ECEN 204 Design Exercise 2

An audio preamplifier Part 1: Design, Construction &Test

1. Project Introduction

This design exercise will let you build a prototype of a Class A amplifier that can serve as the pre-amplifier stage to a power amplifier. You will need to perform the basic design and then construct your circuit on breadboard. This allows you to play around with various components (resistors and capacitors) and observe the influence of these on amplification and frequency response of the amplifier. Once you are happy with your design you can construct a prototype by soldering the components onto stripboard. When this is completed the circuit should again be tested extensively to characterise the behaviour. Finally the project should be written up as a design report (Part 2).

The design exercise will be completed over two weeks of lab work after which the design report must be written:

> **Week 10 (23 – 27 September):** Start with design, prototype on breadboard, evaluation of the influence of different components, initial testing to check that circuit is working as expected.
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> **Week 11 (30 September – 4 October):** Build prototype on stripboard. Extensive testing and evaluation.

Hand in of final report: October 11 5pm in the submission box.

2. Objectives

At completion of this design exercise students should be able to:

(i) Design a class A audio preamplifier.
(ii) To prototype this circuit on breadboard and evaluate the operation of the circuit.
(iii) To prototype this circuit on stripboard.
(iv) To test and critically evaluate this circuit.
(v) Write a technical report detailing the design, construction and testing of your circuit.

3. Reading

Have a look at your notes on BJT amplifier biasing and operation (Sections 3) as well as Lab 5 where you built a similar amplifier. The section of your textbook on BJT transistor will also contain good information. Feel free to use the many good (and not so good!) resources available on the web as well. However, do not just try to copy someone else's circuit – follow your own design steps and make your own decisions.

4. Design Requirements

Basic: You must design, construct and test a preamplifier circuit that can be used to amplify audio signals. It should be based on a BC547 transistor and be able to amplify signals over as wide a part off the audio range as possible. It should be based on a common emitter with feedback resistor configuration and should be able to provide a small signal voltage gain of at least 5 times (no emitter capacitor in place). It should operate from a 9 V supply (your bench power supply) and should provide the maximum possible output swing.

Completion: Add an emitter capacitor to your design to increase the small signal gain. How would this change the gain and the bandwidth of your amplifier? Construct this circuit and test the operation.

Extension: How big is the difference between the Q point you designed for and the actual Q point of your circuit? Think what may cause this difference and can you compensate for it? Discuss this as part of your design report and see if you can improve your design.

5. Testing and characterising your circuit

Testing and characterisation of your circuit will be just as important as construction. Remember this is intended as an audio amplifier, so we will have to evaluate the frequency response of the circuit. It is also worth thinking and calculating what are the expected voltages (DC) in the circuit and what points can be used as good test points if the circuit is not working. Testing should be done for each of the three design stages of the amplifier and should include the following:

- Is it working – i.e. does it provide the expected DC operating point.
- If so, test the small signal gain at a single frequency – is that operating as expected.
- Now measure the frequency response (gain and phase) over the audio spectrum. How does it perform?
- What is the power consumption of your amplifier both under DC conditions and in active operation? Is this within the limits of the transistor?
- What other tests you think may be relevant.

Ensure that you keep careful record of all your test results, as this need to be included in your report.

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