



TSI Electric and Hybrid Vehicle Safety Training Systems

Technical training equipment & teaching resources

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Electric Vehicle High Voltage Safety Operation Panel Trainer	4
Safety Equipment and Tools for Electric Vehicles Training Stand	6
Training Topics	7
Troubleshooting Panel Trainer for High Voltage Vehicles	8
BEKI Modular Electricity/Electronics & Mechatronics Kit	10

TSI Electric and Hybrid Vehicle Safety Training Systems



Introduction

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 and a Troubleshooting Panel.

We even include 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.

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Electric Vehicle High Voltage Safety Operation Panel Trainer



This mobile training stand has been specifically design 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:

The machine also incorporates and graphs showing various driving cycles power flows.

Approx dimensions:

W 1250 mm x H1750mm x D800mm

- HV Battery Pack
- Battery Control Module (BCM)
- HV DC/DC Converter
- Inverter
- AC Compressor
- PTC
- 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 voltage that can be accessed and measured throughout the panels test points uses 4mm safety banana sockets and they are kept to a safer level of 12V DC, 24V DC and 25V Three Phase 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 batteries are 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.



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

Safety Equipment and Tools for Electric Vehicles Training Stand

This is a training resource that presents students with fundamental 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 an explanation of the items.

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 1kV Gloves
- Insulated Rubber Electrical Matting Tested to 11Kv
- Electrical Safety Helmet with visor.
- High Voltage Rescue Pole 45Kv
- HEV A set of Insulated Spanners/Ratchet and
- Set of HEV Insulated Screwdrivers flat and posidrive blades
- Set of HEV Insulated Pliers
- HEV Lockout Hasp
- HEV Lockout Padlock
- HEV Lockout Tags
- HEV Keyring Warning Tags
- HEV On Vehicle Warning Sign set
- HEV CAT III 1000V CAT IV 600V Clamp Meter with multimeter and NCV.

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.

Approx dimensions:

W 1160mm x H1950mm x D800mm



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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)



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

Order Code: TSI AUT MK2 HV-COMBO 1

(Contains both The Safety Equipment and Tools for Electric Vehicles Training Stand and the Electric Vehicle High Voltage Safety Operation Panel Trainer)

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Troubleshooting Panel for High Voltage Vehicles



This training Panel can be seen as step 2 and as a continuation of our very popular High Voltage and Safety Training Panel.

With the Panel, students will practice electrical troubleshooting on a high-voltage vehicle

The tasks include performing practical tasks that help them develop safe working and troubleshooting methods.

The front panel provides a simulation of a battery-powered vehicle with the HV / LV systems and the circuits and components that make up the system.

All voltages in the training station's AC and DC circuits are kept within levels to ensure the students safety.

The students will follow the practical tasks in the accompanying teaching material which, among other things, requires them to connect cables and connect all the HV and LV components on the panel to form a system.

Once the circuit has been built, they must make a series of voltage measurements to check that the system is operating normally and make necessary changes.

Once they understand the full function of the system and have removed any faults in their connection, they will perform a series of practical troubleshooting exercises to track and fix common electric vehicle faults identified by the manufacturer.

The errors are introduced by the teacher who can turn one or more faults by opening a locked control unit.

These include the most common electrical faults found in both HEV and BEV such as LOI (Loss of Insulation), cable faults and component faults.

At the back of the training panel, there are additional exercises with a unique system that allows students to perform common insulation tests on HV cables, HV battery and AC motors.

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Experiments:

The troubleshooting tasks will all be practical and require the use of test equipment from the tool and the safety equipment panel.

Diagnostic content

Fault on HV system relay

Common EV service and maintenance errors

Disable an EV procedure

HV battery fault

Insulation resistance fault in HV components (LOI)

"Megger" test on cables and traction motors

(pilot line):

Increased resistance or intermittent connections

(loose contacts and pins, intermittent short circuits, intermittent open connections)

Components with internal damage (non-functioning circuit breaker, incorrect resistance in any of the HV components)

Order Code: TSI E-AUT 30

Main components displayed on the Panel:

Pilot line

HV Lion battery with LBMS

Built-in battery charger

DC fast charging contact

220V AC charging port

220V AC charging socket

EV-ECU - Vehicle control module

Electric AC compressor

12V battery

12V DC fuse box with 4 fuses

PTC heater

Main control relays 1 and 2

Inverter/power supply with DC/DC converter

The Training Panel includes:

The exercise panel mounted in an aluminum stand on casters.

Teaching materials in English.

Insulation tester

Mobile stand for hanging and organizing cables

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BEKI Modular Electricity/Electronics & Mechatronics Kit

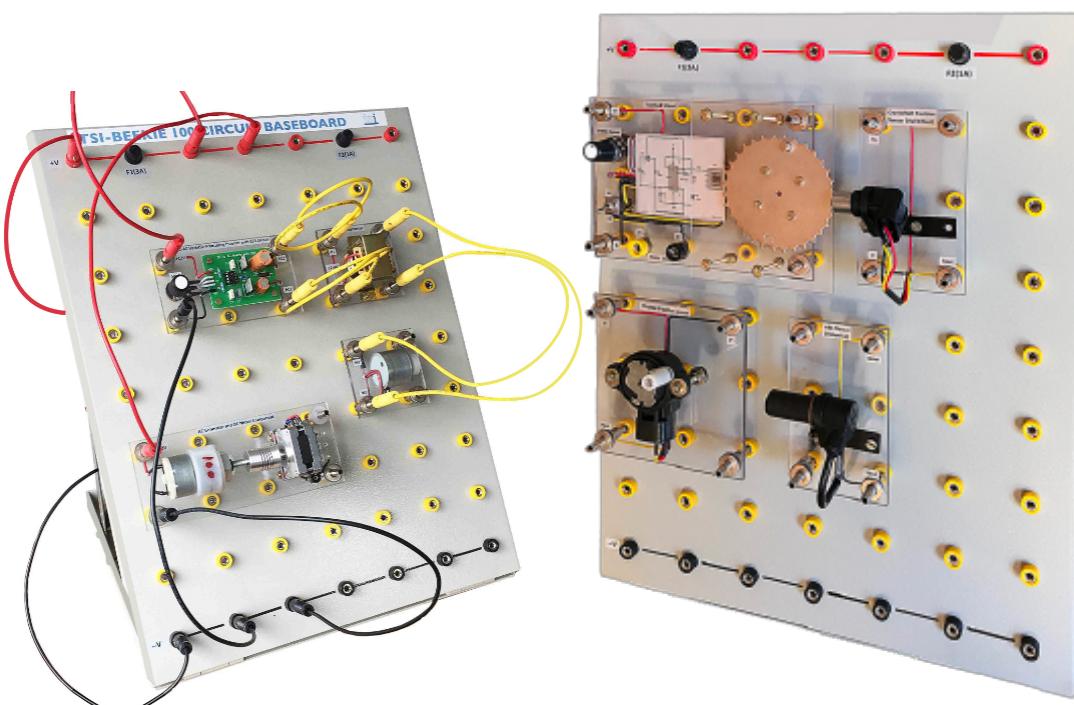
This is a flexible training resource has been designed to provide a hands-on introduction to the basic principles of electrical, electronics and mechatronic systems . It is designed to help deliver the underpinning knowledge for a wide range of students and trainee technicians in the following areas:

- Fundamental Automotive Electrical /Electronics
- Fundamental Electric and Hybrid vehicles
- Fundamental Hydrogen vehicles
- Fundamental Automotive Sensors and Actuators
- Fundamental Pneumatics and electro pneumatics
- Fundamental Hydraulics

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.



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The main kit which is the Fundamental electrics and electronics TSI-AUT EL012V consists of the ruggedly constructed powder-coated steel base board. A Matrix of 4mm sockets provide both power rails and locating points for the component carriers. Like in an automotive circuit diagram the red power rail is in the top and the negative grounding is in the bottom of the panel. 4 boxes with over 30 different components mounted on carriers. is supplied with the main kit. The components supplied is a wide range of components found in automotive applications such as lamps, fuses, switches , buzzers ,dc motor, relays, logic gates , thermistor etc. A set of Test leads and a manual with practical experiments and 12 V power supply is also included.

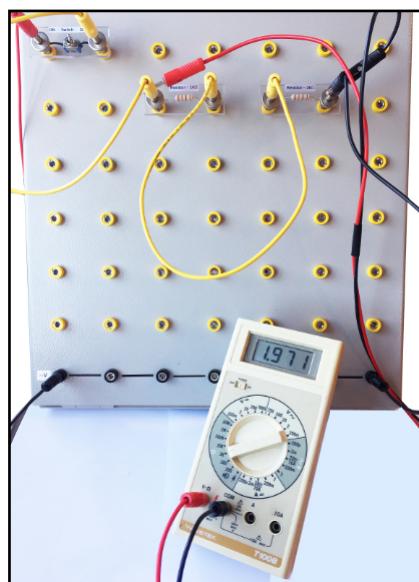
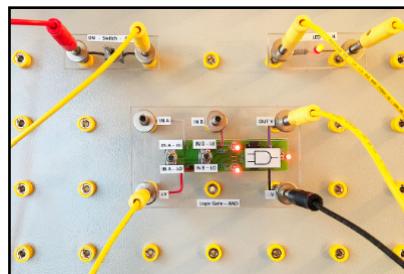
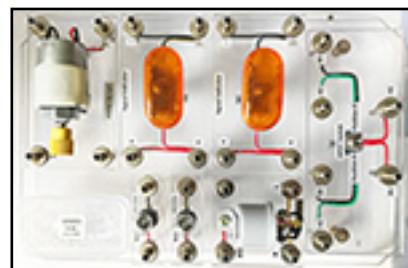
The system is modular and you can add new boxes of components for new topic like the Box (TSI AUT EHV12) Hybrid Electric and Hybrid vehicles that contains components such as , AC motors, DC/DC converters, Variable frequency inverter. DC Motor/AC generator set etc.

To build the new circuits from the added box you use some of the components ,leads and the power supply from the main kit.
Supplied in storage cases which makes them easy for the students to use.

Building circuits on the baseboard is a quick and easy process.

All the components are mounted on carriers.
These have that have 4mm Posts with sockets on the top and pins on the bottom.
The pins locate in the Yellow sockets on the baseboard.
There are NO power connections on these Yellow sockets.

To interconnect the components with the power rails or each other you use the 4mm connection leads by plugging them into the top sockets on the carriers.
The connection leads have a 4mm hole in the barrel, this is used to "Stack" connections when required.
This useful when using a multimeter to measure circuit voltages, as shown below.



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UK TSI
Tel: +44 7824 166 428
Email: info@tsi-london.com
www.tsi-london.com

TSI SWEDEN
Sweden Head-Office
Tel. +46 723 124 100
Email: info@tsi-jkpg.com
www.tsi-jkpg.com

