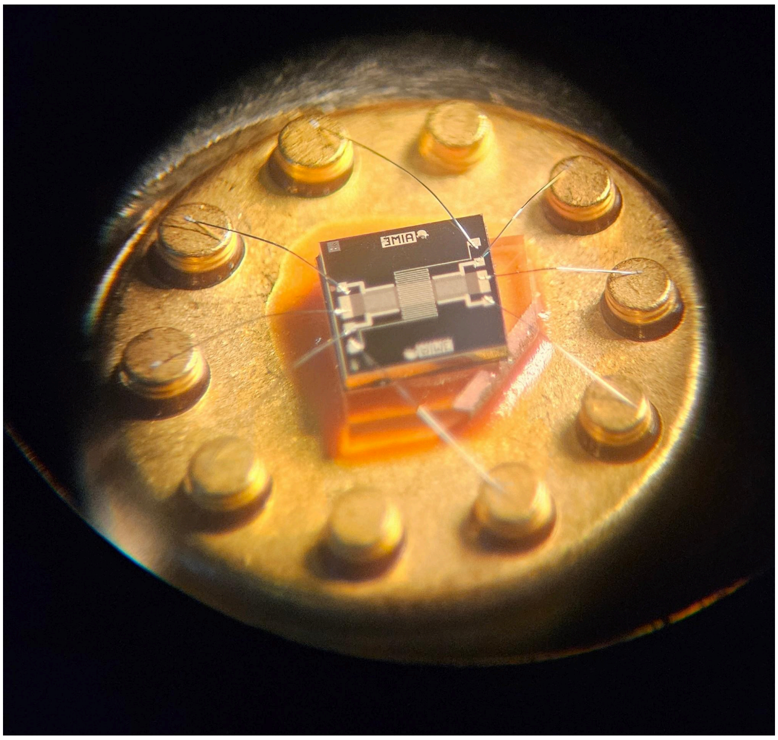
Smart Gas Sensor for IoT application



Features

- Capable of detecting 3 different gases (N2O2, NH3 and CH3CH2OH)
- Low power
- Low cost
- Durable
- Integrated temperature sensor
- Integrated heating resistor
- Analog readings
- Compact
- Wide operational range for both temperature and voltage

Applications

- Internet of Things (IoT)
- Environment monitoring for safety

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Description

This passive smart sensor is an analog gas sensor, allowing it to be versatile and thus be used in applications such as IoT.
It was made at the AIME lab in Toulouse and is composed of two interdigitated combs of silicon substrate with tungsten trioxide (WO_3) nanoparticles. The resistivity of this layer depends on the ambient air composition, allowing us to detect the presence and concentration of gases.
The temperature sensor part was made using an aluminum resistor and allows us to monitor the temperature of the active zone.
The heating resistor was made using a N-doped polysilicon semiconductor. It allows us to heat the sensor up to 550K, allowing us to control the sensitivity and selectivity of the sensor.
This sensor is high-resistivity, making it capable of operating with very low current (~mA), making it low-power consuming.
While this sensor is theoretically capable of detecting ammonia (NH_3), we weren't able to test this capability and cannot provide any data in this regard.

INSA TOULOUSE

AIME Micro-Nano
Pôle CNFM de Toulouse

Pins description and layout

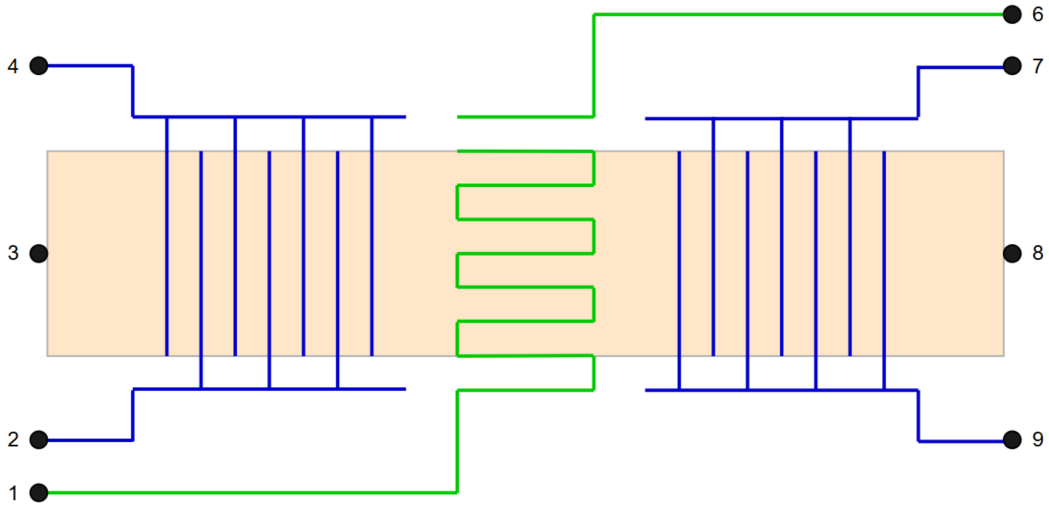

Fig x : Pins inside of the sensor

PIN N°	USAGE
1 , 6	**Temperature Sensor** *Aluminum*
2 , 4	**Gas Sensor n°1** *Nanoparticles of Tungsten on Aluminum*
7 , 9	**Gas Sensor n°2** *Nanoparticles of Tungsten on Aluminum*
3 , 8	**Heater Resistor**
5 , 10	Ø

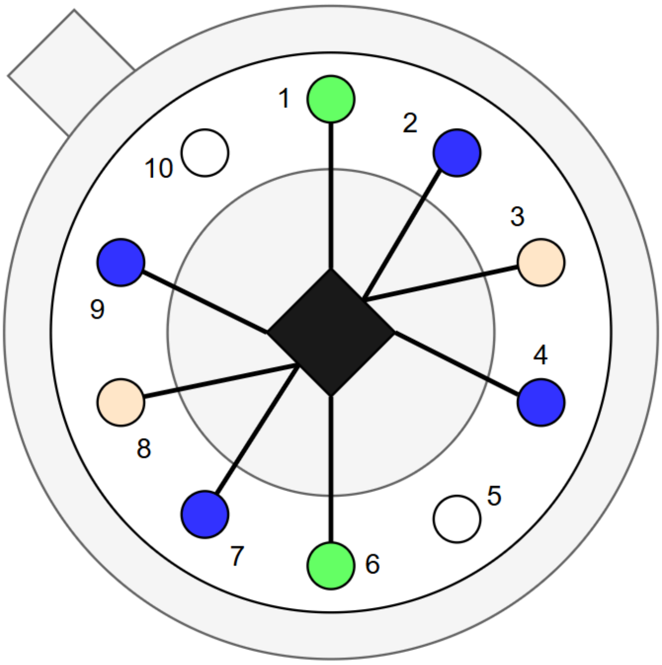

Fig x : Pins outside of the sensor

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Specifications

Absolute maximum values

Name	Description	Unit	Min. value	Max. value
V_S	Voltage across the gas sensor's resistor	V	-	-
V_T	Voltage across the temperature sensor's resistor	V	0	10
V_H	Voltage across the heating resistor	V	-15	15

Recommended operating voltages

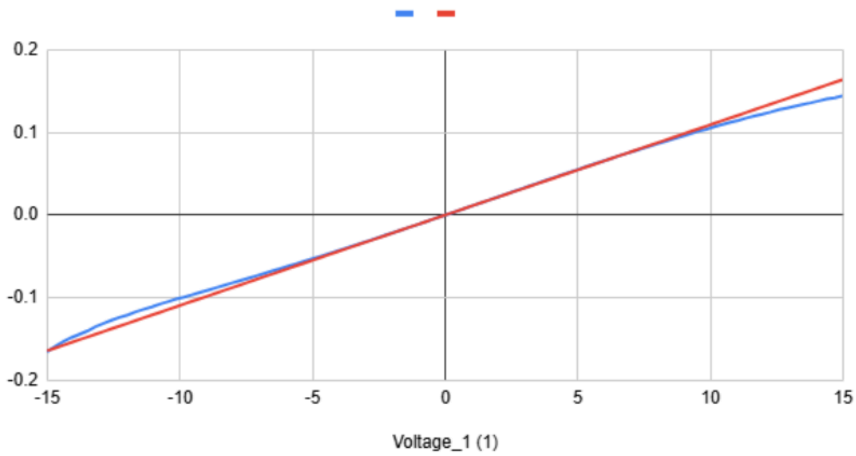
Name	Description	Unit	Min. value	Max. value
V_S	Voltage across the gas sensor's resistor	V	-	-
V_T	Voltage across the temperature sensor's resistor	V	0	5
V_H	Voltage across the heating resistor	V	-5	7

Typical characteristics

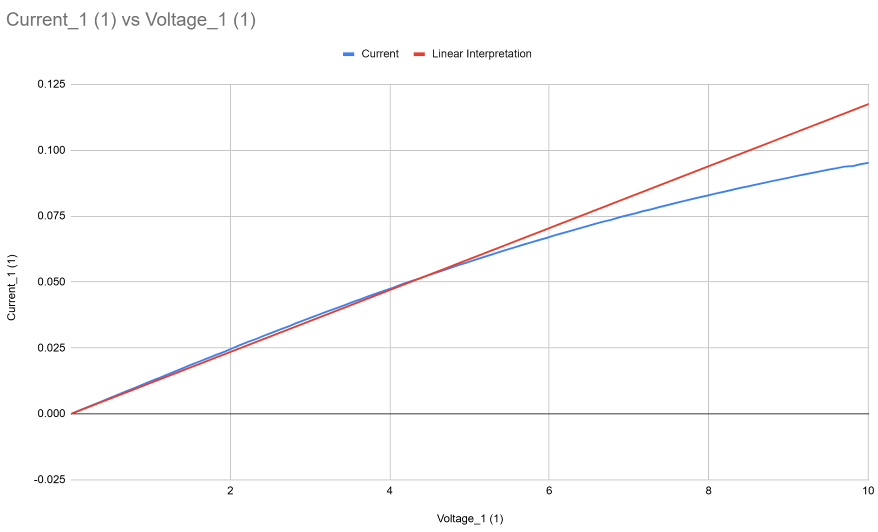
Name	Description	Unit	Temperature	Value
R_S	Resistivity of the gas sensor's resistor	GΩ	21°C	10
R_T	Resistivity of the temperature sensor's resistor	Ω	21°C	85.1
R_H	Resistivity of the heating resistor	Ω	21°C	91.1

Characterization and sensitivity Graphs

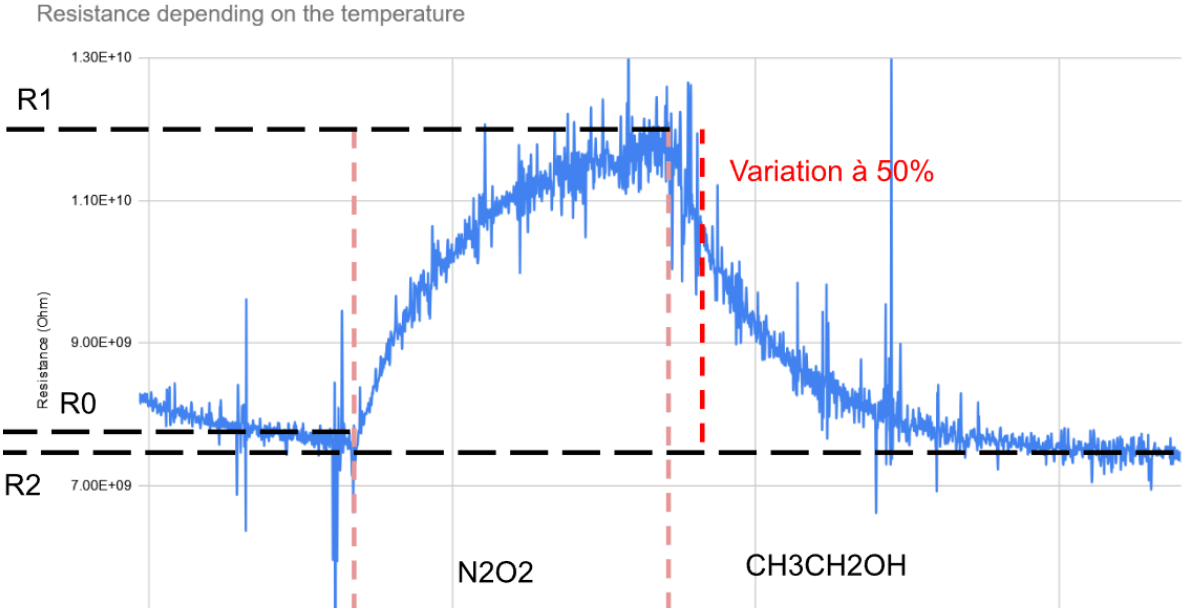
Sensitivity curve of the heating resistor over [-15,15V] range :



Sensitivity curve of the thermistor over [0,10V] range :

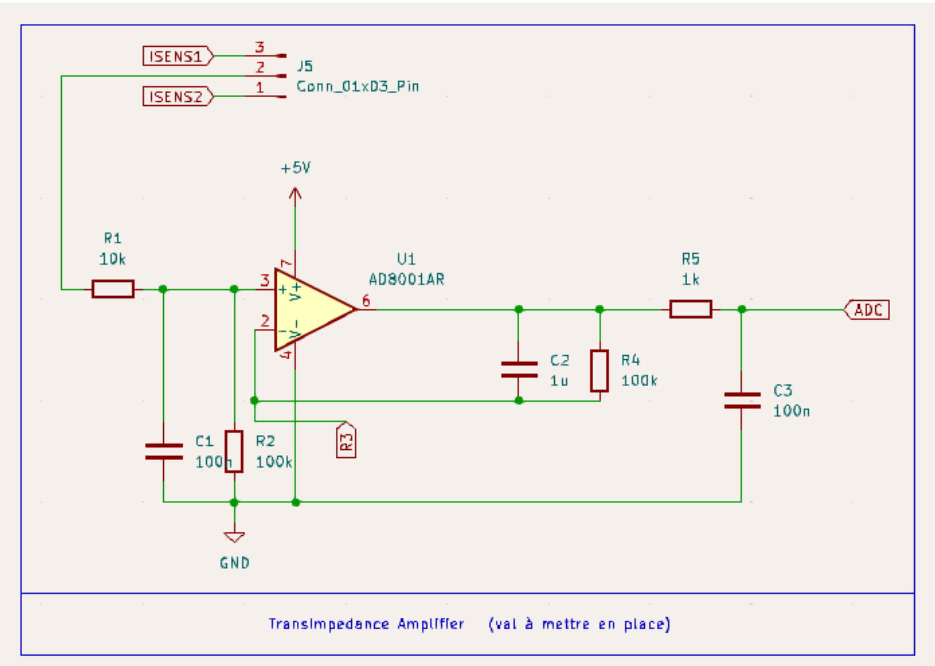


Resistance over time depending on the surrounding gases



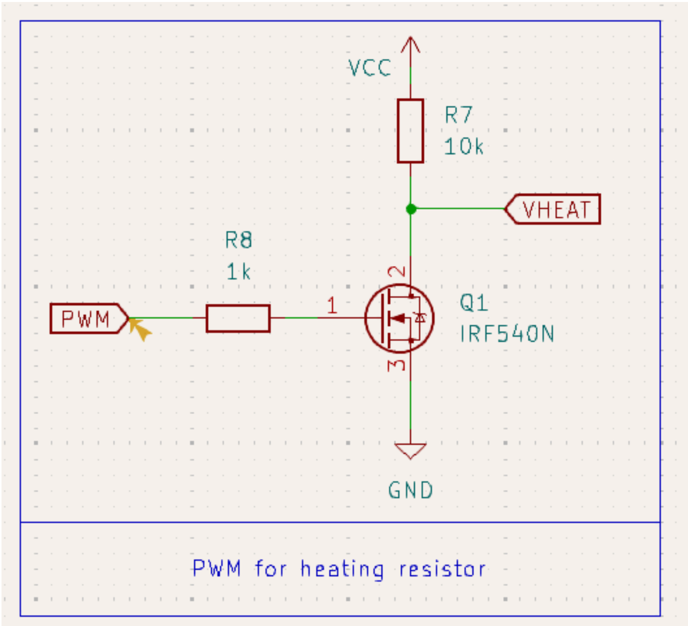
Typical application

To properly use this gas sensor, it is recommended implementing an amplifying circuit such as the following transimpedance amplifier.

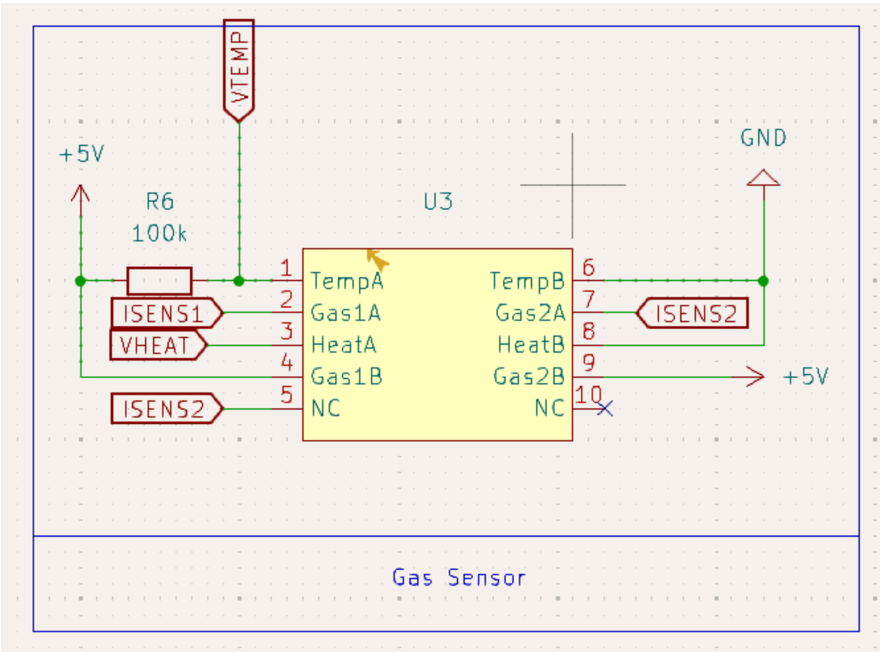


In order to get the data from the temperature sensor, it is necessary to apply a voltage to it, preferably along with an additional resistor in order to create a voltage bridge.

The heating resistor should be powered by an external voltage source as well. It is controllable via a PWM, which the next setup facilitates.

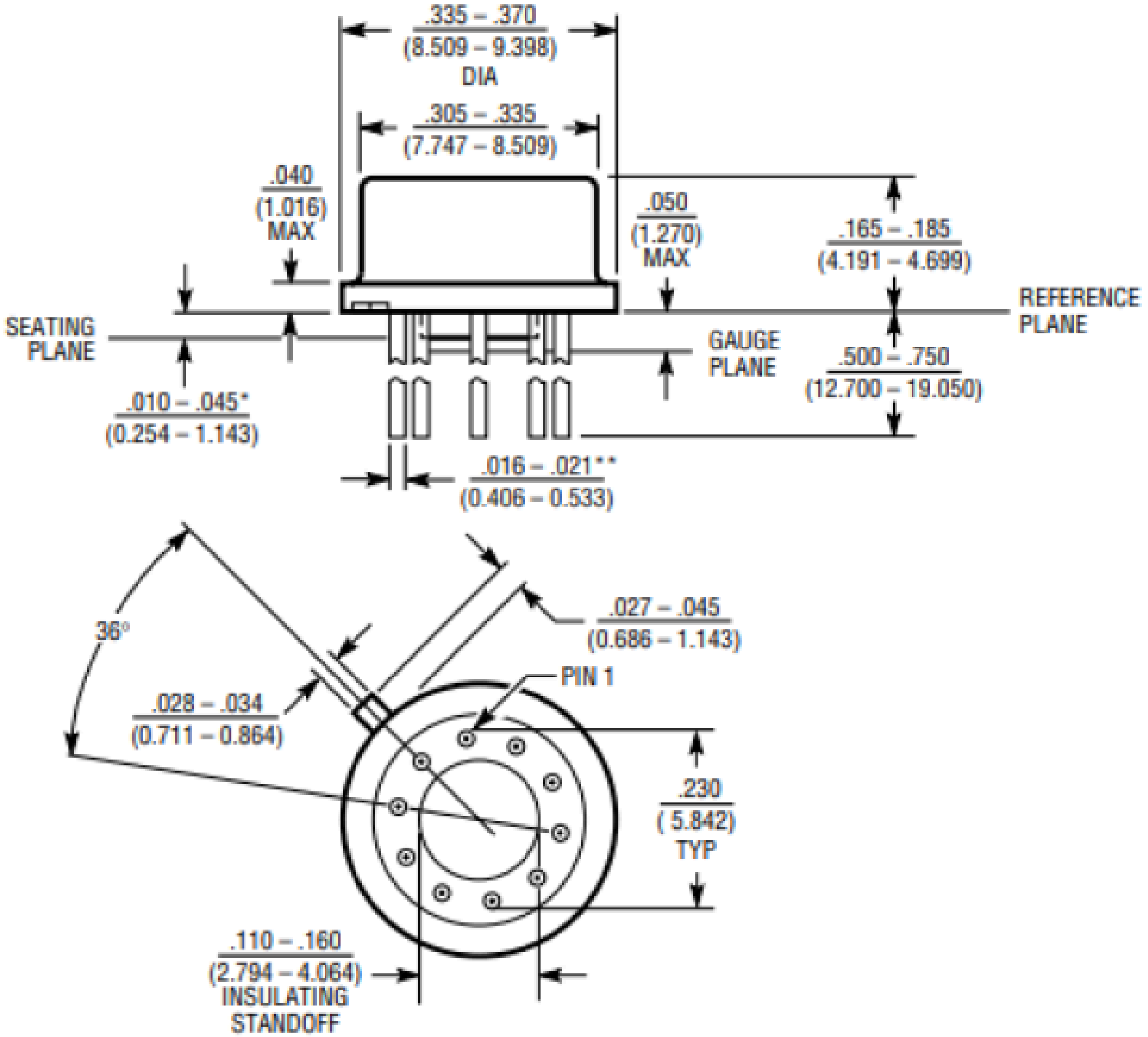


Finally, here is the electrical scheme of the gas sensor :



Package informations

H Package
10-Lead TO-5 Metal Can
(Reference LTC DWG # 05-08-1322)



*LEAD DIAMETER IS UNCONTROLLED BETWEEN THE REFERENCE PLANE AND THE SEATING PLANE

**FOR SOLDER DIP LEAD FINISH, LEAD DIAMETER IS $\frac{.016 - .024}{(0.406 - 0.610)}$ H10(TO-5) 0204