edibon

Technical Teaching Equipment

Final User Smart Grid - **Net Metering Trainer**

AEL-FUSG-N

AEL-FUSG-N. Final User Smart Grid - **Net Metering Trainer**

GMG4K. 4KW Generator-Group

AEL-FUSG-LO. Smart Grid Loads

Static Loads

Dynamic Loads

Key features:

- **Managing real Smart Grid devices used by prestigious utilities.**
- **Control of a real wind turbine.**
- **Control of Active Power Generation.**
- **Simulation of different wind speeds.**
- **Isolating grid work mode.**
- **Coupling the generation to the grid: Net-Metering.**
- **Autoconsumption.**
- **Simulation of selling electricity to the grid.**
- **Measuring the input and output power flows generated by the wind turbine (generator-motor group).**
- **Network Analyzer Unit with oscilloscope display to perform an advanced Net Metering.**
- **This Trainer may be expanded with:** AEL-FUSG-M. Final User Smart Grid - **Smart Meter Trainer** and/or AEL-FUSG-E. Final User Smart Grid - **Smart Energy Trainer.**

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Products
Products range
Units
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ISO 9000: Quality Management
(for Design, Manufacturing, Commercialization and After-sales service)

European Union Certificate
(total safety)

Certificates ISO 14000 and
ECO-Management and Audit Scheme
(environmental management)

Worlddidac Quality Charter Certificate and
Worlddidac Member

INTRODUCTION

Nowadays, Micro Electrical Grids are very important to achieve the sustainability of the Energy Systems.

Micro Electrical Grids, where each final user can generate its own electricity, are the future.

For this reason, EDIBON has developed the AEL-FUSG-N. Final User Smart Grid - Net Metering Trainer, through which the user can simulate the sale or consumption of the generated energy. Thus, the user will learn different simulations, such as selling electricity to the grid, Net Metering and measuring the input and output power flows generated by the Renewable Energy simulators.

GENERAL DESCRIPTION

The complete system consists of:

a) AEL-FUSG-N. Final User Smart Grid - Net Metering Trainer.

b) Required accessories.

c) Optional accessories.

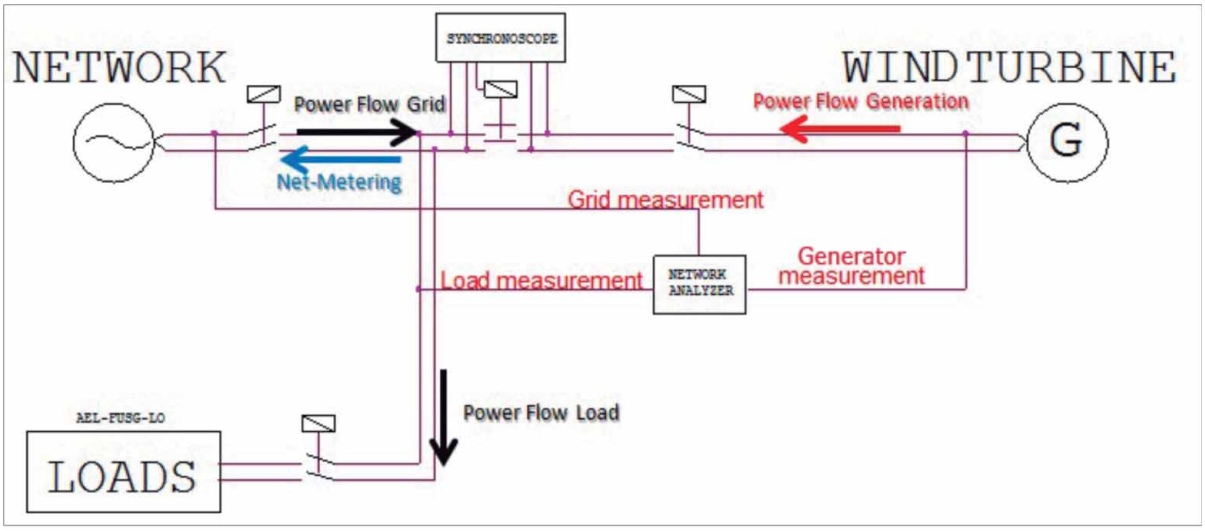
a) AEL-FUSG-N. Final User Smart Grid - Net Metering Trainer.

The AEL-FUSG-N is a trainer that reflects actual operations about Net-Metering, auto-consumption and electricity selling. For that purpose, this trainer has a synchronous generator that simulates a wind turbine.

The wind turbine will be controlled with a voltage regulator and a prime motor (wind speed). With the voltage regulator the user will control the generation voltage. The prime motor will be controlled through a frequency controller, so the user will control the speed of the generator (generation frequency) and the active power generated.

Besides, a synchronoscope is included to synchronize the generator and the grid. This device lets user to study different actual operations: Net-Metering, Auto-consumption, isolated grid mode, parallel operation mode, etc.

Finally, a network analyzer is included to take readings in different important points. This module let us to measure energy demanded by the loads, energy supplied by the grid, energy supplied by the generator and energy injected by the generator in the grid and the loads. All this maneuvers can be done in real time with the main module, the N-PFD (Power Flow Distribution Module).



The AEL-FUSG-N Trainer consists of the following modules:

N-ALI01. Industrial Power Supply.

This module is used to supply others modules and to simulate the grid.

N-PFD. Power Flow Distribution Module.

This module is used to control the power flows that come from the generator and the grid to supply the loads. Besides, this module has an internal PLC to control automatically the measurement point by means of three switches. This module together the network analyzer (N-EALDG) let us to know the electrical parameters in the grid, in the generator and the loads in order to calculate the Net-Metering electrical parameters.

N-EALDG. Network Analyzer Unit with Computer Data Acquisition + Oscilloscope Display.

This module is used to take readings of the power flows of the loads, the grid and the generator. Thus the user will study the measured energy from different points.

This network analyzer includes data acquisition, PC oscilloscope and screen oscilloscope. It can monitor every electrical parameter involved in an electric network.

The user can measure the flow power injected to the grid and the local consumption in order to carry out the Net Metering.

Continue...

N-VREG. Voltage Regulator Module.

This module is used to regulate the current excitation of the electrical generator.

This module has a switch to enable and disable the control of the excitation. Through a potentiometer, the user can regulate the amount of the current excitation and control the generator voltage output.

This module has an ammeter in order to show the current excitation level.

N-ASY. Synchronoscope Module.

This module is used to synchronize the generator with the grid, so the user can inject energy and makes Net-Metering.

This module has a push-button to enable the synchronization and other push-button to disable the synchronization. Besides, the synchronoscope has different push-buttons to display the phase-angle, voltage-angle and frequencies of the grid and the generator.

N-REL46. Thermal Electric Motor Protection Module.

Magneto-thermal protection for the generator.

N-VVCA4K. 4 KW Motor Controller Module.

This module is used to control the motor that moves the electrical generator. With this module we simulate the wind speed that is to say, the active power generated. For this purpose the module has a potentiometer that allows control the speed of the motor in order to simulate different speed conditions.

GMG4K. 4 KW Generator-Group.

This is an unit that simulates a wind turbine in home or industrial installations. To simulate a prime energy, the generator is coupled to an induction motor.

b) Required accessories:

In order to simulate different real consumptions and to carry out all the practical possibilities proposed AEL-FUSG-N trainer requires a set of static and dynamic loads. The following loads must be acquired:

AEL-FUSG-LO. Smart Grid Loads, formed by:

Static Loads:

N-REV. Variable Resistor.

This module is used to limit the torque of the universal motor (EMT12).

N-LAM16. Halogen Lamp.

N-IND. Variable Inductance Load with commutator.

This module is used to simulate a reactive energy consumption.

N-CAR19. Single-Phase Commutable Capacitor Load.

This module is used to simulate a reactive energy compensation.

N-LAM32. LED Lamp.

This module is used to simulate a low consumption light.

N-VVCC/M. DC Motor Speed Controller.

N-REF. Resistor Load with commutator. (4 units)

Dynamic Loads:

EMT12. Universal Motor.

This motor is used to simulate a washing machine together the eddy current brake.

FRECP. Eddy Current Brake.

This brake is used to reduce the EMT12 speed and to increase the energy consumed by him.

EH. Electric Heating Module.

This module is used to simulate a conventional electric heating.

c) Optional accessories:

For AEL-FUSG-N. Final User Smart Grid-Net Metering Trainer:

It can be included a set of modules to simulate different renewable energy power generation:

PPINV. Photovoltaic Panel with Inverter.

SWTI. Small Wind Turbine with Inverter.

For AEL-FUSG-LO. Smart Grid Loads:

AEL-APFC. Single-phase Automatic Power Factor Compensation.

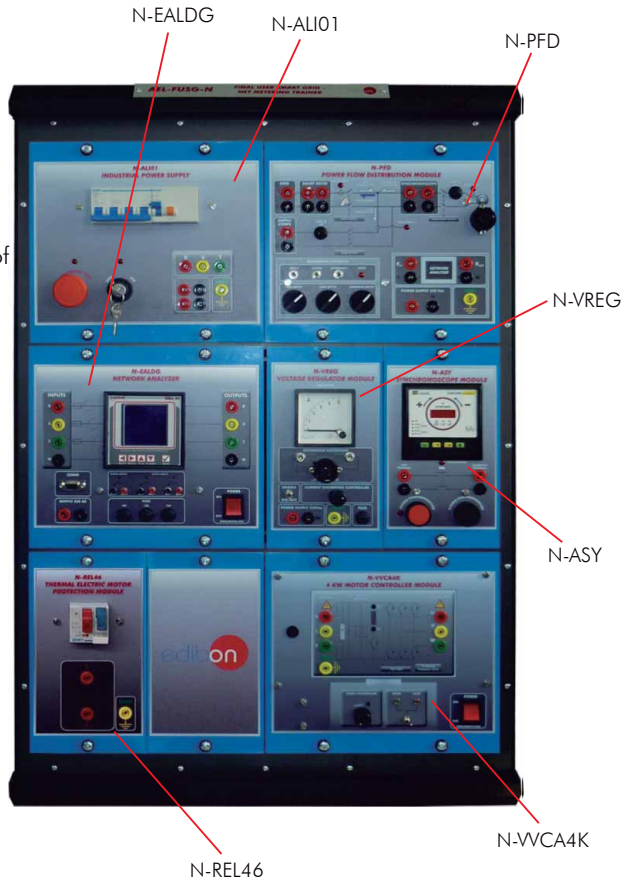
SPECIFICATIONS

The complete system consists of:
a) AEL-FUSG-N. Final User Smart Grid - Net Metering Trainer.
b) Required accessories.
c) Optional accessories.

a) **AEL-FUSG-N. Final User Smart Grid - Net Metering Trainer**, consist of the following modules:

N-ALI01. Industrial Power Supply.

This module is used to supply others modules.
Three-phase differential protection.
Three-phase output: 380 Vac.
Single-phase output: 230 Vac.
Safety key.
Emergency stop button.
Required power supply: three-phase 380 Vac.



N-PFD. Power Flow Distribution Module.

This module is used to control the power flows that come from the generator and the grid to supply the loads. Besides, this module has an internal PLC to control automatically the measurement point by means of three switches. This module together the network analyzer (N-EALDG) let us to know the electrical parameters in the grid, in the generator and the loads in order to calculate the Net-Metering.

N-EALDG. Network Analyzer Unit with Computer Data Acquisition + Oscilloscope Display.

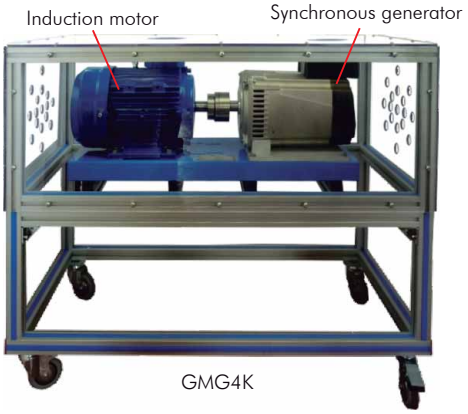
This module is used to take readings of the power flows of the loads, the grid and the generator.
With this unit the user can measure the following parameters:
+KWh, -KWh, +KVar, -KVar, +KVa, -KVa, +P, -P, +Q, -Q.
Besides this module can show currents and voltages waves.
This module includes data acquisition PC oscilloscope and screen oscilloscope. It can monitor every electrical parameter involved in an electrical network.

N-VREG. Voltage Regulator Module.

This module is used to regulate the current excitation of the electrical generator.
This module has a switch to enable and disable the control of the excitation. Through a potentiometer, the user can regulate the amount of the current excitation.
This module has an ammeter in order to show the current excitation level.

N-ASY. Synchronoscope Module.

This module is used to synchronize the generator with the grid, so the user can inject energy and makes Net-Metering.
This module has a push-button to enable the synchronization and other push-button to disable the synchronization.
Besides it has a display that shows the following parameters:
Grid frequency.
Generator frequency.
Grid Voltage.
Generator output voltage.
Grid and Generator phase angle degrees.



N-REL46. Thermal Electric Motor Protection Module.

Magneto-thermal protection for the generator, with a current range from 6 to 10 Amperes, with trip type 10. It provides protection against overcurrent and short-circuits.

N-VVCA4K. 4 KW Motor Controller Module.

This module is used to control the motor that moves the electrical generator. With this module we simulate the wind speed. For this purpose the module has a potentiometer that allows control the speed of the motor, that is to say, the wind speed. Thus, the user can increase or decrease the generated active power.
Required power supply: 230 Vac.
Enable control switch.
Control speed potentiometer.
Nominal power: 4KW.
PWM Three-phase output.

GMG4K. 4 KW Generator-Group.

This is an unit that simulates a wind turbine in home or industrial installations.
The generator has a nominal power of 3.5KVa and it is moved by mean of induction motor to simulate the wind speed.
It includes:
Induction motor: 4 KW.
Synchronous generator: 3.5 KVa.
When the electrical generator is synchronized with the grid, the potentiometer of the N-VVCA4K let us increase or decrease the active power generation.

Cables and Accessories, for normal operation.
Manuals.

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b) Required accessories:

In order to simulate different real consumptions and to carry out all the practical possibilities proposed AEL-FUSG-N Trainer requires a set of static and dynamic loads that represent different consumption generally used at home, industries and other places.

The following loads must be acquired:

AEL-FUSG-LO. **Smart Grid Loads:**

It is formed by:

N-REV. Variable Resistor.
- Nominal current: 2 A.
- Nominal power: 500 W.

N-LAM16. Halogen Lamp.
- Input voltage: 2 terminals of 230 Vac.
- Power: 60W.

N-IND. Variable Inductance Load with commutator.
- Nominal current: 2 A.
- Inductance: 33 mH; 78 mH; 140 mH; 236 mH.
- Commutator.

N-CAR19. Single-Phase Commutable Capacitor Load.
- Nominal voltage: 230 Vac.
- Capacitance: 7 µF; 14 µF; 21 µF; 28 µF; 35 µF.
- Commutator.

N-LAM32. LED Lamp.
- Nominal voltage: 230 Vac.

N-VVCC/M. DC Motor Speed Controller.
- Adjustable voltage: up to 320 Vdc.
- Maximum current: 2 A.

N-REF. Resistor Load with commutator. (4 units)
- Nominal current: 2 A.
- Nominal power: 500 W.

EMT12. Universal Motor.
- Power: 230 W.
- Speed: 5000/9000 r.p.m.
- Frequency: 50Hz/60Hz.
- V.Armature.: 230 V.

FRECP. Eddy Current Brake.

FRECP is an unit designed to work as a magnetic brake by means of the induction of Foucault's parasitic currents.

The FRECP is similar to an electrical motor, since it has a stator winding, the inductor, that we will feed with a DC voltage. We will change the braking torque by means of this direct voltage.

The breaking torque is proportional to the current injected.
- Nominal current: 1.67 A.
- Maximum current: 1.8 A.
- Maximum braking torque: 1.4 Nm.
- Bench - support.
- DC power supply.

EMT12 + FRECP

EH. Electric Heating Module.
- This module can be used for different purposes.
- Load purpose: this module is used like a resistive load of 700 W.

EH

IMPORTANT!: These loads can be used simultaneously with AEL-FUSG-M. Final User Smart Grid - Smart Meter Trainer, AEL-FUSG-E. Final User Smart Grid - Smart Energy Trainer and AEL-FUSG-N. Final User Smart Grid - Net Metering Trainer.

c) Optional accessories:

For AEL-FUSG-N. Final User Smart Grid-Net Metering Trainer:

It can be included a set of modules to simulate different renewable energy power generation:

PPINV. Photovoltaic Panel with Inverter.
- For simulating photovoltaic energy production.

SWTI. Small Wind Turbine with Inverter.
- For simulating wind energy production.

For AEL-FUSG-LO. Smart Grid Loads:

AEL-APFC. Single-phase Automatic Power Factor Compensation.

SOME SOFTWARES SCREENS

N-EALDG software screen. Measures indicators panel.

EXERCISES AND PRACTICAL POSSIBILITIES

1.- Synchronization operations of the generator.

2.- Real time monitoring of local consumptions with induction, resistor or capacitive loads.

3.- Simulation of renewable energy generation through Generator-Motor Group.

4.- Measurement of the energy generated by the Generator-Motor Group.

5.- Net Metering. Measuring the energy consumed and the energy injected to the grid and, finally, measuring the positive or negative energy balance.

6.- Measuring of the energy consumption by the loads without generator.

7.- Measuring the energy consumption by the loads with the generator and the grid controlling the power flows from the generator.

8.- Net-Metering operations: selling energy to the grid.

Additional practical possibilities:

If the user acquires the AEL-FUSG-M. Final User Smart Grid - Smart Meter Trainer and AEL-FUSG-E. Final User Smart Grid - Smart Energy Trainer, then he can perform, among many others, the following practical exercises:

9.- Measurement of energy consumption at home or by an industrial consumer and comparison of this measurement with the utility´s register (smart meter).

10.-Remote scheduling of Smart devices (Smart plug, Smart relays, thermostat, different sensors, etc.) according to the tariff proposed by the utilities.

11.-Development of switching schemes through the management platform for appliances connected to the smart plugs, smart relays or the thermostat.

12.-Scheduling the energy consumption for optimal periods of sunlight.

REQUIRED SERVICES

- Electrical supply: single phase, 220 V./50 Hz. or 110 V./60 Hz.
- Computer (PC).
- AEL-FUSG-LO. Smart Grid Loads.

DIMENSIONS & WEIGHTS

AEL-FUSG-N. Final User Smart Grid - Net Metering Trainer:

Modules in Rack:	-Dimensions: 640 x 320 x 920 mm. approx. (25.19 x 12.59 x 36.22 inches approx.)
	-Weight: 35 Kg. approx. (77 pounds approx.)
GMG4K:	-Dimensions: 1180 x 700 x 740 mm. approx. (46.45 x 27.55 x 29.13 inches approx.)
	-Weight: 80 Kg. approx. (176.3 pounds approx.)

Required accessory:

AEL-FUSG-LO. Smart Grid Loads:

Static Loads in Rack:	-Dimensions: 640 x 320 x 920 mm. approx. (25.19 x 12.59 x 36.22 inches approx.)
	-Weight: 30 Kg. approx. (66 pounds approx.)
EMT12:	-Dimensions: 285 x 250 x 260 mm. approx. (11.22 x 9.84 x 10.24 inches approx.)
	-Weight: 8 Kg. approx. (17.6 pounds approx.)
FRECP:	-Dimensions: 285 x 250 x 270 mm. approx. (11.22 x 9.84 x 10.63 inches approx.)
	-Weight: 8.25 Kg. approx. (18.2 pounds approx.)
EH:	-Dimensions: 450 x 340 x 300 mm. approx. (17.71 x 13.38 x 11.81 inches approx.)
	-Weight: 4 Kg. approx. (8.81 pounds approx.)

ADDITIONAL TRAINERS

- AEL-FUSG-M. Final User Smart Grid - Smart Meter Trainer.

  To study a real Smart Meter used by Utilities.

- AEL-FUSG-E. Final User Smart Grid - Smart Energy Trainer.

  The user can improve its knowledge about the influence of the load demand through home energy devices.

  Managing a real Home Energy Management System.

  Developing different automation programs to get an efficient consumption.

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

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REPRESENTATIVE: