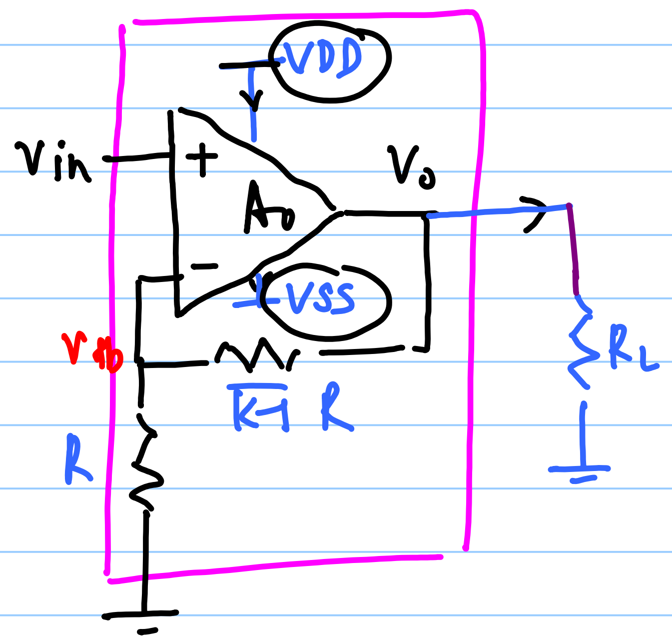
Note Title 04-02-2022

Lecture # 9



#1 : OPAMP is ideal with infinite gain and infinite bandwidth.

#2 : OPAMP has finite DC gain but infinite bandwidth

#3 : OPAMP has finite DC gain and bandwidth

#1: $V_{in} = A\sin(\omega_{in} t)$

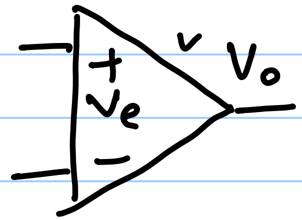
$V_{fb} = V_{in}$

$\frac{V_o}{K} = V_{in} \Rightarrow V_o = K V_{in}$

#2: $\left(V_{in} - \frac{V_o}{K}\right) A_o = V_o$

$$V_o = \frac{V_{in}}{\frac{1}{K} + \frac{1}{A_o}} = \frac{K V_{in}}{1 + K/A_o}$$

#3.



$$\frac{V_o}{V_e} = \frac{A_0}{1+s/\omega_p} \checkmark$$

$$\left(V_{in} - \frac{V_o}{K}\right)\frac{A_0}{1+s/\omega_p} = V_o$$

$$V_{in} = \frac{V_o(1+s/\omega_p)}{A_0} + \frac{V_o}{K}$$

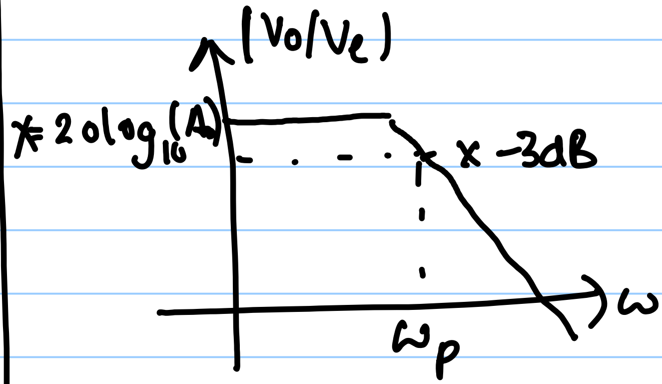
$$\frac{V_o}{V_{in}} = \frac{1}{\frac{1}{K} + \frac{1}{A_0} + \frac{s}{A\omega_p}}$$

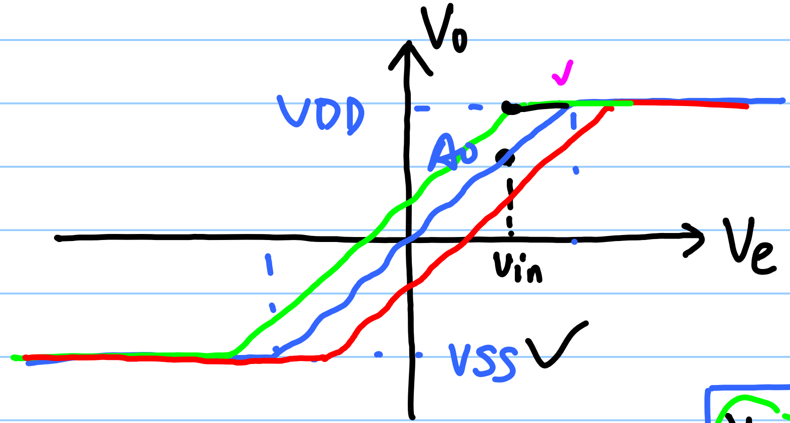
$$H(s) = \frac{V_o}{V_{in}} = \frac{K}{1 + \frac{K}{A_0} + \frac{s}{(A\omega_p/K)}}$$

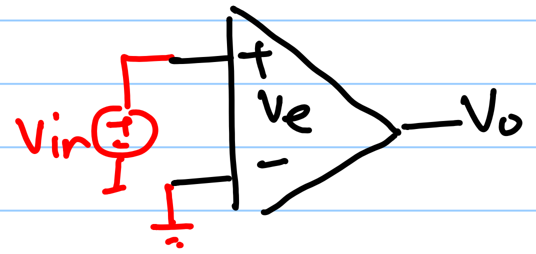
$V_{in}(s) \longrightarrow \boxed{H(s)} \longrightarrow V_o(s)$

$$V_o(s) = H(s)\,V_{in}(s)$$

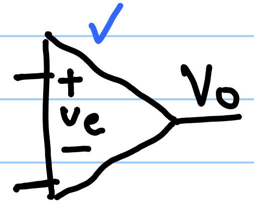
$$V_o(t) = \mathcal{L}^{-1}\{V_o(s)\}$$





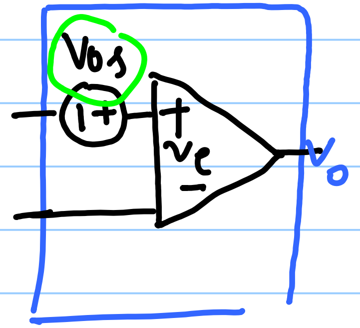


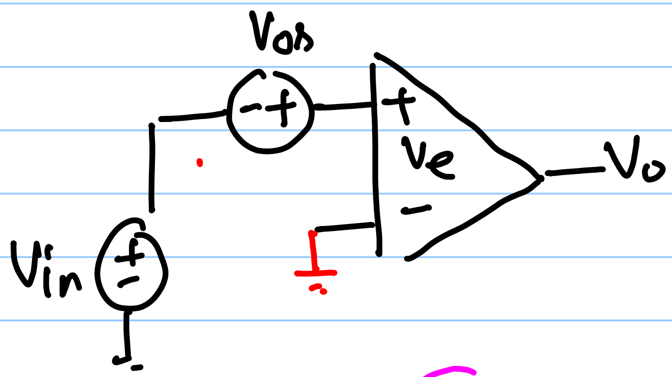
$A_0 = 1000$



Opamp w/ offset

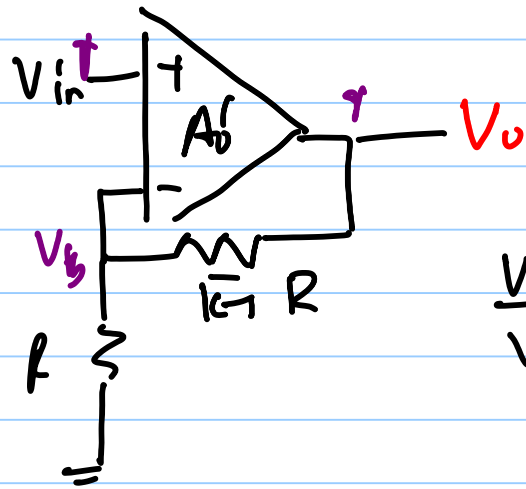
$\equiv$



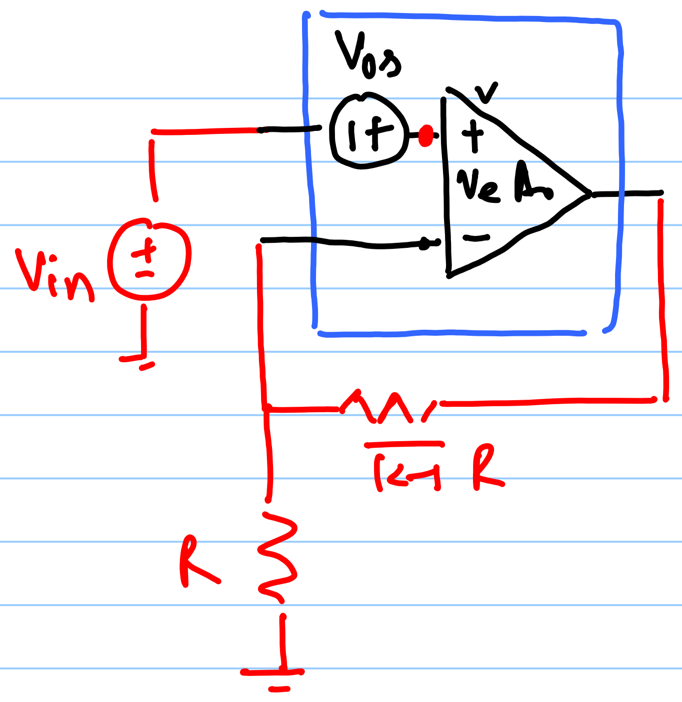


$$V_o = \underset{\sim}{A_0}\left(V_{in} + V_{os}\right) = K\left(V_{in} + V_{os}\right)$$

$$= K V_{in} + \underset{\sim}{K V_{os}}$$



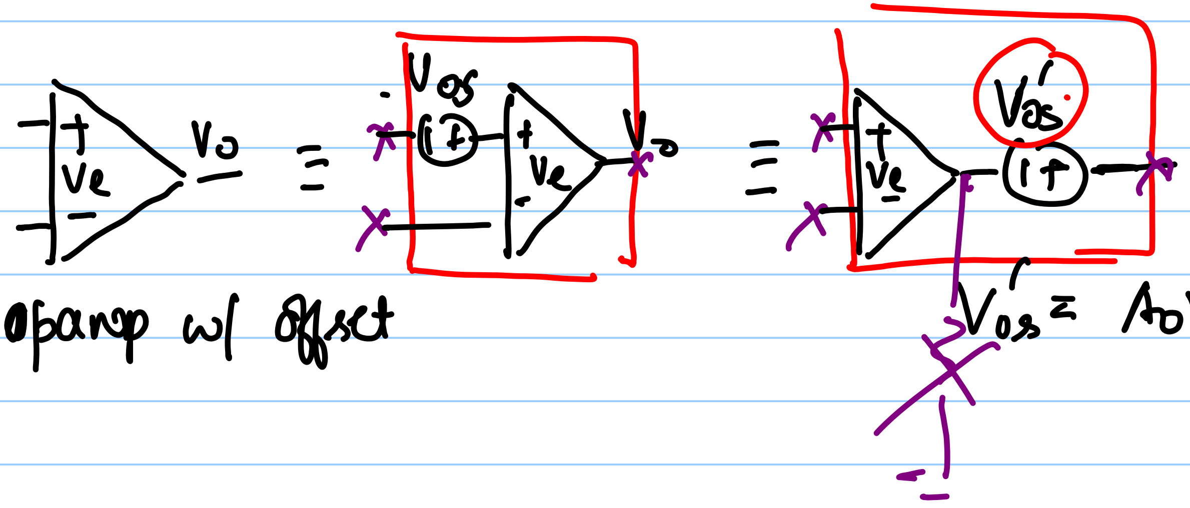
$$\frac{V_o}{V_{in}} = 1000$$



$$\left(V_{in} + V_{os} - \frac{V_o}{K}\right) A_o = V_o$$

$$V_{in} + V_{os} = V_o\left(\frac{1}{K} + \frac{1}{A_o}\right)$$

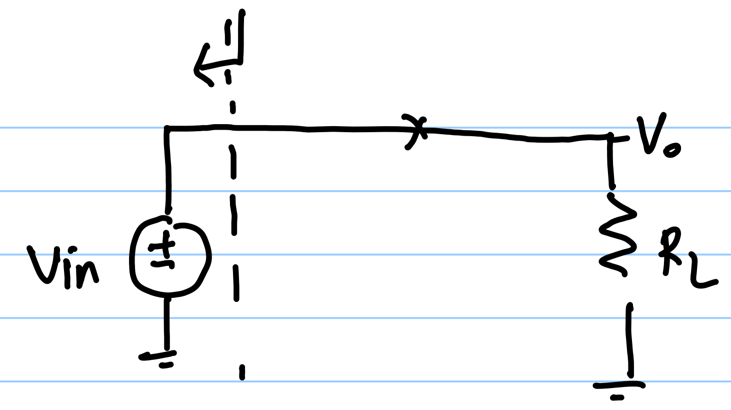
$$V_o = \frac{K V_{in}}{1 + \frac{K}{A_o}} + \frac{K V_{os}}{1 + \frac{K}{A_o}}$$ ✓

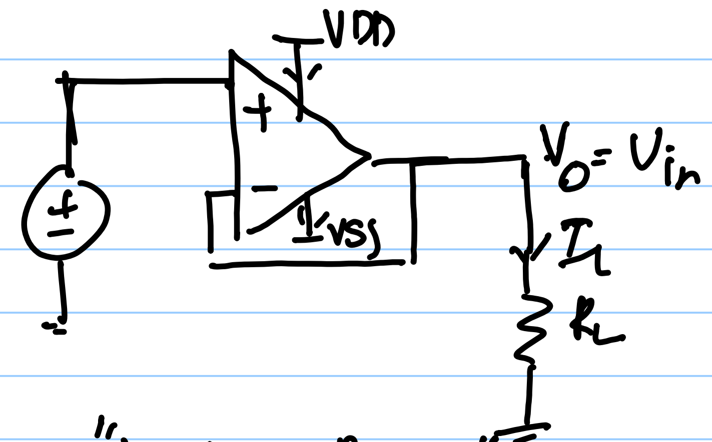


Opamp w/ offset

$V_{os}' = A_o V_{os}$

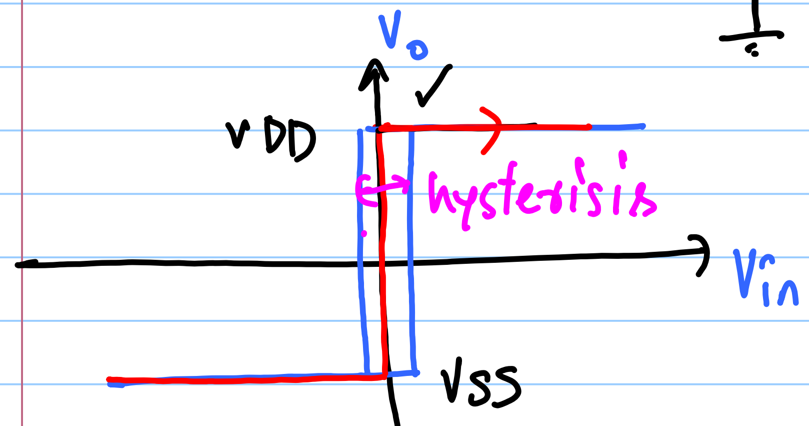
$\cancel{A_o} V_{os}$



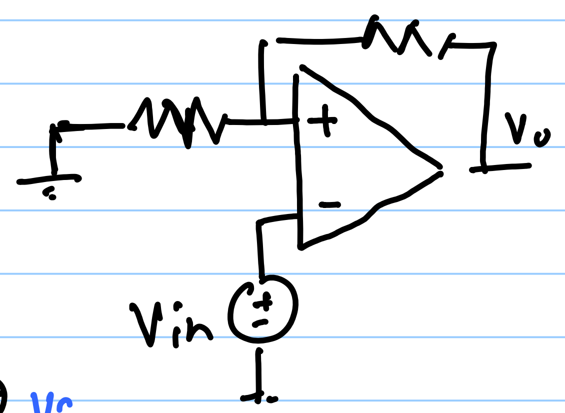


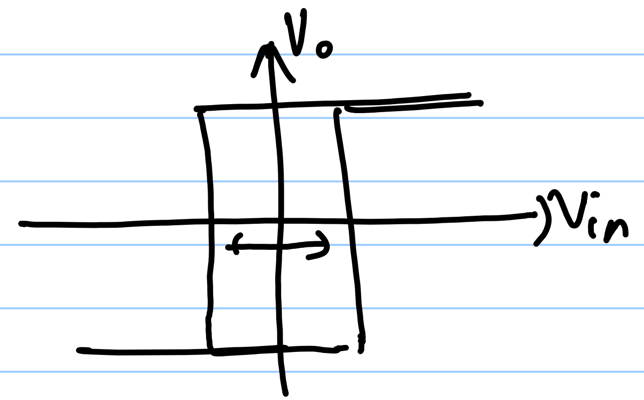
"Voltage Buffer"

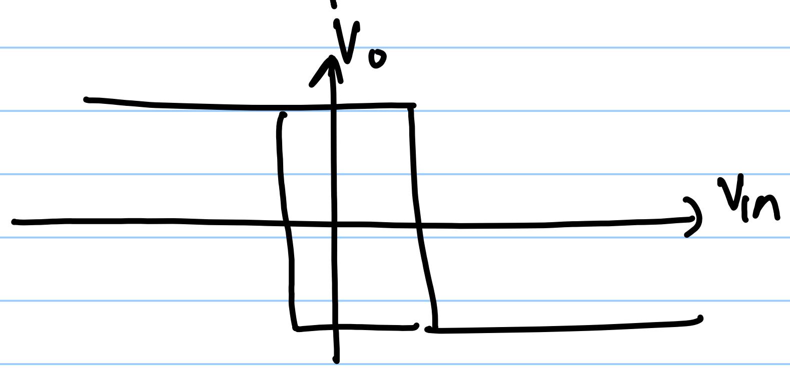
- Gain blocks with the +/-ve sign
- Buffers
- Schmitt Trigger.

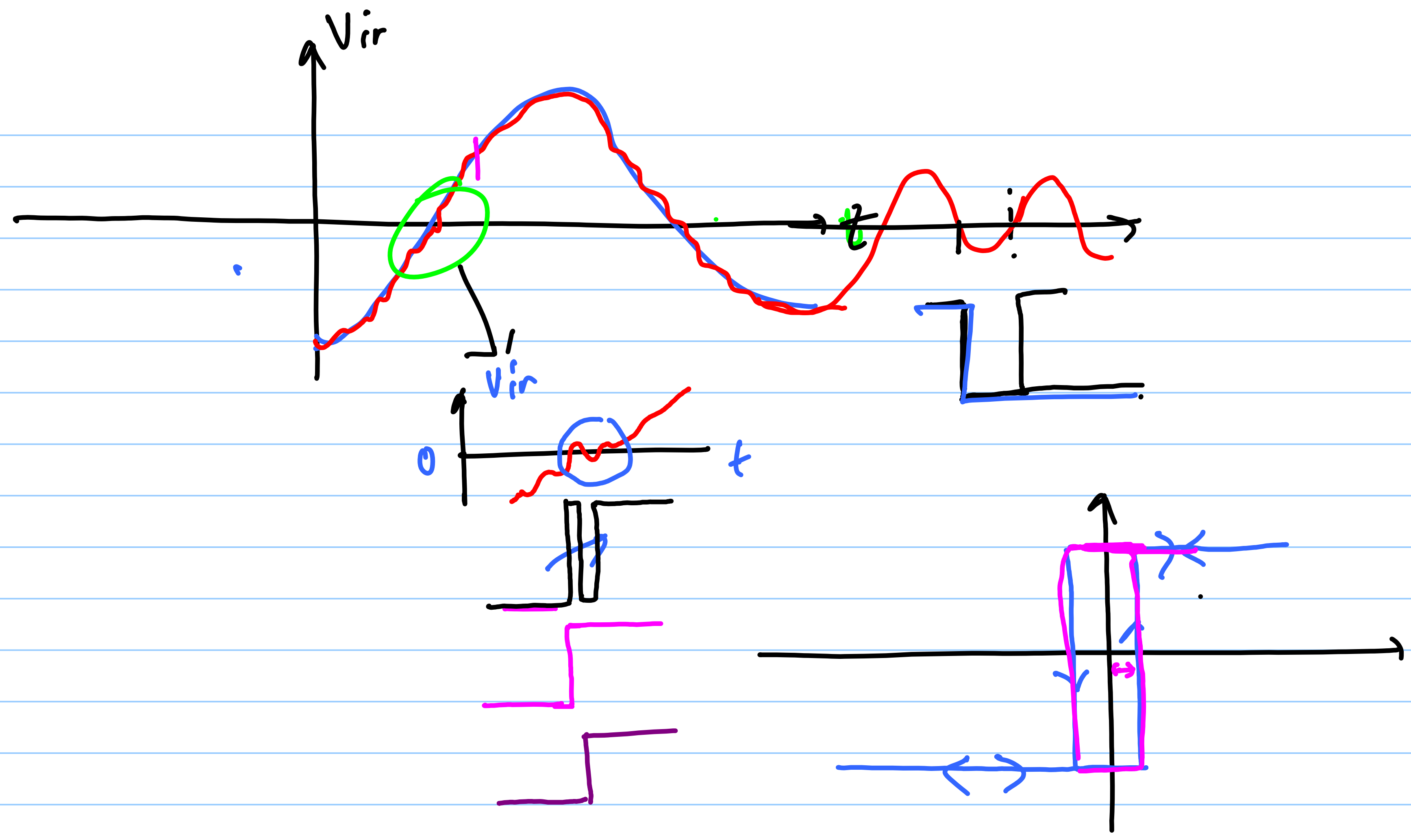


"Comparator"





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