Build your own Bat Detector!

Bats use ultra-sonic pulses to navigate and to detect prey. These pulses are very high pitch (around 5 times the maximum frequency humans can hear).
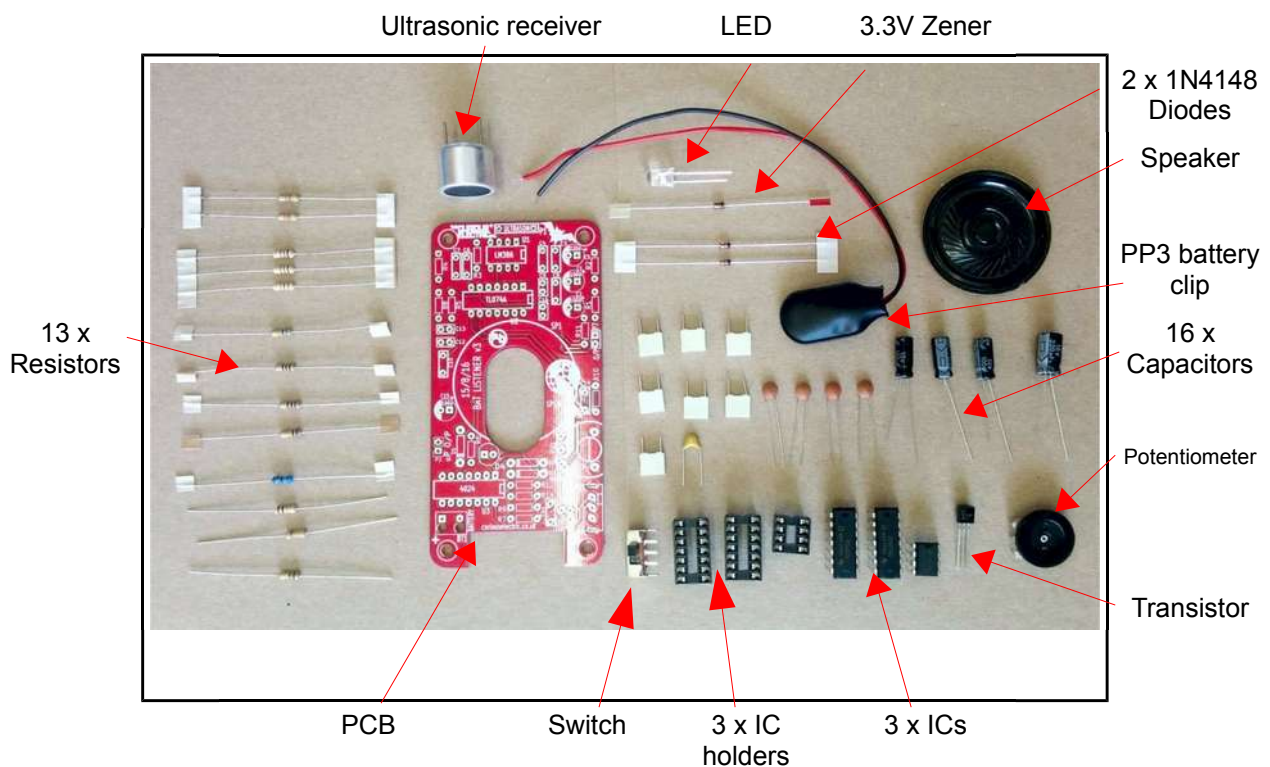
This electronic circuit converts the high pitched sounds produced by bats to a human-audiable level.

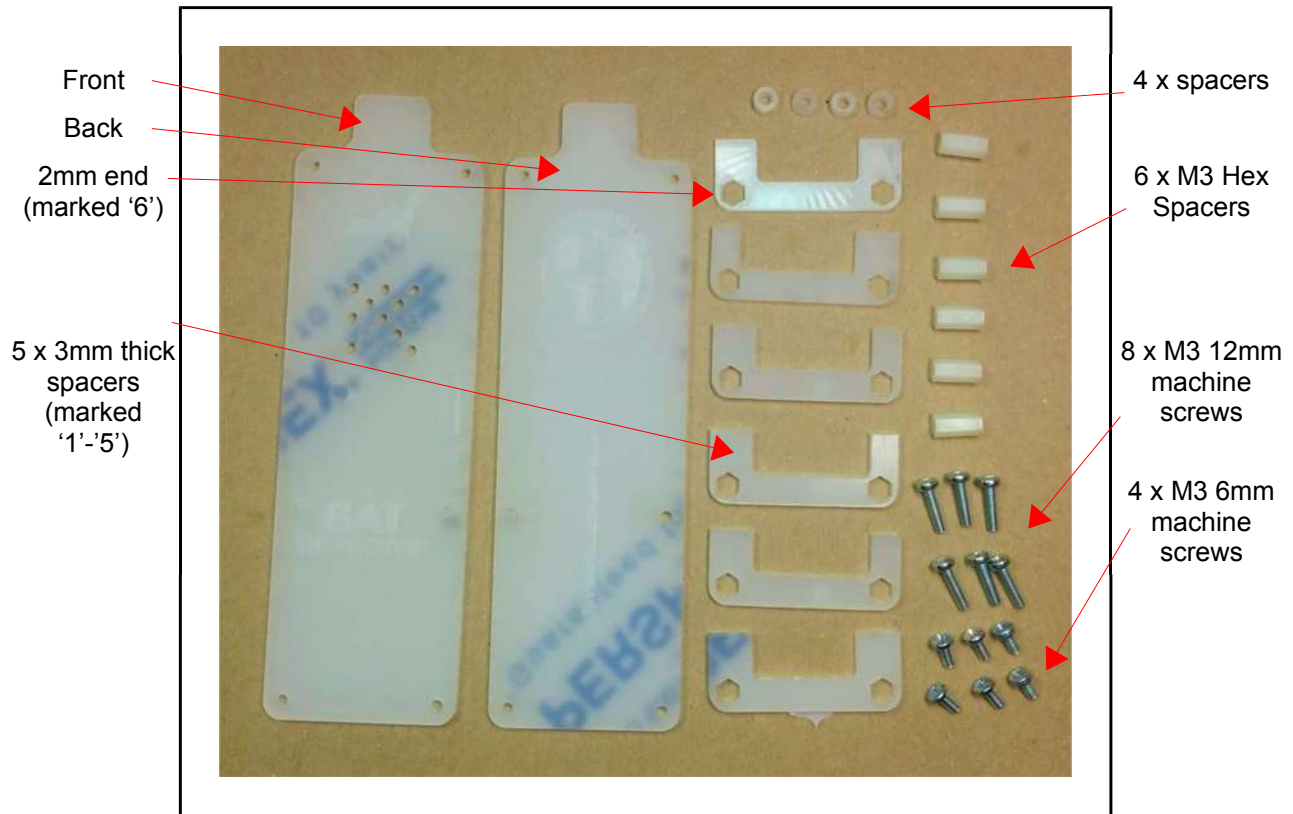It has a sensitivity control to adjust for different conditions.

It can also be used to listen to other high frequencies such as peeling sticky tape, compact fluorescent lights and power supplies.

This kit, although easy to build, requires quite a lot of soldering so will take in the region of 2-3 hours.

Parts included:

Ultrasonic receiver   LED   3.3V Zener

2 x 1N4148 Diodes

Speaker

PP3 battery clip

16 x Capacitors

Potentiometer

Transistor

13 x Resistors

PCB   Switch   3 x IC holders   3 x ICs

Enclosure Parts:

Front
Back
2mm end (marked '6')
5 x 3mm thick spacers (marked '1'-'5')

4 x spacers
6 x M3 Hex Spacers
8 x M3 12mm machine screws
4 x M3 6mm machine screws

Parts list:

Item	Ref	Item	Ref
PP3 Battery Clip	BT1	47k Resistor	R1, R2
100uf Capacitor	C1, C2, C15	10 ohm Resistor	R3
220nf Capacitor	C3	1.3k Resistor	R4
47nf Capacitor	C4, C6	150k Resistor	R5
220uf Capacitor	C5	100k Resistor (*Note: Use a 10k here if connecting to an Arduino*)	R6
2.2nf Capacitor	C7	1k Resistor	R7,R8,R14
1.5nf Capacitor	C8	470k Resistor	R9
100pf Capacitor	C9, C16	560k Resistor	R10
1nf Capacitor	C10	100 ohm Resistor	R11
33nf Capacitor	C11	10k Resistor	R12
470pf Capacitor	C12,C13	20k Potentiometer	RV1
100nf Capacitor	C14	40mm Loudspeaker	SP1
3.3V Zener Diode	D1	Switch	SW1
1N4148 small signal Diode	D2,D3	LM386 Audio Amplifier IC	U1

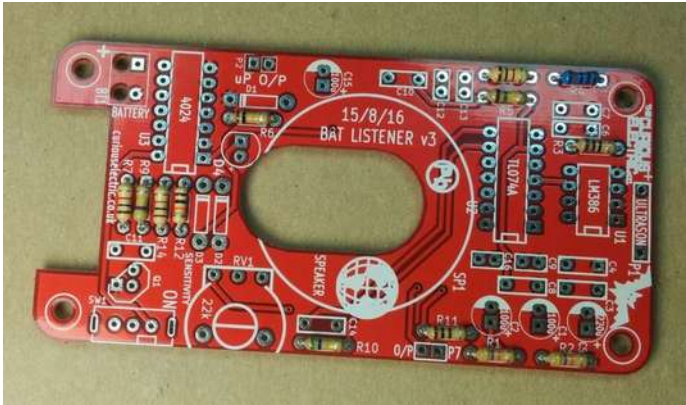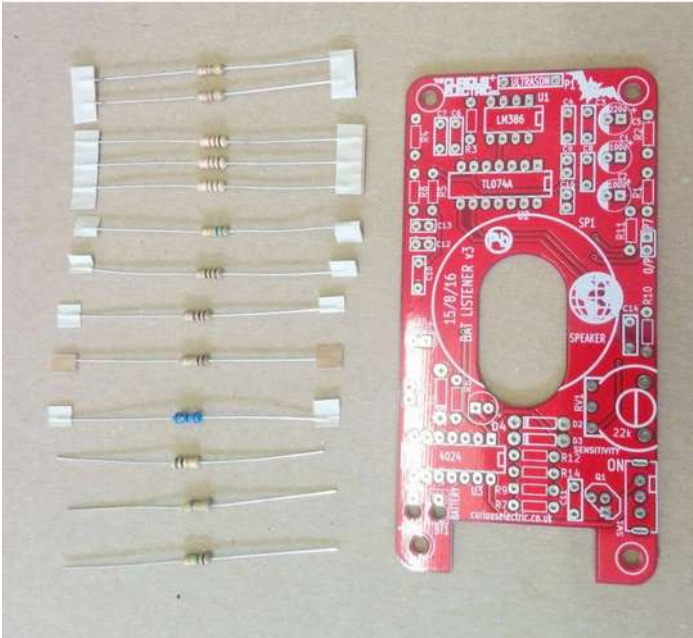|			
5mm Red LED	D4	TL074A Quad-comparator IC	U2
Ultrasonic Receiver	P1	4024 Counter IC	U3
BC337 Transistor	Q1		
Enclosure			
Front	x1	3mm PCB spacer rings	x4
Back	x1	M3 Hex spacers 9mm	x6
2mm clear plastic spacer (marked '6')	x1	M3 6mm machine screws	x4
3mm frosted plastic spacer (numbered '1' - '5')	X5	M3 12mm machine screws	x8

Tools required:

PCB Instructions:

Step: 1	Solder resistors

Value	Ref	Colour
47k	R1, R2	Yellow, Violet, Orange, Gold
10	R3	Brown, Black, Black, Gold
1.3k	R4	Brown, Orange, Black, Brown, Brown (**This resistor is blue**)
150k	R5	Brown, Green, Yellow, Gold
~~100k~~ * 10k	R6	Brown, Black, Orange, Gold
1k	R7,R8,R14	Brown, Black, Red, Gold
470k	R9	Yellow, Violet, Yellow, gold
560k	R10	Green, Blue, Yellow, Gold
100	R11	Brown, Black, Brown, Gold
10k	R12	Brown, Black, Orange, Gold

Insert and solder the resistors. Polarity does not matter for resistors. Ensure they are soldered flat close to the PCB.

Use a multimeter or colour code chart to ensure correct resistor values.

* Note: R6 is only needed if using the arduino connection. 10k, rather than 100k, should be used.

| Step: 2	Solder capacitors

First solder the non-polarised capacitors. Orientation of these does not matter:

Value	Ref	Marking
220nf	C3	.22K63 (cream box)
47nf	C4, C6	47nK100 (cream box)
2.2nf	C7	2n2K100 (cream box)
1.5nf	C8	152 (brown blob)
100pf	C9, C16	101 (brown disk)
1nf	C10	1nK100 (cream box)
33nf	C11	33nK100 (cream box)
470pf	C12,C13	471 (brown disk)
100nf	C14	.1K63 (cream box)

Note: You may need a magnifying glass for reading the text on these capacitors.

Next solder the polarised capacitors. Ensure correct orientation of these components.
The negative lead is marked with a white strip. The positive lead is slightly longer than the negative. Align the positive lead with the + sign and the negative lead with the white PCB marking.

Value	Ref	Marking
100uf Capacitor	C1, C2, C15	10V 100uf
220uf Capacitor	C5	16V 220uf
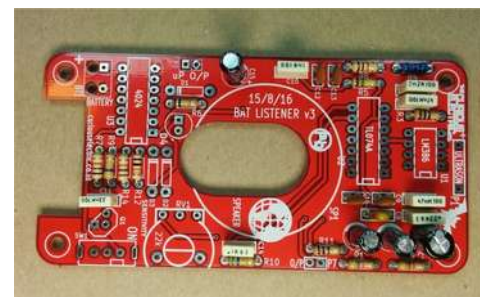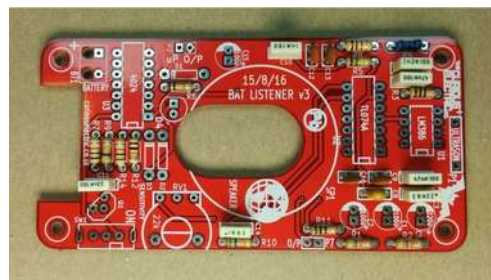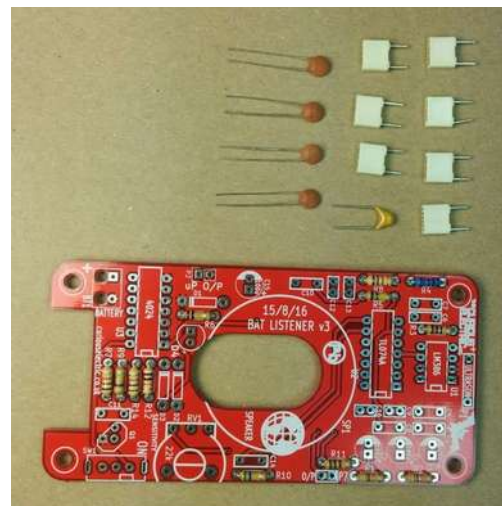
Step: 3	Solder diodes
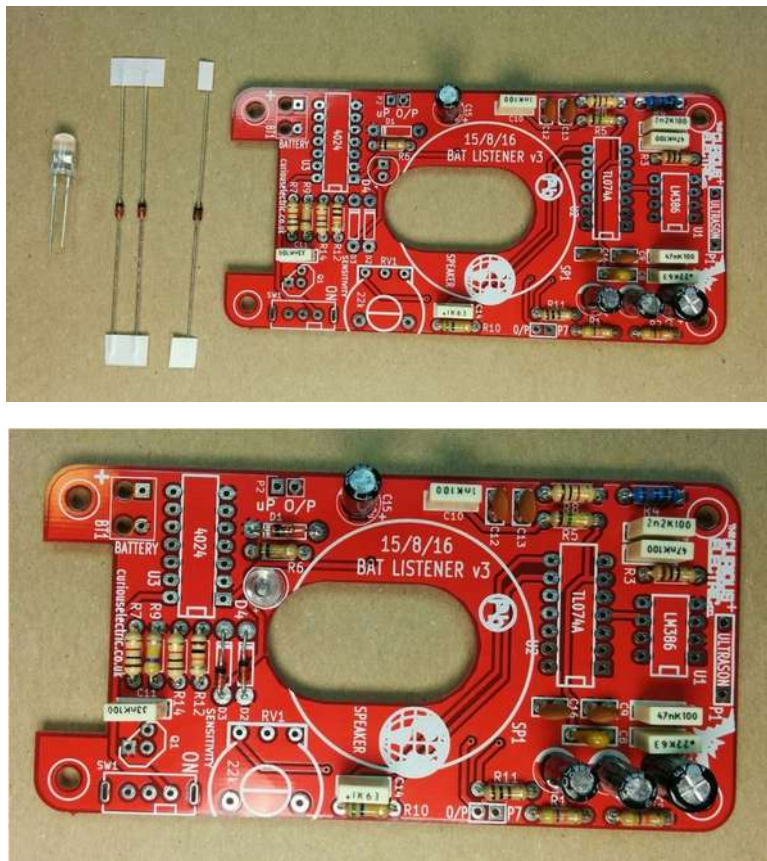
There are 4 diodes to solder. Ensure correct orientation for these components.

First solder the LED into D4. The long lead is positive, so place that into the hole marked +. The negative side is slightly flat.

Then solder the 3.3V zener diode into D1. This diode is on its own and has very tiny marking of "3V3". Ensure the black band aligns with the white band marked on the PCB.
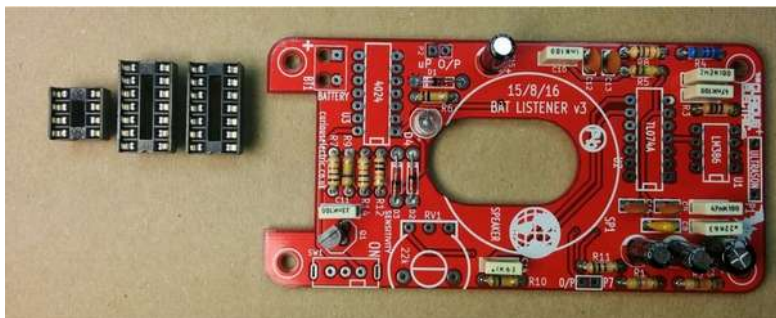
Then solder the remaining 2 diodes into D2 and D3. These have tiny markings saying "4148". Ensure the black band aligns with the white band marked on the PCB.

Step: 4	Solder transistor

There is just one transistor to solder, Q1, BC337.
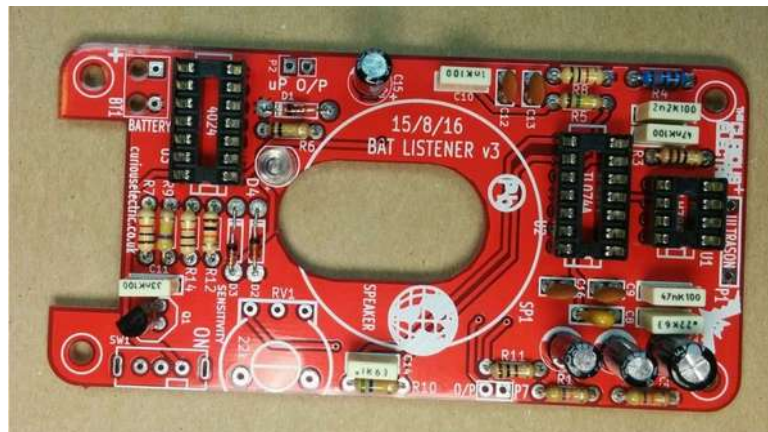Ensure the flat side of the transistor aligns with the PCB markings.
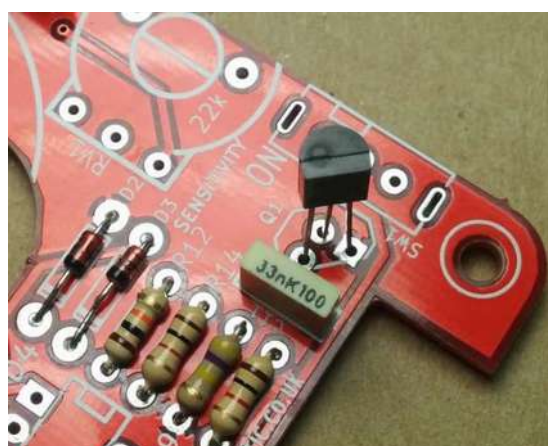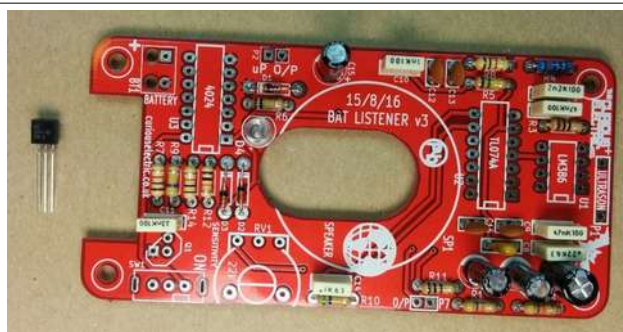
Step: 5	Solder IC holders

There are two 14 pin IC holders and one 8 pin IC holder. These fit into the areas marked U1, U2 and U3.

Ensure correct orientation!

Ensure the notch on the holder aligns with the notch shown on the PCB.

Step: 6	Solder Switch and Potentiometer

The switch fits into the holes marked SW1. The switch knob goes off the PCB. Solder all metal tabs.

The potentiometer fits into the holes marked RV1. There are 5 pins to align and the pins might need slightly moving to ensure they align correctly.
Solder all metal tabs.
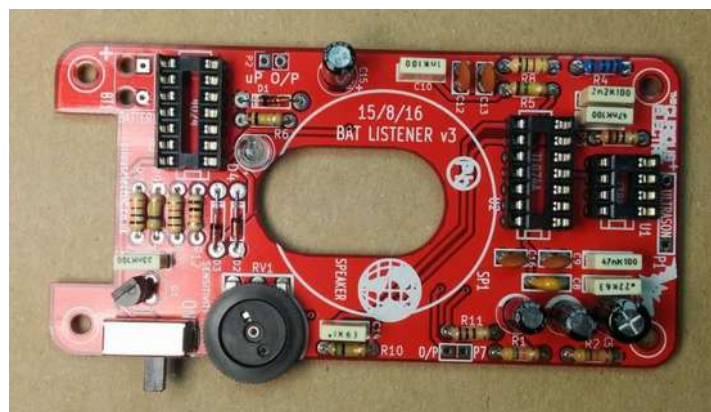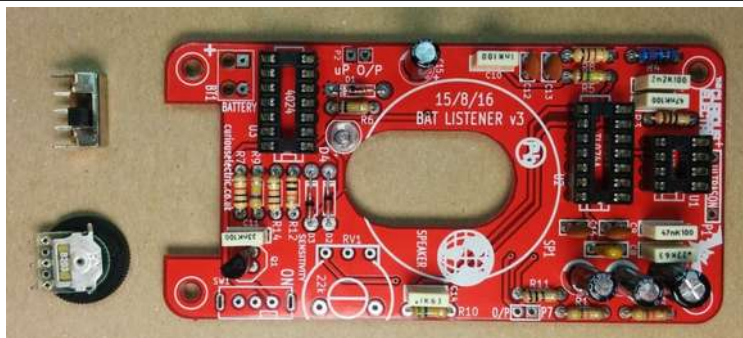
Step: 7	Solder the ultrasonic receiver

The ultrasonic receiver has two pins, one is attached to the metal case of the unit, the other has a small ring around it.

The pin with the small ring around it is the +ve connection and this pin fits in the hole with the + symbol. The ground fits next to the indicator P1.

Carefully bend the legs to 90 degrees to the receiver is facing away from the PCB.
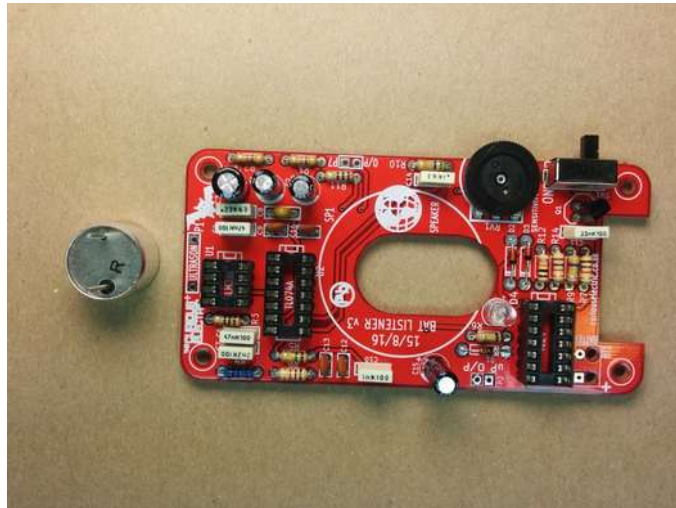

Step: 8	Solder Speaker
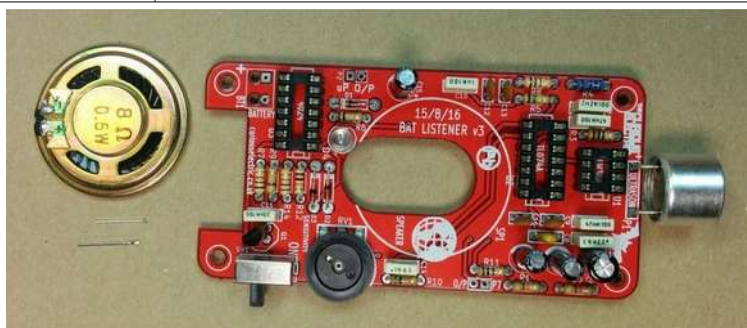
The speaker has a slightly unusual mounting method.

The speaker base fits through the large hole in the PCB and the speaker tabs align with the PCB tabs.

Use an offcut of resistor lead and solder two small leads from the PCB (as shown). Carefully bend the legs to 90 degrees before soldering in position facing away from the PCB.

Then put the speaker in place and solder the small wires to the speaker.

This method holds the speaker in place, as well as being the electrical connection.
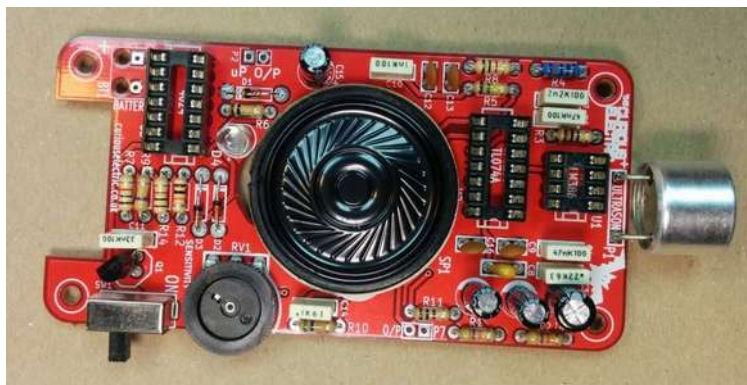
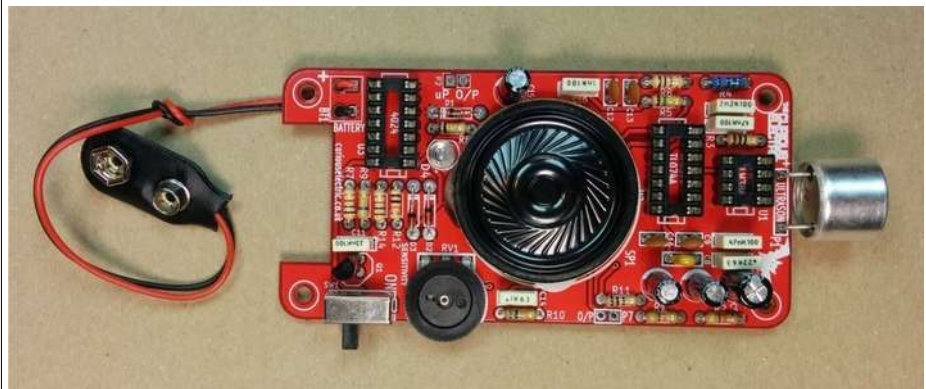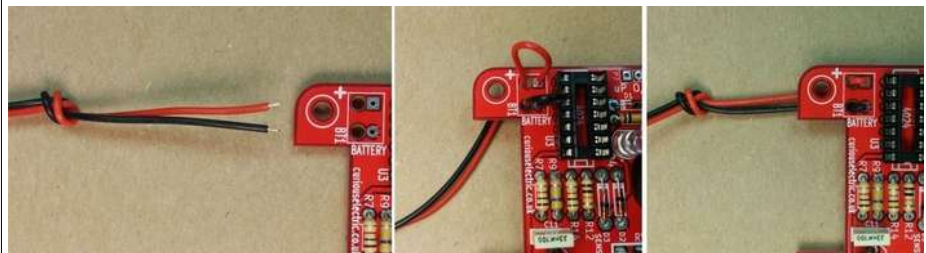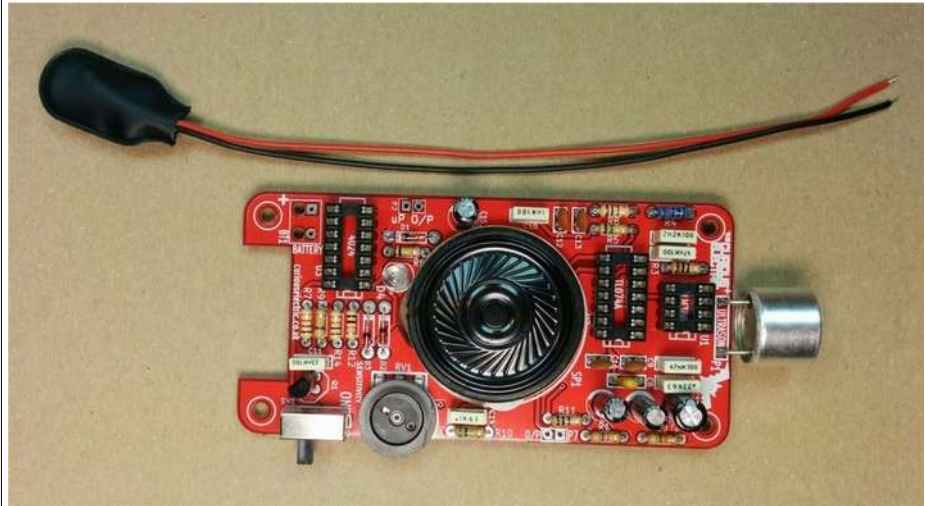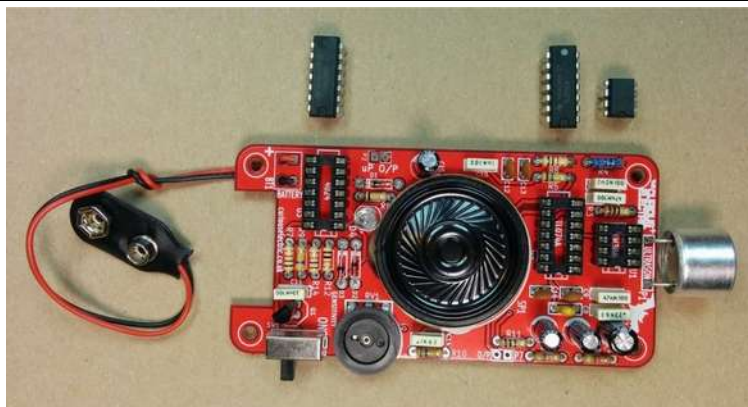| **Step: 9**	Solder PP3 battery connector

Nearly there!
The PP3 battery clip as two wires: one positive (red) and one negative (black).

I usually put a knot in the cable for strain relief.

The cables then go through the larger holes from the underside and are fed back into the solder pads.

The red cable goes through the hole to the pad marked "+".

Step: 10	Insert ICs

Now we need to insert the ICs into their holders.
Ensure the notches align with the notches on the IC holders and the PCB.

U1 is the LM386 (8 pin)
U2 is the TL074A (14 pin)
U3 is the 4024 (14 pin)

Step: 11	Insert battery and test

Add a PP3 9V battery to the battery clip. Switch the unit on. You may hear a squeal from the device. Adjust the potentiometer until you just do not hear any noise. The red LED should also flash when the speaker clicks. Use a reel of sticky tape to test. Slowly peel the tape off the reel and you should hear crackles from the speaker. This is picking up high frequency sound from the glue breaking. You can also test by pointing at a compact fluorescent light bulb. These switch at around 100kHz and hence give off ultrasonic noise.	

Step: 12	PCB is finished!

|	Have a nice cup of tea.

Enclosure Instructions:

Step: 1	Push out laser-cut parts and peel off protective layer
Sometimes not all the small laser-cut pieces have been removed. These can be pushed out using the point of a screwdriver. Only slight force should be required.	
There is a protective film on one side of the laser cut parts. This can be removed by peeling off the film.	

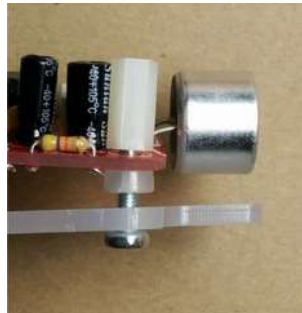| **Step: 2**	Screw down the PCB
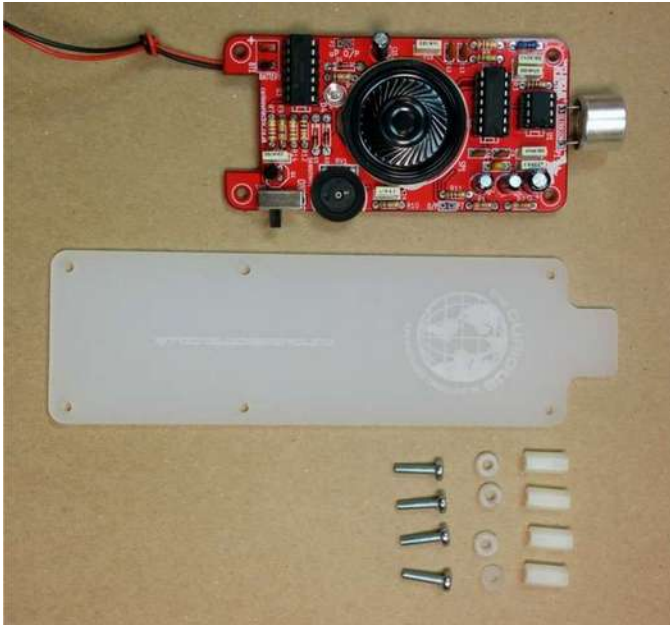
The PCB is held onto the back plate using 4 of the M3 12mm screws and the hex spacers.

The back plate has the text facing to the back.

The screws fit through the back plate then through a small circular spacer ring and then through the PCB.

It is then held in place using the threaded hex spacer.

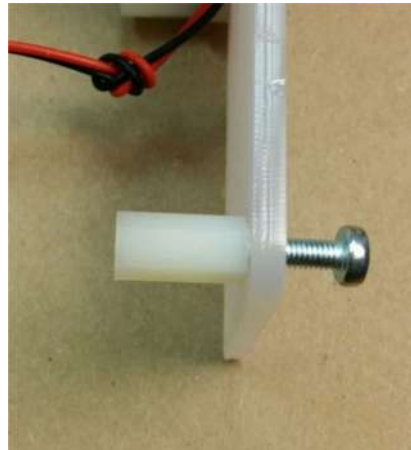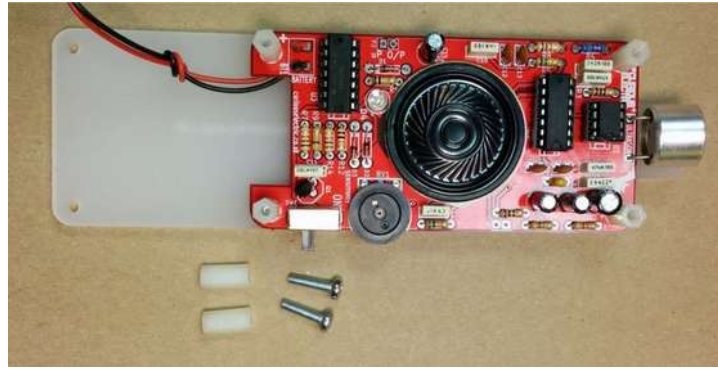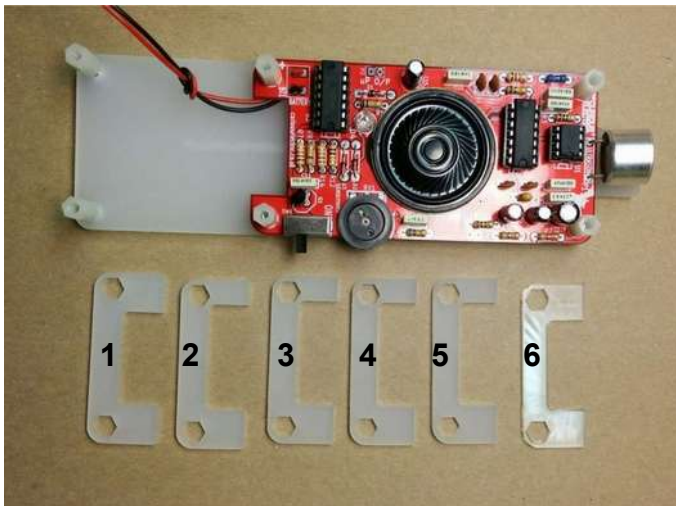Do this for all four corners of the PCB.

Step: 3	Add end spacers

To hold the end spacers in place we again use the 12mm screws and 2 of the hex spacers.

Put them through the back plate and slightly screw the hex spacer onto the screw.

Do not fully tighten this, as it will need to spin to be adjusted in the next step.

Step: 4	Add battery holders

The battery holders are 6 spacers which holds one end of the battery, with the other end being held the notch in the PCB.

There are three types of spacer:

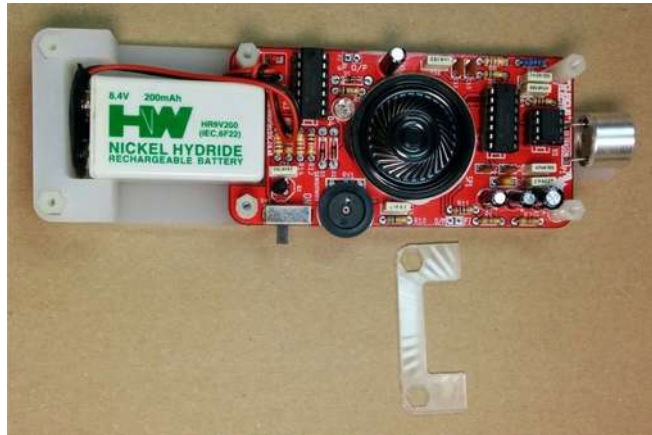1 x narrow 3mm spacer (in white frosted plastic, marked "1")

4 x wide 3mm spacers (marked "2", "3", "4" & "5").

1 x narrow 2mm spacer in clear plastic (marked "6").

These fit onto the hex spacers we just added.

First add the narrow 3mm piece(marked "1").

Then the 4 wide 3mm pieces (marked "2", "3", "4" & "5").

1   2   3   4   5   6

SIDE VIEW

Put the battery into the enclosure. The PP3 battery clip fits within the wider section, with the cable able to come out of the side.

The final narrow 2mm spacer (marked "6") is put on top.

Step: 5	Fit top cover

The front cover is then put on with the text facing upwards. Use the 4 x 6mm M3 machine screws to hold the front cover in place to the PCB holes and the final 2 x 12mm M3 machine screws to hold the end spacers in place.
These fasten into the threaded hex spacers.

Note: Some covers do not have the hole for the LED. The LED can be seen through the frosted plastic, so it is not needed.

Step: 6	Finished!

That is the unit finished!

The on/off switch and the potentiometer are accessible via the side of the unit.

You now have your own bat detector.

There are many things you can investigate including:

Nature: monitor bats, mice and rats

Electrical: Check the sound from switching power supplies and fluorescent lights

Please note: *This unit is NOT waterproof. Do NOT leave outside if it will get wet.*

Contact details:

We would like you to be happy with this kit. If you are not happy for any reason then please contact us and we will help to sort it out.

Please email **hello@curiouselectric.co.uk** with any questions or comments.
Please tweet us at **@curiouselectric**

If any parts are missing from your kit then please email **hello@curiouselectric.co.uk** with details and, if possible, where the kit was purchased.

More technical information can be found via **www.curiouselectric.co.uk**

This kit has been designed and produced by:
The Curious Electric Company
hello@curiouselectric.co.uk
www.curiouselectric.co.uk
Hopkinson, 21 Station Street, Nottingham, NG2 3AJ, UK

History

This kit is based upon a circuit originally published by Elektor Electronics:
http://www.elektor.com/magazines/2011/november/simple-bat-detector.1971945.lynkx

and was originally developed as a workshop for Nottingham Hackspace:
www.nottinghack.co.uk

Circuit Schematic

Resistor Colour Codes

	1st Digit	2nd Digit	3rd Digit	Multiplier	Tolerance	Temperature Coefficient
				0.01	10%	
				0.1	5%	
0	0	0	0	1		
1	1	1	1	10	1%	100ppm
2	2	2	2	100	2%	50ppm
3	3	3	3	1k		15ppm
4	4	4	4	10k		25ppm
5	5	5	5	100k	0.5%	
6	6	6	6	1M	0.25%	
7	7	7	7	10M	0.1%	
8	8	8	8		0.05%	
9	9	9	9			

4 Bands — 4.7KΩ, 10%

5 Bands — 68KΩ, 5%

6 Bands — 560KΩ, 0.1%