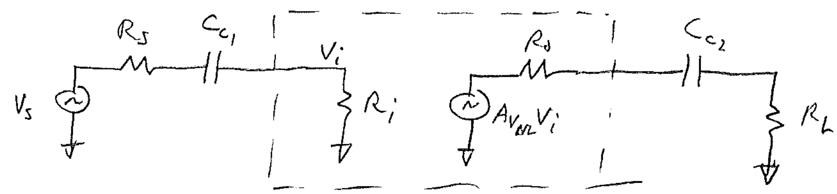
Coupling Capacitors

Consider CE Amp AC ckt (with C_b big)



"How do we select C_c?"

"Consider V divider at input:"

$$\frac{V_i}{V_s} = \frac{R_i}{R_i + R_s - j|X_c|}$$

$$|X_c| = \frac{1}{\omega C_{c1}} = \frac{1}{2\pi f C_{c1}}$$

C_{c1} acts "like a short" provided

$$\boxed{|X_{c_1}| << R_s + R_i}$$

$$\Rightarrow \frac{1}{2\pi f C_{c1}} << R_s + R_i$$

$$\Rightarrow C_{c1} >> \frac{1}{2\pi f (R_s + R_i)}$$

Example:

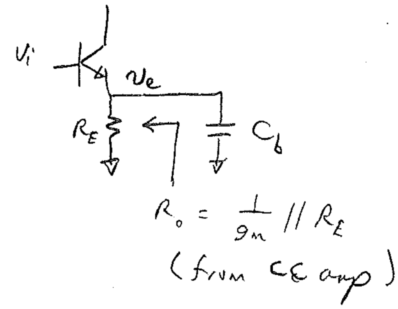
$$R_s + R_i = 50 + 1K$$
$$f = 100 MHz$$
$$\Rightarrow C_{c1} >> 1.5 pF$$

Similarly at output, choose $C_{c2} >> \frac{1}{2\pi f (R_o + R_L)}$

Conclusion: Very small C can produce sufficiently low Z at RF ☆

Bypass Caps

Consider Emitter Bypass:



To prevent gain reduction, we need:

$$|X_{C_b}| \ll \frac{1}{g_m} \| R_E$$

$$\Rightarrow C_b \gg \frac{1}{2\pi f \left(\frac{1}{g_m} \| R_E\right)} \approx \frac{g_m}{2\pi f}$$

Why?

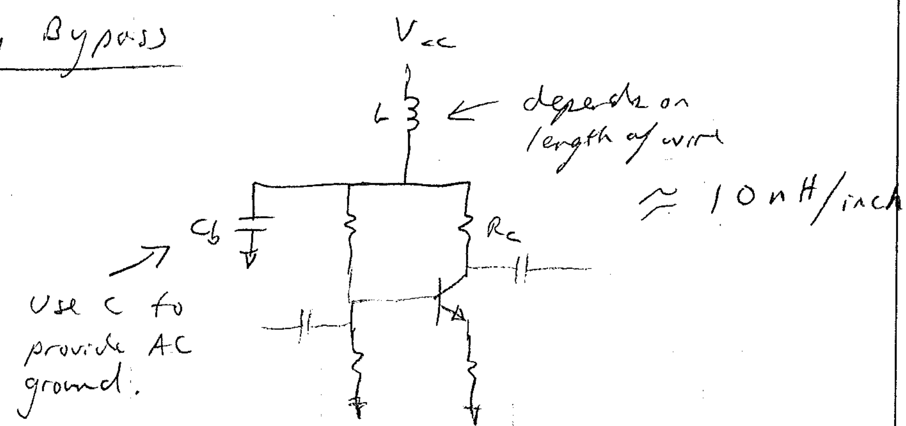
Want full v_i across be junction

Think of ckt as CC amp.

If $X_c \not\ll R_o$, will have AC signal at emitter and $|v_{be}| = |v_i - v_e| < |v_i|$

Hence, full v_i not across be junction & gain falls

Consider Supply Bypass



make ~~smaller than~~ $X_c \ll R_c$ so that output voltage drop is across R_c and not L