FIGARO GAS SENSORS

1-Series
8-Series

The 1-Series and 8-Series of Figaro Gas Sensors are bulk type metal oxide semiconductor sensors. Field proven metal oxide materials and Figaro's original bulk shape sintered sensor elements ensure high sensitivity, long sensor life and reliability. A wide variety of sensor models are offered to choose from for specific needs of gas detection.

Product List

Application	Target gas	1-Series	8-Series		
			R-type	C-type	M-type
Combustible gas detection	General hydrocarbons		TGS813	TGS816	
	Methane Natural gas		TGS842		
	Hydrogen			TGS821	
Solvent vapor detection	Alcohol Organic solvents		TGS822	TGS823	
Halocarbon gas detection	R-22			TGS830 TGS831	
	R-134a			TGS832	
Toxic gas detection	Carbon monoxide	TGS203			
	Ammonia			TGS826	
	Hydrogen sulfide			TGS825	
Odor detection	Ammonia/amine			TGS826	
Cooking control	Water vapor				TGS883
	Fumes from food (alcohol, odor)				TGS880 TGS882
Air quality control	General air contaminants		TGS800		
Automobile ventilation control	Gasoline exhaust		TGS822		

Sensor structure and packaging

Each sensor requires two voltage inputs. Heater voltage(V_H) is applied to the heater coil to maintain the sensing element at the elevated working temperature required to attain the best sensor performance. 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.

With the exception of TGS203, a common power supply circuit can be used for both V_C and V_H to fulfill the electrical requirements specified for each type of sensor.

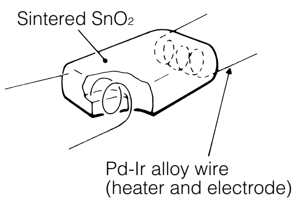
The value of R_L can be chosen to optimize the alarm threshold value or output voltage range for signal processing. The value of R_L should be chosen to keep the power consumption of the metal oxide semiconductor(P_S) below a limit of 15 mW. The value of Ps will be highest when the value of sensor resistance(R_S) is equal to R_L on exposure to gas. The value of Ps is calculated using the following formula:

$$P_s = \frac{(V_C - V_{out})^2}{R_s}$$

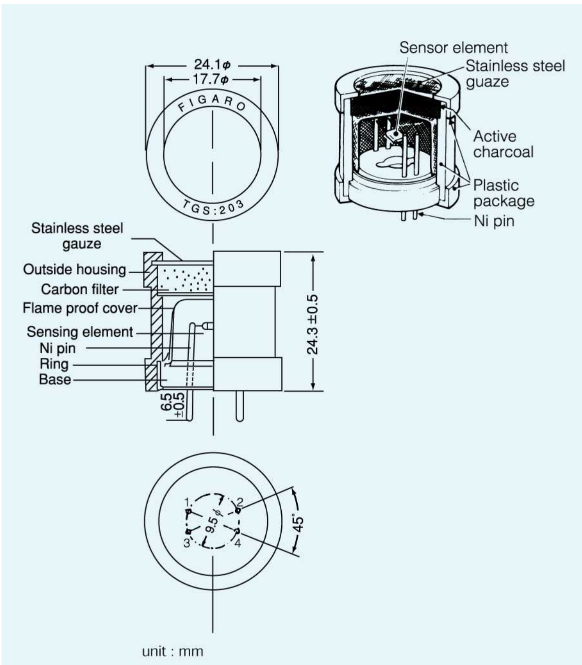
1-series

Element structure

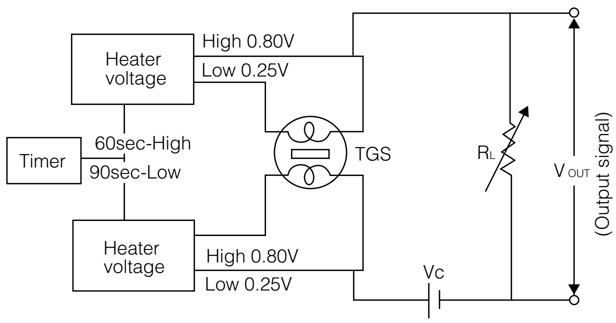
1-series sensors have two coiled electrodes made of iridium/ palladium alloy which are encapsulated inside the sintered sensor element and are used as the heater.



Structure



Basic measuring circuit



Circuit conditions

Circuit voltage(Vc) :12v max. AC or DC
Heater voltage(V_H) : High 0.80V(60sec)ACorDC
Low 0.25V(90sec)ACorDC
Load resistance(R_L) : variable (Ps<15mW)

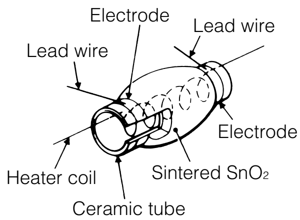
Depending on the change in the sensor resistance (R_s), output voltage across the load resistor changes (V_{out}). The relationship between R_s and V_{out} is expressed by the following equation.

$$R_s = \frac{V_C - V_{out}}{V_{out}} \times R_L$$

8-series

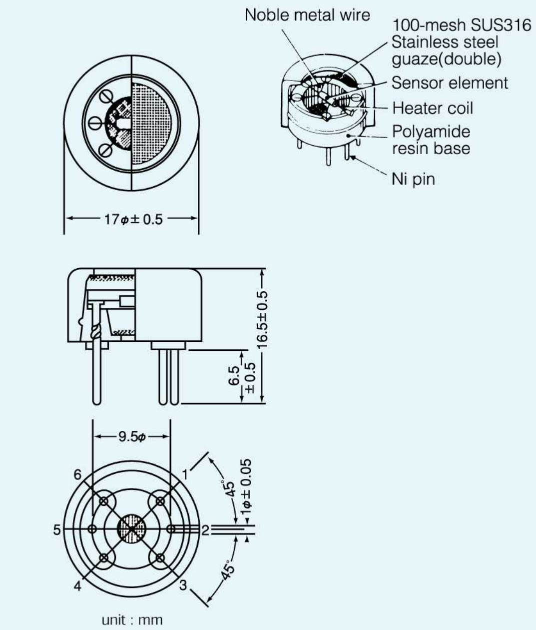
Element structure

8-series sensors have a heater in an alumina ceramic tube on which two gold electrodes are printed, and the semiconductor material is mounted on the tube.

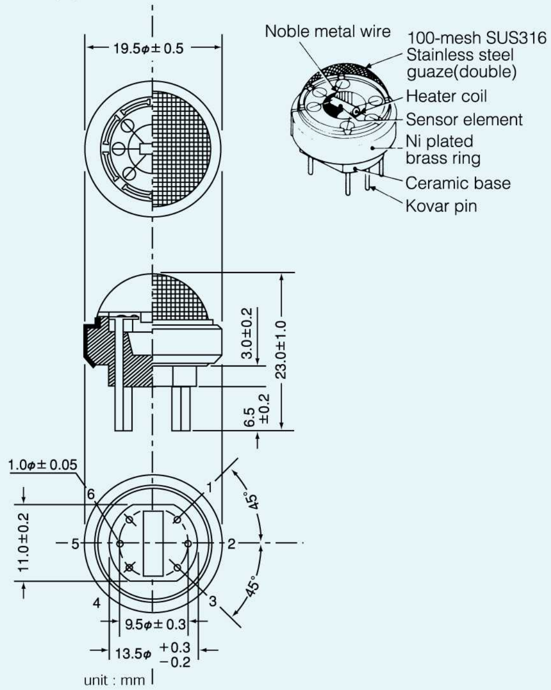


Structure

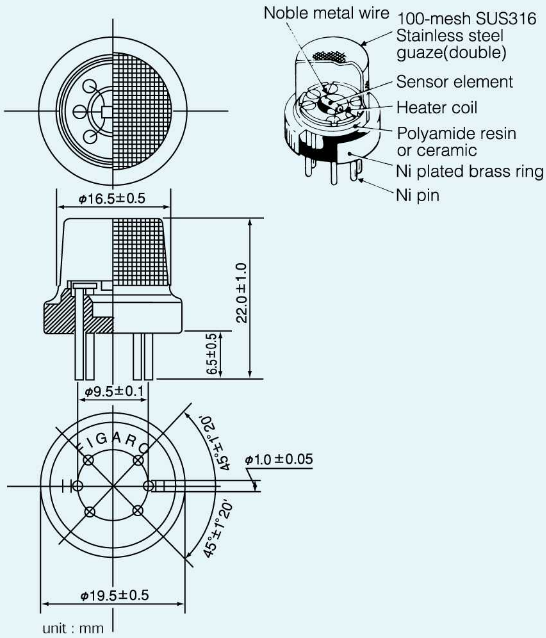
R type : resin base + resin cover



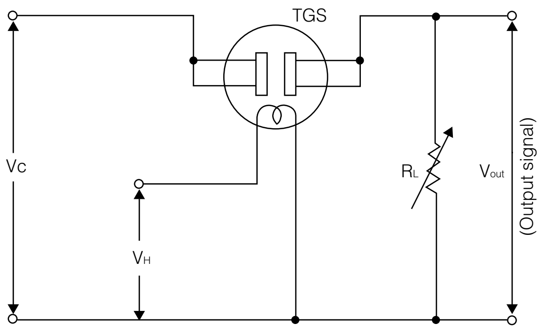
C type : ceramic base + metal cover



M type : resin base / ceramic base + metal cover



Basic measuring circuit



Circuit conditions

Circuit voltage(V_c) : 24v max. AC or DC
Heater voltage(V_H) : 5.0V AC or DC
Load resistance(R_L) : variable (Ps<15mW)

Depending on the change in the sensor resistance (R_s), output voltage across the load resistor changes (V_{out}). The relationship between R_s and V_{out} is expressed by the following equation.

$$R_s = \frac{V_c - V_{out}}{V_{out}} \times R_L$$

Sensitivity characteristics

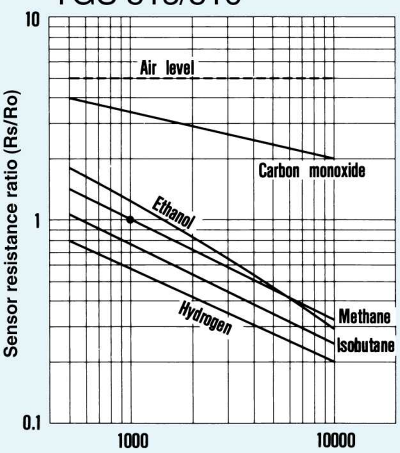
The sensitivity of the Figaro Gas Sensor is defined by the relationship between gas concentration changes and sensor resistance changes. This relationship is based on a logarithmic function.

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.

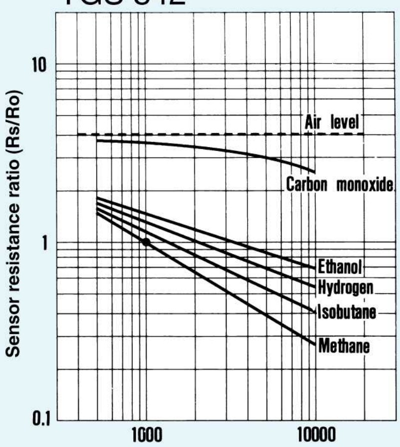
Combustible gas detection

TGS 813/816



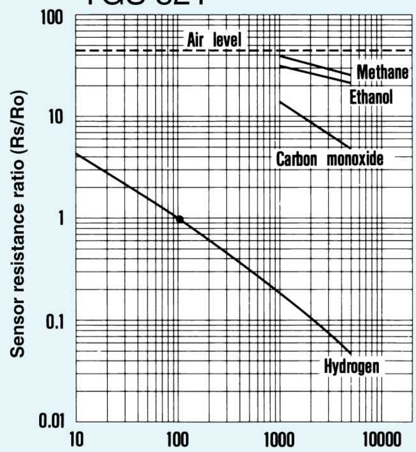
Gas concentration(ppm)
Ro: Rs at 1000 ppm Methane

TGS 842



Gas concentration(ppm)
Ro: Rs at 1000 ppm Methane

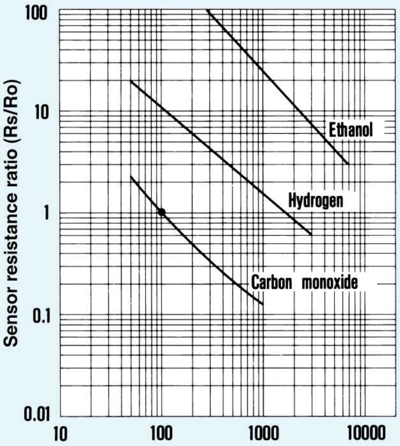
TGS 821



Gas concentration(ppm)
Ro: Rs at 100 ppm Hydrogen

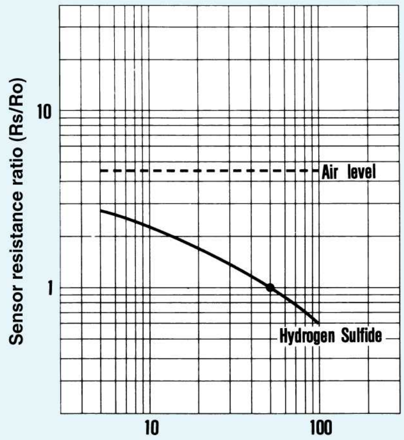
Toxic gas detection

TGS 203



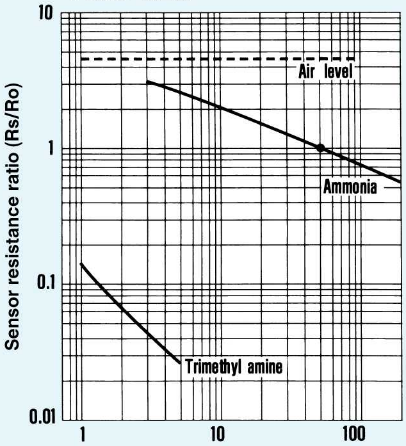
Gas concentration(ppm)
Ro: Rs at 100 ppm Carbon monoxide

TGS 825



Gas concentration(ppm)
Ro: Rs at 50 ppm Hydrogen sulfide

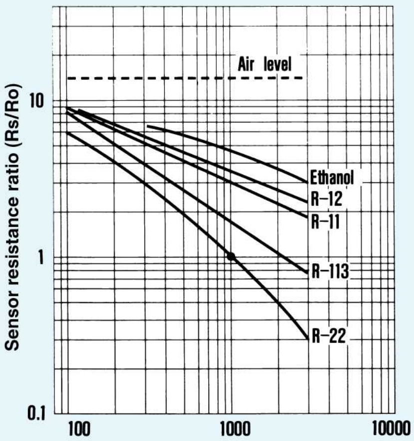
TGS 826



Gas concentration(ppm)
Ro: Rs at 50 ppm Ammonia

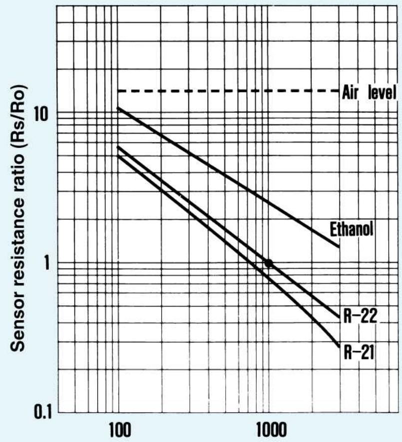
Halocarbon gas detection

TGS 830



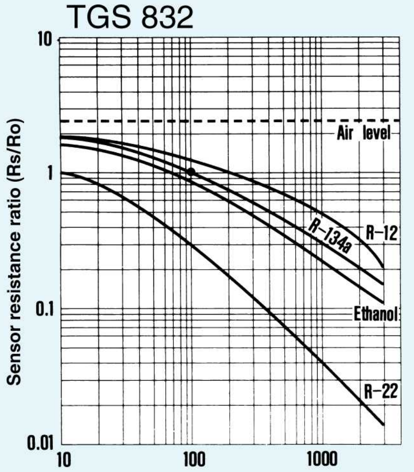
Gas concentration(ppm)
Ro: Rs at 1000 ppm R-22

TGS 831



Gas concentration(ppm)
Ro: Rs at 1000 ppm R-22

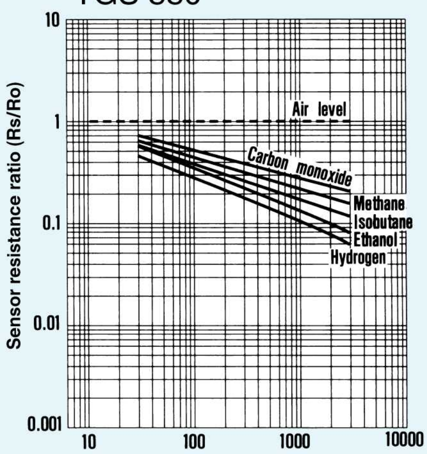
TGS 832



Gas concentration(ppm)
Ro: Rs at 100 ppm R-134a

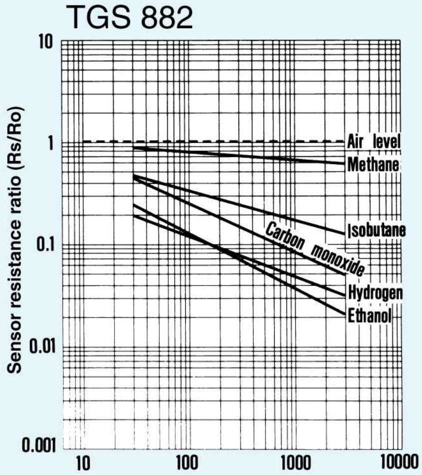
Cooking control

TGS 880



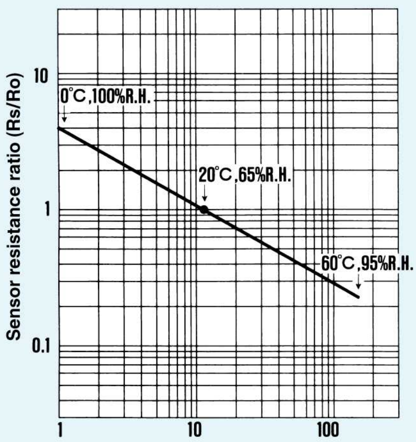
Gas concentration(ppm)
Ro: Rs in clean air

TGS 882



Gas concentration(ppm)
Ro: Rs in clean air

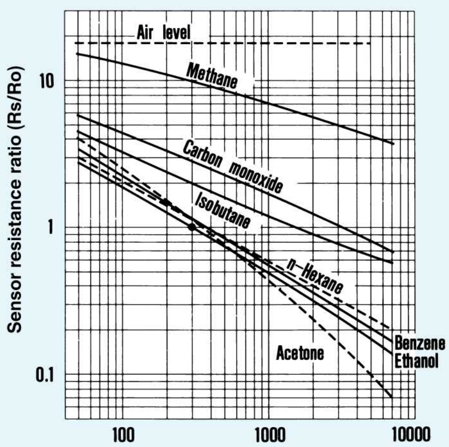
TGS 883



Absolute humidity(g/m³)
Ro: Rs in clean air at 20℃,65%R.H.

Solvent vapor detection

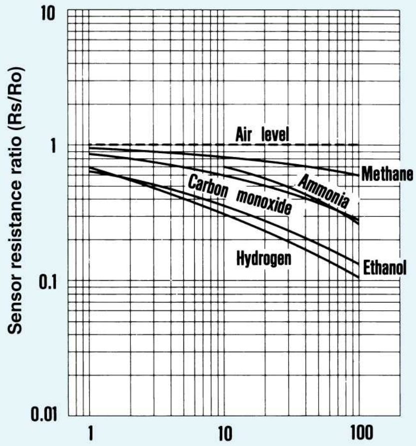
TGS 822/823



Gas concentration(ppm)
Ro: Rs at 300 ppm Ethanol

Air quality control

TGS 800



Gas concentration(ppm)
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
TGS 813/816	Combustible gases	500ppm～10,000ppm	5V±0.2V(AC/DC)	≦24V(AC/DC)	Variable	≦15mW
TGS 842	Methane	500ppm～10,000ppm	5V±0.2V(AC/DC)	≦24V(AC/DC)	Variable	≦15mW
TGS 821	Hydrogen	30ppm～1,000ppm	5V±0.2V(AC/DC)	≦24V(AC/DC)	Variable	≦15mW
TGS 822/823	Solvent vapor	50ppm～5,000ppm	5V±0.2V(AC/DC)	≦24V(AC/DC)	Variable	≦15mW
TGS 830	R-22	100ppm～3,000ppm	5V±0.2V(AC/DC)	≦24V(AC/DC)	Variable	≦15mW
TGS 831	R-22,R-21	100ppm～3,000ppm	5V±0.2V(AC/DC)	≦24V(AC/DC)	Variable	≦15mW
TGS 832	R-134a,R-22	100ppm～3,000ppm	5V±0.2V(AC/DC)	≦24V(AC/DC)	Variable	≦15mW
TGS 203	Carbon monoxide	50ppm～1,000ppm	High 0.8V±0.08V (60sec)(AC/DC) Low 0.25V±0.025V (90sec)(AC/DC)	≦12V(AC/DC)	Variable	≦15mW
TGS 825	Hydrogen sulfide	5ppm～100ppm	5V±0.2V(AC/DC)	≦24V(AC/DC)	Variable	≦15mW
TGS 826	Ammonia and amine compounds	30ppm～300ppm	5V±0.2V(AC/DC)	≦24V(AC/DC)	Variable	≦15mW
TGS 880	Vaporized gases, Water vapor	10ppm～1,000ppm	5V±0.2V(AC/DC)	≦24V(AC/DC)	Variable	≦15mW
TGS 882	Alcohol vapor	50ppm～5,000ppm	5V±0.2V(AC/DC)	≦24V(AC/DC)	Variable	≦15mW
TGS 883	Water vapor	1g/m^3～150g/m^3	5V±0.2V(AC/DC)	≦24V(AC/DC)	Variable	≦15mW
TGS 800	Gaseous air contaminants	1ppm～30ppm	5V±0.2V(AC/DC)	≦24V(AC/DC)	Variable	≦15mW

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

2.Electrical characteristics

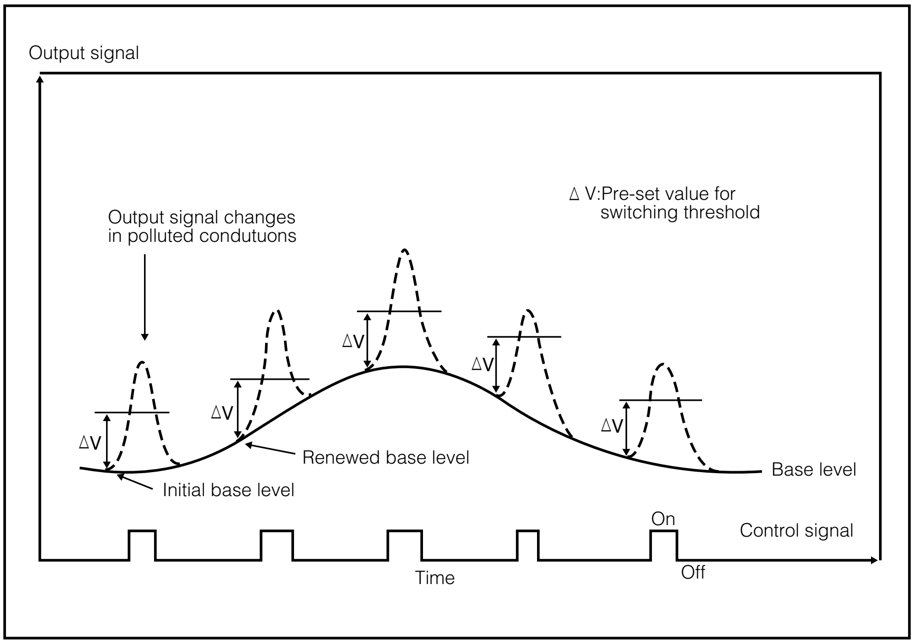
Standard test conditions : 20℃ ±2℃, 65% ±5% R.H.

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	β γ	
TGS 813/816	30Ω	167mA	835mW	5kΩ～15kΩ in 1,000ppm	β(CH4 1,000–3,000) =0.55～0.65	Methane
TGS 842	30Ω	167mA	835mW	5kΩ～20kΩ in 1,000ppm	β(CH4 1,000–3,000) =0.55～0.65	Methane
TGS 821	38Ω	132mA	660mW	1kΩ～10kΩ in 100ppm	β(H2 100–1,000) =0.6～0.25	Hydrogen
TGS 822/823	38Ω	132mA	660mW	1kΩ～10kΩ in 300ppm	β(EtOH 50–300) =0.3～0.5	Ethanol
TGS 830	30Ω	167mA	835mW	1kΩ～5kΩ in 1,000ppm	β(R-22 1,000–3,000) =0.2～0.4	R-22
TGS 831	30Ω	167mA	835mW	1kΩ～10kΩ in 1,000ppm	β(R–22 300–1,000) =0.25～0.55	R-22
TGS 832	30Ω	167mA	835mW	4kΩ～40kΩ in 100ppm	β(R–134a 100–300) =0.5～0.65	R-134a
TGS 203	1.9Ω	369/133mA	295/33mW ×2	1kΩ～15kΩ in 100ppm	β(CO 100–300) =0.19～0.45	Carbon monoxide
TGS 825	38Ω	132mA	660mW	3kΩ～30kΩ in 50ppm	β(H2S 10–50) =0.3～0.6	Hydrogen sulfide
TGS 826	30Ω	167mA	835mW	20kΩ～100kΩ in 50ppm	β(NH3 50–150) =0.4～0.7	Ammonia
TGS 880	30Ω	167mA	835mW	20kΩ～70kΩ in Air	β(EtOH 50–300) =0.4～0.6	Air and ethanol
TGS 882	38Ω	132mA	660mW	10kΩ～100kΩ in Air	γ(EtOH 300) =0.03～0.09	Air and ethanol
TGS 883	25Ω	200mA	1,000mW	10kΩ～100kΩ in Air	γ(EtOH 300) =1.00～0.71	Air and ethanol
TGS 800	38Ω	132mA	660mW	10kΩ～130kΩ in Air	γ(H2 10) =0.2～0.6	Air and hydrogen

$\beta(\text{Gas name } C_1-C_2)=\frac{R_s(C_2)}{R_s(C_1)}$ C_1,C_2:Gas concentration(ppm) $C_1<C_2$

$\gamma(\text{Gas name } C)=\frac{R_s(C)}{R_s(\text{Air})}$ C:Test gas concentration(ppm)

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 TGS800 or AMS800, and exclusively designed microprocessors 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.

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