Table of Contents

Building management systems

Training systems / trainers for electrical wiring/building management systems:

- Protective circuitry, protective measures, building mains feed, lighting and intercom systems

- Industrial wiring, intercoms, alarm systems, hazard alarms and access control

- KNX/EIB, LON

- Project work, technical practice, assembly practice systems, planning software

UniTrain in wiring and installation technology

UniTrain in wiring and installation technology

The area of wiring and installation technology is not limited only to vocations related to electronics specialists for energy and building management systems. Select topics are also taught in related vocational subjects as well as in vocations with only modest electrical engineering content. As such, a topic like safety measures plays a very important role in the areas of heating, air-conditioning and sanitary technology. But basic knowledge also has to be learned in special vocational training programs like ones targeting "electrical technicians for special assignments".

For that reason the UniTrain training system contains, in addition to basic topics such as DC circuits, AC circuits and three-phase circuits, also topics like network systems and safety measures in power engineering as well as process control technology with contactor circuitry.

UniTrain-I Basic Set

UniTrain-I Basic Set

The UniTrain-I system is a computer-based training and experimentation system for vocational and further training and education in the areas of basic and advanced electrical engineering and electronics. Its multimedia courses combine cognitive and hands-on (haptic) training units into a comprehensive unified concept, specifically enabling students to acquire skills in the handling of equipment. Starting with basic courses and advancing to cover a huge variety of electrical engineering and electronics topics, a wide range of multimedia courses is available for study in school or in professional and advanced training courses.

The UniTrain-I system is completely self-contained and can be used anywhere at any time. The multimedia learning environment the system provides high degrees of motivation, and maximum learning effectiveness in laboratories, at work or at home. It thus becomes a guarantor for effective and efficient study.

Access to the multimedia courses and control of virtual instruments and experiment hardware is provided by LabSoft, the system's open experiment platform. The courses teach the theoretical building blocks and provide experiments to be carried out using the course-specific experiment hardware. The intelligent measurement interface supplies the analog and digital measuring and control I/O and represents, in combination with the system's virtual instruments, a high quality item of laboratory equipment. In addition, students' progress can be monitored and electronically documented on the basis of fault finding experiments with faults simulated by the hardware as well as tests of knowledge. The electrical and electronic circuits needed for the experiments are connected to the system with the aid of an Experimenter module.

Basic equipment set UniTrain system, consisting of:

Basic equipment set UniTrain system, consisting of:

The following courses require no Experimenter:

SO4204-3A, -3C, -6P, -6Q, -6R, -6S, -6T, -6U, -7C, -7F, -8U, -8V

The following courses require one Experimenter:

All courses for topics in electronics, digital technology, electrical machines and mechatronics (IMS) plus courses SO4204-3B, -4A, -4B, 4C, -4D, -4F, -4K,-6H, -7A, -7B, -7H, -7J, -7Q, -9A, -9D, -9K, -9U, -9V, -9W, -9X and -9Y.

The following courses require two Experimenters:

All courses for topics in instrumentation technology, control technology plus courses SO4204-4H, 6J,-6Z, -7D, -7E, -7K, -7M, -7N, -9E, -9F, -9L, -9M, -9Q, -9R and -9S.

The following courses require three Experimenters:

SO4204-6V, -7P, -8N, -9J and 9N

When using digital multimeter LM2330 an additional Experimenter is recommended for use as a docking station using an IrDa interface.

| Pos.	Product name	Bestell-Nr.	Anz.
1	**UniTrain-I measurement accessories, shunts and connection cables**	SO4203-2J	1

Shunt resistors on a PCB, for current measurement using the analog inputs of the UniTrain system.

- 6 Shunt resistors: 2 x 1 ohm, 2 x 10 ohm, 2 x 100 ohm

- Screen print of symbols for identifying resistors, the voltage taps and current inputs

- 24 x 2-mm sockets

- Dimensions: 100 x 40 mm

Set of connection cables 2mm (22 pcs) for UniTrain consisting of:

- 8 x connection leads 2mm, 15cm, blue

- 4 x connection leads 2mm, 15cm, yellow

- 2 x connection leads 2mm, 45cm, black

- 2 x connection leads 2mm, 45cm, yellow

- 2 x connection leads 2mm, 45cm, red

- 2 x connection leads 2mm, 45cm, blue

- 2 x adapter leads 4mm to 2mm, 50cm, white

- 10 x 2-mm connector plugs / Plug spacing 5mm
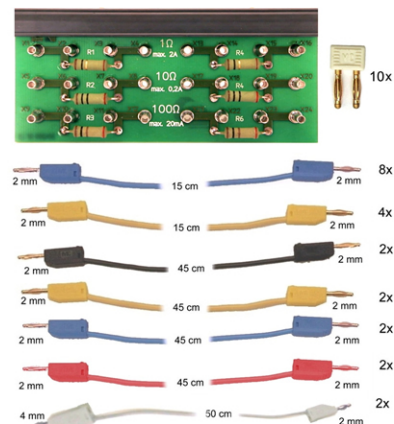
| 2 | **Multi13S digital multimeter** | LM2330 | 1 |

Universal precision lab multimeter and temperature meter with IR interface for high-quality, universal measurement and testing in educational settings, power plants, process control installations etc.

- 3¾-digit multimeter; resolution: ±3,100 digits

- Measurement classification CATII-1000V

- Can be connected to UniTrain system via IR interface

- Voltage and current measuring ranges: 30mV-1000V DC, 3V-1000V AC; 3mA-16A DC; 30mA-10A AC

- Resistance ranges: 30ohm-30Mohm

- Special functions: for temperature measurements using PT100/1000 thermocouple (optional accessory)

- Continuity and diode testing

- Automatic range selection and battery shut-off, min./max. and data hold function

- Safety fuse for current measurement range up to 300mA

- Protection against high currents in the mA range for nominal voltage of 1000V

- Display with bar chart and backlighting

- Includes protective sleeve, measuring leads, 1 x spare fuse, 9V battery, calibration certificate

| 3 | **UniTrain storage case for one system** | CO4203-2Y | 1 |

Sturdy aluminium case with moulded foam block to accommodate a complete UniTrain system (without equipment)

- Capable of accommodating 1 Interface, 2 Experimenters, 1 power supply as well as cables and smaller accessories

- Lockable padlock; stable padlock hinge

- Colours: aluminium, black, chrome

- Dimensions: 610 x 480 x 100 mm

- Weight: 4,6 kg

| 4 | **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
- 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, 100mV to 50V, true RMS, AV
- 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 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 version)
- CD-ROM drive for installing software
- USB port for connection to Interface

| 5 | **UniTrain Experimenter** | CO4203-2B | 2 |

UniTrain Experimenter for coupling to the UniTrain Interface or to other Experimenter modules.

Equipment:

- Connects to the UniTrain Interface and additional Experimenters via UniTrain bus
- UniTrain bus connection for experiment cards
- High-quality designer casing with aluminium feet and surface-hardened Plexiglas front window
- Suitable for accommodating training panel frames for DIN A4 training panels
- Fixed and variable voltages available via 8 2-mm sockets
- Designed for connection of 2-mm safety measuring leads
- Accommodates UniTrain experiment cards
- Eject mechanism for UniTrain experiment cards with return spring
- Accommodates a breadboard for experimenting with discrete components and integrated circuits
- Accommodates a multimeter using IrDa interface
- Dimensions: 29.6 x 19 x 8.6 cm
- Weight: 1.0 kg
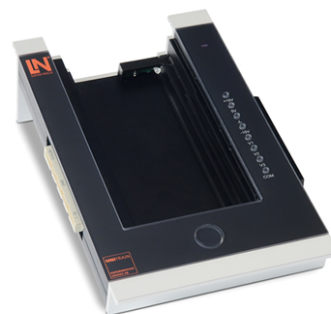
Accessories:

The extended power supply is necessary for the following courses:

SO4204-4H Course - Electrical engineering 3: Three-phase Technology

SO4204-5P Course - Electronics 6: Power Semiconductor Devices

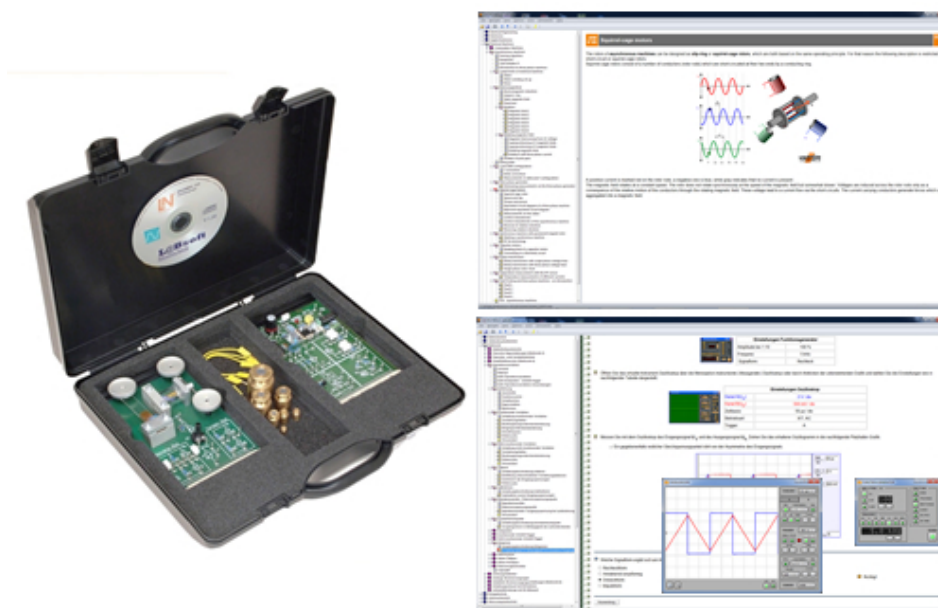SO4204-6V, -7D, -7F Automotive technology courses

SO4204-7M, -7N, -7P, -7Q Power electronics courses

SO4204-7S, -7T, -7U, -7X, -7Y, -7Z Electrical Machine courses

SO4204-8K to SO4204-8Z, Automation Technology and Mechatronics courses

SO4204-1N UniTrain-I Three-phase Technology component kit

UniTrain-I courses

UniTrain-I courses

UniTrain-I electrical engineering courses

UniTrain-I multimedia courses in electrical engineering introduce those taking the course to the fundamentals of electrical engineering. The students are familiarised with measuring instruments including the multimeter and the oscilloscope. They are made familiar with the basic circuitry, terminology and laws of electrical engineering by way of making their own voltage and current measurements. This knowledge can then be applied in a wide variety of compact and well-tested experiments.

All experiments are conducted using safety extra-low voltage that is safe to the touch.

List of articles:

Pos.	Product name	Bestell-Nr.	Anz.
6	**Course - Electrical engineering 1: DC technology**	SO4204-4D	1

Includes:

- 1 Experiment card with various resistor circuits, capacitor and coil
- 1 Experiment card with voltage divider circuits
- 1 Experiment card with circuits for studying temperature, light and voltage-dependent resistors
- CD-ROM with Labsoft and course software

Course contents:

- Familiarisation with the term electricity
- Examples of the use of electricity
- Introduction to the Bohr model of the atom
- Electric charge and electric fields
- Differences between conductors, insulators and semiconductors
- Familiarisation with the terms current, voltage and resistance
- Investigation of a simple electrical circuit with a lamp
- Different types of DC sources
- Measurement using voltmeters and ammeters
- Colour coding and design of resistors
- Experimental verification of Ohm's law
- Experimental verification of Kirchhoff's laws
- Measurements on resistances in series and parallel
- Investigation of circuits with resistors in mixed series and parallel connection
- Measurements on voltage divider circuits with fixed/variable resistors
- Measurements on bridge circuits
- Power measurements in DC circuits
- Investigation of the in-circuit response of variable resistors (LDRs (photocells), NTC and PTC thermistors, VDRs)
- Measurement and interpretation of variable resistor characteristics (LDR, NTC, PTC, VDR)
- Measurements on coils and capacitors in a DC circuit
- Fault simulation (9 simulated faults activated by relay)
- Course duration 8 h approx. (fault finding 1.5 h approx.)
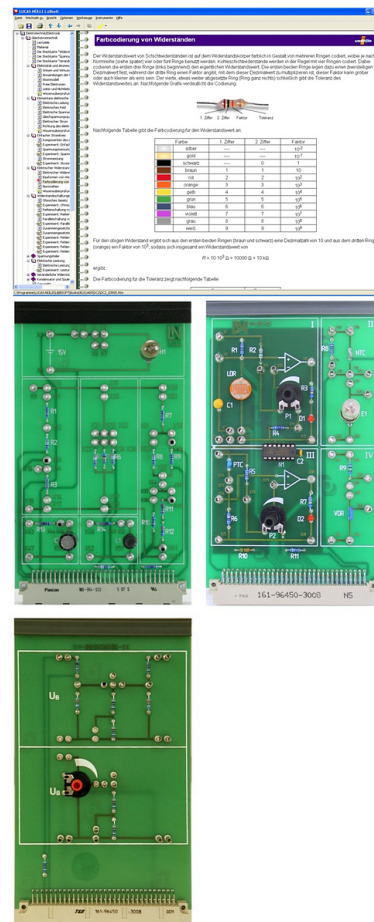
Includes:

- 1 Experiment card with R, L, C passive components for combination using 2-mm sockets
- 1 Experiment card with RLC resonant circuits, 1 circuit tunable
- 1 Experiment card with 1 power transformer, 1 repeater transformer and load circuits
- CD-ROM with Labsoft browser and course software

Course contents:

- The distinction between DC and AC variables
- Characteristics of sinusoidal signals
- RMS values of various periodic signals
- Using vector diagrams to depict sinusoidal signals
- Using vector diagrams for computation
- Introduction to characteristic parameters for capacitors and inductors
- How capacitors and coils store energy
- Determining the capacitance of capacitors by measurement
- Determining the inductance of coils by measurement
- Introduction to the term reactance and the difference between capacitive reactance and inductive reactance
- Determining the reactance of coils and capacitors by experiment
- Investigating the AC-response of RC and RL voltage divider circuits
- Investigating the frequency response of simple filter circuits for alternating and square-wave voltages
- How electrical resonant circuits work
- Introduction to the terms resonance, quality Q, bandwidth and critical frequency of resonant circuits
- Measuring the frequency response of series and parallel resonant circuits
- Tuning a parallel resonant circuit with a varicap diode
- Explanation of the terms active, reactive and apparent power
- Investigating response of transformers to loads: loaded, unloaded and short-circuit measurements
- Identifying the typical areas of application for power and repeater transformers
- Measurement and analysis of the frequency response of power transformers
- Investigating the frequency response of repeater transformers
- Measurement and analysis of the frequency response of repeater transformers
- Fault simulation (4 simulated faults activated by relay)
- Course duration 8 h approx. (fault finding 1 h approx.)
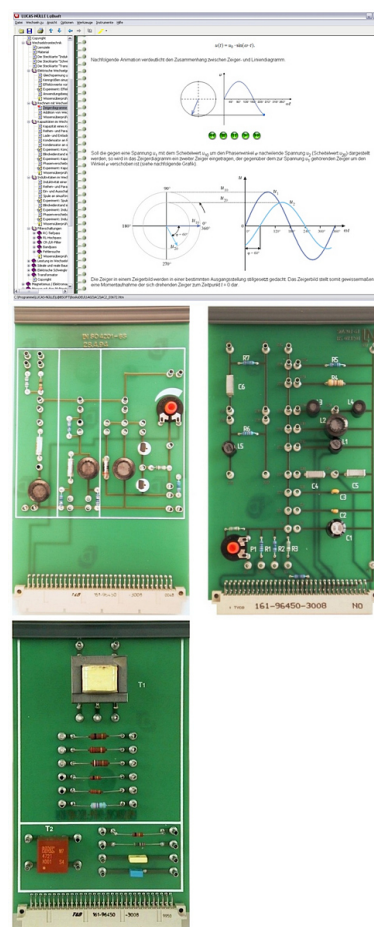
Includes:

- 1 Experiment card with 1 circuit in star configuration and 1 in delta configuration plus resistive and capacitive loads

- 1 Experiment card 3-channel oscilloscope for voltage and current measurement

- CD-ROM with Labsoft browser and course software

Course contents:

- Becoming familiar with three-phase applications

- Familiarisation with terms used in three-phase systems

- Measurement of phase and line quantities in three-phase networks

- Determining and identifying laws relating phase voltages by measurement

- Investigating resistive and capacitive loads in star and delta circuits

- Determining phase shift between phase voltages

- Measurement of compensating currents in neutral conductors and explanation of the effect of breaks in the neutral line

- Current and voltage measurements for symmetrical and asymmetrical loads

- Measurement of power with a three-phase load

- Course duration 4 h approx.
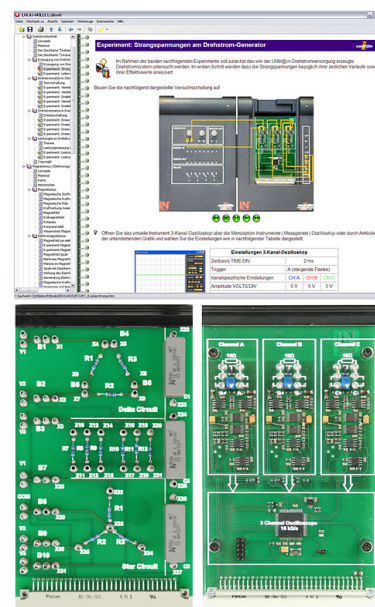
<u>Includes:</u>

- 1 Experiment card with 7 specific circuits
- Transformer with removable iron core
- Compass needle for investigating magnetic fields
- Electromagnetic components: reed switches, Hall switches and relays
- CD-ROM with Labsoft browser and course software
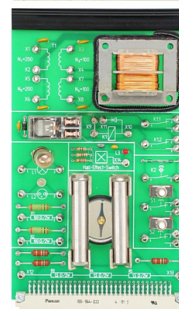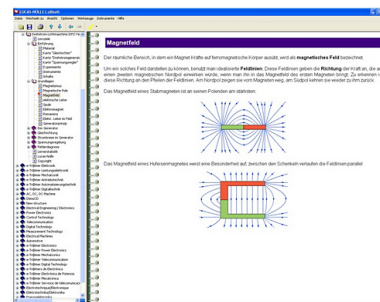
<u>Course contents:</u>

- Explanation of the phenomenon of magnetism
- Identification of magnetic materials
- Listing examples for the use of magnetic materials in electrical engineering
- Introduction to and explanation of the terms magnetic poles, magnetic fields, field lines and field intensity
- Investigating the magnetic field of a current-carrying conductor
- Investigating the magnetic field of a coil (with air, with iron core)
- Introduction to and explanation of the term electromagnetic induction
- Investigating the switch-on and switch-off response of an inductor
- Lorentz force
- Design and function of a transformer
- Investigating the effect of an iron core on the transmission response of a transformer
- Determining the transmission ratio of a transformer by measurement
- Measuring the response of a transformer to various loads
- Design of electromagnetic components: relays, reed switches
- Experimental demonstration of the function of relays and reed switches
- Experimental investigation of application circuits using electromagnetic components: control circuits with latching, Hall sensors
- Course duration 4 h approx.

10 **Course - Electrical engineering 5: Conducting measurements with the multimeter**   SO4204-4B   1
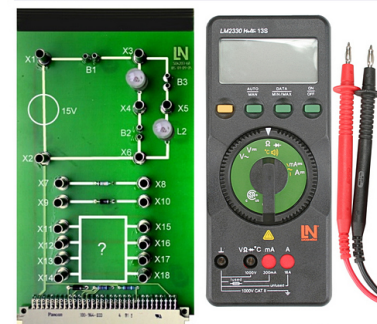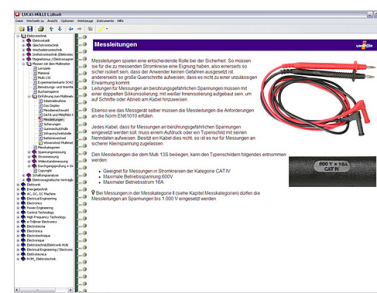
Includes:

- 1 experiment card with components for measuring current, voltage and resistance

- Circuit for measurement of unknown components

- Digital multimeter Multi 13S

- CD-ROM with Labsoft browser and course software

-

Course contents:

- Multimeter controls

- Identifying potential dangers in measurements on electric circuits

- Measuring AC and DC voltages with a multimeter

- Measuring AC and DC currents with a multimeter

- Measuring resistance with a multimeter

- Measuring diodes with a multimeter

- Measurements using balance and contact methods

- Matching measuring ranges

- Identifying possible errors in measurements

- Identifying unknown components in a circuit by measuring voltage and current

- Duration of course: 3 hours approx.

Includes:

- 1 Experiment card with connector panel for setting up resistor networks

- 2 Constant current and 2 constant voltage sources

- 15 Plug-in resistors on card

- CD-ROM with Labsoft browser and course software

Course contents:

- Introduction to basic equations used in electrical networks

- Applying Kirchhoff's equations to a resistor network

- Analysing resistor networks using Kirchhoff's equations

- Power matching in resistor circuits

- Conversion of electrical networks (star-delta conversion)

- Introduction to superposition theorem and its application

- Simplification of resistor networks using Thevenin's theorem

- Simplification of resistor networks using Norton's theorem

- Simplification of resistor networks with 2 sources using Millman's theorem

- Thevenin-Norton equivalencies

- Analysing resistor networks using the loop or mesh current method

- Analysing resistor networks using the node voltage method

- Course duration: 5 h approx.
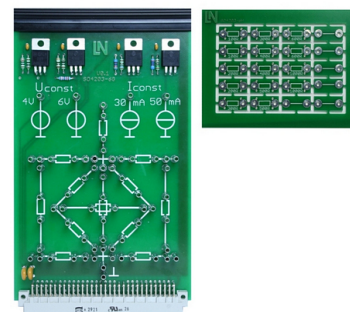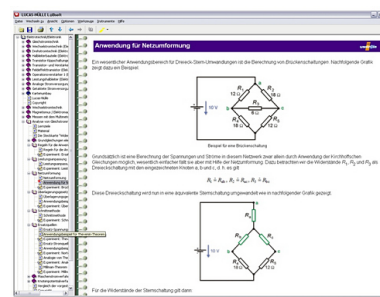
Course - Electrical engineering 7: Electromagnetic compatibility (EMC)   SO4204-4K   1

Includes:

- 1 Experiment card with parallel tracks for studying galvanic, inductive and capacitive coupling effects, with measuring amplifier

- CD-ROM with LabSoft browser and course software

Course contents:

- Familiarisation with terminology for electromagnetic compatibility, EMC

- Electromagnetic coupling effects

- Natural and man-made sources of interference

- Key European standards and guidelines for EMC

- Measurement of galvanic coupling between two parallel tracks

- Measurement of capacitive coupling between two parallel tracks

- Measurement of inductive coupling between two parallel tracks

- Ways of improving the EMC characteristics of a circuit

- Ways of improving the resistance to interference of a circuit

- Course duration: 4 h approx.
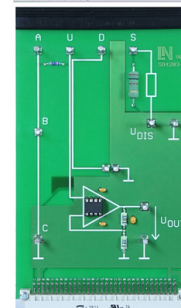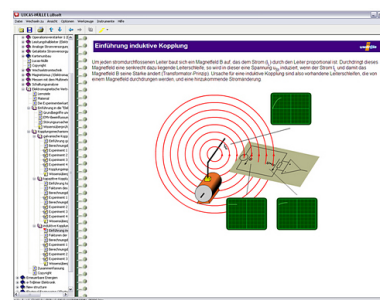
| 13 | **Course - Installation engineering 1: Protective measures and power network types** | SO4204-4M | 1 |

This training system lays the foundations for understanding how to handle voltage and current safely. For electrical engineers and electricians in particular, but for other professions too, handling of high voltage and current is a key skill. Trainees taking the course can learn for themselves how safe handling can be assured, what safety measures need to be taken and how installations can be tested.

Includes:

- 1 Experiment board for assembling various 3-phase mains systems including the following components:
  1 RCD, 4-pole, 30mA
  1 Isolating transformer
  1 Transformer for safety extra-low voltage (SELV)
  1 Insulation monitor, adjustable
  1 Model of a person
  1 Simulated earthing electrode
  1 Single-phase load
  1 Three-phase load
  16 Different fault simulation resistors
  Set of measuring leads and jumpers

- CD-ROM with LabSoft browser and course software
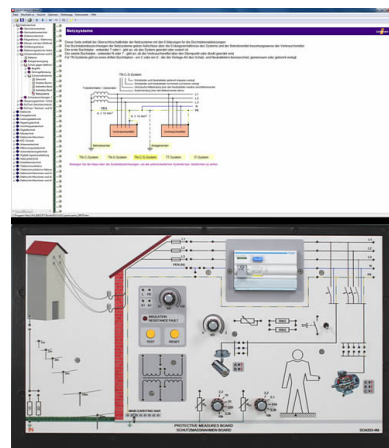
Training contents:

- Design of various mains systems (TN, TT, IT)

- Protection against direct and indirect contact

- Protection by isolation

- Protection using safety extra-low voltage

- Excess current circuit breakers

- Residual leakage current circuit breakers (RCDs)

- Measurement and testing of protective measures
  Protective earth resistance measurement
  Insulation resistance measurement
  RCD testing with and without tripping
  Earthing electrode measurements
 Loop resistance measurement

- Course duration: 10 h approx.

| 14 | **Course - Installation engineering 2: Control systems/protective circuitry** | SO4204-4N | 1 |

Includes

- Experiment board for contactor controls with the following features:

- 4 Primary contactors

- 3 Motor protection switches

- 2 Auxiliary contactors

- 1 Universal time-delay relay

- 1 Current surge relay

- 6 Indicator lights

- 3 Limit switches

- 1 Emergency shut-down switch

- 3 Buttons

- 1 Manual-automatic switch

- 25 Project overlay masks

- Set of measuring leads and jumpers

- CD-ROM with LabSoft browser and course software
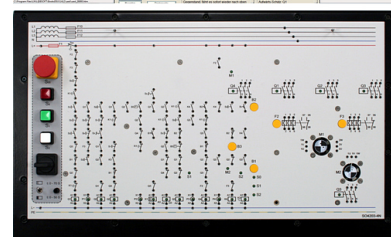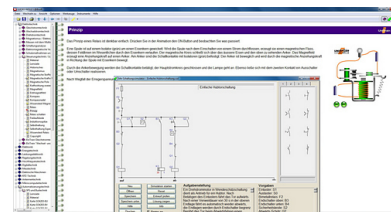
Training contents

- Familiarisation with control components

- Planning control projects

- Testing functionality with circuit simulators

- Function testing and troubleshooting in control projects

- Project contents:
  Two-handed operation of a cutting machine (AND circuit)
  Turning on a ventilator from various locations (OR circuit)
  Self-latching pump control (dominant off)
  Self-latching pump control (dominant on)
  Pump control with contactor interlock
  Pump control with inching circuit
  Pump control with self-latching or inching circuit
  Pump control with sequence control circuit
  Drill control with external fan (sequence control circuit)
  Direction control for a drill (simple reversing contactor circuit)
  Sliding door control with button interlock
  Crane control with direct change of direction
  Crane control with delayed change of direction
  Time-dependent conveyor-belt control
  Time-dependent fan control
  Manually controlled star-delta circuit
  Automatically controlled star-delta circuit with no load
  Automatically controlled star-delta circuit with load

Automatic star-delta reversing contactor circuit
Simple roller shutter control with safety bar
Enhanced roller shutter control with remote monitoring
Time-dependent speed control for Dahlander motors
Speed control for Dahlander motors
Immersion bath control
Pump control with current surge relays

- Course duration: 25 h approx.

| 15 | **Course - Installation engineering 3: LED lighting and colour detection** | SO4204-4P | 1 |

<u>Includes</u>

- LED lighting experiment card with the following features:
- 4 different types of LED, including white and multi-coloured
- 1 Universal brightness sensor
- 3 LEDs, RGB, adjustable via potentiometers
- 1 Programmable high-power LED, RGB LED
- 1 Scanner for detecting colours
- Plexiglass cover with reflective surfaces
- Colour chart
- CD-ROM with Labsoft browser and course software

<u>Training contents</u>

- Familiarisation with different types of LED
- Brightness control for various LEDs using pulse width modulation (PWM)
- Recording of characteristics and measurement of brightness
- Additive mixing of colours and setting of colour temperature
- Colour detection and reproduction
- Course duration: 10 hrs approx.
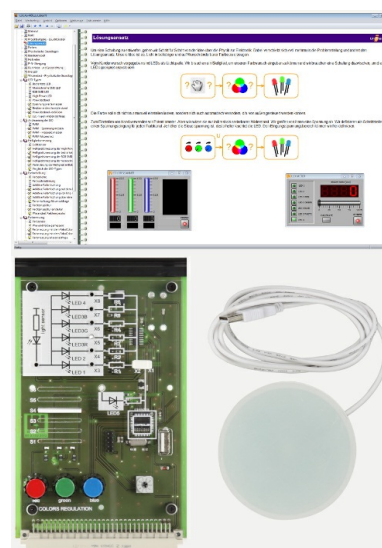
Additionally recommended for course SO4204-4M:

Pos.	Product name	Bestell-Nr.	Anz.
16	**UniTrain storage case for experiment board**	SO4203-2V	1

Sturdy aluminium case with moulded foam block to accommodate an experiment board

- Capable of accommodating 1 experiment board and smaller accessories
- Lockable padlock; stable padlock hinge
- Colours: aluminium, black, chrome
- Dimensions: 600 x 450 x 175 mm
- Weight: 2.5 kg

Additionally recommended for course SO4204-4N:

Pos.	Product name	Bestell-Nr.	Anz.
17	**UniTrain storage case for experiment board**	SO4203-2V	1

Sturdy aluminium case with moulded foam block to accommodate an experiment board

- Capable of accommodating 1 experiment board and smaller accessories
- Lockable padlock; stable padlock hinge
- Colours: aluminium, black, chrome
- Dimensions: 600 x 450 x 175 mm
- Weight: 2.5 kg

18 **Cable set 2mm, connection plugs 2/5mm for course SO4204-4N**   SO5146-1Q   1

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

- 5 measuring leads, 2mm, 7.5cm, blue
- 5 measuring leads, 2mm, 15cm, blue
- 12 measuring leads, 2mm, 7,5cm, yellow
- 12 measuring leads, 2mm, 15cm, yellow
- 12 measuring leads, 2mm, 7,5cm, black
- 12 measuring leads, 2mm, 15cm, black
- 20 jumpers 2mm /5mm