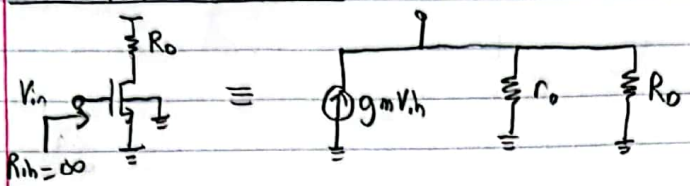
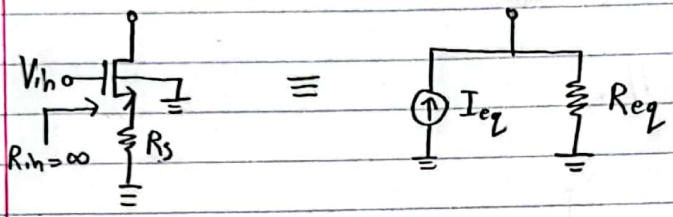
EE 536 Useful Circuits

Common Source



$$A_{v_0} = -g_m(R_D \| r_o)$$

Common Source with Source Degeneration

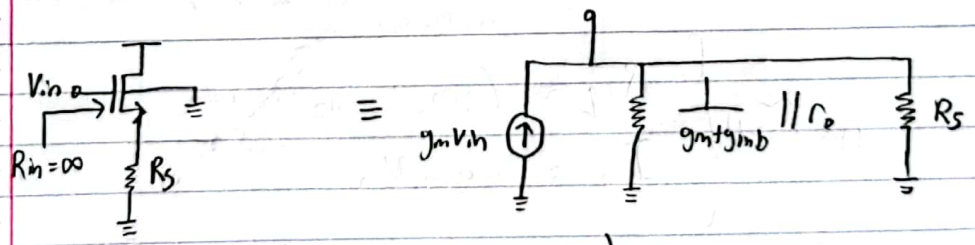


$$I_{eq} = \frac{-g_m V_{in}}{1 + (g_m + g_{mb} + \frac{1}{r_o})R_S}$$

$$R_{eq} = r_o\left[1 + (g_m + g_{mb} + \frac{1}{r_o})R_S\right]$$

$$I_{eq} \times R_{eq} = -g_m r_o V_{in}$$

Source Follower

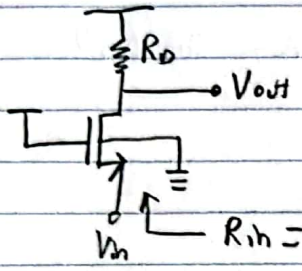


$$A_{v_0} = g_m\left(\frac{1}{g_m + g_{mb}} \| r_o \| R_S\right)$$

$$\approx_{(g_m r_o \gg 1)} g_m\left(\frac{1}{g_m + g_{mb}} \| R_S\right)$$

$$\approx_{\left(\frac{1}{g_m + g_{mb}} \ll R_S\right)} \frac{g_m}{g_m + g_{mb}}$$

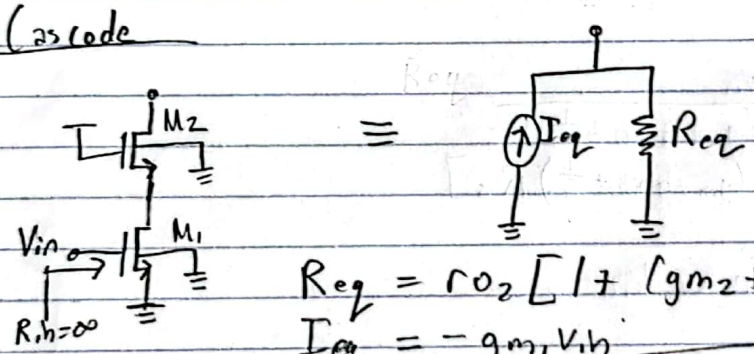
Common Gate



$$R_{in} = \left(1 + \frac{R_D}{r_o}\right)\left(\frac{1}{g_m + g_{mb}} \| r_o\right)$$

$$A_{v_o} = \left(g_m + g_{mb} + \frac{1}{r_o}\right)(R_D \| r_o)$$

Cascode



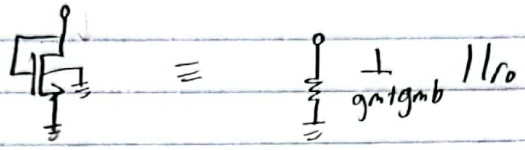
$$R_{eq} = r_{o2}\left[1 + (g_{m2} + g_{mb2} + \frac{1}{r_{o2}})\, r_{o1}\right]$$

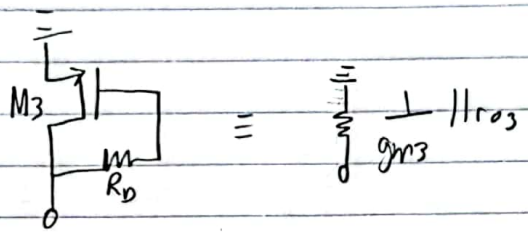
$$I_{eq} = -g_{m1} V_{in} \frac{r_{o1}}{\frac{1}{g_{m2}+g_{mb2}} \| r_{o2} + r_{o1}}$$

$$\overset{(g_m r_o >> 1)}{\approx} \begin{cases} R_{eq} \approx (g_{m2} + g_{mb2})\, r_{o1} r_{o2} \\ I_{eq} \approx -g_{m1} V_{in} \end{cases}$$

Folded cascode is the same, except no g_{mb2}

Common Circuits




M3
RD