**Datasheet for Lab 15: Frequency Selective Circuits**

Name(s): \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Date: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Approximate time to complete:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Parts: R = 470 Ω Measured \_\_\_\_\_\_\_\_\_\_\_\_\_
 L = 0.033 H (blue or black cylinder) Measured RL \_\_\_\_\_\_\_\_\_\_\_\_\_
 C = 0.1 uF (code 104 stamped on side) Assume ideal \_\_0.1 uF\_\_\_\_\_\_

**Part 1 RL Low-Pass Filter**

Approximate Corner frequency *fc* = $\frac{R}{2πL}$ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Corner frequency including RL *fc* = $\frac{\sqrt{R^{2}-2RR\_{L}+R\_{L}^{2} } }{2πL}$\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

 % difference \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Table I RL Low-Pass filter measurements

|  |  |  |  |
| --- | --- | --- | --- |
| **Frequency, f** | **Vin, pk-pk** | **Vout, pk-pk** | **Gain (Vout/Vin)** |
| 100 Hz |  |  |  |
| 200 Hz |  |  |  |
| 500 Hz |  |  |  |
| 1000 Hz |  |  |  |
| calculated fc = \_\_\_\_\_\_ |  |  |  |
| measured fc = \_\_\_\_\_\_(adjust f for gain of 0.707) |  |  |  |
| 2000 Hz |  |  |  |
| 5000 Hz |  |  |  |
| 10000 Hz |  |  |  |
| 20000 Hz |  |  |  |
| 50000 Hz |  |  |  |

1. Use FreeMat to plot the Gain (linear ratio) vs frequency using linear axes. Enter your test data into two vectors f and G in FreeMat and use these commands to plot the data.

plot(f,G,'+-'); xlabel('freq, Hz'); ylabel('Gain, Vout/Vin');

title('Low-Pass Filter Frequency Response (Linear Scale)');

 Copy and paste your plot here.

1. Repeat the plot, only now make a new vector GDB for Gain in decibels, and plot frequency on a logarithmic scale. The semilogx command will do that, since the Gain GDB will already be in decibels (logarithmic)

GDB = 20\*log10(G);

semilogx(f,GDB,'+-'); xlabel('freq, Hz'); ylabel('Gain, dB');

title('Low-Pass Filter Frequency Response (Log Scale)');

 Copy and paste your plot here.

1. Record the frequency of the X cursor in your datasheet.

Corner frequency meaured by Network Analyzer, fc = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. Copy your Network Analyzer plot here.
2. Compare the Network Analyzer plot to your MATLAB plot and comment on any similarities or differences you observe. Also compare the different measurements of the corner frequency of the filter.

**Part 2 RC High-Pass Filter**

1. Build the RC high-pass filter using R = 470, C = 0.1 uF.

Calculate corner frequency fc=1/(2πRC) \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. Record the frequency of the X cursor in your datasheet.

Corner frequency meaured by Network Analyzer, fc = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. Copy your Network Analyzer plot here.
2. Comment on any similarities or differences you observe, between your Network Analyzer measurement of the corner frequency and the theoretical estimate of the corner frequency from step 14.

 **Part 3 Band-Pass Filter**

1. Build the series RLC BandPass filter. Using the formulae given in the lab,

Calculate fc1 = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Calculate fc1 = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Calculate fr = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Calculate Q = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. Use two X cursors to locate the two corner frequencies fc1 and fc2 on the Network Analyzer response curve. Then capture the plot from the display and paste here.
2. Record the corner frequencies measured by Network Analyzer,

fc1 = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

fc2 = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. Comment on any similarities or differences you observe, between your Network Analyzer measurement of the corner frequencies and the theoretical estimates of the corner frequencies from step 19.

**Part 4 (Optional) Filter an Audio Signal**

You can use your low-pass and high-pass filters in a practical application by playing the following two YouTube videos at the same time (which combines their audio onto a single channel) and feed the audio signal into your filter as Vin using the 3.5mm audio jack in your lab kit. Then take Vout and run it into the Radio Shack loudspeakers in the lab (online students: just plug earbuds into the audio jack on the side of the Analog Discovery while monitoring the output with the scope).

YouTube Videos with high and low pitched voices. Play these at the same time:

1. Tim Storm, [Lowest Male Voice](https://www.youtube.com/watch?v=_QbPy-tZxmg)
2. [High Pitched Girl’s Voice](https://www.youtube.com/watch?v=mkEu7ewEaDo)

With the low pass filter, you should be able to filter out the high pitched girl (to lower the cutoff frequency, choose a smaller resistor such as 220 or 100 Ohms).

When you are finished, please add an estimate of the approximate time to complete this lab at the top of the datasheet, and turn in to the server.