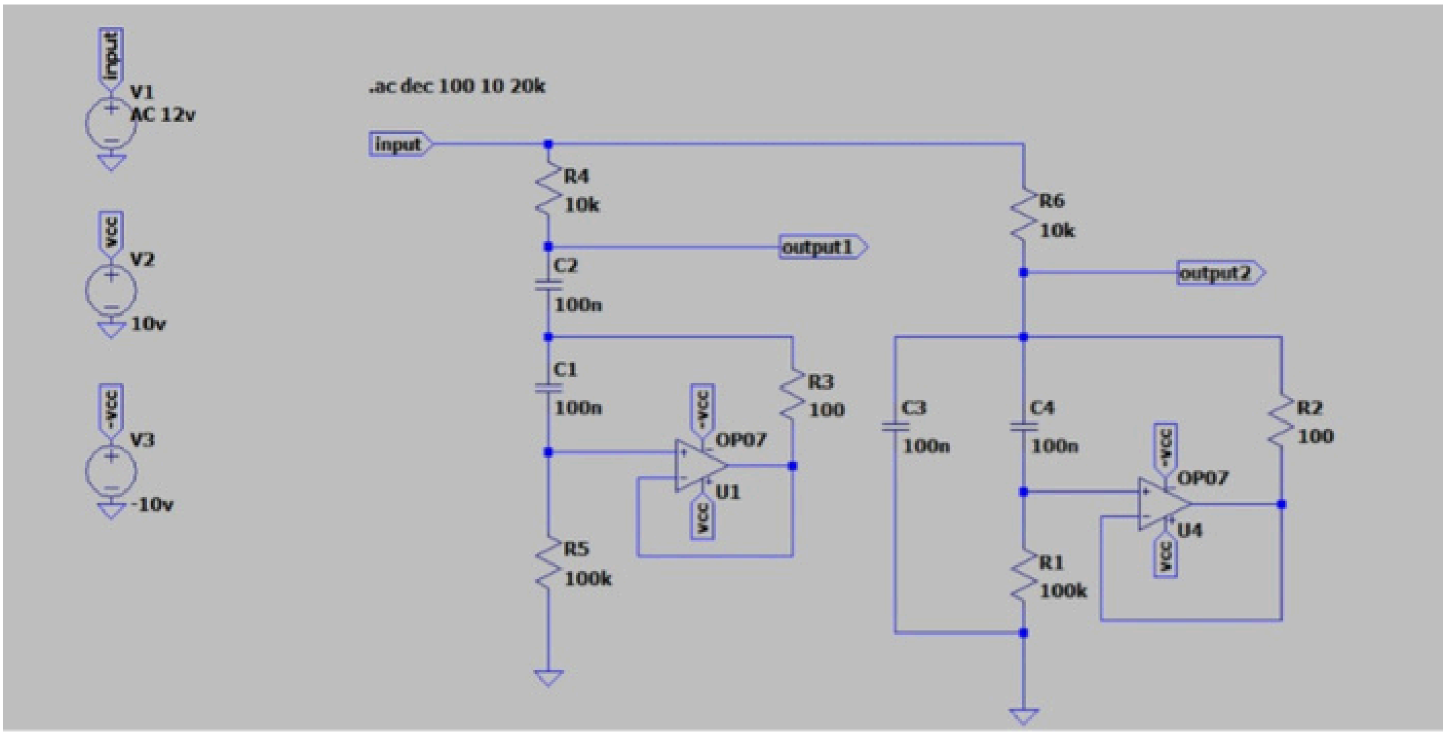
Inductorless Realization of Resonant Filters Using Gyrator Circuits

Problem Statement:

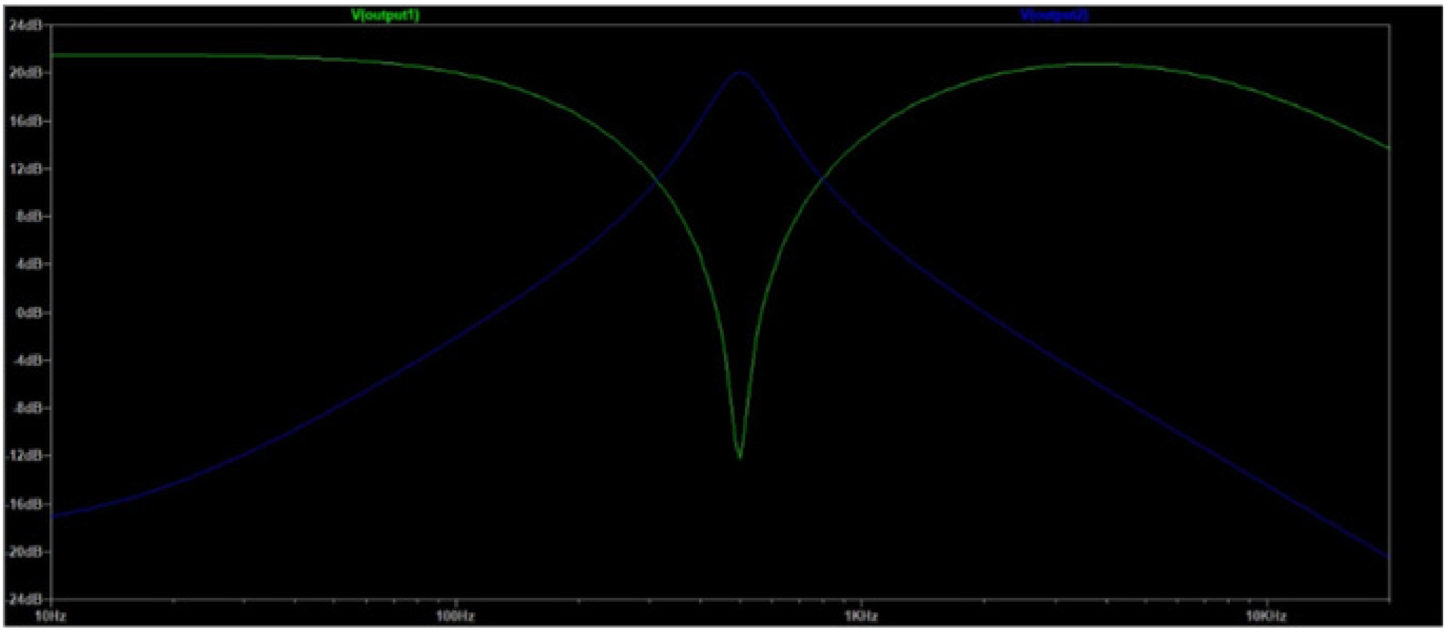
The concept of analog signal processing with passive LC filters is well known. Such filtering structures have good selectivity and are organized into simple, ladder based topologies. However, implementing such circuits on chips causes many problems because of the presence of inductive elements. The inductors remain bulky and are hard to design to be implemented as the parts of integrated circuits in classical CMOS technology. The alternative approach in LC filters implementation assumes using the prototype circuits. A floating inductance L may be replaced by gyrator.One of the most common applications for LC filters (whether made using 'real' or simulated inductors) is the resonant filter. This can be configured to be either a notch (aka band stop) or bandpass filter. A notch filter is configured as a series resonant circuit, and the resonant circuit has a very low impedance at resonance. A parallel resonant circuit has a high impedance at resonance and a bandpass pass filter is realized from it.

Circuit Diagram :



Gyrator Notch & Bandpass Filters

Results :



The inductance presented by the gyrator is :

L = (R2 - R1) × R1 × C1L ≈ R2 × R1 × C1L ≈ 100k × 100 × 100n = 1 Henry

The resonant frequency is done just as one would calculate the resonant frequency of a traditional LC filter

f = 1 / (2π × √(L × C))f

= 1 / (2π × √(1 × 100n)) = 503 Hz

Source/Reference(s) :

1. Gyrator Resonant Filters
2. An Introduction To Gyrator Theory - Bryan T Morrison