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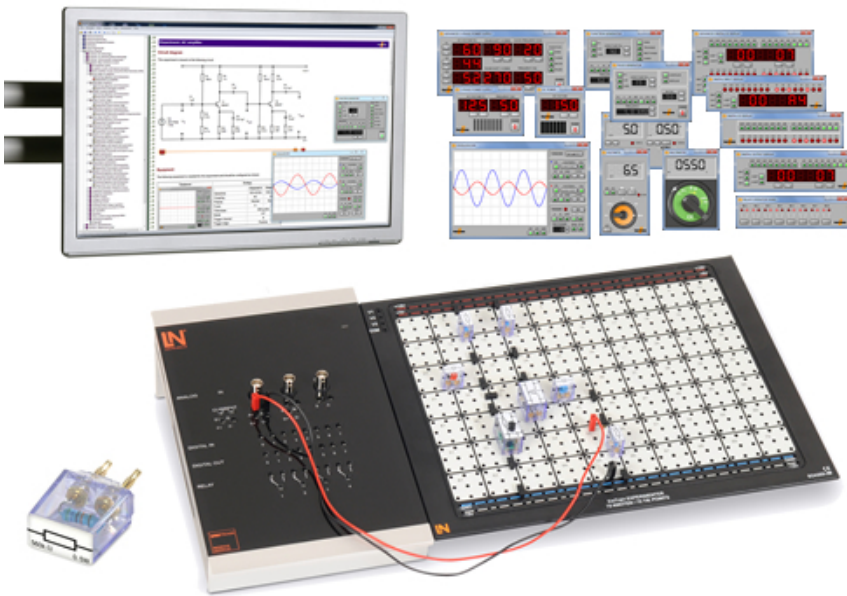
EloTrain - Plug-in System

Fundamentals of electrical engineering and electronics

A comprehensive education in the fundamentals of electrical engineering is essential to the understanding of more complex relationships in the various applied sectors in both electrical engineering and electronics.

The freedom to experiment is backed up by formal experiment literature and the use of safety extra-low voltage means that the system is even safe for complete laymen. It leads to in-depth knowledge and eventually to the kind of practical skills that form an essential basis for further education and training.

2-mm plug-in system for UniTrain

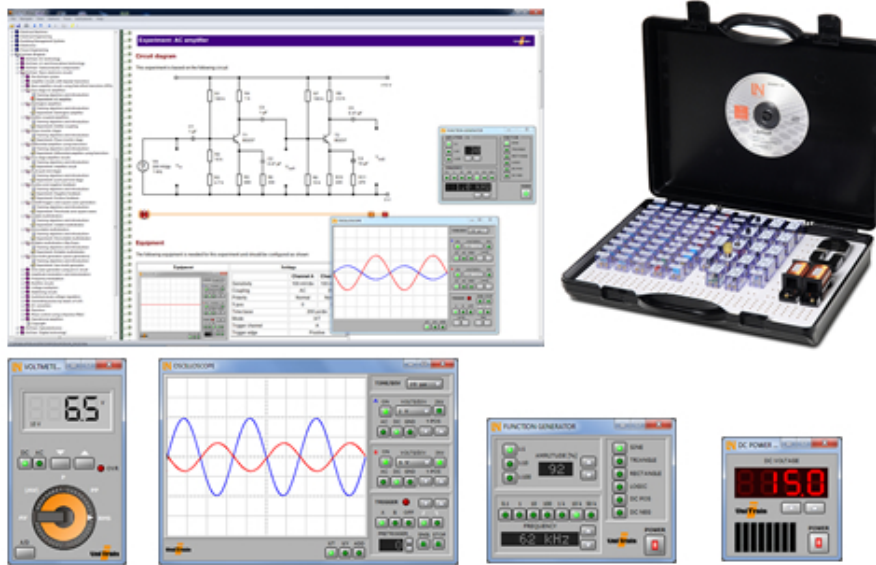


2-mm plug-in system for UniTrain

The multimedia experiment and training system

The EloTrain 2-mm plug-in system combines with the multimedia experiment and training system UniTrain to create a modern and powerful learning environment for well grounded training in the fundamentals of electrical engineering and electronics. Students are guided through experiments by clearly structured course software aided by text, graphics, animations and tests of knowledge. The experiments themselves are carried out on a 2-mm Experimenter unit specially developed for UniTrain. A wide variety of virtual instruments is available so that students can make real-time measurements. The plug-in modules contain both passive and active electronic components connected via 2-mm laminated plugs featuring gold-plated contacts. When inserted into the plug-in board, the laminated plugs clip the components into place mechanically as well as providing an electrical connection to the plug-in board's nodes. Cables or jumpers can be used to make connections to other nodes, components or measuring instruments. As a rule the 2-mm components are available in two sizes, one for two-pole components and the other for four poles. If a component requires more terminals, these are generally provided in the form of sockets on top of the component. The housings are comprised of two plastic parts clipped together. The upper part features a scratch-proof, high-contrast print of the component's circuit diagram or symbol along with a type name for the component. The transparent body is made of extremely tough see-through plastic allowing the inside of the component to be seen. The base plate is also made of containing 2-mm laminated plugs and joined to the body via an easy-to-open ratchet clip for repair purposes.

EloTrain courses



EloTrain courses

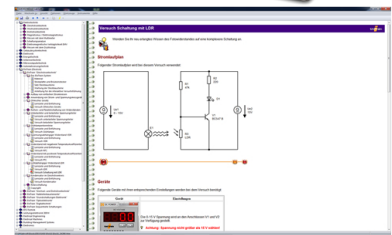
Special multimedia courses are specifically designed for basic education in various applied topics in electrical engineering and electronics. Complex relationships are illustrated at a level entirely comprehensible for schoolchildren using numerous images and illustrations. Students are continually encouraged to apply the knowledge they have learned in experiments using the plug-in components. Experiment instructions and virtual instruments are available for this purpose. Experiments are always safe, even for uninitiated laymen, thanks to the use of non-hazardous safety extra-low voltage.

List of articles:

Pos.	Product name	Bestell-Nr.	Anz.
1	Course, EloTrain 1: DC technology	SO4206-1A	1

Training contents:

- Assembly of simple electric circuits
- Use of voltmeters and ammeters.
- Ohm's law
- Series and parallel connection of resistors
- Voltage dividers with and without loads
- Light bulb characteristics
- Voltage dependent resistors (VDRs)
- Negative temperature coefficient thermistors (NTCs)
- Positive temperature coefficient thermistors (PTCs)
- Light-dependent resistors (LDRs)
- Capacitors in DC circuits
- Relay circuit
- Course duration 8 h approx.



2-mm plug-in components:

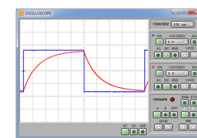
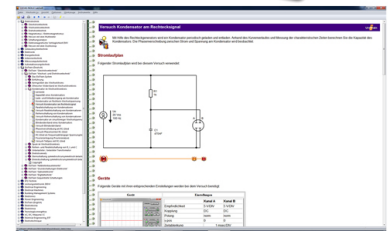
- All components and jumpers equipped with gold-plated 2-mm contacts
- Housing made of transparent, highly impact-resistant plastic
- Top featuring scratch-resistant, high-contrast screen print of type and circuit diagram of component
- Easy-to-open housing for repair purposes

Includes:

- 1x Button
- 1x Switch
- 1x Incandescent lamp
- 1x Relay
- 1x LED, red
- 1x LED, green
- 1x 22 Ω, 1x 100 Ω, 2x 220 Ω, 1x 470 Ω, 2x 1 kΩ, 2x 2.2 kΩ, 2x 10 kΩ, 1x 22 kΩ, 1x 47 kΩ, 1x 100 kΩ, 1x 1 MΩ resistors
- 1x VDR, 1x LDR, 1x NTC, 1x PTC resistors
- 1x 100 μF, 1x 470 μF capacitors
- 1x NPN transistor, BC 547
- Browser and course software
- Case for storage of component set and CD-ROM

Training contents:

- Generating AC
- Characteristics of AC
- Resistors in AC circuits
- Capacitors in AC circuits
- Series and parallel connections of resistors and capacitors (RC)
- Coils (inductors) in AC circuits
- Series and parallel connections of resistors and inductors (RL)
- Series and parallel connections of resistors, inductors and capacitors (RLC)
- Transformers with and without loads
- Three-phase networks
- Star circuit with symmetric/asymmetric loads
- Delta circuit with symmetric/asymmetric loads
- Course duration: 8 h approx.

2-mm plug-in components:

- All components and jumpers equipped with gold-plated 2-mm contacts
- Housing made of transparent, high impact-resistance plastic
- Top featuring scratch-resistant, high-contrast screen print of type and circuit diagram of component
- Easy-to-open housing for repair purposes

Includes:

- 1x Button
- 1x LED, red
- 1x LED, green
- 1x 10 ohms, 1x 22 ohms, 1x 33 ohms, 2x 100 ohms, 1x 220 ohms, 1x 680 ohms, 3x 1 kOhm, 1x 2,2 kOhm
- 1x 1 μ F, 1x 0.47 μ F capacitors
- 1x 10 mH, 1x 33 mH inductors
- 3x coils, C-core, 1x N=300, 2x N=900

- Set of cut-strip-wound cores
- Labsoft browser and course software
- Case for storage of component set and CD-ROM

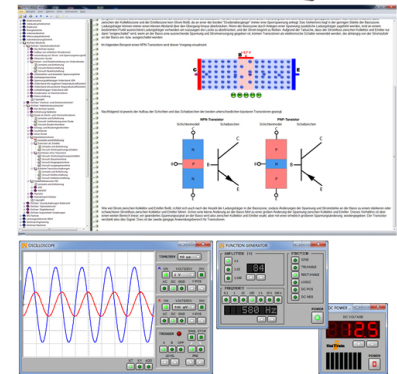
3 Course, EloTrain 3: Semiconductors

SO4206-1C

1

Training contents:

- Fundamentals of semiconductors
- Doping of semiconductors
- Diodes in DC and AC circuits
- Half-wave and bridge rectifiers
- Displaying diode characteristics on an oscilloscope
- Light-emitting diodes
- Zenerdiodes
- Diode-like characteristics of transistor circuits
- Input, output and control characteristics of transistors
- Transistors in common emitter, common collector and common base circuits
- Transistors used as switches
- Fundamentals of field effect transistors (FETs)
- Input and output characteristic of a JFET
- Input and output characteristic of a MOSFET
- Characteristics of diacs, thyristors and triacs
- Thyristors used as switches
- Phase control using triacs and diacs



2-mm plug-in components:

- All components and jumpers equipped with gold-plated 2-mm contacts
- Housing made of transparent, high impact-resistance plastic
- Top featuring scratch-resistant, high-contrast screen print of type and circuit diagram of component
- Easy-to-open housing for repair purposes

Includes:

- 1x Switch
- 1x Push button
- 1x Incandescent lamp
- 1x LED, red
- 1x LED, green
- 1x 33 Ω , 2x 100 Ω , 1x220 Ω , 1x 330 Ω , 1x 470 Ω , 1x 680 Ω , 2x

1 k Ω , 1x 2.2 k Ω , 2x 4.7 k Ω , 3x 10 k Ω , 1x 22 k Ω , 1x 47 k Ω , 1x 100 k Ω resistors

- 2x Potentiometer, 1k Ω + 10 k Ω
- 1x 0.1 μ F; 1x 22 μ F, 1x 0.47 μ F, 1 x 1 μ F capacitors
- 1x 1 μ F electrolytic capacitor, 1x 10 μ F electrolytic capacitor
- 6 x Diodes, 1N4007, 1 x germanium diode, AA118
- 1 x Zener diode, 4.7 V, 1 x Zener diode, 10 V
- 1 x Transistor, BC547, base left
- 1 x Transistor, BD237, base left
- 1 x Field effect transistor, 2N3819
- 1 x MOSFET BS170
- 1 x Diac, 1 x thyristor, 1 x triac
- Labsoft browser and course software
- Case for storage of component set and CD-ROM

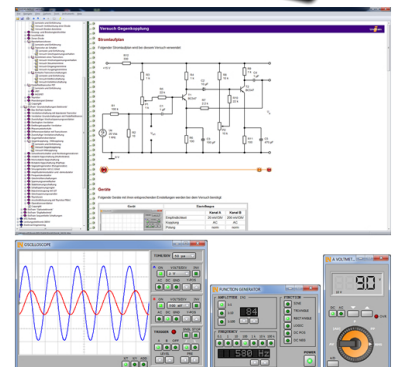
4 Course, EloTrain 4: Basic electronic circuits

SO4206-1D

1

Training contents:

- Basic amplifier circuits using bipolar transistors
- Basic amplifier circuits using field effect transistors (FETs)
- Two-stage AC amplifier
- Darlington pair amplifier
- Coupled emitter amplifiers
- Phase reversing stages
- Differential amplifiers
- Two-stage DC amplifier with complementary transistors
- Push-pull amplifiers
- Positive and negative feedback
- Square-wave generators
- Threshold switches (Schmitt triggers)
- Astable multivibrators
- Monostable multivibrators
- Bistable multivibrators (flip-flops)
- Saw tooth generators (pulse generators)
- Sine-wave generators with RC and LC elements
- Amplitude modulators and demodulators
- Frequency modulator
- Single-phase and three-phase rectifier circuits
- Voltage multipliers
- Stabilising circuits
- Voltage and current regulators (linear)
- Switched-mode voltage regulators
- DC converters
- Pulse generation using diacs



- Pulse generation using unijunction transistors
- Phase control using thyristors
- Phase control using triacs
- Full-wave control with zero-voltage switch
- DC voltage switch using thyristors
- Using op amps as inverting amplifiers
- Using op amps as non-inverting amplifiers
- Using op amps as differential amplifiers
- Dynamic response of operational amplifiers (op amps)

2-mm plug-in components:

- All components and jumpers equipped with gold-plated 2-mm contacts
- Housing made of transparent, high impact-resistance plastic
- Top featuring scratch-resistant, high-contrast screen print of type and circuit diagram of component
- Easy-to-open housing for repair purposes

Includes:

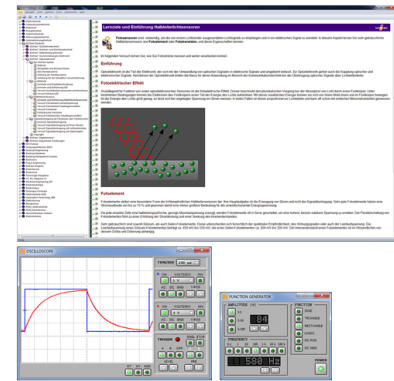
- Storage case for plug-in component modules
- "EloTrain 4 – Basic Electronic Circuit" course
- 29 film resistors 10 Ω ... 1 M Ω
- 2 potentiometers, linear 1 k Ω ... 10 k Ω
- 11 capacitors 100 pF ... 0,47 μ F
- 3 electrolyte capacitors 1 μ F ... 470 μ F
- 2 coils 10 mH ... 33 mH
- 2 transformer coils N = 300, N = 900
- 1 cut strip-wound core (1 pair)
- 2 LEDs, green
- 6 silicon diodes 1N4007, 1 germanium diode AA118
- 1 Zener diode 4.7 V
- 2 transistors BC547 base left + base right
- 2 transistors BD237 base left + base right
- 1 transistor BD238 base right
- 1 field effect transistor 2N3819
- 1 unijunction transistor
- 1 DIAC, 1 thyristor, 1 TRIAC
- 1 operational amplifier
- 1 switch
- 1 button
- 1 incandescent lamp 15 V with socket E10
- 1 speaker

Training contents:

- Parameters and characteristics of light-emitting diodes (LEDs)
- Control of LEDs
- Infra-red LEDs
- Photodetectors
- Photodiodes
- Phototransistors
- Transmitting signals using photodiodes and phototransistors
- Optocouplers
- Optical fibres

2-mm plug-in components:

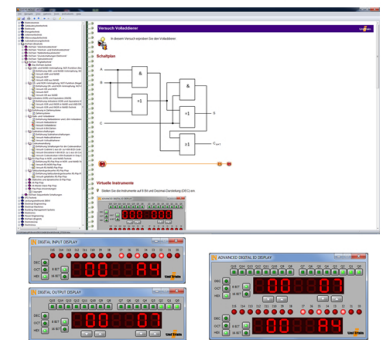
- All components and jumpers equipped with gold-plated 2-mm contacts
- Housing made of transparent, high impact-resistance plastic
- Top featuring scratch-resistant, high-contrast screen print of type and circuit diagram of component
- Easy-to-open housing for repair purposes

Includes:

- 7 film resistors 100 Ω ...22 k Ω
- 1 capacitor 10 μ F
- 1 transistor BC547 base left
- 1 LED red, 1 LED infrared
- 1 silicon photodiode, 1 silicon phototransistor
- 1 silicon photoelement
- 1 optocoupler
- 2 optical waveguide housings + fibre-optic waveguide
- 1 adjustable incandescent lamp 15 V with socket E10
- 1 loudspeaker, 1 pushbutton
- LabSoft browser and course software
- Storage case for component set and CD-ROM

Training contents:

- NOT function, AND and NAND gates
- OR and NOR gates
- Antivalence (XOR) and equivalence (XNOR)
- Half adders and full adders
- Subtracting circuits
- Code conversion
- RS-NOR flip-flops
- Clocked RS-flip-flops
- Static and dynamic D flip-flops
- JK flip-flops
- JK master-slave flip-flops
- Flip-flop applications



2-mm plug-in components:

- All components and jumpers equipped with gold-plated 2-mm contacts
- Housing made of transparent, high impact-resistance plastic
- Top featuring scratch-resistant, high-contrast screen print of type and circuit diagram of component
- Easy-to-open housing for repair purposes

Includes:

- 1 x monoflop, 2-fold
- 1 x 4-bit buffer/NOT gate
- 2 x AND/NAND gates, 4 inputs, 2-fold
- 1 x OR/NOR gates, 4 inputs, 2-fold

- 1 x AND/NAND gate, 2 inputs, 4-fold
- 2 x OR/NOR gate, 2 inputs, 4-fold
- 1 x XOR/XNOR gate, 2 inputs, 4-fold
- 1 x JK flip-flop, 2-fold
- 1 x JK master-slave flip-flop, 2-fold
- 1 x adder, 4-bit
- Labsoft browser and course software
- Case for storage of component set and CD-ROM

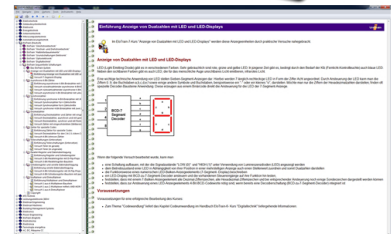
7 Course, EloTrain 7: Sequential circuits

SO4206-1G

1

Training contents:

- Display of binary numbers on LEDs and LED displays
- Asynchronous 4-bit counter
- Synchronous counter
- Decimal counter
- Counters for special codes
- Divider circuits (prescalers)
- Registers and shift registers
- Serial and parallel data exchange
- Multiplexers and demultiplexers



2-mm plug-in components:

- All components and jumpers equipped with gold-plated 2-mm contacts
- Housing made of transparent, high impact-resistance plastic
- Top featuring scratch-resistant, high-contrast screen print of type and circuit diagram of component
- Easy-to-open housing for repair purposes

Includes:

- 1 x display, 7-segment
- 1 x clock generator
- 1 x 4-bit buffer/NOT gate

- 2 x AND/NAND gate, 2 inputs, 4-fold
- 1 x XOR/XNOR gate, 2 inputs, 4-fold
- 1 x AND/OR/NOT gates
- 2 x JK flip-flop, 2-fold
- 1 x counter, 4-bit
- 1 x shift register, 4-bit, 2-fold
- 1 x multiplexer, 1 from 4
- 1 x buffer, 4-bit, tri-state
- Labsoft browser and course software
- Case for storage of component set and CD-ROM

The EloTrain course provides the perfect introduction for students to the world of electrical engineering. All the necessary fundamentals are conveyed by simple and visually memorable means, always retaining the relevance to the automotive mechanics.

The course covers the following topics:

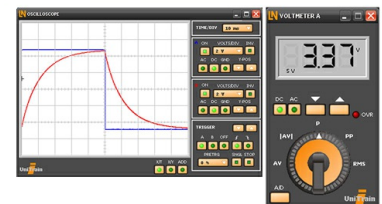
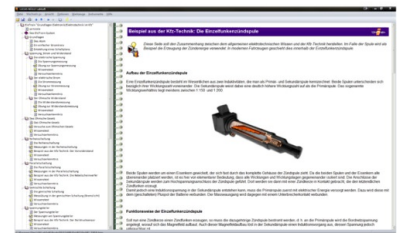
- Introduction to electrical engineering (current, voltage, electrical resistance)
- Use of Ohm's law
- Thorough understanding of different varieties of circuit (serial, parallel, mixed)
- Voltage dividers
- Electrical resistors (ohmic resistance, LDRs, thermistors)
- Potentiometers
- Diodes (LEDs, Zener diodes, standard diodes)
- Capacitors
- Coils and relays
- Complex components such as bipolar and unipolar transistors (field effect transistors)

Theory is conveyed by means of an easily understood section of text concentrating on the key aspects, as well as multiple pictures and professional animations. The knowledge imparted in this way is then checked in various tests and then further enhanced by practical experiments.

In the latter, one of the most important parts of the training is the use of the key measuring instruments (oscilloscopes, multimeters), another is the use of experiments to analyse the features and functioning principle of the individual components. The highlight of such sections is a special automotive experiment, in which a direct link is made between vehicle technology and the component being studied. That means that an affinity with motor vehicles is engendered in the trainees from day one. The course features the following automotive experiments:

- Wiring of headlights
- Brake light with junction resistance
- Bridge circuit for rail pressure sensor
- Determination of engine and air intake temperatures
- 6-pulse rectification in an alternator
- Simulation of indicator control using relays
- Interior lighting (using a transistor as a switch)
- DC/AC conversion for HID lights
- Simulation of a single-spark ignition coil
- Switching via relays (rear fog lamp)

The EloTrain course offers an introduction into the worlds of electronics and electrical engineering suitable for any age groups, which can provide trainees with all the all the knowledge they require in this area to proceed with more advanced training. Such knowledge is of vital importance, particular in an age in which vehicles are becoming more and more electrified.



Additionally required:

UniTrain System:

- Computer-based training and experimentation system for vocational and further training and education
- Multimedia combines cognitive and hands-on (haptic) training units into a comprehensive unified concept
- Areas of basic and advanced electrical engineering, electronics and automotive technology
- Enabling students to acquire skills in the handling of equipment
- Wide range of multimedia courses available for study in school or in professional and advanced training
- Self-contained and usable anywhere at any time
- Multimedia learning environment with high degrees of motivation
- Maximum learning effectiveness in laboratories, at work or at home
- Guarantor for effective and efficient study
- Virtual instruments with experiment hardware
- LabSoft, an open experiment platform
- Courses teach the theoretical building blocks and provide experiments
- Intelligent measurement interface supplies analog and digital measuring and control I/O
- High quality item of laboratory equipment with virtual instruments
- Students' progress monitored and electronically documented on the basis of fault finding experiments
- Faults simulated by the hardware as well as tests of knowledge

Pos.	Product name	Bestell-Nr.	Anz.
9	UniTrain Interface with virtual instruments (basic VI)	CO4203-2A	1

The UniTrain Interface is the central unit of the UniTrain system. It incorporates all inputs and outputs, switches, power and signal sources and measurement circuitry needed to perform experiments. The Interface is controlled via the connected PC.

Equipment:

- 32-bit processor with storage memory for measurements
- USB interfaces, transfer rate 12 Mbits/s
- WLAN/WiFi interface, 2.4 GHz, IEEE 802.11 b/g/n
- Simultaneous connection of any number of Experimenters via serial bus system
- High-quality designer casing with aluminium feet and surface-hardened Plexiglas front panel
- Suitable for accommodating in training panel frames for DIN A4 training panels
- Designed for connection of 2-mm safety measuring leads
- Multi-coloured LEDs for displaying status
- Adjustable analog output, +/-10 V, 0.2 A, DC – 5 MHz, via BNC and 2-mm sockets
- 4 Analog differential amplifier inputs with 10 MHz band width, safe for voltages up to 100 V, sampling rate 100 mega samples, 9 measuring ranges, memory depth 4 x 8 k x 10 bits, inputs via BNC (2 inputs) or 2-mm sockets (4 inputs)
- 2 Analog inputs for current measurement, overcurrent-protected up to 5 A, sampling rate 250 kilo samples, 2 measuring ranges, resolution 12 bits, connection via 2-mm sockets
- 3 variable analog outputs +/- 20V, 1 A, DC-150 Hz (requires



- CO4203-2B)
- 16-bit digital signal output, of which 8 bits are accessed via 2-mm sockets, TTL/CMOS, clock frequency 0 – 100 kHz, electric strength +/- 15 V
 - 16-bit digital signal input, of which 8 bits are accessed via 2-mm sockets, memory depth 16 bit x 2 k, TTL/CMOS, sampling rate 0 – 100 kHz, electric strength +/- 15 V,
 - 8 Relays, 24 V DC/1 A, of which 4 are accessed via 2-mm sockets
 - Dimensions: 29.6 x 19 x 8.6 cm
 - External power supply with wide range input 100-264 V, 47-63 Hz, output 24 V / 5 A
 - Weight (including power supply): 2.1 kg

Virtual instruments (meters and sources):

- 2 x Voltmeter VIs, 2 x Ammeter VIs: AC, DC, 9 ranges, 100 mV to 50 V, true RMS, AV
- 1 x Power meter, 9 ranges, 100 mV to 50 V
- 1 x VI with 8 relays, 1 x Multimeter VI: multimeter display (optional LM2330, LM2331 or LM2322) in LabSoft
- 1 x 2-channel ammeter VI: AC, DC, 2 ranges, 300 mA and 3 A, TrueRMS, AV
- 1 x 2-channel voltmeter VI: AC, DC, 9 ranges, 100 mV to 50 V, TrueRMS, AV
- 1 2-/4-channel oscilloscope: band width 10 MHz, 25 time ranges, 100 ns/div to 10 s/div, 9 ranges 20 mV/div to 10 V/div, trigger and pre-trigger, XY and XT modes, cursor function, addition and multiplication function for 2 channels
- 1 x VI Spectrum Analyzer: 9 voltage ranges 100 mV to 50 V, input frequency range 3 Hz to 1 MHz, time domain display
- 1 X VI Bode-Plotter: 9 voltage ranges 100 mV to 50 V, frequency range 1 Hz - 5MHz, time domain display and locus diagram
- 1 x Adjustable DC voltage VI 0 - 10 V
- 1 x Function generator VI: 0.5 Hz - 5 MHz, 0 - 10 V, sine, square, triangular,
- 1 x Arbitrary generator VI, 1 x Pulse generator VI
- 1 x VI with 16 digital outputs, 1 x VI with 16 x digital inputs, 1 x VI with 16 digital input/outputs. Display modes: binary, hex, decimal and octal numerals
- 1 x Three-phase power supply VI, 0 - 150 Hz, 0 - 14 Vrms, 2 A (requires CO4203-2B)
- 1 x Adjustable DC power supply VI, 3 x (-20 V - +20 V), 2 A (requires CO4203-2B)
- 1 x Three-phase power supply VI with additional phase-shift and clock rate adjustment (requires CO4203-2B)

Includes:

- Interface
- Power supply
- Power lead

- USB cable
- CD with basic software
- Operating manual

System requirements:

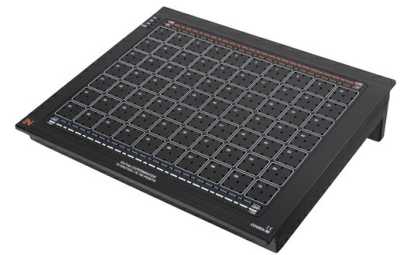
- Personal computer with Windows Vista, Windows 7, Windows 8, Windows 8.1, Windows 10 (32 or 64 bit)
- CD-ROM drive for installing software
- USB port for connection to Interface

10 EloTrain Experimenter

CO4203-3B

1

EloTrain Experimenter for 2-mm plug-in component system to be linked to UniTrain-I Interface. 70 nodes allow for easily understood circuit set-ups in a compact space. Circuits are built by inserting the plug-in modules between nodes on the board. Connections between nodes can be made using 2-mm or 7.5-mm jumpers.



- Links to a UniTrain-I Interface
- Fixed and variable power supply connections via 2-mm sockets
- For use with 2-mm plug-in components
- 70 nodes each with 9 x 2-mm sockets
- 7.5-mm grid for 2-mm sockets
- 4 bus lines for power supply (+15 V, +5 V, -15 V, earth) via 2-mm sockets
- Outputs for variable three-phase power supply
- Ergonomic working thanks to console housings
- Suitable for accommodating in training panel frames for DIN A4 training panels
- Contact loading: max. 10 A
- Dimensions: 363 x 297 x 85 mm (WxDxH)
- Weight: 1.7 kg

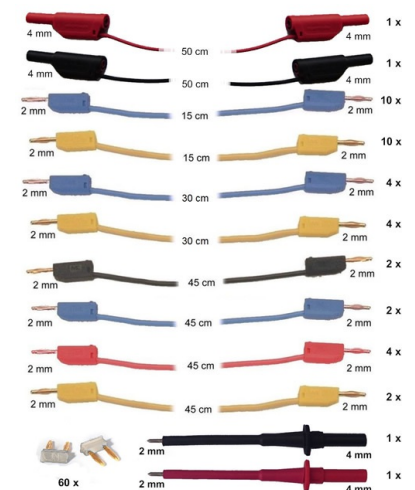
11 EloTrain set of connection cables and plugs for 2mm system

SO5146-1N

1

Measuring lead and plug set, 2mm-system, consisting of:

- 10 measuring leads, 2mm, 15cm, blue
- 4 measuring leads, 2mm, 30cm, blue
- 10 measuring leads, 2mm, 15cm, yellow
- 4 measuring leads, 2mm, 30cm, yellow
- 2 measuring leads, 2mm, 45cm, black
- 4 measuring leads, 2mm, 45cm, red
- 2 measuring leads, 2mm, 45cm, blue
- 2 measuring leads, 2mm, 45cm, yellow
- 1 safety measuring lead, 4mm, 50cm, black
- 1 safety measuring lead, 4mm, 50cm, red
- 1 safety probe 2mm, black
- 1 safety probe 2mm, red
- 60 jumpers 2mm /7.5mm, white



Universal and easy-to-use laboratory multimeter for measurement and testing in educational settings, power plants, process control installations etc.

- 3¾-digit multimeter; resolution: $\pm 4\,000$ Digits
- Measurement classification CATII - 600V / CATIII - 300V
- Voltage and current measuring ranges: 400mV–1000V DC, 400mV–1000V AC; 40 μ A–10A DC; 40 μ A-10A AC
- Measurement ranges: 100mohm-40Mohm
- Capacitance measuring range 1pF to 200 μ F
- Frequency measuring range 0.001Hz to 500kHz
- Duty cycle measurements
- Continuity and diode testing
- Automatic range selection and battery shut-off, min./max. and data hold function
- Includes protective sleeve, measuring leads and battery

