Engineering and Technical Teaching Equipment

Smart Micro-Grids Power Systems Application, with Automatic Control Generation and Loads, with SCADA

AEL-CPSS-02S

① Unit: AEL-CPSS-02S.Smart Micro-Grids Power Systems Application, with Automatic Control Generation and Loads, with SCADA

Key features:

- **EDIBON SCADA System (Supervision, Control and Data Acquisition) always included.**
- **Smart Grid devices.**
- **Micro-Grids.**
- **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

POWERED BY NATIONAL INSTRUMENTS LabVIEW

www.edibon.com
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

INTRODUCTION

Micro-grids are modern, small-scale versions of the centralized electricity system. They active specific local goals, such as reliability, carbón emission reduction, diversification of energy sources, and cost reduction, established by the community being served. Like the bulk power grid, smart micro-grids generate, distribute, and regulate the flow of electricity to consumers, but do so locally. Smart micro-grids are an ideal way to integrate renewable resources on the community level and allow for customer participation in the electricity enterprise.

GENERAL DESCRIPTION

The "Smart Micro-Grids Power System Application, with Automatic Control Generation and Loads, with SCADA", AEL-CPSS-02S has been designed by Edibon for the training at both the theoretical and practical levels in the field of Smart Micro-Grids Energy Systems.

The AEL-CPSS-02S application provides several levels of training to give the user full knowledge and experiences about the most important principles of micro-grid in the context of control, distribution and energy consumption.

For this purpose, this application includes a specific manual, which explains at theoretical level the subjects relating to Micro-Grids Power Systems. The thematic of the manual covers from the coordination of different energy sources working in the same distribution grid up to issues as the protection relays coordination, electric generators control and system response against a black-out to maintain the electricity supply. On the other hand, it is provided a series of modules and options to put into practice all theoretical concepts previously studied in this manual.

One of the advantages of this application is its modularity and flexibility. This allows carry out different Micro-Grids configurations. For example, the user can configure the power system as "Generation + Distribution + Consumption" working with the generator in stand-alone mode or the can be configured with the generator connected to the grid for parallel operation purposes. Electrical generator can be synchronized with the laboratory network to establish an energy delivery network in order to develop a Micro-Grid with one or more energy generation sources.

In functional terms the whole system can be controlled either locally through the operation of switches, breakers and signals, and remotely through the Data Acquisition and Control Software offered optionally.

The AEL-CPSS-02S optionally offers both a Data Control and Data Acquisition Software (AEL-CPSS-02S/CCSOF) and a PLC control module that allow the user carries out the remote control of the Micro-Grid. The SCADA control system allows carrying out the most important operations of real power systems such as speed and voltage control of the turbine and synchronous generator, coupling maneuvers of the generator with the mains (synchronization), stand-alone operations with the generator (micro-grid concept), loads commutation, current and voltage measurements in different points of the system, etc.

In addition the AEL-IOP-01S can be optionally acquired. This application consists of a second motor-generator group with its respective control and measurement modules for parallel operations with several power generation sources. This allows the user load sharing studies with several generators connected in parallel to supply Micro-Grid.

The following is a description of the most important modules included in this application:

- Generator Protection and Control Relay Unit: it is an industrial control and protection device of power generator groups with more than 150 configurable variables. The Relay Unit provides different levels of access to be configured. For example, protection thresholds such as overcurrent (50/51), over/under-voltage, over/under-frequency (81), inverse power, over/underspeed of the turbine (12), number of poles of the machine and nominal power can be set. In addition, for more advanced settings, it is possible to set the PID control system parameters under different operation conditions of the turbine-generator group.

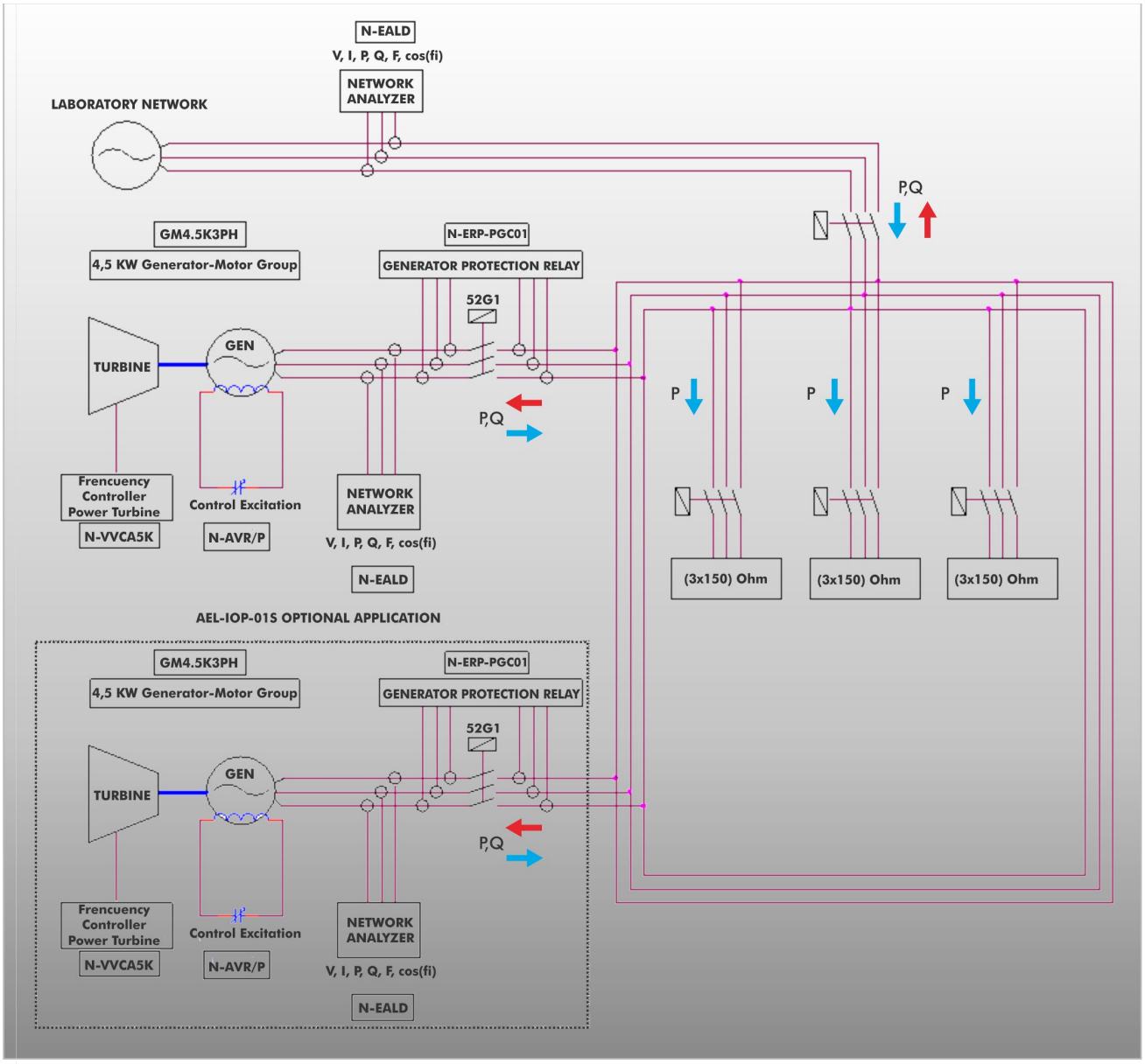
  During motor-generator group start-up, it is possible to monitor the PID signals, to analyze the generator disturbances and to remake real time setting adjustments through the provided relay configuration software.

  Due to the versatility of the Generator Protection and Control Relay Unit, Edibon provides configured this device to work properly from scratch with the generator-motor group. In addition, it is provided a relay setting file to restore the relay to the initial configuration. On this way, the user can change any relay parameter and recovery the initial setting.

  This device offers the advantage of managing the generator-motor group to supply power autonomously to the micro-grid and, at the same time, it allows synchronizing the generator with the grid to work as a support system.

- Automatic Voltage Regulator: this device is designed for manual and automatic control of the current excitation of the synchronous generator. The regulator has a switch that allows the user to select the control mode. If manual control mode is selected, the current excitation of the synchronous generator can be controlled manually with a potentiometer and the effects of the generator output voltage can be seen. Automatic control mode allows the Generator Protection and Control Relay Unit to take the control of the current excitation.
- Three-Phase bank of Commutable Resistors Module: this module is designed in order to carry out local consumption of the generated energy by the synchronous generator. This module has three switches to introduce three active power consumption stages.
- DC Generator Analyzer. This module allows measuring electrical parameters of the current excitation of the synchronous generator (V, I, P).
- Turbine Speed Controller: this device allows controlling manually and automatically the turbine speed. Manual control allows the user to manage the turbine speed through a potentiometer included in this module. On the other hand, automatic control function is carried out by the Generator Protection and Control Relay unit with an analog signal of 0-10V. On this way, the user can either study the whole system operations working autonomously, as a real power station works, or taking the manual control of the system to study the effects of the turbine speed changes in the electrical system.

Example of configuration



Example of two power generators in parallel operation supplying energy to the loads.

The AEL-CPSS-02S includes the following modules:

- N-ALI01. Industrial Main Power Supply.
- N-VVCA5K. 5KW Motor Speed Controller.
- N-EALDC/G. DC Generator Analyzer.
- N-AVR/P. Automatic Voltage Regulator.
- N-ERP-PGC01. Generator Protection and Control Relay Module.
- N-EALD. Network Analyzer Unit with Computer Data Acquisition.
- N-CAR35T3D. Three-Phase Digital Bank of Commutable Resistors Module.
- GMG4.5K3PH. 4.5KW Generator-Motor Group.

Required module if the optional SCADA is acquired:

- N-PLC04. PLC04 Control Module.

Required PC if optional SCADA is acquired:

- AEL-PC. Touch Screen and Computer. (to work with the optional SCADA Control System).

Optional SCADA software:

- AEL-CPSS-02S/CCSOF. Computer Control + Data Acquisition + Data Management Software.

Optional learning software:

In addition, Edibon provides optional software (AEL-CPSS-02S/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).

Optional application:

The AEL-IOP-01S Isolated Parallel Operation application, with SCADA can be acquired as a supplement to AEL-CPSS-02S to study isolated parallel operations with two generators in a Micro-Grid.

The AEL-IOP-01S includes the following modules:

- N-VVCA5K. 5KW Motor Speed Controller.
- N-EALDC/G. DC Generator Analyzer.
- N-AVR/P. Automatic Voltage Regulator.
- N-ERP-PGC01. Generator Protection and Control Relay Module.
- N-EALD. Network Analyzer Unit with Computer Data Acquisition.
- GMG4.5K3PH. 4.5KW Generator-Motor Group.

Required module if the optional SCADA is acquired:

- N-PLC05. PLC05 Control Module.

The application AEL-CPSS-02S is mounted on rack.

This application required the following racks:

- N-RACK-A.
- N-RACK-M.
- N-RACK-B (4 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, 3 and 4.
- Optional items: 2, 5, 6 and 7.

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

① AEL-CPSS-02S. Unit.

The trainer AEL-CPSS-02S includes the following modules:


N-ALI01

• 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 400V connecting plug.
Differential magnetothermal, 4 poles, 25A, 300mA AC 6KA.


N-WCA5K

• N-WCA5K. **Speed control of the 5KW motor.**
AC 5KW motors control module.
Three-phase supply voltage: 400VAC + N.
Rated power: 5KW.
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-EALD/G

• N-EALDC/G. **DC Generator Analyzer.**
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-AVR/P

• 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-ERP-PGC01

• 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-01generator 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/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.

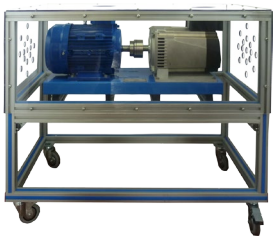
- N-EALD. **Network Analyzer Unit with Computer Data Acquisition**
  - ON-OFF switch.
  - Supply voltage: 400 VAC.
  - Input terminals: Input connection with the measurement point.
  - Output terminals: Output connection with the measurement point.
  - Digital outputs: Three digital outputs are used 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-CAR35T3D. **Three-phase digital bank of commutable resistors module.**
  - Digital bank of commutable resistors module.
  - Three sliding load switches.
  - Three three-phase commutable banks of resistors of 150 ohms.
  - Local/remote control switch.
  - ON-OFF switch.
  - Communications connector SUB-D of 62 pins.

N-CAR35T3D

- GMG4.5K3PH. **4.5KW 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

Required module if the optional SCADA is acquired:

- N-PLC04. **PLC04 control module.**
  - PLC Siemens S7-300.
  - Communication connector SUB-D of 62 pins.
  - ON-OFF switch.
  - Fuses: 2 x 2 A.

N-PLC04

Required PC if optional SCADA is acquired:

- AEL-PC. **Touch Screen and Computer.**
  - Touch Scree:
    - 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

The AEL-IOP-01S application trainer includes the following modules:

- N-VVCA5K. **Speed control of the 5KW motor**
  - AC 5KW motors control module.
  - Three-phase supply voltage: 400VAC + N.
  - Rated power: 5KW.
  - 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

- N-EALDC/G. **DC Generator Analyzer.**
  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

- 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-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-01generator 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/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-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

• GMG4.5K3PH. **4.5KW 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

Required module if the optional SCADA is acquired:

• N-PLC05. **PLC05 control module.**
PLC Siemens S7-300.
Communication connector SUB-D of 62 pins.
ON-OFF switch.
Fuses: 2 x 2 A.


N-PLC04

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

The complete unit includes as well:

EDIBON SCADA System (Supervision, Control and Data Acquisition) always included. Smart Grid devices.

Micro-Grids.

Advanced Real-Time SCADA.

Open Control + Multicontrol + Real-Time Control.

Specialized EDIBON Control Software based on LabVIEW.

Projector and/or electronic whiteboard compatibility allows the unit to be explained and demonstrated to an entire class at one time.

Capable of doing applied research, real industrial simulation, training courses, etc.

Remote operation and control by the user and remote control for EDIBON technical support, are always included.

Totally safe, utilizing 4 safety systems (Mechanical, Electrical, Electronic & Software).

Designed and manufactured under several quality standards.

Optional ICAI software to create, edit and carry out practical exercises, tests, exams, calculations, etc.

Apart from monitoring user's knowwledge and progress reached.

This unit has been designed for future expansion and integration. A common expansion is the EDIBON Scada-Net (ESN) System which enables multiple students to simultaneously operate many units in a network.

②AEL-CPSS-02S/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.


AEL-CPSS-02S/CCSOF

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.

③Cables and Accessories, for normal operation.

④Manuals:

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-02S + AEL-CPSS-02S/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.- Study of generation power systems in Micro-Grids.

2.- Analysis of the measurements of the power flows of the synchronous generator in the Micro-Grids.

3.- Analysis of the active and reactive power of the generator in the Micro-Grids.

4.- Automatic synchronization maneuvers of synchronous generator with the mains.

5.- Study of the synchronous generator in island operation mode in Micro-Grids.

6.- Study of excitation/voltage regulation of synchronous generator in island mode in Micro-Grids.

7.- Study of turbine regulation (frequency control) in the Micro-Grids.

8.- Study of excitation/voltage regulation of synchronous in Micro-Grids.

9.- Study of the power factor regulation of the synchronous generator in Micro-Grids.

Some practical exercises possibilities with the optional SCADA:

10.- Remotely control of generation power systems in Micro-Grids.

11.- Analysis with the SCADA software of synchronous generator power flows in Micro-Grids.

12.- Analysis with SCADA software of active and reactive power of synchronous generator in Micro-Grids.

13.- Remotely control of synchronous generator in Micro-Grids.

Additional practical exercises possibilities with the Optional Application "AEL-IPO-01S":

14.- Control of multiple generator in a standalone network.

15.- Control of multiple generator in parallel generation mode.

16.- Manual/Automatic frequency control of synchronous generators.

17.- Manual/Automatic voltage control of synchronous generators.

18.- Power factor control generator in island mode.

Other possibilities to be done with this Unit:

19.- Many students view results simultaneously.

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

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

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

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

23.- 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.

DIMENSIONS AND WEIGHTS

AEL-CPSS-02S:

-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.)

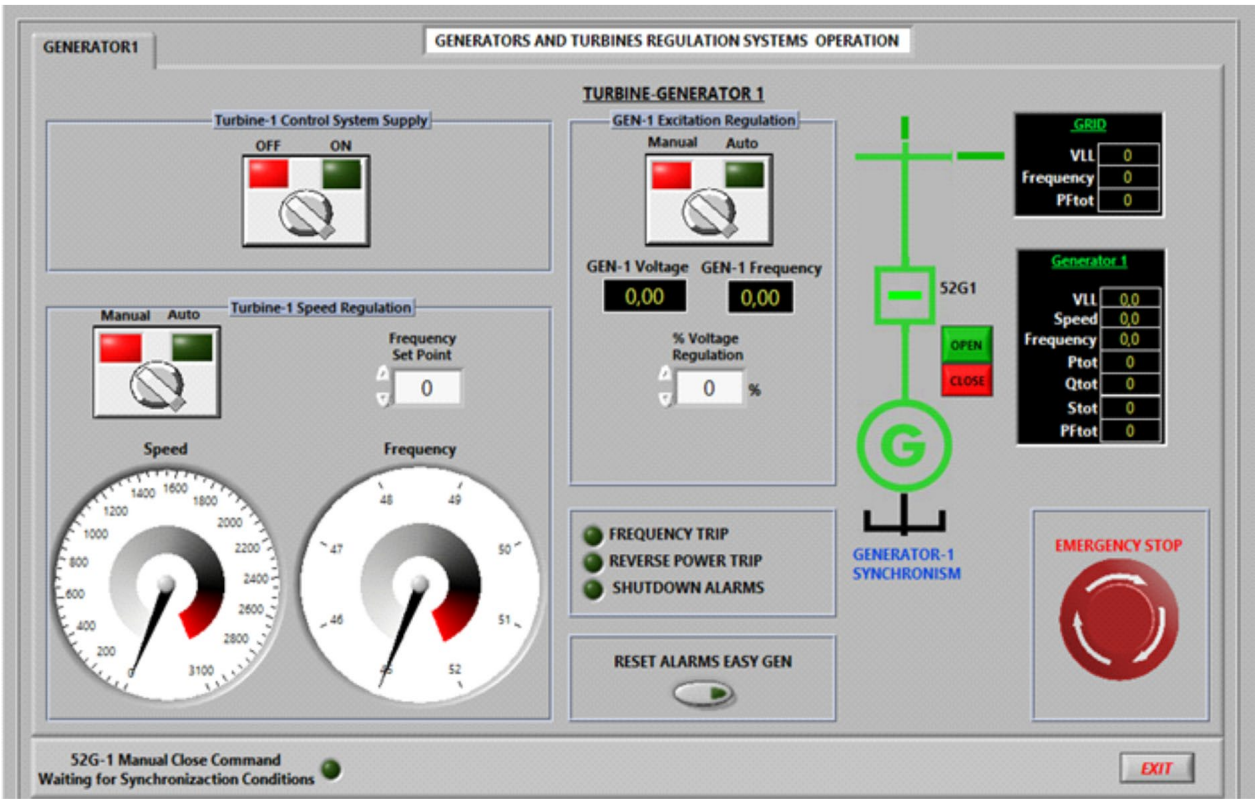
AVAILABLE VERSIONS

Offered in this catalogue:

- AEL-CPSS-02S. Smart Micro-Grids Power Systems Application, with Automatic Control Generation and Loads, with SCADA.

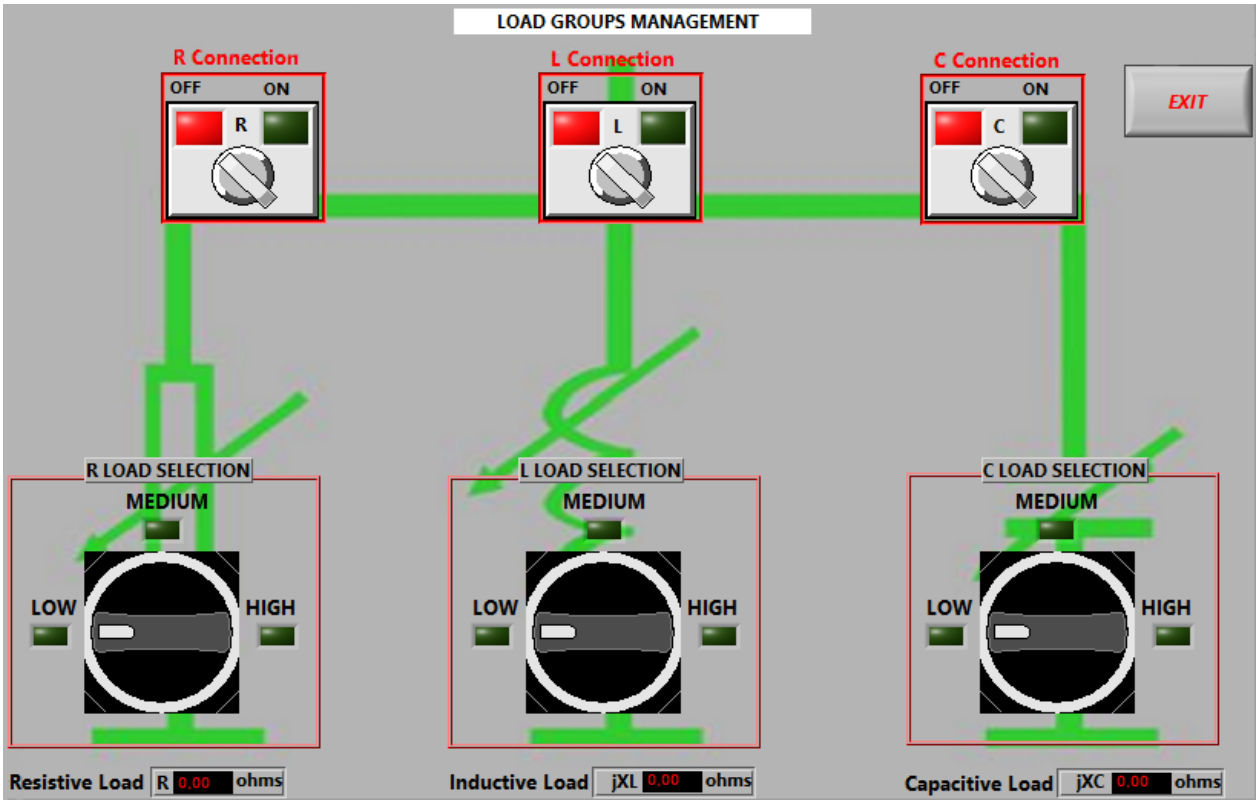
Offered in other catalogue:

- AEL-CPSS-01S. Smart Grid Power Systems Application, with Automatic Control Generation, Transmission Line and Loads, with SCADA.
- AEL-CPSS-03S. Smart Grid Power Systems Application, with Two Parallel Generators, Two Distribution Lines and Loads, with SCADA.



Display control of the turbine and the synchronous generator. This menu offers multiple possibilities for control and regulation of the group.

- Precise and manual control of turbine frequency.
- Automatic control of the turbine frequency.
- Precise manual control of the excitation of the synchronous generator.
- Automatic control of synchronous generator excitation.
- Manual synchronization of synchronous generator with the mains.
- Automatic synchronization of synchronous generator with electrical network.
- Island operation mode.
- Alarm monitoring of frequency and reverse power.
- Emergency stop.
- Supervision of the electrical parameters of the generator and the power grid.
- Monitoring the speed of the turbine.



COMPLETE TECHNICAL SPECIFICATIONS (for optional items)

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)

a) Technical and Vocational Education configuration

⑤ AEL-CPSS-02S/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.

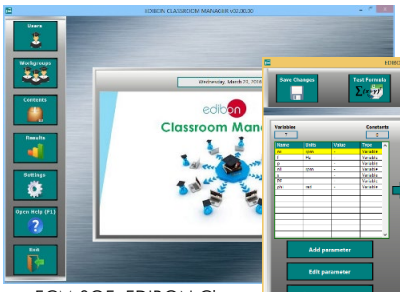
User Monitoring Learning & Printable Reports.

Multimedia-Supported auxiliary resources.

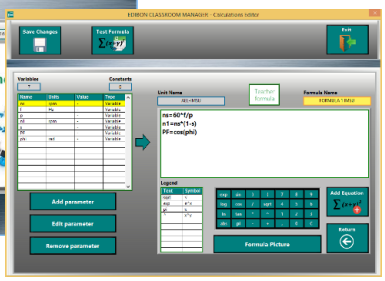
For more information see **ICAI** catalogue. Click on the following link:

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

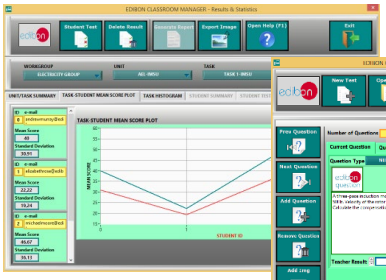
Instructor Software



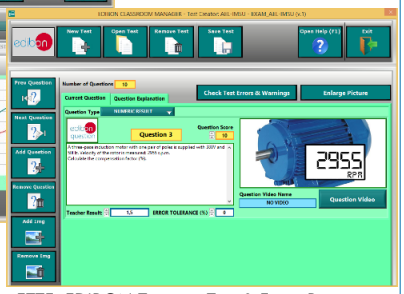
ECM-SOF. EDIBON Classroom Manager Software Application main screen



ECAL. EDIBON Calculations Program Package - Formula Editor Screen

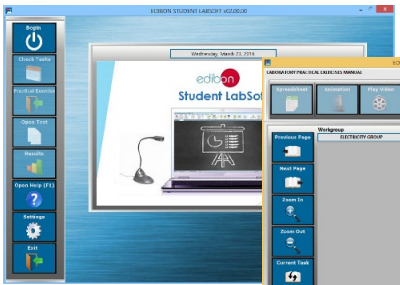


ERS. EDIBON Results & Statistics Program Package - Student Scores Histogram

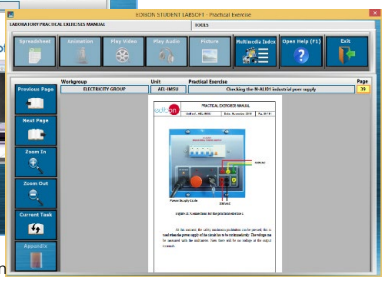


ETTE. EDIBON Training Test & Exam Program Package - Main Screen with Numeric Result Question

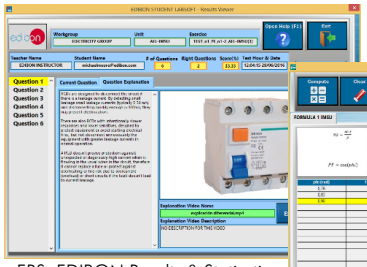
Student Software



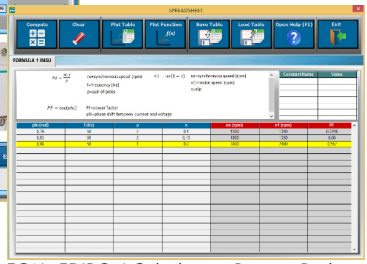
ESL-SOF. EDIBON Student Lab-Soft (Student Software) Application Main Screen



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:

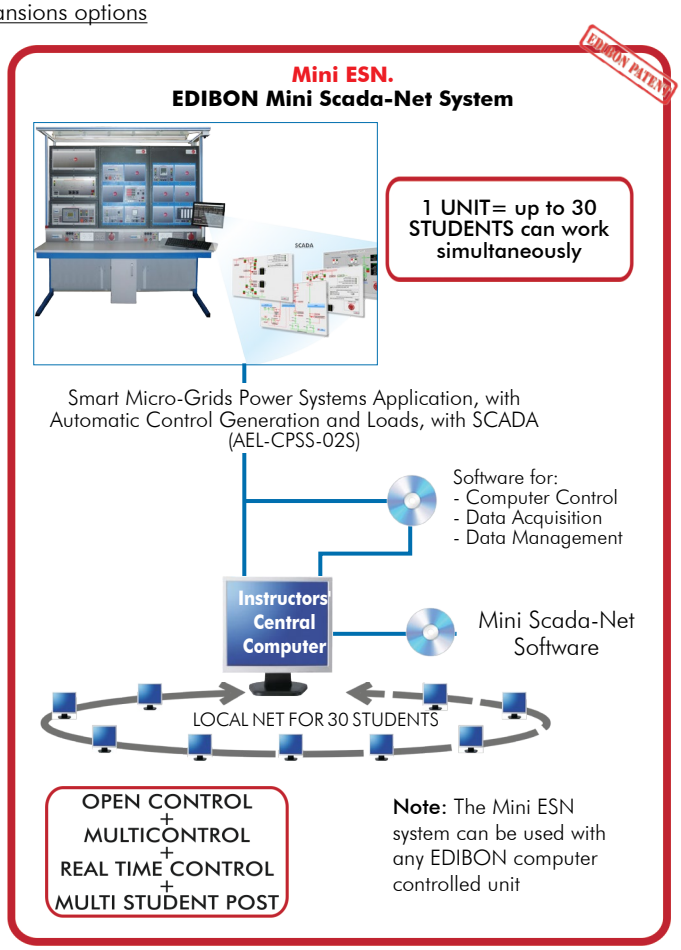
-It allows an easier and quicker understanding.

-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



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-02S. Smart Micro-Grids Power Systems Application, with Automatic Control Generation and Loads, with SCADA.**

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

④ **Manuals**.

*IMPORTANT: Under AEL-CPSS-02S we always supply all the elements for immediate running as 1, 3 and 4.

Optional items (supplied under specific order)

② AEL-CPSS-02S/CCSOF. Computer Control + Data Acquisition + Data Management Software.

a) Technical and Vocational configuration

⑤ AEL-CPSS-02S/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-02S. Unit.

The trainer AEL-CPSS-02S includes the following modules:

- 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 400V connecting plug.
  - Differential magnetothermal, 4 poles, 25A, 300mA AC 6KA.
- N-VVCA5K. Speed control of the 5KW motor.
  - AC 5KW motors control module.
  - Three-phase supply voltage: 400VAC + N.
  - Rated power: 5KW.
  - 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-EALDC/G. DC Generator Analyzer.
  - 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-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-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-01generator 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/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-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-CAR35T3D. Three-phase digital bank of commutable resistors module.
  - Digital bank of commutable resistors module.
  - Three sliding load switches.
  - Three three-phase commutable banks of resistors of 150 ohms.
  - Local/remote control switch.
  - ON-OFF switch.
  - Communications connector SUB-D of 62 pins.
- GMG4.5K3PH. 4.5KW 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.

Required module if the optional SCADA is acquired:

- N-PLC04. PLC04 control module.
  - PLC Siemens S7-300.
  - Communication connector SUB-D of 62 pins.
  - ON-OFF switch.
  - Fuses: 2 x 2 A.

Required PC if optional SCADA is acquired:

- AEL-PC. Touch Screen and Computer.
  - Touch Scree:
    - 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.

The AEL-IOP-01S application trainer includes the following modules:

- N-VVCA5K. Speed control of the 5KW motor
  - AC 5KW motors control module.
  - Three-phase supply voltage: 400VAC + N.
  - Rated power: 5KW.
  - 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-EALDC/G. DC Generator Analyzer.
  - 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-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-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-01generator 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/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-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.

• GMG4.5K3PH. 4.5KW 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.

Required module if the optional SCADA is acquired:

• N-PLC05. PLC05 control module.

PLC Siemens S7-300.

Communication connector SUB-D of 62 pins.

ON-OFF switch.

Fuses: 2 x 2 A.

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

The complete unit includes as well:

EDIBON SCADA System (Supervision, Control and Data Acquisition) always included.

Smart Grid devices.

Micro-Grids.

Advanced Real-Time SCADA.

Open Control + Multicontrol + Real-Time Control.

Specialized EDIBON Control Software based on LabVIEW.

Projector and/or electronic whiteboard compatibility allows the unit to be explained and demonstrated to an entire class at one time.

Capable of doing applied research, real industrial simulation, training courses, etc.

Remote operation and control by the user and remote control for EDIBON technical support, are always included.

Totally safe, utilizing 4 safety systems (Mechanical, Electrical, Electronic & Software).

Designed and manufactured under several quality standards.

Optional ICAI software to create, edit and carry out practical exercises, tests, exams, calculations, etc.
Apart from monitoring user's knowwledge and progress reached.

This unit has been designed for future expansion and integration. A common expansion is the EDIBON Scada-Net (ESN) System which enables multiple students to simultaneously operate many units in a network.

② AEL-CPSS-02S/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 generation power systems in Micro-Grids.

2.- Analysis of the measurements of the power flows of the synchronous generator in the Micro-Grids.

3.- Analysis of the active and reactive power of the generator in the Micro-Grids.

4.- Automatic synchronization maneuvers of synchronous generator with the mains.

5.- Study of the synchronous generator in island operation mode in Micro-Grids.

6.- Study of excitation/voltage regulation of synchronous generator in island mode in Micro-Grids.

7.- Study of turbine regulation (frequency control) in the Micro-Grids.

8.- Study of excitation/voltage regulation of synchronous in Micro-Grids.

9.- Study of the power factor regulation of the synchronous generator in Micro-Grids.

Some practical exercises possibilities with the optional SCADA:

10.- Remotely control of generation power systems in Micro-Grids.

11.- Analysis with the SCADA software of synchronous generator power flows in Micro-Grids.

12.- Analysis with SCADA software of active and reactive power of synchronous generator in Micro-Grids.

13.- Remotely control of synchronous generator in Micro-Grids.

Additional practical exercises possibilities with the Optional Application "AEL-IPO-01S":

14.- Control of multiple generator in a standalone network.

15.- Control of multiple generator in parallel generation mode.

16.- Manual/Automatic frequency control of synchronous generators.

17.- Manual/Automatic voltage control of synchronous generators.

18.- Power factor control generator in island mode.

Other possibilities to be done with this Unit:

19.- Many students view results simultaneously.

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

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

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

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

23.- 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-02S/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

edibon INTERNATIONAL

C/ Del Agua, 14. Polígono Industrial San José de Valderas.
28918 LEGANÉS. (Madrid). SPAIN.
Phone: 34-91-6199363 FAX: 34-91-6198647
E-mail: edibon@edibon.com WEB site: **www.edibon.com**

Edition: ED01/17
Date: February/2017