Experiment 27

Monday, April 17, 2023 2:54 PM

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Pre-Lab:

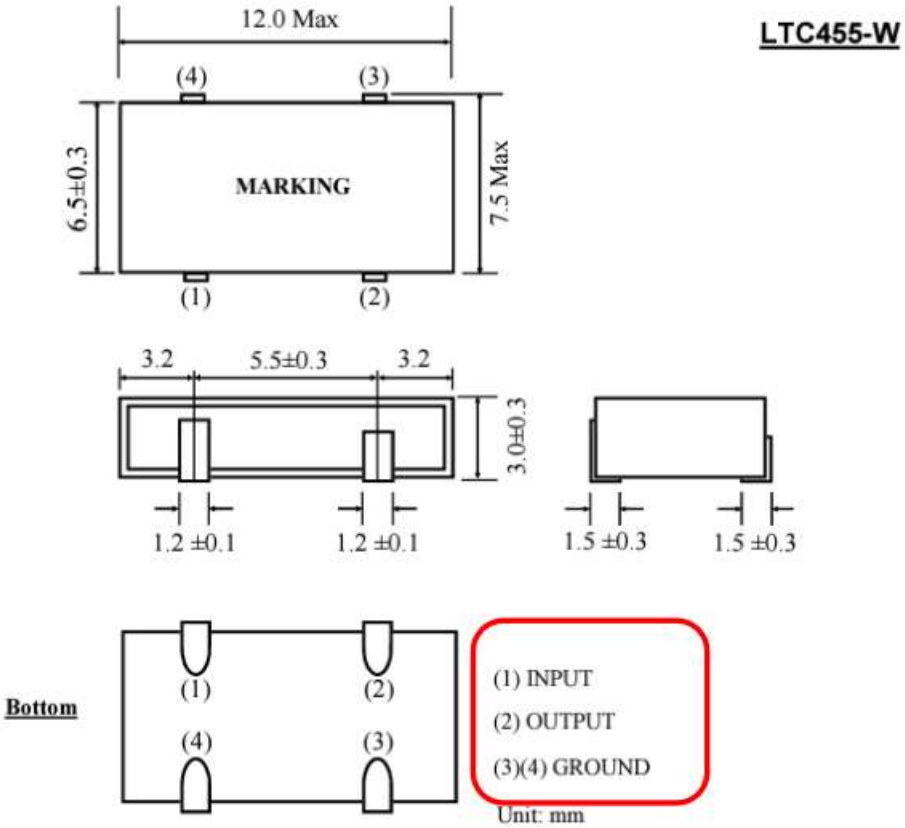

Figure 1: Schematic of ceramic filter

Ceramic Filter Specifications:
- Digikey Part No. LTC455FW
- Center Frequency = 455 ± 1.5 kHz
- Bandwidth = 8 kHz
- Max passband ripple = 2 dB
- Input / Output Impedance = 1.5 kΩ
- 4 lead surface mount device (SMD)

Procedure:

Step 1:

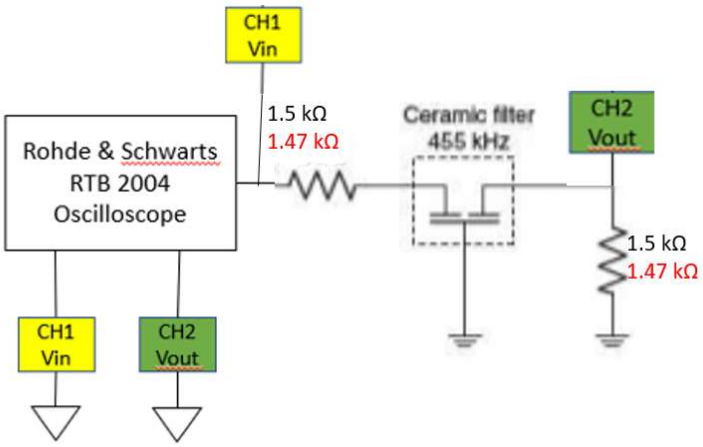

Figure 2: Circuit schematic of ceramic bandpass filter

Step 2-4:

Table 1: Manual frequency sweep of Figure 2

Frequency [Hz]	Vin [Vpp]	Vo [mVpp]	Gain [V/V]	Gain [dB]
100 k	2	14	0.007	-43.1
200 k	2	15	0.0075	-42.5
447.5 k	2	625	0.3125	-10.1
459 k	2	930	0.465	-6.7
463.5 k	2	615	0.3075	-10.2
636.9 k	2	140	0.07	-23.1
800 k	2	30	0.015	-36.5
1 M	2	30	0.015	-36.5

Figure 3: Oscilloscope screenshot of Figure 2 at the center frequency of 459 kHz where Vin = 2 Vpp (CH

1) and Vo = 930 mVpp (CH2)

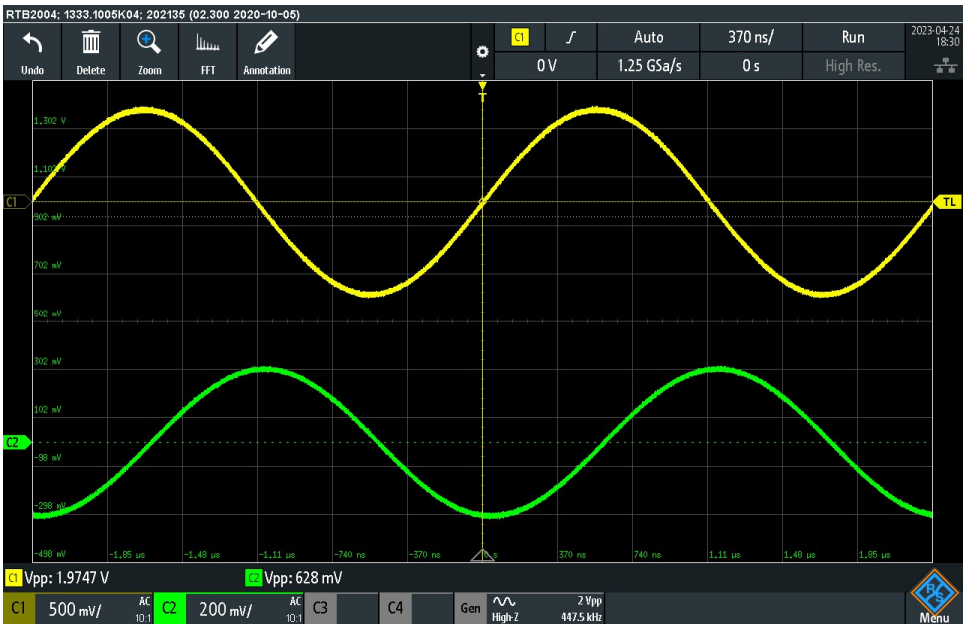

Figure 4: Oscilloscope screenshot of Figure 2 at the corner frequency of 447.5 kHz where Vin = 2 Vpp (CH 1) and Vo = 630 mVpp (CH2)

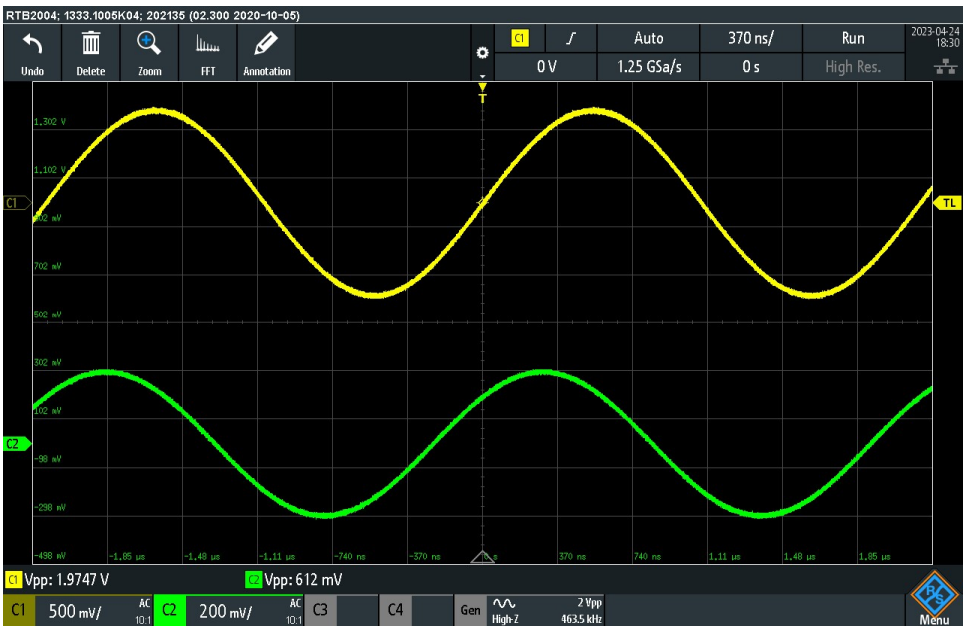

Figure 5: Oscilloscope screenshot of Figure 2 at the corner frequency of 463.5 kHz where Vin = 2 Vpp (CH 1) and Vo = 615 mVpp (CH2)

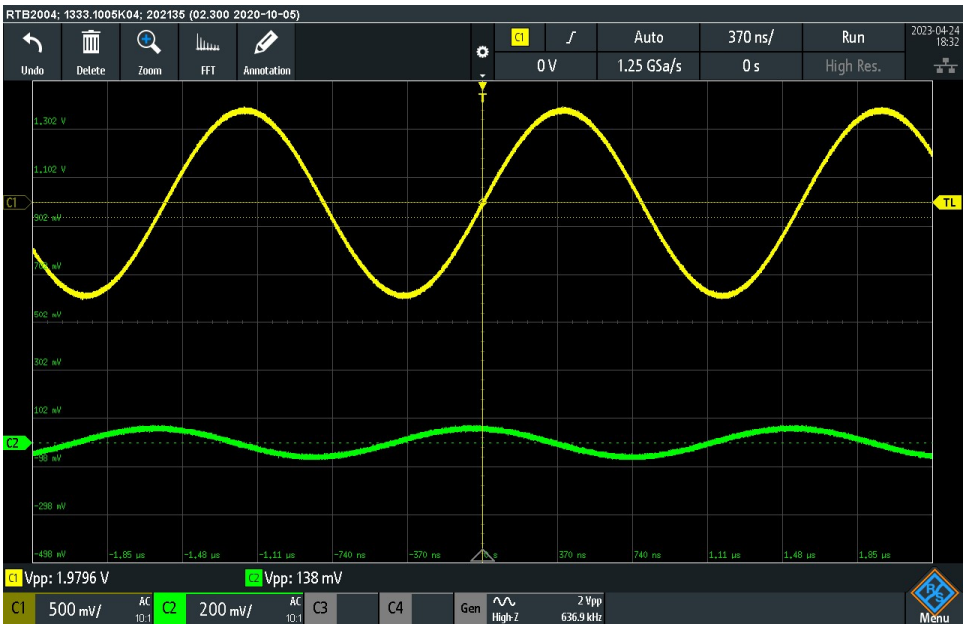

Figure 6: Oscilloscope screenshot of Figure 2 at secondary peak gain frequency of 636.9 kHz where Vin = 2 Vpp and Vo = 140 mVpp

Figure 7: Frequency sweep of Figure 2 from 100 kHz to 1 MHz at 2 Vpp

In Figure 7 above, the blue plot represents the gain in decibels and the orange plot represents the phase in degrees. The abnormal spike in gain after the center frequency between 595 kHz and 638 kHz

Step 5:

How fast the output changes at the center frequency:

Just within 10 kHz, the output voltage at CH2 goes from 930 mVpp to 30 mVpp on either side of the center frequency

Step 6-7:

Table 2: Frequency analysis data of Figure 2

Center Frequency [kHz]	Corner Frequency 1 [kHz]	Corner Frequency 2 [kHz]	Bandwidth [kHz]
459	447.5	463.5	16

Compared to the ceramic filters specifications which show the bandwidth of the filter is 8 kHz, the measured bandwidth is 16 kHz which is two times the expected bandwidth.

Questions:

1. Does the filter have gain or attenuation? How much?
   - Attenuation is the damping of a signal while gain is the amplification of a signal. By looking at the AC sweep of the circuit in Figure 7, the ceramic filter has attenuation. The peak attenuation of this filter is -43.1 dB and a minimum attenuation of -6.7 dB