Design and Implementation of Active band Stop filter

Vignesh S, Karpagam College of Engineering

24th April , 2023

ABSTRACT

This paper presents the design of an active band-stop filter using high-pass and low-pass filters in conjunction with an operational amplifier (op-amp). The band-stop filter is designed to attenuate or eliminate a specific range of frequencies from a signal, while allowing frequencies outside of that range to pass through. The design process involves determining the center frequency of the band-stop filter, selecting appropriate high-pass and low-pass filter types, designing the high-pass and low-pass filters with appropriate cutoff frequencies, connecting them in series with an op-amp, and fine-tuning the component values to achieve the desired filter characteristics. The performance of the band-stop filter is verified using test equipment, and considerations for the op-amp's specifications are taken into account. The designed active band-stop filter can find applications in various fields such as audio processing, telecommunications, and signal conditioning, where the removal of specific frequencies from a signal is required.

CIRCUIT DESIGN

The design of an active band-stop filter using high-pass and low-pass filters with an operational amplifier (op-amp) can be divided into several blocks or stages, each with its specific function. Here's an overview of the different blocks involved:

1. High-Pass Filter: This block is designed to attenuate or block frequencies below the center frequency (f0) of the band-stop filter. It typically consists of passive components (such as resistors and capacitors) or active components (such as op-amps) arranged in a configuration that allows higher frequencies to pass through while attenuating lower frequencies.

2. Low-Pass Filter: This block is designed to attenuate or block frequencies above the center frequency (f0) of the band-stop filter. Similar to the high-pass filter, it can be implemented using passive components or active components in a configuration that allows lower frequencies to pass through while attenuating higher frequencies.

3. Operational Amplifier (Op-Amp): The op-amp is used as an active element in the design, serving as a voltage amplifier and providing gain to the filtered signal. It is typically used to combine the outputs of the high-pass and low-pass filters and provide the final output of the band-stop filter. The op-amp may also require additional passive components, such as resistors and capacitors, to set its gain, bandwidth, and stability.

CALCULATION

The low-pass filter is formed by R_L, C, and the non-inverting input of the op-amp. It attenuates frequencies above the cutoff frequency determined by the R2 and C2 values

Let C=0.1µF
F_L= 1/(2π*R_L*C) =20HZ
R_L=70kΩ

The high-pass filter is formed by R_H, C, and the non-inverting input of the op-amp. It attenuates frequencies below the cutoff frequency determined by the R1 and C1 values.

Let C=0.1µF
F_L= 1/(2π*R_L*C) =200HZ
R_L=8kΩ

bandwidth= **F_H** – **F_L**=800-200 = 180HZ

IMPLEMENTED CIRCUIT

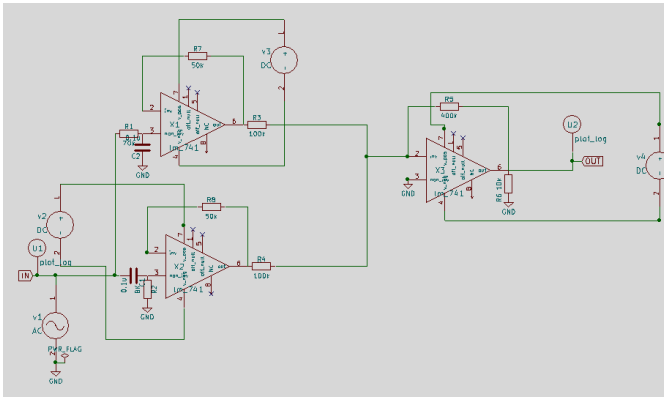
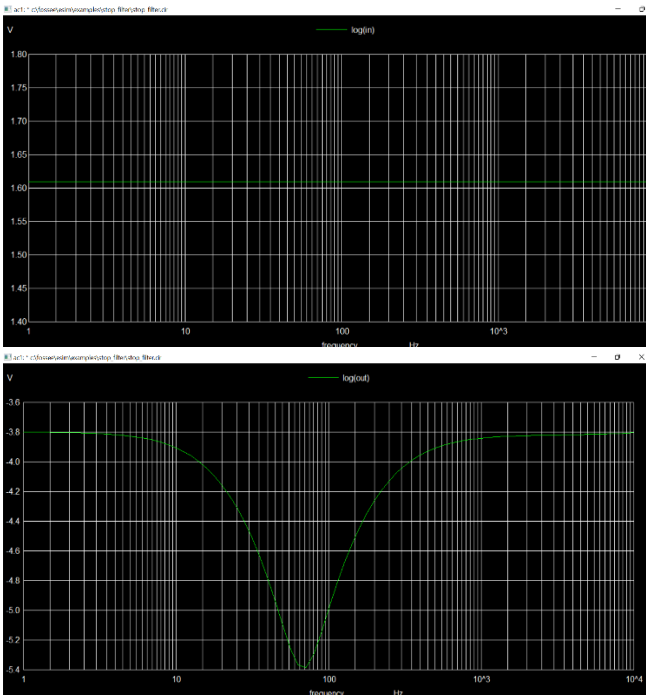


Figure 1: Implemented circuit diagram.

IMPLEMENTED WAVEFORMS



1

REFERENCES

1. Texas Instruments - This application report provides an in-depth overview of active filter design techniques, including band-stop filters, using op-amps. It covers theory, design considerations, and practical implementation examples.

2. "Op Amps: Design, Application, and Troubleshooting" by David Terrell - This book provides a comprehensive overview of op-amps, including their design, applications, and troubleshooting techniques. It covers various types of active filters, including band-stop filters, in detail.

3. "Active Filter Cookbook" by Donald E. Lancaster - This classic book covers the theory and practical design of active filters using op-amps, including band-stop filters. It includes design equations, circuit diagrams, and practical tips for designing active filters for different frequency ranges.

4. "Filter Design Guide" by Analog Devices - This online guide provides detailed information on various types of filters, including active filters, and their design using op-amps. It includes theory, design considerations, and practical implementation examples.