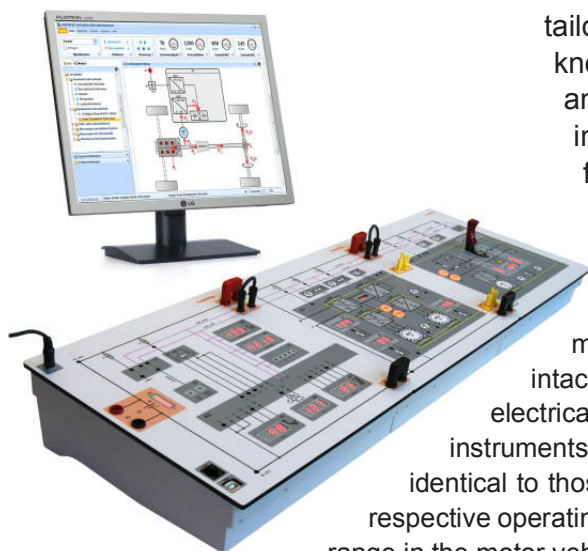




Diagnostic trainer for hybrid motor vehicle drive systems

Basic training in hybrid technology



The new and innovative training platform is ideally tailored to the requirements for conveying basic knowledge about hybrid vehicles. The modular and network-capable concept enables the intuitive investigation and comparison of all familiar hybrid drive systems in the motor vehicle.

Diversity

Numerous functions are provided for the measurement of all essential components in the intact system and in fault cases. Measurements of electrical values are made here with real measuring instruments. The measurable voltage values are nearly identical to those in the real vehicle and are geared toward the respective operating condition. Voltages lying above the low voltage range in the motor vehicle are at a ratio of 1:10 to the measurement for reasons of accident prevention.

The system provides extensive operating modes. In addition to the driving situations, these include start and charging situations, measurement and diagnostic modes and the work on HV components. The driving situations include the conventional driving mode, the purely electronic driving mode, boosting, recuperation, load point raising, a 16-part driving profile in the EV mode and the new European standard driving cycle

Networking

The networked concept consists of extensive control software and the connected device panels. The integration in the existing Ethernet laboratory network makes it possible for individual fault cases to be switched to the student work stations from the teacher's desk. The system can alternatively be linked by the supplied THERPALink cable.

The teacher can actively access the device panels on his/her computer and thus let the students perform the corresponding troubleshooting. Numerous practical faults can be selected – whereby several causes can be selected in turn for every fault message. This makes it possible for all students, for example, to switch the message "Can-Bus malfunction" or "Water pump for high temperature cooling circuit non-functional", but for each of them to individually determine the cause of the fault.

The control by the teacher is carried out with differing amounts of intervention in the student workstation. Thus, each student can have complete control of his/her system or the selection and activation of the functions can be solely up to the teacher.

Platform

The modular learning platform "component set for motor vehicle technology" is based on the structural logic of a vehicle drive system. The hardware components consist of the central equipment panel "Basic vehicle system" and the device panel modules "Inverter and electrical machines" and "Battery and high voltage unit". This platform concept makes it possible to later expand the basic system to include additional thematic areas and device panel modules – such as petrol injection systems or diesel systems. The device panels primarily serve as measuring boxes with correlation displays which symbolise and explain the drive mode.

Component set for hybrid drive systems

Thanks to the diversity of the practical information and the real measured values for the intact and defective vehicle, the present teaching system makes a decisive contribution to the introduction of theory and practical service.

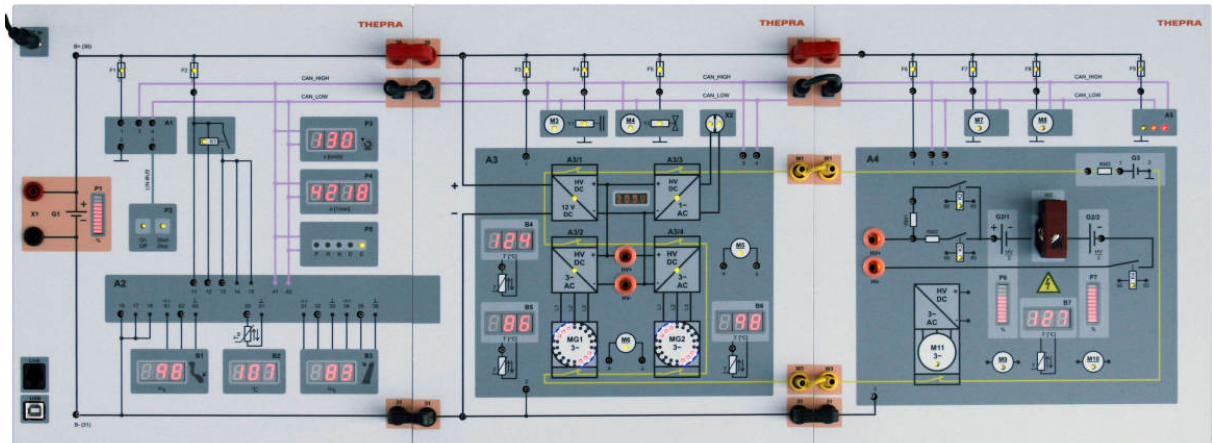
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Design and configuration

The type, design and configuration of the components promotes transfer competence from pure theory to the real assembled vehicle components.



Basic combustion engine

Inverter and electrical machines

Battery and high-voltage unit

The teaching system for hybrid drives covers the following motor vehicle systems

- Parallel hybrid
- Serial hybrid
- Axle split hybrid
- Power split hybrid
- Plug-in for all systems
- Charging situations while driving
- Plug-in and external start

Target-oriented features

System-independent three-way division
Electricity/electronics of the combustion engine
Power and control electronics (inverters and three-phase machines)
High voltage battery range
Practical safety concept of the hybrid system in accordance with the manufacturer's specifications
Training on safety measures for maintenance work
No voltages above the low voltage range

Equipment

Three device panels in console housings in accordance with the three-way division

Menu-guided operation on the PC screen

LIN and CAN-BUS controlled components of the three laboratory panels

Measured data transmission via CAN BUS standard display and labelling of the components

LED-supported display of the operating conditions

Diagnostic mode shuts off the supporting LED displays for troubleshooting in the system.

40 measuring points for actual value determination with multimeter
Display of the BUS signals with oscilloscope

Measuring points protected against destruction in the case of incorrect connection.

Digital and analogue display of all system-dependent relevant physical parameters

Teaching situations

Up-front or group teaching

Multifaceted tasks and extensive solution proposals for trainers

Free choice of tasks

Task allocation by trainer networking

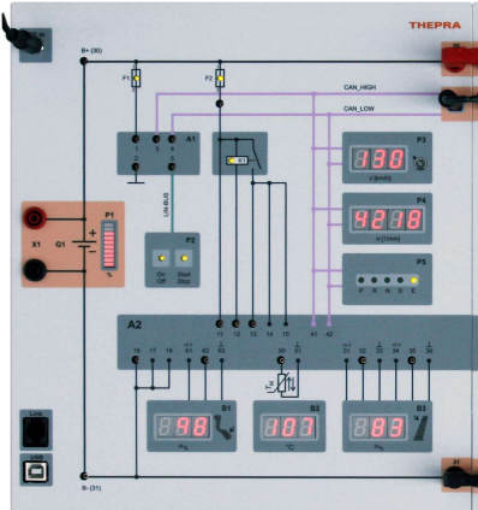
Measurements for gaining understanding (BUS-systems, power supplies, sensors, actuators) with multimeter and oscilloscope

Measurements and diagnostics for fault messages

Development of repair recommendations

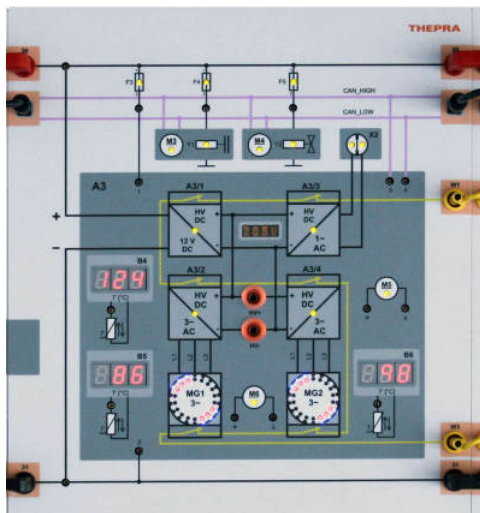


Central basic equipment panel



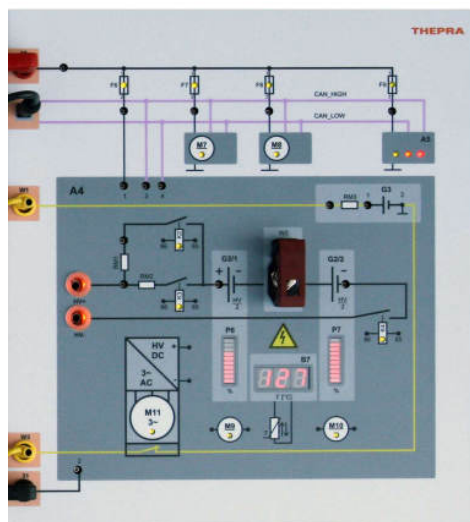
- A1 Gateway
- A2 Combustion motor control unit
- B1 Brake pedal sensor
- B2 Temperature sensor refrigerant combustion engine
- B3 Pedal sensor
- F1, F2 Fuses
- G1 12-V vehicle battery
- K1 Main relay control unit combustion motor
- P1 Message bars of the charging status of the 12-V battery
- P2 Message "Ignition ON/OFF" and "Start/Stop"
- P3 Vehicle speed
- P4 Speed combustion engine
- P5 Gear indicator / driving mode
- X1 12 V connections for start assistance

Inverter and electrical machines



- A3 Power and control electronics
- A3/1 Inverter 1
- A3/2 Inverter 2
- A3/3 Inverter 3
- A3/4 Inverter 4
- B4 Power electronics temperature sensor
- B5 Machine MG1 temperature sensor
- B6 Machine MG2 temperature sensor
- F3..F5 Fuses
- L1 Conductor 1 in three-phase network
- L2 Conductor 2 in three-phase network
- L3 Conductor 3 in three-phase network
- MG1 Three-phase machine 1
- MG2 Three-phase machine 2
- M3 Pressure pump for decoupler
- M4 Oil pressure pump gear
- M5 Low temperature circulating pump
- M6 Additional pump for high temperature cooling circuit
- X2 External charging socket
- Y1 Pressure regulator for decoupler
- Y2 Gear oil pressure valve

Battery and high-voltage unit



- A4 High-voltage battery unit
- A5 Airbag control unit
- B7 Temperature sensor for high voltage battery pack
- F6..F9 Fuses
- G2/1 High-voltage battery 1
- G2/2 High-voltage battery 2
- G3 Power supply for safety circuit
- K2 Safety relay
- K3 HV line power relay 1
- K4 HV line power relay 2
- M7 Water pump for high temperature cooling circuit
- M8 Vacuum pressure pump for braking force support
- M9 Radiator fan 1
- M10 Radiator fan 2
- M11 Air conditioning compressor with integrated DC/AC converter
- Rm1 Measuring resistor 1, high-resistance
- RM2 Measuring resistor 2, low-resistance
- RM3 Measuring resistor safety circuit, high-resistance
- P6 State of charge HV-battery G2/1
- P7 State of charge HV-battery G2/2
- W1 Safety plug 1
- W2 Safety plug / maintenance plug 2
- W3 Safety plug 3



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Learning objectives

Higher learning objective

Development and comparison of the system-related physical requirements and connections in the various implemented hybrid drives depending on driving profiles and operating conditions. Simultaneous training on the safety regulations.

Individual learning objectives

Overview of the system variations of the hybrid drive systems
Detection of the system-dependent interaction of the separate components
Calculations of the driving resistance and the acceleration forces, the tyre and three-phase machine outputs, the changes in the battery charging conditions, the driving routes in pure electric mode.

Knowledge of the electrical target values of all influential vehicle sensors and actuators.

Measurement options, actual value records and diagnostics

Knowledge of the safety regulations, precautionary measures and the accident prevention directives

Training on safety regulations, depending on the stored fault

Extensive control and learning software

Features

The extensive software and student materials do not just contain instructions but also all of the basic information on the various drive concepts and accident prevention for HV vehicles. Particular value is also placed on the usage of the oscilloscope and the evaluation of diagnostic images.



Fig.: Driving profiles and conditions in diagrams and with value tables

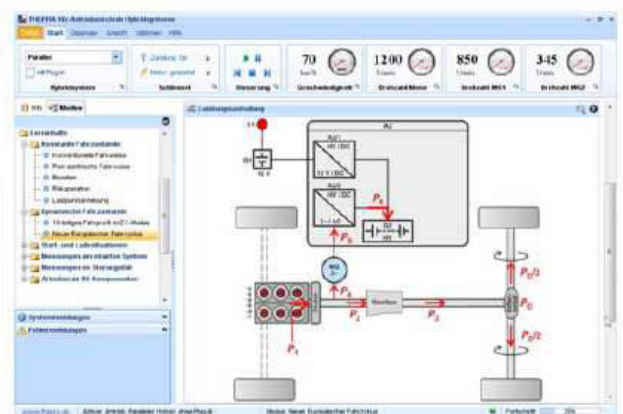


Fig.: Schematic and animated display of force flows and outputs

Technical data

- Power source from supplied power pack: 230 V
- Dimensions of the front panels each: 266 x 297 mm
- Weight of each approx. 3 kg
- All of the console housing with rubber feet for table installation or in the A4 frame

System requirements

- PC with Windows XP/Vista/7
- At least Pentium 1 Ghz
- 2 GB RAM
- CD-ROM drive
- USB 2.0
- 1280 x 1024 Pixel display possible

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