Experiment 43

Sunday, April 9, 2023 11:33 AM

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Objectives:
1. Demonstrate an active bandpass filter.
2. Plot the frequency response of an active bandpass filter and determine the Q.

Pre-Lab:

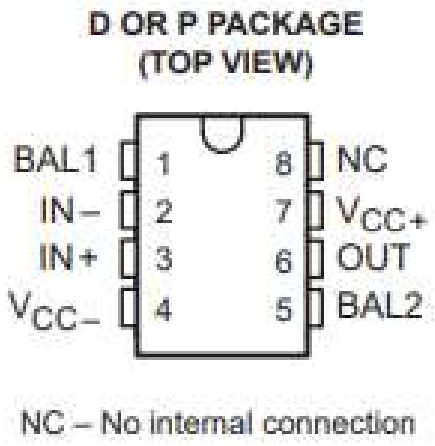

Figure 1 (LF411 Op Amp diagram)

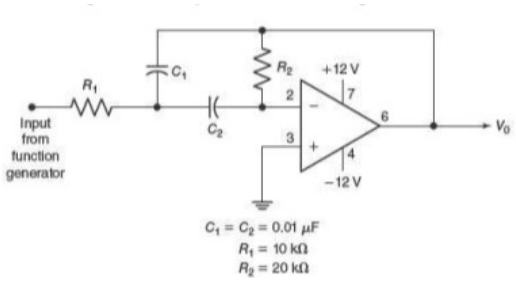

Figure 2 (Active Bandpass Filter Circuit Schematic)

Formulas:
Center Frequency:

$$f_c = \frac{1}{2\pi\sqrt{R_1 R_2 C_1 C_2}}$$

$$Q = 0.5\sqrt{R_2/R_1}$$

Bandwidth:

$$\mathrm{BW} = f_c/Q$$

Voltage Gain:

$$A_v = -R_2/2R_1$$

Note: To find the corner frequencies in a bandpass filter, find the points that are -3 dB from the center frequency

Procedure:
Step 2:

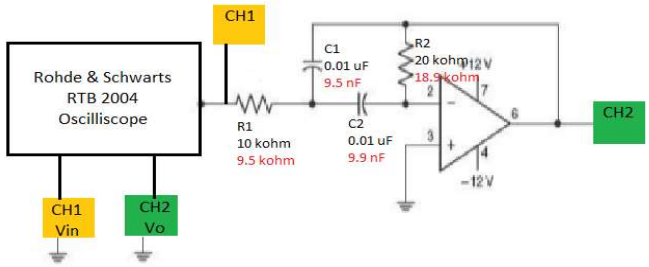

Figure 3 (Active Bandpass Filter Circuit Schematic with real values)

Steps 1, 4-6:

Table 1 (Ideal, Expected and Real Circuit Values)	Center Frequency [kHz]	Bandwidth[kHz]	Q	Av [V/V]	Corner Frequencies [kHz]
Ideal (calculated)	1.13	1.59	0.707	1	N/A
Real (calculated)	1.2	1.74	0.705	0.995	N/A
Real (measured)	1.2	1.39	0.705	0.958	0.707, 2.24

Steps 3-5:

- Center Frequency: 1.2 kHz, -0.37 dB
- Corner Frequencies: 1) 707.95 Hz, -2.58 dB 2) 2.24 kHz, -2.74 dB

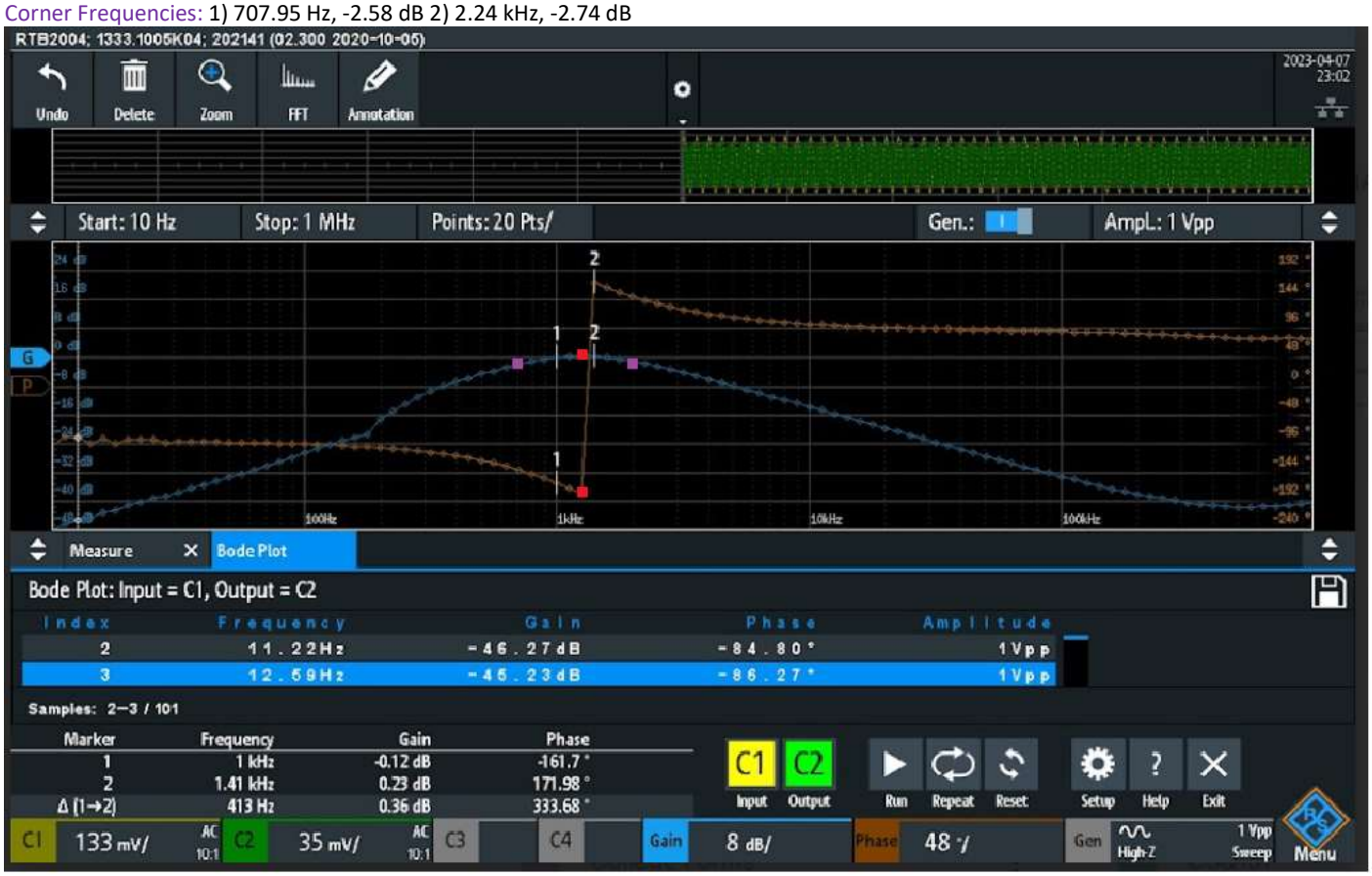

Figure 4 (Bode plot generated from oscilloscope with center and cutoff frequencies marked)

Questions:

1. How can the gain of this circuit be changed?

The gain of the circuit can be changed by altering the value of R1 and/or R2, shown by the formula,

$A_v = -R_2/2R_1$

2. Lowering the capacitor values will have what effect on the center frequency?

Lowering the capacitor values will increase the center frequency

3. How can the bandwidth of the filter be decreased?

The bandwidth of the filter can be decreased by increasing the value of R2 (larger Q/smaller fc) or by increasing the value of the capacitors (smaller fc)