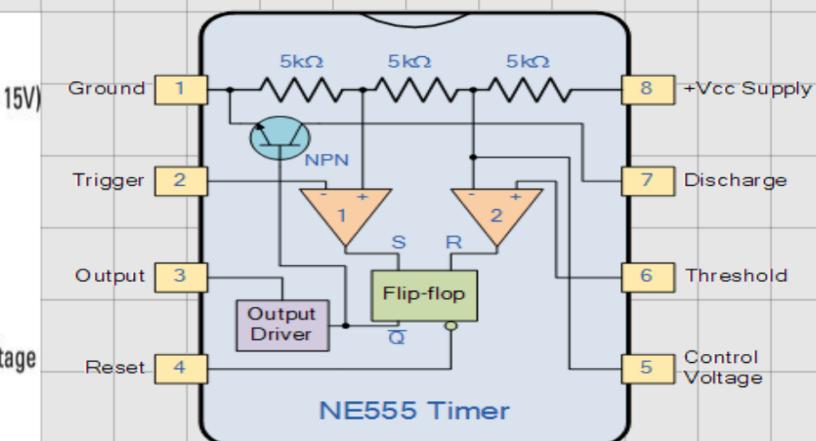
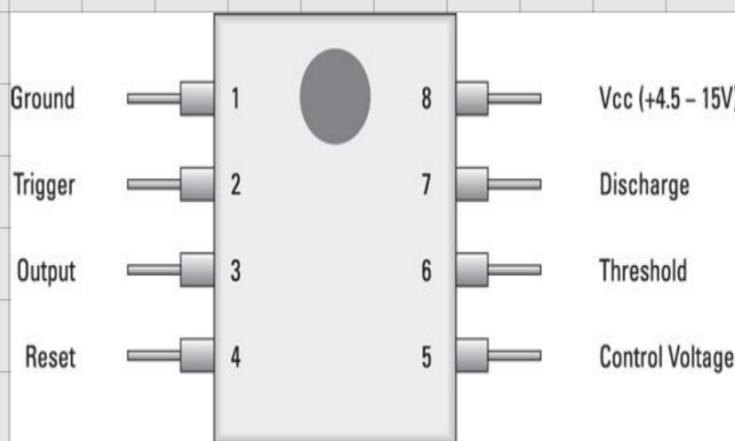


Introduction:

It is an IC that output a digital high or low signal, and it is controlled to determine how long will it be high and how long will it be low.

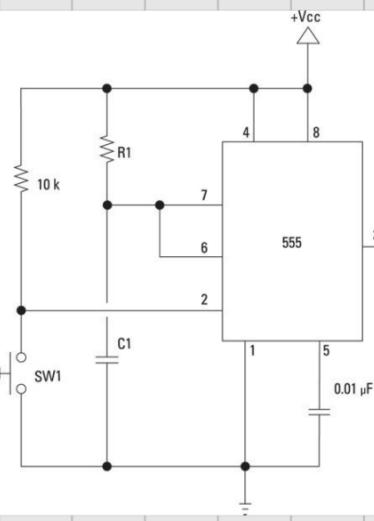
Pins and Wiring:

- \* Pin 1 : Ground.
- \* Pin 2 : Trigger, it is an active low trigger, thus it triggers the IC when  $V_{trig} \leq \frac{1}{3} V_{cc}$ . When the 555 is triggered the output is High.
- \* Pin 3 : Output.
- \* Pin 4 : Reset pin, it is an active low pin, if Pin 4 is grounded the 555 operation is interrupted and it won't start again until triggered via Pin 2.
- \* Pin 5 : Control pin, in most circuits it is simply grounded through a  $0.01\text{MF}$  capacitor.
- \* Pin 6 : Threshold pin, it monitors the voltage across the capacitor that discharges by Pin 7. When  $V_{thr} \geq \frac{2}{3} V_{cc}$ , output goes low.
- \* Pin 7 : Discharge pin, it is used to discharge the external capacitor.
- \* Pin 8 :  $V_{cc}$ .

## Functionning Modes:

- \* Monostable : Single Pulse.
- \* Astable : Alternating Pulses (PWM).
- \* Bistable : Flip-Flop.

## Monostable Mode:

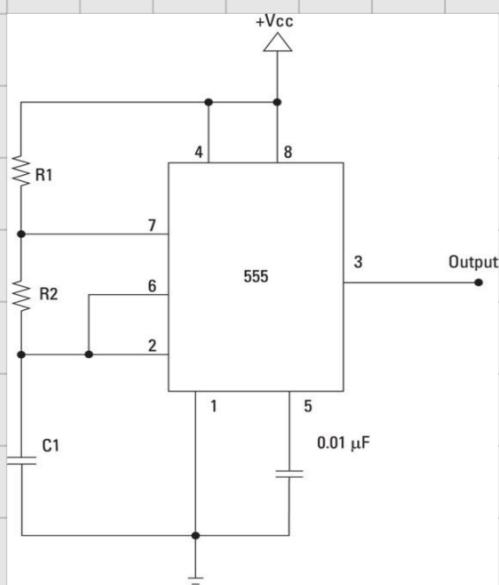


- \* 10kΩ resistor and the SW1 are connected to pin 2 which keep the trigger high  $\Rightarrow$  output Low (on open SW1)
- \* When SW1 is depressed, the supply voltage is short circuited to ground, which activate low the trigger  $\Rightarrow$  output High.
- \* When 555 is triggered, C<sub>1</sub> start charging, and Pin 6 watches the voltage across the capacitor, when  $V_{ca} \geq \frac{2}{3} V_{cc}$ , the cycle ends, and Pin 3 go Low.

## Controlling the Time Interval:

We use the formula :  $T_s = 1.1 R_2 C_F$

## Astable Modes:



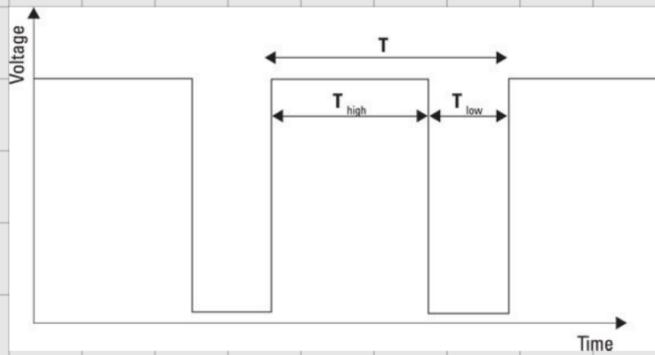
- \* With output High ; the discharge (pin 7) is open forcing current through R<sub>2</sub> and C<sub>1</sub>; this cause C<sub>1</sub> to charge at a rate dependind on R<sub>1</sub> and R<sub>2</sub> and the value of C<sub>1</sub>.
- \* When  $V_{ca} = V_{pin6} \geq \frac{2}{3} V_{cc}$  the output on pin 3 go low grounding pin 7 thought the internal transistor and discharging C<sub>1</sub> through R<sub>2</sub> to  $V_{c1} \leq \frac{1}{3} V_{cc}$ .
- \* When  $V_{c1} \leq \frac{1}{3} V_{cc}$ ; the output is High and pin 7 is open again.

## Controlling the Time Interval:

$T$  : Total duration of the wave.

$T_{\text{High}}$  : Duration of the High pulse.

$T_{\text{Low}}$  : Duration of the Low pulse.



$$T = 0,7(R_1 + 2R_2)C_1$$

$$T_{\text{High}} = 0,7(R_1 + R_2)C_1$$

$$T_{\text{Low}} = 0,7R_2C_1$$

\* Formula deduced from  $Z=RC$ .

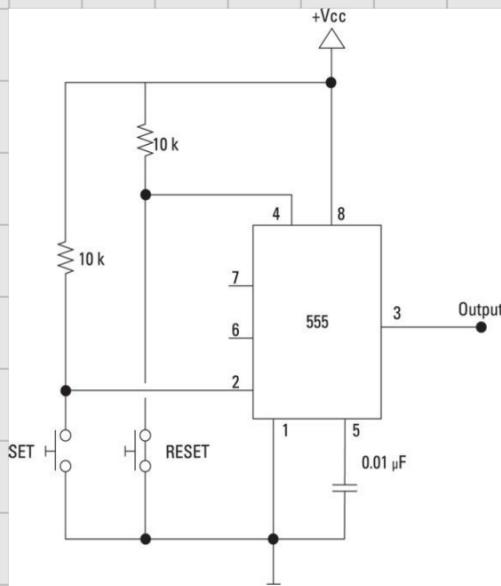
\* 0,7 is derived from  $\frac{2}{3} + R_{\text{int}}C_1$ .

\*  $C_1$  charge through  $R_1$  and  $R_2$  but discharge only through  $R_2$ .

## Bistable Mode (Flip-Flop):

\* A flip-flop is a circuit that alternates between two output states.

\* In a flip-flop a short pulse on the Trigger pin will set the output High and stay High even when the trigger goes Low waiting for a High signal on the Reset pin to go Low.



\* Both Trigger (2) and Reset (4) are connected to Vcc through a 10 kΩ resistor.

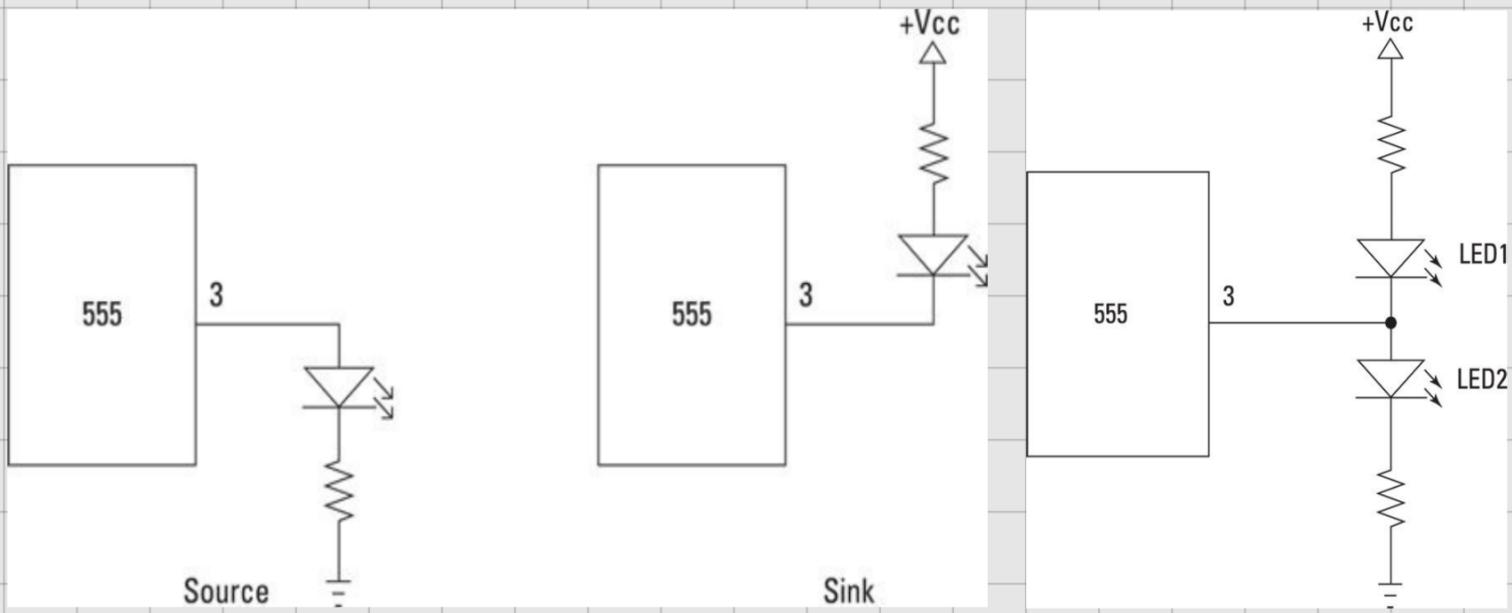
\* When the Set Switch is depressed, pin 2 is shorted to ground, this triggers the 555, and the Output goes High.

\* The output will remain High because the Threshold is not connected to anything.

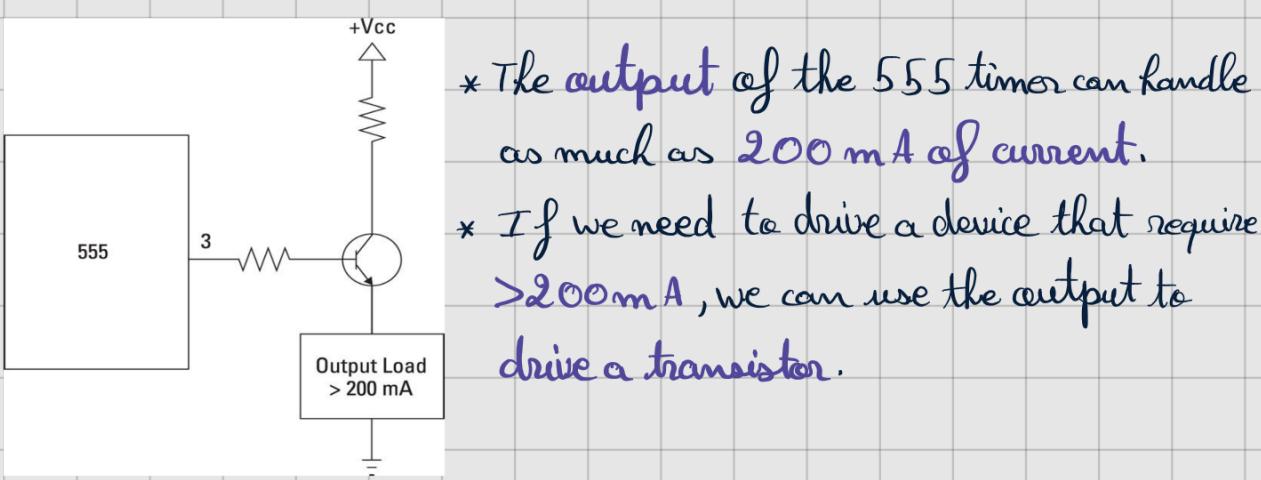
\* The 555 output will go Low when the Reset is pressed.

## Using the 555 timer Output:

There are two ways to connect a component to the output of the 555.



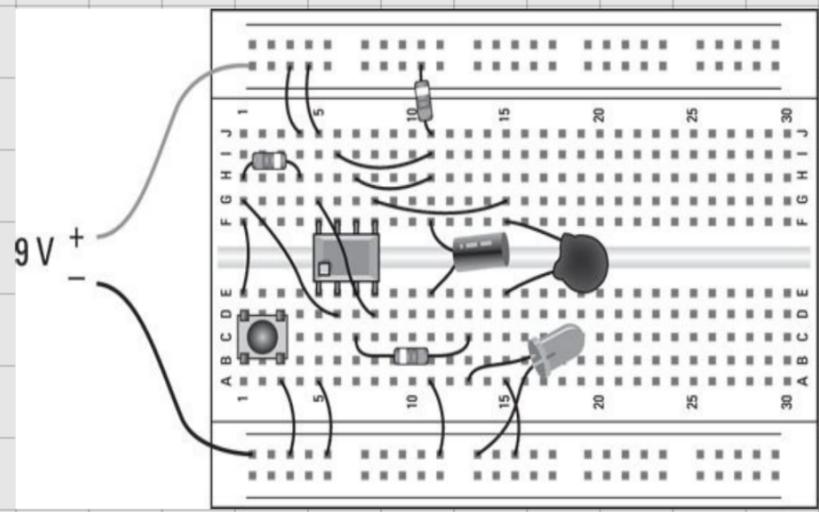
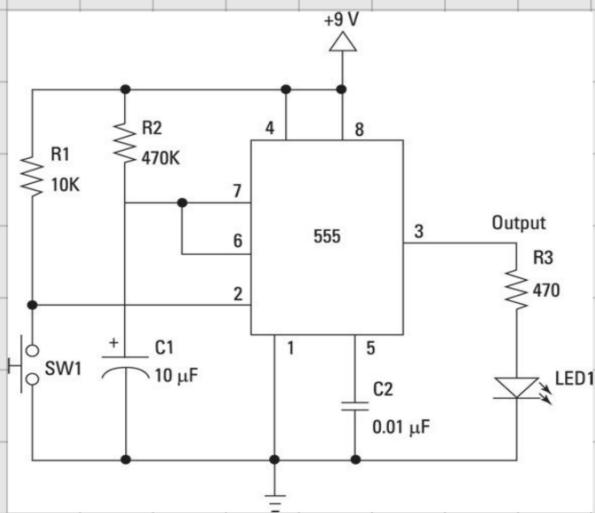
- \* In the circuit in the left the current flow through the LED when the output is High. This configuration is called **Sourcing**.
- \* In the circuit in the right the current flow through the LED when the output is Low. This configuration is called **Sinking**.
- \* We can combine both sinking and sourcing.



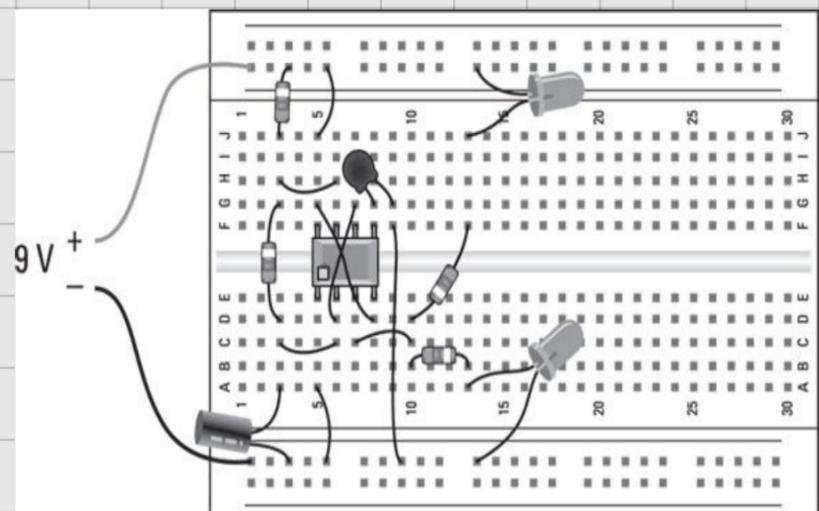
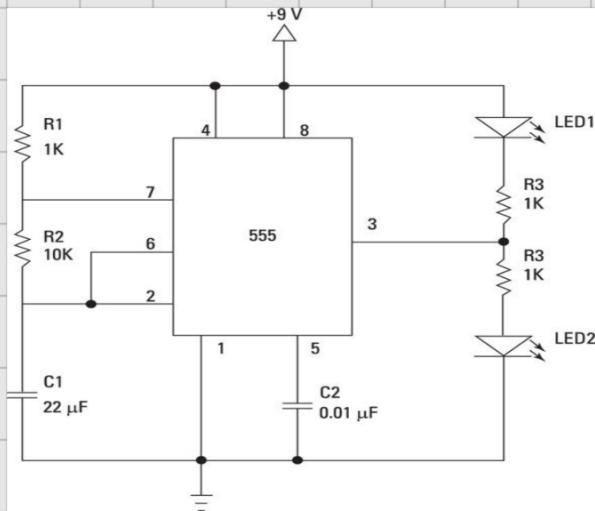
**Note :** There are some chips that contain multiple 555 timers like the 556 double-timer.

# Some projects to try:

## One-shot 555 Timer:



## LED flasher:



## LED flasher with Set-Reset switch:

