

555 Astable Kit

MitchElectronics 2018

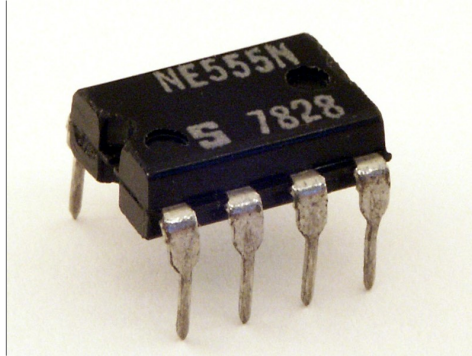


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INTRODUCTION

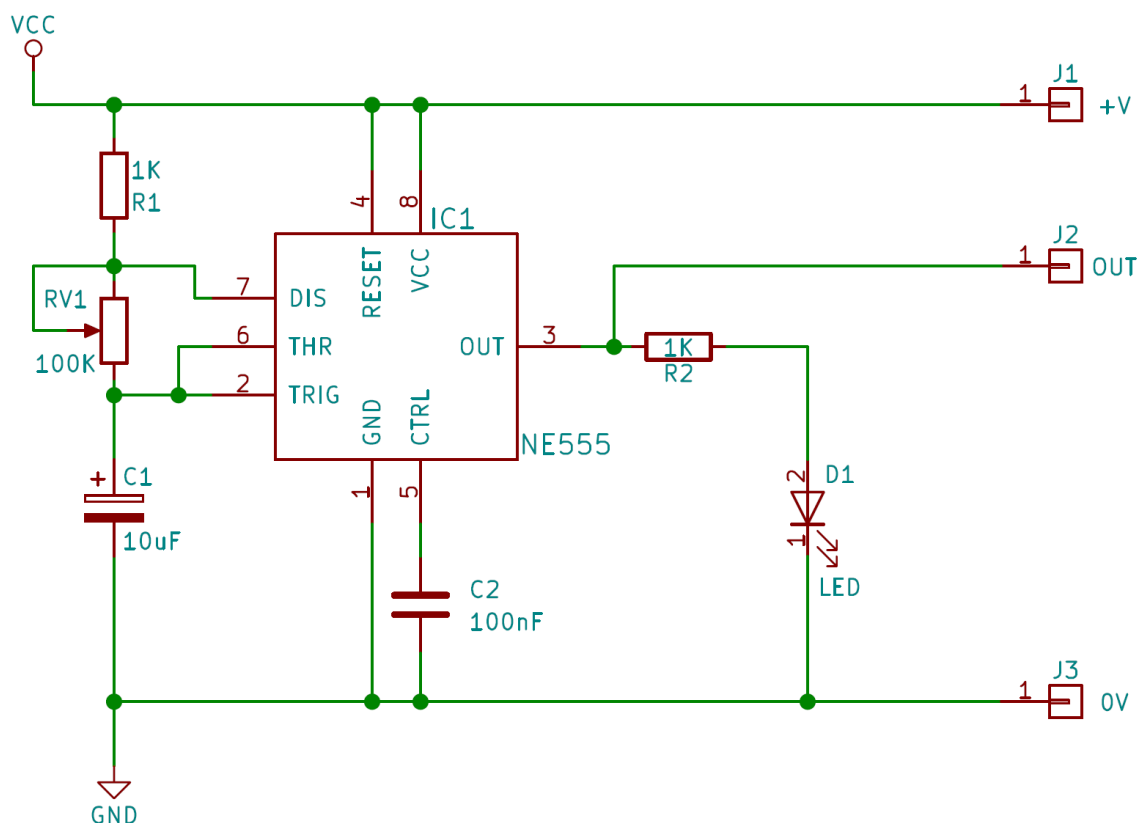
The 555 timer is arguably the most famous integrated circuit ever invented. Created by Hans Camenzind in 1971 for Signetics (now NXP), the 555 timer is still widely used and in production. These devices are so common that over 1 billion are made each year.



http://en.wikipedia.org/wiki/555_timer_IC

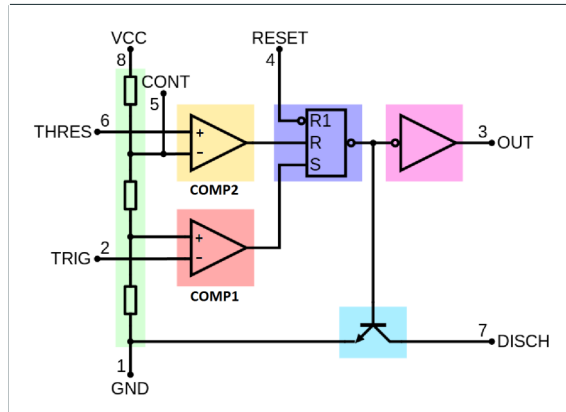
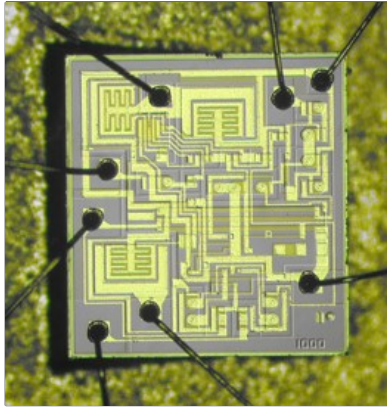
But what makes the 555 timer so useful? Why is this tiny little 8 pin device still be mass produced despite being over 40 years old? In this kit you will be making a 555 astable circuit which is one of the most common uses for this chip.

SCHEMATIC



SCHEMATIC EXPLANATION

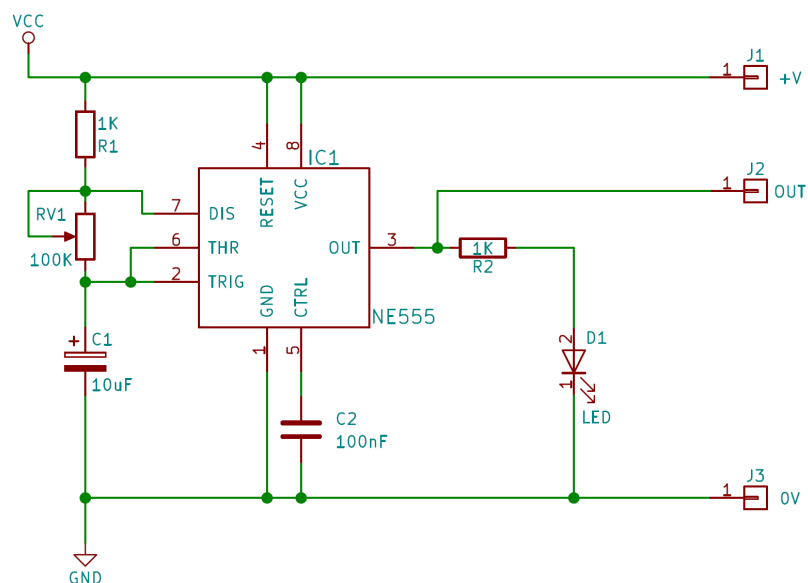
Before the 555 astable circuit can be explained in detail it is important to see what is actually inside the 555 timer!



The image on the left shows a 555 silicon chip and the image on the right shows the circuit diagram of what is inside. Looking at the internal circuit diagram of the 555 timer the following can be seen:

- 3 resistors (highlighted in green. 5kΩ each, hence the name 555)
- A flip flop (highlighted in blue. Has two resets)
- Two comparators (one red (call this comparator 1), and one orange (comparator 2))
- One inverter (highlighted in pink. Connects to the output)
- One NPN transistor (highlighted in turquoise)

The complete circuit diagram is shown below.



SCHEMATIC EXPLANATION

Initially the voltage across the capacitor C1 is 0V, this will result in the voltage on COMP1 inverting input to also be 0V. Since the COMP1 non-inverting input is connected to $1/3 VCC$ this means that the $V+$ input is larger than the $V-$ input. This results in the output of COMP1 turning on (9V), which in turn turns the flip flop output off. The output of the flip flop is connected to an inverter which inverts this off signal into an on signal which means the output is now on (9V).

As the flip flops output is currently off the transistor will also be off and therefore the capacitor will charge through R1 and the potentiometer (POT). While the capacitor charges the voltage across the capacitor will begin to increase.

While all of this is happening the voltage on the inverting input of COMP2 is always connected to $2/3 VCC$ (created by the potential divider made by the three $5k\Omega$ resistors).

Eventually the voltage across the capacitor will become larger than $2/3 VCC$ which means that the voltage on the non-inverting input of COMP2 will become larger than the inverting input. When this happens the output of COMP2 will turn on which will reset the flip flop. Remember how the flip flop has an inverting output so when the flip flop is reset the output will switch on. This means that the output will turn off (since it is inverted again).

When the flip flop resets the transistor is turned on as well. This means that the capacitor will begin to discharge through the potentiometer, into the discharge pin, through the transistor and then back to ground.

Eventually the voltage across the capacitor will fall below $1/3 VCC$ and the whole process happens all over again, and again, and again!

This circuit is known as an astable circuit because the circuit is not stable in any state (on or off). The output of the 555 timer is connected to an LED so when this circuit operates the LED will turn on and off. But how is the rate of flashing controlled? How can the flashing be slowed down or made faster? This is done by the potentiometer! The time it takes for the capacitor to discharge and charge is dependent on R1 and the potentiometer.

If the potentiometer's resistance is increased then it takes more time for the capacitor to charge and discharge which results in the LED flashing becoming more slow. If the potentiometer's resistance is decreased then it takes less time for the capacitor to charge and discharge which results in the LED flashing becoming faster.

CONSTRUCTION

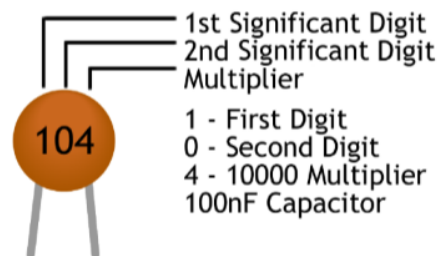
Check that you have the following components

Component	Component Name	Quantity	Looks like
8 DIP Socket	IC1	1	
555	IC1	1	
100nF Capacitor (Ceramic)	C1	1	
10uF Capacitor (Electrolytic)	C2	1	
1kΩ Resistor	R1, R2	2	
Potentiometer	POT	1	
LED	D1	1	
PP3 Connector	-	1	
PCB	-	1	

RESISTOR AND CAPACITOR IDENTIFICATION

Colour	1 ST Band	2 ND Band	3 RD Band	Multiplier	Tolerance
BLACK	0	0	0	1Ω	
BROWN	1	1	1	10Ω	±1%
RED	2	2	2	100Ω	±2%
ORANGE	3	3	3	1kΩ	
YELLOW	4	4	4	10kΩ	
GREEN	5	5	5	100kΩ	±0.50%
BLUE	6	6	6	1MΩ	±0.25%
VIOLET	7	7	7	10MΩ	±0.10%
GREY	8	8	8		±0.05%
WHITE	9	9	9		
GOLD					±5%
SILVER					±10%

4 Band Resistor
5.6k ±5%



CONSTRUCTION

Download the electronics construction manual

To learn how to construct circuits on PCBs download the Electronics Construction Manual from MitchElectronics using the link below. This document shows you how to install all electronic components used in MitchElectronics kits. The list below shows the sections relevant to this kit so do not worry if you see component sections in the document that don't come with this kit!

www.mitchelectronics.co.uk/electronicsConstructionManual.pdf

Relevant sections in the electronics construction manual

Resistors

Capacitors

Potentiometers

LEDs

Integrated Circuits

Wires

IMPORTANT INFORMATION



RoHS Compliant Kit (Lead free)



Low Voltage Kit



Caution! Soldering Required