

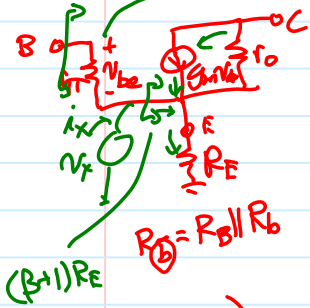
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Inspection Analysis

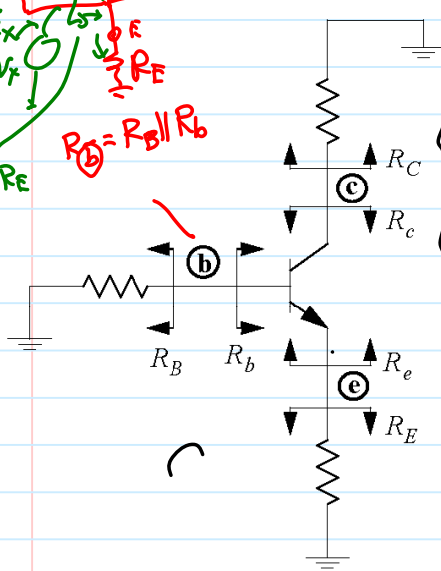
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Useful Inspection Formulas



The General Case (Midband)



$$R_b = (r_e + R_E)(\beta + 1) = r_\pi + (\beta + 1)R_E$$

$$R_e = \frac{r_\pi + R_B}{\beta + 1} \approx \frac{1}{g_m} + \frac{R_B}{\beta + 1}$$

$$R_c = r_o \left[1 + \frac{g_m R_E}{1 + (R_B/r_\pi)} \right]$$

($r_o \gg R_c$)
($g_m R_E \ll \beta_0$) $\Rightarrow R_E$ is small

Base-to-Collector Gain:
 $\frac{v_c}{v_b} = -G_m R_c$ $G_m = \frac{g_m}{1 + g_m R_E}$

Emitter-to-Collector Gain:
 $\frac{v_c}{v_e} = -G_m R_c$ $G_m = -\left(\frac{r_\pi}{r_\pi + R_B}\right) g_m$

Base-to-Emitter Gain:
 $\frac{v_e}{v_b} = \frac{R_E \parallel r_o}{R_E \parallel r_o + r_e}$

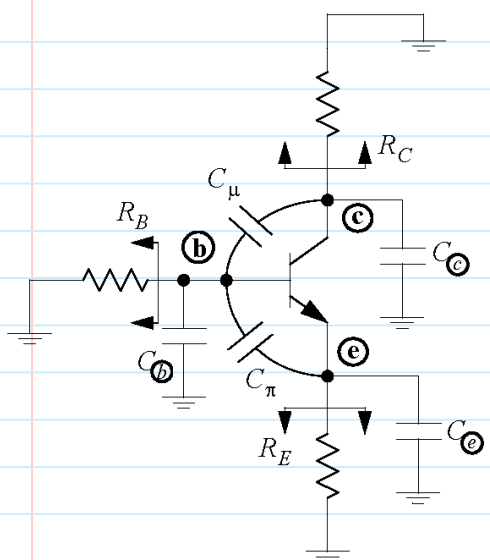
Node Resistances:

$$R_a = R_C \parallel R_c$$

$$R_b = R_E \parallel R_e$$

$$R_d = R_B \parallel R_b$$

High Frequency Analysis



$$\omega_H = \frac{1}{\tau_b + \tau_c + \tau_e + \tau_{\mu o} + \tau_{\pi o}}$$

$\tau_b = C_b R_b$ *$\tau_{\pi o} = C_\pi R_{\pi o}$*
 $\tau_c = C_c R_c$ *$\tau_{\mu o} = C_\mu R_{\mu o}$*
 $\tau_e = C_e R_e$

$$R_{\pi o} = r_\pi \parallel \frac{R_B + R_E}{1 + g_m R_E}$$

$$R_{\mu o} = R_d + R_c + G_m R_c R_b$$

$\tau_b = \frac{C_b R_b}{\omega_s}$ *$\tau_{\pi o} = \frac{C_\pi R_{\pi o}}{\omega_s}$*
 $\tau_c = \frac{C_c R_c}{\omega_s}$ *$\tau_e = \frac{C_e R_e}{\omega_s}$*

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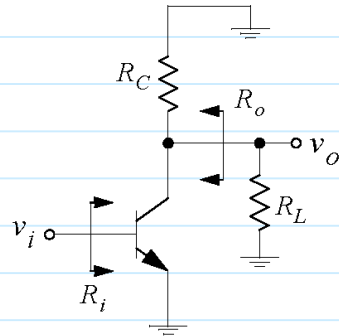
Inspection Analysis

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Frequent Cases (Midband)

Common Emitter

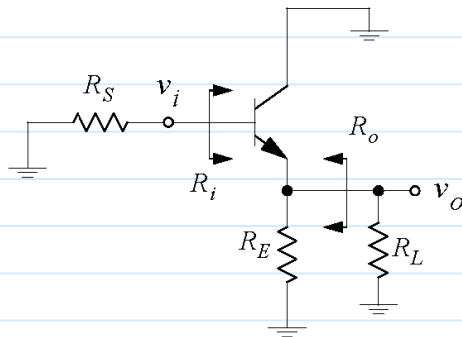


$$R_i = r_\pi$$

$$R_o = r_o \parallel R_C \approx R_C$$

$$\frac{v_o}{v_i} = -g_m(r_o \parallel R_C \parallel R_L) \approx -g_m(R_C \parallel R_L)$$

Common Collector (Emitter Follower)



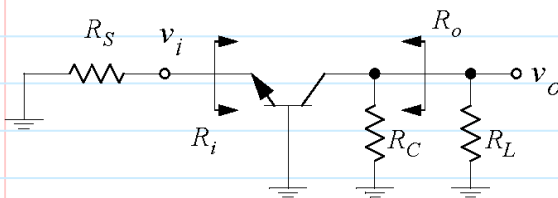
$$R_i = r_\pi + (\beta + 1)(r_o \parallel R_E \parallel R_L)$$

$$\approx r_\pi + (\beta + 1)(R_E \parallel R_L)$$

$$R_o \cong \left(\frac{1}{g_m} + \frac{R_S}{\beta + 1} \right) \parallel R_E$$

$$\frac{v_o}{v_i} = \frac{(r_o \parallel R_E \parallel R_L)}{(r_o \parallel R_E \parallel R_L) + r_e} = \frac{(\beta + 1)(r_o \parallel R_E \parallel R_L)}{(\beta + 1)(r_o \parallel R_E \parallel R_L) + r_\pi} \approx \frac{(\beta + 1)(R_E \parallel R_L)}{(\beta + 1)(R_E \parallel R_L) + r_\pi}$$

Common Base



$$R_i = r_e \cong \frac{1}{g_m}$$

$$R_o = r_o(1 + g_m R_S) \parallel R_C \approx R_C$$

$$\frac{v_o}{v_i} \cong g_m(R_C \parallel R_L)$$