

Names _____

Objectives:

- 1) Design active highpass and bandpass filters to meet performance criteria.
- 2) Predict magnitude response for the filters with hand-drawn Bode plots.
- 3) Compare predictions to MATLAB simulation and laboratory measurements
- 4) Compare predictions to laboratory measurements.

Deliverables

- 1) Detailed design calculations, neatly done for for HP and BP.
- 2) Hand-drawn straight-line Bode magnitude plots (on semilog paper).
- 3) MATLAB-generated Bode magnitude plots.
- 4) Comparison of measurement to calculation **and** comparison of measurement to simulation (plot laboratory data **both** on hand-drawn plot **and** on MATLAB-generated plot).

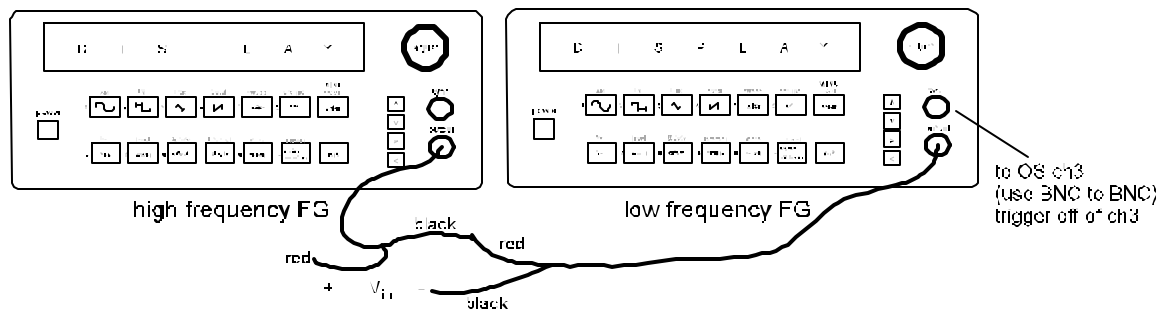
Procedure

Highpass filter

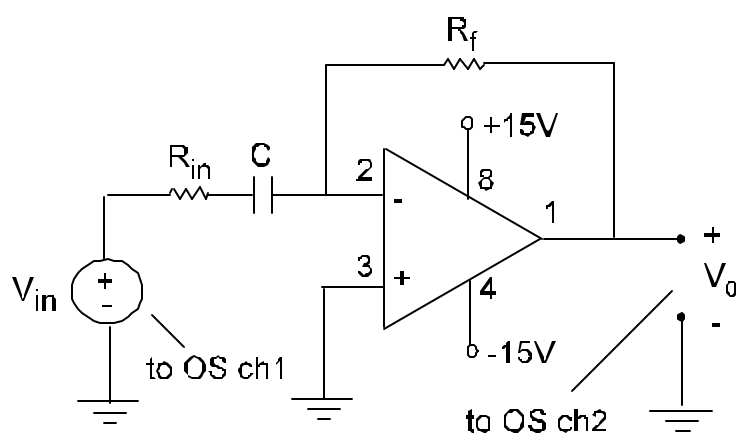
1. A 3300 Hz signal with a 2V amplitude (4 V peak-to-peak), is corrupted by a 2V amplitude noise at 60 Hz. Design a HP filter with a n approximate HP gain of 3 that would significantly attenuate the noise (**use $R_{in} = 1KW$**) Note: R_f should be 3 KW ... 1 KW in series with 2 KW.

To construct this circuit, V_{in} will be formed from the series combination of the outputs of both function generators. (Remember to adjust both for High-Z output terminations)

Wiring hints: 1) Use a bare loop of wire on the breadboard to connect the function generators together. 2) Use power supply connections as binding posts to connect breadboard to $\pm 15V$ supply with wires.



2. Measure $R_{in} = \underline{\hspace{2cm}}$, $R_f = \underline{\hspace{2cm}}$, and $C = \underline{\hspace{2cm}}$. Use these measured values (DDM for R_s , LCR meter for C) when calculating model predictions and in producing MATLAB-generated plots.



3. Calculate the signal-to-noise ratio at the input. $V_{in\text{-signal}}/V_{in\text{-noise}} =$ _____
4. Measure the amplitude ($\frac{1}{2}$ of peak-to-peak) of the signal and the noise at the output. Calculate the signal-to-noise ratio when the signal frequency is varied as indicated below.

f_{signal} (Hz)	330	1650	3300	6600	33000
$ V_{o\text{-signal}} $					
$ V_{o\text{-noise}} $					
$ V_{o\text{-signal}} / V_{o\text{-noise}} $					

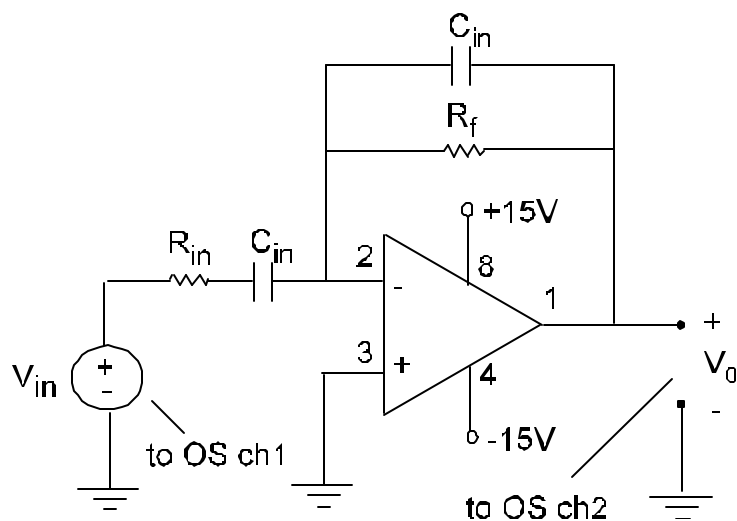
Bandpass filter

5. A signal, 3V peak-to-peak, at 12 kHz is corrupted by 1V peak-to-peak LF noise at 60 Hz and by 3V peak-to-peak HF noise at 300 kHz.

For this step, since there is only one function generator for "noise", you will have to simulate the noise by first adjusting the low frequency FG for noise (high frequency FG as signal) and then take measurements pertaining to LF noise. Next, adjust the high frequency FG for noise (low frequency FG as signal) and take the measurements pertaining to HF noise.

Design a BP filter with an approximate passband gain of 3 that significantly attenuates the LF and HF noise. (Use $R_{in} = 4.7 \text{ KW}$ and $R_f = 15 \text{ KW}$).

6. Measure $R_{in} =$ _____, $R_f =$ _____, $C_{in} =$ _____. and C_f _____.
Use these measured values when calculating model predictions and in producing MATLAB-generated plots.



$$|V_{\text{in-signal}}| = \underline{\hspace{10em}}$$

$$|V_{\text{in-HF noise}}| = \underline{\hspace{10em}}$$

$$|V_{\text{in-LF noise}}| = \underline{\hspace{10em}}$$

7. At the output, measure the signal amplitude, LF noise amplitude, and HF noise amplitude. (amplitude is $\frac{1}{2}$ of the peak-to-peak values)

$$|V_{\text{o-signal}}| = \underline{\hspace{10em}}$$

$$|V_{\text{o-HF noise}}| = \underline{\hspace{10em}}$$

$$|V_{\text{o-LF noise}}| = \underline{\hspace{10em}}$$

Demonstrate the BP filter to instructor.

Instructor initials _____