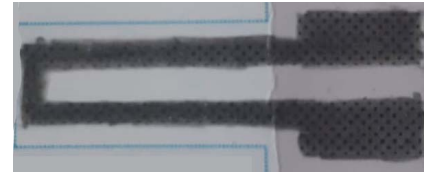


GRAPHITE SENSOR

I Overview

- 1 input signal 0-5V
- 1 output signal
- Graphite layers on paper sheet



II Description

- Passive sensor.
- Graphite sensor works as a strain gauge. The graphite on the paper sheet is laid in a percolated network of graphite particles that change their electrical resistance upon mechanical efforts as compression or deflection.
- The sensor must be powered by 5V DC power supply
- The resistance at rest depends on how much graphite is present on the paper sheet and which pencil is used. The more usual orders of magnitude of resistance for B and HB pencils are around the $M\Omega$.
- Graphite sensor has to be connected to an electrical circuit which can be seen in the Figure 1. For more details on the behavior of the electrical circuit, we recommend reading the LTSpice report.

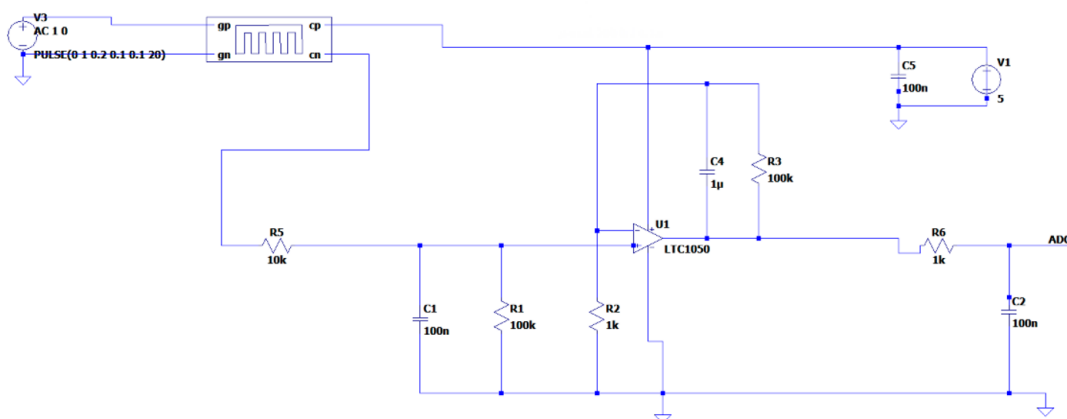


Figure 1: Electrical circuit used for the sensor

- The most optimal quantity of graphite that has to be present on the paper sheet is when the output signal is around a 3 V.
- Graphite sensor has a service life limited by the number of mechanical stresses it is subjected to. In the case of B pencil-sensor it can properly work for around 400 efforts (compression and deflection) and in the case of a HB pencil-sensor is 200 (Figure 4).

III Technical specification

	Unit	Value
Power voltage	V	5
Dimensions	$mm * mm$	35x15
Recommended Temperature	$^{\circ}C$	25
n° of inputs		1

IV Measures

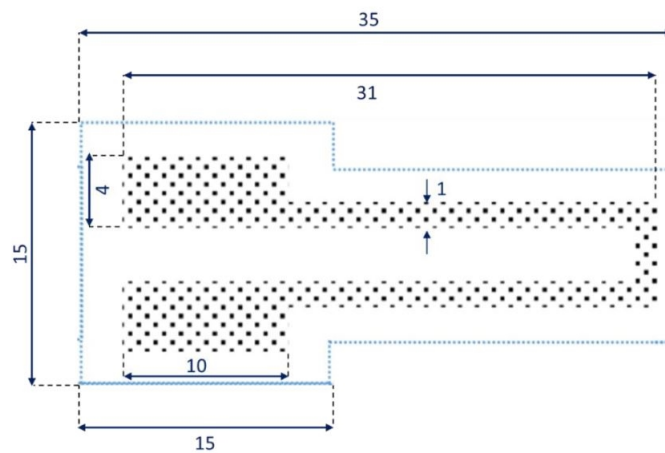
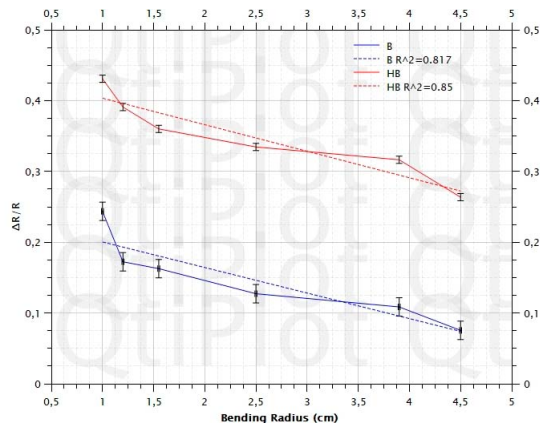


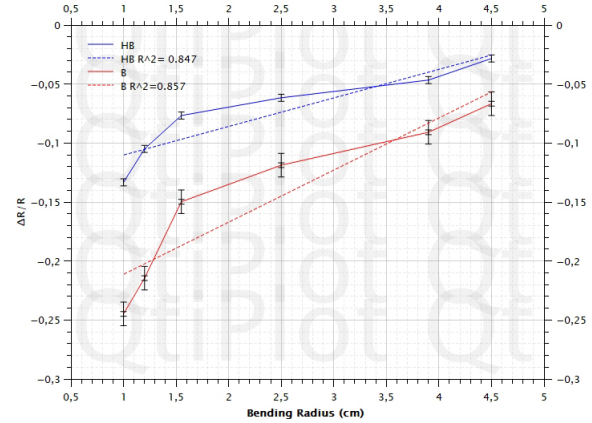
Figure 2: Measures of the graphite sensor in mm (CC_Seby_2021-GitHub)

V Behaviour

Different test have been made to know how much does the resistance change with mechanical stress. Figure 3 shows that HB pencils leave graphite layers much more likely to change their electrical resistance with compression. However, B pencils layers are more reactive to deflection stress.



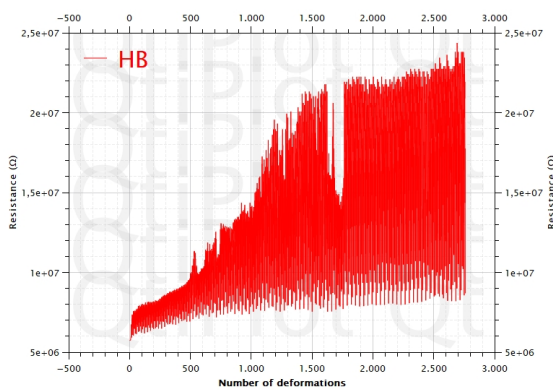
(a) Relative variation of resistance as a function of tensile



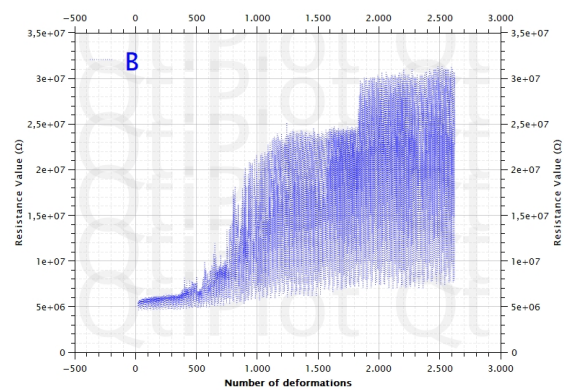
(b) Relative variation of resistance as a function of compression

Figure 3: Relative variation of resistance as a function of deformation

Figure 4 shows that B pencil-sensor have a longer service life than HB sensors: it can withstand up to twice the number of deformations. The graphite on B sensors is less reactive than the HB one, so its resistance is more stable and it can be used many more times.



(a) HB pencil-sensor



(b) B pencil-sensor

Figure 4: Resistance of graphite sensor as a function of the number of deformation it has undergone