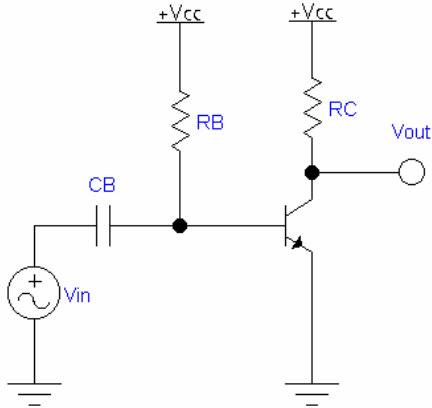


Transistor Amplifiers

Small Signal Modeling Examples

1. Common Emitter Amplifier (Base Bias)



DC Bias

$$V_{BE} = 0.7$$

$$V_{RB} = V_{CC} - V_{BE}$$

$$I_B = V_{RB} / R_B$$

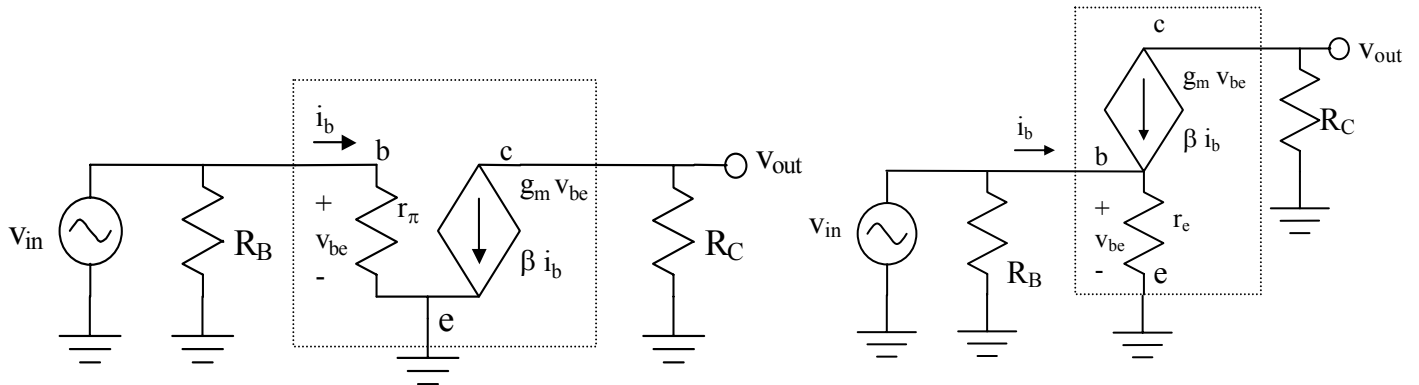
$$I_C = \beta I_B$$

$$V_{RC} = I_C (R_C)$$

Check for saturation, ($V_{RC} > V_{CC}$)

$$V_{OUT (BIAS)} = V_{CC} - V_{RC}$$

Small Signal Model



AC Parameters

$$g_m = I_{C(BIAS)} / V_T$$

$$r_{\pi} = \beta / g_m$$

$$r_e = \beta / (\beta + 1) (1/g_m) \approx 1/g_m$$

Voltage Gain (Av)

$$v_{out} = -g_m v_{be} R_C$$

$$v_{in} = v_{be}$$

$$A_v = v_{out} / v_{in} = -g_m R_C \approx -R_C / r_e$$

Input & Output Impedance (Rin, Rout)

$$R_{in} = R_B \parallel r_{\pi}$$

$$= R_B \parallel (\beta + 1) r_e$$

$$R_{out} = R_C$$

Notes:

(1) $I_{C(BIAS)}$ depends greatly on β .

(2) This means that g_m and A_v are also heavily β dependent.