Frequency Response Measurements
Laboratory IV

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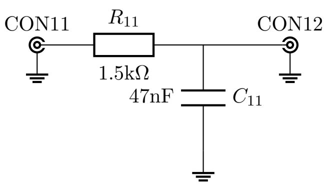
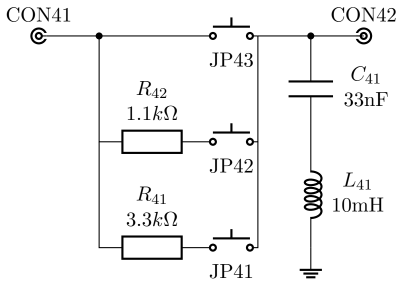
1 Goal of the exercise

2 Frequency response

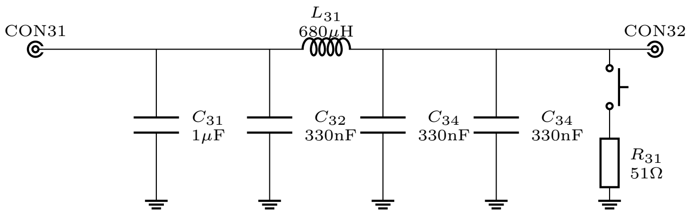
3 Course of measurements



(a) RC low-pass filter



(b) Resonant RLC circuit



(c) III-order low-pass filter

Figure 1: Measured circuits

4 Data processing

Source code for this section can be found in Appendix A

First step in finding amplitude-frequency characteristics was calculating gain in Volts

$$\text{Voltage gain [V]} = \frac{V_{\text{CON2}}}{V_{\text{CON1}}} \tag{1}$$

then we calculated voltage gain in decibels

$$\text{Voltage gain [dB]} = 20\log_{10}(V_{\text{gain}}) \tag{2}$$

Voltage gain is on the left plot in figure 2, vertical blue axis represents scale in volts and orange axis decibel scale.

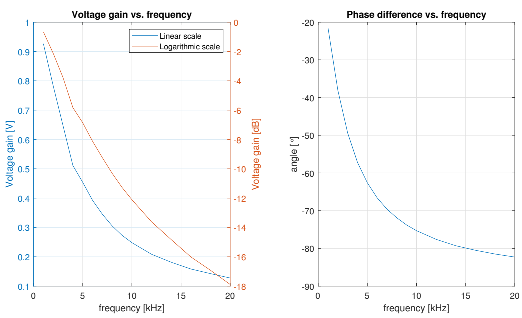


Figure 2: Example

Phase-frequency characteristics didn't require any calculation and is simply plotted on the right plot in figure 2.

5 Characteristics analysis

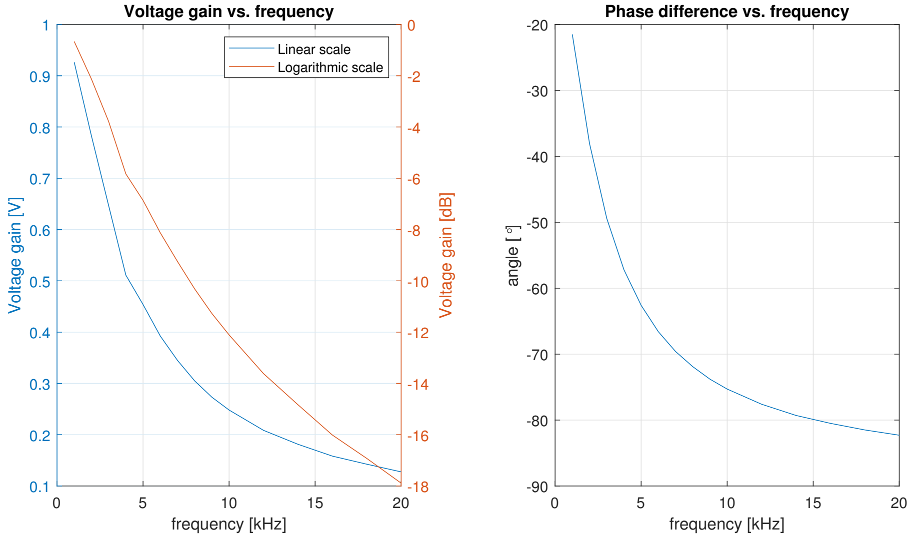


Figure 3: Frequency response of RC low-pass filter

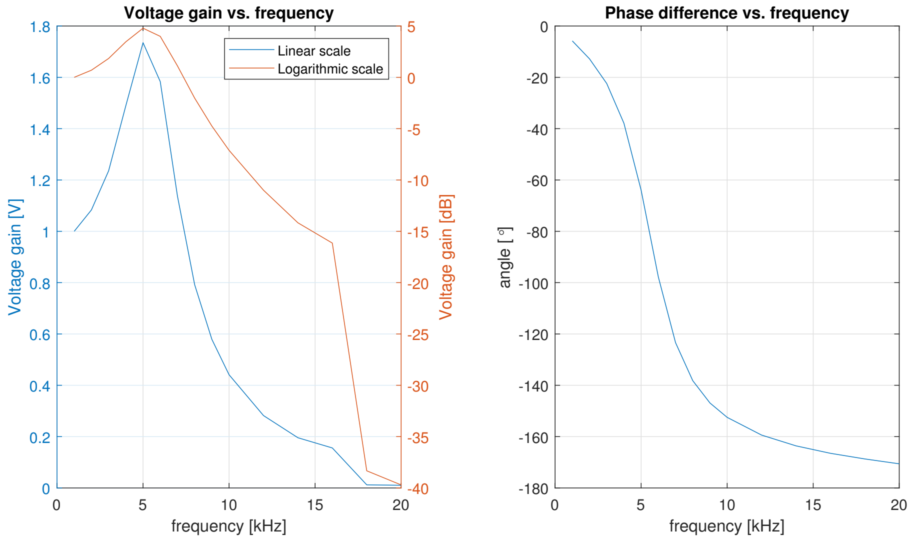
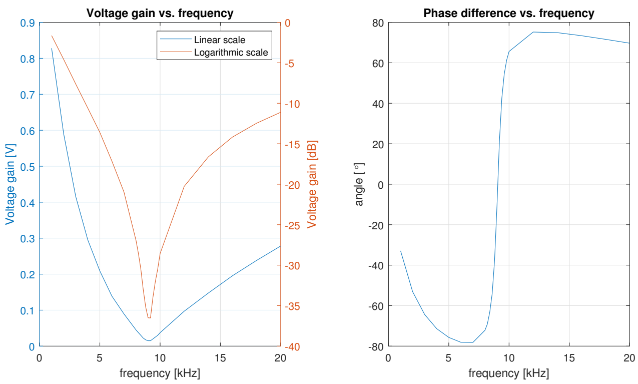
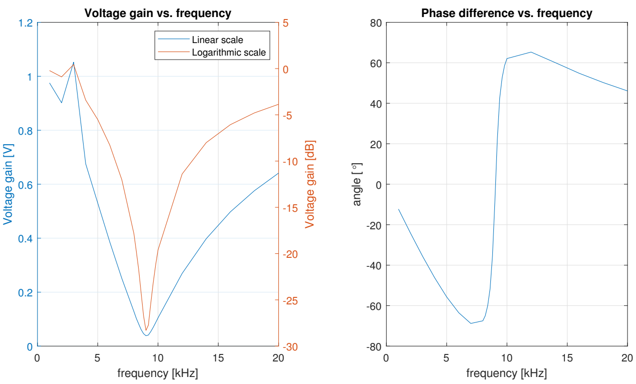


Figure 4: Frequency response of III-order low-pass filter



(a) with JP41



(b) with JP42

Figure 5: Frequency response of Resonant RLC circuit

6 Conclusions

A Appendix

GITHUB repository

```
clear all; close all; clc;

[frequency1_1, CH1_11, CH2_11, anglediff_11] = import_csv('../csv/11.csv');
[frequency1_2, CH1_12, CH2_12, anglediff_12] = import_csv('../csv/12.csv');
[frequency_131, CH1_131, CH2_131, anglediff_131] = import_csv('../csv/131.csv');
[frequency_132, CH1_132, CH2_132, anglediff_132] = import_csv('../csv/132.csv');
characteristics(frequency1_1, CH1_11, CH2_11, anglediff_11, '11', '11');
characteristics(frequency1_2, CH1_12, CH2_12, anglediff_12, '12', '12');
characteristics(frequency_131, CH1_131, CH2_131, anglediff_131, '131', '131');
characteristics(frequency_132, CH1_132, CH2_132, anglediff_132, '132', '132');

% close all;

function [frequency, CH1, CH2, anglediff] = import_csv(file)
CSV = readtable(file, VariableNamingRule="preserve");
N = size(CSV,1);
frequency = table2array(CSV(1:N,1));
CH1 = table2array(CSV(1:N,2));
CH2 = table2array(CSV(1:N,3));
anglediff = table2array(CSV(1:N,4));
end

function [] = characteristics(frequency, CH1, CH2, anglediff, name, filename)
fig = figure('Name', name);
fig.Position(3:4) = [1000 500];
H = CH2 ./ CH1;
%% plot 1 linear V gain
% subplot(1, 3, 1);
subplot(1, 2, 1);
% semilogx(frequency, H);
yyaxis left;
plot(frequency, H);
title('Voltage gain vs. frequency')
% subtitle('linear scale')
xlabel('frequency [kHz]')
ylabel('Voltage gain [V]')
grid on;
%% plot 2 log V gain
% subplot(1, 3, 2);
% semilogx(frequency, 20 * log10(H));
yyaxis right;
plot(frequency, 20 * log10(H));
% title('Voltage gain vs. frequency')
% subtitle('logarithmic scale')
% xlabel('frequency [kHz]')
ylabel('Voltage gain [dB]')
legend('Linear scale', 'Logarithmic scale');
grid on;
%% plot 3 phase diff
subplot(1, 2, 2);
% semilogx(frequency, anglediff);
```

```
plot(frequency, anglediff);
title('Phase difference vs. frequency')
xlabel('frequency [kHz]')
ylabel('angle [\circ]')
grid on;
print(join(['img/',filename]), '-depsc');
end
```