

Electrical Engineering



Pedagogical equipment for

TVET
STEM

Technical and Vocational Education & Training
Science, Technology, Engineering, Mathematics

English Edition 2021



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For the equipments provided by Mentor and Tergane, a team with long experience in the field of educational equipments is at your disposal to assist you in your projects and maintenance issues.



EDITO



Dear teachers,

Didalab has been a higher and technical education's key player for many years, thanks to you. Our only wish is, and has always been, to provide the best facilities for the best value. You've always managed to show us the right direction through our partnership.

This catalog presents many new materials specifically developed to optimize the transmission of knowledge in your increasingly innovative fields.

Our aim : to provide a better service, a support always more precise, to understand and answer to your requests, to go forward together.

Together, let's take a stand for evolution and let's build together tomorrow education.

Jean SANCERRE

President

A handwritten signature in black ink, consisting of a stylized 'J' and 'S' followed by a long horizontal stroke.

The logo for Didalab, featuring a blue square with the letters 'db' in white. Below this, the word 'didalab' is written in a bold, blue, sans-serif font. Underneath the word, the website address 'WWW.DIDALAB.FR' is written in a smaller, blue, sans-serif font.

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Green Energies

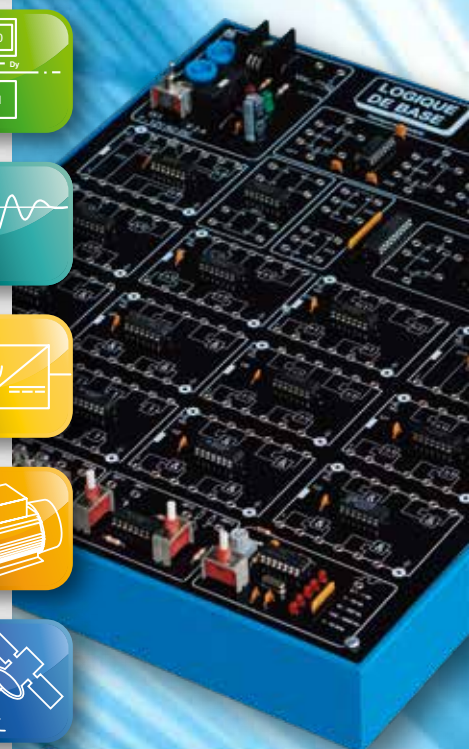
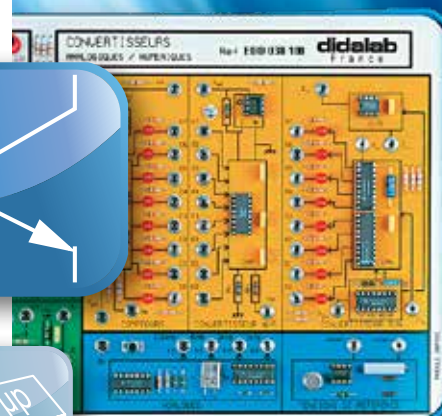
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Basic Analogical functions



Highlights

- LFG embedded : sine square, triangle
- Quality of the contacts : 2-mm rivets

Studied topics

- Stabilised Power supply
- Transistor circuits configuration
- Operational amplifier circuits
- Filters of the 1st order
- Filters of the 2nd order : Structure of Sallen-Key and structure of Rauch

Technical Characteristics - EAD 110 000

Power supplies in the monitor	One dual Power Supply +/-12 VDC fixed voltage & 15 VAC One dual Power Supply +/- 0/10 V DC variable voltage & dc, individually adjustable
Embedded LF Generator	Sine (10 Hz to 1 MHz), Square and Triangle (10 Hz to 200 kHz)
Composants	Resistors : 4 power resistors 2W (1 Ohm, 4.7 Ohms, 100 Ohms et 1 kOhms), 4 1/4W-resistors (2 x 10 kOhms et 2 x 100 kOhms), 1 50-kOhms potentiometer Capacitors : 3 biased capacitors (1000 µF, 150 µF et 10 µF), 4 unbiased capacitors (2x10 nF and 2x100 nF) Diodes : 4 rectifier diodes (1N4007), 1 Zener diode (5.1 V), 1 Diode (1N4148) Transistors : 2 transistors (BDX33 and 2N2222) Operational amplifier : 2 operational amplifiers (TL081 et AD818)
Accessories	3x 2-mm/4-mm safety adaptators for signal inputs 2 set of 2-mm distributors 4x free places for resistors, capacitors, selfs-inductances 3x 2-mm / BNC adaptators
Protections	Electronical Protection against short-circuits and protection with fuse
External power supply	15 VAC transformer

Experiments

EXP 1	Single wave rectifier bridge	EXP 8	Trigger comparator, or 2-threshold comparator
EXP 2	Dual waves rectifier bridge	EXP 9	Function generator, saw, square
EXP 3	Stabilised Power Supply	EXP 10	Filters of the 1st order (low-pass, high-pass filters)
EXP 4	Transistor Amplifier (common emitter, common collector)	EXP 11	Active filters of the 2nd order (Sallen and Key, Rauch)
EXP 5	Operational Amplifier, direct current range (Follower assembly, Amplifier assembly, Inverting, Inverting summing, non-inverting, subtractor amplifier)	EXP 12	Gain x band product for an Amp-Op
EXP 6	Operational Amplifier, alternative current range (Diverter, integrator)	EXP 13	Regulated Power Supply
EXP 7	Comparator		

Pack EAD 110 B : Study of basic analogical functions

Référence	Description	Quantity
EAD 110 000	Basic analogue electronic circuits training Monitor	1
PEM 061 151	Set of 10 yellow patching cords ; Ø 2 mm, 10cm long	1
PEM 061 440	Set of 10 red patching cords ; Ø 2 mm, 25 cm long	1
PEM 061 610	Set of 10 blue patching cords ; Ø 2 mm, 50cm long	1
PEM 010 021	BNC/BNC black cable, male/male, 1 m long, 50 Ohms	2
EGD 000 013	15 V AC Power Supply	1
EAD 110 050	Manual of Experiments for the student	1
EAD 110 040	Manual of Experiments for the teacher (with answers)	1

(We suggest the composition of the Package, for special configuration, please ask)



Optoelectric Transducers



Highlights

- Study of the main optoelectric transducers
- Possibility to illustrate some applications such as light gates, data transmission, optical fiber, telephone ...

Studied topics

- Production and detection of light pulses.
- Transmission of a sound with an optical fiber.
- Transmission of digital data.
- Study of a transmission medium.
- Etc.

Technical Characteristics - PED 037 910

Functions	Incandescent lamp, LED (red, yellow, green), infraed diode, optical fiber transmitter
Power supply	+/- 15 Vdc external power supply

Technical Characteristics - PED 037 920

Functions	Photoresistor, phototransistor, optical fiber receiver, optical fiber detector, photodiode, photobattery
Power supply	+/- 15 Vdc external power supply.

Experiments

EXP 1	Static specification of a LED
EXP 2	Dynamic specification of a LED
EXP 3	Static specification of a photodiode
EXP 4	Detection of a light
EXP 5	Production and detection of light pulses
EXP 6	Production and detection of modulated light pulses
EXP 7	Sound transmission with an optical fiber
EXP 8	Transmission of digital data
EXP 9	Light gate
EXP 10	Study of a transmission medium

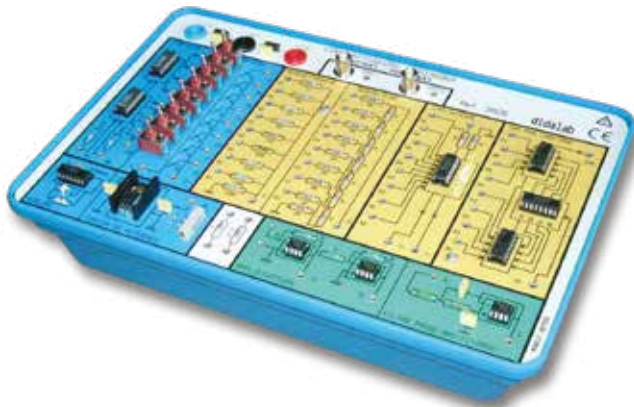
Pack PED 3790 C : Study of optoelectronic transducers

Référence	Description	Quantity
PED 037 910	Emitter monitor : Incandescent lamp, LED (red, yellow, green), infraed diode, optical fiber transmitter	1
PED 037 920	Receiver monitor : Photoresistor, phototransistor, optical fiber receiver, optical fiber detector, photodiode, photobattery	1
ERD 037 782	Bag of security stackable patching cords (several lengths and colours) 20 of 2 mm and 5 of 4 mm	1
PMM 062 180	Symetrical power supply, +/-15 V, 1 A	1
	Manual of Experiments	1

(We suggest the composition of the Package, for special configuration, please ask)



Digital Analogical Conversion



Highlights

- Comparison between several kinds of converters.

Studied topics

- D/A Conversion with weighted resistors.
- D/A Conversion with R/2R networks.
- D/A Conversion by counting.
- Built-in D/A Conversion
- **Several experiments are supplied with the monitor**

Technical Characteristics - EDD 038 060

Studied functions	DA conversion with weighted resistors (8 bits), with R/2R networks (8 bits), by counter (8 bits), built-in DA conversion (8 bits)
Counter	Natural binary 8 bits Up & Down counter (CMOS technology)
Clock	F = 50 kHz (CMOS technology)
Switch	8 logic state readouts using on/off contacts switches
Reference voltage	Built-in controller with multi-turn potentiometer adjustable output voltage
Weighted networks	8 bits weighted network using accuracy resistors
R-2R networks	8 bits R-2R network using accuracy resistors
Built-in DA conversion	DAC 0800 industrial Digital / Analog converter
Amplifier	Current / Voltage conversion and inverter amplifier using Operational Amplifier
DA conversion by counting	8 bits Counter linked to 2x 4 bits comparators enabling the conversion of a digital value into a rectangular voltage cyclic ratio
Power supply	External power supply, ± 15 V (ref PMM 062 180)

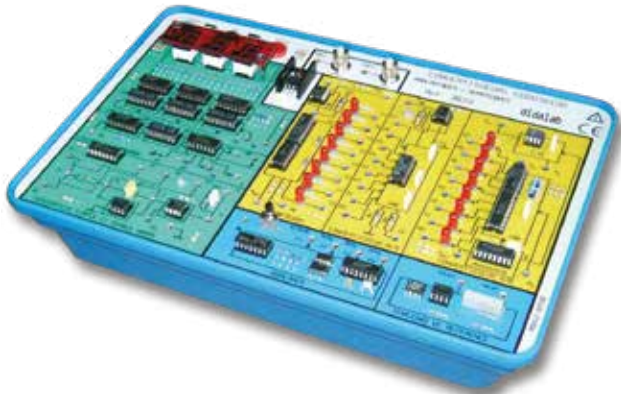
Pack EDD 3806 B : Study of the D/A conversion

Référence	Description	Quantity
EDD 038 060	Digital / Analogical Conversion Monitor	1
ERD 037 782	Bag of security stackable patching cords (several lengths and colours) 20 of 2 mm and 5 of 4 mm	1
PMM 062 180	Symmetrical Power Supply : ± 15 V, 1 A	1
	Manual of experiments	1

(We suggest the composition of the Package, for special configuration, please ask)



Analogical Digital Conversion



Highlights

- Comparison between several kinds of converters

Studied topics

- Sample & Hold unit
- Single and double ramp converter
- Converter by counting.
- Built-in Converter.
- **Several experiments are supplied with the monitor.**

Technical characteristics - EDD 038 100

Studied functions	Sample and hold unit, single / double ramp converters, conversion by counting, converter with integrated circuit
Single / double ramp integrator	Operational Amplifier integrator, comparator and three analog switches
Control logic	CMOS Up & Down counter logic for the analog switch control
Readout and counting unit	Counting & readout on 3 digits with 3 inputs : clock, reset and storing
Counter	CMOS 8 bits counter – Light emitting diodes outputs display
Industrial converter	AD C 08000 8 bits D/A conversion Integrated Circuit including the Sample & Hold unit and the control monostable
Clock	Quartz clock providing the following output frequencies: 512, 4, 2 & 1 kHz
Pushbutton	Pushbutton with bounce free logic for manual study
Reference voltage	Integrated controller with multi-turn potentiometer adjustable output voltage and outputs +U ref. & -U ref
Power supply	External power supply, ± 15 V (ref PMM 062 180)

Pack EDD 3810 B : Study of the A/D conversion

Référence	Description	Quantity
EDD 038 100	Analogical / Digital Conversion Monitor	1
ERD 037 782	Bag of security stackable patching cords (several lengths and colours) 20 of 2 mm and 5 of 4 mm	1
PMM 062 180	Symmetrical Power Supply : ± 15 V, 1 A	1
	Manual of experiments	1

(We suggest the composition of the Package, for special configuration, please ask)

Pack EDD 3810 C : Study of D :A and A :D conversions

Référence	Description	Quantité
EDD 038 060	Digital / Analogical Conversion Monitor	1
EDD 038 100	Analogical : Digital Conversion Monitor	1
ERD 037 782	Bag of security stackable patching cords (several lengths and colours) 20 of 2 mm and 5 of 4 mm	2
PMM 062 180	Symmetrical Power Supply : ± 15 V, 1 A	1
	Manual of experiments	1

(We suggest the composition of the Package, for special configuration, please ask)



Core Transformer



Studied topics

- Plotting of Hysteresis cycle with adjustable frequency (from 0,2 Hz to 500 Hz).
- Plotting of the 1st magnetization curve with the ramp generator.
- Visualization of the immediate power with an integrated multiplier.
- Measurement of average power with a low-pass filter.
- **Several experiments are supplied with the monitor**

Technical Characteristics - PED 037 460

Transformers	Iron and Ferrite core transformers
Functions	Power amplifier, Current measurement amplifier, ramp generator, integrator, multiplier, low-pass filter
Power supply	+/- 15 V external power supply

Pack PED 3746 B : Study of the core transformer

Reference	Description	Quantity
PED 037 460	Core transformer monitor	1
ERD 037 782	Bag of security stackable patching cords (several lengths and colours) 20 of 2 mm and 5 of 4 mm	1
PMM 062 200	Power supply : +10 to +15 Vdc 4 A and -10 to -15 Vdc 2 A	1

(We suggest the composition of the Package, for special configuration, please ask)

Nodal Breakdown supplies



Studied topics

- Flyback power supply.
- Forward power supply.
- Push Pull power supply.
- Choppers with inductive and capacitive accumulation.
- **Several experiments are supplied with the monitor**

Technical Characteristics - PED 037 670

Functions	Energy conversion with transformers (Flyback, Forward and Push Pull)	Smoothing
	Transistor controlled switch	Load with a RC circuit
	Pulse generator with adjustable frequency and duration	
	Condenser-diode detection (for the visualization of energy transfer)	Optoelectronic insulation (for the realization of a regulated power supply)
Power supply	6/12 V external power supply	

Pack PED 3767 B : Package for the study of "Nodal breakdown power supply"

Reference	Description	Quantity
PED 037 670	Nodal breakdown power supply monitor	1
PMM 062 200	Power supply : +10 to +15 Vdc 4 A and -10 to -15 Vdc 2 A	1
ERD 037 782	Bag of security stackable patching cords (several lengths and colours) 20 of 2 mm and 5 of 4 mm	1

(We suggest the composition of the Package, for special configuration, please ask)



Magnetic circuits



Studied topics

- Several magnetic circuits transformer with iron core and transformer with ferrite core, pulse transformer.
- Measurement of the inductance of a circuit with a ferrite core.
- Hysteresis cycle.
- Flyback power supply.
- Etc.
- **Several experiments are supplied with the monitor**

Technical Characteristics - EPD 037 650

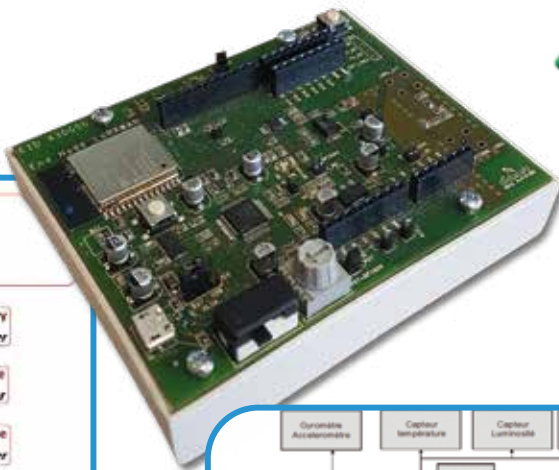
Functions	Energy Conversion with iron core, ferrite core or pulse transformer	
	Self coil	Integregation by an operating amplifier assembly
	Pulse generator, with adjustable frequency	Rectifier, filtering made with diodes and condenser
	Amplification with power OP Amp	Load resistor
	Power transistor, Zener diode (demagnetizing ofr instance)	
Power supply	+/- 15 V ecternal power supply	

Pack EPD 3765 B : Study of magnetic circuits

Reference	Description	Quantity
EPD 037 650	Monitor for the study of magnetic circuits	1
ERD 037 782	Bag of security stackable patching cords (several lengths and colours) 20 of 2 mm and 5 of 4 mm	1
PMM 062 200	Power supply : +10 to +15 Vdc 4 A and -10 to -15 Vdc 2 A	1

(We suggest the composition of the Package, for special configuration, please ask)

IoT : End Nodes LoRa Sensors



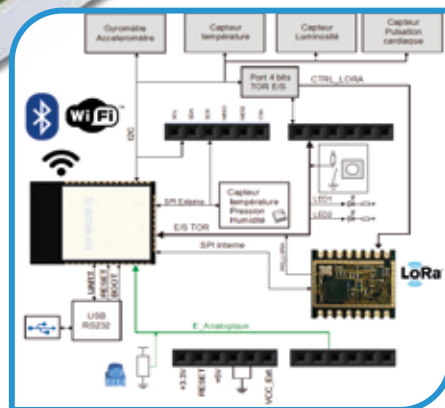
Studied topics

- The experiments we suggest are intended to familiarize the student with the use of different sensors and the diversity of possible applications
- We also highlight the particular technology used by LoRa to drastically reduce the power consumption while ensuring a communication of several kilometers between the different elements.

See page 18 - LoRa/LoRaWAN

Sensors

- Hygrometry
Hygrometer
- Pressure
Barometer
- Temperature
Thermometer
- Luminosity
Luxmeter
- Pulse oxygen saturation SpO₂
Heart rate
Pulse oximeter
- Linear and angular
Acceleration
Inertial unit
- Magnetic field
Magnetometer
- Rapid Prototyping
GPS, Gauge, Wattmeter...





Basic Logic



Highlights

- Signal generators.
- Protection against short-circuits.
- Correspondance of the screen printing on the monitor with the manufacturers' datasheets

Studied topics

- Basic logic, based on diodes, diodes/transistors), TTL
- Logic functions with 2 or 3 inputs.
- Flip flops

Technical Characteristics - EDD 100 000

Basic functions	2 resistors, 3 diodes, 1 transistor (to get the functions AND, OR, NOR, NAND with RTL & DTL), 6 NOT
2 inputs functions	2 x 4 AND, 2 x 4 NAND, 2 x 4 OR, 4 x XOR, 2 x 4 NOR
3 inputs functions	3 NAND, 3 NOR
Flip flops	2 RS flip-flops, 2 RSH flip-flops, 2 D flip-flops, 4 JK flip-flops with forced inputs
Generators	8 switches for programming 0 or 1 levels, 1 potentiometer, 1 bounce-free pushbuttons 1 pushbutton to be wired, 1 fixed clock 1 kHz, 1, 1 Adjustable clock 100 Hz to 2 kHz
Visualization	8 LED, 2 adaptators (BNC/ 2-mm sockets)

Experiments

EXP 1	From DTL logic to TTL logic	EXP 7	Lock or latch Flip-flops
EXP 2	De Morgan theorems	EXP 8	RS Flip-flops JK master/slave Flip-flops
EXP 3	Decoders, multiplexers, demultiplexers	EXP 9	D Flip-flops
EXP 4	Additionneur	EXP 10	BCD synchronous Counter and decouner
EXP 5	3-bits comparator	EXP 11	Synchronous and programmable Binary Counter
EXP 6	RS basic Flip-flops		

Pack EDD 100 B : Basic Logic

Reference	Description	Quantity
EDD 100 000	Basic logic training monitor	1
PEM 061 151	Set of 10 yellow patching cords ; Ø 2 mm, 10 cm long	1
PEM 061 190	Set of 10 red patching cords ; Ø 2 mm, 10 cm long	1
PEM 061 200	Set of 10 black patching cords ; Ø 2 mm, 25 cm long	1
PEM 061 440	Set of 10 red patching cords ; Ø 2 mm, 25 cm long	1
PEM 061 600	Set of 10 red patching cords ; Ø 2 mm, 50 cm long	1
EGD 000 001	8 VAC, 2 A Power supply	1
EDD 100 040	Manual of Experiments for the student	1
EDD 100 050	Manual of Experiments for the teacher (with answers)	1

(We suggest the composition of the Package, for special configuration, please ask)



Digital Logic



Highlights

- Optional monitor of the EDD100000 monitor

Studied topics

- First steps to the study of microprocessors.
- Counter – Decounter.
- Multiplexer – Demultiplexer.
- Offset Register.
- ALU.
- NAND with open collector inputs – 3 states Buffers.

Technical Characteristics - EDD 120 000

Combinatory circuits	NAND with open collector, 3-states buffers
Studied functions	Programmable counter / decounter, 4-bits comparators, 2x4 3-state buffers with common control, parallel serial register, 2x 2/4 demultiplexer, 2x 4/1 multiplexers, 8 operations ALU (Arithmetic and Logic Unit) (set, reset, addition, subtraction, OR, AND, XOR, multiplication)
Generators	3 switches for programming 0 or 1 levels, 4 pull-up resistors
Visualization	2x 7 segments display with encoder

Experiments

EXP 1	Gates with open collector ininput
EXP 2	3 strates gate
EXP 3	Multiplexer
EXP 4	Decoder
EXP 5	ALU : Arithmetic and Logic Unit
EXP 6	Binary and programmable Counter decounter
EXP 7	Universal offset register
EXP 8	Comparator

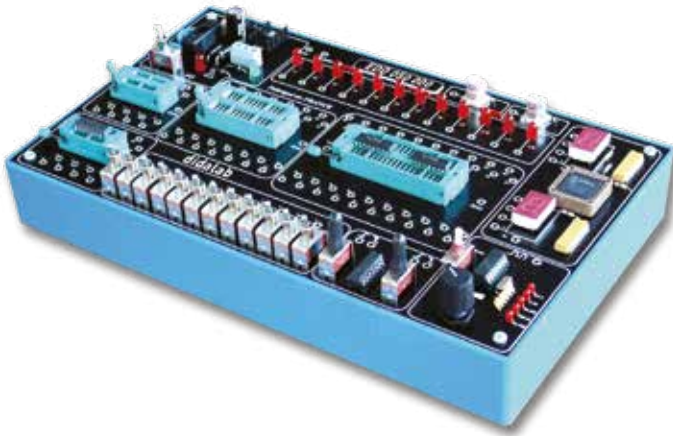
Pack EDD 120 B : Digital logic

Reference	Description	Quantity
EDD 120 000	Digital logic training monitor (optional of EDD100000)	1
PEM 061 600	Set of 10 red patching cords; Ø 2 mm, 50 cm long	1
EDD 120 040	Manual of Experiments for the student	1
EDD 120 050	Manual of Experiments for the teacher (with answers)	1

Pack EDD 100 C : Basic and Digital logic

Reference	Description	Quantity
EDD 100 B	Pack Basic Logic	1
EDD 120 B	Pack Digital Logic	1

(We suggest the composition of the Package, for special configuration, please ask)



Highlights

- Implantation of all kind of circuits.
- Textool sockets with 2 mm connections,
- 8 to 40 pins.
- Signal generator.
- 12 LED, 2 7-segments display.
- Protection against short-circuits.

Technical Characteristics - EDD 050 000

DIL sockets	2* 16 pins sockets 7.62 mm, 1* 28 pins sockets 7.62/15.24 mm, 1* 40 pins sockets 7.62/15.24 mm
Generators	12 switches for programming 0 or 1 levels, 2 bounce-free pushbuttons for practical works on flip-flops, counters and registers 1 Adjustable clock : 0.1 Hz to 10 kHz (adjustement with pushbutton and fine ajustement with potentiometer)
Visualization	2* 7 segments display with encoder, 12 display LEDs with transistor interface, 2 adaptators (BNC/ 2-mm sockets)

Pack EDD 050 B : Study of the digital technologies

Reference	Description	Quantity
EDD 050 000	Basic logic monitor	1
EDD 050 100	Set of components (74LS00, 74LS04, 74LS08, 74LS32, 74LS86, 74LS02, 74LS10, 74LS112, 74LS74, 74LS244, 74LS194, 74LS85, 74LS191, 74LS139, 74LS253).	1
PEM 061 190	Set of 10 red stackable leads ; Ø 2 mm, 10 cm long.	1
PEM 061 440	Set of 10 red stackable leads ; Ø 2 mm, 25 cm long.	1
PEM 061 600	Set of 10 red stackable leads ; Ø 2 mm, 50 cm long.	1
EGD 000 001	9 VAC, 2 A Power supply.	1

(We suggest the composition of the Package, for special configuration, please ask)



All modules are supplied with experiments manuals, written by partner teachers.



Programmable Logic



Highlights

- 64 Macrocells, 32 Inputs/Outputs
- Signal generator
- Visualization with LEDs or with 7-segments display
- PC104 bus
- LATTICE ISP Lever developing tool

Studied topics

- Description with diagrams or VHDL language.
- Simulation and component's syntheses.

Technical Characteristics - EDD 200 000

Circuit	EPLD LATTICE MACH4-64/32.
Generators	5 switches for programming 0 or 1 levels, 1 bounce-free pushbuttons for practical works on flip-flops and counters, 1 2Hz/2kHz switchable clock.
Visualization	2 multiplexed 7-segments display, 4 LEDs

Experiments

EXP 0	Commissioning of the EPLD package, realisation of the 4-bits inverter function
EXP 1	Combinatory Logic
EXP 2	Multiplexer
EXP 3	Demultiplexer
EXP 4	7-segments decoder
EXP 5	Basic RS Flip-flops
EXP 6	BCD programmable counter-decounter BCD

Pack EDD 200 B : Programmable logic

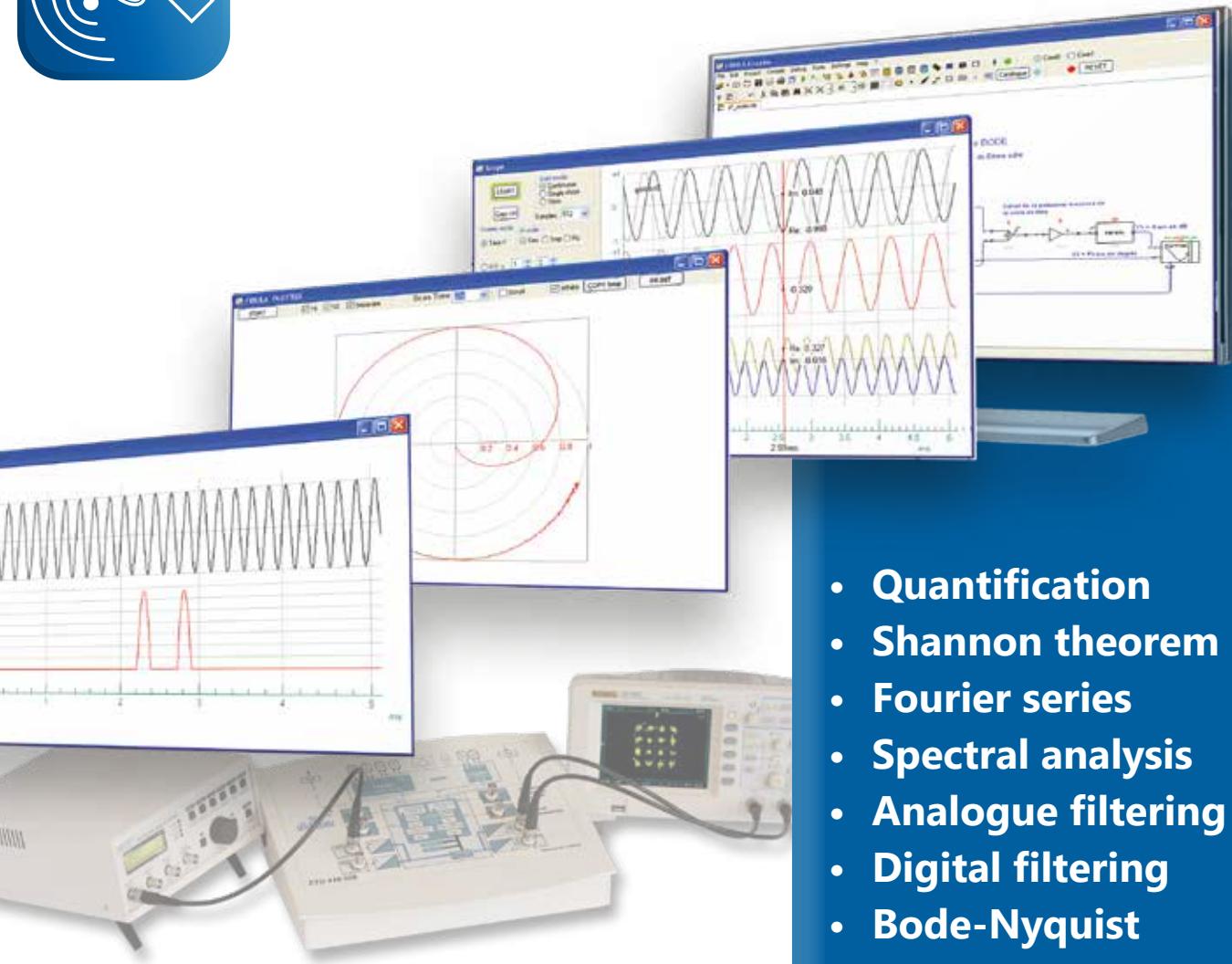
Reference	Description	Quantity
EDD 200 000	Programmable logic training monitor, based on a EPLD.	1
EDD 200 100	VHDL software, for edition, simulation and filtering	1
EGD 000 006	USB lead, AA kind	1
EGD 000 001	A8-VAC/ 2A power supply.	1
EDD 200 040	Manual of Experiments for the teacher (with answers)	1
EDD 200 050	Manual of Experiments for the student.	1

(We suggest the composition of the Package, for special configuration, please ask)

Nota : Use of ISP Lever Starter can be downloaded, free of charge, on LATTICE website, for education customers.



Real time signal processing



- Quantification
- Shannon theorem
- Fourier series
- Spectral analysis
- Analogue filtering
- Digital filtering
- Bode-Nyquist
- Modulation - demodulation



ETD 410 video



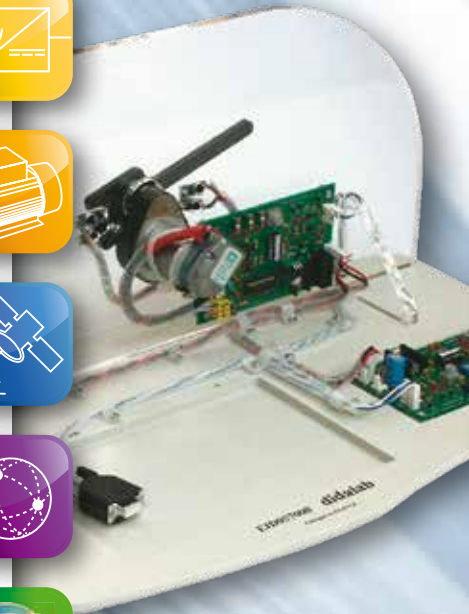
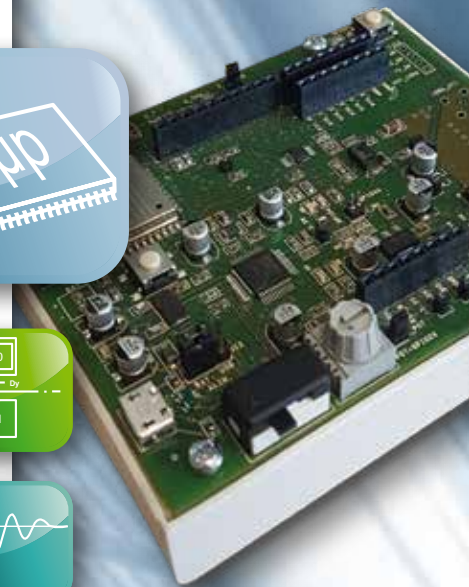
Didalab forum



For more information, please see page 124.

Computer Science

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IoT : End Nodes LoRa

New

Highlights

- Very low consumption
- Long distance
- High power processor : "ESP32"
- Embedded sensors
- Wifi, Bluetooth
- USB
- Compatible with Arduino sensors
- Prototyping

Studied topics

- The experiments we suggest are intended to familiarize the student with the use of different sensors and the diversity of possible applications
- We also highlight the particular technology used by LoRa to drastically reduce the power consumption while ensuring a communication of several kilometers between the different elements.

See page 122 - LoRa/LoRaWAN



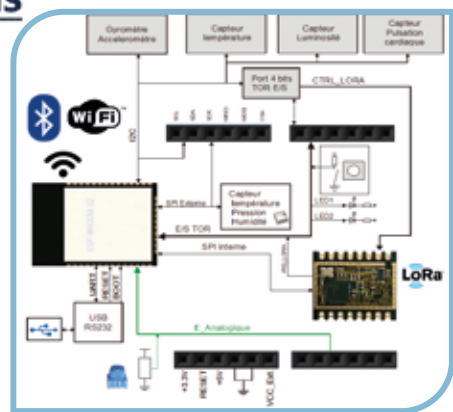
Programmations



Protocoles



Serial Bus



COMPUTER SCIENCE

Technical characteristics - EID 430 000 - Hardware structure

CPU	ESP32 Soc (XTENSA dual core 32 bits LX6 microprocessor à 240 MHz, 600 DMIPS), Bluetooth, WIFI
Memory	32-Mbit Flash
Serial bus	UART, 2 SPI, I2C, USB, RS232
Port	6 ADC inputs, 2 DAC outputs., 1 potentiometer, 2 LEDs, 1 On/Off I/O USB debug and ESP programming
Measures	Current, signals, serial bus
Modem	LoRa/ GFSK at 868 MHz with LoRaWAN stack (class A, B and C), measure of RSSI and SNB with 1 embedded antenna and 1 20 dB attenuator output.
Sensors	Temperature, pressure, humidity, luminosity, heart pulse rate, accelerometer, 3-axis gyroscope magnetometer
Power supply	5V via USB or battery (built-in charger)
Support	Arduino shield with 1 port for power supply, 1 analogue port and 1 digital port

Pack EID 430 A : Basic IoT LoRa/LoRaWAN package :

Reference	Description	Quantity
EID 430 000	LoRa / LoRaWAN End Device module, 868 MHz, including 1 ESP32 with 32 Mbit Flash, 1 UART, 2 SPI, 2 I ² C, 1 WIFI, 1 Bluetooth, 6 ADC inputs, 2 DAC outputs. Programming and debug via USB interface. It includes 1 push button, 1 potentiometer, 2 LEDs, 1 temperature sensor, 1 humidity and pressure sensor, 1 luminosity sensor, 1 heart pulse sensor, 1 accelerometer and 3-axis gyroscope sensor, 1 current measure , and 1 shield arduino (with 1 port for power supply, 1 analogue port and 2 digital ports). 1 LoRa / GFSK Modem, 868 MHz (with LoRaWAN stack (Class A, B and C), measure of RSSI and SNR) with 1 embedded antenna and 1 20-dB attenuation output. Power supply : 5V via USB or batteries.	1



8/16-bits 68HC12 Microprocessor & Microcontroller



Highlights

- Study of the structure of microcontrollers and microprocessors.
- Use of a circuit, well spread in the industry and in the education worlds
- Use of the instruction codes of the 68HC11.
- Lots of available applications board : traffic lights, keypad/display board, CAN network, speed and position servosystem, and everyboard with a 8-bits PC104.

Studied topics

- Discovery of the structure of a microsystem, CPU, memory, registers, accumulator, index register, On/Off Inputs /Outputs, analog Inputs /Outputs, interruptions.

Technical characteristics - EID 110 000 - Motherboard for the study of 68HC12 microprocessor

CPU	68HC12, 8 MHz
Memories	Flash EPROM 128 ko, EEPROM 2 ko, RAM 8 ko
Serial bus	RS232, USB, SPI & I2C
Parallel bus	PC104 for the connection of a lot of application boards
Parallel port	24-bits On/Off I/O ports, 1 interruption, 6x 10-bits analog inputs and 4x 8-bits analog outputs

Experiments - EID 110 040 - Motherboard in assembler, in «C» language

EXP 0	Installation, commissioning, discovery of the developing environment , writing, RAM memory reading
EXP 1	Use of the LCD display
EXP 2	Use of the Joystick in asking mode then in interruption mode
EXP 3	Development of the time base, integrated in the μP (RTI function), Development of a chronometer
EXP 4	Development of a RS232 connection, in asking mode then in interruption mode
EXP 5	Detection of fronts on On/off Input, in asking mode then in interruption mode, discovery of the memory paging mechanism
EXP 6	Development of a communication via CAN networks

Experiments - EID 110 140 - Motherboard with inputs/outputs simulator, in assembler and in « C » language

EXP 1	Recopy of a 8-inputs port on a 8-outputs port
EXP 2	Development of a basic sequencer with the time base au μP integrated in the μP (RTI function)
EXP 3	Development of a 0-to-9 counter (1 Hz), transcoding and display on a 7-segments display segments
EXP 4	Configuration and acquisition of an analog quantity,display of the result on the LCD and analog output
EXP 5	Detection of fronts on On/off Input, in asking mode then in interruption mode

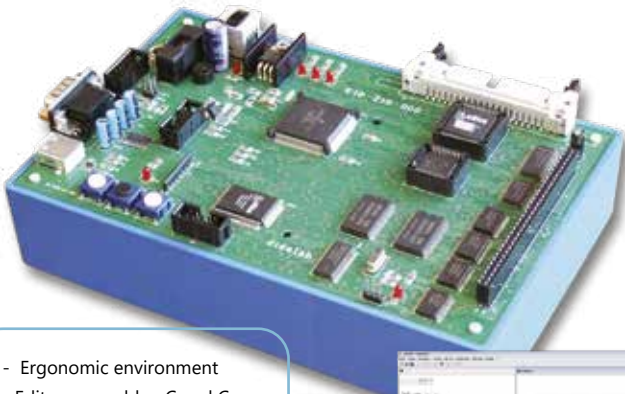
Package EID 110 B : System based on the 68HC12, 8/16 bits, editor, assembler and C compiler

Reference	Description	Quantity
EID 110 000	Studying board of the 68HC12 microcontroller, supplied with CODE WARRIOR environment, special version (limited to 32 ko of code) developed by Freescale company	1
EID 001 000	Input/ Output Simulator, with a 40-points connector	1
EGD 000 003	Serial connector : DB9/DB9 F/F X modem	1
EGD 000 006	USB lead, type AA	1
EGD 000 001	8-VAC power supply, 2 A	1
EID 110 040	Manual of experiments for the EID110000 board, files on a CD-ROM	1
EID 111 040	Manual of experiments for the EID110000 board, with applications on the I/O board redf EID001000, files on a CD-ROM	1

(We suggest the composition of the package, for special configuration, please ask)



16/32 bits CPU32 Microprocessor & Microcontroller



Highlights

- Study of the structure of 16 and 32-bits microcontrollers and microprocessors
- Use of instruction codes of the « 68000 »
- Compatibility with the programs of the « 68000 »
- Lots of available applications board : traffic lights, keypad/display board, CAN network, speed and position servosystem, and everyboard with a 8-bits PC104

- Ergonomic environment
- Editor, assembler, C and C++ cross compiler
- Debugger, stop points, display and modifications of registers, accumulators, memory zones
- GDB debugger



Studied topics

- Discovery of the structure of a microsystem, CPU, memory, registers, accumulator, index register, On/Off Inputs /Outputs, analog Inputs /Outputs, interruptions.

Technical characteristics - EID 210 000 - Mother board : study of the «68332»

CPU	68332, 16,7 MHz
Memories	Flash EPROM : 128 kbytes, RAM : 128 kbytes of 16 bits
Serial bus	RS232, USB, SPI & I2C
Parallel bus	PC104 for the connection of a lot of application boards
Parallel port	24-bits On/Off I/O ports, 1 interruption, 6x 12-bits analog inputs and 4x 8-bits analog Outputs

Experiments - EID 210 040 - Mother board, solutions in assembler and C

EXP 0	Installation and comissioning of the equipment
EXP 1	Writing in a RAM memory zone
EXP 2	Development of a basic sequencer on the QS port of the CPU
EXP 3	Development of a "écho" mode on the computer, terminal mode
EXP 4	Display of the register value on the computer screen, at the user's request
EXP 5	Writing and reading at a specific address in the memory zone of the board

Experiments - EID 211 040 - Mother board with I/O simulator board

EXP 1	Development of a basic sequencer on the LEDs of the I/O simulator
EXP 2	Copy out of a byte of the Input port (microswitchs) on the 8-LEDs Output port
EXP 3	Development of a 0-to-9 counter (1 Hz), transcoding and display on a 7-segments display
EXP 4	Configuration of a converter, acquisition, conversion and display of its value on the 7-segments display
EXP 5	Counting of the commutations on the interruption Input

Package EID 210 B : system based on a 68332, 16/32 bits, editor, assembler and C/C++ compiler

Reference	Description	Quantity
EID 210 000	Studying board for the CPU32 microcontroller with editor, cross assembler, linker, debugger, technical guide	1
EID 001 000	Input/ Output Simulator, with a 40-points connector	1
EGD 000 003	Serial connector : DB9/DB9 F/F X modem	1
EGD 000 001	8-VAC power supply, 2- A	1
EID 210 040	Manual of experiments for the EID210000 board, files on a CD-ROM	1
EID 211 040	Manual of experiments for the EID210000 board, with applications on the I/O board redf EID001000, files on a CD-ROM	1
EID 210 100	Development environment, GNU C++ compiler, for the EID210000 board	1

(We suggest the composition of the package, for special configuration, please ask)



Embedded web server, with TCP/IP stack



Highlights

- Applications board for our motherboards.
- Can be used with all our boards supplied with a PC104 bus

Studied topics

- Realization of an embedded Web server servosystem ; car.
- Consultation from a distance via internet.
- Study of a 10-Mbits Ethernet network.

Technical characteristics - EID 003 000 - Embedded Web server

CPU	IP2022 (Internet Processor), developed by UBICOM, ping function integrated
Functions	TCP/IP stack supplied, control of the TELNET port (port 23), WEB port (port 80). Sockets, Web server, SPI bus, I2C
Bus	Can be connected on any board with an industrial PC104 bus

Experiments - EID 213 040 - Embedded Web server

EXP 1	Control of Telnet
EXP 2	Creation of a Chat via the Telnet port
EXP 3	Reception of an Internet Explorer frame
EXP 4	Reception of an answer on Internet Explorer
EXP 5	Integration of the CGI

Package EID 003 B : Embedded Web server Optional extra (for use with EID110B or EID210B)

Reference	Description	Quantity
EID 003 000	Operating part board : study of a 10 Mbits Ethernet network with TCP/IP stack, sockets, Web server, 1 SPI, I2C bus	1
EGD 000 010	RJ45 lead, 50 cm	1
EID 213 040	Manual of experiments for the EID 110 000 or EID 210 000 board, files on CD-ROM	1

(We suggest the composition of the package, for special configuration, please ask)

Watch our videos on Didalab Youtube Channel



DIDALAB78





Traffic lights Simulator



Highlights

- Applications board for our motherboards.
- Complete crossroads
main road, secondary road, left-slip road
car detection, pedestrian's call

Studied topics

- Yellow lights flashing.
- Alternate continuous operation on both roads
(Green/Yellow/Red lights).
- Consideration of pedestrians' calls.
- Car detection on the left-slip road, etc

Package EID 002 B : Traffic lights applications board (optional complement of EID110B or EID210B)

Reference	Description	Quantity
EID 002 000	Applications unit : Traffic lights, supplied with 40-points connector, technical manual	1
EGD 000 001	8 VAC, 2 A. power supply	1
EID 212 040	Manual of experiments for EID 110 000 or EID 210 000 boards, files on a CD-ROM	1

(We suggest the composition of the package, for special configuration, please ask)

Display/Keypad



Highlights

- Applications board for our motherboards.
- Can be associated with all our main boards delivered with a PC104 bus.

Studied topics

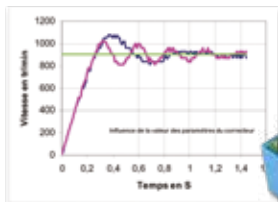
- 16 pads matrix keypad.
- ASCII display device, graphic, monochrome.
- Realization of a Clock.

Package EID 005 B : Display/keypad applications board (optional complement of EID110B or EID210B)

Reference	Description	Quantity
EID 005 000	Applications unit : Display/keypad board, supplied with 40-points connector, technical manual	1
EID 215 040	Manual of experiments for EID 110 000 or EID 210 000 boards, files on a CD-ROM	1

(We suggest the composition of the package, for special configuration, please ask)

Study of speed and position servosystem for a DC motor via microprocessor



Highlights

- Encoder 100pts/turn
- PWM motor control.
- Speed 2 position information with analogue or On/Off measurement
- Digital control with C corrector.
- Recovery of the system characteristics and plotting of the response curve.

Package de base EID 060 B : Speed and position servosystem on DC motor via 68332 microcontroller

Reference	Description	Quantity
EID 060 000	DC motors group with encoder and 40-pts connector, technical and user's manual	1
EGD 000 001	9 VAC, 2 A power supply	1
EID 060 040	Manual of experiments speed and position servocontrols via 68332 microprocessor, in C language, supplied with programs on a CDROM	1

(We suggest the composition of the package, for special configuration, please ask)



Set of boards for CAN networks

Highlights

Many configurations suggested

(cf following pages)

- Control of standard or comprehensive CAN modes.
- Drivers and source codes supplied.
- Many experiments available

Technical characteristics - EID 004 000 - CAN networks controller



Function	CAN bus controller
Environment	Setting up on EID 210 000 board or every other PC-104 compatible board
CAN controller	SJA 1000 Philips
Interface	optoelectronic kind
Communicating speed	up to 1 Mbits/s

Technical characteristics - EID 050 000 - 8-On/Off Inputs CAN board

Function	Can generate user instructions on the CAN bus
Environment	Direct connection on the CAN bus
Power supply	2x 0/12 V connectors (1 arrival, 1 recovery). 5 V regulator on the board
Microcontroller	CAN Expander MCP25020
On/Off inputs	4 pushbuttons, 4 microswitchs
Analog input	1 potentiometer on the 0/5 V analog input and 10-bits converter
10-pts connector	8 On/Off inputs, 1 analog input, 1 common point
Visualization	8 LED for the visualization of the inputs



Technical characteristics - EID 051 000 - 4-ON/Off power Outputs CAN board



Function	Can operate 12 V/12 A lamps via the CAN bus
Environment	Direct connection on the CAN bus
Power supply	2x 0/12 V connectors (1 arrival, 1 recovery). 5 V regulator on the board
Microcontroller	CAN Expander MCP25050
On/Off Outputs	4x 12 V/12 A On/Off power outputs
Visualization	4 LED for the visualization of the states, connected to the power outputs
Simulations of failures	1 microswitch for the simulation of a filament breaking

Technical characteristics - EID 052 000 - Motor speed control and regulation board

Function	Can control a motor (windscreen wiper with speed servocontrol). Conduct of the securities and the endtravels
Environment	Direct connection on the CAN bus
Power supply	2x 0/12 V connectors (1 arrival, 1 recovery). 5V regulator on the board
Microcontroller	CAN Expander MCP25050
Power stage	4-quadrants chopper, L6203. PWM 1A / 12 Vdc
Encoder Input	1 encoder input
On/Off inputs	2 On/Off endstroke inputs, 1 overtravel input 3 microswitchs for the simulation of endstrokes and overtravels
Analog Input	1 potentiometer





Optional Extra : « Car signal lights system » via CAN networks



Highlights

- Applications board for our motherboards
- Friendly ergonomics
 - Plexiglas board with imprints
 - Power supplies and CAN bus pre-connected
- Applications source codes supplied.
- CAN Bus in accordance to CAN2.0B norms

Studied topics

- Gradual experiments
 - Commuting of the lamps of an optical block.
 - Knowing the state of the control handlever.
 - Check of the running of an optical block.
 - Control of the optical block via the control handlever.

Technical characteristics - Optional CAN01A - «Lighting system of a car via CAN networks»

1x 8 On/Off inputs board	EID 050 000 (see description in previous page).
4x 4 On/Off power outputs CAN boards	EID 051 000 (see description in previous page).
1 CAN network controller board	EID 004 000 (see description in previous page).

Manual of experiments - EID 050 040

EXP 1	Commuting of the lamps of an optical block
EXP 2	Knowing the state of the lights control handlever
EXP 3	Check of the running of an optical block
EXP 4	Control of the optical block via the control handlever

Package CAN 01 A : Optional «Lighting system of a car via CAN networks»»

Reference	Description	Quantity
EID 004 000	CAN bus on PC 104 board	1
EID 050 000	8 On/Off and 1 analog inputs CAN bus module with power bus and CAN cable	1
EID 051 000	4 On/Off outputs and 4 inputs CAN bus module with power bus and CAN cable	4
EID 050 040	Manual of experiments (bus can) in C language, adapted for the EID210, files on a CD-ROM	1
EGD 000 007	12 V/1 A power supply	1
EID 056 000	Plexiglas board, pre-connected for the optional CAN01A	1

(We suggest the composition of the package, for special configuration, please ask)



Optional Extra :

« Control and regulation of the motor of a windscreen wiper » via CAN networks

CAN - LIN



Highlights

- Applications board for our motherboards.
- Friendly ergonomics
 - Plexiglas board with imprints
 - Power supplies and CAN bus pre-connected
- Applications source codes supplied.
- CAN Bus in accordance to CAN2.0B norms.

Studied topics

- Gradual experiments
 - Control of the motor of the windscreen wiper
 - Make the wiper swing
 - Control the speed of the wiper
 - Make the control of the wiper

Technical characteristics - Optional CAN01B - «Control of the motor of the windscreen wiper»

1x 8 On/Off inputs board	EID 050 000 (see description in previous page).
1 motor speed control board	EID 052 000 (see description in previous page).
1 CAN network controller board CAN	EID 004 000 (see description in previous page).

Manual of experiments - EID 050 040

EXP 5	Control of the motor of the windscreen wiper
EXP 6	Make the wiper swing
EXP 7	Control of the speed of the wiper
EXP 8	Make the control of the wiper

Package CAN 01 B : optional extra "Control and regulation of the motor of a windscreen wiper" via CAN networks

Reference	Description	Quantity
EID 004 000	CAN bus on PC 104 board	1
EID 050 000	8 On/Off and 1 analog inputs CAN bus module with power bus and CAN cable	1
EID 053 000	Windscreen with wiper with motor, EID 052 000 CAN board and connections	1
EID 050 040	Manual of experiments (bus can) in C language, adapted for rhe EID210, files on a CD-ROM	1
EGD 000 007	12 V/1 A power supply	1
EID 057 000	Plexiglas board, pre-connected for the optional CAN01B	1

(We suggest the composition of the package, for special configuration, please ask)



Pedagogical Multiplexed car, basic version



Highlights

- A real automotive environment
 - Thermoformed support.
 - Embedded computer with Man/Machine Interface
 - Car signal lights system.
 - Power modules.
 - Lights handlever
- Applications source codes supplied.
- CAN Bus in accordance to CAN2.0B norms

Studied topics

- Gradual experimentss
 - Commuting of the lamps of an optical block.
 - Knowing the state of the "handlever".
 - Check of the running of an optical block.
 - Control of the optical block via the « handlever ».
 - Creation of a Man/Machine interface

Experiments

EID 210 040	Experiments supplied for the 68332 mother board (EID 210 000)
EID 211 040	Experiments supplied for the 68332 mother board (EID 210 000). + I/O board
EID 215 040	Experiments supplied for Display/keypad applications board (EID 005 000)
EID 050 040	Experiments supplied for the CAN packages (CAN01A and CAN01B)

Experiments - EID 211 060 - Board based on the 68332 + UML and C++ analysis

EXP 1	Commuting of the lamps of an optical block	EXP 3	Check of the running of an optical block
EXP 2	Knowing the state of the lights "handlever"	EXP 4	Control of the optical block via the « handlever"

Package VMD 01 B : Pedagogical Multiplexed car, basic version

Reference	Description	Quantity
EID 210 000	Board fo the study of 32-bits 68332 microcontroller, with editor, cross assembler, linker, dbugger, technical manual	1
EID 001 000	Inputs/Outputs simulator, with a 40-points connector	1
EGD 000 003	Serial connector : DB9/DB9 F/F X modem	1
EGD 000 001	8 VAC, 2-A power supply	1
EID 210 040	Manual of experiments for the EID 210 000 mother board, files on a CD-ROM	1
EID 211 040	Manual of experiments for the I/O EID 001 000 board, application of the EID 210 000, files on a CD-ROM	1
EID 211 060	Manual of experiments for the UML and OBJECT programming on the EID 210 000 board and EID 001 000 board, files on a CD-ROM	1
EID 210 100	Developing environment, GNU C/C++ compiler, 1-licence GDB for the EID 210 000 board.	1
EID 004 000	CAN bus on PC 104 board	1
EID 050 000	8 On/Off and 1 analog inputs CAN bus module with power bus and CAN cable	1
EID 051 000	4 On/Off outputs and 4 inputs CAN bus module with power bus and CAN cable	4
EID 050 040	Manual of experiments (bus can) in C language, adapted for rhe EID210, files on a CD-ROM	1
EID 005 000	Display/keypad board: ASCII display device, (7 to 20) x 16 characters and/or 128 x 64 graphic, monochrome	1
EID 215 040	Manual of experiments for the EID005 000 display/keypad board, files on a CD-ROM	1
EID 055 000	Support representing a car, 1/4 scale, pre-connected	1
EID 054 000	Set of real components: 1 lights handlever, 2 30-W front optical blocks (sidelights / crossing lights/ headlights, turn signals), 2 back optivcal blocks (stop lights / sidelights / turn signals), horn, each module delivered with its connections	1
EGD 000 004	13,5 Vdc 20 A, power supply	1



Pedagogical Multiplexed car, complete version



Highlights

- A real automotive environment
 - VMD01B environment.
 - Control and regulation of the windscreen wiper via CAN bus.
 - Set windscreen with wiper.
 - Wiper handlever.
 - Embedded WEB server.
 - Real time kernel.

Studied topics

- Gradual Experiments
 - Control of the lights function via CAN bus.
 - Servocontrol of a motor via CAN bus.
 - Control of the wiper function via CAN bus.
 - Creation of a Man/Machine interface.
 - Commissioning of a real time kernel
 - UML Analysis

Manuals of Experiments - EID 213 040 - Networks board

EXP 1	Control of the Telnet
EXP 2	Creation of a Chat via the Telnet port
EXP 3	Reception of an Internet Explorer frame
EXP 4	Reception of an answer on Internet Explorer
EXP 5	Integration of the CGI

Manual of experiments - EID 050 050 - CAN Bus and real time kernel

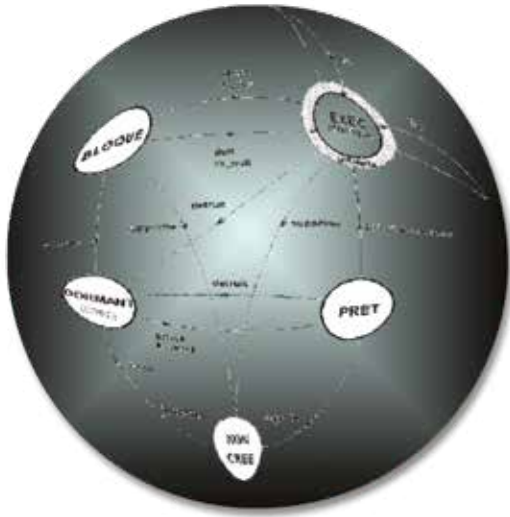
EXP 1	Commuting of the lamps of an optical block
EXP 2	Knowing the state of the lights "handlever"
EXP 3	Check of the running of an optical block
EXP 4	Control of the optical block via the « handlever"
EXP 5	Control the wiper with the wiper handlever
EXP 6	Control of the PMC (Pedagogical Multiplexed Car) with the real time kernel (regular interrogation of the different modules)
EXP 7	Automatic sending of a frame via MCP25050
EXP 8	Control of the PMC with the real time kernel (the modules send their state directly by themselves)

Package VMD 01 C : Pedagogical Multiplexed car, complete version

Reference	Description	Quantity
VMD 01 B	All the components of the basic version	1
EID 053 000	Windscreen with wiper and motor set, EID 052 000 CAN board, handlever with its connections	1
EID 003 000	Operating part board: study of a 10 Mbits Ethernet network with TCP/IP battery, sockets, Web server, 1 SPI, I2C bus	1
EGD 000 010	RJ45 networks cord, 50 cm	1
EID 213 040	Manual of experiments for the EID 003 000 networks board	1
EID 210 200	MTR86 real time kernel (1 computer license)	1
EID 210 240	Manual for multitasks systems, real time system and MTR86	1
EID 050 050	Manual of experiments for the CAN bus and MTR86 real time kernel, for the EID210 board, files on a CD-ROM	1
EID 055 100	Protecting slip cover, made of PVC	1



Real time Kernel



Highlights

- Multitask monitor.
- Manages the resources of the EID 210 000 motherboard.
- Control of the RS232 port.
- Control of the USB port

Studied topics

- Implanting the MTR86 on our EID 210 000 board.
- Control of the CAN bus via MTR86

Technical characteristics - MTR 86 - Real Time Kernel

Dynamic creation of tasks (max 32, 32 levels of priority)
Immediate launch or cyclic launch of task (user mode)
Destruction and cancellation of tasks
Control of the interruption procedures
Control of the counts signals
Control of the resources
Synchronisation with rendez-vous
Communication via tubes, letterbox and messages
Control of the Inputs/Outputs (non-blocking)
Statistic recording of the resources, used via the processor
Dynamic/static modification of the quantum time from 1 to 50 ms

Package MTR 86 : Real time kernel, optional extra

Reference	Description	Quantity
EID 210 200	MTR86 real time Kernel (1 computer license)	1
	Reference manual	1
	Examples of experiments for the EID 210 000 board	1



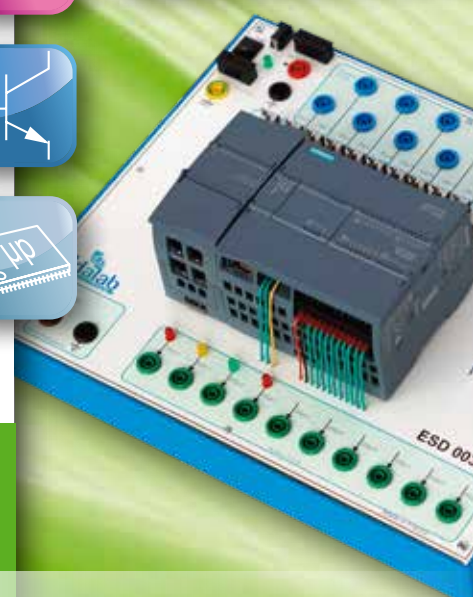
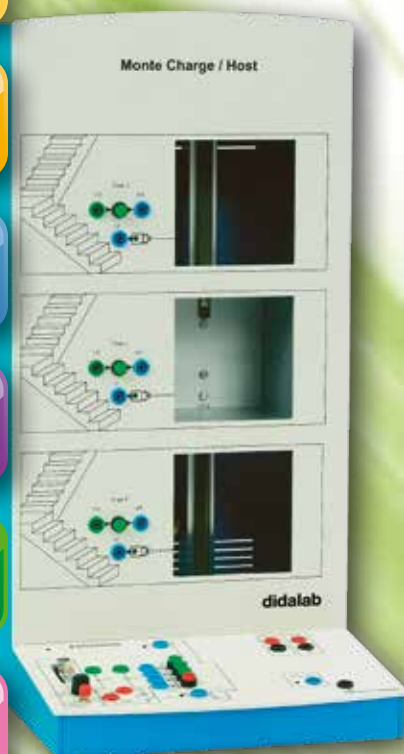
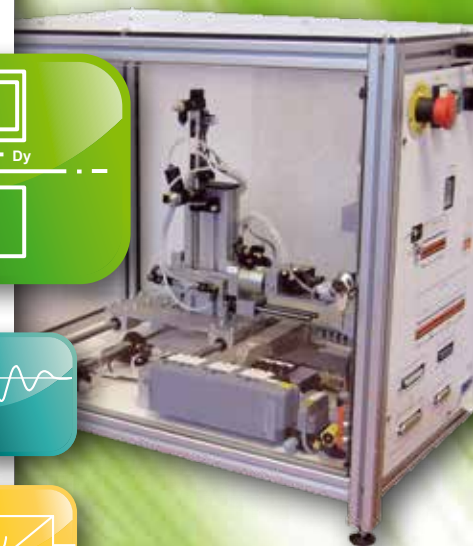
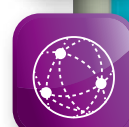
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Automatic control

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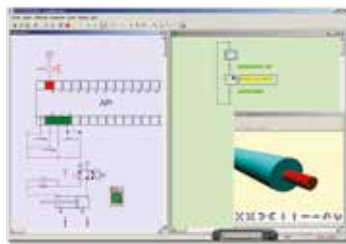


AUTOMSIM – Simulation of electric, pneumatic, hydraulic PLCs

AUTOMGEN – Creation of Industrial PLC programs

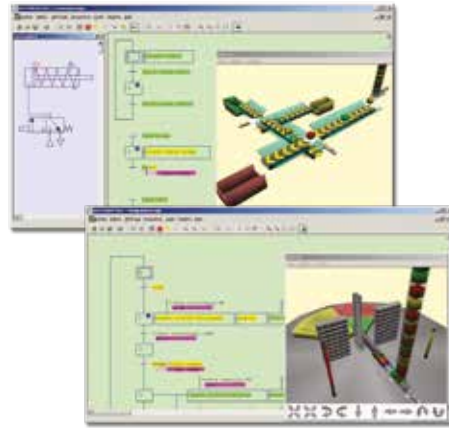
Highlights

- Integrated package (AUTOMGEN/AUTOMSIM).
- Easy and quick handling.
- Very large library.
- Dynamic modification of the diagrams during the simulation.
- Very widely used automatic control program
- Used in the Industry
- Standard programming languages (GEMMA, Grafset, ladder...).
- Very realistic simulation of operating parts.



Studied topics

- Simulation of 3D operating parts with physical engine.
- Electric /pneumatic / hydraulic and digital electronic simulation.
- Creation of programs for PLC.
- Supervision.



Technical Characteristics - AUTOMGEN/AUTOMSIM

Minimal configuration	Microsoft WINDOWS, 256 MB RAM with video board, 1024x768
Programming languages	Grafset, Gemma, Ladder, Logic, Flow chart, Literal, CEI 1131-3
Compatible PLCs or targets	SCHNEIDER (PB, SMC, TSX17-10, 17-20, 47, 07, 37, 57, ZELIO, ZELIO2, TWIDO), SIEMENS (S5, S7), ABB (CS31, AC31), KLOCKNER-MOELLER (PS3, PS4, PS414), GE-FANUC (90 Micro, 9030), CEGELEC (C50, C100, 8005, 8035), OMRON (C, CV, CS), MITSUBISHI (FX, Q), FESTO, PANASONIC, LEGO RCX and NXT, LANGAGE C, PC (I/O drivers available with I/O for I/O driving – use a PC as a PLC), Didalab (ESD030, ESD250, ESD350), others (contact us).
3D Simulation	Import of 3D files from SOLIDWORKS*, SOLID CONCEPT*, 3D STUDIO*, etc... TOKAMAK physical engine
Objects Library	Electric Pneumatic Hydraulic Digital Electronic
Advanced functionalities	Curves drawing (pressure, etc...), exportation of diagrams in EMF format (WORD, etc, ...), extension of the objects library.

VIRTUAL UNIVERSE PRO – Automation software for 3D Creation and Simulation

Highlights

- Creation et simulation of virtual machines in a 3D environment with physical engines.
- Customizable by importing a full model from the main CAD softwares : Solidworks, Inventor, Catia...



Studied topics

- Modelling
- Real time simulation
- Creation and validation fo PLC programs.



Technical Characteristics - VIRTUAL UNIVERSE PRO

Minimum configuration	XP, Vista and Seven 32 et 64 bits
Model importation	Solidworks, Inventor, Catia,
3D file format	3DXML, 3DS, OBJ, etc.

Pedagogical M221 PLC, 24 I/16 O on safety sockets



Highlights

- Pedagogical M221 PLC
- 24 On/Off inputs, 16 of them with simulator
- 16 On/Off outputs,
- Connections with Ø4-mm safety sockets
- 16 mini switches
- Embedded power supply. Compact product to be put on a table
- USB adaptation lead
- Programming software SoMachine ; languages : contact (ladder), list.

Package ESD 006 B : Basic package "Pedagogical Programmable Logic Controller M221" :

Reference	Description	Quantity
ESD 006 000	Schneider M221 PLC, 24 On/Off inputs, 16 On/Off Outputs, programmable with Somachine Basic software (to download)	1
	Power cable with 2P+E 16-A socket, to connect the module to Mains	1
	USB lead, to connect the module's PLC to the computer	1
ESD 006 040	Technical and pedagogical manual «Study of programming and applications in ladder or grafcet language»	1

Pedagogical M340 PLC, 52 I/O on safety sockets, CANOPEN bus, Ethernet



Highlights



- Connections with Ø4-mm safety sockets for
 - 16 On/Off relay outputs
 - 16 On/Off inputs
 - 4 analog inputs and 2 analog outputs
- Connections with DB37 and DB25 compatible with ESD030 flexible cell :
 - 31 On/Off inputs
 - 21 On/Off relay outputs.
 - 16 miniswitches for test
 - 1 CANOPEN master link embedded in the CU
 - 1 Ethernet link (no web server) embedded in the CU
 - USB lead for PC/PLC connection
 - EcoStruxure Program (1 licence) ; languages: LD, FBD, SFC, ST and IL

Package ESD 002 B : Basic package "Pedagogical Programmable Logic Controller M340"

Reference	Description	Quantity
ESD 002 000	Schneider M340 PLC, 31 On/Off inputs, 21 On/Off Outputs, 4 analog inputs and 2 analog outputs, CAN OPEN, Ethernet, connections with Ø4-mm safety sockets and SUBD37 and 25 pts connectors, simulator of inputs, embedded power supply	1
	USB lead, to connect the module's PLC to the computer	1
	Programming software, 1 licence for programming in LD, FBD, SFC, ST and IL languages.	1

Pedagogical S7-1200 PLC



Highlights

- Industrial S7 1200 PLC
- 14 On/Off inputs, 10 On/Off outputs, 24 VDC
- 1 analog input and 1 analog output, on Ø 4-mm socket
- 1 analog input on potentiometer
- TIA portal software for PC (1 station licence)

Package ESD 003 B : Basic package «Pedagogical, Industrial Programmable Logic Controller S7-1200»

Reference	Description	Quantity
ESD 003 000	Siemens S7-1200 PLC, 14 On/Off inputs 10 On/Off Outputs, 1 analog input, 1 analog output, Programming software, (1 license), UTP lead	1
ESD 003 100	Automgen software	1
ESD 003 040	Manual of practical works (applications with the ESD250 hoist)	1
EGD 000 005	24 Vdc power supply, 2.9 A	1

(We suggest the composition of the Package, for special configuration, please ask)

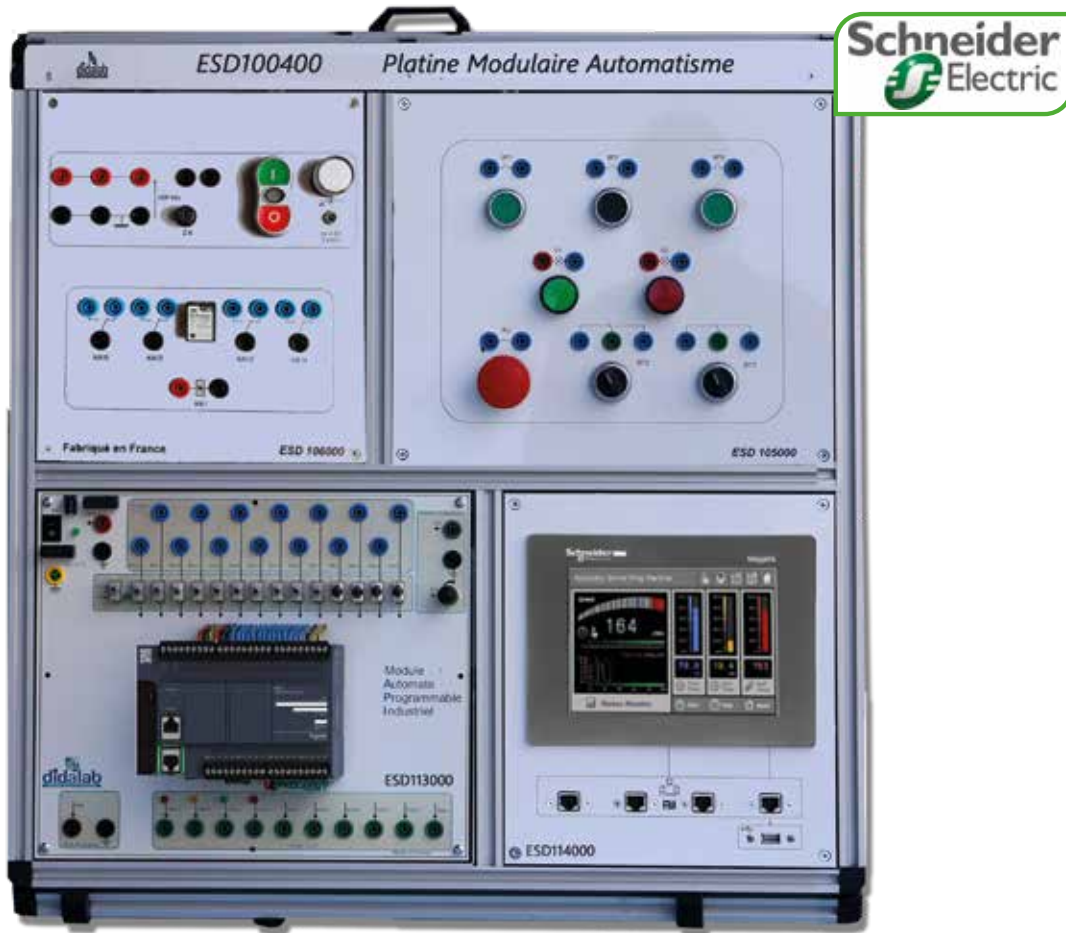


Highlights

- Very progressive training in the field of automation.
- Based on Schneider Electric® PLC and HMI
- Compatible with all the operating parts of our Automatic control range : (Hoist, lift, traffic lights, electropneumatic cell)

Studied topics

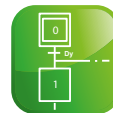
- Study of a developed wiring diagram in automation
- Study and implementation of a PLC network
- Study of PLC programming
- Study of HMI programming



AUTOMATIC CONTROL

Package ESD 100 SE : PLC modular bench (Schneider Electric)

Reference	Description	Quantity
ESD 100 400	Structure made of aluminium profile, with 4 locations for electrical and PLC modules. 1 USB flash drive with the technical guide, the pedagogical manual with experiments	1
ESD 106 000	Electrical power supply module	1
ESD 113 000	PLC module M221 PLC, supplied with SoMachine software : - 16 On/Off Inputs, 24 VDC, 16 outputs with state visualization, - 1 analogue input, 0/10 V ; 1 analogue output, +/-10V 12 bits, - 1 simulator with 8 miniswitches Put on a pedagogical module with Ø 4-mm security	1
ESD 114 000	Magelis HMI module	1
ESD 105 000	Electric HMI interface (1 Emergency stop button, 1 green light, 1 red light, 2 2-position switches, 2 green push-buttons, 1 black push-button)	1
PEM 080 030	Set of 10 patching cords, 1 m, black, Ø4-mm safety sockets, stackable	1
PEM 080 031	Set of 10 patching cords, 1 m, red, Ø4-mm safety sockets, stackable	1
PEM 080 032	Set of 10 patching cords, 1 m, blue, Ø4-mm safety sockets, stackable	1

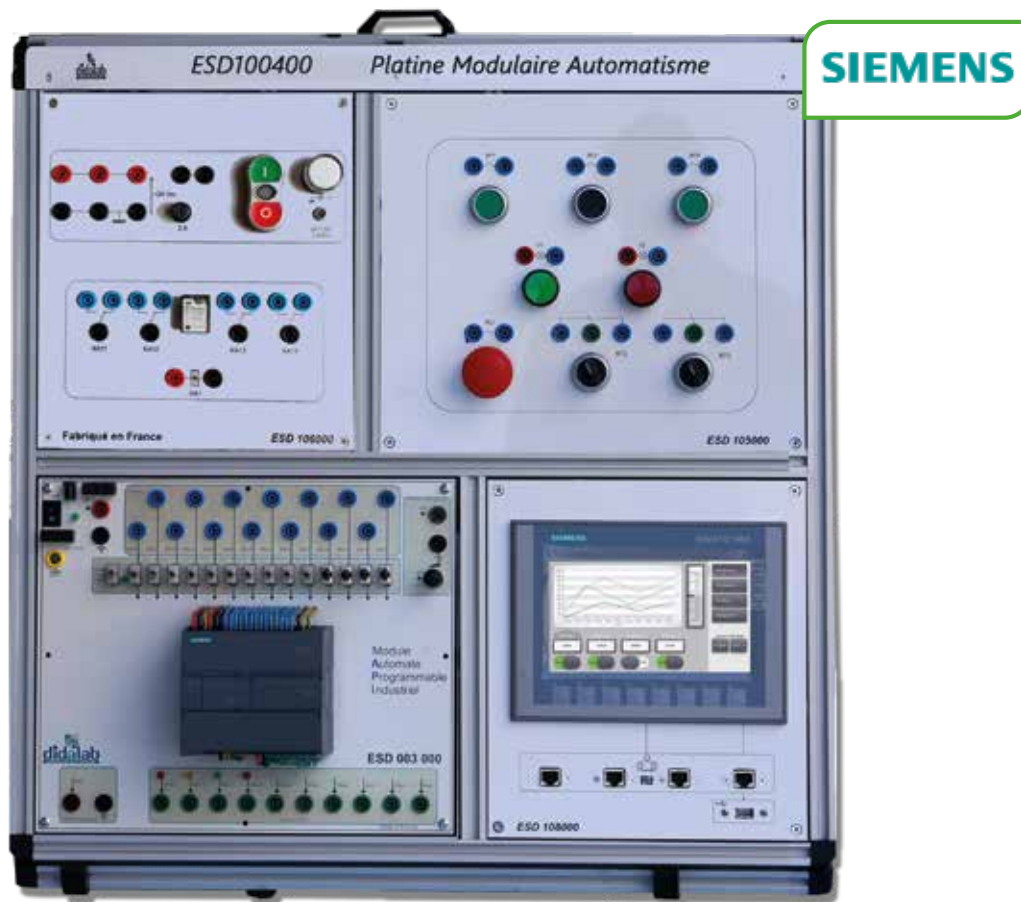


Highlights

- Very progressive training in the field of automation.
- Based on Siemens® PLC and HMI
- Compatible with all the operating parts of our Automatic control range : (Hoist, lift, traffic lights, electropneumatic cell)

Studied topics

- Study of a developed wiring diagram in automation
- Study and implementation of a PLC network
- Study of PLC programming
- Study of HMI programming



Package ESD 100 SI : PLC modular bench (Siemens)

Reference	Description	Quantity
ESD 100 400	Automate Structure made of aluminium profile, with 4 locations for electrical and PLC modules. 1 USB flash drive with the technical guide, the pedagogical manual with experiments	1
ESD 106 000	Electrical power supply module	1
ESD 107 000	PLC module S7-1200 PLC, supplied with TIA Portal software : - 14 On/Off Inputs, 24 VDC, 10 outputs with state visualization, - 1 analogue Input, 0/10 V ; 1 analogue output, +/-10V, 12 bits, - 1 simulator with 8 miniswitches Put on a pedagogical module with Ø 4-mm security	1
ESD 003 100	Autogen software extension	1
ESD 108 000	KTP 700 HMI module with 4 RJ45-ports and 1 USB connector	1
ESD 105 000	Electric HMI interface (1 Emergency stop button, 1 green light, 1 red light, 2 2-position switches, 2 green push-buttons, 1 black push-button)	1
PEM 080 030	Set of 10 patching cords, 1 m, black, Ø4-mm safety sockets, stackable	1
PEM 080 031	Set of 10 patching cords, 1 m, red, Ø4-mm safety sockets, stackable	1
PEM 080 032	Set of 10 patching cords, 1 m, blue, Ø4-mm safety sockets, stackable	1

AUTOMATIC CONTROL



SA TRI BOX 4.0 : Automated System for sorting boxes, 4.0

Highlights

- Numerous technologies (industrial drives for SELV DC motors and brushless, sensors, automation)
- Sensors and actuators accessible via 4 mm sockets on the front panel
- Limited space requirement (table top)
- Work in SELV
- All sensor and actuator information accessible via a web interface

Studied topics

- Setting of the different organs
- Conveyor management
- Learning of electric axis
- Speed / position control
- Supervision by Web server
- Preventive maintenance
- Implementation of a complete sorting line

Back Side



AUTOMATIC CONTROL

Technical characteristics - ESD 600 000 - SA TRI BOX 4.0

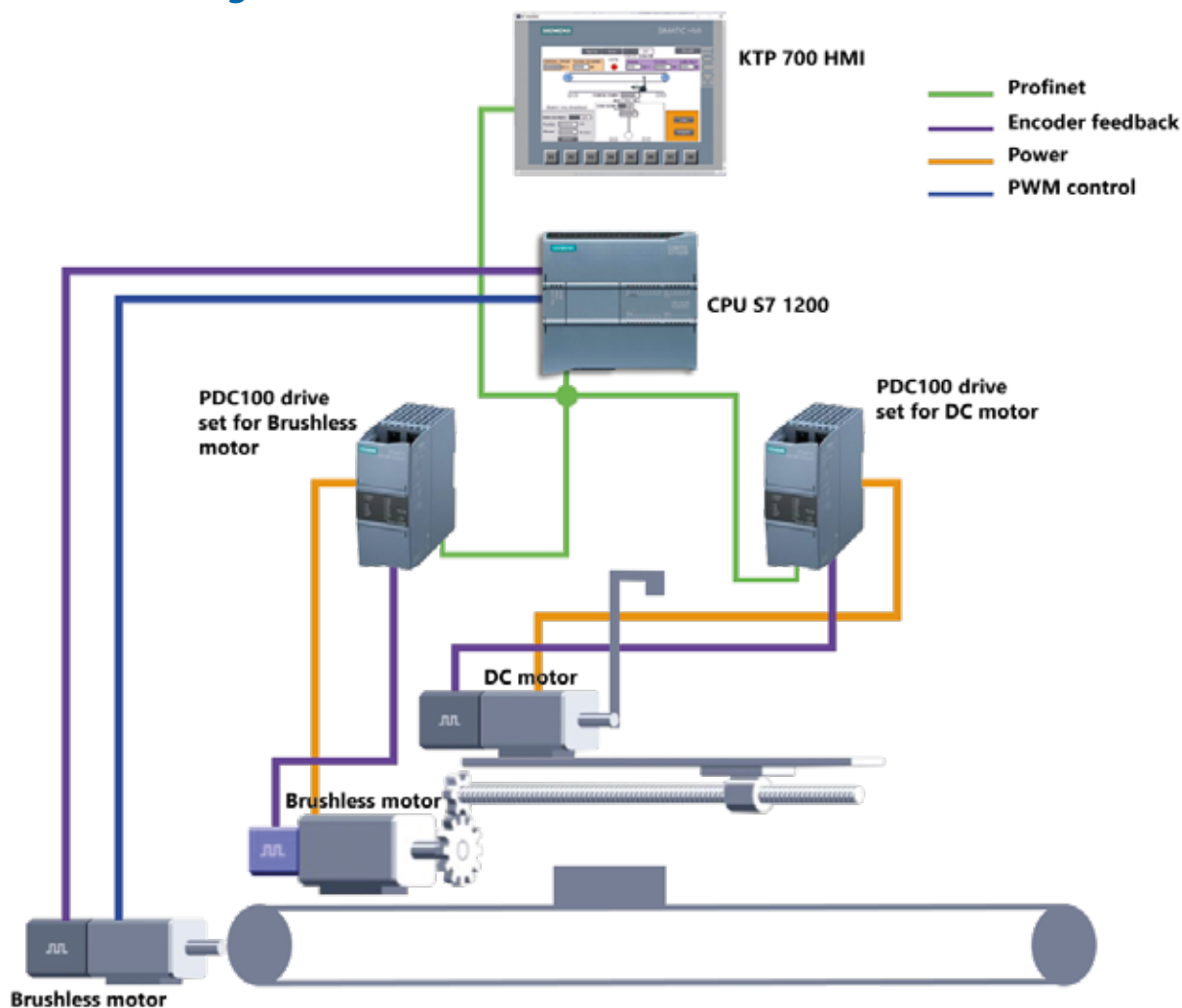
Conveyor	1 meter long conveyor with its encoder motor. It includes 1 carriage with its brushless motor reducer 1 arm with mcc motor reducer and an electromagnet 2 recycling bins; 1 waste bin
Sensors	1 box presence sensor 1 Inductive sensor
Industrial PLC	SIMATIC S7 1200 PLC - 50 kB working memory, 6 fast counters and 2 integrated pulse outputs, - Cycle time: 1ms for 1000 instructions, - PROFINET port for programming. - 1 single-user TIA Portal license
HMI	KTP 700 HMI - 7" graphic color operator panel KTP700 - WEB Server function allowing the connection of several PCs simultaneously
Motors	1 Brushless motor with incremental encoder 500 pts/rev 1 Brushless motor with incremental encoder 12 pts/rev 1 DC motor with incremental encoder 500 pts/rev
Drives	SIMATIC MICRO-DRIVE PDC100, drive controller for servo control in the SELV range 24 to 48 VDC of the drive voltage supply max. 100W motor power, with STO hardwired



» Contextualization : recycling line 4.0

A conveyor is fed with different boxes (aluminum, plastic, ferrous metals). At the beginning of the conveyor, a presence/box size sensor and then an inductive sensor are used to characterize the boxes. The parts identified as too small for recycling and/or non-metallic are then conveyed to the end of the line to be sent to the wastebin. Metallic boxes, of sufficient size, identified as parts to be recycled are then removed from the conveyor using a mechanical arm and placed in a sorting bin. To best meet the new requirements of Industry 4.0, all sensor and actuator information is accessible via a web interface, allowing remote supervision and control of the sorting line.

» Schematic diagram



Package ESD 600 B : SA-TRI BOX 4.0

Reference	Description	Quantity
ESD 600 000	Aluminium profile system including : 1 meter long conveyor with its encoder motor. 1 box presence sensor, 1 Inductive sensor 1 carriage with its brushless motor reducer 1 arm with mcc motor reducer and an electromagnet 2 recycling bins ; 1 waste bin	1
ESD 003 000	S7-1200 PLC, TIA Portal software on a trainer board with Ø 4 mm sockets - 14 digital inputs 24 VDC, 10 outputs with status display, - 1 analog input 0/10 V, 1 output +/-10V 12 bits, - 1 simulator 8 miniswitches	1
ESD 108 000	HMI module KTP 700 with 4 RJ45 crossings and USB socket	1
ESS 1X0 000	2 preset PDC100 drives (1 for DC motor, the other for Brushless motor)	1
	1 switch	
	Set of 30 cords 1 m, (black, red, blue) safety sockets Ø 4mm, stackable	



Modular training bench for the study of pneumatic and electro pneumatic technologies

Highlights

- Modular bench
- Pneumatic connections
- Electrical connections
- Electro-pneumatic connections

Studied topics

- Study of components and their technology
- Study of pneumatic logic functions



Technical Characteristics - ESD 100 B - Modular training bench for the study of pneumatic and electro pneumatic technologies

Power supply module	1 pressure regulator, 1 pneumatic supply, 1 manual valve, 10 4-mm 1/8 connectors, 1 30-s time function, 1 memory function, 2 AND, 2 OR, 2 NO functions
Electro-pneumatic interface module	2 pneumo-electrical, and 5 electropneumatic interfaces, 1 3/2-pneumatic valve, 2 5/2-pneumatic valves
Cylinders module	1 simple acting cylinder, 2 double acting cylinders, ILS, pressure drop, rollers sensors
Pneumatic HIM module	1 Emergency stop button, 2 green lights, 2 2-position switches, 2 green push-buttons, 1 black push-button
Electrical HIM module	1 Emergency stop button, 1 green light, 1 red light, 2 2-position switches, 2 green push-buttons, 1 black push-button
Electrical power supply module	24-Vdc power supply, 1 Power presence indicator, 1 ON/OFF button, 1 4-contact relay

Package ESD 100 B : Modular training bench for the study of pneumatic and electro pneumatic technologies

Reference	Description	Quantity
ESD 100 000	Structure made of aluminium profile, with 6 locations for pneumatic, electrical and electropneumatic modules. Supplied with two Ø4-mm, 25-m hoses (1 red + 1 blue), 1 pipe cutter, one 2-m Ø 8-mm hose 1 flash drive with the technical and user guide, the pedagogical book with experiments.	1
ESD 101 000	Cylinders Module (1 simple acting cylinder, 2 double acting cylinders, ILS, pressure drop, rollers sensors)	1
ESD 102 000	Interfaces module : 2 pneumoelectrical, and 5 electropneumatic	1
ESD 103 000	Pneumatic functions module (1 memory, 2 AND, 2 OR, 2 NOT, 1 temporisation)	1
ESD 104 000	Pneumatic HMI interface (1 Emergency stop button, 2 green lights, 2 2-position switches, 2 green push-buttons, 1 black push-button)	1
ESD 105 000	Electric HMI interface (1 Emergency stop button, 1 green light, 1 red light, 2 2-position switches, 2 green push-buttons, 1 black push-button)	1
ESD 106 000	Electrical power supply module (1 white light 1 ON/OFF push-button, fuse)	1

(We suggest the composition of the Package, for special configuration, please ask)



Automatic modular training bench for the study of pneumatic and electro pneumatic technologies with PLC

Highlights

- Modular bench
- Pneumatic connections
- Electrical connections
- Electro-pneumatic connections
- PLC control

Studied topics

- Study of components and their technology
- Study of pneumatic logic functions
- PLC programming and HMI



or



Technical Characteristics - ESD 100 A - Automatic modular training bench for the study of pneumatic and electro pneumatic technologies

Power supply module	1 pressure regulator, 1 pneumatic supply, 1 manual valve, 1 24-Vdc power supply, Power presence indicator, 1 ON/OFF button , 1 4-contact relay
Electro-pneumatic interface module	2 pneumo-electrical, and 5 electropneumatic interfaces, 1 3/2-pneumatic valve, 2 5/2-pneumatic valves
Cylinders module	1 simple acting cylinder, 2 double acting cylinders, ILS sensors
PLC module	S7-1200 PLC, TIA Portal program, including : - 14 ON/Off Inputs, 24 VDC, 10 outputs with state visualization, - 1 0/10-V analogue input, 1 +/-10V-output, 12 bits,
Electrical HMI module	1 green light, 1 red light, 2 2-position switches, 2 green push-buttons, 1 black push-button, 1 Emergency stop button
HMI module	7" operator terminal, graphic, ref KTP700 WEB Server function for the simultaneous connection of several computers

Package ESD 100 A : Automatic modular training bench for the study of pneumatic and electro pneumatic technologies

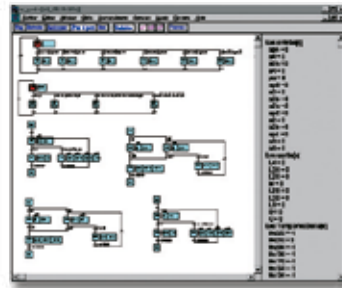
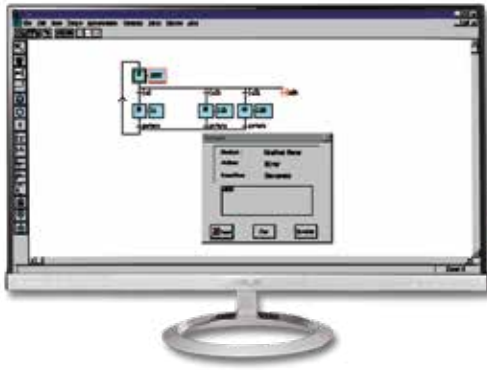
Reference	Description	Quantity
ESD 100 000	Structure made of aluminium profile, with 6 locations for pneumatic, electrical and electropneumatic modules. Supplied with two Ø4-mm, 25-m hoses (1 red + 1 blue), 1 pipe cutter, one 2-m Ø 8-mm hose 1 flash drive with the technical and user guide, the pedagogical book with experiments.	1
ESD 111 000	Cylinders module (1 simple acting cylinder, 2 double acting cylinders, ILS sensors)	1
ESD 112 000	Interfaces module : 2 pneumo-electrical, and 5 electropneumatic	1
ESD 109 000	Pneumatic and electrical power supplies module	1
ESD 107 000	PLC module	1
ESD 108 000	HMI module, KTP 700 HIM with 4 RJ45 crossover and USB socket	1
ESD 105 000	Electric HMI interface (1 Emergency stop button, 1 green light, 1 red light, 2 2-position switches, 2 green push-buttons, 1 black push-button)	1

(We suggest the composition of the Package, for special configuration, please ask)

AUTOMATIC CONTROL



MENTORGRAF Software- Editor, generator and simulator of GRAFCET



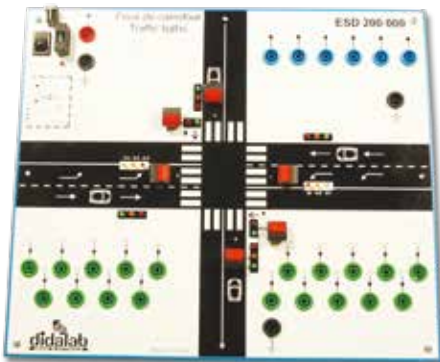
Highlights

- Can control all our operating units
- Simulator of GRAFCET

Technical characteristics - MENTORGRAF Software

Environment	Operates with Windows XP, Vista or Seven		
Applications units (see the following pages)	ESD 030 000, ESD 200 000, ESD 250 000, ESD 350 000.		
Editor	It draws the GRAFCET with basic tools, steps, transitions, divergence/convergence with AND, OR, macro steps...		
Generator	It converts the GRAFCET into an executable code, checks the syntax and the coherence between target variables and used variables..		
Simulator	It runs the GRAFCET in simulation, one "click" on the input variable enables the activation of the corresponding transition, the complete graph can be checked before controlling the operating units		
Interpreter	It runs and controls with the modes : step by step, trace and quick mode		
Number of steps	256	Number of transitions	256
Number of memories	256 memories 8 bits		
Specificity	Ability to simultaneously operate several independent GRAFCETS		

Traffic lights



Highlights

- 19 Inputs and 6 Outputs
- 19 LED (Green, Yellow, Red), with On/Off 5/24 Vdc control
- 6 push-buttons for pedestrian call or car presence simulation
- Can be controlled by any PLC as :
Schneider M221, Schneider M340, Siemens S7-1200, Omron CP1E ...).

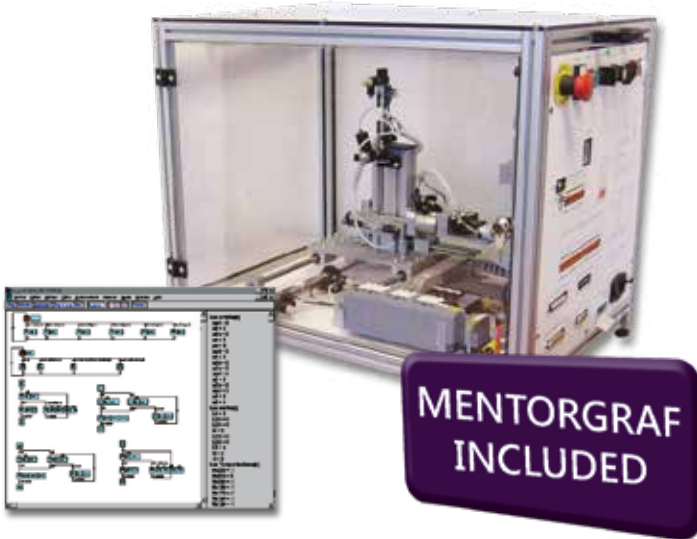
Studied topics

- Very progressive Practical Works:
From yellow flashing light to complete functioning of traffic lights with pedestrian call, secondary road car detections, left slip road.

Package ESD 200 B : Basic package, Traffic light with PLC control, including

Reference	Description	Quantity
ESD 200 000	Traffic lights module, with main and secondary roads - 6 Outputs (4 car presence detections, 2 pedestrian calls) - 19 Inputs (red, green yellow LEDs (traffic lights), The On/Off I/O are connected with Ø 4-mm security sockets I/O functioning voltages: 5 to 24 VDC Supplied with technical guide	1
EGD 000 005	24Vdc, 2,9A Power supply	optional extra
ELD 100 200	Set of 52 security patching cords, 36 A, stackable	optional extra

Electropneumatic robot



Highlights

- 4-axis + gripper robot.
- can be controlled by PLC or by computer

Studied topics

- Control of a automatic system with GRAFCET via PLC or PC (Mentor Graf software).
- Computer science : control of a sequential system with high-level language.

Technical characteristics - ESD 030 000 - Electropneumatic robot

Description	This system is the result of a collaboration between Didalab and Schneider companies, it shows a flexible cell for swaging of parts. It includes : - A 4-axis electropneumatic robot (translation, away/back, up/down, rotation) + gripper (open/close), - A swaging station, - An arrival store, - An outgoing rail, - A control program.
GRAFCET software	Editor, Generator, Simulator, Interpreter M-GRAF
Power supply	Electrical : 230 Vac / 50 Hz ; Pneumatical : 6 bars

Experiments

EXP 1	Introduction, reminder on Grafcet, technical description of the system
EXP 2	Grip, swaging, routing
EXP 3	Same specifications with a blink of the «Cycle departure» button
EXP 4	Development of a Man Machine Interface for the successive control of all the actuators of the cell in manual mode
EXP 5	Same subject as the exp. n°2 with light of the Cy D light
EXP 6	Same subject as the exp. n°2 but the swaging is done with a Grafcet macro
EXP 7	Same subject as the exp. n°2 with the memorisation of the number of cycles to do
EXP 8	Same subject as the exp. n°2 with simplification of the conditional actions
EXP 9	Same subject as the exp. n°2 with control via parallelism
EXP 10	Development of a Man Machine Interface for the control in manual mode
EXP 11	Complete operation of the electropneumatic unit

Package ESD 030 B : Basic Package «Study of the control of a robot with Grafcet»

Reference	Description	Quantity
ESD 030 000	Operation unit : electropneumatic flexible cell with 4-axis + gripper robot, swaging station, in-going and out-going rails, power supply, built-in interface board	1
ESD 030 100	MENTOR GRAF, Software for the edition and control with GRAFCET, operation with Windows (PC not supplied)	1
ESD 030 040	Manual of experiments «application for a FLEXIBLE CELL»	1
EGD 000 009	USB serial lead, AB kind	1

NB : a pneumatic supply is needed

Package ESD 030 C : Complete Package «Study of the control of a robot with Grafcet software and PLC»

Reference	Description	Quantity
ESD 030 B	Basic Package «Study of the control of a robot with Grafcet»	1
ESD 030 300	Industrial Programmable Logic Controller (PLC) in a box with DB25 and DB37 connections and corresponding patching cords.	1

(We suggest the composition of the Package, for special configuration, please ask)

AUTOMATIC CONTROL



3-level hoist 21 Inputs/Outputs



Highlights

- 21 Inputs/Outputs.
- Can be controlled by any kind of 12 or 24 V PLC or a computer with Mentorgraf (USB port).

Studied topics

- Discovery of a sequential automatic control with Grafcet.
- Simple cells, divergence.
- Divergence, convergence with AND and OR.
- Macro steps, internal variables, time delays.
- Master and Slave Grafcet

AUTOMATIC CONTROL

Technical characteristics - ESD 250 000 - Hoist operating unit

Description	Illustration of a sequential automatic control used by everybody
Details of the inputs	3 car calls display, 1 Up control, 1 Down control, 3 floor calls display
Details of the outputs	3 car calls, located on the vertical front panel, 3 car calls (inside the car, located on the control panel), 3 detectors with car presence display, Emergency stop with display, Car overweight detection
Securities	1 emergency stop 1 programmable overload detection
Analog outputs	Cabin motor voltage & current images
Power supply	Built-in, 230 V/50 Hz

Manual of experiments

GRAF CET N°1	Monostable actions, divergence, convergence	GRAF CET N°6	Bistable actions
GRAF CET N°2	Conditional actions, time delays	GRAF CET N°7	Divergences with AND
GRAF CET N°3	Front receptivity	GRAF CET N°8	Macro steps
GRAF CET N°4	Master and Slave Grafcets	GRAF CET N°9	Complete use of the hoist
GRAF CET N°5	Internal Variables (memories)		

Package ESD 250 C : Study of a sequential automatic control based on Grafcet

Reference	Description	Quantity
ESD 250 000	3-level hoist operating unit with built-in power supply, technical manual and MENTOR GRAF software for the GRAFCET edition and execution	1
ESD 250 040	Manual of Experiments « GRAFCET Programming for a hoist», with CD-ROM	1
EGD 000 003	Serial lead, DB9/DB9 F/F X modem	1
EGD 000 009	USB lead, AB kind.	1

(We suggest the composition of the Package, for special configuration, please ask)



5-level lift, up to 80 I/O with Mgraf or CANOPEN



Highlights

- 50 On/Off I/O on the diam-4 security sockets.
- 80 I/O with CAN OPEN or with Mgraf via a computer.
- Analog and On/Off Variables.
- In accordance to the new European norms for the security of the lifts.

Studied topics

- Discovery of a sequential automatic control with Grafset.
- Simple cells, divergence.
- Divergence, convergence with AND and OR.
- Macro steps, memorized actions, internal variables, analog variables (speed)
- Front Actions.
- Partition of a Grafset

Technical characteristics - ESD 350 000 - Lift operating unit

Details of the inputs	5 lights for level car presence, 5 lights for car call recording (passenger on the floor), 5 lights for car call recording (passenger inside the car), 1 light for emergency stop recording, 1 door opening control, 1 car up motion control, 1 car down motion control, 4 lights for up motion (level 0 to 3), 4 lights for down motion (level 4 to 1)
Details of the outputs	5 level calls (car buttons), 4 car calls for up motion (level buttons), 4 car calls for down motion (level buttons), 1 car overweight detection, 1 emergency stop (car button), 5 door opening detections.
Securities	1 emergency stop, 2 overtravels (high and low), 2 mechanical travelling ends (high and low), 1 overload detection.
Analog outputs	Cabin motor voltage & current images
Power supply	built-in, 230 V/ 50 Hz

Manual of experiments

EXP 1	Sequential string of events	EXP 6	Memorized actions
EXP 2	Selection and resumption of a sequence	EXP 7	Internal variables
EXP 3	Structural and interpreted parallelism	EXP 8	Front input variable
EXP 4	Macro étapes.	EXP 9	Time delay
EXP 5	Conditional actions	EXP 10	Complete control of the lift

Package ESD 350 C : Study of a sequential automatic control based on Grafset with CANOPEN

Reference	Description	Quantity
ESD 350 000	5-level lift operating unit with built-in power supply, technical manual and MENTOR GRAF software for the GRAFCET edition and execution	1
ESD 350 040	Manual of Experiments « GRAFCET Programming and control of a lift»	1
EGD 000 003	Serial lead, DB9/DB9 F/F X modem	1
EGD 000 009	USB lead, AB kind	1

(We suggest the composition of the Package, for special configuration, please ask)

AUTOMATIC CONTROL



Highlights

- Compact et modular , Cube-Elec 300 allows to implement a complete chain of automatic control
- The cube consists of an HMI and a Programmable Logic Controller and driver either for asynchronous motor either for brushless motor

Studied topics

- Profinet connections
- WinCC programming
- Web Server management
- TIA Portal
- PLC programming
- Setting and parameterization
- Study of the asynchronous motor
- Study of the brushless motor



NEW

AUTOMATIC CONTROL

HMI Side



- The HMI used is a KTP700
- 7"-operator console
- Graphic
- Colored
- WEB Server function for the simultaneous connection to several computers

Drive Side



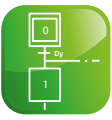
The drive used is
 - a SIMATIC G120C 0.55 kW with a graphic screen embedded, without any filter (for asynchronous motor)
 - a SIMATIC V90 (for brushless motor)

PLC Side



The PLC used is a SIMATIC S7-1200.
 Several characteristics :

- Working memory : 50 ko, 6 fast counters and 2 pulse Outputs included
- Time of cycle : 1 ms for 1000 instructions
- PROFINET port for programming



» **Block diagram**

» **Setting**



Associated products



EL 31_ : Motor bench with magnetic brake, 300W

EL 32_ : Motor bench with active load, 300W



Motor example



Squirrel cage asynchronous motor
240/400 V, operating power 370 W

AUTOMATIC CONTROL

Package EST 120 G : Cube-Elec 300 for Asynchronous motor

Reference	Description	Quantity
EST 100 000	Cube, made of aluminium frame, with 1 side for 230 VAC power supply and the switch for power ON	1
EST 101 000	KTP 700 HMI side, with 4 RJ45 crosses and USB sockets	1
ESD 003 000	S7-1200 PLC side, with TIA Portal program, with ø 2-mm socket optional	1
EST 120 000	G120C drive side, for 0,55 kW asynchronous motor (without filter)	1
Optional extra (not included)		
EL 303 000	Squirrel cage asynchronous motor, 240/400V, operating power 370 W, with coupling accessories	

Package EST 110 V : Cube-Elec 300 for brushless motor

Reference	Description	Quantity
EST 100 000	Cube, made of aluminium frame, with 1 side for 230 VAC power supply and the switch for power ON	1
EST 101 000	KTP 700 HMI side, with 4 RJ45 crosses and USB sockets	1
ESD 003 000	S7-1200 PLC side, with TIA Portal program, with ø 2-mm socket optional	1
EST 110 000	V90 drive side, supplied with brushless motor 200-W	1



Compatibility table : Cube-Elec 300

The product can be declined in several configurations, for our several power ranges (SELV 30 and 300 W, LV 300 and 1500 W)
 The 1500-W Cubes will need a 3-phase 380-V power supply (3P+N+E) with safety socket.

The other Cubes will need a 1-ph 220-V power supply. They will be supplied with a standard Mains socket.

The PLC and IHM are compatible with all the drives but are not mandatory.

We'll put a blank side when needed.

All the configurations here after are in PROFINET

For configurations with a Schneider PLC/HMI or for other communication networks (Modbus), please ask.

The 300-W (SELV or LV) external motors are compatible with our BICSIN(S) and BICMAC(S) load benches.

Depending of the configuration, the motor will be inside the box or not, same for the braking resistance.



AUTOMATIC CONTROL

	References	Drives						
		SELV 30/120 W range		SELV 300-W range	LV 300-W range		LV 1500-W range	
		Drive for DC motor 100 W	Drive for Brushless motor, 100 W	Drive for DC or Brushless motors, 300 W	Drive for Brushless motor, 300 W	Drive for 3-phase Asynchronous motor, 300 W	Drive for Brushless motors, 1500 W	Drive for 3-phase Asynchronous motor, 1500 W
		ESS 110 000	ESS 120 000	ESS 130 000	EST 110 000	EST 120 000	EST 210 000	EST 220 000
Internal motors <i>(Inside the cube)</i>								
DC motor, SELV 30 W		X						
Brushless motor, SELV 30 W			X					
External Motors		Optional						
DC motor, SELV 30 W	EPD 037 580	X	X					
Brushless motor, SELV 30 W	EPD 037 400	X	X					
DC motor, SELV 300 W	ELS 302 000			X				
Brushless motor, SELV 200 W	ELS 306 000			X				
Brushless motor, LV 200 W	ELS 308 000				X			
Asynchronous motor, LV 300 W	ELS 303 000					X		
Brushless motor, LV 1500 W	EL 408 000						X	
Asynchronous motor, LV 1500 W	ELD 152 000							X
Braking resistance								
70 Ohms 1500 W	ELD 115 070						X	X
Internal resistance		X	X	X	X	X		
S7-1200 PLC side	ESD 003 000	X	X	X	X	X	X	X
ø-2 mm safety sockets optional extra	ESD 000 010				X	X	X	X
HMI side	EST 100 100	X	X	X	X	X	X	X

» Exemple de configuration

Choice	Side - Designation	Motors	Optionnal	Reference	Note
1	Side 1 - Drive			ESS 110 000	
2		Internal motor	YES / NØ	Inclus	Motor and internal resistance embedded
		External motor	YES-/ NO	-	
3	Side 2 - Power supply			-	Automatic choice depending of the motor
4	Side 3 - PLC		YES / NØ	ESD 003 000	
5	Side 4 - HMI		YES-/ NO	-	

Choice	Side - Designation	Motors	Optionnal	Reference	Note
1	Side 1 - Drive			EST 220 000	Drive for 1.5-kW 3-ph asynchronous motor
2		Internal motor	YES / NØ	Inclus	Motor and internal resistance embedded
		External motor	YES-/ NO	-	
3	Side 2 - Power supply			-	Automatic choice depending of the motor
4	Side 3 - PLC		YES / NØ	ESD 003 000	
5	Side 4 - HMI		YES-/ NO	-	

Servo System and Process control

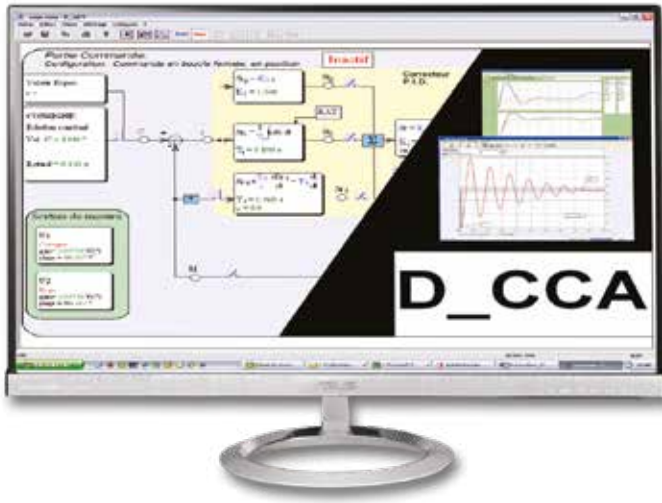
> Software for the control and the acquisition in automatic control engineering	46
> Automatic real time corrector generator	48
> Speed and position servosystem – ERD 050	52
> Speed and position servosystem – ERD 100 SYNUM	54
> Speed and position servosystem – ERD 150 AXNUM	56
> Air temperature and air flow process control	58
> Water level and water flow process control	60
> Air pressure process control	62
> Speed servosystem	64
> Position servosystem	65
> Temperature process control	66





Software for the control and the acquisition in automatic control engineering

Highlights



D-CCA : « Didalab Servo Control »

To be associated with all our operating units

- 3 main windows
 - Overview diagram.
 - Display of the curve of the on-going test.
 - Comparison of curves.
- Functions of specific measurements
 - 5% response time.
 - Maximum overflow
 - Time Constant.
 - Harmonic analysis
- Several type of correctors
 - P, PI, PD, PID, Z, fuzzy logic, cascade, etc.

Optional extra (read following pages)

- D_Scil, automatic generator of correctors
- Simulation of process.

Practical works available for each operating partse

Technical characteristics - D_CCA Software - Didalab Servo Control

Definition	D_CCA software is associated with each of our operating parts. It is used to control it and to make measurements everywhere in the circuit and to draw the responding curves. It is associated with several DIDALAB equipment studying process control. The environment is the same for all the operating parts in the servo system / process control chapter
Operating parts	Speed & position servosystems Water level and flow, air temperature and flow, air pressure process control Control on power motors, rectifiers, choppers, 3-ph inverters
Structures	Open loop , closed loop
Correctors	Analog corrector : P, PI, PD, PID. Digital corrector Z. Fuzzy logic. Tachymetric return, cascade
Generic functions	Exportation of the curve in a file of « points », saving, printing, etc. Setting-up of the sampling frequencies Generator of set-value : constant step, sine, trapezoid, ramp...
Simulator	Simulation of process by definition of operation equations
« Overview diagram » window	Choice of the type of structure and of the corrector to use for the on-going test. Parameter setting of the set value. Setting of the programmable load (for several operating parts). Choice of the test points to display. Immediate measurement of each test point of the overview diagram.
« Real time curves » window	Display of the temporal plotting of the corrector, specific measurements (5% response time, maximum overflow, time constant, gain, phase shift, etc.). Plotters.
« Comparison of curves » window	Comparison of tests (maximum 4). Recall of the setting parameters for each test

D_CCA Software : Didalab D_CCA

Reference	Description	Quantity
ERD XXX 100	D_CCA software, adapted for each operating part.	1

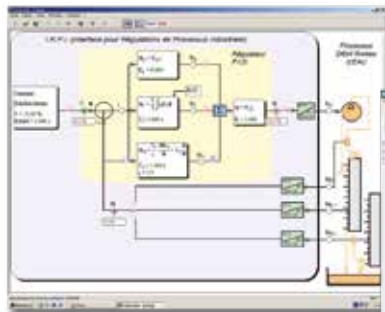
Soft optional extra for D_CCA

Reference	Description	Quantity
ERD XXX 800	Module for prototyping and generating new correctors with SCILAB/XCOS	1

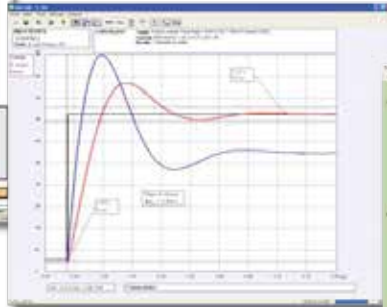


Software for the control and the acquisition in automatic control engineering

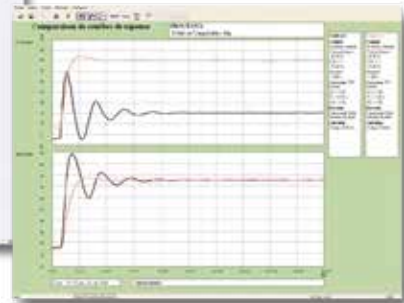
Three main windows



« Overview diagram » window



"Real time curves" window



"Comparison of feedback curves » window

Generator of set value and programmable load



Generator of set values

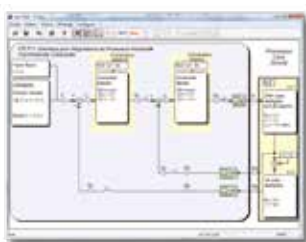
- Constant step
- Sine
- Ramp
- Trapezoid profile
- External potentiometer
- External input



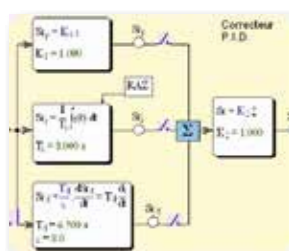
Programmable load

- Possible on : ERD 050 000
- 300W range :
- EP(S) 130 000
- EP(S) 210 000
- EP(S) 230 000
- 1,5kW range :
EP 360 000
EP 560 000
EP 660 000

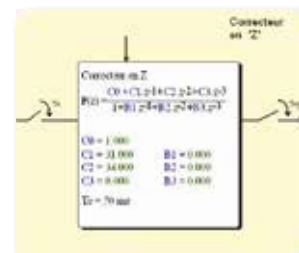
Correctors



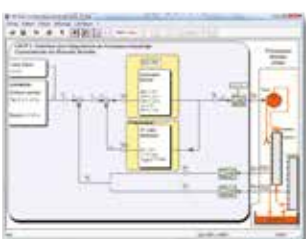
Cascade Corrector or tachymetric return (Software Optional extra)



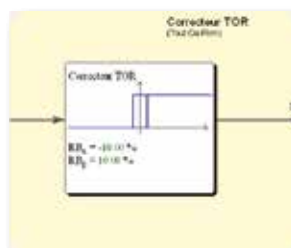
PID Corrector



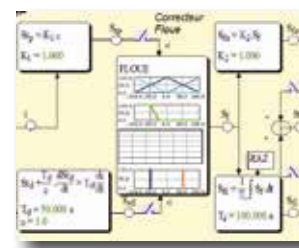
Z Corrector



PID Corrector PID with compensation



On/Off Corrector



Fuzzy logic Corrector

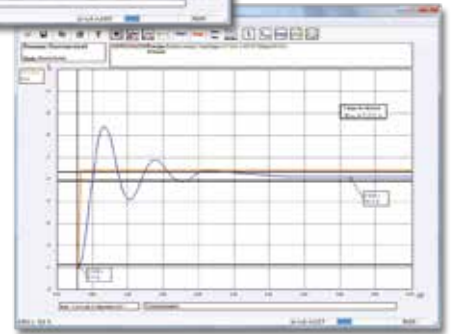
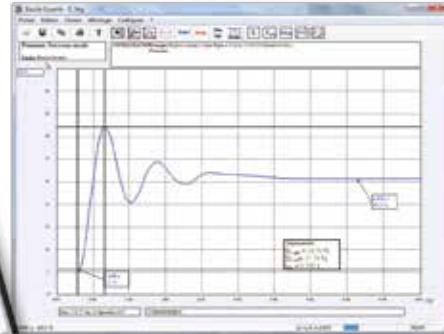


Automatic real time corrector generator

Several typical measures

Time constant

Max Overshoot

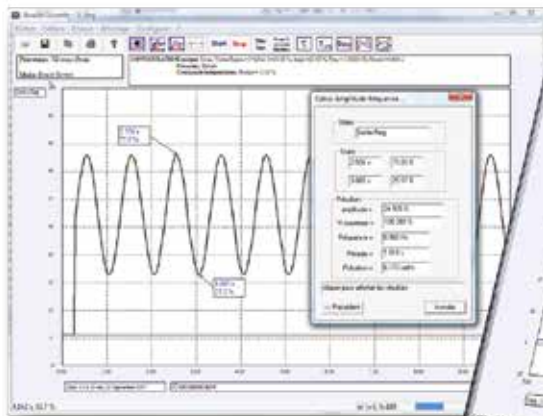


5% response time

Harmonic Study

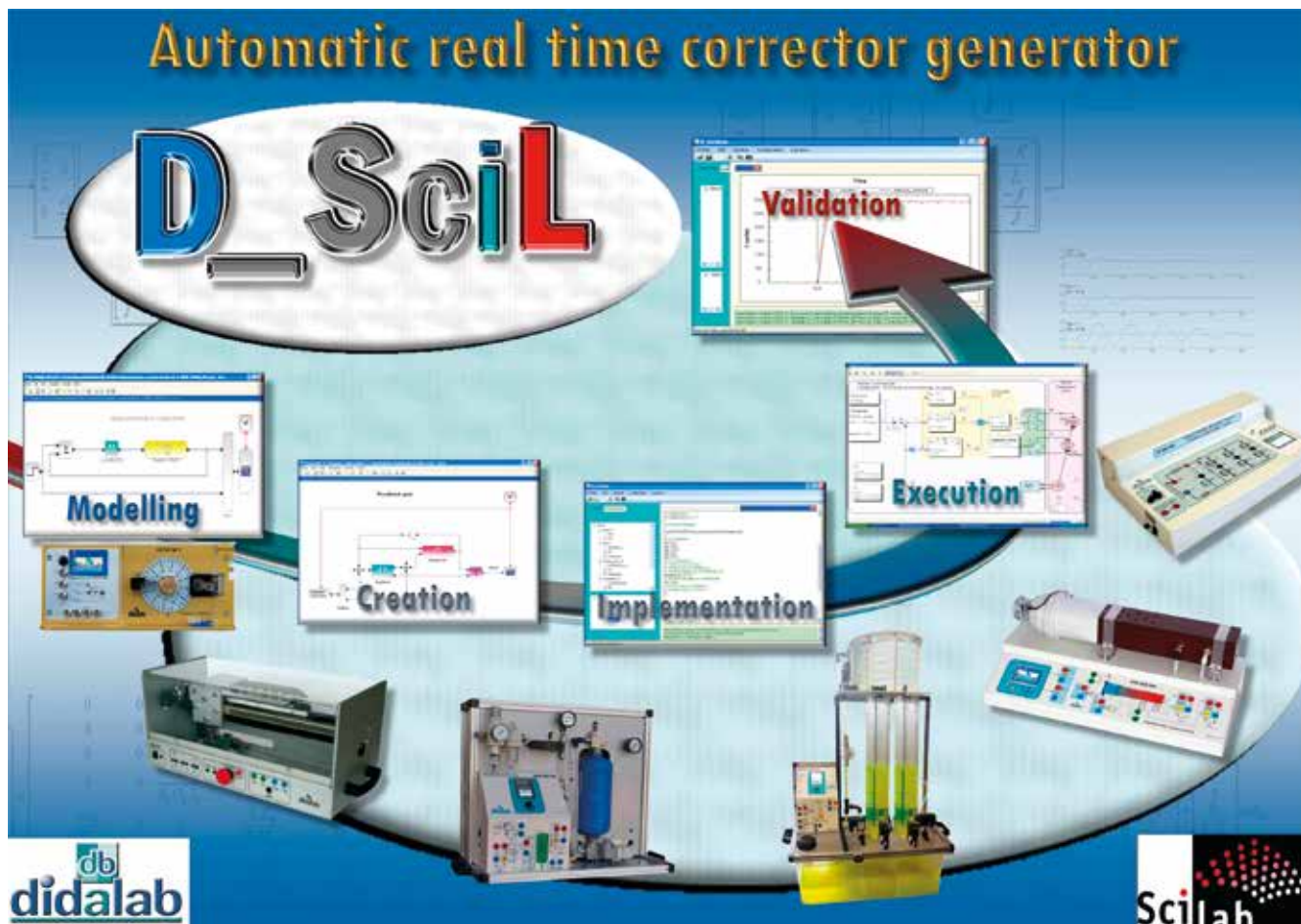
Sine calculation
(amplitude, frequency, mean value, etc)

Harmonic calculation
(gain and phase shift)





Automatic real time corrector generator



D_Scil is the result of a collaboration between Scilab-entreprises® and Didalab.

D_Scil is a software module for the automatic generation of code based on a set of functioning diagram blocks defined and simulated with Scilab/Xcos®. It can be implemented in a servo system, and compares dynamic simulated and real results. **D_Scil** : Module for the creation of real time correctors with SCILAB/XCOS (Réf : ERDxxx800)

Highlights

- Automatic generator of real time corrector in C code with Scilab/Xcos® freeware,
- D_scil is an optional extra for D_CCA (described in the previous pages), thus, it benefits from all the pedagogical power of D_CCA.
- Compatible with a lot of operating parts in automatic engineering :
 - > Angular speed and position servosystems,
 - > Servo controlled digital axis,
 - > Water level and water flow process control,
 - > Air flow and air temperature process control,
 - > Air pressure process control,
 - > 3-phase inverter (chopper, MLI rectification, 3-phase inverter with MLI intersective or state vector)...
- Creation of real time correctors,
- Does not need specific knowledge in real time computers,
- Can be used in Research departments.



Automatic generator of real time correctors

Complete development process, it belongs to a very modern development method in automatic engineering. This method is described here after, in 3 successive global steps ; it is a very realistic development context of an industrial R&D office, it allows cost savings in development and material prototypes manufacturing costs.

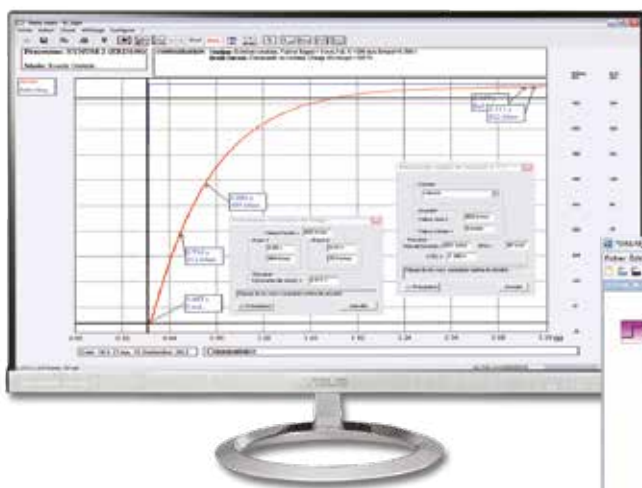
Identification in open loop of the real process (order, time constant, gain...)

The process described here after has been realised with SyNum, Analog and Digital servo system of the Electrical Engineering range of products.

These tests and practical works can be implemented on all the products shown in the previous page



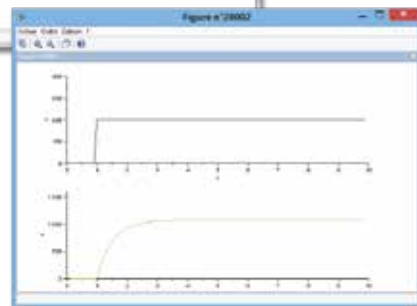
SERVO SYSTEMS AND PROCESS CONTROL



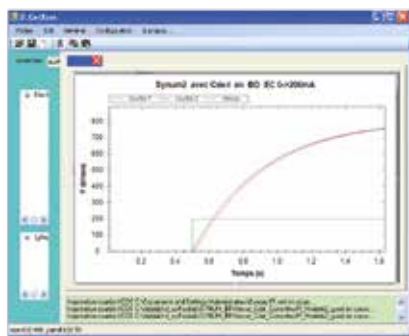
With **D_CCA**, identification and characterization of the system in open loop. In this case, dominant 1st order



Creation of the model with Scilab/ Xcos



Result of the simulation with Xcos. Dynamic response curve of the system in open loop.

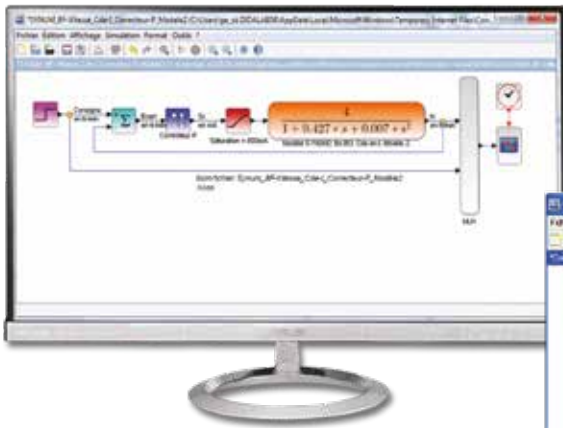


With **D_SciL**, comparison of the simulation results with Xcos and the measured results with D_CCA, validation of the open loop model.

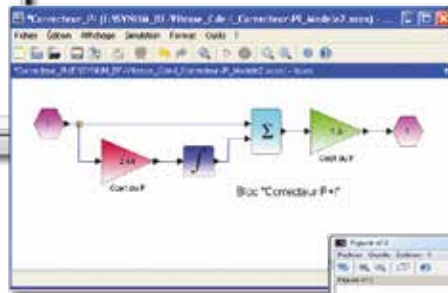


Automatic generator of real time correctors

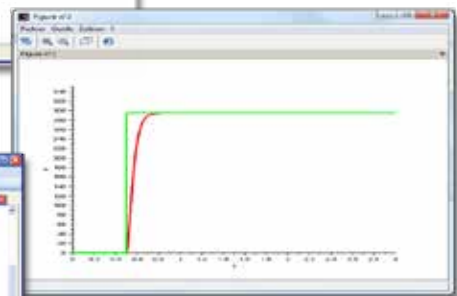
Synthesis of the corrector with Xcos



With Xcos, searching an appropriated corrector to the system (P, PI, PID, RST, state return...).



P.I. in this case

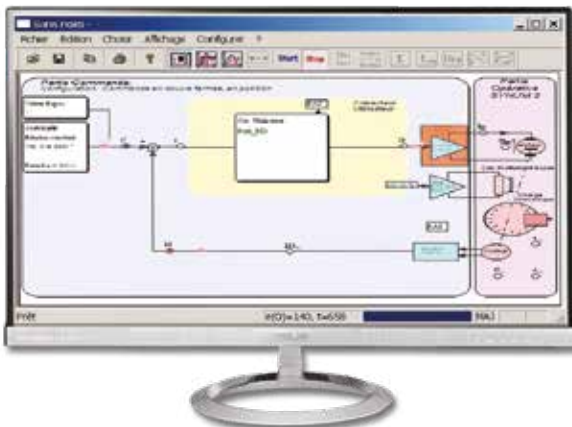


Result of the dynamic simulation of the system in closed loop.

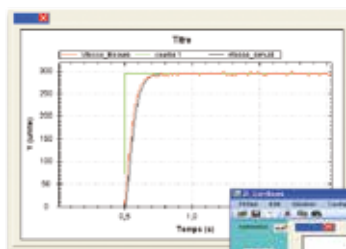
With D_Scil, automatic generation of the C code corresponding to this corrector.

If he wishes so, the user can directly act on the C code

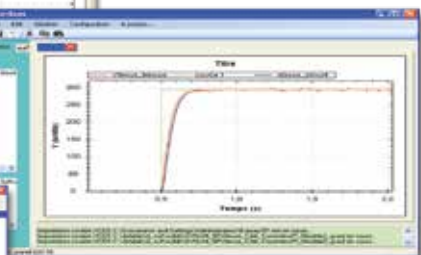
Corrector implementation and validation of the results



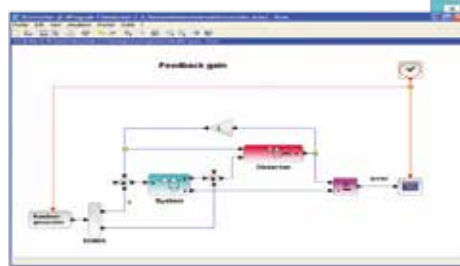
With D_CCA, implementation on the C code corrector on the target (SYNUM in this case).



Result of the test



More elaborate example (State feedback corrector).



With D_Scil, comparison of the results, check of the consistency between dynamic curves in simulation and test, validation or, if necessary, adjustment of the corrector or search of another corrector with Scilab.



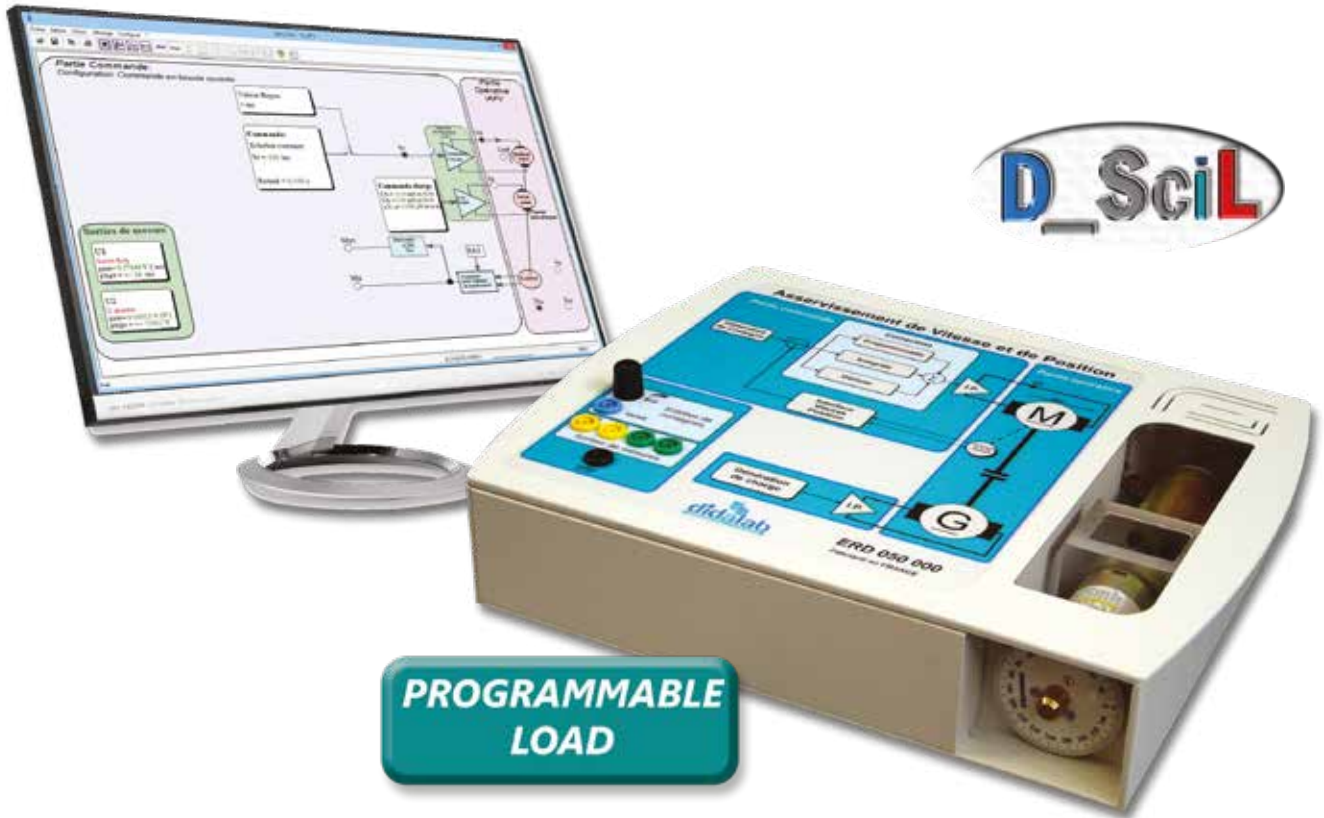
Speed and position servosystem

Highlights

- Uses the D_CCA software (see description at the beginning of the chapter).
- Programmable load.
- Dry friction compensator
- Autonomous control
- USB.

Studied topics

- Open loop or closed loop.
- Linear or non-linear range.
 - Analog Correctors : P, PI, PD, PID
- Optional extra :
 - Z digital corrector ,
 - tachymetric return,
 - simulation.
 - Prototypage rapide.



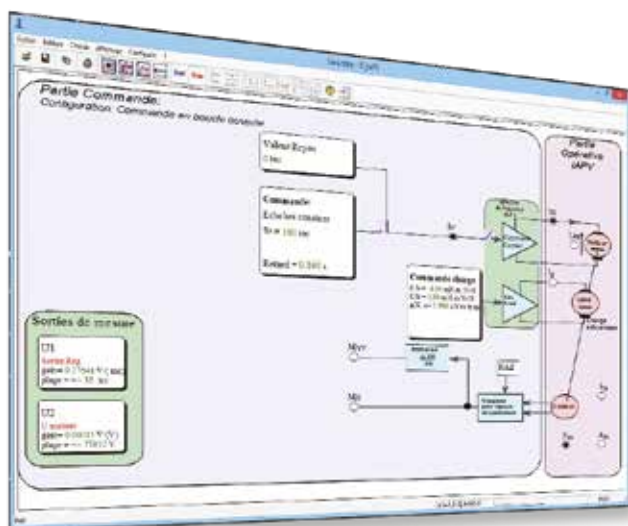
Technical characteristics - ERD 050 000 - Speed and position servosystem

D_IAPV Software	D_CCA software adapted for this unit. Needs Windows environment (XP pro, VISTA, SEVEN). Acquisition, saving, comparison, characterization of the feedback curves for the system. Exportation of the result to other softwares like Matlab® and Scilab®.
Specific Measurements characteristics	Time constant, overflow amplitude, 5 % response time, gain, phase shift.
Set value generator	Constant step, sine, ramp, trapezoid profile.
Analog inputs	Potentiometer or input for an external LF generator
Correctors	Analog corrector : P, PI, PD, PID. Digital corrector : Z (optional). Tachymetric return (optional).
Power Interface	Voltage Control or Current control of the motor.
Programmable load	DC generator fitted to the motor by OLDAM clutch, enables the load generation. Driving load, depending of the speed, of the square speed, programmable load depending of the rotating angle, compensation of the dry friction, fluid friction...
Visualization of the movements	Graduated disc.
Analog outputs	2 display outputs on oscilloscope (image of the motor voltage, motor current). 2 programmable output for the visualization of every point of the corrector (speed, position, P, I, D, gap...).
Power supply	24 Vdc external power supply.

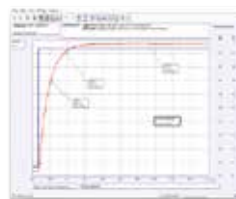
SERVO SYSTEMS AND PROCESS CONTROL



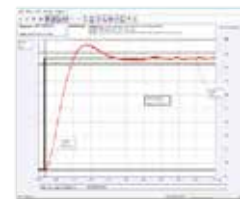
> **Example :**



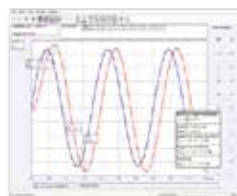
Time constant



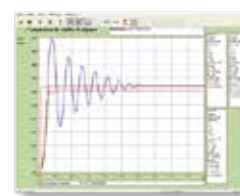
5% reponse time



Harmonic study



Test comparison



Experiments

ANALOG RANGE		DIGITAL RANGE	
EXP 1	Position sensor	EXP 1	Characterization in open loop in digital range
EXP 2	Speed and acceleration sensors	EXP 2	Speed control with a digital Proportional correction
EXP 3	Characterization in Open loop (current motor)	EXP 3	Speed control with a digital Integral correction
EXP 4	Characterization in Open loop (voltage motor)	EXP 4	Speed control with Integral correction and digital Zero
EXP 5	Speed control with a Proportional correction	EXP 5	Position control with a digital Proportional correction
EXP 6	Speed control with a digital PI correction	EXP 6	Position control with a digital Zero correction
EXP 7	Position control with a Proportional correction	EXP 7	Position control with pole correction and digital Zero
EXP 8	Position control with a PD correction		Technical Book
	Technical Book		

Package ERD 050 B : Speed and Position servosystem with PID correctors

Reference	Description	Quantity
ERD 050 000	Equipment + software	1
EGD 000 006	USB lead, AA type	1
EGD 000 005	24 Vdc Power supply, 2,9 A	1
ERD 050 020	Teacher's manual, High school level, supplied with flash drive	1
ERD 050 030	Student's manual, High school level, supplied with flash drive	1
ERD 050 040	Teacher's manual, Bachelor/ Master level, supplied with flash drive	1
ERD 050 050	Student's manual, Bachelor/ Master level, supplied with flash drive	1
ERD 050 500	Suitcase	1

(We suggest the composition of the Package, for special configuration, please ask)

Package ERD 050 C : Speed and Position servosystem with PID correctors+ Z corrector

Reference	Description	Quantity
ERD 050 B	Basic package Speed and Position servosystem with PID correctors	1
ERD 050 200	Software : Z corrector , tachymetric return, simulation	1
ERD 050 060	Teacher's manual for the study of servosystem in digital range, for the ERD050 module	1
ERD 050 070	Student's manual for the study of servosystem in digital range, for the ERD050 module	1

(We suggest the composition of the Package, for special configuration, please ask)



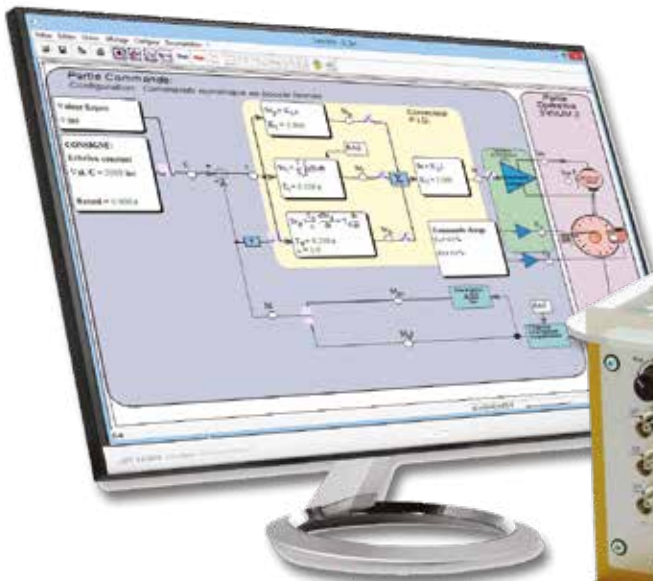
Speed and position servosystem

Highlights

- Uses the D_CCA software (see description at the beginning of the chapter)
- Very high quality servo motor
- Linear behaviour.
- Motorization of dry friction.
- Adjustable fluid friction.
- Additional inertia
- Autonomous control
- Compatible with Matlab Simulink Dspace®.

Studied topics

- Open loop or closed loop
- Linear or non-linear range
- Analog correctors : P, PI, PD, PID
- Digital Z corrector
- Tachymetric return
- Optional extra :
 - D_Scil, Module for the creation of real time correctors with SCILAB/XCOS.



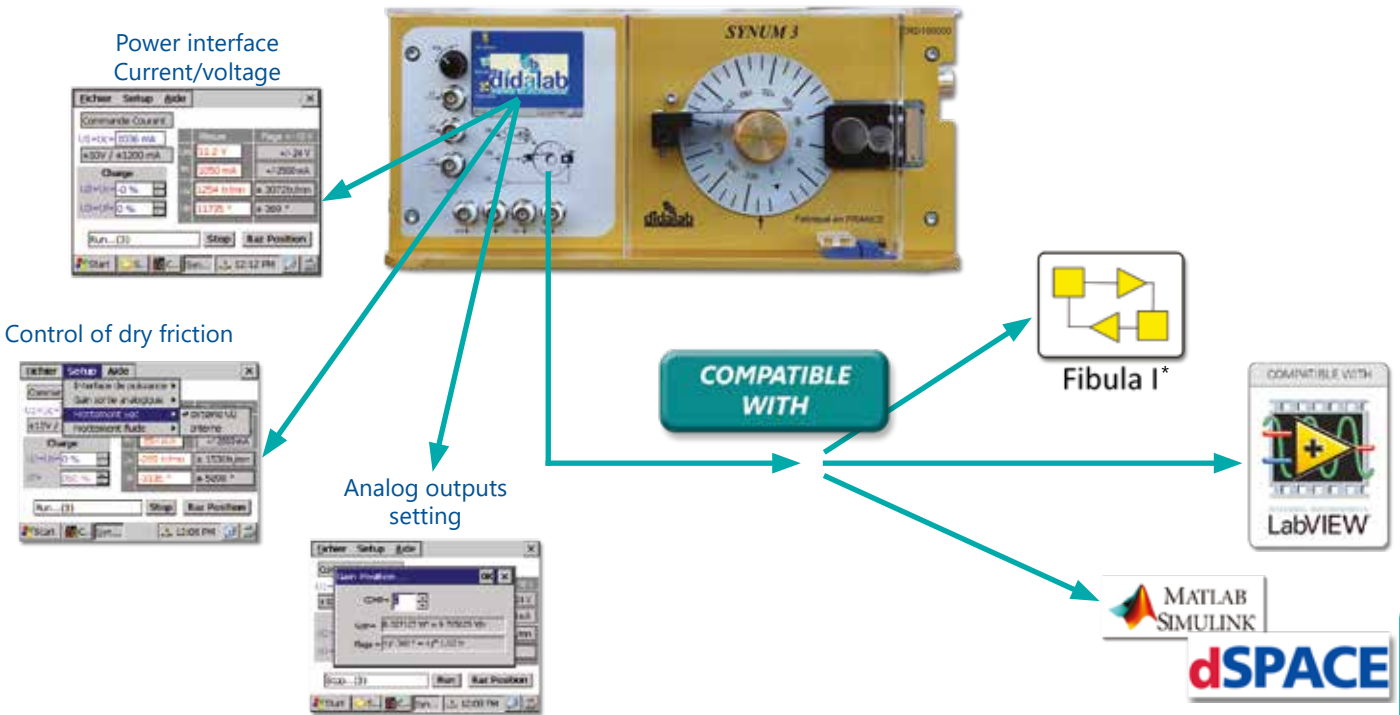
**DRY FRICTION
MOTORIZED**

Technical characteristics - ERD 100 000 - Analog and digital servosystems

D_SYN Software	D_CCA software adapted for this unit. Needs Windows environment (XP pro, VISTA, SEVEN) Acquisition, saving, comparison, characterization of the feedback curves for the system Exportation of the result to other softwares like Matlab® and Scilab®.
Specific measurements	Time constant, overflow, 5 % response time, gain, phase shift.
Set value generator	Constant step, sine, ramp, trapezoid profile.
Correctors	Analog : P, PI, PD, PID. Digital Z. Tachymetric return. D_Scil, Module for the creation of real time correctors with SCILAB/XCOS.(optional).
Power Interface	Voltage control or Current control of the motor.
Servo motors	The operating part is based on a very high quality motor (ratio between Idle current / Nominal current < 2,5 %).
Physical disturbances	Eddy current brake, dry friction, inertia
Visualization of the movements	Graduated disc
Analog inputs	Potentiometer or inut for an external LF generator. 3 analog inputs for the control of the motor, the dry friction and the damp friction
Analog outputs	4 outputs to visualize several measures on an oscilloscope (speed, position, image of the motor voltage, image of the motor current).
Power supply	24 Vdc external power supply.



> Example : Autonomous control



Experiments

ANALOG RANGE		DIGITAL RANGE	
EXP 1	Position sensor	EXP 1	Characterization in open loop in digital range.
EXP 2	Speed and accélération sensor.	EXP 2	Speed control with digital Proportional corrector.
EXP 3	Characterization in open loop (current motor).	EXP 3	Speed control with digital Integral corrector.
EXP 4	Characterization in open loop (voltage motor).	EXP 4	Speed control with digital Integral corrector and digital Zero
EXP 5	Speed control with Proportional corrector.	EXP 5	Position control with digital Proportional corrector
EXP 6	Speed control with PI corrector.	EXP 6	Position control with digital Zero corrector.
EXP 7	Speed control with PID corrector.	EXP 7	Position control with pole correction and digital Zero.
EXP 8	Position control with Proportional corrector.	EXP 8	Prototyping in the digital range
EXP 9	Speed control with PD corrector.		
EXP 10	Behaviour with isolated PID.		
EXP 11	Prototyping in the continuous range (current control).		
EXP 12	Prototyping in the continuous range (voltage control).		

Package ERD 100 B : : Study of analog and digital servosystems

Reference	Description	Quantity
ERD 100 000	SYNUM 3 – Equipment + software.	1
ERD 100 040	Teacher's manual : Servosystems in continuous range, for SYNUM 3.	1
ERD 100 050	Student's manual : Servosystems in continuous range, for SYNUM 3	1
ERD 100 060	Teacher's manual : Servosystems in digital range, for SYNUM 3.	1
ERD 100 070	Student's manual : Servosystems in digital range, for SYNUM 3.	1
ERD 100 080	Teacher's manual : Servosystems in non linear range.	1
ERD 100 090	Student's manual : Servosystems in non linear range, for SYNUM 3.	1
EGD 000 010	RJ45 lead	1
EGD 000 005	24 Vdc power supply, 2,9 A.	1

Package ERD 100 S : Study of analog and digital servosystems, with prototyping, simulation and real time C correctors

Reference	Description	Quantity
ERD 100 B	Basic package « Study of analog and digital servosystems»	1
ERD 100 800	D_Scil Module for prototyping with SCILAB/XCOS ; Editor based on graphic diagram blocks, C code real time generator	1

(We suggest the composition of the Package, for special configuration, please ask)



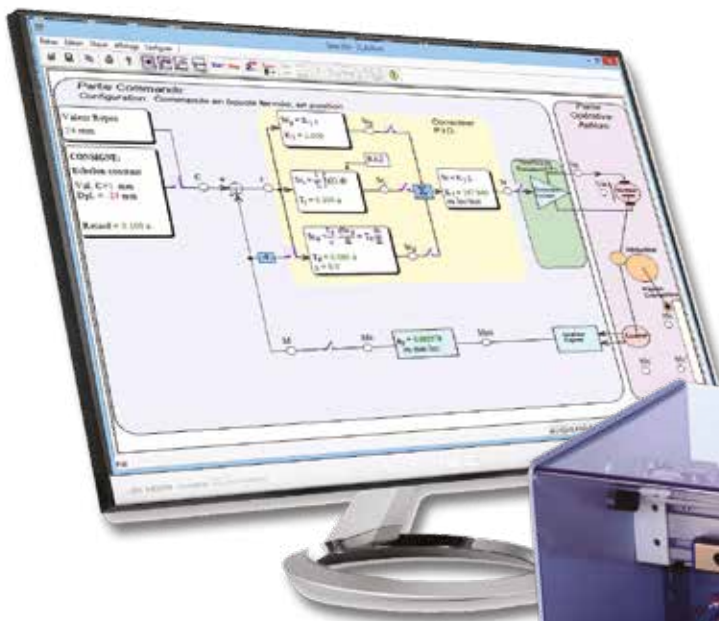
Speed and position servosystem

Highlights

- Uses the D_CCA software (see description at the beginning of the chapter).
- Come from an industrial system
- USB..

Studied topics

- Open loop or closed loop.
- Linear or non-linear range.
- Several type of correctors
 - Analog : P, PI, PD and PID.
 - Z digital.
 - Tachymetric return
- Optional extra :
 - D_Scil, Module for the creation of real time correctors with SCILAB/XCOS.



INDUSTRIAL SYSTEM



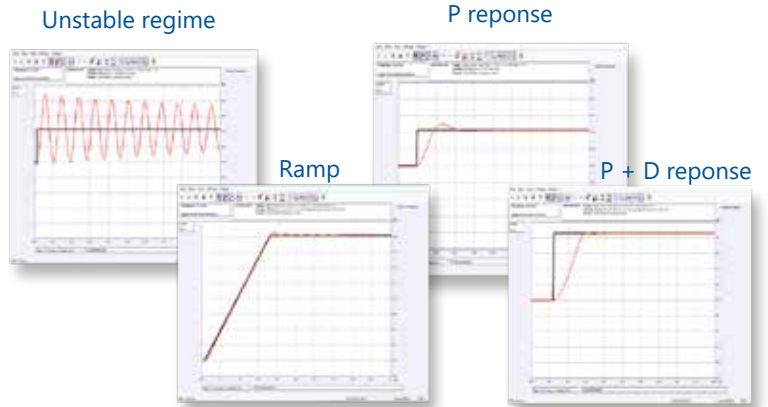
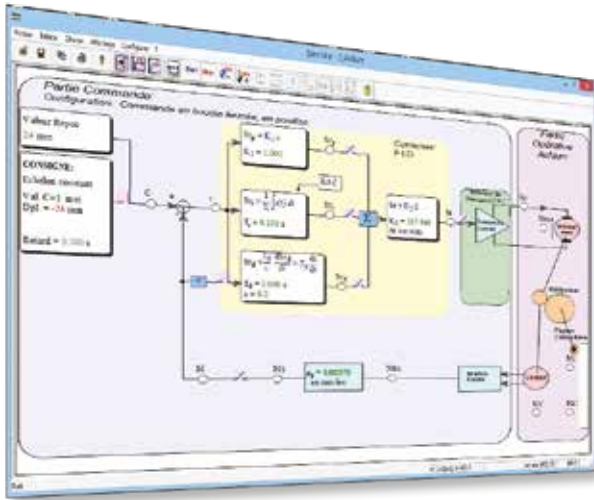
Technical characteristics - ERD 150 000 - Speed/position servosystem on digital axis

D_AXNUM software	D_CCA software adapted for this unit. Needs Windows environment (XP pro, VISTA, SEVEN) Acquisition, saving, comparison, characterization of the feedback curves for the system Exportation of the result to other softwares like Matlab® and Scilab®.
Specific measurements	Time constant, overflow amplitude, 5 % response time, gain, phase shift.
Set value generator	Constant step, sine, ramp, trapezoid profile
Correctors	Analog : P, PI, PD, PID. Z digital. Tachymetric return. D_Scil, Module for the creation of real time correctors with SCILAB/XCOS.(optional).
Power Interface	Voltage control or current control of the motor
Operating part	The operating part is based on a servocontrolled digital axis. The mobile part is a roller carriage on a rail, the drive is realized by a rack and pinion system driven by a gear motor, the return loop is ensured by an encoder.
Physical disturbances	Can be used when the axis is put horizontally or vertically.
Visualization of the movements	Graduated rule, fixed on the axis.
Analog outputs	4 outputs to visualize several measures on an oscilloscope (speed, position, image of the motor voltage, image of the motor current).
Power supply	24 Vdc external power supply

SERVO SYSTEMS AND PROCESS CONTROL



> **Example :**



Experiments

ANALOG RANGE		DIGITAL RANGE	
EXP 1	Characterization in open loop, power interface: current control.	EXP 1	Characterization in open loop, power interface: current control
EXP 2	Position control with Proportional correction	EXP 2	Position control with digital Proportional correction
EXP 3	Position control with Proportional + Derivate correction	EXP 3	Position control with digital Proportional correction + digital Zero
EXP 4	Position control with Proportional correction and a profile as excitation mode	EXP 4	Position control with digital Proportional correction + pole + digital Zero
EXP 5	Position control with Proportional correction and a non-linear load	EXP 5	Characterization in open loop, power interface: voltage control
EXP 6	Characterization in open loop, power interface: voltage control.	EXP 6	Position control with digital Proportional correction
EXP 7	Position control with digital Proportional correction.	EXP 7	Position control with digital Proportional correction + digital Zero
EXP 8	Position control with digital Proportional + Derivate correction.	EXP 8	Position control with digital Proportional correction + pole + digital Zero
EXP 9	Position control with digital Proportional correction and tachymetric return.	EXP 9	Position control with digital C corrector
EXP 10	Prototyping in the continuous range (current control).	EXP 10	Prototyping in the digital range
EXP 11	Prototyping in the continuous range (voltage control).		

Package ERD 150 B : Speed/position servosystem on a digital axis

Reference	Description	Quantity
ERD 150 000	AXNUM, operating part, axis with reducing gear, direct current and rack, coder, driving software	1
ERD 150 020	Teacher's manual, 1st level, supplied with flash drive	1
ERD 150 030	Student's manual, 1st level, supplied with flash drive	1
ERD 150 040	Teacher's manual, 2nd level, supplied with flash drive	1
ERD 150 050	Student's manual, 2nd level, supplied with flash drive	1
ERD 150 060	Teacher's manual, in digitized range, supplied with flash drive	1
ERD 150 070	Teacher's manual, in digitized range, supplied with flash drive	1
EGD 000 006	USB lead, AA type	1
EGD 000 005	24 Vdc power supply, 2,9 A.	1

(We suggest the composition of the Package, for special configuration, please ask)

Package ERD 150 S : Speed/position servosystem on digital axis, with prototyping, simulation and real time C correctors

Reference	Description	Quantity
ERD 150 B	Basic Package « Speed/position servosystem on a digital axis»	1
ERD 150 800	D_Scil, Module for prototyping an creation of real time correctors with SCILAB/XCOS	1

(We suggest the composition of the Package, for special configuration, please ask)



Air temperature and air flow process control

Highlights

- Operates with D_CCA program (see description at the beginning of this chapter)
- 2 process (flow and temperature)
- Ethernet link
- Compatible with Matlab Simulink Dpace
- Compatible with industrial 4/20-mA regulator

Studied topics

- Study in open or closed loop.
- Linear and non-linear range
- Analog correctors : P, PI, PD and PID with dead time offset
- Z digital corrector.
- Cascade
- Full State feedback
- Creation of real time correctors with SCILAB/XCOS..



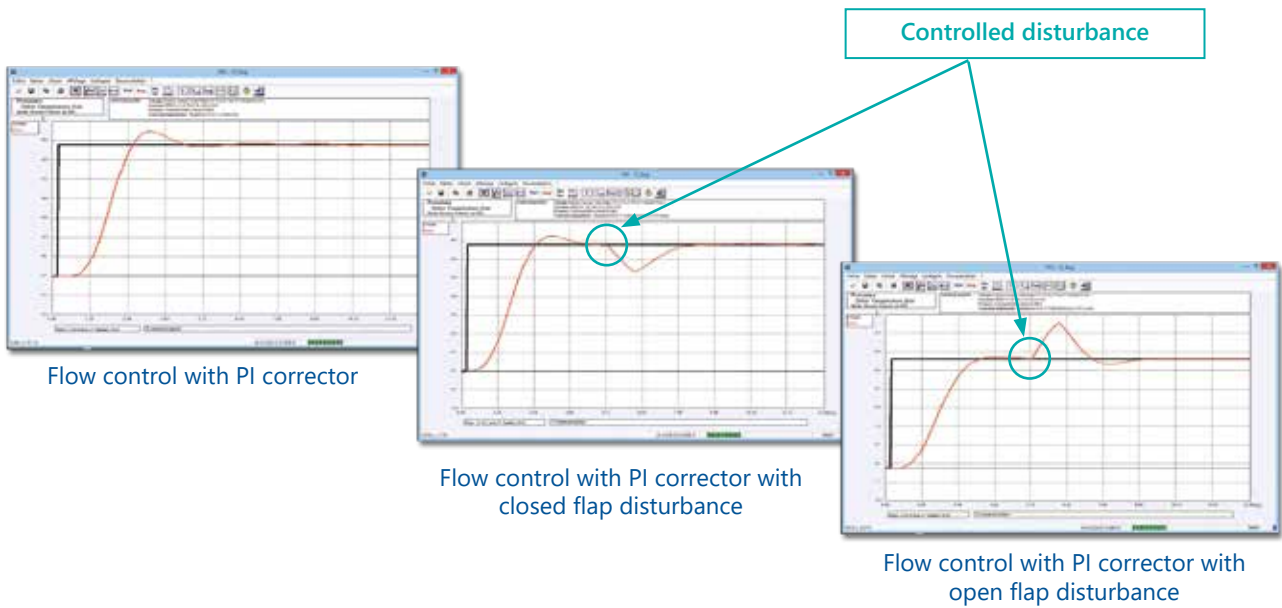
MOTORIZED DISTURBANCE

Technical characteristics - ERD 540 000 - Air temperature and air flow control

Operating unit	Moto fan with proportional control (time constant : 380 ms). Heating resistance with disturbance by heat power variation (time constant: 22 s).
Physical disturbances	A flap creates the flow disturbance by modifying the inlet diameter. The temperature disturbance is done by the flow variation or the heat power variation. On/Off disturbance for the flow and the heating power for which the activation information is given by dry contacts.
D_REG Software	D_CCA software adapted for this unit. Needs Windows environment Acquisition, saving, comparison, characterization of the feedback curves for the system Exportation of the result to other softwares like Matlab® and Scilab®.
Specific measurements	Time constant, overflow amplitude, 5 % response time, gain, phase shift.
Set value generator	Constant level, sine, ramp, trapezoidal profile
Correctors	Analog : P, PI, PD, PID. Z digital, Cascade regulation (Optional extra : Module for the creation of real time correctors).
Inputs/Outputs Interface	0/20 or 4/20 mA current loops (3 inputs, 2 outputs). 0-10 V (1 input, 1 output).
On/Off Inputs/Outputs	Dry contacts (2 inputs, 2 outputs).
Power supply	External 24-Vdc power supply



> **Examples :**



Experiments - ERD 540 040/ERD 540 050 - Air flow control

EXP 1	Characterization in open loop
EXP 2	Air flow control with PI, PID corrector
EXP 3	Air flow control with isolated PID corrector
EXP 4	Air flow control with discrete corrector (digital Z)
EXP 5	Air flow control with On/Off corrector

Experiments - ERD 540 060/ERD 540 070 - Air temperature control

EXP 1	Characterization in open loop
EXP 2	Air temperature control with PI, PID corrector
EXP 3	Air temperature control with isolated PID corrector
EXP 4	Cascade regulation

Package ERD 540 C : Study of an air temperature and flow control

Reference	Description	Quantity
ERD 540 000	Operating unit of an air temperature and flow control with its technical documentation	1
ERD 540 100	D_CCA software (process control operating with Windows, including the correctors (PID, On/Off, PID, Cascade, Z digital, fuzzy corrector).	1
ERD 540 040	Teacher's manual : experiments on air temperature and flow control	1
ERD 540 050	Student's manual : experiments on air temperature and flow control	1
ERD 540 060	Teacher's manual : experiments on air temperature and flow control, in continuous and digital ranges	1
ERD 540 070	Student's manual : experiments on air temperature and flow control, in continuous and digital ranges	1
EGD 000 010	RJ45 lead	1

Package ERD 540 S : Study of an air temperature and flow control » with prototyping, simulation and real time C correctors

Reference	Description	Quantity
ERD 540 C	Complete package "Study of an air temperature and flow control »	1
ERD 540 800	D_Scil, Module for prototyping and the creation of real time correctors with SCILAB/XCOS	1



Water level and water flow process control

New

Highlights

- 2 versions :
 - 1 column
 - 2 columns
- Level control and flow control
- Retard pur
- Uses the D_CCA software
- Cascade regulation
- Ethernet link
- Autonomous control
- Compatible with Matlab Simulink Dpace
- Compatible with industrial 4/20-mA regulator

Studied topics

- Study in open or closed loop.
- Several kinds of correctors
 - Analog correctors : P, PI, PD and PID with dead time offset
 - Z digital corrector.
 - Cascade
- Creation of real time correctors with SCILAB/XCOS

2 VERSIONS :
1 or 2 COLUMN(S)

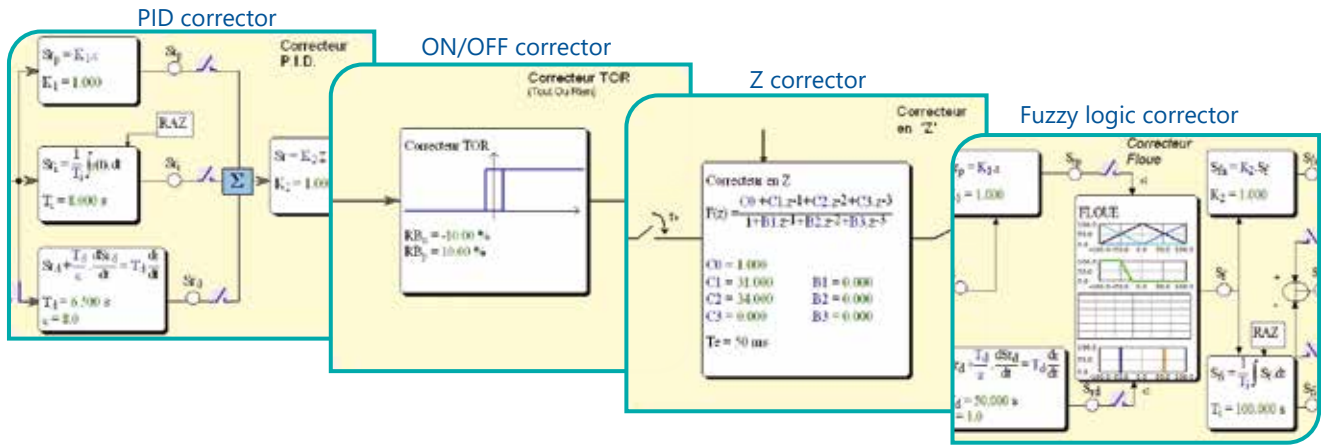


Technical characteristics - ERD 551/ERD552 - Water level and water flow control

Operating unit	1 or 2 columns are placed on a recovery tank. The pump delivers in the first column. This structure is a level regulation of the first order with a timeconstant of approximately 70 to 200s for the second level. 5% response time for the flow is about 0.5s. The user can introduce a pure delay (10s) in the loop and regulate the flow rate and/or water level in the column(s) with or without the pure delay. Two valves allow the second column to be added (for the ERD552 version). The process then becomes second-order with or without pure delay.
Physical disturbances	A solenoid valve is used to create a leakage disturbance in the tank
Sensors	The level sensors are placed in the bases of the columns (20 mA for 50 cm). A flow measurement is available for cascade control
D_REG Software	D_CCA software adapted for this unit. Needs Windows environment Acquisition, saving, comparison, characterization of the feedback curves for the system Exportation of the result to other softwares like Matlab® and Scilab®.
Specific measurements	Time constant, overflow amplitude, 5 % response time, gain, phase shift.
Set value generator	Constant level, sine, ramp, trapezoidal profile
Correctors	Analog: P, PI, PD, PID. Z digital, Cascade regulation (Optional extra : Module for the creation of real time correctors).
Inputs/Outputs Interface	0/20 or 4/20 mA current loops (3 inputs, 2 outputs). 0-10 V (1 input, 1 output).
On/Off Inputs/Outputs	Dry contacts (2 inputs, 2 outputs).
Power supply	External 24-Vdc power supply



> Example : Several correctors



Experiments - Water level control

WITHOUT THE COIL FOR PURE DELAY	
EXP 1	Characterization in open loop
EXP 2	Water level control with PI, PID corrector
WITH THE COIL FOR PURE DELAY	
EXP 3	Characterization in open loop
EXP 4	Water level control with PI, PID corrector
EXP 5	Cascade regulation

Experiments - Flow level control

EXP 1	Characterization in open loop
EXP 2	Water flow control with PI, PID corrector
EXP 3	Process control with discrete corrector ("Z" digital)
EXP 4	Process control with On/Off corrector
EXP 5	Process control with PID corrector with dead time offset
EXP 6	Process control with C corrector
EXP 7	Process control with fuzzy corrector

Package ERD 551 C : "Study of a water level and water flow control", 1 column

Reference	Description	Quantity
ERD 551 000	Operating unit of a water level and water flow control with x tanks and pure delay	1
ERD 550 100	D_CCA software (process control operating with Windows, including the correctors (PID, On/Off, PID, Cascade, Z digital, fuzzy corrector).	1
ERD 550 040	Teacher's manual : experiments on water level and water flow control	1
ERD 550 050	Student's manual : experiments on water level and water flow control	1
EGD 000 023	24-Vdc Power supply, 6.2 A	1
EGD 000 006	USB lead, AA type	1

Package ERD 552 C : "Study of a water level and water flow control", 2 columns

Reference	Description	Quantity
ERD 552 000	Operating unit of a water level and water flow control with 2 tanks and pure delay	1
ERD 550 100	D_CCA software (process control operating with Windows, including the correctors (PID, On/Off, PID, Cascade, Z digital, fuzzy corrector).	1
ERD 550 040	Teacher's manual : experiments on water level and water flow control	1
ERD 550 050	Student's manual : experiments on water level and water flow control	1
EGD 000 023	24-Vdc Power supply, 6.2 A	1
EGD 000 006	USB lead, AA type	1

Package ERD 55X S : Study of a water level and water flow control » with prototyping, simulation and real time C correctors

Reference	Description	Quantity
ERD 55X C	Complete package «Study of a water level and water flow control»	1
ERD 550 800	D_Scil, Module for prototyping and the creation of real time correctors with SCILAB/XCOS	1



Air pressure process control

Highlights

- Operates with D_CCA program (see description at the beginning of this chapter)
- USB.
- Compatible with Matlab Simulink Dspace
- Compatible with industrial 4/20-mA regulator

Studied topics

- Study in open or closed loop.
- Analog correctors : P, PI, PD and PID.
- Z digital corrector.
- Creation of real time correctors with SCILAB/XCOS.

NEW MODEL



Technical characteristics - ERD 560 000 - Air pressure control

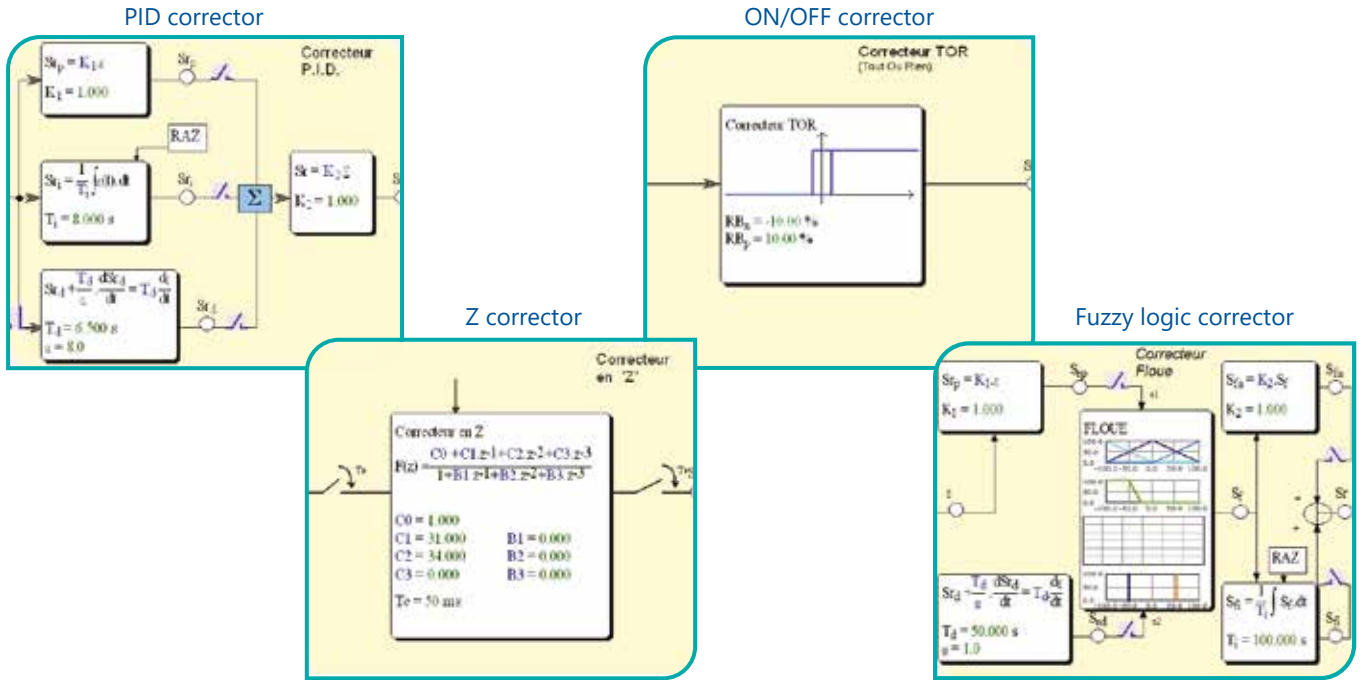
Operating unit	1 support frame made of PVC sheet 1 experimental chamber, 1000 cm3 1 proportional filling valve
Physical disturbances	1 On/Off leakage disturbance valve 1 On/Off valve for power supply disturbance
Sensors	1 Pressure sensor 4/20 mA 3 manometers
D_REG Software	D_CCA software adapted for this unit. Needs Windows environment Acquisition, saving, comparison, characterization of the feedback curves for the system Exportation of the result to other softwares like Matlab® and Scilab®.
Specific measurements	Time constant, overflow amplitude, 5 % response time, gain, phase shift
Correctors	Analog : P, PI, PD, PID. Z digital, Cascade regulation (Optional extra : Module for the creation of real time correctors).
Inputs/Outputs Interface	0/20 or 4/20 mA current loops (2 inputs, 2 outputs).
On/Off Inputs/Outputs	Dry contacts (2 inputs, 2 outputs).
Power supply	External 24-Vdc power supply

NB : prévoir une alimentation pneumatique

SERVO SYSTEMS AND PROCESS CONTROL



> **Example : Several correctors**



Experiments - Air pressure control

EXP 1	Characterization in open loop
EXP 2	Air pressure control with PI, PID corrector
EXP 3	Air pressure control with isolated PID corrector
EXP 4	Air pressure control with discrete corrector (digital Z)
EXP 5	Air pressure control with On/Off corrector
EXP 6	Air pressure control with fuzzy corrector

Package ERD 560 C : Study of a air pressure control

Reference	Description	Quantity
ERD 560 000	Operating unit of an air pressure control with its technical documentation	1
ERD 560 100	D_CCA software (process control operating with Windows, including the correctors (PID, On/Off, PID, Cascade, Z digital, fuzzy corrector)	1
ERD 560 040	Teacher's manual : experiments on air pressure control	1
ERD 560 050	Student's manual : experiments on air pressure control	1
EGD 000 006	USB lead, AA type	1
EGD 000 005	24 Vdc power supply, 2,9 A.	1

Package ERD 560 S : Study of a air pressure control » with prototyping, simulation and real time C correctors

Reference	Description	Quantity
ERD 560 C	Complete package "Study of a air pressure control »	1
ERD 560 800	D_Scil, Module for prototyping and the creation of real time correctors with SCILAB/XCOS	1



Speed servosystem



Highlights

- DC servo motor.
- DC generator load.
- Voltage or current control.
- Speed sensor with Hall effect
- Analog correctors P, I and D
- **Manual of Experiments**

Technical characteristics - ERD 037 860 - Speed servosystem

Set value generator	Set value level generator (with a potentiometer). Possibility to have a sine, square, triangle, external set value with BNC connector
Comparator and Correctors	P, PI, PD and PID.
Amplification function	PWM power amplifier with current control or voltage control
Feedback	Speed feedback loop by Hall Effect sensor & frequency/voltage converter
Servo motor	1,2-W, 12-Vdc motor, 5000 rpm with magnetic encoder (5 points/turn)
Load	1,2-W, 12-Vdc DC generator, 5000 rpm.
Power supply (not supplied)	An external power supply (+/- 15 Vdc 1 A) is needed.

Package ERD 3786 B : «Study of a speed servosystem»

Reference	Description	Quantity
ERD 037 860	Speed servosystem monitor, PID corrector, DC motor, load with a DC generator, supplied with manual of experiments.	1
ERD 037 782	Bag of security stackable patching cords (several lengths and colours) 20 of 2 mm and 5 of 4 mm	1

(We suggest the composition of the package, for special configuration, please ask)



Position servosystem



Highlights

- DC servo motor.
- Asymmetrical inertial loads.
- Current control.
- Feedback loop with potentiometer
- Analog correctors P, I and D.
- **Manual of Experiments**

Technical characteristics - ERD 037 870 - Position servosystem

Set value generator	Set value level generator (with a potentiometer). Possibility to have a sine, square, triangle, external set value with BNC connector
Comparator and Correctors	Comparator. P, I and D with adjustable gain. 3-input adder with direct or indirect input.
Amplification function	Current linear mode power amplifier
Feedback	Feedback loop by potentiometer with limits & saturations display
Servo motor	12-Vdc motor, 1,7 W reduction system with pulleys belt
Load	Inertia disk load with additional weights
Power supply (not supplied)	An external power supply (+/- 15 Vdc 1 A) is needed.

Pack ERD 3787 B : «Study of a position servosystem»

Reference	Description	Quantity
ERD 037 870	Position servosystem monitor, PID corrector, DC motor, feedback potentiometer, supplied with a manual of experiments.	1
ERD 037 782	Bag of security stackable patch cords (several lengths and colours) 20 of 2 mm and 5 of 4 mm.	1

(We suggest the composition of the package, for special configuration, please ask)



Temperature process control

Highlights



- Several kinds of temperature sensors
 - Heating module : 25 W.
 - Analog correctors : P, I and D.
 - LCD display of the parameters
- **Manual of Experiments**

Technical characteristics - ERD 037 780 - Temperature process control

Set value generator	Set value level generator (with a potentiometer). Possibility to have a sine, square, triangle, external set value with BNC connector.
Comparator and Correctors	Comparator. P, I and D with adjustable gain. 3 input adder.
Temperature sensors	Resistive probe with positive ratio. Platinum probe (100 Ohms at 0 °C). Resistive probe with negative ratio (CTN 22 kOhms at 20 °C). Thermo-electric probe. Iron Constantan Thermocouple.
Display	Direct display on a 2 x 16 character LCD screen of the temperature measurements (PT100, CTN and thermocouple, power of the heating module and order).
Perturbation	Fan
Power supplies (not supplied)	2 power supplies are needed : +/- 15 Vdc 1A power supply and 30 Vdc 2,5 A power supply.

Package ERD 3778 B : «Study for a temperature process control»

Reference	Description	Quantity
ERD 037 780	Temperature process control monitor, PID corrector, supply with manual of experiments	1
ERD 037 782	Bag of security stackable patch cords (several lengths and colours) 20 of 2 mm and 5 of 4 mm	1

(We suggest the composition of the package, for special configuration, please ask)

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Power range

In order to answer our clients' needs, DIDALAB offers four ranges of power : **30W**, 300 W (SELV and LV), 1.5kW.

30-W range - SELV



This range presents little or no electro-technical phenomena (characteristics of motors) ; nevertheless it allows a first approach on converters and their structure (technology, control, insulation, power).



This range addresses mainly :

- *The unspecialized trainings, in electro technical eng. (to have notions in power electronics of power)*
- *The first years in electro technical studies to be able to visualize and connect directly the components of the power part and the control part.*

1-phase power supply, reversible current



Highlights

- *Reversible current power supply.*
- *Mains reference.*

Technical characteristics - EMD 030 340 - 1-phase power supply, reversible current

Available outputs	D.C. +15 V/-15 V, 500 mA. - Adjustable 0-30 V/2,5 Amp. Mains reference: 24 V/0,2 Amp. - Fixed alternative voltage: 2 x 24 V/2,5 A.
Protections	Protection by current limitation (DC). Protection by fuse or serial resistor (AC outputs). Fuse protection on the input transformer primary
Mains power supply	230 V - 50/60 Hz.

Pack EMD 030 340 : 1-phase power supply, reversible current

3-phase power supply



Highlights

- *Mains references.*
- *Star or delta wiring.*

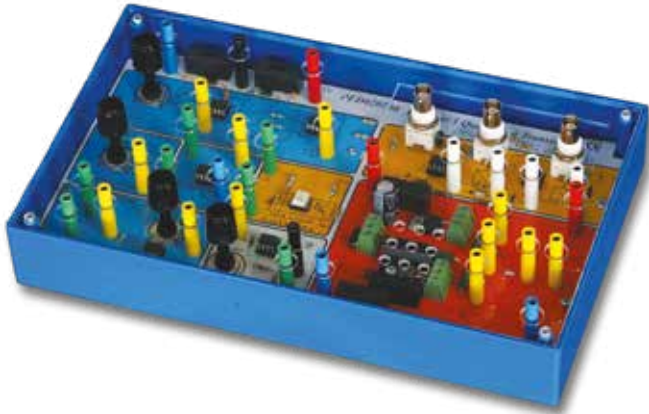
Technical characteristics - EMD 030 390 - 3-phase low voltage power supply

Power Outputs	3 x 24 V - 2,5 A. (Outputs on 6 x Ø 4 mm sockets). – Star or delta wiring.
Mains reference outputs	3 x 24 V - 0,2 A (Outputs on 6 x Ø 4 mm sockets). - Star or delta wiring.
Mains power supply	380 V 3-phase.
Protection	Fuses for the power outputs. Serial resistors protection for the mains reference outputs.

Pack EMD 030 390 : 3-phase low voltage power supply



One Quadrant transistorized Chopper, 2A



Studied topics

- Step-down voltage chopper.
- Step-down voltage chopper with current control.
- Step-up voltage chopper.
- Step-up voltage chopper with current control.
- Differential probes for current and voltage embedded (BNC sockets)
- **Experiments supplied with the module**

Technical characteristics - PED 020 100 - Quadrant transistorized Chopper, 2A

Studied Functions	Step-down voltage choppers (or serial) - Step-up voltage choppers (or parallel)
External control	A feedback loop enables the study with control current with an external +/- 10 V control unit.
Insulation	Galvanic insulation is achieved through optocoupler device
Visualization of the current	Shunts in each branch allow the visualization of the currents (2 A max at 30 V).
Power supplies	Power: 30 Vdc 1-phase, 2,5 A. Control : +/- 15 Vdc

Package PED 201 B : Serial and // transistorized chopper, 2A

Reference	Description	Quantity
PED 020 100	Serial Step-down voltage chopper and // Step-up voltage chopper training monitor, with training manual	1
PED 020 101	Bag of 20 security stackable patch cords (several lengths and colours) diam 4 mm, I 20 A	1

(We suggest the composition of the package, for special configuration, please ask)

Package PED 201 C : Serial and // transistorized chopper, 2A

Reference	Description	Quantity
PED 020 100	Serial Step-down voltage chopper and // Step-up voltage chopper training monitor, with training manual.	1
PED 020 101	Bag of 20 security stackable patch cords (several lengths and colours) diam 4 mm, I 20 A.	1
EPD 037 580	DC rotating machines bench.	1
EMD 030 340	General purpose 1-phase Power Supply Unit. Reversible current.	1
EPD 037 340	Self inductance 1, 2, 4, 6, 8 mH, 5 A.	1
PMM 064 730	Rheostat 320 W, 10 Ohms, 5,7 A.	1

(We suggest the composition of the package, for special configuration, please ask)



1-quadrant thyristor chopper 2A



Studied topics

- Study of the step-down voltage thyristor chopper.
- Manual or automatic mode.
- BNC connection for signals measurement
- **Experiments supplied with the module**

Technical characteristics - PED 020 700 - 1-quadrant thyristor chopper

Studied functions	Step-down voltage thyristor chopper (Load of the extinction circuit...).
Duty cycle control	Duty cycle linear control by DC voltage between -10 V and +10 V.
Isulation	Galvanic insulation and pulse transformer switches.
Visualization of the current	Shunts in each branch allow the visualization of the currents (2 A max at 30 V).
Differential measurement	2 differential amplifier allow th measurement of voltage and current everywhere in the circuit
Power supplies	Power: 30 Vdc, 2 A. Control +/- 15 Vdc, 400 mA

Package PED 207 B : 1-quadrant thyristors chopper

Reference	Description	Quantity
PED 020 700	2 A thyristors chopper training monitor, with training manual	1
PED 020 101	Bag of 20 security stackable patch cords (several lengths and colours) diam 4 mm, l 20 A	1

(We suggest the composition of the package, for special configuration, please ask)

Package PED 207 C : 2 A serial thyristors chopper

Reference	Description	Quantity
PED 020 700	2 A thyristors chopper training monitor, with training manual	1
PED 020 101	Bag of 20 security stackable patch cords (several lengths and colours) diam 4 mm, l 20 A	1
EPD 037 580	DC rotating machines bench	1
EMD 030 340	General purpose 1-phase Power Supply Unit. Reversible current	1
EPD 037 340	Self inductance 1, 2, 4, 6, 8 mH, 5 A.	1
PMM 064 730	Rhéostat 640 W, 165 Ω, 2 A	1

(We suggest the composition of the package, for special configuration, please ask)



4-quadrant transistorized chopper, 2 A



Studied topics

- Study of the speed control of the DC motors.
- 4-quadrant chopper.
- Symmetrical control inverter.
- Off-set control inverter.
- Constant U/f control inverter.
- PWM Inverter.
- **Experiments supplied with the module**

Technical characteristics- PED 020 420 - 4-quadrants transistorized chopper, 2 A

Studied functions	4-quadrants chopper, 1-phase inverter with symmetrical control, Inverter with off-set control, inverter with constant U/f control, PWM inverter.
Duty cycle control	Linear duty cycle variation by DC voltage adjustable from -10 V to +10 V.
Switching frequencies	200 Hz to 2 kHz
Insulation	Galvanic insulation is achieved through optocoupler device
Visualization of the current	Shunts in each branch allow the visualization of the currents (2 A max at 30 V).
Power supplies	Power: 30 Vdc, 1-phase, 2 A. Control : +/- 15 Vdc

Package PED 2042 B : 4-quadrant transistorized chopper, 2 A

Reference	Description	Quantity
PED 020 420	4-quadrant transistorized chopper, 2 A, 1-phase inverter training monitor, with training manual.	1
PED 020 101	Bag of 20 security stackable patch cords (several lengths and colours) diam 4 mm, l 20 A.	1

(We suggest the composition of the package, for special configuration, please ask)

Package PED 2042 C : 4-quadrant transistorized chopper, 2 A

Reference	Description	Quantity
PED 020 420	4-quadrant transistorized chopper, 2 A, 1-phase inverter training monitor, with training manual.	1
PED 020 101	Bag of 20 security stackable patch cords (several lengths and colours) diam 4 mm, l 20 A	1
EPD 037 580	DC rotating machines bench	1
EPD 037 820	AC rotating machines bench.	1
EMD 030 340	General purpose 1-phase Power Supply Unit. Reversible current.	1
EPD 037 340	Self inductance 1, 2, 4, 6, 8 mH, 5 A.	1
PMM 064 730	Rhéostat 640 W, 165 Ω, 2 A	1

(We suggest the composition of the package, for special configuration, please ask)



1-phase thyristors rectifier



Studied topics

- Thyristor Graetz bridge with or without free wheel diode.
- Single or double wave bridge with middle coil point transformer.
- Mixed bridge.
- All thyristors controlled rectifiers (assisted inverter).
- Display of the start angle.
- **Experiments supplied with the module**

Technical characteristics - PED 020 500 - 1-phase thyristors rectifier

Studied functions	Single wave diode bridge or double wave diode bridge with middle coil point transformer, Graetz bridge, single wave thyristors bridge, double wave thyristor bridge with middle coil point transformer, mixed bridge, thyristors Graetz bridge with or without free wheel diode assisted inverter.
Display	A LCD display allows the direct visualization of the Thyristors start angle.
Control of the Thyristors	Digital control of the thyristors by single pulse or by pulse train.
External control	A feedback loop enables the study with control current with a external +/- 10 V control unit
Insulation	Two pulse transformers are used for the galvanic insulation of the control and the power circuits
Visualization of the current	Shunts in each branch allow the visualization of the currents (2 A max at 30 V).
Power supplies	Power: 24 VAC (single phase), 2,5 A. Control : +/- 15 Vdc 400 mA.

Package PED 205 B : 1-phase controlled rectifier

Reference	Description	Quantity
PED 020 500	1-phase diode, thyristors rectifier, mixed bridge training monitor, with training manual.	1
PED 020 101	Bag of 20 security stackable patch cords (several lengths and colours) diam 4 mm, l 20 A	1

(We suggest the composition of the package, for special configuration, please ask)

Package PED 205 C : 1-phase controlled rectifier

Reference	Description	Quantity
PED 020 500	1-phase diode, thyristors rectifier, mixed bridge training monitor, with training manual.	1
PED 020 101	Bag of 20 security stackable patch cords (several lengths and colours) diam 4 mm, l 20 A.	1
EPD 037 580	DC rotating machines bench	1
EMD 030 340	General purpose 1-phase Power Supply Unit. Reversible current	1
PMM 064 730	Rhéostat 640 W, 165 Ω, 2 A	1

(We suggest the composition of the package, for special configuration, please ask)



3-phase thyristors rectifier



Studied topics

- 3-phase rectifier.
- All diodes, all thyristors or mixed.
- Single wave rectifier-P3.
- Double wave rectifier-PD3.
- Assisted inverter
- **Experiments supplied with the module**

Technical characteristics - PED 020 600 - 3-phase thyristors rectifier

Studied functions	Single wave diodes bridge (P3), double wave diodes bridge (PD3), mixed single and double wave all thyristors bridge (with or without free wheel diode) assisted inverter.
Duty cycle control	A feedback loop enables the study with control current with a external +/- 10 V.
Insulation	Six pulse transformers are used for the galvanic insulation between power and control circuits
Visualization of the current	Shunts in each branch allow the visualization of the currents (2 A max at 30 V).
Power supplies	Power 3 x 24 VAC 3-phase, 2 A. Control +/- 15 Vdc, 400 mA.

Package PED 206 B : 3-phase controlled rectifier

Reference	Description	Quantity
PED 020 600	3-phase thyristors rectifier training monitor, with training manual	1
PED 020 101	Bag of 20 security stackable patch cords (several lengths and colours) diam 4 mm, I 20 A.	2

(We suggest the composition of the package, for special configuration, please ask)

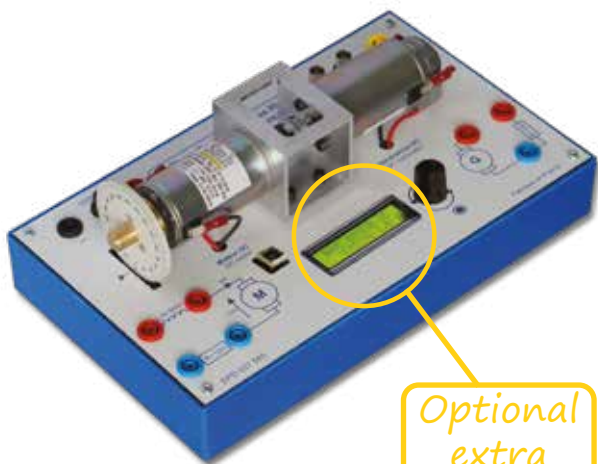
Package PED 206 C : 3-phase controlled rectifier

Reference	Description	Quantity
PED 020 600	3-phase thyristors rectifier training monitor, with training manual.	1
PED 020 101	Bag of 20 security stackable patch cords (several lengths and colours) diam 4 mm, I 20 A	2
EPD 037 580	DC rotating machines bench	1
PMM 062 180	(AL890N) symmetrical power supply: +/-15V, 1A.	1
EMD 030 390	3-phase, low voltage power supply	1
PMM 064 730	Rhéostat 640 W, 165 Ω , 2 A	1

(We suggest the composition of the package, for special configuration, please ask)



VLV load bench, DC motor and generator



Highlights

- Protected against overvoltage and overcurrent.
 - High quality servomotors.
 - Industrial optical incremental coder.
 - Display of the coder's channels.
 - In addition to the 30-W power bridges (Chopper/ Rectifier).
- En option :
- Embedded measures for speed, position, voltage, current and power.

Technical characteristics - EPD 037 580 - VLV load bench with DC motor and generator

Nominal voltage	24 Vdc	Nominal current : 700 mA Maximal current : 2 500 mA	C nom : 25 mNm C max : 102 mNm
Mechanical power Max efficiency : 76,9%	12,85 Watts	Mechanical powerMax efficiency : 49%	29,37 Watts
Optional extra : Measurement of speed, position, voltage, current, power, EPD037620			
IHM	2x16 lines ASCII characters display and digital potentiometer		
Electrical measures	Motor current	Motor voltage	Motor power
Mechanical measurements	Speed	Position	

Pack EPD 037 580 : VLV load bench, DC motor and generator

Pack EPD 3758 S : VLV load bench, DC motor and generator with speed measurement

Asynchronous machine bench, very low voltage



New Version

Highlights

- To be associated with the 4-quadrant chopper monitor PED 020 420 (for single phase inverter mode).

Technical characteristics - EPD 037 820 - Mini Asynchronous machine bench

Kind of motor	Phase shading ring, single phase asynchronous machine.		
Nominal voltage	24 VAC	Nominal current	250 mA

Package EPD 037 820 : Asynchronous machine bench, very low voltage



PID corrector



Highlights

- Used to study motors speed servo control in the VLV 30 W power electronics range.

Technical characteristics - PED 020 300 - PID corrector

Functions	Control generator, Comparator, Correctors with adjustable gain : P, I and D.
Power supply	External unit +/-15 Vdc 400 mA

PED 020 300 : PID corrector

Self inductance

Technical characteristics - EPD 037 340

Function	Self with multiple outputs : 1, 2, 4, 6, 8 mH.
Core	Sheet of silicium
Average current	5A
Ovoltage Coefficient	22



EPD 037 340 : Self inductance

Resistive load

Technical characteristics - PMM 064 730

R max	165 Ohms
Power	640 W
Nominal current	2A



PMM 064 730 : Resistive load



2-quadrant transistorized chopper, 5 A



Highlights

- Voltage and current probes with galvanic insulation
- Shunts in each branch allow the visualization of the currents.

Studied topics

- Subvoltage chopper.
- Chopper with energy recovery.
- **Experiments supplied with the module**

Technical characteristics - PED 020 200 - 2-quadrant transistorized chopper, 5 A

Studied Functions	Step-down voltage chopper, step-down voltage chopper with current control, chopper with voltage recovery
Duty cycle control	A feedback loop enables the study with control current with an external +/- 10 V control unit
Insulation	Galvanic insulation is achieved through optocoupler device
Visualization of the current	Shunts in each branch allow the visualization of the currents (5 A max at 30 V).
Insulation of the measures	Differential probes are used for the visualization of the voltage and of the current on an oscilloscope.

PED 020 200 : 2-quadrant transistorized chopper, 5 A

Reference	Description	Quantity
PED 020 200	2-quadrant transistorized chopper, 5 A.	1



All our modules are supplied with manuals of experiments, written by teachers we are working with.



120-W machines group



Highlights

- 2x 120-W DC machines.
- Built-in tachymetric generator.
- 2 embedded loads (12 Ohms)

Studied topics

- Operative unit for the study of :
 - Energy static converters,
 - Speed servo systems
- **Compatible with the SELV power electronics range**
 - **EPS130B page 85**
 - **EPS210B page 87**
 - **EPS230B page 89**

Technical characteristics - ELD 037 480 - 120-W machine bench

Motors	Motors with separate excitation				
Nominal power	120 watts	R	0.68 Ohm	Pa	120 W
Nominal voltage	24 Vdc	L	2 mH	Pem	103 W
Nominal current of the motor	5 A	J	$1,38310^{-4}$ kg.m ²	Pu	95 W
Nominal excitation current	0.6 A	Tem	0.33 Nm	Pm	8 W (mechanical losses)
Nominal speed	3100 rpm	Tn	0.29 Nm		
Tachymetric generator	Synchronous generator with 12 pairs of poles, gain : $n = 5 \times f$ (n in rpm).				

ELD 037 480 : 120-W machine bench

Package ELD 3748 C : Experiments in power electronics, 120-W range

Reference	Description	Quantity
ELD 037 480	120-W DC motors bench	1
PED 020 200	2-quadrant transistorized chopper, 5 A, current reversible	1
EPD 037 340	Self Inductance : 1, 2, 4, 6, 8 mH, 5 A	1
PMM 064 000	Rheostat 320 W, 10 Ohms, 5,7 A	1
PED 020 300	PID corrector monitor	1
PMM 062 830	Adjustable power supply, with digital display: 0/30 Vdc, 0/5 A	2
PMM 062 180	Symmetrical power supply, +/-15 V, 1 A	1
ELD 100 200	Set of 52 safety stackable patching cords diam 4 mm (25, 50, 100, 200 cm)	1

(We suggest the composition of the package, for special configuration, please ask)

New
range

Power range



To answer the needs of its customers, DIDALAB has 4 ranges of power 30 W, 300W (SELV and LV), 1.5 kW

300-W range, SELV



To alleviate the problem of security, Didalab has developed a range of products power electronics and electrical engineering in SELV 300 W (Safety Extra Low Voltage).



This range of power has many advantages. It allows :

- *The students to work in autonomy and without supervision from a teacher when they switch on the equipment (power supplies, converters, motor benches ...)*
- *To work with «standard» tables (with 1-phase 230 V / 16 A sockets).*
- *To work on the motors characterizations (mechanical and electrical characteristics)*
- *to make an energy power balance*

This range addresses mainly :

- *Colleges, which must teach the power converters et motors but don't have dedicated electrical engineering laboratories (with 3-phase power supplies ...)*
- *Several training in electrical engineering (ISCED level 3 or 4)....*

SELV 430-W Power Supply, 1-Phase, 3-Phase, and DC



Highlights

- *3-phase power supply (3*24 VAC - 11A) from Mains (1-phase 230 VAC, 16A).*
- *DC power supply (48 V DC - 9 A)*
- *Excitation power supply (48 V DC - 2 A)*
- *HMI with LCD display (voltages, currents, phaseshift, cosφ, ...).*

EMS 300 000 : SELV 430-W power supply, 1-Phase, 3-Phase, and DC (see page 108)

SELV 430-W DC Power Supply

Highlights

- *DC power supply (48 V DC - 9 A)*
- *Auxiliary DC power supply (48 V DC - 2 A)*
- *Protected against overvoltage, overcurrent, overpower, temperature ...*
- *HMI with LCD display*
- *Display of voltage, current*



EMS 200 000 : SELV 430-W DC power supply



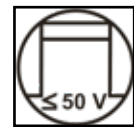
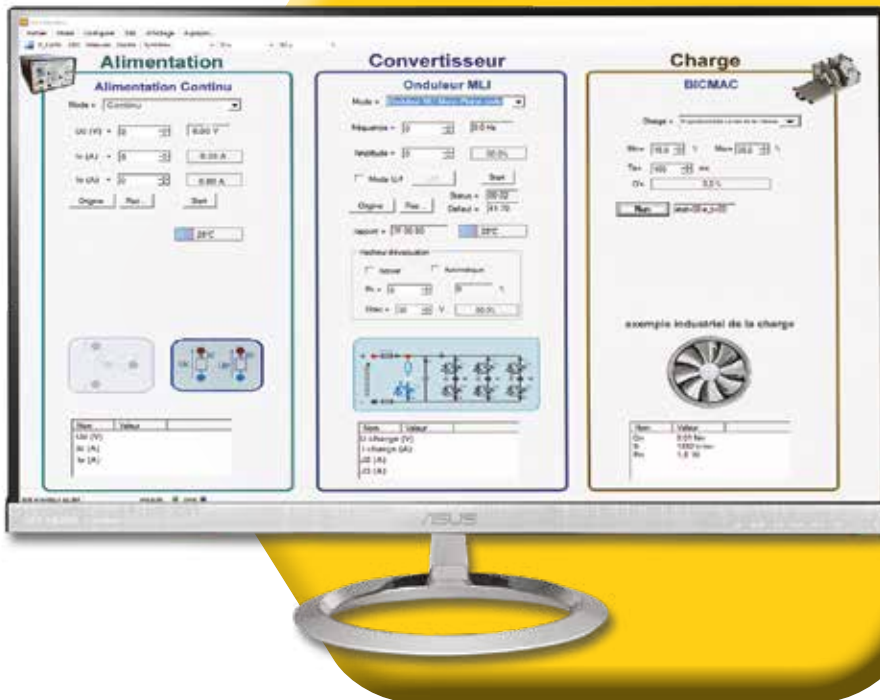
EP_Monitor : Control and data acquisition software for Power electronics and electrical engineering

Highlights

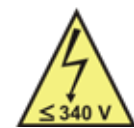
- 3 softwares in 1
- Control
 - Power supply
 - Converters
 - Loads
- Data acquisition
 - Electrical measures
 - Mechanical measures
- Oscilloscope
 - 8 channels
 - FFT function
 - Low-pass filter
- Motors characteristics
 - XY mode
- 2 versions :
 - SELV: 3x24 VAC – 48 VDC
 - LV : 3x220 VAC – 320 VDC

Studied topics

- Motors characterisations :
 - DC motors
 - AC motors
 - Brushless motor
- Measure of mechanical quantities
- Plotting of
 - Mechanical characteristics
 - Electrical characteristics
- Power electronics



or



Technical characteristics

Definition	EP monitor can be associated with each of our operative units. It controls of the unit, acquires the measurements at all points of the setting and plots the different curves. It has been conceived for the whole 300-W range (SELV or LV) of power electronics and electrical engineering products
Operative units	<ul style="list-style-type: none"> - Power supplies : EM 300 / EMS 300 - see page 108 - Converters : EP(S) 230 - Chopper, 1-phase / 3-phase inverter – see page 89/99 EP(S) 130 - 1-phase / 3-phase rectifier – see page 85/95 EP(S) 120 - 1-phase / 3-phase AC-controller – see page 81/91 - Loads : BICMAC(S) - see page 110 BICSIN(S) - see page 112

EP Monitor software : Control and data acquisition software



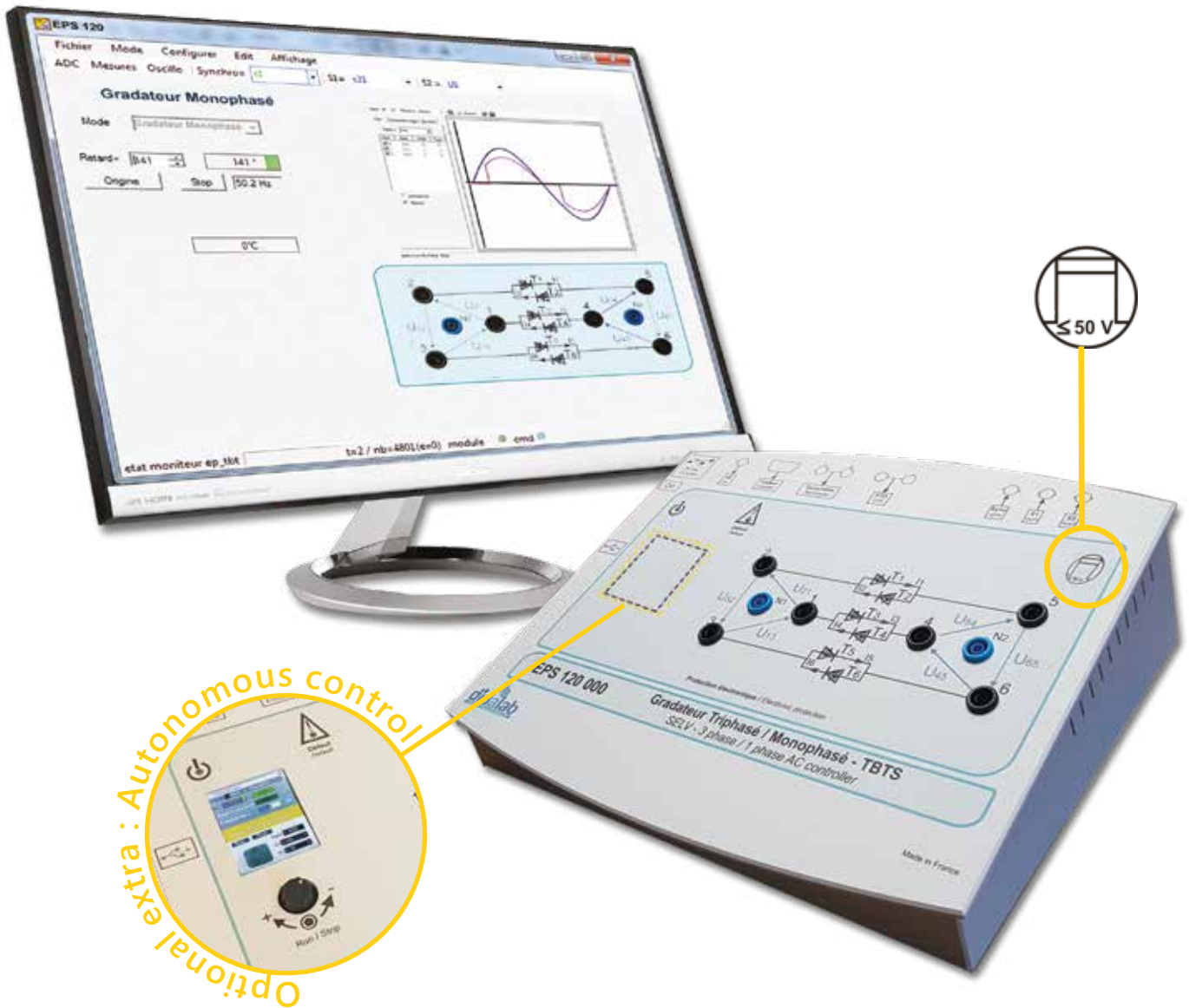
1-phase / 3-phase AC controller, 120/ 300 W SELV

Highlights

- Safety Extra Low Voltage.
- Control and supervision software, USB connection.
- Virtual real time oscilloscope
- Display Leds for the bridge structure.
- A lot of electronic protections.
- Measures with display BNC.

Studied topics

- Up-line 1-phase AC controller :
- All thyristors
- Up-line 3-phase AC controller :
- All thyristors
- Mixed diodes/ all thyristors

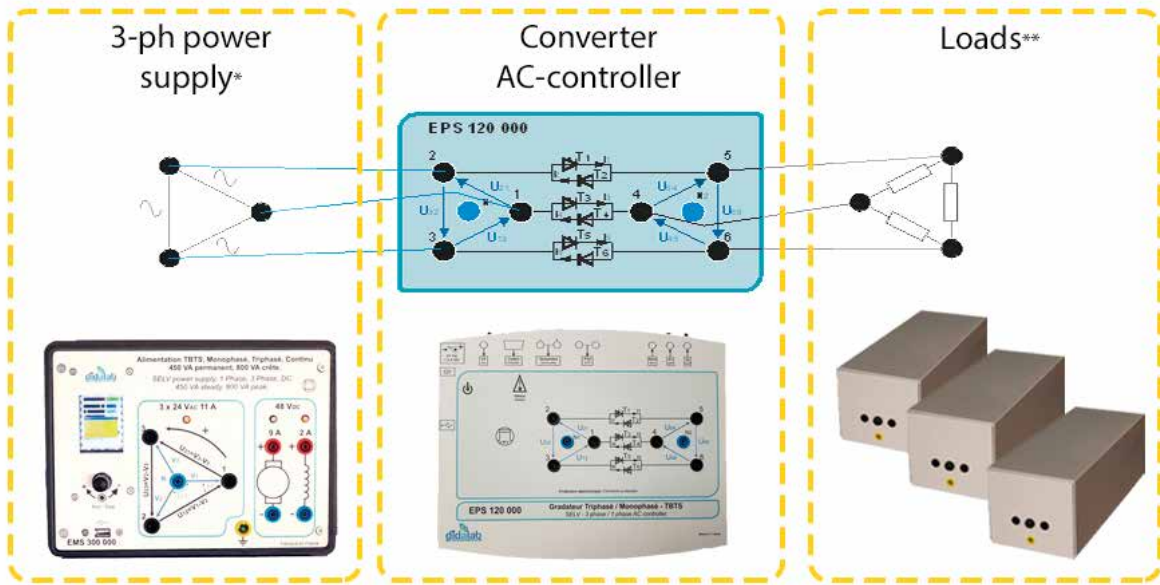


Technical characteristics - EPS 120 000 - Secure power bridge, with 6 Thyristors

Functions	Up-line 1-phase AC controller: all thyristors Up-line 3-phase AC controller: mixed diodes/ all thyristors External control: with +/-10 Vdc electronic setting (static chopper or 1-phase inverter).
Supervision and Measures	All the probes are also used for the security supervision of the equipment.
Securities	Protection against short-circuit, constant supervision of power supply. Supervision of the motor temperature.
Power supply (ext)	Power supply voltage: 24 VAC phase/phase. Max peak current in each static switch: 10 A
Analogue I/O	3 +/- 10V analogue outputs to visualize the signals, 1 +/- 10Vdc analogue input



> **Settings :**

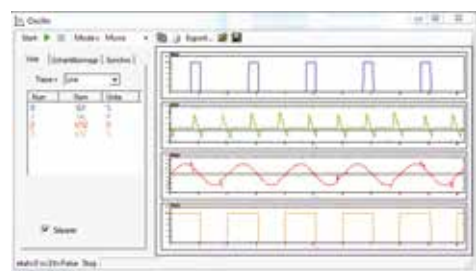


* See page 106
 ** See page 117

> **Examples :**



Setting depending of what you want to study



Vizualisation with an material oscilloscope

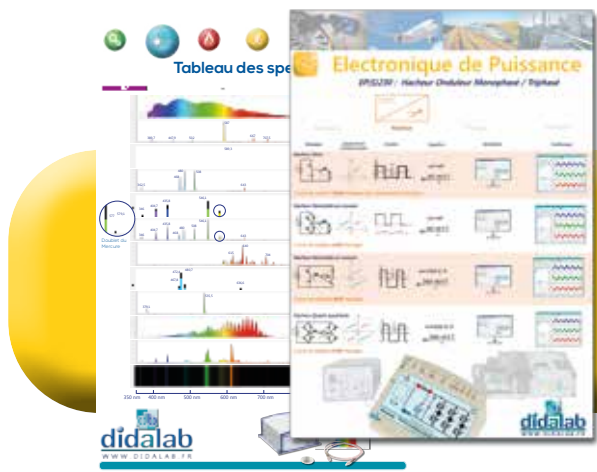
Experiments

1-phase AC controller	3-phase AC controller
All thyristors	Mixed diodes /all thyristors

Package EPS 120 B : Basic package «STUDY OF A 1-phase and 3-phase AC CONTOLLER, 120/300W»

Reference	Description	Quantity
EPS 120 000	Secure module for power electronics, 120/300 W, 1-phase and 3-phase AC controller	1
EPS 120 100	Control and supervision software	1
EGD 000 005	24 Vdc power supply, 2,9A with Jack socket	1
EPS 120 010	User manual and technical guide	1
EGD 000 006	USB lead, AA kind	1
EGD 000 018	Storage case	1

(We suggest the composition of the package, for special configuration, please ask)



Please, ask your pedagogical poster



1-phase rectifier, 120/ 300 W SELV

Highlights

- Control and supervision software, USB connection.
- Virtual real time oscilloscope
- Display Leds for the bridge structure.
- Electronic protections.
- Measures with display BNC.
- Tacho-generator input.
- Incremental coder input .

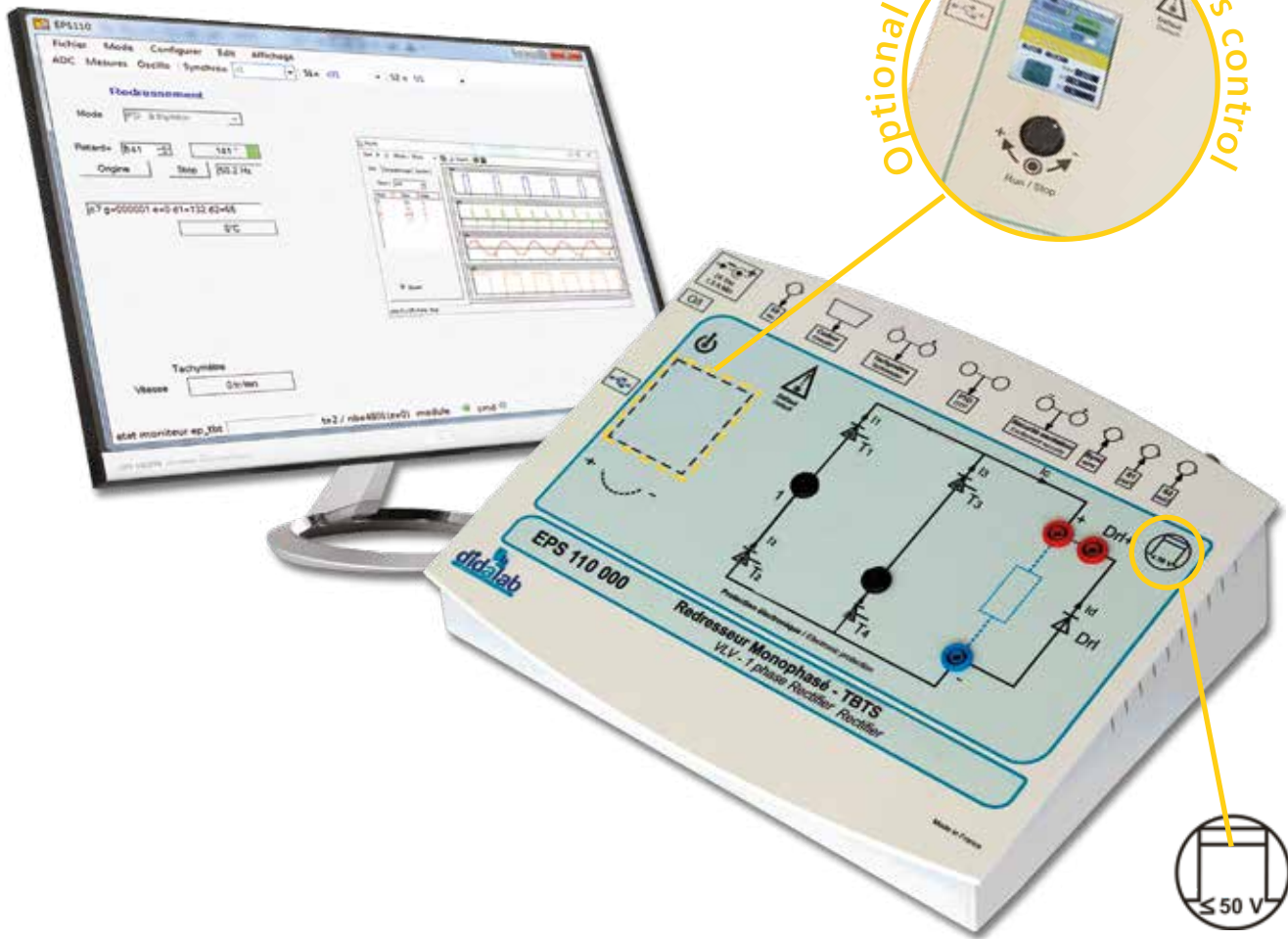
Optional extra :

- Speed servo-control.
- Prototyping
- Autonomous control

Studied topics

- 1-phase rectifier : commutation cell, all diodes, all thyristors, mixed symmetrical,
- mixed asymmetrical.
- Assisted inverter.
- Speed servo-control.
- Prototyping.

Optional extra : Autonomous control

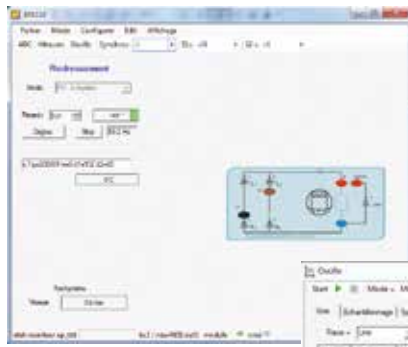


Technical characteristics - EPS 110 000 - Secure power bridge, with 4 Thyristors

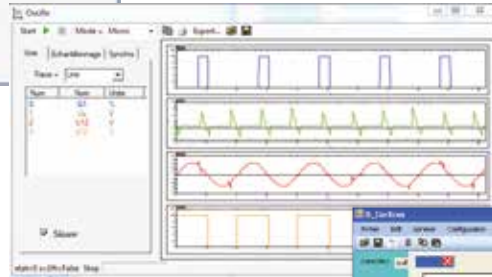
Functions	1-phase rectifier : commutation cell, all diodes, all thyristors, mixed symmetrical and asymmetrical. Assisted inverter.
Supervision and Measures	All the probes are also used for the security supervision of the equipment.
Securities	Protection against short-circuit, constant supervision of power supply. Supervision of the motor temperature.
Power supply (ext)	24VDC, 2,9A power supply – 3x24 VAC Max for the power.
Analogue I/O	3 +/- 10V analogue outputs to visualize the signals, 1 +/- 10Vdc analogue input, Inputs : DB15 incremental coder, tacho-generator
Optional extra	D_CCA : Program module for the speed and position servo-control, (see page 46) D_Scil : Module for prototyping with SCILAB/XCOS. (see page 49)



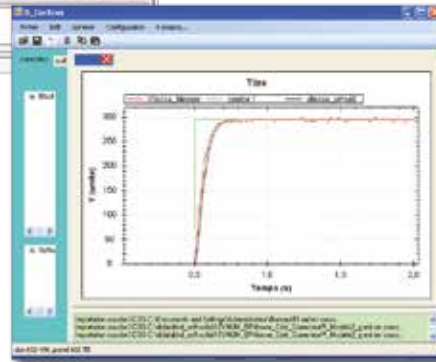
> **Example :**



Setting parameters



Vizualisation via virtual oscilloscope



D_SciL Speed control



Experiments

Half-wave rectification	1-phase rectifier
Commutation cell	Assisted Inverter

Package EPS 110 B : Basic package «STUDY OF A 1-phase RECTIFIER, 120/300W»

Reference	Description	Quantity
EPS 110 000	Secure module for power electronics, 120/300 W, 1-phase rectifier	1
EPS 110 100	Control and supervision software	1
EGD 000 005	24 Vdc power supply, 2,9A with Jack socket	1
EPS 110 010	User manual and technical guide	1
EGD 000 006	USB lead, AA kind	1
EGD 000 018	Storage case	1

Package EPS 110 C : Complete package "STUDY OF 1-phase RECTIFIER, 120/300W, with speed servo-control with a DC motor"

Reference	Description	Quantity
EPS 110 B	Basic package «STUDY OF A 1-phase RECTIFIER, 120/300W»	1
EPS 110 200	Program module for the speed and position servo-control, acquisition and response curves on a computer (computer not included).	1
EPS 110 040	Manuel of experiments for the teacher «Study of a speed servo-system with a EPS110000 rectifier»	1
EPS 110 050	Manuel of experiments for the student «Study of a speed servo -system with a EPS110000 rectifier»	1

Package EPS 110 S : Simulation and experiment package «CONTROL OF A 1-phase RECTIFIER, 120/300W, with speed servo-control with a DC motor»

Reference	Description	Quantity
EPS 110 C	Complete package « STUDY OF 1-phase RECTIFIER, 120/300W, with speed servo-control with a DC motor»	1
EPS 110 800	D_SciL, module for prototyping with SCILAB/XCOS, Editor based on graphic diagram blocks, C code real time generator	1

(We suggest the composition of the package, for special configuration, please ask)



1-phase, 3-phase rectifier, 120/ 300 W SELV

Highlights

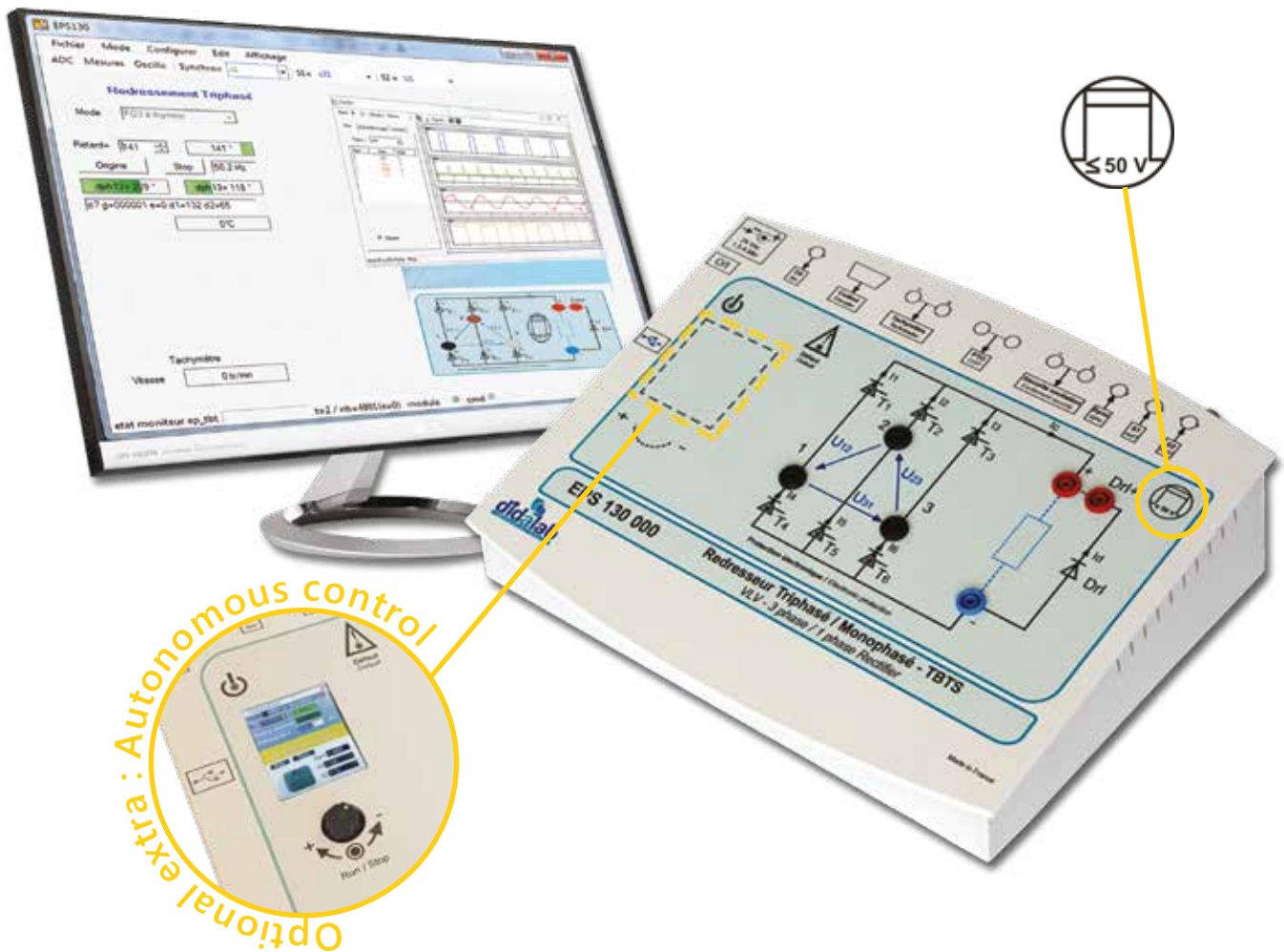
- Control and supervision software, USB connection.
- Virtual real time oscilloscope
- Display Leds for the bridge structure.
- Electronic protections.
- Measures with display BNC.
- Tacho-generator input.
- Incremental coder input.

Optional extra :

- Speed servo-control.
- Prototyping
- Autonomous control

Studied topics

- 1-phase rectifier : commutation cell, all diodes, all thyristors, mixed symmetrical, mixed asymmetrical
- 3-phase rectifier : all diodes, mixed, all thyristors
- Assisted inverter.
- Speed servo-control.
- Prototyping.



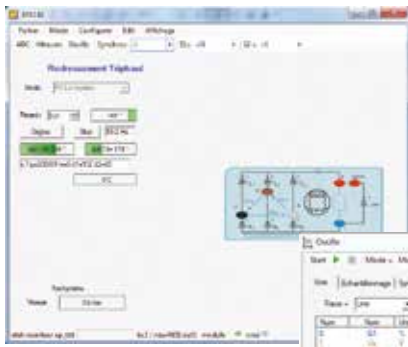
Optional extra : Autonomous control

Technical characteristics - EPS 130 000 - Secure power bridge, with 6 Thyristors

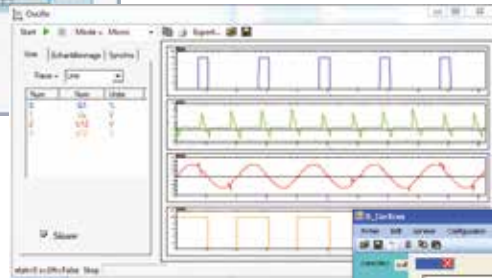
Functions	1-phase rectifier : commutation cell, all diodes, all thyristors, mixed symmetrical and asymmetrical. 3-phase rectifier : all diodes, mixed, all thyristors. Assisted inverter
Supervision and Measures	All the probes are also used for the security supervision of the equipment.
Securities	Protection against short-circuit, constant supervision of power supply. Supervision of the motor temperature.
Power supply (ext)	24VDC, 2,9A power supply – 3x24 VAC Max for the power.
Analogue I/O	3 +/- 10V analogue outputs to visualize the signals, 1 +/- 10Vdc analogue input, Inputs: DB15 incremental coder, tacho-generator.
Optional extra	D_CCA : Program module for the speed and position servo-control, (see page 46) D_Scil : Module for prototyping with SCILAB/XCOS. (see page 49)



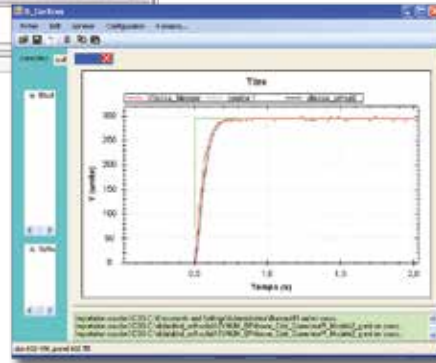
> **Example :**



Setting parameters



Vizualisation via virtual oscilloscope



D_SciL Speed control

Experiments

Half-wave rectification	3-phase rectifier
Commutation cell	Assisted Inverter
1-phase rectifier	

Package EPS 130 B : Basic package «STUDY OF A 1-phase and 3-phase RECTIFIER, 120/300W»

Reference	Description	Quantity
EPS 130 000	Secure module for power electronics, 120/300 W, 1-phase and 3-phase rectifier	1
EPS 130 100	Control and supervision software	1
EGD 000 005	24 Vdc power supply, 2,9A with Jack socket	1
EPS 130 010	User manual and technical guide	1
EGD 000 006	USB lead, AA kind	1
EGD 000 018	Storage case	1

Package EPS 130 C : Complete package "STUDY OF 1-phase and 3-phase RECTIFIER, 120/300W, with speed servo-control with a DC motor"

Reference	Description	Quantity
EPS 130 B	Basic package «STUDY OF A 1-phase and 3-phase RECTIFIER, 120/300W»	1
EPS 130 200	Program module for the speed and position servo-control, acquisition and response curves on a computer (computer not included).	1
EPS 130 040	Manuel of experiments for the teacher «Study of a speed servo-system with a EPS130000 rectifier»	1
EPS 130 050	Manuel of experiments for the student «Study of a speed servo -system with a EPS130000 rectifier»	1

Package EPS 130 S : Simulation and experiment package « CONTROL OF A 1-phase and 3-phase RECTIFIER, 120/300W, with speed servo-control with a DC motor»

Reference	Description	Quantity
EPS 130 C	Complete package « STUDY OF 1-phase and 3-phase RECTIFIER, 120/300W, with speed servo-control with a DC motor».	1
EPS 130 800	D_SciL, module for prototyping with SCILAB/XCOS, Editor based on graphic diagram blocks, C code real time generator.	1

(We suggest the composition of the package, for special configuration, please ask)



Chopper, 1-phase Inverter 120/ 300 W, SELV

Highlights

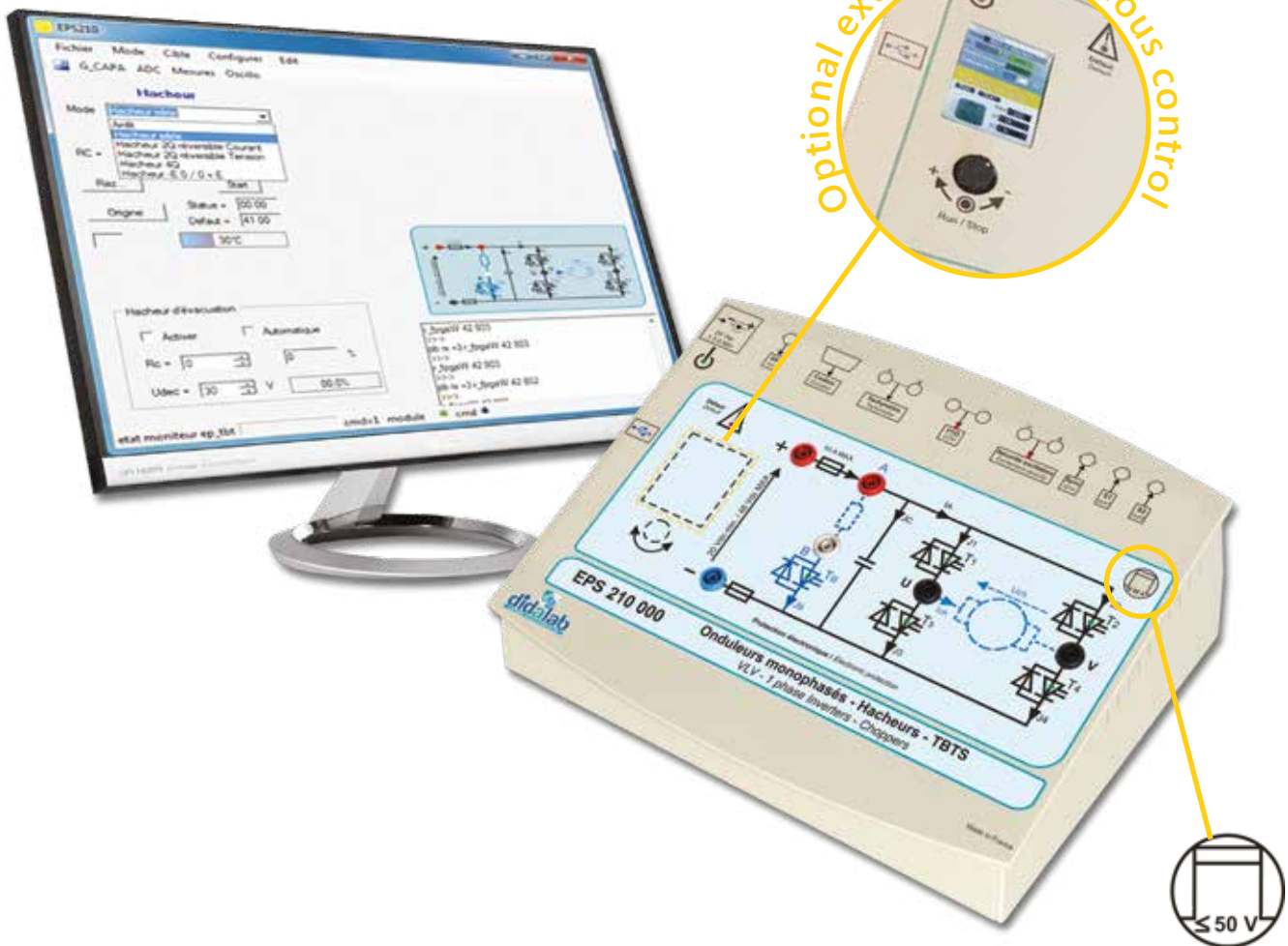
- Control and supervision software, USB connection.
- Virtual real time oscilloscope
- Display Leds for the bridge structure.
- Electronic protections.
- Measures with display BNC.
- Tacho-generator input.
- Incremental coder DB15 input

Optional extra :

- Speed servo-control,
- Prototyping.
- Autonomous control

Studied topics

- Study of choppers : serial, voltage reversible, current reversible, four quadrants, over-fitted double serial
- Study of 1-phase inverter : shift control full wave with fixed frequency, with variable frequency, +E/-E PWM , +E/0/-E PWM , constant U/F ratio
- Speed and position servo-control.
- Prototyping



Technical characteristics - EPS 210 000 - Secure power bridge, chopper and 1-phase inverter

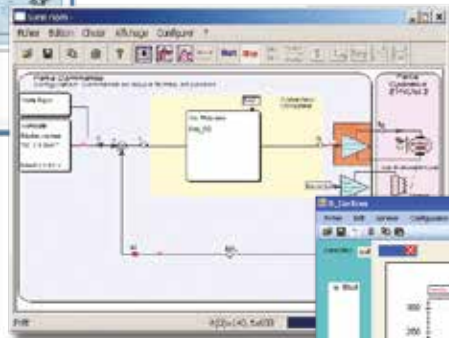
Functions	Chopper : serial, voltage reversible, current reversible, 4 quadrants, over-fitted double serial. Inverter : shift control full wave with fixed frequency, with variable frequency, +E/-E PWM , +E/0/-E PWM , constant U/F ratio.
Supervision and Measures	All the probes are also used for the security supervision of the equipment.
Securities	Protection against short-circuit, constant supervision of power supply. Supervision of the motor temperature. Function for return energy evacuation.
Power supply (ext)	24V dc, 2,9A power supply – 50 VDC Max for the power.
Analogue I/O	3 +/- 10V analogue outputs to visualize the signals, 1 +/- 10Vdc analogue input, Inputs: DB15 incremental coder, tacho-generator.
Optional extra	D_CCA : Program module for the speed and position servo-control, (see page 46) D_Scil : Module for prototyping with SCILAB/XCOS. (see page 49)



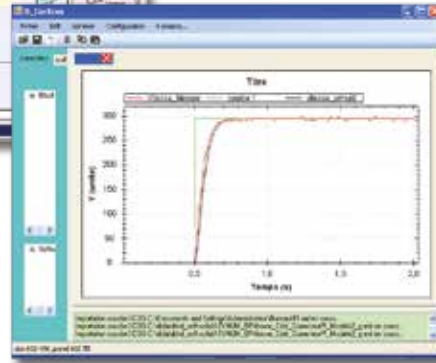
> **Example :**



Setting parameters



Vizualisation via virtual oscilloscope



D_SciL Speed control



Experiments

Serial chopper	Shift control inverter	Servocontrol
voltage reversible, current reversible chopper	PWM inverter	OL/CL
4- quadrant chopper	PWM inverter, constant U/F ratio	Speed/position

Pack EPS 210 B : Basic package «STUDY OF A 1, 2, 4-Quadrant CHOPPER, 1-phase INVERTER, 120/300W»

Reference	Description	Quantity
EPS 210 000	Secure module for power electronics, 120/300 W, 1, 2, 4-quadrant choppers, 1-phase inverter, +E /-E, +E/0/-E PWM.	1
EPS 210 100	Control and supervision software	1
EGD 000 005	24 Vdc power supply, 2,9A with Jack socket	1
EPS 210 010	User manual and technical guide	1
EGD 000 006	USB lead, AA kind	1
EGD 000 018	Storage case	1

Pack EPS 210 C : Complete package «STUDY OF A 1, 2, 4-Quadrant CHOPPER, 1-phase INVERTER, 120/300W, with speed and position servo-control with a DC motor»

Reference	Description	Quantity
EPS 210 B	Basic package «STUDY OF A 1, 2, 4-Quadrant CHOPPER, 1-phase INVERTER, 120/300W»	1
EPS 210 200	Program module for the speed and position servo-control, acquisition and response curves on a computer (computer not included)	1
EPS 210 040	Manuel of experiments for the teacher "Study of a speed and position servo-system with a EPS210000 chopper».	1
EPS 210 050	Manuel of experiments for the student "Study of a speed and position servo -system with a EPS210000 chopper».	1

Pack EPS 210 S : Simulation and experiment package «CONTROL OF A 1, 2, 4-Quadrant CHOPPER, 1-phase INVERTER, 120/300W, with speed and position servo-control with a DC motor»

Reference	Description	Quantity
EPS 210 C	Complete package «STUDY OF A 1, 2, 4-Quadrant CHOPPER, 1-phase INVERTER, 120/300W, with speed and position servocontrol with a DC motor»	1
EPS 210 800	D_SciL, module for prototyping with SCILAB/XCOS, Editor based on graphic diagram blocks, C code real time generator.	1

(We suggest the composition of the package, for special configuration, please ask)



Chopper, 1-phase & 3-phase inverter, 120/ 300 W, SELV

Highlights

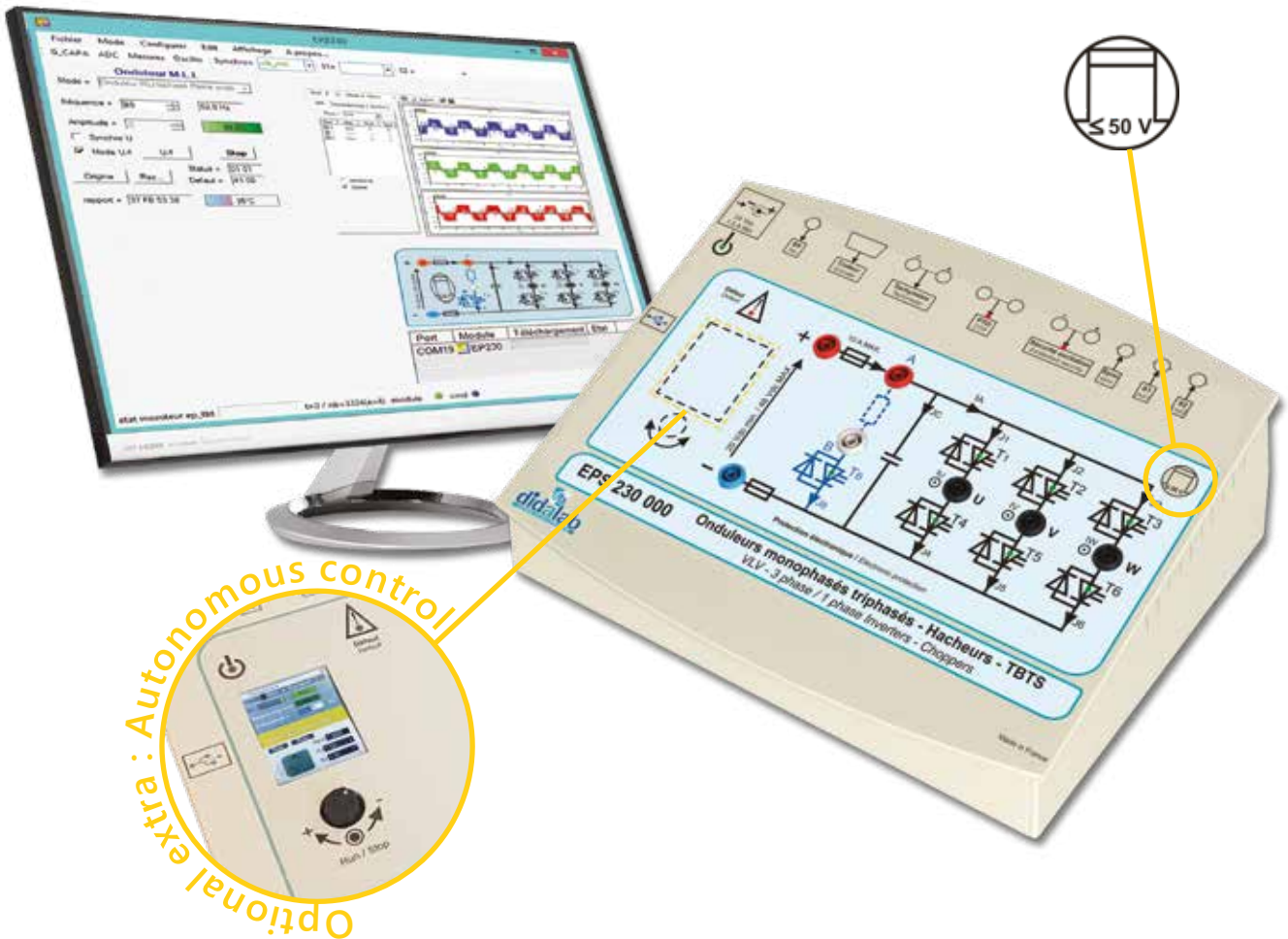
- Control and supervision software, USB connection.
- Virtual real time oscilloscope
- Display Leds for the bridge structure.
- Electronic protections.
- Measures with display BNC.
- Tacho-generator input.
- Incremental coder DB15 input.

Optional extra :

- Speed servo-control,
- Prototyping
- Autonomous control

Studied topics

- Choppers : serial, voltage reversible, current reversible, four quadrants, over-fitted double serial
- 1-phase inverter : shift control full wave with fixed frequency, with variable frequency, +E/-E PWM , +E/0/-E PWM , constant U/F ratio
- 3-phase inverter : shift control full wave with fixed frequency, with variable frequency, +E/-E PWM , +E/0/-E PWM , constant U/F ratio
- Speed and position servo-control.
- Prototyping.



Technical characteristics - EPS 230 000 - Secure power bridge, chopper and 1-phase and 3-phase inverter

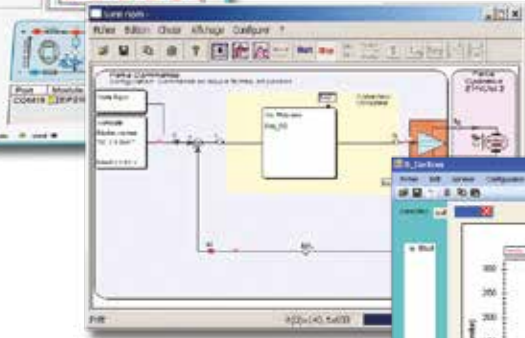
Functions	Chopper : serial, voltage reversible, current reversible, 4 quadrants, over-fitted double serial. 1-phase Inverter : shift control full wave with fixed frequency, with variable frequency, +E/-E PWM , +E/0/-E PWM , constant U/F ratio. 3-phase Inverter : shift control full wave with fixed frequency, with variable frequency, +E/-E PWM , +E/0/-E PWM , constant U/F ratio
Supervision and Measures	All the probes are also used for the security supervision of the equipment
Securities	Protection against short-circuit, constant supervision of power supply. Supervision of the motor temperature. Function for return energy evacuation.
Power supply (ext)	24V dc, 2,9A power supply – 50 V DC Max for the power.
Analogue I/O	3 +/- 10V analogue outputs to visualize the signals, 1 +/- 10Vdc analogue input. Inputs : DB15 incremental coder, tacho-generator.
Optional extra	D_CCA : Program module for the speed and position servo-control, (see page 46) D_Scil : Module for prototyping with SCILAB/XCOS. (see page 49)



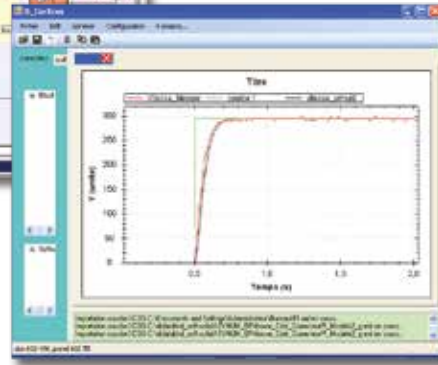
> **Example :**



Setting parameters



Vizualisation via virtual oscilloscope



D_SciL Speed control



Experiments

Chopper	1-phase inverter	3-phase inverter	Servocontrol
Serial chopper	Shift control	Adjustable modulation index	OL/CL
voltage reversible, current reversible chopper	PWM, constant U/F ratio	PWM, constant U/F ratio	Speed and position
4- quadrant chopper	PWM	PWM	Prototyping

Pack EPS 230 B : Basic package «STUDY OF A 1, 2, 4-Quadrant CHOPPER, 1-phase and 3-phase INVERTER, 120/300W»

Reference	Description	Quantity
EPS 230 000	Secure module for power electronics, 120/300 W, 1, 2, 4-quadrant choppers, 1-phase and 3-phase inverter, full wave, +E /-E, +E/0/-E PWM	1
EPS 230 100	Control and supervision software	1
EGD 000 005	24 Vdc power supply, 2,9A with Jack socket	1
EPS 230 010	User manual and technical guide	1
EGD 000 006	USB lead, AA kind	1
EGD 000 018	Storage case	1

Pack EPS 230 C : Complete package «STUDY OF A 1, 2, 4-Quadrant CHOPPER, 1-phase and 3-phase INVERTER, 120/300W, with speed and position servo-control with a DC or AC motor»

Reference	Description	Quantity
EPS 230 B	Basic package "STUDY OF A 1, 2, 4-Quadrant CHOPPER, 1-phase and 3-phase INVERTER, 120/300W"	1
EPS 230 200	Program module for the speed and position servo-control, acquisition and response curves on a computer (computer not included).	1
EPS 230 040	Manuel of experiments for the teacher "Study of a speed and position servo-system with a EPS230000 chopper».	1
EPS 230 050	Manuel of experiments for the student "Study of a speed and position servo-system with a EPS230000 chopper».	1

Pack EPS 230 S : Simulation and experiment package «CONTROL OF A 1, 2, 4-Quadrant CHOPPER, 1-phase and 3-phase INVERTER, 120/300W, with speed and position servo-control with a DC or AC motor»

Reference	Description	Quantity
EPS 230 C	Complete package «STUDY OF A 1, 2, 4-Quadrant CHOPPER, 1-phase and 3-phase INVERTER, 120/300W, with speed and position servo-control with a DC or AC motor»	1
EPS 230 800	D_SciL, module for prototyping with SCILAB/XCOS, Editor based on graphic diagram blocks, C code real time generator	1

(We suggest the composition of the package, for special configuration, please ask)



Power range



To answer the needs of its customers, DIDALAB has 4 ranges of power 30 W, **300W** (SELV and LV), **1.5 kW**.

New range

300-W range, LV

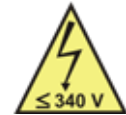


This range of power already presents electrical engineering phenomena (characteristics of motors). However, by having a relatively low(weak) power the cost of equipment remains moderate.

This range addresses mainly :

- *All the trainings which propose practical class of electronics of power and electrical engineering with a dedicated laboratory (mandatory electro-engineering environment with 3-ph measuring workbenches (3-phase alternative current (fixed and adjustable), adjustable continuous current ...).*

LV 300-W Power Supply, 1-Phase, 3-Phase, and DC

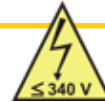


Highlights

- 3-phase power supply (3*240 VAC - 2A) from Mains (1-phase 230 VAC, 16A).
- DC power supply (320 V DC - 1.5 A)
- Excitation power supply (320 V DC - 0.6 A)
- HMI with LCD display (voltages, currents, phaseshift, $\cos\phi$, ...)

EM 300 000 : LV 300-W power supply, 1-Phase, 3-Phase, and DC (see page 108)

1.5-kW range, LV



This range of power presents real electrical engineering phenomena (characteristics of motors).

This range addresses mainly :

- *All the trainings specialised in electronics of power and electrical engineering.*

Of course, this range needs a dedicated laboratory (mandatory electro-engineering environment with 3-ph measuring workbenches (3-phase alternative current (fixed and adjustable), adjustable continuous current ...).

Electrical engineering, measuring Workbench



Highlights

- *Especially conceived for experiments in power electronics (1-ph or 3-phase rectifiers, PWM, 4-quadrant choppers, 1-ph or 3-phase inverters, rotor or stator recovery on asynchronous motors ...)*
- *2x 3-phase power supplies, 2 DC power supplies*

Pack ELD 100 B : Electrical engineering, measuring Workbench (See page 118)



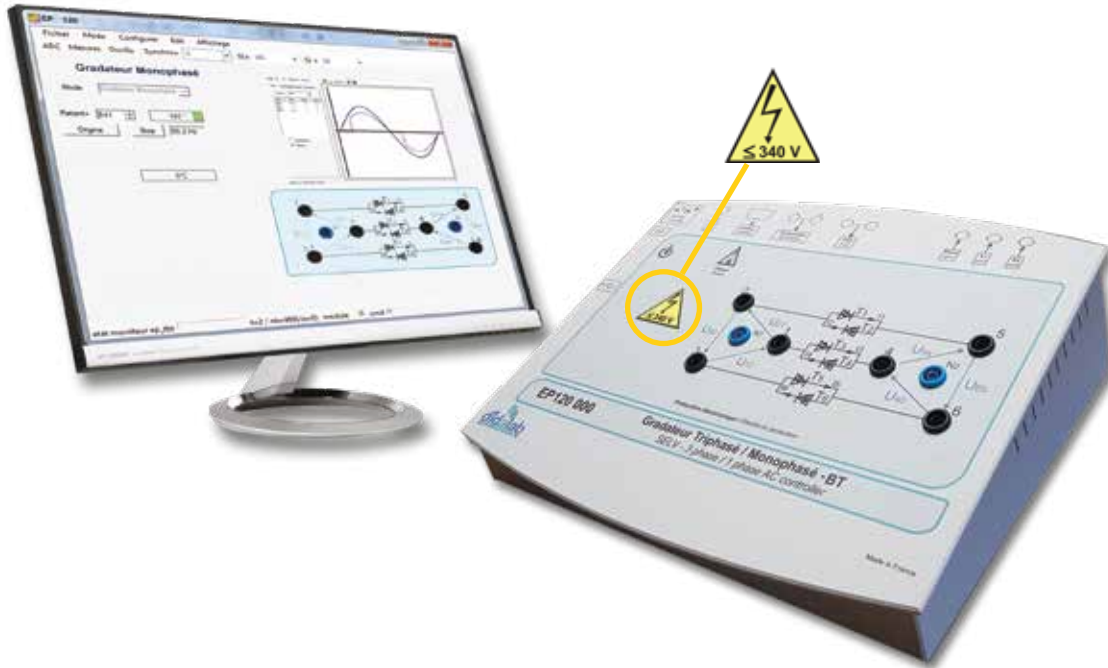
1-phase / 3-phase AC controller, 300 W LV

Highlights

- Control and supervision software, USB connection.
- Virtual real time oscilloscope
- Display Leds for the bridge structure.
- A lot of electronic protections.
- Measures with display BNC.

Studied topics

- Up-line 1-phase AC controller :
- All thyristors
- Up-line 3-phase AC controller :
- All thyristors
- Mixed diodes/ all thyristors



Technical characteristics - EP 120 000 - Secure power bridge, with 6 Thyristors

Functions	Up-line 1-phase AC controller: all thyristors Up-line 3-phase AC controller: mixed diodes/ all thyristors External control: with +/-10 Vdc electronic setting (static chopper or 1-phase inverter)
Supervision and Measures	All the probes are also used for the security supervision of the equipment
Securities	Protection against short-circuit, constant supervision of power supply. Supervision of the motor temperature.
Power supply (ext)	Power supply voltage : 240 VAC phase/phase. Max peak current in each static switch : 2A
Analogue I/O	3 +/- 10V analogue outputs to visualize the signals, 1 +/- 10Vdc analogue input

Experiments

1-phase AC controller	3-phase AC controller
Phase angle	Phase angle with or without neutral

Package EP 120 B : Basic package «STUDY OF A 1-phase and 3-phase AC CONTROLLER, 300W»

Reference	Description	Quantity
EP 120 000	Secure module for power electronics, 120/300 W, 1-phase and 3-phase AC controller	1
EP 120 100	Control and supervision software	1
EGD 000 005	24 Vdc power supply, 2,9A with Jack socket	1
EP 120 010	User manual and technical guide	1
EGD 000 006	USB lead, AA kind	1
EGD 000 018	Storage case	1

(We suggest the composition of the package, for special configuration, please ask)



1-phase rectifier, 300 W LV

Highlights

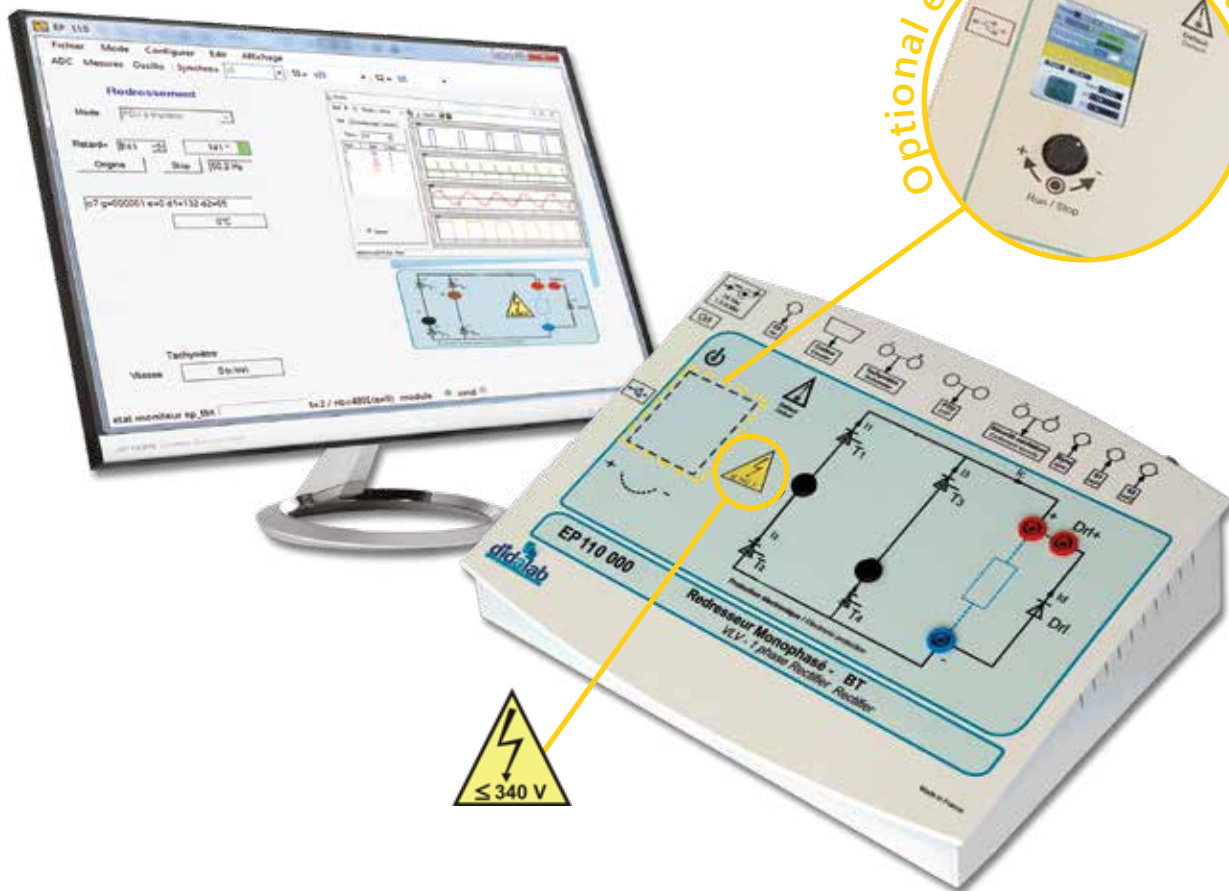
- Control and supervision software, USB connection.
- Virtual real time oscilloscope
- Display Leds for the bridge structure.
- Electronic protections.
- Measures with display BNC.
- Tacho-generator input.
- Incremental coder input

Optional extra :

- Speed servo-control.
- Prototyping
- Autonomous control

Studied topics

- 1-phase rectifier : commutation cell, all diodes, all thyristors, mixed symmetrical, mixed asymmetrical.
- Assisted inverter.
- Speed servo-control.
- Prototyping.

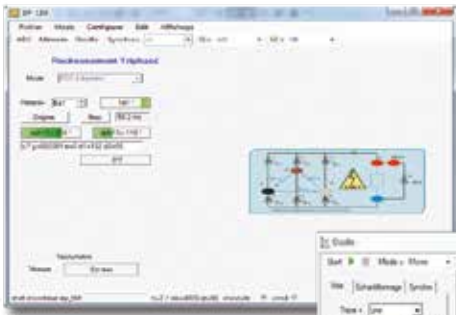


Technical characteristics - EP 110 000 - Secure power bridge, with 4 Thyristors

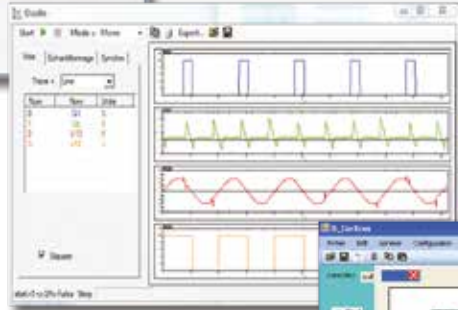
Functions	1-phase rectifier : commutation cell, all diodes, all thyristors, mixed symmetrical and asymmetrical. Assisted inverter.
Supervision and Measures	All the probes are also used for the security supervision of the equipment
Securities	Protection against short-circuit, constant supervision of power supply. Supervision of the motor temperature
Power supply (ext)	24VDC, 2,9A power supply – 3x240 VAC Max for the power.
Analogue I/O	3 +/- 10V analogue outputs to visualize the signals, 1 +/- 10Vdc analogue input, Inputs : DB15 incremental coder, tacho-generator.
Optional extra	D_CCA : Program module for the speed and position servo-control, (see page 46) D_Scil : Module for prototyping with SCILAB/XCOS. (see page 49)



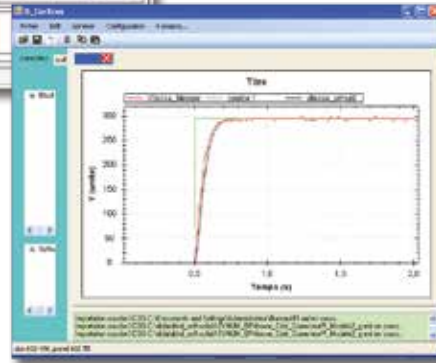
> **Exemple :**



Setting parameters



Vizualisation via virtual oscilloscope



D_SciL Speed control



Experiments

Half-wave rectification	1-phase rectifier
Commutation cell	Assisted Inverter

Package EP 110 B : Basic package «STUDY OF A 1-phase RECTIFIER, 300W»

Reference	Description	Quantity
EP 110 000	Secure module for power electronics, 300 W, 1-phase rectifier	1
EP 110 100	Control and supervision software	1
EGD 000 005	24 Vdc power supply, 2,9A with Jack socket.	1
EP 110 010	User manual and technical guide	1
EGD 000 006	USB lead, AA kind	1
EGD 000 018	Storage case	1

Package EP 110 C : Complete package «STUDY OF 1-phase RECTIFIER, 300W, with speed servo-control with a DC motor»

Reference	Description	Quantity
EP 110 B	Basic package «STUDY OF A 1-phase RECTIFIER, 300W»	1
EP 110 200	Program module for the speed and position servo-control, acquisition and response curves on a computer (computer not included).	1
EP 110 040	Manuel of experiments for the teacher "Study of a speed servo-system with a EP110000 rectifier»	1
EP 110 050	Manuel of experiments for the student "Study of a speed servo -system with a EP110000 rectifier»	1

Package EP 110 S : Simulation and experiment package « CONTROL OF A 1-phase RECTIFIER, 300W, with speed servo-control with a DC motor»

Reference	Description	Quantity
EP 110 C	Complete package « STUDY OF 1-phase RECTIFIER, 300W, with speed servo-control with a DC motor»	1
EP 110 800	D_SciL, module for prototyping with SCILAB/XCOS, Editor based on graphic diagram blocks, C code real time generator	1

(We suggest the composition of the package, for special configuration, please ask)



1-phase, 3-phase rectifier, 300 W LV

Highlights

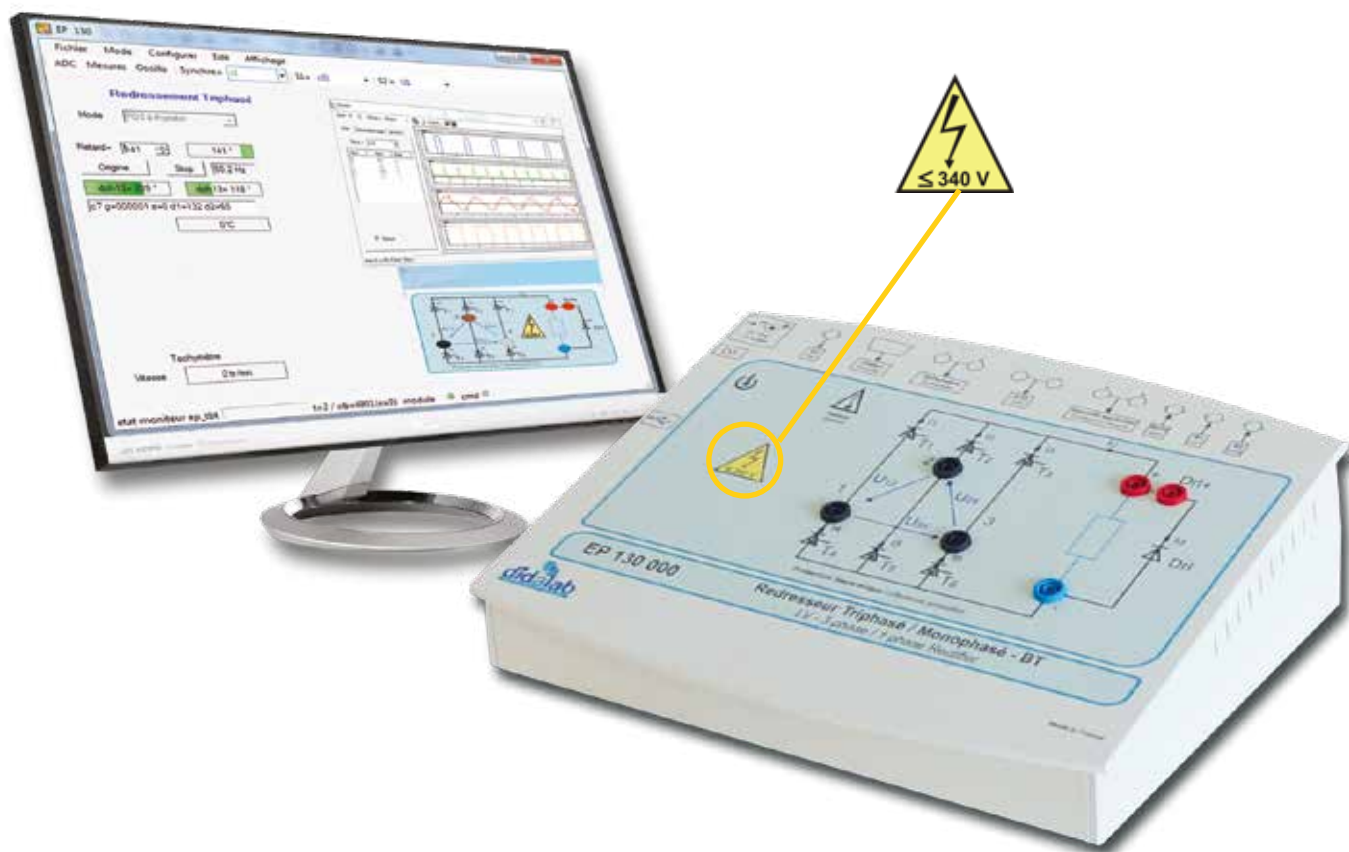
- Control and supervision software, USB connection.
- Virtual real time oscilloscope
- Display Leds for the bridge structure.
- Electronic protections.
- Measures with display BNC.
- Tacho-generator input.
- Incremental coder input

Optional extra :

- Speed servo-control.
- Prototyping
- Autonomous control

Studied topics

- 1-phase rectifier : commutation cell, all diodes, all thyristors, mixed symmetrical, mixed asymmetrical
- 3-phase rectifier : all diodes, mixed, all thyristors.
- Assisted inverter.
- Speed servo-control.
- Prototyping

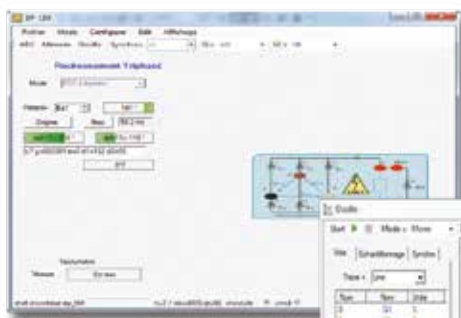


Technical characteristics - EP 130 000 - Secure power bridge, with 6 Thyristors

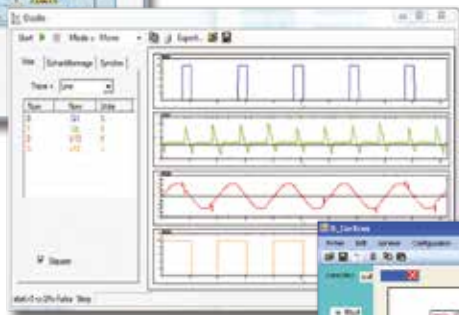
FFunctions	1-phase rectifier : commutation cell, all diodes, all thyristors, mixed symmetrical and asymmetrical. 3-phase rectifier : all diodes, mixed, all thyristors. Assisted inverter.
Supervision and Measures	All the probes are also used for the security supervision of the equipment.
Securities	Protection against short-circuit, constant supervision of power supply. Supervision of the motor temperature.
Power supply (ext)	24 VDC, 2,9A power supply – 3x240 VAC Max for the power.
Analogue I/O	3 +/- 10V analogue outputs to visualize the signals, 1 +/- 10Vdc analogue input, Inputs: DB15 incremental coder, tacho-generator.
Optional extra	D_CCA : Program module for the speed and position servo-control, (see page 46) D_Scil : Module for prototyping with SCILAB/XCOS. (see page 49)



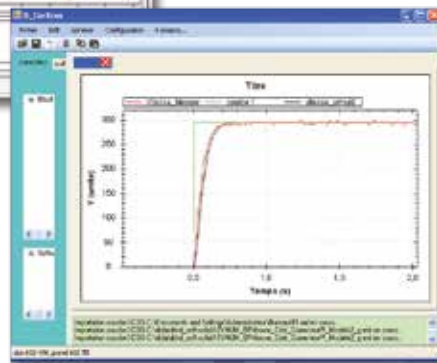
> **Example :**



Setting parameters



Vizualisation via virtual oscilloscope



D_SciL Speed control

Experiments

Half-wave rectification	3-phase rectifier
Commutation cell	Assisted Inverter
1-phase rectifier	

Package EP 130 B : Basic package «STUDY OF A 1-phase and 3-phase RECTIFIER, 300W»

Reference	Description	Quantity
EP 130 000	Secure module for power electronics, 300 W, 1-phase and 3-phase rectifier	1
EP 130 100	Control and supervision software	1
EGD 000 005	24 Vdc power supply, 2,9A with Jack socket	1
EP 130 010	User manual and technical guide	1
EGD 000 006	USB lead, AA kind	1
EGD 000 018	Storage case	1

Package EP 130 C : Complete package «STUDY OF 1-phase and 3-phase RECTIFIER, 300W, with speed servo-control with a DC motor»

Reference	Description	Quantity
EP 130 B	Basic package "STUDY OF A 1-phase and 3-phase RECTIFIER, 300W"	1
EP 130 200	Program module for the speed and position servo-control, acquisition and response curves on a computer (computer not included).	1
EP 130 040	Manuel of experiments for the teacher «Study of a speed servo-system with a EP130000 rectifier».	1
EP 130 050	Manuel of experiments for the student «Study of a speed servo -system with a EP130000 rectifier».	1

Package EP 130 S : Simulation and experiment package « CONTROL OF A 1-phase and 3-phase RECTIFIER, 300W, with speed servo-control with a DC motor»

Reference	Description	Quantity
EP 130 C	Complete package « STUDY OF 1-phase and 3-phase RECTIFIER, 120/300W, with speed servo-control with a DC motor».	1
EP 130 800	D_SciL, module for prototyping with SCILAB/XCOS, Editor based on graphic diagram blocks, C code real time generator.	1

(We suggest the composition of the package, for special configuration, please ask)



Chopper, 1-phase Inverter 300 W, LV

Highlights

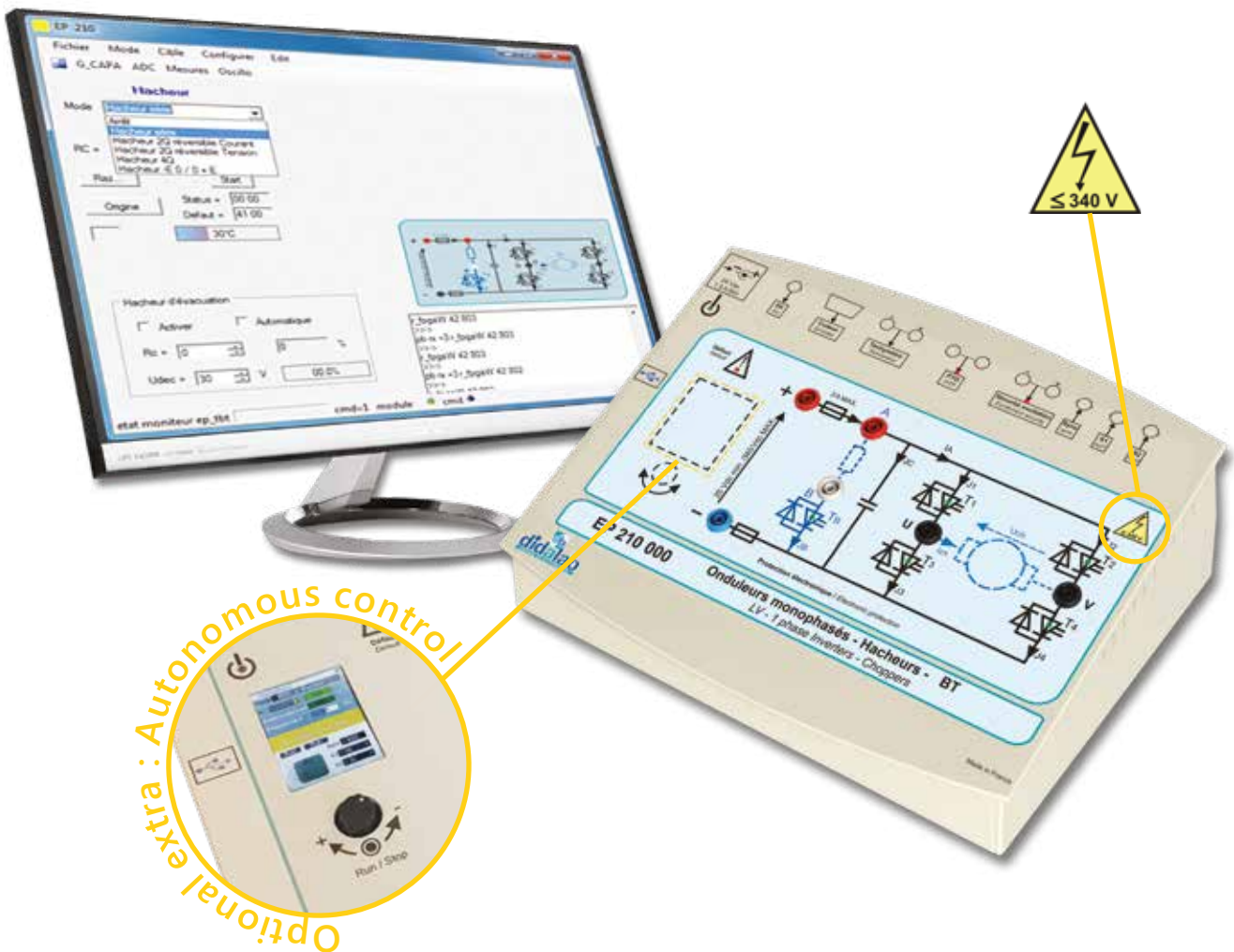
- Control and supervision software, USB connection.
- Virtual real time oscilloscope
- Display Leds for the bridge structure.
- Electronic protections.
- Measures with display BNC.
- Tacho-generator input.
- Incremental coder DB15 input.

Optional extra :

- Speed servo-control,
- Prototyping.
- Autonomous control

Studied topics

- Study of choppers : serial, voltage reversible, current reversible, four quadrants, over-fitted double serial.
- Study of 1-phase inverter : shift control full wave with fixed frequency, with variable frequency, +E/-E PWM , +E/0/-E PWM , constant U/F ratio.
- Speed and position servo-control.
- Prototyping.



Technical characteristics - EP 210 000 - Secure power bridge, chopper and 1-phase inverter

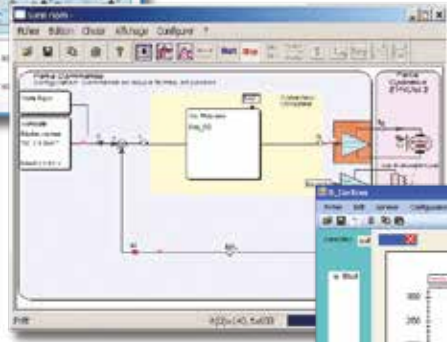
Functions	Chopper : serial, voltage reversible, current reversible, 4 quadrants, over-fitted double serial. Inverter : shift control full wave with fixed frequency, with variable frequency, +E/-E PWM , +E/0/-E PWM , constant U/F ratio.
Supervision and Measures	All the probes are also used for the security supervision of the equipment.
Securities	Protection against short-circuit, constant supervision of power supply. Supervision of the motor temperature.
Power supply (ext)	24V dc, 2,9A power supply – 340 VDC Max for the power.
Analogue I/O	3 +/- 10V analogue outputs to visualize the signals, 1 +/- 10Vdc analogue input, Inputs : DB15 incremental coder, tacho-generator.
Optional extra	D_CCA : Program module for the speed and position servo-control, (see page 46) D_Scil : Module for prototyping with SCILAB/XCOS. (see page 49)



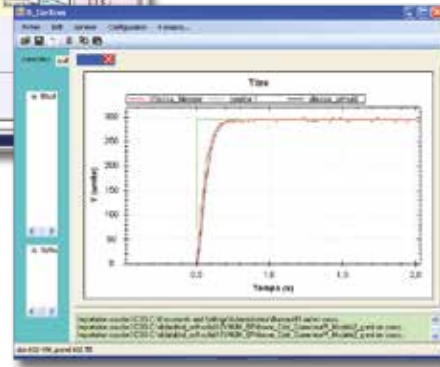
> **Example :**



Setting parameters



Vizualisation via virtual oscilloscope



D_SciL Speed control



Experiments

Serial chopper	Shift control inverter	Servocontrol
voltage reversible, current reversible chopper	PWM inverter	OL
4- quadrant chopper	PWM inverter, constant U/F ratio	CL

Package EP 210 B : Basic package "STUDY OF A 1, 2, 4-Quadrant CHOPPER, 1-phase INVERTER, 300W"

Reference	Description	Quantity
EP 210 000	Secure module for power electronics, 300 W, 1, 2, 4-quadrant choppers, 1-phase inverter, +E /-E, +E/0/-E PWM.	1
EP 210 100	Control and supervision software	1
EGD 000 005	24 Vdc power supply, 2,9A with Jack socket	1
EP 210 010	User manual and technical guide.	1
EGD 000 006	USB lead, AA kind.	1
EGD 000 018	Storage case.	1

Package EP 210 C : Complete package "STUDY OF A 1, 2, 4-Quadrant CHOPPER, 1-phase INVERTER, 300W, with speed and position servo-control with a DC motor"

Reference	Description	Quantity
EP 210 B	Basic package "STUDY OF A 1, 2, 4-Quadrant CHOPPER, 1-phase INVERTER, 300W	1
EP 210 200	Program module for the speed and position servo-control, acquisition and response curves on a computer (computer not included).	1
EP 210 040	Manuel of experiments for the teacher "Study of a speed and position servo-system with a EP210000 chopper».	1
EP 210 050	Manuel of experiments for the student "Study of a speed and position servo -system with a EP210000 chopper».	1

Package EP 210 S : Simulation and experiment package "CONTROL OF A 1, 2, 4-Quadrant CHOPPER, 1-phase INVERTER, 300W, with speed and position servo-control with a DC motor"

Reference	Description	Quantity
EP 210 C	Complete package "STUDY OF A 1, 2, 4-Quadrant CHOPPER, 1-phase INVERTER, 300W, with speed and position servocontrol with a DC motor".	1
EP 210 800	D_SciL, module for prototyping with SCILAB/XCOS, Editor based on graphic diagram blocks, C code real time generator.	1

(We suggest the composition of the package, for special configuration, please ask)



Chopper, 1-phase & 3-phase inverter, 300 W, LV

Highlights

- Control and supervision software, USB connection.
- Virtual real time oscilloscope
- Display Leds for the bridge structure.
- Electronic protections.
- Measures with display BNC.
- Tacho-generator input.
- Incremental coder DB15 input

Optional extra :

- Speed servo-control,
- Prototyping.
- Autonomous control

Studied topics

- Choppers : serial, voltage reversible, current reversible, four quadrants, over-fitted double serial.
- 1-phase inverter : shift control full wave with fixed frequency, with variable frequency, +E/-E PWM , +E/0/-E PWM , constant U/F ratio.
- 3-phase inverter : shift control full wave with fixed frequency, with variable frequency, +E/-E PWM , +E/0/-E PWM , constant U/F ratio.
- Speed and position servo-control.
- Prototyping.

Optional extra : Autonomous control

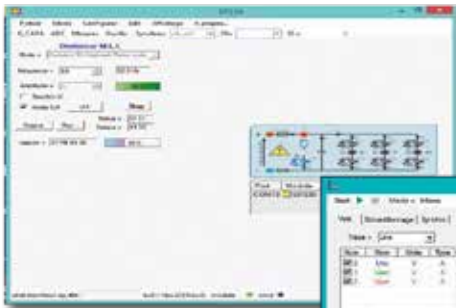


Technical characteristics - EP 230 000 - Secure power bridge, chopper and 1-phase and 3-phase inverter

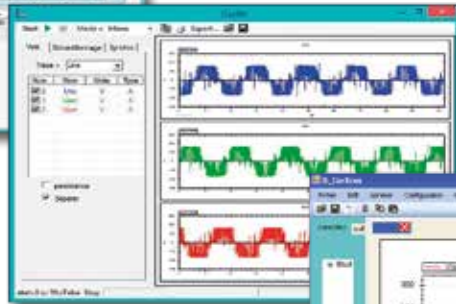
Functions	Chopper : serial, voltage reversible, current reversible, 4 quadrants, over-fitted double serial. 1-phase Inverter : shift control full wave with fixed frequency, with variable frequency, +E/-E PWM , +E/0/-E PWM , constant U/F ratio. 3-phase Inverter : shift control full wave with fixed frequency, with variable frequency, +E/-E PWM , +E/0/-E PWM , constant U/F ratio.
Supervision and Measures	All the probes are also used for the security supervision of the equipment.
Securities	Protection against short-circuit, constant supervision of power supply. Supervision of the motor temperature. Function for return energy evacuation.
Power supply (ext)	24V dc, 2,9A power supply – 340 V DC Max for the power
Analogue I/O	3 +/- 10V analogue outputs to visualize the signals, 1 +/- 10Vdc analogue input. Inputs : DB15 incremental coder, tacho-generator.
Optional extra	D_CCA : Program module for the speed and position servo-control, (see page 46) D_Scil : Module for prototyping with SCILAB/XCOS. (see page 49)



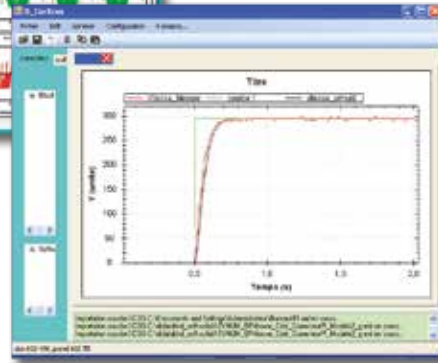
> **Example :**



Setting parameters



Vizualisation via virtual oscilloscope



D_SciL Speed control



Experiments

Chopper	1-phase inverter	3-phase inverter	Servocontrol
Serial chopper	Shift control	Adjustable modulation index	OL / CL
voltage reversible, current reversible chopper	PWM, constant U/F ratio	PWM, constant U/F ratio	Speed and position
4- quadrant chopper	PWM	PWM	Prototyping

Package EP 230 B : Basic package "Study of A 1, 2, 4-Quadrant CHOPPER, 1-phase and 3-phase INVERTER, 300W"

Reference	Description	Quantity
EP 230 000	Secure module for power electronics, 300 W, 1, 2, 4-quadrant choppers, 1-phase and 3-phase inverter, full wave, +E /-E, +E/0/-E PWM	1
EP 230 100	Control and supervision software.	1
EGD 000 005	24 Vdc power supply, 2,9A with Jack socket	1
EP 230 010	User manual and technical guide	1
EGD 000 006	USB lead, AA kind	1
EGD 000 018	Storage case	1

Package EP 230 C : Complete package "STUDY OF A 1, 2, 4-Quadrant CHOPPER, 1-phase and 3-phase INVERTER, 300W, with speed and position servo-control with a DC or AC motor"

Reference	Description	Quantity
EP 230 B	Basic package "STUDY OF A 1, 2, 4-Quadrant CHOPPER, 1-phase and 3-phase INVERTER, 300W".	1
EP 230 200	Program module for the speed and position servo-control, acquisition and response curves on a computer (computer not included).	1
EP 230 040	Manuel of experiments for the teacher "Study of a speed and position servo-system with a EP230000 chopper».	1
EP 230 050	Manuel of experiments for the student "Study of a speed and position servo-system with a EP230000 chopper».	1

Package EP 230 S : Simulation and experiment package "CONTROL OF A 1, 2, 4-Quadrant CHOPPER, 1-phase and 3-phase INVERTER, 300W, with speed and position servo-control with a DC or AC motor"

Reference	Description	Quantity
EP 230 C	Complete package "STUDY OF A 1, 2, 4-Quadrant CHOPPER, 1-phase and 3-phase INVERTER, 300W, with speed and position servo-control with a DC or AC motor".	1
EP 230 800	D_SciL, module for prototyping with SCILAB/XCOS, Editor based on graphic diagram blocks, C code real time generator.	1

(We suggest the composition of the package, for special configuration, please ask)



1-phase, 3-phase Rectifier, AC-controller, 1,5/3 kW

Highlights

- Safe power structure.
- Many securities.
- Many measuring probes
- Colour display with Windows CE.

Optional extra :

- Speed servo control.
- Prototyping with SCILAB/XCOS..

Studied topics

- 1 ph rectifier : commutation cell, all diodes, all thyristors, mixed and symmetric, mixed and asymmetric.
- 3-phase rectifiers : 3-phase rectifiers: all diodes, mixed, all thyristors
- AC-controller
- Assisted inverter.
- Speed servo control.
- Prototyping with SCILAB/XCOS.

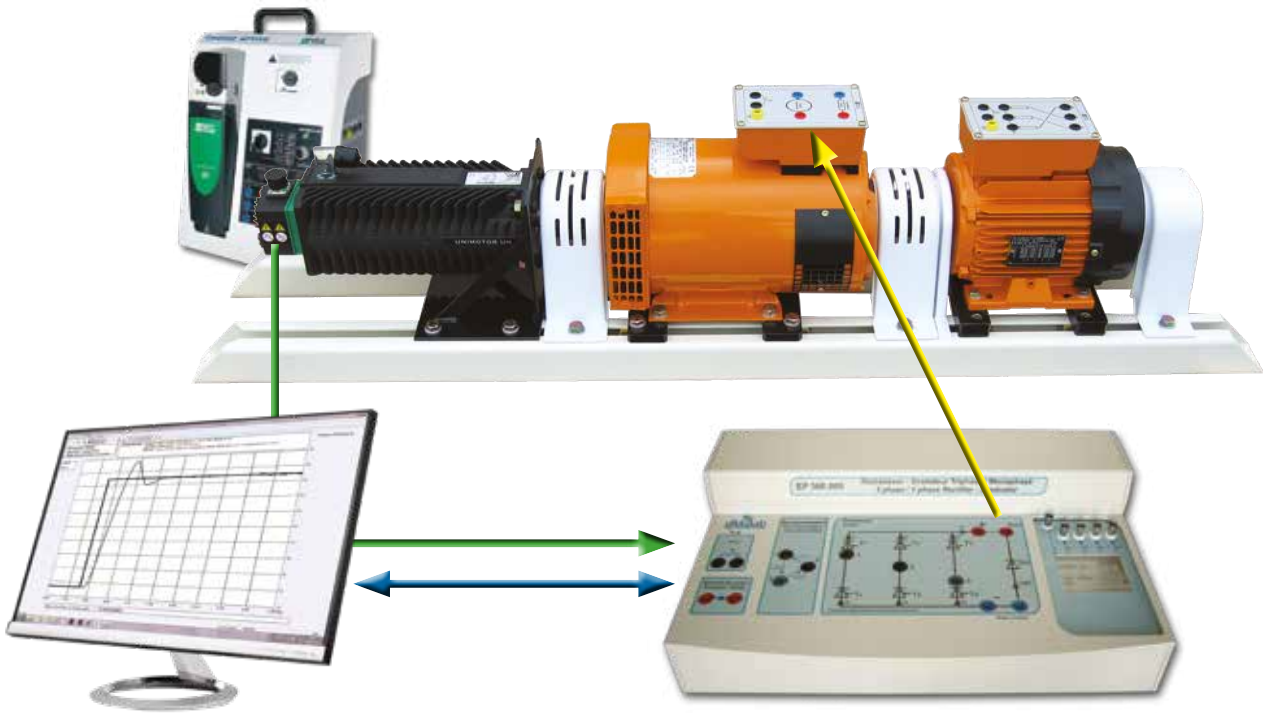


Technical characteristics - EP 360 000 - 6-thyristor safe power structure

Functions	1-phase rectifiers : all diodes, mixed and symmetric, mixed and asymmetric, all thyristors, 3-phase rectifiers : all diodes, mixed, all thyristors, assisted inverter, assisted inverter, 1-ph and 3-ph AC-controller
Supervision and Measures	8 current probes (measured) 3 current probes (calculated by FPGA) 7 voltage probes <i>These probes are also used for the securities of the module.</i>
Securities	Protection against short-circuits. Supervision of the excitation current (against runaway). Constant supervision of power supply (100 Vac, 400 Vac.) Supervision of the evacuators temperature. Supervision of the motor temperature (PTO).
Power supplies	24 Vdc power supply, 2.9 A – Power : 100 / 400 Vac – 20 A max.
Analog I/O	4 ±10-V analogue outputs to visualize the signals, 1 ±10-V uboyt, feedbackloop with RS422 incremental encoder
Display	Choose the configuration you want to study. Choose the running parameters (frequency, cyclic ratio, ...). Choose the signals you want to display (current, voltage, speed,).
Processor	ARM9, 200 MIPS with Windows CE, 400 000-gates FPGA, Master USB and Ethernet
Optional extra	D_CCA : Program module for the speed and position servo-control, (see page 46) D_Scil : Module for prototyping with SCILAB/XCOS. (see page 49)



> Example : Speed control with DC motor



Experiments

Mono alternation rectification	1-phase AC-controller on R load
Switching cell	1-phase AC-controller on RL load
3-phase rectification	3-phase AC controller

Package EP 360 B : Basic package «Study of a rectifier and AC-controller, 1-phase and 3-phase, 1,5/3 kW»

Reference	Description	Quantity
EP 360 000	Module of power electronics in the 1.5 / 3 kW range Graëtz bridge, gradator, 1-phase, 3-phase Built-in current and voltage probes, Man Machine Interface on LCD screen. Control software (Win CE embedded), Mouse	1
EP 360 010	User's manual and technical guide	1
EP 360 020	Teacher's manual, 1-ph and 3-ph rectifiers	1
EP 360 030	Student's manual, 1-ph and 3-ph rectifiers	1
EGD 000 005	24 Vdc power supply, 2.9 A with Jack connector	1
EGD 000 019	Storing case	1

Pack EP 360 C : Complete Package «Study of a rectifier and AC-controller, 1-phase and 3-phase, 1,5/3 kW, speed servocontrol of a DC motor »

Reference	Description	Quantity
EP 360 B	Basic package «Study of a rectifier and AC-controller, 1-phase and 3-phase, 1,5/3 kW	1
EGD 000 010	RJ45 cable, 2 m	1
EP 360 200	Software for the control of speed and the acquisition of feedback curves on a PC (computer not included)	1
EP 360 040	Teacher's manual, study of speed control 1-ph and 3-ph rectifiers	1
EP 360 050	Student's manual, 1-ph and 3-ph rectifiers	1

Pack EP 360 S : Simulation and experimentation package «Control of a 1-phase and 3-phase rectifier and AC-controller, 1,5/3 kW speed servocontrol of a DC motor and asynchronous motor, development of new correctors»

Reference	Description	Quantity
EP 360 C	Complete Package «Study of a rectifier and AC-controller, 1-phase and 3-phase, 1,5/3 kW, speed servocontrol of a DC motor »	1
EP 360 800	Module for prototyping with SCILAB/XCOS. Editor based on graphic diagram blocks, C code real time generator	1

(We suggest the composition of the package, for special configuration, please ask)



Chopper, 1-phase inverter 1,5/3 kW

Highlights

- Many electronic safeties
- Insulated measuring probes (with visualization via BNC and/or TFT color screen).
- With Windows CE.
- USB master and Ethernet connections.

Optionnal extra :

- Speed and position control.
- Prototyping.

Studied topics

- Study of choppers : serial, voltage reversible, current reversible, 4 quadrants, over-fitted double serial.
- 1-phase inverter : shift control full wave with fixed frequency, with variable frequency, +E/-E PWM, +E/0/-E PWM, constant U/F ratio.
- Speed and position control.
- Prototyping.

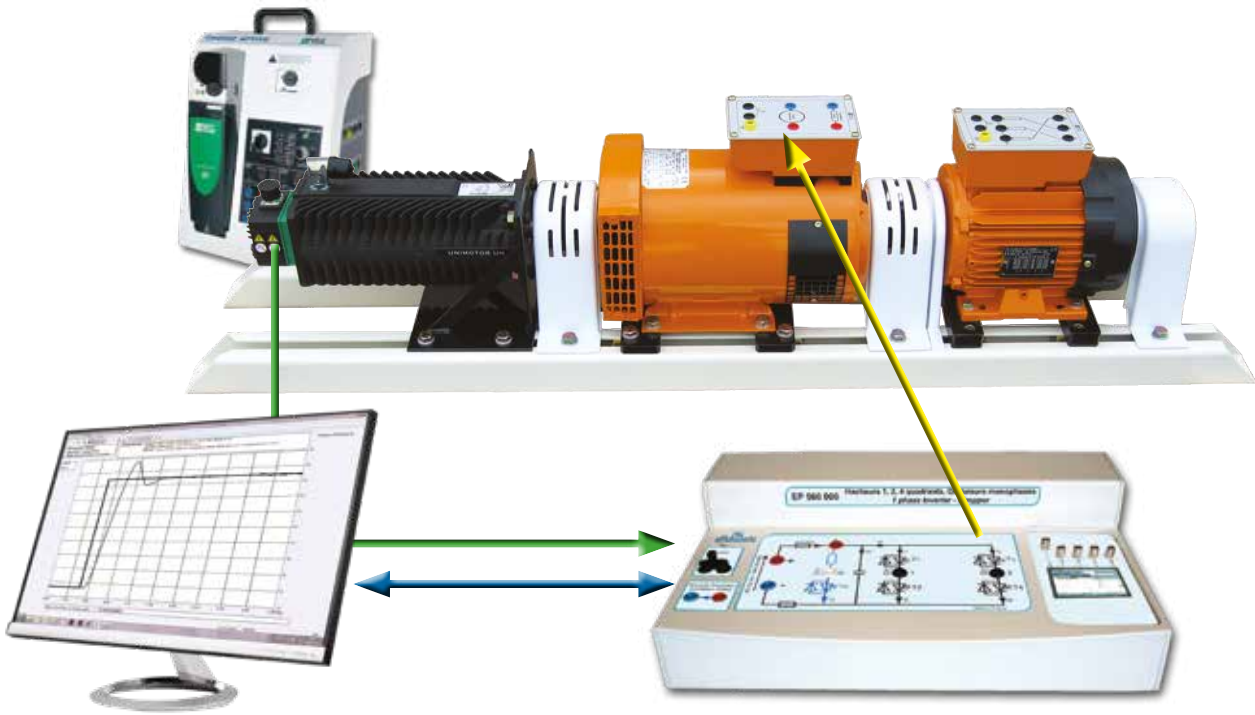


Technical characteristics - EP 560 000 - Secure power bridge

Functions	Chopper : serial, voltage reversible, current reversible, 4 quadrants, over-fitted double serial. 1-phase Inverter : shift control full wave with fixed frequency, with variable frequency, +E/-E PWM, +E/0/-E PWM, constant U/F ratio. Servo control : speed/position, prototyping (optional extras).
Supervision and Measures	7 current probes (measured). 2 current probes (calculated). 4 voltage probes. <i>These probes are also used for the securities of the module.</i>
Securities	Protection against short-circuit, Supervision of the excitation current. Constant supervision of power supply (60 Vdc 300 Vdc). Supervision of the motor temperature. (PTO)
Power supply (ext)	12V dc, 2,9A ; power supply: 60/340 VDC - 20 A max
Analogue I/O	4 +/- 10V analogue outputs to visualize the signals, 1 +/- 10Vdc analogue input. Boucle de retour par codeur incrémental RS422.
Displays	To choose the configuration you want to study, the operation parameters (serial, 4Q, 1-Hz to 20-kHz frequency ...). To select the signals you want to display (current, voltage, speed, position ...).
Processor	ARM9, 200 MIPS with Windows CE, 400 000-gates FPGA, USB (master) and Ethernet.
Optional extra	D_CCA : Program module for the speed and position servo-control, (see page 46) D_SciL : Module for prototyping with SCILAB/XCOS. (see page 49)



> Example : Position control on DC motor



Experiments

Serial chopper	1-ph inverter, shift control
Chopper, Voltage, current reversible	1-phase PWM inverter
4 Quadrants chopper	1-phase PWM inverter, Constant U/f

Pack EP 560 B : Basic package "study of A 1, 2, 4-Quadrant CHOPPER, 1-phase and 3-phase INVERTER, 1.5/3 kW"

Reference	Description	Quantity
EP 560 000	Secure module for power electronics, 1.5/3 kW, 1, 2, 4-quadrant choppers, 1-phase inverter, full wave, +E /-E, +E/0/-E PWM.	1
EP 560 010	User manual and technical guide.	1
EP 560 020	Manuel of experiments for the teacher	1
EP 560 030	Manuel of experiments for the student	1
EGD 000 005	24 Vdc power supply, 2,9A with Jack socket	1
EGD 000 019	Storage case.	1

Pack EP 560 C : Complete package "STUDY OF A 1, 2, 4-Quadrant CHOPPER, 1-phase INVERTER, 1.5/ 3kW, with speed and position servo-control with a DC motor"

Reference	Description	Quantity
EP 560 B	Basic package "STUDY OF A 1, 2, 4-Quadrant CHOPPER, 1-phase INVERTER, 1.5/3 kW".	1
EGD 000 010	RJ45 cable, 2 m	1
EP 560 200	Program module for the speed and position servo-control, acquisition and response curves on a computer (computer not included).	1
EP 560 040	Manuel of experiments for the teacher "Study of a speed and position servo-system with a EP560000 chopper».	1
EP 560 050	Manuel of experiments for the student "Study of a speed and position servo -system with a EP560000 chopper».	1

Pack EP 560 S : Simulation and experiment package "CONTROL OF A 1, 2, 4-Quadrant CHOPPER, 1-phase INVERTER, 1.5/3 kW, with speed and position servo-control with a DC motor"

Reference	Description	Quantity
EP 560 C	Complete package "STUDY OF A 1, 2, 4-Quadrant CHOPPER, 1-phase INVERTER, 1.5/ 3kW, with speed and position servo-control with a DC motor".	1
EP 560 800	D_Scil, module for prototyping with SCILAB/XCOS, Editor based on graphic diagram blocks, C code real time generator.	1

(We suggest the composition of the package, for special configuration, please ask)



Chopper, 1-phase and 3-phase Inverter, 1,5 kW

Highlights

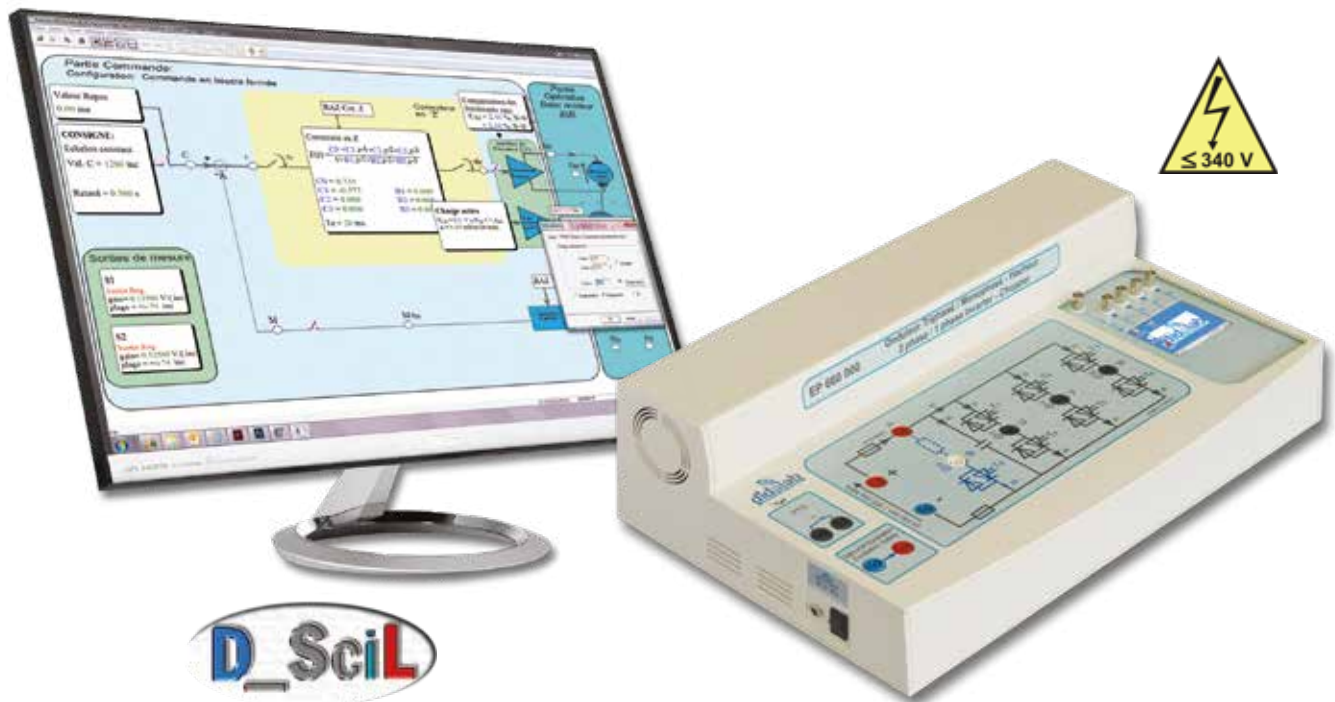
- Many electronic safeties
- Insulated measuring probes (with visualization via BNC and/or TFT color screen).
- With Windows CE.
- USB master and Ethernet connections.

Optionnal extra :

- Speed and position control.
- Prototyping.

Studied topics

- Chopper : serial, voltage reversible, current reversible, 4 quadrants, over-fitted double serial.
- 1-phase Inverter : shift control full wave with fixed frequency, with variable frequency, +E/-E PWM , +E/0/-E PWM , constant U/F ratio.
- 3-phase Inverter : PWM with variable modulation, variable frequency, +E/-E PWM , +E/0/-E PWM , constant U/F ratio,
- Speed and position control.
- Prototyping.

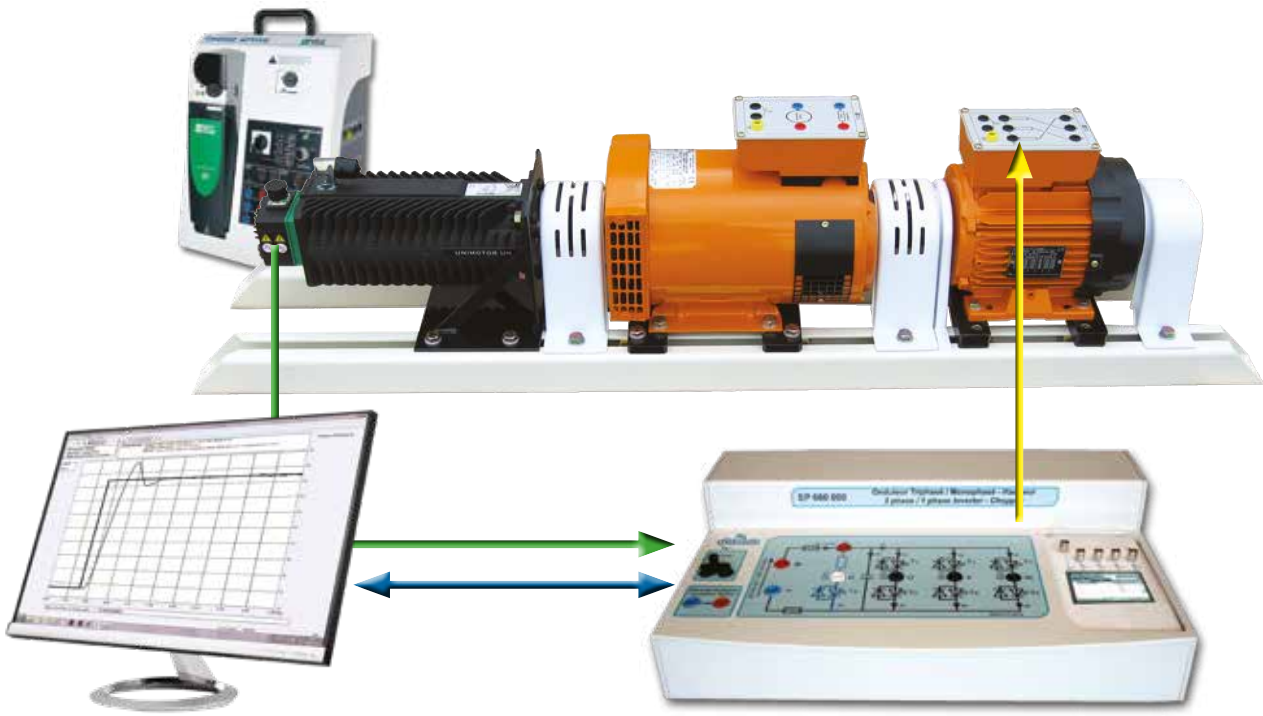


Technical characteristics - EP 660 000 - Secure power bridge

Functions	Chopper : serial, voltage reversible, current reversible, 4 quadrants, over-fitted double serial. 1-phase Inverter : shift control full wave with fixed frequency, with variable frequency, +E/-E PWM , +E/0/-E PWM , constant U/F ratio. 3-phase Inverter : PWM with variable modulation, variable frequency, +E/-E PWM , +E/0/-E PWM , constant U/F ratio, Rectifier : PWM. Servo control : speed/position, vector control, prototyping (optional extras).
Supervision and Measures	8 current probes (measured). 3 current probes (calculated). 7 voltage probes. <i>These probes are also used for the securities of the module.</i>
Securities	Protection against short-circuit, Supervision of the excitation current. Constant supervision of power supply (60 Vdc 300 Vdc). Supervision of the motor temperature. (PTO)
Power supply (ext)	12V dc, 2,9A ; power supply: 60/340 VDC - 20 A max.
Analogue I/O	4 +/- 10V analogue outputs to visualize the signals, 1 +/- 10Vdc analogue input.
Displays	To choose the configuration you want to study, the operation parameters (3-phase inverter, half-wave, PWM, 1-Hz to 20-kHz frequency ...). To select the signals you want to display (current, voltage, speed, position ...).
Processor	ARM9, 200 MIPS with Windows CE, 400 000-gates FPGA, USB (master) and Ethernet.
Optional extra	D_CCA : Program module for the speed and position servo-control, (see page 46) D_SciL : Module for prototyping with SCILAB/XCOS. (see page 49)



> Example : Speed control on asynchronous motor



Experiments

Chopper	1-phase inverter	3-phase inverter	Servo-control
Serial	Shift control	Adjustable modulation index	Speed and position
Voltage, current reversible	PWM, Constant U/f	PWM, Constant U/f	Speed Prototyping
4 Quadrants	PWM	PWM	Vector control

Pack EP 660 B : Basic package "STUDY OF A 1, 2, 4-Quadrant CHOPPER, 1-phase and 3-phase INVERTER, 1.5/3 kW"

Reference	Description	Quantity
EP 660 000	Secure module for power electronics, 1.5/3 kW, 1, 2, 4-quadrant choppers, 1-phase and 3-phase inverter, full wave, +E /-E, +E/0/-E PWM.	1
EP 660 010	User manual and technical guide.	1
EP 660 020	Manuel of experiments for the teacher.	1
EP 660 030	Manuel of experiments for the student.	1
EGD 000 005	24 Vdc power supply, 2,9A with Jack socket.	1
EGD 000 019	Storage case.	1

Package EP 660 C : Complete package "STUDY OF A 1, 2, 4-Quadrant CHOPPER, 1-phase and 3-phase INVERTER, 1.5/3 kW, with speed and position servo-control with a DC or AC motor"

Reference	Description	Quantity
EP 660 B	Basic package "STUDY OF A 1, 2, 4-Quadrant CHOPPER, 1-phase and 3-phase INVERTER, 1.5/3 kW".	1
EGD 000 010	RJ45 cable, 2 m.	1
EP 660 200	Program module for the speed and position servo-control, acquisition and response curves on a computer (computer not included).	1
EP 660 040	Manuel of experiments for the teacher "Study of a speed and position servo-system with a EP660000 chopper».	1
EP 660 050	Manuel of experiments for the student "Study of a speed and position servo -system with a EP660000 chopper».	1

Package EP 660 S : Simulation and experiment package "CONTROL OF A 1, 2, 4-Quadrant CHOPPER, 1-phase and 3-phase INVERTER, 1.5/3 kW, with speed and position servo-control with a DC or AC motor"

Reference	Description	Quantity
EP 660 C	Complete package « STUDY OF A 1, 2, 4-Quadrant CHOPPER, 1-phase and 3-phase INVERTER, 1.5/ 3kW, with speed and position servo-control with a DC or AC motor».	1
EP 660 800	D_Scil, module for prototyping with SCILAB/XCOS, Editor based on graphic diagram blocks, C code real time generator.	1

(We suggest the composition of the package, for special configuration, please ask)



Speed drive for Asynchronous motors, 0.3 to 1.5 kW



Highlights

- Speed drive with vector control
- Operating in the 4 quadrants
- Controlled by PC

Studied topics

- Speed control.
- Highlight in the 4 quadrants of the torque/speed plane

Package Unidrive M 200 : Speed drive for Asynchronous motors, 0.3 to 1.5 kW

Reference	Description	Quantity
ELT 151 450	Speed variator Unidrive M 200, with vector control for asynchronous motors, 0.3 to 1.5 kW	1
	Cable for connection with PC	1
	Software M-connect	1

Universal speed drive, 0.3 to 1.5 kW 400 V, 3-phase



Highlights

- Flux vector control, open loop.
- Flux vector control, closed loop.
- U/F control, open loop.
- Servo mode with brushless motors.

Studied topics

- Speed and/or torque control.
- 8 digital speeds in both rotation ways.
- Preset of acceleration/deceleration ramp for each speed (ex. machine tool pin).
- Asynchronous and Synchronous motor control.

Package UNIDRIVE-M 701 : Basic Package Study of an industrial speed variator for 0.3 to 1.5 kW AC motors

Reference	Description	Quantity
ELT 151 500	1.5 kW Speed variator Unidrive M 701, for asynchronous and brushless motors	1
	Cable for connection with PC	1
	M-connect software on a CDROM	1

Cube-Elec 300

Highlights

- Compact et modular, Cube-Elec 300 allows to implement a complete chain of automatic control
- The cube consists of an HMI and a Programmable Logic Controller and driver either for asynchronous motor either for brushless motor



Cube-Elec 300 : See page 43-44

Electric Motors

> SELV or LV 450-VA Power Supply, 1-phase, 3-phase and DC	109
> BIC MAC (S) 300	110
> BIC SIN 300W	112
> 300-W motors, SELV	114
> 300-W motors, LV	115
> Test group 1.5 kW : DC and 3-phase asynchronous motors with active load	116
> Electrical engineering/power electronics table	118
> Electronics table	118
> Resistances	119
> Rheostats	119
> Self load/Inductive load	119
> Compatibility table	120





SELV or LV 450-VA Power Supply , 1-Phase, 3-Phase, and DC

Highlights

- 3-phase power supply from Mains (1-phase 230 VAC, 16A).
- Adjustable frequency (20 Hz to 100 Hz)
- DC power supply and excitation power supply
- Protected against overvoltage, overcurrent, overpower, temperature.
- Touchscreen
- Measures: display of voltages, currents, power, $\cos\phi$, ...).
- USB connection (measurement evaluation on PC)
- 2 versions :
 - SELV: 3x24 VAC – 48 VDC
 - LV : 3x220 VAC – 320 VDC

Studied topics

- 1-phase / 3-phase
- Single voltage, compound voltage
- Active/ reactive / Apparent power
- $\cos\phi$

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ELECTRIC MOTORS

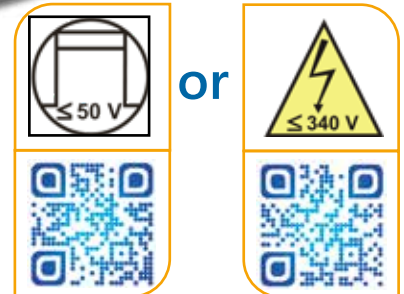


Measures





3 phases

DC

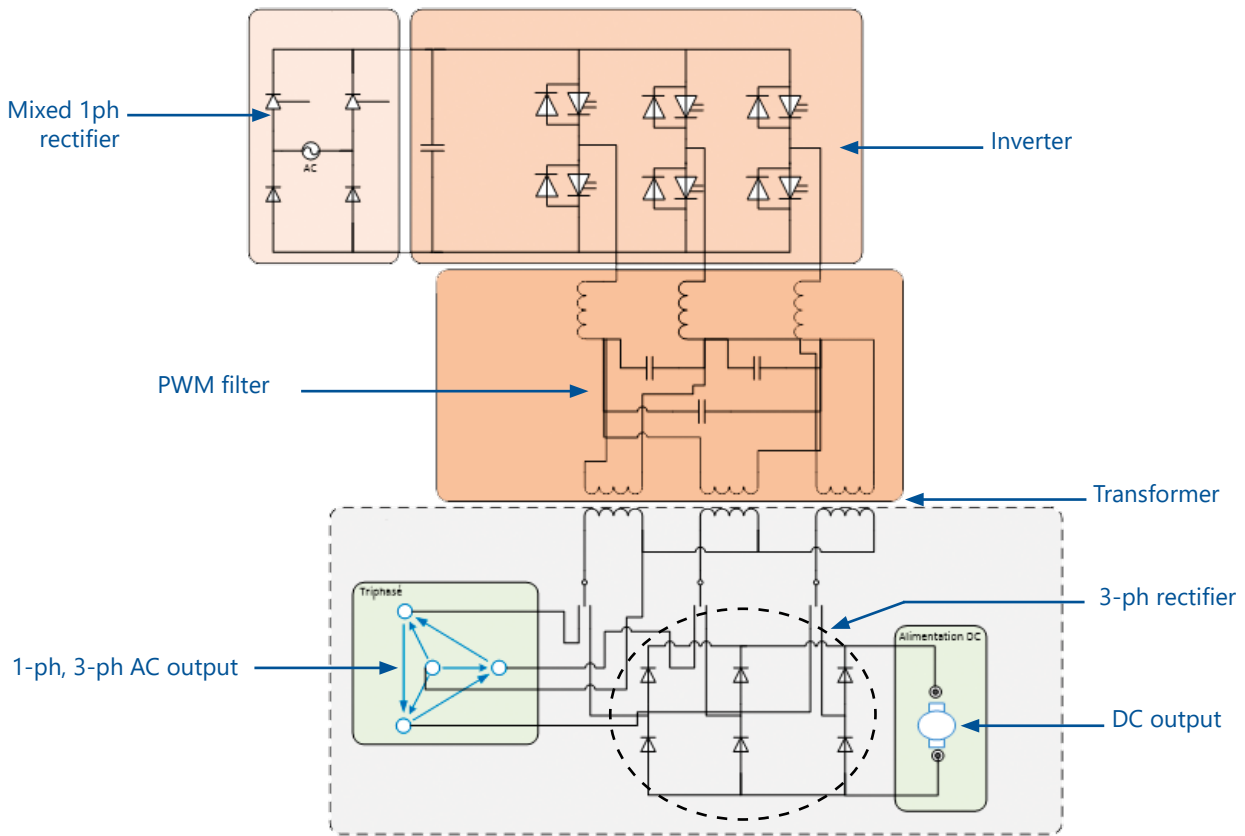


Technical characteristics - EM(S) 300

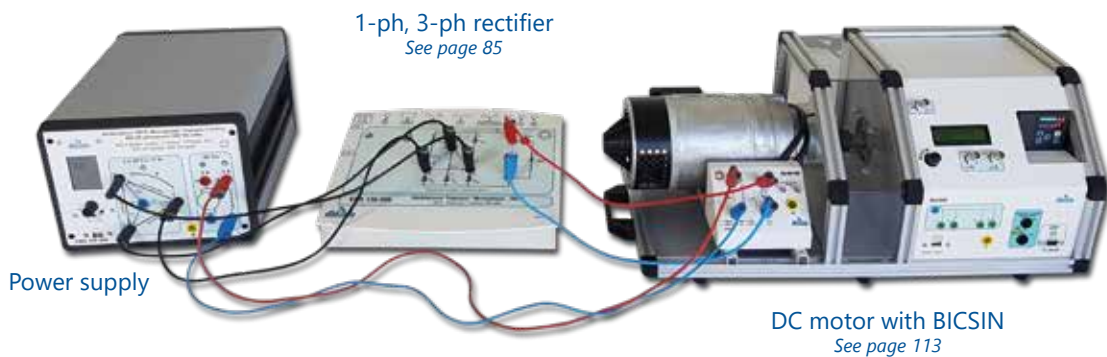
RANGE	 SELV EMS 300	 LV EM 300
Power supply	Mains, 230 VAC 16A	Mains, 230 VAC 16A
1-phase output	14 V _{AC} / 11 A	127 V _{AC} / 2 A
3-phase output	3 x 24 V _{AC} / 11 A	3 x 230 V _{AC} / 2 A
Frequency	adjustable from 20 Hz to 100 Hz	adjustable from 20 Hz to 100 Hz
DC output	48 V _{DC} / 9 A	320V _{DC} / 1,5 A
Auxiliary output	48 V _{DC} / 2 A	320V _{DC} / 0,6 A
Display	LCD touch screen, graphic, 2.8" with white backlight Display of all parameters (mode, measures,...)	
USB	Data recovery in PC (voltage, current, power, $\cos\phi$,...)	
Power	450 VA permanent, 800 VA peak	
Protections	Against short-circuits Against excessive heatings Against overcurrents in the Mains input with fuses	



> Internal structure



> Example of setting : Control of a DC motor with rectifier



> Example of setting : Control of a 3-ph asynchronous motor with a PWM inverter





BICMAC(S) 300 : Instrumented Load Bench for DC or AC machines, 300 W

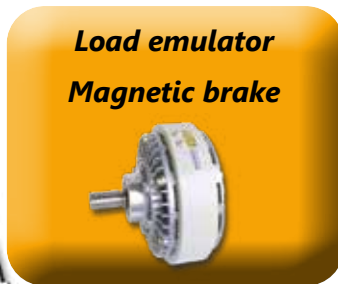
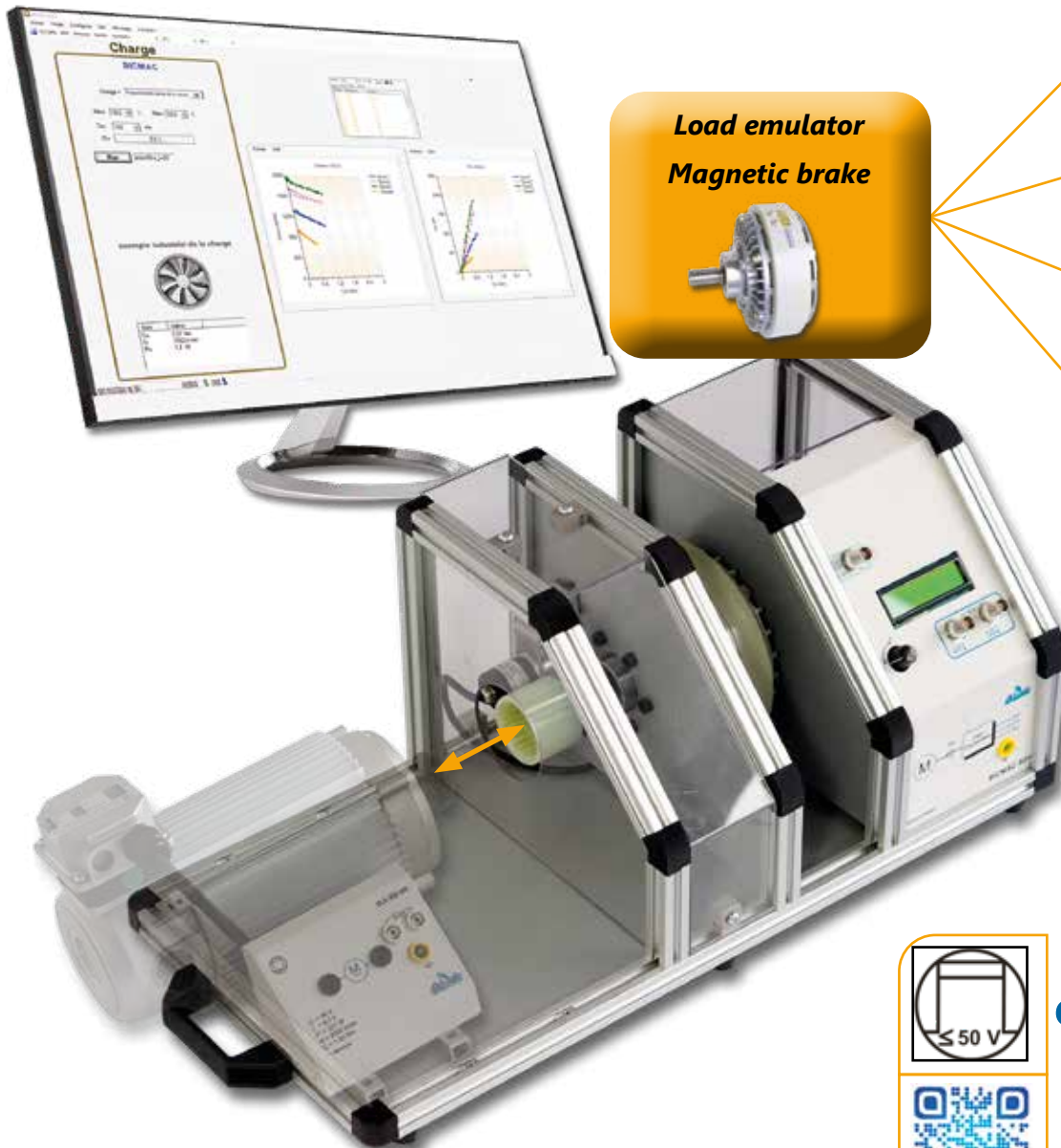
Highlights

- Braking load generator (magnetic brake)
 - Constant torque
 - Fluid torque
 - Torque proportional to the speed, to the square speed
 - Programmable
- Acquisition of mechanical variables
 - Torque
 - Speed
 - Mechanical power
- 2 versions :
 - SELV: 3x24 VAC – 48 VDC
 - LV : 3x220 VAC – 320 VDC

Studied topics

- Motor characterization :
 - Direct current
 - Alternative current
 - Brushless
- Measurement of mechanical variables
- Characteristics plot
 - Mechanical variables
 - Speed / torque / mechanical power
- Power electronics
- Servo control
 - Speed
 - Position

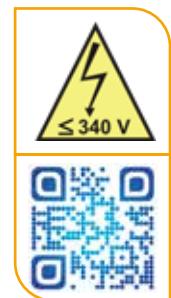
ELECTRIC MOTORS



- a
- a.N
- b.N²
- Programmable



or



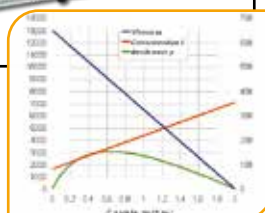


> Motor characteristics plot :

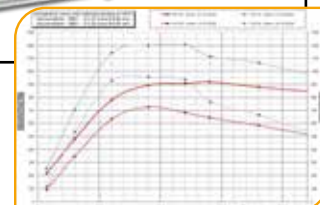
Torque speed relation
3-ph AC motor (ELS 313 000)



Torque speed relation
DC motor (ELS 312 000)



Torque speed relation
Brushless motor (ELS 316 000)



> Example of speed control with our EP230 power bridge on AC motor



EL(S) 31_B - BICMAC (S) 300 : Instrumented Load Bench for DC or AC machines, 300 W

LV reference	SELV reference	Description	Quantity
EL 310 000	ELS 310 000	Test motor bench with magnetic brake load, control electronic board with its power supply, set on a aluminium frame with carrying handles	1
EL 310 100	ELS 310 100	Basic program, generation of loads and acquisition of mechanical variables (speed, torque, mechanical power)	1
Choice of motors (see characteristics p xxx to xxx)			
EL 301 000	ELS 301 000	300-W DC motor, with separate excitation	
EL 302 000	ELS 302 000	300-W DC motor, with permanent excitation	
EL 303 000	ELS 303 000	300-W 3-ph asynchronous squirrel motor	
EL 305 000		300-W 3-phase synchronous motor/generator	
EL 306 000	ELS 306 000	300-W Brushless motor	
EL 307 000		300W 1-ph/3-ph asynchronous motor 240/400V	
EL 31X 000	ELS 31X 000	Other motors : please ask	

> Examples of configuration :

ELS 313 B : BICMAC, SELV 300-W load bench with magnetic brake and measurement of mechanical variables and 3-ph asynchronous squirrel motor 24/42 VAC .

EL 311 B : BICMAC, LV 300-W load bench with magnetic brake and measurement of mechanical variables and DC motor with separate excitation, 170 VDC



BICSIN(S) : Instrumented Load Bench with industrial digital systems emulation for DC or AC machines, 300 W

New

Highlights

- Braking or driving load generator
 - Constant torque
 - Fluid torque
 - Torque proportional to the speed, to the square speed
 - Programmable
 - Speed mode
- Acquisition of mechanical variables
 - Torque
 - Speed
 - Mechanical power
- Emulation of several realistic industrial situations (optional extra)
- 2 versions :
 - SELV: 3x24 VAC – 48 VDC
 - LV : 3x220 VAC – 320 VDC

Studied topics

- Motor characterization :
 - Direct current
 - Alternative current
 - Brushless
- Measurement of mechanical variables
- Characteristics plot
 - Mechanical variables
 - Speed / torque / mechanical power
- Power electronics
- Servo control
 - Speed
 - Position

ELECTRIC MOTORS

Load emulator
Drive + Brushless



$a.N$

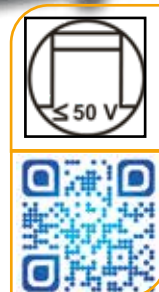
$b.N^2$

Inertia

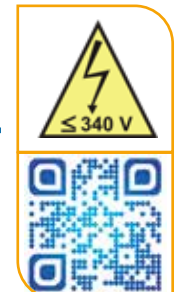
External
(Brake)

Constant

Speed profile



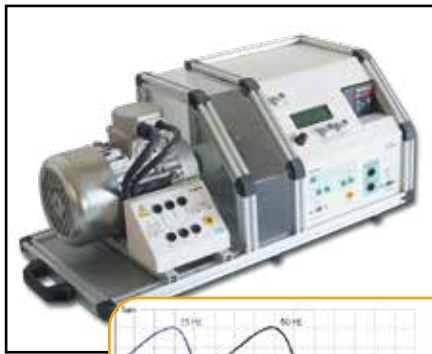
or



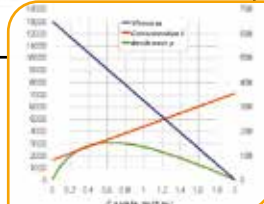


> **Motor characteristics plot :**

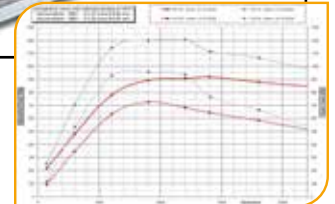
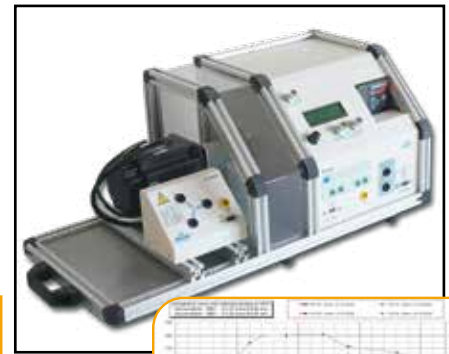
Torque speed relation
3-ph AC motor (ELS 323 000)



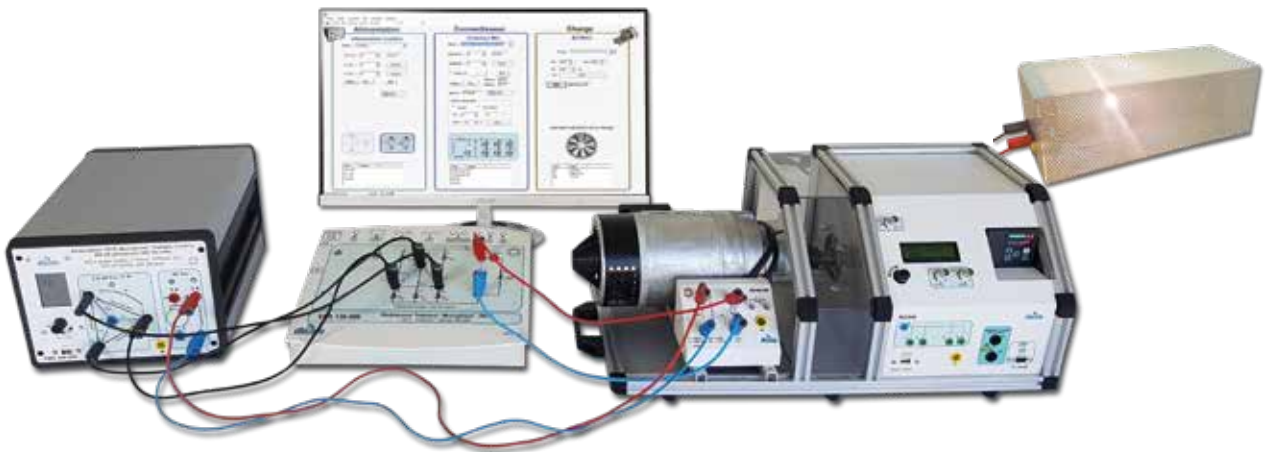
Torque speed relation
DC motor (ELS 322 000)



Torque speed relation
Brushless motor (ELS 326 000)



> **Example of speed control with our EPS130 power bridge on DC motor**



ELECTRIC MOTORS

EL(S)32_B - BICSIN(S)300 : Instrumented Load Bench with industrial digital systems emulation for DC or AC machines, 300 W

LV reference	SELV reference	Description	Quantity
EL 320 000	ELS 320 000	Test motor bench with Brushless motor, control electronic board, SINAMICS V90 drive with its power supply, set on a aluminium frame with carrying handles	1
EL 320 100	ELS 320 100	Basic program, generation of loads and acquisition of mechanical variables (speed, torque, mechanical power)	1
Choice of motors (see characteristics p XXX to XX)			
EL 301 000	ELS 301 000	300-W DC motor, with separate excitation	
EL 302 000	ELS 302 000	300-W DC motor, with permanent excitation	
EL 303 000	ELS 303 000	300-W 3-ph asynchronous squirrel motor	
EL 305 000		300-W 3-phase synchronous motor/generator	
EL 306 000	ELS 306 000	300-W Brushless motor	
EL 307 000		300W 1-ph/3-ph asynchronous motor 240/400V	
EL 30X 000	ELS 30X 000	Other motors : please ask	
Optionnal extra :			
EL 320 200	ELS 320 200	System for real time simulation of industrial processes	

> **Examples of configuration :**

ELS 323 B : BICSIN, SELV 300-W load bench with load emulated by a Brushless motor coupled with 3-ph asynchronous squirrel motor 24/42 VAC .

EL 321 B : BICSIN, LV 300-W I load bench with load emulated by a Brushless motor coupled with DC motor with separate excitation, 170 VDC



300-W motors, SELV, for BICMAC-S and BICSIN-S benches



Highlights

- Interchangeable motor for the benches
 - BICMAC: Load bench with magnetic brake (page xx)
 - BICSIN: Load bench with Brushless motor and its drive, load emulator (page xxx)

Studied topics

- Power electronics.
- Motor tests :
 - DC motors
 - AC motors
 - Brushless motors.

Compatible with SELV 300-W power bridges (pages 80 to 88)

Motor characteristics	Value	Units
Power voltage	48	V _{DC}
Nominal current	6,5	A
Excitation current	1,4	A
Electrical power	412	W
Speed at nominal current	2 000	Rpm



ELS 301 000 : 300**-W DC motor, separate excitation, 48 VDC



Motor characteristics	Value	Units
Power voltage	48	V _{DC}
Nominal current	6,7	A
Electrical power	321	W
Speed at nominal current	2 000	Rpm

ELS 302 000 : 300**-W DC motor, permanent excitation, 48 VDC

Motor characteristics	Value	Units
Nominal voltages	24/42	V _{AC}
Nominal current	11,5/6,6	A
Cos φ	0,68	
Operating power	180	W
Efficiency	60	%
Speed (synchronism)	1 360	Rpm



ELS 303 000 : 300**-W 3-phase asynchronous squirrel motor, 3x24 VAC



Motor characteristics	Value	Units
Sine power voltage	23	V _{AC}
DC power supply (trapezoid)	35	V _{DC}
Speed at nominal current	2 000	Rpm
Mechanical power	300	W

ELS 306 000 : 300-W Brushless motor, 23 VAC

> Examples of configuration :

ELS 313 B : BICMAC, SELV 300-W load bench with magnetic brake and 3-ph asynchronous squirrel motor 24/42 VAC .



ELS 326 B : BICSIN, SELV 300-W load bench with load emulated by a Brushless motor coupled with a second Brushless motor.



** Electrical power



300-W motors, LV, for BICMAC and BICSIN benches

Compatible with LV 300-W power bridges (pages 92 to 98)



Motor characteristics	Value	Units
Power voltage	170	V _{DC}
Nominal current	2	A
Excitation voltage	190	V _{DC}
Excitation current	0,52	A
Mechanical power	300	W
Speed at nominal current	2 000	Rpm

EL 301 000 : 300-W DC motor, separate excitation, 170 VDC

Motor characteristics	Value	Units
Power voltage	170	V _{DC}
Nominal current	2	A
Mechanical power	300	W
Speed at nominal current	2 000	Rpm

EL 302 000 : 300-W DC motor, permanent excitation, 170 VDC



Motor characteristics	Value	Units
Nominal voltages	240/400	V _{AC}
Nominal current	2/1,2	A
Cos φ	0,74	
Operating power	370	W
Speed(synchronism)	1 360	Rpm

EL 303 000 : 300-W 3-phase asynchronous squirrel motor, 240/400 VAC

Motor characteristics	Value	Units
Sine power voltage	230	V _{AC}
DC power supply (trapezoid)	310	V _{DC}
Speed at nominal current	2 000	Tr/min
Mechanical power	300	W

EL 306 000 : 300-W Brushless motor, 230 VAC, 310 VDC



Motor characteristics	Value	Units
Nominal voltages	240/400	V _{AC}
Nominal current	2/1,2	A
Cos φ	0,74	
Operating power	370	W
Capacitor	30	μF
Speed(synchronism)	1 500	Rpm

EL 307 000 : 300-W 1-ph/3-ph asynchronous motor, 240/400 VAC

Motor characteristics	Value	Units
Sine power voltage	230	V _{AC}
Nominal current	0,9	A
Speed at nominal current	1 500	Rpm
Mechanical power	300	W

EL 305 000 : 300-W 3-phase synchronous motor/generator



ELECTRIC MOTORS



Test group 1,5 kW : DC and 3-phase asynchronous motors with active loads

Highlights

- Electrotechnics
- Power Electronics
- Load simulator :
constante, fonction de la vitesse, carré de la vitesse, inertie




Studied topics

- Power electronics.
- Motor tests :
 - DC
 - 3-phase asynchronous
- Speed and position servocontrol



ELECTRIC MOTORS

Technical characteristics - ELD 150 B - Testing bench

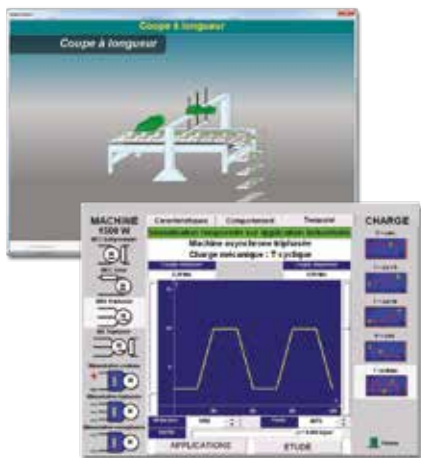
	Load module	The load is made of a 1.5 kW brushless motor and encoder, with its control and acquisition system
	Load function	This load creates a load profile on the tested motor (braking torque, function of the speed, of the speed square, constant, inertia).
	Measuring function (with PC)	Acquisition of the electrical and mechanical values : current, voltage, speed, torque (calculated). Display and analysis of the typical curves of a motor (current, voltage speed, torque). Assistance au couplage d'un alternateur sur le réseau.
	Power supply Connections	3-phase : 400 V 50Hz. Measurement via diam 4-mm security connectors, connection to PC with USB. Outputs of the 1096 point optic encoder for servocontrol experiments.
	DC Motor	DC motor in motor or generator mode : <ul style="list-style-type: none"> - Power 930 W at 1500 rpm. - Armature : Voltage : 170Vcc. - Current : 6.5 A. - Excitation : Voltage : 190 Vcc. - Current 400 mA. - PTO probe. - Supplied with 2 output axis. - Pedagogical connections panel.
	3-phase AC motor	3-phase asynchronous motor in motor mode : <ul style="list-style-type: none"> - Power : 1,5 kW - Squirrel cage rotor 1500 rpm. - Voltage 230/400 VAC three phase - Current : 6.1A/3.5 A. - PTO probe. - Supplied with 2 output axis. - Pedagogical connections panel.
	Presentation	The motors (brushless, DC and AC) are mounted on a slide rail test bed; on a support with castos. The control panel of the active load will be put on a table.



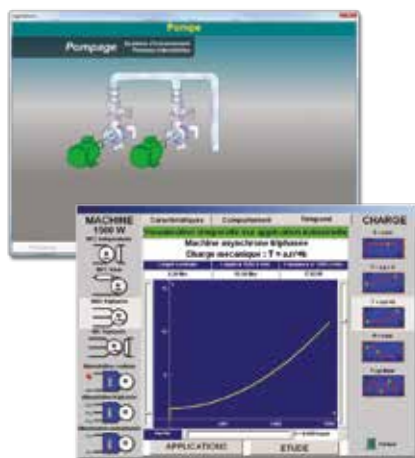
> Industrial scenario :

Industrial scenarii : To concretize laws of loads applied to machines, industrial animations are available for every law of load, some examples :

Shear cutting
Torque by fits and starts



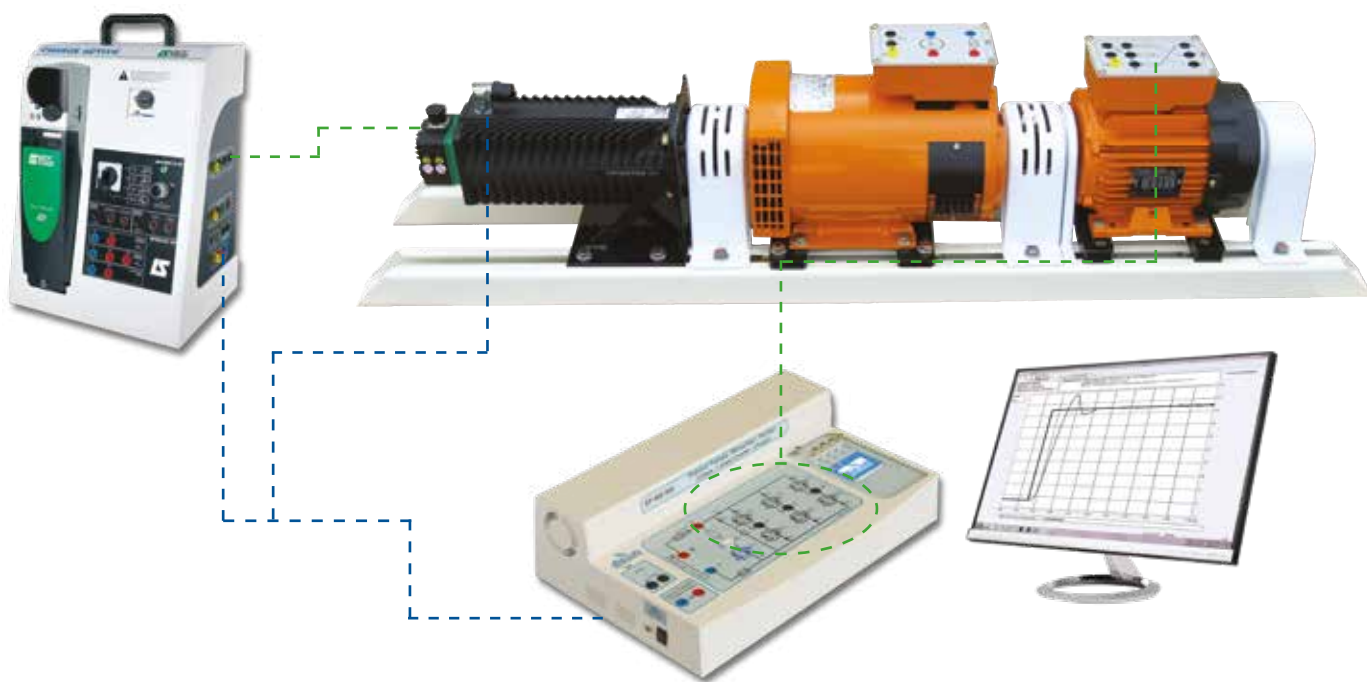
Pumping
Constant torque + F square speed



Unwinding
Constant torque - F reverse of the Ø of the reel



> Example of speed control with our EP660* power bridge on AC motor



ELECTRIC MOTORS

Package ELD 150 B : Complete test bench, with its load simulator and control software, DC motor, 1.5kW AC motor on support

Reference	Description	Quantity
ELD 151 000	(ACTIVE1500) : Active load, 1500 W including : - Brushless motor with encoder - Load generation unit, acquisition data system for the electrical and mechanical measures - Load resistance for energy recovery - Control and acquisition software for PC (computer not supplied), USB cord	1
ELD 152 000	3-phase asynchronous motor, squirrel cage, 1.5 kW, 230V 5,5A, 400V 3,2A	1
ELD 153 000	DC motor, 930 W, with separate excitation	1
EP 000 100	Incremental encoder interface for experiments in speed and position control with SVGA/DB15 cables	1
ELD 151 100	Support with castors	1
ELD 151 200	Slide rail test bed ; 1500 mm	1

* See reference EP660 page 104



Electrical engineering/power electronics table



Highlights

- Especially conceived for practical works in power electronics
- Analog measurements of AC and DC currents and voltage,
- 2x 3-phase power supplies, 2 DC power supplies,
- Secured

Optional extra :

- Measuring instruments for :
current, voltage, frequency, Cos ϕ , power

Technical characteristics - ELD 100 000 - Table for electrical engineering and power electronics

Functions	1 Start/Stop button, lockable, with indicator light, emergency stop button, 30 mA quadripolar circuit breaker. Powered with individual Start/Stop switch. • 1 3-ph power supply: 400V + N + E on Ø 4-mm safety sockets with protection by a magneto thermal circuit breaker • 4 1-ph 230-V/16 A sockets • 1 3-ph adjustable power supply, 0-430VAC-8A or DC adjustable power supply, 0-270VDC-16A on Ø4-mm security sockets, with analog ammeter and voltmeter • 1 Auxiliary power supply : 0-250VAC-2,5A or 0-250VDC-2,5A on Ø 4-mm safety sockets, with analog ammeter and voltmeter.
Measurements	Analog voltmeters and ammeters on the programmable 3-phase AC and DC outputs.
Securities	Differential circuit-breaker, emergency stop button, lockable contactors for the power supplies.
Power supply	Mains : 400 V 3-phase + neutral + earth.

Package ELD 100 B : Electrical engineering/power electronics table

Electronics table



Highlights

- Electric panel
- Optional extra :
- Shelf for measuring instruments
 - Vertical connecting pole
 - Set of 2 student chairs, height-adjustable



Pack EMO 100 B : Electronics table

Reference	Description	Quantity
EMO 100 000	Metallic structure for heavy weights ; H850 x L2000 x d750 mm, epoxy paint for, compatch tabletop.	1
EMO 100 100	Electrical panel. It includes : 30mA differential circuit breaker, On/Off switch button, Emergency pushbutton; 3x3 electric sockets, 230V 16A, 1 RJ45 socket Connections : a 3-m cable is supplied, the plug is not supplied.	1
EMO 100 300	vertical connecting pole	Optional extra
EMO 100 200	Shelf (for measuring instruments)	Optional extra
ELD 100 100	Set of 2 student chair, height-adjustable	Optional extra

(for specific dimensions or equipment, please ask)

Electric ramp

- 16 A circuit-breaker
- 3x3 electric sockets
- Voltage presence indicator
- RJ45 socket

EMO 100 100



(for specific dimensions or equipment, please ask)



Resistances

Highlights

- Protecting fuse
- Visualization lamp



Reference	Power (W)	Resistance value (Ohms)	Nominal current (A)
ELD 108 100	1000	33	5,5
ELD 108 200	1000	47	4,6
ELD 108 300	1000	100	3,2

Rheostats

Highlights

- Independant Rheostats.
- Possibility to get non-equilibrated loads.
- Compatible with all types of 3-phase AC-controllers.



Reference	Power (W)	Resistance value (Ohms)	Nominal current (A)
PMM 064 730	660	165	2
PMM 064 000	320	10	5,7
ELD 103 000	950	11	9,3
ELD 050 000	300	210	1,2
ELD 101 000	2000	220	3
ELD 100 500	960	33	5,4

Self load, 35mH / 5A with fuse

Highlights

- Independant loads.
- Possibility to get non-equilibrated loads.
- Compatible with all types of 3-phase AC-controllers.



Technical characteristics - ELD 102 000 - Self load

Characteristics	Smoothing self, 35 mH, 5 A
Securities	Securities 4-mm security connectors. 3 A fuse.

ELD 102 000 : Self load, 35mH / 5A with fuse

Inductive load



Technical characteristics - EPD 037 340

Functions	self with multiple outputs : 1, 2, 4, 6, 8 mH
Core	Silicium sheet
Average current	5A
Overvoltage coefficient	22

EPD 037 340 : Inductive load



Compatibility table

ELECTRIC MOTORS

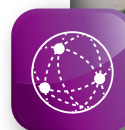
Reference	30W RANGE	120W RANGE	300W RANGE		1 500W RANGE
			SELV	LV	
Resistance					
ELD 108 100			X	X	X
ELD 108 200			X	X	X
ELD 108 300			X	X	X
Rheostats					
PMM 064 730	X				
PMM 064 000		X			
ELD 103 000			X		
ELD 050 000				X	
ELD 101 000					X
ELD 100 500				X	
Inductive load					
EPD 037 340	X	X			
ELD 102 000			X	X	X

Example of an installation :



Telecommunications

> Study of LoRa/LoRaWAN protocole	122
> Signal processing with Fibula graphic	124
> Radio transmission/reception with «SDR»	126
> Compact optical fiber fusion splicer	128
> Mechanical splice	128
> Measurement with OTDR	128
> Implementation of Passive Optical network (PON)	129
> Communications with optic fiber	130
> Study of Antenna	131
> DTTV & satellite TV (DVB T -T2 - S - S2)	132
> Did@VideoWall	134
> Microwaves study (in free propagation)	136
> Hyperfrequency waves unit	137
> SWR meter	137
> Power meter	137
> Time division switching unit	138





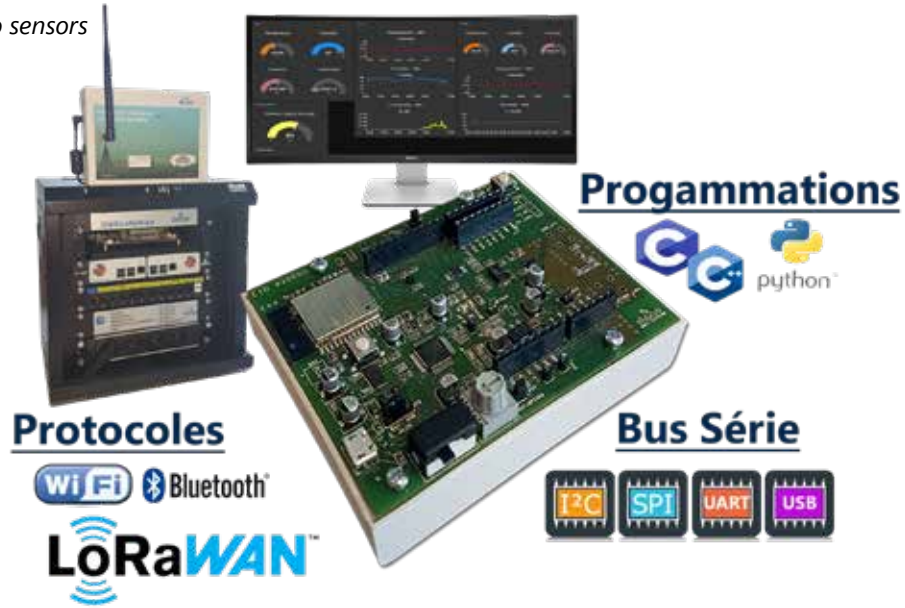
Study of LoRa/LoRaWAN protocole

Highlights

- Very low consumption
- Long distance
- High power processor : "ESP32"
- Embedded sensors (hygrometry, pressure, temperature, luminosity, heart rate, gyroscope, magnetic field)
- Wifi, Bluetooth
- USB
- Compatible with Arduino sensors
- Prototyping

Studied topics

- Study of LoRa protocole
 - Frequency / Spreading Factor / Band Width
- Study of LoRaWAN protocole
 - Classes / APB/ OTAA
- Complete transmission from the sensor to the server
- Frame analysis (I²C, SPI, UART)
- WIFI and Bluetooth protocole



EID 430 000 : LoRa/LoRaWAN End Device module, 868 MHz



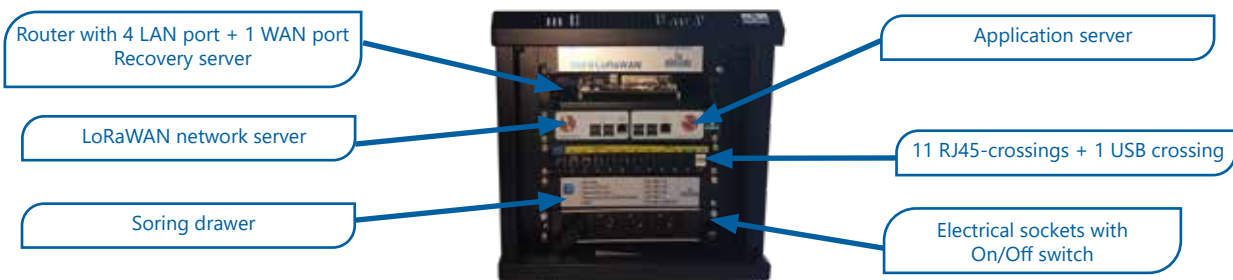
CPU	ESP32 Soc (XTENSA dual core 32 bits LX6 microprocessor à 240 MHz, 600 DMIPS), Bluetooth, WIFI
SX1272 Modem	LoRa/ GFSK at 868 MHz with LoRaWAN stack (class A, B and C), measure of RSSI and SNB with 1 embedded antenna and 1 20 dB attenuator output.
Sensors	Temperature, pressure, humidity, luminosity, heart pulse rate, accelerometer, 3-axis gyroscope magnetometer

EID 420 000 : LoRa/LoRaWAN Gateway, 868 MHz with Raspberry Pi

Server	LoRaWAN server, embedded in Raspberry PI gateway
TX & RX Interfaces	Parallel demodulation on 8 frequencies (LoRA and FSK)
Antenna	External, 868 MHz
Configuration	Web Interface: frequency, Spreading factor, bandwidth and speed Activation of the End devices with ABP or OTAA, management of Class A, B and C.

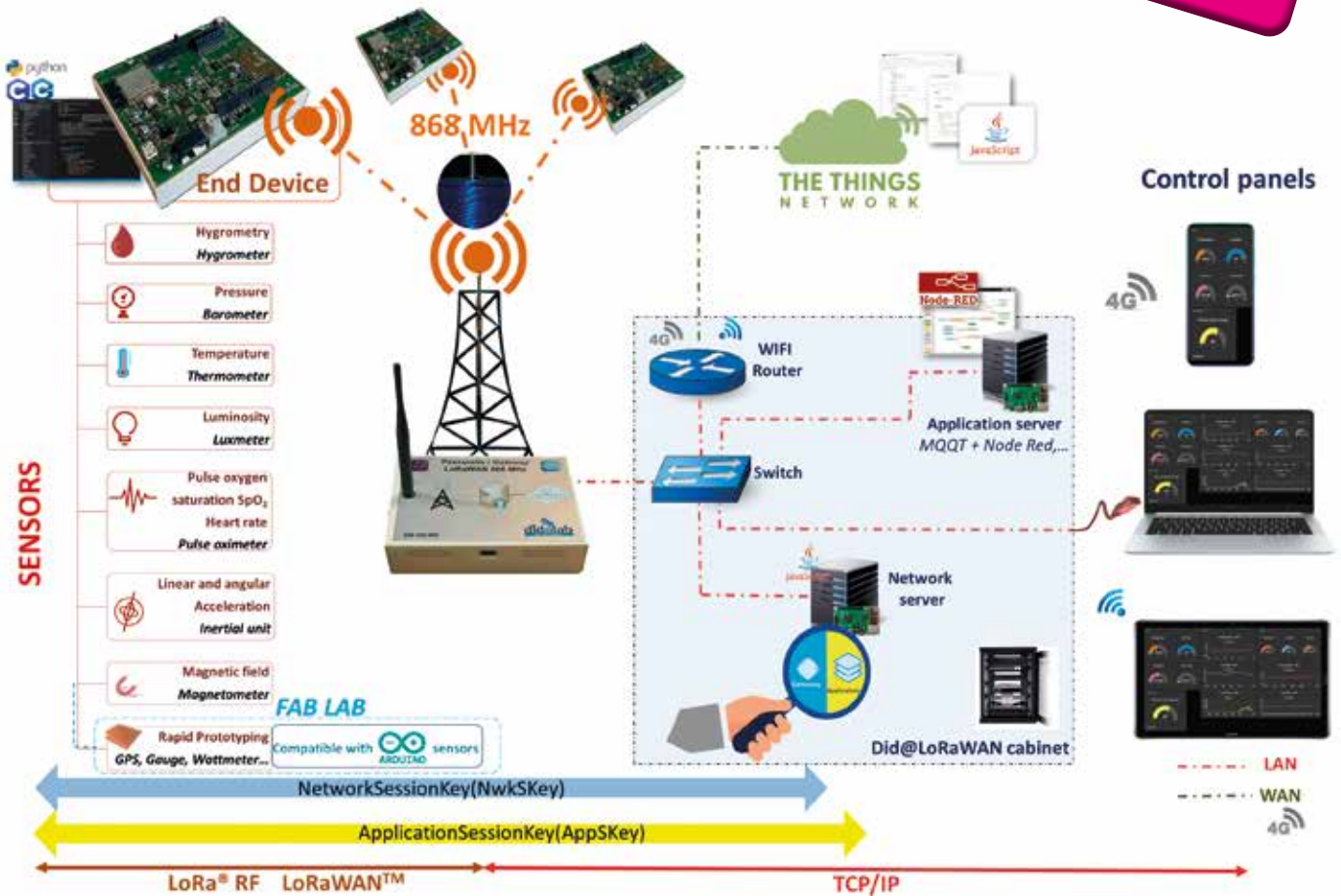


ETR 100 000 : Did@LoRaWAN cabinet



> Schematic diagram

New



TELECOMMUNICATIONS

Compatible with our VDI laboratories - See pages 146/148

Package ETR 100 C : Complete IoT LoRa/LoRaWAN package :

Reference	Description	Quantity
EID 420 000	LoRa/LoRaWAN gateway, 868 MHz with Rasberry pi. with 2 TX & RX interfaces for the parallel demodulation on 8 frequencies. LoRa and GFSK demodulation. 1 external antenna, 868 MHz.	1
EID 430 000	LoRa / LoRaWAN End Device module, 868 MHz, including 1 ESP32 with 32 Mbit Flash, 1 UART, 2 SPI, 2 I ² C, 1 WIFI, 1 Bluetooth, 6 ADC inputs, 2 DAC outputs. Programming and debug via USB interface. It includes 1 push button, 1 potentiometer, 2 LEDs, 1 temperature sensor, 1 humidity and pressure sensor, 1 luminosity sensor, 1 heart pulse sensor, 1 accelerometer and 3-axis gyroscope sensor, 1 current measure , and 1 shield arduino (with 1 port for power supply, 1 analogue port and 2 digital ports). 1 LoRa / GFSK Modem, 868 MHz (with LoRaWAN stack (Class A, B and C), measure of RSSI and SNR) with 1 embedded antenna and 1 20-dB attenuation output. Power supply : 5V via USB or batteries.	1
EMD 430 000	Radio spectrum processor ,14 bits, covering frequencies from 1 kHz to 2 GHz	1
ETR 100 000	Computer cabinet, with : - 1 4-port switch - 1 Mixing panel composed of 11 RJ45 crossings and 1 USB crossing - 1 Router board, with 4 LAN ports +1 WAN Wifi port , with recovery server	1
ETR 120 000	Server rack composed of : - 1 «Raspberry Pi3» network server with SD card - 1 «Raspberry Pi3» application server with SD card	1
EID 431 000	Programming unit, all configurations done	1



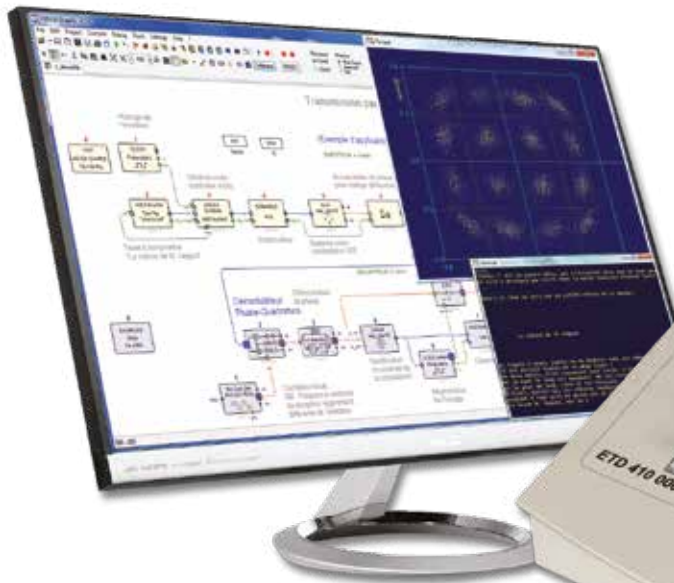
Signal processing with FIBULA Graphic

Highlights

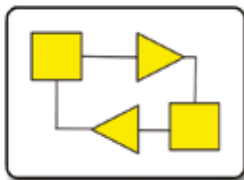
- User friendly.
- A/D Inputs, 16 bits, 1 MSa/s, ± 10 Vdc
- D/A Outputs, 12 bits 100 kSa/s, ± 10 Vdc
- Programmation with graphic blocks, dual core DSP (2 x 200 MIPS).
- Graphic compiler with optimized code
- Real time virtual Oscilloscope (8 channels)
- More than 250 macro functions available.

Studied topics

- *Signal Theory*
Sampling, quantification, FFT, IIR or FIR filters, hazardous signals, etc.
- *Introduction to digital transmissions.*
Base band, ASK, PSK, QAM modulations, multiplexing, etc.
- *Theory of information and coding.*
Channel coding, FEC, Signal to Noise ratio measurement, information flow, etc.



REAL TIME



Fibula I

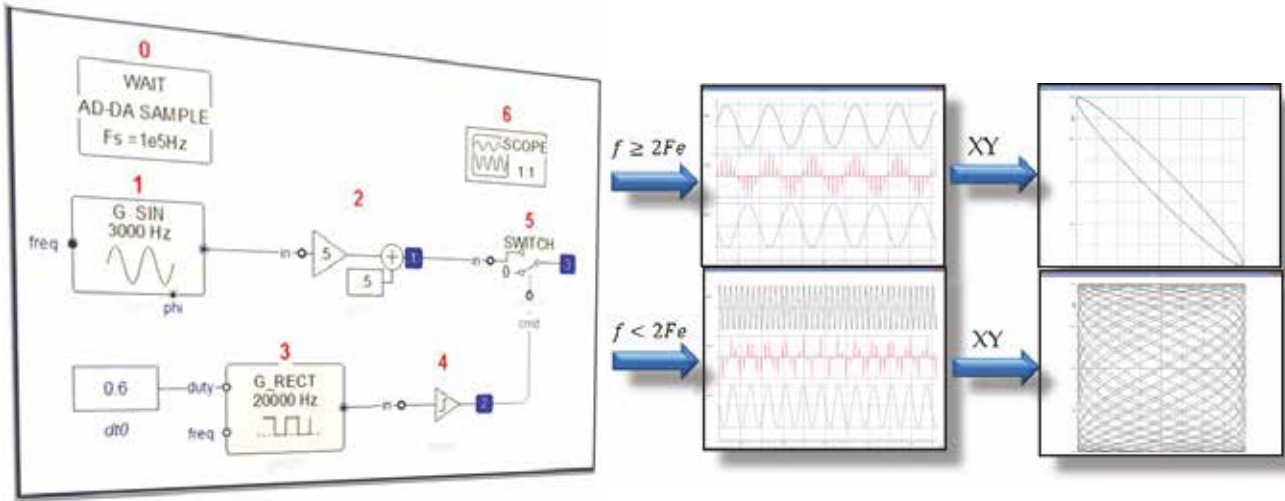


Technical characteristics

Mother board (processor with fixed point)	Dual core DSP, specialized in audio			
	24 bits	2 x 200 MIPS	RAM 2 x 92 k + 64 k 24 bits	arithmetic operation on 48 bits
	SDRAM 32 Mbytes	3 timers	1 USB port	1 serial port for terminal mode experiments
Inputs	A/D, 16 bits, 1 MSa/s, ± 10 Vdc on BNC 50 sockets, 1 CODEC 8k to 192 kHz 24 bits, microphone and line gain inputs, -34 to +12 dB, 2 TTL inputs			
Outputs	D/A, 12 bits, 100 kSa/s, ± 10 Vdc on BNC 50 sockets, 1 CODEC 8 k to 192 kHz 24 bits, line and stereo headphone outputs, 40 mW, 2 TTL outputs			
Examples of available macros (FIBULA software, more than 250 block functions in libraries)	Inputs / Outputs (analog, TTL), Signal generators, (sine, square, triangle, complex, Gaussian noise...), Filters (RIL, RIF, Hilbert, recursive, non recursive...), Matrix (matrix sums, discrete Fourier series, matrix product...), Telecommunications, (analog modulations, digital modulations, ASK, PSK, FSK, QAM, coding AMI, NRZ, Manchester, fading...), Floating point, (multiplication+sum, sign inversion, square root...), etc...			
Environment	PC with Windows			
Power supply	15 VAC power supply.			



> Example : Shannon Theorem



Experiments

ETD 410 020/030 : Experiments manuel, signal processing, CITE-2001 3rd and 4th levels :

EXP 1	RS Basic flip-flops	EXP 7	Digital / Analog Conversion : DAC
EXP 2	Latch flip-flop	EXP 8	ADC single ramp with counter and DCA
EXP 3	RS and JK master/slave flip-flops	EXP 9	Tracking ADC
EXP 4	D flip-flops	EXP 10	Implementation of a semi-Flash ANC
EXP 5	BCD synchronous counter, count-down counter	EXP 11	Analog filters
EXP 6	Review on D/A and A/D conversions		

ETD 410 040/050 : Experiments manuel, signal processing, CITE-2001 5th, 6th, and 7th levels :

EXP 1	Digital filters	EXP 7	Base band transmission, coding, spectral density
EXP 2	Non-recursive digital filters, (1st and 2nd orders)	EXP 8	Review on digital transmissions
EXP 3	Recursive digital filters, (1st and 2nd orders)	EXP 9	ASK digital transmissions
EXP 4	Review on analog transmissions	EXP 10	FSK digital transmissions
EXP 5	AM and FM analog transmissions	EXP 11	PSK digital transmissions
EXP 6	Sampling : Nyquist, Shannon's theorem	EXP 12	QAM digital transmissions

Package ETD 410 B : «Signal Processing with FIBULA Graphic»

Reference	Description	Quantity
ETD 410 000	Signal processing module based on a dual core DSP, 2 x 200 Mips, with 2 audio inputs/outputs and 2 broadband inputs/outputs	1
ETD 410 100	FIBULA, programming software, in real time, with diagram blocks	1
ETD 410 010	Technical manual with examples	1
EGD 000 013	15-VAC power supply, 1.6 A	1
EGD 000 006	AA-USB lead	1
ETD 410 200	Set of accessories (microphone, 2 speakers, 2 BNC stoppers (50 Ohms).	1
PEM 010 021	BNC/BNC lead,male/male, 1m, 50 Ohms.	2
PEM 063 960	Set of 2 BNC "T".	1
EGD 000 018	Carrying case.	1
ETD 410 020/030	Manual of experiments, level 3 and 4 (CITE-2011)	1
ETD 410 040/050	Manual of experiments, level 5 to 7 (CITE-2011)	1



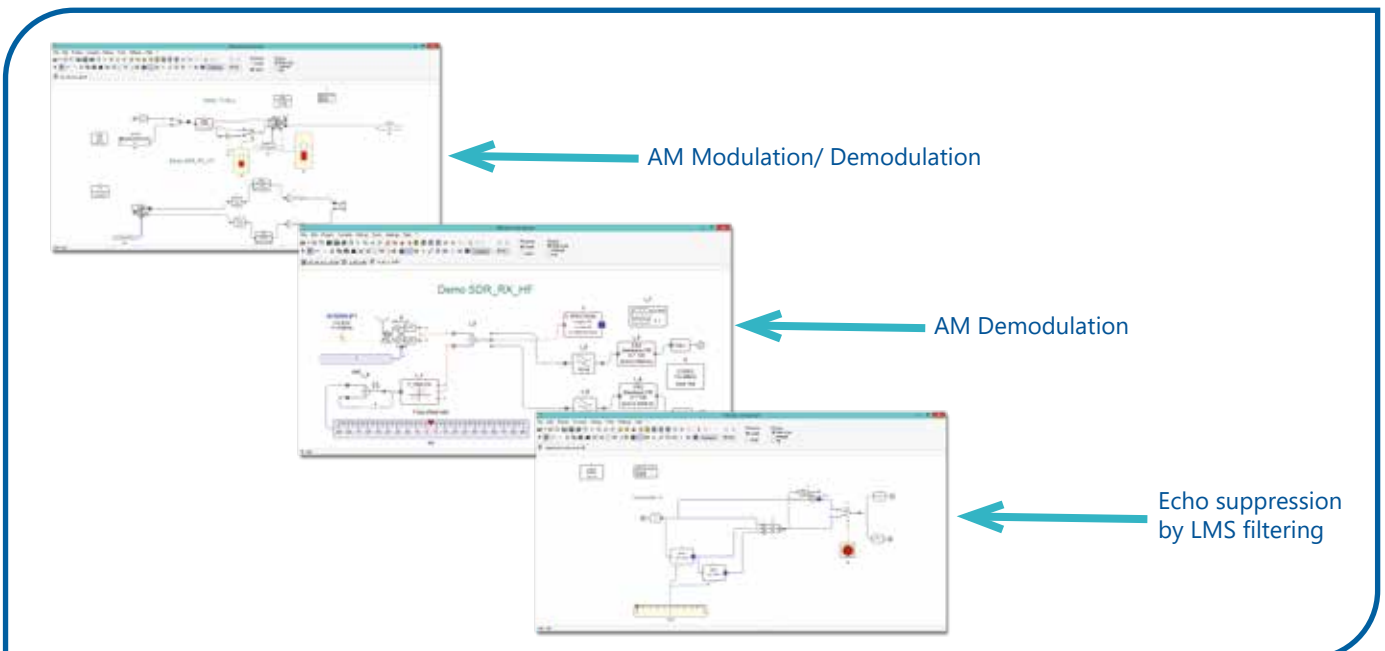
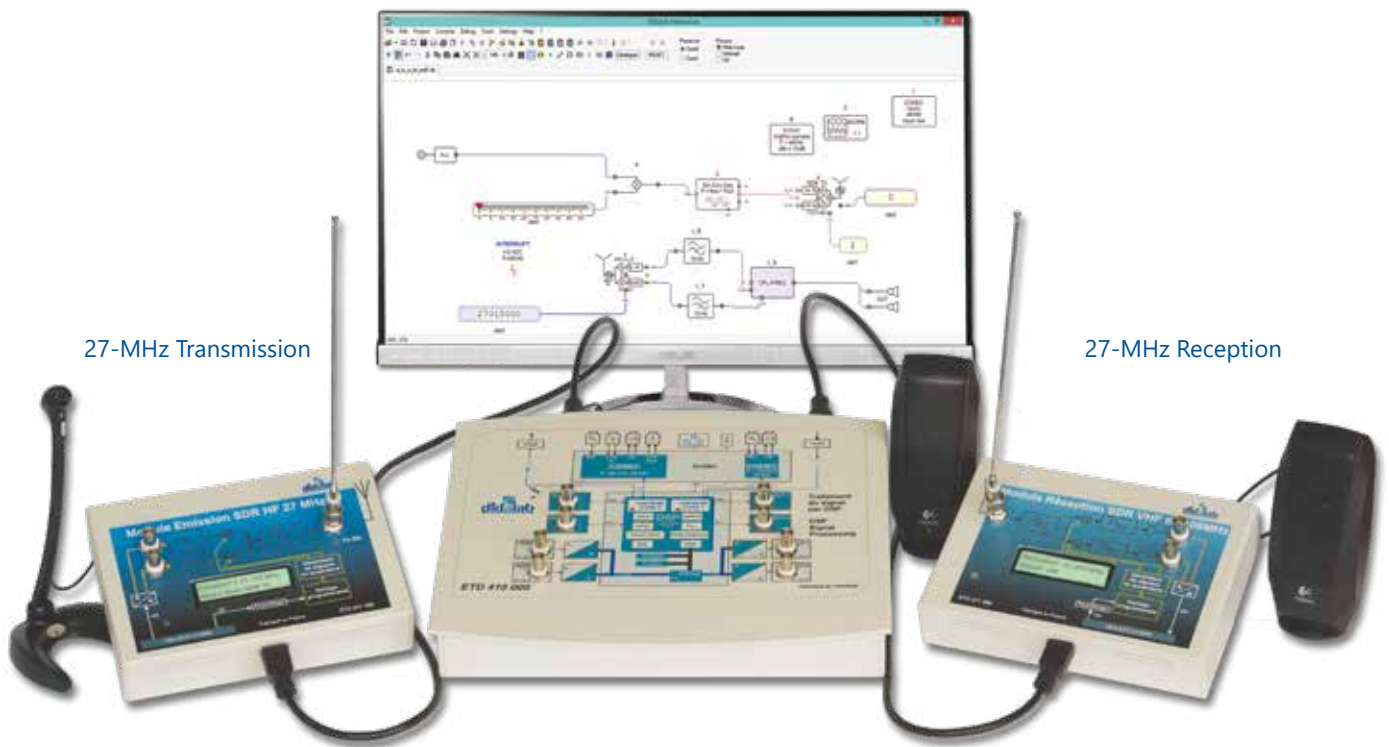
Radio Transmission/ Reception with "SDR"

Highlights

- Study of modern telecommunications with the SDR technology (Software Defined on Radio)
- The ERD411-serie modules are optional extra for the ETD410000 module and then they benefit from all the pedagogical power of Fibula graphic
- HF Transmission reception
- Reception in the FM, general public VHF band
- Study of digital modulations and all-free codings

> Assembly of FM Transmission / Reception with 1 ETD410B module

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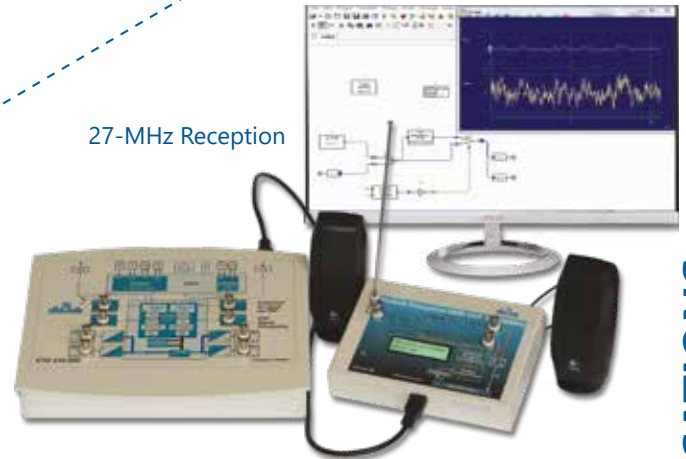


> **Example : Assembly of AM Transmission / Reception with 2 ETD410B modules**



27-MHz Transmission

New



27-MHz Reception

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Technical characteristics - ETD 411 100 : SDR Transmission Module HF 27 MHz (IQ modulator)



Frequencies	from 27,000 to 27,400 MHz
Power	10 mW max
Modulations	IQ by DSP with FibulaG graphic software,
Analog	AM, FM, BLU
Digital	ASK, PSK, FSK, QPSK, QAM, DPSK...
Conversion	with 24-bits 192-kHz CODEC
Transposition	LF/HF by « perfect mixer »

Technical characteristics - ETD 411 200 : SDR Reception Module, VLF, LF, HF (IQ demodulator)

Frequencies	LF : 150 to 280 kHz, MF : 3 500 to 3 800 kHz HF : 27,000 to 27,400 MHz
Sensitivity	-90 dbm
Transposition	LF/HF by « perfect mixer »
Conversion	with 24-bits 192-kHz CODEC
Demodulation	IQ by DSP with FibulaG graphic software,
Analog	AM, FM, BLU
Digital	ASK, PSK, FSK, QPSK, QAM, QPSK...



Technical characteristics - ETD 411 300 : Transposition Module, VLF, LF, and HF (IQ demodulator)



Frequencies	88 to 108 MHz
Sensitivity	-90 dbm
Transposition	Double VHF/HF by « perfect mixer »
Conversion	with 24-bits 192-kHz CODEC
Demodulation	IQ by DSP with FibulaG graphic software
Analog	AM, FM, BLU
Digital	BPSK demodulation, NRZ decoding (ex : RDS decoder)



Compact optical fibre fusion splicer



Highlights

- Skills acquisition for the fibre preparation to fusion / splicing.
- Essential and much used tool for the connection technicians
- Automatic fibre aligning

Studied topics

- Manipulation and fibre preparation.
- Cleaning, stripping and cleaving.
- Fusion, fibre protection.
- Loss estimation

EFO 200 B : Implementation of an optical fibre fusion splicer

Reference	Description	Quantity
EFO 200 000	3-axis optical fibre fusion splicer, (with heating unit, loss estimation) , optical fibre stripper, optical fibre cleaver, carrying case, 50 heat shrink sleeves	1
EFO 001 000	Optical fiber, 900- μ m optical cladding, with SC/APC connector, L=10 m	2

Mechanical splice



Highlights

- To master optical fibre implies going through a stage of manipulation (preparation, connection, cleanliness...)
- Technical understanding
- Manipulation skills.

Studied topics

- Fibre manipulation and preparation.
- Cleaning, stripping and cleaving.
- Mechanical splice setting, transparent, reusable for fibres connections.
- Use of the red laser to find mechanical stresses and help aligning.

EFO 400 B : Basic package Mechanical splicing

Reference	Description	Quantity
EFO 400 000	Tool box for mechanical splicing with stripper, cleaver tools, red laser, cleaning kit.	1
EFO 401 000	Transparent mechanical splice kit (50 pieces).	2
EFO 001 000	Optical fiber, 900- μ m optical cladding, with SC/APC connector, L=10 m	1

Measurement with OTDR



Studied topics

- Optical fibre characterization with signal reflection,
- Analysis of all the fibre's events (connectors, fusion,, splices, etc)

EFO 300 B : Measurement with OTDR

Reference	Description	Quantity
EFO 300 000	OTDR (Optical Time Domain Reflectometer), wavelengths: 1300 and 1550 nm (single mode)	1
EFO 301 000	150-m launch fiber reel, with SC/PC connector	1
EFO 302 000	Accessories : 250-m reels, SC/APC + 2 crossovers	1



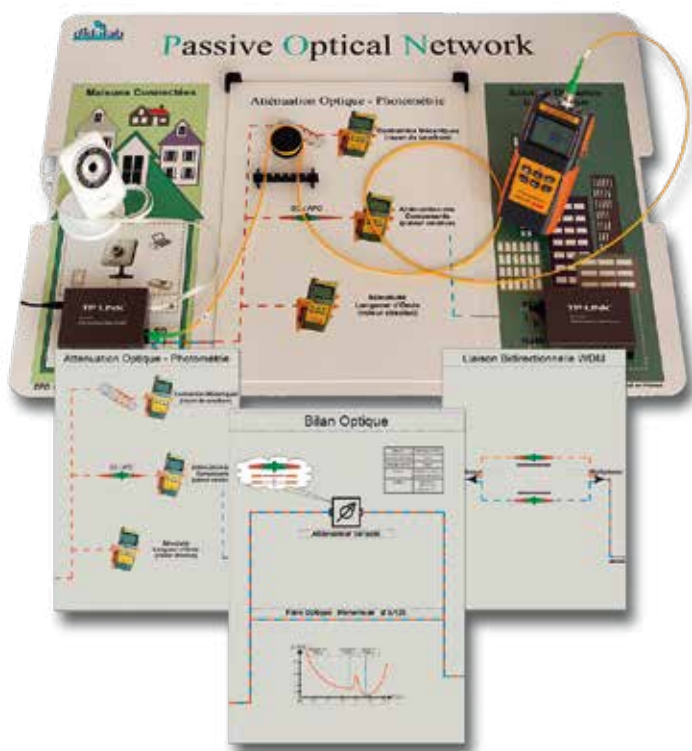
Implementation of a Passive Optical Network (PON)

Highlights

- This pedagogical bench is not conceived to optical fibre connection but to study and implement a single mode optical connection.
It is a complete package, putting the student in a real situation.
It is also used for the cleanliness learning, essential to fibre manipulation, the measurement instrument calibration, optical measure according to the system's wavelength, implementation of an optical transmitter/receiver couple and of an IP camera.

Studied topics

- Manipulation and cleaning of the telecom single mode optical connectors
- Calibration of the power meter
- Absolute power ratio (dBm) and relative power ratio (dB)
- Sensitivity threshold search or the receiver with the adjustable attenuator.
- Measurement of the max authorized loss.
- Study of a WDM bidirectional connection



Experiments - Implementation of a Passive Optical Network (PON)

Configuration and communication of the webcam	Transmission chain
Optical attenuation - photometry	Attenuation, line loss, transmission distance
Optical assessment	WDM bi-directional connection

Package EFO 100 B : Implementation of a IP/OF connection

Reference	Description	Quantity
EFO 100 000	Pedagogical scenario module 3 application decks for 3 scenarios : (Optical loss, power meter, Optical balance, WDM bidirectional connection)	1
EFO 101 000	IP/OF converter, wavelengths: Tx1550, Rx1310	1
EFO 102 000	IP/OF converter, wavelengths: Tx1310, Rx1550	1
EFO 103 000	Optical power meter	1
EFO 104 000	Adjustable optical attenuator	1
EFO 105 000	1300/1550 Multiplexer with SC/APC connectors	2
EFO 106 000	Set of : 5 SC/APC-SC/APC cords, simplex single mode, LSZH yellow 2.8-mm jacket, 2-m length ; 10 SC/APC crossings, simplex single mode, with flange and ceramic sleeve	1
EFO 107 000	Connector cleaner	1
EFO 108 000	IP camera	1
EFO 100 020	Experiments	1
EGD 000 029	Carrying case	1



Communications with optic fiber



Highlights

- **8 independent inputs.**
Built-in LF generator, analog and digital inputs, switches, microphone.
- **6 cyclically selectable photoemitters,**
different wavelengths, WDM application,
- **Built-in milliammeter.**
Measures the polarization current flowing through the chosen photoemitter
- **4 kinds of photodetectors**
mm Si PIN, 2.5 mm Si PIN, 1mm InGaAs PIN, 0.1 mm Ge APD
- **Optical power meter**
Resolution : 0,1 dB or 0,01 dB.

Technical characteristics - ETD 038 600 : Communications with optic fiber

EMITTER	
8 inputs	LF generator: sinusoidal, triangular or square (internal) signal 2 analog inputs(75 Ohms) (with DC coupling and AC coupling). 1 microphone input. Digital input, Inverted digital input, Digital input permanently on «1». Digital switch «1» / «0».
2 independent channels	One of the stage can be configured with a feedback circuit in order to maintain a stable and unalterable optical power no matter what the external conditions are (temperature, ageing ...).
6 optical outputs	6 cyclically selectable photoemitters : 526-nm Led, 590-nm Led,, 660-nm Led, 850-nm Led, 1300-nm Led, 650-nm laser diode. Two photoemitters may be activated at the same time.
1 milliammeter	It measures the polarization current flowing through the chosen photoemitter.
1 fault simulator	
RECEIVER	
4 optical inputs	4 kinds de photodetectors : 1 mm Si PIN, 2,5 mm Si PIN, 1 mm InGaAs PIN, 0,1 mm Ge APD.
1 analog channel	Made of 2 serial power stages. gain of each : 20 dB (total gain: 40 dB). The signal block possesses a switch to select the type of coupling, DC or AC, applied to the first amplifier input and to the analogue channel output section
1 digital channel	The amplitude of the channel output may be selected as either TTL level or RS-232 level.
1 optical power meter	Measures the optical power (relative or absolute).
4 different measuring modes	analog signal (sensitivity 0,1 dB) digital signal (sensitivity 0,1 dB). 1 kHz component (sensitivity 0,01 dB). DC component (sensitivity 0,01 dB).
1 fault simulator	
Outputs	1 analog output (high or low impedance). 1 digital output (TTL or RS232). 1 speaker or headphone output

Experiments

Measuring optical power.
Measuring the attenuation of an optical fibre (Insertion losses method, spectral dependence).
Influence of ambient light
Connecting optical fibre using ST-ST adapters
Measuring repeatability.
Study of photoemitters (characteristics, P/I and V/I, optical stability, modulation frequency).
Study of photodetectors (spectral dependence, inverse voltage, bandwidth).
Signal Transmission (analog, audio, video, digital, RS232).

Package ETD 038 600 : communications with optical fibre - type EF970-E

Reference	Description	Quantity
ETD 038 600/1	Emitter monitor	1
ETD 038 600/2	Receiver monitor.	1
	Technical guide.	1
	Manuel of Experiments	1



Study of Antenna

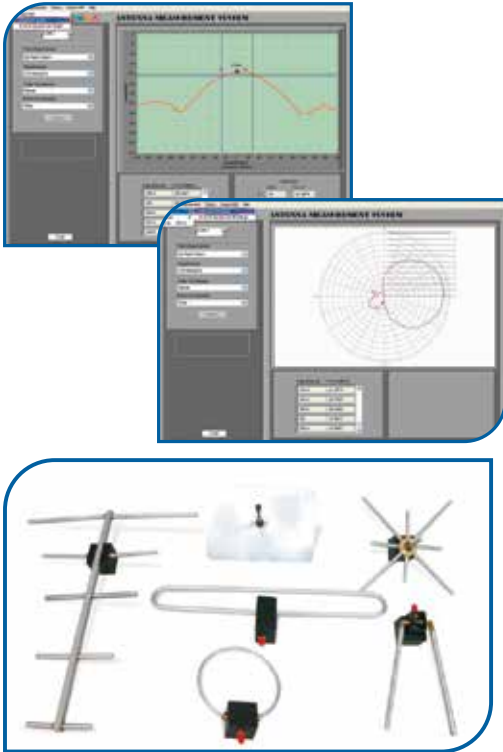
Highlights

- Study of all kind of antenna : Yagi, Spiral, Diamond loop, Helical, Dipole, Horn, Patch, rectangular microstrip, circular microstrip ...
- Complete set: Transmission and Reception
- Supplied with software

Studied topics

- Radiation pattern,
- Co and Cross polarization

New model



Technical characteristics - ETD 700 000 : Study of Antenna

Generator frequencies	100 MHz to 4 GHz
Transmitted Power	-50 dBm to +5 dBm
Impedance	50 Ohms, SMA connector
Detector frequencies	100 MHz to 8 GHz
Stepper motor controllery	1.8° and 5.4° resolution

Experiments - Antenna

EXP 1	Measure the variation of field strength/inverse square law	EXP 8	Measure co-polarization, cross polarization
EXP 2	Prove the reciprocity theorem of antenna	EXP 9	Measurement circularly polarized antennas
EXP 3	Plot Radiation pattern of all Wired antenna	EXP 10	Measurement of Front to back (F/B) ration of Yagi antenna
EXP 4	Plot Radiation pattern of all Aperture antenna	EXP 11	Measurement of 3 dB beamwidth of horn antenna
EXP 5	Plot Radiation pattern of all Reflector antenna	EXP 11	Side lobe level measurement
EXP 6	Plot Radiation pattern of all Array antenna	EXP 12	Comparative study of different antenna type and its radiation pattern
EXP 7	Plot Radiation pattern of all Planar (microstrip) antenna		

Package ETD 700 B : «Study of Antenna»

Reference	Description	Quantity
ETD 700 000	Transmitter, PLL Synthesized, 100 MHz to 4 GHz, transmitted power -50 to +50 dBm, Receiver, logarithmic detector, 100 MHz to 8 GHz, resolution 0.1 dB, noise level -90 dBm, 0 to 360° rotation	1
ETD 710 000	Set of 22 Antennas	1
ETD 720 000	Antenna mounting assembly (legs, base plate for transmitter and receiver, accessories)	1
	Supplied with accessories (software, experiments manual, cables ...)	1

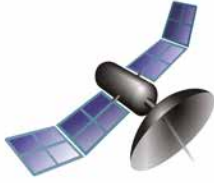
TELECOMMUNICATIONS



DTTV & satellite TV (DVB T - T2 - S - S2)

Highlights

- HDMI DTTV Transmission
- Insertion of a private channel in the DTTV package
- Multistreams measure and decoding



Studied topics

- Transmission standards
- Transmission encodings
- COFDM
- Wired transmission
- Transmission in a clear channel
- Reception
- Measures of Quality (Power, MER, CBER, VBER)
- Code rate effect, guard intervals, FFT on the flow



TELECOMMUNICATIONS

ETV 110 000 - Digital modulator, HD DTTV (EN206)



HDMI encoding to DVB-T (VHF and UHF).
Video encoding : MPEG-4 AVC/H.264.
Constellation (QPSK, QAM16, QAM 64).
LCN programming.

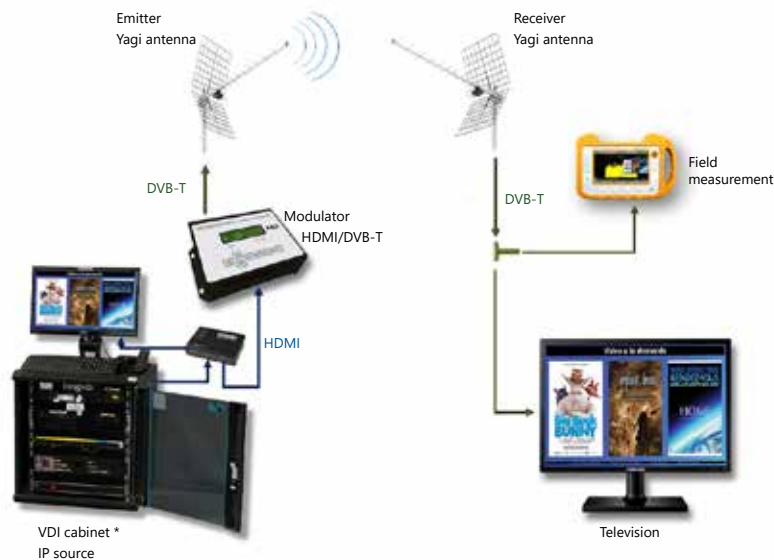
ETV 300 000 - DVB-S/S2 to IPTV transmodulator (TS or IP)

4 satellite inputs transmodulated over a maximum of 10 IPTV streams (SPTS or MPTS)
CI slots for decryption modules (CAMs)
PID filtering to select the desired output channels
Reconstruction of the PAT, PMT, SDT and NIT tables
Remote control and management via webserver through LAN or Internet

New



> Assembly example : DTTV modulation from a IP source (VDI cabinet)



* See page 142

Experiments - Digital Terrestrial and Satellite Television

Introduction to the DTTV (DVB-T)	Wired transmission in DVB-T	Hertzian terrestrial transmission DVB-T
COFDM transmission for DVB-T	Signal strength	Reception diagram in DVB-T
Equipment architecture	Amplifier	Satellite reception (DVB-S)

EMD 038 220 - HD Ranger Lite, field measurement TVB-T/T2/C/C2/S/S2

Spectrum analyser	
Tuning ranges	5 to 1000 MHz (terrestrial) and 950 to 2150 MHz (satellite)
Full span	500MHz/ 200MHz/ 100MHz/ 50MHz/ 10MHz
Measurement	
DVB-T-& DVB-T2, COFDM	35 dBμV to 115 dBμV Power measurements : CBER, VBER, MER, S/N
Tools	
- Constellation diagram	- Echoes analyzer mode



ETV 100 C : Complete Package for the study of DVB-T and satellite broadcasting

Reference	Description	Quantity
ETV 100 000	HDMI Source, Software for the audio and video peripherals, 21.5" HD screen, 1680*1050, loud-speakers, embedded Webcam, power supply.	1
ETV 110 000	DVB-T digital modulator, high definition, (EN-206), BNC output, supplied with HDMI lead	1
ETV 110 200	Full HD HDMI Hub, 3 HDMI leads	1
ETV 111 000	Full HD television, 48", BNC/TV transfer, BNC "T"	1
EMD 038 220	Field strength meter, TVB-T/T2/C/C2/S/S2 (HD Ranger Lite) BNC input, protective cover	1
ETV 101 000	DTTV antenna with tripod and RG58 coaxial connecting lead, 10m, 75 Ω BNC	2
ETV 102 000	Satellite antenna kit, with tripod, and RG58 coaxial connecting lead, 10m, 75Ω BNC	1
ETV 103 000	100-m cable, RG58, with BNC connections	1
ETV 104 000	Set of accessories : (2 BNC "T", 3 BNC 20 dB dimmers, 3 1-m BNC leads, RF amplifier)	1
ETV 100 040	User with experiments manual	1

ETV 300 C : Complete Package for the study of DVB-T and satellite broadcasting

Reference	Description	Quantity
ETV 100 000	HDMI Source, Software for the audio and video peripherals, 21.5" HD screen, 1680*1050, loud-speakers, embedded Webcam, power supply.	1
ETV 300 000	DVB-S/S2 to IPTV transmodulator (TS or IP)	1
EMD 038 220	Field strength meter, TVB-T/T2/C/C2/S/S2 (HD Ranger Lite) BNC input, protective cover	1
ETV 102 000	Satellite antenna kit, with tripod, and RG58 coaxial connecting lead, 10m, 75 Ω BNC , compass.	1
ETR 370 B	Package "Image and Video transportation via TCP/IP"	optional



Highlights

- Digital signage can also be transformed into into a single wall of screens.
- The Did@VideoWall solution offers a simplified way to build a fascinating, creative and/or complex video wall in the desired format

Studied topics

- Installation and configuration of a Raspbian distribution
- Network
 - IP configuration
 - Implementation of VLAN levels 1 and 2
 - IGMP Snooping and Mirroring configuration
- Broadcast / Receive streams
 - Point to point type (HTTP, RTSP)
 - Multicast (IGMP, UDP)
- Synthesizing a video stream to create a video wall



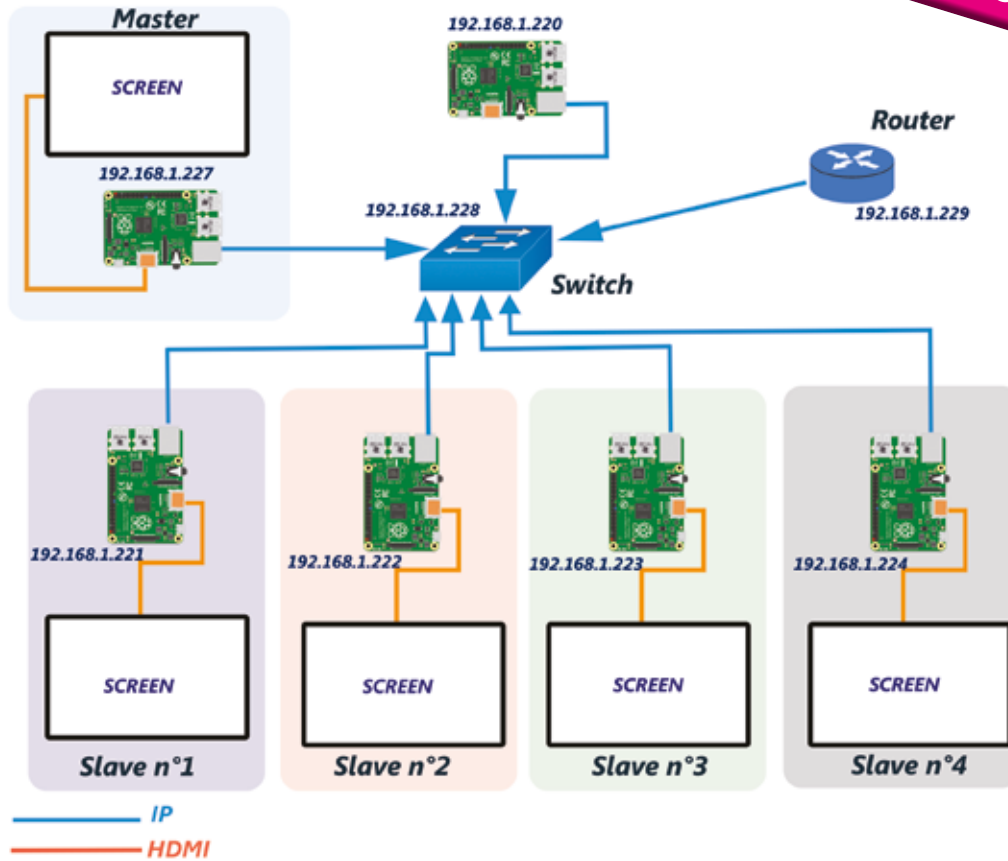
Did@VideoWall is autonomous, it is totally isolated from the Internet network; this feature has four major advantages :

- Any false manipulation made by the students will not cause any damage on the school network
- The network cabling is done via a mixing panel in order to protect the mechanical parts (connectors) of the active parts (server, switch)
- A simplified reset server facilitates full system recovery
- A «Mirroring» port allows the visualization of the entire network exchanges



> Schematic diagram

New



Experiments

	Level 1	Level 2	Level 3
Network	<ul style="list-style-type: none"> Cabling IP network Study of the DHCP protocol Analysis via Wireshark 	<ul style="list-style-type: none"> IP configuration of Raspberry SSH connection Switch configuration Port Mirroring configuration 	<ul style="list-style-type: none"> Router configuration SSH Pass installation Wifi card configuration
Video Protocol	<ul style="list-style-type: none"> Playing a video stream Broadcasting a video stream 	<ul style="list-style-type: none"> Playing a video stream Broadcasting a video stream Wireshark analysis - Multicast protocol Creation of a web page with 4 video streams 	<ul style="list-style-type: none"> Playing a video stream Broadcasting a video stream
Video wall	<ul style="list-style-type: none"> Software configuration Modification of a configuration file 	<ul style="list-style-type: none"> Software Configuration 	<ul style="list-style-type: none"> Dynamic Display Project /Automation of video streams

Package ETV 200 B : Did@VideoWall

Reference	Description	Quantity
ETV 200 000	<ul style="list-style-type: none"> - 10" computer cabinet with glass door with: - 1 Shelf with 1 8-port Cisco switch, 1 Raspberry PI3 with its display (Master) , 1 basic recovery server - 3 mixing panels with RJ-45 and USB crossings - 2 Shelves to support Raspberry PI 3 (Slave) with 2 16-Go SD cards, DB_Boot programmed - 1 block with 4 sockets - 1 1-unit black face 	1
ETV 200 400	Raspberry PI 3 with firmware update	4
ETR 340 200	Set of accessories: 10 UTP cords, 100 Ohms, cat. 6, length 50 cm,	1
ETV 200 100	5 Screens (about 19,5») with HDMI output, with HDMI leads. 4 of them are mounted on the screen-support	1
ETV 200 300	Keyboard + mouse	5
ETV 200 020	Manuel of experiments.	1



Microwaves study (in free propagation)

Highlights

- Study of microwaves in free propagation
- Possible comparison with optical phenomena

Studied topics

- Microwave linear propagation
- Reflection, absorption and transmission
- Polarisation
- Refraction
- Diffraction and interference
- Standing waves



Technical characteristics - PED 022 150

Transmitter	Gunn diode located in a resonating cavity (frequency: 11.4 GHz and 9.5 GHz).
Receivir	Hyperfrequency reception diode, the diode also located inside resonating cavity. Rotating assembly for the polarization study.
Electronic box	Power supply for the transmission and reception diodes. Amplification of the reception diode signal Direct reading of the measure with the digital display.
Detection antenna	Hyperfrequency reception diode. The stand is specially designed in order to be located outside of the field
Accessories	Bench with goniometric coupling, adjustable single slot, adustable multiple slot, gratings, absorbing wooden screen, reflective metallic screen, paraffin prism.

Experiments

EXP 1	Microwaves linear propagation
EXP 2	Reflection, absorption and transmission
EXP 3	Polarisation
EXP 4	Refraction
EXP 5	Diffraction and interference
EXP 6	Standing waves

PED 022 150 : Study of microwaves

Reference	Description	Quantity
PED 022 160	Transmitter, Receptor, Detection antenna, electronic box	1
PED 022 161	Mechanical set made of bench with goniometric coupling, adjustable single slot, adustable multiple slot, gratings, absorbing wooden screen, reflective metallic screen, paraffin prism.	1



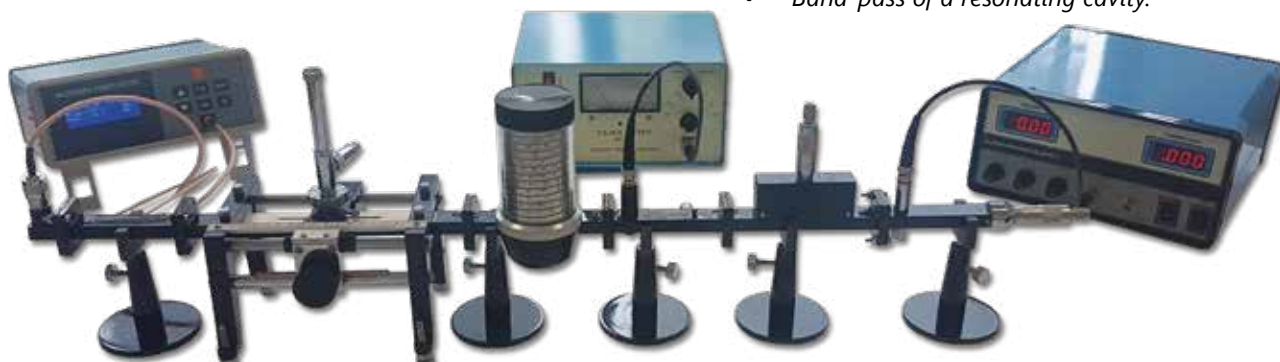
Hyperfrequency waves unit

Highlights

- Complete package, supplied in carrying case.
- SWR Meter
- Power meter

Studied topics

- Gunn oscillator.
- Detector and Modulator.
- Propagation modes, wavelength and phase speed inside wave guide
- Band-pass of a resonating cavity.



Experiments - Hyperfrequency waves in wave guide

EXP 1	To study V-1 characteristics of Gunn Diode
EXP 2	To determine the frequency & wavelength in a rectangular wave-guide working on TE ₁₀ mode.
EXP 3	To determine the Standing Wave-Ratio and Reflection Coefficient
EXP 4	To measure an unknown Impedance with Smith chart
EXP 5	To study the following characteristic of Gunn Diode : - Output power and frequency as a function of Voltage - Square wave modulation through PIN diode
EXP 6	To measure the polar pattern and the gain of a wave-guide horn Antenna
EXP 7	Study the function of multi-hole directional coupler by measuring the following parameters : - Main-line and Auxiliary-line VSWR - Coupling factor and directivity
EXP 8	Study of Magic Tee
EXP 9	Study of Circulator/Isolator
EXP 10	Study of Attenuator (Fixed and Variable type)

PED 022 B : Hyperfrequency waves in wave guide

Reference	Description	Quantity
PED 022 000	Hyperfrequency unit with Gunn oscillator, slotted lin.	1
	Modulator fine diode, frequency meter.	1
	Varying damper, wave guide, adapted load, directive coupler, hybrid T.	1
	Coaxial/transmitter guide, horn antenna, reflector with support, guide support, power supply	1
	SWR meter	1
	Power meter	1

SWR meter

Technical characteristics : SWR meter

Function	Measure of the Stationary waves ratio.
Input frequency	1000 Hz, compatible with the hyperfrequency modulator unit
Operating range	70 dB with 10 dB steps



Power meter

Technical characteristics : Power meter

Function	Power measuring device by thermocouple.
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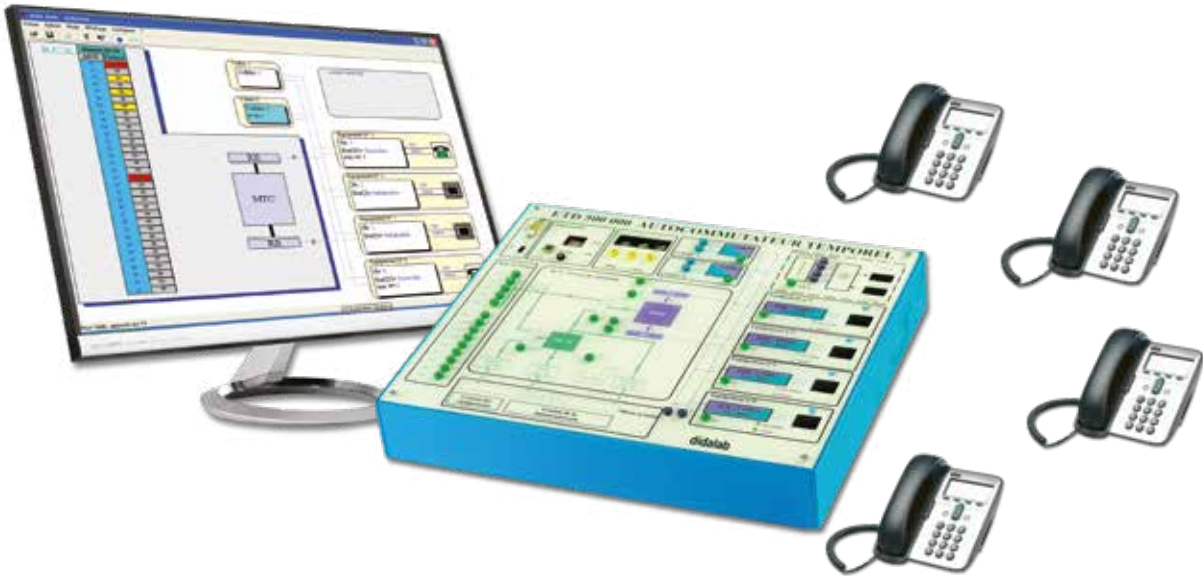
Time division switching unit

Highlights

- Experimental study of time division switching central office (3 Mbit/s PCM)
- Control software operating with Windows®.
- Test points enable the display all fundamental signals.

Studied topics

- Speech coding, 64 kbits/s.
- Study of a time division switching unit
- Telephone connections between subscribers in local mode.
- Base band digital transmission.
- Control of semaphore channel.



Technical characteristics - ETD 500 000 : Time division switching unit

Functions	Allocation to a subscriber 's handset number, Allocation of a tax level to a subscriber (fixed price, depending on duration, free N°,...).	
Visualization (with connectors or LED)	2 Mbits clock. Register counter Control for the register multiplexer	Write pip in CTM. Write pip into the outgoing register PCM input / PCM output
C/C++ compiler	New services (automatic recall, double call management ...).	
Inputs / Outputs	2 Audio CODEC for signal injection/ reception 4 RJ11 sockets to connect the analog telephones	
Power supply	External power supply, 24 Vdc.	

Experiments - Introduction to time division switch

EXP 1	Speech coding, 64 kbits/s.
EXP 2	Study of a time division switch with downstream control
EXP 3	Telephone connections between subscribers in local mode.
EXP 4	Digital transmissions in base band and semaphore channel signals

Package ETD 500 B : Introduction to time division switch

Reference	Description	Quantity
ETD 500 000	Time division switching module in PVC case, 4 handsets	1
ETD 500 100	Control software operating with Windows and C et C++ compiler.	1
ETD 500 010	Technical guide	1
ETD 501 000	Set of accessories : 4 telephones with their RJ11 cables, 1 RJ9 cable	1
ETD 500 030	Reference manual : Principles of time division switching.	1
ETD 500 040	Manual of Experiments.	1
EGD 000 003	Serial cord, DB9/DB9 F/F X modem.	1
EGD 000 008	12 Vdc/4,2 A power supply, with jack connector.	1
PMM 061 600	Set of 10 2-mm stackable patching cords, red, 50 cm	1
PEM 010 021	BNC lead, 1 m, 50 Ohms.	3

Networks and VDI convergence

> Why studying VDI ?	140
> Discovery of network communication and Voice Data Image convergence, Data, Image, VoD, Voice	142
> Did@VDI package, Introduction to VDI	144
> Did@VDI package, Advanced training to VDI	146
> Did@VDI package, Expert training to VDI	148
> Some references	150





Why studying VDI ?

VDI is now used «everywhere» :

At home, in business companies, in schools, universities, in local authorities, hospitals, malls ...

VDI is now used «for everything» :

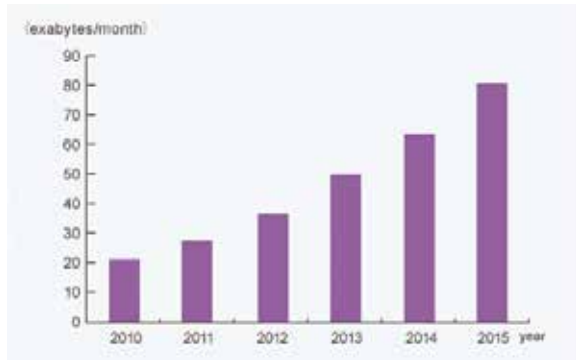
Web, IPBX, VoIP, Video conference, Home automation, IPTV, Triple play, VOD, Streaming, video surveillance.

VDI has experienced such a sustained growth over the last years that we cannot even yet foresee its significant impact in new areas.



Some examples of the market growth :

IP INTERNET TRAFFIC



Total Internet traffic has experienced dramatic growth in the past two decades. More than 20 years ago, in 1992, global Internet networks carried approximately 100 GB of traffic per day. Ten years later, in 2002, global Internet traffic amounted to 100 gigabytes per second (GBps). In 2014, global Internet traffic reached 16,144 GB per second. (Cisco Source).

The current Cisco Visual Networking Index (VNI) forecast projects global IP traffic to nearly triple from 2014 to 2019. Overall IP traffic is expected to grow to 168 exabytes per month by 2019, up from 59.9 exabytes per month in 2014, a CAGR of 23 percent.

VOIP VOICE (TELEPHONY)



VoIP is an important part of VDI. (V of VDI).

Telephony is a non insignificant part of a company operating costs.

The opposite graph shows the economic importance of IP PBX (IP Private Branch Exchange).

IP PBX economic weight has been continuously increasing while "classic" PBX has dropped rather steeply.

DYNAMIC DISPLAY



Dynamic display is a small part of VDI but it is very representative of our modern world.

This graph shows the evolution of dynamic display in places we visit all the time: it concerns:

- Retail, Hospitality, Entertainment, Bank, Transport, Education, Health, Outdoor, Corporate.

It is used to communicate, revitalize, welcome, inform and stall people ...

A study shows that a dynamic display in a retail shop increase sales by 24%.



The training needs in Ethernet Networks, telephony and images and videos broadcasting are more and more important.

To address this challenge, Didalab Electrical Engineering department has developed a global laboratory to train in these areas.

We named this project Di@VDI, Did@VDI+ and Di@VDI++ ; it comes in 3 versions :

- ETR 300 STI2D, especially conceived for the levels III and IV (ISCED 2011)
- ETR 300 B, conceived to give technicians and engineers (levels V to VII) a global knowledge in Networks and Telecommunications.
- ETR 400 B, conceived to train experts in Networks, VDI convergence and Telecommunications, for the levels V to VII (ISCED 2011).

In the following pages, you'll see Didalab' whole proposition.

All the suggested solutions are progressive. We put all our know-how to conceive these laboratories and they have the following advantages :

- Totally stand-alone, they don't need to be connected to the Internet network or the university network and thus, there is no risk to disrupt the university's network.
- All accesses are given to the students (configuration of the switches, routers, computers). To secure the proper functioning of the laboratories, all the configuration images (for each of the network organs) are available in the central server. The time saving is substantial for the teachers as they don't have to configure again the equipment after the Practical Works.

Look at the following pages or through our website (www.didalab.fr) to see all the possibilities of Did@VDI, Did@VDI+, Did@VDI++ . In our website, you can also watch some videos.





Discovery of network communication and Voice Data Image convergence, Data, Image VoD, Voice

Highlights

- Totally off-line functioning.
- Doesn't disrupt the school's network.
- Secure restarting when handling errors.
- Active organs protected with mixing panels.
- Progressive system, from de 1 to 8 working stations.
- Training in Networks.
- Training in VDI convergence.

Studied topics

- Client Server Architecture.
- TCP/IP frames analysis.
- Voice Services, SIP and RTP protocols.
- Data Services, FTP and HTTP protocols.
- Images Services, RTSP, IGMP, RTP, UDP protocols.
- Videoconference.
- QOS

NETWORKS AND VDI CONVERGENCE



Did@VDI laboratory's Server

The server is the system's nerve centre. It is inside the ETR340B/ETR440B cabinet (different content according to the cabinet version). Combined with a router and a switch, it independently provides all the services of the cabinet: 3 films for the VOD, registered channels for broadcasting, all the parameters for the network's organs (PC, STB, videophone, router and switch).

With a keypad with display, we can activate and deactivate all the services.

Practical works, popularizer pedagogical videos and multiple choice items are provided.



ETR 350 B, Videophone : with a LCD colour screen, video camera. It is used to communicate via videoconference between 2 videophones or with a PC via the network. It has got 6 SIP accounts. It includes an Internet browser and it is a concrete representation of today's and tomorrow's telephony.



ETR 360 B, Student PC, supplied with Linux and Open Office, ready to use. A lot of freewares: Nmap, Client FTP, FileZilla, Iceweasel, Ekiga, Ngrep, VLC, Wireshark, these freewares, from registered trademarks, are used to send requests, analyse SIP frames, communicate with a phone via IP ... It is supplied with a full HD LCD screen, HDMI input and embedded Webcam, keyboard, mouse, headphone.



ETR 370 B, STB, Image transport via IP, it includes a professional STB and its remote control, a HD television set with embedded webcam. This set allows to illustrate the broadcasting of television channels and VOD «Video On Demand» existing under the shape of boxes in the private individuals homes or in the public places of broadcasting «hotels, malls ...».



ETR 450 000, Student server*, the student server, completely accessible to the student (SSH) to allow a free and autonomous development of the VDI.

Software functions : Linux working system with a set of preconfigured free programs : SSH Server, FTP server, HTTP server, IPBX server, Video-surveillance server, IPTV Server ...

* For ETR 300 B and ETR 400 LRT packages

Optional Extra



ETR310B, Internet Radio, Complete set to study software radio including :

- Logitech UE Smart Radio
- Media Logitech Server
- UTP cable, 5m



EFO 108 000, HD IP Camera, HD IP camera, new generation, up-to-date. It allows video streaming towards mobile phones and videophones. Embedded PoE, WIFI, microphone. Video compression format: H,264,MJPEG,JPEG SIP account.



Did@VDI Package, self-operating laboratory (1 to 4 workstations), Introduction to VDI convergence and networks"

Highlights

- Totally off-line functioning.
- Doesn't disrupt the school's network.
- Secure restarting when handling errors.
- Active organs protected with mixing panels.
- Progressive system
- Introduction to Networks
- Introduction to VDI convergence.

Studied topics

- Client Server Architecture.
- Architecture Réseau
- TCP/IP frames analysis.
- Voice Services, SIP and RTP protocols.
- Data Services, FTP and HTTP protocols.
- Images Services, RTSP, IGMP, RTP, UDP protocols.
- Videoconference.
- Videosurveillance



NETWORKS AND VDI CONVERGENCE

Practical works

Designations, (2011 ISCED level)	TP	Designations, (2011 ISCED level)	TP
ETR 340 040 : Discovery of VDI convergence, (III, IV)	28 h	ETR 450 020 : Discovery of Linux Operating System (Debian), (III IV)	8 h
PW1 FTP Protocol	4 h	PW1 Linux discovery	2 h
PW2 HTTP Protocol	4 h	PW2 Files	2 h
PW3 RTSP and IGMP video service protocols	4 h	PW3 Process	2 h
PW4 Voice protocol, phone functions	4 h	PW4 Scripts	2 h
PW5 Voice, SIP and RTP Protocols	4 h		
PW6 ARP protocol	4 h		
PW7 DHCP protocol	4 h		
ETR 400 050 : Discovery of Network 's architecture (III, IV)	8 h	ETR 450 030 : Discovery of C language on client PC (III, IV)	32 h
PW1 Switch	4 h	PW1 GCC compiler	8 h
PW2 Router	4 h	PW2 Data type	4 h
		PW3 Inputs/Outputs	4 h
		PW4 Tables/Structures	4 h
		PW5 Network programming (sockets)	12 h
		Total :	76 h



Introduction to Networks VDI (Levels III, IV **)

> Example of Configuration : 2 station block (4 student)



** Training level according to CITE 2011 (UNESCO)

> Watch our videos on : www.didalab.fr



Main presentation



Serveur & networks organs



Network



EXP1 : ICMP and FTP protocole



EXP1 : SIP and RTP protocole

Pack ETR 300 STI2D : «Did@VDI, Self-Operating laboratory, Introduction to the VDI convergence and networks»

Reference	Description	Quantity
ETR 340 B	Pack for Did@VDI+ self-operating laboratory, including : - 4 workstations + STB pre-fitted cabinet, 12Units, including - 1 shelf with one 8-port switch, one 4 -port router, Wifi bridge, UTP leads, - 1 mixing panel, 1 sliding drawer for telephone, remote control & leads storage, - 1 connection block with 4+6 sockets & differential circuit-breaker, On/off. - Did@VDI network emulator, SIP, HTTP, FTP server, leads, UTP, IHM drop-down menu. - Set of accessories: 10 UTP leads, 100 Ohms, 6th class, 50 cm long. - Set of pedagogical manuals.	1
ETR 350 B	Basic pack "VOICE TELEPHONY WORKBENCH" including : - 1 telephone / videophone set with IP & fullgraphics color display (SIP protocole), - Power Supply & UTP leads.	1
ETR 360 B	Student pack "Data transfer" including : - 1 mini PC with Linux, Power Supply, Audio / peripheral control programs provided - 1 21" screen, loud-speakers, embedded Webcam, 1 set of leads - 1 audio-ponic microphone & headphone.	1
ETR 370 B	"IMAGE VIDEO TRANSPORT via TCP/IP" Pack, including : - 1 Set-top Box adapter - HTTP/FTP server interface to HDMI, remote control - 1 Qwerty USB keyboard, UTP & HDMI leads	1

(We suggest the composition of the package, for special configuration, please ask)

NETWORKS AND VDI CONVERGENCE



Advanced training to Networks & VDI (Levels III, IV, V **)

> Example of Configuration : 4 station block (8 students)



** Training level according to CITE 2011 (UNESCO)

Pack ETR 300 B : «Did@VDI+, Self-operating laboratory, development of the VDI convergence & network architecture»

Reference	Description	Quantity
ETR 340 B+	"ISP" Pack for Did@VDI+ self-operating laboratory, including : <ul style="list-style-type: none"> - 4 workstations + STB pre-fitted cabinet, - 12Units, including 1 shelf with one 8-port switch, - 1 Cisco 4 – port router, Wifi bridge, - 17 UTP leads, - 1 mixing panel, - 1 sliding drawer for telephone, remote control & leads storage, - 1 connection block with 4+6 sockets & differential circuit-breaker, On/off. - Did@VDI+ network emulator, SIP, HTTP, FTP server, leads, UTP, IHM drop-down menu. - 1 dual student server with connection cables. - Set of accessories: 10 UTP leads, 100 Ohms, 6th class, 50 cm long. - Set of pedagogical manuals. 	1
ETR 370 B	"IMAGE VIDEO TRANSPORT via TCP/IP" Pack, including : <ul style="list-style-type: none"> - 1Set-top Box adapter, HTTP/FTP server interface to HDMI, remote control, - 1 Qwerty USB keyboard, - TP & HDMI leads. 	1
ETR 460 B	Student pack "VDI convergence development" including : <ul style="list-style-type: none"> - 1 mini PC with Linux, DualCore Atom 1,8G, 6 USB, - 1 LAN, HD 320 GB, Ram 2 GB HDR3, Power Supply, Audio / peripheral control programs provided, - 1 22" screen, loud-speakers, embedded Webcam, 1 set of leads , - 1 audio-ponic microphone & headphone. 	1 to 4
ETR 350 B	Basic pack "VOICE TELEPHONY WORKBENCH" including : <ul style="list-style-type: none"> - 1 telephone / videophone set with IP & fullgraphics color display (SIP protocole), - Power Supply & UTP leads. 	1 to 4

(Proposition de composition, configuration spéciale nous consulter)

NETWORKS AND VDI CONVERGENCE



Did@VDI++ Package, self-operating laboratory (1 to 8 workstations), Development of VDI convergence & Network Architecture"

Highlights

- Complete workstations for development (server & network's organs) directly accessible to the students.
- Programs already installed in student PCs.
- Up-to-date technology.
- Stand alone network (off-line), doesn't disrupt the university's network.

Studied topics

- A lot of practical works in the large area of the creation of services in network communication:
- Voice,
- Data,
- Images & videos.
- Networks architecture.



Practical works

Designations, (2011 ISCED level) PWs	TP	Désignations (Niveau CITE 2011)	TP
ETR 340 040 : Discovery of VDI convergence, (III, IV)	28 h	ETR400060 : Domain controller (DNS, mail server), (VI, VII)	24 h
PW1 FTP Protocol	4 h	PW1 Domain server	8 h
PW2 HTTP Protocol	4 h	PW2 DNS Server, HTTP protocol	8 h
PW3 RTSP and IGMP video service protocols	4 h	PW3 Mail server	8 h
PW4 Voice protocol, phone functions	4 h		
PW5 Voice, SIP and RTP Protocols	4 h		
PW6 ARP protocol	4 h		
PW7 DHCP protocol	4 h		
ETR 400 020 : VoIP settings via Digium GUI, (V, VI)	32 h	ETR 400 070 : VoIP server writing in command line, (VI, VII)	40 h
PW1 IPBX VoIP calls, Trunk SIP voice interconnection	16 h	PW1 Asterisk configuration: SIP account management, calls, voicemail	12 h
PW2 IPBX Phone functions	8 h	PW2 Trunk configuration: remote call Asterisk inter-server.	8 h
PW 3 IPBX voice mail and voice menus	8 h	PW3 Complete scenario of VoIP server.	12 h
		PW4 Implementation of a control web interface	8 h
ETR 400 030 : Imaging & Video, (V, VI)	24 h	ETR 400 080 : Streaming server & VOD, (VI, VII)	24 h
PW1 IPTV ,Web Video service and clients Set Top Boxes	8 h	PW1 Handling VLC software	4 h
PW2 IPTV, DVR and customer service Media center	8 h	PW2 Encoding, distribution & streaming reception (GUI)	4 h
PW3 CCTV Service	8 h	PW3 Encoding, distribution & streaming reception (commande line)	4 h
		PW4 Video on Demand Service	4 h
		PW5 Streaming & VOD Integration in PHP server.	8 h
ETR 400 040 : Web development (on student server) , (V, VI)	40 h	ETR 400 020 : Linux operating System (Debian) , (V, VI)	8 h
PW1 HTML	8 h	PW1 Linux discovery	2 h
PW2 PHP	8 h	PW2 Files	2 h
PW3 Creating SQL Databases/Tables, import & export rights management	8 h	PW3 Process	2 h
PW4 Implementation of a Website (HTML/PHP & SQL)	16 h	PW4 Scripts	2 h
ETR 400 050 : Network architectures, (V, VI)	28 h	ETR 400 030 : C language on client PC, (V, VI)	32 h
PW1 Switch discovery	4 h	PW1 GCC compiler	8 h
PW2 VLANs (1 & 2 level)	8 h	PW2 Data type	4 h
PW3 Router discovery	4 h	PW3 Inputs/Outputs	4 h
PW4 Static routing	4 h	PW4 Tables/Structures	4 h
PW5 Dynamic Routing (RIP)	8 h	PW5 Network programming (sockets)	12 h
		Total :	280h



Networks & VDI Expert (Levels III, IV, V, VI, VII **)

> Example of Configuration : 8 station laboratory (16 students)



** Training level according to CITE 2011 (UNESCO)

Pack ETR 400 LRT : Did@VDI++, Self-operating laboratory (from 1 to 8 workstations), development of the VDI Convergence & Network Architecture

Reference	Description	Quantity
ETR 440 B	"ISP" Pack for Did@VDI++ self-operating laboratory, including : <ul style="list-style-type: none"> - 8 workstations + STB pre-fitted cabinet, 12Units, including - 1 shelf with one 8-port switch, - 1 Cisco 4 -port router, Wifi bridge, 17 UTP leads, - 1 mixing panel, - 1 sliding drawer for telephone, remote control & leads storage, - 1 connection block with 4+6 sockets & differential circuit-breaker, On/off. - Did@VDI+ network emulator, SIP, HTTP, FTP server, leads, UTP, IHM drop-down menu. - 2 Telephone/ videophone set, IP & color graphic screen, Power Supply & UTP leads, 5m & 2m. - Set of accessories: 10 UTP leads, 100 Ohms, 6th class, 50 cm long. - Set of pedagogical manuals. 	1
ETR 370 B	IMAGE VIDEO TRANSPORT via TCP/IP" Pack, including : <ul style="list-style-type: none"> - 1Set-top Box adapter, HTTP/FTP server interface to HDMI, remote control, 1 Qwerty USB keyboard, - UTP & HDMI leads. 	1
ETR 450 B	Did@VDI++ & network architecture development workstation, including : <ul style="list-style-type: none"> - Data processing cabinet, 6 Units, table-top, equipped of 1 shelf with 4-LAN port router, 1 WAN, Wifi, 8-port Cisco Switch, UTP leads, 1 mixing panel, 1 sliding storage drawer, 1 connection block with 4+6 sockets & differential circuit-breaker, On/Off. - Student server with connection leads: UTP, USB & DVI/HDMI. - Set Top Box with Power Supply, remote control, leads, 1 Qwerty keyboard 	1 to 8
ETR 460 B	Student pack "VDI convergence development" including : <ul style="list-style-type: none"> - 1 mini PC with Linux, DualCore Atom 1,8G, 6 USB, 1 LAN, HD 320 GB, Ram 2 GB HDR3, Power Supply, Audio / peripheral control programs provided, - 1 22" screen, loud-speakers, embedded Webcam, - 1 set of leads , - 1 audio-ponic microphone & headphone. 	1 to 8
ETR 350 B	Basic pack "VOICE TELEPHONY WORKBENCH" including : <ul style="list-style-type: none"> - 1 telephone / videophone set with IP & fullgraphics color display (SIP protocole), - Power Supply & UTP leads 	1 to 8

NETWORKS AND VDI CONVERGENCE



Some references :



Lycée Diderot - Paris (France)
Formation BTS SN



IUT GEII (Polytechnics)
Cachan (France)
Bachelor degree in Networks
and Telecommunication



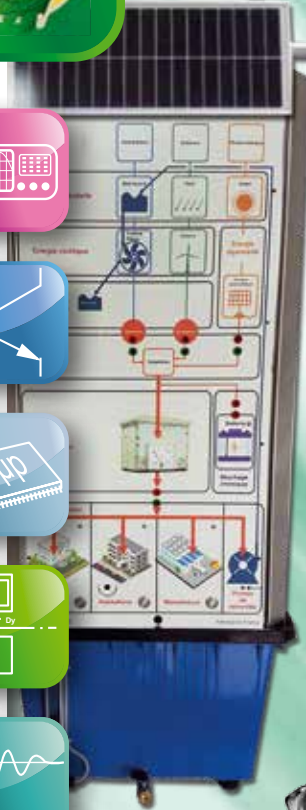
ESATIC - Abidjan – Ivory Coast
Telecommunication Engineer
school



Army Signal Corps
Dakar - Senegal
Vocational Training Center

Green energies

> <u>Hydrelec 3E : 3-energy power plant</u>	152
> <u>Hydrelec 300 : 250-W Hydroelectric power plant</u>	154





Hydrelec 3E : 3-energy Power plant

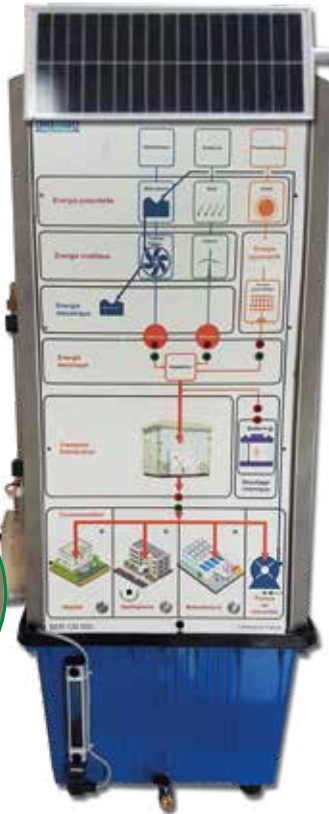
Highlights

- Contextualization: energy autonomy: «The Sun, Water and Wind at the service of the island of El Hierro»
- Implementation of a complete chain, from production (water, wind, sun) to consumption (hospital, home, factory) through energy distribution.
- Energy management according to production (storage, load shedding)

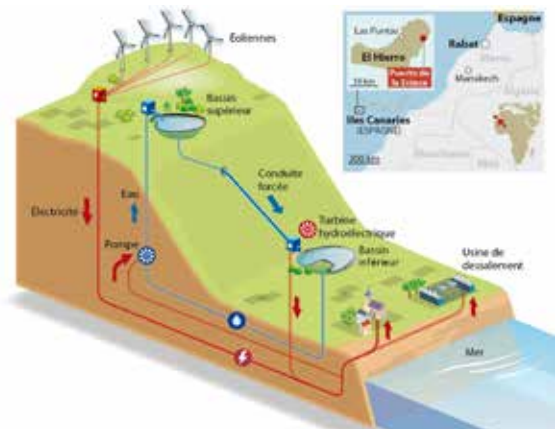
Studied topics

- Energy : Electricity production
 - Hydraulic energy (water fall)
 - Fluid energy (wind)
 - Solar energy (photovoltaic)
- Electricity storage
 - Potential energy (stored water)
 - Chemical (battery)
- Material and structures : study of the turbine
 - Choice of a material according to the constraints
- Prototyping (3-D printing)
 - Information...
- Acquire : pressure and flow meters

SmartGrid Technologies



Contextualization : energy autonomy : «The Sun, Water and Wind at the service of the island of El Hierro»



GREEN ENERGIES

Technical description :

Operating part :

- Upstream tank (potential energy)
- Forced water pipeline (30-m waterfall)
- Flow and pressure transmitters
- Pelton turbin with one injector
- DC generator, 12V, with voltage controller
- Upwelling pup, with a 15-l/min flowrate
- 90-W marine wind-turbine,
- 20-W solar pannel

Study of the turbine

- Conception (solidworks)
- Choice of a material according to the constraints
- Prototyping (3-D printing)



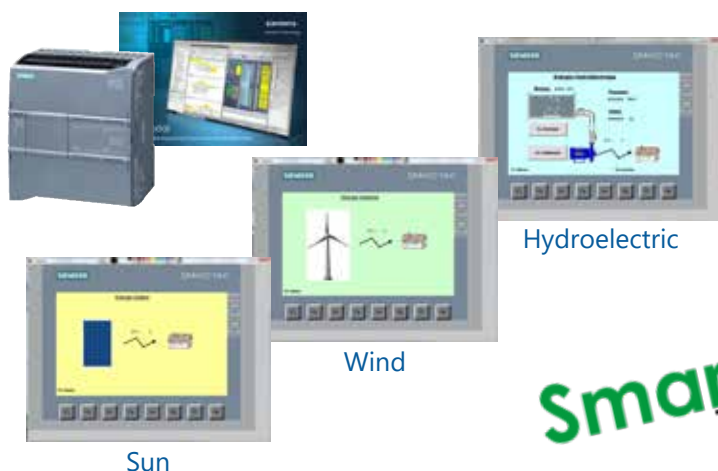
Optional extra : PLC and HMI

Control part



- S7 1200 Programmable Logic Controller, data acquisition
- Operator terminal, KTP 700, 7"graphic colour touchscreen
- Measurement and display of :
 - the electric power, supplied by the generator, the wind turbine and the solar panel
 - the pressure
 - the flow in the turbine circuit
 - the level of the water tank
 - the speed of the generator

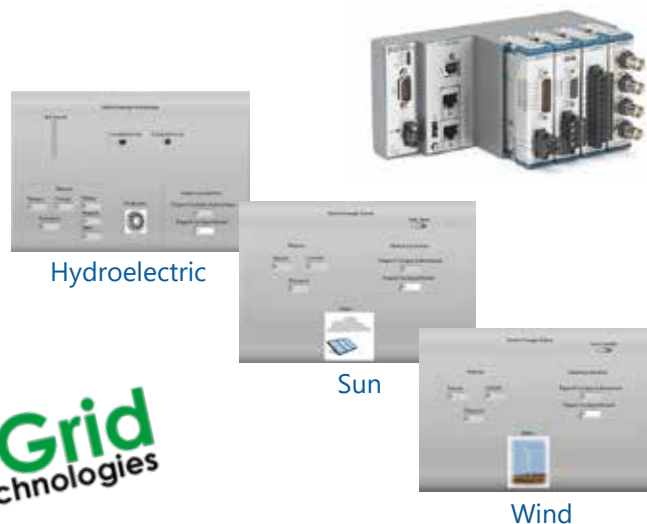
Study of the 3 energy sources in isolated mode



Control part :



- Compact RIO platform
- LabVIEW control
- Measurement and display of :
 - the electric power, supplied by the generator, the wind turbine and the solar panel
 - the pressure
 - the flow in the turbine circuit
 - the level of the water tank
 - the speed of the generator



SmartGrid Technologies

SER 130 S7 : Hydrelec 3E : Autonomous 3-energy Power plant

Reference	Description	Quantity
SER 130 000	Metallic base frame, upper and lower tanks, Pelton turbine Pressure flow transmitters Voltage regulation with 3 inputs (Pelton, Photovoltaic, Wind)	1
SER 130 040	Manual of experiments	1
SER 130 800	Optional extra : 30-W solar panel with its insulator (light spot)	1
SER 130 900	optional extra : 90-W wind turbine, with its fan	1

Siemens version : RS11 200 B : Basic package « Control unit with Siemens PLC »

Reference	Description	Quantity
RS11 200 000	API S7 1200 package, with, KTP700 HMI for Smartgrid SER 130	1
	Extension modules : 1 module 1 analogue Input, 1 module 4 analogue Inputs, 1 module 8 analogue Inputs and 1 module 4 analogue Outputs	
	The set is put in the SER 130 electrical cabinet, supplied with connecting accessories	
	Manual of experiments with application programs	

National Instrument version : RNI1 200 B : Basic package «Control unit Compact RIO»

Reference	Description	Quantity
RNI 783 830	4-slot frame, 667 MHz dual-core Cortex-A9 CPU, A-7 FPGA, 256 MB DDR3	1
RNI 781 093	NI PS-15 power supply, 24 VDC, 5A, 10-120/200-240 VAC Input	1
RNI 781 030	NI 9375 On/Off Inputs/Outputs module , type C, 16 channels DO, SUBD 37 connector with 50-cm cord	1
RNI 779 357	NI 9205 Analogue Input module, 16/32 channels,16 bits, 250 kS/s, +10V, SUBD 37 connector with 50-cm cord	1
RNI 779 012	NI 9263 Analogue Output module, 4 channels, +10V, 16 bits, 100 kS/s/channel, connection with screw terminal	1
	Set mounted in SER 130 electrical cabinet, supplied with connection accessories	



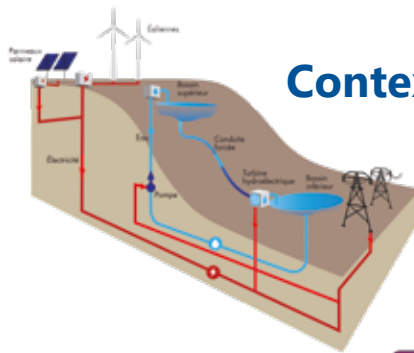
Hydrelec 300 : 250-W Hydroelectric power plant

Highlights

- This system shows the contextualization of a Pumped Storage Power plants (PSP), identical to dams situated in "Grand'Maison » in Isère and "Lac noir » in Vosges (France).
- It allows the students to apprehend the installation, commissioning fo a frequency variator, to master the control part, with approaches similar to real industrial world.

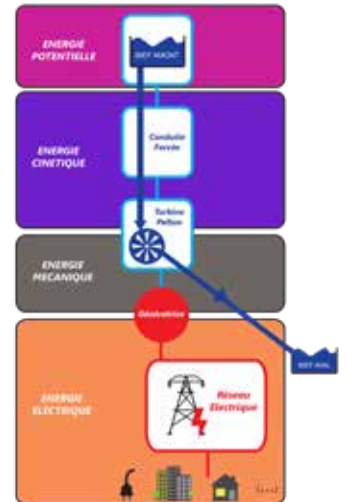
Studied topics

- Various processes for energy transformation
- Converting hydraulic energy to electric energy
- Electric reversibility, connected to the network
- Energy autonomy in islands
- Electrical protection of workers in a power plant
- Energy sizing
- Energy quality (harmonics) and electric performance (line sizing)
- Effects and influence of a polluting load
- Control and regulation
- Remote control management



Context diagram

Energy chain



GREEN ENERGIES

Control part

- Stainless steel frame, weight : about 195 kg for 70 litres of water. Graduated tank for the water impoundment.
- Hydraulic pump : It allows the emulation of a 45-m waterfall.
- Turbine flow : Nominal flow rate of 85 litres/min.

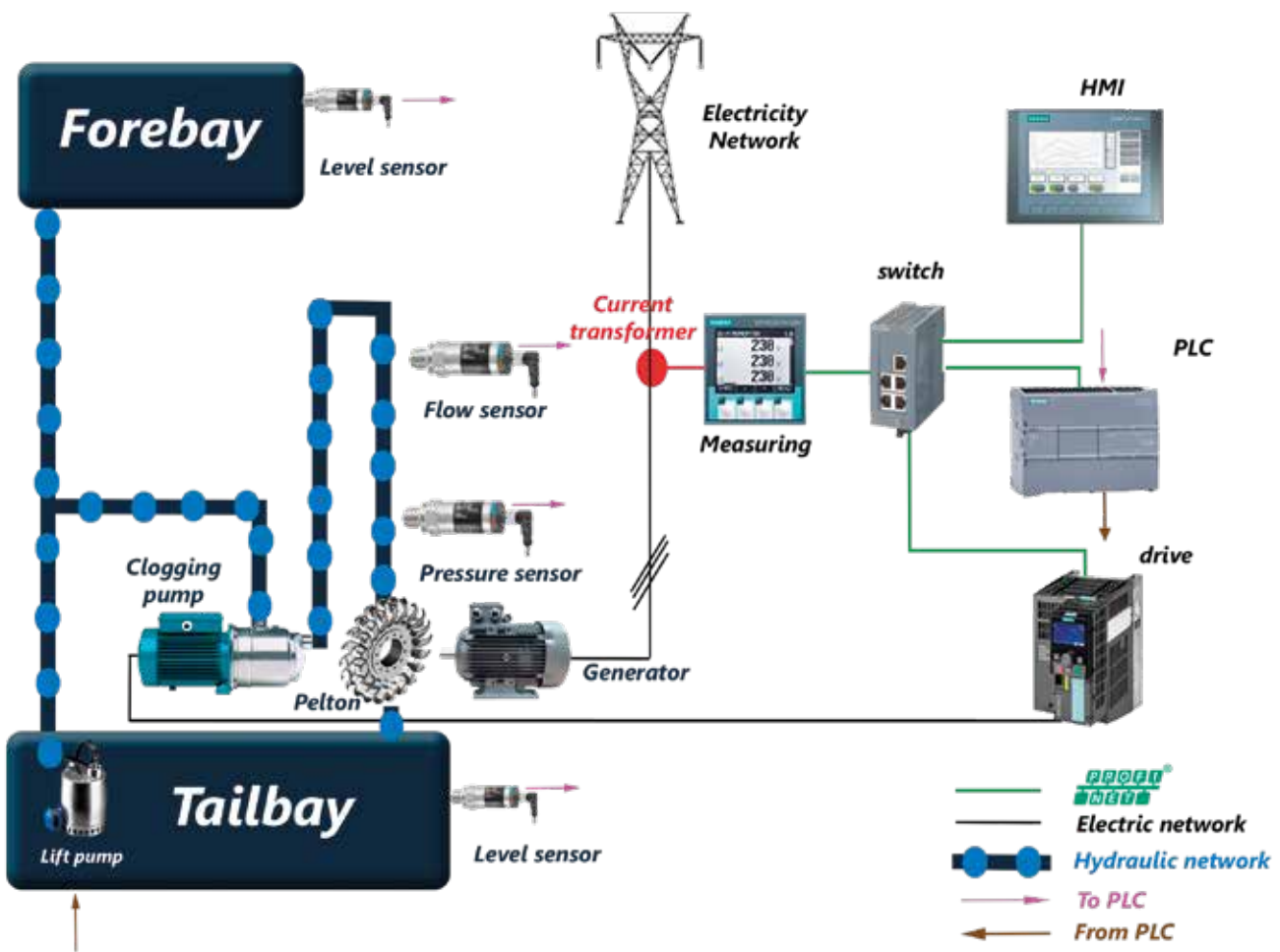
Main descriptions

- Pelton turbine with one injector. The Pelton turbin supplied with our system is manufactured with 3-D printers.
- Analogue flow and pressure transmitters
- 400V- asynchronous generator

Control and measuring part

- Siemens PLC, range S7-1200 (14 inputs/10 outputs) with WEB Server and HMI, 7" graphic colour screen. Programming software are supplied.
- Frequency controlloer, 1,1 kW G120 to connect and set up
- Measuring module: Energy Meter for the electric production of the generator

» **Schematic diagram**



SER 430 B : Hydroelectric power plant «Hydroelectric 300»

Reference	Description	Quantity
SER 430 000	<p>Operating part</p> <p>Stainless steel frame, weight : about 195 kg for 70 litres of water. Graduated tank for the water poundment.</p> <ul style="list-style-type: none"> - Hydraulic pump : It allows the emulation of a 45-m waterfall. - Turbine flow : Nominal flow rate of 85 litres/min. - Safety measures : Emergency stop directly connected to the control chain of the coupling system which allows quick disconnection from the mains and stopping of the hydraulic pump. - Pelton turbine with one injector supplied. - Analogue flow and pressure transmitters - 400V- asynchronous generator - Loading current : about 1.2 A - Siemens PLC, range S7-1200 (14 inputs/10 outputs) with WEB Server and HMI, 7" graphic colour screen - Programming software are supplied. - Frequency controller, 1,1 kW G120 to connect and set up - Measuring module: Energy Meter for the electric production of the generator - Implementation: Connection of the measuring box (current transmitter and student's protection) 	1

SER 430 C : Hydroelectric power plant «Hydroelectric 300» with measuring box

Reference	Description	Quantity
SER 430 B	Centrale Hydrelec 300	1
SER 431 000	<p>Additional connection pannel</p> <p>Measuring box</p> <p>Circuit breaker + 3 current transmitters + plug-in terminal block</p>	1

Example of installation and commissioning in a School in Ivory Coast



Measure

> Laboratory power supplies	158
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> Laboratory power supplies	160
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> Power and energy quality analyzer	162
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> Digital oscilloscope	164
> Voltage differential probe/Current probe	165
> Multimeter	166
> Safety cords	166
> «T» BNC adapter	167
> BNC cords	167





Laboratory power supplies



Highlights

- Adjustable output voltage, balanced
- Floating outputs on 4-mm safety sockets
- Protected against short circuits

Technical characteristics - PMM 062 180

Voltage	+/- 15 V with common 0V
Ripple	< 3 mV RMS
Maximum Current	1A on each output ; +/- 15 V 3A at 10V 2,5A at 12V 2A at 15V (+15 V alone)
Switch	On/Off
Protections	Against short-circuits and voltage inversions
Visualization	Power-on indicator

PMM 062 180 : Power supply, ± 15 Vdc – 1A

Highlights

- Adjustable output voltage, balanced
- Floating outputs on 4-mm safety sockets
- Protected against short circuits

Technical characteristics - PMM 062 200

Voltage	Adjustable, from ± 10 to ± 15 V
Ripple	< 3 mV RMS
Maximum Current	5 A (10/12 V), 4 A (15 V), 2 A (-10/-12/-15 V)
Switch	On/Off
Protections	Against short-circuits and voltage inversions
Vizualisation	Power-on indicator

PMM 062 200 : Power supply, -15/+15 Vdc – 2 A



Highlights

- Power supply/ Battery charger
- On/Off switch
- Adjustable output voltage

Technical characteristics - PMM 062 470

Voltage	Adjustable, from 5 to 29 V / 2.1 to 4 A with a 12-position switch
Ripple	< 3 mV RMS
Maximum Current	4 A (5 V), 3.5 A (12 V), 2.5 A (24 V), 2.1 A (29V)
Switch	Off/On
Protections	Against short-circuits and voltage inversions
Visualization	Power-on indicator

PMM 062 470 : Adjustable power supply





SELV power supply

New

SELV 430-W Power Supply , 1-Phase, 3-Phase, and DC



Highlights

- 3-phase power supply, 3x24 VAC 11 A, from Mains (1-phase 230 VAC, 16 A).
- DC power supply 48 VDC /9 A and 48 VDC /2 A
- Protected against overvoltage, overcurrent, overpower, temperature.
- HMI via LCD display
- Display (voltages, currents, phase shift, $\cos\phi$, ...).

EMS 300 000 : SELV 430-W Power Supply, 1-Phase, 3-Phase, and DC (See pages 78-108)

SELV 430-W DC Power Supply

Highlights

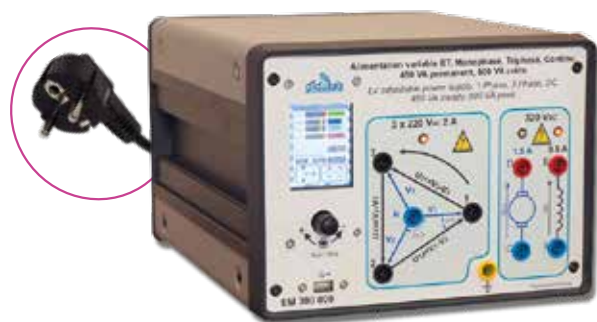
- DC power supply 48 VDC /9 A
- Auxiliary power supply 48 VDC /2 A
- Protected against overvoltage, overcurrent, overpower, temperature.
- HMI via LCD display
- Display (voltage, current,)



EMS 200 000 : SELV 430-W DC Power Supply (See page 78)

LV power supply

LV 300-W Power Supply , 1-Phase, 3-Phase, and DC



Highlights

- 3-phase power supply, 3x230 VAC 2 A, from Mains (1-phase 230 VAC, 16 A).
- DC power supply 320 VDC /1.5 A
- Power supply for excitation: 320 VDC /0.6 A
- HMI via LCD display
- Display (voltages, currents, phase shift, $\cos\phi$, ...).

EM 300 000 : LV 300-W Power Supply, 1-Phase, 3-Phase, and DC (See pages 90-108)

MEASURING INSTRUMENTS



Laboratory power supplies

Highlights

- 3 outputs available simultaneously.
- Adjustable current limitation.
- Digital display of the voltage and current.



Technical characteristics - PMM 062 610

Voltage	2 x 0-30 Vdc adjustable.	5 Vdc fixe.
Ripple	1 mV RMS.	
Maximum current	2 x 0-3 A adjustable.	3 A fixe.
Protections	Current limitation and fuse.	
Visualization	2 LCD for the voltage and 2 LCD for the current.	

PMM 062 610 : 2 x 30 Vdc (3A) and 5 Vdc (3A) power supply

Highlights

- Large graphic display
- Sensitive keypad
- Connections: USB, RS232, RS485 and 0-10 V, insulated
- Performance: output in the rear-panel, used for remote-sensing



Technical characteristics - PMM 062 225

Voltage	0-32 V, adjustable
Ripple	1 mV RMS
Current	0-20 A
Display	Graphic LCD 128 x 64 pixels with white backlight. Visualization of all parameters CV (Constant Voltage) mode or CC (Constant Current)
Power	640 W
Protections	Against short-circuits, by current regulation. Against overtemperature by fan and thermal circuit-breaker. Against overcurrent on main input, by internal fuses.

PMM 062 225 : 32 VDC (20 A) power supply

Highlights

- Large graphic display
- Sensitive keypad
- Connections: USB, RS232, RS485 and 0-10 V, insulated, labVIEW driver and executable program
- Performance : output in the rear-panel, used for remote-sensing

New



Technical characteristics - PMM 062 630

Voltage VDC	2 x 0-32	± 0-32	0-64	0-32	1-15
Ripple mV	< 0,7	< 0,7	< 1,5	< 1	< 2
Current A	2 x 0-6	± 0-6	0-6	0-12	3/1
Display	Same as PMM 062 225				
Power	400 W				
Protections	Same as PMM 062 225				

PMM 062 630 : 2x32 VDC (6 A) and 15V (1A) power supply



Functions generator



Highlights

- Frequency range: 1 μ Hz to 12MHz.
- Sine, square, saw, ramp, pulse, DC, TTL.
- Modulations AM, FM, FSK, PSK.
- Frequency meter: from 0.8 to 100 MHz
- Display with 4 or 10 digits in frequency mode or period mode.

Technical characteristics - EMD 019 040

Max frequency range	1 μ Hz à 12 MHz
Signals	Sine, square, saw, ramp, pulse, DC, TTL
Modulations	AM, FM, FSK, PSK.
Output impedance	50 Ω
Output amplitude (max)	20 V peak to peak (10 V on 50 Ω)
TTL output	0-5 V (rising and downing time < 10 ns)
Protections	Against +/- 60 V reinjection, and against short-circuits for all the outputs
Display	2 lines, 16 characters
Interfaces	RS232 link (SUB-D 9 pins) and USB link (B type)
Safety	CEI 1010-1 Class I, CAT II 600 V
Power supply	230 V 50-60 Hz
Dimensions	220 x 240 x 90 mm
Weight	About 2.5 kg
Optional extra	USB/RS232 adaptor
Software	LabVIEW driver, can be downloaded free of charge

EMD 019 040 : Low frequency function generator, 1 μ Hz to 12 MHz

Radio Frequency Generator



Highlights

- Max frequency: 160 MHz, 2 channels.
- A lot of analog and digital modulations.
- Arbitrary waveform generator.
- Possibility to add harmonics.

Technical characteristics - EMD 028 020

Frequency range	1 μ Hz to 160 MHz
Output amplitude	< 20 MHz from 1 mVpp to 10 Vpp, to 160 MHz, 1 mVpp to 1 Vpp
Frequency resolution	1 μ Hz
Intern generator	2 MHz to 50 kHz
Modulations	AM, FM, PM, ASK, FSK, BPSK, QPSK, 3FSK, 4FSK, OSK, PWM.
Interfaces	USB host, USB master, LAN, basic software supplied (user manual + application)

EMD 028 020 : Radio Frequency generator, 1 μ Hz to 160 MHz



Spectrum analyzer



Highlights

- Frequency: 9 kHz to 1,5 GHz.
- Specially aimed at the study of HF and VHF radiofrequencies.
- Very good RF resolution.

Technical characteristics - EMD 028 030

Frequency range	9 kHz to 1,5 GHz.
Frequency resolution	1 kHz
Noise / Inputs levels	Input levels : from -135dBm to -80 dBm Display Average Noise Level (DANL) to +20 dBm, 50 Ohm, N female connector.
Display	8" colour screen, WVGA (800x480)
Trigger source	Manual, video, external.
Interfaces	USB, LAN, software as an optional extra.

EMD 028 030 : 1,5-GHz Spectrum analyser

Power and energy quality Analyzer



Highlights

- Measure all the necessary voltage, current and power parameters.
- Capture and record all the parameters, transients, alarms and wave forms simultaneously.
- 10-minute Inrush mode.
- Calculation of distorting power.
- Proven simplicity of use.

Technical characteristics - EMD 100 010

Number of channels	4 voltage inputs / 4 current inputs
Number of inputs	5 voltage inputs / 4 current inputs
Voltage (TRMS AC+DC)	2V to 1000 V
Frequency	40 Hz to 69 Hz
Power values	W, VA, var, VAD, PF, DPF, cos ϕ , tan ϕ .
Energy values	Wh, varh, Vah, VADh
Harmonics (THD)	Yes, orders 0 to 50
Flicker (Pst & Plt)	yes
Communication interface	USB (B kind).
Battery life	Up to 13 hours
Power supply	9.6 V NiMH rechargeable battery or external mains charger
Connections	Supplied with 5 \emptyset 4-mm safety sockets for voltage NOT supplied with any ampermetric clamps

EMD 100 010 : Power and Energy quality Analyzer (Qualistar CA8336)

MEASURING INSTRUMENTS



Digital oscilloscope 2 x 100 MHz



Highlights

- 2 x 100 MHz,
1 Giga sample/s.
- Colour TFT Screen,
- Recording on USB Key,
- 2 probes 1:1 / 10:1 included,
- Software: Ultrascope (optional).

Technical characteristics - EMD 018 010

Bandwidth	100 MHz.
Number of channels	2 channels + external triggering
Input impedance	1 MOhm 13 pF.
Vertical Deflection	2 mV/div to 5 V/div
Max input Voltage	300 Vrms.
Time base	5 ns/div to 50 s/div.
Sampling /channel	1 GS/s on 1 channel, 500 MS/s on 2 channels - resolution: 8 bits
Trigger	Edge, video, impulsion, slope, alternate.
Mathematics functions	FFT, +, -, x, inversion
Human-Machine Interface	Colour LCD - 320 x 234 mm
E/S	USB port, master USB, RS232, Pass/Fail (isolated output).

EMD 018 010 : Oscilloscope numérique 2 x 100 MHz - type DS 1102 E

Digital oscilloscope 2x60 MHz



Highlights

- For an electrotechnical environment
Insulated input : 600 V cat. III. No needs to add differential probes.
- 5 tools in 1
Oscilloscope, Multimeter, FFT analyzer.
Harmonic Analyzer and recorder (optional).
- 2 x 60 MHz
2.5 Giga sample/s..
- Touch screen

Technical characteristics - EMD 022 020

Human-Machine Interface	LCD 7" WVGA FTF touch screen 800x400 – LED backlighting (adjustable sleep mode)
Number of channels	2 isolated channels
Sweep speed	35 calibres from 1 ns/div to 200 s/div., accuracy \pm (50 ppm + 500 ps) – Roll mode from 100 ms to 200 s/div
Trigger	Edge, pulse width (16 ns-20 s), delay (48 ns to 20 s), counting (3 to 16,384 events) Continuous adjustment of Trigger position
Max sampling	2.5 GS/s in one-shot mode on each channel (100 GS/s max. in ETS mode)
Vertical resolution	12 bits (vertical resolution 0.025%)
FFT analyser and Math functions	2,500-point FFT (Lin or Log) with measurement cursors – Functions +, -, x, / and mathematical function editor
Acquisition	Duration: 20,000 s – Interval: 0.2 s – Files: 100,000 measurements

EMD 022 020 : digital oscilloscope 2 x 60 MHz B&W - type: OX 9062 M



Digital oscilloscope 4x100 MHz



Highlights

- 4 x 100 MHz,
2.5 Giga sample/s.
- Colour TFT Screen,
- Decoding of serial bus
 - I²C
 - SPI

Technical characteristics - EMD 020 040

Display	10.1", colour, 1280x800 pixels
Number of channels	4 channels
Vertical Deflection (V/div at 1 MOhm)	1 mV to 5 V
Sampling /channel (GS/s)	1.25 GS/s ; 2.5 (2 interlinked channels)
Max memory (per channel/ per active channel)	10 MS ; 20 MS
Resolution	10 bits
FFT analyser and Math functions	2,500-point FFT (Lin or Log) with measurement cursors – Functions + , - , x , / and mathematical function editor
Trigger and decoding	I ² C, SPI Optional extra : UART/RS-232/RS-422/RS-485/CAN/LIN

EMD 020 040 : Digital oscilloscope 4x100 MHz

Digital oscilloscope 4x1 GHz



Highlights

- 4 x 1 GHz,
5 Giga Sample/s.
- Colour TFT Screen,
- Decoding of serial bus
 - I²C, I2S, SPI and UART
- Spectrogramme

Technical characteristics - EMD 020 060

Display	10.1", colour, 1280x800 pixels
Number of channels	4 channels
(V/div at 1 MOhm) (V/div at 50 Ohm)	500 µV to 10 V 500 µV to 10 V
Sampling /channel (GS/s)	2.5 GS/s ; 5 (2 interlinked channels)
Max memory (per channel/ per active channel)	40 MS ; 80 MS
Resolution	10 bits
FFT analyser and Math functions	2,500-point FFT (Lin or Log) with measurement cursors – Functions + , - , x , / and mathematical function editor
Trigger and decoding	I ² C, SPI, I2S, UART Optional extra : RS-232/RS-422/RS-485/CAN/LIN

EMD 020 060 : Digital oscilloscope 4x1 GHz



Voltage differential probe, 1 channel



Technical characteristics - EMD 019 030

Bandwidth	DC to 25 MHz (at 3dB)
Input voltage	DC + AC, 200/500/1400 Vdc
Oscilloscope output	+/- 7 Vdc
Attenuator factor	x20, x50, x200
Power supply	9-V battery or Mains adaptor

EMD 019 030 : Voltage differential probe AC/DC

Voltage differential probe, 2 channels



Technical characteristics - EMD 019 060

Voltage ratios	1/10 - 1/100 Supplied with 2 BNC BNC cords (20 cm) + 2 sets of Ø 4-mm cords (1m)
Number of channels	2
Max Input voltage	600V
Accuracy	± 3%
Power supply	230 VAC ± 10%
Frequency	50/60 Hz
Dimensions	270 x 250 x 63 mm
Weight	1,2 kg

EMD 019 060 : Voltage differential probe AC/DC

Current probe



Highlights

- Bandwidth : DC to 100 kHz
- Measurements from 50 mA to 30A
- Ac/DC currents

Technical characteristics - EMD 028 005

Sensor	Hall effect sensor
Measuring range	50 mA to 30 A
Gain, accuracy	Output signal ratio : 100 mV/1A ; +/- 1% of the reading + 2 mA, manual zero setting
Band width	DC to 100 kHz
Clamp opening	19 mm
Others	Connection : 2m-BNC/cable, cat 3000 V CATIII, manual zero setting, power supply : 1 9-V battery

EMD 028 005 : Current probe



TRMS multimeter

Technical characteristics - EMD 200 010

Voltage range	60 mV to 1 000 V
Current range	600 μ A to 10 A/20 A (30 sec. max)
Bandwidth	100 kHz
Frequency	60 Hz to 600 kHz
Resistance	60 Ω to 60 M Ω
Capacitance	60 nF to 60 mF
Temperature (PT100/1000)	- 200° C to 800° C
PWM filter	4th-order 300 Hz low-pass filter for measuring on variable speed drives of asynchronous motors
Secondary functions	dBm and VA resistive power, +/- duty cycle, pulse width
Power supply	4 AA batteries (or Ni-MH battery)

EMD 200 010 : TRMS multimeter

Highlights

- 100 kHz bandwidth.
- Low-pass filter (PWM filter).



Highlights

- 8 devices in 1 :
Voltmeter, ammeter, frequency meter, ohmmeter, capacitance measurement, temperature measurement, continuity and diode test



Hand-held multimeter

Technical characteristics - PMM 062 324

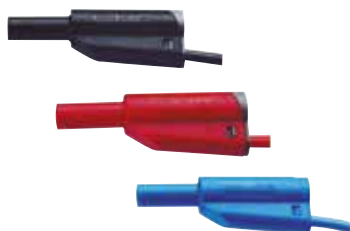
Digital display	4000 points.
Analogue display	with 82 segments bargraph
Functions	dB, dBm, HOLD, MIN/MAX, Average, REL
Interface	USB opto insulated
Security	600 V CAT IV and 1000 V CAT III.
Voltage, current, resistance measurement	
Capacitance measurement	40 nF to 40 mF in ranges
Temperature measurement	-200°C to 1200°C / resolution: 1°C.
Continuity and diode test	
Backlight	
Power supply	4 LR6AA 1,5 V.
Battery lifetime	100 hrs

PMM 062 324 : Hand held multimeter

Ø 4-mm safety cords

All the cords on this page are in compliance with the security requirements : EN 61010.

Sold by set of 10.



- Wire Ø 1 mm² - I_{max} = 20 A - V_{max} = 1000 V > (stackable)

Length	Black	Red	Blue
10 cm	PEM 080 000	PEM 080 001	PEM 080 002
25 cm	PEM 080 010	PEM 080 011	PEM 080 012
50 cm	PEM 080 020	PEM 080 021	PEM 080 022
100 cm	PEM 080 030	PEM 080 031	PEM 080 032

- Wire Ø 2.5 mm² - I_{max} = 36 A - V_{max} = 1000 V > (stackable)

Length	Black	Red	Blue
25 cm	PEM 080 050	PEM 080 051	PEM 080 052
50 cm	PEM 080 060	PEM 080 061	PEM 080 062
100 cm	PEM 080 070	PEM 080 071	PEM 080 072



«T» BNC adapter, insulated

Technical characteristics - PEM 063 960



Insulated branch «T»	1 BNC male/2 female BNC.
Operating Voltage max.	500 V

PEM 063 960 : «T» BNC adapter , insulated



Standardized BNC cords

CEI 1010 insulated.

PEM 010 021 : Black cord BNC/BNC, male-male, 1 m, 50 Ohms

PEM 010 180 : Black cord BNC/2 Ø-4 mm safety male connectors, 1m, 50 Ohms

BNC /4-mm sockets adapter

BNC insulated (male) / 2 Ø 4 mm safety sockets (female) adapter.



PEM 063 700 : 1 BNC adaptor / 4-mm sockets adapter



Cords holder support on wheels

This support is perfect to store and carry the cords in your laboratories and classrooms. It consists of 2 aluminium rails (length = 250mm) that allow to store more than 200 cords. Moreover, you also have a plastic box to store the accessories and/or the measuring devices (multimeters...).

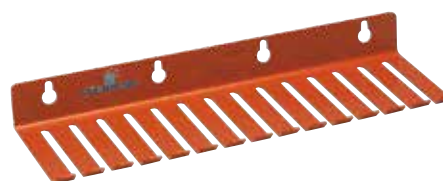
This box is adjustable in height (from 1 to 1.8 m).

ELD 100 300 : Cords holder on wheels

Cords holder support

This wall mounted support allows to store 80 cords.

Max Ø of the cords: 5.33 mm.



Cord holder

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All late payments shall automatically and without official notification be subject to the payment of late payment penalties of 1.5 % per month late, in addition to any corresponding collection or legal fees. In the event of failure to pay by the contractual dates indicated on our invoices and return mail receipt, we reserve the right to suspend or cancel orders in progress.

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All goods, even shipped within France, are shipped at the risk of the recipient, who must seek recourse against the carrier in case of missing or broken items, loss or other damage.

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The purchaser shall check the condition of packages and their contents in the presence of the deliverer. For the goods that DIDALAB ships or has shipped, risk is transferred at the time of loading at DIDALAB or its representative. For goods to be picked up at DIDALAB or its representative by the purchaser or its representative, risk is transferred when the purchaser of its representative takes possession. No returned goods shall be accepted without our written consent.

Only goods that have not deteriorated and/or been modified, in their original packages, may be returned.

RETURN RIGHTS

All items that do not provide satisfaction may be returned to us, after our agreement is obtained, within 8 days following their receipt.

A return item may be exchanged, credited to the customer's account or reimbursed. Only equipment that is complete, in good condition and in its original package may be returned.

Unless otherwise agreed, return expenses are paid by the purchaser. These terms are also applicable to shipments outside of France.

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The equipment supplied by DIDALAB is guaranteed, beginning at the time of its delivery against any hidden or other defects. This warranty is valid for 1 year after delivery and is limited to repair or replacement of the defective equipment. The warranty ceases to be valid in case of damage caused by improper use of the equipment.

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Complaints concerning apparent defects must be received within fifteen days after delivery to be valid. This time is extended to one month for export.

The warranty is invalidated if repairs or servicing is performed by someone other than an employee of our company.

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For the equipment concerned by the n°2005/829 law about waste of Electrical and Electric Equipment, the responsibility of the removing and the treatment of the waste is delegated to the customer who accepts this responsibility.

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We reserve ownership of goods until full payment is received. Drafts or any other commercial paper creating an obligation to pay shall not be considered as payment in respect of this clause.

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If the goods are resold, the purchaser transfers all claims resulting from resale to a third party purchaser to DIDALAB, but still remains principally liable to DIDALAB for the payment of the price stipulated for the initial sale. In case of attachment or any action brought by a third party, the purchaser must immediately inform the seller by registered mail with return mail receipt. In case of partial or total failure to pay the price when due, the seller may duly and without formality demand return of the item in question at the purchaser's risk.

LEGAL COMPETENCE

In the event of dispute, any type whatsoever, the court of Versailles alone shall be competent. All agreement between the purchaser and DIDALAB are exclusively subject to French law. In compliance with current legal requirement, the purchaser agrees to obtain our approval, prior to any exporting or re-exporting from continental France of the equipment sold. Otherwise, we refuse all liability and obligation if this approval procedure is not observed by the purchaser.

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DIDALAB RESALER :



- English Edition 2021



didalab

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