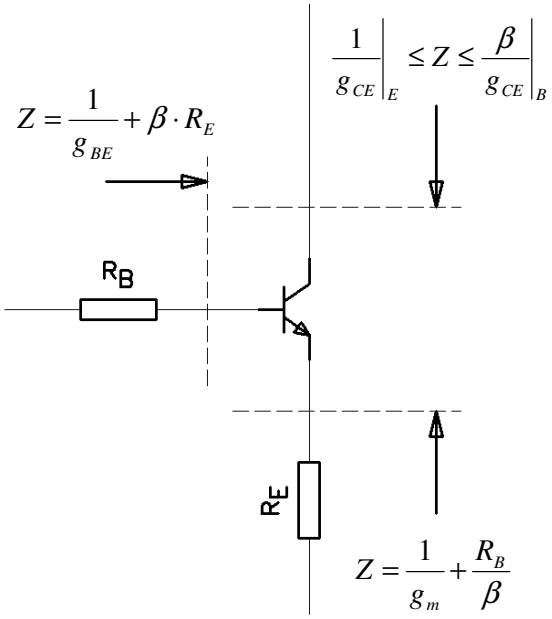
# BIPOLAR TRANSISTOR




$$g_m = \frac{I_{C0}}{U_T}$$

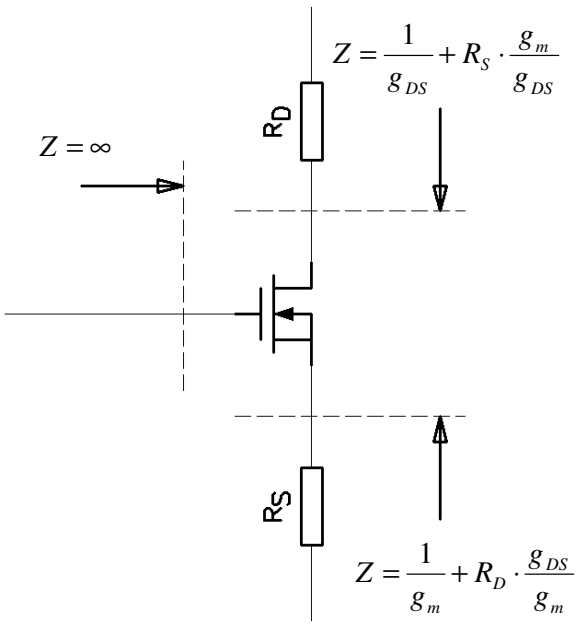
$$g_{BE} = \frac{I_{B0}}{U_T} = \frac{g_m}{\beta}$$

$$g_{CE} = \frac{I_{C0}}{V_A}$$

$$I_C = I_S \cdot e^{\frac{V_{BE}}{U_T}}$$

$$U_T = 26\text{mV}\big|_{T=300\text{K}}$$

# MOS TRANSISTOR




$$V_P = \frac{V_G - V_{T0}}{n}$$

$$g_m = \beta \cdot (V_P - V_S)$$

Blocking: $V_G < V_{T0} + n \cdot V_S$

Conducting: $V_D < V_P$

$$g_{DS} = \frac{1}{R_{ON}} = \beta \cdot (V_G - V_{T0} - n \cdot V_S)$$

Saturating: $V_D > V_P$

$$I_D = \frac{\beta}{2n} \cdot (V_G - V_{T0} - n \cdot V_S)^2$$

$$g_{DS} = \frac{I_{D0}}{V_A}$$

$$I_{D,sat} = \frac{\mu \cdot C_{OX}}{2n} \cdot \frac{W}{L} \cdot (V_{GS} - V_{T0})^2$$

$$I_{D,cond} = \frac{\mu \cdot C_{OX}}{n} \cdot \frac{W}{L} \cdot \left( (V_{GS} - V_{T0}) \cdot V_{DS} - \frac{V_{DS}^2}{2} \right)$$