XYZ Strain Gauge

1 Features

- Low cost/ environmentally friendly
- Easy to fabricate
- Transportable

2 Applications

- For pedagogical use
- In noncritical applications

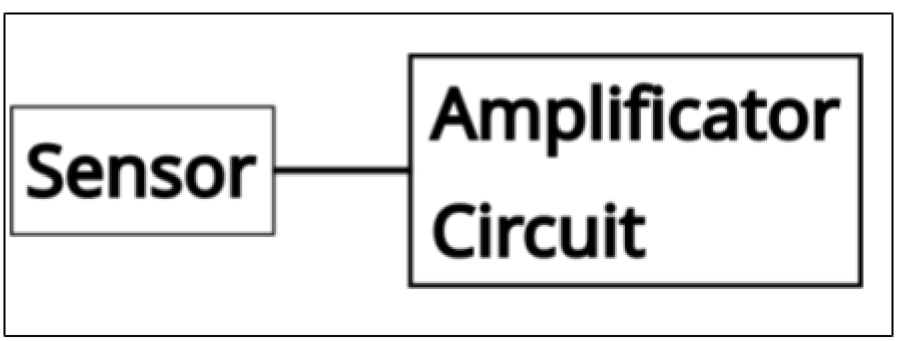
3 Description

The XYZ series is a general purpose strain gauge that distinguishes itself from other commercially available gauges by its ease of fabrication and low cost. It is environmentally friendly and requires only a few tools to fabricate.

This strain gauge was based on the publication Pencil Drawn Strain Gauges and Chemiresistors on Paper.

The XYZ is mainly identical to the other low-tech strain gauges fabricated by the physics department students of INSA Toulouse.

Simplified Schematic



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4 Specifications

4.1 Absolute Maximum Ratings

over operating free-air temperature range (unless otherwise noted)[1][2]

	MIN	MAX	UNIT
Supply Voltage		10	V
Operating Temperature	0	100	°C
Storage Temperature	-50	100	°C

(1) Stresses beyond those listed under Absolute Maximum Ratings may cause permanent damage to the device.

(2) The device cannot be used if absolute precision and reliability are necessary

4.2 Recommended Operating Conditions

over operating free-air temperature range (unless otherwise noted)

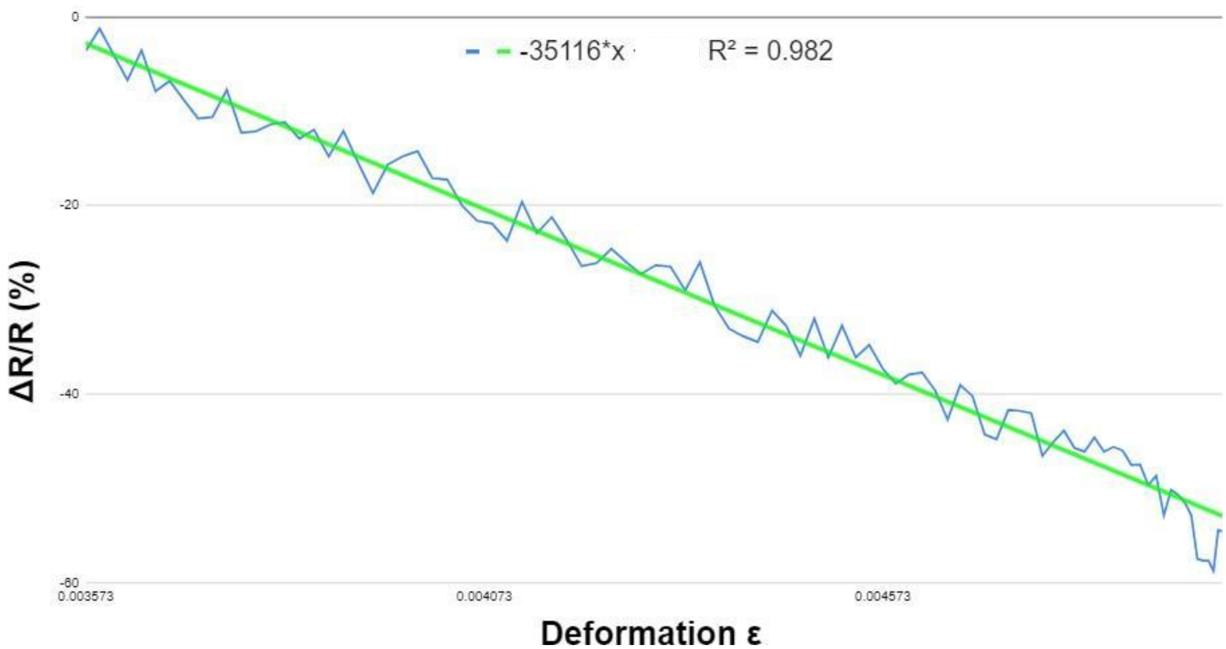
	MIN	NOM	MAX	UNIT
Supply Voltage	3	5	10	V
Output Current	0	25	100	°C
Humidity	0	30	70	%

4.3 Electrical Characteristics

	MIN	NOM	MAX	UNIT
Sensor Resistance	5	~20	+inf	MΩ
Output Current	-	100	-	nA
Output Voltage	0		5	V

4.4 Resistance Variation Under Deformation

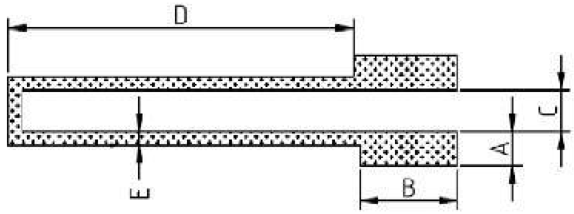
Capteur graphite en flexion



Capteur graphite en traction

5 Detailed Description

5.1 Dimensions



		Unit	Value
A	Connexion pad width	mm	4
B	Connexion pad height	mm	10
C	Gap between pads	mm	3
D	Sensor length	mm	23
E	Sensor thickness	mm	1.5

5.2 Fabrication Procedure

Cut the paper based on the abovementioned dimensions. Then take an HB2 pencil and draw on the dotted zone. Beware that with this procedure, having a single layer of graphite is impossible, and the resistance of the sensor will vary significantly based on the drawing motion. It is recommended to keep the same pressure while drawing and to fill in the paper in one or two strokes. The sticky tape can remove excess graphite if a more uniform distribution is desired. It is important to note that this step must be done carefully.

Two other methods are presented below:

- A little bit of tape is put on a graphite crystal, removed then put again to deal with impurities on the surface of the graphite. A new tape is taken and put on the surface of the crystal. The tape is then bent over (facing the sticky sides together), and the graphite is captured on both sides. Then the tape is pulled back again to separate the fragments of graphite. This can be repeated, and eventually, a single layer of graphite can be achieved. The tape is afterward put on a clean sensor.
- A monocrystal silicon wafer is taken, and the graphite crystal or the pencil is drawn across it. The sheets will come off onto the silicon, which can be put on paper using sticky tape.

5.3 Theoretical Background

When pencil traces are drawn on paper, friction between the pencil lead and the paper rubs off graphite particles that adhere to the paper fibers. Pencil traces can be regarded as conductive thin films made of percolated graphite particle networks on paper. The deformation of the paper leads to the gap between particles changing, which has an effect on the conductivity of the paper.

6 Application and Implementation

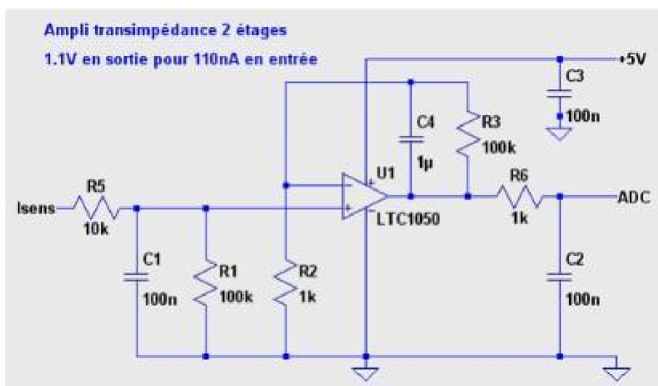
NOTE
Information in the following applications sections is not part of the XYZ component specification, and the authors do not warrant its accuracy or completeness. The end users are responsible for determining suitability of components for their purposes. Users should validate and test their design implementation to confirm system functionality.

6.1 Application Information

The sensor can be used with any amplification circuit if the gain is sufficient and the noises are filtered.

6.2 Typical Low-Cost Application

Below can be found a simple amplification circuit with three filters with the following cutoff frequencies: 1.2Hz, 1.4Hz, and 14Hz.



An Arduino can be used to read the values.

6.3 Design Requirements

DESIGN PARAMETER	EXAMPLE VALUE
Input Voltage	0 V to 10 V
Amplification Factor	5 to 200
Reading Frequency	0.5 Hz to 2 Hz
Offset of the Amplificator	3 µV to 5 µV

7 Device and Documentation Support

To receive notification of documentation updates, follow the GitHub repository. From there, seeing the project in greater detail can be possible. For further inquiries, the creators of this datasheet can be contacted by e-mail.