FIGARO

an ISO9001 company

FIGARO GAS SENSORS
2000 Series

The FIGARO 2000 Series comprises a new type of thick film metal oxide semiconductor gas sensor fabricated using a novel screen printing technique. This Technique enables narrow sensor to sensor variation within production lots.
Additionally, Figaro's material technology has expanded the range of sensing materials to metal oxides other than the tin dioxide.
Gases which are oxidizing or have specific odor properties can now be detected as well as flammable gasses. Also, by having multi-elements on one chip, FIGARO can provide intelligent sensors with multiple output signals.

Product List

∗For equivalents, please refer to Product Catalogue①

Application	Target gas	Type S1	Type S2	Type M1	Type D1	Equivalents
Combustible gas detection	Butane LP gas				TGS2610	TGS 813
	Methane Natural gas				TGS2611	TGS 842
	Methane and Carbon monoxide				TGS2670*	
Solvent vapor detection	Alcohol Organic solvents				TGS2620	TGS 822
Toxic gas detection	Carbon monoxide			TGS 2442		TGS 203
Odor detection	Volatile sulfide			TGS 2450*		TGS 830 TGS 831
Cooking control	Water vapor	TGS 2180				TGS 883 TGS 882
Air quality control	General air contaminants	TGS 2100		TGS 2400*	TGS 2600	TGS 800
	VOC				TGS 2602*	
Automobile ventilation control	Gasoline exhaust	TGS 2104	TGS 2201*			TGS 822
	Diesel exhaust	TGS 2106*				

*Under development

Product Code for FIGARO 2000 series

TGS 2 X XX

Technology	
1	
2	Printed semiconductor
3	
4	Solid state electrolyte

Element type	
1	S1
2	S2
3	
4	M1
5	
6	D1
7	
8	
9	
0	

Target gas / Application	
10~19	Combustible gasses
20~29	Organic solvent vapor
30~39	Halocarbon gasses
40~49	Toxic gasses
50~59	Volatile sulfide/amine odor
60~69	Other gasses
70~79	Multiple gasses
80~89	Cooking control
90~99	
00~09	Air quality control

Sensor structure and packaging

There are four types of sensor elements and four different configurations. The equivalent circuit for each type of sensor is illustrated below in the basic measuring circuit with a special symbol and is represented by a sensor resistance (R_S) and a heater resistance (R_H).

Each sensor requires two voltage inputs. Heater voltage (V_H) is applied to an integrated heater to maintain the sensing element at the required temperature. A circuit voltage (V_C) is applied to allow measurement of the voltage (V_{out}) across a load resistor (R_L) which is connected in series with the sensor.

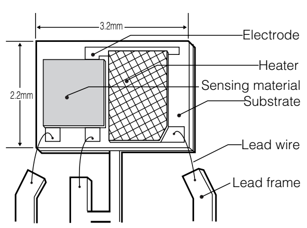
A common power supply circuit can be used for both V_C and V_H to fulfill electrical requirements which are specified for each type of sensor.
The value of R_L can be chosen to optimize the alarm threshold value or output voltage range for signal processing. The value of R_L should be chosen to keep the power consumption of the metal oxide semiconductor (P_S) below a limit of 15 mW. The value of P_S will be highest when the value of sensor resistance (R_S) is equal to R_L on exposure to gas. The value of P_S is calculated using the following formula:

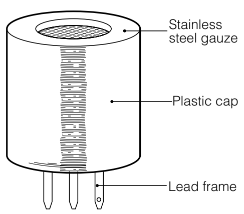
$$P_S = \frac{(V_C - V_{out})^2}{R_S}$$

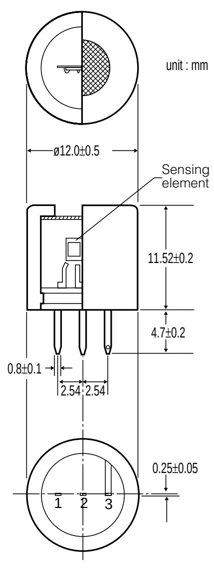
The sensor resistance (R_S) is calculated with a measured value of V_{out} from the following formula:

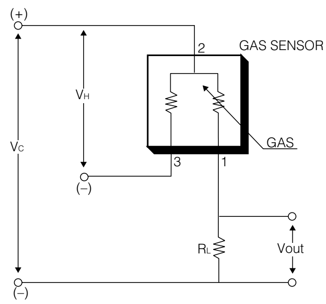
$$R_S = \frac{(V_C - V_{out})}{V_{out}} \times R_L$$

Model	**TGS 21XX**
Element type	**S1**
Package type	**Plastic**









Configuration : -Single sided, 1 element

Features : -Simple structure

Benefits : -Suitable for large volume and low cost applications

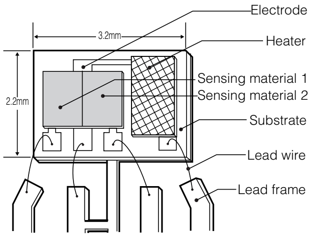
Pin connection

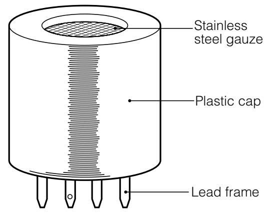
1 : Sensor electrode(–)
2 : Common(+)
3 : Heater(–)

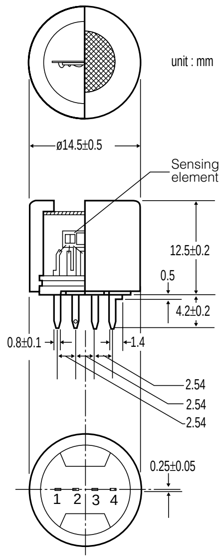
Circuit conditions

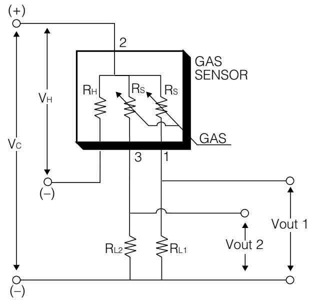
V_C: 5V±0.2V DC
V_H: 5V±0.2V DC
R_L: Variable($P_S \leqq$15mW)

Model	**TGS 22XX**
Element type	**S2**
Package type	**Plastic**









Configuration : -Single sided, 2 element

Features : -Dual elements on one chip

Benefits : -Two output signals for enhanced information
-High selectivity

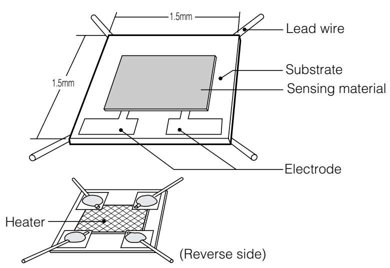
Pin connection

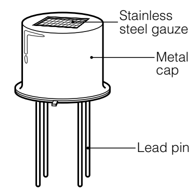
1 : Sensor electrode 1(–)
2 : Common(+)
3 : Sensor electrode 2(–)
4 : Heater(–)

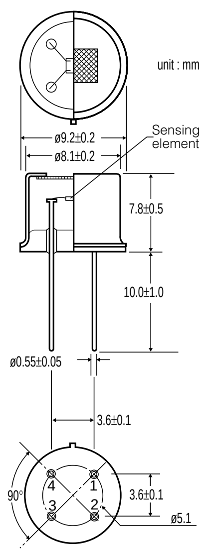
Circuit conditions

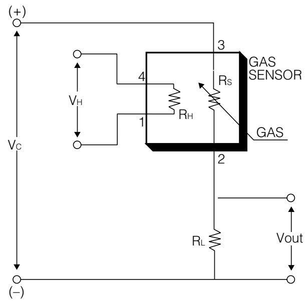
V_C : 5V±0.2V DC
V_H : 5V±0.2V DC
R_{L1} : Variable(Ps≦15mW)
R_{L2} : Variable(Ps≦15mW)

Model	**TGS 26XX**
Element type	**D1**
Package type	**Metal can**









Configuration : -Double sided, 1 element
-Heater printed on reverse side of chip

Features : -Small package

Benefits : -Low power consumption

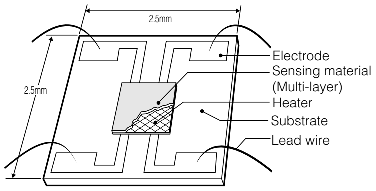
Pin connection

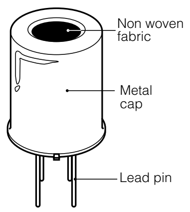
1 : Heater
2 : Sensor electrode (–)
3 : Sensor electrode (+)
4 : Heater

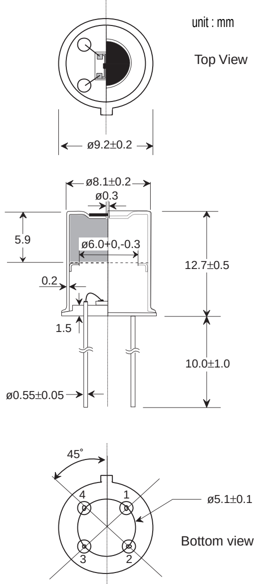
Circuit conditions

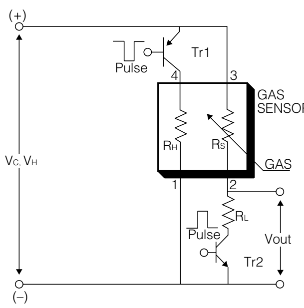
V_C: 5V±0.2V DC
V_H: 5V±0.2V DC/AC
R_L: Variable(Ps≦15mW)

Model	**TGS 24XX**
Element type	**M1**
Package type	**Metal can**









Configuration : -Multi-layer, 1 element

Features : -Pulsed heating

Benefits : -Low power consumption
-Battery back up

Pin connection

1 : Heater
2 : Sensor electrode (–)
3 : Sensor electrode (+)
4 : Heater

Circuit conditions

V_C: 5V±0.2V DC(Pluse drive)
V_H: 5V±0.2V DC(Pluse drive)
R_L: Variable(≧10KΩ)

Note:Typical voltage drop in Tr1 is 0.2V.

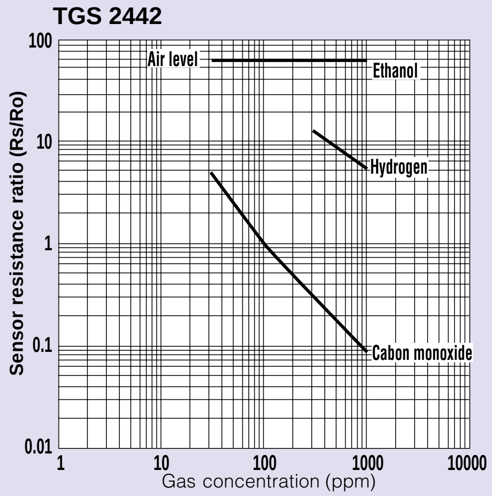
Sensitivity characteristics

The sensitivity of the Figaro Gas Sensor is defined by the relationship between gas concentration changes and sensor resistance changes. This relationship is based on a logarithmic function.

Sensitivity characteristics of Figaro sensors are shown in the following figures. In these figures, the sensor resistance values (Rs) are normalized according to the sensor resistance at specified conditions (Ro) for each model, and the Y-axis is indicated as sensor resistance ratio: Rs/Ro.

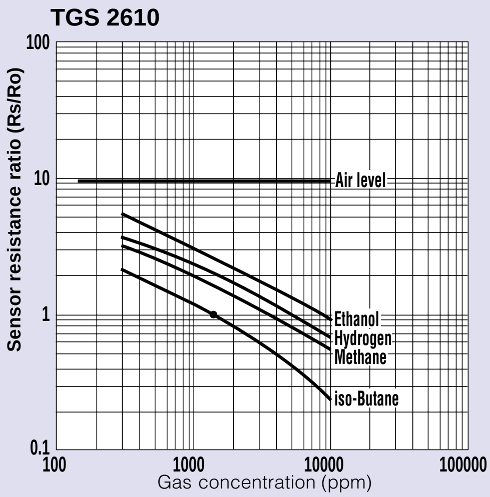
All the sensor characteristics in this catalogue represent typical characteristics.

Toxic gas detection

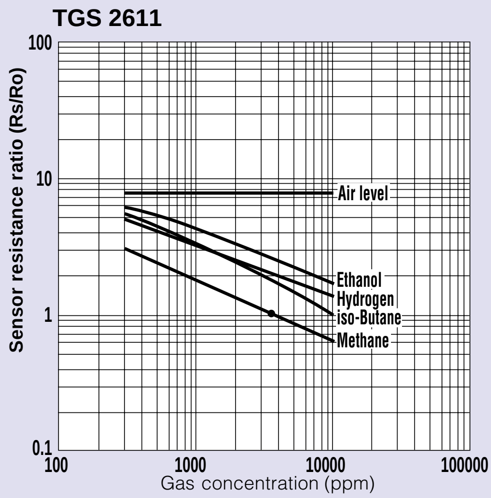


R_0: Rs at 100ppm Carbon monoxide

Combustible gas detection

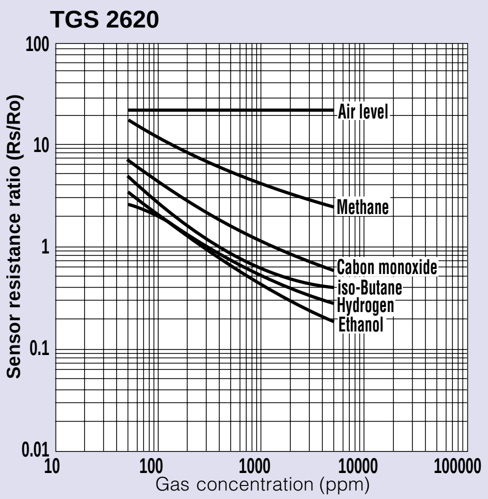


R_0: Rs at 1500ppm Carbon iso-Butane



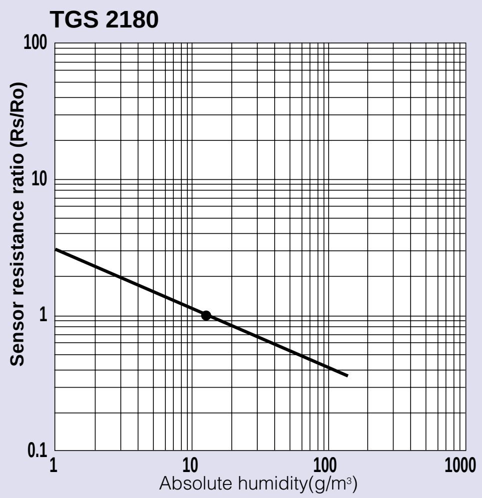
R_0: Rs at 4500ppm Methane

Solvent vapor detection



R_0: Rs at 300ppm Ethanol

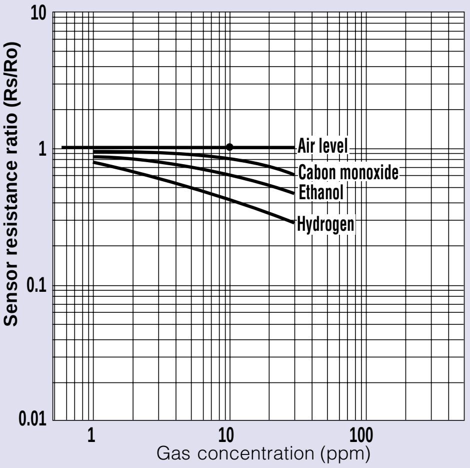
Cooking control



R_0: Rs in clean air at 20°C, 65%R.H.

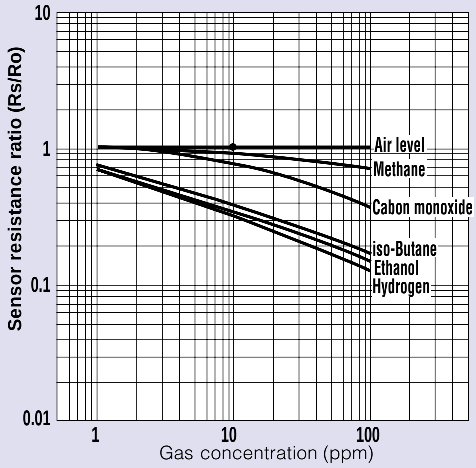
Air quality control

TGS 2100



Ro: Rs in clean air

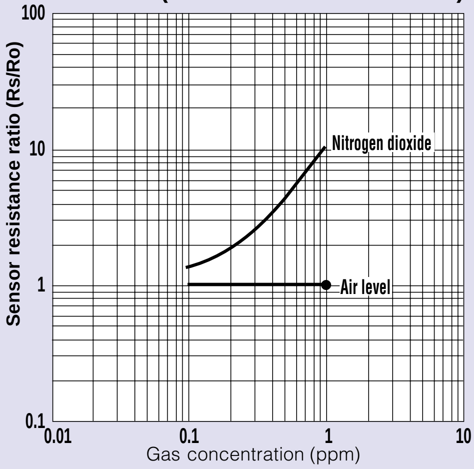
TGS2600



Ro: Rs in clean air

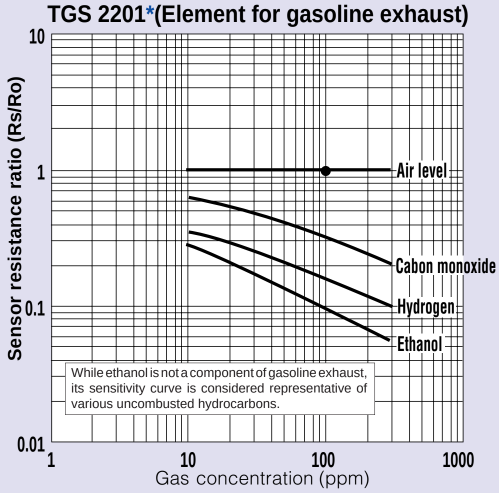
Automobile ventilation control

TGS 2201*(Element for diesel exhaust)



Ro: Rs in clean air

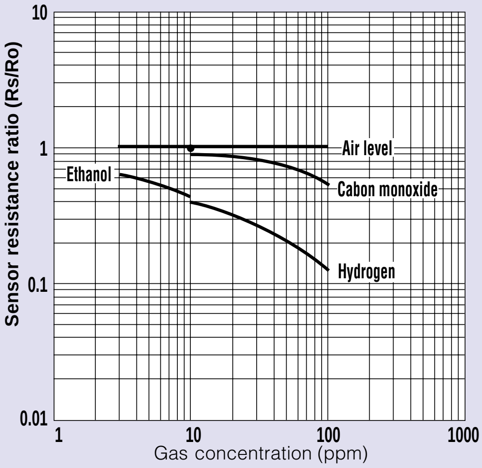
TGS 2201*(Element for gasoline exhaust)



Ro: Rs in clean air

*Under development

TGS 2104



Ro: Rs in clean air

Specifications

The electrical characteristics in this table represent typical values and characteristics.

1.Target gases & Standard Circuit conditions

Model	Target gases	Typical detection ranges	Heater voltage	Circuit voltage	Load resistance	Sensor power consumption
			V_H	V_C	R_L	P_S
TGS2610	Butane LP gas	500ppm~10,000ppm	5V±0.2V(DC/AC)	5V±0.2V(DC)	Variable	≦15mW
TGS2611	Methane Natural gas	500ppm~10,000ppm	5V±0.2V(DC/AC)	5V±0.2V(DC)	Variable	≦15mW
TGS2620	Alcohol Organic solvents	50ppm~5,000ppm	5V±0.2V(DC/AC)	5V±0.2V(DC)	Variable	≦15mW
TGS2442	Carbon monoxide	30ppm~1,000ppm	5V±0.2V(DC,Pulse)**	5V±0.2V(DC,Pulse)	Variable (≧10KΩ)	
TGS2180	Water vapor	$1g/m^3$~$150g/m^3$	5V±0.2V(DC)	5V±0.2V(DC)	Variable	≦15mW
TGS2100	General air contaminants	1ppm~30ppm	5V±0.2V(DC)	5V±0.2V(DC)	Variable	≦15mW
TGS2600	General air contaminants	1ppm~30ppm	5V±0.2V(DC/AC)	5V±0.2V(DC)	Variable	≦15mW
TGS2104	Gasoline exhaust	10ppm~100ppm	7V±0.35V(DC)	15VDC Max	Variable	≦15mW
TGS2201*	Gasoline exhaust	10ppm~100ppm	7V±0.35VDC	15VDC Max	Variable	≦15mW
	Diesel exhaust	0.1ppm~1ppm				

$$P_S = \frac{(V_C - V_{out})^2}{R_S}$$

* Under development

** VH is the voltage across the heater and a transister Tr1.

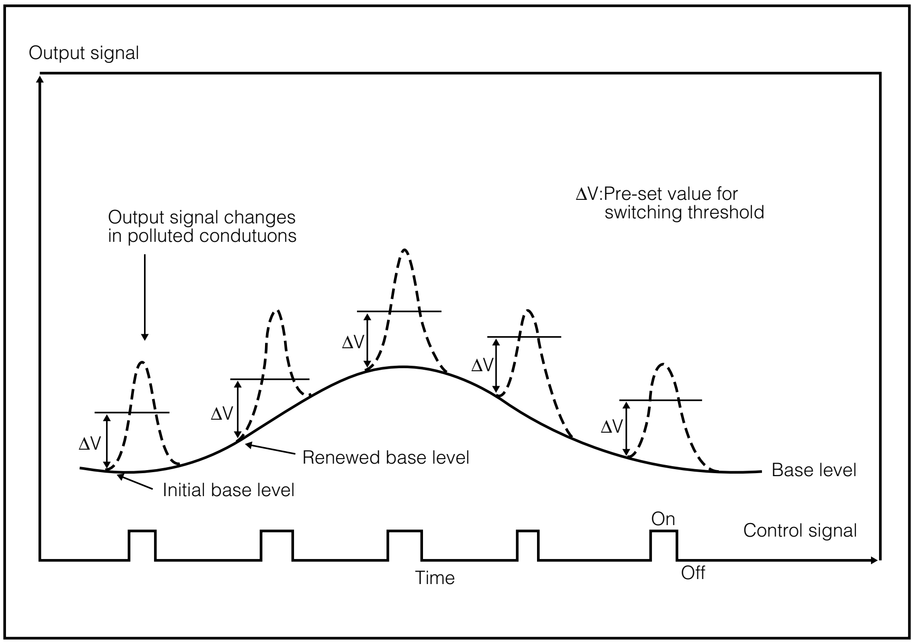
2.Electrical characteristics

Standard test conditions : 20°C±2°C, 65%±5% R.H.

Model	Heater resistance at room temp	Heater current	Heater power consumption	Sensor resistance	Resistance ratio of sensor	Standard test gas
	R_H	I_H	P_H	R_S		
TGS2610	57Ω	56mA	280mW	1KΩ~5KΩ in 1,500ppm	R_S(iso-C_4H_{10} 4,500ppm) / R_S(iso-C_4H_{10} 1,500ppm) =0.53±0.05	iso-Butane
TGS2611	57Ω	56mA	280mW	0.681KΩ~6.81KΩ in 5,000ppm	R_S(CH_4 9,000ppm) / R_S(CH_4 3,000ppm) =0.60±0.06	Methane
TGS2620	83Ω	42mA	210mW	1KΩ~5KΩ in 300ppm	R_S(EtOH 300ppm) / R_S(EtOH 50ppm) =0.4±0.1	Ethanol
TGS2442	17Ω	203mA (for 14msec)	14mW (average)	6.81KΩ~68.1KΩ in 100ppm	R_S(CO 300ppm) / R_S(CO 100ppm) =0.23~0.49	Carbon monoxide
TGS2180	18Ω	166mA	830mW	23KΩ~145KΩ in Air	R_S(25°C68%R.H.) / R_S(20°C68%R.H.) =0.77~0.92	Air and ethanol
TGS2100	20Ω	152mA	760mW	7KΩ~65KΩ in Air	R_S(H_2 10ppm) / R_S(Air) =0.2~0.6	Air and hydrogen
TGS2600	83Ω	42mA	210mW	10KΩ~90KΩ in Air	R_S(H_2 10ppm) / R_S(Air) =0.3~0.6	Air and hydrogen
TGS2104	50Ω	91mA	640mW	10KΩ~80KΩ in Air	R_S(H_2 10ppm) / R_S(Air) =0.3~0.6	Air and hydrogen
TGS2201*	65Ω	72mA	505mA	25KΩ in Air	R_S(10ppm of H_2) / R_S(Air) =0.35	Air and hydrogen
				250KΩ in Air	R_S(0.3ppm of NO_2) / R_S(Air) =2.5	Air and nitrogen dioxide

* Under development

Signal processing technique for air quality sensors



Basic diagram for air quality control system

Air quality control

Detection of low concentrations of air pollution, eg. cigarette smoke, cooking fumes, etc. is possible with the combination of an air quality sensor and exclusively designed microprocessor 93619A.

The microprocessor calculates the average value of the sensor resistance in ambient air over a certain period and renews the base level. This reduces influence from humidity, temperature and basic environmental changes. This method is effective for automatic controls in ventilation systems by detecting rapid changes in the atmosphere from the base levels.

LIMITED WARRANTY

Figaro Engineering Inc. warrants its products to be free from defects in materials and workmanship for a period of one (1) year from the date of the original retail purchase of its products. Figaro will, at its option, either repair or replace any products returned to the factory which Figaro shall, upon inspection, determine to be defective. The foregoing shall constitute the sole remedy for any breach of Figaro's warranty.

THERE ARE NO WARRANTIES WHICH EXTEND BEYOND THE DESCRIPTION ON THE FACE HEREOF.

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