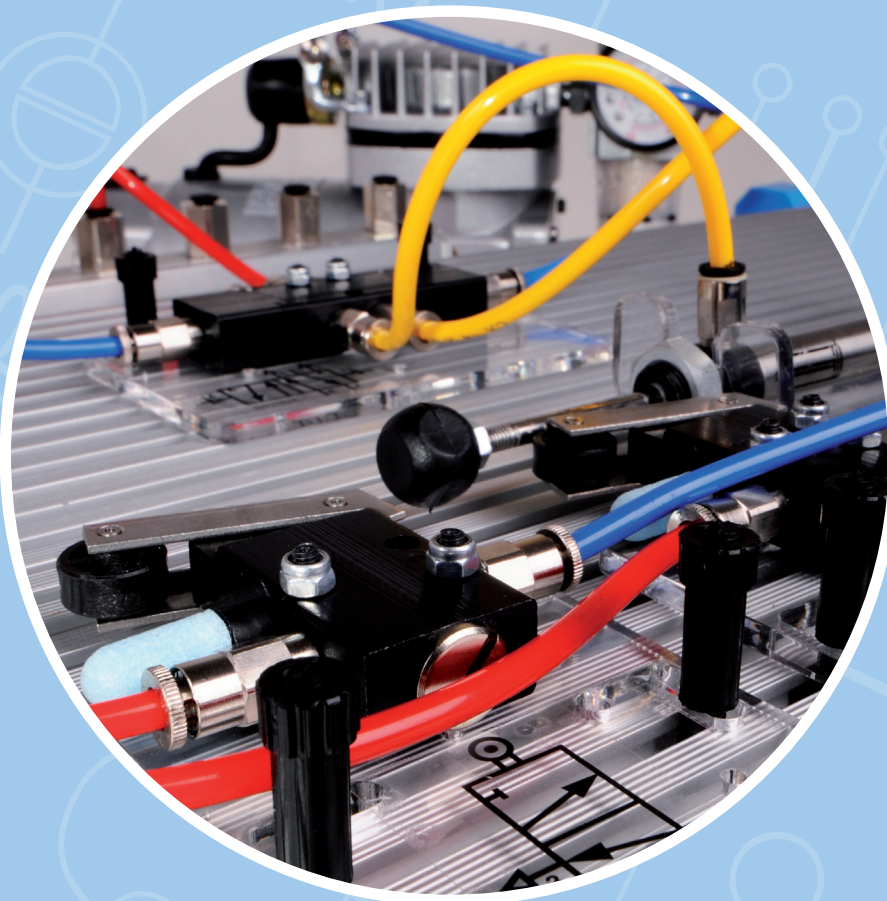


# AUTOMATICS

Simplifying pneumatics  
and automation



Pneumatics

Automation

# Introduction

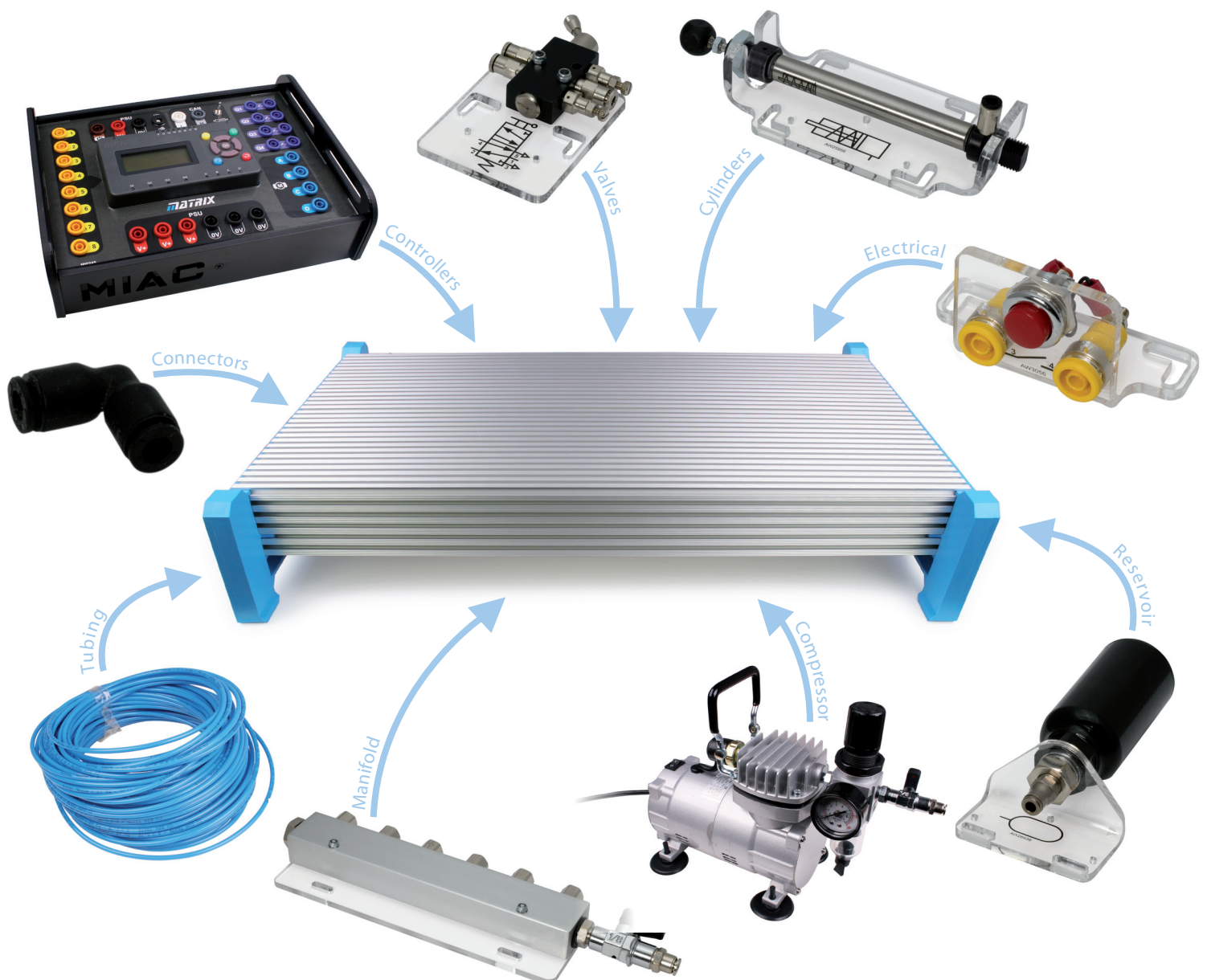
Automatics is a range of products that simplifies the process of teaching and learning about pneumatics and automation systems.

The Automatics range consists of around 100 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.

The range of products is used extensively in education because Automatics allows students to:

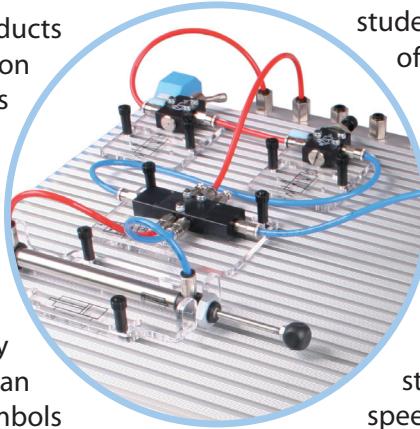
- Learn through building
- See the circuit symbols for all components
- Quickly build different circuits
- Integrate pneumatics with electrical control



## A complete modular system

Automatics is a complete range of products containing examples of all of the common components used by pneumatics and automation engineers in real industrial environments.

Students learn how each component operates, and how they can be connected together to produce both manually operated and fully automated pneumatic systems. They will also learn how these systems can be represented using component symbols and circuit diagrams.



Automatics also integrates electrical components and even a USB programmable microcontroller, so that students will gain familiarity with the most modern of software controlled systems.

## 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.

## How does Automatics work?

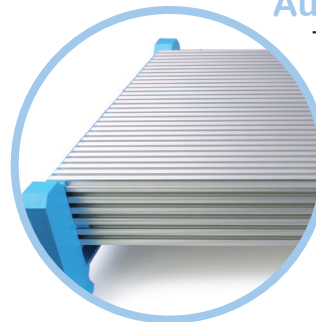
The Automatics range contains examples of many commonly used type of pneumatic and automation components, including...

- Cylinders - turn air pressure into motion.
- Mechanical valves - for user input or detecting the position of the cylinders.
- Solenoid valves - route the air supply under electrical control.
- Sensors and switches - provide feedback on the system's current state.
- Reservoir - to create time delays.
- Manifold - to distribute the air supply
- Controllers - to add programmable control to your pneumatic circuits.

## 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.



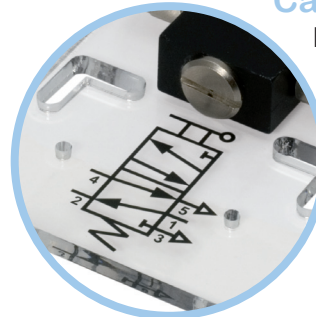
## Simple to connect

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 the 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.



## Tee-bolt fixings

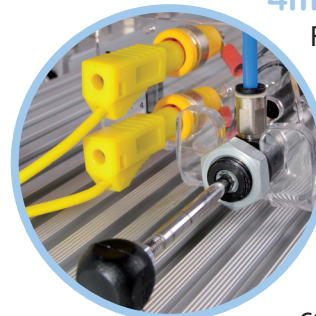
Components are attached to the slots on the sturdy aluminium platform using tee-bolts. These are easily secured and released without requiring any tools, allowing components to be quickly positioned and held firmly in place.



## 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.

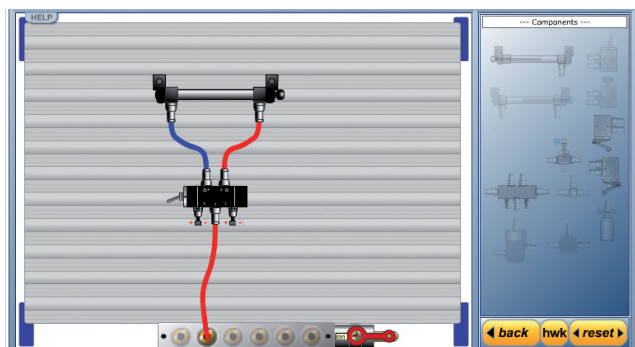




## Automatics courseware

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 on-screen 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.

1. This picture shows the sequential circuit that you have simulated for the sequence A+ B+ A- B-. The pipes that carry the pilot signals have each been given a symbol (numbers might be confusing!).

Complete each row of the table below by dragging in an item from each of these lists:

**List One - Signal responds to:**

- Outstroke of cylinder a
- Instroke of cylinder a
- Outstroke of cylinder b
- Instroke of cylinder b

**List Two - Result of signal:**

- Cylinder a extends
- Cylinder a retracts
- Cylinder b extends
- Cylinder b retracts

Pipe	Signal responds to:	Result of signal:
&		
@		
%		
\$		

2. In this circuit, the lever stop/start valve is inserted in the pipe labelled @, so the sequence starts with cylinder a extending. If you wanted the sequence to start with cylinder b extending, which pipe would you insert the lever valve into?

Type your answer here:

3. If you change the circuit in this way, will cylinder a be left extended or retracted when you operate the lever valve to stop the sequence?

Type your answer here:

When you have answered all the questions, click the mark it button. Use the REFRESH button on your browser to reset this worksheet.

**Mark it?** **score =** 0/10

© Copyright Economatics

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.

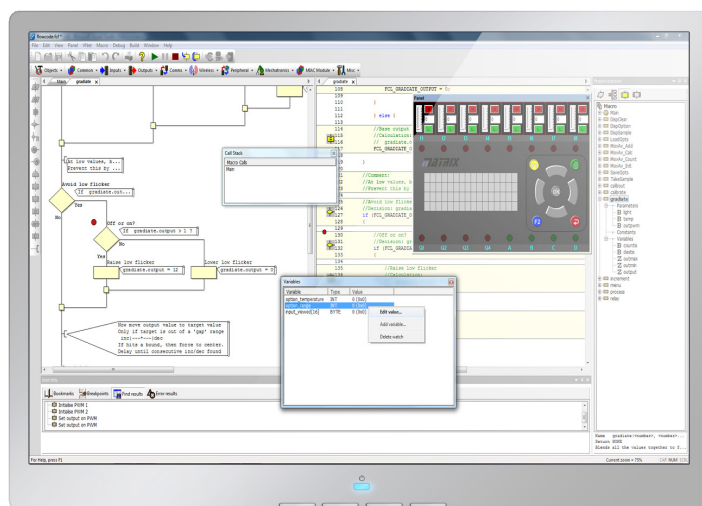
Automatics interactive courseware is compatible with all versions of Windows from Windows 95 upwards, and has very modest PC requirements. It is available with an educational site licence.

The advanced MIAC controller used within the Automatics Control solution and curriculum is fully compatible with our Flowcode microcontroller programming software.

## No coding required!

Flowcode does not require any previous knowledge of programming, as it uses an intuitive graphics-based interface that allows users to create their program by drawing it as a flowchart.

As well as being able to program the MIAC via a standard USB connection, Flowcode is able to simulate every function of the MIAC hardware unit. It also allows user interaction with the 'virtual' hardware on screen so that different input conditions can be emulated, and the output shown in real time. This allows your program to be thoroughly tested and de-bugged on your PC before being uploading to the MIAC controller.



Flowcode is available with several user licence options, including multi-user licences suitable for large teaching institutions.

### Flowcode user licence options

10 user	TEFLC105
Professional	TEFLCSI5
Site licence	TEFLCSL5

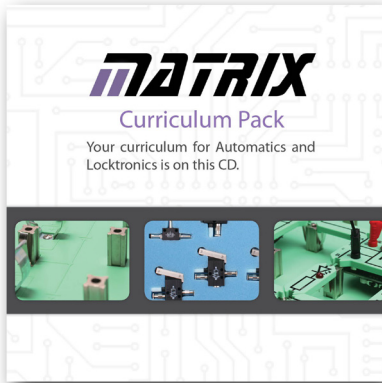
### Ordering information

Automatics interactive courseware site licence	AW20780
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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

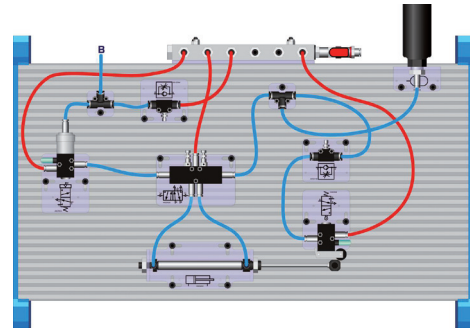


Our curriculum CD-ROM includes a set of .pdf workbooks that provide lesson plans, student worksheets and teacher's notes for a variety of courses that can be used individually or as a coherent series.

Each workbook is professionally written by experienced teachers who have used the Automatics hardware in a real learning environment.

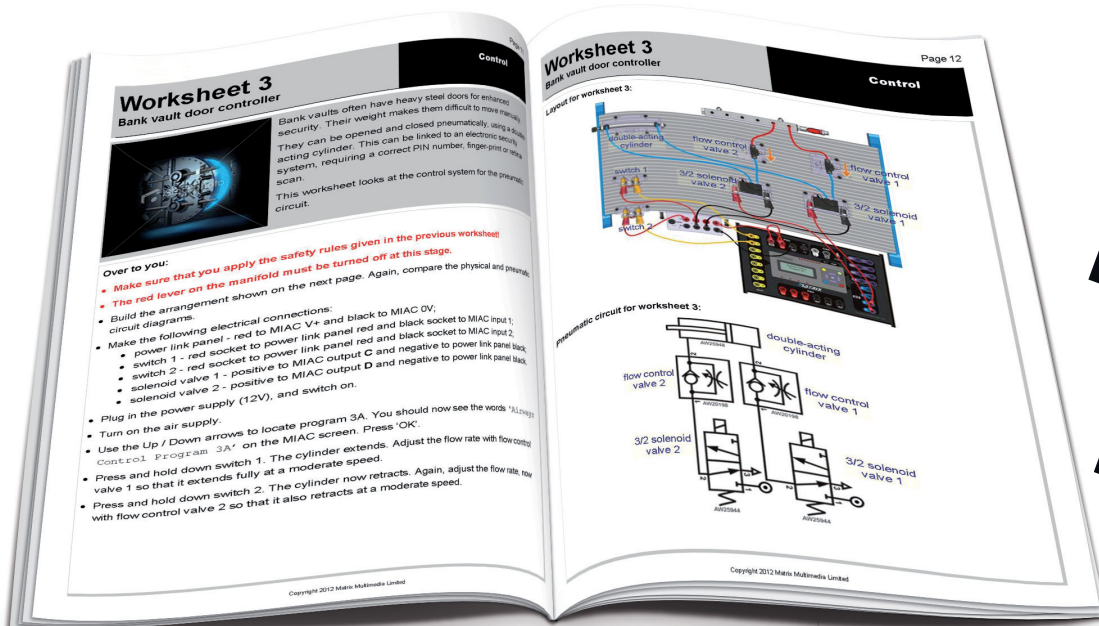
Students are guided through each subject in a logical sequence with clear, concise learning objectives at each stage, complete with quizzes and short tests by which their progress can be assessed.

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.

The curriculum CD, complete with every Automatics course, is provided free with every kit.



## Simplifying kit selection

While it is perfectly possible to assemble your own custom collection of Automatics parts, there is a much simpler way to ensure that you have everything you need.

For each of our curriculum courses, we have put together kits of parts that include almost everything that you need to be able to teach a course.

This has several advantages over buying separate components...

- It takes the hard work out of choosing the appropriate equipment.
- You will receive generous quantities of 'consumables' such as pneumatic tubing and fixings.
- Power supplies and tools are included where necessary.
- Shipped in sturdy ABS plastic storage trays.
- Programmable items, such as the MIAC controller, are pre-programmed with all of the programs that you'll need to complete our curriculum courses.

And, naturally, every curriculum and kit of components is extensively tested here at Matrix; so you can be sure that every worksheet experiment will work as intended!

## Solutions

A 'solution' is a stand-alone set of equipment that provides everything necessary to teach an associated curriculum course.

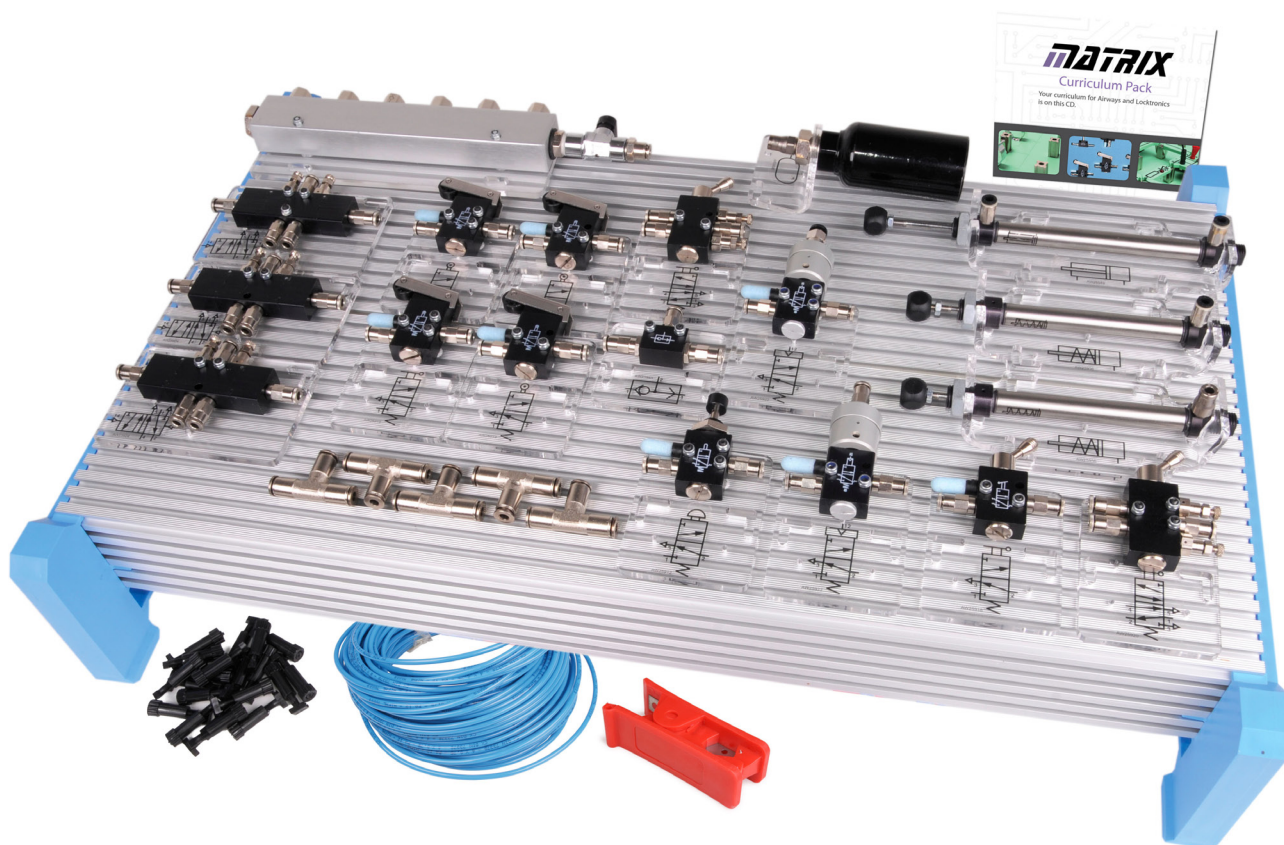
In addition, solutions can be used to provide a 'core' of essential components which can be expanded with more specialist parts once the basic principles have been mastered.

As many workshops and laboratories may already have a suitable compressed air supply, an air compressor and conditioning unit is the only item that is not supplied as standard. We do however offer a suitable unit at very reasonable cost should you require it.

## Add-on packs

Add-on packs are designed to extend the features of a core solution, to save you from having to purchase duplicate equipment if you intend to teach more than one curriculum course.

For example, the Automatics essentials solution can be extended with the Control add-on kit as your students progress from learning basic pneumatic principles to more advanced programmable control applications.





AW20801



## The Automatics essentials solution

This kit provides a complete introduction to pneumatic circuit design and construction. The included 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.

### Components

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

### Ordering information

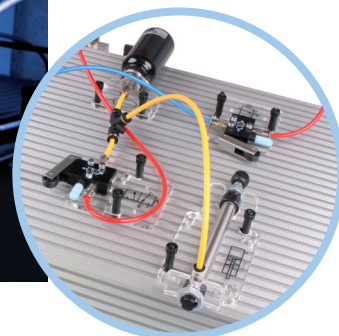
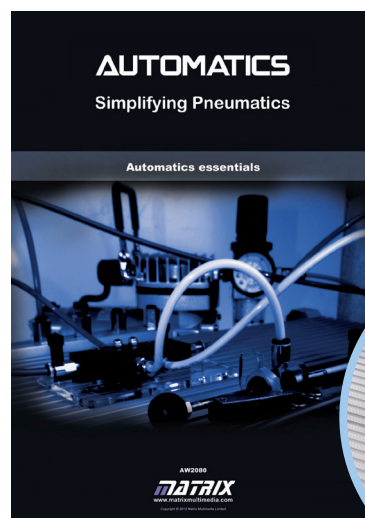
Automatics essentials solution AW20801

### You may also need...

Compressor AW30100

## 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





AW20792



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.

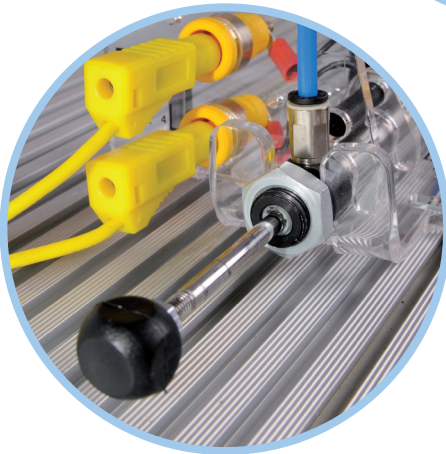
Working two to a kit, students follow the detailed worksheets to gain a comprehensive understanding of electro-pneumatics. By the end of the course, students will be able to create reciprocating and sequential circuits, and will have an understanding of how these are used to solve real world engineering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

Components

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

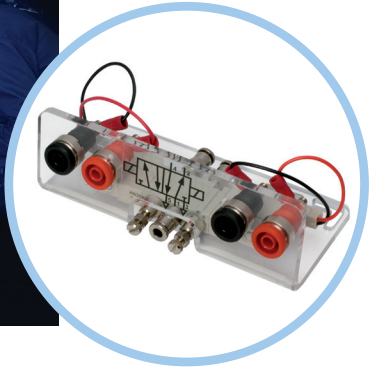
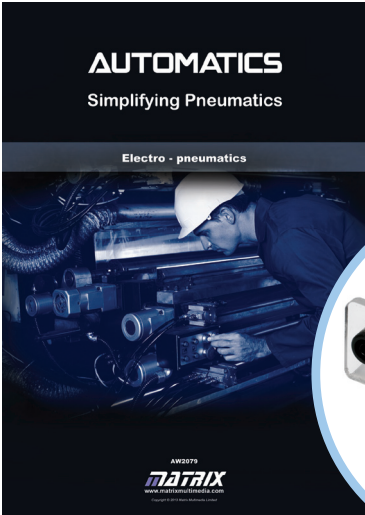
Ordering information

Electro-pneumatics add-on kit	AW20792
You may also need...	
Automatics essentials solution	AW20801



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



AW4955



### 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.

#### Components

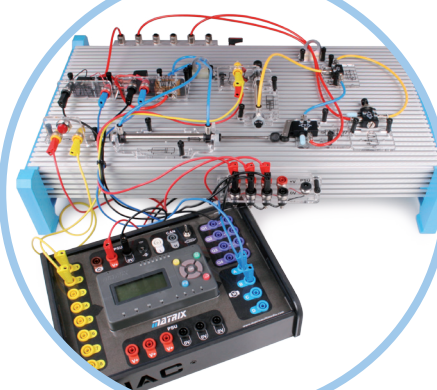
1	MIAC controller	2	Switch, push to make
1	Reed switch and holder	2	Valve, flow control
1	Light sensor	4	Valve, 3/2, solenoid-spring
1	Power supply	1	Power distribution carrier
6	Lead, 4mm plugs, red	6	Lead, 4mm plugs, black
2	Lead, 4mm plugs, yellow	1	Curriculum CD

#### Ordering information

Automatics control add-on kit AW4955

#### You may also need...

Automatics essentials solution AW20801  
Flowcode *see page 4*



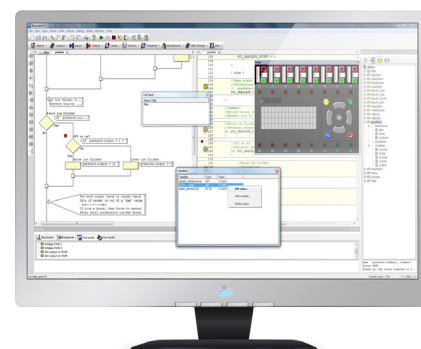
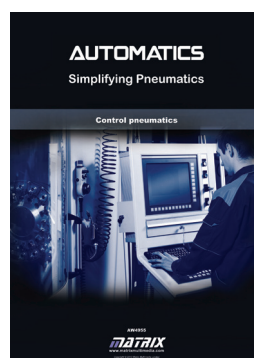
### Learning objectives

- 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.



# 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.

### Components

Cylinder, single acting, 10 × 40 mm	AW-C1040S
Cylinder, double acting, 10 × 80 mm	AW-C1080D

## 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.

### Components

Tubing, 4mm, blue, 30 m length	AW23119
Tubing, 4mm, yellow, 30 m length	AW23124
Tubing, 4mm, clear, 30 m length	AW25688
Tubing, 4mm, red, 30 m length	AW23122
Tubing, 4mm, red, 5 m length	AW23123
Tube cutting tool	AW-CUTTER
Junction, equal tee	AW-EQTEE

## 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.

### Components

Valve, flow control	AW-V22FC
Valve, mini shuttle	AW-V32MS
Valve, 3/2, button-spring	AW-V32BS
Valve, 3/2, roller-spring	AW-V32RS
Valve, 3/2, lever-spring	AW-V32LS
Valve, 3/2, diaphragm-spring	AW-V32DS
Valve, 5/2, lever-spring	AW-V52LS
Valve, 5/2, pilot-pilot	AW-V52PP

## Valves - electrical

These valves are operated by solenoids for control by discrete electrical circuits, or by the MIAC microcontroller unit.

### Components

Valve, 3/2 solenoid-spring	AW-V32ES
Valve, 5/2, double-solenoid	AW-V52EE

## 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.

### Components

Compressor	AW30100
Manifold	AW-MANI
Platform	AW-PLATFORM
Tee-bolts and sleeves (pack of 50)	AW22876

## Reservoir

Create time delays in your pneumatic circuits by allowing pressure to gradually build up inside the reservoir.

### Components

Reservoir 45cc	AW-RES45CC
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## Electrical

Everything you need to integrate electrical and electronic control into your pneumatic systems.

### Components

Reed switch and holder	AW-ERS
Switch, push to make	AW-ESWP
Microswitch	AW-EMS
Light sensor	AW-ELS
Power supply	HP2666
Power panel	AW-EPD
Lead, 4mm to 4mm, red	LK5603
Lead, 4mm to 4mm, black	LK5604
Lead, 4mm to 4mm, yellow	LK5607

## 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. (see below)

### Components

Cased MIAC with 4mm shrouded sockets	MI0245
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## 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.

### Components

Automatics essentials solution	AW20801
Automatics electro-pneumatics add-on kit	AW20792
Automatics control add-on kit	AW4955
Curriculum CD-ROM	LK6492

## Flowcode

Flowcode is a graphical programming tool that allows those with little experience to develop complex electronic systems in minutes.

Programs are written using graphical flowcharts rather than lines of code, so no previous coding experience is required.

Flowcode is available with several user license types to suit different numbers of user.

### Flowcode user licence options

10 user	TEFLC105
Professional	TEFLCSI5
Site licence	TEFLCSL5

## Interactive courseware

The Automatics interactive courseware creates a virtual pneumatics system on your PC, for use when a hardware system is not practical.

### Components

Automatics interactive courseware site licence	AW20780
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Also available: E-blocks &  
Locktronics catalogues



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