ECE 5255 Biomedical System Design Fall 2013

Lab 3A ECG Amplifier

Purpose: This lab exercise provides an opportunity to design, simulate in a SPICE circuit simulator, and build a portion of a biopotential amplifier for ECG signal amplification.

Background:

Background necessary for this lab can be found in Lectures 6 Biopotentials & The Biopotential Amplifier as well as Lecture 5 ECG.

Procedure:

Design a biopotential amplifier to amplify an ECG signal. Use the table on slide 18 of Lecture 6 to determine the desired bandwidth (corner frequencies for your first order lowpass and highpass filters) as well as the gain necessary to amplify the signal such that the largest ECG signal produces approximately a 5 V output. You will not need to design/implement a driver leg circuit. Consider using the amplifier circuit that is given on slide 34 of Lecture 6 for your biopotential amplifier design and simulation but note that in the actual construction on the breadboard that you will be given an AD620 instrumentation amplifier to use and therefore note the relation of resistor RG to gain G.

For the simulation portion of your design, you may use ideal operational amplifiers (see provided model from instructor) as well as represent the instrument amplifier with 3 operational amplifiers. Use ac or any other simulations to verify the circuit design performances such as differential gain, peak-to-peak output swing, and the lower and upper cutoff frequencies (bandwidth). You should also double check that the common mode signal is significantly rejected. Please note that you will breadboard this design so make sure to choose component values (external to the instrument amplifier) that are available in the sophomore crash cart. In such cases, you may need to readjust the bandwidth of the amplifier to more achievable/reasonable bandwidth (corner frequencies) for the filters.

For the biopotential amplifier construction on a breadboard, the MyDAQ's +/-15VDC should be used for the supplying power to the active circuits. Draw a schematic of your circuit showing the pin connections for the discrete ICs and values for all the components and power supplies. Show also where the input signal source is applied and where the output measurements are taken. For the measurements, you need to show that you'd achieved the desired gain and frequency response (estimated cutoff frequencies). As the available lab function generator

cannot produce low enough signals to test the ECG circuit, you must attenuate the signals applied to the amplifier, possibly using a voltage divider.

Submission:

You will need to demonstrate your simulation and its results as well as the constructed circuit measurement results to your instructor such as the differential gain, bandwidth, and output voltage swing of the amplifier and the common mode gain and/or CMRR. Other considerations are the power drawn (in terms of DC current).

To receive consideration for full credit for Lab 3A, you will need to submit the recorded simulation and measurement results and a drawn schematic with the proper labels and pinouts. For the simulation portion of this lab, save your team's Spice simulation as Lab3A_Bio_Amp_lastname1_lastname2.asc, for example, for Dr. Khuon and Sachin Namboodiri, the filename would be **Lab3B_IA_Khuon_Namboodiri.asc** (for an LTSpice file). Submit this Spice file to the digital dropbox under the Labs folder on the course Blackboard website. All submissions are due by Thursday, October 9.