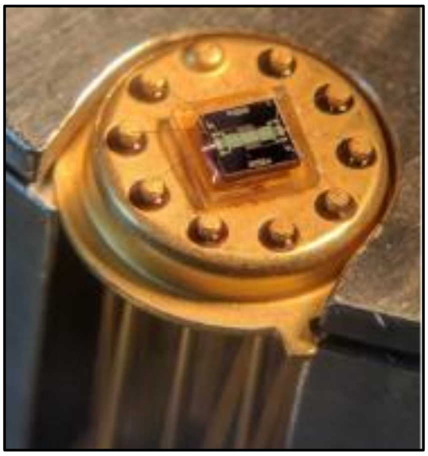
Gas sensor datasheet



Features and applications

Applications

Detection of various gases:
- Nitrogen dioxide (NO_2)
- Carbon monoxide (CO)
- Hydrogen sulfide (SO_2)
- Dihydrogen (H_2)
- Methane (CH_4)
- Alcohols (-OH)

Temperature sensor

Main features

High sensitivity and selectivity
Low power consumption
Low cost
Small and compact
Easy to use
Long lifetime

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 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 traces of atmospheric gases, including for instance nitrogen dioxide, carbon monoxide and dihydrogen.

TABLE OF CONTENT

1. DEVICE OVERVIEW

1.1. Pin description

FIGURE 1-1: PIN MAPPING

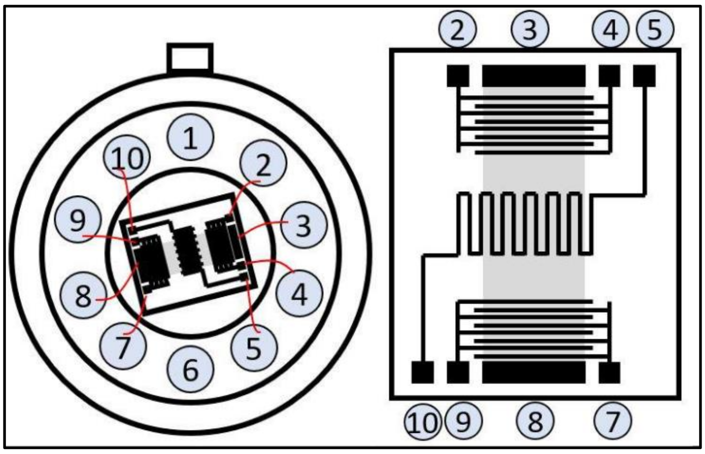
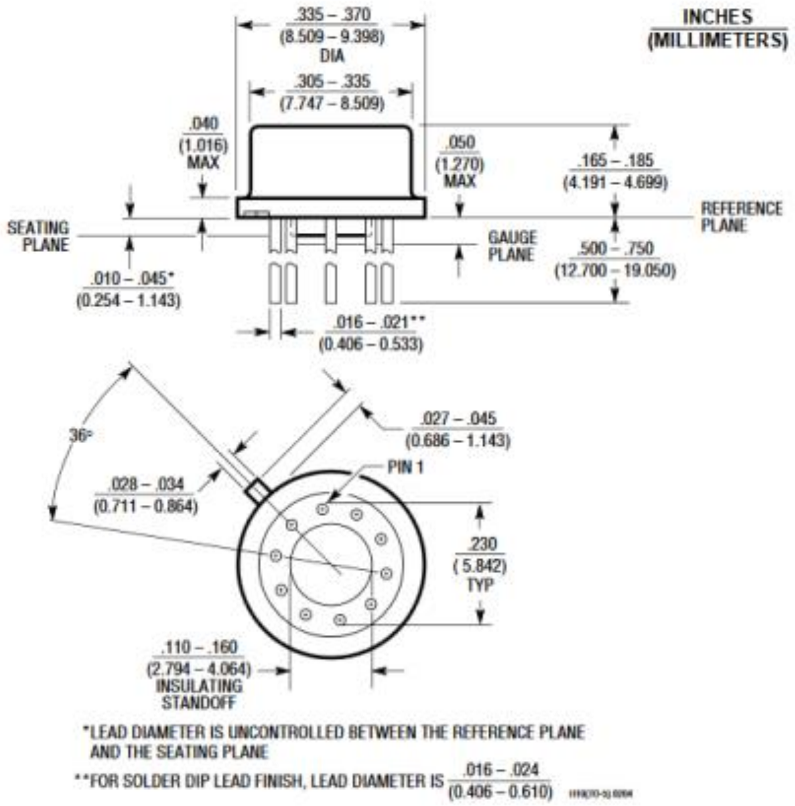


TABLE 1-2: PIN USAGE

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

1.2. Dimensions and structure

FIGURE 1-2: SENSOR DIMENSION



2. GENERAL SPECIFICATIONS

2.1. Specification

TABLE 2-1: GENERAL SPECIFICATIONS

Specification	Description
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

TABLE 2-1: GENERAL SPECIFICATIONS (CONTINUED)

Specification	**Description**
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
Aluminium resistance	80 Ω

TABLE 2-2: STANDARD USE CONDITION

	Unit	Typical Value
Temperature	**°C**	**25 +/- 5**
Relative Humidity	**%**	**60 +/- 5**

TABLE 2-3: USE DOMAINS

	Nominal domain	**Non deterioration domain**
Aluminium	[0V;5V]	[5V;10V]
Polysilicium	[0V;7.5V]	[7,5;15V]
Gas sensor	Up to 523K	Up to 623K

2.2. Electrical characteristics of our sensor

FIGURE 2-1: I(V) characteristics of the sensor at 15V

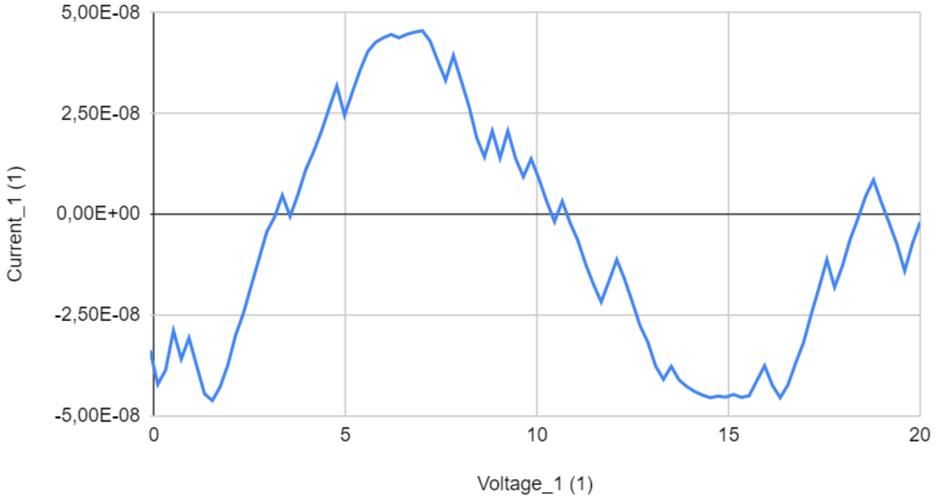


FIGURE 2-2: I(V) characteristics of the aluminium at 10V

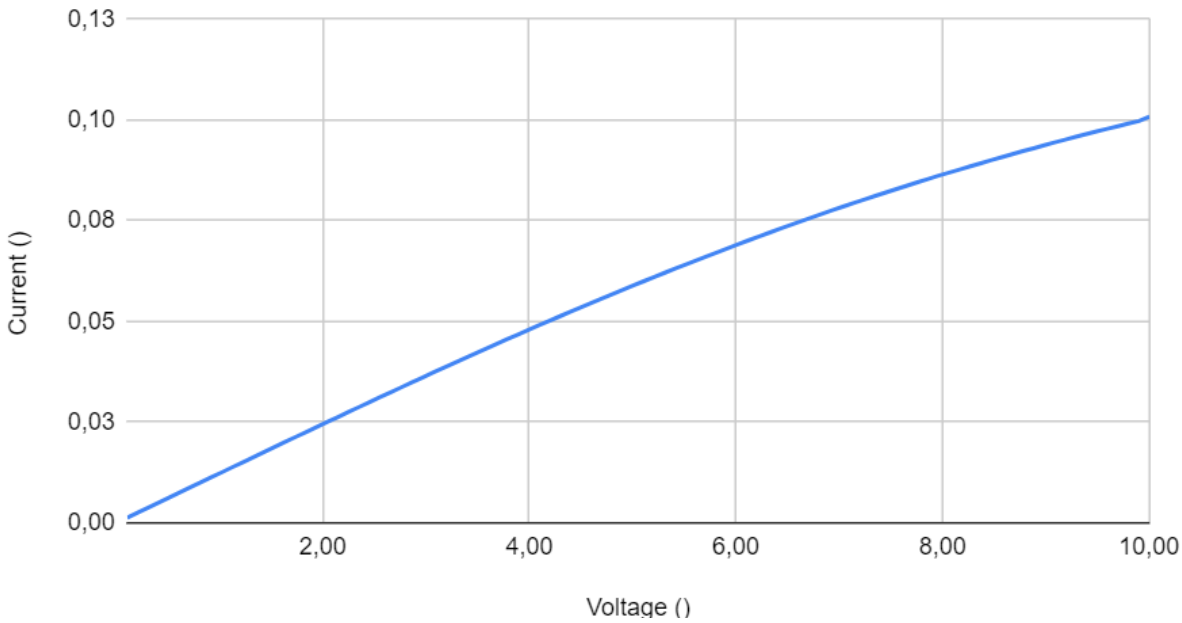


FIGURE 2-3: I(V) characteristics of the comb at 15V

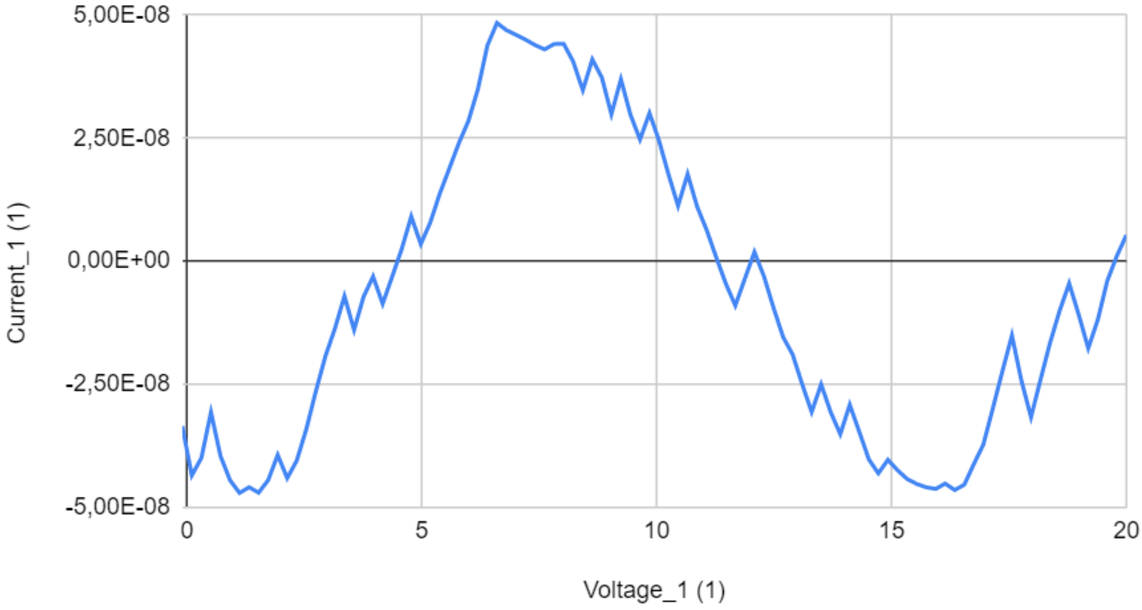
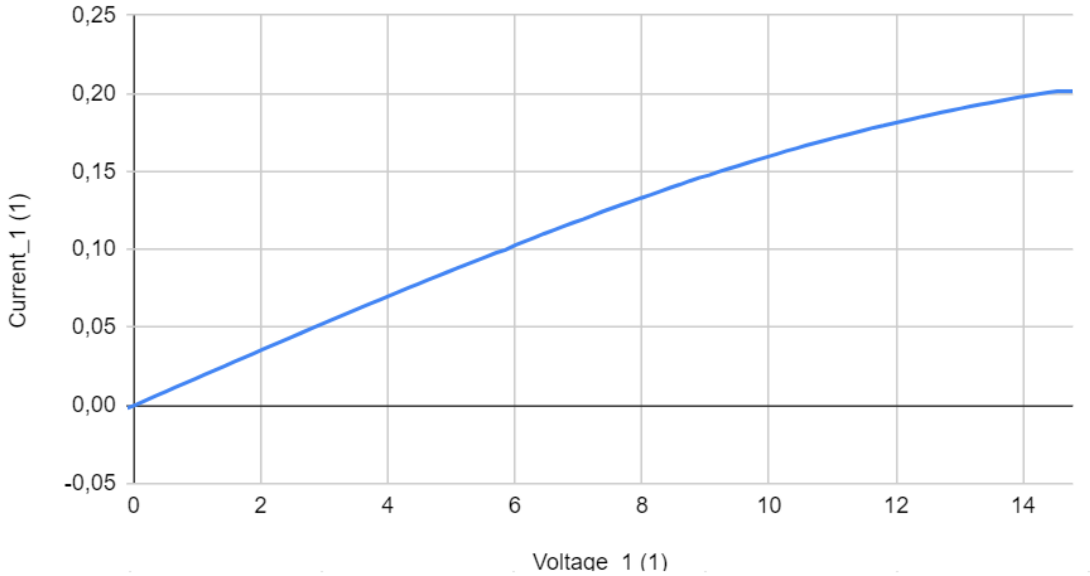


FIGURE 2-4: I(V) characteristics of the polysilicon at 15V



2.3. Variations with temperature

We realised test following this process :

TABLE 2-4: GAS INJECTED

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

FIGURE 2-5: Variation of the sensor resistance at 500K

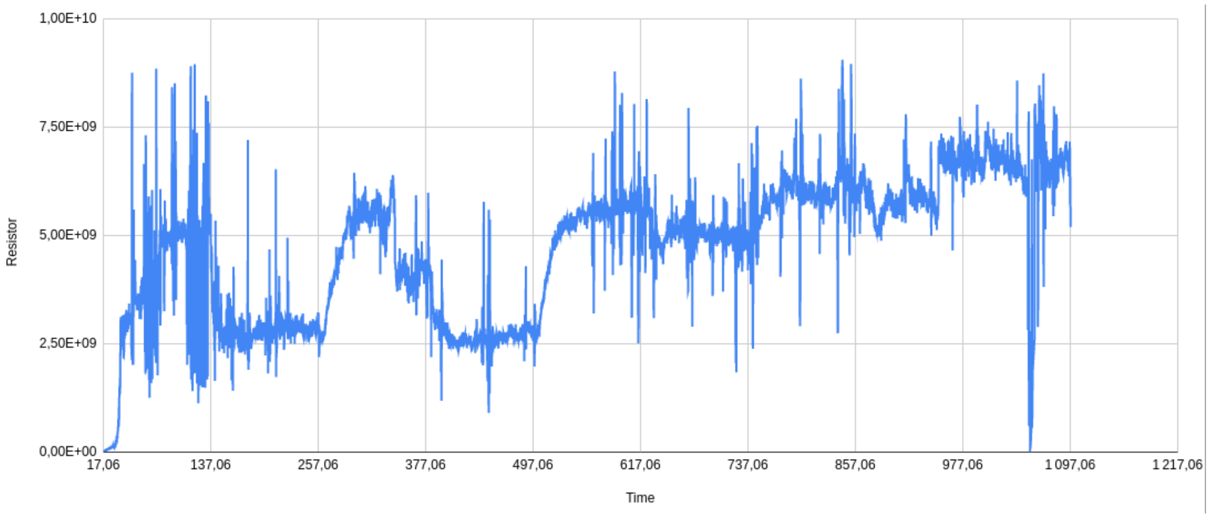


FIGURE 2-6: Variation of the sensor resistance at 600K

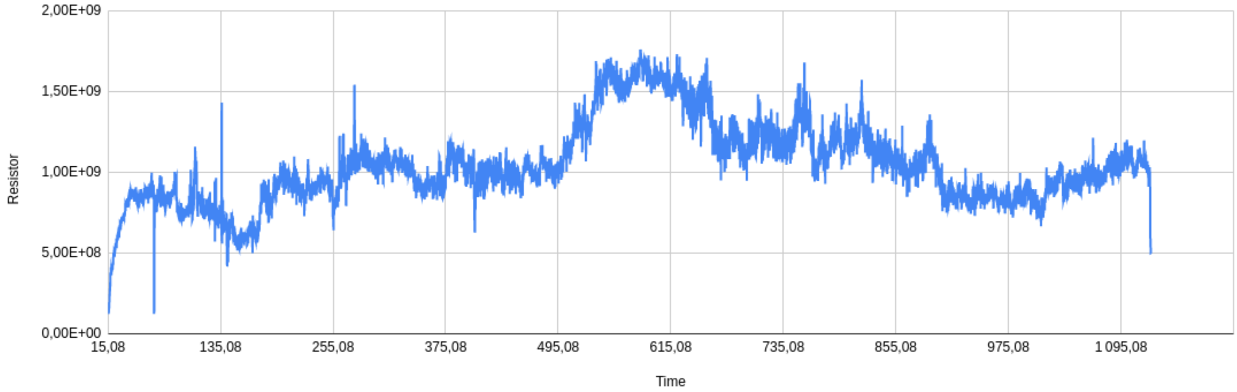
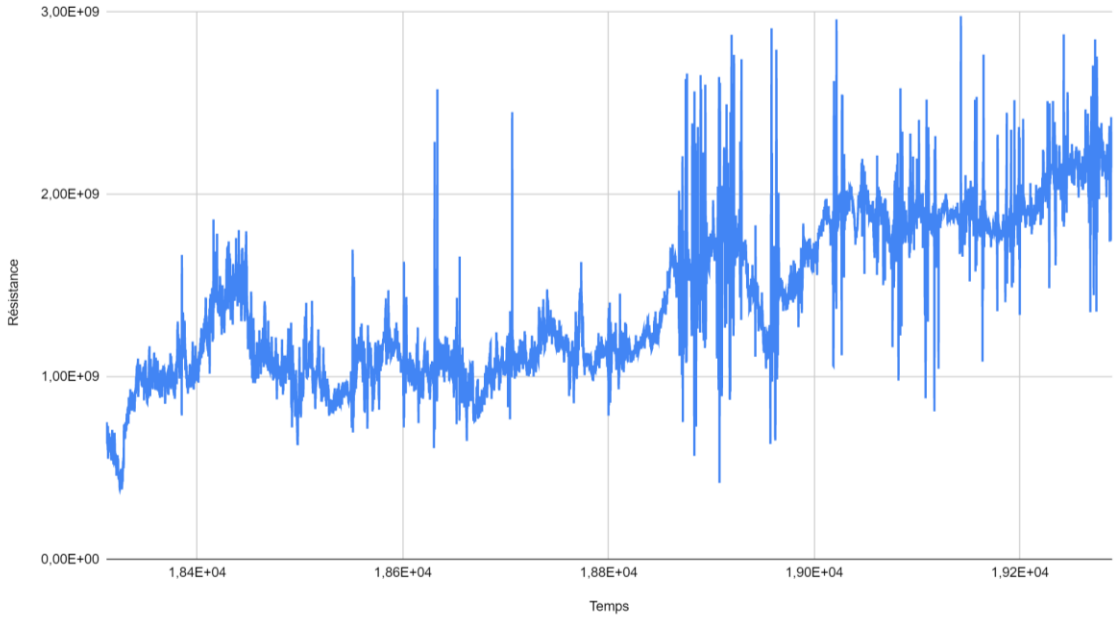


FIGURE 2-7: Variation of the sensor resistance at 610K



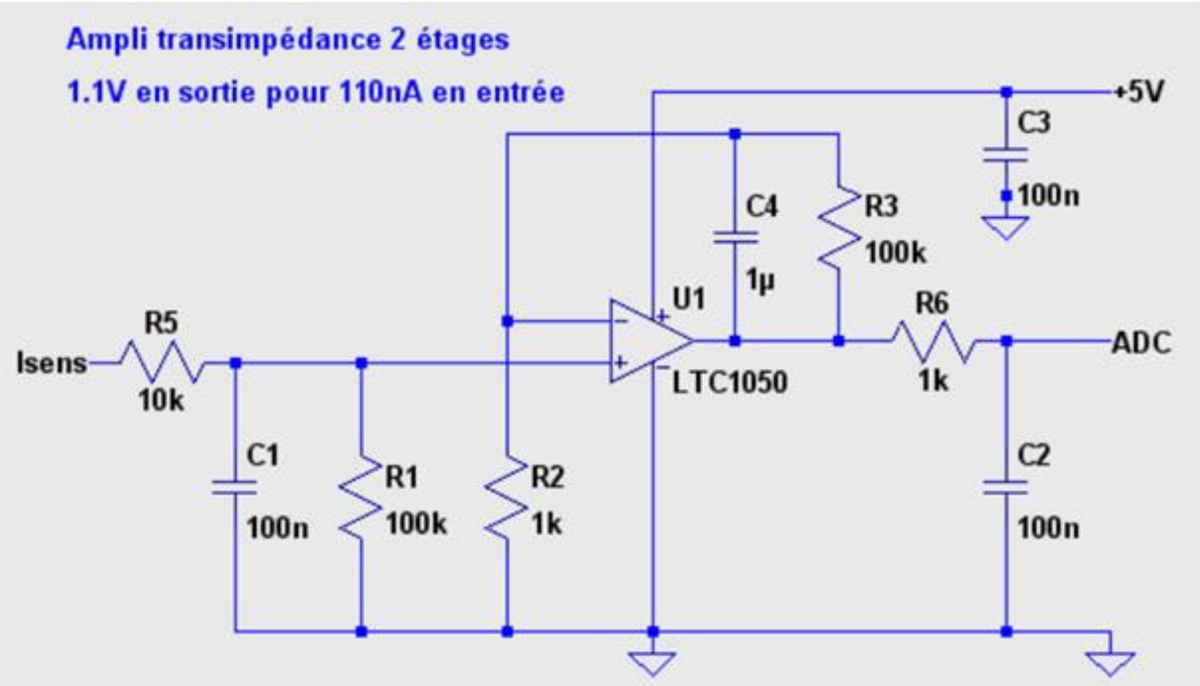
3. TYPICAL CIRCUIT APPLICATION

3.1. Typical circuit connection

The output current of the sensor is about 100 nanometres Ampere. It is very difficult to measure such small currents with a basic microcontroller, so we must amplify it. Moreover, because of the very high impedances of the sensor, we will have to adapt the impedance in the amplification stage to have a reliable measurement. The solution chosen is described in the following schema.

The gas sensor must be powered on pin 2/4 and the output (pin 7/9) must be filtered or amplified with the circuit below.
Then the value can be read with an Arduino or any device equipped with GPIO.

FIGURE 3-1: HARDWARE CONNECTION



3.2. Typical values of the analog filters

Analog filters can be added in the electronic circuit to improve sensor's performance. On the table below you will find the typical values used to build the filters at respectively 1kHz , 7.5kHz and 15kHz.
In the following table you can read the characteristics of the chosen components.

TABLE 3-1: TYPICAL VALUES

Variable	Typical Value
Sensor	
R_{sensor}	≈1GOhm
I_{sens}	≈ 100 nA
Sensor Bandwidth	1Hz
ADC	
f_{ADC}	[50kHz-200kHz]
ADC Resolution	5mV
f_{mesure}	15 kHZ
f_{max} (shannon's criteria)	7.5 kHz
Circuit	
V_{R1}	10mV
Amplifier circuit gain	500
Output Voltage	5V
AO	
V_{offset}	10mV

Input current	1nA