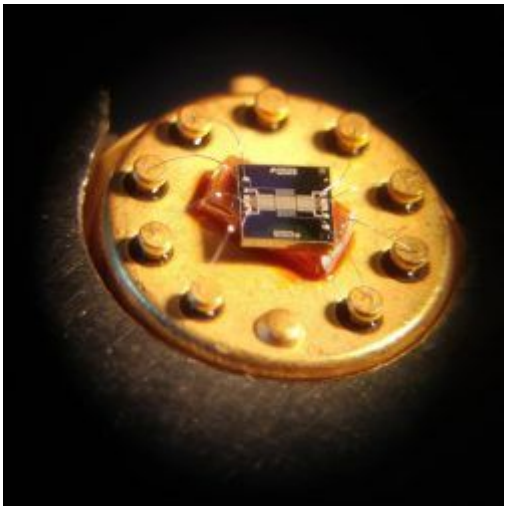
Gas sensor using based on tungsten trioxide (WO3) nanoparticles

- **Features and applications**

Applications	Main features
Detection of various gases: - Nitrogen dioxide (NO2) - Carbon monoxide (CO) - Hydrogen sulfide (SO2) - Dihydrogen (H2) - Methane (CH4) - Alcohols (-OH) Also a temperature sensor	High sensitivity Low power consumption Low cost Small and compact Easy to use Two integrated gas sensor in one

- **General description**

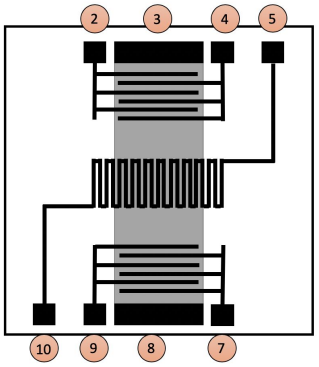


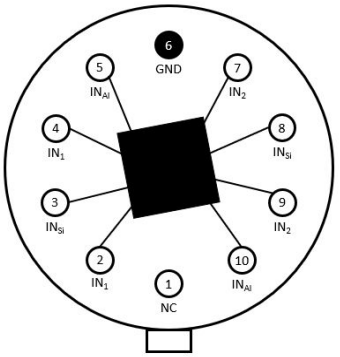
This gas sensor was developed at the AIME laboratory of INSA Toulouse. The goal of the sensor is to detect outdoor or indoor quality. The module's sense element consists of a heater element on a silicon-based structure and a metal-oxide chemiresistor. Tungsten trioxide nanoparticles (WO3) are integrated on carved aluminium elements and on temperature sensitive resistor.

The sensor module is optimized for the detection of trace atmospheric gases, including for instance nitrogen dioxide, carbon monoxide and dihydrogen.

- **Pin description**

Pin Number	Usage
1/6	Temperature sensor(Aluminium resistor)
2/4	Gas sensor(WO3 nanoparticles)
3/8	polysilicon resistor
7/9	Gas sensor(WO3 nanoparticles)
5/10	Not connected





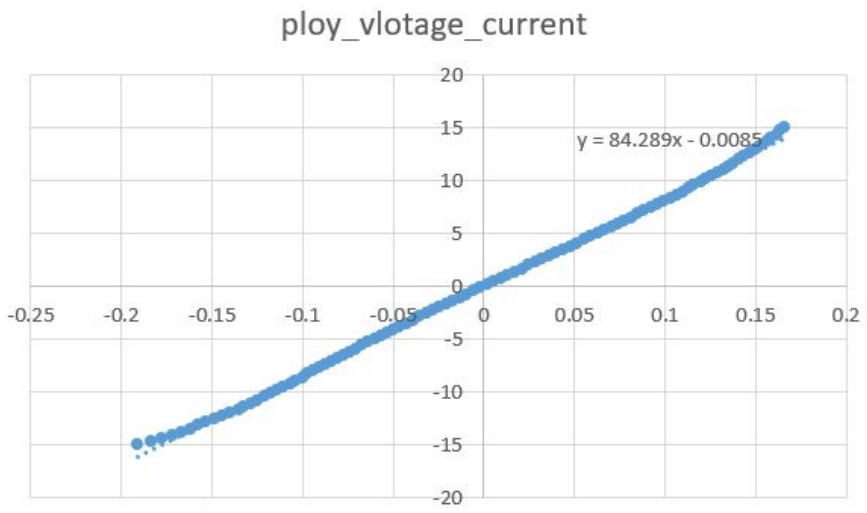
- **Specifications**

Type	Semi-conductor
Materials	• Tungsten trioxide nanoparticles • Aluminium • Silicon • N-doped poly-silicon
Packaging	10-Lead TO-5 metal
Typical measure precision	Resistive measure
Power supply requirement	Active sensor
Nature of output signals	Analog signal
Nature of measurands	Resistive measurement
Head diameter	<10mm
Head height	<5mm
Package height	<25mm
Pin diameter	<1mm
Mounting	Through hole fixed
Detectable gases	- Nitrogen dioxide (NO2) - Carbon monoxide (CO) - Hydrogen sulfide (SO2) - Dihydrogen (H2) - Methane (CH4) - Alcohols (-OH)
Time response	Ethanol < 35s Ammonia < 20s

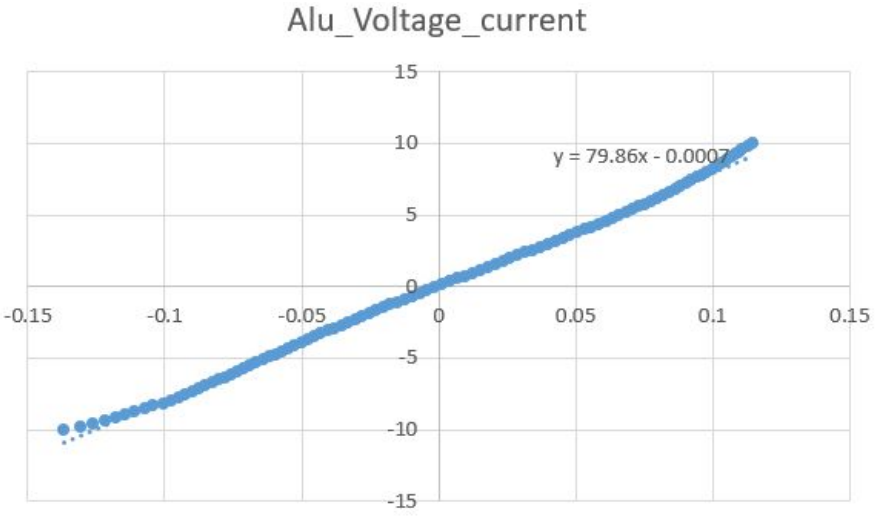
- **Standard use condition**

	Unit	Typical value
Temperature	°C	20+-5
Humidity	%	60+-5
Air quality	%N2/O2	80/20

- **Electrical characterisation : table + figures**
  a. V-I Polysilicium : 1 Graph + Rpoly = 84.289Ohms

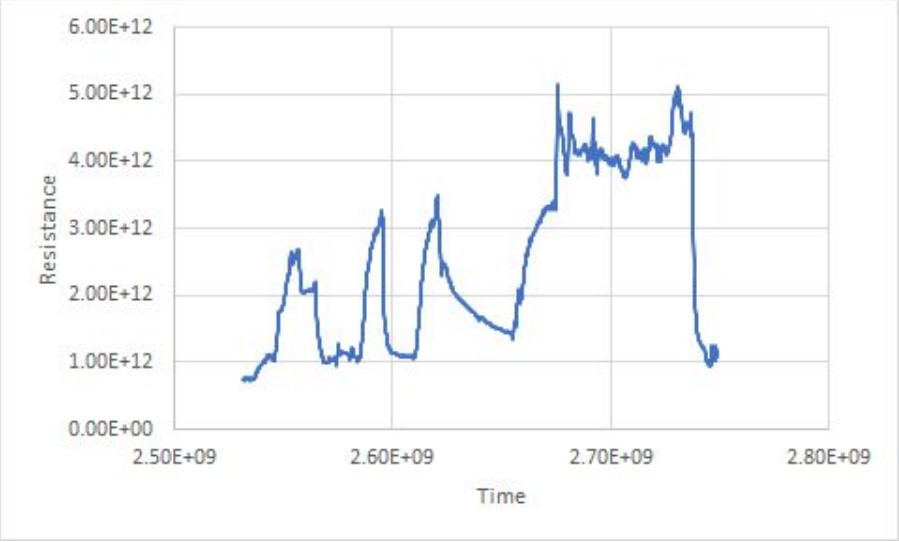


  b. I-V Alu : 1 Graph + R alu = 79.76 Ohms



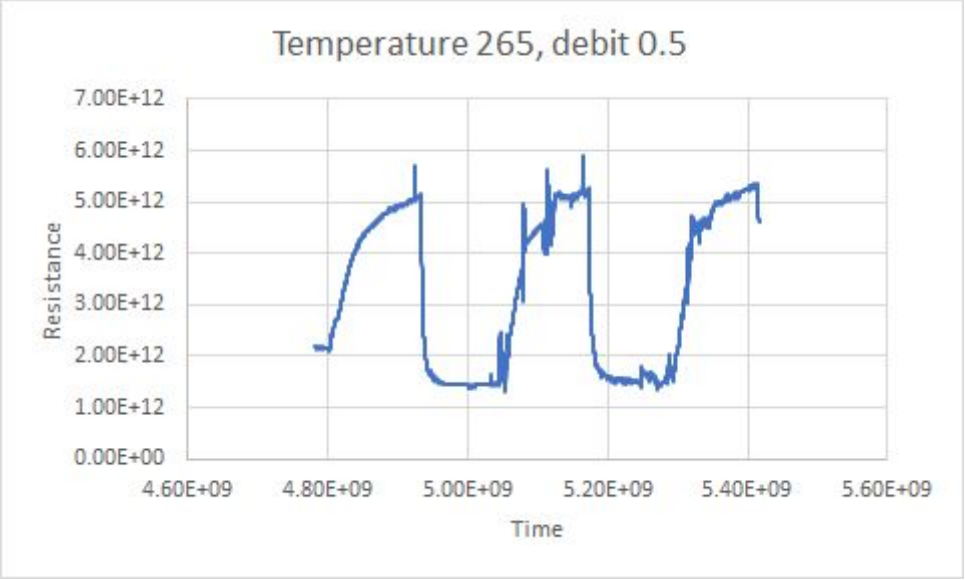
c. Resistance with NP (sensor “peigne”) : several graph – Estimation of the resistance

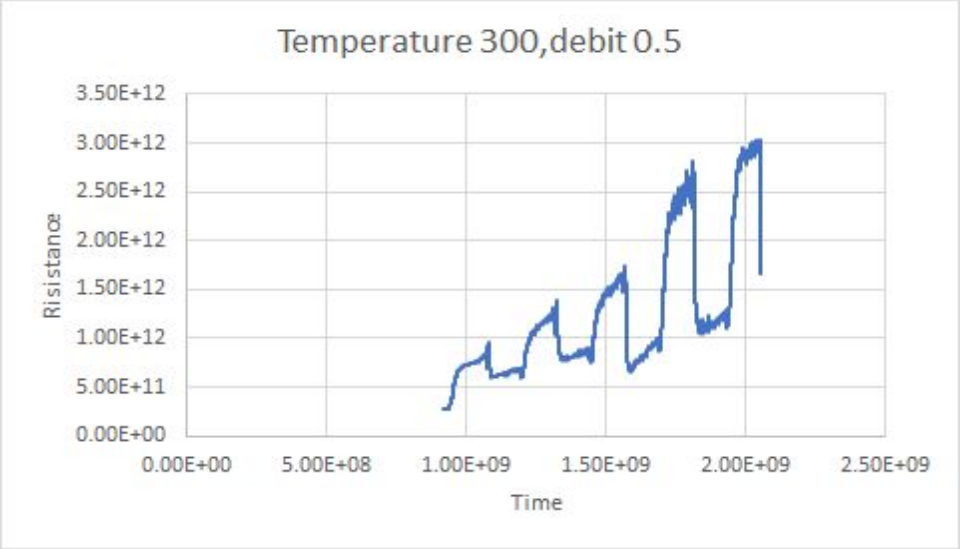
The sensor is exposed alternatively and for two minutes to three different types of air: dry air, air enriched with ethanol, air enriched with Ammonia



In this figure, we can see that the resistance change with different nano parti.

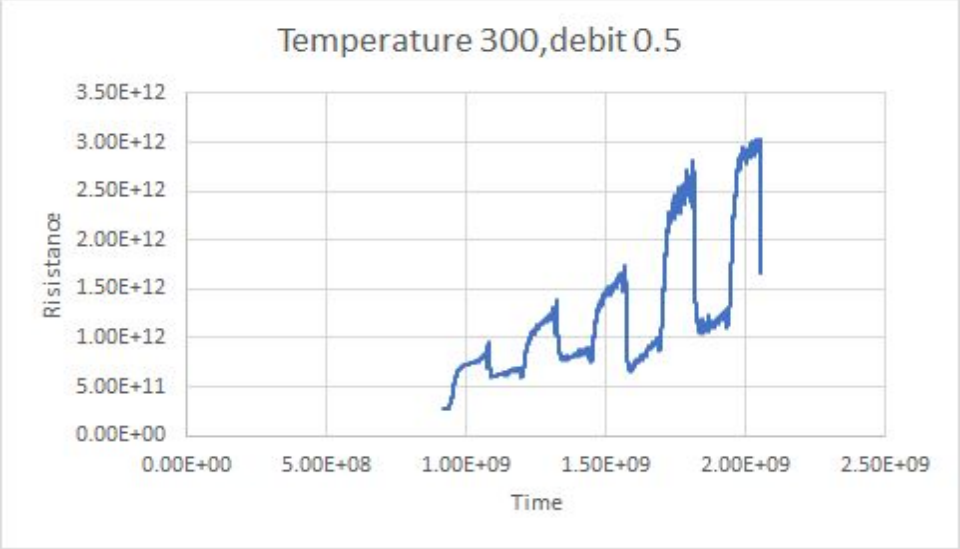
Variations with Temp :

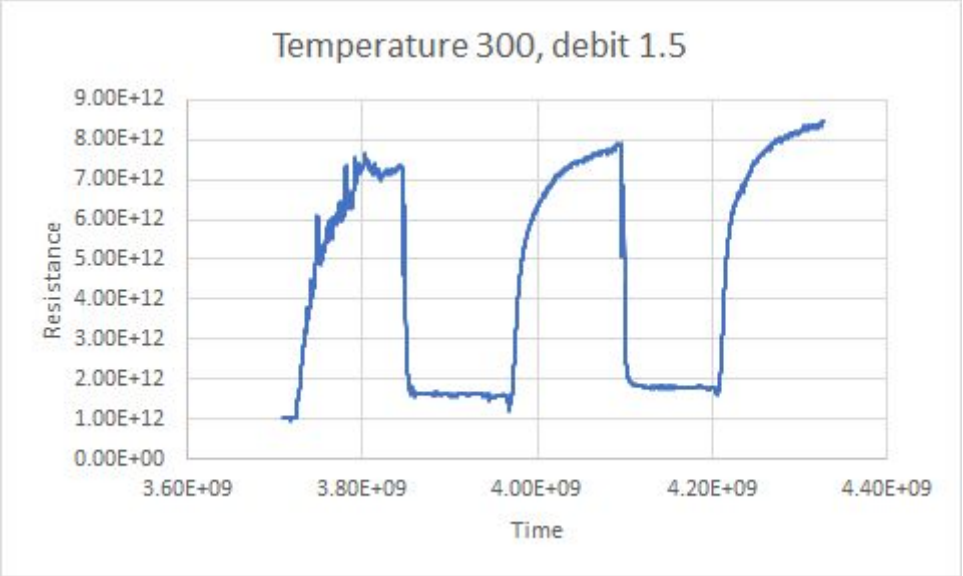


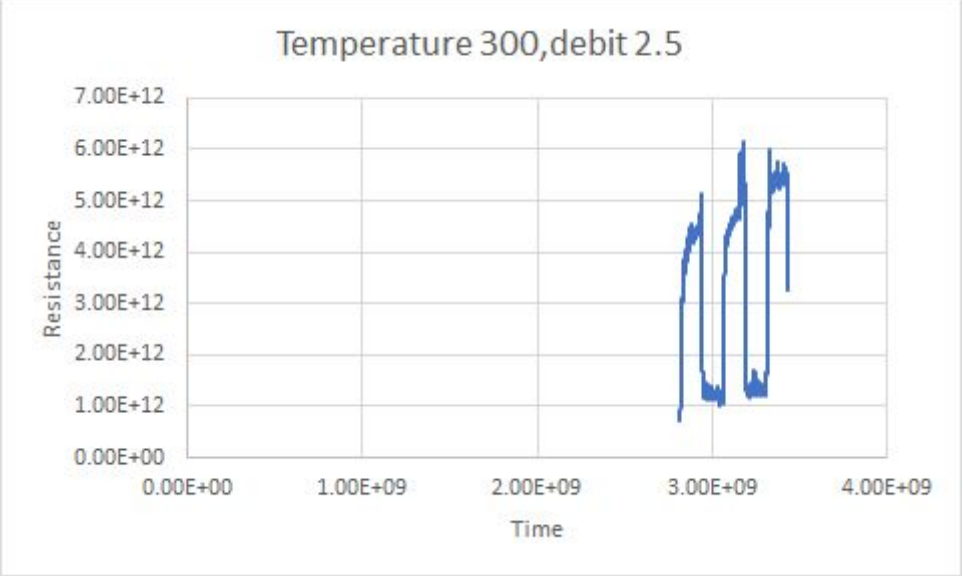


In these two figures, we can see that the resistance decreases when the temperature increases which confirms the characteristic of Aluminum.

Variations with Débit :







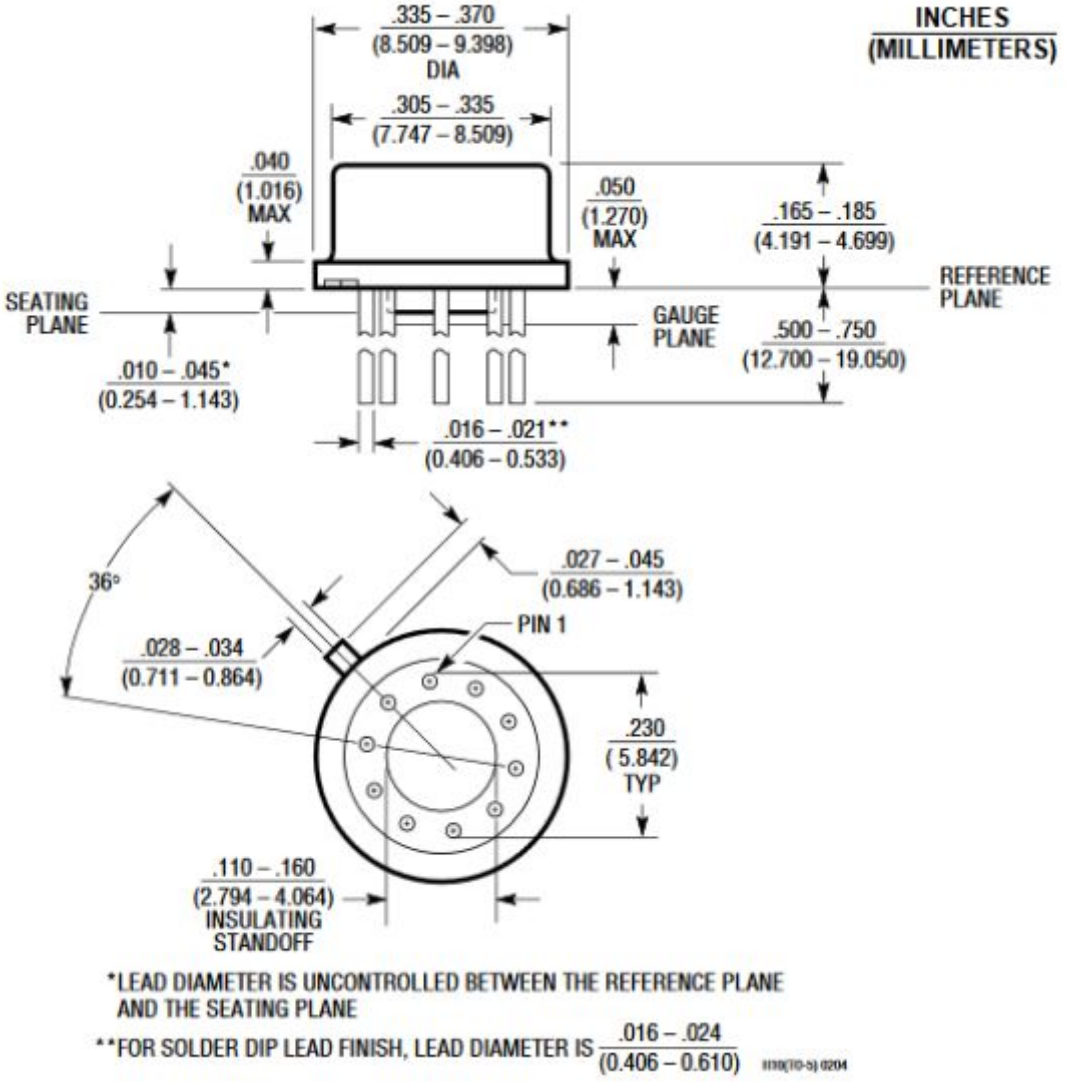
Ethanol :

T = 300°	D1	D2	D3
Resistance	3.0E+12	8.5E+12	6.0E+12

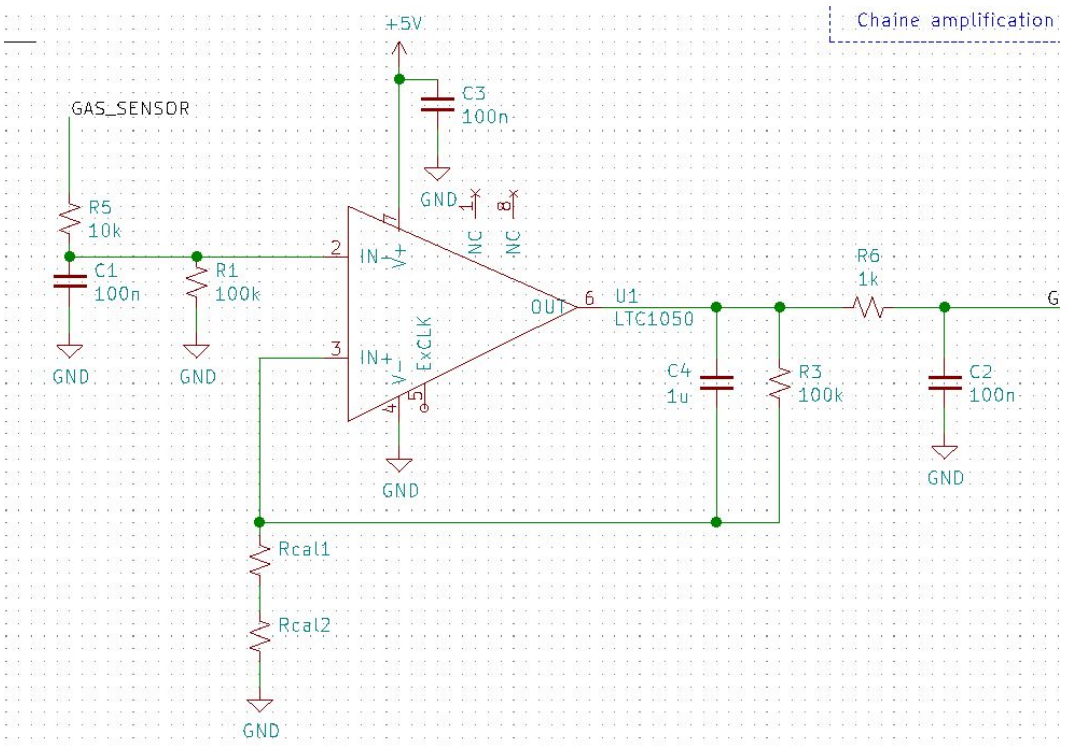
We can see that in the same temperature, the resistance change with different debit. And it's not proportional, the resistance in the 1.5 debit is higher than in the 2.5 debit.

- **Dimensions**

The package used for this sensor is a 10-Lead TO-5 metal. Dimensions are the following :



- **Typical Applications**



Above is an example of integration of the gas sensor for a typical application. The gas sensor must be powered on pin 2/4 and the output (pin 7/9) must be filtered or amplified with the circuit above. Then the value can be read with an Arduino or any device equipped with GPIO.