



# AUTOMOTIVE TRAINING RANGE



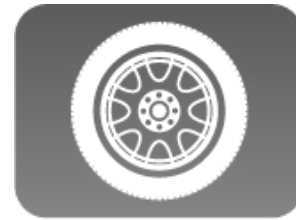
Excellence in education  
for over 30 years

[www.matrixtsl.com](http://www.matrixtsl.com)





# AUTOMOTIVE TRAINING RANGE



The automotive teaching equipment from Matrix has been designed to teach students the underlying technology of vehicle repair. We supply high quality educational resources that allows students to get hands on learning of fundamental subjects, before they move on to working on real vehicles.

Our automotive range is used and endorsed by many of the world's most prestigious automotive manufacturers as a platform for simplifying automotive electrics to complete novices and advanced technicians alike.

## 10 FULL FREE CURRICULUM WITHIN OUR AUTOMOTIVE RANGE :

- Automotive electricity
- Automotive fault finding
- Motors, generators and charging systems
- ECU architecture and logic
- Oscilloscope use
- High voltage battery circuits
- Sense and Control
- CAN bus and LIN bus fundamentals
- CAN bus under the hood
- Build your own vehicle network

“

“Having used the Student Automotive kits for over 15 years, I have found them to be an excellent teaching and instructional aid in giving our students a better understanding of Basic Electrical principles.

We have recently purchased the CAN bus Locktronics kits from Matrix to reflect the more complex systems now being introduced to our vehicles. This has allowed us to better structure our courses. Increasing the practical content when using these kits, has a distinct advantage in that it gives our students more of a hands on approach to these new technologies.

Being able to construct and test a CAN network using the Locktronics kits, they find it easier to understand the principles and operation of Multiplex systems, when they are applied to our vehicles.

The new kits allow us to simulate all these systems on a table top, which certainly has the benefit in that all the students are involved at the same time.”

*Kevan Woodier*

“

## CAN BUS Training

“Using the Locktronics CANBUS equipment makes it so easy for us to delivery and educate delegates to help them understand how it work and to diagnose. As with all technicians they learn better with practical tasks, and traditionally CANBUS systems are difficult to understand as there is not a lot to see, but with the Locktronics equipment and the delegates actually constructing their own system to make it work and run through some troubleshoot really give the Technicians confidence in applying it to real world situations on actual vehicles.

*Eliot Smith – Director / Instructor*



*Pro-moto*

”

## High Voltage Battery Systems

Simple stuff like how does a HV battery start up and shut down can be sometimes difficult to grasp. With the Locktronics components we get them to replicate the switching of the HV battery contactors and their relationship with the capacitor charge-up process. With this they make their own circuit based on prior learning and work out how the system works.”

*Eliot Smith – Director / Instructor*



Range Coverage

www.matrixtsl.com/learning

Automotive Electricity  
CP4388

Basics of Automotive Electricity  
LK2240

Automotive Fault Finding  
CP0687

Automotive Fault Finding  
LK8170

Automotive Motors, Generators & Charging  
CP5937

Automotive Motors, Generators and Charging Systems  
LK2410

Matrix DC Motor / Brushless DC Motor Pair  
HP2001

Automotive ECU's, Architecture and Logic  
CP8408

Automotive ECU Architecture and Logic  
LK1800

Automotive High Voltage Battery Circuits  
CP6290

Batteries and High Voltage Systems  
LK5281

Matrix DC Motor / Brushless DC Motor Pair  
HP2001

Automotive Oscilloscope Use  
CP5950

Automotive Oscilloscope Use  
LK9155

Automotive Sense and Control  
CP7241

Sense and Control V3  
LK1142

Automotive Actuators and Sensors Add-on  
HP8256

CAN bus and LIN Bus Fundamentals  
CP0607

CAN and LIN Bus Systems  
LK0235

Automotive Actuators and Sensors Add-on  
HP8256

CAN Bus: Under the Hood  
CP0411

CAN and LIN Bus Systems  
LK0235

LEARNING CENTRE

Enter the product code on the learning centre to find the curriculum

PRODUCT NAME

PRODUCT CODE

All solutions from Matrix come with a full free curriculum. This is easily accessed from our Learning Centre on the website and includes full student worksheets and teachers notes.

LEARNING CENTRE

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Our sales team are available to speak to you

Call or email us now

+44 (0) 1422 252 380

sales@matrixtsl.com

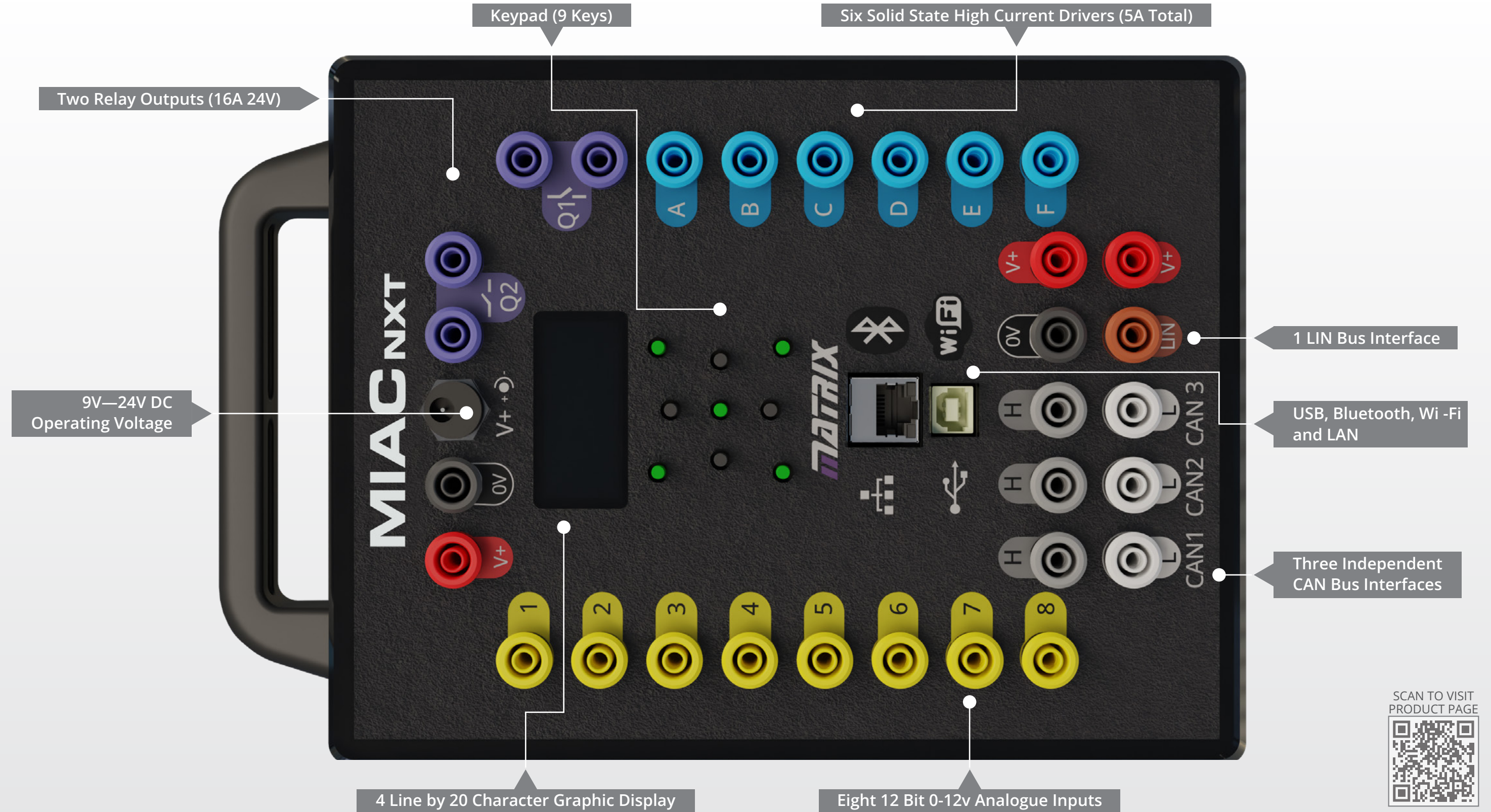
www.matrixtsl.com



The MIAC NXT is an educational Electronic Control Unit designed specifically for use in teaching automotive students how ECUs are used to control the electronic systems in vehicles. The MIAC NXT includes 8 analogue or digital inputs, 2 relays, 6 transistor outputs, 3 CAN buses, a LIN bus and connections for USB, Bluetooth, Wi-Fi and LAN. The MIAC NXT is provides with an accompanying operating system, or API, which allows it to be controlled by any third party programming system and is compatible with Flowcode Embedded and Flowcode App Developer. The MIAC NXT is built with real automotive technology and provides the same functionality as an automotive ECU. J1939 and OBDII connection are supported through software libraries within Flowcode software which are user accessible and allow users to create their own automotive system.

KEY FEATURES

- World's only educational ECU
- Real automotive componentry
- Supports J1939 open CAN standard
- 8 inputs
- 2 relays
- 6 transistor outputs
- 3 x CAN bus
- 1 x LIN bus
- USB, Bluetooth, Wi-Fi and LAN
- Full API provided
- Flowcode compatible.

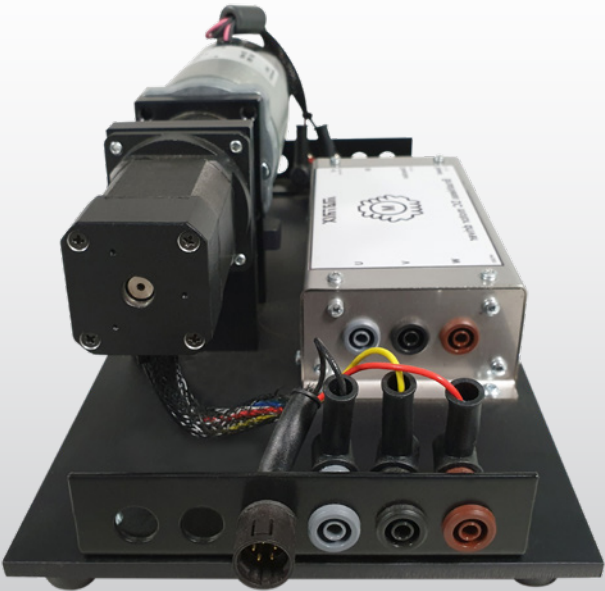
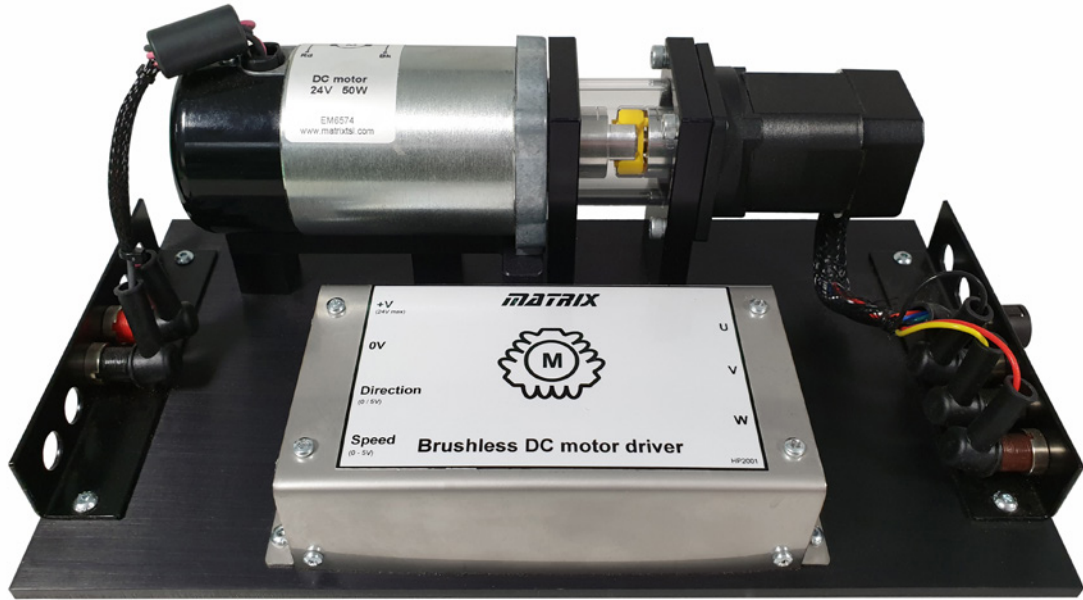




Matrix DC Motor / Brushless DC Motor Pair

HP2001

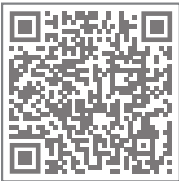
The HP2001 DC motor/brushless motor pair allows students to study the concepts of motors and generators. The HP2001 consists of a 24V DC motor coupled to a 24V brushless three phase motor with integral brushless motor driver module. The two motors are coupled together but the rotating parts are contained under a clear plastic tube so that no rotating parts are exposed. The system can be driven both ways: A DC voltage between 0V and 24V can be applied to the DC motor and the Brushless DC motor then generates three phase electricity. Conversely the Brushless motor can be driven with 24V and a single analogue voltage control signal and the DC motor acts as a DC generator.



This permanently coupled Brushless motor and DC motor on a platform is required for study of the following kits:

- LK8170 Automotive fault finding (final worksheets only)
- LK2410 Automotive motors, generators & charging systems
- LK5281 Automotive high voltage battery circuits

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PRODUCT PAGE



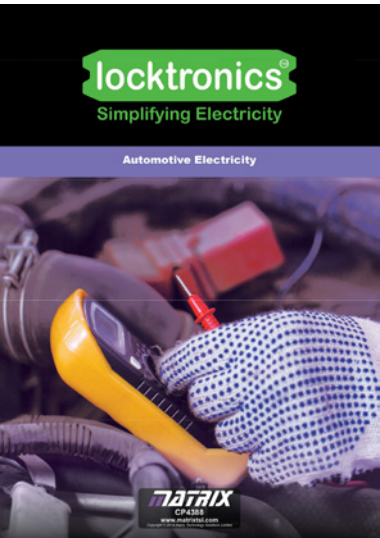
Basics of Automotive Electricity

LK2240

This level 1 course allows students to understand the key concepts that underpin automotive electricity. Each worksheet provided includes an introduction to the topic under investigation, step by step instructions for the investigation that follows and a summary of the significance of the results. A pattern that is followed through all of the Locktronics worksheets used to deliver the courses in our automotive range.



ANSI version also available **LK2240A**



LEARNING OBJECTIVES & EXPERIMENTS:

- Ohm's law
  - Voltage power
  - Current -DC
  - Resistance
  - Magnetism
  - Electromagnetism
  - Electrical units and symbols
  - Electrical terminology
  - DC motors
- Switches
  - Solenoids and principles of relays
  - A complete solution to learning
  - Includes carriers, baseboard and power supply
  - Includes worksheets with teacher's notes

Additional Instruments Required. **See Page 19**

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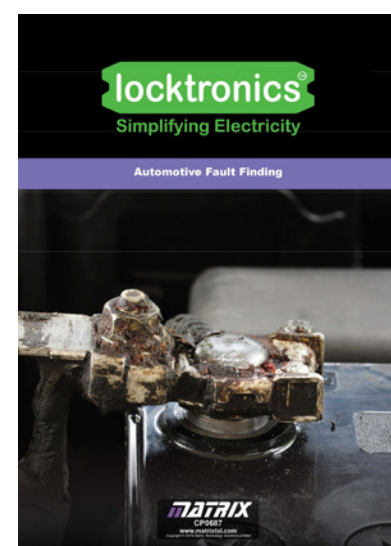




## Automotive Fault Finding

LK8170

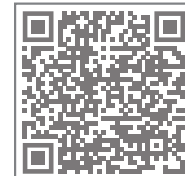
This kit teaches students and automotive technicians the techniques of fault finding in an automotive context. Students are provided with a series of clear worksheets which guides them through a series of practical exercises using Locktronics components and base boards. The worksheets start with instruction on using multimeter's and current clamp meters for testing each type of component and making basic measurements. Students are then guided through debugging circuits using multimeter's and clamp meters using techniques like fault grids


ANSI version also available **LK8170A**


### LEARNING OBJECTIVES & EXPERIMENTS:

- Use of multimeter's and clamp meters
- Current, voltage, resistance, capacitance, continuity
- Voltage drop
- Testing resistors, potentiometers, bulbs, switches, relays, thermistors, batteries
- Open circuit faults
- Short circuit faults
- Ground faults, and corrosion
- Fault finding techniques and fault grids
- Fault finding projects
- A complete solution to learning
- Includes carriers, baseboard and power supply
- Includes worksheets with teacher's notes

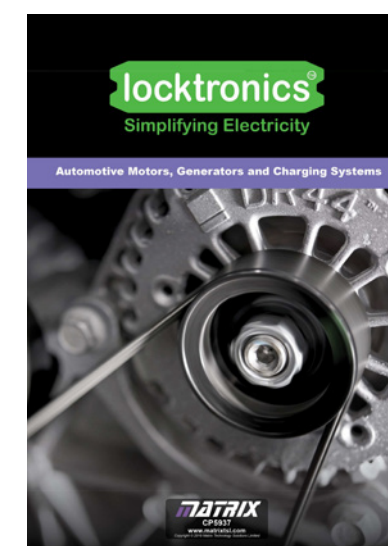
Additional Instruments Required. **See Page 19**

SCAN TO VISIT  
PRODUCT PAGE


## Automotive Motors, Generators & Charging Systems

LK2410

This kit allows students to investigate the technology behind motors and charging systems. Students start by understanding the basics of motor construction and then carry out a range of experiments that helps them understand how charging systems in vehicles work. A key theme of this pack is introducing the use of oscilloscopes and triggering oscilloscopes for simple signals: AC, DC pulse width modulated and single pulse. Suitable for Level 2 students and technicians. A full workbook of exercises is provided. This kit relies on the HP2001 DC/Brushless DC motor pair which is ordered separately.


ANSI version also available **LK2410A**


### LEARNING OBJECTIVES & EXPERIMENTS:

- Current - AC, DC, RMS
- Motor principles
- Generator principles
- DC permanent magnet motor, brushless three phase motor, three phase generator
- Half and full wave rectification
- Three phase rectification
- Charge systems in vehicles
- DC power supplies and ripple
- Zener diodes
- DC motor control using Pulse Width Modulation
- Oscilloscope triggering
- Generating high tension
- Fault finding in high tension systems

Additional Instruments Required. **See Page 19**

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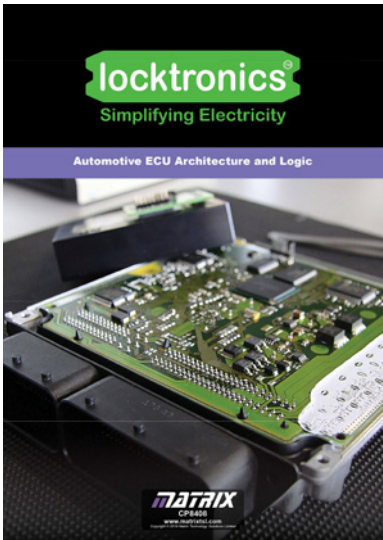

Automotive ECU Architecture and Logic

LK1800

This kit allows students to investigate Electronics Control Unit circuits using a pre-programmed micro ECU. Students start by building a fully functioning ECU with inputs, a relay and a transistor output and carry out the bulk of learning with it. Students construct a circuit around the ECU, select one of 14 programs on the ECU and work through the workbook provided. The workbook includes a number of fault finding exercises so that students can understand how faults in ECU circuits can be diagnosed and interpreted. Suitable for Level 3 students and technicians. A full workbook of exercises is provided.



ANSI version also available **LK1800A**



LEARNING OBJECTIVES & EXPERIMENTS:

- ECU operation and structure
- Logic functions
- Pulse width Modulation
- Inputs and switches
- Sensors – light, temperature, Hall effect
- Transistor and relay outputs
- Simple actuators – motors and solenoids
- Fibre optics
- Fault finding in ECU circuits

Additional Instruments Required. **See Page 19**

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PRODUCT PAGE



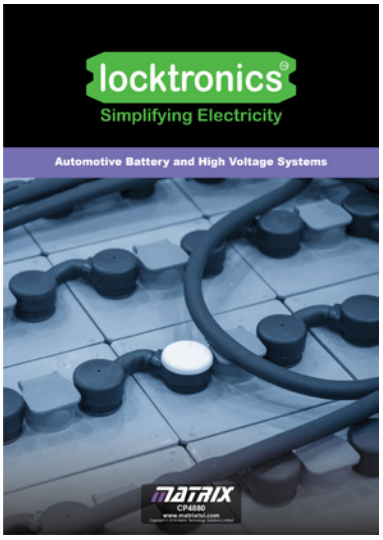
Batteries and High Voltage Systems

LK5281

The kit includes a number of small lead acid and lithium-ion batteries that can form various batteries with different voltage and current capabilities. Students construct circuits around these batteries and understand the battery circuits used in modern electric vehicles including charging systems, voltage up converters and down converters, battery management systems. Students build batteries of different voltage and current capabilities and measure and characterise battery performance and test batteries. Various fault components are included so that students can understand fault finding in battery systems. Students will also require the Matrix DC motor / Brushless DC motor pair (available separately, see HP2001). Suitable for Level 3 students and technicians. A full workbook of exercises is provided.



ANSI version also available **LK5281A**



LEARNING OBJECTIVES & EXPERIMENTS:

- Lead Acid battery technology
- Lithium Ion battery technology
- Testing of batteries
- Battery construction
- Building large batteries from small batteries
- Charging systems
- Battery management systems
- Voltage converters
- Powering DC motors
- Powering three phase motors
- Three phase generators
- Fault finding in battery systems
- Electric vehicle project

Additional Instruments Required. **See Page 19**

SCAN TO VISIT  
PRODUCT PAGE





## Automotive Waveform Generator

LK9155

The LK9155 Oscilloscope trainer has been designed to provide a platform on which automotive technicians can be trained to use an oscilloscope to capture and diagnose automotive waveforms. The unit is capable of generating several basic waveforms, sine, triangle, square wave, as well as a number of pre recorded waveforms. The unit also generates CAN bus signals – high and low.

The desk mounted unit is powered from an external plug top 12V power supply. It has a graphical LCD display and two signal selection UP and DOWN button switches to the left of the display. Two additional button switches on the right of the display are used for waveform properties sub-selection for individual waveforms. The unit can be used with traditional oscilloscope probes or with 4mm 'banana plug' wires and connectors. The unit is housed in a rugged plastic case.

Students are asked to practice triggering the oscilloscope using the small buttons to select a number of automotive waveforms and to take measurements from those waveforms. Finally students are tasked with capturing CAN bus signals and decoding them. Teacher's notes are provided.



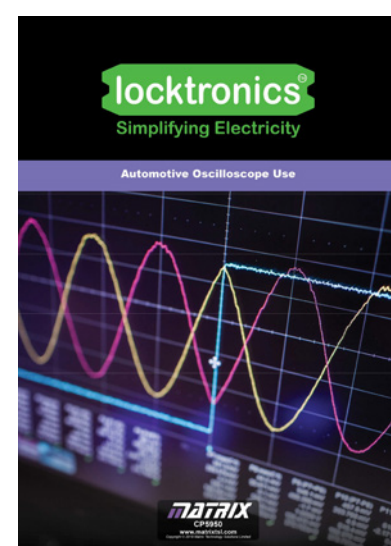
**There are currently 3 options available in the range:**

LK9155 - VW waveforms

LK9155-Vol - Volvo waveforms

LK9155-Dai - Daimler (Mercedes waveforms)

New waveforms can be added to the unit by Matrix staff if Pico technology devices are used to capture the waveforms. If this is of interest then please get in touch.



### LEARNING OBJECTIVES & EXPERIMENTS:

- CAN bus signals – high and low
- Sine, Triangle and Square Waveform
- Capturing CAN bus signals and decoding
- Triggering Waveforms
- Graphical LCD display
- Rugged Case
- Desk Mounted

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PRODUCT PAGE



## Sense and Control V3

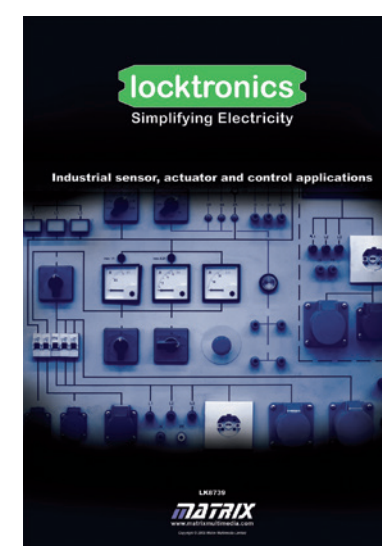
LK1142

This solution provides an introduction to the role of an Electronic Control Unit (ECU) based on our MIAC NXT controller. Students are provided with a number of pre-written programs for the MIAC which they call up using the keypad and display. They then construct different INPUT – PROCESS - OUTPUT - circuits around the MIAC using firstly Locktronics components and then real automotive components.

The Sense and Control system can be enhanced through the addition of real automotive sensors that are added to the system.



ANSI version also available **LK1142A**



### LEARNING OBJECTIVES & EXPERIMENTS:

- ECU structure and function
- Lamps and actuators
- Transistor outputs
- Relay outputs
- Digital inputs
- Analogue inputs
- Open vs closed loop
- Controlling DC motors
- Controlling stepper motors
- Circuit design for fault finding
- A complete solution to learning
- Includes carriers, baseboard and power supply
- Includes worksheets with teacher's notes
- Includes MIACNXT

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PRODUCT PAGE

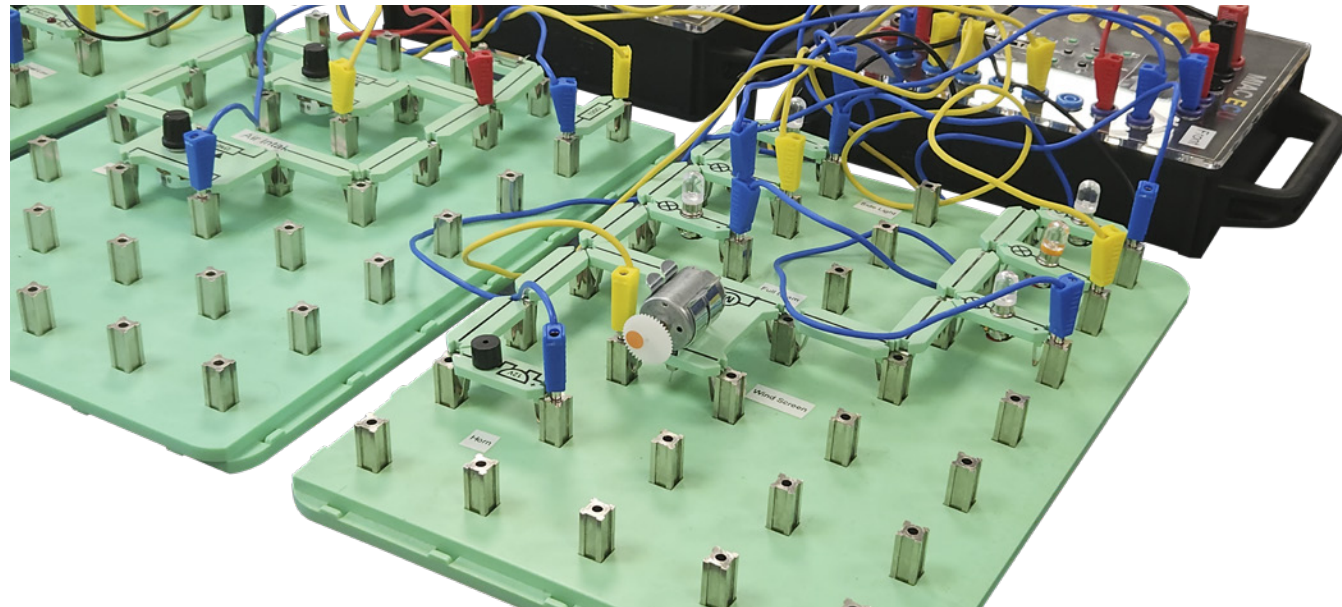




## CAN and LIN Bus V3

LK0235

This consists of 6 MIAC NXT educational Electronic Control Units and accompanying Locktronics boards which mimic the electrical system in a vehicle. The system includes 3 CAN bus networks at different speeds: CAN convenience bus, CAN drive train bus, CAN OBDII bus and a LIN bus for the instrument cluster. One MIAC NXT performs the function of a Gateway ECU which provides communication between the system and OBDII scan tools.

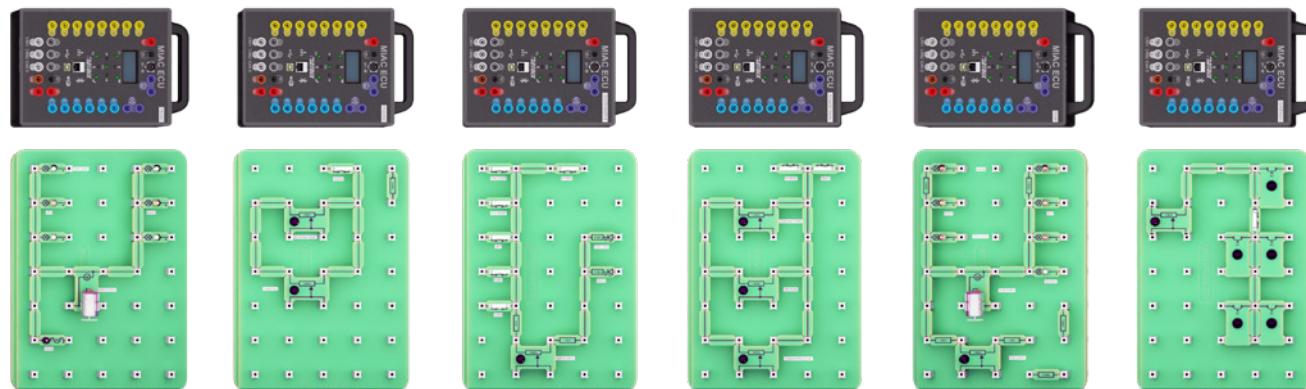


## CAN and LIN Bus Software

Software included allows a Windows PC to connect to the hardware and show the communications flowing through the various busses on the software. It emulates a simple dashboard and includes decoded readouts for various sensors and actuators in the system. Selecting each of the decoded readouts will highlight the corresponding bus and message showing where the data is coming from. Also available is a console view with optional filter that provides a time based log of the incoming messages. Messages can also be overridden or injected into the running system.

## The 6 Locktronics / MIAC Nodes are:

- A – Body and control front
- B – Engine control
- C – Instrument control
- D – Powertrain control
- E – Body control – rear
- F – Gateway and master



## CAN and LIN Bus V3

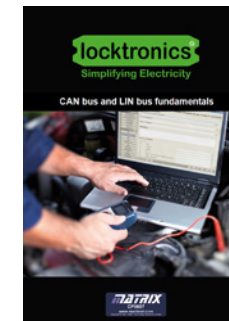
LK0235

The CAN and LIN bus system can be enhanced through the addition of real automotive sensors and actuators that are added to the system.

Accompanying free curriculum is provided for Level 3 students (CAN and LIN BUS fundamentals) and level 4/5 students (CAN bus: Under the hood). The system makes use of the J1939 open CAN bus standard and the J1979 OBDII standard so that it is compatible with all third party scan tools.

## CAN and LIN Bus Fundamentals CP0607

This course gives an introduction to the use of CAN buses and LIN buses in automotive applications. It is a practical course designed to teach students the basics of CAN and LIN bus connections and voltages, and it also teaches students how to debug faults in CAN and LIN systems.



## LEARNING OBJECTIVES &amp; EXPERIMENTS:

- CAN and LIN bus wiring
- ECU function
- Network topology
- CAN and LIN bus
- Using scan tools
- Debugging CAN bus systems with a multimeter
- Circuit design for fault detection

## CAN Bus Under the Hood CP0411

This course takes the student a step further into CAN and LIN bus protocols and explains how they are used to pass information between the ECUs in a vehicle. The course also gives an insight into how vehicle designers construct a system of ECUs and circuits to provide the functionality that modern vehicles require.



## LEARNING OBJECTIVES &amp; EXPERIMENTS:

- PC based diagnostics
- Sensors and actuators in CAN and LIN bus systems
- CAN bus message encoding
- LIN bus message encoding
- ECU and vehicle circuit function
- Gateway function: CAN to LIN, LIN to CAN
- Start up routines
- J1939 CAN bus protocol
- OBDII functions

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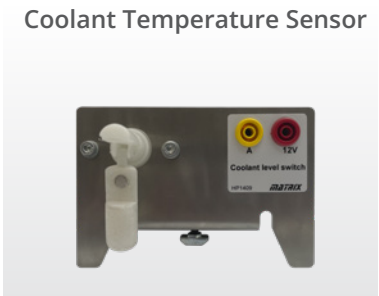
Automotive Actuators and Sensors Add-on

HP8256

This collection of real automotive sensors provides additional functionality to both the Sense and Control and the CAN and LIN bus packages. The sensors allow students to migrate from the electronic component sensors found in Locktronics to real automotive sensors and to understand the difference between them.

All sensors are mounted onto a rugged stainless steel bracket with 4mm connectors that allow for bench mounting or mounting on 40mm extruded rails with T nuts. All sensors are useable with both Sense and Control V3 (LK1142) and CAN and LIN bus V3 (LK0235).

SENSORS INCLUDE:



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Additional Instruments

Product	Instrument Required
LK2240 Basics of Automotive Electricity	LK1110
LK8170 Automotive Fault Finding	HP2001, HP2222, HP1324
LK2410 Automotive Motors, Generators & Charging Systems	HP2001, HP2222, HP1324, HP8279
LK1800 Automotive ECU Architecture and Logic	HP2222, HP1324, HP8279
LK5281 Batteries and High Voltage Systems	HP2001, HP1324, HP8279
LK9155 Oscilloscope trainer	HP8279
LK1142 Sense and Control	HP8279, LK1110
LK0235 CAN bus trainer	HP8279

Multimeter (LK1110)



Fluke 115 True RMS Digital Multimeter (HP1324)



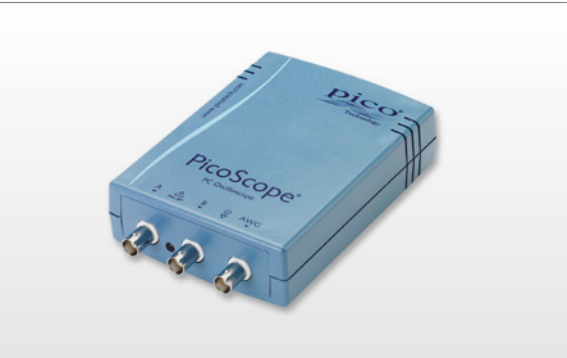
Matrix DC Motor / Brushless DC Motor Pair (HP2001)



Digital Clamp Meter (HP2222)



25MHz PC Based Oscilloscope/ Signal Generator Pack (HP8279)





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