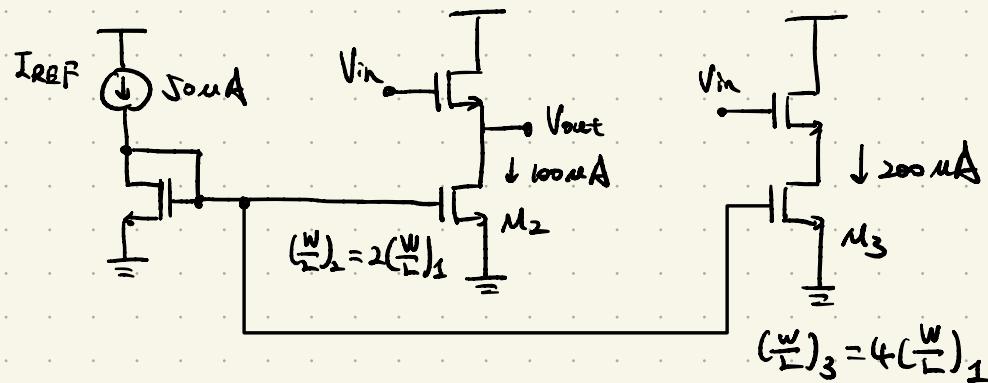


# Lec6

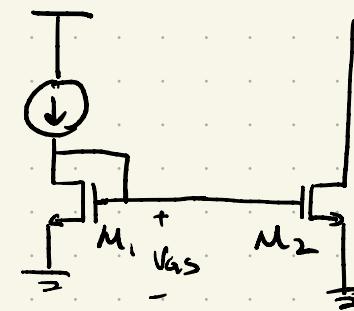
- Current Mirror Examples
- Alternative Perspective
- Proper Scaling
- Bipolar Current Mirrors

## Example

A circuit include two source followers biased at 100mA and 200mA. We have a reference current of 50mA.



## • Alternative Perspective

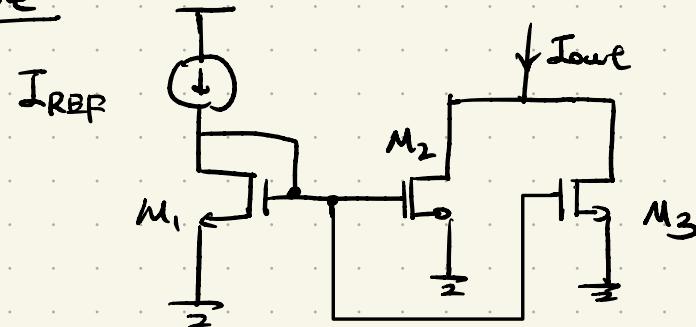


$$I_{D1} = \frac{1}{2} I_{REF} \ln \left( \frac{W}{L} \right)_1 (V_{GS} - V_{TH})^2$$

$$I_{D2} = \frac{1}{2} I_{REF} \ln \left( \frac{W}{L} \right)_2 (V_{GS} - V_{TH})^2$$

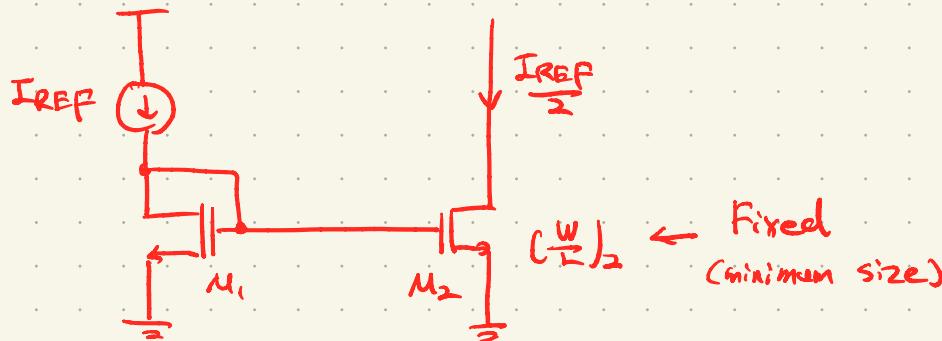
$$\frac{I_{D2}}{I_{D1}} = \frac{\left( \frac{W}{L} \right)_2}{\left( \frac{W}{L} \right)_1}$$

## Example



$$I_{out} = I_{REF} \frac{\left( \frac{W}{L} \right)_2 + \left( \frac{W}{L} \right)_3}{\left( \frac{W}{L} \right)_1}$$

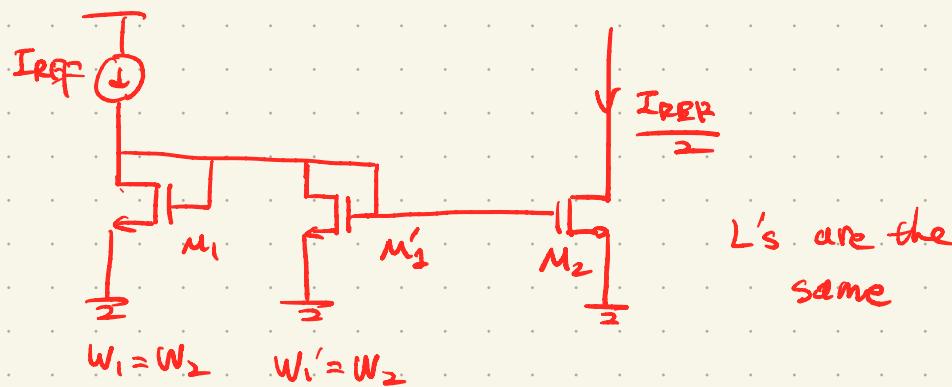
Q:



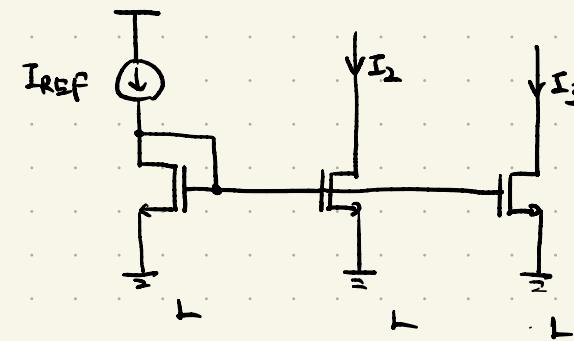
$$I_2 = \frac{(W/L)_2}{(W/L)_1} I_{REF}$$

to get  $I_{REF}/2$  we double  $(W/L)_1$

Alternative Way:



- Proper Scaling

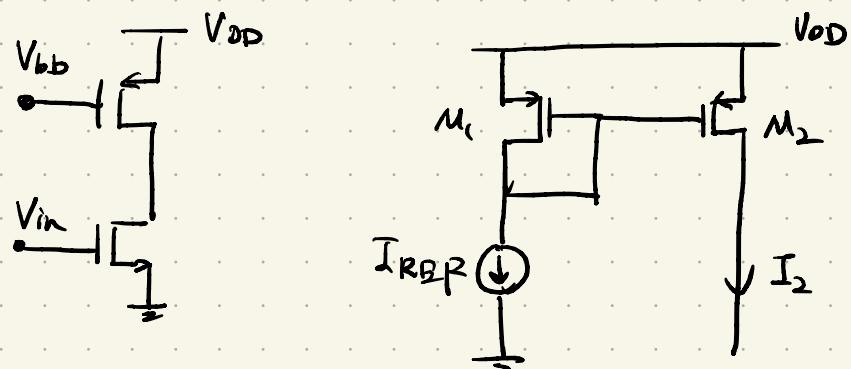


Always choose the same L

Only scale W:

$$\frac{W_2}{W_1} \cdot I_{REF} = I_2, \quad \frac{W_3}{W_1} \cdot I_{REF} = I_3$$

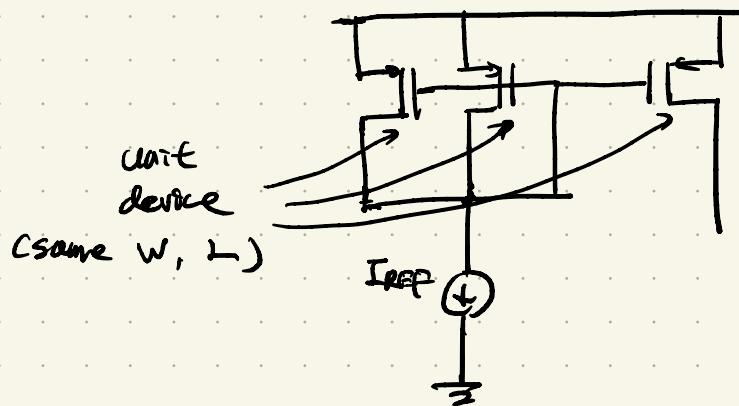
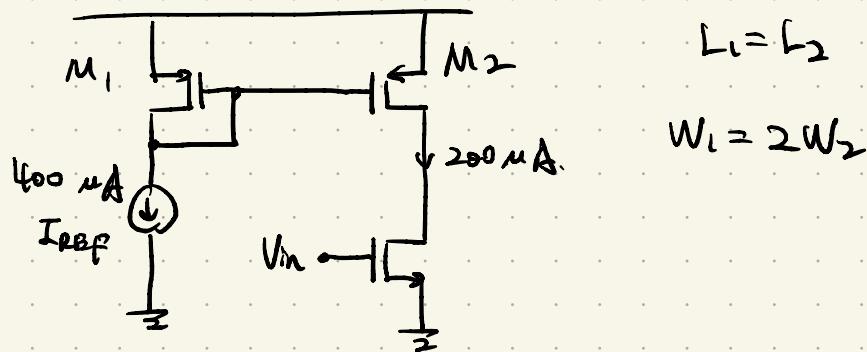
- PMOS Current Mirrors



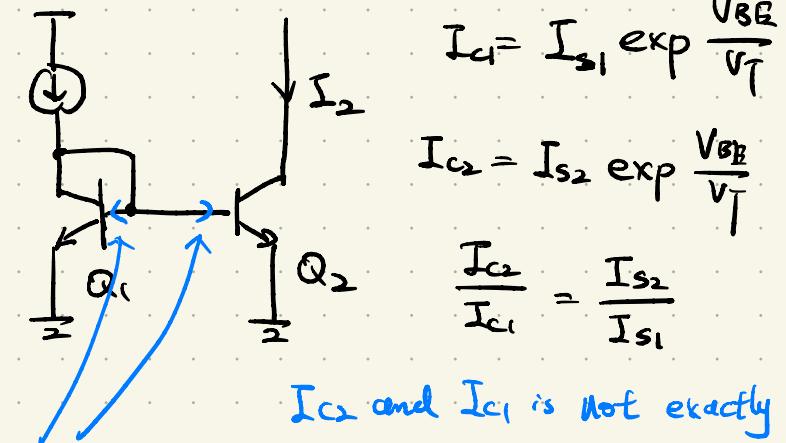
$$I_2 = \frac{(W/L)_2}{(W/L)_1} I_{REF}$$

### Example

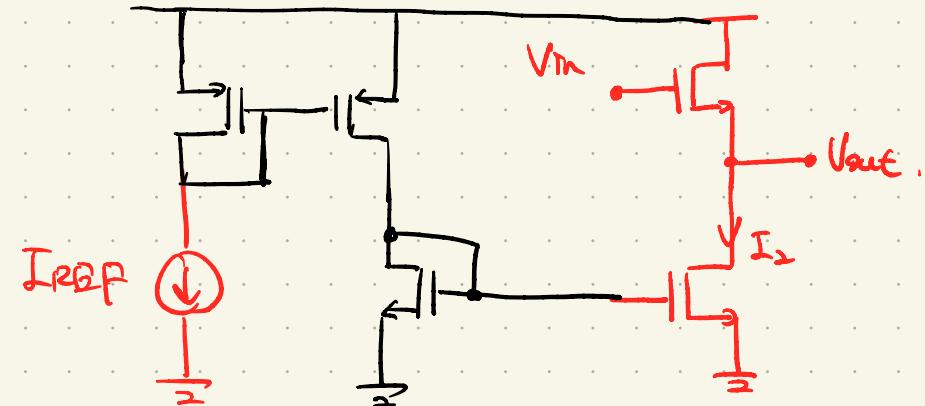
An NMOS common-source stage requires a load current source equal to  $200 \mu\text{A}$ . We have a reference current equal to  $400 \mu\text{A}$ .



### Bipolar Current Mirrors



### Problems



By copying  $I_{REF}$  continuously,  
I would be less stable than  $I_{REF}$