UNIVERSITY OF CALIFORNIA AT BERKELEY
College of Engineering
Department of Electrical Engineering and Computer Sciences

EE105 Lab Experiments

Report 7: Frequency Response

Solutions

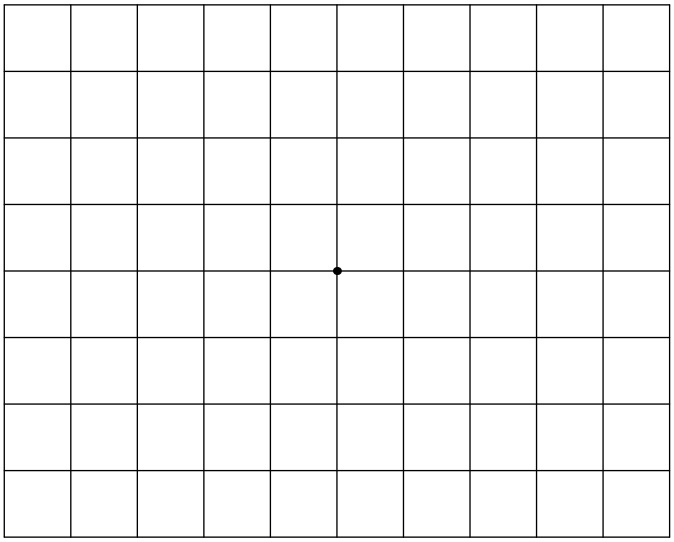
3.1.3 Measure I_{BIAS} and the DC voltage at V_{OUT}.

$\boxed{I_{BIAS} = 0.21 \text{ mA}}$

$\boxed{v_{OUT} = 2.9 \text{ V}}$

3.1.4 Sketch the waveforms at v_{IN} and v_{OUT}.

The input and output are sinusoidal with frequency 1 kHz.
V_{p-p} of v_{IN} is 20 mV. V_{p-p} of v_{OUT} is 1.484 V.



3.1.5 What are the magnitude and phase of v_{out}/v_{in} measured from the oscilloscope?

$\boxed{|v_{out}/v_{in}| = 37.4 \text{ dB}}$

$\boxed{\angle v_{out}/v_{in} = 180^\circ}$

3.1.7 What are the magnitude and phase of v_{out}/v_{in} measured from the software? How different is this measurement compared to the one obtained with the oscilloscope?

Magnitude error is:

$$\frac{37.4 - 35.9}{37.4} = 4\ \%$$

Phase error is:

$$\frac{180 - 178.6}{180} = 0.78\ \%$$

$$\boxed{|v_{out}/v_{in}| = 35.9\ \text{dB}}$$

$$\boxed{\angle v_{out}/v_{in} = 178.6^\circ}$$

3.1.8 What is the frequency at which the gain drops by 3 dB? What is the phase at this frequency? Is the phase consistent with the magnitude?

The phase of a pole should be 45° less than the phase at $0.1 \cdot f_{-3\ \text{dB}}$. Since the phase measured is about 45° less, it is consistent with the magnitude.

$$\boxed{f_{-3\ \text{dB}} = 110\ \text{kHz}}$$

$$\boxed{\angle v_{out}/v_{in}|_{f_{-3\ \text{dB}}} = 132.6^\circ}$$

3.1.9 Attach the Bode plot to the Lab Report.

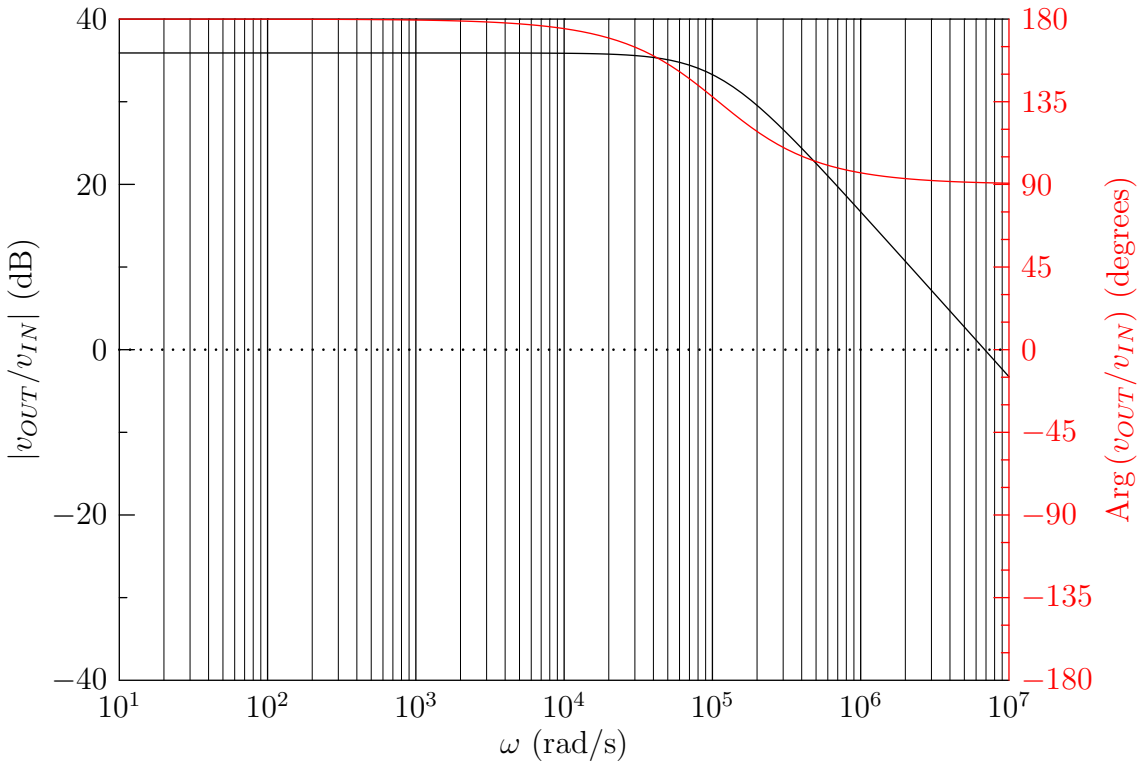
3.2.2 Frequency response of the amplifier with a Miller capacitor.

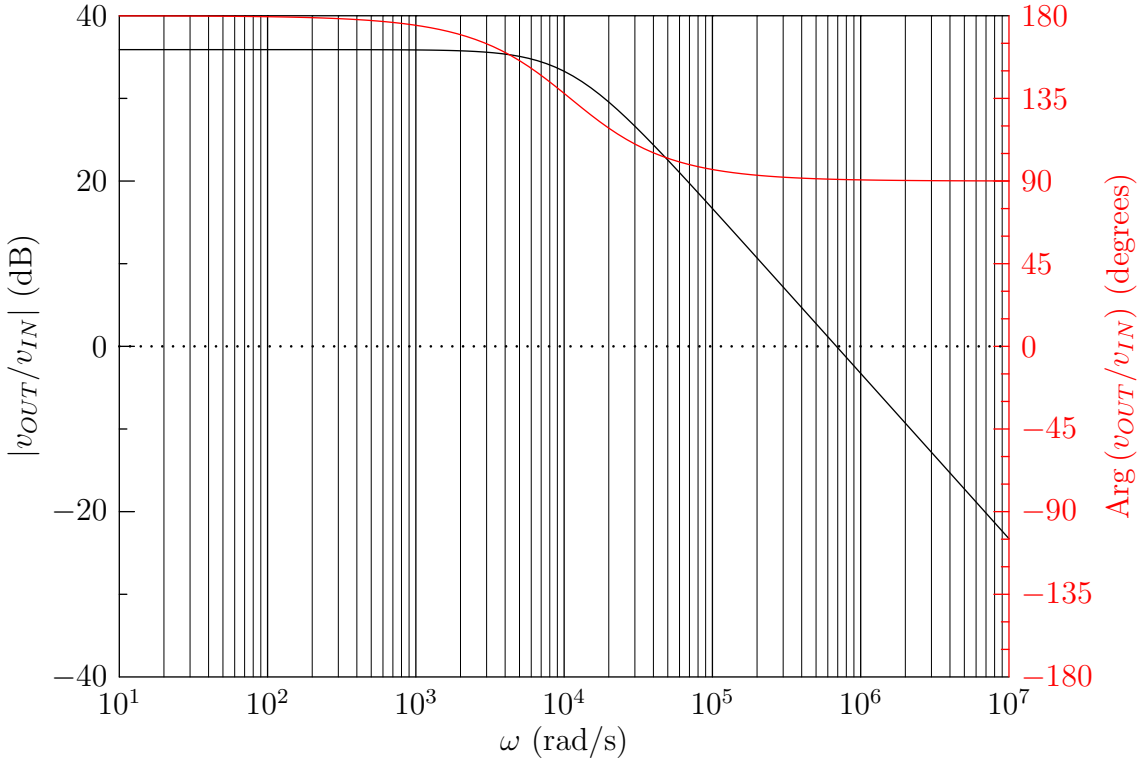
$$\boxed{f_{-3\ \text{dB}} = 11\ \text{kHz}}$$

$$\boxed{\angle v_{out}/v_{in}|_{f_{-3\ \text{dB}}} = 135.1^\circ}$$

3.2.3 How does the dominant pole of this amplifier compare to the dominant pole of the previous amplifier? Is this expected?

The dominant pole of this amplifier is lower than the previous amplifier because the Miller capacitor lowers the pole of this amplifier. This is expected.





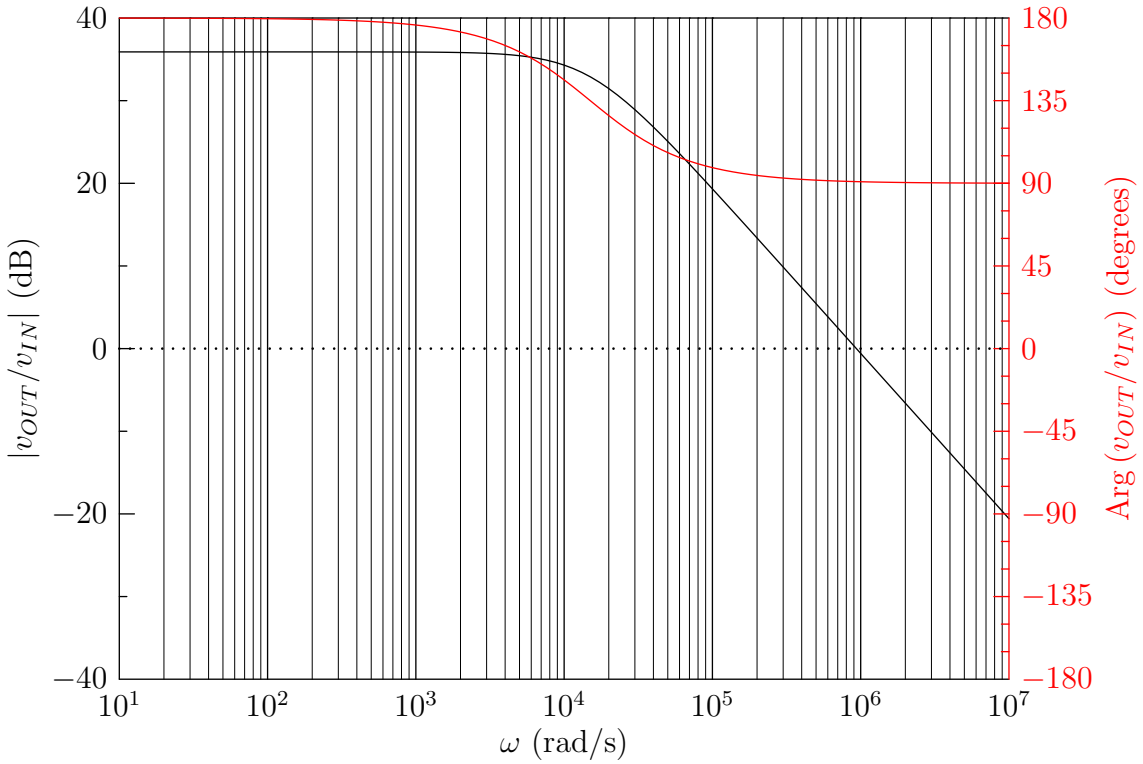
3.2.4 If we are to design an amplifier with high bandwidth, is a transistor with large C_μ desirable?

No. A large C_μ hurts the bandwidth of the amplifier.

3.3.2 Frequency response of the amplifier with an output capacitor.

$f_{-3\text{ dB}} = 15$ kHz

$\angle v_{out}/v_{in}|_{f_{-3\text{ dB}}} = 135.8°$



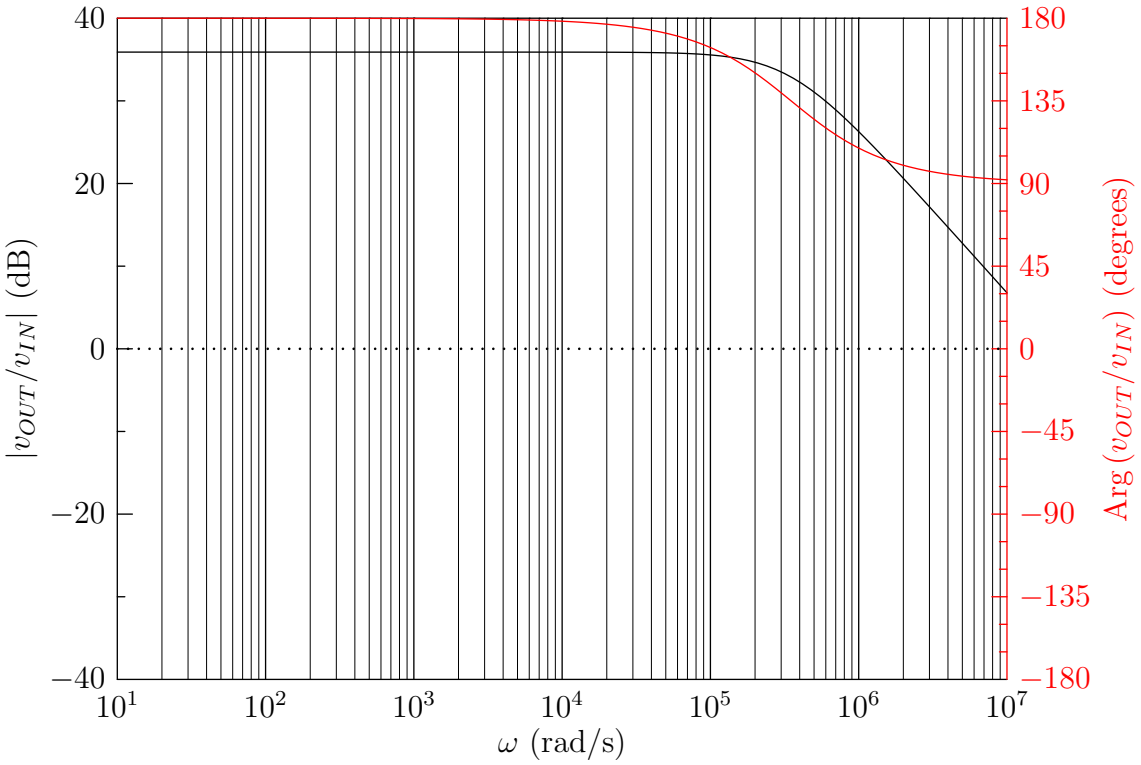
3.3.3 How does the dominant pole of this amplifier compare to the dominant pole of the previous two amplifiers? Is this expected?

The dominant pole of this amplifier is slightly better than the one with Miller capacitor. The output capacitor is expected to lower the dominant pole, but not as much as the Miller capacitor because of the lack of Miller multiplier.

3.4.2 Frequency response of the common collector amplifier.

$f_{-3\text{ dB}} = 350$ kHz

$\angle v_{out}/v_{in}|_{f_{-3\text{ dB}}} = 135°$



3.4.3 How does the bandwidth of this amplifier compare to the bandwidths of the previous amplifiers?

This amplifier has three times the bandwidth of the common emitter amplifier.