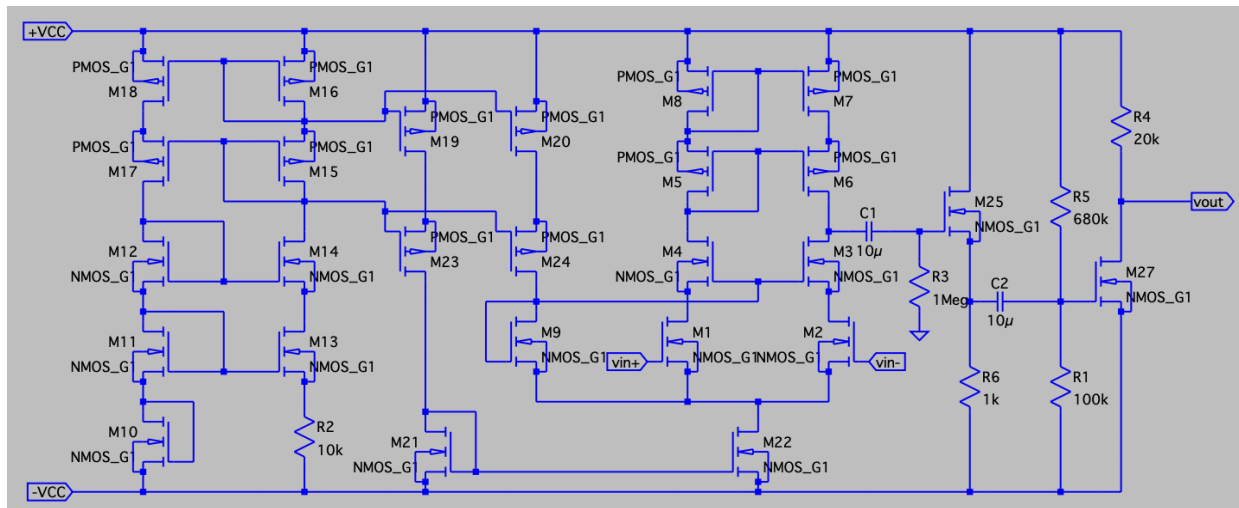
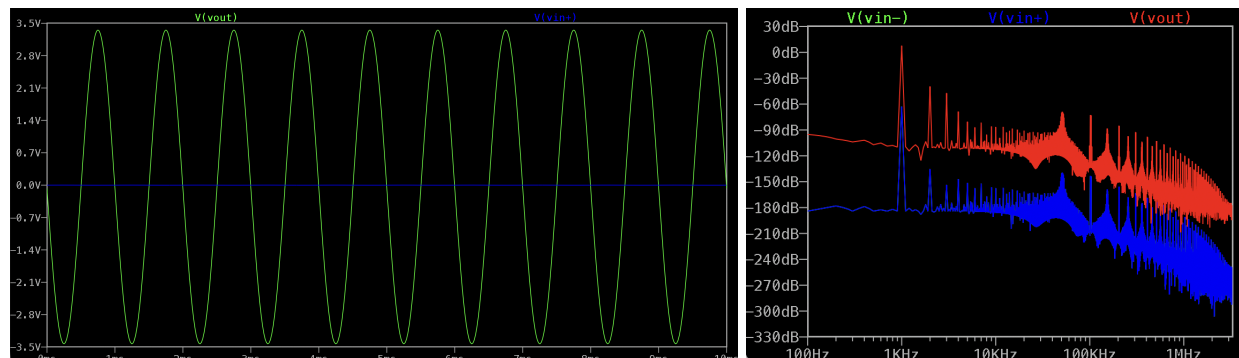


Op-amp Schematic:



Transient Simulation Results:

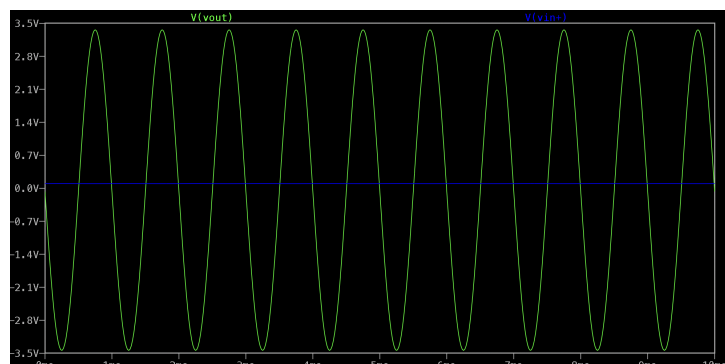
V_{in+} is a 1 kHz sine wave with amplitude 1 mV and V_{in-} is a 1 kHz sine wave with amplitude -1 mV. We see that V_{out} is a 1 kHz sine wave with amplitude of ~3.5 V.



This gives a differential mode gain of ~65 dB, which is large, and could be improved by adding further amplification stages.

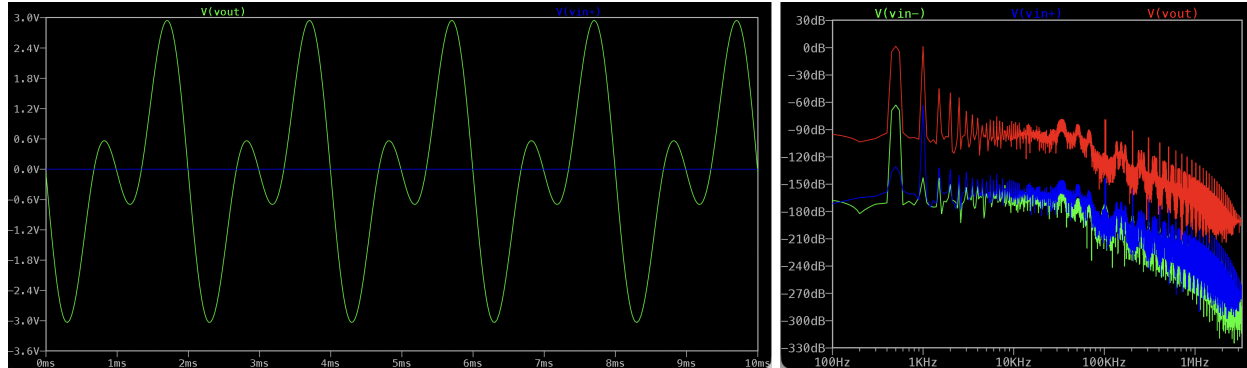
We see from the FFT plot that V_{out} has a similar frequency profile as V_{in+} and V_{in-} , which indicates minimal distortion through the op-amp. Also, V_{out} is shifted up by ~65 dB, which is the op-amp gain, as expected.

V_{in+} is a 1 kHz sine wave with amplitude 1 mV and V_{in-} is a 1 kHz sine wave with amplitude -1 mV. Both signals are given the same DC offset of 100 mV. We see that V_{out} is a 1 kHz sine wave with amplitude of ~3.5 V and has minimal offset,



meaning that the op-amp rejects the common mode offset, as expected.

V_{in+} is a 1 kHz sine wave with amplitude 1 mV and V_{in-} is a 500 Hz sine wave with amplitude -1 mV. We see that V_{out} is the superposition of 1 kHz and 500 Hz sine waves, which corresponds to the difference between the input signals, as expected.

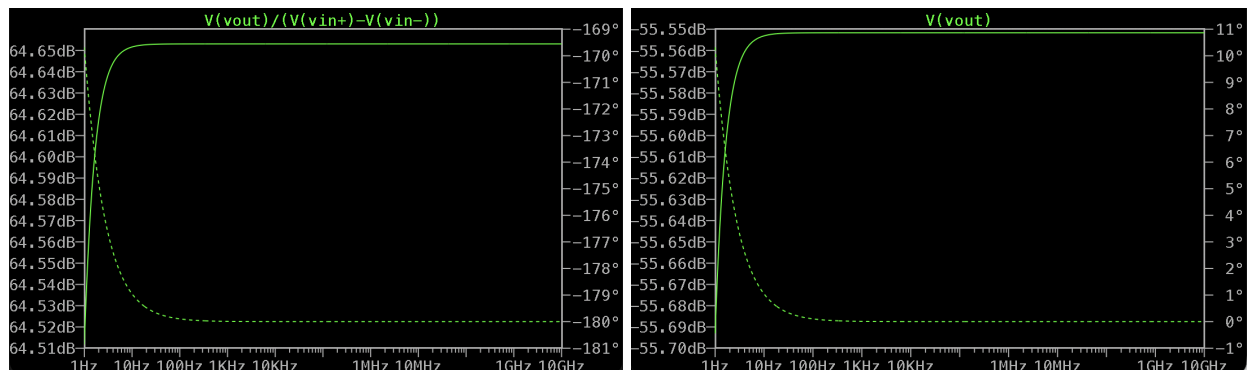


We see from the FFT plot that V_{out} indeed contains spikes corresponding to frequencies of 1 kHz and 500 Hz, and is shifted up by the gain of the amplifier, as expected.

AC Analysis

We run AC analysis on LTSpice to construct the Bode plots of differential and common mode gain over frequency. We see that this amplifier has a very high bandwidth, although this may be caused by the simplicity of the transistor models used that do not accurately capture their high frequency behaviors (i.e. rolloff).

Differential (Left) and Common (Right) Mode Gain:



Common Mode Rejection Ratio (CMRR):

We see that the CMRR is approximately 120.2 dB across much of the passband of the op-amp, which is relatively large and means that the op-amp is very good at rejecting common mode signals between both inputs.