

Formulas

$$I_D = 0$$

$$I_D = K' \frac{W}{L} \left((V_{GS} - V_T) \cdot V_{DS} - \frac{V_{DS}^2}{2} \right)$$

$$I_D = \frac{K'}{2} \frac{W}{L} (V_{GS} - V_T)^2 (1 + \lambda V_{DS})$$

$$V_{GS} < V_T$$

$$V_{GS} > V_T ; V_{DS} < V_{GS} - V_T$$

$$V_{GS} > V_T ; V_{DS} > V_{GS} - V_T$$

small signal

$$g_m = \frac{dI_D}{dV_{GS}}$$

$$g_{ds} = \frac{dI_D}{dV_{DS}}$$

$$g_{mb} = \frac{dI_D}{dV_{BS}}$$

saturation
 $\sqrt{2K' \frac{W}{L} I_{D0}}$

$$\lambda I_{D0}$$

$$\sim \frac{1}{10} \text{ of } g_m$$

ohmic

$$K' \frac{W}{L} V_{DS}$$

$$K' \frac{W}{L} (V_{GS} - V_T - V_{DS})$$

noise

resistor $V_n^2 = 4kTR \text{ df}$ where $k = 1.38 \cdot 10^{-23}$ and T is abs. Temp $\sim 300K$

mosfet $V_n^2 = \frac{8}{3} kT \frac{1}{g_m} \text{ df} + \frac{K_F}{WL f} \text{ df}$

g_m of a diff/pair

$$g_m = \frac{\Delta I_{out}}{V_{in}} = \sqrt{k' \frac{W}{L} I_{tail}}$$

gain of a single stage amp $A \approx g_m r_o$

gain of a cascode amp $A \approx g_m^2 r_o^2$

gain of a source follower $A = \frac{g_m}{g_m + g_{mb} + g_{ds}}$

$$r_o = \frac{1}{g_{ds}}$$

Quadratic equation

$$ax^2 + bx + c = 0 \Rightarrow x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

Transfer function $H(s) = A_{DC} \cdot \frac{(1 + s/\omega_{z0}) \dots}{(1 + s/\omega_{p0}) \dots}$