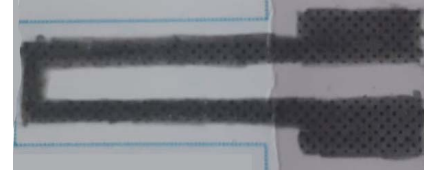


GRAPHITE SENSOR

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 found in the LT-Spice report to amplify and obtain a clean and readable output signal.
- 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 3).

III Technical specification

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

IV Measures

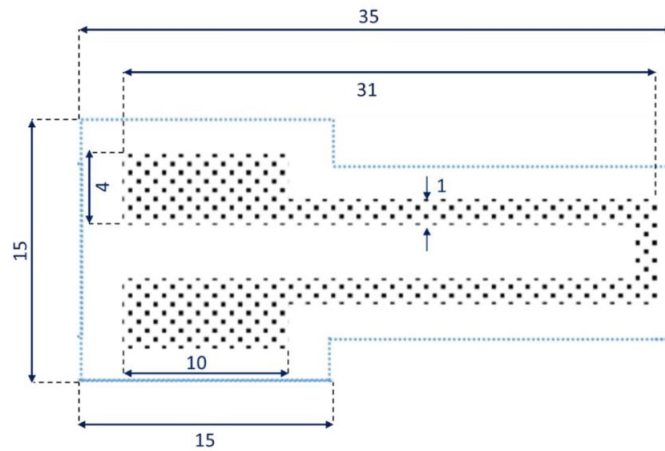
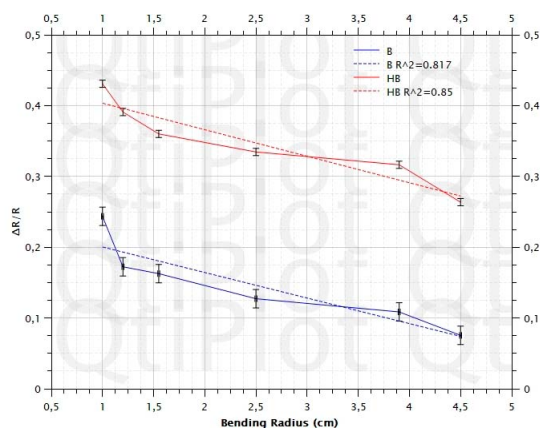


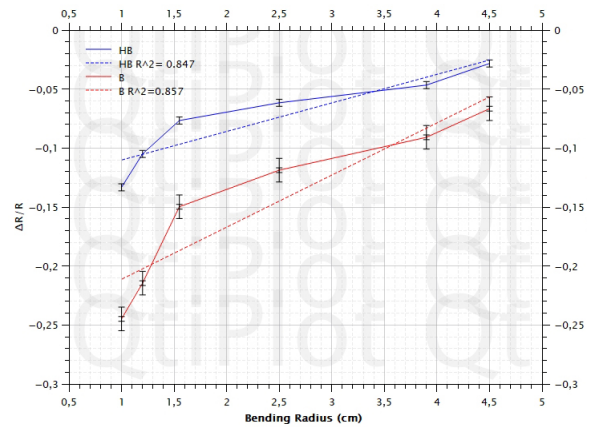
Figure 1: Measures of the graphite sensor in mm (CC_Seby_2021-GitHub)

V Behaviour

Different tests have been made to know how much the resistance changes with mechanical stress. Figure 2 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.



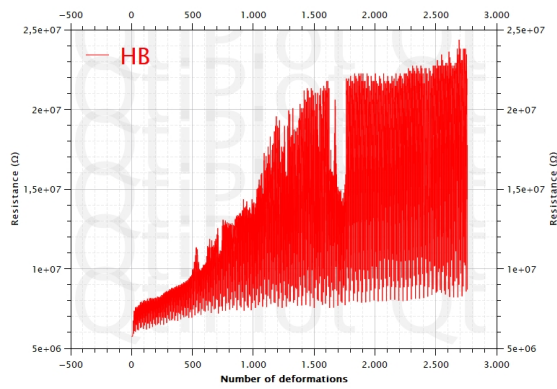
(a) Relative variation of resistance as a function of tensile



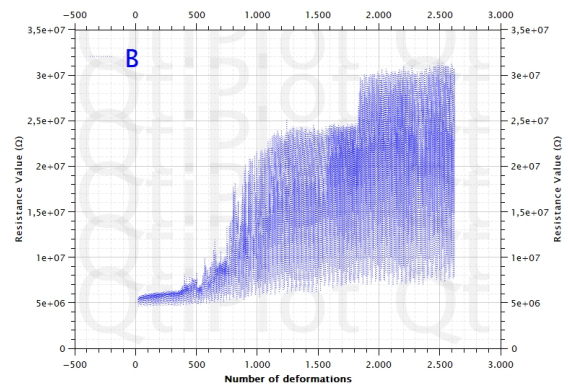
(b) Relative variation of resistance as a function of compression

Figure 2: Relative variation of resistance as a function of deformation

Figure 3 shows that B pencil-sensors 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 3: Resistance of graphite sensor as a function of the number of deformation it has undergone