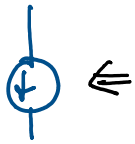
ECE 310 - Lecture 26

Wednesday, March 28, 2018 10:31 AM

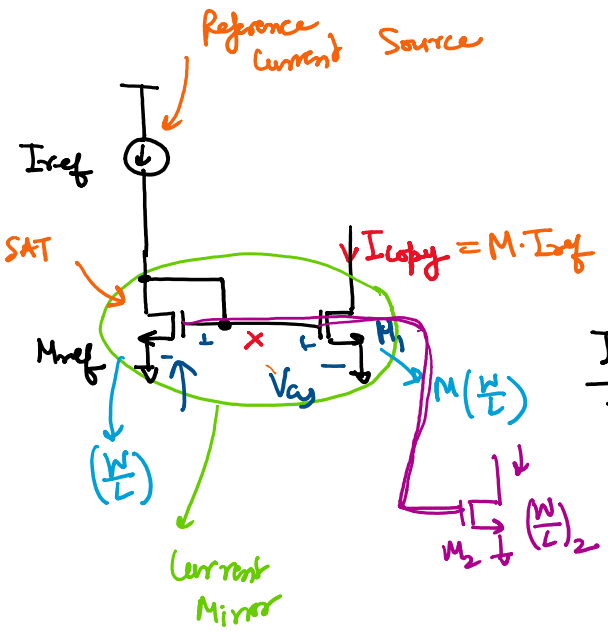
Section 9.2.3.

Chapter 9

Current Mirrors



Assume $\lambda = 0 \Rightarrow r_o \to \infty$

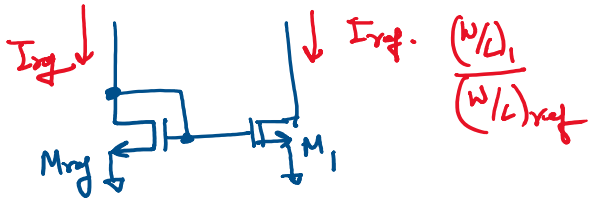


$$I_{ref} = \frac{1}{2} k_n \left(\frac{W}{L}\right)_{ref} (V_x - V_{THN})^2$$

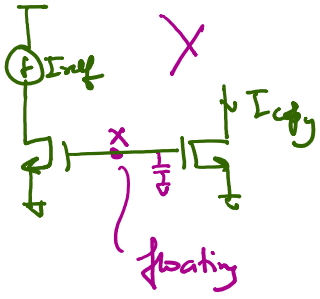
$$I_{copy} = \frac{1}{2} k_n \left(\frac{W}{L}\right)_1 (V_x - V_{THN})^2$$

$$\frac{I_{copy}}{I_{ref}} = \frac{(W/L)_{copy}}{(W/L)_{ref}} \Rightarrow \left.\frac{W_{copy}}{W_{ref}}\right|_{L = \text{same}}$$

Also if Lengths were the same = L

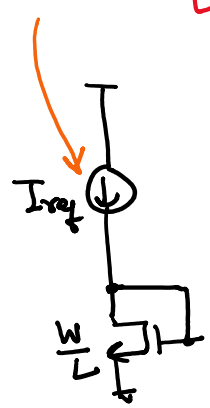


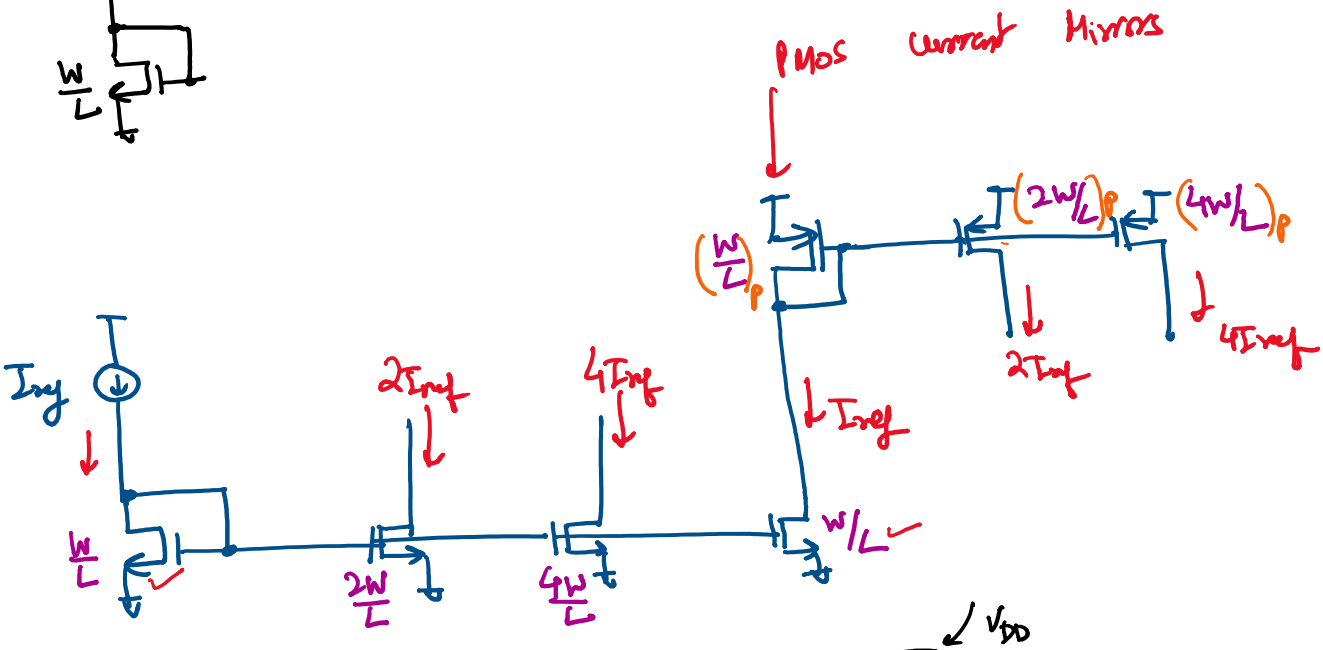
Ex.

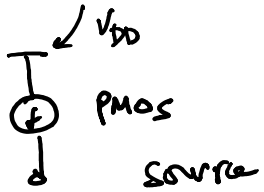


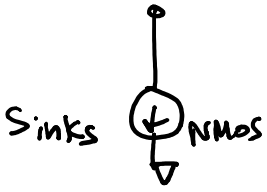
Icopy is poorly defined

410/415 Bandgap Reference
↳ Current reference independent of Temp, V_{DD} variations and device variations



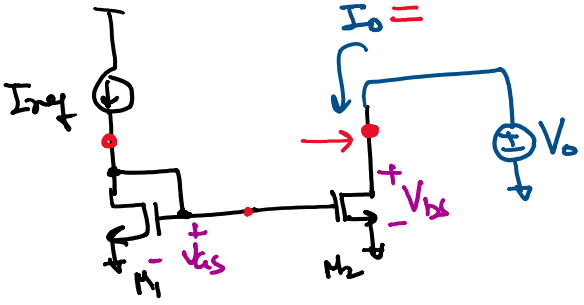


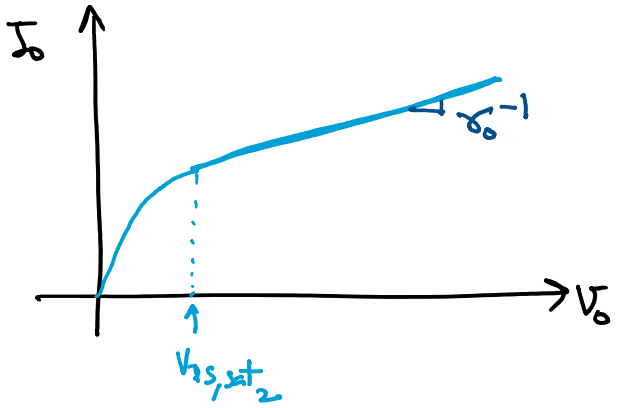




$\lambda \neq 0$

I_D, V_{DS} curve

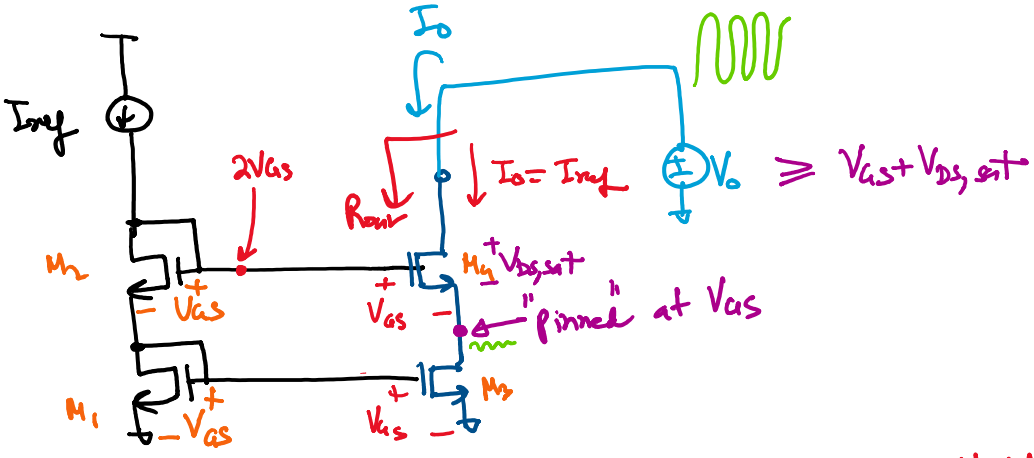




Variation in current (I_o) due to finite r_o or CLM

$V_{GS_1} = V_{GS_2}$

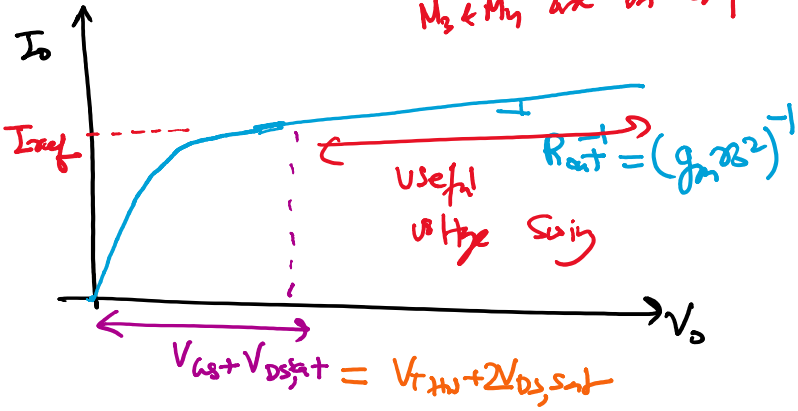
$V_{DS_1} = V_{DS_2}$ ←



All Transistor are identical

By Cascoding

$R_{out} \simeq g_m r_o^2 \Rightarrow r_o$



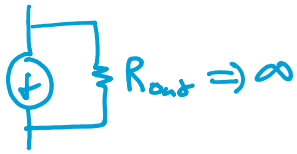
" Cascode Current Mirror

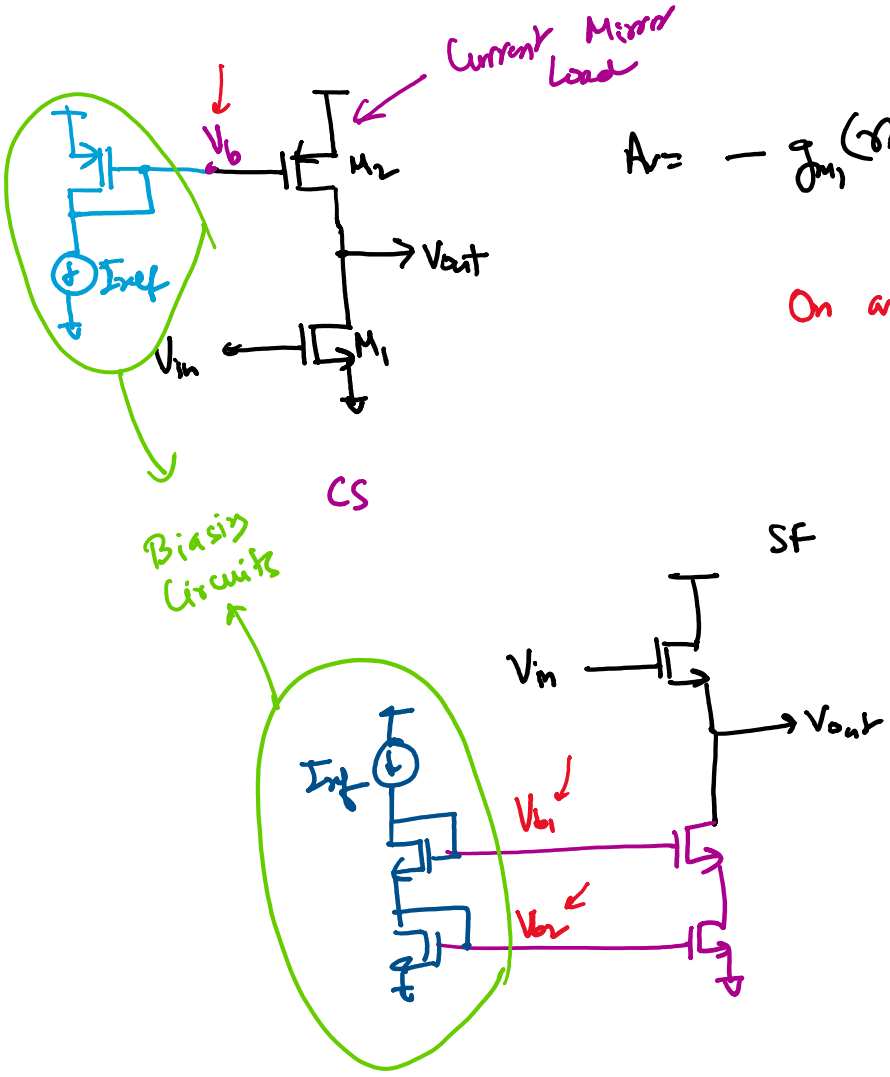
$R_{out} \Rightarrow \infty$

" Cascade Current Mirror

Better Current mirror but

with reduced voltage headroom"





$$A_v = -g_{m_1}(r_{o_1} \| r_{o_2})$$

On an "Mixed-Signal" IC Most biasing is done using Current Mirrors.

5G

Bipolar Junction Transistors (BJTs)

BiCMOS

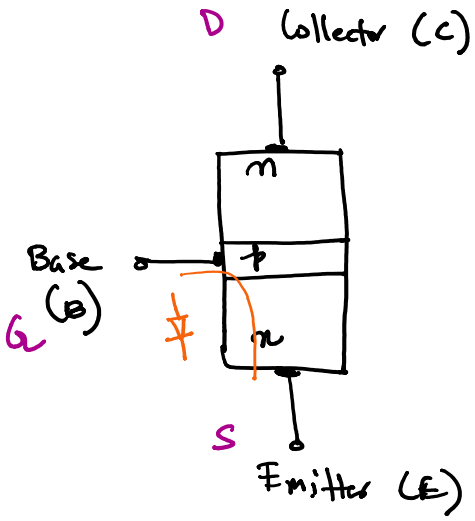
Wifi

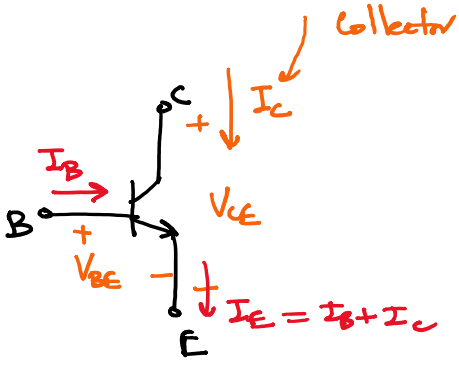
2 GHz, 5 GHz

mmWave

fcc ⇒
- 28 GHz
- 60 GHz
- 70
- 90
- 100 GHz

Bipolar → both type of carriers (holes & electrons) are responsible for current flow.





(in a MOSFET $I_G = 0$)