Experiment # 2

555 TIMER ADDITIONAL INDUSTRIAL APPLICATIONS

INTRODUCTION:

From your lecture note you know that the 555 timer can be used in two modes: the stable mode and the monostable (one shot) mode. In the astable mode once you switch on the dc supply you will get a train of pulses. The frequency of these pulses is dependent on the externally connected resistors and capacitor. However, its mark/space ratio is not equal to 1. Over the years designers were trying to obtain a mark/space ratio equal to 1 using different approaches. Fig. 1 shows one approach. In this circuit the output will be Hi for a time t_1=0.693$R_A$$C$ as usual.
However, the output will be low for a time

$$t_2 = \frac{R_A R_B}{R_A + R_B} C \ln\left[\frac{R_B - 2R_A}{2R_B - R_A}\right] \qquad (1)$$

Try to prove equation (1). Thus, by proper selection of R_A and R_B one can obtain $t_1 = t_2$. That is a mark/space ration equal to 1.

NOTE THAT THIS CIRCUIT WILL NOT OSCILLATE IF RB IS GREATER THAN R_A/2 BECAUSE THE JUNCTION OF R_A and R_B CANNOT BRING PIN 2 DOWN TO V_{CC}/3 AND TRIGGER THE LOWER COMPARATOR OF THE 555 TIMER.

On the other hand the 555 timer can be used to generate linear ramp (sawtooth) signals. As you know these signals are very important in many applications. Give examples. A possible circuit for generating ramp signals using the 555 timer is shown in Fig. 2. First try to understand what the transistor is doing in this circuit. Then show that the circuit can produce a ramp voltage at the output every time a trigger pulse is applied to pin 2. Show that the duration of the ramp can be expressed by

$$T = 2/3 \frac{V_{CC} R_E (R_1 + R_2)}{R_1 V_{CC} - V_{BE}(R_1 + R_2)} C \qquad (2)$$

Finally, the 555 timer configured as an astable circuit has many useful applications. In experiment (1) we have considered some of these applications. Here is another more sophisticated one. Fig. 3 shows a

Monotone alarm circuit activated by (a) dark, (b) light, (c) under-temperature, (d) over-temperature.
Here we exploit the fact that pin 4 must be at a hi potential to enable the 555 timer. If it is at a Lo potential then the 555 timer will be disabled and can perform its function as an astable. Try to understand the role played by the transistor. In short the transistor will switch pin 4 between Hi and Lo potentials depending on the temperature or the light intensity. Accordingly, the 555 timer astable will be enabled or disabled.

EXPERIMENTAL WORK:

In the laboratory you are expected to construct the three circuits of Figs. 1-3 using the recommended values of components shown. Verify their operation. Write a report including your observations. BY THE END OF THIS EXPERIMENT WE EXPECT THAT YOU WILL BE FAMILIAR WITH THE VARIETY OF APPLICATIONS OF THE 555 TIMER. CAN YOU THINK OF OTHER APPLICATIONS? PLEASE TRY.

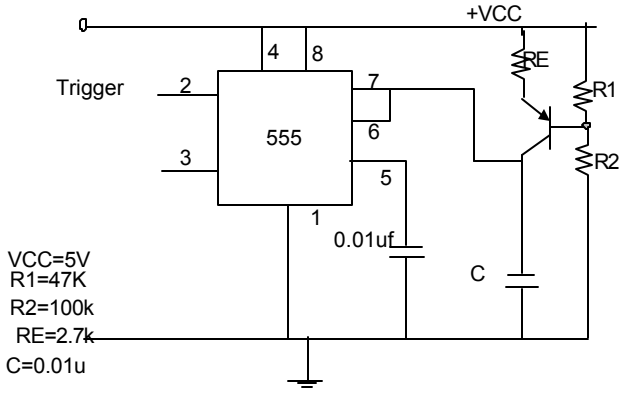

Fig.1: Square Wave Oscillator

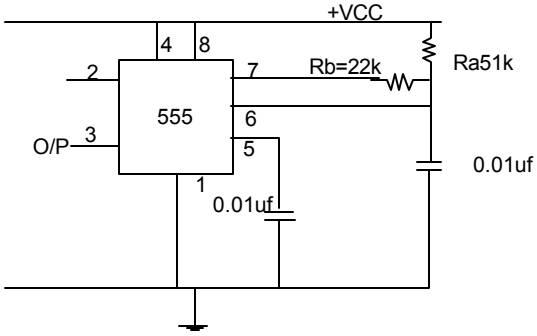

Fig.2: Ramp Signal Circuit

Fig.3: Monotone Alarm Circuit