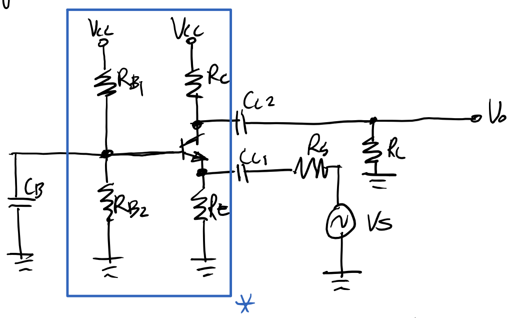
Common Base Amplifier

October 17, 2017 3:48 PM

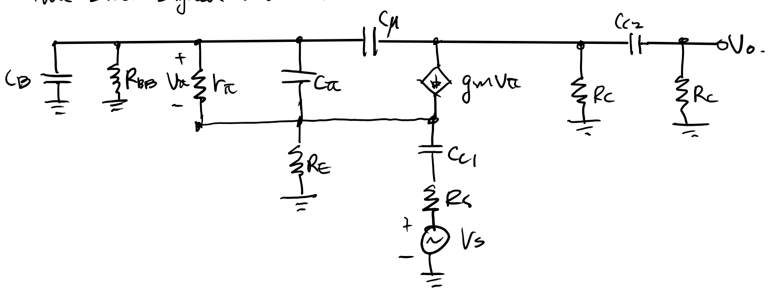
Typical common-base amplifier:



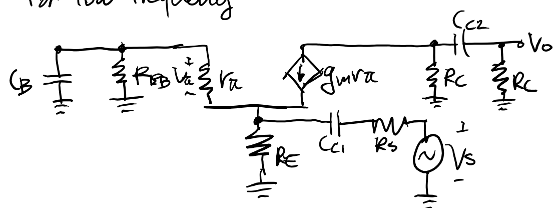
* Assuming that it is biased using 1/3 Rule, * (Same way for Common Emitter Amplifiers)

→ R_{B1}, R_{B2}, R_C, R_E is known.

The small signal model is:

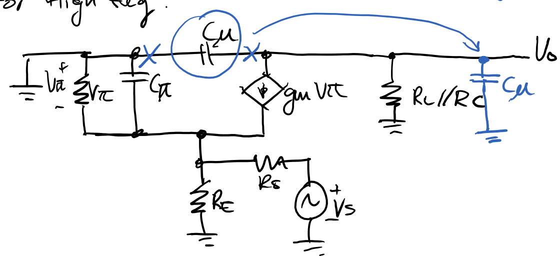


For low frequency



For High freq.

notice that it actually shares a node to GND.



Midband:

$$V_\pi = -\frac{\left(\frac{1}{1+\beta}\right) r_\pi // R_E}{R_s + \left[\left(\frac{1}{1+\beta}\right) r_\pi // R_E\right]} V_s$$

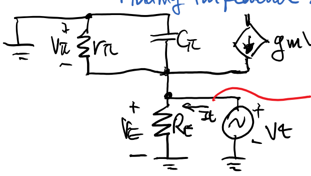
$$\approx -\frac{\left(\frac{1}{1+\beta}\right) r_\pi}{R_s + \frac{r_\pi}{1+\beta}} V_s$$

$$A_m = \frac{V_o}{V_s} = g_m (R_C // R_L) \cdot V_\pi$$

* Notice that common base amplifiers are <u>non-inverting</u>

High Frequency:

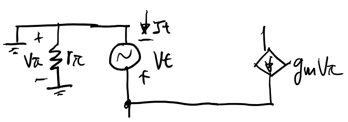
Finding impedance seen looking into the emitter

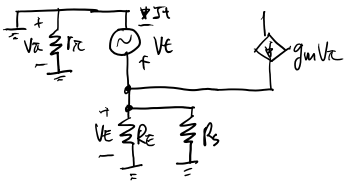


Rs is ignored for now

$$Z_E = \left(R_E // \frac{r_\pi}{1+\beta} // \frac{1}{sC_\pi}\right)$$

notice that Cπ is unaffected





$I_t = \frac{V_t}{R_E} + \frac{V_t}{R_S} - \frac{V_\pi}{R_\pi} - g_m V_\pi$, and $V_\pi = -V_t$

$= V_t\left(\frac{1}{R_E} + \frac{1}{R_S} + \frac{1}{R_\pi} + g_m\right)$, and $g_m = \frac{\beta}{r_\pi}$

$= V_t\left(R_E \,//\, R_S \,//\, \frac{r_\pi}{1+\beta}\right)$

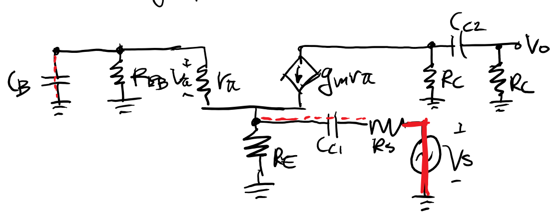
thus $\frac{I_t}{V_t} = Y_E = R_E \,//\, R_S \,//\, \frac{r_\pi}{1+\beta}$

Low Frequency

Immediately, we can recognize C_{C2} and it's pole is:

$$\omega_{Lp1} = \frac{1}{C_{C2}(R_C+R_L)}$$

For the remaining poles, we need to do SCTC tests.



For the collector side, no SCTC test is required.

For the base side, do SCTC and OCTC tests:

$$\begin{cases} \tau_{SC}^{CB} = C_B \cdot (R_{BB} \,\|\, (r_\pi + (1+\beta) R_E \,\|\, R_S)) \\ \tau_{SC}^{CC1} = C_{C1}\left(R_S + R_E \,\|\, \frac{r_\pi}{1+\beta}\right) \end{cases}$$ ← More resistance

$$\begin{cases} \tau_{OC}^{CB} = C_B \cdot (R_{BB} \,\|\, [r_\pi + (1+\beta) R_E]) \\ \tau_{OC}^{CC1} = C_{C1} \cdot \left(\frac{r_\pi + R_{BB}}{1+\beta} \,\|\, R_E + R_S\right) \end{cases}$$