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Level: **one**

EMG

(Electromyography)

EMG-electromyography- records the movement of our muscles. It is based on the simple fact that whenever a muscle contracts, a burst of electric activity is generated which propagates through adjacent tissue and bone and can be recorded from neighbouring skin areas. The signals can be analysed to detect medical abnormalities, the amount of fatigue in a muscle, activation level, or to analyse the biomechanics of human or animal movement, or as a control signal for prosthetic devices.

How does EMG work?

EMG activity (measured in microvolts) is linearly related to the amount of muscle contraction as well as the number of contracted muscles. The stronger the muscle contraction and the higher the number of activated muscles, the higher the recorded voltage amplitude will be.

EMG activity is even measurable when we do not display obvious actions or even inhibit certain behaviours, EMG recordings represent an additional source of information into cognitive-behavioural processing which would be hidden based on pure observation.

Types of EMG

There are two kinds of EMG:

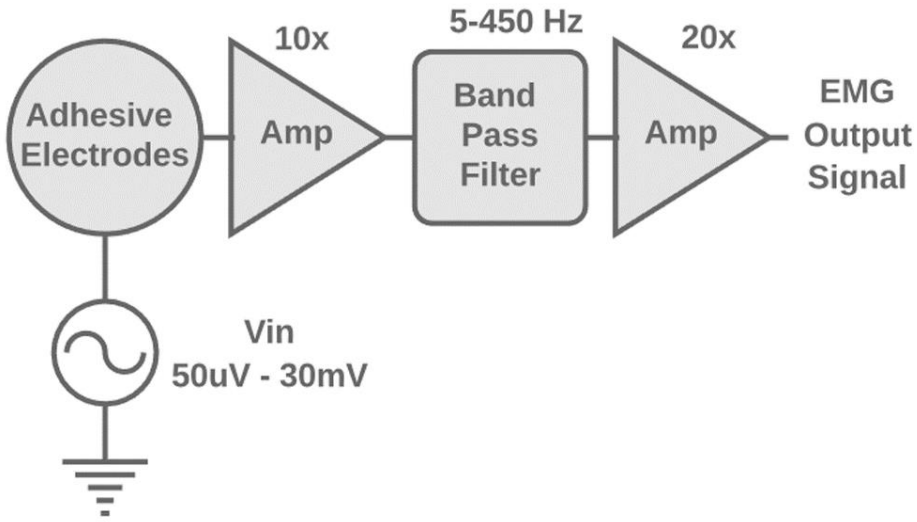
1. **Surface EMG**

- Surface EMG assesses muscle function by recording muscle activity from the surface above the muscle on the skin.
- Surface electrodes are able to provide only a limited assessment of the muscle activity.
- Surface EMG can be recorded by a pair of electrodes or by a more complex array of multiple electrodes. (More than one electrode is needed because EMG recordings display the potential difference (voltage difference) between two separate electrodes)

2. **Intramuscular EMG:**

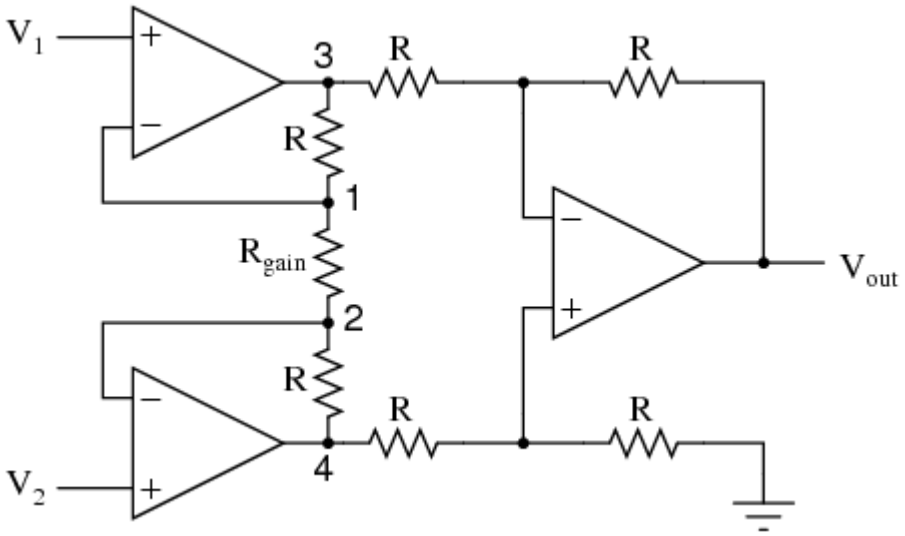
- Intramuscular EMG can be performed using a variety of different types of recording electrodes.
- The simplest approach is a monopolar needle electrode. This can be a fine wire inserted into a muscle with a surface electrode as a reference; or two fine wires inserted into muscle referenced to each other.

EMG Sensing circuit:

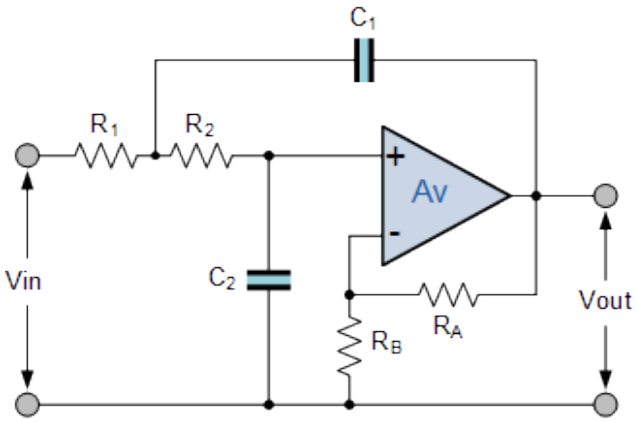


The stages of the circuit:

1. **Instrumentation amplifier**: provides high input impedance to match the high output impedance of skin.



2. **Band pass filter:** removes frequency content out of the bandwidth of the EMG.



$$\text{Gain (Av)} = 1 + \frac{R_A}{R_B}$$

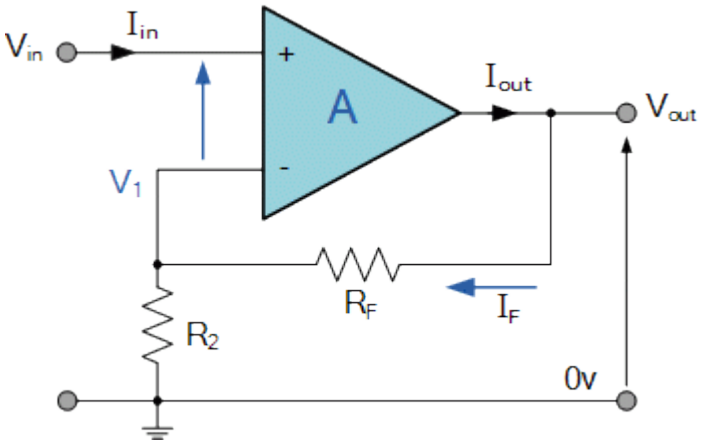
If Resistor and Capacitor values are different:

$$f_C = \frac{1}{2\pi\sqrt{R_1 R_2 C_1 C_2}}$$

If Resistor and Capacitor values are the same:

$$f_C = \frac{1}{2\pi RC}$$

3. **Non-inverting amplifier:** provides enough gain to make the small EMG signal large enough to be usable.



The EMG circuit requires three electrodes: positive input, negative input, and ground. The placement of the electrodes will vary based on the muscle that you intend to measure. For example, the bicep, the elbow is a suitable placement for ground. The positive and negative electrodes should be placed on the upper arm.