



TSI Electric and Hybrid Vehicle Safety Training Systems

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TSI Electric and Hybrid Vehicle Safety Training Systems

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Today's generation of Electric and Hybrid vehicles provide a number of challenges to the auto technician who will work on them.

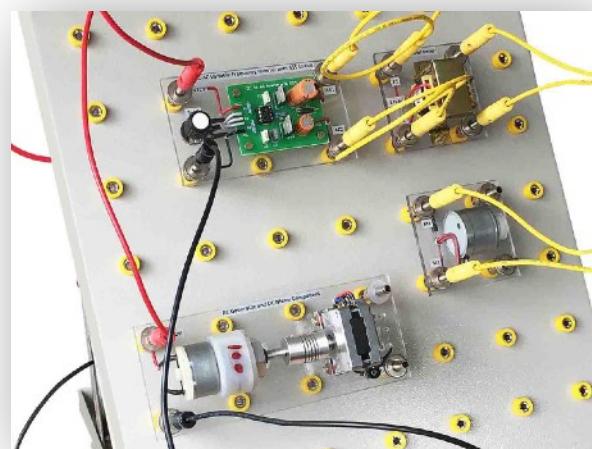
In particular the extreme voltage, sometimes up to 800V, that are found in Electric Vehicle power systems and the very high currents that are found in the HV battery packs can prove to be lethal to the untrained technician.

Technical Solutions International offer a range of training solutions that specifically address the hands on training needs of technicians who will work on EV and HEV systems. Our practical resources include simulated safety training systems that allow students to safely explore the correct procedures for disabling EV and HEV's.

We even offer a complete set of safety tools and equipment packaged as a workshop training aid. The tools and equipment are fully insulated and rated to handle the high voltages and currents found in EV and HEV's, allowing them to be used on actual vehicles in the workshop.

To ensure that students gain an in-depth understanding of the electrical and electronic principles behind the power systems found in today's EV and HEV's we have developed a unique foundation package called BEKI.

It is a rugged, easy to use modular training system that has been specifically designed for use in technical and vocational training. Its compact format makes it a much more affordable solution for real hands-on skills training.



TSI Electric and Hybrid Vehicle Safety Training Systems

Safety Equipment and Tools for Electric Vehicles Training Stand

This is a unique panel trainer that presents students with all the safety equipment, signs and tools that are required to work on hybrid and electric vehicles.

The panel has a printed legend that identifies the components and also provides shadows for any removable item.

On the rear of the panel there is a full explanation of the items included on the stand and what they are used for. This is in both Swedish and English and it provides a good training aid for the students.

Tools are held in place using clips, hangers and tool racks where appropriate.

The panel includes:

- Kit For Marking Out Restricted Area For HEVs
- Large HEV Warning Sign
- Pair of Insulated HEV 12kV Gloves
- Insulated Rubber Electrical Matting Tested to 11kV
- High Voltage Rescue Pole 45kV
- HEV Insulated Spanners - 7mm to 14mm
- Set of HEV Insulated Screwdrivers flat and posidrive blades
- Set of HEV Insulated Pliers
- HEV Lockout Hasp 38mm
- MasterLock HEV Lockout Padlock
- HEV Lockout Tags
- HEV Keyring Warning Tags
- HEV On Vehicle Warning Sign
- HEV CAT III Clamp Meter

A comprehensive training manual is also supplied with the stand. This details the steps that must be taken when working on Hybrid or Electric vehicles and what safety equipment must be used.

A supporting PowerPoint Presentation is also supplied with the manual. Both are in electronic form on a USB stick.



Hybrid and Electric Vehicle Technology

Hands-On Training Course for Automotive Instructors



Disabling Hybrid and High Voltage Systems



In this presentation you will:

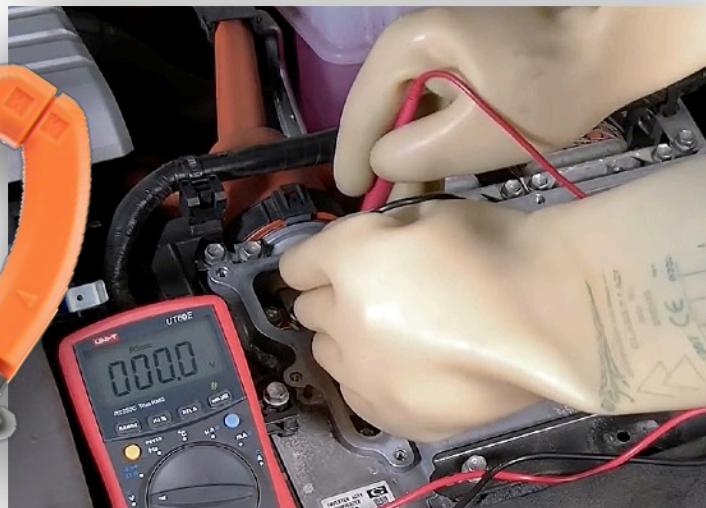
- Recognise the safety requirements for disabling hybrid and high voltage vehicles.
 - Understand the correct sequence for disabling hybrid and high voltage vehicles.
- Recognise the tools and equipment required for disabling hybrid and high voltage vehicles.

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Training Topics:

- Electric and hybrid vehicles Safety Rules
- Voltages present in E & HV
- Electric vehicles
- Hybrid vehicles
- Risks of working with E & HV's
- Safe working with E & HV's
 - Valeting, sales and other lower risk activities
 - Incident response including emergency services and vehicle recovery
- Maintenance and repair excluding high voltage electrical systems
- Working on high voltage electrical systems
 - Electric Shock
 - Earth Leakage
 - Electric Arcing
- Disabling Hybrid and High Voltage Systems
 - Before Starting Work
 - Disabling the Hybrid System
 - How to disable the high voltage system
 - Removing the Service Plug
 - How to test that the high voltage system is safe on completion of the task
- Transient protection in test equipment
- Over-voltage installation categories (CAT)

Order as TSI-AUT EV20

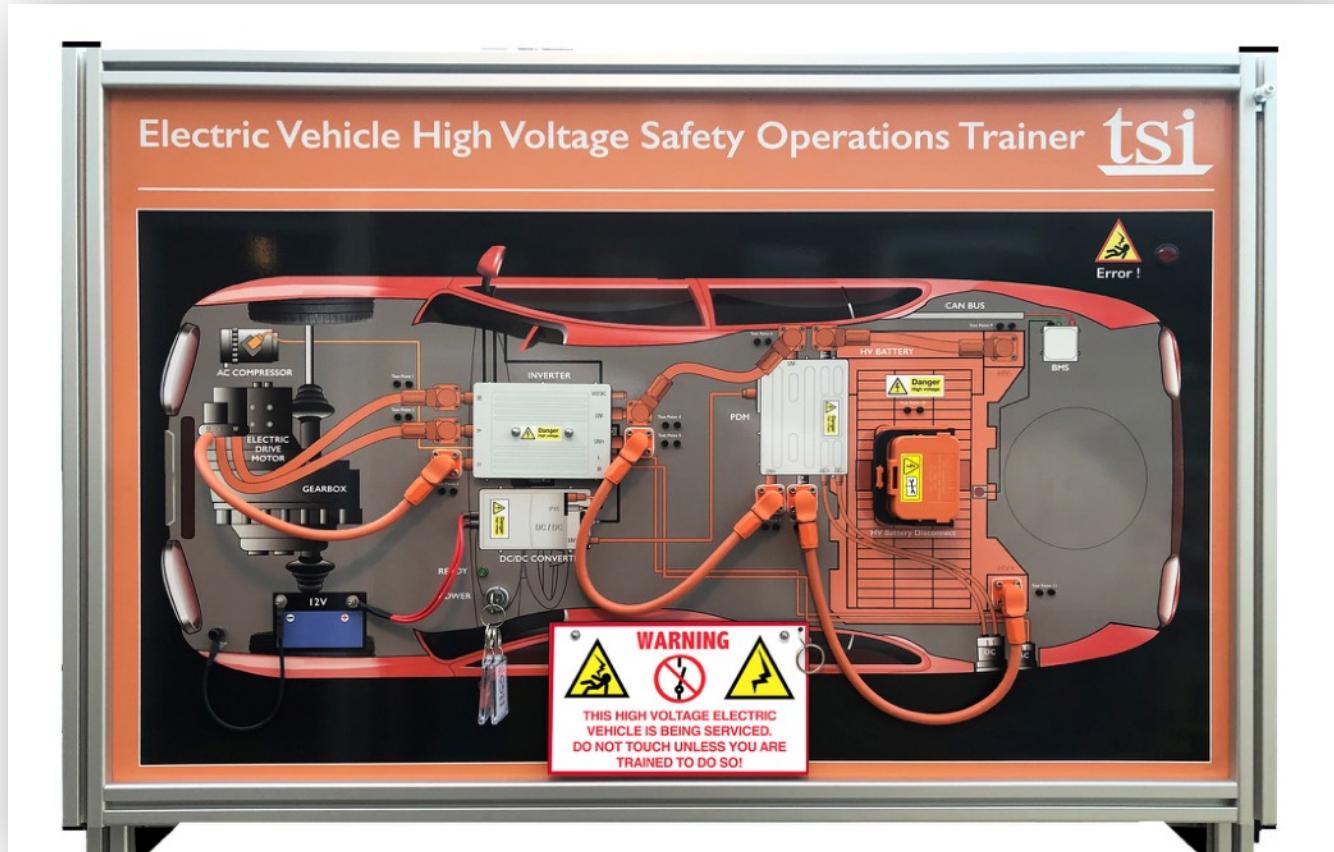


- All the tools and equipment can be removed from the stand and used by students under close supervision for tasks in the workshop on actual EV and HEV's



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Electric Vehicle High Voltage Safety Operation Panel Trainer



This mobile training stand has been specifically designed to teach the principles of safe working on Electric Vehicles.

It includes a simulation on a typical electric vehicle power and drive system. A full colour graphic shows the layout and the interconnections of the various units including:

- HV Battery Pack
- Battery Control Module (BCM)
- HV DC/DC Converter
- Inverter
- AC Compressor
- Drive motor and gearbox
- 12V Battery

It incorporates real OEM EV components including cables and connectors as well as a Service Disconnect Plug. These can be disconnected and voltage measurements can be performed using the test points provided. The 12V Battery can also be disconnected to allow the user to perform EV disabling exercises.

TSI Electric and Hybrid Vehicle Safety Training Systems

All the voltages are kept to safe levels of 12V DC and 12V AC. In the training manual there is a reference table that shows the multiplication factor that should be applied to obtain the actual voltages that would be found on a real vehicle.

The lid of the inverter can be removed to provide access to the internal connections for the inputs and outputs. These can be used to check if the EV system is fully disabled before work commences.

An internal electronic control system provides audible and visual warnings if the user attempts to disable the EV system without following the proper procedures as documented in the courseware provided with the trainer.

It also incorporates a capacitor system that creates a decaying DC voltage once the HV Battery is disconnected.

Voltages will be present for several seconds once power has been removed, just as in a real system.

An EV Safety sign is also included. This has to be mounted on the vehicle when it is being worked on.

Any attempt to remove the top of the inverter or work on the system without the safety sign in place will trigger the warning system.

We recommend the use of our Safety equipment and tools for electric vehicles training stand with this trainer as it provides access to all the required equipment used when disabling Electrical and Hybrid vehicles.

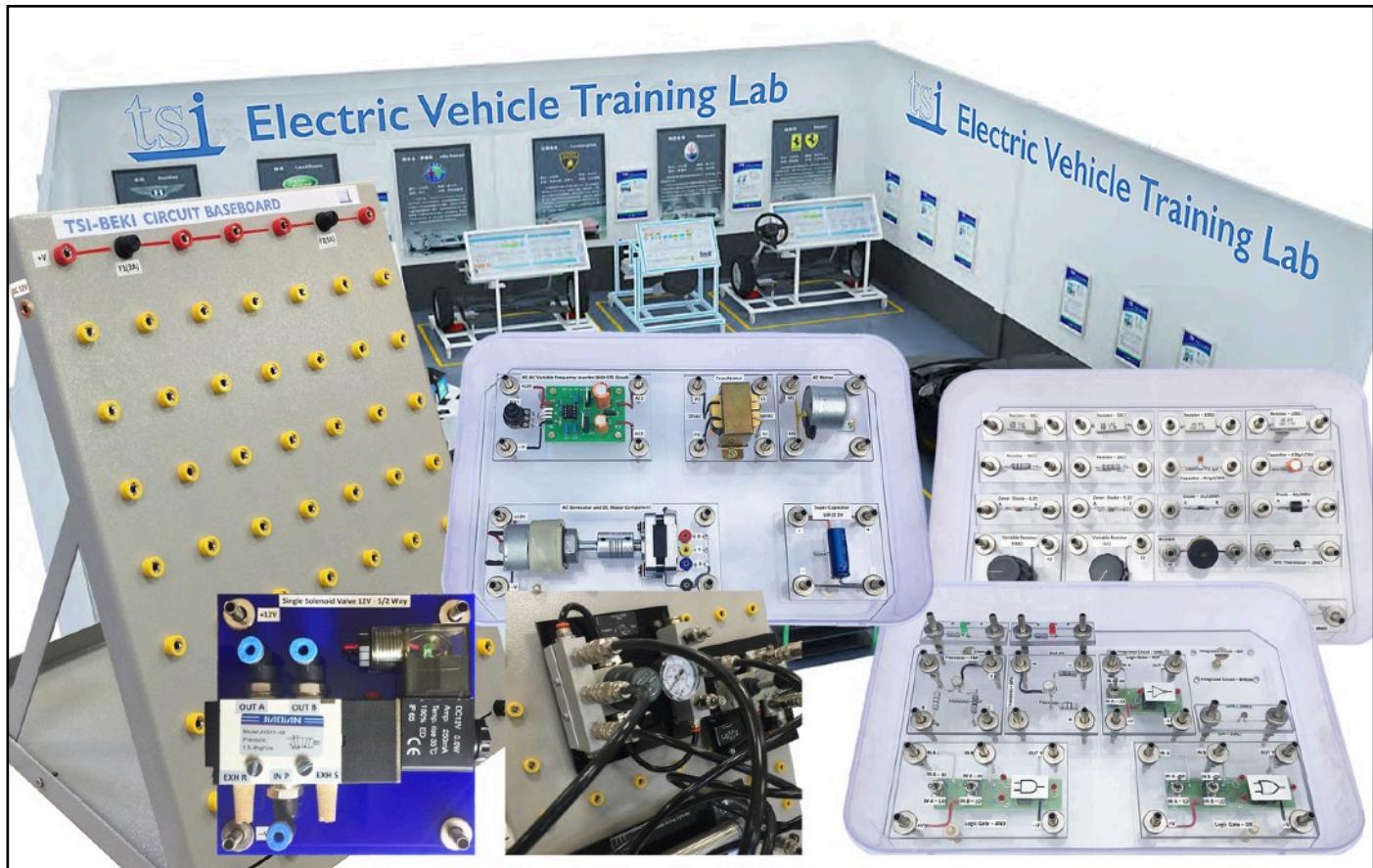
Order as TSI-AUT EV25



- The trainer incorporates real OEM EV components including cables and connectors as well as a Service Disconnect Plug

TSI Electric and Hybrid Vehicle Safety Training Systems

BEKI Modular Electricity/Electronics & Mechatronics Kit



This is a flexible training resource has been designed to provide a hands-on introduction to the basic principles of electrical, electronics and mechatronic systems . It is designed to help deliver the underpinning knowledge for a wide range of students and trainee technicians in the following areas:

- Electrical /Electronics
- Mechatronics
- Automotive electronics/diagnostics
- Electric and Hybrid vehicles
- Power/Energy

It provides the right amount of theory and practical experiments to ensure that students have a practical grasp of the concepts of electrical and electronic circuits and basic test and measurement.

Traditional training resources that cover such a broad range of technologies are large and expensive and often prohibit individual use by students, restricting the amount of hands-on training that they typically are able to undertake.

BEKI is a rugged, easy to use modular training system that has been specifically designed for use in technical and vocational training. Its compact format makes it a much more affordable solution for real hands-on skills training.

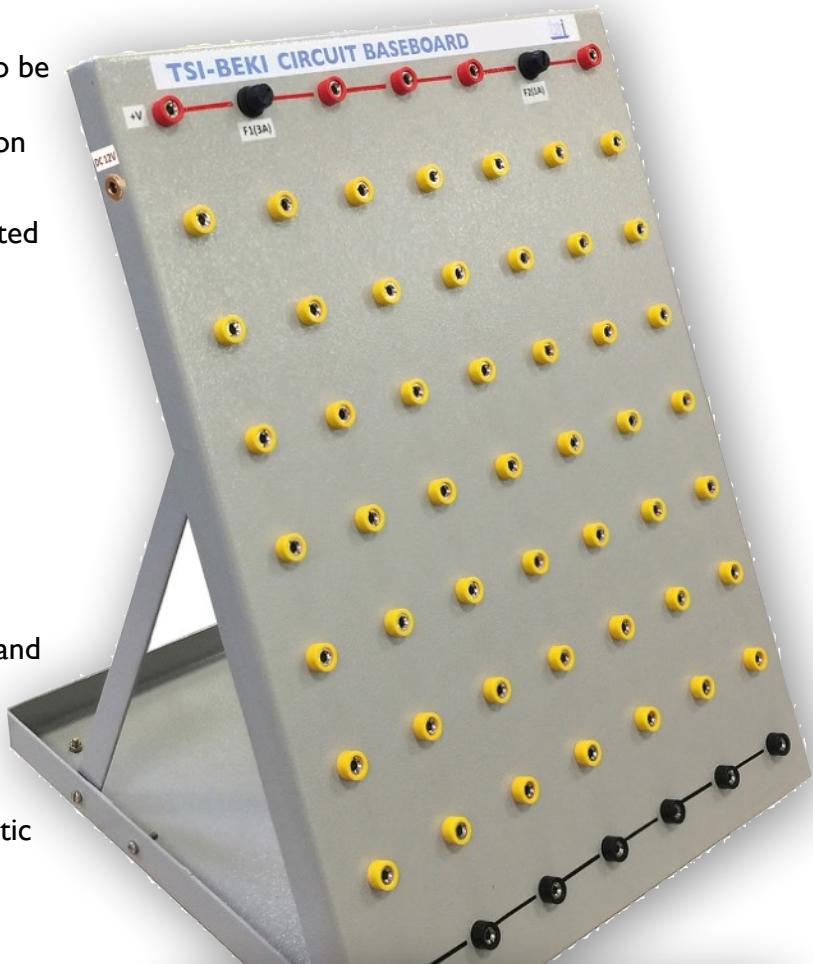
TSI Electric and Hybrid Vehicle Safety Training Systems

- **Folding Circuit Baseboard**

- Adjustable struts allow the baseboard to be used as a demonstration stand by the instructor and as a hands-on work station by the trainee.
- Ruggedly constructed from powder-coated steel
- Matrix of 4mm sockets provide both power rails and locating points for the component carriers.
- Separate 4.5mm power input socket

- **Carrier-mounted components**

- Supplied in storage cases which makes them easy for the students to use.
- Facilitates easy classroom management and storage.
- Separate power supplies for electrical, pneumatics and hydraulics
- Sets of interconnection cables and pneumatic and hydraulic pipes and hoses.



The Electricity/Electronics curriculum material is specifically written around everyday applications such as lighting, circuits, motor control, battery operations and we have even included a section on hybrid energy systems.

A complete Automotive Electrics/Electronics curriculum manual is also available.

The additional BEKI Mechatronics manuals cover typical industrial applications of pneumatic and hydraulic systems, including machinery operation, component sorting, hydraulic and air braking systems and heavy vehicle applications for hydraulic cylinders.

A separate manual for Electric and Hybrid vehicle applications is also available for use with the appropriate kits from the BEKI range.

Each manual typically provides the right amount of theory and practical experiments to ensure that students have a practical grasp of the concepts of the topic areas and use of basic test and measurement equipment.

TSI ECA-100 Basic Electricity/Electronics Training Kit



Hybrid and Electric Vehicle Circuits Experiment Manual

To help you understand the different electrical/electronic applications being used we will carry out a series of practical experiments where you will build different Hybrid Vehicle systems using components from Kit D.

- 1 x DC-AC Power Inverter
- 1 x Transformer
- 1 x AC Motor
- 1 x DC Motor/AC Generator Set
- 1 x 500Ω Variable Resistor - Kit B
- Connection leads

Experiment 6 Electric Motor/Generator

The first system we will examine is the drive from the battery to the Electric Motor/Generator. The image on the left shows the MG2 Motor/Generator from a Toyota Hybrid Vehicle. Notice that it has three output/input terminal as it is a 3-phase AC Motor/Generator.



In the experiment we will be using the 12V DC supply, in a real vehicle the power would be from the HV Battery (DC).

The power inverter will turn the DC into AC to drive the motor. We use a step-up transformer to increase the voltage. The image on the left shows Hybrid Synergy Drive unit (Inverter/Power Controller) from a Toyota Hybrid Vehicle.



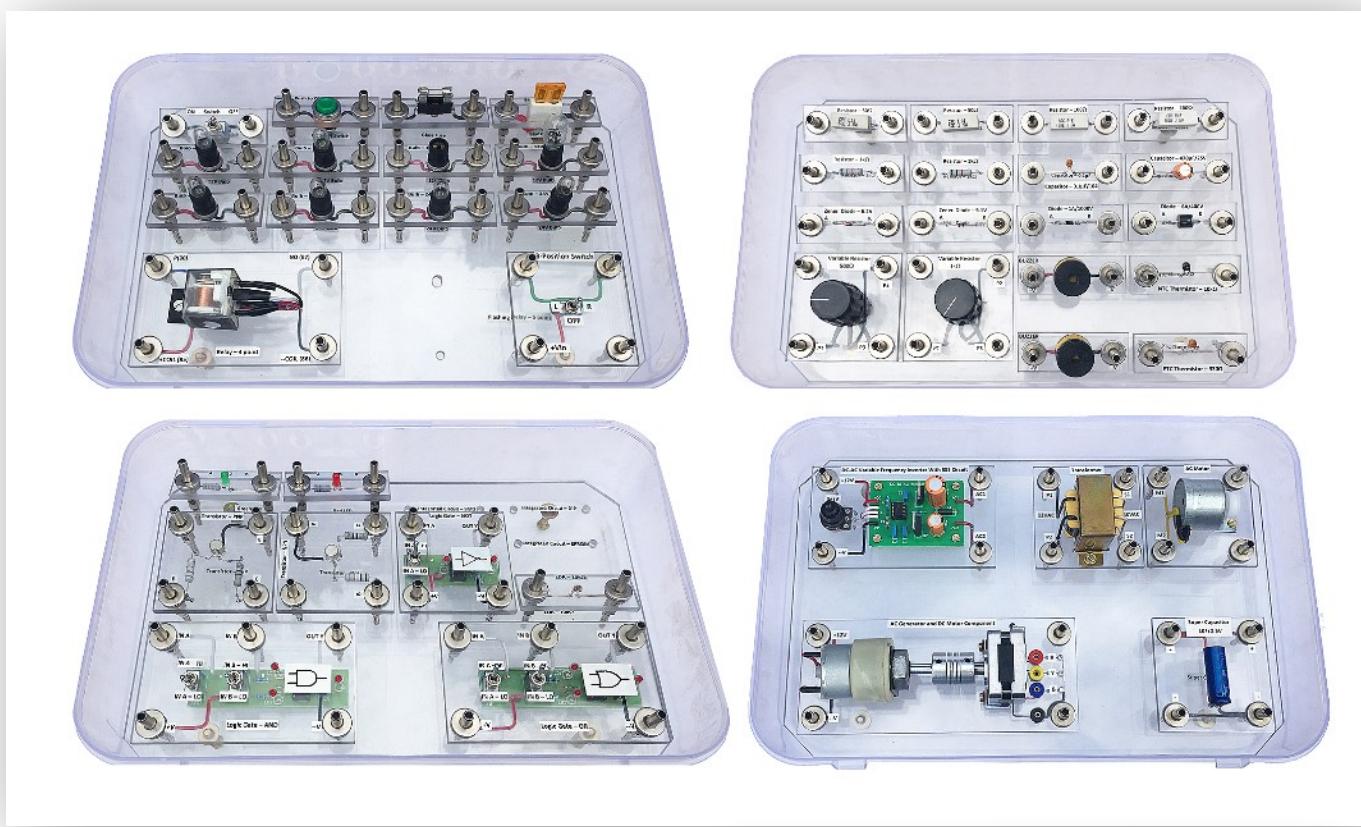
The speed control is provided by the potentiometer. In a real system this function is integrated into the Hybrid Control Unit and the ECU.

Place the DC-AC Power Inverter, Transformer and AC Motor fixtures on the baseboard as shown.

- On the DC-AC Power Inverter connect +12V to +V using a red connecting cable. Connect -V to -V using a red black connecting cables.
- Connect P1 (Primary winding) of the transformer to AC1 of the DC-AC inverter fixture using a yellow connecting cable.
- Connect P2 (Primary winding) of the transformer to AC2 of the DC-AC inverter fixture using a yellow connecting cable.
- Place the AC motor fixture next to the Transformer fixture on Demo bench.
- Connect M1 of the AC motor to S1 of the Transformer fixture using a yellow connecting cable.
- Connect M2 of the AC motor to S2 of the Transformer fixture using a yellow connecting cable.
- Connect M2 of the AC motor to S2 of the Transformer fixture using a yellow connecting cable.



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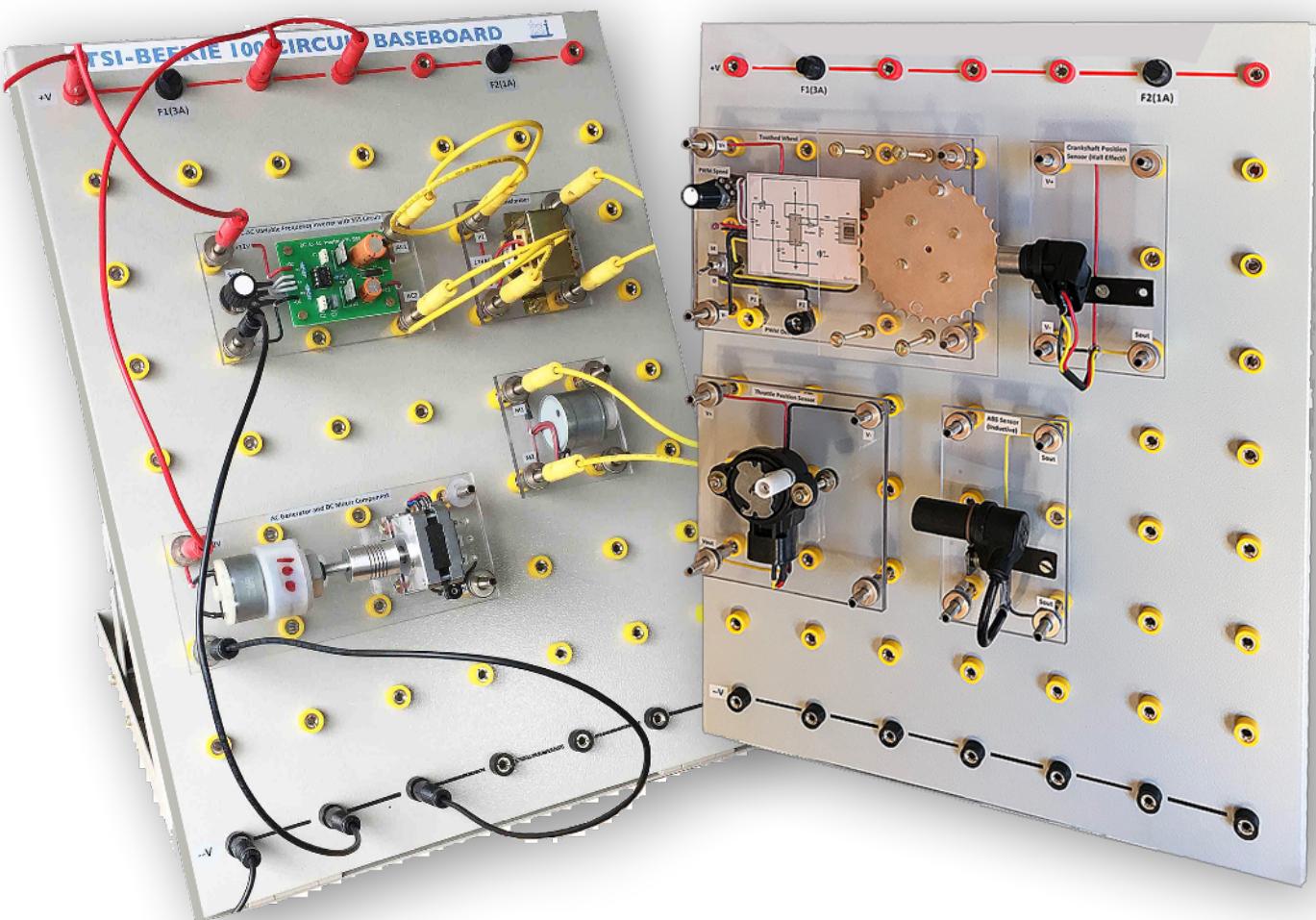


A series of component kits are available to cover the following study areas:

- Basic electricity
- AC/DC circuits
- Semiconductors and linear devices
- Basic digital logic
- Power inverters and hybrid circuits
- Automotive electrics/electronics
- Automotive sensors and actuators
- Electric and Hybrid Electric vehicles
- Basic pneumatics
- Electro-pneumatics
- Basic hydraulics
- Electro-hydraulics



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In addition to the basic automotive electrics/electronics and automotive sensors kits we also have special component set for EV/HEV technology.

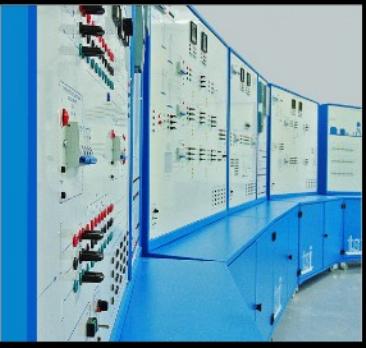
This component kit contains a number of carrier mounted components that are used to perform practical experiments that mimic the operation of a hybrid energy systems as found in Electric and Hybrid vehicles as well as for Alternative energy applications.

The curriculum material presents both theory and practical work that help student develop a full understanding of the working of hybrid and electric vehicles.

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Power Training Systems Simulator

Technical Solutions International 



Operator Training Simulation Software for Power Generation & Oil and Gas

Technical Solutions International 



On The Job Training Environments (OJTE)

Technical Solutions International 



TSI Electric and Hybrid Vehicle Safety Training Systems

Technical Solutions International 



TSI Automotive Electrical Systems Trainer

Technical Solutions International 



CAN/LIN Bus Training System

The TSI BEKI Modular Electricity/Electronics & Mechatronics Training System is just one of a wide range of effective, affordable training solutions from Technical Solutions International.

Contact us for more information on any of our systems.

Design & specifications of items included in this catalogue are subject to change without notice.

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