VE215 Lab 5

Filter Lab

Data Sheet

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Date: _____ TA's Signature: _____

Note: You will get grade deductions if you violate the following rules:

1. You are required to sign in the Logbook once you get your seat.
2. You are supposed to restore all the equipment and materials before you leave the lab.
3. You mustn't move any of the equipment and the material without TA's permission.

Procedures:

1. According to the pre-lab assignments, you are supposed to fill in the **Expected Data columns** in the tables below before the lab.
2. During the lab:
   - i) Construct the circuit for each type of filter. Resister: **R = 982Ω**; Capacitor: **C = 0.1μF**; Inductor: **L = 1mH**.
   - ii) Set the Input Signal in the function generator to be **Sine Wave** with amplitude of **5 V_{ppk}** and **change the frequency** accordingly.
   - iii) Use the oscilloscope to detect the **amplitudes** of the **Input and Output** signals. Record them respectively in the first two column in the tables.
   - iv) Additionally for the **Band-reject Filter**, when the frequency approach the critical frequency at which the **Transfer Function Magnitude** reaches its minimum, the **Output Signal Amplitude** changes rapidly. For a more accurate result, you can (but not strictly required to) add some more rows to record the data (**Table V**).
3. After the lab, you should calculate with the experimental data for the "**Transfer function magnitude**" and "**Transfer function magnitude, in dB**" columns.

I) Low-pass Filter

Frequency	Input signal amplitude, Vppk	Output signal amplitude, (m)Vppk	Transfer function magnitude	**Expected** transfer function magnitude	Transfer function magnitude, in dB	**Expected** transfer function magnitude, in dB
1 MHz	9.6	0.200	0.0208	1.621×10^{-4}	-33.6268	-75.806
100 kHz	10.1	0.237	0.0235	0.0162	-32.5915	-35.807
50 kHz	10.3	0.470	0.0456	0.0326	-26.8148	-29.790
10 kHz	10.1	2.21	0.0219	0.1600	-13.1986	-15.918
5 kHz	10.1	4.1	0.0406	0.308	-7.83075	-10.219
1 kHz	10.7	9.8	0.916	0.851	-0.76315	-1.401
500 Hz	10.7	10.5	0.981	0.956	-0.16389	-0.395

II) High-pass Filter

Frequency	Input signal amplitude, Vppk	Output signal amplitude, Vppk	Transfer function magnitude	**Expected** transfer function magnitude	Transfer function magnitude, in dB	**Expected** transfer function magnitude, in dB
1 MHz	9.6	9.8	1.02	1	0.179	-1.141×10^{-7}
100 kHz	10.1	10.1	1.00	1	0	-1.141×10^{-3}
50 kHz	10.1	10.1	1.00	1	0	-4.561×10^{-3}
10 kHz	10.1	9.8	0.970	0.987	-0.262	-0.113
5 kHz	10.1	9.2	0.911	0.951	-0.811	-0.434
1 kHz	10.5	4.2	0.400	0.525	-7.96	-5.595
500 Hz	10.7	2.29	0.214	0.295	-13.4	-10.610
100 Hz	10.7	0.51	0.0477		-26.4	

III) Band-pass Filter

Frequency	Input signal amplitude, Vppk	Output signal amplitude, (m)Vppk	Transfer function magnitude	**Expected** transfer function magnitude	Transfer function magnitude, in dB	**Expected** transfer function magnitude, in dB
1 MHz	10.3	1.21	0.117	0.190	-18.6	-16.226
500 kHz	10.3	3.02	0.293	0.299	-10.7	-10.498
100 kHz	10.3	8.8	0.854	0.848	-1.37	-1.427
50 kHz	10.1	9.6	0.900	0.961	-0.461	-0.335
10 kHz	10.1	10.1	1	0.995	0	-0.0410
1 kHz	103	4.2	0.408	0.527	-7.79	-5.570
500 Hz	10.7	2.33	0.218	0.295	-13.2	-10.602

IV) Band-reject Filter

Frequency	Input signal amplitude, Vppk	Output signal amplitude, (m)Vppk	Transfer function magnitude	**Expected** transfer function magnitude	Transfer function magnitude, in dB	**Expected** transfer function magnitude, in dB
1 MHz	10.3	10.3	1	0.988	0	-0.105
500 kHz	10.3	9.8	0.951	0.9544	-0.432	-0.406
300 kHz	10.3	9.0	0.874	0.886	-1.172	-1.048
200 kHz	10.3	8.0	0.777	0.786	-2.195	-2.091
100 kHz	10.3	5.1	0.495	0.529	-6.105	-5.528
50 kHz	10.1	2.49	0.246	0.02763	-12.162	-11.172
10 kHz	10.1	1.67	0.165	0.0976	-15.632	-20.209
5 kHz	10.3	4.0	0.388	0.280	-8.216	-11.040
1 kHz	10.5	9.8	0.933	0.850	-0.599	-1.410
500 Hz	10.7	10.5	0.981	0.955	-0.166	-0.396

Theoretically find the corresponding frequency when the output signal amplitude reaches its minimal value and fill in the following table:

V) Band-reject Filter (Not Strictly Required)

Frequency	Input signal amplitude, Vppk	Output signal amplitude, (m)Vppk	Transfer function magnitude	**Expected** transfer function magnitude	Transfer function magnitude, in dB	**Expected** transfer function magnitude, in dB
Critical:						