

ECE 320 - Homework #8

Push-Pull Amplifiers, Filters, Transistor Amplifiers (DC)

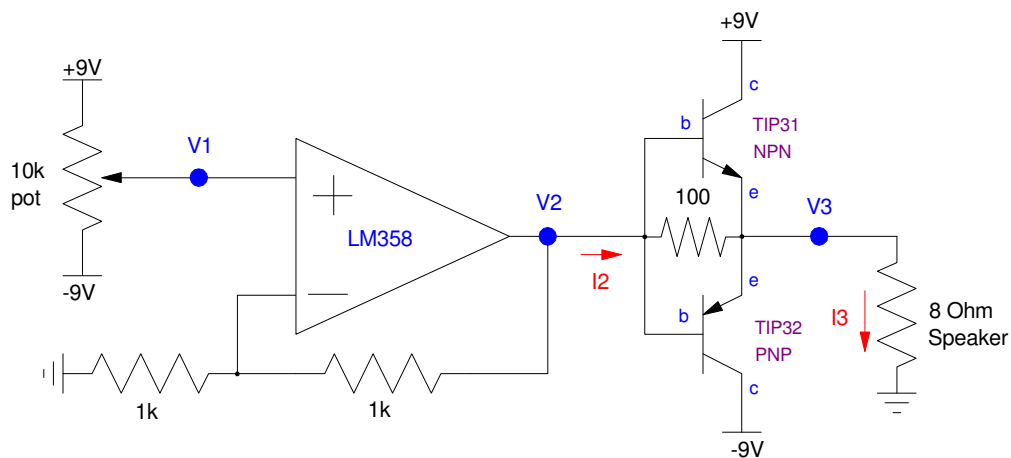
Push-Pull Amplifier

1) Determine the voltages and currents for the following circuit when $V_1 = 2V$. Assume the transistors have the following characteristics

- $\beta = 10$
- $|V_{be}| = 1.4V$ (Darlington pair)
- $|V_{ce(sat)}| = 0.9V$

2) Simulate this circuit in CircuitLab with V_1 being a 2Vp 100Hz sine wave

- Include a graph of $V_2(t)$ and $V_3(t)$ using a transient simulation

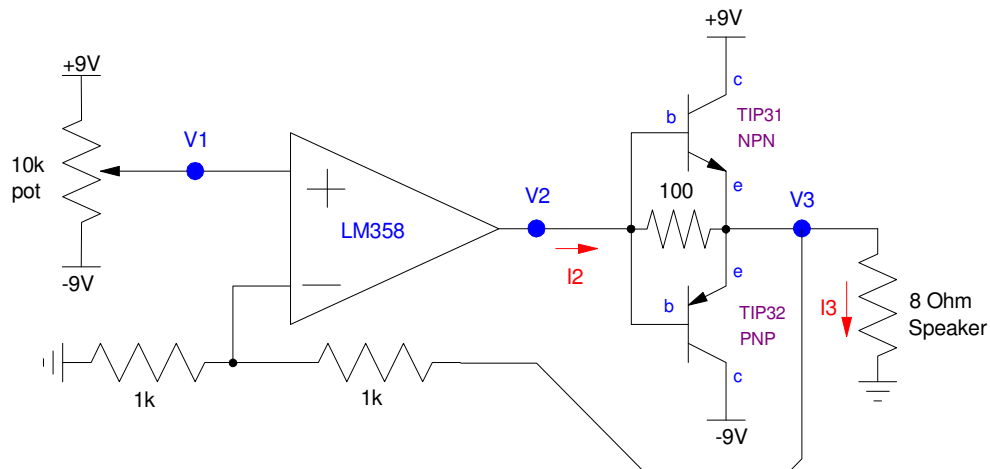


Problem 1-2

3) Determine the voltages and currents for the following circuit when $V_1 = 2V$.

4) Simulate this circuit in CircuitLab with V_1 being a 2Vp 100Hz sine wave

- Include a graph of $V_2(t)$ and $V_3(t)$ using a transient simulation



Problem 3-4

Filter Analysis

5) Let

$$Y = \left(\frac{10}{(s+2)(s+3)} \right) X$$

a) What is the differential equation relating X and Y?

b) Find y(t) assuming

$$x(t) = 2 + 3 \sin(4t)$$

Filter Design

6) Design an active filter to implement

$$Y = \left(\frac{10}{(s+2)(s+3)} \right) X$$

7) Verify the gain of your design using CircuitLab

- Run a frequency domain sweep from 0.1 to 10 rad/sec

8) Design an active filter to implement

$$Y = \left(\frac{20}{s^2 + 2s + 17} \right) X$$

9) Verify the gain of your design using CircuitLab

- Run a frequency domain sweep from 0.1 to 10 rad/sec

CE Amplifiers (DC Analysis)

10) Determine the Q point for the following CE amplifier.

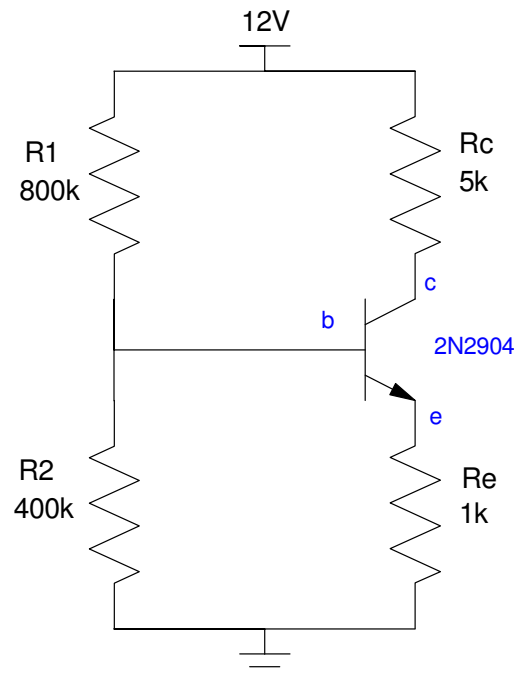
Assume a 2N3904 NPN transistor

- $\beta = 200$ $range = 100 \dots 300$
- $V_{be} = 0.7V$
- $V_{ce(sat)} = 0.2V$

11) Change R1 and R2 so that

- The Q point is stabilized for variations in β , and
- The Q-point is at $V_{ce} = +6V$

12) Verify your calculations for problem #11 using CircuitLab



Lab

13) Build the following push-pull amplifier with your lab kit

- Include a photo of your breadboard for full credit
- Use +/-9V to power this circuit, similar to homework #7

14) Measure the voltage at V1, V2, and V3 using your FNRSI meter for

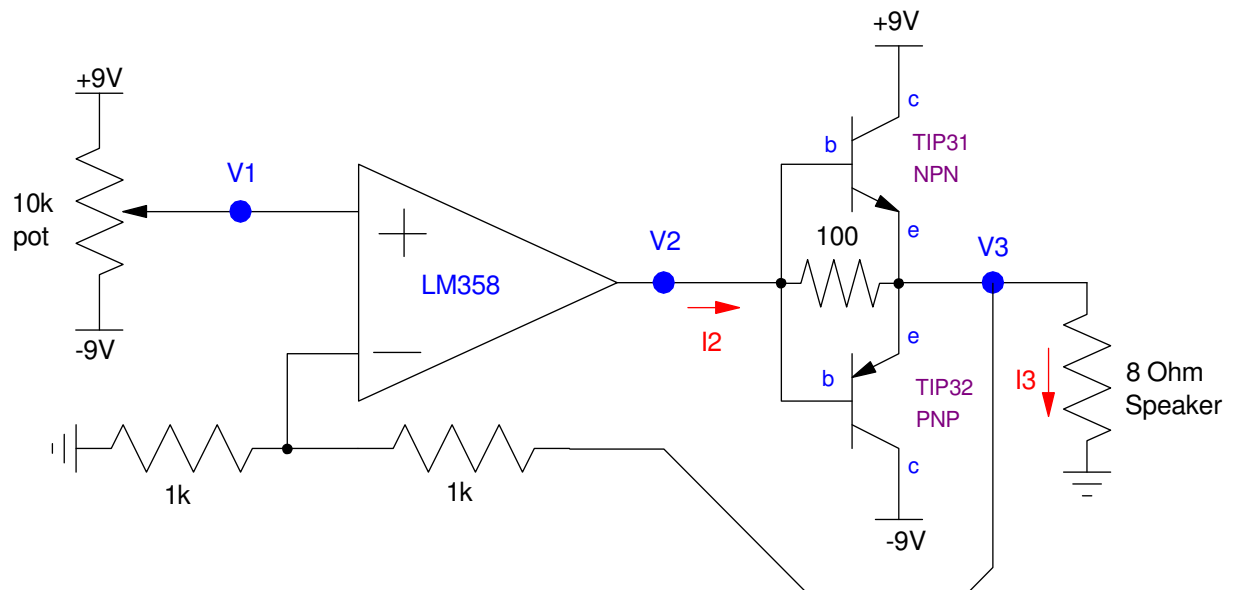
- V1 = +1V
- V1 = 0V
- V1 = -1V

15) Change V1 to a 1Vp 200Hz sine wave. Measure the voltages at V2 and V3 using your FNRSI oscilloscope

- Use your FNRSI meter to output a sine wave
- Include a photo of the oscilloscope traces

16) Change V1 to an audio signal from your cell phone or computer playing a YouTube video. Demonstrate your working amplifier

- Photo of an oscilloscope trace at V3 works
- YouTube video showing your amplifier also works



(over)

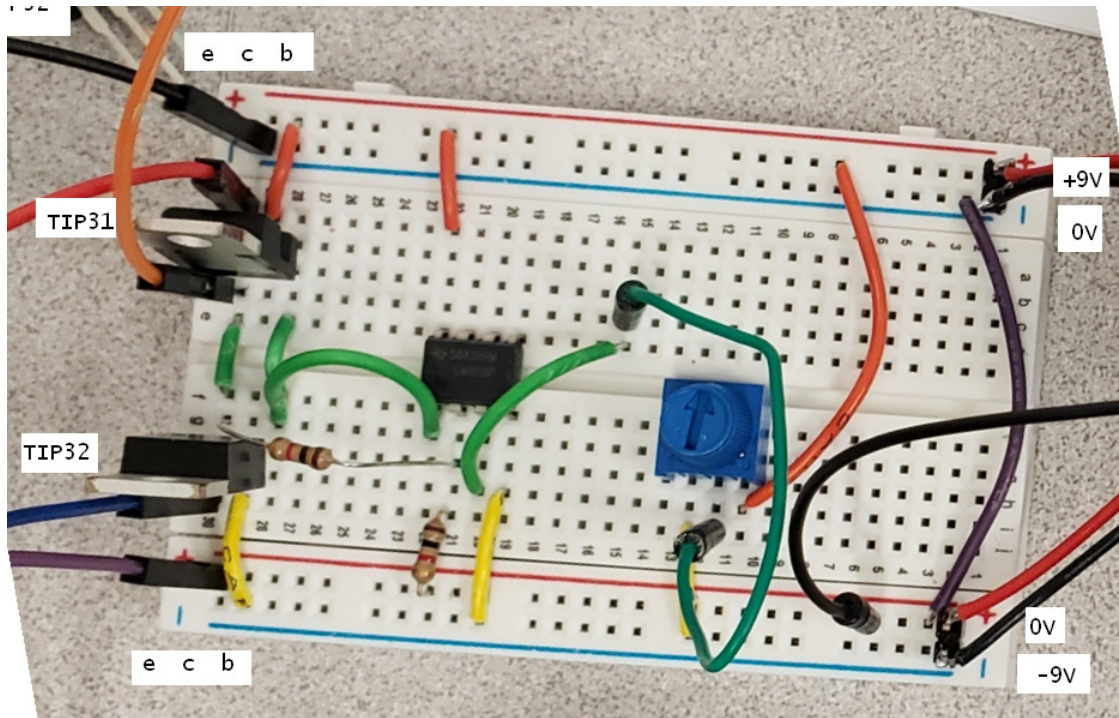


Photo of what your final circuit might look like

Notes:

- Use two +9V batteries (top rail and bottom rail)
 - This provides +9V, 0V, -9V power
- Use an LM358 op-amp (+/- analog)
- Color code your wires
- Keep your circuit neat and orderly
- Take a photo of your final working breadboard circuit