IR81BB
Carbon Dioxide Infrared Mini Sensor

FEATURES

- Configured for 0 to 2% vol. CO_2
- Low power
- Self-compensating
- Fast response
- Rugged construction

DESCRIPTION

e2v technologies' series of IR sensors uses the proven non-dispersive infrared (NDIR) principle to detect and monitor the presence of gases. This non-poisoning sensing technique relies on the target gas having a unique, well defined absorption signature. This is used to identify the presence of the target gas and is highly gas specific. Using a suitable infrared source, an analysis of the optical absorption through the gas allows the concentration of the target gas to be determined.
e2v technologies' IR sensors benefit from:

- reliability and low maintenance,
- fail safe operation,
- no moving parts.

The IR81BB is designed to detect and monitor the presence of CO_2 in the range 0 to 2% volume. The IR81BB operates from 0 to 100% relative humidity and ambient temperatures from −10 to +50 °C. It is suitable for reliable monitoring of CO_2 levels in general industrial safety applications, where the infrared sensor size is restricted and does not require flameproof/explosion-proof certification. The stable 316S11 stainless steel construction is resistant to most weak acids, bases and solvents with no damage after prolonged exposure to H_2S.

OPERATION

The ambient gas diffuses into the optical chamber through a particulate filter, at one end of the sensor body. Internal lithium tantalate pyroelectric detectors are used to provide output signals, dependent upon changes in the thermal energy incident on their surface. A long-life tungsten filament lamp is used as a broadband infrared thermal source directed at the detectors. The lamp supply voltage must be pulsed (see Fig.1). The optimum pulse rate is 4 Hz at 50% duty. By pulsing the source background interference effects may also be reduced or eliminated. The detector signals consist of the response ripples superimposed on a DC offset voltage.

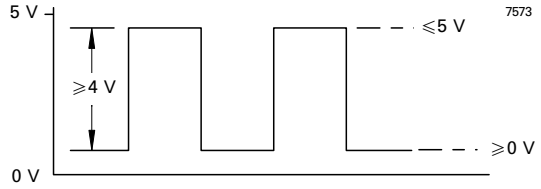

Fig. 1 Lamp Supply

(Photograph shows device approximately 3 x actual size)

Two infrared detectors are used. The filter fitted to the 'active' detector is transparent to the strong fundamental absorption band of CO_2. This allows a short optical path length to be used while maintaining satisfactory resolution and allowing a compact sensor package. The output peak to peak ripple amplitude from the active detector is then reduced as the optical radiation is attenuated on passing through the CO_2 gas. The second 'reference' detector is made insensitive to this change by using a different filter. By taking the ratio of the two peak to peak detector signals, the user can discriminate the signal reduction due to the target gas, from that due to ambient and physical variations.

The fractional absorption (F_a) is determined by the following relationship:

$$F_a = 1-[S_1/(R.S_2)]$$

where S_1 and S_2 are the peak-to-peak values of the output from detector 1 (active) and detector 2 (reference) respectively, and R is defined by:

$$R = S_1'/S_2'$$

where S_1' and S_2' are S_1 and S_2 respectively determined in the absence of CO_2, e.g. 100% vol. N_2 during calibration. The sensitivity to CO_2 is shown in Fig. 2.

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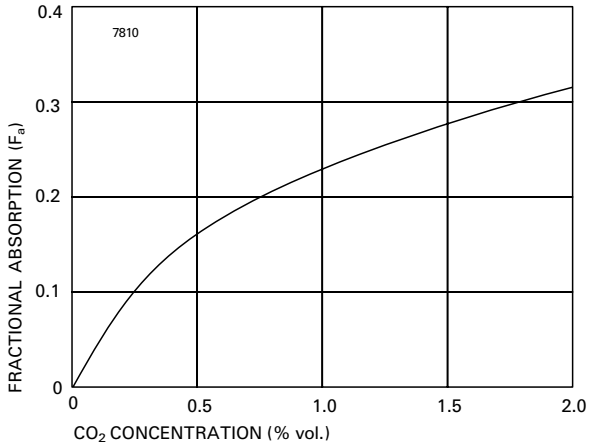


Fig. 2 Typical Sensitivity to 0 to 2% vol. CO_2

Further details of the sensor and signal handling with suggested circuits, can be found in the e2v technologies Infrared Sensor Application Notes, available from the e2v technologies website.

GENERAL DATA

This information relates to the device operating continuously with e2v technologies' IREL3 Pre-amplifier and IREL1 Transmitter. The performance of this device is affected significantly by the signal handling circuits used and its environment.

Operation . . . . . continuous
Measuring range:
  nominal . . . . . 0 to 2% vol. CO_2
  maximum . . . . . 0 to 5% vol. CO_2
Resolution . . . . . 2% FSD
Warm up time:
  to final zero $\pm$0.06% CO_2 . . . . . $<$20 s
  to specification . . . . . $<$30 minutes
Response time to target gas T_{90} . . . . . $\leqslant$20 s
Typical sensitivity . . . . . see Fig. 2
Repeatability during operation:
  zero . . . . . $\pm$0.01% CO_2
  span (at 2% CO_2) . . . . . $\pm$0.05% CO_2
  span (at 1000 ppm CO_2) . . . . . 50 ppm CO_2
Long term zero drift . . . . . $\pm$100 ppm CO_2/month
MTBF . . . . . $>$10 years for 5 V operation,
$>$20 years for 3 V operation

Electrical

Detector supply (to pin 1) (see note):
  recommended . . . . . +5 V
  maximum . . . . . +15 V
Lamp supply (see Fig.1):
  maximum voltage (see note) . . . . 5 V_{peak} (60 mA)
  recommended frequency . . . . . 4 Hz, 50% duty
Recommended detector load current . . . . . 10 μA
Typical detector outputs (x 165 pre-amplifier gain):
  active (in 100% vol. N_2) . . . . 0.8 V min, 1.95 V max
  reference (in 100% vol. N_2) . . . 0.8 V min, 2.45 V max

Note Applying a voltage greater than the maximum will reduce the operating lifetime of the sensor.

Mechanical

Net weight: . . . . . 27 g max
Pin connections . . . . . see outline
Dimensions . . . . . see outline

Environmental

Temperature:
  operating . . . . . $-$10 to +50 °C
  storage . . . . . $-$20 to +60 °C
  zero drift . . . . . $\pm$10 ppm CO_2/°C
  span . . . . . negligible
Relative humidity (non-condensing) . . . . . 0 to 100%

HANDLING PRECAUTIONS

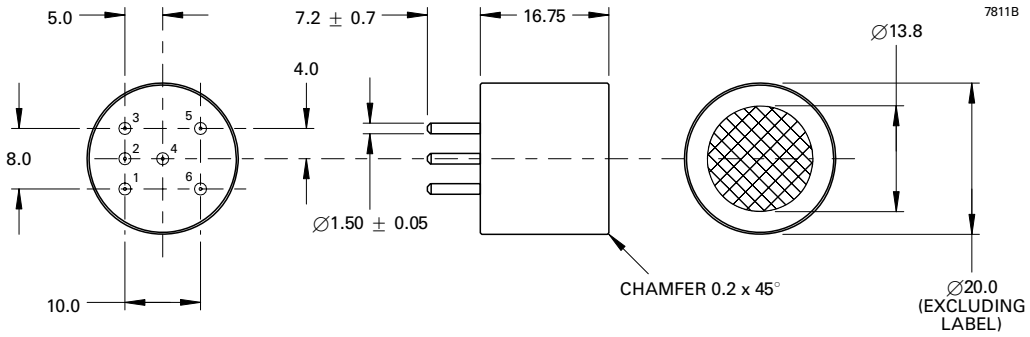
1. Do not allow sensors to fall on the floor. This could cause lamp filament breakage, damage to the pins and the gas entrance aperture.
2. Do not apply mechanical force against the gas entrance aperture.
3. Do not immerse sensors in water or other fluids.
4. Protect the gas entrance aperture against dust ingress and sprayed materials.
5. Anti-static handling precautions must be taken.
6. Under no circumstances should the sensor pins be soldered directly to a pcb or wires. Excessive heat could cause irrepairable damage to the pyroelectric detectors.

HEALTH AND SAFETY HAZARDS

Warning

If the intended use is in hazardous areas, e2v technologies recommends that the sensor is used with a suitable flame arrestor.

OUTLINE (All dimensions without limits are nominal)



Pin	Connection
1	+5 V common detector input
2	Lamp
3	Lamp return
4	Active detector output
5	Reference detector output
6	0 V input

Outline Note

The IR81BB is designed to fit into press-mount pcb sockets. e2v technologies recommend Wearns Cambion type 450-3326-01-03-00 or equivalent.