

### TGS 4160 - for the detection of Carbon Dioxide

#### Features:

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

#### Applications:

- \* Air quality control
- \* Fermentation process control

The **TGS4160** is a hybrid sensor unit composed of a carbon dioxide sensitive element and a thermistor. 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** displays good long term stability and shows excellent durability against the effects of high humidity through the application of innovative technology in the sensor's electrode design.



The figure below represents typical sensitivity characteristics of TGS4160. The Y-axis is indicated as  $\Delta$ EMF which is defined as follows:

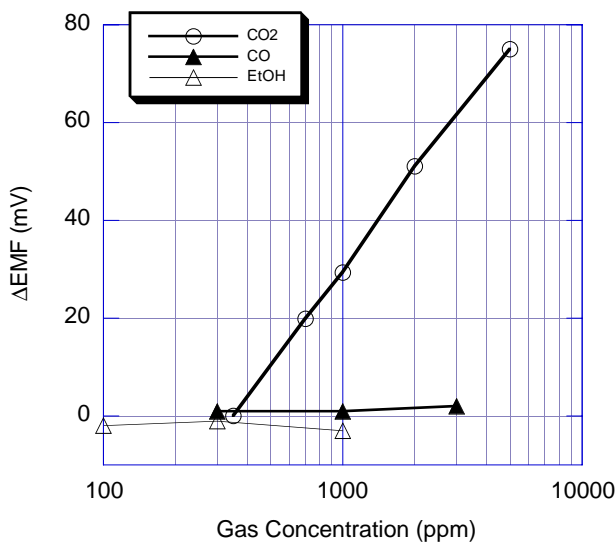
$$\Delta\text{EMF} = \text{EMF}_1 - \text{EMF}_2$$

where

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

EMF<sub>2</sub> = EMF in listed gas concentration

#### Sensitivity Characteristics:



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:

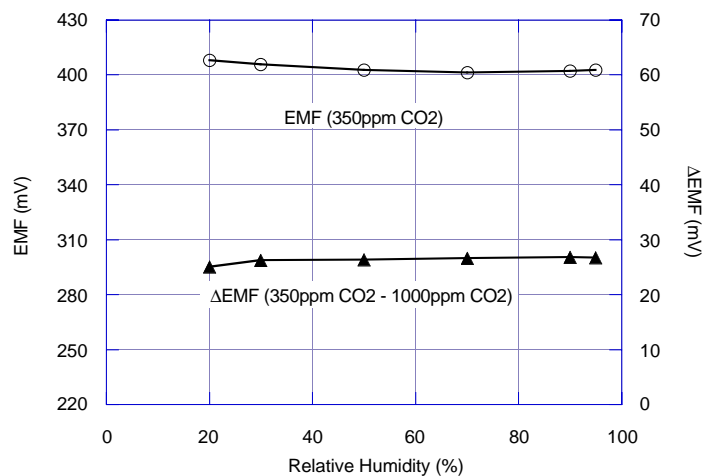
$$\Delta\text{EMF} = \text{EMF}_1 - \text{EMF}_2$$

where

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

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

#### Humidity Dependency:

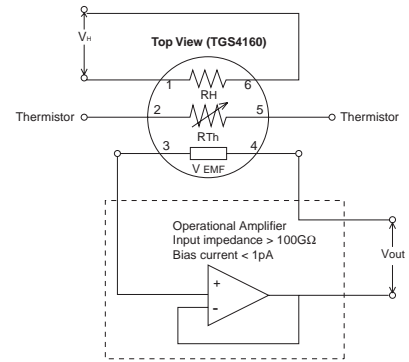


**IMPORTANT NOTE:** OPERATING CONDITIONS IN WHICH FIGARO SENSORS ARE USED WILL VARY WITH EACH CUSTOMER'S SPECIFIC APPLICATIONS. FIGARO STRONGLY RECOMMENDS CONSULTING OUR TECHNICAL STAFF BEFORE DEPLOYING FIGARO SENSORS IN YOUR APPLICATION AND, IN PARTICULAR, WHEN CUSTOMER'S TARGET GASES ARE NOT LISTED HEREIN. FIGARO CANNOT ASSUME ANY RESPONSIBILITY FOR ANY USE OF ITS SENSORS IN A PRODUCT OR APPLICATION FOR WHICH SENSOR HAS NOT BEEN SPECIFICALLY TESTED BY FIGARO.

### 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

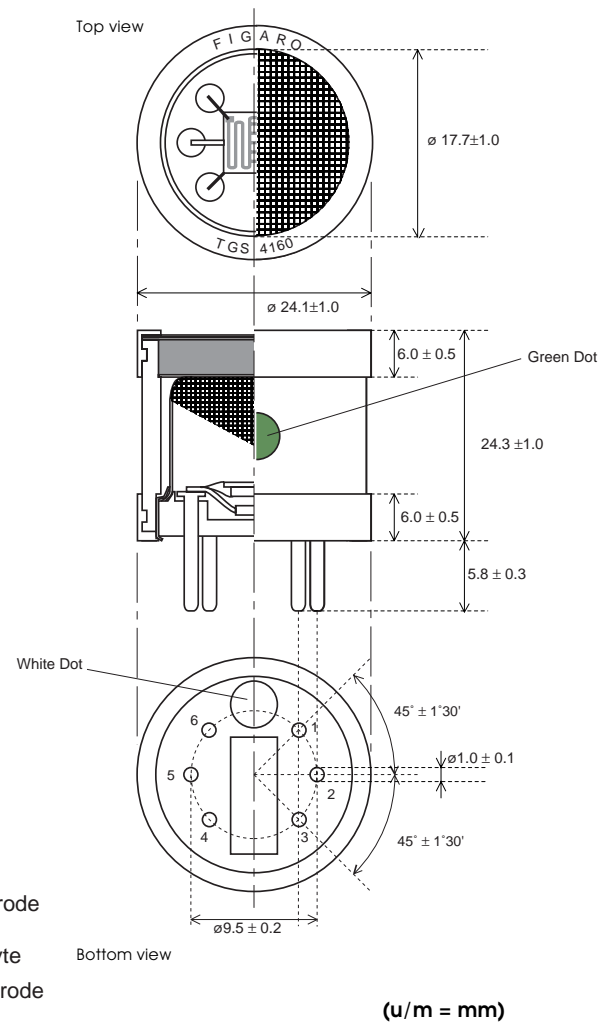
functions as a kind of battery, the EMF value itself would drift using this basic measuring circuit. However, the change of EMF value ( $\Delta\text{EMF}$ ) shows a stable relationship with the change of  $\text{CO}_2$  concentration. Therefore, in order to obtain an accurate measurement of  $\text{CO}_2$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



### Specifications:

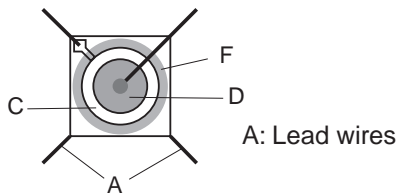
|   |                                 |  |                                     |
|---|---------------------------------|--|-------------------------------------|
| Model number  |                                 | TGS 4160   |                                     |
| Sensing element type                                      |                                 | Solid electrolyte  |                                     |
| Target gases  |                                 | Carbon dioxide   |                                     |
| Typical detection range                                   |                                 | 300 ~ 5000 ppm   |                                     |
| Electrical characteristics under standard test conditions | Heater resistance               | RH   | 11.5 ± 1.1Ω at room temp.           |
|   | Heater current                  | IH   | approx. 250mA                       |
|   | Heater power consumption        | PH   | approx. 1.25W                       |
|   | Heater voltage                  | VH   | 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<br>(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              | VH = 5.0±0.05V DC  |                                     |
|   | Conditioning period before test | 7 days   |                                     |

### Structure and Dimensions:

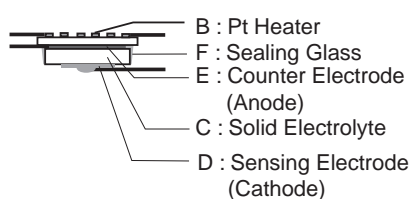


### Sensing Element Structure:

Bottom View (Sensor Element)



Side view (Sensor Element)



#### FIGARO ENGINEERING INC.

1-5-11 Senba-nishi  
Mino, Osaka 562 JAPAN  
Phone: (81)-727-28-2561  
Fax: (81)-727-28-0467  
email: figaro@figaro.jp.org

#### FIGARO USA, INC.

3703 West Lake Ave. Suite 203  
Glenview, Illinois 60025 USA  
Phone: (1)-847-832-1701  
Fax: (1)-847-832-1705  
email: figarousa@figarosensor.com