Kitronik

CREATE YOUR OWN ELECTRONIC MUSICAL INTRUMENT WITH THIS

XYLOPHONE KIT
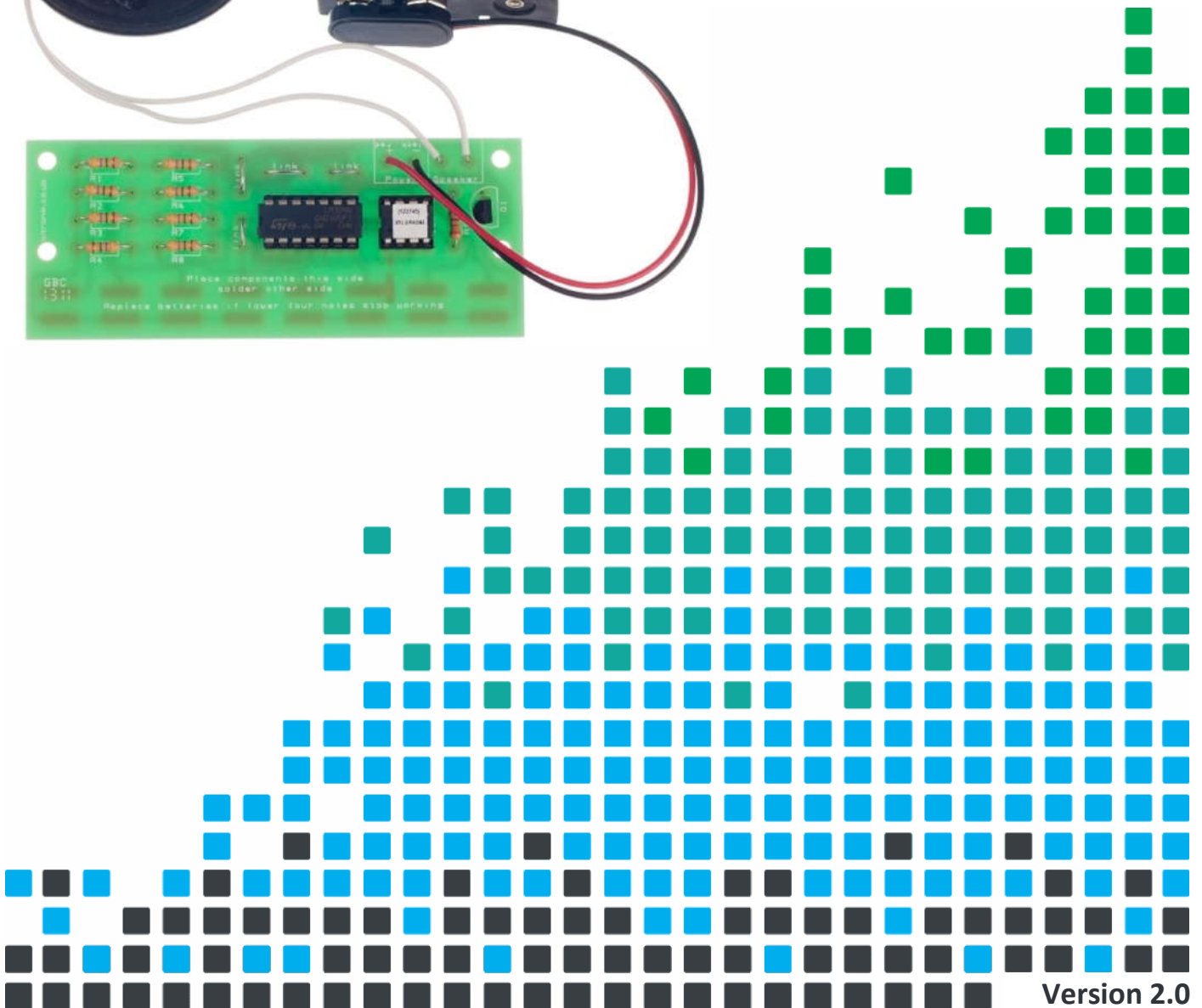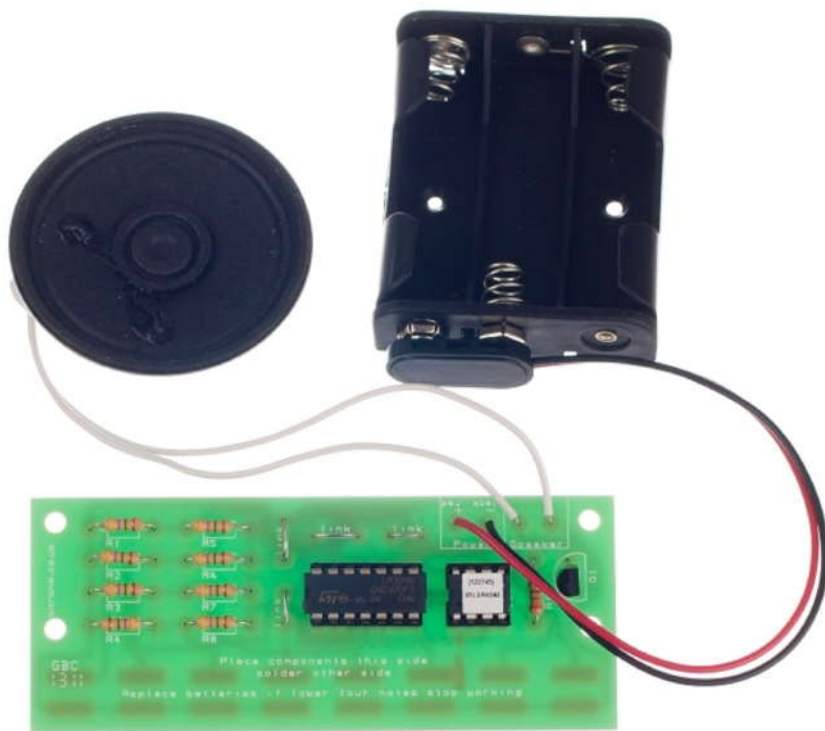
Version 2.0

Build Instructions

Before you start, take a look at the Printed Circuit Board (PCB). The components go in the side with the writing on and the solder goes on the side with the tracks and silver pads.

1 PLACE RESISTORS

Start with the nine resistors:
The text on the PCB shows where R1, R2 etc go.
Ensure that you put the resistors in the right place.

PCB Ref	Value	Colour Bands
R1 to R8	4.7MΩ	Yellow, violet, green
R9	3.3kΩ	Orange, orange, red

2 CONNECT THE WIRES

Solder the four wire links into place. You will need to cut and strip the pieces to the correct size. The places that these need to go are indicated on the PCB by four solid white lines and the text 'link'.

3 SOLDER THE SMALLEST IC HOLDER

Solder the smallest Integrated Circuit (IC) holder into IC1. When putting this into the board, be sure to get it the right way around. The notch on the IC holder should line up with the notch on the lines marked on the PCB.

4 SOLDER THE LARGEST IC HOLDER

Solder the largest Integrated Circuit (IC) holder into IC2. When putting this into the board, be sure to get it the right way around. The notch on the IC holder should line up with the notch on the lines marked on the PCB.

5 SOLDER THE TRANSISTOR

Solder the transistor into Q1. Take care to ensure that the 'D' shape of the transistor lines up with the 'D' shape on the PCB.

6 ATTACH THE BATTERY CLIP

The battery connector should be soldered into the 'Power' terminal. The red wire must go to the '+' terminal and the black wire must go to the '-' terminal.

7 **CONNECT THE SPEAKER**

To connect the speaker to you need to cut two pieces of wire to the desired length. Strip both ends and solder them into 'Speaker' and the other end to the tabs on the speaker. The wires can go either way around.

8 **INSERT THE IC CHIP**

The ICs can now be put into the holders, ensuring that the notch on the chips line up with the notch on the holders.

Checking Your Xylophone PCB

Check the following before you insert the batteries:

Check the bottom of the board to ensure that:
- All holes (except the 4 large 3mm holes) are filled with the lead of a component.
- All these leads are soldered.
- Pins next to each other are not soldered together.

Check the top of the board to ensure that:
- The notch on both of the ICs and the IC holders are in the same orientation as the markings on the printed circuit board.
- The colour bands on R9 are Orange, orange and red.
- The red wire on the battery connector goes to the '+' terminal on the power terminals and the black wire goes to the '-' terminal.
- The 'D' shape of the transistor and the board marking line up.

Testing the PCB

The software on the microcontroller has been specially designed to allow easy testing of the PCB.

When the batteries are inserted the xylophone will:
- Produce a short bleep.
  - If it does not beep use the fault finding flow chart to find the cause of the fault.
- Once the unit has finished its short bleep, test that all of the keys work correctly.
  - If it does not beep use the fault finding flow chart to find the cause of the fault.
- To turn the system off disconnect the batteries.

Adding an On / Off Switch

If you wish to add a power switch, don't solder both ends of the battery clip directly into the board, instead:

1

Solder one end of the battery clip to the PCB, either black to '-' or red to '+'.
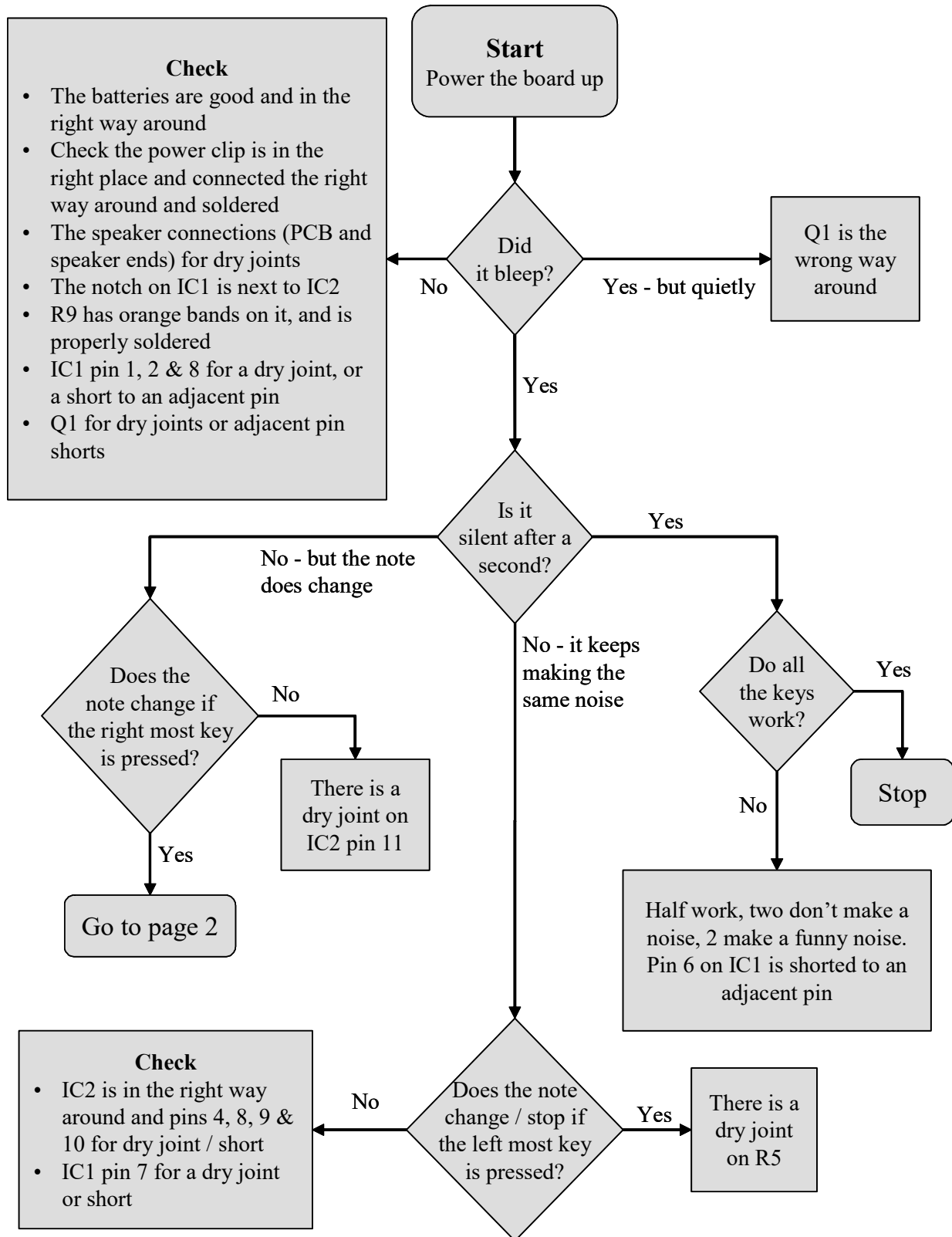

2

Solder the other end of the battery clip to the on / off switch.

3

Using a piece of wire, solder the remaining terminal on the on / off switch to the remaining power connection on the PCB.

Fault finding flow chart

Start
Power the board up

Did it bleep?

- No →
- Yes - but quietly → Q1 is the wrong way around
- Yes ↓

Check
- The batteries are good and in the right way around
- Check the power clip is in the right place and connected the right way around and soldered
- The speaker connections (PCB and speaker ends) for dry joints
- The notch on IC1 is next to IC2
- R9 has orange bands on it, and is properly soldered
- IC1 pin 1, 2 & 8 for a dry joint, or a short to an adjacent pin
- Q1 for dry joints or adjacent pin shorts

Is it silent after a second?

- No - but the note does change →
- Yes →
- No - it keeps making the same noise ↓

Does the note change if the right most key is pressed?
- No → There is a dry joint on IC2 pin 11
- Yes → Go to page 2

Do all the keys work?
- Yes → Stop
- No → Half work, two don't make a noise, 2 make a funny noise. Pin 6 on IC1 is shorted to an adjacent pin

Does the note change / stop if the left most key is pressed?
- No →
- Yes → There is a dry joint on R5

Check
- IC2 is in the right way around and pins 4, 8, 9 & 10 for dry joint / short
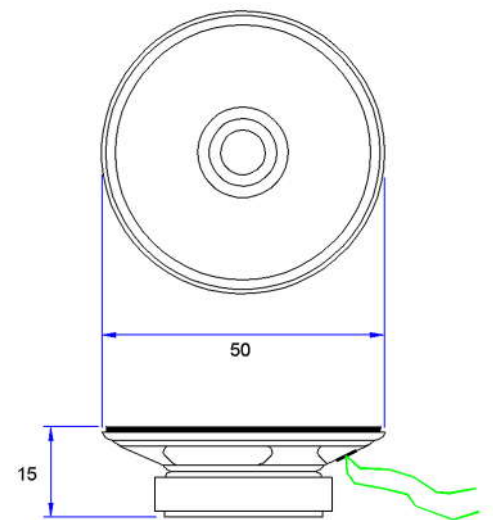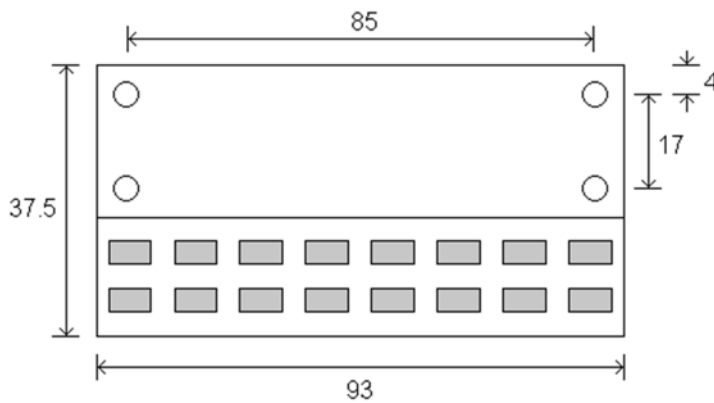- IC1 pin 7 for a dry joint or short

Designing the Enclosure

When you design the enclosure, you will need to consider:

- The size of the PCB (below, top left).
- Where and how accessible the keys will be.
- Where the speaker will be mounted (top right).
- Access to the batteries to allow them to be changed (bottom right).

Technical drawings of these items are illustrated on this page, which should help you to design your enclosure.
All dimensions are in mm.
x4 PCB mounting holes are 3.3mm diameter.

Mounting the PCB to the enclosure

The drawing to the left shows how a hex spacer can be used with two bolts to fix the PCB to the enclosure.

*Your PCB has four mounting holes designed to take M3 bolts.*
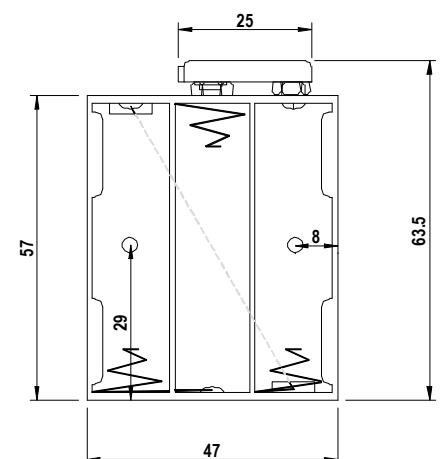
Speaker Grill

The speaker grill pattern below has been designed for the speaker supplied. The three outer points have been designed as retaining points for holding the speaker in place.

The grill is printed to size and can be used when developing your enclosure design as well as for a template for drilling the holes when you are building your enclosure. The recommended drill size is 5mm, except for the three outer points which may need to be different depending upon how these are used to secure the speaker.
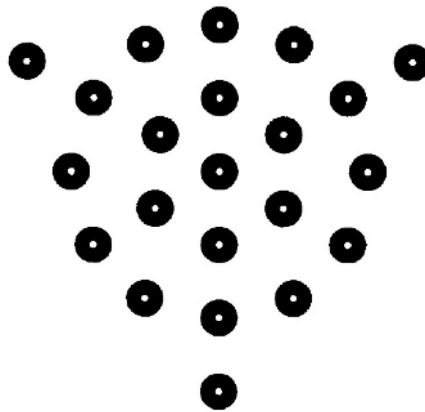
How the Xylophone Works
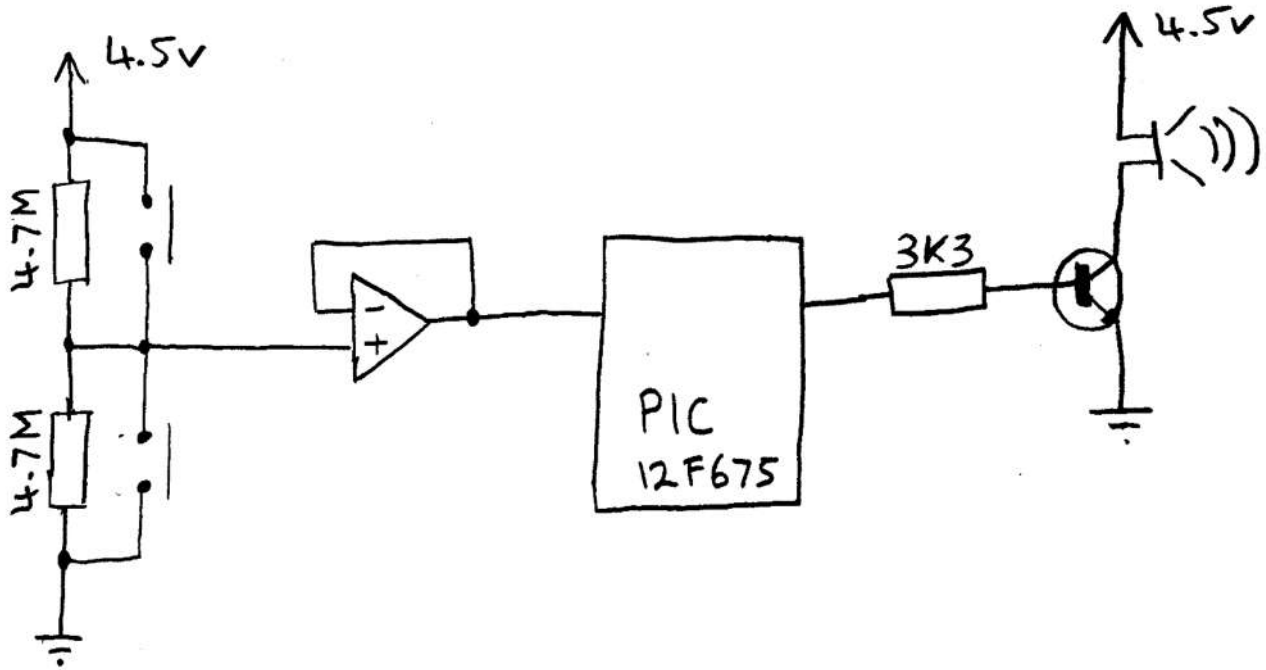
The circuit (above) only shows two of the eight keys as the other six work in the same way. The switches used on the xylophone are formed from tracks on the PCB. These have been placed close together so that when a finger is placed on them, there is a resistance created between the pads. The typical resistance of a finger is around 2 - 8 MΩ.. Two 4.7MΩ resistors are used to make a potential divider, the centre of which will have half the voltage of the power supply. The switches are placed across these resistors and cause the voltage at the centre of the potential divider to move up or down, depending on which switch is pressed. This voltage is fed into an operational amplifier (op amp) that has a unity gain. This means that the output of the op amp is the same as the input. Whilst this might sound a little pointless, the drive power of the input at 10 MΩ is very weak and not good enough to drive the microcontroller's inputs. What the op amp does is impedance match the switches so that they can be read by the microcontroller.

The microcontroller, which is like a small computer, reads the four channels (two keys per channel) and decides if the voltage has moved from the default centre position. If the voltage it reads is above or below the centre voltage, it sounds the appropriate note for the key that has been pressed. This is done by turning a transistor on and off very quickly, depending on which note is being sounded somewhere between 400 and 1000 times each second. The transistor acts as a switch to drive the speaker. This is needed because the microcontroller is not powerful enough to drive the speaker directly.

Online Information

Two sets of information can be downloaded from the product page where the kit can also be reordered from. The 'Essential Information' contains all of the information that you need to get started with the kit and the 'Teaching Resources' contains more information on soldering, components used in the kit, educational schemes of work and so on and also includes the essentials. Download from:

www.kitronik.co.uk/2105

🇬🇧 This kit is designed and manufactured in the UK by Kitronik

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