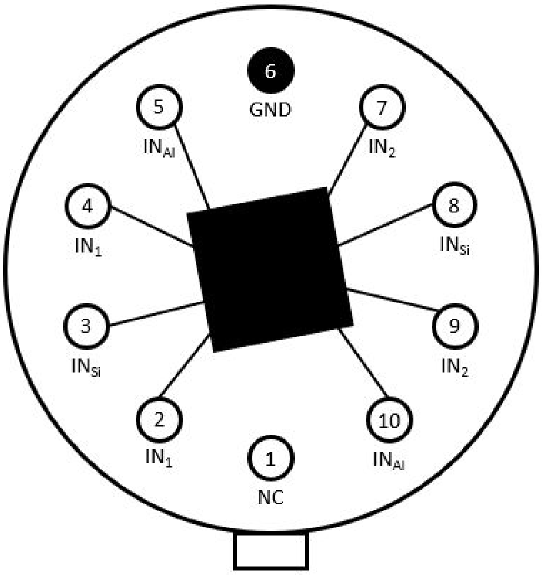
Low Power Gas Sensor based on tungsten trioxide nanoparticles

General features

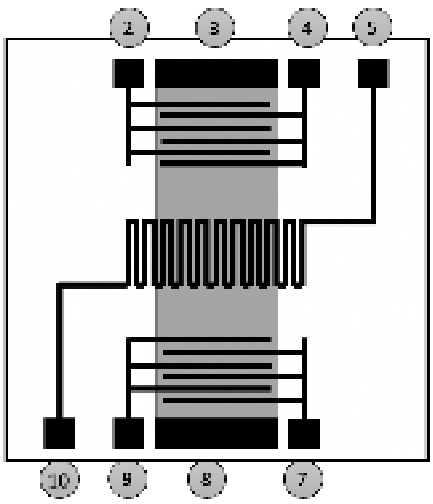


- Low power consumption
- Easy-to-use
- Small size
- Low Cost
- Short response time
- Detection of NH3
- Detection of C2H6O
- Temperature sensor included
- 2 Integrated gas sensors
- Heater included (resistor)

Description

This gas sensor based on tungsten trioxide nanoparticles has been designed to monitor air quality and detect different kinds of gas. The sensing part is composed of two interdigitated combs of silicon substrate, coated with a thin tungsten trioxide nanoparticles (WO3) deposit. A simple contact from the detectable gases with the tungsten trioxide nanoparticles can modify the conductivity. A heater formed on a wide N-doped polysilicon layer is integrated to allow heating the sensor up to 300°C.

Pin description



PIN	Utility
2/4	Gas Sensor n°1
7/9	Gas Sensor n°2
3/8	Heating resistor
5/10	Temperature sensor

Specifications

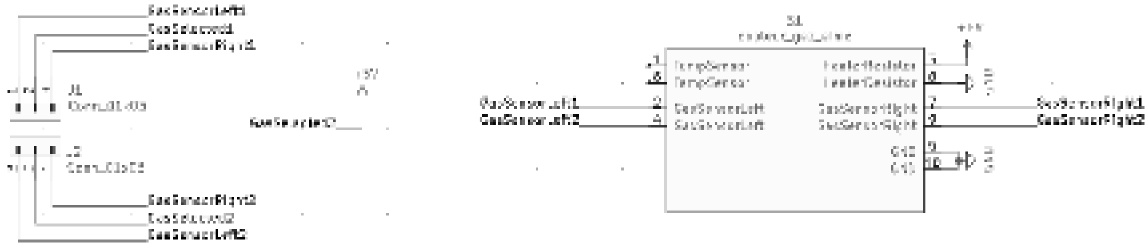
Type	**Semi-conductor**
Materials	● Silicon ● Doped polysilicon ● Aluminum ● Tungsten trioxide nanoparticles
Packaging	10 Pins TO-5
Typical measure precision	Above 1 ppm
Mounting type	Crossing
Gas Sensor supply voltage	from -20V to 20V
Resistance supply voltage	from -10V to 10V
Temperature sensor supply voltage	from -10V to 10V
Resistance's sensitive layer characteristics	Typical : from 1 to 20 MΩ
Heater's sensitive layer characteristics	Typical 130Ω
Air quality test condition	Ambient air
Temperature test condition	19°C ±2
Humidity test condition	60±5%

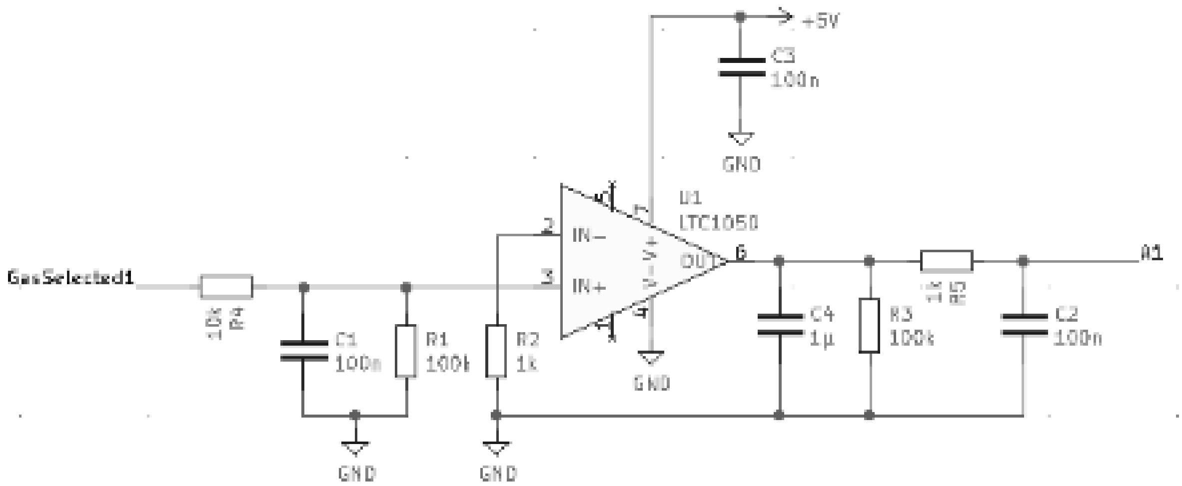
Standard use condition

For optimal use, it is required to always stay above 100°C. If your main objective is low energy consumption, while the sensor is in stand by the temperature can stays slightly above 100°C. When a threshold of reaction detection is crossed, the temperature needs to be raised, for instance up to 400°C to enable a more precise detection. The lower the temperature is, the longest the regeneration cycles of exposition to dry air needs to be.

Example of use

The diagram below shows a typical use of the gas sensor. The gas sensor and the resistor R4 form a dividing bridge. The output current of this bridge is filtered by an RC low-pass filter. Next, an LTC1050 amplifier operational is here to amplify and convert the current to a tension. Finally, the output can be connected to an ADC (a pin of your micro-controller for example). The gas sensor consists of two sides named GasSensorLeft and GasSensorRight as you can see in the following schematic. You can use both sides to do measurements, just power with 5V the one you are not using. The “HeaterResistor” can be powered with 5V (up to 12V).

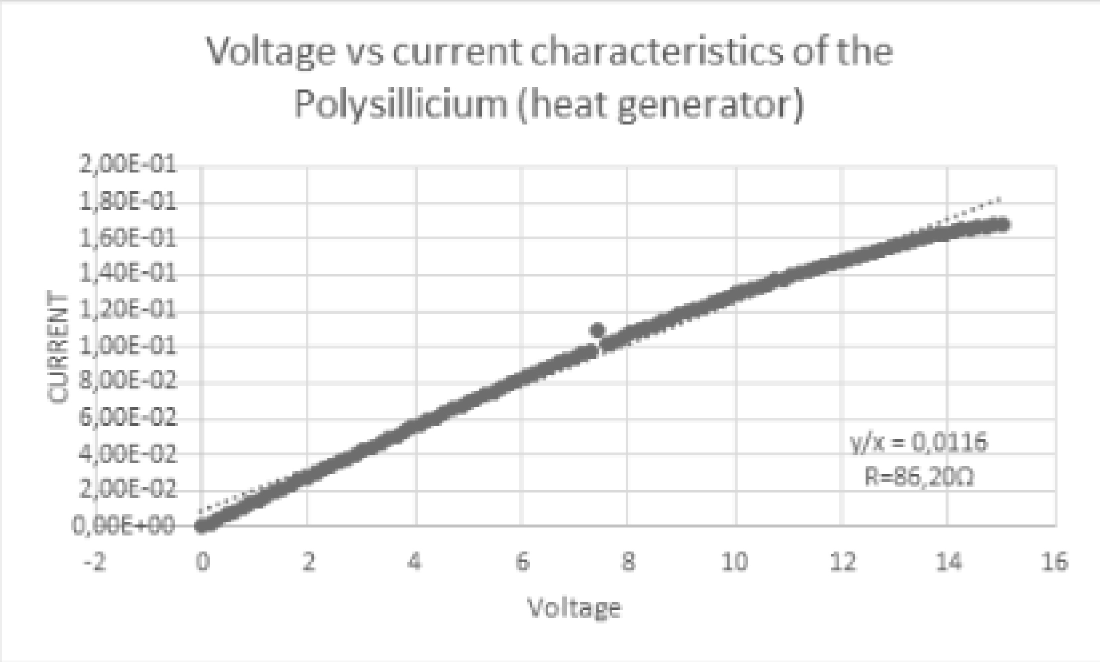




Electrical characterisation

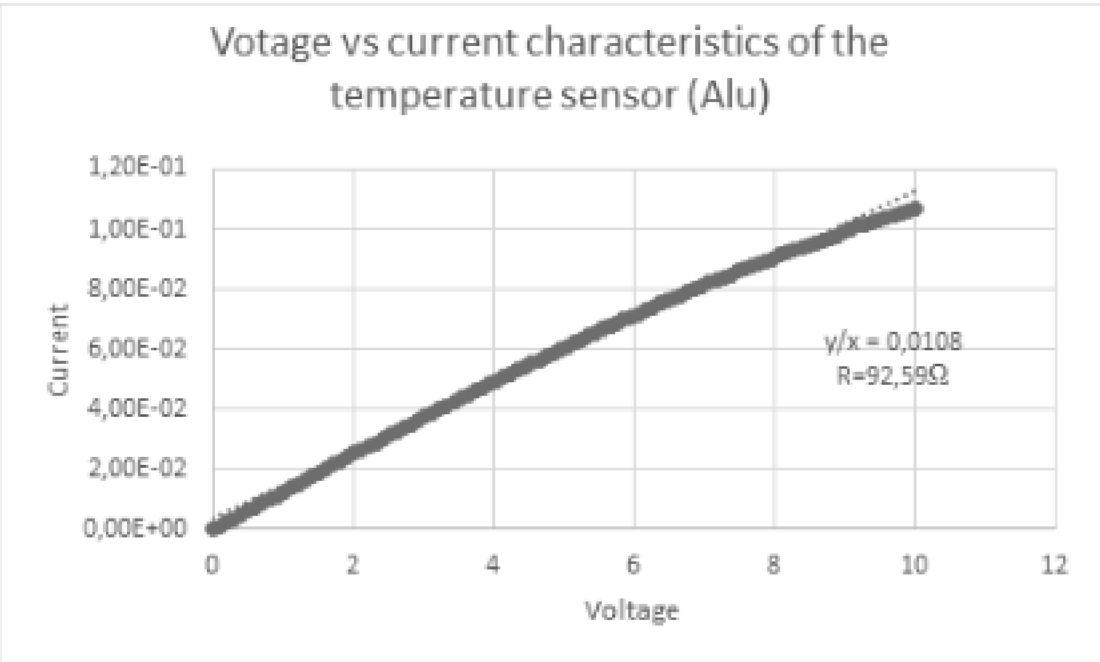
Polysilicium heat generator

R_{Poly} ~ 86,20Ω

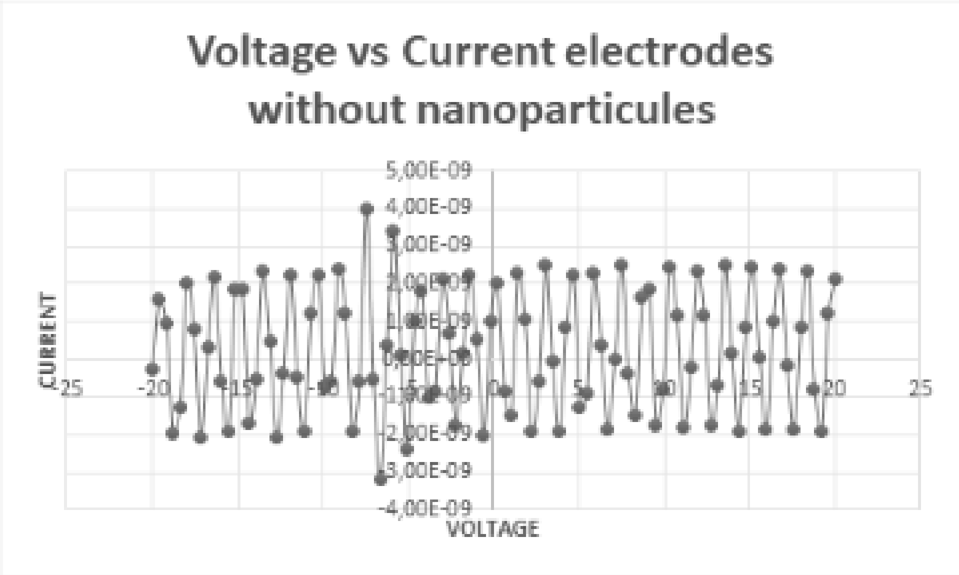


Aluminum temperature sensor

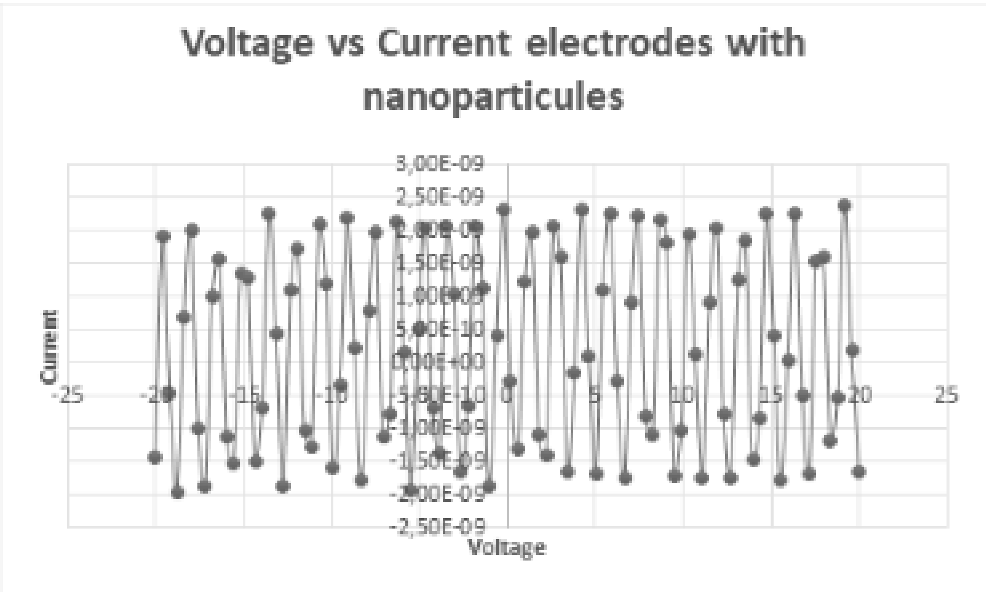
R_{Al} ~ 92.59Ω



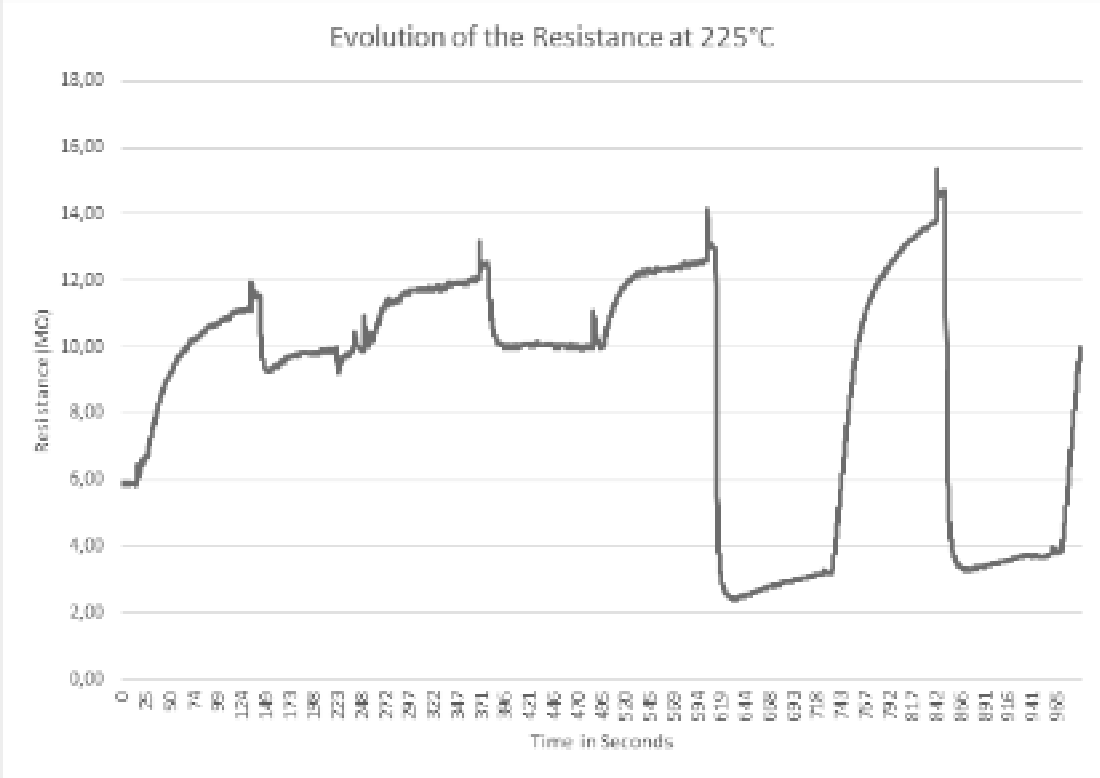
Without NPs



With NPs

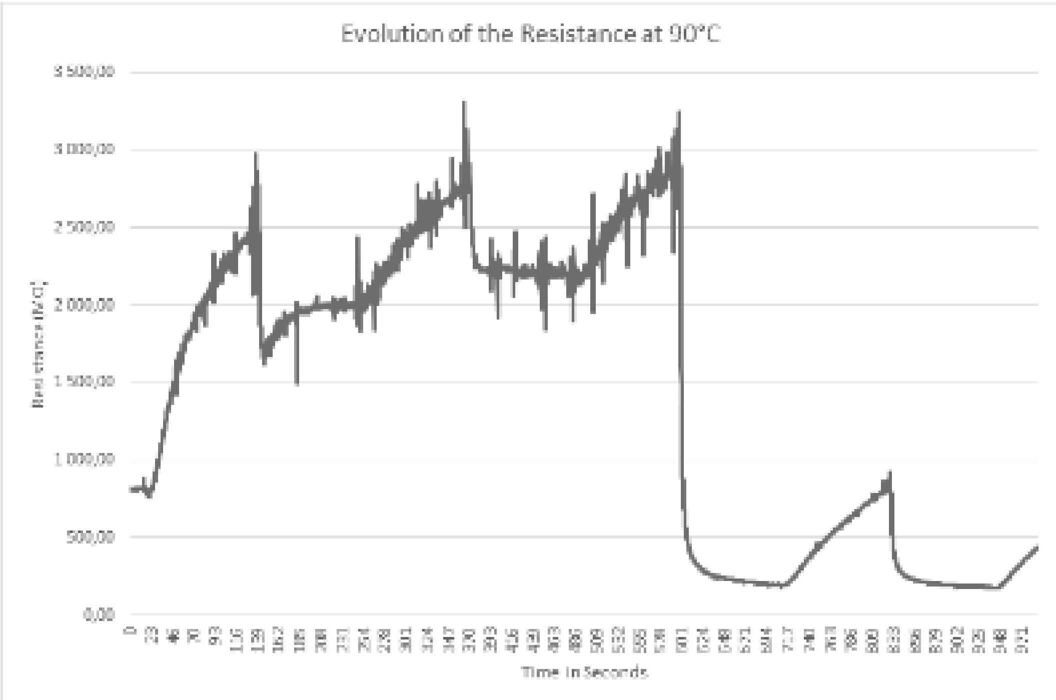


Gas sensor resistor behavior at 225°C



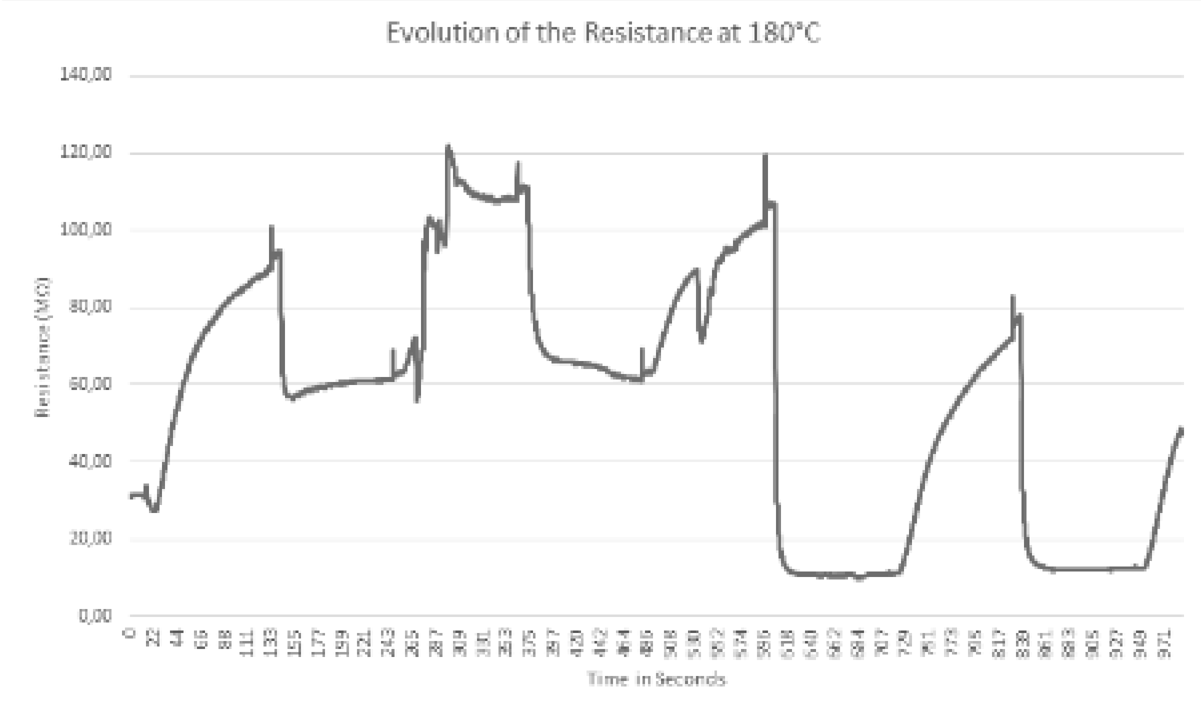
	DRY AIR	Ethanol	DRY AIR	Ethanol	DRY AIR	NH3	DRY AIR	NH3	..

Gas sensor resistor behavior at 90°C



	DRY AIR	C2H6O	DRY AIR	C2H6O	DRY AIR	NH3	DRY AIR	NH3	..

Gas sensor resistor behavior at 180°C



	DRY AIR	C2H6O	DRY AIR	C2H6O	DRY AIR	NH3	DRY AIR	NH3	..

<u>Variation with temperature in</u> $k\Omega.s^{-1}$

- Ammonia eg:

T	90°C	180°C	225°C
$\frac{\Delta R}{\Delta T}$	-1.0104	12.680	6.3188

Graph $\frac{\Delta R}{\Delta T}$ = f(T) ⇒ $\frac{\Delta(\frac{\Delta R}{\Delta T})}{\Delta T}$

- Ethanol eg:

T	90°C	180°C	225°C
$\frac{\Delta R}{\Delta T}$	3366.306	5.9138	3.257

Dimensions

The package of the sensor is a 10-Lead TO-5 metal. You can find all the dimensions on the following figure: