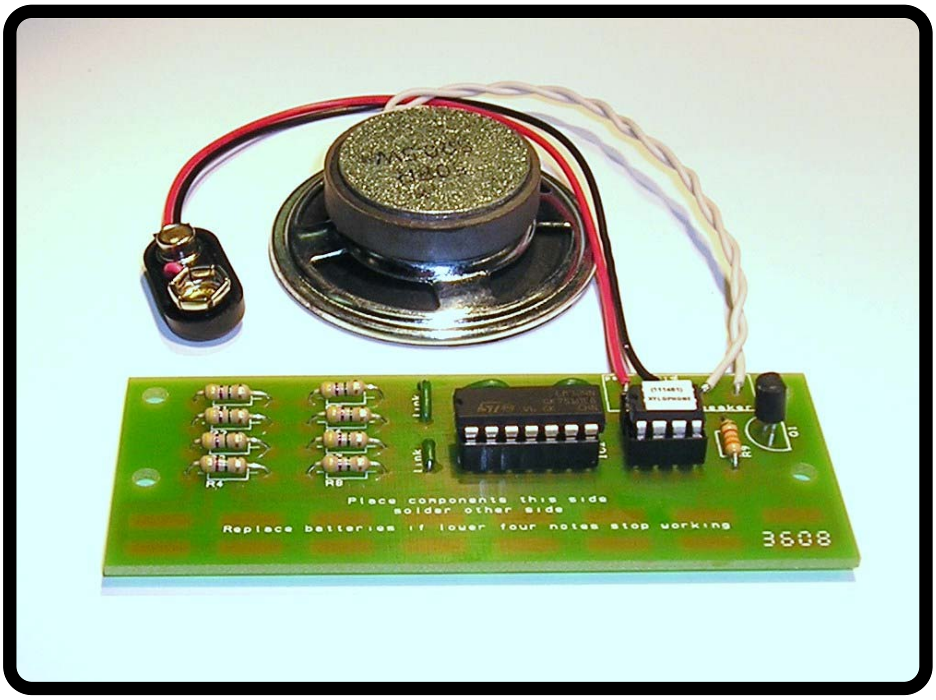
Xylophone



Build Instructions

Issue 1.2

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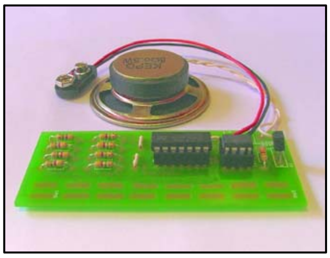
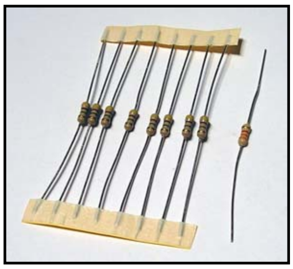


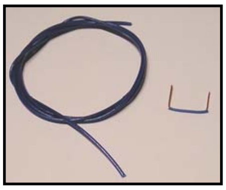
Before you put any components in the board or pick up the soldering iron, just take a look at the Printed Circuit Board (PCB). The components go in the side with the writing on and the solder goes on the side with the tracks and silver pads.

You will find it easiest to start with the small components and work up to the taller larger ones. If you've not soldered before get your soldering checked after you have done the first few joints.

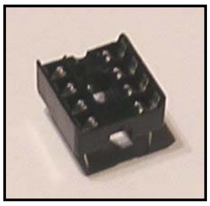


Step 1
Start with the nine small resistors (shown right):
R1to R8 are 4.7MΩ (Yellow, Violet, Green coloured bands).
R9 is 3.3kΩ (Orange, Orange, Red coloured bands).

The text on the board shows where R1, R2, etc go. Make sure that you put the resistors in the right place.

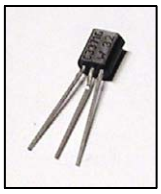


Step 2
Solder the four wire links into place. You will need to cut and strip the pieces to the correct size. The places that these need to go are indicated on the PCB by four solid white lines and the text 'link'.



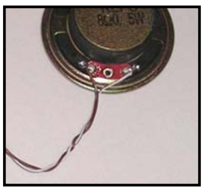
Step 3
Solder the smallest Integrated Circuit (IC) holder in to IC1. When putting this into the board, be sure to get it the right way around. The notch on the IC holder should line up with the notch on the lines marked on the PCB.

Step 4
Solder the largest Integrated Circuit (IC) holder (shown left) in to 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.



Step 5
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.

Step 6
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.



Step 7
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.

Adding an on / off switch
- Solder one end of the power clip to the PCB, either black to '-' or red to '+'.
- Solder the other end of the power clip to the on / off switch.
- Using a piece of wire, solder the remaining terminal on the on / off switch to the remaining power connection on the PCB.

Step 8
The IC's can now be put into the holders ensuring the notch on the chips line up with the notch on the holders.

Checking Your PCB

Check the following before you insert the batteries:

Check the bottom of the board to ensure that:

- All holes (except the 4 large 3 mm 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 IC's 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.

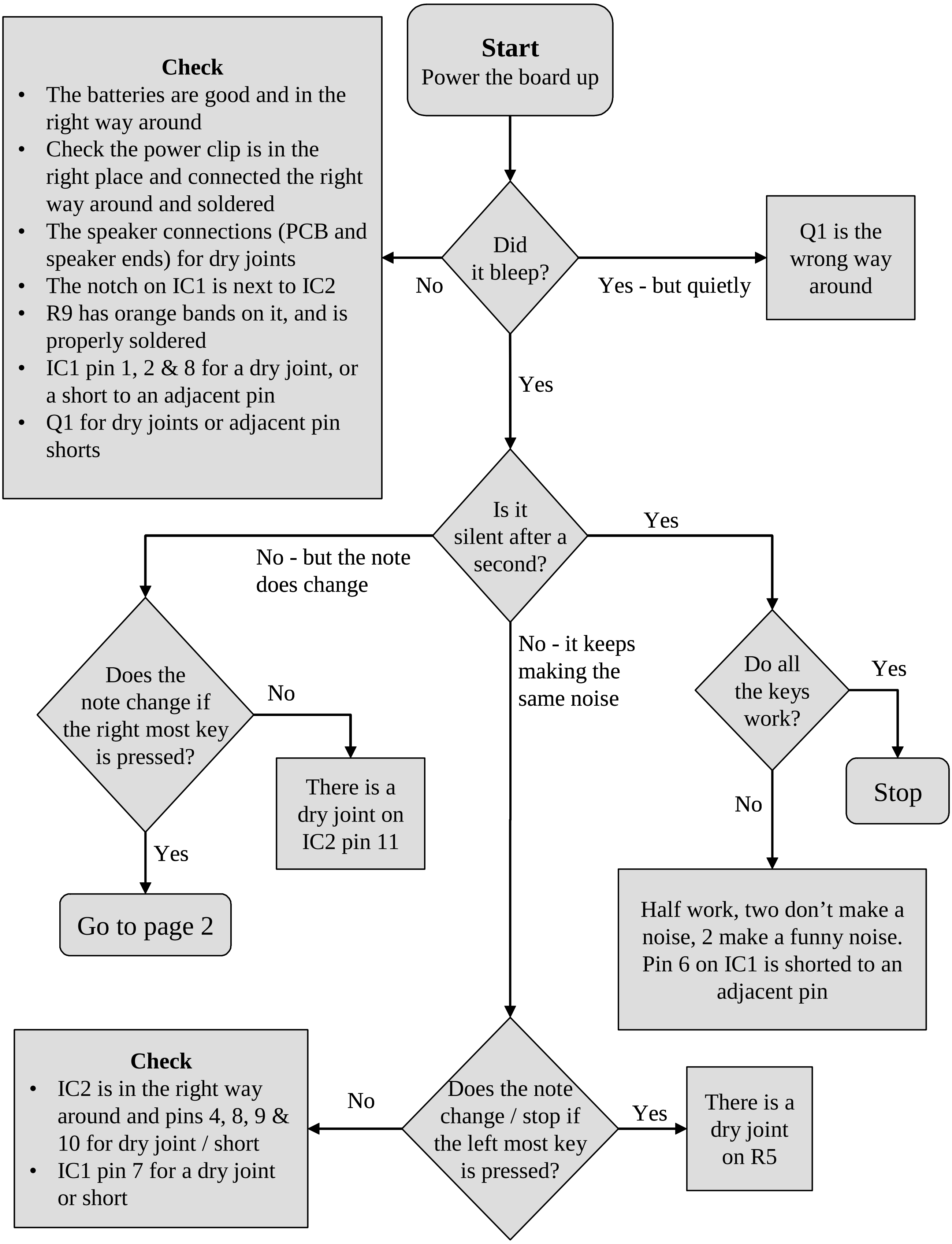
Testing the PCB

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

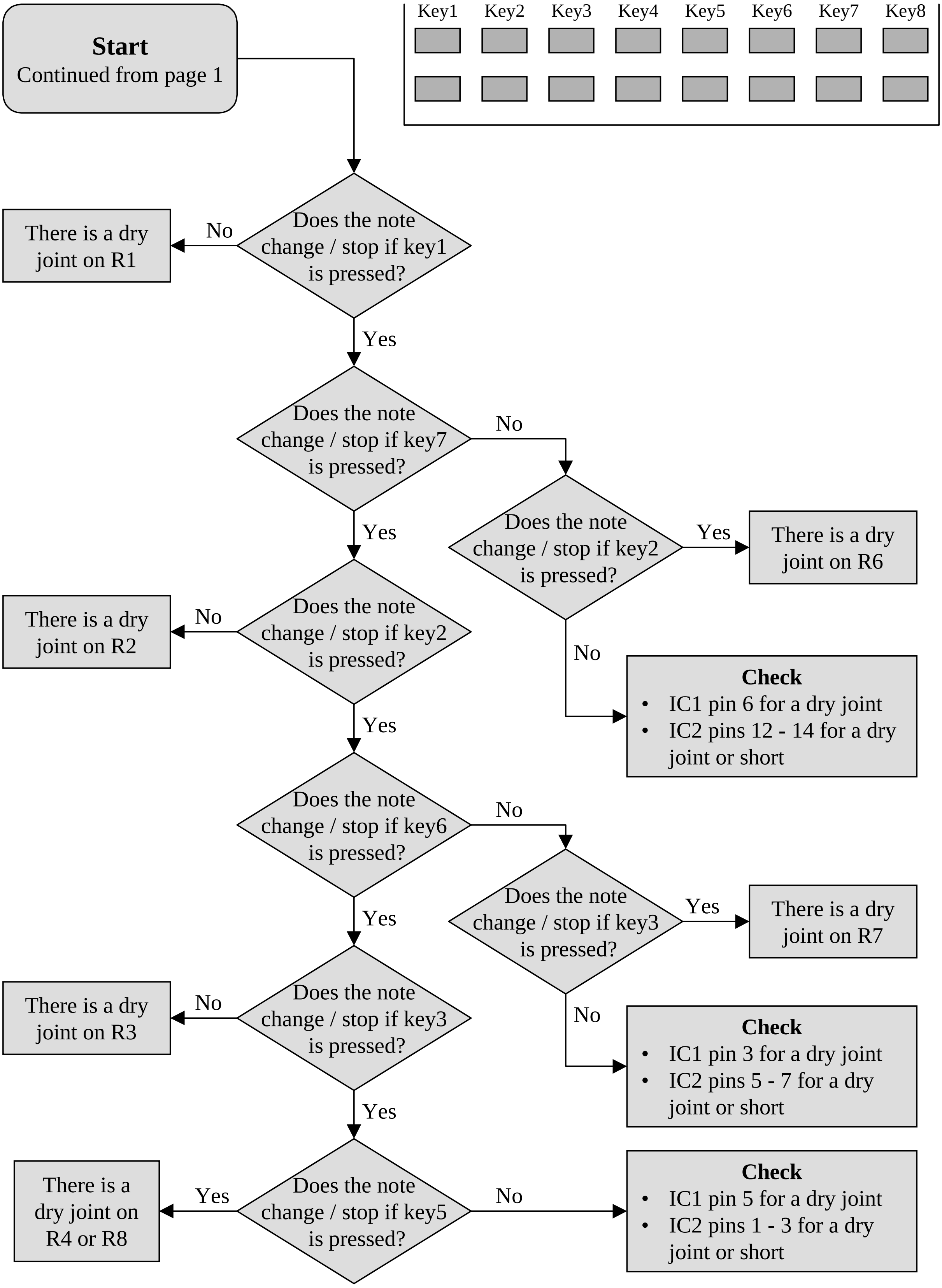
When the batteries are inserted the xylophone will:

- 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 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.

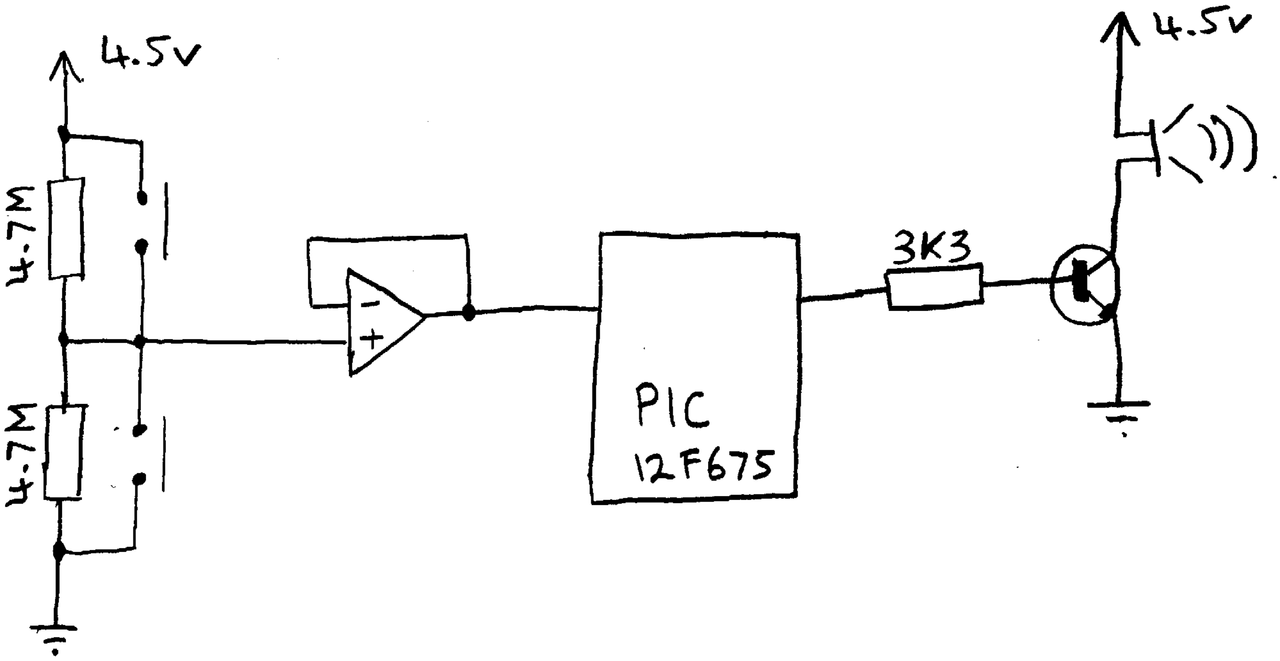
Fault finding flow chart



Fault finding flow chart - Page 2



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 resisters 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 microcontrollers inputs. What the op amp does is impedance match the switches so 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 center 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.