

# TGS 4161 - for the detection of Carbon Dioxide

## Features:

- \* High selectivity to CO<sub>2</sub>
- \* Compact size
- \* Low dependency on humidity
- \* Long life and low cost
- \* Low power consumption

## Applications:

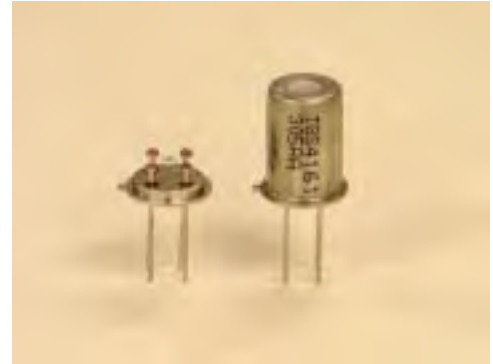
- \* Indoor air quality control
- \* CO<sub>2</sub> monitors

**TGS4161** is a new solid electrolyte CO<sub>2</sub> sensor which offers miniaturization and low power consumption. A range of 350~10,000ppm of carbon dioxide can be detected by TGS4161, making it ideal for indoor air control applications.

The CO<sub>2</sub> sensitive element consists of a solid electrolyte formed between two electrodes, together with a printed heater (RuO<sub>2</sub>) substrate. By monitoring the change in electromotive force (EMF) generated between the two electrodes, it is possible to measure CO<sub>2</sub> gas concentration.

The top of the sensor cap contains adsorbent (zeolite) for the purpose of reducing the influence of interference gases.

**TGS4161** exhibits a linear relationship between  $\Delta$ EMF and CO<sub>2</sub> gas concentration on a logarithmic scale. The sensor displays good long term stability and shows excellent durability against the effects of high humidity.



The figure below represents typical sensitivity characteristics of TGS4161. The Y-axis is indicated as  $\Delta$ EMF which is defined as follows:

$$\Delta\text{EMF} = \text{EMF}_1 - \text{EMF}_2$$

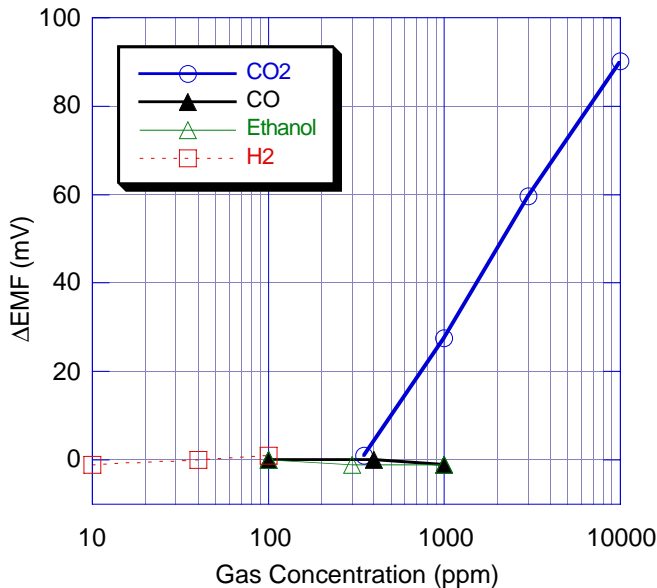
where  
 EMF<sub>1</sub> = EMF in 350 ppm CO<sub>2</sub>  
 EMF<sub>2</sub> = EMF in listed gas concentration

The figure below shows typical humidity dependency of TGS4161. Again, the Y-axis is indicated as  $\Delta$ EMF which is defined as follows:

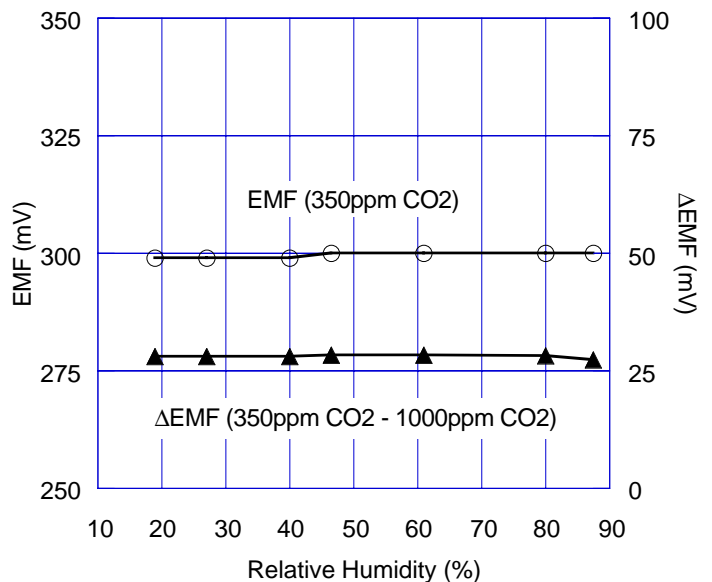
$$\Delta\text{EMF} = \text{EMF}_1 - \text{EMF}_2$$

where  
 EMF<sub>1</sub> = EMF in 350 ppm CO<sub>2</sub>  
 EMF<sub>2</sub> = EMF in 1000ppm CO<sub>2</sub>

### Sensitivity Characteristics:



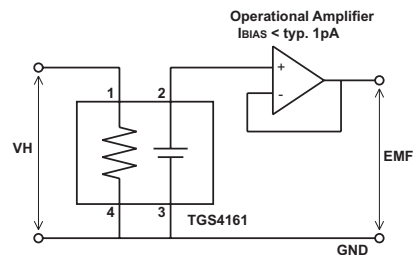
### Humidity Dependency:



### Basic Measuring Circuit:

The TGS4161 sensor requires heater voltage ( $V_H$ ) input. The heater voltage is applied to the integrated heater in order to maintain the sensing element at a specific temperature which is optimal for sensing. Electromotive force (EMF) of the sensor should be measured using a high impedance ( $>100\text{ G}\Omega$ ) operational amplifier with bias current  $< 1\text{ pA}$  (e.g. Texas Instruments' model #TLC271). Since the solid electrolyte type sensor

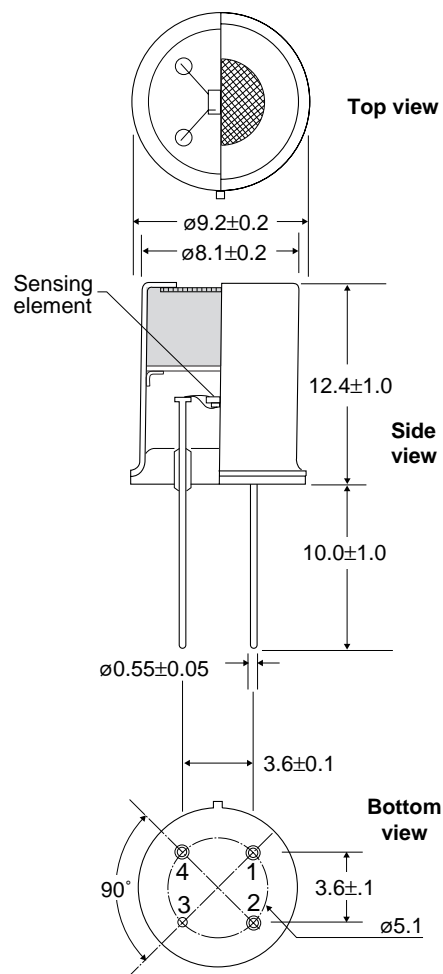
functions as a kind of battery, the EMF value itself would drift using this basic measuring circuit. However, the change of EMF value ( $\Delta\text{EMF}$ ) shows a stable relationship with the change of  $\text{CO}_2$  concentration. Therefore, in order to obtain an accurate measurement of  $\text{CO}_2$ , a special microprocessor for signal processing should be used with TGS4161. Figaro can provide a special evaluation sensor module (AM-4-4161) for TGS4161.



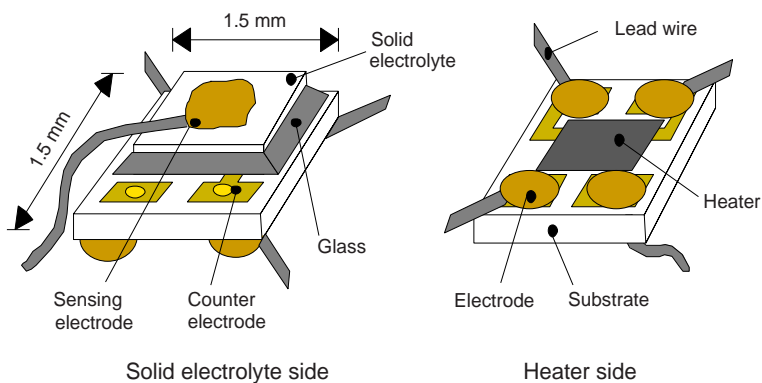
### Specifications:

Model number		TGS 4161		
Sensing element type		Solid electrolyte		
Target gases		Carbon dioxide		
Typical detection range		350 ~ 10,000 ppm		
Electrical characteristics	Heater resistance	$R_H$	$70 \pm 7\Omega$ at room temp.	
	Heater current	$I_H$	approx. 50mA	
	Heater power consumption	$P_H$	approx. 250mW	
	Electromotive force	EMF	220~490mV in 350ppm $\text{CO}_2$	
	Sensitivity	$\Delta\text{EMF}$	44~72mV	EMF(350ppm $\text{CO}_2$ )-EMF(350ppm $\text{CO}_2$ )
	Heater voltage	$V_H$	$5.0 \pm 0.2\text{V}$ (DC)	
Sensor characteristics	Response time	approx. 1.5 min. (to 90% of final $\Delta\text{EMF}$ value)		
	Measurement accuracy	approx. $\pm 20\%$ at 1,000ppm $\text{CO}_2$		
Operating conditions		$-10\text{--}50^\circ\text{C}$ , 5~95%RH		
Storage conditions		$-20\text{--}60^\circ\text{C}$ , 5~90%RH (store in moisture proof bag with silica gel)		
Standard test conditions	Test gas condition	$\text{CO}_2$ in air at $20 \pm 2^\circ\text{C}$ , 65 $\pm$ 5%RH		
	Circuit condition	$V_H = 5.0 \pm 0.05\text{V}$ DC		
	Conditioning period before test	12 hours or longer		

### Structure and Dimensions:



### Sensing Element Structure:



- Pin Connection:**
1. Heater (+)
  2. Counter electrode (+)
  3. Sensing electrode (-)
  4. Heater (-)

u/m = mm