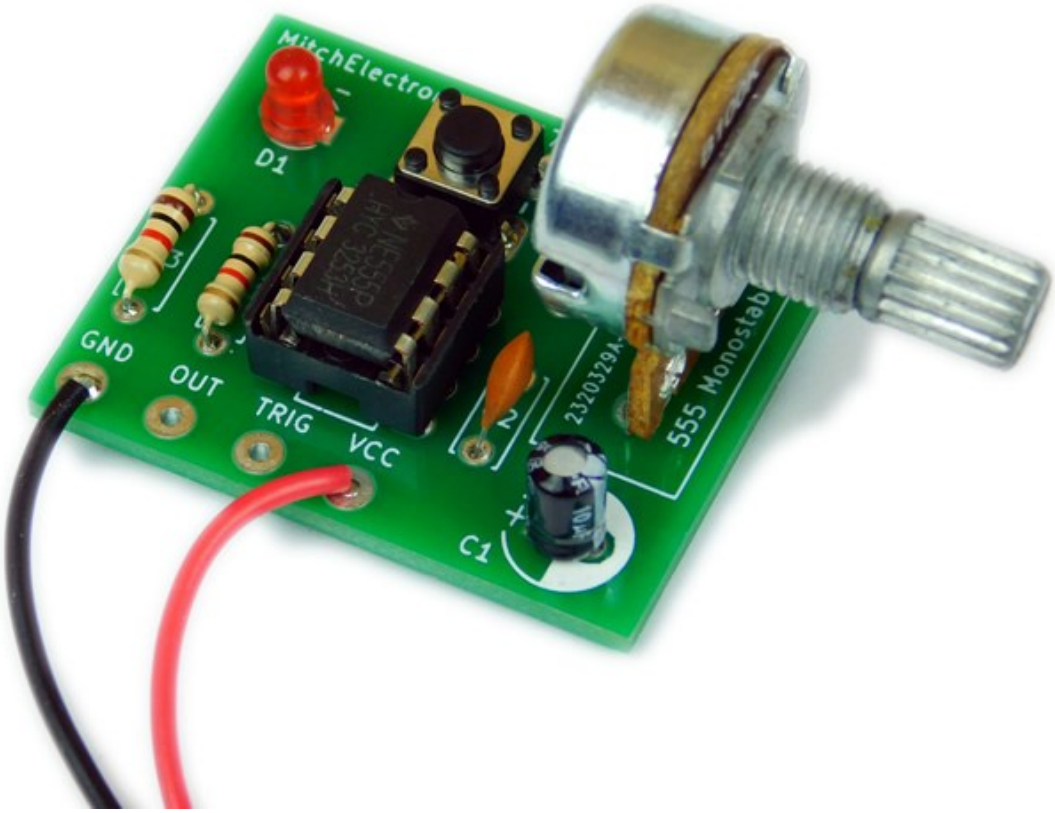
555 Monostable Kit

MitchElectronics 2018



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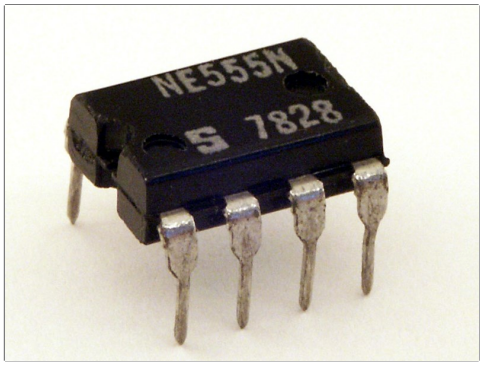
INTRODUCTION

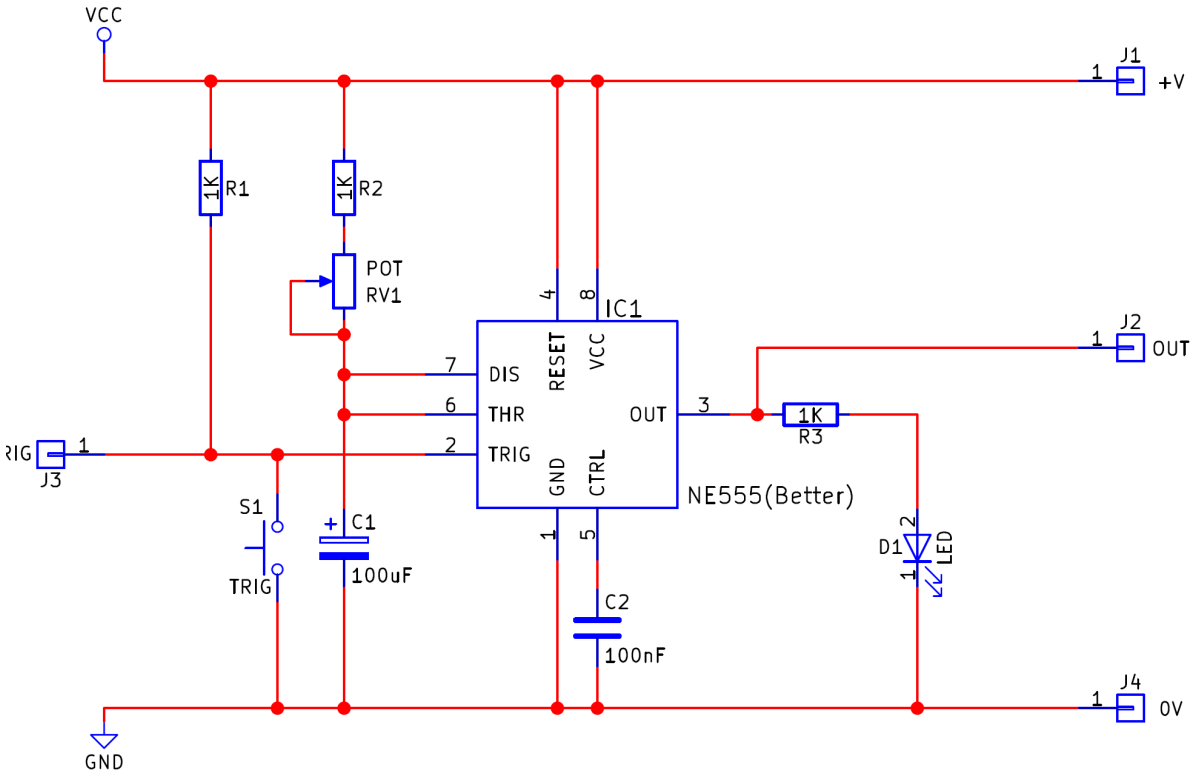
The 555 timer is arguably the most famous integrated circuit ever invented. Created by Hans Camenzind in 1971 for Signetics (now NXP), the 555 timer is still widely used and in production. These devices are so common that over 1 billion are made each year.



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

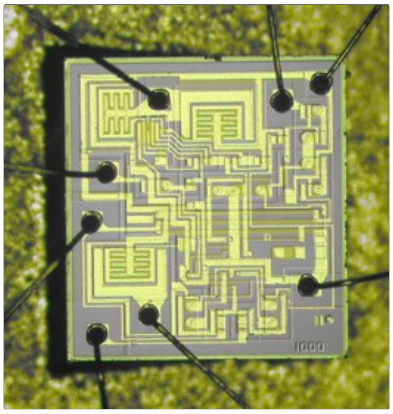
But what makes the 555 timer so useful? Why is this tiny little 8 pin device still be mass produced despite being over 40 years old? In this kit you will be making a 555 monostable circuit which is one of the most common uses for this chip.

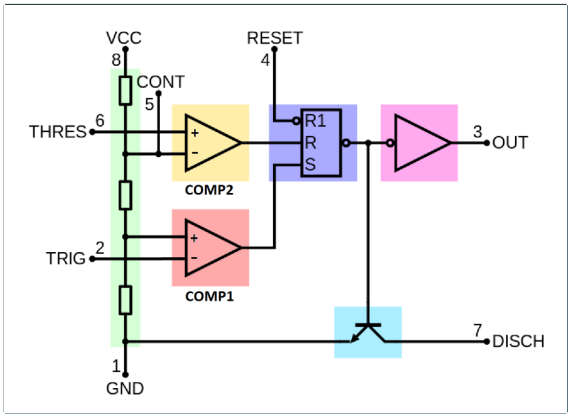
SCHEMATIC



SCHEMATIC EXPLANATION

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

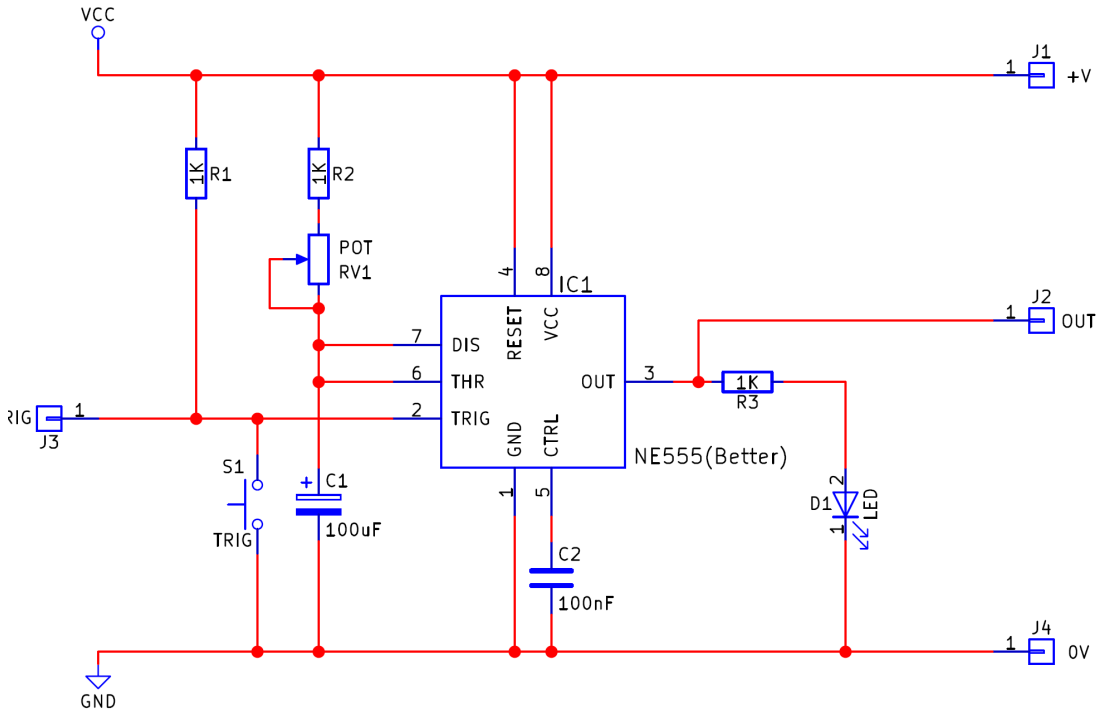




The image on the left shows a 555 silicon chip and the image on the right shows the circuit diagram of what is inside. Looking at the internal circuit diagram of the 555 timer the following can be seen:

- 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

In the starting state of the circuit the following is true

The voltage across the capacitor C1 is 0V
Both comparators inside the 555 chip have 0V on their outputs to the flip flop
The flip flop is in reset mode. The flip flop output voltage is therefore 9V
The 555 output voltage is 0V
The trigger input is at 9V (due to the pull up resistor R1)
VCC is 9V

To start the mono stable the trigger voltage needs to quickly be dropped to 0V. This is done by pressing the switch (when the switch contacts are shorted the trigger input is connected directly to ground and therefore will have a voltage of 0V). COMP1 inverting input is connected to the trigger pin and the non inverting input is connected to 1/3VCC. This means that normally the output of COMP1 is off but when the switch is press the inverting pin is (for a short time), is at a lower voltage than the non inverting pin. Therefore the output of COMP1 is on for a short amount of time.

This short pules from COMP1 sets the flip flop and therefore the output of the flip flop will be 0V. The flip flop output is connected to the base of the discharge transistor so when the switch is pressed the transistor stops discharging the capacitor. Even when the switch is depressed the transistor stays off because the flip flop remembers what the last input was (i.e. it stays latched). As the flip flop output is 0V the output stage of the 555 inverts this and therefore the output switches to 9V.

With the discharge pin no longer discharging the capacitor C1 begins to charge through R3 and the potentiometer. Note that the capacitor is connected to the threshold input on the 555 which is internally connected to the non inverting input to COMP2.

Eventually the voltage across C1 will become larger than 2/3 VCC. Since the inverting input of COMP2 is connected to 2/3 VCC and the non inverting input to the capacitor the non inverting input voltage will become greater than the inverting input. When this happens COMP2's output will turn on which will in turn reset the flip flop. This results in the flip flop output to be on and therefore turn on the discharge transistor. C1 very quickly discharges through the discharge transistor making the voltage across C1 0V. Therefore the output switches back to 0V and the circuit is back in the starting state.

This circuit is called mono stable because it is only stable in one state, the off state. While the 555 is in the on state it will only be a matter of time (depending on the resistance of the potentiometer and the size of C1), before the system is reset back into the off state.

MATERIALS

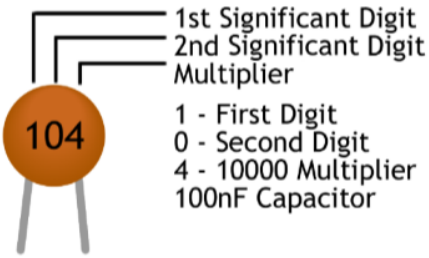
Check that you have the following components

Component	Component Name	Quantity	Looks like
8 DIP Socket	IC1	1	
555	IC1	1	
100nF Capacitor **(Ceramic)**	C2	1	
10uF Capacitor **(Electrolytic)**	C1	1	
1kΩ Resistor	R1, R2, R3	3	
Potentiometer	POT	1	
LED	D1	1	
Tactile Switch	S1	1	
PP3 Connector	-	1	
PCB	-	1	

RESISTOR AND CAPACITOR IDENTIFICATION

Colour	1ST Band	2ND Band	3RD 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	7	7	7		
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 Mitch-Electronics 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

Switches

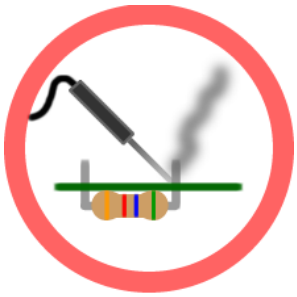
Integrated Circuits

Wires

IMPORTANT INFORMATION

RoHS Compliant Kit (Lead free)

Low Voltage Kit



Caution! Soldering Required