AUTOTRONICS

SES

EDUCATION
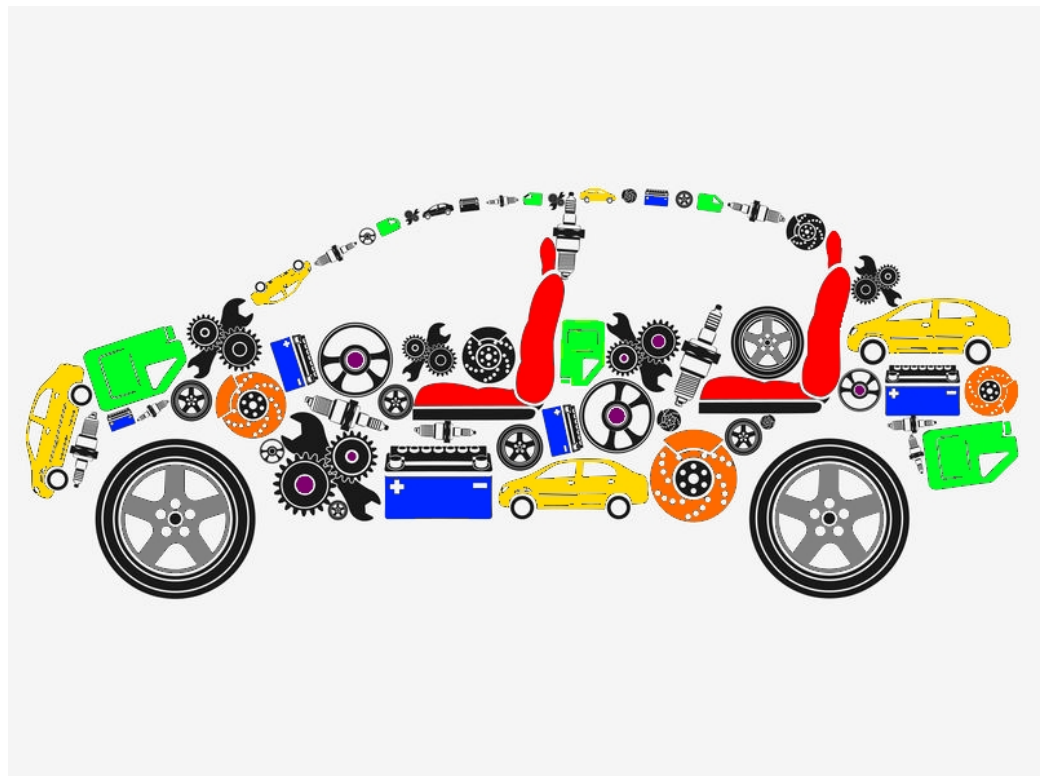
Autotronics
Training Lab

About SES

An EdTech industry leader and innovator**, SES Scientific Educational Systems**, goes above and beyond to supply educators and learners with the best educational systems, including **NeuLog, Degem Systems, MultiCenter** and **MagiClass.**

Renowned for their ability to cater to numerous fields, sectors and segments, SES Education systems spread across a wide spectrum, offering unique solutions in the fields of **electronics, microcontrollers, telecommunication, autotronics, mechatronics, pneumatics, hydraulics, CNC machines, refrigeration and air-conditioning, green energy, computerized systems, science, robotics, logger sensors and STEM.**

Each proprietary SES system and device is perfectly designed and manufactured from the highest quality materials in accordance with all safety requirements and regulations. SES is a quality assured firm with the certification of ISO-9001:2015.

SES solutions are used in over 50 countries worldwide by professional developers for high-level technological commercial products and both governmental and private institutions covering educational programs for universities, colleges, vocational training centers and schools, high schools, junior high schools and primary schools.

The Car is an Electronic System

- All car systems are computerized electronic systems.

- Each of them is based on ECU (Electronic Control Unit), sensors and actuators.

- For example, the engine ECU uses the information from the sensors and controls the actuators to:

  * Ensure proper fuel injection and ignition timing.
  * Provide additional functions, such as reporting engine status to the instrument cluster.
  * Handle diagnostic tests.

  Sensors **Instrument cluster** **Actuators**

- The ECU's are connected in Controller Area Network (CAN BUS).

- This is just the beginning.

- In autonomous car, a computer makes the driving decisions according to radar sensors and cameras.

The Car Fault Troubleshooting

- The faults in the car are more electronics faults than mechanical faults.
- Mechanical malfunctions are easy to troubleshoot and to repair.
- The wiring is more complex and many faults are wire faults.
- Even when the scanner reports on a fault diagnosis, it is still required to locate whether the fault is in the component, in the wire or in the connector.

Automotive electronics study envelope

The **EB-3000**, the **AT-3000**, the **AT-5000** and the **AT-6000** create an electronics study envelope for the automotive mechanics study.

The automotive mechanics study covers the car sub-systems demonstrators, real automotive parts recognition, assembly and disassembly car systems, maintenance, etc.

EB-3000

AT-3000   Automotive Mechanics   AT-5000

AT-6000

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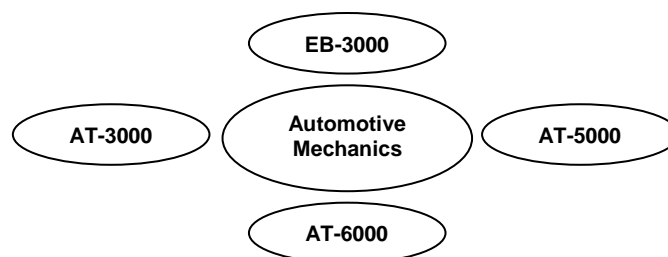
Autotronics recommended study program

Five stages comprise the recommended automotive program:

- **Basic electronics**

  Basic electronics topics including automotive electronics topics are needed to understand the modern car technology.

  The electronics universal training system **EB-3000** and experiment cards cover this stage.

- **Car sub-system simulators**

  The **AT-3000** simulators demonstrate the behavior and signals of car systems and they are the best tool for the teacher to explain the electronics behind the systems.

  The simulator simulates various operations of the system, typical faults that cannot be demonstrated with a real system.

- **Automotive mechanics**

  The **AT-4000** demonstrators demonstrate real car sub-systems installed on a metal training bench with facilities and accessories that enable to operate it exactly as in the car.

  The demonstrator's metal panel is with graphics clearly presenting the system components and schematics.

  The values and signals measured on the panel test points are real values of the system.

  This stage includes also real automotive parts recognition, assembly and disassembly car systems, maintenance, etc.

- **Car diagnostic and troubleshooting methods**

  The **AT-5000** series are advanced simulators to practice diagnosing faults and troubleshooting methods.

  Practice using **AT-5000** allows the student to deal with complex systems and enhances the capability to deal with future vehicle systems.

- **Troubleshooting faults in a real car**

  Fault insertion in a real vehicle is the summary step of the automotive study.

  The faults are inserted by a special interface controlled by courseware - **AT-6000**.

  The system can be adapted to any type of vehicle that supports the OBDII protocol.

  There are three levels of automotive study programs:

- **Maintenance and light repair**
- **Automobile service technology**
- **Master automobile service technology**

Autotronics Topics

- **Electricity and Electronics Basics**

  - ✳ Concepts of electricity
  - ✳ Direct current, Ohm's Law and electrical power
  - ✳ Kirchhoff's laws and electric circuits
  - ✳ Resistors and potentiometers
  - ✳ Semiconductor – diodes, LEDs
  - ✳ Transistors
  - ✳ Magnetism
  - ✳ Alternate current
  - ✳ Transformers, motors and generators
  - ✳ Capacitors and inductors
  - ✳ Electronic systems
  - ✳ Sensors
  - ✳ Actuators
  - ✳ Converters (ADC, DAC)
  - ✳ CAN BUS communication

  These topics are exercised in the electronics laboratory.

- **Gasoline and Diesel engines**

  - ✳ Structure
  - ✳ Operation principles
  - ✳ Suction
  - ✳ Exhausting
  - ✳ Sensors and control
  - ✳ Injection
  - ✳ Ignition (in gasoline engines)
  - ✳ Cooling
  - ✳ Disassembly and assembly
  - ✳ Lubrication

- **Transmission systems**
- **Braking systems**
- **Suspension systems**
- **Steering systems**
- **Electric systems**
- **Preventative safety systems (lighting, signaling, horn)**
- **Protection safety systems (seat belts, airbags)**
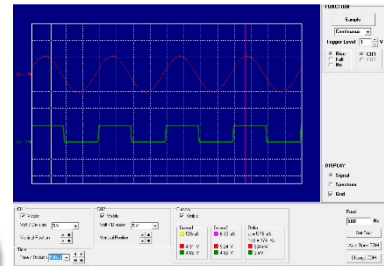- **Electrical and electronic accessories (windows, mirrors, windshield wipers and windshield fluid)**
- **Climate control**
- **Maintenance and fault prevention**
- **Car diagnostic scanner**
- **Diagnostics and troubleshooting**

EB-3000 Universal Training System

EB-3000 supports every stage of electronics study, which is a must for professionals in: **electronics, electricity, mechatronics, automotive, instrumentation, process control**, etc.

- The Universal Training System includes a **5-voltages power supply, 2 voltmeters, an ammeter, a frequency counter, a logic probe, a logic analyzer, a 2-channel digital oscilloscope, and a function generator** (sine, triangle and square signals).

- The Universal Training System also includes: a 3.2" color graphic display with touch panel, keyboard, and 10 relays for inserting faults.

- The system provides USB wire communication with the PC for:

    * Virtual instrument **D-Scope** software that controls the system function generator and graphic display of the scope signals.
    * Microprocessor and microcontroller editor, assembler, C compiler and debugger development software.

- The plug-in cards are connected to the trainer through a 48-contact, very low resistance industrial connector.

- Each plug-in card has its own controller, is identified by the main platform to save its required configuration and for automatic self-diagnostics while plugged in.

- Experiment manual and courseware (including theory) for every card.

- Additional electronics study programs for Mechatronics, Autotronics, Electrical Machines and Electricity using the EB-3000 Universal Training System and its plug-in experiment cards are available.

EB-3000 Basic and Automotive Electronics Cards

Electricity and Electrical Circuits
EB-3121   Ohm and Kirchhoff Laws and DC circuits
EB-3122   Norton, Thevenin and superposition
EB-3123   AC circuits, signals and filters
EB-3124   Magnetism, electromagnetism, induction and transformers
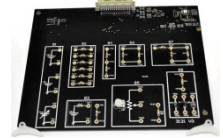
Semiconductor Devices
EB-3125   Diodes, Zener, bipolar and FET transistors characteristics and DC circuits
EB-3126   Bipolar and FET transistor amplifiers
EB-3127   Industrial semiconductors – SCR, Triac, Diac and PUT
EB-3128   Optoelectronic semiconductors – LED, phototransistor, LDR, 7-SEG
EB-3129   Electrical Control components & Circuits

Motors, Generators and Inverters
EB-3141   Analog, PWM DC motor speed control, step motor control, generators
EB-3142   Motor control – optical, Hall Effect, motor closed control
EB-3145   Electrical Accessories Module
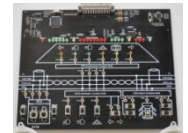EB-3146   Ignition and Charging Module

Digital Electronics
EB-3151   AND, OR, NOT, NAND, NOR, XOR logic components & Boolean algebra
EB-3152   Decoders, multiplexers and adders
EB-3153   Flip-flops, registers, and counters sequential logic circuits
EB-3154   555, ADC, DAC circuits

Automotive
EB-3170   CAN-BUS Systems

The document '**Electronics Training Labs**' describes the specifications of the EB-3000 universal training system and the EB-3000 electronics cards.

AT-3000 Car Simulators

The AT-3000 Car Simulators exhibit and allow for a comprehensive understanding of a car's systems; their actual components and their interconnections, their functions, operation and signals, with hands-on and safe experiment.

The simulator exhibits the operation of a system in different situations and at different settings. It will simulate typical faults for example and troubleshooting. None of these can be performed in a real car.

Every simulator has an **LCD display**, a **two channel oscilloscope**, **a simulation program selector** and a **fault selector**. The values measured as test points are similar to the values that are measured in a real system.

Every simulator comes with a theory and tutorial manual complete with introductions, prepared questions and summary questions for each experiment and interactive courseware.

AT-3001 – Engine Injection Simulator

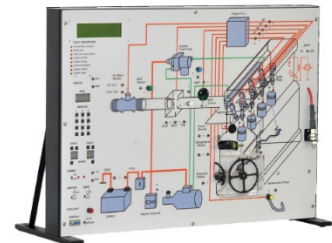Demonstrates the injection system parts, components and sensors.

Simulates the injection system, and the parameters that affect injection: air density and temperature, engine load, engine RPM, Idle condition and troubleshooting.
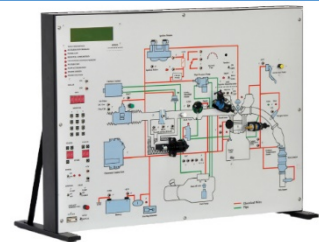
AT-3002 – Electronic Ignition Simulator

Demonstrates the ignition system parts, components and sensors.
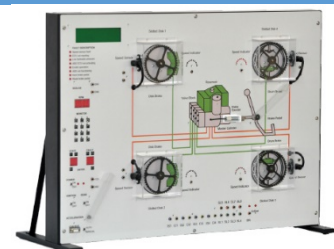
Simulates the electronic ignition system, triggering pulses, timing, RPM measurement, spark production and troubleshooting.

AT-3003 – ABS 4-Channel System Simulator

Demonstrates the ABS system parts, components and sensors.

Simulates the brake system without ABS and with ABS, on dry road and on wet road, different ABS systems, measurements and troubleshooting.
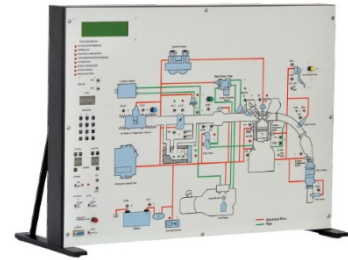
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AT-3004 – Engine Controls & Sensors Simulator

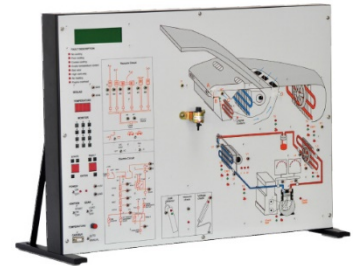Demonstrates the engine actuators and sensors.

Simulates the ignition and the injection system, EGR and the parameters that affect injection: air density and temperature, engine load, engine RPM, idle condition and troubleshooting.

AT-3005 – Car Air-conditioning & Climate Control Simulator

Demonstrates the car's air-conditioning and climate control.

Simulates real and simulated components controlled by internal controller that produces the signals for measurement according to its internal simulating program or according to PC simulation programs.

AT-3006 – Suspension Simulator

Demonstrates the active suspension system parts, components and sensors.

Simulates an active suspension system, sensors, reaction to acceleration and braking, reaction to turns, reaction to road conditions and troubleshooting.

AT-3007 – Transmission Simulator

Demonstrates the automatic transmission system parts, components and sensors.

Simulates the automatic transmission system operation at different gear positions, display of speed and engine RPM, engine load effect and troubleshooting.
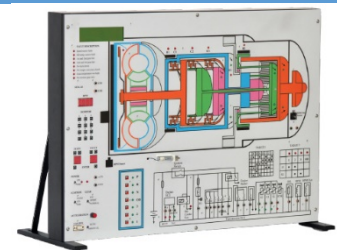
AT-3008 – Safety Systems Simulator

Demonstrates the prevention safety systems (signaling, horn, lights and indicator bulbs), protection safety systems (air bag, seat belts) parts, components and sensors.

Simulates the safety systems controlled by ECU, inputs, outputs, signals, measurements and troubleshooting.

AT-4000 Car Demonstrators

The AT-4000 Demonstrator series is a car system with all its components installed on a metal training bench with facilities and accessories that enable it to operate it exactly as it does in the car. The demonstrator enables to observation and access to every component of the system.

The AT-4000 Demonstrator's metal panel exhibits colored graphics clearly. It presents the particular system's components, all its connections and inter-relations with test points for real and actual measurements. The values and signals measured on these test points are true values of the system.

Each demonstrator is connected to a computer and comes with detailed courseware. Electrical non-destructive faults can be planted for troubleshooting exercises.

Measurements may be done on the panel test points and faults can be installed for troubleshooting experiments.

AT-4001 – Gasoline Car Engine Demonstrator

The AT-4001 Gasoline Car Engine Demonstrator training bench is based on the electronically controlled gasoline engine (including the original vehicle wiring harness, fuse box, relay etc.) removed from a car.

During operation, the AT-4001 Demonstrator enables illustration of the structures and working principles of electronically controlled gasoline engines.

The AT-4001 Demonstrator enables actual practicing startup, speedup, slowdown and other actions of the engine.

AT-4002 – Car Air-Conditioning & Climate Control Demonstrator

The AT-4002 Air Conditioning & Climate Control Demonstrator training bench is based on the automatic air conditioning part (Including original car wiring harness) removed from a car.

At operation, it displays the working state of the system under different working conditions.

The demonstrator includes an electric motor that rotates the A/C compressor.

AT-4003 – Car ABS Demonstrator

The AT-4003 Car ABS Demonstrator training bench is based on the ABS system and components removed from a car and have an operating principle diagram to demonstrate operation of the system.

The AT-4003 Demonstrator includes an electrical motor that rotates the system wheels.

AT-4004 – Power Electrical Steering Demonstrator

The AT-4004 Power Electrical Steering Demonstrator training bench is based on the power electronic steering system (including original car wiring harness) removed from a car.

It fully demonstrates the structure and working principle of the electronic power steering system and front axle suspension system.

AT-4005 – Common Rail Diesel Engine Demonstrator

The AT-4005- Common Rail Diesel Engine Demonstrator training bench is based on a modern common rail diesel engine which incorporates electronic fuel injection and an engine electronic control unit (ECU).

The engine is fully operational and allows the student to study diesel engine operation in starting, idle, acceleration and deceleration operating modes.

AT-5000 Simulators for Advance Diagnostics

The AT-5000 Simulators allow for practice in advanced diagnosis of faults in the vehicle. Each fault diagnosis starts with the customer complaint, the scanner results, and continues with fault finding using various logical diagnostic step-by-step methods and procedures.

AT-5001 – Base and Main Panel for AT-5000 Modules

The AT-5001 Base and Main Panel houses five different plug-in simulator modules and a central control module. It comprises of a 19" color LCD monitor and several push button and rotary controls.

The system software adapts to the specific needs of each lesson by dynamically setting the function of each control. Interactive courseware is supplied for the required theory and diagnostic procedures.

Application software controls each module under test to emulate the vehicle operating conditions. Virtual instruments, such as a digital multimeter and oscilloscope are simulated on the LCD monitor.
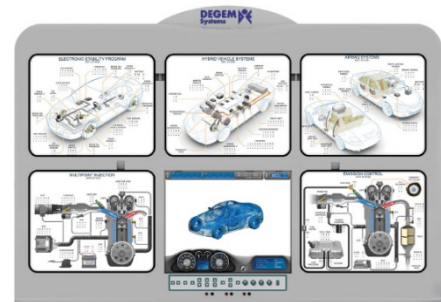
AT-5101 – Multipoint Injection Simulator Module

The AT-5101 Multipoint Injection Simulator Module demonstrates the fuel injection system and its components – theory, electrical wiring and operation.

The AT-5101 Multipoint Injection Simulator Module components are: MAP sensor, MAF sensor, motorized throttle, injectors, DIS ignition coil, CMP: Hall Effect camshaft position sensor, CKP: inductive crankshaft position sensor, ECT: engine coolant temperature sensor, Knock sensor, Accelerator position Hall Effect sensor, engine Electronic Control Unit (ECU).
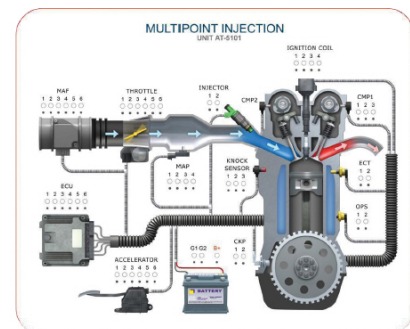
AT-5102 – Electronic Emission Control Simulator Module

The AT-5102 Electronic Emission Control Simulator Module demonstrates the electronic emission system and its components – theory, electrical wiring and operation.

The AT-5102 components are: Fuel tank, fuel pump and fuel filter; variable valve timing (VVT); front and rear O2 sensors, carbon canister and purge valve; EGT: Exhaust gas temperature sensor, exhaust gas analyzers, three-way catalytic converter.

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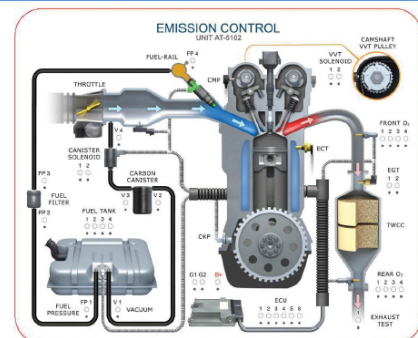
AT-5201 – Airbag Systems Simulator Module

The AT-5201 Airbag Systems Simulator Module demonstrates the airbag system and its components – theory, electrical wiring and operation.
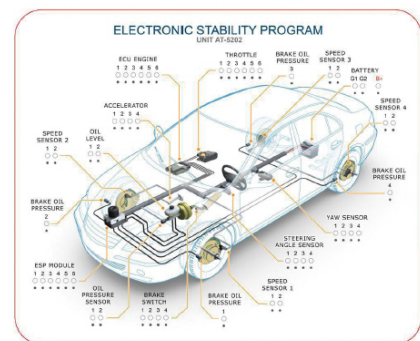
The AT-5201 Module components are: Airbag construction and operation; pyrotechnic seatbelt actuation, airbag electronic control unit, accelerometer, passenger and driver dual detonator airbag, knee and curtain airbags, satellite side impact sensor, Passenger deactivation switch.
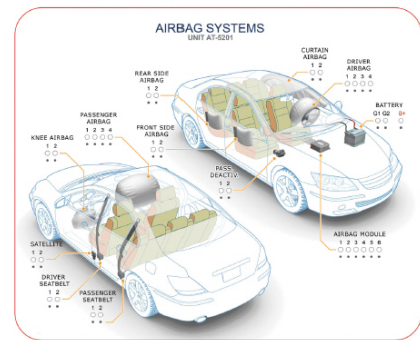
AT-5202 – Electronic Stability Program Simulator Module

The AT- 5202 Electronic Stability Program Simulator Module demonstrates the Electronic Stability Program (ESP) system and its components – theory, electrical wiring and operation.

The AT-5202 Module components are: Electronic stability control systems, wheel speed sensor, yaw (vehicle rotation) rate sensor, steering wheel angle optical sensor, brake oil pressure sensor, brake pedal switch, throttle position sensor, ESP control module for the hydraulic unit.

AT-5301 – Hybrid Vehicle Systems Simulator Module

The AT-5301 Hybrid Vehicle Systems Simulator Module demonstrates the hybrid vehicle system and its components – theory, electrical wiring and operation.

The AT-5301 Module components are: Nickel metal battery characteristics: terminal voltage, ampere-hour capacity; battery charging with motor-generator #1, engine starting with motor-generator #1, driving performance with motor-generator #2, regenerative braking with motor-generator #2, DC-DC booster for main electric drive, DC to 3 phase AC variable frequency inverter, 12 VDC converter for accessory battery, current sensors, hybrid electronic control unit.
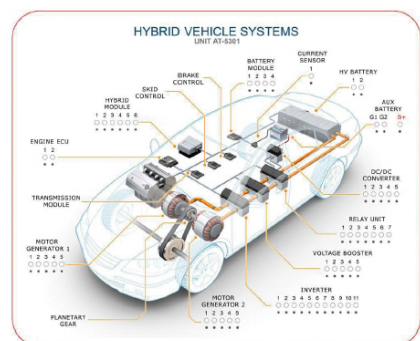
AT-6000 Fault Troubleshooting Unit for use in a Real Car

The AT-6000 is a unit for fault insertion in a real vehicle controlled by courseware and can work as standalone.

The At-6000 Unit can be adapted to any type of vehicle equipped with an ECU that supports the OBDII protocol.

The AT-6000 can insert at least 16 different faults using the various signals that connect to the ECU.

A customer complaint is displayed on the student monitor and instructions in the courseware guide the student through to the correct diagnostic procedure to find the fault.

The student performs the required tests and measurements on the car as well as on the faulty wiring and test point unit.

A step-by-step procedure to test the components in the vehicle leads the student to a final diagnosis and decision that is recorded and can be evaluated.

Required (not included)

- Working vehicle equipped with a gasoline engine
- Personal computer with MS Windows
- Digital multimeter
- Vehicle scanner

Learning Resources

The eAT interactive e-learning software program that is ideal for autotronics training. It is designed for both a teaching aid for the instructor and a self-paced, self-monitored tutorial for the student to reinforce learning. The interactive format of the program features sound and animated graphics that motivate student interest in an active learning environment, while introducing automotive operations and components.

The theory learned in this course will help prepare the student to troubleshoot real vehicles on the job.

The course, which consists of a number of learning sessions, can be easily integrated with specific school curricula for training motor vehicle technicians. The flexible e-Learning approach provides students with the option of taking this course either in school or at home.

eAT-204   Brake system theory
eAT-205   Drive train system theory
eAT-206   Engine theory
eAT-207   Heating, ventilation and air-conditioning theory
eAT-208   Engine performance theory
eAT-209   Shop, safety and tools theory
eAT-210   Steering and suspension theory
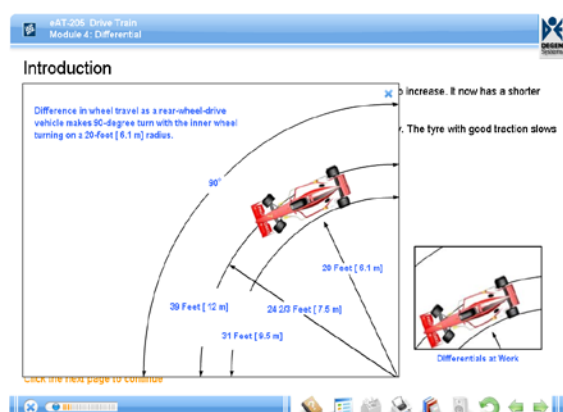
AT-3000 Car Simulator Specifications

The **AT-3000 Automotive Training Simulator Series** is designed to provide students with automotive training program introducing various systems and components in modern cars.

The simulator brings a comprehensive view of all the systems in the car, their components and their interconnection, functions, operation, signals, diagnosis and repair methods with hands-on safe activities.

The simulator enables simulation and demonstration of the system's behavior and its signals in conditions which cannot be demonstrated in a real system. The simulator enables fault simulations which is difficult and sometimes impossible to create and exercise in a real system.

The training simulators include a controller which controls the simulation on the trainer's panel and produces the signals for measurement, generated by its internal program or by a program downloaded from a PC.

The simulator's panel is composed of colored graphics clearly representing the system's components, connections and inter-relations with test points for real measurements and LEDs describing the component status.

Each simulator includes:

- Wide metal case (80 x 60 x 10 cm)
- A power switch with an indication light
- Warning indication light
- Operation and simulation switches
- Simulation potentiometers
- PC/MANUAL switch
- 2 channel PC oscilloscope
- 7-SEG. display
- STATE mode switches and display
- FAULT insertion switches and display
- Monitor with pushbuttons and LCD display
- CAN-BUS interface
- Serial communication interface with the PC
- External power supply
- Digital multimeter

AT-3001 – Engine Injection Simulator

Demonstrates the injection system parts, components and sensors.

Simulates the injection system, and the parameters that affect injection: air density and temperature, engine load, engine RPM, Idle condition and troubleshooting.
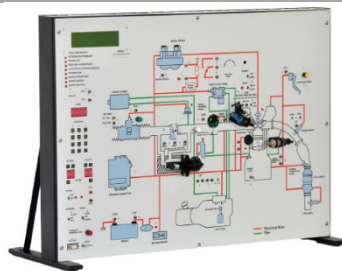
Panel simulation units:

- Color graphic of an engine and its units
- Simulation potentiometers including:
  Manifold Air Mass, Manifold Air Pressure and Air Temperature sensors
- Acceleration pedal simulation potentiometer
- Main switch and main switch relay
- Fuel delivery system simulation
- Injection system Bosch type
- Light bar indicating injection duration
- ECU combined ignition and injection
- Throttle control with Throttle Position Sensor
- Vacuum unit
- Air control module
- O_2 simulation sensor
- Coolant temperature sensor
- Engine load simulation potentiometer
- Speed LED display
- Speaker
- Vacuum meter

Contents and Experiments:

- Fuel injection engine control
- Fuel delivery system
- Speed and position sensors
- Acceleration pedal position sensor (APP)
- Throttle position sensor (TPS)
- DIS – Distributor-less Ignition System
- Electromagnetic injectors
- IOD - Injection opening duration at operating conditions: Cold start, Post start, Warm start, Acceleration, Part load, Full load, Idle, Overrun, Engine speed limiting, High altitude.
- Lambda O_2 sensor
- Intake air mass and temperature measurement
- Coolant temperature sensor
- Manifold absolute pressure (MAP) sensor
- Idle air control
- Fuel pump safety circuits
- Circuit cut-out during fuel overflow
- Fault simulation and troubleshooting

AT-3002 – Electronic Ignition Simulator

Demonstrates the ignition system parts, components and sensors.

Simulates the electronic ignition system, triggering pulses, timing, RPM measurement, spark production and troubleshooting.
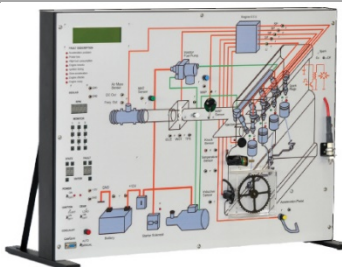
Panel simulation units:

- Color graphic of an engine and its units
- Acceleration pedal simulation potentiometer
- ECU combined ignition and injection
- Throttle control with Throttle Position Sensor
- Iron disk driven by DC motor
- Crankshaft inductive sensor
- Distributor-less Ignition System (DIS)
- Ignition coils
- Spark plug
- Spark plug firing sequence indicators
- Injection indicators
- Knock and MAP sensors
- Coolant temperature sensor
- Vacuum unit
- MAP simulator potentiometer
- Air temperature and air mass sensor simulation
- Coolant temperature simulation potentiometer

Contents and Experiments:

- Fuel injection engine control
- Principles of motion and position sensors
- Speed and position sensors
- Acceleration pedal position sensor (APP)
- Throttle position sensor (TPS)
- DIS – Distributor-less Ignition System: Triggering pulses, primary and secondary circuits, Ignition angle and ignition timing, ignition according to engine speed, load, temperature and knocks.
- Electromagnetic injectors
- IOD – Injection opening duration
- Lambda O_2 sensor
- Intake air mass and temperature measurement
- Coolant temperature sensor
- Manifold absolute pressure (MAP) sensor
- Fault simulation and troubleshooting

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AT-3003 – ABS 4-Channel System Simulator

Demonstrates the ABS system parts, components and sensors.

Simulates the brake system without ABS and with ABS, on dry road and on wet road, different ABS systems, measurements and troubleshooting.

Panel simulation units:

- Color graphic of a ABS system and its units
- ABS Electronic Control Unit (ECU) simulation module
- Solenoid
- Inductive wheel rpm sensors
- Four wheels with slotted disks driven by motors with analog and digital outputs
- Four speed analog LED displays
- LED indicators for the operation ABS modulator
- LED's simulate hydraulic brake operation
- Acceleration pedal simulation potentiometer
- Brake pedal simulation potentiometer
- ABS warning light
- ABS wiring with test points

Contents and Experiments:

- Hydraulic brake system principles
- ABS basic construction and components
- Inductive RPM sensor
- Inductive Hall Effect sensor
- Electronic brake control
- Hydraulic modulator
- ABS electrical circuit
- ABS basic principles and operation states: Braking, Holding, Releasing, Pressure building.
- Vehicle acceleration
- Vehicle braking process and wheel lock
- Controls and measurements
- ABS control system
- ABS types: 1, 2, 3, 4 – Channel ABS
- Operation in various drive conditions
- Fault simulation and troubleshooting

AT-3004 – Engine Controls & Sensors Simulator

Demonstrates the engine actuators and sensors.

Simulates the ignition and the injection system, EGR and the parameters that affect injection: air density and temperature, engine load, engine RPM, idle condition and troubleshooting.
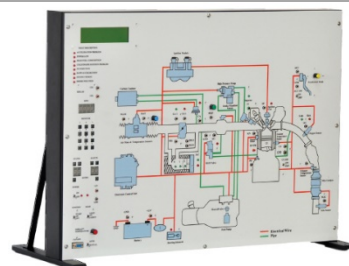
Panel simulation units:

- Color graphic of an engine and its units
- Engine Electronic Control Unit
- Intake air pressure and temperature sensors
- Air flow and mass sensors
- MAP simulation potentiometer
- Coolant temperature sensor
- Knock sensor
- Exhaust gas oxygen and NOx sensors
- Exhaust gas temperature sensor
- Fuel pump and high pressure fuel pump
- Fuel delivery system
- Electronic fuel Injector
- Acceleration pedal sensor and RPM display
- Throttle position sensor
- Electronic DIS ignition system and spark plug
- EGR valve
- Air control module
- Carbon canister and canister valve
- Battery and electrical system

Contents and Experiments:

- Fuel injection engine control
- MPI fuel delivery system: fuel pump, fuel filter, fuel rail, pressure regulator
- Sensors and valves: Exhaust Gas Recirculation (EGR) valve, Active charcoal canister valve, NOx sensor, Lambda sensor
- Principles of motion and position sensors
- Speed and position sensors
- Acceleration pedal position sensor (APP)
- Throttle position sensor (TPS)
- DIS – Distributor-less Ignition System
- Electromagnetic injectors
- IOD – Injection opening duration
- Intake air mass and temperature measurement
- Coolant temperature sensor
- Manifold absolute pressure (MAP) sensor
- Fault simulation and troubleshooting

AT-3005 – Car Air-Conditioning & Climate Control Simulator

Demonstrates the car's air-conditioning and climate control.

Simulates real and simulated components controlled by internal controller that produces the signals for measurement according to its internal simulating program or according to PC simulation programs.

Panel simulation units:

- Color graphic of a car air-distribution
- Stepper motors and levers for air-distribution simulation
- Color graphic of a car air-conditioning system
- Pushbuttons and color LEDs simulating the cold/warm state of each A/C component.
- Two analog A/C pressure displays
- Compressor operation simulator
- Air distribution vacuum/Stepper control diagram
- Driver A/C control switches
- Electrical system schematic diagram of the car A/C system including valves.
- Electric motor simulating the A/C fan
- Vacuum valve
- Voltage, coolant leakage, and vacuum testers
- Voltage, leakage and vacuum testing point sockets
- Required temperature simulation potentiometer

Contents and Experiments:

- Basic principles of Air-Conditioning
- Refrigeration cycle and circuit components
- Basic thermodynamic principles and terms
- Electric fan (blower) speed control
- The A/C control circuit
- Idle solenoid control
- Cooling circuit gas pressure and load control
- Cooling fan control
- Temperature and pressure characteristics
- The heating system
- Air distribution control with vacuum valves
- Air distribution control with stepper motors
- Air distribution using servo DC motors
- Climate control automatic and manual operation
- Various operating conditions and their effect on the climate control
- Economic cycle mode
- Fault simulation and troubleshooting

AT-3006 – Suspension Simulator

Demonstrates the active suspension system parts, components and sensors.

Simulates an active suspension system, sensors, reaction to acceleration and braking, reaction to turns, reaction to road conditions and troubleshooting.

Panel simulation units:

- Color graphic of a car and its suspension units
- Shock absorber
- Acceleration pedal simulation
- Steering simulation potentiometer
- Wheels' high weight simulation switches
- Solenoid
- Mode selector switch
- Brake switch
- Ignition switch
- Speed meter signal
- Steering sensor signals
- Accelerometer signal
- TPS and RPM signals
- Wheels' level sensors
- Wheels' valve actuators
- Active Body Module
- Signal test points
- Indicating LEDs

Contents and Experiments:

- Introduction to modern car suspension systems
- Active Body Control (ABC)
- The ABC hydraulic system
- The oil pump and valves
- The driving signal of the absorber valves
- Acceleration sensor and its signal waveform
- Gravity, level and steering sensors
- Analyzing the steering sensor signals
- The ABC switches and signals
- Throttle opening signal
- Engine speed signal
- Vehicle speed sensor
- Mode selector switch
- Brake light switch
- Logic intervention in relation to: the gear selected, acceleration and car speed, to vertical acceleration, to steering angle and car speed, to braking pressure, to steering speed and car speed
- Fault simulation and troubleshooting

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AT-3007 – Transmission Simulator

Demonstrates the automatic transmission system parts, components and sensors.

Simulates the automatic transmission system operation at different gear positions, display of speed and engine RPM, engine load effect and troubleshooting.
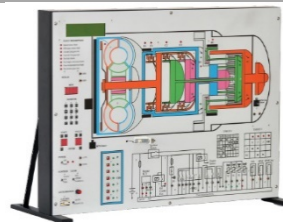
Panel simulation units:

- Color graphic of automatic transmission system
- Acceleration pedal simulation potentiometer
- LED indicators of operated Clutches
- LED indicators for rotation direction
- RPM sensor
- Switches for selecting transmission gear
- LEDs for indication gear shift position
- Transmission ECU
- Engine IOD signal
- Transmission signals to engine ECU
- Electric fan for the oil cooler on automatic transmission,
- Brake switch
- Transmission ECU gear selector signals
- Solenoid actuators' test points
- Solenoids' indicating LEDs
- Oil level signal
- RPM signal
- Speed signal
- Solenoid

Contents and Experiments:

- Introduction to automatic transmissions
- Torque converter
- Flywheel operation
- Automatic transmission shafts
- Planetary gear set
- Multiple disc clutches
- Clutch construction and overrun clutches
- Bands and servos, Parking pawl
- Gears and Transmission Ratio
- The Hydraulic and Electric System
- RPM sensors
- Kick-down switch
- Braking light switch
- The signal of the throttle valve mode
- Transmission Operating Programs
- Canceling the possibility of shifting into reverse
- Uphill and downhill driving
- The engine's cooling fan
- Cold ignition/climate strategy
- Fault simulation and troubleshooting

AT-3008 – Safety Systems Simulator

Demonstrates the prevention safety systems (signaling, horn, lights and indicator bulbs), protection safety systems (air bag, seat belts) parts, components and sensors.

Simulates the safety systems controlled by ECU, inputs, outputs, signals, measurements and troubleshooting.
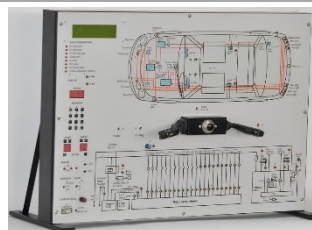
Panel simulation units:

- Color graphic of a car and its safety units
- Lighting system simulation for head lights, parking lights, interior lights, rear lights, reversing light, turn signaling system
- Horn buzzer
- Windshield wipers and washer system modules
- Signaling, light and horn handle unit
- Airbag simulator with electronic control unit and accelerometer sensor, movement sensors and pneumatic valve self-diagnostics warning light
- Pre-tension actuator of safety belts simulator, collision simulator, warning light signaling the intervention of belts
- Safety tension belts system simulation with electronic control
- Fuel cut-off system simulation
- Coolant temperature simulation potentiometer
- Engine ECU Oil and coolant temperature signals
- Gear ECU select signal

Contents and Experiments:

- Main head lights
- Parking lights, rear lights
- Turn signaling lights, reversing lights, stop lights, hazard lights
- Interior lighting system
- Electric horns
- Wipers and washer system
- Sensors and indicators: fuel level, reverse gear, oil pressure, coolant temperature, brake fluid level and warning light
- Airbag electronic control unit
- Shock sensors
- Safety belt tightening
- Inertial security switch for fuel cutoff
- Fuel leakage security valve
- ACU self-test and diagnostic
- Anti-titling valve
- Fault simulation and troubleshooting

AT-4000 Car Demonstrators Specifications

The AT-4000 Car Demonstrator Module has all of its components installed on a metal training bench. The systems and accessories operate exactly as they do in a car. The Demonstrator enables observation and access to every component of the system.

The demonstrator's metal panel has color graphics clearly presenting the system components, connections and inter-relations with test points for real measurements. The values and signals measured on these test points are real values of the system.

Each demonstrator is connected to the computer and comes with detailed courseware. Electrical non-destructive faults can be planted for troubleshooting exercises.

AT-4001 –Gasoline Car Engine Demonstrator

The AT-4001 Gasoline Car Engine Demonstrator is a training bench based on the electronically controlled gasoline engine and automatic transmission (including the original vehicle wiring harness, fuse box, relay etc.) removed from a car.

During operation, the AT-4001 Demonstrator enables understanding of the structures and working principles of electronically-controlled gasoline engines.

The AT-4001 enables actual practicing of startup, speedup, slowdown and other actions of the engine.

Measurements can be done on the panel test points and faults can be installed for troubleshooting experiments.

AT-4002 – Car Air-Conditioning & Climate Control Demonstrator

The AT-4002 Car Air-Conditioning & Climate Control Demonstrator is a training bench houses the automatic air conditioning part (Including original car wiring harness) removed from a car.

At operation, it displays the working state under different working conditions.

The demonstrator includes an electrical motor that rotates the A/C compressor.

Measurements can be done on the panel test points and faults can be installed for troubleshooting experiments.

AT-4003 – Car ABS Demonstrator

The AT-4003 Car ABS Demonstrator is a training bench based on the ABS system and with an operating principle diagram to demonstrate operation of the system.

The demonstrator includes an electrical motor that rotates the system wheels.

Measurements can be done on the panel test points and faults can be installed for troubleshooting experiments.

AT-4004 – Power Electrical Steering Demonstrator

The AT-4004 Power Electrical Steering Demonstrator is a training bench based on the power electrical steering system (including original car wiring harness) removed from a car.

It fully demonstrates the structure and working principle of the electric power steering system and front axle suspension system.

Measurements can be done on the panel test points and faults can be installed for troubleshooting experiments.

AT-4005 – Common Rail Diesel Engine Demonstrator

The AT-4005 Common Rail Diesel Engine Demonstrator is a training bench based on a modern common rail diesel engine, incorporating electronic fuel injection and an engine electronic control unit (ECU).

The engine is fully operational and allows a student to study diesel engine operation in starting, idle, acceleration and deceleration operating modes.

Measurements can be done on the panel test points and faults can be installed for troubleshooting experiments.

AT-5000 Simulators for Advanced Diagnostics Specifications

The AT-5000 Simulators are advanced simulators to practice diagnosing faults in the vehicle. Practice using these simulators allows a student to deal with complex systems and enhances their capability to deal with future vehicle systems.
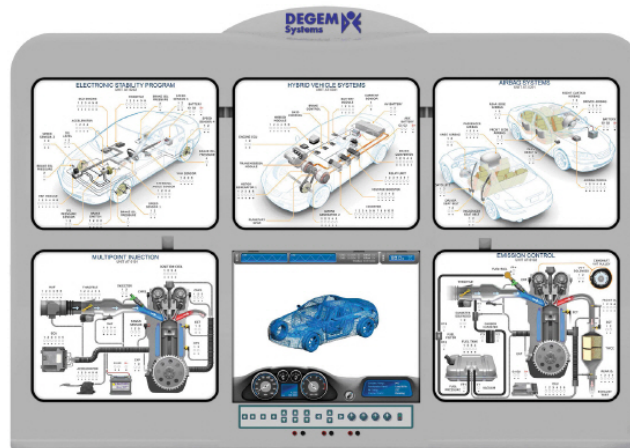
AT-5001 – Base and Main Panel for AT-5000 Modules

AT-5001 training system houses five different plug-in simulator modules and a central control module, which comprises a 19" color LCD monitor and several push buttons and rotary controls.

The system software according to the specific needs of each lesson dynamically sets the function of each control. Interactive courseware supplies the required theory and diagnostic procedure.

Application software controls the modules under test to emulate the required vehicle operating conditions to be simulated.

All of these provide the ideal learning environment for valuable true-to-life diagnostic exercises. Pedagogical experts in state-of-the-art automotive technology wrote the courseware. The procedure for each experiment is clearly written to allow the students to easily complete each experiment.

- Provides all support functions for the entire family of plug-in simulator modules
- Test equipment is not required
- Virtual instruments, such as a digital multimeter and oscilloscope are simulated on the LCD monitor and provide realistic diagnostic measurement facilities.
- Quick & easy setup for plug-in modules
- Unique learning platform provides a safe and efficient learning environment
- Inherent expansion and upgrade capability
- Realistic troubleshooting exercises
- USB data communication to PC
- Fully documented operating instructions in courseware
- Each of the 5 module compartments contains securing magnets for quick module change and detachable cable(s)

Main Panel

- The main panel contains the following:
- Digital control module
- Houses five 300 x 365 mm plug-in simulator modules
- USB2 communications interface to PC
- USB to VGA converter
- USB hub for 5 plug-in modules, digital control module and LCD display
- Overall dimensions: 1240 x 864 x 100 mm
- Power supply for 100-250 VAC, 50-60Hz.
- Power on-off switch
- Power consumption 150 VA maximum

Digital Control Module

- The digital control module contains the following:
- 19" LCD display
- 14 push buttons
- 4 rotary controls
- 6 4-mm virtual instrument measurement jacks:
- DMM (+), DMM (-)
- Oscilloscope CH1, GND1
- Oscilloscope CH2. GND2
- 6 virtual measurement probes with 4 mm plug for connecting to control module and 2mm plug to connect to plug-in module test points.
- The LCD screen is divided into 3 sections:
  - ✳ Top section for virtual measuring equipment
  - ✳ Middle section for animations
  - ✳ Bottom section for displaying the function for the dynamic controls

AT-5101 – Multipoint Injection Simulator Module

AT-5101 Multipoint Fuel Injection course consists of a module and computer courseware. The module, which plugs into any free compartment in the AT-5000 main panel, contains multicolor graphic of the entire multipoint system, several test points and LED indicators.
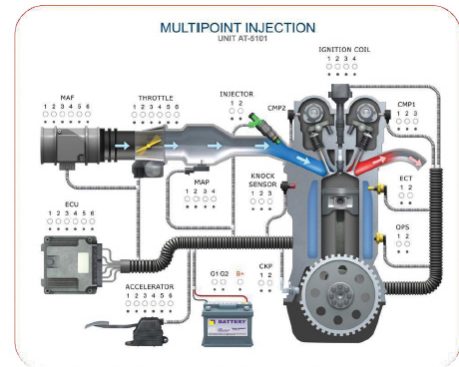
The interactive courseware contains essential theory enhanced with vivid simulations, guided exercises that interact with the MPI module, guided diagnostic exercises and self-assessment exercises.

Theory and experiments:

- MAP sensor, MAF sensor
- Motorized throttle
- Injectors
- DIS ignition coil
- CMP: Hall Effect camshaft position sensor
- CKP: inductive crankshaft position sensor
- ECT: engine coolant temperature sensor
- Knock sensor
- Accelerator position Hall Effect sensor.
- Engine electronic control unit (ECU)

Testing and measurement using virtual test instruments, such as digital multimeter and oscilloscope at designated test points, for observing normal operation conditions.

Fault finding using various logical diagnostic step-by-step methods and procedures.

AT-5102 – Electronic Emission Control Simulator Module

AT-5102 Emission Control course consists of a module and computer courseware. The module, which plugs into any free compartment in the AT-5000 main panel, contains multicolor graphic of the entire EMISSION CONTROL system, several test points and LED indicators.
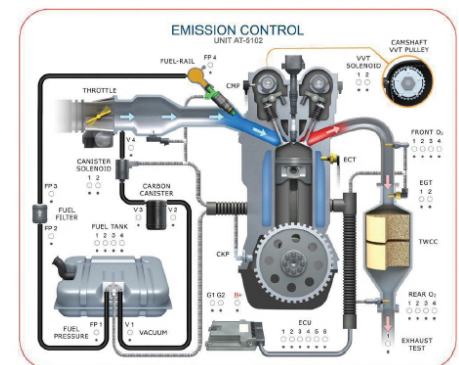
The interactive courseware contains essential theory enhanced with vivid simulations, guided exercises that interact with the EMC module, guided diagnostic exercises and self-assessment exercises.

Theory and experiments:

- Fuel tank, fuel pump and fuel filter
- Variable valve timing (VVT)
- Front and rear O_2 sensors
- Carbon canister and purge valve
- EGT: Exhaust gas temperature sensor
- Exhaust gas analyzers
- Three-way catalytic converter

Testing and measurement using virtual test instruments, such as digital multimeter and oscilloscope at designated test points, for observing normal operation conditions.

Fault finding using various logical diagnostic step-by-step methods and procedures.

AT-5201 – Airbag Systems Simulator Module

AT-5201 Airbag Systems course consists of a module and computer courseware. The module, which plugs into any free compartment in the AT-5000 main panel, contains multicolor graphic of the entire Airbag system, several test points and LED indicators.
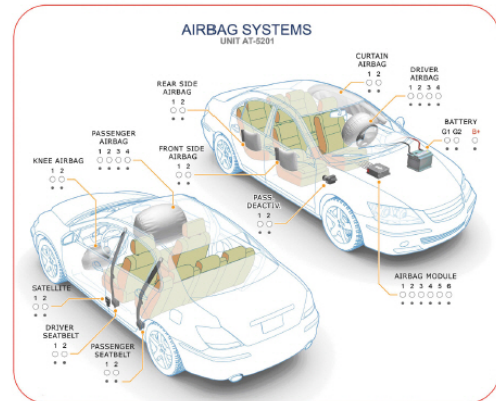
The interactive courseware contains essential theory enhanced with vivid simulations, guided exercises that interact with the Airbag module, guided diagnostic exercises and self-assessment exercises.

Theory and experiments:

- Airbag construction and operation
- Pyrotechnic seatbelt actuation
- Airbag electronic control unit
- Accelerometer
- Passenger and driver dual detonator airbag
- Knee and curtain airbags
- Satellite side impact sensor
- Passenger deactivation switch

Testing and measurement using virtual test instruments, such as digital multimeter and oscilloscope at designated test points, for observing normal operation conditions.

Fault finding using various logical diagnostic step-by-step methods and procedures.

AT-5202 – Electronic Stability Program Simulator Module

AT-5202 Electronic Stability Program (ESP/ESC) course consists of a module and computer courseware. The module, which plugs into any free compartment in the AT-5000 main panel, contains multicolor graphic of the entire electronic stability system, several LED indicators to illustrate system operation and test points to measure appropriate signals and parameters during the learning process.

The interactive courseware contains essential theory enhanced with vivid simulations, guided exercises that interact with the ESP module, guided diagnostic exercises and self-assessment exercises.

Theory and experiments:

- Electronic stability control systems
- Wheel speed sensor
- Yaw (vehicle rotation) rate sensor
- Steering wheel angle optical sensor
- Brake oil pressure sensor
- Brake pedal switch
- Throttle position sensor
- ESP control module for the hydraulic unit

Testing and measurement using virtual test instruments, such as digital multimeter and oscilloscope at designated test points, for observing normal operation conditions.

Fault finding using various logical diagnostic step-by-step methods and procedures.

AT-5301 – Hybrid Vehicle Systems Simulator Module

AT-5301 Hybrid Vehicle Systems course consists of a module and computer courseware. The module, which plugs into any free compartment in the AT-5000 main panel, contains multicolor graphic of the entire HYBRID VEHICLE system, several test points and LED indicators.
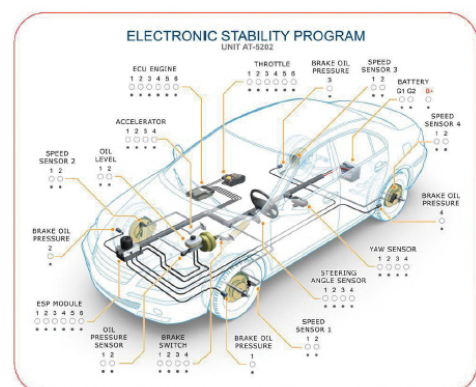
The interactive courseware contains essential theory enhanced with vivid simulations, guided exercises that interact with the HYBRID VEHICLE module, guided diagnostic exercises and self-assessment exercises.

Theory and experiments:

- Nickel metal battery characteristics: terminal voltage, ampere-hour capacity
- Charging battery with motor-generator #1
- Starting engine with motor-generator #1
- Driving performance with motor-generator #2
- Regenerative braking with motor-generator #2
- DC-DC booster for main electric drive
- DC to 3 phase AC variable frequency inverter
- 12 VDC converter for accessory battery
- Current sensors
- Hybrid electronic control unit

Testing and measurement using virtual test instruments, such as digital multimeter and oscilloscope at designated test points, for observing normal operation conditions.

Fault finding using various logical diagnostic step-by-step methods and procedures.

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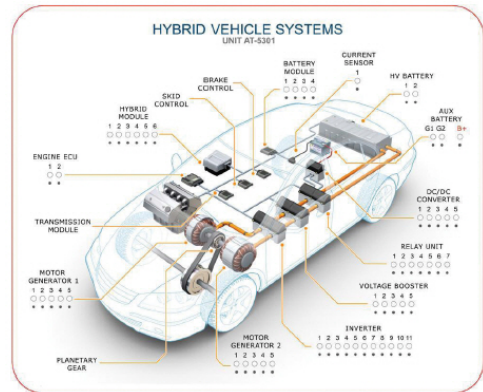
AT-6000 Fault Troubleshooting in Real Car Specifications

Fault insertion in a real vehicle can be controlled by the courseware at the student workstation (PC) and can work as standalone.

AT-6000 can be adapted to any type of vehicle equipped with an ECU that supports the OBDII protocol.

A proprietary interface can insert at least 16 different faults by the various signals that connect to the ECU.

A customer complaint is displayed on the student monitor and instructions in the courseware guide the student through the correct diagnostic procedures to find the fault.

The student performs the required tests and measurements on the car as well as on the faulty wiring and test point unit.

A step-by-step procedure testing the components in the vehicle will lead the student to a final decision that is recorded and can be evaluated.

The AT-6000 includes the following:

- 2 Digit display
- 2 buttons for standalone control
- 12 wires cable to the vehicle ECU
- 12 wires cable to the vehicle sensors and actuators
- 16 relays
- USB connectivity to PC
- Power and USB indicating LEDs
- Fault insertion from PC
- Standalone fault insertion ability
- 3 optional power source
  - ❋ 15V power supply
  - ❋ Car battery
  - ❋ 12V auto socket
- Customized courseware for specific vehicle
- Installation guide Managed Laboratory
- Dimension 32x16x4(+2 legs) cm
- Weight 2 Kg

Required (not included)

- Working vehicle equipped with a gasoline engine
- Personal computer with MS Windows
- Digital multimeter
- Vehicle scanner

AT-7000 Electric Car Demonstrators

The AT-7000 Demonstrator series is electric car systems with all their components installed on a metal training bench with facilities and accessories that enable to operate it exactly as it does in a real car. The demonstrator enables observing and accessing every component of the system.

The AT-7000 Demonstrator's metal panel exhibits clearly colored graphics. It presents the particular system's components, all its connections and inter-relations with test points for real and actual measurements. The values and signals measured on these test points are true values of the system.

Each demonstrator is connected to a computer and comes with detailed courseware. Electrical non-destructive faults can be planted for troubleshooting exercises.

AT-7001 – Electric car power battery and management demonstrator

The AT-7001 Electric car power battery and management demonstrator training bench is based on a Lithium iron phosphate power battery pack (including 13 power battery modules), 6 distributed BMS collectors, a set of orange high-voltage power lines, a set of low-voltage control lines, a maintenance switch control box, a mobile platform and a mobile teaching board.

The main components are installed on the platform mimicking the original vehicle layout position. They are covered by a transparent cover for safety.

Both the low-voltage control line and the high-voltage power line are original vehicle parts. The high-voltage power line is coated with a protective bellows.

The AT-7001 demonstrator enables learning and getting familiar with the voltage level and capacity of a single power cell, the composition, voltage level and capacity of a power battery pack, the composition and functions of the distributed BMS, the collects' voltage difference and temperature difference of the power battery pack, the power battery night cooling system, the power battery PTC heating system, the logic control relationship of the power battery pack under various conditions, and master the change rules of parameters such as current, voltage, battery voltage difference, battery temperature, etc.

The course also covers the safety precautions of operating a high-voltage system, mastering the plugging and unplugging methods of high-voltage connectors and low-voltage connectors, faults and troubleshooting methods, the role of the maintenance switch in safety protection, mastering the slow charging features and the boost fast charge features.

The AT-7001 is based on the BYD e5 electrical car.

AT-7002 – Electric car transmission and motor control demonstrator

The AT-7002 electric car transmission and motor control demonstrator training bench is based on a high-voltage electronic control assembly (four-in-one controller), a BMS power battery management controller, a main controller assembly, a MICU body controller, a gateway control module, a EPB electronic parking controller, an intelligent key controller, an AC charging port, a DC charging port, a gear controller, a brake system, a mobile platform and a mobile teaching board.
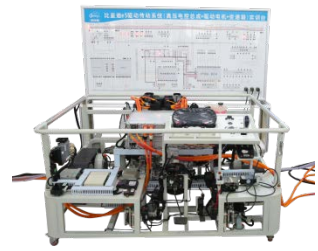
The main components are installed on the platform, including a high-voltage electronic control assembly, a BMS power battery management controller, a main controller assembly, a MICU body controller, a gateway control module, an EPB electronic parking controller and an intelligent key controller.

Both the low-voltage control line and the high-voltage power line are original vehicle parts. The high-voltage power line is coated with a protective bellows.

The whole vehicle CAN communication is integrated through the gateway to let the trainees understand the advanced nature of the CAN communication network of new energy electric vehicles.

The training platform is connected to the power battery and management system training platform for operation. It inputs the high-voltage direct current of the power battery pack, and inverts it into three-phase alternating current through the high-voltage electronic control assembly and outputs it to the drive motor for operation.

The AT-7002 demonstrator enables learning and getting familiar with transmission main controller assembly, the body controller assembly, the gateway controller, the high-voltage electronic control assembly, the high-voltage electronic control assembly's four-in-one technology, the DC charging boost module, the electronic accelerator pedal, the control relationship between the electronic accelerator pedal angular displacement signal and the drive motor power, the measurement methods of high-voltage and high current of the clamp type digital multimeter in the control system, the relationship between DC bus voltage/current and three-phase AC voltage/current during the operation of the high-voltage electronic control assembly and the brake energy recovery process.

The AT-7002 is based on the BYD e5 electrical car.

AT-7003 – Electric car climate control demonstrator

The AT-7003 Electric car climate control demonstrator training bench is based on the AC cooling system and the PTC heating module. It includes a condenser, an electronic expansion valve, an evaporator, an A/C panel, a water pump assembly, a heater core assembly, a mobile platform and a teaching board.

The main components are installed on the platform. The electrical connection is identical to the electrical connection in a real vehicle.
It can be easily disassembled after the power is cut off, so that the trainees can master the disassembly and assembly points of the electric HVAC system during the disassembly and assembly connection process.

The training platform is connected with the power battery and management system training platform for operation. The connecting cable is matched with the original vehicle and it is connected in the same way as in the original vehicle. It is powered by the power battery and management system training platform.

The AT-7003 demonstrator enables learning and getting familiar with the A/C cooling system, the functions of the main components for the A/C cooling, the A/C cooling difference between the electric car and the traditional vehicle, the heater module, the functions of the main components of the heater module, the heating system difference between the electric car and the traditional vehicle.

The AT-7003 is based on the BYD e5 electrical car.

AT-7004 – Electric car power steering (EPS) demonstrator

The AT-7004 electric car electric power steering demonstrator training bench is based on a steering wheel and steering column assembly, an electric power steering gear with tie rod assembly, a set of front sub-frame, a set of front suspension assemblies, two front wheels, an electric power steering gear (dissected for demonstration) and a set of mobile platform and teaching board.

The main components are installed on the platform. The electrical connection is identical to the electrical connection in a real vehicle.
It can be easily disassembled after the power is cut off, so that the trainees can master the disassembly and assembly points of the EPS system components during the disassembly and assembly connection process.

The AT-7004 demonstrator enables learning and getting familiar with the EPS system, the EPS technology, the power control function, the aligning control function, and the high-speed damping control function.

The AT-7004 is based on the BYD e5 electrical car.

AT-7005 – Electric car body demonstrator

The AT-7005 Electrical car body demonstrator training bench is based on vehicle body (partial cut), main controller assembly (master ECU), gateway controller, body low-voltage control system and mobile teaching board.

The parts of the low-voltage system of the vehicle body are kept, and the electrical connection remains the same.

The insertion, removal and disassembly exercises can be carried out, so that the trainees can master the disassembly and assembly points of the low-voltage system parts of the vehicle during the disassembly and assembly connection process.

This training platform can work alone, and the 12VDC power supply is provided by the switching power supply.

The AT-7005 demonstrator enables learning and getting familiar with the ignition process, the network management unit operation, how the master ECU works, and the meanings of the common fault codes.

The AT-7005 is based on the BYD e5 electrical car.

Learning Resources Specifications

The eAT interactive e-learning software program that is ideal for autotronics training. It is designed for both a teaching aid for the instructor and a self-paced, self-monitored tutorial for the student to reinforce learning. The interactive format of the program features sound and animated graphics that motivate student interest in an active learning environment, while introducing automotive operations and components.

The theory learned in this course will help prepare the student to troubleshoot real vehicles on the job.

The course, which consists of a number of learning sessions, can be easily integrated with specific school curricula for training motor vehicle technicians. The flexible e-Learning approach provides students with the option of taking this course either in school or at home.

eAT-204 – Brake system theory

Course topics

- Purposes of the hydraulic and pneumatic components
- Foot brake – hydraulics and pneumatics
- Friction components
- Parking brake
- Driver assistance systems - ABS, ESP, MSR, ASR, TCS

4 Learning Hours
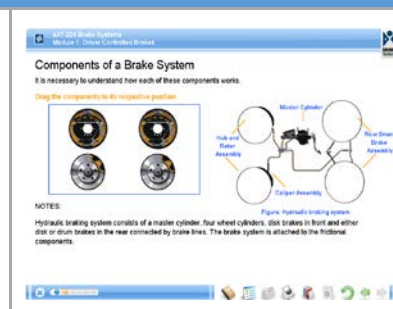
eAT-205 – Drive train system

Course topics

- Drive-train layouts - Front, rear and all-wheel drive concepts
- Clutches and torque converters - dry single and dual plate clutches
- Gearboxes – manual, automatic, sequential, continuously variable
- Differentials - standard and limited slip
- Drive shafts – types of joints

4 Learning Hours

eAT-206 – Engine theory

Course topics

- Main components of petrol engines
- Operating principles
- Four cycle combustion
- Engine construction
- Engine assembly simulated exercise
- Simulated engine compression test
- Engine fault finding exercise

6 Learning Hours

eAT-207 – Heating, ventilation and air-conditioning theory

Course topics

- Heating sources – residual, electrical and fuel
- Ventilation – ducting, defrosting, and filtering
- Refrigeration basics
- Refrigerant circuit – restrictor and TXV types
- Service – maintenance and diagnostics
- Protecting the environment

3 Learning Hours

eAT-208 – Engine performance theory

Course topics

- Heating sources – residual, electrical and fuel
- Fuel delivery systems
- Throttle control – conventional linkage and drive-by-wire
- Pressure charging – turbo and supercharger
- Variable valve timing – Intake and exhaust
- Variable geometry intake
- Storage and filtration
- Pressure charging – constant and variable pressure and supply on demand
- Delivery – indirect (manifold based only) and direct
- Vapor recycling – tank purging and testing (OBDII)

5 Learning Hours

eAT-209 – Shop, safety and tools theory

Course topics

- Measuring tools – Vernier caliper, micrometer, dial gauge
- Hand tools – Spanners, sockets, screwdrivers etc.
- Workshop / special tools – Pullers, floor jack, axle stands etc.
- Accident and fire prevention
- Personal protection equipment – gloves, ear and eye defenders, overalls
- Hazardous materials
- Lifting procedure
- Circuit diagrams
- Workshop manuals
- Owner's manuals

4 Learning Hours
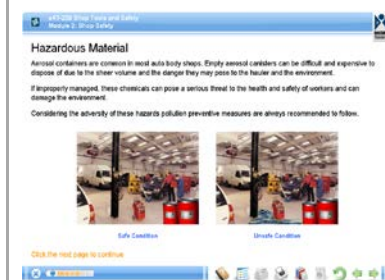
eAT-210 – Steering and suspension theory

Course topics

- Suspension – steel spring suspension systems- un-sprung masses
- Vibration damping – hydraulic and gas variants
- Suspension – hydraulic and pneumatic spring systems
- Dampers – manually and automatically adjustable systems Characteristics and principles – under, over, bump
- Steering systems – steering box, rack and pinion, Ackerman principle oversteer, understeer
- Hydraulic / electric / electro-hydraulic power assistant steering
- Steering alignment
- Wheel types, tire specifications, tire wear, balancing

5 Learning Hours

Automotive Electronics Study Envelope Recommended Set

The following is a recommended set for workshop classes of 16 students.

Item	Description	Qty
EB-3000	Universal Electronics Work Station	8
EB-3121	Ohm and Kirchhoff Laws and DC circuits	8
EB-3122	Norton, Thevenin and Superposition	8
EB-3123	AC Circuits, signals and filters	8
EB-3124	Magnetism, Electromagnetism, Induction and transformers	8
EB-3125	Diodes, Zener, transistors characteristics and DC circuits	8
EB-3126	Bipolar and FET Transistor amplifiers	8
EB-3127	Industrial Semiconductors – SCR, Triac, Diac and PUT	8
EB-3128	Optoelectronic Semiconductors – LED, phototransistor, LDR, 7-SEG	8
EB-3129	Electrical Control components & Circuits	8
EB-3141	Analog, PWM DC motor speed control, step motor control, generators	8
EB-3142	Motor Control – Optical, Hall effect, motor closed control	8
EB-3145	Electrical Accessories Module	8
EB-3146	Ignition and Charging Module	8
EB-3151	AND, OR, NOT, NAND, NOR, XOR Logic Components & Boolean Algebra	8
EB-3152	Decoders, Multiplexers and Adders	8
EB-3153	Flip-Flops, Registers, and counters Sequential Logic Circuits	8
EB-3154	555, ADC, DAC circuits	8
EB-3170	CAN-BUS System	8
AT-3001	Engine Injection Simulator	4
AT-3002	Electronic Ignition Simulator	4
AT-3003	ABS 4 Channel System Simulator	4
AT-3004	Engine Controls & Sensors Simulator	4
AT-3005	Car air conditioning & Climate Control Simulator	4
AT-3006	Suspension Simulator	4
AT-3007	Transmission Simulator	4
AT-3008	Safety systems Simulator	4
AT-5000	Main Panel (MP) including DCM module	8
AT-5101	Simulator module (SM) - Multipoint Injection	8
AT-5102	Simulator module (SM) Electronic Emission Control	8
AT-5201	Simulator module (SM) Airbag Systems	8
AT-5202	Simulator module (SM) Electronic Stability Program	8
AT-5301	Simulator module (SM) Hybrid Vehicle Systems	8
AT-6000	Fault insertion in a real car system	2

SES Training LABs

The training labs are based on learning-by-doing, which makes the students learn more quickly and remember what they have studied by performing practical experiments. They provide the students high profession skills and the knowledge on how to improve their chance of employment and earning capacity.

The manuals and courseware that accompany each course provide the theory background and experiments.

Electronics Training Lab
This modular laboratory is aimed for the **Electronics** profession, but also for technology disciplines that are also based in electronics, such as: **Electricity, Mechanics, Automotive, Robotics, Automation, Process control**.

Autotronics Training Lab
This modular laboratory is aimed for the five stages that comprise the automotive program: **Basic and automotive electronics, Car sub-systems simulators, Car sub-systems demonstrators, Car diagnostic and troubleshooting methods, Troubleshooting faults in a real car**.

Mechatronics Training Lab
This modular laboratory is aimed for the mechatronics program which includes the following disciplines: **Basic electronics, Pneumatics systems, Hydraulics systems, CNC machines**.

Refrigeration and Air-Conditioning Training Lab
The Refrigeration and Air-Conditioning training lab covers actual components and their interconnection, related functions, operation, diagnosis and repair methods through safe, hands-on practical activities.

Technology Preparation Training Lab
The Technology Preparation (Tech Prep) laboratory is a classroom-integrated laboratory consisting of educational modules covering a wide range of subjects such as: **Green energy, Computerized systems, Basic electronics, Basic communication, Mechanical systems.**

Science Training Labs
These laboratories (for primary, secondary and high schools) introduce the students to the computerized sensors world, **nature and industry processes** and **nature laws**. It will help them understand modern technologies such as: **home and medical appliances, wearing sensors, precise agriculture** and more.

Robotics Training Labs
The robotics programs (for primary, secondary and high schools) help students to build innovation and creativity skills. The idea is to make the students understand how systems work, to believe that they can improve them and be able to realize their ideas.

MultiCenter Training Lab
The MultiCenter offers a variety of selected interactive learning environments, with a large range of topics and activities such as: **Science, Technology, Graphic Design, Digital Music, Robotics, Computer Technologies** and much more for all sectors of society, cultures, different socio-economic groups and different age groups – from very young children to senior citizens.

Our Training Labs:

SCIENCE

ROBOTICS

ELECTRONICS

ELECTRICITY

TELECOMMUINCATION

AUTOTRONICS

MECHATRONICS

MULTICENTER

SCIENCE & ROBOTICS

TECHNOLOGY PREPARATION

REFRIGIRATION & AIR-CONDITIONING

AUTOTRONICS