Neural Recorder

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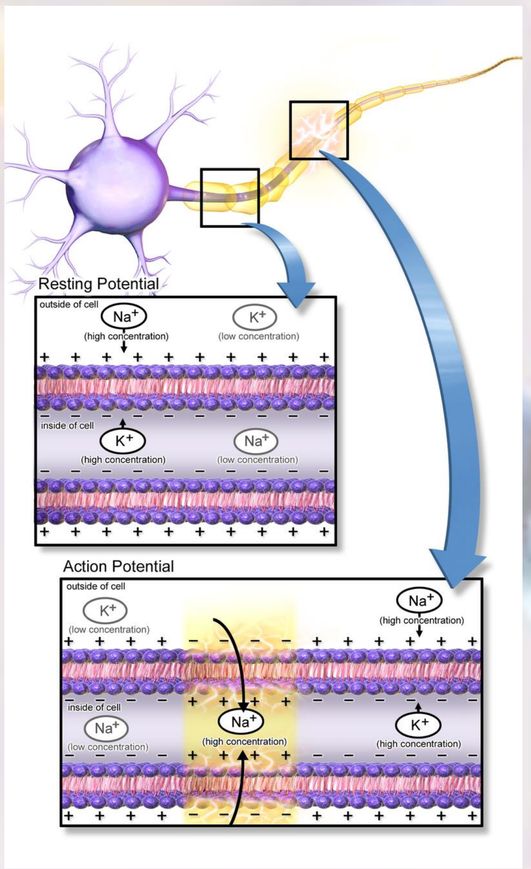
Introduction

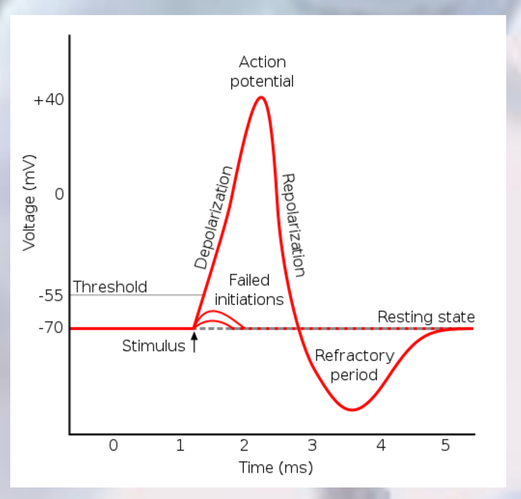


The nervous system is still a system that has not been fully resolved and has many question marks. Neurological diseases still do not have a complete solution.

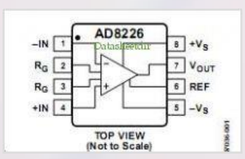
The aim of the project is the designing a product which takes neural activity from cockroach and worms and display on the computer with a microprocessor.

The product has designed for everyone who has interest in neuroscience. The person who has the product can have a significant knowledge about neuroscience. It is the biggest aim of the project. The product is easy to use and portable.

A microelectrode is inserted into an axon in such a way that the surface membrane seals itself around the electrode. The potential difference maintained across the cell membrane in the absence of stimulation is called the resting potential (in humans, −70 mV and varies from cell to cell)(it is negative because the interior of the cell has a negative voltage relative to the exterior).



To record neural activity , other than microelectrodes we will need an amplifier to enlarge the very tiny changes in membrane potential into a measurable size. And finally we need to connect a microprocessor to our circuit so we can see the changes in membrane potential on the computer. For digitalization we used RaspberryPi 2 microprocessor. We achieved 10kHz sampling rate while transferring data to computer.



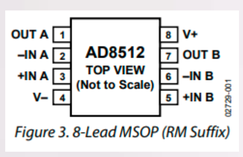


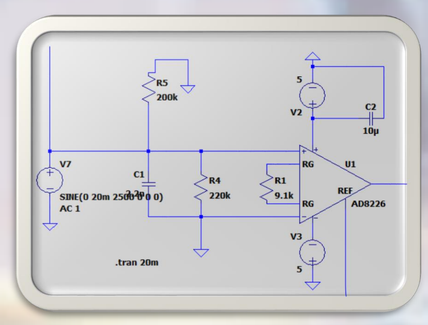
Figure 3. 8-Lead MSOP (RM Suffix)

Generally, when designing neural amplifiers, to provide the required signal quality , several factors should be considered. These factors are sufficient gain, high SNR, appropriate bandwidth , high CMRR and power supply rejection ratio, low power consumption and low chip area.

Design Specifications

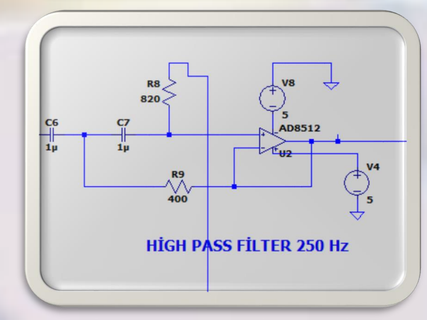
❖ Gain of Input Amplifier:

$$G = 1 + \frac{49.4\ k\Omega}{R_G}$$



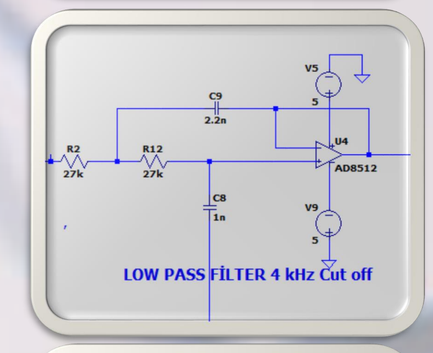
❖ Cut-off Frequency of High Pass Filter:

$$fc = \frac{1}{2\pi RC} Hz$$



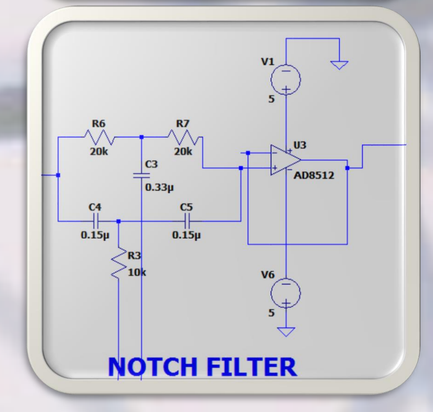
❖ Cut-off Frequency of Low Pass Filter:

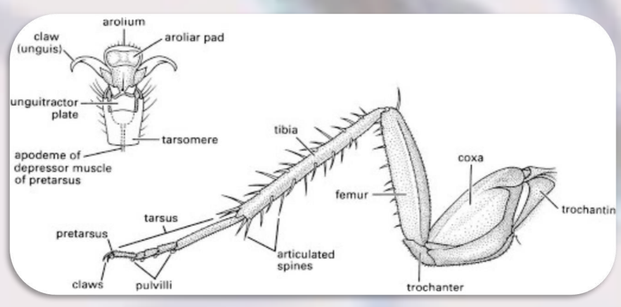
$$fc = \frac{1}{2\pi RC} Hz$$

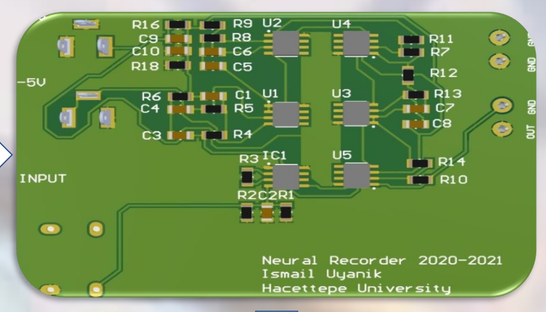


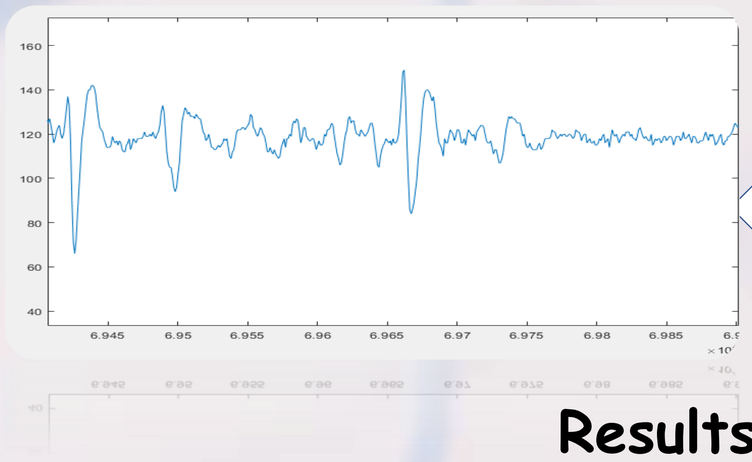
❖ Cut-off Frequency of Notch Filter:

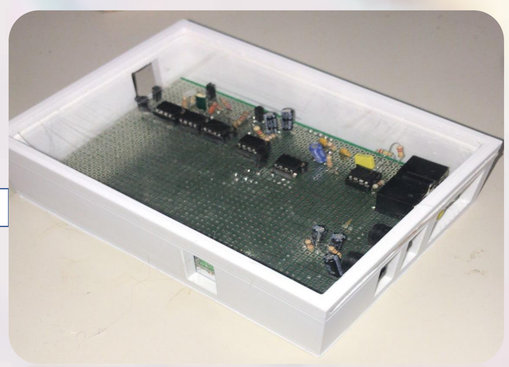
$$fc = \frac{1}{4\pi RC} Hz$$











Results

With the circuit designed in the project, the signals were observed in the desired frequency range and the signals were digitized via the microprocessor. The digitized signals were displayed in the computer environment with the interface. Considering the usage purposes of this project, progress can be made in neuroscience and interneural transmission can be observed. These recorded signals can be interpreted and transferred back to the live with stimulation.