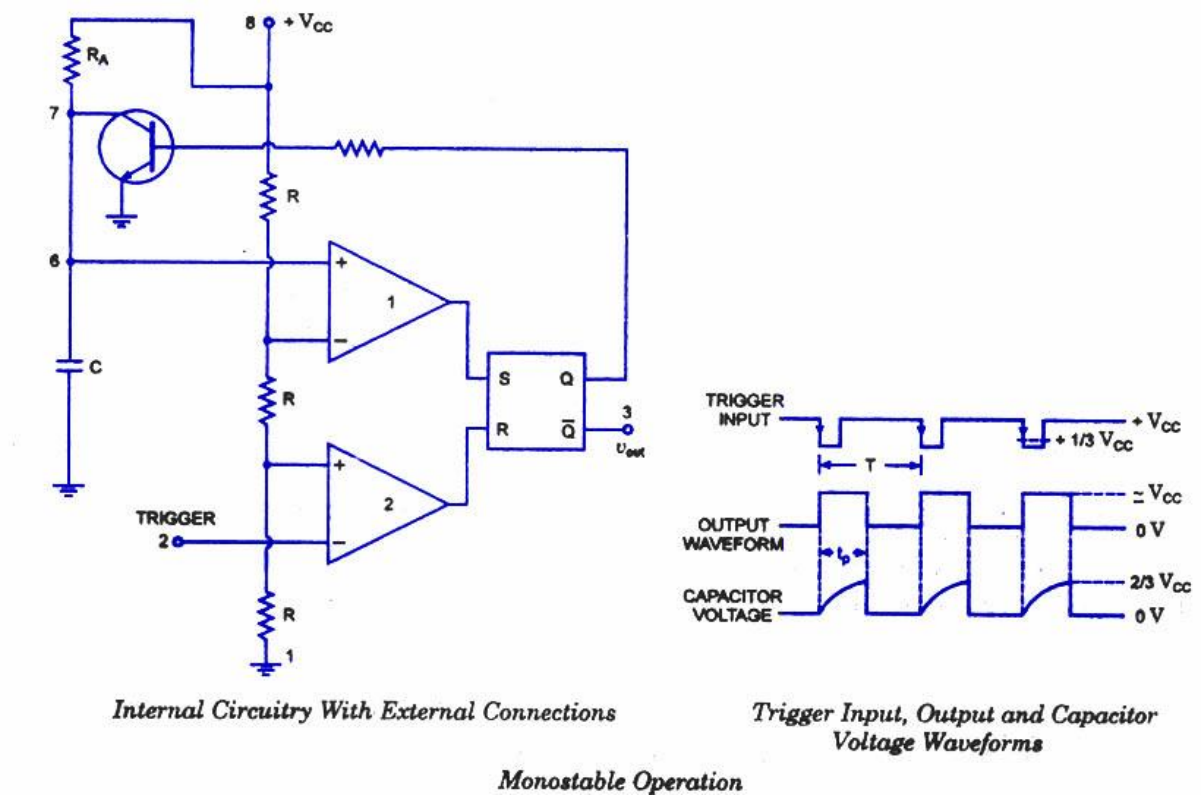
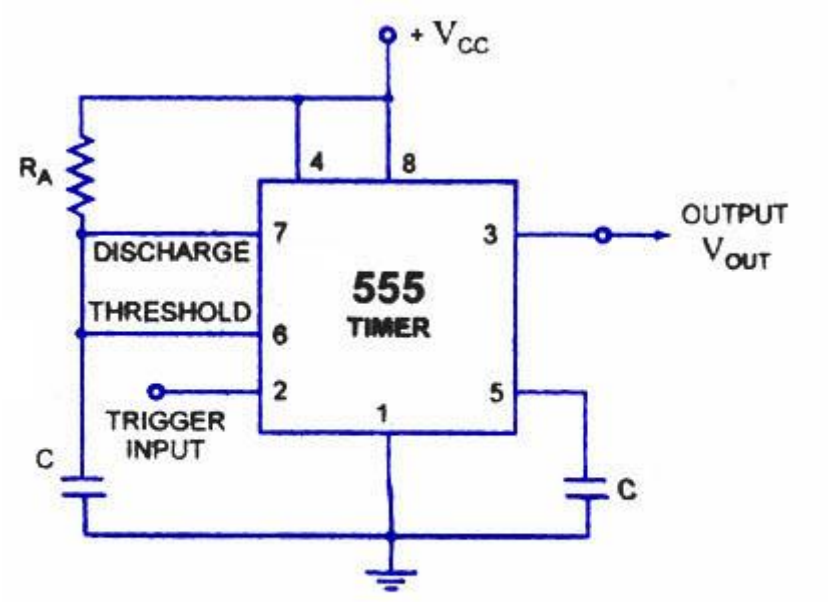
IC 555 as monostable multivibrator



Internal Circuitry With External Connections

Trigger Input, Output and Capacitor Voltage Waveforms

Monostable Operation



Circuit of The Timer 555 as a Monostable Multivibrator

- Initially when the circuit is in the stable state i.e., when the output is low, transistor is ON and the capacitor C is shorted out to ground.

- Upon the application of a negative trigger pulse to pin 2, transistor is turned OFF, which releases the short circuit across the external capacitor C and drives the output high.

- The capacitor C now starts charging up towards V_{CC} through R.

- When the voltage across the capacitor equals 2/3 V_{CC}, comparator 1's output switches from low to high, which in turn drives the output to its low state via the output of the flip-flop.

- At the same time the output of the flip-flop turns transistor ON and hence the capacitor C rapidly discharges through the transistor. The output of the monostable multivibrator (single stable state i.e. low state) remains low until a trigger pulse is again applied. Then the cycle repeats. The pulse width of the trigger input must be smaller than the expected pulse width of the output waveform. Also the trigger pulse must be a negative going input signal with amplitude larger than $1/3V_{CC}$.

Formula derivation of 555 Monostable multivibrator

The ON time and OFF time of the monostable multivibrator circuit can be calculated by taking the charging and discharging time of the capacitor C. The ON time of a cycle is equal to the charging time of the capacitor from 1/3Vcc to 2/3Vcc

V(t) is the voltage value across the capacitor at a particular instant of time t.

$$V(t) = V_{Final} - (V_{Final} - V_{Initial})\, e^{-t/RC}$$

During charging, the capacitor is charging towards the source voltage V_{cc} which is the final voltage. And the initial voltage is 0 volts.

The time period of the quasi-stable state or ON time is the charging time of the capacitor C from 0 to 2/3Vcc through resistance R_A by the source voltage V_{cc}.

T1 is the time required to charge the capacitor C through resistance R_A from the voltage 0 v to 2/3Vcc by the source V_{cc}.

$$2V_{cc}/3 = V_{cc}\,(1 - e^{-T/(R_A * C)})$$

$$2/3 = 1 - e^{-T/(R_A * C)}$$

$$1/3 = e^{-T/(R_A * C)}$$

Applying natural logarithm,

$$\ln(1/3) = \ln(e^{-T/(R_A * C)})$$

$$-\ln(3) = -T/(R_A * C) \ldots\ldots \text{ since } \ln(1/x) = -\ln(x)$$

$$T = \ln(3)(R_A * C)$$

Equation for calculating ON time,

$$\boxed{T1 = 1.1 * R_A * C}$$