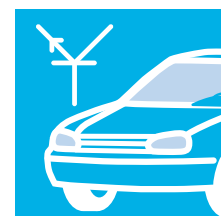


# Training and Further Education in Automotive Engineering

Know-how – Skills – Passion  
Training in the Automotive Diagnostics  
Workshop Lab



# Contents

## **Know-how – Skills – Passion**

Training Systems for Automotive Engineering .....	4
---	---

## **More Than a Laboratory**

Complete Solution – Diagnostics Workshop Lab for Automotive Engineering .....	6
---	---

## **System Overview**

Needs-oriented Training Systems .....	8
---------------------------------------	---

## **Multimedia Learning Environment**

LabSoft as a System-based Training/Administration Software .....	14
--	----

## **The Entire Program at a Glance**

Solutions for Vocational Training and Education in Automotive Engineering .....	16
---	----



# Contents

<b>Electricity/Electronics</b> .....	20-27
DC and AC Technology in the Motor Vehicle, Automotive Electronics and Digital Technology, Three-phase (Alternator) Generator, Pulse-width Modulated Signals (PWM), Three-phase Generator with Multifunction Controller, Three-phase Generator with Hybrid Controller	
<b>Sensors and Actuators</b> .....	28-33
Sensors and Actuators in the Motor Vehicle, Engine Management Sensors	
<b>Motor Vehicle Lighting</b> .....	34-43
Main Lighting and Signalling Systems, Trailer Lighting, Static Cornering Lightings, CAN Bus Extension, Onboard Power Supply Extension	
<b>Comfort Systems</b> .....	44-51
Alarm System and Immobilizer, GPS Navigation, Air-conditioning and Climate Control, Auto Shop Communications with RFID, Comfort Systems and Keyless Entry	
<b>Alternative Drives</b> .....	52-61
CarTrain E-mobility, Hybrid Drive in Motor Vehicles, DC/AC Conversion, Fuel Cells, Photovoltaic Technology	
<b>Engine Management</b> .....	62-83
CarTrain Motronics 2.8, CarTrain Direct Fuel Injection, CarTrain Common Rail, Student/Teacher Measurement Stations, Function Motors and Cutaway Models, Ignition Systems, Diesel Injection System Common Rail, Common Rail, Electronic Diesel Control (EDC), Connect®-Fire Chip Tuning, Auto-diagnostics Trainer Software	
<b>Vehicle Diagnostics</b> .....	84-91
Onboard-Diagnosis II, CAN/LIN Monitor, High-voltage Instrumentation, Snap-on MODIS, Snap-on SOLUS PRO, Snap-on VERUS	
<b>Chassis and Driving Safety</b> .....	92-101
Electromechanical Parking Brake, Electromechanical Power Steering, Airbag, Belt Tensioner and Crash Response, SRS Airbag and Belt Tensioner, ABS, ASR and ESP, Brake Power Control with ABS and ASR	
<b>Networked Systems</b> .....	102-111
CAN Bus, CAN Lighting Technology, CAN Comfort Technology, LIN Bus, Fiber Optic Waveguides, FlexRay, Dashboard Training Model Incorporating CAN and LIN Buses	
<b>Practical Automotive Workshop Lab</b> .....	112-119
Exhaust Gas Analysis and EOBD Data Readout, Tyre-Mounting Machine, Balancing Machine, Axle Measurement, Two-column Hydraulic Car Lifting Platform, Four-column Hydraulic Car-lifting Platform, Fully-automatic Air-conditioning Service Unit, Tool Trolley	
<b>Topics</b> .....	120-121

# Know-how – Skills – Passion

## Training Systems for Automotive Engineering

### Rapid developments in the sector ...

Technical developments in the automotive industry are so rampant that even well-trained experts are not always finding it so easy to keep up on the job. Getting trainees and students up to speed, cultivating their enthusiasm for new technologies and providing them with the tool set needed for a successful future career – these are today's automotive training challenges for tomorrow. After all, only well-trained, committed specialists are able to cope with new challenges and promote innovation.

### ... require solid training ...

Rising demands being placed on equipment, cost efficiency, safety optimization, intelligent drive systems and mobile communication in the motor vehicle are making this field exciting and the dream profession of many young people. At the same time these developments are putting more and more intense pressure on industry and the skilled trades. Ultimately, it is only the specialists who are capable of developing their own strategies and solutions and able to perform best in a team that will be able to keep up the momentum driving innovation in the industry. Modern automotive technology instruction that is able to cultivate the next generation must therefore combine practical and theoretical content in a consistent manner and promote independent learning while at the same time remain oriented towards the latest technologies.





### ... using premium training systems.

To be able to impart this in a sustained fashion training systems are needed which are not only state of the art technically but also didactically conceived to comply with the requirements prevalent in the workplace. Practical exercises and well-grounded theoretical background information form the foundation for one of the key competences: excellent hands-on skills. These skills are already developed by the trainee during the training period in conjunction with the Lucas-Nülle training systems. In the course of working on projects and during self-monitored learning processes, young people discover the fascination of automotive technology while at the same time attaining a high degree of work satisfaction. This is because individual learning and positive feedback are part of the didactic concept.

### Covering everything from the basics to final graduation

"The training systems from Lucas-Nülle cover every aspect of training in automotive technology. Whether the subject is the basics of automotive electricity, lighting and comfort systems or motor vehicle diagnostics, LN has the corresponding system for every subject and situation.

All of the training subjects are thoroughly covered in the Automotive Diagnostics Workshop Lab.

Using modular and scalable learning and training systems the foundation is laid for an enduring, continuously updated training and educational program at the workplace, in vocational schools and industry-wide training."



**Siegfried Schulz**  
*Product Manager Automotive Engineering*



**Martijn Vincken**  
*Product Manager Automotive Engineering*



# More Than a Laboratory

## Complete Solution – Diagnostics Workshop Lab for Automotive Engineering

Lucid presentations of complex concepts with modern training and educational media

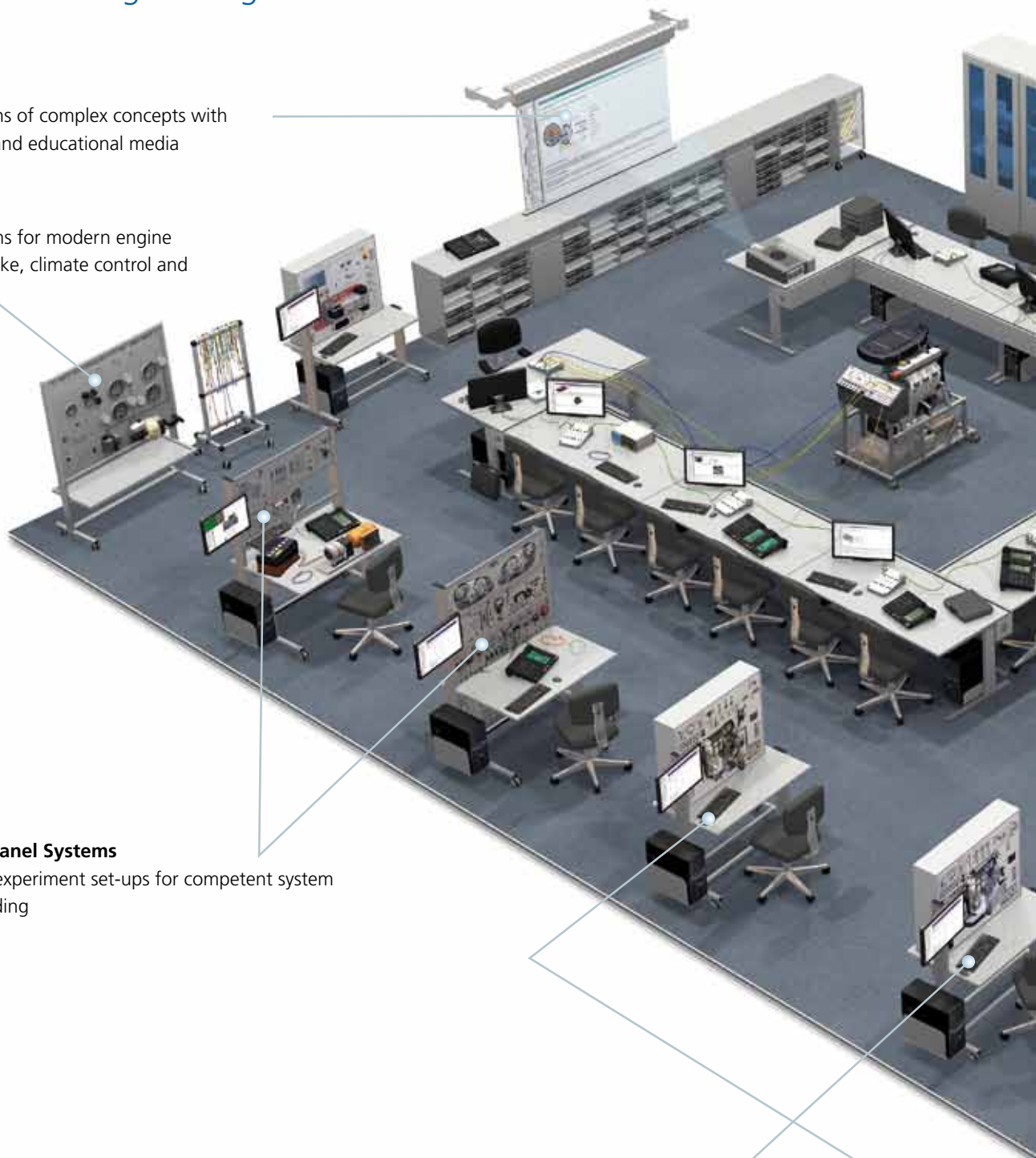
Complete solutions for modern engine management, brake, climate control and airbag systems

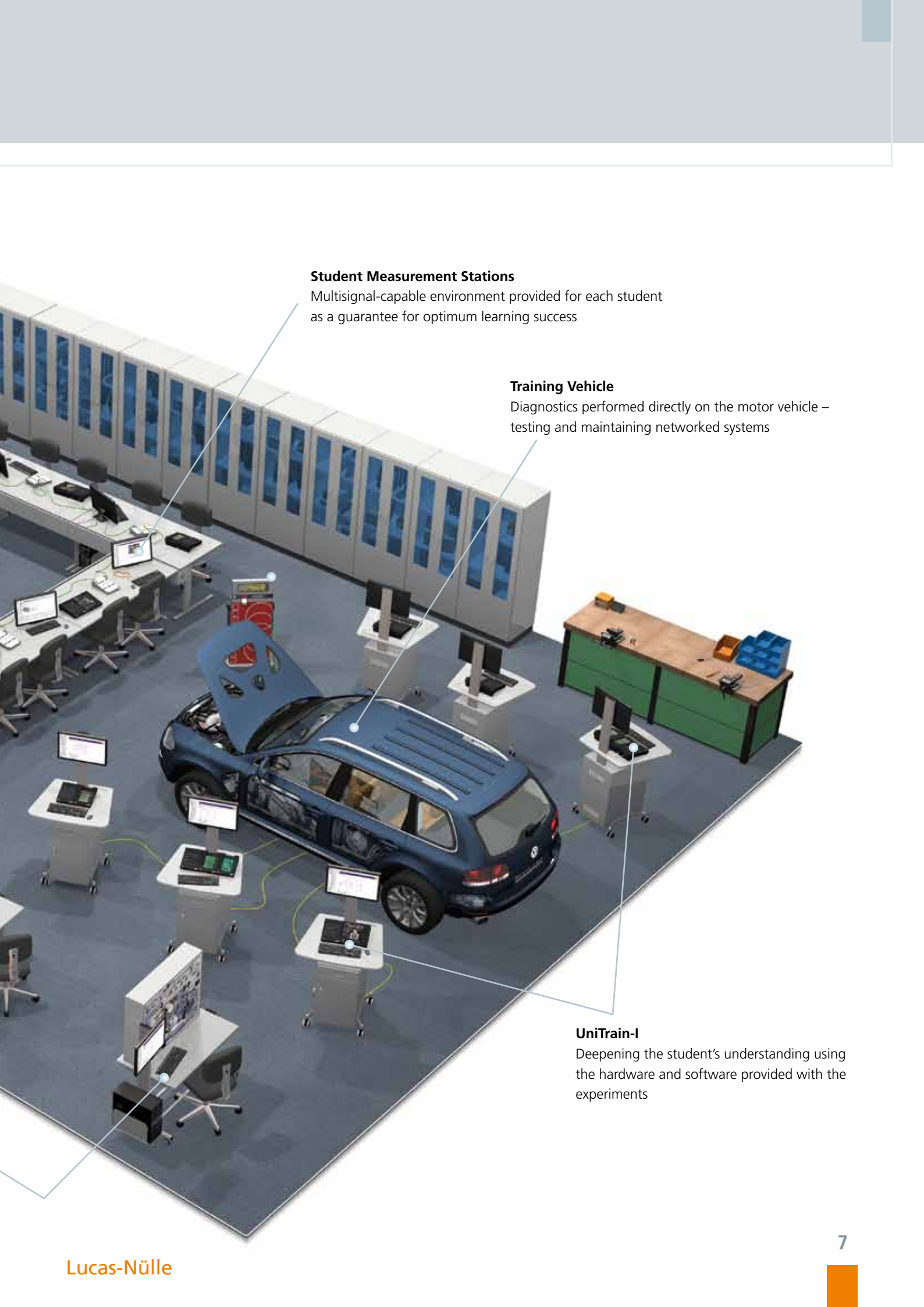
### Training Panel Systems

Individual experiment set-ups for competent system understanding

### CarTrain

Training on real components – interactive course software is used to facilitate overall system comprehension





### Student Measurement Stations

Multisignal-capable environment provided for each student as a guarantee for optimum learning success

### Training Vehicle

Diagnostics performed directly on the motor vehicle – testing and maintaining networked systems

### UniTrain-I

Deepening the student's understanding using the hardware and software provided with the experiments



# System Overview

## Needs-oriented Training Systems

### UniTrain-I – a Multimedia Laboratory with over 100 Courses

With the UniTrain-I multimedia experiment and training system, students are guided through the experiments by means of clearly structured course software including texts, graphics, animations and knowledge tests. In addition to the training software, each course comes with an experiment card for performing practical exercises. Courses such as those on the fundamentals of electrical engineering, automotive sensors and ignition

systems convey the knowledge and skills needed to understand, connect, diagnose and operate modern automotive systems. Animations and numerous experiments on authentic systems found in the various courses impart the fundamentals, principles and attributes of electrical, safety, lighting and engine-management equipment.



#### Your benefits

- Theory and practice all in one
- PC and new media for high levels of student motivation
- Quick success through structured course design
- Animated theory for quick understanding
- Practical competence through independent experimentation
- Guided trouble shooting with an integrated fault simulator
- Protective, extra-low voltages ensure safe operation
- Sample solutions for teachers and students





### UniTrain-I system

- Comprehensive, portable laboratory
- Multimedia-based courses
- High-tech measurement and control interface
- Trains theory and practice at same time and location



### Integrated meters and power supply units

- Multimeter, ammeter, voltmeter
- 2-channel storage oscilloscope
- Function and signal generator
- Three-fold power supply unit for AC and DC
- Three-phase power supply unit
- ... and many more instruments



### LabSoft learning and experimenting software

- Wide selection of courses
- Comprehensive background theory
- Animations
- Interactive experiments with instruction guide
- Free navigation
- Documentation of measurement results
- Tests available in the language of your choice



### UniTrain-I interface with USB

- Oscilloscope with 2 analogue differential inputs
- Sampling rate of 40 Msamples/s
- 9 measuring ranges from 100 mV - 50 V
- 22 time ranges from 1  $\mu$ s - 10 s
- 16 digital inputs/ outputs
- Function generator for frequencies up to 1 MHz
- 8 relays for fault simulation



### UniTrain-I experimenter

- Holds experiment cards
- Experiment power supply of  $\pm 15$  V, 400 mA
- Experiment power supply of 5 V, 1 A
- Variable direct or three-phase current, 0 - 20 V, 1 A
- IrDa interface for multimeters
- Serial interface for additional experiment cards

# System Overview

## Needs-oriented Training Systems

### EloTrain Courses: 2mm Plug-In System

Together with the multimedia experimentation and training system, the EloTrain 2-mm plug-in system provides a modern and efficient environment for sound training in the fundamentals of electrical engineering and electronics.

Students are guided through the experiments by means of clearly structured course software including texts, graphics,

animations and knowledge tests. The experiments are tailored especially to automotive applications to facilitate an understanding of this complex subject and are conducted on a 2-mm experimenter developed specially for the UniTrain-I. A wide range of virtual instruments are available for real-time measurements by students.



*Multimedia course with measure interface*

#### Your benefits

- Modern educational media combined with a proven system of plug-in modules
- Virtual instruments for real-time measurements of current, voltage and resistance; no need for external power supplies or measuring instruments
- High student motivation through new, PC-based media
- Quick success through structured courses
- Practical competence through independent experimentation
- Regular feedback through quizzes and knowledge tests
- Safe handling thanks to protective, extra-low voltages

## EloTrain Courses: 4mm Plug-In System

The EloTrain 4-mm plug-in system is an extensive kit for experimentation in the field of electrical engineering, electronics and digital technology. By installing 4-mm plug-in modules on an EloTrain experimenter, electronic circuits of any required size can be assembled, operated and tested. Students are guided through the experiments by means of clearly organized experimentation instructions; the knowledge acquired in this process is

consolidated in numerous tests.

This set is especially tailored to the needs of students in the field of automotive and allows a vast range of experiments on the fundamentals of automotive electrical engineering and electronics. The set comes on an A4 storage plate with scratch-resistant, colour print.



*Training course with comprehensive manuals*

### Your benefits

- Gold-plated contacts
- Extremely practical approach
- Students' exercises tailored specially to automotive engineering
- 1:1 mapping of circuit diagrams on the rastered plug-in board
- Exploring complex relationships through experimentation
- Universal applications
- Robust components
- High degree of transparency

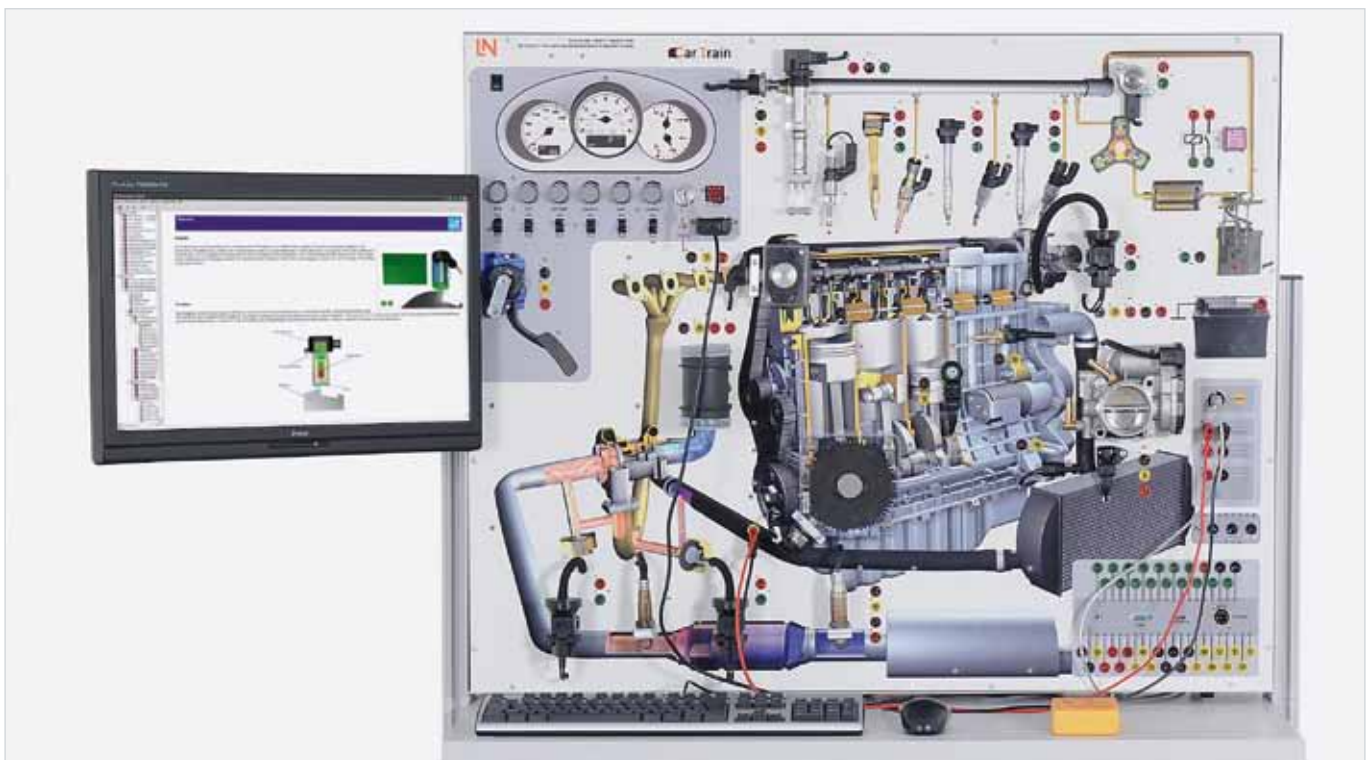
# System Overview

## Needs-oriented Training Systems

### Training on Real Components: CarTrain

CarTrain combines multimedial teaching material with real motor vehicle components. System complexity is made far more accessible and hence understandable to the student using didactically

modified graphic interface design combined with optimized component configuration.



#### Your benefits

- Practice-oriented training using original components
- Fault simulation with up to 50 different faults
- Real and simulation mode
- OBD readout function using CAN-Bus interface
- Integrated instrumentation
- Freely-programmable control unit
- Measurements using workshop tester
- Interactive learning software
- 3-D animations of individual components
- Tests and system comprehension questions

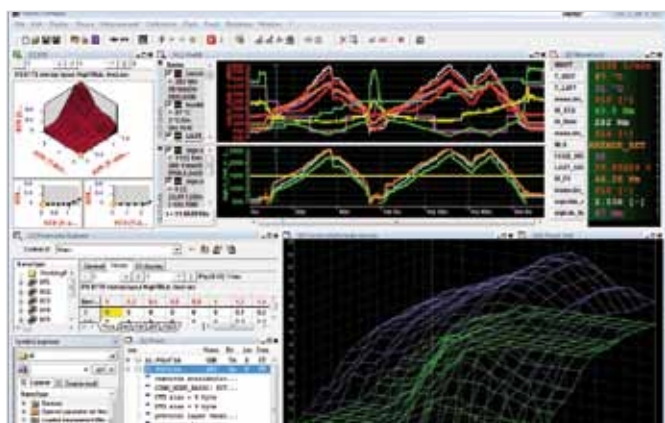




**Simulation and/or real mode** assists in solidifying knowledge and understanding for the overall system. Switchover can be carried out during operation.



**Using the OBD II terminal** you can connect any OBD II-capable diagnostics tester and read out important data needed for trouble shooting.



**Deploys expert systems**, determines data and updates it using control unit software, perform resets to default settings on motor vehicle systems.



**Didactically designed interactive training software** shows how to design and operate sensors, actuators and subsystems of the direct fuel injection system MED with turbo charger.

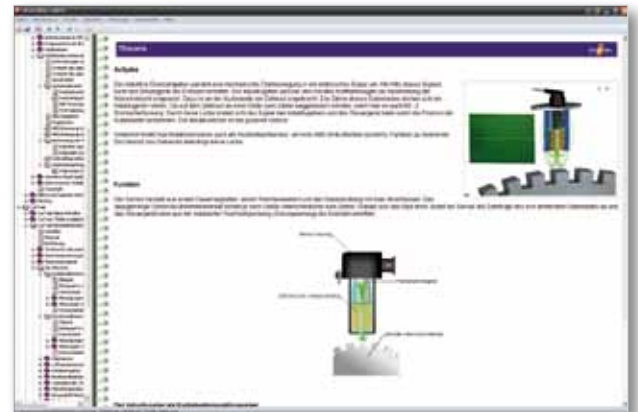
# Multimedia Learning Environment

## LabSoft as System-based Training/Administration Software

### LabSoft

LabSoft is the user interface for all automotive courses and constitutes an open experimentation platform that permits access to all laboratory media:

- Navigation window with tree structure for display and direct selection of all course components
- Experiment procedure including documentation
- Evaluation and storage of the measurement results
- Built-in fault simulator
- Virtual instruments perform real-time measurements
  - Voltmeter, ammeter
  - Storage oscilloscope
  - Function generators



### LabSoft Classroom Manager

The LabSoft Classroom Manager is comprehensive administration software for all LabSoft courses. The Classroom Manager consists of various program elements:

#### LabSoft Reporter:

Monitor learning progress and generate statistics

#### LabSoft Editor:

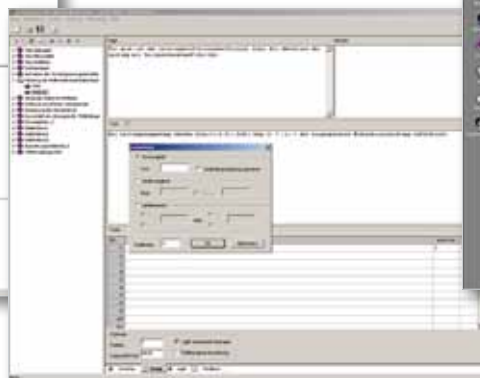
Create and edit your own courses and tests

#### LabSoft Manager:

Manage user data and courses in LabSoft

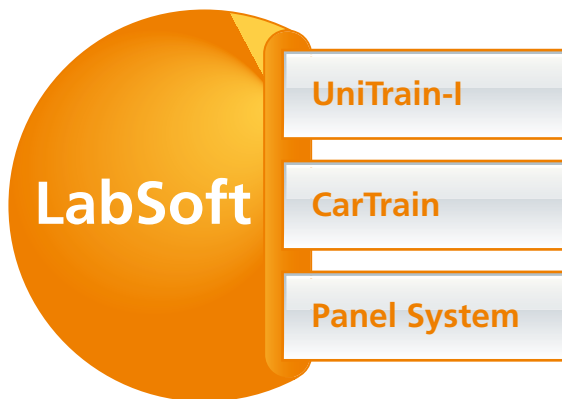
#### LabSoft TestCreator:

Create test problems and exams

A screenshot of the LabSoft Manager interface. It shows a navigation tree on the left and a main workspace on the right. The workspace contains technical diagrams, including a circular diagram with a red arrow and a diagram of a mechanical component. There are also text boxes and a small window with a form.

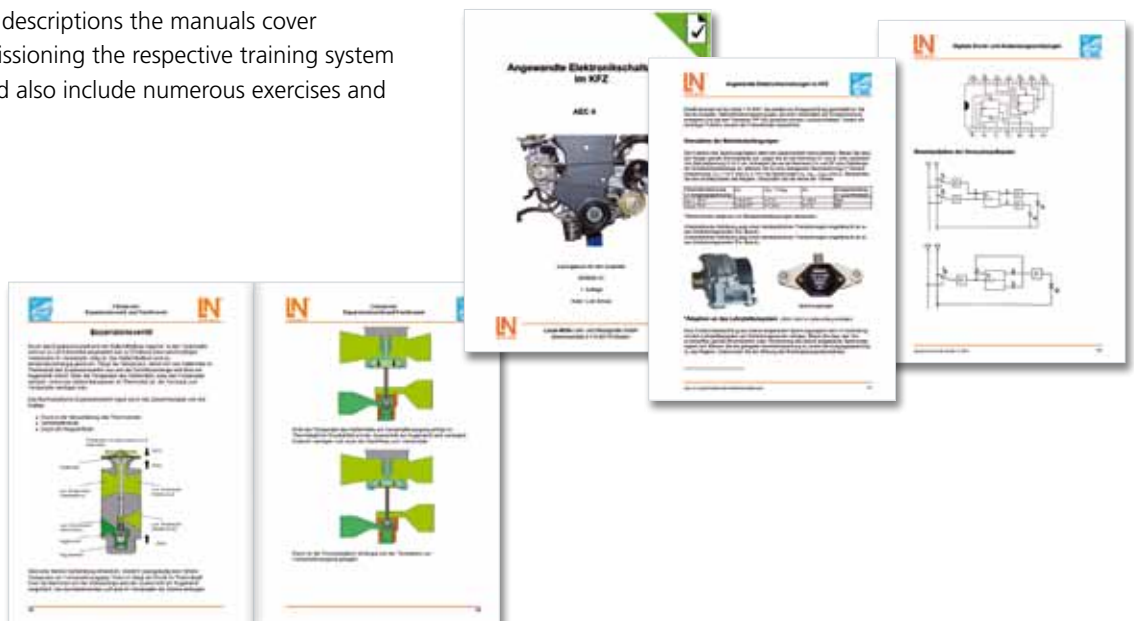
## LabSoft in the Network

LabSoft supports both local installation on the user's computer as well as installation on a central server that permits access via intranet or internet. To facilitate integration into Learning Management Systems the developers of LabSoft incorporated international standards.



## Manuals

In addition to in-depth descriptions the manuals cover everything from commissioning the respective training system to project examples and also include numerous exercises and experiments.



# The Entire Program at a Glance

## Solutions for Vocational Training and Education in Automotive Engineering

### Electricity/Electronics

#### UniTrain-I

Basics of Electrical Engineering .....	22
Basics of Electronics and Digital Technology .....	23
Three-phase Generator .....	24
Pulse-width Modulated Signals .....	25

#### Panel System

Generator with Multifunction Controller .....	26
Generator with Hybrid Controller .....	27

### Alternative Drives

#### CarTrain

Electromobility .....	56
-----------------------	----

#### UniTrain-I

Hybrid Drive in Motor Vehicles .....	58
DC/AC Conversion .....	59
Fuel Cells .....	60
Photovoltaics .....	61

### Sensors and Actuators

#### UniTrain-I

Sensors and Actuators in the Motor Vehicle .....	32
--	----

#### Compact System

Sensor Technology in Engine Management .....	33
--	----

### Motor Vehicle Lighting

#### Panel System

Main Lights .....	39
Auxiliary Lights .....	40
Trailer Lights .....	41
Static Cornering Light .....	42
CAN-Bus Extension .....	42
Onboard Power Supply Expansion .....	43

### Comfort Systems

#### Panel System

Alarm System .....	48
--------------------	----

#### Compact System

GPS Navigation .....	48
Air-conditioning System .....	49

#### UniTrain-I

Auto Repair Shop Communication .....	50
Comfort Systems .....	51



### Chassis and Driving Safety

#### Compact System

Electromechanical Parking Brake .....	96
Electromechanical Power Steering .....	97
SRS Airbag .....	99
ABS and ASR .....	101

#### UniTrain-I

Airbag .....	98
ABS/ASR and ESP .....	100



## Networked Systems

### UniTrain-I

CAN Bus .....	106
LIN Bus .....	108
Fibre Optic Waveguides .....	109
FlexRay .....	110

### Panel System

CAN Lighting Technology .....	107
CAN Comfort Technology .....	107

### Compact System

Dashboard Training Model/Stand .....	111
--------------------------------------	-----

## Practical Training Lab

### Compact System

Exhaust Gas Analysis and EOBD Data Readout .....	112
Tire-Fitting Machine .....	112
Balancing Machine .....	113
Axle Measurement .....	113
Hydraulic Lifting Platform .....	114
Air-conditioning Service Unit .....	115
Motor Vehicle Tool Trolley .....	115



## Engine Management

### CarTrain

Motronic 2.8 .....	68
Direct Fuel Injection .....	70
Common Rail .....	72

### UniTrain-I

Ignition Systems .....	78
Common Rail .....	79

### Compact System

Common Rail .....	80
Electronic Diesel Control .....	81
Student/Teacher Measurement Stations .....	74
Functional Engine and Cutaway Model .....	76
Chip Tuning .....	82
Auto-Diagnosis Trainer Software .....	83

## Motor Vehicle Diagnostics

### Panel System

OBD-II .....	88
--------------	----

### Diagnostics Equipment

CAN/LIN Monitor .....	89
High-voltage instrumentation .....	89
Snap-on MODIS .....	90
Snap-on SOLUS PRO .....	91
Snap-on VERUS .....	91



# Electricity/Electronics

DC and AC Technology in the Motor Vehicle.....	22
Electronics and Digital Technology in the Motor Vehicle .....	23
Three-phase Alternator/Generator.....	24
Pulse-width Modulated Signals (PWM) .....	25
Three-phase Generator with Multifunction Controller .....	26
Three-phase Generator with Hybrid Controller .....	27



# Electricity/Electronics

## Basic Practice-oriented Know-how

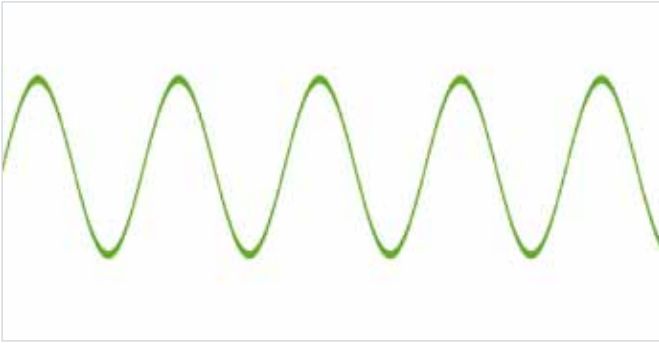
For years now electrical and electronic applications have been playing an ever more important role in the motor vehicle. For that reason it is essential for trainees to become familiar with the most important fundamentals of automotive electrical engineering from the outset. This is the prerequisite to understanding the complex interactions taking place in the vehicle. It is no accident that 80 training hours are planned for

this topic in the initial training year. Our training systems for electronics and electrical engineering have been fine-tuned specifically for everyday applications found on the job. Supported by a host of examples, explanations, lessons and practical exercises, the trainee acquires the background know-how and develops the necessary skills.



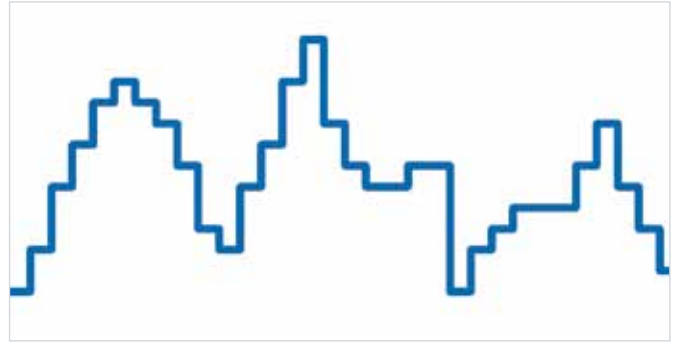


### Analogue Technology



In electrical engineering, an analogue system is one where physical quantities continuously vary in value and time. The LN case system imparts the related fundamentals in a practical manner.

### Digital Technology



This topic deals with the processing of discrete-value and discrete-time numerical sequences as well as digital signals. Our basic courses are made up of typical automotive examples and exercises intended to provide the most practical training possible.

### Training Systems

Our training systems cover the most important topics. Students and trainees acquire the basics of electrical engineering and electronics, become familiar with semiconductor components and learn about basic and applied electronic circuits and basic and applied digital circuits.



# Electricity/Electronics

## DC and AC Technology in the Motor Vehicle

The growing importance of electrical and electronic components in the motor vehicle makes the hands-on training approach to basic electronic circuits an absolute necessity. Our UniTrain-I course on DC and AC technology in the vehicle enable students to acquire this know-how through independent self-

learning. They come to grips with such terms as current, voltage and resistance, train in how to operate measuring instruments and conduct experiments using Ohm's and Kirchhoff's laws. All of the required measuring instruments are already built into the UniTrain-I's multimedia training environment.



**UniTrain**  
SYSTEM

### Training contents

- Basic concepts of current, voltage and resistance
- Handling power sources and measuring instruments
- Usage of circuit diagrams for the analysis of electrical components
- Putting to use accident prevention regulations pertaining to work with electrical current
- Measurements on series and parallel circuits, voltage dividers and mixed circuits
- Evaluation of measurement findings using comparative tables
- Recording characteristics of variable resistors (LDR, NTC, PTC, VDR)
- Trouble shooting

## Electronics and Digital Technology in the Motor Vehicle

Knowledge of the characteristics and functionality of electronic components forms the basis for understanding and analysing such components and their circuits in motor vehicles. Course

topics include diode characteristics, basic transistor circuits, determination of valve- and rectifier-action of a diode and circuit design.



**UniTrain**  
SYSTEM

### Training contents

- Open- and closed-loop control operations in motor vehicle components
- Component classification according to hydraulic, pneumatic or electrical/electronic systems
- Recording diode characteristics
- Setting the operating point on the basic transistor circuit
- Understanding and using gain, emitter and collector circuits
- Design of basic logic circuitry
- Becoming familiar with Boolean functions and laws
- Experimenting with static and dynamic switching response
- Design of counter circuitry

# Electricity/Electronics

## Three-phase Alternator/Generator

Virtually all modern motor vehicles are equipped with a three-phase generator to produce the required electrical energy. With the UniTrain-I course the trainees gain insight into the

generator's basic functions and learn how to control it. They also plan and carry out diagnostics, maintenance and repair work on the power supply and the starting systems.



### Training contents

- Generator principle
- Basics of three-phase current
- Diode and rectifier circuits
- Functionality of an unregulated three-phase alternator/generator
- Discrete and integrated voltage controllers
- Regulated three-phase alternator/generator
- Fault diagnosis
- Compliance with accident prevention regulations



## Pulse-width Modulated Signals (PWM)

Many actuator systems in motor vehicles require variable power levels for the devices being controlled. Actuators which need to assume intermediate values between the ON and OFF limits are controlled by means of pulse-width modulated signals. With our

training system trainees document their measurement results, signals and fault protocols and analyse, evaluate and present their findings. This way they are able to isolate faults and propose suitable strategies for fault rectification.



**UniTrain**  
SYSTEM

### Training contents

- Principle of PWM
- Automotive PWM applications
- Adjusting the power of electrical loads with PWM
- Measuring a PWM signal's characteristics: frequency, amplitude, mark-to-space ratio
- Pulse width, edges and signal shapes
- Control and operating-current circuits
- Diagnosis of PWM-controlled components

# Electricity/Electronics

## Three-phase Generator with Multifunction Controller

This training system is used to examine how energy is generated in modern motor vehicles. Today's compact generators make use of a monolithic controller. This kind of multifunction controller (MFC) has now largely replaced hybrid controllers. A progres-

sive sequence of experiments gradually introduces students to the subject of power generation in automobiles.



### Training contents

- Workshop orders and descriptions of faults form the basis of students' plans for testing and repairing automotive electrical and electronic systems
- Principle of three-phase generation and voltage regulation
- Understanding how a three-phase alternating voltage arises
- Properties of a multifunction controller
- Understanding rectification and protection using power Z-diodes
- Battery monitoring (sensing)
- Examining pre-excitation (PWM)
- Fault diagnosis in the system

## Three-phase Generator with Hybrid Controller

Our system enables the trainees to become familiar with the function of the hybrid controller. Experiments are conducted and observations made as to how the hybrid controller maintains the generator voltage at a certain level, regardless of speed and load. The role of the average excitation current is explored

as well as how changes are brought about in the magnetic field and stator winding induction. The trainees thereby learn independently and can monitor their knowledge in exercises and tests.



### Training contents

- Workshop orders and descriptions of faults form the basis of students' plans for testing and repairing automotive electrical and electronic systems
- Principle of three-phase generation and voltage regulation
- Understanding how a three-phase alternating voltage arises
- Properties of a hybrid controller
- Understanding the necessity of exciter diodes
- Investigating the exciter current
- Fault diagnosis in the system





# Sensors and Actuators

Sensors and Actuators in the Motor Vehicle .....	32
Sensor Technology in Engine Management .....	33



# Sensors and Actuators

## Processes Involving Sensors and Actuators

Sensors are like the motor vehicle's "sensory organs". They are used to monitor rpm, vehicle speed, acceleration, fuel concentration and other input variables. Such signals have become indispensable for many process control functions in management systems, be it related to the engine, the chassis or

safety and comfort. The LN training systems have been didactically designed and include typical automotive components integrated into them to demonstrate the functions and applications of sensors and actuators.



### Maximum Learning Efficiency



The multimedia training platform ensures fast learning, even during independent study phases. Since the virtual measuring devices are versions of their real-life counterparts and have been integrated into the work environment, the courses are fully self-contained and complete.

### Practical



For the most practical possible instruction, all sensors in our training and educational systems have features found typically on automotive components. The compact system's exercise stands are especially well suited for demonstrations.

### Hands-on

Our training systems also cover the topics on sensors on the automobile body and chassis as well as sensors in engine management systems. This virtually covers all of the relevant areas of study (areas 3, 4 and 7).



# Sensors and Actuators

## Sensors in the Motor Vehicle

In modern motor vehicles more and more components are being monitored and controlled electronically. Sensors have several jobs to do, including the detecting of physical data and converting this information into electrical signals which can then be processed by control units.

Trainees should be able to grasp how this process works and the effects different sensor stimuli have on these signals. Our system allows students and trainees to learn and analyse the most essential aspects of this process.



**UniTrain**  
SYSTEM

### Training contents

- Physical principles of sensors: induction, Hall effect, piezo effect
- Understanding the function of sensors involved in engine control
- Comprehending inductive and Hall speed sensors and their function
- Throttle valve position measurement: throttle valve switch and potentiometer
- Air-flow measurement with hot-wire and hot-film sensors
- Pressure measurement in intake manifold
- Detection of shock waves with the knock sensor
- Temperature measurement with NTC and PTC sensors



## Sensor Technology in Engine Management

This training system from the “Compact” product family permits hands-on experimentation and demonstrations using a variety of engine-management and chassis sensors. The system’s practical design makes for highly realistic training. The students perform

diagnostics and repair work in the area of engine management – just the way it is required on the job.



### Training contents

- Understand how typical sensors operate
- Conduct typical electrical measurements on various engine management sensors
- Develop skills in interpreting and using circuit diagrams
- Build up diagnostic skills
- Plan and implement typical diagnostic strategies
- Conduct typical electrical measurements on various chassis sensors



# Motor Vehicle Lighting

Main Lights .....	39
Auxiliary Lights .....	40
Trailer Lights .....	41
Static Cornering Light .....	42
CAN-Bus Extension .....	42
Onboard Power Supply Expansion .....	43



# Motor Vehicle Lighting

## From Metal Filament Lamps to Adaptive Headlight Systems

For some time now lighting systems have been developing into highly complex systems in modern vehicles. This has placed growing demands on instructors in the automotive field to meet the huge challenge of making the topic more “hands-on” and easier to understand in the classroom. With our lighting wall

panel you not only have theoretical knowledge combined with practical skills but a versatile training system that can cover static cornering lights and also headlight systems with headlamp range adjustment as well as auxiliary and trailer lighting.





### Active Safety Provided by Lighting Systems



Vehicle lighting components are among those contributing to active safety. The networking of the electrical system includes also the vehicle's lighting components. Innovations integrated into state-of-the-art headlight systems are explored and explained here in a clear and practical manner.

### Static Cornering Lights



This feature involves control of the headlights via the indicator unit, yaw rate and travelling speed so as to perfectly illuminate the road ahead, even on curves. This ensures a high level of convenience and safety when cornering. The LN "Static cornering lights" training system can be integrated as an expansion kit into the existing lighting system.



### Training Systems

Our training systems cover the topics such as main lighting and static cornering lights too. Furthermore, system expansion is possible at any time to include, for example, auxiliary and trailer light systems.



# Motor Vehicle Lighting

## Auxiliary Lighting and Signalling Systems

Driving safety can be enhanced through the use of auxiliary headlights and fog lamps. There are diverse means of controlling such components. Furthermore, every vehicle must possess a signalling system by law. Circuits of practical relevance provi-

ding various means of controlling components serve as a bridge between theory and practice.



### Training contents

- Fog lights with relay
- Fog lights system including rear fog light and 2 relays
- Halogen lights for enhanced road illumination
- Reversing lights
- 3rd brake light
- Interior lights
- Delayed switching of interior lights
- Horn unit
- Standard-tone/loud-tone horn unit with relay

## ALC 1.1 Main Lighting Equipment Set

The main lighting system including all supplementary equipment is comprised of original automotive components. With this system you establish the foundation for an individually

expandable lighting panel wall. Combine other modules together to provide clear and easy understanding of a highly complex lighting system.



### Training contents

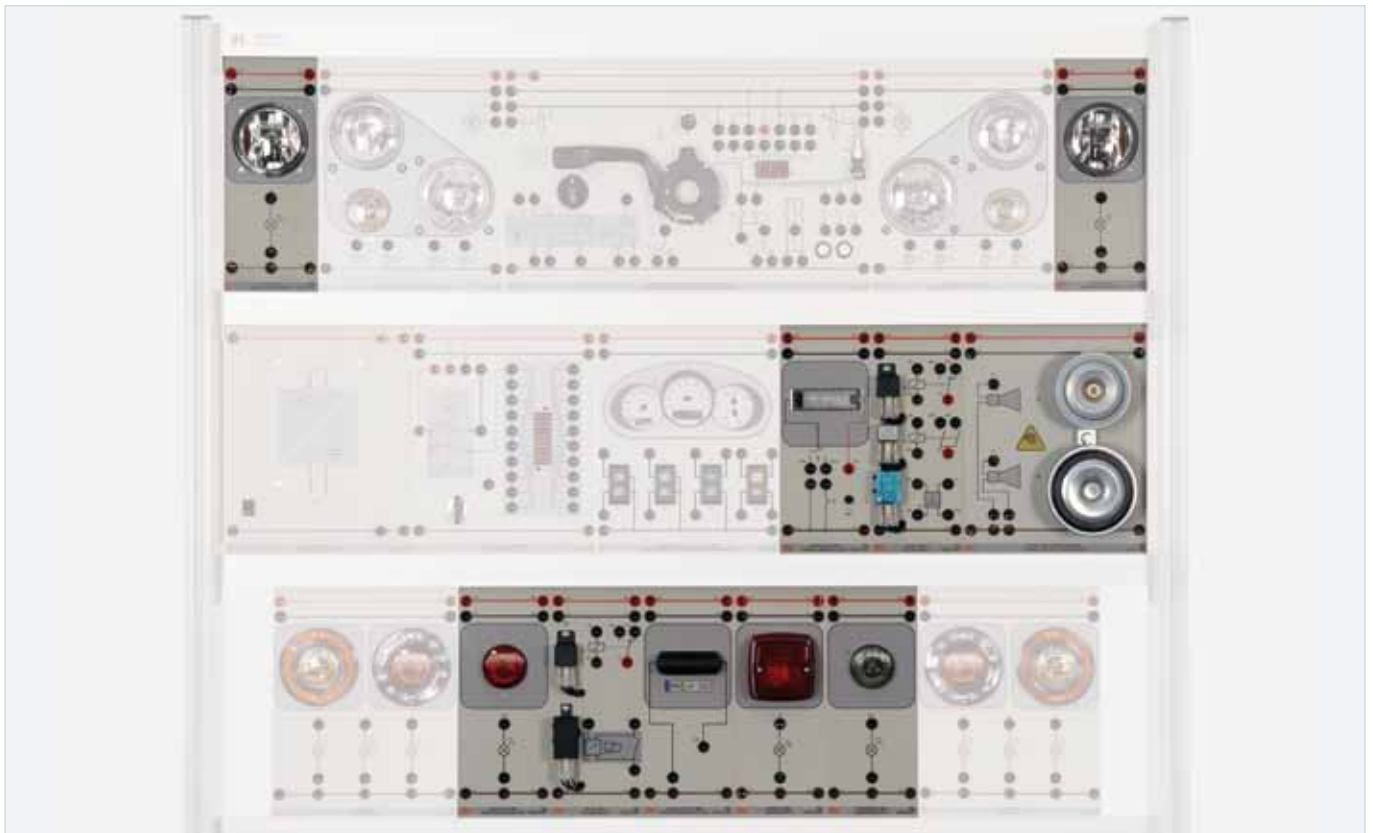
- Become familiar with local road traffic regulations
- Learn to distinguish between control and load circuit
- Practice protecting circuits with fuses
- Learn to use electronic relays
- Investigate how the manual headlight range adjustment works
- Record measurement values and document faults

# Motor Vehicle Lighting

## ALC 1.2 Auxiliary Lighting Equipment Set

This system is used to cover the topics involving auxiliary head-lights and signalling systems – the latter is obligatory in every vehicle and thus enjoys special consideration in training programs. What is of interest here is that control of these components can

vary depending on the vehicle. For that reason, instructors can only profit from a system that allows them to become familiar with different versions of these right there in the classroom.



### Training contents

- Become familiar with local road traffic regulations
- Learn to distinguish between control and load circuit
- Practice protecting circuits with fuses
- Learn to use electronic relays
- Investigate how the manual headlight range adjustment works
- Record measurement values and document faults



## ALC 1.3 Trailer Lighting Equipment Set

Once upon a time trailer lighting was simple to explain but those days are over. Now the demands being made on teachers have grown in step with the complexity of the electrical system in question. In today's classroom it is not just how the plug's

7-pin or 13-pin socket assignment works but also how to protect the towing vehicle from overloading and whether or not the control functions on the trailer comply with legal stipulations.



### Training contents

- Installation and commissioning of auxiliary equipment and systems according to manufacturing specs
- Perform retrofitting of lighting systems on the motor vehicle and become familiar with local road regulations
- Become familiar with local road traffic regulations
- Distinguish between control and load circuits
- Protect circuitry with fuses
- Record measured values and perform trouble shooting
- Trailer socket and plug assignments

# Motor Vehicle Lighting

## ALC 1.4 Static Cornering Light Equipment Set

This system helps instructors to impart know-how in all topics involving auxiliary headlights and signalling systems – the latter being obligatory in every vehicle and thus enjoying special consideration in training programs. What is of interest here is that control of these components can differ depending on the vehicle. For that reason instructors can only profit from a system that allows them to become familiar with various versions of these right there in the classroom.



### Training contents

- Use of circuit diagrams
- How the yaw rate sensor works
- Retrofitting auxiliary systems
- Combination of cornering light and low beam headlight
- Calibration of motor vehicle components

## ALC 1.6 CAN-Bus Extension Equipment Set

Expand any of the existing automotive lighting displays by a CAN-bus node that is diagnostics capable. This novel concept permits operation in low-speed mode and, with just the push of a button, in high-speed mode, too. As a result, even without a CAN-bus drive you can explore the basics of the different transmission speeds and the voltage levels associated with them. With the fault simulator you only have to activate a switch to feed various ISO standard fault codes onto the CAN bus.



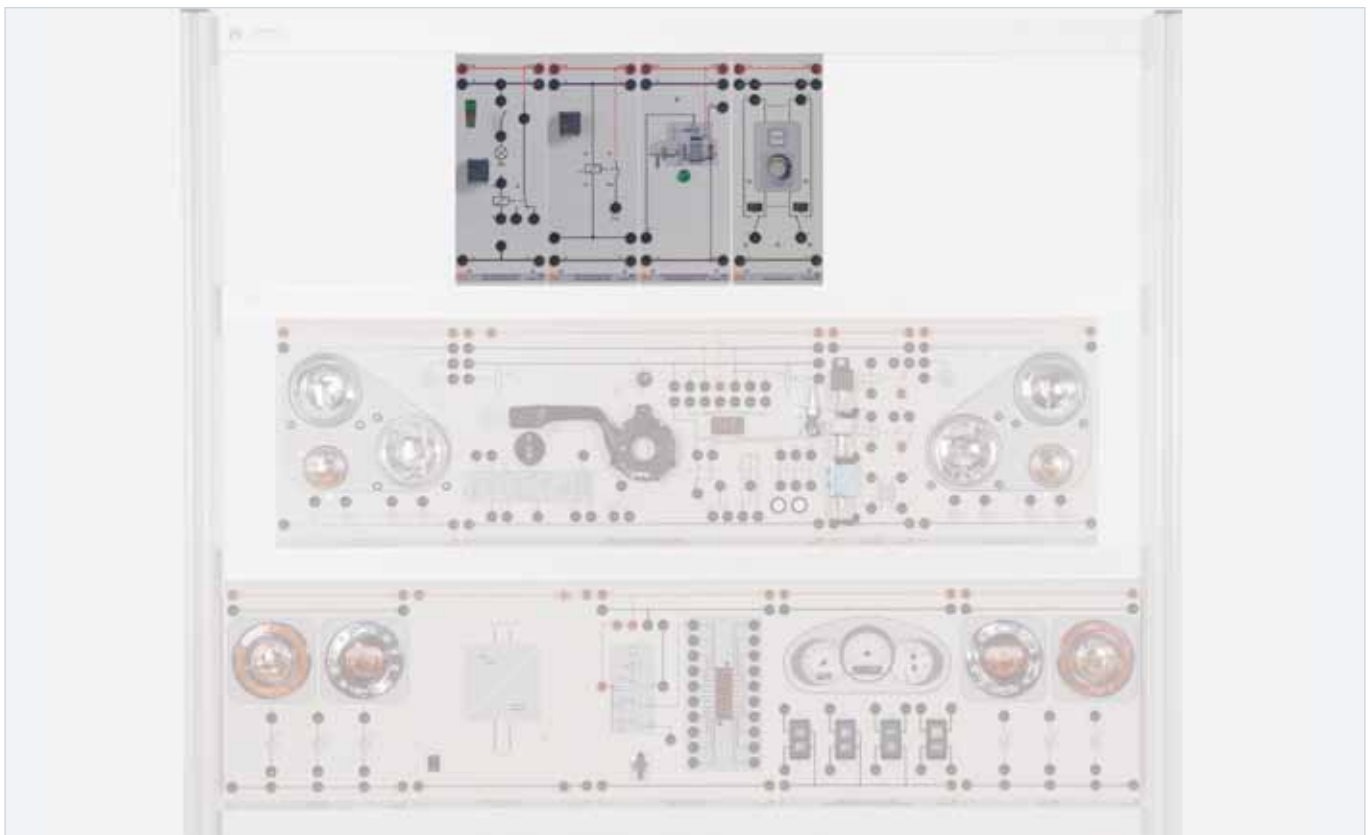
### Training contents

- Design of a steering column control unit
- Data transmission via a CAN bus
- Data protocol for low-speed CAN (class B), data protocol for high-speed CAN (class C)
- Fault patterns on a high-speed CAN bus and on a low-speed CAN bus
- Perform diagnostics on the CAN bus and analyse the Baud rate
- Carry out short-circuit test of the power output stage

## ALC 1.7 Onboard Power Supply Expansion

The motor vehicle's onboard power supply is very complex. The authorities are constantly stipulating new rules and regulations involving this aspect in motor vehicles. This means that expansions and adaptations of the training material should permit the

training system to reflect existing legal requirements. Facilitating the adaptation of onboard power supply systems to the latest technologies is one of the hallmarks of a training system designed for practical applications.



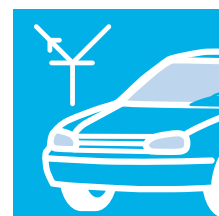
### Training contents

- Design a daytime running light controlled using PWM control
- Use incandescent lamp circuit in practical applications
- Assemble a circuit designed to unload the onboard power supply during start ignition
- Understand the design of relay circuits and be able to use them in practical application
- Comprehend starter connection and how the internal starter circuitry works



# Comfort Systems

Alarm System and Immobilizer .....	48
GPS Navigation .....	48
Air-conditioning and Climate Control .....	49
Auto Shop Communications with RFID .....	50
Comfort Systems and Keyless Entry .....	51





# Comfort Systems

## Process Procedures with Sensors and Actuators

Comfort systems increase the general safety and comfort of both drivers and passengers of motor vehicles. Among these amenities are electronic seat adjustments, interior air-conditioning and the storage of individualized preferences. This area includes an extremely broad range of technologies.

Whether it be RFID, CAN or MOST bus technology, the comfort systems field is expanding continuously. Based on job orders and fault descriptions students plan diagnostics of individual components, carry out testing on comfort systems and do repair work on original motor vehicle parts.



### Air-conditioning



A person's ability to perform and concentrate is heavily influenced by the temperature and condition of the surrounding air. Consequently, all efforts must be made to supply the passenger compartment with fresh, filtered air whose temperature can be raised or lowered depending on the exterior temperature.

### Immobilizer and Alarm System



The training system introduces students to the design and functionality of an alarm system including an immobilizer and a remote control. The system demonstrates how vehicles can be safeguarded in actual practice.

### Training Systems

Our training systems cover such topics as air-conditioning systems, alarm systems and GPS navigation but also some of the latest RFID technologies are didactically adapted on such subjects as keyless entry and comfort data storage.



# Comfort Systems

## ALC 7 Alarm Systems and Immobilizers

The alarm system issues optical and acoustic signals in the event of attempted intrusion. Arranged compactly on a panel for training purposes, this fully functional alarm system permits clear demonstrations of functionality. In this course students can activate and deactivate the alarm system. The system can easily and optimally be integrated into the existing lighting systems and it is extremely well suited to accommodate the retrofitting of auxiliary systems for teaching.



CO3216-3C  
Alarm System and Immobilizer

### Training contents

- Design type and operation of an alarm system with immobilizer
- Testing and adjusting alarm system function and immobilizer
- Programme the country-specific modifications of the alarm system and test how the alarm system works with other motor vehicle components
- Fault simulation

## GPS Navigation

To simulate navigation, special software is used to put the GPS system into simulation mode. This is absolutely essential to learn how the system operates. For storage purposes the navigation system is housed in a light and robust case to protect it from damage. The students are instructed how to put an auxiliary system into operation. They also check whether system installation is technically feasible and permitted for specific motor vehicles.



### System contents

- Simulation mode for navigation routes
- 3-D map display
- Traffic lane guidance system
- Automatic route calculation
- Active route search function
- Real-time language guidance
- Highway information display
- Integrated RDS-TMC receiver
- Operable via remote control and touchscreen
- Integrated gyroscope and speedometer
- Switchable between DVD and navigation mode
- Includes a connection and switch for a reversing camera

## Air-conditioning and Climate Control

This training system permits practical experimentation and demonstration with a "Climatronic" automotive air-conditioning unit with climate control. The system's very realistic design in

our compact system makes for equally realistic training. The fully functional system also permits training of evacuation and filling of the air-conditioning system.



### Training contents

- Assemble and put into operation an air-conditioning unit
- Consider how air-conditioning systems add to the comfort and safety features of a motor vehicle
- Deepen your understanding of refrigeration technology
- Investigate air-conditioning operation principles
- Elaboration of air-conditioning components promotes independent learning
- Learn how to handle refrigerants and to comply with regulations
- Perform independent trouble shooting, maintenance and repairs on the air-conditioning system
- Learn how open- and closed-loop temperature control works in the vehicle's passenger compartment

# Comfort Systems

## Auto Shop Communications with RFID

Communication with customers and filling out customer job orders form the basis for every single activity that follows. Information on motor vehicle data is obtained not only in talks with the customer but also by technical means involving communication between the motor vehicle and the PC. RFID (radio-frequency identification) technology is used to access the motor vehicle

data contained in the motor vehicle's key and read it out. This course provides insight into this functionality and its applications in the area of automotive engineering. The system comprising reader and transponder is studied both in terms of power as well as data transmission.



### Training contents

- Communication with internal and external customers
- Planning and preparation of work processes
- Service job order
- Complete job order
- The driver's key as a communication tool
- Reading data into the motor vehicle key
- Reading data out of the motor vehicle key
- RFID applications generally and specifically in the motor vehicle
- Understanding the components required for data exchange
- RFID transponder and antenna ranges
- Physical context and standards



## Comfort Systems and Keyless Entry

Comfort systems in the motor vehicle provide an essential, overall boost to active safety. Drivers are reluctant to do without a certain amount of driving comfort. New innovative operating systems quickly penetrate the market and rapidly become the standard. Training covers all the essentials of testing, diagnosing,

repairing and performing adjustments on comfort systems, safety systems and door-locking systems all in accordance with customer requirements and includes documenting the results. With an excellent grasp of the system the applications are easier to implement in practice.



### Training contents

- Comfort settings in the motor vehicle
- Active safety
- Door-locking system
- Central locking
- Remote radio control
- Keyless access to vehicle
- Capacitive pushbutton
- Basics of antenna technology
- How central locking works with CAN bus and expansion to keyless system



# Alternative Drives

CarTrain Electromobility .....	56
Hybrid Drive in Motor Vehicles .....	58
DC/AC Conversion .....	59
Fuel Cells .....	60
Photovoltaics .....	61



# Alternative Drives

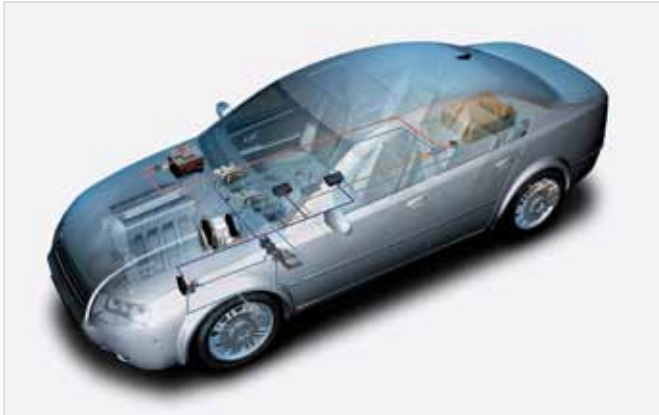
## Hybrid Drives

These drives are revolutionizing the car industry and your students need to keep pace with the latest developments and technologies. Demonstrate in the classroom how less fuel consumption, lower emissions and maximum driving pleasure can be realized with alternative drives. Sustainable, environmentally

friendly mobility is the trend for the future. Students and trainees should become familiar with this today so that they can hold their own in the workplace of tomorrow. Our training system covers the entire area of alternative drives and subsystems.



### Generator Operation



Source: Bosch

In generator mode, the power output of the combustion engine is higher than that needed for moving the vehicle. The excess power is fed to the generator, where it is converted into electrical energy and stored.

### Regenerative Braking



Source: Bosch

In this mode, the vehicle is braked entirely or partly without the service brake's frictional torque, which is replaced by the braking moment generated by the electric motor. In this process, the vehicle's kinetic energy is converted into electrical energy and stored.

### Training Systems

Our training systems cover not only these but additional topics as well. The UniTrain-I system for hybrid drives serves to impart the basics of alternative drives. Later, this acquired know-how is supplemented using the CarTrain system covering electromobility. As such the trainee becomes familiar with photovoltaic and fuel cell functionality.





# Alternative Drives

## CarTrain Electromobility

When we think about the future of our planet the development and production of vehicles equipped with hybrid drives is a logical and necessary step. Lower emissions and less fuel consumption are benchmarks for future generations of modern automobiles. Such measures ensure that the fundamentals necessary for life are sustained while quality of life improves.

Hybrid motor vehicles and electric cars are not just a future consideration, but in fact the auto industry has already made them available on the market. The only rational diagnostic strategy available for these vehicles presupposes the necessary system understanding.



### Training contents

- Use of HV systems in motor vehicles
- Smart grid
- Vehicle to grid
- Drive concepts in HV vehicles
- Energy flows in HV systems
- Onboard power supply of HV vehicles
- Practical, hands-on procedures in the repair shop
- How electrical machines function
  - Inverters
  - Switching possibilities of three-phase motors
- Work safety
- Design of electrical machines
- Asynchronous machines
- Synchronous machines
- Electromagnetic compatibility

## Your benefits



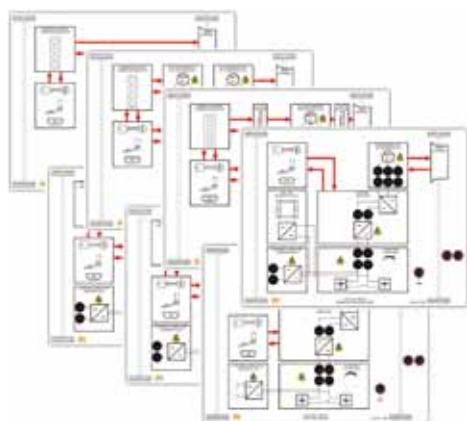
### Interactive Course Software

- Structured course software
- 3-D animations
- Animated energy flows
- Knowledge tests
- PC-based evaluations
- Integrated measurement software
- Job orders



### Parameter Settings

- Adjustable driving modes
  - Ascending gradient
  - Level plane
  - Descending gradient
- Speed
- Battery charge level



### Drive Concepts

Interchangeable overlay masks for:

- Serial hybrid
- Serial hybrid with plug-in
- Parallel hybrid
- Parallel hybrid with plug-in
- Fuel-cell operated vehicle
- Purely electric vehicle
- 7 drive configurations



### Practical Work

- Circuit isolation
- Protect against reactivation
- Establish zero-voltage
- Operate original measuring instruments
- Integrated fault simulator
- Indication of fault codes in the HV system
- Handling HV systems

# Alternative Drives

## Hybrid Drive in Motor Vehicles

Hybrid drives are essentially meant to meet three objectives: save fuel, reduce emissions, and increase torque/power. Different hybrid concepts can be employed depending on the required application. With our system trainees can learn on their own the most important technical fundamentals of hybrid drives. Based on job orders and fault descriptions students plan diagnostics

of individual components, carry out testing on systems and do repair work on original motor vehicle parts. In the course of measurements and experiments the students acquire practical know-how for every day on the job and vocational training.



### Training contents

- Benefits of hybrid systems
- Serial hybrid system
- Parallel hybrid system
- Combined hybrids
- Design of electrical machines
  - Asynchronous machines
  - Synchronous machines
- Fundamentals of inverters
  - Converters
- Fundamentals of frequency converters
- Three-phase voltage supply
- Measuring
  - DC voltage
  - AC voltage
  - Three-phase AC voltage
- Investigation of energy and power flows
- Onboard power supply of hybrid vehicles

## DC/AC Conversion

Electric energy is tapped at the car battery in the form of DC voltage and is then applied as a DC current. However, in modern electrical drives an AC voltage is needed with an approximate sinusoidal alternating current. In this course the generation of AC voltage and currents is described and demonstrated in a simple and graphic fashion.

The knowledge acquired in the theoretical section is then verified empirically by means of experiment. All of the components needed for the experiment are arranged on a single printed circuit board. In knowledge tests the student's progress is checked and thus the most important aspects of DC/AC conversion are effectively learned in the fastest possible time.



### Training contents

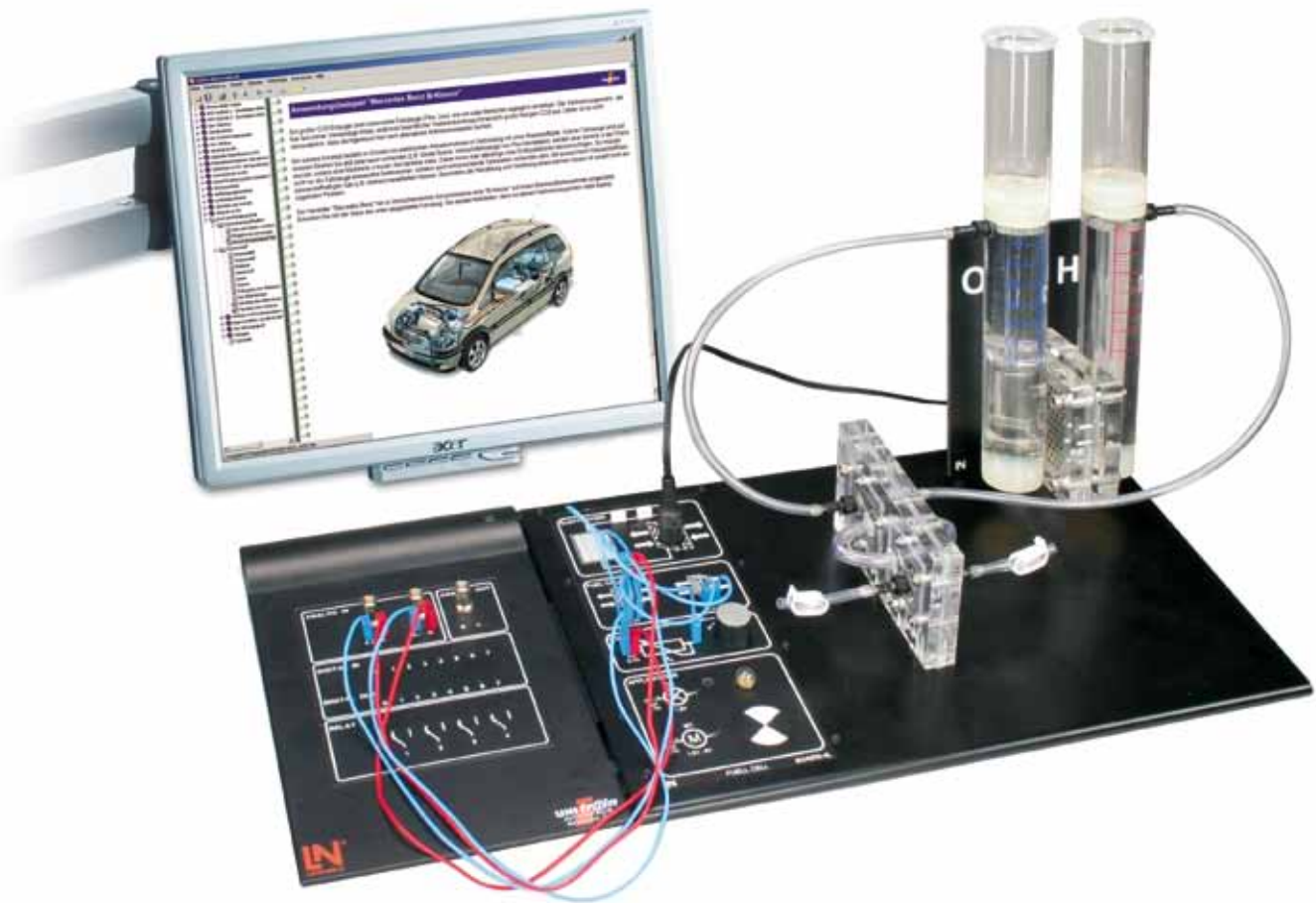
- Ohm's law
- PWM modulation
- Generation of half-wave sinusoidal current
- Generation of a negative voltage
- Alternating voltage and alternating current
- Magnetic fields permeating a coil
- The rotating electrical field

# Alternative Drives

## Fuel Cells

Motorized vehicles (cars, trucks) produce large quantities of CO<sub>2</sub>. Despite considerable advancements, the internal combustion engine still has very high CO<sub>2</sub> emission levels. It is therefore no surprise that engineers are seeking alternative drive concepts

here. In this training system students get to know and understand this fascinating technology. One interesting drive concept involves the use of electrical drive motors in conjunction with a fuel cell.



### Training contents

- Fuel cell application in the motor vehicle
- Function of a fuel cell
- Design of a fuel cell
- Fundamentals of the chemical process
- Properties of fuel cells
- Recording characteristics
- Efficiency of a fuel cell



## Photovoltaics

The term photovoltaics means a direct conversion of sunlight into electrical energy by means of solar cells. The energy obtained in this manner can be supplied to ancillary consumers to enhance driving comfort, e.g. to additionally cool a vehicle's

interior in extremely bright sunshine. With our Unitrain-I Photovoltaics System students very quickly grasp the fundamentals of this technology.



### Training contents

- Use of a photovoltaic system on a motor vehicle
- Design of a photovoltaic cell
- Open-circuit voltage
- Short-circuit current
- V-I characteristic
- Power of a photovoltaic cell
- Series-connected photovoltaic cells
- Parallel-connected photovoltaic cells
- Direct operation
- Storage operation



# Engine Management

CarTrain Motronic 2.8 .....	68
CarTrain Direct Fuel Injection .....	70
CarTrain Common Rail .....	72
Student/Teacher Measurement Stations .....	74
Functional Engine and Cutaway Models .....	76
Ignition Systems .....	78
Diesel Injection System Common Rail .....	79
Common Rail .....	80
Electronic Diesel Control (EDC) .....	81
Connect <sup>®</sup> -Fire Chip Tuning .....	82
Auto-Diagnostics Trainer Software .....	83



# Engine Management

## Networked Systems in the Engine Compartment

Increasingly complex engine management systems place growing demands on trainees in the automotive field. Our modular training systems provide students with step-by-step introductions to how modern systems involved here operate. That trainees frequently have problems following the material is due less to the material itself and more often to the way it is presented.

Thanks to practical hands-on elements our system assists the instructor by motivating each and every student regardless of the degree of difficulty or the student's knowledge level. The following pages provide an introduction to our training systems.





### Fuel Mixture Preparation



Source: Bosch

Lucas-Nülle's training systems provide students with a fully comprehensive introduction to the subject of fuel mixture preparation. The steps needed for optimizing fuel mixtures, registering and processing operational data, and outputting the data as actuator signals can be directly observed and understood here.

### Chip Tuning



All modern vehicles have an engine controlled by a central processor. This so-called engine control unit, or ECU, also monitors operating states. The Connect®-FIRE training system permits chip tuning on a single-cylinder, four-stroke engine.

### Training Systems

Besides the topics mentioned above, our training systems also cover ignition systems, engine management systems for spark-ignition and diesel engines, functional engines and chip tuning. All of these systems feature a close linkage between the practical and the theoretical.





# Engine Management

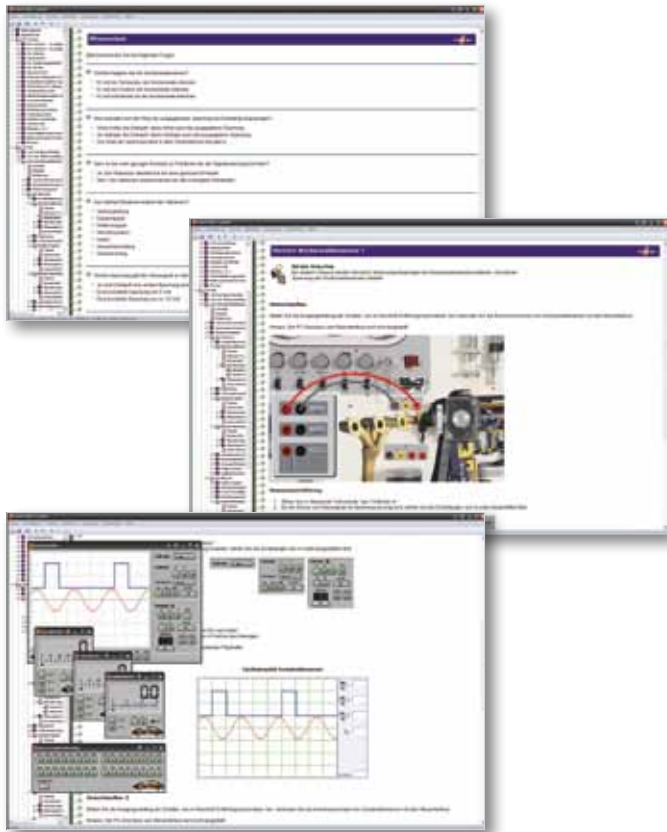
## From the Theoretical to the Practical – CarTrain as a Universal Solution

Modern combustion engines are not only facing constant mechanical optimization but also continuous and increasing complexity of their engine management systems. Laws and regulations are in constant flux also in an effort to minimize environmental pollution. But how we deal with new testing procedures and work rules does not alter the fact that the biggest challenge to doing perfect maintenance, repair and diagnostics

work is still overall “system understanding”. For that reason the link between theory and practice is even more important in the training phase. Knowing and recalling the location and function of the sensors and actuators is of particular importance and comes from hands-on work. Using original motor vehicle components in the training system facilitates the learning and understanding of this fascinating technology.

### Multimedia Training Course

The world of multimedia-based learning has opened up whole new horizons to both students as well as teachers and instructors. Self-learning is possible thanks to the text guiding method. Technical relationships and context which are difficult to explain with a two-dimensional image are converted into animations and clips which provide detailed insight into the technology and its complexity. Many of the test pages directly show learning progress of the student(s) and can be evaluated individually or as a group by the teacher at the press of a button.



### Integrated Measuring Instruments

There is a whole series of integrated measuring instruments which bring together hardware and multimedia training courses. This is how measurement results and oscilloscope traces can be integrated directly into the documentation using drag and drop or other applications utilized. This saves time and reduces the number of errors. Clarity and accessibility remain guaranteed, and the written instructions on how to operate the measuring instruments are also included in the multimedia training course.

## Your benefits



### Simulation and/or Real Modus

The sensors can be switched between simulation modus and real modus. In simulation modus rotary switches can be used to make random settings so that students can learn how these have repercussions on engine management. In real modus the actual ambient variables are put into the equation.



### OBD-II Function

This course demonstrates how to read out emission data with the help of the onboard diagnosis OBD II or an OBD-II capable terminal, interpret the data and use the results as a basis for eliminating systemic faults. Many more OBD-II functions are also at your disposal including read out of actual values and error memory deleting.

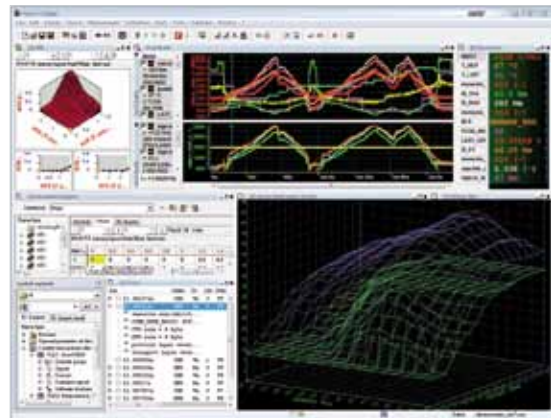


### Fully Functional Original Components

Using fully functional original components you can learn how the various engine management systems operate. Here one important focus is on trouble shooting in connection with realistic sensor and actuator variables.

### Fault Simulation

All CarTrain systems come equipped with a built-in fault simulator. The complexity of the faults ranges from simple line interruptions to fault-to-earth or fault-to-positive battery terminal, and even includes contact resistances, defective components and control unit faults.



### Programming Engine Characteristics Map

Using expert systems to identify, check and upgrade control unit software: these are all topics involving expert systems and engine characteristics programming. The CarTrain engine management systems are equipped with a freely programmable control unit in which you can read out, process and optimize existing characteristic maps. As such this system is perfectly suitable for an introduction into the fascinating topics of chip tuning, control unit programming and remote diagnostics.

# Engine Management

## CarTrain Motronic 2.8

The motronic system unites in one control unit the engine management's entire electronics (air-fuel mixture and ignition). Motronic 2.8 is a multi-point injection system in which each cylinder has its own injection valve. The actuators contained in this training system are controlled as a function of corresponding

sensor signals. Different driving conditions can be reproduced and analysed. All sensors and actuators of the engine management system are original, fully functional components.



### Training contents

- Understand how the engine management system works
- Function and operation of the relevant control loops
- Design and operating principles of the sensors and actuators
- Interpretation and application of circuit diagrams
- Conducting hands-on measurements on engine management components
- Fault memory read out
- Measuring and testing electrical, electronic, hydraulic, mechanical and pneumatic variables
- Engine management system settings
- Expert systems and remote diagnostics

## Your benefits



### Interactive Course Software

- Structured course software
- 3-D animations
- Knowledge tests
- PC-based question evaluation
- Integrated measurement software
- Job orders
- Fault enabling via software



### Operating Unit

Switch individual sensors between real and simulation mode

- RPM
- Coolant temperature
- Intake air temperature
- Knock sensor
- Air mass
- Lambda sensor



### Original Components

- Crankshaft sensor
- Camshaft sensor
- Throttle valve potentiometer
- Knock-sensor
- Air-mass meter
- Voltage jump sensor
- Single-spark ignition coil
- Idle actuator and much more



### Hands-on Work

- Record characteristics
- Compare actual and desired values
- Read out fault memory
- OBD function
- Trouble shooting
- Fault elimination and repair
- Connect up original workshop tester



# Engine Management

## CarTrain Direct Fuel Injection

The MED direct fuel injection system with turbo charger combines the entire engine control system (air-fuel mixture and ignition) in one single control unit. The MED direct fuel injection with turbo charger is a multi-point injection system meaning that each cylinder is equipped with its own injection valve.

The training system is designed to perform actuator control as a function of corresponding sensor signals. Different driving conditions can be reproduced and understood. The sensors and actuators used in the engine management system are original, fully-operational components.

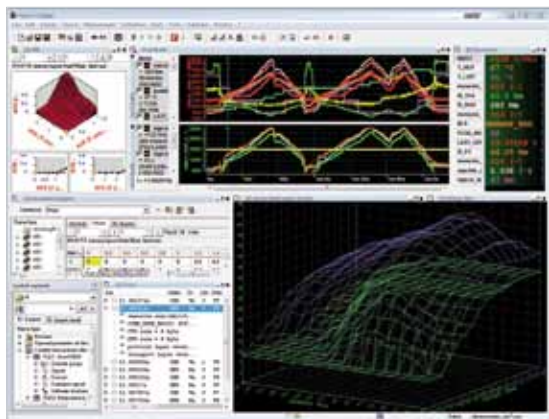


### Training contents

- Understand how the engine management system works
- Grasp how the control loops in the system operate
- Learn about the design and function of sensors and actuators
- Learn how to interpret and use circuit diagrams
- Conduct practical, hands-on measurements on the engine management components
- Read out fault memory
- Measure and test electrical, electronic, mechanical, hydraulic and pneumatic variables
- Adjust engine management system parameters
- Learn to use expert systems and remote diagnostics



## Your benefits



### Characteristic Map Programming

- Reading out characteristics map
- Processing characteristics
- Adjusting setpoint values
- Control unit flashing
- Display of all parameters
- How to use programming software



### Workshop Work

- Read out vehicle data
- Read out fault memory
- Repair cables
- How to use circuit diagrams



### Original Components

- Accelerator pedal sensor
- Broadband Lambda sensor
- Voltage jump sensor
- Rail pressure sensor
- Manifold pressure sensor
- Rail pressure control valve
- High-pressure injection valve
- E-gas throttle valve and more



### Practical Hands-on Work

- Record characteristics
- Compare actual and setpoint values
- Read out fault memory
- OBD function
- Fault finding
- Trouble shooting
- Connect up original workshop tester

# Engine Management

## CarTrain Common Rail

The common rail engine management system combines the entire engine control electronics into a single control unit. The training system is designed to perform actuator control as a function of the corresponding sensor signals. This makes it pos-

sible to reproduce and understand different driving conditions. The sensors and actuators used in the engine management system are genuine, fully-operational components.



### Training contents

- Understand how the engine management system works
- Grasp how the control loops in the system operate
- Learn about the design and function of sensors and actuators
- Learn how to interpret and use circuit diagrams
- Conduct practical, hands-on measurements on the engine management components
- Read out fault memory
- Measure and test electrical, electronic, mechanical, hydraulic and pneumatic variables
- Adjust engine management system parameters
- Learn to use expert systems and remote diagnostics

## Your benefits



### OBD-II Terminal

- Read out motor vehicle data
- Delete error memory
- Display actual values
- Compatible to all OBD-II diagnostic equipment
- CAN-bus data protocol



### Realistic Workshop Activities

- Read out motor vehicle data
- Delete error memory
- Repair cables
- Handle circuit diagrams



### Original Components

- Accelerator pedal sensor
- Air mass meter
- Rail pressure sensor
- Rail pressure controller
- Crankshaft sensor
- Camshaft sensor
- Engine temperature sensor
- Air temperature sensor and more



### Hands-on Work

- Recording characteristics
- Comparing actual and setpoint values
- Read out error memory
- OBD function
- Trouble shooting
- Fault correction
- Connecting original workshop tester



# Engine Management

## Student/Teacher Measurement Stations

Extremely flexible, closely networked and safe student/teacher measurement stations are just what teachers and instructors are looking for. That's why Lucas-Nülle has developed a system which permits the trainee and the trainer to receive the same signals. The signals are transmitted by a training system like Car-Train or by a real vehicle. This is because the new system can be connected to any electronic device, in other words from other Lucas-Nülle training systems outside the automotive area. The new student/teacher measurement stations from Lucas-Nülle

also permit high-voltage signals to be sent from the teacher's workstations. The signal is automatically converted and output to the student workstations at a lower voltage. But the signal curve depicted graphically is shown precisely as it would be for the high-voltage case. This way the students learn to cope with typical aspects of high-voltage work without being exposed to the danger.

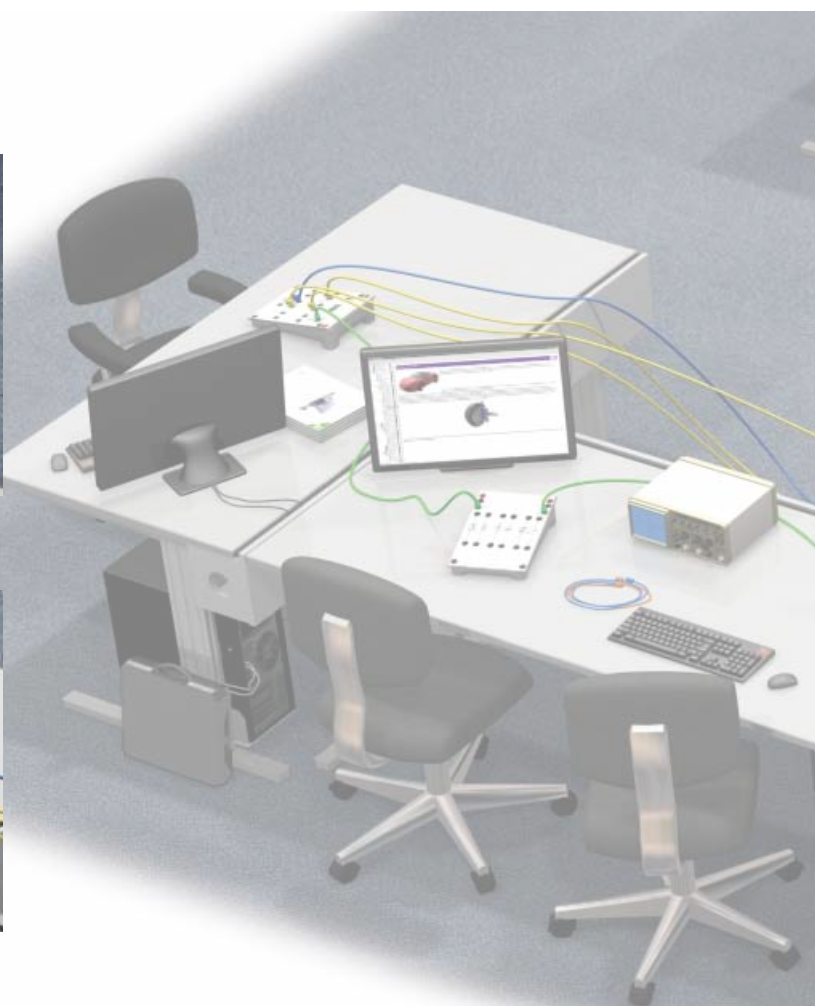
Training System with Signal Generation



Teacher Measurement Station Interface



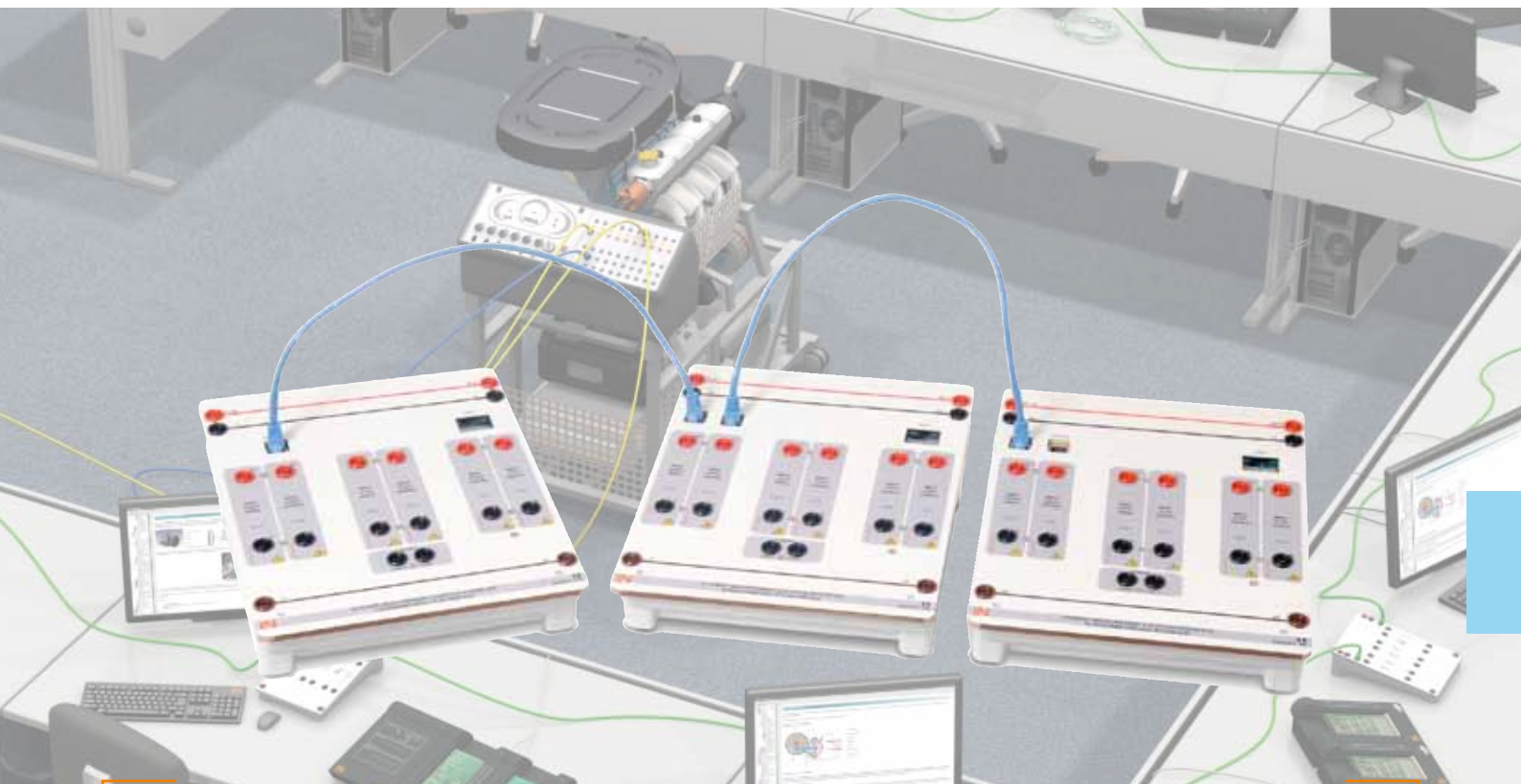
Student Measurement Stations



## Student/Teacher Measurement Station

A gateway has been integrated into the teacher's measurement station. This enables the feed-in of different CAN-bus signals. This exam-relevant subject makes for efficient instruction particularly in combination with the new student/teacher measurement stations. A terminating resistor is connected to the last interface of each system for automatic bus determination. An additional and very essential advantage for the teacher is

the fact that any malfunctions or interruptions occurring at the student measurement stations are indicated with the actual workstation number. This allows the teacher or instructor to immediately detect and respond to the interruption. This minimizes any unnecessary breaks in the instruction and thus boosts learning success.



### Your benefits

- Universal deployment in all types of vocational training classes
- Transmission of analogue and digital signals
- Signal inputs up to  $\pm 500\text{ V}$  / signal outputs up to  $\pm 15\text{ V}$
- Precise signal transmission
- Easy assembly and disassembly
- Digital display for diagnosing line interruptions
- Low disturbance rate
- Simple lab network using Ethernet cables



# Engine Management

## Functional Engine and Cut-away Models

Naturally, as a full-service outfitter of technical training centres and educational institutions, we also offer pure functional engines with up-to-date technology. You can decide for yourself whether you need only a functional engine or a complete motor vehicle that has been modified for training purposes. All of the manufactured systems comply with high safety standards so

that there is no exposure to moving parts. Protective covers are also included to safeguard hot components. All systems can be retrofitted with a fault-simulation circuit whose signals can be tapped using break-out boxes. Furthermore these systems are supplied with original workshop documentation. Contact us for further information!

### Functional Engines

Standard commercial diagnostic testers can be used to read out the functional engine's error memory via the OBD terminal in order to perform typical automotive diagnoses. As in real life, all signals can be tapped from the cable harness or the plug connectors. A switch can be used to easily simulate typical electrical faults on the engine. In addition to short set-up times and solid training units the trainee also achieves more than just collecting abstract knowledge – real hands-on work skills are developed. Many different instructional situations can be produced using this system. Accordingly the trainee can work through a customer order during a project in which the motor vehicle is prepared for servicing and the prescribed check-up and testing conditions are set up. You identify the motor vehicle using technical information systems and record the manufacturer and customer data. Finally the system is checked for errors during trouble shooting.



*Example of a functional engine. Additional models and information can be obtained from your sales partner!*



*Examples of a cut-away model. Even more models and information available from your sales partner!*

## Cut-away Models

In order to organise training as practically as possible the LN cut-away motor vehicle has been specially modified didactically for training purposes. All important components have been configured accessibly in order to permit direct measurement access to sensor and actuator signals. To simulate typical workshop situations, malfunctions can be fed into the system by means of a hidden fault switching box.



### Your benefits

- Practice-oriented training with original vehicles and components
- All components are fully functional
- Interpreting technical documentation
- Simulating malfunctions
- Conducting direct measurements on the motor vehicle/engine without assembly or disassembly
- Conducting measurements on all systems with the engine running
- Examination of electrical and mechanical components

# Engine Management

## Ignition Systems

To ignite the air-fuel mixture, combustion engines have always needed an ignition system. Nowadays such ignition systems have become extremely complex and precise in order to comply with emission standards while at the same time enabling modern combustion engines to unleash their tremendous power. With our training system the trainees come to grips with these topics

early on and can use the UniTrain-I system to learn on their own and at their own speed how the ignition system is designed, what can go wrong and how this can be identified. Trainees also learn to carry out diagnostics and maintenance in the area of engine management.



### Training contents

- Observe how the ignition spark is generated
- Learn about ignition timing (mechanical and map-based)
- Conventional ignition system and dual-spark ignition systems are introduced
- Transistorized ignition systems with Hall and inductive sensors
- Become acquainted with the electronic ignition system
- Learn how to record and evaluate ignition oscillographs
- Find out the basics of static and rotary high-voltage distribution

## Common Rail Diesel Injection System

What goes into making a diesel engine run “smoothly”? How can engines be designed to lower exhaust gas emissions? The fact that everything is just a question of the injection system makes this field all the more exciting. This topic is made easier to comprehend using our training system which empowers the

trainee to learn about injection pressures, processes and air-fuel quantities in a self-controlled learning process. Covering the entire spectrum of systems available on the market the trainees are able to switch between the various injector types and thus gain an overview of the entire topic.



**UniTrain**  
SYSTEM

### Training contents

- Requirements to be met by diesel injection systems
- Introduction to various designs
- Design and functionality of a common rail system
- Fault localization on a common rail system
- Injection characteristics of common rail systems and piezo injectors (with up to seven injection cycles)
- Investigation of the fuel system and differentiation between low- and high-pressure circuits
- Understand the process of electrical tests of injectors
- Examination of a common rail system's hydraulics

# Engine Management

## Common Rail

Common rail is an injection system for self-igniting combustion engines. Map-controlled injectors can be operated and diagnosed here just like on a real engine. As such, trainees at vocational schools or industrial training centres have access to a realistic work environment which they need to develop solid

skills and expertise. Using our comprehensive system the students learn on original components. They consider the ramifications of malfunctions on the engine's subsystems, the combustion process and gas emission composition.



### Training contents

- Combustion process
- Pollutant emissions
- Reduction in pollutant emissions
- Block circuit diagrams, circuit diagrams, functional diagrams and graphs
- Signal, material and energy flows
- Diagnostic, testing and measuring equipment
- Test and measurement procedures
- Sensors and actuators
- Open-loop and closed-loop control
- Engine management subsystems
- Assembly groups and systems for fuel mixture preparation in diesel engines
- Adaptive systems
- Interfaces to other systems
- Fuels



## Electronic Diesel Control (EDC)

Electronic diesel control is an electronic management system for diesel engines. With our system the trainee can become familiar with and understand EDC and all the open- and closed-loop control functions in one electronic engine control unit as well as

the large number of sensors and actuators that are connected to it. Furthermore the students learn to analyse malfunctions and their impact on the engine's sub-systems, the combustion process and the composition of the gas emissions.



### Training contents

- Combustion process
- Pollutant emissions
- Reduction in pollutant emissions
- Block diagrams, circuit diagrams, function diagrams, graphs
- Signal, material and energy flows
- Diagnostic, testing and measuring equipment
- Test and measuring methods
- Sensors and actuators
- Open-loop and closed-loop control
- Engine management sub-systems
- Assembly groups and systems for fuel mixture preparation in diesel engines
- Adaptive systems
- Interfaces to other systems
- Fuels

# Engine Management

## Connect®-FIRE Chip Tuning

### Software-controlled Performance Optimization at the Engine Test Stand

Connect®-FIRE is the compliment to the globally unique interactive multimedia-based Connect® engine management system. The Connect®-FIRE's extraordinary feature is its compact injection engine, designed in miniature format including an electronically controlled load, control unit, interface and

intelligent teach- and software. Here original components are merged with a didactically designed, multimedia-based training platform to create a training system that gets any student passionate about cars.



*Performance Optimization on the Engine Test Stand*

#### Training contents

- Trainees conduct measurements on different engine management components
- Observe engine response to changes in timing settings
- Edit and optimize characteristic maps for idling, ignition and injection
- Record performance and torque characteristics
- Carry out performance and torque optimization (chip tuning)
- Ultimately trainees also investigate emission characteristics

## Auto Diagnosis Trainer Software

Lucas-Nülle's new automobile diagnosis trainer (ADT) software is meant for students to develop and consolidate strategies for successful automotive diagnosis and trouble shooting using a training program before moving on to real vehicles.

Thus the new software constitutes the ideal preparation for work on real systems. By completing this preliminary step the trainees are able to handle work on the vehicle more confidently, more effectively and thus mistake-free.



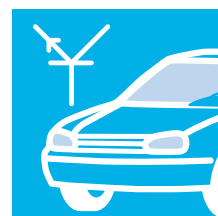
### Training contents

- Diagnosis and maintenance in the area of engine management
- Developing diagnostic strategies
- Planning fault localization and repair measures
- Documenting, monitoring and assessing implemented measures
- Working with block, circuit and function diagrams
- Working with measurement devices and diagnostic tools



# Vehicle Diagnostics

Onboard Diagnosis II .....	88
CAN/LIN Monitor .....	89
High-voltage Instrumentation .....	89
Snap-on MODIS .....	90
Snap-on SOLUS PRO .....	91
Snap-on VERUS .....	91





# Vehicle Diagnostics

## Developing Diagnostics Strategies

Teaching systematic vehicle diagnostics including the associated trouble shooting methods in such a way that the trainees not only follow the procedures but can also implement them confidently on their own is the true challenge for any trainer. It is also important to consider manufacturer-specific diagnostic concepts in this process. Maintenance strategies are planned on the basis

of customer information, visual checks and the results of independent diagnosis. Trainees use our systems on vehicle diagnostics to assimilate this multi-facetted approach while working on modular courses and at experiment stands that empower them to carry out project work on their own.



### Onboard-Diagnosis II



This is used by students to perform diagnoses in the area of engine management. Students identify the engine management system with the help of electronic information systems and vehicle-specific documents, and perform system analyses. A standard interface provides access to the engine control unit. This is how students learn the entire, realistic process of on-board diagnostics as it is carried out on the job everyday in the automotive workshops and businesses.

### Engine Tester



The engine tester is an indispensable aid for diagnosis, maintenance and repair of all important automotive systems. It can be used to read vehicle-specific data, errors and parameters out of the various control units. For that reason it constitutes one of those key tools that trainees need to master very early on, like the engine tester which also has to be operated confidently.

### Training Systems

Our products include training systems for such topics as on board diagnosis II and trouble shooting methods. Furthermore, we offer supplementary systems which can be used to carry out instruction in the petrol and diesel diagnostics.



Lucas-Nülle



# Vehicle Diagnostics

## Onboard Diagnosis II

This course demonstrates how to read out emission data with the help of the onboard diagnosis unit (OBD II or EOBD), interpret the data and use the results as a basis for eliminating systemic faults. Students have the possibility to adjust various

parameters on their own to see how these settings affect the tester. They also have the opportunity to tap the CAN transmission signal to display it on the oscilloscope.

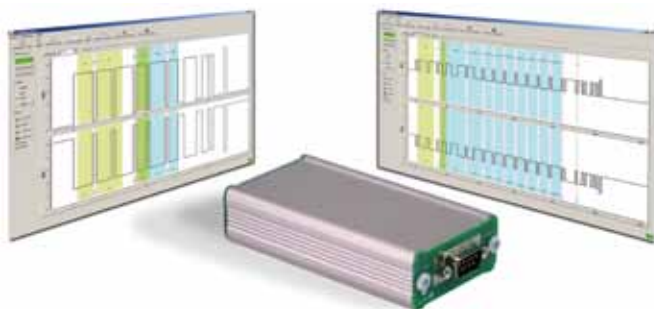


### Training contents

- The system permits the diagnosis of emission-relevant systems
- Systematic development of trouble shooting and diagnostic strategies
- Working with test devices
- Planning fault localization and repair measures
- Evaluating and documenting test results

## CAN/LIN Monitor

The CAN/LIN monitor allows bus protocols on a CAN bus, LIN bus or any serial bus to be recorded and investigated.



### Your benefits

- Visual display of bus protocol structure
- Option for displaying in binary or hexadecimal code format
- Recording of bus packets
- Transmission of bus packets
- Suitable for student experiments and demonstrations
- Simple to put into operation
- Displays
  - identifier
  - data length
  - period
- User-configurable graphic interface

## High-voltage Instrumentation

This flexible measurement system permits rapid, safe and simple diagnosis of high-voltage motor vehicles. Here emphasis is on maximum protection for personal safety and the motor vehicle.



### Your benefits

- Flexible system for simple integration into the testing and diagnostics platform
- Adaptable interface to log test procedure and record results
- Multimeter up to 1000 V
- HV insulation resistance measurement
  - Test voltage up to 1000 V
  - Voltage according to SAE J1766
- Simple operation
  - Even includes HV protective clothing
- Calibration certificate in accordance with DIN EN ISO 9002
- Self-testing
- Test current max. 1 mA
- Automatic disabling of test voltage in the event of a fault or physical contact



# Vehicle Diagnostics

## Snap-on MODIS

This is the latest generation of diagnostics systems with multiple applications. It is based on a modular diagnostic concept and includes very high manufacturer coverage and enormous testing depth. Before you have to replace the control unit this device is capable of localizing sporadically occurring faults and malfunc-

tions and provides a wide range of testing possibilities. In addition to a four-channel oscilloscope the Modis offers an additional VGA output. Consequently this diagnostics unit can be connected directly to a projector making it an unbeatable highlight for any type of instruction.



### Your Benefits

- Lightweight device, easy to handle on the job, simple to operate
- No subscription obligation, no disabling of device after 2 years
- Fully functional, high-performance diagnostics tool: fast lab and ignition scope, error code scanner, trouble shooting module and multimeter all in one device
- All cable sets are included in the scope of delivery
- Rapid diagnosis: quick vehicle selection, short communication set-up with control unit
- Very high manufacturer coverage and data depth of individual vehicle makes
- Stores measurement value sequences/data film; simplifies discovery and analysis of sporadic faults



## Snap-on SOLUS PRO

Using the Solus Pro you can read out all of the vehicle data of every single manufacturer. The graphic display simplifies making comparisons between different parameters.



### Your benefits

- Large 6.2" display
- Rapid communication setup
- Window CE operating system
- Freeze frame function for rapid and easy diagnosis
- Graphic display of all data
- USB connection to PC
- CAN-bus support
- Adapter cable for
  - 11 OBD-I plugs
  - OBD-II adapter
- Error code display in plain language

## Snap-on VERUS

VERUS is the first fully integrated, hand-held diagnostics tool with customer/vehicle recording function, scanner, Snap-on trouble shooting, component test meter, 4-channel lab scope, Fast-Track® reference database and optional ShopKey repair information as well as reprogramming feature using J2534 pass-thru interface.



### Your benefits

- The bright colour display with 26.4 cm (10.4 inch) diagonal screen measurement and a resolution of 1024 x 768 facilitates the read out of curves, waveforms, circuit diagrams, web pages and much more besides
- Time-saving navigation via touchscreen and key shortcuts for each application
- Comprehensive screen display – real Window Multitasking for multiple applications
- Intuitive Windows XP operating system – rapid startup and operation thanks to embedded technology



# Chassis and Driving Safety

Electromechanical Parking Brake .....	96
Electromechanical Power Steering .....	97
Airbag, Seat-belt Tensioner and Crash Behaviour .....	98
SRS Airbag and Seat-belt Tensioner .....	99
ABS, ASR and ESP .....	100
Brake Power Control with ABS and ASR .....	101



# Chassis and Driving Safety

## Active and Passive Safety

The sensors and actuators of the systems involved here perform important functions for active and passive safety, comfort as well as engine management in motor vehicles. Driving safety and impact protection features are especially significant to the safety of a vehicle's occupants. Work on such safety components requires

sound qualifications acquired through first-rate training and education systems. Students are introduced to the complex subjects by a combination of e-learning courses and real-life compact systems, and are able to apply acquired skills on true replicas of original components.



## ABS



ABS measures a wheel's circumferential speed. During braking, the wheel's slip is calculated automatically and the brake pressure regulated accordingly. This prevents the wheel from blocking. Our true replica of an original ABS system allows students to examine these functions and perform related measurements.

## Airbag



The airbag training environment from our family of panel systems allows practical experiments and demonstrations using an SRS airbag and seat-belt tensioner. This UniTrain-I airbag course includes a steering wheel with a fully functional, re-usable airbag.

## Training Systems

Our training systems cover such topics as airbag and belt tensioner, ABS and ASR, chassis technology, steering systems and transmission technology. All systems feature original components and thus have a very stimulating effect on students and trainees alike.





# Chassis and Driving Safety

## Electromechanical Parking Brake with Auto-hold Function

An electromechanical parking brake replaces the conventional handbrake with a simple switch on the dashboard so that there is no need for a handbrake lever. On uphill starts, sensors determine how steep the slope is. If the driver stops the vehicle, the brake engages automatically until the car is started again.

This new auto-hold function is being integrated into more and more vehicles and in the future will gain in significance. In our system we have depicted the modern electromechanical parking brake in such a way that it is easily understood and can be experimentally tested by trainees and students.



### Training contents

- How rear-wheel brake actuators work
- Sensors and actuators in an electromechanical parking brake
- How an electromechanical parking brake works
- Parking brake function
- Dynamic pull-away assistant
- Dynamic emergency brake function
- Auto-hold function
- Gauging of brake discs
- Understanding how brake boosters and hydraulic brakes work
- Interpretation and use of technical documentation
- Experimental investigation of the various functions for improved understanding
- Assembly, configuration and testing of mechanical components
- Design and function of disc brakes

## Electromechanical Power Steering

Electromechanical power steering has many advantages over hydraulic steering. It assists the driver not just in purely physical terms, but also intelligently by responding only when the driver explicitly requests it. Steering assistance is provided as a function of vehicle speed as well as steering moment and angle. With

this fully functional cutaway model the trainees quickly learn just how electromechanical power steering works. They also have the opportunity to conduct CAN measurements directly on the steering mechanism.



### Training contents

- Design of an electromechanical power steering
- Function of the individual assembly groups
- Steering geometry
- Inverter control
- CAN-bus control
- Vehicle speed sensor
- Steering angle sensor
- Steering moment sensor

# Chassis and Driving Safety

## Airbag, Belt Tensioner and Crash Response

Active safety systems like airbags and seat-belt tensioners have been standard features in all vehicle classes for years. Regular inspections of these features are needed to ensure that they operate properly. For that reason this has become a routine

part of everyday auto garage work. Trainees learn the necessary know-how and trouble shooting strategies using this system as realistically as possible.



**UniTrain**  
SYSTEM

### Training contents

- Active and passive safety in motor vehicles
- Operating principles of airbags and seat-belt tensioners
- Safety switch and ignition cap
- Operating principle of pressure and acceleration sensors
- Measurement of acceleration
- Typical crash situations
- Trigger times and sequences
- Fault management for airbag systems
- Trouble shooting

## SRS Airbag and Belt Tensioner

This training environment from our family of "Compact" systems allows the trainee to analyse corresponding systems in practical experimentation and demonstrations using an SRS airbag and

seat-belt tensioner and includes testing exercises. The system's very realistic design, including the use of manufacturer-specific diagnostic concepts, makes for equally realistic training.



### Training contents

- Understanding the functionality of an SRS system
- Understanding the operating principles of pyrotechnic actuators (airbag and seat-belt tensioner)
- Identifying the effects of typical faults on SRS systems
- Conducting various electrical measurements
- Interpreting and employing technical documentation
- Building up diagnostic skills
- Planning and implementing typical diagnostic strategies

# Chassis and Driving Safety

## ABS/ASR/ESP

Brake systems of modern motor vehicles are becoming increasingly complex. Electronic aids such as ABS, ASR and ESP are now standard features in such systems. They are designed to keep the vehicle stable with physical limits and thus help assist in protec-

ting the driver. Each individual system is mutually dependent and in part uses the same sensor signals. With this training system the trainee becomes familiar with and understands how the various systems function and interact.



### Training contents

- Basic physics of driving
- Understeering
- Oversteering
- Function and design of sensors
- ABS function and design
  - What is slip?
  - ABS control loop
- ASR function and design
  - Controlling situations
- ESP function and design
  - Operating principle



## Brake Power Control with ABS and ASR

This training system permits practical experimentation and demonstrations by means of an electronically controlled ABS / ASR brake system (Bosch 5.3). All important electrical signals can be tapped centrally via 4-mm sockets. As such, trainees have

the opportunity to practice realistic work and thus eventually transfer the acquired know-how to the real job. This system also permits read-outs using OBD diagnostics tools.



### Training contents

- Understanding the functionality of typical ABS and ASR brake systems
- Understanding the functionality of brake boosters and hydraulic brakes
- Identifying the effects of typical malfunctions on ABS and ASR brake systems
- Conducting various electrical measurements
- Interpreting and employing technical documentation
- Building up diagnostic skills
- Planning and implementing typical diagnostic strategies



# Networked Systems

CAN Bus .....	106
CAN Lighting Technology .....	107
CAN Comfort Technology .....	107
LIN Bus .....	108
Fibre Optic Waveguides .....	109
FlexRay .....	110
CAN- and LIN-Bus Dashboard Training Stand/Model .....	111



# Networked Systems

## Active and Passive Safety

The onboard network of a new motor vehicle resembles the IT network of a medium-sized company, in which 70 to 90 control units are connected by various data buses over which data is exchanged at an intense rate. Today over two-thirds of all innovations in the automobile are software-based. That makes it all the more essential to integrate and to teach this know-how

and the necessary practical expertise that goes with it. The LN training systems have content that covers all of the standard bus systems. The combination of original components, experiments and self-directed learning leads to the acquisition of solid know-how and skills.



## Optical Data Bus Systems



Large quantities of data can be transmitted with the help of light waves. The UniTrain-I course on optical waveguides contains practical examples demonstrating how to handle such waveguides.

## Networks



An automobile can be divided into various data communication zones, each one being assigned particular duties which place corresponding demands on the network. For this reason, the automobile is organized into a number of sub-networks. The various possibilities of doing this are clearly demonstrated in our courses on bus systems.

## Training Systems

With our training systems teachers and trainers can provide instruction of the typical automotive bus systems like CAN bus, LIN bus, MOST bus and FlexRay. The trainees not only become familiar with them but experiment on them independently and thus learn to comprehend their complex technical relationships.



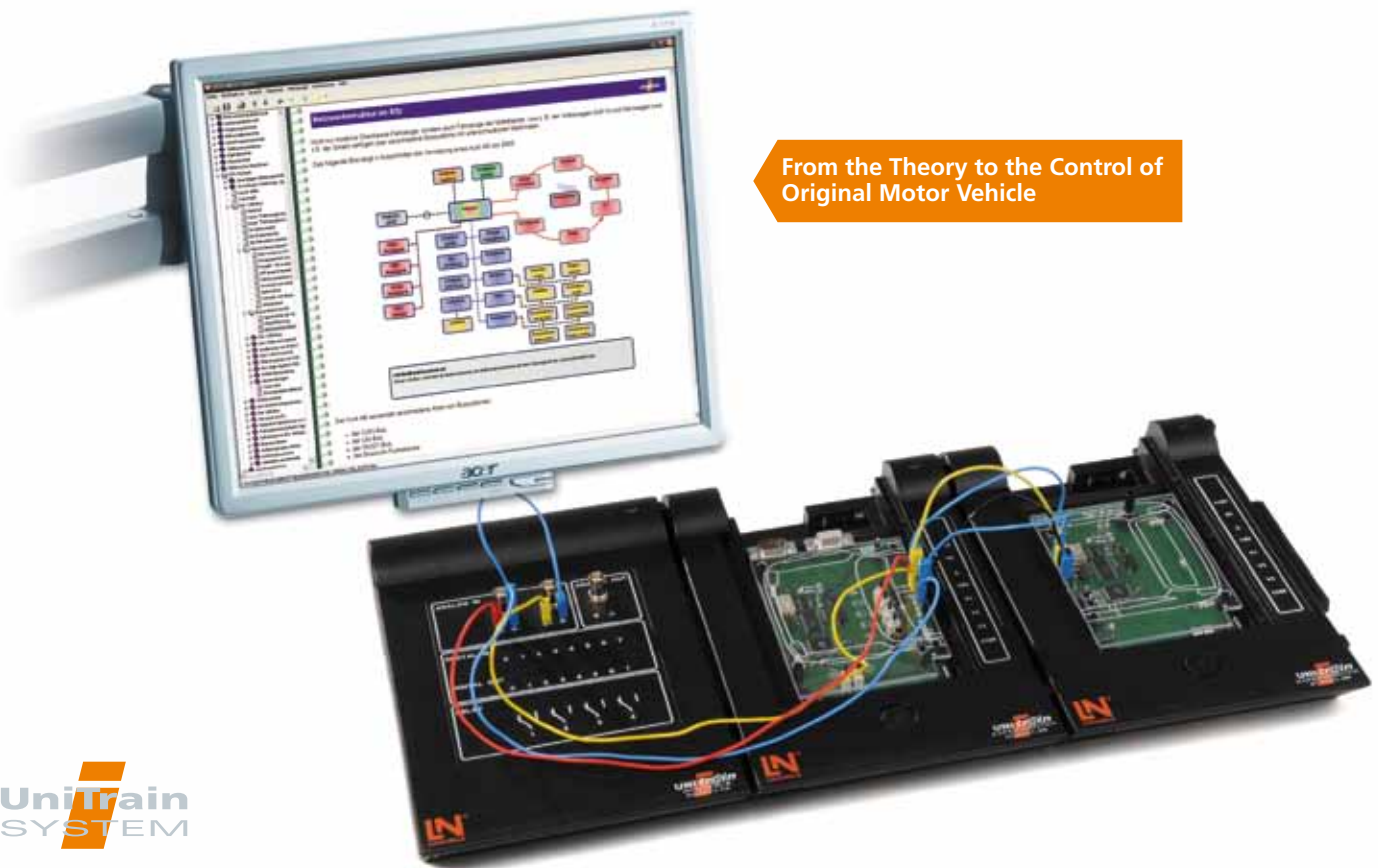


# Networked Systems

## CAN Bus

Modern motor vehicles incorporate numerous electronic control units which communicate with each other continually via digital bus systems. Widely used for this purpose in passenger cars as well as commercial vehicles are CAN buses, especially when it comes to comfort, engine management and diagnostic applica-

tions. This training system thus conveys important information in a very realistic manner. Trainees can use this system to carry out diagnostics and repair work on networked electronic systems inside the motor vehicle.



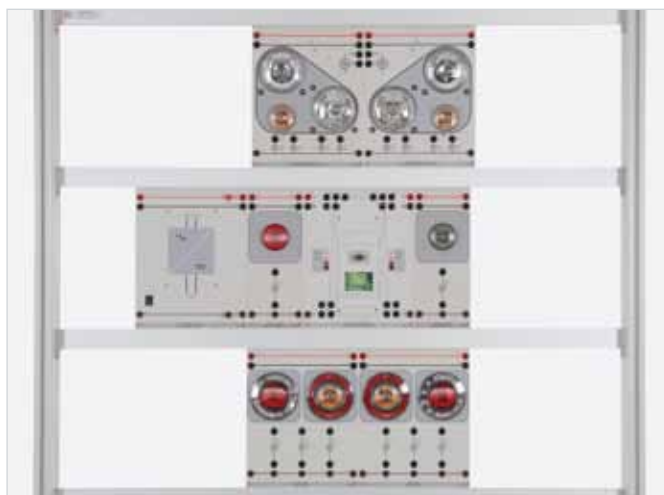
**UniTrain**  
SYSTEM

### Training contents

- Rationale for using bus systems in motor vehicles
- Topology and components of a CAN-bus system in a motor vehicle
- Differences between low-speed and high-speed CAN
- Electrical properties of a CAN bus
- Data rate, identifier, addressing and arbitration (low-speed and high-speed CAN)
- Design of a CAN message's frame
- Analysing CAN messages with a CAN monitor and oscilloscope
- Editing and sending CAN messages via a PC
- Trouble shooting

# Training Projects Involving a CAN Bus

## CAN Lighting Technology, Programming and Diagnostics



### Your benefits

The "Lighting technology" training project supplements the CAN-bus course with an additional control unit. The "Lighting technology" interface makes it possible to control any conventional lighting system. Such systems can be controlled via the switches and buttons on the UniTrain-I cards forming part of the "CAN bus" course.

- Universally deployable
- Baud rate can be set arbitrarily
- Trouble shooting carried out on real components
- Freely programmable data

## CAN Comfort Technology Programming and Diagnostics



### Your benefits

The "Car door" training project integrates an original car door into the experimentation system. This allows the door's essential functions (e.g. electric window winder and electrically adjustable external mirror) to be controlled by means of real CAN messages. The resultant data traffic on the CAN bus can be analysed using the applications forming part of the LabSoft course.

# Networked Systems

## LIN Bus

In addition to the CAN bus, the somewhat simpler LIN bus is also used. This bus is employed mainly for comfort systems which are not crucial to safety. With this training system stu-

dents examine the bus protocol and learn to perform systematic trouble shooting.



**UniTrain**  
SYSTEM

### Training contents

- Development of bus systems in motor vehicles
- Topology and components of a LIN-bus system
- Electrical properties of a LIN bus
- Addressing of a LIN bus
- Master/slave principle
- Measurement tests of data fields
- Message frame structure
- Analysis of LIN messages
- Editing and sending LIN messages
- Trouble shooting

## Fibre Optic Waveguides

At present, optical bus systems are used mainly to achieve high data transmission rates in luxury automobiles. However, optical buses are likely to find broader use in view of the increase in data volumes that generally require processing in automobiles. For that reason fibre optics is an important topic for today's trainees

and will be met with more and more frequently on the job. Our training system has been designed so that trainees can distinguish between open and closed loops and classify them in accordance with their electronic systems.



### Training contents

- Data networks in motor vehicles
- Rationale for using optical waveguides in automotive applications
- Fundamentals of the MOST bus
- MOST protocol and control units
- Ring breakage diagnosis
- Design of optical waveguides in motor vehicles
- Optical bus systems in motor vehicles
- Fundamentals of ray optics (refraction, reflection)
- Attenuation by optical waveguides
- Data transmission and optical measurements on optical waveguides

# Networked Systems

## FlexRay

In recent years the amount of electronics present in the automobile has increased at a steady rate. This also involves an ever more complex network of sensors, actuators or control units

as well as entertainment and navigation systems. FlexRay is the communication system when it comes to x-by-wire systems. The system requirements are primarily focused on data.



### Training contents

- Becoming familiar with and distinguishing between the various bus systems used in motor vehicles
- How the FlexRay bus system work
- Component communication using the FlexRay bus
- Data exchange in a FlexRay network
- Developing deeper understanding through practical applications of the FlexRay protocol
- Identification of typical errors and their verification using measurement techniques
- Learning about the function and operation of the steer-by-wire technology



## Dashboard Training Model Incorporating CAN and LIN Buses

This model comprises an original dashboard (VW Golf V) with an instrument panel, driver's and front passenger's airbags, as well as the entire lighting system, including instrument lighting. The

model includes a flexible fault simulation circuit. Also present are diagnostic plugs for measurements on control units, e.g. for the airbag or illumination.



### Training contents

- CAN bus for light control/central locking/comfort window winder
- LIN bus for wiper and mirror control
- Circuit comprising headlights and range adjustment mechanism
- Headlight settings
- Indicator light settings
- Hazard warning system
- Horn operation
- Fan, ventilation, circulating-air mode
- Clear demonstration of instrument lighting



# Practical Automotive Workshop Lab

Exhaust Gas Analysis and EOBD Data Readout .....	116
Tire-Fitting Machine .....	116
Balancing Machine .....	117
Axle Measurement .....	117
Two-column Hydraulic Lifting Platform .....	118
Four-column Hydraulic Lifting Platform .....	118
Fully Automatic Air-conditioning Service Unit .....	119
Vehicle Tool Trolley .....	119



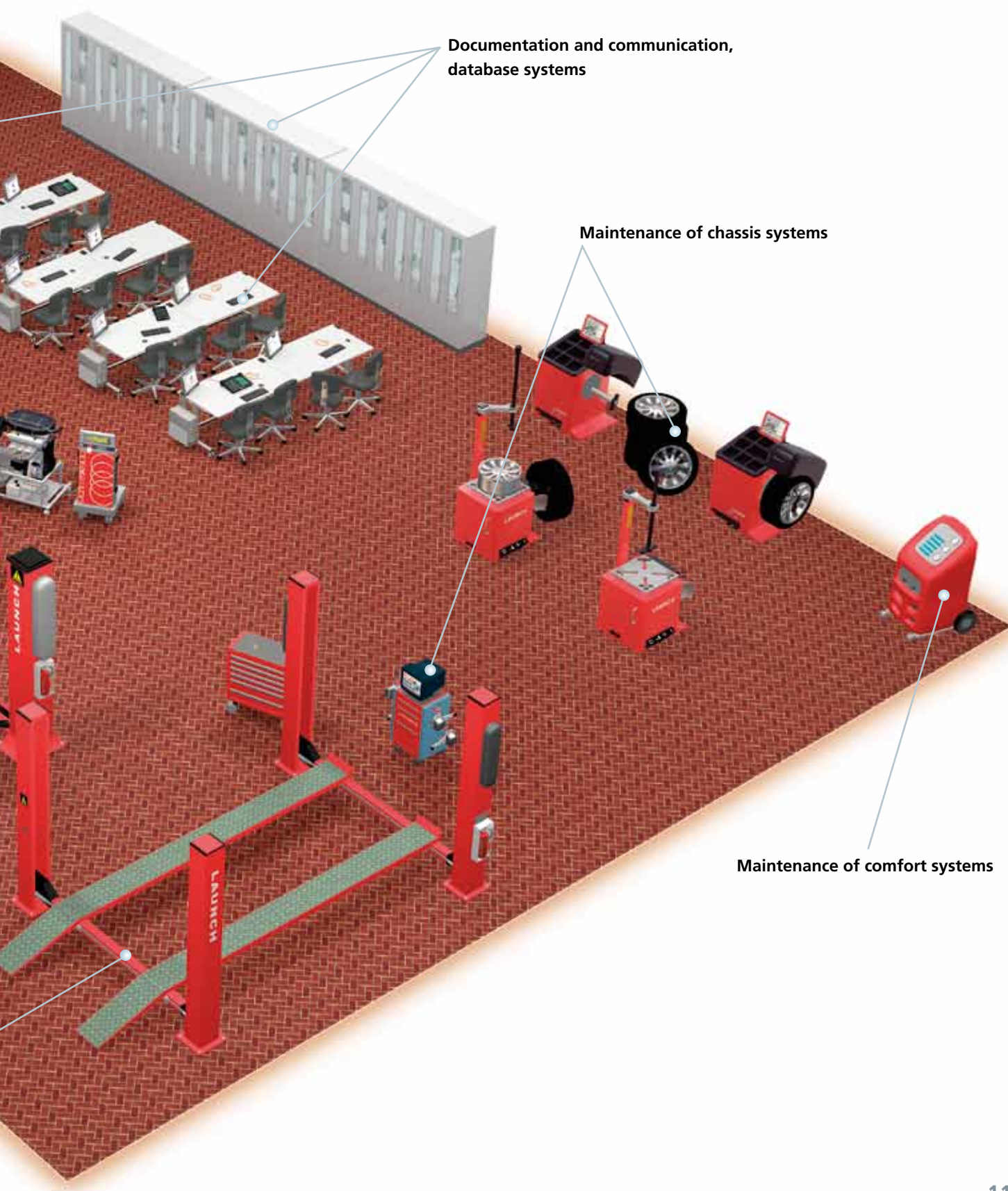
# Practical Automotive Workshop Lab

Complete Solution – a Practical Lab for Assembly, Dismantling and Diagnosis of Vehicles and Automotive Assembly Groups

**Diagnosis and maintenance of engine management systems**

**Dismantling, repair and installation of automotive assembly groups and systems**







# Practical Automotive Workshop Lab

## Exhaust Gas Analysis and EOBD Data Readout

Analyses of exhaust gases from combustion engines provide information on the composition of such gases and depend on a variety of factors, including the type of fuel, combustion process and engine model.



### Your benefits

- Emission tests of vehicles with a spark-ignition or diesel engine and of EOBD vehicles with a spark-ignition or diesel engine
- Large LCD display for indicating results
- Integrated vehicle database
- Storage of customer-specific data
- Interface for export to the "AU-Plus" module
- Infrared remote control
- Rollers for device mobility

## Tyre-Fitting Machine

The tyre-fitting machine covers all workshop requirements for modern tyre-fitting technology. Stable, safe and fast, the machine complies with international specifications.



### Your benefits

- Ability to accommodate wide range of tyres
- Pneumatic locking of the fitting arm and release of the fitting head
- Pneumatic, backward-tilting mounting column
- Powerful drive motor
- Compliant with UL/CE international specifications

## Balancing Machine

Increasingly complex chassis components on modern motor vehicles entail increasingly precise wheel-balancing techniques.



### Your benefits

- Three programs for aluminium rims
- Program for hiding weights behind rim spokes
- Manual entry of wheel data
- Simple switchover between grams and ounces
- Quick wheel locking and release
- High dependability to the nearest gram
- Universal tightening nut

## Axle Measurement

Axle measurement and adjustment are required if the vehicle drifts left or right instead of travelling straight ahead.



### Your benefits

- Standard measurement, quick measurement and supplementary measurement
- Program for low-chassis vehicles
- Customer-specific vehicle database
- Robust measuring heads
- System protection against water spray
- Standard batteries and standard PC
- Self-centering clamp holder

# Practical Automotive Workshop Lab

## Two-Column Hydraulic Lifting Platform

The lifting platform is an essential feature at any automotive workshop.



### Your benefits

- Two-column hydraulic lifting platform with a floor-level cable receptacle
- Electromagnetic release of the safety mechanism
- Manufactured according to international standards, e.g. CE standard
- Two hydraulic cylinders each
- Chain guard for protecting operators
- Electromechanical height limitation
- Levelling of both lifting carriages via cable control

## Four-Column Hydraulic Lifting Platform

This lifting platform is especially suited to axle measurement. All necessary components such as the axle jack, sliding plates and rotary disc for axle measurement are included.



### Your benefits

- Variable distance between the rails
- Axle jack, sliding plates and rotary disc for axle measurement included
- Manufactured according to international standards, e.g. CE standard
- Two hydraulic cylinders each
- Chain guard for protecting operators
- Electromechanical height limitation
- Leveling of both lifting carriages via cable control

## Fully Automatic Air-Conditioning Service Unit

This easily operable air-conditioning service unit incorporates several functions such as leakage detection, recycling, cleaning, evacuation and replenishment.



### Your benefits

- Recycling of residual refrigerant
- Cleaning of refrigerant through drying, filtration and separation of oil as well as liquids according to the SAE standard
- Refilling of the air-conditioning system
- Checks of the cooling system for leakages
- Replacement of old oil with a fresh batch to lengthen the compressor's life cycle
- Emptying of hoses and system parts to ensure that exactly the required quantity of refrigerant is refilled
- Measurement of the filling quantity

## Trolley with 64-part Tool Kit

This specially composed vehicle tool kit contains all the tools necessary for carrying out professional repairs. Made of high-quality alloys, the entire assortment of tools complies with DIN as well as ANSI standards.



### Your benefits

- Professional, high-quality tool kit
- Compliant with DIN and ANSI standards
- Contains all tools needed for professional repairs
- Tools are stored in a practical, hard-shell case

# Training Topics

Training Topics		Fundamentals of DC and AC technology	Fundamentals of electronic/digital technology	Three-phase generator	Pulse-width modulated signals	Engine management sensors	Motor vehicle lighting	Alarm system	GPS	Air-conditioning	Repair shop communication RFID
		p. 18	p. 19	pp 20, 22, 23	p. 21	pp. 28, 29	pp. 34, 35, 36, 37, 38, 39	p. 44	p. 44	p. 45	p. 46
1	Maintenance/care of vehicles and automotive systems										X
2	Dismantling, repair and installation of automotive assembly groups and systems										
3	Testing/maintenance of electrical and electronic systems	X	X	X	X	X				X	X
4	Testing/maintenance of open-loop and closed-loop control systems		X	X	X	X		X	X	X	X
5	Testing/maintenance of power supply and starting systems	X	X	X							
6	Testing/maintenance of engine mechanics										
7	Diagnosis and maintenance of engine management systems					X					
8	Servicing and maintenance of exhaust systems										
9	Maintenance of power transmission systems										
10	Maintenance of chassis and brake systems										
11	Retrofitting and commissioning of auxiliary systems							X	X		
12	Testing and maintenance of networked systems				X						
13	Diagnosis and maintenance of body, comfort and safety systems							X		X	
14	Servicing and maintenance for statutory inspections										





# Essential Product Benefits

... Ensure Long-term Customer Satisfaction



**Bernd Klein, instructor at the Nikolaus-August-Otto vocational school, regularly uses Lucas-Nülle's automotive training systems in his lessons.**

Having worked with Lucas-Nülle for many years now, we are satisfied with their self-learning concepts. Our trainees are especially keen to use software-based training systems.

Also very popular with instructors here are the robust lighting and signalling units.

**In general, Lucas-Nülle's training systems make instruction at vocational schools much more practical.**

# The Whole is Greater than the Sum of its Parts

## Individual consultation with Lucas-Nülle

**Do you require comprehensive advice or a firm offer?**

**Then you can contact us using any of the following means:**

Tel.: +49 2273 567-0

Fax: +49 2273 567-39

**Lucas-Nülle is a byword for custom occupational training courses in all of the following areas:**



Electrical Wiring



Electropneumatics and Hydraulics



Electrical Power Supply Technology



Measurement and Instrumentation Technology



Renewable Energies



Refrigeration and Air-conditioning Technology



Power Electronics, Electrical Machines, Drive Technology



Microcomputers



Fundamentals of Electrical Engineering and Electronics



Automation



Communications Technology



Automotive Technology



Control Technology



Laboratory Systems

**Ask us for detailed information using any of the given methods of contact.**

**Our employees will be happy to advise you.**

**Further information on our products can be found at the following web addresses:**

**[www.lucas-nuelle.com](http://www.lucas-nuelle.com)**

## Lucas-Nülle Lehr- und Meßgeräte GmbH

Siemensstraße 2 · D-50170 Kerpen-Sindorf  
Telephone: +49 2273 567-0 · Fax: +49 2273 567-69  
[www.lucas-nuelle.com](http://www.lucas-nuelle.com) · [export@lucas-nuelle.com](mailto:export@lucas-nuelle.com)

