Power electronics

Embedded current and voltage probes.

EPS 130 000

Redresseur Triphasé / Monophasé - TBTS
3-phase / 1 phase Rectifier

Made in France

SELV (300 W) 1-/3-PHASE THYRISTORISED RECTIFIER

GENERAL CHARACTERISTICS

The **EPS130B, C, and S** packs from the **Electrical Engineering** range include the EPS130000 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 EPS130C includes in option:
- Speed servo-control.

EPS130S *new control laws*
- Simulation and creation of new control laws

TECHNICAL CHARACTERISTICS

Nominal characteristics
- Voltage range of the power supply: 24 V_{AC} phase/phase.
- Maximum peak current in each static switch: 10 A.

SECURITES :
- Excitation current monitoring
- Short-circuit protections
- PTO (thermal protection)
- Power supply monitoring:
  min. 12 V_{AC} / max. 24 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 EPS130 is also specially adapted to spot a particular phenomenon during a lecture *via* a video-projector (with the EPS130100 software and a PC).

ENVIRONMENT

Equipment necessary for a correct use of the EPS 130 pack:
- SELV 3-phase power supply 3x24 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 **EPS 130** pack is provided with a commissioning and maintenance booklet indicating the general conditions of commissioning and use.
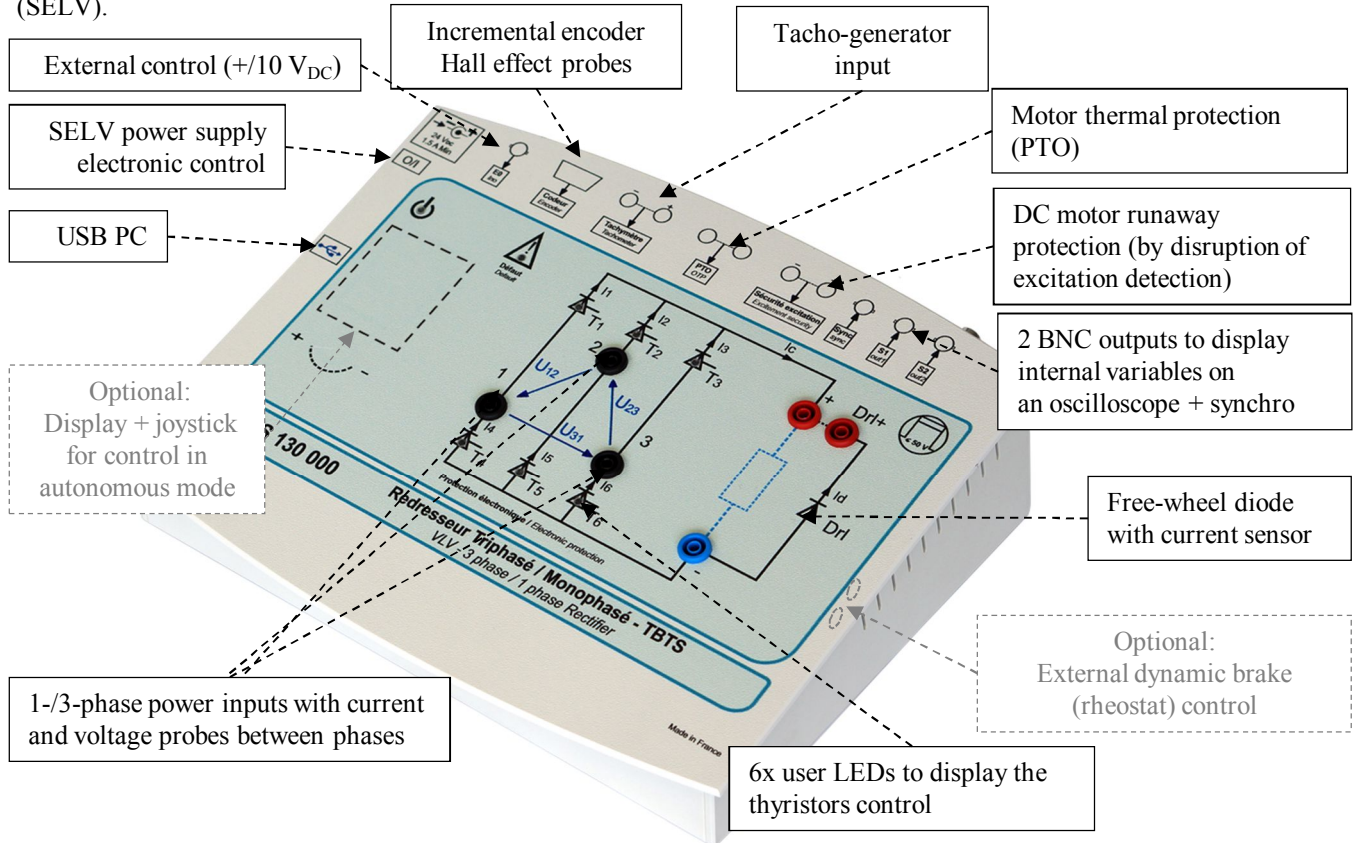
PACKING:

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

EPS130000 – SELV (300 W) 1-/3-phase Graetz bridge
Technical characteristics:

The EPS130000 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 (24 V_{AC}) in compliance with established safety standards (SELV).

External control ($+/10$ V_{DC})

Incremental encoder
Hall effect probes

Tacho-generator
input

SELV power supply
electronic control

Motor thermal protection
(PTO)

USB PC

DC motor runaway
protection (by disruption of
excitation detection)

Optional:
Display + joystick
for control in
autonomous mode

2 BNC outputs to display
internal variables on
an oscilloscope + synchro

Free-wheel diode
with current sensor

1-/3-phase power inputs with current
and voltage probes between phases

Optional:
External dynamic brake
(rheostat) control

6x user LEDs to display the
thyristors control

The EPS130000 connects to the PC *via* USB, it can be operating in complete autonomous mode (option EPS130100).
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.: EPS130100) 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 ($120 \rightarrow 300$ W).
- Create simulation models and new real-time correctors from the modelling software: *Scilab*.

# EMS 300 : Power supply, SELV, 450 VA, 1-phase, 3-phase & DC

TECHNICAL CHARACTERISTICS:
- Single-phase power supply 240 V_{AC} 16 A (mains).
- Alternating output voltages 3 phases + neutral 24 V_{AC} 11A or continuous 48 V_{DC} 9A (by PD3).
- Silkscreen printed front panel.
- Permanent power: 450 VA ; peak power: 800 VA.
- Electronic protection: voltage, current, temperature (components & transformers).

EPS130100: DRIVER AND ACQUISITION SOFTWARE

- It is operating under *Windows* environment and enables to drive the EPS130 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, …
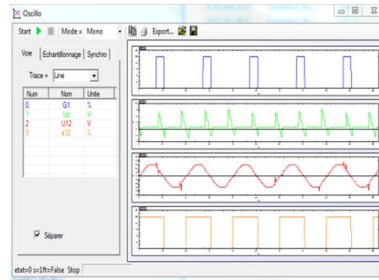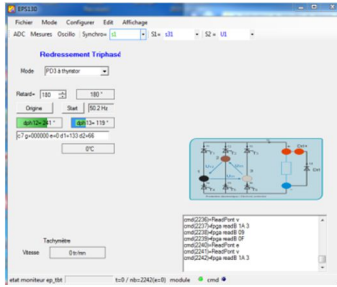
EPS130200: CONTROL COMMAND SOFTWARE « D_CCA »

- It is operating under *Windows* environment and enables to drive the EPS130 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
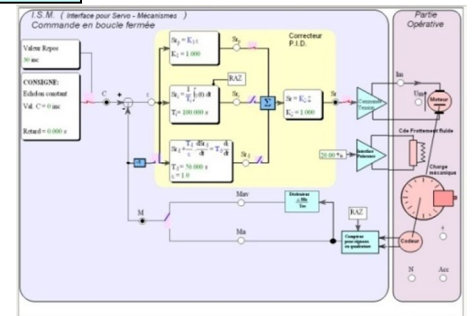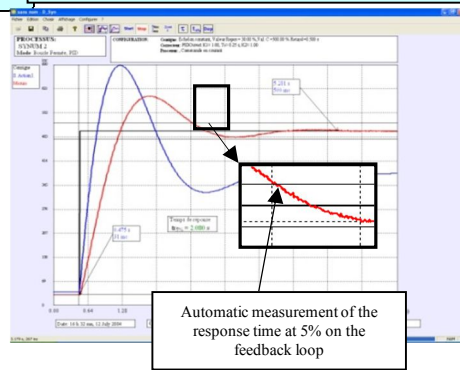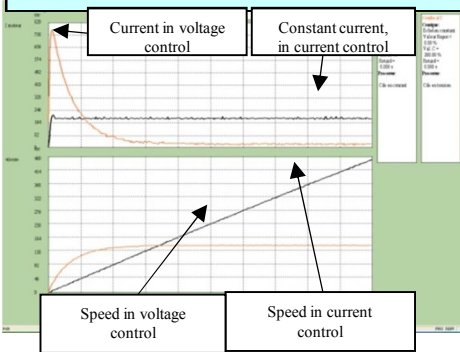
EPS130800 – Rapid prototyping software:

To emphasize the teaching qualities, even for research purpose, of the EPS130000 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...).
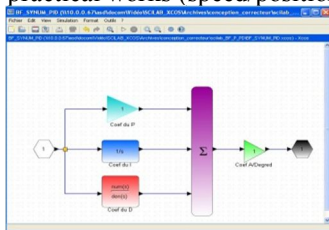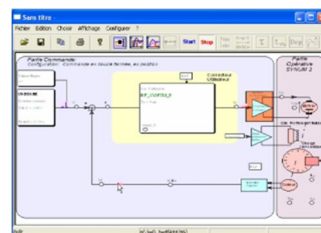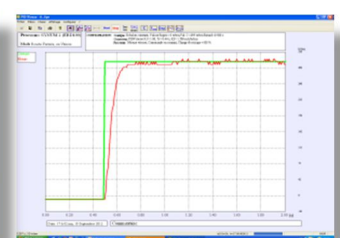

PID corrector under *Xcos*   Code generated *via D_Scil*   Implementation in *D_CCA*   Time response

Standard configurations:

EPS130A: Basic package « STUDY OF A 1-/3-PHASE RECTIFIER 150/300 W SELV & Power supply », including:		
Reference	Designation	Qty
EPS130000	Safety SELV module, Graetz bridge, 1-/3-phase 150/300 W Embedded current and voltage probes	1
EPS130100	Driver and acquisition software	1
EGD000005	24 V_{DC}, 2.9 A Power supply with jack plug	1
EPS130011	User manual and technical guide	1
EGD000006	USB cable (AA-type)	1
EGD000018	Storage case	1
EMS300000	SELV Power supply, 450 VA, 1-phase, 3-phase & DC	1

EPS130B: Basic package « STUDY OF A 1-/3-PHASE RECTIFIER 150/300 W SELV », including:		
Reference	Designation	Qty
EPS130000	Safety SELV module, Graetz bridge, 1-/3-phase 150/300 W Embedded current and voltage probes	1
EPS130100	Driver and acquisition software	1
EGD000005	24 V_{DC}, 2.9 A Power supply with jack plug	1
EPS130011	User manual and technical guide	1
EGD000006	USB cable (AA-type)	1
EGD000018	Storage case	1

Optional: EPS131000, TFT colour display (320x240) and digital potentiometer for autonomous control (without PC).

EPS130C: Complete package « STUDY OF A 1-/3-PHASE RECTIFIER 150/300 W SELV, speed and position servo-control of DC motors », including:		
Reference	Designation	Qty
EPS130B	**Basic package « STUDY OF A 1-/3-PHASE RECTIFIER 150/300 W SELV »,**	**1**
EPS130200	Driving software for speed servo-control, response curves acquisition on a PC (*PC not included*)	1
EPS130040	Teacher's manual "Study of the speed and position regulation on the EPS130000 rectifier"	1
EPS130050	Student's manual "Study of the speed and position regulation on the EPS130000 rectifier"	1

EPS130S: Simulation & experimentation package «STUDY OF A 1-/3-PHASE RECTIFIER 150/300 W SELV, speed and position servo-control of DC motors, creation of new control laws » including:		
Reference	Designation	Qty
EPS130 C	**Complete package «STUDY OF A 1-/3-PHASE RECTIFIER 150/300 W SELV, speed and position servo-control of DC motors »**	**1**
EPS130800	*D_Scil*, rapid prototyping under SCILAB/XCOS, graphical objects editor, real-time C-code generator.	1

Recommended accessories:
SELV three-phase power supply 3x 24 V_{AC}, 9A (included in package EPS130A)
ELD037480: load bench 120 W with separate excitation DC motor or **BICMAC S300** or **BICSIN S300**.
ELD103000: 960-W rheostat, 11 Ohms, 9.3 A, ELD102000 : Inductive load 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}.