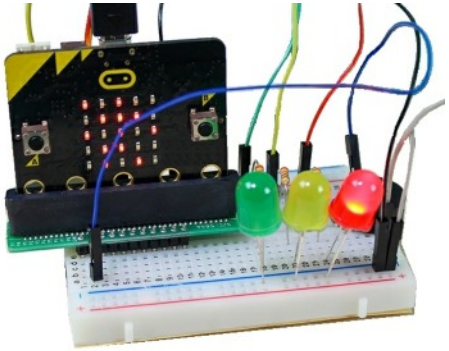
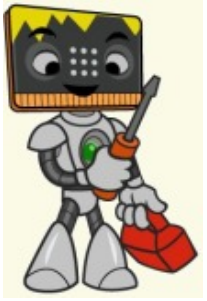
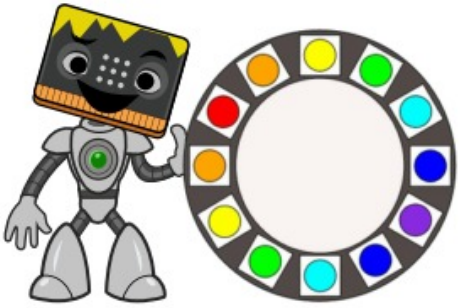
EXPERIMENT BOX

FOR THE BBC MICRO:BIT



Learn about connecting sensors and LEDs to the BBC micro:bit with Mr Bit.



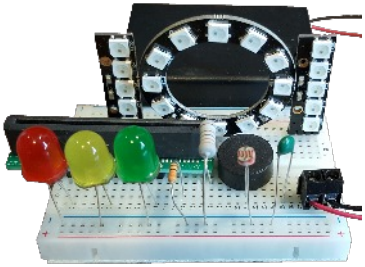


The Experiment Box consists of the Discovery Kit and ZIP LEDs Pack from Kitronik together with some extra sensors.

You can download *Mr Bit* Solutions and instructions for all the experiments at www.insightresources.co.uk/microbit/exptbox.html

Experiment Box contents

Kitronik Discovery Kit
Breadboard
Breakout connector
LEDs: green, yellow, red (2 of each)
Resistor: 330Ω (x10)
Piezo speaker
Jumper wires (x10)



Kitronik ZIP LEDs
ZIP ring, ZIP stick (x2)
Battery pack
Terminal connector

Sensors
Thermistor 1kΩ
Light dependent resistor
Resistor: 3.3kΩ

BBC micro:bit

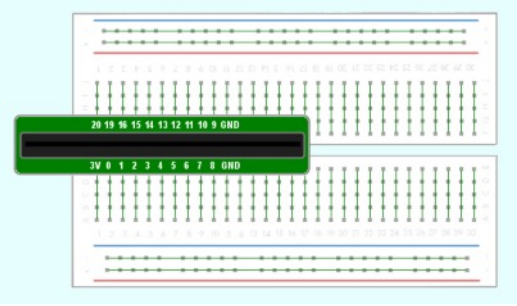
The BBC micro:bit is an extremely versatile miniature computer. As well as helping you understand how to create code, it is especially useful for detecting signals from sensors and controlling electrical devices. The Experiment Box provides an easy way of connecting components to the micro:bit with the minimum of fuss. Combined with the *Mr Bit* plain English approach to coding, you are all set to learn the skills for making the micro:bit perform interesting tasks.

Why Mr Bit?

The *Mr Bit* Coding Editor lets you create programs for the BBC micro:bit on your computer screen or iPad. Your program code can be sent to the micro:bit using a USB connection (PC only) or by Bluetooth wireless. It is an alternative to the *MakeCode* and *Micropython* coding systems available on the the microbit.org website. The advantage of using *Mr Bit* is that the program code appears in plain English sentences compared with the jigsaw-style blocks of *MakeCode* or the specialised computer language of *Microphython*. It is ideal for beginners to coding; you can get results quickly and learn to think about computer tasks in simple steps that a computer can act upon.

Breadboard

The *Kitronik Discovery Kit* contains the breadboard and breakout connector for the micro:bit which are used for all the experiments. The breadboard enables you to connect and build a circuit without the need of solder required on normal circuit boards. You push the components and jumper leads into the sockets in the board. It is helpful to understand how the sockets are connected underneath so that the circuit becomes complete. The green lines in this diagram show the invisible connections.

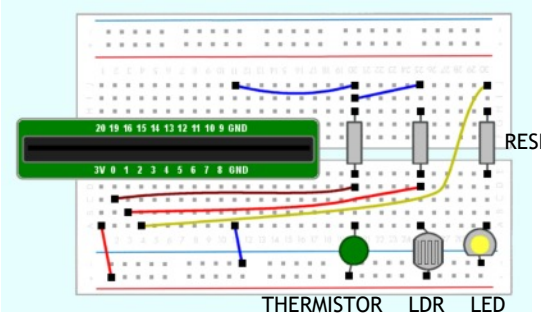


The micro:bit slots into the connector which sits as a bridge across the middle part of the board. The pins of the connector must be inserted to occupy the first 10 sockets on the left-hand side of the board.

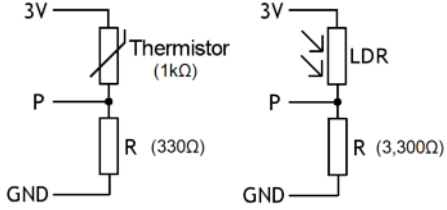
Sensors

The thermistor is a common sensor for measuring temperature. It works by reducing its resistance as it gets hotter. It must be connected in series with a fixed resistor, across which the voltage indicates the temperature. Mr Bit shows this in degrees celsius.

The Light Dependent Resistor (LDR) indicates the intensity of light falling on it. As the light gets brighter its resistance reduces. Again It must be connected in series with a fixed resistor, across which the voltage indicates the light level in arbitrary units. Mr Bit shows this as a percentage.



Circuit diagrams:



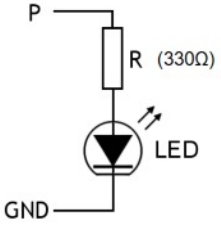
Resistor colour codes:

330Ω:
ORANGE - ORANGE - BROWN

3,300Ω:
ORANGE - ORANGE - RED

Outputs: LEDs and speaker

A light emitting diode (LED) lights up when a voltage is applied to it by a micro:bit output. It only passes current in one direction so the two legs must be inserted the correct way round: the long leg must have a positive connection and the shorter leg (next to the flat edge) must be made negative. It must also be wired up with a resistor in series. This protects it from taking too much current from the micro:bit.



Resistor colour code:

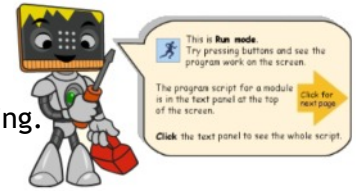
ORANGE - ORANGE - BROWN

Look out for the flat edge to identify the negative terminal on the LED.

The piezo speaker creates a sound when the micro:bit sends it a tone signal. The Mr Bit music editor lets you choose a range of tones from musical notes. A single note is sufficient to create a beep, but with more notes you can compose tunes and jingles.

Discovery Kit Experiments

The *Kitronic Discovery Kit* Tutorial Book describes five introductory experiments that help you to get used to building circuits on the breadboard. You can download *Mr Bit* solutions and instructions for all these at
www.insightresources.co.uk/microbit/exptbox.html



When you open a file Mr Bit speech bubbles give you things to do:

- See the program working.
- Build the circuit.
- Control the micro:bit.
- Send the code to the micro:bit.
- Practice: Build the program yourself.
- Challenges: Make changes to the program.

1. LED Control Circuit
   Use the micro:bit buttons to switch an LED on and off.
2. Buzzer Juke Box
   Produce signals which make the speaker play a tune.
3. Lights in Sequence
   A 'loop' program to light three LEDs in turn.
4. Digital LED thermometer
   LEDs indicate the temperature of the micro:bit.
5. Traffic Light with Pedestrian Crossing
   A traffic control program with flashing LEDs, animated image and sound signal.

Mr Bit Experiments

The *Mr Bit* coding editor contains instructions for 18 experiments with sensors, LEDs and a speaker. You can download *Mr Bit* solutions and instructions for all these at www.insightresources.co.uk/microbit/exptbox.html

With each file you can:

- See the program working.
- Build the circuit.
- Control the micro:bit.
- Send the code to the micro:bit.

Mr Bit speech bubbles give you detailed instructions for building the program script for yourself.

Program scripts:

1. Alarm Test

When button A is pressed, play tones on the buzzer for 0.5 s.
Wait for 0.5 seconds.

2. Time Signal

When button A gets pressed, pulse the buzzer 6 times.

3. Telephone Call

While button A is pressed, repeat :
Pulse the buzzer twice.
Wait for 2 seconds.

4. Hazard Warning

Switch on the Yellow LED for 0.5 seconds.
Wait for 0.5 seconds.

5. Colour Code

When button A is pressed, switch on the Red LED for 0.2s.
Switch on the Yellow LED for 0.2 seconds.
Switch on the Green LED for 0.2 seconds.
Switch on the Yellow LED for 0.2 seconds.

6. Traffic Lights

Switch on the Red LED until button A gets pressed.
Switch on the Red LED and the Yellow LED for 2 seconds.
Switch on the Green LED until button B gets pressed.
Switch on the Yellow LED for 2 seconds.

7. Light Meter

Show the LED number (light level) until exit.

8. Light Report

When it is light, show the LED message "LIGHT" until it is dark.
When it is dark, show the LED message "DARK" until it is light.

9. Light Graph

Plot the LED bar graph (light level) until exit.

10. Shadow Counter

Count how many times it gets darker until button A gets pressed.
Show the LED message (counter) until exit.

11. Who is There?

When it is darker than 50, play tones on the speaker for 0.6s.
Wait for 1 second.
Show the LED message (light level) until exit.

12. Perfect Light

While it is darker than 50 or lighter than 60, switch on the Red LED.
While it is lighter than 50 and darker than 60, switch on the Yellow LED.

13. Digital Thermometer

Show the LED number (temperature) until exit.

14. Climate Message

While it is hot, show the LED message "HOT".
While it is cold, show the LED message "COLD".

15. Temperature Graph

Plot the LED trace graph (temperature) until exit.

16. Weather Report

While it is warmer than 30, show the LED message "HOT".
While it is cooler than 30 and warmer than 25, show the LED message "WARM".
While it is cooler than 25 and warmer than 20, show the LED message "NICE".
While it is cooler than 20 and warmer than 10, show the LED message "COOL".
While it is cooler than 10, show the LED message "COLD".

17. Comfort Zone

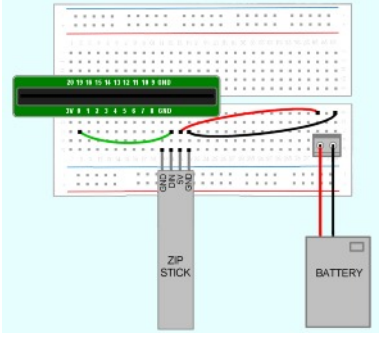
While it is warmer than 20 and cooler than 25, switch on the Green LED.
While it is warmer than 25 or cooler than 20, switch on the Red LED.

18. Extreme Alert

When it is cooler than 20, play tones on the speaker for 0.6 s.
Wait for 1 second.
When it is warmer than 25, play tones on the speaker for 0.6 s.

ZIP LEDs

The *Kitronik ZIP LEDs* pack contains addressable RGB LEDs capable of showing any colour in the spectrum. Individual LEDs can be controlled independently of each other, but a group of them may be controlled using just one output pin of the micro:bit. The LEDs are fixed on circuit boards in the shape of a stick and ring. They require a higher voltage than the micro:bit and this is supplied by the extra battery pack. They fit very conveniently on the breadboard and the wiring for the 5-LED stick is shown here.



The Kitronic ZIP LEDs manual describes ten experiments using the *MakeCode* editor. As an alternative, the *Mr Bit* editor offers a very simple method for programming the LEDs. You can download *Mr Bit* solutions for all these at www.insightresources.co.uk/microbit/exptbox.html

As before, when you open a file you see the program working and there are instructions for building the circuit and sending the code. In addition there are extra ideas for you to try.

ZIP LEDs Experiments - Program scripts

1. Turn an LED on and off

When button A gets pressed, show the LED pixels pattern (r----) until button B gets pressed.

2. Changing an LED's Colour

While button A is pressed, show the LED pixels pattern (y-y-y).
While button B is pressed, show the LED pixels pattern (b-b-b).

3. Make an LED Move

While button A is pressed, show the LED pixels pattern (rotate right --g--).
While button B is pressed, show the LED pixels pattern (rotate left --m--).

4. Controlling Multiple LEDs

Show the LED pixels pattern (r----) until button A gets pressed.
Show the LED pixels pattern (oo---) until button A gets pressed.
Show the LED pixels pattern (ggg--) until button A gets pressed.
Show the LED pixels pattern (cccc-) until button A gets pressed.
Show the LED pixels pattern (vvvvv) until button A gets pressed.
While button B is pressed, show the LED pixels pattern (roygc).

5. Control Two LED Sticks

When button A gets pressed, show the LED pixels at 0 pattern (r----) for 2 s.
When button B is pressed, show the LED pixels at 1 pattern (roygc) for 2 s.

6. Display Sensor Readings on ZIP sticks

Show the LED pixels at 0 array pattern (light level) for 1 second. Repeat.
Show the LED pixels at 1 array pattern (tilt angle) for 1 second. Repeat.
Calculate light index = light level / 10 until exit.
Calculate tilt index = pitch / 20 until exit.

7. Spin an LED Around the ZIP Ring

While button A is pressed, show the LED pixels pattern (bounce r----------).
While button B is pressed, show the LED pixels pattern (rotate left g--------).

8. Display a Rainbow and Lower Brightness

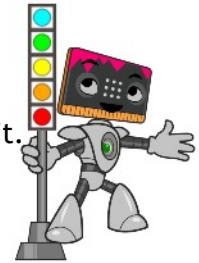
While button A is pressed, show the LED pixels pattern (rotate right roygcbvmroyg) at roll brightness.
While button B is pressed, show the LED pixels pattern (rotate left gggggmmmmmm) at roll brightness.

Mr Bit ZIP LEDs Experiments

These experiments show the range of possible effects you can create with the *Mr Bit* programming tools. You can download solutions and instructions for them at
www.insightresources.co.uk/microbit/exptbox.html

As before, when you open a file you see the program working and there are instructions for building the circuit and sending the code. In addition there are extra ideas for you to try. With each file you can:

- See the program working.
- Build the circuit.
- Control the micro:bit.
- Send the code to the micro:bit.



Mr Bit speech bubbles then give you more things to try and challenge you to build the program script yourself.

Program scripts:

1. Single Stick Colour Patterns

While button A is pressed, show the LED pixels pattern (ggggg).
While button A is pressed, show the LED pixels pattern (ovovo).
While button A is pressed, show the LED pixels pattern (bybyb).
While button A is pressed, show the LED pixels pattern (cmcmc).

2. Rotate Colour Patterns

While button A is pressed, show the LED pixels pattern (rotate right rgggg).
While button A is pressed, show the LED pixels pattern (rotate left ooovo).
While button A is pressed, show the LED pixels pattern (rotate right byyyy).
While button A is pressed, show the LED pixels pattern (rotate left cccmc).

3. Shift Colour Patterns

When button A is pressed, show the LED pixels pattern (shift right rgggr) for 1.6 s.
When button A is pressed, show the LED pixels pattern (shift right ovvvo) for 1.6 s.
When button A is pressed, show the LED pixels pattern (shift left byyyb) for 1.6 s.

4. Scroll Colour Patterns

When button A is pressed, show the LED pixels pattern (scroll right rgrgr) for 4 s.
When button A is pressed, show the LED pixels pattern (scroll left ovovo) for 4 s.
When button A is pressed, show the LED pixels pattern (scroll right bybyb) for 4 s.

5. Bounce Colour Patterns

While button A is pressed, show the LED pixels pattern (bounce rg---).
While button A is pressed, show the LED pixels pattern (bounce ov---).
While button A is pressed, show the LED pixels pattern (bounce by---).

6. Two Stick Patterns

While button A is pressed, show the LED pixels at 0 pattern (rgrgr).
While button A is pressed, show the LED pixels at 1 pattern (ovovo).
While button A is pressed, show the LED pixels at 0 pattern (bybyb).
While button A is pressed, show the LED pixels at 1 pattern (cmcmc).

7. Fading Two Stick Patterns

Count every 0.1 seconds until the counter is equal to 10.
Count (down) every 0.1 seconds until the counter is equal to 0.
Show the LED pixels at 0 pattern (roygc) at counter brightness for 2 s.
Show the LED pixels at 1 pattern (roygc) at counter brightness for 2 s.

8. ZIP Ring - Colour Chase

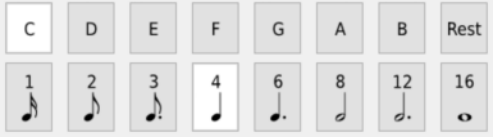
When button A gets pressed, show the LED pixels pattern (rotate right rxxxxxxxxxxx) until button A gets pressed again.
When button B gets pressed, show the LED pixels pattern (rotate left bxxxxxxxxxxx) until button B gets pressed again.

9. ZIP Ring - Rainbow Show

When button A gets pressed, count every .5 s until the counter is greater than 12.
Show the LED pixels array pattern (counter) until the counter is greater than 12.
Show the LED pixels pattern (rotate right gcbvbcgyoroy) for 5 seconds.
Show the LED pixels pattern (rotate left gcbvbcgyoroy) for 5 seconds.
Show the LED pixels sequence for 3 seconds.
Flash the LED pixels pattern (gcbv-----roy) 4 times.

Mr Bit Music

The piezo speaker can play a tune when you create a sequence of tone codes for the micro:bit. Creating code is easy with the Mr Bit music editor.



For each note, type, click or tap a:

- LETTER to choose the pitch
- NUMBER to choose the duration

The resulting code looks like this:

```
C4:4 F A C5 A4 F F G B♭:2 A G F E:4 C C F A:2
G F E D:4 B♭3 D4 C F E F:8 R:4
```

You can download ready-made tunes and learn more about making your own at www.insightresources.co.uk/microbit/exptbox.html

Mr Bit Music Experiments

1. Discover Music
   Copy notes from a music score
2. Music Maker
   Compose your own music and effects
3. Music Box
   Explore the tunes in the *Mr Bit* music library

www.insight-mrbit.com