

SYSTEM FOR THE STUDY OF ELECTRONICS (TIME)





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TIME ELECTRONIC BOARDS



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OTHERS

BOARD FOR ELECTRONIC DESIGN
DIGITAL MULTIMETER

DL 3155DES
DL 3155SEM02



TIME ELECTRONIC BOARDS



POWER SUPPLIES

BASE FRAME WITH POWER SUPPLY AND INTERFACE TO PC AND VIRTUAL INSTRUMENTATION



DL 3155AL2RM

Power supplies:

- 0/+15 Vdc, 1 A
- 0/-15 Vdc, 1 A
- +15 Vdc, 1 A
- -15 Vdc, 1 A
- +5 Vdc, 1 A
- -5 Vdc, 1 A
- 6 – 0 – 6 Vac, 1 A

Virtual instrumentation:

Multimeter

- 3 and 3/4 digits
- dc/ac voltage: 400 mV, 4 V, 40 V, 400 V or Autorange
- resistance: 400 Ohm, 4 kOhm, 40 kOhm, 400 kOhm, 40 MOhm
- dc/ac current: 200 mA, 8 A

Function Generator

- sinusoidal, square, triangular, dc
- frequency: 0.1 Hz - 200 kHz
- output: ± 10 V
- attenuator: 0 dB, -10 dB, -20 dB

Digital oscilloscope

- dual trace oscilloscope
- input: dc/ac, 1 MOhm
- meas. ranges: 20/50/100/200/500 mV, 1/2/5 V per division
- sampling frequency: 100 Hz to 10 MHz

Digital Pattern Generator

- output rate: from 200ms to 10s
- pattern selection: manual or automatic
- display: 20 states of the patterns

Logic Wave Analyzer

- display: 20 states of the inputs

Features:

- Interface board for connection to PC.
- Robust structure and modern design.
- Voltage regulation and protection against over voltage or short circuit.
- Complete with a set of connecting cables.

BASE FRAME WITH POWER SUPPLY AND INTERFACE TO PC



DL 3155AL2

Power supplies:

- 0/+15 Vdc, 1 A
- 0/-15 Vdc, 1 A
- +15 Vdc, 1 A
- -15 Vdc, 1 A
- +5 Vdc, 1 A
- -5 Vdc, 1 A
- 6 – 0 – 6 Vac, 1 A

Features:

- Interface board for connection to PC.
- Robust structure and modern design.
- Voltage regulation and protection against over voltage or short circuit.
- Complete with a set of connecting cables.



BASE FRAME WITH POWER SUPPLY



DL 3155AL5

Power supplies:

- 0/+15 Vdc, 1 A
- 0/-15 Vdc, 1 A
- +15 Vdc, 1 A
- -15 Vdc, 1 A
- +5 Vdc, 1 A
- -5 Vdc, 1 A
- 6 – 0 – 6 Vac, 1 A

Features:

- Voltage regulation and protection against over voltage or short circuit.
- Complete with a set of connecting cables

DC POWER SUPPLY



DL 2555ALF

Power supplies:

- ± 5 Vdc, 1 A
- ± 15 Vdc, 1 A
- 0 / + 15 Vdc, 1 A
- 0 / - 15 Vdc, 1 A

DC POWER SUPPLY



DL 2555ALG

Power supplies:

- ± 5 Vdc, 1 A
- ± 15 Vdc, 1 A

AC POWER SUPPLY



DL 2555ALA

Power supplies:

- 24 Vac, 2 A



TIME ELECTRONIC BOARDS

SOFTWARE



CAI SOFTWARE



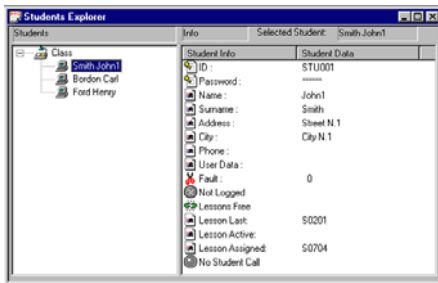
DL NAV

Each board of the TIME system can be supplied complete with a Student Navigator software that allows students to perform their learning activities through a Personal Computer, without the need for any other documentation. Moreover, the Student Navigator is provided with an interface to the Laboratory Management software DL Lab, to allow the realization of fully integrated training systems, where all the educational tasks are managed and controlled by the Teacher, through his own work station.

Features:

- theoretical subjects through PC with hyper textual navigation according to the standard World Wide Web Internet method
- practical training guided through PC, with test questions and computer control of the answers
- fault insertion from PC (or from remote teacher station) and troubleshooting operations with computer control of the answers
- use of the computer as a stand-alone work station or integrated in the computer network of the laboratory

LABORATORY MANAGEMENT SOFTWARE



DL LAB

This application allows Teachers a complete management of all the activities inside the Laboratory:

- assignment of the lessons that the students must study
- monitoring of the activities of each student (in/out from the lessons, right or wrong answers, rating, etc.)
- direct communication with each student workstation (sending and receiving messages, fault insertion on the student workstations
- recording of all the students' activities in a database (Microsoft Access compatible) on the Teacher's workstation
- processing of the stored data for the control of the individual or group learning level

Features:

- unlimited number of classes (one database for each class)
- unlimited number of students per class
- maximum number of work stations connected at the same time: 256
- 32 bit operating systems
- user interface similar to Windows Explorer
- control of the Students' access through Username and Password
- assignment of the lessons to study, insertion of the faults, access control
- communication with the students and message exchange
- visualization of every activity performed by the students
- complete list of all the on-line lessons and faults
- results of each student in the last performed lesson: details relevant to each question, average rating, time
- results of class performance
- export of the results in ASCII format

The DL LAB software offers a simple and effective user interface (similar to Explorer in Windows) that allows teacher to move among students, lessons, faults and results in the same way he is used to explore the computer resources.

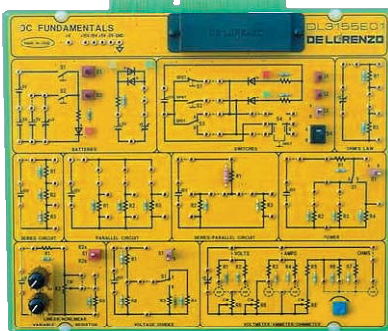


TIME ELECTRONIC BOARDS

ELECTRICITY AND ELECTROMAGNETISM



DC FUNDAMENTALS



DL 3155E01

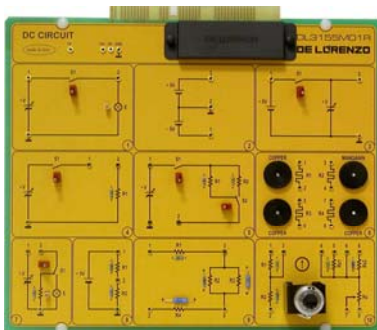
Theoretical topics:

- DC power sources
- Batteries
- Conventional directions of voltages, e.m.f. and currents
- Ohm's law
- Circuit with linear resistance and non linear resistance
- Series/parallel resistive circuits
- Power in dc circuits
- Linear/non linear variable resistor
- Voltage/current divider circuits
- Direct current meters
- Fault simulation

Circuit blocks:

- Batteries
- Switches
- Ohm's law
- Series circuit
- Parallel circuit
- Series/Parallel circuit
- Power
- Linear/non-Linear variable resistor
- Voltage divider
- Voltmeter/Ammeter/Ohmmeter

DC CIRCUITS



DL 3155M01R

Theoretical topics:

- Structure of the circuits
- Electric current
- Voltage and electromotive force
- Electric resistance
- Conventional sense of voltage and current
- Types of measurement and types of errors
- Types of instruments
- Measurement of e.m.f. and voltage
- Measurement of the current
- Measurement of the resistance
- Relationships among current, voltage and resistance: Ohm's law
- Conductors resistivity and temperature coefficient
- Circuit with linear and non-linear resistance
- Types of resistors
- Identification of the value of the resistors
- Series and parallel resistors
- Constant signals
- Variable signals
- Wheatstone Bridge
- Fault simulation

Circuit blocks:

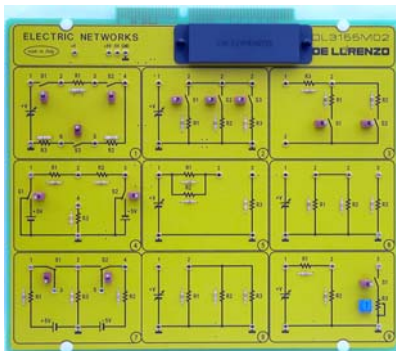
- Electrical circuit: Components and measurements
- Series generators
- Parallel generators
- Ohm's law
- Application of the Ohm's law: how a resistance influences the current
- The resistivity: resistance, length, section and resistivity of a conductor
- Linear and non-linear ohmic resistance
- Series circuit: current, resistance and voltage
- Colour code of the resistors
- Wheatstone Bridge



TIME ELECTRONIC BOARDS



ELECTRIC NETWORKS



DL 3155M02

Theoretical topics:

- Elements of an electrical network: node, arm, mesh
- First Kirchoff principle
- Second Kirchoff principle
- Series resistances
- Parallel resistances
- Series-parallel connection
- Voltage dividers
- Theorem of the effect superposition
- Thevenin theorem
- Norton theorem
- Millman theorem
- Fault simulation

Circuit blocks:

- Series resistors and Kirchoff voltage law verification
- Parallel resistors and Kirchoff current law verification
- Series-parallel resistors
- Effect superposition
- Thevenin theorem
- Norton theorem
- Millman theorem
- Voltage divider

ELECTRIC POWER AND ENERGY



DL 3155M03

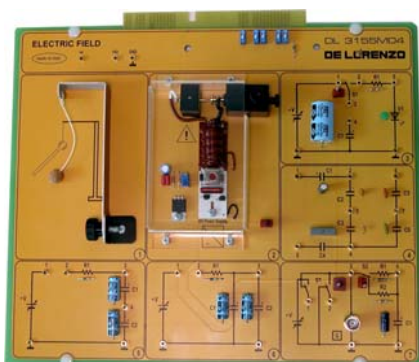
Theoretical topics:

- The power and the electric energy
- Their measurement
- Thermal effect of the current: Joule's law
- Practical applications of the Joule's law
- Energy balance and efficiency
- Energy transfer from a supply unit to a load
- Adaptation of the load
- Fault simulation

Circuit blocks:

- Electrical power in parallel connection
- Electrical power in series connection
- Energy: Joule's law
- Bimetallic sheet switch: thermostat
- Energy balance and efficiency

ELECTRIC FIELD



DL 3155M04

Theoretical topics:

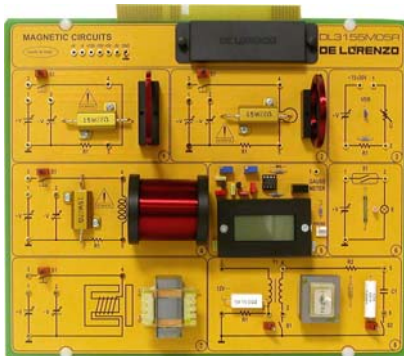
- Fields of force
- The field vector
- The potential and the potential difference
- Characteristics of the electric field and its measurement units
- The electric field generated by a uniformly loaded unlimited plane surface
- The electric field of a double plane surface
- Capacitors: composition, identification, connection
- Charge of capacitors
- Discharge of capacitors
- Energy of the electric field in the capacitors
- Fault simulation

Circuit blocks:

- Superficial electrification of the bodies
- Electrostatic machine
- Energy of the capacitors
- Type of capacitors
- Capacitors in series
- Capacitors in parallel
- Charge and discharge of a capacitor



MAGNETIC CIRCUITS



DL 3155M05R

Theoretical topics:

- Characteristics of the magnetic field
- Diamagnetic, paramagnetic and ferromagnetic materials
- Soft and rigid ferromagnets
- Hysteresis cycle
- Magnetic quantities and relevant measurement units
- Hall's effect and Hall's potential difference
- Hopkinson's law
- Energy of the magnetic field
- Study of VDR
- Fault simulation

Circuit blocks:

- Magnetic field created by a rectilinear conductor
- Magnetic field created by a circular conductor
- Magnetic field created by a solenoid conductor
- Measurement of the magnetic induction
- Magnetic switch
- Electromagnet
- Hysteresis cycle
- Resistor not linear (VDR)

ELECTROMAGNETISM



DL 3155M06

Theoretical topics:

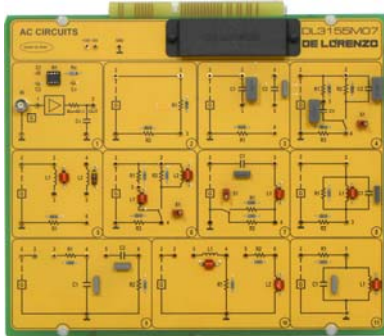
- Lorentz's force
- Force in a wire run by current in a magnetic field
- The induction phenomenon and the Faraday-Neumann's and Lenz's laws
- The self-induction phenomenon
- The relay
- The moving coil ammeter
- The static transformer
- Alternators and dynamos
- Direct current electric motors
- Fault simulation

Circuit blocks:

- Electrodynamical action
- Magnetic field of a coil: the relay
- Electromagnetic induction
- Self-induction
- Moving coil instrument
- Transformer
- Electric motor principle
- Direct current motor



AC CIRCUITS



DL 3155M07

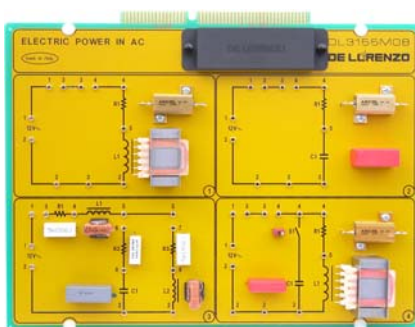
Theoretical topics:

- Sinusoidal alternating currents and voltages
- Vector and symbolic representation of the sinusoidal electric quantities
- Product of a sinusoidal quantity by a constant
- Sum and difference of sinusoidal quantities
- Product of two sinusoidal quantities
- Product of a sinusoidal quantity by a complex number
- Elementary bipoles: R, L, C
- Series and parallel of the bipoles: R-L, R-C, R-L-C
- Oscillating circuits: frequency response of the ac circuits
- Low-pass filter, high-pass filter, pass-band filter
- Fault simulation

Circuit blocks:

- Alternating quantities
- Resistive circuit
- Capacitive circuit
- R-C circuit (series and parallel)
- Inductive circuit
- R-L circuit (series and parallel)
- Series resonant circuit
- Parallel resonant circuit
- Low-pass filter (R-C)
- High-pass filter (C-R)
- Low-pass filter (L-R)
- High-pass filter (R-L)
- Pass-band filter

ELECTRIC POWER IN ALTERNATING CURRENT



DL 3155M08

Theoretical topics:

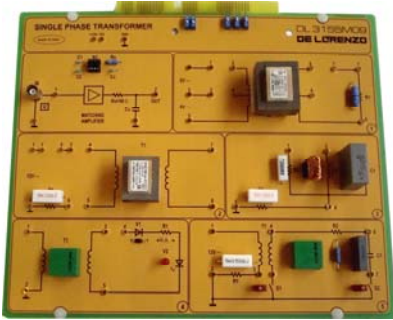
- Active power
- Reactive power
- Apparent power
- Boucherot's theorem
- Power and energy measurements
- Phasing of a single-phase system
- Calculation of the phasing capacity
- Fault simulation

Circuit blocks:

- Active, reactive and apparent power (ohmic, inductive, ohmic-inductive load)
- Active, reactive and apparent power (ohmic, capacitive, ohmic-capacitive load)
- Boucherot's theorem
- Phasing of an ohmic-inductive load



SINGLE-PHASE TRANSFORMER



DL 3155M09

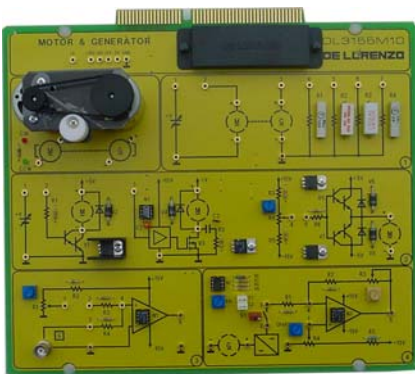
Theoretical topics:

- Ideal transformer: no-load operation
- Ideal transformer: load operation
- Real transformer: no-load and load operation
- Tests on the transformer
- The autotransformer
- Magnetic core
- Electric windings
- Transformer cooling
- Transformer applications
- Pulse transformers
- Transformers for blocked oscillators
- Analysis of the behaviour of voltage vs. time
- Fault simulation

Circuit blocks:

- Voltage and current transformation ratio
- No-load transformer
- Transformer in different load conditions; phase displacement
- Pulse transformer
- Hysteresis cycle of a pulse transformer; magnetic saturation curve

MOTOR AND GENERATOR



DL 3155M10

Theoretical topics:

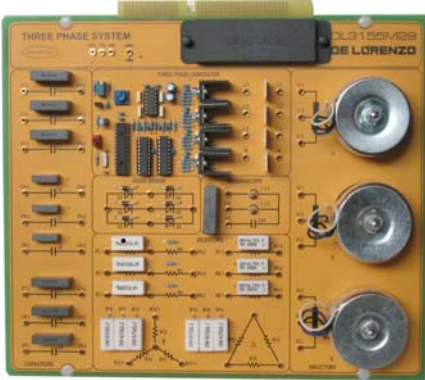
- Separate excitation dc motors
- Shunt excitation dc motors
- Series excitation dc motors
- Compound excitation dc motors
- Power and efficiency
- Dc motors as generators
- Dc motors as tachometric dynamo
- Dc motor speed control
- Transistor operation
- Semi controlled single-phase bridge operation
- Totally controlled single phase bridge operation
- Linear control and PWM control
- Closed loop control
- Fault simulation

Circuit blocks:

- Measurement of the speed of a dc motor
- Counter electromotive force of a dc motor
- Load operation of a dc motor
- Power and efficiency
- Control circuit of a dc motor
- Adjustment of the PWM speed
- Adjustment of the closing loop speed



THREE-PHASE SYSTEMS



Theoretical topics:

- Star connected three-phase load
- Triangle connected three-phase load
- Balanced three-phase load
- Unbalanced three-phase load
- Inductive load
- Capacitive load
- Re-phasing circuit
- Resonance circuit
- Displacement of the centre of the star
- Half-wave rectifier circuit
- Full-wave rectifier circuit
- Half-bridge three-phase rectifier circuit
- Six-phase rectifier circuit
- Fault simulation

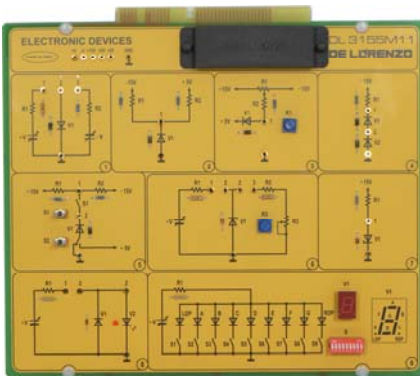
Circuit blocks:

- 4 three-phase resistive circuits
- 3 three-phase capacitive circuits
- 2 three-phase inductive circuits
- 1 diode rectifier circuit
- 1 sequence scope circuit
- 1 three-phase and neutral generator with variable frequency between 10 and 500 Hz

DL 3155M29



ELECTRONIC DEVICES



DL 3155M11

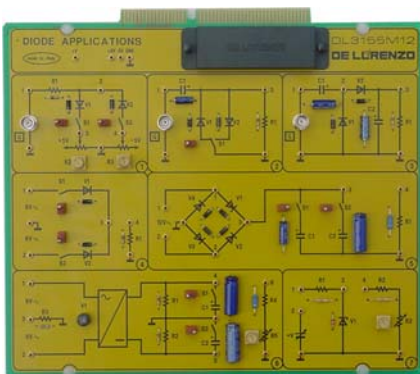
Theoretical topics:

- Physics of the semiconductors and joint P-N
- Semi conductive material
- Formation of a joint P-N
- Polarization of a joint P-N
- The ideal diode and the real diode
- Diode in dc circuits
- Check of the integrity of a diode through an ohmmeter
- Direct polarization
- Inverse polarization
- The Zener diode
- The diode as stabilizer
- The LED diode
- Fault simulation

Circuit blocks:

- Direct and inverse polarization of a diode
- Voltage at the diode ends
- Minimum and maximum voltages
- Minimum and maximum voltages with series connected diodes
- Characteristics of the Zener diode
- Zener diode as a voltage stabilizer
- Voltage value on a Zener diode
- Characteristics of a LED diode
- Seven segment digital display

DIODE APPLICATIONS



DL 3155M12

Theoretical topics:

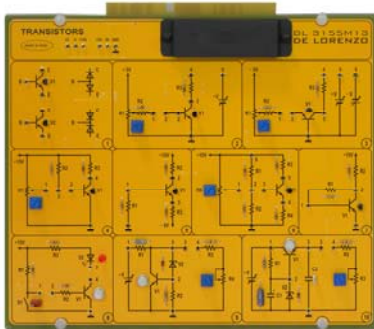
- Behaviour of the diode inserted in circuits that enclose generators of variable signals
- Simple and double clipper circuits
- Clamper circuits
- Half-wave voltage doublers
- Simple half-wave rectifier circuit
- Double half-wave rectifier circuit
- Bridge rectifier circuit
- Power supplies
- Filters
- Regulators
- Fault simulation

Circuit blocks:

- Clipping circuit
- Clamping circuit
- One half-wave voltage doubler
- Simple and double half-wave rectifier
- Diode bridge rectifier (Graetz bridge) with capacitive input filter
- Dual power supply
- Stabilized power supply



TRANSISTORS



DL 3155M13

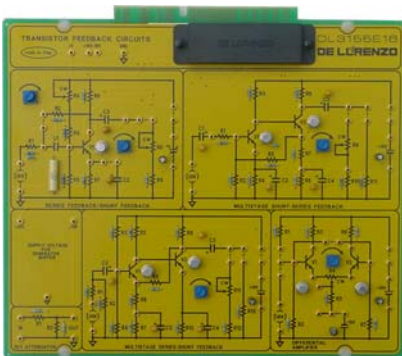
Theoretical topics:

- The transistor currents
- Input and output characteristics
- Collector feedback polarization
- Voltage divider polarization
- Emitter polarization
- The transistor as a switch
- The transistor as a regulator
- Reading and use of technical specifications taken from the catalogues
- Fault simulation

Circuit blocks:

- Verification of the integrity of the junctions of a BJT transistor
- Recording of the input and output characteristics of a BJT transistor in the common emitter configuration
- Recording of the output characteristics of a BJT transistor in the common base configuration
- The base polarization of a BJT transistor
- The emitter polarization of a BJT transistor
- The polarization of a BJT transistor with voltage divider
- The polarization of the collector feedback BJT transistor
- Operation of a BJT transistor as a switch
- Voltage regulator with parallel transistor
- Voltage regulator with series transistor

TRANSISTOR FEEDBACK CIRCUITS



DL 3155E16

Theoretical topics:

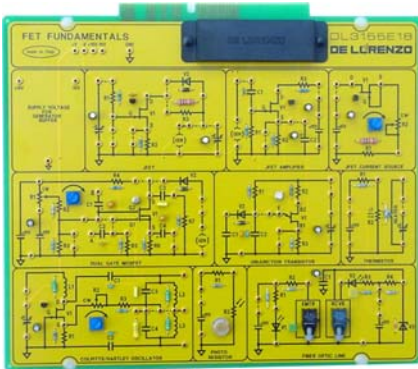
- Typical quantities and basic configurations of a feedback amplifier
- Feedback of a multistage amplifier
- The effects of series feedback on ac gain and on input and output impedance
- The effects of negative series feedback on bandwidth
- The effects of shunt feedback on ac gain and on input and output impedance
- Multistage shunt-series and series-shunt Feedback
- The shunt-series multistage amplifier current gain and output impedance
- Series-shunt multistage amplifier voltage gain and output impedance
- Differential amplifier operation
- Single-ended and differential gain characteristic
- Common mode gain and rejection ratio
- Fault simulation

Circuit blocks:

- Series feedback / shunt feedback
- Multistage shunt-series feedback
- Attenuator
- Multistage series-shunt feedback
- Differential amplifier



FET FUNDAMENTALS



DL 3155E18

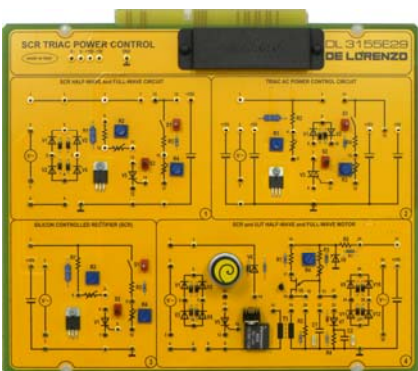
Theoretical topics:

- Junction FET
- JFET operating characteristics
- The effect of gate bias on pinch-off
- JFET dynamic characteristic curves
- JFET amplifier fundamentals
- JFET amplifier dc operation
- JFET amplifier ac operation
- JFET used as current sources
- Dual Gate MOSFET
- MOSFET fundamentals and modes of operation
- MOSFET voltage amplifier
- Unijunction transistors fundamentals
- UJT operating characteristics
- UJT waveform generation
- Hartley and Colpitts oscillators fundamentals
- Hartley oscillator operation
- Colpitts oscillator operation
- Transducers fundamentals
- Thermistor operation
- Photo resistor operation
- Fibre optic light transfer
- Fault simulation

Circuit blocks:

- JFET
- JFET Amplifier
- JFET Current Source
- Dual Gate MOSFET
- Unijunction Transistor
- Thermistor
- Colpitts / Hartley Oscillator
- Photo resistor
- Fibre Optic Link

SCR TRIAC POWER CONTROL



DL 3155E29

Theoretical topics:

- Thyristor component familiarization
- Thyristor circuit fundamentals
- Test a Silicon Controlled Rectifier
- SCR DC operation
- Gate trigger voltage and holding current
- SCR half-wave rectifier
- SCR control of a half-wave rectifier
- SCR control of a full-wave rectifier
- UJT characteristics
- UJT half-wave and full-wave phase control
- Bidirectional conduction
- The four triggering modes
- Half-wave and full-wave phase control
- Fault simulation

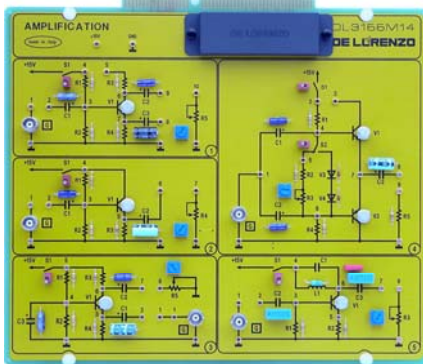
Circuit blocks:

- Silicon Controlled Rectifier (SCR)
- Triac AC power control circuit
- SCR half-wave and full-wave circuit
- SCR and UJT half-wave and full-wave Motor



AMPLIFICATION

AMPLIFICATION



DL 3155M14

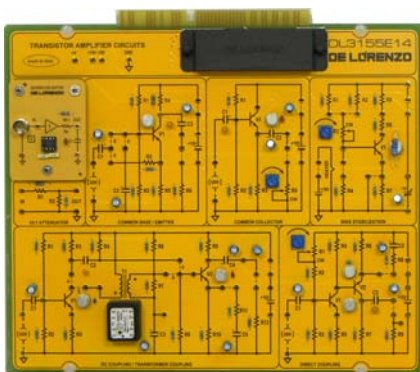
Theoretical topics:

- Linear amplification of current, voltage and power
- BJT amplifiers: EC, CC and BC configurations
- Thermal stability of a linear amplifier
- Static and dynamic load line
- Intermediate stage – final stage pre-amplifiers
- Power amplifiers in class A
- Power amplifiers in class B
- Power amplifiers in class C
- Fault simulation

Circuit blocks:

- The common emitter amplifier
- The common collector amplifier
- The common base amplifier
- The push-pull power amplifier in class B
- The power amplifier tuned in class C

TRANSISTOR AMPLIFIER CIRCUITS



DL 3155E14

Theoretical topics:

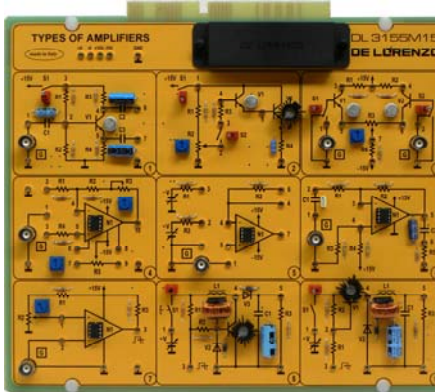
- Idea of linear amplification of current, voltage and power
- Common base configuration: circuit and behaviour
- Common emitter configuration: circuit and behaviour
- Common collector configuration (emitter follower): circuit and behaviour
- Circuits for the control of alternate current motors
- Thermal and bias stabilization of a linear amplifier
- Static and dynamic load lines
- Multi-stage amplifiers
- RC coupled amplifiers
- Transformer coupled amplifiers
- Direct-coupled amplifiers
- Fault simulation

Circuit blocks:

- Attenuator
- Common Base / Emitter
- Common Collector
- Bias Stabilization
- RC Coupling / Transformer Coupling
- Direct Coupling



TYPES OF AMPLIFIERS



DL 3155M15

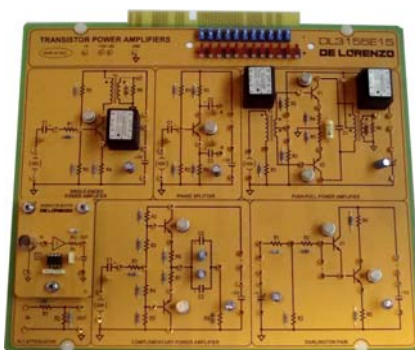
Theoretical topics:

- Phase inverter or buffer circuit
- Darlington configuration amplifier
- Differential amplifiers
- Operational amplifiers
- Inverting configuration
- Non-inverting configuration
- Voltage follower
- Offset voltage
- Slew-rate
- I/V and V/I converters
- Single supply operational amplifiers
- Switching amplifiers
- Power amplifiers
- Switching operation
- PWM modulator
- Converter or electronic switch
- DC-DC converter
- Fault simulation

Circuit blocks:

- Phase separator
- Darlington connection amplifier
- Differential amplifier
- Operational amplifier: reduction of the offset voltage, inverting and non-inverting configuration, and slew-rate
- Voltage follower
- Voltage-current converter
- Current-voltage converter
- Single supply operational amplifier
- PWM modulator
- Step-up DC-DC converter
- Step-down DC-DC converter

TRANSISTOR POWER AMPLIFIERS



DL 3155E15

Theoretical topics:

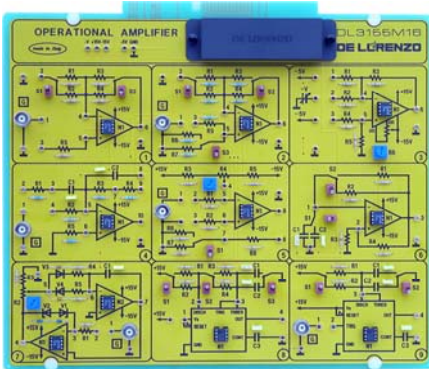
- BJT power amplifiers
- Classification of the output stages
- Harmonic distortion
- Heat dissipation
- Amplifiers in class A
- Amplifier with load flown by direct current
- Amplifier with output transformer (single-ended power amplifier)
- Phase splitter
- Amplifiers in class B
- Push-Pull amplifiers
- Transformer amplifiers in class B
- Output stage in class B (complementary power amplifiers)
- Single-ended amplifiers in class B
- Darlington configuration amplifiers
- Fault simulation

Circuit blocks:

- Single-ended power amplifier
- Phase splitter
- Push-pull power amplifier
- Attenuator
- Complementary power amplifier
- Darlington pair



OPERATIONAL AMPLIFIERS



DL 3155M16

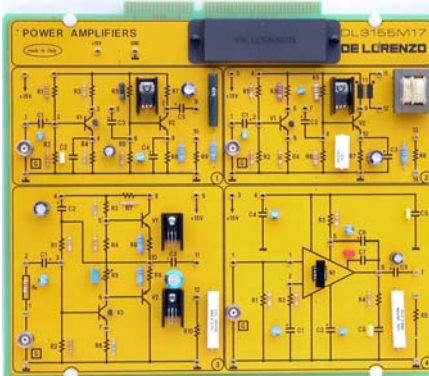
Theoretical topics:

- Ideal operational amplifier
- Concept of common mode and differential voltage
- The negative feedback
- Main operational amplifier linear configurations
- Concept of virtual mass
- Inverting and non-inverting configuration
- Inverting summing amplifier
- Zero and different from zero level detector
- Differential amplifier
- Integrator and derivator
- 741 operational amplifier
- The meaning of CMRR, V_{os} and slew rate
- Comparators, ramp and square wave generators
- Comparator circuit
- Transfer characteristics
- Inverting Schmitt trigger
- Square wave generator (astable multivibrator with operational amplifier)
- Ramp generator
- 555 integrated circuit as astable and monostable multivibrator
- Fault simulation

Circuit blocks:

- Inverting and non-inverting operational amplifier
- Operational amplifier parameters: CMRR, slew rate
- Offset voltage reduction, differential amplifier, summing amplifier
- Operational amplifier: integrator and shunt
- Comparator: inverting, non-inverting, with hysteresis (Schmitt trigger)
- Operational amplifier as astable multivibrator
- Ramp generator
- Timer 555 as astable multivibrator
- Timer 555 as monostable multivibrator

POWER AMPLIFIERS



DL 3155M17

Theoretical topics:

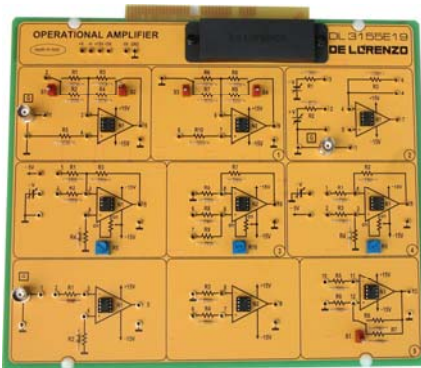
- Typical problems relevant to power devices
- Power amplifier parameters
- Classification of the output stages
- Harmonic distortion
- Heat dissipation
- Main circuit configurations
- Class A amplifiers
- Amplifiers with load run by direct current
- Amplifier with output transformer
- Class B output stage
- Fault simulation

Circuit blocks:

- Class A power amplifier
- Class A power amplifier with transformer coupling
- Class AB power amplifier
- Integrated power amplifier



OPERATIONAL AMPLIFIER



DL 3155E19

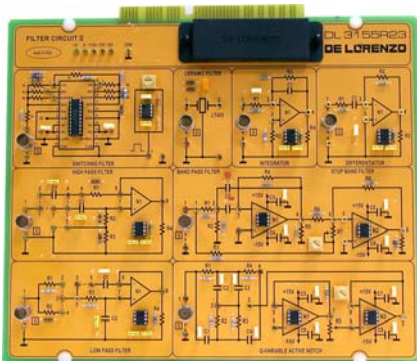
Theoretical topics:

- The ideal operational amplifier
- The negative feedback
- The operational amplifier
- Main configurations of the linear circuits
- Idea of virtual mass
- Inverting and non-inverting configuration
- Buffer
- IV and V/I inverter
- Inverting and non-inverting adder
- Differential amplifier
- Non-linear circuits: comparators, comparator with hysteresis
- Inverting and non-inverting comparators
- Reference voltage different from zero
- Comparator with hysteresis or Schmitt trigger
- Fault simulation

Circuit blocks:

- Inverting Operational Amplifier
- Non-inverting Operational Amplifier
- Voltage follower
- Voltage/Current converter
- Current/Voltage converter
- Adder Amplifier (inverting and non-inverting)
- Differential Amplifier (Offset reduction)
- Inverting comparator
- Non-inverting comparator
- Inverting comparator with hysteresis (Schmitt trigger)

CIRCUITS WITH FILTERS



DL 3155R23

Theoretical topics:

- The ideal Operational Amplifier
- The negative feedback
- Inverting configuration
- Not inverting configuration
- Integrator
- Differentiator
- Filters and parameters
- Filters transfer functions
- Study of ceramic filters
- Study of active filters
- Study of passive and active notch filters
- Study of switching filters (Chebyshev filter)
- Filters in cascade
- Attenuation characteristics of the active low-pass, high-pass, stop-band and band-pass filters
- Fault simulation

Circuit blocks:

- Switching filter
- Ceramic filter
- High pass filter
- Band pass filter
- Stop band filter
- Low pass filter
- Q-variable active notch filter
- Integrator
- Differentiator

Note: this board is not provided with CAI software

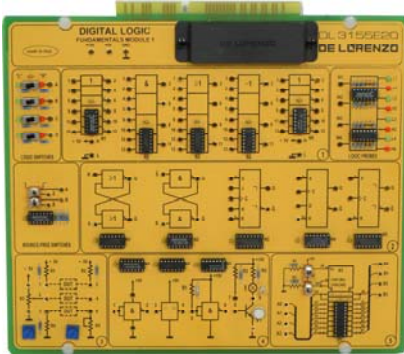


TIME ELECTRONIC BOARDS



DIGITAL ELECTRONICS

DIGITAL LOGIC FUNDAMENTALS 1



DL 3155E20

Theoretical topics:

- Ideas of logic: logic connectives and fundamental theorems of the Boolean algebra
- Binary system
- Logic functions
- Algebraic description of the logic networks and the truth tables
- Theorems of the Boolean algebra
- Minimization techniques of logic functions through theorem applications and Karnaugh maps
- Logic gates and truth tables
- Fundamental logic operators
- NOT, AND, OR logic operators
- Operation of the AND and OR operators as control devices in the transfer of logic signals
- OR-EXCLUSIVE logic operator
- Canonical forms of a function
- Graphic representation of functions
- AND - OR - NOT function
- NAND and NOR logic operators
- Operation of the NAND and NOR operators as control devices in the transfer of logic signals and carrying out of logic functions
- Generalities and definition of flip-flop
- S - R flip-flop, with NOR and NAND operators
- J - K flip-flop
- Master-slave J - K flip-flop
- T and D flip-flops
- Fundamental logic families
- TTL and CMOS families
- Characteristic parameters of the logic gates
- Interfacing of the logic families, outputs and types of TTL circuits
- Interfacing from CMOS to TTL
- Interfacing from TTL to CMOS
- TTL with totem-pole outputs
- The open-collector gates
- Wired-and function Page
- Types of TTL circuits
- Schottky and low power Schottky of advanced type (AS/ALS)
- Interfacing with the bus
- An example of transmitter / receiver for bi-directional bus
- Fault simulation

Circuit blocks:

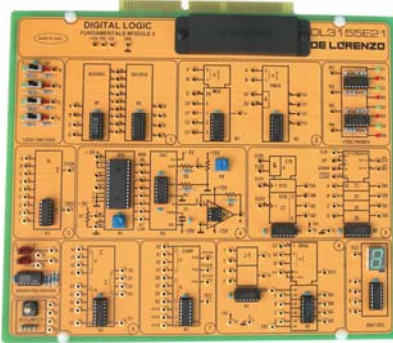
- AND / NAND
- OR / NOR
- XOR / XNOR
- Open Collector
- SET / RESET Flip-Flop
- D-Type Flip-Flop
- JK Flip-Flop
- Tri-State Output
- TTL / CMOS Comparison
- Data Bus Control

In addition, the Circuit Board contains:

- +5 V regulated supply
- Built-in clock circuit
- Manual input signal control



DIGITAL LOGIC FUNDAMENTALS 2



DL 3155E21

Theoretical topics:

- Definition and characteristics of a combinatory logic network
- The BCD code
- DEC/BCD and BCD/DEC code converters
- Encoders
- Decoders
- Multiplexer
- Demultiplexer
- Parity
- Parity logic circuits
- Nine bit 74180 parity generator/detector
- Unipolar codes
- Bipolar codes
- A/D converters
- Staircase A/D converter
- ADC converter of parallel or flash type
- ADC converter with simple slope
- ADC converter with double slope
- D/A converters (DAC)
- D/A converter with weighed resistances
- D/A converter with R–2R network
- 4 bit asynchronous binary counter
- 4 bit synchronous binary counter
- Asynchronous decimal counter
- Synchronous decimal counter
- Up/down synchronous counters
- Adders
- Half adder
- Full adder
- Parallel binary adders – four-bit adder
- Quantity comparators
- Four-bit comparator
- Definition and classification of shift registers
- Operation principle
- 4 bit bi-directional shift registers
- Applications
- Fault simulation

Circuit blocks:

- BCD Decimal Decoder / BCD Priority Encoder
- ADC / DAC
- Multiplexer / Demultiplexer
- 7-Segment Driver / Display
- Parity Generator / Checker

In addition, the Circuit Board includes the following:

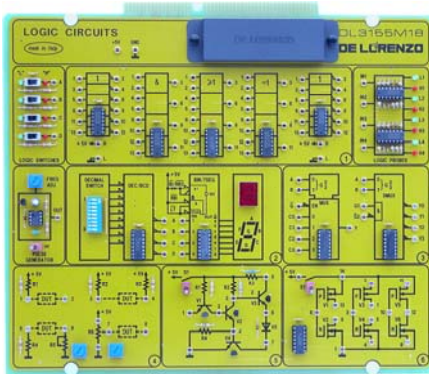
- +5 V regulated supply
- Built-in clock circuit
- Built-in pulse generator circuit
- Built-in counter circuitry
- The 74LS42 decoder and LS147 encoder
- AD673 ADC and AD558 DAC
- The LS151 multiplexer and LS155 demultiplexer
- The LS280 7-Segment decoder / driver



TIME ELECTRONIC BOARDS



LOGIC CIRCUITS



DL 3155M18

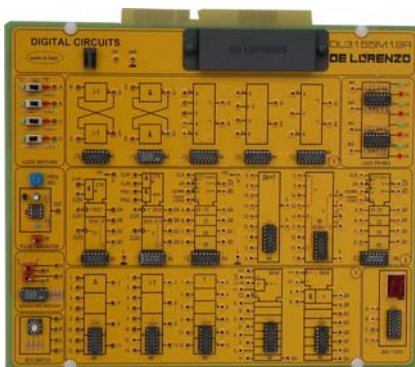
Theoretical topics:

- Binary system
- Logic functions
- The algebraic description of the logic gates
- The truth tables
- The theorems of the Boolean Algebra
- Techniques for the minimization of the logic functions through the application of the theorems
- Fundamental logic operators
- NOT, AND and OR logic operators
- Use of the AND and OR operators as control devices for the transfer of logic signals
- OR-exclusive logic operator
- Classic form of a function
- Graphic representation of the functions
- AND-OR-NOT function
- NAND and NOR logic operators
- Use of the NAND and NOR operators as control devices for the transfer of logic signals
- The TTL family
- The CMOS family
- Characteristic parameters of the logic gates
- Definition and characteristics of a combinatory logic network
- The Karnaugh' maps
- The BCD code
- Encoders, decoders, multiplexer and demultiplexer
- Fault simulation

Circuit blocks:

- Logic gates, Boolean Algebra, Karnaugh's maps and combinatory networks
- Encoder and decoder
- Multiplexer and demultiplexer
- Electric characteristics of the TTL logic gates
- The TTL logic family
- The CMOS logic family

DIGITAL CIRCUITS



DL 3155M19R

Theoretical topics:

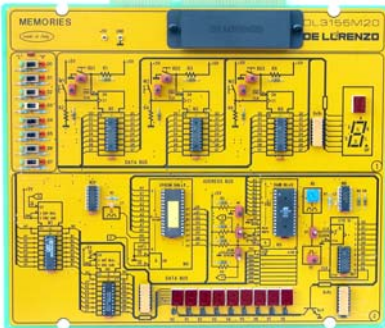
- Flip-flop S-R, with NOR and NAND operators
- Flip-flop J-K
- Flip-flop J-K Master-Slave
- Flip-flop T and D
- Synchronous and asynchronous 4 bit binary counter
- Synchronous and asynchronous decimal counter
- Parity generator
- Adders
- Definition, classification and operating principle of the most common shift registers
- Fault simulation

Circuit blocks:

- Flip-flops
- Counters
- Shift registers



MEMORIES



DL 3155M20

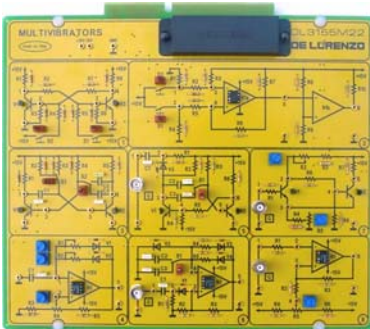
Theoretical topics:

- Memory classification
- Terminology and main characteristics
- Elementary memory cells
- Structure and operating principles
- ROM memory
- RAM memory
- Sequential memory
- Fault simulation

Circuit blocks:

- Elementary memory cells
- Types of memories: RAM and EPROM

MULTIVIBRATORS



DL 3155M22

Theoretical topics:

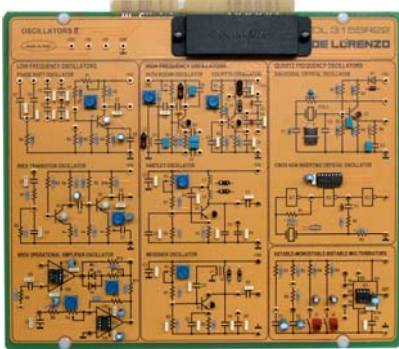
- BJT bistable multivibrator
- Resolution or transition time
- Bistable multivibrator using the operational amplifiers
- BJT astable multivibrator
- Astable multivibrator using the operational amplifiers
- BJT monostable multivibrator
- Monostable multivibrator using the operational amplifiers
- Schmitt trigger
- Schmitt trigger using the operational amplifiers
- Fault simulation

Circuit blocks:

- Operation modes of a BJT bistable multivibrator (flip-flop)
- BJT bistable multivibrator (flip-flop) using the operational amplifiers
- Operation modes of a BJT astable multivibrator
- Astable multivibrator using the operational amplifiers
- Operation modes of a BJT monostable multivibrator
- Operation modes of a monostable multivibrator using the operational amplifiers
- Operation modes of a BJT Schmitt trigger
- Schmitt trigger



OSCILLATORS



DL 3155R22

Theoretical topics:

- Characteristics of RC-phase shift oscillator
- Characteristics of Wien bridge oscillator with BJT transistor
- Characteristics of Wien bridge oscillator with Operational amplifier
- Characteristics of Huth-Kuehn oscillator
- Characteristics of Colpitts oscillator
- Characteristics of Hartley oscillator
- Characteristics of Meissner oscillator
- Characteristics of Crystal oscillator
- Characteristics of non-inverting crystal oscillator
- Characteristics of astable, monostable and bistable multivibrators with IC 555
- Fault simulation

Circuit blocks:

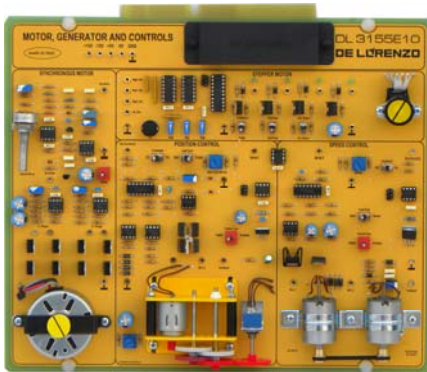
- Low frequency oscillators:
 - Phase shift oscillator
 - Wien transistor oscillator
 - Wien OA oscillator
- High frequency oscillators:
 - Huth-Kuehn oscillator
 - Colpitts oscillator
 - Hartley oscillator
 - Meissner oscillator
- Quartz frequency oscillators:
 - Sinusoidal crystal oscillator
 - CMOS non inverting crystal oscillator
- Astable – Monostable – Bistable multivibrators

Note: this board is not provided with CAI software



REGULATIONS AND CONTROLS

MOTORS, GENERATORS AND CONTROLS



DL 3155E10

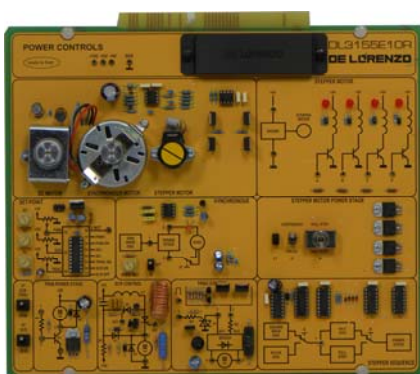
Theoretical topics:

- Types of electric motors
- Familiarization with AC motor circuits
- Familiarization with DC motor connection types
- Familiarization with stepper motor circuits
- Main characteristics of DC motor driving systems
- Speed variation in motor controls
- Position control with DC motor
- PWM DC motor control
- Bi-directional H bridge DC motor control circuit
- Advantages and disadvantages of synchronous motors
- Comparison between stepper motor and DC motor
- Familiarization with unipolar/bipolar/bifilar/multi phase stepper motors
- Fault simulation

Circuit blocks:

- Synchronous motor
- Stepper motor
- Open/Closed loop position control of a DC motor
- Digital/Analog position control of a DC motor
- Open/Closed loop speed control of a DC motor with Tachogenerator
- Digital/Analog speed control of a DC motor with Tachogenerator

POWER ELECTRONICS AND CONTROLS



DL 3155E10R

Theoretical topics:

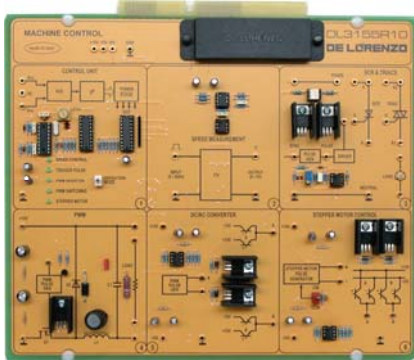
- Direct current motors
- Generators
- Circuits for the control of direct current motors
- Alternate current motors
- Circuits for the control of alternate current motors
- Stepping motors
- Circuits for the control of stepping motors
- Fault simulation

Circuit blocks:

- Motors
- Stepper motor
- PWM power stage
- Synchronous
- Stepper motor power stage
- Set point and PWM generator
- Stepper sequence
- SCR TRIAC control



MACHINE CONTROL



DL 3155R10

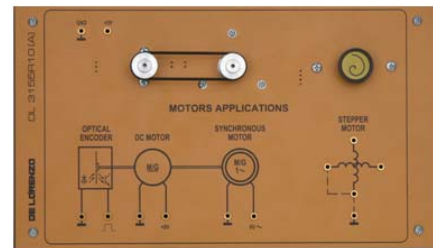
Theoretical topics:

- Familiarization with power devices
- The MOSFET
- The SCR & the TRIAC characteristics
- Familiarization with DC motor driving systems
- Circuits for the control of direct current machines
- Circuits for the control of AC machines
- Circuits for the control of stepper motors
- Study of the PWM power stage
- Frequency/Voltage converter
- Effect of feedback (speed and torque)
- Fault simulation

Note: this board is not provided with CAI software

Circuit blocks:

- Control unit (speed, trigger pulse, PWM and stepper motor)
- Speed measurement unit
- SCR & TRIAC
- PWM
- DC/AC Converter
- Stepper motor control unit

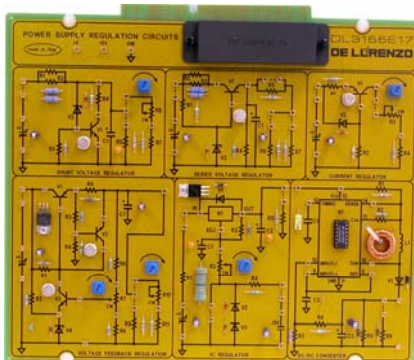


MOTORS APPLICATIONS (APPLICATION BOARD FOR MACHINE CONTROL)

DL 3155R10A

- Direct current motor/generator
- Synchronous motor
- Stepper motor
- Characteristics of an optical encoder

POWER SUPPLY REGULATION CIRCUITS



DL 3155E17

Theoretical topics:

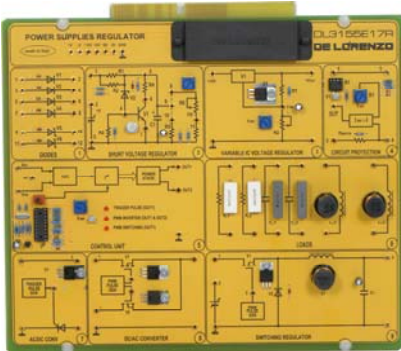
- Regulated power supplies
- Shunt voltage regulator
- Zener diode introductory information
- Shunt voltage regulator with Zener diode parallel connected to the load
- Shunt voltage regulator with bipolar transistor
- Series voltage regulators
- Voltage feedback regulators with current limiting protection
- Series current regulators
- IC regulators and DC-to-DC converter
- General characteristics of monolithic regulators
- Three-pin IC regulator operation (LM317T)
- DC-to-DC converter operating characteristics (LM78S40N)
- Fault simulation

Circuit blocks:

- Shunt Voltage Regulator
- Series Voltage Regulator
- Current Regulator
- Voltage Feedback Regulation
- IC Regulation
- DC-to-DC Converter



POWER SUPPLY REGULATORS



DL 3155E17R

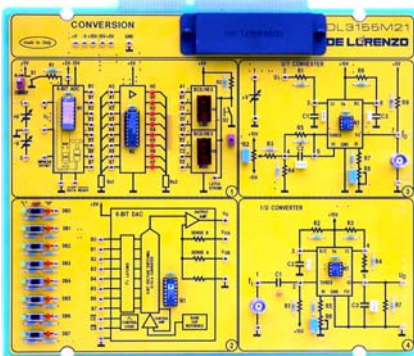
Theoretical topics:

- Diodes circuits
- Voltage regulator with transistor
- Variable IC voltage regulator with overload protection
- AC/DC conversion
- DC/AC conversion
- Switching regulator
- Fault simulation

Circuit blocks:

- Diodes
- Shunt voltage regulator
- Variable IC voltage regulator
- Protection circuit
- AC/DC converter
- DC/AC converter
- Switching regulator

CONVERSION



DL 3155M21

Theoretical topics:

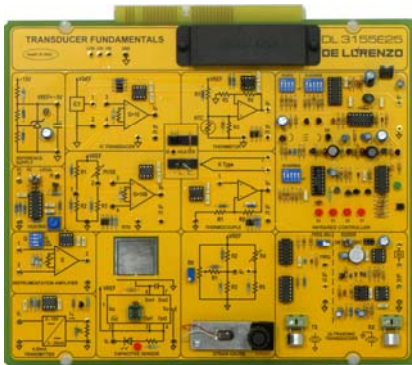
- Analogue and digital signals
- Unipolar codes
- Bipolar codes
- The A/D conversion
- Step A/D converters
- A/D converter of parallel or flash type
- Simple slope A/D converter
- Double slope A/D converter
- The D/A conversion
- Weighed resistance D/A converter
- D/A converter with R-2R network
- Voltage/frequency conversion
- Voltage/frequency conversion with slope method
- Voltage/frequency conversion with charge balance method
- Fault simulation

Circuit blocks:

- Analogue to digital converter
- Digital to analogue converter
- Voltage to frequency converter
- Frequency to voltage converter



TRANSDUCER FUNDAMENTALS



DL 3155E25

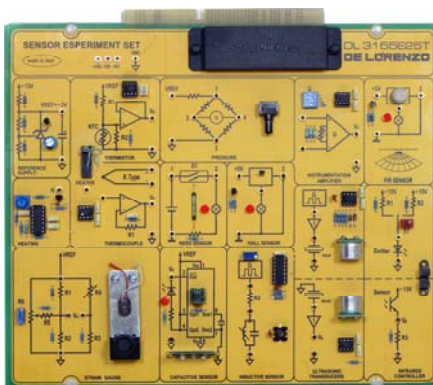
Theoretical topics:

- Measurement of temperature through an IC transducer
- Measurement of temperature through a current output IC transducer
- Measurement of temperature through a thermocouple
- Measurement of temperature through an NTC thermistor
- Measurement of temperature through an RTD
- Familiarization with capacitive sensors
- Measurement of the deformation through an instrumentation amplifier
- Familiarization with Infrared controllers and protocols (TX/RX)
- Familiarization with Ultrasonic sensors and transducers (TX/RX)
- Fault simulation

Circuit blocks:

- Reference voltage supply
- Heating section (with internal or external command)
- Instrumentation amplifier
- Current transmitter (4÷20 mA)
- IC transducer
- Thermistor (NTC)
- Resistance Temperature Detector (RTD)
- Thermocouple
- Capacitive sensor
- Strain gauge
- Infrared controller
- Ultrasonic transducers

SENSOR EXPERIMENT SET



DL 3155E25T

Theoretical topics:

- Measurement of the temperature through a thermistor
- Measurement of the temperature through a thermocouple
- Applications of the Wheatstone
- Types of fluid pressure measurements
- Absolute pressure sensor
- Gauge pressure sensor
- Differential pressure sensor
- Pressure transducers
- Passive Infrared Sensors (PIRS)
- Hall's effect and Hall's potential difference
- Measurement of the deformation through a strain gauge
- Capacitive sensors
- Inductive proximity sensors
- Ultrasonic transducers
- Reception of ultrasonic signals
- Infrared transmission and controller
- Fault simulation

Circuit blocks:

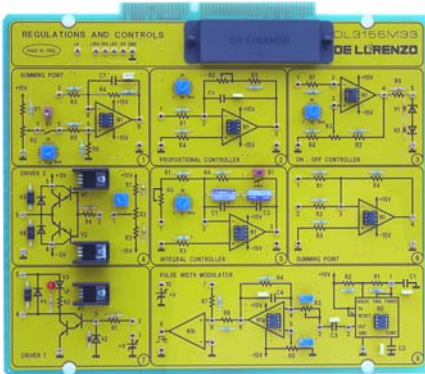
- Measurement of T through a thermistor
- Measurement of T through a thermocouple
- Pressure Sensor
- P.I.R. Sensor
- Magnetic switch
- Hall sensor
- Measurement of the deformation through a strain gauge
- Use of the capacitor sensor
- Inductive sensor
- Transmission and reception of ultrasonic signals
- Infrared transmission and reception



TIME ELECTRONIC BOARDS



REGULATION AND CONTROL



DL 3155M33

Theoretical topics:

- Control and regulation
- Types of controls
- Automatic regulation systems
- Proportional regulation (P)
- Integral regulation (I)
- Derivative regulation (D)
- Proportional-Integral-Derivative regulation (PID)
- ON-OFF regulation
- PWM regulation
- Characteristics of the transducers
- Position transducers
- Speed transducers
- Pressure transducers
- Temperature transducers
- Thermistors
- Actuators
- Dc motors
- Peckling motors
- Fault simulation

APPLICATION BOARD FOR MOTOR SPEED CONTROL



DL 3155M33A

- Characteristics of an encoder
- Operation of an open loop and closed loop system

APPLICATION BOARD FOR TEMPERATURE CONTROL



DL 3155M33B

- Characteristics of the temperature sensor
- Characteristics of the heater
- ON-OFF control of the temperature
- Closed loop proportional control of the temperature
- Closed loop proportional-integral control of the temperature



APPLICATION BOARD FOR POSITION CONTROL



DL 3155M33C

- Characteristics of the position sensor
- Closed loop control of the position

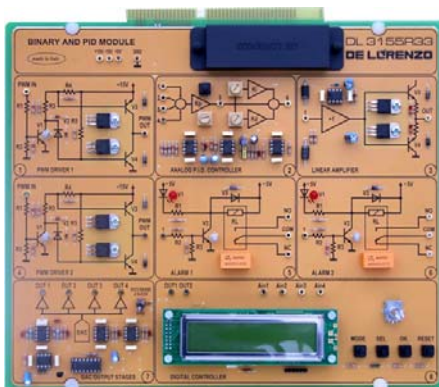
APPLICATION BOARD FOR PRESSURE CONTROL



DL 3155M33D

- Characteristics of the pressure sensor
- Closed loop proportional-integral control of the pressure

REGULATION SYSTEMS



DL 3155R33

Theoretical topics:

- Familiarization with control and regulation
- Familiarization with different types of control (Open and Closed loops)
- Characteristics of different regulating types (P, PI, PD, PID and On-Off)
- PWM regulation
- Linear power amplifier
- The behavior of an analog PID controller (K_p , K_i and K_d)
- Digital controller
- A/D and D/A converters
- Relays alarms circuitry
- Fault simulation

Circuit blocks:

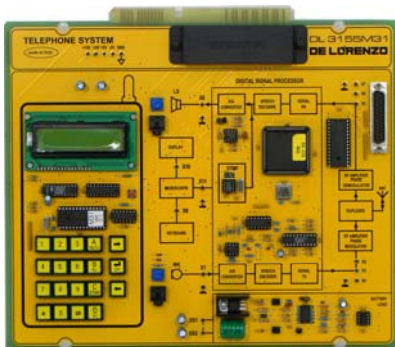
- PWM drivers
- Alarm circuits
- DAC output stages
- Linear amplifier
- Analog PID controller
- Digital controller with Display

Note: this board is not provided with CAI software



TELECOMMUNICATIONS

CELLULAR TELEPHONY



DL 3155M31

Theoretical topics:

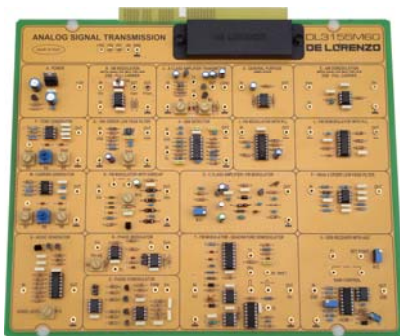
- Basic functions of the GSM cellular telephone
- Telephone keyboard and display
- Microphone and loudspeaker
- Digital Signal Processor (DSP)
- Connection to an external microphone and loudspeaker
- Connection to a personal computer
- Fault simulation

Technical features:

- Keyboard and display
- Microphone and loudspeaker
- Digital Signal Processor (DSP)

THIS IS NOT A MOBILE PHONE

ANALOGUE SIGNAL TRANSMISSION



DL 3155M60

Theoretical topics:

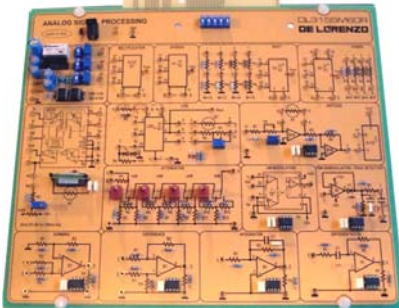
- Amplitude modulation and demodulation (AM)
- Double side band modulation and demodulation (DSB)
- Single side band modulation and demodulation (SSB)
- Frequency modulation and demodulation (FM)
- Phase modulation and demodulation (PM)
- VCO and PLL circuits
- Carrier generator
- Low frequency generator
- Noise generator
- Fault simulation

Technical features:

- AM modulation and demodulation
Carrier input 0 – 15 V peak-to-peak, 70 – 700 kHz
Modulator input 0 – 15 V peak-to-peak, 3.5 – 50 kHz
- DSB modulation and demodulation
Carrier input 0 – 15 V peak-to-peak, 70 – 700 kHz
Modulator input 0 – 15 V peak-to-peak, 3.5 – 50 kHz
- SSB modulation and demodulation
Selective filter
Carrier input 0 – 15 V peak-to-peak, 300 - 350 kHz
Modulator input 0 – 2 V peak-to-peak, 30 – 50 kHz
SSB demodulator with ACG
- FM modulation and demodulation
Input 1 – 10 V peak-to-peak, 2-5 kHz
Carrier 6-9 MHz
- Quadrature FM modulation and demodulation
Input 1 – 10 V peak-to-peak, 3-5 kHz
- PM modulation and demodulation
Input 1 – 5 V peak-to-peak, 0 – 300 Hz
- VCO and PLL circuits
Input 0 – 4 V peak-to-peak, 0 – 6 kHz
- Carrier generator
0 – 15 V peak-to-peak, 70 – 700 kHz
- Low frequency generator
0 – 15 V peak-to-peak, 3.5 – 50 kHz
- Noise generator
- Transmission with class C amplifier
- Gain of the receiver 15 dB



ANALOGUE SIGNAL PROCESSING



DL 3155M60R

Theoretical topics:

- Familiarization with analogue computing technique
- Basic and advanced linear operations
- Simultaneous multiplication and division
- Analog computation of powers and roots
- Log ratio computation
- Antilog computation
- Square root operation
- Attenuator overview
- Characteristics and key specifications for fixed and step attenuators
- Audio attenuators
- Forms of amplitude modulation
- Amplitude modulation and demodulation methods
- The Operational Amplifier characteristics
- Main configurations of the OA
- Fault simulation

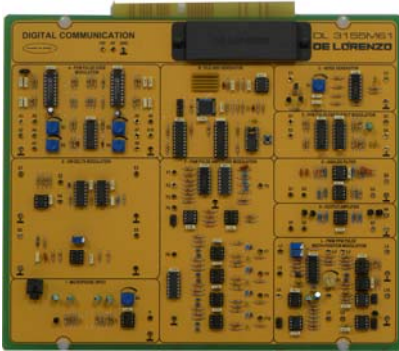
Circuit blocks:

- Reference power supply unit
- Real-time Analog computational unit
- One-quadrant multiplication unit
- One-quadrant division unit
- Root circuit
- Power circuit
- Log ratio operation with thermic compensation
- Antilog operation with thermic compensation
- Attenuator
- Amplitude modulation and demodulation
- Non inverting summing block
- Difference amplifier
- Integrator
- Differentiator (Shunt)

Note: this board is not provided with CAI software



DIGITAL MODULATION- DEMODULATION



DL 3155M61

Theoretical topics:

- Different types of digital modulation and demodulation for analogue signals
- Evaluation of pros and the cons of each conversion mode
- Fault simulation

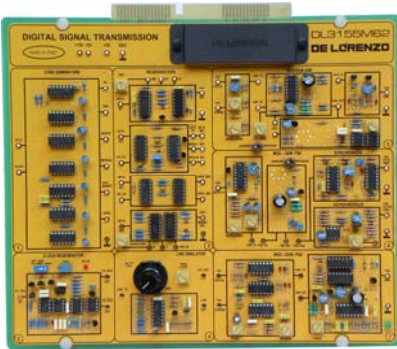
Technical features:

- PCM modulator and demodulator
- 8 bit coding with compression, Mu or A selectable through bridge
- 2 channels for transmission and 2 channels for reception
- Possibility to use 1 or 2 digital channels
- Integrated anti-aliasing and band limiting analogue filters in reception, capacitive switching type
- Passing band from 300 Hz up to 3400 Hz
- PAM signal generation, demodulation, transmission for each single channel
- PAM modulator and demodulator
- Two channel time division
- Regeneration of the synchronism and channel signals
- Sampled, but not quantified signal
- PTM Signal Generation
- Passing band from continuous to 4000Hz
- PWM and PPM modulator and demodulator
- Single channel with passing band from continuous to 4000 Hz
- Regeneration of the synchronism signal
- Conversion of the PWM signal to PPM and from the PPM signal to PWM
- PCM signal generation and demodulation
- PCM Signal Time-Division Multiplexing

- PFM modulator and demodulator
- Single channel with passing band from 300 Hz to 3400 Hz
- Circuit realization with the use of a PLL
- Delta modulator and demodulator
- Single channel with passing band from continuous to 3400 Hz
- Timing
- Ramp signal generation
- Channel noise
- Possibility to adjust the noise that is superimposed to both analogue and digital signals
- Analogue filters
- 2 analogue filters with 3400 Hz limited band
- Output amplifier
- 2 amplifiers able to pilot a small loudspeaker
- Microphone amplifier
- Microphone amplifier with automatic gain control
- Channel bandwidth



DIGITAL SIGNAL TRANSMISSION



DL 3155M62

Theoretical topics:

- The transmission of digital signals
- The base band transmission analysed through the study of NRZ, RZ, Manchester, Biphase, DPSK and duo-binary coders and decoders
- The numerical modulators and demodulators to realize, verify and test the ASK, the FSK, the PSK modulation
- Fault simulation

Circuit blocks:

- NRZ (Non Return to Zero) coding and decoding
- RZ (Return to Zero) coding and decoding
- Manchester coding and decoding
- Bi-phase coding and decoding
- Duo-binary coding and decoding
- ASK modulation and demodulation
- FSK modulation and demodulation
- PSK modulation and demodulation

This board needs the DL 3155M62A.

AUXILIARY BOARD



DL 3155M62A

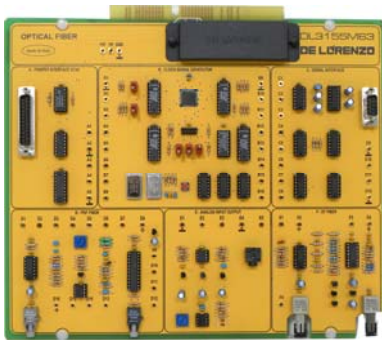
- Clock and carrier generator, obtained by a single quartz source at 2.4576 Mc/s with a selectable clock frequency of 2400, 4800, 9600, 19200 or 38400 cycles / sec,
- Pseudo-random data generator that generates two random sequences of 1 and 0 of different length, 15 bits and 255 bits,
- Bit Error Rate (BER) meter,
- Digital delay equalizer,
- Artificial noise generator, that generates a quasi-white spectrum signal in the band 2 - 40 kHz,
- Jitter meter.



TIME ELECTRONIC BOARDS



FIBRE OPTICS



DL 3155M63

Theoretical topics:

- Introduction to fibre optics communication
- Attenuation
- Numerical openings
- Propagation methods
- Transmitted power specifications
- Chromatic and modal dispersion
- Cable attenuation specifications
- Received power specifications
- Time division (TDM) and wave length division(WDM) transmission
- Fault simulation

Circuit blocks:

- Clock signal generation
- Serial interface
- ST fiber
- Analogue input / output
- POF fiber
- Printer interface

TRANSMISSION LINE



DL 3155M64

Theoretical topics:

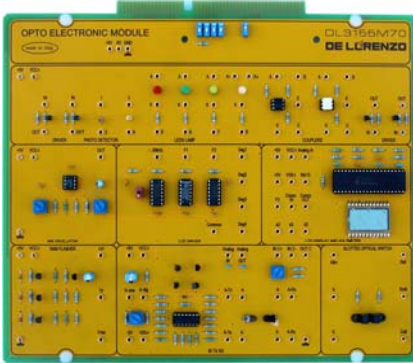
- Familiarization with the transmission line theory
- The four terminal model of the transmission line (Equivalent circuit model)
- Input impedance of lossless transmission line
- Special cases of a transmission line (Half-wave and quarter-wave lengths, matched, shorted and open load)
- Stepped transmission line
- Practical types of transmission lines (Coaxial, microstrip, stripline, balanced, single wire, waveguide and optical fiber)
- Measuring the characteristics of a transmission line
- Measuring the attenuation of a transmission line
- Frequency characteristics of a transmission line
- Stationary waves
- Fault simulation

Circuit blocks:

- Function generator
- Input and output stages
- RLC simulated transmission line of 100m (4*25m)
- R loads
- L loads
- C loads



OPTO ELECTRONICS



DL 3155M70

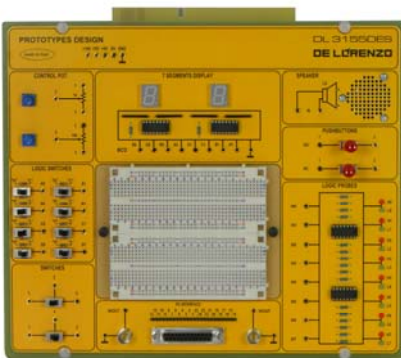
Theoretical topics:

- Concepts of physics on light and colours
- Light radiation
- The vision of colour
- Light bulb operation
- LEDs
- LEDs technical features
- Concepts of Liquid Crystal Display
- LCD types
- Light sensors
- Photodiodes
- Photoresistors
- Infrared radiation
- Opto-isolators
- Fault simulation

Circuit blocks:

- Photo detector
- LEDs
- Couplers
- Light drivers
- 555 Oscillator
- LCD driver
- LCD display and voltmeter
- 3909 Flasher
- Infrared Transmitter/Receiver
- Slotted optical switch

BOARD FOR ELECTRONIC DESIGN



DL 3155DES

It contains all of the necessary elements for the student to carry out the design and wiring of his own electronic circuits, both analogue and digital.

Technical features:

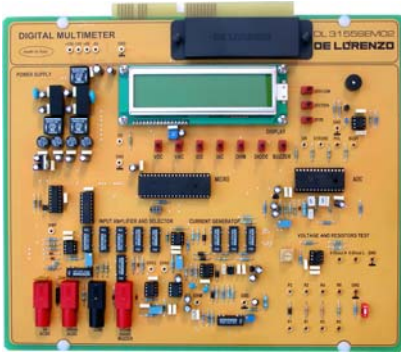
- Removable breadboard
- 2mm terminals to connect to the breadboard
- Cables with 2mm banana terminations for connection to the breadboard
- 8 red logic indicators for high levels and 8 green logic indicators for low levels
- 2 pushbuttons with normally open and normally closed outputs
- 1 Potentiometer - 1 kW
- 1 Potentiometer - 10 kW
- 2 slide switches with free terminals
- 2 BNC Connectors
- 8 logical switches
- 1 loudspeaker, 8 W
- 2 7-segments LCD displays with decoder
- Interface for PC



TIME ELECTRONIC BOARDS



DIGITAL MULTIMETER



DL 3155SEM02

Theoretical topics:

- Evaluation of the characteristics of a digital multimeter
- Voltage measurements on open circuits
- Measurement of the internal resistance of the voltmeter
- Voltage measurements on closed circuits
- Resistance measurements in direct mode
- Resistance measurements through the voltage – current ratio
- Current measurements
- Measurement of the internal resistance of the ammeter

Circuit blocks:

- Power supply
- Voltmeter inputs
- Ammeter inputs
- Control of the ohmmeter current
- Control of the current for the diode test
- RMS alternating current converter
- Analogue-digital converter
- Microcontroller
- Push-buttons reading
- Display writing