

# Ballistocardiograph

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## Abstract

The purpose of this lab is to make use of active filters in the form of band pass and Sallen-Key low pass filters to construct a circuit that filters and amplifies the heartbeat signal from an electric scale.

## 1 Description

In this lab, another pulse measuring circuit was constructed but this time with a electronic scale that could pick up the force of the heart pumping blood throughout the body. This principle of measurement is called ballistocardiograph. The circuit was built in three increments as described in the lab description. It consists of an instrumentation amplifier, two band-pass filters, and a Sallen-Key low pass filter and a non-inverting amplifier. The breadboard setup is shown in Figure 1. There were four wires coming out of the electric scale: one red, one black, one green and one white. The red wire was plugged into +2.5V and the black wire was grounded, and the green and white wires were the signal wires for the BCG circuit. The heartbeat data was taken in the end by standing very still on the scale on a hard surface and recorded with Analog Discovery.

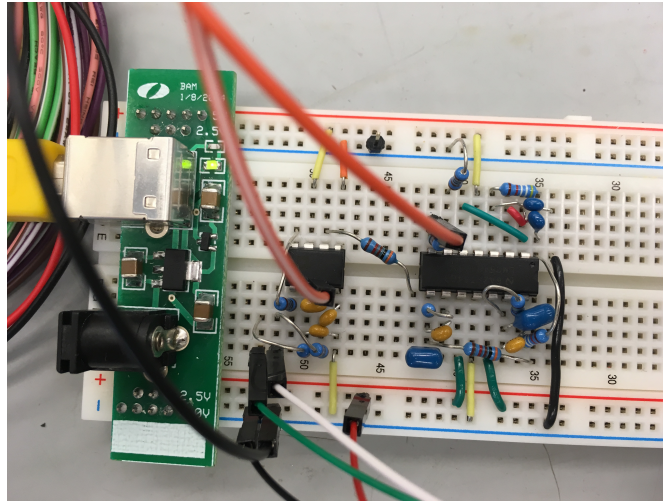
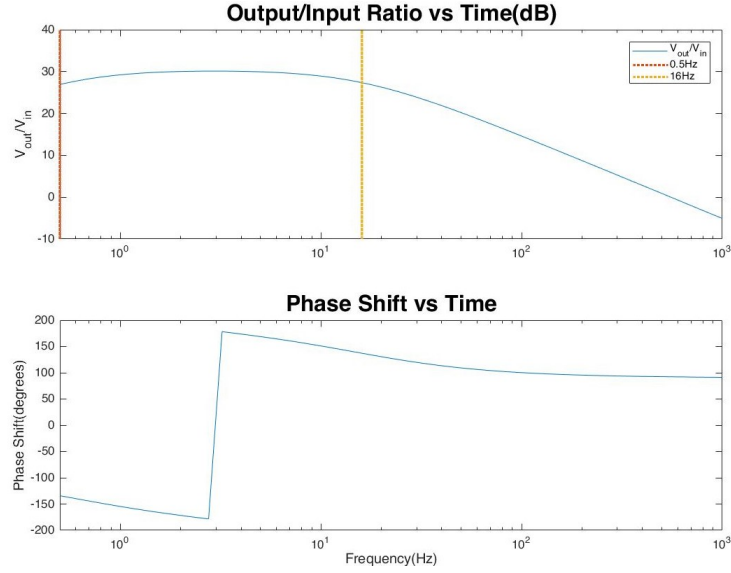


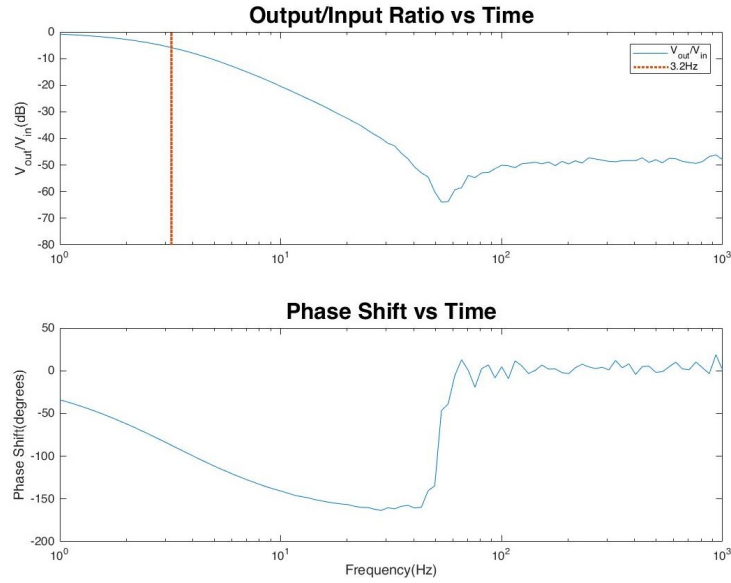
Figure 1: Breadboard Setup.

## 2 Evidence

The second increment in the circuit involves two band pass filters with a low-pass cut-off frequency at around 16Hz and a high-pass cut-off frequency at around 500mHz. The bode plot generated with Analog Discovery Network Analyzer for one of the two band pass filters is shown in Figure2(a). The input was a sinusoidal signal with 2.5V offset and 50mV amplitude.



(a) The band-pass filter



(b) The Sallen-Key low-pass filter

Figure 2: Bode Plots in this lab.

The third increment was a Sallen-Key low-pass filter that could provide a second-order attenuation for high frequencies. The Bode plot of this part of the circuit in isolation is shown in Figure 2(b). Once all the parts of the circuit was put together and functioning(as demonstrated by Waveform's Scope responding to light tabbing on the scale), the scale would be placed on the hard floor.

The author would then step onto the scale, and then the following BCG measurement was taken.

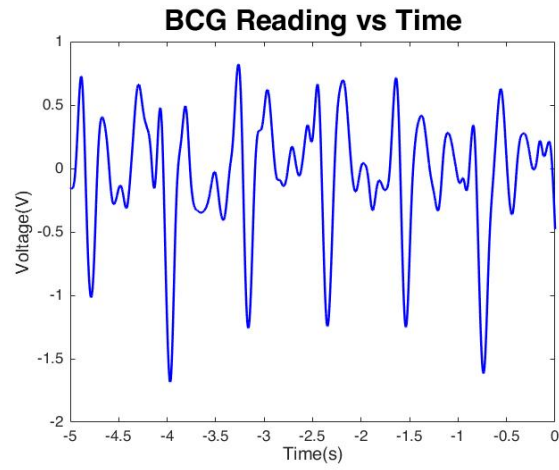


Figure 3: BCG Measurement

### 3 Interpretation

According to the lab description, this lab does not need to contain a section on analysis since the materials weren't covered in class yet.