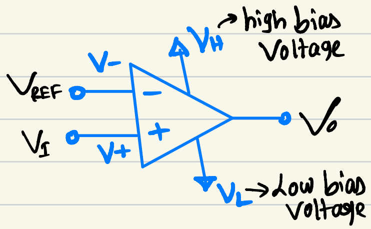
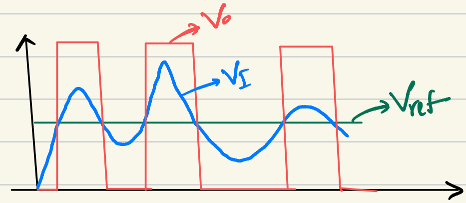
Schmitt Trigger Circuit

Otto H. Schmitt (1934) → an electrical engineer proposed this ckt.

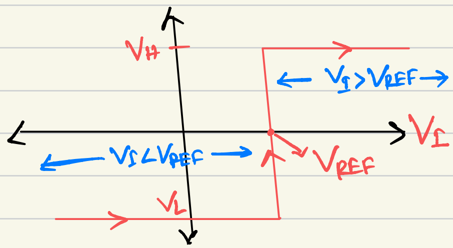
Comparators

① Non-Inverting Comparator:



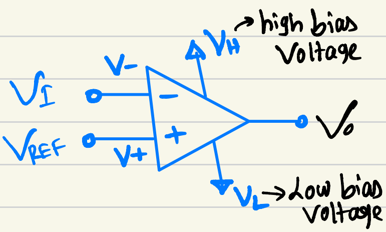


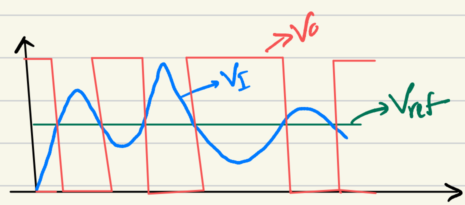
→ $V_I > V_{REF}$ → $V_o = V_H$
→ $V_I < V_{REF}$ → $V_o = V_L$



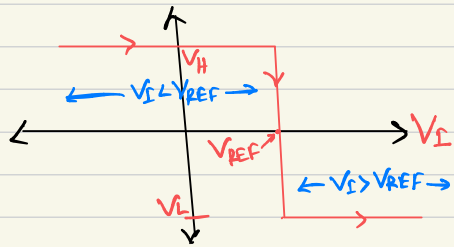
Transfer characteristics

② Inverting Comparator:





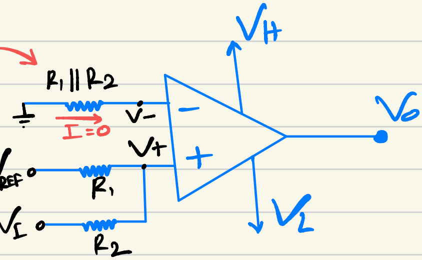
→ $V_I > V_{REF}$ → $V_o = V_L$
→ $V_I < V_{REF}$ → $V_o = V_H$

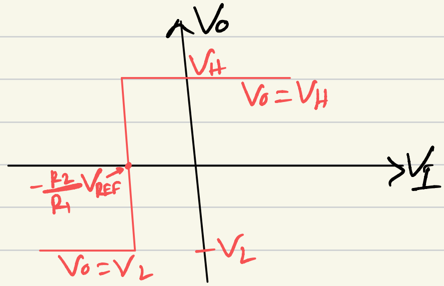


Transfer characteristics

(3) Non-Inverting comparator with ref. voltage:

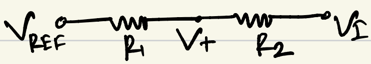
This prevent DC bias effect inside op-amp





$\rightarrow I = 0 \rightarrow V- = 0$ always

Node equation at $V+$



$$\frac{V_+ - V_{REF}}{R_1} + \frac{V_+ - V_I}{R_2} = 0$$

$$\begin{cases} V_+ = V_{REF}\left(\frac{R_2}{R_1+R_2}\right) + V_I\left(\frac{R_1}{R_1+R_2}\right) \\ V_- = 0 \end{cases}$$

Now,

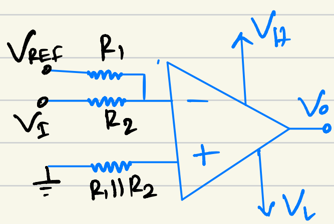
$V_+ > V_- \longrightarrow V_o = V_H$

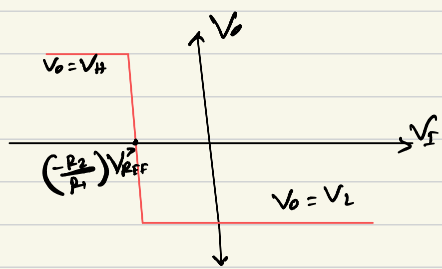
$$\Rightarrow \frac{V_I R_1}{R_1+R_2} + \frac{V_{REF} R_2}{R_1+R_2} > 0$$

$\therefore V_I > \left(-\frac{R_2}{R_1}\right) V_{REF} \rightarrow \boxed{V_o = V_H}$

and $V_I < \left(-R_2/R_1\right) V_{REF} \rightarrow \boxed{V_o = V_L}$

(4) Inverting comparator with ref. voltage:





$$\begin{cases} V_+ = 0 \\ V_- = V_I \frac{R_1}{R_1+R_2} + V_{REF} \frac{R_2}{R_1+R_2} \end{cases}$$

$\rightarrow$ if $V_I < \left(-\frac{R_2}{R_1}\right) V_{REF} \rightarrow V_o = V_H$

$\rightarrow$ if $V_I > \left(-\frac{R_2}{R_1}\right) V_{REF} \rightarrow V_o = V_L$