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Laboratory 5:
Analogue Filter Design

Part 1:Experimental equipment and devices

1. A signal generator
2. Oscilloscope
3. Breadboard (bring your own one)
4. Resistors and capacitors
5. LM741

Part 2:Experimental content

I construct two circuits to implement and analyze two analogue low pass filters.

Part 3:Experimental procedure and results

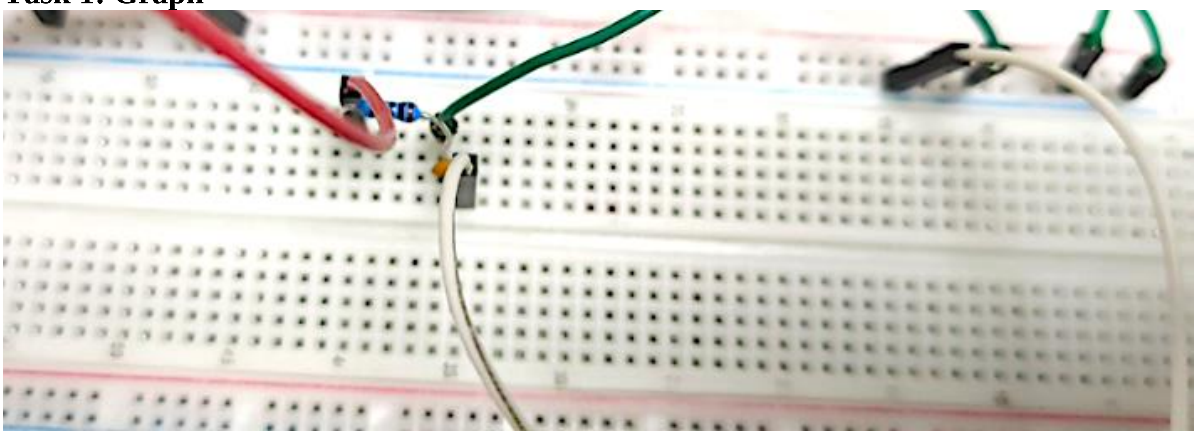
Task 1

(1) Procedure

I build the circuit and check the Vout and Vin. I increase the frequency to 100 kHz from 0.1 kHz. Then add up the numbers and form a conclusion.

(2)Results

Task 1: Graph

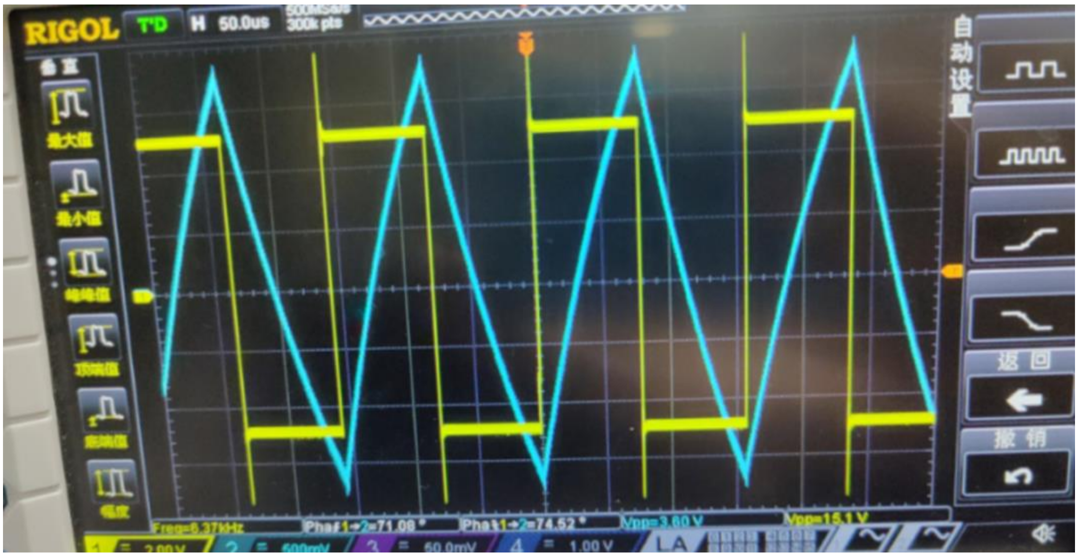


Task 2:Explain why fc is called 3dB cutoff frequency.

Because the Vpp becomes ($\frac{\sqrt{2}}{2}$) times the original Vpp when I change the frequency to fc. As a result, I refer to the frequency as fc 3dB cutoff frequency.

Task 3:

Input(KHz)	*Vin(V)*	*Vout(V)*	*Vout/vin*	*20log10(Vout/Vin)*	*phase*
0.1	*10.2*	*10*	*0.980432*	*-0.1720035*	*-2.29°*
1	*10.2*	*8.10*	*0.792123*	*-2.023772*	*-36.3°*
10	*10.2*	*1.62*	*0.156842*	*-16.089608*	*-78.20°*
100	*10.2*	*0.23*	*0.023429*	*-32.56776*	*-90.0°*
1.59	*10.2*	*6.84*	*0.670582*	*-3.4708811*	*-44.73°*



Task 4:

As I change the sine signal to square wave, and f=4fc, I get the output which meets our expectation

Task 5:

As I change the sine signal to triangle wave, and f=4fc, I get the output which meets our expectation with just small error.

Comment:

As I increase the frequency of input, the Gain decreases, and 20log10(Vout/Vin) decreases at the same time. The phase difference between output and input voltage shrinks as well.

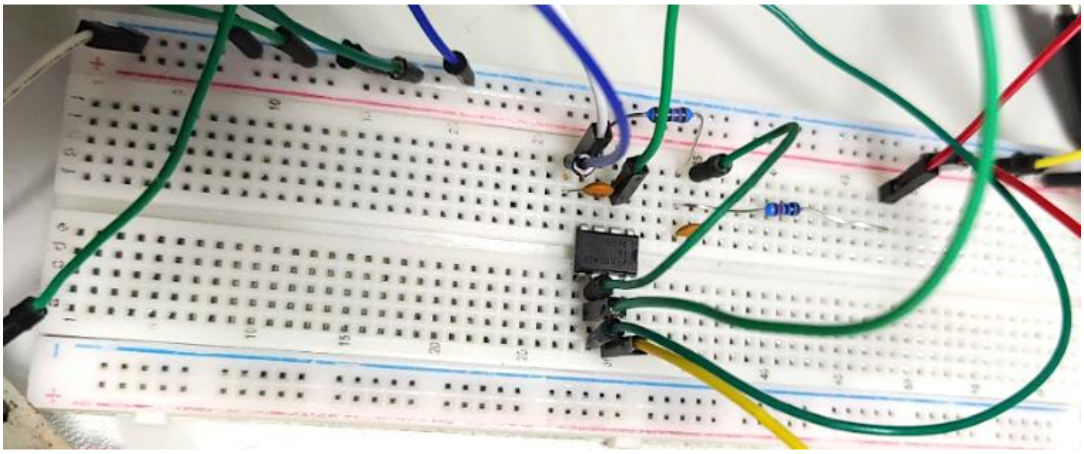
Part2

(1) Procedure

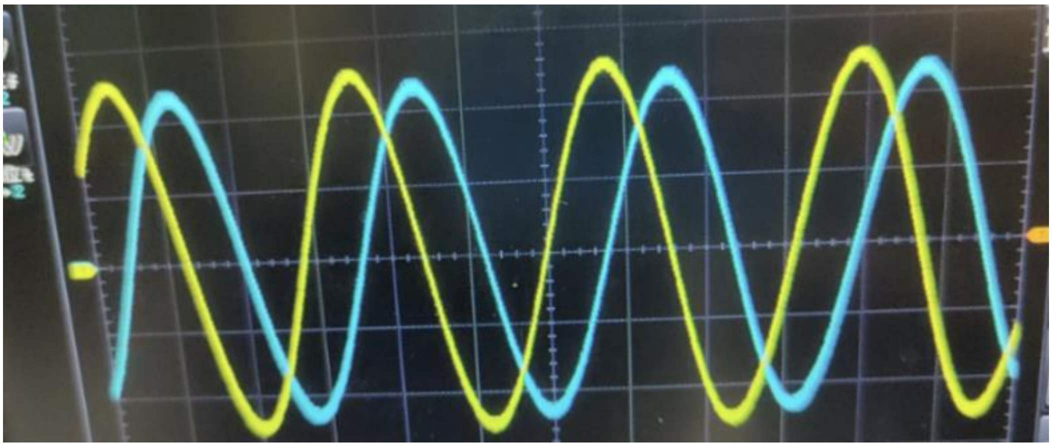
I construct the circuit, and measure the Vout and Vin. I change the frequency from 0.1Khz to 100Khz. Then calculate the data and draw the conclusion.

(2)Results

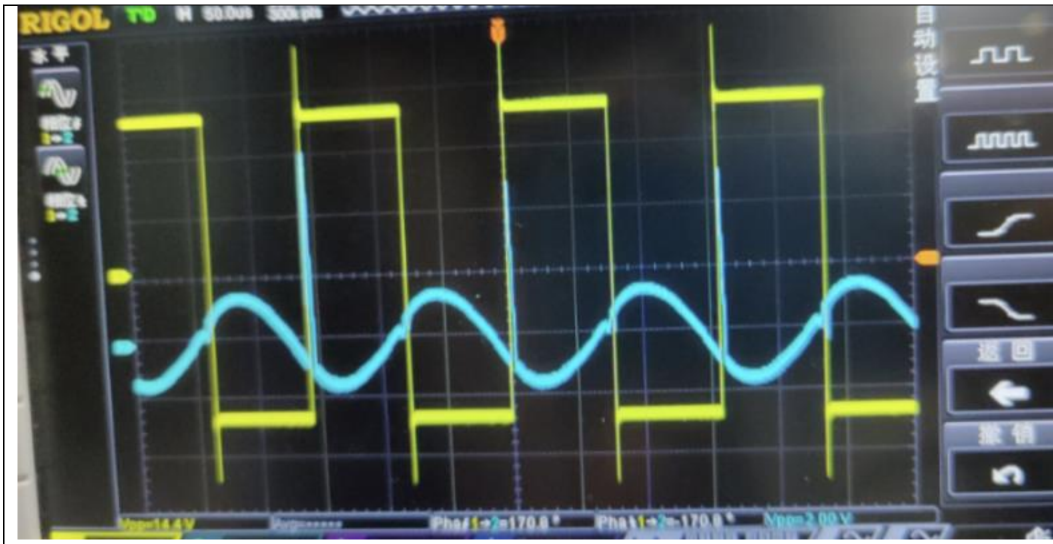
Task 6:



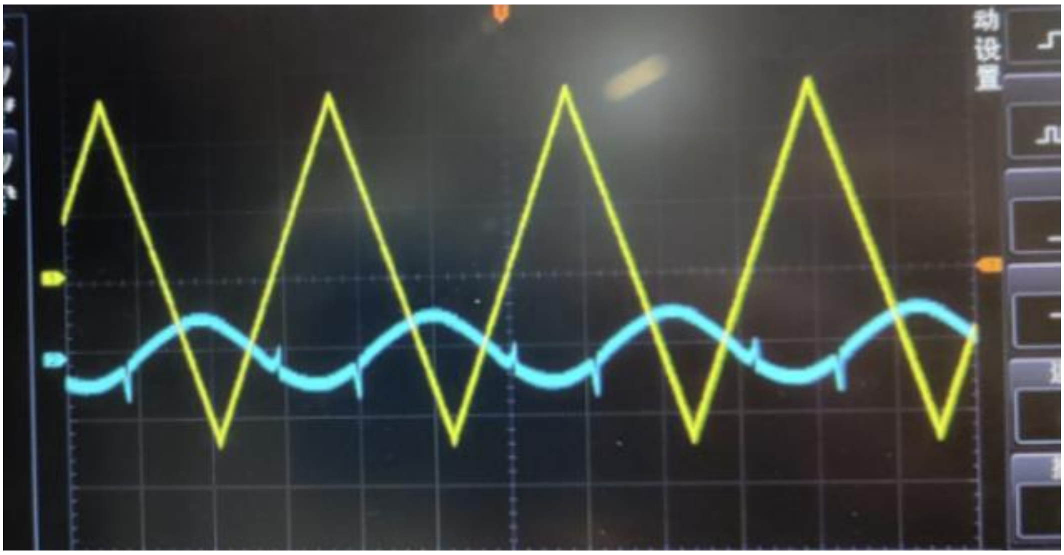
Task 7:



input	*vin*	*vout*	*vout/vin*	*20log10(vout/vin)*	*phase*
0.1	*10.2*	*10.2*	*1*	*0*	*7.21°*
1	*10.2*	*6.88*	*0.67451*	*-3.420234671*	*66.23°*
10	*10.2*	*0.6*	*0.058824*	*-24.60897843*	*190°*
100	*10.2*	*2.23*	*0.218627*	*-13.20590617*	*280°*
1.5915	*10.2*	*4.68*	*0.458824*	*-6.767086374*	*88.3°*



As I change the sine signal to square wave, and f=4fc, I get the output which meets our expectation



As I change the sine signal to square wave, and f=4fc, I get the output which meets our expectation with just small error

Comment:

As I increase the frequency of input, the Gain decreases, and 20log10(Vout/Vin) decreases at the same time. The phase difference between output and input voltage shrinks as well. However, if I increase the frequency too much, the output will not satisfy our expectations, and the data would be useless.

Part 4: Summary

In lab 5, To create and analyze two analogue low pass filters, I built two circuits.

I now have a better grasp of low pass filters and am more knowledgeable about their qualities as a result of this lab.

That's all, thank you for your patient examination!

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