Assignment 6

1 Design Exercises

1.1 (5 points)

Derive the gain expression (G) for a non-ideal inverting amplifier (see figure 1) with a correction due to a finite open loop gain of an OpAmp (A).

1.2 (5 points)

Show that in the above problem the inverting input potential is close to the non-inverting input potential, i.e. $V_- \approx V_+$, for the large, compared to G_{ideal}, values of A.

1.3 (5 points)

Derive the expression for the output impedance Z_{out} for a inverting amplifier base on an ideal OpAmp ($A \to \infty$, $R_{input_{internal}} \to \infty$, and $R_{out_{internal}} \to 0$). I.e. find the equivalent internal Thevenin resistance. Assume that you know V_{in}, R_1, and R_2.

Hint: imagine different load resistors (R_{load}) connected to the output and see what is the current (I_{load}) running through them. What does it tell about output impedance (Z_{out})?

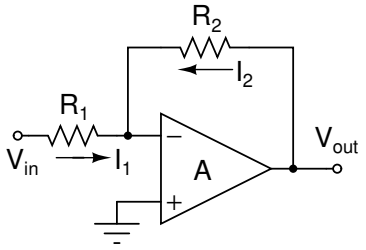

Figure 1: An inverting amplifier circuit.

1.4 (5 points) (Can be done after the lab)

Derive the expression for the input impedance (Z_{in}) for a inverting amplifier based on an ideal OpAmp ($A \to \infty$, $R_{input_{internal}} \to \infty$, and $R_{out_{internal}} \to 0$). Recall that it can be expressed as V_{in}/I_{in}, where I_{in} is the current sourced to or consumed by the amplifier.

2 Lab 6: Buffer

Always start with a circuit diagram and only then build it in hardware.

Your notebooks must be complete, understandable, and address all activities, design exercises, observations, and questions noted in the laboratory's procedures. Remember to use your notebook as a laboratory journal and record your data, design calculations, notes and scratch work. *Make sure to write a conclusion for each exercise and each week.*

Task 0

Demand

- a tutorial about bipolar power supply
- a tutorial about OpAmps connections and pins labeling
- a tutorial about railing or clipping of output voltage of OpAmps

Task 1 (20 points) Our old friend voltage divider

Build a 50/50 voltage divider with resistors about 100 kΩ. Measure its output impedance (Thevenin resistance) at AC signal frequency of about 10 kHz.

Do not disassemble, you will need it in the next task.

Task 2 (30 points) Buffer

Build an OpAmp buffer (based on LM741 amplifier) and power it from ±15V. Do not proceed to next step unless you have tested that the buffer/follower works as it should.

Connect your buffer input to the voltage divider output from the previous taks. Measure the output impedance of this combo (i.e. at the buffer output) at frequency of 10 kHz.