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EEN 204

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EXPERIMENT 9

THE 555 TIMER

PURPOSE: To introduce the student to the use of integrated circuits by studying the popular 555 timer IC. Two modes of operation will be studied. The first is the *Astable Operation* or *Free Running* mode. In this mode, the circuit produces an oscillating square wave at the output whose frequency is controlled by two resistors and one external capacitor attached to the IC. The second mode is the *Monostable Operation* or *One Shot*. In this mode, a trigger sets the output voltage high for a specified delay of time. This delay is controlled by one resistor and one external capacitor.

Experimental Procedure

I. Astable Operation (Free Running):

A 555 timer circuit is shown in Fig. 12.1 with the connections to operate it in free running mode. In this mode, the output of the timer will be a square wave of frequency and duty cycle that depends on the external components. These parameters can be calculated from the following equations:

High Time	$t_1 = 0.693(R_A + R_B)C$
Low Time	$t_2 = 0.693R_BC$
Period	$T = t_1 + t_2$
Frequency	$f = \frac{1}{T}$
Duty Cycle	$D = \frac{t_1}{T} = \frac{R_B}{R_A + 2R_B}$

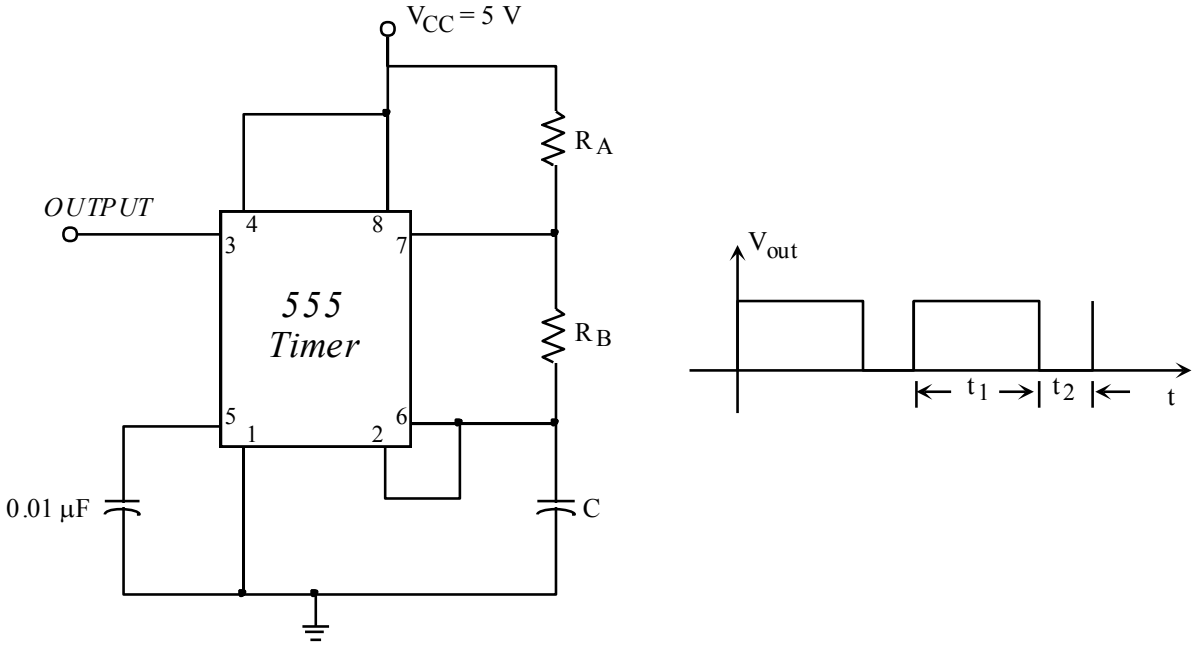


Figure 12.1 555 Timer circuit in astable operation (free running).

a) Design R_A and R_B to give t_1 = 0.7 ms and t_2 = 0.3 ms.

R_A = 5.7kΩ

R_B = 4.3 kΩ

C = 100µF

b) Measure and record your values for t_1, t_2, T, *f*, and the duty cycle.

t_1 = 0.71 ms

t_2 = 0.288ms

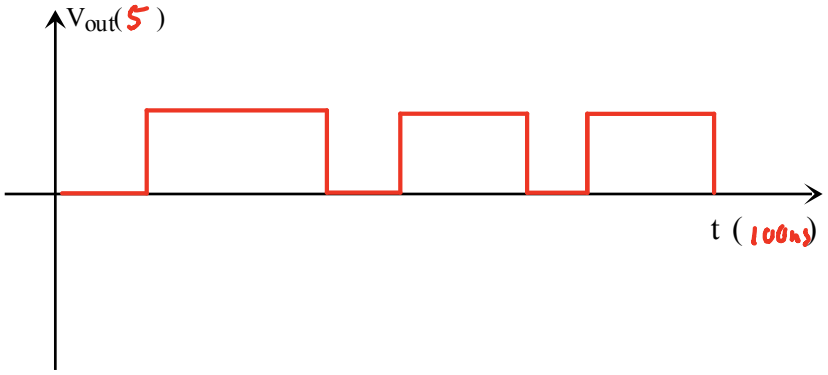
T = 0.998 ms

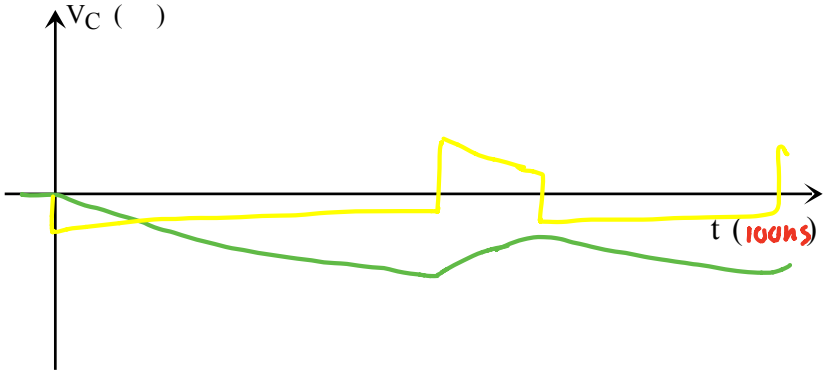
$D = \frac{R_B}{R_A + 2R_B} = \frac{4.3k}{5.7k + 2(4.3k)}$

$f =$ 1.002 m

D = 0.300699

c) Record V_{out} and V_C. Mark on the graphs time and voltage values.





d) Find the % errors for all measured quantities.

$\left| \frac{0.7 - 0.71}{0.7} \right| \times 100 = 1.4\%$

$\left| \frac{0.3 - 0.288}{0.3} \right| \times 100 = 4\%$

$\left| \frac{1 - 0.998}{1} \right| \times 100 = 0.2\%$

$\left| \frac{1 - 1.002}{1} \right| \times 100 = 0.2\%$

% error t_1 = 1.4 %

% error t_2 = 4 %

% error T = 0.2 %

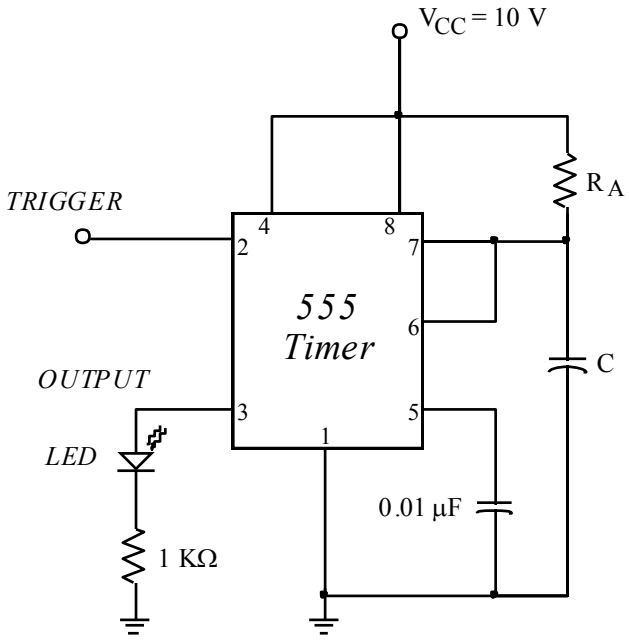
% error f = 0.2 %

% error D = 0 %

II. Monostable Operation (One Shot):

A 555 timer circuit is shown in Fig. 12.2 with the connections to operate it in one shot mode. In this mode, timer is triggered by a signal at *pin* 2 the output will go high and remain high for a period determined by R_A and C. The duration of the delay can be calculated as

$$t = 1.1R_AC$$



$t = 1.1 R_A 10\mu F$

$10 = 1.1 R_A 10\mu F$

909091

Figure 12.2 555 Timer circuit in monostable operation (one shot).

a) Let C = 10 μF. Design R_A such that t = 10 seconds.

$R_A =$ 909091 Ω

b) Connect *pin* 2 to ground for a short time to act as a trigger. Measure the time that the LED is on.

$t =$ ∞