.
   Synchronism deactivation pushbutton.
   Local/remote control switch.
   Indicating lamp of the synchronization contactor state.
   ON-OFF switch.
   Connection terminals.
   Safety fuses.
   Communication connector SUB-D of 62 pins.

• **N-EALD. Network Analyzer Unit with Computer Data Acquisition.**
   ON-OFF switch.
   Supply voltage: 400 VAC.
   Input terminals: Input connection with the measurement point.
   Output terminals: Output connection with the measurement point.
   Digital outputs: Three digital outputs are used for pulses or alarms, or for combining both.
   RS-485 Communication port.
   Fuses: 3x10 A
   Network Analyzer Display. It shows:
      Active, reactive and apparent power.
      Active, reactive and apparent energies.
      Lines and phase currents.
      Line and phase voltages.
      Frequencies.
      Power Factor.

• **N-VVCA5K. 5 kW Motor Speed Controller.**
   AC 5KW motors control module.
   Three-phase supply voltage: 400VAC + N.
   Rated power: 5 KW.
   Motor speed control potentiometer.
   ON-OFF control switch.
   Local/remote control switch.
   Signals connector SUB-D of 62 pins.
   ON-OFF switch.
   Connection terminals.

• **GMG4.5K3PH. 4.5 kWA Generator-Motor Group.**
   Motor-generator group coupled in an aluminum frame with wheels.
   Rated power of the generator: 4.5 KVA
   Stator rated I: 6.5 A.
   Excitation rated I: 4 A.
   RPM: 3000 r.p.m.
   Motor rated power I: 5 KVA.
   Rated I: 7.2 A.
   RPM: 3000 r.p.m.

- N-ERP-PGC01. Generator Protection and Control Relay Unit.
  Generator protection relay module.
  Single-phase supply voltage: 230 VAC.
  "Island grid/parallel grid" control switch.
  "Local/remote" control switch.
  Manual control switches of the relay:
      SW1, emergency stop.
      SW2, automatic start of the motor-generator group.
      SW3, protections reset pushbutton.
      SW4, generator frequency control activation.
      SW5, 52G1 synchronization circuit breaker closure manual permission.
  State light indicators.
  Alarm light indicators.
  Synchronization safety key.
  Emergency stop pushbutton.
  SUB-D signals connector of 62 pins.
  ON-OFF switch.
  Connection terminals.
  The N-ERP-PGC-01 generator protection relay:
      Enables to connect up to 16 diesel generators in parallel-island with distribution of active and reactive load and start/stop in function of the load demand.
      Enables to connect one generator in parallel with the grid.
      Enables different switches control modes, such as opening, closing and synchronization.
      Includes analogical outputs to control voltage and frequency regulators available in the market.
      Three-phase measurement of the grid and generator voltage.
      Three-phase measurement of the generator intensity and power.
      Single-phase measurement of the grid intensity.
    Protections:
        - Generator protections: max/mín-voltage (59/27), max/min-frequency (81O/U), voltage asymmetry, dead bus detection, overload (32), unbalance load (46), reverse power/reduce (32R/F), overcurrent time define curve (50/51), inverse time overcurrent (IEC255), fault ground (50N/51N), phases, breakers fault.
        - Motor: over/sub speed (12).
        - Mains: max/min-voltage (59/27), max/min-frequency (81O/U), vector surge.
- N-CAR35T3D. Three-Phase Digital Bank Resistors Module.
   Digital bank of commutable resistors module.
   Three sliding load switches.
   Three three-phase commutable banks of resistors of 150 ohm.
   Local/remote control switch.
   ON-OFF switch.
   Communications connector SUB-D of 62 pins.
- WN-CAR36T3D. Three-Phase Digital Bank of Commutable Inductances Module.
   Digital banks of commutable inductances module.
   Three sliding load switches.
   Three three-phase commutable banks of inductances of 1.4 H.
   Local/remote control switch.
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).
   Calibration exercises, which are included, teach the user how to calibrate a sensor and the importance of checking the accuracy of the sensors before taking measurements.
   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-EESD/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.
Sampling velocity up to 250 KS/s (kilo samples per second).
Calibration system for the sensors involved in the process.
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.- Commissioning of generation group and coupling to the electrical grid.

2.-Inductive reactive power generation.

3.-Capacitive reactive power generation.

4.-Coupling operations between generator and electrical grid.

5.-Monitoring of voltages and phase angles in order to carry out a correct coupling.

6.-Main connections for the synchronization module to perform the appropriate readings of the phases angles.

7.-Monitoring of the generator´s power flux before and after the synchronization.

8.-Search of the optimum point to couple the generator to the grid.

9.-Frequency and voltage manual control of the generator to carry out the synchronization to the grid.

Additional practical exercises possibilities with the optional modules:

10.-Island grid operations.

11.-Parallel grid operations.

12.-Manual and automatic voltage regulation operations.

13.-Manual and automatic frequency regulation operations.

14.-Transference of manual to automatic voltage regulation operations.

15.-Transference of manual to automatic frequency regulation operations.

16.-Studying of the power factor regulation of synchronous generator in parallel grid operation.

17.-Studying of turbine regulation (frequency control) in island mode.

18.-Studying of turbine regulation (frequency control) in parallel grid mode.

19.-Studying of excitation/voltage regulation in island mode.

20.-Studying of excitation/voltage regulation in parallel grid mode.

21.-Analysis of active and reactive power.

22.-Automatic control of active power.

23.-Automatic control of reactive power.

24.-Studying of the micro-grids.

25.-Setting of Overcurrent protection.

26.-Setting of Overvoltage and Undervoltage protection of the synchronous generator.

27.-Reverse power protection.

28.-Remote control operation with the SCADA Control System.

Other possibilities to be done with this Unit:

29.-Many students view results simultaneously.
To view all results in real time in the classroom by means of a projector or an electronic whiteboard.

30.-The Computer Control System with SCADA allow a real industrial simulation.

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

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

33.-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-EESD/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.**

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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