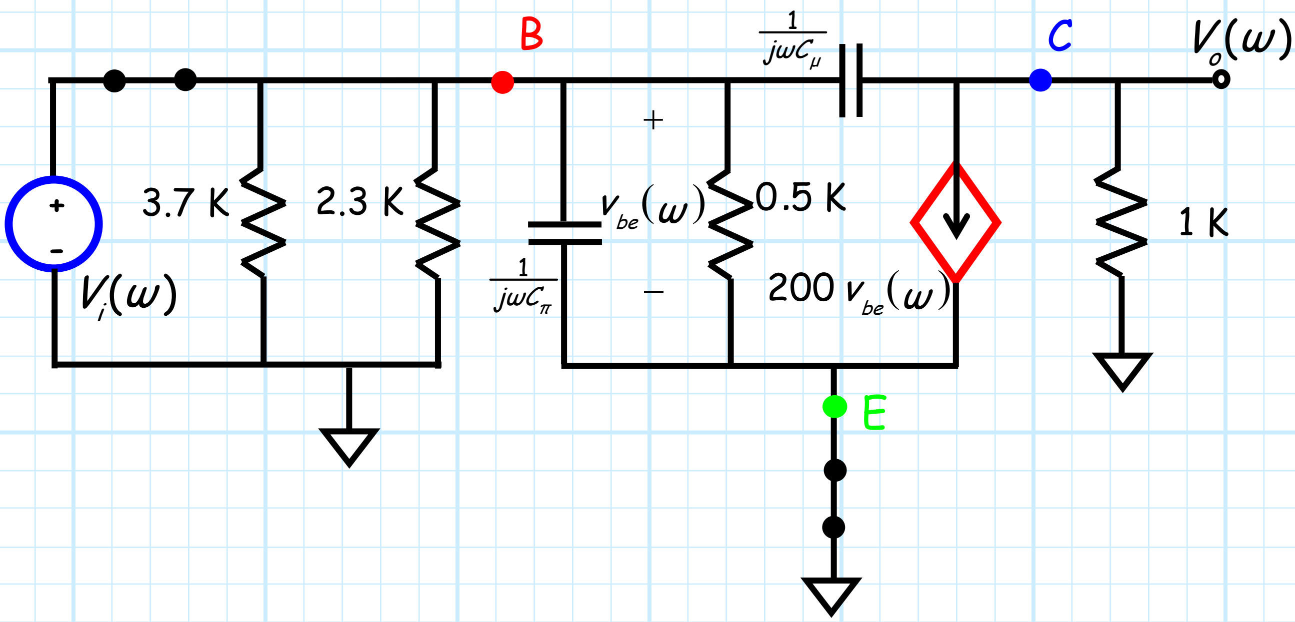
High-Frequency Response

To determine the high-frequency response of our example common-emitter amp, we simply consider explicitly the parasitic capacitances in the small-signal model, while approximating the COUS as small-signal short-circuits:



Now, since we are **ignoring** the COUS, the function $F_L(\omega)$ that describes the low- frequency response is:

$$F_L(\omega) = 1$$

And so:

$$A_{vo}(\omega) = F_L(\omega)\ A_M\ F_H(\omega) = A_M\ F_H(\omega)$$

We will find that the high-frequency response will (approximately) have the form.

$$F_H(\omega) = \left(\frac{1}{1 + j(\omega/\omega_{P3})}\right)\left(\frac{1}{1 + j(\omega/\omega_{P4})}\right)$$

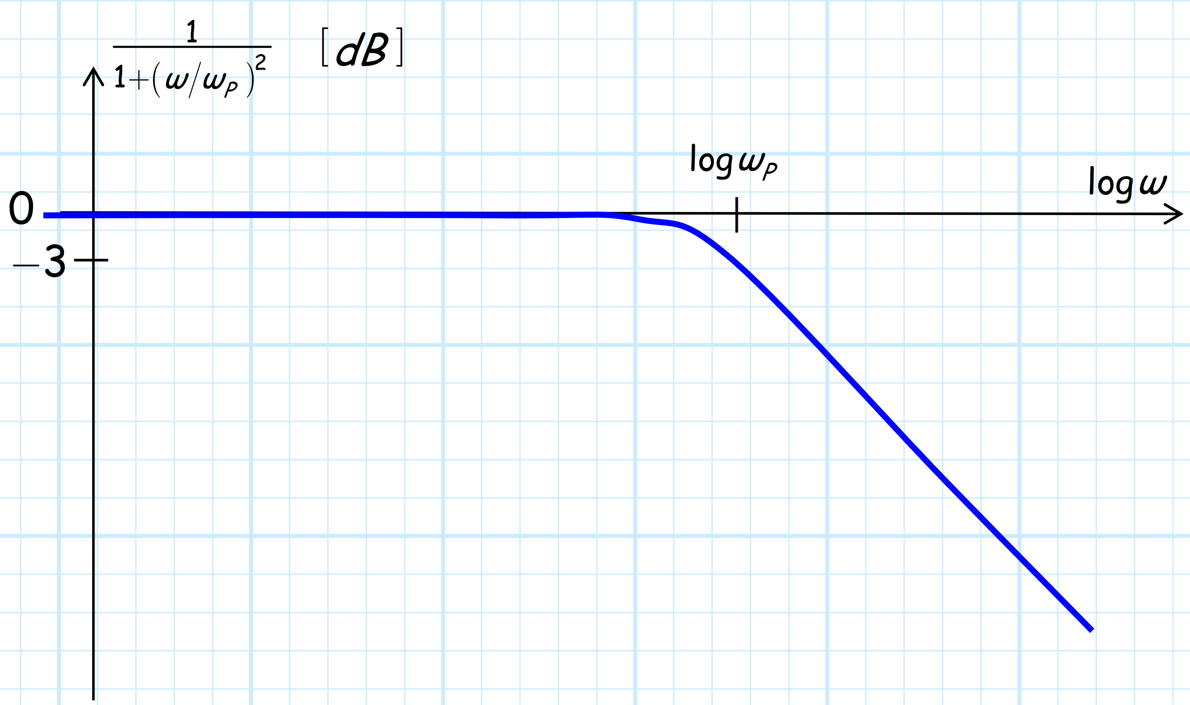
Now, functions of the type:

$$\left(\frac{1}{1 + j(\omega/\omega_P)}\right)$$

are **low-pass** functions:

$$\left|\frac{1}{1 + j(\omega/\omega_P)}\right|^2 = \frac{1}{1 + (\omega/\omega_P)^2}$$

with a **3dB break frequency** of ω_P.



Thus:

$$\frac{1}{1+(\omega/\omega_p)^2} = \begin{cases} \cong 1.0 & \text{for } \omega < \omega_p \\ 0.5 & \text{for } \omega = \omega_p \\ 0 & \text{for } \omega \to \infty \end{cases}$$

As a result, we find that the transfer function:

$$\begin{aligned} A_{vo}(\omega) &= A_M\ F_H(\omega) \\ &= (-200)\left(\frac{1}{1+j(\omega/\omega_{P3})}\right)\left(\frac{1}{1+j(\omega/\omega_{P3})}\right) \end{aligned}$$

will be **approximately** equal to the midband gain $A_M = -200$ for all frequencies ω that are less than **both** ω_{P3} **and** ω_{P4}.

I.E.,:

$$A_{vo}(\omega) \cong A_M = -200 \qquad \text{if } \omega < \omega_{P3} \textbf{ and } \omega > \omega_{P4}$$

Hopefully, it is **now** apparent (please tell me it is!) that the higher end of the amplifier bandwidth—specified by frequency ω_H—is the determined by the **smaller** of the two frequencies ω_{P3} and ω_{P3}!

The **smaller** of the two frequencies is called the **dominant pole** of the transfer function $F_H(\omega)$.

Generally speaking, to **increase** the value ω_H, we must increase the **DC bias currents** of our amplifier design!