Power Electronics

EP360 pack

Probes of currents and tensions integrated into every branch of the studied system.

1-PHASE, 3-PHASE RECTIFIER –AC-CONTROLLER 1,5/3 kW

GENERAL CHARACTERISTICS

Pack EP360B, C, and S of the range Electric Engineering includes the secondary, technical writing desk EP360000, the guide and according to the version, the software of subjection for it C and the extension of simulation and creation of new real time correctors for the version S.
They allow the study:

Single-phase rectifiers:
- All diodes,
- Mixed symmetric, asymmetric,
- Any thyristors,
- Assisted inverter.

➢ **Rear AC-controller one-phase,**

➢ **Three-phase rectifiers:**
- All diodes,
- Mixed,
- All thyristor,
- Assisted inverter,

➢ **Rear AC-controller 3-phase,**

➢ **Regulation of speed.**
EP360C includes in more the options: Study of speed regulation,

➢ **EP360S new laws of command**
Simulation and creation of new laws of command

CARACTERISTIQUES TECHNIQUES

➢ Nominal characteristics
Power supply voltage: 100 / 400VAC phase / phase.

➢ Pick current in 10 A,

➢ Control:
- Pull-down menu under Win CE by color screen TFT 3,5 " and USB mouse,

SAFETIES :

♦ Short circuits protection,
♦ Permanent voltage supply surveillance : 100 AC/400VAC.
♦ Dissipators temperature,
♦ Surveillance of the temperature engine (PTO),
♦ Surveillance of the driving current of excitement (anti-racing).

TRAINING IN :

- **Technical High School,**
- **Bachelor degree**
- **Master degree**
- **School for Engineers.**

ENVIRONMENT

Equipment to be used together with the EP 360 Unit:
- Electrotechnical bench with variable DC voltage, Power:1.5 kW & auxiliary Power Supply (excitation),
- Resistance load bench: 1.5 kW,
- Single & three-phase self-inductance load bench: 2/4 kvar,
- Asyncronous motor bench with load generator: 1.5 kW,
- Dual beam 60 MHz Oscilloscope with voltage differential probe & current clamp.
- 600 V/20 Amp. Multimeter, Ø 4 mm leads, double plugs.

Technical manual

the **EP 360** Unit is provided with one installation & maintenance handbook giving all informations concerning the installation & use conditions .

Packing :

Net weight : 16 Kg
Gross weight : 20 Kg
Dimensions net : 40 x 60 x 25 cm
(L x W x H) gross : 50 x 80 x 35 cm

EP360000 – Graëtz Bridge & single/three-phase AC-controller, 1,5/3 kW, Technical characteristics:

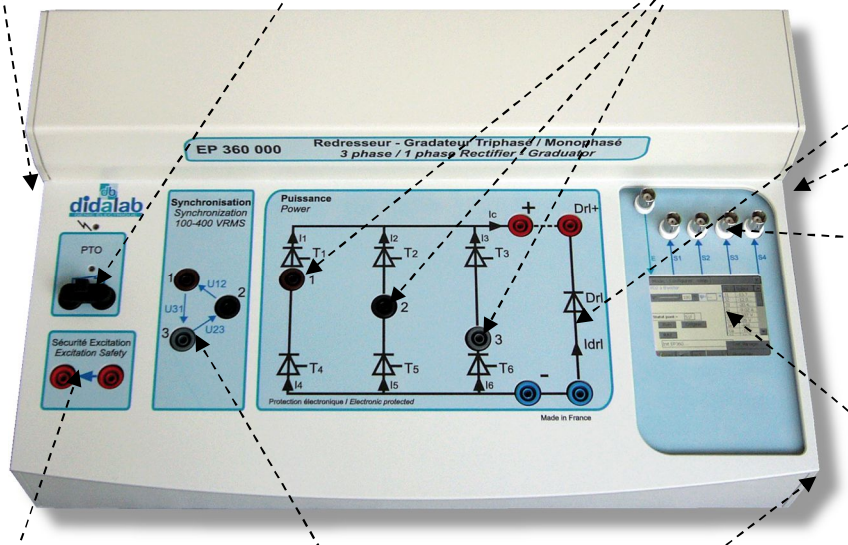
The EP360000 module is based on a PVC structure to be put on table. The power supply is external (100/400 VAC max, 10A).
The console of command integrated into module is totally digital and of very high power level (ARM9 32 bits, 200 Mips associated with a FPGA of 400 000 doors), it insures the parameterisation and control of the system of the safety load, power, short circuit, overvoltage. It is designed to be used on an alternative variable power supply (100/400 VAC), in compliance with the current safety standards.

Electronic power supply 230VAC mono. Side M/A

Protection driving warm-up by PTO

1/3 phases input, with probes of current and tension between phases

Diode of free wheel with sensor of current



In side DB15HD: Input optical coder sound in effect hall.

4 outputs analogic for current/voltage visualisation.

Color graphic screen with HMI under Win CE and USB mouse, selection of ways of functioning, display the currents and the tensions curves in autonomous.

Protection driving anti-racing DC by detection of break of excitation

Input, between phase voltage references 400 VAC max.

PC Ethernet side conection for the study of speed servocontrol, creation of new correctors…

The EP360000 module is functional in autonomy.
The main board is based on a processor of very high power level (ARM9, 200 MIPS) under Windows CE, assisted by a FPGA 400 000 doors.
An IHM based on a graphic screen associated with a USB mouse, allows to choose:

- The drawing which he wishes to study (single-phase, three-phase rectifier, in diodes, mixed, any thyristors),
- The delay in the initiating,
- The selection of a signal to be displayed on screen or on BNC (voltage, current, thyristor trigger signal…)

Details of the acquisition functions by converters 12 bits:

- 8 probes of current, each 6 thyristors, current in load, free wheel diode,
- 3 probes of current (calculated by FPGA), current in every phase of power supply,
- 3 probes of voltage between phases,
- 3 probes of voltage (calculated by FPGA), voltage between each power supply phase.

The protection of the system is totally electronic, it protects the current means, the crest, it is effective against the short circuits, an overprotection by fuse allows of landing a possible major defect

CONTROL:

Analog input +/-10 V)

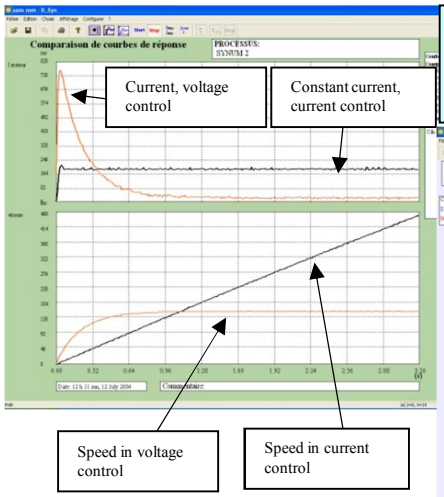
4 outputs of display on oscilloscope (images of voltage, speed, position, current…

Color display 320 x 240 pixels RVB 24 bits, under Windows CE and HMI of configuration

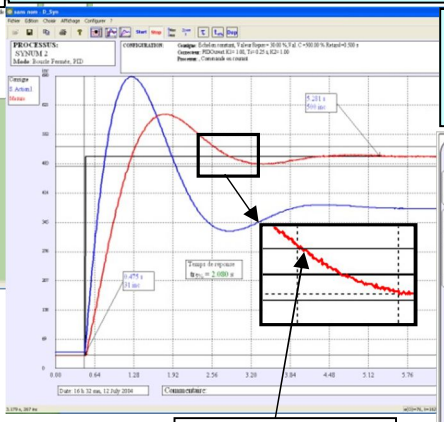
EP360200 : SERVO CONTROLE SOFTWARE « D_CCA » (optional)

- Can be operated under Windows (Professional editions), it enables the control of the servosystem via USB Link.
- It enables the User the 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 and characteristic values: constant step, limited ramp, sine, speed trapezoid signals
  - Selection of the corrector and its adjustments (P, PI, PID, Cascade, "Z" corrector, Corrector programmed in «C»…)
  - Selection of the power interface type (current or voltage)
  - Selection of the acquisition and recording parameters (Choice of sampling periods)
  - Selection of the measurements units (mm or digital increments for the position and mm/s or digital increments for the speed)
- It also enables the structured running of the experimental work:
  - Time response display of one (or several) characteristics parameters:
    position, speed, acceleration, motor current, motor voltage, control signal, overflow, corrector output etc…
  - modification of the time diagram scales (zoom in X, or Y)
  - Determination of the automatic control characteristic values:
    - constant step : time constant, 5% response time, absolute overlap, relative overlap,
    - sine excitation : average value, amplitude, frequency, period
    - response in a harmonic system : ratio of medium values, ratio of the amplitudes, phase shift
  - saving the configuration of the current test with the response curves of various recordable sizes
  - comparing the result of the on-going trial with results previously recorded
  - export curves to be used by other processing such as Excel and SCILAB
  - allow modelling in the linear range thanks to a compensation of dry friction

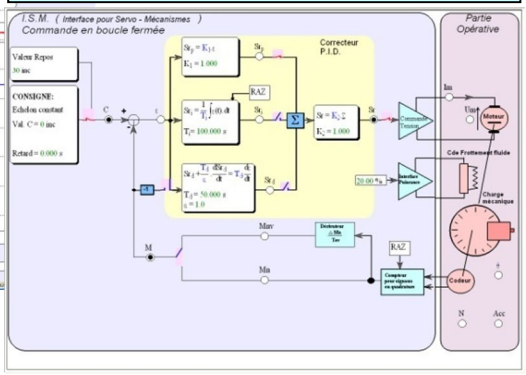
Comparison screen between open loop responses in voltage control mode, and current mode, without friction disturbances.



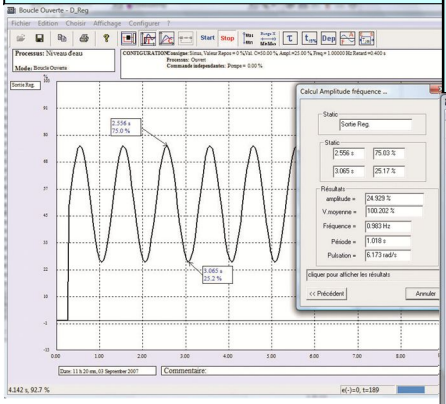
Response in closed loop speed control, with automatic calculation of the reaching time in the 5% zone.



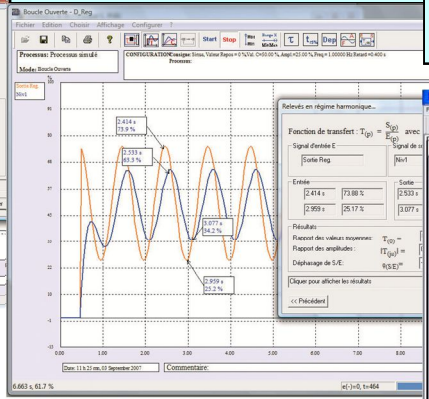
Parameter screen
Exemple of speed control by PID single loop corrector



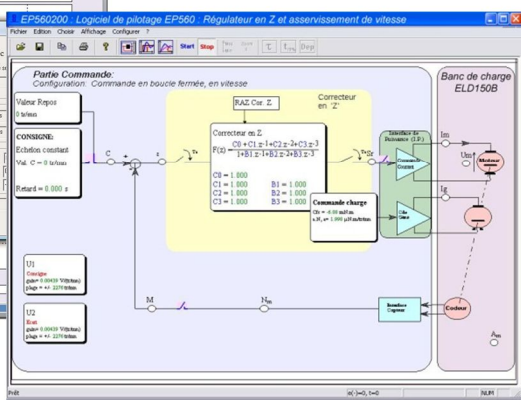
Open loop response, measurement of the amplitude, the average value, the frequency, period and pulsation



Harmonic analysis,
Amplification,
Phase shift



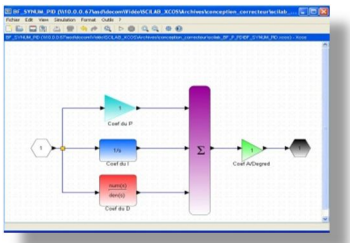
Parameter screen
Example of speed control by « Z » corrector



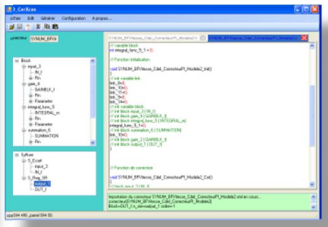
EP360800 – D_Scil, prototyping code generator:

In order to accentuate the pedagogical and even research qualities of the EP360000 rectifier module, a software module is proposed. It can synthesize any type of command (OL command, CL with PI, PID, state feedback...) under Scilab® environment, then generate the executable code that will be downloaded in the rectifier allowing its real-time control. This graphical tool has all the power of Scilab®/Xcos simulation software, so the simulation to real is accessible in experiments (speed control of a DC motor...).

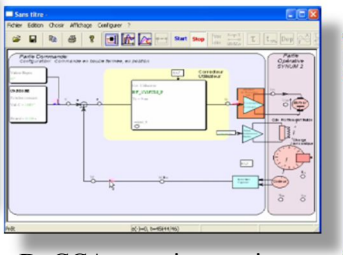
Example: From a simulation of the system in OL then CL under the Scilab/Xcos® open source software module, the D_Scil software module automatically generates the code that will be transferred to the three-phase bridge then tested under the D_CCA software module in order to compare the simulation results to the experiment results



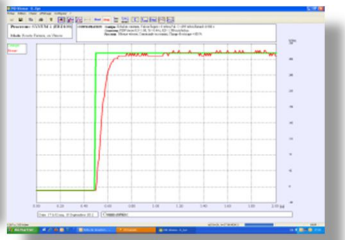
PID edited under Xcos



Software code generated under D_Scil



D_CCA experimentation



Time result

Standard configurations:

EP360 B : Basic pack «STUDY OF A SINGLE-PHASE AND THREE-PHASE RECTIFIER, AC-CONTROLLER, 1,5/3 kW», including :		
References	Descripiton	Qty
EP360000	Securised module, graëtz bridge, ac-controller, single-phase / three-phase 1,5/3 kW, Probes of current and tension integrated, HMI on color LCD screen. Control software (embedded under Win CE), USB mouse,	1
EP360010	User manual and technical guide	1
EGD000008	Power electronic supply 12 Vdc, 4.2 A with Jack connector	1

EP360C : Complete pack «STUDY AND OF A SINGLE-PHASE AND THREE-PHASE RECTIFIER, AC-CONTROLLER,1,5/3 kW, AND SPEED SERVOCONTROL DC MOTOR» including :		
Références	Descripiton	Qty
EP360B	**Basic pack «STUDY OF A SINGLE-PHASE & THREE-PHASE RECTIFIER, AC-CONTROLLER, 1,5 kW»**	**1**
EGD000010	RJ45 lead	1
EP360200	Speed software servocontrol, Acquisition of the answer curves on PC (PC non included).	1

EP360S : Simulation pack «**STUDY OF A SINGLE-PHASE & THREE-PHASE RECTIFIER, AC-CONTROLLER, 1,5 kW, speed servocontrol on DC motor, creation of new laws of command**» including:		
Références	Descripiton	Qty
EP360C	**Complete pack «STUDY AND OF A SINGLE-PHASE AND THREE-PHASE RECTIFIER AC-CONTROLLER, 1,5/3 kW, AND SPEED SERVOCONTROL DC MOTOR »**	**1**
EP360800	D_Scil Automatic code generator under SCILAB/XCOS Editor, real time code generator	1

Accessories :

ELD101B : Rheostat 220 ohms with fuse of protection 3 A on cursor, 3 recommended,
ELD100B : Electrotechnical work bench,
ELD150B : Active load 1,5kW with DC motor CC independant excitation, asynchronus three phase motor.
Accessoires : securized Leads 4 mm, mesuring devices, PC,

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