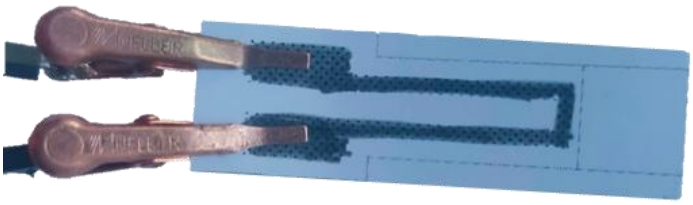
INSA INSTITUT NATIONAL DES SCIENCES APPLIQUÉES TOULOUSE

B&B Technologies

LOW-TECH GRAPHITE STRAIN GAUGE: LTG-SG24

FEATURES

- Low power consumption (3,3V-5V)
- Environmentally-friendly
- Small size (10 cm^2)
- Ultra light (10 g)
- Low cost
- Plug & Use
- Easily repairable & replaceable



DESCRIPTION

This low-tech strain sensor is made by the student of the Physics department of INSA Toulouse based on the publication *Pencil Drawn Strain Gauges and Chemiresistors on Paper*[1]. It is composed of a piece of paper on which layers of graphite are deposed using pencils.

By deforming the paper, the number of connected graphite particles making up the pencil deposited on the paper varies depending on the type of deformation. This granular system undergoes a change in resistance and conductance. Thanks to this, we will be able to trace the deformation like a traditional strain gauge.

An transimpedance amplifier should be necessary to amplify the signal and analyzing the resulting signal and trace the deformation.

DIMENSIONAL DIAGRAM

Graphite Layer

Thickness: 0,2

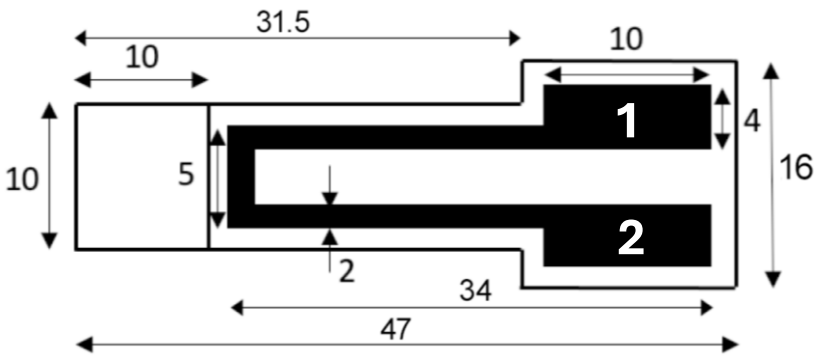


Fig 1: Top view – Dimensions (mm)

Pin number	Typical voltage
1	V_{in}
2	$+V_{cc}$ *

**Vcc is typically a +5V voltage.*

[1] Lin, C.-W., Zhao, Z., Kim, J. & Huang, J. Pencil Drawn Strain Gauges and Chemiresistors on Paper. Sci. Rep. 4, 3812; DOI:10.1038/srep03812 (2014).

ABSOLUTE MAXIMUM RATINGS

Total supply voltage $(V^+ \; to \; V^-)$ 5V
Temperature..... 10°C to 30°C
Humidity of air..... 30% to 60%
Life cycle.....10 to 15 usage
Paper thickness..... 0,15mm to 0,3mm
Pencil tone.....4B to 2H *
**Corresponding to #0 to #4 for USA grading*

ELECTRICAL CHARACTERISTICS

Parameter	Unit	Value		
		Min	Typical	Max
Power Supply	V	3,0	5,0	7,0
4B	MΩ	0,9	1	1,3
2B	MΩ	32	34	47
B	MΩ	9	15	21
HB	MΩ	2,2	3	4,1
H	MΩ	200	440	700
2H	MΩ	150	3000	10000

**High dispersion of values: it varies grandly with the quantities of graphite deposed with the pencil (± 5x)*

TYPICAL PERFORMANCE CHARACTERISTICS

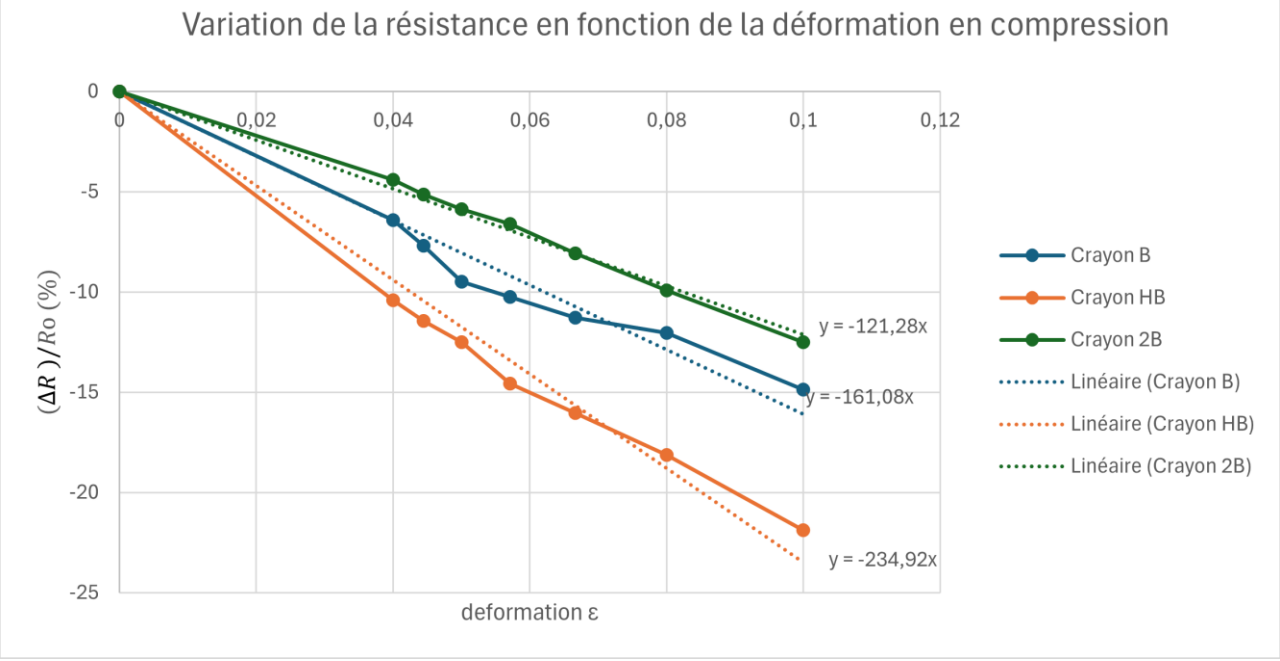


Fig 2: Characteristics in compression

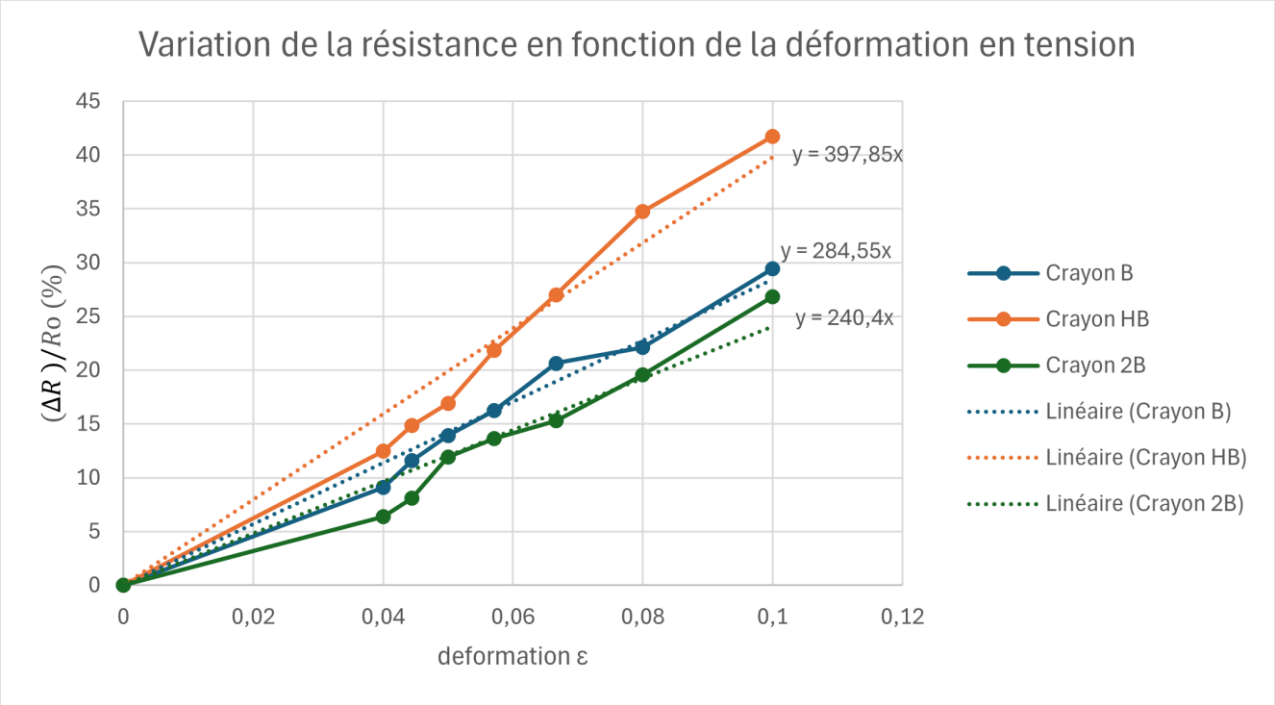


Fig 3: Characteristics in tension

TYPICAL APPLICATION

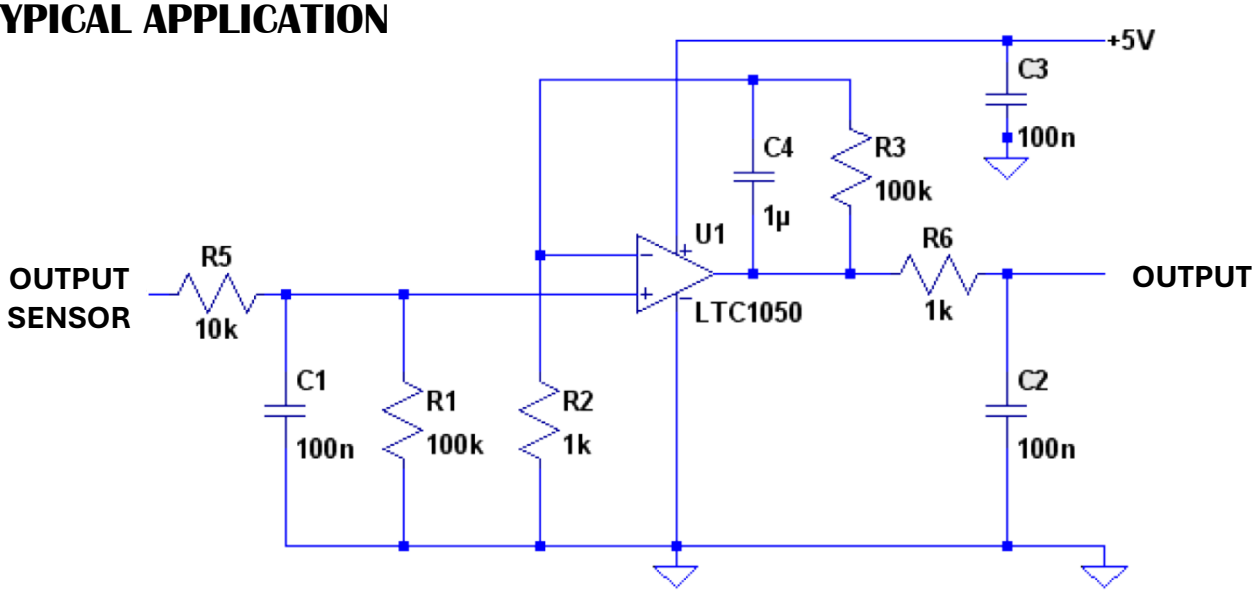


Fig 4: Transimpedance amplifier circuit to use the sensor

The sensor is connected to a transimpedance amplifier circuit with low-pass and high-pass filters to cancel the noises due to the amplification, the current and 50Hz effects of the signal.

Then, the resulting signal can be transmitted, for instance, to the ADC of an Arduino-board in order to be treated without saturating the ADC. A variable resistance can used for R2 to match amplification of circuit for each pencil tone.

It is possible to know the value of the resistance of the LTG-SG24 with the value of the final voltage and the following formula :

$$Res = R1 * (1 + \frac{R3}{R2}) * \frac{Vcc}{Vadc} - R1 - R5$$