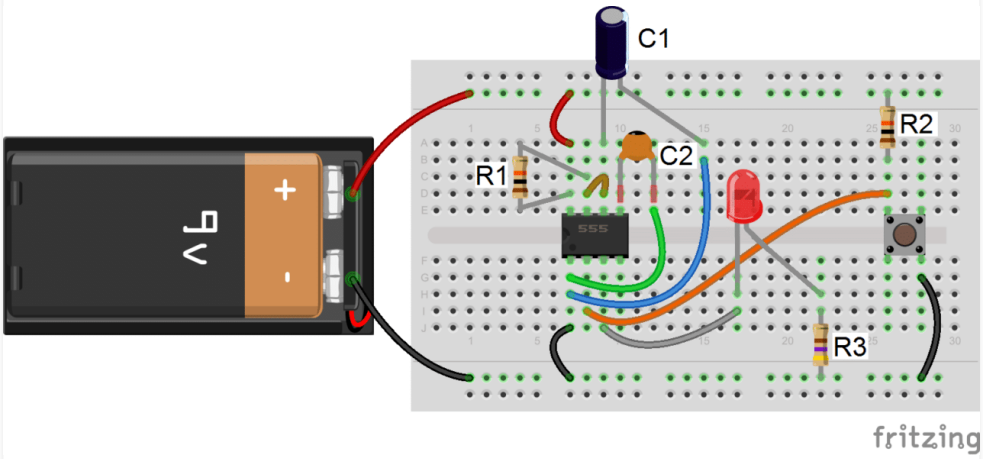
MONOSTABLE MODE

Posted by Scott Campbell | DIY Electronics | 29



The 555 timer could easily be the most common chip used in DIY electronics projects because it's small, inexpensive, and very useful.

It's considered a timer because it can output pulses of electrical current for exact amounts of time. For example, it could be used to turn an LED off exactly 5 seconds after a button is pressed. It can also make an LED blink on and off, or generate higher frequency pulses that will make sound when connected to a speaker.

This is the first article in a series where we'll look into the three different modes of the 555 timer – monostable, bistable, and astable. Each mode has different characteristics that determine how the 555 timer outputs current. In this tutorial, I'll discuss the monostable mode, but check out our articles on the astable mode and bistable mode as well.

> BONUS: I made a quick start guide for this tutorial that you can download and go back to later if you can't set this up right now. It includes all of the wiring diagrams and instructions you need to get started.

Here's the 555 timer's datasheet for detailed technical information:

555 Timer Datasheet

MONOSTABLE MODE OF THE 555 TIMER

In monostable mode, the 555 timer outputs a single pulse of current for a certain length of time. This is sometimes referred to as a one-shot pulse. An example of this can be seen with an LED and a push-button. With one press of the button, the LED will light up, then turn off

automatically after a predetermined length of time. The time the LED stays on depends on the values of a resistor and capacitor connected to the 555 timer. The time can be calculated from the equation:

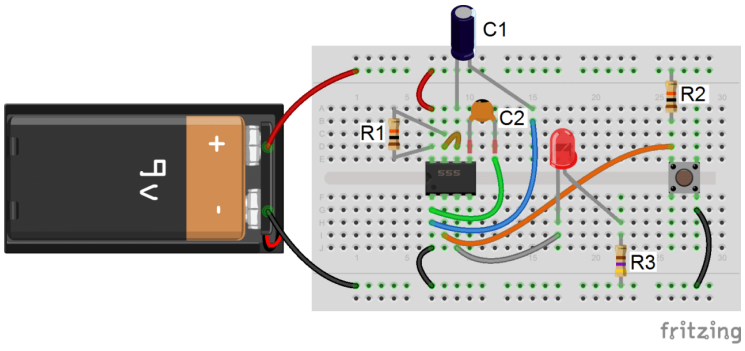
$$t = 1.1 \times R \times C$$

Where t is the length of the electrical output in seconds, R is the resistance of the resistor in Ohms, and C is the capacitance of the capacitor in Farads.

As you can see from the equation, the length of the electrical output can be increased by using larger resistor or capacitor values. The opposite is also true. You can get a shorter output pulse with smaller resistor or capacitor values.

A ONE-SHOT LED TIMER

To observe the monostable mode of the 555 timer, let's build a simple one-shot timer that will turn off an LED after a certain length of time. Use the diagram below to connect the circuit:



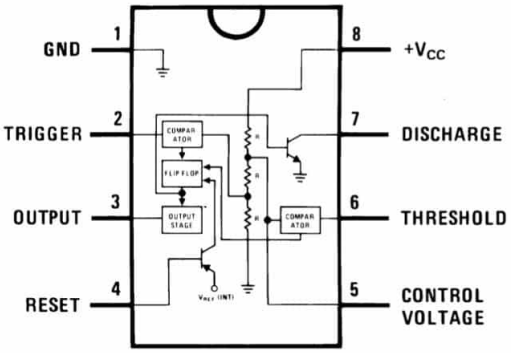
- R1: 10K Ohms
- R2: 10K Ohms
- R3: 470 Ohms
- C1: 470 µF

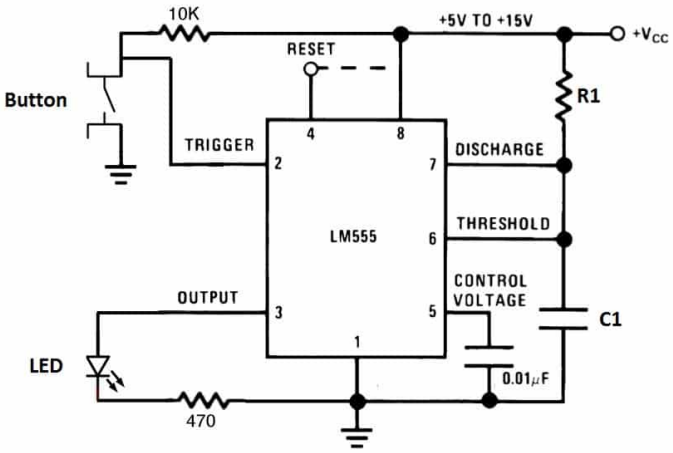
- C2: 0.01 µF

In this circuit, after you press the button once, the LED will light up then turn off after about 5 seconds. The values of R1 and C1 determine how long the LED stays on:

$$t = 1.1 \times R1 \times C1$$
$$= 1.1 \times 10000\ \Omega \times 0.00047\ F$$
$$= 5.17\ seconds$$

HOW MONOSTABLE MODE WORKS





- *Pin 1 – Ground*: Connected to 0 V
- *Pin 2 – Trigger*: Turns on the output when the voltage supplied to it drops below 1/3 of Vcc.

- *Pin 3 – Output*: Outputs up to 200 mA of current at about 1.5 V.
- *Pin 4 – Reset*: Resets the timing operation of the output when it is connected to ground (0 V).
- *Pin 5 – Control*: Controls timing output independently of the RC circuit when the voltage supplied to it is above 2/3 Vcc. When not in use, it is usually connected to ground via a 0.01 µF capacitor to prevent fluctuations in timing of the RC circuit.
- *Pin 6 – Threshold*: Turns off the output when the voltage supplied to it reaches above 2/3 Vcc.
- *Pin 7 – Discharge*: When output voltage is low, it discharges the capacitor in the RC circuit to ground.
- *Pin 8 – Vcc (supply voltage)*: Can range from 4.5 V to 15 V.

Before the button is pressed, the voltage at the trigger pin is high. Whenever the trigger pin voltage is high, the discharge pin allows current to flow to ground and prevents charge from building up on capacitor C1.

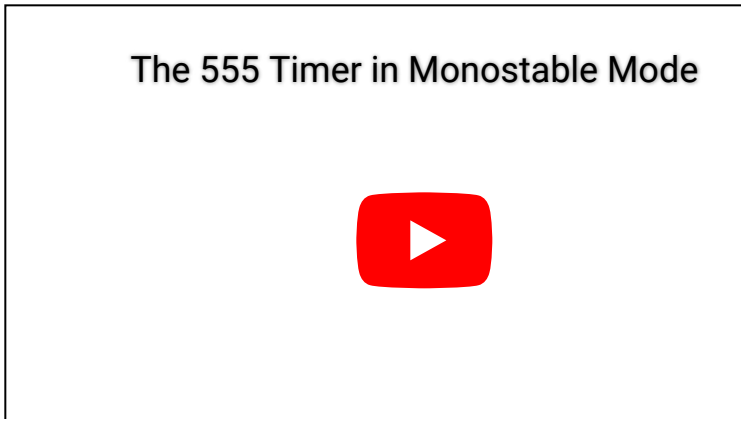
When the button is pressed, the voltage at the trigger pin drops low. Whenever the trigger pin voltage is low, the output pin turns on. At the same time, the discharge pin stops the flow of current from C1 to ground, allowing it to charge.

C1 takes time to charge though, and while the voltage across it is below 2/3 Vcc, the threshold pin remains low so the output pin stays on. When the charge finally builds up enough to

make the voltage across C1 greater than 2/3 Vcc, the threshold pin switches off the output pin. At the same time, the discharge pin switches back on and prevents the capacitor from charging until the button is pressed again.

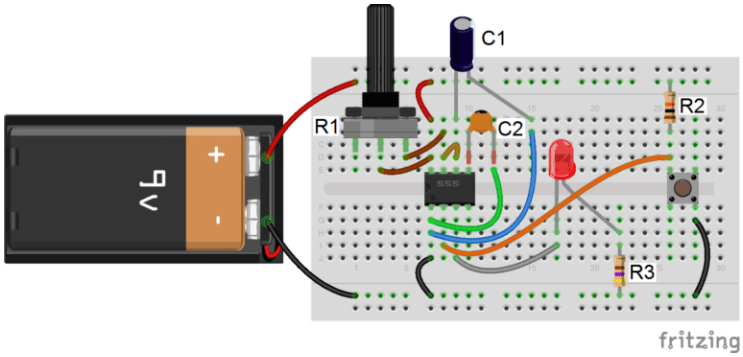
The length of time the LED remains on is a function of the time it takes for the capacitor to become charged to 2/3 Vcc. It's also determined by R1, since the resistor prevents the flow of current to the capacitor and thus increases the time it takes for the voltage across it to reach 2/3 Vcc.

You can watch this video to see the circuit above in action:



A VARIABLE ONE-SHOT LED TIMER

A good way to observe the dependency of time on resistance in this circuit is to replace R1 with a variable resistor (potentiometer):



If you adjust the potentiometer, you should see that the LED starts blinking faster or slower. The effect is quite dramatic. For a great resource on the 555 timer, OpAmps, and other IC's check out the Engineer's Mini Notebook: Timer, Op Amp, and Optoelectronic Circuits & Projects. There are 24 different 555 timer circuits in this book!

Click here to continue on to part 2 of this series, 555 Timer Basics – Bistable Mode.

If you have any questions about this circuit, or are having trouble getting it to work, please leave a comment below. And be sure to subscribe to get an email when we publish new posts!

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