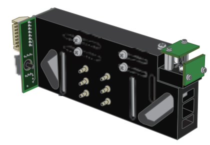
Interferometer Method Sensor: FI



Stationary sensor
Example: FI-23

Category	Detectable gas
Optical	Combustible

1. Brief description

This gas detector, one of the oldest gas sensors of ours, recognizes changes in the refractive index of gas. With a high accuracy, it maintains stability over the long term. In early times, it was used inside coal mines to measure the methane concentration and in recent years, it is widely used to measure solvent concentrations or heat quantities of fuel gases such as natural gas.

2. Structure and principles

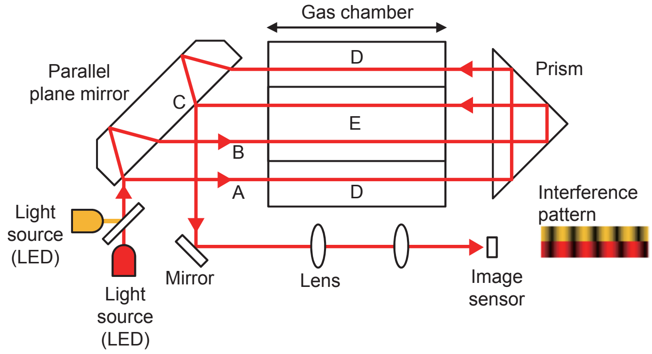
[Structure]

The light source emits light, which is split by a parallel plane mirror into two light rays (A and B) and reflected by a prism. Ray A makes one round trip within the gas chamber, D, where the detectable gas flows, and ray B makes one round trip within the gas chamber, E, where the reference gas flows. The two light rays, A and B, meet each other at point C of the parallel plane mirror, and form an interference pattern on the image sensor through the mirror and lens.

[Principles]

An interference pattern moves in proportion to the difference in the refractive index between the detectable gas and reference gas. The light wave interferometer-based sensor measures the distance the interference pattern has travelled to determine the refractive index of the detectable gas and convert it to a gas concentration or heat quantity.

[Conceptual rendering of the sensor elements]



3. Features

The travel distance of the interference pattern, Δθ, measured by this sensor is represented as the equation below:

$$\Delta\theta = \frac{2\pi L(n_{GAS} - n_{REF})}{\lambda} \times \frac{273.15}{T} \times \frac{P}{101.325}$$

L : Gas chamber length
n_{GAS} : Refractive index of the detectable gas
n_{REF} : Refractive index of the reference gas
λ : Light source wavelength
T : Temperature
P : Pressure

○ Output characteristics

Since the change in the refractive index is proportional to the change in gas concentration, the sensor provides a very high linearity.

○ Responsiveness

The sensor finishes measurement by completing the substitution within the gas chamber with a volume of 0.5 to 5 mL. Some models finish measurement in 5 to 10 seconds with a 90% response.

○ Aging characteristics

The most striking feature of this sensor is that it does not degrade in sensitivity. The sensitivity of the sensor depends only on the gas chamber length, L, and the light source wavelength, λ. Since both of these parameters are invariant, the sensor provides stable sensitivity over the long term. The optical element, even if soiled, does not affect the travel distance of the interference pattern; therefore, the sensor does not degrade in sensitivity so long as it can recognize the pattern.

○ Pressure and temperature characteristics

Although the refractive index of gas varies depending on the temperature, T, and pressure, P, the sensor measures the temperature and pressure to correct them and therefore is not affected by them.

4. Measurement type, detectable gas, molecular formula, and detection range (examples)

Measurement type	Detectable gas	Molecular formula	Detection range
Purity measurement	Hydrogen	H_2	0-100 vol%
	Sulfur hexafluoride	SF_6	
	Carbon dioxide	CO_2	99.50-100.00 vol%
Solvent concentration measurement	Toluene	C_7H_8l	0-100% LEL
	Vinyl chloride	C_2H_3Cl	
	Methyl ethyl ketone	C_4H_8O	
Calorimetric measurement	Natural gas	-	25-55 MJ/m^3
	Propane air	-	0-75 MJ/m^3
	Butane air	-	0-70 MJ/m^3

5. Products of this type (examples)

○Stationary products

... FI-900, FI-915

○Portable products

... FI-8000

FI-900