LEARN ABOUT SIMPLE TIMING CIRCUITS WITH THIS

EASY BUILD TIMER KIT
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.

<table>
<thead>
<tr>
<th>PCB Ref</th>
<th>Value</th>
<th>Colour Bands</th>
</tr>
</thead>
<tbody>
<tr>
<td>R1 &amp; R2</td>
<td>10KΩ</td>
<td>Brown, black, orange</td>
</tr>
<tr>
<td>R3</td>
<td>47Ω</td>
<td>Yellow, purple, black</td>
</tr>
</tbody>
</table>

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) 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.
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.

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.
Easy Build Timer Essentials

www.kitronik.co.uk/2111

Fault finding flow chart

Start
Power the board up

Does the LED light at all?

No

Does the LED start green?

Yes

Check
• The batteries are good and in the right way around
• The power clip is connected the right way around and soldered correctly
• The pins on LED1 for dry joints or shorts
• R3 for dry joints

No - its red

Check
• Q3 for dry joints
• LED1 for a short

No - it goes off

Is the LED dim?

Yes

Check
• Q1 for shorts
• Q2 for dry joints or shorts
• R2 for dry joints
• LED1 is in the right way around

No

How bright is the green?

Always bright

Check
• Q1 for shorts or dry joints
• Q2 for shorts
• Q3 for dry joints
• R1 for dry joints
• R4 for dry joints
• C1 for shorts

Always dim

Make sure R2 and R3 are in the right place

Does the timer work when the switch is pressed?

No

Stop

There is short on Q3

Yes

There is a dry joint on SW1

Fault finding flow chart

Start
Power the board up

Does it turn red after 1 second?

No - it's always green

Check
• Q3 for dry joints
• LED1 for a short

Yes

How bright is the green?

Always bright

Check
• Q1 for shorts
• Q2 for dry joints or shorts
• R2 for dry joints
• LED1 is in the right way around

No - it goes off

Does the timer work when the switch is pressed?

Yes

Check
• Q1 for dry joints or shorts
• Q2 for shorts
• Q3 for shorts
• R1 for dry joints
• R4 for dry joints
• C1 for shorts

No - it's orange, then dim red

Check
• Q1 for dry joints or shorts
• R2 for dry joints
• LED1 is in the right way around
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.

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.*
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 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

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