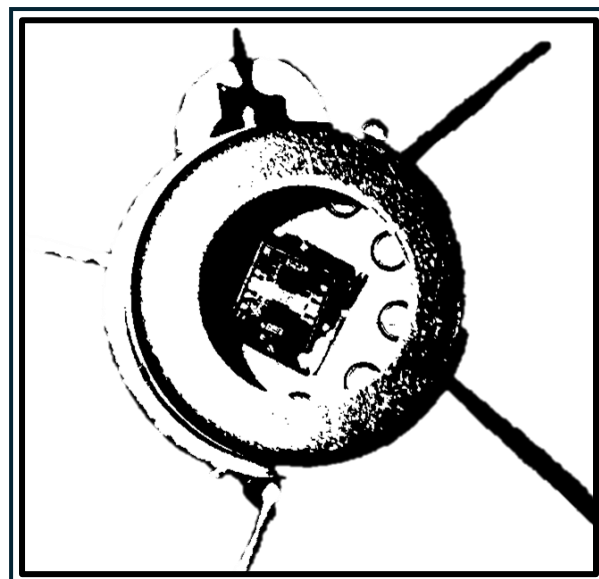


# Low Power Gas sensor based on tungsten trioxide (WO<sub>3</sub>) nanoparticles

## 1. Features

- Nano-structured WO<sub>3</sub> (tungsten oxide) sensing layer for high sensitivity to reducing gases (e.g. NH<sub>3</sub>, ethanol)
- Integrated buried polysilicon micro-heater for precise operating temperature control
- Additional aluminum track usable as heater or on-chip thermistor for temperature monitoring
- Interdigitated electrode structure for improved interaction between gas and sensing film
- Fast response and recovery time thanks to high surface area nanoparticles
- Compatible with standard microelectronic fabrication processes
- Low footprint, suitable for multi-sensor arrays and portable devices
- Operation in controlled or ambient atmosphere
- Suitable for batch fabrication and low-cost production



- Smart building and HVAC monitoring systems
- Portable and wearable gas detection equipment
- Educational and research demonstrators for nano-based gas sensing

## 2. Applications

- Environmental air quality monitoring (indoor and outdoor)
- Industrial safety and leak detection (ammonia, alcohol vapors, etc.)
- Process control in the chemical, food, and automotive industries
- Laboratory gas analysis and sensing platforms

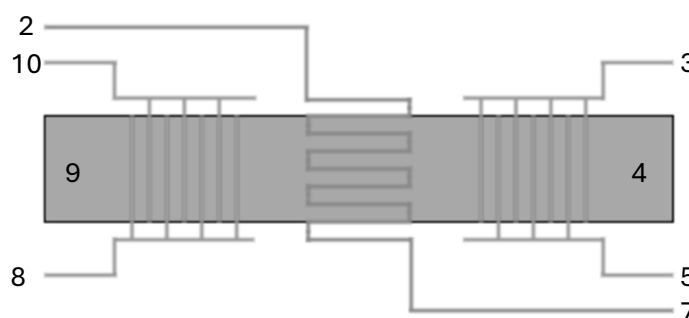
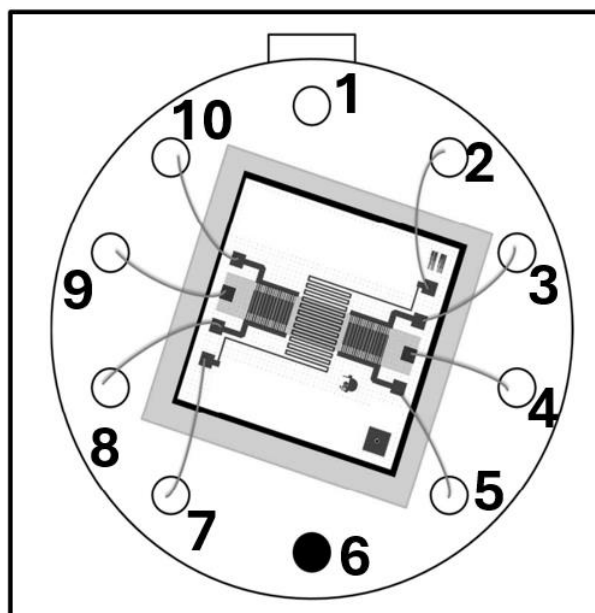
## 3. Description

The GQ32107 is a nano-based metal-oxide gas sensor designed for the detection of reducing gases such as ammonia (NH<sub>3</sub>) and ethanol vapors. The sensing element is a layer of WO<sub>3</sub> nanoparticles / nanowires integrated on a microfabricated chip that combines a buried n-doped polysilicon heater, an optional aluminum heating/thermistor track, and interdigitated electrodes.

During operation, the integrated heater sets the sensor to an elevated temperature, enhancing surface reactions between the target gas and the  $\text{WO}_3$  layer. These reactions induce a change in the electrical resistance measured across the interdigitated electrodes, which can be monitored using a simple bias and readout circuit. The on-chip structure allows fast thermal cycling, reduced power consumption, and a compact form factor suitable for multi-sensor modules and portable instruments. Designed to be compatible with standard microelectronics and thin-film processing, the GQ32107 offers an ideal platform for environmental monitoring, safety systems, and academic research on gas sensing with nanostructured metal oxides.

#### 4. Pin description

Pin number	Description
1/6	Not connected
2/7	Temperature sensor (Aluminium resistor)
8/10	Gas sensor ( $\text{WO}_3$ nanoparticles integrated on aluminium interdigital combs)
3/5	Gas sensor ( $\text{WO}_3$ nanoparticles integrated on aluminium interdigital combs)
4/9	Heater resistor (Polysilicon resistor)



## 5. Specifications

<b>Type</b>	Active Nanoparticle base sensor
<b>Materials</b>	<ul style="list-style-type: none"> <li>➤ Silicon</li> <li>➤ N-doped poly-silicon (heater)</li> <li>➤ Aluminium (temp sensor)</li> <li>➤ Nanoparticle (WO<sub>3</sub>)</li> </ul>
<b>Measurment</b>	Resistive measure
<b>Detectable gaz</b>	<ul style="list-style-type: none"> <li>➤ Air (N<sub>2</sub>O<sub>2</sub>)</li> <li>➤ Methane (CH<sub>4</sub>)</li> <li>➤ Ethanol (C<sub>2</sub>H<sub>6</sub>O)</li> </ul>
<b>Package</b>	10-Lead TO-5 metal
<b>Diameter</b>	9.5mm
<b>Mouting</b>	Through hole THT
<b>Time response (1τ)</b>	<ul style="list-style-type: none"> <li>➤ Dry air : 0,0825s</li> <li>➤ Ethanol : 0,0942s</li> <li>➤ Methane : 0,0557s</li> <li>➤ Overall responce time ~10s (5τ)</li> </ul>

### a. Standard work condition

Symbol	Parameter name	Technical conditions	Units	Remarks
$V_{Ts}$	Temperature nominal sensing voltage	[0, 4]	V	
$V_{Ts\_ND}$	Temperature non-degradation sensing voltage	]4; 9]	V	Non linear working condition without damaging sensor
$V_H$	Nominal heating voltage	[10, 15]	V	
$V_{H\_ND}$	Non degradation heating voltage	]5, 9]	V	Non linear working conditions without damaging sensor
$R_S$	Sensing resistor	79, 5	Ω	
$R_H$	Heating resistor	98, 9	Ω	Room temps
$T_o$	Operating temperature	250	°C	

**b. Environment condition**

Symbol	Parameter name	Technical conditions	Units	Remarks
$T_{op}$	Operating temps	$25 \pm 5$	$^{\circ}\text{C}$	
$H_{op}$	Humidity	$60 \pm 5$	%	
$A_{CN}$	Nominal air quality	80, 20	% $N_2O_2$	

**c. Sensitivity characteristic**

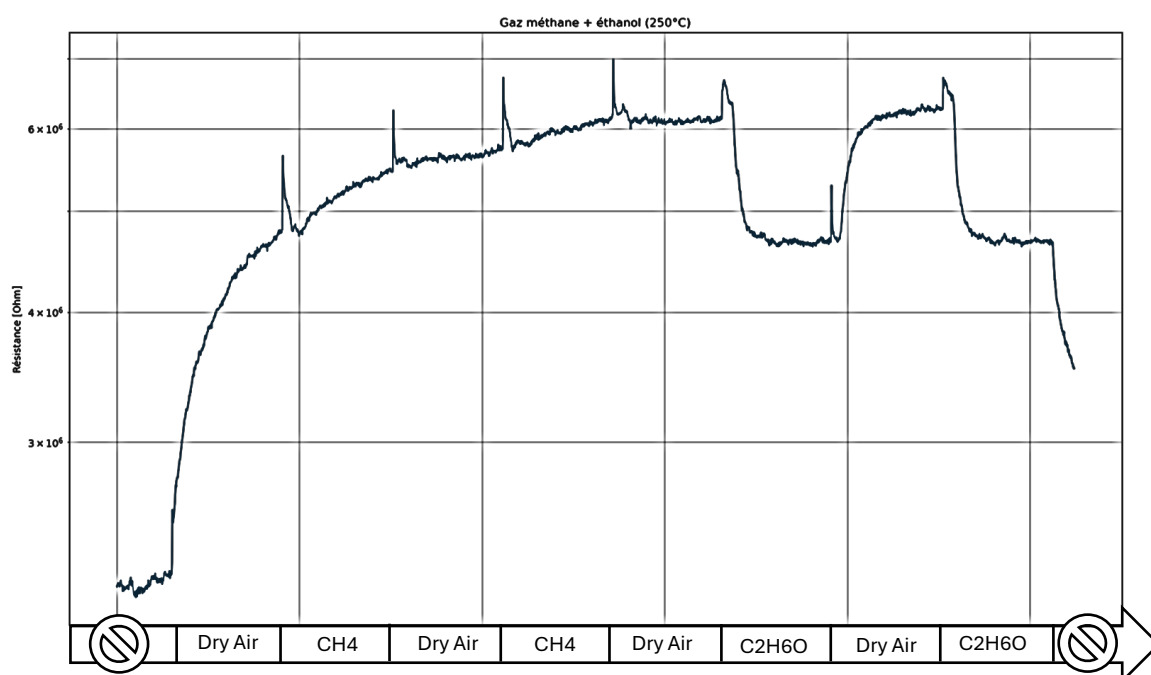
Symbol	Parameter name	Technical conditions	Units	Remarks
$S_n$	Nominal sensisitivity	Air : 17 Ethanol : 1396	$\Omega/\text{ppm}$	Tested with 1000ppm concentrations. Methane couldn't be computed.
$S_{lim}$	Sensitivity limit	Air : 14, 71 Ethanol : 35, 82	ppm	Methane couldn't be computed
$P_T$	Preheat time	60	s	

**d. Absolute maximum rating**

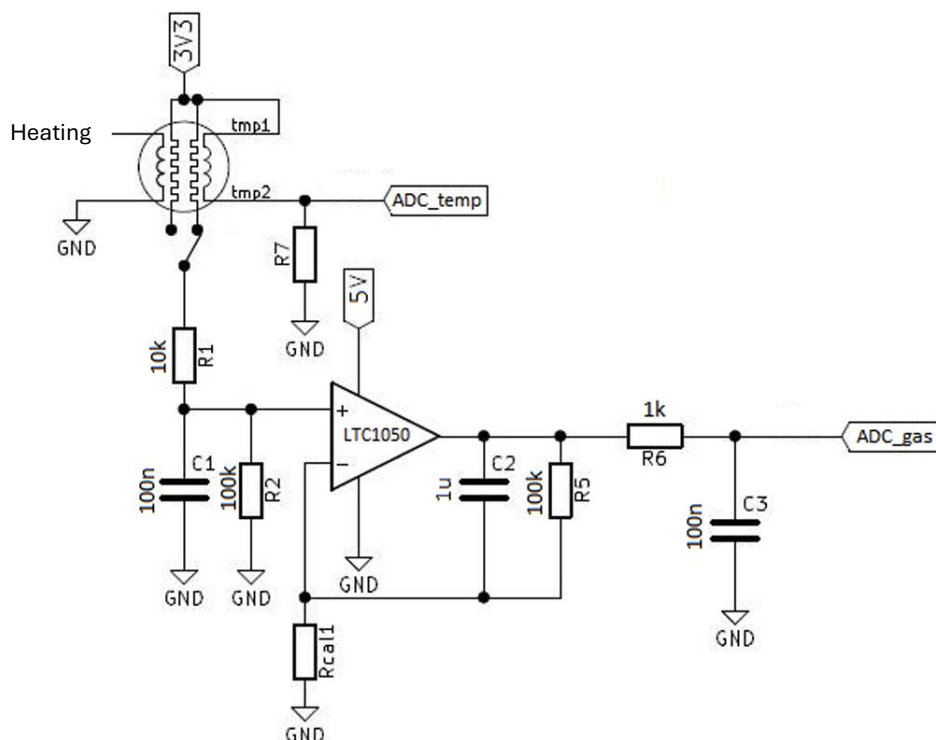
Symbol	Parameter name	Rating	Units	Remarks
$V_{Tmax}$	Maximum temperature sensing voltage	9 >	V	
$V_{Hmax}$	Maximum heating voltage	9 >	%	

## 6. Gaz sensor characteristics

The gas sensor characteristic is determined by measuring the resistance evolution in presence of different gases. In order to determine the sensed gas we can measure the time constant of the exponential growth. A resistance spike reveals a change in gas.



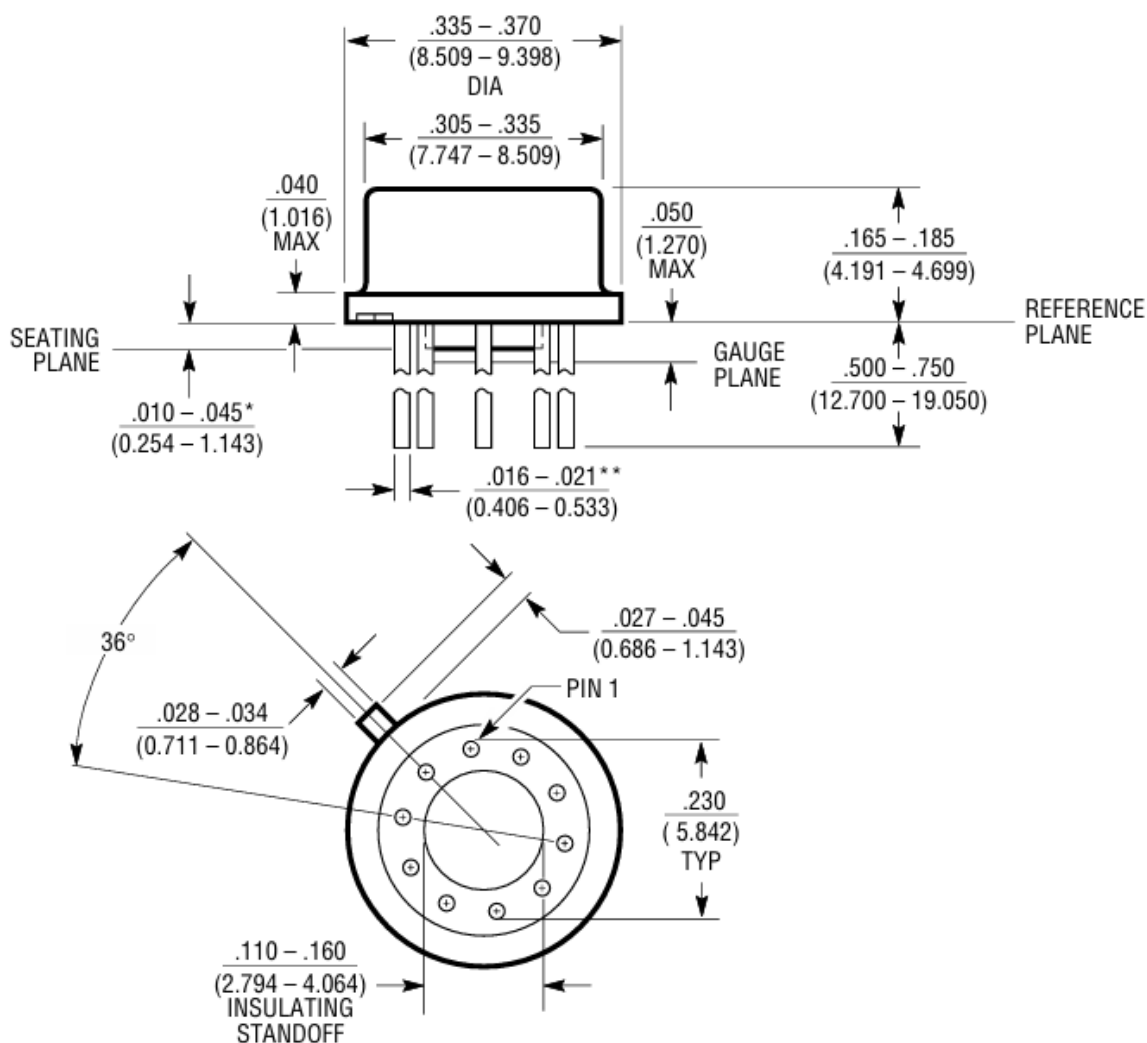
## 7. Typical applications



Above is a typical application of the sensor in an analogue circuit. One of the two gas sensors is connected in series with two resistors in a voltage divider. The resulting voltage is filtered in order to keep only the DC value amplified by an LTC1050 operational amplifier before being filtered by a low-pass filter to prevent aliasing. The voltage from the ADC\_gas label can be connected to a 5 V ADC (an Arduino, for example). The temperature sensor (tmp1 – tmp2) is also used as a resistor in a divider bridge and the voltage can be converted by an ADC.

## 8. Package

### 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(TO-5) 0204