

2015 Edition

MATRIX

Simplifying technology

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FLOWCODE6®



FLOWCODE SE



AUTOMATICS



MIAC

Welcome to Matrix



Our commercial team from left to right: Mark Illidge, Laura Stevens, John Dobson, Nichola Normanton, Chris Partington and Liam Walton

It has been a year of consolidation for us here at Matrix: in terms of our premises, our new building is almost watertight – Finally! Everything is decorated nicely, artwork is on the walls, carpets are down and plants installed.

We have hired a number of new people this year to help take us forward: our commercial team now numbers 6 people and we sell products to more than 50 countries across the World. We now ship huge orders with great speed and seemingly little effort. Recently we supplied Ford training centres in Indonesia, Singapore, Thailand, and the Philippines with Locktronics automotive training equipment. Early in 2014 we supplied a number of vocational schools in Peru with a large amount of equipment for delivering courses in electricity and electronics. (I am looking forward to going to Lima to deliver product training early next year.)

On the product development front we have spent the last 12 months polishing our Flowcode software and it is now looking rather nice. A really great accolade for Flowcode is that large numbers of practicing engineers are now using the software in industry. In one month alone this year we sold in excess of 300 professional copies to practicing engineers who use Flowcode for a wide range of projects from developing test systems for cars to burglar alarms for large buildings.

A big initiative for us this year has been to develop more products for the Arduino processor and Flowcode and E-blocks are now compatible with Arduino and Arduino compatible hardware boards. Arduino has been great for electronics as a subject and has encouraged lots of technically creative individuals into the world of Electronics.

Thanks for taking the time to look at our 2015 catalogue and I hope that you have a great year.

John Dobson
Managing Director

Keep in touch with new developments:



New products this year include:



New dsPIC board



New Arduino shield with chipKIT



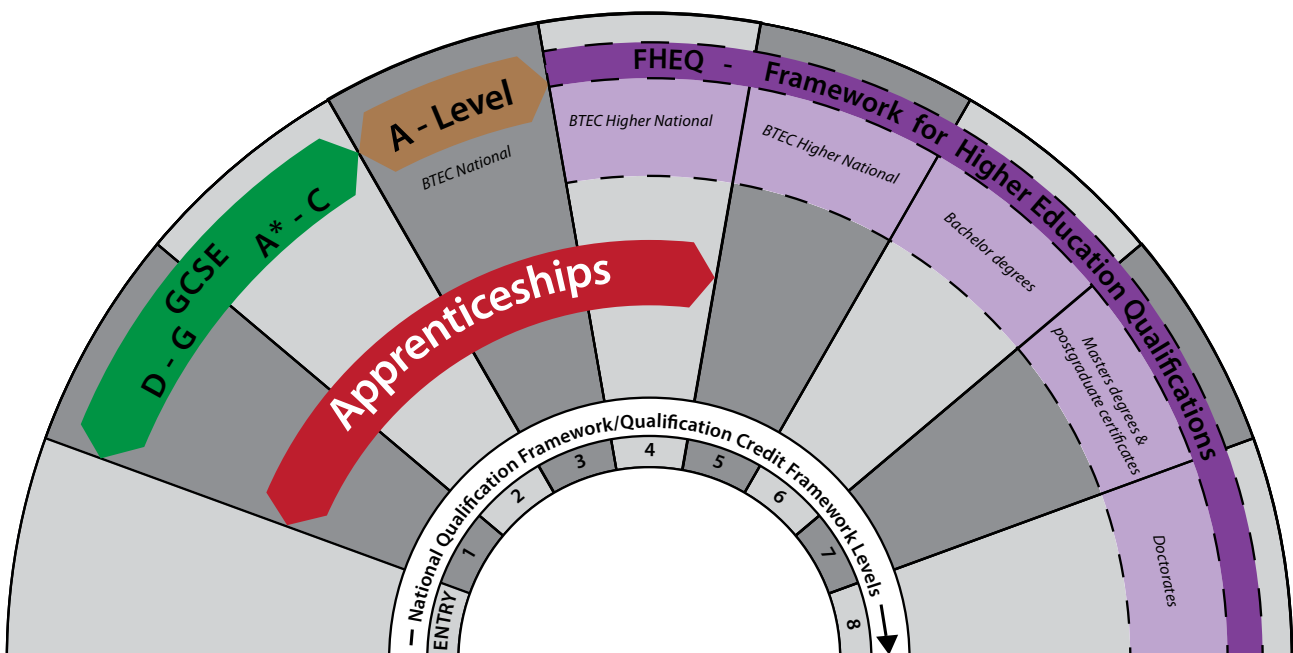
New motors board



Three phase Locktronics kit

Curriculum mapping

	Science/Physics	Technology/ Computer Science	Aviation	Automotive
Level 4, 5, 6 Levels 4, 5, 6 correspond to BTEC Higher National Diploma, or degree level at 18+ years old			EASA electrical fundamentals. EASA module 3. LK9339. EASA electronic fundamentals. EASA module 4. LK9282.	
Level 3 Level 3 corresponds to A level or BTEC National Diploma usually at an age of 18 years old	Physics A level kit. KS5. LK9329. A level Physics class pool kit. KS5. LK6802.			Sense and control in automotive applications. Level 3. LK9834. CAN bus systems and operation. Level 3. LK7629. Hybrid vehicle demonstration system. Level 3. LK6483.
Level 1, 2 Level 2 corresponds to GCSE grades A-C at 16 years old, or BTEC First	Electricity, magnetism and materials kit. KS3 & KS4. LK9071. Energy and environment. KS4. LK7345. Fundamentals of electricity. KS1 & KS2. LK6444.	PIC micro microcontroller systems investigation. KS3/4. LK8922 Computer science and control 1. KS3/4. SE4829. Programming Arduino microcontrollers. KS3/4. HP7745. Programming the RPi. KS4. HP4930. Simple microcontroller circuits. KS3/4. SE3829.	Design and make electronic products. KS3/4. SE4855. Introduction to robotics. KS3/4. HP794. Automatics essentials solution. KS3/4. AU9020. Electro-pneumatics add-on kit. KS3/4. AU9015. Pneumatics control add-on kit. KS3/4. AU90910.	AC principles for Automotive technicians. Level 2. LK8222. Introduction to motors, generators, and hybrid. Level 2. LK7444. Introduction to digital electronics. Level 2. LK4221. Electricity, magnetism and materials kit. Level 1. LK9071.



Curriculum mapping

Engineering			
Robotics/automation/mechatronics	Electrical engineering	Electronic engineering	
<p>Mechatronic systems. Unit 57 HNC. HP4550.</p> <p>Dynamic seat. Unit 57 HNC. HP8834.</p> <p>Motor control training course. Unit 57 HNC. EB8493.</p>	<p>Three phase systems. Unit 63 HNC. LK4961.</p>	<p>Advanced electronic principles. Unit 39 HNC. LK6804.</p> <p>Adv. electrical/electronic & digital principles. Unit 66 HNC. LK9044.</p> <p>Programming PICmicro microcontrollers with C. Unit 57 HNC. HP4832.</p> <p>Programming PICmicro MCUs with Assembly. Unit 57 HNC. HP4832.</p>	<p>Audio DSP course. EB650.</p> <p>USB training course. EB479.</p> <p>CAN bus training course. EB237.</p> <p>Bluetooth training course. EB860.</p> <p>Mobile phone training course. EB118.</p> <p>Embedded internet training course. EB643.</p> <p>RFID training course. EB699.</p> <p>Zigbee course. EB284.</p> <p>FPGA course. EB940.</p>
<p>Automatics essentials solution. Unit 15 NC. AU9020.</p> <p>Electro-pneumatics add-on kit. Unit 15 NC. AU9015.</p> <p>Pneumatics control add-on kit. Unit 22 NC. AU9010.</p>	<p>Intermediate electrical and electronic principles. Unit 5, 101 HNC. LK9862.</p> <p>Industrial sensors, actuators and control. Unit 25 NC. LK5783.</p>	<p>Operational amplifiers add-on pack. Various. LK6906.</p> <p>Combinational logic add-on pack. Various. LK6904.</p> <p>Sequential logic add-on pack. Various. LK6905.</p>	<p>Transistor amplifier add-on pack. Various. LK9435.</p> <p>Principles and applications of electronic devices and circuits. Unit 35 NC. LK9422.</p> <p>Programming PICmicro microcontrollers with flow charts. Unit 59 NC, 22 HNC. HP4832.</p> <p>Programming Arduino microcontrollers with flow charts. Unit 59 NC, + unit 22 HNC. HP7745.</p>
Basic engineering - BTEC First			
<p>Applied electrical science. Unit 4 F. LK9071.</p> <p>Electronic devices and communication applications. Unit 7 F. LK3889.</p> <p>Fault finding in electronic circuits. Unit 13 F, 60 NC. LK3566.</p> <p>Automatics interactive courseware. Unit 24 F, AW20780.</p> <p>Automatics essentials solution. Unit 24 HNC, AU9020.</p>			

On these two pages you can see a map of the solutions we offer for delivering practical work. These are all mapped to internationally renowned syllabuses from BTEC, City and Guilds and the IMI and the UK's academic levels of achievement.

To understand the academic level system you can use the diagram on the left published by the UK Office of Qualifications.

F = BTEC First

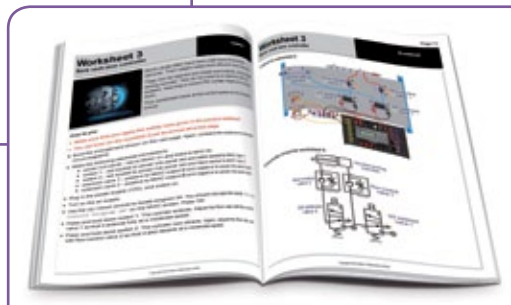
NC = BTEC National Certificate

HNC = BTEC Higher National Certificate

*Please note, all images are intended as a guide only.
The actual kit may differ from that shown*

Solutions

In the following pages we present our solutions for learning and teaching: from basic science through to Automotive technology. All our solutions are available with the curriculum needed to deliver successful experiments and learning in the lab. If you want to know more about the ranges of products these solutions are made up of then please see the second section of the catalogue.



Our learning solutions:

- Include curriculum which guides students through the experiments and saves teachers' preparation time
- Are rugged and designed to withstand the rigours of the lab
- Have storage trays as standard - or can be provided as options
- Are linked to the requirements of internationally recognised syllabuses
- Are designed in conjunction with experienced teachers



"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, IVECO.

Locktronics is used in around 2,000 schools and colleges for teaching the fundamental principles of electricity from age 8 upwards. In this section we list our solutions for science.



Our learning solutions:

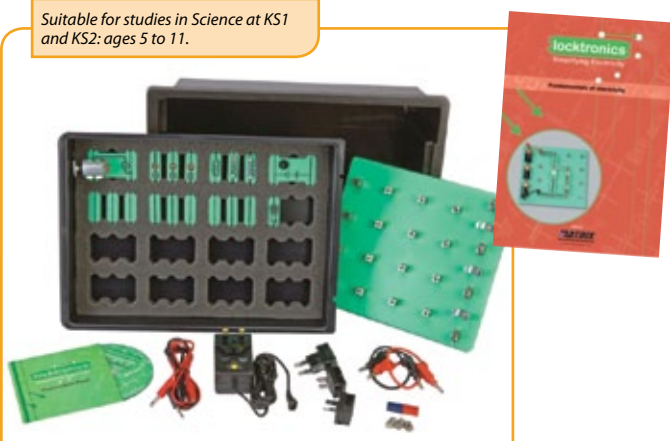
- Meet RoHS compliancy stipulations and are rugged and designed to withstand the rigours of the lab or classroom
- Clearly display circuits to learners to develop their understanding of the topic being studied
- Allow for the building of solid foundational knowledge with the ability to build on this knowledge with advanced topics
- Include curriculum which guides students through the experiments and saves teachers preparation time



Locktronics kits have been very simple to use, and the printed symbols have allowed learners to see how the circuit diagrams they are learning from are really put together. The kits are robust, very adaptable, and easy to store and keep track of - ideal for use with teenagers, and easy to look after in a classroom environment. They are simple to connect and use, with a wide range of components and kits available to adapt to the needs of the National 5 and Higher curriculum for Engineering Science in Scotland. I have found that Locktronics has added a welcome practical experience that can make learning more real - circuits can be designed and simulated in other software packages such as Yenka, but this doesn't replace real testing in real life.

Graham Dick, Buckhaven High School, Scotland

Suitable for studies in Science at KS1 and KS2: ages 5 to 11.



Fundamentals of electricity

This kit provides an introduction to the fundamentals of electricity. It is ideal for those who are completely new to the subject, and is suitable for use from ages 8+. The kit is supplied with 30 pages of notes and worksheets on CD ROM.

Learning objectives / experiments

- What is electricity?
- Simple electrical components
- The simplest circuit
- Conductors and insulators
- Switches
- Two way switches
- Series circuits
- Parallel circuits
- Buzzers
- Motors

Components included

1	Curriculum CD ROM	3	MES bulb, 6.5V, 0.3A
9	Connecting Link	1	Power supply carrier with battery symbol
3	Lampholder, MES	1	Power supply
1	Switch, push to make, metal strip	1	Pair of leads, red and black, 600mm, 4mm to croc clip
1	Switch, on/off, metal strip	1	Small bar magnet
1	Buzzer, 6V, 15mA	1	Locktronics User Guide
1	Motor 3 to 12V DC, 0.7A	1	Switch, reed, normally open
1	4 x 4 baseboard with 4mm pillars and battery holders	1	Lead, red, 500mm, 4mm to 4mm stackable
2	MES bulb, 2.5V, 0.2A	1	Lead, black, 500mm, 4mm to 4mm stackable

Ordering information	DIN	ANSI
Fundamentals of electricity with baseboard, storage tray and DC power supply.	LK6444	LK6444A
Corresponding curriculum	LK6816	



Suitable for studying electricity as part of a science course from ages 11 to 16. (In the UK suitable for KS3 and KS4).

Electricity, magnetism and materials V2

This kit provides a comprehensive range of practical assignments in electricity and magnetism and is ideal for those who are studying science and electricity within a wide variety of academic or vocational courses. The kit is supplied with a comprehensive set of worksheets that cover the electrical properties of materials and introduce students to electricity.

Learning objectives / experiments

- Electrical properties of materials
- Simple circuits
- Heat and magnetism
- Basic circuit symbols
- Current flow
- Series and parallel circuits
- Patterns of voltage and current
- Electrical sensors
- Relays and electromagnets

Instruments

To deliver this course you will also need:

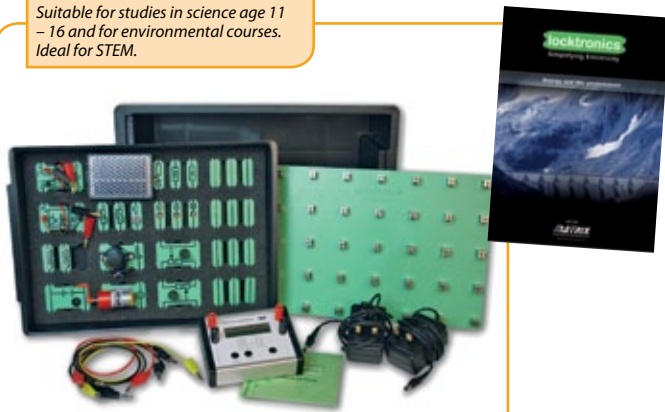
LK1110	Multimeter pack
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Components included

1	Switch, push to make, metal strip	1	400 Turn coil carrier
1	Power supply	1	Thermistor, 4.7k, NTC (DIN)
1	Resistor, 12 ohm, 1W, 5% (DIN)	1	LED, red, 12V (SB)
1	Motor, 6V, open frame	1	Voltmeter, 0V to 15V
1	Photodiode	1	Relay, reed, normally open
2	Resistor, 1k, 1/4W, 5% (DIN)	1	Pair of leads, red and black, 600mm, 4mm to croc clip
1	Resistor, 10k, 1/4W, 5% (DIN)	1	Power supply carrier with battery symbol
1	Potentiometer, 10k (DIN)	1	Fuse/universal component carrier
1	Diode, power, 1A, 50V	1	Curriculum CD ROM
9	Connecting Link	1	Buzzer, 12V, 15mA
3	Lampholder, MES	1	Switch, on/off, metal strip
1	7 x 5 metric baseboard with 4mm pillars	1	Resistor, 100 ohm, 1W, 5% (DIN)
1	Ammeter, 0A to 1A	1	EMM V2 Accessories pack
1	Resistor 1M, 1/4W, 5% (DIN)	1	Resistor, 47k, 1/4W, 5%

Ordering information	DIN	ANSI
Electricity, magnetism and materials solution with storage, baseboard and power supply.	LK9071-2	LK9071-2A
Corresponding curriculum	LK7325 & LK7326	

Suitable for studies in science age 11 – 16 and for environmental courses. Ideal for STEM.



Energy and the environment

This course provides an introduction to renewable energy generation and energy saving measures through intelligent building control. As such, it addresses the aims of a number of courses in Science and Technology. A comprehensive set of curriculum worksheets and supporting documentation deliver experiments to illuminate the issues raised.

Learning objectives

- Advantages / disadvantages of renewable energy sources: photovoltaic, wind, wave, hydroelectric
- Solar cells and their operation
- Electricity generators
- Solar heating and energy storage
- Voltage regulation
- Efficiency of a filament lamp and LED lamp
- Insulation and double glazing
- Energy efficient building design using microcontrollers

Instruments

To deliver this course you will also need:

LK1110	Multimeter pack		
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Components included

1	Power supply carrier with battery symbol	1	Lead, yellow, 500mm, 4mm to 4mm stackable
1	USB reprogrammable PIC carrier with power lead	2	Lead, black, 500mm, 4mm to 4mm stackable
2	Thermistor, 470 ohm, NTC (DIN)	2	Lead, red, 500mm, 4mm to 4mm stackable
1	Phototransistor	1	Lampholder, MES, for automotive LEDs
2	Lampholder, MES	2	Switch, push to make, metal strip
12	Connecting Link	1	Locktronics User Guide
1	Solar cell	1	MES bulb, 6.5V, 0.3A
1	Hand cranked generator	1	Potentiometer, 10k (DIN)
1	MES bulb, 6V, 0.04A	1	Resistor, 1k, 1/4W, 5% (DIN)
1	Slotted opto sensor with 2mm to 4mm lead	1	7 x 5 metric baseboard with 4mm pillars
2	Power supply	1	Energy Meter
1	Capacitor, 22,000uF, Electrolytic 16V	1	Resistor, 270 ohm, 1/2W, 5% (DIN)
1	LED, red, 5V (SB)	1	Curriculum CD ROM
1	MES bulb, 12V, LED, white	1	Resistor 1M, 1/4W, 5% (DIN)
1	Resistor, 47K, 1/4W, 5%		

Ordering information	DIN	ANSI
Energy and environment solution including storage, power supply and energy meter.	LK7345-2	LK7345-2A
Corresponding curriculum	LK7122	



Suitable for studying electricity as part of a Physics course aged 16 to 18 (A level courses in the UK).

Physics A level kit

The kit provides a comprehensive range of practical assignments for electricity and magnetism and is ideal for those who are studying science and electricity at a more advanced level. The kit is supplied with a comprehensive set of worksheets and teachers' notes.

Note

To add PICmicro investigation to this kit please see the PICmicro add-on kit on our web site.

To add Operational amplifier investigation to this kit the Op-amp add-on kit on page 23.

Instruments

To deliver this course you will also need:

LK1110	Multimeter pack	HP8279	Picoscope
HP7894	Signal generator		

Components included

1	Resistor, 10 ohm, 1W 5% (DIN)	1	Resistor, 5.6k, 1/4W, 5% (DIN)
1	1:1 transformer with retractable ferrite core	1	Transformer, 2:1 turns ratio
1	Capacitor, 22,000uF, Electrolytic 16V	1	Resistor, 3.9 ohm, 3W, 5% (DIN)
1	Phototransistor	1	Potentiometer, 250 ohm (DIN)
1	Thermistor, 4.7k, NTC (DIN)	1	Curriculum CD ROM
1	Resistor, 22k, 1/4W, 5% (DIN)	1	Resistor, 2.2k, 1/4W, 5% (DIN)
1	Resistor, 1k, 1/4W, 5% (DIN)	1	Capacitor, 2,200 uF, Electrolytic, 25V
1	Resistor, 100 ohm, 1W, 5% (DIN)	1	Constantan Wire Carrier, 0.075 x 500mm
1	LED, red, 12V (SB)	1	Nichrome Wire Carrier, 0.21 x 500mm
1	Resistor, 47 ohm, 1/2W, 5% (DIN)	1	Nichrome Wire Carrier, 0.075 x 250mm
1	Choke, 47mH	1	Nichrome Wire Carrier, 0.075 x 500mm
1	Switch, on/off, metal strip	1	Capacitor, 1,000 uF, Electrolytic 30V
1	Power supply	1	Small bar magnet
1	7 x 5 metric baseboard with 4mm pillars	1	Power supply carrier with battery symbol
1	Resistor, 68 ohm 1/2W, 5% (DIN)	12	Connecting Link
1	Locktronics User Guide	3	AA battery holder carrier
1	Resistor, 270 ohm, 1/2W, 5% (DIN)	3	MES bulb, 6V, 0.04A
1	Resistor, 10k, 1/4W, 5% (DIN)	1	400 turn induction coil
1	Capacitor, 1 uF, Polyester	3	Lampholder, MES
1	Resistor, 47K, 1/4W, 5%		

Ordering information	DIN	ANSI
Physics A level solution with storage, baseboard and power supplies.	LK9329	LK9329A
Corresponding curriculum	LK7664 & LK7773	

Suitable for extending work in Physics to various topics at ages 16 to 18. Ideal for STEM.



Class pool kit

This 'one per class' kit is designed to give you a flexible suite of parts that can be added to the Electrical and electronic principles pack to allow a much wider range of experiments and demonstration in Electronics from our Operational Amplifiers, PICmicro, Logic and Energy and environment solutions. The pack also includes useful equipment for teaching Lenz's law, Faraday's law and motor principles.

Learning objectives / experiments

- Batteries in series and parallel
- Internal resistance of batteries
- Power dissipation and efficiency
- Potential dividers
- Resistivity
- Kirchoff's laws
- AC circuits
- Capacitors
- Fleming's laws
- Inductors
- Faraday's and Lenz's laws
- Transformers

Instruments

To deliver this course you will also need:

LK1110	Multimeter pack	HP8279	Picoscope
HP7894	Signal generator		

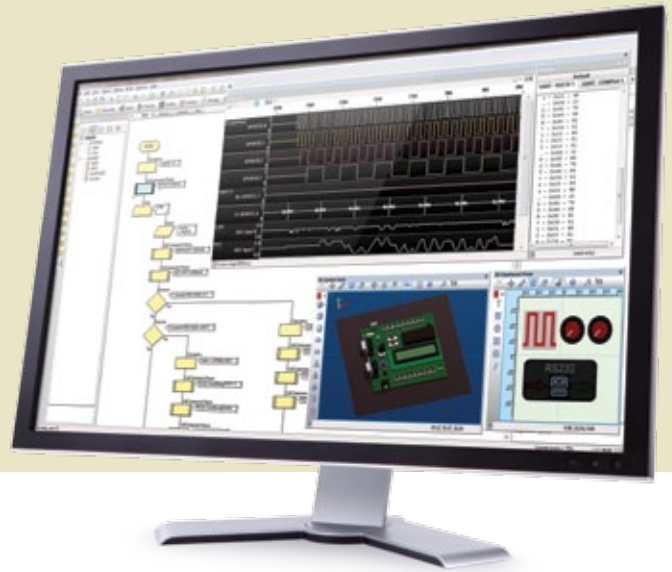
Components included

2	Resistor, 10k, 1/4W, 5% (DIN)	1	NOT Gate with 2mm to 4mm lead - ANSI
2	MES bulb, 6.5V, 0.3A	2	Lead, red, 300mm, 4mm to 2mm stackable
2	Capacitor, 10 uF, Electrolytic, 25V	2	Lead, blue, 500mm, 4mm to 4mm stackable
1	Capacitor, 4.7uF, Electrolytic, 25V	2	Lead, yellow, 500mm, 4mm to 4mm stackable
1	Capacitor, 1 uF, Polyester	1	Lead, black, 500mm, 4mm to 4mm stackable
1	Capacitor, 0.1 uF, Polyester	4	Connecting Link
1	Thermistor, 4.7k, NTC (DIN)	1	Low power solar motor
1	Thermistor, 470 ohm, NTC (DIN)	1	Speaker
1	Potentiometer, 10k (DIN)	1	Energy Meter
1	Resistor, variable, 250 ohm	1	Solar cell
1	Potentiometer, 25 ohm (DIN)	1	Slotted opto sensor with 2mm to 4mm lead
1	Resistor, 270k, 1/4W, 5% (DIN)	1	NOR Gate with 2mm to 4mm lead - ANSI
1	Diode, power, 1A, 50V	1	Capacitor, 100uF, Electrolytic, 25V
1	Resistor, 22k, 1/4W, 5% (DIN)	1	OR Gate with 2mm to 4mm lead - ANSI
1	Bridge rectifier	2	Lead, black, 300mm, 4mm to 2mm stackable
1	Resistor, 180 ohm, 1/2W, 5% (DIN)	1	AND Gate with 2mm to 4mm lead - ANSI
1	Resistor, 120 ohm, 1/2W, 5% (DIN)	1	USB reprogrammable PIC carrier with power lead
1	Resistor, 47 ohm, 1/2W, 5% (DIN)	1	Op Amp module (TL081)
1	Resistor, 10 ohm, 1W 5% (DIN)	1	Hand cranked generator
1	Switch, on/off, metal strip	2	400 turn induction coil
1	Switch, push to make, metal strip	1	Faraday's law kit
1	LED, yellow, 12V (SB)	1	Lenz's law kit
1	LED, green, 12V (SB)	1	Motor 3 to 12V DC, 0.7A
2	LED, red, 12V (SB)	1	Fleming's motor rule apparatus
1	Lampholder, MES, for automotive LEDs	1	Choke, 200mH
1	MES bulb, 12V, LED, white	1	Choke, 10mH
1	Resistor, 100k, 1/4W, 5% (DIN)	1	NAND Gate with 2mm to 4mm lead- ANSI

Ordering information

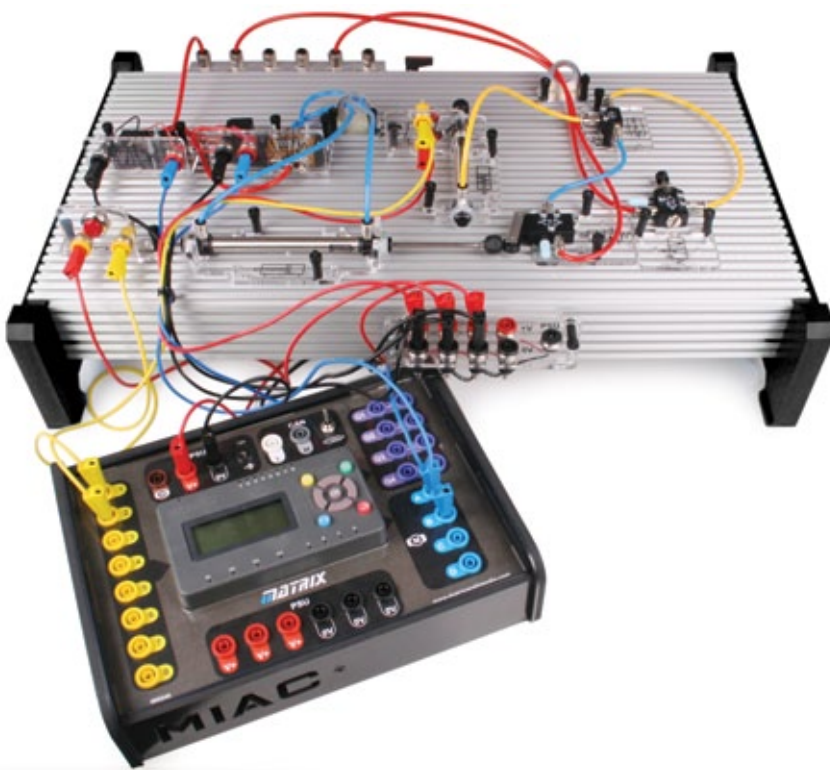
	DIN	ANSI
Electrical and electronics principles class pool kit.	LK6802	LK6802A

In the following pages we present some of the off-the-shelf solutions we have for delivering a motivating course in some parts of Design Technology and Computer Science curricula which are based on our Flowcode flow chart programming software and PIC, Arduino or Raspberry Pi microcontrollers. This is a very exciting area of education right now with great change afoot. You can learn more about Flowcode Schools Edition in the Flowcode section of the catalogue.



Our learning solutions:

- New Schools Edition of Flowcode provides superb learning platform
- Free Flowcode SE licences for students learning at home with every SE purchase
- Learning solutions for PIC, Arduino or RPi
- Hardware, software and curriculum
- Ideal for collaboration between Technology and Computer science departments



"The staff at Matrix have been very helpful since the first tentative pricing inquiry. I have been given very honest and reliable advice about what products suit my needs and the national curriculum I am delivering, including what products I need and the ones I don't."

Follow-up customer care has been very impressive and on a personal level - if I have any technical queries Matrix have been only a phone call or an email away. I can thoroughly recommend the training courses offered for Flowcode, where the training materials were first class, delegates were very well looked after, and assistance was always available."

Overall, I am delighted to recommend Matrix to other schools who want to start delivering Engineering Science courses, or who need to replace old kit coming to the end of its time."

Graham Dick, Buckhaven High School, Scotland



Suitable for Design Technology age 11 – 16.

PICmicro microcontroller systems investigation

This new kit allows students to investigate circuits and systems based on the popular PICmicro microcontroller. The kit focuses on system construction with a pre-programmed PIC carrier which includes 8 programs, selectable by hardware switches. The work can be extended to include programming of PICmicro® microcontrollers using flowcharts with our Flowcode software. A full curriculum pack is included.

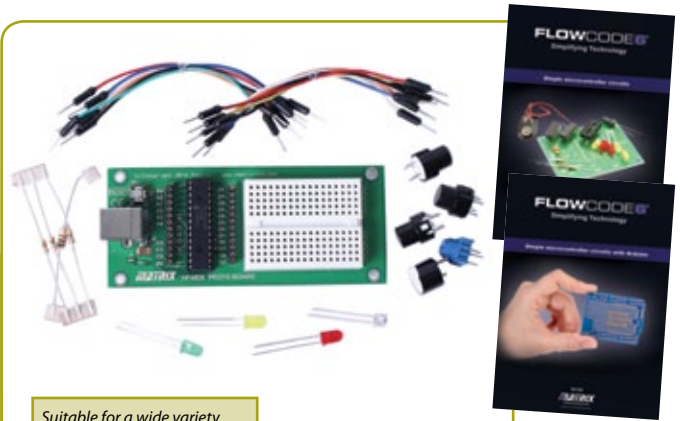
Learning objectives / experiments

- Switch inputs
- Sensors and sensor circuits
- Digital comparators
- Driving transducers
- Output transducers
- DC motor speed control
- Open and closed loop control

Components included

1	Power supply	1	LED, yellow, 5V (SB)
1	USB reprogrammable PIC carrier with power lead	1	MES bulb, 6.5V, 0.3A
1	Light dependent resistor		Locktronics User Guide
2	Resistor, 10k, 1/4W, 5% (DIN)	1	USB2 high speed A to mini B lead
16	Connecting Link	2	Lead, yellow, 500mm, 4mm to 4mm stackable
1	Lampholder, MES	1	Thermistor, 4.7k, NTC (DIN)
2	Switch, push to make, metal strip	1	Transistor RHF, NPN
2	Switch, on/off, metal strip	1	Motor 3 to 12V DC, 0.7A
1	Buzzer, 6V, 15mA	1	Resistor, 2.2k, 1/4W, 5% (DIN)
1	Curriculum CD ROM	1	7 x 5 metric baseboard with 4mm pillars
1	Potentiometer, 10k (DIN)	1	Power supply carrier with battery symbol
2	LED, red, 5V (SB)	1	Resistor, 100 ohm, 1W, 5% (DIN)
1	LED, green, 5V (SB)	1	Resistor, 1k, 1/4W, 5% (DIN)

Ordering information		DIN	ANSI
PICmicro systems solution with storage tray, baseboard and power supply		LK8922-2	LK8922-2A
You may also need:			
Flowcode SE 50 user licence		FC6SE50	
Curriculum pack		LK7209	



Suitable for a wide variety of courses in electronics and technology age 11 – 16.

Simple microcontroller circuits

This solution introduces students to the basic principles of circuit construction and prototyping using a breadboard and a few simple electronic components. The PDF manual includes 10 simple microcontroller circuits along with guides to developing the associated control programs using Flowcode. This low cost solution is an ideal starting point for students of Design and Technology who want to understand how to incorporate microcontrollers into their projects. Needs Flowcode SE software. Requires USB cable.

Learning objectives / experiments

- Microcontroller programming and circuits
- Microcontroller clocks, pins, inputs, outputs, ports,
- Programming using flowcharts: input, system, output, loops, decision, subroutine, go to, calculations, delays, simple variables, A/D conversion, pulse and tone generation
- Components: switches, LEDs, sensors, buzzers, resistors, potential dividers
- Logic: AND, OR, NAND, NOR, NOT



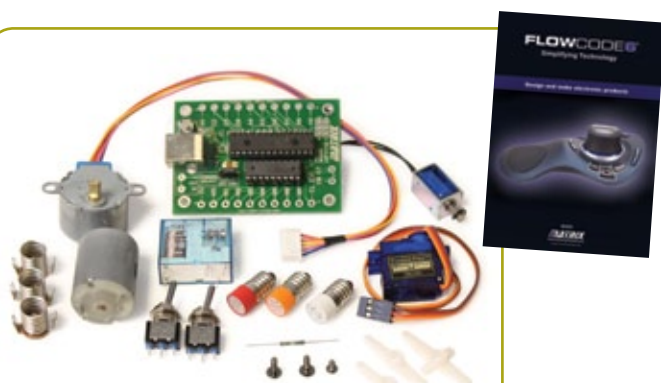
Prototype board in use

Components included

1	Buzzer	1	Photodiode
3	470R resistors	3	LEDs (red, green, orange)
1	1K resistor	3	Push to make switches
1	4k7 trimmer	1	Lengths single core wire
1	USB prototype board	1	Pack connector leads
1	Resistor 1M, 1/4W, 5% (DIN)		

Ordering information

Simple microcontroller circuits solution	SE3829-2
Class set of 20	SE4758-2
Curriculum pack (PIC)	SE3830
Curriculum pack (Arduino)	SE1498
You may also need:	
USB cable	HPUSB
Flowcode SE 50 user licence	FC6SE50



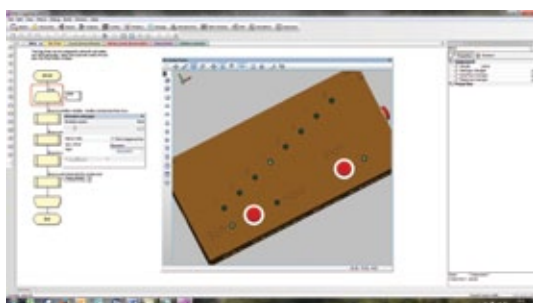
Suitable for Design Technology age 11 – 16.

Design and make electronic products solution

This solution is designed to provide a framework to allow students to first investigate the design of electronic products and then to design and manufacture a project of their own. The curriculum first guides students through a number of pre-built designs based on our PIC project board and pre-designed Solidworks projects. Students then undertake a design brief to develop an electromechanical project of their own. Needs Flowcode SE software. Requires USB cable.

Learning objectives /experiments

- Controlling DC motors, servo motors, stepper motors, solenoids and pneumatic systems
- Investigating electro mechanical designs
- Packaging and packaging design for electronic products using Solidworks® CAD
- Designing, making and testing electronic products using Flowcode
- Designing, making, testing and evaluating mechanical products using laser cutters, 3D printers and other CAD/CAM resources
- Writing up projects



Egg timer project with mechanics created in Solidworks

Components included

1 Relay	3 MES lamp holder
1 DC motor	1 Red MES LED bulb
1 Stepper motor	1 Yellow MES LED bulb
1 Servo motor	1 White MES LED bulb
1 Reed switch	1 Solenoid
1 Toggle switches	1 USB project board

Ordering information

Design and make electronics products pack	SE4855
Class set of 20	SE9885

You may also need:

USB cable	HPUSB
You may also need:	
Flowcode SE 50 user licence	FC6SE50
Curriculum pack	SE3844, SE3810



Suitable for Computer Science age 11 – 16.

Computer science and control 1

This kit of parts allows Computer Science students to develop an understanding of simple control systems and to develop programs using flow charts. The kit uses our MIAC controller as a PC slave and as an embedded microcontroller target. The kit includes switches, bulbs, motors and sensors which plug into the MIAC using 4mm connectors to allow students to cement their understanding of control using real physical parts. Requires Flowcode SE software.

Learning objectives /experiments

- Microcontroller based systems
- Control system theory of simple systems: Input, system, output, open loop, closed loop
- Programming using flowcharts: input, system, output, loops, decision, subroutine, go to, calculations, delays, variables, strings, A/D conversion, interrupts, hardware macros, software macros, arrays
- Control components: switch, light sensor, bulbs, motors
- Industrial controllers, Microcontroller based systems

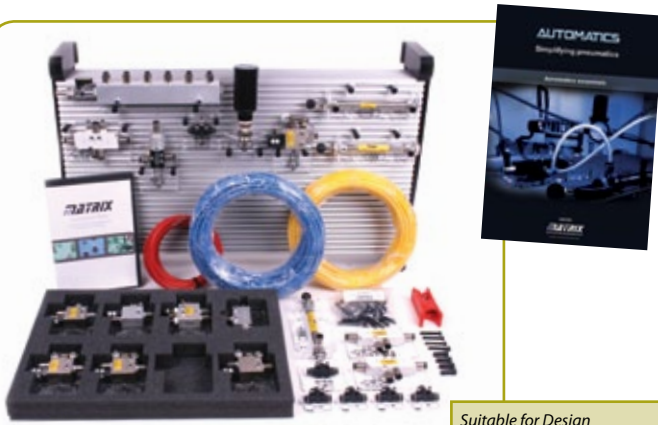
See MIAC section for full MIAC details

Components included

1 Cased MIAC	2 MES LED bulbs
1 Power supply	1 4mm Light sensor
1 USB lead	2 4mm to 4mm lead, black
2 4mm Push to make switches	2 4mm to 4mm lead, red
1 4mm DC motor	2 4mm MES bulb holders

Ordering information

Computer science and control 1	SE4829-2
Curriculum pack	SE7761
You may also need:	
Flowcode SE 50 user licence	FC6SE50



Suitable for Design technology and Engineering Science age 11 – 18. Ideal for STEM.

The Automatics essentials solution

This kit provides a complete introduction to pneumatic circuit design and construction. The curriculum pack includes a comprehensive set of worksheets that allow students to progress from first principles through to circuits of moderate complexity; including reciprocating circuits and generating sequences of movements.

The solution is intended for students in their early teens and older who are learning technology and engineering subjects. Tasks are designed to be suitable for pairs of students sharing a single kit. Everything you will need to teach the course is included in the solution pack, with the exception of an air compressor.

Learning objectives

- Understanding the different varieties of valves and where each is appropriate in a system
- Understanding the basic types of cylinder, controlling speed and the factors that influence power output
- Combining valves to produce logic functions
- Semi-automatic and automatic reciprocation
- Creating sequences of movements
- Using reservoirs to create time delays
- Air bleed and pilot operated circuits
- Component symbols and circuit diagrams
- Staying safe when using air at high pressure

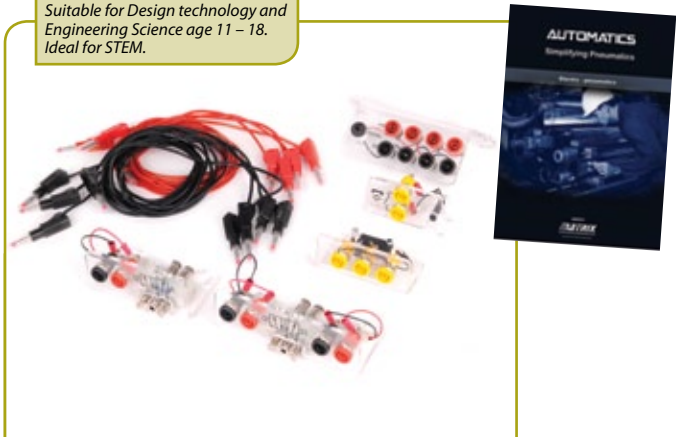
Components included

1 Cylinder, single acting	2 Cylinder, double acting
1 Valve, 3/2, button-spring	1 Valve, 3/2, lever-spring
4 Valve, 3/2, roller-spring	1 Valve, 3/2, diaphragm
1 Valve, 5/2, lever-spring	3 Valve, 5/2, pilot-pilot
1 Valve, shuttle	2 Valve, flow control
1 Reservoir	1 Automatics platform
1 Manifold	1 Tubing, red, 5 m
1 Tubing, yellow, 30 m	1 Tubing, blue, 30 m
4 Connector, tee junction	1 Tee bolts (pack of 50)
1 Tube cutting tool	1 Curriculum CD ROM
1 Set of storage trays	

Ordering information

Automatics essentials solution	AU9020
You may also need...	
Compressor	AU1050

Suitable for Design technology and Engineering Science age 11 – 18. Ideal for STEM.



Electro-pneumatics add-on kit

This kit supplements the Automatics essentials solution by adding a selection of electrically operated valves and a range of sensors. By following the curriculum, students will learn how to use these new components to create systems in which pneumatics and electrical circuits are combined into complete systems.

The electrical components are connected together quickly and reliably using 4mm connectors, for which all of the necessary leads and accessories are provided. Electrical components are robustly mounted to the Automatics platform using the same 'tee' bolt system used for the pneumatic parts and are printed with standard circuit symbols.

Working two to a kit, students follow the detailed worksheets to gain a comprehensive understanding of electro-pneumatics. By the end of the course, students will be able to create reciprocating and sequential circuits and will have an understanding of how these are used to solve real world engineering problems.

Learning objectives

- Understand the operation of electrically controlled pneumatic valves
- Use of electrical switching to control circuit operation
- Using microswitches to sense cylinder position
- Sensing position without physical contact using reed switches
- Expressing electrical circuits using ladder diagrams
- Electrically operated reciprocal circuits
- Sequential control circuits
- Analysing real world problems and formulating solutions

Components included

2 Reed switch and holder	2 Switch, push to make
2 Microswitch	1 Valve, 3/2, solenoid-spring
1 Valve, 5/2, solenoid -spring	2 Valve, double solenoid
6 Lead, 4mm plugs, black	6 Lead, 4mm plugs, red
1 Power supply	1 Curriculum CD ROM

Ordering information

Electro-pneumatics add-on kit	AU9015
You may also need...	
Automatics essentials solution	AU9020



Suitable for Design technology and Engineering Science age 11 – 18. Ideal for STEM.

Pneumatics control add-on kit

This kit extends your Automatics pneumatics solution by adding a powerful programmable microcontroller unit, the MIAC, together with the pneumatic components necessary to put it through its paces.

By following the included curriculum, students will learn how the combination of a controller and custom software can create powerful and flexible pneumatic systems.

Students will learn how to establish the state of a pneumatic machine using sensors, the use of logic to process that data and the issuing of commands to the included solenoid valves.

Two versions of the curriculum are supplied. In the first, students use pre-programmed control systems supplied in the MIAC's built in memory. A more advanced course, Control plus, teaches students how to write their own programs for the controller.

Learning objectives

- Reading sensors and switches
- Issuing commands to the pneumatic circuits
- Learning the difference between digital and analogue signals
- Using flowcharts to visualise programs
- Program flow and decision making
- Programming sequences
- Using feedback to enhance reliability and improve safety

Control Plus

This curriculum introduces students to writing their own programs for the control system.

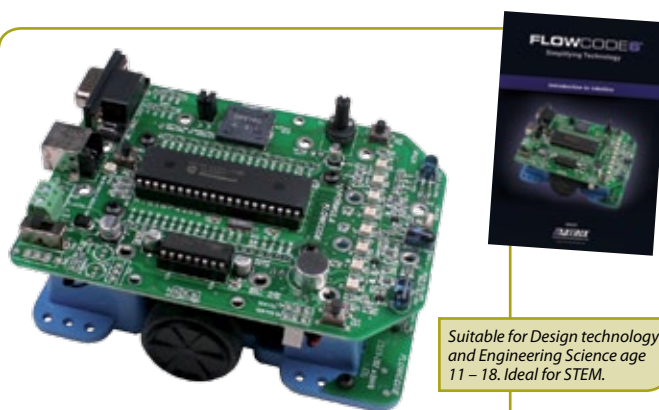
This is done using our Flowcode software - which makes programming easy by using graphical flowcharts. Note that you may need to purchase Flowcode separately.

Components included

1	MIAC controller	2	Switch, push to make
1	Reed switch and holder	2	Valve, flow control
1	Light sensor	4	Valve, 3/2, solenoid-spring
1	Power supply	1	Power distribution carrier
6	Lead, 4mm plugs, red	6	Lead, 4mm plugs, black
2	Lead, 4mm plugs, yellow	1	Curriculum CD ROM

Ordering information

Automatics control add-on kit	AU9010
You may also need...	
Automatics essentials solution	AU9020
Flowcode SE 50 user licence	FC6SE50



Suitable for Design technology and Engineering Science age 11 – 18. Ideal for STEM.

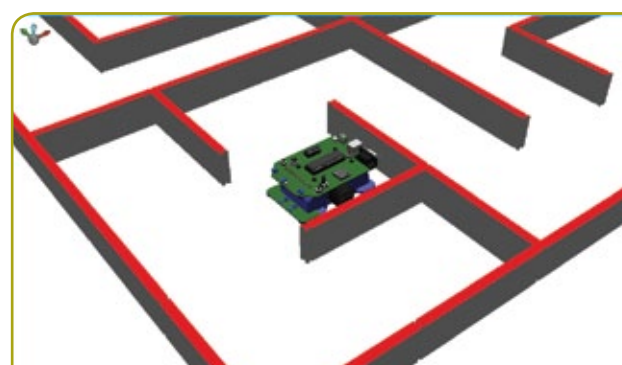
Suitable for Computer Science age 11 – 16.

Introduction to Robotics

This training solution provides a 20 hour course allowing students to carry out a number of robotics practical exercises. The Formula Flowcode robot is a high specification, low cost microcontroller-controlled robot buggy which is great for introducing students to programming and robotics in a fun and motivating way with huge scope for further work and competitions. The buggy is supplied with new simulations in Flowcode 6/SE, a beginners' course, easy to follow circuit diagrams and information, and lots of follow on exercises and expansion options (including Bluetooth, Wifi) using E-blocks.

Learning objectives /experiments

- Microcontroller programming and robotics
- Programming using flowcharts: input, system, output, loops, decision, subroutine, go to, calculations, delays, simple variables, A/D conversion
- Robotic components: switches, LEDs, light sensors, distance sensors, infrared sensors, audio level sensors, speaker, motor drivers, motors and gearboxes
- Robotic tactics including power control, motion control and steering, motor characterisation, obstacle avoidance
- Progressive exercises include: light following, line following, song and dance, time trials, races, simple maze solving, creating custom mechanics

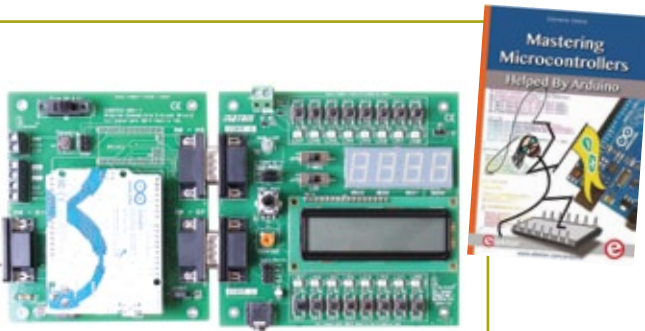


Buggy and a line following exercise

See Formula Flowcode section for full details

Ordering information

Formula Flowcode robot buggy	HP794
Maze walls	HP458
Starter class bundle	HP926
Pro class bundle	HP600
Curriculum pack	SE8832



Suitable for Computer Science age 11 – 16.

Suitable for Design Technology age 11 – 16.

Programming Arduino microcontrollers

This pack provides a great platform for students to learn how to develop projects for Arduino and Arduino compatible hardware systems. The pack includes an Arduino/ E-blocks interface board and a 'Combo' board with switches, LEDs, 2 line 16 character LCD and sensors. The hardware is fixed to one of our panels which clearly shows the Arduino connections to the hardware and associated circuit diagram. The hardware is available with an optional book from Elektor which guides students through the process of setting up the Arduino and developing hardware programs for it using the Arduino C/C++ software environment. Arduino board not included.



Accelerate your student's learning with a copy of Flowcode for Arduino.

Learning objectives / experiments

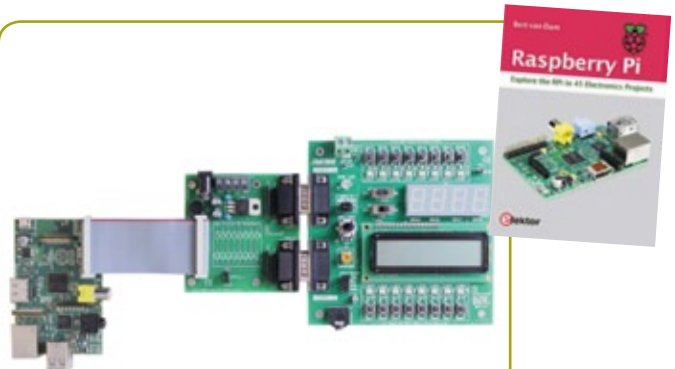
- Arduino boards and chip architecture
- Arduino software tools and programming
- Arduino command set: void, if-else, types, outputs, delays, case, break, while, for
- Simple programs with LEDs
- Serial communications and LCDs
- Analogue and digital signals
- Sensors and motor control
- Interrupts and timer interrupts

Components included

1	Arduino E-blocks interface shield	1	E-blocks Combo board
1	Power supply	1	USB cable

Ordering information

Development board and Arduino shield combo	HP7745
'Mastering microcontrollers' book	HP2686
Flowcode for PIC and Arduino 50	FC6SE50AVR



Suitable for Computer Science age 14 – 18.

Interface for model B+ under development

Programming the Rpi

This hardware only pack provides a great platform for students to learn how to develop projects for the Raspberry pi computer. The pack includes a Rpi/E-blocks interface board and a 'Combo' board with switches, LEDs, 2 line 16 character LCD display and sensors. The hardware is supplied with an optional book from Elektor which guides students through the process of setting up the Rpi and developing hardware programs for it. RPi board not included.

Learning objectives / experiments

- Getting started: SD card, keyboard, mouse, display, internet connection etc.
- A quick tour: LX terminal, Debian reference, Midori, Wifi configuration, Scratch, tools
- Software intro: installing, Debian Linux, Bash, Python, Javascript
- GPIO: LEDs, flashing LEDs, switches, timers, pin comms
- More power: interface chips
- PWM: fixed frequency, variable frequency, brightness control
- SPI: Introduction, D/A and A/D systems
- I2C: introduction, I/O extender, digital thermometer
- RS232: loopback, echo, ADC
- Web server: HTML server, CGI,
- Client server: TCP multiplication, LED control, DAC, wave generator, voltmeter, echo, light meter

Components included

1	RPi to E-blocks expansion board with cable	1	E-blocks Combo board
1	Power supply		

Ordering information

Development board and RPi interface board combo	HP4930
'45 projects for the Raspberry Pi' book	HP3091

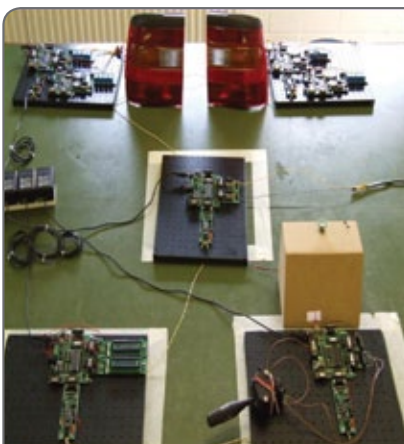
Engineering

In this section we present some of our solutions for learning various aspects of engineering. In most cases these link to a British BTEC qualification which is considered by many in the UK to be the gold standard in engineering education. Remember that if you don't see exactly what you are looking for you can make up your own solution from the many parts in the various ranges.



Our learning solutions:

- Deliver a focus on 'learning through building' which motivates and challenges students
- Take students from understanding of basic engineering principles through to complex, focused engineering topics
- Provide solutions in topics including electronics, robotics, automation and mechatronics
- Deliver fantastic value for money with multiple hours of learning curriculum and teachers notes with each offering



The School of Electronic and Aeronautical Engineering (SEAE), one of the British Army's key training establishments in the United Kingdom, has reacted to the need to dominate the Digital Battlefield by equipping a number of classrooms and project rooms with a comprehensive range of E-Block modules and Flowcode. The E-blocks system has enabled SEAE to develop courses to teach the students fault-finding procedures applicable to microprocessor and/or embedded microcontroller systems.

This means that the students can develop practical experience of designing, programming and building systems similar to what they will encounter during an operational tour of duty.

A particular success has been the student project work on CAN bus which is a communications system used to link sub systems together in military vehicles. Students are split into groups, given real automotive components and tasked with developing a functional vehicle electronic control system.



Suitable for much of unit 4 of the BTEC First award in Engineering: 'Applied electrical science'.

Applied electrical science

The Electricity, magnetism and materials solution provides a comprehensive range of practical assignments in electricity and magnetism and is ideal for those who are studying science and electricity within a wide variety of academic or vocational courses. The kit is supplied with a comprehensive set of worksheets that cover the electrical properties of materials, and introduce students to electricity.

Learning objectives / experiments

- Electrical properties of materials
- Simple circuits
- Heat and magnetism
- Basic circuit symbols
- Current flow
- Series and parallel circuits
- Patterns of voltage and current
- Electrical sensors
- Relays and electromagnets

Instruments

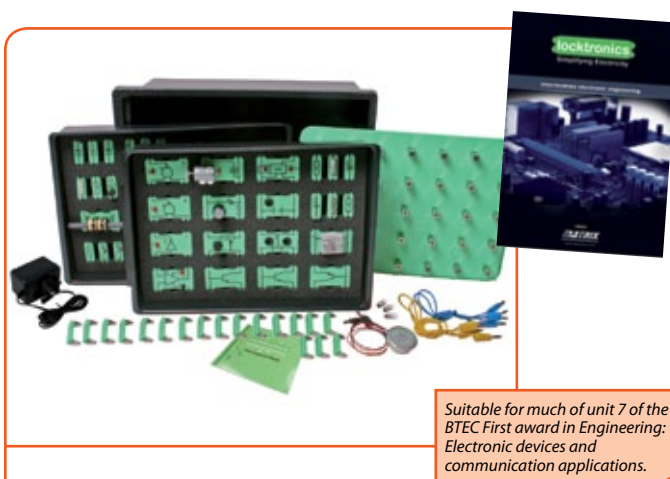
To deliver this course you will also need:

LK1110 Multimeter pack

Components included

1 Switch, push to make, metal strip	1 400 Turn coil carrier
1 Power supply	1 Thermistor, 4.7k, NTC (DIN)
1 Resistor, 12 ohm, 1W, 5% (DIN)	1 LED, red, 12V (SB)
1 Motor, 6V, open frame	1 Voltmeter, 0V to 15V
1 Phototransistor	1 Relay, reed, normally open
2 Resistor, 1k, 1/4W, 5% (DIN)	1 Pair of leads, red and black, 600mm, 4mm to croc clip
1 Resistor, 10k, 1/4W, 5% (DIN)	1 Power supply carrier with battery symbol
1 Potentiometer, 10k (DIN)	1 Fuse/universal component carrier
1 Diode, power, 1A, 50V	1 Curriculum CD ROM
9 Connecting Link	1 Buzzer, 12V, 15mA
3 Lampholder, MES	1 Switch, on/off, metal strip
1 7 x 5 metric baseboard with 4mm pillars	1 Resistor, 100 ohm, 1W, 5% (DIN)
1 Ammeter, 0A to 1A	1 EMM V2 Accessories pack
1 Resistor 1M, 1/4W, 5% (DIN)	1 Resistor, 47K, 1/4W, 5%

Ordering information	DIN	ANSI
Electricity, magnetism and materials solution with storage, baseboard and power supply.	LK9071-2	LK9071-2A
Corresponding curriculum	LK7325 & LK7326	



Suitable for much of unit 7 of the BTEC First award in Engineering: Electronic devices and communication applications.

Electronic devices and communication applications

This solution provides a broad-based introduction to electronics and provides substantial syllabus coverage of the relevant BTEC First Award (Unit 8). It provides a series of practical investigations that allow students to unify theoretical work with practical skills - from bulbs in series to radio circuits. The kit is supplied with a comprehensive 60 page manual which includes experiments and notes for teachers.

Learning objectives / experiments

- Phototransistors and thermistors
- Diodes and their function
- Combinational logic
- Transistors as a switch/amplifier
- Operational amplifiers
- Timers
- Simple radio circuits

Instruments

To deliver this course you will also need:

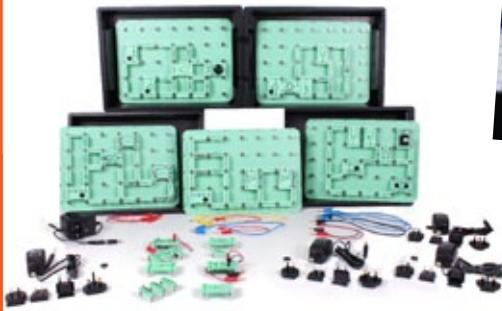
LK1110 Multimeter pack

Components included

1 Systems block, 555 timer, with 4mm to 2mm lead	2 Switch, on/off, metal strip
1 7 x 5 metric baseboard with 4mm pillars	2 Resistor, 100k, 1/4W, 5% (DIN)
2 Transistor RHF, NPN	2 Resistor, 10k, 1/4W, 5% (DIN)
1 Transistor RHF, PNP	2 LED, red, 5V (SB)
1 1:1 transformer with retractable ferrite core	1 Resistor, 100 ohm, 1W, 5% (DIN)
1 Voltmeter, +/- 7.5V	18 Connecting Link
1 Op Amp Carrier (TL081) with 2mm to 4mm Lead	1 Power supply carrier with battery symbol
1 Speaker	2 Resistor, 1k, 1/4W, 5% (DIN)
1 Motor 3 to 12V DC, 0.7A	1 Potentiometer, 10k (DIN)
2 Power supply	2 Capacitor, 0.47 uF, Polyester
2 Lead, blue, 500mm, 4mm to 4mm stackable	1 Thermistor, 4.7k, NTC (DIN)
1 Voltmeter, 0V to 15V	1 Capacitor, 47uF, Electrolytic, 25V
1 Curriculum CD ROM	1 Diode, germanium
1 Locktronics User Guide	1 Diode, power, 1A, 50V
1 NOT Gate with 2mm to 4mm lead - ANSI	1 Capacitor, 4n7, Ceramic
1 NOR Gate with 2mm to 4mm lead - ANSI	3 Lampholder, MES
2 Lead, yellow, 500mm, 4mm to 4mm stackable	3 MES bulb, 12V, 0.1A
1 OR Gate with 2mm to 4mm lead - ANSI	1 Capacitor, 100pF, Ceramic
1 NAND Gate with 2mm to 4mm lead - ANSI	1 Choke, 10mH
1 AND Gate with 2mm to 4mm lead - ANSI	1 Dual rail power supply carrier
1 Ammeter, 0mA to 100mA	1 Buzzer, 6V, 15mA
1 Phototransistor	2 Capacitor, 4.7uF, electrolytic, 25V
1 Switch, push to make, metal strip	1 Resistor, 47K, 1/4W, 5%

Ordering information	DIN	ANSI
Intermediate electronic engineering solution with storage, baseboard and power supply.	LK3889	LK3889A
Corresponding curriculum	LK8293	

Suitable for unit 13 of BTEC First in Engineering : Operation and maintenance of electronic systems and Unit 60, BTEC National in Engineering: Fault finding.



Fault finding in electronic circuits

This solution allows students to gain experience of fault finding on several analogue and digital systems. Students first learn how to use test equipment and test the major groups of active and passive components. Then students are given a fully working circuit so that they can understand the circuit's function. Supervisors then insert one of a number of faults on each circuit and the student must deduce the fault through the use of the appropriate instruments.

Faulty components are clearly marked underneath the carrier. Five fully tested and assembled circuits supplied: one set is sufficient for 10 students working in rotation.

Learning objectives

- Safety in fault finding
- Using multimeters
- PC based oscilloscopes
- Testing diodes and transistors

Fault finding circuits:

- Combinational logic circuit
- Counter circuit
- Motor control circuit
- Regulated AC power supply circuit
- Astable multivibrator
- Class C transistor amplifier circuit

Instruments

To deliver this course you will also need:

LK1110	Multimeter pack	HP8279	Picoscope
HP7894	Signal generator		

Components included

5	Power supplies	1	AC power supply circuit
1	Combinational logic circuit	1	Multivibrator circuit
1	Counter circuit	1	Class C amplifier
1	Motor control circuit	1	Set fault components

Ordering information

Fault finding in electronic circuits	LK3566
Corresponding curriculum	LK9333

Suitable for much of unit 24 of the BTEC First award in Engineering : Operation and maintenance of fluid power systems and components.



Automatics interactive courseware

The automatics interactive courseware is a complete pneumatics and automation curriculum in the form of an interactive PC application.

Students are guided through the construction of systems using onscreen simulations of the physical Automatics components and a simple drag and drop interface.

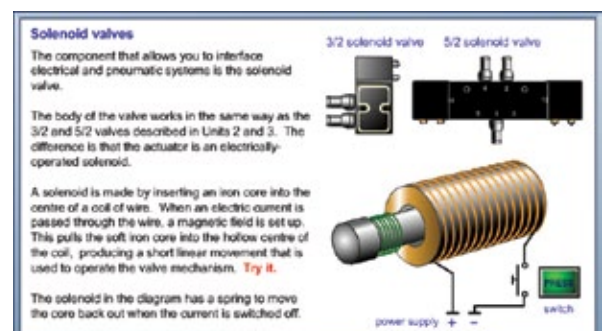
The courseware is a complete curriculum, covering everything from basic component identification and learning circuit symbols, through to the construction of complete automated systems.

The similarity between the graphical representation and real components then make it very simple for students to apply what they have learned when they are constructing real systems using the Automatics hardware solutions.

Automatics interactive courseware is compatible with all versions of Windows from Windows 95 upwards, and has very modest PC requirements. It is available with an educational site licence.

Learning objectives

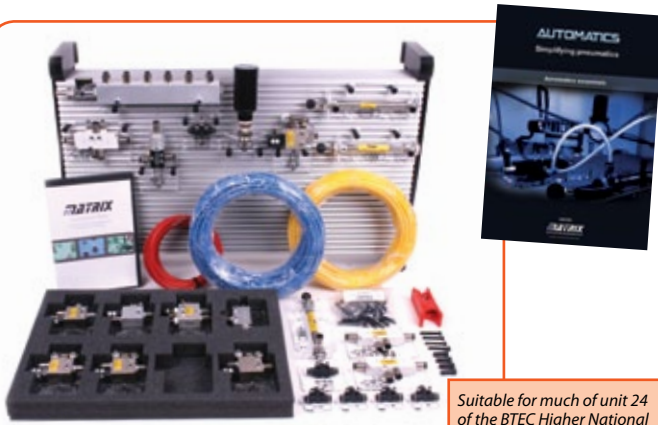
- Single and double acting cylinders
- Three port valves, valve actuators, flow control valves, five port valves, pilot-operated five port valves
- Piston speed control with flow control valves
- Semi-automatic return circuits, automatic return circuits and applications
- Reservoirs, time delays and applications, diaphragm valves, pressure decay sensing
- AND and OR functions
- Sequential circuits and applications, cascade method
- Electrical control of pneumatics with solenoid valves, switches, toggle switches, microswitches, reed switches, and computer control
- Circuit diagrams and circuit symbols
- Force exerted by a cylinder and calculations
- Instroke and outstroke forces and calculations
- Construction of pneumatic and electropneumatic systems



Virtual lab on solenoid valves

Ordering information

Automatics interactive courseware site licence	AW20780
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Suitable for much of unit 24 of the BTEC Higher National award in Engineering : Applications of pneumatics and hydraulics.

The Automatics essentials solution

This kit provides a complete introduction to pneumatic circuit design and construction. The curriculum pack includes a comprehensive set of worksheets that allow students to progress from first principles through to circuits of moderate complexity; including reciprocating circuits and generating sequences of movements.

The solution is intended for students in their early teens and older who are learning technology and engineering subjects. Tasks are designed to be suitable for pairs of students sharing a single kit. Everything you will need to teach the course is included in the solution pack, with the exception of an air compressor.

Learning objectives

- Understanding the different varieties of valves and where each is appropriate in a system
- Understanding the basic types of cylinder, controlling speed and the factors that influence power output
- Combining valves to produce logic functions
- Semi-automatic and automatic reciprocation
- Creating sequences of movements
- Using reservoirs to create time delays
- Air bleed and pilot operated circuits
- Component symbols and circuit diagrams
- Staying safe when using air at high pressure

Components included

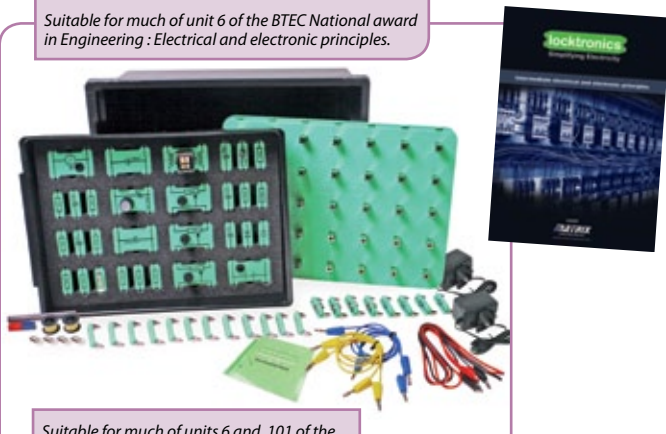
1	Cylinder, single acting	2	Cylinder, double acting
1	Valve, 3/2, button-spring	1	Valve, 3/2, lever-spring
4	Valve, 3/2, roller-spring	1	Valve, 3/2, diaphragm
1	Valve, 5/2, lever-spring	3	Valve, 5/2, pilot-pilot
1	Valve, shuttle	2	Valve, flow control
1	Reservoir	1	Automatics platform
1	Manifold	1	Tubing, red, 5 m
1	Tubing, yellow, 30 m	1	Tubing, blue, 30 m
4	Connector, tee junction	1	Tee bolts (pack of 50)
1	Tube cutting tool	1	Curriculum CD ROM
1	Set of storage trays		

Ordering information

Automatics essentials solution	AU9020
You may also need...	
Compressor	AW30100

Electrical engineering

Suitable for much of unit 6 of the BTEC National award in Engineering : Electrical and electronic principles.



Suitable for much of units 6 and 101 of the BTEC Higher National award in Engineering : Electrical and electronic principles

Intermediate electrical and electronic principles

This kit, with its accompanying workbook, is intended to reinforce the learning that takes place in the classroom or lecture room for intermediate level electrical engineering. The 70 page workbook provides a series of practical activities and investigations that are designed to complement learning in the classroom and a comprehensive set of teacher's notes is included.

Learning objectives / experiments

- Current and voltage measurement
- Current and voltage dividers
- Kirchhoff's laws
- Power in DC circuits
- Electrostatics and capacitors
- AC measurements
- L-R, C-R and L-C-R circuits
- Transformers
- Diode characteristics
- Half and full wave bridge rectifiers

Instruments

To deliver this course you will also need:

LK1110 Multimeter pack

Components included

1 Potentiometer, 250 ohm (DIN)	2 Lead, yellow, 500mm, 4mm to 4mm stackable
3 MES bulb, 12V, 0.1A	1 Voltmeter, 0V to 15V
1 AC voltage source carrier	3 AA battery holder carrier
1 Power supply	1 Choke, 47mH
12 Connecting Link	1 Resistor, 100 ohm, 1W, 5% (DIN)
1 Resistor, 180 ohm, 1/2W, 5% (DIN)	1 400 Turn coil carrier
1 Resistor, 270 ohm, 1/2W, 5% (DIN)	1 Capacitor, 1 uF, Polyester
1 Resistor, 1k, 1/4W, 5% (DIN)	1 1:1 transformer with retractable ferrite core
2 Resistor, 10k, 1/4W, 5% (DIN)	1 Ammeter, 0mA to 100mA
1 Locktronics User Guide	1 Switch, push to make, metal strip
1 Capacitor, 47uF, Electrolytic, 25V	1 Power supply carrier with battery symbol
1 Capacitor, 1,000 uF, Electrolytic 30V	1 Resistor, 22k, 1/4W, 5% (DIN)
1 Transformer, 2:1 turns ratio	1 Capacitor, 2,200 uF, Electrolytic, 25V
1 Curriculum CD ROM	3 Lampholder, MES
2 Pair of leads, red and black, 600mm, 4mm to croc clips	1 Capacitor, 150 uF, Electrolytic, 25V
2 Lead, blue, 500mm, 4mm to 4mm stackable	1 Capacitor, 100uF, Electrolytic, 25V
1 Diode, germanium	1 Resistor, 2.2k, 1/4W, 5% (DIN)
1 7 x 5 metric baseboard with 4mm pillars	1 Small bar magnet
1 Diode, power, 1A, 50V	1 Bridge rectifier

Ordering information	DIN	ANSI
Intermediate electrical and electronic principles	LK9862	LK9862A
Corresponding curriculum	LK6530	

Suitable for much of unit 25 of the BTEC National award in Engineering : Selecting and using Programmable Logic Controllers.



Industrial sensors, actuator and control applications

This kit provides an introduction to the role of industrial controllers - under control of conventional controller software, as well as with third party applications like LabView™ and Visual Basic™. Students are given several industrial applications that they need to construct and develop programs for and sample applications in Flowcode, Visual Basic and LabView are provided.

Learning objectives / experiments

- DC motors with speed control
- Stepper motors
- Relays and solenoids
- Temperature and light sensors
- Potential dividers and their use
- Transistors as switches
- Electric controllers and their function
- Open and closed loop feedback
- Control system operation and function
- Control of systems using Flowcode, Visual Basic and LabView

Instruments

To deliver this course you will also need:

LK1110 Multimeter pack

Components included

1 Relay, 12V coil, 10A, normally open	1 Microswitch
4 Switch, on/off, metal strip	1 LED, green, 12V (SB)
4 Switch, push to make, metal strip	1 Buzzer, 12V, 15mA
6 Lead, yellow, 500mm, 4mm to 4mm stackable	1 Solenoid
1 Lead, red, 500mm, 4mm to 4mm stackable	1 Motor 3 to 12V DC, 0.7A
1 Switch, reed, normally open	1 Power supply carrier with battery symbol
2 LED, red, 12V (SB)	1 Potentiometer, 10k (DIN)
1 Lampholder, MES	1 Cased MIAC with Shrouded 4mm Connectors
6 Lead, blue, 500mm, 4mm to 4mm stackable	1 Power supply
1 Diode, power, 1A, 50V	1 USB2 high speed A to mini B lead
1 Resistor, 10k, 1/4W, 5% (DIN)	1 Small bar magnet
2 Resistor, 1k, 1/4W, 5% (DIN)	1 MES bulb, 12V, LED, white
1 Phototransistor	1 Transistor LHF, NPN
1 Stepper Motor	14 Connecting Link
1 Potentiometer, 1k (DIN)	1 Locktronics User Guide
1 Resistor, 10 ohm, 1W 5% (DIN)	1 Curriculum CD ROM
1 Thermistor, 4.7k, NTC (DIN)	1 MIAC Getting Started Guide
1 LED, yellow, 12V (SB)	1 7 x 5 metric baseboard with 4mm pillars
1 Lead, black, 500mm, 4mm to 4mm stackable	1 MES bulb, 14V, 0.06A
1 Resistor, 47k, 1/4W, 5%	

Ordering information	DIN	ANSI
Industrial sensor, actuator and control applications solution with storage trays, power supply and leads.	LK5783	LK5783A
Ordering information	DIN	ANSI
Industrial sensor, actuator and control applications with storage trays, PSU, leads and engineering panel	LK6499	LK6499A
Corresponding curriculum	LK8739	

Suitable for unit 63 of the BTEC Higher National award in Engineering: Electrical power.



Three phase systems

This pack is suitable for initial investigations into three phase systems. The pack includes the parts needed to set up three phase systems based on star and delta topologies with balanced and unbalanced loads. The pack allows power measurements to be understood and it includes a low voltage three phase motor. A full colour workbook with teacher's notes is included on CD ROM.

Learning objectives

- Three phase circuits – star and delta
- Phase relationships
- Current and voltage phase relationships
- Three phase inductance and reactance
- Power in three phase systems
- Motors in three phase systems

Components included

1	7x5 baseboard with 4mm pillars	3	Choke, 68mH
10	Connecting link	1	Capacitor, 2200mF, electrolytic, 25V
4	Lead, yellow 4mm to 4mm, stackable	1	Capacitor, 2.2mF, electrolytic, 25V
4	Lead, yellow 4mm to 4mm, stackable	1	Capacitor 33mF, non polarised
1	Three phase power supply	6	Diode, silicon, 1A
1	Three phase motor	3	MES lampholder
1	Potentiometer, 10k	3	MES bulb, 12V
3	Resistor, 1k, 1/4W, 5%	3	Voltmeter, -7.5V/+7.5V

Recommended

Pico 4 input oscilloscope kit	HP5834
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Ordering information

Three phase systems	LK4961
Current Clamp	HP5561
Recommended - Oscilloscope	HP5834
Curriculum pack	LK2686



Operational amplifiers add-on pack

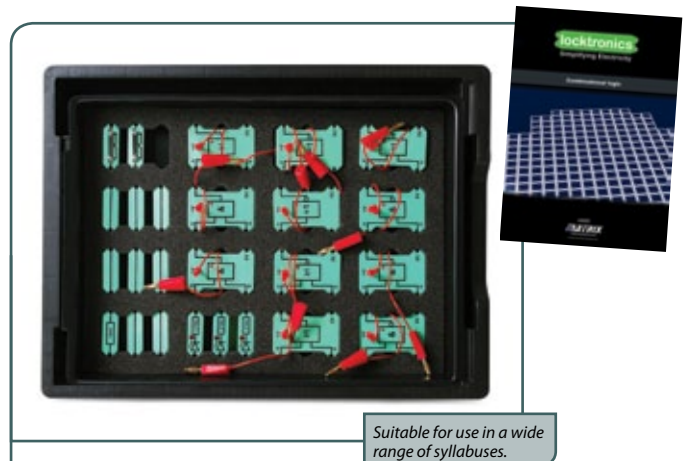
This add-on pack can be added to one of our basic kits to allow students to investigate the properties and function of operational amplifiers. It is suitable for students studying engineering or applied science aged 16+. The solution includes a 33 page workbook with student instructions and teacher's notes.

Learning objectives / experiments

- Operational amplifier properties
- Comparator and Schmitt trigger
- Non-inverting and inverting amplifier
- Voltage follower
- Summing and different amplifier
- Active filter
- Relaxation oscillator

The operational amplifiers add-on kit can be added to our basic LK9071 Electricity, magnetism and materials kit.

Operational amplifiers add-on-kit			
1	Capacitor, 100uF, Electrolytic, 25V	1	Power supply
2	BNC male to dual 4mm binding post	3	Lead, black, 500mm, 4mm to 4mm stackable
1	AC voltage source carrier	1	Capacitor, 1 uF, Polyester
1	Resistor, 100 ohm, 1W, 5% (DIN)	1	LED, red, 12V (SB)
1	Low power solar motor	1	LED, green, 12V (SB)
1	Resistor, 1k, 1/4W, 5% (DIN)	1	Op Amp Carrier (TL081) with 2mm to 4mm Lead
2	Resistor, 10k, 1/4W, 5% (DIN)	1	Dual rail power supply carrier
1	Potentiometer, 10k (DIN)	1	Speaker
1	Capacitor, 0.1 uF, Polyester	1	Voltmeter, +/- 7.5V
9	Connecting Link	1	Lead, blue, 500mm, 4mm to 4mm stackable
1	Thermistor, 470 ohm, NTC (DIN)	2	Lead, red, 500mm, 4mm to 4mm stackable
Ordering information		DIN	ANSI
Operational amplifiers add-on-kit		LK6906	LK6906A
Corresponding curriculum		LK3061	



Combinational logic add-on packs

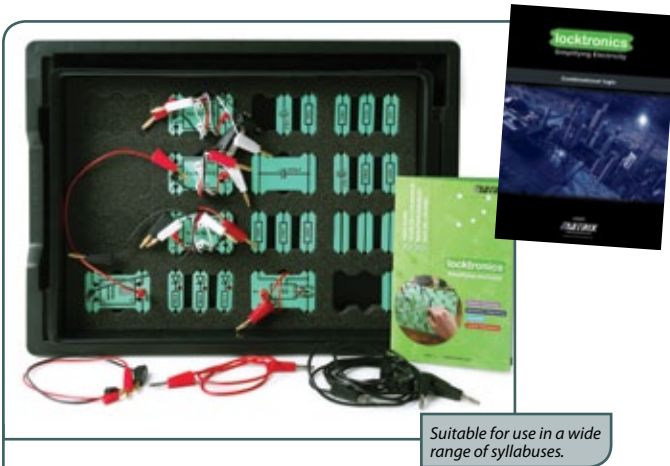
This kit is designed to be added to one of our basic kits to allow extended work in understanding logic gates and combinational logic systems. The pack starts by allowing students to understand basic logic gate operation and builds up to circuits and systems with up to four logic gates. A full set of worksheets and teacher's notes are provided on CD ROM.

Learning objectives

- Logic gates NOT, AND, NAND, OR, NOR, XOR
- Three input gates
- Equivalent gates
- Boolean expressions
- Combinational logic circuits: adder, encoder, multiplexer
- RS bistables

The combinational logic add-on pack can be added to our basic LK9071 Electricity, magnetism and materials kit.

Components included			
1	AND gate carrier with 2mm to 4mm lead	1	XOR gate carrier with 2mm to 4mm lead
1	OR gate carrier with 2mm to 4mm lead	3	LED, red, 5V
1	NOT gate carrier with 2mm to 4mm lead	3	Switch, on/off metal strip
1	NAND gate carrier with 2mm to 4mm lead	8	Connecting link
1	NOR gate carrier with 2mm to 4mm lead	1	Resistor, 10k, 1/W, 5%
Ordering information			
Combinational logic add-on pack			LK6904
Curriculum pack			LK2094



Sequential logic add-on pack

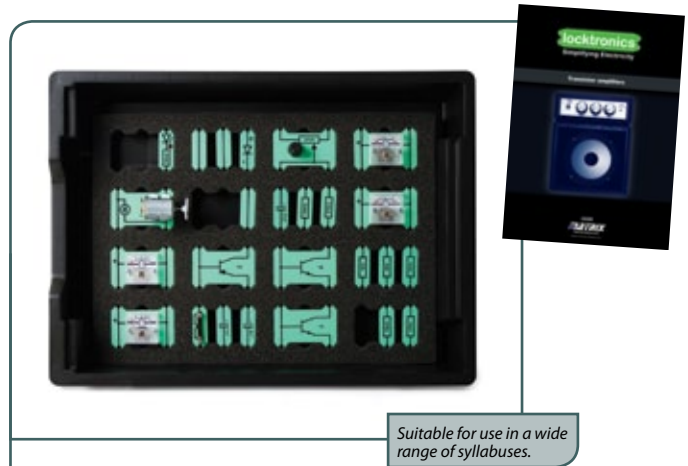
The worksheets used with this kit assume a customer has bought one of our basic kits, like LK9071, as well as the Combinational logic add-on pack, LK6904. Together these kits allow students to do extended work in understanding sequential logic circuits and systems. The pack starts by allowing students to understand basic flip flop operation and builds up to the design of circuits and systems with three flip flops. A full colour workbook with teacher's notes is included.

Learning objectives / experiments

- JK Bistable
- D-type flip flop
- Monostables and bistables
- Synchronous and asynchronous circuits
- Debounce circuits
- Latches
- 3 stage counter
- BCD counter
- 7-segment displays
- 3 stage shift register – PISO and PIPO
- R2R ladder DAC

The sequential logic add-on pack can be added to our basic LK9071 Electricity, magnetism and materials kit and should be used in conjunction with the LK6904 Combinational add-on pack.

Components included			
1	Resistor, 1k, 1/2W, 5% (DIN)	3	Resistor, 10k, 1/4W, 5% (DIN)
1	Resistor, 5.6k, 1/4W, 5% (DIN)	1	Resistor, 100k, 1/4W, 5% (DIN)
1	Capacitor, 10 uF, Electrolytic, 25V	4	Connecting Link
1	Capacitor, 100uF, Electrolytic, 25V	1	Capacitor, 2,200 uF, Electrolytic, 25V
4	Lead, black, 500mm, 4mm to 4mm stackable	4	Lead - red - 750mm, 4mm to 4mm stackable
1	Lead, red, 300mm, 4mm to 2mm stackable	4	Lead, red, 300mm, 2mm to 2mm stackable
1	Lead, black, 300mm, 4mm to 2mm stackable	1	Systems block, 555 timer, with 4mm to 2mm lead
4	Lead, black, 300mm, 2mm to 2mm stackable	3	D-Type Flip-Flop (horizontal) with 2mm to 4mm lead
3	Resistor, 22k, 1/4W, 5% (DIN)	3	LED, Red, 5V
1	Systems block counter/display		
Ordering information			
Sequential logic add-on pack		LK6905	
Curriculum pack		LK9945	



Transistor amplifiers add-on pack

This add-on pack can be added to one of our basic kits to allow students to understand the use of transistors in amplifier circuits. Students construct a number of different types and classes of transistor amplifiers including classes A, B and AB, and analyse their behaviour. A full colour workbook, supplied in PDF format, contains all the experiments, worksheets and teacher's notes.

Learning objectives / experiments

- Testing transistors
- BJT transistor characteristics
- Transistor as a switch
- Transistor as an amplifier
- Transformer coupled amplifier
- Stabilised common-emitter amplifier
- Two-stage amplifier
- Push - pull amplifier

The transistor amplifiers add-on pack can be added to our basic LK9071 Electricity, magnetism and materials kit.

Components included			
2	Voltmeter, 0V to 15V	1	Resistor, 100 ohm, 1W, 5%
2	Resistor, 1k, 1/2W, 5%	1	Resistor, 10k, 1/4W, 5%
1	Resistor, 270 ohm, 1/2W, 5%	1	Potentiometer, 250 ohm
2	Resistor, 100k, 1/4W, 5%	1	Capacitor, 47uF, Electrolytic, 25V
2	Transistor RHF, NPN	1	Diode, power, 1A, 50V
3	Connecting Link	1	Transistor RHF, PNP
2	Capacitor, 4.7uF, electrolytic, 25V	1	Switch, push to make, metal strip
1	LED, Red	1	Motor 3 to 12V DC, 0.7A
2	Ammeter, 0mA to 100mA		
Ordering information			
Transistor amplifiers add-on pack		LK9435	
Curriculum pack		LK4403	



Suitable for unit 35 of the BTEC National in Engineering: Principles and applications of Electronic Devices and Circuits.

Principles and applications of Electronic Devices and Circuits

This unit provides a practical introduction to basic electronic devices and analogue and digital electronic principles. It provides learners with an opportunity to investigate the operation of diodes, transistors operational amplifiers, logic gates, and their associated circuits. The pack includes a full suite of worksheets and a teacher's guide.

Learning objectives / experiments

- Diodes and zener diodes
- Half wave rectifiers
- NPN and PNP transistors
- Transistors bias and circuits
- Transistor amplifiers
- Operational amplifiers
- Inverting and non-inverting amplifiers
- Filters and oscillators
- AND, OR, NAND, NOR, and NOT gates
- Combinational logic circuits
- RS and JK flip flops
- Counters and shift registers

Components included		
1 Resistor, 1k, 1/2W, 5% (DIN)	1 Diode, power, 1A, 50V	
9 Connecting Link	1 Curriculum CD ROM	
1 Power supply carrier with battery symbol	1 7 x 5 metric baseboard with 4mm pillars	
1 2200uF capacitor	1 Power supply	
1 Full wave rectifier	1 Potentiometer 250ohm	
1 4v7 zener diode	1 6v8 zener diode	
1 Voltmeter, 0V to 15V	1 Pair of leads, red and black, 600mm, 4mm to croc clip	
1 Operational amplifier add-on pack	1 Combinational logic add-on pack	
1 Sequential logic add-on pack	1 Transistor amplifier add-on pack	

Ordering information

Principles and applications of electronic devices and circuits	LK9422
Curriculum pack	LK9331



Suitable for unit 39 of the BTEC Higher National award in Engineering: Electronic principles.

Advanced electronic principles

The experiments in this pack are designed for the more advanced students of electronics who needs to understand the theory and practice of a wide range of electronic components and circuits: from basic diode circuits through to feedback and oscillator design. The 42 experiments are guided by a 100 page book and full instructor notes are included.

Learning objectives / experiments

- Semiconductor devices: diodes, zener diodes, transistors, photodiodes, thyristor, voltage regulator, operational amplifiers. Semiconductor circuits: Full and half wave rectifiers, transistors as switches and amplifiers
- Amplifiers: characteristics, power amplifiers (A, B, AB), inverting, non-inverting, tuned, integrator, differentiator, comparator, Schmitt, filters (high pass, low pass, band pass, notch)
- Amplifiers with feedback
- Oscillators: Wien bridge, twin T, RC ladder, LC coupled, crystal

Components included

2 Power supply	1 AC voltage source carrier
1 Voltmeter, 0V to 15V	1 Resistor, 100 ohm, 1W, 5% (DIN)
1 Capacitor, 1,000 uF, Electrolytic 30V	1 Transformer, 2:1 turns ratio
1 Low power solar motor	3 Resistor, 1k, 1/2W, 5% (DIN)
3 Resistor, 10k, 1/4W, 5% (DIN)	1 Resistor, 270 ohm, 1/2W, 5% (DIN)
2 Resistor, 180 ohm, 1/2W, 5% (DIN)	1 Potentiometer, 250 ohm (DIN)
2 Potentiometer, 10k (DIN)	2 Resistor, 100k, 1/4W, 5% (DIN)
2 Capacitor, 47uF, Electrolytic, 25V	1 Transistor RHF, NPN
1 Transistor LHF, NPN	1 Diode, germanium
3 Diode, power, 1A, 50V	1 Zener diode, 4.7V
1 Thyristor	12 Connecting Link
1 Zener diode, 8.2V	1 Transistor RHF, PNP
1 Transistor LHF, PNP	1 Bridge rectifier
1 Thermistor, 4.7k, NTC (DIN)	2 Lead, red, 500mm, 4mm to 4mm stackable
2 Lead, black, 500mm, 4mm to 4mm stackable	2 Lead, yellow, 500mm, 4mm to 4mm stackable
2 Lead, blue, 500mm, 4mm to 4mm stackable	1 Capacitor, 100uF, Electrolytic, 25V
1 Capacitor, 1 uF, Polyester	4 Capacitor, 4.7uF, electrolytic, 25V
2 Switch, push to make, metal strip	1 Switch, on/off, metal strip
1 Capacitor, variable, 15-140pF	3 Capacitor, 0.47 uF, Polyester
1 Resistor, 2.2k, 1/4W, 5% (DIN)	1 Switch, changeover, toggle
1 Resistor, 500k, 1/4W, 5% (DIN)	1 Op Amp Carrier (TL081) with 2mm to 4mm Leads
1 Resistor, 200k, 1/4W, 5% (DIN)	1 Capacitor, 1nF, Polyester
1 Curriculum CD ROM	2 LED, Red
1 Motor 3 to 12V DC, 0.7A	1 AA battery holder carrier
1 2:1 transformer with retractable ferrite core	2 Power supply carrier with battery symbol
1 Dual rail power supply carrier	2 7 x 5 metric baseboard with 4mm pillars
2 Ammeter, 0mA to 100mA	1 Photodiode
1 Triac	1 Transistor, JGFET
1 Phototransistor	

Ordering information	DIN	ANSI
Advanced electronic principles	LK6804	LK6804A
Corresponding curriculum	LK3061, LK9945, LK2094, LK4403	

Suitable for unit 66 of the BTEC Higher National award in Engineering : Electrical, electronic and digital principles.



Advanced electrical, electronic and digital principles

This pack brings together the different aspects of electrical, electronic and digital principles. Students start by understanding circuit theorems to analyse voltage and current in electrical circuits with passive components. Having learned the basic principles students move on to understanding circuits containing reactive components with series and parallel combinations. Then they construct a number of different types and classes of amplifiers: discrete and based on op-amps. Finally, students investigate digital components and simple digital logic circuits. A full colour workbook with teacher's notes is included on CD ROM.

Learning objectives / experiments

- Series and parallel LCR circuits
- Frequency response and Q factor of reactive circuits
- Norton, Kirchoff, Thevenin theorems
- Superposition and maximum power transfer
- Transistor amplifiers – A, B, AB
- Logic gates NOT, AND, NAND, OR, NOR, XOR
- Simple logic gate circuits
- Combinational logic circuits
- Sequential logic circuits

Instruments

To deliver this course you will also need:

LK1110	Multimeter pack	HP8279	Picoscope
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Components included

1	Advanced electrical principles pack	1	Transistor amplifiers add-on pack
1	Combinational logic add-on pack		

Ordering information	DIN	ANSI
Advanced electrical, electronic and digital principles	LK9044	LK9044A
Corresponding curriculum	LK8473, LK8749, LK2094, LK4403	



BTEC Higher National:
Unit 66: Electrical, electronic and digital principles
Unit 71: Combinational and sequential logic

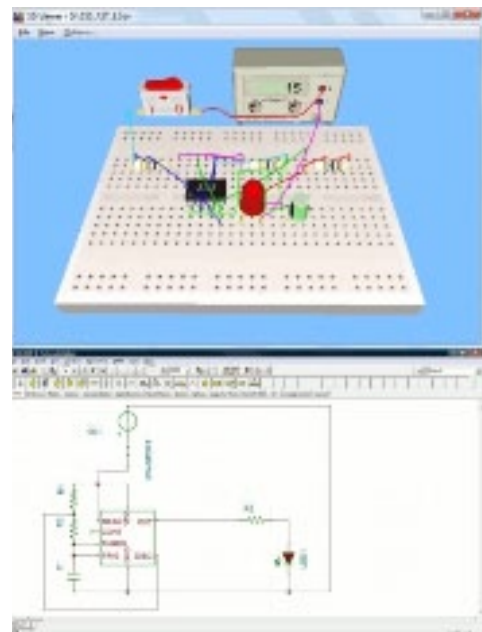
BTEC National:
Unit 34: Electronic circuit design and manufacture
Unit 35: Principles and applications of electronic devices and circuits
Unit 57: Principles and applications of Analogue electronics

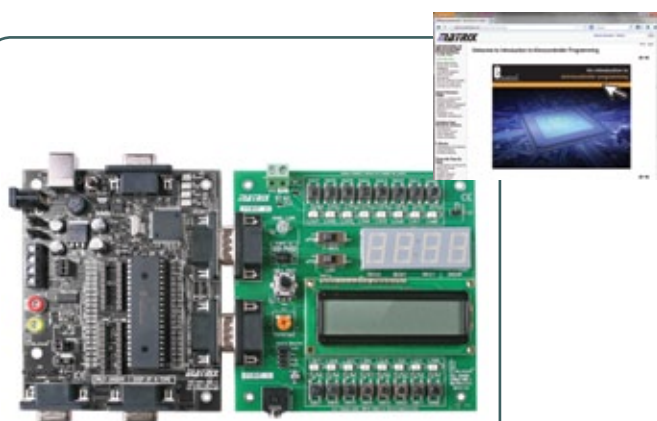
TINA V10

TINA is a powerful yet affordable circuit simulation and PCB design software package for analyzing, designing, and real time testing of analogue, digital, VHDL, microcontroller, and mixed electronic circuits and their PCB layouts. You can also analyse Switched Mode Power supplies, RF, communication, and optoelectronic circuits; and test microcontroller applications in a mixed circuit environment. Electrical engineers will find TINA an easy to use, high performance tool, while educators will welcome its unique features for the training environment.

Learning objectives / experiments

- Schematic entry with more than 20,000 component models
- Mixed signal circuit simulation
- Full simulation suite with virtual instruments
- PCB design with full data output for PCB manufacture and 3D visualisation
- Microcontroller circuit simulator for PIC, AVR and Arm with test and debug facilities from Assembler or C with external C compiler
- VHDL and Verilog design suite with simulation





Suitable for unit 59 of the BTEC National award in Engineering: Microprocessor systems and applications.

Programming PIC microcontrollers with flow charts

This pack guides students through the process of developing microcontroller based electronic products using flowcharts with our Flowcode software. The pack includes a downstream 'Combo' board with switches, LEDs, LCD and sensors, and a PIC programmer board with Ghost technology - which provides in-circuit-debug, oscilloscope, logic analyser and packet decoder functions. Circuit connections are provided using one of our new full colour printed platforms. Students are guided through the learning process using a free online course - 'Introduction to microcontroller programming' which provides up to 50 hours of student centered learning. Tasks and Excel marking scheme included.

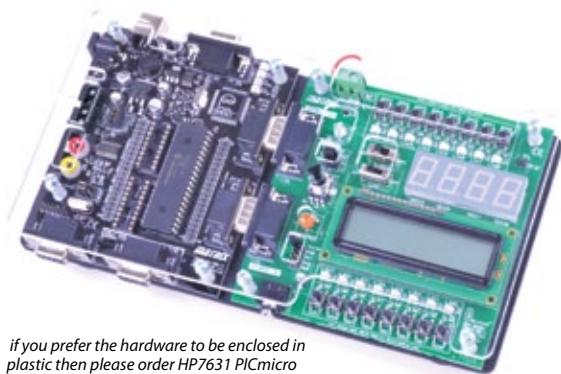
Learning objectives / experiments

- Microcontroller programming and circuits, clocks, pins, inputs, outputs, ports, memory and memory types, current limits
- Programming using flowcharts: input, system, output, loops, decision, subroutine, go to, calculations, delays, variables, strings, A/D conversion, interrupts, hardware macros, software macros, arrays
- Techniques: Binary, Hexadecimal, ASCII, calculations
- Components: clocking devices, switches, LEDs, LED arrays, sensors, buzzers, keypad, LCD, 7-segment displays, quad 7-segment displays, power supply, EEPROM
- Techniques: switch debounce, Schmitt trigger, prototyping with E-blocks strip board, PCBs and proto boards, using batteries



Instrumentation included

- Ghost and Flowcode provide:
- In-Circuit-Debug
 - In-Circuit-Test
 - Multi channel oscilloscope
 - Multi channel logic analyser
 - Multi channel packet decoder
 - Data console display



if you prefer the hardware to be enclosed in plastic then please order HP7631 PICmicro development centre kit.

Ordering information

Development board and EB006 combo	HP4832
PICmicro development centre	HP7631



Suitable for unit 59 of the BTEC National award in Engineering: Microprocessor systems and applications.

Programming Arduino microcontrollers with flow charts

This pack guides students through the process of developing microcontroller based electronic products using flowcharts with our Flowcode software. The pack includes a downstream 'Combo' board with switches, LEDs, LCD and sensors, and an Arduino/E-blocks interface shield. Circuit connections are provided using one of our new full colour printed platforms. Students are guided through the learning process using a free online course - 'Introduction to microcontroller programming' which provides up to 50 hours of student centered learning. Tasks and Excel marking scheme included. Arduino board not included.

Learning objectives / experiments

- Microcontroller programming and circuits, clocks, pins, inputs, outputs, ports, memory and memory types, current limits
- Programming using flowcharts: input, system, output, loops, decision, subroutine, go to, calculations, delays, variables, strings, A/D conversion, interrupts, hardware macros, software macros, arrays
- Techniques: Binary, Hexadecimal, ASCII, calculations
- Components: clocking devices, switches, LEDs, LED arrays, sensors, buzzers, keypad, LCD, 7-segment displays, quad 7-segment displays, power supply, EEPROM
- Techniques: switch debounce, Schmitt trigger, prototyping with E-blocks strip board, PCBs and proto boards, using batteries

Also an ideal platform for learning C/C++ with Arduino

This kit is also available with our Arduino Mega shield

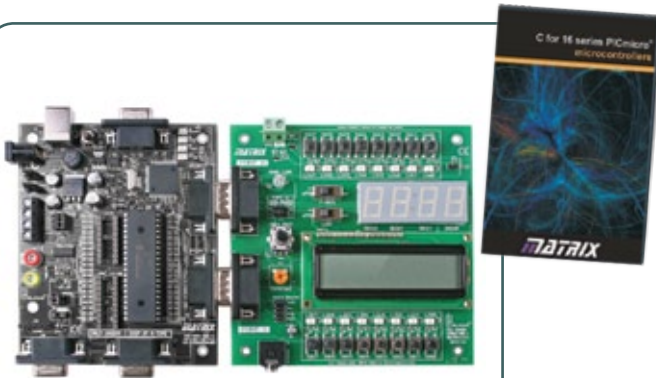


Components included

1 Arduino E-blocks interface shield	1 E-blocks Combo board
1 Power supply	1 USB cable
1 Flowcode v6	

Ordering information

Development board and Arduino shield combo	HP7745
'Mastering microcontrollers' book	HP2686
Flowcode for PIC and Arduino 50	FC6SE50AVR

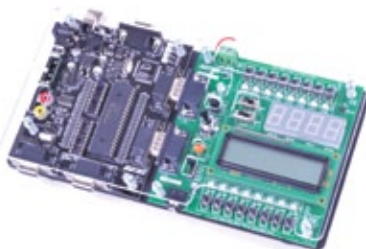


Programming microcontrollers with C

By working through this pack students will acquire the skills needed to program microcontrollers in C code and develop simple electronic products based on them. The CD ROM based learning resources (around 40 hours) take students through the fundamentals of C programming in a series of on-screen tutorials. Once students have understood the basics they carry out a series of labs using the Integrated Development Environment and C compiler provided, to help build on their understanding. Tests and exercises to reinforce learning are provided. The pack includes a PIC programmer board, and a downstream 'Combo' board with switches, LEDs, LCD and sensors. C compiler/IDE and program send utility are provided.

Learning objectives / experiments

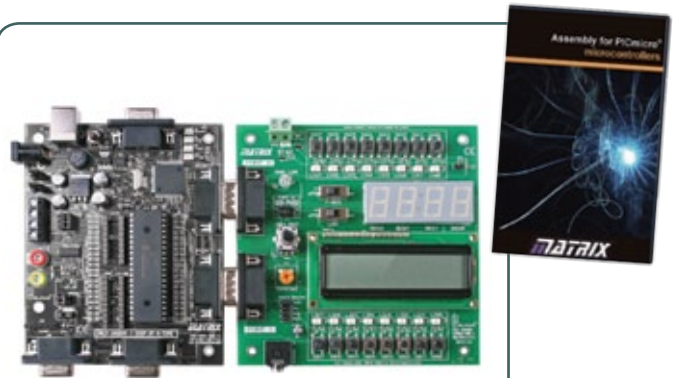
- What is a C program?: Comments, The main function header, The main function body, The end of the line
- Variables: Types, Characters, Declaration, Initialization, Names, Assigning statements, Expressions, Operators and Operands, Operators and divide, Working on bits, Casting
- Conditional Statements: Logical operators, Equality, Else, Unary operators in conditions
- Statements and Blocks: Blocks in Blocks, Global and local variables, Local variable scope
- Looping the loop: While, Counting, For loop, Breaking out of loops, Continuing loops
- Functions: When to use a function, return values, parameters
- Arrays: The need for arrays, Declaring, elements in an array, Sorting
- Switches: The switch condition, Switches and breaks
- Pointers: Declaring, Using a pointer, Comparing a pointer, Null pointers, Functions, Strings
- Structures: Creating, How structures work, Pointers in structures, Structures in structures
- The pre-processor: #include directive, magic numbers and #define, Conditional compilation
- Software engineering in C : Deciding on specification, test, creating functions, Using functions, Making a project, External data
- Labs: Lab 1: flashing lights, Lab 2: Switches and torches, Lab 3: Follow the leader, Lab 4: LEDs and Clocks, Lab 5: LCDs and libraries, Lab 6: Mystic LCD, Lab 7: The Elock, Lab 8: reaction timer, Lab 9: Inspect your morse, Lab 10 – Analogue fun



If you prefer the hardware to be enclosed in plastic then please order HP7631 PICmicro development centre kit.

Ordering information

Development board and EB006 combo	HP4832
PICmicro development centre	HP7631
C for 16 series PICmicro microcontrollers	EL543S15

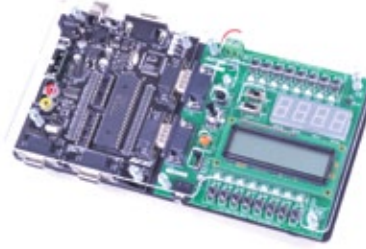


Programming microcontrollers with Assembly

This pack includes the hardware software and courseware needed to teach students to program microcontrollers in Assembly code and to develop simple electronic systems. The pack includes a PIC programmer board, and a downstream 'Combo' board with switches, LEDs, LCD and sensors. The pack makes use of Microchip's MPLAB programming suite which includes a full IDE and Assembler and links into our own wend utility. The courseware shipped on CD ROM includes around 40 hours of course material which is based on a sequence of labs that take students from first principles of programming through to programs of medium complexity.

Learning objectives / experiments

- Introduction: An introduction to the PICmicro series of microcontrollers, to the Assembly for PICmicro microcontrollers package and to the structure of the CD ROM
- Getting started: Information to get you up and running quickly and to let you check out your development kit
- Section 1: tutorials 1 - 14 Machine code assembler, downloading files to the PICmicro MCU, binary, basic commands, Input and output ports, switch monitoring, flags, loops and control structures
- Section 2: tutorials 15 - 29 Audio tone generation, subroutines, tables, indirect addressing, timers, driving 7-segment LED displays, simple clocks
- Section 3: tutorials 30 - 39 LCD displays, 24-hour clock program, burglar alarm (with circuit), EEPROM data memory use, watchdog timer, interrupts, sleep mode
- Section 4: tutorials 40 - 45 Library and include files, different PICs, ADC, internal EEPROM, serial comms

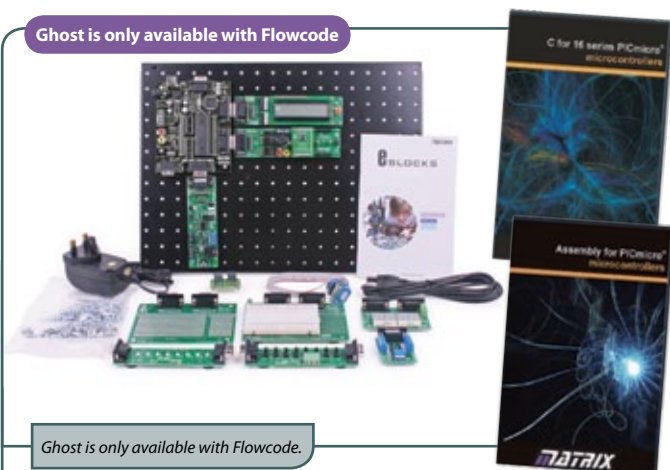


If you prefer the hardware to be enclosed in plastic then please order HP7631 PICmicro development centre kit.

Ordering information

Development board and EB006 combo	HP4832
PICmicro development centre	HP7631
Assembly for PICmicro microcontrollers	EL5629S15

Ghost is only available with Flowcode



Ghost is only available with Flowcode.

Standard starter packs

If you are looking for greater flexibility for learning and project work then the E-blocks starter packs are ideal general purpose kits which enable studying and projects in a variety of programming languages. Packs are available for PIC, AVR, Arduino, ARM and dsPIC / PIC24 cores. Many other processors can also be used from vendors with Arduino compatible products. The packs include the relevant E-blocks boards, a metal backplane, quick snap mounting pillars, leads, power supplies and rugged storage cases. Additional E-blocks and sensor boards can be added to these packs as required.

Learning objectives /experiments

Typical 50 hour self-guided learning courses in device programming in Flowcode, C, Assembly are all available from Matrix. These packs are also compatible with a wide variety of books and third party software languages.

Deluxe starter packs

These packs are great for the more sophisticated learner and developer who needs to learn more than just the basics of microcontroller programming - particularly where communications between one microcontroller and another are an important issue - and for this reason they include two device programmer boards/shields. Packs are available for PIC, AVR, Arduino, ARM and dsPIC /PIC24 cores. Many other processors can also be used from vendors with Arduino compatible products. The packs include the relevant E-blocks boards, a metal backplane, quick snap mounting pillars, leads, power supplies and rugged storage cases. Additional E-blocks and sensor boards can be added to these packs as required.

Learning objectives /experiments

Typical 50 hour self-guided learning courses in device programming in Flowcode, C, Assembly are all available from Matrix. These packs are also compatible with a wide variety of books and third party software languages.

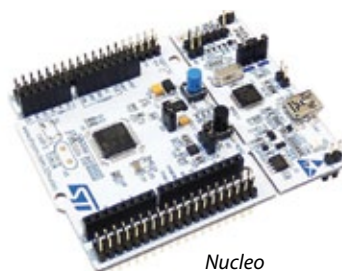
The Arduino version of these products is compatible with a large range of additional processors from many vendors including Intel (Edison), STM (STM32 Nucleo), microchip (Chip kit 32), Freescale (ARM coretex M0) and many others.



Arduino uno



Cypress



Nucleo



Freescale ARM

Components included

1 Device programmer board/ shield	1 Patch board
1 LED board	1 Digital temperature sensor
1 Switch board	1 Thermistor sensor
1 Terminal board	1 Set of leads and accessories
1 Quad 7-segment display	1 Power supply
1 SPI and D/A board	1 Backplane
1 Sensor mother board	1 Storage trays and packaging
1 Prototype board	1

Ordering information

Standard PICmicro starter pack	EB2161
Standard AVR starter pack	EB3441
Standard ARM starter pack	EB1401
Standard dsPIC/PIC24 starter pack	EB6511
Standard Arduino starter pack	EB9488

Components included

2 Device programmer board/ shield	1 1 USB232 board
2 LED boards	1 Digital temperature sensor
2 Switch boards	1 Thermistor sensor
1 Terminal board	1 Gyroscope sensor
1 Quad 7-segment display	1 PIR sensor
1 SPI and D/A board	1 Magnetometer sensor
1 Sensor mother board	1 Set of leads and accessories
1 Prototype board	2 Power supplies
1 Patch board	2 Backplanes
1 Power board	1 Storage trays and packaging

Ordering information

Deluxe PICmicro starter pack	EB4838
Deluxe AVR starter pack	EB9532
Deluxe ARM starter pack	EB7859
Deluxe dsPIC/PIC24 starter pack	EB7845
Deluxe Arduino starter pack	EB7021

Note that Arduino based versions include an E-blocks Arduino shield, the Arduino board itself must be sourced separately.



Instrumentation included
 Ghost and Flowcode provide:
 • In-Circuit-Debug
 • In-Circuit-Test
 • Multi channel oscilloscope
 • Multi channel logic analyser
 • Multi channel packet decoder
 • Data console display

Electronic engineering



Zigbee bundle

This bundle includes everything you need to rapidly develop Zigbee based systems linked to microcontroller hardware. The bundle includes an LCD board, LED board, switch board, three Zigbee boards, a Matrix sensors motherboard alongside two Matrix sensors - the thermistor and digital temperature sensors - and three power supplies. Add a PIC, dsPIC, ARM, Arduino or Raspberry pi board as required. Full datasheets provided. Photo shows bundle with EB006 PIC programmers and Flowcode software.

Components included

1	E-blocks LED board	EB004	1	E-Blocks LCD board	EB005
1	E-Blocks push-to-make switch board	EB007	1	E-blocks Zigbee coordinator board	EB051C
2	E-Blocks Zigbee router board	EB051R	2	E-blocks sensors motherboard	EB090
1	Thermistor sensor module	EBM003	1	Digital temperature sensor module	EBM004
3	Power supply	HP2666			



RFID bundle

This bundle includes everything you need to rapidly develop RFID based systems linked to microcontroller hardware. The bundle includes an LCD board, LED board, switch board, RFID board, power supply, two mirfare type RFID cards, and two I-code SLI type RFID cards. Add a PIC, dsPIC, ARM, Arduino or Raspberry pi board as required. Full datasheets provided. Photo shows bundle with EB006 PIC programmer and Flowcode software.

Components included

1	E-blocks LED board	EB004	1	E-Blocks LCD board	EB005
1	E-Blocks push-to-make switch board	EB007	1	E-blocks RFID board	EB052
1	Power supply	HP2666	2	Mifare RFID card	HP089
2	i-code RFID card	HP459			



Mobile phone bundle

This bundle includes everything you need to rapidly develop GSM based systems linked to microcontroller hardware. The bundle includes an LCD board, LED board, E-blocks sensor motherboard and digital temperature module, a keypad board, GSM board with integral SIM card holder and antenna, and power supply. SIM card not included. Add a PIC, dsPIC, ARM, Arduino or Raspberry pi board as required. Full datasheets provided. Photo shows bundle with EB006 PIC programmer and Flowcode software.

Components included

1	E-blocks LED board	EB004	1	E-Blocks LCD board	EB005
1	E-Blocks Keypad board	EB014	1	E-blocks GSM board	EB066
1	E-blocks sensors motherboard	EB090	1	Digital temperature sensor module	EBM004
1	Power supply	HP2666			



CAN bus bundle

This bundle includes everything you need to rapidly develop CAN systems. It includes an LCD board, a switch board, an LED board, two CAN bus boards, and two power supplies. Datasheets on each individual item are available separately. Add a PIC, dsPIC, ARM, Arduino or Raspberry pi board as required. Full datasheets provided. Photo shows bundle with EB006 PIC programmer and Flowcode software.

Components included

1	E-blocks LED board	EB004	1	E-Blocks LCD board	EB005
1	E-Blocks push-to-make switch board	EB007	2	E-blocks CAN bus board	EB018
2	Power supply	HP2666			



Bluetooth bundle

This bundle includes everything you need to rapidly develop a fully working Bluetooth system. The bundle includes an LED board, and LCD board, A switch board, a Bluetooth board (TDB BLU2i module) and a Bluetooth dongle for packet analysis. Add a PIC, dsPIC, ARM, Arduino or Raspberry pi board as required. Full datasheets provided. Photo shows bundle with EB006 PIC programmer and Flowcode software.

Components included

1	E-blocks LED board	EB004	1	E-Blocks LCD board	EB005
1	E-Blocks push-to-make switch board	EB007	1	E-blocks Bluetooth board	EB024
1	Bluetooth USB Dongle	HP444	1	Power supply	HP2666



Internet of things bundle

This bundle includes everything you need to rapidly develop Wireless LAN / Wi-Fi based systems linked to microcontroller hardware. The bundle includes an LCD board, LED board, a sensors board, a Wireless LAN board with integral antenna, and power supply. Add a PIC, dsPIC, ARM, Arduino or Raspberry pi board as required. Full datasheets provided. Photo shows bundle with EB006 PIC programmer and Flowcode software.

Components included

1	E-blocks LED board	EB004	1	E-Blocks LCD board	EB005
1	E-blocks wireless LAN board	EB007	1	Digital temperature sensor module	EBM004
1	Power supply	HP2666	1	E-blocks sensors mother board	EB090

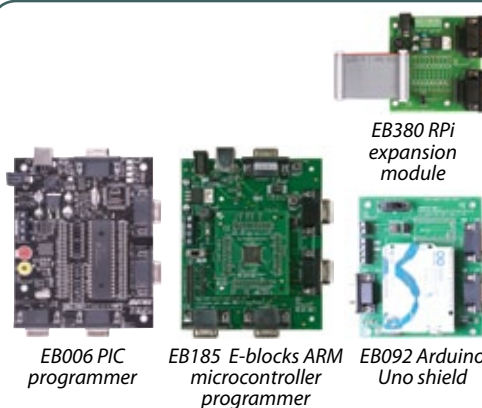


GPS bundle

This bundle includes everything you need to rapidly develop a fully working GPS system. The kit includes an E-Blocks LED board, E-Blocks LCD board, E-Blocks Switch board, E-blocks GPS board with antenna, and an International power supply. This bundle is based on a Navman Jupiter 31 module which acquires GPS positions faster than any other GPS engine. Add a PIC, dsPIC, ARM, Arduino or Raspberry pi board as required. Full datasheets provided. Photo shows bundle with EB006 PIC programmer and Flowcode software.

Components included

1	E-blocks LED board	EB004	1	E-Blocks LCD board	EB005
1	E-Blocks push-to-make switch board	EB007	1	E-blocks GPS board	EB056
1	Power supply	HP2666	1		



Upstream boards and shields

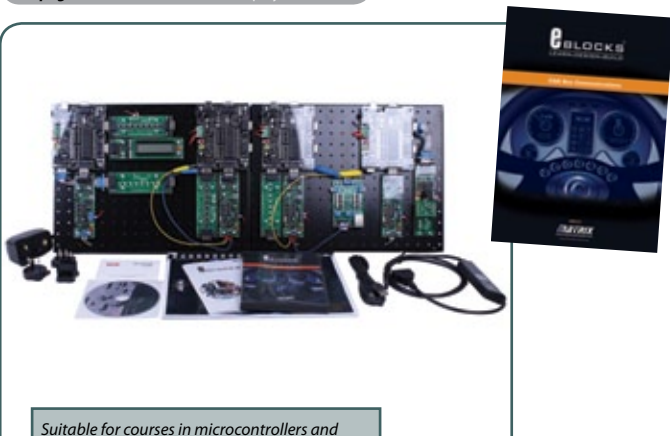
Please order all boards in bundles individually. To make use of the bundles with your hardware choose the appropriate chip programmer board or shield. Ghost instrumentation is only available on selected Matrix boards. Please consult the datasheets on your processor board to see if you need any splitter cables. Note that you will need to supply your own RPI, Arduino or Arduino compatible boards.

Components included

E-blocks PIC multiprogrammer with Ghost	EB006	E-blocks dsPIC programmer	EB064
E-blocks dsPIC with Ghost	EB091	Arduino Uno compatible shield	EB093
Arduino mega compatible shield	EB092	RPI expansion module	EB380
ARM microcontroller programmer	EB194		

- In-Circuit-Debug
- In-Circuit-Test
- Multi channel oscilloscope
- Multi channel logic analyser
- Multi channel packet decoder
- Data console display

Electronic engineering



Suitable for courses in microcontrollers and digital communications at undergraduate level.

CAN bus training course

This 20 hour training solution is designed to facilitate the development and investigation of systems that use the CAN bus protocol. The solution is suitable for both automotive students and for electronics undergraduates. Four fully programmable CAN nodes are included in the solution, along with circuit boards which mimic the functions of indicator lamps, switches and sensors. A CAN bus analyser and message generator are also included. An 80 page teacher's manual contains a range of exercises for automotive technicians upwards.

Learning objectives /experiments

- CAN technology, wiring, topology and networks
- CAN message structure and physical layer transmission
- Understanding CAN bus protocols
- Using buffers in CAN systems
- Using CAN transmit and receive messages
- Errors in CAN systems
- Programming techniques in CAN systems
- Masks and filters in CAN systems
- Higher level protocols
- Development of complete CAN systems based on microcontrollers

Components included

2 LED boards	1 Kvaser analyser
2 Switch boards	1 Curriculum CD ROM
4 CAN communications boards	2 Backplanes
1 Prototype board	2 Power supplies
1 Sensor interface	1 Set of leads
1 16 x 2 LCD board	1 Temperature sensor
1 PIC Multiprogrammer boards	1 Flowcode V6 academic licence
1 CAN faults board	1 Storage trays and packaging

Ordering information

CAN bus training course	EB237
Curriculum CD ROM and manual only	EB9012



Suitable for courses in microcontrollers and digital communications at undergraduate level.

Bluetooth training course

This 20 hour training solution allows students to carry out investigations into the Bluetooth standard using high level macros written in Flowcode. Students use the hardware, software and curriculum to investigate various Bluetooth protocols and functions including the serial protocol (SPP), local area protocol (LAP) and the headset protocol (HPP). An 80 page teacher's manual covers system set-up, Bluetooth theory and a range of exercises for students to work through.

Learning objectives /experiments

- Data communication between microcontroller and Bluetooth modules
- AT command structure and programming strategy in AT controlled systems
- Bluetooth visibility
- Device discovery, pass keys and addresses
- Responses - sequence flow and error checking
- Connecting and pairing
- Data communication
- Using Bluetooth for control applications
- Audio and implementation of the audio gateway
- Headset and telephone profiles

Components included

1 LED board	2 Sets headphones
2 Switch boards	2 Backplanes
2 Bluetooth boards	2 Power supplies
1 Prototype board	1 Set of leads
2 Voice CODEC boards	1 Flowcode V6 academic licence
1 16 x 2 LCD board	1 Curriculum CD ROM
2 PIC Multiprogrammer boards	1 Storage trays and packaging
1 Keypad board	

Ordering information

Bluetooth training course	EB860
Curriculum CD ROM and manual only	EB9127

- In-Circuit-Debug
- In-Circuit-Test
- Multi channel oscilloscope
- Multi channel logic analyser
- Multi channel packet decoder
- Data console display



Suitable for courses in microcontrollers and digital communications at undergraduate level.

Mobile phone technology training course

This training solution provides a complete course in developing communication systems. In completing the 20 hour course, students will learn about communications systems, the AT command protocol, communications strategies and many aspects of project development and management. The solution includes a fully working mobile phone based on Eblocks. A 50 page teacher's manual contains a range of exercises.

Learning objectives /experiments

Programming:

- General programming of systems including LCD, Keypad etc
- RS232 protocol and programming
- String construction and deconstruction in communications
- The use of state machines in controlling electronic systems

Communications:

- RS232 communications and handshaking protocols
- ASCII representation of characters in messages
- AT command structure and command protocols used in telecommunications
- Sending and receiving text messages in mobile phone systems
- Modem control and messaging

Components included

1 LED board	1 RS232 board
1 Switch board	2 Backplanes
1 D/A and memory board	1 Power supply
1 Prototype board	1 Miniature speaker
1 Sensor interface	1 Set of leads
1 16 x 2 LCD board	1 Curriculum CD ROM
1 PIC Multiprogrammer board/ shield	1 Flowcode V6 academic licence
1 Keypad board	1 Storage trays and packaging
1 Patch board	

Ordering information

Mobile phone technology training course	EB118
Curriculum CD ROM and manual only	EB9134



Suitable for courses in microcontrollers and digital communications at undergraduate level.

Embedded internet training course

This 40 hour "Internet of Things" training solution gives students a full understanding of modern digital communications protocols and the development of embedded internet-based products. An 80 page teacher's manual covers system set-up, digital communications theory and contains a range of exercises for students to work through.

Learning objectives /experiments

- OSI model and layers
- Ethernet, DLC, MAC, ARP, TCP, IP, UDP, ICMP, HTTP and POP3 protocols
- MAC packet structure and message creation using microcontrollers
- Communication strategy and information flow
- Packet injectors and debuggers

Labs include:

- ARP scanning
- Ping
- Time and date messages using UDP
- Sending HTML using HTTP protocol
- Receiving HTML
- Sending an email using SMTP protocol

Advanced tasks include:

- Custom messaging using UDP
- A firewall application

Components included

1 LED board	1 Temperature sensor
2 Switch boards	1 Backplane
2 Internet boards	1 Power supply
1 Sensor interface board	1 Set of leads
1 Keypad board	1 Flowcode V6 academic licence
1 16 x 2 LCD board	1 Curriculum CD ROM
1 PIC Multiprogrammer boards	1 Storage trays and packaging
1 Keypad board	

Ordering information

Embedded internet training course	EB643
Curriculum CD ROM and manual only	EB9222

**Instrumentation included****Ghost and Flowcode provide:**

- In-Circuit-Debug
- In-Circuit-Test
- Multi channel oscilloscope
- Multi channel logic analyser
- Multi channel packet decoder
- Data console display

See page 78

Electronic engineering



Suitable for courses in microcontrollers and digital communications at undergraduate level.

RFID training course

This training solution provides a complete 20 hour course in developing RFID systems. It gives students who are familiar with microcontrollers an understanding of the programming involved in developing RFID systems. An E-blocks RFID board and four RFID tags embedded into credit cards are included. This hardware allows students to learn about reading and writing transponder data in both I-code and Mifare mode. A 50 page teacher's manual contains a range of exercises.

Learning objectives /experiments

- RFID systems and applications
- Configuring RFID readers
- Commands and syntax used in reading and writing data to and from RFID cards
- Communication with both Mifare and I-code systems
- Development of microcontroller based systems using

RFID technology

For both Icode and Mifare modes:

- Transponder unique ID
- Reading transponder data
- Writing transponder data
- Value format

Components included

1 LED board	1 I-code RFID cards
1 Switch board	1 Backplane
1 RFID board	1 Power supply
1 Sensor interface	1 Set of leads
1 16 x 2 LCD board	1 Curriculum CD ROM
1 PIC Multiprogrammer board	1 Flowcode V6 academic licence
1 Keypad board	1 Storage trays and packaging
2 Mifare RFID cards	

Ordering information

RFID training course	EB699
Curriculum CD ROM and manual only	EB9329



Suitable for courses in microcontrollers and digital communications at undergraduate level.

Zigbee training course

This training solution provides a complete 20 hour course in developing wireless area networks based on the ZigBee standard. It gives students who are familiar with microcontrollers an understanding of the programming techniques involved in developing ZigBee wireless communications systems. A ZigBee packet analyser is included in the solution, along with four fully working ZigBee nodes based on E-blocks. A 50 page teacher's manual contains a range of exercises.

Learning objectives /experiments

- Zigbee protocols, message transmission and reception, and networks
- Zigbee principles, topologies and components
- Development of microcontroller based systems using

Zigbee technology

- Moulding the network
- Adding nodes
- Expanding the network
- Reducing power consumption
- Dynamic networks
- Message routing
- Data logging gateways
- A complete modular fire and burglar alarm
- Improving network security

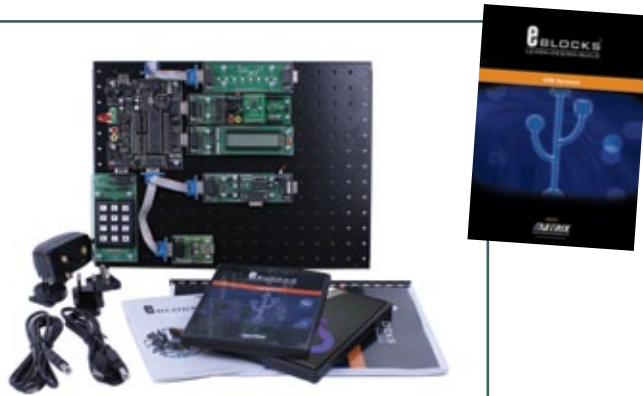
Components included

1 LED board	2 Sensor boards
1 Switch board	2 Backplanes
3 Zigbee router boards	2 Power supplies
1 Keypad board	1 Set of leads
1 Colour LCD board	1 Flowcode V6 academic licence
1 16 x 2 LCD board	1 Curriculum CD ROM
4 PIC Multiprogrammer boards	1 Storage trays and packaging
1 USB232 board	1 Zigbee message analyser

Ordering information

Zigbee training course	EB284
Curriculum CD ROM and manual only	EB9457

- In-Circuit-Debug
- In-Circuit-Test
- Multi channel oscilloscope
- Multi channel logic analyser
- Multi channel packet decoder
- Data console display



Suitable for courses in microcontrollers and digital communications at undergraduate level.

USB training course

This training solution provides a complete 20 hour course allowing students to carry out a number of practical exercises in USB technology. Students learn about USB through eight different systems: mouse, joystick, temperature logger, USB terminal, USB to RS232 converter, basic slave, storage scope and oscilloscope with variable trigger. By working through these exercises, students build an understanding of the various types of USB system including Human Interface Devices, communications devices and slave devices. A 50 page teacher's manual contains a range of exercises.

Learning objectives /experiments

- USB protocol and packet structure
- Devices, descriptors and configuration
- USB HID, Serial and slave protocols
- Development of microcontroller based systems using USB technology

Exercises include the development of:

- HID Mouse
- HID Keyboard
- HID Datalogger
- HID USB terminal
- HID RS232
- Storage and triggered scope

Components included

1	LED board	1	Backplanes
1	USB interface board	1	Power supply
1	RS232 board	1	Set of leads
1	Sensor interface	1	Curriculum CD ROM
1	16 x 2 LCD board	1	Flowcode V6 academic licence
1	PIC Multiprogrammer board	1	Storage trays and packaging
1	Keypad board		

Ordering information

USB training course	EB479
Curriculum CD ROM and manual only	EB9538

NEW



Suitable for courses in electronics at undergraduate level.

FPGA training course

This training solution provides a complete 40 hour course in the techniques of developing projects based on FPGAs using either Verilog or VHDL using an Altera FPGA and the free version of the Quartus design software, which requires registration with Altera. The equipment is ideal for learning and for project work and students can go on to develop more advanced projects which might even include embedding NIOS processors. A full instructors' manual is included.

Learning objectives /experiments

- FPGA design techniques
- Quartus development environment: top down and bottom up projects
- VHDL design language
- Verilog design language
- Combinational logic circuits: simple circuits, encoders, decoders, parity checkers, adders, subtractors, multipliers
- Sequential logic circuits: SR, D, JK flip flops, asynchronous up, down and BCD counters, synchronous binary up and down counters, state machines
- Project work

Components included

1	LED board	1	Backplane
1	Switch board	1	Power supply
1	Dual 7-segment display	1	Set of leads
1	FPGA board	1	Curriculum CD ROM
1	Keypad board	1	Storage trays and packaging

Ordering information

FPGA training course	EB940
Curriculum CD ROM and manual only	EB941

**Instrumentation included****Ghost and Flowcode provide:**

- In-Circuit-Debug
- In-Circuit-Test
- Multi channel oscilloscope
- Multi channel logic analyser
- Multi channel packet decoder
- Data console display

See page 78

Electronic engineering

**NEW**

Suitable for Music technology and electronics courses at undergraduate level.

Audio DSP training course

This training solution provides a complete 25 hour course on the development of audio Digital Signal Processing systems based on the popular Microchip dsPIC series of processors. This highly motivating course uses systems charts made up of the DSP functional blocks contained in Flowcode and focusses on practical aspects of DSP, concealing the high-level mathematics involved. A 60 page teacher's manual contains a range of exercises.

Learning objectives /experiments

- Flowcode DSP software and set up
- Sampling rates, ticks, Nyquist and DSP basics
- Audio A/D and D/A processes
- Simple audio in/out systems
- Mixing audio signals in audio systems
- Tone generation and guitar tuning
- Digital filters
- Echo and reverb techniques

Components included

1 LED board	1 Prototype board
1 DSP input board	1 Sensor board
1 DSP output board	1 7-segment display board
1 dsPIC Multiprogrammer	1 Backplane
1 16 x 2 LCD board	1 FC6 dsPIC academic licence
1 Switch board	1 Storage trays and packaging
1 EB084 colour graphical LCD	1 Curriculum CD ROM
1 Terminal board	1 Set of leads
1 Patch board	1 Power supply

Ordering information

Audio DSP training course	EB650
Curriculum CD ROM and manual only	EB9005

Mechanical engineering



Forces Kit

This kit includes a set of different plastic shapes which fit onto a work panel for experiments in centres of gravity of two-dimensional objects. It also includes pulleys, weights and a magnetic protractor for experiments in concurrent and non-concurrent coplanar forces and angles. The selection of pulleys and weights allows you to create force triangles, polygons and linked polygons. The guidance notes show how to analyse and predict forces using Bow's Notation and the parallelogram of forces. Worksheets, guidance notes and lecturer notes (with answers) needed for typical experiments are supplied with the work panel. Work panel and kit must be ordered separately.

Learning objectives /experiments

- Centre of gravity
- Force triangles
- Force Polygons and Bow's Notation
- Linked Polygons (non-current forces)

Ordering information

Forces Kit	HP5005
Essential base unit	HP5000



Suitable for Unit 2 of
BTEC Higher National:
Engineering Science

Suitable for Unit 5
of BTEC National:
Mechanical principles and
applications.

Moments Kit

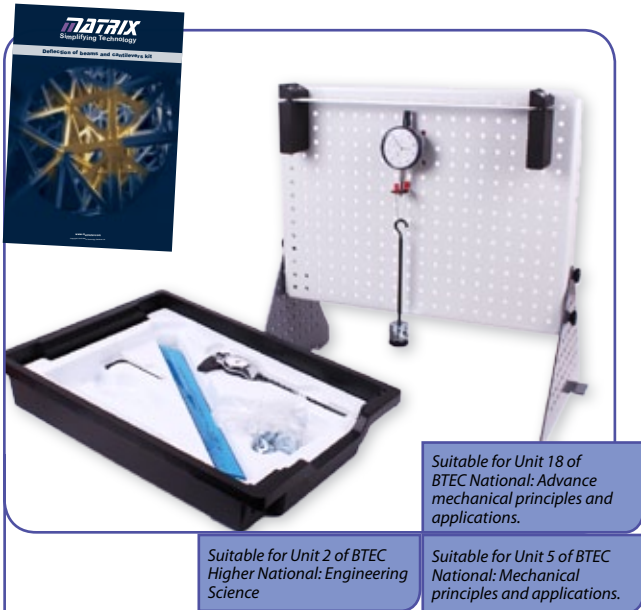
This kit includes a rigid beam for experiments in the principle of moments, extending to levers and beams. It shows the three main lever types (1st, 2nd and 3rd order) and includes an 'L' shape plate for experiments in bell crank levers. A pulley allows extra experiments with moments caused by oblique forces. The rigid beam allows experiments that show the use of moments to find unknown weights, creating simple beam balances. It also works with spring balances to show reaction forces on beams with point loads and uniformly distributed loads (UDLs). Worksheets, guidance notes and lecturer notes (with answers) needed for typical experiments are supplied with the work panel. Work panel and kit must be ordered separately. .

Learning objectives /experiments

- Principle of moments
- Beam Balances
- 1st, 2nd and 3rd order levels
- Bell Crank Level
- Beam Reactions

Ordering information

Moments Kit	HP5010
Essential base unit	HP5000



Deflection of Beams and Cantilevers Kit

This kit includes different beams and fixing blocks. The fixing blocks work as clamps or knife-edge supports. They hold the beams in different ways, such as a cantilever, simply supported, fixed (encastre) and a propped cantilever. Students set up a beam on the supports and add weights to deflect the beams. An accurate dial indicator measures the deflection at the point of loading. The choice of different beams allow extra experiments, showing the relationships between beam deflection and 'I' (second moment of area) value. They also allow comparisons of different beam material and how it affects deflection, introducing Young's Modulus. Students also use the cantilever for easy experiments showing the relationship between beam length and deflection. Worksheets, guidance notes and lecturer notes (with answers) needed for typical experiments are supplied with the work panel. Work panel and kit must be ordered separately.

Learning objectives /experiments

- Beam length and deflection
- Beam material and deflection (Young's Modulus)
- Beam 'I' value and deflection
- Beam supports (cantilever, propped cantilever, fixed beam and simply supported) and deflection



Torsion of Circular Sections Kit

This kit includes different circular section specimens and adjustable chucks which fit on to a work panel for experiments in torsion. Students fix the specimens in the chucks and apply weights to a lever arm. The arm applies a moment (torque) to one end of the specimen. A scale on the arm shows the angle of twist. Standard tests show the relationship between torsion and 'J' (polar second moment of area) value. Students use this to predict the twist angle for any given specimen. The choice of different specimens allows comparisons of different specimen material and how it affects torsion, introducing the Modulus of Rigidity. Students also move the chuck positions for easy experiments showing the relationship between specimen length and angle of twist. Worksheets, guidance notes and lecturer notes (with answers) needed for typical experiments are supplied with the work panel. Work panel and kit must be ordered separately.

Learning objectives /experiments

- Specimen length and angle of twist
- Specimen material and angle of twist (Modulus of Rigidity)
- Specimen 'J' value and angle of twist

Ordering information

Deflection of Beam and Cantilevers Kit	HP5015
Essential base unit	HP5000

Ordering information

Torsion of Circular Sections Kit	HP5020
Essential base unit	HP5000



Suitable for Unit 5 of BTEC National: Mechanical principles and applications.

Tensile Tester Kit

This kit includes specimens of different materials, which fit onto a work panel to show students the principles of tensile tests. Students use the tensile tester to stretch the specimens to destruction, while measuring the extension and force. The tests introduce students to tensile test terms including: overall stress and strain, yield properties, tensile strength and elongation. The choice of different specimens allows comparisons of different specimen material and how it affects its tensile properties. Worksheets, guidance notes and lecturer notes (with answers) needed for typical experiments are supplied with the work panel. Work panel and kit must be ordered separately.

Learning objectives /experiments

- Tensile tests (to destruction) of different materials
- Finding the tensile strength of a material
- Material behaviour in the elastic and plastic region
- Creating a force and extension chart



Suitable for Unit 2 of BTEC Higher National: Engineering Science

Suitable for Unit 18 of BTEC National: Advance mechanical principles and applications.

Simple Harmonic Motion Kit

This kit includes different pendulums and a spring which fit onto a work panel to show students the principles and use of simple harmonic motion. Students test different pendulums and a spring to see how different factors, such as mass or pendulum length affect simple harmonic motion and the period of oscillation. The theory shows how to predict the period of oscillation for a given pendulum or spring for comparison with actual results. The kit includes an experiment with the Kater's pendulum that shows the relationship between simple harmonic motion and gravity, for prediction of gravity to a reasonable accuracy. The kit also introduces students to a simple 'spring rate' test, and key scientific terms such as moments of inertia and parallel axis theorem. Worksheets, guidance notes and lecturer notes (with answers) needed for typical experiments are supplied with the work panel. Work panel and kit must be ordered separately.

Learning objectives /experiments

- Simple harmonic motion of simple, bifilar and trifilar pendulums of different length and mass
- Simple harmonic motion of a spring with different masses, and a simple spring rate test
- Simple harmonic motion of a compound pendulum
- Simple harmonic motion and gravity using a Kater's pendulum

Ordering information

Tensile Tester Kit	HP5025
Essential base unit	HP5000

Ordering information

Simple Harmonic Motion Kit	HP5030
Essential base unit	HP5000



Suitable for Unit 4 of BTEC
Higher National: Mechanical
principles

Friction and Inclined Plane Kit

This kit includes parts which fit on to a work panel to show experiments in friction and forces on a flat or inclined plane. The plane has an inclinometer and adjustment to allow the student to set the plane to any angle between zero and 90 degrees. The parts include different friction surfaces, a roller set, a rolling car or sled with adjustable mass and a simple roller. Students fit the different parts to the plane and apply masses. They learn how different surface finishes and mass affect friction and how surface angles and mass affect forces around a body on a plane. The experiments introduce students to important engineering and scientific terms, such as the coefficient of friction, sliding friction and kinetic friction. The inclinable plane allows students to do the classic 'forces on an inclined plane experiments'. It also shows the relationship between frictional forces and angles other than horizontal. Worksheets, guidance notes and lecturer notes (with answers) needed for typical experiments are supplied with the work panel. Work panel and kit must be ordered separately.

Learning objectives /experiments

- Forces on an inclined plane
- Rolling and Sliding Friction on different surfaces
- Kinetic and Static Sliding Friction between different surfaces
- Surface angle and friction between different surfaces

Ordering information

Friction and Inclined Plane Kit	HP5035
Essential base unit	HP5000



Suitable for Unit 2 of BTEC
Higher National: Engineering
Science

Suitable for Unit 11 of
BTEC National: Further
mechanical principles and
applications.

Potential and Kinetic Energy Kit

This kit includes a pendulum, a spring and a flywheel which fit onto a work panel for experiments in potential and kinetic energy. Students test each part to discover the difference between potential and kinetic energy and the transfer of energy from one form to another. The kit introduces students to key engineering terms such as 'moment of inertia' and 'elastic potential energy'. Worksheets, guidance notes and lecturer notes (with answers) needed for typical experiments are supplied with the work panel. Work panel and kit must be ordered separately.

Learning objectives /experiments

- Kinetic and potential energy in a pendulum
- Elastic potential energy in a spring
- Kinetic energy in a flywheel

Ordering information

Potential and Kinetic Energy Kit	HP5040
Essential base unit	HP5000



Suitable for Unit 5 of BTEC National: Mechanical principles and applications.

Drive Systems Kit

This kit includes three different drive systems, which fit on to a work panel, to show their relative advantages and disadvantages. Students test a universal coupling, a belt drive and a chain drive to see how they work and how they differ in the way they transfer motion (power). The kit includes extra parts to help show the importance of the angle of lap around a pulley and its relationship with friction. The kit introduces students to key engineering terms such as gear ratio, pulley ratio and efficiency. Worksheets, guidance notes and lecturer notes (with answers) needed for typical experiments are supplied with the work panel. Work panel and kit must be ordered separately.

Learning objectives /experiments

- Power transfer, efficiency and direction in a belt drive
- Power transfer and efficiency in a chain drive
- Friction and angle of lap on a pulley



Suitable for Unit 2 of BTEC Higher National: Engineering Science

Suitable for Unit 11 of BTEC National: Further mechanical principles and applications.

Cam Crank and Toggle Kit

This kit includes a crank and slider, which fit onto a work panel, to show the relative forces during crank motion. It also includes four popular cam shapes to show their different characteristics. Another set of parts in the kit shows the characteristics of a mechanical toggle. Students fit the crank and slider with weights and a spring balance to see the change in linear and rotational forces (moments) as the crank turns. They also use the slider with different followers on a set of four popular shape cams - heart, pear, spiral and round. This gives several cam and follower combinations to help students understand the different characteristics of each cam and why engineers choose between them for different applications. The last set of parts in the kit has a simple linkage that allows students to see the characteristics of a toggle mechanism. It shows the relative forces and angular conditions of the toggle in its initial state and how they affect the point at which it locks or 'snaps' into a horizontal state. The kit introduces students to key engineering terms such as a 'flat follower', a 'roller follower' and 'toggle action'. Worksheets, guidance notes and lecturer notes (with answers) needed for typical experiments with each kit are supplied with the work panel. Work panel and kit must be ordered separately.

Learning objectives /experiments

- Displacement and angle characteristics of pear, heart, round and spiral cams
- Characteristics of a mechanical toggle
- Turning moments and forces during crank motion

Ordering information

Drive Systems Kit	HP5045
Essential base unit	HP5000

Ordering information

Cam Crank and Toggle Kit	HP5040
Essential base unit	HP5000



Suitable for Unit 11 of
BTEC National: Further
mechanical principles and
applications.

Gear Trains Kit

This kit includes a selection of different gears which fit on to a work panel for experiments to find their unique characteristics. The gears include Spur Gears, a Bevel Gear and a Worm Drive. The spur gears have two sets of teeth on the same shaft, allowing extra experiments in compound gear trains. Students test each set of gears to see how it works and note the differences in characteristics (such as efficiency, gear ratio and mechanical advantage) of each set. The gear sets are a selection of the most common sets, similar to those used in real applications, such as automobile gear boxes, domestic and industrial hand tools and clockwork instruments. Each has advantages and disadvantages that make them suitable for a particular job. The kit introduces students to key engineering terms such as gear ratio, efficiency, mechanical advantage and velocity ratio. Worksheets, guidance notes and lecturer notes (with answers) needed for typical experiments are supplied with the work panel. Work panel and kit must be ordered separately.

Learning objectives /experiments

- Characteristics of Spur Gears, including single and compound gear trains and the 'idler' gear
- Characteristics of a Bevel Gear
- Characteristics of a Worm Drive

Ordering information

Gear trains Kit	HP5055
Essential base unit	HP5000



Simple Mechanisms Kit

This kit includes three popular mechanisms which fit on to a work panel for experiments in conversion of motion from linear to rotary or rotary to linear. These include the Scotch Yoke (sometimes called 'donkey crosshead' or 'slotted link'), the Crank and Slider and the Quick Return mechanisms. Students test each mechanism to see how it works and note the differences in the way that each mechanism converts the motion. The three mechanisms are the same as those used in real applications, such as combustion engines, power assisted valves or fluid pumping systems. Each has a unique way of converting motion, shown by the experiments. The kit introduces students to key engineering terms such as reciprocating motion, rotary to linear motion and linear to rotary motion. Worksheets, guidance notes and lecturer notes (with answers) needed for typical experiments are supplied with the work panel. Work panel and kit must be ordered separately.

Learning objectives /experiments

- Conversion of motion using the 'Scotch Yoke' (or 'slotted link')
- Conversion of motion using the Quick Return mechanism
- Conversion of motion using the Crank and Slider

Ordering information

Simple Mechanisms Kit	HP5060
Essential base unit	HP5000



Suitable for much of unit 24 of the BTEC Higher National award in Engineering : Applications of pneumatics and hydraulics.

The Automatics essentials solution

This kit provides a complete introduction to pneumatic circuit design and construction. The curriculum pack includes a comprehensive set of worksheets that allow students to progress from first principles through to circuits of moderate complexity; including reciprocating circuits and generating sequences of movements.

The solution is intended for students in their early teens and older who are learning technology and engineering subjects. Tasks are designed to be suitable for pairs of students sharing a single kit. Everything you will need to teach the course is included in the solution pack, with the exception of an air compressor.

Learning objectives

- Understanding the different varieties of valves and where each is appropriate in a system
- Understanding the basic types of cylinder, controlling speed and the factors that influence power output
- Combining valves to produce logic functions
- Semi-automatic and automatic reciprocation
- Creating sequences of movements
- Using reservoirs to create time delays
- Air bleed and pilot operated circuits
- Component symbols and circuit diagrams
- Staying safe when using air at high pressure

Components included

1 Cylinder, single acting	2 Cylinder, double acting
1 Valve, 3/2, button-spring	1 Valve, 3/2, lever-spring
4 Valve, 3/2, roller-spring	1 Valve, 3/2, diaphragm
1 Valve, 5/2, lever-spring	3 Valve, 5/2, pilot-pilot
1 Valve, shuttle	2 Valve, flow control
1 Reservoir	1 Automatics platform
1 Manifold	1 Tubing, red, 5 m
1 Tubing, yellow, 30 m	1 Tubing, blue, 30 m
4 Connector, tee junction	1 Tee bolts (pack of 50)
1 Tube cutting tool	1 Curriculum CD ROM
1 Set of storage trays	

Ordering information

Automatics essentials solution AU9020

You may also need...

Compressor AU1050



Suitable for much of unit 15 of the BTEC National award in Engineering : Electro, pneumatic and hydraulic systems and devices.

Electro-pneumatics add-on kit

This kit supplements the Automatics essentials solution by adding a selection of electrically operated valves and a range of sensors. By following the curriculum, students will learn how to use these new components to create systems in which pneumatics and electrical circuits are combined into complete systems.

The electrical components are connected together quickly and reliably using 4mm connectors, for which all of the necessary leads and accessories are provided. Electrical components are robustly mounted to the Automatics platform using the same 'tee' bolt system used for the pneumatic parts and are printed with standard circuit symbols.

Working two to a kit, students follow the detailed worksheets to gain a comprehensive understanding of electro-pneumatics. By the end of the course, students will be able to create reciprocating and sequential circuits, and will have an understanding of how these are used to solve real world engineering problems.

Learning objectives

- Understand the operation of electrically controlled pneumatic valves
- Use of electrical switching to control circuit operation
- Using microswitches to sense cylinder position
- Sensing position without physical contact using reed switches
- Expressing electrical circuits using ladder diagrams
- Electrically operated reciprocal circuits
- Sequential control circuits
- Analysing real world problems and formulating solutions

Components included

2 Reed switch and holder	2 Switch, push to make
2 Microswitch	1 Valve, 3/2, solenoid-spring
1 Valve, 5/2, solenoid -spring	2 Valve, double solenoid
6 Lead, 4mm plugs, black	6 Lead, 4mm plugs, red
1 Power supply	1 Curriculum CD ROM

Ordering information

Electro-pneumatics add-on kit AU9015

You may also need...

Automatics essentials solution AU9020

Suitable for unit 22 of the BTEC Higher



Pneumatics control add-on kit

This kit extends your Automatics pneumatics solution by adding a powerful programmable microcontroller unit, the MIAC, together with the pneumatic components necessary to put it through its paces.

By following the included curriculum, students will learn how the combination of a controller and custom software can create powerful and flexible pneumatic systems.

Students will learn how to establish the state of a pneumatic machine using sensors, the use of logic to process that data and the issuing of commands to the included solenoid valves.

Two versions of the curriculum are supplied. In the first, students use pre-programmed control systems supplied in the MIAC's built in memory. A more advanced course, Control plus, teaches students how to write their own programs for the controller.

Learning objectives

- Reading sensors and switches
- Issuing commands to the pneumatic circuits
- Learning the difference between digital and analogue signals
- Using flowcharts to visualise programs
- Program flow and decision making
- Programming sequences
- Using feedback to enhance reliability and improve safety

Control Plus

This curriculum introduces students to writing their own programs for the control system.

This is done using our Flowcode software - which makes programming easy by using graphical flowcharts. Note that you may need to purchase Flowcode separately.

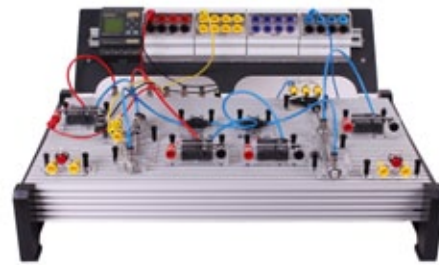
Components included

1	MIAC controller	2	Switch, push to make
1	Reed switch and holder	2	Valve, flow control
1	Light sensor	4	Valve, 3/2, solenoid-spring
1	Power supply	1	Power distribution carrier
6	Lead, 4mm plugs, red	6	Lead, 4mm plugs, black
2	Lead, 4mm plugs, yellow	1	Curriculum CD ROM

Ordering information

Automatics control add-on kit	AU9010
You may also need...	
Automatics essentials solution	AU9020
Flowcode	See page 50

Unit 24 of the BTEC Higher
National award in Engineering:
Applications of pneumatics and hydraulics



Unit 22 of the BTEC Higher
National award in Engineering:
Programmable logic controllers

Programmable logic controllers

We are now able to supply pneumatics training equipment which can be used with any PLC with the Automatics PLC adaptor rail. The Adaptor rail allows students to connect to relay and motor outputs using standard 4mm connectors which connect directly to other Automatics components. This pack combines standard pneumatics components with Control pneumatics components to provide a complete learning platform for pneumatics and PLC programming in one package. A PLC is not included. Any programming language - including ladder logic - can be used. Worksheets are based on flow charts. PLC adaptor modules included: power distribution, inputs (8), motor outputs (8), relays (4).

Learning objectives / experiments

- Pneumatic components, circuits and circuit diagrams
- Sensors and switches in pneumatic systems
- Digital and analogue signals
- PLC programming with ladder logic or block diagrams
- PLC inputs and outputs
- Logic functions

Works with Siemens S7,
Mitsubishi, Omron or any standard PLC
which fits onto a 50mm DIN rail.



SIEMENS
OMRON

Ordering information

Automatics Essentials	AU9020
PLC Adaptor - Input module	HP6700
PLC Adaptor - Power module	HP6711
PLC Adaptor - Motor module	HP6723
PLC Adaptor - Relay module	HP6752
PLC adaptor - mounting bracket	HP6785

A great cross-curricular resource for vocational and academic engineering courses.

NEW



Relevant for unit 57, BTEC Higher National in Engineering: Mechatronic systems.



Dynamic seat

This full size electronic seat allows students to make a study of electromechanical system design from the perspectives of the mechanics, the electronic control system, the energy and the programming. The bucket seat is constructed from rugged metal sections and is powered by two DC motors.

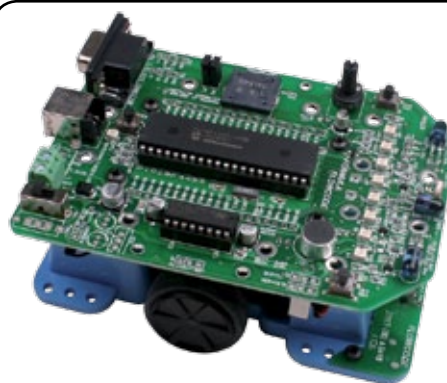
The system is controlled using E-blocks based on PIC technology housed in a metal cabinet fitted with basic controls. Workbooks provide around 40 hours of study across a number of separate engineering disciplines which gives students a good understanding of the key issues in the design of electromechanical systems. Requires 220VAC.

Learning objectives / experiments

- Mechanics: Mechanical design and system modelling using Solidworks (not supplied)
- Sensors: feedback using data from Hall sensors, accelerometers, encoders and potentiometers. Use accelerometer feedback to determine position
- Actuators: PWM control of motors speed and acceleration.
- Kinematics: simulation of systems and analysis of movement and degrees of freedom
- Energy: function of energy pathways, energy storage and usage
- Control: using a PC with LabView (not supplied) or with a PIC using Flowcode (supplied)
- Modelling of complete electromechanical systems in using Flowcode
- Electromechanical control using Lab-View

Ordering information

Dynamic seat	HP8834
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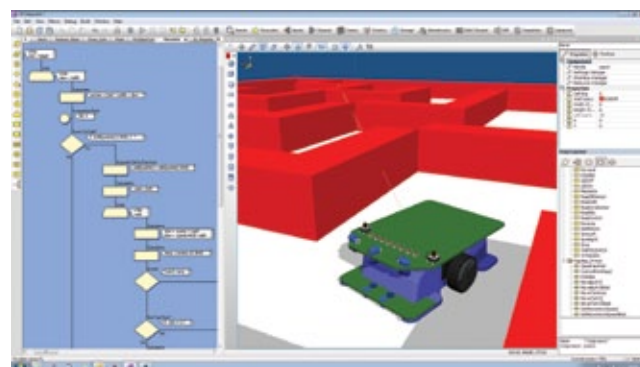
Suitable for Robotics age 11 – 16.

Introduction to Robotics

This training solution provides a 20 hour course allowing students to carry out a number of robotics practical exercises. The Formula Flowcode robot is a high specification, low cost microcontroller controlled robot buggy which is great for introducing students to programming and robotics in a fun and motivating way with huge scope for further work and competitions. The buggy is supplied with new simulations in Flowcode 6/SE, a beginners' course, easy to follow circuit diagrams and information and lots of follow on exercises and expansion options (including Bluetooth, Wifi) using E-blocks.

Learning objectives / experiments

- Microcontroller programming and robotics
- Programming using flowcharts: input, system, output, loops, decision, subroutine, go to, calculations, delays, simple variables, A/D conversion
- Robotic components: switches, LEDs, light sensors, distance sensors, infrared sensors, audio level sensors, speaker, motor drivers, motors and gearboxes
- Robotic tactics including power control, motion control and steering, motor characterisation, obstacle avoidance
- Progressive exercises include: light following, line following, song and dance, time trials, races, simple maze solving, creating custom mechanics



Buggy and a line following exercise

See Formula Flowcode section for full details

Ordering information

Formula Flowcode robot buggy	HP794
Maze walls	HP458
Starter class bundle	HP926
Pro class bundle	HP600
Curriculum pack	SE8832

NEW



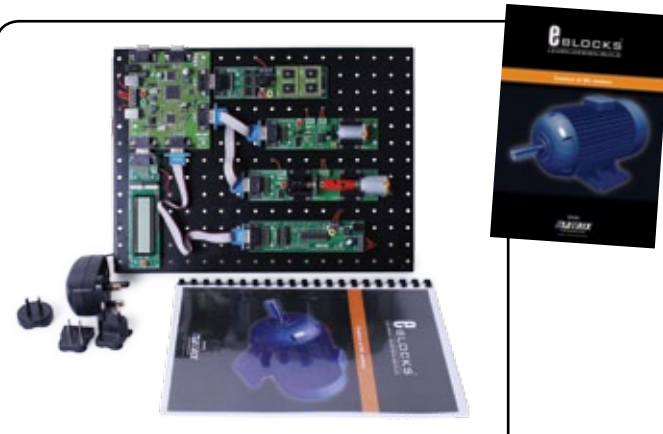
Suitable for unit 57 of the
BTEC Higher National award
in Engineering: Mechatronic
systems

Mechatronic systems

This pack contains products from three of our ranges of equipment: Locktronics, E-blocks and Automatics. The pack includes a wide variety of resources suitable for studying mechatronics using three types of control system: a PIC microcontroller, a micro PLC, and a PC. Students can learn the basics of control using flow charts before progressing to other languages like C++ or LabView software (C++ and LabView not included). A wide range of curriculum is included in the packs covering Industrial sense and control, flow chart programming of microcontrollers, Industrial sense and control with C++ or LabView programming, and design of pneumatic control systems. Further curriculum options for programming in C or Assembly are available.

Learning objectives

- PIC and controller programming using flow charts
- Programming options: Embedded C, Assembly, C++ or LabView
- Mathematical models of sensors
- PID control of DC motors with speed and position (2nd order)
- Sensors: thermistor, light, thermocouple, rotary, Gyroscope, Hall effect, PIR, Cap touch, Magnetometer, Ultrasonic, Colour
- Actuators: relays, stepper motors, DC motors with feedback, servo motors



Motor control training course

This solution provides a practical and low cost way of allowing students to understand the techniques of controlling DC motors. The solution is based on dsPIC technology. The equipment consists of a number of E-blocks boards mounted on a metal backplane, a programmer board, a switch board, an LCD board, a motor power board, a DC motor velocity control board and a DC motor position control board. Students can undertake a range of exercises from simple speed and direction control through to complex control using PID techniques with velocity and position as key parameters.

Learning objectives / experiments

- Simple motor control – direction, speed
- Sensors in motor control systems: IR, F to V conversion, resistive
- PID control of velocity
- Servo systems
- PID control of position
- First and second order functions
- Flowchart programming using Flowcode
- Programming using C/C++

Components included

1	Locktronics Industrial sense and control kit	1	Compressor
1	Sensors add-on pack	1	CD ROM with curriculum
1	Automatics essentials kit	1	Introduction to microcontrollers (online)
1	Automatics Control add-on kit	1	DC motor position training board (PID)
1	Standard PICmicro starter pack	1	DC motor speed training board (PID)
1	DMOS motors power board		

Ordering information

Flowcode academic single	FC6AC01NE
Mechatronic systems	HP4550
Corresponding Curriculum	HP3096, AW2080, AW4956, LK8739

Components included

1	Backplane	1	E-blocks Combo board
1	Motors power board	1	DC motor velocity control board
1	DC motor position control board	1	dsPIC board
1	Sensors board	1	LCD board
1	Flowcode v6 academic license		

Ordering information

Motor control training course	EB8493
Curriculum pack	HP3096

In this section we introduce you to two kits that satisfy the requirements of Part 66 modules 3 and 4 of the European Aviation Safety Agency syllabus which is internationally recognised as the gold standard for training Aviation maintenance engineers.



Our learning solutions:

- Designed around the requirements of modules 3 and 4
- 8 sets of full colour PDF worksheets with thorough topic coverage and teacher's notes
- Supplied in rugged storage trays

"We value the Locktronics equipment during the training of apprentices and engineers progressing down the route of EASA part 66 Maintenance Engineers Licence. They are invaluable both as demonstration equipment on short courses and apprentices conducting their own experiments, construction of circuits, testing and understanding of electrics, electronics and digital techniques".

Tony Russell, British Airways.





EASA electrical fundamentals (module 3)

This comprehensive solution is designed to fulfil the learning requirements of the European Safety Agency (EASA) module 3 - electrical fundamentals - for aircraft maintenance engineers. The solution contains all the Locktronics parts needed as well as 4 separate workbooks covering each of the sub-modules in the EASA specification.

Instruments

To deliver this course you will also need:

LK1110	Multimeter pack	HP8279	Picoscope
HP7894	Signal generator		

Components included

1	Resistor, 10 ohm, 1W 5% (DIN)	1	Resistor, 100 ohm, 1W, 5% (DIN)
1	Resistor, 5.6k, 1/4W, 5% (DIN)	1	Resistor, variable, 10k (DIN)
1	Resistor, 12 ohm, 1W, 5% (DIN)	1	Faraday's law kit
1	Switch, on/off, metal strip	1	Lenz's law kit
1	Diode, germanium	1	Resistor, 2.2k, 1/4W, 5% (DIN)
1	1:1 transformer with retractable ferrite core	3	Resistor, 10k, 1/4W, 5% (DIN)
2	Lead, yellow, 500mm, 4mm to 4mm stackable	1	Capacitor, 1 uF, Polyester
1	Transformer, 2:1 turns ratio	1	Resistor, 15k, 1/4W, 5% (DIN)
1	Resistor, 270 ohm, 1/2W, 5% (DIN)	3	MES bulb, 6V, 0.04A
1	Fleming's motor rule apparatus	1	Potentiometer, 250 ohm (DIN)
1	Resistor, 22k, 1/4W, 5% (DIN)	1	7 x 5 metric baseboard with 4mm pillars
1	Resistor, 47 ohm, 1/2W, 5% (DIN)	3	MES bulb, 6.5V, 0.3A
1	Switch, push to make, metal strip	2	Lead, blue, 500mm, 4mm to 4mm stackable
1	Choke, 47mH	2	Power supply
3	Choke, 10mH	14	Connecting Link
1	Choke, 5mH	1	AC voltage source carrier
3	Capacitor, 10 uF, Electrolytic, 25V	2	Power supply carrier with battery symbol
2	Capacitor, 4.7uF, electrolytic, 25V	1	Ammeter, 0mA to 100mA
2	Capacitor, 2.2 uF, Polyester	1	Motor, 6V, open frame
1	Resistor, 1k, 1/4W, 5% (DIN)	1	Fuse/universal component carrier
1	Alnico Rod Magnet	3	AA battery holder carrier
1	AC power supply, 12VAC, 1.5A, UK	1	Solar cell
1	Locktronics User Guide	1	Thermocouple and carrier
1	Curriculum CD ROM	3	Lampholder, MES

Ordering information

EASA electrical fundamentals solution including storage trays, baseboard, DC (multinational) and AC (UK) power supplies.	LK9339
Corresponding curriculum	LK7378, LK7381, LK7393 & LK7415



EASA Electrical fundamentals 1

- Series and parallel circuits
- Measuring voltage and current
- Cells and batteries
- Thermocouples
- Photocells
- Ohm's law



EASA Electrical fundamentals 2

- Resistors in series and in parallel
- Series/parallel networks
- Voltage and current dividers
- Kirchoff's laws
- Power in DC circuits
- Power transfer



EASA Electrical fundamentals 3

- Capacitors and electrostatics
- Inductors and inductance
- DC motors
- Generator principles
- Transformers and their construction
- Transformer losses



EASA Electrical fundamentals 4

- AC measurements
- Inductance and capacitance
- LR and CR series AC circuits
- LCR series AC circuits
- LR and CR parallel AC circuits
- LCR parallel AC circuits
- Q factor and bandwidth
- Low pass and high pass filters
- Band pass and band stop filters

Note: These packs are delivered with an international DC power supply and a UK style (3 square pin) 220V AC power supply. If you are ordering outside the UK please let us know which kind of mains plug you require on the AC supply.



EASA electronic fundamentals (module 4)

This solution is designed to fulfil the learning requirements of the European Safety Agency (EASA) module 4 - electronic fundamentals - for aircraft maintenance engineers. The solution contains all the Locktronics parts needed including 4 separate workbooks covering each of the sub-modules in the EASA specification.

Instruments

To deliver this course you will also need:

LK1110	Multimeter pack	HP8279	Picoscope
HP7894	Signal generator		

Components included

1	Resistor, 100 ohm, 1W, 5% (DIN)	1	Transistor LHF, NPN
1	Potentiometer, 250 ohm (DIN)	1	Transistor RHF, NPN
1	Capacitor, 1,000 uF, Electrolytic 30V	1	Thyristor
2	Capacitor, 47uF, Electrolytic, 25V	3	Diode, power, 1A, 50V
4	Capacitor, 4.7uF, electrolytic, 25V	2	Switch, push to make, metal strip
3	Capacitor, 0.47 uF, Polyester	1	Transformer, 2:1 turns ratio
2	Resistor, 100k, 1/4W, 5% (DIN)	1	Zener diode, 8.2V
3	Resistor, 10k, 1/4W, 5% (DIN)	1	Transistor RHF, PNP
3	Resistor, 1k, 1/4W, 5% (DIN)	2	Power supply carrier with battery symbol
2	Resistor, 180 ohm, 1/2W, 5% (DIN)	1	Dual rail power supply carrier
1	Resistor, 500k, 1/4W, 5% (DIN)	12	Connecting Link
2	7 x 5 metric baseboard with 4mm pillars	1	Diode, germanium
2	Power supply	1	AA battery holder carrier
2	Lead, blue, 500mm, 4mm to 4mm stackable	2	LED, red, 5V (SB)
2	Lead, yellow, 500mm, 4mm to 4mm stackable	1	Switch, on/off, metal strip
2	Lead, black, 500mm, 4mm to 4mm stackable	2	Ammeter, 0mA to 100mA
2	Lead, red, 500mm, 4mm to 4mm stackable	1	Voltmeter, 0V to 15V
1	Resistor, 270 ohm, 1/2W, 5% (DIN)	1	OR gate carrier (ANSI)
1	AC power supply, 12VAC, 1.5A, UK	1	Zener diode, 4.7V
1	Resistor, 200k, 1/4W, 5% (DIN)	2	NOT gate carrier (ANSI)
1	Capacitor, 1nF, Polyester	1	Transistor LHF, PNP
1	Capacitor, variable, 15-140pF	1	Op Amp Carrier (TL081) with 2mm to 4mm Lead
1	Thermistor, 4.7k, NTC (DIN)	1	1:1 transformer with retractable ferrite core
2	Potentiometer, 10k (DIN)	1	Switch, changeover, toggle
1	Capacitor, 100uF, Electrolytic, 25V	1	Low power solar motor
1	Resistor, 2.2k, 1/4W, 5% (DIN)	1	AC voltage source carrier
1	Capacitor, 1 uF, Polyester	1	Bridge rectifier
1	Locktronics User Guide	1	Motor 3 to 12V DC, 0.7A
1	Curriculum CD ROM	1	AND gate carrier (ANSI)

Ordering information

	DIN	ANSI
EASA electronic fundamentals solution including storage trays, baseboard, DC (multinational) and AC (UK) power supplies.	LK9282	LK9282A
Corresponding curriculum	LK7419, LK7422, LK7426 & LK7430	

Ordering information

	DIN	ANSI
EASA electrical and electronic fundamentals combined solution including storage, baseboard, DC (multinational) and AC (UK) power supplies.	LK9672	LK9672A



EASA Electronic fundamentals 1

- Diodes and diode types
- Full and half wave rectifiers
- Rectifier efficiency
- Reservoir capacitors
- Voltage multipliers
- Thyristor and SCR circuits
- Zener diodes and circuits
- LEDs in AC and DC circuits



EASA Electronic fundamentals 2

- NPN and PNP transistors
- Transistor characteristics
- Transistor bias and decoupling
- Common base, common emitter and common collector circuits
- Class A, B and C amplifiers
- Other transistor circuits



EASA Electronic fundamentals 3

- AND, OR, NAND, NOR and NOT gates
- Simple logic circuits
- Operational amplifiers
- Inverting and non-inverting amplifiers
- Integrator, differentiator, comparator
- Positive and negative feedback in amplifiers

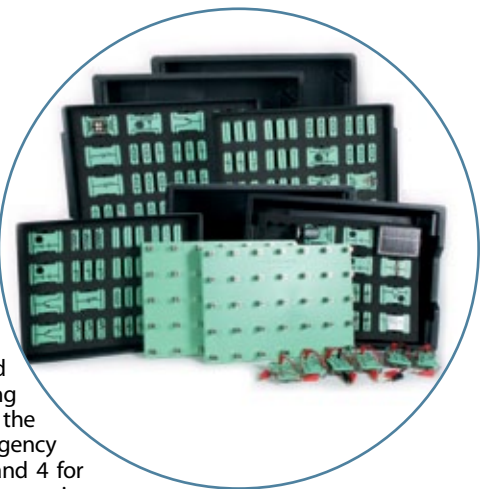


EASA Electronic fundamentals 4

- Open and closed loop systems
- Analogue transducers
- Damping in feedback systems

This comprehensive solution is designed to fulfil the learning requirements of the European Safety Agency (EASA) modules 3 and 4 for aircraft maintenance engineers. The solution contains all the Locktronics parts needed as well as 8 separate workbooks covering each of the sub-modules in the EASA module 3 and 4 specification.

For a complete list of parts in this solution please see our website.



The Locktronics automotive range has been designed to meet the Automotive training requirements of both industry and education. The range is split into three levels for basic, intermediate and advanced students. The Locktronics approach is ideal for automotive technicians who gain a good understanding of components, circuits and circuit fault finding through the process of building Locktronics.



Locktronics automotive customers

Locktronics automotive equipment and curriculum is used by colleges, vocational schools, independent automotive training companies and some of the World's leading automotive companies including:



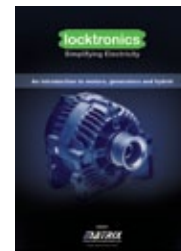
Level 1

At Level 1, the Electricity, magnetism and materials solution allows you to teach students how basic electrical components and circuits work.



Level 2

At Level 2 three solutions on AC principles, motors and generators and digital electronics builds on students' understanding of electricity, electrical circuits and electrical systems.



Level 3

At Level 3 the Sense and Control, the CAN bus systems solution and the Hybrid demonstration system give students experience and understanding of how Electronic Control Unit based systems in modern vehicles operate.





Suitable for IMI and City and Guilds level 1 courses.

Electricity, magnetism and materials V2

This kit provides a comprehensive range of practical assignments in electricity and magnetism and is ideal for those who are studying science and electricity within a wide variety of academic or vocational courses. The kit is supplied with a comprehensive set of worksheets that cover the electrical properties of materials, and introduce students to electricity.

Learning objectives / experiments

- Electrical properties of materials
- Simple circuits
- Heat and magnetism
- Basic circuit symbols
- Current flow
- Series and parallel circuits
- Patterns of voltage and current
- Electrical sensors
- Relays and electromagnets

Instruments

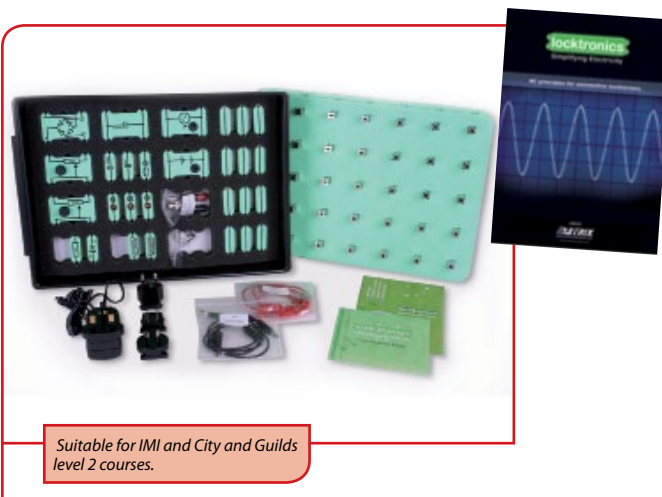
To deliver this course you will also need:

LK1110 Multimeter pack

Components included

1	Switch, push to make, metal strip	1	400 Turn coil carrier
1	Power supply	1	Thermistor, 4.7k, NTC (DIN)
1	Resistor, 12 ohm, 1W, 5% (DIN)	1	LED, red, 12V (SB)
1	Motor, 6V, open frame	1	Voltmeter, 0V to 15V
1	Phototransistor	1	Relay, reed, normally open
2	Resistor, 1k, 1/4W, 5% (DIN)	1	Pair of leads, red and black, 600mm, 4mm to croc clip
1	Resistor, 10k, 1/4W, 5% (DIN)	1	Power supply carrier with battery symbol
1	Potentiometer, 10k (DIN)	1	Fuse/universal component carrier
1	Diode, power, 1A, 50V	1	Curriculum CD ROM
9	Connecting Link	1	Buzzer, 12V, 15mA
3	Lampholder, MES	1	Switch, on/off, metal strip
1	7 x 5 metric baseboard with 4mm pillars	1	Resistor, 100 ohm, 1W, 5% (DIN)
1	Ammeter, 0A to 1A	1	EMM V2 Accessories pack
1	Resistor 1M, 1/4W, 5% (DIN)	1	Resistor, 47K, 1/4W, 5%

Ordering information	DIN	ANSI
Electricity, magnetism and materials solution with storage, baseboard and power supply.	LK9071-2	LK9071-2A
Corresponding curriculum	LK7325 & LK7326	



Suitable for IMI and City and Guilds level 2 courses.

AC principles for automotive technicians

This course provides an introduction to AC electrical principles that underpin many automotive units. A comprehensive set of curriculum worksheets and supporting documentation deliver experiments to illuminate the theory behind much of the automotive electrical technology.

Learning objectives / experiments

- Batteries and their properties
- AC signal fundamentals
- DC equivalent, peak and RMS values
- Reactance, inductance and suppression
- Diode and zener diode behaviour
- Half and full wave rectifiers
- Battery charging systems

Instruments

To deliver this course you will also need:

LK1110 Multimeter pack HP8279 Picoscope

HP7894 Signal generator

Components included

12	Connecting Link	1	7 x 5 metric baseboard with 4mm pillars
1	Resistor, 1k, 1/4W, 5% (DIN)	2	Switch, on/off, metal strip
1	Potentiometer, 10k (DIN)	1	AC voltage source carrier
1	Potentiometer, 250 ohm (DIN)	1	Power supply carrier with battery symbol
1	Capacitor, 100uF, Electrolytic, 25V	1	Power supply
1	Capacitor, 2,200 uF, Electrolytic, 25V	2	Lead, red, 500mm, 4mm to 4mm stackable
1	Capacitor, 1 uF, Polyester	2	Lead, black, 500mm, 4mm to 4mm stackable
1	Choke, 47mH	1	Locktronics User Guide
3	MES bulb, 6V, 0.04A	1	BNC male to dual 4mm binding post
3	Lampholder, MES	1	Curriculum CD ROM
1	Diode, power, 1A, 50V	1	Bridge rectifier

Ordering information	DIN	ANSI
AC principles for automotive technicians solution including storage trays, baseboard and power supply.	LK8222	LK8222A
Corresponding curriculum	LK8392	



Suitable for IMI and City and Guilds level 2 courses.

An introduction to motors, generators and hybrid

This course investigates the electrical principles behind motors and generators and is designed to support the teaching of a range of automotive units. It is accompanied by a comprehensive set of curriculum worksheets and supporting documentation to facilitate the learning of this core topic in automotive electrical technology.

Learning objectives / experiments

- Magnetic fields, field strength and flux density
- Electromagnets
- The force on a conductor in a magnetic field (Fleming's left-hand motor rule)
- DC motor principles
- The induced current when a conductor moves inside a magnetic field (Fleming's right-hand dynamo rule)
- Investigate the factors that determine the magnitude of the induced current
- AC generator principles
- Transformer construction and operation
- Electrical energy storage

Instruments

To deliver this course you will also need:

LK1110	Multimeter pack	HP8279	Picoscope
HP7894	Signal generator		

Components included

1	Resistor, 1k, 1/4W, 5% (DIN)	1	Faraday's law kit
1	Power supply	1	Curriculum CD ROM
1	Zener diode, 4.7V	1	BNC male to dual 4mm binding post
1	Switch, push to make, metal strip	1	Pair of leads, red and black, 600mm, 4mm to croc clip
1	Bridge rectifier	1	Lead, black, 500mm, 4mm to 4mm stackable
1	Diode, power, 1A, 50V	1	Lead, red, 500mm, 4mm to 4mm stackable
1	7 x 5 metric baseboard with 4mm pillars	1	AC voltage source carrier
1	Potentiometer, 250 ohm (DIN)	1	Power supply carrier with battery symbol
1	Resistor, 270 ohm, 1/2W, 5% (DIN)	1	Lenz's law kit
1	Transformer, 2:1 turns ratio	1	Alnico Rod Magnet
1	Motor 3 to 12V DC, 0.7A	1	1:1 transformer with retractable ferrite core
1	Ammeter, 0A to 1A	1	Locktronics User Guide
1	Ammeter, 0mA to 100mA	1	400 Turn coil carrier
5	Connecting Link	1	Fleming's motor rule apparatus
1	Capacitor, 2,200 uF, Electrolytic, 25V		

Ordering information	DIN	ANSI
An introduction to motors, generators and hybrid	LK7444	LK7444A
Corresponding curriculum	LK8822	



An introduction to digital electronics

This course covers the basics of digital electronics, a core topic in modern automotive electrical technology. In doing so, it supports the delivery of a range of automotive units. It focuses on the use of logic functions and shows how these can be delivered through conventional discrete gates and through programmable logic systems. It is accompanied by a comprehensive set of curriculum worksheets and supporting documentation.

Learning objectives / experiments

- Analogue and digital signals
- Binary and hexadecimal number systems
- A simple logic probe
- Truth tables for AND, OR, NOT, NAND, NOR
- NAND gates and circuits
- Microcontroller circuits and logic systems

Instruments

To deliver this course you will also need:

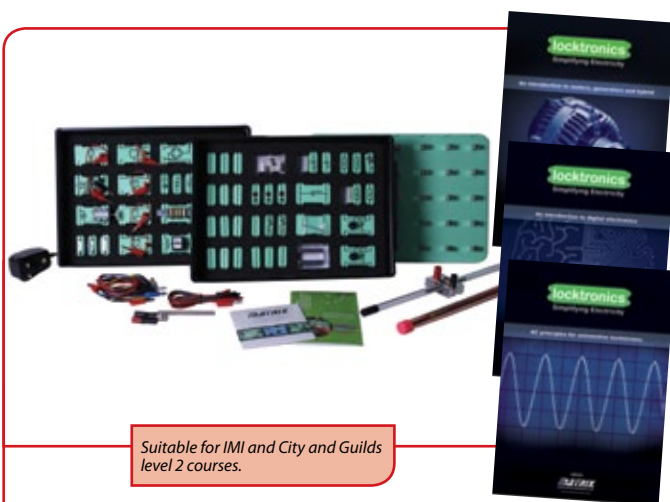
LK1110	Multimeter pack		
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Components included

1	Power supply	1	Curriculum CD ROM
1	Locktronics User Guide	2	LED, red, 5V (SB)
1	USB reprogrammable PIC carrier with power lead	1	AND Gate with 2mm to 4mm lead - ANSI
1	Light dependent resistor	1	OR Gate with 2mm to 4mm lead - ANSI
2	Resistor, 10k, 1/4W, 5% (DIN)	1	NOT Gate with 2mm to 4mm lead - ANSI
16	Connecting Link	1	NAND Gate with 2mm to 4mm lead - ANSI
1	Lead, yellow, 500mm, 4mm to 4mm stackable	1	NOR Gate with 2mm to 4mm lead - ANSI
1	Lead, blue, 500mm, 4mm to 4mm stackable	1	Power supply carrier with battery symbol
2	Switch, on/off, metal strip	1	7 x 5 metric baseboard with 4mm pillars

Ordering information	DIN	ANSI
An Introduction to digital electronics.	LK4221	LK4221A
Corresponding curriculum	LK9392	

If you would like a combined kit that allows you to deliver all level 2 automotive courses (AC principles, Motors and generators, and Digital electronics) then please ask us about our LK4500 combined solution.



Suitable for IMI and City and Guilds level 2 courses.

Combined level 2 Automotive pack

This kit provides a comprehensive set of experiments for learning AC principles, motors, generators Hybrid basics, and an introduction to digital electronics. With a single base board, a number of trays of components and three separate workbooks with teacher's notes, this kit represents great value for money learning opportunities for level 2 automotive students.

Learning objectives / experiments

- Batteries and their properties
- AC signal fundamentals
- DC equivalent, peak and RMS values
- Reactance, inductance and suppression
- Diode, zener diodes and rectifiers
- Battery charging systems
- Magnetic fields, field strength and flux density
- Electromagnets, induction and Fleming's rule
- Motor and generator principles
- Transformer construction and operation
- Electrical energy storage
- Analogue and digital signals
- Binary and hexadecimal number systems
- AND, OR, NOT, NAND, NOR and NAND gates and circuits
- Microcontroller circuits and logic systems

Components included

The LK4500CUS includes the components necessary for delivery of learning objectives from the LK8222, LK7444 and LK4221 kits.

Instruments

To deliver this course you will also need:

LK1110	Multimeter pack	HP8279	Picoscope
HP7894	Signal generator		

Ordering information

Combined level 2 automotive pack	LK4500CUS
Corresponding curriculum	LK8822, LK9392, LK8392



Suitable for IMI and City and Guilds level 3 courses.

Sensors and control in automotive applications

This kit provides an introduction to the role of an Electric Control Unit. Students use a number of pre-written programs for the MIAC Electronic Control Unit (ECU) to enable them to construct a wide variety of Input - Process - Output circuits using sensors and actuators typically found in vehicles. A full curriculum pack is provided.

Learning objectives / experiments

- DC motors with speed control
- Stepper motors
- Temperature sensor
- Light sensor
- Potential dividers and their use
- Transistors as switches
- Use of relays
- ECU action and function
- Automotive control systems
- Sensor and actuator waveforms and signals
- Sensors and motor faults

Components included

1	Microswitch	1	Motor 3 to 12V DC, 0.7A
1	Thermistor, 4.7k, NTC (DIN)	1	USB2 high speed A to mini B lead
1	Resistor, 10 ohm, 1W 5% (DIN)	1	Curriculum CD ROM
2	Resistor, 1k, 1/4W, 5% (DIN)	1	Locktronics User Guide
1	Capacitor, 4,700 uF, Electrolytic, 16V	1	Hall effect switch
1	Potentiometer, 10k (DIN)	1	Buzzer, 12V, 15mA
1	Relay, 12V coil, 10A, normally open	1	Phototransistor
1	Solenoid	1	7 x 5 metric baseboard with 4mm pillars
1	Stepper Motor	6	Lead, yellow, 500mm, 4mm to 4mm stackable
1	LED, red, 12V (SB)	6	Lead, blue, 500mm, 4mm to 4mm stackable
1	Transistor RHF, NPN	1	Lead, black, 500mm, 4mm to 4mm stackable
1	Automotive fuse carrier	1	Lead, red, 500mm, 4mm to 4mm stackable
2	Switch, on/off, metal strip	1	Cased MIAC with Shrouded 4mm Connectors
4	Switch, push to make, metal strip	1	Small bar magnet
1	Power supply	16	Connecting Link
1	Power supply carrier with battery symbol	1	MES bulb, 14V, 0.06A
1	Resistor, 10k, 1/4W, 5% (DIN)	1	MIAC Getting Started Guide
1	Lampholder, MES	1	MES bulb, 12V, LED, white
1	Lampholder, MES, for automotive LEDs	1	Resistor, 47K, 1/4W, 5%

Ordering information	DIN	ANSI
Sensors and control solution with baseboard, storage trays, power supply and leads.	LK9834	LK9834A
Corresponding curriculum	LK8849	



Sensors and control with Engineering panel

The LK6491 sensors and control solution includes an Engineering panel that allows you to set up a more permanent lab for automotive electrical training.

Ordering information

	DIN	ANSI
Sensors and control solution on Engineering panel	LK6491	LK6491A



CAN bus make-up kit

The LK9813 CAN bus make-up kit allows you to transform 5 sensors and control in automotive solutions into a CAN bus systems and operations solution.

Ordering information

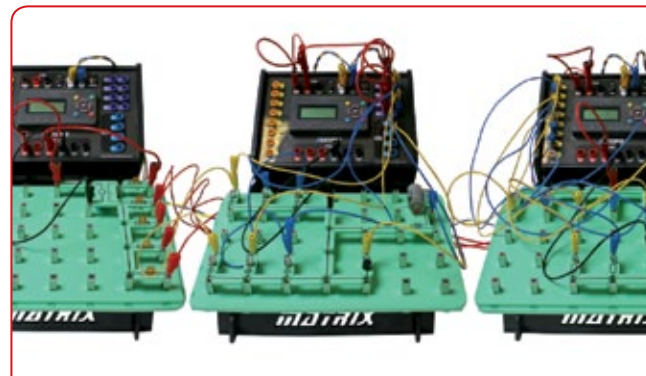
	DIN	ANSI
CAN bus make-up kit	LK9813	LK9813A



Suitable for IMI and City and Guilds level 3 courses.

CAN bus systems and operation

This kit allows a fully functioning CAN bus system, mimicking vehicle operation, to be set up using 5 MIAC Electronic Control Units representing Instrument Panel, Front ECU, Powertrain control, Rear ECU and system diagnosis. Students can set up a fully working CAN bus system, insert faults and use scan tools to understand fault diagnosis procedures and practice. Supplied with a full curriculum pack.

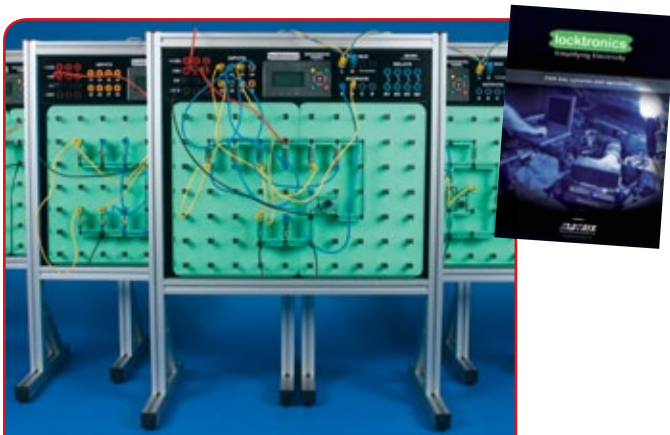


Components included

1	MIAC Getting Started Guide	5	7 x 5 metric baseboard with 4mm pillars
5	Cased MIAC with Shrouded 4mm Connectors	1	Locktronics User Guide
1	OBD2 to 4mm Lead	53	Connecting Link
9	Lead, black, 500mm, 4mm to 4mm stackable	1	Lead, D-type to yellow and blue 4mm for CAN analyser
19	Lead, red, 500mm, 4mm to 4mm stackable	1	USB2 high speed A to mini B lead
4	Lead, red, 2000mm, 4mm to 4mm plug	1	USB CAN sniffer
24	Lead, yellow, 500mm, 4mm to 4mm stackable	6	Switch, on/off, metal strip
24	Lead, blue, 500mm, 4mm to 4mm stackable	4	MES bulb, 12V, LED, red
13	Lampholder, MES, for automotive LEDs	5	MES bulb, 12V, LED, white
3	Switch, push to make, metal strip	4	MES bulb, 12V, LED, yellow
6	Resistor, 1k, 1/4W, 5% (DIN)	1	Motor 3 to 12V DC, 0.7A
1	Relay, 12V coil, 10A, normally open	4	Potentiometer, 10k (DIN)
1	Buzzer, 12V, 15mA	4	Power supply
5	Automotive fuse carrier	1	Resistor, 560 ohm, 1/4W, 5% (DIN)
2	Resistor, 68 ohm 1/2W, 5% (DIN)	1	Zener diode, 8.2V
1	Curriculum CD ROM	2	LED, red, 12V (SB)

Ordering information

	DIN	ANSI
CAN bus systems and operation solution with storage trays, power supply, leads and Kvaser analyser.	LK7629	LK7629A
CAN bus systems and operations solution with storage trays, power supply, leads and PICOscope 4000.	LK8391	LK8391A
Corresponding curriculum	LK9893	

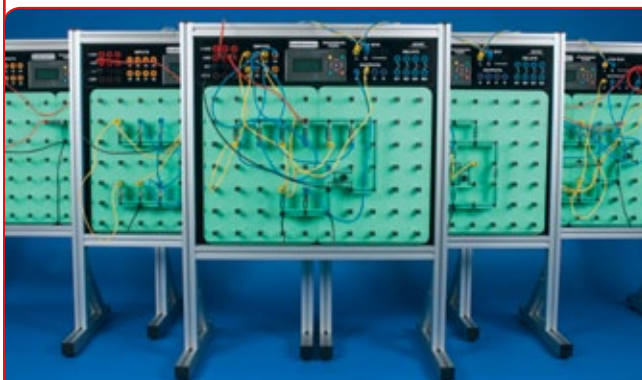


CAN bus systems and operation solution with engineering panel

The LK2839 CAN has the same learning objectives and components as the LK7629 but is based on our engineering panel which makes it more suitable for a dedicated automotive electrical training lab.

Learning objectives / experiments

- ECU action and function
- Automotive control systems
- Wiring in CAN bus systems
- CAN bus faults
- Faults in sensors and actuators

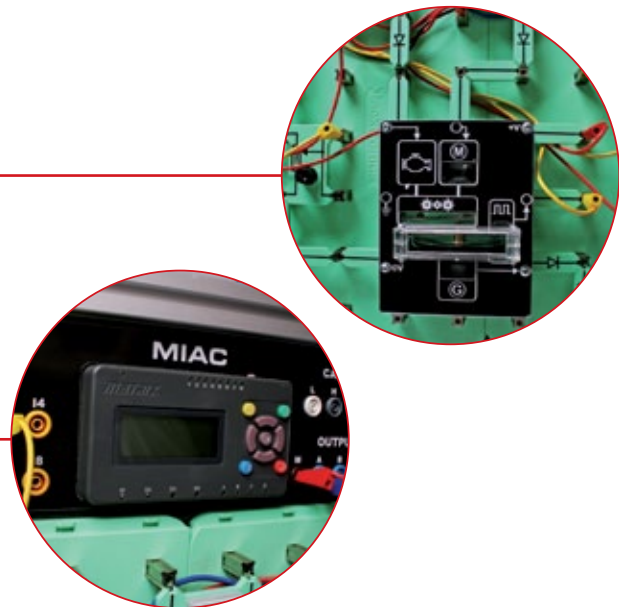


Hybrid vehicle demonstration system

This Locktronics based hybrid demonstration system uses MIAC technology to demonstrate the energy pathways in hybrid systems and shows how the engine management system makes decisions on energy usage based on the State Of Charge (SOC) of the vehicle battery.

Learning objectives / experiments

- Power modes in a series-parallel hybrid vehicle
- Regenerative braking
- Advantages of regenerative braking
- Factors affecting the acceleration of a vehicle
- Battery voltage, internal resistance, battery capacity, state of charge
- The role of the ECU in controlling the changes between power modes



Components included

1 Resistor, 1k, 1/4W, 5% (DIN)	7 Lead, red, 500mm, 4mm to 4mm stackable
1 Locktronics engineering panel	4 Lead, yellow, 500mm, 4mm to 4mm stackable
4 Diode, power, 1A, 50V	6 Lead, blue, 500mm, 4mm to 4mm stackable
1 Hybrid principles inlay (DIN)	1 Hybrid Car Motor Unit
1 Power MOSFET transistor	1 Hybrid Car Battery Unit
18 Connecting Link	1 Hybrid Car Power Output Meter
1 Potentiometer, 10k (DIN)	2 Hybrid Car Input Power Meter
4 Lead, black, 500mm, 4mm to 4mm stackable	1 Switch, push to make, metal strip

Ordering information	DIN	ANSI
Hybrid automotive principles on engineering panel	LK6483	LK6483A
Corresponding curriculum	LK4483	

Ordering information	DIN	ANSI
CAN bus systems and operation solution with the Engineering panel	LK2839	LK2839A

FLOWCODE[®]

Simplifying programming

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These Computer Science students in Oulu Vocational College, Finland, used Flowcode to develop a control system for an Electric motorbike and raced it against other schools

Testimonials

"I am very new to Flowcode, but have experience of 9+ years with another PIC RAD capable program. They have a great program but unfortunately their user support has become poor over the years, so finally decided to review the market and chose to go with Flowcode V6.

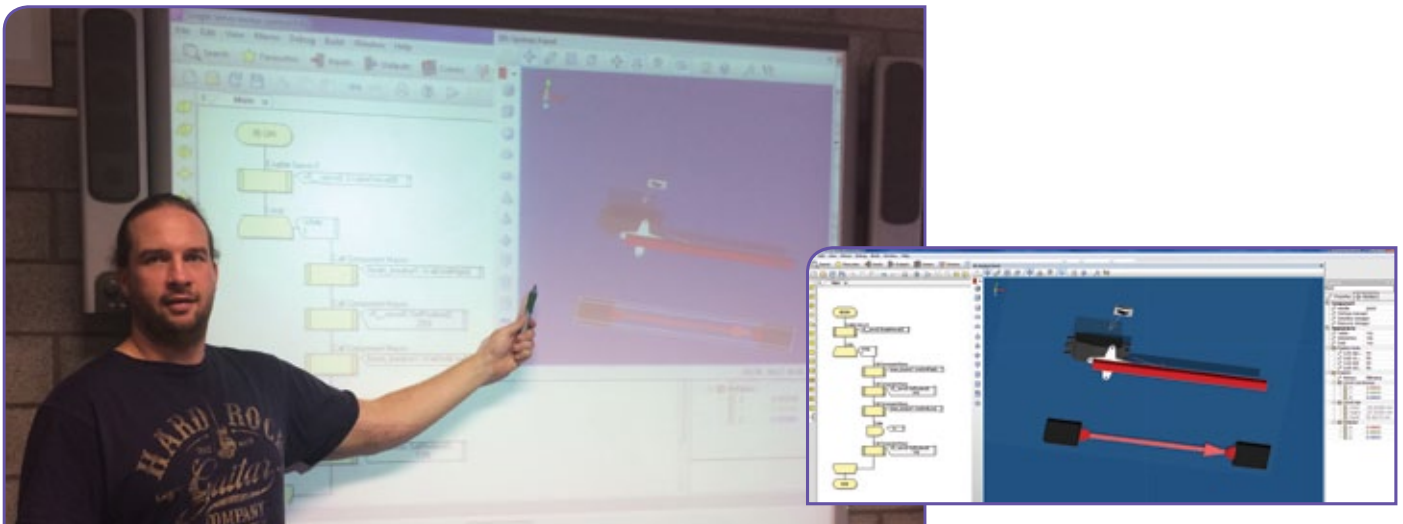
I'm very much still coming to grips with Flowcode. But Flowcharting is very intuitive and the use of supplied and user generated components is a great idea. The customer and user support information being given via the forum, blog and Twitter is just so excellent - timely and constructive.

Well done Matrix on V6 and the effort that has and very obviously is still going into making V6 a great and very useable product."

Richard Blick, Telecommunications Engineer.

"As the Senior Electrical/Electronic Technician in the Faculty of Engineering, I find that using 'Flowcode' is an invaluable tool, to clearly convey the Embedded Code to be used in applications with Microchip's 18F4455 & 18F2455 (ECIO Modules). Previously, the School of Electrical & Electronic Engineering have introduced students to the 'Formula Flowcode' with the little robot vehicle at their command. The School of Mechanical Engineering students build their own buggy designs and I am confident a few incorporate 'Flowcode' Modules into their designs."

**Matthew Buckley,
Leeds University, UK.**



"Teaching electronics and embedded systems to 15-18 year old students in a technical school near Antwerp in Belgium. We have been using Flowcode and E-blocks in most of the electronics courses all over Flanders for the past 8 years. It's a great tool to put your first steps in embedded programming and it's also great to do the high level stuff like embedded webserver, Bluetooth and USB. The excellent and fast support of the Matrix team gives teachers the necessary confidence to take their projects to the next level.

Our curriculum is changing from pure electronics to engineering and I was very pleased to see that Flowcode 6 also evolved in this way. Students do 'product-design' now – FC6 lets them creatively combine microcontroller circuits with their 3D mechanical drawings and lets them fully 3D-simulate their idea at home. They can download the tested code to the actual hardware the next day in classroom.

The very first small project we did with FC6 was to develop an automatic gate with a servo motor that opens automatically whenever an object breaks the beam. Something we could use with our model railtrack. The available videolessons and example programs were enough for our students to get this up and running in no time."

Bart Huyskens, teacher of embedded systems, St.Jozefinstituut Schoten, Belgium.

What is Flowcode?

Flowcode software allows you to develop complex electronic and electromechanical systems with ease.

Flowcode software allows you to quickly and easily develop complex electronic and electromechanical systems. The graphical programming tool allows even those with little experience to develop complex electronic systems in minutes.

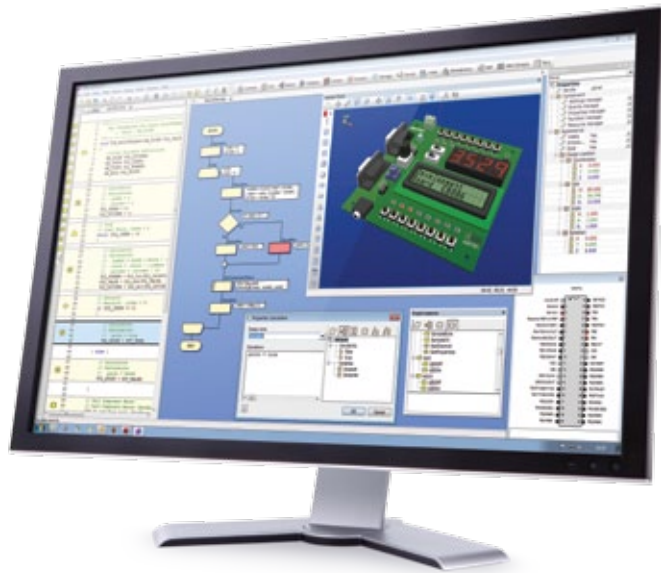
Flowcode is one of the world's most advanced environments for electronic and electromechanical system development. Engineers use Flowcode to develop systems for control and measurement based on microcontrollers, on rugged industrial interfaces or on Windows compatible personal computers.

A 2D and 3D graphical development interface allows students to construct a complete electronic system on-screen, develop a program based on standard flowcharts, simulate the system and then produce hex code for PICmicro® microcontrollers, dsPIC and PIC24 microcontrollers, AVR and Arduino microcontrollers and ARM microcontrollers.

Flowcode version 6 has a number of new developments which come together to create a software package which is amongst the best of its kind in the world. Flowcode is aimed at the 16+ market.

Flowcode SE has now also given the ability for those aged 12+ to learn about the development of complex electronic and electromechanical systems.

Flowcode is available in over 20 languages and is used by thousands of engineers and educators.

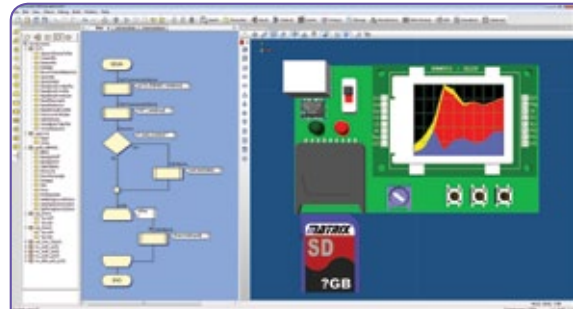


Based on flowcharts - minimal programming experience is required.

Open architecture - all aspects of Flowcode are fully customisable for your projects.

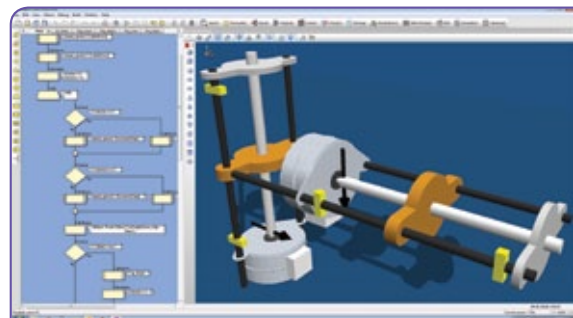
Fully Supported - with online tutorials, documentation and an active online community.

Transfer your design - easily between Windows, PICmicro, AVR, Arduino and ARM.



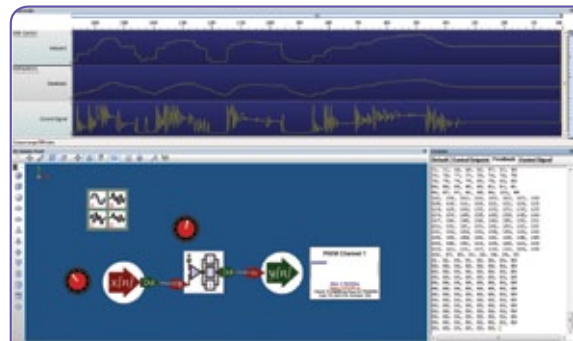
Improved Simulation:

Flowcode v6 has improved its simulation, making system design easier and faster.



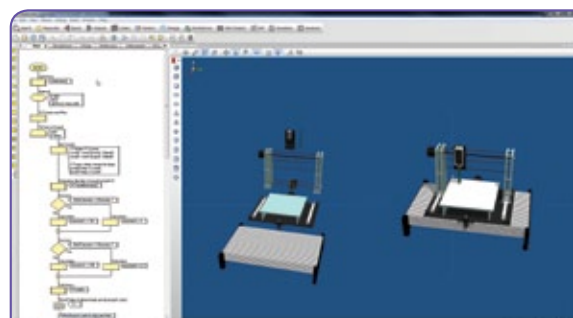
3D Graphics Engine:

Extend your design to include electromechanical components and systems.



New Test Features:

The new test features in Flowcode v6 allow users to verify and record a system under test.

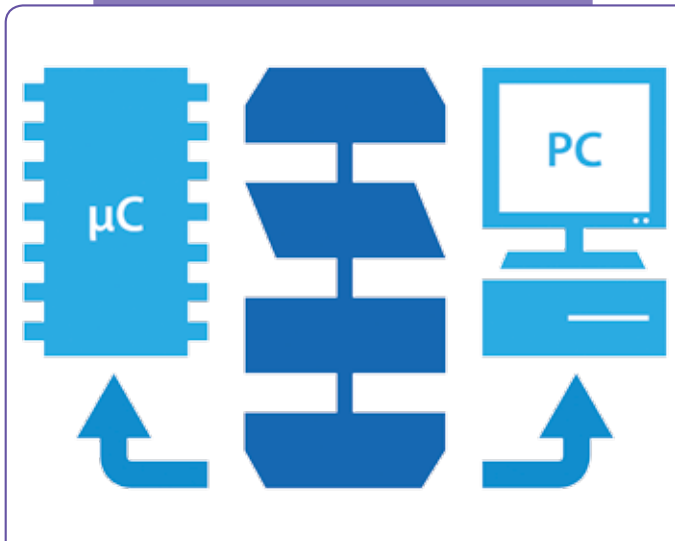


Component Creation:

Users can create their own components for more realistic system design and simulation.

Advantages of using Flowcode

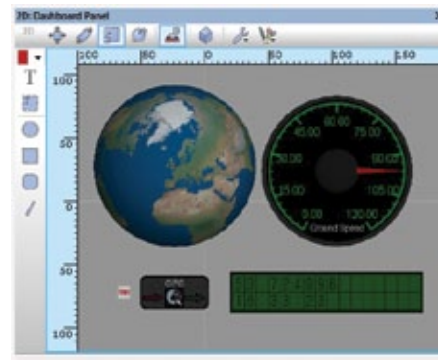
Microcontroller compiler and PC interpreter together make the design process easier.



Flowcode software is based on standard Flow chart symbols. Flow chart icons can be compiled to a microcontroller and can also be executed on a Windows PC. The PC-side software in Flowcode includes a full suite of Windows commands for mathematics, controlling graphics on the monitor, communications via Ethernet etc. In fact Flowcode 6 now includes a full Windows programming language as well as a microcontroller compiler.

This 'PC-side' and 'chip-side' functionality makes Flowcode really powerful:

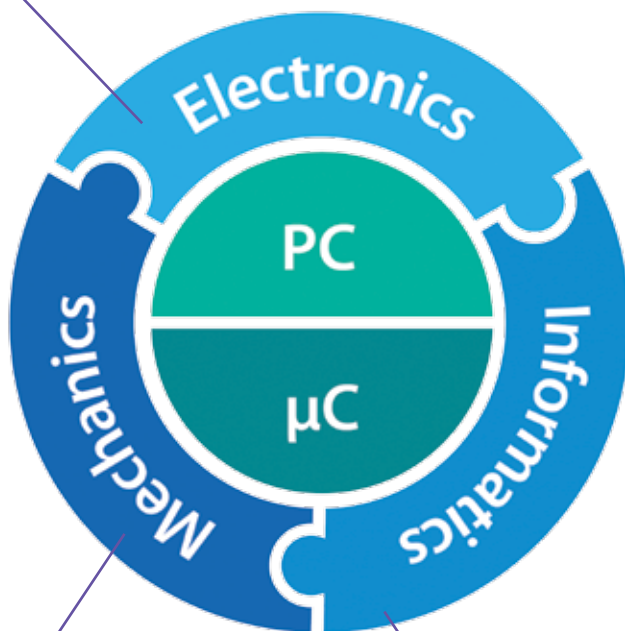
- Complex systems can be designed and simulated before chip-side compilation which saves design time
- In-Circuit-Test data can be linked to simulations to show system performance at run-time which proves designs function properly
- Programs can be deployed on a microcontroller or a Windows PC.



For example: GPS data from microcontroller In-Circuit-Test is processed by PC-side software into a human friendly format so that system design can be verified.

Focus on three technologies facilitates a systems level design which makes the design process easier.

- Sensors
- Signal processing
- Drive systems

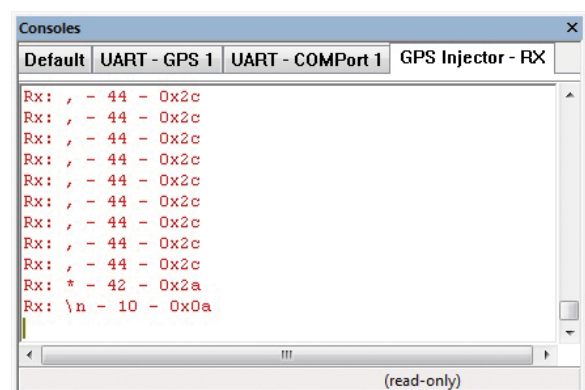


- Actuators
- Mechanisms
- Ergonomics

- Data manipulation
- Communications
- User interface

Flowcode's PC-side and chip-side features focus on Electronics, Informatics and Mechanics which gives Flowcode several advantages over other microcontroller compilers:

- Program design takes place at a systems level rather than at a chip level
- Program design time is shortened and made easier
- Programs for microcontrollers can be linked to PC side data files during design time
- Data decoding algorithms can be tested at the same time as control programs are developed

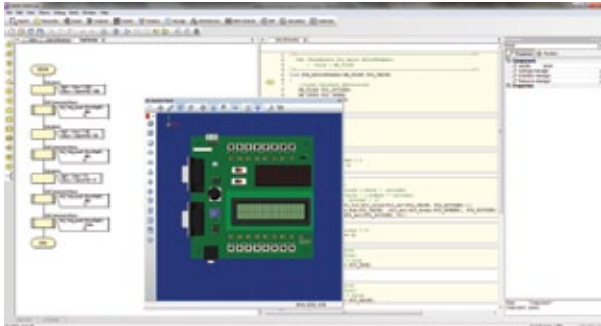


For example: During the design phase mock streams of serial digital data can be injected into a simulation so that decoding algorithms can be tested before compilation to chip.

Flowcode design flow

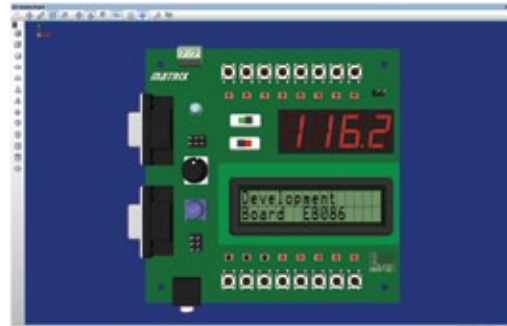
Design

Circuit level



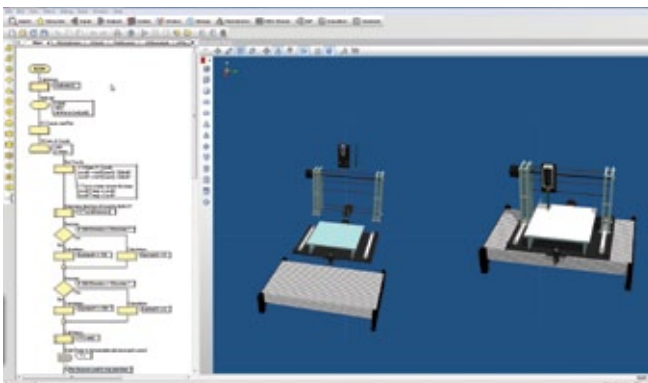
Design a virtual circuit board with PCB level components that connect to a virtual microcontroller and develop the program using flowcharts.

Simulate

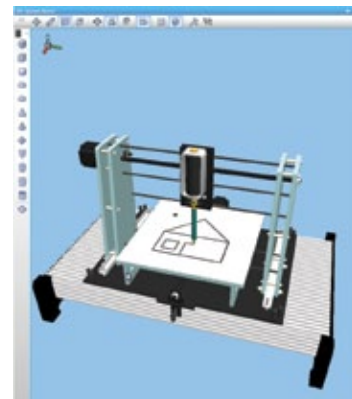


Simulate the program and circuit board components to check function using LEDs, displays to see function and interacting with virtual switches to control the system.

Electromechanical level

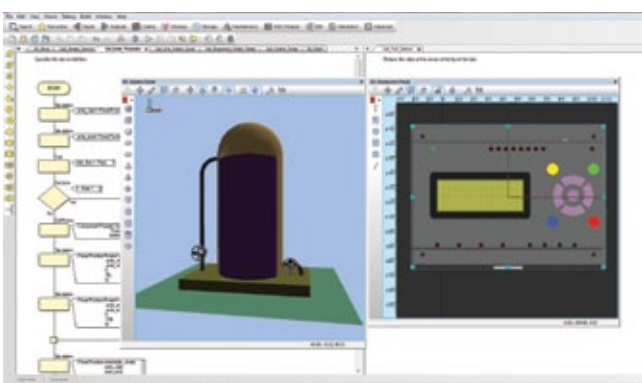


Develop a mechanical system in Solidworks and characterise it for Flowcode. Develop a flowchart program for control and operational data conditioning.



Simulate the mechanical system, the electronic system and the data decoding algorithms all in one package.

Systems level



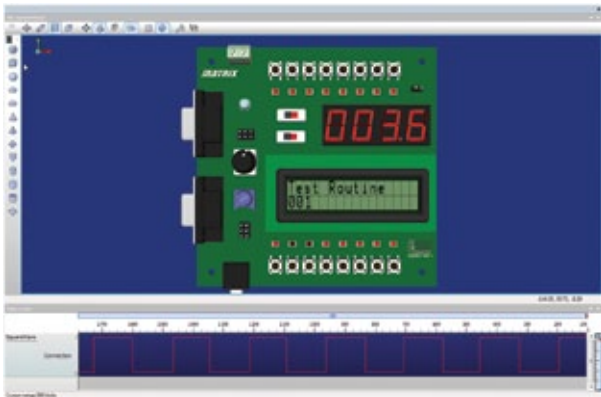
Develop a mathematical and/or physical model of your system and develop a flowchart control program using Flowcode.



Use Flowcode Dashboard objects to simulate system performance in human friendly graphical format.

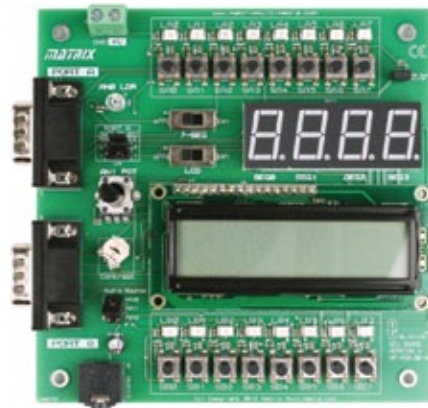
Flowcode design flow

Test

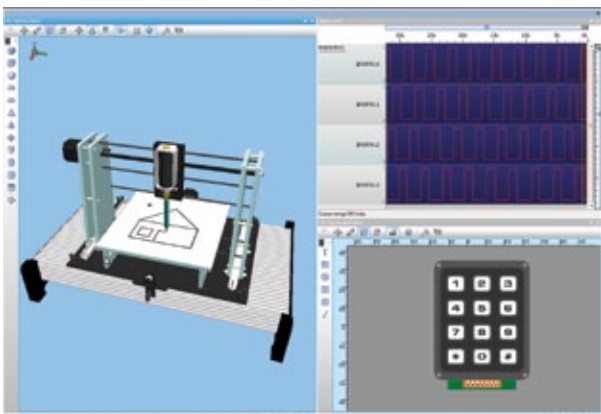


Download to the microcontroller in the E-blocks development system and use In-Circuit-Test and Softscope feature to verify operation at pin level.

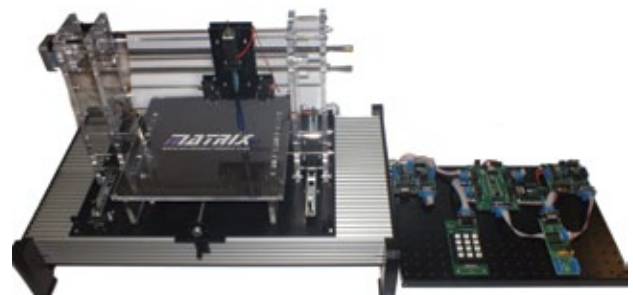
Deploy



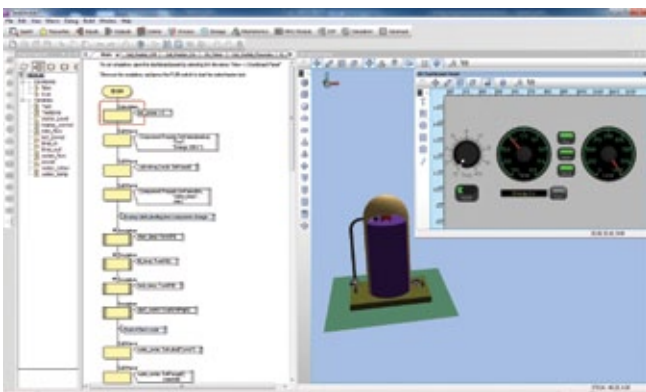
Develop the final circuit board and release to market.



Use In-Circuit-Test to test and debug at a pin level.



Develop the final product, verify operation and release to market.



Link Dashboard objects, Softscope and Console to third party instruments using DLLs in SCADA fashion to verify performance in real time.



Deploy your system in a control system based on microcontrollers, MIAC controller or Windows PC linked to third party controllers using DLLs.

Flowcode specification and ordering

Specification

OS/Processor cores

Windows XP, Vista, Windows 8, PIC10, 12, 16, 18, dsPIC/PIC24/PIC33, Atmel TINY, MEGA, Atmel AT91, SAM7, ARM, Arduino.

Inputs

Various switches, knobs and potentiometers both PCB and panel mounted. Keypads.

Outputs

Various LEDs and indicators, LED array, RGB LED, bar graph, single 7-seg display, quad 7-seg display, various monochrome LCDs, various colour graphic LCDs, multimedia modules. LED matrices, 4D Visi interface.

Mechatronics

PWM, servo, stepper, DC motor, solenoid, Formula Flowcode robot.

Media

Audio, video, MIDI, speech.

Wired communications

CAN, CAN2, I2C master, LIN master, LIN slave, RS232, RS485, SPI, TCP/IP, web server, MIDI, USB HID, USB serial, USB slave, Modbus, One wire.

Wireless communications

Bluetooth, GPS, GSM, RF ISM, RC5, IrDA, RFID, WLAN, Zigbee.

Storage

FAT16 and 32, internal EEPROM, lookup tables.

DSP

System, Kalman filter, output, inverse FFT, frequency generator, filter, FFT, control, level, scale, input, delay and sum.

Sensors

Accelerometer, gyro, compass, photo reflector, beam breaker, reed switch, thermistor, digital temperature, quadrature encoder, thermocouple, hall effect, cap touch on/off, cap touch slider, magnetometer, humidity, colour, ultrasonic, infrared.

Dashboard HMI controls

Text label, value reactor, switches and buttons, control knob, slider, bargraph meter, 'analogue' style meter, vertical scale, horizontal scale.

Injectors

CAN, GPS, Human interface, VNET, DS1307, AT.

3rd party instruments with DLL

ECIO, MIAC, FTDI UM232R, FTDI, UM245R, Velleman 8805 interface board, Picoscope 200 series, TTI Signal Generator (TG5011), TTI Power Supply (PL155-P).

Versions

The versions and features of Flowcode are shown in the table on the right. Academic versions are designed for vocational schools, universities, and schools with highly technical curriculum content. The schools edition (SE) is designed for schools delivering a Design and Technology curriculum.

Chip packs are reduced function versions for hobbyists and also characterise Flowcode for the various microcontroller cores supported. Order a second chip pack if you need a second microcontroller core.

MIAC is only supported in PIC versions.

For ordering Substitute 'XXX' for the appropriate core: PICmicro 16 and 18 series: 'PIC' AVR/Arduino: 'AVR', dsPIC/PIC24: 'DSP', Arm 7: ARM.

Feature	Version					
	Free - first 30 days	Free - post 30 days	Chip pack only	Professional *	Academic	Flowcode SE
1 General						
Commercial product rights	✗	✗	✗	✓	✗	✗
Multi-seat license available	✗	✗	✗	✓	✓	✓
Compile to Chip	✓	✗	✓	✓	✓	✓
Unrestricted Chip selection	✓	✓	✓	✓	✓	✗
2 System design						
Unrestricted programming icons	✓	✓	✓	✓	✓	✓
Unrestricted programming size	✓	✓	✓	✓	✓	✓
Control 3rd party hardware	✓	✓	✓	✓	✓	✓
Code commenting	✓	✓	✓	✓	✓	✓
Save and publish templates	✓	✓	✓	✓	✓	✓
Access to plugins	✓	✓	✓	✓	✓	✓
Access to simulation API	✓	✓	✓	✓	✓	✓
Auto document	✓	✓	✓	✓	✓	✓
3 Flowcode Components						
Input / Output components	✓	✓	✓	✓	✓	✓
Wired communications	✓	✗	✗	✓	✓	✗
Wireless communications	✓	✗	✗	✓	✓	✗
Wrapped wireless	✓	✗	✓	✓	✓	✓
Mechatronics	✓	✗	✗	✓	✓	✓
DSP	✓	✗	✗	✓	✓	✗
Formula Flowcode**	✓	✗	✓	✓	✓	✓
MIAC**	✓	✗	✓	✓	✓	✓
4 SCADA support						
In-Circuit-Test	✓	✗	✓	✓	✓	✓
Third party instruments	✓	✓	✓	✓	✓	✓
Consoles	✓	✗	✗	✓	✓	✓
Softscope	✓	✗	✗	✓	✓	✓

* Professional requires at least one 'Chip Pack' to compile.

** PIC 'Chip Pack' required to compile.

Ordering information

Flowcode Academic single	FC6AC01NEXXX
Flowcode Academic 10 user	FC6AC10NEXXX
Flowcode academic 50 user	FC6AC50NEXXX
Flowcode SE 50 user licence - PIC only	FC6SE50
Flowcode SE 50 user licence - PIC, AVR and Arduino	FCSE50AVR

locktronics

Simplifying electricity

Contents

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Why choose Locktronics?	66
Choosing your Locktronics package	67
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Apprentice training at the UK Jaguar Land Rover Training Centre.

Testimonials

"I use Locktronics to teach Motor Vehicle students through all levels. It is a simple, easy to use, teaching resource that allows students to learn at their own pace. With easy to read symbols students can see their circuits come to life which is a great way of reinforcing learning".

Paul Mangan, Leicester College.



Automotive Locktronics:

"The kits have proven invaluable for the Nissan production programmes. They are learning about Basic Electric all the way up to battery technology and AC/DC motor theory etc. They are an excellent teaching aid for our programmes".

Steve Burr, Auto Skills Centre Manager, Gateshead College.

"We value the Locktronics equipment during the training of apprentices and engineers progressing down the route of EASA part 66 Maintenance Engineers Licence. They are invaluable both as demonstration equipment on short courses and apprentices conducting their own experiments, construction of circuits, testing and understanding of electrics, electronics and digital techniques".

Tony Russell, British Airways.



"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.

Because of more and more complex systems now being introduced to our vehicles, in the last year we have purchased a number of new kits (CAN) which has allowed us to structure our courses to an even greater extent practically.

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, IVECO.

What is Locktronics?

Simplifying Electricity & Electronics

Locktronics is a range of products that simplifies the process of learning and teaching electricity and electronics.

The core range consists of more than 200 electronic components mounted on rugged plastic carriers which are printed with the corresponding circuit symbol. Students use these carriers, in conjunction with a baseboard with interconnecting metal pillars, to build up a working circuit. They then use the curriculum provided to carry out experiments in electricity and electronics.

The key benefit of Locktronics is that as students construct the working circuit, they can also see the corresponding circuit diagram. This helps students link theory to practice and simplifies the process of learning electricity and electronics.

Locktronics can be used in a wide range of subject areas.

Disciplines include:

- Science and technology
- Electronics
- Engineering
- Automotive
- Aviation maintenance



The Locktronics range includes:

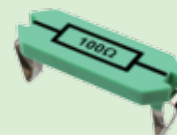


Baseboards

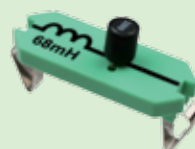
To which students add...



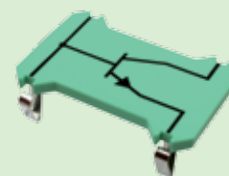
Capacitors



Resistors



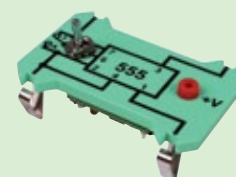
Inductors



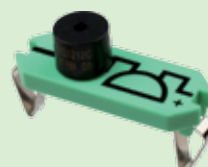
Semiconductors



Logic gates



System blocks



Electromechanical



Lamps and LEDs

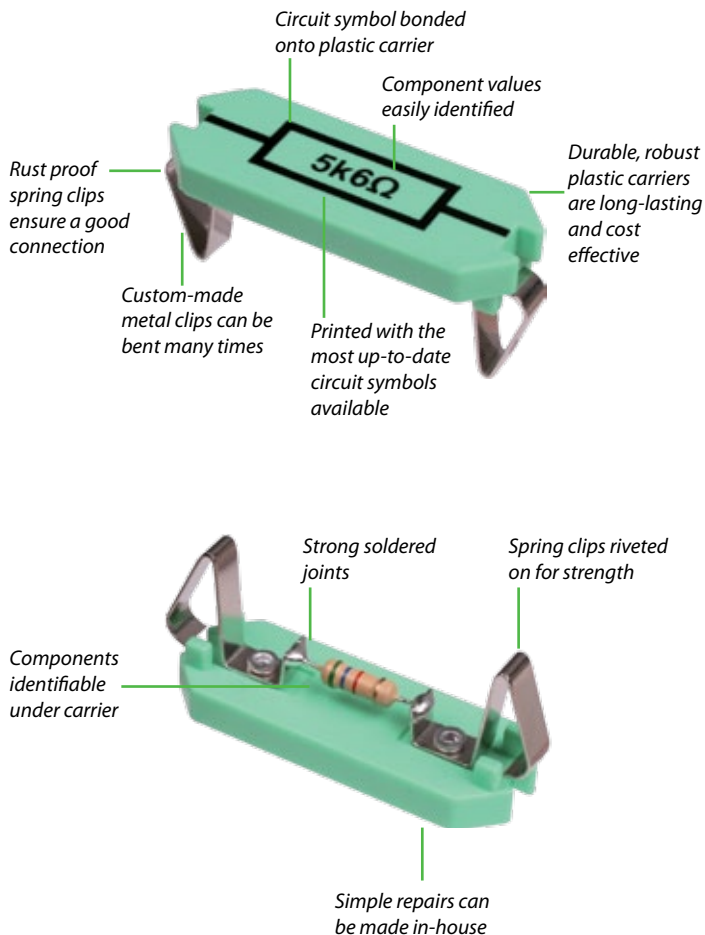


Curriculum packs



Power supplies

Why choose Locktronics?

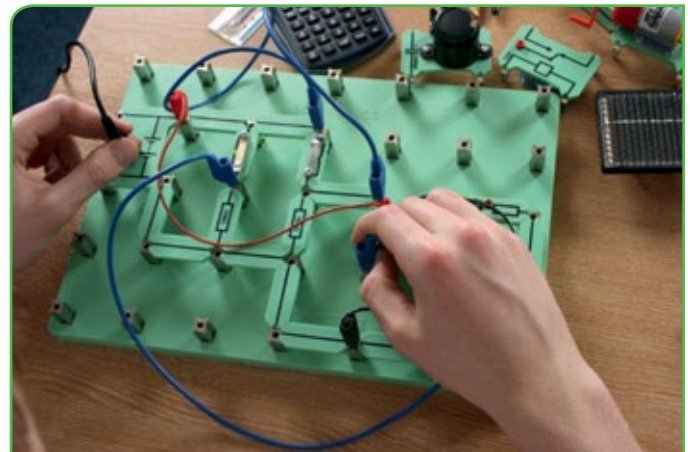


Theory



Teach students electrical theory in the classroom using text books, CD ROMs, or other means...

Application



...students apply theory to practice using Locktronics kits...

Simplifying Electricity & Electronics

Locktronics is used in over 10,000 schools worldwide. Teachers and students like to use Locktronics for a number of reasons:

Makes learning easier

- Students can see the circuit diagram and the **real circuit**
- Circuits are **fast to build** and **easy to work with**
- **Support materials** guide students step-by-step

Saves preparation time

- Locktronics is **reliable** and works year after year
- **Curriculum and worksheets** are provided

It lasts and lasts

- Components mounted on **rugged plastic carriers**
- **Simple, effective, strong** baseboards
- Component legend **bonded** to plastic carriers

Versatility

- Can be used in **many subject areas**, at many levels
- Vast **range** of components
- Ideal for **demonstrations, projects** and **practical work**.

Support

- **Components and curriculum** now updated
- **12 month guarantee** on all items
- Unlimited **telephone support** on all products

Understanding



...understanding comes from completing assignments in curriculum packs.

Choosing your Locktronics package

In the earlier part of this catalogue, you can choose from our extensive range of kits tailored to syllabuses in primary education, secondary education and further education, in engineering, science, technology and automotive.

Choosing the right solution

Take a look at our range of over 40 curriculum packs that you can see on page 60. View them on our website and make sure the experiments are right for you.

Choosing accessories and extras

Bills of material showing the complete contents of each kit are available online. Make sure you have the test equipment you need for teaching your course. Most courses require the use of one or two multimeters. Some require signal generators and oscilloscopes.

Component and kit variations

Make sure you choose the correct version of your solution - components are available with ANSI (USA) and DIN (European) circuit symbols.

Making up your own kit

If the kits we have don't suit you then you can make up your own kit from our vast library of parts - see page 62.

Choosing additional manuals and parts

If you already have some Locktronics parts, then you can download free updated manuals from our website and can buy additional components which will allow you to deliver new courses.



Take a look at our curriculum packs online...



...choose one of our solutions...



...with ANSI (North American) symbols...



...or DIN/SB (European) symbols...



...with accessories like our current probe...



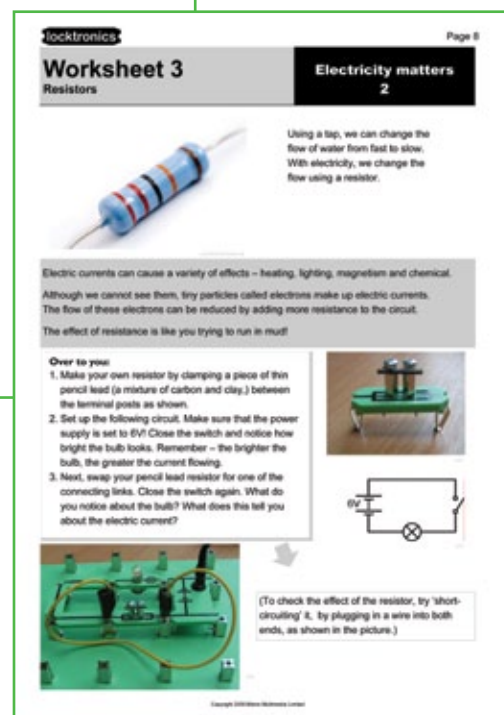
...and our active MIAC control unit.

Curriculum packs



Description	Part No.
Fundamentals of electricity (primary)	LK6816
Introduction to the transistor	LK4556
Basic and extended logic workbook	LK6920
Operational amplifiers	LK3061
Transistor linear applications	LK7003
Electricity matters 1	LK7325
Electricity matters 2	LK7326
Electricity matters 3	LK7664
Electricity matters 4	LK7773
Advanced electrical principles DC	LK8473
Advanced electrical principles AC	LK8749
Electronic devices and communication applications	LK8293
Automotive sense and control	LK8849
CAN bus systems and operation	LK9893
PICmicro microcontroller systems	LK7209
Industrial sensor, actuator and control	LK8739
Energy and the environment	LK7122
AC principles for automotive technicians	LK8392
An introduction to motors, generators and hybrid	LK8822
An introduction to digital electronics	LK9392
EASA electrical fundamentals 1	LK7378
EASA electrical fundamentals 2	LK7381
EASA electrical fundamentals 3	LK7393
EASA electrical fundamentals 4	LK7415
EASA electronic fundamentals 1	LK7419
EASA electronic fundamentals 2	LK7422
EASA electronic fundamentals 3	LK7426
EASA electronic fundamentals 4	LK7430
Hybrid vehicle systems	LK4483
Intermediate electrical and electronic engineering	LK6530
PICmicro getting started guide	LK8741
Combinational logic systems	LK2094
Sequential logic systems	LK9945
Fault finding in electronic circuits	LK9333
Transistor amplifiers	LK4403
Principles and applications of Electronic Devices and Circuits	LK9331
Advanced electronic principles	LK3008
Three phase systems	LK2686

Most worksheets follow the same format. Illustrated introduction to topic area and components supports student learning.



'Over to you' allows students to experiment based on what they have learnt and allows teachers to assess their understanding through a series of exercises.

Additional information to support the outcomes of the exercises for students to read or copy, often leading them into the next worksheet.

There are over 40 different curriculum packs available for the Locktronics range covering a wide spectrum of topics: from simple electricity for wiring technicians, through to advanced transistor characteristics for undergraduate electronic engineers. The table on the left shows the complete list of products available.

For up to date curriculum, please visit our website:
www.matrixtsl.com/locktronics/resources

MIAC technology



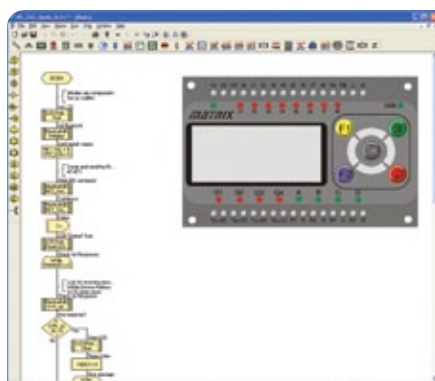
Features

- The world's only educational Electronic Control Unit
- A flexible resource with many uses in many areas of engineering
- Physically and electrically rugged
- Compatible with Flowcode, C, Assembly, LabView and Visual Basic
- 8 digital or analogue inputs, 4 relay outputs, 4 motor outputs with speed control, 4 line LCD display and control keys and CAN bus
- Compatible with a wide range of industrial sensors
- Fast CAN bus for networking

The MIAC is a fully specified industrial grade Programmable Logic Controller (PLC). It has 8 analogue or digital inputs, 4 high current relay outputs, 4 motor outputs and an integrated Controller Area Network (CAN) bus which allows many units to be

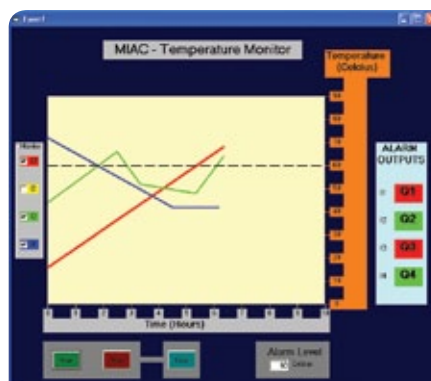
networked together. The MIAC is available in a rugged plastic case with all connections made available using 4mm shrouded 'banana' sockets. The status of all I/O lines is indicated with an individual LED. A keypad and 4 line 16 character display facilitate

user interactions. The unit is programmed directly from a PC's USB port using Matrix's own Flowcode graphical programming language, C code or Assembly code. The unit can also be controlled via the LabView and Visual Basic development environments.



Use with Flowcode...

Flowcode is an easy-to-use graphical programming language based on flow charts. Drag and click on icons and components to create a program, simulate on screen and then download to the MIAC.



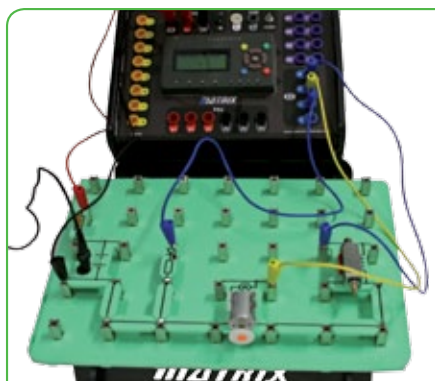
...Visual Basic®...

A free program can be downloaded to the MIAC which makes it function as a VB or LabView interface. A DLL with function calls is supplied which allows a wide variety of PC based control systems to be developed.

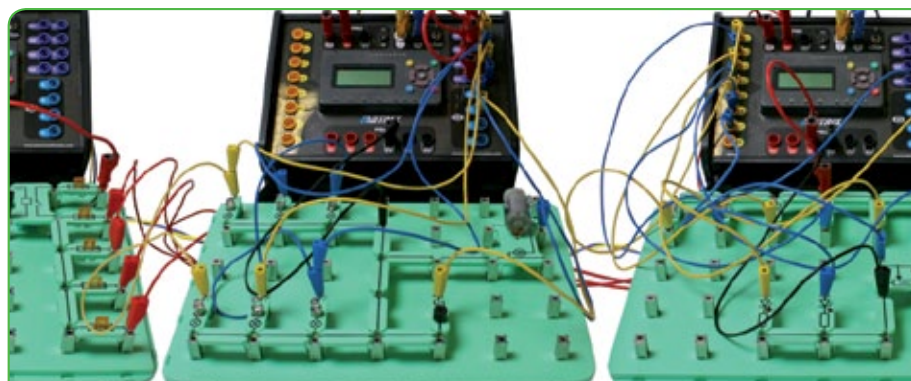


...or LabView®

- PC based data capture and control
- LabView and VB via USB
- Ideal for advanced engineering concepts such as PID
- A flexible lab interface

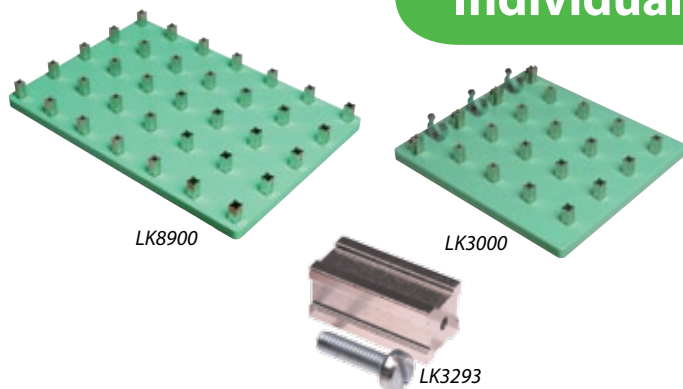


MIAC used to demonstrate sense and control in an industrial context.



MIAC and Locktronics used to study the role of ECUs in an automotive system.

Individual components



Baseboards and spares

Description	Part number
7 x 5 baseboard with 4mm pillars	LK8900
4 x 4 baseboard with 4mm pillars and battery holders	LK3000
Spare 4mm pillar and bolt	LK3293
Battery contact spring	LK3288
Battery retaining clip	LK8615
7 x 5 baseboard with 2mm pillars	LK7302
4 x 4 baseboard with 2mm pillars and battery holders	LK5940
Spare 2mm pillar and bolt	LK5939



Instruments

Description	Part number
Multimeter	LK1110
Energy meter	LK8591
25MHz Pico 2205 oscilloscope with free lead set	HP8279
3MHz TTI signal generator with free lead set	HP7894
Picoscope 4223 automotive oscilloscope	HP3829
Three phase power supply	HP9390

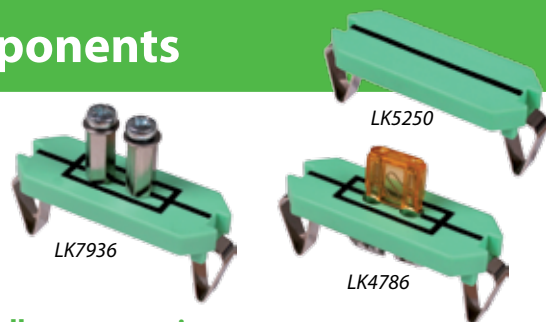


Leads

Description	2mm option	Standard part
Lead, black, 320mm, 4mm stackable to croc clip	LK5297E	LK5297
Lead, red, 300mm, 4mm to 2mm stackable	LK5555E	LK5555
Pair of 4mm to croc clip leads		LK5570
Lead, red, 320mm, 4mm to croc clip	LK5298E	LK5298
Lead red, 500mm, 4mm to 4mm stackable		LK5603
4mm to 4mm lead, black		LK5604
Lead, green, 320mm, 4mm to 4mm stackable		LK5601
4mm to 4mm lead, yellow		LK5607
4mm to 4mm lead, blue		LK5609
General purpose lead set (LK5603 x 2, LK5604 x 2)		LK8022
Lead, D-type to yellow and blue 4mm for Kvaser analyser		LK5695
Lead, black, 300mm, 4mm to 2mm stackable	LK5556E	LK5556
Lead, white, 300mm, 4mm to 2mm stackable	LK5557E	LK5557
Lead, red, 2000mm, 4mm to 4mm plug		LK6574

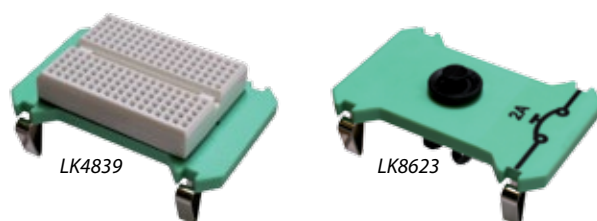
Need more information?

Our website includes photographs and descriptions of every product in the Locktronics range. Data sheets on many products are also available.



Miscellaneous carriers

Description	Part number
Connecting link	LK5250
Crossover link	LK5251
Fuse/universal component carrier	LK7936
Sampler	LK5290
Automotive fuse carrier	LK4786
Protoboard	LK4839



Non-carrier products

Description	Part number
MES bulb, 2.5V, 0.2A	LK2341
MES bulb, 6V, 0.04A	LK2347
MES bulb, 6.5V, 0.3A	LK2350
MES bulb, 14V, 0.06A	LK2363
MES bulb, 12V, 0.1A	LK2346
Locktronics current probe	LK5100
MES bulb, 12V, LED, red	LK6749
MES bulb, 12V, LED, yellow	LK6822
MES bulb, 12V, LED, white	LK6841
400 turn induction coil	LK5299
Curriculum CD ROM	LK6492
Terminal post	LK5294
Small bar magnet	LK0123
Small compass	LK0124
Locktronics user guide	LK4000
Lenz's law kit	LK7487
Faraday's law kit	LK7489
Fleming's motor rule apparatus	LK6482
Locktronics mini prototype board	LK4839
Circuit breaker	LK8623
BNC male to dual 4mm binding post	HP6529
OBDII lead	LK5697
Three phase motor	HP3920



Packaging and storage

Description	Part number
Deep tray	HP5540
Tray lid	HP4039
62mm daughter tray	HP9564
Daughter tray foam insert	HP7750
18 tray trolley	HP3025N
12 tray trolley	HP2025Q

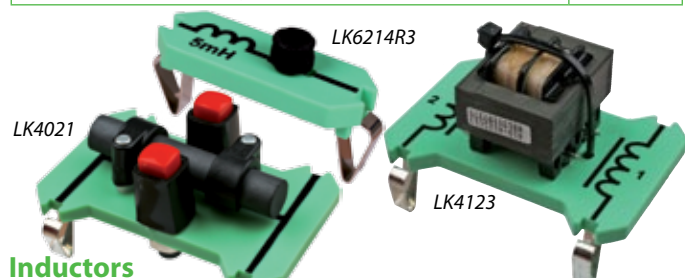


Individual components



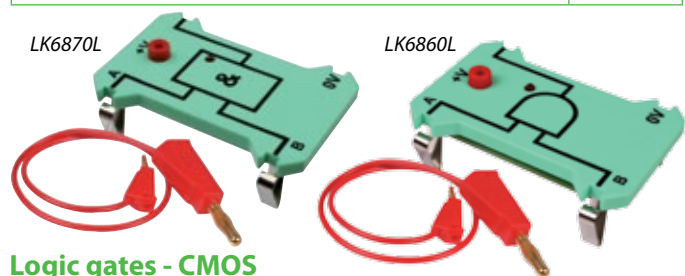
Capacitors

Description	Part number
Capacitor, 100pF, Ceramic	LK6283
Capacitor, 0.1µF, Polyester	LK5222
Capacitor, 0.47µF	LK6216
Capacitor, 1µF, Polyester	LK6205
Capacitor, 2.2µF, Polyester	LK6217
Capacitor, 4.7µF, 25V	LK6206
Capacitor, 4.7µF, Ceramic	LK6239
Capacitor, 100µF, 25V	LK6202
Capacitor, 150µF, 25V	LK6223
Capacitor, 1000µF, Electrolytic, 30V	LK4003
Capacitor, 2200µF, 25V	LK6203
Capacitor, 4700µF, Electrolytic, 16V	LK6653
Capacitor, 22000µF, Electrolytic, 16V	LK3662
Capacitor, 10uF, Electrolytic, 25V	LK5221
Capacitor, 47uF, Electrolytic, 25V	LK5224
Capacitor, Variable, 15-140PF	LK6214
Capacitor, 1nF, Polyester	LK6239
Capacitor, 33uF, non-electrolytic	LK5987



Inductors

Description	Part number
Choke, 5mH	LK6214R3
Choke, 10mH	LK6214R1
Choke, 47mH	LK6214R2
Choke, 68mH	LK6215
Choke, 200mH	LK9877
Transformer, 2:1 turns ratio	LK4123
Ferrite rod carrier	LK4021
2:1 transformer	LK7483
Dual 400 turn coil	LK9998



Logic gates - CMOS

Gates are available with either American National Standards Institute (ANSI) symbols or with Systems Block (SB) symbols. All sub-systems and logic gates are fitted with 2mm power connector sockets. Gates are delivered with 2mm to 4mm power leads as standard - 'L'. Gates are also available with 2mm to 2mm leads for use in labs where only 2mm connectors are allowed - 'LE'.

Description	Part no. SB 2mm to 2mm	Part no. ANSI 2mm to 2mm	Part no. SB 2mm to 4mm	Part no. ANSI 2mm to 4mm
AND gate with lead	LK6870LE	LK6860LE	LK6870L	LK6860L
NAND gate with lead	LK6873LE	LK6863LE	LK6873L	LK6863L
NOR gate with lead	LK6874LE	LK6864LE	LK6874L	LK6864L
NOT gate with lead	LK6872LE	LK6862LE	LK6872L	LK6862L
OR gate with lead	LK6871LE	LK6861LE	LK6871L	LK6861L
XOR gate with lead	LK6875LE	LK6865LE	LK6875L	LK6865L



Resistors

Here is our range of resistors. If you do not see the value you need, then you can make your own with our pre-printed blank carrier resistors.

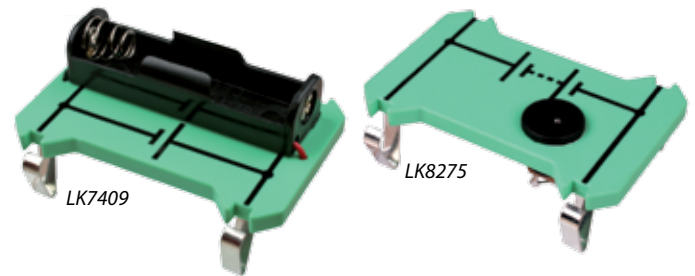
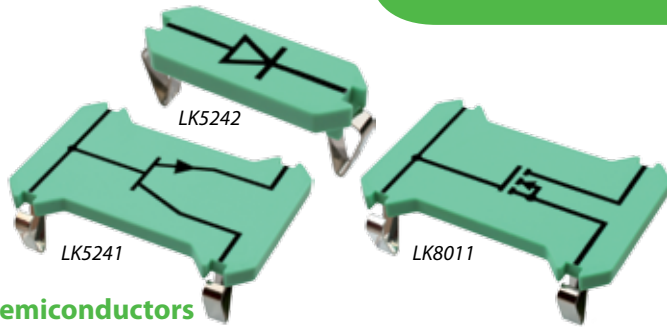
Description	Part no. DIN	Part No. ANSI
Resistor, 3.9Ω, 3W, 5%	LK5211	
Resistor, 10Ω, 1W, 5%	LK4025	LK4025A
Resistor, 12Ω, 1W, 5%	LK4100	LK4100A
Resistor, 47Ω, 0.5W, 5%	LK4065	LK4065A
Resistor, 68Ω, 0.5W, 5%	LK5217	LK5217A
Resistor, 100Ω, 1W, 5%	LK4002	LK4002A
Resistor, 120Ω, 0.5W, 5%	LK5206	LK5206A
Resistor, 180Ω, 0.5W, 5%	LK5207	LK5207A
Resistor, 220Ω, 0.5W, 5%	LK5215	LK5215A
Resistor, 270Ω, 0.5W, 5%	LK5205	LK5205A
Resistor, 500Ω, 0.5W, 5%	LK6237	
Resistor, 560Ω, 0.25W, 5%	LK6219	LK6219A
Resistor, 1KΩ, 0.25W, 5%	LK5202	LK5202A
Resistor, 2.2KΩ, 0.25W, 5%	LK6218	LK6218A
Resistor, 5KΩ, 0.25W, 5%	LK6230	
Resistor, 5.6KΩ, 0.25W, 5%	LK5209	LK5209A
Resistor, 10KΩ, 0.25W, 5%	LK5203	LK5203A
Resistor, 22KΩ, 0.25W, 5%	LK6211	LK6211A
Resistor, 33KΩ, 0.25W, 5%	LK5201	LK5201A
Resistor, 50KΩ, 0.25W, 5%	LK6231	LK6231A
Resistor, 100KΩ, 0.25W, 5%	LK5218	LK5218A
Resistor, 150KΩ, 0.25W, 5%	LK6212	
Resistor, 200KΩ, 0.25W, 5%	LK6238	LK6238A
Resistor, 270KΩ, 0.25W, 5%	LK5204	LK5204A
Resistor, 330KΩ, 0.25W, 5%	LK6201	LK6201A
Resistor, 500KΩ, 0.25W, 5%	LK6232	LK6232A
Resistor, 1MΩ, 0.25W, 5%	LK6200	LK6200A
Resistor, 1.5MΩ, 0.25W, 5%	LK5210	
Resistor, 10MΩ, 0.25W, 5%	LK6233	
Resistor, Rx	LK5252	LK5252A
Potentiometer, 25Ω	LK5212	
Potentiometer, 250Ω	LK5208	LK5208A
Potentiometer, 1KΩ	LK4034	LK4034A
Potentiometer, 10KΩ	LK5214	LK5214A
Potentiometer, 100KΩ	LK5219	
Potentiometer, 1MΩ	LK5213	
Resistor, variable, 250Ω	LK3893	
Resistor, variable, 10KΩ	LK6630	
Resistor, variable, 100KΩ	LK6631	
Resistor, 50ohm, 1/4w, 2%	LK8980	

System blocks and other ICs

All sub-system and logic gates are fitted with 2mm power connector sockets. Gates are delivered with 2mm to 4mm power leads as standard - 'L'. Gates are also available with 2mm to 2mm leads for use in labs where only 2mm connectors are allowed - 'LE'.

Description	Part number	
Systems block transistor switch	LK6831	
Systems block transducer driver	LK6832	
Description	2mm to 2mm	2mm to 4mm
555 timer	LK6300LE	LK6300L
Op Amp module (TL081)	LK6234LE	LK6234L
Voltage regulator (7805)	LK7208	LK7208
Flip-flop, horizontal carrier	LK6500LE	LK6500L
Flip-flop, vertical carrier	LK6501LE	LK6501L

Individual components

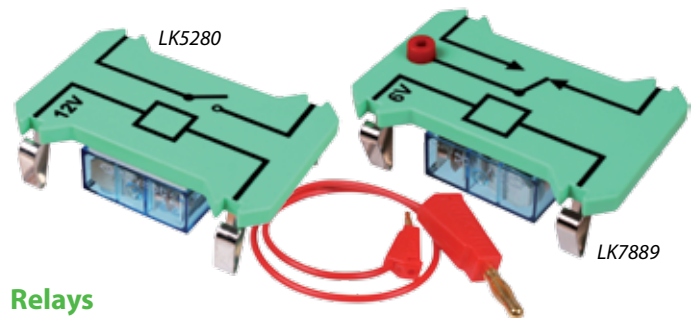


Semiconductors

Description	Part number
Diode, germanium	LK5242
Diode, power, 1A, 50V	LK5243
Diode, silicon	LK5249
Zener diode, 4.7V	LK5247
Zener diode, 6.8V	LK5253
Zener diode, 8.2V	LK5254
Zener diode, 12V	LK5258
Schottky diode	LK8000
Bridge rectifier	LK5266
Transistor LHF, NPN	LK5241
Transistor LHF, PNP	LK5256
Transistor RHF, NPN	LK5240
Transistor RHF, PNP	LK5255
Transistor, unijunction	LK5246
Power transistor, NPN, 1.5A	LK6705
Power transistor, NPN, 10A	LK7203
Transistor, JGFET	LK5146
Transistor, FET	LK7219
Power MOSFET transistor	LK8011
Thyristor	LK5248
Triac	LK4051
Photodiode	LK7361
Phototransistor	LK7290

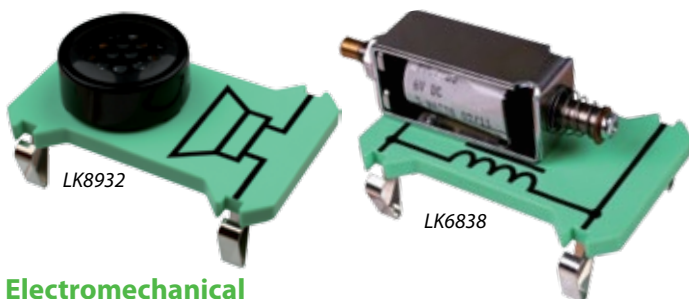
Power / battery carriers

Description	Part number
Power supply carrier	LK8275
Power supply carrier with voltage source symbol	LK7461
Dual voltage rail power supply carrier	LK8492
AC voltage source carrier	LK2340
AA battery holder carrier	LK7409



Relays

Description	Part number
Relay, 12V coil, 10A normally open	LK5280
Relay, 6V coil, 10A normally open	LK5403
Relay, 6V coil, 10A changeover with 2mm to 4mm lead	LK7889L
Relay, reed, changeover	LK4103
Relay, reed, normally open	LK5405
Relay, 12V coil, 10A changeover with 2mm to 4mm lead	LK7049L



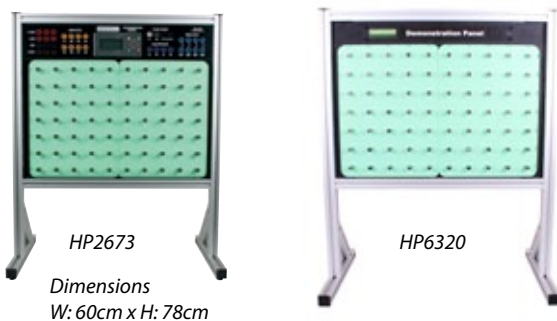
Electromechanical

Description	Part number
Solenoid	LK6838
Buzzer, 6V, 15mA	LK6423
Buzzer, 12V, 15mA	LK3246
Speaker	LK8932



Power supplies

Description	Part number
Adjustable DC power supply, 3V to 13.5V, 1A, no carrier	HP2666
AC power supply, 12VAC, 1A, UK	HP3728
AC power supply, 12VAC, 1A Europe	HP4429
AC power supply, 12VAC, 1A, USA	HP4688
+/-12VDC power supply, 5 pin DIN, inc UK mains lead	HP8405
IEC mains connector lead, for +/-12 VDC PSU, Europe	HP3702
IEC mains connector lead, for +/-12 VDC PSU, USA	HP3703
DC power supply, 15VDC, 25A, UK	HP0056

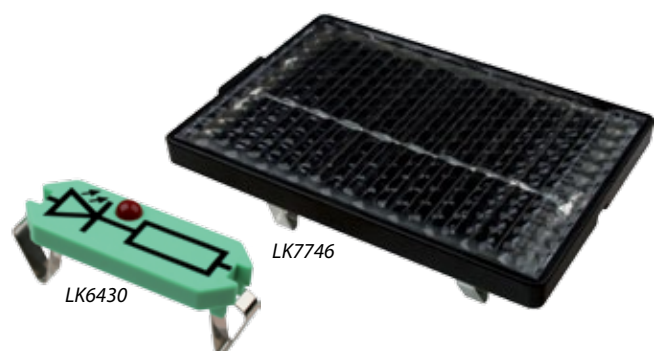


Dimensions
W: 60cm x H: 78cm

Engineering panel

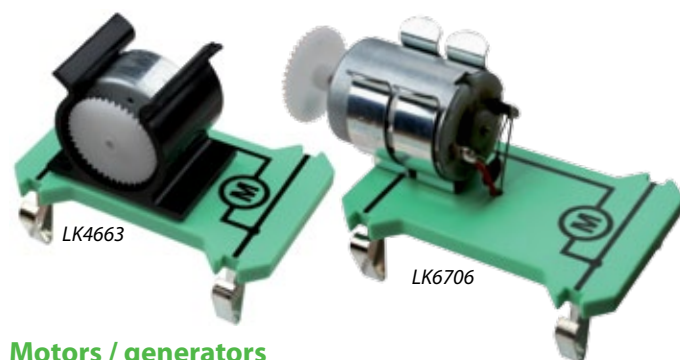
Description	Part number
Engineering panel	HP2673
Demonstration panel	HP6320

Individual components



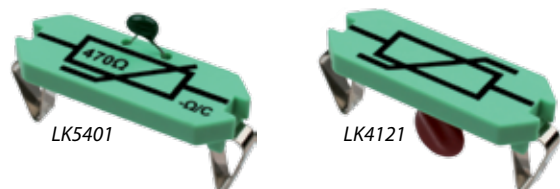
Optoelectric and lights / lamps

Description	Part no. SB	Part no. ANSI
Lampholder, MES, for automotive LEDs	LK5287	
Lampholder, MES	LK5291	
LED, red	LK6635	LK6635A
LED, green	LK6636	LK6636A
LED, yellow	LK6637	LK6637A
Solar cell	LK7746	



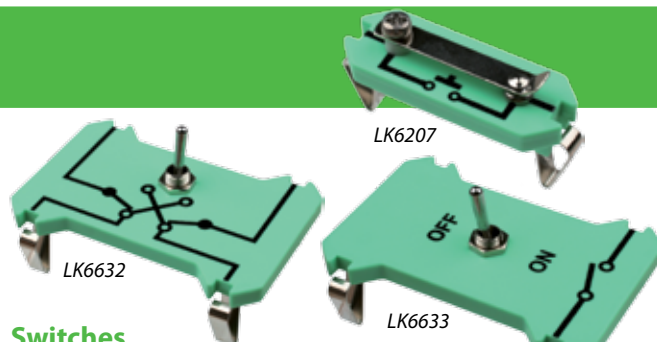
Motors / generators

Description	Part number
Motor, 3V to 12VDC, 0.7A	LK6706
Motor, 6V, open frame	LK4102
Stepper motor	LK4322
Low power solar motor	LK4663
Hand cranked generator	LK4893
Hand cranked generator spare handle	LK4894
Motor with reluctor	LK8113



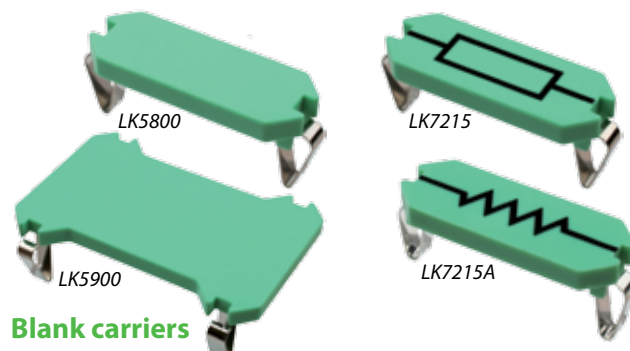
Sensors

Description	Part no. DIN	Part no. ANSI
Hall effect switch	LK6734	
Thermistor, 470Ω, NTC	LK5401	LK5401A
Thermistor, 4.7KΩ, NTC	LK5402	LK5402A
Thermistor and moisture sensor PCB	LK6850	
Thermocouple carrier	LK8988	
Voltage dependent resistor	LK4121	
Slotted opto sensor with 2mm to 4mm lead	LK6707L	
Magnetic pickup	LK8743	



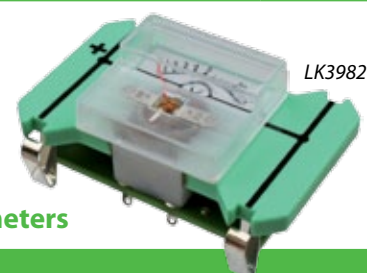
Switches

Description	Part number
Switch, on/off, toggle	LK6633
Switch, push to make, metal strip	LK6207
Switch, normally open, reed	LK5404
Switch, reversing, toggle	LK6632
Switch, changeover, toggle	LK6224
Switch, changeover	LK6208
Microswitch	LK6634
Switch, on/off, metal strip	LK6209



Blank carriers

Description	Part no. SB	Part no. ANSI
Blank carrier, large, pack of 10	LK5900	
Blank carrier, small, pack of 20	LK5800	
Blank resistor carrier	LK7215	LK7215A
Blank capacitor carrier	LK7216	
Blank electrolytic carrier	LK7217	
Blank diode carrier	LK8013	
Blank transistor carrier	LK7218	



Moving coil meters

Description	Part number
Voltmeter, 0V to 15V	LK3982
Voltmeter, +/-7.5V	LK9438
Ammeter, 0mA to 100mA	LK9381
Ammeter, 0A to 1A	LK8397



Resistivity carriers

Description	Part number
Nichrome 0.075mm ² x 500mm	LK8150
Nichrome 0.075mm ² x 250mm	LK8152
Nichrome 0.21mm ² x 500mm	LK8154
Constantan 0.075mm ² x 500mm	LK8156

Individual components



Lenz's law apparatus

The Lenz's law apparatus allows students to easily see that, "An induced current is always in such a direction to oppose the motion or change causing it". The apparatus consists of a copper tube, with one side removed and two identical cylinders only one of which is magnetised. Lenz's law is demonstrated by the fact that when the metal cylinders are dropped through the copper tube, the magnetised cylinder falls at a much slower rate because of induced eddy currents in the copper tube wall. Students will be intrigued by this highly visual experiment which forms an ideal part of a course on motors and generators.

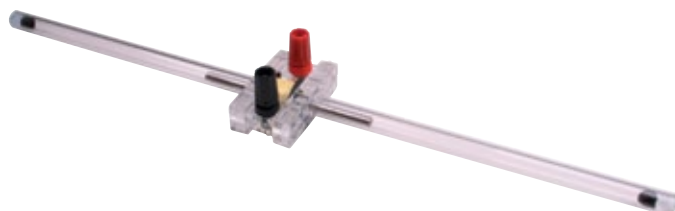
Description	Part number
Lenz's law apparatus	LK7487



Energy meter

This simple meter is ideal for giving students a quantitative and qualitative feel for the unit of energy - the Joule - and power - the Watt. The meter measures voltage, current, power consumption and shows energy used over time. For simplicity, the instrument automatically adjusts the display to show suitable units and an appropriate number of decimal places so that it can deal with a very wide range of values (e.g. for energy, from 0.01 millijoules up to 300 kilojoules). The function button has four settings to select the desired quantities to be measured (energy and time, power, average power, voltage and current). The meter includes a 9V mains adaptor (UK only).

Description	Part number
Energy meter	LK8591



Faraday's law apparatus

This apparatus is ideal for demonstrating Faraday's law of electromagnetic induction. It consists of a clear plastic tube containing a powerful magnet, with a 400 turn coil bonded onto the surface of the tube. When the tube is inverted the magnet passes through the coil, inducing a voltage on the coil terminals. Students are able to use an oscilloscope or datalogger to easily see the induced voltage. This is an ideal precursor to understanding generator theory.

Description	Part number
Faraday's law apparatus	LK7489



Locktronics PICmicro microcontroller

This carrier includes a reprogrammable PICmicro microcontroller with four general purpose input output pins. When used as inputs the pins can be configured to be analogue or digital. The carrier includes three slide switches which can be used for selecting one of 8 internal programs in the PIC. The device can also be reprogrammed from the USB port. Power can be derived from the on-board 2mm connectors or from the USB port.

Description	Part number
USB reprogrammable PICmicro MCU with 2mm to 4mm lead	LK4690L
Replacement chip for Locktronics PIC	LK8372
USB2 high speed A to mini B lead	HPUAB



Fleming's motor rule apparatus

This apparatus is used to demonstrate the fact that a force is exerted on a current-carrying conductor when it is placed in a magnetic field. The apparatus consists of three parts - a large Locktronics carrier with two parallel wires, a powerful magnetic yoke with North and South poles clearly visible, and a thin metal tube as the conductor. The tube 'kicks' off the carrier when a current is passed through it. This highly visual apparatus provides an opportunity of demonstrating Fleming's left hand motor rule.

Description	Part number
Fleming's motor rule apparatus	LK6482



MIAC

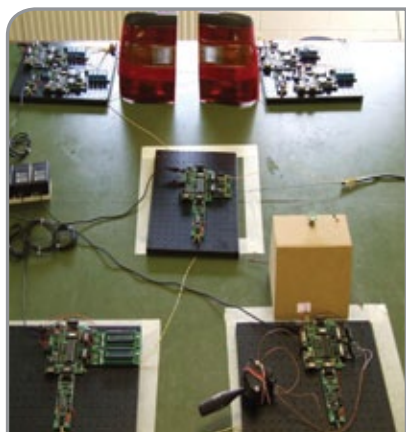
MIAC is a powerful controller which has applications in Science, Technology, Electronics, Mechanical engineering, Automotive engineering and Chemical engineering. This version of the MIAC is supplied with 4mm shrouded sockets which are internally connected to all of the input outputs of the MIAC. The 4mm connectors mean that connection to Locktronics baseboards is extremely easy. Power supply and USB lead are not included.

Description	Part number
MIAC with 4mm shrouded sockets	MI0245
Power supply for MIAC (international)	HP2666
USB2 high speed A to B mini lead	HPUAB



Contents

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The School of Electronic and Aeronautical Engineering (SEAE), one of the British Army's key training establishments in the United Kingdom, has reacted to the need to dominate the Digital Battlefield by equipping a number of classrooms and project rooms with a comprehensive range of E-Block modules and Flowcode. The E-blocks system has enabled SEAE to develop courses to teach the students fault-finding procedures applicable to microprocessor and/or embedded microcontroller systems.

This means that the students can develop practical experience of designing, programming and building systems similar to what they will encounter during an operational tour of duty.

A particular success has been the student project work on CAN bus which is a communications system used to link sub systems together in military vehicles. Students are split into groups, given real automotive components and tasked with developing a functional vehicle electronic control system.

What are E-blocks?

Simplifying Technology & Electronic Systems

E-blocks modules provide learners and developers with a flexible suite of electronics blocks that snap together to form a wide variety of electronic systems.

E-blocks are small circuit boards each of which contains a block of electronics that you would typically find in an electronic system. The 50 circuit boards in the E-blocks range use rugged 9-way D-type connectors as connection busses for 8 signal lines and earth. Power (3.3V or 5V) is wired separately. This allows a complete system to be assembled in a matter of minutes.

Systems based on microcontrollers can be programmed using flowcharts, C, assembly, or anything else that generates an appropriate HEX file. Systems based on FPGA technology can be programmed in block diagrams, VHDL or Verilog. A range of CD ROM tutorials, which include compilers, development tools and manuals, provide support to students who are new to any of these technologies.

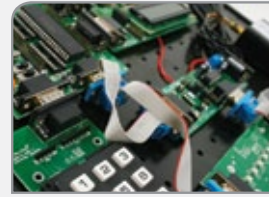
Disciplines include:

Electronic engineering

Mechanical engineering

Computer Science

Design Technology

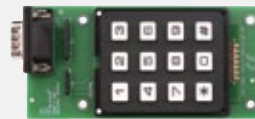


The E-blocks range includes:



A range of upstream programmer boards

To which students add:



Input /output boards



Communications boards



Wireless comms boards



Graphical displays



Prototype boards



Motor driver boards



A/D and D/A boards



Sensors



Accessories



Test instruments



Why choose E-blocks?

Flexibility

The modular nature of E-blocks makes them one of the most flexible kits available: almost anything in modern digital electronics that you want to teach, learn or construct can be done with E-blocks.

Supported programmable devices

To give you flexibility in the courses you can deliver with E-blocks, we support a wide range of programmable devices which includes 8, 16 and 32 bit microcontrollers and Altera FPGAs:

PICmicro® microcontroller
ARM® microcontroller
Atmel AVR® microcontroller
dsPIC/PIC24® microcontroller
Altera Cyclone IV FPGA
Arduino

Supported programming languages

E-blocks microcontroller boards are supplied with download utilities for native hex code which means that most chip programming languages are supported.

Comms systems compatibility

Most chip to chip and system to system communications standards are supported. The list continues to grow and includes:

CAN, LIN, Bluetooth, GSM, RS232, RS485, IrDA, PS2, VGA, TCP/IP, MIDI, SPI, I2C, ZigBee, RFID, VGA, USB, GPS, SD/FAT16/FAT32, RS485, RF (ISM), RC5, WiFi

Curriculum support

E-blocks are well supported with a range of curriculum materials for different levels of learners. This includes free online tutorials for beginners and schools, 50 hour courses in programming and chip development for undergraduates and a range of specialist courses in advanced techniques like mobile telephony and embedded internet technology for the advanced user.

Rugged design

E-blocks are designed to be electrically and mechanically rugged to withstand the pressures of the lab: downstream board interfaces include damage protection resistors and can not be damaged by programming errors. Boards can be mounted onto metal backplanes to make them mechanically rugged during use. Plastic covers are available for all boards which offer further protection and prevent chips from being removed.

Product information

All E-blocks are provided with full datasheets - including circuit diagrams - which can be downloaded from our web site. Up to date drivers for all boards are also available free of charge.

Forum support

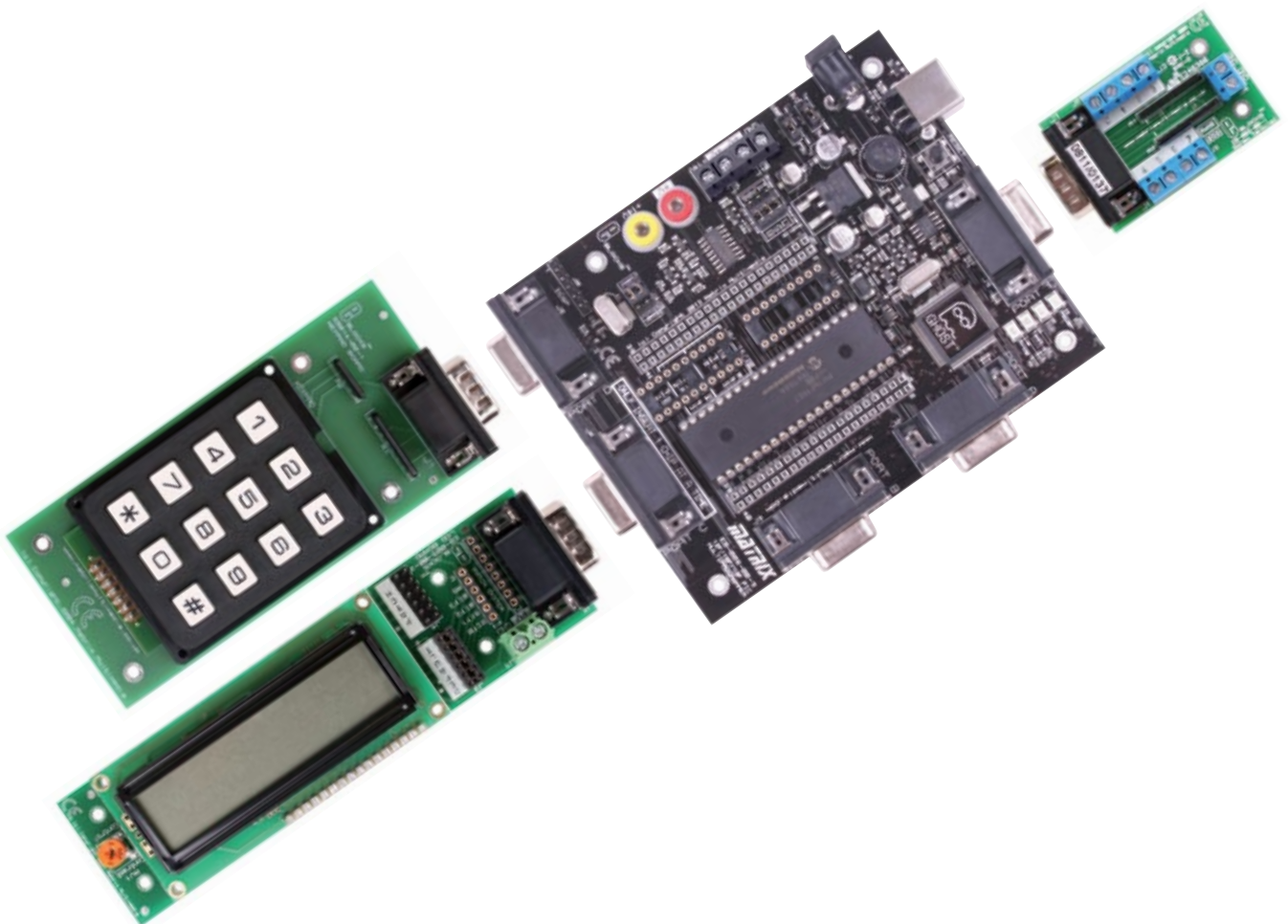
The Matrix development team provides excellent support for our products online through our very active forums. Additional support is provided by our network of valued contributors via our forums.

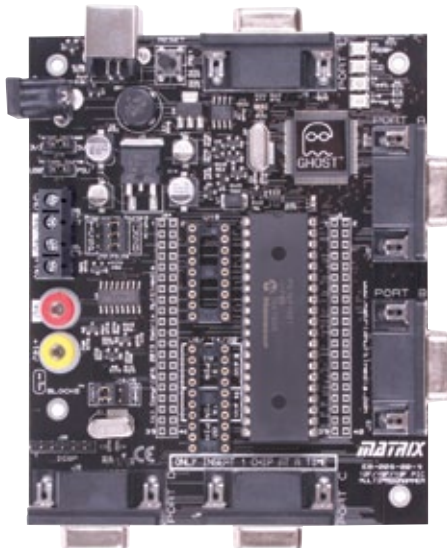
Tight integration with Flowcode

E-blocks are tightly integrated with Flowcode version 6 and Flowcode components are available for all E-blocks as they are released.

Industry standard technology

E-blocks are used as much by engineers in industry as they are used by students and teachers in education. The technology is real, up to date and provides a great base for training the next generation of engineers.





The Ghost chip on our new EB006 PICmicro Multiprogrammer enables advanced debug features.

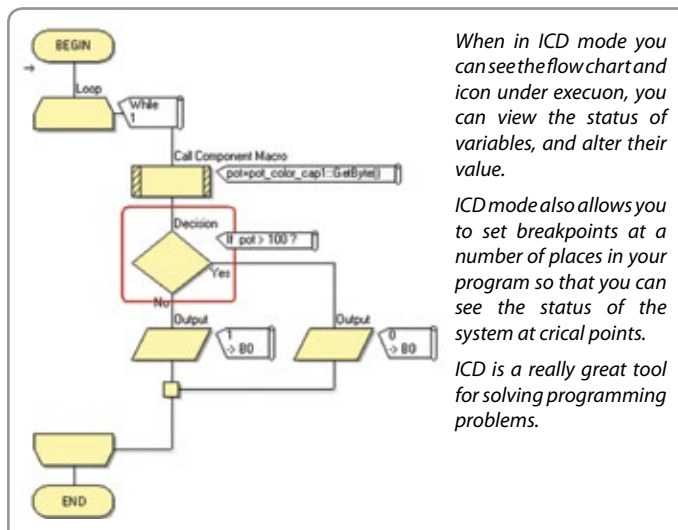
Ghost is a combination of PC-side and chip-side technologies which, when combined with Flowcode, provides a new way of debugging electronic systems.

Ghost technology provides a real time log of the status of all the pins on the microcontroller whilst a Flowcode program is running in real hardware. Ghost is designed to provide you with the best way of understanding what is happening in your electronic system.

There are two parts to Ghost technology: In-Circuit-Debug and In-Circuit-Test.

In-Circuit-Debug

When connected to Ghost compatible hardware the In-Circuit-Debug function allows you to run your program in hardware, to pause, to step through each command, and to run the program at different speeds.



When in ICD mode you can see the flowchart and icon under execution, you can view the status of variables, and alter their value.

ICD mode also allows you to set breakpoints at a number of places in your program so that you can see the status of the system at critical points.

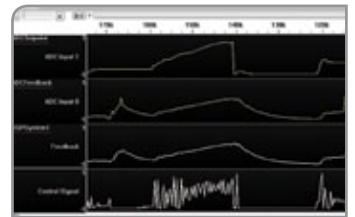
ICD is a really great tool for solving programming problems.

In-Circuit-Test

Ghost software within Flowcode takes the data gathered from the target chip and displays it in human friendly ways so that you can understand what is happening in your electronic system and debug it more easily. There are four instruments within Ghost:

Multichannel analogue scope

The multichannel 'scope allows you to see the voltages on the analogue pins of the microcontroller.



Multichannel logic analyser

The logic analyser displays the digital status of the input output pins on your microcontroller. 32 pins are monitored and you can display as many as will fit on your screen.



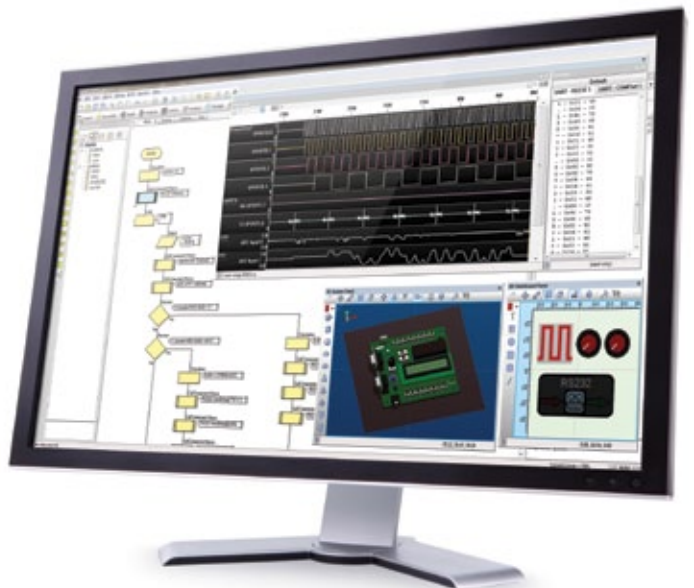
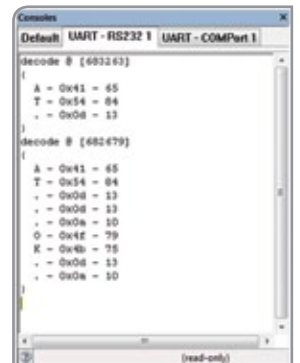
Packet decoder

The packet decoder allows you to convert the digital signals from the logic analyser into hexadecimal and see the traces as well as their numerical values. You can choose between different types of decoding such as I2C, RS232 etc.



Data console display

The data console displays a different view of the data captured by the packet decoder in Ghost. The console consists of a multi window scrolling text box displaying the sequentially decoded data. The different tabs in the console show different levels of decoding which makes the console a superb tool for developing projects involving digital communications.



Find out more about Ghost technology at: www.matrixsl.com/ghost



Introduction to microcontroller programming course

This free online resource provides a complete course in developing microcontroller based systems using Flowcode. The course contains a suite of 13 labs each of which has an accompanying Word worksheet. Students print a worksheet and then work through the contents of the CD ROM, developing systems using Flowcode to complete each lab. Each worksheet has a number of tasks, graded to cater for mixed ability classes. Supervisors can use the accompanying Excel marking scheme to track the progress of students as they work through the material. The course is based on E-blocks but is usable on other hardware platforms.

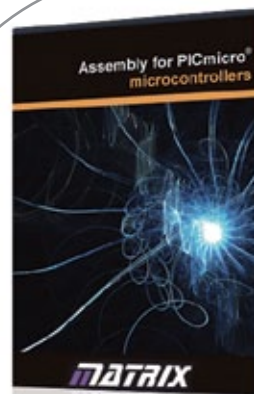
Learning objectives /experiments

- Microcontroller programming and circuits, clocks, pins, inputs, outputs, ports, memory and memory types, current limits
- Programming using flowcharts: input, system, output, loops, decision, subroutine, go to, calculations, delays, variables, strings, A/D conversion, interrupts, hardware macros, software macros, arrays
- Techniques: Binary, Hexadecimal, ASCII, calculations
- Components: clocking devices, switches, LEDs, LED arrays, sensors, buzzers, keypad, LCD, 7-segment displays, quad 7-segment displays, power supply, EEPROM
- Techniques: switch debounce, Schmitt trigger, prototyping with E-blocks strip board, PCBs and proto boards, using batteries

Available free online

Ordering information

Introduction to microcontroller programming	FREE
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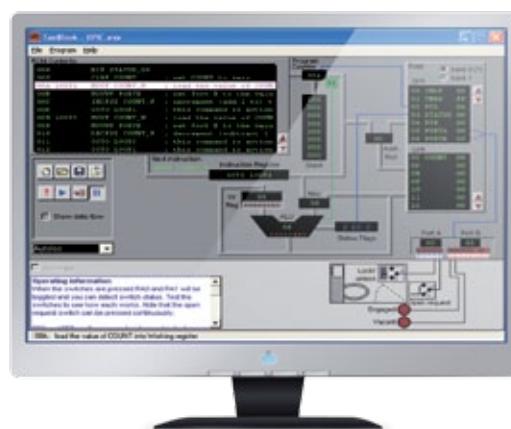


Assembly for PICmicro MCUs CD ROM V5

This CD ROM contains a complete 50 hour course in programming the PICmicro microcontroller. The tutorials start with fundamental concepts and extend up to complex programs including watchdog timers, interrupts and sleep modes. The CD ROM includes unique simulation tools which help students overcome key problems in programming in assembly code and a simplified development environment is included.



Typical tutorial screen



The Virtual PICmicro microcontroller

Ordering information

Single user	EL629SI5
10 user	EL629I05
Site licence	EL629SL5



C programming courseware and software

This CD ROM provides you with a complete solution to teaching and learning C programming for the PICmicro microcontroller.

The course is structured in two parts: firstly students are taken through the fundamentals of C programming in a series of on-screen tutorials that make use of our virtual microcontroller to explain to students how C works. This well proven methodology centres around a simulation of the microcontroller which allows students to clearly see the effects on the chip, internal variables and registers as each line of C code executes.

Once students have understood the basics, they carry out a series of labs using the Integrated Development Environment (IDE) and compiler provided. Tests and exercises to reinforce learning are provided. The software tools supplied on the CD are suitable for a wide variety of projects.



Tutorial and simulation screen

Students read through the tutorials, simulate the program on-screen, compile the source code in the IDE...



...and verify the program on the hardware

Ordering information

C for 16 series PICmicro microcontrollers

Single user	EL543SI5
10 user	EL543I05
Site licence	EL543SL5

Note that the C compiler is only licensed for educational use.

Upstream and interface boards

PICmicro® microcontroller multiprogrammer

This board connects to a PC via USB to provide a high speed, low cost PICmicro MCU programmer for development and programming. This board can be used with assembly, C or Flowcode along with most third party compilers. The board programs a wide range of microcontroller devices and has 5 D-type sockets for E-blocks connection. When used with Flowcode this board provides full Ghost support and instrumentation including multi channel oscilloscope, multi channel logic analyser, packet decoder and data console.

Ordering information

PICmicro® microcontroller multiprogrammer

EB006V9

NEW



dsPIC/PIC24 multiprogrammer board

This board can be used with MPLAB or Flowcode and most third party C compilers. The board programs a wide range of PICmicro microcontroller devices from the PIC24F, PIC24H, dsPIC30 and dsPIC33 series PICmicro ranges using the programming software provided. There are 5 D-type sockets for E-blocks connection. A Microchip PICKit socket provides alternative reprogramming and debugging techniques.

Ordering information

dsPIC/PIC24 multiprogrammer board

EB064



Extended functionality dsPIC board

The Extended functionality dsPIC board provides a higher speed processor, increased memory and more peripheral inputs outputs than the EB0064 dsPIC/PIC24 board. It is also fitted with Ghost technology which, when used with Flowcode, provides in-circuit debugging and instrumentation including multi channel oscilloscope, multi channel logic analyser, packet decoder and data console. The board is shipped with a powerful 16bit dsPIC processor – the dsPIC33EP256MU806 with 256K ROM and 28K RAM - which provides a huge assortment of functionality including remappable peripherals, 4x UART, 4 x SPI, 12-bit ADC, 16 x PWM, 2 x I2C and 2 x Internal CAN and USB.

Ordering information

Extended functionality dsPIC board

EB091

NEW



ARM® microcontroller multiprogrammer

This board is a development tool for the Atmel AT91 SAM 7 microcontroller. The SAM 7 is a 32 bit RISC device running at an internal frequency of 80MHz with 128k ROM and 32K static RAM as well as 2 USARTs, 4 x 10 bit A/D converters and a native USB bus. The board has 5 D-type sockets for E-blocks. The processor is housed on a removable daughter board so that the ARM can be incorporated into custom PCBs.

Ordering information

ARM® microcontroller multiprogrammer

EB185



Upstream and interface boards

AVR® microcontroller multiprogrammer

This board includes everything you need to program an AVR microcontroller and develop AVR projects. The board comes with a CD ROM containing development tools (including an Integrated Development Environment for code writing) and an in-system programmer. The board programs a wide range of AVR devices and has 4 D-type sockets for E-blocks.

Ordering information

AVR® microcontroller multiprogrammer

EB194



Raspberry Pi expansion board with cable

This adaptor board allows you to connect a Raspberry Pi device to downstream E-blocks boards, including the prototype board, using a 26-way IDC cable. Circuitry on the adaptor board offers protection for the Raspberry Pi pins from short circuits to ground or the supply voltage and presents the 17 general purpose I/O pins on D-type E-blocks connectors. Additional zener diodes can be added to the board for further circuit protection. Raspberry pi board not included.

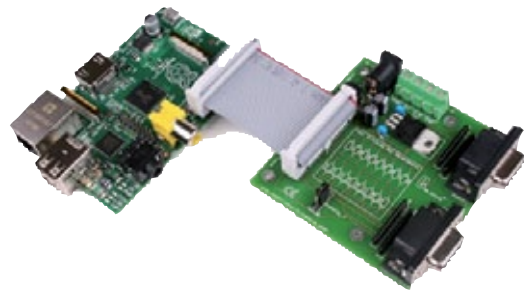
Ordering information

Raspberry Pi expansion module with cable

EB380

Raspberry Pi expansion board and case kit

EB385



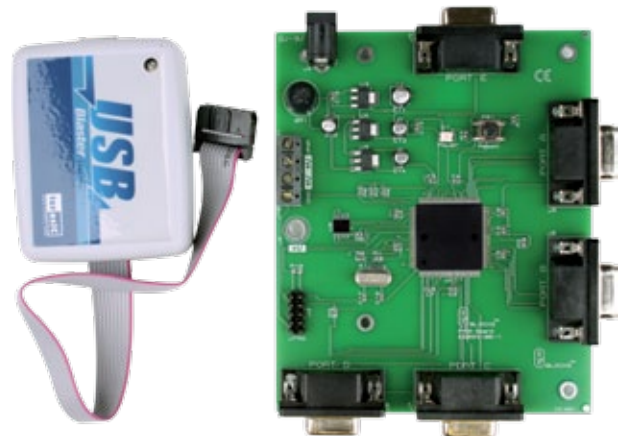
Altera FPGA board

The FPGA board contains a 10320 macrocell Cyclone IV series FPGA complete with configuration device to allow the code to be passed into the FPGA on power up. The board is packaged with and programmed via a USB-Blaster compatible USB JTAG dongle which allows the board to be re-programmed directly from within the Altera Quartus software using a standard USB port. The board provides five full E-blocks ports allowing other boards in the E-blocks range be connected to the upstream FPGA board. CD ROM courses and compilers for this board are available.

Ordering information

FPGA board

EB089



3.3V

E-blocks CAN Bus Faults board

A board for use with CAN bus systems for allowing faults to be inserted onto an active CAN bus. Also allows investigations between CAN systems and actual CAN hardware such as automobiles.

Ordering information

E-blocks CAN bus faults board

EB048



Upstream and interface boards

Interface shield for Arduino Uno compatible boards

This board allows you to connect standard Arduino Uno compatible boards into an E-blocks system and take advantage of the large range of E-blocks boards. The D-type connectors provide a bus system that enables clean access to all I/O lines, allowing you to use standard E-blocks with the Arduino upstream microcontroller architecture. All the standard signals from the Arduino board are brought across onto the shield board. This board is compatible with a host of Arduino footprint boards including the Uno, Leonardo, Micro, Mini, Nano, STM Nucleo, Cypress PSOC ARM M0, Chip kit for Microchip PIC32 and many more. Arduino board not included.

Ordering information

Interface shield for Arduino Uno compatible boards

EB093



E-blocks Arduino mega shield

This board allows you to connect the Arduino Mega and compatible boards into an E-blocks system and take advantage of the large range of E-blocks I/O boards. The D-type connectors provide a bus system that enables clean access to all I/O lines, allowing you to use standard E-blocks with the Arduino upstream microcontroller architecture. The standard signals from the Arduino Mega board are brought across onto the shield board. This board is designed around the mechanical and electrical requirements of the Arduino Mega and is also compatible with the Uno, Leonardo, Micro, Mini, and Nano. Arduino board not included.

Ordering information

E-blocks Arduino mega shield

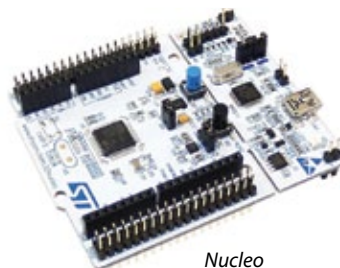
EB092



Arduino uno



Cypress



Nucleo



Freescale ARM

Arduino compatibility

These shields make E-blocks compatible with several Arduino boards including:



1. Uno



2. Leonardo



3. Mega



4. Micro



5. Mini

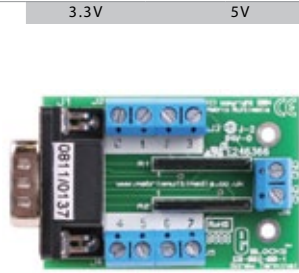


6. Nano

Downstream boards

Terminal board

Allows connection to all 8 pins of a standard E-blocks port with bare wires by using screw terminals.



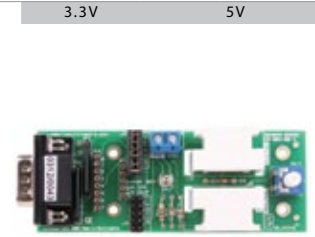
Ordering information

Terminal board

EB002

Sensor board

Contains a variable resistor and a light sensor for simple analogue experiments, as well as sockets which allow users to interface to our range of sensors.



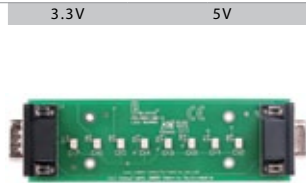
Ordering information

Sensor board

EB003

LED board

Has 8 LEDs which show the status of each bit on the port. Upstream and downstream E-blocks connectors allow this board to be used in bus configurations.



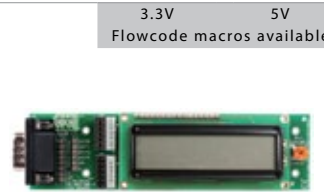
Ordering information

LED board

EB004

LCD board

Contains a 16 character, 2 line alphanumeric LCD display on a 5 wire serial bus.



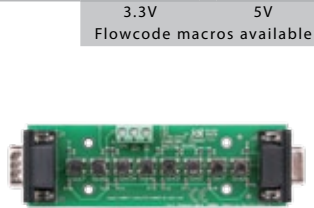
Ordering information

LCD board

EB005

Switch board

This board contains 8 push-to-make switches. Upstream and downstream E-blocks connectors allow this board to be used in bus configuration.



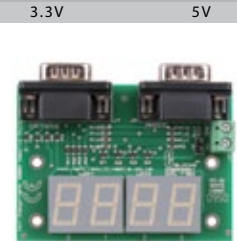
Ordering information

Switch board

EB007

Dual 7-segment display

Has a quad 7-segment common anode display with anodes controlled via one port and cathodes controlled by the other.



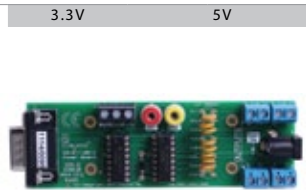
Ordering information

Dual 7-segment display

EB008

Power board

Contains two L293 quad push pull driver chips which provide power outputs for driving lamps or motors. The board supplies 8 outputs which sink or source 500mA at up to 36V.



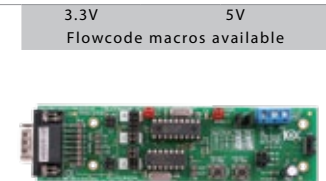
Ordering information

Power board

EB011

IR/IrDA transceiver board

This board provides a complete solution to infrared communications - with both standard IR and IrDA protocol for communications with laptops or PDAs.



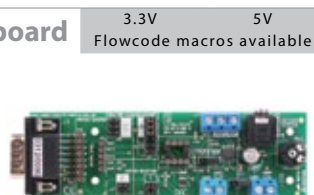
Ordering information

IR/IrDA transceiver board

EB012

SPI bus D/A and memory board

Adds serial memory (8K) and D/A functions (8 bit with amplifier and headphone socket) to any microcontroller / FPGA with an SPI interface.



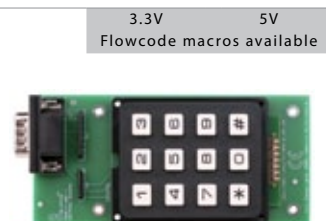
Ordering information

SPI bus D/A and memory

EB013

Keypad board

A simple 4 x 3 keypad that allows data entry into bus based systems.



Ordering information

Keyboard board

EB014

Downstream boards

RS232 board

3.3V 5V
Flowcode macros available

Provides an RS232 interface which can be used to facilitate communication between a microcontroller / FPGA and third party devices like PC serial ports, projectors etc.



Ordering information

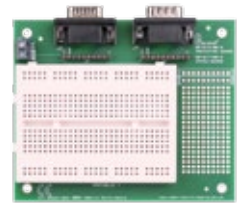
RS232 board

EB015

Prototype board

3.3V 5V

Contains a small prototype board for developing circuits and projects. Connectors for two E-blocks ports allow prototype wires and leads to be connected to the prototype board.



Ordering information

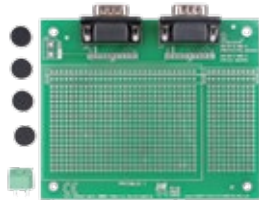
Prototype board

EB016

Patch board kit

3.3V 5V

Contains a small patch for developing circuits and projects. For use when a permanent circuit is required to add to your E-blocks system. D-type connectors need soldering on.



Ordering information

Patch board kit

EB017

CAN bus board

5V
Flowcode macros available

Allows you to add CAN bus functionality to any microcontroller with an SPI interface. The board includes both a CAN controller and a CAN transceiver.



Ordering information

CAN bus board

EB018

MIDI interface board

3.3V 5V
Flowcode macros available

With MIDI in, out and thru ports, this E-block allows any microcontroller to generate, process or respond to any MIDI datastream.



Ordering information

MIDI interface board

EB021

Motors board

3.3V 5V
Flowcode macros available

This board is based on the L298 device which can drive two motors operating from up to 46V at up to 4A each. The board can be used in a variety of motor control configurations.



Ordering information

Motors board

EB022

Internet board

3.3V 5V
Flowcode macros available

Adds Ethernet functionality to a microprocessor /FPGA system without the need for developing a TCP/IP software stack.



Ordering information

Internet board

EB023

Bluetooth board

3.3V 5V
Flowcode macros available

The Bluetooth board allows you to add Bluetooth capability to any microcontroller with UART functionality.



Ordering information

Bluetooth board

EB024

Voice CODEC board

3.3V

This audio coder-decoder board allows students to investigate Bluetooth systems that use audio. The board is based on a Freescale MC145483 linear 13 bit CODEC.



Ordering information

Voice CODEC board

EB032

PS2 / VGA board

5V

Allows you to connect standard keyboards, mice and VGA monitors to an E-blocks system.



Ordering information

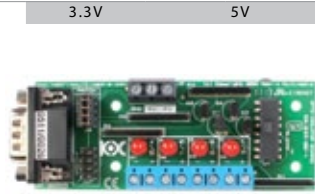
PS2 / VGA board

EB033

Downstream boards

Opto-isolator board

This board contains 4 separate isolated inputs to your E-blocks system for telecoms and Programmable Logic Controller applications.

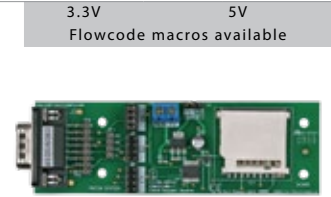


Ordering information

Opto-isolator board	EB035
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MMC card reader board

This MMC card reader sits on the serial port of a microcontroller and provides up to 32GB of memory to an E-blocks system. An MMC card must be bought separately.

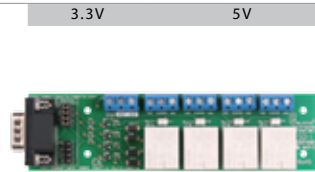


Ordering information

MMC card reader board	EB037
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Relay board

This board contains 4 relays (choose high or low nibble) each rated at 250V and 6A. This is ideal for building PLC type applications.

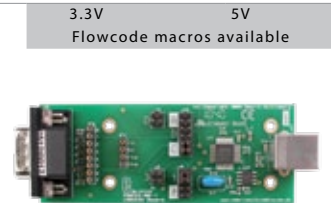


Ordering information

Relay board	EB038
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USB232 board

This board allows you to connect a microcontroller with a USART back to a PC via USB. A virtual COM port driver is supplied for interfacing to PC software applications.

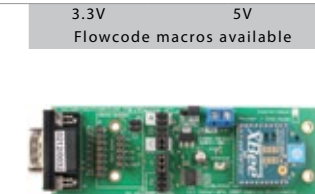


Ordering information

USB232 board	EB039
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Zigbee board

Gives the capability of developing 2.4GHz wireless networks based on the Zigbee standard.

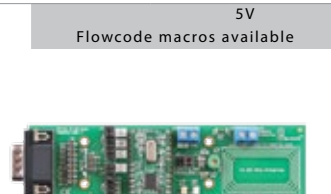


Ordering information

ZigBee coordinator board	EB051C
ZigBee router board	EB051R

RFID board

This board allows you to develop RFID systems based on the Mifare, I-CODE and Ultralight protocols and includes a built-in antenna.



Ordering information

RFID board	EB052
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Pasco sensor board

This E-block allows the Pasco Scientific range of Science Workshop sensors to be connected to a Matrix programmer board. The board provides two analog input channels and two bi-directional digital channels.

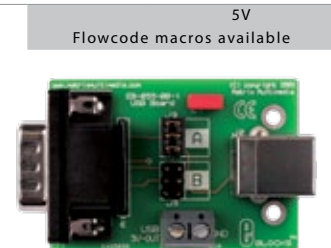


Ordering information

E-blocks PASCO sensor board	EB054
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USB interface board

Provides direct connection to the USB interface for microcontrollers that include an internal USB peripheral allowing you to easily communicate directly with your device.

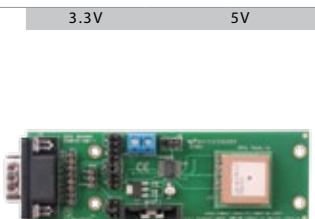


Ordering information

USB interface board	EB055
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GPS board

Includes a UP500 GPS module from Fastrax. Once an initial position has been acquired, the GPS receiver continues to send position information directly to the microcontroller.

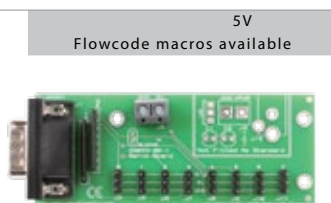


Ordering information

GPS board	EB056
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Servo board

Allows up to 8 servo motors to be connected to an E-blocks systems for use with the Flowcode Servo component.



Ordering information

Servo board	EB059
-------------	-------

Downstream boards

RC5 infrared transceiver

3.3V 5V
Flowcode macros available

Allows the exploration of the RC5 and other popular IR protocols. It features a tuned and filtered 36KHz IR receiver and an amplified IR emitter.



Ordering information

RC5 infrared transceiver	EB060
--------------------------	-------

ISM band RF comms.

3.3V 5V
Flowcode macros available

Allows RF communications at various carrier frequencies.



Ordering information

ISM-band RF board with 433 module	EB063-433
ISM-band RF board with 868 module	EB063-868
ISM-band RF board with 915 module	EB063-915

E-blocks basic sensors board

3.3V 5V
Flowcode macros available

The E-block Basic sensors board incorporates a light sensor, thermistor, hall effect sensor and potentiometer which can be used for simple experiments, projects and learning. Each of the sensors return a reading as an analogue voltage which can be between 0V and 5V.



NEW

Ordering information

E-blocks basic sensors board	EB067
------------------------------	-------

Wireless LAN board

3.3V 5V
Flowcode macros available

Allows easy access to standard wireless local area networks. It is capable of being a client or a server on a network. It can serve html and javascript web pages in either mode.



Ordering information

Wireless Lan board	EB069
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Slide switch board

3.3V 5V
Flowcode macros available

This board contains 8 slide switches with upstream and downstream D-type connector.



Ordering information

Slide switch board	EB074
--------------------	-------

RS485 board

5V
Flowcode macros available

Allows the exploration of RS485 communications. The board facilitates any type of RS485 configuration to be put together.



Ordering information

RS485 board	EB062
-------------	-------

NEW

GSM board

3.3V 5V
Flowcode macros available

Comes complete with a SIM card socket and a small antenna. It is fitted with 2.5mm jack sockets for microphone and headphone use.



Ordering information

GSM module	EB066
------------	-------

E-blocks motion sensor board

3.3V 5V
Flowcode macros available

This board features a 3-axis acceleration sensor which can be used for force meters, balancing robotics, calibration tools and digital spirit levels. The board can be used to measure G force or can also be used to measure orientation in terms of pan / tilt and roll.



Ordering information

E-blocks motion sensor board	EB068
------------------------------	-------

Rotary encoder board

3.3V 5V
Flowcode macros available

Has two rotary encoders, an LED and a push switch. It does not have a start and end position so keeps turning in either direction to allow a continually turning potentiometer.



Ordering information

Rotary encoder board	EB073
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E-blocks 4D touch screen board

3.3v 5v
Flowcode macros available

The E-blocks 3.2" multimedia board is a compact and cost effective all in one 'SMART' board that uses the latest state of the art LCD technology with an embedded graphics controller to deliver full colour functionality to any project. Powerful graphics, text, image, animation and countless more features are built inside the module.



Ordering information

E-blocks 4D touch screen board	EB076
--------------------------------	-------

Downstream boards

LCD board

3.3V 5V
Flowcode macros available

The new graphical display board features a new low cost 128 x 160 pixel, 16-bit colour, 1.77 inch graphical TFT display. The display features a LED backlight with microcontroller based brightness control as well as compatibility with 3V3 and 5V E-block systems.



Ordering information

LCD board	EB084
Graphical display module only	EBM001

DSP output board

3.3V 5V
Flowcode macros available

The DSP output board features all the components required to allow high quality 16-bit audio from your microcontroller system. Featuring high quality potentiometers, an on-board speaker, fully adjustable gain and filters.



Ordering information

DSP output board	EB086
------------------	-------

Cap-touch board

3.3V 5V
Flowcode macros available

The cap-touch board allows easy investigation and implementation of cap touch technology. The board features five separate cap-touch pads to allow you to command up, down, left, right and center button presses.



Ordering information

Cap-touch board	EB088
-----------------	-------

NEW

DC Motor Speed Trainer E-block

3.3V 5V
Flowcode macros available

This board is designed to teach the basics of DC motor speed control. The board comes with a DC motor which is connected to an optical encoder to record how fast the motor is travelling. The digital signal from the encoder is fed into an IC on the E-block to convert the digital frequency into an analogue voltage which is proportional to the motor speed. This then makes it very easy to use advanced control techniques such as PID or fuzzy logic to control the motor speed.



Ordering information

DC Motor Speed Trainer E-block	EB096
--------------------------------	-------

DSP input board

3.3V 5V
Flowcode macros available

The DSP input board features all the components required to allow high quality 16-bit audio into your microcontroller system. Includes on-board microphone, fully adjustable gain and filters.



Ordering information

DSP input board	EB085
-----------------	-------

E-blocks LED array board

3.3V

The LED array board offers an array of 8 x 5 high brightness red LEDs which can be easily controlled to create visual animations, pointers and signs. The boards plug together in a way to allow large message boards to be created by cascading data through from one board to the next.



Ordering information

E-blocks LED array board	EB087
--------------------------	-------

DMOS Motor driver board

NEW

The motor driver board allows the user to connect and independently drive two motors in full bridge configuration with up to 5.6A output peak current. The board operates with both 3v and 5v logic systems and with motor power supplies from 8 to 30 volts.



Ordering information

DMOS Motor driver board	EB094
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DC Motor Servo Trainer E-block

3.3V 5V
Flowcode macros available

This board is designed to teach the basics of DC motor position control. The board comes with a DC motor which is connected to a 3-turn potentiometer to provide an analogue signal proportional to the angle of the motor shaft. This then makes it very easy to use advanced control techniques such as PID or fuzzy logic to control the motor position as can be seen in a standard servo motor.



Ordering information

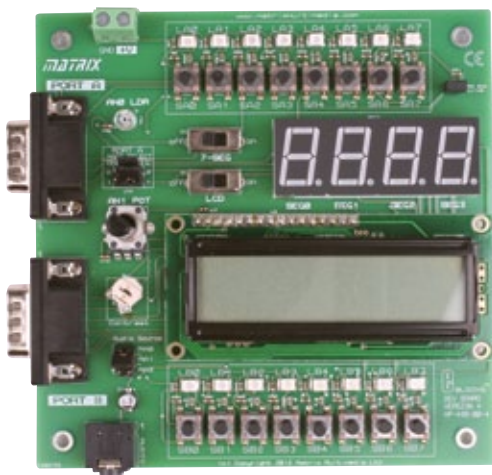
DC Motor Servo Trainer E-block	EB097
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Development boards

Development board

3.3V 5V
Flowcode macros available

The new E-blocks Development board works with any of our upstream boards to provide a physically compact development environment for your projects. The board plugs directly onto ports A and B and provides two banks of LEDs, two banks of switches, a 2 line 16 character LCD display, a light sensor, a potentiometer mimicking a sensor, a quad 7-segment display, and an audio output jack. An EB006 PICmicro Multiprogrammer and Development board replaces our older HP488 Development board but also gives full In Circuit Debug facilities when used with Flowcode.



Ordering information

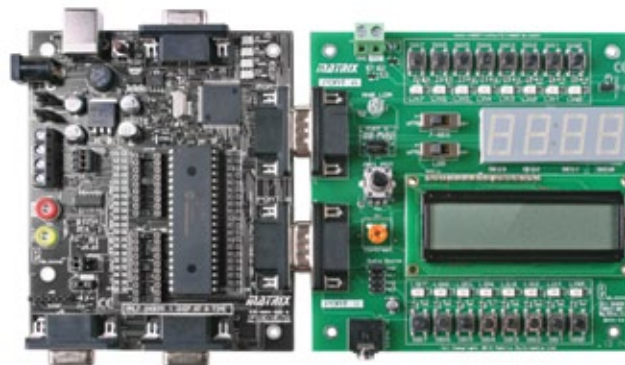
Development board

EB083

Development Board and EB006 Combo

3.3V 5V
Flowcode macros available

This pack consists of a EB006 PICmicro multiprogrammer and an EB083 Development board which together provide a low cost way of developing PIC projects and learning PIC programming. Descriptions of the EB006 and EB083 are available separately. Power supply and USB cable included.



Ordering information

Development Board and EB006 Combo

HP4832

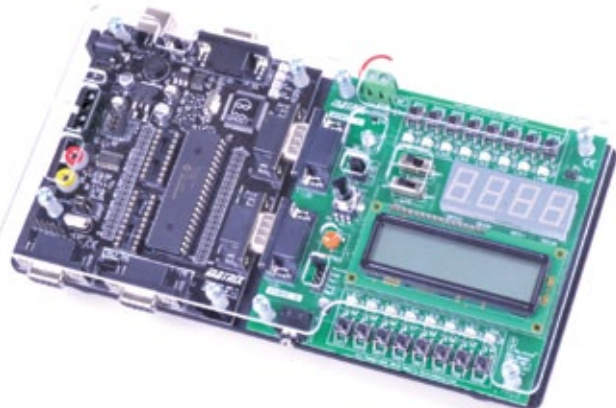
NEW

PICmicro development centre kit

3.3V 5V
Flowcode macros available

If you are looking for a protected and physically compact and rugged development environment for PICmicro projects then the HP7631 is ideal for you. The HP7631 Development Centre consists of a EB006 PICmicro Multiprogrammer (with 16F1937 40 pin device) and an EB083 Development board encased in a tough plastic enclosure. The plastic enclosure allows access to the switches and potentiometers needed for every day use but prevents users from interfering with key link settings or removing the PICmicro device. A power supply and USB cable are included.

This product is shipped in kit form and requires some light assembly. Posidrive screw driver and pliers needed.



Ordering information

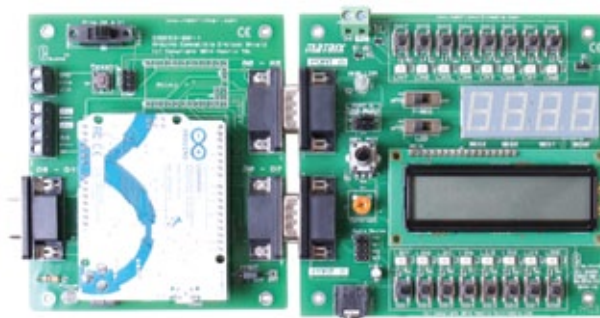
PICmicro development centre kit

HP7631

Arduino E-blocks shield and development board

3.3V 5V
Flowcode macros available

If you are an Arduino user and you are looking for a rugged and flexible way of turning an Arduino board into a rugged development platform then the HP7745 is the answer. The Arduino shield and Development board allow you to interface an Arduino Uno into the E-blocks system and also provide a rugged general purpose interface board for learning and development with switches, sensors, LEDs and displays. A power supply and USB cable are included. Arduino board not included.



Ordering information

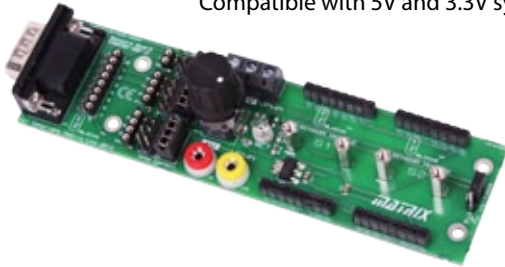
Development board and Arduino shield combo

HP7745

E-blocks sensors mother board

This new range of electronic sensors can be used to both learn how sensors work and can be incorporated into your projects. The solution is based on the EB090 sensor mother board. Each sensor simply connects into the mother board using simple 0.1" header connectors. The sensor boards can then be screwed down into the mother boards to prevent easy removal when used in open labs. The mother board also includes a light sensor and a general purpose potentiometer.

Compatible with 5V and 3.3V systems.



Ordering information

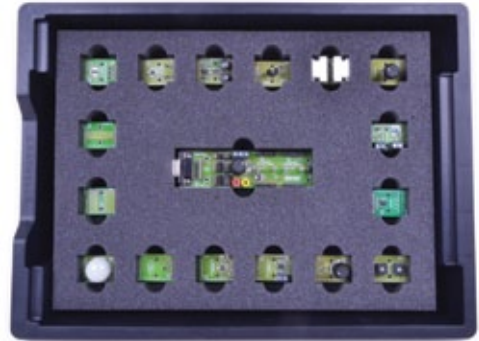
E-blocks sensors mother board

EB090

E-blocks Sensors Bundle

NEW

The E-blocks Sensors bundle includes our most popular sensor modules neatly packaged into one container making it ideal for a learning environment. It also comes complete with one EB090 sensors motherboard.



Ordering information

E-blocks Sensors Bundle

EBM1000

Potentiometer sensor board

This board consists of a standard shaft rotary potentiometer that provides a linear voltage output ranging between the microcontroller power rails. This can be connected to an Analogue to Digital input of the microcontroller in order to provide a control value.



Ordering information

Potentiometer

EBM002

Thermistor sensor board

This board includes a 10K NTC thermistor and two screw terminals allowing two external thermistor based temperature probes to be wired up to the board.



Ordering information

Thermistor

EBM003

Digital temperature sensor board

This board contains a LM75B Digital Temperature sensor that returns the temperature from an 11 bit ADC via an I2C two wire interface to the microcontroller. Temperature resolutions of 0.125°C can be achieved with an accuracy of up to $\pm 2^\circ\text{C}$.



Ordering information

Digital Temperature

EBM004

Dual trimmer sensor board

This board provides two screwdriver slotted pre-set rotary potentiometers. These output a linear voltage ranging between the microcontroller power rails, such that they can be connected to Analogue to Digital inputs of the microcontroller in order to provide, for example, calibration or other control values.



Ordering information

Dual Trimmer

EBM006

Rotary encoder sensor board

Provides a rotary encoder with dual digital outputs that provide rotation and direction information. When connected to two digital inputs of a microcontroller a "digital pot" can be implemented to convert to digital values.



Ordering information

Rotary Encoder

EBM007

Thermocouple sensor board

This board houses a 2 way screw terminal block for attaching a Type K Thermocouple. The output can be used with an Analogue to Digital converter and converted to temperature. It also has an on-board thermistor for ambient temperature compensation reading.



Ordering information

Thermocouple

EBM008

Gyroscope sensor board

This board contains an L3G4200D three axis digital gyroscope. Pitch, Roll and Yaw parameter values are read via an I2C interface.



Ordering information

Gyroscope	EBM009
-----------	--------

Hall effect sensor board

The board has a Hall Effect sensor that gives a digital output in the presence of a magnetic field (in the region of 60 Gauss) from a permanent magnet or electromagnet, either North or South pole.



Ordering information

Hall Effect	EBM011
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PIR sensor board

This Passive Infrared sensor gives a digital output and illuminates an on-board LED when a heat source movement is detected.

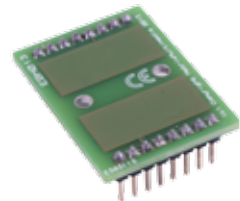


Ordering information

PIR	EBM012
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Touch pads sensor board

This board provides two touch areas for use with capacitive sensing. Hence two digital touch switches can be implemented.

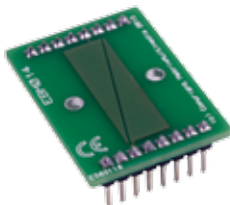


Ordering information

Touch Pads	EBM013
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Touch slider sensor board

This board provides a touch area for use with capacitive sensing. A sliding variable value can be determined from the relative touch position along the slider.



Ordering information

Touch Slider	EBM014
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Magnetometer sensor board

This board provides an LSM303DLHC sensor device which contains both a digital 3D accelerometer and a 3D magnetometer. All information is available via an I2C interface, such that a high performance e-compass with numerous applications can be implemented.



Ordering information

Magnetometer	EBM015
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Humidity sensor board

This board uses the SHT21 Humidity sensor and provides both digital relative humidity and temperature information via an I2C interface.



Ordering information

Humidity	EBM016
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Colour sensor board

The colour sensor provides a digital conversion of the colour of the incident light intensity in separate values for Red, Green and Blue light components. Reflected light can also be measured by using the on-board bright white light LED illuminators. A plastic housing is included to prevent white LED illuminators contaminating the colour sensor.



Ordering information

Colour Sensor	EBM018
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Ultrasonic distance sensor board

This board has a microcontroller controlled ultrasonic transmitter, driven by an on-board 40KHz oscillator and an amplifier-receiver. The receiver signal can be processed by a single channel ADC of the microprocessor to allow the measuring of distance from an object between 3cm and 3m.

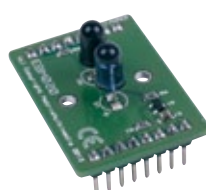


Ordering information

Ultrasonic Distance	EBM019
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Infrared distance sensor board

The Infrared distance sensor board contains both an IR transmitter and receiver. The transmitter is enabled via a control signal and the receiver provides an analogue output. By enabling the transmitter and reading the variable voltage output of the receiver it is possible to measure the distance of an object in the region of 1cm to 10cm.



Ordering information

Infrared	EBM020
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Vernier sensor socket

This sensor adaptor allows the superb range of lab sensors from Vernier (both analogue and digital) to be added to your development system.



Ordering information

Vernier sensor socket	EMB021
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E-blocks test pod

The loop through E-blocks test pod gives you a complete digital test bench in a small and affordable package. To help you debug your designs the test pod consists of two separate functions: a signal analyser and a signal generator. The signal analyser starts out as an easy-to-use Logic Analyser and Oscilloscope and adds serial bus decoding (including : I2C, SPI, USB, CAN, 1-Wire) that lets you solve your electronics problems quickly.

Features include:

- 8 channels
- 24Msps max sample rate
- Windows software
- USB powered
- Separate clock and trigger

Ordering information

E-blocks test pod	EB070
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ZigBee analyser

This wireless network analyser graphically displays wireless network traffic following the IEEE 802.15.4 specification on the 2.4GHz band. The analyser supports ZigBee, MiWi and MiWi PRP protocols. In conjunction with the hardware packet sniffer, the software can analyse complete network traffic and graphically display decoded packets. It can also display a graphical representation of the network topology and the messages as they flow through the network.

This information can then be saved and/or exported for further analysis. For developing with either ZigBee or the MiWi protocols, the ZigBee analyser is an essential development tool. Connects through USB.

The analyser is shipped in a rugged plastic case and can be mounted onto a standard E-blocks metal backplane.

Ordering information

ZigBee USB analyser	HP387
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Benchtop signal generator

The function generator is one of the most versatile pieces of test and measurement equipment available. It can generate a variety of precision waveshapes over a range of frequencies from mHz to MHz. It can provide a wide range of controlled amplitudes from a low-impedance source and maintain constant amplitude as the frequency is varied. The TG300 series represents the state-of-the-art in low-cost analogue function generators.

Ordering information

Benchtop signal generator pack	HP7894
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Free accessories with this pack: this pack also includes a pair of 4mm to croc clip leads, two 4mm stackable leads and a BNC male to dual 4mm binding post.



Multimeter

This high accuracy multimeter is classroom ready with a rubber holster to protect it. It has a large 3½ digit LCD display and test positions for both transistors and diodes. It measures AC and DC voltage, current and resistance.

Ordering information

Multimeter	LK1110
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5MHz PC oscilloscope/signal generator pack

This pack is based on a PicoScope 2203 dual-channel PC oscilloscope which has a bandwidth of 5MHz and samples at 40M samples per second - 8 bit. It has two input channels which are used as oscilloscope or spectrum analyser inputs and it includes an arbitrary waveform.

25MHz PC oscilloscope/signal generator pack

This pack is based on a PicoScope 2205 dual-channel PC Oscilloscope which has a bandwidth of 25MHz and samples at 40M samples per second - 8 bit. It has two input channels which are used as oscilloscope or spectrum analyser inputs and it includes an arbitrary waveform generator.

Ordering information

5MHz PC oscilloscope/signal generator pack	HP2577
25MHz PC oscilloscope/signal generator pack	HP8279
Free accessories with this pack: two scope probes, a BNC male to dual 4mm binding post, a pair of 4mm croc clip leads and a USB led.	



CAN analyser

This analyser provides a dual channel CAN bus interface through a standard USB interface. This analyser is capable of analysing traffic on two separate CAN busses simultaneously. The free software operates on all Windows platforms. This unit is supplied with a D-type to dual 4mm cable which makes it suitable for direct connection to MIAC units, or which can be modified for direct connection to a system's CAN bus.

Ordering information

CAN analyser	EL3498
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SCADA power supply

This high specification lab power supply integrates into Flowcode using a DLL to provide one part of a superb test or control rig that can be used as part of your projects. The 0-15V, 5A linear power supply with current limit is fully controllable from within Flowcode via the USB connection and a Flowcode component. Based on a TTI PL155-P.

Ordering information

SCADA power supply	HP4449
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SCADA function generator

This function/Arbitrary/pulse generator integrates into Flowcode using a DLL to provide one part of a superb test or control rig that can be used as part of your projects. The 50MHz generator is fully controllable from within Flowcode via the USB connection and a Flowcode component. Based on a TTI TG5011.

Ordering information

SCADA function generator	HP8445
--------------------------	--------

ZIF socket programmer adaptor

By putting this adaptor board on top of your EB006 PICmicro microcontroller programmer board you can create a fully functioning PIC programmer for 8, 14, 20, 28 and 40 pin PICmicro devices with easy to use ZIF (Zero Insertion Force) sockets. For a full list of devices supported please refer to the data sheet on the EB006 (available on our web site). Note that the pins of the chip are not connected to the D-type sockets on the EB006.

Ordering information

ZIF socket programmer adaptor

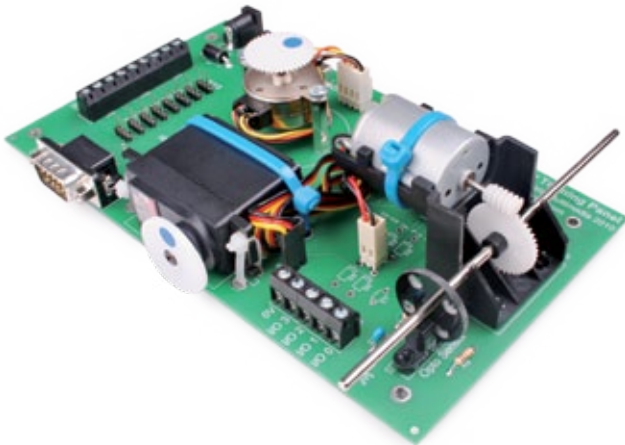
EB072



**EB006 not included.*

Actuators training panel

A general purpose training panel that allows students to carry out experiments with motors. The actuators on the panel include: a 7.5 degree/step stepper motor, a 120 degree servo motor and a bidirectional DC motor with gearbox and rotational feedback. Worksheets and operating instructions are included. An E-blocks compatible port facilitates connection with upstream boards.



Ordering information

Actuators training panel

HPACT

IDC cables

These cables can be used to connect E-blocks boards together.



Ordering information

Male - Male IDC connector	EB251
E-blocks cable Male - Male 500mm	EB251B
E-blocks IDC cable	EB634
E-blocks cable Male - Female 500mm	EB634B
Dual E-blocks IDC cable	EB635
Dual E-blocks IDC cable	EB635S

RFID cards

A Mifare card and an I-code card are available. Each includes 1k of memory and is compatible with the E-blocks RFID card board.



Ordering information

Mifare RFID card	HP089
I-code SLI card	HP459

USB lead

This is a standard USB lead shipped with some Matrix USB compatible products.



Ordering information

USB lead

HPUSB

Prototype board leads

This pack of 10 multi-strand leads allows you to design circuits using a prototype board.



Ordering information

Prototype board lead pack	FLLPCK
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USB high speed A to mini B

This lead connects a USB lead to the miniature USB plug as used on MIAC and ECIO ARM.



Ordering information

USB high speed A to mini B

HPUAB

Tray trolleys

Storage trays can be mounted into one of our tray trolleys.



Ordering information

12 tray trolley	HP2025Q
18 tray trolley	HP3025N

E-blocks accessories

PIC programmer with ZIF sockets

This PICmicro microcontroller programmer will program any 8, 14, 18, 28 and 40 pin PICmicro device from the 16 or 18 series of PICmicro devices. The unit has two ZIF sockets which accept 0.3" or 0.6" pitch pins. The unit is powered by USB and is housed in a rugged plastic case. A USB cable is included.

Ordering information

PICmicro microcontroller programmer with ZIF sockets	HP6339
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Metal backplane

This backplane can be used to bolt development tools and E-blocks together to form a rigid backplane. The usable area is 270 x 250mm and these backplanes fit our standard trays.



Ordering information

Metal backplane	BP232
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Storage trays

These trays are ideal for storage of E-blocks and accessories.



Ordering information

Plastic tray	HP2045
Clip on tray lid	HP4039
Foam layer insert	HP3844
4 section insert	HP2935

M3 nuts and bolts

E-blocks covers are not supplied with fittings. These are required for attaching covers.



Ordering information

100 x M3 anti-slip nuts	EB216
100 x M3 12mm bolts	EB217
100 x M3 25mm bolts	EB211
25 x M3 12mm spacers	EB210

Microcontroller devices

Chips for your project, compatible with E-blocks programmers.



Ordering information

PIC16F1827 chip	HP16F1827
PIC16F877A chip	HP16F877
PIC16F88 chip	HP16F88
PIC18F4455 chip	HP18F4455
PIC24FJ64GB002 chip	HP24FJ64GB002
dsPIC30F2014 chip	HP30F3014
dsPIC33FJ128GP802 chip	HP33FJ128GP802
PIC16F1937 chip	HP16F1937

Headphones

Headphones with microphone.



Ordering information

Headphones with microphone	HP347
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Adjustable power supply

This switched mode power supply can output seven easily selected voltages: 3V, 4.5V, 5V, 6V, 7.5V, 9V and 12V. Up to 1A of current can be supplied at all voltage settings. UK, European, US and Australian plug adaptors are included.



Ordering information

Power supply	HP2666
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E-blocks covers

These covers extend the life of your E-blocks boards. Boards are made 'student friendly' by protecting removable components.



Ordering information

Covers are available for most E-blocks. The product code is the same as the code of the board the cover is for, with a '7' replacing the first '0' in the code. For example, the code for the EB003 sensor board cover is an EB703. See the Matrix website for a complete list of available covers.

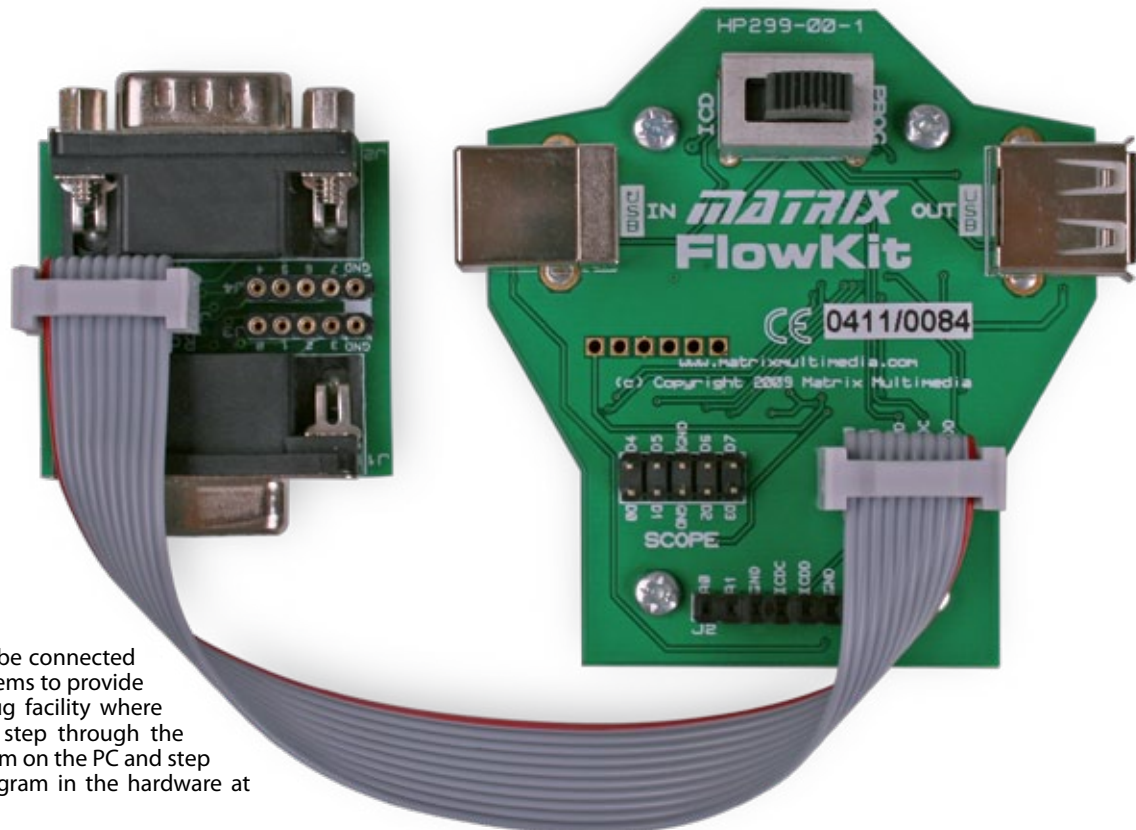
Plastic mounting pillars

Temporary mounting pillars to attach E-blocks to a backplane.



Ordering information

Plastic mounting pillars x 25	HP6219
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The FlowKit can be connected to hardware systems to provide a real time debug facility where it is possible to step through the Flowcode program on the PC and step through the program in the hardware at the same time.

This function is available with Flowcode 4.2 or later.

Benefits

- A fast way to solve programming problems
- Seamless program and debug

Features

- Compatible with a variety of hardware systems including E-blocks
- Compatible with ECIO, MIAC and Formula Flowcode systems via the USB lead
- Allows start, step and play of programs
- Allows users to see and alter variable values

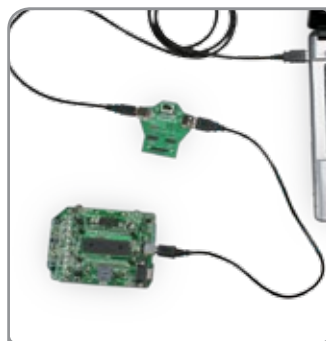
Whilst Flowcode simulation allows debug of a system to a first pass, FlowKit takes debug to a new level by running the program in the hardware and on the screen at the same time. The system is controlled from within the Flowcode environment where controls allow users to start, stop, pause and step through their program one icon at a time. Under user control the Flowcode software shows the location of the program in the flow chart, the value of all variables in the program and allows users to alter the variable values when the program is paused.

Ordering information

FlowKit In-Circuit Test board	HP299
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Using FlowKit with MIAC



Using FlowKit with Formula Flowcode



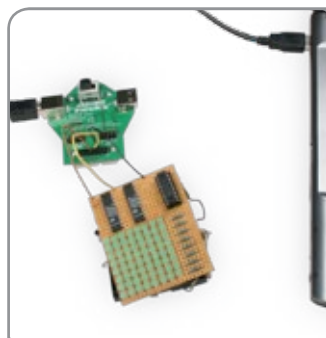
Using FlowKit with ECIO



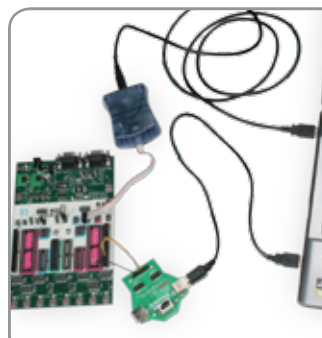
Using FlowKit with AVR E-blocks



Using FlowKit via a PICkit 2 interface



Using FlowKit with a project



Using FlowKit with Atmel STK500



The complete FlowKit package

USB prototype board

The Project board has been created to allow students to take designs from schematic concept to realisation very quickly. It achieves this through a small section of breadboard which allows students to create simple electronic circuits. This breadboard is simple to interface with the microcontroller through two SIL connectors providing access to all ports of the device. Breadboard also allows flexibility at a design stage with students easily able to modify designs until they have a working system. The system is powered and programmed via USB - cable not included.



Ordering information

USB prototype board	HP4829
USB prototype board x 20	HP4820
Component kit only for SE3829-2	HP4800
USB lead	HPUSB

USB project board

The project board includes a USB programmable 18 pin microcontroller and a ULN2803 power output chip which give students a rugged miniature input output board that can be embedded in a wide variety of projects that include motors, lamps and solenoids. The system can be powered from the USB lead (not included) or from batteries. The chip is based on open source Microchip code.



Ordering information

USB project board	HP1110
USB project board x 20	HP9954
USB lead	HPUSB

Cased MIAC

The Cased MIAC with 4mm shrouded sockets is internally connected to all of the input outputs of the MIAC (except CAN bus terminations). This allows rapid development of circuits based on the MIAC up to mains voltages. Power supply and USB lead included.



Ordering information

Cased MIAC	MI0245
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MIAC components with 4mm leads

This range of add-on components are fitted with 4mm connectors which plug into the MIAC to allow fast development of simple control systems



Ordering information

Motor with 4mm leadset	SE3945
Push to make switch with 4mm leadset	SE 2995
Light sensor with 4mm leadset	SE7045
MES bulb holder with 4mm leadset	SE3400
4mm to 4mm lead, black	LK5604
4mm to 4mm lead, red	LK5603
4mm to 4mm lead, blue	LK5609
4mm to 4mm lead, yellow	LK5607

Formula Flowcode

The Formula Flowcode maze solving robot vehicle can be used for a wide range of learning activities for students aged 12+.

This robot vehicle has been designed to address the requirements of the technology education curriculum between the ages of 12 to 16. It is also used up to university level for motivation, learning and project work. The robot is great for running competitions and for open days where you can motivate students to want to learn more about electronics and technology in just a few hours.

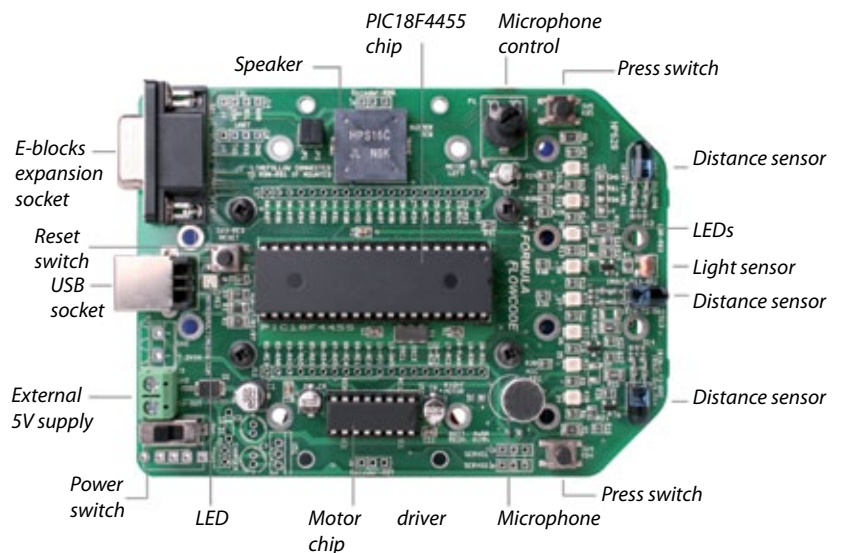
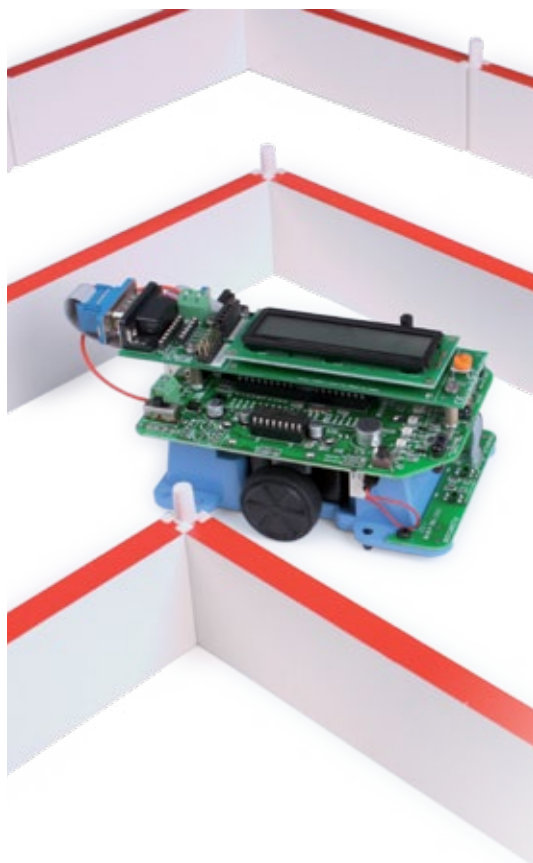
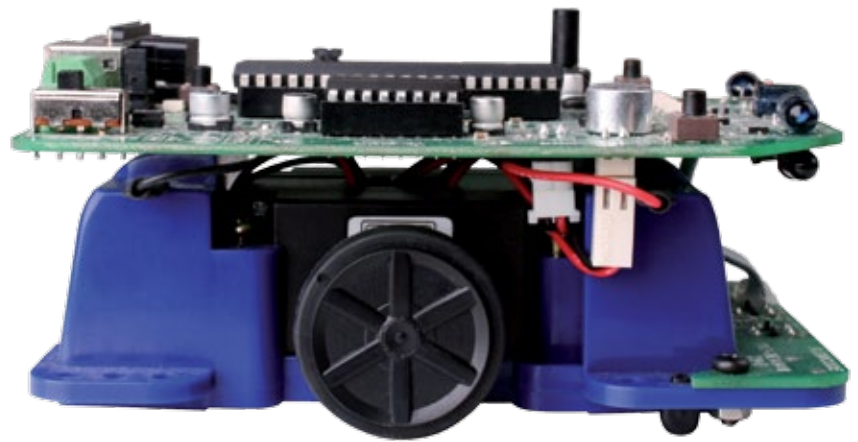
- A low cost, all-inclusive solution for technology students
- Great for motivating students to learn more
- Works with the free version of Flowcode
- Superb technical specification
- E-blocks compatible
- Micromouse competition compatible

Hardware

The robot vehicle is based on a plastic moulded chassis with two wheels, gearboxes and motors and is powered by AA batteries. The circuit board connects directly to a PC using the USB port and provides a high specification PIC18F4455 controller with many features including 2 user switches, 8 LEDs, sound level sensor, light sensor, buzzer, motor controller (including Pulse Width Modulation), line follower sensors and distance sensors.

Software

The robot is supplied with a full simulation model inside the Flowcode 3D panel. This allows students to develop and test a program before downloading it to the robot buggy. The Formula Flowcode robot can also be programmed with C and Assembly.



Line following circuit board

Plastic chassis with battery compartment, motors with gear boxes and 2 wheels

Formula Flowcode

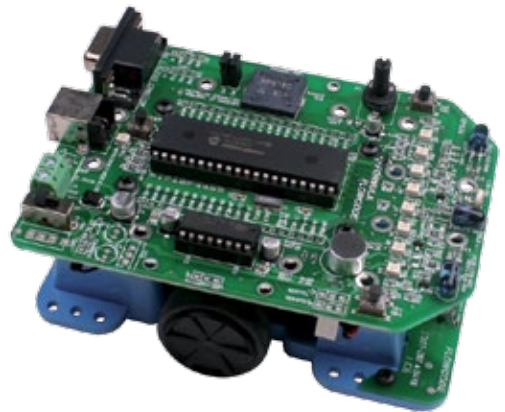
Formula Flowcode buggy

The two wheel Formula Flowcode buggy is powered from conventional or rechargeable batteries. Students develop the program, simulate its functionality on-screen and then download the program to the buggy via USB. The buggy uses an advanced PICmicro 18 series microcontroller with internal precision motor controller circuitry. It has 3 infrared distance sensors, line following sensors, a buzzer, audio level sensor, light sensor, two spare switch inputs, 8 user programmable LEDs and various expansion busses - including an E-blocks port. The buggy can be expanded with a range of additional boards including graphical LCD displays and Bluetooth. Flowcode is not included.

Ordering information

Formula Flowcode buggy

HP794



Formula Flowcode starter class bundle

Includes 5 Formula Flowcode kits, one set of maze walls, and a storage tray. This is sufficient for 10 students working in pairs. Flowcode is not included.

Ordering information

Formula Flowcode starter class bundle

HP926



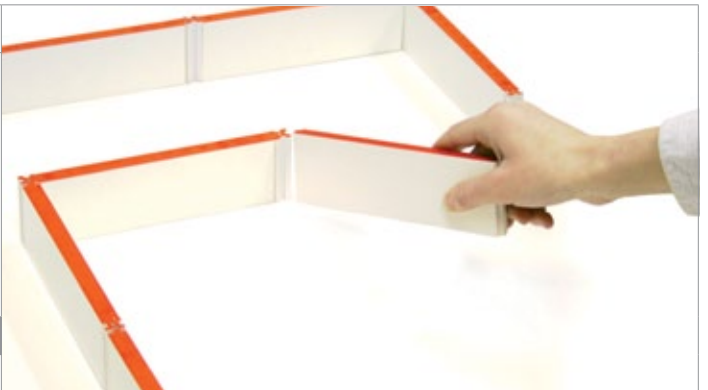
Maze walls

These walls and posts are designed to allow you to create a maze of your own. Each wall measures 168 x 12 x 50mm. 30 walls and posts are included in the pack which allows you to make a 5 x 5 cell maze.

Ordering information

Maze walls

HP458



Formula Flowcode pro class bundle

Includes 10 Formula Flowcode chassis kits, 1 set of maze walls, Academic 50 user licence of Flowcode V6 software, 5 LCD displays, 5 IDC cables and two storage trays. Sufficient for 20 students working in pairs. Compatible with all challenges.

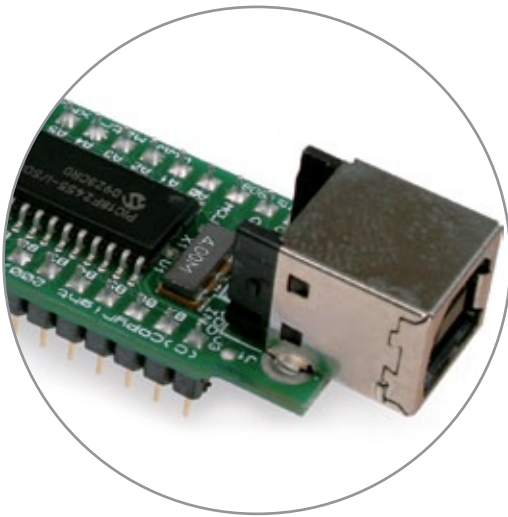
Ordering information

Formula Flowcode pro class bundle

HP600



ECIO single board computers



ECIO single board computers provide one of the fastest and lowest cost ways of embedding advanced intelligence and control into your project.

- 28 and 40 pin 0.6" footprint, professional capability.
- Adds USB reprogrammability to your own circuit boards.
- Programmable from USB, power from USB.
- Compatible with Flowcode, C, Assembly, LabView and Visual Basic.

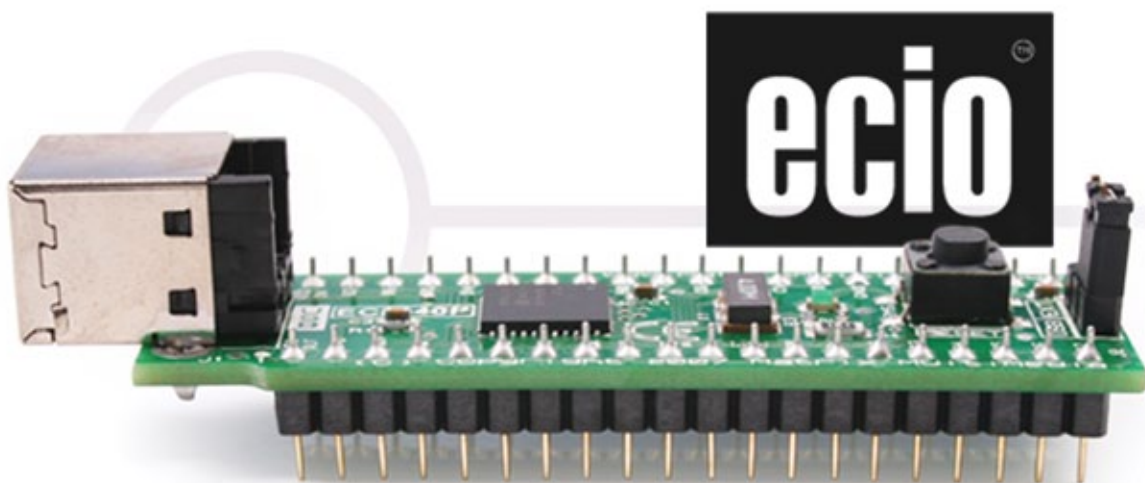
ECIO

ECIO hardware provides a low cost and simple way to move your projects to a finished state by allowing you to commit the ECIO into a static design. The ECIO boards all feature a direct USB connection to the microcontroller allowing for very easy USB communications and power. ECIO combined with Flowcode should all work great out of the box without having to worry about complicated road blocks such as configurations and oscillator circuits. They also provide one of the fastest and lowest cost ways of embedding advanced intelligence and control into your project.

ECIOs are used by hobbyists, students and engineers to develop projects based on microcontroller technology and are particularly

useful when in-field reprogrammability or USB features are required. The ECIO family of USB programmable single board computers provides an incredibly simple way of adopting microcontroller technology into your projects. ECIO devices include a microcontroller with clock, power and programming circuitry on a standard 0.6" DIL header. When you plug the USB lead in to an ECIO you can reprogram the device or use the USB interface for communications with a PC.

Currently there are three ECIO devices based on PIC and dsPIC microcontrollers. ECIO devices are compatible with hex code from a number of compilers including Flowcode, BASIC, C and assembler.



ECIO single board computers

The ECIO family of USB programmable microcontroller modules behave just like a normal microcontroller - but when you plug the USB lead in and press the reset switch you can send a new program to the device. This, along with the low cost, makes ECIO ideal for student work at home and for incorporating into student circuit boards. ECIO microcontrollers are pre-programmed with a bootloader program which allows you to send a new program to the

microcontroller via USB. ECIO is compatible with hex code from any appropriate compiler including Flowcode, C compilers and MPLAB.

Flowcode programs and Windows drivers are available for ECIO devices making them suitable for use with LabView, Visual Basic, C++ etc.

28 pin PIC 18 ECIO

Base chip	PIC18F2455
Oscillator	4MHz ext, 48MHz internal
I/O lines	19
A/D	10 x 10 bit
A/D sample rate	100ksps
Program memory	24K bytes
RAM	2K bytes
EEPROM	256 bytes
Power	5V, USB or external
PWM channels	2
Timers	1 x 8 bit, 3 x 16 bit
Interfaces	EUSART, I ² C, SPI, USB2.0
Package	28 pin, 0.6", DIP compatible



ECIO28P

40 pin PIC 18 ECIO

Base chip	PIC18F2455
Oscillator	4MHz ext, 48MHz internal
I/O lines	30
A/D	13 x 10 bit
A/D sample rate	100ksps
Program memory	24K bytes
RAM	2K bytes
EEPROM	256 bytes
Power	5V, USB or external
PWM channels	5
Timers	1 x 8 bit, 3 x 16 bit
Interfaces	EUSART, I ² C, SPI, USB2.0
Package	40 pin, 0.6", DIP compatible



ECIO40P

40 pin dsPIC ECIO

Base chip	dsPIC33EP256MU806
Oscillator	8MHz ext., 70MHz internal
I/O lines	34
A/D	20 x 12 bit
A/D sample rate	1.1 Msps
Program memory	256K bytes
RAM	28K bytes
EEPROM	0 (internal ROM overwrite)
Power	5V, USB or external
PWM channels	16
Timers	9 x 16 bit
Interfaces	4 x UART, 2 x I ² C, 4 x SPI, 2 x CAN, USB2.0
Package	40 pin DIP, 0.6" compatible

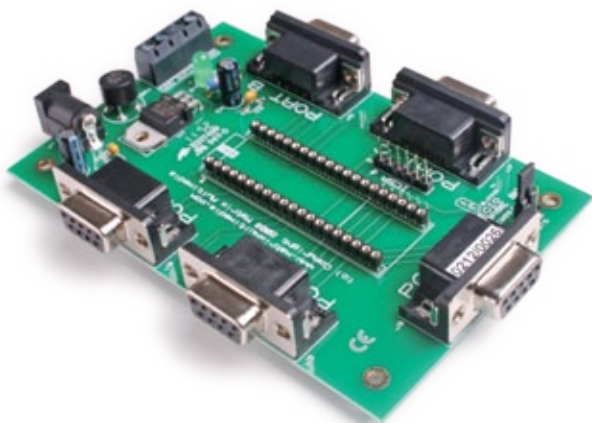


ECIO40P16

E-blocks application board

The ECIO application board adds E-blocks compatibility to the ECIO 28 and 40 pin devices. The application board provides up to 5 E-blocks ports which allow you to attach a wide range of E-blocks boards- from simple LED and switch boards through to Bluetooth, IrDA and Internet communications boards.

Use ECIO modules with a prototype board (HPAD01), with the E-blocks application board (EB061) or build it into your own circuit. A free set of 10 basic worksheets are available on our website which can be used with the Student ECIO starter kit (EC2961).



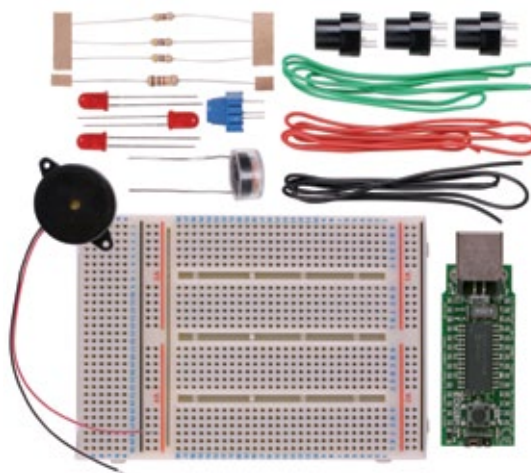
Ordering information

E-blocks application board

EB061

Student ECIO starter kit

This kit is designed for students and hobbyists who want to start learning microcontroller circuit development at home. The kit is supplied with a high quality HPAD01 prototype board, a 28 PIN PICmicro microcontroller ECIO device (ECIO28P), 1.5 metres of single core prototype wire (red, black and green) and 13 electronic components which allow a wide range of experiments to be conducted. A suite of worksheets which includes build and software development instructions for 10 analogue and digital experiments are available from our website.



Ordering information

Student ECIO starter kit

EC2961

Workstations

The Electronic Workstation meets all your power and instrumentation needs for electronics education and prototyping in one self-contained, easily portable unit.

The Electronic Workstation is a multifunction electronics workbench for electronics engineers. It combines a number of instruments that make the development and learning of electronic systems easier.

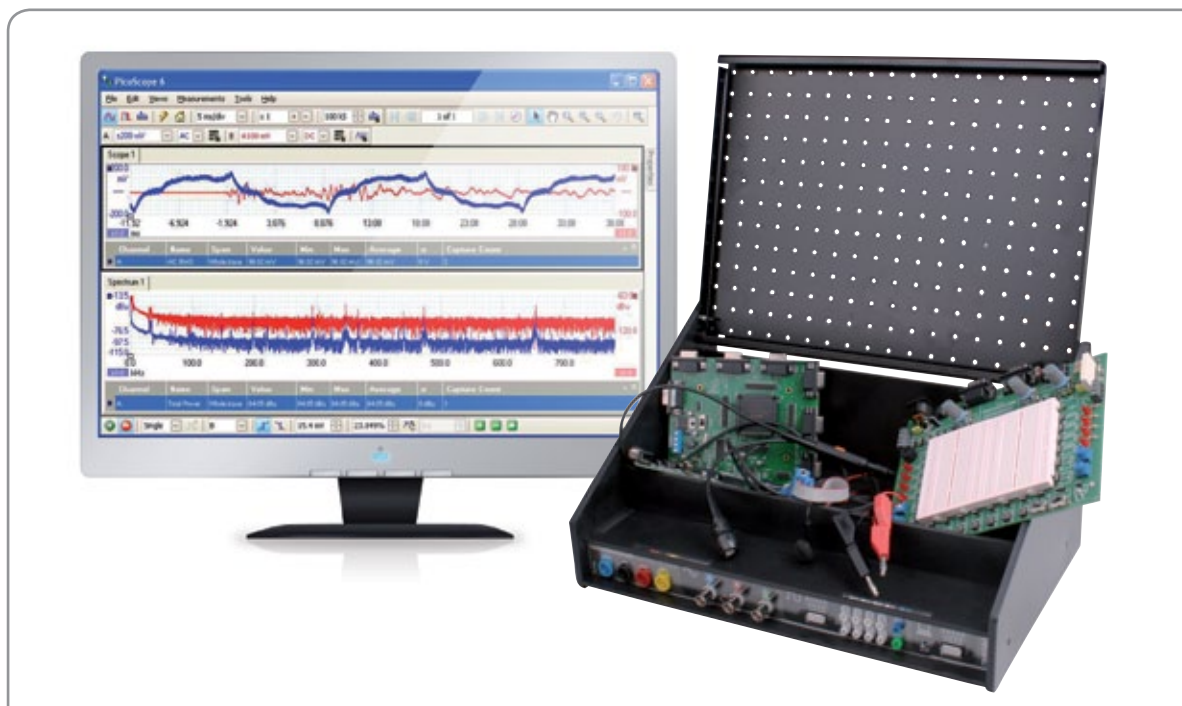
The Electronic Workstation consists of a number of virtual instruments housed in a rigid plastic case. The front panel of the Electronic Workstation has 2 analogue oscilloscope inputs, a signal generator output, 8 channel logic analyser / digital signal generator connectors, 8 channel PC interface connectors which supports use with LabView, Visual Basic, C etc. and power supply outputs. The angled top of the unit is fabricated from strong anodised black aluminium with a grid of holes that make it suitable for use with E-blocks. This lifts up to reveal a storage area for leads and accessories. The oscilloscope inputs and signal generator output are presented on standard 50ohm BNC connectors. The range of leads supplied with the Electronic Workstation includes: 1 x USB leads, 2 x 9-way D-type leads, 2 x 50ohm scope probes, 10 x 2mm micro gripper analyser probes and 25 x backplane mounting pillars and red and black 4mm 'banana' leads.

A compact version of the Electronic Workstation is available, which folds down flat and comes in a kit containing the leads and accessories (see the following page for more information).



Features

Power supply	
+12V (2A) / -12V (0.8A) .5V(5A)	Yes
Digital multimeter	Yes
2 channel oscilloscope	
Bandwidth	25MHz
One channel sampling rate	40MHz
Scope resolution	8 bit
Signal generator	Variable
External trigger	-
Arbitrary waveform generator	Yes
Spectrum analyser	
Bandwidth	25MHz
Logic analyser	
Channels	8
Sample rate	24MHz
Digital signal generator	Yes
Bus decoder	Yes
PC interface	
Channels	8



Workstations



Electronic Workstation - desktop

The angled top of the Electronic Workstation desktop version lifts up to reveal a storage area for leads and accessories. See the previous page for a list of the leads and accessories included with this product.

Ordering information

Electronic Workstation EU	HP886EU
Electronic Workstation UK	HP886UK
Electronic Workstation USA	HP886USA



Protostation

Protostation is the perfect complement to the Electronic Workstation. Together they form a complete electronics prototyping and analysis system that needs less desk space than an open textbook. Protostation can also be used on its own for the convenience of its integral signal sources and output devices.

- Large prototyping area
- Build circuits with no soldering or tools required
- Easy access to controls and transducers
- Make your prototypes more portable
- Free your work space from clutter

The Protostation features 0.1" pitch sockets which take standard IC packages. It also contains 2 E-blocks ports, a versatile range of supply voltages, a signal generator and the following inputs and outputs:

- Inputs: Switches, potentiometers, phototransistors, thermistors, voltage source
- Outputs: LEDs, buzzer, relay

Protostation fixes to the backplane of the Electronic Workstation creating a compact, portable and extremely sturdy prototyping system.

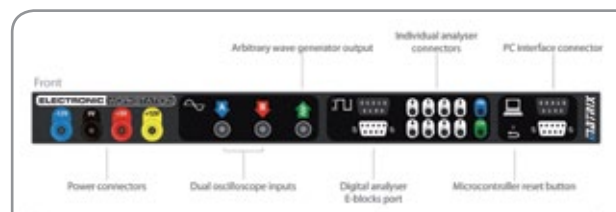
Ordering information

Protostation	HP512
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Electronic Workstation - compact

The compact version of the Electronic Workstation is housed in a plastic case with a folding backplane that can be angled at 45° or left flat.



Ordering information

Electronic Workstation with case EU	HP834EU
Electronic Workstation with case UK	HP834UK
Electronic Workstation with case USA	HP834USA



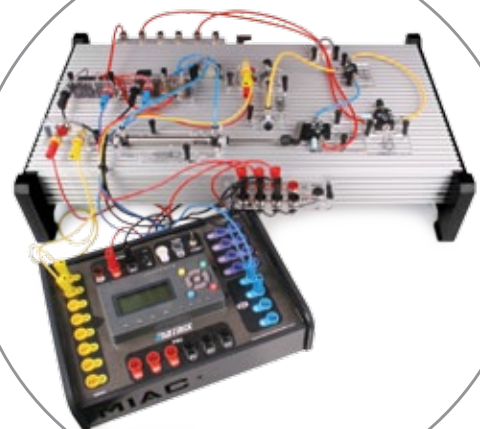
MIAC modules provide learners and developers with a flexible suite of rugged, high power, electronics blocks which quickly connect together to form a wide variety of control and data-logging systems.

The MIAC is a general purpose controller based on PICmicro technology which is suitable for use in many areas of technical education including mechanical engineering, automotive engineering, computer science, electronics and technology. Its electrically and mechanically rugged design makes it the ideal interface for educational projects.

Each MIAC module contains a block of electronics which you would typically find in an industrial electronic control or data acquisition system.

The system is programmed using Flowcode software. Flowcode is a graphical programming environment based on flowcharts.

MIAC is compatible with a vast range of industrial sensors and add-ons that sit on 25mm 'top hat' DIN rails.

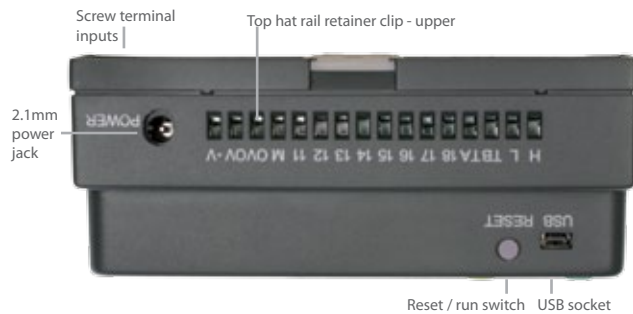




MIAC (Matrix Industrial Automotive Controller) is an industrial grade control unit which can be used to control a wide range of different electronics systems.

The MIAC is a fully specified industrial electronic controller designed to operate off typical industrial control voltages: 0 - 10V inputs, 24V motor outputs, 240V switching relays. MIAC has 8 analogue or digital inputs, 4 high current relay outputs and 4 transistor outputs. The MIAC is housed in an attractive, rugged, anthracite grey plastic moulding. It has two physical mounting options: it can be mounted onto a 35mm 'top hat' DIN rail, or it can be mounted directly onto any surface using the 4 screw holes provided.

Top hat rail mounting — recess



The MIAC unit has screw terminal connector inputs across the top and bottom of the unit. It has several input buttons for user control and a 4 line 16 character alphanumeric display.

The unit is programmed directly from a PC's USB port and is compatible with the Flowcode graphical programming language. Users can develop a program using Flowcode, press the reset button on the back of the unit, and the program will automatically download and start. The MIAC can also be programmed in C and Assembly code, or any program that is compatible with PICmicro microcontrollers.

MIAC is equipped with a fully operational CAN bus interface so that many MIACs can be networked together to form wide area electronic systems.

A DLL and sample programs are provided to enable MIAC to be used with PC based control programs like LabView, Visual Basic, C++ etc.

Features

- Programmable from USB
- 8 digital or analogue inputs
- 4 relay outputs, 4 transistor outputs with PWM
- Compatible with LabView, Visual Basic and C compilers

Benefits

- Flexible and expandable
- Easy to program with flowcharts, C or assembly code
- Physically and electrically rugged



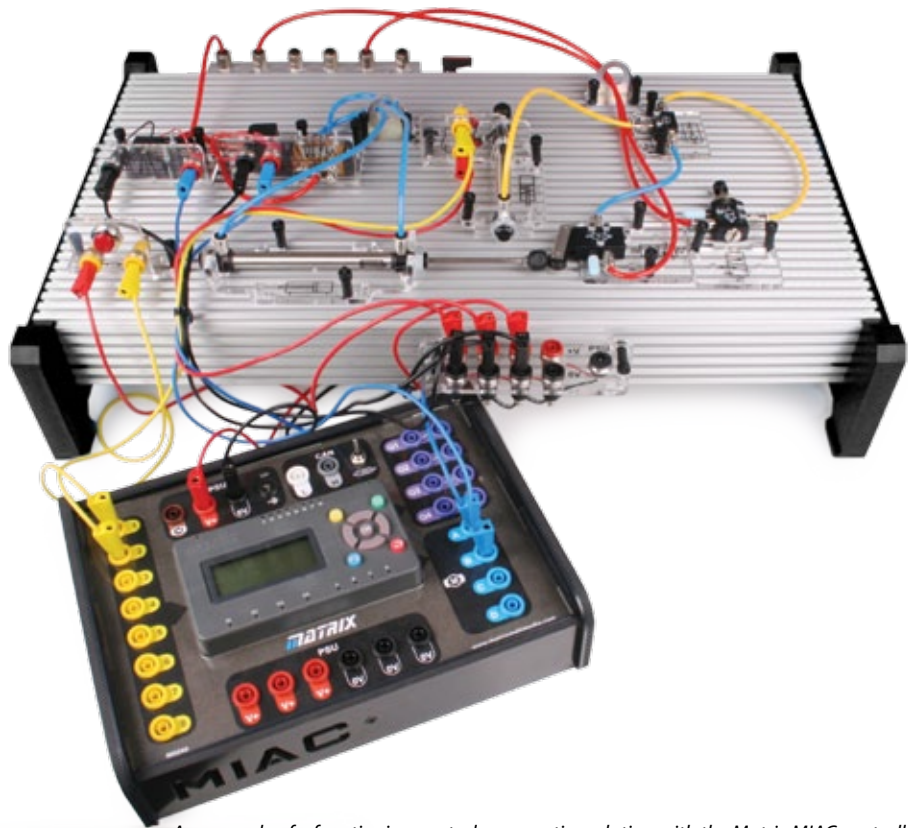
Ordering information	
MIAC controller	MI0235
Cased MIAC with 4mm shrouded sockets	MI0245
Power supply	HP2666
MIAC, Flowcode 6 and FlowKit bundle	HP2035
USB high speed A to mini B lead	HPUAB
3 MIAC units with Flowcode 6 pro	MI6100

AUTOMATICS

Simplifying pneumatics

Contents

What is Automatics?	107
Why choose Automatics?	108
Curriculum	109
Component guide	110 - 111



An example of a functioning control pneumatics solution with the Matrix MIAC controller

What is Automatics?

Simplifying pneumatics and automation

Automatics is a range of products that simplifies the process of teaching and learning about pneumatics and automation systems.

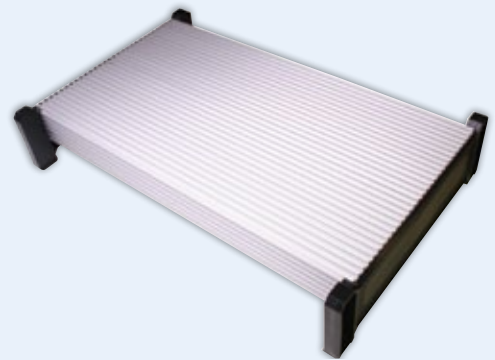
The Automatics range consists of separate rugged components that mount onto a stable aluminium platform. Components are clearly marked with the appropriate pneumatic or electrical symbol. Students take the rugged components, mount them to the platform using plastic 'tee' bolts and connect the components together with nylon tubing to build working pneumatic circuits.

They then use the curriculum provided to carry out experiments in pneumatic and electronic control.

Disciplines include:

- Pneumatics
- Automation
- Design technology

The Automatics range includes:

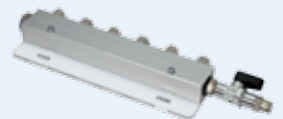


A rugged aluminium platform

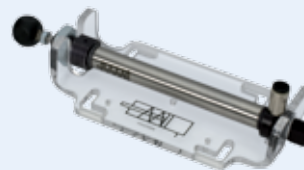
To which students add...



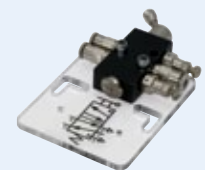
A compressor



A manifold



Cylinders



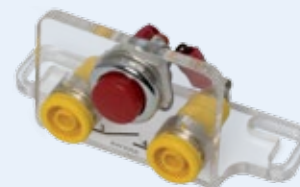
Mechanical valves



Electrical valves



Connectors



Switches and sensors



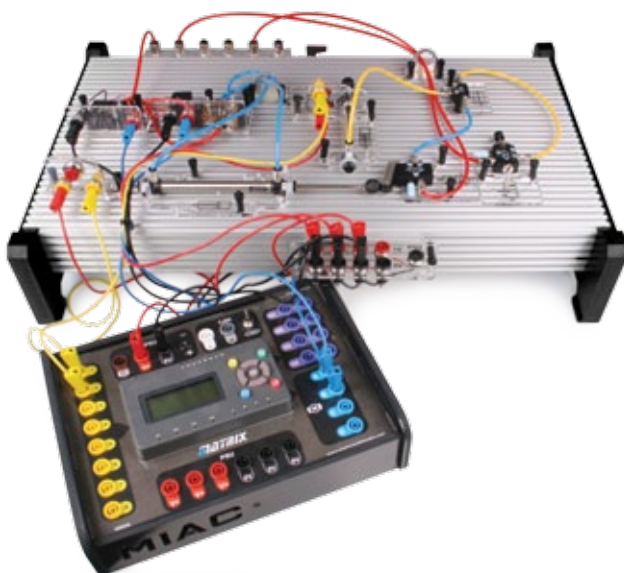
A controller



Pneumatic tubing



Electrical cables



Why choose Automatics?

Automatics platform

The extruded aluminium platform provides a solid foundation to which the other components are fixed. It is large enough to provide a comfortable work area for the largest of the circuits in our curriculum worksheets.

Reliability and robustness

Automatics has been designed from the ground up to suit the classroom environment. The pneumatic components are identical to those used by real engineers, but we have cleverly adapted them so that students can construct automation systems speedily and without requiring any tools.

Simple to connect

The compressed air supply is distributed using plastic tubing that is easily cut to length. This simply pushes into the component connectors. To release the tube, simply depress the connector collar and pull out the tube.

Carriers and symbols

Each component is secured to a clear acrylic carrier. The carrier is printed with a product code for easy identification and the industry standard symbol for the part. Slots in the carrier allow for easy positioning in any orientation on the platform.

Tee-bolt fixings

Components are attached to the slots on the sturdy aluminium platform using plastic tee-bolts. These are easily secured and released without requiring any tools, allowing components to be quickly positioned and held firmly in place.

4mm connectors

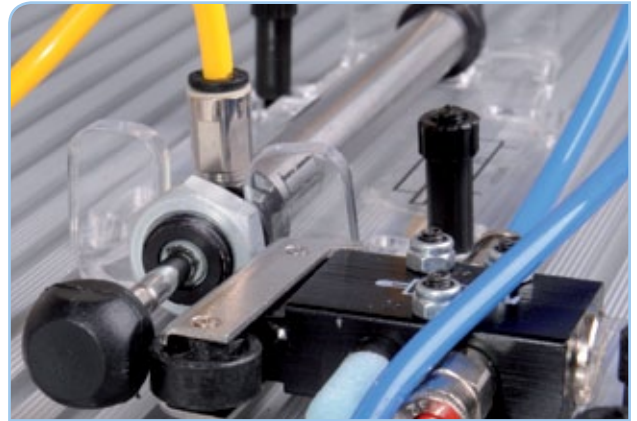
For components which require electrical connections, we have used standard 4mm single pole connectors which are suitable for 'safety' shrouded plugs. Suitable leads are provided when you purchase any kit of components.

Full curriculum support and courseware

Our Automatics courseware CD ROM contains a complete student centered interactive course on pneumatic system design. High quality worksheets are supplied in electronic format on CD ROM with each kit. Worksheets are all free of charge and contain clear well written instructions for each experiment. Teachers can hand students a full manual, or can print just the worksheets required.

Software and control system support

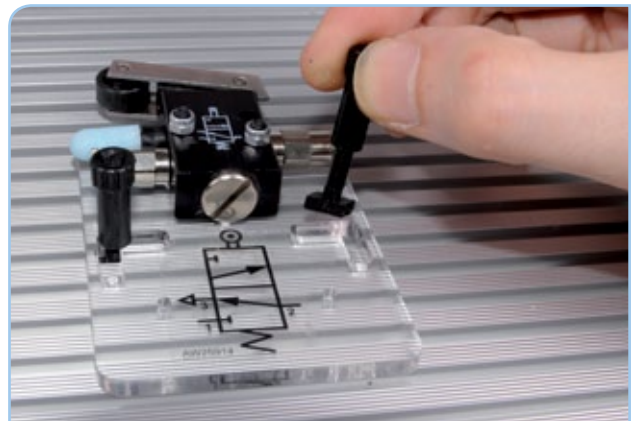
Students learn to design control pneumatics systems using Matrix's Flowcode software which is based on flow charts. Control systems are based on our MIAC controller which is designed with education in mind.



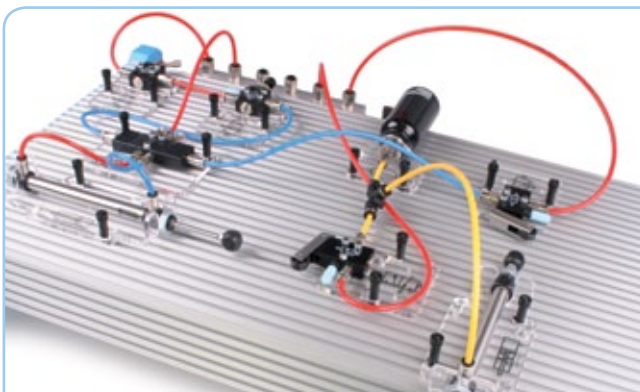
All pneumatic fittings are quick release



Circuit symbol clearly printed on each carrier



Quick release tee-bolts



A typical Automatics project



Standard 4mm cables used for all electrical connections

Automatics curriculum

Automatics is more than just a range of hardware - it also offers a suite of learning resources that assist both students and educators to maximise the educational value of the equipment.

The curriculum CD

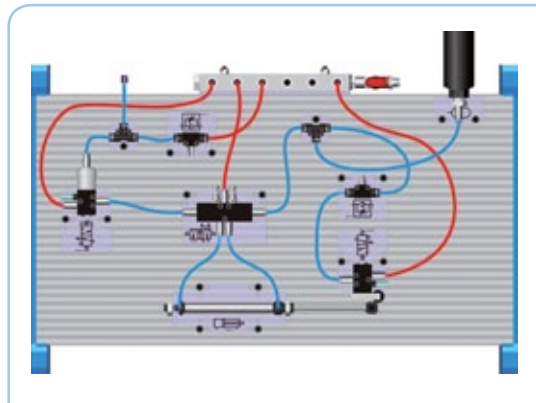


Our curriculum CD-ROM includes a set of .pdf workbooks that provide lesson plans, student worksheets and teacher's notes for a variety of courses that can be used individually or as a coherent series.

Each workbook is professionally written by experienced teachers who have used the Automatics hardware in a real learning environment.

Ordering information	
Automatics essentials	AW2080
Electro-pneumatics	AW2079
Control pneumatics	AW4956
Control pneumatics plus	AW4957

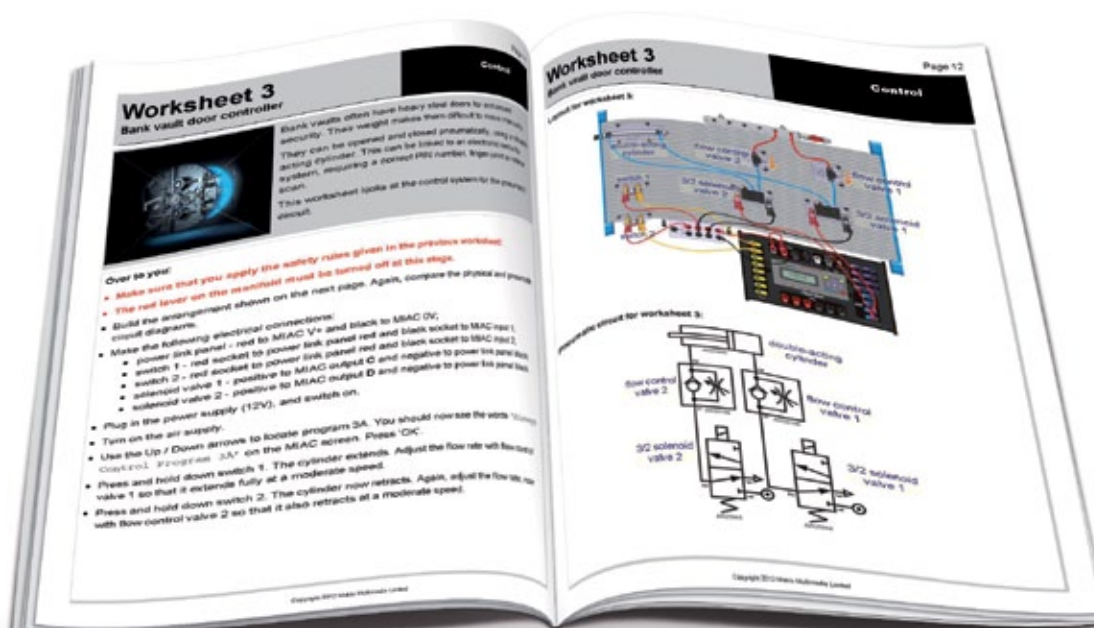
Students are guided through each subject in a logical sequence with clear, concise learning objectives at each stage, complete with quizzes and short tests by which their progress can be assessed.



For each curriculum objective, there is a worksheet designed to be printed and handed out to students, with areas set aside for them to enter the results and conclusions of their experiments.

Throughout each worksheet, pictures and diagrams of the Automatics hardware are used to make setting up the experiments easy. Examples from real world applications help students to understand the context of what they are learning, helped by our use of internationally recognised symbols for all of the components.

For up to date curriculum, please visit our website:
www.matrixtsl.com/automatics/resources



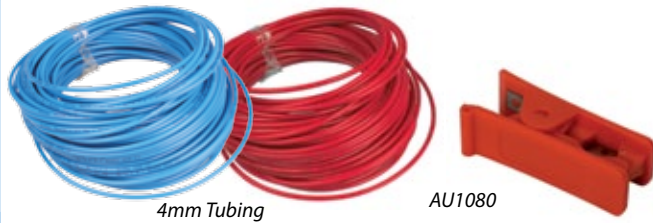
Automatics component guide



Cylinders

Cylinders provide the motive power of your pneumatic circuit. Single acting cylinders use a spring to return the piston to its rest position. All cylinders are a standard 10 mm diameter, the second figure represents the range of motion of the piston.

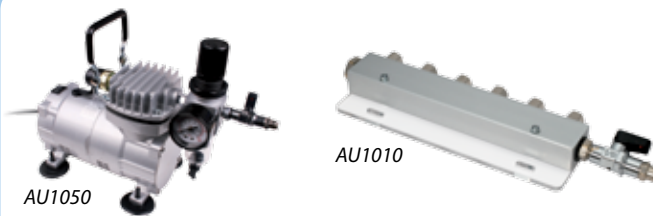
Description	Part number
Cylinder, single acting, 10 × 40 mm	AU2140
Cylinder, double acting, 10 × 80 mm	AU2280



Tubing & connectors

Tubing is available in several colours, in bulk reels which are easily trimmed to length using the custom cutting tool. The connectors allow you to join lengths of tubing and create junctions.

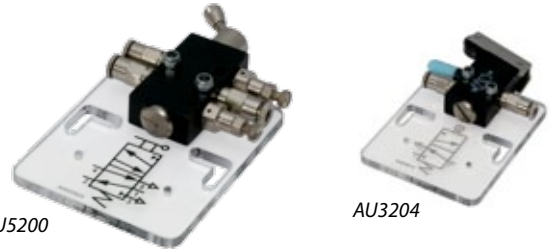
Description	Part number
Tubing, 4mm, blue, 30 m length	AU1072
Tubing, 4mm, yellow, 30 m length	AU1071
Tubing, 4mm, clear, 30 m length	AU1073
Tubing, 4mm, red, 30 m length	AU1070
Tube cutting tool	AU1080
Junction, equal tee	AU1030



Essentials

These are the basic components needed to supply pressurised air to your pneumatic circuits - and a sturdy physical platform to anchor everything in place.

Description	Part number
Compressor	AU1050
Manifold	AU1010
Platform	AU1040
Tee-bolts and sleeves (pack of 50)	AU1060



Valves - mechanical

These valves are operated mechanically by buttons, levers, rollers or air pressure. 3/2 valves control the flow from the source to a single destination. 5/2 valves allow the source to be switched between two destinations.

Description	Part number
Valve, flow control	AU3022
Valve, mini shuttle	AU3203
Valve, 3/2, button-spring	AU3200
Valve, 3/2, roller-spring	AU3204
Valve, 3/2, lever-spring	AU3202
Valve, 3/2, diaphragm-spring	AU3201
Valve, 5/2, lever-spring	AU5200
Valve, 5/2, pilot-pilot	AU5201



Valves - electrical

These valves are operated by solenoids for control by discrete electrical circuits, or by the MIAC microcontroller unit.

Description	Part number
Valve, 3/2 solenoid-spring	AU6010
Valve, 5/2, double-solenoid	AU6015



Reservoir

Create time delays in your pneumatic circuits by allowing pressure to gradually build up inside the reservoir.

Description	Part number
Reservoir 45cc	AU1020

Automatics component guide



AU8030



AU8020

Electrical

Everything you need to integrate electrical and electronic control into your pneumatic systems.

Description	Part number
Reed switch and holder	AU8025
Switch, push to make	AU8030
Microswitch	AU8015
Light sensor	AU8010
Power supply	HP2666
Power panel	AU8020
Lead, 4mm to 4mm, red	LK5603
Lead, 4mm to 4mm, black	LK5604
Lead, 4mm to 4mm, yellow	LK5607



MI0245



MI0235

MIAC

The Matrix Industrial Automation Controller (MIAC) is an integrated programmable microcontroller unit. Its features include :-

- 8 analogue or digital inputs
- 4 high current relay outputs
- 4 powerful transistor outputs (2 with PWM)
- 4 line, 16 column LCD display
- Keypad
- User programmable via USB
- Expandable via CAN communication bus
- Rugged ABS casing and shrouded 4mm sockets

You can design and upload your own custom programs for the MIAC using our Flowcode software.

Description	Part number
Cased MIAC with 4mm shrouded sockets	MI0245



AU9020

AU9010

Solutions

Our starter kit provides sufficient kit and teaching materials to learn the fundamental principles of pneumatic systems. As your students become more confident, you can then supplement this with the electro-pneumatics and/or control add-ons.

Description	Part number
Automatics essentials solution	AU9020
Automatics electro-pneumatics add-on kit	AU9015
Automatics control add-on kit	AU9010
Curriculum CD ROM	LK6492

FLOWCODE6®

Flowcode 6 Customer Support



Our support processes are focussed at all times on providing you with a responsive and cost-effective service, while maintaining or improving the quality of the product.

To maximise support efficiency and software quality, we ensure that the developers who originally wrote the code are involved with support activity as much as possible. Fortunately, our extremely committed and knowledgeable staff are also users of our solutions in their own time. As such, they can totally empathise with the demands of our customers.

Do you need to ensure a rapid response to any challenge you face when working on your projects?

If so, our professional support agreement is an essential component for your planning.

Our goal is to ensure your satisfaction each time you need to contact us for support by:

- Responding to your requests within targeted guidelines.
- Providing ongoing communication regarding your problem status through problem resolution.
- Taking ownership of your request for support.
- Providing a defined escalation process when management assistance is needed.
- Maintaining our commitment to continuous improvement of our service process.

Matrix offer full courses on all our product lines for teachers and professionals. To find out more about the training we offer both at our premises or at your site, call us on 01422 252380.



MATRIX

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EXTENDED SERVICES

Flowcode 6 and Electronic design



Our purpose in offering this service is to allow our industrial customers to reduce their time to market for their solutions.

The extended services offering from Matrix allows Flowcode 6 customers the ability to subcontract specific pieces of work within the development cycle to the development team at Matrix. The basis for this is that an agreed amount of work per quarter (within limits) is blocked in the diaries of Matrix developers and allows the customer the flexibility when to call this work off.

"We see the Matrix Extended Services as a key element to enhance our designs, improve our time to market and reduce our overall design costs."

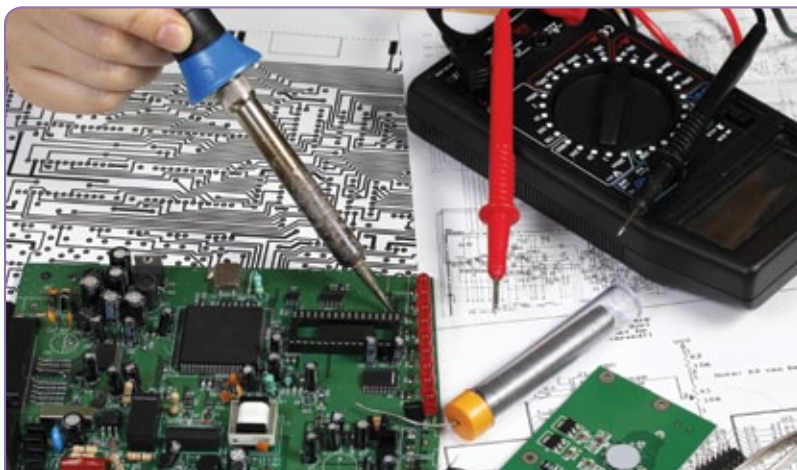
Dave Chapman

Sargent Ltd

SARGENT

The Extended Service process:

- Quarterly workloads agreed to create a "bag of hours" (with auto flex of $\pm 25\%$ carry over/pull forward with following quarter).
- Single invoice management on both parties reduce administration costs.
- Single point of contact for Project Management of work.
- Start of work commitment within agreed SLA's.
- Monthly timesheets to communicate consumption against the "bag of hours" agreed.
- Preferential consultancy rates for the "bag of hours" agreed.
- Ability to use these hours for a broad range of tasks (required skills to be agreed within Matrix competencies).



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Matrix offers custom or bespoke training courses for engineering/electronics and automotive departments and industry customers in the UK covering the Locktronics and E-blocks product ranges including our popular Flowcode software.

Advantages of training:

- Keeps you up-to-date with changing technologies
- Training to your specific requirements ensuring that you and your staff get the most from the products
- Maximises familiarity with the products and gives lecturers more confidence
- Motivates your students through hands-on learning

As well as having the ability to come and deliver bespoke training courses at your school / college / University / organisations headquarters, Matrix now also offers on-site training at Matrix HQ for all our customers.

With a well equipped training room at our Halifax home, we can deliver specialist training for users of our products from basic/ beginner level right through to advanced level.

We have some scheduled training dates for 2015 ready to book via our website so make sure you visit:

www.matrixtsl.com/training.php
for more information and to book your place today.

www.matrixtsl.com/blog

 **@MatrixTSL**

or visit **www.matrixtsl.com** for more



Welcome to Matrix



The south side of building



The Matrix team



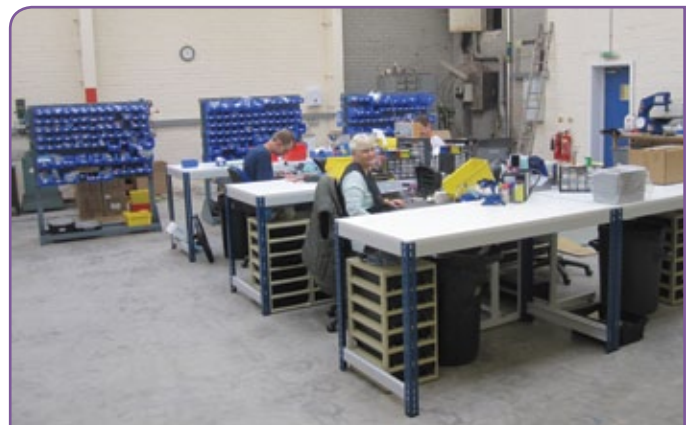
The north side of building



The product development team



The training room



The production hall



The kitting and despatch hall



Goods out



FLOWCODE SE



FLOWCODE 6

AUTOMATICS



MIAC

Keep in touch with new developments:





Photograph of trainees at the Automotive Hybrid training seminar held at the Latihan Perindustrian institute in Kuala Lumpur in August 2014.

MATRIX

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