Low Power Gas Sensor based on tungsten trioxide nanoparticles

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1 General features

- Low power consumption
- Easy-to-use
- Small size
- Low Cost
- Short response time
- Detection of NH3
- Detection of C2H6O
- Temperature sensor included
- 2 integrated gas sensors
- Heater included (resistor)

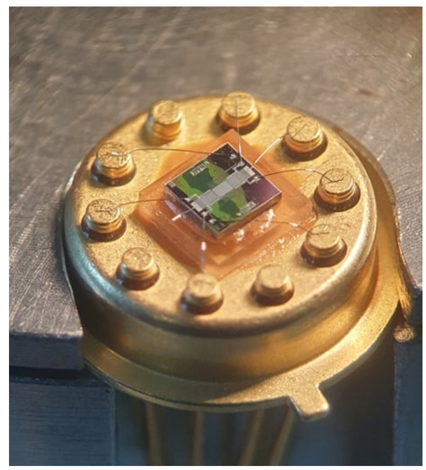

Figure 1: Gas sensor

2 Description

The GSWO3-AIME is a solid-state gas sensor designed to detect multiple gases in surrounding air. The GSWO3-AIME sensor uses a highly sensitive sensing element composed of interdigitated aluminium combs upon which tungsten trioxide nanoparticles have been deposited. Selectivity and sensitivity of the gas sensing elements can be adjusted using the integrated wide N-doped polysilicon layer, to heat the sensor up to 300°C. An aluminium resistor is provided to monitor the temperature of the sensor. The GSWO3-AIME detects gases such as Nitrogen dioxide (NO2), Carbon monoxide (CO), Hydrogen sulfide (SO2), Dihydrogen (H2), Methane (CH4), Alcohols (-OH) and more.

The gas sensors in the GSWO3-AIME family are based on the principle that metal-oxide materials undergo surface interactions (physisorption and chemisorption) with gas molecules at elevated temperatures, resulting in a measurable change in electrical resistance. As metal-oxide materials are polycrystalline (i.e., composed of multiple grains with distinct grain boundaries), the adsorbed gases have significant electronic effects on the individual grains. These gas-solid interactions result in a change in electron (or hole) density at the surface, which in turn changes the electrical conductivity of the oxide. The variation of conductivity is the function of concentration and type of gas. An external electronic circuit can be used to detect and quantify variations in order to determine the nature and the concentration of a gas

3 Pin description

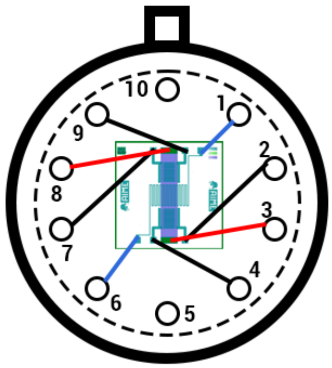

Figure 2: Bottom view

Pin number	Usage
1/6	Temperature sensor (Aluminium resistor)
2/4	Gas sensor (WO3 nanoparticles integrated on aluminium inter-digital combs)
3/8	Heater resistor (Polysilicon resistor)
7/9	Gas sensor (WO3 nanoparticles integrated on aluminium inter-digital combs)
5/10	Not connected

Table 1: Pins description

4 Specifications

Type	Nanoparticle based sensor
Materials	• Silicon • N-doped poly-silicon (heater) • Aluminum (temperature measurement) • Nanoparticles of tungsten trioxide (WO3)
Sensor type	Active (power supply required)
Gas measurement	Resistive measure
Temperature measurement	Resistive measure
Detectable gaz	• Ammonia (NH3) • Ethanol (C2H6O)
Diameter	9.5mm
Mounting	Through hole fixed
Time response	Ammonia $\approx$ 11s
Sensibility	800kΩ /ppm
Minimal detection	$\frac{1}{8}$ppm
Aluminium nominal tension	min: -4V max: 5V
Aluminium non deterioration range	min: -10 max: 10V
Aluminium resistor (20°C)	60Ω
Polysilicium resistor (20°C)	84Ω

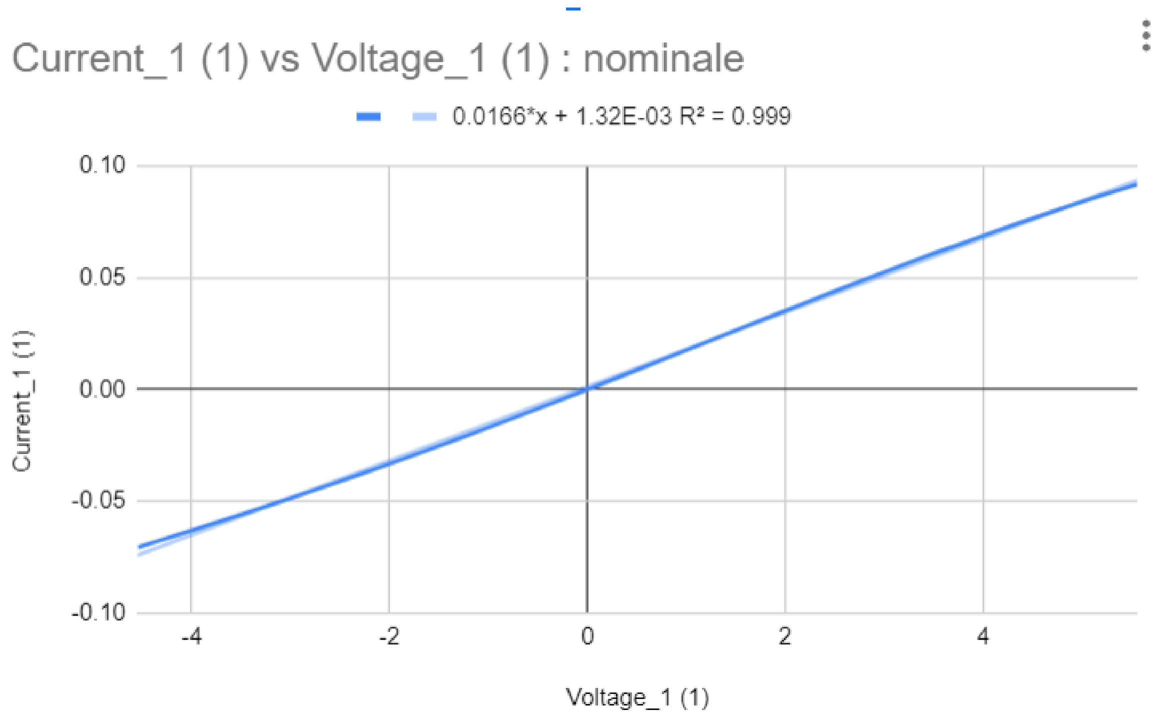

Figure 3: Nominal Current/Voltage characteristic of the sensor resistor (aluminium) at 20°C

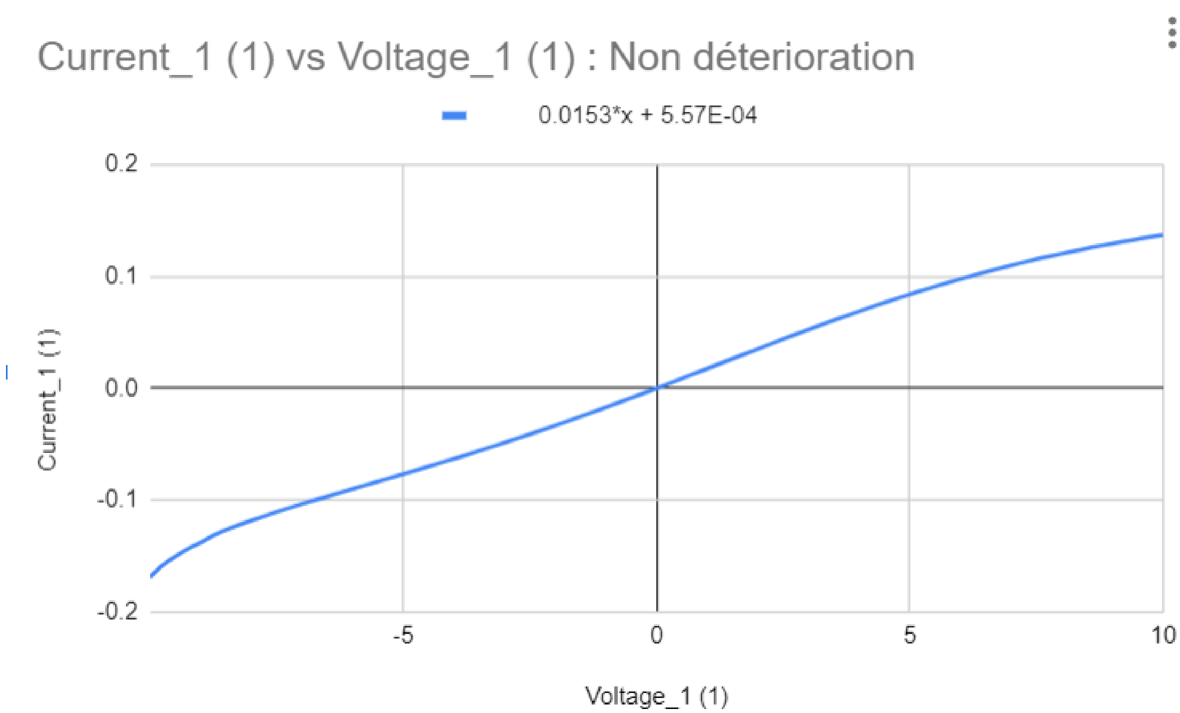

Figure 4: non deterioration Current/Voltage characteristic of the sensor resistor (aluminium) at 20°C

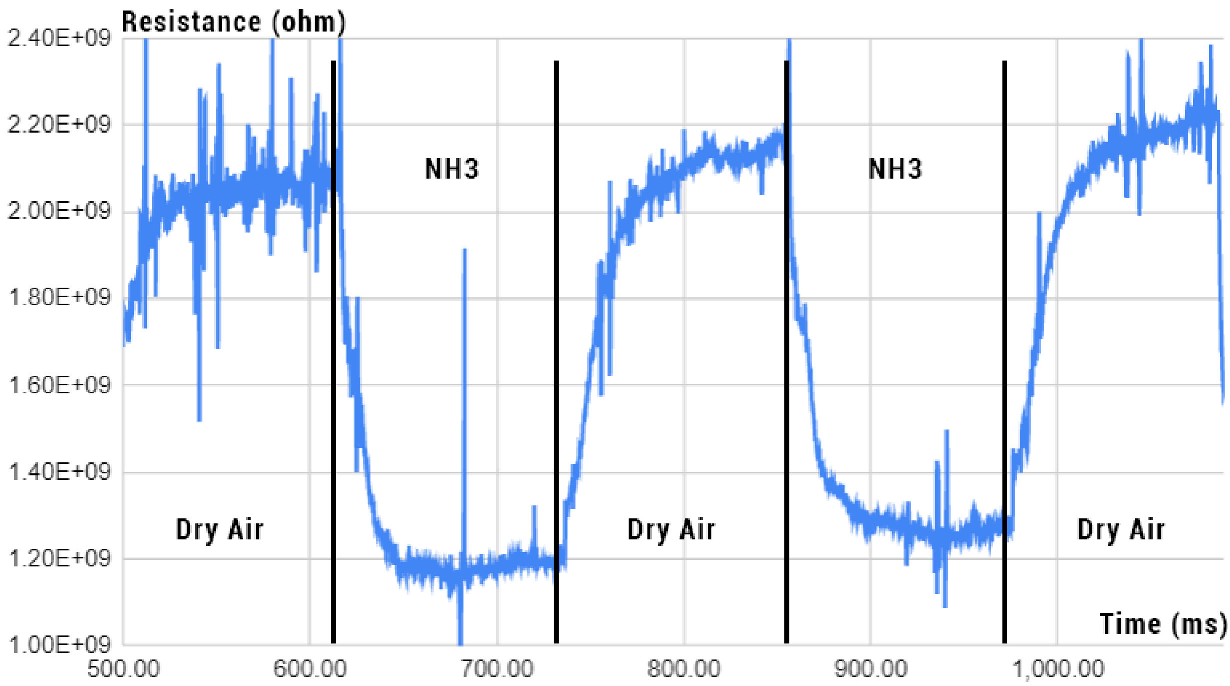

Figure 5: Resistance dynamic in presence of Amonia at 575K

5 Dimensions

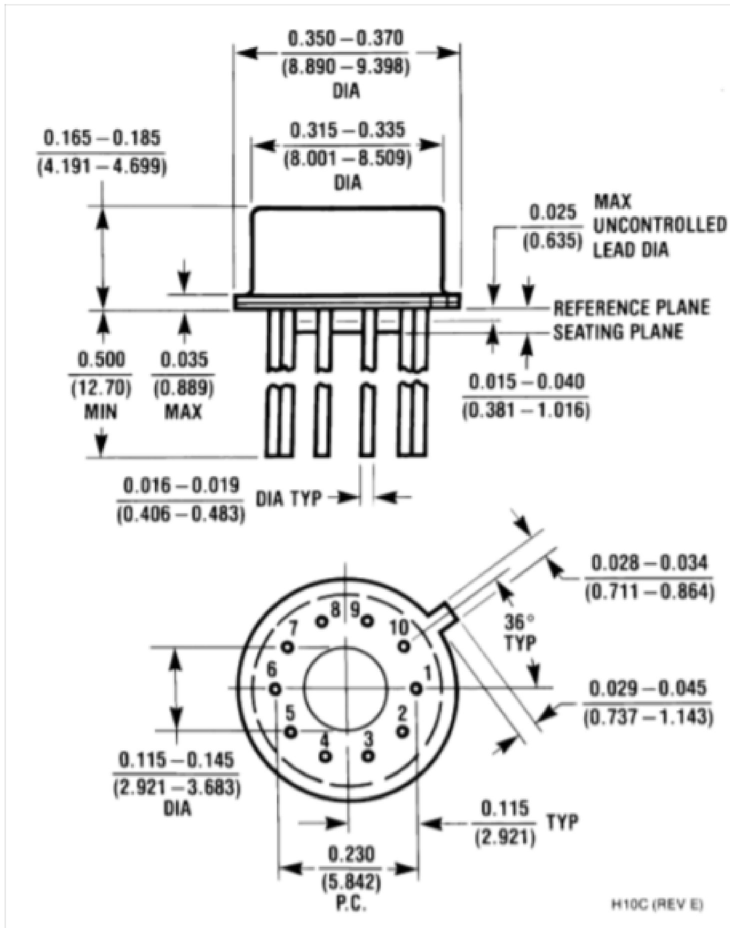

Figure 6: Dimension of the package 10-Lead TO-5 metal

6 Typical application

The output current of the sensor is about 100 nanometres Ampere. It is very difficult to measure such small currents with a basic microcontroller, so we must amplify it. Moreover, because of the very high impedances of the sensor, we will have to adapt the impedance in the amplification stage to have a reliable measurement. The solution chosen is described in the following schema. The gas sensor must be powered on pin 2/4 and the output (pin 7/9) must be filtered or amplified with the circuit below. Then the value can be read with an Arduino or any device equipped with GPIO.

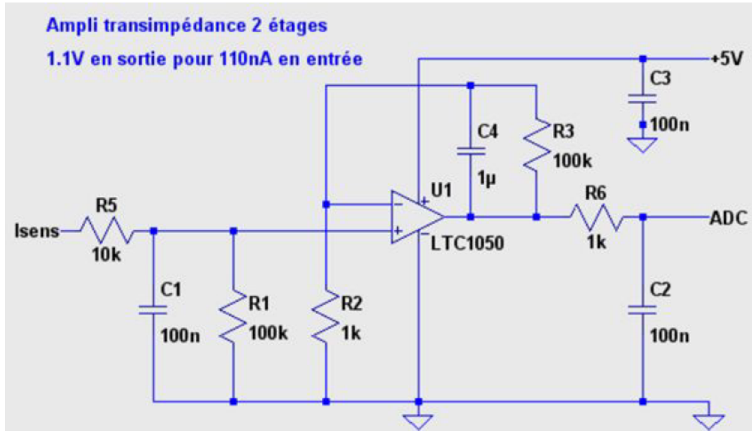

Figure 7: Dimension of the package 10-Lead TO-5 metal