



① Unit: AEL-EECFP. Advanced Power Factor Compensation Application

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**

POWERED BY  
NATIONAL INSTRUMENTS  
**LabVIEW™**

**www.edibon.com**  
↳ PRODUCTS  
↳ 4.- 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)



"Worlddidac Quality Charter" and Platinum Member of Worlddidac

## GENERAL DESCRIPTION

Industrial customers use three-phase power consumption with different power factors. If their power factor drops below a prescribed value, power losses in transmission lines increase. For this reason, the customers have to pay a penalty. In order to avoid these troubles, industrial customer installs power factor correction capacitors.

The AEL-EECFP Advanced Power Factor Compensation Application has been developed as a complement to AEL-MRPC in order to study in depth the power factor compensation when there is a dynamic load.

The three-phase induction motor is the most used motor in the industry. For this reason, a group servomotor and induction motor is included in this application. With this group, the user can cause different motor load conditions modifying the power factor.

Power factor compensation (when the induction motor is working) is necessary to avoid excess reactive energy. For this purpose the user can realize it manually through the three-phase capacitors module or automatically with advanced power factor controller module together three-phase digital capacitor banks module. The first module measures the voltage and current values of the grid and calculates the power factor. Such module enables the connection of six stages of capacitors, which enable the regulation of the power factor according to the desired value.

Required Basic equipment:

- AEL-MRPC. Manual Reactive Power Compensation Application.

The AEL-EECFP includes the following modules:

- EMT7B/1K. Three-phase Asynchronous Motor of Squirrel Cage.
- N-SERV1K. 1 kW Servomotor Module.
- N-ARR01. Manual Star-Delta Starter.
- N-TRANS03. Three-Phase Autotransformer 400/230 VAC, 1 kVA, Module.
- N-CFP. Advanced power factor controller module.
- N-MPS. Motor Protection.
- N-CAR19T4D. Three-phase digital capacitor banks module.

Optional SCADA software:

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

Optional learning software:

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

- ECM-SOF. EDIBON Classroom Manager (Instructor Software).
- ESL-SOF. EDIBON Student Labsoft (Student Software).

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

Option A:

This application needs the following racks:

- N-RACK-B. (3 units)

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

Option B:

This application can be mounted on rail.

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

Optionally this unit is supplied with the EDIBON Computer Control System (SCADA), and includes: The unit itself + Computer Control, Data Acquisition and Data Management Software Packages, for controlling the process and all parameters involved in the process.

With this unit there are several options and possibilities:

- Main items: 1, 3 and 4.
- Optional items: 2, 5, 6 and 7.

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

① **AEL-ECCFP Unit.**

Required basic equipment of AEL-MRPC:

- **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-ALI01

- **N-REVT/1K. 1kW Three-Phase Variable Resistors Module.**

Parallel, series, star and delta connection.

Resistance: 3 x 750 Ohm.

Current: 3 x 2 A.



N-REVT/1K

- **N-CONT/1K. 1kVA Three-Phase Capacitors Module.**

Nominal Voltage: 400 VAC.

For parallel, series, star and delta circuits.

Capacity: 3 x 5/10/20/30 μF.



N-CONT/1K

- **N-INDT/1K. 1kVA Three-Phase inductances module.**

Parallel, series, star and delta connections.

Nominal Voltage: 400 VAC.

Inductances: 1,2H; 1,6H; 2H; 2,4H; 2,8H; 3,2H.

Currents: 0,65A; 0,5A; 0,45A; 0,35A; 0,30A; 0,25A.



N-INDT/1K

- **N-EALD. Network Analyzer Unit with 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-PSM. Power Switch Module.**

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-PSM

- **N-CON02. 3-poles Contactor (220 Vac.).**

Supply Voltage Coil: 240 VAC.

Power terminals:

3 input power terminals.

3 output power terminals.

Auxiliary contacts:

3 normally open contacts (black).

3 normally closed contacts (red).



N-CON02

- **N-RELO9. Time Electronic Relay against Overcurrents (1.2 - 7 A).**

Electronic thermal relay.  
Overload protection.  
Range 1.2 - 7 A.  
Reset and test function.  
1 NONC contact.  
Temporization.



N-RELO9

The trainer AEL-EECFP includes the following modules:

- **EMT7B/1K. Three-phase Asynchronous Motor of Squirrel Cage.**

Nominal power: 1KW.  
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).



EMT7/1K

- **N-SERV1K. 1 kW Servomotor Module.**

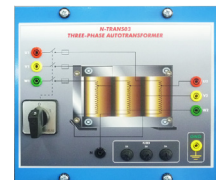
Dynamic and static four-quadrant operation.  
Speed and torque displays.  
Four-quadrant monitor.  
Thermal monitoring of the machine under test.  
Testing for the presence of a shaft cover.  
Connection voltage: 400V.  
Frequency: 50Hz.  
Maximum power output: 10kVA.  
Maximum speed: 4000rpm.  
Maximum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



N-SERV1K

- **N-TRANS03. Three-Phase Autotransformer 400/230 VAC, 1 kVA, Module.**

Three-phase autotransformer.  
Nominal supply voltage: 400 VAC (3PH).  
Nominal output voltage: 3 x 230 VAC (3PH+N).  
Nominal power: 1 kVA.  
Free configuration (delta, star and zig-zag).  
Start/stop commutator for instantaneous connection/disconnection of the grid transformer.  
Fuses: 3x5 A.



N-TRANS03

- **N-ARR01. Manual Star-Delta Starter.**

Nominal voltage: 400 VAC.  
Maximum contacts current: 10A  
Star-Delta three positions commutator:  
0: Open circuit.  
Y: Star connection.  
Δ: Delta connection.



N-ARR01

- **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 3x7μF.  
Voltage supply of 400 Vac.  
Step signal input jack.  
Micro connector of 8 pins.



N-CAR194D

- **N-MPS. Motor Protection Module.**  
ON/OFF commutator.  
Limit thermal current:  
From 1,6A to 2,5A.  
Input Power Terminals:  
Power input connections: L1, L2, L3.  
Output Power Terminals:  
Power output connections: L1, L2, L3  
Ground Terminal.



N-MPS

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



AEL-EECFP/CCSOF

## EXERCISES AND PRACTICAL POSSIBILITIES TO BE DONE WITH THE MAIN ITEMS

Some practical exercises possibilities of basic equipment (AEL-MRPC):

- 1.- Wiring star and delta connection with resistive, capacitive and inductive load.
- 2.- Calculating of necessary capacitive load in order to carry out the adequate power factor correction.
- 3.- Studying different classes of reactive compensation methods: general compensation, local compensation, etc.
- 4.- Measurement of active power consumed by a receiver (resistive circuit).
- 5.- Measurement of the inductance of a coil.
- 6.- Measurement of the reactance XL considering RL.
- 7.- Measurement of reactive power consumed by a receiver (inductive circuit).
- 8.- Measurement of reactive power consumed by a receiver (capacitive circuit).
- 9.- Measurement of apparent power consumed by a receiver.
- 10.- Measurement of power factor of a receiver.
- 11.- Measurement of active energy consumed by a receiver.
- 12.- Measurement of reactive energy consumed by a receiver.
- 13.- Compensation of reactive energy (improvement of the power factor).
- 14.- Comparison of the active energy consumed after the compensation.
- 15.- Comparison of the reactive energy consumed after the compensation.
- 16.- Measurement of power factor after the compensation.
- 17.- Determination of the first and second power maxima.
- 18.- Determination of the power maximum in the event of an asymmetric load.

Some practical exercises possibilities with the specific modules of AEL-EECFP:

- 19.- Measuring the maximum and minimum reactive power levels of the grid.
- 20.- Studying the manual reactive power compensation for dynamic loads: induction motor coupled to servomotor.
- 21.- Measuring the reactive power consumed by a capacitive receptor.
- 22.- Comparison of the reactive energy before and after of manual power factor compensation.
- 23.- Optimum configuration of the reactive power controller.
- 24.- Checking the compensation control unit applying different reactive power levels.

- 25.- Automatic compensation of reactive energy (improvement of the power factor).
- 26.- Comparison of the active energy consumed after the automatic compensation.
- 27.- Comparison of the reactive energy consumed after the automatic compensation.
- 28.- Measurement of power factor after the automatic compensation.
- 29.- Results comparison between manual and automatic compensation.

Some Practical exercises possibilities with SCADA:

- 30.- Recording of load profiles.
- 31.- Real Time electrical parameters visualization.
- 32.- Remote active power display.
- 33.- Remote reactive power display.
- 34.- Monitoring of energy waves and data logging.

Other possibilities to be done with this Unit:

- 35.- Many students view results simultaneously.  
To view all results in real time in the classroom by means of a projector or an electronic whiteboard.
  - 36.- The Computer Control System with SCADA allows a real industrial simulation.
  - 37.- This unit is totally safe as uses mechanical, electrical and electronic, and software safety devices.
  - 38.- This unit can be used for doing applied research.
  - 39.- 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.

## DIMENSIONS AND WEIGHTS

AEL-EECFP:

- Dimensions: 1380 x 840 x 2010 mm approx.  
(54.33 x 33.07 x 79.13 inches approx.).
- Weight: 80 Kg approx.  
(176 pounds approx.).

## AVAILABLE VERSIONS

- AEL-EECFP. Advanced Power Factor Compensation Application.  
*Offered in this catalogue:*
- AEL-MRPC. Manual Reactive Power Compensation Application.  
*Offered in other catalogue:*
- AEL-ARPC. Automatic Reactive Power Compensation Application..

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-ECCFP/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.

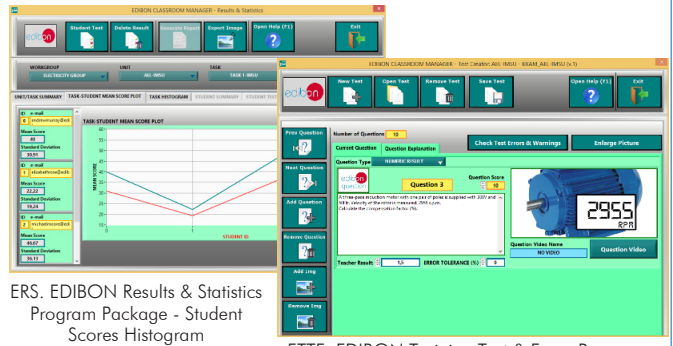
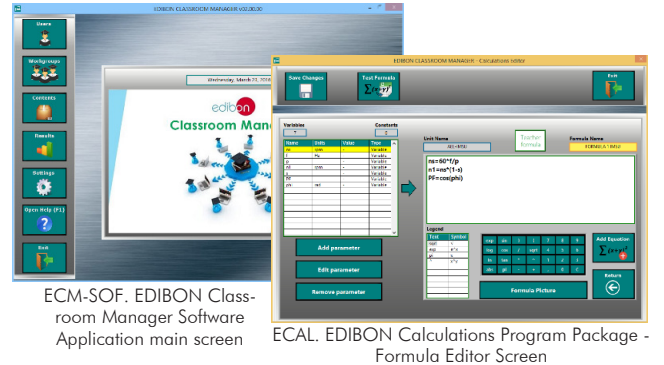
Innovative features:

- 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.**

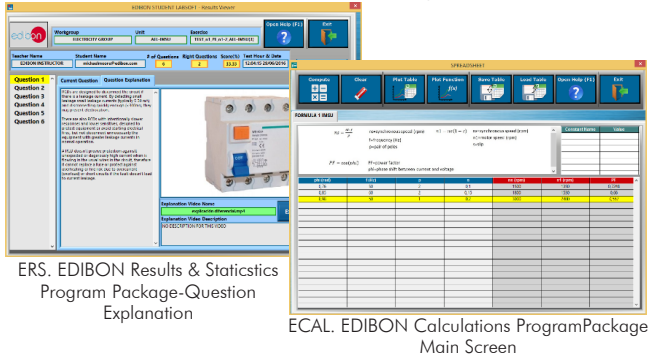
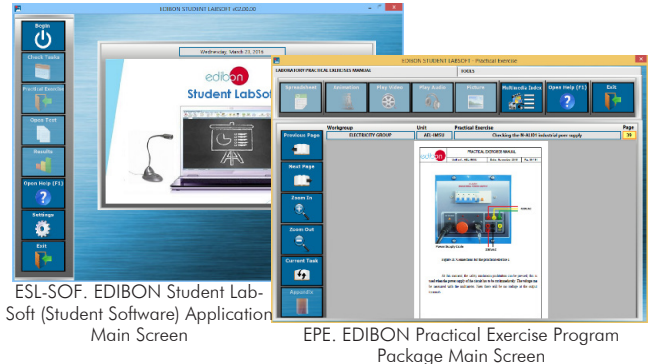
For more information see ICAI catalogue. Click on the following link:

[www.edibon.com/en/files/expansion/ICAI/catalog](http://www.edibon.com/en/files/expansion/ICAI/catalog)

Instructor Software



Student Software



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:

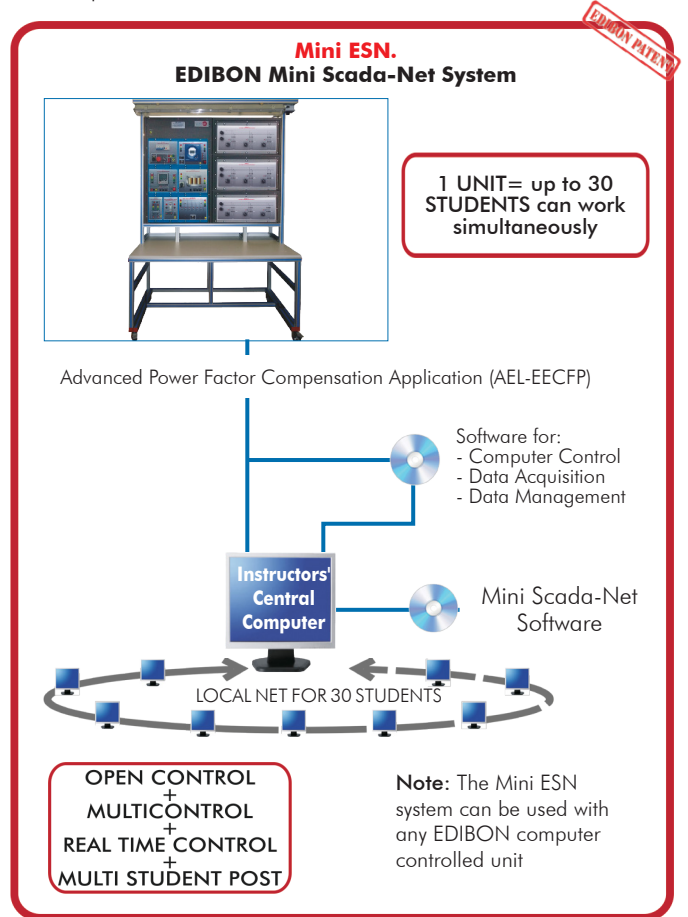
- It allows an easier and quicker understanding.
- This system allows you can save time and cost.
- Future expansions with more EDIBON Units.

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

[www.edibon.com/products/catalogues/en/Mini-ESN.pdf](http://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 **AEL-EECFP. Advanced Power Factor Compensation Application.**
- ③ **Cables and Accessories**, for normal operation.
- ④ **Manuals.**

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

### **Optional items** (supplied under specific order)

- ② AEL-EECFP/CCSOF. Computer Control + Data Acquisition + Data Management Software.
  - a) Technical and Vocational configuration
- ⑤ AEL-EECFP/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.

**①AEL-EECFP Unit.**

Required basic equipment of AEL-MRPC:

- 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-REVT/1K. 1kW Three-Phase Variable Resistors Module.  
Parallel, series, star and delta connection.  
Resistance: 3 x 750 Ohm.  
Current: 3 x 2 A.
- N-CONT/1K. 1kVA Three-Phase Capacitors Module.  
Nominal Voltage: 400 VAC.  
For parallel, series, star and delta circuits.  
Capacity: 3 x 5/10/20/30  $\mu$ F.
- N-INDT/1K. 1kVA Three-Phase inductances module.  
Parallel, series, star and delta connections.  
Nominal Voltage: 400 VAC.  
Inductances: 1,2H; 1,6H; 2H; 2,4H; 2,8H; 3,2H.  
Currents: 0,65A; 0,5A; 0,45A; 0,35A; 0,30A; 0,25A.
- N-EALD. Network Analyzer Unit with 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-PSM. Power Switch Module.  
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-CON02. 3-poles Contactor (220 Vac.).  
Supply Voltage Coil: 240 VAC.  
Power terminals:  
3 input power terminals.  
3 output power terminals.  
Auxiliary contacts:  
3 normally open contacts (black).  
3 normally closed contacts (red).
- N-RELO9. Time Electronic Relay against Overcurrents (1.2 - 7 A).  
Electronic thermal relay.  
Overload protection.  
Range 1.2 - 7 A.  
Reset and test function.  
1 NONC contact.  
Temporization.

The trainer AEL-EECFP includes the following modules:

- EMT7B/1K. Three-phase Asynchronous Motor of Squirrel Cage.  
Nominal power: 1KW.  
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-SERV1K. 1 kW Servomotor Module.  
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: 400V.  
Frequency: 50Hz.  
Maximum power output: 10kVA.  
Maximum speed: 4000rpm.  
Maximum torque 30Nm.  
Temperature monitoring.
- N-TRANS03. Three-Phase Autotransformer 400/230 VAC, 1 kVA, Module.  
Three-phase autotransformer.  
Nominal supply voltage: 400 VAC (3PH).  
Nominal output voltage: 3 x 230 VAC (3PH+N).  
Nominal power: 1 kVA.  
Free configuration (delta, star and zig-zag).  
Start/stop commutator for instantaneous connection/disconnection of the grid transformer.  
Fuses: 3x5 A.
- N-ARR01. Manual Star-Delta Starter.  
Nominal voltage: 400 VAC.  
Maximum contacts current: 10A  
Star-Delta three positions commutator:  
0: Open circuit.  
Y: Star connection.  
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- 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.
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Digital capacitors bank module.  
6 stages of 3x7μF.  
Voltage supply of 400 Vac.  
Step signal input jack.  
Micro connector of 8 pins.
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ON/OFF commutator.  
Limit thermal current:  
From 1,6A to 2,5A.  
Input Power Terminals:  
Power input connections: L1, L2, L3.  
Output Power Terminals:  
Power output connections: L1, L2, L3  
Ground Terminal.
- All necessary cables to realize the practical exercises are included.  
The complete unit includes as well:  
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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

Some practical exercises possibilities of basic equipment (AEL-MRPC):

- 1.-Wiring star and delta connection with resistive, capacitive and inductive load.
- 2.-Calculating of necessary capacitive load in order to carry out the adequate power factor correction.
- 3.-Studying different classes of reactive compensation methods: general compensation, local compensation, etc.
- 4.-Measurement of active power consumed by a receiver (resistive circuit).
- 5.-Measurement of the inductance of a coil.
- 6.-Measurement of the reactance  $X_L$  considering  $R_L$ .
- 7.-Measurement of reactive power consumed by a receiver (inductive circuit).
- 8.-Measurement of reactive power consumed by a receiver (capacitive circuit).
- 9.-Measurement of apparent power consumed by a receiver.
- 10.-Measurement of power factor of a receiver.
- 11.-Measurement of active energy consumed by a receiver.
- 12.-Measurement of reactive energy consumed by a receiver.
- 13.-Compensation of reactive energy (improvement of the power factor).
- 14.-Comparison of the active energy consumed after the compensation.
- 15.-Comparison of the reactive energy consumed after the compensation.
- 16.-Measurement of power factor after the compensation.
- 17.-Determination of the first and second power maxima.
- 18.-Determination of the power maximum in the event of an asymmetric load.

Some practical exercises possibilities with the specific modules of AEL-EECFP:

- 19.-Measuring the maximum and minimum reactive power levels of the grid.
- 20.-Studying the manual reactive power compensation for dynamic loads: induction motor coupled to servomotor.
- 21.-Measuring the reactive power consumed by a capacitive receptor.
- 22.-Comparison of the reactive energy before and after of manual power factor compensation.
- 23.-Optimum configuration of the reactive power controller.
- 24.-Checking the compensation control unit applying different reactive power levels.

Some practical exercises possibilities with the AEL-EECFP modules:

- 25.-Automatic compensation of reactive energy (improvement of the power factor).
- 26.-Comparison of the active energy consumed after the automatic compensation.
- 27.-Comparison of the reactive energy consumed after the automatic compensation.
- 28.-Measurement of power factor after the automatic compensation.
- 29.-Results comparison between manual and automatic compensation.

Some Practical exercises possibilities with SCADA:

- 30.-Recording of load profiles.
- 31.- Real Time electrical parameters visualization.
- 32.- Remote active power display.
- 33.- Remote reactive power display.
- 34.-Monitoring of energy waves and data logging.

Other possibilities to be done with this Unit:

- 35.-Many students view results simultaneously.  
To view all results in real time in the classroom by means of a projector or an electronic whiteboard.
  - 36.-The Computer Control System with SCADA allows a real industrial simulation.
  - 37.-This unit is totally safe as uses mechanical, electrical and electronic, and software safety devices.
  - 38.-This unit can be used for doing applied research.
  - 39.-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.

## TENDER SPECIFICATIONS (for optional items)

### a) Technical and Vocational Education configuration

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

This complete software package consists of an Instructor Software (EDIBON Classroom Manager -ECM-SOF) totally integrated with the Student Software (EDIBON Student Labsoft -ESL-SOF). Both are interconnected so that the teacher knows at any moment what is the theoretical and practical knowledge of the students.

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

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

Innovative features:

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

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

ESL-SOF is the application addressed to the Students that helps them to understand theoretical concepts by means of practical exercises and to prove their knowledge and progression by performing tests and calculations in addition to Multimedia Resources. Default planned tasks and an Open workgroup are provided by EDIBON to allow the students start working from the first session. Reports and statistics are available to know their progression at any time, as well as explanations for every exercise to reinforce the theoretically acquired technical knowledge.

Innovative features:

- Student Log-In & Self-Registration.
- Existing Tasks checking & Monitoring.
- Default contents & scheduled tasks available to be used from the first session.
- Practical Exercises accomplishment by following the Manual provided by EDIBON.
- Evaluation Methods to prove your knowledge and progression.
- Test self-correction.
- Calculations computing and plotting.
- Equation System Solver Engine.
- User Monitoring Learning & Printable Reports.
- Multimedia-Supported auxiliary resources.

### b) Multipost Expansions options

#### ⑥ Mini ESN. EDIBON Mini Scada-Net System.

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

The Mini ESN system consists of the adaptation of any EDIBON Computer Controlled Unit with SCADA integrated in a local network.

This system allows to view/control the unit remotely, from any computer integrated in the local net (in the classroom), through the main computer connected to the unit.

Main characteristics:

- It allows up to 30 students to work simultaneously with the EDIBON Computer Controlled Unit with SCADA, connected in a local net.
- Open Control + Multicontrol + Real Time Control + Multi Student Post.
- Instructor controls and explains to all students at the same time.
- Any user/student can work doing "real time" control/multicontrol and visualisation.
- Instructor can see in the computer what any user/student is doing in the unit.
- Continuous communication between the instructor and all the users/students connected.

Main advantages:

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

The system basically will consist of:

This system is used with a Computer Controlled Unit.

- Instructor's computer.
- Students' computers.
- Local Network.
- Unit-Control Interface adaptation.
- Unit Software adaptation.
- Webcam.
- Mini ESN Software to control the whole system.
- Cables and accessories required for a normal operation.

\* Specifications subject to change without previous notice, due to the convenience of improvement of the product.



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