Stereo Audio Amplifier

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Description:

We designed our stereo audio amplifier using the LM1877. The op-amp has feedback resistors R_f = 15kΩ and input resistors R_i = 470Ω. The left and right inputs are connected to the non-inverting terminals of the LM1877. The gain of each of the two non-inverting amps are therefore:

$$A_v = 1 + \frac{R_f}{R_i} = 1 + \frac{15k}{470} = +32.915$$

The op-amps are powered with a single voltage supply of +9V. The DC power supply has a *power-supply bypass capacitor* (C_B) placed in parallel to remove any unwanted power-supply ripple voltage from appearing in the signal. A non-ideal DC voltage source will produce some small AC ripple that will introduce noise to the circuit. This capacitor will provide a path to ground for this AC ripple. The value of the capacitor will be 0.1μF.

Two *coupling capacitors* (C_{I1} and C_{I2}) are placed at the inputs. These will block the half-supply DC bias voltage (4.5V) from being fed back into the input (in this case our iPod). The values of these capacitors will be 0.1μF. Likewise, two coupling capacitors (C_{O1} and C_{O2}) will be placed at the output to prevent any DC voltage from appearing at the output. We are only interested in putting AC voltage to the output; the output coupling capacitors will block DC voltage from going to the speakers. The value of these capacitors will be large - 470μF.

Normally an op-amp will contain some input offset voltage. This will be amplified at the output and produce noise. With very high gain, the DC offset voltages can cause the op-amp to exceed its rail voltages. There are two *DC stabilizing capacitors* (C_{DC1} and C_{DC2}) placed at the inverting inputs of the op-amps. These will prevent the DC offsets from being amplified. With these caps the gain at DC will be unity and $1 + \frac{R_f}{R_i}$ at all other frequencies. The value of these capacitors will be 10μF.

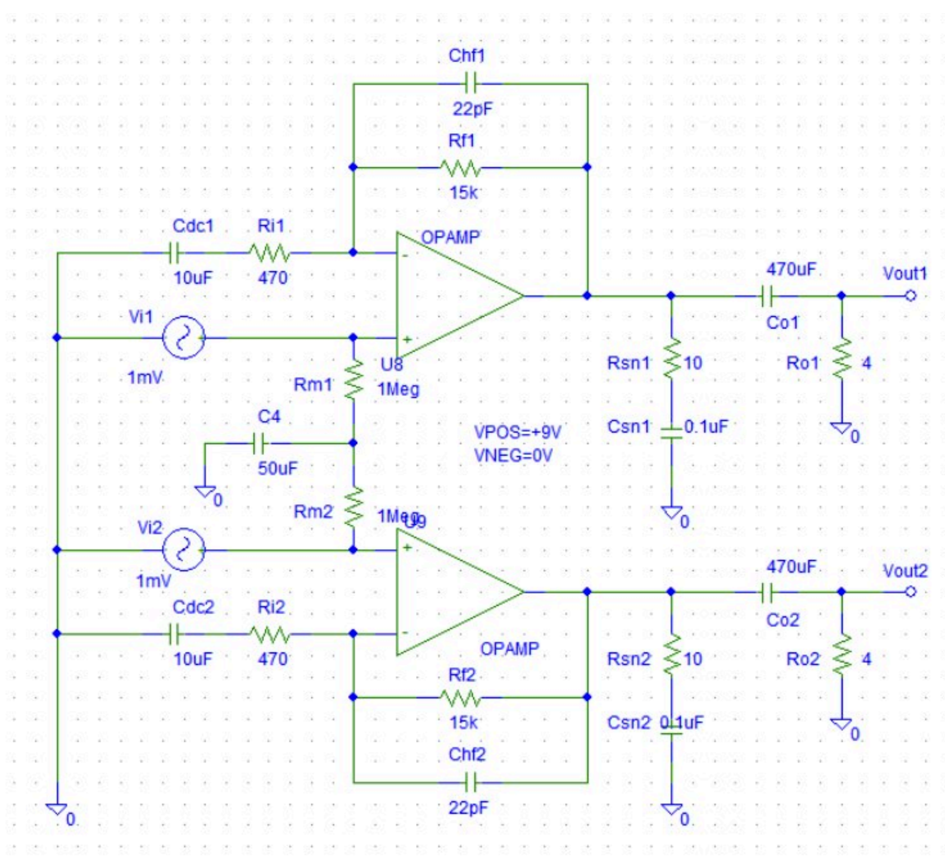
High-frequency compensation capacitors (C_{HF1} and C_{HF2}) are placed in parallel with the feedback resistor to remove high-frequency oscillations from occurring. These high-frequency oscillations occur when parasitic capacitance at the op-amp's inputs combine with the feedback resistors. The HF compensations capacitors will provide a path for this capacitance so it won't travel through the feedback resistors. The values for these capacitors will be small – 22pF.

To further improve the quality of the output audio signal we included two "snubber" circuits – one at each op-amp's output. The snubber circuit consists of a path to ground that includes a resistor and a capacitor. Its purpose is to prevent any additional high-frequency oscillations (squeals) from appearing at the output. It basically acts as a low-pass filter at the output – removing higher frequencies from being put to the speakers. Both the resistor and capacitor will be small values – our resistors (R_{SN1} and R_{SN2}) are 10Ω and the capacitors (C_{SN1} and C_{SN2}) 0.1μF.

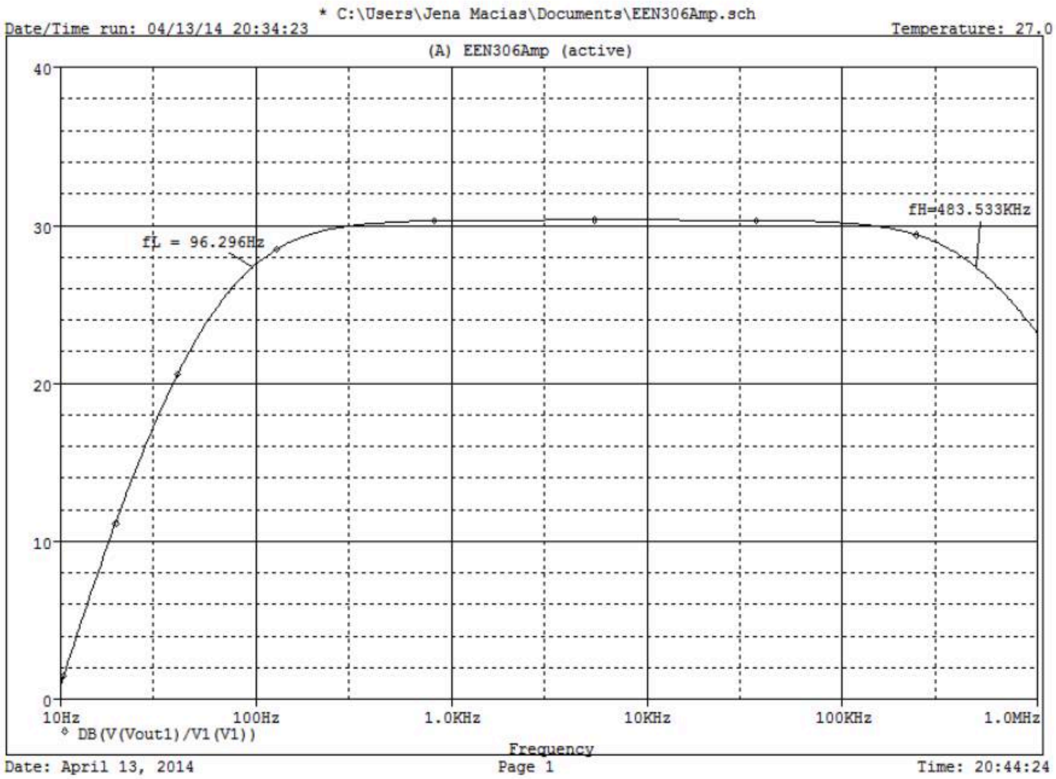
Input impedance resistors will be put at the input to set the input impedance of the op-amp to a non-infinite value. They will also ground the op-amp's input when no external input is connected so that the circuit's inputs won't be floating. They will be set to very large (but finite values). Our input impedance resistors (R_{M1} and R_{M2}) will be 1MΩ.

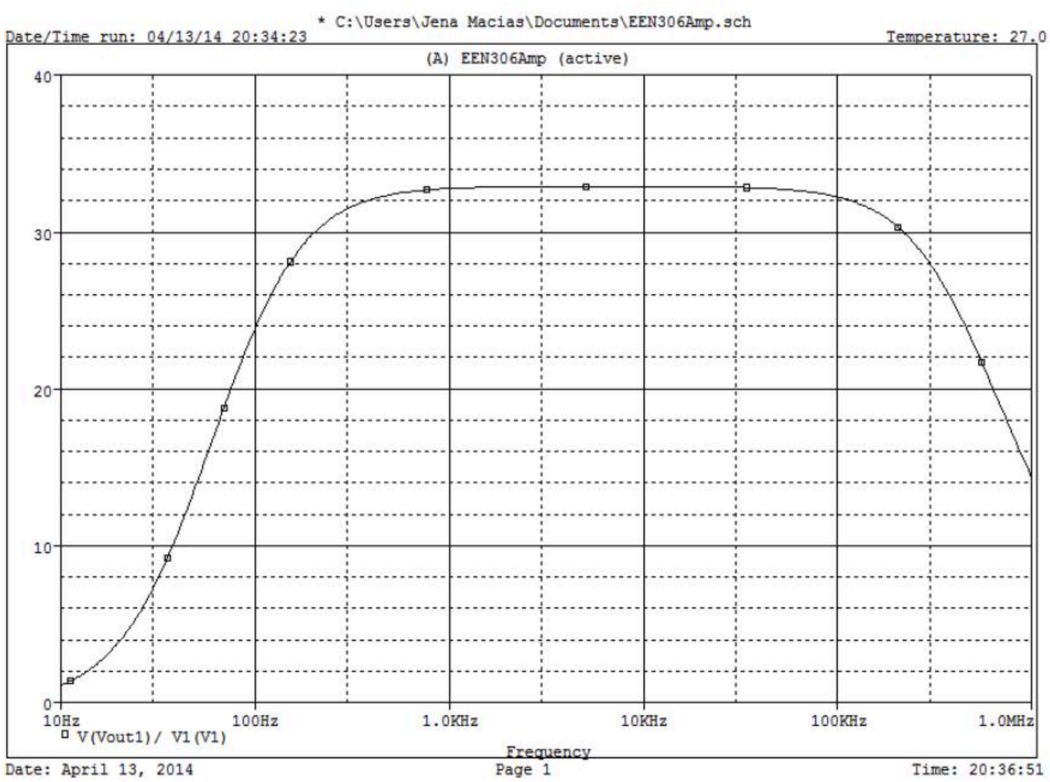
Finally, our load will be a set of 4Ω speakers.

Circuit:



Simulation:


* C:\Users\Jena Macias\Documents\EEN306Amp.sch
Date/Time run: 04/13/14 20:34:23
Temperature: 27.0
(A) EEN306Amp (active)
40
30
20
10
0
fL = 96.296Hz
fH=483.533KHz
10Hz
100Hz
1.0KHz
10KHz
100KHz
1.0MHz
DB(V(Vout1)/V1(V1))
Frequency
Date: April 13, 2014
Page 1
Time: 20:44:24


* C:\Users\Jena Macias\Documents\EEN306Amp.sch
Date/Time run: 04/13/14 20:34:23
Temperature: 27.0
(A) EEN306Amp (active)
40
30
20
10
0
10Hz
100Hz
1.0KHz
10KHz
100KHz
1.0MHz
V(Vout1)/ V1(V1)
Frequency
Date: April 13, 2014
Page 1
Time: 20:36:51

Pictures: