

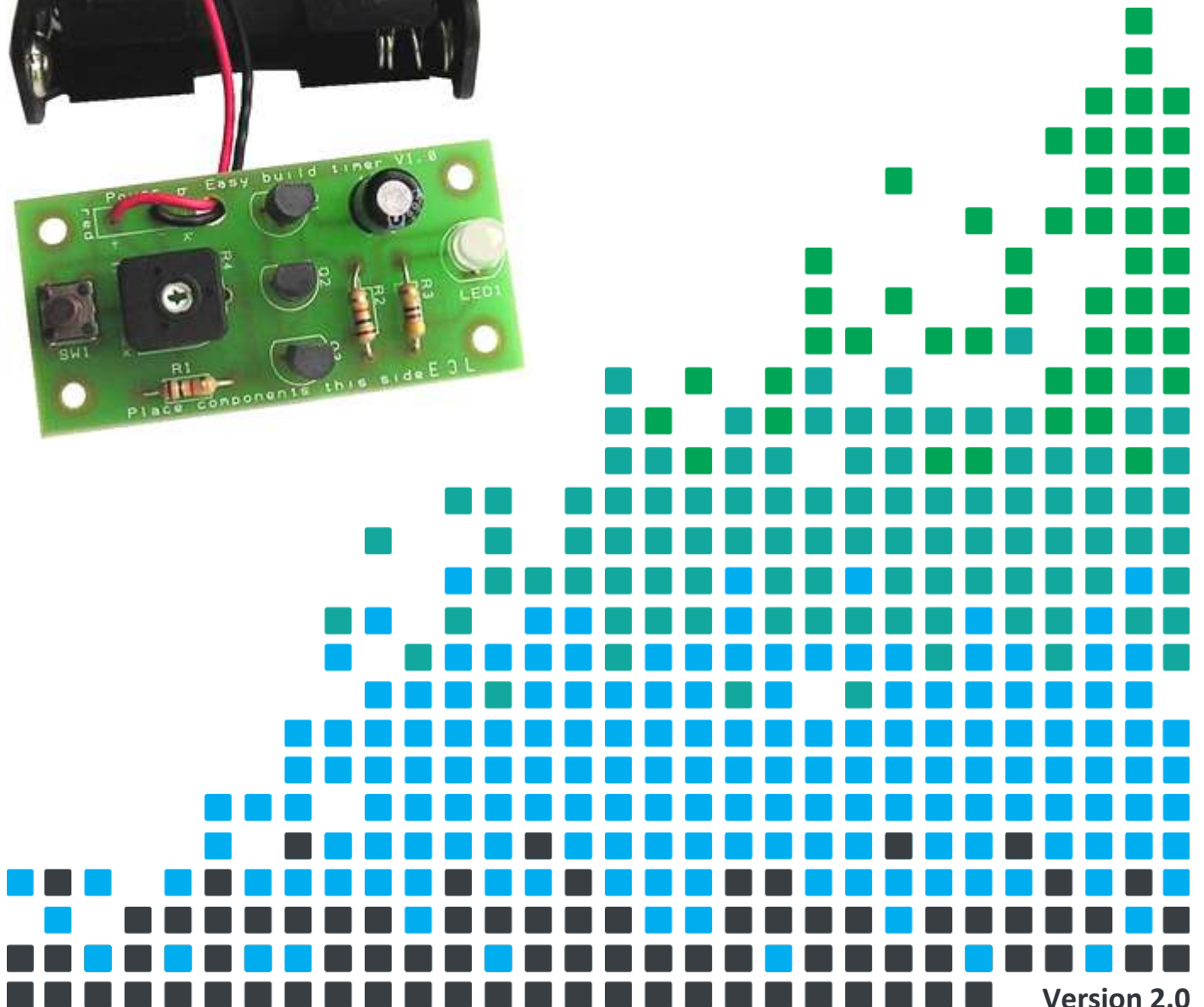
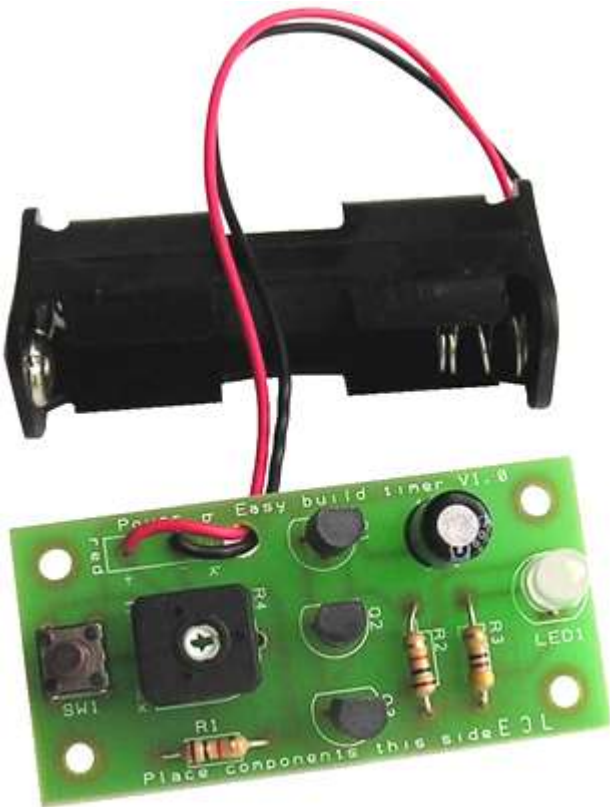


## ESSENTIAL INFORMATION

BUILD INSTRUCTIONS  
CHECKING YOUR PCB & FAULT-FINDING  
MECHANICAL DETAILS  
HOW THE KIT WORKS

LEARN ABOUT SIMPLE TIMING CIRCUITS WITH THIS

# EASY BUILD TIMER 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 three 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 & R2	10K $\Omega$	Brown, black, orange
R3	47 $\Omega$	Yellow, purple, black



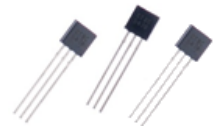
### 2 SOLDER THE POTENTIOMETER

Solder the variable potentiometer into the PCB where it is labelled R4.



### 3 SOLDER THE TRANSISTORS

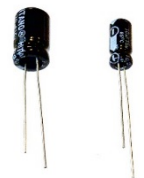
The three transistors are all the same type so it doesn't matter which one goes where, so long as they are soldered into Q1, Q2, Q3 on the board. You will notice that the transistors are a 'D' shape and the outline on the PCB is also a 'D' shape, make sure that the transistor lines up with the markings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



### 4 SOLDER THE ELECTROLYTIC CAPACITORS

Solder the electrolytic capacitor into C1. It is important that the '-' on the capacitor lines up with the '- ---' markings on the PCB.

**Using an electrolytic capacitor backwards could result in it being destroyed.**



### 5 SOLDER THE LED

Solder the Light Emitting Diode (LED) into LED1. The LED colours will be the wrong way around if 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.



## 6

### SOLDER THE PUSH BUTTON SWITCH

The push button switch should be soldered into the board where it is labelled SW1. Once you have got the pins lined up with the holes, the switch can be pushed firmly into place.

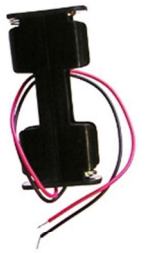


## 7

### FIT THE BATTERY HOLDER

Finally you must attach the battery holder. 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 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 '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 your timer doesn't work as described, use the 'Checking Your Timer PCB' information above.



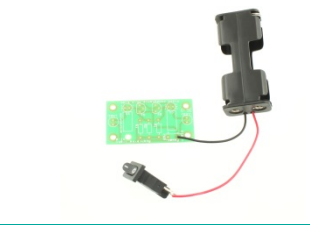
## Adding an On / Off Switch

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

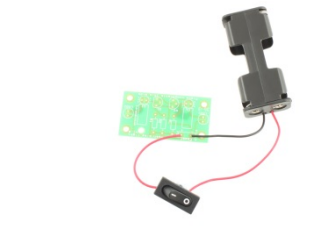
1

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


2

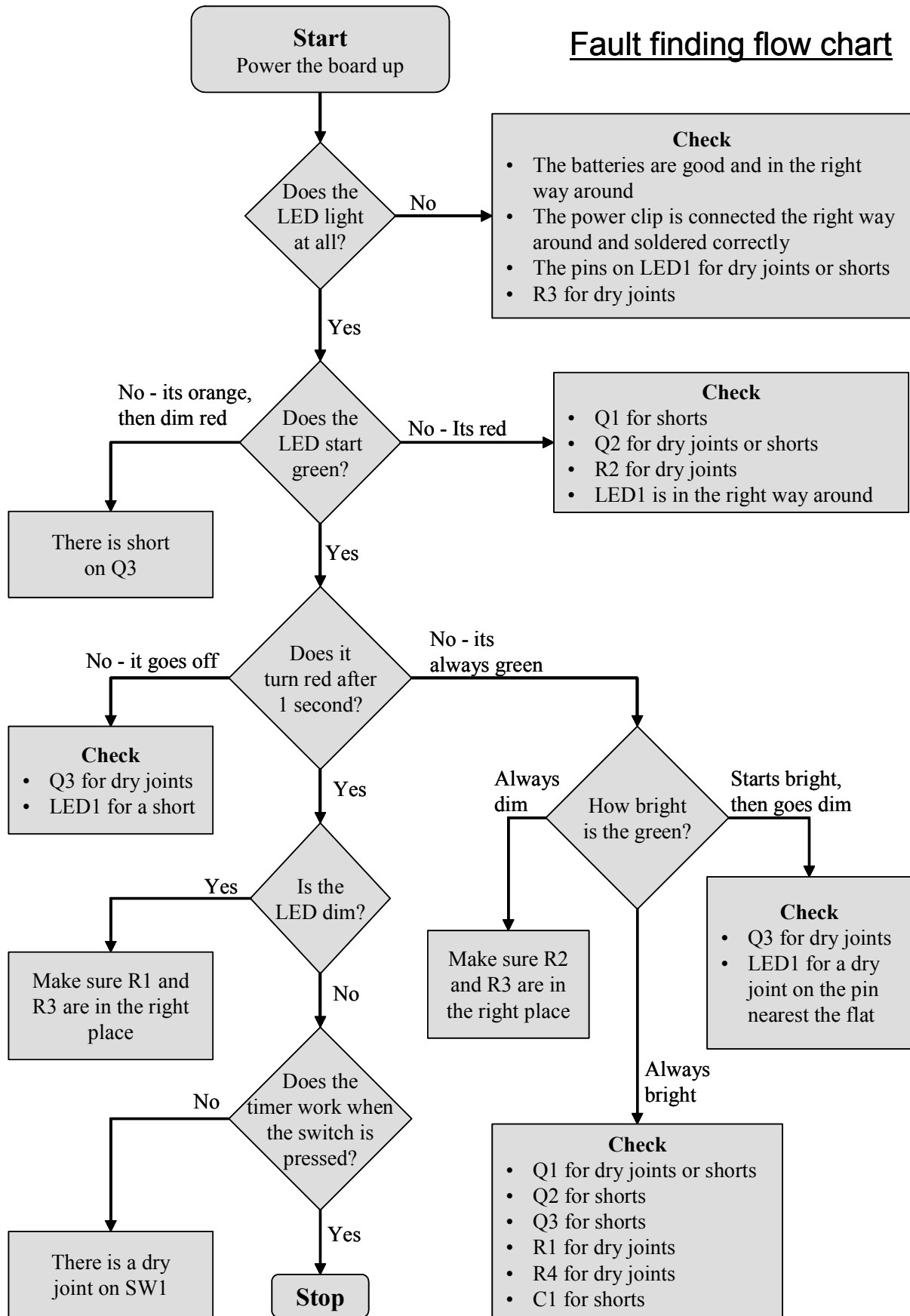
Solder the other end of the battery clip to the on / off switch.  


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



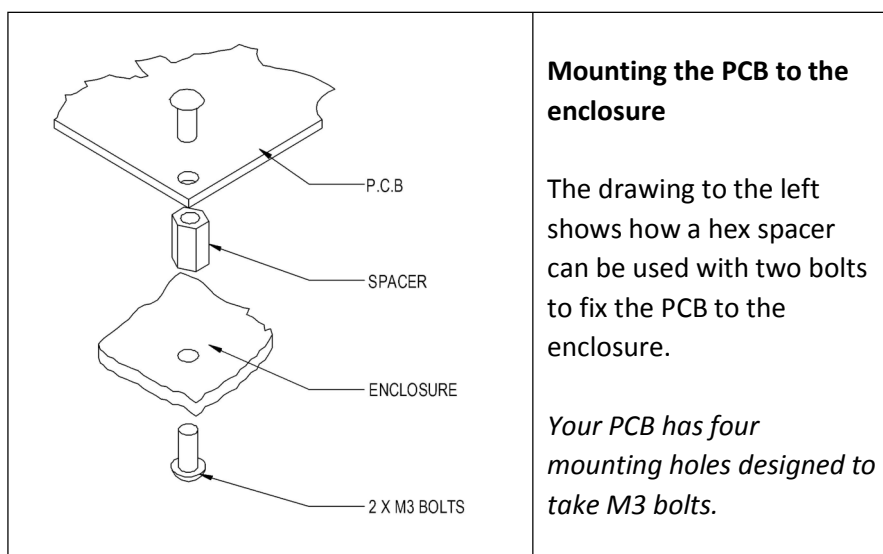
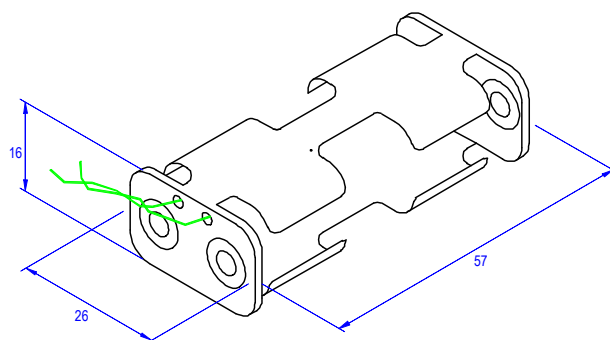
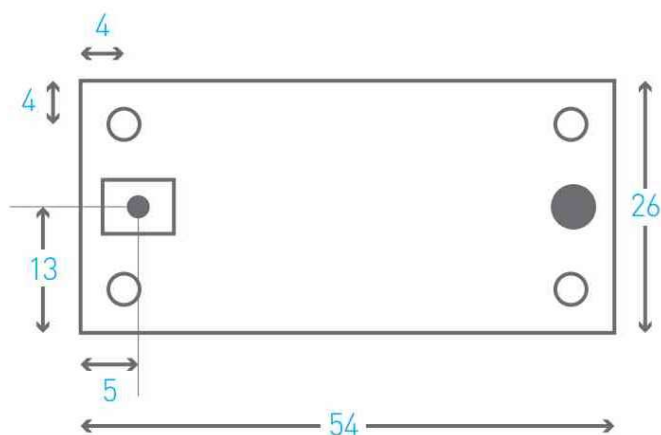
## Designing the Enclosure

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

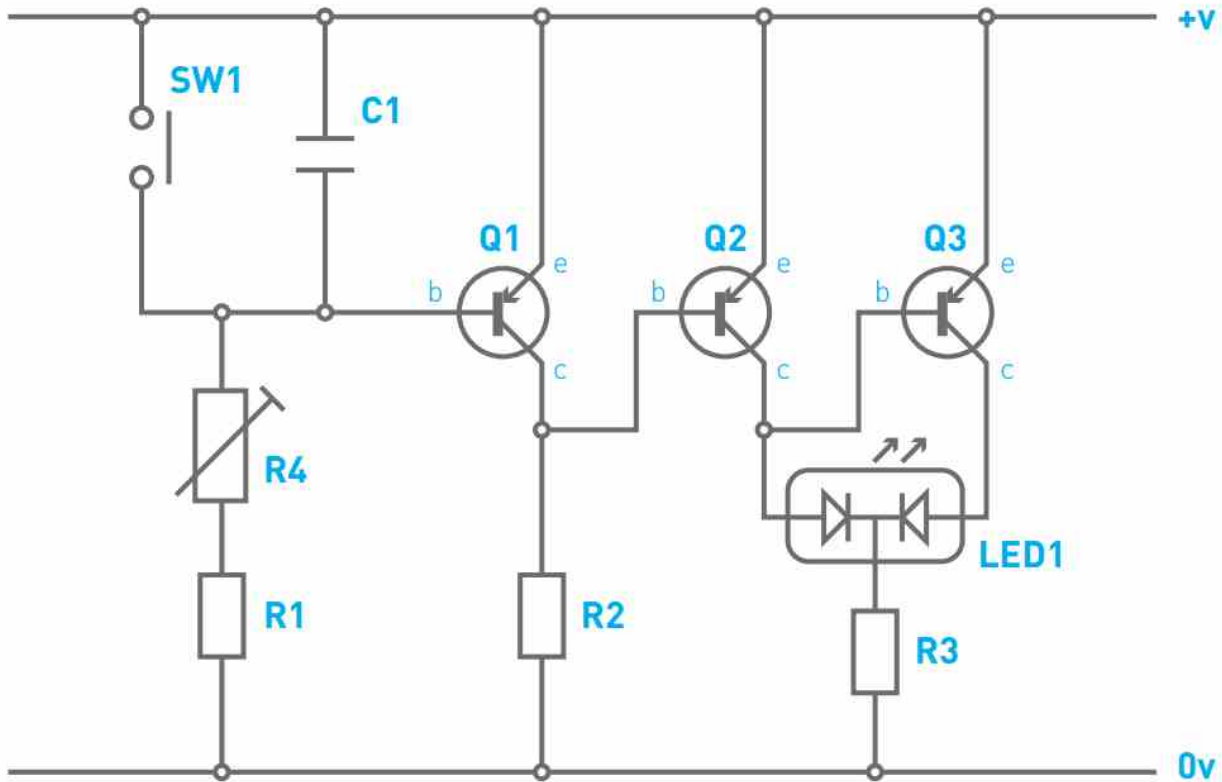
- The size of the PCB (below left).
- Where the switch and LED are located on the PCB.
- Access to the batteries to allow them to be changed (below right).

These technical drawings of all of these items are illustrated on this page, which should help you design your enclosure.

All dimensions are in mm.



## 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 as 1 M $\Omega$  or 1,000,000 $\Omega$ . 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 in case 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.





## 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/2111](http://www.kitronik.co.uk/2111)



This kit is designed and manufactured in the UK by Kitronik

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