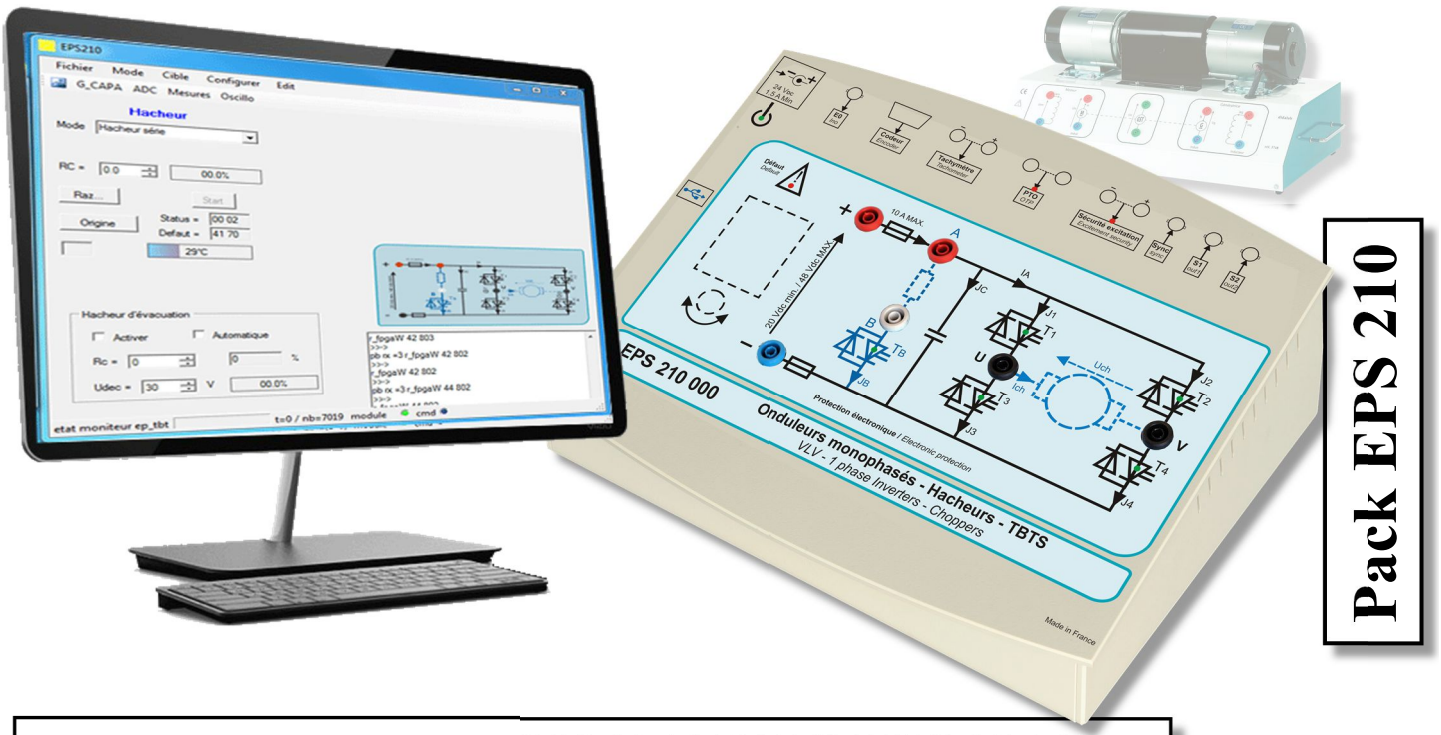
Power electronics

Embedded current and voltage probes.



SELV (150/300 W) CHOPPER / 1-PHASE INVERTER

GENERAL CHARACTERISTICS

The **EPS210B, 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:

Choppers:

- Series
- Voltage reversible
- Current reversible
- Four quadrants
- Double nested series (+E /0 /–E)

Single-phase inverters:

- Full-wave shifted control, variable frequency
- PWM +E/-E, +E/0/-E
- Constant U/F

External control:

- Electronic editing +/-10 V_{DC} (static chopper modulated inverter).

A setting software is provided (ref.: EPS210100).

Optional: the EPS211100 TFT colour display (320x240) with digital potentiometer enables the functioning in autonomous mode.

TECHNICAL CHARACTERISTICS

Nominal characteristics

- Voltage range of the power supply: 10 V_{DC} → 48V_{DC} (SELV)
- Maximum peak current in each static switch: 10 A.
- Frequency: 1 Hz → 20 kHz
- Parametrizable acceleration ramp
- Duty cycle: 0% → 100%
- Adjustable dead time
- Intersective commutation mode or state vector

AREAS OF APPLICATION

Practical works:

Basic training:

Secondary & higher technical education.

- Prep school
- Vocational training in electrical engineering
- Institute of technology
- Engineering school & University

Class illustration/demonstration:

The EPS210 is also specially adapted to spot a particular phenomenon during a lecture *via* a video-projector (with the EPS210100 software and a PC).

SAFETY DEVICES:

- Excitation current monitoring
- Short-circuit protections
- PTO (thermal protection)
- Power supply monitoring: min. 10 V_{DC}/max. 48 V_{DC} before switching on
- Control of the filtering capacity current when switching on
- Emergency stop if the reverse capacitor voltage exceeds 50 V_{DC}
- Current monitoring within the discharge transistor
- Voltage monitoring of the reverse capacitor.

TECHNICAL GUIDE:

The **EPS 210** pack is provided with a commissioning and maintenance booklet indicating the general conditions of commissioning and use.

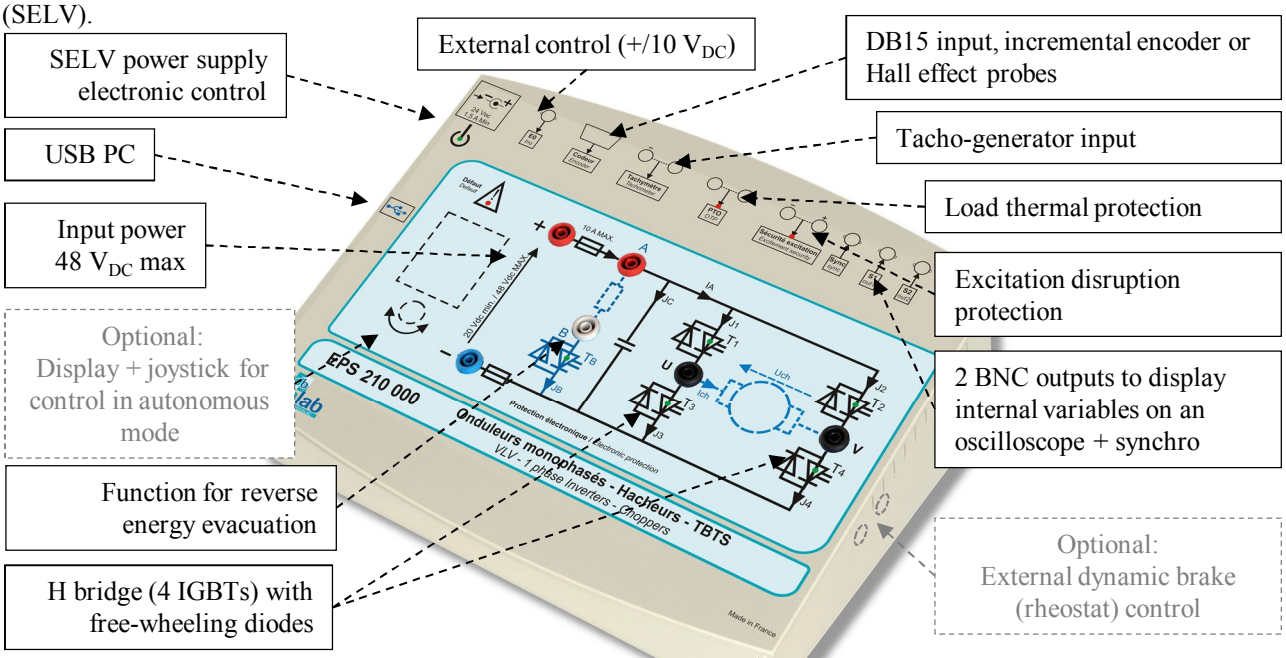
Under maximum supply voltage, protected against short-circuits.

PACKING:

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

EPS210000 – SELV (150/300 W) chopper / 1-phase inverter
Technical characteristics:

The EPS210000 is composed of a PVC insulated frame with a front panel including operating diagrams, the device is suitable for table-top installation. The power supply unit is external (50 V_{DC} max, 10A). The adjustment control and choice is made by a PC due to the EPS210100 software.
It is designed to be used from an adjustable continuous power supply in compliance with established safety standards (SELV).



The EPS210000 connects to the PC *via* USB, it can be operating in complete autonomous mode (option EPS210100). 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.: EPS210100) enables to select the electronic configurations:

- Series chopper
- Reversible chopper in current, voltage
- 4-quadrant chopper
- Double nested series (0 +E 0 / 0 –E 0)
- Single-phase inverter with offset drive, PWM, constant U/F

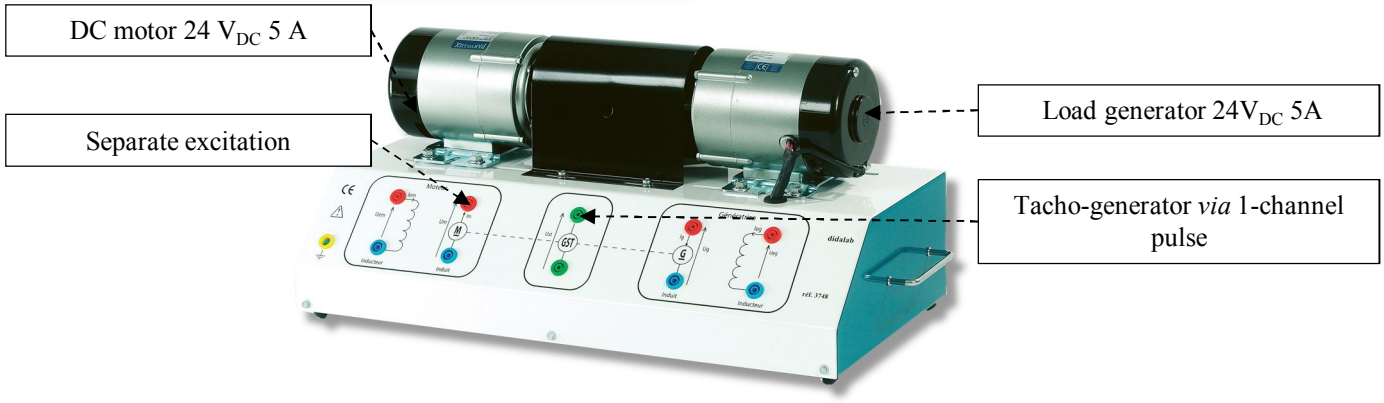
The operating parameters can be chosen (depending on the studied assembly):

- The operating frequency, the duty cycle
- The LF type and frequency (external by BNC or internal)
- The signals to be displayed on an oscilloscope by 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:

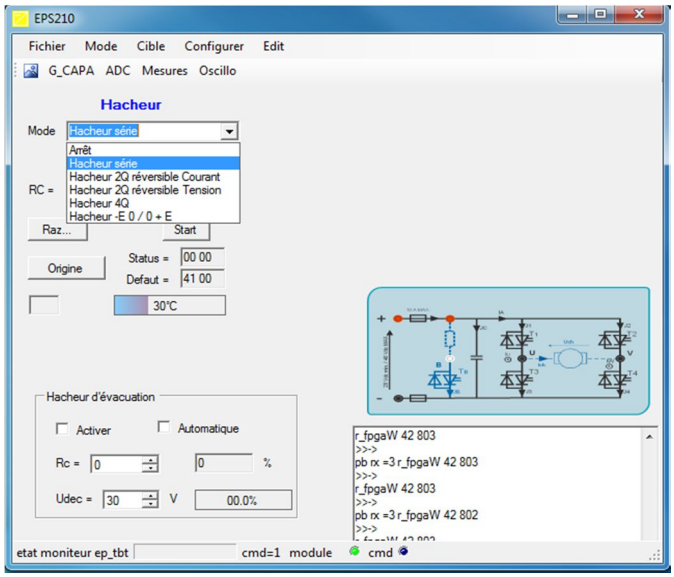
- Display the time curves: voltage – current on a PC.
- Carry out practical works in speed/position servo-control of a DC motor (120 → 300 W).
- Create simulation models and new real-time correctors from the modelling software: *Scilab*.

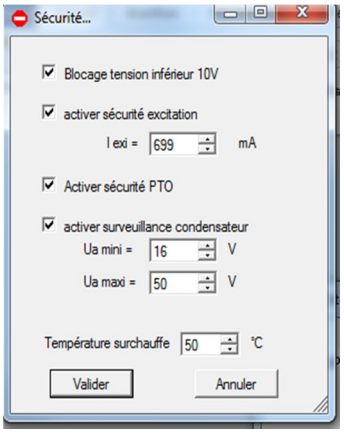
ELD 037 480: recommended load bench



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 , frequency, duty cycle, ….

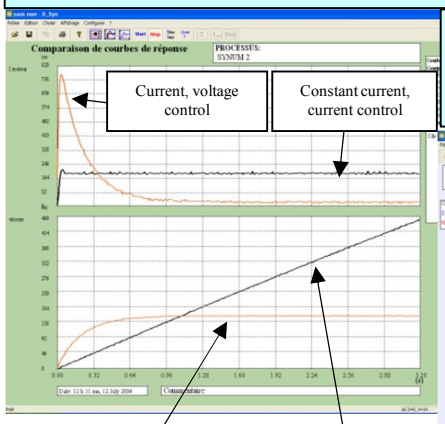




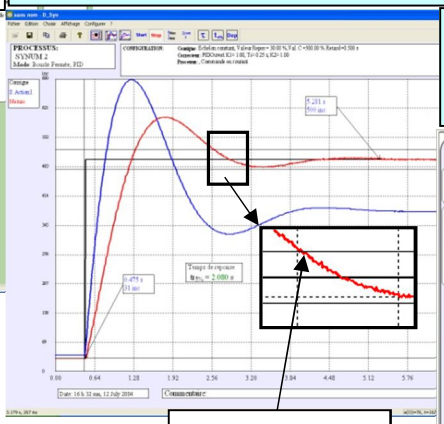
EPS210200: CONTROL COMMAND SOFTWARE « D_CCA »

- 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/close 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…)

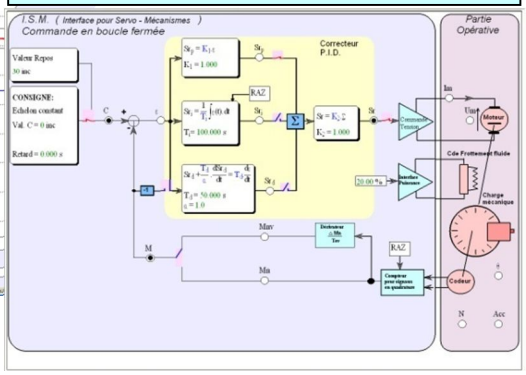
Comparison screen between OL responses in voltage control mode, and current mode, without friction disturbances.



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



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

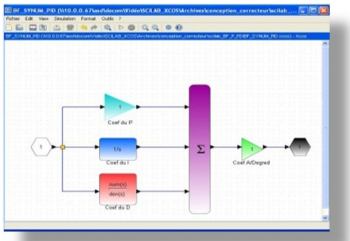


EPS130800 – Rapid prototyping software:

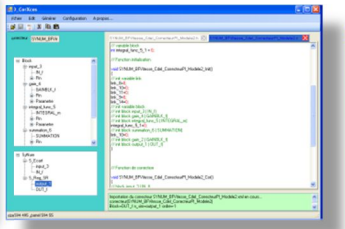
To emphasize the teaching qualities, even for research purpose, of the EPS130000 module, a software can be provided. It can synthetize any type of control (OL, CL, PI, PID, state feedback...) under *Scilab*® environment, then to generate the executable code that will be downloaded in the chopper/inverter 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...).

Example below:

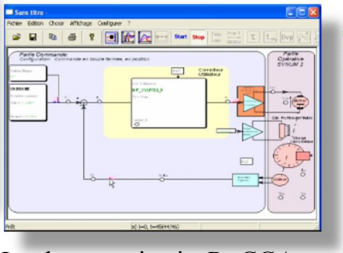
From a simulation of the system in OL then in CL with the open-source software *Scilab/Xcos*®, the module *D_Scil* automatically generates the code which will be transferred into the chopper/inverter bridge then tested under the software *D_CCA* to compare results from simulation and experiments (cf.: *D_Scil* documentation).



PID corrector under *Xcos*



Code generated *via D_Scil*



Implementation in *D_CCA*

Time response

Standard configurations:

EPS210B: Basic package « STUDY OF A 1-/2-/4-quadrant CHOPPER / single-phase INVERTER 150/300 W (SELV) », including:		
Reference	Designation	Qty
EPS210000	Safety SELV module 300 W, 1-/2-/4-quadrant chopper, 1-phase inverter 1-phase inverter full-wave, PWM +E/-E, +E/0/-E, embedded current and voltage probes	1
EPS210100	Driver and acquisition software	1
EGD000005	24 V_{DC}, 2.9 A Power supply with jack plug	1
EPS2100010	User manual and technical guide	1
EGD000006	USB cable (AA-type)	1
EGD000018	Storage case	1

Optional: EPS211000, TFT colour display (320x240) and digital potentiometer for autonomous control (without PC).

EPS210C: Complete package « STUDY OF A 1-/2-/4-quadrant CHOPPER / single-phase INVERTER 150/300 W (SELV), speed and position servo-control of DC motors » including:		
Reference	Designation	Qty
EPS210B	**Basic package « STUDY OF A 1-/2-/4-quadrant CHOPPER / single-phase INVERTER 150/300 W (SELV) »**	**1**
EPS210200	Driving software for speed servo-control, response curves acquisition on a PC (*PC not included*)	1
EPS210041	Teacher's manual "Study of the speed and position regulation on the EPS210000 chopper"	1
EPS210051	Student's manual "Study of the speed and position regulation on the EPS210000 chopper"	1

EPS210S: Simulation & experimentation package «STUDY OF A 1-/2-/4-quadrant CHOPPER / 1-/3-phase INVERTER 150/300 W (SELV), speed and position servo-control of DC motors, creation of new control laws » including:		
Reference	Designation	Qty
EPS210 C	**Complete package « STUDY OF A 1-/2-/4-quadrant CHOPPER / single-phase INVERTER 150/300 W (SELV), speed and position servo-control of DC motors »**	**1**
EPS210800	*D_Scil*, rapid prototyping under SCILAB/XCOS, graphical objects editor, real-time C-code generator.	1

Recommended accessories:

30 V / 6 A or 50 V / 6 A power supply

ELD037480: load bench 120 W with separate excitation DC motor or **BICMAC S300** **or** **BICSIN S300** .

ELD103000: 960-W rheostat, 11 Ohms, 5.7 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}.

didalab GÉNIE ELECTRIQUE

Z.A. La Clef St Pierre - 5, rue du Groupe Manoukian 78990 ELANCOURT France
Tél. : 33 (0)1 30 66 08 88 - Télécopieur : 33 (0)1 30 66 72 20
e-mail : ge@didalab.fr - Web : www.didalab.fr

Non contractual document
®Registered trademark
Updated 2015/11/02