schmitt_osc_411.sqproj

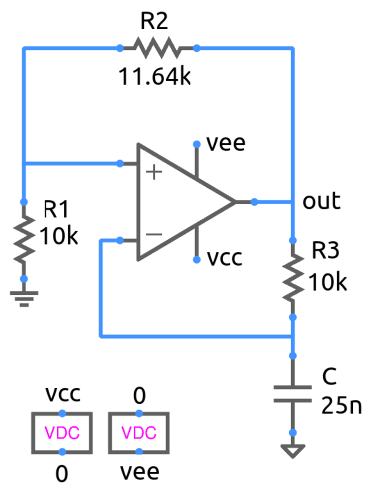

Figure 1: Oscillator circuit using a Schmitt trigger.

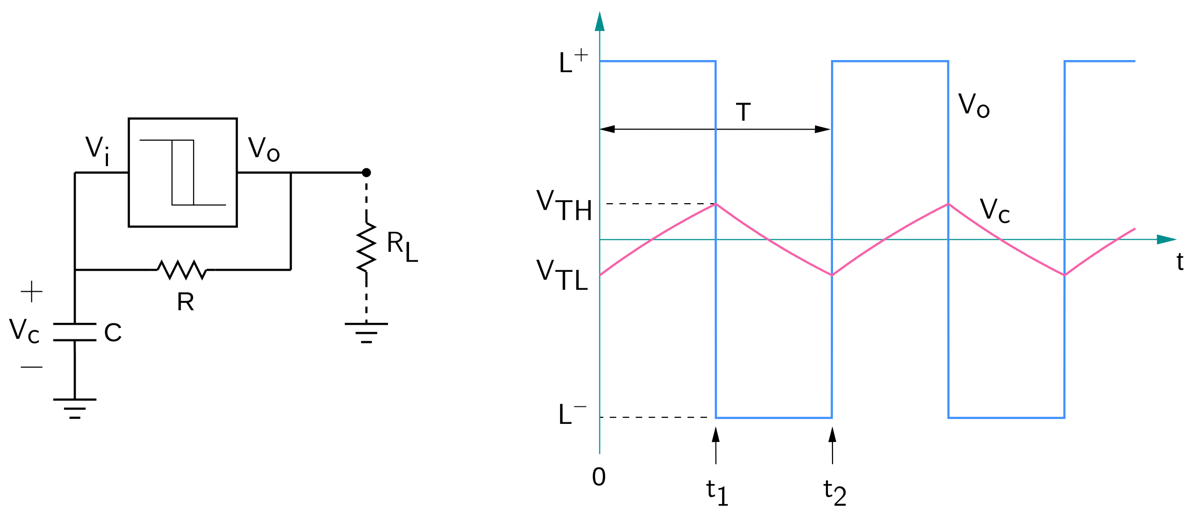

Figure 2: Waveforms for output voltage (blue) and capacitor voltage (red).

Shown in Fig. 1 is an oscillator circuit using an inverting Schmitt trigger. Fig. 2 shows the associated waveforms. The capacitor voltage V_C varies between V_{TL} and V_{TH}, the low and high thresholds of the Schmitt trigger, respectively. When V_o is high (denoted by L^+ in Fig. 2), the capacitor charges toward L^+. However, when it crosses V_{TH}, the output changes to L^-. Now the capacitor starts discharging toward L^-. When it crosses V_{TL}, the output changes again, and this cycle continues.

Exercise Set

1. Assuming $L^+ = -L^- = L$, show that $V_{TL} = -V_{TH} \equiv V_T$. Calculate V_T for $L = 13.4\,\text{V}$.

2. Show that the period of oscillation is given by

$$T = 2\,R\,C\,\ln\frac{L + V_T}{L - V_T}\,. \tag{1}$$

3. Run the simulation, and plot $V_o(t)$ and $V_C(t)$. Calculate T and compare it with the simulation result.

4. Compare the waveforms with those obtained with the 741 Op amp model (see `schmitt_osc_741.sqproj`). Comment on the difference you observe in the waveforms.

References

1. S. Franco, *Design with Operation Amplifiers and Analog Integrated Circuits,* McGraw-Hill, 1998.

2. A. S. Sedra, K. C. Smith, and A. N. Chandorkar, *Microelectronic Circuits: Theory and Applications*, Fifth edition, Oxford University Press, 2009.

3. J. Millman and A. Grabel, *Microelectronics,* McGraw-Hill, 1988.