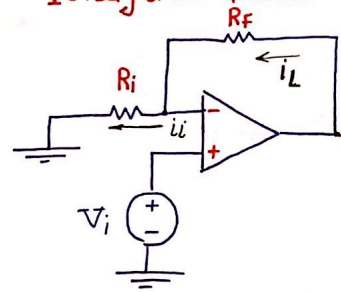


Electronics: 236 → L20 Op Amps Apps

Voltage to Current Converter :



$$i_L = \frac{V_i}{R_i}$$

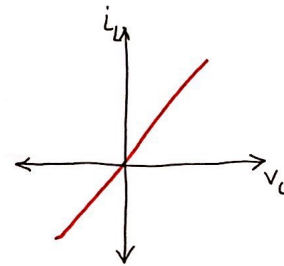
$$i_i = i_L$$

Let $V_i = 1V, R_i = 1k$

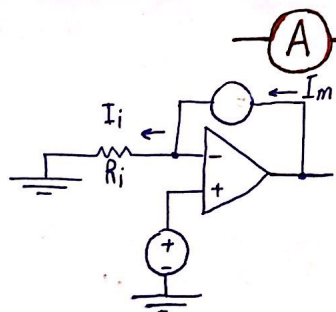
$$i_L = \frac{1V}{1k} = 1mA$$

Let $V_i = -1V$

$$i_L = -1mA$$



V to I Converter → Replace R_L by a PMMC



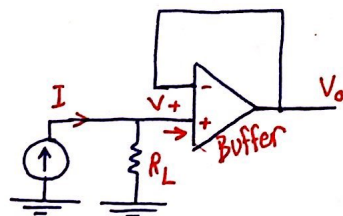
← Ammeter ← (Galvanometer)

Range $\pm I_m$

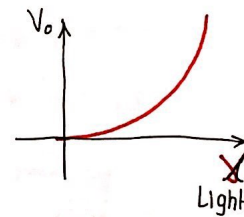
$$\pm i_i = \pm I_m$$

let $V_i = 71V \Rightarrow R_i = 1k$

Current to voltage Converter



$$V_o = V_+ = I \cdot R_L$$



Op-amp as a Comparator (non-linear application)

1 $V_o = \pm V_{sat}$, $V_d = V_+ - V_-$

If $V_d > 0 \rightarrow V_o = +V_{sat}$
 If $V_d < 0 \rightarrow V_o = -V_{sat}$

Comparator: Zero level detector

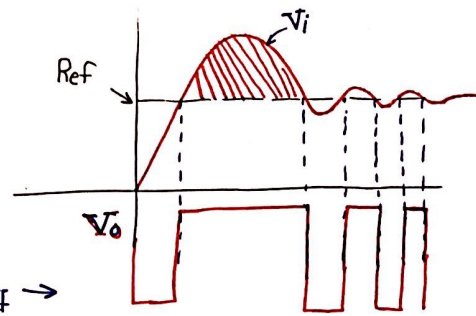
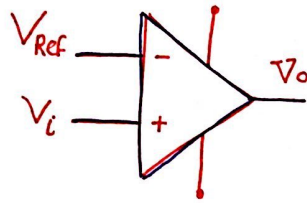
$V_o = \pm V_{sat} = \pm 13V$

When $V_i > 0 \rightarrow V_o = +13V$
 When $V_i < 0 \rightarrow V_o = -13V$

Non-zero level detector

$V_o = \mp 13$

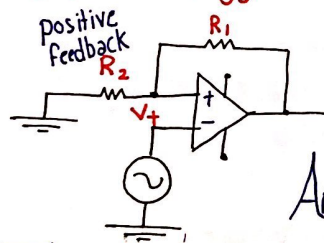
When $V_i > 2 \rightarrow V_o = +13$
 When $V_i < 2 \rightarrow V_o = -13$



When V_i oscillates around $V_{REF} \rightarrow$
 V_o keeps changing between $\pm V_{sat}$

This is bad \Rightarrow use Comp. with $\mp V_e$ Feedback (Hyst.) Schmitt trigger

Schmitt trigger



This is a Comparator

$$V_o = \mp V_{sat}$$

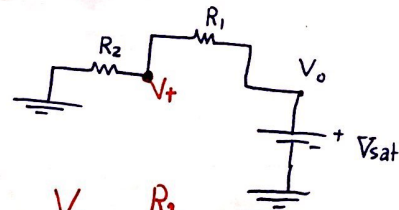
Analysis Method:

Step 1: Let $V_o = +V_{sat}$

$$\therefore V_d > 0$$

$$V_d = V_+ - V_- > 0$$

$$V_+ > V_i = V_{i+}$$



$$V_+ = \frac{R_2}{R_1 + R_2} \cdot (+V_{sat})$$

V_{i+} "Upper Threshold"

As long As

$$V_{i+} > V_i \rightarrow V_o = +V_{sat}$$

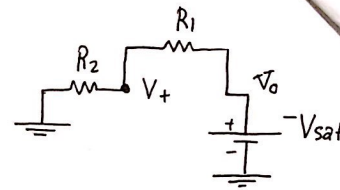
If $V_i \uparrow$ & becomes $> V_{i+} \rightarrow \therefore V_o$ switches from $+V_{sat}$ to $-V_{sat}$

Step 2: Let $V_o = -V_{sat}$

$$V_+ < V_- = V_i$$

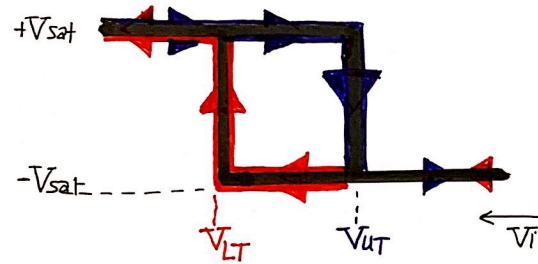
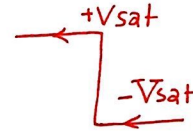
$$V_+ = \frac{R_2}{R_1 + R_2} (-V_{sat})$$

$$= V_{LT} \text{ "Lower Threshold"}$$



as long as $V_{LT} < V_i \Rightarrow V_o = -V_{sat}$

if $V_i \downarrow$ & becomes $< V_{LT} \Rightarrow V_o$ switch from $-V_{sat}$ to $+V_{sat}$



هون عملية ال
من واحد فقط
Switching

