

Electronics Training LAB

Electronics

Autotronics

Mechatronics

Refrigeration

Tech Prep



About SES

SES Scientific Educational Systems develops, manufactures and markets worldwide educational training systems since 1982.

SES is a quality assured firm with of ISO-9001:2008 certification.

SES products cover study programs for:

Universities, colleges, vocational schools, high schools, secondary schools and primary schools.

SES products are off-the-shelf products and are course modular systems. They can be adapted to various types of study programs and laboratories.

SES has 4 product lines:

DEGEM Systems Professional training for universities, colleges and vocational schools.

NeuLog Logger sensors for science experiments and robotics systems for all schools.

MagiClass Response system with intuitive clickers for all schools.

MultiCenter Science, robotics, technology, art, music and language training systems for ages 5+.

Electronics Training Program

Professions based in electronics are:

- **Computers and networks,**
- **Instruments,**
- **Medical instruments,**
- **Communication,**
- **Consumer products,**
- **Many others.**

Technology disciplines that are also based in electronics:

Electricity, Mechanics, Automotive, Robotics, Automation, Process control.

Success in these disciplines require study in the following basic electronics topics:

- **Electricity Laws and circuits**
- **Semiconductors**
- **Analog Electronics**
- **Digital Electronics**
- **Power supplies**

An embedded controller (or controllers) system is the basis of every electronic system. Software directs the system functions.

The essence of electronics today is **control unit, signal conversion, communication** between units and **coding**.

The ARM 32 bit controller family is the dominant controller in such applications (more than 75%).

Advance topics for electronics specialties are:

- **Industrial Electronics**
- **Programmable logic devices (PLD)**
- **Microprocessors and microcontrollers**
- **Embedded systems**
- **Telecommunications**

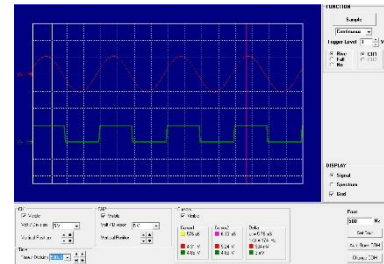
Basic Electronics Topics

- **Electricity**
 - * Direct current, Ohm's Law and electrical power
 - * Kirchhoff's laws and electric circuits
 - * Resistors and potentiometers
 - * Alternate current and RLC circuits
 - * Magnetism and electricity
 - * Transformers, motors and generators
 - * Power control – SCR, TRIAC, DIAC, PUT
- **Semiconductors**
 - * Diodes and Zener diodes
 - * LEDs
 - * LDR, phototransistor and photodiode
 - * Displays
- **Analog electronics**
 - * The bipolar transistor in DC circuits and as an amplifier
 - * The FET transistor in DC circuits and as an amplifier
 - * Operational amplifiers
 - * Oscillators
 - * Filters
 - * Power amplifiers
- **Digital electronics**
 - * Logic gates
 - * Boolean algebra, functions and equations
 - * Codes, decoders and multiplexers
 - * Binary adding, subtraction and comparison
 - * Flip-flops and their applications
 - * Registers and their applications
 - * Counters and their applications
 - * Converters (ADC, DAC)
- **Power supplies**
 - * Transformers
 - * Rectifiers
 - * Filters
 - * Regulators
 - * Converters

Advance Topics for Electronics Specialties

- **Programmable components**
 - * Logic function implementation with graphic editor
 - * Compilation and simulation
 - * Programming and troubleshooting
 - * VHDL
- **Principles of microcontrollers**
 - * The microcomputer and its operation principles
 - * Machine and assembly languages
 - * Registers, addressing modes and flags
 - * The CPU instruction set
 - * I/O Ports, keyboards and displays
 - * DAC and ADC
 - * Communication between computers
- **Advance processors and embedded systems**
 - * 32 bit ARM microcontroller
 - * The ARM microcontroller structure and its registers
 - * C language and C programs
 - * ARM I/O ports
 - * Displays operated by ARM
 - * Switches and keyboards
 - * Counters and timers
 - * DAC and ADC
 - * Embedded ARM project
 - * Embedded Linux system
- **Communication**
 - * AM transmission and reception
 - * FM transmission and reception
 - * Digital communication – modulation and demodulation
 - * Optical communication and fiber optics
 - * Analog to digital and digital to analog signal conversion
- **Industrial electronics**
 - * Actuators, control components and control circuits
 - * DC motor and Step motor control
 - * Sensors
 - * DC-AC and AC-DC conversion
 - * Three phase motor control

EB-3000 Universal Training System

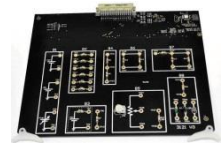


- EB-3000 supports every stage of electronics study, which is a must for almost every profession such as: **electronics, electricity, mechatronics, automotive, instrumentation, process control**, etc.
- The system includes: **5-voltages power supply, 2 voltmeters, ammeter, frequency counter, logic probe, logic analyzer, 2-channel digital oscilloscope, function generator** (sine, triangle and square signals).
- The system contains also: 3.2" color graphic display with touch panel, keyboard, 10 relays for inserting faults.
- The system provides USB wire communication with the PC for:
 - Virtual instrument **D-Scope** software that control the system function generator and graphic display of the scope signals.
 - Microprocessor and microcontroller editor, assembler, C compiler and debugger development software.
- The plug-in cards are connected to the trainer through a 48-contact, very low resistance industrial connector.
- Each plug-in card has its own controller for automatic identification by the main platform, for saving its required configuration and for automatic self-diagnostics while plugging it in.
- Experiment manual and courseware (including theory) for every card.
- Various electronics study programs for Mechatronics, for Autotronics, for Electrical Machines and Electricity using EB-3000 and its plug-in experiment cards are available.

EB-3000 Plug-In Experiment Cards

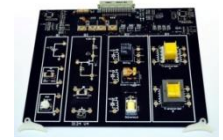
Electricity and Electrical Circuits

- EB-3121 DC Circuits I - Ohm and Kirchhoff Laws
- EB-3122 DC Circuits II - Norton, Thevenin and Superposition
- EB-3123 AC circuits - Signals and Filters
- EB-3124 Magnetism, Induction and Transformers



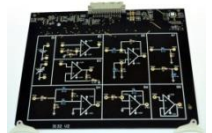
Semiconductor Devices

- EB-3125 Diodes, Zener diodes and Transistors
- EB-3126 Bipolar and FET Transistor amplifiers
- EB-3127 Industrial semiconductors – SCR, Triac, Diac and PUT
- EB-3128 Optoelectronic semiconductors – LED, phototransistor, LDR, 7-SEG
- EB-3129 Electrical components and Control circuits



Analog Electronics

- EB-3131 Operational amplifiers I - Inverter, Non-inverter, Summing and Differential.
- EB-3132 Operational amplifiers II - Comparators, integrator, differentiator, filter
- EB-3135 Power amplifiers
- EB-3136 Power supplies and regulators
- EB-3137 Oscillators



Motors, Generators and Inverters

- EB-3141 DC motor, Step motor and Generator Control
- EB-3142 Motor control with Optical and Hall Effect sensors
- EB-3143 AC-DC and DC-AC conversion circuits
- EB-3144 3 Phase Motor Control
- EB-3145 Sensors and Actuators
- EB-3146 Automotive Charging and Ignition



Digital Electronics

- EB-3151 Logic components - AND, OR, NOT, NAND, NOR, XOR
- EB-3152 Decoders, Multiplexers and Adders
- EB-3153 Sequential logic - Flip-flops, Registers and Counters
- EB-3154 555, ADC and DAC circuits
- EB-3155 Logic Families



Telecommunication

- EB-3161 AM Transmitter and Receiver
- EB-3162 FM Transmitter and Receiver
- EB-3163 Digital Communication - Modulation and Demodulation
- EB-3164 Digital Communication - Signal Conversion
- EB-3165 Optical Communication and Fiber Optic
- EB-3166 SSB – DSB Transmitter Receiver



Automotive

- EB-3170 CAN-BUS Systems

Microprocessor/Microcontroller Technology

- EB-3191 Introduction to 8 bit Microcontrollers with the 8051
- EB-3192 Introduction to 32 bit Microcontrollers with the ARM
- EB-3193 Introduction to 16 bit Microcontrollers with the AVR
- EB-3198 Programmable Logic Devices
- TS-3090 Embedded Project development card with the 8051
- TS-3092 Standalone Introduction to 32 bit Microcontrollers with the ARM card



Experiment Card Configurations

Card	Description	Electricity set	Electronics set	Automotive set	Mechatronics set
EB-3121	DC circuits I – Ohm and Kirchhoff Laws	1	1	1	1
EB-3122	DC circuits II – Norton, Thevenin and Superposition	1	1	1	1
EB-3123	AC circuits – Signals and Filters	1	1	1	1
EB-3124	Magnetism, Induction and Transformers	1	1	1	1
EB-3125	Diodes, Zeners diodes and Transistors	1	1	1	1
EB-3126	Bipolar and FET Transistor Amplifiers	1	1	1	1
EB-3127	Industrial Semiconductors – SCR, Triac, Diac and PUT	1	1	1	1
EB-3128	Optoelectronic Semiconductors – LED, Phototransistor, LDR, 7-SEG.	1	1	1	1
EB-3129	Electrical components and Control Circuits			1	
EB-3131	Operational Amplifiers I – Inverter, Non-Inverter, Summing and Differential	1	1	1	
EB-3132	Operational Amplifiers II – Comparators, Integrators, Differentiator and Filters		1		
EB-3135	Power Amplifiers		1		
EB-3136	Power Supplies and Regulators		1		
EB-3137	Oscillators		1		
EB-3141	DC Motor, Step motor and Generator Control	1			1
EB-3142	Motor control with optical and Hall Effect sensors	1			1
EB-3143	AC-DC and DC-AC Conversion circuits	1			1
EB-3144	3-Phase Motor Control	1			1
EB-3145	Sensors and Actuators			1	
EB-3146	Automotive Charging and Ignition			1	
EB-3151	Logic Components – AND, OR, NOT, NAND, NOR, XOR	1	1	1	1
EB-3152	Decoders, Multiplexers and Adders	1	1	1	1
EB-3153	Sequential Logic – Flip-flops, Registers, and Counters	1	1	1	1
EB-3154	555, ADC and DAC Circuits	1	1	1	1
EB-3155	Logic Families		1		
EB-3161	AM Transmitter and Receiver		1		
EB-3162	FM Transmitter and Receiver		1		
EB-3163	Digital Communication - Modulation and Demodulation		1		
EB-3164	Digital Communication - Signal Conversion		1		
EB-3165	Optical Communication and Fiber Optic		1		
EB-3166	SSB–DSB Transmitter and Receiver		1		
EB-3170	CAN-BUS systems			1	

Card	Description	Electricity set	Electronics set	Automotive set	Mechatronics full set
EB-3191	Introduction to 8 bit Microcontrollers with the 8051		1		1
EB-3192	Introduction to 32 bit Microcontrollers with the ARM		1		
EB-3193	Introduction to 16 bit Microprocessors with the AVR		optional		
EB-3198	Programmable Logic Devices		1		
TS-3090	Embedded Project development card with the 8051		1		

Textbook (theory and practice) and courseware accompany each card.

Electronics Lab

The recommended number of workstation desks in an electronics lab is 10. These desks can serve 10 to 20 students.

Each desk should contain one EB-3000 (the Universal Training System) and one computer.

The EB-3000 experiment cards are located in the desk closet part. One at a time is taken out for experimenting.

The EB-3000 has built-in test equipment for efficient training and exercising.

In order to familiarize the students with the equipment they will find in industry, it is recommended to have also on each desk:

- a digital two channel oscilloscope
- digital multi-meter

The computer fulfills three functions:

- **Courseware** – study the theory, answer the preparation and summary questions, teacher monitoring.
- **Virtual instrument** – enables a view of signals on a larger display, running FFT, saving and printing screen results.
- **Coding** – Programming and debugging the microcontroller and PLD experiment cards.

EB-3000 Universal trainer specifications

EB-3000 is a universal training system for electricity and electronics with experiment plug-in cards.



The EB-3000 includes built-in measurement devices:

- 5 voltages power supply (+12V, +5V, -5V, -12V and variable)
- Function generator (sine, triangle and square signals) up to 1MHz
- Two channel digital oscilloscope
- Frequency counter up to 1MHz
- Logic analyzer with 8 digital inputs and trigger input
- Two voltmeters
- Ammeter
- CMOS/TTL level logic probe (high, low, open, pulse, memory)
- Fault insertion for practicing troubleshooting

The EB-3000 peripherals are:

- Sturdy plastic case
- 3.2" color graphic display
- Touch panel to program the measurement devices and the display options
- USB wire communication with the PC
- A 16-key keyboard for changing modes
- 4-key navigation buttons
- Ten relays for switching the plug-in cards or for inserting faults
- 48-pin very low resistance industrial connector for the plug-in cards
- Transparent sturdy cover covers the protected area above the plug-in cards

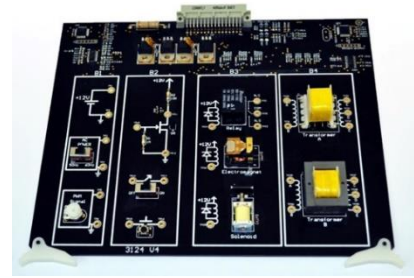
EB-3000 Special features:

- Plug-in a card and unplugging is simple and safe
- The plug-in card saves the relay configuration in a flash memory
- The plug-in card has silk printing of the actual circuit and symbols
- A sturdy transparent cover protects the plug-in card components
- The system works standalone or with a PC
- The system provides USB wire communication with the PC
- **Virtual instrument** software that control the system function generator and graphic display of the scope signals.
- Editor, assembler, C compiler and debugger development software for microprocessor and microcontroller training.
- The system identifies the plugged-in card automatically.
- Each plug-in card automatic diagnostics itself by its own controller
- The system displays current consumption of each voltage source
- Power supply is short circuit and overload protected

EB-3000 Experiment card specifications

Each experiment card covers complete hands on experiment in electronics.

Each card contains various practical circuits for performing meaningful experiments, which help reinforce the student's comprehension of the related concepts.



Experiment cards characteristics:

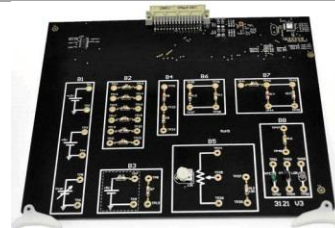
- Dimensions: 220 X 180 mm
- Industrial 48 pin DIN connector
- 2 card ejectors
- Silk drawing of the circuit schematics
- Banana 2mm jacks for wire connections and measurements
- Built-in controller for:
 - * Automatic card self-diagnostic while power on
 - * Relay configuration setting
 - * communication with the EB-3000 main controller

Experiment cards special features:

- Minimal wiring and setup time during experiment reduces wiring errors while increasing the time available for training.
- Fault insertion provides valuable true-to-life troubleshooting exercises and develops diagnostic skills.
- A comprehensive student experiment manual provides essential theory and clearly detailed experiment procedures.
- Courseware enhances the learning procedure and tests the students' level of competence.
- The student may learn in the standalone mode or under the optional CML (Computer Management Laboratory).
- A teacher's guide, a student experiment manual and an evaluation manual accompany the system.

EB-3121 – DC Circuits I – Ohm and Kirchhoff Laws

The EB-3121 DC Circuits I board is a comprehensive instructional module designed to teach the fundamental concepts of DC circuits the basic laws of electricity.



Components and circuits:

- * Voltage sources
- * Variable voltage source
- * Resistance circuits
- * Potentiometers
- * LDR, NTC, PTC components

Contents and Experiments:

- **Resistors and Ohm's Law**
 - * The electric circuit, voltage and current
 - * Ohm's law
 - * Resistors and value recognition
 - * Units and measurements
- **Voltage Sources**
- **Resistors in Series & 1st Kirchhoff's Law**
 - * Kirchhoff's Law – the voltage law
 - * Voltage divider
- **Resistors in Parallel & 2nd Kirchhoff's Law**
 - * 2nd Kirchhoff's Law – the current law
 - * Current divider
- **Variable Resistors**
 - * Potentiometer and rheostat
 - * Thermistors
 - * LDR – Light Dependent Resistor
- **Troubleshooting**

EB-3122 – DC Circuits II – Norton, Thevenin and Superposition

The EB-3122 DC Circuits II board is a comprehensive instructional module designed to teach some of the more advanced concepts of DC circuits and advance laws of electricity.



Components and circuits:

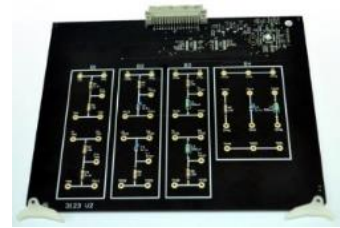
- * Voltage sources
- * Variable voltage source
- * Resistance circuits
- * Potentiometer
- * Current source circuit
- * Voltage source circuit

Contents and Experiments:

- **Voltage Sources and Power Transfer**
- **Thevenin Theorem**
- **Norton Theorem**
- **Superposition Theorem**
- **Troubleshooting**

EB-3123 – AC circuits – Signals and Filters

The EB-3123 AC Circuits board is a comprehensive instructional module designed to teach the fundamental concepts of AC circuits, signals and filters.



Components and circuits:

- * Resistor circuits
- * RC circuits
- * RL circuits
- * RLC circuits

Contents and Experiments:

- **Resistors in Alternate Current**
 - * Alternate current and AC waveforms
 - * Effective values
- **Resistor-Capacitor in Alternate Current**
 - * Capacitors
 - * RC circuits voltage and phase
 - * Low pass RC filter and frequency response
 - * High pass RC filter and frequency response
- **Resistor-Coil in Alternate Current**
 - * Coils
 - * RL circuits voltage and phase
 - * Low pass RL filter and frequency response
 - * High pass RL filter and frequency response
- **RLC in Alternate Current**
 - * RLC circuits
 - * RLC band pass filter
 - * Filter tuning
- **Troubleshooting**

EB-3124 – Magnetism, Induction and Transformers

The EB-3124 Magnetism and Induction board is a comprehensive instructional module designed to teach the fundamental concepts of magnetism, electromagnets and transformers.



Components and circuits:

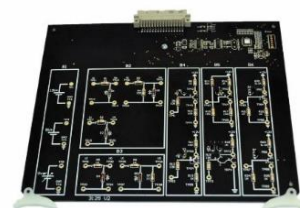
- * DC voltage source
- * AC voltage source
- * PWM signal source
- * FET driver
- * Switch
- * Pushbutton
- * Relay
- * Electromagnet
- * Solenoid
- * Transformer
- * Transformer without core

Contents and Experiments:

- **Electromagnet and Solenoid**
 - * Magnet
 - * Magnetic fields
 - * Electricity and magnetism
 - * Magnetic self and mutual induction
 - * Magnetic penetrability
 - * Magnetic Hysteresis
 - * Electromagnet
 - * The relay
 - * Solenoid
 - * PWM signal
- **The Transformer**
 - * Induced drive electro power
 - * The transformer
- **Troubleshooting**

EB-3125 – Diodes, Zeners and Transistors

The EB-3125 Diodes, Zeners and Transistors board is a comprehensive instructional module designed to introduce the student to the basic concepts of diodes, bipolar and field effect transistors and related DC circuits.



Components and circuits:

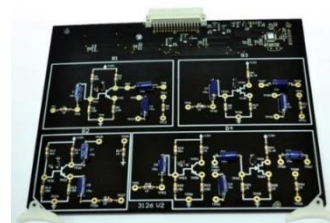
- * Diode circuits
- * Zener diode circuits
- * NPN and PNP transistor circuits
- * Darlington transistor circuit
- * FET circuits

Contents and Experiments:

- **Crystal Diode**
 - * Solid state devices
 - * P-N junction
 - * Diode circuits
 - * Forward and reverse bias
- **Zener Diode**
- **The Bipolar Transistor Characteristics**
 - * The bipolar transistor
 - * The transition characteristic
 - * A planar silicon transistor
 - * Load line and operating point
 - * Fix and self-bias circuits
- **The Field Effect Transistor Characteristics**
 - * Field effect transistor
 - * JFET – Junction Field Effect Transistor
 - * MOSFET
 - * The transition characteristic
 - * The MOSFET DC bias
- **Troubleshooting**

EB-3126 – Bipolar and FET Transistor amplifiers

The EB-3126 Bipolar and FET Amplifiers board is a comprehensive instructional module designed to introduce the student to the basic concepts of bipolar and Field Effect Transistor amplifiers.



Components and circuits:

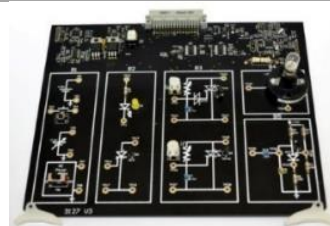
- * Bipolar transistor amplifier circuits
- * FET amplifier circuit
- * Bi-stage bipolar and FET amplifier circuits

Contents and Experiments:

- **The Bipolar Transistor Amplifier**
 - * Linear amplifier
 - * Bipolar transistor h parameters
 - * Common emitter amplifier
 - * Common Emitter with RE Amplifier
 - * Emitter follower amplifier
 - * Common base amplifier
 - * How to measure amplifier parameters
- **The FET Transistor Amplifier**
 - * The FET amplifier
 - * Common source amplifier (CS)
 - * Common source + RS amplifier (CS + RS)
 - * Source follower amplifier (CD)
- **Two-Stage Amplifier**
 - * Bi-stage amplifier
- **Troubleshooting**

EB-3127 – Industrial semiconductors

The EB-3127 Industrial Semiconductors board is a comprehensive instructional module designed to introduce the student to the basic concepts of SCR, TRIAC, DIAC, PUT semiconductors and related circuits.



Components and circuits:

- * DC voltage source
- * Variable voltage source
- * AC voltage source
- * Pushbutton
- * LED circuit
- * SCR circuit
- * TRIAC circuit
- * DIAC-TRIAC circuit
- * PUT circuit
- * Lamp

Contents and Experiments:

- **Silicon Controlled Rectifier and GTO**
 - * The SCR thyristor and circuits
 - * The GTO thyristor and circuits
- **Triac and Diac**
 - * The triac and circuits
 - * The diac and circuits
- **PUT - Programmed Uni Transistor**
 - * The PUT and circuits
- **Troubleshooting**

EB-3128 – Optoelectronic semiconductors

The EB-3128 Optoelectronic Semiconductors board is a comprehensive instructional module designed to introduce the student to the basic concepts of the LED, LDR, photodiode, phototransistor, 7-Segment display and related circuits.



Components and circuits:

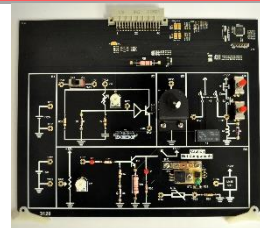
- * DC voltage sources
- * LED – phototransistor opto-coupler circuit
- * IR LED – photodiode opto-coupler circuit
- * LED – LDR opto-coupler circuit
- * Monolithic opto-coupler circuits
- * 8 switches and 7-Segment display
- * Optical transmitter – Receiver with fiber optic
- * Red, yellow and green LEDs
- * Red – green bi-color LED

Contents and Experiments:

- **Light Emitting Diode (LED)**
- **LDR (Light Dependent Resistance)**
 - * LDR – Light Dependent Resistor
 - * The LDR light response
- **Phototransistor**
- **Photodiode**
- **7-Segment Display**
- **Troubleshooting**

EB-3129 – Electrical components and Control circuits

The EB-3129 Electrical Control Circuits board is a comprehensive instructional module designed to introduce the student to the basic concepts of electrical components and circuits.



Components and circuits:

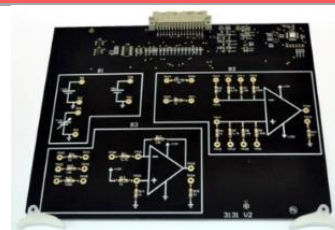
- * DC voltage sources
- * Switch
- * Driver circuit
- * Motor
- * Start – Stop relays circuit
- * Heater circuit
- * Thermostat circuit
- * NTC temperature sensor
- * LM35 temperature sensor

Contents and Experiments:

- **Relay Principles and Operation**
- **Start/Stop Motor Control Circuit**
- **Relay Delay Circuit Sequencer**
- **Thermostat Characteristics**
 - * Thermal switch
- **Potentiometers and Thermistors**
 - * Potentiometer and rheostat
 - * Thermistors
- **Troubleshooting**

EB-3131 – Operational Amplifiers I

The EB-3131 Operational Amplifiers I board is a comprehensive instructional module designed to introduce the student to the basic concepts of the inverting, non-inverting, adder and differential amplifiers.



Components and circuits:

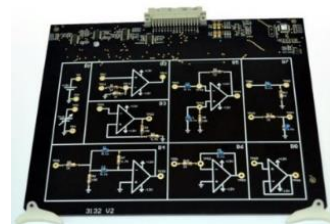
- * DC voltage sources
- * Variable voltage source
- * Dual voltage operational amplifier
- * Single voltage operational amplifier

Contents and Experiments:

- **Inverter Amplifier**
 - * Transistor differential amplifier
 - * The inverting amplifier
 - * Single supply voltage method
 - * Logarithmic amplifier
 - * How to measure amplifier parameters
- **Non Inverter & Follower Amplifier**
 - * Non inverting amplifier
 - * Voltage to current converter
 - * Current to voltage converter
 - * Follower amplifier (unity amplifier, buffer amplifier)
- **Adder & Differential Amplifiers**
 - * Adder amplifier
 - * Differential amplifier
- **Troubleshooting**

EB-3132 – Operational Amplifiers II

The EB-3132 Operational Amplifiers II board is a comprehensive instructional module designed to introduce the student to the basic concepts of the comparators, integrators, differentiators and filters using operational amplifiers.



Components and circuits:

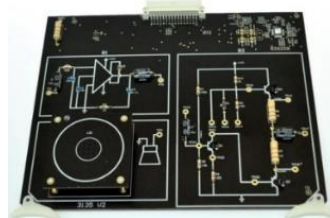
- * DC voltage sources
- * Variable voltage source
- * Comparator circuit
- * Schmitt trigger circuit
- * Band pass filter circuit
- * Differentiator circuit
- * Integrator circuit
- * RC circuits
- * Buffer amplifier

Contents and Experiments:

- **Comparator & Schmitt Trigger Comparator**
 - * Comparator amplifier
 - * A schmitt trigger comparator
- **Integrator & Differentiator Amplifiers**
 - * Integrator amplifier
 - * Differentiator amplifier
- **Filters**
 - * Filtering using the multiple feedback method
 - * Planning a filter in the multitude feedback method
 - * Tuning a filter with different components
 - * Low pass filter
 - * High pass filter
- **Troubleshooting**

EB-3135 – Power Amplifiers

The EB-3135 Power Amplifiers board is a comprehensive instructional module designed to introduce the student to the basic concepts of power amplifier circuits and their related components.



Components and circuits:

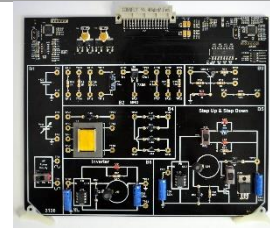
- * Monolithic power amplifier
- * Transistor power amplifier
- * A speaker

Contents and Experiments:

- **Transistor Power Amplifier**
 - * Introduction
 - * Capacitor coupling amplifier
 - * Transformer coupling amplifier
 - * Harmonic distortion
 - * Class A push-pull amplifier
 - * Class B, Class C and class AB push-pull amplifier
 - * Crossover distortions and class AB amplifier
 - * A complementary symmetry amplifier
 - * Real complementary amplifier
 - * Darlington power amplifiers
- **Operational Power Amplifier**
- **Troubleshooting**

EB-3136 – Power supplies and Regulators

The EB-3136 Power Supplies board is a comprehensive instructional module designed to introduce the student to the basic concepts of rectifiers, linear voltage regulators and switching regulators.



Components and circuits:

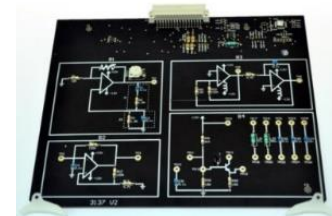
- * DC voltage sources
- * Variable voltage source
- * AC voltage source
- * Monolithic regulator circuit
- * Zener – transistor regulator circuit
- * Transformer
- * Rectifier circuit
- * Inverter switching regulator circuit
- * Step up / step down switching regulator circuit

Contents and Experiments:

- **Voltage Rectifiers**
 - * Introduction
 - * DC to AC converter
 - * Half wave rectifier
 - * A full wave rectifier with center branch transformer
 - * A diode bridge rectifier
- **Voltage Smoothing**
- **Linear Voltage Regulators**
 - * Zener diode regulation
 - * Zener diode with current amplifier
 - * Monolithic voltage regulator
- **Step-Down Switching Regulator**
- **Step-Up Switching Regulator**
- **Inverter Switching Regulator**
- **Troubleshooting**

EB-3137 – Oscillators

The EB-3137 Oscillators and tuned amplifiers board is a comprehensive instructional module designed to introduce the student to the basic concepts of various oscillators and tuned circuits.



Components and circuits:

- * Wein bridge oscillator circuit
- * Square wave oscillator circuit
- * Triangle wave oscillator circuit
- * Transistor oscillator circuit

Contents and Experiments:

- **Wein Bridge Oscillator**
- **A Square Wave Oscillator**
- **A Triangle Wave Oscillator**
- **Transistor Oscillator**
 - * Hartley oscillator
 - * Colpitz oscillator
- **Troubleshooting**

EB-3141 – DC Motor, Step motor and Generator Control

The EB-3141 Motor and Generator Control board is a comprehensive instructional module designed to introduce the student to the basic concepts of stepper motors, digital to analog (D/A or DAC) converter, pulse width modulation (PWM) circuit, electric generator and dynamo and motor – dynamo speed control.



Components and circuits:

- * Switches and DAC
- * PWM controller
- * Step motor controller
- * Step motor
- * DC motor
- * Dynamo
- * Load resistors

Contents and Experiments:

- **Stepper Motor Control**
 - * The stepper motor
 - * Step motor control
- **PWM and DAC Analog Control**
 - * Digital to analog converter
 - * The PWM circuit
- **Motor and Generator**
 - * Electric generator and dynamo
 - * Electric motor for direct current
 - * Motor – dynamo speed control
- **Troubleshooting**

EB-3142 – Motor control with Optical and Hall Effect sensors

The EB-3142 Motor Speed Control board is a comprehensive instructional module designed to introduce the student to the basic concepts of position and speed sensors open loop control and various closed loop control schemes.



Components and circuits:

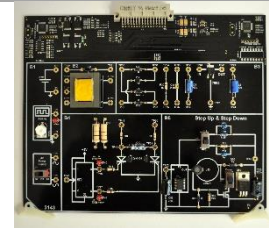
- * Motor controller
- * LCD display
- * Hall Effect detector
- * Optical detector
- * DC motor with rotating disk
- * Hall Effect sensor
- * Optical sensor
- * Load resistor

Contents and Experiments:

- **Principles & function of the Motion & Position Sensors**
 - * The Hall Effect sensor (Hall generator)
 - * Optical RPM (position) Sensor
- **Open and Close Loop Systems**
 - * Control systems and systems control
 - * Regulation and control systems
 - * Dual stage, multi stage and continuous control
 - * Open loop and closed loop control
 - * Motor RPM control
- **Troubleshooting**

EB-3143 – AC-DC and DC-AC Conversion circuits

The EB-3143 AC/DC and DC/AC Conversion board is a comprehensive instructional module designed to introduce the student to the basic concepts of voltage regulators, step-down and step-up switching regulators and DC/AC converters.



Components and circuits:

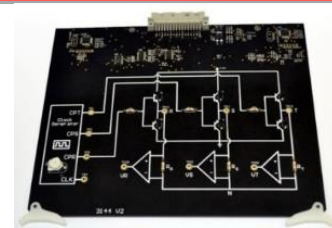
- * DC voltage sources
- * Pulse generator
- * AC voltage source
- * Transformer
- * Rectifier circuit
- * Monolithic regulator circuit
- * DC to AC converter circuit
- * Step up / step down switching regulator circuit

Contents and Experiments:

- **Voltage Rectifiers**
 - * Introduction
 - * Half wave rectifier
 - * A full wave rectifier with center branch transformer
 - * A diode bridge rectifier
- **Voltage Smoothing**
- **Linear Voltage Regulators**
 - * Zener diode regulation
 - * Zener diode with current amplifier
 - * Monolithic voltage regulator
- **Step-Down Switching Regulator**
- **Step-Up Switching Regulator**
- **DC-AC Converter**
- **Troubleshooting**

EB-3144 – 3-Phase Motor Control

The EB-3144 3-Phase Motor Control board is a comprehensive instructional module designed to introduce the student to the basic concepts of three phase motors and controllers.



Components and circuits:

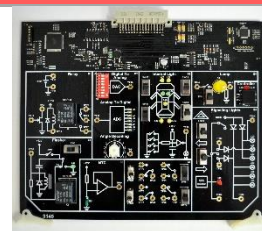
- * 3 phase clock generator
- * 3 phase driver circuit

Contents and Experiments:

- **3-Phase Motor Control**
 - * How 3-Phase motors work
 - * 3-phase motor controller
- **Troubleshooting**

EB-3145 – Sensors and Actuators

The EB-3145 Sensors and Actuators board is a comprehensive instructional module designed to introduce the student to the basic concepts of the sensor and actuator components and their related circuits.



Components and circuits:

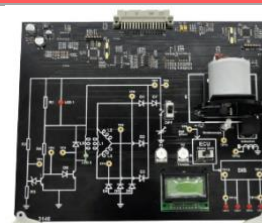
- * DC voltage source
- * FET driver
- * Relay
- * Relay flasher circuit
- * 8 switches and DAC circuit
- * 8 LEDs and ADC circuit
- * Potentiometer angle sensor
- * NTC circuit
- * CAR internal light circuit
- * Toggle and slide switches
- * Lamp circuit
- * Car signaling lights circuit

Contents and Experiments:

- **Lights and Switches**
 - * Switches and the door switches
 - * The electric lamp
 - * The car internal lights delay
 - * The transistor driver
 - * The electrical relay
 - * Light switching
 - * Stop light
- **Signaling & Emergency Lights**
 - * Principles of the turn signal control system
 - * Diode circuits
- **Relays in the Car**
 - * The electrical relay
 - * Electronic transistor driver
 - * The solid state switch
 - * Relay flasher
 - * Thermal switch
- **DAC and ADC Analog Control**
 - * DAC – Digital to Analog Converter
 - * ADC – Analog to Digital Converter
 - * Angular sensor
 - * Acceleration pedal position sensor
 - * Thermistors
- **Troubleshooting**

EB-3146 – Automotive Charging and Ignition

The EB-3146 Automotive Charging and Ignition board is a comprehensive instructional module designed to introduce the basic concepts of electrical components and circuits employed in automotive battery charging and electronic ignition systems.



Components and circuits:

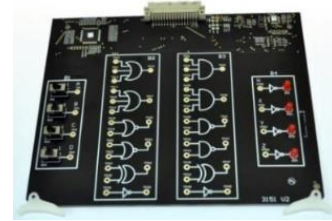
- * Alternator circuit
- * LCD display
- * DC motor with rotating disk and magnet
- * Inductive sensor
- * LED stroboscope
- * DIS circuit
- * Phase shift switch
- * Speed control potentiometer

Contents and Experiments:

- **Automotive Charging System**
 - * The automotive charging system
 - * Alternating current
 - * Alternator principles, signals and construction
 - * AC to DC conversion
 - * Voltage regulation, changing indication
 - * Alternator as a tachogenerator
- **Motion and Position Sensors**
 - * Ignition system with Hall Effect sensor
 - * Hall Effect sensor and applications
 - * Inductive Engine RPM / Reference-mark Sensor
 - * Ignition system with inductive sensor
 - * Optical RPM (position) sensor
 - * Distributing sparks
 - * The stroboscope as a calibrating tool
- **Distributor-less Ignition System**
- **Troubleshooting**

EB-3151 – Logic Components – AND, OR, NOT, NAND, NOR, XOR

The EB-3151 Logic components board is a comprehensive instructional module designed to introduce the student to the basic concepts of logic gates, Boolean functions, Karnaugh maps and simplifying logic functions.



Components and circuits:

- * 4 switches
- * 4 LEDs
- * 3 input OR gates
- * 3 input AND gates
- * 2 input NOR gates
- * 2 input NAND gates
- * 2 input XOR gates
- * NOT gates

Contents and Experiments:

- **Logic Gates**
 - * Logic components
 - * "AND" gate
 - * "OR" gate
 - * "NOT" gate – inverting gate
 - * "NAND" gate
 - * "NOR" gate
 - * "XOR" (eXclusive OR) gate
 - * Actual logic devices
- **Boolean Laws**
 - * Group theory and Venn diagrams
 - * Boolean algebra
- **Constructing Boolean Functions**
 - * Boolean functions
- **Constructing Functions with NAND or NOR Gates**
- **Karnaugh Map**
 - * Σ and π values of Boolean functions
 - * Karnaugh maps
 - * Simplifying functions by Karnaugh map
- **Equations with Don't Care States**
- **Designing a Logic Circuit**
 - * Constructing a multi output logic device
- **Troubleshooting**

EB-3152 – Decoders, Multiplexers and Adders

The EB-3152 Multiplexers, Decoders and Adders board is a comprehensive instructional module designed to introduce the student to the basic concepts of various decoders, creating a logic function with a decoder, multiplexers and their use in implementing logic functions and binary arithmetic implementation.



Components and circuits:

- * 8 switches
- * 8 LEDs
- * 7-Segment display
- * 4 NOT gates
- * 3 input AND gate
- * 2 input AND gates
- * 2 input XOR gates
- * 2 input OR gate
- * Decoders
- * Multiplexer
- * 4 Full Adders

Contents and Experiments:

- **Constructing a Decoder**
- **The Decoder**
 - * Integrated logic components
 - * Binary and BCD decoders
 - * 1 of n decoder
 - * The decoder as a decoder
 - * Primary and secondary decoding
 - * BCD to decimal as a 1 of 8 decoder
- **Using a Decoder to Materialize a Function**
- **Multiplexer Applied as a Multiplexer**
 - * A 1 of n multiplexer
- **Using a Multiplexer to Materialize Functions**
- **Binary Addition**
- **Binary Subtraction**
- **Binary Comparison**
- **Troubleshooting**

EB-3153 – Sequential Logic – Flip-Flops, Registers and Counters

The EB-3153 Sequential Logic board is a comprehensive instructional module designed to introduce the student to the basic concepts of flip-flops, registers, counters and sequential logic circuit.



Components and circuits:

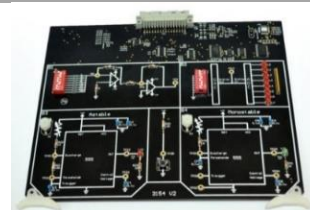
- * 4 switches
- * 4 LEDs
- * 3 input AND gates
- * 2 input NAND gates
- * 2 input OR gates
- * 2 input AND gates
- * 2 NOT gates
- * Clock generator
- * Pushbutton
- * 2 shift registers
- * Up/Down counter
- * 4 JK Flip-Flops

Contents and Experiments:

- **S-R Flip-Flop**
 - * S-R flip-flop
 - * Clock controlled S-R flip-flop
 - * D-Latch
- **J-K F-F**
 - * J-K flip-flops
 - * A clock controlled J-K flip-flop
 - * T flip-flop
 - * D flip-flop
 - * Flip-flops with edge triggering
- **Implementing a Register**
 - * Shift registers
- **PISO and SIPO Registers**
 - * Serial to parallel converter
 - * Parallel to serial conversion
- **Serial Processing**
 - * Serial operations on binary numbers
- **Ripple Counter**
 - * Count up and down binary ripple counter
 - * Modulo n and divide by n
 - * BCD count up ripple counter
 - * Integrated ripple counters
- **Synchronous Counters**
 - * A binary synchronous counter counting up
 - * A binary synchronous counter counting up/down
 - * A BCD synchronous counter
 - * A programmable synchronous counter
 - * Integrated synchronous counters
 - * Counter applications
- **Troubleshooting**

EB-3154 – 555, ADC and DAC circuits

The EB-3154 555, ADC and DAC board is a comprehensive instructional module designed to introduce the student to the basic concepts of timer circuits, analog to digital conversion and digital to analog conversion circuits.



Components and circuits:

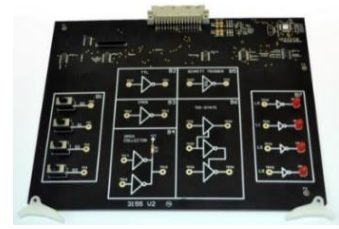
- * DAC with operational amplifier circuit
- * DAC and ADC circuit
- * 555 Astable circuit
- * 555 Monostable circuit

Contents and Experiments:

- **555 Timing Circuit**
 - * Monostable mode
 - * Astable mode
 - * Pulse width modulation
- **Operating DAC**
 - * Implementing a DAC with an operational amplifier & a resistor network
 - * The DAC08 – A monolithic DAC
 - * DAC0832
- **Employing DAC and ADC**
 - * ADC – materialized by a DAC
 - * ADC0820
- **Troubleshooting**

EB-3155 – Logic Families

The EB-3155 Logic Families board is a comprehensive instructional module designed to introduce the student to the basic concepts of logic gate characteristics, Schmitt trigger, open collector and tri-state outputs.



Components and circuits:

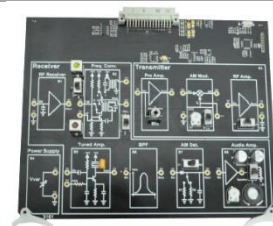
- * 4 switches
- * 4 LEDs
- * TTL NOT gate
- * CMOS NOT gate
- * Schmitt Trigger NOT gate
- * Open collector circuit
- * Tristate gate circuit

Contents and Experiments:

- **Gate Characteristics**
 - * Solid state devices – the major technologies
 - * The TTL family
 - * CMOS technology
 - * Input and output stages
 - * Input stages
 - * Output stages
 - * Characteristics
 - * Schmitt trigger
 - * Gates materialized by discrete components
 - * Technical specifications & data sheets reading
- **Troubleshooting**

EB-3161 – AM Transmitter and Receiver

The EB-3161 AM receiver and transmitter board is a comprehensive instructional module designed to introduce the student to the basic concepts of amplitude modulation (AM) and the corresponding transmitter and receiver as well as their related circuits.



Components and circuits:

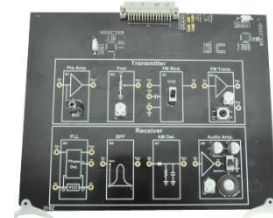
- * DC variable voltage source
- * RF receiver circuit
- * Frequency converter circuit
- * Pre-amplifier
- * AM Modulator
- * RF amplifier
- * Tuned amplifier
- * Band pass filter
- * AM detector
- * Audio amplifier
- * A speaker
- * A microphone
- * 2 PCB antennas

Contents and Experiments:

- **AM Amplitude Modulation**
- **AM Detection**
- **Band Pass Filter**
 - * Band Pass Filter
 - * Designing a filter in multiple feedback
 - * Tuning a filter by variable components
- **Tuned Amplifier, Mixer and Frequency Converter**
- **Crystal Tuned Amplifier & AGC**
- **Audio Amplifier and Speaker**
- **Preamplifier and Microphone**
- **Sensitivity, Selectivity, Tuner**
 - * Input circuit
 - * The radio sensitivity
 - * The radio selectivity
 - * Frequency response
 - * Simulated antenna and magnetic transmission
- **Troubleshooting**

EB-3162 – FM Transmitter and Receiver

The EB-3162 FM receiver and transmitter board is a comprehensive instructional module designed to introduce the student to the basic concepts of frequency modulation (FM) and the corresponding transmitter and receiver as well as their related circuits.



Components and circuits:

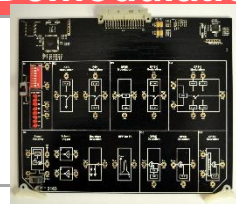
- * Pre-Amplifier
- * Variable voltage circuit
- * FM modulator
- * FM transmitter
- * PLL and FM detector circuit
- * Band pass filter
- * AM detector
- * Audio amplifier
- * A speaker
- * A microphone
- * Wire antenna

Contents and Experiments:

- **FM Modulation**
 - * Frequency modulation and phase
 - * Frequency reaction
 - * Measuring the frequency deviation
 - * Creating a frequency modulated wave
- **Band Pass Filter & Slope Detector (FM)**
 - * FM detector
 - * Frequency slope detector
 - * Time Delay Differentiator
 - * Designing a filter in multiple feedback
 - * Tuning a filter by variable components
- **PLL Oscillator & FM Detector**
- **Audio Amplifier and Speaker**
- **Preamplifier and Microphone**
- **Troubleshooting**

EB-3163 – Digital Communication - Modulation & Demodulation

The EB-3163 Digital Modulation and Demodulation is a comprehensive instructional module designed to introduce the student to the basic concepts of various digital modulation and demodulation techniques as well as their related circuits.



Components and circuits:

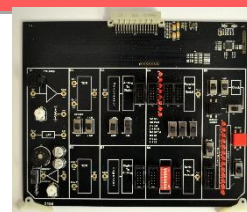
- * 8 switches
- * 8 LEDs
- * ASK modulator
- * FSK modulator
- * DPSK modulator
- * BPSK modulator
- * QPSK modulator
- * PLL signal follower
- * Schmitt Trigger gates
- * Envelope detector
- * Band pass filter
- * DPSK detector
- * BPSK detector
- * QPSK detector

Contents and Experiments:

- **Introduction to digital communication**
 - * Encoding and synchronization methods
 - * The RZ/NRZ methods
 - * Synchronous & asynchronous communication
 - * Transmission channel capacity
 - * The Nyquist Rule
 - * The Shannon formula
 - * Types of noise
 - * Modem and modulation methods
- **Transmitting & Receiving Digital Signals**
- **Band Pass Filter**
 - * Filtering using the multiple feedbacks method
 - * Designing a filter in the multiple feedbacks method
 - * Tuning a filter with different components
- **ASK Transmitting and Receiving**
 - * Envelope demodulation
 - * The roles of the components
- **FSK Transmitting and Receiving**
- **BPSK Transmitting and Receiving**
- **DPSK Transmitting and Receiving**
- **QPSK Transmitting and Receiving**
- **Tracking a Carrier Wave and FSK detecting using PLL**
- **Troubleshooting**

EB-3164 – Digital Communication - Signal Conversion

EB-3164 Digital Communication Signal Conversion is a comprehensive instructional module designed to introduce the basic concepts of converting analog and digital signals as well as some commonly used digital encoding techniques employed in digital communications systems.



Components and circuits:

- * Pre-amplifier
- * Variable voltage potentiometer
- * Low pass filter
- * Time Division Multiplexer
- * Compressor module
- * ADC module
- * 8 LEDs
- * Parallel to Serial module
- * Coding control module
- * RAM recording circuit
- * Serial to Parallel module
- * 8 switches
- * DAC module
- * Expander module
- * Time Division Demultiplexer
- * Audio amplifier
- * A speaker
- * A microphone
- * 4 flat cables

Contents and Experiments:

- **Analog Signals and Binary Numbers**
 - * The decimal system
 - * Base 2 – the binary system
 - * Base 16 – the hexadecimal system
 - * Voltage and current as analog signals
- **Audio Amplifier & Preamplifier**
- **ADC (Analog to Digital Converter)**
 - * ADC – materialized by a DAC
 - * Microcontroller ADC
- **DAC (Digital to Analog Converter)**
 - * Implementing a DAC with an operational amplifier and resistor network
 - * Microcontroller DAC
- **Signal Sampling and Reconstructing**
 - * Sample and Hold (S/H)
 - * Pulse Amplitude Modulation (PAM)
 - * Pulse Code Modulation (PCM)
 - * Delta Modulation (ΔM)
 - * The sampling frequency influence on the reconstruction quality
 - * Time Division Multiplexing (TDM)
- **RAM (Random Access Memory)**
- **Digital Voice Recording**
- **Troubleshooting**

EB-3165 – Optical Communication and Fiber Optic

The EB-3165 Optical Communications is a comprehensive instructional module designed to introduce the student to the basic concepts of digital optical communications.



Components and circuits:

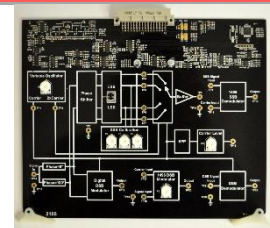
- * DC variable voltage source
- * 8 switches with parallel to serial shift register
- * RZ/NRZ Encoder
- * Pre-amplifier
- * Optical transmitter
- * IR modulator transmitter
- * IR receiver demodulator
- * Optical receiver
- * Fiber optic transmitter receiver
- * Schmitt Trigger module
- * Counter with 7-Segment display
- * RZ/NRZ decoder
- * Serial to parallel shift register
- * 8 LEDs
- * Audio amplifier
- * A speaker
- * A microphone

Contents and Experiments:

- **Audio Amplifier and Speaker**
- **Preamplifier and Microphone**
- **Optical Transmitter**
- **Optical Receiver & Fiber Optic Light Transmission**
- **Schmitt Trigger Comparator**
- **Infrared Communication**
- **Optical Digital Communication**
- **Troubleshooting**

EB-3166 – SSB – DSB Communication

The EB-3166 SSB - DSB Communication is a comprehensive instructional module designed to introduce the student to the basic concepts of SSB and DSB communications.



Components and circuits:

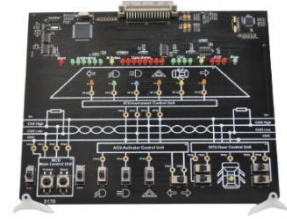
- * Carrier signal variable oscillator module
- * Phase shifter
- * USB/LSB selector switch
- * Signal multiplexer
- * SSB calibration potentiometers
- * SSB demodulator
- * Digital DSB modulator
- * Analog DSB modulator
- * DSB demodulator

Contents and Experiments:

- **Introduction to DSB-SSB**
- **DSB Modulation and Detection**
 - * DSB modulation
 - * Creating a DSB signal
 - * DSB signal detection
 - * Digital modulation and detection
 - * The analog DSB modulation circuit
 - * The analog DSB detection circuit
 - * The digital DSB modulation and detection circuit
- **SSB Modulation and Detection**
 - * SSB single side band modulation
 - * SSB signal detection
 - * Digital modulation

EB-3170 – CAN-BUS systems

The EB-3170 CAN-BUS Systems board is a comprehensive instructional module designed to introduce the student to the basic concepts of the CAN-BUS system and related circuits.



Components and circuits:

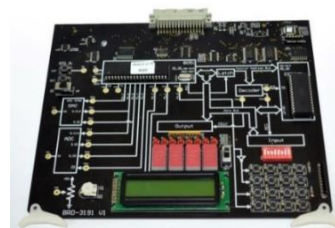
- * LED display for CAN-BUS data protocol
- * Instrument Control Unit with LED display
- * Actuator Control Unit with switches
- * Door Control Unit with switches and LED
- * Main Control Unit with switches and Pushbuttons
- * CAN-BUS lines with test points

Contents and Experiments:

- **CAN-BUS Communication Principles**
 - * What is the meaning of "CAN-BUS"?
 - * What are the purposes for using CAN-BUS communication?
 - * What are the principles of a CAN network?
 - * What is the structure of a CAN-BUS protocol?
 - * Arbitration and priority
 - * CRC and acknowledgement
 - * The system CAN-BUS protocol
- **CAN-BUS Communication Signals**
 - * How does the data transferred on the CAN-BUS lines?
 - * What are the CAN-BUS components?
- **Troubleshooting**
 - * CAN-BUS faults
 - * System faults
 - * Troubleshooting practice

EB-3191 – Introduction to 8 bit Microcontrollers with the 8051

The EB-3191 Introduction to Microcontrollers board is a comprehensive instructional module designed to introduce the student to the basic concepts of microprocessor and microcontroller architecture, principles of operation, addressing modes and flags. Instructions and programming.



Components and circuits:

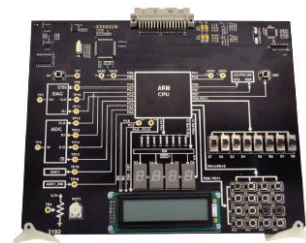
- * 8051 microcontroller
- * Decoding circuit
- * EEPROM memory unit
- * Input port
- * 8 switches
- * 16 key keyboard
- * Output port
- * 8 LEDs
- * 4 7-Segment unit display
- * LCD display
- * Variable voltage potentiometer
- * ADC – Analog to Digital Converter
- * DAC – Digital to Analog Converter
- * RST pushbutton
- * Interrupt pushbutton

Contents and Experiments:

- **Microcomputer Principles of Operation**
 - * Input, Output, Memory, Clock, CPU
 - * Principles of the microprocessor's operation
- **Addressing Modes**
 - * Register, Immediate, Direct, Indirect addressing modes
 - * Bit manipulation
- **Flags**
 - * Carry flag, Aux Carry, Zero, Over flow, Parity flags
- **Machine and Assembly Language with the 8051**
- **The Debugger Functions**
- **Assembly Programming**
 - * Registers and conditional branching
 - * Breakpoints and single step
 - * Embedded micro-controller system
- **The 8051's Structure, Instructions and Exercises**
 - * Structure of the internal direct RAM
 - * Interrupts and stack
 - * Code, Mnemonic instructions, Bytes, Cycles
 - * Data transfer instructions
 - * Arithmetic operations
 - * Logical operations
 - * Boolean variable manipulation
 - * Program branching
 - * Input and processing of a data byte
 - * PLC – Programmable Logic Controller
 - * Look up tables
 - * Subroutines
 - * Interrupts
 - * Timer/counter
 - * Serial communication
- **Addresses Decoding and Memories**
 - * The 8051 timing diagrams
 - * Memory types
- **Selecting a RAM in an address range**
 - * Determining a ROM unit in the addresses range
 - * Locating a RAM unit in the addresses range
- **I/O Ports**
 - * Addressing to input/output ports
- **Input and Output Ports**
 - * The EB-3191 output and input ports
- **Displays**
 - * LED's and their connection to an output port
 - * An image of an output port
- **7-Segment display**
 - * The 7-Segment display
 - * 7-Segment display in multiplexing
- **LCD display**
- **Switches and Keys**
- **Identifying a key being pressed**
- **Scanning momentary switches**
 - * Debouncing (canceling key bouncing)
- **Connecting a Keyboard in a Matrix**
- **Operating a DAC**
 - * Implementing a DAC with an operational amplifier
 - * A monolithic DAC
 - * Serial interface
- **Employing the ADC**
 - * ADC0838 8-bit serial ADC

EB-3192 – Introduction to 32-bit Microcontrollers with the ARM

The EB-3192 Introduction to 32-bit Microcontrollers board is a comprehensive instructional module designed to introduce the student to the basic concepts of 32-bit ARM microcontroller architecture, principles of operation, addressing modes and flags. Instructions and programming.



Components and circuits:

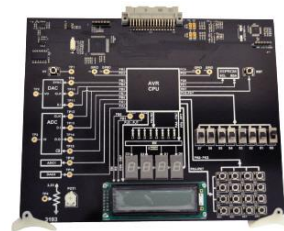
- * ARM microcontroller
- * Decoding circuit
- * Serial EEPROM memory unit
- * Input port
- * 8 switches
- * 16 key keyboard
- * Output port
- * 8 LEDs
- * 4 7-Segment unit display
- * LCD display
- * Variable voltage potentiometer
- * ADC – Analog to Digital Converter
- * DAC – Digital to Analog Converter
- * RST pushbutton
- * Interrupt pushbutton
- * ARM ADC input terminal
- * ARM DAC output terminal

Contents and Experiments:

- **Microcomputer Principles of Operation**
 - * Input, Output, Memory, Clock, CPU
 - * Principles of the microprocessor's operation
 - * About ARM processors
- **C Language**
 - * Machine, Assembly, High-level languages
 - * C language
 - * Editor, compiler, linker and locator, HEX format
- **Writing Programs in C Language**
 - * Header file and #include directive
- **First C Program**
 - * WHILE instruction, Variables
 - * Assignment, Remarks and remark lines
- **For loops**
- **Subroutines & Functions**
 - * Functions and Define
- **If-Else and Logic Operations**
 - * Logic AND, OR, NOT operations
 - * Logic AND, OR, NOT operations on binary numbers
 - * Logic conditions, Shifting binary numbers, Break
- **Do-While**
- **Switch-Case**
- **Arrays and Strings**
 - * Array initialization and multi-dimension array
 - * Strings
- **Pointers**
 - * I/O, variables and block addressing using pointers
- **Enum, Struct, Union and Typedef**
- **Hardware and Peripherals**
- **GPIO and LEDs**
 - * The STM32F100 in the EB-3192 card
 - * GPIO terms, functions and registers
 - * Programs with GPIO
- **Bit Manipulation and GPIO Initialization**
 - * Bit manipulation with logic operations
 - * Reset and Clock Control (RCC)
- **7-Segment Display**
- **LCD Display**
- **GPIO and Switches**
 - * Identifying the switch being pressed
- **Connecting a Keyboard in a Matrix**
- **Operating a DAC**
 - * Serial interface DAC
 - * The ARM DAC
- **Employing the ADC**
 - * ADC0838 8-bit serial ADC
- **The ARM Cortex M3**
 - * Registers and special registers
 - * Processor modes and operation modes
 - * Nested and vectored interrupt support
 - * Dynamic priority changes support
 - * Reduction of interrupt latency, Interrupt masking
 - * The memory map, The bus interface, The MPU
 - * Interrupts and exceptions
 - * Low power and high energy efficiency
 - * Reset sequence, Interrupt/exception sequences
 - * Stacking, Vector fetches, Register updates
 - * Exception exits, Nested interrupts

EB-3193 – Introduction to 16-bit Microprocessors with the AVR

The EB-3193 Introduction to Microprocessors board is a comprehensive instructional module designed to introduce the student to the basic concepts of 16-microcontroller architecture, principles of operation, addressing modes and flags. Instructions and programming.



Components and circuits:

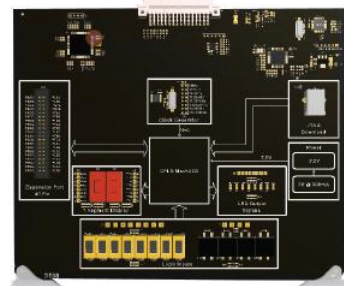
- * AVR microcontroller
- * Decoding circuit
- * Serial EEPROM memory unit
- * Input port
- * 8 switches
- * 16 key keyboard
- * Output port
- * 8 LEDs
- * 4 7-Segment unit display
- * LCD display
- * Variable voltage potentiometer
- * ADC – Analog to Digital Converter
- * DAC – Digital to Analog Converter
- * RST pushbutton
- * Interrupt pushbutton
- * AVR ADC input terminal
- * AVR DAC output terminal

Contents and Experiments:

- **Microcomputer Principles of Operation**
 - * Input, Output, Memory, Clock, CPU
 - * Principles of the microprocessor's operation
- **The AVR XMEGA AU**
 - * About the AVR processors
 - * Overview
 - * Atmel AVR XMEGA AU features
 - * AVR CPU and registers
 - * Hardware multiplier
 - * Program flow
 - * Instruction execution timing
 - * Status register
 - * Stack and stack pointer
 - * Register file
- **C Language**
 - * Machine language
 - * Assembly language
 - * High-level language
 - * Memories
 - * C language
 - * Editor, compiler, linker and locator
 - * HEX format
 - * Variables
- **Writing a C Program to Light LEDs**
 - * Header file and #include
 - * Subroutines
- **Debugging Techniques**
- **Light LEDs According to Switch Status**
 - * WHILE – switches to LEDs
 - * Light emitting diode – LED
- **Digital Inputs and LEDs**
 - * Logic operations
 - * Logic operations on binary numbers
 - * Logic conditions
 - * Break
- **Subroutines, Functions & LCD Display**
 - * Functions
 - * Define
- **7-Segment Display**
 - * Break
- **Keyboard and LCD Display**
- **Serial Digital to Analog Converter**
- **Parallel DAC and Switches**
- **Serial Analog to Digital Converter**
- **Parallel ADC with LEDs and LCD**
- **Storing Data on an EEPROM and Displaying on LCD**
- **Interrupts**
- **Serial Communications**
 - * Classification of communication methods
 - * Serial asynchronous communication

EB-3198 – Programmable Logic Devices

The EB-3198 Programmable Logic Device board is a comprehensive instructional module designed to introduce the student to the basic concepts of programmable logic such as CPLD and FPGA devices, CPLD device architecture, familiarization with industry-standard software, creating a program source, compilation, pin-out assignment, downloading the CPLD code to the device and debugging.



Components and circuits:

- * CPLD MACHX02
- * 8 switches
- * 8 LEDs
- * 4 pushbuttons
- * 2 7-Segment units
- * Clock generator
- * Expansion port connector
- * JTAG download connector

Contents and Experiments:

- **Introduction to EB-3198**
 - * General description
 - * EB-3198 technical description
- **Introduction to the Programming and Burning Tools**
 - * The programming process
 - * Introduction to the schematic entry editor and logic function implementation
- **Programming a NOR Gate using Graphic Entry**
- **Programming a Decoder in VHDL**
- **Self-test VHDL Program**
- **Installing the Lattice Diamond 2.1 Software**
 - * Obtaining a license for a single workstation
 - * Installing the software
- **VHDL Programming Examples**
 - * Complex logic gates
 - * PWM – Pulse Width Modulation
 - * MUX 2 x 1
 - * BCD to seven-segment
 - * Divider
 - * One shot
 - * Big and small and EQ
 - * Up down counter
 - * Count with state machine
 - * RAM with 5 byte
 - * 4 bit output vector

TS-3090 – Embedded Project development card with the 8051

An independent microcontroller student card for self-study and embedded controller project development.



Components and circuits:

- * 8051 microcontroller
- * EEPROM
- * Output port with 8 LEDs
- * Input port with 8 switches
- * Power supply
- * USB serial communication interface
- * Breadboard expansion area

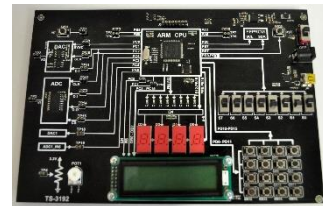
Contents and Experiments:

- 8051 machine and assembly language
- 8051 input/output units
- Assembly programming
- C language programming
- Embedded controller project development

TS-3192 – Standalone Introduction to 32-bit Microcontrollers with the ARM

TS-3192 is 32-bit Microcontrollers standalone board that operated **without** the EB-3000 universal trainer.

It is a comprehensive instructional module designed to introduce the student to the basic concepts of 32-bit ARM microcontroller architecture, principles of operation, addressing modes and flags. Instructions and programming.



Components and circuits:

- * Power supply circuit
- * USB communication circuit
- * ARM microcontroller
- * Decoding circuit
- * Serial EEPROM memory unit
- * Input port
- * 8 switches
- * 16 key keyboard
- * Output port
- * 8 LEDs
- * 4 7-Segment unit display
- * LCD display
- * Variable voltage potentiometer
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- * DAC – Digital to Analog Converter
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 - * Exception exits, Nested interrupts

Electronics Program

The material accompanying the training systems covers a large number of hours of study and practice.

The study material enables adaptation to various study programs.

The following proposal is for a training center and is one of the options for building a training system.

Selecting experiments is done according to the requirements of the center and the level of its students.

The electronics program is based on 9 study units:

1. Electricity and electrical circuits
2. Semiconductor devices
3. Analog electronics
4. Digital electronics
5. Industrial electronics
6. Analog communication
7. Digital communication
8. Microcontrollers
9. Programmable Logic Devices (PLD)

Each unit is for 18 workshop hours.

The units can be taught sequentially at this order in workshop rooms according to the school space, study years and number of students.

The following arrangement enables maximum capacity of students.

Each study unit is taught in a separate workshop room for 20 students.

The program starts with Introduction to Electronics.

All the center teachers give this Introduction for 18 hours to all the students.

This Introduction enables the students to study in parallel the program units.

In this arrangement, 180 students can cover all units in 6 weeks of 30 hours in each (180 hours program).

In a 36 study week year, 1080 students can study in the electronics center at full capacity.

SES Training LABs

The training labs are based on learning-by-doing, which makes the students learn more quickly and remember what they have studied by performing practical experiments. They provide the students high profession skills and the knowledge on how to improve their chance of employment and earning capacity.

The manuals and courseware that accompany each course provide the theory background and experiments.

Electronics Training Lab

This modular laboratory is aimed for the **Electronics** profession, but also for technology disciplines that are also based in electronics, such as: **Electricity, Mechanics, Automotive, Robotics, Automation, Process control.**

Autotronics Training Lab

This modular laboratory is aimed for the five stages that comprise the automotive program: **Basic and automotive electronics, Car sub-systems simulators, Car sub-systems demonstrators, Car diagnostic and troubleshooting methods, Troubleshooting faults in a real car.**

Mechatronics Training Lab

This modular laboratory is aimed for the mechatronics program which includes the following disciplines: **Basic electronics, Pneumatics systems, Hydraulics systems, CNC machines.**

Refrigeration and Air-Conditioning Training Lab

The Refrigeration and Air-Conditioning training lab covers actual components and their interconnection, related functions, operation, diagnosis and repair methods through safe, hands-on practical activities.

Technology Preparation Training Lab

The Technology Preparation (Tech Prep) laboratory is a classroom-integrated laboratory consisting of educational modules covering a wide range of subjects such as: **Green energy, Computerized systems, Basic electronics, Basic communication, Mechanical systems.**

Science Training Labs

These laboratories (for primary, secondary and high schools) introduce the students to the computerized sensors world, **nature and industry processes** and **nature laws**. It will help them understand modern technologies such as: **home and medical appliances, wearing sensors, precise agriculture** and more.

Robotics Training Labs

The robotics programs (for primary, secondary and high schools) help students to build innovation and creativity skills. The idea is to make the students understand how systems work, to believe that they can improve them and be able to realize their ideas.

MultiCenter Training Lab

The MultiCenter offers a variety of selected interactive learning environments, with a large range of topics and activities such as: **Science, Technology, Graphic Design, Digital Music, Robotics, Computer Technologies** and much more for all sectors of society, cultures, different socio-economic groups and different age groups – from very young children to senior citizens.



Scientific Educational Systems



www.degem.com



www.neulog.com



www.magicclass.com



www.multicenter.co