

Introduction to Sensors, Measurement and Instrumentation

Lab 6: Blood Pressure

Sparsh Gupta

Olin College of Engineering

March 16, 2023

Circuit Diagram

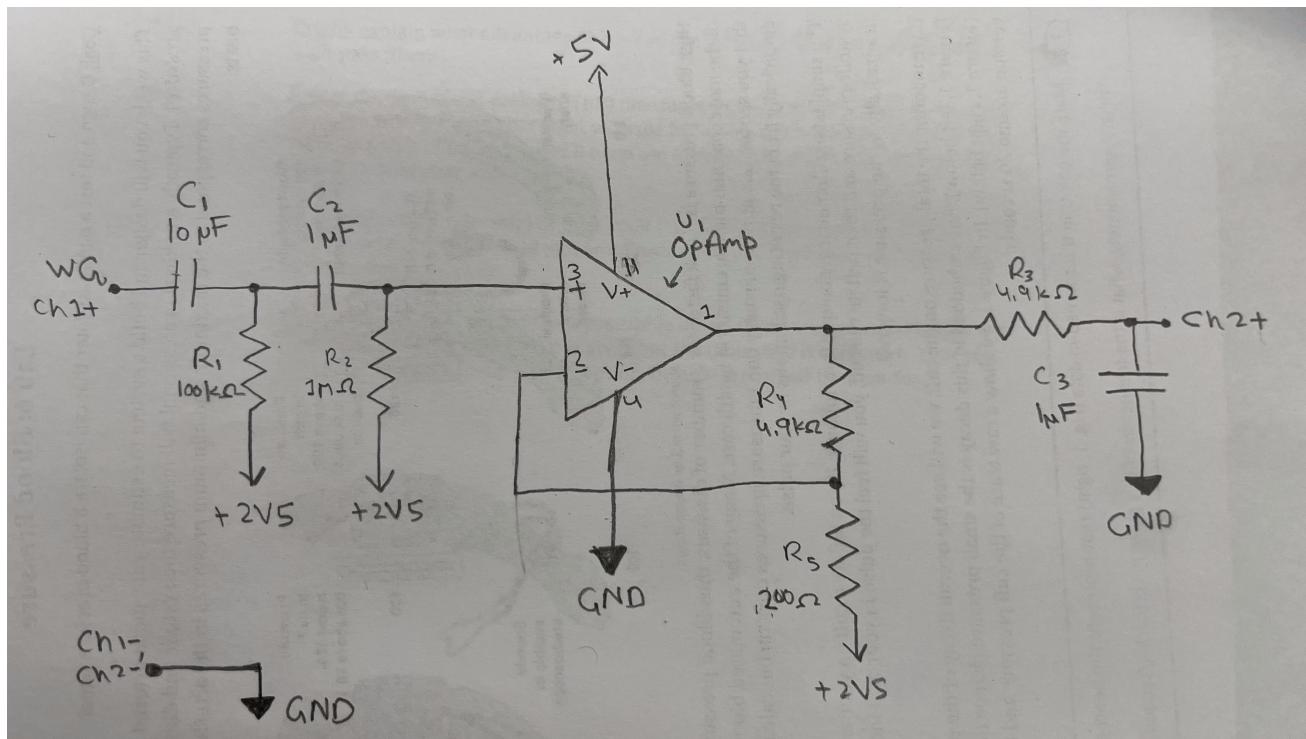


Figure 1: The circuit diagram demonstrates a blood pressure measurement circuit that utilizes an Op-Amp and RC filters.

The values of Resistors and capacitors are as follows:

$$R_1 = 100k\Omega, C_1 = 10\mu F; R_2 = 1M\Omega, C_2 = 1\mu F; R_3 = 4.9k\Omega, C_3 = 1\mu F$$

Circuit Description

The circuit utilizes two high-pass RC filters and one low-pass RC filter.

The cut-off frequencies obtained from the filters are:

- R_1C_1 (high-pass) = 0.15915 Hz
- R_2C_2 (high-pass) = 0.15915 Hz
- R_3C_3 (low-pass) = 32.48 Hz

The amplifier gain of the circuit is 25.

Advantage of 2.5V as the reference

For circuits with wave-gen inputs (time-varying signals), we observe that the output voltage goes below 0V (negative V) if 0V is used as the reference because the op-amp measurement range lies between 0V to +5V and as a result, the negative voltage signal gets clipped.

Therefore, using the middle spot of the op-amp power supply (which is 2.5V here) as the reference input voltage (obtained from the two high-pass filters centered at 2.5V), lets us measure the complete output voltage as the op-amp now gets centered at 2.5V.

This change does not affect the circuit because now there is just a 2.5V offset relative to the ground and we want to measure the difference in voltage, so instead this provides an advantage to us to be able to measure the complete signal.

Blood Pressure Measurement Plot

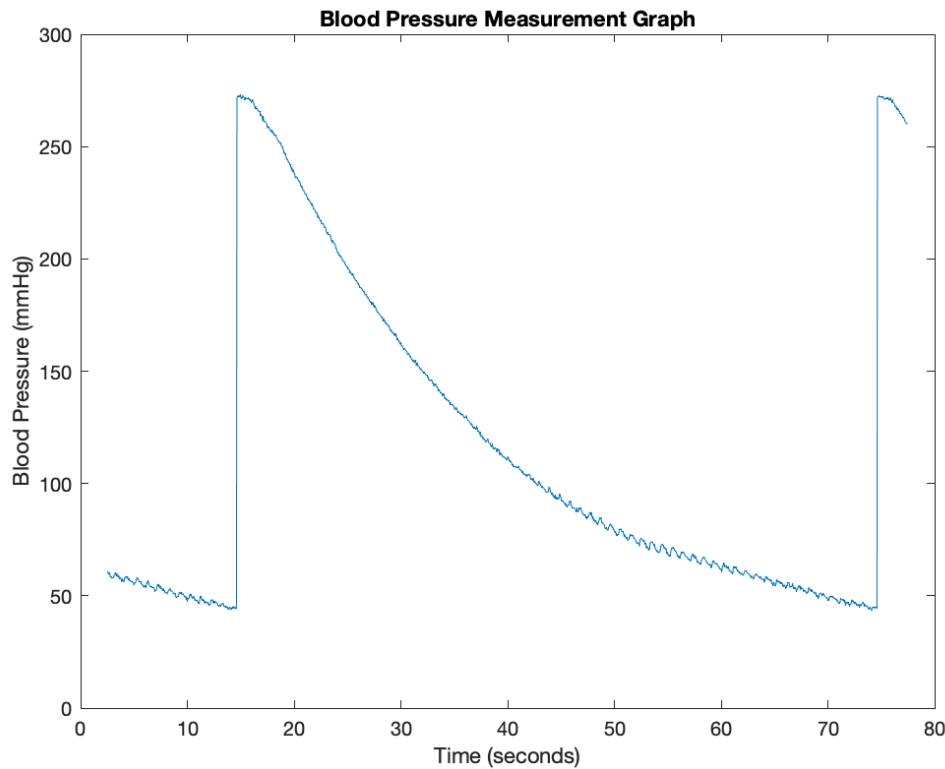


Figure 2: The Blood Pressure Graph (BP(mmHg) vs Time(s)) plots the variation of blood pressure with respect to time. It is created using a transfer function for the sensor to convert the circuit voltage readings (V) to Blood Pressure readings (mmHg).

$$\text{The transfer function is: Blood Pressure (mmHg)} = \frac{\left(\frac{V}{5}\right) - 0.04}{0.018} * \left(\frac{760}{101.325}\right)$$

Bode Plot

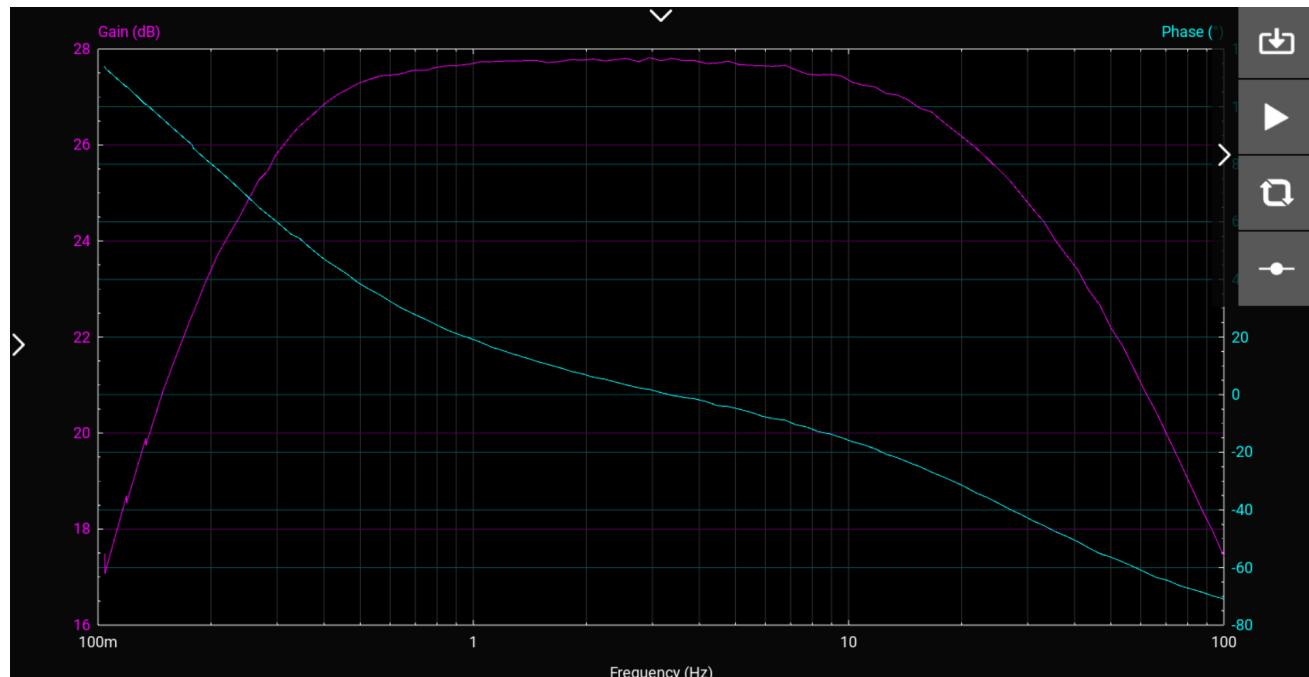


Figure 3: The Bode plot (Gain(dB) vs Frequency (Hz)) for the Bloop Pressure Measurement Circuit to monitor the Amplitude.

The cut-off frequencies are 0.15915 Hz and 32.48 Hz.