ic555a.sqproj

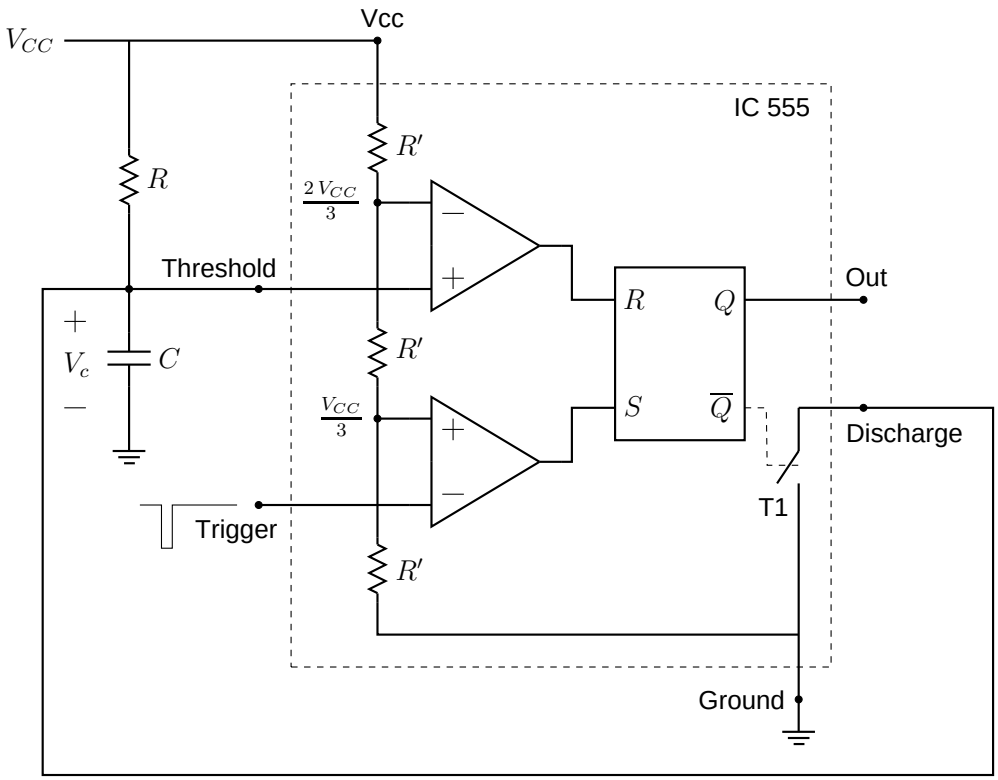

Figure 1: Monostable operation of the 555 timer.

The purpose of a monostable circuit is to produce an output pulse of a desired duration when a short input triggering pulse is applied. In the circuit of Fig. 1, the triggering pulse is required to be negative-going. Fig. 2 shows the waveforms resulting from the application of a trigger pulse. Before t_0, we have a steady-state situation in which the flip-flop output Q is low. The switch T1 (which is actually a BJT) is closed since $\overline{Q}$ is high. The capacitor voltage is therefore $V_c = 0\,V$. During this time, $R = S = 0$, and the flip-flop holds its present state. At $t = t_0$, the triggering pulse goes low, thus making $S = 1$. Note that the capacitor voltage V_c remains $0\,V$ since it cannot change instantaneously, and we have $R = 0$, $S = 1$. The flip-flop output Q goes high, $\overline{Q}$ goes low, the switch T1 opens, and the capacitor starts charging toward V_{CC} with a time constant $\tau = RC$.

In the meanwhile, the trigger pulse (which is by design shorter in duration than the output pulse) has become high again (see Fig. 2), and we have $R = S = 0$. This situation continues up

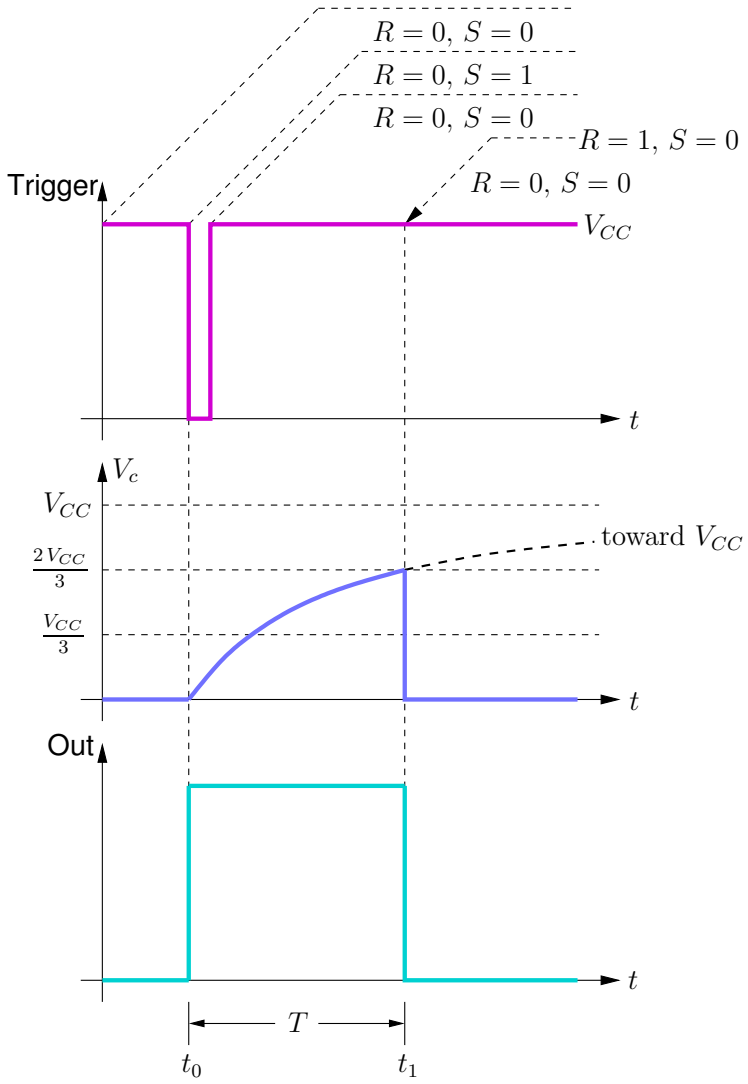

Figure 2: Waveforms for monostable operation of the 555 timer.

to $t = t_1$ at which point V_c crosses $2\,V_{CC}/3$, thus causing $R = 1$, $S = 0$, which resets the flip-flop, and it is once again in the stable state, with $Q = 0$, $R = 0$, $S = 0$, $V_c = 0\,V$.
The duration of the output pulse (T in Fig. 2) is determined by the time taken by the capacitor to charge from $0\,V$ to $2\,V_{CC}/3$ with a time constant of $\tau = RC$, and is given by,

$$T = R\,C\ln 3\,. \tag{1}$$

Exercise Set

1. For $R = 1\,\mathrm{k}\Omega$ and $C = 1\,\mu F$, calculate the expected pulse width T. Verify by simulation.

2. By simulation, obtain waveforms for V_c and Q. Compare with the expected waveforms shown in Fig. 2.

3. What will happen if C is increased/decreased by a factor of 2? Verify by simulation.