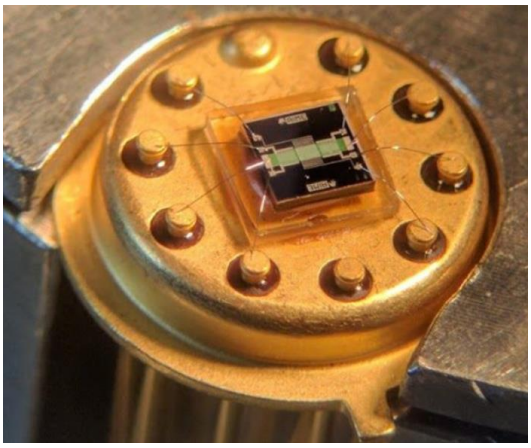
Low Cost Gas Sensor based on tungsten trioxide (WO_3) nanoparticles

MAIN FEATURES

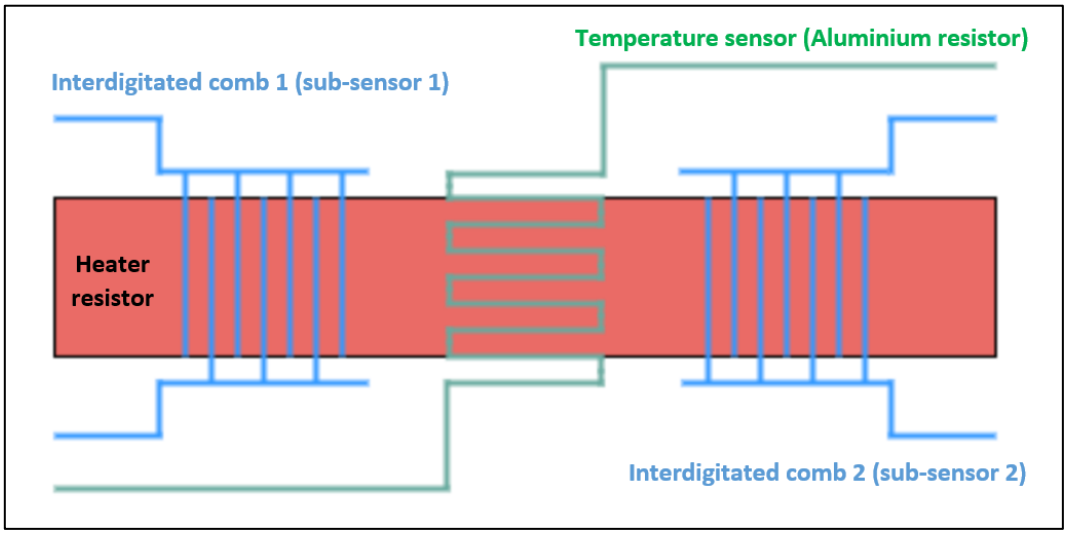
- Low cost
- Small size
- Long lifespan
- 2 integrated gas sensors
- Integrated temperature sensor
- Integrated heater
- Especially designed to detect CH_3CH_2OH and $NH_3$with high reliability
- 10-Lead TO-5 metal can package
- Passive sensor – conditioner not integrated in the package



GENERAL DESCRIPTION

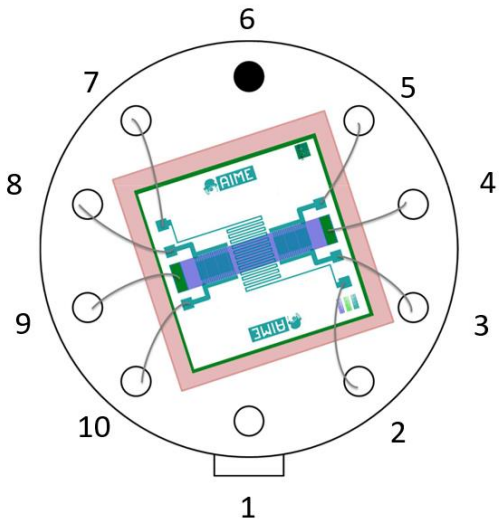
The GSW03AIME20 is a fully integrated, pin-compatible, gas sensor with a detection system based on WO_3 nanoparticles. The sensor is composed of two identical interdigitated combs hosting the nanoparticles tubes. By settling down on the nanoparticles, the gas molecules of the environment change the combs resistivity, depending on their nature and concentration. The operating temperature can be selected with the integrated heater resistor made of a N-doped poly-silicon layer. An additional aluminium resistor acts as a temperature sensor to retrieve the operating temperature of the measurement.

FUNCTIONNAL DIAGRAM



PIN CONFIGURATION

Pin number	Description
1	NC
2	Temperature sensor (Al resistor)
3	Gas sensor 1
4	Heater resistor (N-poly resistor)
5	Gas sensor 1
6	NC
7	Temperature sensor (Al resistor)
8	Gas sensor 2
9	Heater resistor (N-poly resistor)
10	Gas sensor 2



SPECIFICATIONS

Table 1.

PARAMETER	TEST CONDITION	MIN	TYP	MAX	UNIT
Temperature sensor					
Input impedance (R_{Al})	T = 25°C	60	71	80	Ω
Operating voltage	T = 25°C	-	5	10	V
Heater resistor					
Input impedance (R_h)	T = 25°C	60	80	105	Ω
Operating voltage	T = 25°C	-	7,5	15	V
Gas sensor					
Input impedance ($R_{gas\_T=25°C}$)	T = 25°C	-	10	-	GΩ
Input impedance ($R_{gas\_T=250°C}$)	T = 250°C	2	20	250	MΩ
Operating voltage	T = 25°C	-	20	20	V
CH_3CH_2OH detection					
Impedance variation : ΔR/$R_{gas\_T=250°C}$	T = 250°C	20	34	54	%
Response time τ	T = 250°C	10	20	30	s
Sensitivity	T = 250°C	-	54	-	kΩ/ppm
NH_3 detection					
Impedance variation : ΔR/$R_{gas\_T=250°C}$	T = 250°C	45	82	140	%
Response time τ	T = 250°C	4	-	25	s
Sensitivity	T = 250°C	-	143,3	-	kΩ/ppm

ABSOLUTE MAXIMUM RATINGS

Table 2.

Parameter	Rating
Temperature sensor	
Operating voltage	Nominal range of use : 0V to 5V Range of non-deterioration : 5V to 10V
Heater resistor	
Operating voltage	Nominal range of use : 0V to 7,5V Range of non-deterioration : 7,5V to 15V
Gas sensor	
Operating voltage	Range of non-deterioration : 0V to 20V
Operating temperature	Until 350°C

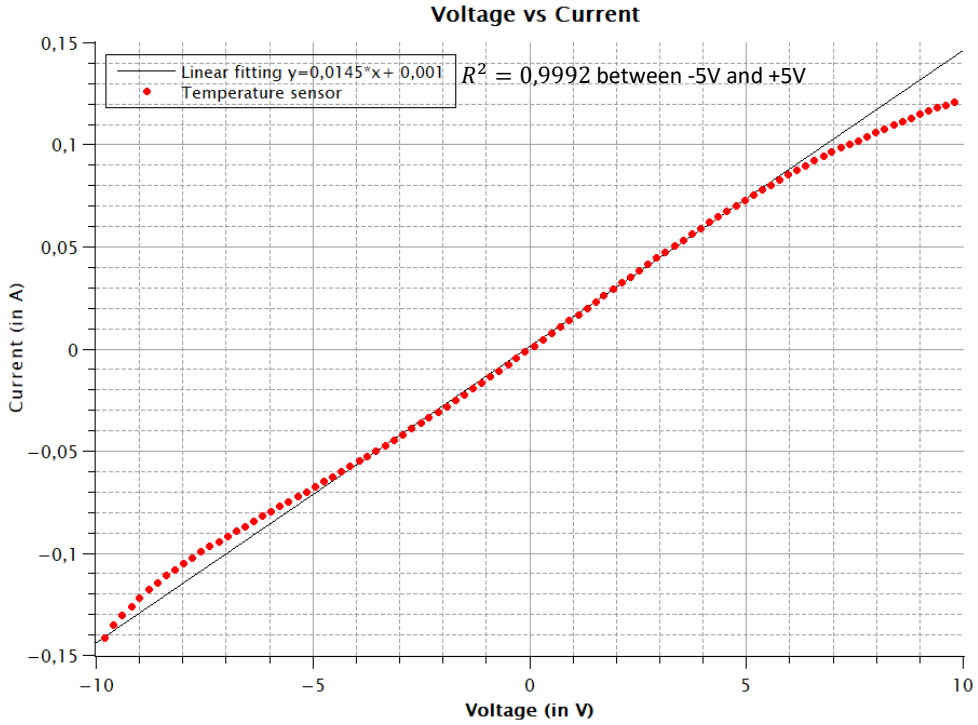
RECOMMENDED OPERATING CONDITIONS

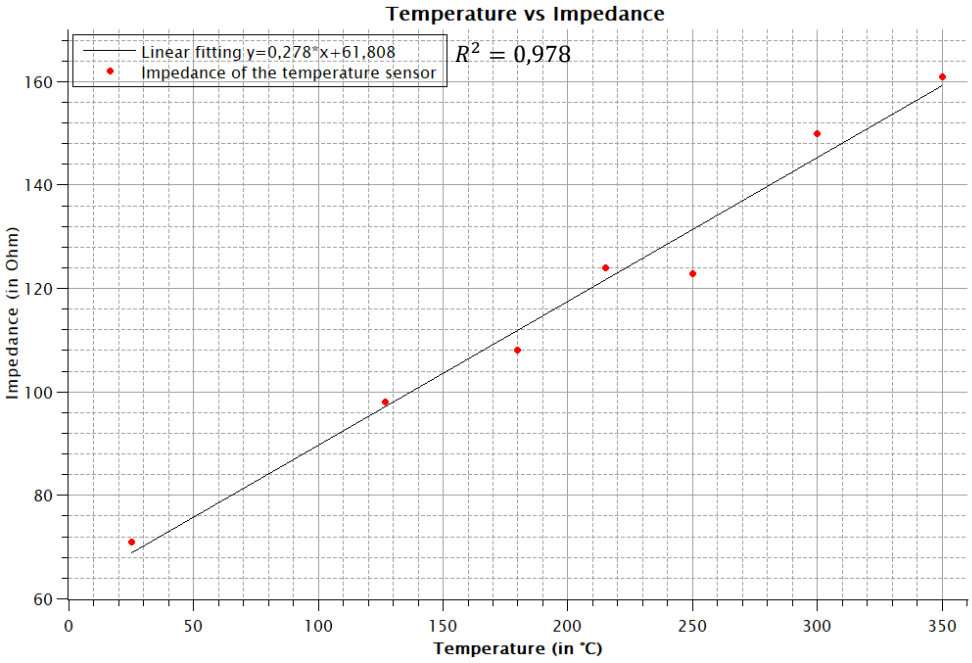
Table 3.

	TYP	Unit
External temperature	20 ± 5	°C
Internal temperature	250	°C
Humidity	60 ± 5	%
Air quality	80 / 20	% (N_2 / O_2)

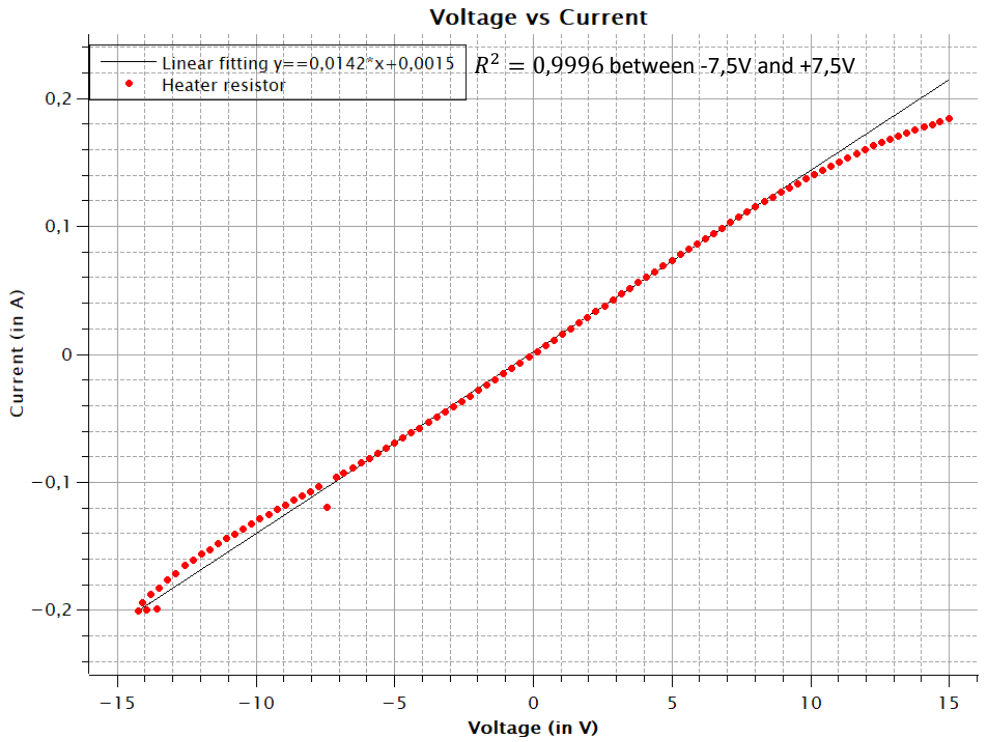
TYPICAL PERFORMANCE CHARACTERISTICS

1. Temperature sensor





2. Heater resistor



3. Gas sensor

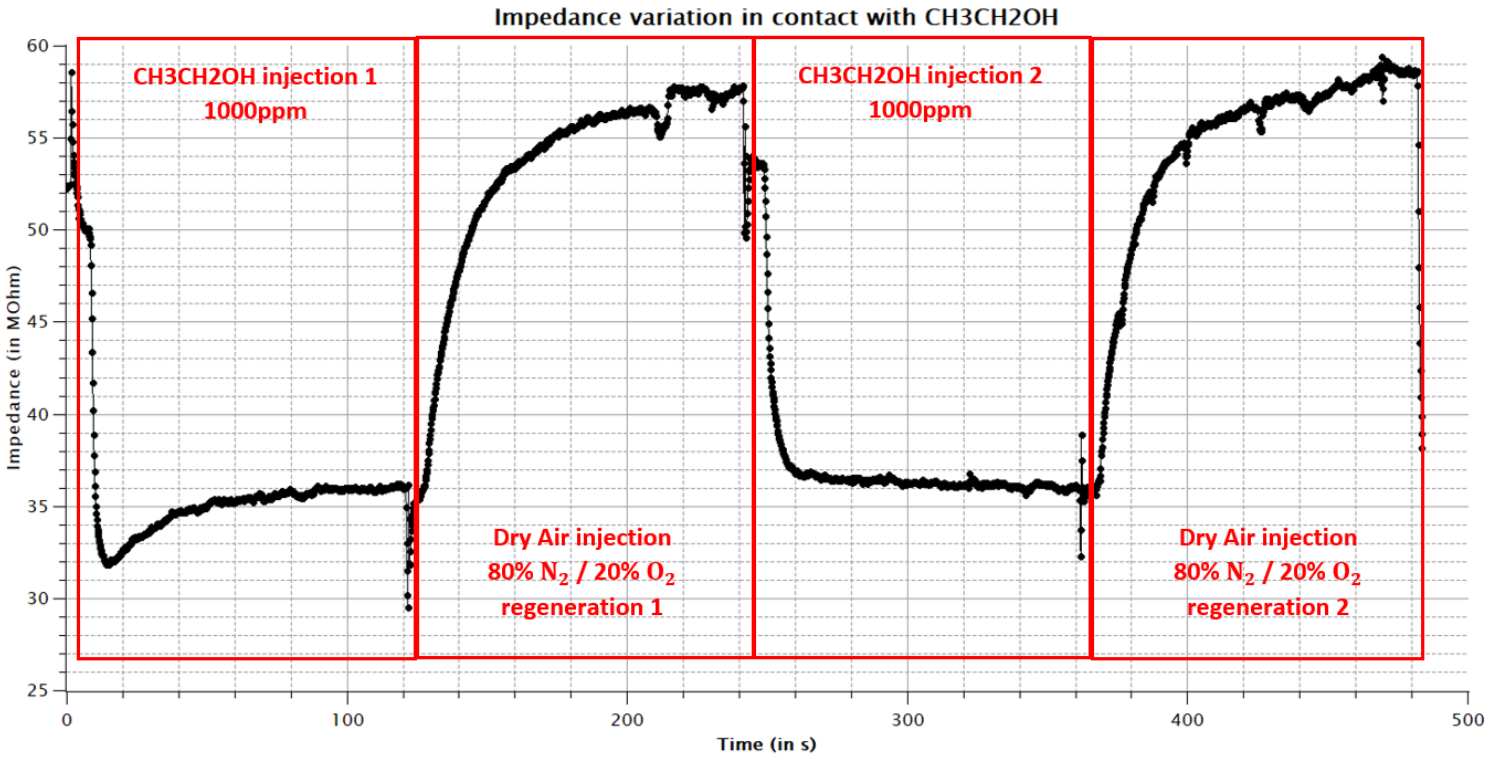
For the gas sensor characterization, the following protocol has been used :

The gas composition is respectively :

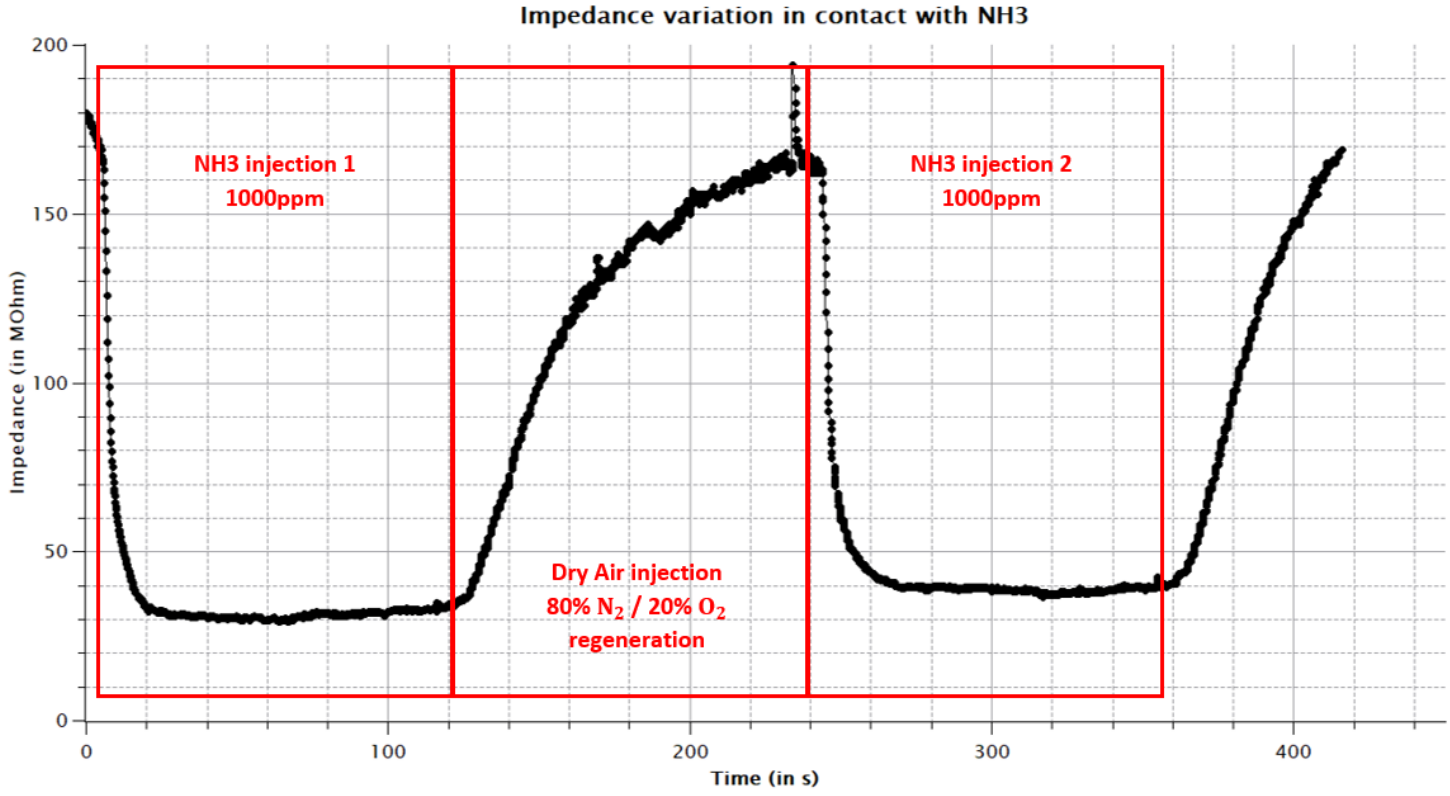
- 80% N_2 and 20% O_2 for “dry air”
- CH_3CH_2OH at about 0,1% in dry air for “Ethanol”
- NH_3 at about 0,1% in dry air for “NH_3”

The measurements have been performed with a 20V polarization voltage across the gas sensor and by a temperature of 250°C.

3.1. Gas sensor - CH_3CH_2OH detection

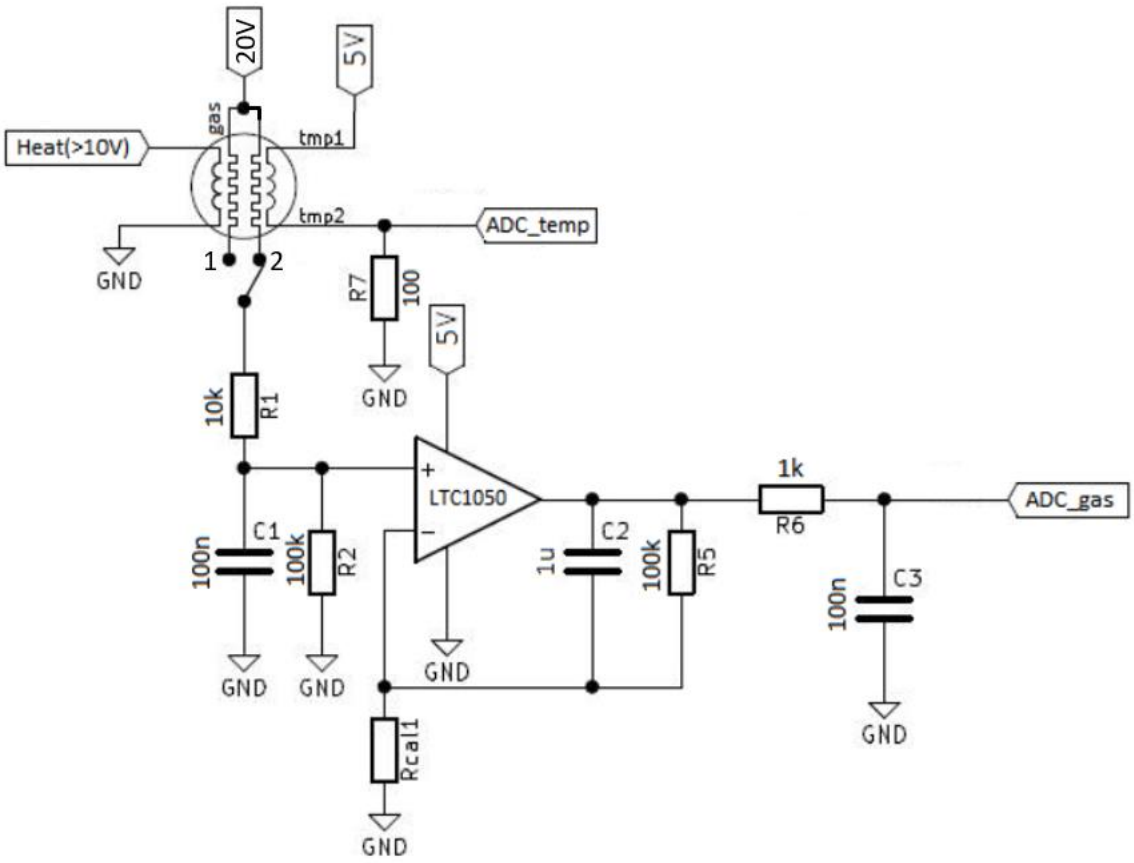


3.2. Gas sensor - NH_3detection



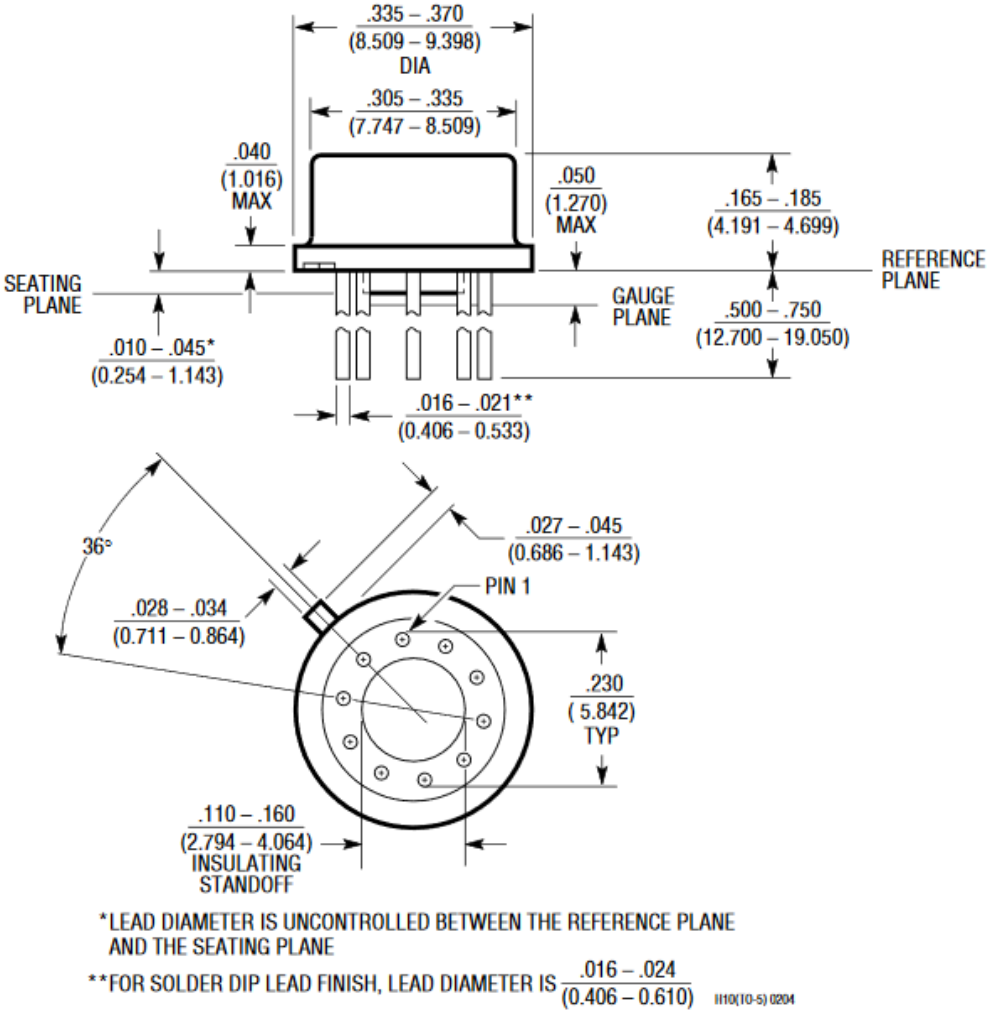
APPLICATION INFORMATION

A typical application of the sensor in an analogic circuit is described below. With this conditioning circuit, the low current delivered by sensor 1 or 2 (around 100nA) is transformed into a readable voltage for the ADC (of an Arduino board for example). An amplifier with small input current and ultra-low voltage offset such as LTC1050 is needed. 3 low-pass filters are included to attenuate the 50Hz coming from the 230V and to make an anti-aliasing filter. It also reduces the noise introduced by the analogic treatment. The temperature sensor is seen as a resistor in a dividing bridge and the voltage can be read by another ADC. Finally, a voltage of more than 10V must supply the heater resistor to reach the operating temperature of the gas sensor. With this circuit, a 100nA current at the output of the sensor is detected as a 1V voltage by the ADC_gas input.



PACKAGE MATERIAL INFORMATION

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 .016 – .024 (0.406 – 0.610)

H10(10-5) 0204