

Introduction

The purpose of this project is to design, simulate, analyze, implement, and test a single-supply, 15-V, multi-stage, transistor amplifier which fulfills a set of specifications.

For this project, **the pre-lab shall be treated as your formal design report and, therefore, must be much more detailed than usual** (please see **Evaluation** heading on the next page of this document). **The report shall be submitted to the TA by the deadline.** As with the previous labs, **the report is an individual assignment.**

Physical construction and demonstration is optional (highly recommended) and worth extra credit. Should you opt for this option, you would construct your amplifier on a breadboard, book an appointment and meet with Dr. Yazdani, either in his office or in the lab, to demo your design. You shall be interviewed by Dr. Yazdani in regards to your design and selection of its components. Therefore, you are expected to know your design very well.

Specifications

- Open-circuit (no-load) voltage gain: $|A_{vo}| = 50 (\pm 10\%)$
Note: *The overall amplifier can be inverting. However, the zero-crossings of the output signal must coincide with those of the input signals, for the frequency range 1 kHz to 20 kHz. In other words, the so-called mid-band frequency response of your amplifier must cover the aforementioned range.*
- Number of transistors (stages): **no more than 3 BJTs**;
- Power supply: **+15V** relative to the ground;
- Output resistance: **no larger than 500 Ω** ;
- Input resistance: **no less than 80 k Ω** ;
- Quiescent current drawn from the power supply: **no larger than 5 mA**;
- Maximum no-load output signal swing: **no less than 8 V peak to peak (from -4 V to +4 V).**

The amplifier shall be AC-coupled for the load and signal source. However, the coupling between its intermediate stages may be of AC or DC type (bonus mark for inter-stage DC coupling!, due to the more challenging design of the DC bias network). The design details are left to the designer. Thus, there is no right or wrong solution, as long as the aforementioned specifications are met. In particular, there are no restrictions on the type of transistors, NPN or PNP. However, the components chosen for the design must exist in your ELE 404 lab kit.

Report Content and Length

Including the cover page, the report is limited to 15 pages. In his/her report, the designer must:

1. Identify and justify the types of the constituting amplification stages, which, when cascaded, will meet the given design requirements (e.g., a CC stage followed by a CE stage, etc., and why...).
2. Present manual calculations for, and explain in sufficient details, his/her selection of the resistance and capacitance values.
3. Simulate the designed amplifier by Multisim (or any other circuit simulation software) and demonstrate that the design indeed meets the requirements and that its simulated performance is in a reasonable agreement with those predicted through manual calculations.

Evaluation (Read Carefully)

Your report shall be evaluated on the following:

1. Description of the circuit and its choice of configuration (e.g., a CC stage followed by a CE stage, etc., and why...)
2. Manual calculations for the resistance and capacitance values, bias voltages and currents, etc.
3. Detailed simulations of the design, using the circuit elements having come out of the manual calculations of item 2, clearly testing of the amplifier on its adherence to the design specifications (describe each test and provide all the corresponding waveforms).
4. Explanation of discrepancies, if any, between the simulation results and your manual calculation results, and provision of reasons for the discrepancies (to the best of your knowledge).
5. Organization and English of the report.

Physical Construction of the Amplifier (Optional)

In case you choose to physically implement and demonstrate your design, you should construct and test it ahead of time, to ensure its functionality and adherence to specifications, before you book an appointment to meet with Dr. Yazdani. When tested by Dr. Yazdani, your amplifier shall be tested for and is expected to reasonably closely adhere to the specifications. Collected test results and captured waveforms will be considered a bonus. You should bring them to the appointment and also append them to your report.