Circuit Library #2
Bandpass filter

Basic Information

Designer	林映君(電機 28)	Revision	1.0
Status	Tested	Date	2026/01/22
Summary	Two Multiple feedback bandpass filters with a dual-potentiometer to adjust the resonant frequency.		

Design Idea

The multiple-feedback topology is widely used as a second order bandpass filter., enabling it to pass only a narrow range of frequencies. By adjusting the value of resistors and capacitors, the resonant frequency can be tuned accordingly.

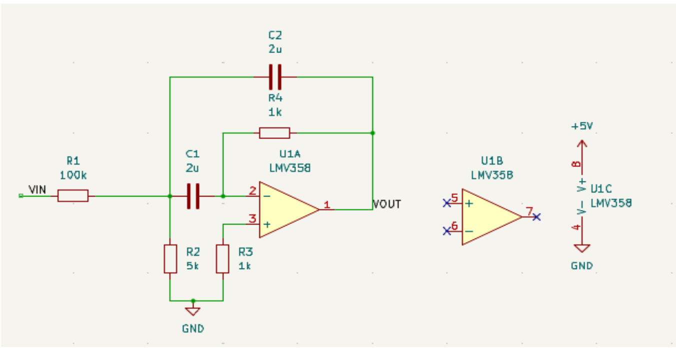


Figure 1: Typical multiple-feedback bandpass filter.

In this design, only one resistor is adjustable in each bandpass filter, simplifying frequency tuning. Furthermore, by cascading two bandpass filters, unwanted frequencies can be cut off more effectively, result in a sharper frequency response.

Schematic

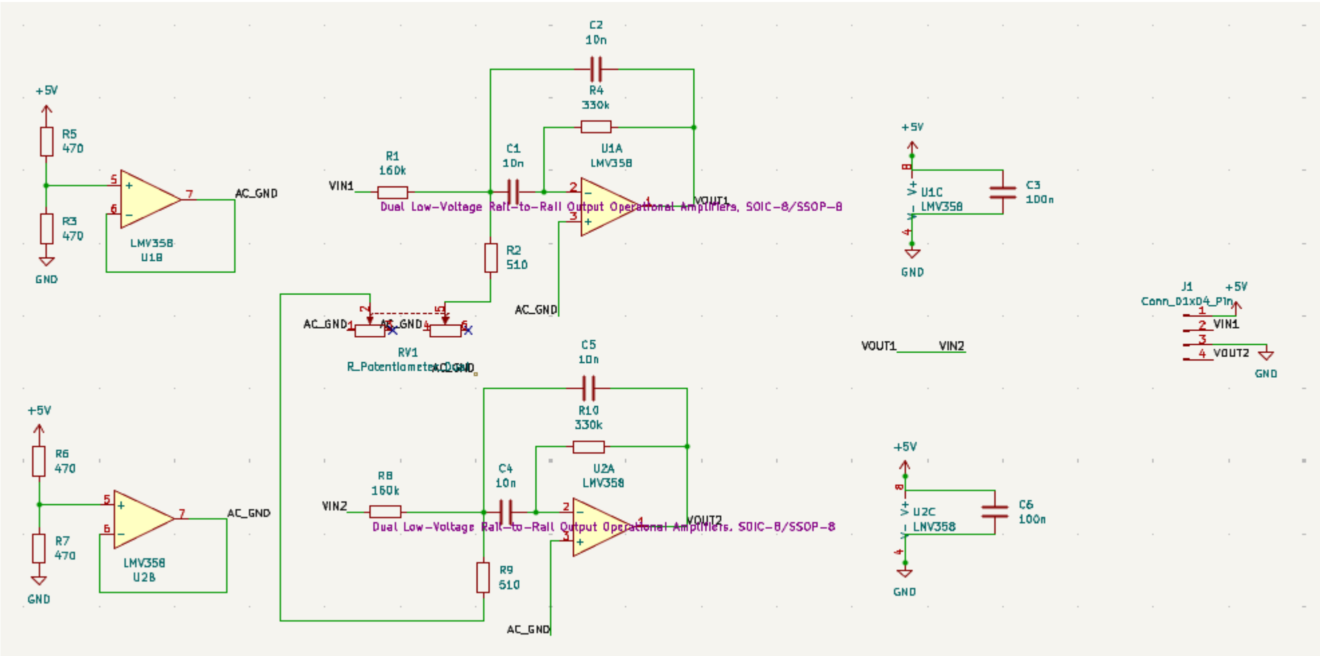
A voltage divider is use to generate a 2.5V AC ground, which is connected to the non-inverting (+) input of the operational amplifier, since the op-amp operates from a single 0–5 V supply.

The two bandpass filters are connected in series, with VIN1 serving as the external input and VOUT2 as the external output.

A A100k dual-potentiometer replaces R3 in Figure 1, so that the resonant frequency can be adjusted. Experimental observations show that rotating the potentiometer fully to the left leads to unpredictible behavior. Therefore, R2 and R9 are set to the minimum resistance values that can still produce a valid bandpass response.

C3 and C6 function as decoupling capacitors to improve circuit stability.

Figure 2: Schematic of the designed multiple-feedback bandpass filter.



Simulation Results

The simulation aims to determine an appropriate potentiometer value. The target frequency range is 100 Hz to 1000 Hz; therefore, both R2 and R9 in Figure 3 are adjusted to evaluate the resulting frequency response.

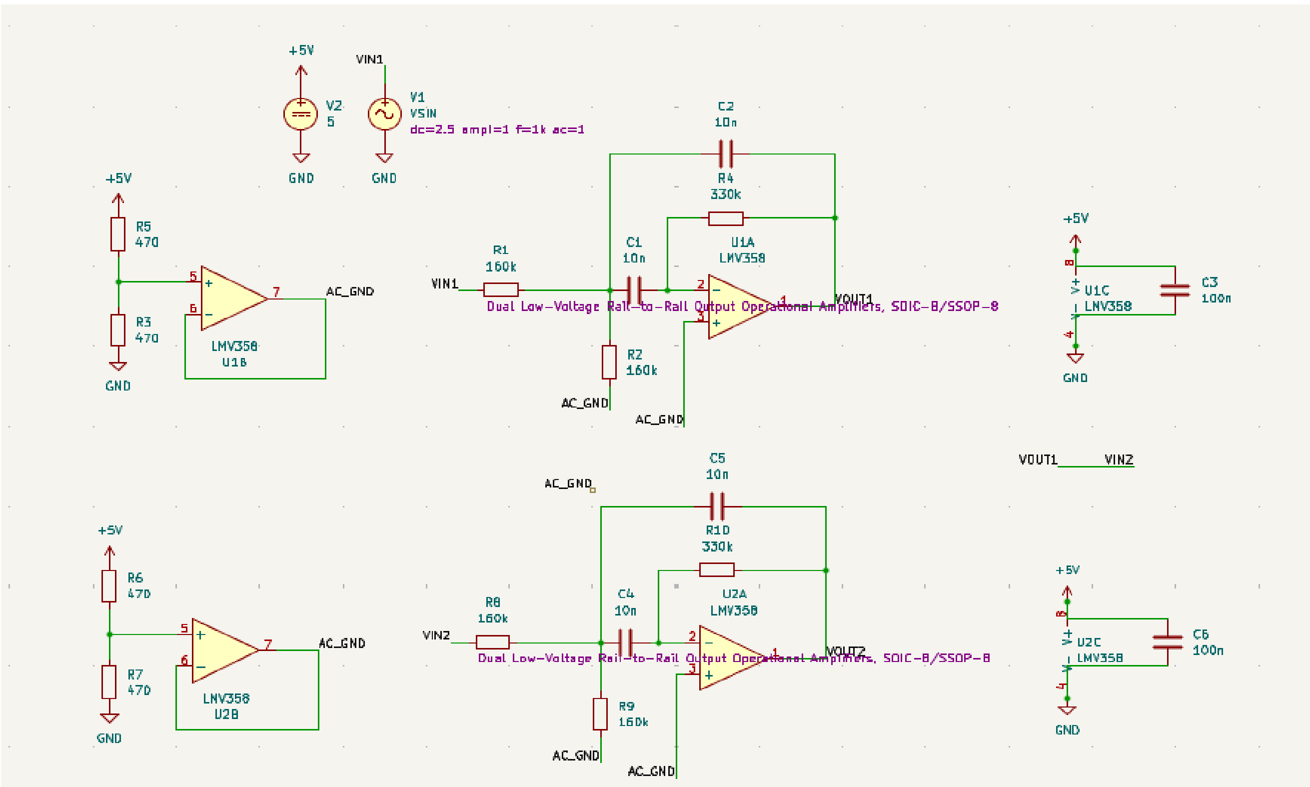
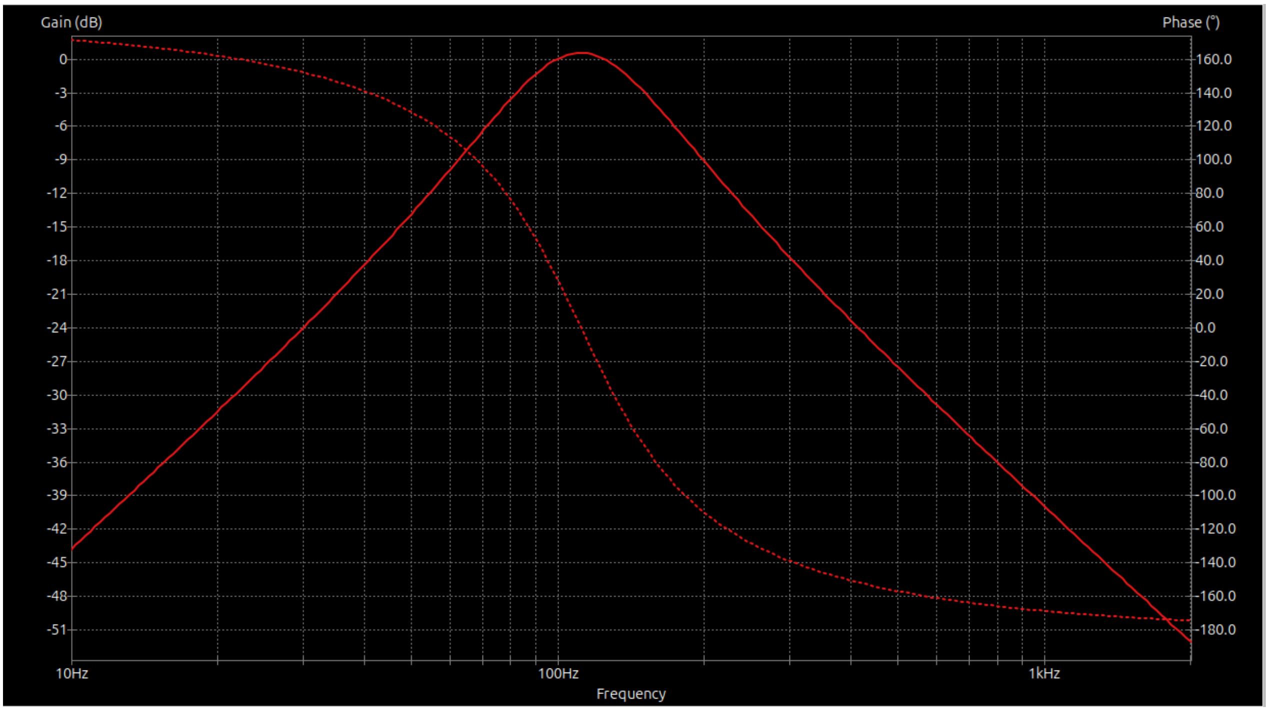


Figure 3: Schematic of the simulation

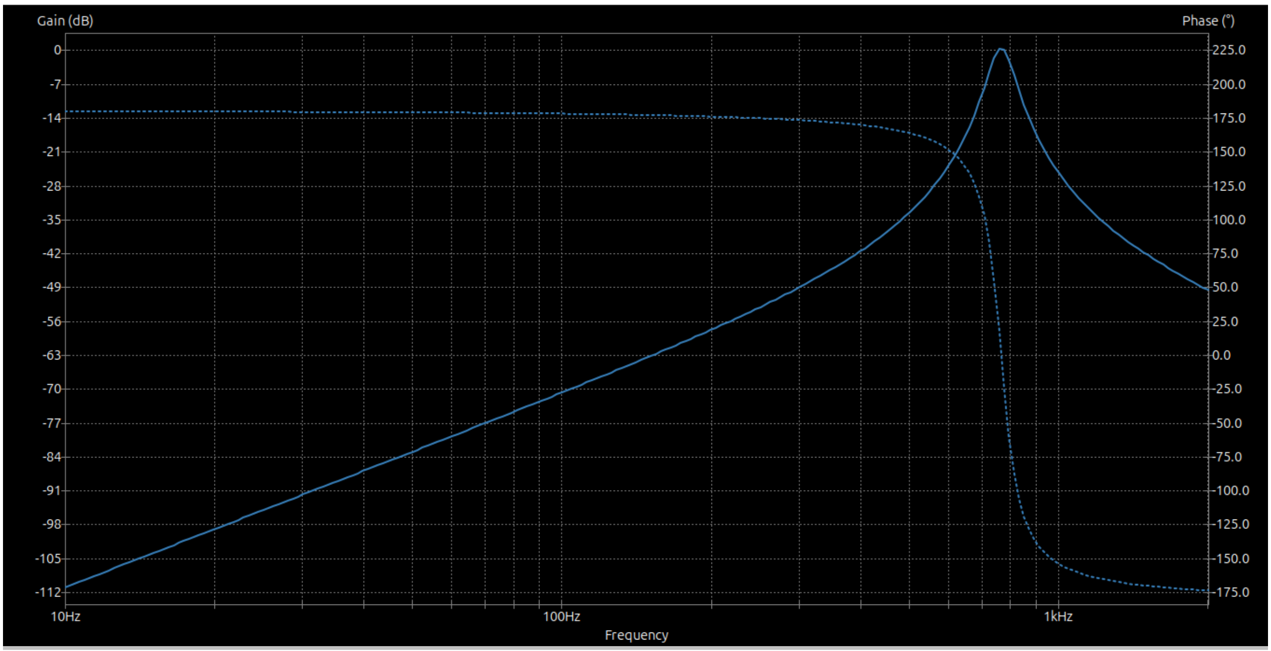
During testing, setting the value of R2 and R9 to 160k will results in a resonant frequency at 100hz.

Figure 4: Bode plot of the bandpass filter test results with a resonant frequency of 100 Hz.



Furthermore, setting the value of R2 and R9 to 1250 results in a resonant frequency at 1000hz. Therefore, selecting a A100k potentiometer is a proper choice.

Figure 5: Bode plot of the bandpass filter test results with a resonant frequency of 1000 Hz.



References

1. Filter Design and Analysis