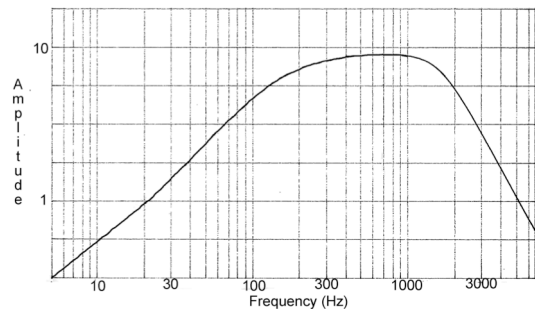


The goal of the "final" exercise is to build a band-pass amplifier. The specifications are:

1. A very high, i.e., FET-like, input impedance.
2. A very low, i.e., \sim few Ohms, output impedance
3. A pass-band of \sim 150 to \sim 1500 Hz
4. A composite gain of +5 to +10 in the pass-band
 - Gain $\propto f$ for $f \ll 150$ Hz
 - Gain $\propto 1/f^2$ for $f \gg 1500$ Hz

See Bode plot, i.e., $\log|V_{out}(f)/V_{in}(f)|$ versus $\log(f)$, at the right.



Construct the band-pass amplifier in five stages, selecting from the following parts:

- LF411 FET Op-Amp
- 2N5485 n-channel JFET
- 0.01 H inductor
- 0.001 μ F, 0.01 μ F, 0.1 μ F, and 1.0 μ F capacitors
- 1.0 k Ω , 4.7 k Ω , 9.1 k Ω , 10 k Ω , 11 k Ω , 91 k Ω , 100 k Ω , and 110 k Ω resistors

(A) Use an FET follower with a current source as a load for the input buffer. In particular, (re)build the *exact* circuit from exercise 7.5 (figure 7.9 in laboratory 7).

- (1) What is the gain at 50 Hz?, 500 Hz, 5,000 Hz? Use a 1.0 V_{peak-to-peak} sine wave.
- (2) What is the offset voltage?

(B) Build a high-pass filter (laboratory 2) with a capacitor and a resistor with $f_{3dB} \sim 150$ Hz. To minimize loading on the FET follower, pick $R \geq 100$ k Ω .

- (3) What is the desired time constant, τ ?
- (4) What R and C combination did you choose?
- (5) What is your measured f_{3dB} (high pass)?

Connect stages (A) and (B).

(C) Use an FET Op-Amp to build an amplifier (laboratory 4) that has a gain $G \approx +10$.

- (6) What circuit configuration, i.e., inverting vs. non-inverting, should you use?
- (7) What resistance values did you choose for the circuit?

Connect stages (A), (B), and (C).

(D) Build a low pass / resonant circuit that will complete the band-pass (laboratory 2). Use an inductor with $L \approx 0.01$ H and a capacitor with $C \approx 1.0$ μ F.

- (7) How should these two elements be configured?
- (8) What is the calculated transfer function for this circuit element, i.e., $V_{out}(f)/V_{in}(f)$ (ignore internal resistance in the inductor)?

Connect stages (A), (B), (C), and (D).

- (9) What is your measured f_{3dB} (low pass) for this circuit, i.e., the high frequency cut-off?

(E) Use an FET Op-Amp to build a unity-gain follower (laboratory 4) that drives a 10 k Ω load.

Connect stages (A), (B), (C), (D), and (E).

- (10) Measure the frequency dependence of your circuit at ~ 20 logarithmic steps in frequency (10 Hz to 10 kHz) and form a Bode plot on 3x3 cycle log-log paper.