



Engineering and Technical Teaching Equipment

Compact Smart Grid Power Systems Application, with Two parallel Generators, Two Distribution Lines and Loads, with SCADA

AEL-CPSS-03S



Standard configuration for MPSS/CPSS

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



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↳ PRODUCTS
↳ 40.- 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)



Certificate and Worlddidac Member

GENERAL DESCRIPTION

A Smart Grid is an advanced electrical grid that uses analog information, digital information and communications technology to gather and act on information about the behavior of suppliers and consumers, in an automated way to improve the efficiency, reliability, economics, and sustain ability of the production and distribution of electricity.

The AEL-CPSS-03S is an application that reflects the most important operations carried out in the actual Smart Grids Power Systems.

- Generation:

- Parallel operations with different renewable energy sources.
- Real time monitoring and control the demanded energy and the energy production.
- Automatic control operations of synchronization.
- Parallel operations of hydroelectric, two synchronous generators.

- Transmission:

- Transmission and distribution flow powers.
- Energy losses.
- Distribution transformer with voltage regulator.
- Parallel distribution lines.

- Consumption:

- Active, capacitive and inductive loads.
- Automatic power factor compensation.
- Feeder protection relay.

This application shows different operations of an entire power system, from the energy is generated until it reaches the final consumer.

In the generation field, the students will learn how work different generation systems from three different sources: conventional energy source like carbon, fuel, gas, etc.; hydroelectric source, wind source.

The AEL-CPSS-03S includes a SCADA Control System that will allows the users supervise, control and manage the generation, transmission and consumption electrical system:

- Disconnecter and circuit breakers control.
- Data Acquisition of all electrical parameters of the system.
- Manual and automatic control of the generators.

The AEL-CPSS-03S includes the following modules:

- N-ALI01. Industrial Main Power Supply.
- N-TRANS3/1KR. Three-Phase Regulation Transformer. (3 units)
- N-ERP-MA01. Feeder Management Relay Module.
- N-ERP-MF01. Digital Fault Simulator Module.
- N-AE1/1K. 1KVA Transmission Line Simulator Module (2 units)
- N-EALD. Network Analyzer Unit with Data Acquisition Unit. (3 units)
- N-PSM. Power Switch Module. (4 units)
- N-ERP-PGC01. Generator Protection Relay Module.
- N-AVR/P. Automatic Voltage Regulator.
- N-SERV1K. 1 kW Servomotor Module. (2 units)
- N-EALDC/G. DC Generator Analyzer. (2 units)
- EMT6B/1K. 1 kW three-phase Synchronous generator.
- EMT7B/1K. 1 kW three-phase Asynchronous motor of squirrel cage.
- N-CFP. Advanced Power Factor Controller.
- N-CAR19T4D. Three-Phase Digital Capacitor Banks Module.
- N-CAR35T3/1.2K. 1.2 kW Three-Phase Step-Variable Resistor Load Module.
- N-CAR36T3/0.9K. 0.9 kW Three-Phase Step-Variable Inductive Load Module.
- N-CAR35T3/0.8K. 0.8 kW Three-Phase Step-Variable Capacitive Load Module.
- N-GINV300. 300W Three-Phase Grid Inverter.
- LP3. 3 lamps panel.
- FVP96. 96W Photovoltaic Panel.
- AEL-WBR. Electrical Workbench (Rack).
- AEL-WBMG. Electrical Mobile Workbench (2 units).
- AEL-PC. Touch Screen and Computer.
- SCADA (Supervision, Control and Data Acquisition).

Optional learning software:

In addition, Edibon provides optional software (AEL-CPSS-03S/ICAL) 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-CPSS-03S is mounted on rack.

This application required the following racks:

- N-RACK-A. (9 units)

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

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-CPSS-03. 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-TRANS3/1KR. Three-Phase Regulation Transformer (3 units).**

Three-Phase voltage transformer with secondary taps: -7,5%, -5%, -2,5%, 0%, +2,5%.

Primary: 3x380 VAC.

Secondary: 3x380 with tap.

Rated power: 1 kVA.



N-TRANS3/1KR

- **N-ERP-MA01. Feeder management Relay Module.**

This protection relay is used to test different short circuits in any point of the power system. This protection relay allows investigations into protection and monitoring of overhead lines, underground cables and feeders.

The connections are via safety sockets.

The main functions:

Four levels of Phase Instantaneous Overcurrent Element (50P).

Four levels of Negative-Sequence Overcurrent Element (50Q).

Four levels of Residual Overcurrent Element (50G).

Four levels of Neutral Overcurrent Element (50G).

Two levels of Phase Time-Overcurrent Element (51P).

Two levels of Residual Time-Overcurrent Element (51G).

Two levels of Ground Time-Overcurrent Element (51G).

One level of Negative-Sequence Time-Overcurrent Element (51Q).

Phase to Ground Overvoltage (59G).

Phase to Phase Overvoltage (59P).

Negative-Sequence Overvoltage (59Q).

Residual Overvoltage (59G).

Phase to Ground Undervoltage (27G).

Phase to Phase Undervoltage (27P).

Six levels of Secure Overfrequency (81O).

Six levels of Secure Underfrequency (81U).

Two levels of Negative Power Flow with Definite Time Delay (32).

Two levels of Positive Power Flow with Definite Time Delay (32).

Station Battery Monitor.

Breaker Wear Monitoring.

Synchrophasor Protocol.

Peak Demand and Demand Metering.

Auto-Reclosing.

Creating fault and disturbance records.

The connection to the experimental circuit is via current transformers with ratio to suit the inputs of the relay.

It allows an effective demonstration of the effect of current and voltage transformer ratio, connection and rating on protective relays.

Accuracy: +- 10%.

Current: 5 A (A. C.).

Frequency: 50 or 60 Hz.

Operating time: typically 10 ms to 25 ms.



N-ERP-MA01

- **N-ERP-MF01. Digital Fault Simulator Module.**

This module offers the possibility to inject different kind of short circuits in any point of the power system directly or through a variable resistor. Employing this module we can analyze the different protection elements functionality with different fault intensity.

The short circuit injection possibilities are:

Three-pole short circuit.

Two-pole short circuit.

Two-pole to ground short circuit.

Single-pole short circuit.



N-ERP-MF01

- **N-AE1/1K. 1KVA Transmission Line Simulator Module (2 units).**

Phase Resistance: 4 Ohm; 8 Ohm.
 Phase Inductance: 125mH 250mH.
 Phase Capacity:
 Line-to-line: 2 x 100nF; 175nF.
 Line-to-ground: 2 x 0,4μF; 0,8μF.
 Maximum power: 1kVA.
 Nominal Voltage: 3 x 400V; 50/60Hz.
 Maximum Current: 4,5A.



N-AE1/1K

- **N-EALD. Network Analyzer Unit with Computer Data Acquisition (3 units).**

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-PSM. Power Switch Module (4 units).**

The voltage can be switch on and off manually or automatically.
 Nominal voltage: 230/400VAC.
 Frequency: 50/60Hz.
 Control voltage: 24V.
 Nominal operating current: 15A.
 Functions: 2 pushbutton switches and remote control for switch-off relay.
 Contacts:
 Three normally open contact.
 One auxiliary normally open contact.



N-PLC04

- **N-ERP-PGC01. Generator Protection Relay Module.**

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: max/min-voltage (59/27), max/min-frequency (81 O/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 (81 O/U), vector surge.



N-ERP-PG01

- **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-SERV1K. 1 kW Servomotor Module. (2 units).**

Dynamic and static four-quadrant operation.
 Speed and torque displays.
 Four-quadrant monitor.
 Thermal monitoring of the machine under test.
 Testing for the presence of a shaft cover.
 Connection voltage: 400 V.
 Frequency: 50 Hz.
 Maximum power output: 10kVA.
 Maximum speed: 4000 r.p.m.
 Maximum torque 30 Nm.
 Temperature monitoring.



N-SERV1K

- **N-EALDC/G. DC Generator Analyzer. (2 units)**

Rated voltage range: 0 - 100 VDC.
 Rated current range: 0 - 10 A.
 Communication port: RS-485
 Digital display for current, power and energy visualization.



N-EALD/G

- **EMT6B/1K. 1 kW Three-Phase Synchronous Generator.**

Three-phase synchronous generator.
 Nominal power: 1 KVA.
 Synchronous speed: 3000 r.p.m.
 2 poles.
 Independent excitation.



EMT6B/1K

- **EMT7B/1K. 1 kW three-phase Asynchronous motor of squirrel cage.**

Nominal power: 1 kW.
 RPM: 1405 r.p.m.
 Nominal torque: 7,48 Nm.
 Performance:
 75,5 % (at 50% of full load).
 77,8 % (at 75% of full load).
 76,7 % (at 100% of full load).
 Power Factor: 0,8.
 Nominal current:
 4,5 A (at 230 VAC).
 2,7 A (at 380 VAC).
 2,6 A (at 400 VAC).



EMT7B/1K

- **N-CFP. Advanced power factor controller module.**

Power factor automatic controller.
 Regulation in four quadrants.
 FCP (fast computerized program) system.
 Compensation stages: 6 relay type outputs.
 LCD screen with three digits and more than 20 icons to indicate different operating conditions.
 ON-OFF switch.



N-CFP

- **N-CAR19T4D. Three-phase digital capacitor banks module.**

Digital capacitors bank module.
 6 stages of 3x7uF.
 Voltage supply of 400 VAC.
 Step signal input jack.
 Micro connector of 8 pins.
 Rated voltage: 380 VAC.



N-CAR19T4D

- **N-CAR35T3/1.2K. 1.2 kW Three-Phase Step-Variable Resistor Load Module.**

Maximum power: 3 x 400 W.
 Rated voltage: 380 VAC.

- **N-CAR36T3/0.9K. 0.9 kW Three-Phase Step-Variable Inductive Load Module.**

Maximum power: 3 x 300 VAR.
 Rated voltage: 380 VAC.

- **N-CAR35T3/0.8K. 0.8 kW Three-Phase Step-Variable Capacitive Load Module.**

Maximum power: 3 x 300 VAR.
 Rated voltage: 380 VAC.

- **LP3. 3 lamps panel.**

Power: 3 x 250W.
 Switch ON/OFF.
 Intensity Regulator.
 Aluminium frame.



LP3

- N-GINV300. **300W Three-Phase Grid Inverter.**

- FVP96. **96W Photovoltaic Panel.**

Maximum Power: 96W.

Voltage at maximum power: 17,8 V.

Current at maximum power: 3,7 A.

Short-Circuit Current: 4,05 A.

Opened-Circuit Voltage: 22,25 V.

- AEL-WBR. **Electrical Workbench.**

Available for 1 to 4 students working at the same time.

- AEL-WBMG. **Electrical Mobile Workbench (2 units).**

Available for 1 to 4 students working at the same time.

- **SCADA (Supervision, Control and Data Acquisition).**

The SCADA System allows to study real operations carried in actual power systems. This software enables the student to control the devices that make up the power systems remotely, observe in real time how the typical operations of an electrical substation work, which are the voltage and current values at different points of the transport lines, how much energy is generated and what occurs when the excitation current of our generator is increased or decreased.

- **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-CPSS-03S/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.

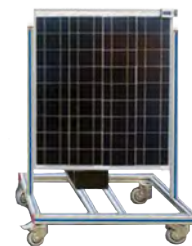
This unit allows the 30 students of the classroom to visualize simultaneously all the results and the manipulation of the unit, during the process, by using a projector or an electronic whiteboard.

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-CPSS-03S + AEL-CPSS-03S/CCSOF + Cables and Accessories + Manuals are included in the minimum supply for enabling normal and full operation.



FVP96



AEL-CPSS-03S/CCSOF

EXERCISES AND PRACTICAL POSSIBILITIES TO BE DONE WITH THE MAIN ITEMS

- 1.-Study of synchronous machine in stand-alone operation mode.
 - 2.-Study of parallel operation with one synchronous generator and the grid.
 - 3.-Study of parallel operation with two synchronous generators and the grid.
 - 4.-Study of parallel operation with two synchronous generators: load sharing.
 - 5.-Study of micro-grids.
 - 6.-Study of manual power factor compensation.
 - 7.-Study of automatic power factor compensation.
 - 8.-Study of brushless motors.
 - 9.-Study of transformers: step-up voltage transformer, step-down voltage transformer, energy losses, voltage regulation.
 - 10.-Study of drop voltages in transmission lines according to the line lengths.
 - 11.-Study of the main operations of the protection relay: phase instantaneous overcurrent element 50P, negative sequence overcurrent element 50Q, Time-overcurrent element 51P, overvoltage element 59P and many other parameters.
 - 12.-Study of different short circuit tests: single pole, two pole, two pole to ground and three-phase short circuits.
 - 13.-Wiring of photovoltaic system.
 - 14.-Checking the photovoltaic system with feed to the power grid.
 - 15.-Measurement of energy production by the photovoltaics panel.
 - 16.-Finding the Maximum Power Point.
 - 17.-Minimum power of the photovoltaic inverter.
 - 18.-Losses of the power grid inverter.
 - 19.-Visualizing the electrical parameters of the photovoltaic panel through SCADA Control System.
 - 20.-System's response in case of power outage on the grid.
- Other possibilities to be done with this Unit:
- 21.-Many students view results simultaneously.
To view all results in real time in the classroom by means of a projector or an electronic whiteboard.
 - 22.-The Computer Control System with SCADA allows a real industrial simulation.
 - 23.-This unit is totally safe as uses mechanical, electrical and electronic, and software safety devices.
 - 24.-This unit can be used for doing applied research.
 - 25.-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-CPSS-03S:
- Generation:
 - 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.)
 - Transmission/Distribution:
 - 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.)
 - Load consumption:
 - 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.)

AVAILABLE VERSIONS

Offered in this catalogue:

- AEL-CPSS-03S. Smart Grid Power Systems Application ,with Two Parallel Generators, Two Distribution Lines and Loads , with SCADA.

Offered in other catalogue:

- AEL-CPSS-01S. Smart Grid Power Systems Application, with Automatic Control Generation, Transmission Line and Loads.
- AEL-CPSS-02S. Smart Micro-Grids Power Systems Application, with Automatic Control Generation and Loads.

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-CPSS-03S/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.**

-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.

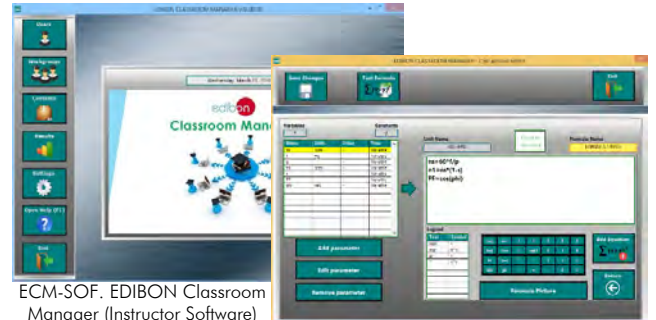
Innovative features:

- 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:

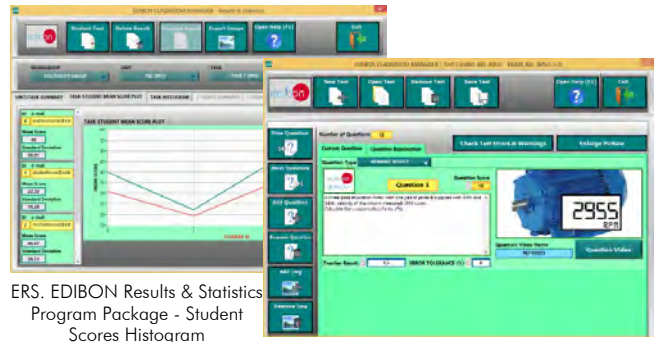
www.edibon.com/products/catalogues/en/units/electricity/ICAI-Electricity/ICAI-Electricity.pdf

Instructor Software



ECM-SOF. EDIBON Classroom Manager (Instructor Software) Application main screen

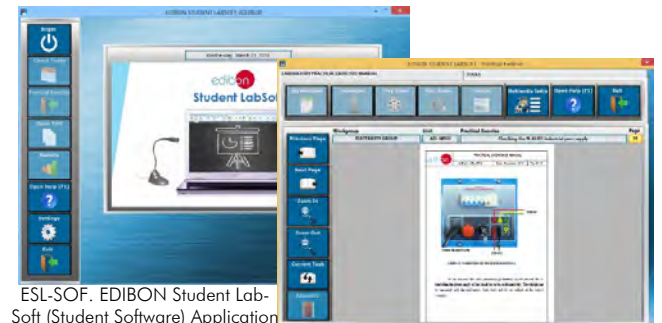
ECAL. EDIBON Calculations Program Package - Formula Editor Screen



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

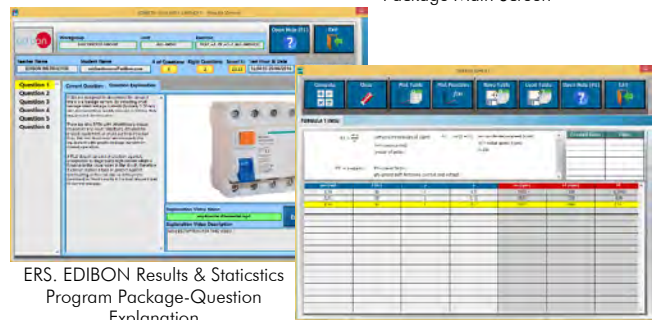
ETTE. EDIBON Training Test & Exam Program Package - Main Screen with Numeric Result Question

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

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:

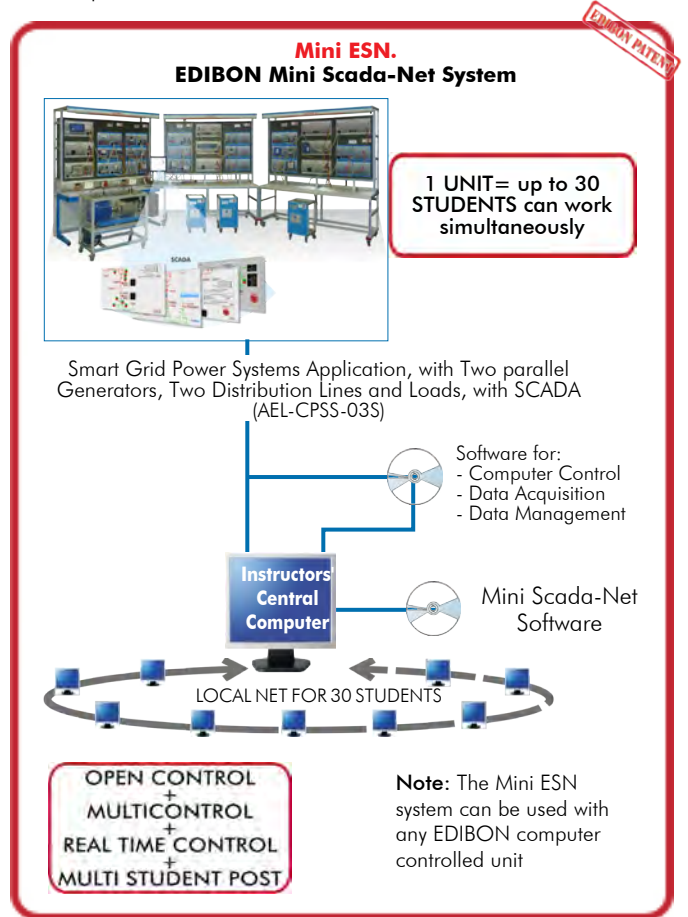
- It allows an easier and quicker understanding.
- This system allows you can save time and cost.
- Future expansions with more EDIBON Units.

For more information see Mini ESN catalogue. Click on the following link:

www.edibon.com/products/catalogues/en/Mini-ESN.pdf

⑦ **ESN. EDIBON Scada-Net System.**

This unit can be integrated, in the future, into a Complete Laboratory with many Units and many Students.



ORDER INFORMATION

Main items (always included in the supply)

Minimum supply always includes:

- ① **Unit: AEL-CPSS-03S. Smart Grid Power Systems Application, with Two parallel Generators, Two Distribution Lines and Loads, with SCADA.**
- ② **AEL-CPSS-03S/CCSOF. Computer Control + Data Acquisition + Data Management Software.**
- ③ **Cables and Accessories**, for normal operation.
- ④ **Manuals.**

***IMPORTANT:** Under AEL-CPSS-03S 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 configuration

- ⑤ AEL-CPSS-03S/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-CPSS-03. 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-TRANS3/1KR. Three-Phase Regulation Transformer (3 units).
Three-Phase voltage transformer with secondary taps: -7,5%, -5%, -2,5%, 0%, +2,5%.
Primary: 3x380 VAC.
Secondary: 3x380 with tap.
Rated power: 1 kVA.
- N-ERP-MA01. Feeder management Relay Module.
This protection relay is used to test different short circuits in any point of the power system. This protection relay allows investigations into protection and monitoring of overhead lines, underground cables and feeders.
The connections are via safety sockets.
The main functions:
Four levels of Phase Instantaneous Overcurrent Element (50P).
Four levels of Negative-Sequence Overcurrent Element (50Q).
Four levels of Residual Overcurrent Element (50G).
Four levels of Neutral Overcurrent Element (50G).
Two levels of Phase Time-Overcurrent Element (51P).
Two levels of Residual Time-Overcurrent Element (51G).
Two levels of Ground Time-Overcurrent Element (51G).
One level of Negative-Sequence Time-Overcurrent Element (51Q).
Phase to Ground Overvoltage (59G).
Phase to Phase Overvoltage (59P).
Negative-Sequence Overvoltage (59Q).
Residual Overvoltage (59G).
Phase to Ground Undervoltage (27G).
Phase to Phase Undervoltage (27P).
Six levels of Secure Overfrequency (81O).
Six levels of Secure Underfrequency (81U).
Two levels of Negative Power Flow with Definite Time Delay (32).
Two levels of Positive Power Flow with Definite Time Delay (32).
Station Battery Monitor.
Breaker Wear Monitoring.
Synchrophasor Protocol.
Peak Demand and Demand Metering.
Auto-Reclosing.
Creating fault and disturbance records.
The connection to the experimental circuit is via current transformers with ratio to suit the inputs of the relay.
It allows an effective demonstration of the effect of current and voltage transformer ratio, connection and rating on protective relays.
Accuracy: +- 10%.
Current: 5 A (A. C.).
Frequency: 50 or 60 Hz.
Operating time: typically 10 ms to 25 ms.
- N-ERP-MF01. Digital Fault Simulator Module.
This module offers the possibility to inject different kind of short circuits in any point of the power system directly or through a variable resistor. Employing this module we can analyze the different protection elements functionality with different fault intensity.
The short circuit injection possibilities are:
Three-pole short circuit.
Two-pole short circuit.
Two-pole to ground short circuit.
Single-pole short circuit.
- N-AE1/1K. 1KVA Transmission Line Simulator Module (2 units).
Phase Resistance: 4 Ohm; 8 Ohm.
Phase Inductance: 125mH 250mH.
Phase Capacity:
Line-to-line: 2 x 100nF; 175nF.
Line-to-ground: 2 x 0,4μF; 0,8μF.
Maximum power: 1kVA.
Nominal Voltage: 3 x 400V; 50/60Hz.
Maximum Current: 4,5A.
- N-EALD. Network Analyzer Unit with Computer Data Acquisition (3 units).
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.

Tender Specifications (for main items)

- N-PSM. Power Switch Module (4 units).
The voltage can be switch on and off manually or automatically.
Nominal voltage: 230/400VAC.
Frequency: 50/60Hz.
Control voltage: 24V.
Nominal operating current: 15A.
Functions: 2 pushbutton switches and remote control for switch-off relay.
Contacts:
Three normally open contact.
One auxiliary normally open contact.
- N-ERP-PGC01. Generator Protection Relay Module.
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: max/min-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-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-SERV1K. 1 kW Servomotor Module. (2 units).
Dynamic and static four-quadrant operation.
Speed and torque displays.
Four-quadrant monitor.
Thermal monitoring of the machine under test.
Testing for the presence of a shaft cover.
Connection voltage: 400 V.
Frequency: 50 Hz.
Maximum power output: 10 kVA.
Maximum speed: 4000 r.p.m.
Maximum torque 30 Nm.
Temperature monitoring.
- N-EALDC/G. DC Generator Analyzer. (2 units)
Rated voltage range: 0 - 100 VDC.
Rated current range: 0 - 10 A.
Communication port: RS-485
Digital display for current, power and energy visualization.
- EMT6B/1K. 1 kW Three-Phase Synchronous Generator.
Three-phase synchronous generator.
Nominal power: 1 KVA.
Synchronous speed: 3000 r.p.m.
2 poles.
Independent excitation.
- EMT7B/1K. 1 kW three-phase Asynchronous motor of squirrel cage.
Nominal power: 1 kW.
RPM: 1405 rpm.
Nominal torque: 7,48 Nm.
Performance:
75,5 % (at 50% of full load).
77,8 % (at 75% of full load).
76,7 % (at 100% of full load).
Power Factor: 0,8.
Nominal current:
4,5 A (at 230 VAC).
2,7 A (at 380 VAC).
2,6 A (at 400 VAC).

Tender Specifications (for main items)

- N-CFP. Advanced power factor controller module.
 - Power factor automatic controller.
 - Regulation in four quadrants.
 - FCP (fast computerized program) system.
 - Compensation stages: 6 relay type outputs.
 - LCD screen with three digits and more than 20 icons to indicate different operating conditions.
 - ON-OFF switch.
- N-CAR19T4D. Three-phase digital capacitor banks module.
 - Digital capacitors bank module.
 - 6 stages of 3x7uF.
 - Voltage supply of 400 VAC.
 - Step signal input jack.
 - Micro connector of 8 pins.
 - Rated voltage: 380 VAC.
- N-CAR35T3/1.2K. 1.2 kW Three-Phase Step-Variable Resistor Load Module.
 - Maximum power: 3 x 400 W.
 - Rated voltage: 380 VAC.
- N-CAR36T3/0.9K. 0.9 kW Three-Phase Step-Variable Inductive Load Module.
 - Maximum power: 3 x 300 VAR.
 - Rated voltage: 380 VAC.
- N-CAR35T3/0.8K. 0.8 kW Three-Phase Step-Variable Capacitive Load Module.
 - Maximum power: 3 x 300 VAR.
 - Rated voltage: 380 VAC.
- LP3. 3 lamps panel.
 - Power: 3 x 250W.
 - Switch ON/OFF.
 - Intensity Regulator.
 - Aluminium frame.
- N-GINV300. 300W Three-Phase Grid Inverter.
- FVP96. 96W Photovoltaic Panel.
 - Maximum Power: 96W.
 - Voltage at maximum power: 17,8 V.
 - Current at maximum power: 3,7 A.
 - Short-Circuit Current: 4,05 A.
 - Opened-Circuit Voltage: 22,25 V.
- AEL-WBR. Electrical Workbench.
 - Available for 1 to 4 students working at the same time.
- AEL-WBMG. Electrical Mobile Workbench (2 units).
 - Available for 1 to 4 students working at the same time.
- SCADA (Supervision, Control and Data Acquisition).
 - The SCADA System allows to study real operations carried in actual power systems. This software enables the student to control the devices that make up the power systems remotely, observe in real time how the typical operations of an electrical substation work, which are the voltage and current values at different points of the transport lines, how much energy is generated and what occurs when the excitation current of our generator is increased or decreased.
- All necessary cables to realize the practical exercises are included.

The complete unit includes as well: 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-CPSS-03/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 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.-Study of synchronous machine in stand-alone operation mode.
 - 2.-Study of parallel operation with one synchronous generator and the grid.
 - 3.-Study of parallel operation with two synchronous generators and the grid.
 - 4.-Study of parallel operation with two synchronous generators: load sharing.
 - 5.-Study of micro-grids.
 - 6.-Study of manual power factor compensation.
 - 7.-Study of automatic power factor compensation.
 - 8.-Study of brushless motors.
 - 9.-Study of transformers: step-up voltage transformer, step-down voltage transformer, energy losses, voltage regulation.
 - 10.-Study of drop voltages in transmission lines according to the line lengths.
 - 11.-Study of the main operations of the protection relay: phase instantaneous overcurrent element 50P, negative sequence overcurrent element 50Q, Time-overcurrent element 51P, overvoltage element 59P and many other parameters.
 - 12.-Study of different short circuit tests: single pole, two pole, two pole to ground and three-phase short circuits.
 - 13.-Wiring of photovoltaic system.
 - 14.-Checking the photovoltaic system with feed to the power grid.
 - 15.-Measurement of energy production by the photovoltaics panel.
 - 16.-Finding the Maximum Power Point.
 - 17.-Minimum power of the photovoltaic inverter.
 - 18.-Losses of the power grid inverter.
 - 19.-Visualizing the electrical parameters of the photovoltaic panel through SCADA Control System.
 - 20.-System's response in case of power outage on the grid.
- Other possibilities to be done with this Unit:
- 21.-Many students view results simultaneously.
To view all results in real time in the classroom by means of a projector or an electronic whiteboard.
 - 22.-The Computer Control System with SCADA allows a real industrial simulation.
 - 23.-This unit is totally safe as uses mechanical, electrical and electronic, and software safety devices.
 - 24.-This unit can be used for doing applied research.
 - 25.-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-CPSS-03S/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.

REPRESENTATIVE



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