

# DESIGN AND ANALYSIS OF A BUTTERWORTH FILTER CIRCUIT USING eSIM

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## Theory-

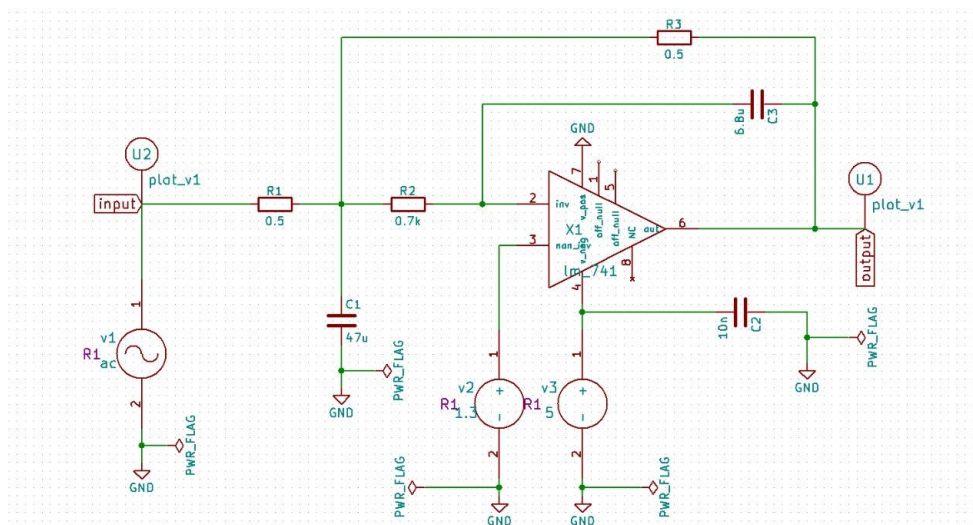
This project explores the design and functionality of a 2nd-order low-pass Butterworth filter. Butterworth filters are widely used in signal processing due to their maximally flat frequency response in the passband, providing minimal attenuation within this range while effectively attenuating frequencies beyond the cutoff. The 2nd-order filter provides a steeper roll-off beyond the cutoff frequency compared to a 1st-order filter, making it suitable for applications requiring sharp attenuation of high-frequency noise.

In an **active 2nd-order low-pass Butterworth filter**, the circuit includes:

- Two resistors and two capacitors for defining the cutoff frequency and controlling the roll-off.
- An **operational amplifier** (op-amp) to provide gain and buffering, ensuring a stronger and more stable output signal.

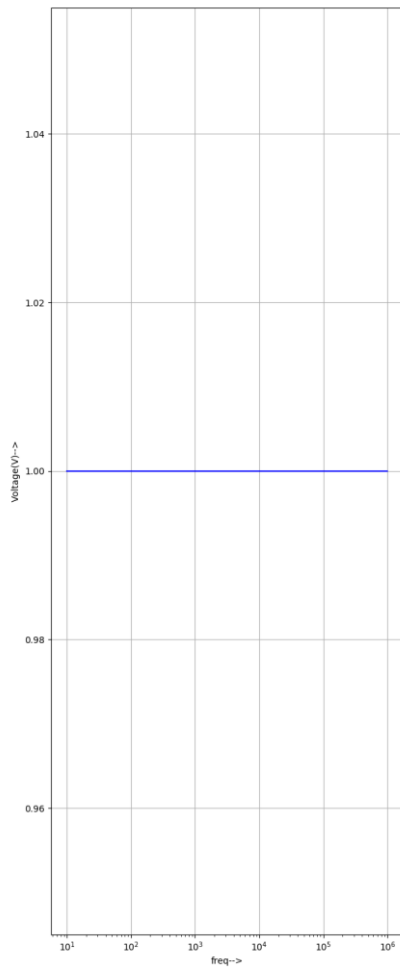
## Circuit diagram –

### Schematic-

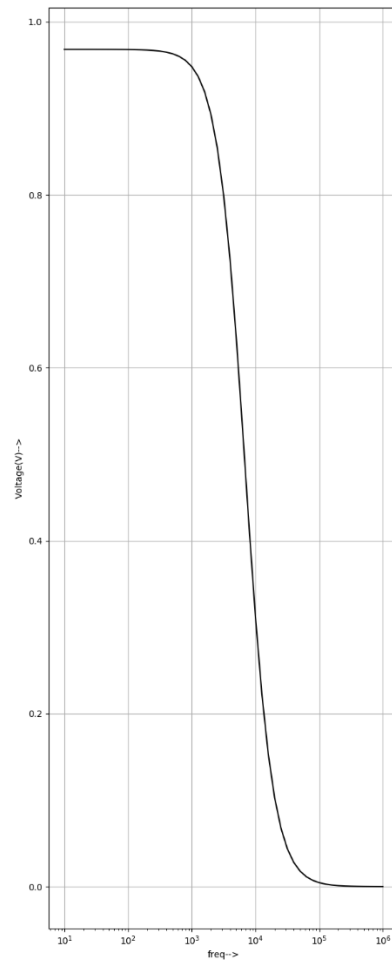


## Results-

### Python Plots -



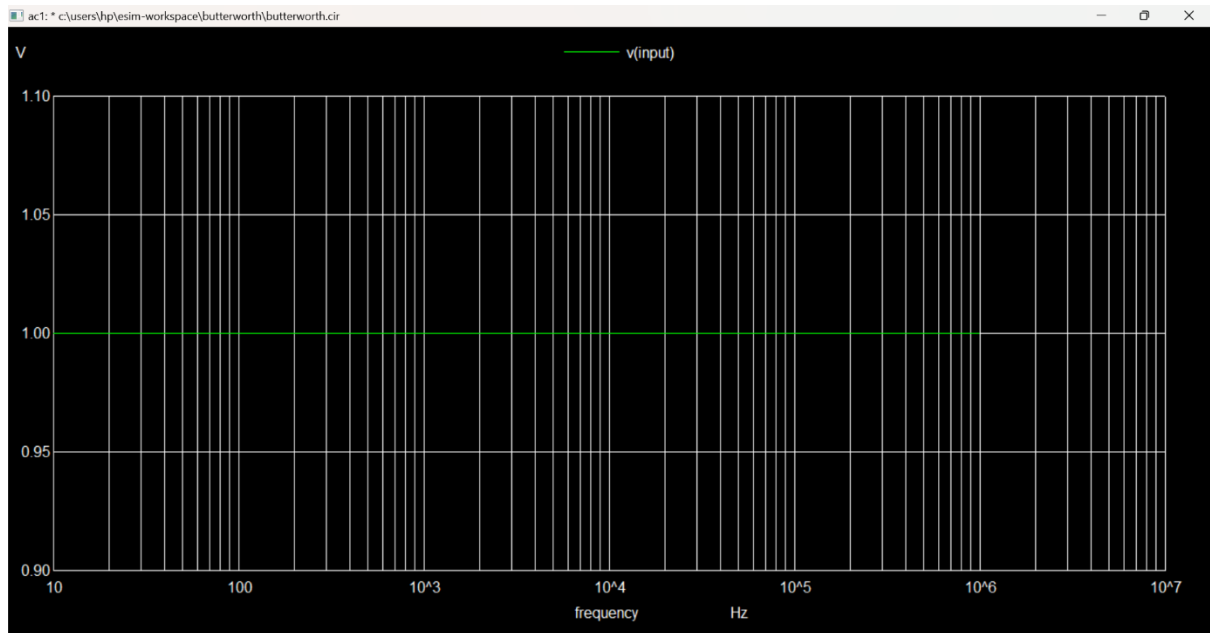
**Input**



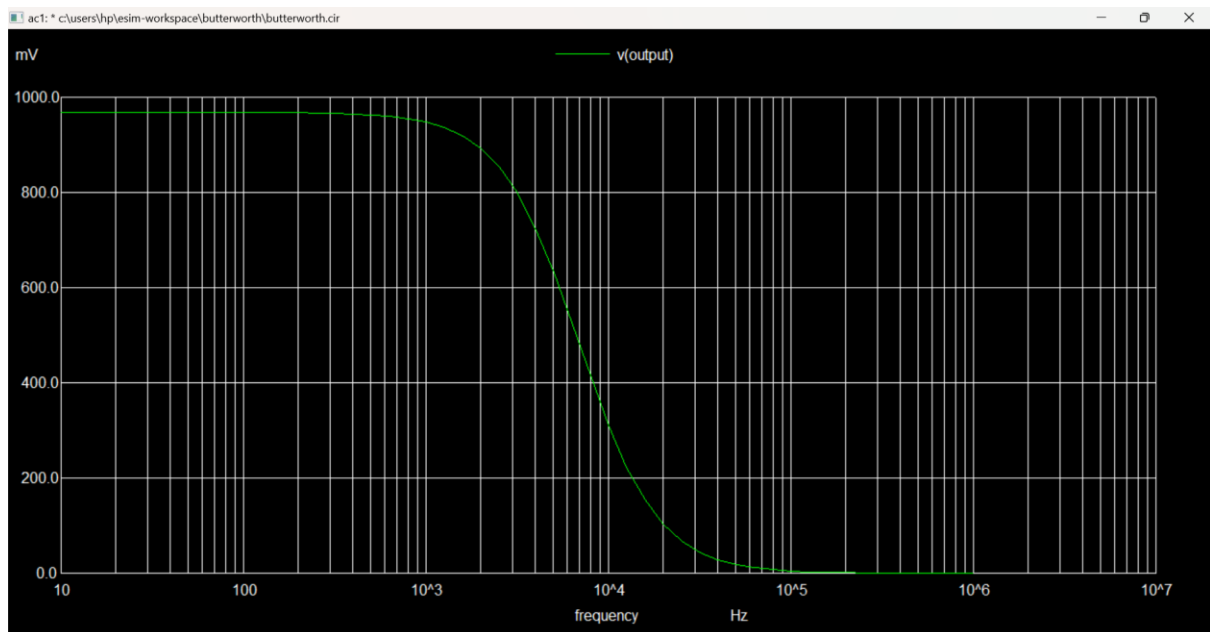
**Output**

## NgSpice-

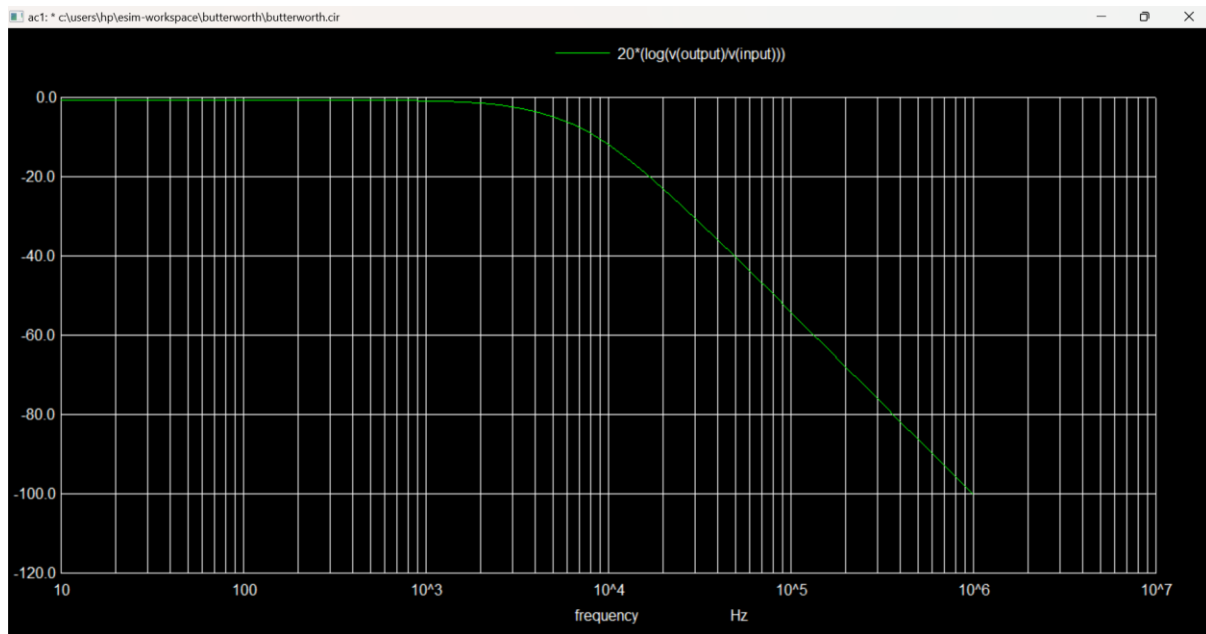
Input –



Output vs Frequency -



## Gain vs Frequency graph-



## References –

<https://youspice.com/spiceprojects/spice-simulation-projects/general-electronics-spice-simulation-projects/active-filters-spice-simulation-projects/second-order-butterworth-low-pass-filter/>

<https://www.ijeter.everscience.org/Manuscripts/Volume-4/Issue-6/Vol-4-issue-6-M-25.pdf>