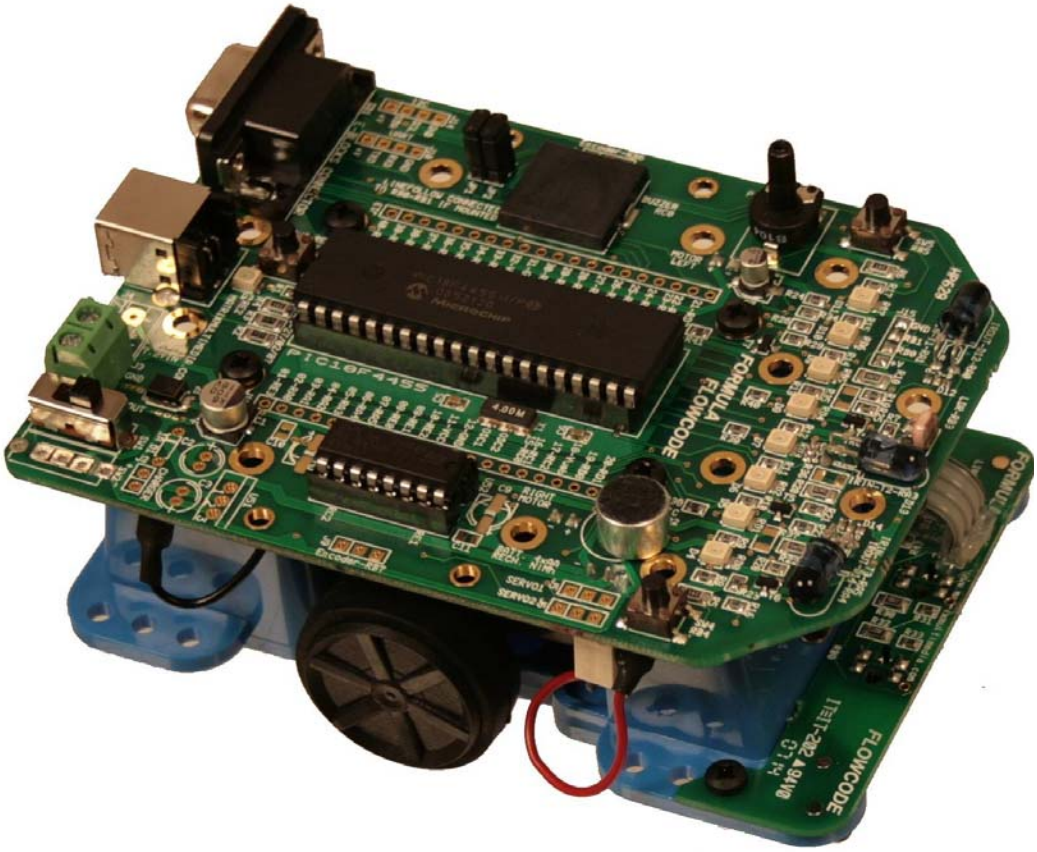
# FORMULA FLOWCODE

- Programmable robot vehicle
- A motivating technology teaching resource
- A complete solution: robot + software + curriculum
- Line following, maze solving and much more.....

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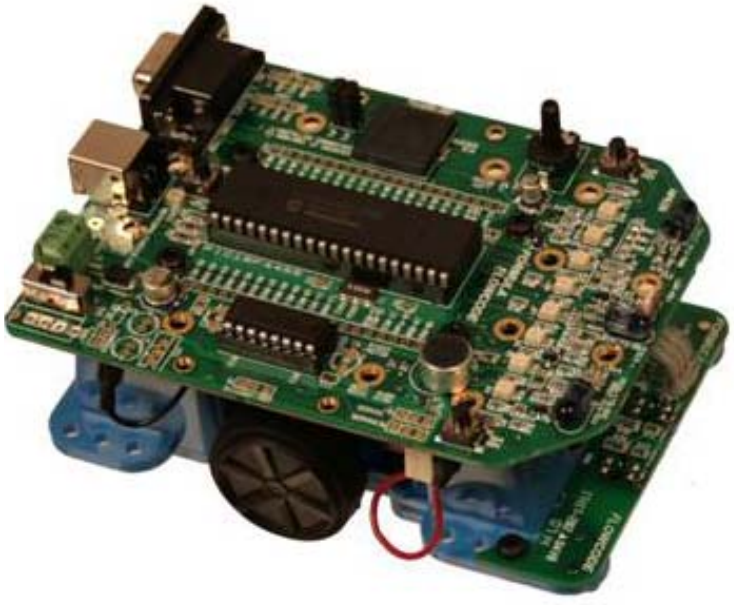
# Introduction

## What does it do?

Formula Flowcode is a robot vehicle which is used to teach robotics, and to provide a platform for competing in robotics events.



## Benefits

- A low cost, all-inclusive solution
- Can also be used for mechanical studies
- A highly motivating approach to learning

## Features

- Includes graphical programming software (Flowcode)
- USB programmable
- High technical specification
- Micromouse competition compatible
- Can also be programmed in C and Assembly
- A2 line following track is provided.

## Description

This maze solving robot has been designed to provide a motivating platform for learning robotics for all ages. The robot addresses the requirements of technology education in schools and colleges and the electronic circuit board can also be used for mechanical projects at 16+. The high specification two wheel robot is powered from rechargeable batteries and is supplied with a function limited version of Flowcode graphical programming software - available in 12 languages. Flowcode's drag and drop interface allows students with no previous programming experience to create a wide range of programs for the robot. Simply develop the program, simulate its functionality on-screen and then click on a button to download the program to the robot via USB. The robot is designed to allow learners to complete a range of programming tasks with increasing levels of difficulty, building their understanding as they progress through the tasks.

The technical specification of Formula Flowcode is impressive: it uses an advanced PICmicro 18 series microcontroller with internal precision motor controller circuitry, has 3 infrared distance sensors, line following sensors on a separate circuit board, a speaker, audio level sensor, light sensor, two spare switch inputs, 8 user programmable LEDs, and various expansion buses - including an E-blocks port.

*"Lego NXT is a great product. This is better - it actually teaches students how robots think and work"*
*Bart Huyskens*
*St Joseph's College, Belgium*

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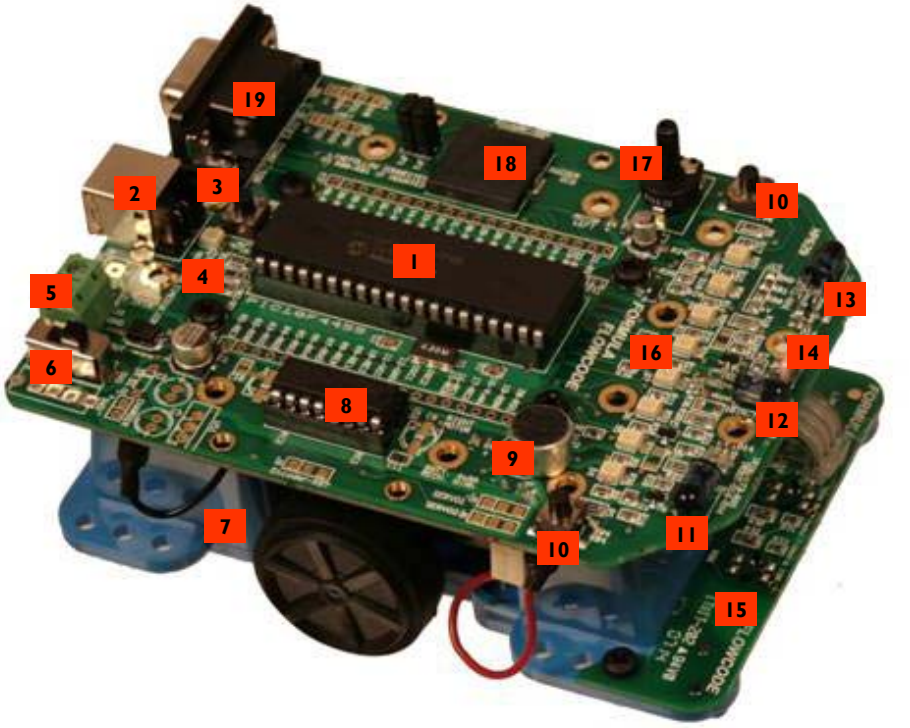
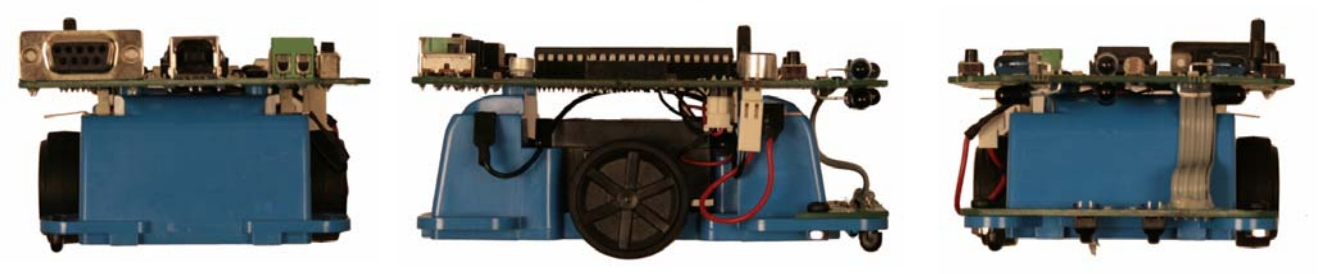
# Package details




1. The brains of Formula Flowcode - a PIC18F4455 chip
2. USB socket
3. Master reset switch
4. Programming LED
5. External 5V supply input
6. Power switch
7. Plastic chassis with battery compartment, motors with gearboxes, and 2 wheels.
8. Motor driver chip - a L293D
9. Microphone with sound level amplifier circuit
10. User definable press switches
11. Distance sensor - right
12. Distance sensor - centre
13. Distance sensor - left
14. Light sensor
15. Line following circuit board
16. 8 user definable LEDs
17. Loudspeaker volume control
18. Loudspeaker
19. E-blocks expansion socket



## Chassis

| | |
|---|---|
| Speed | 5 - 20cm/s |
| Size | 130 x 80 x 37 cm |
| Motor | MRM-GM03 with gearbox |
| Battery | AA x 4 |

## Controller circuit board

| | |
|---|---|
| CPU | PIC18F4455 |
| outputs | 8 x user definable LEDs, power LED, one bit speaker |
| Inputs | 2 push-to-make switches sound level sensor |
| Motor driver | L293D |
| Distance sensors | TSAL5100, BPV11F transceivers |
| Line followers | TCRT5000 on daughter board |
| Power | 4 x AA rechargeable NiMH |

## Software requirements

Windows 98, ME, 2000, XP, NT, Vista

## Pack contents

Plastic moulded chassis and gearbox
Controller circuit board
4 x M3 posidrive self-tapping screws
CD ROM with Flowcode and drivers
User guide

## Assembly requirements

Chassis is built and tested in the factory. The controller circuit board is built and tested in the factory, Final assembly using posidrive screwdriver is all that is required. No soldering required.

Formula Flowcode is micromouse competition compatible.

## Formula Flowcode software specification

The package contains a free multilingual version of Flowcode 3. See below for details.

# Formula Flowcode software


The Formula Flowcode robot includes a reduced functionality version of Flowcode. Flowcode 3 is one of the world's most advanced graphical programming languages for microcontrollers.
The great advantage of Flowcode is that it allows those with little experience to create complex electronic systems in minutes. Flowcode achieves this in two steps: firstly users drag and drop flowchart symbols onto the screen, and fill in the dialog boxes when prompted. Then Flowcode compiles the flow chart into code that is downloaded to a PICmicro microcontroller which executes the program.

Flowcode is available in many languages including: Danish, Dutch, English, Finnish, French, German, Greek, Spanish, (full translation) and also: Italian, Mandarin, Romanian, and Thai (menus only).

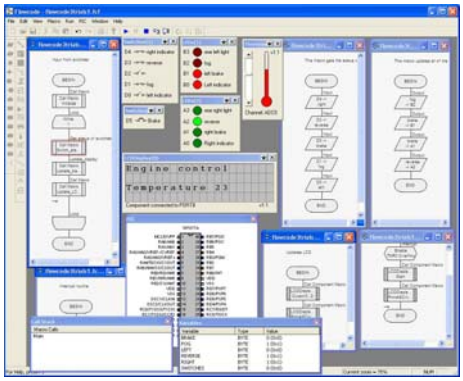
The version of Flowcode shipped with the Formula Flowcode robot is function limited. Limitations include: it can only compile code for the Formula Flowcode robot, it has a maximum code size of 2K, and a maximum of 64 icons, and not all components are supported. The version supplied is sufficient for most of the robot exercises including line following.

More functionality can be obtained by purchasing an upgrade to Flowcode Student/Home or Flowcode Professional.

Reduced cost multiuser education versions of Flowcode are available.

The Formula Flowcode robot can also be programmed in C or assembly and a hex download program is provided.

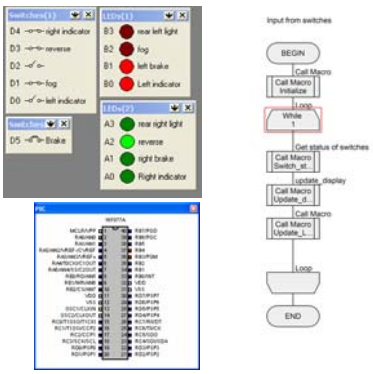
## Design



Flowcode contains standard flow chart icons and electronic components that allow to you to create a virtual electronic system on screen. Drag icons and components onto the screen to create a program, then click on them to set properties and actions.

- Easy to use interface
- Allows complex programs to be developed and managed quickly
- All robot I/O and expansion options are supported in Flowcode

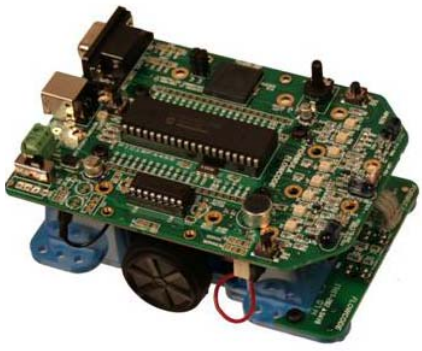
## Simulate



Once your system is designed you can use Flowcode to simulate it in action. Test the system's functionality by clicking on switches or altering sensor values, and see how your program reacts to the changes in the electronic system.

- Simulation aids understanding
- Debug before download
- Shorten the design cycle

## Download



When you are happy with your design click one button to send the program directly to the Formula Flowcode robot. Remove the USB lead and press the reset button and your program starts to run.

- One button download
- Compiles to C then ASM
- Link in your own C files

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# Curriculum and support

## Curriculum

As background learning material the CD ROM 'An introduction to microcontroller programming' is available. This CD ROM includes a wealth of material on PICmicro microcontrollers, their operation, circuitry and project work. It also includes a large section on developing programs using Flowcode which covers, inputs, outputs, loops, decisions, macros, memory, string handling and much more.

At the time of going to press this is only available in English. This CD ROM is included in the class packs. See below for details.

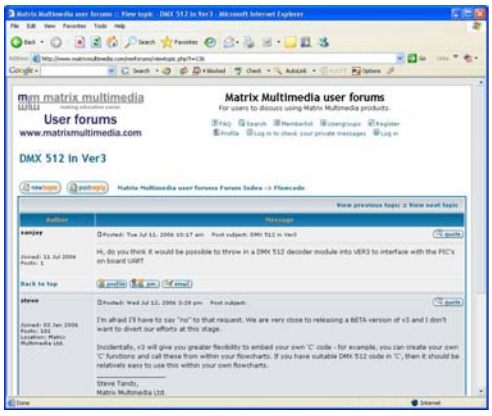
## Support

User support for Formula Flowcode is available on Matrix Multimedia's web site forum where users can ask each other questions and swap programs.

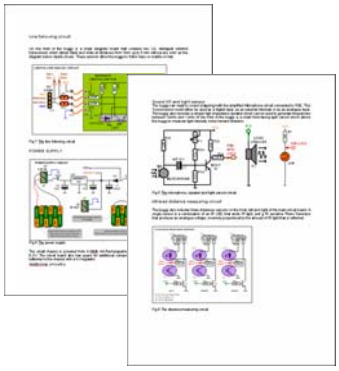
## User guide

A user guide is shipped with Formula Flowcode which includes assembly instructions, installation instructions, the circuit diagram and operation.


The CD ROM ' An introduction to microcontroller programming' provides background material on developing electronics systems with Flowcode.




Support is delivered using the Matrix Multimedia Forum site



The User's Guide contains easy-to-read circuit diagrams, assembly instructions and more.

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# Challenges

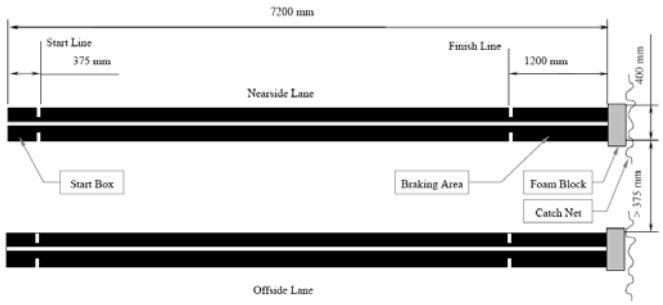
'Formula Flowcode' is named after the Formula Ford racing competition where the cars are all identical and winning only comes down to the driver's skills. In this case winning comes down to the programming skills of the user. As you might expect there are a number of separate challenges that users have to complete to increase their skills level. These challenges start with getting a single LED to light up, and finish with full maze solving using a custom made chassis, with wheel encoders etc. This is the really clever idea behind Formula Flowcode – it is great for complete beginners to robotics and electronics, and it will also provide a considerable challenge to those studying for degrees in electronics and computer science. Many challenges are possible, the 10 prescribed challenges are:

1. LEDs and switches: use switches and LEDs to understand inputs, outputs and binary operation.
2. Robopop: use the loudspeaker to generate tones and even music themes.
3. Driving the motors: program the robot to drive the motors with a specific speed and direction so that predetermined figures such as a triangle, a square, a circle or a spiral are made.
4. Follow my line: follow an unknown line (closed figure, white line on black background) as fast as possible. The fastest mouse wins.
5. I can see the light: The robot shall be placed as far away from the light as possible, not facing to the light. The robot needs to find it's way to the light, as fast as possible, and stop in the white rectangle in front of the light without hitting the wall.
6. Drag Race: travel as fast as possible over a straight course, following a white line, then brake and stand still before hitting the end wall. This is a competition event.
7. Daytona race: do 3 laps round the maze, as fast as possible. The fastest mouse wins. 1 sec will be added, every time you hit a wall or make a 'touch'. This is a competition event.
8. Lefty: solve a known maze as past as possible, using the wall-following technique. Stop on the white square. 1 sec will be added, every time you hit a wall or make a 'touch'. This is a competition event.
9. Full maze: Solve an unknown maze by mapping it first and then driving the fastest course as fast as possible. The fastest run out of 5 runs counts. This is an advanced competition event.
10. Pimp my ride: Build your own chassis from scratch and carry out exercise 9. This is an advanced competition event.

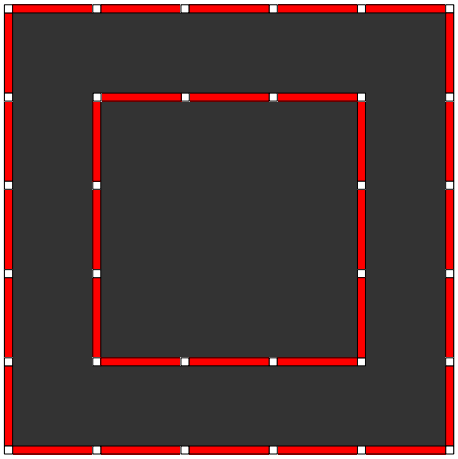




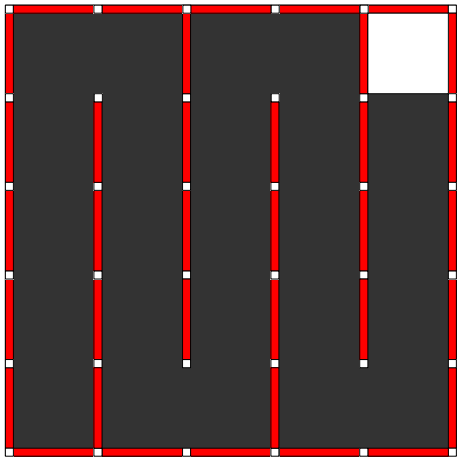



Level 6 - the drag race, made with electrical tape on a white surface



Level 7 - the Daytona 5, a simple maze based race



Level 8 - the Lefty, a more complex maze based race

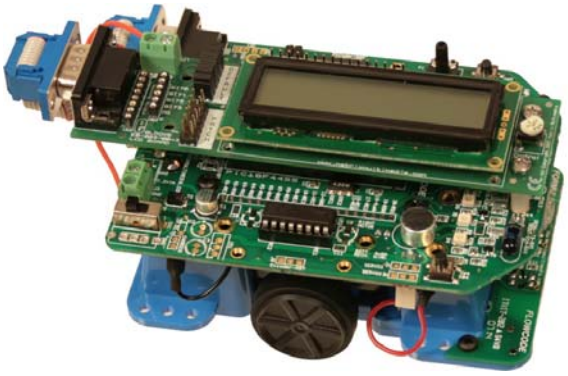
# Expansion options

### E-blocks

The Formula Flowcode robot is fitted with holes at 20mm intervals and a full expansion port on a D-type E-blocks connector. These features mean that it is possible to add an E-blocks board to the chassis to extend its functionality: for example an additional LCD display or a Bluetooth communications board.

### Other expansion

The E-blocks connector exposes the communications port of the chassis so that it is also possible to add a wider range of accessories including ultrasonic, image, speech etc. Servo motor connectors are also available to provide additional robotics functions.

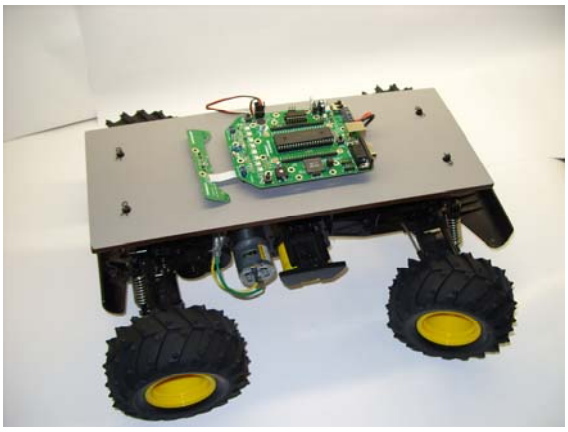


Formula Flowcode is compatible with E-blocks, like the LCD board shown here.

### Mechanical engineering work

The Flowcode controller circuit board is designed so that it can be used on a mechanical chassis, other than the one supplied as standard, using expansion features such as additional connections for servo motors, and wheel encoder inputs.

This makes the chassis suitable for use as part of a course where students study both electrical and mechanical engineering. In these courses students are tasked with designing their own chassis using custom made metal parts and higher specification motors. This approach also allows students to develop their expertise further with full international standard mazes being solvable with the chassis.



Students can use the controller circuit board as a basis mechanical engineering design work

Based on:

FLOWCODE3
NO CODING, NO LIMITS...

Compatible with:

E-BLOCKS™
LEARN•DESIGN•BUILD

### Upgrade with additional E-blocks

| | |
|---|---|
| LCD display | EB005 |
| Graphical display | EB043 |
| Keypad | EB014 |
| Bluetooth board | EB024 |
| Power supply | HPPSU2 |

### Upgrade to a full version of Flowcode

| | |
|---|---|
| Flowcode Pro | TEFLCSI3 |
| Flowcode 10 user educational | TEFLC103 |
| Flowcode site educational | TEFLCSL3 |

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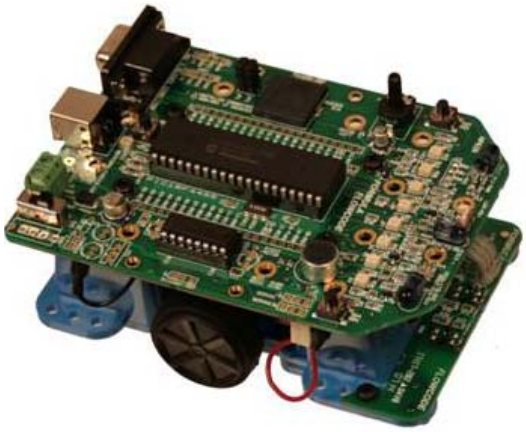
# Products and purchase options

## Formula Flowcode — HP794




Individual Formula Flowcode kits - includes built and tested controller board, and plastic chassis with gearbox. Includes a function limited version of Flowcode.

## Starter class bundle — HP926

Includes 5 Formula Flowcode kits, 1 set of maze walls, a function limited version of Flowcode, a storage tray and a 10 user version of the 'Introduction to microcontroller programming' CD ROM. Sufficient for 10 students working in pairs. Compatible with challenges 1 to 5.

## Pro class bundle — HP454

Includes 10 Formula Flowcode chassis kits, 1 set of maze walls, Site licence of Flowcode V3 Pro software (worth £700), Site licence of the 'Introduction to microcontroller programming' CD ROM, 5 LCD displays, 5 IDC cables, and two storage trays. Sufficient for 20 students working in pairs. Compatible with all challenges.

## Maze walls — HP458

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.

## Formula Flowcode parts

| | |
|---|---|
| Chassis only | HP295 |
| Circuit board only | EB629 |