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Electrical Power Engineering

Training systems on the generation, distribution and management of electrical energy:

- Power engineering trainer, distribution trainer
- Energy generation trainer, renewable energy generation trainer
- Transformer trainer, high-voltage transmission lines trainer, protective systems trainer
- Energy management trainer, smart grid trainer

The Lucas-Nülle training systems have been designed in anticipation of the newest developments:

- Smart measuring instruments which avail of various communication interfaces (e.g. LAN, RS485, USB) and control elements
- SCADA Power Engineering Lab software for the intelligent control and evaluation of the "Smart Grid" with soft plc
- Didactically designed SCADA software
- Permits investigation of dynamically alternating loads and power generation inside the laboratory
- Intelligent energy management
- Modular integration of renewable energies into the smart grid using protective engineering
- Wind power plant with doubly-fed asynchronous generator (DFIG) with mains synchronisation
- Interactive multimedia training course

Renewable Energies



Renewable Energies

The move away from coal, oil and nuclear power to renewable forms of energy is gaining momentum. Today, technology has evolved to a point where solar energy, wind power, hydrogen fuel and biomass can be exploited as environmentally friendly energy sources.

Throughout the world well-qualified technicians and engineers are being sought after to help keep this trend moving forward. Today, technologies are undergoing rapid change. This trend is being compounded by rising expectations in training and education. Lucas-Nülle has developed the appropriate training systems needed to cope with the ever more complex world of training and education.

EWG 2 Small wind power plant



EWG 2 Small wind power plant

Small wind power plants up to approx. 5 kW power are being deployed today for decentralised power supplies. These systems are used for the supply of objects that do not avail over central power supplies, for example, remotely located mobile radio converters or vacation homes. These plants generate DC voltage. The energy can be stored in accumulators using charge controllers. AC voltages are generated via inverters for operation of loads connected to a grid. The effects of wind power and the mechanical design of wind power stations can be emulated down to the last detail using the servo machine test stand and the software WindSim. The corresponding Interactive Lab Assistant Multimedia course imparts knowledge, provides interactive experiment setup support and allows for PC-assisted evaluation of the measurement data.

Training content:

- Understand the design and operation of modern small wind power stations
- Explore the physical fundamentals “from wind to wave“
- Become familiar with different wind power station concepts
- Design and initial operation of a small wind power generator
- Operation with fluctuation wind force in offline operation
- Energy storage, optimisation of the system
- Design of an off-grid system for the generation of a 230V AC voltage
- Explore hybrid systems for off-grid power supply using wind power and photovoltaic systems

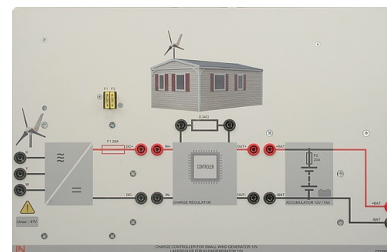
Equipment set, consisting of:

Equipment set, consisting of:

Pos.	Product name	Bestell-Nr.	Anz.
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1	Charge controller for small wind generator 12 V	CO3208-3E	1
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The charge controller is specially designed for the operation of small-scale wind turbines. It ensures optimum charging of the associated battery. If the battery is unable to charge up any further, the excess energy is converted into heat by means of load resistors. This ensures that there is always a load on the wind generator and prevents it rotating at unacceptably high speeds. In addition to the charge controller itself, both the battery and load resistors are integrated into the package.



The charge controller has the following features:

- Battery voltage 12V
- Charging/discharging current: 20A
- Load resistor 0.34ohms/300W
- Battery capacity 7Ah
- Terminals: 4mm safety sockets
- Dimensions: 297 x 456 x 105mm (HxWxD)
- Weight: 6.3 kg

2	Synchronous generator 12V for small wind power plant with permanent magnets	SE2673-1M	1
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The generator is a permanently excited synchronous generator of similar design to this used in small-scale wind turbines.

- Voltage with no load: 19V
- Nominal voltage: 10A
- Nominal speed: 1000rpm
- Nominal power: 0.3kW
- Dimensions: 340 x 210 x 210mm (WxHxD)
- Weight: 9kg



3 Lamp board 12V

CO3208-1K

1

The lamp board allows for study and comparison of halogen and LED lights. The bulbs are of the same brightness and each can be activated individually. This allows for a variety of power-consumption scenarios to be investigated.

The lamp board has the following features:

- Halogen lamps 25W
- LEDs 2W
- Operating voltage: 12V
- Dimensions: 297 x 114 x 210 mm (HxWxD)
- Weight: 1.2 kg



4 Load unit 1kOhm, 500W

CO3208-1J

1

Load resistor for solar module and solar power units.

The resistor can be used with the following:

- Solar module/simulation for recording characteristics and load resistance
- Solar charge regulator as load resistance
- Inverter as load resistor

The solar load is equipped with the following features:

- Resistor: 0...1 kOhm / 500 W continuously adjustable, with stepped winding
- Current:
0 – 50 Ohm max. 6A
51 – 200 Ohm max 2A
201- 1k Ohm max 0.6A
- Connection terminals: 4 mm safety sockets
- Dimensions: 297 x 228 x 160 mm (HxWxD)
- Weight: 4.3 kg



5 Off-grid inverter 230V, 275VA

CO3208-1F

1

To operate standard commercially available electrical devices used in standalone solar power systems, the generated DC voltage must be converted into AC voltage. The board consists of a commercially available off-grid inverter which generates an output voltage of 230 V AC from an input voltage of 12 V DC. The off-grid inverter is equipped with a deep depletion protection facility with which it can be connected directly to a lead accumulator.

The off-grid inverter is equipped with the following features:

- On/off switch
- LED display of operating status
- Acoustic alarm to signal warnings
- Output voltage: sinusoidal 230V +/- 5%
- Power: 275VA
- Efficiency: 93%
- Safety functions:
 - Cut out for excess battery voltage
 - Over temperature and overload protection
 - Short-circuit protection
 - Pole reversal protection
- Earthing contact socket outlet
- Connection terminals: 4 mm safety sockets
- Dimensions: 297 x 228 x 145 mm (HxWxD)
- Weight: 3.1 kg



6 Lamp board 230V

CO3208-1L

1

The lamp board permits the investigation and the comparison of light bulb, energy saving lamp and LED bulb.

All illuminant have the same brightness and can be switched on individually.

Technical Data:

- Light bulb: 25W
- Energy saving lamp: 4W
- LED-bulb 4W
- Operating Voltage: 230V/ 50/60Hz
- 3 sockets E27
- Dimensions: 297 x 114 x 210 mm (HxBxT)
- Weight: 1,8 kg



Additionally required - Machine test bench equipment set for servo-drive/braking system:

7 Servo machine test stand for 0.3kW machines incl. software ActiveServo (D,GB,F,E)

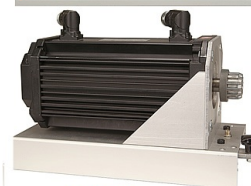
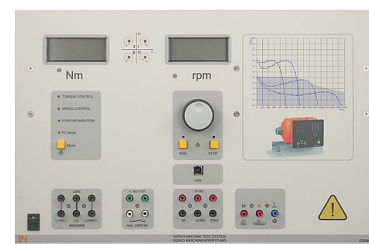
CO3636-6V

1

The servo-machine test bench is a complete testing system for examining electrical machines and drives. It consists of a digital controller, a brake and the ActiveServo software. The system combines state-of-the-art technology with ease of operation. The system also allows manual and automated synchronisation to be carried out.

The controller has the following features:

- Dynamic and static four-quadrant operation
- 10 selectable operating modes/machine models (torque control, speed control, flywheel, lifting drive, roller/calander, fan, compressor, winding gear, arbitrarily defined time-dependent load, manual and automated network synchronisation)
- Integrated galvanically isolated amplifier for voltage and current measurement
- Speed and torque displays
- Four-quadrant monitor
- USB interface
- Thermal monitoring of the machine under test
- Testing for the presence of a shaft cover.
- Connection voltage: 400V, 45...65Hz
- Maximum power output: 4kVA
- Dimensions: 297 x 460 x 420mm (HxWxD)
- Weight: 13.3kg



The brake is self-cooled asynchronous servo-brake with resolver.

The motor and sensor leads are connected via polarity-safe plugs. The machine has thermal monitoring and, in conjunction with the controller, it constitutes a driving and braking system that is free of drift and requires no calibration.

- Maximum speed: 4000rpm
- Maximum torque 10Nm
- Temperature monitoring: continuous temperature sensor (KTY)
- Resolver resolution: 65536 pulses/revolution
- Dimensions: 275 x 210 x 210mm (WxHxD)
- Weight: 6kg

ActiveServo is a program for recording characteristics of machines and for determining dynamic and static operating points. It emulates

seven different loads (flywheel, pump, calander, lifting drive, compressor, winding gear, arbitrarily configurable time-dependent load) for which the parameters can be individually configured.

Features:

- Measurement, calculation and display of mechanical and electrical variables
- (Speed, torque, mechanical power output, current, voltage, active, apparent and reactive power, efficiency, power factor)
- Simultaneous display of measured and calculated values (e.g. instant display of efficiency)
- Measurement of voltage and current (including RMS values even for non-sinusoidal waveforms)
- Speed or torque-controlled operation
- Recording of variables over time
- Programming of limiting values of speed or torque to prevent inappropriate loading of the machine under test.
- Operation in all four quadrants (display of generated torque)
- Arbitrarily defined ramp functions for PC-controlled load experiments
- Display of characteristics from several experiments to better illustrate the effect of parameter changes
- Export of graphics and measurements
- 32-bit version for Windows

8 Rubber coupling sleeve, 0.3kW

SE2662-2A

1

Rubber coupling sleeve used for the coupling of two machines

- Permits rapid and safe assembly
- Designed with internal ring gear
- Material: rubber (neoprene)
- Dimensions: 40 x 45mm (length x diameter)
- Weight: 0.1kg



9 **Coupling guard, 0.1/0.3kW, transparent**

SE2662-7B

1

Plug-in plastic panel to prevent people touching the revolving coupling between two machines

- Material: clear makrolon with plug
- Dimensions: 115 x 90 x 60mm (HxBxT)
- Weight: 0.1kg



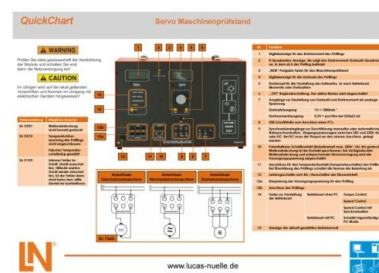
10 **QuickChart, Servo-machine test stand safety and operating instructions (GB)**

SO6200-7D

1

Short documentation covering the putting into operation of complex equipment and experiment set-ups.

- Terminal assignment, safety instructions, help
- Circuit and assembly diagrams
- Color print in DIN A3 format
- Laminated: 2 x 250 µm



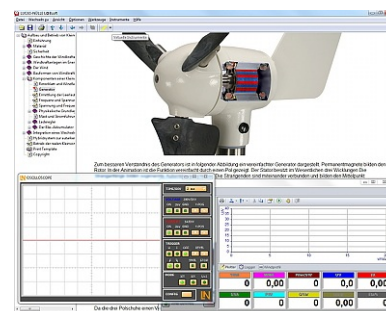
Media:

Pos.	Product name	Bestell-Nr.	Anz.
11	Interactive Lab Assistant: Small wind power plants	SO2800-3C	1

The experiment instructions are provided by an interactive lab wizard course. This multimedia course guides students step by step through the topics of design and operation of small-scale wind turbines. Physical principles are explained by means of easily understood animations. The interactive lab wizard combined with virtual instruments creates a comfortable environment for experiments.

Features:

- Interactive experiment set-up
- Measurements and graphics can be saved in the experiment instruction pages themselves by means of drag and drop.
- Virtual instruments can be started directly from the experiment instruction pages
- Questions with feedback and evaluating logic to test knowledge
- Printed document for easy print-out of the experiment instructions complete with results
- CD-ROM with Labsoft browser, course software and virtual instruments



Measuring instruments:

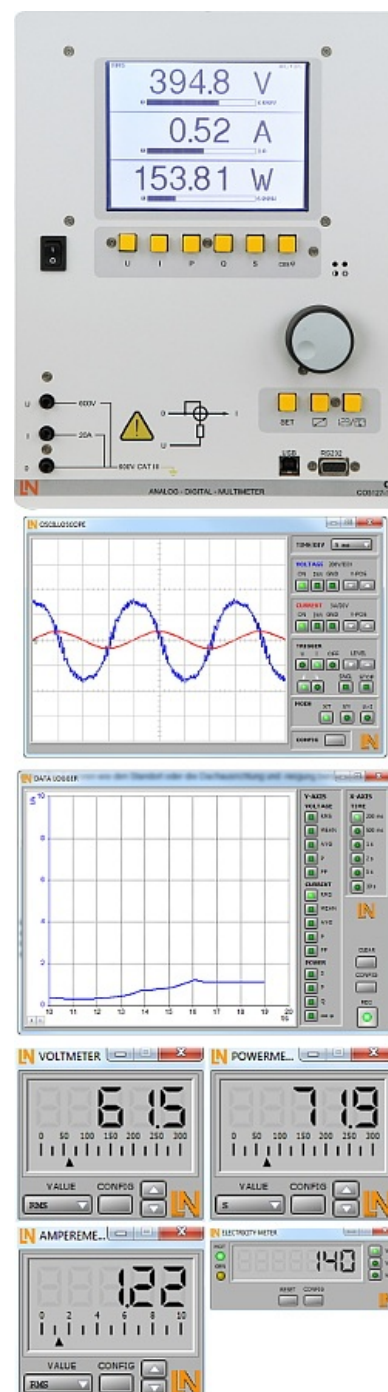
12 Analog/digital multimeter, wattmeter + power-factor meter incl. Software

CO5127-1Z

1

The areas of electrical machines, power electronics and drive technology pose particular problems for measuring instruments. In addition to high-performance overload protection, the acquisition of measurement values must be performed accurately independently of the curve's shape. The universal measuring device has been designed particularly to satisfy these requirements. It can simultaneously replace as many as four different measuring instruments – constituting a current/voltmeter, power and phase-angle meter all in one. The graphic display allows for both student as well demonstration experiments. The VI Starter software included allows for visualisation of measurements on a PC.

- Simultaneous, measurement of voltage and current independent of the curve shape (max. 600 V, 20 A) (measurement of clocked voltages)
- Calculation of active, apparent and reactive power as well as the power factor
- Measurement of the total rms (RMS-AC+DC); AC rms (RMS-AC) and arithmetic mean (AV-AC+DC)
- Impervious to electrical damage up to 20 A/600 V
- Large-scale, high-contrast background-illuminated graphic display (5,7")
- Large-scale display or display of up to 4 measurement values
- Digital or pseudo-analog display
- USB interface
- Internal resistance: current path 10mOhm, voltage path 10MOhm
- Voltage ranges: 30;300; 600V
- Current ranges: 1; 10; 20A
- Measurement accuracy: 2%
- Automatic or manual measurement range selection
- Demonstration test instrument for mains operation
- Operating voltage: 230V, 50/60Hz
- Dimensions: 297 x 228 x 140mm (HxBxT)
- Weight: 2kg





The VI Starter software allows all the measurements to be displayed on the PC. Up to 17 different displays can be opened.

- Oscilloscope display of voltage, current and power
- Consumption meter to display power consumed and output

- Data logger for 14 different variables
- Data export for data logger
- Characteristic recorder
- Labview driver and supplied examples
- 32-bit version for Windows

Accessories:

Pos.	Product name	Bestell-Nr.	Anz.
13	Safety connection plug 19mm/4mm, black, with tapping Max. sustained current: 24A <ul style="list-style-type: none"> • Contacts: 4mm laminated plugs • Contact-protected • Insulation class CAT II / 600V 	SO5126-9R	5
			
14	Safety connection plug 19mm/4mm, black Max. sustained current: 24A <ul style="list-style-type: none"> • Contacts: 4mm laminated plugs • Contact-protected • Insulation class CAT II/600V 	SO5126-9Y	20
			

15 Set of safety measurement cables, 4mm (23 leads)

SO5148-1L

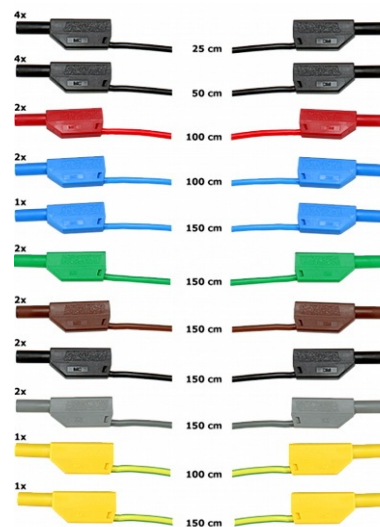
1

Safety measurement cables with 4mm safety plugs, coloured, PVC insulation, highly flexible

Each set includes the following:

- 4 x 25cm long, black
- 4 x 50cm long, black
- 2 x 100cm long, blue
- 2 x 100cm long, red
- 1 x 100cm long, green/yellow
- 1 x 150cm long, blue
- 1 x 150cm long, green/yellow
- 2 x 150cm long, green
- 2 x 150cm long, brown
- 2 x 150cm long, black
- 2 x 150cm long, grey

- Wire cross section 2.5 mm²
- Capacity/category: 600V CAT II, 32A

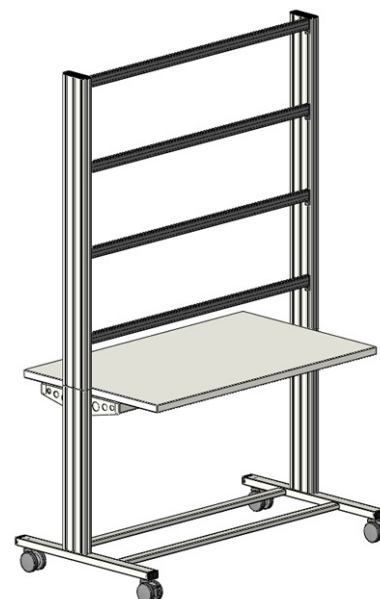


16 **Mobile aluminium experiment stand, 3 levels, 6x earthed sockets, 1250x700x1955mm** ST7200-3A 1

High-quality, mobile experiments stand from the SybaPro range for demonstrations and experiments. Features aluminium profile legs compatible with all add-ons and extensions for the SybaPro system. The mobile experiment stand is supplied in kit form and needs to be assembled by customers themselves.

Table top:

- 30-mm table top made of highly compressed, multi-layer fine chipboard conforming to DIN EN 438-1
- Colour grey, RAL 7035, with 0.8-mm slightly textured laminate coating (Resopal) on both sides, conforming to DIN 16926
- Resistant to many chemicals and reagents including dilute acids and alkalis
- Resistant to heat, e.g. molten solder or heating at specific points such as by soldering tips or cigarette ends
- Table top with solid impact-resistant protective edging made of 3mm thick RAL 7047 coloured plastic
- Coating and adhesive are PVC free
- Power supply with 6-outlet socket strip mounted underneath the table top, 2-m lead and earthed plugs



Frame:

- 2 extruded aluminium profiles with multiple grooves 1800 x 120 x 40 mm (WxHxD)
- 8 equally sized grooves in extruded aluminium profiles (3 on each side and 1 each on the front and back)
- Grooves accommodate standard industrial mountings
- 4 H-shaped aluminium profiles, 1150 mm, for 3-layer organisation of DIN A4 panels
- Space for extension of power supply duct
- Base made of rectangular tubing with 4 swivelling double casters, 2 of which have brakes
- Table frame made of tough combination of rectangular tubing around the full perimeter
- Acid-resistant epoxy-resin coating, 80 µm thick (approx.), colour RAL 7047

Dimensions:

- Height of table top 760 mm
- 1250 x 1955 x 700 mm (WxHxD)

17 **Wall or aluminium-profile mounting cable storage for 48 cables**

ST8003-8E

1

Accommodates about 48 safety measuring leads Suitable for mounting on walls or aluminium profiles



18 **PC holder for Syba experiment trolleys, height and width adjustable**

ST7200-5A

1

Shelf for desktop PC made of 1.5mm sheet steel punched with holes, suitable for all furniture in the SybaPro aluminium profile range

- Adjustable assembly height
- Adjustable width (160 - 255mm)
- Can be mounted to left or right
- Includes all equipment necessary for assembly (4 bolts and 4 tenon blocks)
- Acid-resistant epoxy-resin powder coating, 80µm thick approx., colour RAL7047



19 **Monitor holder for flat screen monitor of weight up to 10kg, VESA 75/100**

ST8010-4L

1

Pivoting monitor holder for attachment to aluminium profiles of furniture in the SybaPro range. Allows a monitor to be placed in the optimum position so that work and experiments are less tiring.



- Pivoting arm with two-part joint
- Quick-lock for adjustment to any height on extruded aluminium profile
- VESA fastening 7.5 x 7.5cm
- Includes VESA 75 (7.5x7.5) - VESA 100 (10x10) adapter
- 2 Cable clips
- Adequate carrying capacity 10kg
- TFT monitor can be turned parallel to the table edge
- Separation can be adjusted to anywhere between 105 and 480mm

Additionally included:

Cable management set for installing cables along the profiles of the aluminium lab system furniture in the SybaPro range

The set consists of the following:

- 3 Cross cable binders for front and rear grooves of aluminium profile
- 3 Cross cable binders for side grooves of aluminium profile
- 12 Cable binders
- 4 Aluminium cover profiles for covering and enabling wires to be run along the grooves of an aluminium profile

20 **Protection cover for three-level experiment trolleys**

ST8010-9Y

1

Dust cover for three-level experiment trolleys

- For protecting equipment from dust and damp
- For keeping equipment out of sight
- Colour: matt dark grey with printed LN logo in orange)
- Material: nylon fabric with polyurethane coating
- High resistant to tearing, impregnated to be washable and waterproof



Additionally recommended

Small wind power plants for outdoors and presentation

Training content:

- Understand the design and operation of modern, small wind power plants
- How to set up, put into operation and operate an authentic small wind power plant
- Explore the physical fundamentals “from wind to shaft”
- Set up and put into operation a small wind power generator
- Outdoor operation

Pos.	Product name	Bestell-Nr.	Anz.
21	Small-scale wind turbine 370W, with demonstration mast	CO3208-3F	1

This small-scale wind turbine is suitable both for laboratory demonstrations or use outdoors. Its built-in permanent-field synchronous generator produces direct current, which can then be stored by a rechargeable battery. The rotor blades can be adjusted in a manner similar to the pitch adjustment used in large-scale wind power plants.

The small-scale wind turbine possesses the following features:

- Power output: 370W
- Nominal wind speed 12.5m/s
- Rotor diameter 1.2m
- Control of rotor blades dependent on wind speed
- Permanent-field generator, 3-phase with rectifier
- Demonstration mast with base, made of V2A steel
- Height of generator axle: 1.5m
- Weight: 18.3kg



22 Mast set for small-scale wind turbine

CO3208-3G

1

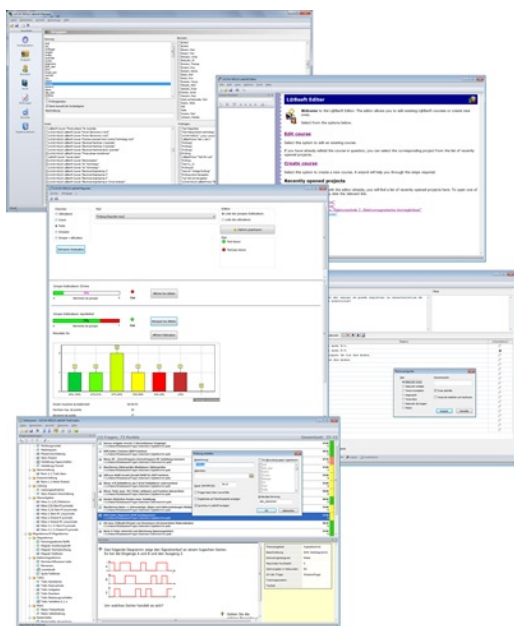
The mast set allows the small-scale wind turbine set to be used out of doors. It includes an extension to the supplied mast along with guy cables, bracing and anchoring for attaching to the ground. Use of this mast set raises the axle of the wind turbine to a height of 3m.

The mast set includes the following components:

- Mast extension, 1.5m with bracing eyelets, made of VA steel
- 3 Guying cables, diam. 3mm, made of steel
- 3 Cable tensioners
- 3 Ground anchors
- Weight: 8.3kg



Recommended learning management software for all LN multimedia courses:

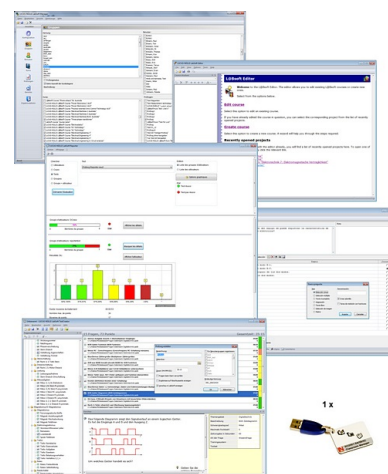


Optionally available: multi user license with 5 or 10 dongles and update to version 4.0

Pos.	Product name	Bestell-Nr.	Anz.
23	Software, LabSoft Classroom Manager 4.0, single licence (D, GB, F, E, RU, PT)	SO2001-5A	1

LabSoft Classroom Manager is a comprehensive set of administration software for the UniTrain-I system and all LabSoft courses. Classroom Manager comprises the following independent program components:

- LabSoft Manager: Administration of students and courses in LabSoft
- LabSoft Reporter: Student reports and statistics
- LabSoft Editor: Creation and editing of courses and tests
- LabSoft Questioner: Creation of questions, measuring exercises and sets of questions for courses and tests
- LabSoft TestCreator: Automatic generation of tests on the basis of sets of questions



Features:

- Ease of use of all programs thanks to graphical user interface in all component programs
- For use in local area networks or on stand alone PC
- Ease of installation
- No additional database software required
- Access control via USB dongle
- Available languages: D, GB, E, F, RU, PT

LabSoft Manager:

- Administration of LabSoft network installation
- Administration of an unlimited number of students and courses in LabSoft
- Addition, deletion and editing of courses and tests in LabSoft
- Addition, deletion and editing of students and student data
- Addition, deletion and editing of student groups (classes)
- Assignment of students to classes
- Assignment of courses and tests to students or classes

LabSoft Reporter:

- Electronic monitoring of student progress
- Graphical presentation of progress in courses and tests
- Presentation of student or group results
- Reports on courses, tests, single users or classes
- Summary of results and time
- Calculation of average results for groups
- Multiple search options for students, classes, courses or tests

LabSoft Editor:

- HTML editor for easy to use editing of LabSoft courses
- Editing of course pages
- Wizard for creation of new courses and course pages
- Automatic inclusion of new courses in an existing LabSoft

- installation
- Automatic creation of IMS-compatible navigation tree without the need for programming knowledge
- Moving course pages within the navigation tree at the click of a mouse
- Editing in WYSIWYG mode
- HTML view and page preview
- Insertion of graphics, animations and tables
- Insertion of test questions
- Page templates for a variety of page types

LabSoft Questioner:

- Program for creating and editing questions, practical measuring exercises and sets of questions (question files) for electronic evaluation
- Easy creation of exercises and questions for courses and tests
- 7 different types of question: single and multiple choice, missing text, assignment, matrices, arbitrary text, selection of images
- Ability to input meta data (points, time for questions, difficulty, required resources, etc.)
- Easy specification of tolerances for practical measuring exercises

LabSoft TestCreator:

- Program for automatically creating electronic tests from sets of questions (question files)
- Automatic and manual selection of questions and measuring exercises
- Filter functions (e.g.: type of question, difficulty) for pre-selection of questions
- Automatic generation of tests according to a set time or number of questions
- Various test options: arbitrary order of questions in a test, immediate display of results after completion
- Automatic registration of tests in LabSoft
- Preview function showing the test as created

Includes:

- CD-ROM with LabSoft Classroom Manager
- 1 USB-dongle for operation of program

System requirements:

- Server or PC with Windows Vista, 7, 8 or 8.1
- Microsoft Internet Explorer 7.0 or higher
- Minimum 100 MB free disk space
- 1 free USB-port for USB-dongle

24 Collection of assignments Power Engineering / Renewable Energies

SO2001-6D

1

Collection of electronic assignments questions and measuring exercises for the UniTrain-I courses on the topic of electrical power engineering and renewable energies. With the help of Labsoft TestCreator, these questions and measuring exercises can easily be assembled into electronic tests. The tests can then be carried out in LabSoft.

- A total of some 200 questions and measuring exercises for the UniTrain-I courses on the topics of Photovoltaics, Fuel cell technology, Transient processes in AC and DC networks and the multimedia course Small wind power plant
- About 25% are practical exercises to be carried using the training systems in order to test handling skills and practical abilities
- About 30% are newly assembled questions previously contained in the courses
- It is possible to extend the collection with your own questions and assignments
- Other collections can be imported
- All questions and assignments can be edited
- 6 different types of questions (single choice, multiple choice, missing text, matching, matrix matching and image choice)
- Extensive metadata for all questions and assignments to make it easier to create tests (degree of difficulty, points, topic area, time to complete, type of question, training systems needed for practical exercises)

