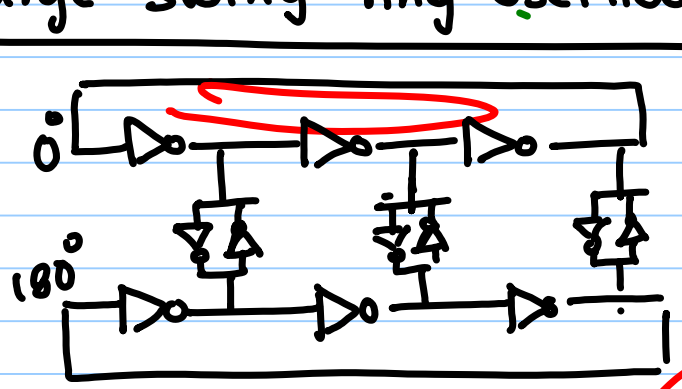
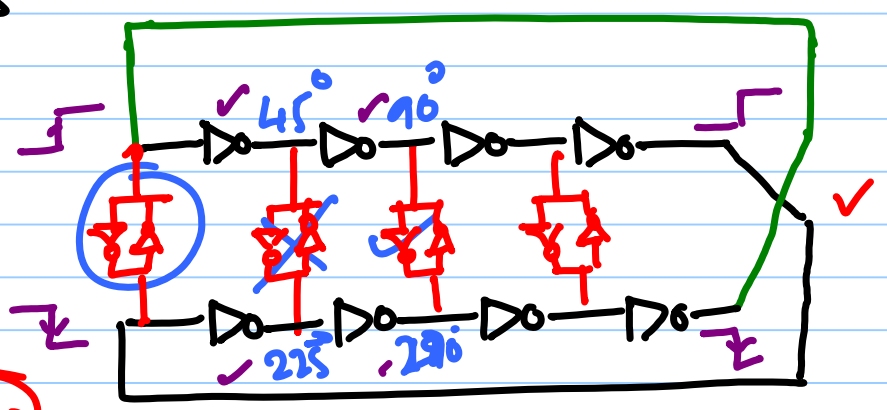
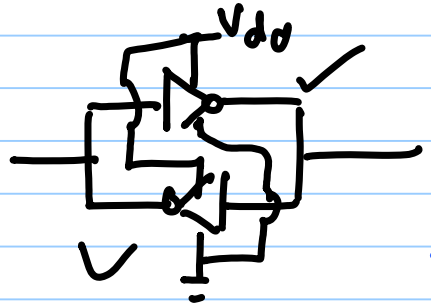
Lecture # 35

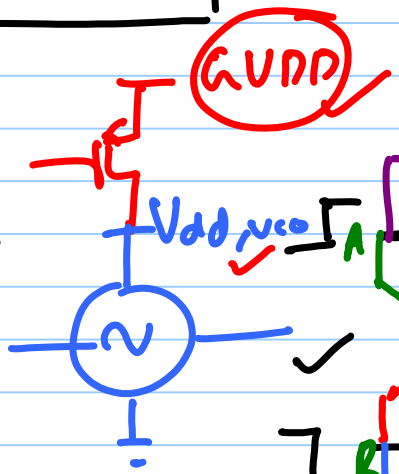
Note Title 10-10-2017

Large-swing ring oscillators

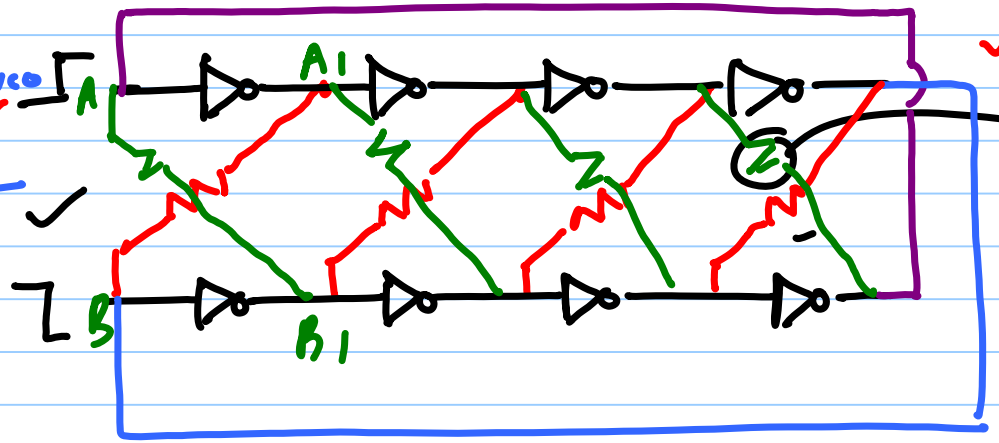






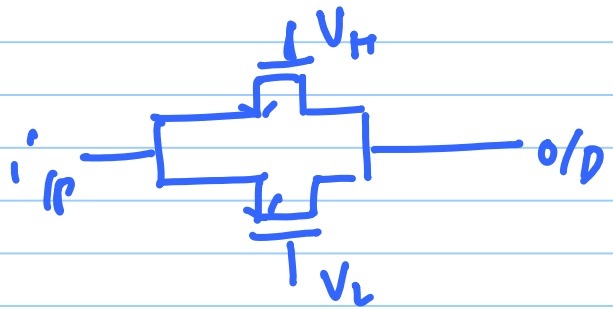


0°, 90°, 180°, 270°



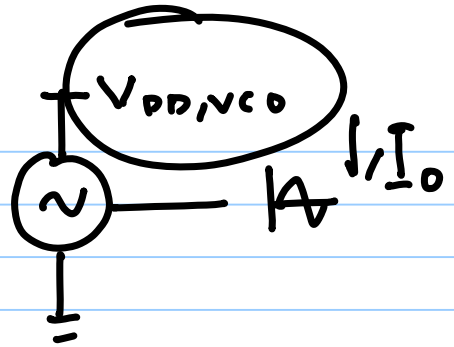
Poly res.

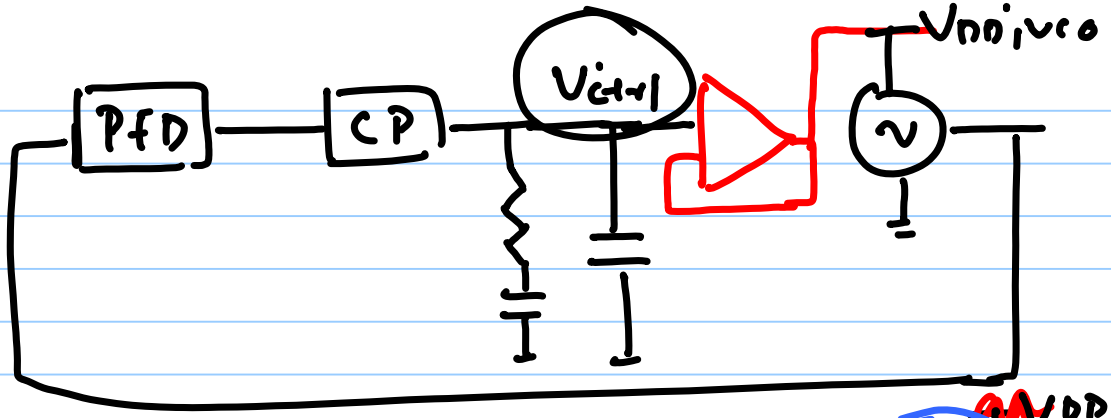
Transmission gate

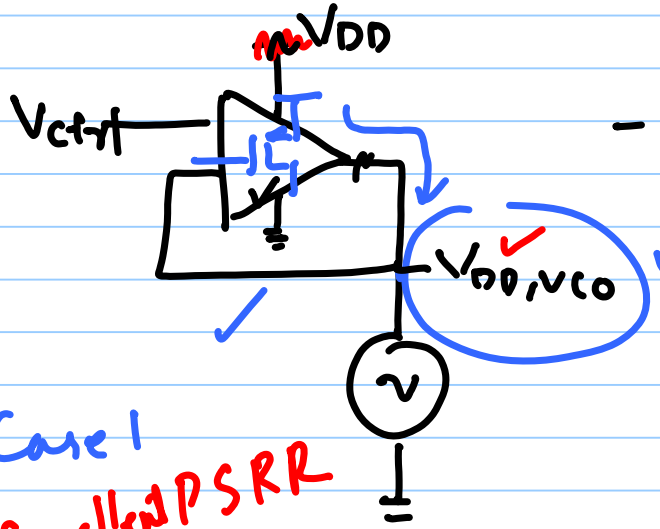


$V_L = 0$

$V_H =$

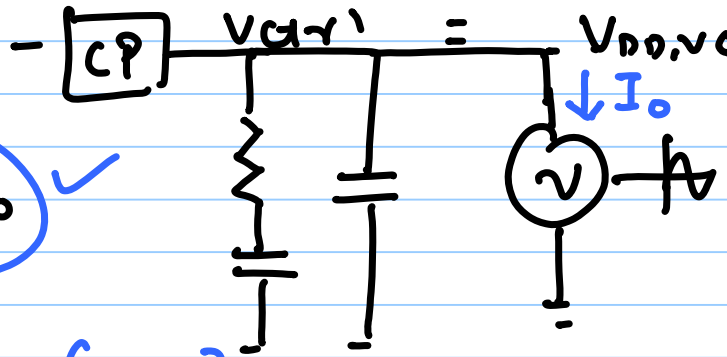




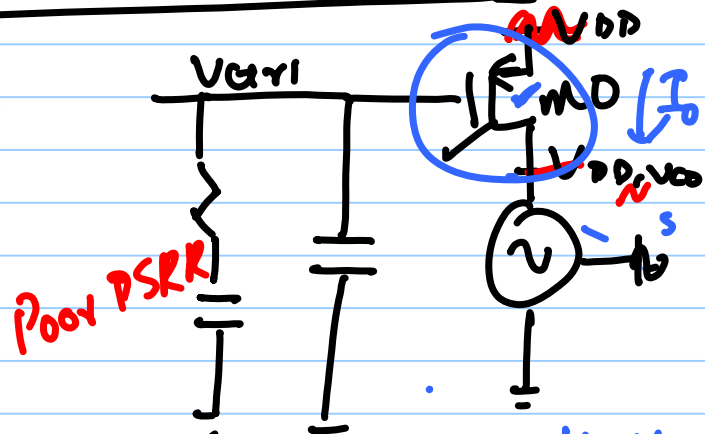


Case 1

Excellent PSRR



Case 2



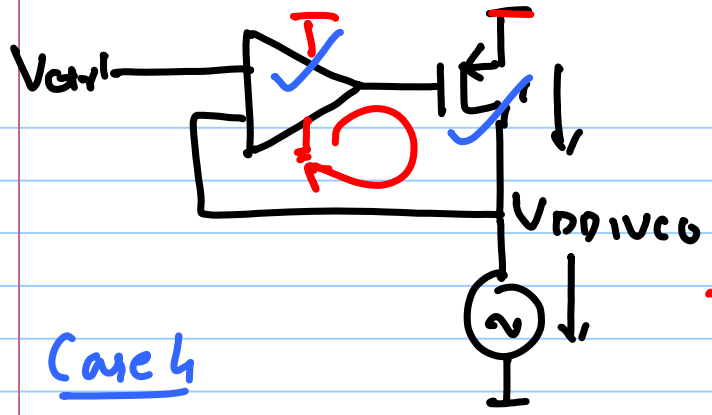
Case 3

$V_{DD,VCO} \leq V_{DD} - V_{DSat}$

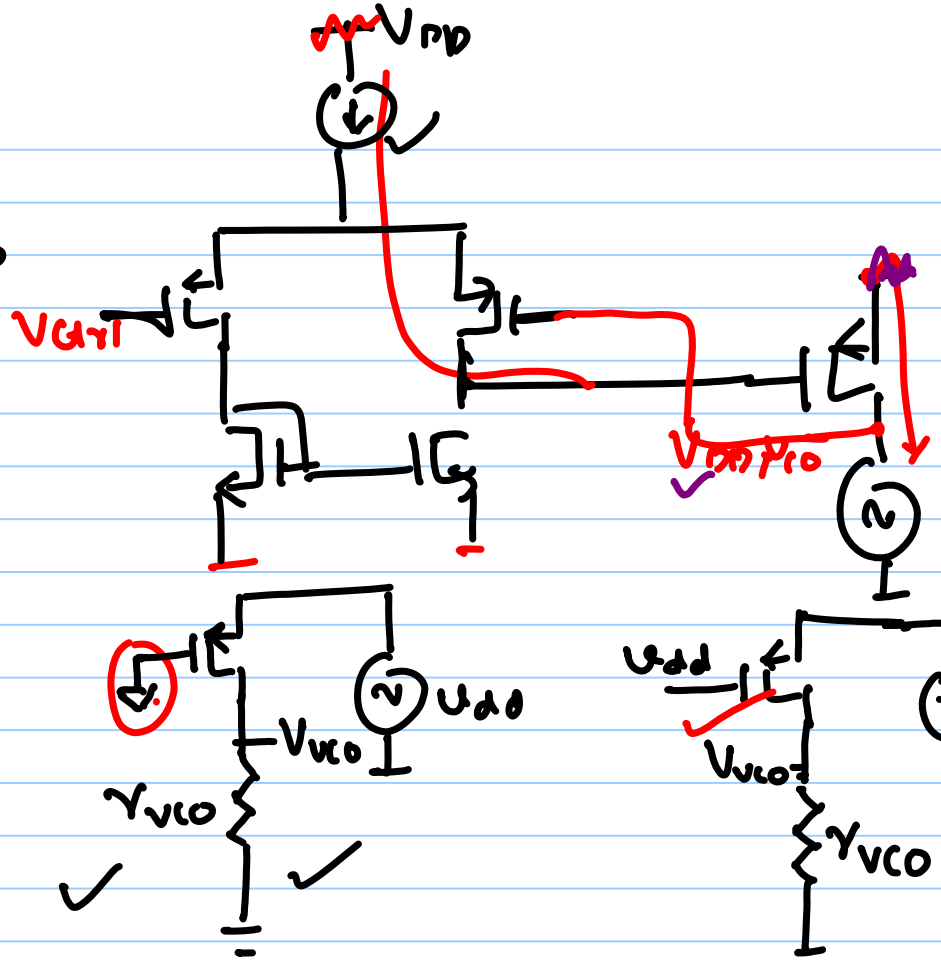
- $f_{VCO} = K_{VCO} \cdot V_{DD,VCO}$

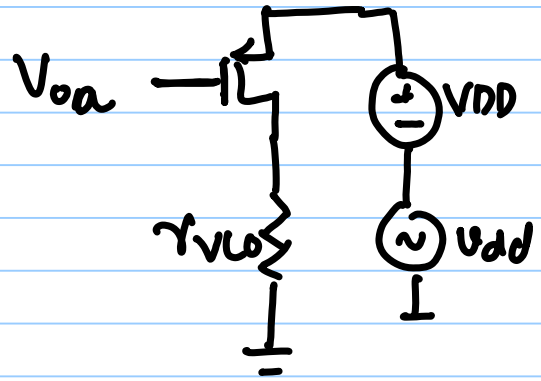
$I_O = g_m V_{Ctrl}$

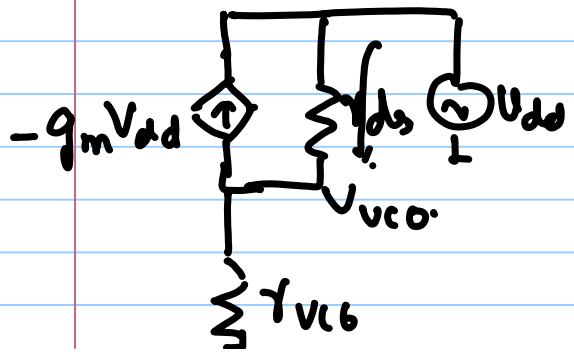
$f_{VCO} = K_{CCO} \cdot I_O$



Case 4

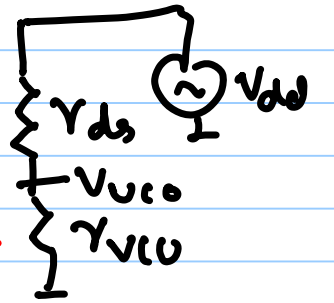






$$\frac{V_{VCO}}{V_{dd}} =$$

$$\frac{V_{VCO}}{V_{dd}} = \frac{r_{VCO}}{r_{VCO} \| r_{ds}}$$

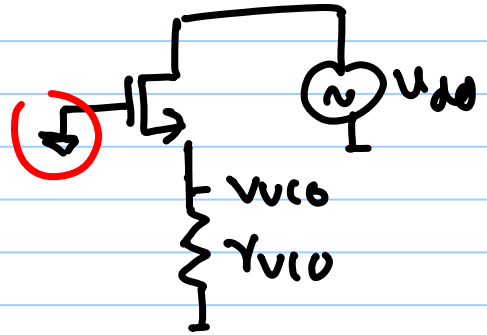


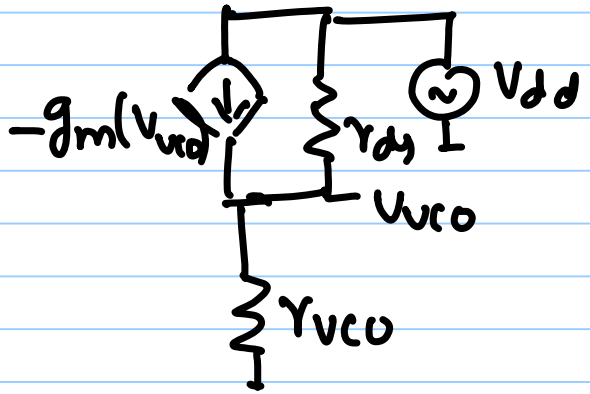
$$\frac{(V_{dd}-V_{vco})}{r_{ds}} + g_m V_{dd} = \frac{V_{vco}}{r_{vco}} \Rightarrow V_{dd}\left(\frac{1}{r_{ds}}+g_m\right) = V_{vco}\left(\frac{1}{r_{ds}}+\frac{1}{r_{vo}}\right)$$

$$\frac{V_{vco}}{V_{dd}} = \frac{\left(\frac{1}{r_{ds}}+g_m\right)}{\left(\frac{1}{r_{vco}}+\frac{1}{r_{ds}}\right)} \approx g_m r_{vco}$$

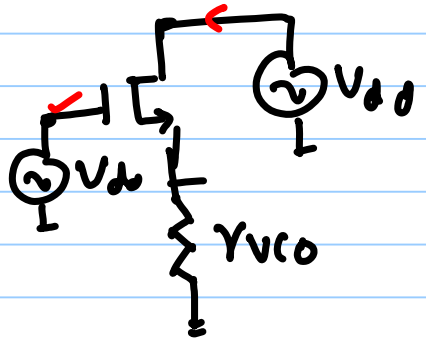
$g_m \gg \frac{1}{r_{ds}}$.

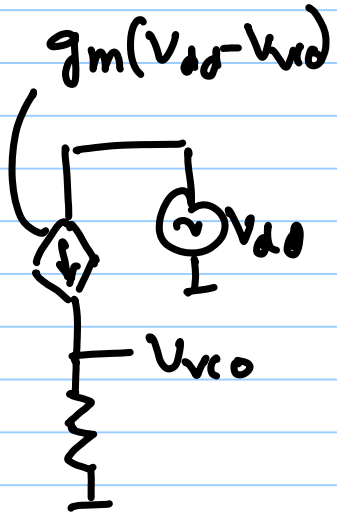
NMOS current source



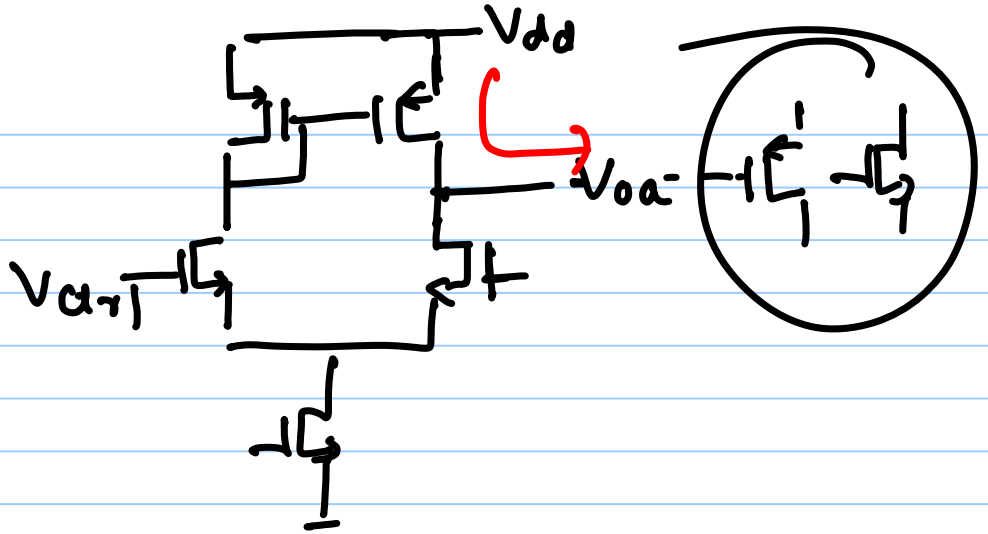


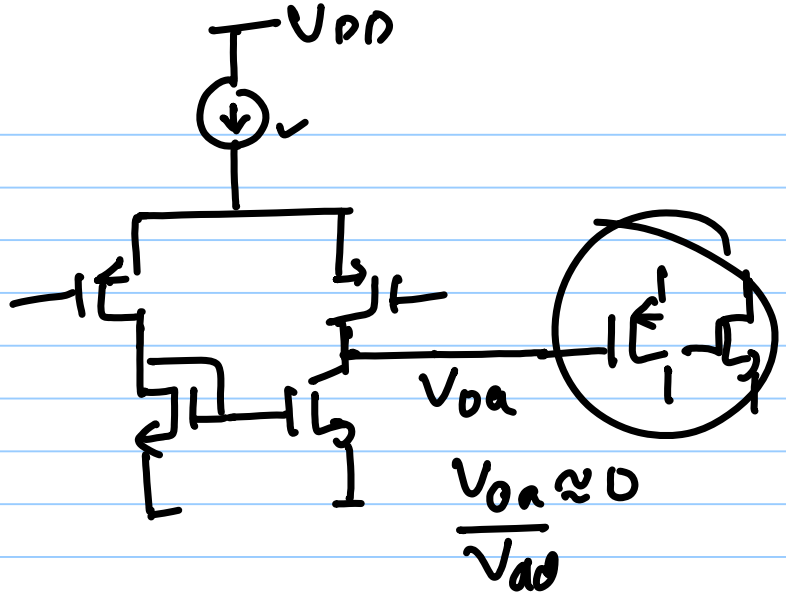
$$\frac{V_{vco}}{V_{dd}} = \frac{1}{g_m r_{ds}}$$





$$\frac{V_{vco}}{V_{dd}} = 1$$



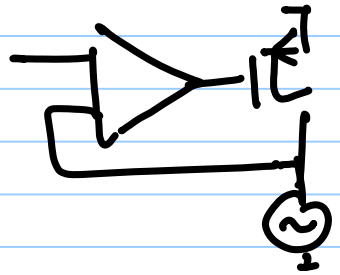


a) PMOS i/p OPAMP + PMOS Current source

b) + NMOS Current Source ✓

c) NMOS i/p OPAMP + PMOS Current Source ✓

NMOS Current Source



Supply-regulated VCO