ECE 321 - Homework #1

Op Amp Amplifiers, Push-Pull Amplifiers.

For all problems, assume you are using

- LM833 Op Amps (max current = 50mA)
- 2SC6144 transistors (β = 200, 10A max, |Vbe| = 0.7V), or
- TIP112 / TIP117 NPN and PNP power transistors (for a push-pull amplifier).
  - β = 1000, 3A max, |Vbe| = 1.4V

Amplfier:

1) Design a circuit to implement

a) Y = +5X

b) Y = -5X

c) Y = 7 - 5X

Mixer

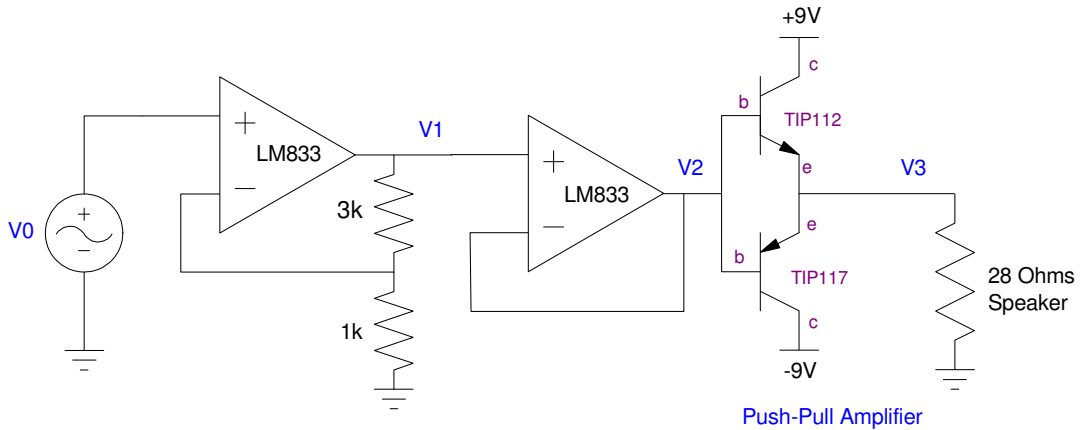2) Design a circuit to mix three signals together:

- Y = 3A + 8B + 4C

Push-Pull Amplifier with Crossover Distortion

3) For the circuit below, calculate the voltages and currents when

- V1 = +0V
- V1 = +1V
- V1 = +2V

4) Simulate in CircuitLab with

- V1 being a 4Vpp sine wave at 1kHz, or
- V0 being a 1Vpp sine wave at 1kHz (same result)
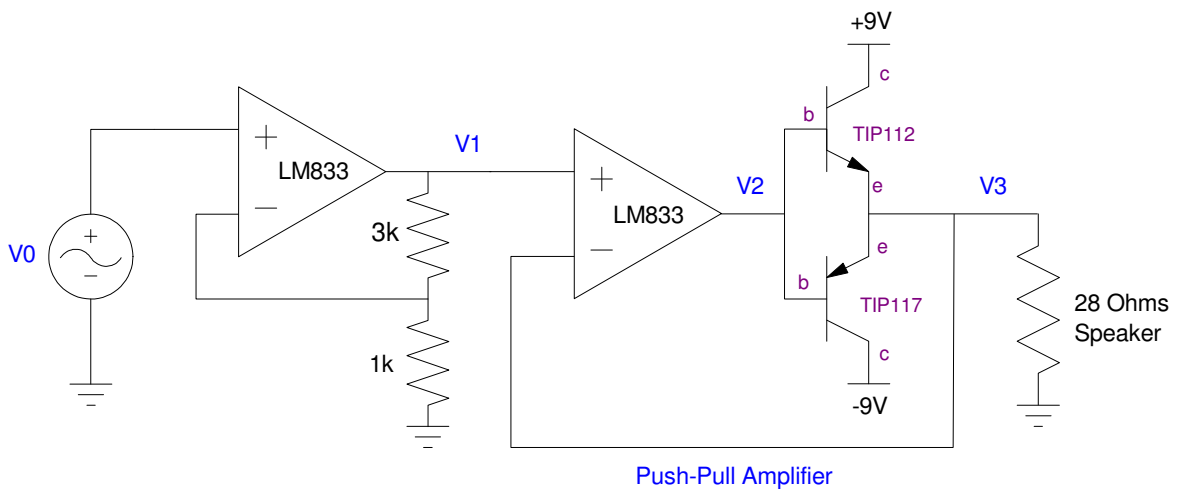
Problem 3-5: Amplifier with Crossover Distortion

Push-Pull Amplifier without Crossover Distortion

5) For the circuit below, calculate the voltages and currents when

- V1 = +0V
- V1 = +1V
- V1 = +2V

6) Simulate in CircuitLab with

- V1 being a 4Vpp sine wave at 1kHz, or
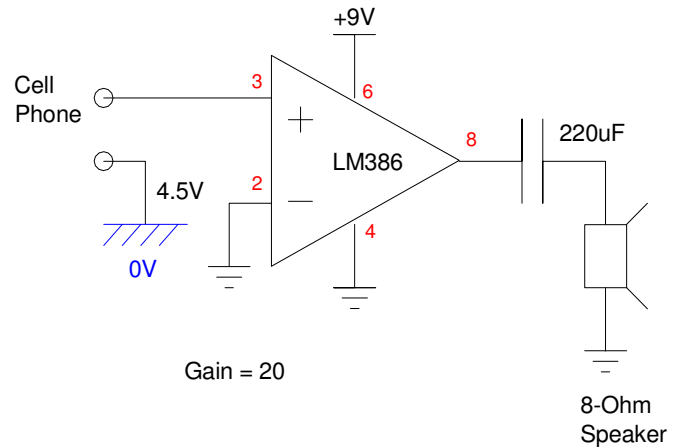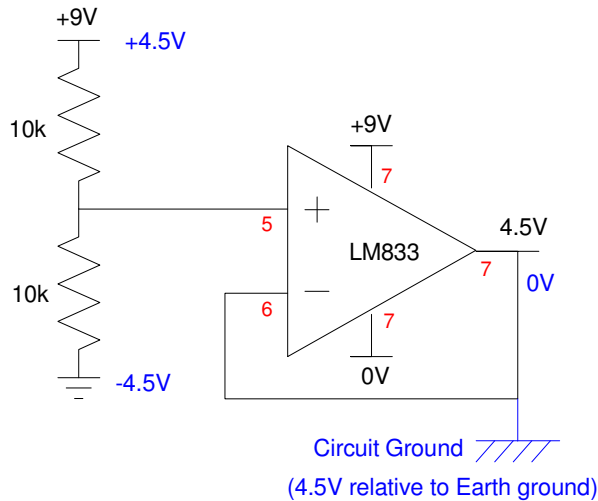- V0 being a 1Vpp sine wave at 1kHz (same result)

Problem 5 -6: Amplifier Withour Crossover Distortion

Lab

(over)

An LM386 is a 700mW audio amplifier (essentially a push-pull anmplifier on a chip - provides better sound quality).

+9V
+4.5V
10k
+9V
7
5
+
4.5V
LM833
7
0V
6
7
10k
-4.5V
0V
Circuit Ground
(4.5V relative to Earth ground)

Cell
Phone
3
6
+
8
220uF
LM386
2
4.5V
4
0V
0V
Gain = 20
8-Ohm
Speaker

7) Build the two circuits above on a breadboard using a 9V battery (or any 6-12VDC power source)
- Creating a 4.5V reference signal (acts as circuit ground) capable of sourcing / sinking up to 25mA
- A gain of 20 audio amplifier (LM386)

Include photo of your resulting breadboard circuit.

8) Check the functioning of the 4.5V reference source (LM833) under load. Measure the output votlage with
- No load on the output.
- The output connected to +9V through a 220 Ohm resistor (sinking 20.5mA)
- The output connected to 0V through a 220 Ohm resistor (sourcing 20.5mA)

9) Check the functioning of the audio amplifier (LM386) under load (connected to an 8-Ohm speaker). Connect the input to a function generator (cell phone app preferred). Measure the gain when the input is
- A 200Hz sine wave
- A 1kHz sine wave
- A 5kHz sine wave

note: Keep your circuit together - we'll use it for the next few weeks.