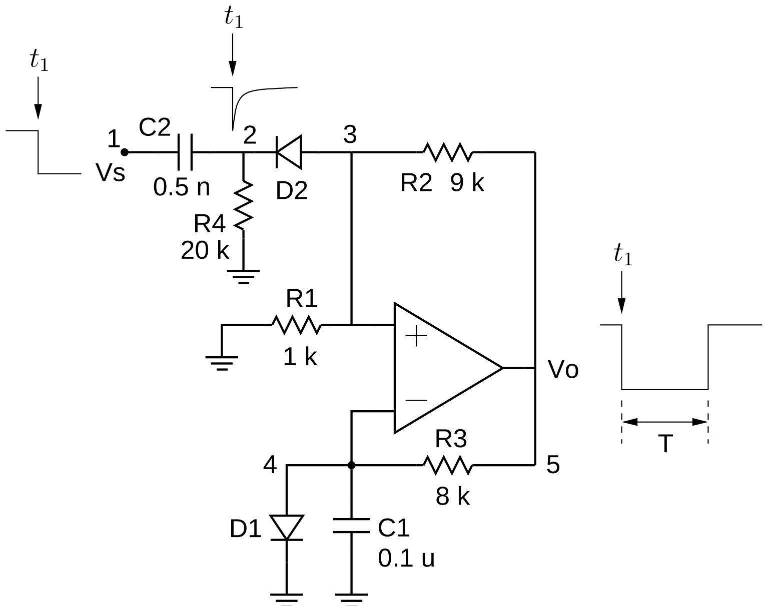
opamp_monostable_1.sqproj

Description



The purpose of a monostable circuit is to produce an output pulse when a transition is applied at the input. In the above circuit, a negative-going (i.e., high to low) transition works as a trigger, producing a negative pulse at the output, as shown in the figure. The operation of the circuit can be understood as follows [1]:

(a) In the stable state, the output is high, i.e., $+V_{\text{sat}}$, D1 is conducting, thus clamping V_- of the Op Amp at about $0.7\,V$. The resistance R_4 is chosen to be large enough to ensure that it draws a small current, and the voltage at node 3 (i.e., V_+ of the Op Amp) is determined approximately by the R_1-R_2 divider. This voltage is larger than V_-, and therefore V_o stays at $+V_{\text{sat}}$.

(b) When a negative-going transition appears at the input, a negative pulse is produced by the R_4C_2 differentiator. Node 3 is pulled low, i.e., lower than $V_- \approx 0.7\,V$, and the output changes to $-V_{\text{sat}}$. The diode D_2 is now reverse biased and isolates the Op Amp circuit from the differentiator circuit. V_+ is given by voltage division as $-\beta V_{\text{sat}}$, where $\beta = R_1/(R_1 + R_2)$.

C_1 now starts discharging toward $-V_{\text{sat}}$ through R_3. When it crosses $-\beta V_{\text{sat}}$ (i.e., V_+), the output changes back to $+V_{\text{sat}}$.

Exercise Set

1. Show that the output pulse width is given by,

$$T = R_3 C_1 \ln\left(\frac{1}{1-\beta}\right). \tag{1}$$

2. Simulate the circuit with the component values given and verify that the output pulse width matches with the above expression.

3. What would you do to increase the pulse width by 50 %? Verify by simulation.

4. How would you choose the component values for the differentiator circuit (i.e., R_4 and C_2)?

References:

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