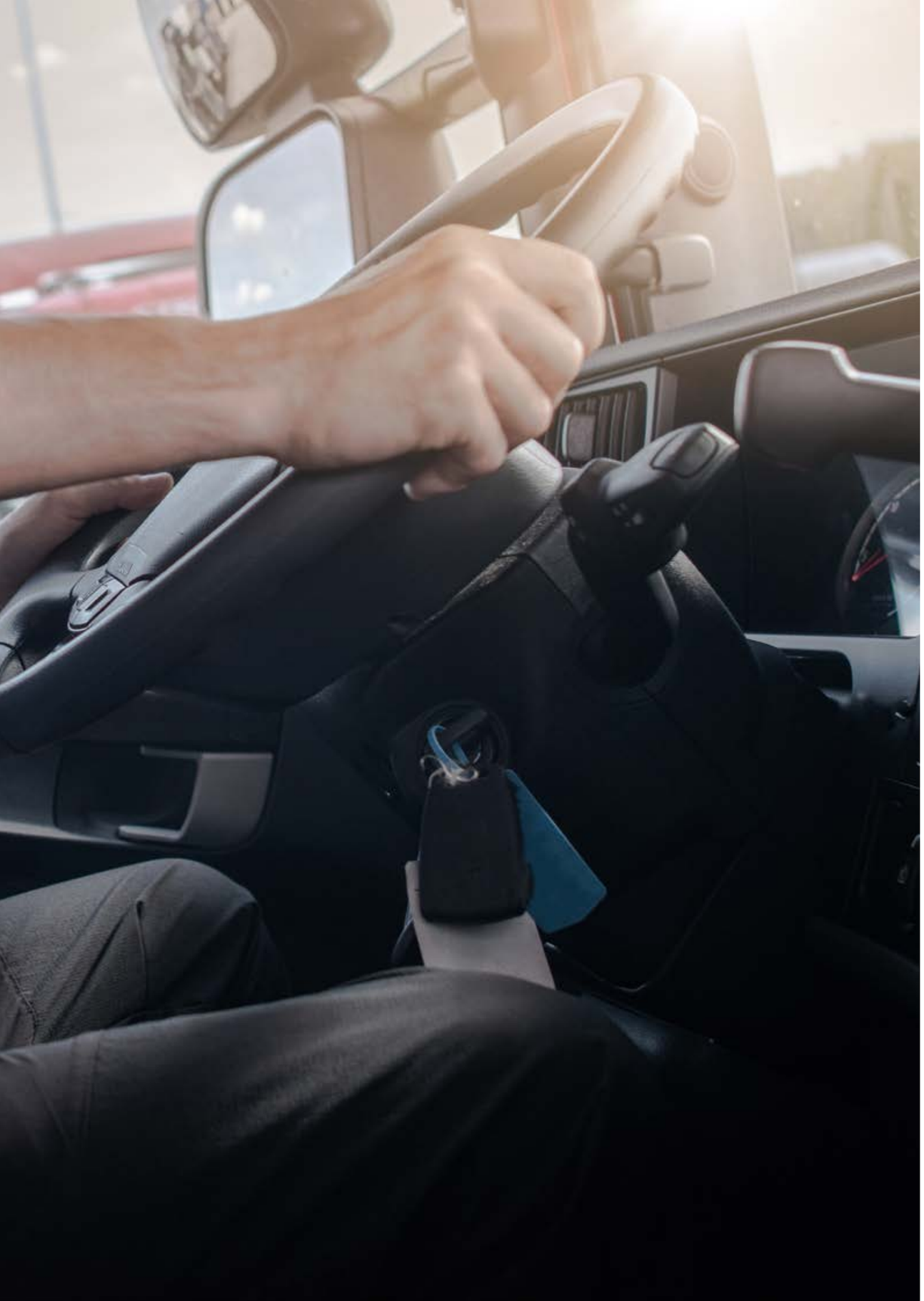
LUCAS-NÜLLE

COMMERCIAL VEHICLE TECHNOLOGY AGRICULTURAL AND CONSTRUCTION MACHINERY

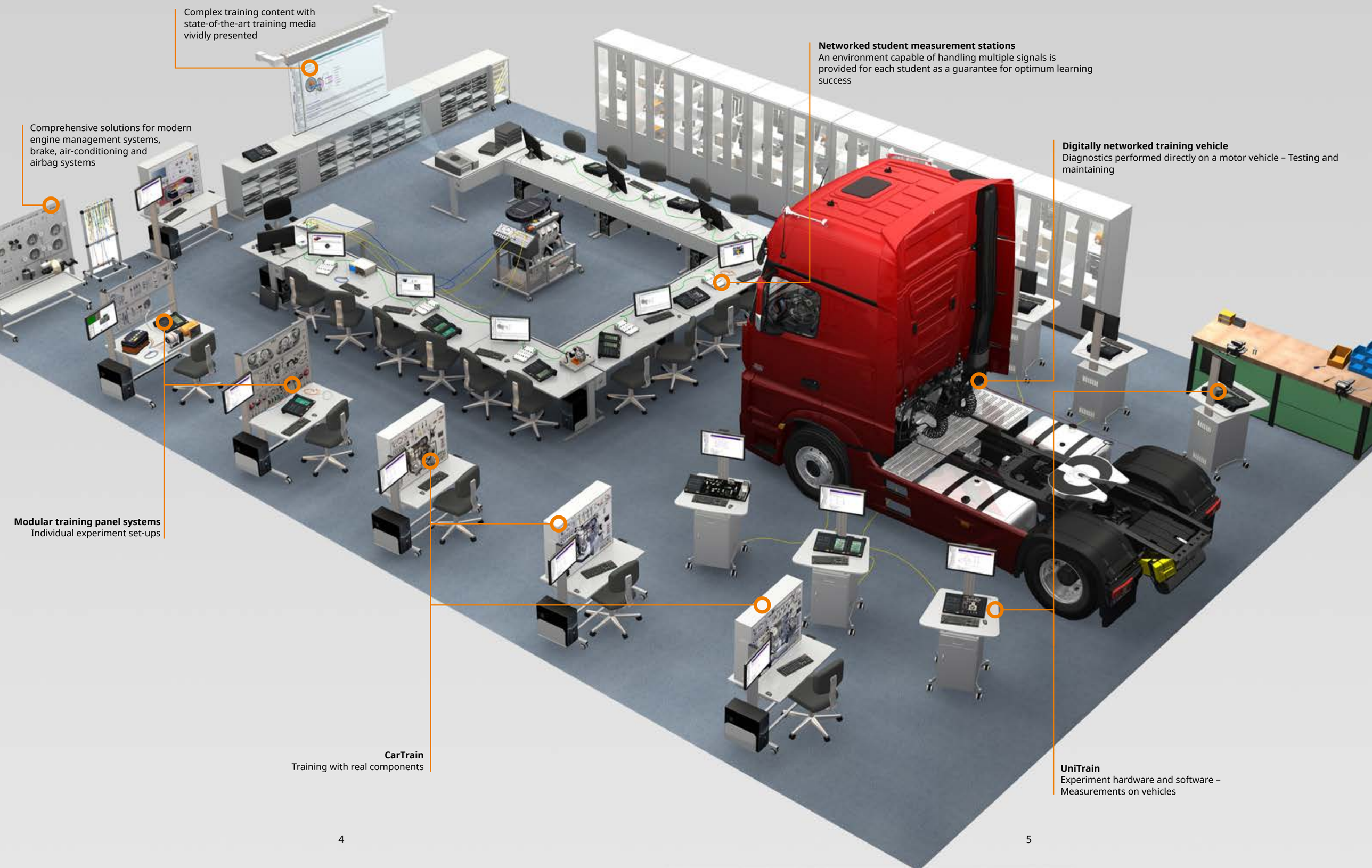
Training systems for vocational and advanced training and education

3rd Edition



CONTENTS

MORE THAN A LABORATORY



Complex training content with state-of-the-art training media vividly presented

Comprehensive solutions for modern engine management systems, brake, air-conditioning and airbag systems

Networked student measurement stations
An environment capable of handling multiple signals is provided for each student as a guarantee for optimum learning success

Digitally networked training vehicle
Diagnostics performed directly on a motor vehicle – Testing and maintaining

Modular training panel systems
Individual experiment set-ups

CarTrain
Training with real components

UniTrain
Experiment hardware and software – Measurements on vehicles

PRACTICAL APPROACH TO LEARNING

EXPERIMENT. LEARN. UNDERSTAND.

Sometimes theory only becomes understandable when applied to a practical situation. That is why we adopt a practical approach to learning. The level of adherence to genuine practice can be even greater depending on the system being used. This provides a positive learning experience and makes the whole learning process enjoyable in itself.

UniTrain

CarTrain und modulare Trainingssysteme

Digitally Networked Training Vehicles

FEATURING INTER-ACTIVE SOFTWARE

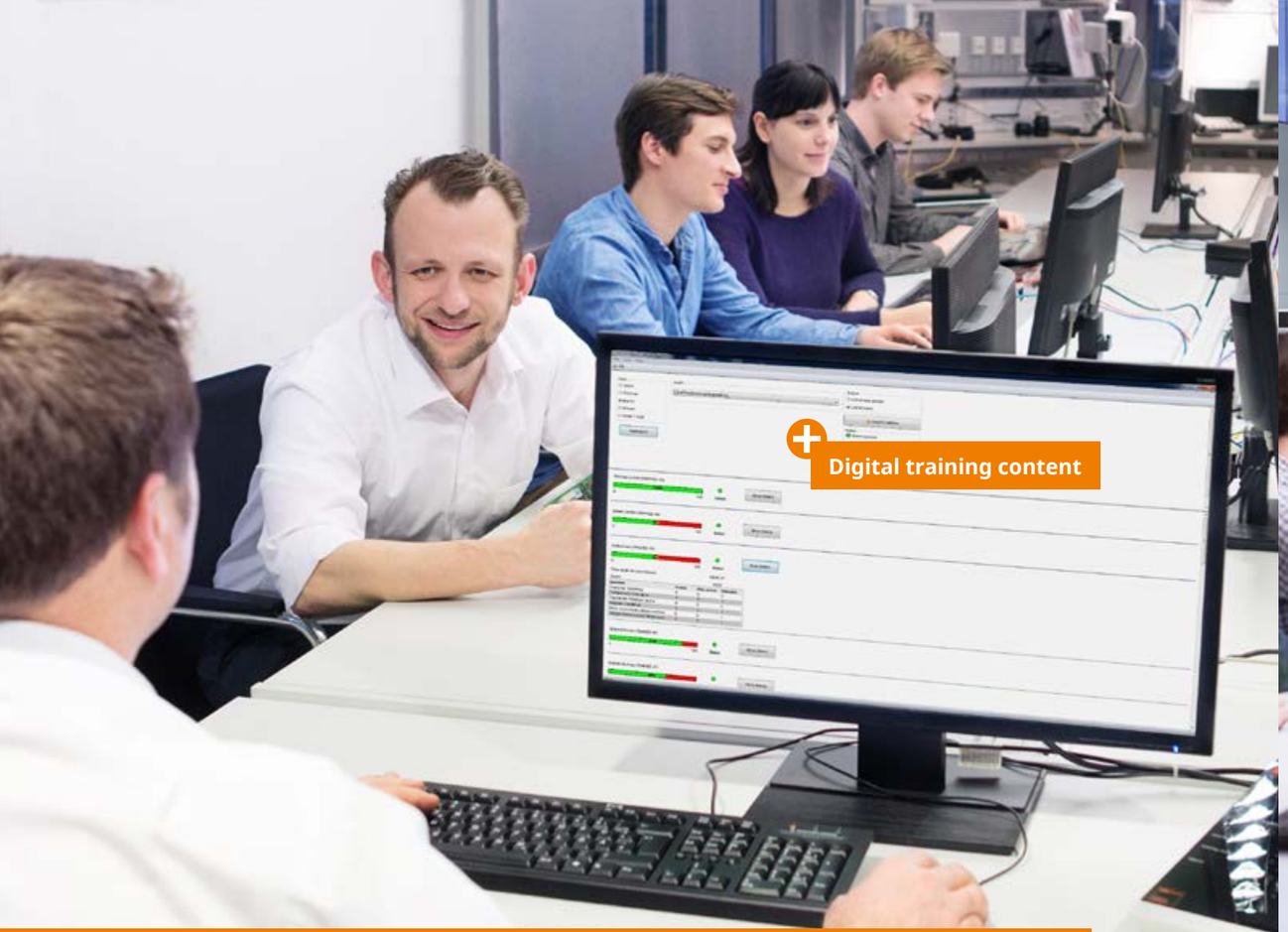
DIGITAL TRAINING CONTENTS METHODICALLY PRESENTED

More than hardware: Interactive training contents are an essential element of all our systems. The digital courses include animations, virtual instruments and experiments for highly motivating, methodical learning.

LABSOFT – THE MULTIMEDIA TRAINING PLATFORM

LabSoft is the comfortable learning environment from Lucas-Nülle. Apart from the animated digital presentation of essential content, the software also allows for control of Lucas-Nülle hardware. With the “LabSoft Classroom Manager”, we also offer a useful suite of software for designing all aspects of your own lessons.

Further information can be found at lucas-nuelle.com



LABSOFT – DIGITAL LEARNING AND CONTROL OF HARDWARE

Smart presentation of complex content
Labsoft provides users with a simple navigation concept to access all the content. The intelligent software also controls the UniTrain Interface and all the Lucas-Nülle hardware. Labsoft also stores all the measurements made by each user separately, making it the ideal tool for monitoring progress of students.

Benefits
- Direct access to complete course content
- Control of Lucas-Nülle hardware via virtual instruments
- User-specific storage of measurement results
- The system can operate locally, on a network or in combination with learning management systems
- Available in a wide variety of languages: All languages supported by HTML

Pages featuring this icon show you that the system is accompanied by a digital LabSoft course.

LABSOFT CLASSROOM MANAGER

LabSoft Classroom Manager
Lucas-Nülle's comprehensive administration software for groups of students helps you organise your daily routines. The easy-to-install program runs on your own local network without any need to access additional databases or server systems.

Benefits
- Manager: Administer groups of students
- Reporter: All student progress at your fingertips
- Editor: Customise content
- Questioner: Devise your own assignments and exercises
- TestCreator: Monitor students' knowledge and skills
- Control Center: Effective supervision of training groups

Order nos. SO2001-5A, 5B, 5C

FUNDAMENTALS OF ELECTRICAL ENGINEERING

Education based on authentic practice right from the start. Centred on the UniTrain system, our training systems for automotive engineering rely on experiments, virtual instruments and animations. This puts the focus ever more on vehicles themselves, so learning the key essentials is more enjoyable and hands-on skills can be developed at an early stage.

DC AND AC CIRCUITS IN VEHICLES

including troubleshooting

UNITRAIN
SYSTEM

Fundamentals of electronics have become essential for vehicle mechanics. Our UniTrain course “DC and AC circuits in vehicles” gives students this knowledge by letting them experiment for themselves. The training system shows what is meant by the terms "current", "voltage" and "resistance" through hands-on experience and provides training in the use of measuring instruments.

In the course of the experiments, students can verify Ohm's and Kirchhoff's laws for themselves. All of the required measuring instruments are already built into UniTrain’s multimedia training environment.

Training contents

- Basic terminology: Current, voltage, resistance
- Handling power sources and measuring instruments
- Usage of circuit diagrams for the analysis of electrical components
- Accident prevention regulations pertaining to work with electric 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)
- Troubleshooting

Order no. CO4204-7A

ELECTRONICS AND DIGITAL TECHNOLOGY IN MOTOR VEHICLES

UNITRAIN
SYSTEM

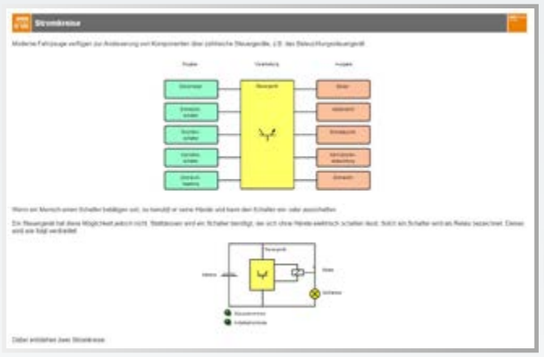
Understanding and analysing electronic components and circuits in vehicles requires in-depth knowledge of their properties and operating principles. This system trains students in the fundamentals of digital technology and electronics, e.g. transistor circuits, circuit design or how to test the valve and rectification capabilities of diodes.

Training contents

- Open- and closed-loop control of components typically used in vehicles
- Categorising components of electric/electronic systems
- Recording diode characteristics
- Setting the operating point on a basic transistor circuit
- Using gain, emitter-follower and collector-follower circuits
  - Design of basic logic circuitry
  - Familiarisation with Boolean functions and laws
  - Experiment: Static/dynamic switching characteristics
  - Design of counter circuitry

Order no. CO4204-7B

PULSE-WIDTH MODULATED SIGNALS (PWM)



UNITRAIN
SYSTEM

Many actuator systems in motor vehicles require variable power levels for the devices being controlled. Actuators which need to operate over a continuous range can be controlled using pulse-width modulation.

Trainees can use this system to document measurements and signals, assess them and catalogue the results. This way, they are able to isolate faults and propose suitable strategies for fault rectification.

Training contents
- Understanding the principle of PWM
- Learning about automotive PWM applications
- Adjusting the power of electrical loads with PWM
- Measuring a PWM signal’s characteristics: frequency, amplitude, mark-to-space ratio
- Analysing pulse width, edges and signal shapes
- Setting up control and operating-current circuits
- Diagnosis of PWM-controlled components

Order no. CO4204-7J, Optional: power supply and headlights

FUNDAMENTALS OF AUTOMOTIVE ELECTRONICS

including troubleshooting

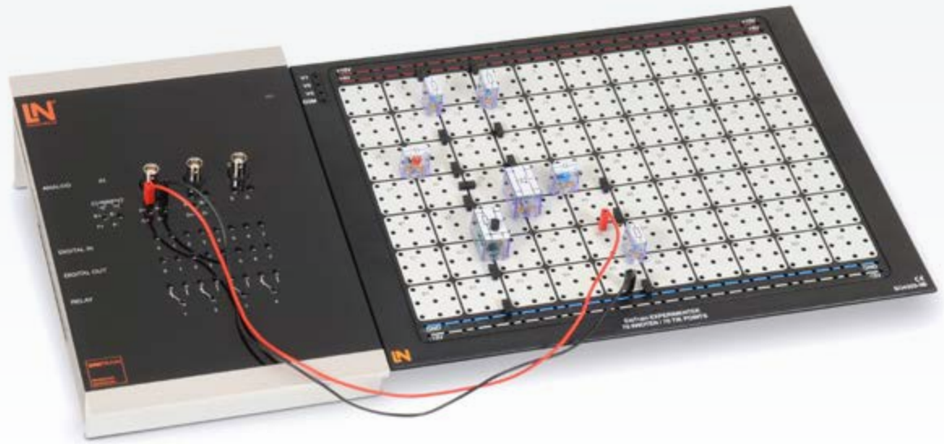
UNITRAIN
SYSTEM

This training system is your introduction to the fascinating world of electronics in vehicles. All the circuits are prefabricated and can be put into action simply by plugging in a few jumpers. One stand-out feature is the chance to handle instruments for use on a customer's vehicle.

Training contents
- Becoming familiar with series and parallel circuits
- How to use the mulitmeter
- How to use the oscilloscope
- Explain how a relay functions
- Investigating transistor circuits
- Experiments on a series resistor for a ventilation system
- Resistance measurements

Order no. CO4205-1G

FUNDAMENTALS OF ELECTRICITY/ELECTRONICS IN VEHICLES ...USING 2-MM PLUG-IN SYSTEM



UNITRAIN
SYSTEM

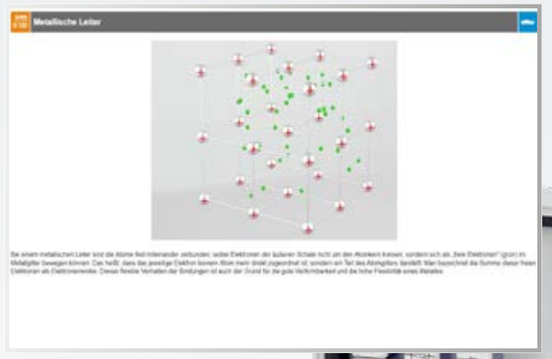
Teach the basics of electrical engineering in hands-on fashion using experiments specifically designed for vehicle mechanics. Our 2-mm plug-in system on the basis of UniTrain offers a multimedia learning experience closely aligned with authentic practice. Rugged components and safety extra-low voltage ensure that learning is safe.

Training contents

- Fundamentals of electrical engineering
- Calculations using fundamental electrical variables
- Voltage dividers (with and without load)
- Measurement of voltage, current and resistance
- How to read circuit diagrams
- Fundamentals of semiconductor technology
- Characteristic curves for diodes and zener diodes
- Use of diodes for rectification
- Voltage stabilisation using zener diodes
- Fundamentals of transistors
- Transistor applications
- Transistors used as amplifiers, switches and current sources

Order no. SO4206-1J

....4-MM PLUG-IN SYSTEM



All the benefits of the 2-mm system, but with bigger components, more power supply options and all contained in a single case - the 4-mm system means circuits can be put together quickly without any need for computers. A multifunctional power supply with built-in function generator and three-phase generator provides safety extra-low voltage. Self-resetting circuit breakers cut off in the event of overload current, meaning there is no need to replace fuses. Extremely safe and maintenance-free – ideal for learning the basics of electrical systems in vehicles.

Training contents

- Becoming familiar with series and parallel circuits
- How to use the mulitmeter
- How to use the oscilloscope
- Explain how a relay functions
- Investigating transistor circuits
- Experiments on a series resistor for a ventilation system
- Resistance measurements

Order no. ATF 4

GENERAL ELECTRICAL SYSTEMS IN VEHICLES

With vehicles in the hands of electrons, a stable power supply is essential for a modern motor vehicle. Electrical energy is needed for virtually all open- and closed-loop control purposes, as well as for comfort systems and driver assistance. Our training systems demonstrate various aspects of supplying an on-board vehicle network with electricity and explain the whole of the lighting system in detail, all in ways which closely follow authentic practice.

THREE-PHASE GENERATOR WITH HYBRID CONTROLLER

including troubleshooting

With our training system, the trainee becomes familiar with what the hybrid controller does. They do experiments and observe how the generator voltage is maintained at a certain level for all speeds and loads. Additional topics include the role played by the mean excitation current, fluctuations in the magnetic field, and what role induction plays in the stator winding.

Training contents

- Planning based on job order and malfunction description
- Inspection/repair of electrical/electronic systems
- Principle of three-phase power generation and voltage regulation
- Production of 3-phase AC voltage
- Properties of a hybrid controller
- Necessity of exciter diodes
- Investigation of exciter current
- Diagnosing malfunctions in the system

Order no. ASA 7

THREE-PHASE GENERATOR WITH MULTIFUNCTION CONTROLLER

including troubleshooting

Today‘s compact generators make use of a monolithic controller. This kind of multifunction controller (MFC) has now largely replaced hybrid controllers. The training system shows how electrical energy is generated in modern vehicles with the help of experiments that build on one another.

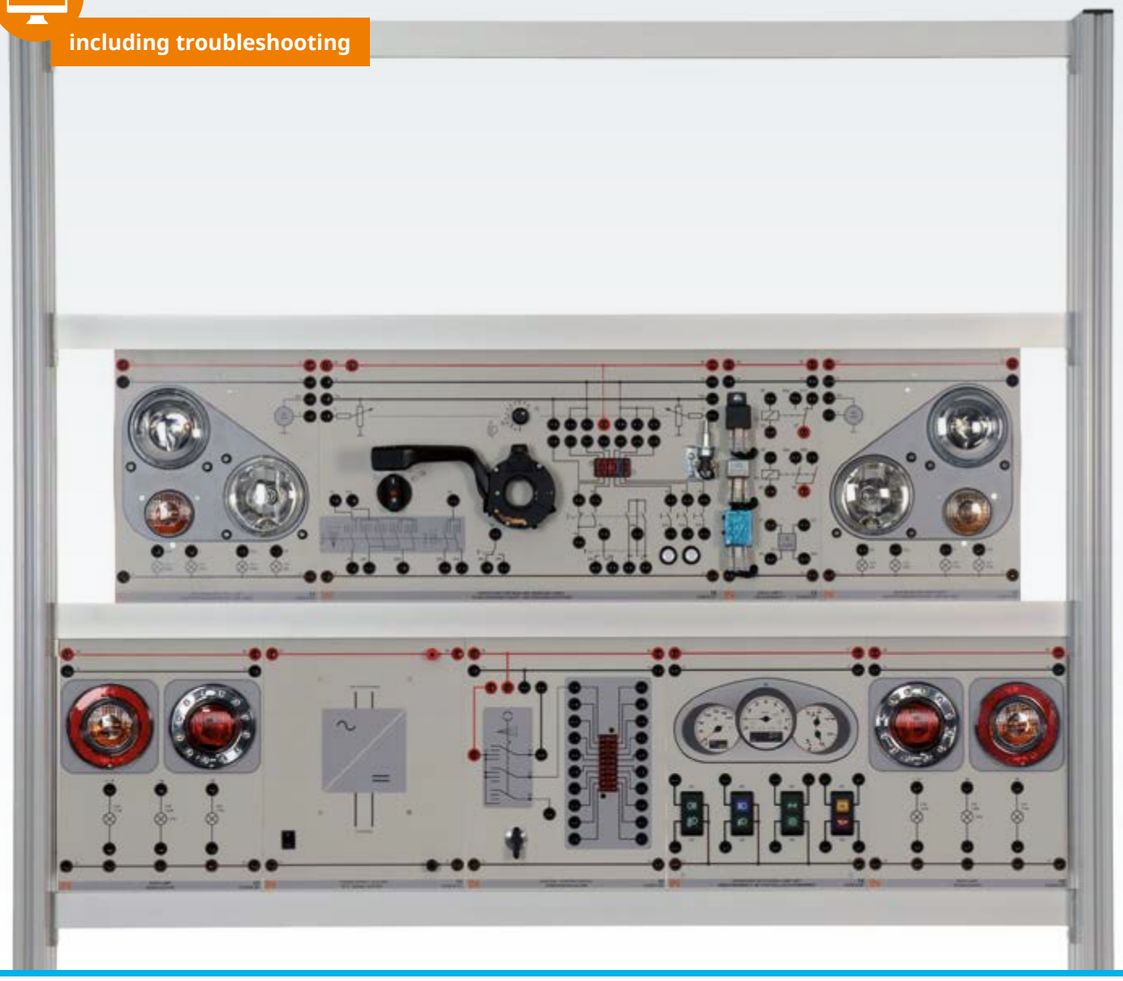
Training contents

- Planning based on job order and malfunction description
- Inspection/repair of electrical/electronic systems
- Principle of three-phase power generation and voltage regulation
- Production of 3-phase AC voltage
- Properties of a multifunction controller
- Rectification and protection using power zener diodes
- Battery monitoring (sensing)
- Preliminary control using pulse-width modulation
- Diagnosing malfunctions in the system

Order no. ASA 6

“BASIC LIGHTING” EQUIPMENT SET

including troubleshooting

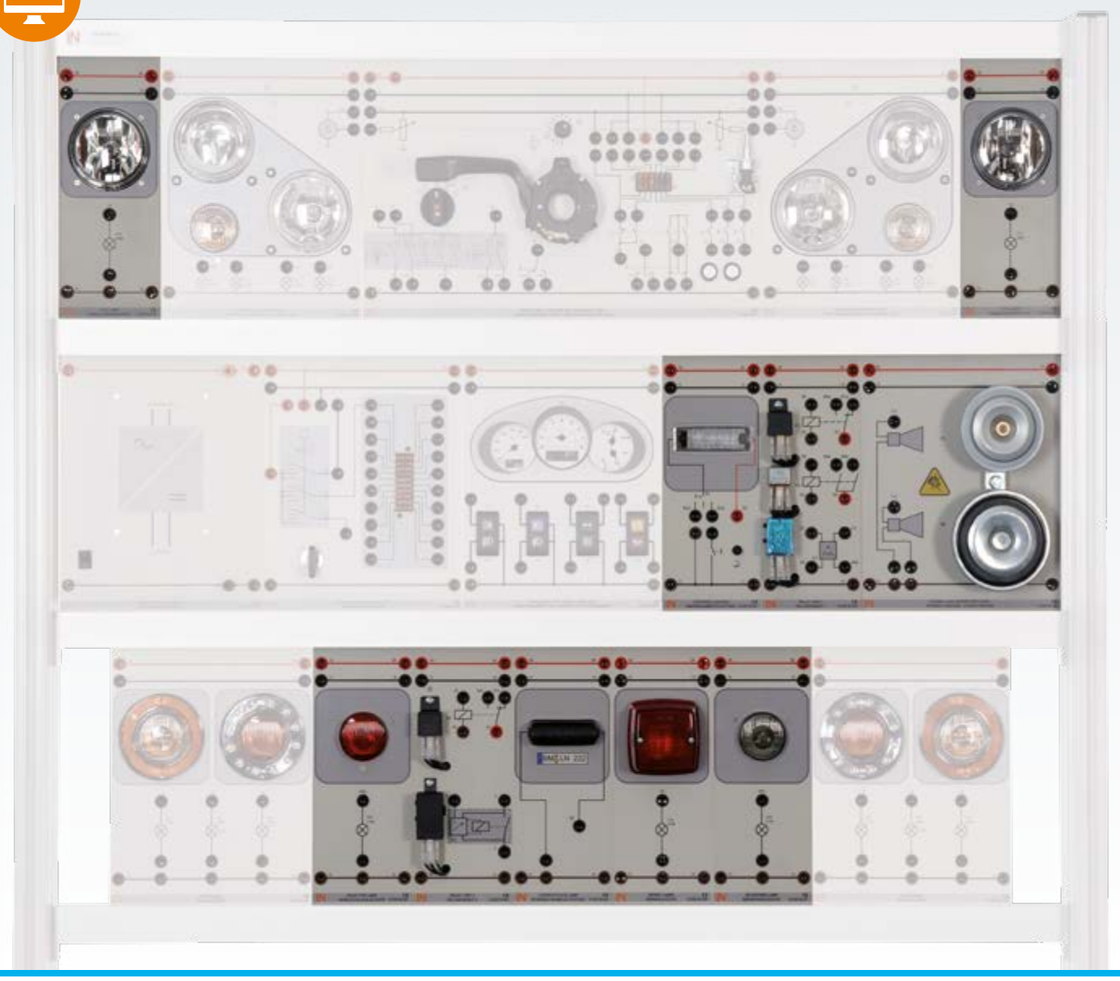


The main lighting system including all supplementary equipment is comprised of original automotive components. With this system, you establish the foundation for an individually expandable lighting panel. Combine other modules to provide clear and easy understanding of a highly complex modern lighting system.

Training contents
- Difference between control and load circuits
- Protecting circuits with fuses
- Use of electronic relays
- How manual headlight range adjustment works
- Recording of measurements and documentation of faults

Order no. ALC 1.1

SUPPLEMENTARY SET “SUPPLEMENT TO BASIC LIGHTING INCL. HORN”



This supplementary set completes the lighting system. Students become familiar with an audible signal system as well as other mandatory lights in vehicles.

Training contents
- Difference between control and load circuits
- Protecting circuits with fuses
- Use of electronic relays
- Addition of extra lights
- Recording measurements and compiling documentation

Order no. ALC 1.2 (supplement to ALC 1.1)

SUPPLEMENTARY SET “TRAILER LIGHTING”

Teaching the topic of lighting for trailers has also become far more demanding as the complexity of electrical systems has increased. The content imparted by the training system, therefore, goes beyond the principle of 7- or 13-pin plug connectors. It also explains how the towing vehicle is protected against overloading and when the control functions for the trailer meet regulations.

Training contents

- Set-up and configuration of supplementary components
- and systems according to manufacturers' stipulations
- Addition of extra lighting
- Familiarity with local road traffic regulations
- Working with circuit diagrams
- Recording of measurements and troubleshooting
- Trailer socket and plug assignments

Order no. ALC 1.3 (supplement to ALC 1.1)

SUPPLEMENTARY SET “STATIC CORNERING LIGHTS”

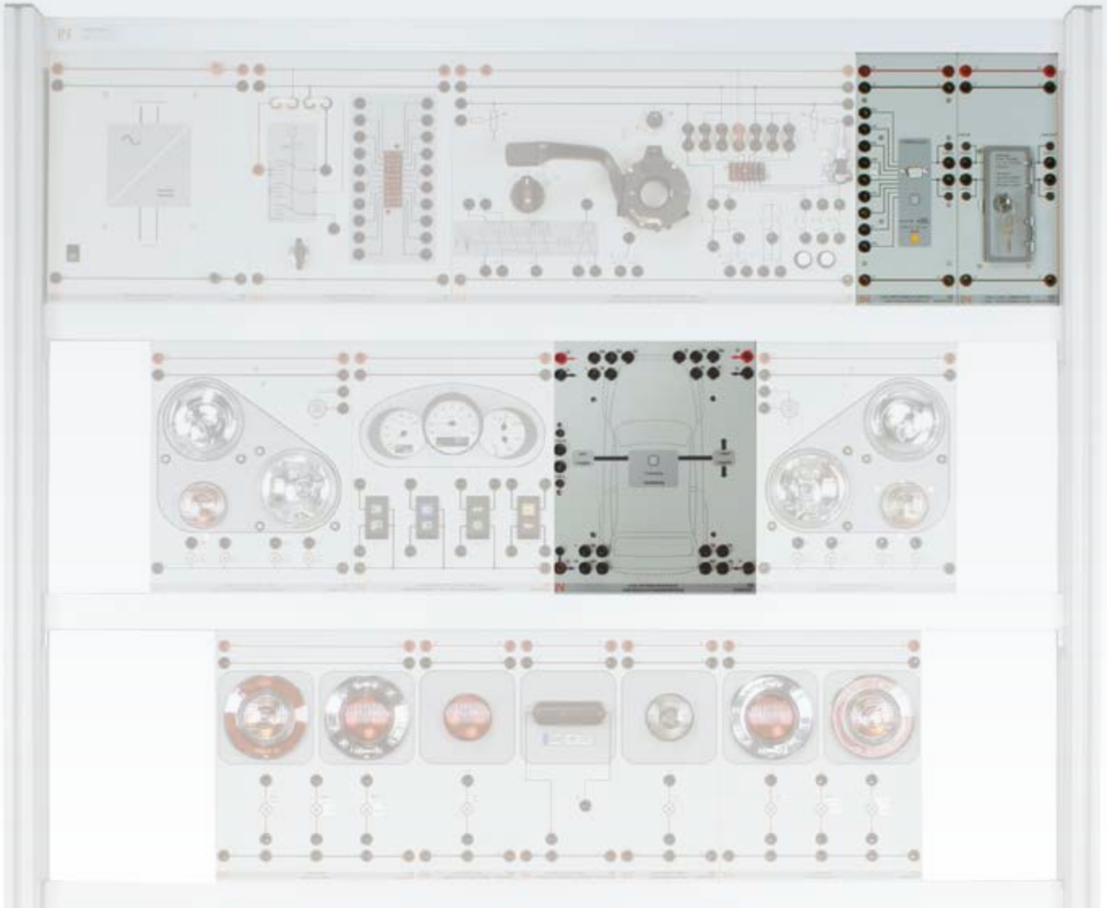
The lighting system for the vehicle is supplemented by static cornering lights,
a control unit and two additional headlights.
This means more safety and comfort when driving at night.
The system involves a sensor detecting the degree of tilt (yaw) of the vehicle in its own specific control unit. As well as this key component, this set explains precisely how the system as a whole functions.

Training contents

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

Order no. ALC 1.4 (supplement to ALC 1.1)

SUPPLEMENTARY SET “CAN BUS”



Supplement any lighting system you have with a fully diagnosis-capable CAN bus network. Apart from working in low-speed mode, this new concept also allows the high-speed mode to be activated – simply at the press of a button. This means you can grasp the fundamental aspects of having different transmission rates and the voltage levels needed to operate them.

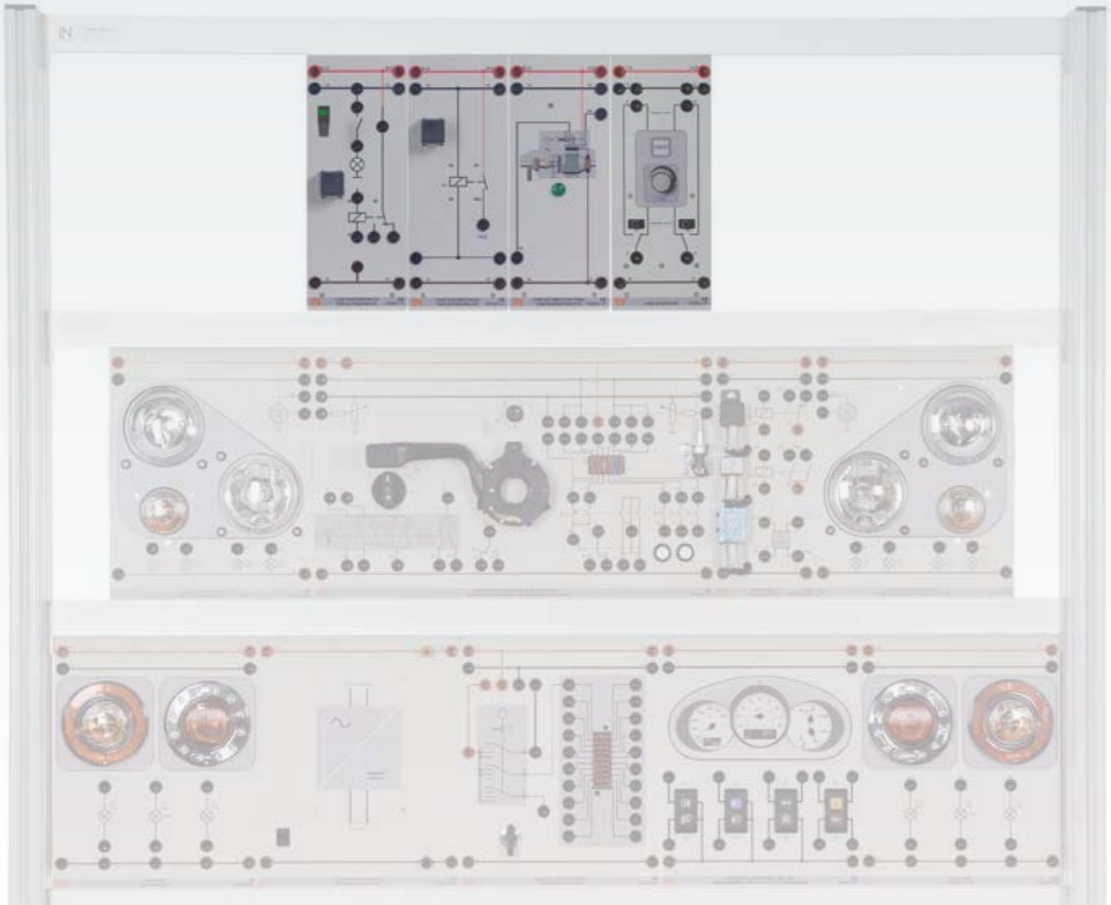
With the help of the fault simulation system, it is also possible to set up various fault codes conforming to ISO recommendations on the CAN bus.

Training contents

- Assembling a steering column control unit
- Data transmission via a CAN bus
- Data protocol for low-speed CAN (class B), high-speed CAN (class C)
- How recordings made in the event of a fault would look: high-speed and low-speed CAN bus
- Performing diagnostics on a CAN bus and analysis of baud rate

Order no. ALC 1.6 (supplement to ALC 1.1)

SUPPLEMENTARY SET “ON-BOARD NETWORK”



The on-board network in modern vehicles has become a highly complex system which is used for a multitude of purposes.

Relieving on-board networks of work, expanding them and adapting them to new technologies is one of the key training objectives. Achieving these ends in a practical manner is what this supplementary set makes possible.

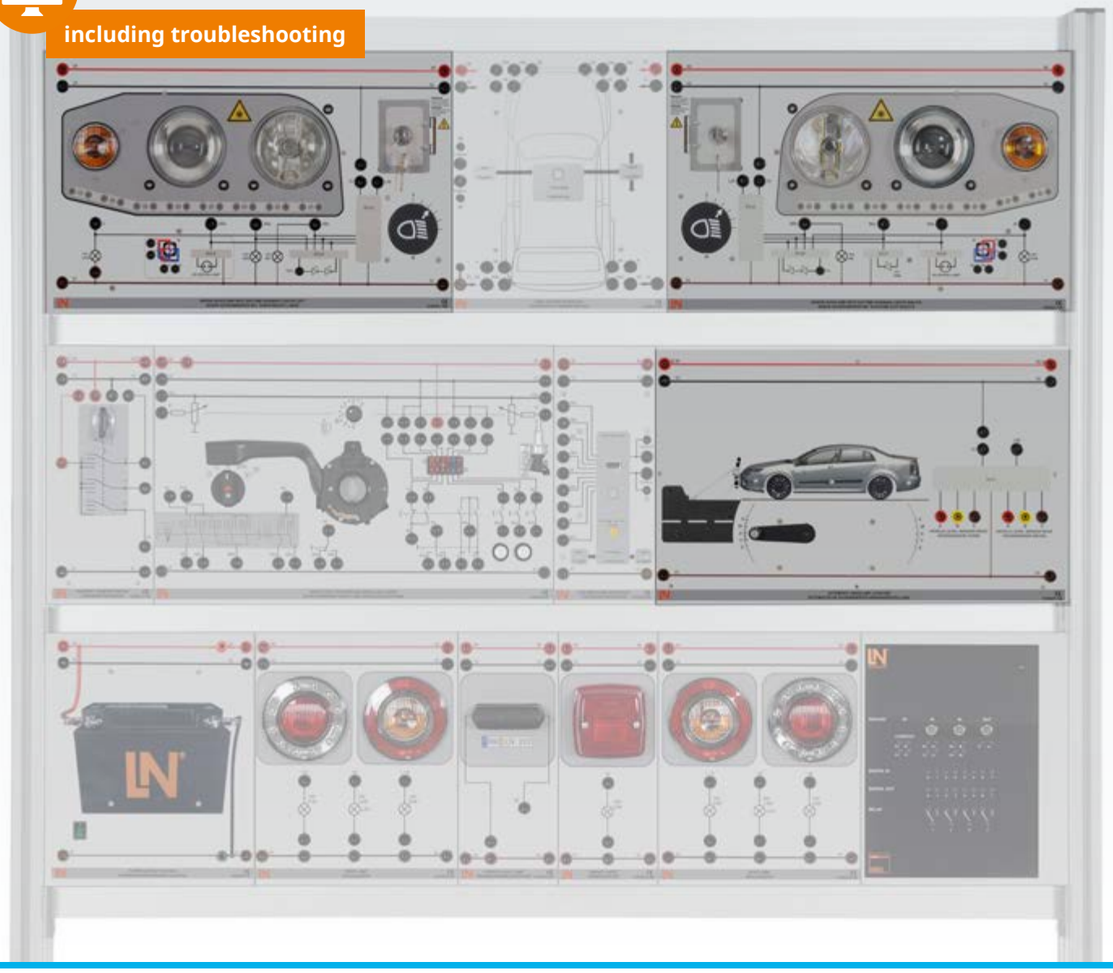
Training contents

- Designing a daytime running light system controlled using pulse width modulation (PWM)
- Use of an incandescent lamp circuit in practical applications
- Assembling a circuit designed to reduce load on an on-board power supply during ignition
- Design of relay circuits
- Understanding starter connections and how internal starter circuitry works

Order no. ALC 1.7 (supplement to ALC 1.1)

SUPPLEMENTARY SET “XENON LIGHTS, LEDS AND DAYTIME DRIVING LIGHTS”

including troubleshooting



Supplement any lighting set-up utilising a CAN bus to feature the latest lighting concepts. This package focuses on the topics of xenon lights, LEDs and daytime driving lights, all encompassed in one training system. Trainees can therefore carry out parallel studies on all these different lighting systems at once and thus determine the differences between them by practical means.

Even height adjustment for xenon-beam headlights is fully incorporated into the system. By activating various simulated faults, you can set up authentic faults on the LIN bus, among other things.
Essential diagnostic skills for any trainee.

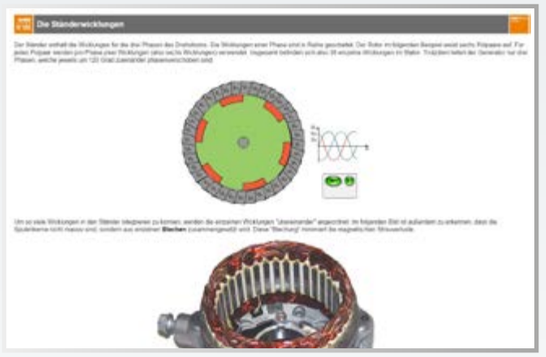
Training contents

- Activation of faults in the lighting system
- Direct comparison of modern lighting concepts
- Automatic height adjustment of headlights
- Communication via CAN bus and LIN bus
- Measurements on stepper motor

Order no. ALC 1.8 (supplement to ALC 1.6)

THREE-PHASE GENERATORS (ALTERNATORS)

including troubleshooting



UNITRAIN
SYSTEM

Virtually all modern motor vehicles are equipped with a three-phase generator/alternator to produce electrical energy. This UniTrain course offers a look at their basic functionality and demonstrates how they are controlled. Practical experiments give trainees the necessary understanding of such systems.

Training contents

- Familiarisation with the principle of a generator
- Basics of three-phase current
- Use of diode and rectifier circuits
- Functionality of an unregulated three-phase alternator/ generator
- Discrete and integrated voltage controllers
- Use of regulated three-phase alternator/generators
- Carrying out fault diagnosis
- Accident prevention regulations

Order no. CO4204-7D

NETWORKED SYSTEMS

Bus systems – Communication is everything. Information is exchanged constantly between the various control units included in a modern vehicle: that is why people talk about networked systems. This kind of communication is implemented in a vehicle by means of bus structures. Our training systems give you an idea of the most important bus systems on the market. They explain the physical specifications of these systems and how communication proceeds within and between them. The fact that these systems are configured to mirror authentic practice so closely makes the subject tangible and comprehensible to trainees and students.

CAN BUS

including troubleshooting

UNITRAIN
SYSTEM

Modern vehicles feature many electronic control units which can constantly communicate with one another via digital bus systems. CAN bus systems are as common in construction and agricultural machinery as they are in private or commercial road vehicles.

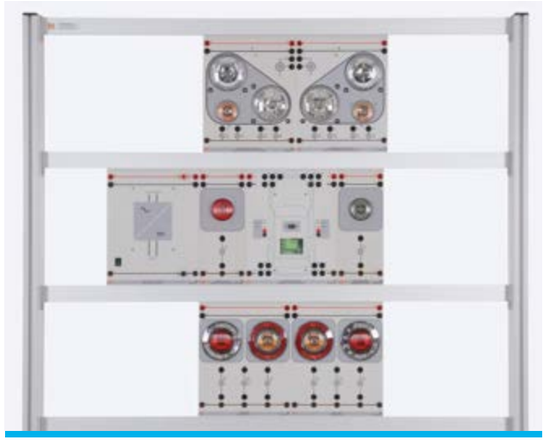
This training system teaches this key topic in a way which closely resembles authentic practice. Trainees start by learning the fundamentals of communication procedures before using simulated faults for an introduction to diagnostics.

Training contents

- Reasons for using bus systems in vehicles
- Topology and components of CAN bus systems as used in vehicles
- Differences between low-speed and high-speed CAN
- Electrical properties of a CAN bus
- Data rate, identifiers, addressing and arbitration (low-speed and high-speed CAN)
- Structure of a message frame in a CAN message
- Analysis of CAN messages using CAN monitor and an oscilloscope
- Editing and transmitting CAN messages from a PC
- Troubleshooting

Order no. SO4204-7KN

CAN BUS SUPPLEMENTS



CAN lighting systems, programming and diagnostics

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 cards forming part of the “CAN bus” course.

Order no. CO3216-3F

CAN comfort systems, programming and diagnostics

Our “Driver‘s door” training project unites a genuine driver's door from a real vehicle with the LN experiment system. Essential functions for such a door (such as electric window winders or electrically adjustable mirrors) can thus be controlled using authentic CAN bus messages. The resulting exchange of data on the CAN bus can be analysed using the applications included in the LabSoft course.

Order no. SO3216-2Y

CAN-FD

including troubleshooting

UNITRAIN
SYSTEM

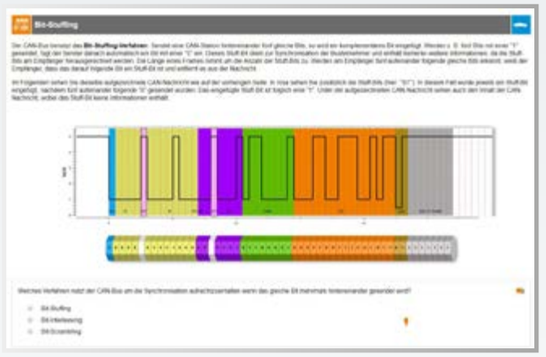
From small cars to commercial vehicles, CAN bus systems dominate the market. However, the ever-increasing “electrification” of vehicles is stretching even universally used aids such as these to their very limits. The answer has been to develop a new version of the bus, known as CAN FD (flexible data rate), which is already appearing in production-line vehicles.

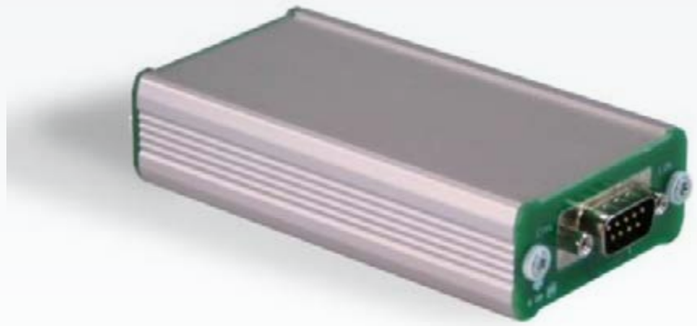
This UniTrain course explains the features introduced by this innovation in an easily understood fashion. Trainees learn efficient methods for diagnostics by means of numerous experiments. They can put their own CAN-FD networks into operation on them and carry out all kinds of measurements as well as diagnostic work.

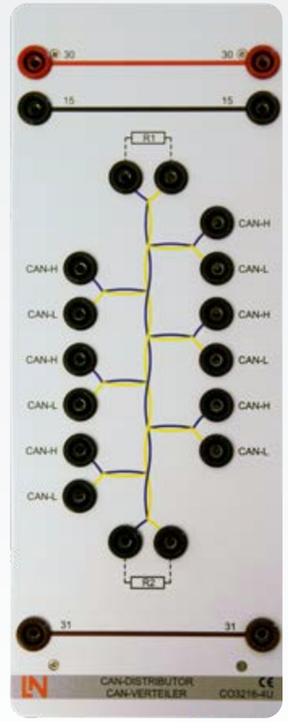
Training contents
- Features of CAN-FD bus systems
- Diagnostics as performed in practice at real workshops
- Measurements on a genuine CAN-FD network
- Diagnostic software for read-outs from the CAN-FD bus
- Selection of different pre-configured data rates

Order no. CO4205-1S

CAN BUS IN CARS, AGRICULTURAL MACHINERY AND COMMERCIAL VEHICLES







Here is a chance to gain an even greater understanding of CAN buses. This course helps trainees build up their own CAN network. A CAN distribution point can be used to put even a complex network into operation in a short period of time.

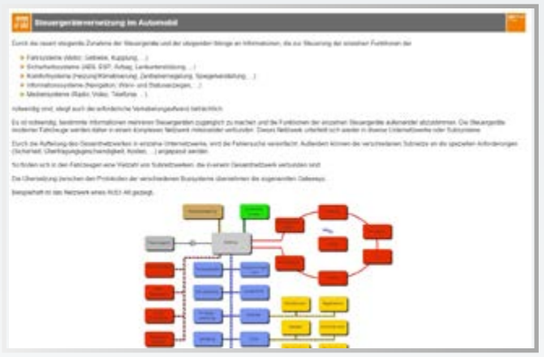
Subsequent control of the individual CAN nodes can then be carried out by an entire group since the educational concept provides full support for group working. The system can also be supplemented with components for a lighting installation.

Training contents
- Structure of a CAN network
- Setting up a system with the aid of a CAN distribution point
- Control of CAN nodes
- Transmitting and receiving messages
- Group work (with up to four teams)

Order no. ATS 2

LIN BUS

including troubleshooting



UNITRAIN
SYSTEM

Another type of bus is used in addition to CAN buses. LIN buses are mainly used for non-safety-relevant comfort systems. With our training system, trainees can learn how and where such buses can be used and what their limitations are. They also carry out investigations of the bus protocol and targeted fault finding on the system.

Training contents
- Development of bus systems in vehicles
- Topology and components of a LIN bus system
- Electrical properties of a LIN bus
- Addressing in a LIN bus
- Master-slave principle
- Investigation of data fields by measurement
- Structure of message frames
- Analysis of LIN messages
- Editing and transmission of LIN messages
- Troubleshooting

Order no. CO4204-7E

MOST BUS

UNITRAIN
SYSTEM

Currently, optical bus systems are primarily used for multimedia systems using high data rates in the most expensive luxury vehicles. However, in view of the increasing data processing required in vehicles, their implementation is expanding rapidly.

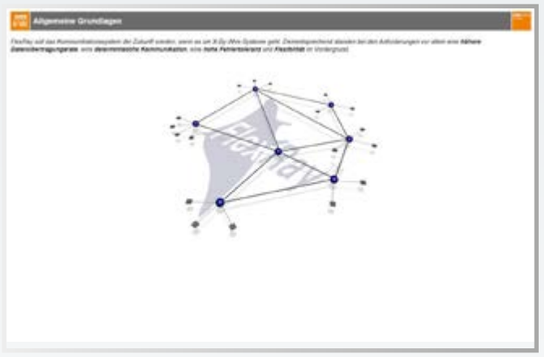
Today's trainees will therefore be encountering this topic often during the course of their careers. Our training system focuses on the physical fundamentals and teaches the kind of diagnostic techniques used in practice.

Training contents
- Data networks in vehicles
- Reasons for use of fibre optics in vehicles
- Fundamentals of MOST buses
- MOST protocol and control units
- Ring-break diagnostics
- Structure of optical fibres in vehicles
- Optical bus systems in vehicles
- Fundamentals of ray optics (refraction, reflection)
- Attenuation in optical fibres
- Data transfer and optical measurements

Order no. SO4204-7H

FLEXRAY

including troubleshooting



UNITRAIN
SYSTEM

The fact of there being more and more electronics in motor vehicles is accompanied by there being ever more complex networks. This now includes sensors, actuators and control units as well as entertainment and navigation systems.

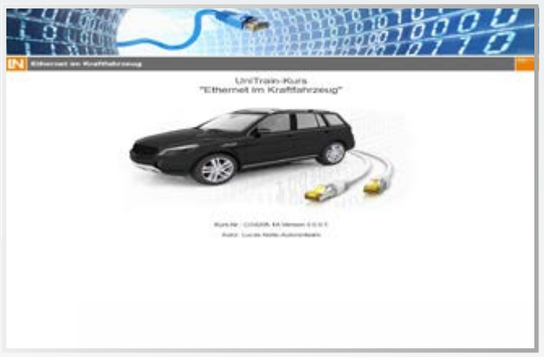
FlexRay is probably the most important communications system used by electrical installations in vehicles. The demands on such a system primarily include even faster data rates, deterministic communication, as well as excellent fault tolerance and flexibility. This UniTrain course covers the topic of FlexRay much as it is used in practice.

Training contents

- Bus systems in vehicles
- How a FlexRay bus works
- Communication between components via FlexRay
- Data exchange in FlexRay networks
- Practical application of the FlexRay protocol
- Identifying typical faults and how to trace them by measurement
- Functions of steer-by-wire technology and how it works

Order no. SO4204-6Y

ETHERNET



UNITRAIN
SYSTEM

This training system enables trainees to set up a real Ethernet network and put it into operation. As in the real vehicle, the communication to the outside world is achieved specifically via the existing EOBD connection. That connection is integrated as a real connection to one of the three modules. The two remaining modules form an infotainment network, which communicates via Ethernet. The special emphasis here is on the transmission of real-time data. The separate control units can be individually configured by means of firmware dongles supplied with the system. As a result, one module becomes the media server and the other module becomes the control unit for the sound system of the vehicle.

Training contents

- Setting up an Ethernet network in a vehicle
- Areas of application
- Real-time data transmission
- Ethernet system components
- Difference CAN to Ethernet
- Ethernet vs. automotive Ethernet
- Software updates of the vehicle systems via Ethernet
- Use of the OBD II interface through Ethernet
- Advantages and dangers

Order no. CO4205-1A

WORKSHOP COMMUNICATION USING RFID

UNITRAIN
SYSTEM

On the one hand, communication with actual customers and the drafting of customer job orders forms the basis of everything. On the other hand, though, technical communication with the actual vehicle via a PC is now an essential way of gaining vital information. Nowadays, vehicle data can be stored on the vehicle's key by means of RFID (radio-frequency identification) and can then be read out from there afterwards.

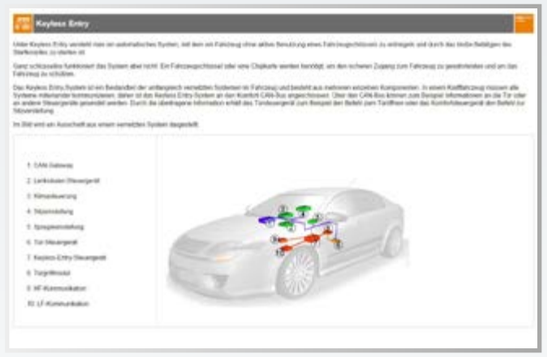
This course gives an insight into the principle of how this works and how it is used in vehicles. Trainees investigate aspects of energy and data transfer in the reader and transponder system.

Training contents

- Communication with internal and external clients
- Planning and preparation of working procedures
- Procedure of acceptance for servicing
- Compiling a work order
- Use of vehicle keys as instruments of communication
- Writing data to vehicle keys
- Reading data from a vehicle's key
- RFID applications in general and those specific to vehicles
- Understanding the essential components for data transfer
- Range of RFID transponders and antennae
- Physical relationships and standards

Order no. CO4205-1N

COMFORT SYSTEMS AND KEYLESS ENTRY



UNITRAIN
SYSTEM

Comfort systems in vehicles make a major contribution to enhancing active safety and security. Innovative operating systems are now breaking into the marketplace and setting new standards.

Keyless entry, comfort systems, safety and security technology and door locking mechanisms: this UniTrain course offers a deep insight into all these systems. This means that trainees gain skills in essential parts of their training, such as testing, diagnostics, repairs and configuring parameters to customers' own needs and desires.

Training contents

- Comfort settings in vehicles
- Active safety
- Door-locking systems
- Central locking
- Radio remote control
- Keyless access to vehicles
- Capacitive pushbuttons
- Fundamentals of antenna technology
- How central locking works via a CAN bus and how such a system can be expanded to implement keyless systems

Order no. CO4204-6G

DRIVER ASSISTANCE SYSTEMS

Increasing traffic densities in urban areas and ever larger and more dynamic vehicles also demand more and more concentration on the part of the people who operate them. That’s why automotive manufacturers are intently focused on the development of modern assistance systems that ease the burden on drivers. At the same time, synergies among the individual systems are also paving the way in the development of autonomous vehicles.

Lucas-Nülle training systems provide guidance on this complex topic. These training solutions not only provide access to the individual driver assistance systems on a target group basis, but they also illustrate the interaction among the systems. They are always based on the proven combination of digital training content and practical applications.

RECOGNITION OF ROAD SIGNS AND ACCOMPANYING SPEED CONTROL

UNITRAIN
SYSTEM

Modern driver assistance systems incorporate anticipatory speed control which works in conjunction with road sign recognition capability. The core of the system is a camera that focuses on the area ahead of the vehicle. The driver is shown all the road signs picked up on the camera. In the case of active speed control, the vehicle will even limit its speed accordingly all by itself.

Use a UniTrain course to practically integrate this complex system into your classroom. Trainees put a complete driver assistance system into operation and perform various practical tasks. Last but not least, the course teaches the requisite diagnostic skills.

Training contents
- Design and function of driver assistance system
- Incorporating the camera into the overall system
- Purpose of driver assistance system
- Learning diagnostic techniques
- Getting to know the system limitations

Order no. CO4205-1B

REVERSING CAMERA WITH PARKING ASSISTANCE

UNITRAIN
SYSTEM

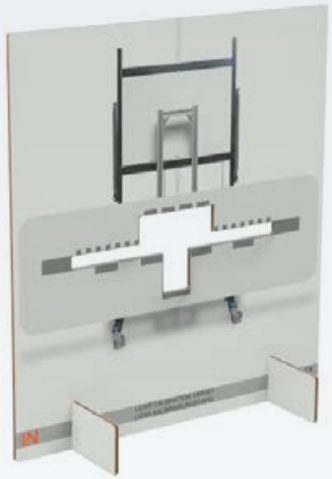
A complete system for the rear of a vehicle, composed of multiple ultrasonic sensors and a camera. This UniTrain course gives trainees a practical insight into the handling of a rear-view reversing camera with parking assistance, as well as diagnostics on the system.

The training system encompasses the technical features of the whole installation, as well as showing how the individual components operate. Trainees can, therefore, find out about the physical limitations of the assistance system and learn diagnostic techniques for various possible malfunctions.

Training contents
- Design and function of driver assistance systems
- Incorporating a camera into the overall system
- How ultrasonic sensors work
- Learning diagnostic techniques
- Getting to know the system limitations

Order no. CO4205-1C

LIDAR - LIGHT DETECTION AND RANGING



UNITRAIN
SYSTEM

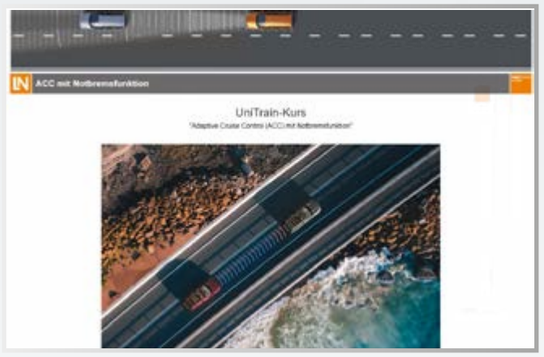
A direct introduction to the topic of LIDAR (Light Detection and Ranging): Use this training system to teach important diagnostic skills in the area of optical distance and speed measurement. The hardware of this driver assistance teaching system is based on a real, largely exposed LIDAR module, thereby offering the trainees unique insights into the structure of the system.
When combined with its associated e-learning course, the system not only allows you to teach how the system functions but also to demonstrate diagnostic techniques quickly and efficiently. Trainees themselves can easily activate various fault scenarios by means of the e-learning course. With the aid of the accompanying calibration board, you can also show them directly how to adjust a lidar system right in the classroom.

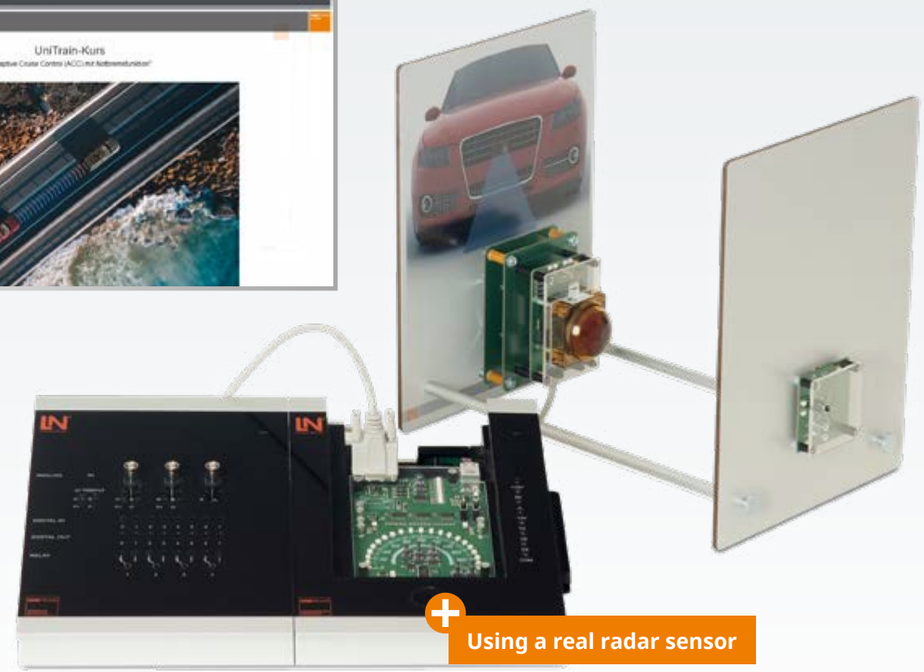
Training contents

- Fundamentals of driver assistance systems
- Significance for self-driving vehicles
- Physical principles of light and lasers
- Safety regulations when handling and operating lasers
- Design and function of lidar systems in vehicles
- Calibration of lidar system by means of a calibration board
- Diagnostics for CAN bus, power supply and actuators
- Measuring techniques and reflection properties
- Signal processing and detection of surroundings
- Networked driver assistance systems and system architecture

Order no. CO4205-1E

ACC - ADAPTIVE CRUISE CONTROL





UNITRAIN
SYSTEM

This UniTrain course introduces the trainee to how the control strategy of the adaptive cruise control (ACC) works, including the emergency brake assistant. In addition to the system design and networking, each individual component of the driver assistance system is explored in detail. An essential focal point here is the calibration of the radar sensor. This is carried out realistically with an appropriate calibration panel. The module is optimally aligned using the adjustment points on the ACC module.

Training contents

- Carrying out the calibration of the radar sensor
- Calibration by laser
- Adjustment of the sensor by the trainee
- ACC system control strategy
- Networking and structure of the ACC system
- Fundamentals of radar technology

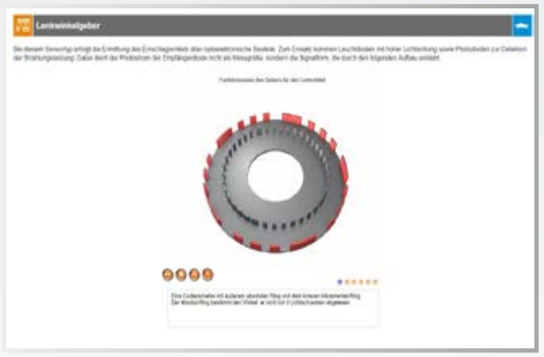
Order no. CO4205-1V

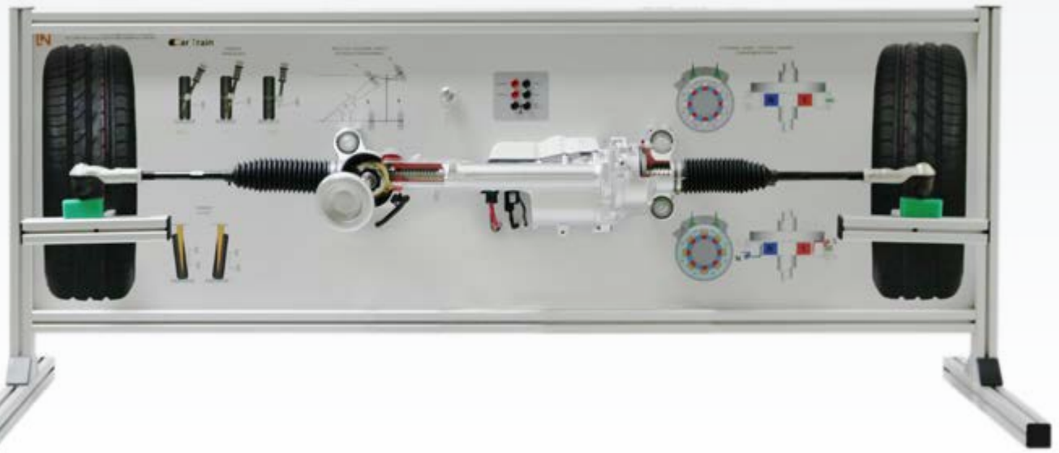
SAFETY & COMFORT

Safety and comfort underlie most vehicle electronic systems - especially the active and passive safety systems. Already today, in the case of a crash, for example, many different processes take action: ranging from collision avoidance beforehand to interruption of the fuel supply afterwards.

It is to be expected that developments will throw up even more milestones in future. That is why our training systems pay specific attention to the topics of safety and comfort, covering essential subjects such as air conditioning, various SRS systems and braking systems.

ELECTROMECHANICAL POWER STEERING





Electromechanical servo-steering offers many advantages over steering systems without such assistance. It provides not only physical but also psychological benefits to drivers. Steering assistance is provided based on need. This means that it only becomes active when a driver wants it. Simultaneously, though, it also responds to speed, steering torque and angle.

By means of this cut-away model, trainees can learn the full scope of how electromechanical steering assistance works. In addition, they can also make measurements on the steering system via the CAN bus.

Training contents

- Design of electromechanical power steering
- Function of the individual assembly groups
- Steering geometry
- CAN bus control
- Vehicle speed sensors
- Steering angle sensors
- Steering torque sensors

Order no. CO3221-9B

ELECTROMECHANICAL PARKING BRAKES WITH AUTO-HOLD FUNCTION

An electromechanical parking brake replaces the conventional handbrake with a simple switch on the dashboard. This means there is no need for a handbrake lever. The switch can activate the parking brake on the rear wheels with the aid of an electronic actuator.

In our system, we have recreated a modern electromechanical parking brake in slightly simplified form so that trainees can carry out extensive testing in the course of experiments.

Training contents

- How rear-wheel brake actuators work
- Sensors and actuators for this type of brakes
- How an electromechanical parking brake works
- Parking brake function
- Dynamic starting assistant and emergency brake function
- Auto-hold function
- Gauging of brake discs
- Brake boosters/hydraulic brake: Operating principle
- Technical documentation: Interpretation and application
- Experimental ascertainment of various functions
- Assembly, configuration and testing of mechanical components
- Design and function of disc brakes

Order no. CO3221-9A

AIRBAGS, BELT TENSIONERS AND CRASH RESPONSE

including troubleshooting

UNITRAIN
SYSTEM

Active safety systems such as airbags and belt tensioners have developed into indispensable standard equipment in vehicles of all price ranges. Regular checks to monitor their functionality are essential and make up an everyday part of the work in a motor repair workshop.

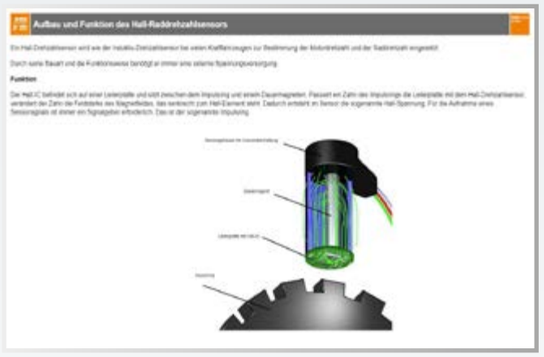
This system supplies trainees with the knowledge of such systems they will need and also shows them some realistic troubleshooting strategies.

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
- Response times and sequences
- Fault management for airbag systems
- Troubleshooting

Order no. CO4204-6Z, optional: with original airbag SO3219-1P

WHEEL SPEED SENSORS

including troubleshooting



UNITRAIN
SYSTEM

Signal recording methods for wheel speed have undergone drastic changes in recent years. The mechanics of the pulse generator ring have been replaced in many vehicles by a magnetic encoder. This has led to whole new diagnostic methods both for monitoring electrical signals and for checking mechanical components.

With our training system, students can compare conventional inductive and Hall sensors directly with a magneto-resistive sensor. Mechanical testing of pulse generator rings and magnetic encoders are also included in the practical training.

Training contents

- Purposes and applications of wheel speed sensors
- Design and function: Inductive sensors, Hall sensors
- Magneto-resistive sensors
- Mechanical checks of pulse generator rings and magnetic encoders
- Measurement and diagnostics for inductive sensors, Hall sensors and magneto-resistive sensors
- Changing wheel bearings possessing a magnetic encoder
- Reading and understanding circuit diagrams
- Using diagnostic functions
- Repair methods and customer consultations
- Impact of faults of practical relevance

Order no. CO4205-1F

TRACTION CONTROL SYSTEMS (ABS/ASR/ESP)

including troubleshooting

UNITRAIN
SYSTEM

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 within physical limits and thus help assist in protecting drivers.

Each individual system is mutually interdependent 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
- Oversteer and understeer
- Sensors: Function and design
- ABS: Function and design (slip, ABS control loop)
- ASR: Function and design (controlling situations)
- ESP: Function and design (operating principle)

Order no. CO4204-6W

GESTURE CONTROL AND CAPACITIVE SENSORS IN VEHICLES

UNITRAIN
SYSTEM

This training system enables trainees to gain a deeper understanding and learn the necessary diagnostic skills for the modern operating concepts of today's motor vehicles. They learn how capacitive and resistive touchscreens work, as well as their differences in operation. Closely related to the capacitive touchscreens are the capacitive switches, which are also a didactic component of the training system. The highlight, however, is the integrated gesture control, which trainees will learn about in detail in a practical test. The overall package is rounded off by numerous diagnostic tasks, which automatically transfer faults to the training system.

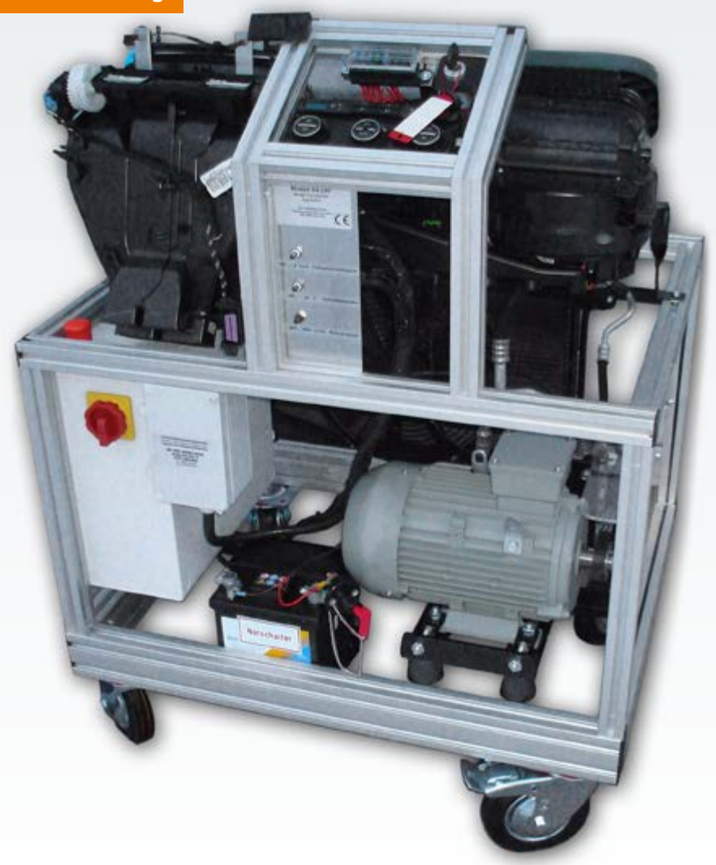
Training contents

- Fundamentals of capacitive touch sensors
- Input, processing, output principle (IPO)
- Switching thresholds of touch sensors
- Analog and digital voltage outputs
- Control of seat heating
- Fundamentals of capacitive gesture control
- Opening a tailgate with a gesture
- Networking in vehicles - CAN bus
- Diagnostics

Order no. CO4205-1U

TRAINING MODEL “2-ZONE AIR CONDITIONING”

including troubleshooting



A training model that imparts know-how on all necessary diagnostics components of a real 2-zone air-conditioning system. It is comprised completely out of original components from a VW Golf 5 and thus provides an authentic real-world learning experience. Even connection of an air-conditioning service station to the entire refrigerant circuit with expansion valve is no problem.

Thanks to continuous control of engine revs and simulation of driving speed, it is even possible to demonstrate the adjustment of pressure flaps at high speed. For the safety of trainees, dangerous locations are protected with a perspex cover. The model does not require a three-phase connection.

Benefits

- Fully functional air-conditioning system
- Built-in fault simulation (20 faults)
- Break-out box with 62 4-mm measurement terminals
- Hella “air conditioning measuring instruments” (including test fittings, pressure gauge, quick-release couplings and digital thermometer)
- OBD diagnostic connection
- Failsafe air-conditioning control unit thanks to residual bus simulation
- Wiring in accordance with original circuit diagrams
- Includes repair guides and circuit diagrams

Order no. SO3240-3F

INTERNAL COMBUSTION ENGINES - GENERAL

Conventional internal combustion engines continue to enjoy a large share of the market and are still used even in electrically based hybrid vehicles. The success of the design has been based on its continuous optimisation. The efficiency and performance of such engines remain unparalleled to the present day.

The Lucas-Nülle training system covers the entire subject of internal combustion engines. In addition to detailed observation of whole engines, our training equipment also elucidates parts of the system, as well as special functions.

SENSORS IN MOTOR VEHICLES

UNITRAIN
SYSTEM

Sensors do the job of recording physical quantities as expressed in the surroundings and converting them into electrical signals so that they can be processed by electronic control units.

This training system helps to explain in both theory and practice the operating principles and diagnostic procedure for key sensors used in engine management.

Training contents

- Physical principles: 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 a knock sensor
- Temperature measurement with NTC and PTC sensors

Order no. CO4204-7F

SENSOR TECHNOLOGY, OPEN- AND CLOSED-LOOP CONTROL SYSTEMS

including troubleshooting

CARTRAIN
SYSTEM

In addition to the number of sensors inside vehicles, the degree to which they are interconnected is also on the increase. Sensors and actuators work in conjunction by means of open- and closed-loop control systems.

This is a complex topic which you can teach on a practical, hands-on basis with the help of this training system. Trainees can measure, test and assess signals. They can carry out realistic diagnostics with the help of feedback from customers and working from circuit diagrams and function plans. Specialised protection for the sensitive sensing equipment allows for free and untroubled experimentation.

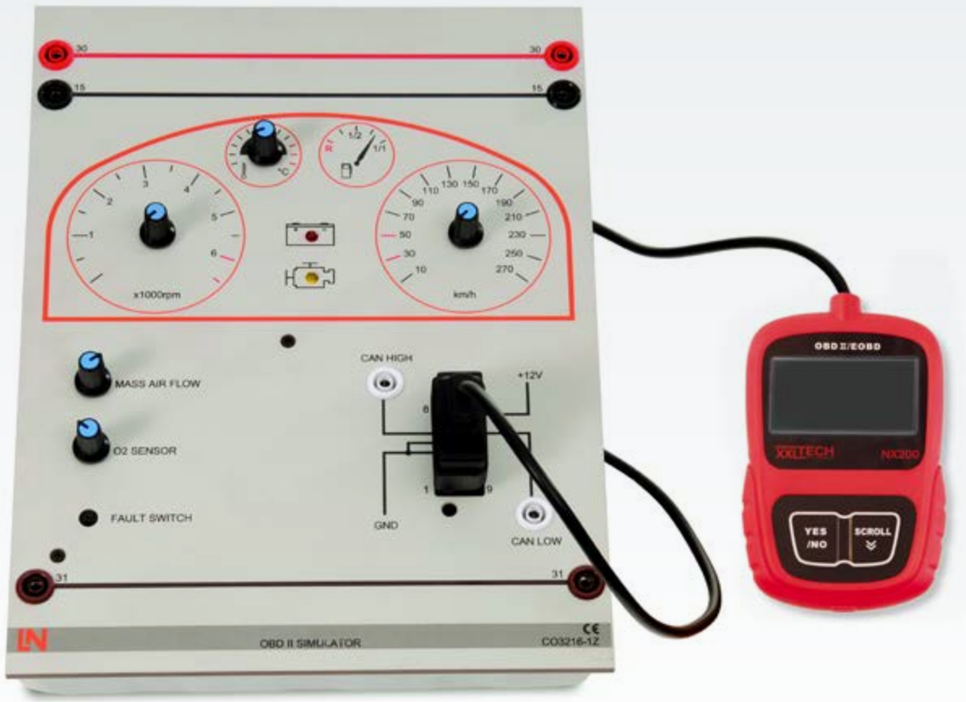
Training contents

- Interaction between real sensors and actuators
- Familiarisation with open- and closed-loop control processes
- Practical implementation of the input-process-output (IPO) model
- Extensive fault simulation (32 faults which can be activated wirelessly or via USB)
- Direct measurement of signals
- Built-in 4-channel oscilloscope
- Specially protected sensors

Order no. CO3221-6N

ON-BOARD DIAGNOSTICS TRAINING SYSTEM (EOBD/OBD II)

including troubleshooting



Read out data from components related to exhaust emissions with the help of on-board diagnostics (OBD II or EOBD). This system shows how OBD testers should be properly used and how to make optimum use of their functional capability. The course also focuses on the correct interpretation of fault readouts.

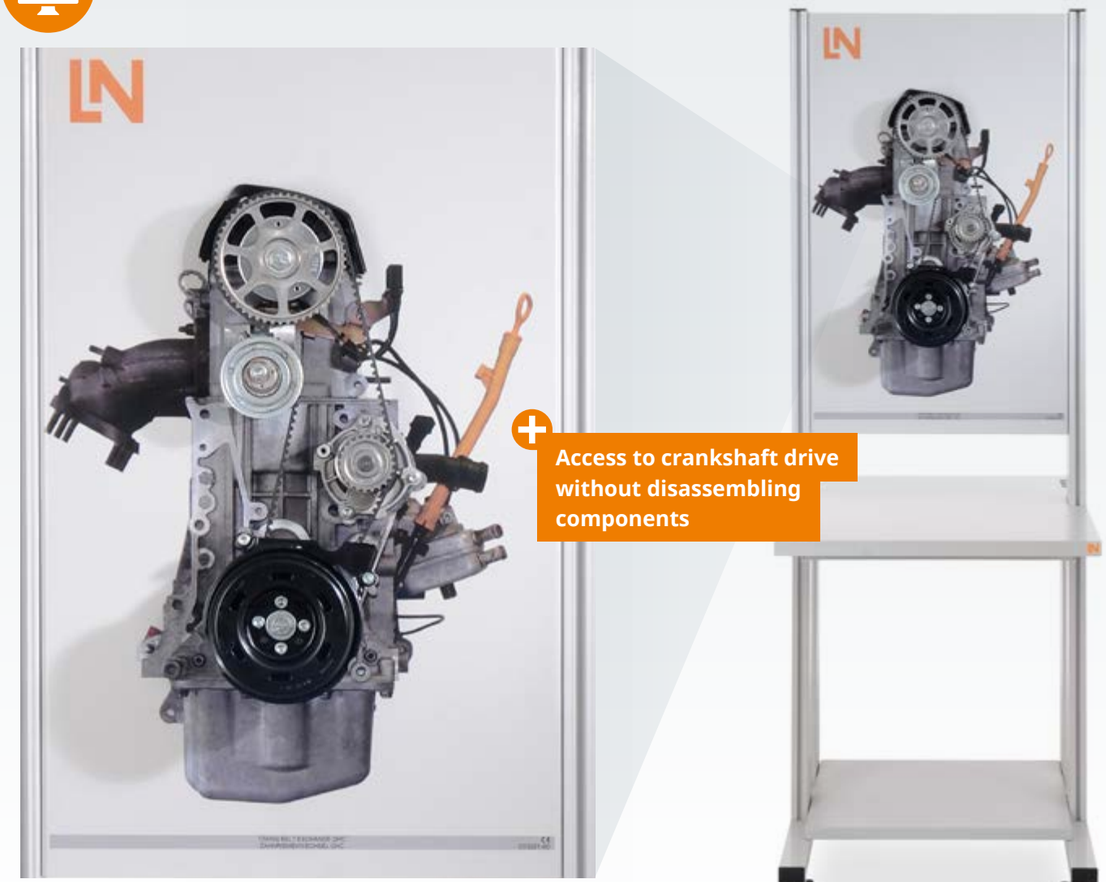
Students can adjust parameters themselves in order to practice recognising the effects on the tester. It is also possible to trace the transmitted CAN signals for display on an oscilloscope.

Training contents

- Permits the diagnosis of emission-relevant systems
- Systematic development of troubleshooting and diagnostic strategies
- Working properly with diagnostic testers
- Evaluating and documenting test results

Order no. CO3216-1Z

CHANGING TOOTHED BELTS IN AN ENGINE WITH OVERHEAD CAMSHAFT



Access to crankshaft drive without disassembling components

Changing toothed timing belts is one of the key jobs to be carried out when servicing vehicles controlled using such belts. It is particularly important to keep the timing accurate and not to change the position of the camshaft with respect to the drive shaft. This training system teaches you the best and safest way to change a timing belt.

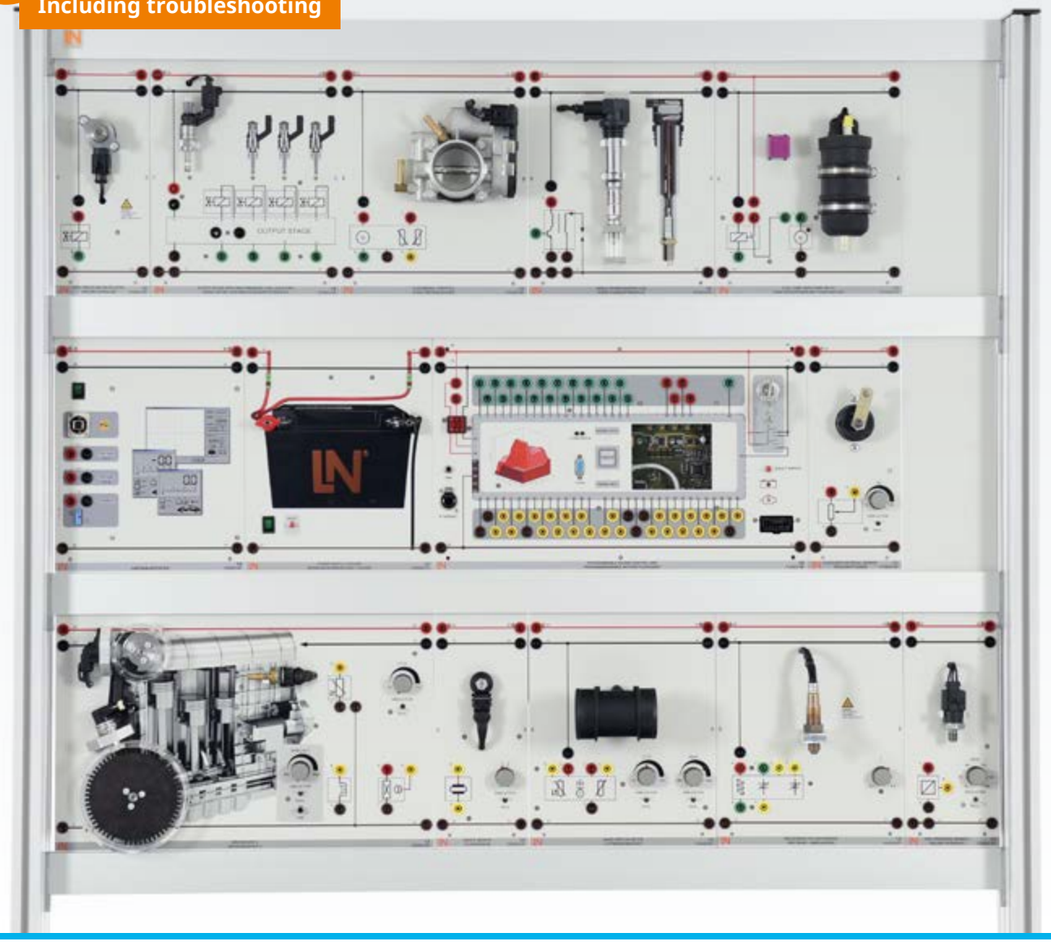
Training contents

- Changing timing belts
- Info: Maintaining systems subject to wear
- Engine management
- Purpose of the pulleys
- Correct tensioning of belts
- Interaction between crankshaft and the valves
- Correct tightening torque for screws

Order no. CO3221-9D

MODULAR ENGINE MANAGEMENT

Including troubleshooting

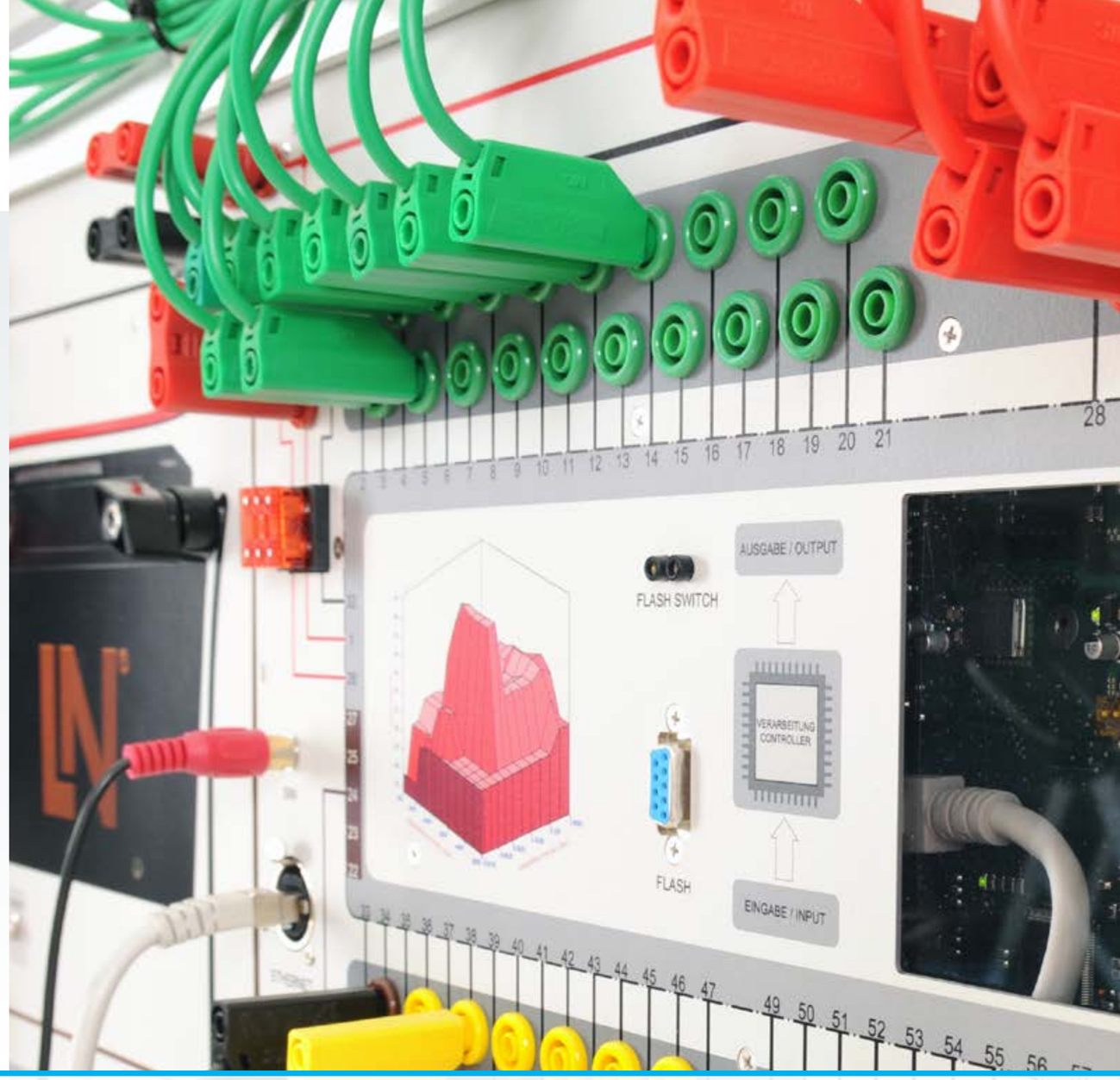


Understanding open- and closed-loop control of engines: With this training system, students learn how to use the IPO model for themselves as well as how to efficiently employ circuit diagrams for the purpose of diagnosis. Thanks to its modular design, the engine management system can easily be adapted for learning each separate sensor, actuator or learning unit in conjunction with different fuel injection techniques or the diesel common rail system.

To make that essential link between theory and practice easily understandable, Lucas-Nülle systems always use authentic OEM items. Simulation or real operating modes can also be set up in order to aid success in learning.

Training contents

- Various fuel injection systems plus common rail
- Sensors and actuators as part of engine management
- Interactions between sub-systems
- Recording of signal waveforms
- Understanding the input-process-output (IPO) model
- The relationships and dependencies of open-loop and closed-loop control systems
- Selecting and using appropriate measurement and testing techniques
- Developing diagnostic skills



Benefits

- Engine control unit programmable for different engine management systems
- Fault memory which can be read via an OBD port
- All-in-one measuring instrument
- Modular structure
- 4-mm safety sockets for measurements
- Multimedia, practice-oriented course content
- Digitally networked with PCs

Order no. for diesel engines
MMM1 (common rail)
Order nos. for petrol engines
MMM2 (direct fuel injection)
MMM3 (Motronic 2.8.2)
MMM4 (Motronic 2.8.1)
MMM7 (Motronic ME 1.0.2)
MMM8 (Motronic ME 1.0.1)
MMM9 (BDE with demand-regulated fuel pump)

CABLE HARNESS REPAIR

This UniTrain course introduces trainees to the operating principles and control strategy of adaptive cruise control (ACC), including autonomous emergency braking (AEB). Along with the structure and networking of the system, the course examines in detail the individual components comprising this driver assistance system. Particular attention is paid here to the calibration of the radar sensor. This is carried out in a practical exercise with an appropriate calibration table. The adjustment points on the ACC module can be used to optimise the set-up of the module.

Training contents

- Cable harness design
- Types of plug connectors
- Assembly of connectors
- Bundling of wires
- Cable harness repairs

Order no. SO2803-3E + CO3223-7T

This training system can be used in conjunction with the following LN systems:

Order no. for diesel engines
MMM1 (common rail)
Order nos. for petrol engines
MMM2 (direct fuel injection)
MMM3 (Motronic 2.8.2)
MMM4 (Motronic 2.8.1)
MMM7 (Motronic ME 1.0.2)
MMM8 (Motronic ME 1.0.1)
MMM9 (direct fuel injection with demand-based fuel pump)
Order no. for modular lighting system
ALC 1.1 - ALC 1.8

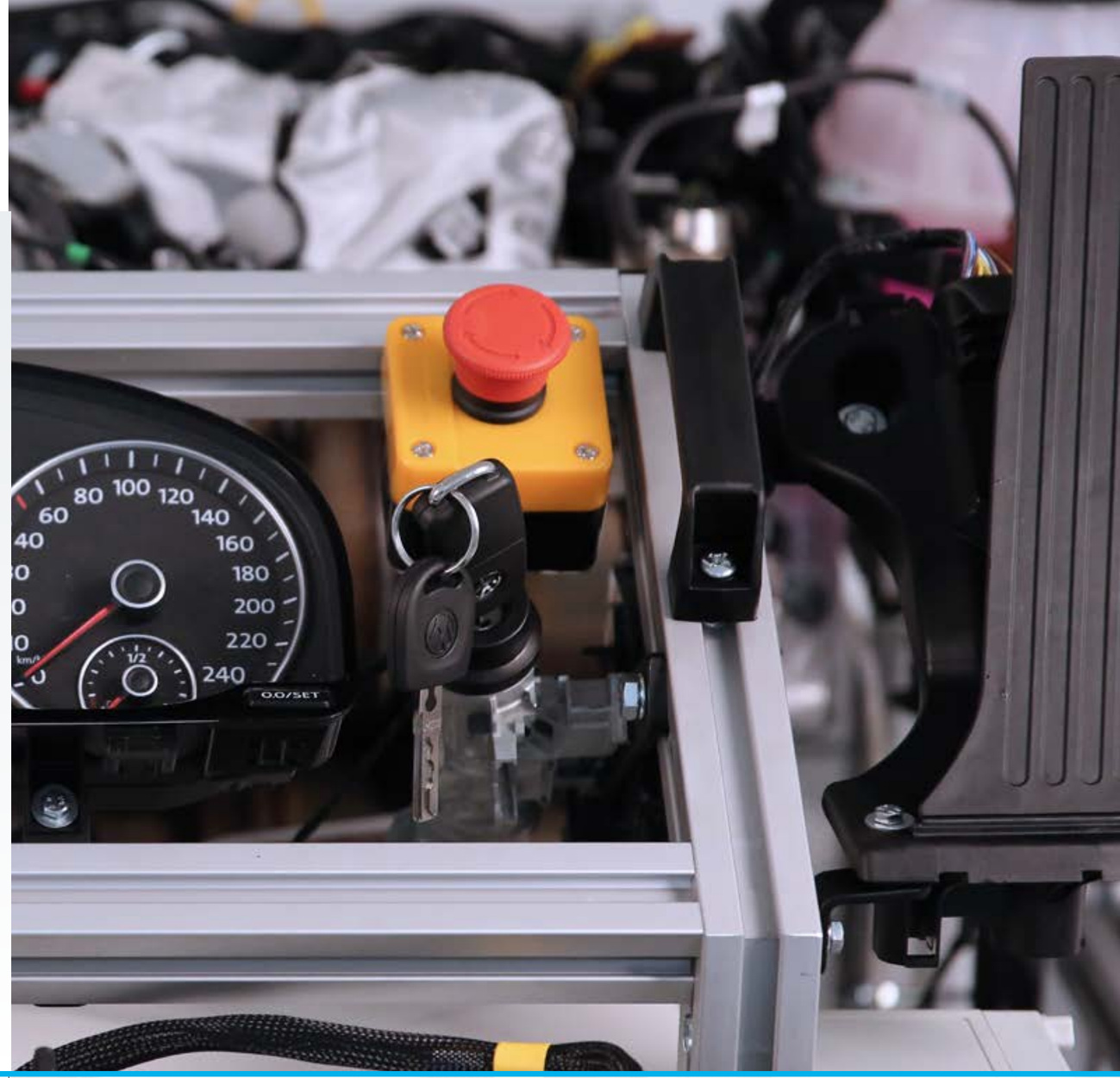
FUNCTIONAL ENGINES

+ including troubleshooting

Not a single rotating part is accessible and components that get hot are covered over. Thus these fully functional engines are very safe as well as being equipped with fault simulation. Signals from sensors and actuators can be accessed easily by means of break-out boxes.

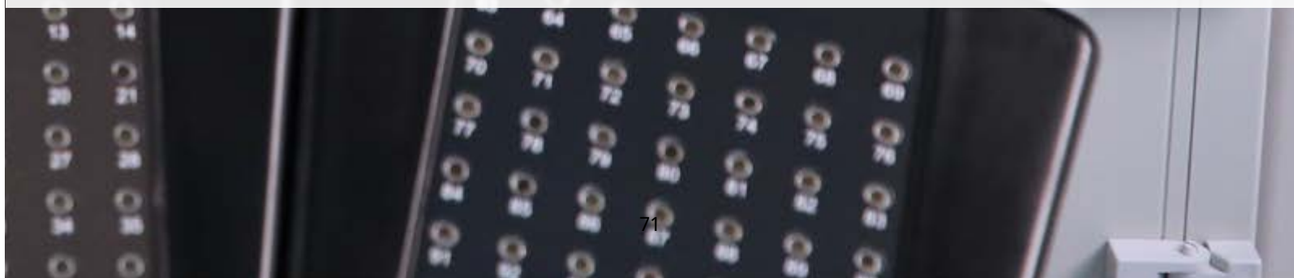
Original circuit diagrams are supplied with all systems.
You can choose from a range of engines.

Training contents
- IPO model
- OBD diagnostics on a real engine
- Design of an engine
- Open- and closed-loop control processes
- Servicing work on an engine



Benefits
- Real engine adapted for educational needs
- Fault memory can be read out via OBD interface
- Realistic measurements on cable harness and plug connectors
- High standard of safety
- Fault simulation
- Original circuit diagrams

Request your individual offer.



PETROL ENGINES

It was one of those combustible ideas. It is now well over a hundred years since the success story of the internal combustion engine began. Since then, the design has shown itself to be flexible to developments and has undergone any amount of optimisation. Nowadays, increasing use of electronics has immensely heightened the precision of its open- and closed-loop control processes.

IGNITION SYSTEMS

UNITRAIN
SYSTEM

Even conventional components such as the ignition systems in petrol engines have undergone spectacular developments thanks to electronics. Modern ignition systems are complex but extremely precise. They have made it possible to unleash remarkable advances in the performance of combustion engines while conforming to ever-stricter emissions regulations.

Now trainees can learn for themselves on the basis of the UniTrain system not only how ignition systems are designed but how they can go wrong and how such faults can be diagnosed.

Training contents

- How an ignition spark is generated
- Ignition timing (mechanical and map-based)
- Conventional ignition systems and dual-spark ignition systems
- Transistorised ignition systems with Hall and inductive sensors
- Electronic ignition systems
- Recording and evaluating ignition oscilloscope traces
- Basics of static and rotary high-voltage distribution

Order no. CO4204-7C

DIRECT FUEL INJECTION

including troubleshooting

CARTRAIN
SYSTEM

MED direct fuel injection with turbocharging represents the current apex of modern petrol engine development. Direct fuel injection and turbocharging provide the perfect platform for so-called “downsizing”.

This training system enables students to control actuators on the basis of the relevant sensor signals and therefore to understand various driving conditions. All sensors and actuators of the engine management system are fully functional original components.

Training contents

- How an engine management system works
- Function and operation of relevant control loops
- Design and operating principles of the sensors and actuators
- Interpretation and application of circuit diagrams
- Execution of measurements as carried out in practice
- Fault memory read-out
- Engine management system settings
- All sensors and actuators are fully functional original components

Order no. CO3221-6G

MOTRONIC 2.8.2

including troubleshooting

CARTRAIN
SYSTEM

Our training system covering the Motronic 2.8.2 engine management system integrates all the electronics of engine management (including preparation of fuel mix and ignition) into a single control unit. Each of the cylinders in a multi-point injection system is equipped with its own injection valve.

This CarTrain system enables students to control actuators on the basis of the relevant sensor signals and therefore to understand various driving conditions. All sensors and actuators of the engine management system are original, fully operational components.

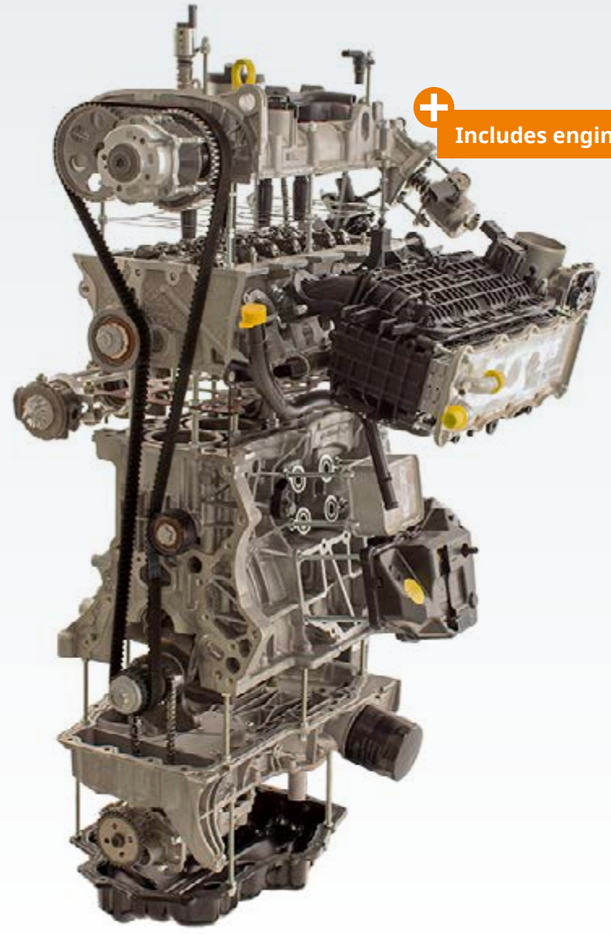
Training contents

- How an engine management system works
- Function and operation of relevant control loops
- Design and operating principles of the sensors and actuators
- Interpretation and application of circuit diagrams
- Execution of measurements as carried out in practice
- Fault memory read-out
- Engine management system settings
- All sensors and actuators are fully functional original components

Order no. CO3221-7C

DIRECT FUEL INJECTION, EXPLODED MODEL

Includes engine mounting



Give your students the chance to view an engine in startling detail. This exploded mechanical model of an authentic direct injection engine with turbocharger offers decisive advantages over conventional cut-away models.

Because none of the components are omitted or incomplete due to being cut away, this means no part of the engine is lost from sight. In addition, components which would normally be hidden from outside view are now freely accessible in the exploded model. The model is entirely free of hazards resulting from liquids, rotating parts or hot surfaces.

Benefits

- Complete engine with all components
- All components are fully accessible
- No hazards from liquids or rotating parts
- Intercooler built into intake manifold
- Perfect supplement to direct fuel injection CarTrain training system

Order no. SO3240-1M

DIESEL ENGINES

Diesel engines are powerful and efficient. Self-ignition renders them quiet and, in principle, clean.

By means of the common rail diesel injection system, Lucas-Nülle helps you teach your trainees about engine management for diesel engines. The various training systems also explain other parts of the system and put you in a position to cover the entire subject in the course of your training schemes.

HIGH-SPEED PRE-HEATING SYSTEM

Operation with real 12 V starter battery

For diesel engines to start well when cold, it is necessary to pre-condition the combustion chamber to the right temperature.

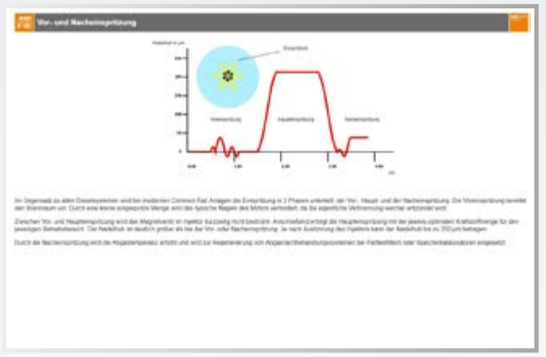
Modern pre-heating systems are controlled by pulse-width modulation with a resulting voltage of close to 12 V when it is just switched on but around 5 V in normal heating operation.

The training system focuses on practical investigation of so-called high-speed glow plugs on a foundation of theory as provided by our digital courses.

Training contents
- Necessity for starting aids
- System components in a heater (glow) plug system
- Glow plugs and control unit
- Phases in the glow process before the engine is started
- Intermediate and post-glow
- Measuring voltage with an oscilloscope

Order no. ATS 1

COMMON RAIL DIESEL INJECTION SYSTEM



Piezo technology with up to five injection cycles

UNITRAIN
SYSTEM

Why are diesel engines so quiet? How is it possible to reduce emissions? This training system helps you teach students about modern common rail injection systems.

The system helps them learn about typical injection pressures, procedures and quantities at their own pace. In order to cover the whole variety of systems available on the market, it can be reconfigured for a whole range of different injector types. This means that this one equipment set is able to cover the full scope of the topic.

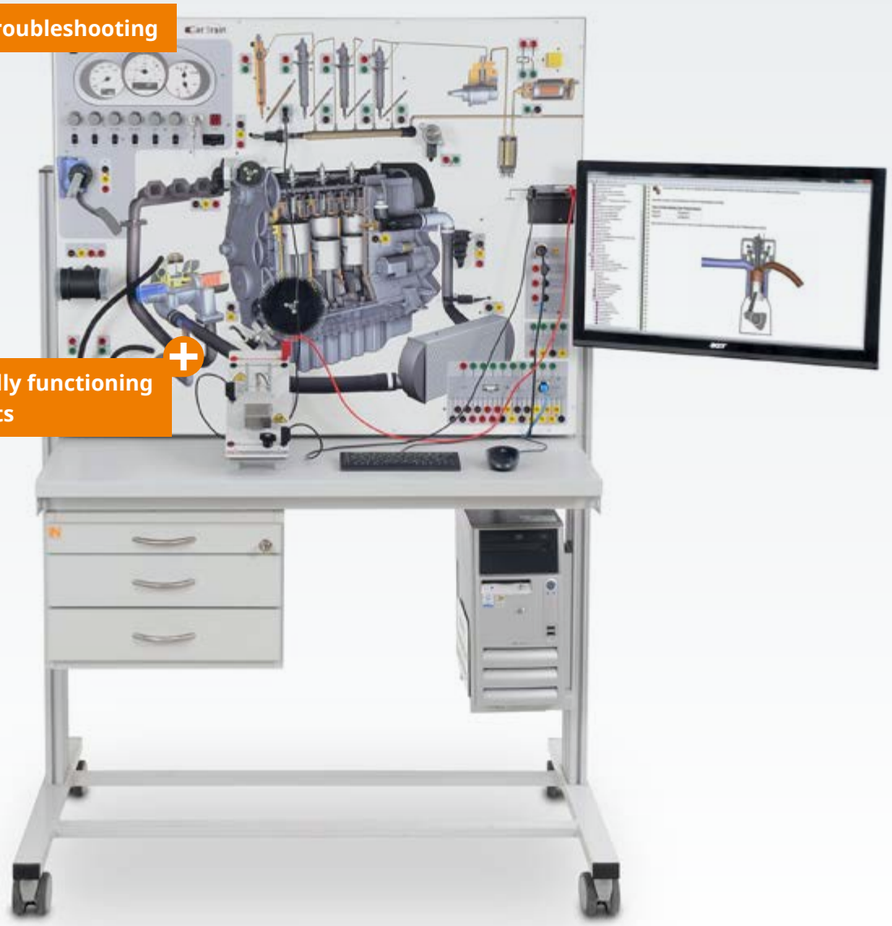
Training contents
- Requirements to be met by diesel injection systems
- Introduction to various designs of diesel injection systems
- Design and function of a common rail system
- Troubleshooting on a common rail system
- Injection response: electromagnetic and piezo-injectors
- Low-pressure and high-pressure circuits
- Procedure for electrical tests on injectors
- Familiarisation with hydraulics in a common rail system

Order no. CO4204-6X

COMMON RAIL WITH VARIABLE GEOMETRY TURBOCHARGER

including troubleshooting

Original fully functioning components



This combination of a common rail engine management system with a variable turbine geometry (VTG) turbocharger combines a modern fuel injection system with the fascinating topic of charge optimisation.

Trainees can investigate and assess all sensors and actuators by means of various measurements. The built-in fault simulation feature makes it just like authentic practice.

Training contents

- How an engine management system works
- How the control loops making up the system function
- Design and operating principles of the sensors and actuators
- Interpretation and application of circuit diagrams
- Measurements on engine management components just like in genuine practice
- Fault memory read-out
- Engine management system settings

Order no. CO3221-6J

FOR THE MOBILITY OF TOMORROW

We rely on the experience of a strong partner for automotive certification.

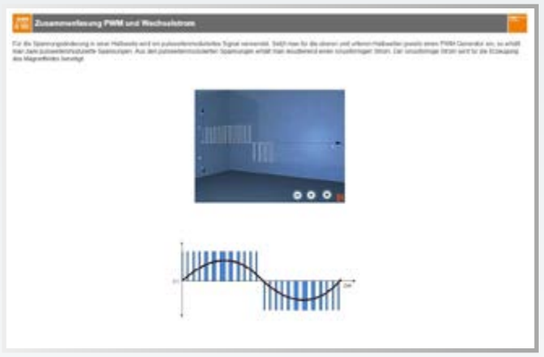
IMI INSTITUTE OF THE MOTOR INDUSTRY

ELECTRIC AND HYBRID VEHICLES

An electrically charged moment in time: Electric vehicles have truly arrived on the market. Businesses and institutions all around the world are relying on Lucas-Nülle to keep them right up to date with the latest developments in electric and hybrid vehicles. Our training systems are even used in the Worldskills contests.

With the help of Lucas-Nülle, you can cover the full range of topics and teach subjects such as high-voltage electrical systems with the same degree of safety guaranteed by all our other systems.

DC/AC CONVERSION



UNITRAIN
SYSTEM

Vehicles obtain their electricity in the form of direct current from batteries and most components utilise the energy in this DC guise. Modern electric traction equipment, however, operates using alternating current and requires a waveform as close as possible to a sine wave.

This course provides a simple and clear description of how alternating current and voltage can be generated using inverters. Students can apply the theoretical knowledge they gain from the course in a series of experiments. All the components and circuits needed for this are provided. There are also tests of knowledge to monitor student progress.

Training contents
- Ohm's law
- Pulse-width modulation
- Generation of half-wave sinusoidal current
- Generation of a negative voltage
- Alternating voltage and alternating current
- Magnetic fields permeating a coil
- Rotating electrical fields

Order no. CO4204-6L

DC-DC STEP-UP AND STEP-DOWN CONVERTERS

UNITRAIN
SYSTEM

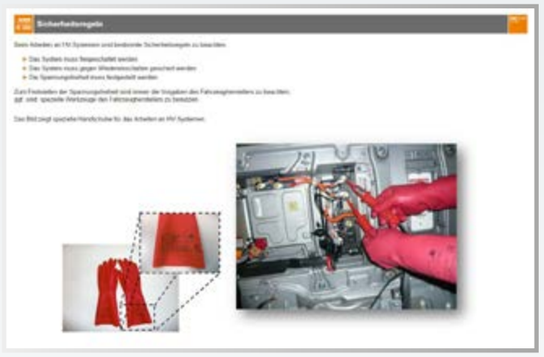
Direct voltages of various levels are required by the inverters of all-electric and hybrid vehicles, as well as numerous other application circuits. With the help of this training system, students can investigate the possibilities for conversion of DC voltages using UniTrain as their basis.

One of the courses covers step-up conversion (converting voltage at one DC level to a higher DC voltage), while another deals with step-down conversion (high-voltage to low voltage).

Training contents
- Step-up conversion (1 course)
- Step-down conversion (1 course)
- Safe handling thanks to safety low voltage
- Practical experience of voltage conversion
- Function and design of DC-DC converters
- Measurement of input and output voltages

Order nos. CO4205-1K/CO4205-1L

HYBRID DRIVES IN MOTOR VEHICLES



UNITRAIN
SYSTEM

Hybrid drives exist to achieve three essential aims: saving of fuel, reduction of emissions and improving both torque and power output. There are various different hybrid concepts which may focus on one or more of these objectives. With the help of this UniTrain system, trainees can gain an understanding of the technical principles behind hybrid drives for themselves.

They can independently plan their own diagnostics, maintenance and repairs of power supply and starting systems and carry them out themselves while conforming to all manufacturers' specifications and health and safety regulations. By means of various measuring exercises and experiments, they can then develop the practical knowledge and skills they will need in the course of their careers.

Training contents
- Benefits of hybrid systems
- Serial and parallel hybrid systems
- Combined hybrids
- Design of electrical machines (asynchronous and synchronous machines)
- Fundamentals of inverters (three-phase converters)
- Fundamentals of frequency converters
- Three-phase power supply
- Measurement of DC, AC and three-phase voltages
- Investigation of energy and power flows
- On-board power supply for hybrid vehicles

Order no. CO4204-6V

FUEL CELLS

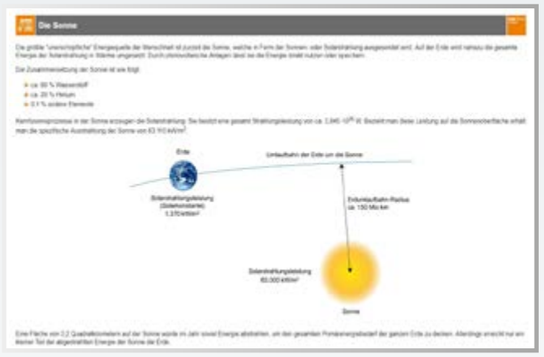
UNITRAIN
SYSTEM

The future of electromobility is a blank page. That means it is always essential to pursue the development of powering alternatives. One of the more popular options at present is the use of fuel cells in conjunction with electric traction. This training system can help students get to know about this fascinating topic.

Training contents
- Fuel cell application in motor vehicles
- Properties and design of fuel cells
- How a fuel cell works
- Fundamentals of the chemical process
- Recording characteristics
- Efficiency of a fuel cell

Order no. CO4204-6M

PHOTOVOLTAICS



UNITRAIN
SYSTEM

Photovoltaics is a term describing the direct conversion of sunlight into electrical energy by means of solar cells. In vehicles, energy obtained in this way is used for auxiliary electrical loads, i.e. for the comfort of drivers and passengers, for instance cooling the interior on hot sunny days. This UniTrain system helps trainees understand the technological principles behind this in rapid time.

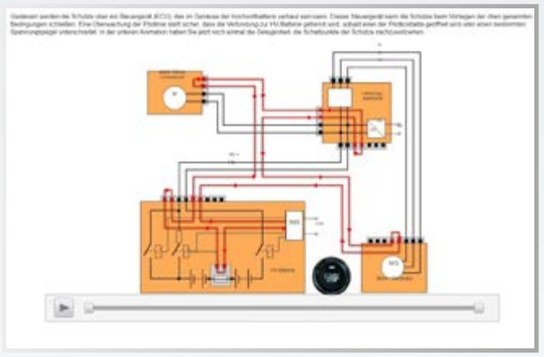
Training contents

- 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 and energy storage

Order no. CO4205-1P

INTERLOCKS

Including troubleshooting



UNITRAIN
SYSTEM

Interlock systems are an essential safety precaution in vehicles. They ensure the safety not only of vehicle users but also of mechanics working in service workshops. Should a cable become disconnected or faults occur, the interlock system will isolate the high-voltage battery.

This training system helps trainees become familiar with interlocks by means of interactively based experiments.

Training contents

- Electric circuitry for interlocks
- Interlock signals
- Investigation of an interlock by measurement
- Troubleshooting for faults commonly encountered in practice

Order no. CO4205-1H

HIGH-VOLTAGE BATTERY DISCONNECTION UNIT

Including troubleshooting

UNITRAIN
SYSTEM

This training system explains how the contactors of a high-voltage battery disconnection unit work. This unit monitors the high-voltage system and only connects the battery when a self-test has successfully proven that the system is safe.

With this system, you can gain an in-depth understanding of high-voltage battery monitoring systems in a way which would not be possible in a real vehicle.

Training contents

- Design and function of battery disconnection units
- How the contactors work
- Switching sequence of contactors in circuit
- Fault diagnostics – simulated faults can be activated
- Investigation by measurement

Order no. CO4205-1J

48-VOLT ON-BOARD ELECTRIC SYSTEM

Including troubleshooting

UNITRAIN
SYSTEM

A 48 V on-board electric system opens up a multitude of options for digitalisation of vehicles. The higher voltage of the onboard power network based on use of lithium-ion batteries does, however, require some rethinking with regard to working with such systems.

This UniTrain course focuses particularly on safe handling of the new technology. The complete package shows ways to carry out practical and targeted work on a 48 V onboard electric system. This provides trainees with essential diagnostic skills.

Training contents

- Benefits of a 48 V on-board electric system
- Design of a 48 V on-board electric system
- Possible dangers from electricity
- Disconnection/isolation of a 48 V system using a tester
- Manual disconnection/isolation of a 48 V system
- Diagnostics in 48 V systems

Order no. CO4205-1T

SAFE HANDLING OF HIGH-VOLTAGE SYSTEMS

Including troubleshooting

UNITRAIN
SYSTEM

Safety when working on high-voltage electric vehicles and the hazards of high current flowing through the human body are fundamental aspects for any professional work on hybrid and electric vehicles. This training system imparts key fundamental knowledge within the safe environment of the UniTrain system. The hazards to a human body can still be directly measured, though, with the help of a model.

Training contents

- Fundamentals: Safety when working with high-voltage vehicles
- Effects of faults encountered in practice
- Using a model to measure the current passing through a human body

Order no. CO4205-1M

TRAINING SYSTEM FOR HIGH-VOLTAGE AND AIR-CONDITIONING SYSTEMS

Including troubleshooting

Fully functional AC cooling system for the high-voltage battery

CARTRAIN
SYSTEM

This combined system enables an advanced introduction to high-voltage systems in vehicles. It focuses on diagnostic skills for the aspects of high-voltage drive systems, intrinsic safety systems and high-voltage air-conditioning.

Trainees can carry out non-contact measurements on a high-voltage traction motor itself – in the utmost safety. Interlock and insulation monitors are made comprehensible on a measured level. The method used imparts theoretical knowledge and practical repair skills to an equal degree.

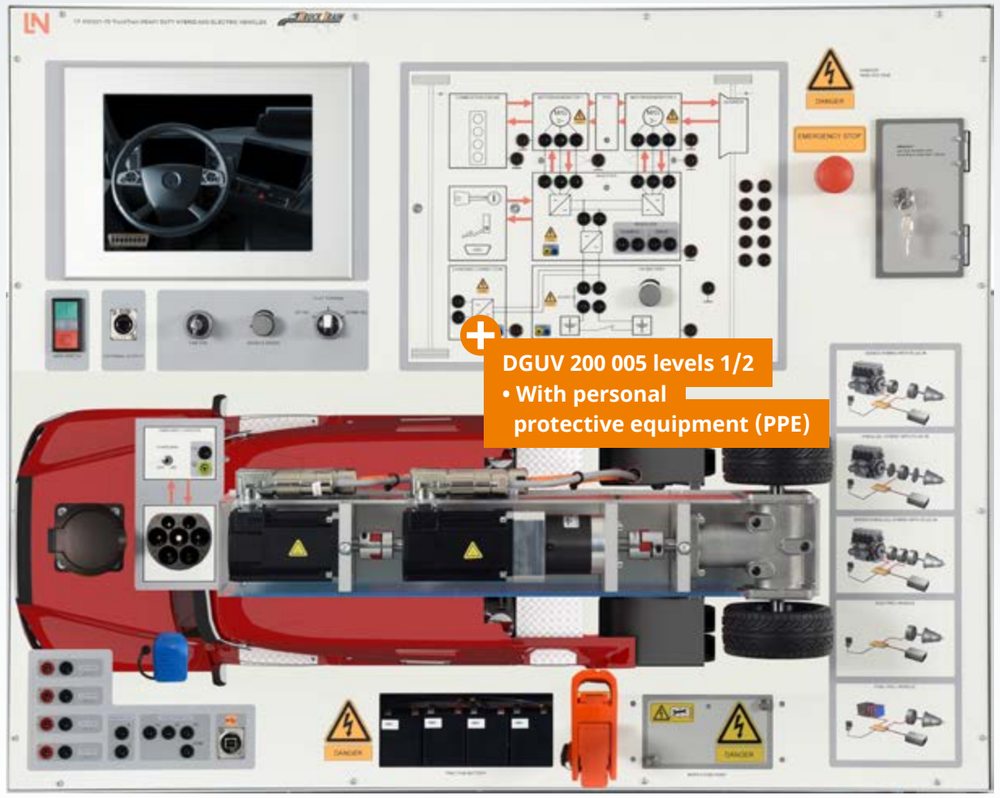
Training contents

- Optimisation of control for high-voltage drive systems
- Measurements on the interlock system
- Measurements on the insulation monitor
- Diagnostic work based on practical experience using customer job orders
- High-voltage drive, air conditioning and intrinsic safety systems

Order no. CO3221-6P

HYBRID AND ELECTRIC VEHICLES

Including troubleshooting



TRUCKTRAIN SYSTEM

The subject of increasing electrification is also on the rise in the area of commercial vehicles. This is a huge challenge in the area of vocational and advanced training. With this TruckTrain system from Lucas-Nülle you can prepare trainees safely and realistically for the new technologies without forcing them to work on a real electric-powered commercial heavy vehicle.

The training system is based on our successful CarTrain series devoted to "Electric and Hybrid Vehicles" and has been specially adapted for the requirements of heavy and commercial vehicles.

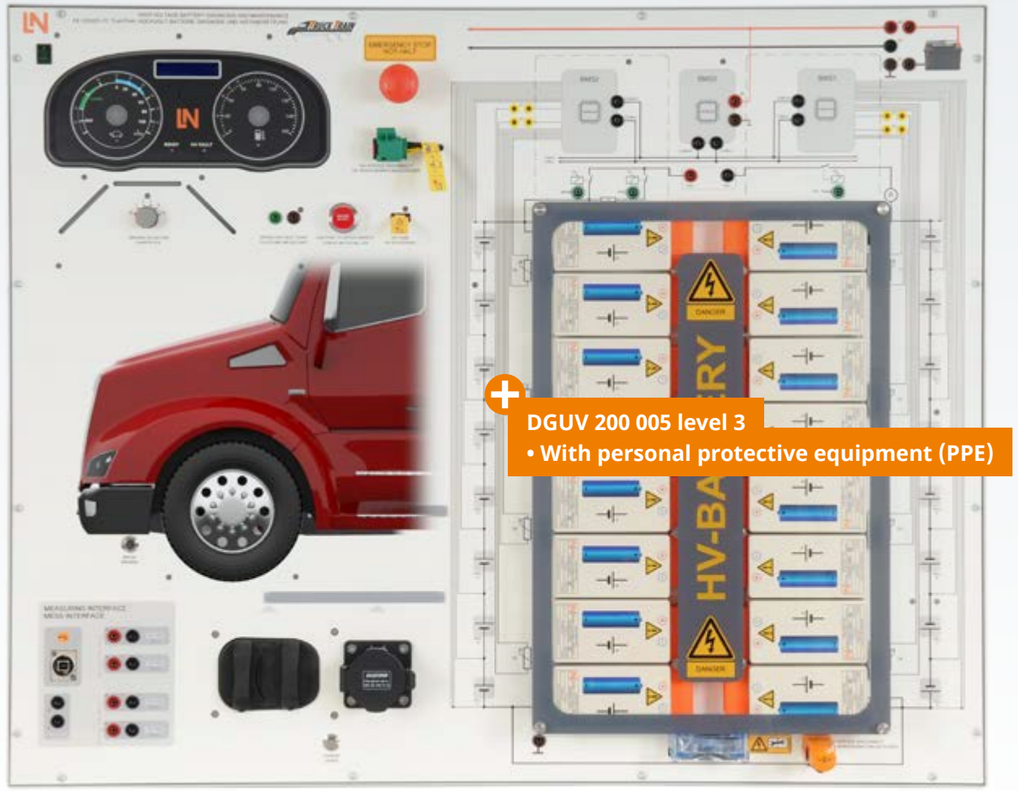
Training contents

- Servicing vehicles and systems and complying with safety measures according to valid DGUV standards
- Analysis of HV systems / Training in electrical safety
- Isolation/disconnection of a HV system according to manufacturer specifications
- Performing fault and malfunction diagnosis of HV systems and HV components
- Perform equipotential bonding and insulation measurement on vehicle and document findings
- Putting HV systems back into operation in accordance with vehicle manufacturer's specifications

Order no. CO3221-7D

DIAGNOSIS AND REPAIR OF A HIGH-VOLTAGE BATTERY

Including troubleshooting



TRUCKTRAIN SYSTEM

More and more manufacturers carry out repairs on high-voltage batteries themselves. This is a whole new challenge that requires a specific understanding of the system. This training equipment makes it possible to work on a real high-voltage battery directly. Trainees can carry out measurements inside the battery, work upon it at the cell level and even remove and replace actual cells.

Extensive but easy to use, the fault simulation capability provides simulations of many common faults. Trainees can gain the practical skills they need for these up-to-the-minute workshop challenges while they are learning the correct diagnostic methods.

Training contents

- Design and analysis of a real HV battery
- Diagnostic work on HV battery using simulated faults which can be separately activated
- Disconnection/isolation using service and maintenance plug
- Extra training for first responders (fire service, police)
- Various measurements including high voltage at temperature sensors
- Charging infrastructure (AC, CGS DC)
- Disconnection as carried out in practice using high-voltage diagnostic tester
- Dealing with damaged HV batteries (accident-damaged vehicles)
- Classification of damaged HV batteries based on their potential hazard

Order no. CO3221-7E, optional: safety zone kit LM8671

ISO BUS

Including troubleshooting

TRUCKTRAIN SYSTEM

This training system focuses on the subject of "Farming 4.0" based on the ISO bus. The key feature here is the function of "Precision Farming with Section Control". The use of original components and the full integration of the ISO and J1939 bus ensures maximum practical relevance. Numerous measurement points and comprehensive fault simulation make TruckTrain a customisable training system perfect for your specific needs.

The theoretical material appropriate for the target group comes in the corresponding e-learning course and includes high-quality animations and videos. With this system, you simulate "Precision Farming" by having your tractor and seed drill at work virtually in your classroom.

Training contents
- ISO bus technology
- J1939 bus technology
- Topology and design of bus systems
- Tractor Electronic Control Unit (TECU) functionality
- GPS/GNSS receiver
- Diagnostics and troubleshooting on the ISO bus incl. ISO SPY
- Function of "Precision Farming"
- "Job Preparation" process

Order no. CO3221-7F

CHARGING STATIONS

A real charging station: This training system provides an educationally modified version of an authentic charging station. In conjunction with the CarTrain electric vehicle set, it is possible to understand how communication between vehicles and charging stations proceeds.

Of course, the system encompasses all the necessary safety precautions. One other capability is the option of remote control via a smart electricity grid. In addition, you can even charge real electric vehicles.

Training contents
- Charging of high-voltage vehicles
- Sequence of charging procedure
- Safety concepts
- Analysis of communication between charging station and vehicle
- Function of CP and PP contacts

Order no. CO3221-6Q

DIAGNOSTICS AND INSTRUMENTATION

For successful troubleshooting, the right equipment is of indispensable assistance. A vehicle comprises many different component systems, from the chassis to the comfort enhancements. Any of these systems, though, could develop a fault.

For electrical systems in particular, diagnosis without the right tools is no longer possible. We provide you with a choice of high-quality, user-friendly diagnostic aids and measuring instruments and can even advise you which of them would be best suited to your own training needs.

STUDENT/TEACHER MEASURING STATIONS

Flexibly interconnectable and secure student measuring stations. This system also provides trainees with the required signals. The source of the signals can be any electrical system, whether it be the training system itself or a real vehicle.

Benefits

- For universal use in all training classes
- Transmission of both analog and digital signals
- Signal inputs up to ±500 V/Signal outputs up to ±15 V
- Suitable for high-voltage systems
- Accurate transmission of signals

Instructors can feed in high-voltage signals from their own desks. These are then automatically output at student workstations at a safe voltage. The key point is that the actual signal waveform remains unaltered. The teachers' station also includes a gateway through which CAN bus signals can be fed. There is even automatic bus determination.

Benefits

- Ease of assembly and disassembly
- Digital display for diagnosing circuit breaks
- No hazardous or interference responses
- Ease of networking in the lab by means of Ethernet cables

Order no. CO3221-7A and CO3221-7B

DIAGNOSTIC TESTERS

AXONE diagnostic tester with Navigator TXTs

The full set includes everything you need to carry out diagnostics on multiple car makes, including passenger cars, sports cars, luxury cars or even lightweight commercial vehicles. Vehicles featuring OBD diagnostic ports can be connected directly to Navigator TXTs modules. In addition to remarkably intuitive operation, the AXONE NEMO stands out due to its high-quality manufacture and extraordinary computing power. Customers also get Supercar software provided free with any purchase of an AXONE NEMO with its basic PKW software. Using the Navigator TXTs customers can also make use of the pass-through (Pass-Thru) technology provided by vehicle manufacturers.

Benefits

- Unparalleled diagnostic coverage for cars and light commercial vehicles (vans).
- SUPERCAR diagnostics included free
- Dual-mode, display of oscilloscope/multimeter and self-defined diagnostic procedures
- Automatic interrogation of fault memory for all known systems
- Read-out and deletion of fault memory entries plus display of trouble code descriptions
- Electrical circuit diagrams with component layout
- Search for status indications and parameters
- Configuration and encoding
- Built-in camera for documentation of repairs
- High-capacity rechargeable battery
- Wireless communication with diagnostic interface via Bluetooth®
- Wi-Fi interface
- Pass-Thru technology
- Automatic update function

Order no. LM8322

Navigator TXTs diagnostic tester (PC version)

IDC5 PKW diagnostic software makes it possible to diagnose passenger cars (including via HV vehicle and driver assistance systems apps) and lightweight vans. The BIKE and SUPERCAR options for motorcycles, sports and luxury cars can also be integrated into the functionality. The Navigator TXTs diagnostic interface works entirely without wires thanks to the supplied USB Bluetooth® antenna. The IDC5 diagnostic software can be installed on any commonplace PC.

The Navigator TXTs module also offers the option to record parameters and to make use of the Pass-Thru standards (J2534 and ISO22900). Enhancements are also available so that the Navigator TXTs can be used for trucks, overhead camshaft vehicles, bikes (motorcycles) and marine applications.

Benefits

- Unparalleled diagnostic coverage with more than 350 000 options
- Simplified car identification using VIN or engine code
- Automatic interrogation of fault memory in all known systems (TGS3)
- Read-out and deletion of fault memory entries plus display of trouble code descriptions
- Electrical circuit diagrams with component layout
- Search for status indications and parameters
- Configuration and encoding
- Control of actuators
- Wireless communication with diagnostic interface via Bluetooth®
- Pass-Thru standard
- Parameter recording

Order no. LM8323

OSCILLOSCOPE MODULE FOR NAVIGATOR TXTS/BRAKE FLUID TESTER

Oscilloscope module for Navigator TXTs

The UNIProbe instrumentation module combines all the functions needed for use in professional workshops, whether it involves complex testing using a 4-channel oscilloscope and a signal generator or routine measurement using a multimeter. Even complicated checks of a data bus will in future be capable of assessment using software. One particular feature, though, is the ability to measure pressures. Communication is via wireless link with an AXONE tester or Windows PC. The necessary software is supplied or seamlessly integrated via the IDC4/5 diagnostic software .

Benefits

- 4-channel oscilloscope with SIV (signal information viewing) function
- Battery and starter system checks
- Analysis of CAN, VAN and LIN data bus networks
- Signal generator for control of actuators
- Multimeter function for measuring voltage, current and resistance
- Measurement of turbocharger and fuel pressures

Order no. LM8324

Brake fluid tester

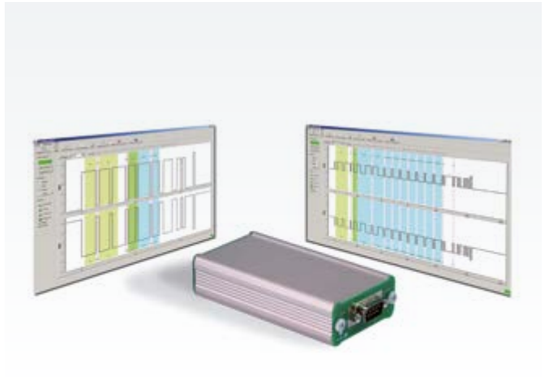
This practical pen-type brake-fluid tester is suitable for determining the quality of brake fluid to classes DOT 3, DOT 4 and DOT 5.1. It measures the moisture content in the brake fluid and displays it by means of three LEDs. To carry out a test, the cover of the brake fluid tank should be unscrewed and the cap removed. The tester is then turned on by the button. The test class can be selected by holding the button down. Once the tester is properly configured, immerse the tips of the probes fully in the brake fluid. After about two seconds, the result of the test can be read from the three LEDs which display quality.
A function test can be carried out by dipping the tester in a container holding water. The test procedure for this is the same as when testing brake fluid. The test is satisfactory if all the LEDs light up.

Technical data

- Test classes: DOT 3, DOT 4, DOT 5.1
- Display
  ' 3 LEDs (Quality)
  ' 2 LEDs (Class)
- Power: 1.5 V/AAA
- Impact- and acid-resistant plastic

Order no. LM8314

CAN/LIN MONITOR / HV MEASURING INSTRUMENTS



CAN/LIN MONITOR

The CAN/LIN monitor allows messages using the native bus protocols on a CAN bus and LIN bus to be recorded, displayed, transmitted and investigated.

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
- Display of identifier, data length and period
- Simple, user-defined interface

Order no. SO2000-2A

AVL DITEST HV SAFETY 2000 high-voltage instrumentation

This flexible measurement system permits swift, safe and simple diagnosis of high-voltage vehicles. Emphasis is on maximum protection of personal safety and of the vehicle itself.

Benefits

- Simple to integrate into testing and diagnostic platform
- Adaptable interface: Logging of test procedures and results
- Multimeter for up to 1000 V
- Measurement of HV insulation resistance (test voltage up to 1000 V in accordance with SAE J1766)
- Easy to operate even when wearing clothing to protect against high voltage
- Calibration certificate compliant with DIN EN ISO 9002
- Measurement of equipotential bonding with test current max. 1000 mA
- Automatic disabling of test voltage in the event of a fault or physical contact

Order no. LM8258

COMMON-RAIL DIAGNOSTICS SET

High-pressure injectors in the recirculation procedure

With the portable diagnostics set common rail high-pressure injectors are tested while the engine is running. All commercially available common-rail systems can be connected with the diagnostics set using the original connections. During diagnosis, you can constantly measure the fuel recirculating rate, fuel pressure, and also fuel temperature in the return line and analyse the results using the application in the LabSoft course.

Training contents

- Understanding how common rail technology works
- Testing high-pressure injectors in recirculation procedure
- Diagnose and maintain engine management systems
- Building up diagnostics expertise and skills
- Carrying out measurements on the common rail system
- Operating principles of automatic rail pressure control

Order no. LM8265

Test the low-pressure circuit

The inlet and return pressure in the various systems must correspond to the specific manufacturer specifications. An inspection of the low-pressure circuit permits disturbances to be located or eliminated. That is how air bubbles and contaminants are detected in the fuel system.

Training contents

- Become familiar with the common rail low-pressure system
- Diagnose and maintain engine management systems
- Building up diagnostics expertise and skills
- Operating principles of automatic rail pressure control
- Carrying out measurements on the common rail system

Order no. LM8233

VEHICLE DIAGNOSTICS CASE/OBD II BREAK-OUT BOX

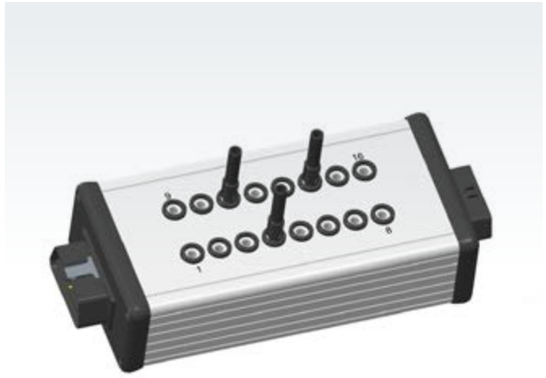
VEHICLE DIAGNOSTICS CASE

This case provides a universal set of contact equipment for all the plug connectors used in vehicles. Reliable contacts for diagnostics and troubleshooting in vehicles allow optimum measurement and test results to be achieved quickly and easily. The case keeps up with all the demands from vehicle manufacturers, vehicle workshops and training establishments.

Benefits

- High-quality, comprehensive service case for diagnostics and troubleshooting in vehicles
- Built-in universal lab multimeter
- Safe contacts for the most important vehicle connecting plugs
- Flexible, heat-resistant adapter leads
- Steel needle-form miniature spring test probes (especially suitable for enclosed plugs)

Order no. LM8243



OBD II BREAK-OUT BOX

This package allows you to analyse the individual terminals of an OBD II or EOBD connection in detail. All the contacts of an OBD plug are accessible via 4-mm terminals. This makes it possible to connect all kinds of measuring instruments easily.

Since the break-out box handles both inputs and outputs, it is possible to measure and analyse data exchanged between the tester and OBD interface in real-time.

Benefits

- Usable with any vehicle featuring an OBD II interface
- Usable with any training systems featuring an OBD II interface
- 4-mm measurement socket for every pin
- Very easy and quick to start using
- No additional software required

Order nos. LM8303 (12 V), LM8299 (24 V)

VCDS WIFI/INFRA-RED CAMERA FOR VEHICLE DIAGNOSTICS

VCDS WIFI

The new diagnostic interface paves the way for smart workshops of the future. The new HEX-NET diagnostic interface makes it possible to carry out VCDS work in your workshop wirelessly. Simply incorporate the system into the workshop's WiFi network and any computer in the network will be able to access the vehicle.

If you have no WiFi in the workshop or you want to use HEX-NET while you are out on a job, that is also no problem. You can simply configure the HEX-Net device itself as a router by the simple press of a button and any WiFi capable device will be able to access it.

Benefits

- Full version of VCDS diagnostic software
- Usable with or without cables
- Compatible with almost all vehicles made by the Volkswagen-Audi Group (VAG)
- Rugged case with improved plug

Order no. LM8306

Infra-red camera for vehicle diagnostics

This thermal imaging camera allows surface temperatures to be displayed in the form of a real-time image. This facilitates diagnostics for such things as engine compartments, brakes, cooling and heating systems. Hot and cold points are coded on a colour display to identify the hottest and coldest temperatures detected. In addition, it is possible to save images to the devices own memory and also to transfer them to computers by means of a USB cable.

Technical data

- Measuring range (optimum): 0.2 – 50 m
- Screen: 3.2" TFT display
- Colour palette: Selectable
- Temperature measurement range: -20 – 300°C
- Measurement precision: ±2°C
- Emission level (adjustable): 0.1 – 10.0
- Device memory: 3 GB
- Image resolution: 220 x 160 pixels
- Image format: JPG
- Power supply: Rechargeable battery

Order no. LM8315

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