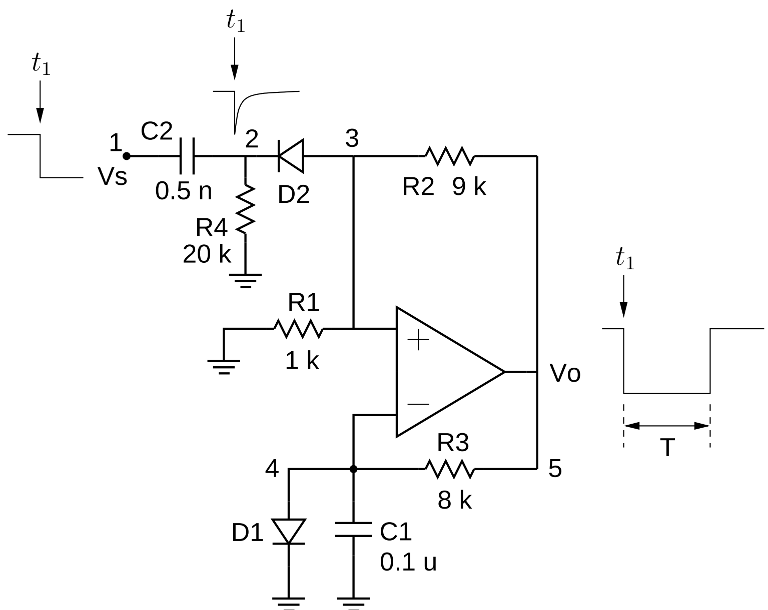
# opamp_monostable_1.sqproj




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,

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

   Verify with simulation.

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

3. 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.