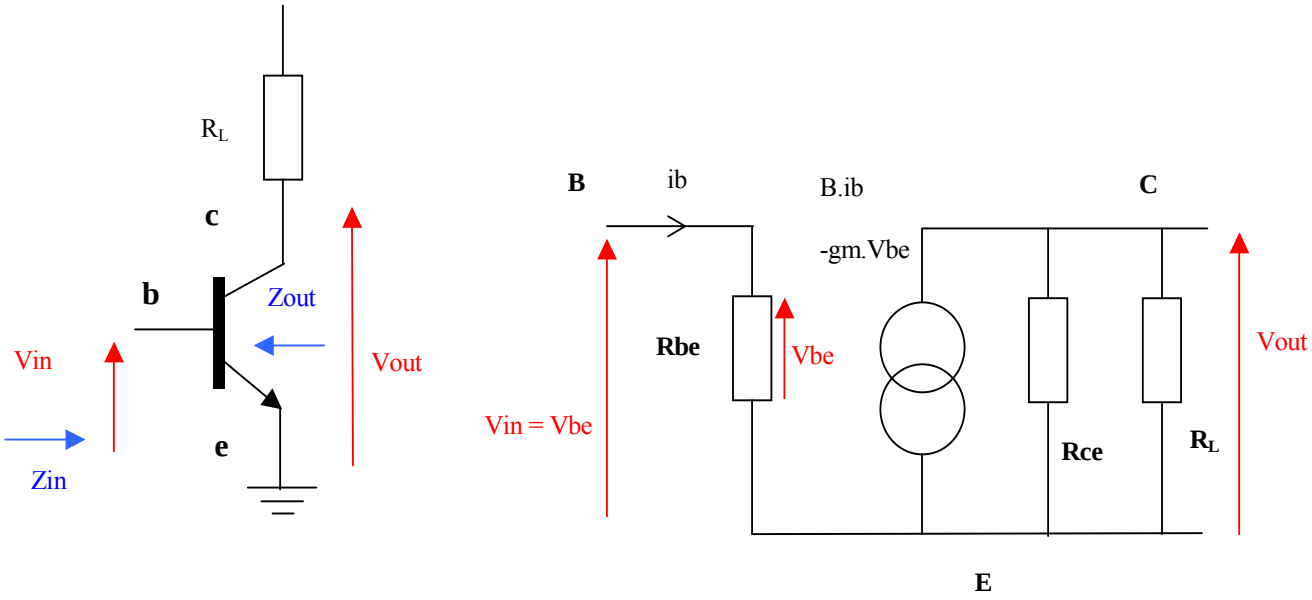
Common-Emitter/Source Circuits

Common-emitter BJT circuit

The figure below shows the simplied 'Pi' model of a common-emitter BJT.



$$R_{IN} = \frac{\beta}{gm} \quad \text{where } gm = \frac{I_{CQ}}{V_T} \;;\; V_T = \frac{k.T}{q} \quad \text{where } k = \text{Boltzmans constant} = 1.3807 \times 10^{23} JK^{-1}$$

$q = \text{Electron charge} = 1.6022 \times 10^{19} C$

$T = \text{Temperature in Kelvin}$

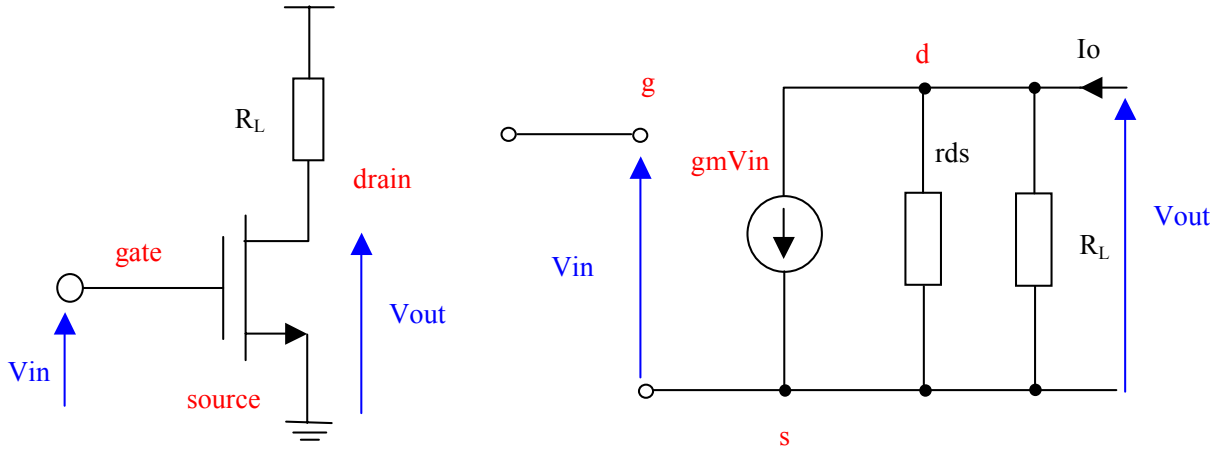
$gm = \text{Transconductance (mS)}$

$$R_{OUT} = rce = \frac{V_A}{I_{CQ}} \quad \text{Where } V_A = \text{Early Voltage (V)}$$

$$A_V = \frac{V_{OUT}}{V_{IN}} = \frac{-gm.V_{be}.rce}{V_{be}} = -gm.rce = \frac{I_{CQ}}{V_T}.\frac{V_A}{I_{CQ}} = \frac{V_A}{V_T}$$

$$A_i = \frac{I_{OUT}}{I_{IN}} = \frac{-\beta.i_b}{i_b} = -\beta$$

Common-Source MOS FET Circuit



Voltage Gain A_v

$$A_V = \frac{V_O}{V_{IN}}$$

$$V_O = -gmV_{IN}(r_{ds}//R_L) \quad A = -gm\left(\frac{r_{ds}.R_L}{r_{ds}+R_L}\right)$$

Input Resistance

$R_{IN} = \infty$

Output Resistance

$$R_{OUT} = \frac{V_O}{I_O} = r_{ds}//R_L$$

Current Gain A_i

$A_i = \infty$