

## TGS 4160 - for the detection of Carbon Dioxide

### Features:

- \* High selectivity to CO<sub>2</sub>
- \* Low dependency on humidity
- \* Long life

### Applications:

- \* Air quality control
- \* CO<sub>2</sub> control in agricultural applications
- \* CO<sub>2</sub> monitoring

The **TGS4160** is a hybrid sensor unit composed of a carbon dioxide sensitive element and a thermistor. A wide range of 350–50,000ppm of carbon dioxide can be detected by TGS4160, making it ideal for usage in a variety of applications.

The CO<sub>2</sub> sensitive element consists of a solid electrolyte formed between two electrodes, together with a printed heater (Pt) 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.

Adsorbent (zeolite) is filled between the internal cover and the outer cover for the purpose of reducing the influence of interference gases.

**TGS4160** 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 TGS4160. 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 for an energized sensor. Again, the Y-axis is indicated as  $\Delta$ EMF which is defined as follows:

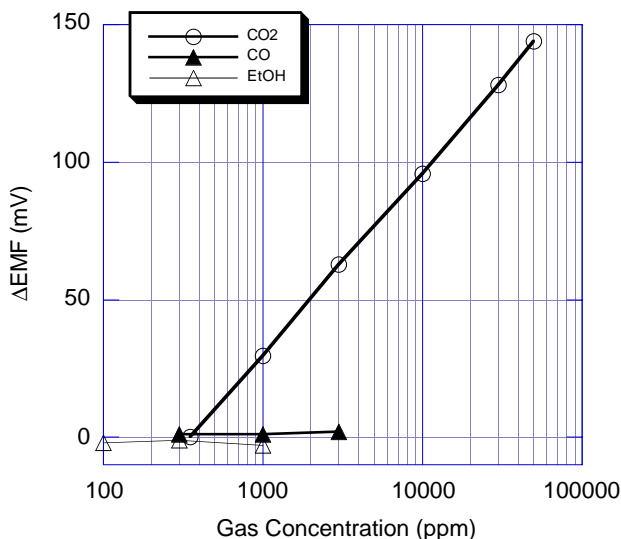
$$\Delta\text{EMF} = \text{EMF}_1 - \text{EMF}_2$$

where

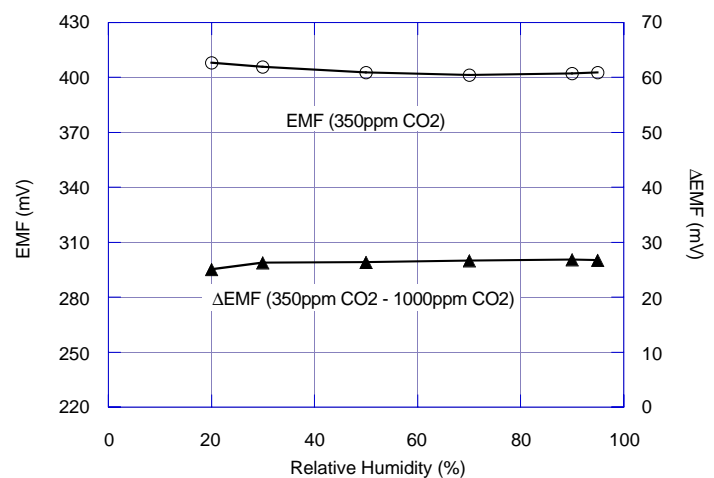
EMF<sub>1</sub> = EMF in 350 ppm CO<sub>2</sub>

EMF<sub>2</sub> = EMF in 1000ppm CO<sub>2</sub>

### Sensitivity Characteristics:



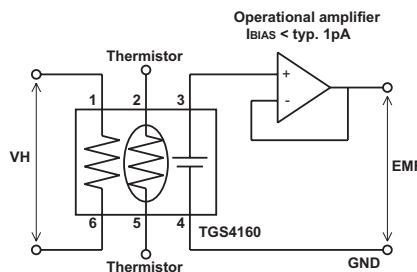
### Humidity Dependency:



### Basic Measuring Circuit:

The TGS4160 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

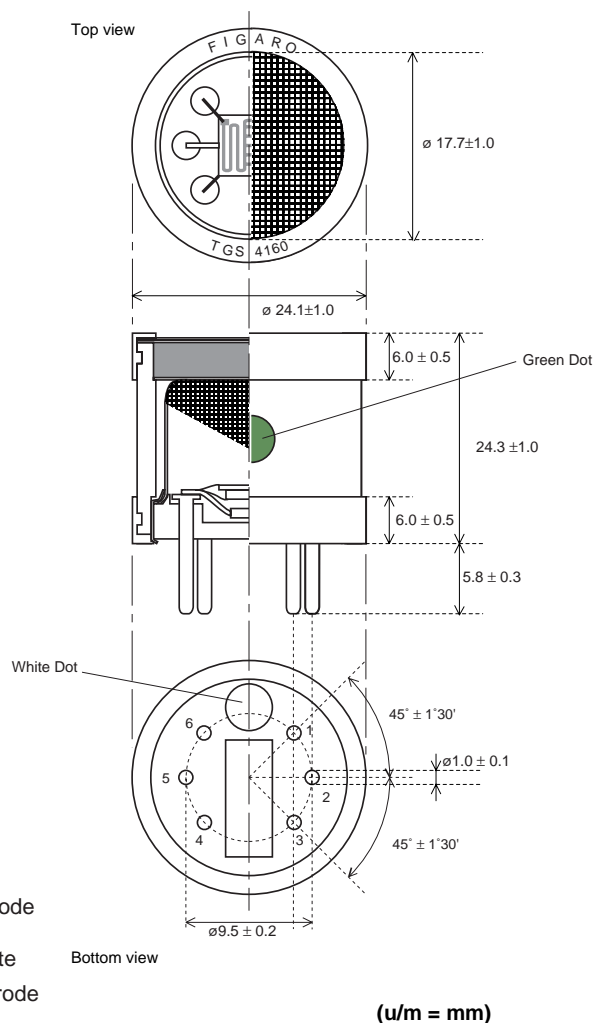
functions as a kind of battery, the EMF value itself would drift using this basic measuring circuit. However, the change of EMF value ( $\Delta\text{EMF}$ ) shows a stable relationship with the change of  $\text{CO}_2$  concentration. Therefore, in order to obtain an accurate measurement of  $\text{CO}_2$ , a special microprocessor for signal processing should be used with TGS4160. Figaro can provide a special evaluation sensor module (AM-4) for TGS4160.



### Specifications:

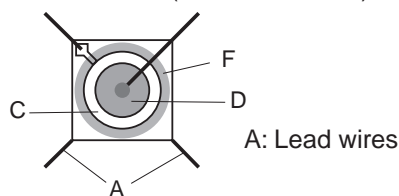
Model number		TGS 4160	
Sensing element type		Solid electrolyte	
Target gases		Carbon dioxide	
Typical detection range		350 ~ 50,000 ppm	
Electrical characteristics under standard test conditions	Heater resistance	R <sub>H</sub>	11.5 ± 1.1Ω at room temp.
	Heater current	I <sub>H</sub>	approx. 250mA
	Heater power consumption	P <sub>H</sub>	approx. 1.25W
	Heater voltage	V <sub>H</sub>	5.0 ± 0.2V (DC)
	Electromotive force	EMF	220~490mv in 350ppm CO <sub>2</sub>
	Sensitivity	ΔEMF	44~72mV
Sensor characteristics	Response time	approx. 2 min. (to 90% of final value)	
	Measurement accuracy	approx. ±20% at 1,000ppm CO <sub>2</sub>	
Operating conditions		-10~50°C, 5~95%RH	
Storage conditions		-20~60°C, 5~90%RH (store in moisture proof bag with silica gel)	
Standard test conditions	Test gas conditions	CO <sub>2</sub> in air at 20±2°C, 65±5%RH	
	Circuit conditions	V <sub>H</sub> = 5.0±0.05V DC	
	Conditioning period before test	7 days	

### Structure and Dimensions:

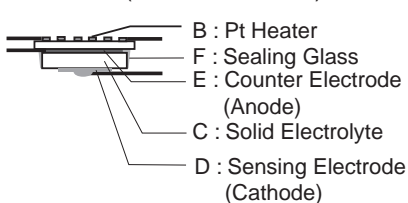


### Sensing Element Structure:

Bottom View (Sensor Element)



Side view (Sensor Element)



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