Experiment No: 14

ASTABLE MULTIVIBRATOR USING IC 555

AIM

To design and set up astable multivibrator of 1000 Hz frequency and 60% duty cycle using IC 555

THEORY

IC 555 timer is an analog IC used for generating accurate time delay or oscillations. The entire circuit is usually housed in an 8-pin package as specified in figures 1 & 2 below. A series connection of three resistors inside the IC sets the reference voltage levels to the two comparators at $\frac{2}{3}V_{CC}$ and $\frac{1}{3}V_{CC}$, the output of these comparators setting or resetting the flip-flop unit. The output of the flip-flop circuit is then brought out through an output buffer stage. In the stable state the $\bar{Q}$ output of the flip-flop is high (ie Q low). This makes the output (pin 3) low because of the buffer which basically is an inverter.The flip-flop circuit also operates a transistor inside the IC, the transistor collector usually being driven low to discharge a timing capacitor connected at pin 7. The description of each pin s described below,

Pin 1: (Ground): Supply ground is connected to this pin.

Pin 2: (Trigger): This pin is used to give the trigger input in monostable multivibrator. When trigger of amplitude greater than (1/3)Vcc is applied to this terminal circuit switches to quasi-stable state.

Pin 3: (Output)

Pin 4 (Reset): This pin is used to reset the output irrespective of input. A logic low at this pin will reset output. For normal operation pin 4 is connected to Vcc.

Pin 5 (Control): Voltage applied to this terminal will control the instant at which the comparator switches, hence the pulse width of the output. When this pin is not used it is bypassed to ground using a 0.01μF capacitor.

Pin 6 (Threshold): If the voltage applied to threshold terminal is greater than (2/3)V_{CC}, upper comparator switches to +Vsat and flip-flop gets reset.

Pin 7: (Discharge): When the output is low, the external capacitor is discharged through this pin

Pin 8 (V_{CC}): The power supply pin

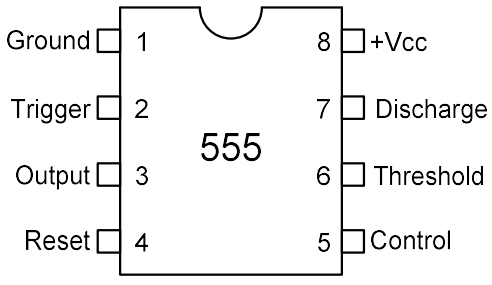

Figure 2: IC 555 pin diagram

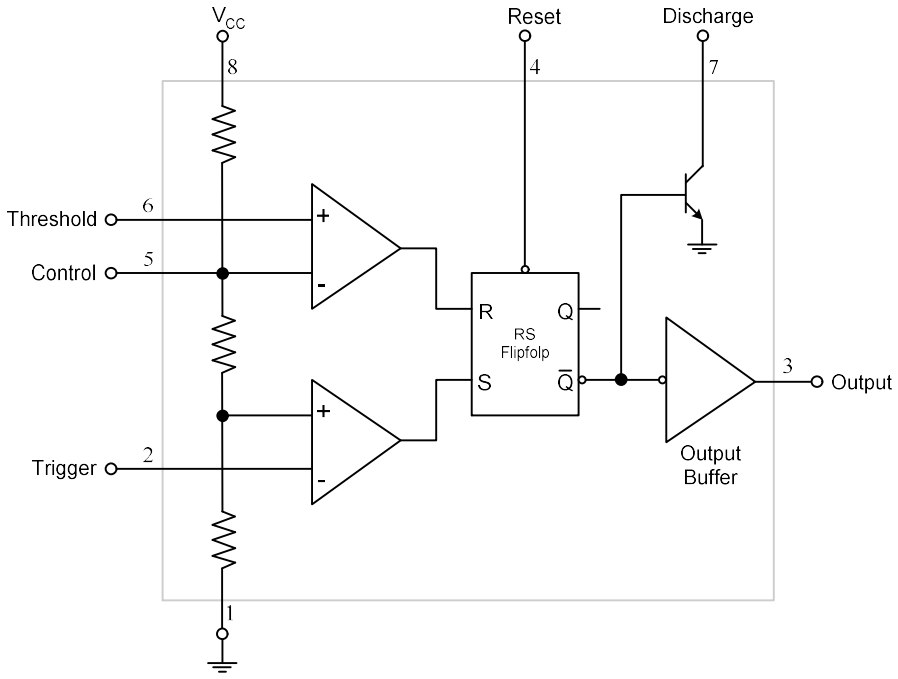

Figure 1: IC 555 Functional block diagram

Astable multivibrator using IC 555

One popular application of the 555 timer IC is as an astable multivibrator or clock Circuit. Figure 3 shows an astable circuit built using 2 external resistors and a capacitor to set the timing interval of the output signal. Capacitor C charges toward V_{CC} through external resistors R_A and R_B. Referring to figure, the capacitor voltage rises until it goes above $\frac{2}{3}V_{CC}$. This voltage is the threshold voltage at pin 6, which drives comparator 1 to trigger the flip-flop(Q low $\bar{Q}$ high) so that the output at pin 3 goes low. In addition, the discharge transistor is driven on, causing the output at pin 7 to discharge the capacitor through resistor R_B. The capacitor voltage then decreases until it drops below the trigger level $\frac{1}{3}V_{CC}$. The flipflop is triggered so that the output goes back high and the discharge transistor is turned off, so that the capacitor can again charge through resistors R_A and R_B towards V_{CC}.

CIRCUIT DIAGRAM & DESIGN

Take $V_{CC} = 10V$ and f = 1000 Hz and duty cycle = 60 %

Then t = 1 ms, t_H = 0.6 ms, t_L = 0.4 ms

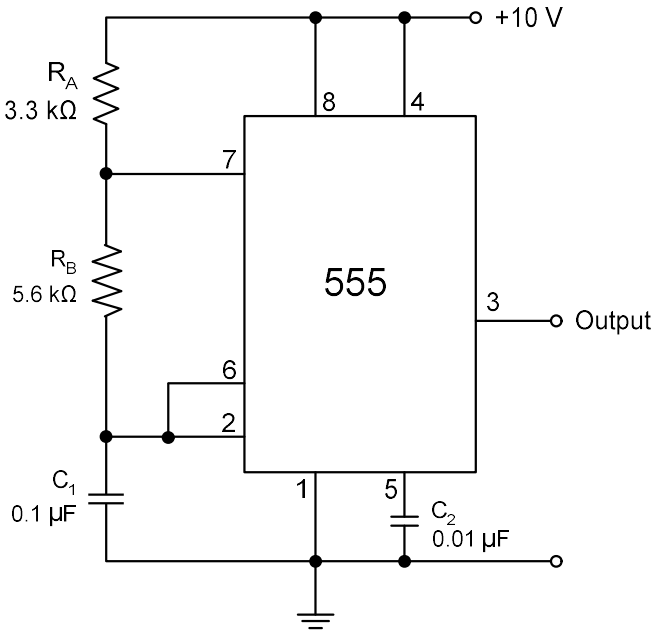

Figure 3 Astable multivibrator circuit using IC 555

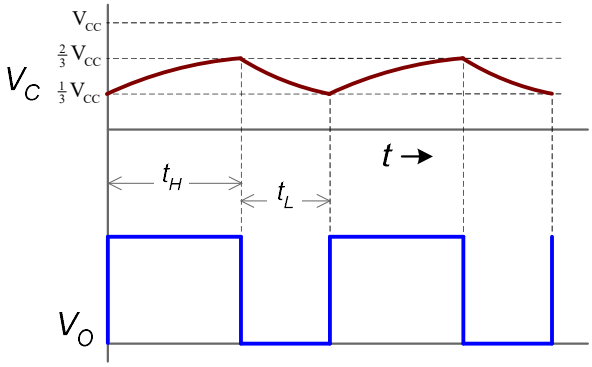

Figure 4 Waveforms of voltage across the capacitor and output voltage

Assume C = 0.1 μF

$t_L = 0.693 \times R_B \times C$ then R_B = 5.77 kΩ take R_B = 5.6 kΩ

$t_H = 0.693 \times (R_A + R_B) \times C$ then R_A = 3.06 kΩ take R_A = 3.3 kΩ

The resistance R_A and R_B should be in the range of 1k to 10k to limit the collector current of the internal transistor.

PROCEDURE

1. Set up the circuit after verifying the condition of IC
2. Observe the waveforms at pin number 3 and 6 of the IC

RESULT

Astable multivibrator using timer IC 555 is designed and setup, and the waveforms are obtained.