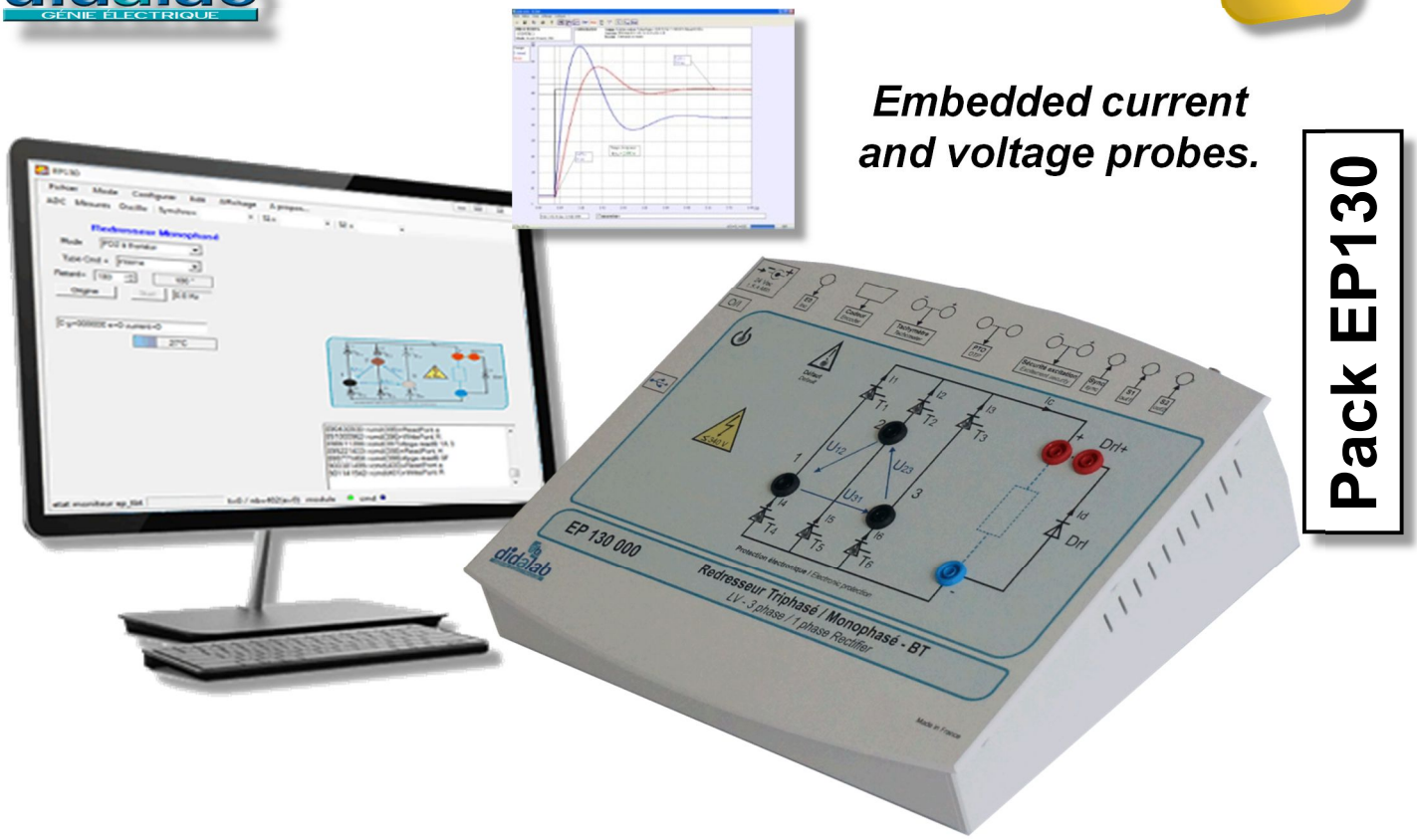
# Power electronics




***Embedded current and voltage probes.***

**Pack EP130**

## LV (300 W) 1-/3-PHASE THYRISTORISED RECTIFIER

### GENERAL CHARACTERISTICS

The **EP130B, C, and S** packs from the **Electrical Engineering** range include the EP130000 operations module, manual, a set of accessories and, depending on the version, the control software (for the C version) and simulation extension as well as implementation of new correctors (for the S version).
It enables the study of:

**Single-phase rectifier:**
- Diodes.
- Symmetrical/Asymmetrical mixed.
- All types of thyristors.
- Assisted inverter.

**Triphase rectifier:**
- Diodes.
- Mixed.
- All types of thyristors.
- Assisted inverter.

**Speed control.**

**The EP130C includes in option:**
- Speed servo-control.

**Ep130S *new control laws***
- Simulation and creation of new control laws

### TECHNICAL CHARACTERISTICS

#### Nominal characteristics
- Voltage range of the power supply: 220 $V_{AC}$ phase/phase.
- Maximum peak current in each static switch: 2 A.

### SECURITES :
- Excitation current monitoring
- Short-circuit protections
- PTO (thermal protection)
- Power supply monitoring:
  min. 60 $V_{AC}$ / max. 240 $V_{AC}$.

### AREAS OF APPLICATION

Secondary & higher technical education.
- Prep schools
- Vocational training in electrical engineering
- Institue of technology
- Engineering school & University

**Class illustration/demonstration:**
The EP130 is also specially adapted to spot a particular phenomenon during a lecture *via* a video-projector (with the EP130100 software and a PC).

### ENVIRONMENT

Equipment necessary for a correct use of the EP 130 pack:
- LV 3-phase power supply 3x220 $V_{AC}$.
- 300 W resistive load banks.
- 1-/3-phase inductive load banks with independent branches.
- Engine test bench: AC squirrel cage with 300-W load generator.
- PC.

### Technical guide

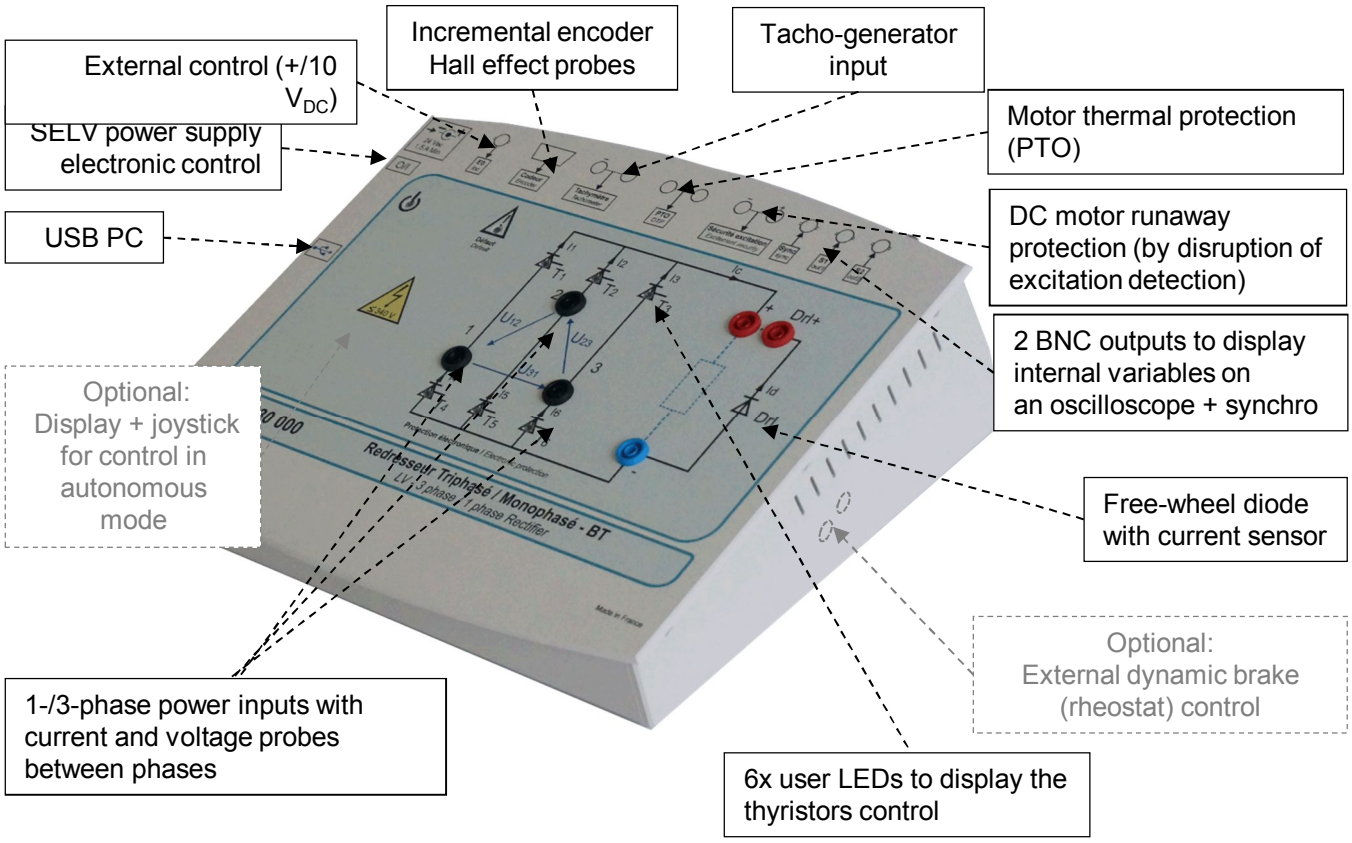
The **EP 130** pack is provided with a commissioning and maintenance booklet indicating the general conditions of commissioning and use.

### PACKING:

Dimensions (l x w x h) - net: 330x265x110 mm
- gross: 595x560x160 mm
Weight: Net 2 kg, Gross 5 kg.

# EP130000 – LV (300 W) 1-/3-phase Graetz bridge
# Technical characteristics:

The EP130000 is composed of a PVC insulated frame with a front panel including operating diagrams, the device is suitable for table-top installation. The control console system is completely digital and integrated to the panel.
A front silkscreen printing represents in a very clear way the studied schematic diagram.
It is designed to be used from an alternating power supply (220 $V_{AC}$) in compliance with established safety standards (LV).




The EP130000 connects to the PC *via* USB, it can be operating in complete autonomous mode (option EP130100). The control board is based on a very high power level processor (ARM-M4), assisted with a 50,000-gate FPGA.
The control software under Windows (ref.: EP130100) enables to select the electronic configurations:

- The assembly to be studied (1-/3- phase rectifier, with diodes, mixed, all types of thyristors, …)
- Phase delay triggering
- Signal selection to be displayed on the display or on BNC (voltage, current, gate voltage...)

It enables to select the signals to be displayed on an oscilloscope (*via* BNC) or on a PC:

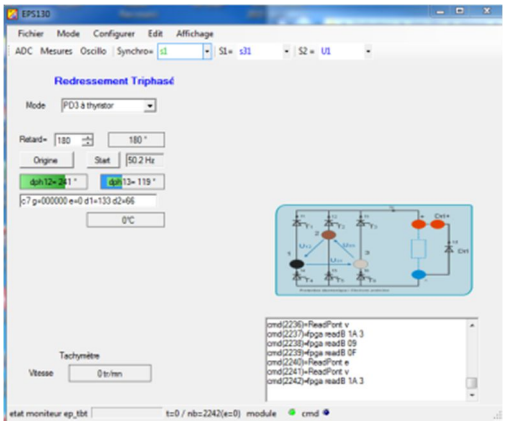
- Current in one of the branch, current into the load
- Voltage into a branch

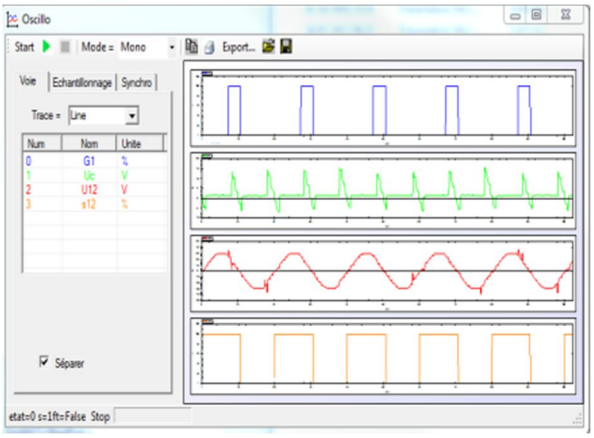
At any time, the module can be connected (depending on the software options) to a PC in order to:

- Display the time curves voltage – current on a PC.
- Carry out practical works in speed/position servo-control of a DC motor (120 → 300 W).
- Create simulation models and new real-time correctors from the modelling software: *Scilab.*

## EP130100: DRIVER AND ACQUISITION SOFTWARE

- It is operating under *Windows* environment and enables to drive the EP130 power bridge *via* USB.
- The students chooses the structure of the power bridge.
- They choose the values they want to display on the embedded oscilloscope
- They adjust the operating parameters, delay triggering, …

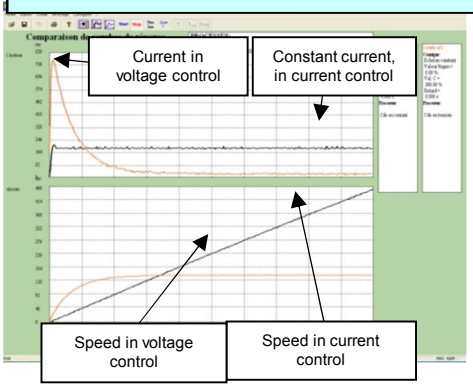


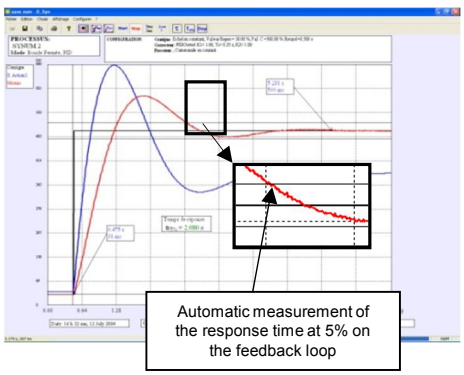

## EP130200: CONTROL COMMAND SOFTWARE « D_CCA »

- It is operating under *Windows* environment and enables to drive the EP130 power bridge *via* USB.
- Configuration of the system, *via* an ergonomic graphic interface:
  - selection of the system structure: speed or position open/closed loop.
  - selection of the control type, characteristic values: constant step, ramp, sine, trapezoid signals.
  - selection of the corrector and its adjustments (P, PI, PID, Z corrector, fuzzy logic, tacho-generator feedback)
  - selection of the acquisition and recording parameters
  - selection of the measurements units (degree angle, radians, rotations)
- Structured processing for a series of experimental tests:
  - request for the displaying of a time response of one (or several) characteristic parameter(s): position, speed, acceleration, motor current/voltage, control signal, overflow, corrector output etc…
  - modification of the time diagram scales (zoom in X, or Y)
  - recording of the running test, comparison with the previous tests.
  - determination of the automatic control characteristic values (time constants, response time at 5%, overflow amplitude, phase difference etc…)

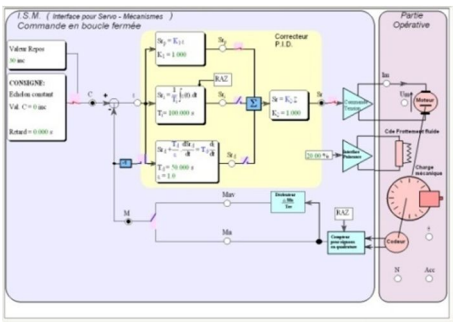
Comparison screen between OL responses in voltage control mode, and current mode, without friction disturbances.




Response in closed loop speed controlled, with automatic calculation of the reaching time in the 5% zone.

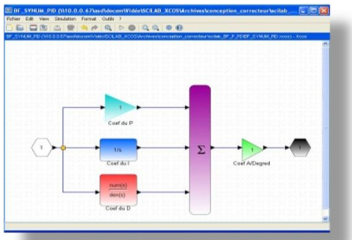



Parameter screen
Example of speed control by PID single-loop corrector

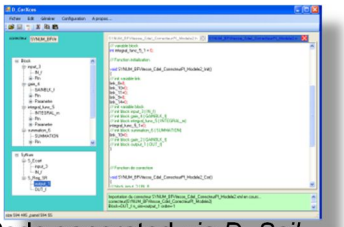


## EP130800 – Rapid prototyping software:

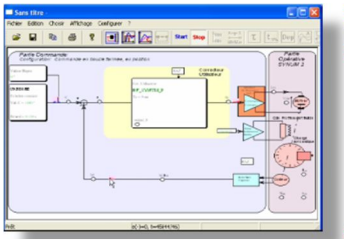
To emphasize the teaching qualities, even for research purpose, of the EP130000 module, a software can be provided. It can synthetize any type of control (OL, CL, PI, PID, state feedback...) under *Scilab*® environment, then to generate the executable code that will be downloaded in the rectifier enabling its real-time control. This graphical tool has the whole power from the simulation software *Scilab/Xcos*® ; thus, the comparison between simulation and real behavior is possible in practical works (speed/position servo-control of a DC motor...).



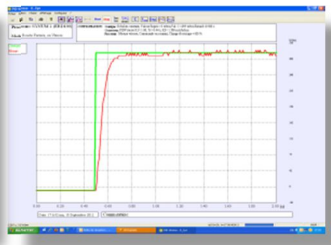
PID corrector under *Xcos*



Code generated *via D_Scil*



Implementation in *D_CCA*



Time response

## Standard configurations:

| **EP130B: Basic package « STUDY OF A 1-/3-PHASE RECTIFIER 300 W LV », including:** | | |
|---|---|---|
| Reference | Designation | Qty |
| EP130000 | Safety LV module, Graetz bridge, 1-/3-phase 300 W<br>Embedded current and voltage probes | 1 |
| EP130100 | Driver and acquisition software | 1 |
| EGD000005 | 24 $V_{DC}$, 2.9 A Power supply with jack plug | 1 |
| EP130011 | User manual and technical guide | 1 |
| EGD000006 | USB cable (AA-type) | 1 |
| EGD000018 | Storage case | 1 |

**Optional: EP131000,** TFT colour display (320x240) and digital potentiometer for autonomous control (without PC).

| **EP130C: Complete package « STUDY OF A 1-/3-PHASE RECTIFIER 300 W LV, speed and position servo-control of DC motors », including:** | | |
|---|---|---|
| Reference | Designation | Qty |
| **EP130B** | **Basic package « STUDY OF A 1-/3-PHASE RECTIFIER 300 W LV »,** | **1** |
| EP130200 | Driving software for speed servo-control, response curves acquisition on a PC (*PC not included*) | 1 |
| EP130040 | Teacher's manual "Study of the speed and position regulation on the EP130000 rectifier" | 1 |
| EP130050 | Student's manual "Study of the speed and position regulation on the EP130000 rectifier" | 1 |

| **EP130S: Simulation & experimentation package «STUDY OF A 1-/3-PHASE RECTIFIER 300 W LV, speed and position servo-control of DC motors, creation of new control laws » including:** | | |
|---|---|---|
| Reference | Designation | Qty |
| **EP130 C** | **Complete package «STUDY OF A 1-/3-PHASE RECTIFIER 300 W LV, speed and position servo-control of DC motors »** | **1** |
| EP130800 | *D_Scil*, rapid prototyping under SCILAB/XCOS, graphical objects editor, real-time C-code generator. | 1 |

**Recommended accessories:**
**LV three-phase power supply 3x 220 $V_{AC}$, 2A** (EM300B)
**BICMAC 300** : Load Bench for DC motor with magnetic brake or **BICSIN 300** : Load Bench for DC motor with active load
**ELD050000 :** 320-W rheostat, 210 Ohms, 1.2 A, **ELD102000** : Inductive loads 35 mH, 5 A.
**Accessories:** 4-mm safety patching cords, measuring instruments, PC.
**Nota:** for servo-control experiments on another bench, the group has to be equipped with an incremental encoder 5 $V_{DC}$.

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