

Selected Exercise Packages





The Lucas-Nülle Group of Companies

The COMPACT Catalogue

represents a selection of the extensive modular product spectrum of the Lucas-Nülle Lehr- und Meßgeräte Company. The selected examples are sorted according to subject matter and illustrate a few highlights.

If questions arise:

Our "LN-Compact" is intended to provide stimulation and suggestions however it is not possible to show all systems or the numerous experiment and exercise possibilities that are available.

If questions arise or more information is required, our employees and sales team will be pleased to assist and advise or further catalogues can be provided with the information required for a specific subject.

When support is needed:

Use our service and competence in the preparation of planning complete laboratories.

We and our partners in marketing guarantee professional and competent advice that will result in providing you with a didactically conceived laboratory complete with economical high-quality products.

The Lucas-Nülle Group of Companies

is made up of three companies rich in tradition, with different orientation but with a common cause: Trade and vocational training and further education.

Our competence, global organisation and high-quality products "Made in Germany", have resulted in the companies playing a leading role in the world market.

More than 300 highly qualified employees guarantee well-founded know-how, quality products, expert advice and excellent service.

For our customers, suppliers and employees this means a truly reliable and competent foundation for co-operation and team-work.

Lucas-Nülle Lehr- und Messgeräte GmbH

was founded in 1979 in Kerpen-Sindorf, near Cologne. The forerunner was the engineering office Lucas-Nülle that in 1971 had begun with the development, planning and sale of technical training systems. Today the company develops, manufactures and sells LN teaching systems for trade training and has been awarded a certificate for their performance in accordance with the DIN ISO 9001 standards. The essence of our competence lies in



- Training systems for the whole areas of electrical engineering and electronics,
- Laboratory furnishings and fittings, and
- Measuring and test instruments.

The training systems are designed for student practical exercises and demonstrations in classrooms, workshops and laboratories in the framework of basic trade-training and further education (vocational training). This indicates the wide range of our customers:

- Vocational schools
- Engineering schools
- Chambers of Industry and Commerce
- Military basic and advanced, trade training
- Technical colleges
- Universities
- Industrial basic and advanced, trade training

The service offered by LN, apart from the supply of individual products, includes planning and supplying complete, ready-to-use classrooms together with instruction and training for the teaching personnel. Comprehensive handbooks are offered with all training systems, which ensure an immediate and straightforward application of the equipment. LN is at present represented in more than 50 countries, world-wide, by trading partners.



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The Company, "Phywe Systeme GmbH"

since 1913, has been developing, manufacturing and selling high-quality products and systems for instruction and training in natural sciences, i.e. Physics, Biology and Chemistry in secondary schools and universities.



The scope of their performance extends to:

- World-wide advice and consultation for training in natural sciences and technologies
- Equipment sets optimised to individual requirements
- Complete training systems for student and teacher experiments
- Didactically compiled experiment literature, specific to each subject
- Individual training in the products and systems.

Years of experience and the knowledge of leading experts from education and science is reflected in our teaching and training systems. Up-to-date technical subjects continually find their place in our new developments and of course, there is also regular communication with our customer on such developments. With more than 6000 documented experiments, almost all subjects of natural science are covered by practical exercises. The unique combination of teacher demonstration experiments and student exercises, enables the student to become active in the actual instruction. The quality of the products guarantees a reliable functionality and a high degree of safety.

Phywe is represented in over 80 countries, world-wide. In Europe, Phywe has a full-coverage structure of sales personnel, that ensure short response times and optimum customer service. Exports of Phywe products to almost all countries in the world, are organised by our sales representatives who are supported by an Export-team in our main office at Göttingen and a further team for the Francophone area based in Liège in Belgium.



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INTEA, the International Training and Development Agency

is active world-wide as a service for advice and training. Since 1968, the company has been involved with the development and compilation of customer-specific courses and training documents. The various activities are conducted either at the customer's own premises or in one of the 6 national or 4 world-wide training centres. More than 80 training staff are employed together with 200 freelance instructors who between them, in more than 30 languages and 15 countries, are responsible for our top-quality services that have been awarded a certificate in accordance with the DIN ISO 9001 standards.



INTEA Facilities Available

- Advice / Training development
- Train the Trainer
- Creation and operation of training centres
- Training logistics
- Coaching
- Providing training
- Analysis + Evaluation

INTEA Program

- *Technical training:*
Automotive, Information technology, Mechatronics, Automation engineering, Building services automation, (EIB)
- *Non-technical training:*
Management training, Marketing and sales training, Team training, Assessment, Project management, Crises and ecological communication, Business foundation

INTEA Customers

- Automotive
- Telecommunication
- Chemical industry
- Commercial / Service providers
- Government/National institutions



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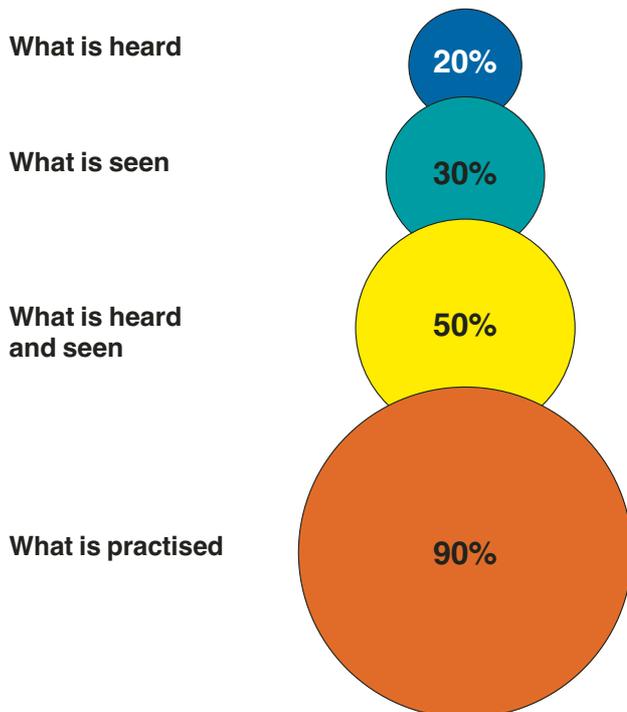
The Lucas-Nülle Philosophy

Why are training systems necessary ?

Technical training is continually subject to change. The changes are caused by the rapid development in the fields of electrical engineering and electronics, as well as the need for new interdisciplinary training (e.g. mechatronics, information technology, communications techniques) and new methods of training (e.g. "hands-on" instruction).

All three types of change can only be implemented by reinforcing theoretical instruction with practical exercises in a laboratory. Studies have shown that the human memory (ability to recall) is considerably better after active participation, compared to passive "consumption" of lectures. It has been discovered that only 20% of what is heard can be remembered; the recall ability is increased to 50% of what is heard and seen. However, maximum recall of 90%, is achieved by those who in addition, have performed practical exercises.

Human memory



An important factor in the higher percentage of recall for self-performed exercises, is that the method of "trial and error" is often used. However, this also means that by applying the exercise material, there is little danger of any mistakes being introduced.

To meet the demands on the use of technical equipment in teaching, in addition to conforming to the obligatory national and international standards such as DIN/ISO, VDE or CEM, all LN training systems also conform to our own criteria proved by years of experience.



Practice-oriented

Basic and vocational training are essential for a qualified labour force. At the same time, industry requires that trainees are prepared for their future work in such a way that the "on-the-job" training time is as short as possible. To satisfy this requirement, instruction must be reinforced with practical exercises that use equipment that will ensure a direct transfer of knowledge. For this reason, all LN training systems are based on the use of industrial types of equipment. In particular in LN training systems, the various items of equipment are not simulated but actual, real components are integrated in the training systems. Thus, for measurements and fault-finding, commercially available test and diagnosis instruments can be used.



Transparency

The typical industrial equipment used in LN training systems is prepared so that, for the purposes of instruction, numerous test and fault simulation possibilities are included. In industry, there is continuous pressure for a higher degree of integration, therefore, training systems must provide the facilities to assist the students to understand and in the true sense, "come to grips" with the new technologies. LN training systems are designed, therefore, so that all relevant signals are accessible at test sockets. The electrical circuit is either directly printed on the unit in the training system or included in the accompanying exercise literature.

The Lucas-Nülle Philosophy



Efficient

In training, the equipment is always subject to other demands as compared to industrial use. As a rule, equipment is assembled for a particular exercise then dismantled and stored in a cupboard. Normally, the time for completing an exercise is between 45 minutes to perhaps three hours. To make full use of this time for training purposes, the exercise assemblies must be completed as fast as possible, so that the actual learning time is at its maximum. This factor is particularly significant in vocational training. LN training systems are such that exercises can be readily assembled without the use of tools. Electrical connections are realised via laboratory plugs, whilst mechanical connections are achieved by specially designed couplings.

PC Support



Lucas-Nülle training systems are based on real industrial components and not simulations. Numerous programs are available for control and measured data acquisition, that offer the advantages of economy and didactic representation. The Lucas-Nülle programs are completely integrated in the MS-Windows® operating system, allowing an exchange of data with other application programs. The LN interfaces are constructed for straightforward connection to the serial interface of a PC. Plug-in cards are not required, for reasons of compatibility, since some newer operating systems have modified bus protocols for internal slots.

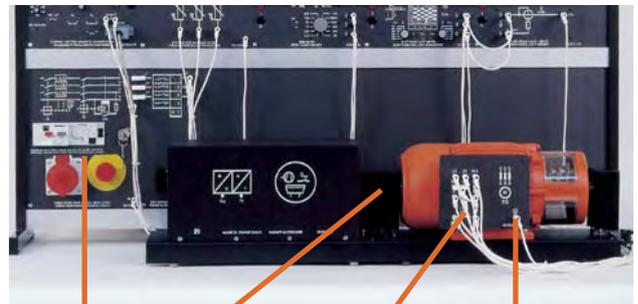
Quality / After Sales Service

The entire development and production processes of Lucas-Nülle are subject to stringent quality control systems, which are certified according to ISO 9001. All products are 100% tested before delivery. In the development of our products, we ensure that all components are from known manufacturers, so that, in the case of a repair being necessary, replacement parts are readily available, worldwide.

Future-oriented

The training systems are of modular construction. This ensures that a laboratory can be easily modified to keep in step with future technical developments. Furthermore, the modular construction guarantees that laboratories can be individually equipped to suit the syllabus of training that is being followed. Both aspects result in considerable economic advantages of the LN training systems.

Safety



Safety mains connection Shaft end guard 4mm safety sockets Thermostat

Also, the safety aspects of training equipment differ to those required in industry. It is reasonable to assume that in industry, the User (or operator) has been trained, whereas, in training, the User of a training system has yet to be instructed in the correct use of the equipment. Therefore, LN training systems are designed so that the best possible protection is provided for the students as well as the equipment, itself. All equipment is designed and manufactured to conform to all standards and recommendations (e.g. DIN/ISO, VDE, CEM). The equipment also conforms to the requirements of CE-identification, with reference to the standards 89/336/EEC (electro-magnetic compatibility) and 93/68/EEC (low voltage recommendations). For protecting the equipment, the units normally incorporate overvoltage protection at the inputs and short-circuit protection at the outputs. In the cases where electronic protection is not possible, inputs and outputs are protected by fuses.

Literature



An important part of the LN training systems is the comprehensive exercise literature for the various equipment assemblies. Each exercise handbook includes several exercises and each exercise comprises three main sections:

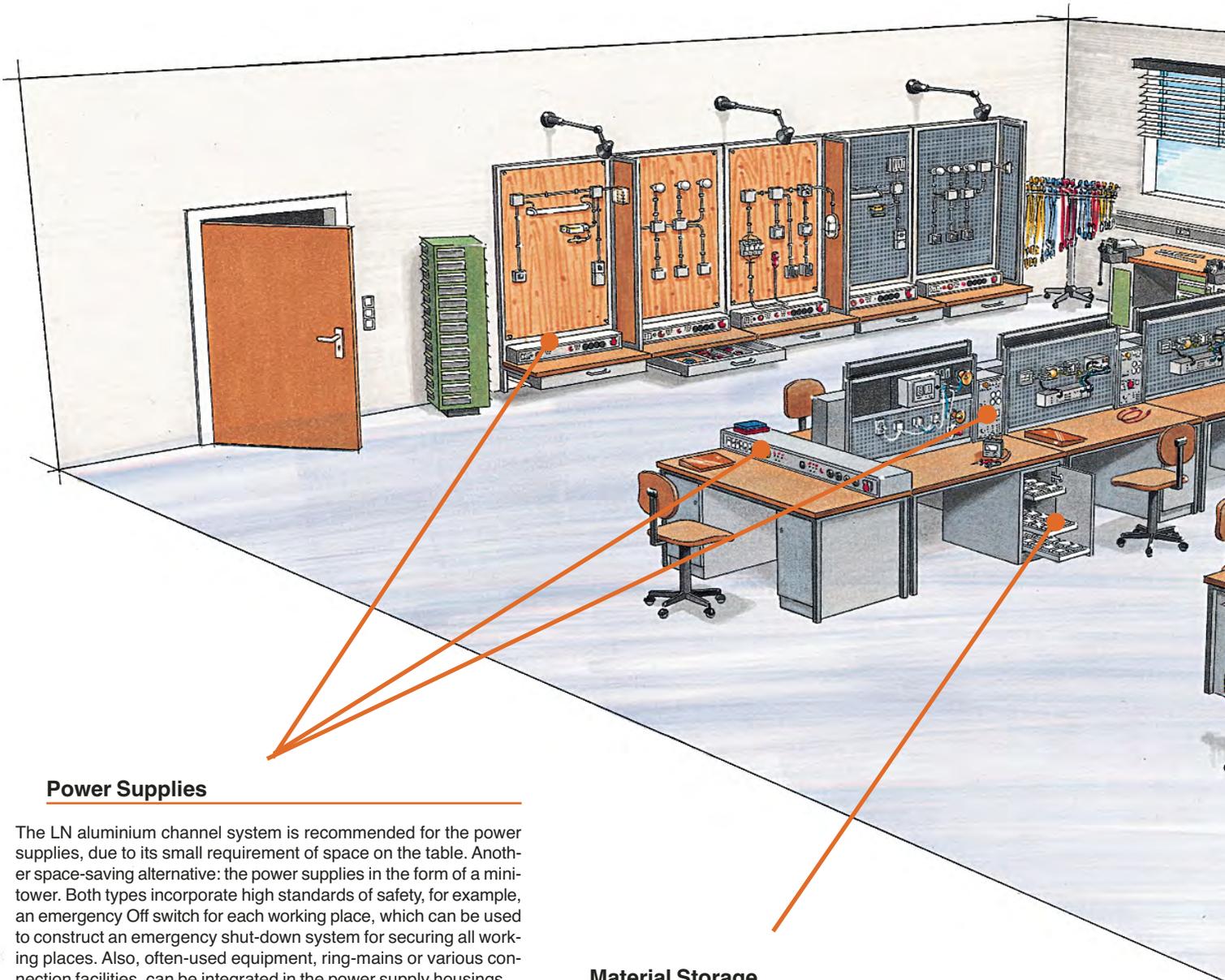
- Introduction, including general explanations and safety notices
- Student working sheets section, for copying and distribution in the class
- Typical results sheets, that contain the correct results for each exercise.



Electrical Engineering Workshop

The LN Workshop Equipment

The LN program covers an extensive spectrum for furnishing electrical engineering workshops, that is specially designed for the rough use to be expected in a training environment. All working surfaces are multi-layered or solid beechwood. The installation exercises can be completed using the LN box system or with commercially available components.



Power Supplies

The LN aluminium channel system is recommended for the power supplies, due to its small requirement of space on the table. Another space-saving alternative: the power supplies in the form of a mini-tower. Both types incorporate high standards of safety, for example, an emergency Off switch for each working place, which can be used to construct an emergency shut-down system for securing all working places. Also, often-used equipment, ring-mains or various connection facilities, can be integrated in the power supply housings.

Material Storage

Grooved and moulded trays are available for storing materials and equipment. These trays can be incorporated in the cupboards suspended below the working tops or as slide-in units for special cupboards.

Electrical Engineering Workshop

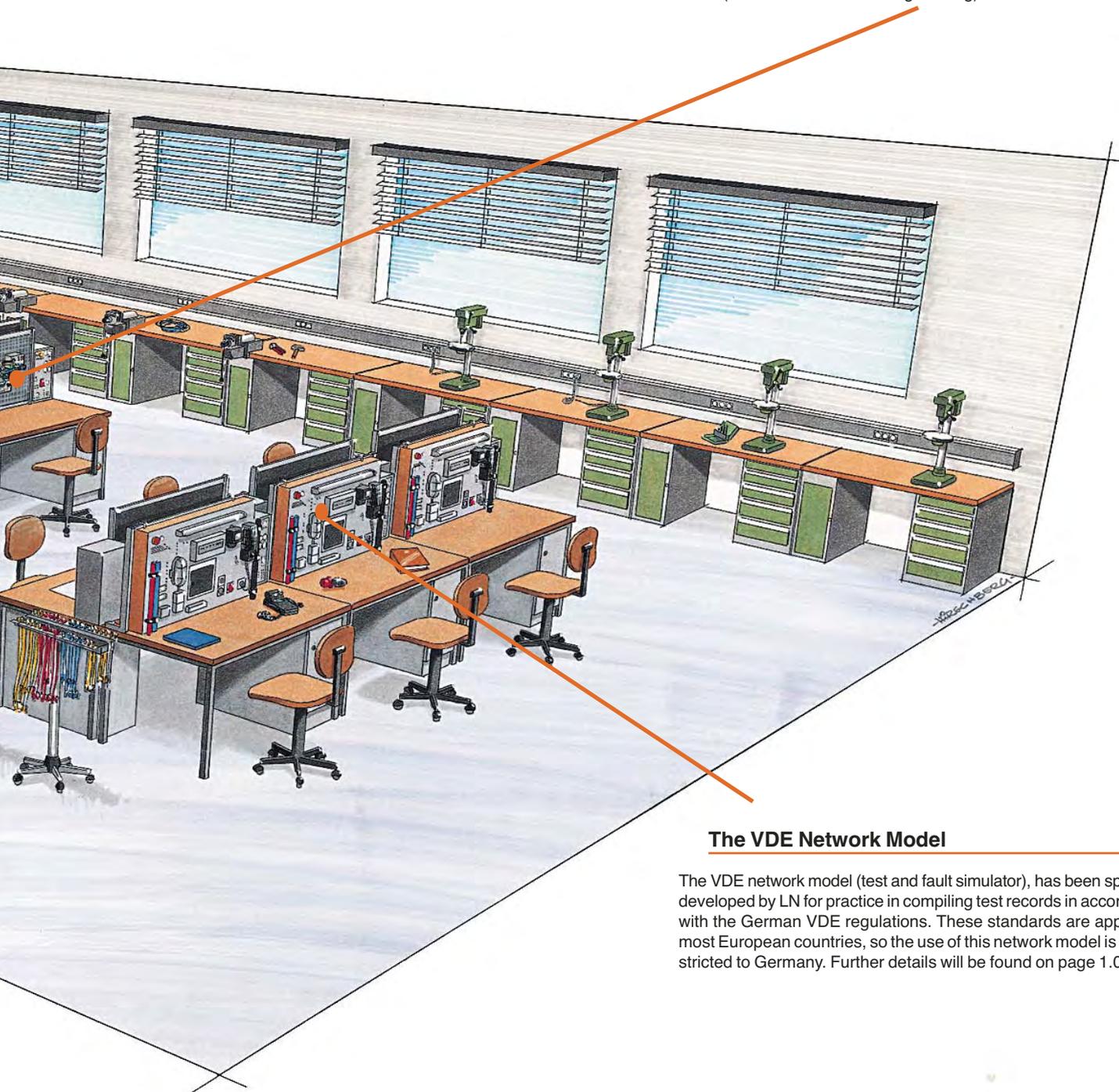


Installation Exercises with Commercially Available Materials

Punched-hole panels are available with wall-plugs for surface mounting, or special installation panels for flush-type mounting, for all installation exercises with commercially available materials. Exercise handbooks are also available matched to the material and tool sets. In the exercises which use commercially available materials, emphasis is placed on learning manual skills.

The LN Box System

The LN box system provides excellent teaching possibilities in understanding circuit construction. The students must assemble the various circuits using individual components. This is achieved quickly and safely, using 4mm safety-protected connection techniques. The electrical components are mounted on or enclosed in, unbreakable transparent macrolon boxes so that a high degree of practice orientation is ensured. The boxes are fixed, mechanically, on punched-hole panels. Examples of exercise assemblies will be found in section 1 (Electrical Installation Engineering).



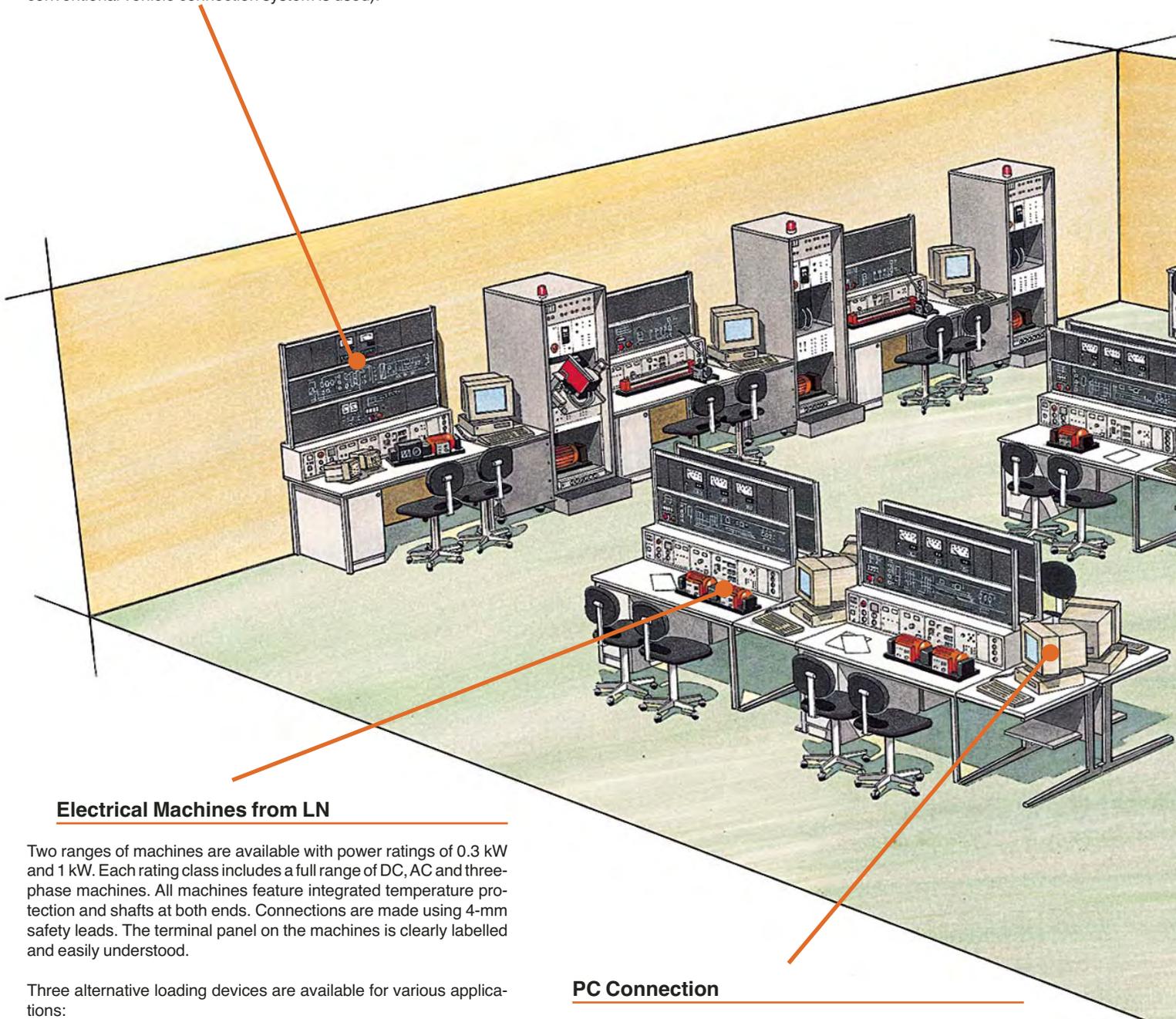
The VDE Network Model

The VDE network model (test and fault simulator), has been specially developed by LN for practice in compiling test records in accordance with the German VDE regulations. These standards are applied in most European countries, so the use of this network model is not restricted to Germany. Further details will be found on page 1.05.



The LN Panel System

The LN panel system is standardised to A4 dimensions. The panels are mounted in any order required, in a single or multiple level H-profile panel mounting frame. All information, circuits and safety notices where applicable, are screen-printed, white on a dark background. This offers excellent contrast and is wear-resistant and insensitive to dirt. Electrical connections are made using 4mm safety-protected cables (the only exception is in automotive techniques, where the conventional vehicle connection system is used).



Electrical Machines from LN

Two ranges of machines are available with power ratings of 0.3 kW and 1 kW. Each rating class includes a full range of DC, AC and three-phase machines. All machines feature integrated temperature protection and shafts at both ends. Connections are made using 4-mm safety leads. The terminal panel on the machines is clearly labelled and easily understood.

Three alternative loading devices are available for various applications:

- Magnetic powder brake
- DC dynamometer (1 kW only)
- Servo-brake

PC Connection

LN has developed an extensive range of software, operating under MS-Windows®, for controlling and measured value acquisition. All programs provide On-line detection of measured data and easy data export to other Windows application programs, to allow for example, easy preparation of overhead foils for use in instruction sessions. Connection is made to a PC via the RS232 interface without the need of an additional plug-in card.

Drive Techniques Laboratory



The PDU Trainer (Professional Drive Unit)

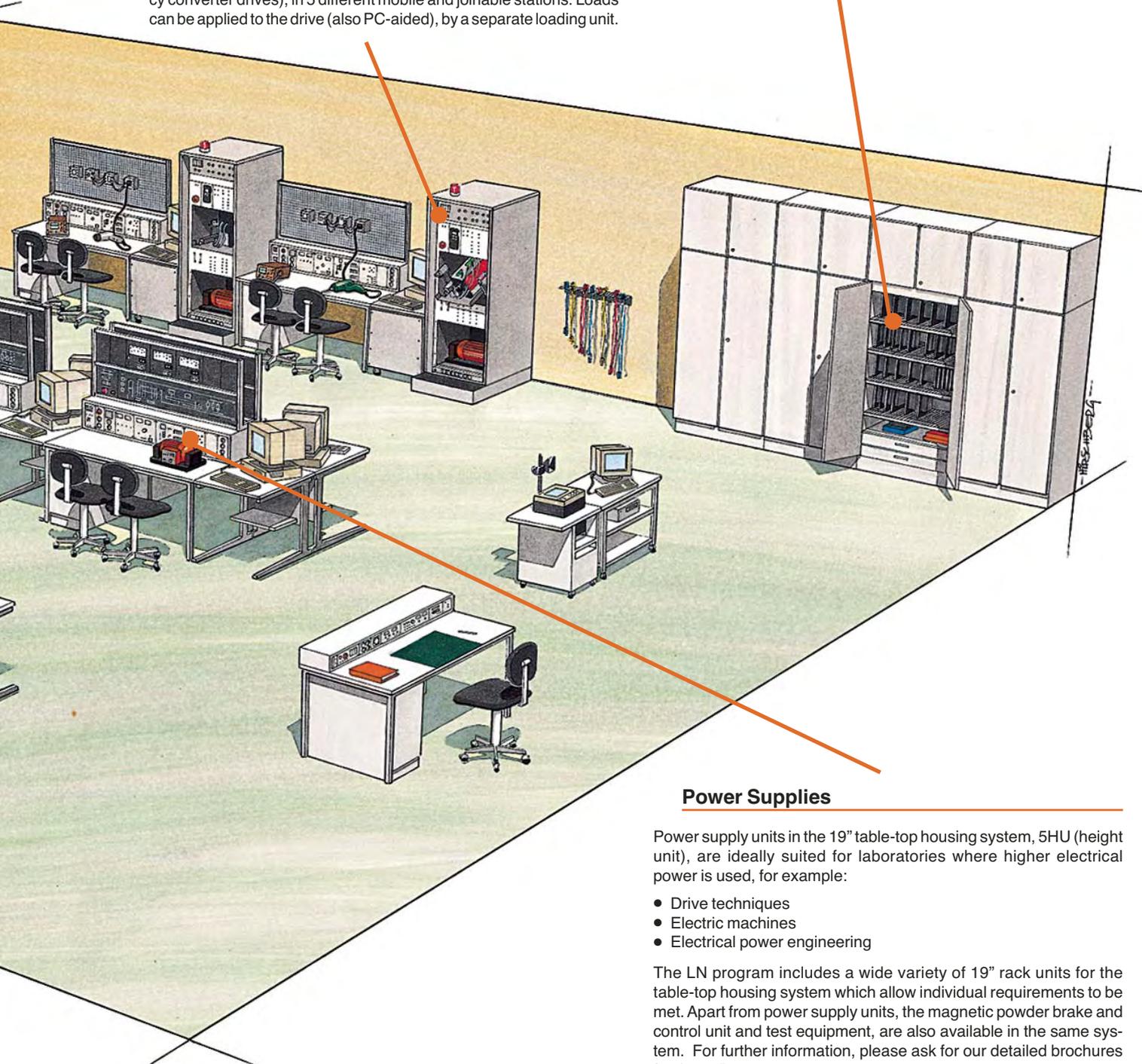
The primary aims of the PDU trainer, a fully-developed teaching unit, are:

- Understanding the complete drive system comprising control, amplifier, drive machine and the driven machine.
- Connection, operating, maintenance, repair and evaluating the operating performance of the drive machine in use.

The overall system has been designed for use with various industrial type machines up to 3kW (e.g. three-phase servo drives or frequency converter drives), in 5 different mobile and joinable stations. Loads can be applied to the drive (also PC-aided), by a separate loading unit.

Material Storage

The panels are all of A4 format; i.e. all with a standard height of 297mm. The panels can be safely stored in cupboards (floor-standing or suspended below the working surfaces), that incorporate shelves with keyway mats, providing a space-saving method of storage. Telescopic shelves with full pull-out, are available for electric machines, with a load carrying capacity of 50kg.



Power Supplies

Power supply units in the 19" table-top housing system, 5HU (height unit), are ideally suited for laboratories where higher electrical power is used, for example:

- Drive techniques
- Electric machines
- Electrical power engineering

The LN program includes a wide variety of 19" rack units for the table-top housing system which allow individual requirements to be met. Apart from power supply units, the magnetic powder brake and control unit and test equipment, are also available in the same system. For further information, please ask for our detailed brochures for the 19" system.



Communications Techniques Laboratory

Electrical Equipment from LN

The communications technology lab illustrated here is representative of a typical layout for an electronics laboratory, as used for example for teaching the following subjects:

- Electric and electronic circuits
- Telecommunications
- Control systems
- Automation technology/Industrial microcomputing

It features characteristic 19" system power supply assemblies, which occupy three height units. The exercises are designed to employ various systems suitable for any training requirements:

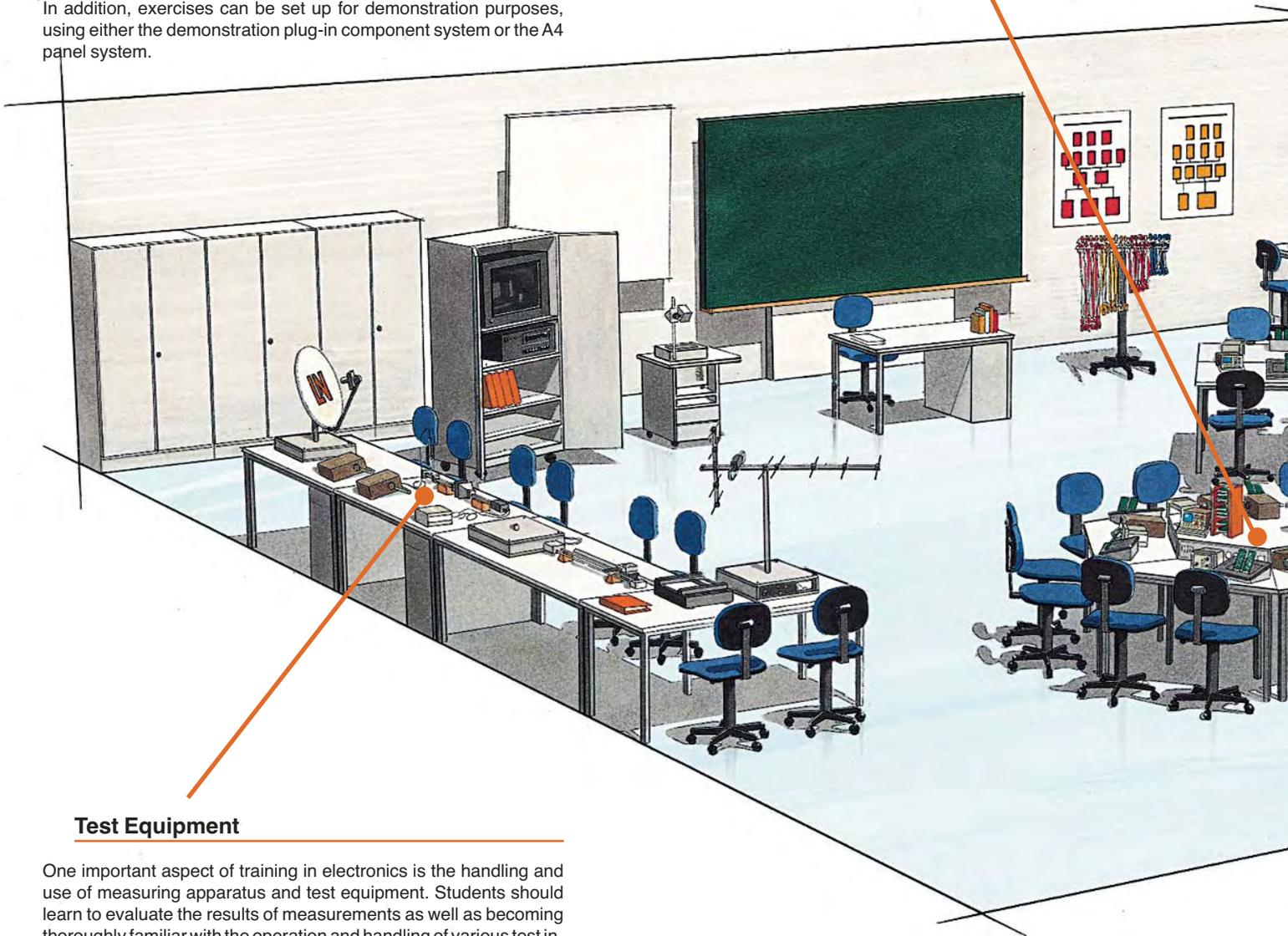
- Snap-in system
- Plug-in system
- UniTrain-I

In addition, exercises can be set up for demonstration purposes, using either the demonstration plug-in component system or the A4 panel system.

Power Supplies

Power supply units for the 19" table-top housing system occupy three height units (HUs) and allow for a compact layout of power supply units, measuring apparatus and test equipment. 3-HU table-top units are available in various formats.

- Lengthways set-up in a variety of lengths
- Corner set-up
- Octagonal islands for group work



Test Equipment

One important aspect of training in electronics is the handling and use of measuring apparatus and test equipment. Students should learn to evaluate the results of measurements as well as becoming thoroughly familiar with the operation and handling of various test instruments that they may subsequently use in industry. For this reason, the PC-assisted measurement and control software packages offered by LN should be regarded as supplementary to and not replacements for commercially available test equipment.



The UniTrain-I System

The UniTrain-I system is a powerful and computer assisted training system for vocational training in the field of electrical and electronic engineering. Conforming to international training syllabi, experiments and exercises have been developed from didactic aspects, constructed on exercise cards and accompanied by multimedia courses. The cards have a Euro-card format, typical to those used in industry, and are inserted into the UniTrain-I Experimenter. The cards can be cascaded, enabling larger more complex exercises to be completed. This ensures a simple and fast assembly of an exercise. Only the interconnections required, according to the training objectives, need to be completed by the student.

The UniTrain-I incorporates a complete power supply unit, a function generator and all necessary test instruments. In addition, the UniTrain-I Interface incorporates 8 fault simulation relays via which the prepared faults in the various cards, can be activated. All components on the experiment cards are easily accessible and at selected sig-

nificant points on the card, 2mm sockets are included for connecting test instruments. The fixed and time-saving circuit assembly can be modified by using 2mm jumper plugs. The subject currently being studied can be quickly changed by simply replacing the exercise cards so that the UniTrain-I system is suitable, not only for basic training, but, also for vocational training in small instructional sections. Courses for the following subjects are currently available:

Electrical Engineering

DC, AC and three-phase circuits

Electronics

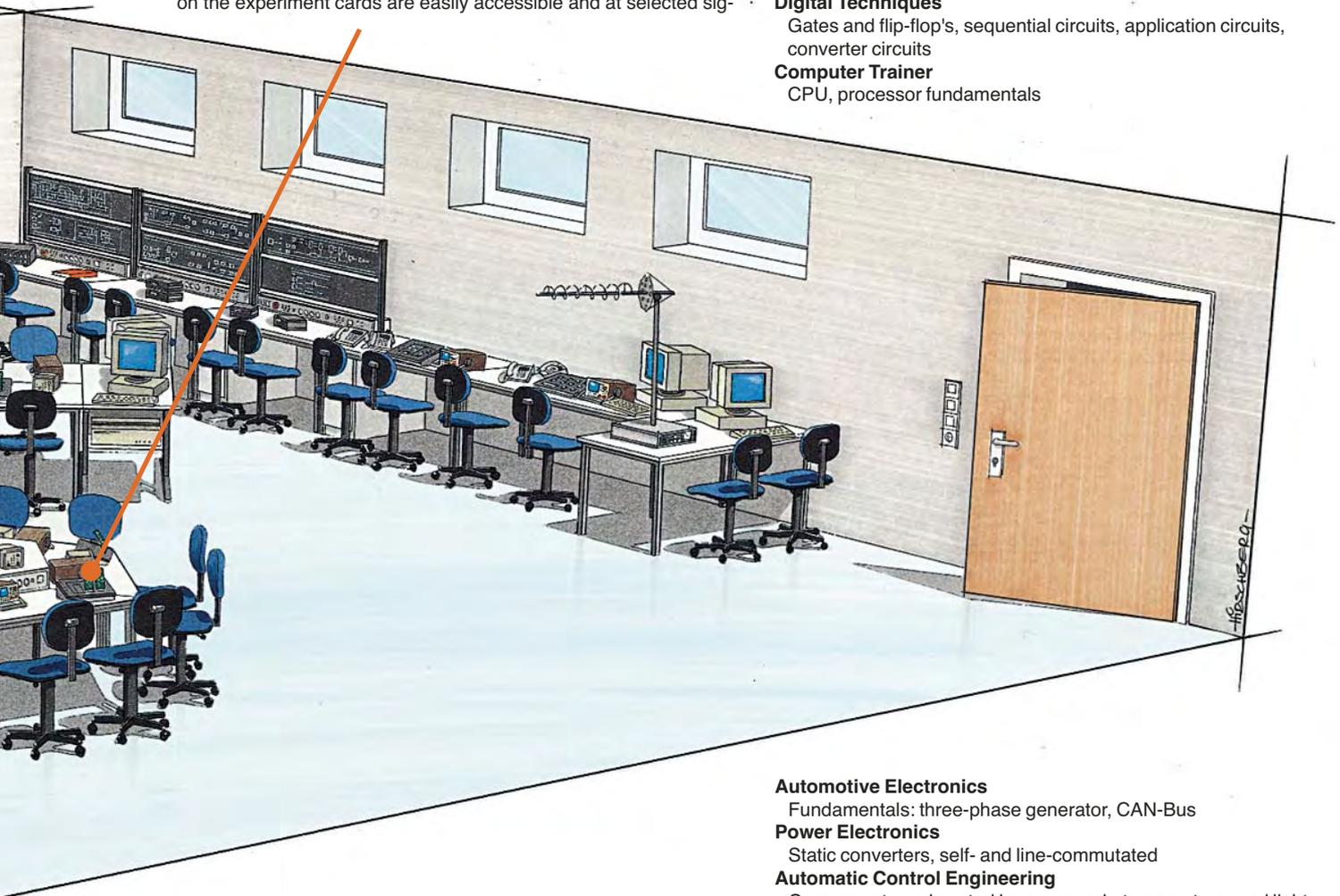
Semiconductor components, transistor and amplifier techniques, transistor multivibrator circuits, FET, operational amplifiers, power semiconductors, power supply circuits, switched-mode power supplies

Digital Techniques

Gates and flip-flop's, sequential circuits, application circuits, converter circuits

Computer Trainer

CPU, processor fundamentals



Automotive Electronics

Fundamentals: three-phase generator, CAN-Bus

Power Electronics

Static converters, self- and line-commutated

Automatic Control Engineering

Components and control loops, speed-, temperature- and light control systems, numeric control, FUZZY

Communications Techniques

Four-pole and filters, coax lines, fibre-optics, four-wire lines, pulse modulation techniques PAM / PCM / PTM, modem techniques ASK / PSK / FSK, AM / FM-modulation and demodulation, AM transmit and receive techniques, Fourier analysis and synthesis.



CERTIFICATE

DIN EN ISO 9001:2000



hereby certifies that the company



Lucas-Nülle Lehr- u. Meßgeräte GmbH

business field:
Development, production and sales of technical training systems
location:
Siemensstr. 2 * D-50170 Kerpen

has implemented and effectively applies a quality management system according to the standard (12/2000) mentioned above. The conformity was inspected during the certification audit documented in audit report no. Z-40307450. This certificate is only valid in connection with the successful performance of the surveillance audits.

Date of the first certification: 09.10.1997
This certificate is valid until: 13.01.2007

Date of the last recertification: 14.01.2004
Certificate-registration no.: 51197026/2 duplicate



Accredited by TGA
of the German Accreditation Council

Reg Nr.: TGA-ZM-05-01-00

DEKRA-ITS Certification Services GmbH · Hans-Winkelstraße 10 · D-70372 Stuttgart



This is to certify that
Lucas-Nülle Training Systems GmbH
Germany

has obtained accreditation under
the Worlddidac Quality Charter
for the years
2004 to 2007

The decision to grant the aforementioned company accreditation under the Worlddidac Quality Charter was based upon the results of the evaluation undertaken by the WQC Board of Experts.
Companies accredited under the Worlddidac Quality Charter meet the highest standards in product quality, services and after sales support and have the capacity to contribute to the sustainability of educational programmes worldwide.

Berne, October 26, 2004

David C. Macey
WQC Board of Experts
Chairman

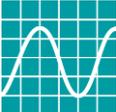
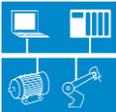
Beat Jost
Worlddidac Association
Executive Director

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Summary of Contents



This catalogue contains specially selected exercise packages, from the extensive modular product range of the LUCAS-NÜLLE Lehr- und Messgeräte company, covering the subjects of:

	E1: <u>Electrical Installation Engineering</u> Domestic Installation, Control Techniques, Building Security, Electrical Safety Measures, Mains Network Model, Instabus EIB	1
	E2: <u>Electrical Power Engineering</u> Current and Voltage Transformers, Generator Differential Protection, Three-phase Busbar Model, Peak Load Monitoring	2
	E3: <u>Power Electronics, Drives, Electric Machines</u> Power Electronics, Servo Motor, Frequency Converter, Three-phase Motors, DC Machines, Linear Motor	3
	G0: <u>Electrical and Electronic Circuits</u> DC Circuits, AC Circuits, Three-phase Circuits, Power Supply Circuits, Transistor and Amplifier Circuits, Digital Technology	4
	T0: <u>Communications Technology</u> Data Transmission, Analog and Digital Modulation Technology, Modem, Telephone Technology, Microwave Technology, Antenna Technology	5
	I0: <u>Process Control</u> Study of Closed-loop Control Systems Applied Automatic Control, Control of Servo Systems	6
	I0: <u>Instrumentation</u> Measurement of Electric and Non-electric Values	6
	C0: <u>Micro Controllers</u> Microprocessor, Microcontroller	7
	C1: <u>Automation Technology</u> Sensorics, PLC, Industrial Bus Systems	7
	A0: <u>Automotive Technology</u> Electric Circuits, Automotive Electronic Engineering, Convenience Systems, Safety Systems, Motor Management Systems, Connect [®]	8

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EIT 8	instabus EIB (Compact Unit)	01.06
ESM 4	Lightning and Over-voltage Protection	01.07



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EUL 1	Study of a Three-phase Transmission Line	02.03
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EUB 5/7	Current-dependent, Overcurrent Time Relay	02.06
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MTI 3	Fundamentals of Digital Techn. with UniTrain-I	04.06
BTI	Fundamentals of Electrical Engineering and Electronics with UniTrain-I Project Work / Component Kits	04.07



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CMC 10	Programming a PIC 16F84 microcontroller	07.02
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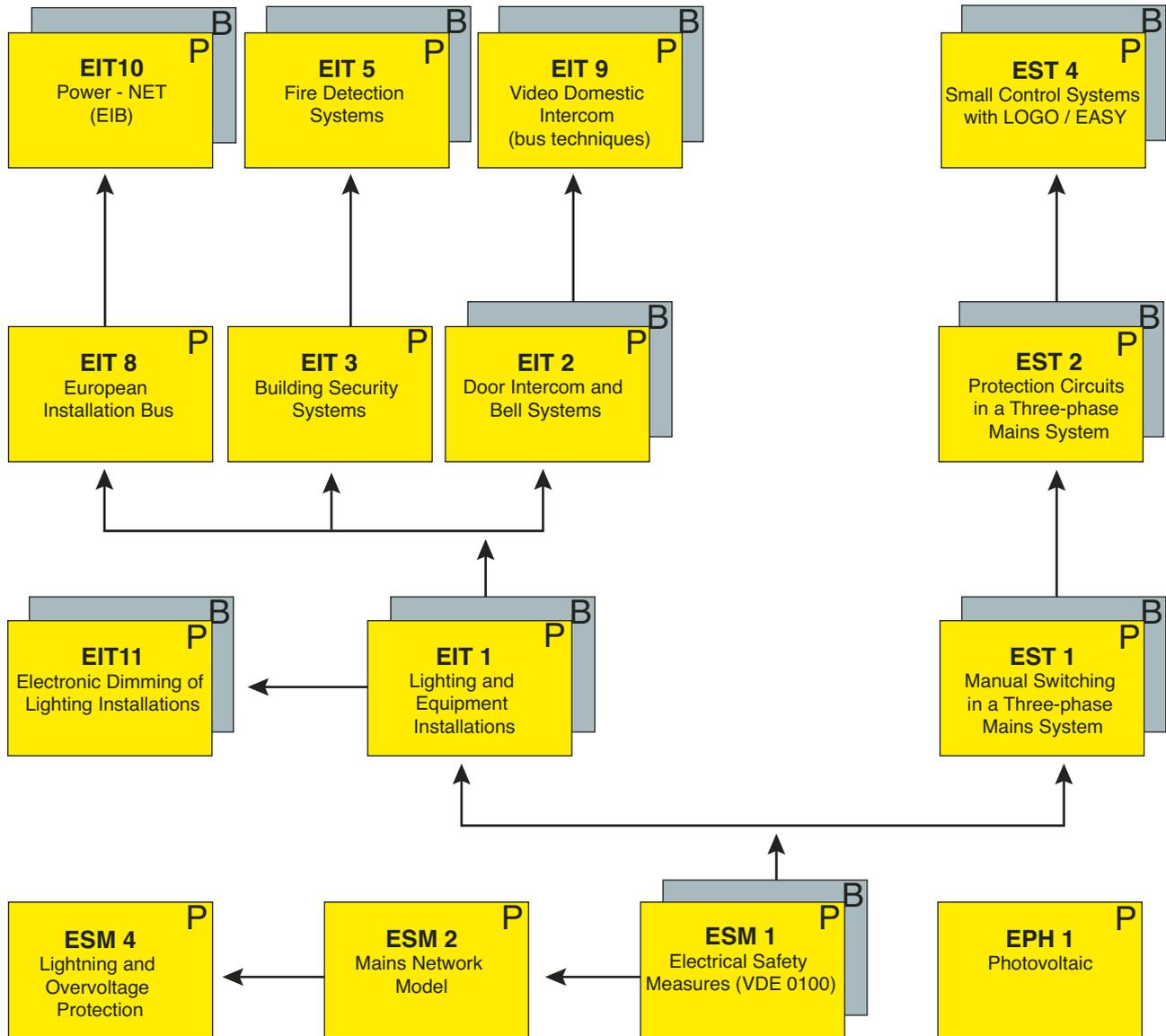
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Automotive Technology 08.00

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1.00

Practical exercises using commercially available materials:

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Note: P= Panel system
B= Box system



1.01



System Description

Exercise Boards

The exercise boards have been designed for practical exercises in installation techniques, at a student workplace. The clear arrangement of components follows the presentation in the appropriate training manual. All inputs and outputs for mains voltage (230V) are terminated at 4mm safety-protected sockets. All voltages <42V (safety extra low voltage, SELV) employ 2mm safety techniques. The compact construction means that any classroom can be very quickly and easily be converted to a fully-functional laboratory. There are no problems in integrating the boards in the LN teaching equipment program, so that individual exercises can easily be extended as required.

Installation Board – Lamp Circuits, consisting of:

- 2 Off / Changeover switch
- 1 Series switch
- 1 Intermediate switch
- 2 'Schuko' mains socket with earth connection
- 4 Junction box
- 3 Filament lamps, 25W / E14

Installation Board – Bell and Intercom Systems, consisting of:

- 1 Mains transformer, 230V/8V AC 1A
- 2 Push-button with bell symbol
- 2 Push-button with light symbol
- 2 Filament lamps, 25W / E14
- 1 Door opener
- 2 Door intercom with push-button for door opener function and additional lighting
- 1 House intercom for two flats with 2 illuminated bell push-buttons (outside)

Installation Board – Electronic Dimmer Circuits, consisting of:

- 1 Dimmer for filament lamps
- 1 Filament lamp, 25W / E14
- 1 Dimmer for LV halogen lamps
- 1 Electronic transformer for LV halogen lamps, 12V, 20/60W
- 1 LV halogen lamp, 12V/50W
- 1 Dimmer for compact fluorescent lamp
- 1 Electronic reactor
- 1 Compact fluorescent lamp



Topics Covered

EIT 1 Lamps and Equipment Circuits

- Testing the function of components used in domestic installations
- Drawing and extending installation plans and schematic diagrams
- Construction, test and operating switching and dimmer circuits
- Off, series, changeover and intermediate switch circuits, with and without a mains outlet socket

EIT 2 Bell and Door Opener Systems

- Construction, test and operating bell and door opener systems with one or two terminating locations
- Locator installations (with and without callback)
- Door intercom systems with 2 intercom units and door opener
- Circuits with current impulse switch for stairway lighting

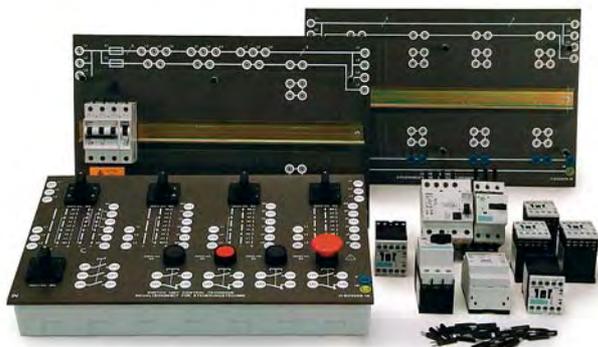
EIT 11 Electronic Dimmer Circuits for Lighting

- Filament lamp dimmer
- Dimmer circuit for LV halogen lamps with electronic transformer
- Dimmer circuit for compact fluorescent lamp with electronic reactor



Ordering Information

Equipment List	Qty.	Order No.
Installation and Lighting Circuits		
Installation board for <i>lighting circuits</i>	1	SO3209-8A
Bell and Intercom systems		
Installation board for <i>bell systems</i>	1	SO3209-8C
Electronic Dimmers for Lighting		
Installation board for <i>electronic dimmers</i>	1	SO3209-8B
Exercise Literature		
EIT 1/2 Electrical Installation Techniques (GB)	1	SO5156-6A
EPE Power Electronics		
Principles of Control in Power Electronics (GB)	1	SO5159-2N
Accessories		
Single-phase AC supply with line protection switch & "Schuko"-socket	1	SO3211-1A
Multimeter	1	LM2105
Safety protected connection plug 19/4mm, white	20	SO5126-9X
Set of safety connection cables	1	SO5148-1B



System Description

The LN teaching system "Contactor Circuits" has been designed so that electric circuits typical to industrial plants can be presented in a practice-oriented and didactic manner. Depending on the exercise required, the contactors are suitably arranged on an exercise board and the wiring completed. All electrical connections are achieved quickly and without any tools using 4mm safety-protected adapters. The LN board system provides a particularly practice-oriented type of training, as all connections must be completed by the students.

The circuits can be realised with all power classes of machines in the LN-program (0.1kW, 0.3kW and 1kW). The LN-teaching system presented here is combined with machines in the 0.3kW class that match the rating of the protection relay. Since the training objective is mainly concerned with the construction of control circuits, a test meter or indicating lamp can be used to show the functionality of the circuit.

The exercise handbook contains various exercises, each of which includes worksheets for the students in addition to typical results sheets for the instructor.

Circuit Board for Control Techniques, consisting of:

3-pole Off switch, 3 On-Off push-buttons, Emergency-Off button, Star-Delta switch, Star-Delta changeover switch, Dahlander pole changeover switch, Pole changeover switch for 2 separate windings.

Control Techniques I, Basic Functions

Equipment Set, consisting of:

Motor protection switch, 6 Latched push-buttons, 6 Indicator lamps, 5 Main contactors, 5 Auxiliary contactors, 2 Delay relays, pull-on and drop-out delayed

Control Techniques II, Complex Installation Circuits

Equipment Set, consisting of:

4 Main contactors, 4 Auxiliary contactors, Multifunction relay with 7 functions

Control Techniques III, Project Work

Equipment Set, consisting of:

2 Earth-leakage (I - operated) circuit breakers, Motor protection switch, 2 Auxiliary switches, Open-circuit shunt release, Under-voltage trip, Multifunction relay, 4 End switches, Seven-day time-switch, Mains socket with earth contact (Schuko)

Control Techniques IV, Industrial Measuring Techniques

Equipment Set, consisting of

Digital ammeter, voltmeter, frequency meter; AC kWh-meter, Three-phase kWh-meter, Operating hours meter, Measuring point selector, Current transformer



Topics Covered

EST 1 Manual Switching of Three-phase Motors

- Motor protection switch
- Off switch
- Rotation reversing switch
- Star-Delta switch
- Star-Delta changeover switch
- Dahlander pole changeover switch
- Pole changeover switch for 2 separate windings

EST 2 Contactor and Protection Circuits for Three-phase Motors

- Contactor circuit with self-holding relay
- Contactor circuit with time relay, delayed drop-out
- Contactor circuit with time relay, delayed pull-on
- Pulsed contactor circuit
- Reversing contactor circuit with contactor interlocking
- Reversing contactor circuit with contactor and push-button interlocking
- Limit control with mechanical limit and reversing switches
- Star-Delta circuit
- Automatic Star-Delta circuit
- Automatic Star-Delta reversing circuit

1.02

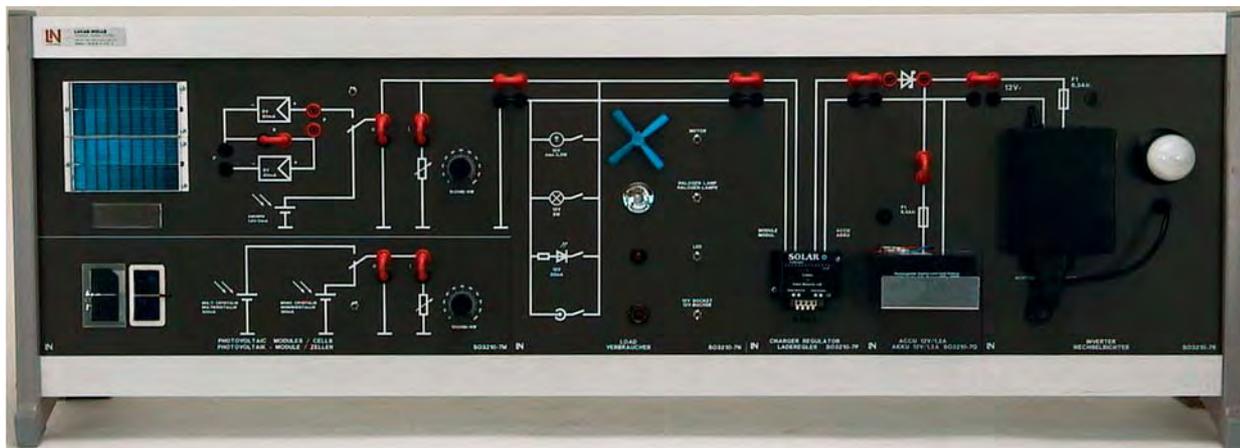


Ordering Information

Equipment List	Qty.	Order No.
Equipment EST 1		
Patchboard for control techniques	1	SO3209-1A
Equipment EST 2		
Control techniques, basic board, incl.		
Line protection switch, 3-pole		
Line protection switch, single pole	1	SO3209-1C
Control Techniques I, set	1	SO3209-1D
Extension Equipment for Complex Installation Circuits		
Control Techniques II, extension board	1	SO3209-1E
Control Techniques II, equipment set	1	SO3209-1F
Extension Equipment for Project Works		
Control Techniques III, extension board	1	SO3209-1G
Control Techniques I, set	1	SO3209-1H
Extension Equipment Industrial Measuring Techniques		
Control Techniques IV, equipment set	1	SO3209-1J
Machines and Braking System 300 W		
Three-phase asynchronous motors 0.3kW	1	SE2662-3G
Three-phase motors, pole changing		
Dahlander 0.3kW	1	SE2662-3K
Three-phase motors pole changing		
2 separate windings 0.3kW	1	SE2662-3L
Coupling guard 0.3kW	1	SE2662-2B
Clutch Sleeve 0.3kW	1	SE2662-2A
Shaft end guard, 0.3kW	2	SE2662-2C
Magnet powder brake 0.3kW	1	SE2662-4P
Alternative		
Magnetic powder brake with built in excitation	1	SE2662-3R
Control unit 300W	1	SO3212-6S
Exercise Literature		
EST 1 Contactor & Manual Switching of Three-phase Motors (GB)	1	SO5156-8B
EST 2 Contactor Circuits with Protection Units for Three-phase Motors (GB)	1	SO5156-8C
Accessories		
Safety connection cables (set) 4mm	1	SO5148-1B



1.03



System Description

Technical Description of the Photovoltaic Trainer

The photovoltaic trainer teaches the basic principles of solar techniques. It is possible to construct a fully-functional photovoltaic stand-alone system with solar modules that incorporate the various technologies. The teaching system is modular-constructed on DIN A4 panels and is compatible to all teaching systems. As a light source the exercise assembly incorporates a reflector lamp, adjustable in intensity and incident angle, enabling all basic exercises on the subject of photovoltaics to be completed.



Topics Covered

EPH 1 Photovoltaic Trainer 1

- Measuring the strength of irradiation
- Characteristics, off-load voltage and short-circuit current of various PV cells
- Power characteristics and temperature response of various PV cells
- Series and parallel circuits PV cells
- Consumers operated directly or in storage mode
- Inverter operation mode



Ordering Information

Equipment List	Qty.	Order No.
Photo-voltaic modules, 4 pcs, various methods of connection incl.		
2 load pots	1	SO3210-7M
Consumer 12V with bell-type armature motor, halogen lamp, LED & 12V univ. socket	1	SO3210-7N
Accu 12V / 1.2Ah with 6A fuse and Shottky-diode	1	SO3210-7T

Exercise Literature

Measuring Sheets for Photo-voltaic Trainer with Copy Licence(GB)	1	SO5156-6Z
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Extensions

Inverter 12V DC to 230V AC / 200W with 230V consumer	1	SO3210-7R
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Also recommended, is the use of an easily operated simulation software for the photovoltaic system.

Simulation Software

Simulation Software Photo-voltaic PVS 2.000 (school licence) (GB)	1	SO2205-1A
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Recommended Photovoltaic Measure Technique

Radiant exposure meter with temperature detection and data logger	1	LM8512
Evaluation and display software for radiation meter	1	LM8513
Solar digital multimeter, 3 digit	1	LM2320
Safety protected connection plug 19/4mm, red	8	SO5126-9U
Safety protected connection plug 19/4mm, black	8	SO5126-9Y
Panel mounting frame for table top mounting, 2 levels, W 1460 x H 700mm, grey	1	ST8003-2S



System Description

Electrical energy is the most widely used form of energy today. Because of its physical properties, if not treated with respect, electrical energy is highly dangerous. The German association of electrical engineers (VDE) has therefore compiled special recommendations and regulations to protect the User as well as possible, from any serious danger. The subject of protection from excessive body-contact voltages (protection according to VDE0100), is important to all who are concerned with adjustments, operation and repair of electrical installations, in particular students in electro-engineering trades.

The LN training system ESM 1 offers the optimum support in theoretical and practical instruction in the subjects of protection, according to VDE0100, for various types of mains networks (TN-C-S, TN-C, TN-S, TT and IT networks). One of the more significant points of the LN training system, is the direct relation to practice. All LN training systems are constructed, using industrial components. Measurements on individual exercise assemblies, are completed using commercially available test meters.

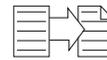


Topics Covered

ESM 1 Electrical Safety Measures (VDE0100)

- Body contact voltage
Fault current and body current; safety rules; reference current
- Protection against indirect body contact
Active, external and conductive parts; explanation of basic isolation
- Protective low voltage
Different classes of protection; function of low voltage; purpose of protective low voltage
- Protective measures in a TN mains supply
Potential balance; circuit breaker current; loop impedance measurement
- Protective isolation
- Protective measures in a TT mains supply
Earthing methods; test procedures; possible dangers
- Types of mains supply networks
Structure of various networks
- Protection against indirect body contact
Insulation faults; short circuit to frame; conductor fault; double fault

- Additional protection with leakage current protective devices
Construction of a leakage current trip switch; advantages and disadvantages of the protective devices
- Faults in a TN mains supply
Assembling various exercise circuits; integrating fault combinations in the exercise assemblies
- Insulation resistance
Minimum permissible values; requirements of an insulation tester
- Earth resistance measurement
Purpose of system and signal earthing rods; current/voltage measurements; earth measurement fault sources
- Protective measures in an IT mains supply
Single and double faults; insulation monitoring
- Protective isolation
Protection by non-conductive separation; protection by a local, floating potential balance; protective isolation for one or more consumers



Ordering Information

Equipment List	Qty.	Order No.
Transformer unit TN-C-S with overlay masks	1	SO3211-9A
Isolating transformer	1	SO3211-9G
Bonding	1	SO3211-9J
Fault current circuit breaker	1	SO3211-9K
Earth leakage monitor	1	SO3211-9L
Load 1	1	SO3211-9N
Load 2	1	SO3211-9P
Mains simulation	1	SO3211-9Q
Model Human	1	SO3211-9R
Earthing rod	1	SO3211-9S
Probe	1	SO3211-9T
Loop impedance	1	SO3211-9U
Resistor panel	1	SO3211-9X
Resistor 2W, 2W, SO1	1	SO5121-1S
Resistor 47W, 2W, SO1	1	SO5121-2J
Resistor 22kW, 0,5W, SO1	1	SO5121-3U

Exercise Literature

ESM 1 Electrical Safety Measures VDE 0100	1	SO5156-7B
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Accessories

Filament lamp 230V / 25W / E14	1	SO5123-9C
Filament lamp 24V / 5W / E14	1	SO5123-8W
Safety prot. connection plug 19/4mm, green/yellow	5	SO5126-9W
Safety protected connection plug 19/4mm, bl.	5	SO5126-9V
Safety protected connection plug 19/4mm, wh.	8	SO5126-9X
Set of safety connection cables 4mm (30 pcs)	1	SO5148-1A
Table-top frame, 2 levels, 1230x740mm, grey	1	ST8003-1C

Test Instruments

Analog multimeter AC 0-1000V / 0-10A, DC 0,1-1000V / 50µA-10A, 2kΩ-2MΩ	1	LM1122
Protective measures test unit VDE 0100	1	LM8505
Insulation tester	1	LM8501
Loop impedance	1	LM8510
Test lead, K042 for VDE test unit M5010	1	LM9043



1.05



System Description

The realignment of responsibilities for work in the electrical professions and the way the disciplines are ordered in a training curriculum creates the need for education to be highly practice-oriented. In this respect, incorporation of new training media with established experiment systems is playing an ever greater role. Only with the aid of self-driven, practical learning is it possible to assimilate the necessary skills for handling modern equipment.

The "Instrain" experiment system is a multimedia laboratory covering all aspects of wiring installation with training software that can be coupled directly to authentic instruments, so that trainees can learn all the necessary skills to use them. The first module, "Wiring installation – domestic mains connection", includes a PC interface, software and fault simulation and covers the following topics:

- Pre-calculation and planning of domestic mains connections
- Selection of cables and wiring
- Planning and design for a sub-distribution system
- Protective measures (fuses and circuit breakers) as per VDE regulations

The module integrates practice-based experiments along with advanced information leading on from exercises and their solutions. Links to the internet providing even more detailed information top off the capabilities of the experiment system.



Topics Covered

- Mains feed to a building, mains sub-distribution
- Hazards due to electric current
- Protection against electric shock
- Mains systems
- Short circuits, shorts to frame, shorts to earth
- Testing an electrical installation for conformance with currently applicable standards
- Testing of TN/TT systems
- Testing of RCDs
- Insulation testing, earthing measurements, measurement of loop resistance
- Testing of three-phase rotating field, testing of protective conductors, measurement of equipotential bonding conductors
- Lightning and overvoltage protection



Ordering Information

Equipment List	Qty.	Order No.
EGT 1 Domestic mains connection and sub-distribution as per VDE 0100		

VDE wiring installation training module consisting of:

Mains connection box with low-voltage, high breaking capacity (NH) main fuse Meter box with electronic electricity meter Plus 5-row sub-distribution panel, computer interface with USB connection and virtual measuring instruments, fault simulation	1	SE2671-1A
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Equipment List	Qty.	Order No.
EGT2 Wiring installation for external mains network		

Wiring installation training module consisting of:

Building floor plan with six rooms, sub-distribution for 12 circuits, all commonly used wiring circuits: one-off, two-way, series-parallel and intermediate switch circuits push button circuits, remote control switches (Eltako) dimmer circuits for electronic transformers, electronic ballast and incandescent lamps, AC and three-phase loads, computer interface with USB connection and virtual measuring instruments, fault simulation	1	SE2671-1C
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Equipment List	Qty.	Order No.
Accessories		

Installation tester for testing protective mechanisms as per DIN VDE 0100 Section 610	1	LM8550
Software and interface cable for installation tester	1	LM8551



System Description

With the instabus EIB, an intelligent installation system has been developed that meets the requirements for better flexibility, economy and ecological compatibility in building system techniques. The costs involved in preparing a building system installation are considerably reduced by software-supported projects and installation planning.

All control elements (e.g. switches) in an instabus EIB system, are identified as sensors which are connected to the system by a two-wire line (24V), isolated from the mains supply network that carries the so-called data telegram. The control signals are fed on the actuators (e.g. contactors or lamps). The bus is split into groups of lines, whereby the bus management functions in "multi-master" mode (signals on the bus are fed to all devices connected). In order that one particular actuator can be caused to react, each actuator/sensor must have a unique identification (physical address). Later modification or additions to the system, are effected by simply changing or adding the address in the management software.

A prominent feature is the possibility of combining components from different manufacturers in one system. In such a case, when ordering the software, the relevant data base must also be requested.

The LUCAS-NÜLLE training system EIT 8 for student exercises, is a compact equipment, using components manufactured by the Siemens company and incorporates the following components:

- Voltage supply for the bus system (24V DC, 320mA) with integrated RS232 interface
- Indicator for correct phase coupling, to the mains supply
- Four-fold buttons for the functions On/Off and dimmer action
- Two switches
- Binary input, 4-fold
- Binary output, 4-fold
- Room simulation with 6 lamps and overlay masks for different building arrangements
- Top-hat (DIN) rails for the bus signals, and terminal blocks for connecting extra, commercially available components

Furthermore, this compact equipment is compatible with the modular structure of LN training systems. In particular, all connections are matched (safety-protected cables: 4mm for the 230V/50 Hz mains and 2mm for the bus signals). Thus, the compact unit can be used with the modular components of the LN panel system, to extend the instruction syllabus (for example, switched dimmer for fluorescent lighting).

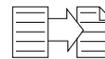


Topics Covered

1.06

EIT 8 Lighting Circuits with the Instabus EIB

- Planning a series switching circuit
- Operating a series switching circuit
- Re-programming a series switching circuit
- Adding an extra conventional switch



Ordering Information

Equipment List	Qty.	Order No.
EIB compact trainer, power supply, RS232 interface, binary I/O, 2 switch/push buttons, room simulation with 6 lamps	1	SO3210-6L

Computer Connection

Software for instabus EIB (D)	1	SO4001-3S*
Serial interface cable 9/9 pole	1	LM9040

Additionally, a PC with Windows is required

Exercise Literature

Building System Technology with the Instabus EIB (GB)	1	SO5156-6W
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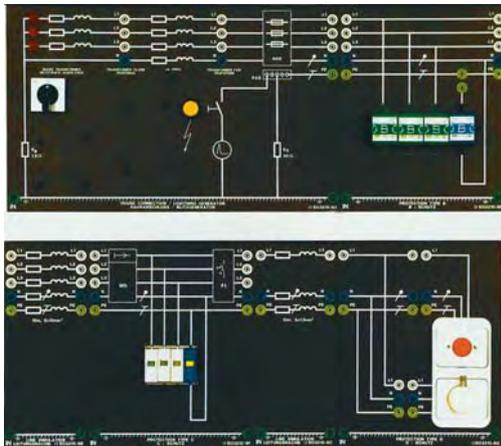
Accessories

Safety protected connection plug 19/4mm, white	6	SO5126-9X
Safety protected connection plug 19/4mm, white, with tapping	2	SO5126-9Z
4mm safety cable 25cm white	2	SO5126-8F

NOTE:

EIBA (European Installation Bus Association) licensing regulations stipulate that their software products may be ordered from outside Germany, only by End-users. The software is available in the majority of European languages. At the time of ordering, details must also be given of the components used in the proposed assembly, so that the corresponding software library is supplied. Our instabus EIB training system is equipped with Siemens components. The address of your local EIB dealer, can be obtained from:

EIBA s.c.
 Avenue de la Tanche 5
 B-1160 Brussels
 BELGIUM
 Tel.: +32 2 675 5020
 Fax: +32 2 675 5028



System Description

The lightning protection network training system is designed for teaching skilled workers, craftsmen and students the basic principles of multi-stage, over-voltage protection with lightning and over-voltage arresters, directly on the model.

The model consists of a three-phase system with integrated lightning stroke current and over-voltage arresters, together with a surge current generator for injecting an artificial lightning stroke current.

For reasons of safety, the model is scaled down to operate with 24V. The surge current generator produces about 0.5 % of the greatest known lightning current. Because of the scaled-down voltage of 24V, the functions of the lightning and over-voltage arresters here, are simulated with electronic components that are incorporated in original type housings.

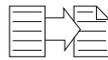
The currents and voltages can be measured so that the over-voltages in this type of network can be closely observed.



Topics Covered

ESM 4 Lightning and Over-voltage Protection

- Protection concept for Domestic Installations
- Coarse, medium and fine protection
- Insulation co-ordination
- Transformer-distant, lightning strike
- Transformer-close, lightning strike



Ordering Information

Equipment List	Qty.	Order No.
Decoupling inductances 4pole	1	SO3210-9A
Line simulation for 10m, 5 x 10mm ²	1	SO3210-9B
Line simulation for 10m, 5 x 1.5mm ²	1	SO3210-9C
Protection type B	1	SO3210-9E
Protection type C	1	SO3210-9F
Protection type D	1	SO3210-9G
Mains supply, 3 x 23 / 40V 50Hz, lightning generator 1000V / 500A	1	SO3210-9J

Test instruments

Digital multimeter	1	LM2005
Digital 2-channel storage oscilloscope	1	LM6205
Test lead, BNC/4mm safety plugs, 160cm	1	LM9031

Accessories

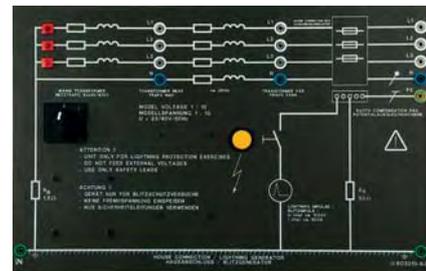
4mm safety cable, 50cm, g/y	2	SO5126-8R
4mm safety cable 4mm, 50cm, blue	2	SO5126-8P
4mm safety cable 4mm, 50cm, white	5	SO5126-8Q
4mm safety cable 19/4mm, g/y	10	SO5126-9W
4mm safety cable 19/4mm, blue	10	SO5126-9V
4mm safety cable 19/4mm, white	30	SO5126-9X
Panel mounting frame, 2 levels, W 1460 x H 700mm, grey	1	ST8003-2S

Technical Data

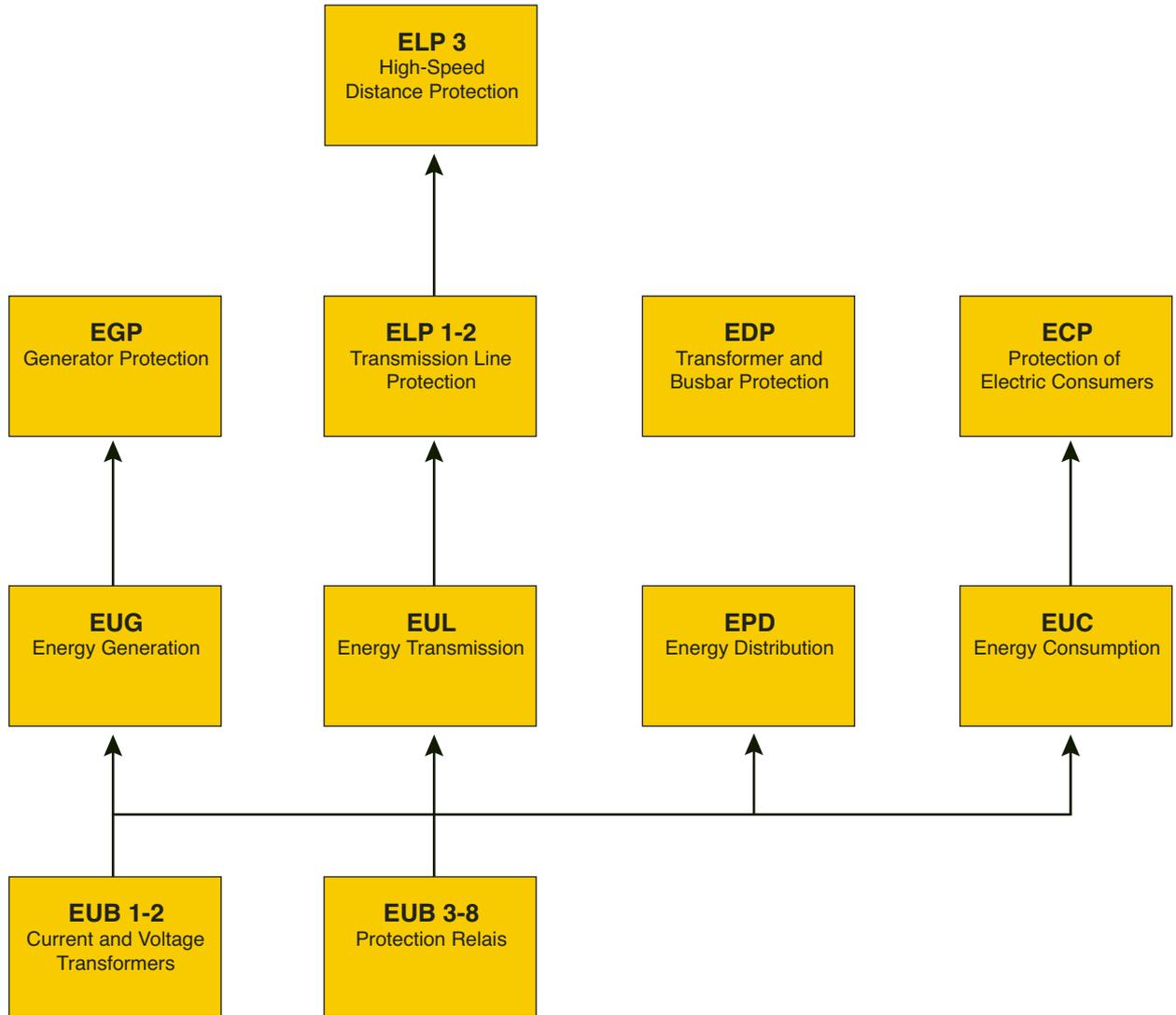
**Mains connection
3x23/40V 50Hz,
Supply and Surge
Generator
1000V/500A**

The mains connection provides the model voltage for the exercises. Also included, is a line-balancing network of 250m

buried cable / over-head cable to enable the difference to be examined between transformer-distant and transformer-close lightning strikes. For generating the lightning voltage, a surge generator is used that produces a standardised lightning pulse that is injected at the correct locations.



Input voltage:	3x400V
Model voltage:	3x23/40V
Nominal frequency:	0...50Hz
Surge generator pulse:	1kV/500A
Test pulse:	10/350
Inputs/Outputs:	4mm safety-protected sockets
Weight:	5 kg
Order number:	SO3210-9J





System Description

Current and voltage transformers are used for a great variety of tasks in electrical power engineering.

The exercises in the "EUB" module provide practice-oriented examination of the transfer response, the class accuracy compared to a special standard transformer class 0.2, the overcurrent factor, together with the absolute-value error and phase displacement, for example with various loads. Also, the demands in normal operation, short circuit and fault operation are examined.

The exercises are assembled using the A4 panel system which has a clear print of the circuit symbols in a pale colour on a dark background. Panels are interconnected by means of 4mm safety-protected cables. The system is of modular construction and can be extended with further modules from the LN program of teaching units. Voltage supplies here, are recommended in the form of 19" table-top rack units. Power supply units are available either as table-top units or as A4 panels.

For a detailed summary of the LN training system "Electrical Power Engineering", a separate brochure is available on request.



Topics Covered

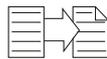
EUB 1.1 Current Transformers for Protective Installations

- Testing an accurate current transformer, for calibration purposes
- Secondary current as a function of the primary current and comparison with the calibrated unit
- Effects of a load on the current error
- Checking the rated overcurrent factor
- Current transformer circuit in a 3-wire network
- Current transformer circuit in a 4-wire network
- Establishing the residual current
- Determining the secondary current in a differential circuit connection

EUB 2.1 Voltage Transformers for Protective Installations

- Testing an accurate voltage transformer, for calibration purposes
- Recording the characteristics and comparison with the calibrated unit
- Calculation of voltage errors and class accuracies

- Effects of a load on the transformation ratio
- Three-phase voltage transformer in a serviceable mains network
- Three-phase voltage transformer in a network with earth-short in the primary



Ordering Information

Equipment List	Qty.	Order No.
Current converter set, three-phase (prim. 4/2A, sec. 1A, 15VA)	1	SO3213-1B
Current transformer, standard, class 0.2	1	SO3213-1C
Earth voltage transformer set, three-phase, 15VA	1	SE2663-8W
Voltage transformer standard, class 0.2	1	SE2663-8X
Load for current transformer	1	SO3213-1E
Load for voltage transformer	1	SO3213-1F
Three-phase ohmic load	1	SO3213-8K
Test resistance for inverse time relay	1	SO3301-4P

Exercise Literature

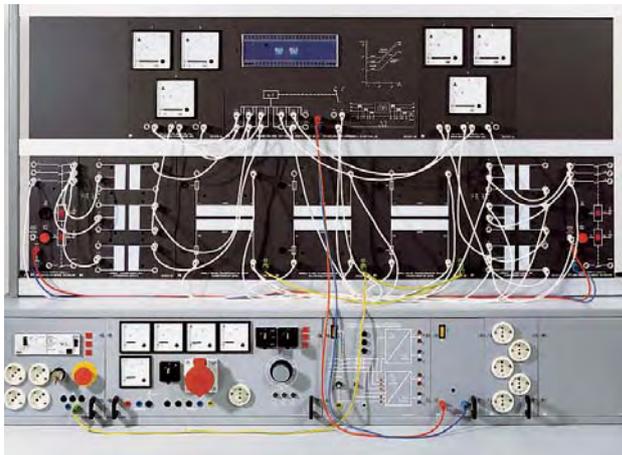
EUB 1-2 Study of Current & Voltage Transformers (GB)	1	SO5158-7E
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Test Instruments

Analog multimeter AC 0-500 V, DC 0-1000V / 5 A / 1Ω-500kΩ	3	LM1101
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Accessories

Power console, desktop unit 1340mm, 3HU/264 PU	1	ST8008-2H
Three-phase power supply, 230V/16A, ELCB, emergency off, key switch, 54PU	1	ST8008-3B
Socket panel unit, 4 earth pin sockets, 24PU	1	ST8008-3J
Adjustable three-phase power supply 0 - 400V/8A, 60PU	1	ST8008-4M
DC power supply, 0 - 24V/2,5A, switched mode power supply, 24 PU	1	ST8008-3U
Blank Panel, 24 PU	1	ST8008-5C
Blank Panel, 30 PU	1	ST8008-5D
Blank Panel, 48 PU	1	ST8008-5F
Set of safety connection cables 4mm	1	SO5148-1B
Safety protected conn.plug 19/4mm, white	20	SO5126-9X
Safety protected connection plug 19/4mm, white with tapping	20	SO5126-9Z
Panel mounting frame, ATP 2 levels, 1460x700mm, grey	1	ST8003-2E



System Description

The LN training system EDP V, provides practice-oriented measurements and fault finding in the subject of transformers. The main components here, are the three single-phase transformers (500VA), that are examined by measurements in various vector groups (star, delta), in relation to the neutral point (floating, direct or via a neutral earthing coil), when subject to normal loading and in the case of fault connection. Also included, is a three-phase exercise transformer, which is used to construct various forms of single- and three-phase networks. By combining both types of transformers, parallel circuits of single- and three-phase transformers can be examined. Scott transformers and a Kuebler circuit can also be examined with this LN training system.

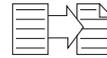
Loads for the transformers are in the form of resistive, inductive and capacitive loads, each selectable in 14 stages for simulating various operating conditions both in single- and three-phase operation. The loads are designed so that they are suitable for generator exercises up to a rating of 1 kW. The system is part of the modular LN product group, "Electrical Power Engineering" and can be extended by the addition of other modular components (e.g. digital protection relays for transformers).



Topics Covered

EDP V Study of Single- and Three-phase Transformers

- An ideal transformer
- Single-phase transformer, off-load and with a short circuit
- Rush effect
- Single-phase transformer with resistive, inductive and capacitive loading
- Efficiency of transformers
- Single-phase transformers, operated in parallel
- Autotransformer
- Constructing a three-phase transformer from three, single-phase transformers
- Multi-phase (polyphase) transformer, off-load and with a short circuit
- Determining the vector group of three-phase transformers and measuring the current distribution
- Polyphase transformer with resistive, inductive and capacitive loading
- Parallel operation of polyphase transformers
- Current distribution in various vector groups
- Measuring the zero-sequence impedance
- Study of a Scott transformer
- Measurements in a Kuebler circuit



Ordering Information

Equipment List	Qty.	Order No.
Three-phase exercise transformer	1	SE2663-5A
Single-phase transformer 500VA	3	SO3301-4S
Cut-out switch, 4 pole	1	SO3212-1W
Ohmic load, three-phase, 14-stage, 1kW	1	SE2662-8P
Inductive load, three-phase, 14-stage, 1kW	1	SE2662-8C
Capacitive load, three-phase, 14-stage, 1kW	1	SE2662-8H

Exercise Literature

EDP0V Study of Transformers (GB)	1	SO5158-4A
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Test Instruments

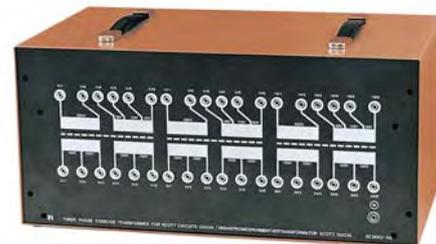
Electronic universal wattmeter (electrically indestructible up to 1000 V / 30 A)	2	LM1010
Analog multimeter METRA max 4, 30A, Ri=3MΩ	3	LM1051
Voltmeter change-over switch, 3 x Ph-N	1	SO3212-4V
Panel with 3 ammeters, 1/5A, Class 1	2	SO3212-7U

Accessories

Power console, desktop unit 1340mm, 3HU/264 PU	1	ST8008-2H
Three-phase power supply, 230V/16A, ELCB, emergency off, key switch, 54PU	1	ST8008-3B
Socket panel unit, 4 earth pin sockets, 24PU	1	ST8008-3J
Adjustable three-phase power supply 0 - 400V/8A, 60PU	1	ST8008-4M
DC power supply, 0 - 24V/2,5A, switched mode power supply, 24 PU	1	ST8008-3U
Blank Panel, 24 PU	1	ST8008-5C
Blank Panel, 30 PU	1	ST8008-5D
Blank Panel, 48 PU	1	ST8008-5F
Set of safety connection cables 4mm	1	SO5148-1B
Safety protected conn.plug 19/4mm, white	20	SO5126-9X
Safety protected connection plug 19/4mm, white with tapping	20	SO5126-9Z
Panel mounting frame, ATP 2 levels, 1460x700mm, grey	1	ST8003-2E

Technical Data

Three-phase Exercise Transformer (3x 500VA)



Three-phase exercise transformer for simulating single-, double- and three-phase mains supply networks. The transformer consists of three, single-phase Scott transformers with which various types of circuits can be assembled.

Input voltage:	3x 29V, 52V, 109V, 190V / AC
Output voltage:	6x 100V AC
Power rating:	3x 500 VA
HxWxD:	227 x 490 x 280 mm
Weight:	approx. 20 kg
Order No.:	SE2663-5A



System Description

High voltage networks are usually operated with voltages in the region of 110kV to 380 kV, whereby large towns and industrial areas are supplied with 110 kV, and 380 kV is used for long distance transmission lines.

The LN line simulation system is designed so that model voltages of between 110kV and 380 V can be used. Various levels of voltage and line lengths can be selected via corresponding tappings. It is possible to vary the ohmic resistance, the inductance of the line and the capacitance between the lines and earth.

Examinations on the LN training system can be made with an open-ended line, during normal operation, with a short-circuit or for an earth fault with and without earth-leakage compensation. The voltage can be supplied from a mains supply with constant voltage and frequency or a synchronous generator up to a power rating of 1kW.



Topics Covered

EUL 1.1 Study of a Three-phase Transmission Line

Open-ended line:

- Recording the voltage and current distribution with and
- without consideration of the effective capacitance

Loaded line:

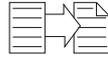
- Voltage and current distribution with and without effective capacitance, for an active load
- Voltage and current distribution with effective capacitance, for an active and reactive load
- Measuring and calculating the phase angle

Short circuited line:

- Voltage and current distribution with and without effective capacitance

Line with earth short:

- Voltage and current measurements with a floating neutral point
- Measuring the earth fault current



Ordering Information

Equipment List	Qty.	Order No.
Transmission line (simulation), 1kW	1	SO3301-3A
Transmission line capacitance, 1kW	2	SO3301-3G
Ohmic load, three-phase, 14-stage, 1kW	1	SE2662-8P
Inductive load, three-phase, 14-stage, 1kW	1	SE2662-8C
Capacitive load, three-phase, 14-stage, 1kW	1	SE2662-8H
Cut-out switch, 4 pole	1	SO3212-1W

Exercise Literature

EUL 1-3 Study of Simulated Three-phase Transmission Lines (GB)	1	SO5158-4G
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Test Instruments

R.M.S. multimeter (electrically indestructible up to 1000 V / 30 A)	1	LM1005
Electronic universal wattmeter (electrically indestructible up to 1000 V / 30 A)	2	LM1010
Analog multimeter AC 0-500 V, DC 0-1000V / 5 A / 1Ω-500kΩ	2	LM1101
Voltmeter change-over switch, 3 x Ph-N	1	SO3212-4V

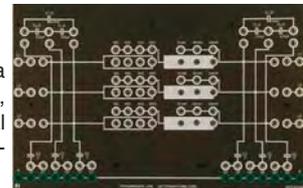
Accessories

Power console, desktop unit 1340mm, 3HU/264 PU	1	ST8008-2H
Three-phase power supply, 230V/16A, ELCB, emergency off, key switch, 54PU	1	ST8008-3B
Socket panel unit, 4 earth pin sockets, 24PU	1	ST8008-3J
Adjustable three-phase power supply 0 - 400V/8A, 60PU	1	ST8008-4M
DC power supply, 0 - 24V/2,5A, switched mode power supply, 24 PU	1	ST8008-3U
Blank Panel, 24 PU	1	ST8008-5C
Blank Panel, 30 PU	1	ST8008-5D
Blank Panel, 48 PU	1	ST8008-5F
Set of safety connection cables 4mm	1	SO5148-1B
Safety protected conn.plug 19/4mm, white	20	SO5126-9X
Safety protected connection plug 19/4mm, white with tapping	20	SO5126-9Z
Panel mounting frame, ATP 2 levels, 1460x700mm, grey	1	ST8003-2E

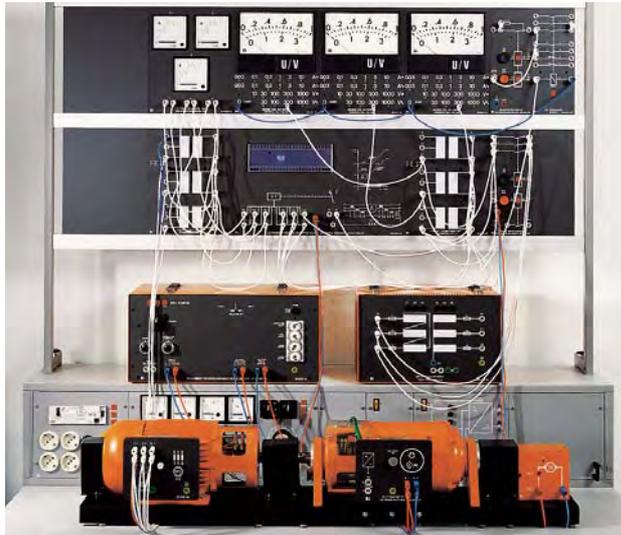
Technical Data

Transmission Line Simulation, 1kW (3-phase)

Three-phase simulated line of a high tension overhead power line, for measuring various operational states (off-load, matched, short-circuit).



Power rating:	max. 1.2 kW
Power requirements:	3 x 400V / 50..60 Hz
Max. current:	2 A
Power factor:	cos (φ) = 0.9
Resistors per phase:	2.5 / 5 / 7.5 / 10 Ω
Inductance per phase:	10 / 21 / 32 mH
Capacitance per phase:	
- Line-to-line:	2 x 0.25 μF
- Line-to-Ground:	2 x 1, 2 x 2 μF
HxWxD:	297 x 456 x 120 mm
Weight:	6.0 kg.
Order No.:	SO3301-3A



Topics Covered

EUG Generator control and synchronising circuits

Manually Operated Synchronising Circuits

- The "dark" circuit
- The "bright" circuit
- The "cyclic" circuit
- Supplying active (true) power to the mains supply
- Supplying inductive reactive power
- Supplying capacitive reactive power

Automatic synchronising circuits

- Putting into operation and setting the parameters of the programmable controller
- Synchronisation in test mode
- Synchronisation to the actual mains power supply network
- Response of the programmable controller to incorrect programming

Automatic power factor control

- Setting the parameters of the automatic cos-phi controller
- Synchronising the generator to the mains power supply network
- Closed-loop cos-phi control of the synchronous generator
- Closed-loop cos-phi control of the mains power supply network

Automatic power control

- Setting parameters of the automatic power controller
- Synchronising the generator to the mains power supply network
- Control and disturbance variable response of the power controller
- Sensitivity and direction of action of the power controller

EGP - Generator Protection with the Multifunction Relay

Overcurrent Time Protection

- Pick up and release response with single- and three-pole faults
- Determining the trip times

Unbalanced Load Protection

- Pull-in and release response for an unbalanced load
- Determining the resetting ratio and the trip times
- Recording the relay characteristic, $T_A = f(\text{unbalanced load})$

Reverse Power Protection

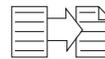
- Synchronising the generator to the mains power
- Adjusting the parameters of the reverse power protection, manually or with a PC
- Generator recognition and switch off when energy flow is reversed

Stator Earth-fault Protection

- Setting parameters of the earth-fault protection relay manually or with a PC
- Measuring the system voltages for normal operation and for a stator earth-fault
- Measuring the trip times
- Calculating the earth-fault current

Overvoltage and Undervoltage Protection

- Adjusting the over- and undervoltage relay parameters manually or with a PC
- Reaction to phase failure
- Measuring the start and trip times



Ordering Information

2.04

Equipment List

	Qty.	Order No.
Servo machine test stand for 1KW Machine		
inkl. Software "ActiveServo"	1	SE2663-6U
Three-phase synchronous machine with smooth core rotor, 1KW	1	SE2662-5Q
Rubber coupling sleeve, 1KW	1	SE2662-6A
Coupling guard, 1KW	1	SE2662-6B
Shaft end guard, 1KW	1	SE2662-6C
Synchronizing panel	1	SO3212-6T
Double frequency meter	1	SO3213-1L
Double voltmeter 2x500V	1	SO3213-3W
Power switch module	1	SO3301-5P
Exciter voltage regulation unit	1	SO3301-5F
Multi-function relay, power controller, cos-phi controller, synchronizing unit	1	SO3301-5Z

Exercise Literature

Manual EUG Synchronising circuits and automatic power/power factor control (GB)	1	SH5006-6E
Manual EGP Generator protection	1	SH5006-6G

Test Instruments

Digital R.P.M. / torque indicator	1	SO5127-2H
Voltmeter, 0-400V, incl. selector switch		
3xPH-PH, 3xPH-N (96x96mm)	1	SO3213-3F
Panel with 3 ammeters, 1/5A, Class 1	1	SO3212-7U

Accessories

Power console, desktop unit 1340mm, 3HU/264 PU	1	ST8008-2H
Three-phase power supply, 230V/16A, ELCB, emergency off, key switch, 54PU	1	ST8008-3B
Socket panel unit, 4 earth pin sockets, 24PU	1	ST8008-3J
Adjustable three-phase power supply 0 - 400V/8A, 60PU	1	ST8008-4M
DC power supply, 0 - 250V/10A, 210V/6A stabilised, 48 PU	1	ST8008-4F
DC power supply, 0 - 24V/2,5A, switched mode power supply, 24 PU	1	ST8008-3U
CEE socket 400V/16A, 18 PU	1	ST8008-3H
Blank Panel, 12 PU	1	ST8008-5A
Blank Panel, 24 PU	1	ST8008-5C
Set of safety connection cables 4mm	1	SO5148-1B
Safety protected conn.plug 19/4mm, white	20	SO5126-9X
Safety protected connection plug 19/4mm, white with tapping	20	SO5126-9Z
Panel mounting frame, ATP 2 levels, 1460x700mm, grey	1	ST8003-2E



System Description

Due to the requirements of the economy and environment, a rational use of energy is becoming increasingly important. The exercises for monitoring and reducing the peak loading by measurements with a kWh meter and a maximum demand meter, show how the loading on the mains supply network can be reduced or evenly distributed over a 24-hour period. Using a meter with a two-tariff movement, together with a tariff timeswitch with daily and weekly programming, the savings in cost can be illustrated by measurements. The requirements for effective use of the measurements, is the analysis of the mains supply together with the consumers (loads) that are connected. Therefore, in the exercises, symmetric and asymmetric loading can be examined in detail. As an option, by connecting a DC dynamometer, dynamic loading can also be examined. For the measurements, commercially available meters are used that have been mounted on A4 panels and incorporate 4mm safety sockets for the connections.

- Three-phase kWh-meter with transparent housing, for measuring current consumption
- Three-phase kWh-meter with high/low tariff movement, programmable, microprocessor-controlled and can save various time periods.
- Three-phase reactive power meter with transparent housing, for long-term measurements on inductive loads

Both symmetric and unbalanced loads can be examined.



Topics Covered

EUC 3 Energy Consumption Measurements

- Measurement with kWh & kVARh meters for a symmetric and asymmetric, RL loads
- Measurement with kWh & kVARh meters with a broken phase line
- Measurement with kWh & kVARh meters with over-compensation (RC load)

EUC 4 Peak Load Monitoring

- Operating the tariff timeswitch and maximum demand meter
- Establishing the first and second maximum power demand
- Establishing the maximum power demand with an asymmetric load
- Recording a power demand curve



Ordering Information

Equipment list	Qty.	Order No.
Servo machine test stand for 1KW Machine		
inkl. Software "ActiveServo"	1	SE2663-6U
Rubber coupling sleeve, 1KW	1	SE2662-6A
Coupling guard, 1KW	1	SE2662-6B
Shaft end guard, 1KW	1	SE2662-6C
Three-phase asynchronous motor, squirrel-cage, 1KW (industrial line)	1	SE 2672-5G

Exercise Literature

EUC 3/4 Energy Consumption and Peak Load Monitoring (GB)	1	SO5158-4S
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Test Instruments

Analog multimeter AC 0-500 V, DC 0-1000V / 5 A / 1Ω-500kΩ	1	LM1101
Electronic universal wattmeter (electrically indestructible up to 1000 V / 30 A)	1	LM1010
Phase angle / Power factor (cos phi) meter (electrically indestructible up to 1000 V / 30 A)	1	LM1020

Accessories

Power console, desktop unit 1340mm, 3HU/264 PU	1	ST8008-2H
Three-phase power supply, 230V/16A, ELCB, emergency off, key switch, 54PU	1	ST8008-3B
Socket panel unit, 4 earth pin sockets, 24PU	1	ST8008-3J
Adjustable three-phase power supply 0 - 400V/8A, 60PU	1	ST8008-4M
DC power supply, 0 - 250V/10A, 210V/6A stabilised, 48 PU	1	ST8008-4F
DC power supply, 0 - 24V/2,5A, switched mode power supply, 24 PU	1	ST8008-3U
CEE socket 400V/16A, 18 PU	1	ST8008-3H
Blank Panel, 12 PU	1	ST8008-5A
Blank Panel, 24 PU	1	ST8008-5C
Set of safety connection cables 4mm	1	SO5148-1B
Safety protected conn.plug 19/4mm, white	20	SO5126-9X
Safety protected connection plug 19/4mm, white with tapping	20	SO5126-9Z
Panel mounting frame, ATP 2 levels, 1460x700mm, grey	1	ST8003-2E



System Description

The security of supply in complex energy supply networks, is ensured by suitable protection relays. Various types are used, which in modern systems, are digital relays.

The LN training system is therefore based on a digital inverse time relay, the parameters for which can be either set manually by controls on the front panel or by software and a PC. An internal program supervises the self-control and trip testing. The relay has three inverse current characteristics: normal inverse, severe and extreme inverse. The relay is connected via a current transformer, as is usual in practice.

The relay is connected to a power switch module that is used to simulate an open-wire line. The voltage is switched on and off, via the signal to the protection relay; the voltage can also be switched, manually.



Topics Covered

EUB 5 / 7 Current-dependent, Overcurrent Time Relay (Invers Time Relais)

- Adjusting the relay parameters, manually or with a PC
- Recording the characteristics
Trip times in relation to the current at various range settings and time factors
- Determining the pull-in and drop-out values
- Measuring the resetting ratio
- Measuring the operating time and the intrinsic consumption
- Testing the relay tripping in conjunction with a power switch
- How the inverse-time relay operates
- How the constant-time relay operates
- How the directional-dependant overcurrent time relay operates
- Setting the relay parameters manually or with a PC
- Determining the pull-in and drop-out values
- Determining the resetting ratio
- Measuring the operating time and the intrinsic consumption
- Determining the operative direction and directional sensitivity

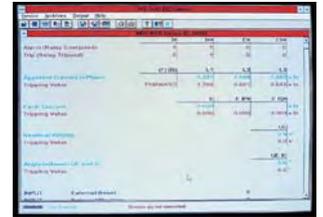


Computer Connection

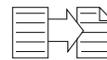
The digital construction of the relay allows the parameters to be set on a PC; the relay incorporates an optical coupling for an interface.

This ensures a galvanic isolation from the PC and also allows the panel with the RS232 component, to be coupled to several different relays. By using an interface converter, the industrial RS485 signal can be converted to the PC interface RS232.

The software available, provides straightforward programming and acquisition of the measured values from current and voltage relays. The software recognises the type of relay and saves all values in a memory. By assigning User numbers, a differentiation can be made between the various relays.



2.06



Ordering Information

Equipment List	Qty.	Order No.
Current converter set, three-phase (prim. 4/2A, sec. 1A, 15VA)	1	SO3213-1B
Inverse time relay	1	SO3301-4J
Test resistance for inverse time relay	1	SO3301-4P
Power switch module	1	SO3301-5P
Cut-out switch, 4 pole	1	SO3212-1W
Independent current directional time relay	1	SO3301-4D
Three-phase ohmic load	1	SO3213-8K
Voltage transformer set three-phase, with tertiary winding	1	SE2663-8W

Computer Connection

Software for adjusting parameters, HTL-PL-Soft3, for power lab. protection relay	1	SO4006-3G
Interface converter, RS485 - RS232	1	SO3301-4Y
Interface RS485 for adjusting parameters in the protective relays	1	SO3301-4Z

Exercise Literature

Study of Electronic Over- and Under-voltage Time Protection Relays (GB)	1	SO5158-7G
Study of Directional Overcurrent Time, Reverse Power and Earth-fault Relays (GB)	1	SO5158-7L

Test Instruments

Analog multimeter AC 0-500 V, DC 0-1000V / 5 A / 1Ω-500kΩ	3	LM1101
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Accessories

Power console, desktop unit 1340mm, 3HU/264 PU	1	ST8008-2H
Three-phase power supply, 230V/16A, ELCB, emergency off, key switch, 54PU	1	ST8008-3B
Socket panel unit, 4 earth pin sockets, 24PU		ST8008-3J
Adjustable three-phase power supply 0 - 400V/8A, 60PU	1	ST8008-4M
DC power supply, 0 - 24V/2,5A, switched mode power supply, 24 PU	1	ST8008-3U
Blank Panel, 24 PU		ST8008-5C
Blank Panel, 30 PU		ST8008-5D
Blank Panel, 48 PU		ST8008-5F
Set of safety connection cables 4mm	1	SO5148-1B
Safety protected conn.plug 19/4mm, white	20	SO5126-9X
Safety protected connection plug 19/4mm, white with tapping	20	SO5126-9Z
Panel mounting frame, ATP 2 levels, 1460x700mm, grey	1	ST8003-2E



System Description

In practice, the distribution of electrical energy in large switching stations, is made almost exclusively using double busbar systems. These systems incorporate bus coupler bays for connecting the two busbars, incoming and outgoing feeders as well as a metering panel.

Power switch modules are used in the coupler bays, the incoming and outgoing feeders, and isolating circuit breakers for each busbar. The switching processes must follow an exact sequence so that the isolating circuit breakers are switched in voltage-free condition. If the sequence is not observed, in a real situation, this would lead to the isolating circuit breakers being destroyed.

The LN double busbar model simulates a 110 kV system and incorporates all functions that are relevant to practical situations. For controlling the power switch modules and isolating circuit breakers, illuminated control discrepancy switches are used, which are also found in the systems used by leading energy supply authorities. The acknowledge signal is delayed, which also corresponds to real situations. Integral test instruments for measuring current and voltages provide facilities for immediately analysing the switching operations.

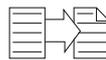
All switching operations can be performed either manually or automatically, using a PC. The acknowledgement of the switching operations, always follows manually.



Topics Covered

EPD 1.1 Manual Busbar Change

- Single busbar operation with one supply voltage
- Single busbar operation with two supply voltages
- Double busbar operation with two supply voltages
- Busbar change, without mains supply interruption



Ordering Information

Equipment List	Qty.	Order No.
Bus-bar model with PC connection	1	SE2663-8G

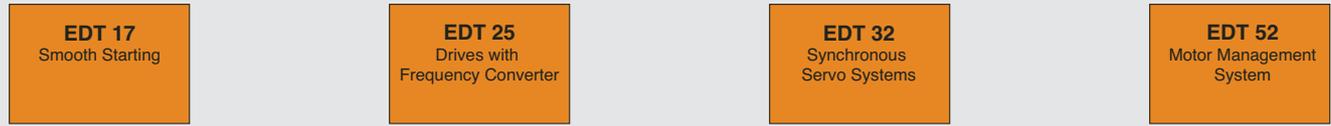
Exercise Literature	Qty.	Order No.
EPD01 Study of Bus-Bar Systems (GB)	1	SO5158-4K

Accessories	Qty.	Order No.
Power console, desktop unit 1340mm, 3HU/264 PU	1	ST8008-2H
Three-phase power supply, 230V/16A, ELCB, emergency off, key switch, 54PU	1	ST8008-3B
Socket panel unit, 4 earth pin sockets, 24PU	1	ST8008-3J
DC power supply, 0 - 24V/2,5A, switched mode power supply, 24 PU	1	ST8008-3U
Blank Panel, 24 PU	1	ST8008-5C
Blank Panel, 30 PU	1	ST8008-5D
Blank Panel, 48 PU	1	ST8008-5F
Set of safety connection cables 4mm	1	SO5148-1B
Safety protected conn.plug 19/4mm, white	20	SO5126-9X
Safety protected connection plug 19/4mm, white with tapping	20	SO5126-9Z
Panel mounting frame, ATP 2 levels, 1460x700mm, grey	1	ST8003-2E



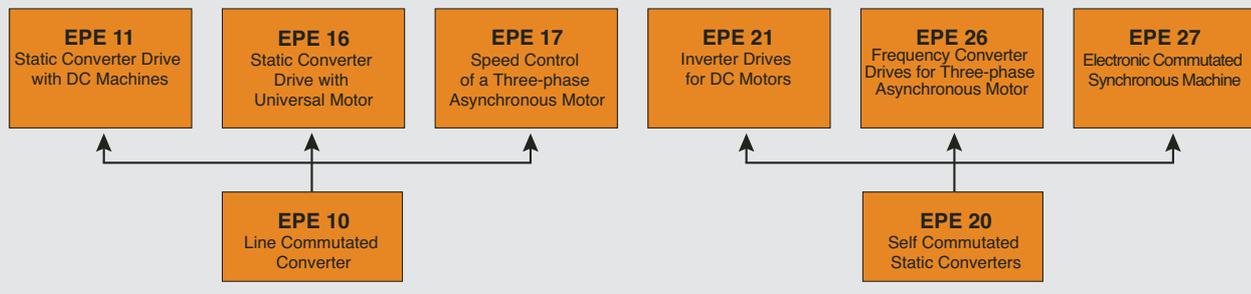
Industrial Drives

Commissioning Parameter Settings



Training Drives

Function



3.00

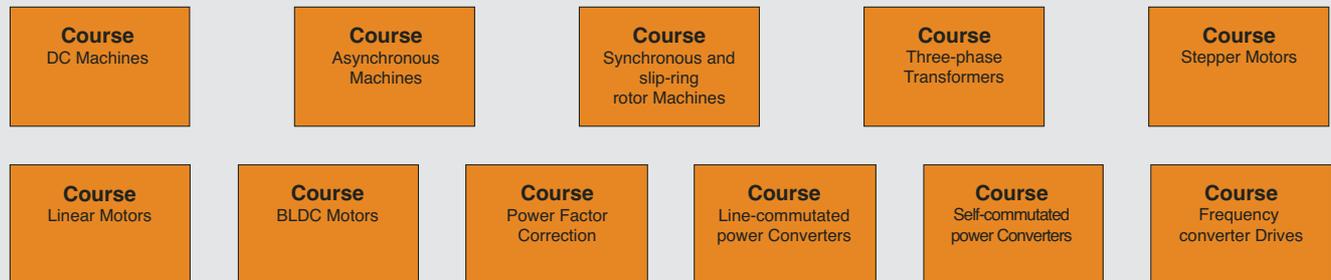
Electrical Machines

Connection starting up Properties Measurement of Speed and Torque Characteristics



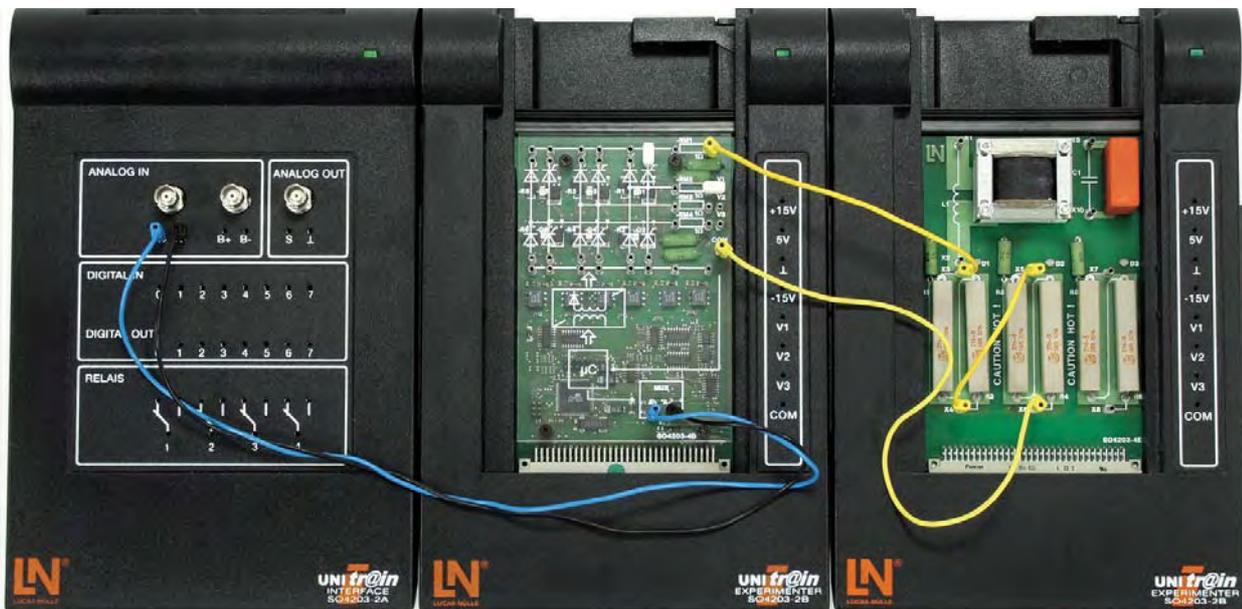
UniTrain-I

Basic Training Fundamentals





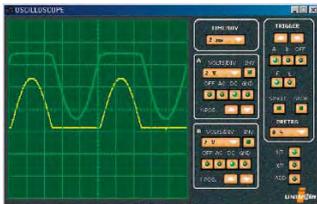
MTI 4.1 Power Electronics I: Line Commutated Static Converter



3.01



System Description



Power electronics has a permanent place in everyday life. For example, dimmer circuits for halogen lighting, variable-speed handdrills or electric heating could not function without some form of power electronics. The subject of modern-day power electronics is easily taught in an understandable way using the UniTrain-I system. This advanced didactic system sets standards in hands-on instruction. Didactic software with "virtual instruments" and the exercise procedures in HTML-format, complete the teaching system.



Topics Covered

The Power Electronics I course consists of 3 experiment cards and a CD-ROM with a multimedia course and the LabSoft experiment platform. The complete package is supplied in a sturdy and stackable polypropylene hard-shell case with a shaped polyurethane foam inlay to accommodate cards and accessories.

Power Electronics I

- Components for power electronics (diodes, thyristors)
- Measurement techniques and variables in power electronics
- Rectifier circuits: M1U, M1C, M2U, M2C, B2U, B6U, B2C, B6C, W1C, W3C
- Control methods: phase control



Extended Power Supply (SO4203-2D)

This power supply is used as an add-on supply for cases where a high-power AC voltage, an adjustable DC voltage or a frequency and amplitude modulated three-phase system is required in the exercises. The UniTrain-I interface is required for creating the power supply functions. The adjustments are made on the virtual instruments.



Ordering Information

Equipment List	Qty.	Order no.
Course - Power Electronics I		
Line-Commutated Power Converters	1	SO4204-7N

Accessories

UniTrain-I Interface with virtual instruments (basic VI)	1	SO4203-2A
UniTrain-I Experimenter	3	SO4203-2B
UniTrain-I Extended power supply (incl. three-phase)	1	SO4203-2D
Measurement accessories for UniTrain-I	1	SO4203-2J

Optional accessories

Storage case for one system	1	SO4203-2Y
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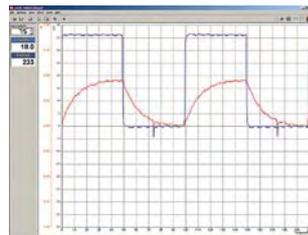
System Description

Modern machines would be inconceivable without converter technology.

It is this know-how which is conveyed in the self-commutated static converter course.

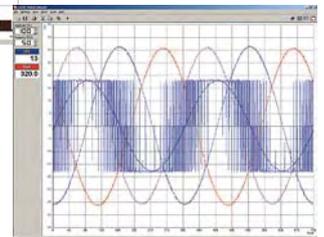
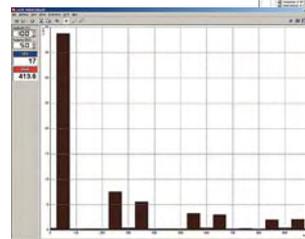
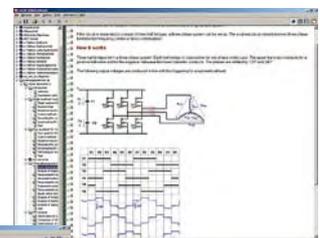
The computer-based training system combines theoretical elements and animation with experiments on real technology. The subjects cover DC voltage generation using PWM, AC and three-phase power generation and space-vector modulation. FFT analysis permits the evaluation of the output signal quality.

This course has been designed for training and education at vocational schools, colleges and specialised institutions of higher learning.

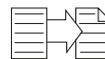


Topics Covered

- Power semiconductors (IGBT, MOSFET)
- Generation of variable DC voltage using PWM
- Single-quadrant operation
- Four-quadrant operation
- Generation of variable AC voltage using PWM
- Three-phase power converters
- Space vector modulation
- Frequency converter
- Influence of operating frequency
- Harmonic analysis using FFT



3.02



Ordering Information

Equipment List	Qty.	Order no.
Course - Power Electronics II		
Self-commutated Power Converters	1	SO4204-7M

Accessories	Qty.	Order no.
UniTrain-I Interface with virtual instruments (basic VI)	1	SO4203-2A
UniTrain-I Experimenter	2	SO4203-2B
UniTrain-I Extended power supply (incl. three-phase)	1	SO4203-2D
Measurement accessories for UniTrain-I	1	SO4203-2J

Optional accessories	Qty.	Order no.
Storage case for one system	1	SO4203-2Y



System Description

3.03

UniTrain-I multimedia courses on electrical machines encompass the entire spectrum of electrical machines. The motors are characterised by their open, accessible stators. These are built onto experiment cards and thus allow a detailed view of the internal design of electrical machines. In addition, the open design makes it possible to exchange rotors quickly and without tools. Students taking the course are familiarised with the physical principles, the operation, properties and basic circuitry for various machines. In many experiments the machines are put into operation and their electrical properties measured using multimeters and oscilloscope, control units are set up and the safe usage of electrical machines is reinforced.



Topics Covered

Course - Electric Machines 1 DC Machines

- Series-wound, shunt-wound, compound-wound and universal machines
- Electromagnetic induction
- Motor and generator operation
- Constituents and design of DC machines
- Commutator
- Measurement of armature and exciter current and voltage
- Changes in speed, rotation reversal

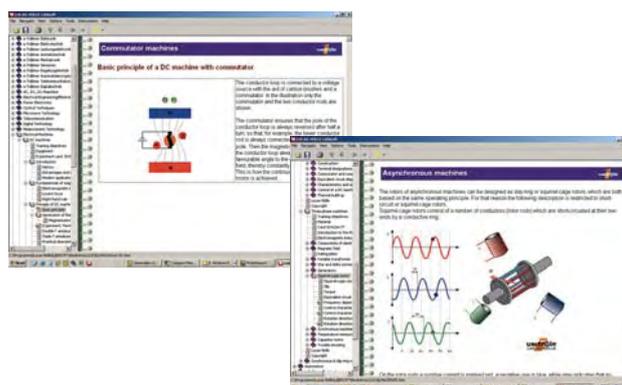
Course - Electric Machines 2 Asynchronous Machines

- Constituents and design of three-phase machines
- Static and rotating magnetic fields
- Star connection, delta connection
- Measurement of line-to-line and phase-to-phase current and voltage and of rotor current and voltage
- Nominal data, rating plate, cos phi
- Number of pole pairs, torque, speed, slip
- Reversal of rotation
- Three-phase transformer
- Squirrel-cage motor
- Permanent magnet rotor, synchronous machines
- Capacitor motor, 'Steinmetz' circuit
- Measurement of winding temperature
- Fault simulation

Course - Electric Machines 3

Synchronous and Slip-ring Machines

- Synchronous machine and Reluctance machine
- Constituents and design of three-phase machines
- Salient pole, full pole, reluctance rotors
- Slip-ring rotor machines
- Measurement of rotor voltage, current and variable frequencies
- Changes in speed, rotation reversal
- Excitement of synchronous machines
- Starting resistors
- Run-up of synchronous machines



Ordering Information

Equipment List	Qty.	Order no.
Course Electric Machines 1: DC-machines	1	SO4204-7S
Course Electric Machines 2: Asynchronous Machines	1	SO4204-7T
Course Electric Machines 3: Synchronous-Machines	1	SO4204-7U
Course Electric Machines 5: Stepper-motor	1	SO4204-7W
Course Electric Machines 6: Linear motor	1	SO4204-7X
Course Electric Machines 7: BLDC-/Servo-motor 1	1	SO4204-7Z

Accessories

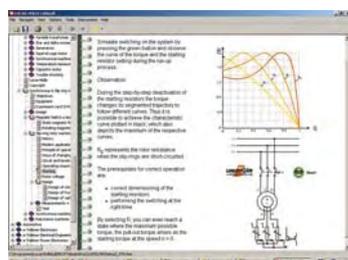
UniTrain-I Interface with virtual instruments (basic VI)	1	SO4203-2A
UniTrain-I Experimenter	1	SO4203-2B
UniTrain-I Extended Power supply	1	SO4203-2D
Measurement accessories for UniTrain-I	1	SO4203-2J

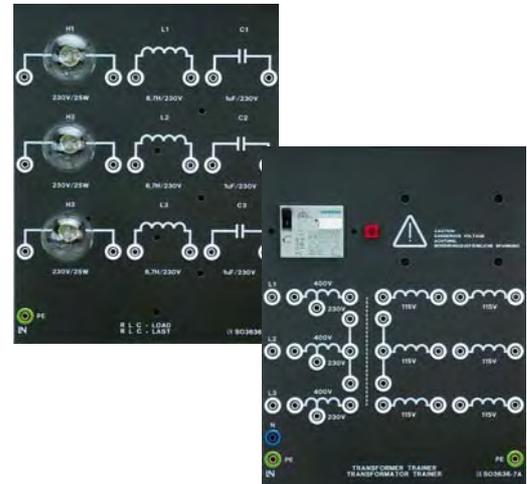
Optional Test Instruments

UniTrain-I Digital Multimeter	1	LM2321
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Optional Accessories

Storage case for one UniTrain-I System	1	SO4203-2Y
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System Description

Transformers are available in all power classes for applications in both industry and in the area of consumer goods. They serve in voltage and current conversion.

The training panel system is equipped with a special transformer with a power rating of 100 VA. The specially designed RLC load makes it possible to perform experiments efficiently on single-phase and three-phase transformers.

The three-phase transformer in the Unitrain-I System is used to convey basic knowledge of transformers. In addition to the actual physical principles involved, we also explore how transformers are designed and how they work - both theoretically and in practice. Virtual instruments such as the oscilloscope, a three-phase generator and other measuring instruments permit comprehensive investigations to be carried out using safety extra-low voltage.



Topics Covered

Single-phase Transformers

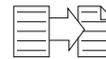
- Single-phase isolating transformer
- Single-phase auto-transformer
- Comprehensive and simplified equivalent circuit diagrams
- Individual variables determined from measurements.
- Transforming current and voltage.
- Measurement and computation of no-load values.
- Measurements with resistive, inductive and capacitive loads.
- Measurement of the short-circuit voltage.
- Determination of efficiency.



Three-phase Transformer

- Measurement of no-load currents in the three input windings.
- Measurement of power.
- Connection and investigation of transformation ratios.
- Phase relationship between primary and secondary windings.
- Effect of asymmetrical loads with various vector groups
- Determination of parameters and characteristics

3.04



Ordering Information

Equipment List	Qty.	Order no.
ENT5 Transformer trainer	1	SO3636-7A
RLC load	1	SO3636-7B

Exercise Literature

ENT 5 Transformer Trainer(GB)	1	SH5007-4A
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Test Instruments

Digital multimeter	1	LM2005
Analog/digital multimeter, wattmeter and power-factor meter	1	SO5127-1Z

Accessories

Safety connection plug 19/4mm, white	10	SO5126-9X
Safety connection plug 19/4mm, white, with tapping	5	SO5126-9Z
Set of safety connection cables 4mm	1	SO5148-1H
Table-top frame, 1 level, W 1230 x H 400mm, slope of 30 degrees, grey	1	ST8003-1A

Optional to the panel system

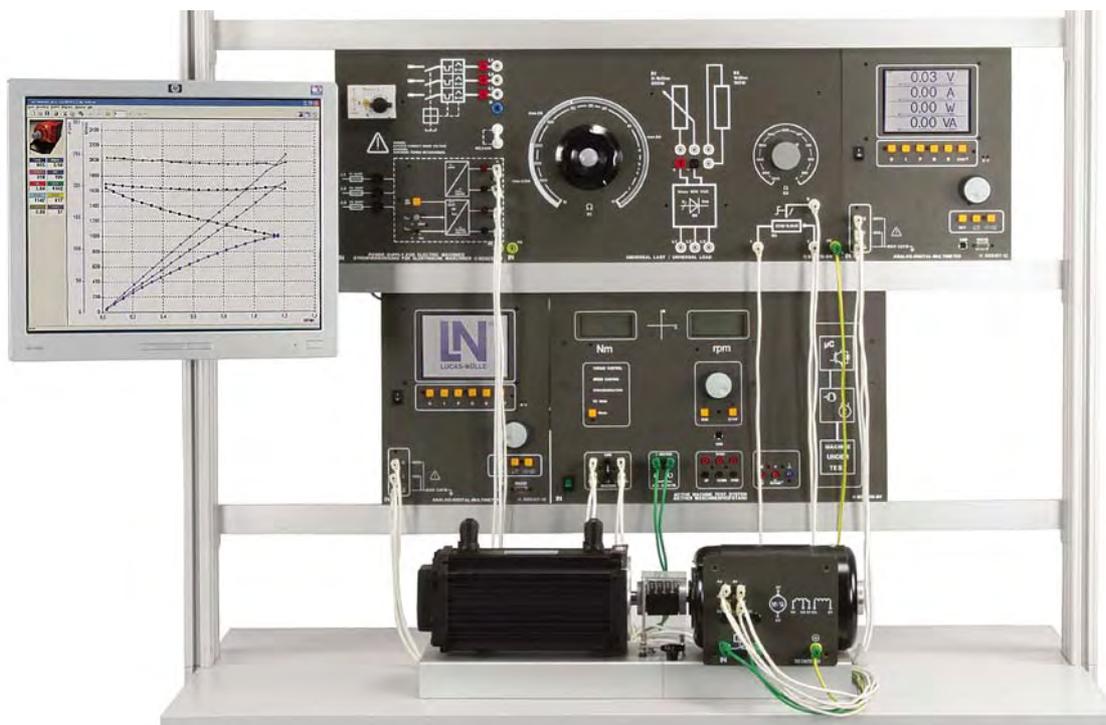
Course - Three-phase Transformer	1	SO4204-7Y
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Accessories

Unitrain-I Interface with virtual instruments	1	SO4203-2A
Unitrain-I Experimenter	1	SO4203-2B
Unitrain-I Extended power supply	1	SO4203-2D
Measurement accessories for Unitrain-I	1	SO4203-2J

Optional accessories

Storage case for one system	1	SO4203-2Y
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3.05



System Description

In numerous professions, DC machines form the foundation for training in the subjects of electric machines. The EEM 2 training system is based on a multi-function DC machine, that, depending on the type of connection selected, can be operated as a series wound, shunt wound or compound wound machine.

As a load for the motor, the high-dynamic LN Servo machine test stand is used. For generator exercise, the system is used as a speed-controlled drive, incorporating the detection of the generator torque.

The software ActiveServo provides optimum support when recording the characteristics of electric machines.

The system is driftfree and requires no calibration.



Topics Covered

Series Wound, Shunt Wound and Compound Wound Machine

- Connection and starting
- Rotation reversing and speed regulation
- Load characteristics

Shunt Wound Motor (separately- and self-excited)

- Voltage control, shunt wound generator
- Load characteristics, shunt wound generator

Series Wound Machine

- Voltage control, series wound generator
- Load characteristics, series wound generator

Compound Wound Machine

- Voltage control, (self-excited) compound wound generator
- Voltage control, (separately-excited) compound wound generator
- Load characteristics, separately-excited 100% shunt wound, 100% Series wound component, compound wound generator
- Load characteristics, self-excited 100% shunt wound 100% Series wound component, compound wound generator
- Load characteristics, compounding 100%
- Shunt wound, 100%, 70%, and 30% series wound component



Computer Connection

The Software ActiveServo provides online measurement of the motor characteristics of DC machines.

The following values can be accessed and displayed:

- Speed and torque characteristics
- Armature current curve
- Armature voltage curve
- Electrical power, mechanical power, efficiency

The PC is connectet via USB.



Ordering Information

Equipment List	Qty.	Order no.
DC multi-circuit, compound wound machine 0.3kW	1	SE2672-3D
Servo Machine test stand incl. Software	1	SO3636-6V
Universal rheostat for 300W machines		SO3212-6W
Analog/digital multimeter, wattmeter and power-factor meter	2	SO5127-1Z
Rubber coupling sleeve 0.1/ 0.3kW	1	SE2662-2A
Coupling guard 0.1/ 0.3kW transparent	2	SE2662-7B

Test Instruments

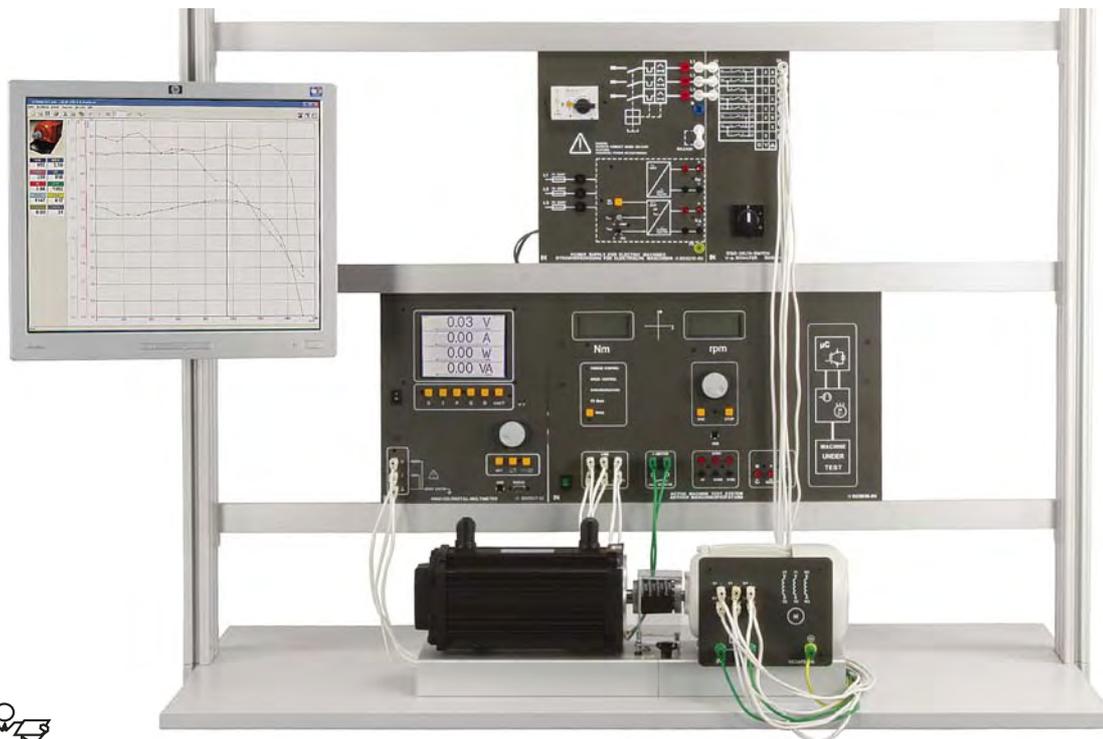
Analog/digital multimeter, wattmeter and power-factor meter	2	SO5127-1Z
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Exercise Literature

EEM 2 Ind. DC machines 0.3kW (GB)	1	SH5007-1B
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Accessories

Universal power supply for machines	1	SO3212-5U
Set of safety connection cables 4mm	1	SO5148-1F
Safety protected connection plug 19/4mm, white	15	SO5126-9X
Safety protected connection plug 19/4mm, white, with tapping	5	SO5126-9Z
Table-top frame, 2 levels, W 1230 x H 740mm, grey	1	ST8003-1C



3.06



System Description

Three-phase asynchronous motors are widely used because of their low cost and maintenance free operation. The EEM 4 teaching system is based on a three-phase motor with squirrel-cage rotor. As a load for the motor, the high-dynamic LN Servo machine test stand is used. This system can be used in all 4 quadrants and can simulate drive machines and inertia wheels. The software ActiveServo provides optimum support when recording the characteristics of electric machines. The system is drift-free and requires no calibration.

The software incorporates export functions, that allow the measured values and graphics to be transferred to other programs (e.g. MS EXCEL, MS WORD).

The PC is connectet via USB.



Topics Covered

- Starting, speed control and rotation reversing
- Checking the power rating data
- Stator-resistance starting circuit
- Starting characteristics, Y-circuit
- Load characteristics, Y-circuit
- Load characteristics, D-circuit
- Reactive power compensation
- Load characteristics in circuits and reactive power compensation
- 'Steinmetz' circuit, connection and rotation reversing
- 'Steinmetz' circuit, run-up characteristics
- 'Steinmetz' circuit, load characteristics



Ordering Information

Equipment List	Qty.	Order no.
Three-phase asynchronous motor, 0.3kW	1	SE2672-3G
Servo machine test stand incl. software	1	SO3636-6V
Star-Delta switch	1	SO3212-2D
Compensation unit, (0.3/1kW), 6x1μF/400V	1	SO3212-6E
Universal rheostat for 300W machines	1	SO3212-6W
Rubber coupling sleeve, 0.1/0.3kW	1	SE2662-2A
Coupling guard, 0.1/0.3kW transparent	1	SE2662-7B

Test Instruments

Analog/digital multimeter, wattmeter and power-factor meter	1	SO5127-1Z
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Exercise Literature

EEM 4 Three-phase Asynchronous Motors 0.3kW (GB)	1	SH5007-1E
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Accessories

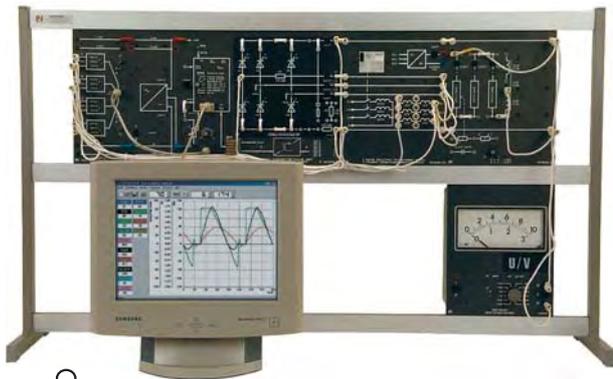
Universal power supply for machines	1	SO3212-5U
Set of safety connection cables 4mm	1	SO5148-1F
Safety protected connection plug 19/4mm, white	15	SO5126-9X
Safety protected connection plug 19/4mm, white, with tapping	5	SO5126-9Z
Table-top frame, 2 levels, W 1230 x H 740mm, grey	1	ST8003-1C



Computer Connection

The Software ActiveServo provides online measurement of the motor characteristics of asynchronous machines. The following values can be accessed and displayed:

- Speed and torque characteristics
- Armature current curve
- Armature voltage curve
- Electrical power, mechanical power, efficiency, $\cos \varphi$, reactive power, apparent power, slip.



System Description

3.07

Power electronics embraces the techniques of switching or converting high-power electrical energy. Today, power semiconductors such as diodes, thyristors and IGBT's are used. The continual development of power semiconductors and the microelectronics required for their control, has led to the field of power electronics becoming one of the most innovative and fastest developing areas of electrical engineering. The main area of application of power electronics is in the field of drive techniques. The LN teaching system EPE10, covers the whole subject area of line commutated static converters. The exercise assembly using the LN-panel system, has been optimised for a clear overall construction with a minimum of cabling. In addition, overlay masks are available that improve the clarity of the circuits involved and their assembly. The heart of the EPE10 system is the universal digital control unit. Apart from the actual control of the power semiconductors, the integrated RS232 interface provides communication with a variety of didactic PC software packages. Also, the control set functions as a measurement interface in conjunction with a differential measuring amplifier. The measured values of current and voltage can then be displayed and evaluated on a PC. Add-on equipment extends the system to include self-commutated static converters and converter drive systems.



Topics Covered

Fundamentals

- Components for power electronics (diode, thyristor, TRIAC)
- Protection circuits
- Average values, RMS value and power measurements
- Mains pollution

Control Principles

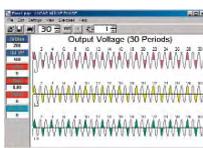
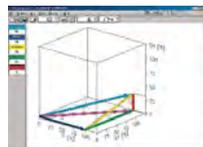
- Rectification
- Phase-cut control
- Multi-cycle control
- Pulse pattern control

Modes of Operation

- Rectifier and inverter operation

Circuits

- Two-pulse full-wave rectifiers
- Two-pulse bridge rectifiers
- Three-pulse half-wave rectifiers
- Three-pulse bridge rectifiers
- Bi-directional control element



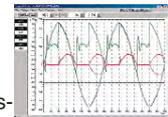
Computer Connection

The support of a PC with didactic software transforms the hardware to become a truly complete training system. The software provides the following facilities:

- Setting the parameters and controlling the hardware
- Measurement and documenting the results of the exercises
- Displaying the various relationships and technologies
- Displaying time and frequency charts, vector diagrams and schematic diagrams

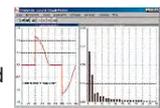
SO6006-1A Software Power Electronics

Basic software with the programs PHACON, SWIPS, PWM; Setting the parameters of the control unit, signal responses, control characteristics, RMS values and more, with phase-cut control, pulse-group control, pulse width modulation



SO6006-1H Fourier-Analysis / Synthesis with DDE

In the frequency range, the software analyzes, amongst other things, the measured or saved responses in PHACON, combines the displays of the spectral components to curves in an animated sequence.



Ordering Information

Equipment List	Qty.	Order no.
Digital universal control unit (microcontroller)	1	SO3636-1A
Static converter valve, 8 thyristors, 6 diodes, 1 triac	1	SO3636-1F
Set of overlay masks, line commutated static current converters (9 pcs)	1	SO3636-1G
RLC load with temperature line and 3 indicating lamps	1	SO3636-2A
Three-phase isolating transformer 300VA incl. DC power supply (max. 220V/3A DC)	1	SO3636-2G
Four channel differential amplifier	1	SO3636-2V
Connection cable 2m (measuring amplifier - control unit / PCI)	1	LM6119

Software

Software power electr. for the digital universal control unit SO3636-1A (GB)	1	SO6006-1A
Software Fourier-analysis and -synthesis with dynamic data exchange (GB)	1	SO6006-1H

Literatur

EPE 10 Line Commutated Static Conv. (GB)	1	SH5007-3A
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Power Supply

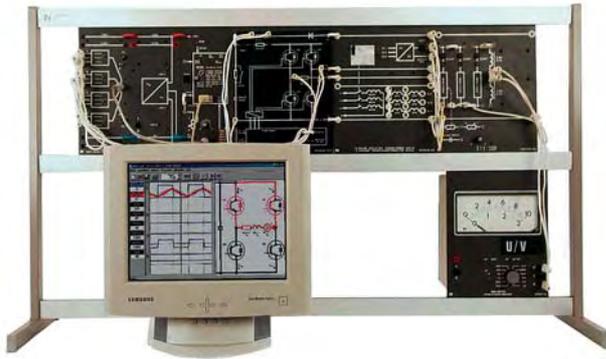
Analog/digital multimeter, wattmeter and power-factor meter	1	SO5127-1Z
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Test Instruments

Large-scale true R.M.S. meter	1	SO5127-1L
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Accessories

Serial interface cable 9/9 pole	1	LM9040
Set of safety connection cables 4mm	1	SO5148-1F
Safety protected connection plug 19/4mm, white	20	SO5126-9X
Safety protected connection plug 19/4mm, white, with tapping	10	SO5126-9Z
Table-top frame, 2 levels, W 1230 x H 740mm, grey	1	ST8003-1C



System Description

The LN teaching system EPE 20 completes the subject area of power electronics, dealing with self-commutated static converters. The system is ideally suited as an add-on stage to the EPE10 system as the same equipment set is used as in EPE10 – only the power semiconductor elements need to be replaced.

By extending the system further with the appropriate machines, converter drives can be assembled.



Topics Covered

Fundamentals

- Components for power electronics, diode, IGBT
- Protection circuits
- Average values, RMS value and power measurements
- Mains pollution
- Link techniques
- Duty cycle

Control Principles

- Pulse width modulation

Modes of Operation

- Single-quadrant and 4-quadrant operation

Circuits

- Single-quadrant DC chopper controller
- Four-quadrant DC chopper controller
- AC power controller

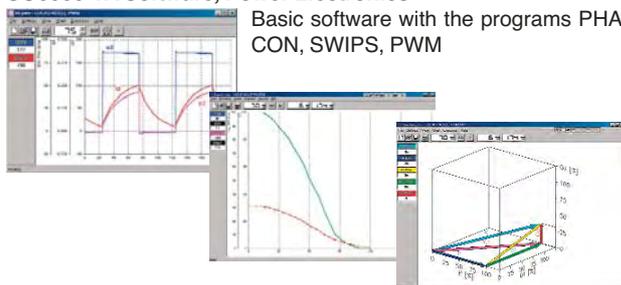


Computer Connection

As with the EPE 10 equipment, the system is completed with didactic software.

SO6006-1A Software, Power Electronics

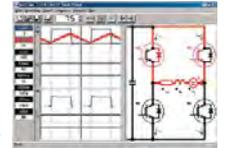
Basic software with the programs PHACON, SWIPS, PWM



SO6006-1E, Software, PWM-TRAIN

Measurement and display of time charts for voltage and current, for all semiconductor elements and the load.

Animated display of the active semiconductor elements as well as current and free-wheel circuits.



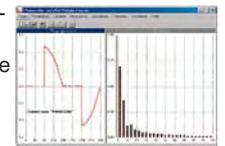
SO6006-1P, Software AC-PWM

Very clear display of the generation of single-phase AC voltage using pulse width modulation.

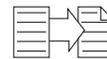


SO6006-1H Fourier-Analysis / Synthesis with DDE

In the frequency range, the software analyzes, amongst other things, the measured or saved responses in PHACON, combines the displays of the spectral components to curves in an animated sequence.



3.08



Ordering Information

Equipment List

Equipment List	Qty.	Order no.
Digital universal control unit (microcontroller)	1	SO3636-1A
DC unit with 6 IGBT's	1	SO3636-1R
Set of overlay masks for DC unit with 6 IGBT's (2 pcs)	1	SO3636-1S
RLC load with temperature line and 3 indicating lamps	1	SO3636-2A
Three-phase isolating transformer 300VA incl. DC power supply (max. 220V/3A DC)	1	SO3636-2G
Four channel differential amplifier	1	SO3636-2V
Connection cable 2m (measuring amplifier - control unit / PCI)	1	LM6119

Software

Software power electr. f. the digital universal control unit SO3636-1A (GB)	1	SO6006-1A
Software PWM-TRAIN (GB)	1	SO6006-1E
Software AC-PWM (GB)	1	SO6006-1P
Software Fourier analysis and synthesis with dynamic data exchange (GB)	1	SO6006-1H

Literatur

EPE20 Self Commutated Static Converters (GB)	1	SH5007-3B
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Power Supply

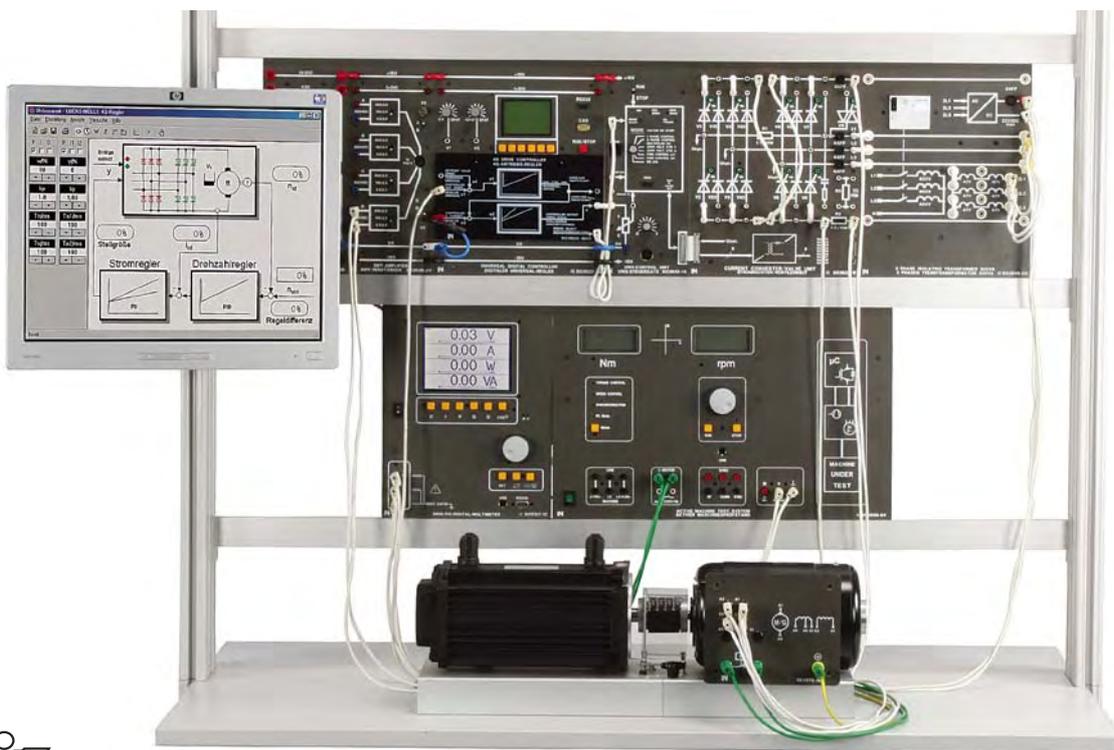
DC Power supply, $\pm 15V/2A$	1	SO3538-8D
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Test Instruments

Analoge/digital multimeter, wattmeter and power-factor meter	1	SO5127-1Z
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Accessories

Serial interface cable 9/9 pole	1	LM9040
Set of safety connection cables 4mm	1	SO5148-1F
Safety protected connection plug 19/4mm, white	20	SO5126-9X
Safety protected connection plug 19/4mm, white, with tapping	10	SO5126-9Z
Table-top frame, 2 levels, W 1230 x H 740mm, grey	1	ST8003-1C



System Description

By adding the appropriate electric machines, the static converter equipment EPE10 and EPE20 can easily be extended – at a minimum of cost – to cover the subject of static converter drives. By further adding a digital controller, a fully regulated drive is the result. The LN teaching system EPE 11 examines the responses of regulated DC motors supplied from static converters. To examine the conditions of the drive with a load applied in all 4-quadrants, a servo machinetest stand is required.



Topics Covered

- Speed control with single converter
- Speed control with double converter
- 4-quadrant operation, power recovery
- Line analysis, P-, PI-, PID controllers
- Optimising the controller
- Speed control in 1 to 4-quadrant operation, with and without secondary current control

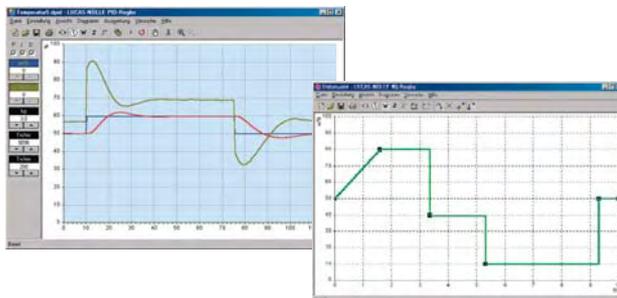


Computer Connection

SO6006-5J Software, 4Q Drive Controller

The program incorporates configuration, measurement and evaluation facilities:

- Displaying the automatic control system as a block diagram using standard-compliant names and symbols.
- Basic functioning and response of various types of controllers.
- Recording the responses of the controller variables in a time chart.
- Freely-definable input variable and disturbance variable functions for examining the dynamic response of the controller.
- Optimising function.



Ordering Information

Equipment List	Qty.	Order no.
Additional Equipment to EPE 10		
Line Commutated Static Converters		
DC shunt wound machine, 0.3kW	1	SE2672-3A
Universal digital controller (microcontroller)	1	SO3620-1A
Set of overlay masks for universal digital controller	1	SO3620-1B
Servo machine test stand, incl. software	1	SO3636-6V
Rubber coupling sleeve, 0.3kW	1	SE2662-2A
Coupling guard, 0.3kW, transparent	1	SE2662-7B

Software

Software 4Q-drive controller for the univ. digital controller SO3620-1A (GB)	1	SO6006-5J
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Literatur

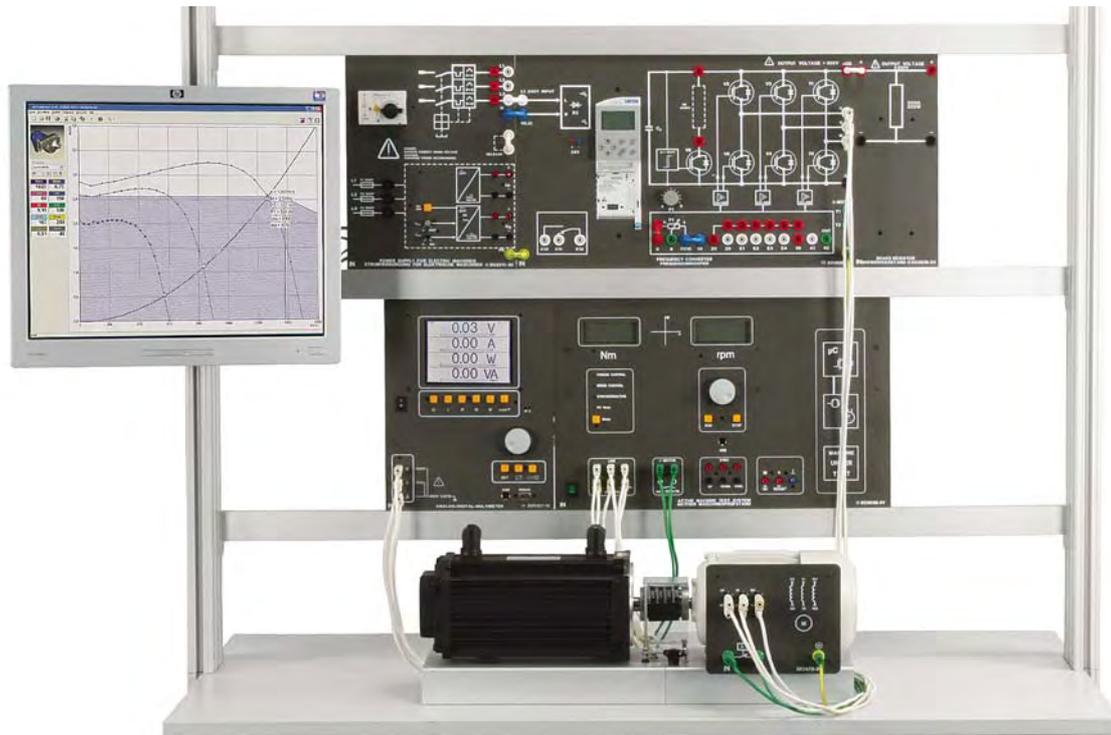
Converter Drives with DC Motors (GB)	1	SH5007-3C
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Power Supply

Universal power supply for machines	1	SO3212-5U
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Accessories

Test lead, BNC/4mm	1	LM9032
Table-top frame, 2 levels, W 1230 x H 740mm, grey	1	ST8003-1C



3.10



System Description

The LN frequency converter is a unit of the latest generation. It incorporates a power output stage comprising six IGBT's with self-sufficient power supply and overcurrent tripping, a constant voltage link supply and a microprocessor as a control unit.

Operation of the frequency converter is menu-assisted with the multifunction operator unit. All parameters can be saved in the integrated memory and later re-called as required, or transferred to other equipment with the multi-function operator unit.



Topics Covered

EDT 25 Frequency Converter

- Connection and operating a three-phase asynchronous motor (steady-state operation)
- Adjusting the starting current (torque)
- Start-up ramps
- Connection and operating a three-phase asynchronous motor (variable-speed operation)
- Establishing the dynamic torque and the rate of speed change (ramps)



Computer Connection

Also as an alternative to the LCD operating unit, the frequency converter can be fitted with an RS 485/RS 232 interface. This provides straightforward adjustment of the parameters and monitoring, in conjunction with the DRIVESOFT software.

In addition, the LN frequency converter can be fitted with all commonly used automation interfaces (e.g. Profibus), so that it is quite straightforward to assemble a field bus with a training PLC system from the LN program (see section 7).



Ordering Information

Equipment List	Qty.	Order no.
Frequency converter industrial type 0.75kW single-phase, incl. LCD Operating Unit	1	SO3636-5D
Brake chopper 0.2kW for Frequency converter1		SO3636-5V
Three-phase asynchronous machine industrial version, 0.3kW n=1400 (230V/400V)	1	SE2673-1K
Servo machine test stand, incl. software	1	SO3636-6V
RS232/485 interface module	1	LM8925
PC connection cable for RS232/485 interface module, l=5m	1	LM9028
Rubber coupling sleeve, 0.3kW	1	SE2662-6A
Coupling guard, 0.3kW, transparent	1	SE2662-7B

Exercise Literature

EDT25 Frequency Converters, Fundamentals	1	SH5007-3M
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Test Instruments

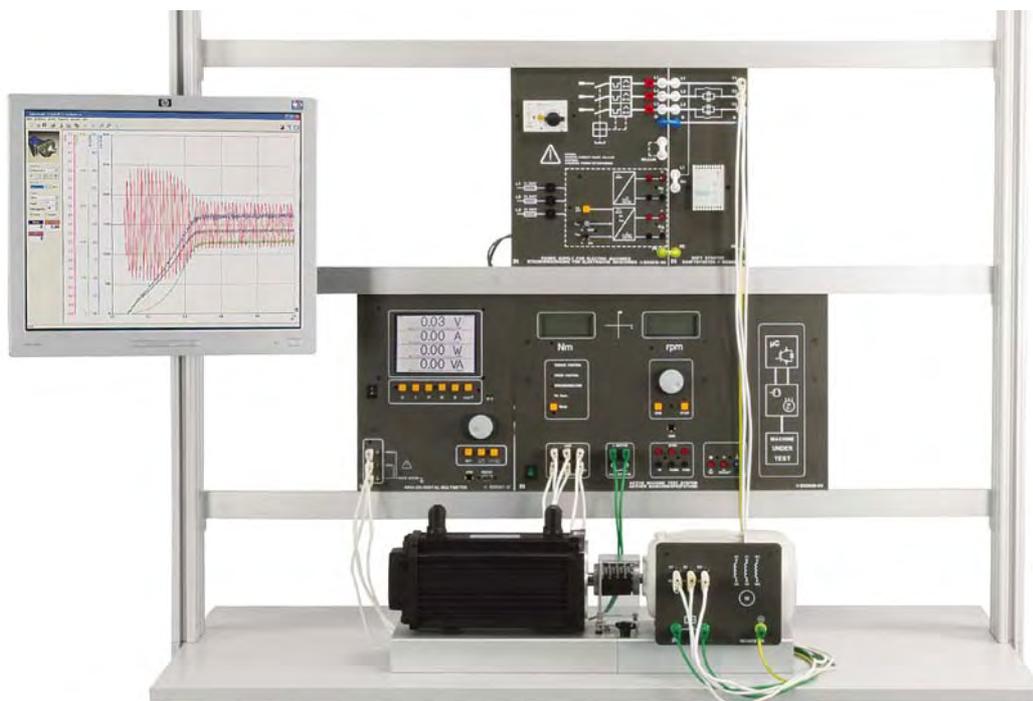
Analog/digital multimeter, wattmeter and power-factor meter	1	SO5127-1Z
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Power Supply

Universal power supply for machines	1	SO3212-5U
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Accessories

Set of safety connection cables 4mm	1	SO5148-1F
Safety protected connection plug 19/4mm, white	15	SO5126-9X
Safety protected connection plug 19/4mm, white, with tapping	5	SO5126-9Z
Table-top frame, 2 levels, W 1230 x H 740mm, grey	1	ST8003-1C



System Description

When a three-phase asynchronous motor is switched on, high transient values of current and torque are produced. In the past, these effects were decreased by using a star-delta starting circuit. In many installations, this is not sufficient since, at the instant of switching, these peaks of current and torque are not present, that for example in the case of conveyor belt systems, could cause the transported goods to be damaged or thrown off.

An alternative to a frequency converter is a soft-starter. Such a device reduces the mains voltage (terminal voltage of the motor) by phase control. At the same time, the starting current is reduced, proportionally to the terminal voltage. The teaching system is based on an industrial soft-starter and a 300W three-phase motor with squirrel-cage rotor.



Topics Covered

- Starting, current, torque
- Examination with various load machines
- Comparison: star-delta switch and soft-starter



Computer Connection

The software ActiveServo allows the measurement of dynamic processes such as for example, the switching on of machines. Various production machines can be simulated and their parameters adjusted, for example inertia wheels, ventilators or calenders (cloth rollers). The measured values such as speed, torque, current, voltage and power, are displayed as a function of time.



Ordering Information

Equipment List	Qty.	Order no.
Three-phase asynchronous machine 0.3kW	1	SE2673-1K
Smooth starter industrial type	1	SO3636-5Q
Servo machine test stand incl. software	1	SO3636-6V
Rubber coupling sleeve, 0.1/ 0.3kW	1	SE2662-2A
Coupling guard 0.3kW, transparent	1	SE2662-7B
Shaft end guard, 0.1/ 0.3kW	1	SE2662-2C

Test Instruments

Analog/digital multimeter, wattmeter and power-factor meter	1	SO5127-1Z
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Exercise Literature

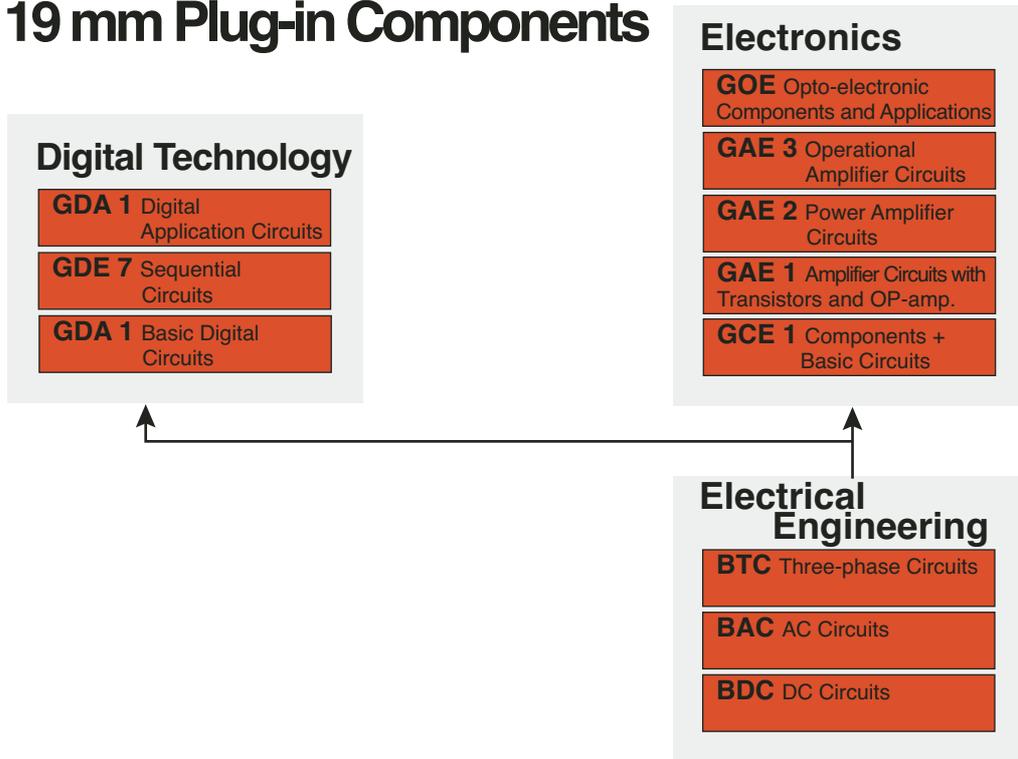
EDT 17 Industrial Type Soft-starter with Three-phase Asynchronous Motor (GB)	1	SH5007-3K
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Accessories

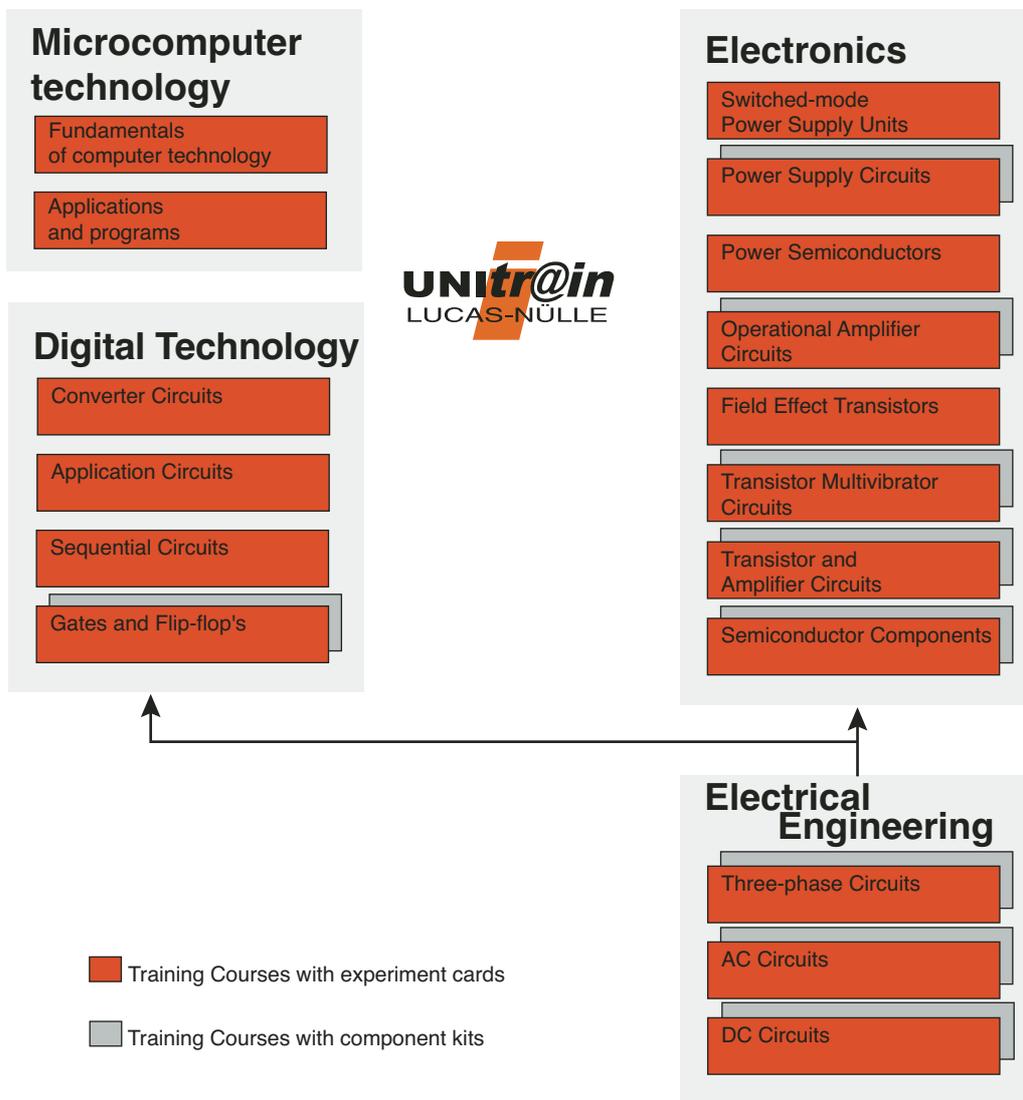
Universal power supply for machines	1	SO3212-5U
Set of safety connection cables 4mm	1	SO5148-1F
Safety protected connection plug 19/4mm, white	15	SO5126-9X
Safety protected connection plug 19/4mm, white, with tapping	5	SO5126-9Z
Table-top frame, 2 levels, W 1230 x H 740mm, grey	1	ST8003-1C



19 mm Plug-in Components

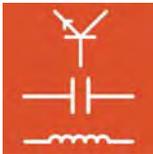


4.00



- Training Courses with experiment cards
- Training Courses with component kits





System Description

4.01

A sound training in the fundamentals of electrical engineering is a prerequisite for understanding the complex relationships in the various application areas of electrical engineering and electronics. The plug-in system is a traditional modular building-block system for a well-founded, practice-oriented training in the area of electrical engineering and electronics:

- Fundamentals of electrical engineering
- Electronics
- Digital techniques
- Opto-electronics

A robust system ideally suited for student exercises, for experimentation and for training. The plug-in system allows an exercise assembly that is almost identical to the circuit diagram. The electronic components are sorted in sets for specific subjects together with the relevant documentation. The exercises are accompanied by comprehensive exercise literature and are absolutely safe to use (even by the inexperienced) due to the use of safe low voltage supplies. The system provides a thorough training in basic knowledge and leads on to building up confidence in handling the components, which overall, provide a sound basis that is essential for further training. Various applications are possible with the Lucas-Nülle plug-in system. The universal patch-panel can be hung in an H-profile exercise frame or can simply be placed on a laboratory table. A more compact solution are our case systems, that are characterised by the very short preparation times. Our power supply units and measurement units are tailor-made to suit the application on hand. Surprise yourself by taking a look at our excellent equipment suggestions!



Topics Covered

BDC 1 The DC Circuit

- Assembly of simple circuits, Voltage source
- Use of ammeters and voltmeters
- Ohm's Law, Kirchhoff's Law
- Parallel and series circuits of resistors
- Extending the measurement range of voltmeters and ammeters, internal resistance
- Resistance measurement with constant current

- Measuring the internal resistance of batteries
- No-load and loaded voltage divider
- Wheatstone bridge
- Characteristics of a filament lamp
- LDR, NTC, PTC, VDR
- Static characteristic of a silicon diode
- Parallel and series circuits of capacitors
- RC series circuit, Self-induction of a coil
- Induction and transformer principle
- Relay circuit

BAC 1 The AC Circuit

- Generation, characteristics of alternating current
- Resistance of resistors, coils and capacitors, in an AC circuit with fixed and variable frequencies
- Series and parallel circuits of R-L or R-C or R-L-C
- Parallel compensation, series compensation
- Diode characteristics (Si, Ge)
- Rectifier circuits
- Transformer, no-load and loaded

BTC 1 The Three-phase Circuit

- Basic terms of a three-phase supply
- Star circuit, symmetric/ asymmetric loading
- Delta circuit, symmetric/ asymmetric loading
- Half-wave, full-wave and bridge rectifiers

GCE 1 Components and Basic Circuits in Electronics

- Diode and Z-diode in DC and AC circuits
- Rectifier, with / without smoothing
- Light emitting diode (LED), photodiode
- Diode characteristics of transistor junctions
- Input, Output characteristics of transistors
- Control characteristics of transistors
- Transistor in common-base, common emitter and common-collector circuits
- Transistor as switch or delay element
- FET, characteristics, use as a controllable resistance
- MOSFET, characteristics, sensor dimmer
- DIAC, thyristor and TRIAC characteristics
- Thyristor as switch
- Phase-cut control with TRIAC and DIAC
- UJT characteristics, pulse generator with UJT



Ordering Information

Equipment List	Qty.	Order No.
Basic equipment DC circuits	1	BDC 1
Add-on set: AC circuits	1	BAC 1
Add-on set: Three-phase circuits	1	BTC 1
Electronic components & basic circuits	1	GCE 1

Accessories

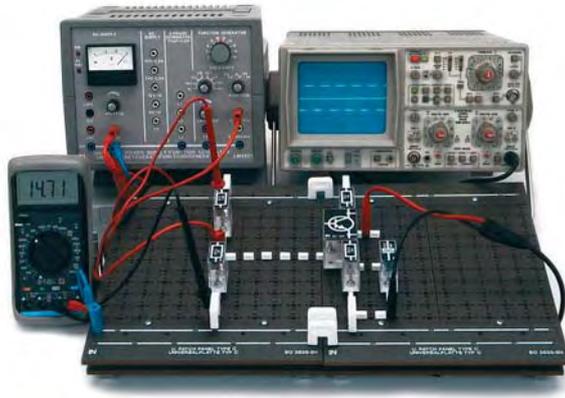
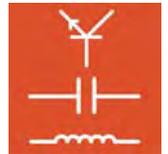
Universal patch panel (2-fold)	1	SO3535-5H
Set of connection cables 4mm (30 pcs)	1	SO5146-1A
Connection plugs 2mm/7.5mm	40	SO5124-7S

Test Instruments

Universal power supply (DC/AC/3-phase) with power function generator (50W)	1	LM4501
Analog multimeter	1	LM1110
Digital multimeter	1	LM2105
Dual trace oscilloscope	1	LM6203
Test lead, BNC/4mm	2	LM9032

Exercise Literature

BDC 1 DC Circuits (GB)	1	SO5159-4D
BAC 1 AC Circuits (GB)	1	SO5159-4F
BTC 1 Three-phase Circuits (GB)	1	SO5159-4H
Electronic Components & Basic Circuits (GB)	1	SO5159-4K



System Description

Further topics on the subject of analog electronics are available with 4 sequential sets of plug-in equipment. In this way, a complete basic knowledge can be built up using interesting exercises.

Passive components and various semiconductors are examined in exercises, characteristics recorded and the knowledge gained is then applied to typical, practical application circuits. In particular, emphasis is placed on the use of multimeters and an oscilloscope in the techniques of measurement.

The plug-in system as a traditional modular building-block system carries considerable advantages for a sound, practice-oriented training in the field of electronics. The plug-in components are inserted in the universal patch-panel as in a circuit diagram to produce the finished circuit and result in a clear, easily understood arrangement.

Our universal patch-panels are available in 4 versions:

- with and without safety-protected sockets, with 2 or 4 mm techniques
- and with widths of 228 or 456 mm.

All versions can be used in an H-profile exercise frame or as a desk-type table-top workplace.



Topics Covered

GAE 1 Amplifier Circuits with Transistor and Op-amp

- Operating values, common-base, common emitter and common-collector circuits
- Darlington amplifier
- Emitter-coupled amplifier
- Push-pull, differential amplifiers
- Operational amplifier circuits (Op-amp)
- Op-amp characteristics

GAE 2 Power Amplifier Circuits

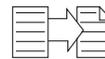
- Single-stage amplifier, Classes A, B & C
- Single-ended class A power amplifier
- Complementary, quasi-complementary output stages
- Push-pull output stage with transformer
- Depletion layer FET, common-source amplifier
- Amplifier with CMOS-FET
- RC-coupled amplifier

GAE 3 Operational Amplifier Application Circuits

- Linear amplifier with op-amp
- Non-inverting amplifier with op-amp
- Inverting amplifier with op-amp
- Inverting AC amplifier with op-amp
- Voltage follower with op-amp
- Comparator with op-amp
- Schmitt trigger with op-amp
- Astable multivibrator with op-amp
- Monostable multivibrator with op-amp
- Constant current source with op-amp
- Integrator with op-amp
- Differentiator with op-amp

GOE 1/2 Opto-electronic Components and Applications

- Photoresistor, Photocell, characteristics and features
- Photodiode, characteristics and features
- Phototransistor, Opto-isolator
- LED, characteristics and features
- Opto-isolator, characteristics and features
- Signal transfer using a photodiode and phototransistor
- Signal transfer using fibre optics
- Light barrier, using an LDR
- LED, Control and drive signals
- Light-sensitive multivibrator with a phototransistor



Ordering information

Equipment List	Qty.	Order No.
Add-on set: Amplifier Circuits	1	GAE 1
Add-on set: Power amplifier	1	GAE 2
Add-on set: Operational amplifier applications	1	GAE 3
Add-on set: Opto-electronics	1	GOE 1/2

Accessories

Universal patch panel (2-fold)	2	SO3535-5H
Set of connection cables 4mm	1	SO5146-1A
Connection plugs 2mm/7.5mm	60	SO5124-7S
Connection plugs 4mm/19mm	10	SO5124-7A

Test Instruments

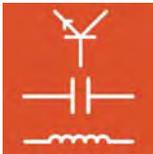
Universal power supply (DC/AC) with function generator	1	LM4500
Digital multimeter	2	LM2105
Dual trace oscilloscope	1	LM6203
Test lead, BNC/4mm	2	LM9032

Exercise Literature

Amplifier Circuits I (GB)	1	SO5156-2B
Amplifier Circuits II (GB)	1	SO5156-2C
Operational Amplifiers, Basic Circuits (GB)	1	SO5156-2D
Opto-electronic Components (GB)	1	SO5156-2P
Opto-electronic Components (Applications) (GB)	1	SO5156-2Q

Alternative Universal Patch Panel

Universal patch panel (4-fold)	1	SO3535-5K
Patch panel, 2-fold, 36 knots	1	SO3535-5Q
Patch panel, 2-fold, 72 knots	1	SO3535-5R



UNITRAIN
LUCAS-NÜLLE



System Description

The UniTrain-I is a powerful experiment and training system for computer-based vocational and further training in the area of basic and advanced electrical engineering and electronics. The UniTrain-I compact laboratory fits onto any desk and can be used in a multimedia laboratory or in an electronic laboratory, in a workshop or in the office.

UniTrain-I combines theory and practice, that results in a highly efficient and effective teaching environment.



It is an open system and consists of a computer-aided high-tech laboratory, a large variety of different experiment possibilities with the relevant multimedia course.

The intelligent measurement interface of the UniTrain-I system can be aligned on several experiments, where the actual real experiment is completed.

The measurement interface has analog and digital, measurement and control inputs and outputs available. The large number of virtual instruments (VI) that are available, result in the generation of high-quality test instruments that saves the cost of purchasing expensive individual equipment.



UniTrain-I Courses: Tried and tested!

They each consists of up to 4 experiment cards and a CD-ROM with multimedia-course and the exercise platform, LabSoft. The complete package is supplied in a sturdy and stackable, polypropylene hard-shell-case with a PU-profile foam material inset for accommodating the cards and accessories. The experiment cards contain compact, tested exercises for all subjects in electrical engineering. The cards are Euro-card format (160 mm x 100 mm), fitted with a grip strip, a 64 / 96-pole connector and where necessary, a print of the circuit. This provides a clear overview, a very short preparation time and exercise completion times. Depending on the complexity, the cards contain more than one group of exercises. Measurement points for voltage and current are easily accessible at 2mm sockets.



Topics Covered

Course Electrical Engineering 1: DC Techniques

- Electric circuit, Lamp circuits
- Measurements with voltmeter and ammeter
- Ohm's Law, Kirchhoff's Laws
- Series and parallel circuits of resistors
- Voltage divider circuits, bridge circuits
- LDR, NTC, PTC, VDR
- Fault finding

Course Electrical Engineering 2: AC Techniques

- Generation and characteristics of alternating current
- Measurements with an oscilloscope
- Frequency-dependent components
- Series and parallel circuits of L and C
- Diode characteristics and circuits
- Transformer, no-load and loaded



Ordering Information

Equipment List	Qty.	Order No.
Course - Electrical Engineering 1: DC Technology	1	SO4204-4D
Course - Electrical Engineering 2: AC Technology	1	SO4204-4F
Course - Electrical Engineering 4: Magnetism/Electromagnetism	1	SO4204-4A
Course - Electrical Engineering 5: Measurement with Multimeter	1	SO4204-4B
Course - Electrical Engineering 6: Circuit Analysis	1	SO4204-4L

Accessories

UniTrain-I Interface with virtual instruments (basic VI)	1	SO4203-2A
UniTrain-I Experimenter	2	SO4203-2B
Measurement accessories for UniTrain-I	1	SO4203-2J

Test Instruments

UniTrain-I Digital multimeter	1	LM2321
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Optional Accessories

Storage case for one system	1	SO4203-2Y
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UNITRAIN
LUCAS-NÜLLE

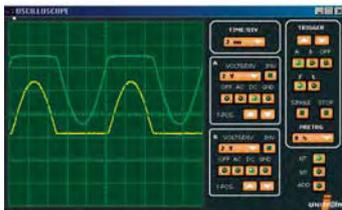


System Description

UniTrain-I courses for electronics have been thoroughly tried and tested. They each consist of up to 4 exercise cards and a CD-ROM with multimedia courses and the exercise platform, LabSoft. The complete package is supplied in a sturdy and stackable, polypropylene hard-shell-case with a PU-profile foam material inset for accommodating the cards and accessories. The experiment cards contain compact, tested exercises for all subjects in Electrical Engineering, Electronics and Digital techniques.



A particularly relevant factor of the UniTrain-I system is that, apart from a computer, no other additional equipment is necessary. All power supplies, function generators, multimeter and oscilloscope, are already integrated.



The work with real components in typical industrial circuits is of particular significance for practice-oriented working.

Operation, alignment and measurement processes are also practised on the clearly arranged experiment cards, as is systematic fault-finding. Here, real faults are connected via the UniTrain-I bus to the experiment cards.



Topics Covered

Course Electronics 1: Semiconductors

Course with 3 experiment cards

- Diodes, characteristics, responses
- Comparison, Si, Ge and Z diodes
- Limiter circuit with Z-diodes
- Opto-electronic fundamentals, IrDa-LED, Phototransistor
- Transistor, common-base, common emitter and common-collector circuits

Course Electronics 2: Transistor Multivibrators

Course with 3 experiment cards

- Astable multivibrator circuit
- Bistable multivibrator circuit
- Monostable multivibrator circuit

Course Electronics 3: Transistor & Amplifier Technology

Course with 3 experiment cards

- Multi-stage transistor amplifier, differential amplifier
- Capacitive or galvanic coupling
- Operating values, working point, frequency response
- Constant current source with FET and bipolar transistor

Course Electronics 4: Field Effect Transistors

Course with 1 experiment card

- Common-Source and Common-Drain circuits
- DC and AC negative feedback

Course Electronics 5: Operational Amplifiers

Course with 2 experiment cards

- Inverting / Non-inverting amplifier
- Summator, comparator
- Comparator with Schmitt-trigger input

Course Electronics 7: Power Supply Circuits

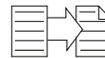
Course with 4 experiment cards

- Rectifier circuits, half-, full-wave and bridge
- Filter and smoothing circuits
- 'Villard' circuit, voltage multiplication
- Linear regulated power supply with adjustable voltage
- Fixed voltage power supply

Course Electronics 8: Switched Mode Power Supply

Course with 2 experiment cards

- DC/DC-converter, Up-, Down-converters
- Pulse width modulation, Switched-mode power supply (SMPS)
- Voltage regulation, current limiting



Ordering Information

Equipment List

	Qty.	Order No.
Course - Electronics 1:		
Semiconductor Components	1	SO4204-5A
Course - Electronics 2: Transistor Multivibrators	1	SO4204-5D
Course - Electronics 3:		
Transistor and Amplifier Technology	1	SO4204-5H
Course - Electronics 4: Field Effect Transistors	1	SO4204-5K
Course - Electronics 5: Operational Amplifiers	1	SO4204-5M
Course - Electronics 7: Power Supply Circuits	1	SO4204-5R
Course - Electronics 8:		
Switched Mode Power Supplies	1	SO4204-5S

Accessories

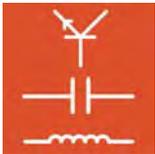
UniTrain-I Interface with virtual instruments (basic VI)	1	SO4203-2A
UniTrain-I Experimenter	2	SO4203-2B
Measurement accessories for UniTrain-I	1	SO4203-2J

Test Instruments

UniTrain-I Digital multimeter	1	LM2321
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Optional Accessories

Storage case for one system	1	SO4203-2Y
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Fundamentals of Electrical Engineering and Electronics MTI 1/2 with UniTrain-I and Extended Power Supply



UNITrain
LUCAS-NÜLLE



System Description

UniTrain-I courses for three-phase technology, power semiconductors or for power electronics provide safe experimentation with three-phase supplies in low voltage techniques.



For this purposes, a three-phase generator is integrated in the UniTrain-I interface that can be used however, with an extended power supply, as an add-on unit.

Each course consists of 1 experiment card and a CD-ROM with multimedia-course and the experiment platform, LabSoft. The complete package is supplied in a sturdy and stackable, polypropylene hard-shell-case with a PU-profile foam material inset for accommodating the cards and accessories.

A particularly relevant factor of the UniTrain-I system is that, apart from a computer, no other additional equipment is necessary. The following are already integrated:

- 3 Fixed voltages, $\pm 15\text{ V} / 0.4\text{ A}$, $5\text{ V} / 1\text{ A}$
- 3 Variable voltages, $3 \times (-20\text{ V} \dots + 20\text{ V})$ up to a maximum of 2 A or $0 \dots 15\text{ VRMS}$ at $0 \dots 150\text{ Hz}$
- Function generator up to 1 MHz
- 2 Multimeters, analog or digital
- Two-channel oscilloscope
- 16-bit digital input/output with binary / hex / decimal displays
- 8 Relays



The work with real components in typical industrial circuits is of particular significance for practice-oriented working. Operation, alignment and measurement processes are also practised on the clearly arranged experiment cards, as is systematic fault-finding. Here, real faults are connected via the UniTrain-I bus to the experiment cards.



Extended Power Supply Unit (SO4203-2D)

This power supply is used as an add-on supply for the cases where a high-power AC voltage, an adjustable DC voltage or a frequency and amplitude modulated three-phase system is required in the exercises. The UniTrain-I interface is required for creating the power supply functions. The adjustments are made on the virtual instruments.



Topics Covered

Course Electrical Engineering 3: Three-phase Technology

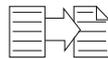
Course with 1 experiment card

- Generation and characteristics of three-phase current
- Phase-to-phase factor
- Line and Phase voltages
- Star- and Delta-circuits
- Symmetric / asymmetric loading
- Neutral point, methods of connection

Course Electronics 6: Power Semiconductor Devices

Course with 1 experiment card

- Thyristor
- Triac
- MOSFET
- IGBT
- Characteristics
- Forward and reverse state responses
- Switching response



Ordering information

Equipment List	Qty.	Order No.
Course - Electrical Engineering 3: Three-phase Technology	1	SO4204-4H
Course - Electronics 6: Power Semiconductor Devices	1	SO4204-5P

Accessories

UniTrain-I Interface with virtual instruments (basic VI)	1	SO4203-2A
UniTrain-I Experimenter	2	SO4203-2B
UniTrain-I Extended power supply	1	SO4203-2D
Measurement accessories for UniTrain-I	1	SO4203-2J

Test Instruments

UniTrain-I Digital multimeter	1	LM2321
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Optional Accessories

Storage case for one system	1	SO4203-2Y
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UNITRAIN
LUCAS-NÜLLE



Topics Covered

Course Digital Technology 1: Gates und Flip-Flop

Course with 2 experiment cards

- Basic logic circuits, NOT, AND, OR, NAND, NOR, EXOR, EXNOR
- Logic gating, using 2 AND, OR, EXOR, NOR
- Truth tables, Boolean algebra
- Circuit equations, symbols
- JK-flip-flop

Course Digital Technology 2: Sequential Circuits

Course with 2 experiment cards

- 4 JK Master-Slave flip-flops with LED displays
- 4 NAND, 8 NOT, 2 debounced switches, 2 debounced pushbuttons
- Flip-flop circuits, counters, dividers and registers
- 4-bit binary code, up- or down-counter

Course Digital Technology 3: Application Circuits

Course with 2 experiment cards

- 2 Half-adder, 4-bit full-adder
- Shift register
- Parallel and serial 4-bit adder circuits
- Multiplexer, Demultiplexer

Course Digital Technology 4: Converter Circuits

Course with 3 experiment cards

- Reference voltage sources
- A/D and D/A converter
- D/A converter with R2R-network or with weighted resistors
- A/D converter with R2R- network or Dual-slope
- V/f - converter, f/V - converter, impedance converter



System Description

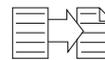
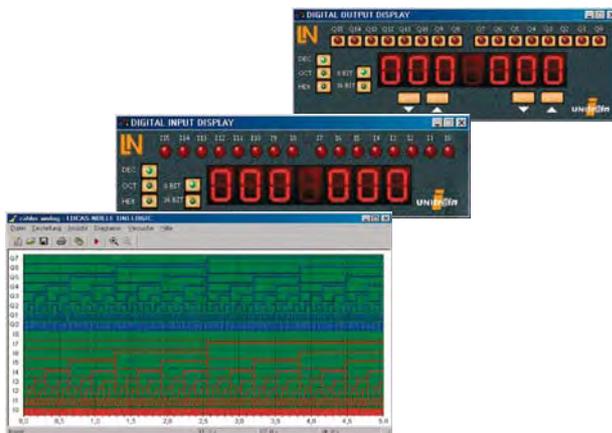


The UniTrain-I system provides a practice-related introduction to digital technology. In a large number of experiments, accompanied by multimedia courses, some with animated displays, the system teaches the students the basics of digital techniques and leads on to more complex application and converter circuits.

The courses each consist of up to 3 exercise cards and a CD-ROM with multimedia courses and the exercise platform, LabSoft. The complete package is supplied in a sturdy and stackable, polypropylene hard-shell case with a PU-profile foam material inset for accommodating the cards and accessories.

A particularly relevant factor of the UniTrain-I system is that, apart from a computer, no other additional equipment is necessary. All power supplies, binary input/output, digital signal generator and logic analyser are already integrated.

The work with real components in typical industrial circuits is of particular significance for practice-oriented working. Operation, alignment and measurement processes are also practised on the clearly arranged experiment cards, as is systematic fault-finding. Here, real faults are connected via the UniTrain-I bus to the experiment cards.



Ordering Information

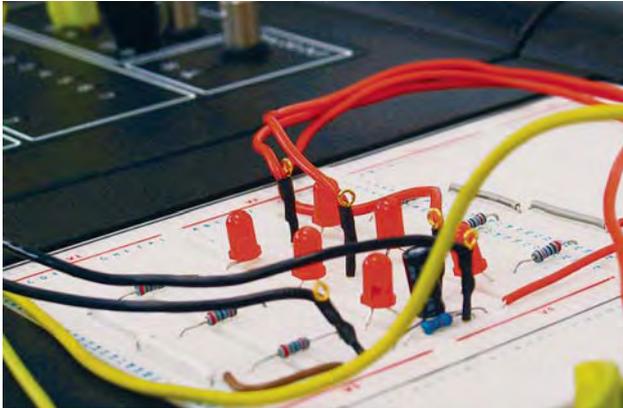
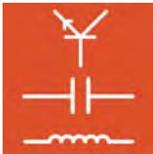
Equipment List	Qty.	Order No.
Course - Digital Technology 1: Gates and Flip-Flops	1	SO4204-6A
Course - Digital Technology 2: Sequential Circuits	1	SO4204-6C
Course - Digital Technology 3: Application Circuits	1	SO4204-6E
Course - Digital Technology 4: Converter Circuits	1	SO4204-6F
Course - Microcomputer Technology 1: Fundamentals of computer technology	1	SO4204-6H
Course - Microcomputer Technology 2: Applications and Programming	1	SO4204-6J

Accessories

UniTrain-I Interface with virtual instruments (basic VI)	1	SO4203-2A
UniTrain-I Experimenter	1	SO4203-2B
Measurement accessories for UniTrain-I	1	SO4203-2J

Optional Accessories

Storage case for one system	1	SO4203-2Y
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System Description

4.07

The UniTrain-I system is the ideal solution for completing project work. The development of new circuits from the initial idea on to the finished and tested hardware, can be realised quickly and easily within the UniTrain-I system. Specialized collections of components offer the greatest possible flexibility when experimenting. The large number of experiments using the prepared components, allow the fundamentals of electronics and electrical engineering to be fully covered. By the addition of any other components, further exercises are possible to produce more complex applications in the field of electronics. Included in the supply, is a CD-ROM documenting the exercises.

SO4203-2C UniTrain-I Breadboard System

Breadboard and cable-set for the UniTrain-I Experimenter. The breadboard is latched onto the Experimenter and results in a convenient system for experimenting with wired components or up to 18 IC's.

- Breadboards with 2 x 948 connection points, nickel-plated contacts
- Incl. cable set in a transparent box with 5 compartments, complete with 140 prepared and twisted experiment wires in 14 different lengths
- Incl. 4 flexible adapter cables, 1mm - 2mm, 20cm long.



SO2002-1A Software NI-MULTISIM

NI-MULTISIM is an intuitive software used to model circuitry with functions designed especially for training and educational purposes.

- Intuitive circuit modeling and powerful SPICE-simulation
- Expanded analysis like, e.g. Monte Carlo, temperature sweep, parameter sweep
- Interactive work with virtual instruments, including oscilloscopes, DMMs, function generators, characteristic recorders, etc.
- Database with thousands of models for the virtual realization of analog and digital circuits
- Virtual plug-in assembly on pin board in 3D-environment prior to implementation in the lab

NI-MULTISIM software is subject to United States export control regulations.

SO4201-2L Printed Circuit Board for Self-soldered Circuits

Exercises for the individual subjects areas, can be assembled by the User, either as soldering practice or hard-wired.



Topics Covered

The software NI-MULTISIM is used for planning, development and testing without the need for the actual hardware. Then, the circuit is tested with real measurements in the UniTrain-I environment using LabSoft. There are two possible methods of assembling the prototype hardware. First, there is the breadboard for quick construction of small analog or digital circuits. Alternatively or additionally, a matrix board can be used as soldering practice for the prototype circuit and then finally tested in the Experimenter system.



Ordering Information

Equipment List	Qty.	Order No.
UniTrain-I Breadboard system	1	SO4203-2C
Component kit 1: DC technology	1	SO4204-1A
Component kit 2: AC technology	1	SO4204-1D
Component kit 3: Rectification	1	SO4204-1G
Component kit 4: Transistors as switches	1	SO4204-1K
Component kit 5: Three-phase technology	1	SO4204-1N
Component kit 6: Electronic components	1	SO4204-2A
Component kit 7: Transistor circuits	1	SO4204-2D
Component kit 8: Operational amplifier circuits	1	SO4204-2G
Component kit 9: Signal generation	1	SO4204-2K
Component kit 10: Digital technology	1	SO4204-2P

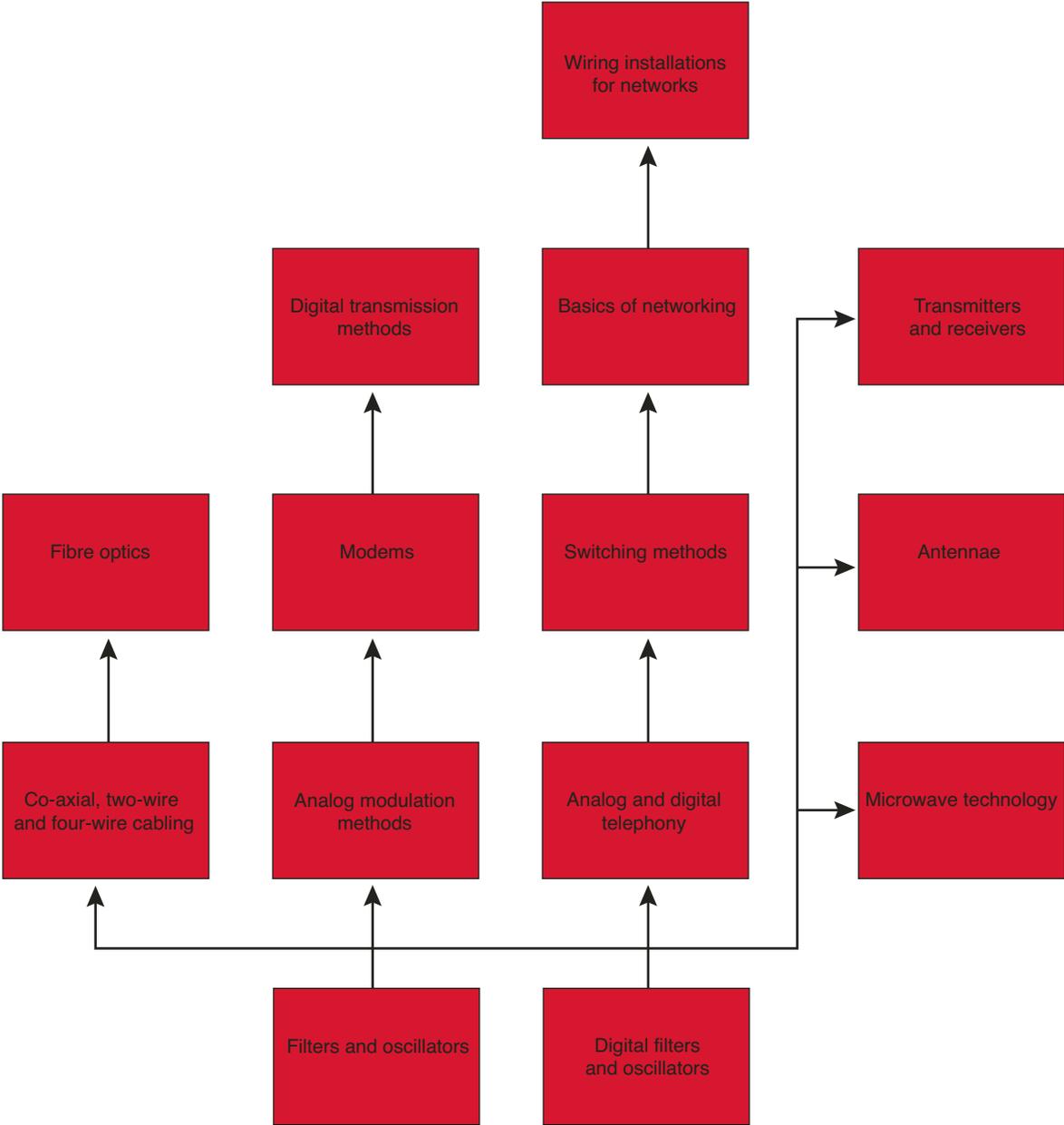
Accessories

UniTrain-I Interface with virtual instruments (basic VI)	1	SO4203-2A
UniTrain-I Experimenter ⁽¹⁾	2	SO4203-2B
UniTrain-I Digital multimeter	1	LM2321
Software NI-MULTISIM	1	SO2002-1A

Optional Accessories

Storage case for one system	1	SO4203-2Y
Printed circuit board for self-soldered circuits	1	SO4201-2L

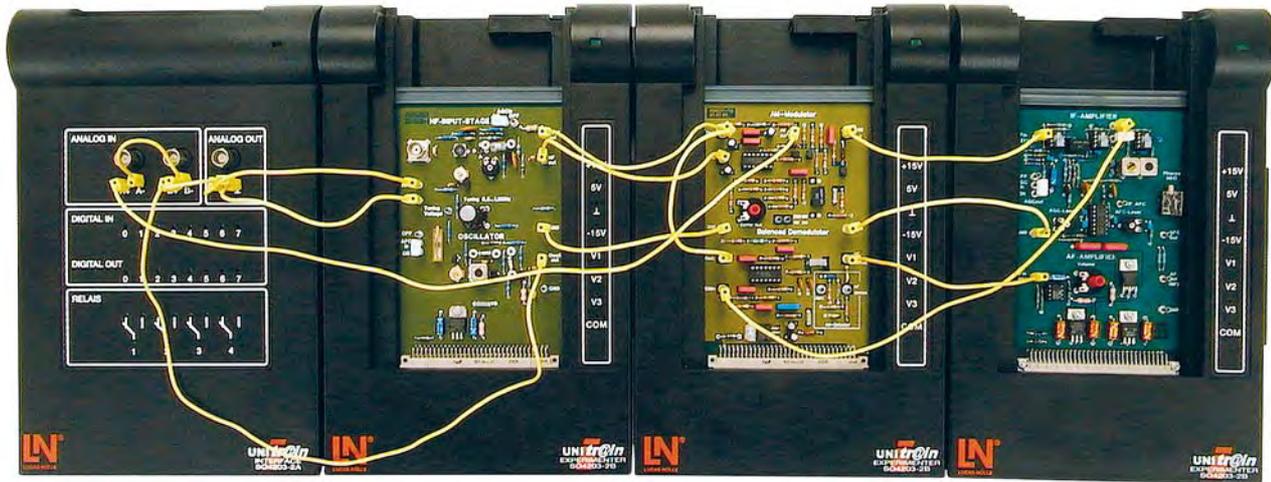
(1): For digital multimeter a second Experimenter is required!



5.00



Analog Data Transmission with UniTrain-I



UNITrain
LUCAS-NÜLLE



System Description

Analog transmission of information with its various types of modulation is, still today, a common form of telecommunications. With the modular LN trainer, based on the UniTrain-I system, the subject can be systematically introduced to the students. Commencing with the fundamentals of send and receive techniques, carrier frequency generation is then introduced. The training program includes the types of modulation using sinusoidal carriers (AM and FM) as well as the modulation without a carrier signal (SSB, DSB).

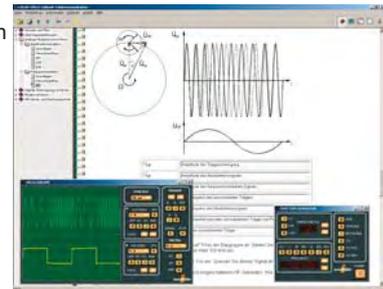
Apart from the pure modulation techniques, the AM modulator/demodulator PCB, in conjunction with the AM input stage PCB and the IF and AF amplifiers PCB, a fully-functional AM receiver can be assembled, which is capable of receiving programs with only a short antenna.

AM Receiver

- Selectivity
- Straight (TRF) reception
- Heterodyne reception
- Image Selectivity
- ZF-Amplifier
- AFC Circuit
- AGC-Circuit

AM Transmitter

- Frequency conversion
- DSB AM transmitter



5.01



Topics Covered

Amplitude Modulation

- Amplitude modulation with a mixer
- Measuring the degree of modulation / modulation trapeze
- Suppressing the carrier
- Double sideband modulation (DSB)
- Single sideband modulation (SSB)
- Amplitude modulation

Frequency Modulation

- Frequency modulation with a VCO
- Frequency deviation
- Modulation index
- Frequency modulation with a phase detector
- Frequency modulation



Ordering Information

Equipment List

	Qty.	Order No.
Communications technology 8:		
AM/ FM modulation / demodulation	1	SO4204-9M
Communications technology 9:		
AM transmission and receiving technology	1	SO4204-9N

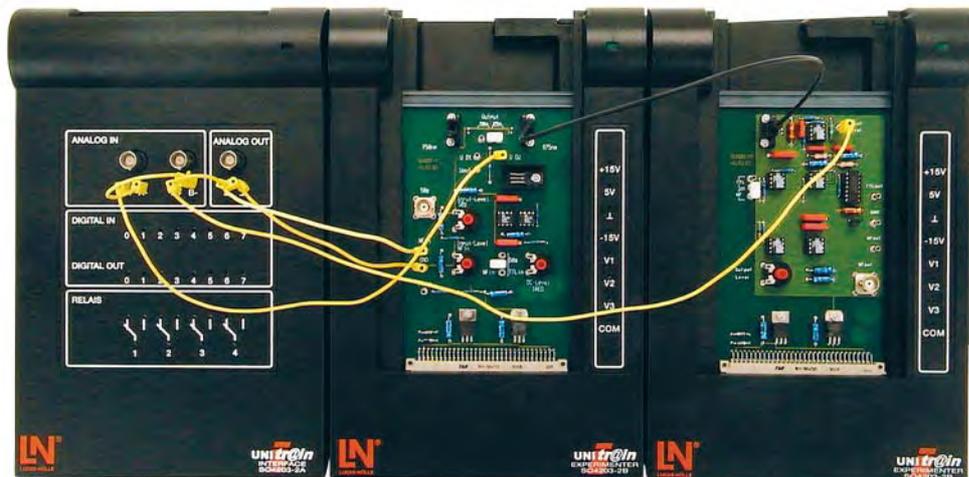
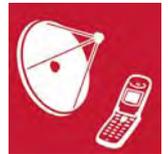
Accessoires

UniTrain-I Interface with virtual instruments (basic VI)	1	SO4203-2A
UniTrain-I Experimenter	3	SO4203-2B
Set of connection cables 2mm for UniTrain-I	1	SO5146-1L
Test probe, 10:1 / 1:1	2	LM9036

Supplementary Equipment

UniTrain-I Storage case for one system	1	SO4203-2Y
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Data Transmission using Fibre-optic Cable with UniTrain-I



UNITR@IN
LUCAS-NÜLLE



System Description

The increasing flood of information and data in industrial transmissions and in the telephone sector, requires an ever increasing speed of transmission. Therefore, the use of fibre-optic cables for transmitting digital and analog data, is becoming increasingly significant due to the much larger bandwidth and quality of transmission.

The LN training system for this subject, is based on the modular, UniTrain-I training system and provides examination of the characteristics and parameters of fibre-optic cables. The exercise assembly comprises transmitter and receiver. Plastic and fibre-glass optical cables that can be cut to various lengths, are used. As an option, an optical gauge is available for examining the responses at coupling points.



Topics Covered

Transmission Lines with Fibre-optics

- Preparing fibre-optic cables
- Comparison of plastic and fibre-glass optical cables
- Adjusting the working point of sender and receiver
- Attenuation, caused by:
 - cable length and material
 - wavelength of light (875nm / 950nm)
 - undermining the permissible bending radius
 - distance and mis-alignment of the couplings
- Limit frequencies for analog and digital signal transmission



Ordering Information

Equipment List	Qty.	Order No.
Communications Technology 3:		
Optical waveguides	1	SO4204-9E

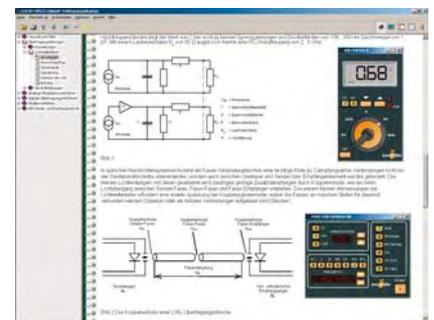
Accessories

UniTrain-I Interface with virtual instruments (basic VI)	1	SO4203-2A
UniTrain-I Experimenter	2	SO4203-2B
Set of connection cables 2mm (22 pcs) for UniTrain-I	1	SO5146-1L
Test probe 1:1/10:1	2	LM9036

Supplementary Equipment

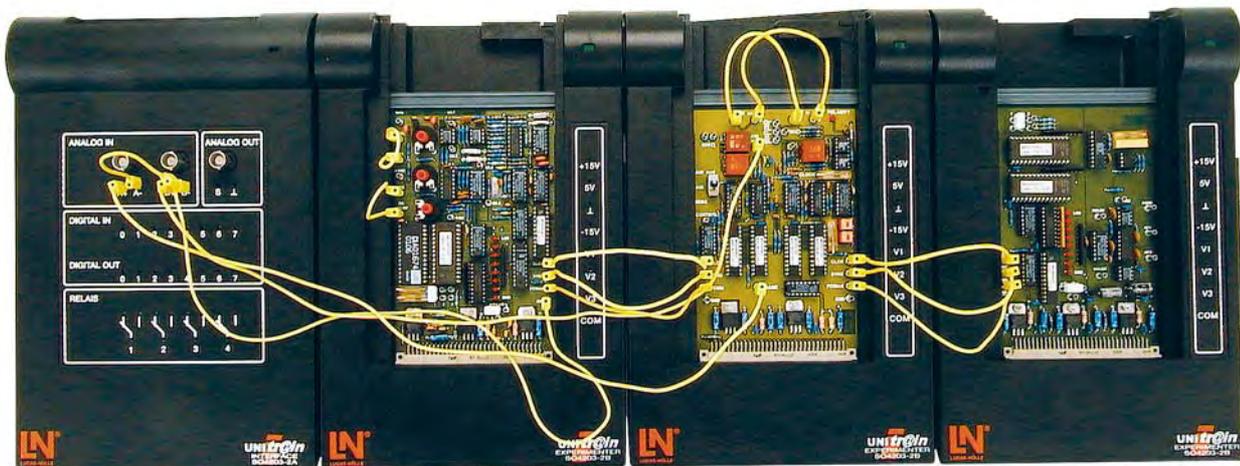
UniTrain-I Storage case for one system	1	SO4203-2Y
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5.02





Pulse Modulation Techniques with UniTrain-I



System Description

In industry as well as in the telephone sector, digital methods of transmitting data play a significant role in telecommunications due to the faster rates of transmission that are possible and the high quality of transmission.

The LN training system for this subject, is based on the modular, UniTrain-I training system. The PCM card incorporates two synchronous sinewave generators with frequencies of 500 and 1000 Hz, that can be connected to the PCM circuit. Alternatively, an external signal can be applied. The PCM modulator/demodulator card has two channels for simultaneous transmission of two signals. The intermediate stages of modulation and demodulation incorporate 2mm sockets for displaying the signals on an oscilloscope. LED's are also included on the PCB for indicating the data word. A line encoder/decoder is available on the PCB for transmission in the baseband; coding methods AMI, HDB3 and modified AMI, are available. The PCB also incorporates framing, which is based on the principle used on the ISDN S0 interface. As an extension to the exercise package dealing with pulse modulation, further methods of modulation for the transmission of data are examined, such as pulse width modulation PWM and pulse position modulation (PPM).



Topics Covered

Pulse Amplitude Modulation

- Principle of pulse amplitude modulation
- Principle of pulse amplitude demodulation
- Principle of time-division multiplex operation of pulse amplitude modulated signals

Pulse Code Modulation

- Quantising and quantising errors without companding. Displaying the data word when transmitting sinusoidal and DC voltages
- PAM and Hold signal shapes
- Displaying the quantising with companding according to A-Law (13-segment characteristics) and μ -Law (15-segment characteristics).
- Principle of time-division multiplex operation of PCM transmission lines.



Signal Encoding

- Forming a pseudo-ternary code
- Displaying the pulse frame
- Displaying the encoding and the various signal responses
- Signal and clock recovery – displaying the phase jitter
- Displaying the complete frame of the ISDN-layer 1, using the modified AMI-code

PWM Modulation and Demodulation

- Introduction to the function principle of pulse width modulation
- Evaluating the advantages and disadvantages of this form of modulation
- Displaying the signal response at the output of the PWM modulator
- Demodulation of the PWM signal

PPM Modulation and Demodulation

- Introduction to the function principle of pulse position modulation
- Comparison with pulse width modulation
- Displaying the signal response at the output of the PPM modulator
- Demodulation of the PPM signal



Ordering Information

Equipment List	Qty.	Order No.
Communications Technology 5:		
Pulse modulation methods PAM /PCM	1	SO4204-9J
Communications Technology 6:		
Pulse modulation method PTM	1	SO4204-9K

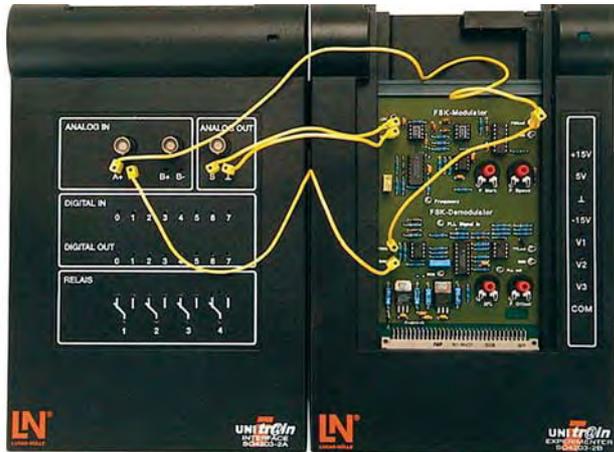
Accessories

UniTrain-I Interface with virtual instruments (basic VI)	1	SO4203-2A
UniTrain-I Experimenter	3	SO4203-2B
Set of connection cables 2mm for UniTrain-I	1	SO5146-1L
Test probe 1:1/10:1	2	LM9036

Supplementary Equipment

UniTrain-I Storage case for one system	1	SO4203-2Y
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Data Transfer with Modem with UniTrain-I



UNITrain
LUCAS-NÜLLE



System Description

If an analog telephone connection is used for the transmission of data, the connection must specially prepared. The data are transmitted either as digital signals in the baseband or transmitted on the telephone line by digitally modulating a sinusoidal carrier. In the latter case, also known as keying a sinewave carrier, the parameters amplitude, frequency and phase of the modulated signal can be modified. Thus, a digital modulation signal allows the modulation methods of Amplitude-shift-keying (ASK), Frequency-shift-keying (FSK) or Phase-shift-keying (PSK).



Topics Covered

ASK-Modulation and Demodulation

- Displaying the signal response at the output of the ASK modulator
- Demodulation of the ASK-signal
- Frequency spectrum of the ASK-signal

FSK-Modulation and Demodulation

- Displaying the signal response at the output of the FSK modulator
- Demodulation of the FSK-signal
- Frequency spectrum of the FSK-signal

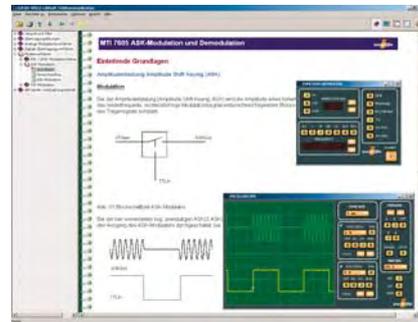
PSK- / QPSK-Modulation and Demodulation

PSK- Modulation and Demodulation

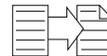
- Assigning the oscillogrammes at the test points DATA and BITCLOCK to a set bit pattern
- Assigning the output voltage U_{PSK} to various bit patterns
- Effects of various data transfer rates
- Demodulation of the PSK-signal

QPSK-Modulation/Demodulation

- Assigning the oscillogrammes at the test points DATA and DIBITCLOCK to a set bit pattern
- Displaying the relationship of the signals DIBIT X and DIBIT Y as a function of the corresponding Dibits of the set bit pattern
- Assigning the output voltage U_{QPSK} to various bit patterns and Dibits
- Effects of various data transfer rates
- Demodulation of the QPSK-signal



5.04



Ordering Information

Equipment List

Equipment List	Qty.	Order No.
Communications Technology 7:		
Modem methods ASK, FSK, PSK	1	SO4204-9L

Accessories

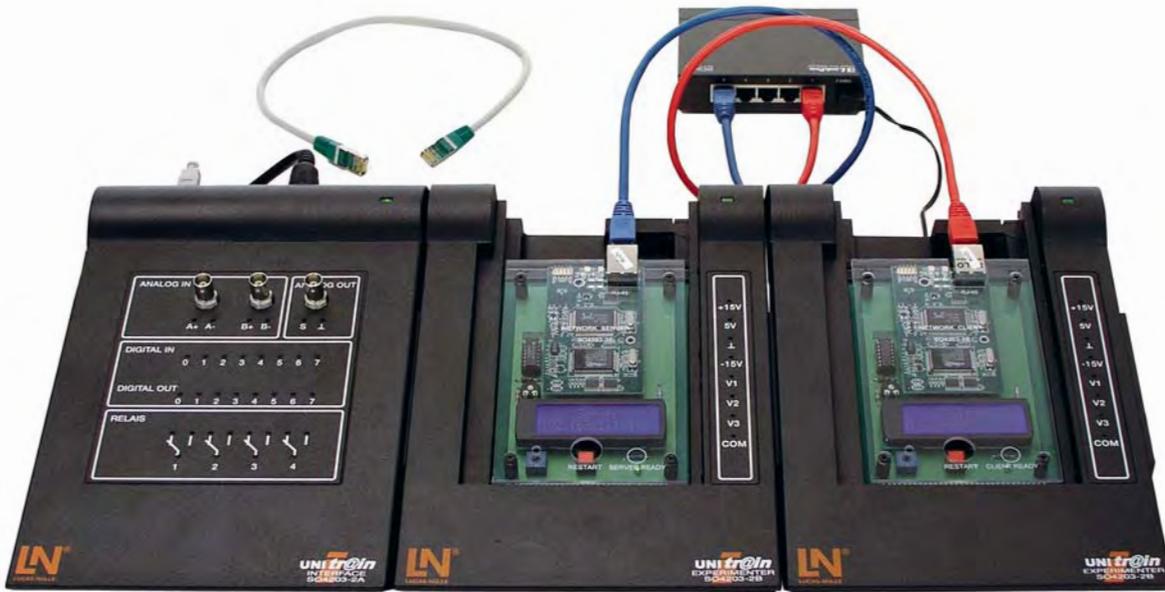
UniTrain-I Interface with virtual instruments (basic VI)	1	SO4203-2A
UniTrain-I Experimenter	2	SO4203-2B
Set of connection cables 2mm (22 pcs) for UniTrain-I	1	SO5146-1L
Test probe 1:1/10:1	2	LM9036

Supplementary Equipment

UniTrain-I Storage case for one system	1	SO4203-2Y
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Networking Technology using UniTrain-I



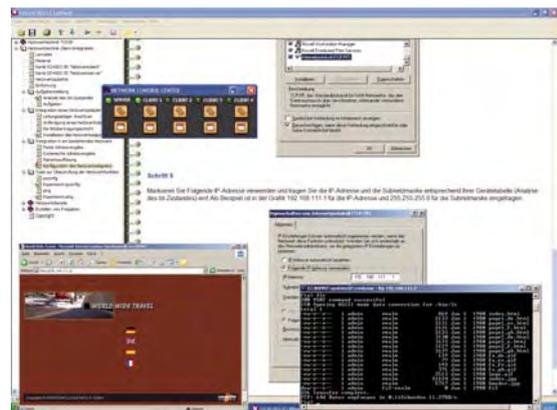
System Description

The UniTrain-I multimedia course in TCP/IP networking provides basic knowledge of network structures and components by means of numerous experiments and animations. Trainees are introduced to the structure and addressing of the worldwide internet. Practical experiments allow students to practice setting up, configuring and testing networks. Groups targeted by the course include electricians as well as telecommunications and office networking technicians.

The training network is included with the hardware for the course and consists of a network server and one network client along with the necessary accessories. Combinations of multiple courses or incorporation in an authentic network can also be implemented at any time.

Course, Networking 2: Client Integration

- Installing a network card in a PC
- Connection to the network, cabling
- Layer 1, Manchester encoding etc.
- Configuration of a network adapter (hardware) under the Windows XP operating system
- Configuration of network interface and relevant drivers
- Integration into an existing network
- Use of tools to test functionality
- DHCP
- Name resolution in Windows networks (host file, lmhosts file, WINS)
- Use of services (http, ftp)
- Managing authorisations



Topics Covered

Course, Networking 1: TCP/IP

- Differences between LAN, MAN, WAN and GAN networks
- Network standards and standard organisations
- Various network topologies
- Network structures (Ethernet, token ring, token bus)
- OSI layer model
- Network components and their functions
- Design of an Ethernet network and its components
- Addressing principles (MAC address)
- Differences between 10base2 und 10BaseT
- Client-server and peer-to-peer networks
- Design and testing of a computer network with a client-server structure
- Design and testing of a computer network with a peer-to-peer structure
- Network interfaces and their functions
- The TCP/IP family of internet protocols
- IPv4 and IPv6 addressing
- Network sub-masks



Ordering Information

Equipment List	Qty.	Order No.
Course Networking 1: TCP/IP	1	SO4204-9Q
Course Networking 2: Client integration	1	SO4204-9R

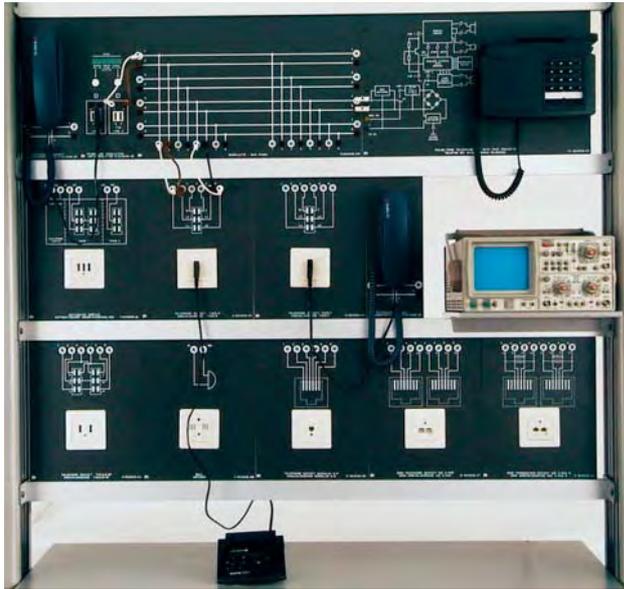
Accessories

UniTrain-I Interface with measuring instruments and network equipment	1	SO4203-2A
UniTrain-I Experimenter	2	SO4203-2B

Optional accessories

Storage case for complete system	1	SO4203-2Y
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Terminal Device Connection System



System Description

The system is in the form of DIN-A4 teaching panels. The hardware components required are of modular construction. For operation and testing the analog telephone facilities available, an Exchange line connection is provided via a processor controlled simulator.

This teaching system has been developed for training in the following groups:

- Vocational schools
- Technical schools
- Technical universities
- Chambers of Industry and Commerce
- Internal further education

The priority groups of trainees include technicians in telecommunications and office communication as well as End-Users in vocational and further education.



Topics Covered

The series of exercises entitled "Installation of Analog and Digital Telephones using the TAE System" describes the TAE system in use in Germany.

The functioning of the system components and their installation is shown in a series of practical exercises. The exercises are assembled with reference to examples based on customer-specific installations. (Customer requirements – Installation suggestions – Completion).

- Function and pin assignment of simple TAE6-F and TAE6-N sockets, installation of single and combined N and F devices
- Function and pin assignment of combined TAE2 x 6-NF and TAE2 x 6-NFN sockets, installation of single and combined N and F devices
- Function and pin assignment of automatic multi-switches, installation of multiple devices to a single line connection



Ordering Information

Equipment List	Qty.	Order No.
Bell	1	SO3538-2M
Telephone set with test sockets, bilingual	1	SO3538-2N
Telephone handset a/b	2	SO3538-2P
Bus panel	1	SO3538-2W
Trunk line simulation	1	SO3538-3B
Digital answering machine	1	SO3538-3E
Telephone socket Modular 6/6	1	SO3538-2R
Telephone socket Modular 8/8	1	SO3538-2S
Automatic multiple Switch	1	SO3538-2L

Supplementary Equipment

ISDN Telephone socket 8/8(4)	1	SO3538-2T
ISDN Termination socket 8/8(4) R	1	SO3538-2U
ISDN-bus connection adapter	1	SO3538-2X
ISDN telephone	1	LM9920E
ISDN telephone (with added features)	1	LM9921E

Accessories

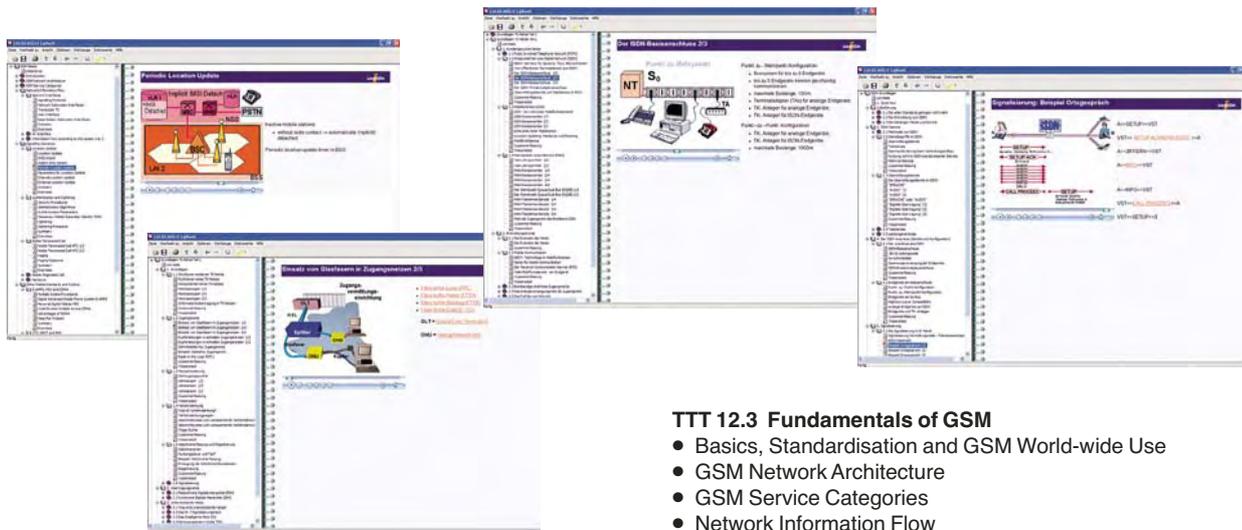
Connection cable, 4mm, 25cm brown	8	SO5126-2D
Connection cable, 4mm, 25cm white	8	SO5126-2F
Safety connection plug (jumper), 19/4 mm white	4	SO5126-9X
Table top Frame 3 Level 1160 mm x 1060mm	1	ST8003-1D

Exercise Literature

TTT 2 Installation of Analog and Digital Telephones using the Modular System	1	SO5157-9N
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Optional Accessories

Hand-held test unit for analog telephones	1	SO3538-4R
Set of accessories for cable preparation in Telecoms laboratory	1	SO3538-4N
ISDN-Tester "D2001Q" Export model (Uk0 2B/1Q-Code)	1	LM9922E



System Description

CBT, uses multimedia methods of instruction. The topic chosen for training is presented on the screen either as a two-dimensional or a 3D animated display. Spoken text explains the processes displayed on the screen. The more significant facts are shown as text at the right hand side of the screen. Hypertext provides easy access, at any time, to additional information on specific keywords.

TTT 12.3 Fundamentals of GSM

- Basics, Standardisation and GSM World-wide Use
- GSM Network Architecture
- GSM Service Categories
- Network Information Flow
- Signalling Scenarios
- other Mobile Standards (D-AMPS, PDC, CDMA...)

TTT 12.4 Fundamentals of SDH

- Evolution of Synchronous Digital Hierarchy, SDH
- Frame structure (STM)
- Integration of payload data into the SDH structure
- Function and purpose of individual bytes
- Pointer actions

TTT 12.5 Fundamentals of ATM

- Introduction / Development of broadband transmission
- Asynchronous transfer mode
- Comparison of synchronous, packet- and asynchronous transfer mode
- Cell structure
- ATM-protocol
- Broadband ISDN network structure

5.07

Each chapter opens with a list of the topics covered and ends with a summary of the subjects where the significant information can be recalled in the form of hypertext or as simplified revision.

At the conclusion of each chapter, exercises are available for the students to test their newly acquired knowledge immediately and if necessary, repeat a subject. Various types of exercise material is available (e.g. multiple choice, drag & drop) which provide a method of testing the knowledge gained in relation to everyday practice.

These interactive teaching programs are used everywhere, where a good knowledge is required about the fundamentals of telecommunications networks.



Topics Covered

TTTT 12.1 Tc-Networks Part 1 and Part 2

- Fundamentals (structure, access network, addressing...)
- Transmission Networks
- Supportive Networks (No.7 signalling network ...)
- Customised Networks (ISDN, GSM, MAN...)
- Development Trends (DECT, Broadband, ADSL...)

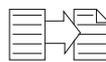
TTT 12.2 Fundamentals of ISDN

- Development of ISDN
- ISDN services and features
- ISDN terminal devices and the ISDN basic access terminal
- Signalling on the D channel
- Practical application examples



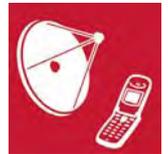
Computer Connection

- PC Pentium, 1 GHz
- Memory 256 MB RAM
- Soundcard
- Operating system Windows 2000, XP or Vista



Ordering Information

Equipment List	Qty.	Order No.
Fundamentals of Telecommunications (Tc) Networks Part 1 (GB)	1	SO2705-1A
Fundamentals of Telecommunications (Tc) Networks Part 2 (GB)	1	SO2705-1B
Fundamentals of GSM (GB)	1	SO2705-1D
Fundamentals of SDH (GB)	1	SO2705-1E
Fundamentals of ATM (GB)	1	SO2705-1F
Fundamentals of ISDN	1	SO2705-1C



System Description

The basic idea of the microwave techniques training system is to teach the fundamental principles of high-frequency technology in practical exercises. In the basic package, emphasis is given to wave propagation in waveguides and in free space. Various materials are examined for their properties of propagation and their attenuation. Also, the fundamentals are established for understanding the function of various waveguide components for controlling the flow of energy.

The basic system consists of a collection of various waveguide components for use in the X-band, that are fixed together using the patented "Easy-Fix" quick fastening system. This provides a fast and secure assembly in the laboratory, excluding the use of nuts, bolts and screws within the system. A stable assembly of the exercises on the work table is ensured by the use of height adjustable guide supports, that can be optionally inserted in the lower face of the waveguide components. A Gunn oscillator is used as an HF-generator, with an adjustable tuned resonant circuit for the transmit frequency. Measurements in the basic system are made using an oscilloscope or a computer-aided measurement system.



Topics Covered

The series of exercises "Microwave Techniques", is part of a training complex covering the subject of "High-frequency Technology" and includes the following topics:

- The Gunn-oscillator as a high-frequency generator
- Propagation of microwaves in waveguides
- Wavelength measurements in waveguides
- SWR measurements
- Impedance measurements
- Waveguide components and their function (cavity resonators, cross couplers, ...)
- Frequency measurement
- Modulation and demodulation of a microwave carrier
- Propagation of waves in free space



Computer Connection

When using the computer-aided measurement interface UniTrain-I, several measurement tasks are made particularly straightforward. Special virtual instruments developed for a PC running under the Windows operating system, allow measurements to be made in microwave techniques on several types of laboratory exercise assemblies. The measurement interface is connected to the PC, via the USB or the serial interface.



Ordering Information

Equipment List	Qty.	Order No.
Gunn oscillator with frequency adjustment	1	SO4100-4A
Ferrite isolator	1	SO4100-4B
PIN-modulator	1	SO4100-4C
Adjustable attenuator	1	SO4100-4D
Frequency meter	1	SO4100-4E
Slotted line	1	SO4100-4F
3-screw impedance adapter	1	SO4100-4G
Waveguide-to-coax transition element	2	SO4100-4H
Coaxial detector	2	SO4100-4J
Waveguide termination	1	SO4100-4K
Waveguide short-circuit plate	1	SO4100-4L
Waveguide support	4	SO4100-4M
Bench support rail	1	SO4100-4N
Horn antenna 15dB	2	SO4100-4P
Set of coupling iris plates	1	SO4100-4Q
Cross coupler 20dB	1	SO4100-4R
Displacement sensor for slotted line	1	SO4100-4S
Waveguide adapter R100 / UBR100	2	SO4100-4T
Gunn power supply unit	1	SO4100-4W
Set of dielectrics	1	SO4100-4X

Test Instruments

UniTrain-I Interface	1	SO4203-2A
UniTrain-I Experimenter	1	SO4203-B
UniTrain-I Measurement-Kit for Microwave Technology	1	S4100-5U

Connection Cables

Test lead, BNC/BNC	4	LM9034
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Accessories

Set of Smith charts	1	SO4100-4Y
Storage case for basic set of equipment, TMW	1	SO4100-4Z

Literature

Fundamentals of Microwave Technology	1	SO5158-8B
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System Description

The antenna training system is used for instruction in trade-training schools, colleges, technical colleges and universities. This applies to civilian and military training. The subject of antenna technology is divided into two courses. The first course, "Fundamentals of Antenna Technology" introduces the basic function and applications of antennae. The second course, "Complex Antenna Systems" builds on the knowledge gained in the Fundamentals course and concentrates on the functioning of special antennae and antenna systems.

The antenna training system is a "Blended Learning" system of teaching. Practical exercises using real techniques, are combined with the theoretical studies in one system. The entire range of test instruments required is also part of the system and there is no requirement for any separate individual test instruments.

The antenna training system is constructed in the normal way in a laboratory environment, on a worktable. Special protective measures are not necessary. By selection of the frequencies available in the range of 8 to 10 GHz, several workplaces can be operated close to each other without any danger of interference.



Topics Covered

The course "Fundamentals of Antenna Technology" is developed for teaching in trade-training schools and colleges up to universities. The course consists following topics:

- Introduction to antenna techniques, types of antennae and their construction, practical examples
- The physics of radiation (propagation) and reception
- Resistance (impedance) of an antenna, impedance matching and balancing (Balun)
- Radiation characteristics in near-field and far-field regions
- The gain of an antenna
- The formation of a polar diagram
- Measurement of polar diagrams of various types of antennae

Antennae

- Monopole
- Dipole and folded-dipole
- 3-element and 6-element Yagi
- Helix antenna; right and left polarisation
- Patch antenna, linear and circular polarisation.

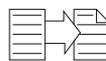


Computer Connection

- Recording of measured values and control of the antenna rotation platform
- Measurement and display of all measured results on the computer monitor screen
- Theory oriented course with practical exercises
- Easy (low-level) entry to the course
- Suitable for trade-training and qualification
- Numerous animated sequences and graphics
- Feedback of the learning process by test questions
- Pre-prepared intermediate and final exam question papers
- Course topics and tests can be edited

Special Integrated Test Instruments for Antenna Techniques

- Level meter up to -65dBm (true measurement)
- True measurement of the carrier frequency
- Polar diagram plotter for horizontal and vertical planes
- 3-D display of the polar diagram
- Display of Cartesian and polar co-ordinates
- Additional test instruments such as oscilloscope, multimeter and level meter, are included in the system.

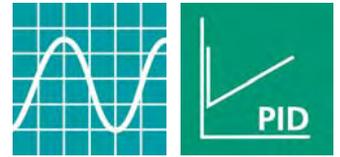


Ordering Information

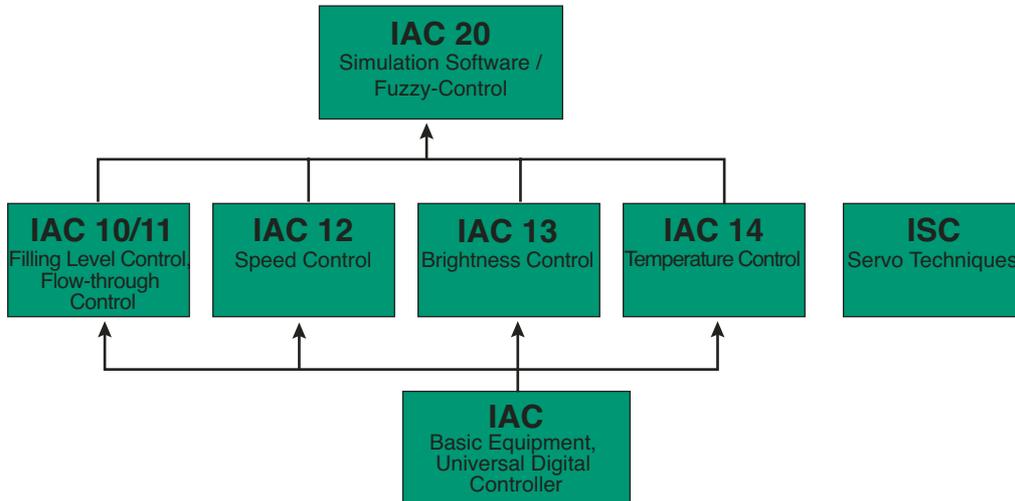
Equipment List	Qty.	Order No.
Course Fundamentals of Antenna Technology	1	SO4204-9W
Supplementary Set: Course "Complex Antenna System"	1	SO4204-9X
Test Instruments		
UniTrain-I Interface	1	SO4203-2A
UniTrain-I Experimenter	1	SO4203-2B

Note: The course SO4204-9W includes all hardware and software for the exercises. The course "Fundamentals of Antenna Technology" is available in 3 frequencies:

Course "Fundamentals of Antenna Technology" 8,5 GHz	1	SO4204-9W85
Course "Fundamentals of Antenna Technology" 9,0 GHz	1	SO4204-9W90
Course "Fundamentals of Antenna Technology" 9,5 GHz	1	SO4204-9W95



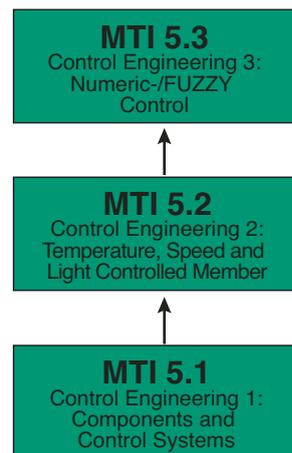
Closed-loop Control Technology with Panel System



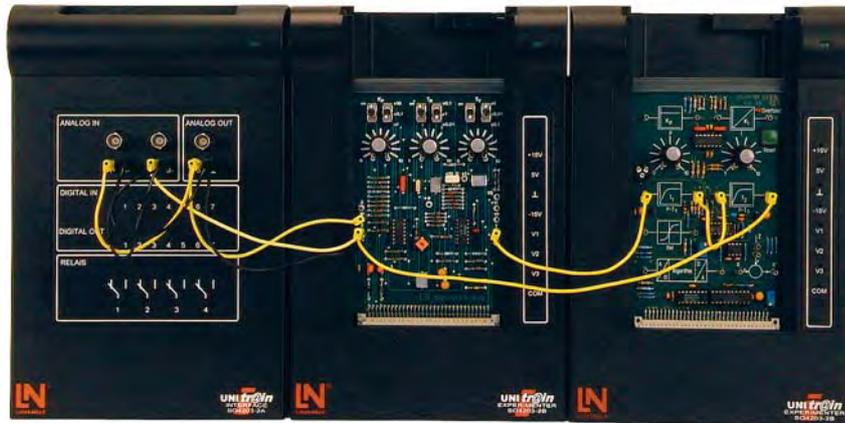
Measurement of Electric and Non-Electric Values with UniTrain-I



Closed-loop Control Technology with UniTrain-I



6.00



UNITRAIN
LUCAS-NÜLLE



System Description

For setting up and optimising a closed-loop control circuit, detailed information is required about the static and dynamic behaviour of the controlled system. The specialist can only choose the suitable controller for an existing controlled system and optimally use it in professional practice if he has this information. With the practice-oriented experiment equipment MTI 5.1 for the UniTrain-I training system the static and dynamic behaviour of closed-loop control circuit elements and closed-loop control circuits can be easily and understandably learnt through self-tuition. The following closed-loop control circuit elements are available for this purpose:

- P element, K_P adjustable
- I element, K_I adjustable
- P- T_1 element with time constant T_1
- P- T_1 element with time constant T_2
- Non-linear characteristic curve element
- Dead time member, T_1 parameterisable
- Summation point with possibility for switching disturbances

For this purpose the software **LabSoft** Control engineering is the experimentation platform for control engineering and, in addition to the intuitive experimenting instructions in HTML format, it offers convenient tools for investigating the closed-loop control circuit elements and closed-loop control circuits, such as step response plotters and frequency response plotters.

The course package "Control Engineering 1" consists of the experimenting cards "Two-point/three-point Controller", "PID controller" and "Controlled System Simulator" and the **LabSoft** course "Control Engineering 1".



Topics Covered

MTI 5.1 Control Engineering 1: Components and Closed-loop Control Circuits

- Investigation of closed-loop control circuit elements
- Time behaviour of closed-loop control circuit elements
- Investigation of continuous controllers (PID controllers)
- Investigation of discontinuous controllers (two-point and three-point controllers)
- Observations of a closed-loop control circuit
- Control and disturbance behaviour of the closed-loop control circuit
- Requirements placed on the closed-loop control circuit, quality criteria
- Introduction to the frequency response
- Stability observations
- Controls with two-point and three-point controllers



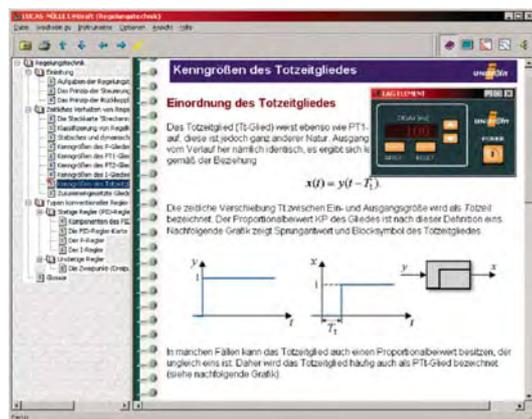
Ordering Information

Equipment List	Qty.	Order No.
Course: Control Engineering 1:		
Components and closed-loop control circuits	1	SO4204-8F

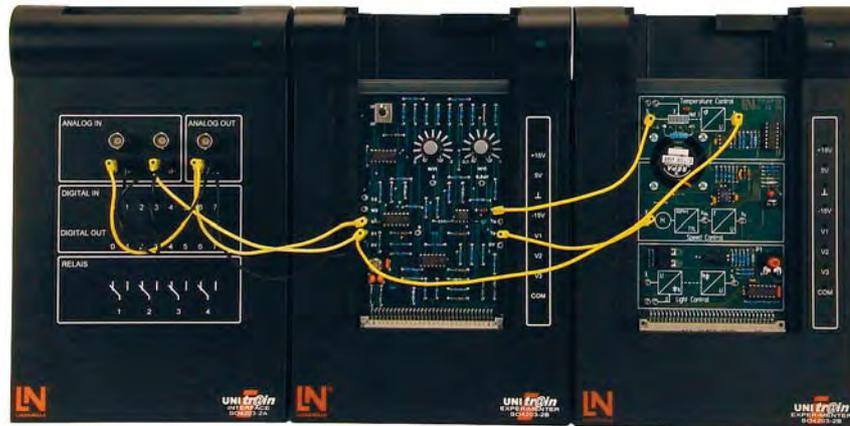
Accessories	Qty.	Order No.
UniTrain-I Interface with virtual instruments	1	SO4203-2A
UniTrain-I Experimenter	2	SO4203-2B
Measurement accessories for UniTrain-I	1	SO4203-2J

Optional Accessories	Qty.	Order No.
UniTrain-I digital multimeter	1	LM2321
Storage case for one system	1	SO4203-2Y

6.01



The main focus of the experiment series is determining the characteristic values of existing closed-loop control circuit elements and the possible combinations of them. In addition the design and the optimisation of closed-loop control circuits is examined.



UNITrain
LUCAS-NÜLLE



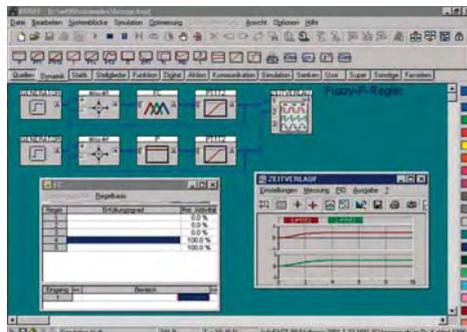
System Description

The course package MTI 5.2 is a set of supplementary equipment for the basic course MTI 5.1. The equipment consists of the experiment card "Temperature, speed and light controlled system" and the related **LabSoft** course "Control Engineering 2". The primary focus of this experiment series is the analysis of the existing real control systems, the choice of a suitable controller and the optimisation of the closed-loop control circuit. In addition observations and optimisations in the frequency area are carried out.

The following controlled systems are available on the experiment card:

- Temperature controlled system with temperature sensor and fan cooling, i.e. for operation with three-point controller
- Speed controlled system with incremental speed measurement
- Light controlled system with photodiode sensor and outside light source (disturbance)

The supplementary equipment MTI 5.3 is the powerful software package WinFact for analysis, synthesis and simulation of conventional control systems and for handling FUZZY systems. The software can be used in standalone operation, and also in combination with the UniTrain-I interface. Hence, in addition to the pure simulation, an integration in real control systems is also possible.



Topics Covered

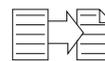
MTI 5.2 Control Engineering 2: Temperature, Speed and Light Control System

- Determining the system parameters
- Operation with two-point and three-point controller
- Operation with PID controller
- Determining the control parameters
- Evaluating the controller quality
- Optimising the control system
- Recording the frequency response of the dissected closed-loop control circuit
- Evaluation and optimisation in frequency area

MTI 5.3 Control Engineering 3: Numerical Control / FUZZY Control

- Simulation of closed-loop control circuits on the PC
- Real time control with the PC
- Investigation of a fuzzy controller
- Fuzzy control on real control systems

6.02



Ordering Information

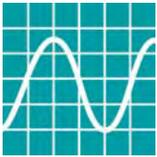
Equipment List	Qty.	Order No.
Course: Control Engineering 1: Components and Closed-loop Control Circuits	1	SO4204-8F
Course: Control Engineering 2: Temperature, Revolution and Light Control System	1	SO4204-8G
Software WinFACT	1	SO6006-5Q

Accessories

UniTrain-I Interface with virtual instruments	1	SO4203-2A
UniTrain-I Experimenter	2	SO4203-2B
Measurement accessories for UniTrain-I	1	SO4203-2J

Optional Accessories

UniTrain-I digital multimeter	1	LM2321
Storage case for one system	1	SO4203-2Y



System Description

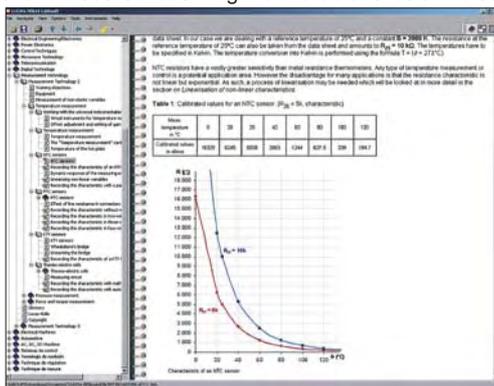
In physics there are several variables that exhibit non-electrical properties, such as for example, temperature, pressure, force, velocity or revolution speed. If these variables are to be detected and measured, then electronically evaluated, the non-electric signals must first be converted to electric signals. This task is often realised by sensors, the electrical properties of which change as a function of the variable to be measured. Photoresistors for instance, change their DC resistance according to the magnitude of incident light; piezo-elements generate an electric voltage when subjected to pressure.

The exercise equipment consists of the following components:

- Experiment cards: Instrumentation amplifier, Temperature measurement, Pressure measurement, Force measurement with strain gauge
- 1 Pressure source with pressure display
- 1 Set of weights, 2g – 200g
- CD-ROM with Labsoft and exercise course Measurement Technology 2

6.03

The multimedia course "Measurement Technology 2: Non-electric Values T/P/F" teaches the physical principles of sensors using numerous animated sequences and exercises together with typical circuits for measured value evaluation. The main topic of the series of exercises is measuring the characteristics of the sensors.



The following sensors are part of the exercise equipment for MTI 8.2:

- NTC, PT 100, KTY and thermocouple for temperature measurement
- Piezo-sensors for absolute and differential pressure measurements.
- Strain gauge for measuring the force on a torsion rod and a bending bar



Topics Covered

- Basic experiments with the instrumentation amplifier
- Measuring circuits
- Temperature measurement
- Operation and characteristics of temperature sensors
- Investigation of NTC, Pt 100, KTY and thermocouples for the electrical measurement of temperature
- Pressure measurement
- Operation and characteristics of pressure sensors
- Absolute and differential pressure sensors
- Measurement of force
- Operation and characteristics of strain gauges
- Torsion rod with strain gauges
- Bending rod with strain gauges

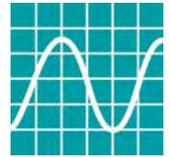


Ordering Information

Equipment List	Qty.	Order No.
Course – Measurement Technology 2: Non-electric Values Temperature, Pressure, Force	1	SO4204-8B

Accessories	Qty.	Order No.
UniTrain-1 Interface with virtual Instruments	1	SO4203-2A
UniTrain-1 Experimenter	2	SO4203-2B
Measurement accessories for UniTrain-1	1	SO4203-2J

Optional Accessories	Qty.	Order No.
UniTrain-1 digital multimeter	1	LM2321
UniTrain-1 storage case for one system	1	SO4203-2Y

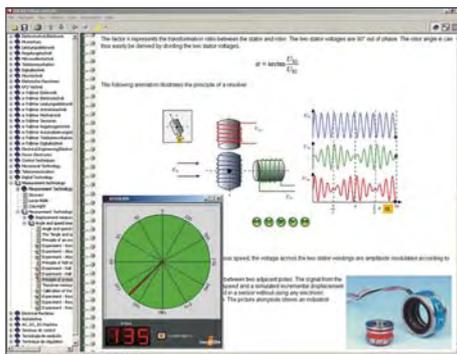


System Description

In automatic control technologies, the detection of physical variables such as displacement, rotational angle and speed are of great significance. Particularly in drive techniques, the exact position and speed of the drive machine must be known in order to correctly regulate the speed of the motor, or to realise precise positioning tasks such as those required in machine tools.

Since the measured values obtained are more often required to be electronically evaluated, the use of digital measurement techniques is becoming more and more the norm.

In the multimedia course "Measurement Technology 3: Non-electric Values Displacement, Angle, Speed", the physical principles and the functioning of these sensors are explained by way of numerous animated sequences and practical exercises.



The following sensors are part of the exercise equipment for MTI 8.3:

- Capacitive position encoder
- Inductive position encoder
- Hall sensors
- Encoder for incremental, BCD and Gray codes
- Resolver

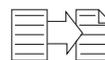
The exercise equipment consists of the following components:

- Experiment cards: Inductive displacement measurement, Capacitive displacement measurement, Speed and angle measurement, measuring amplifier Resolver
- CD-ROM with Labsoft and exercise course Measurement Technology 3



Topics Covered

- Operation and characteristics of sensors for displacement, angle and speed measurement
- Basics and circuitry of analog and digital measurement techniques for displacement, angle, rotational speed
- Study of analog measurement techniques with linear displacement sensors
- Capacitive sensors
- Inductive sensors
- Resolvers
- Encoders
- Hall sensors

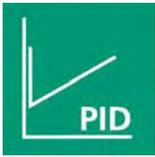


Ordering Information

Equipment List	Qty.	Order No.
Course – Measurement Technology 3: Non-electric Values Displacement, Angle, Speed	1	SO4204-8C

Accessories	Qty.	Order No.
UniTrain-I Interface with virtual Instruments	1	SO4203-2A
UniTrain-I Experimenter	2	SO4203-2B
Measurement accessories for UniTrain-I	1	SO4203-2J

Optional Accessories	Qty.	Order No.
UniTrain-I digital multimeter	1	LM2321
UniTrain-I storage case for one system	1	SO4203-2Y



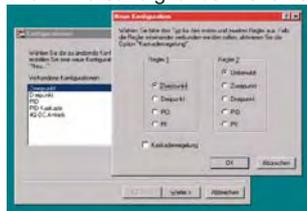
System Description

As in industrial practice, digital controllers are now replacing conventional analog controllers in the field of vocational training and education as well. In addition to their higher degree of precision and greater ease in parameter setting, digital controllers also provide excellent possibilities for integration into a process control or visualisation layer via their built-in interfaces or buses. This digital universal controller combines the functionality of a standard industrial digital controller with the capabilities of a system fully-developed and designed especially for training and education to cover all aspects of automatic engineering. The training system is supplemented by overlay masks which serve the educational purpose of constraining the functionality to the application in question. Also included are software packages for studying and optimising control loops with the aid of a PC



Configuration Software

The universal digital controller is always supplied with a fixed controller configuration. This guarantees that the student can always commence working with the same initial settings. In many cases, it is preferable to modify or delete the existing settings or add new configurations. This can be achieved using the configuration software.

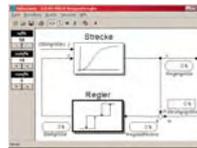


Software for Examining the Controller

With the help of the various programs for the universal digital controller, different types of controllers are easily examined, in particular the individual items following:

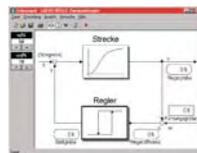
- Fundamental construction of a closed-loop control system as a block schematic diagram with standard identification of the signals
- Functioning principle and control response of the controller
- Displaying the responses of the controller variables as a function of the time
- Freely definable input variable for examining the dynamic response of the controller
- Response of the control system to interference (disturbances) by applying a specified voltage
- Limits of use for the controller
- Graphic determination of the characteristic variables in a controlled line (member)

Software Two-position Controller



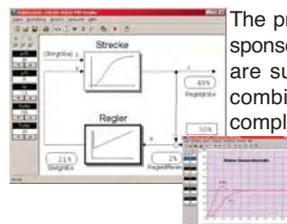
This program is used for examining the functioning of a two-position controller and its task in a closed-loop control system. A quasi continuous response by using one or two feedback paths, is also supported.

Software Three-position Controller



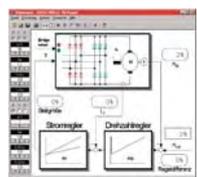
This program is used for examining the functioning of a three-position controller and its task in a closed-loop control system. A quasi continuous response by using one or two feedback paths, is also supported.

Software PID Controller



The program is used for examining the response of a PID-controller. P, I and D sections are supported, together with all possible combinations of the three sections. Also, complex controller structures can be constructed with the aid of a cascade controller.

Software 4Q Drive Controller



This program is used for examining regulated, 4-quadrant drive systems. The program is particularly suitable for use with the speed control of a DC machine. The controller used here, is a pre-configured cascaded controller, consisting of a PID-controller for speed control and a PII-controller for secondary current control.

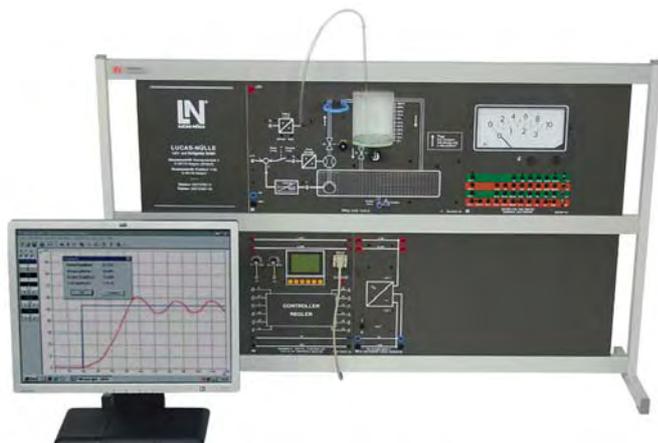
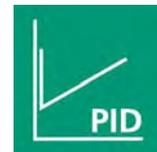


Ordering Information

Equipment List	Qty.	Order No.
Universal digital controller	1	SO3620-1A
Set of overlay masks for SO3620-1A	1	SO3620-1B

Computer Connection	Qty.	Order No.
Configuration Software (GB)	1	SO6006-5A
Software 2-pos. Controller (GB)	1	SO6006-5C
Software 3-pos. Controller (GB)	1	SO6006-5E
Software PID Controller (GB)	1	SO6006-5G
Software 4Q Drive Controller (GB)	1	SO6006-5J

Accessories	Qty.	Order No.
DC Power supply, $\pm 15V/2A$	1	SO3538-8D
Serial interface cable 9/9 pole	1	LM9040
Table-top frame, 1 level, W 1230 x H 740mm, slope of 30 degrees, grey	1	ST8003-1A



System Description

The "Filling Level Control" training system is an educational and practice-oriented experiment set-up for applied control technology.

Since the controlled variable, the height of the liquid, can clearly be seen, the experiment is especially clear and easy to understand and is thus well suited as an introduction to the subject of control technology.

A large range of experiments demonstrates the basics of closed-loop control technology. They concentrate on determining the key characteristics of controlled systems as well as the configuration and optimisation of control loops with continuous and non-continuous controllers.

The compact training module contains a vessel for filling with liquid, a pressure measurement converter for determining the current filling height and a reservoir complete with pump.

To ensure that the pumping performance is constant, a subordinate control system with a flow meter is also incorporated that can also be switched on and off separately. Disturbance variables can be simulated by means of adjustable restrictor valves that alter the flow rate to and from the vessel being filled. Quick release couplings can be used to connect an optional reserve vessel in order to create a second order control loop.

The training system can be operated with a digital controller for the Lucas Nülle panel system or with the multimedia experiment and training system UniTrain-I.

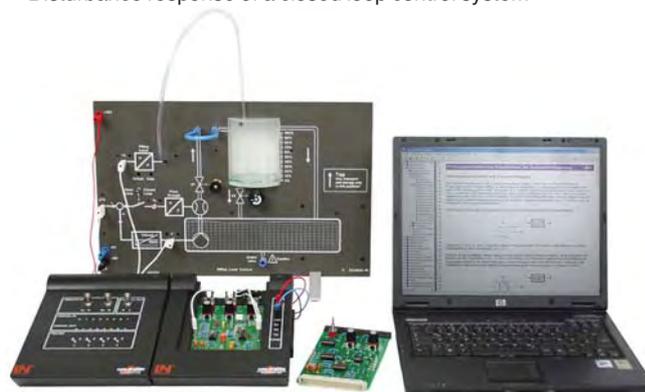
In either case students are guided through the experiments provided by easily understood multimedia software with text, graphics, animations and tests



Topics Covered

IAC10 Filling Level Control

- Control system parameters
- Design and function of a closed control loop
- Two-position controller in an integral system
- Two-position controller in a line of a higher order
- Filling level control with a continuously operating PI/PID-controller
- Filling level control with a subordinate flow control loop
- Filling level control system of a higher order
- Disturbance response of a closed loop control system



Ordering Information

Equipment List	Qty.	Order No.
Basic equipment for UniTrain-I and panel system		
Compact filling level control system	1	SO3620-1H
Additional vessel for filling level control system	1	SO3620-1J

Equipment for UniTrain-I

Course - Introduction to Process Control	1	SO4204-8E
UniTrain-I Interface with virtual instruments	1	SO4203-2A
UniTrain-I Experimenter	1	SO4203-2B
Adapter leads 4/2 mm white	4	SO5126-6V
Adapter leads 4/2 mm red	4	SO5126-6W
Adapter leads 4/2 mm blue	4	SO5126-6X
Adapter leads 4/2 mm black	4	SO5126-6Y

Equipment for panel system

Universal digital controller	1	SO3620-1A
Set of overlay masks for SO3620-1A	1	SO3620-1B
Software package for applied control technology	1	SO2805-1A
DC power supply, $\pm 15V/2A$	1	SO3538-8D
Large-scale moving coil multimeter	1	SO5127-1H
Serial interface cable 9/9 pin	1	LM9040
Safety connection plug 19/4 mm, white	3	SO5126-9X
Safety connection plug 19/4 mm, white, with tap	1	SO5126-9Z
Set of safety connection cables	1	SO5148-1A
Table-top frame, 2 levels, 1230 x 740mm, grey	1	ST8003-1C



System Description

Servo drives are widely used in industrial automatic processes. They are also used in other applications, such as for example, an electronic accelerator on motor vehicles. Therefore, the subject of servo drives has become a fixed item in the Instrumentation and Control training program.

The system consists of a servo motor (DC or AC), a setpoint potentiometer and a PID-controller. A power amplifier is included between the output of the PID-controller and the input to the motor.

6.07

The modular structure of the training system, allows the study of a DC or an AC servo motor. A block diagram of the system is screen-printed on the panels. All connections are made with 4mm safety connection plugs (jumpers).



Topics Covered

ISC 1 DC Servo Motor, Follow-up Potentiometer

- Ramp response of a servo motor to a defined ramp
- Step response of a servo motor
- Loop gain, proportional coefficient K_p , control deviation and overshoot
- Reducing the overshoot, using a D-section
- Setpoint/actual value convergence, using an I-section
- Optimising the PID-controller, by experiment
- Calculating K_p , T_n and T_v , using the dynamic method of Ziegler and Nichols
- Setpoint integrator

ISC 2 Complex DC Servo Drive

- Control characteristic of the motor-tachogenerator set
- Closed-loop control by feedback of the potentiometer voltage
- Reducing the setpoint-actual value deviation
- Transient response, with and without tacho-feedback
- Frequency response of the tacho voltage
- Reversal step response of the servo
- Step response from standstill, with various loading conditions

ISC 3 Complex AC Servo Drive

- Balance and calibrating the scale factor of the setpoint potentiometer
- Function of a frequency controlled servo
- Scale factor of the sensor, in V/degree
- Rate of change of the output signal, rate of rise of the voltage, rate of change of the angle
- Determining the linearity
- Relationship between gain and limit frequency
- Step response at various values of gain



Ordering Information

Equipment List

Equipment List	Qty.	Order No.
Servo set point	1	SO3538-8C
DC servo motor with tacho	1	SO3536-8M
AC servo motor with gear	1	SO3536-8L
PID controller	1	SO3536-6B
Power amplifier	1	SO3536-7Q
Switch, ON/Off, 1 pole, SO1	1	SO5123-7A

Exercise Literature

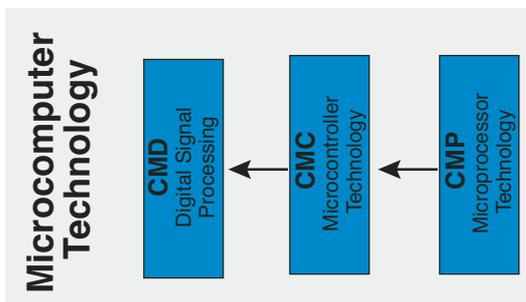
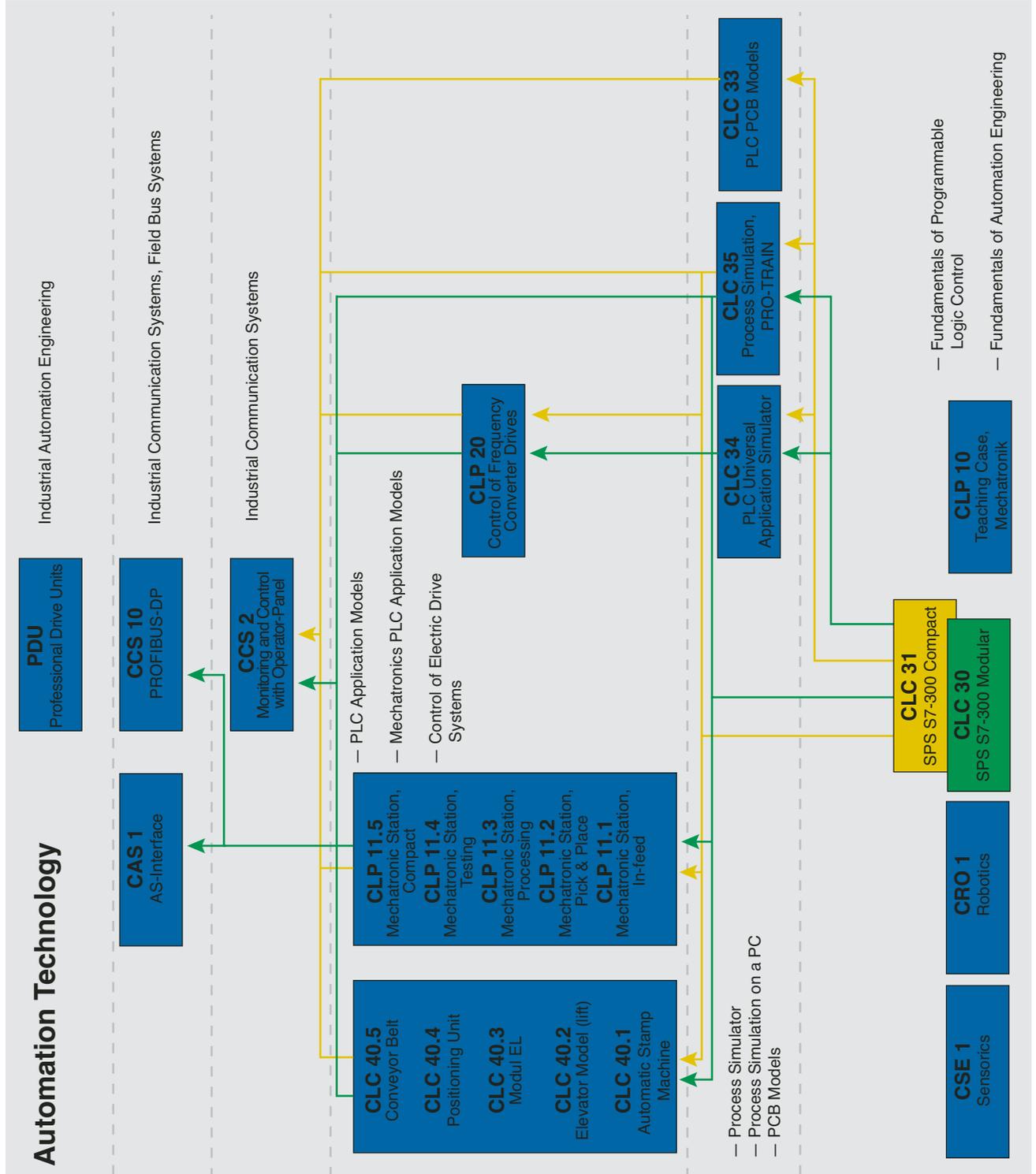
ISC 1-5 Servo Techniques (GB)	1	SO5157-3H
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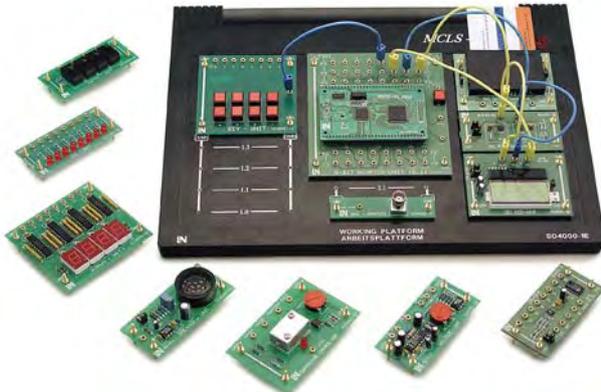
Accessories

DC Power supply, $\pm 15V/2A$	1	SO3538-8D
Function generator 0.2 - 200kHz	1	SO5127-2R
Inertia disc	1	SO3536-9A
Perlon cord (20 meter)	1	SO3536-9B
Dynamometer	2	SO3536-9C
Weight, 1N	1	SO3536-9D
Wire clip	1	SO3536-9E
Safety protected connection plug 19/4mm, white	20	SO5126-9X
Safety protected connection plug 19/4mm, white with tapping	6	SO5126-9Z
Set of safety connection cables 4mm (30 pcs)	1	SO5148-1A
Table-top frame, 2 levels, 1230x740mm, grey	1	ST8003-1C

Test Instruments

Digital storage oscilloscope, incl. probes	1	LM6205
4mm Adapter for test probe	2	LM9010
Test lead, BNC/4mm	1	LM9032





System Description

The MCLS modular microcomputer training system is of modular design and consists of a working platform that accommodates the microcontroller or experiment modules, the exercise modules themselves and a software development environment in four languages.

The hardware is connected to a PC via a serial interface. Inputs and outputs to and from the exercise module are in the form of 2-mm plugs and sockets.



Topics Covered

CMC 1 Introduction to Microcontroller Programming 8051 Microcontroller C515C

- Introduction to the development environment
- Working with a debugger
- Design and function of a microcontroller
- Peripherals (ports, clocking, reset circuit)
- Timing, ALU, I/O-Ports
- Memory structure and instruction list for a microcontroller
- Assembler programming
- Introduction to structured programming

CMC 3 Programming of On-Chip Peripherals

- Function and use of interrupts
- Interrupt vectors and vector tables
- Sequence of interrupt and interrupt handling
- Timer programming
- Main components of a timer
- Counter and timer functions
- Auto-reload, compare mode, capture mode
- Use of analog-digital converters
- Characteristics of on-chip analog-digital converters
- Parameters, timing

CMC 5 C-Programming

- Introduction to the C programming language
- Features of C programming in embedded systems"
- Use of a C compiler
- Use of function libraries
- Basic structure of a C program
- Use of ports and pins
- I/O operations
- Conditional branching
- Sub-routines
- Interrupts, external interrupts, timers

- Numbers of events
- Output and measurement of frequencies
- Functioning and control of I2C bus
- Control of LCD displays
- Use of analog-to-digital converters

Also available:

- CMC 2 Control using a C515C microcontroller
- CMC 4 Programming of data transfer interfaces



Computer Connection

After a short period of familiarisation, the integrated Windows development environment (IDE) for Windows 2000, XP and Vista can be used for compiling, testing and optimising microcontroller programs.

The necessary development tools including an editor, assembler, converter and debugger are incorporated into the development environment. Support for the system is available on the Internet at:

<http://www.mcls-modular.de>



Ordering Information

Equipment List	Qty.	Order No.
Platform with power supply module +5 V	1	SO4000-1E
Plug-in AC power supply 90...230 V 45...65 Hz, DC 9 V 630 mA	1	SO4000-1F
IDE software for MCLS (D, GB, F, E)	1	SO4001-9H
PSD1 flash module controller C515C	1	SO4000-1G
8-bit adapter unit	1	SO4000-1K
Display unit 2 (LCD)	1	SO4000-1B
LED unit (8 bit)	1	SO4000-1P
Key unit (8 keys)	1	SO4000-1Q
Switch unit (4 crossover switches)	1	SO4000-1R
Display unit 1 (7-segment)	1	SO4000-1S
BNC adapter	1	SO4000-1T
Bus driver unit	1	SO4000-1V
Temperature control unit	1	SO4000-3C
Voltage unit	1	SO4000-3D
Speaker unit	1	SO4000-3G
Function generator unit	1	SO4000-3H
D/A unit	1	SO4000-3L
I2C LCD unit	1	SO4000-3M
I2C smart card unit	1	SO4000-3N
I2C memory card	1	SO4000-3O
I2C RTC temp. unit	1	SO4000-3P

Connector Leads

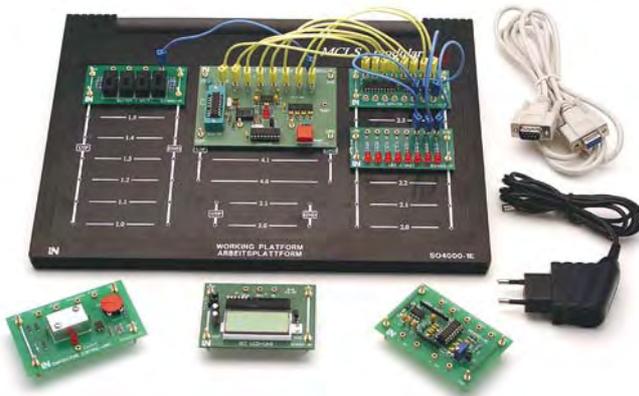
Serial interface cable 9/9 pin	1	LM9040
Measurement leads 2 mm, 15 cm, blue	10	SO5126-5K
Measurement leads 2 mm, 15 cm, yellow	10	SO5126-5M

Optional Accessories

Storage case for MCLS	1	SO4000-1W
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Exercise Literature

CMC 1 Introduction to microcontroller programming 8051 microcontroller C515C	1	SH5004-1A
CMC 3 Programming of on-chip peripherals (C515C)	1	SH5004-1C
CMC 5 C programming for microcontrollers (C515C)	1	SH5004-1D



System Description

The MCLS modular microcontroller training system is intended for teaching programming methods for microcontrollers and microprocessors to electronics engineers. The microcontroller teaching system is of modular design and consists of a working platform that accommodates the processor, the microcontroller, the exercise modules themselves and a software development environment in four languages. The hardware is connected to a PC via a serial interface. Inputs and outputs to and from the exercise module are in the form of 2-mm plugs and sockets.

APIC 16F8x ISP unit handles programming and testing of PIC 16F83, PIC 16F84 and PIC 16C84 microcontrollers. The ISP unit allows for access to all on-chip peripheral hardware as well as for implementation of experimental set-ups.



Topics Covered

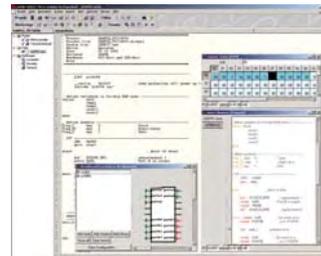
The content of the experimental exercises is designed for the training of electronics engineers setting up control systems and equipment. Training panel 7 is used to teach trainees how to configure hardware and software components by means of microcontroller applications using the PIC 16F84 microprocessor.

- Microcomputers, introduction
- Introduction to the development environment
- Working with a simulator
- Design and function of a microcontroller (internal structure)
- Memory structure and instruction set of the microcontroller
- Programming a microcontroller
- Parallel I/O ports
- Measurement of analog values and conversion from analog to digital
- Output of values (LED lines/LCD display)
- The I²C bus
- Output of values to an I²C display
- Integrated practical exercises
- Analysis and structural design
- Implementation with instructions
- Design, commissioning and testing
- Integrated tests



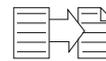
Computer Connection

After a short period of familiarisation, the integrated Windows development environment (IDE) for Windows 2000, XP and Vista can be used for compiling, testing and optimising microcontroller programs. For use of the MCLS modular system with the PIC 16F8x ISP unit, it is assumed that a simulator will be used for debugging of programs. The necessary development tools including an editor, assembler, converter and simulator are incorporated into the development environment.



Support for the system is available on the Internet at:

<http://www.mcls-modular.de>

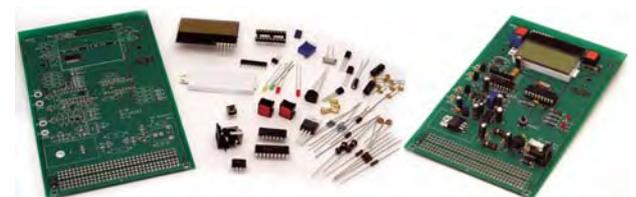


Ordering Information based on CMC 1

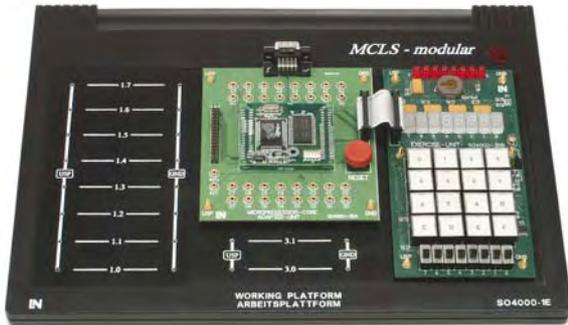
Equipment List CMC 2	Qty.	Order No.
ISP unit PIC16F8x	1	SO4000-1L
Platform with power supply module +5 V	1	SO4000-1E
Plug-in power supply AC 90...230 V 45...65 Hz, DC 9 V 630 mA	1	SO4000-1F
IDE software for MCLS (D, GB, F, E)	1	SO4001-9H
LED unit (8 bit)	1	SO4000-1P
Switch unit (4 crossover switches)	1	SO4000-1R
Bus driver unit	1	SO4000-1V
Temperature control unit	1	SO4000-3C
14-bit ADC unit	1	SO4000-3E
I ² C LCD-Unit	1	SO4000-3M
Practical exercises in microcontroller tech.	1	SO4000-2Y

Connector Leads	Qty.	Order No.
Serial interface cable 9/9 pin	1	LM9040
Measurement leads 2 mm, 15 cm, blue	10	SO5126-5K
Measurement leads 2 mm, 15 cm, yellow	15	SO5126-5M

Exercise Literature	Qty.	Order No.
CMC10 Programming using the PIC16F84 microcontroller (D)	1	SH5004-1K



Practical exercises in microcontroller technology



System Description

The modular microcomputer teaching system is used for training in the subject area of "Microcontroller and Microprocessor Techniques". The microcomputer teaching system is of modular construction and consists of a work-platform for accommodating the microprocessor and exercise modules that may be required, the module itself and a software development environment.

The hardware is connected to the Personal Computer by way of a serial interface. Connections for inputs and outputs on the exercise module, use a 2mm plug and socket system. Flat ribbon cables are used for the Bus connections.

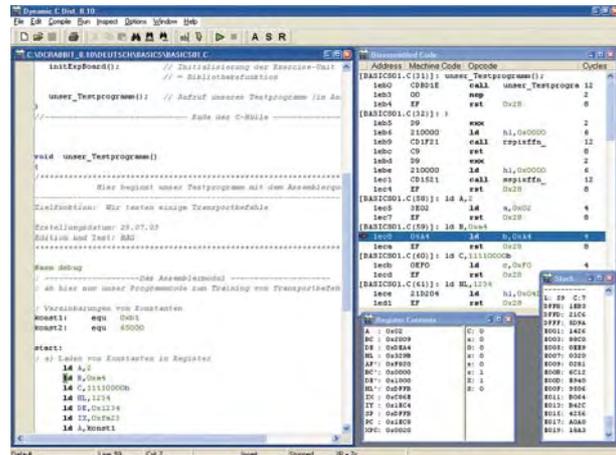
- Fixed exercise assembly, no variable wiring connections within the basic course
- Portable exercise assembly
- Use of the uniform basic equipment within the MCLS – modular[®] system
- Optional exercise modules can be connected
- Connection to PC via RS232
- Z80- derivative used as Target
- Use of software Tools, incl. C

Exercise 4

- Use and initialising Interrupts
- Initiating an external Interrupt (INT0)
- Periodic initiation of Interrupts (TIMER B)

Exercise 5

- Reading binary 8-bit measured values of the ambient temperature
- Filling a memory area with 16 values of measured temperature
- Forming an average value of the 16 measured values
- Converting 8-bit binary to a 3-digit BCD value



Software Tools

- Main properties, Use and special features of the C-environment
- Combined Editor, Compiler, Linker, Loader and Debugger in one Tool
- Assembler code can be included
- Extended functionality in comparison to conventional C, specialised for use with embedded systems
- ISR (interrupt service routine) can be written in C
- Libraries are used in the source code in place of Include-files



Topics Covered

Exercise 1

- Introduction to the development environment
- Transport commands
- Access to I/O components
- Loop instruction, DJNZ
- Using functions in the library of the Exercise-Unit

Exercise 2

- Types of addressing
- Logic and arithmetic instructions
- Conditional Jump (Branch) instructions
- Flags

Exercise 3

- Use of Variables
- Sub-routine techniques
- Stack function



Ordering Information

Equipment List	Qty.	Order No.
Platform with power supply module +5V	1	SO4000-1E
Mains adapter, AC 90...230V 45...65Hz, DC 9V 630mA	1	SO4000-1F
16-bit microprocessor training system	1	SO4000-3S

Connection Cables

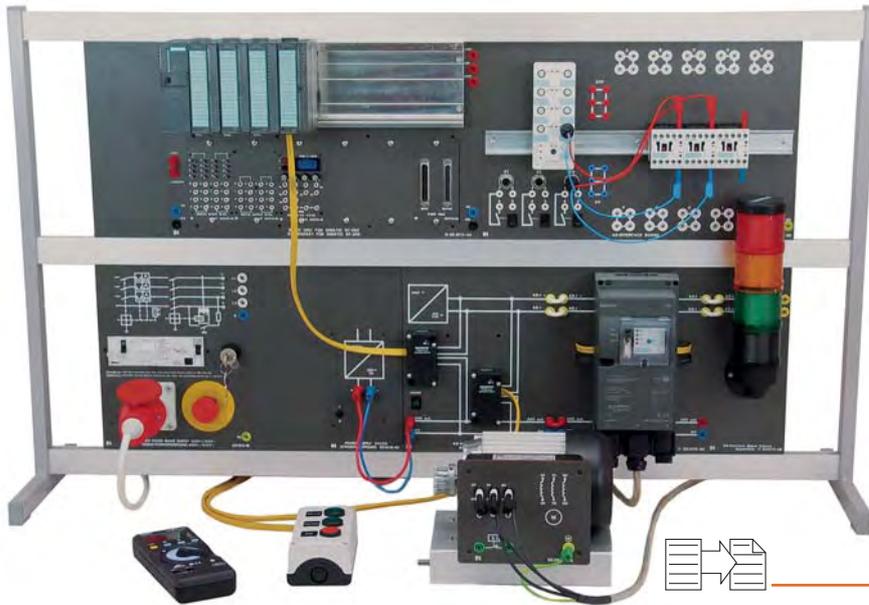
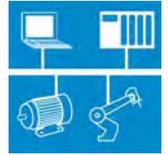
Serial interface cable, 9/9-pole	1	LM9040
Connection cable 2mm, 15cm, blue	8	SO5126-5K
Connection cable 2mm, 15cm, yellow	8	SO5126-5M

Optional Accessories

Logic probe	1	LM8101
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Exercise Literature

CMP 1 Basic Course Microprocessor Techniques	1	SO5159-1T
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System Description

The actuator-sensor interface (AS interface) is an open and standardised networking system for the lowest fieldbus level.

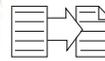
The AS interface is used where individual actuators and sensors are distributed over a wide area of a machine or plant and a direct fieldbus connection has up to now, been impossible to implement either for technical reasons or for reasons of cost. It can do away with the need for the complex wiring of control cables and distributor panels. Service and maintenance requirements are also considerably reduced. Due to such possibilities for savings and its simple installation and commissioning, the actuator-sensor interface has already become a widely used standard in automation technology.

The modular AS interface training system contains a representative and economical selection of AS-i devices. Industrial components are used exclusively and the devices are connected in many cases using the original AS-interface profiled cable in order to advance the students' familiarity with the equipment and convey the necessary practical skills for its use.



Topics Covered

- Connecting and installing AS interface devices
- Addressing AS interface devices and incorporating them into the bus structure
- Developing and analyzing application programs
- Design programming and analysis of control circuits
- Use of the AS-interface addressing and diagnostic equipment



Ordering Information

Equipment List	Qty.	Order No.
Basic unit with CPU 313C (SIMATIC S7) incl. DC 24V/2A ± 15V/1A, 5V/2A	1	SO3713-2C
System connector for PLC basic unit (SIMATIC)	1	SO3713-3A
Blank panel for basic unit	2	SO3713-3Z
Communications processor CP 343-2 P for connecting an S7-300 to the AS-interface	1	SO3713-5K
AS-interface power supply	1	SO3715-5A
AS-interface board	1	SO3715-5D
AS-interface I/O module digital 4/4	1	SO3715-5E
AS-interface control and signal unit	1	SO3715-5K
AS-interface indicator column	1	SO3715-5M
AS-interface compact motor starter	1	SO3715-5N
Three-phase asynchronous motor, 0.3kW N=1400 (230V/400V) (industrial line)	1	SE2673-1K

Computer Connection

Software STEP 7 - Basis for S7, M7, C7 (GB)	1	SO6007-1P
PLC-S7 PC-adapter with RS232/MPI converter	1	SO3713-5C
RS232-cable for PLC-S7 PC-adapter	1	SO3713-5D

Exercise Literature

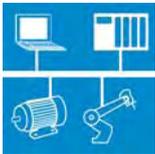
CLC30 PLC Fundamentals, STEP 7 basics (GB)	1	SO5160-1H
CLC30 PLC Fundamentals, STEP 7 reference books (GB)	1	SO5160-1J

Power Supply

Three-phase supply 400V/16A	1	SO3212-1B
DC Power supply, 24V/2A stabilised	1	SO3538-8C

Accessories

AS-interface addressing and diagnostic equipment	1	LM8150
Profiled cable for AS-Interface (yellow), per metre	5	LM9190
Profiled cable for AS-Interface, 24 V DC (black), per metre	2	LM9191
Shaft end guard, 0.1/0.3kW	1	SE2662-2B
Set of safety connection cables 4mm (47 pcs)	1	SO5148-1F
Table-top frame, 3 levels, W 1460 x H 1060, grey	1	ST8003-1T



System Description

Automation engineering is becoming more and more significant both in daily use in production as well as in trade training. PLC systems are an integral part of automation technology today. The objective of the PLC training is to provide practice-oriented training for the trainees. The requirements for this are satisfied by the methodical, didactic structure of the instruction. All essential information and skills are taught in a practical, time-saving and effective manner. The "hands-on" experimenting and teaching with the universal application simulator is oriented towards these requirements. Thus, this training system forms the basis for teaching fundamentals but is equally suitable for further study in the instruction of PLC programming. At the core of the Lucas-Nülle PLC training system is the modular constructed basic unit, incorporating industrial components of the SIMATIC S7-300 series from the Siemens Company. Each industrial component is assigned a didactical input or output module. These modules incorporate 4mm safety-protected sockets and simulation switches and/or potentiometers for simulating digital and analog input signals. The basic unit also has connection facilities for an external emergency stop circuit as well as an integrated DC power supply +24V/2A, ±15V/1A and +5V/2A, for supplying application models. To demonstrate the use of PLCs in this exercise equipment, the PLC universal application simulator is used. By the application of overlay masks, the training system can be used for simulating a variety of applications and processes. The states of actuators and sensors are indicated on a series of LED's. For simulating movement and positioning, 3 running-light displays are integrated in the unit. A LED bar-graph shows the analog states (e.g. filling level). The states of the sensors can be simulated by the integrated pushbuttons and switches. Process check-back indications are automatically generated by the simulator. This means for example, in the case of the "Filling level control" analog model, that the output signal is not adjusted at the integrated potentiometer, but rather the filling rate of the inflow. The corresponding filling level is internally generated so that the real process is depicted as accurately as possible. Connections between the PLC and the universal application simulator are made with 4mm safety connection cables or by way of two, 37-pole cables each SUB-D connectors.



Topics Covered

PLC Programming

- Ladder logic (LAD)
- Sequential function chart (SFC)
- Statement list (STL)

PLC Applications

Description	Dig.in	Dig.out	Anal.in	Anal.out
• Traffic lights (building site)	4	4	–	–
• Star-Delta circuit	3	5	–	–
• Dahlander circuit	3	6	–	–
• Starter control	4	6	–	–
• Monitoring system	2	6	–	–
• Tank filling plant	3	8	–	–
• Sluice-gate control	6	8	–	–
• Re-routing platform	5	8	–	–
• Buffer storage	2	5	–	–
• Filling level line	2	5	1	2
• Mixer plant	3	6	2	2
• Compressed air network	5	6	2	2



Computer Connection

Programming the PLC is realised with typical industrial software. Connection is made to the RS232 interface of a PC. The software is fully integrated with MS-Windows with its typical straightforward operation. The following functions are available:

- Binary logic (including edge evaluation)
- Word operations
- Timer/Counter
- Compare and Conversion functions
- Shift/Rotate
- Mathematic functions (incl. trigonometry, exponents, logarithms)
- Program control (Jumps, Jump distribution, Call, Master control relay)



Ordering Information

Equipment List	Qty.	Order No.
Basic unit with CPU 313C (SIMATIC S7) incl. DC 24V/2A, ±15V/1A, 5V/2A	1	SO3713-2C
WORD input/output with coding switch and LED display	1	SO3713-3F
System connector for basic unit	1	SO3713-3A
Blank panel for basic unit	1	SO3713-3Z
PLC universal application simulator	1	SO3715-1A
Set of overlay masks for PLC universal application simulator I	1	SO3715-1B
Set of overlay masks for PLC universal application simulator II	1	SO3715-1C

Computer Connection

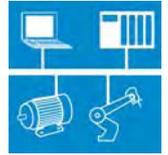
Software STEP 7 - Basis for S7, M7, C7 (GB)	1	SO6007-1P
PLC S7 PC adapter with RS232/MPI converter	1	SO3713-5C
RS232 cable (0-modem) for PLC S7 PC adapter	1	SO3713-5D

Exercise Literature

CLC 30 PLC Fundamentals, STEP 7 basics (GB)	1	SO5160-1H
CLC 30 PLC Fundamentals, STEP 7 reference books (GB)	1	SO5160-1J
CLC 34 Process Simulators; PLC System Simulator I (GB)	1	SO5160-2J
CLC 34 PLC Process Simulators; PLC System Simulator II (GB)	1	SO5160-2K

Accessories

Set of connection cables for PLC	1	SO5145-5B
Table-top frame, 1 level, 1230x740mm, with a slope of 30 degrees, grey	1	ST8003-1A

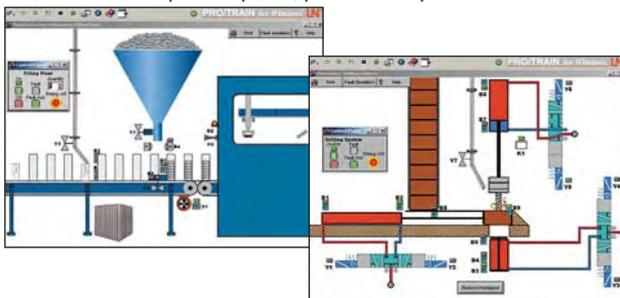


System Description

It is not really satisfactory to attempt to provide an effective and thorough training using the highly complex production systems in industry. Therefore training systems must be used where the primary system relationships are clearly defined and can be processed by the student without any interruption to the actual manufacturing procedure. PRO/TRAIN for Windows is a training system, with which various stages of automatic processing can be presented at a workplace and simulated for practice-oriented training.

The teaching system consists of the components software, hardware and teachware.

The software simulates and provides visual display of typical technological processes, machines and drives on a PC. The software models are exact in detail with respect to form and responses. Each model incorporates a demonstration mode allowing the process to be closely analysed. Sources of disturbance to the processes are simulated in a practice-oriented manner and can be defined by the User as random or activated via the keyboard. Control errors are detected by the software and recorded (memorised). All switches and push-buttons required for operating the models, are integrated in the relevant simulation. The use of real hardware for monitoring and control, such as an Operator panel, presents no problems.



The I/O-Interface connects the PC via the serial interface to the signal inputs and outputs of a PLC system. In this way, process models can be connected to digital actuators and sensors as well as analog actuating elements and signal sensors, to produce practical control. The Actuators in the model are directly controllable by the PLC and the switching states of the sensors are fed back to the PLC. The signal level for connection to the PLC has been designed so that any industrial type of PLC system can be connected to the Interface.

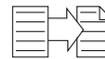
Comprehensive online help is provided in each model package, that contains general descriptions to the simulation models, the control tasks as well as example PLC programs. The control programs are documented as generally valid sequential function charts (SFC), according to the IEC-1131 standards. The input and output signals are annotated with assignment and connection lists. This ensures a simple translation into the respective PLC program language.



Topics Covered

Control of Technical Processes

- Control and testing technical processes.
- Parameter adjustment, programming and operating a PLC system
- Fault finding in technical processes



Ordering Information

Equipment List	Qty.	Order No.
I/O Interface for PRO/TRAIN for Windows	1	SO3715-1H
Basic unit with CPU 313C (SIMATIC S7) incl. DC 24V/2A, ±15V/1A, 5V/2A	1	SO3713-2C
Blank panel for basic unit	2	SO3713-3Z
System connector for basic unit	1	SO3713-3A

Computer Connection

Software STEP 7 Basis for S7, C7, M7 (GB)	1	SO6007-1P
PLC-S7 PC-adapter with RS232/MPI converter	1	SO3713-5C
RS232-cable for PLC-S7 PC-adapter	1	SO3713-5D

PRO/TRAIN Real Process Models

Software pneumatic (GB)	1	SO6006-6C
Software hydraulic (GB)	1	SO6006-6E
Software electrical machines (GB)	1	SO6006-6G
Software manufacturing techniques (GB)	1	SO6006-6J
Software process engineering (GB)	1	SO6006-6L

Exercise Literature

CLC 30 PLC Fundamentals, STEP 7 basics (GB)	1	SO5160-1H
CLC 30 PLC Fundamentals, STEP 7 reference books (GB)	1	SO5160-1J

Accessories

Serial interface cable 9/9 pole	1	LM9040
Set of connection cables for PLC-S7 system connector	1	SO5145-5B
Table-top frame, 1 level, W 1230 x H 740mm, slope of 30 degrees, grey	1	ST8003-1A



System Description

For the automation of technical processes in industry, some form of PLC system is used as a primary system for controlling the individual automation components. To drastically reduce the cabling and maintenance required in manufacturing plants, the system components are all coupled by way of a standardised field-bus system. The PROFIBUS-DP field-bus, used in this equipment set, is commonly used in industry and presents a practical application of drive and automation engineering for the students. The main emphasis of the exercises included in the training system CLP 20, is on project planning and programming the PLC and the Operator panel, as well as operating and parameter adjustment of the frequency converter and field-bus system. The Lucas-Nülle servo brake can be used in this training system for loading the frequency converter controlled drive machine. Here, various production machines can be simulated and their parameters adjusted. All component parts of this equipment set are industrial systems, didactically prepared, where the parameters can be adjusted and programmed with the original software. The system can, also be operated without the PROFIBUS-DP field-bus system.

7.07



Topics Covered

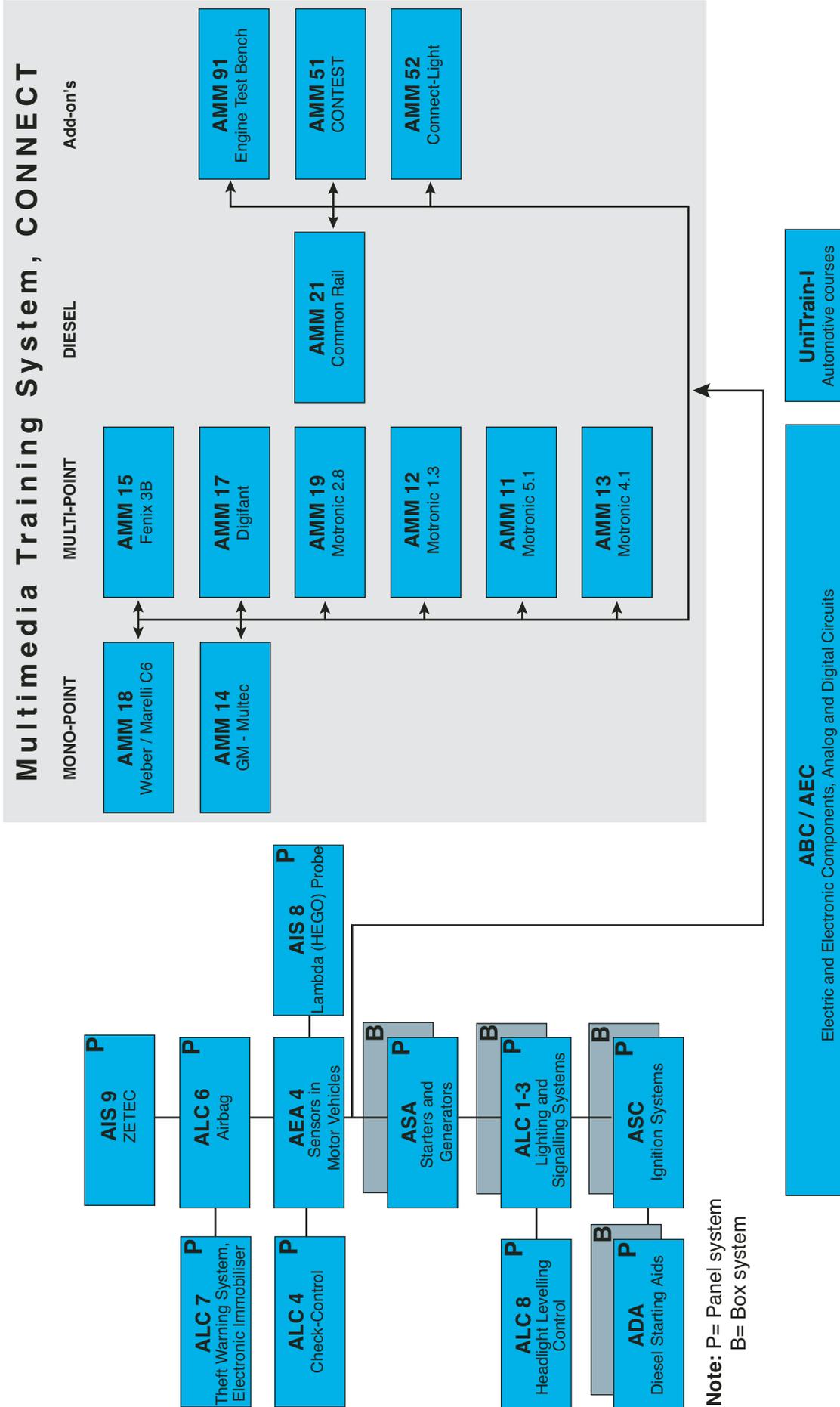
CLP 20 Control of Electric Drive Systems

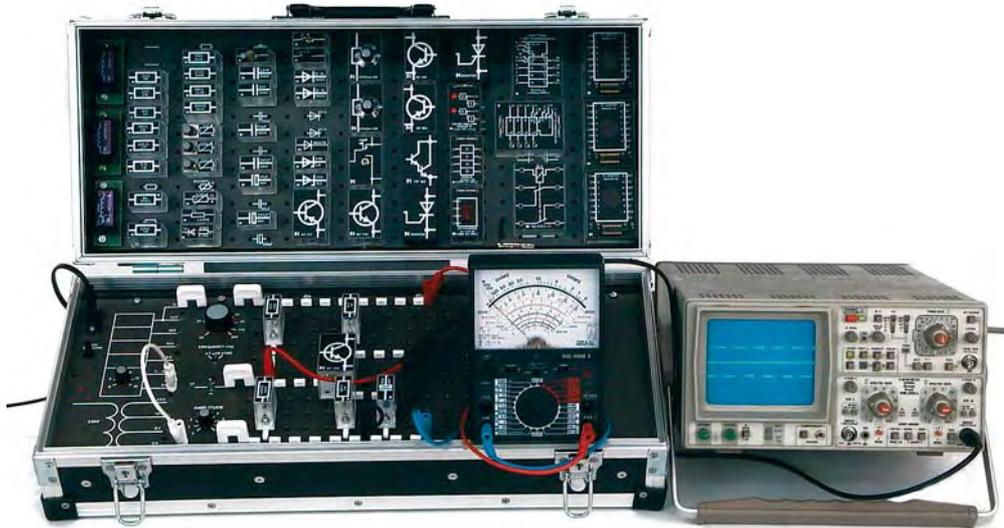
- Parameter adjustment, programming and operating a PLC system
- Project planning and operating an Operator panel
- Parameter adjustment and operating a frequency converter
- Project planning and operating a field-bus system
- Optimising the parameters to the various adjustable work machines



Ordering Information

Equipment List	Qty.	Order No.
Basic unit with CPU 314C-2 DP (SIMATIC S7)		
incl. DC 24V/6A	1	SO3713-8D
Blank panel for basic unit	2	SO3713-7H
Blank panel for basic unit	1	SO3713-7J
Touch Panel TP177B		
incl. WinCC Flexible Advanced	1	SO3713-4L
Frequency converter (VC), industrial type	1	SO3636-5D
PROFIBUS-DP interface module	1	LM8926
Brake resistor for frequency converters	1	SO3636-5V
Three-phase asynchronous machine (ind. v.)	1	SE2673-1K
Servo machine test stand for 0,3kw machines		
incl. Software Active Servo	1	SO3636-6V
Rubber Coupling sleeve 0.3kW	1	SE2662-2A
Shaft guard, 0.1/0.3kW, transparent	1	SE2662-7B
Gear with operating arm	1	SE2664-1A
Mechanical sensor	1	SE2664-1F
Inductive sensor	1	SE2664-1J
Capacitive sensor	1	SE2664-1M
Optical sensor	1	SE2664-1Q
Connection cable for PROFIBUS-DP	3	LM9181
Connection plug for PROFIBUS-DP	3	LM9182
Wire stripper for PROFIBUS cables	1	LM9184
Exercise Literature CLP 20		
Controlling electric drive systems (GB)	1	SO5160-2U
Power Supply		
Universal power supply for DC and threephase	1	SO3212-5U
Test Instruments		
Analog/digital multi meter, wattmeter and power-factor meter	1	SO5127-1Z
Computer Connection		
STEP 7, Basis for S7, M7, C7 (GB)	1	SO6007-1P
PLC-S7 PC-adapter with USB/MPI converter	1	SO3713-5E
RS232/RS485 interface module	1	LM8925
Connection cable for LM8925	1	LM9028
Accessories		
Set of safety connection cables 4mm (47 pcs)	1	SO5148-1F
Safety protected connection plug 19/4mm, white	15	SO5126-9X
Safety protected connection plug 19/4mm, white, with tapping	5	SO5126-9Z
Table-top frame, 3 lev., W 1460 x H 1060mm, gr	1	ST8003-1T





System Description

The LN-Case /Plug-in system contains, in a compact form, electric and electronic plug-in components, modular panels for power supplies, test instruments and exercise systems as well as (where necessary), universal patch-panels for circuit assembly. As a portable exercise system, it can be used anywhere for individual or small group work, whether in the laboratory, in seminars or in the training workshop. The case lid has a printed plan so that each component can be safely stored in a tidy fashion.



Topics Covered

ABC 1 Fundamentals of Electrical Engineering

Connection of test instruments, Voltage & current measurements, Ohm's Law, Kirchhoff's Laws, Resistor networks, Power measurements ...

AEC 1 Fundamentals of Automotive Electronics

Voltage divider, LDR, Bridge circuits, Capacitor circuits, R-L-C-circuits, Transformer...

AEC 2 Semiconductor Components

Diodes, LED's, Z-diode, Transistor, Thyristor....

AEC 3 Basic Electronic Circuits

Rectifier circuits, Transistor-, Thyristor as switch, Voltage stabilisation, Schmitt trigger, Multivibrator circuits

AEC 4 Applied Electronic Circuits

Electronic voltage regulator, Contact-controlled ignition system (TSl-c), Electronic R.P.M. counter, Overvoltage protection for alternators ...

AEA 2 Basic Digital Circuits and Applications

Logic gates (AND, OR, NAND, EXOR), Half- / Full-adder, Bistable multivibrator, RS Flip-flops, Binary and Decimal counters, Shift register, etc.



Ordering Information

Automotive Case

Case, storage system for components	1	SO5127-3D
Universal panel (2mm plugs)	3	SO5127-4M
Power supply (BIBB)	1	SO5127-4T
Sine / Squarewave generator	1	SO5127-4H
Blank panel for case, Format A, 57mm	1	SO5126-1H

Equipment List

	Qty.	Order No.
Basic equipment: Electronic basics	1	ABC 1/SP
Add-on basics of automotive electronics	1	AEC 1/SP
Add-on semiconductors	1	AEC 2/SP
Add-on basic electronic circuits	1	AEC 3/SP
Add-on applied electronic circuits	1	AEC 4/SP
Add-on basic digital circuits and applications	1	AEA 2/SP

Exercise Literature

ABC 1, AEC 1 Fundamentals of Electrical Engineering (GB)	1	SO5157-7Q
AEC 2/3 Semiconductors/Basic Circuits (GB)	1	SO5157-7R
AEC 4 Applied Electronic Circuits (GB)	1	SO5157-7S
AEA 2 Basic Digital Circuits & Applications (GB)	1	SO5157-7T

Accessories

4mm connection cable 100cm red	2	SO5126-2V
4mm connection cable 100cm black	2	SO5126-2W
4mm connection cable hollow plug 15cm	15	SO5126-4E
2mm connection cable 15cm yellow	15	SO5126-5M
2mm connection cable 30cm yellow	15	SO5126-5U
Connection plugs 4mm/19mm	4	SO5124-7A
Connection plugs 2mm/7.5mm	80	SO5124-7S

Test Instruments

Analog multimeter	1	LM1101
Digital multimeter	1	LM2105
Dual trace oscilloscope	1	LM6203
Adapter for test probes	2	LM9010



System Description

The LN lighting systems training system, including all of its auxiliary equipment, is comprised of authentic automotive components. The equipment corresponds to the latest lighting technology currently in use in modern motor vehicles. The rear lights also include, in addition to conventional lights, LED equipped lamps. The front headlamps are standard automotive components already equipped with headlight range adjustment.



Topics Covered

ALC 01 Lighting Systems and Relay Circuits

- Interior lighting
- Tail lighting (towing vehicles and trailers)
- Main lighting with headlight range adjustment
- Fog lamp system
- Halogen headlights
- Parking light circuit

ALC 02 Acoustic and Optical Signalling Systems

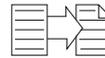
- Standard and power horn system
- Turn indicator system
- Two-circuit indicator system
- Hazard warning and indicator system

ALC 04 Automotive Check Control

- Measurement and control modules
- Dimensioning different
- Investigating overall system
- Fault-finding overall system

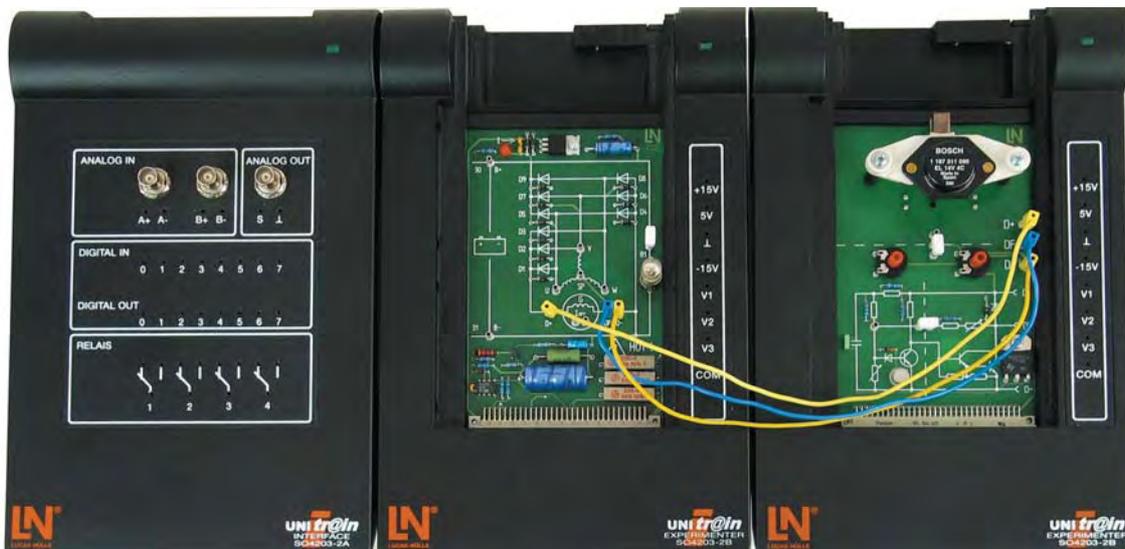
ALC 07 Anti-theft Warning System with Electronic Immobiliser

- Programming the anti-theft alarm system
- Extending anti-theft system, electr. immobiliser



Ordering Information

Equipment List	Qty.	Order No.
Basic equipment main lighting system	1	ALC 1.1
Add-on set Auxiliary lighting	1	ALC 1.2
Add-on set Trailer lighting	1	ALC 1.3
Add-on set Acoustic signaling systems	1	ALC 2
Add-on set Automotive check control	1	ALC 4
Add-on set Anti-theft alarm system with electronic immobiliser	1	ALC 7
Accessories		
Power supply 12V/35A	1	LM4131
Connection plugs 4mm / 19mm	20	SO5124-7A
Set of connection cables 4 mm	1	SO5146-1K
Digital multimeter	1	LM2105
Table top frame (3 levels)	1	ST8003-1D



System Description

The UniTrain – course on the topic "automotive alternator" contains three cards and a multimedia course on the topic of generator, regulator and rectifier circuits.

As tools, we have at our disposal, besides multimeters and the integrated oscilloscope, also an rpm indicator.

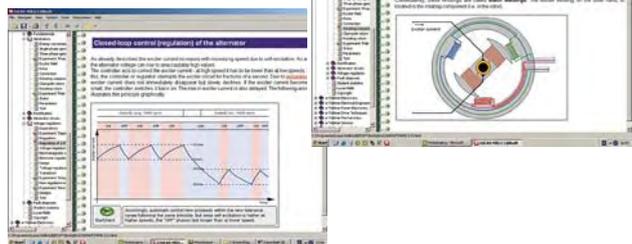
The UniTrain-I – experiment cards "Rectification" contain typical elements on the topics of diodes and multi-way rectifier circuits. The following subjects are covered:

- Diodes, diode types and how they operate
- Rectification, voltage stabilization
- One-way rectification
- Two-way rectification, bridge circuit

The UniTrain-I experiment card "Generator" (alternator) contains in addition to a three-phase voltage feed, also a battery simulation and all necessary diodes for the rectification of the operating voltage and the exciter voltage. The generator can be examined in regulated and unregulated mode.

8.03

Consider the "controller" card as a supplement to the "Generator" (alternator) experiment card. In addition to the real regulator there is also a discretely assembled controller available. Both controllers operate precisely as they do in the motor vehicle, whereby the discretely assembled controller can intervene in the system's control response. The switching thresholds, as well as the operating frequency, can be set using potentiometers.



Topics Covered

The course conveys knowledge and handling skills needed in working with the topic of "alternators".

Experiment-based investigations, measurements and troubleshooting are at the heart of this course and provide training on how the system operates, responds and functions

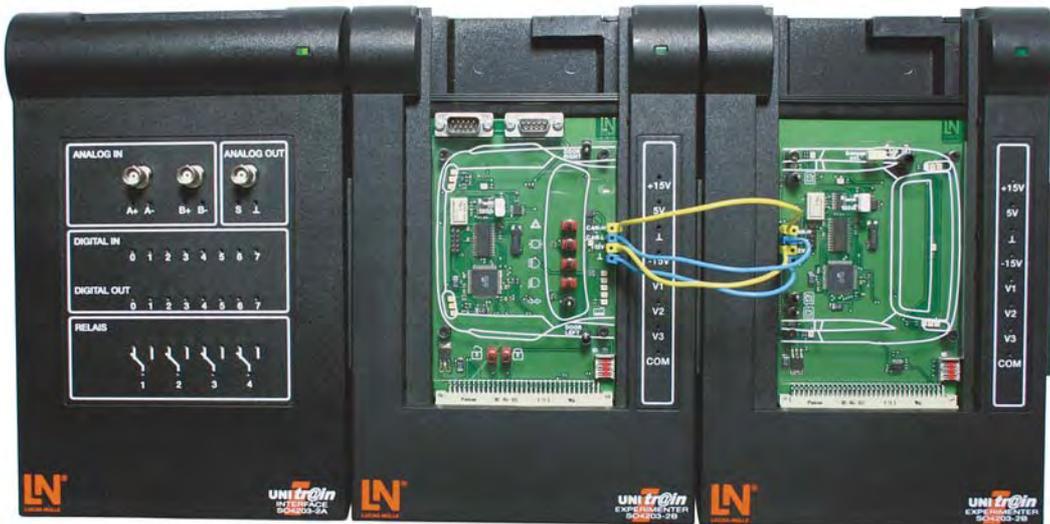
- Fundamentals of the magnetic field, induction
- Generating alternating voltage and rectification
- Diodes, rectification
- The generator, design and function
- The controller, how it works
- Generator circuits
- Voltage regulation
- Fault analysis
- Learning checks



Ordering Information

Equipment List	Qty.	Order No.
Automotive Technology 4: Alternator	1	SO4204-7D

Accessories	Qty.	Order No.
UniTrain-I Interface with virtual instruments	1	SO4203-2A
UniTrain-I Experimenter	2	SO4203-2B
UniTrain-I Extended Power Supply	2	SO4203-2D
Measurement accessories for UniTrain-I	1	SO4203-2J



System Description

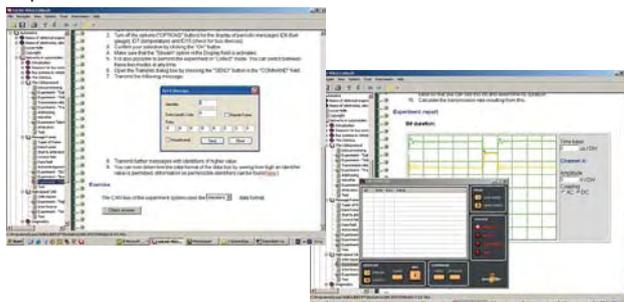
The UniTrain – course on the topic "Networks in Motor Vehicles" contains two experiment cards and a multimedia course on the CAN bus. As tools, in addition to the multimeters and the integrated oscilloscope, we also have a CAN monitor which can be used to carry out bus analysis or to generate and transmit CAN data via the keyboard.

The **UniTrain-I** experiment card "vehicle front" contains elements typical of automotive electronics. The card depicts the front end of the vehicle as independent CAN nodes in a manner similar to that in which they can be found in modern motor vehicles. Operating elements can be used to control the following functions:

- Turn signal left /right/hazard warning flasher
- Dipped headlight/main headlight beam
- Brake light
- Door contacts with dimmable interior lighting
- Central locking system on/off

Every actuation of an operating element causes a CAN – message to be generated, which triggers corresponding actions on this and / or on other connected CAN nodes. The experiment card can be connected to the "rear vehicle" card using the 2-mm sockets on the right side of the card and it can be connected to other CAN nodes via the Sub-D9 sockets on the upper side of the card.

Predefined faults are produced in the circuit using the fault simulation program. This illustrates the influence of bus disturbances and trains systematic troubleshooting techniques. The **UniTrain-I** experiment card "rear vehicle" complements the "front vehicle" card and depicts the rear section of a CAN-bus controlled motor vehicle.



Using rocker switches the following operations can be simulated:

- Window lifter
 - Tank filling level indicators.
- The window motion is depicted using LEDs. The potentiometer is used to simulate the fuel tank filling level.



Topics Covered

The course conveys knowledge and handling skills needed in working with the topic "CAN - Controller Area Network". Experiment-based investigations, measurements and fault finding are at the heart of the course and provide training on how the system operates, responds and functions.

- Why bus systems?
- Bus systems in motor vehicles
- CAN – bus
- CAN – data protocol
- Message frames
- High – Speed – CAN
- Bus fault analysis
- Learning checks



Ordering Information

Equipment List	Qty.	Order No.
Automotive Technology Course 10: CAN	1	SO4204-7K

Accessories

UniTrain-I Interface with virtual instruments	1	SO4203-2A
UniTrain-I Experimenter	2	SO4203-2B
Measurement accessories for UniTrain-I	1	SO4203-2J



System Description

Current subjects in the motor industry such as modern motor management, safety and convenience systems (ABS, ASR, Airbag, Safety belt tightener, Air conditioning, etc.), cannot be realised without sensors that are responsible for the numerous supervision and control functions that are necessary. They are essential for an accurate detection of the current state of motor operating conditions, such as for example, oil pressure, motor temperature and revolution speed.

It is, therefore, imperative that the applications and techniques of sensors are learnt in the basic training phase.

Since, in practice, in original motor vehicles, sensors are difficult to access and are thus not really suitable for training purposes, the Lucas-Nülle company has developed a didactic structured system for teaching the subject of sensor techniques. The practice-oriented training system, "AEA 4 - Sensors in Motor Vehicles" is of modular construction and is ideally suited for clearly demonstrating the function of individual sensors or the complete sensor system of a motor vehicle. The sensors are original components, mounted on A4 panels.

8.05

A particular feature of the LN teaching panels "Hall pick-up" and "Inductive sensor", is that they are enclosed in a transparent housing and can be removed from the panel thus enabling the function principle to be demonstrated on an overhead projector.



Topics Covered

AEA 4 Sensors in Motor Vehicles

- Hall generator
- Light barrier with LDR
- R.P.M. meter
- Inductive sensor
- Current relay with reed contact
- PTC heating element
- PTC resistor
- NTC resistor
- Absolute pressure sensor
- Field plate
- Knock ('pinking') sensor



Ordering Information

Equipment List	Qty.	Order No.
Transparent model, Hall pick-up (IC)	1	SO3216-7Z
Panel for Hall pick-up (IC)	1	SO3216-7X
Light barrier	1	SO3216-7V
R.P.M. sensor	1	SO3216-7Q
Transparent model, inductive sensor	1	SO3216-7Y
Panel for inductive sensor	1	SO3216-7W
Lamp control, sensor	1	SO3216-7F
Temperature sensor (PTC)	1	SO3216-7P
Radiator temperature sensor (NTC)	1	SO3216-7J
Unit for field plate	1	SO3216-7U
Pressure sensor	1	SO3216-7E
Knock (pinking) sensor with removable sensor	1	SO3216-7R
Heating element	1	SO3216-7D
Headlamp with side lamp	2	SO3216-2A

Exercise Literature

AEA 4 Sensor Technology in Motor Vehicles (GB)	1	SO5157-7N
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Accessories

Power supply 12V/35A DC	1	LM4131
Vacuum pump with indicator	1	LM8203
Connection plugs 4mm/19mm	6	SO5124-7A
Set of connection cables 4mm	1	SO5146-1K
Table-top frame, 3 levels, W 1230 x H 1060 mm, grey	1	ST8003-1D

Test Instruments

Digital multimeter AC 0-750V/10μA-10A; DC 0-1000V/1μA-10A; 0.1Ω-2MΩ	1	LM2105
Digital storage oscilloscope, incl. probes	1	LM6205
Adapter BNC/4mm	1	LM9020



System Description

The LUCAS-NÜLLE Connect®-System consists of a series of DIN A4 panels with original components from the relevant motor management system. The supportive information for the individual components and for the complete system, is presented by way of a multimedia program. The software and hardware form one unit and are interactive with each other. The software includes:

- Function videos
- 3D - animations
- Detailed presentations
- Methods of handling
- Technical documentation
- Circuit and wiring diagrams
- Questions for the students and answers for the instructor
- Progress and evaluation checksheets for the instructor

The hardware components are all fully-functional and are driven by the software. The modular Connect®-System can be easily adapted and extended to new motor management systems as they become available on the market.



Topics Covered

Phase 1 Basic Training

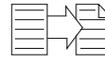
- Introduction to sensors and actuators
- Current, voltage and resistance measurements on original components
- Conversion of non-electric variables to electric variables
- Handling and function of original components

Phase 2 Control System

- Introduction to control systems
- Construction and function of the idle speed regulation
- Construction and function of various ignition control systems
- Construction and function of various fuel injection systems

Phase 3 Special Training

- Introduction to complex fuel injection control systems
- Adjustment of various operating conditions (idle speed, partial and full-load)
- Effects of changing various parameters on the fuel injection control
- Clarifying the differences of various fuel injection systems



Ordering Information

Basic equipment Connect®	Qty.	Order No.
Universal control unit	1	SO3220-1A
Engine temperature sensor	1	SO3220-1B

Equipment AMM 14 GM Multec (Single-Point)

Measurement software GM Multec SPI (GB)	1	SO2000-1D
Manifold absolute pressure sensor (MAP)	1	SO3220-1H
Hall sensor (TC-h, with drive)	1	SO3220-1K
Lambda (HEGO) probe	1	SO3220-1M
Throttle housing (Multec) with single-point injection valve	1	SO3220-1T
Low-pressure injector pump	1	SO3220-1W
Ignition coil with spark plug	1	SO3220-1Y

Equipment AMM 19 Motronic 2.8 (Multi-Point)

Measurement software Motronic 2.8 (GB)	1	SO2000-1J
Air temperature sensor NTC	1	SO3220-1J
Lambda (HEGO) probe with electric heating	1	SO3220-1N
Knock (pinking) sensor	1	SO3220-1P
Road speed sensor with Hall sensor	1	SO3220-1Q
Throttle position potentiometer	1	SO3220-1R
Fuel injection unit	1	SO3220-1U
Fuel tank vent valve	1	SO3220-1V
High-pressure injector pump	1	SO3220-1X
DIS ignition coil	1	SO3220-1Z
Idle-speed controller I	1	SO3220-2A
Mass air flow meter	1	SO3220-2C
Inductive and Hall sensor with drive	1	SO3220-2D

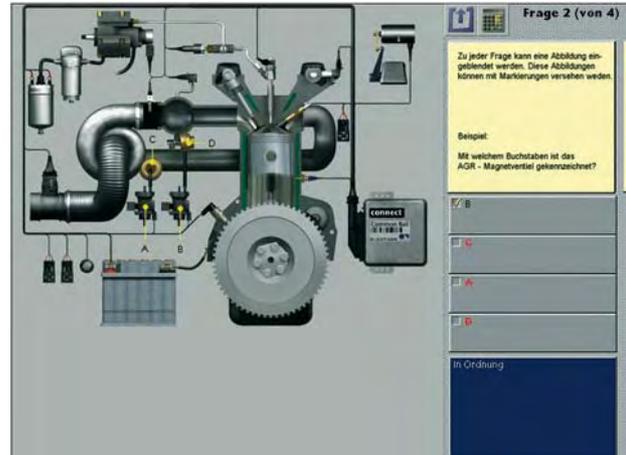
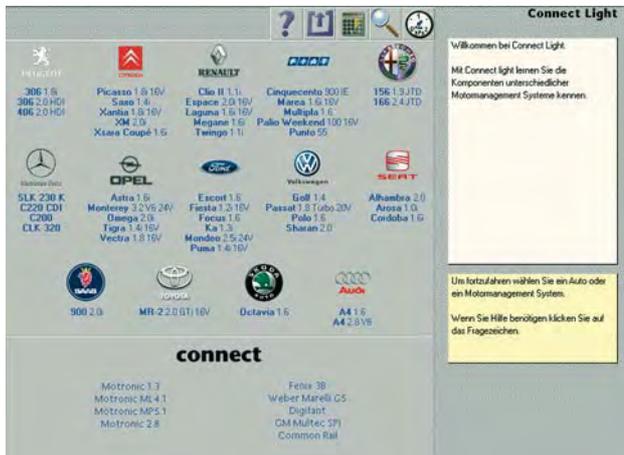
Equipment AMM 21 Diesel Control Common Rail

Measurement software Common-Rail (GB)	1	SO2000-1K
Inductive and Hall sensor with drive	1	SO3220-2D
Air temperature sensor NTC	1	SO3220-1J
High-pressure injector pump	1	SO3220-1X
Mass air flow meter	1	SO3220-2C
Rail - pressure regulator	1	SO3220-2F
Rail - pressure sensor	1	SO3220-2G
Glow time control with glow-plug simulation	1	SO3220-2H
Diesel fuel injector unit with simulation	1	SO3220-2J
Accelerator sensor	1	SO3220-2K
Wastegate valve	1	SO3220-2L
EGR-back pressure transducer for boost pressure control	1	SO3220-2M
Boost pressure sensor	1	SO3220-2N

Accessories

Power supply 12V/35A DC	1	LM4131
Digital multimeter	1	LM2005
Over-/under pressure pump	1	LM8213
Serial interface cable 9/9 pole	1	LM9040
Connection cable set for Connect®	1	SO3220-9Z
Table-top frame, 3 levels, W 1230 x H 1060 mm, grey	1	ST8003-1D

Other multimedia type motor management systems are also available. Ask for our separate AMM-Connect® catalogue.



Connect®-Light

The Connect®-Light software replaces the written documentation that the students compile during their training. At the same time this software can be used in the preparation of the instruction sessions and for the evaluation afterwards.

The tasks to be processed are purely theoretical without any hardware connections or any measurement tasks. Evaluation of the results of the exercises set, is made by the full version of the software Connect®.

The structure and functioning of this software is identical to the Connect® full version, so that no changes are necessary in the working of the User. The individual results can be directly taken over in the Connect® software. Thus, the time required for the specialized exercises in laboratory instruction, is greatly reduced.



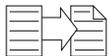
CONTEST

The software Contest is a test and examination software. The software contains picture and text libraries from the Connect®-software. These libraries can be extended with self-produced pictures, photos, etc. By combining different pictures, questions and answers, various test papers can be compiled.

The degree of difficulty and the scope of the tests can be specified by the User. The evaluation can be included in the evaluation software of Connect®. At least one full version of Connect® must be on hand to enable working with this software.

8.07

The Connect®-Light-software is not installed on the computer. It is run directly from the CD-ROM and hardware connections are not required.



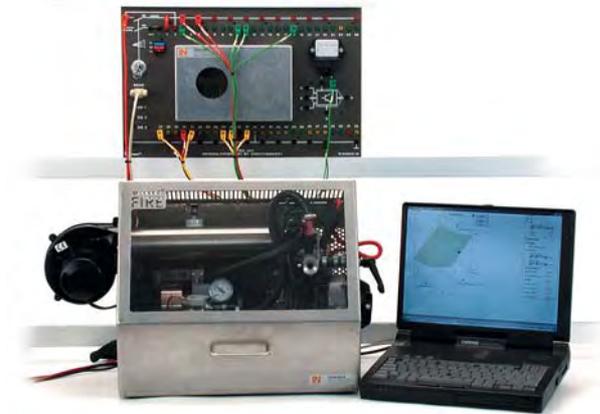
Ordering Information

Equipment List	Qty.	Order No.
Connect-Light (single license)	1	SO2000-8A



Ordering Information

Equipment List	Qty.	Order No.
Contest (class licence)	1	SO2000-8B



System Description

The training system **Connect®- Motormangement**, combines all the advantages of multimedia teaching systems. The heart of the system is a self-developed control unit that can be used in both theoretical instruction and practical training.

The system includes the following components:

- Control unit
- Fuel system
- Single cylinder, 4-stroke engine
- Tuning software
- Loading unit

The internal combustion motor is fitted with all sensors and actuators of an original motor and is all fully-functional. With the aid of the tuning software, the characteristic maps of the fuel injection, idle speed and the ignition, can all be optimised. Using the motor testers, exhaust testers, etc. almost all common types of workshop measurement can be realised. In specialist instruction, mechanical tasks can also be completed, such as for example:

- Dismantling and re-building the motor
- Connection of sensors and actuators
- Optimising the idle speed, load and ignition performances
- Exhaust gas test, before and after the tuning
- Power measurements at various speeds

System Groups

- Fuel supply and fuel injection
- Electronic motor management
- Ignition system
- Motor tuning
- Diagnosis facilities
- Power test



Topics Covered

AMM 91 Electronically-controlled, Single-cylinder, 4-stroke Motor

- This is an electronic, microprocessor controlled motor management that allows high motor power with a low fuel consumption and minimum pollution emission
- The operating data maps specific to the type of motor are loaded in a central control unit.
- Depending on the actual motor and peripheral data, characteristic maps for fuel mixture preparation and ignition system are calculated and output.
- The running of the motor, the exhaust gas response and other technical relationships are optimised by point-to-point or sectional changes in the motor characteristic map.
- Connection and test of sensors and actuators, as well as replacing parts, all form part of the training syllabus.



Ordering Information

Equipment List	Qty.	Order No.
Control unit Motronic	1	SO3220-1A
Software "Connect®-Tuning 4TE" (GB)	1	SO2000-9A
Single cylinder four-stroke engine 1Z4TE, sensoric & actortic for electr. inject.	1	SO3220-9A
Accessories		
Power supply 12...14V/35A	1	LM4131
Safety connection cables set	1	SO3220-9Z
Serial interface cable 9/9 pole	1	LM9040

Fax Request



Please copy this page and return by mail or FAX!

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The Lucas-Nülle GmbH company is based in Germany and can be contacted at the address given below.

The company also has representatives throughout the world, thus ensuring a fast and effective advice service before purchasing, as well as an efficient network of after-sales service centres.

We can be contacted directly at our head office in Kerpen-Sindorf, Germany, or via one of our representatives, at either of the addresses given below.

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