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INTRODUCTION

An alternator is such a machine which converts mechanical energy from a prime mover to AC electric power at specific voltage and current. It is also known as synchronous generator. Synchronous generators can be classified according to their design: Salient pole and Smooth cylindrical.

Salient pole synchronous generator is used as low and medium speed alternator. It has a large number of projecting poles having their cores bolted or dovetailed onto a heavy magnetic wheel of cast iron or steel of good magnetic quality. Such generators are characterized by their large diameters and short axial lengths.

Smooth cylindrical synchronous generator is used for steam turbine driven alternator. The rotor of this generator rotates in very high speed. The rotor consists of a smooth solid forged steel cylinder having a number of slots milled out at intervals along the outer periphery for accommodation of field coils. These rotors are designed mostly for 2 pole or 4 pole turbo generator running at 36000 rpm or 1800 rpm respectively.



ISO 9001: Quality Management (for Design, Manufacturing, Commercialization and After-sales service)



European Union Certificate (total safety)



Certificates ISO 14001 and ECO-Management and Audit Scheme (environmental management)



"Worlddidac Quality Charter" and Platinum Member of Worlddidac

GENERAL DESCRIPTION

The Alternator Study Application, "AEL-EEA", has been designed by Edibon to study the behavior of three-phase synchronous generators with independent excitation.

This application consists of a motor-generator group and a series of modules that allow studying the most important concepts of three-phase synchronous generators with independent excitation. The driver is an induction motor which is used to simulate a turbine.

This application allows the student acquire a depth knowledge about synchronous generators with independent excitation. The user will learn to connect this kind of machines and commissioning the rest of components. For this purpose, the application includes excitation and frequency controllers. The behavior of the machine changes when the load varies, so all types of static loads are included and the user will be able to see the electrical effects thanks to the included network analyzer module. This module shows the most important electric parameters. Other important operation that can be carried out in this application is the power factor compensation. This practical exercise is carried out with the capacitors that are included in the AEL-EEA.

Optionally, this application can be supplied with the Control and Data Acquisition System Software for Electrical Machines, with SCADA, "EM-SCADA", a Data Control and Acquisition Software developed by Edibon that allows monitoring all voltage, current and torque waves shape. This allows studying the behavior of the three-phase induction generator.

The AEL-EEA application includes the following elements:

- N-ALI02. Domestic Main Power Supply.
- N-WCA/M. AC Motor Speed Controller (Intermediate option).
- EMT7. Asynchronous Three-Phase Motor of Squirrel Cage.
- EMT6. A.C. Synchronous three-phase motor alternator
- N-VREG. Voltage Regulator.
- N-REFT300. 300 Ohms Three-phase Fixed Resistor Module.
- N-INDT. Three-phase Commutable Inductive Load.
- N-CONT. Three- phase Commutable Capacitive Load.
- N-MED60. Network Analyzer.
- MED65. Digital Multimeter.

Recommended SCADA software:

- EM-SCADA. Control and Data Acquisition System Software for Electrical Machines, with SCADA.

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

Option A:

This application needs the following racks:

- N-RACK-A.

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

Option B:

This application can be mounted on rail.

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

SPECIFICATIONS

The AEL-EEA application includes the following elements:

- **N-ALI02. Domestic Main Power Supply.**

Supply voltage (Single-Phase): 230 VAC, PH+N+G.
 ON-OFF removable key.
 Output Voltage Connections:
 Two Single-Phase: 230 VAC.
 Single-Phase supply hose connecting plug.
 Differential magnetothermal, 2 poles, 25A, 30mA AC 6KA.



N-ALI02

- **N-WCA/M. AC Motor Speed Controller (Intermediate option).**

Supply voltage: 230 VAC.
 Nominal power: 0,4 kW.
 PWM output voltage connections:
 Three-Phases: 230 VAC
 10K, potentiometer for the induction motor control speed.
 Setting and visualization display of the machine parameters.



N-WCA/M

- **EMT7. Asynchronous Three-Phase Motor of Squirrel Cage.**

Nominal power: 370 W.
 Nominal voltage: 3x 230/400 VAC Δ/Y .
 Frequency: 50/60 Hz.
 Number of poles: 2.
 RPM: 2730 rpm.
 Nominal current: 1,67/ 0,97 A.



EMT7

- **EMT6. Synchronous Three-Phase Motor Alternator.**

Nominal power: 200 W.
 Nominal voltage: 3x 400/230VAC Y/ Δ .
 Frequency: 50/60 Hz.
 Number of poles: 2.
 RPM: 3000 rpm.
 Nominal current: 1 A.
 Nominal excitation current: 0,7 A.



EMT6

- **N-VREG. Voltage Regulator.**

Supply voltage (Single-Phase): 230 VAC PH+N+G.
 Output terminals:
 Terminal to be connected to the generator excitation.
 Analog ammeter 0-10 A.
 Switch to enable the excitation.
 Fuse: 5 A.



N-VREG

- **N-REFT300. 300 Ohms Three-phase Fixed Resistor Module.**

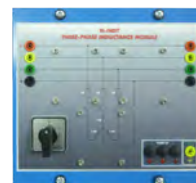
Nominal voltage: 400 VAC.
 Resistor value: 3x300 Ohms.
 Nominal power: 3x200 W.
 Manual commutator to switch on/off the resistors.
 Fuses: 3x5 A.
 Terminals:
 Three input terminals (3PH).
 Three output terminals (3PH).
 Ground terminal.



N-REFT300

• N-INDT. **Three-phase Commutable Inductive Load.**

- Nominal voltage: 400 VAC.
- Inductance value: 1,4 H.
- Nominal current: 1,6 A.
- Manual commutator to switch on/off the inductances.
- Fuses: 3x2 A.
- Terminals:
 - Four inputs terminals (3PH+N).
 - Four outputs terminals (3PH+N).
 - Ground terminal.



N-INDT

• N-CONT. **Three- phase Commutable Capacitive Load.**

- Capacitor value: 3x7 uF.
- Nominal Voltage: 400 VAC.
- Manual commutator to switch on/off the capacitors.
- Fuses: 3x4 A.
- Terminals:
 - Four inputs terminals (3PH+N).
 - Four outputs terminals (3PH+N).
 - Ground terminal.



N-CONT

• N-MED60. **Network Analyzer.**

- Supply voltage: 230 VAC, PH+N.
- ON-OFF power supply switch.
- Fuses: 3x10 A.
- Input terminals:
 - Four input terminals (3PH+N).
- Output terminals:
 - Four output terminals (3PH+N).
- Ground terminal.
- Network Analyzer Display. It shows:
 - Active, reactive and apparent power.
 - Active, reactive and apparent energies.
 - Lines and phase currents.
 - Line and phase voltages.
 - Power Factor.
 - Line frequency.



N-MED60

• MED65. **Digital Multimeter.**

- This module has a digital multimeter of about 3 ½ digits, with double-jack ending cables of about 4 mm to facilitate interconnections.
- With this digital multimeter we will be able to measure:
 - Voltage.
 - Current.
 - Resistance.
 - Capacitors capacity.
 - Temperature.



MED65

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

Cables and Accessories, for normal operation.

Manuals:

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

EXERCISES AND PRACTICAL POSSIBILITIES

- 1.- Checking the main power supply.
 - 2.- Commissioning of the Frequency Controller.
 - 3.- Adjusting the necessary values in the frequency controller.
 - 4.- Adjusting the rotation direction.
 - 5.- Adjusting the start function.
 - 6.- Adjusting the frequency commutation, nominal voltage, nominal current, nominal frequency, etc.
 - 7.- Study the operational performance in the frequency controller.
 - 8.- Measuring power and RMS.
 - 9.- Realize different experiments with the generator and the loads.
 - 10.- U/f function optimization.
 - 11.- Field current regulation and open circuit voltage.
 - 12.- Generator drop voltage with resistive load.
 - 13.- Generator drop voltage with inductive load.
 - 14.- Generator get output voltage constant.
 - 15.- Generator power factor compensation.
- Some practical exercises possibilities with the EM-SCADA:
- 16.- Visualization of synchronous generator waves.
- 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

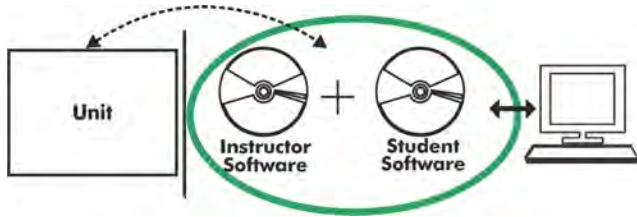
AEL-EEA:

- Dimensions: 1380 x 840 x 2010 mm approx.
(54.33 x 33.07 x 79.13 inches approx.).
- Weight: 75 Kg approx.
(165 pounds approx.).

RECOMMENDED SOFTWARE

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

AEL-EEA/ICAI. Interactive Computer Aided Instruction Software System:



With no physical connection between unit and computer, 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.

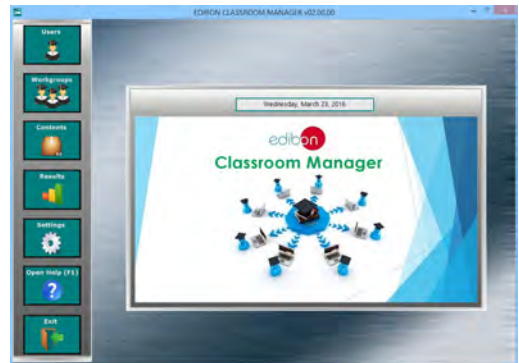
Instructor Software

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

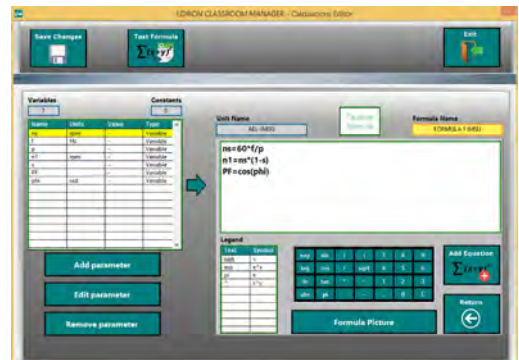
ECM-SOF is the application that allows the Instructor to register students, manage and assign tasks for workgroups, create own content to carry out Practical Exercises, choose one of the evaluation methods to check the Student knowledge and monitor the progression related to the planned tasks for individual students, workgroups, units, etc... so the teacher can know in real time the level of understanding of any student in the classroom.

Innovative features:

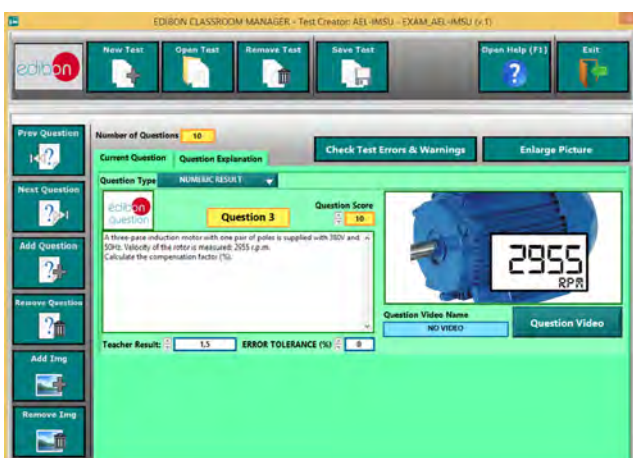
- User Data Base Management.
- Administration and assignment of Workgroup, Task and Training sessions.
- Creation and Integration of Practical Exercises and Multimedia Resources.
- Custom Design of Evaluation Methods.
- Creation and assignment of Formulas & Equations.
- Equation System Solver Engine.
- Updatable Contents.
- Report generation, User Progression Monitoring and Statistics.



ECM-SOF. EDIBON Classroom Manager (Instructor Software) Application Main Screen



ECAL. EDIBON Calculations Program Package - Formula Editor Screen



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



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

