

Assignment 10 - Electrocardiogram (ECG)

This Assignment aims at verifying and expanding, with experiments and supporting simulations, your knowledge and understanding of electrocardiogram circuits, including their high sensitivity and common-mode rejection.

Please document each step with snapshots, pictures, and your observations. Please make visible on WaveForms the date and time fields (top left) and the serial number (bottom right) of your Analog Discovery. Also, please include this page.

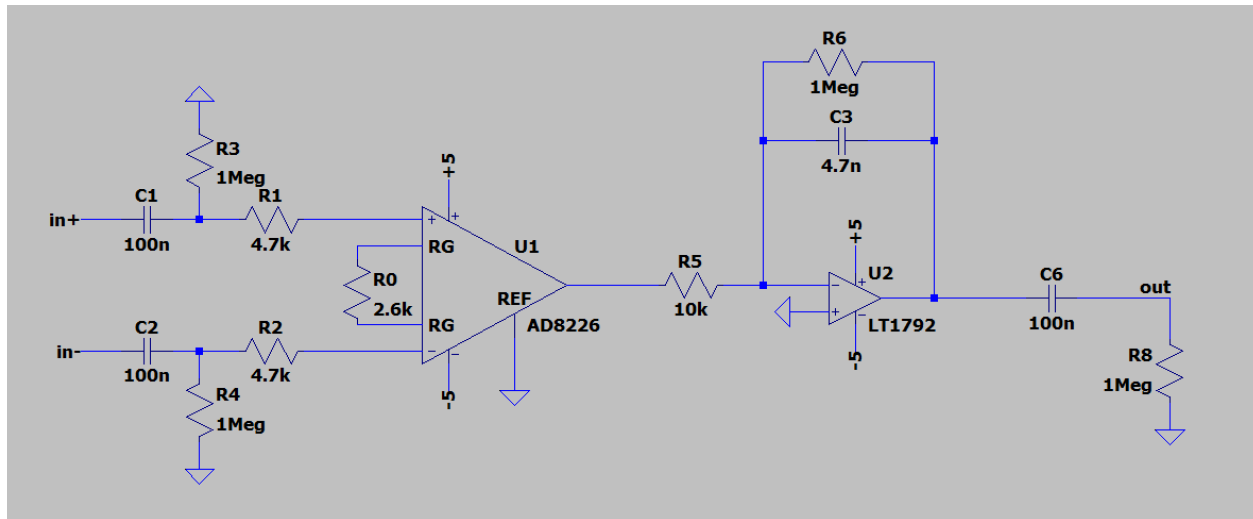


Figure 1 - ECG circuit

- 1) Using the simulator, design the circuit shown in Fig. 1 **(20pts)**
 - a) simulate and show the response to a 50Hz 1mV sinusoidal signal connected between the positive in+ and the negative in- inputs and calculate the gain
 - b) explain in your own words how the circuit operates: what are the roles of the two amplifiers?
- 2) Build the circuit at (1) and experimentally reproduce the simulations **(40pts)**
 - a) in place of the AD8226 you can use the INA111 (AP or BP) or the AMP02
 - b) in place of the LT1792 you can use the AD711 or an alternative low-noise JFET input amplifier
 - c) keep the negative input in- grounded and apply a 1mV ~signal at the positive input by using a ~10mV and a ~x10 resistor divider
- 3) Demonstrate a ECG measurement **(40pts)**
 - a) use two shielded cables (e.g. from a R/L audio cable) to build and connect the two inputs to two electrodes; see example in Figure 2



Figure 2: Example of shielded cable with electrodes for the ECG

b) Connect the two electrodes to your left and right wrists; you must obtain a measurement as shown in Figure 3

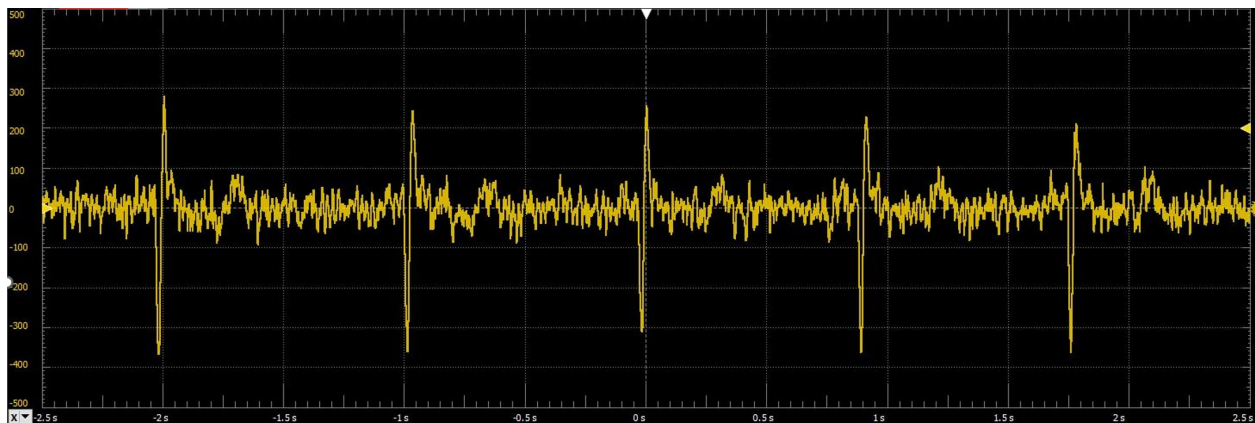


Figure 3: Example of wrist ECG measurement

Hint 1 - The circuit is very sensitive to microphonics: you may need to keep the wires very firm during the measurement.

Hint 2 - The circuit is very sensitive to 60 Hz: you may need to step out of your house (e.g. in your car) with your battery-operated laptop.