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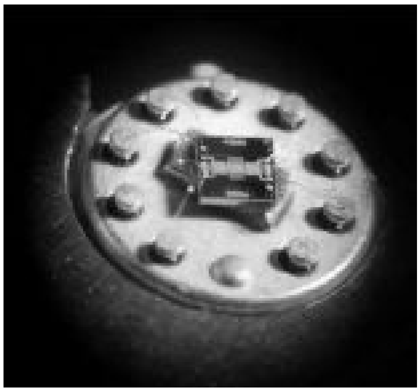
GAS SENSOR DATASHEET

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)

2. General Description

This gas sensor was developed at the AIME ("Atelier Interuniversitaire de Microélectronique") laboratory of INSA Toulouse. The goal of the sensor is to detect outdoor or indoor air 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 resistors. The sensor module is optimized for the detection of trace atmospheric gases, including for instance nitrogen dioxide,carbon monoxide and dihydrogen.

3. Sensor's pin description

- Pins 1 and 5 are used as a temperature sensor (Aluminium resistor)
- Pins 3 and 7 are used as a heater resistor (Polysilicon resistor)
- Pins 2 and 4 are used as a first gas sensor (WO3 nanoparticles integrated on aluminium interdigital combs)
- Pins 6 and 8 are used as a second gas sensor (WO3 nanoparticles integrated on aluminium interdigital combs)

The next figures represent the sensor and the pin connections :

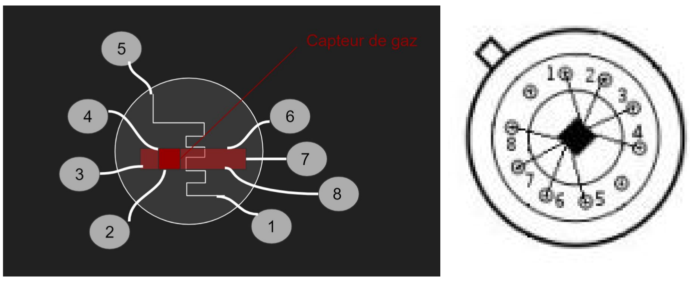


Figure 1 : Pin configuration of the nano gas sensor

4. Structure and dimension of the sensor

The package used for this sensor is a 10-Lead TO-5 metal.

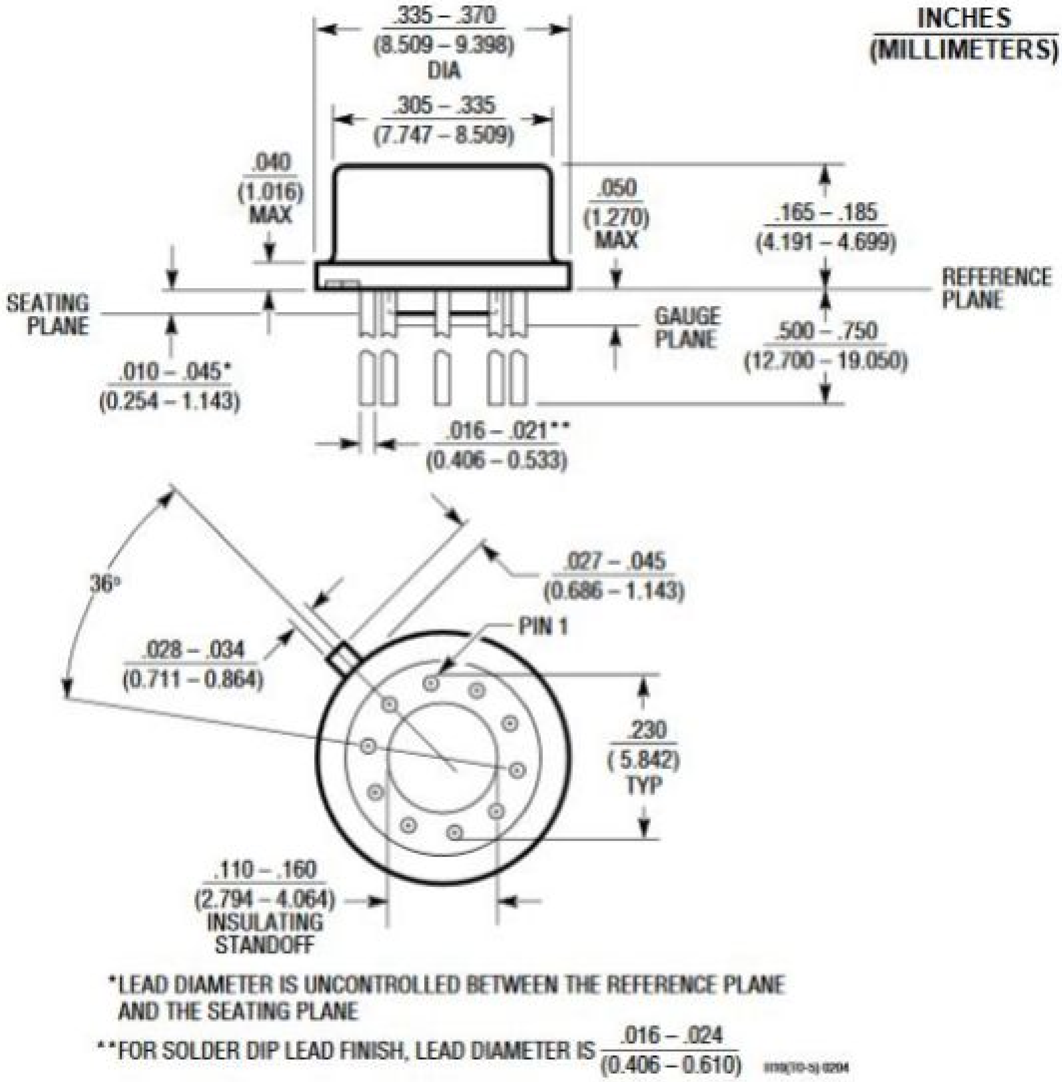


Figure 2 : Structure and dimensions of gas sensor package

5. Standard Use Condition

The sensor is supposed to work on some particular use conditions concerning humidity, temperature and quality of air. They are all listed in the table below.

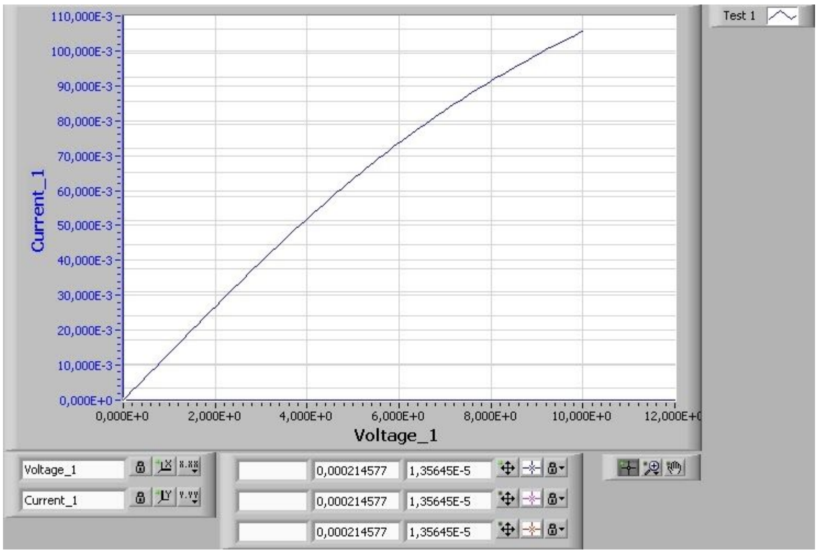
	Unit	Typical Value
Temperature	°C	25°C
Humidity	Percentage (%)	60%
Air Quality	N_2/O_2 ratio (%)	25%

6. Specifications

Type	**Chemical sensor**
Materials	Silicon N-doped poly-silicon (heater) Aluminum 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)
Package	10-Lead TO-5 metal
Head Diameter	9.5 mm
Time response	Ethanol <30s Ammonia <15s
Non-deterioration domain poly silicium	7.5-11 V
Nominal domain poly silicium	0-7.5 V
Non-deterioration domain gas sensor	up to 623 K
Nominal domain gas sensor	up to 523 K

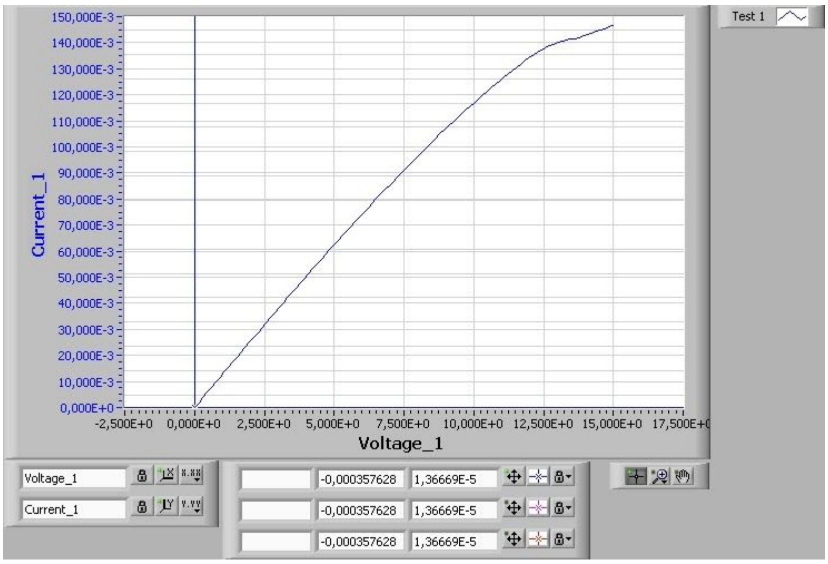
7. Electrical characteristics

From Figure 3, we can determine the slope of the I-V characteristic which will give us the Ralu resistance. We have to be careful to take the measurement in the linear part, not too close to the extrema (0 and 10V). We thus have: **Ralu = 63Ω**



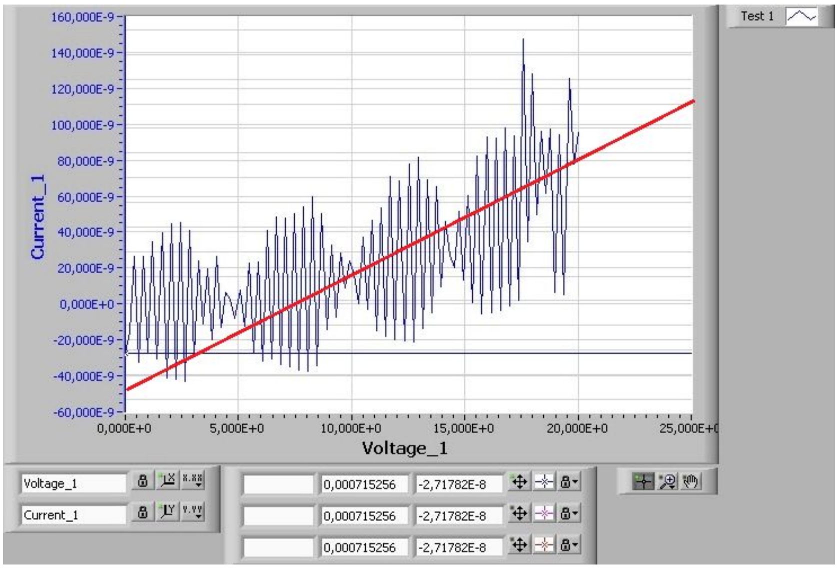
<u>**Figure 3 : Voltage-Current specification for Aluminium from 0 to 10V**</u>

From Figure 4, we can determine the slope of the I-V characteristic which will give us the Rpoly resistance. We have to be careful to take the measurement in the linear part, not too close to the extrema (0 and 15V). We thus have: **Rpoly = 65Ω**

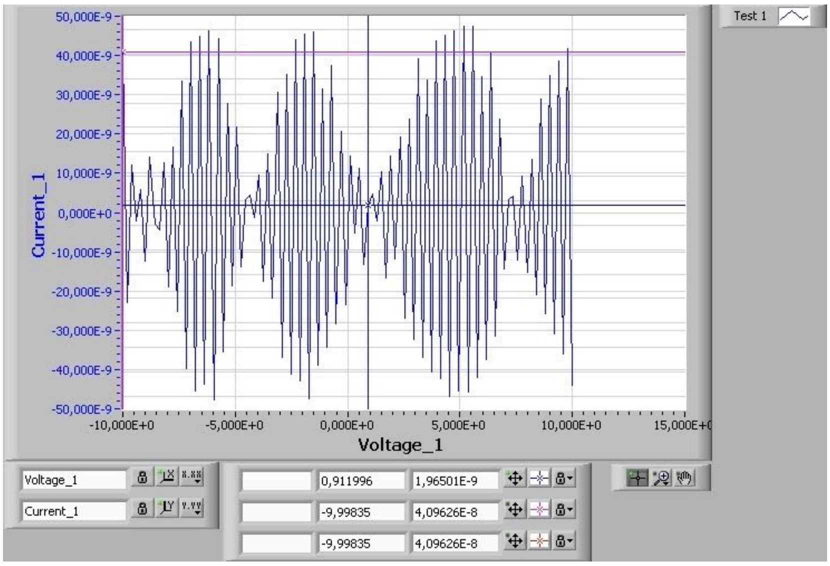


<u>**Figure 4 : Voltage-Current specification for Polysilicium from 0 to 15V**</u>

We also want to determine the resistance through the sensitive layer. We measure very low current values, which are typical of high resistance. From Figure 5, we can determine the slope of the I-V characteristic which will give us the Rsens resistance. We have to be careful to take the measurement apart from the noise. To be sure not to take the noise into account, we measured only the noise level which was plotted on Figure 6. We will not take into account values from 0 to 40.10^{-9}, considered as noise. We thus measure the slope on Figure 5 to determine: **Rsens = 104MΩ**



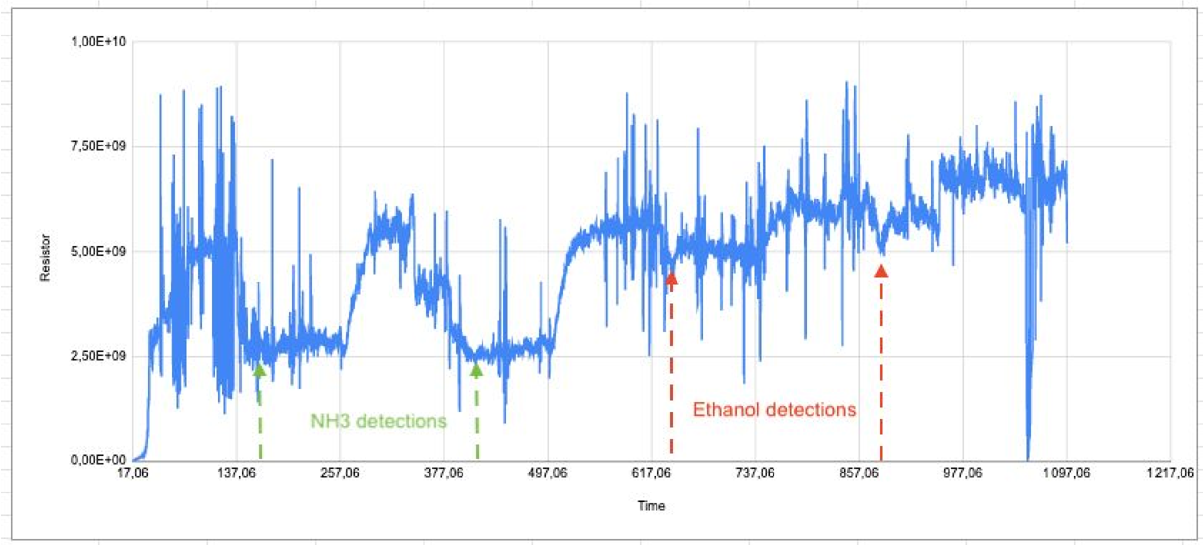
<u>Figure 5 : Voltage-Current specification for Sensitive layer from 0 to 20V</u>



<u>Figure 6 : Voltage-Current specification from 0 to 10V for noise determination</u>

8. Evolution of the resistance under gas effect

This plot shows the evolution of the aluminium resistor when gas is released within range of the sensor.



120	120	120	120	120	120	120	120	120
Dry air	NH3	Dry air	NH3	Dry air	ethanol	dry air	ethanol	dry air

Figure 7 : NH3 and Ethanol detection tests

Green arrows show how the resistance decreases when NH3 is released. We could compute a software that would alert NH3 presence when the resistor is stable around 2,5 GΩ. When red arrows show the evolution of resistance when ethanol is detected. The resistance evolution when ethanol is detected is a little bit more fiddly to detect but it is when there is a resistor slight drop around 5GΩ.

9. Typical Application

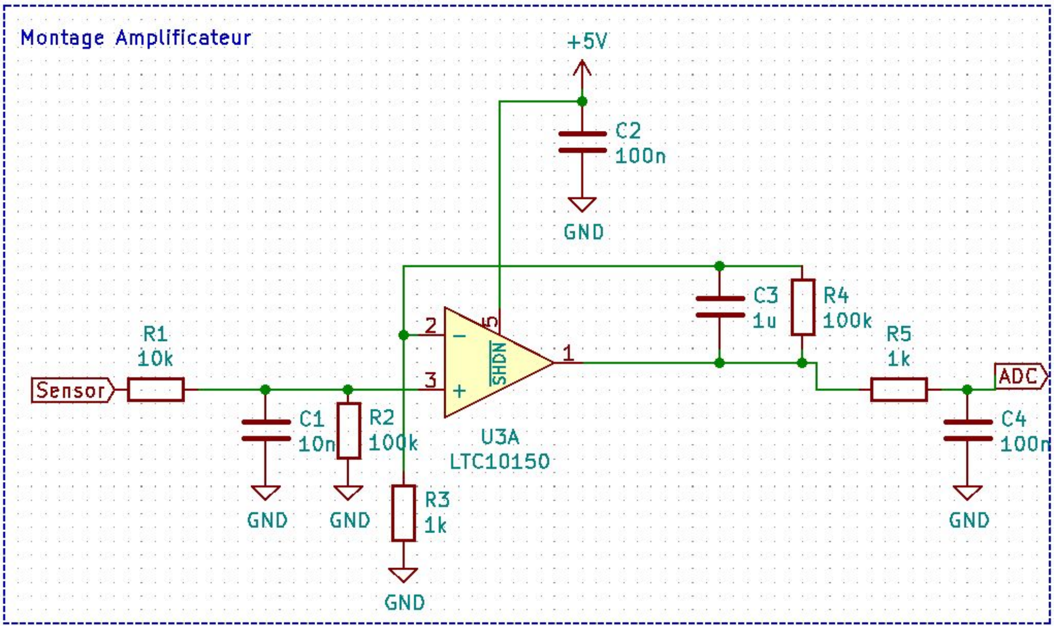


Figure 8 : KiCad schematic for gas sensor application

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.

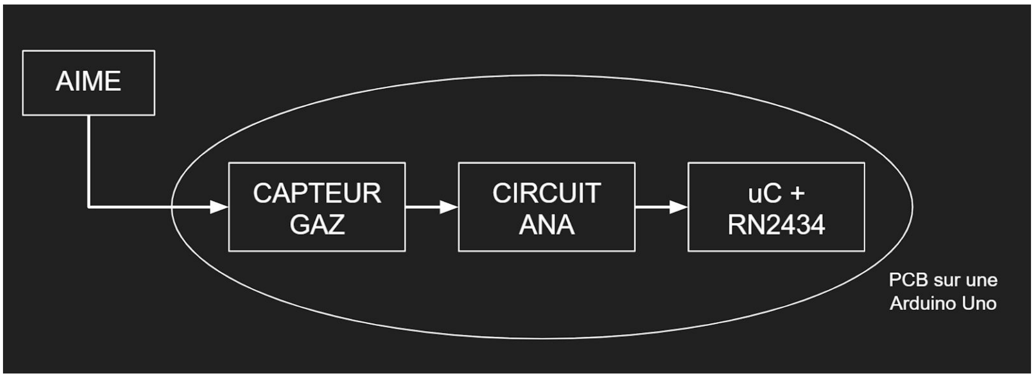


Figure 9 : Example of PCB application for our gas sensor