

Homework Set 4
EECE2412: Electronics – Spring 2013
Due Monday, 18 March 2013

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Complete the following problems from Hambley's book

1 Temperature Dependence

Problem 4.25: This is discussed in the book but we skipped it in class.
Hint: How does V_T change with temperature? Feel free to use the "rule-of-thumb" introduced in the book.

2 Pnp Transistor

Problem 4.34

3 DC analysis

Problem 4.45

4 Common-Emitter Amplifier

Problem 4.56

5 Power supply hum

Problem 4.59

6 Audio Amplifier Design

This assignment will take you through most of the design process to build both a battery-powered transistor audio amplifier.

6.1 Initial Analysis

The first step in analyzing a circuit is to identify its important features. This allows an engineer to understand what is happening in the circuit. The following questions are designed to take you through this process for the BJT amplifier is illustrated in Figure 1. If you are using a calculator in this stage, you are doing it wrong.

- How many amplifier stages are in this circuit?
- What type of amplifier stages are they?
- What voltage should Q_1 's base be at?
- A typical MP3 player has an output impedance of 300 Ohms and a typical speaker has an input impedance of 8 Ohms.
 - What is the desired input impedance of the circuit? Why?
 - What is the desired output impedance of the circuit? Why?
- What purpose do D_1 and D_2 serve?
- What purpose does C_1 serve?
- C_5 and C_6 are called decoupling capacitors and should be placed next to the transistors Q_1 , Q_3 and Q_4 . Why?

6.2 DC Analysis

- Draw the DC circuit model for this amplifier
- Specify the resistor values, R_1 and R_2 , for this circuit.

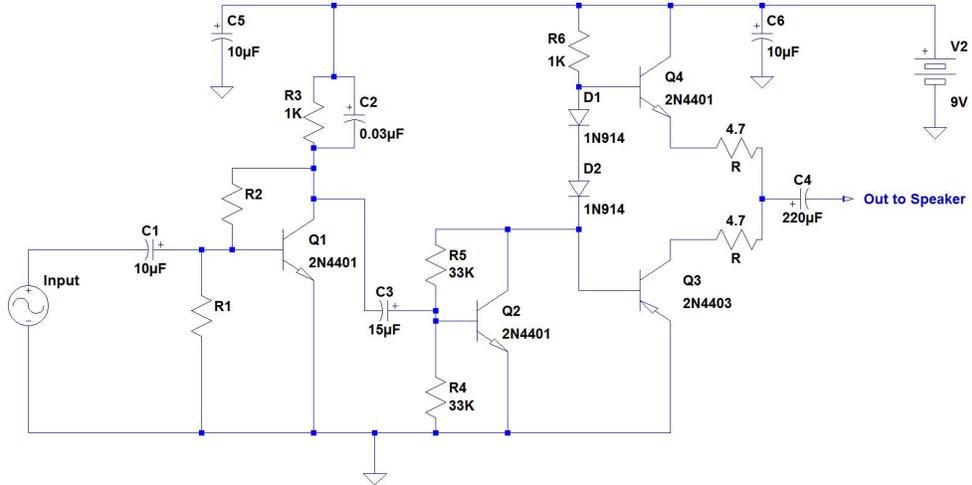


Figure 1: BJT Amplifier with a 9V supply

6.3 AC Analysis

- Draw the small signal model of each amplifier stage separately.
- What is the gain of this circuit?

7 Extra Credit

A small amplifier like this is typically powered using batteries. However, we cannot directly use the battery to provide a voltage for the circuit. This is because the internal resistance of the battery increases as the battery is discharged which results in a voltage drop with time. A typical method for reducing this effect is to use a linear voltage regulator. One well known voltage regulator is the LM317 and is typically utilized in prototype projects because you can change its output voltage by swapping resistors.

- Using the Texas Instruments spec sheet for the LM317, design a 9V power supply capable of accepting DC voltages up to 40V.