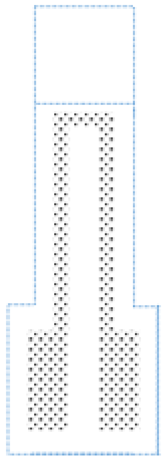
Graphite Strain Sensor



DATASHEET

This graphite sensor is a user-friendly analog Strain Sensor, which is designed to use the up and coming method of paper based electronics. It has been designed based on the scientific paper *Pencil Drawn Strain Gauges and Chemiresistors on Paper*[1] for the purpose of detecting compressive and tensile deflections. Using a simple layer of deposited graphite on paper, the electronic connection between the graphite particles will vary depending on the type of deformation the sensor is subjected to. This results in a variation in resistance which we can use to set up a strain sensor.

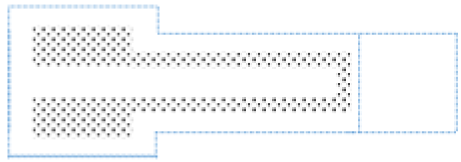
Note that a transimpedance amplifier is necessary to analyze the resulting signal, see Application note 1 for more details.

[1] Lin, CW., Zhao, Z., Kim, J. *et al.* Pencil Drawn Strain Gauges and Chemiresistors on Paper. *Sci Rep* **4**, 3812 (2014). https://doi.org/10.1038/srep03812

Functional specification

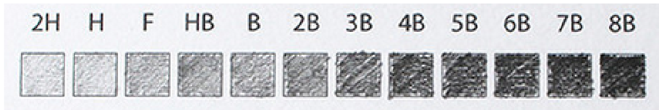
Power supply	Min.	Typical	Max.
Supply voltage	-	5 VDC	5.25 VDC
Humidity			
Operating Humidity	0%	30%	60%
Storage Humidity	0%	50%	90%
Condensation (>100%)	Sensor’s conductive ability would be greatly affected, we recommend using a protective layer on the whole sensor.		
Température			
Operating Temp.	10 °C	-	35 °C
Storage Temp	0°C	-	60°C
Pressure			
Operating Pressure	80kPa - 120kPa		
Storage Pressure	80kPa - 120kPa		
Output Signal			
Analog Output	0 - 5VDC Max		
Technical Specifications			
Body Material	Paper		
Paper Thickness	0.15mm	-	0.30mm
Body Weight	70mg	-	140mg
Pencil Tone[2]	8B	-	2H

[2] The values are based on the US grading system



Features

- Large range of resistivity choice:



- Easy manufacturing, low cost,
- High resolution,
- Analog output of Strain value,
- Typical low power consumption,
- Easy to use, replace or repair

Key Applications

- Learning environment
- Detection and Control
- Automation

Electronic Configuration

(Dimensions in mm)

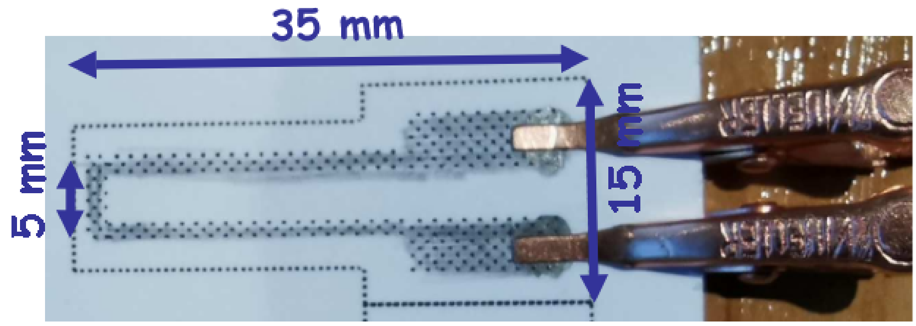


Fig 1. Graphite sensor dimensions.

Pad	Name	Description
1	VIN	5 Volts - 5.25 Volts DC input
2	OUT	Analog output, see Application note 1 for measurements details.
Note 1: All dimensions are in mm. All tolerances Linear +/- 0.1mm unless stated. Note 2: Pad are interchangeable without modification of sensor’s value[3]. Note 3: DO NOT DAMAGE GRAPHITE DEPOSITION, sensor’s integrity could be impacted.		

[3] Depending on the uniformity of graphite deposition, measurements and functionality could be subject to change if pads are exchanged.

Application Note 1 : Typical Performance Characteristics

(All data are related to a calibrated sensor and conditions : Temperature 20°C, Relative Humidity 10%RH, Pressure 101kPa, Averaging of 10 Values unless stated otherwise.)

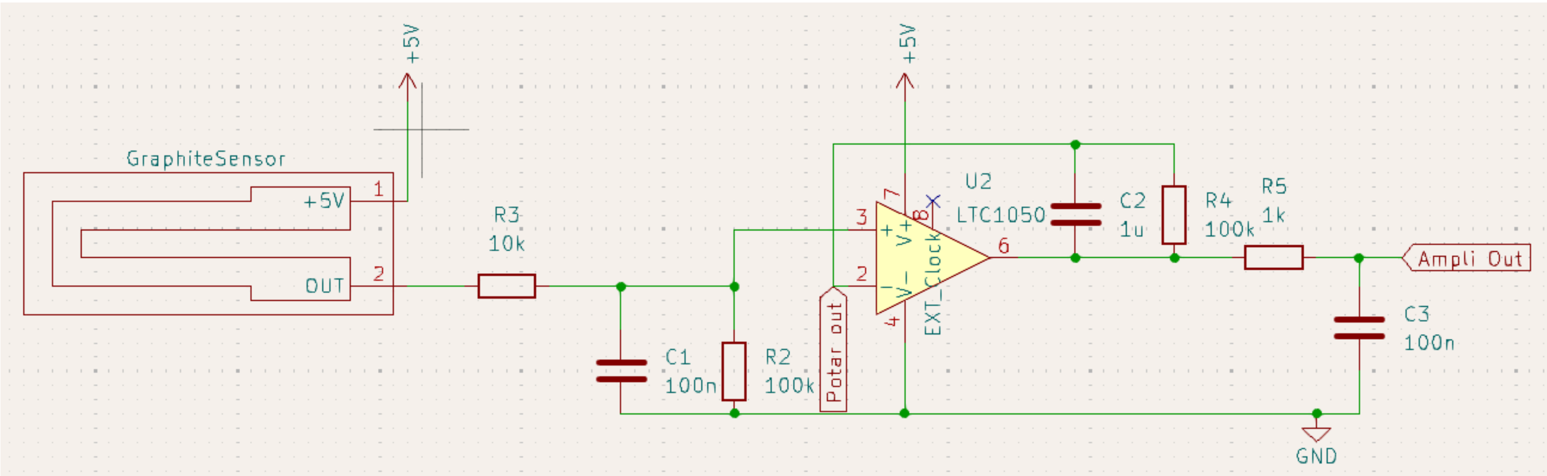


Fig 2. Example of Schematic to operate the Strain Sensor

For the readability of the sensor's value, we recommend connecting it to a transimpedance amplifier circuit that will amplify its signal as its current output being in the range of 10^{-7} A is difficult to read without precise equipment. In this circuit, the entrance resistance is replaced by a digital potentiometer, allowing us to modify the circuit's Gain. This can be necessary to exploit the measurements in their best conditions and avoid saturation or non-readable values.

The Strain sensor's Value can then be calculated using this formula:

$$Rsensor = \left(R2 * \left(1 + \frac{R4}{Rpotentiometre} \right) * \frac{Vin}{Vout} - R2 - R3 \right)$$

With: R2 = 100k Ohms ; R4 = 100k Ohms ; Vin = 5VDC ; R3 = 10k Ohms.

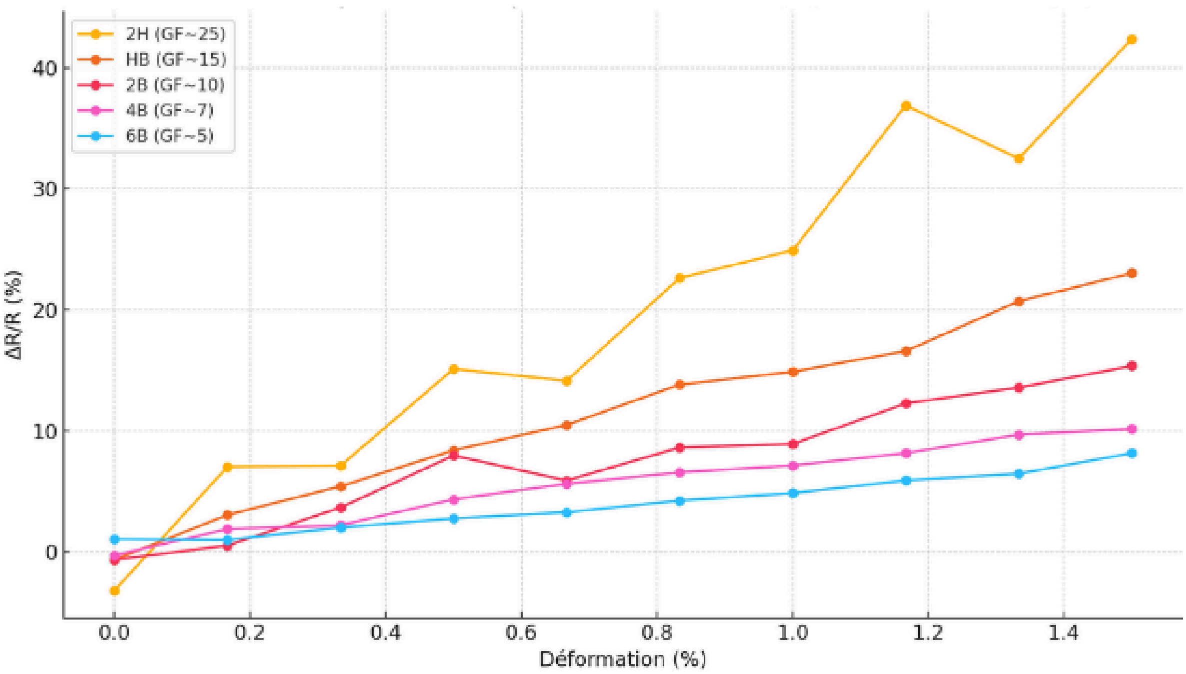


Fig 3. Plot of the relative resistance value (in %) based on deformation(in %) in case of flexion.

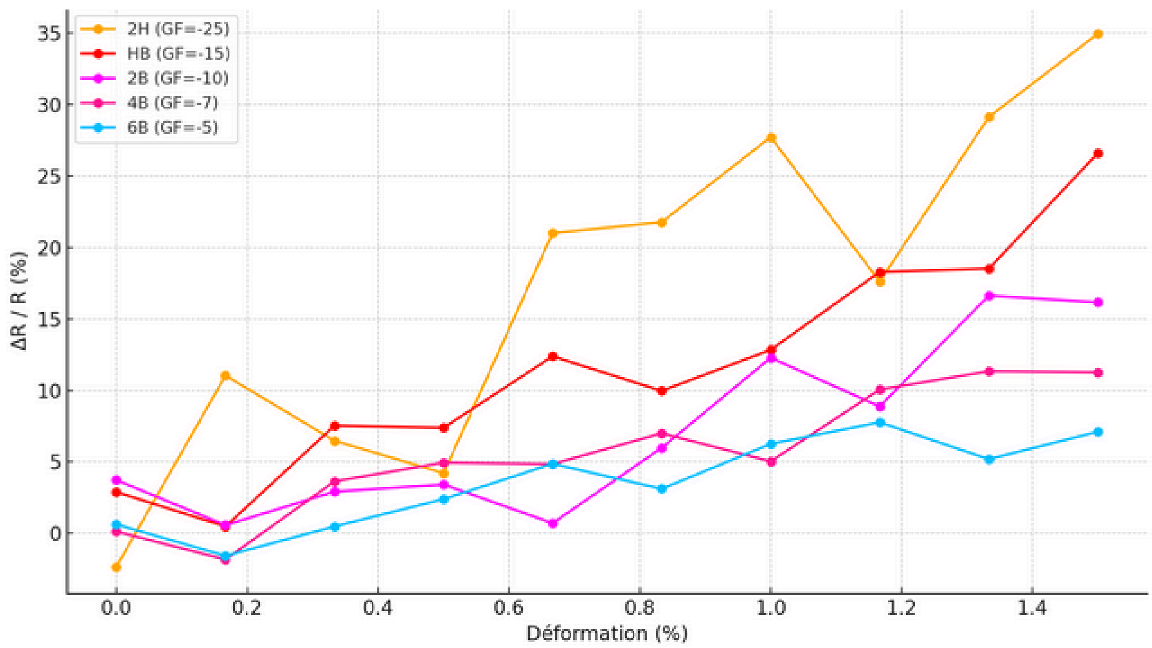


fig 2. Plot of the relative resistance value (in %) based on deformation(in %) in case of compression.

Note : GF refers to the Gauge Factor defined as : GF = $\Delta R / R\varepsilon$