

The Transistor Single Page Model (Strong/Weak-Inversion)

$$g_m \approx \frac{1}{R} \text{ (constant } g_m\text{-biasing)} \quad V_{eff} = V_{GS} - V_T \approx V_{dsat}$$

$$I_{DS} = \frac{\mu_{np} C_{ox}}{2} \frac{W}{L} (V_{GS} - V_T)^2 [1 + \lambda (V_{DS} - (V_{GS} - V_T))] \text{ (MOS1)}$$

$$g_m = \frac{\partial I_{DS}}{\partial V_{GS}} \approx \frac{2I_{DS}}{V_{eff}} \quad V_{eff} \approx \frac{2I_{DS}}{g_m}$$

$$V_{eff} \propto \sqrt{\frac{I_{DS}}{W}} L \propto \sqrt{L} \quad C_{gs} \propto WL$$

$$C_{gd} \propto W$$

$$g_{ds} = \frac{\partial I_{DS}}{\partial V_{DS}} \approx \lambda I_{DS} \propto \frac{1}{L} \quad g_{mb} \propto g_m$$

