Circuits Workshop

Build your own circuits by copying the diagrams below...

Electronics Club

1 Flashing LED ← START HERE!

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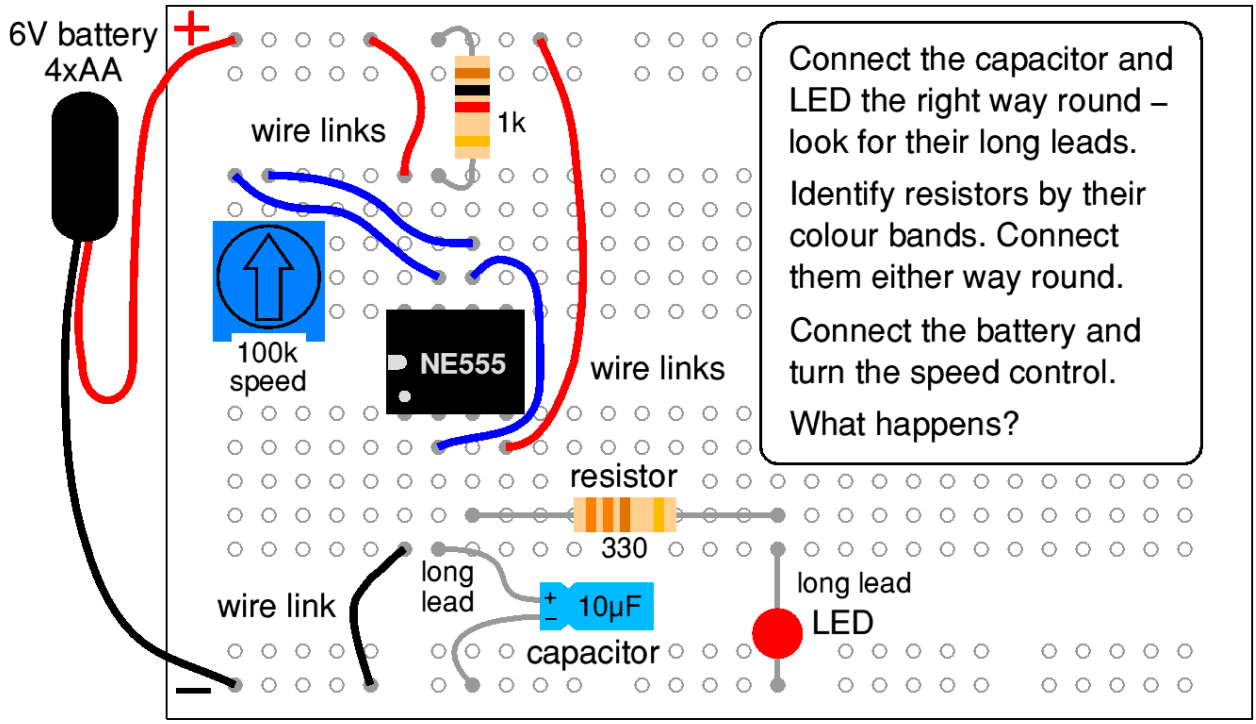

2 Level Crossing Lights

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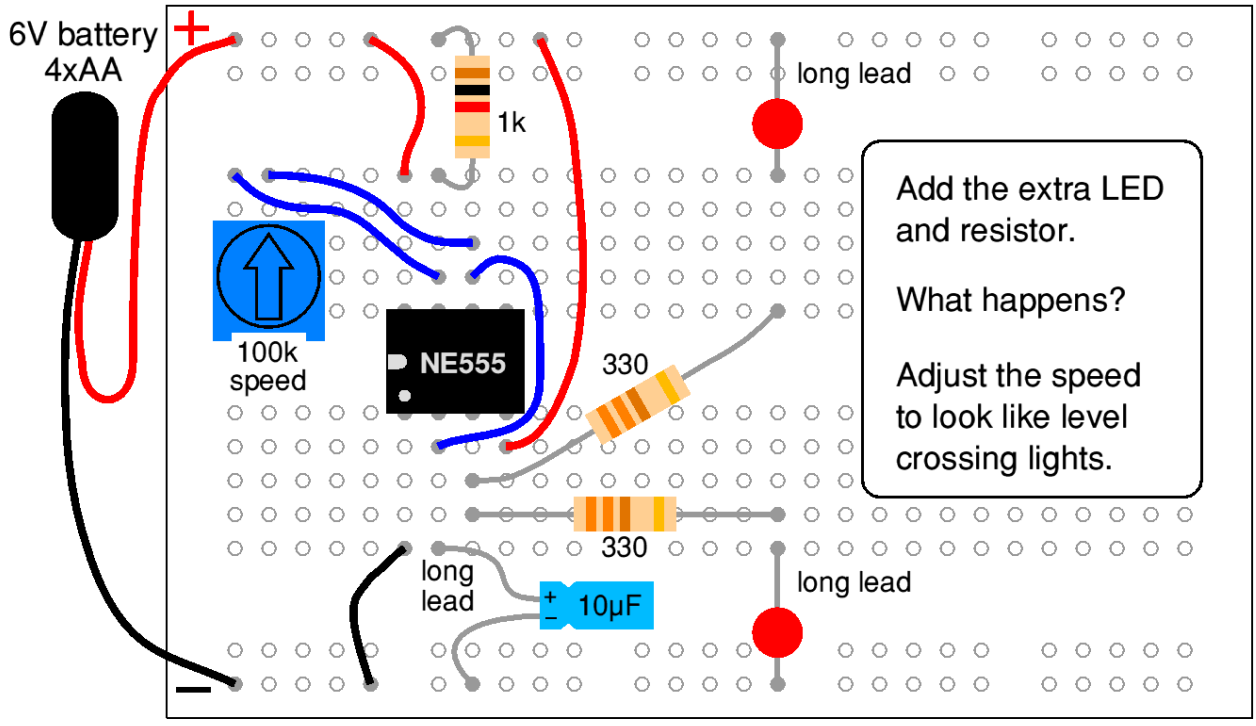

Turn the page to build more circuits →

3 Cat Eyes

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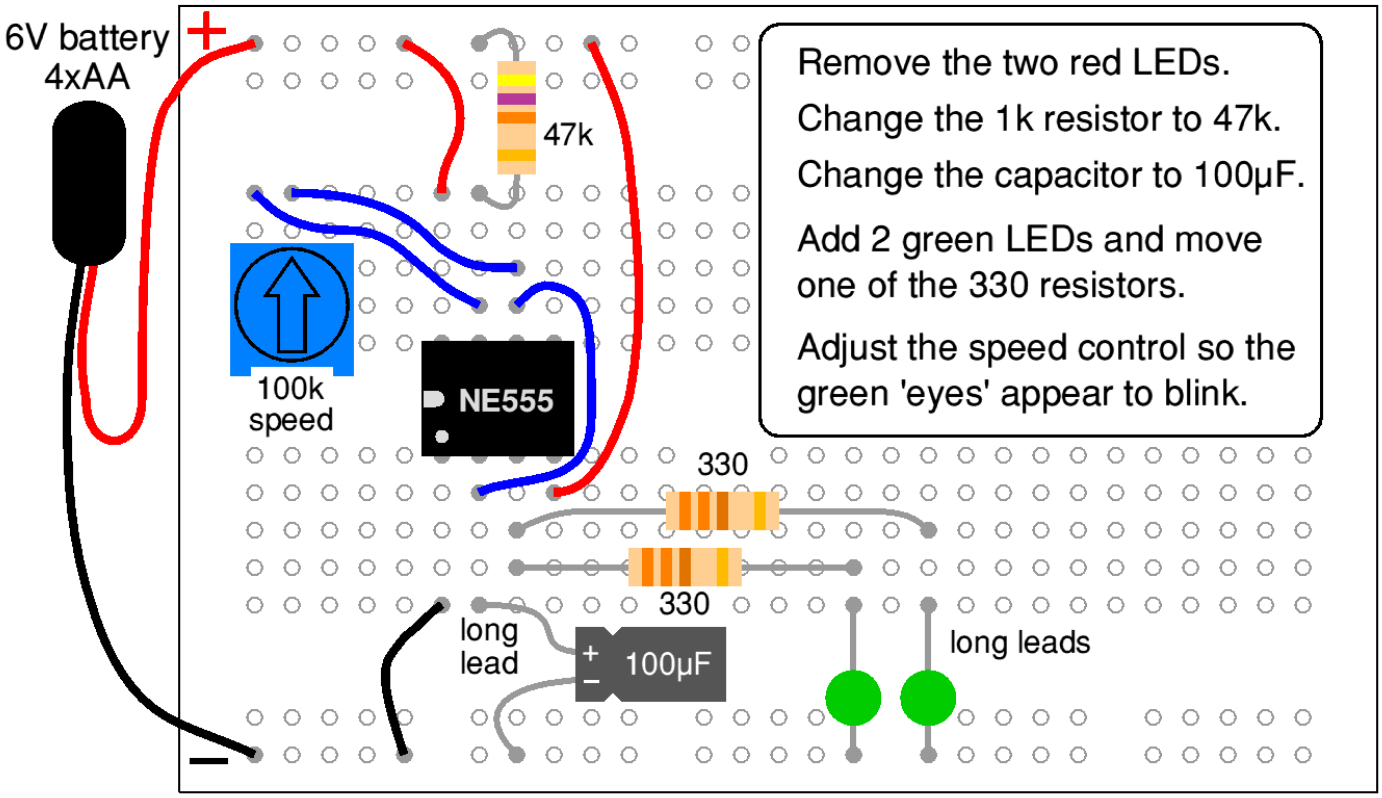

4 Alarm Box Light

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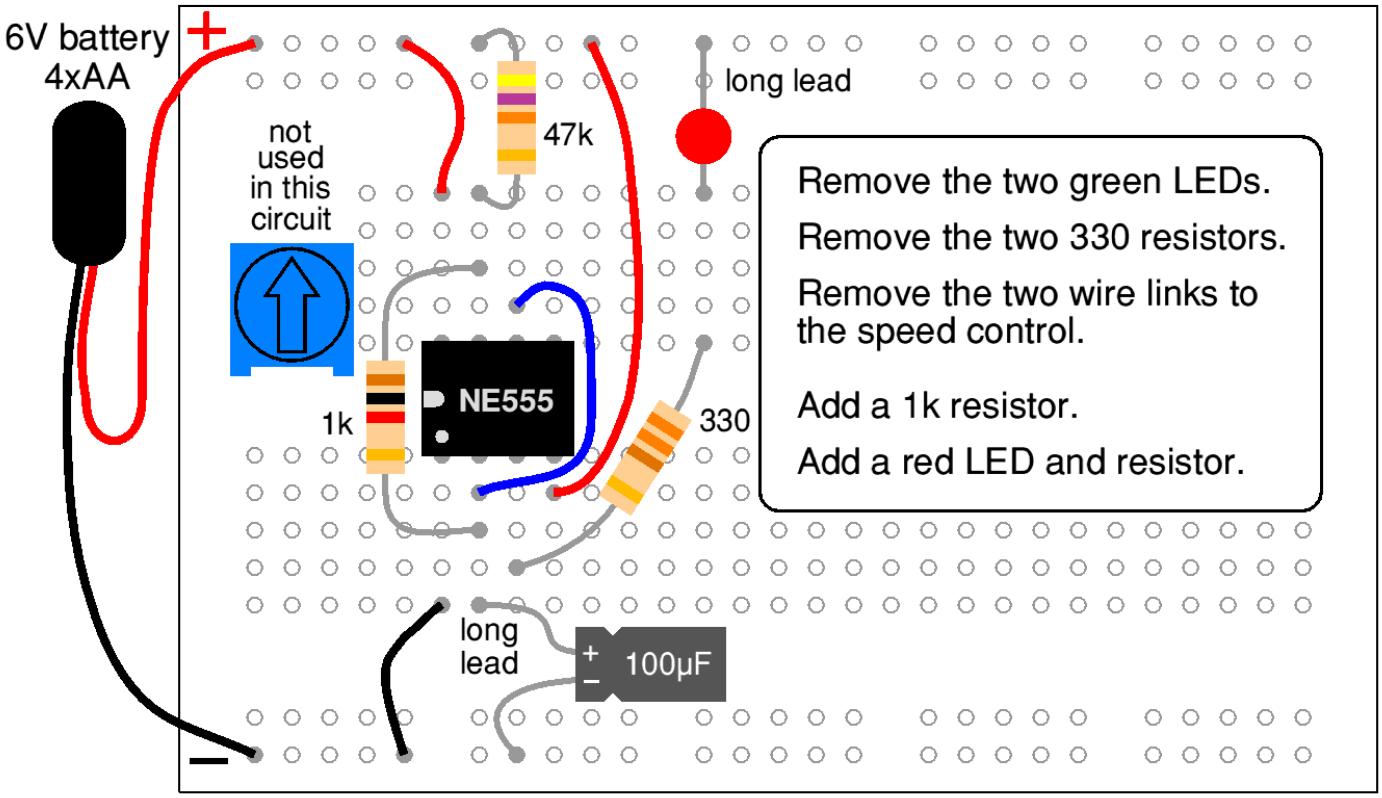

Turn the page to build more circuits ➡

5 Lighthouse

Add the 4017 to build these circuits

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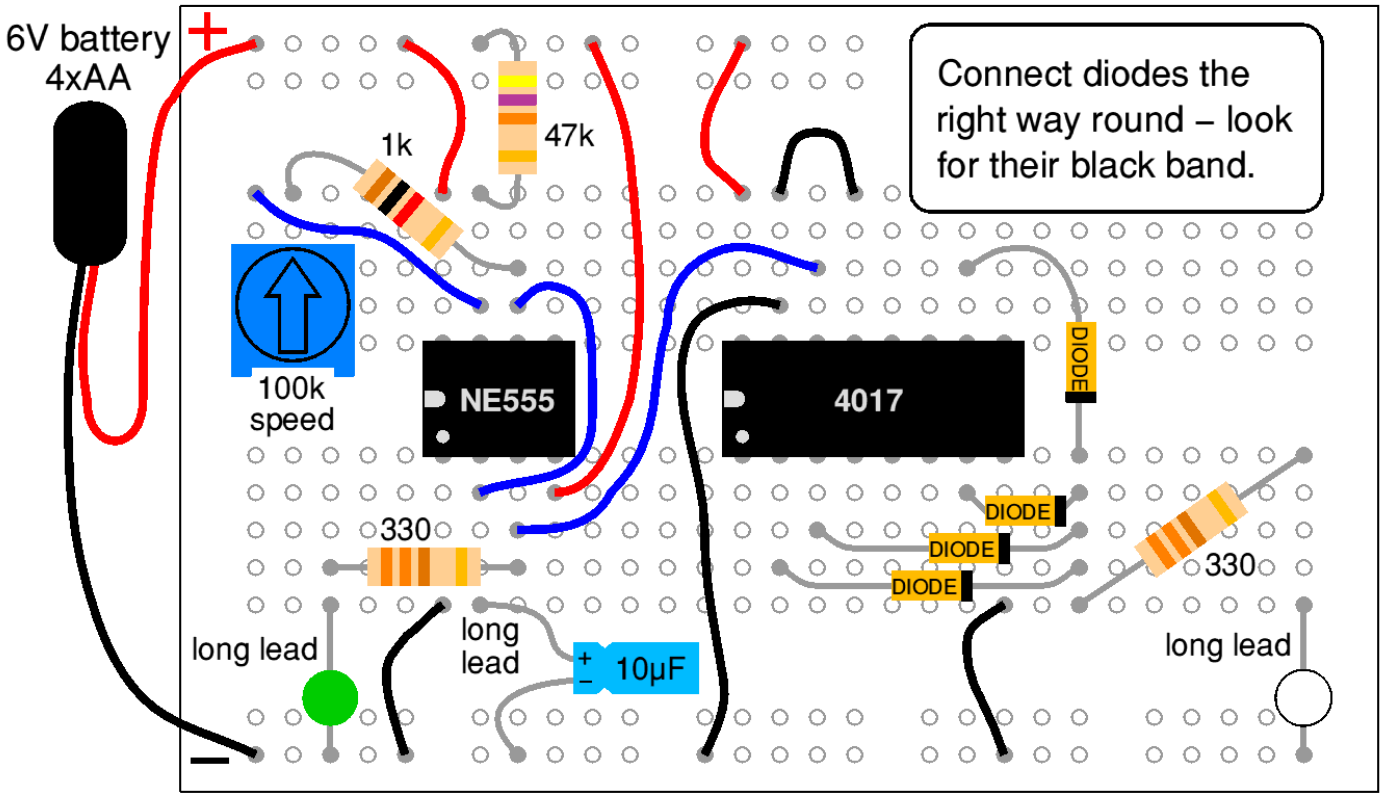

LED to show this part is working

Lighthouse, White LED

6 Traffic Lights

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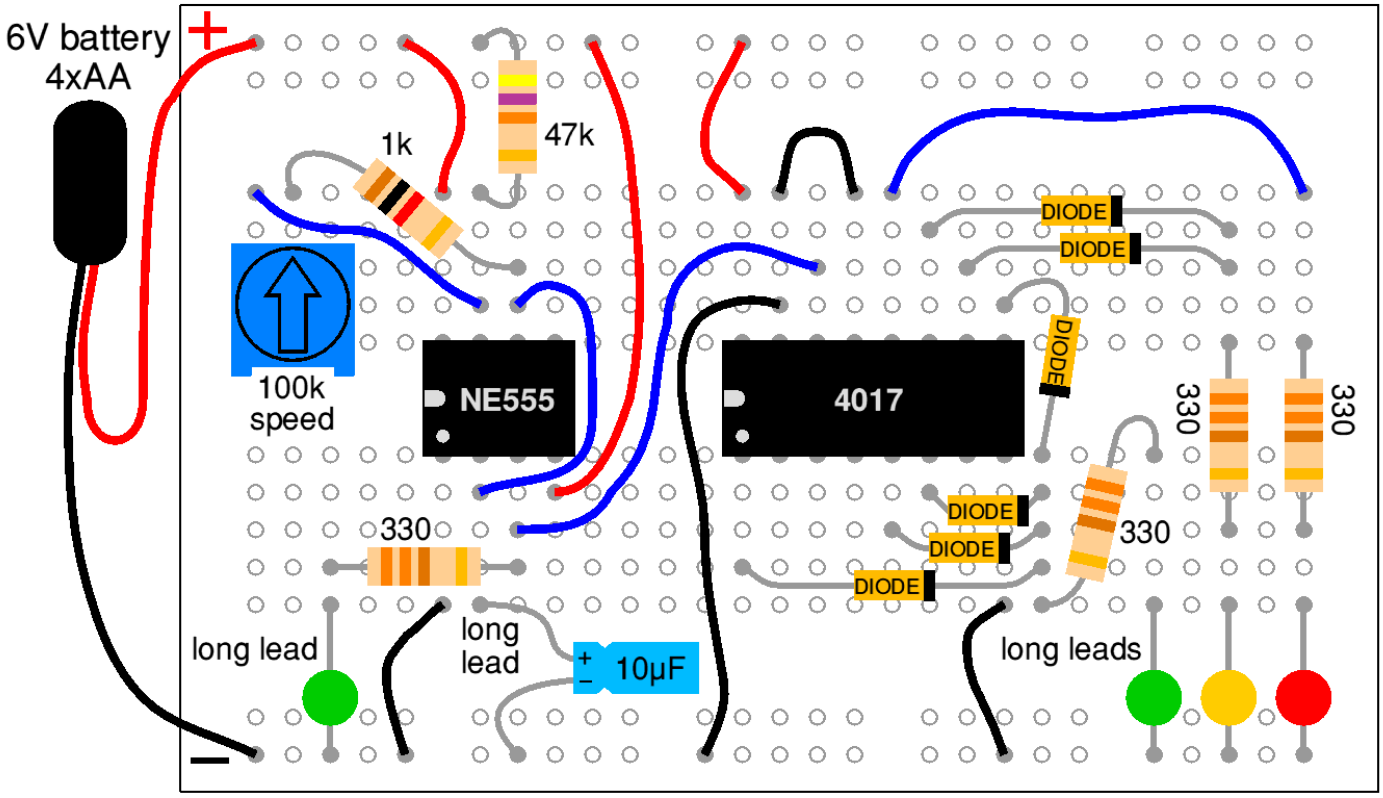


LED to show this part is working

LED traffic lights

Turn the page to find out how these circuits work

How the Circuits Work

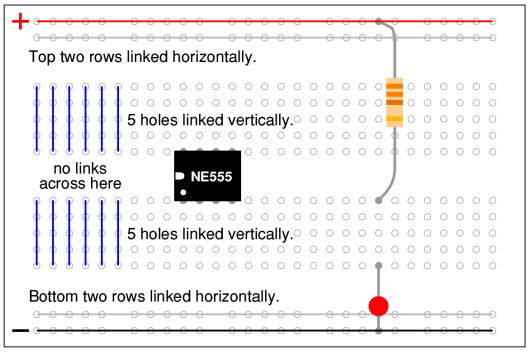
This is a brief explanation — visit electronicsclub.info online for more!

The Breadboard

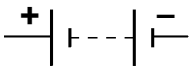
A **breadboard** is used to make up temporary circuits for testing or to try out an idea. No soldering is required so it is easy to change connections and replace components. Parts are not damaged and can be re-used afterwards.

The breadboard has many tiny sockets (**holes**) arranged on a 0.1" grid. The leads of most components can be pushed straight into the holes. **Integrated circuits** (**ICs** or **microchips**) are inserted across the central gap with their notch or dot to the left. Figure A shows how the holes are connected internally.

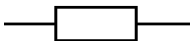
Ⓐ



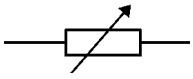
The Basic Components



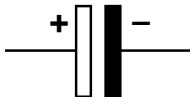
Battery
Four 1.5V AA cells in a box provide a supply voltage of 6V. Electric current flows from + through the circuit to –.



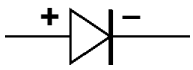
Resistor
Restricts the flow of current. Resistance is measured in ohms (Ω). The symbol is not normally shown in diagrams. 1000Ω = 1kΩ. To identify the value use the Colour Code Calculator.



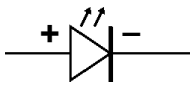
Variable Resistor
Varies its resistance between zero and its value as its knob is turned.



Capacitor (polarised)
Stores charge. Capacitance is measured in farads (F). 1µF = 0.000001F. Value and maximum voltage marked on side. Connect right way around — the long lead is positive (+).



Diode
Allows current to flow in only one direction. Connect right way around — the black band is negative (–).



Light Emitting Diode (**LED**)
A diode that lights up. Very efficient and available in many colours. Connect right way around — the long lead is positive (+).

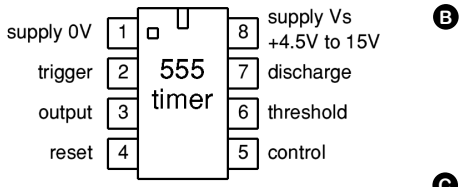
The 555 Timer

In all of these circuits a **555 timer** IC is configured as an **astable** so that its **output** pulses between **high** (the supply voltage, Vs) and **low** (0V) with a regular frequency.

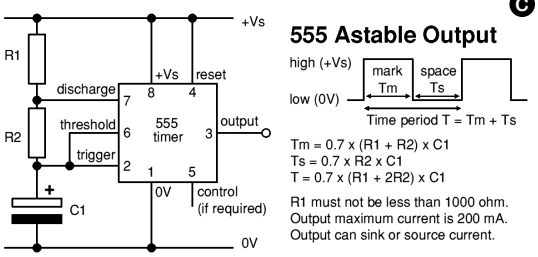
The output drives one or more **LEDs**, but with extra components it could be used to drive lamps, motors and other devices.

Figure B shows the physical layout of the 555 timer's pins, with the notch and dot marking pin 1. Figure C shows the basic astable circuit and the formula used to calculate the timing of the output pulse from the values of the **resistors** R1 and R2 and the **capacitor** C1. The larger the values, the slower the pulse.

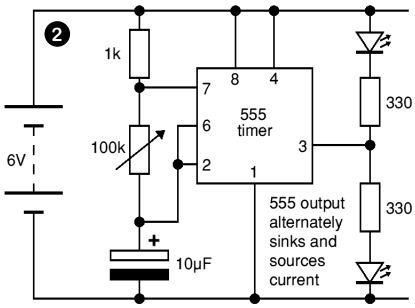
Ⓑ



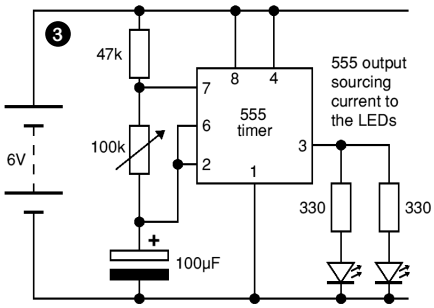
Ⓒ



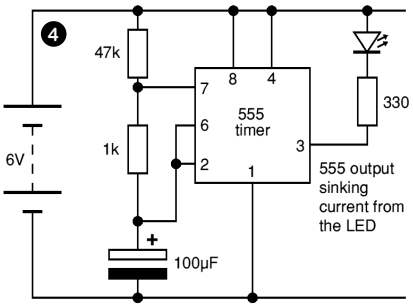
Each of these circuits demonstrates the use of different values of R1, R2 and C1, including the use of a **variable resistor** as the pulse speed control. Circuit ❸ demonstrates current being **sourced** from the output, circuit ❹ demonstrates current **sinking** into the output, and circuit ❷ demonstrates alternate sinking and sourcing.



Level Crossing Lights circuit diagram



Cat Eyes circuit diagram



Alarm Box Light circuit diagram

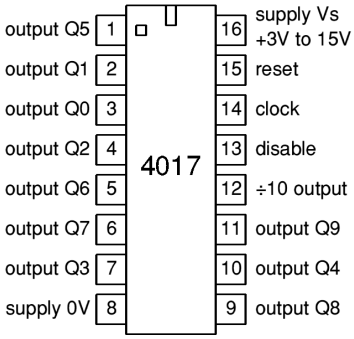
The 4017 Decade Counter

Circuits ❺ and ❻ introduce a **4017 decade counter** IC, which counts from 0 to 9.

Figure D shows the physical layout of the 4017 decade counter's pins, with the notch and dot marking pin 1.

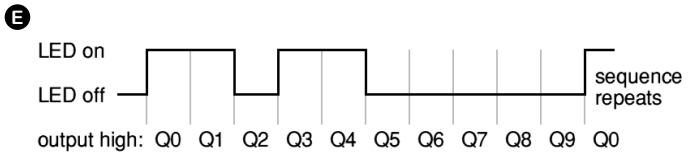
The **output** of the 555 timer is connected to the **clock** input of the 4017 decade counter so that the count advances for every pulse from the 555 timer. Each output **Q0–Q9** is normally **low** (0V), but goes **high** (the supply voltage, Vs) in turn as counting advances.

❹

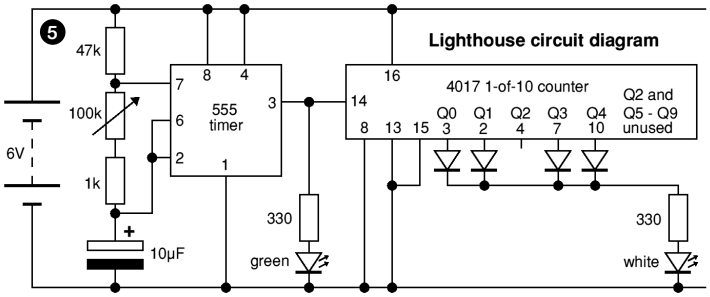


In circuit ❺ the lighthouse flashing sequence (figure E) is achieved by combining outputs **Q0**, **Q1**, **Q3** and **Q4** using **1N4148 signal diodes**. The diodes are required so that the outputs are not directly connected together, which would damage them. Other sequences can be achieved using this technique.

❻



❺

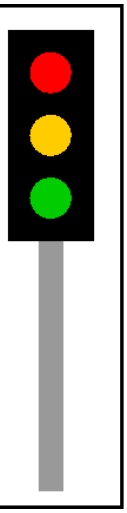


The **÷10** output is high for counts 0–4 and low for counts 5–9, so it provides an output at one tenth of the clock input frequency. It can be used to drive the clock input of another 4017 (to count the tens).

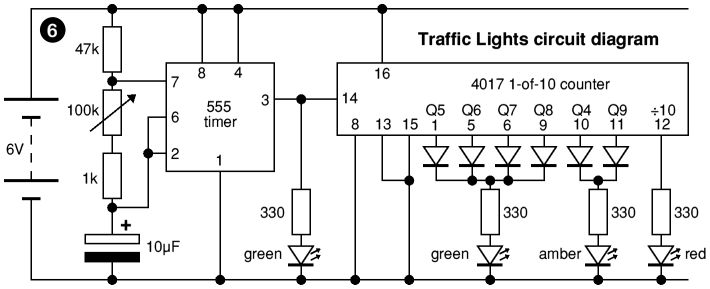
In circuit ❻ this behaviour is used to drive the red LED in the traffic light sequence (figure F), while the amber and green LEDs are driven using diodes as before.

❼

4017 counter outputs high	LEDs ●●● = LED on		
	red	amber	green
Q0 and ÷10	●		
Q1 and ÷10	●		
Q2 and ÷10	●		
Q3 and ÷10	●		
Q4 and ÷10	●	●	
Q5			●
Q6			●
Q7			●
Q8			●
Q9		●	



❻



The LED Resistors

An **LED** will likely be destroyed if it is connected directly to a battery or power supply, so it must always have a **resistor** appropriate to the supply voltage connected in series with it, like the 330Ω ones used in these circuits.

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