ERM AUTOMATISMES

Didactique | Robotique | Fab&Test | Energies

Equipment and solutions for technical education and vocational training

CATALOGUE 2017

ERM AUTOMATISMES
Didactique | Robotique | Fab&Test | Energies

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About us

ERM provides technical systems and services in the fields of education, robotics, manufacturing laboratories (FabLabs), energy and industry. Founded in 1990 in southern France, ERM first focused on industrial automation. Overtaken by its educational culture, ERM quickly became the precursor of introducing industrial production lines within technical training institutions. Upon request by these educational institutions, ERM then extended its offer to other areas, such as electronics, electrical engineering, power engineering and renewable energy.

Today, ERM has become a market leader in didactic solutions and systems for technological and vocational training in France, and is developing its export markets.

More than 1500 academic institutions are equipped with ERM technical teaching equipment in France: Secondary schools for vocational training, Vocational training centers, Universities, Universities of Technology, Major engineering schools, etc.

Abroad, many vocational training institutions are using our systems:

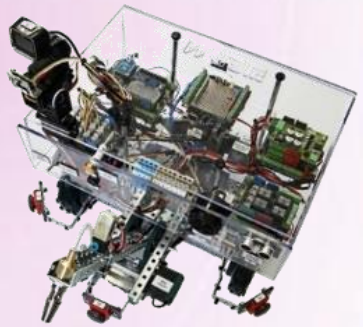
- French overseas territories: Guadeloupe, Guyana, Reunion, Martinique, Mayotte, New Caledonia, French Polynesia, Wallis & Futuna
- Africa : Algeria, Burkina, Cameroun, Gabon, Ivory Coast, Morocco, Mauritania, Senegal, Tunisia, …
- Asia : Vietnam, Korea…
- America : Mexico, Colombia…
- Europe : Belgium, Luxembourg, Romania, Hungary, Slovakia, Switzerland…

Electronics & Communication

Instruments, tools and data acquisition : See pages I8 to I9

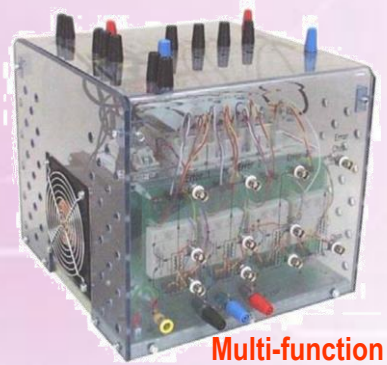
NAO Humanoid Robot & Sub-systems for mechatronics

Token dispenser with embedded PC



Electronics Prototyping Projects

NI USRP Universal Software Radio Peripheral – Training platform for digital wireless communications



Multi-function power electronic converters – Multi-function IGBT or diode & thyristor converters with close control and protection

Robotics & Automation

NAO Humanoid Robot

In partnership with ALDEBARAN SoftBank Group

➢ *Features:*

- **Audio** (4 microphones and 2 loudspeakers)
- **Video** (2 HD cameras 1200 x 960)
- **Inertial unit** (3-axis accelerometer, and 2-axis gyrometer) and **Sonars**
- **Sensors (**pressure FSR, bumpers, tactile)
- Servo-motors (**coreless motors** with **hall effect sensors)**
- Grip (prehensile hands with 3 operable fingers)
- Intel Atom 1.6 GHz CPU with 1 GB RAM and 8 GB Micro SDHC (**text-to-speech, Image and voice recognition**…)
- **WiFi** and **Ethernet** modules
- Lithium-ion battery (90 minutes autonomy)

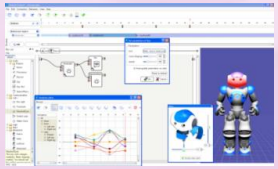
➢ *Training activities:*

- Functional analysis and **SysML** description
- Information chain architecture
- Study of **motion** and **communication**
- Study of **controllers** used on NAO
- **Development and testing of new algorithms** (eg: sight…)
- Project: Develop applications for NAO, **invent missions for NAO**
- Project: Design **software architecture** for activities (eg: NAO monitors a room)

➢ *Key points:*

- Motivating and fun for students, and a **medium of communication** for the institution
- Open environment (Software suite for programming and data logging...)

➢ *Reference:* **AR//H25-EA:** NAO humanoid Robot with SDK, Choregraphe, Monitor, 10 licenses - **AR//SW-CSDK-U**: Software suite Choregraphe, Monitor, SDK, site license - **AR//SW-WNAO**: Webots software for NAO, 1 license - **AR//SW-WNAO10**: Webots software for NAO, 10 licenses



Choregraphe programming software

Webots 3D simulation software

Training system for NAO Foot + Ankle control

➢ *Features:*

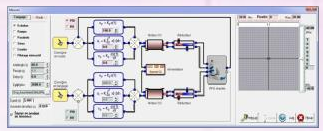
- **Mechanical transmissions** (gears, gear reducer…)
- Motors (**DC motors**)
- Sensors (**magnetic position sensors**)
- **SPI electronic bus**

Compatible with the "Motors & Motion Lab" bench

Page H6

➢ *Training activities:*

- Studying a **DC / DC static converter**
- Influence of a **PI corrector**
- **Model of pitch behavior**
- Impact of **sensor position on control**



➢ *Key points:*

- Ideal resource to teach about design and **servo control for biaxial systems**
- **Viewer software** for **communication with and control from a PC**
- **Electronic diagrams** to study constructive solutions

➢ *Reference:* **NA11**: Training system for NAO "Foot + Ankle" control - **PR09**: USB Logic Analyzer (to see the frames running on the SPI electronic bus)

Pages H2/H3

NAOtronics - Three training modules for the exploration of technology solutions implemented in the NAO robot

NAOtronics Detection

➢ *Features:*

- **FSR pressure** sensors
- **MRE position** sensors
- **Inertial measurement unit**
- **Ultrasonic** (sonar) sensors
- **Infrared** sensors
- **Mechanical contact** (shock) sensors
- **Capacitive** (touch) sensors
- **Sound** (microphone) sensors
- Arduino UNO development pack

➢ *Training activities:*

- **Analysis of sensors in an inertial measurement unit:** accelerometer and gyroscope
- **Analysis of ultrasonic sensors for distance**
- **Analysis of FSR force sensors**
- **Analysis of MRE angular position sensors**

NAOtronics Motorization

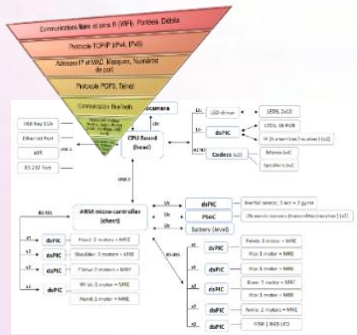
➢ *Features:*

- **DC motor** with reducer
- **Servo motor**
- **Electric cylinder**
- Humanoid finger
- Arduino and Raspberry Pi boards, to control the actuators
- Human-Machine Interface (LCD screen, keyboard…)

➢ *Training activities:*

- Studying the mechanical connections, kinematics, mechanical transmissions, motors and control
- **SED programming** in Python on Raspberry Pi and Arduino on microcontroller

NAOtronics Communication



➢ *Features:*

- **SPI/I2C** communication
- **RS485/CAN** communication
- **Ethernet** communication
- **WiFi** communication
- Arduino UNO development pack

➢ *Training activities:*

- **Study and analysis of the main protocols**
- **Communication: analyzing/modelling and experimenting** on the information chain
- **Experimenting** with different network technologies

python™

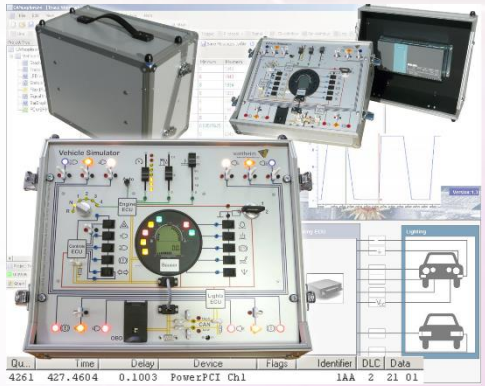
➢ *Key points:*

- Ideal training support for studying multi-physics technology solutions and developing skills and knowledge in a training module
- **Electronic diagrams** for studying constructive solutions using sensor behavior patterns

➢ *References:* **NA15+PR00+PR30+PR31+PR32:** NAOtronics « Detection » pack - **DR10:** Humanoid finger (NAOtronics Motorization pack) – **PR00+PR10+PR11+PR18:** NAOtronics « Communication » pack – **PR09:** USB Logic Analyzer (to see the frames running on the SPI electronic bus)

Embedded systems

Embedded electronic system for vehicles – Studying and commissioning an embedded industrial PC for vehicle simulation with data reporting



In partnership with

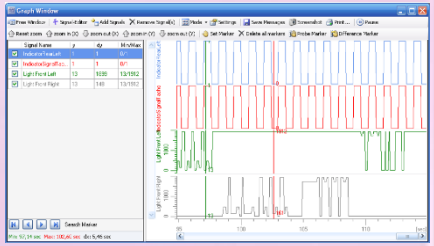
SIEMENS

➢ *Features :*

- **Communications bus** (CAN)
- Communication components (converters, ECU device)
- **Embedded PC** (Microbox Siemens)
- Automotive sensors & actuators (starting, gasoline, lighting, speed…)
- Simulation & diagnostic software (CAN Explorer, Microbox software)

➢ *Training activities :*

- Situation scenario & introduction to system operation
- Installation, commissioning and connection
- **Analyzing the electrical signal** of the control panel
- **Digital signal analysis** of the CAN bus
- **Hardware and software configuration of the embedded PC**
- System diagnostics



CAN Explorer software

➢ *Key points:*

- Multi-scenario open platform for the study of embedded systems
- Configuring and commissioning an industrial embedded PC
- Conduct studies and obtain theoretical measurements (Software) & physical measurements (Measuring points on terminals)
- Compact system

➢ *References:* **VH10:** Embedded electronic system for vehicles – **VH11:** Unit for configuring and commissioning an Embedded Microbox PC (Included: 1 Microbox and 24V power supply, 1 Vehicle simulation application, 1CAN Explorer software, 1 CAN/PC converter PC104) – **VH12:** Microbox Embedded PC (without software) for Hardware and OS installation

Embedded PC

View of simulator

Token dispenser with embedded PC - Studying a token dispenser and its embedded electronics

➢ *Features:*

- **Communications bus** (Profinet, Wifi)
- Communication components (gateways, WiFi access point, SIP telephone, PABX, router)
- **Embedded PC** (Microbox Siemens, inverter)
- Human Machine Interface (**colour touch-screen**)
- Electronic sensors (inductive coil, brightness, impact...)
- Actuators (micro-motors, lighting, voice, alarm…)
- Security (video monitoring, alarm control, RFID access control)
- Programming and configuration software (WinAC RTX, WinCC Flexible)

➢ *Training activities:*

- Situation scenario and introduction to system operation
- Installation, commissioning and connection
- Integration and commissioning of extensions
- **Networking non communication-capable equipment**
- System adjustment and configuration
- **Software configuration of the embedded PC**
- **Industrial WiFi configuration**
- Troubleshooting and Maintenance

Touch-screen with embedded PC

Industrial WIFI access point

➢ *Key points:*

- This system may be used for **electrical certification**
- **Common "embedded" application**
- Technological diversity
- Upgradeable system enabling real interventions

➢ *Reference:* **DJ20:** Token dispenser with Embedded Siemens Microbox PC – **DJ12:** Automated lighting and vandal-resistant kit (Optional)– **DJ13:** Voice guidance kit (Optional) – **DJ15:** Kit for integrating a second dispenser for new token format (Optional) – **DJ16:** Industrial WiFi kit and video monitoring camera with software and recording on NAS server (Optional)

Change machine and token dispenser

DJ12: Option Automated lighting and vandal-resistant kit

DJ13: Option Voice guidance kit

Embedded systems

Aerial imaging gimbal – Studies and projects on a 2-axis controlled gimbal mounted on a drone

➢ *Features:*

- Inertial measurement unit (accelerometer and gyroscope)
- Motorization & Energy (**brushless, DC and stepper motors, industrial motor controller board**)
- **Mechanical linkage** solutions
- Video and image processing (camera)
- **Real-time LabVIEW** control (MyRIO board)
- Communication (CAN bus)

Video control camera

➢ *Training activities:*

- Testing of **gimbal performance**
- Motorization impact on gimbal behavior
- **Behavior pattern of the controlled pitch axis** of the gimbal
- **Impact of axis balancing** on performance
- **Image** control and **recognition**
- Impact of **control sampling frequency**
- **Sensor impact** on gimbal performance
- Analysis of **coupling phenomena**
- Analysis of **gravity** (direction) **impact**
- **Power supply impact** on performance
- Designing a **camera stabilization system**
- Study of sensors (**accelerometer, gyroscope**)
- **Real-time LabVIEW** programming
- **Configuration of industrial motor controllers**
- Study and **configuration of a CAN bus**
- Projects: **Design of a third axis** (mechanical linkage – brushless, DC or stepper motor - **Arduino/Python** electronics and **programming**)

ARDUINO python LabVIEW

➢ *Key points:*

- Opportunity to **compare different technologies and motor powers**
- **Image analysis** and integration in the **position control loop**
- Opportunity to implement projects using a **third motorized axis**
- Control programming/modification in Python
- Two types of control: ❶ Embedded electronics ❷ Real-time industrial electronic platform, based on NI myRIO

Compatible with the "Motors & Motion Lab" bench

Page H6

➢ *References:* **NC10:** Aerial imaging gimbal – **NC10+NC15:** Aerial imaging gimbal with real-time video camera – **NC10+NC00+NC09:** Aerial imaging gimbal with real-time electronic platform (NI myRIO board and controller for 2 brushless motors) – **NC10+NC15+NC00+NC09:** Aerial imaging gimbal with video control camera and real-time electronic platform (NI myRIO board and controller for 2 brushless motors) – **NC11:** Gimbal with more powerful motors (Optional) – **NC15:** Video control camera – **NC16:** Third-axis motorization kit with brushless/DC/stepper motor controller (Optional) – **NC00+NC09:** Real-time electronic platform (NI myRIO kit and controller for 2 brushless motors)

Interface for configuration, measurement and image analysis with LabVIEW

Networks & Telecommunications

Microwave educational bench & Antenna

In partnership with

CHAUVIN® ARNOUX
CHAUVIN ARNOUX GROUP

➢ *Features:*

- GUNN diode oscillator
- Ferrite isolator
- PIN diode modulator
- Micrometer attenuator
- Cavity wavemeter
- Measuring line
- Impedance adaptor
- Waveguide-to-coax transition element
- Adapted load
- Short-circuit platelet
- Guide support

➢ *Training operations:*

- Study of **microwaves** and of **guided electromagnetic wave propagation**
- Study of a **GUNN oscillator**
- Measurement of **impedance**, **wavelength**, **frequency** and **SWR** (standing wave ratio)
- Determination of a detector's quadratic law
- Study of **antennas** and of **free-space propagation of electromagnetic waves**
- 10 GHz energy **radiation method** by means of **various antennas**
- Study of **space attenuation** as a result of **wave polarization** and **gain** measurement
- Obtaining a **radiation chart**

Mounted bench with components

➢ *Key points:*

- **Rectangular waveguide** technology in accordance with the **R100/WR90 standard** covering a range between 8.5 and 9.6GHz
- **Clever assembly system** using EASYFIX™ quick fastening
- A **range of antennas** for studying **free-space propagation**
- **Training and tutorials supplied**

Add-on: SWR Indicator

Add-on: Microwave power meter

➢ *References:* **CA//BDHR100:** Microwave educational bench – There are many components and accessories for guided and free-space wave propagation and specific instrumentation – *Contact us.*

Optical fiber - Studying, implementing and testing FTTH (Fiber To The Home) networks

New

➢ *Features:*
- Optical fiber connection (Fusion splicing or Cold welding)
- Installation control by reflectometry
- Connector inspection and cleaning
- Continuity test and photometry measurements
- Architecture and laying of FTTH networks
- Active network simulation

➢ *Training activities:*
- Learning the basics of optical fiber and its applications in the residential, tertiary and industrial sectors

Optical fiber / Ethernet network:
- Defining network architecture (ring, etc.) according to specifications
- Working with fiber and connectors
- Software addressing and configuration of switches
- Measurements and installation file (with appropriate tools)
- Communication tests

Video surveillance:
- Connecting and configuration of the IP/PoE camera
- Setting up supervision (alarm control) on software

Counting and remote control via PLC:
- Wiring and electrical connections
- Communication configuring
- Programming or modification of controller programs
- Development or modification of the supervision application

2D structure (FF17)

Optical fiber sub-distributor and Operator conveyance box (FF12)

3D structure (FF11)

➢ *Key points:*
- Selection of materials that allows a **comprehensive approach of the different types of technologies, architectures and tools**
- **Teaching guide** with procedures and tutorials

➢ *References:* **FF10:** Optical fiber FTTH tool kit - **FF20:** Optical fiber FTTO tool kit - **FF30:** Urban monitoring and control networks kit ("industrial" optical fiber)

Measuring tools and instruments for optical fiber

Optical fiber connection (core- or clad-alignment fusion splicer and cleaver, mechanical splice kit, optical fiber technician tool kit)

Connector inspection and cleaning / Optical fiber visual or digital fault location – Optical link budgets (single- and multimode photometry kit, single- and multimode optical fiber reflectometer/OTDR)

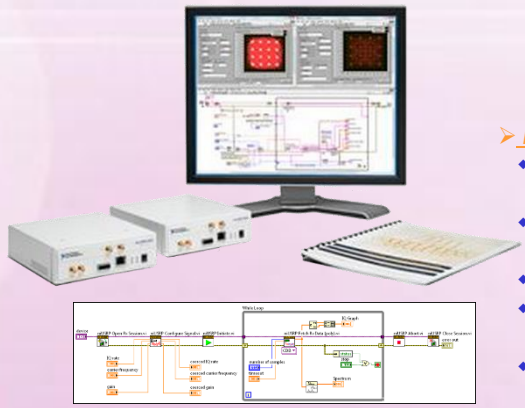
Network qualification and certification (Ethernet and Optical fiber wiring and network qualifier, single- and multimode optical fiber certifier)

Fiber / Ethernet media converters

NI USRP Universal Software Radio Peripheral – Training platform for digital wireless communications

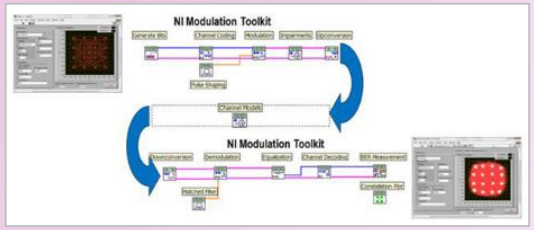
In partnership with:

NATIONAL INSTRUMENTS

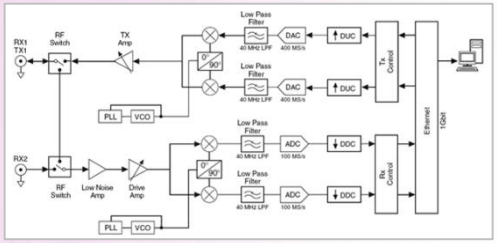


➢ *Features:*
- Real-time communication with 2 RF transceivers from 50 MHz to 2.2 GHz (25 MHz bandwidth)
- Covering of the following frequency bands: ISM, FM, GPS, GSM, Wi-Fi, Bluetooth, ZigBee, Radars
- LabVIEW modulation toolkit
- High-speed analog-to-digital conversion (ADC) architecture
- Digital-to-analog conversion (DAC) architecture with FPGA

➢ *Training activities:*
- AWGN (additive white Gaussian noise) simulator, modulation, demodulation, pulse shaping, energy detection, equalization, frame detection, frequency correction and synchronization, etc.
- Studying the **components of a digital communication modem**
- **Design of an OFDM** (Orthogonal Frequency Division Multiplexing) **radio**
- Analysis of signals (dynamic spectrum management) and study of the **main wireless protocols**



LabVIEW toolkit



USRP architecture

➢ *Key points:*
- Ideal for **experiments** on RF communications (tutorials provided)
- Increased productivity due to the **LabVIEW graphical measuring and programming** interface
- **Teaching guide** for studying the components of a digital communication modem and designing an OFDM radio
- Software radio and RF enclosure enabling **full duplex communication**
- **Integration of its own algorithms** in the software radio under LabVIEW

➢ *References:* **NI//781908-01:** Set of 2 NI USRP-2920 software radios (50 MHz to 2.2 GHz covering ISM, FM, GPS, GSM and radar frequency bands) with accessories (MIMO cable, 30dB attenuator) and laboratory manual **– NI//781915-01:** Triple-band antenna 144, 400 and 1200MHz for USRP-2920 **- NI//781909-01:** NI USRP-2922 software radio (400 MHz to 4.4 GHz covering GNSS, Wi-Fi, Bluetooth, ZigBee frequency bands, other ISM applications and radar L band) with accessories and laboratory manual **– NI//781913-01:** Dual-band antenna 2.4-2.48GHz and 4.9-5.9GHz for USRP-2922 – **NI//782922-3502:** LabVIEW Academic Premium Suite (1 user) license

Electronics Prototyping

ErmaBoard – Electronics prototyping platform (control circuits, communication, sensors, HMI, robotics, multimedia)

➢ *Features:*

- Electronic control (**microcontrollers, FPGA, ARM9**…)
- Power supply (battery, solar cell)
- Communication (**Ethernet, Bluetooth, RFID, Zigbee, GPS, WiFi, CAN**…)
- **Sensors** (temperature, accelerometer, proximity…)
- **Human-Machine Interface** (LCD, keyboard, voice recognition…)
- **Robotics/Mechatronics** (relays, servomotors, mobile robot chassis….)
- **Multimedia** (MicroSD card, JPEG imager, MP3 decoder…)
- **USB logic analyzer** for the study of serial protocols

➢ *Training activities:*

- **Architecture of electronic control systems**
- **Principles of microcontrollers, FPGA and microprocessors (ARM9) operating principles** as well as their applications
- Programming the microcontroller, FPGA, and microprocessor ARM9 with the provided libraries
- **Communications protocols**
- **Prototyping electronic control systems**
- Project 1 : **Design and fabrication of a 2-wheel robot controlled by:**
  1. **a human-machine interface on LabVIEW,**
  2. **a joystick** (Nunchuk of the Wii console) **and a LabVIEW or Arduino application,**
  3. the Wiimote **accelerometer** (Wii console) **and a LabVIEW application**
- Project 2 : **Design, fabrication and commissioning a firefighter robot**
- **Other projects are available**

Resources for projects

➢ *Key points:*

- **Electronic circuits compatible with modular** systems
- Ideal for **projects in the fields of electronics, information processing, communications and robotics**
- Provides introduction to and practice of **several programming languages** (graphics or text)
- May be studied with the **tutorial work provided, or as a resource for other instructional systems** (e.g. : Prototyping a motor control unit with motorized hinges or a 4-wheel vehicle for NAO robot …)

➢ *Programming environment :*

ARDUINO™ RaspberryPi python™

	Arduino IDE	Minibloq	LIFA LabVIEW	Flowcode	MPLAB IDE	GCC	PhP	Python	Quartus II	Terminal
PR00 : Arduino UNO (Atmel Atmega)	✓	✓	✓	✓						
PR01 : Arduino compatible **ERM** (PIC 18)				✓	✓					
PR05 : Raspberry PI (ARM Cortex A7)						✓	✓	✓		
PR02 : FoxBoard (ARM9)						✓	✓	✓		
PR03 : FPGA Altera (Cyclone 4)									✓	
PR04 : Bus Pirate (PIC 24)										✓

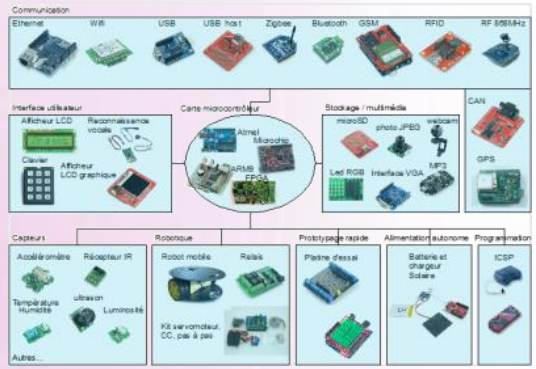
Electronic control

PR00 Arduino UNO development kit (Atmel Microcontroller)
PR01 Arduino, compatible ERM (PIC18 Microcontroller Microchip)
PR05 Raspberry Pi development kit (ARM microcontroller)
PR02 Foxboard development kit (ARM microcontroller)
PR03 FPGA development board
PR04 Interface board for components on bus i2c, SPI, UART (no programming)
PR08 Kit with lithium-ion polymer battery and solar cell
PR09 USB logic analyzer – Protocol analyzer CAN, SPI, I2C, RS232

PR10 – Ethernet kit

Communication

PR10 Ethernet Kit
PR11 Wi-Fi Kit
PR12 USB device and USB host Kit
PR13 Zigbee Kit
PR14 Bluetooth Kit
PR15 GSM Communications Module
PR16 RFID Kit
PR17 RF 868 MHz Kit
PR18 CAN Communications Module
PR20 GPS Kit
PR21 NFC Kit



Sensors

PR30 Sensor kit (temperature, brightness, infrared, capacitive sensing) with connectors
PR31 Sensor kit with accelerometer, gyroscope, compass
PR32 Sensor kit for distance, proximity and color detection

Human-Machine Interface

PR42 Speech recognition kit
PR43 RGB led matrix
PR44 LCD color display

PR30 - Sensor Kit with connectors

Robotics

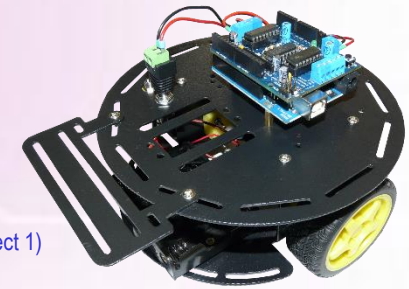
PR50 4-relay board with opto-isolated control
PR51 Servo and motor kit
PR52 Chassis for 2-wheel robot with DC motor

Multimedia

PR60 Storage on microSD card
PR61 JPEG imager
PR62 VGA Interface
PR63 MP3 Decoder
PR64 USB Webcam

Project kits

PJ00 Project kit "Remote-controlled 2-wheel robot" (Project 1)



PJ00: Prototyping a 2-wheel robot

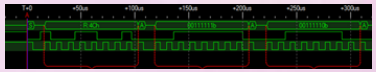
Electronics Prototyping Packs

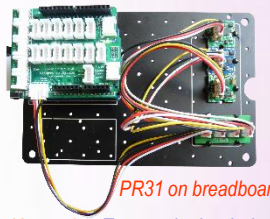
ErmaBoard Sensors & Motors pack – Study of motor control and sensor technologies

PR30 kit

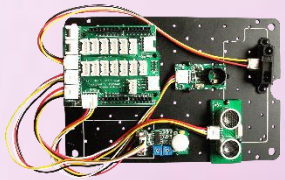
➢ *Features:*
- **Microcontrollers** (Atmel/Arduino UNO or Microchip PIC18)
- **Human Machine Interface** (LCD display)
- **Sensors** (temperature, light, infrared, capacitive sensing, accelerometer, gyroscope, compass, distance, proximity, color detection, etc.)
- Mounting and **prototyping** breadboards
- **Motors** (DC, servomotor and stepper)

➢ *Training activities:*
- Control of several motors (servomotors, DC, etc.)
- Sensor setup (accelerometer, ultrasound, color detection, etc.)
- Analysis of **communication protocols** (I2C, SPI, etc.)
- **Signal processing** and impact of sampling frequency on measurement accuracy

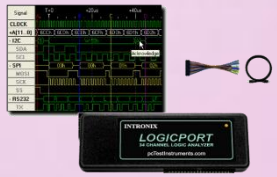




PR31 on breadboard



PR32 on breadboard

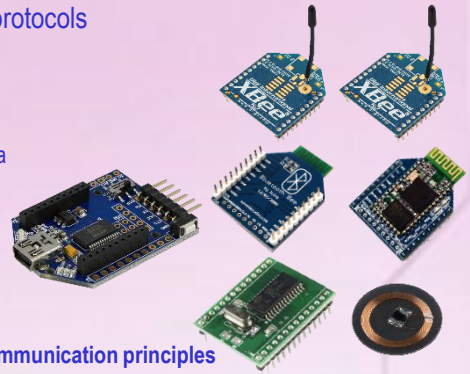


PR09 USB logic analyzer

➢ *Key point:* Economical solution for learning sensor and motor technologies

➢ *References:* **PR00+PR30+PR31+PR32+PR51:** ErmaBoard Sensors & Motors – **PR09:** USB logic analyzer

ErmaBoard RFID / Bluetooth / ZigBee pack – Study of RFID, Bluetooth and ZigBee communication protocols



➢ *Features:*
- Microcontrollers (Atmel/Arduino or Microchip PIC18)
- 2.4 GHz Zigbee radio communication
- 250 Kbps rate, 100 m transmission range, integrated antenna
- Bluetooth V2.0 communication / 3 Mbps ERD modulation
- 2.4 GHz band, - 80 dBm sensitivity, UART interface
- RFID communication with an SM130 circuit of 13.56 MHz
- Compatible Mifare reader, encoder, I2C, UART output
- RFID label: 25 mm diameter, 0.7 mm thickness

➢ *Training activities:*
- Study and **comparison of Bluetooth, ZigBee and RFID communication principles**
- Study of electronic circuits and communication protocols
- Signal recovery and analysis, **frame decoding** and protocol-related operations
- **Implementation of applications using Bluetooth, ZigBee communication**
- **Implementation of applications using RFID encoding**

➢ *Key point:* Economical solution for learning RFID, Bluetooth and Zigbee protocols

➢ *References:* **PR00+PR13+PR14+PR16:** ErmaBoard RFID / Bluetooth / ZigBee

ErmaBoard Wi-Fi & GSM pack – Study of Wi-Fi and GSM communication protocols

GSM

Wi-Fi

➢ *Features:*
- Microcontrollers (Atmel/Arduino UNO or Microchip PIC18)
- Communication using a RN-171 circuit (Wi-Fi)
- 802.1 b/g radio Wi-Fi, 32-bit processor, TCP/IP stack, real-time clock
- Communication using a SIM900 circuit (GSM / CPRS)
- Four-band: 800/900/1800/1900 MHz, UDP / TCP protocol

➢ *Training activities:*
- Study of the operation of GSM and Wi-Fi communication protocols
- Study of circuits and source code using Wi-Fi and GSM cards
- **SMS sending** application
- **Wi-Fi Hotspot creation** (Connectify software) and configuration (**WPA2 encryption**)
- Machine-to-machine **(M2M)** remote control application
- **Geolocation** application using PR20 and **GPRS** coupling

➢ *Key point:* Economical solution for learning protocols (Wi-Fi / GSM)

➢ *References:* **PR00+PR11+PR15:** ErmaBoard Wi-Fi & GSM

ErmaBoard Ethernet pack – Study of the Ethernet communication protocol

➢ *Features:*
- Microcontrollers (Atmel/Arduino UNO or Microchip PIC18)
- Communication using an integrated Wiznet 5100 (Ethernet) circuit
- Micro-SD support
- LEDs indicating status: LINK, FULLD, 100M, TX, RX, COLL
- SPI communication using the microcontroller

➢ *Training activities:*
- Studying the components and **architecture of an Ethernet network**
- Organization and communication protocols (**frame analysis**)
- Network securing
- Internet connection and communication (IP address, DHCP server, HTTP request, HTML page, etc.)
- Programming with implementation of various classes (Ethernet, IP Address, Server, Client, Ethernet UDP)

➢ *Key point:* Economical solution for learning the Ethernet protocol

➢ *References:* **PR00+PR10:** ErmaBoard Ethernet – **PR09:** USB logic analyzer

ErmaBoard GPS pack – Study of GPS geolocation

➢ *Features:*
- Microcontrollers (Atmel/Arduino UNO or Microchip PIC18)
- GPS geolocation
- 66 channels and -165 dBm sensitivity
- Internal antenna and connector for external antenna (add-on)

➢ *Training activities:*
- Study of **GPS principles** (triangulation methods, navigation, accuracy, etc.)
- Study of electronic circuits and of the GPS sensor
- Recovery and analysis of GPS reception signals, **frame decoding and operation**
- Analysis of the impact that the **number of satellite signals** has on **accuracy**
- **Structure improvement proposal** for better GPS signal reception

➢ *Key point:* Economical solution for GPS learning

➢ *References:* **PR00+PR20:** ErmaBoard GPS

Electronics Prototyping Projects

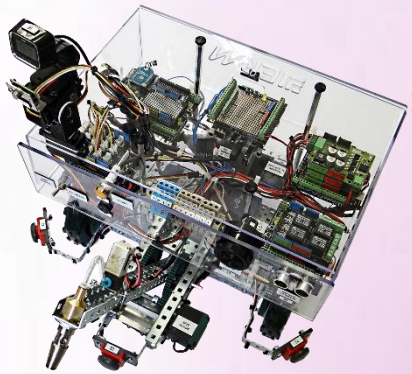
Fire fighter robot – Multi-application assembly kit to design a fire fighter robot

Real situation

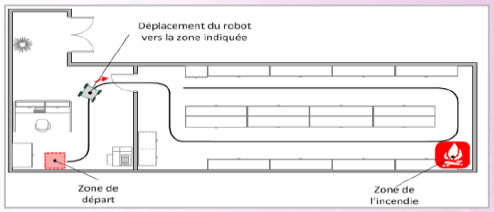
➢ *Features:*
- Electronic control (**microcontrollers, ARM9**…)
- Power supply (battery)
- Communication (RF 868MHz, **WiFi**)
- **Sensors** (proximity, ultrasound, temperature…)
- **Motors** (CC, servo motors)
- **Mechanics** (chassis for mobile robot, VEX Robotics parts…)
- **Multimedia** (cameras…)

➢ *Training activities*
- **Designing a ¼ scale model of a fire fighter robot** to study mechanics, electrical power and electronic controls
- Designing **6 project kits** and the **architecture of the whole robot** in 7 two-person teams
- Designing and testing mechanical transmissions
- Prototyping **3D mechanical parts**

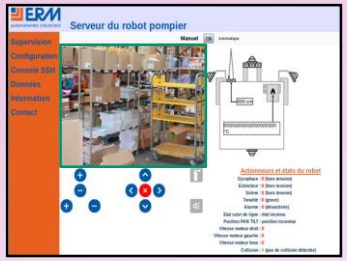
➢ *Key points:*
- Possibility of having up to **14 students in groups of 2** working on the project
- Project can be **taken up and improved every year**
- **Large variety of assembly kits and parts for different constructive solutions**
- **Delivered with the "answers"** (one solution is completely explained and functional)



Example of a possible solution



Specifications for the robot motion

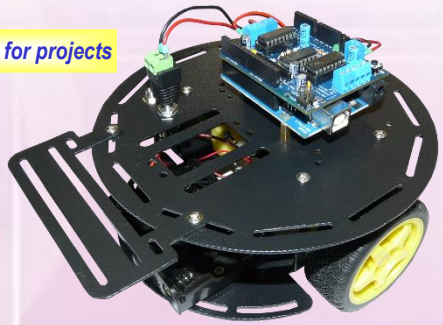


Web server for robot control

➢ *References:* **PJ10+PJ11+PJ12+PJ13+PJ14+PJ15+PJ16:** Fire fighter robot – **PJ11**: Project kit "make the robot move" – **PJ12**: Project kit "Guide the robot by following a line" – **PJ13**: Project kit "Detect obstacles" – **PJ14**: Project kit "Find the source of the fire"– **PJ15**: Project kit "Communication" – **PJ16**: Project kit "Fire alert and fire extinguishing"

ErmaBoard Project - Electronics prototyping platform (control circuits, communication, sensors, HMI, robotics, multimedia)

Resources for projects



PJ00: Prototyping of a two-wheeled robot

➢ *Features:*
- **Electronic control** (microcontrollers, FPGA, ARM9, etc.)
- **Power supply** (battery, solar cell)
- **Communication** (Ethernet, Bluetooth, RFID, ZigBee, GPS, WiFi, CAN, etc.)
- **Sensors** (temperature, accelerometer, proximity, etc.)
- **Human Machine Interface** (LCD display, keyboard, voice recognition, etc.)
- **Robotics/Mechatronics** (relays, servomotors, frame for the mobile robot, etc.)
- **Multimedia** (microSD storage, JPEG imager, MP3 decoder, etc.)
- **USB logic analyzer** enabling the study of serial protocols

➢ *Training activities:*
- Studying the **architecture of electronic control systems**
- Study and programming of **microcontrollers, microprocessors (ARM9) and FPGA** using the provided libraries
- Study of **communication protocols**
- **Prototyping of electronic control systems**
- Project 1: **Design of a two-wheeled robot controlled by:**
  - ❶ **a Human Machine Interface on LabVIEW,**
  - ❷ **a** Nunchuk **joystick** (Wii controller) and a **LabVIEW or Arduino** application,
  - ❸ the Wiimote **accelerometer** (Wii controller) and a **LabVIEW** application
- **Other projects are available**

PR30 – Sensor kit with connection base

➢ *Key points:*
- Family of **interoperable electronic circuits** that allow **modular** assembly resulting in a **prototype control system**
- Ideal for **project activities in the fields of electronics, information processing, communications and robotics**
- Provides introduction to and practice of **several programming languages** (graphics or text)
- The system may be **studied with the tutorial work provided or as a resource for other instructional systems** (e.g., prototyping the motor control unit of a motorized hinge, a 4-wheeled vehicle for the NAO robot, etc.)

➢ *Programming environments:* **See page G7**

➢ *References:* **See page G7/G8 and the Fire Fighter Robot**

Humanoid finger – Multi-technologies project

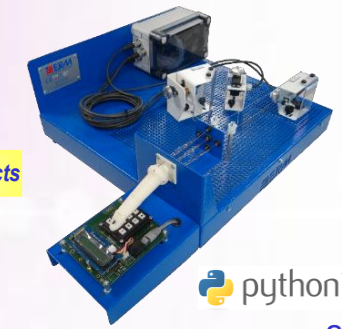
➢ *Features:*
- Sensors, microcontrollers, HMI
- DC motor, servomotor, electric cylinder, mechanical transmissions

➢ *Training activities:*
- Prototyping 3D mechanical parts (3D printing)
- SED programming in Python (Raspberry/Arduino)
- Projects: Create a motorized finger

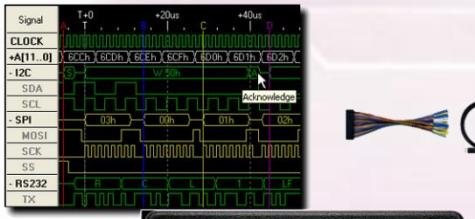
Resources for projects

➢ *Key points:*
- Large variety of parts for different constructive solutions
- Assembly kit project with a correction

➢ *References:* **DR10**: Humanoid finger



Frame analyzer



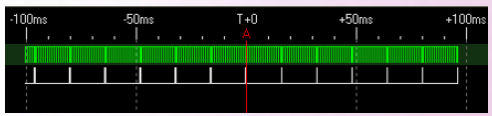
➢ *Technical specifications:*

- Interpreted protocols: **RS232**, **RS485** asynchronous serial communication, **SPI** synchronous serial communication, **I2C** Inter-Integrated Circuit, CAN bus, 1-Wire bus, and more
- Number of sampled channels: **34**
- **500 MHz** timing mode (internal clock)
- **200 MHz** state mode (external clock)
- Built-in 300 MHz frequency counter
- Advanced multi-level triggering
- Adjustable logic threshold: +6 V to –6 V
- Real-time sample compression

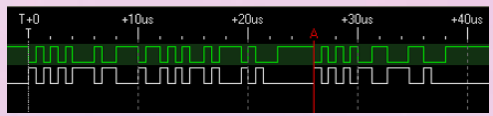
➢ *Key points:*

- **34-channel / 500 MHz logic analyzer connected to a PC via USB.**
- **Frame interpreters for several protocols: UART, I2C, SPI, CAN**

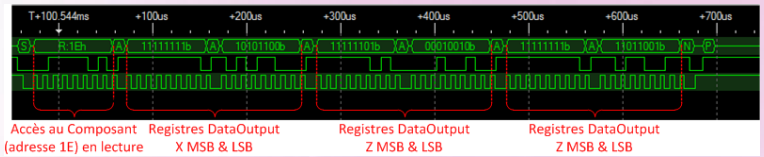
➢ *Reference:* **PR09:** 34-channel logic analyzer



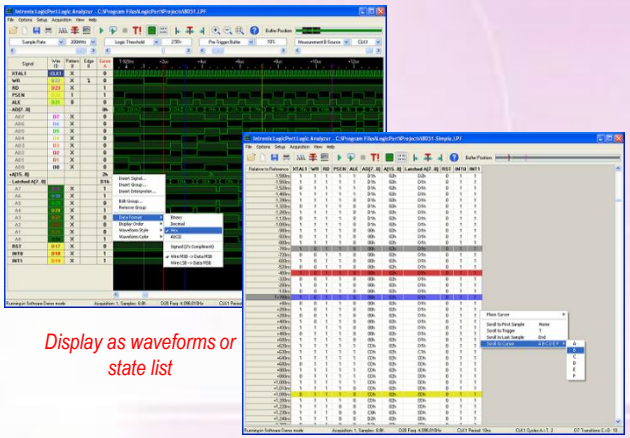
Sampling using data compression



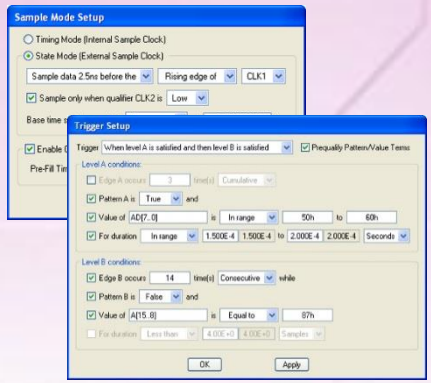
Zoom on some of the sampled data



Example of I²C frame determination



Display as waveforms or state list



Configuration windows

Industrial command prototyping platform - Prototyping of control parts based on a real-time NI myRIO core and industrial motor controller boards

LabVIEW Real-Time
Graphical Development, Real-Time Results

CANopen

➢ *Features:*

- Real-time **LabVIEW** control (**myRIO** board)
- Communication (**CAN** bus)
- Motorization & Energy (**industrial controller for brushless, DC and stepper motors**)
- **Load measurement**
- **Video and image processing**
- **Inertial measurement unit** (accelerometer and gyroscope)

➢ *Training activities and projects:*

- **Real-time** programming in **LabVIEW**
- **Motor controller board configuration**
- Study and configuration of a **CAN bus**
- Experimental **optimization** of control parameters via **autotune**
- Integration of **image analysis** in a control system
- Project: **System control design or upgrade** (position, speed and load control)

Resources for projects

Controller board for brushless / stepper / DC motors

Video control camera

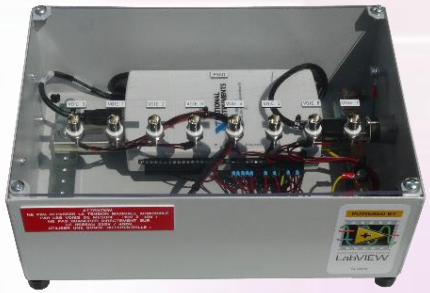
Programming and control interface with video feedback

➢ *Key points:*

- The solution is open to development projects on your existing systems
- Examples of applications with LabVIEW files provided (Aerial imaging gimbal, Cable-driven robot)
- **Compatible with C-Series boards** from National Instruments (for upgrades and projects)

➢ *References:* **NC00:** National Instruments myRIO kit for real-time control and acquisition – **NC09:** Controller board for 2 brushless motors – **NC08:** Controller board for stepper, DC and brushless motors – **NC01:** CAN communication card for myRIO – **NC15:** Video control camera – **NC20:** S-beam load cell with signal conditioner – **NC21:** Inertial measurement unit with accelerometer and gyroscope – **SQ11:** 96 fps USB camera with configuration software (LabVIEW analysis) – **SQ12:** 500 fps USB camera

USB NI 6210 data logger – Temperature datalogging, 0/10V sensors, 0 to 500V voltage, amperage, constraint



➢ *Specifications:*
- **8 Analog Inputs** ± 10V (1- bits, 250 kS/s)
- 8 Digital Inputs/Outputs
- Two 32-bit counter/timers
- Software configuration for thermocouples
- **Isolated input channels by external conditioners**
- User-friendly datalogging software (datalogging, display and analysis)

➢ *Types of measurable data and Conditioners:*
- 0/10V sensors (without conditioner)
- AC and DC voltage: 0/500V (with AC and DC voltage input conditioner)
- AC and DC amperage (with AC and DC amperage conditioner)
- Other sensors (with conditioners)

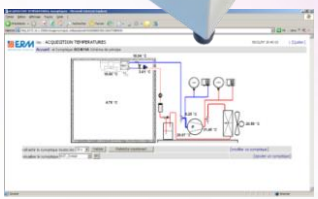
Resources for projects

LabVIEW

➢ *Key points:*
- May be used on ERM systems and any other didactic system
- **User-friendly data logging software: Sysma WinATS** (software in French)
- Possible interface with Labview (executable files supplied for ERM systems, Labview software)
- Possible use of Labview Signal Express, free data logging software
- **Wide range of adjustable sensors and conditioners**

➢ *References:* **AQ10** USB data logger – **AQ11** Differential voltage probe for USB data logger – **AQ12** AC current clamp for USB data logger – **AQ13** AC+DC current clamp for USB data logger – **AQ00** Sysma WinATS data logging software – Many conditioners and sensors are available

Data-logging and tele-monitoring unit



➢ *Technical specifications:*
- Data-acquisition and logging box for any type of measurement
- **16 universal analog entries (0/10V, 4/20mA with external shunt, PT1000, PT100, CTN…)**
- Data export via **USB**, RS232 and Ethernet
- **Tele-monitoring software** (49 variables, Web server, history, alerts…)

➢ *Training activities:*
- Implementation of acquisition and tele-monitoring of thermal engineering systems
- Study of industrial communication solutions

➢ *Key points:* Many I/O and communication possibilities

➢ *Reference:* **MO21:** Data logger and tele-monitoring via Ethernet

Acquisition and control unit with NI 6009 input/output cards

➢ *Specifications of the USB acquisition and control unit:*
- **8 analog input channels** ±10V (14 bits, 48 kS/s)
- 2 analog output channels 0-10V (12 bits, 150 S/s)
- 12 digital I/O
- 32-bit counter
- User-friendly acquisition software (data logging, visualization and analysis)

➢ *Types of measurable data and conditioners:*
- 0/10V sensors (without conditioner)
- 0/500V AC and DC voltages (with AC/DC voltage conditioner)
- AC and DC current (with AC/DC current conditioner)
- Other sensors (with conditioners)

Resources for projects

LabVIEW

➢ *Key points:*
- **Practical and cost-effective solution for interfacing your systems with LabVIEW**
- May be used with ERM systems, and any other training system
- Possible use of LabVIEW Signal Express (free acquisition software)
- **Wide range of available sensors and measurement conditioners**

➢ *References:* **DI15:** Acquisition and control unit with NI 6009 input/output cards – **AQ11:** Differential voltage probe for the USB data logger – **AQ12:** AC current clamp for the USB data logger – **AQ13:** AC+DC current clamp for the USB data logger – Many conditioners and sensors are available (contact us)

High-speed USB cameras - Image analysis and study of physical phenomena

LabVIEW

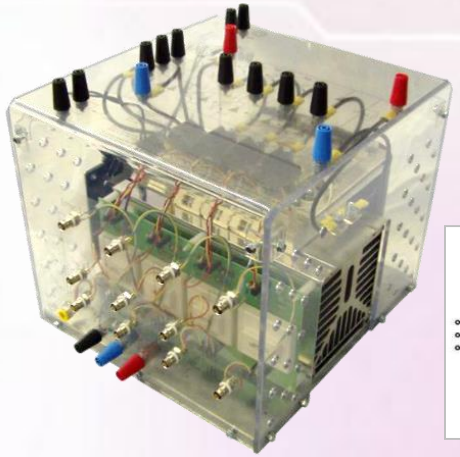
➢ *Specifications:*
- USB video camera (96fps or 500fps)
- Camera configuration software and examples of video processing on LabVIEW

➢ *Training activities:*
- Analysis of **motion, speed and acceleration** (studying free fall, a pendulum, etc.)
- Analysis of fluid motion and flow (**fluid mechanics**)
- **Image analysis** (camera configuration, filters, shape recognition, etc.)

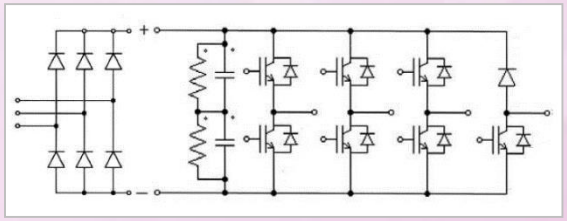
➢ *Key point:* Easy to install and configure

➢ *References:* **SQ11:** 96fps USB camera with configuration software and examples of LabVIEW image analysis applications – **SQ12:** 500fps USB camera

Multi-function power electronic converters – Multi-function IGBT or diode & thyristor converters with close control and protection

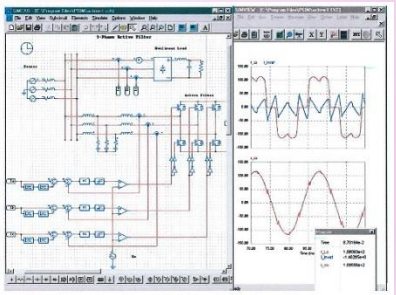


➢ *Features (IGBT):*
- 3x **dual IGBT**
- 1x **IGBT chopper**
- 1x **three-phase diode rectifier** module
- 1x **1100 µF / 800 Vdc capacitor** bench
- **Snubber capacitors**
- 1x **SKHI driver** board

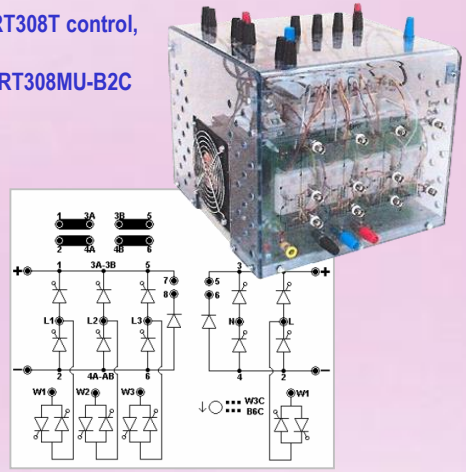


Architecture of the IGBT converter

➢ *Features (thyristors):*
- 1x **three-phase** system with **thyristor module** including **RT308T control, freewheeling diode** and snubber circuit
- 1x **single-phase** system with **thyristor module** including **RT308MU-B2C control, freewheeling diode** and snubber circuit



PSIM software



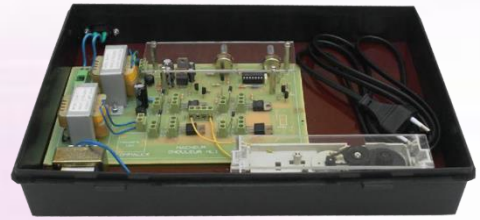
Architecture of the thyristor converter

➢ *Training activities:*
- Study of **three-phase inverters with brake chopper**
- Study of **single-phase inverters**
- Study of **step-down (buck) and step-up (boost) converters**
- Study of **single-phase and three-phase rectifiers**
- **Study of efficiency loss** and heat dissipation

➢ *Key points:*
- Multi-function IGBT or thyristor converter that can **simulate any industrial application**
- **PSIM software** to **design and analyze the converter in situ**
- **Transparent enclosure** allowing visualization of every part

➢ *References:* **IG05:** Multi-function IGBT converter with close control and protection device (0-5V control) - **IG15:** Multi-function IGBT converter with close control and protection device (0-15V control) – **IG20:** Multi-function diode and thyristor converter with close control – **IG10:** Preconfigured control electronic kit for motor control

Powertronics chopper – Trainer for the study of choppers



➢ *Features:*
- Step-down chopper
- H bridge

➢ *Training activities:*
- Study of **chopper control**
- Study of a **step-down chopper (RL load)**
- Study of an **H-bridge chopper (DC motor load, change of speed and direction of rotation)**

➢ *Key points:*
- **Resistive (1,2kΩ), inductive and DC motor loads**
- **Voltage and current can be measured on all power components**: 4 transistors, loads
- Available test points: triangle wave, duty cycle, downtime
- **Variable** frequency and duty cycle according to potentiometers

➢ *Reference:* **AZ10:** Powertronics chopper

Powertronics single-phase inverter – Trainer for the study of single-phase PWM inverters

➢ *Features:*
- Single-phase inverter

➢ *Training activities:*
- Study of **inverter control**
- Study of various ways of assembling a single-phase inverter: 4-transistor bridge, **full wave control** and **sine-triangle PWM**
- Study of parameter influence on a loading inverter

➢ *Key points:*
- Loads used: resistive load, 12/220V step-up transformer
- **Voltage and current can be measured on all power components**: 4 transistors, load
- Variable-frequency triangle wave (carrier), variable-amplitude sine wave (reference), variable duty cycle, downtime

➢ *Reference:* **AZ11:** Powertronics single-phase inverter

Powertronics rectifier – Trainer for the study of single-phase controlled rectifiers

➢ *Features:*
- Single-phase controlled rectifier

➢ *Training activities:*
- Study of various ways of assembling rectifiers: **mixed bridge** (2 diodes and 2 thyristors), **controlled bridge** (4 thyristors)
- Study of **rectifier control**

➢ *Key points:*
- Resistive (24V lamp), inductive and DC motor loads
- Voltage and current can be measured on all power components: thyristors, loads
- Available test points: **zero-crossing detection, synchronous ramp, firing angle control, pulse train**
- **Variable firing angle** according to potentiometers
- Galvanic isolation with pulse transformers
- **Thyristor control by pulse train** (2 kHz pulse frequency)

➢ *Reference :* **AZ12:** Powertronics rectifier

ERM AUTOMATISMES

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