

# @zbit:PiDapter (π)

connecting the BBC micro:bit  
to the Raspberry Pi



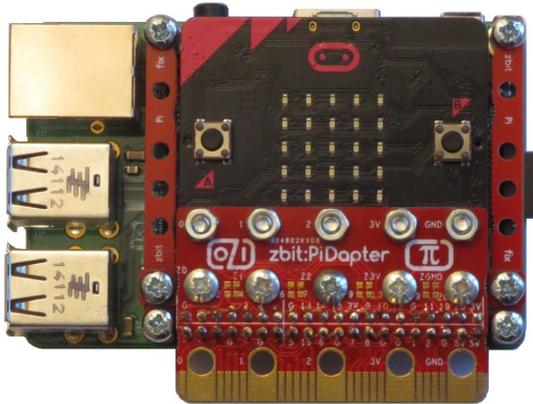
*Have Fun while you Learn !*



[www.zbit-connect.co.uk](http://www.zbit-connect.co.uk)

# zbit:PiDapter - connecting the BBC micro:bit to the Raspberry Pi

The **zbit:PiDapter** is a member of the **zbit:connect** family of add-on boards for the **BBC micro:bit** brought to you by **innovations in education**.



The **zbit:connect** family is designed to **unleash the potential of the BBC micro:bit** allowing your **micro:bit** to connect to **multiple add-on boards** attached in the **'X', 'Y' or 'Z'** axis!

The **zbit:connect** family is designed to encourage an **understanding of software programming** by helping you to learn how to **write code** to **control external electronics**.

The **zbit:connect** family is also designed to encourage an **understanding of electronics** by encouraging **'positive hacking'** such as modifying **zbit:connect** boards to change or enhance their capabilities and/or **attaching your own electronic designs** to the **micro:bit**.

And above all the **zbit:connect** family is designed for you to

***'Have Fun while you Learn'***

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# Contents

- 1 x zbit:PiDapter board
- 1 x spacer board
- 1 x clip board
- 1 x xspacer board
- 2 x zbit:pi:fix bars
- 5 x M3x8 Panel Head Screws
- 5 x M3x8 Countersunk Head Screws
- 10 x M3 Nuts
- 1 x 40 pin connector (*requires soldering*)

**(zbit:connector\* is an *optional* extra - sold separately)**

\*A **zbit:connector** is only required if the board needs to connect to the ‘**small pad**’ GPIO **P3-20**.

For more information see the ‘**zbit:connect family guide**’

## Tools Required

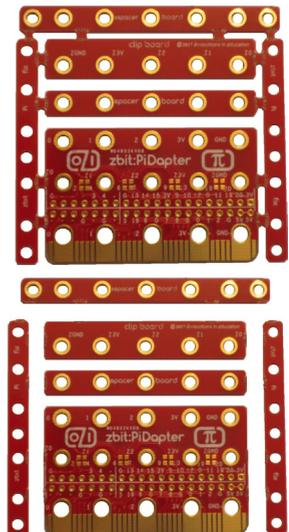
- Pozidrive Screwdriver
- Pliers
- Small File
- Soldering Iron
- Solder

## Assembly Instructions

The 6 individual PCB's are supplied as in single piece as shown. The PCB's are attached to each other by 'break-off' tabs.

1) Break off all of the smaller boards (**spacer board**, **clip board**, **xspacer board** and **zbit:pi:fix bars**) from the main **zbit:PiDapter** PCB. Snap off both ends of the connecting 'break-off' tabs. This will require a pair of pliers. (The **xspacer board** and **zbit:pi:fix bars** are for advanced applications - see '**zbit:PiDapter Designer's Guide**' below)

2) File off any rough edges from where the break-off tabs were attached.



3) Solder the 40 way connector to **back** of the main **zbit:PiDapter** PCB. (The **back** of **zbit:PiDapter** is the side *without* the logos and 'zbit:PiDapter' text.)

If the connector is **soldered flush** with the PCB, when the **micro:bit** is fitted to the **Raspberry Pi** the **micro:bit's** battery connector will rest on the **Raspberry Pi's** audio jack. This will mean that the **micro:bit** will be **not quite horizontal**, but will still work. If you would like the **micro:bit** to sit **horizontally**, solder the **zbit:PiDapter** connector so the pins are flush with the **top** of the PCB which will mean the connector is lifted about 1.5mm off the PCB.

It is recommended you first solder two opposite corner pins. Then check that the connector is **vertical** and is on the **back** the PCB before soldering the remaining pins.

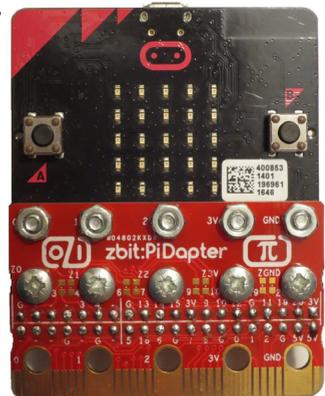
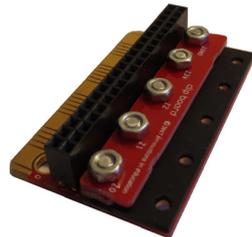
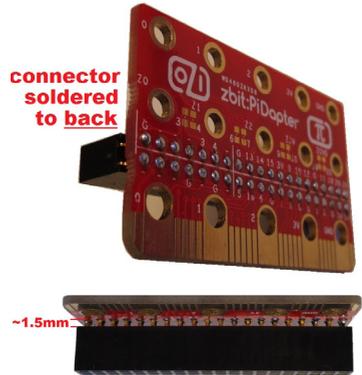
4) Attach the **zbit:connector**, **spacer board** and **clip board** with the **M3 pan head screws** as shown in the '**zbit:connector Assembly Diagram**'.

If **zbit:PiDapter** is being used *without* a **zbit:connector**, fitting the **spacer board** and **clip board** is *optional*.

5) Insert your **micro:bit** into the slot at the top of **zbit:PiDapter** between the main **zbit:PiDapter** PCB and the **clip board**. Use the **M3 countersunk** head screws **inserted from the back** of the **micro:bit** as shown in the '**zbit:connector Assembly Diagram**' to secure your **micro:bit** to **zbit:PiDapter**.

6) Tighten, but **don't over tighten** all screws.

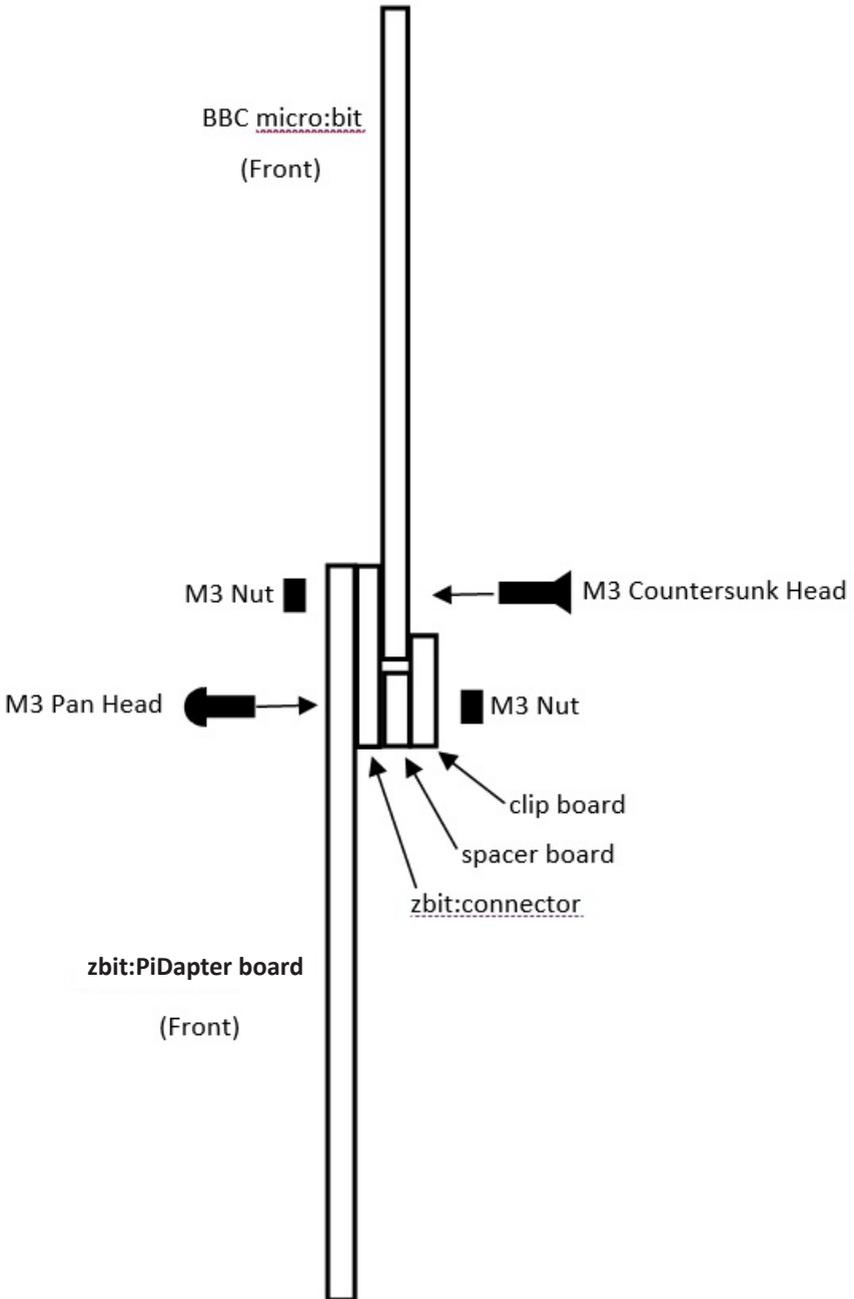
7) Plug **zbit:PiDapter** onto your **Raspberry Pi's** 40 pin GPIO header ensuring the connector is correctly aligned.



**zbit:PiDapter is now ready to use !**

For examples of what you can do with **zbit:PiDapter** see '**zbit:PiDapter Designer's Guide**' or visit [www.zbit-connect.co.uk](http://www.zbit-connect.co.uk)

# zbit:connector Assembly Diagram



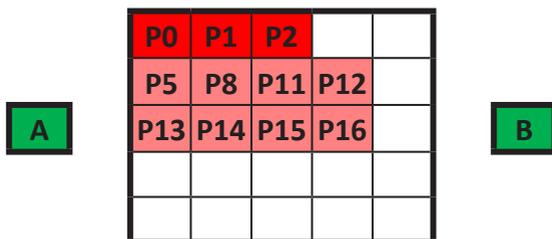
# zbit:PiDapter Test Software

To test that the **Raspberry Pi** GPIO are correctly connected to the **micro:bit's** GPIO via **zbit:PiDapter**, download the **Raspberry Pi** test program '**RPi\_zbit\_PiDapter\_test.py**' and **micro:bit** test program '**microbit\_zbit\_PiDapter\_test.py & .hex**' from

[www.zbit-connect.co.uk](http://www.zbit-connect.co.uk)

Both programs are written in **Python**.

The **Raspberry Pi** program configures its GPIO as '**outputs**' and sets each of them to a '1' in turn. The **micro:bit** program configures its GPIO as '**inputs**' and when it detects a '1' on any of them it illuminates the corresponding LED on the **micro:bit's** display as shown below. For instance when the **Raspberry Pi** sets **GPIO 12** (which is connected to **micro:bit GPIO P0**) to a '1', the top left LED, *and only this LED*, should illuminate!



Note - **GPIO P3, P4, P6, P7, P9, P10, P19, P20**, which are only connected if the corresponding solder links are fitted, are *not* tested as they can only be used as GPIO if the **micro:bit's** Display and I2C bus are turned 'off'

## To Run the Test:-

**Attach** the **micro:bit** to the **Raspberry Pi** using **zbit:PiDapter**.

**Load** Hex file '**microbit\_zbit\_PiDapter\_test.hex**' onto the **micro:bit**

**Boot** the **Raspberry Pi** with **Raspbian**

**Login** and type:-

> **sudo startx** (This will start the IDE Graphical User Interface in '*Super User*' Mode)

**Copy** '**RPi\_zbit\_PiDapter\_test.py**' into a suitable directory on the **Raspberry Pi**

**Run**>**Programming**>**Python** (called **IDLE** if using an early version of **Raspbian**)

**Open** '**RPi\_zbit\_PiDapter.py**'

**Press** <**F5**> to run the program

**Check** that the LED's on the **micro:bit's** display illuminate in turn as described below:-

a) If **zbit:PiDapter** is fitted *without* a **zbit:connector**,

LEDs labelled **P0,P1,P2** shown in **Dark Red** will illuminate in turn (some LEDs highlighted in **Light Red** may also illuminate)

b) If **zbit:PiDapter** is fitted *with* a **zbit:connector**,

LEDs highlighted in **Dark Red** and **Light Red** will illuminate in turn.

# zbit:PiDapter RPi to micro:bit GPIO

The Table below gives the **Raspberry Pi** to **micro:bit** GPIO signal mapping. Signals in brackets are not normally connected - see Notes

RPi Pin	Raspberry Pi Signal	micro:bit Signal	micro:bit Function	Notes
1	3V3	3V	3V	1
2	5V0	(Y)	(AUX_PWR_Y)	2
3	GPIO3/SDA0_1K8_PullUp	(P20)	(I2C_SDA)	3
4	5V0	(Y)	(AUX_PWR_Y)	2
5	GPIO5/SCL0_1K8_PullUp	(P19)	(I2C_SCL)	3
6	GND	GND	GND	1
7	GPIO7/GCLK	P11	BUTTON_B	
8	UART_TXD0/GPIO8	P2	UART_RXD	1
9	GND	GND	GND	
10	UART_RXD0/GPIO10	P1	UART_TXD	1
11	GPIO11	P12	GPIO	
12	PWM/PCM_CLK/GPIO12	P0	SPEAKER	1
13	GPIO13	(P10)	(LED_COL3/ANALOG)	4
14	GND	GND	GND	
15	GPIO15	(P9)	(LED_COL7)	4
16	GPIO16	P8	GPIO	
17	3V3	3V	3V	
18	GPIO18	(P7)	(LED_COL8)	4
19	GPIO19/SPI_MOSI	P15	SPI_MOSI	5
20	GND	GND	GND	
21	GPIO21/SPI_MISO	P14	SPI_MISO	5
22	GPIO22	(P6)	(LED_COL9)	4
23	GPIO23/SPI_SCLK	P13	SPI_CLK	
24	SPI_CE0_N/GPIO24	P16	SPI_CS	
25	GND	GND	GND	
26	SPI_CS1_N/GPIO26	P5	BUTTON_A	
27	ID_SD	N/C	-	
28	ID_SC	N/C	-	
29	GPIO	(P4)	(LED_COL2/ANALOG)	4
30	GND	GND	GND	
31	GPIO	(P3)	(LED_COL1/ANALOG)	4
32	PWM0/GPIO	N/C	-	
33	GPIO/PWM1	N/C	-	
34	GND	GND	GND	
35	GPIO/SPI_MISO	N/C	-	
36	GPIO	N/C	-	
37	GPIO	N/C	-	
38	SPI_MOSI/GPIO	N/C	-	
39	GND	GND	GND	
40	SPI_SCLK/GPIO	N/C	-	

## Notes

**1 - P0, P1, P2, 3V & GND** are connected even if a **zbit:connector** is not fitted. They could all be used as GPIO or **P1, P2** could be used for UART Serial Data.

**2 - 5V** is not connected on **zbit:PiDapter** however 5V could be connected to **zbit:PiDapter** using **zbit:power** on **zbit:toolbelt** connected via **zbit:power:bars**.

**3 - I2C** signals are not normally connected thus avoiding I2C conflicts. However, by fitting solder links 19 & 20 the **Raspberry Pi** could access the I2C devices on the **micro:bit**. To do so, the I2C 'Master' on the **micro:bit** must be disabled in software.

**4 - micro:bit 'display' GPIO P3, P4, P6, P7, P9 & P10** are not normally connected to avoid **Raspberry Pi** activity on these GPIO affecting the **micro:bit's** display. However by fitting solder links 3, 4, 6, 7, 9 and 10 they *could* be connected.

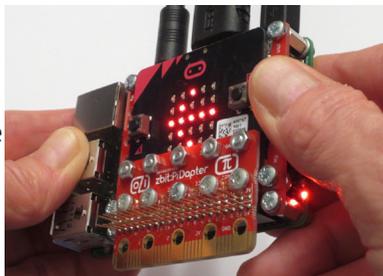
**5 -** By configuring the **micro:bit** as **SPI 'slave'** and swapping **MOSI** and **MISO** pins in software the **Raspberry Pi** could transfer data to the **micro:bit** via **SPIbus**.

# zbit:PiDapter Designer's Guide - Ideas and Applications

There are many possible applications where the **micro:bit** and **Raspberry Pi** can work together. Here are some ideas...

## micro:bit as a 'Sense Hat' for Tilt Controlled Raspberry Pi Games

**zbit:PiDapter Example P1** shows you how to write a **Tilt Controlled Game of 'Snake'** using the **Accelerometer Sensor** on the **micro:bit** to determine if the **Raspberry Pi** is being tilted **up, down, left** or **right** then sending the information to the **Raspberry Pi** via **GPIO** to control a game of **'Snake'** written in **Python** running on the **Raspberry Pi**. A **Worksheet** can be downloaded from:-



[www.zbit-connect.co.uk/zbitpidapter](http://www.zbit-connect.co.uk/zbitpidapter)

## micro:bit as a 'Radio Hat' for Raspberry Pi Wireless Gaming

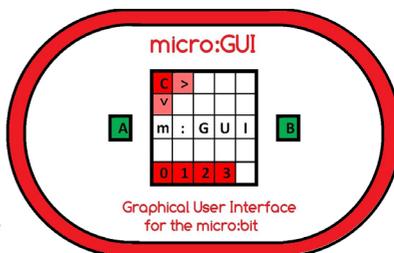
The **micro:bit's Bluetooth Radio** can be used to send messages wirelessly between **micro:bits**. If each **micro:bit** is plugged onto a **Raspberry Pi** this means messages can be sent wirelessly between **Raspberry Pi's**. This could be used, for example, to develop a **Raspberry Pi multiplayer game**.



## micro:bit running microGUI allowing a Raspberry Pi to be operated *without* Monitor, Keyboard or Mouse

The **microGUI Specification** shows how an intuitive **Graphical User Interface** can be written for a **micro:bit**. With a **micro:bit** plugged onto a **Raspberry Pi** this opens up the possibility of operating a **Raspberry Pi** without a **Monitor, Keyboard** or **Mouse** by instead using the **micro:bit's 25 LED's** as the **Display** and its **A + B Buttons** for **User Input**.

The **microGUI Specification** can be downloaded from:-



[www.zbit-connect.co.uk/microGUI](http://www.zbit-connect.co.uk/microGUI)

# zbit:PiDapter Designer's Guide - Modes and Configurations

## Mode 1 - micro:bit plugged onto a Raspberry Pi

This is the main mode of operation for **zbit:PiDapter**. In this mode there are several possible *configurations*...

### Mode 1a) micro:bit + zbit:PiDapter + Raspberry Pi

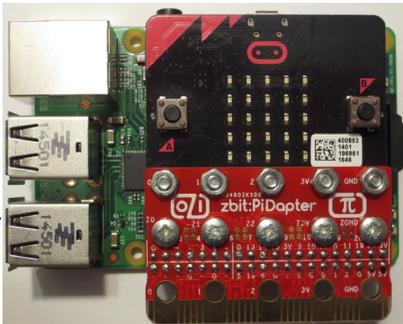
This is the 'normal' configuration. Here the **micro:bit** is first bolted to **zbit:PiDapter** then **zbit:PiDapter** is plugged into the **Raspberry Pi**. This provides the smallest, lightest and most compact way to connect a **micro:bit** to the **Raspberry Pi**.

In this configuration the **micro:bit** will be powered from the **Raspberry Pi's** 3.3Volt supply. The **Raspberry Pi** should be powered whenever the **micro:bit** is being reprogrammed via USB otherwise the **micro:bit** will start to 'back-power' the **Raspberry Pi** from the USB supply which is not be able to supply the current needed to fully power the **Raspberry Pi**. If this happens the **micro:bit** may not operate correctly, however neither **micro:bit** nor **Raspberry Pi** will be damaged.

The **micro:bit** should *not* however be powered via its battery connector.

There are a couple of limitations with this configuration. Firstly it is not possible to power down the **micro:bit** without also powering down the **Raspberry Pi**. If this becomes inconvenient, there is a possible 'hack' to fit a power switch onto 'Z' holes 'Z3V' and 'ZGND'. The second limitation is that access to the **micro:bit's** reset button is restricted. To press the reset button will need something like a pen top or another improvised method!

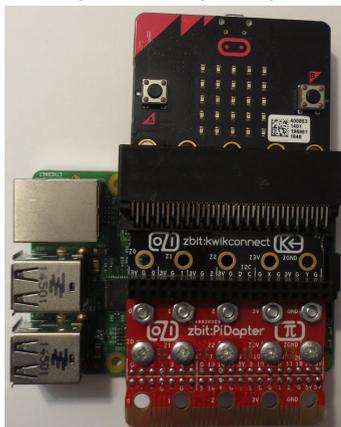
The **Raspberry Pi's** 40 way Header connector should be strong enough to support the **micro:bit** when connected in this way, however if more mechanical support is needed the **zbit:pi:fix bars** can be used along with the **xspacer board**.



### Mode 1b) micro:bit + zbit:kwikconnect + zbit:PiDapter + Raspberry Pi

This is similar to the configuration above but with the addition of **zbit:kwikconnect** bolted to the top of **zbit:PiDapter**. Connected like this means the **micro:bit** can be power cycled without powering down the **Raspberry Pi** by unplugging the **micro:bit** from **zbit:kwikconnect's** edge connector. Also in this configuration the **micro:bit's** reset button is fully accessible. The **micro:bit** will however protrude beyond the **Raspberry Pi**.

It is recommended that in this configuration the boards are mechanically supported using the **zbit:pi:fix bars** and **xspacer board**.



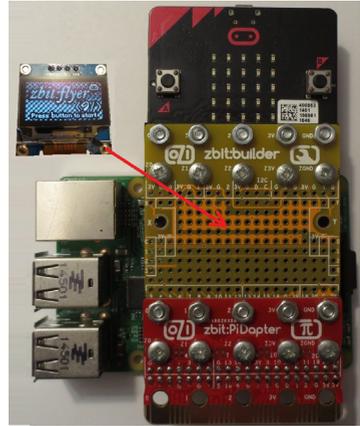
### Mode 1c) micro:bit + zbit:builder + zbit:PiDapter + Raspberry Pi

This is similar to the configuration above but with **zbit:builder** bolted to the top of **zbit:PiDapter** and the **micro:bit** bolted to the top of **zbit:builder**.

**zbit:builder** allows other electronic modules to be soldered on and connected to the **micro:bit** e.g. the **I2C LCD Display** shown.

In this configuration, like configuration (1a), the **micro:bit** can't be independently power cycled, however like configuration (1b), the **micro:bit's** reset button is fully accessible but the **micro:bit** will protrude beyond the **Raspberry Pi**.

It is recommended that in this configuration the boards are mechanically supported using the **zbit:pi:fix bars** and **xspacer board**.



### Mode 1d) micro:bit + zbit:PiDapter + Raspberry Pi + zbit:toolbelt

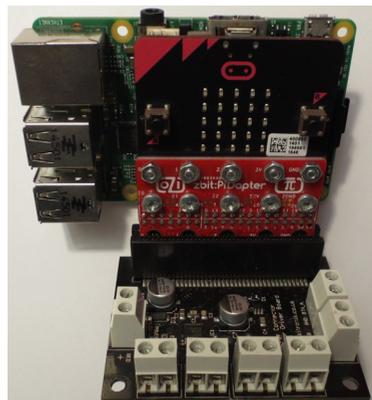
This is similar to configuration (1a) but with **zbit:toolbelt** (or any other **zbit:connect** board) bolted to the *bottom* of **zbit:PiDapter**. **zbit:toolbelt** would give access to the **micro:bit** and **Raspberry Pi** GPIO via its 40 way socket connector so, for instance, **zbit:shaker**, **zbit:trol** or **zbit:thumb** could be plugged into the toolbelt.

e.g. using **zbit:thumb** would allow you to control your **Raspberry Pi** from an **Analog Joystick** by using the **micro:bit** to get the analog input from the Joystick, convert it to digital, then send the digital information to the **Raspberry Pi** via UART Serial Data!



### Mode 1e) micro:bit + zbit:PiDapter + Raspberry Pi + micro:bit accessory

This is similar to configuration (1d) but with **micro:bit** accessories *from other manufacturers* plugged onto the bottom of **zbit:PiDapter**. Such accessories could be ones that use the 80 way edge connector such as the **Kitronik Motor Driver Board** as shown, ones that bolt on, or ones that use crocodile/banana plugs to attach.

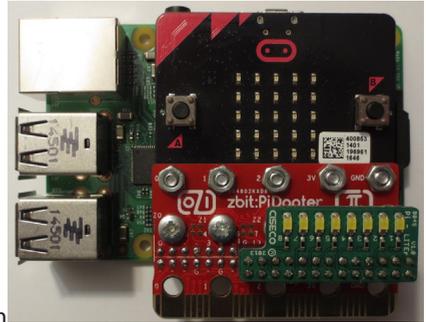


## Mode 1f) micro:bit + zbit:PiDapter + Raspberry Pi + Raspberry Pi accessory

This is similar to configuration (1e) but by soldering a 40 way Header to the *top* of **zbit:PiDapter**, **Raspberry Pi** accessories *from other manufacturers* could be plugged onto this Header. So, for instance **Raspberry Pi 'Sense Hats'** or 'Display Hats' could be plugged in.

In this example **PiLite** is shown.

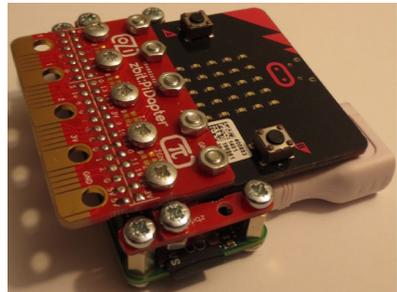
**Note** - Not all **Raspberry Pi** accessories are compatible. It will depend upon which GPIO they use and whether those GPIO conflict with the **micro:bit** GPIO.



## Mode 1g) micro:bit + zbit:PiDapter + PiZero

**PiZero** is the small version of the **Raspberry Pi**. But since this version still has the same 40 way Header as the full sized Raspberry Pi, **zbit:PiDapter**, can also be used with **PiZero** in all of the above configurations.

Also **zbit:pi:fix bars** and **xspacer board** can be used for added mechanical support as shown.



## Mode 2 - micro:bit *emulating* a Raspberry Pi

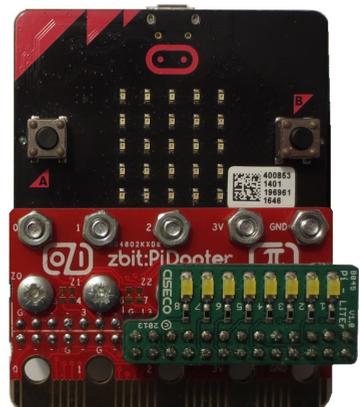
In this mode *no Raspberry Pi* is needed. Instead the **micro:bit** acts like (or '*emulates*') a **Raspberry Pi** by controlling **Raspberry Pi** accessories as if it was a **Raspberry Pi**. In this mode the main configuration is...

### Mode 2a) micro:bit + zbit:PiDapter + Raspberry Pi accessory

In this configuration a 40 way Header would need to be soldered to the top of **zbit:PiDapter**. **Raspberry Pi** accessories *from other manufacturers* could be then be plugged onto this Header. So like configuration (1f), **Raspberry Pi 'Sense Hats'** or '*Display Hats*' could be plugged in.

In this example **PiLite** is shown.

**Note** - Not all **Raspberry Pi** accessories will be compatible as it will depend on which GPIO they use. Also, any that require 5 Volts would not be compatible nor would any that require more than 100mA from 3.3 Volts.

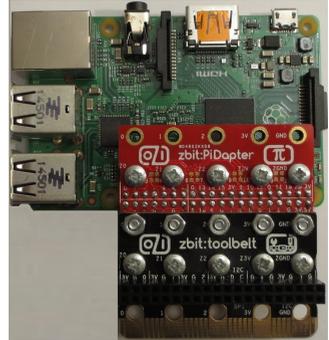


## Mode 3 - Raspberry Pi *emulating* a micro:bit

In this mode *no micro:bit* is needed. Instead the **Raspberry Pi** acts like (or '*emulates*') a **micro:bit** by controlling **micro:bit** accessories. In this mode the configurations are...

### Mode 3a) Raspberry Pi + zbit:PiDapter + zbit:toolbelt

In this configuration the **Raspberry Pi** could control boards such as **zbit:trol** or **zbit:shaker** which plug into the 40 way socket connector on **zbit:toolbelt**.

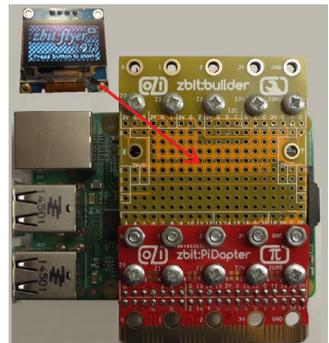


### Mode 3b) Raspberry Pi + zbit:PiDapter + zbit:builder

**zbit:builder** allows other electronic modules to be soldered on and connected to the **micro:bit**.

In this configuration the **Raspberry Pi** could instead control these modules soldered to **zbit:builder**.

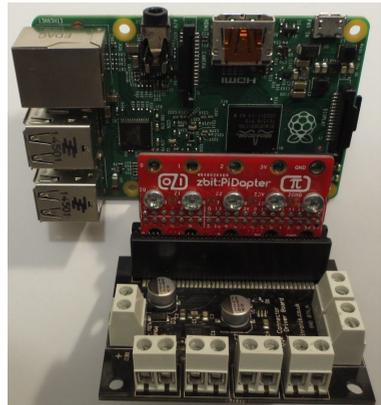
e.g. the I2C LCD Display shown.



### Mode 3c) Raspberry Pi + zbit:PiDapter + micro:bit accessory

In this configuration **micro:bit** accessories *from other manufacturers* could be used with the **Raspberry Pi**.

**Note** - Not all **micro:bit** accessories will be compatible as it will depend on which GPIO they use. Also, any **micro:bit** accessories which need **analog** GPIO inputs would not be compatible nor would some that need **PWM** GPIO outputs.



# zbit:pi:fix bars and xspacer board

The two **zbit:pi:fix bars** and **xspacer board** supplied with **zbit:PiDapter** can be used to mechanically secure **zbit:PiDapter** to the **Raspberry Pi**.

**zbit:PiDapter** can be fixed to all **Raspberry Pi's** that have a 40 way Headers *including PiZero* but it requires the following Screws, Nuts and Threaded Spacers that are *not* included with **zbit:PiDapter**.

8 x M2.5\* x 5mm Panel Head Screws

4 x M2.5\* x 8mm Threaded Spacers

2 x M3 x 6mm Panel Head Screws

2 x M3 Nuts

\* M3 Screws and Spacers *can* be used, however to do so the holes in the **Raspberry Pi** PCB need to be enlarged slightly to 3mm.

## **zbit:pi:fix Assembly Instructions:-**

- Replace **zbit:PiDapter's spacer board** with the **xspacer board**
- Attach the **micro:bit** to **zbit:PiDapter** and tighten all screws
- Fix the two **zbit:pi:fix bars** to the **xspacer board** using the M3 Screws and Nuts
- Fix the 4 x M2.5 x 8mm Threaded Spacers to the top surface of the **Raspberry Pi** using 4 x M2.5 x 5mm Panel Head Screws inserted from the back
- Plug **zbit:PiDapter's** 40 way Socket Connector into the **Raspberry Pi's** 40 way Header
- Fix the two **zbit:pi:fix bars** to the Threaded Spacers using the remaining 4 x M2.5 x 5mm Panel Head Screws

A picture of **zbit:pi:fix bars** fitted to a **Raspberry Pi** can be seen on page 2.

A picture of **zbit:pi:fix bars** fitted to a **PiZero** can be seen on page 11.