Loyola Marymount University

Department of Electrical Engineering and Computer Science

Multi-Stage BJT Amplifier Design

Objectives:

1. To design and study the characteristics of multi-stage amplifiers.

Required equipment and parts:

1. Q2N2222 BJT
2. Resistors
3. DC power supply
4. Signal generator
5. Standard resistors and capacitors

PRELAB

(1) Design an amplifier to meet the following specifications

$|A_V| \geq 100$ $R_L = 10k\Omega$, $R_{in} \geq 600\Omega$, $R_{out} \leq 8\Omega$

Design for $150 \leq \beta \leq 250$

$V_{CC} = 15$ V max.

$I_{supply} = 20$ mA max

Design for output swing as symmetrical as possible

Design for standard values of resistors and capacitors

(2) Test your amplifier design using MultiSim for **all possible extreme values** of β (adjust transistor parameters for simulation). In MultiSim, use the Bode Plotter instrument to plot the gain vs frequency from 10Hz to 100kHz. Show that your mid-band gain is above 100. To test the input resistance, first put a probe at the input terminal. Then select **Simulation->Analyses->AC Analysis->Output**. Click on the **Add expression**, double click on the **mag()** Function, and inside parentheses, put the expression ***V(Probe1)/I(Probe1)*** and click on Simulate. This will plot the input resistance. Adjust the axis scales and labels, and show that your design satisfies the R_{in} requirement. Sumit your circuit diagram along with the simulation results.

(3) Make a table of calculated and simulated values of all DC operating point values. If the calculated and simulated values vary by more than 5%, explain clearly with supporting calculations why they are different.

(4) Draw diagrams showing your input resistance and output resistance measurement schemes.

EXPERIMENT

(1) Build the amplifier and measure its operating point voltages and currents.

(2) Measure the small signal gain at 10kHz and verify that it is as expected.

(3) Measure the input and output resistances R_{in} and R_{out} by voltage division method by applying a 1kHz signal.

(4) Measure the maximum undistorted output voltage swing.

(5) Obtain the signature of the instructor when finished.

REPORT

(1) Submit the report according to the lab-report guidelines.

(2) Include your final circuit diagram in the system-description section of your report.

(3) Compare the calculated and measured value of operating point voltages and currents. Explain any differences. Include your answers in the results and discussion-of-results sections of your report.

(4) Compare the theoretical and measured voltage gain. Explain any differences. Include your answers in the results and discussion-of-results sections of your report.

(5) Compare measured and calculated values of input and output resistance. Explain any differences. Include your answers in the results and discussion-of-results sections of your report.

(6) Explain the model you used for your transistors in PSPICE simulations. You must explain the model parameters **YOU** used for your simulations, not the default parameters. You don't have to explain any default parameters, but must say why you think the default values will work. Include your answers in the system-description section of your report.