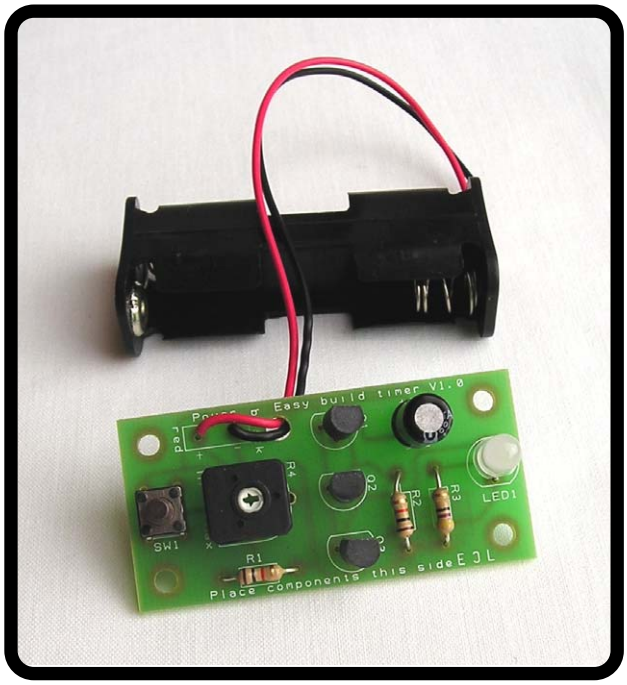
Easy Build Timer



Build Instructions

Issue 1.2

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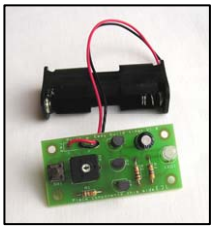
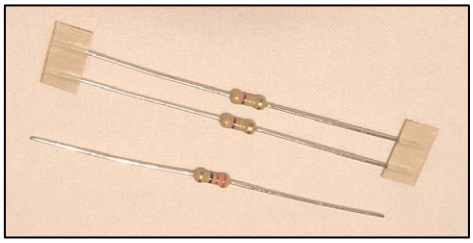


Before you put any components in the board or pick up the soldering iron, just take a look at the Printed Circuit Board (PCB). The components go in the side with the writing on and the solder goes on the side with the tracks and silver pads. You will find it easiest to start with the small components 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 three small resistors (shown right):
R1 and R2 are 10KΩ (Brown, Black, Orange coloured bands)
R3 is a 47Ω (Yellow, Purple, Black coloured bands)



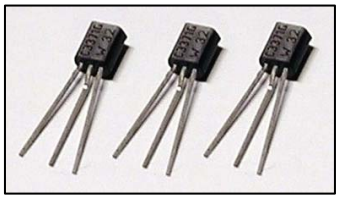
The text on the board shows where R1, R2, etc go.
Make sure that you put the resistors in the right place.

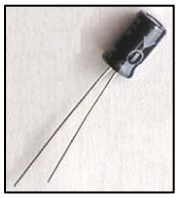
Step 2

Solder R4 - the variable potentiometer
(Pictured left) in to the PCB where it is labeled R4.

Step 3

The three transistors (shown right) are all the same type so it doesn't matter which one goes where, so long as they are soldered into Q1, Q2, Q3 on the board. You will notice that the transistors are a 'D' shape and the outline on the PCB is also a 'D' shape, make sure that the transistor lines up with the markings on the board.





Step 4

Solder the electrolytic capacitor in to C1. It is important that the '–' on the capacitor line up with the ---- markings on the PCB.
Using an electrolytic capacitor backwards could result in it being destroyed.

Step 5

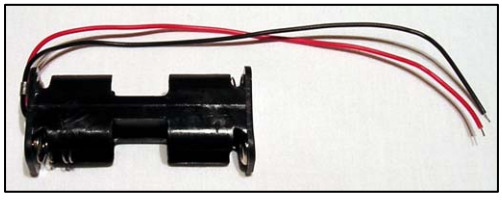
Solder the Light Emitting Diode (LED) (shown right) in to LED1. The LED colours will be the wrong way around it doesn't go in correctly. If you look carefully one side of the LED has a flat edge, which must line up with the flat edge on the lines on the PCB.

Step 6

The push button switch (shown left) should be soldered in to the board where it is labeled SW1. Once you have got the pins lined up with the holes the switch can be pushed firmly into place.

Step 7

Finally you must attach the battery holder (shown right). Start by feeding the leads through the strain relief hole next to the '-' connection. The wire should be fed in from the rear of the board.



The red lead should be soldered to the '+' terminal (also marked with text 'red') and the black lead should be soldered to the '-' terminal (also marked with the text 'black').

Checking Your Timer 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 'D' shape on the transistors match the board marking.
- Resistor R3 has yellow, purple, black bands on it.
- The 'D' shape on the LED matches the board marking.
- The white band / '-' signs on the capacitor are nearest R2 / R3.
- The red wire on the battery connector goes to the + terminal on the power terminals and the black wire goes to the – terminal.

Testing the PCB

Turn the potentiometers to minimum (as marked on the PCB – fully anti-clockwise).
Then insert the batteries. The LED should:

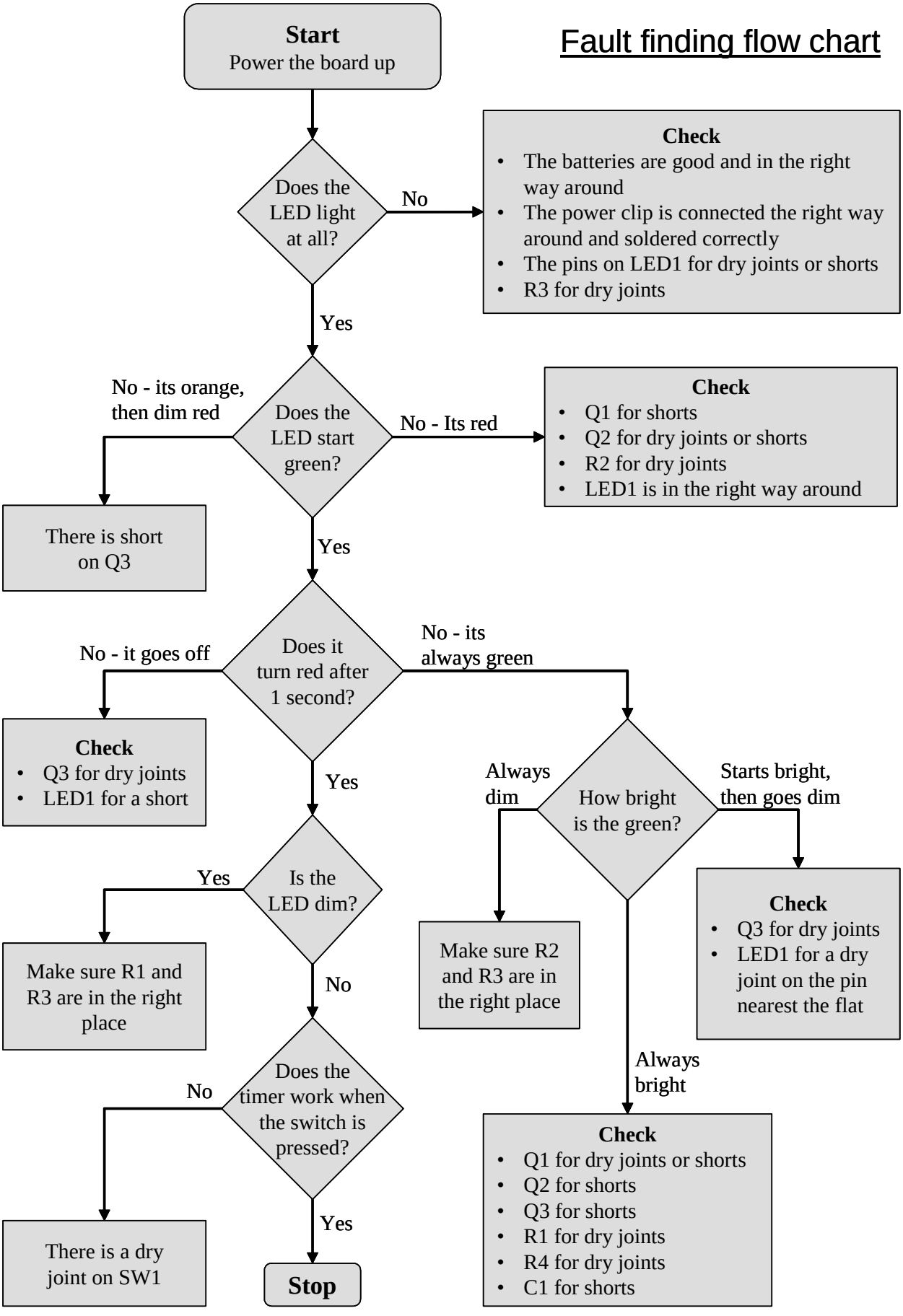
- Be green for 1 second.
- Then turn red.

When the button is pressed and released the same green, then red pattern should occur.

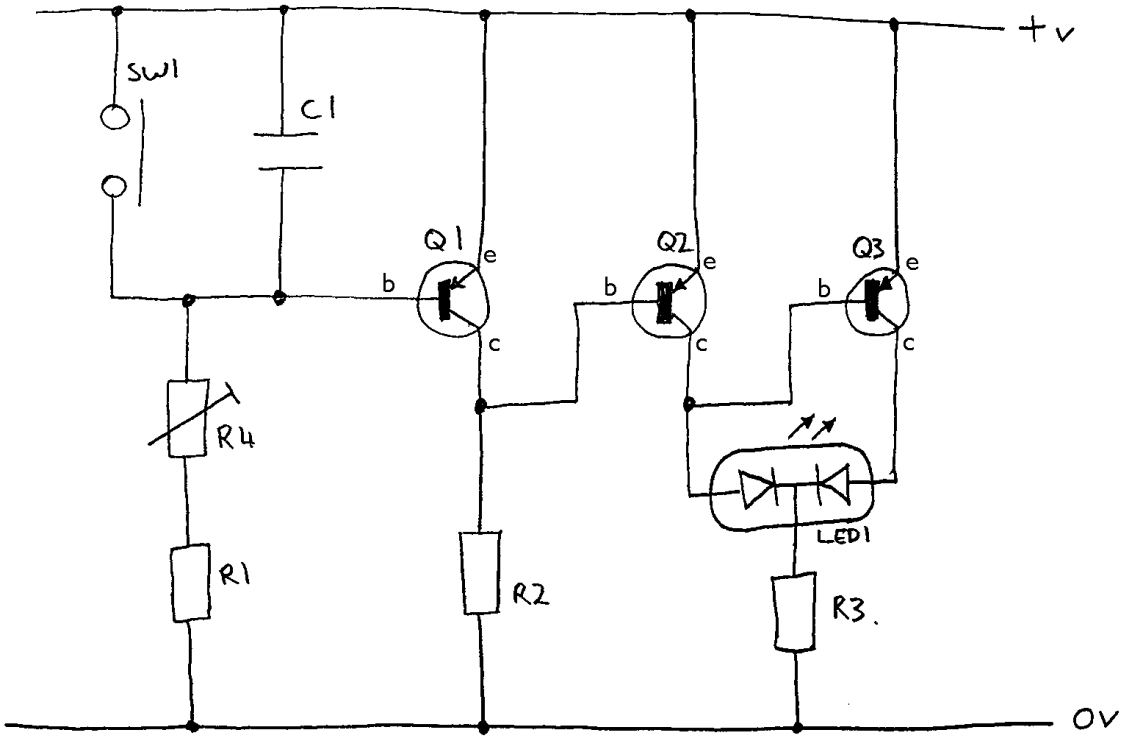
You can now set the timer to the required period by adjusting R4.

If the timer doesn't work correctly check your PCB again, then use the fault finding flow charts to find the cause of the fault.

Fault finding flow chart



How the Timer Works



When the power is connected to the circuit, capacitor C1 will start to fill. As this fills with charge the voltage across it gets bigger. The variable resistor R4 controls the speed at which the capacitor fills.

The three transistors in this circuit are PNP transistors. These allow current to flow from the emitter to the collector, when there is 0.7 volts between the emitter and the base. As capacitor C1 charges the voltage across it and also across the emitter base of Q1 increases, when this reaches 0.7 volts the transistor turns on. At this point Q2 turns off and Q3 turns on and the LED changes from green to red.

The gain of a transistor (called Hfe) is about 200. This means that the amount of current that can flow through the emitter collector is 200 times bigger than the current that flows into the base. In this circuit to get a long delay the variable resistor can be as big a 1 MΩ or 1,000,000Ω. This means that the amount of current flowing into Q1 is very small. R2 has been chosen so that the gain of Q1 is 100 times. Since the current flowing into the base of Q2 is 100 times bigger than the current flowing into the base of Q1 it is able to turn the LED on. Q3 is connected so that as Q2 turns on, it turns off, such that only the red or the green LED is on at any one time.

R3 is used to limit the amount of current flowing into the LED, this determines how bright the LED is.

Finally when the button is pressed to reset the timer the capacitor C1 discharges through the button. As soon as this is released C1 starts to charge again. R1 is included incase the variable resistor is set to zero. As without it, when the switch is pressed lots of current would flow from the battery into the switch. This very high current flow would cause the switch, interconnecting wire and battery to become damaged.