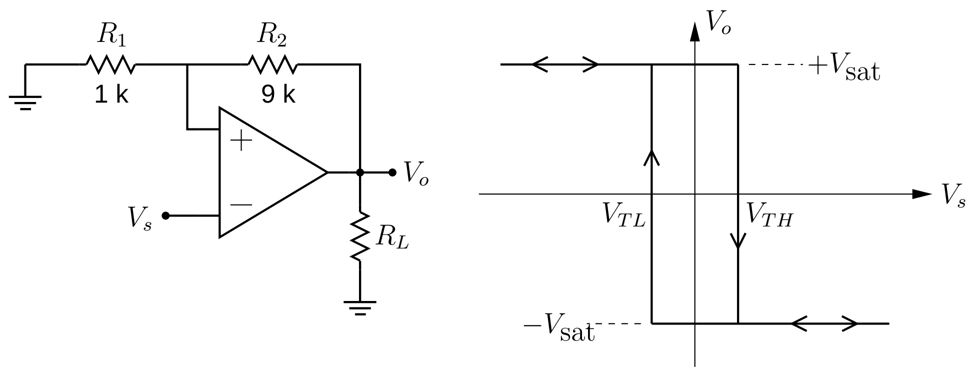
`schmitt_741.sqproj`

Description



The Schmitt trigger circuit shown in the figure works on the basis of positive feedback, which makes the gain very high. As a result of the high gain, the Op Amp operates in the saturation region, i.e., $V_o = \pm V_{\text{sat}}$. Let us consider these two cases:

(a) $V_o = +V_{\text{sat}}$: Since the input current of an Op Amp can be neglected (at the non-inverting terminal), we have, by voltage division,

$$V_+ = \frac{R_1}{R_1 + R_2} \times V_{\text{sat}} \equiv V_{TH} \,. \tag{1}$$

For the Op Amp output V_o to change to $-V_{\text{sat}}$, the input voltage V_s needs cross V_{TH}.

(b) $V_o = -V_{\text{sat}}$: Again, since the input current at the non-inverting terminal can be neglected, we have

$$V_+ = \frac{R_1}{R_1 + R_2} \times (-V_{\text{sat}}) \equiv V_{TL} \,. \tag{2}$$

For V_o to change to $+V_{\text{sat}}$, V_s needs cross V_{TL}.

The above considerations give rise to the V_o versus V_s relationship shown in the figure, and the circuit is therefore called "inverting" Schmitt trigger.

Exercise Set

1. For the component values shown in the figure, what are the values of V_{TL} and V_{TH}?

2. Simulate the circuit with a sinusoidal input voltage of amplitude $10\,V$ and frequency $50\,\mathrm{Hz}$ for, say, two cycles. Plot V_o versus V_s and check if your computed values of V_{TL}, V_{TH} are correct. Also observe V_o and V_s versus time.

3. Plot V_+ versus V_s and explain your observation.

4. If R_2 is changed to $1\,\mathrm{k}$, how will the transfer characteristic change? Verify by simulation.