Band Pass Filtered Inverting Attenuator Circuit

Problem Statement

The design of a band-pass filtered inverting attenuator circuit is required to attenuate input signals while allowing only a defined range of frequencies to pass. This tunable attenuator reduces the signal level by –20 dB over the frequency range from 10 Hz to 100 kHz and also provides independent control of the DC output level. To achieve this, the pole frequencies are selected outside the passband so that attenuation within the specified bandwidth is minimized. The input range is 100 mVpp to 50 Vpp, scaled down to 1 mVpp to 500 mVpp, powered using dual supplies of ±15 V with a 0 V reference.

The circuit ensures amplitude reduction while maintaining the desired frequency components, removing unwanted low-frequency drift and high-frequency noise, and preventing large signals from saturating later stages. Such circuits are widely used in signal conditioning, communication systems, audio processing, instrumentation, and biomedical systems, where controlled attenuation and frequency selection are essential.

Solution

Design Overview

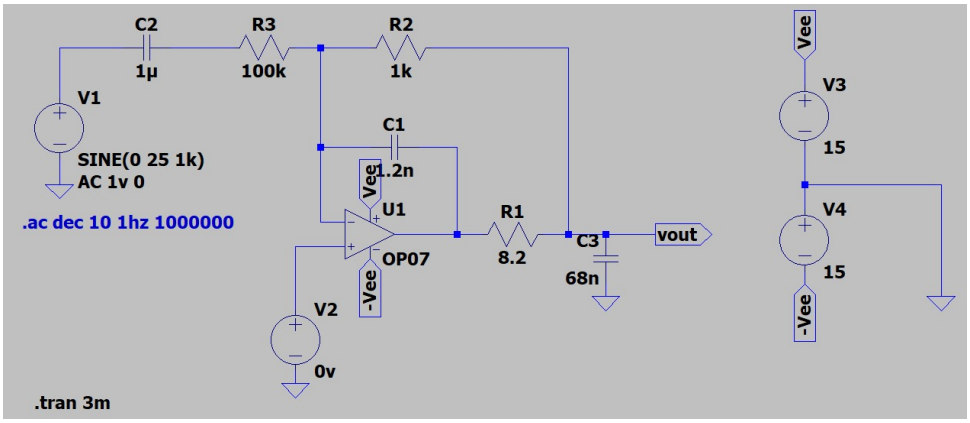

Figure 1: Band Pass Filtered Inverting Attenuator Circuit

Design Simulations

The amplifier passes DC voltages applied to the noninverting pin up to the common mode limitations of the op amp (±15V in this design).

AC Simulation Result:

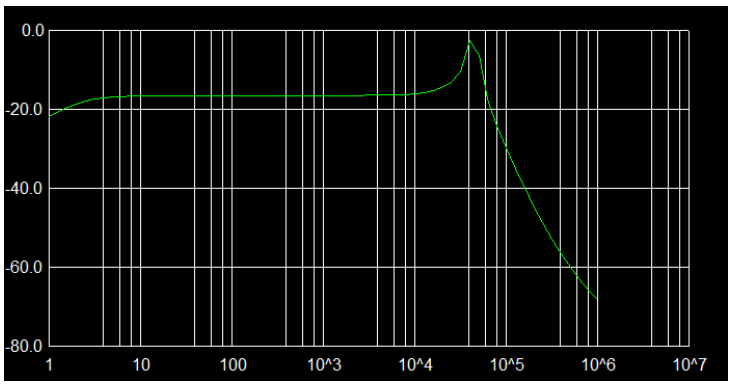

Figure 2: AC Simulation Result

Transient Simulation Result:

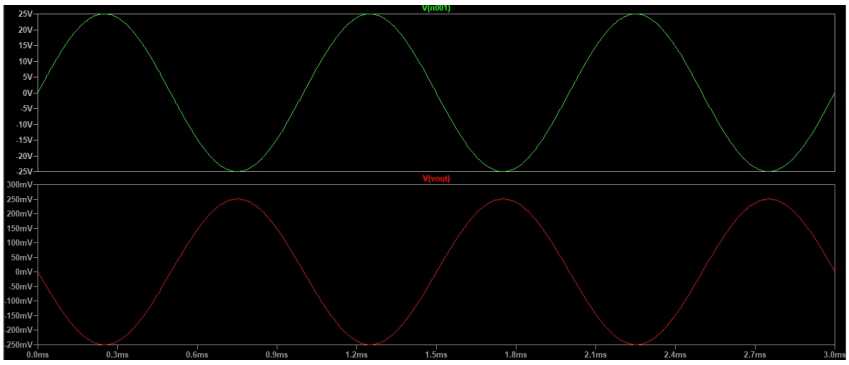

Figure 3: Transient Simulation Result

Result:

- The AC analysis shows a constant attenuation of –20 dB across the frequency range of 10Hz to 100 kHz, confirming proper band-pass behavior.
- The transient simulation shows that for an input of 50V(p-p), the output is attenuated to 500mV(p-p)

References

Band Pass Filtered Inverting Attenuator Circuit