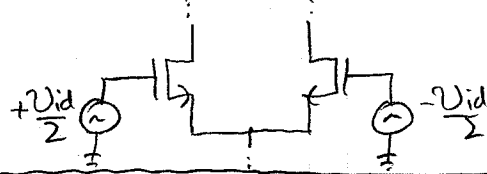
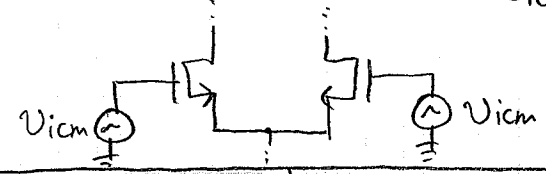


# Differential Pair Taxonomy

$$\text{Differential Mode Gain: } A_{dm} = \frac{V_{out}}{V_{id}}$$



$$\text{Common Mode Gain: } A_{cm} = \frac{V_{out}}{V_{icm}}$$



Amplifier Configuration

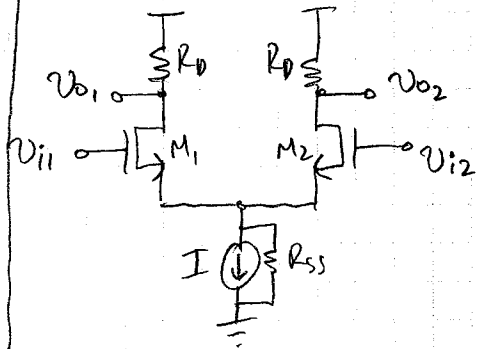
Single-ended Output  
 $V_{out} = V_{o2}$

Differential Output  
 $V_{out} = V_{o2} - V_{o1}$

Single-ended Output  
 $V_{out} = V_{o2}$

Differential Output  
 $V_{out} = V_{o2} - V_{o1}$

Resistive Load



$$A_{dm} = \frac{g_{m1} R_D}{2}$$

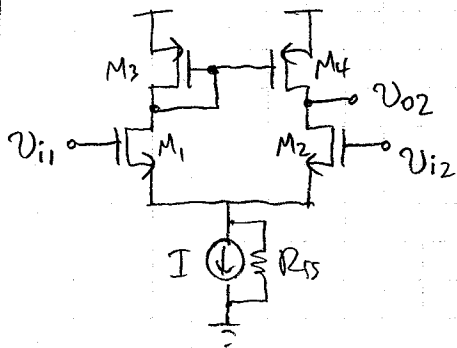
$$A_{dm} = g_{m1} R_D$$

$$A_{cm} = -\frac{R_D}{2 \cdot R_{SS}}$$

$$A_{cm} = 0$$

(assuming no mismatch)

Active Load



$$A_{dm} = g_{m1} (r_{o2} \parallel r_{o4})$$

[N/A]

$$A_{cm} = \frac{-1}{g_{m3} \cdot 2 \cdot R_{SS}}$$

[N/A]

→ In all cases:  $CMRR = \frac{|A_{dm}|}{|A_{cm}|}$