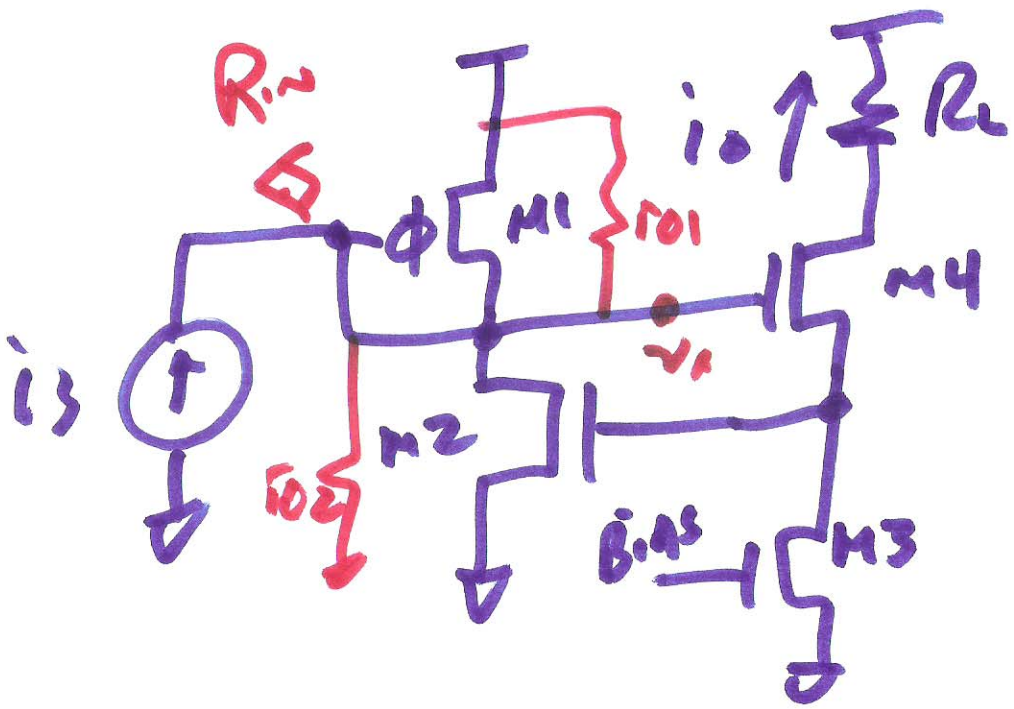
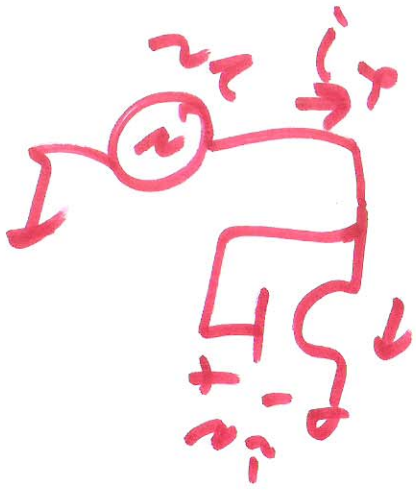
Sec. 5.4

Section 31.7

the current Amplifier



$R_{in} = r_{O2} \| r_{O1} \| 1/g_m$



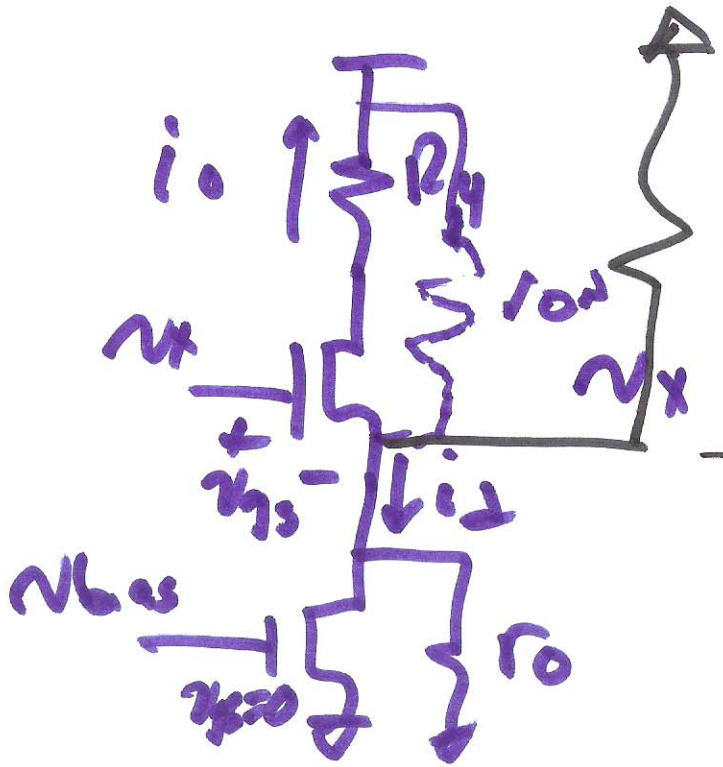
$i_T g_m v_T = i_T$

$\frac{v_T}{i_T} = \frac{1}{g_m}$

Shunt - series

$v_x = i_s \cdot (r_{O1} \| r_{O2} \| 1/g_m)$

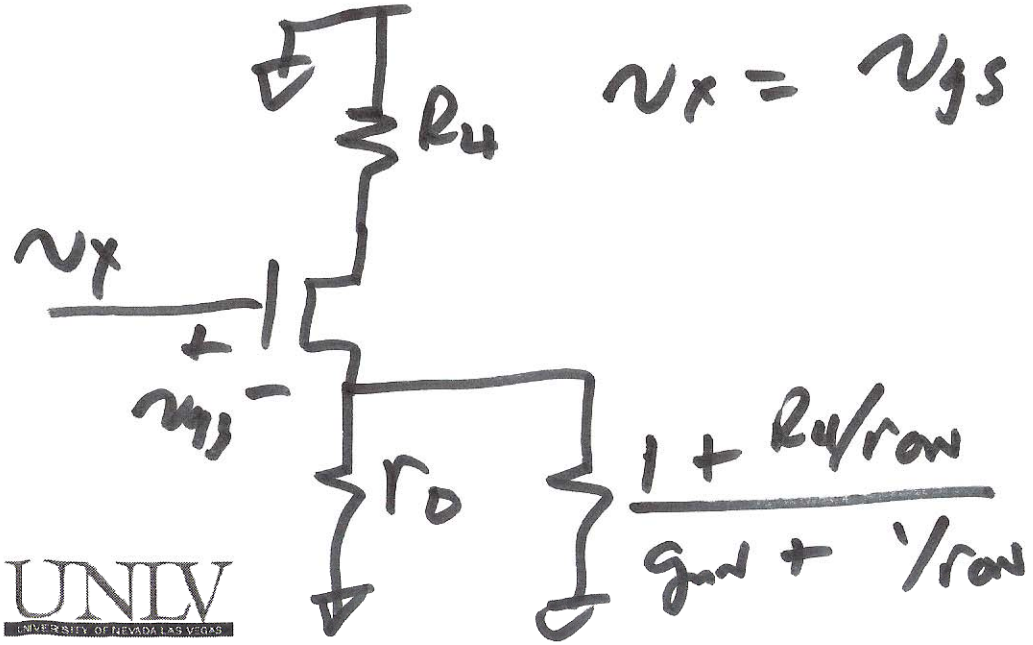
$$\frac{v_x}{i_s} = r_{O1} \| r_{O2} \| 1/g_m$$



$$\frac{1 + \frac{R_4}{r_{ON}}}{g_M + \frac{1}{r_{O1}}},$$

$$v_x = v_{gs} + i_d \cdot r_O \| \frac{1 + R_4/r_{ON}}{g_M + 1/r_{ON}}$$

$$= v_{gs} + i_d \cdot r_O \|$$



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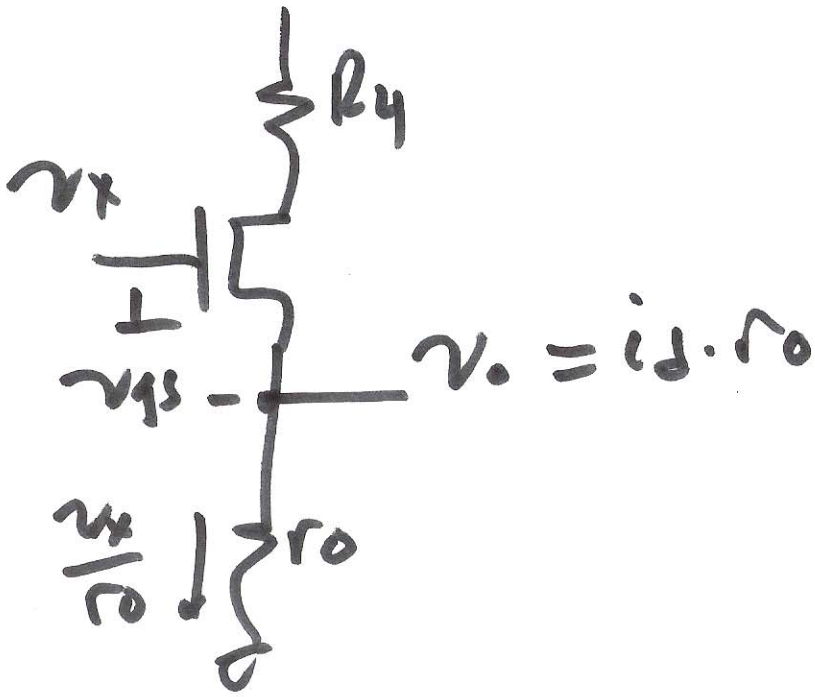
2)



$$v_x = v_{gs} + i_d r_o$$

$$v_x = i_d \left(\frac{1}{g_m} + r_o\right)$$

$$\frac{i_o}{v_x} = \frac{1}{\frac{1}{g_m} + r_o}$$

$$\simeq \frac{1}{r_o}$$

$$\frac{v_o}{i_s} = \frac{1}{r_o} \cdot r_{o1} \| r_{o2} \| \frac{1}{g_m}$$

$$\simeq \frac{1}{g_m \cdot r_o} \text{ (no units)}$$

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3)

$R_{in} = r_{on} \| r_{op}$

$v_x = i_s \cdot r_{on} \| r_{op}$

$i_o = \frac{v_x}{r_o}$

$A_{OL} = \frac{i_o}{v_x} \cdot \frac{v_x}{i_s}$

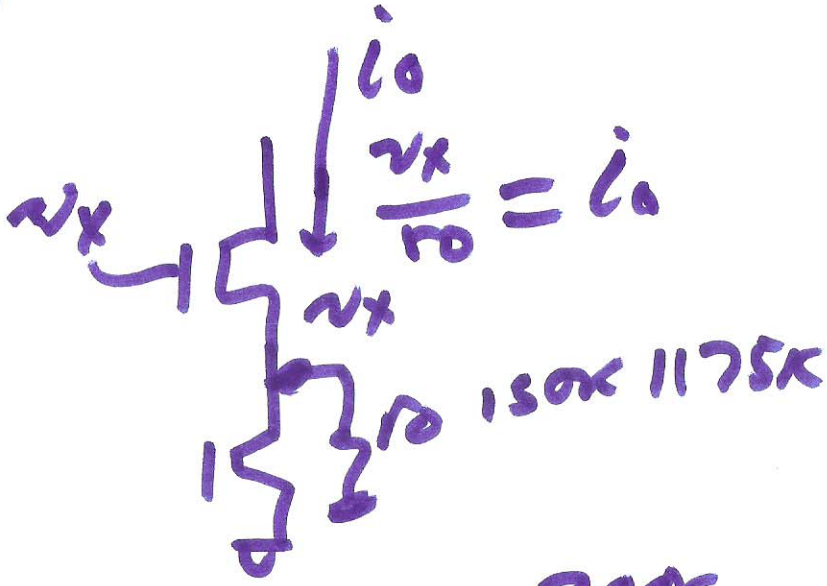
$= \frac{1}{r_{on}} \cdot r_{on} \| r_{op}$

$r_{ON} = r_{op}$

$= \frac{1}{r_{on}} \cdot \frac{r_{on} \cdot r_{op}}{r_{on} + r_{op}} = \boxed{\frac{1}{2} = A_{OL}}$

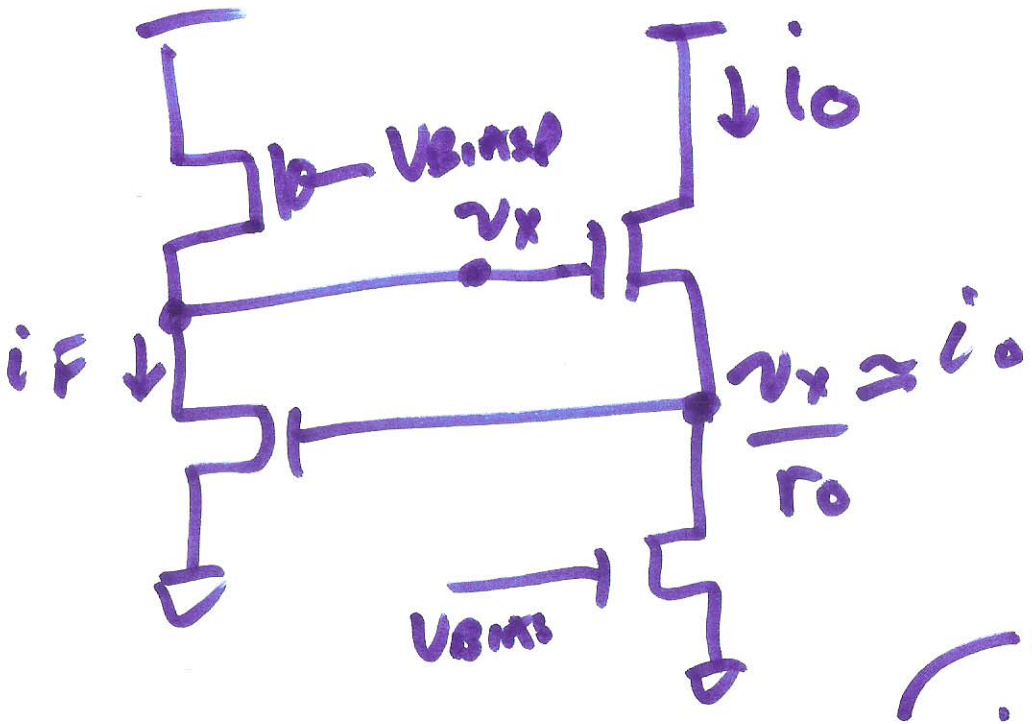
$\frac{1}{50k} \cdot 100K$

-6dB → -20dB



$r_{o1} = 200k$

$r_{o3} = 200k$



over spice example.

$$i_F = g_m v_x = \underbrace{g_m r_o}_{\beta} \cdot i_o$$

$$\beta \cdot i_o = i_F$$

$\beta = 180 \frac{\mu A}{V} \cdot .15$

$\beta = 27$

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5)

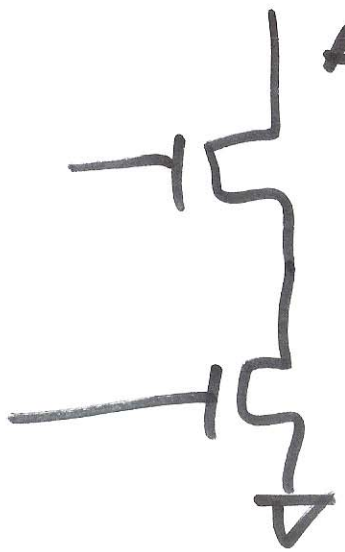
$$A_{CL} = \frac{\frac{1}{2}}{\frac{1}{2}\cdot\frac{37}{2}+1} = \frac{1}{2}\,\frac{1}{14.5} \approx .035$$

$$= \frac{\frac{1}{2}}{13.5+1} = \frac{1}{2}\left(\frac{1}{14.5}\right)$$

$.035 \Rightarrow \simeq 30dB$

$$R_{inf} = \frac{r_{ON} \| r_{op}}{1+\beta \cdot A_{CL}} = \frac{200k \| 1200k}{1+27\cdot\frac{1}{2}}$$

$$= \frac{100k}{14.5} = \underline{\underline{6.9k}}$$

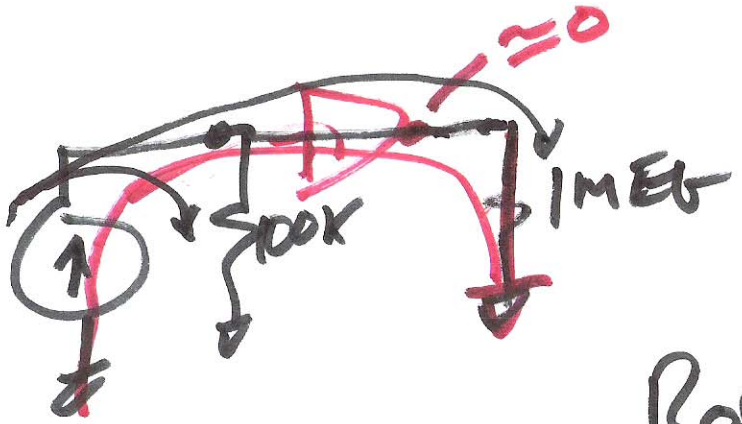


$A_{Rocns} = g_m r_o^2$

$$R_{of} = \frac{g_m r_o^2}{1 + 27 \cdot \frac{1}{2}}$$

$$= \frac{190\mu \cdot 150K \cdot 150K}{14.5}$$

$R_{of} = 300K$ — I'm tired ☺ wrong!



$$R_{of} = g_m r_o^2 \left(1 + 27 \cdot \frac{1}{2}\right)$$

$$= 190\mu \cdot 150K \cdot 150K \cdot 14.5$$

$$R_{of} = 62\,MEG$$

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