

Key features:

- Installation of an automatic reactive power controller.
- Capacitor banks used in function of the consumed reactive power.
- Configuration of a reactive power controller.
- Auto compensation power factor.
- Analysis of the advantages of the automatic reactive power compensation.
- Calculating the energy saving using reactive automatic compensation.

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- ↳ Products
- ↳ Products range
- ↳ Units
- ↳ 4.-Electricity or 5.-Energy



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 (Worlddidac Member)

## INTRODUCTION

In the electrical distribution Grids, in the power supply points to which big industries are connected, there are important reactive energy consumptions that could overload the distribution lines as well as the utilities' transformers.

All electrical devices with windings that work with magnetic fields require reactive energy.

The main disadvantage is that a high consumption of reactive power could generate important problems on the electric networks:

- Increasing the energy losses in the conductors.
- Overloading the transformers and generators.
- Increasing the voltage drop.

On the other hand, high reactive energy consumption can affect the final consumer's economy since utilities penalize those customers who exceed certain levels of reactive energy.

For these reasons, the use of reactive power compensators is essential.

## GENERAL DESCRIPTION

The EECFP Trainer is an automatic reactive power controller of six compensation steps that works together with several loads.

This trainer has been developed to demonstrate the importance of reactive energy compensation.

The EECFP Trainer is formed by:

- EMCFP. Advanced Power Factor Controller Module. This module is the main device of the trainer and it is used to provide automatically the needs of reactive energy of an installation. It also gives the corresponding orders to connect and disconnect the capacitors to keep the optimum power factor.

The EMCFP Module includes a FCP control strategy, an algorithm to minimize the amount of compensation operations.

Besides, the EMCFP Module includes a series of alarms that makes the system safer:

- Lack of compensation.
  - Overcompensation.
  - Overvoltage.
  - Overcurrent.
  - Disconnected transformer.
  - Current below the limit.
- RCL3R. Resistive, Inductive and Capacitive Loads Module. This module consists of a set of static loads: resistors, variable resistors, inductances and capacitors. With this module, the student can use different types of loads to check the EMCFP Module, changing the grid power factor.
  - EMT7. Asynchronous three-phase motor of squirrel cage. This motor will be subjected to load variations to vary the reactive power levels of the electrical grid. Depending on these levels, the reactive power controller, will activate more or less compensation stages.
  - FRECP. Eddy Current Brake. The aim of this unit is to apply a break torque to the induction motor to vary the electrical grid load.
  - EME/B. Electrical Machines Unit. This source will supply the necessary power to the loads in order to carry out the practical exercises.
  - WCC/M. DC Motor Speed Controller. This source will supply the Eddy Current Brake and control its brake torque.

*What can the student learn with the EECFP Trainer?*

How to install an automatic reactive power controller.

Which type of bank of capacitors must be used in function of the consumed reactive power, both by static and dynamic loads.

Preliminary calculations to choose the power of the capacitors.

Configuration of a reactive power controller.

The student will learn the functions of these devices with the aid of the manual and a series of guided practical exercises. The user can check from a practical point of view the advantages of compensating the reactive power levels correctly and, on the other hand, the energy losses generated when the reactive power is excessive.

The EECFP Trainer is formed by:

**- EMCFP Advanced Power Factor Controller Module:**

The EMCFP Module includes the following functions and controls:

Reading of the system and bank of capacitors values:

Current (A): current (A) value in RMS from the Current Transformer.

Voltage: voltage (V) value in RMS.

Reactive Power.

Active Power.

Power Factor PFC.

THD (%) in Current (A): instantaneous harmonic distortion in the network in %.

MAX. V and I register: it records the maximum current and voltage values of the system from the current transformer connection and the bank of capacitors.

Internal counter register which counts the number of operations of each individual capacitor step.

Up 14 alarms conditions can be programmed.

Some alarms included:

The EMCFP module includes a LED and relay output to warn in the event of:

Lack of compensation.

Overcompensation.

Overvoltage.

Overcurrent.

Disconnected transformer.

Current below the limits.

Technical data:

Rated voltage: 400 V.

Frequency range: 45...65 Hz (automatic adjustment).

Current measurement accuracy: 1%.

External current transformer: 10/5 A.

Continuous adjustment of cos fi: 0.85 ind – 0.95 Cap (digital).

LCD display: 1 line x 3 digits x 7 segments + 20 icons.

Cos fi reading: LCD display.

Accuracy of cos fi measurement: 2% + - 1 digit.

Adjustment of C/K factor: 0.02... 1 (digital).

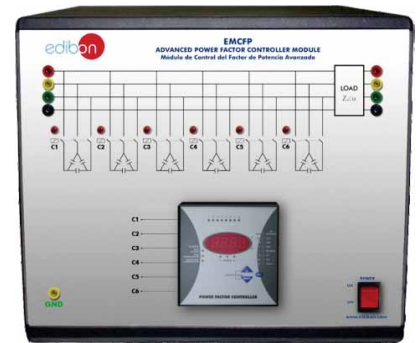
Connection time between steps: 4...999 sec (10 sec by default).

Selection of reconnection time: 5 times the connection time.

Working temperature: -10/+50° C.

Number of output relays: 6 relays.

Control strategy: program to minimize the number of operations.



EMCFP

continue...

**- RCL3R. Resistive, Inductive and Capacitive Loads Module.**

With this module is possible to simulate any proper consumption in the power system or we can test any element of the power system separately under different load conditions.

It has differentiated part on resistive, inductive and capacitive zones and it allows all type of combinations between them, so we can simulate pure resistive, inductive and capacitive load as well as different series-parallel combination of them.

Metallic box. Diagram in the front panel.

Variable resistive loads:  $3 \times [150 \Omega (500 W)]$ .

Fixed resistive loads:  $3 \times [150 \Omega (500 W) + 150 \Omega (500 W)]$ .

Inductive loads:  $3 \times [0, 33, 78, 140, 193, 236 \text{ mH}] (2 A \text{ Max.})$ .

Capacitive loads:  $3 \times [4 \times 7 \mu F] (400 V)$ .

Ground connector.



RCL3R

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

Power: 370W. Speed: 2730 r.p.m. Frequency: 50/60Hz.

V.Armature: 230/400V. I. Armature: 1.67/0.97A.

Connections: Star/triangle.



EMT-7

**- 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 braking 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.



FRECP

**- EME/B. Electrical Machines Unit (basic option).**

Metallic box. Diagram in the front panel.

Thermal Magnetic Circuit Breaker.

DC supply 200 Vdc with fuses.

Connection Key.

Emergency stop push button.

Two push buttons (1NO + 1NC).

One contactor, with three power connections, one control connection and supply control.



EME-B

**- WVCC/M. DC Motor Speed Controller (intermediate option).**

This unit consists in a variable transformer followed by a rectifier bridge and an anti-ripple capacitor with a resistor to get discharged.

Metallic box.

Adjustable voltage: up to 320 Vdc.

Maximum current 2 A.

All the top of the unit there is a knob to adjust the DC voltage.

Front panel including:

Positive, negative and ground connections. ON/OFF switch.



WVCC/M

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

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

1. Measuring the maximum and minimum reactive power levels of the grid.
2. Studying the reactive power compensation for static loads.
3. Studying the reactive power compensation for dynamic loads: induction motor coupled to eddy currents brake.
4. Measuring the coil inductance.
5. Measuring the reactive power consumed by a reactive receptor.
6. Measuring the reactive power consumed by a capacitive receptor.
7. Comparison of the reactive energy before and after of power factor compensation.
8. Optimum configuration of the reactive power controller.
9. Checking the compensation control unit applying different reactive power levels.
10. Checking the compensation control unit alarms.
11. Practical case in which the user carries out manually the reactive energy compensation.
12. Real practical exercise with static and dynamic loads. Verification of the automatic compensation.

**REQUIRED SERVICES**

- Electrical supply: three-phase, 380 V./50 Hz. or 220 V./60 Hz.

**DIMENSIONS & WEIGHTS**

EECFP Trainer:

EMCFP: -Dimensions: 490 x 450 x 470 mm. approx.  
(19.29 x 17.72 x 18.50 inches approx.)  
-Weight: 20 Kg. approx.  
(44 pounds approx.)

RCL3R: -Dimensions: 490 x 450 x 470 mm. approx.  
(19.29 x 17.72 x 18.50 inches approx.)  
-Weight: 30 Kg. approx.  
(66.1 pounds approx.)

EMT7: -Dimensions: 300 x 250 x 250 mm. approx.  
(11.81 x 9.84 x 9.84 inches approx.)  
-Weight: 8 Kg. approx.  
(17.64 pounds approx.)

FRECP: -Dimensions: 300 x 250 x 250 mm. approx.  
(11.81 x 9.84 x 9.84 inches approx.)  
-Weight: 8 Kg. approx.  
(17.64 pounds approx.)

EME/B: -Dimensions: 300 x 190 x 120 mm. approx.  
(11.81 x 7.48 x 4.72 inches approx.)  
-Weight: 5 Kg. approx.  
(11 pounds approx.)

WCC/M: -Dimensions: 300 x 190 x 120 mm. approx.  
(11.81 x 7.48 x 4.72 inches approx.)  
-Weight: 3 Kg. approx.  
(6.6 pounds approx.)

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

Integrating the electrical grids analysis unit, EALDG, is recommended in order to better understand the use of reactive power controllers.

The EALDG unit is a device designed to analyze all parameters of the electrical grids: harmonics level of the grid, reactive, active and apparent power levels, power factors and consumption of active, reactive and apparent power.

Besides, the EALDG unit includes an oscilloscope that shows the voltage and current waves of the grid so the user can analyze their behavior graphically when the power factor compensation is carried out.

The EALDG unit includes software with which the user can analyze all the events of the grid and, thus, determine the optimum levels of reactive power compensation.



Technical data:

This unit shows the main electric parameters on the electric network through the interface and a parameter selection.

Metallic box. Diagram in the front panel.

3 Current inputs, for series intensity.

3 Voltage terminals for each phase measure (R, S, T) and another one for the neutral connection.

Control and visualization digital display and oscilloscope display.

Voltage: Range 0 - 750 Vrms. Prec.:  $\pm 0.5\%$ . Phase to phase - Phase to neutral.

Current: Range 0.01 - 5 Arms. Prec.:  $\pm 0.5\%$ .

Frequency: Range 48 to 62 Hz.  $\pm 0.1$  Hz.

Power: Active, Reactive and Apparent. Range 0.01 to 9900 kW. Prec.:  $\pm 1\%$ .

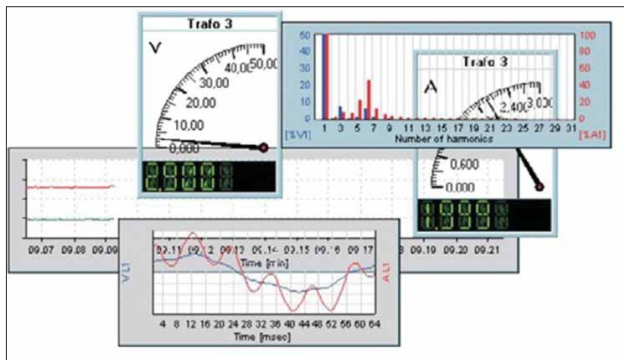
Power Factor: Power Factor for each phase and average. Range -0.5 to + 0.5. Prec.:  $\pm 1\%$ .

Operating temperature 0 to +50°C.

Connection RS232 to computer (PC).

Data Acquisition Software.

EALDG software screen. Measures indicators panel.



EALDG software screen. Loads profile and quality energy measure.



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



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