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**Training Systems Australia**  
First in Vocational Training Equipment  
A Division of Pullman Learning Group

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**LN**  
LUCAS-NÜLLE



INSTITUTE  
OF THE MOTOR  
INDUSTRY

# HYBRID AND ELECTRIC VEHICLES

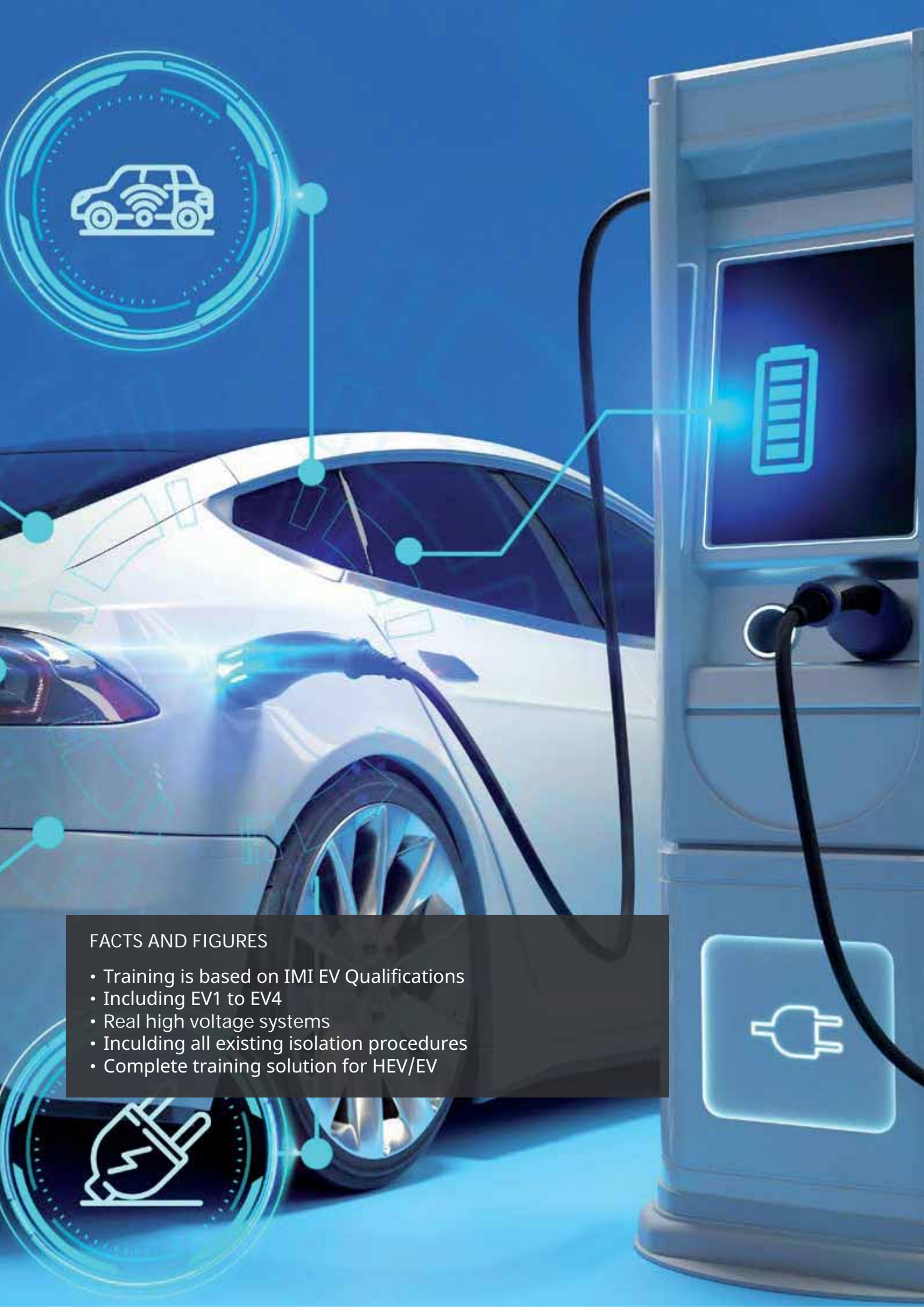
Hands on Training Systems  
Aligned to the IMI EV Qualifications



# TRAINING SYSTEMS FOR ELECTRIC AND HYBRID VEHICLES



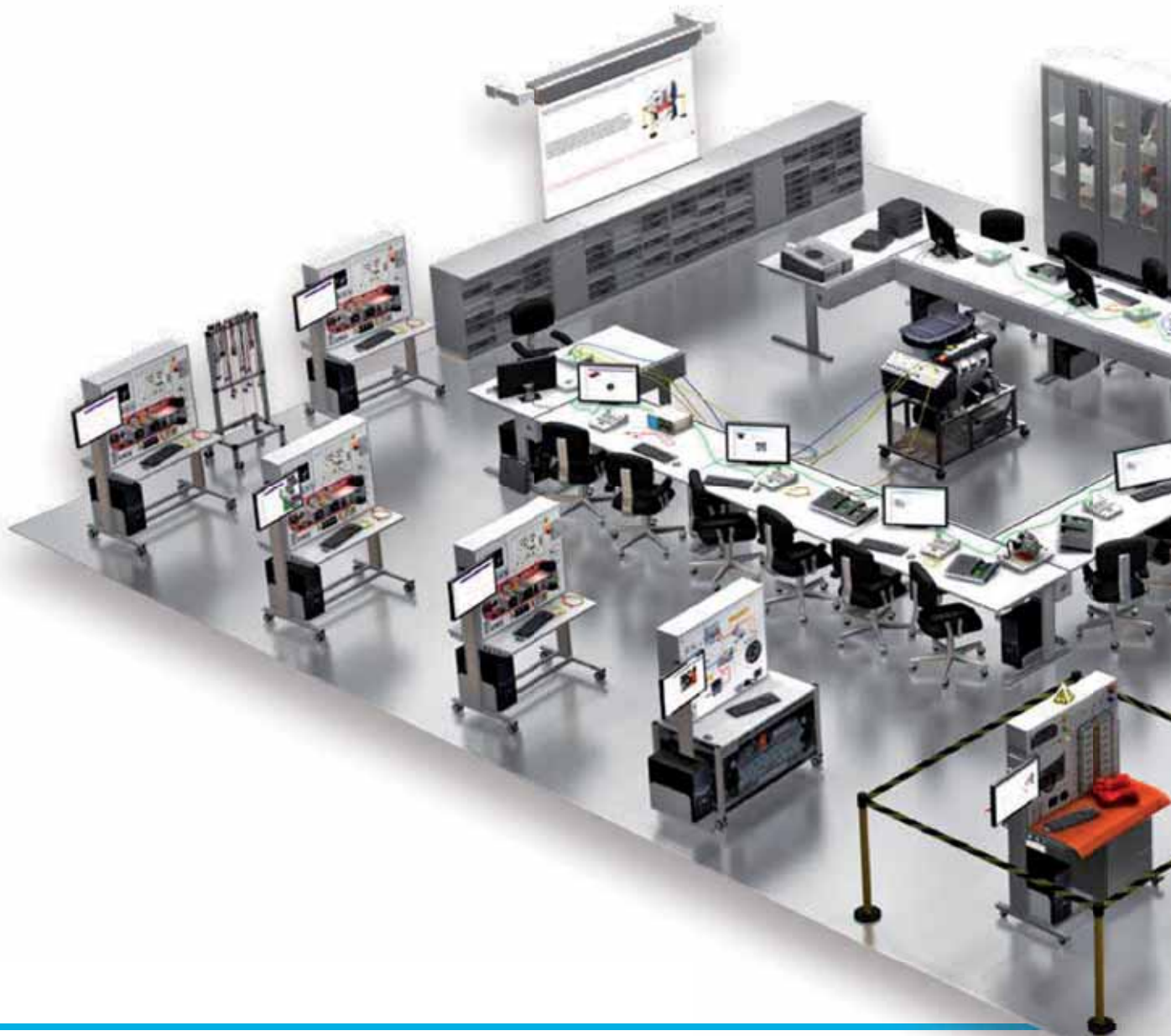




## FACTS AND FIGURES

- Training is based on IMI EV Qualifications
- Including EV1 to EV4
- Real high voltage systems
- Including all existing isolation procedures
- Complete training solution for HEV/EV

# ELECTRIC VEHICLE TRAINING – A NEW LEVEL



Hybrid and electric vehicles are ever increasing in popularity throughout the world and now represent one of the most innovative and trail-blazing areas of automotive technology. Toyota alone has already sold more than 7 million hybrid vehicles across the globe. The next generation of skilled automotive professionals needs the optimum training to be prepared for the demands of this new discipline.

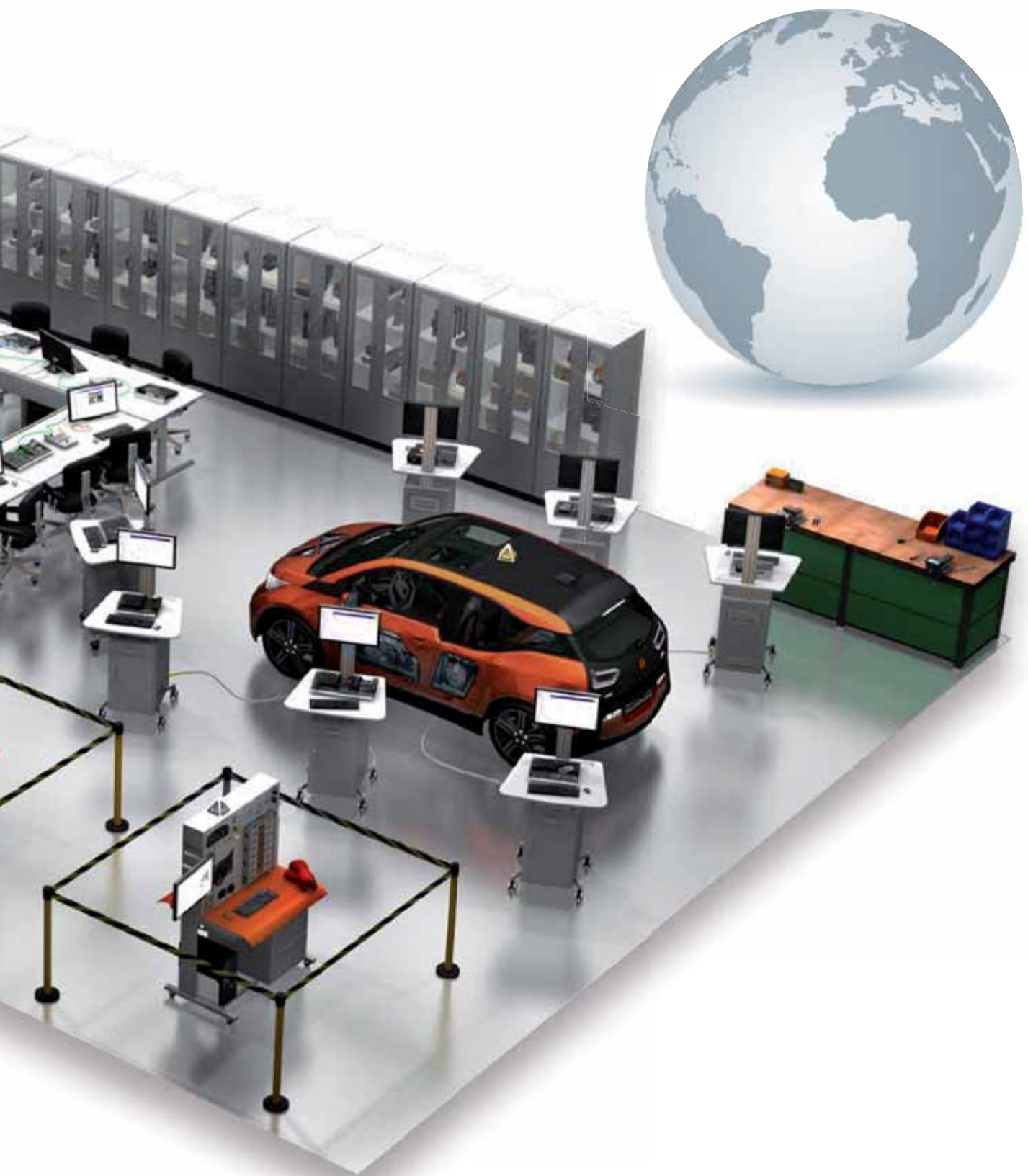
Lucas-Nülle has developed training systems for precisely this kind of teaching. They are setting whole new standards for functionality, educational value and usability. They offer users the opportunity to experience all the facets of working with electric and hybrid vehicles. This starts with how electric drive systems work and how they are controlled in motor vehicles, but then goes deeper into the various drive configurations employed in hybrids and in wholly electric vehicles. All these topics are handled in a way which reflects authentic modern practice but still makes the subject understandable.

Aside from technical content, there is a major focus on safety at work and how to deal safely with high-voltage systems.

All Lucas-Nülle training systems are developed with the objective of imparting content in a manner carefully tailored to the target audience and which is closely aligned to authentic practice. For those taking the courses, this means that the knowledge they have learned can be applied directly in their professional lives, so that they will already possess all the technical skills they require.

**Training to the very latest state of the art!**





# ONE STOP SOLUTION: THE LN TRAINING CONCEPT



For 40 years Lucas-Nülle training systems have been assisting education and training, and the company is synonymous with progressive and innovative training. Each training system developed by engineers at Lucas-Nülle GmbH is incorporated into the overall training concept and smoothes the way to a successful career.

Whether you want to purchase an individual training system or a fully equipped lab for studying hybrid and electric vehicles, we are passionate about meeting all your needs.

### Real cars

Learning to work on a genuine, digitally networked, training vehicle forms the final stage of the Lucas-Nülle training concept. Trainees are ideally prepared for the challenge

of applying the skills they have learned to use on a real car. This means they can not only enhance their skills, but also develop their own working methods.

### CarTrain

The CarTrain systems provide trainees with an effective and efficient learning platform. The hardware is based on the latest technology and is combined with a multimedia LabSoft course on automotive technology. The operation of modern vehicle components is conveyed in a practical, hands-on fashion using authentic original equipment. The

system can be put into use immediately with all the necessary components already installed and configured and thanks to the realistic simulation of faults, trainees can gain elementary diagnostic skills. In order to carry out any measurements, the system comes complete with built-in measurement interface.

### UniTrain

The UniTrain system gives an introduction to the world of automotive training and provides trainees with the necessary fundamental knowledge in a way that is simple and motivating. The compact desktop lab is portable and usable

anywhere. The multimedia training platform ensures a high degree of motivation and the best chance of successful learning, guaranteeing effective and efficient learning.

### UniTrain

In the multimedia courses, the theoretical background is explained and then experiments are carried out using experiment hardware which is specific to each course. In addition, the intelligent measuring interface includes analog and digital inputs and outputs for measurement and control. In combination with virtual instruments, the whole system represents a high-quality piece of lab equipment. Learning

progress can be monitored in troubleshooting exercises on the course hardware as well as by tests, all of which can be digitally documented. The electrical and electronic circuitry needed for the experiments is connected to the system by means of an "Experimenter" module. Access to the courses themselves and control of the virtual instruments and experiment hardware are provided by the LabSoft browser platform.

# UNITRAIN – BASIC KNOWLEDGE TRAINING



## UniTrain Electric drives in cars, trucks and two-wheelers

With the UniTrain training system for electric drives, trainees get the perfect and safe HV drive systems and learn the three key components of the key components "electric motor", "inverter" and, in particular the "HV battery" with its numerous safety functions. safety functions.

In practical exercises and various diagnostic tasks with fault simulation, they acquire practical knowledge and essential diagnostic skills.

### Training contents

- Construction and operation of synchronous and asynchronous motors
- Operation of invertors
- Energy regeneration
- Interlock
- Inverter control
- Synchronous and asynchronous motors
- Practical measurements and fault diagnosis

Order no. CO4204-6N



## UniTrain DC/AC conversion

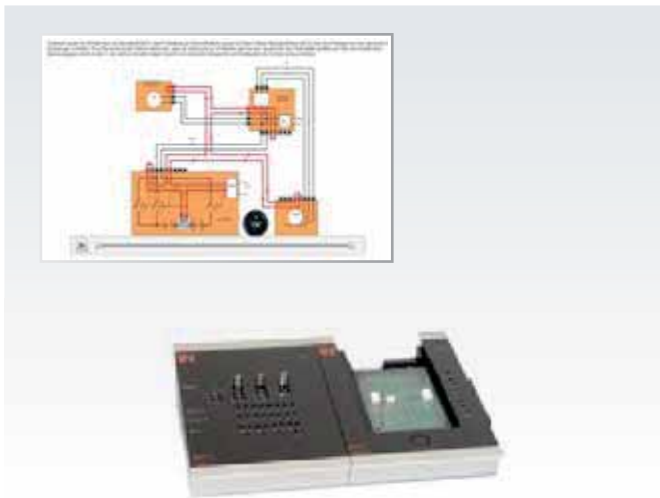
Batteries can only store and supply direct current. However, in order to drive an electric traction motor, an alternating current is required. This course provides a host of experiments to demonstrate how conversion from one form to the other can be achieved.

### Training contents

- Electrical induction
- Current and voltage ratio
- Generation of a pulse-wide modulated voltage
- Conversion of direct voltage into alternating voltage

Order no. CO4204-6L





### UniTrain Electrical interlocks in electric and hybrid vehicles

An interlock is a safety mechanism designed to ensure the safety of drivers and workshop mechanics dealing with electric vehicles. The interlock separates the high-voltage battery from the rest of the vehicle as soon as wires are wrongly disconnected or in the event of malfunctions. Trainees learn all about interlock systems with the help of experiments featuring interactive assistance.

#### Training contents

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

Order no. CO4205-1H



### UniTrain Relais unit of the HV battery

This training system focuses on the high voltage disconnection relays of the battery unit. The system monitors the hybrid system and only connects to the high voltage when it is considered "safe and secure". The accompanying Labsoft course explains this complex system.

#### Training contents

- Design and function of battery disconnection unit
- Fault finding
- Perform the isolation procedure
- Measuring the HV start up and shutdown sequence
- Difference between conventional and smart HV relays

Order no. CO4205-1Z

# UNITRAIN – BASIC KNOWLEDGE TRAINING



## UniTrain Safe handling of HV systems

This training system focuses on safety when working on high-voltage systems and the dangers of electricity passing through the human body.

### Training contents

- Fundamentals of 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



## UniTrain Step-up/Step-down converters

The inverters in electric and hybrid vehicles, as well as many other circuit applications, require DC voltages at multiple different levels. Here students can investigate various options for conversion of DC voltages from one level to another.

### Training contents

- 1 course on step-up conversion (from lower voltage to higher)
- 1 course on step-down conversion (from higher voltage to lower)
- 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 no. CO4205-1K/CO4205-1L



### UniTrain Fuel cells

Internal combustion engines still produce large quantities of CO<sub>2</sub>. That is why it is essential for engineers to seek out alternative drive concepts. One such concept involves the use of electric traction motors in conjunction with a fuel cell. This training system allows trainees to learn about this fascinating technology and gain an understanding of how it works.

#### Training contents

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

Order no. CO4204-6M



### UniTrain Photovoltaics

The term photovoltaics means a direct conversion of (sun) light into electrical energy by means of solar cells. The energy obtained in this manner can be supplied to ancillary consumers to enhance driving comfort, e.g. to provide extra cooling for a vehicle's interior in extremely bright sunshine. With our UniTrain photovoltaics system, students very quickly grasp the fundamentals of this technology.

#### Training contents

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

Order no. CO4205-6N



# UNITRAIN – 48 V BOARD NETWORK AS SUBSYSTEM



Integration of a 48 volt sub-system in an on-board network in conjunction with its own lithium-ion battery requires a consistent rethink of the way mechanics have to work. The focus here is on how to deal with this new technology safely and develop practical, targeted ways of working, as well as learning essential diagnostic skills. We offer all of this to you as part of this package.

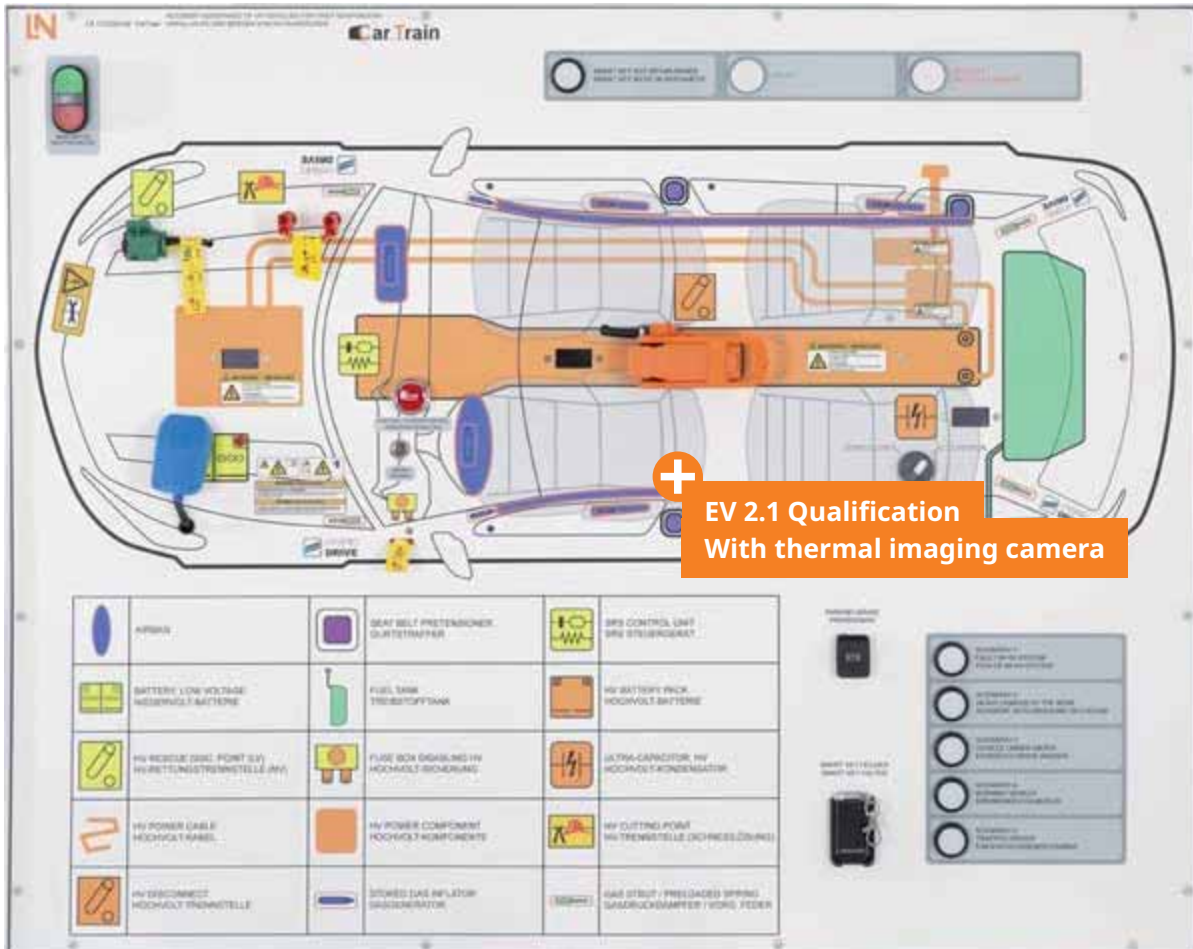
## Training contents

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

# CARTRAIN FIRST RESPONDER TRAINER FOR ELECTRIC VEHICLES



Includes troubleshooting



## CARTRAIN SYSTEM

The growing number of electric vehicles on the road presents a new challenge, especially for emergency and rescue services.

Lucas-Nülle has developed a unique training concept for first responders. This makes it possible to carry out the new tasks with seasoned professionalism and assurance. Integrated accident scenarios perfectly round out this training package.

### Training contents

- Hands on training for first responders
- Immobilizing of the vehicle
- Using rescue cards
- All HV isolation procedures
- Accident scenarios like submerged vehicles
- Getting to know special risks

# HYBRID AND ELECTRIC VEHICLES



**CARTRAIN**  
SYSTEM

## CarTrain Hybrid and electric vehicles

This is the only electric vehicle training system which combines 5 different drive configurations and includes all the necessary terminals for making measurements on a high-voltage system.

Compared to the previous version, the new CarTrain has the following advantages: The high-speed CAN as a communication bus is directly integrated into the control of the HV system. You can easily understand the different drive modes and energy flows via the integrated touch screen.

The system operates using the same high voltage which is present in real vehicles. This means that students can practice how disconnection of real high-voltage systems is accomplished.

## Benefits

- Touchscreen displays the energy flow
- Over 30 measuring points in high-voltage system
- Real high voltage systems
- Complete isolation procedure
- HV fault simulation

Order no. CO3221-6X



# CHARGING STATION



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

# CARTRAIN – DIAGNOSIS AND REPAIR OF A HV BATTERY



Includes troubleshooting



## CARTRAIN SYSTEM

Ever more manufacturers carry out repairs on high-voltage batteries themselves. This is a whole new challenge which requires 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 cell level and even remove and replace actual cells.

An extensive system which is nevertheless easy to use. Fault simulation capability enables study of many potential problems. While trainees work out the right ways to carry out diagnostics, they also gain practical skills for the latest workshop challenges.

### Training contents

- Structure and analysis of a real high-voltage battery
- Diagnostic work on HV battery including fault simulation
- Disconnection via LV service plug, fuse or HV service plug
- Various measurements including high voltage and temperature sensors
- Charging infrastructure (AC, CCS DC)
- Disconnection as carried out in practice using high voltage diagnostic tester
- Dealing with damaged HV batteries
- Optional: Cell swap with external cell balancing

Order no. CO3221-6S (Optional: Cell balancer CO3221-7H)

# CARTRAIN – AC AND DRIVE IN A HV SYSTEM



Combined equipment for the topics of hybrid drive trains and high voltage air conditioning in vehicles. Trainees can use the set to learn about the aspects of servicing, diagnostics and repair of high-voltage networks and air conditioning.

Order no. CO3221-6P

## Benefits

- Secured but real high voltage
- Simulation of various operating modes
- High-voltage air conditioning compressor
- Contactless measurement
- Fault simulation
- Fully functioning high-voltage air conditioning system featuring original components
- High voltage battery with original maintenance plug interlock
- Original insulation monitor



# MEASUREMENT AND DIAGNOSIS ON THE ELECTRIC DRIVE



## Practical insulation and Resistance measurement



The electric motor is one of the central elements of an HV system. Due to the high currents flowing through the electric motor, it is exposed to high thermal stress and various malfunctions or defects can occur. The HV specialist must therefore be able to detect and eliminate these possible malfunctions.

The trainee can carry out a practical insulation measurement or check the resistances of the stator. The modules also offer the possibility to analyse the differences between a star or delta connection of a motor. In addition to these possibilities, further measurements can be carried out on the various modules, which further improve the understanding of the subject and the trainee's own diagnostic skills.

### Training contents

- Structure of an electrical machine
- Differences between synchronous and asynchronous motors
- Differences between star (Y) and delta ( $\Delta$ ) circuits
- Insulation measurement on electrical machines
- Resistance measurement on electrical machines
- Inductance measurement of the coils

# LABSOFT – THE MULTIMEDIA LEARNING PLATFORM

Further information is available at  
[www.lucas-nuelle.com](http://www.lucas-nuelle.com)



## FACTS AND FIGURES

- HTML-based multimedia courses
- All languages supported by HTML
- Animations and graphics
- Theory and diagnostic exercises in a single training unit
- Documentation of results
- Questions for testing knowledge
- Access to all virtual instruments
- Log-in with user data
- Choice of languages
- Choice of courses
- Saving of individual platform configurations



# DIGITALLY NETWORKED TRAINING VEHICLES



Tested vehicles



Choose from four different cars. The cars chosen for these training systems are selected according to strict quality guidelines. This is how we guarantee you a high-quality product with excellent cost efficiency.

All the cars are specially modified so that they fit perfectly into the educational concept. Apart from visualisation of the key systems in a vehicle, various break-out boxes are supplied, along with more than 30 fault activation switches. All these vehicles are accompanied by their original circuit diagrams, allowing diagnostics to be carried out under practical conditions.

Contact us for your individual offer



#### The digitization package – Digital diagnostics on a real vehicle

In order to exploit the full potential of a training vehicle, we recommend installing our digitalisation package. This package introduces a WiFi-capable measurement and diagnostics interface into the vehicle, allowing activation of simulated faults and transmission of measurement results to the training platform. All the measuring instruments (4-channel oscilloscope, multimeters, current probe, etc.) are already built in and can be run directly from the training platform, thus saving space.

##### Benefits

- Digitally networked training platform
- Interactive diagnostic course
- WiFi-capable measuring interface
- Includes non-contact current measuring probe
- WiFi-capable diagnostic interface
- OBD-II-break-out box

Order no. CO3223-7E



#### Measurement expansion package – Simultaneous working for any number of trainees

The measurement expansion package allows multiple trainees to carry out measurements and diagnostics on a single vehicle simultaneously by adding extra student measuring stations. Up to six different signals are fed into the vehicle's signal interface and then made available at the students' workplaces. The number of student measuring stations can be increased as needed. This allows a whole class of trainees to work on the same vehicle at once.

##### Benefits

- Built-in signal interface
- Includes 6 external student measuring stations
- Parallel transmission of signals
- Custom extensibility
- Can be combined with training platform
- Built-in CAN interface

Order no. CO3223-7F





## LABSOFT CLASSROOM MANAGER – ADMINISTRATION, CUSTOMISATION, TESTING AND EVALUATION



### **LabSoft Manager**

Manage your LabSoft courses, students and classes using the LabSoft Manager. This ensures that your students always have the right training content available.



### **LabSoft Questioner**

In order to set up questions, measuring exercises and tests, LabSoft Questioner provides multiple varieties of question. The exercises and questions can then be inserted into courses and tests.



### **LabSoft Editor**

Numerous wizards within the LabSoft Editor help you set up your own new courses and guide users step by step through the necessary procedures.



- Optimal use of resources
- Minimisation of management work
- Maximisation of learning success at all times
- Check on student progress at any time
- Everything always at your fingertips



#### LabSoft TestCreator

LabSoft TestCreator helps you set up tests so that you can check both students' knowledge and their practical skills. Filter functions assist you with manual or automated selection of test questions.



#### LabSoft Reporter

LabSoft Reporter shows you the progress of all your students along with their test results. There are multiple student assessment options for individual or class results in courses and tests, allowing you to monitor them in a quick and targeted fashion.



#### LabSoft TestCenter

With the ControlCenter you are always up-to-date on everything in your classroom. It shows what your classroom is currently working on, inserts help questions and permits the distribution of individual screen content to the group.



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Aligned to the IMI EV Qualifications



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