IR3xxx Series, IR4xxx Series Miniature Infrared Gas Sensors for Non-Hazardous Areas

FEATURES

- Configured for carbon dioxide (IR31BC, IR41BC), hydrocarbons (IR32BC, IR33BC, IR42BC, IR43BC) or acetylene (IR34BC, IR44BC)
- Sensing ranges: 0 – 2% vol. (optional 0 – 5% vol.) for CO_2, 0 – 100% LFL (optional 0 – 100% vol.) for hydrocarbons
- Diffused gas sampling via mesh
- Suitable for use under gas diffusion membranes, particulate filters, flame arrestors and explosion-proof housings
- Low power
- Reference channel for self-compensation
- Special gold plated optical/gas cavity for stable signal levels
- Operational in varying ambients of temperature, pressure and humidity
- Optional extra internal heating to offset condensation (IR4xxx Series only)
- Fast response
- Rugged stainless steel construction
- No moving parts
- Resistance to corrosion
- Series 4 size to complement miniature catalytic and electrochemical gas sensors
- Immunity from 'poisoning'
- Reliable fail-safe operation
- Low maintenance
- Suitable for fixed or portable instrumentation
- Series expandable to other gases or vapours

(Photograph shows device approximately 3x actual size)

DESCRIPTION

The IR3xxx and IR4xxx Series of sensors use the proven non-dispersive infrared (NDIR) principle to detect and monitor the presence of gases. With an infrared source and specific filtering on the pyroelectric detectors mounted inside the optical/gas cavity, individual gases or types of gas can be identified and their concentrations determined.

These sensors are suitable for reliable monitoring of gas levels in general safety applications where the infrared sensor size is restricted. On their own, these sensors cannot be placed in hazardous areas, but they are suitable for installation in instrumentation that is hazard certified. The open front of the sensors (see photograph) must be closed with a suitable gas diffusion membrane, e.g. stainless steel sintered disc or mesh. As well as preventing entry of dust and contamination, the membrane also acts as a partial reflector for infrared. This will cause a slight increase in the pyroelectric detector output voltages. It is important that the gas diffusion membrane be securely attached and rigid enough not to cause flexing and spurious signal instability during ambient temperature and pressure changes.

The IR31BC is filtered specifically for carbon dioxide, whereas the IR32BC and IR33BC are cross-sensitive to a range of hydrocarbons. The IR33BC covers the wider range but has a slight response to water vapour when the RH is high. The IR32BC is filtered to a narrower waveband, more specific to methane and shows less response to the water levels typically found in mining applications. The IR34BC is narrowly filtered for acetylene, but has some response to water due to the close proximity of the water absorption bands. For more information, refer to Infrared Gas Sensor Application Note 1.

The IR4xxx Series are the same as the IR3xxx Series, but extra internal heating is provided from a higher current (115 mA) IR source. By raising the internal temperature to 15 – 20 °C above ambient (depending on installation and insulation), any deleterious effects of condensation inside the sensor can be offset. At present, the IR42BC for methane and other hydrocarbons is the first available in the series.

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OPERATION

To operate as NDIR gas sensors, the IR3xxx and IR4xxx Series must be interfaced to a suitable transmitter for power supply and for amplifying and processing signals. Sensor outputs require linearisation and compensation for ambient temperature variation using algorithms in the system software. This is necessary for sensors to meet their full performance specification. A temperature sensor must be included in the electronics and be positioned close to the gas sensor.

Compensation for pressure changes can also be made in an algorithm, provided there is a suitable input from a pressure sensor.

A set of Application Notes is available from the e2v technologies website, to explain more about NDIR gas sensing and provide advice for the end-user on interfacing sensors and processing signals.

Infrared Sensor Application Note 1: Background to NDIR Gas Sensing

Infrared Sensor Application Note 2: Signal Processing

Infrared Sensor Application Note 3: Software Design

Infrared Sensor Application Note 4: Electronics Design

Infrared Sensor Application Note 5: Determining Coefficients for Linearisation and Temperature Compensation

Infrared Sensor Application Note 6: Advice for Using Infrared Gas Sensors in Mining Applications

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 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, as excessive heat could cause irrepairable damage to the pyroelectric detectors.

HEALTH AND SAFETY HAZARDS

Warning

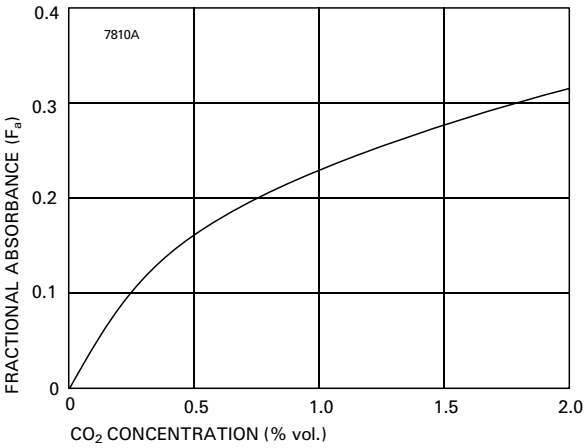
The IR3xxx and IR4xxx Series are not classified as certified devices in hazardous areas. However, they may be used in hazardous areas provided that they are installed in a suitable housing complete with flame arrestor. The housing must also protect the sensor from contamination and mechanical impacts.

For sensors usable on their own in hazardous areas, the IR1xxx Series 1 and 2 or the IR600 Series are recommended.

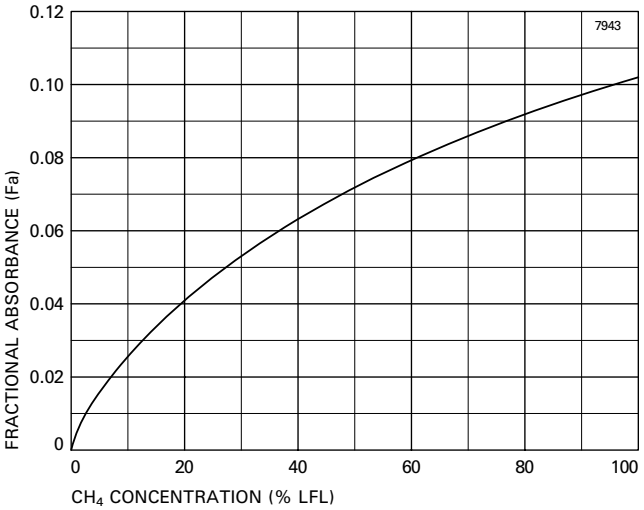
FRACTIONAL ABSORBANCE CURVES

These show the sensitivity versus concentration before linearisation for the range of gases. For further explanation, refer to the Infrared Sensor Application Note.

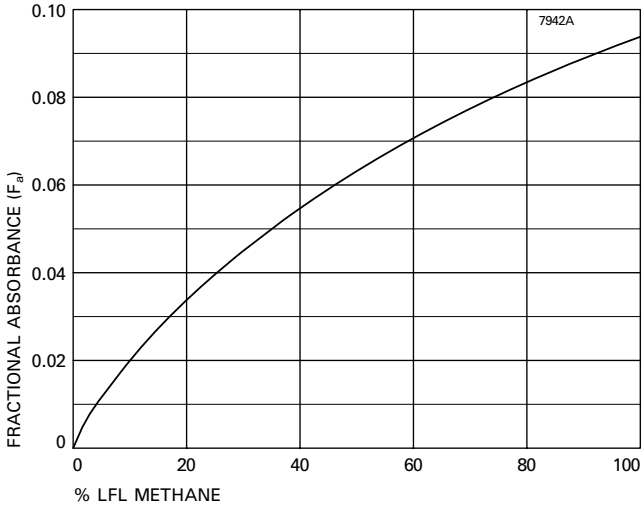
Typical Sensitivity to 0 to 2% vol. Carbon Dioxide (IR31BC)



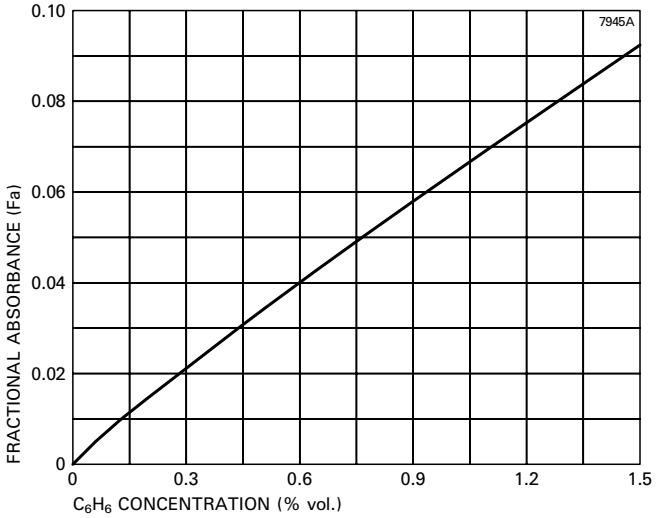
Typical Sensitivity to Methane (100% LFL = 5% vol.) (IR33BC)



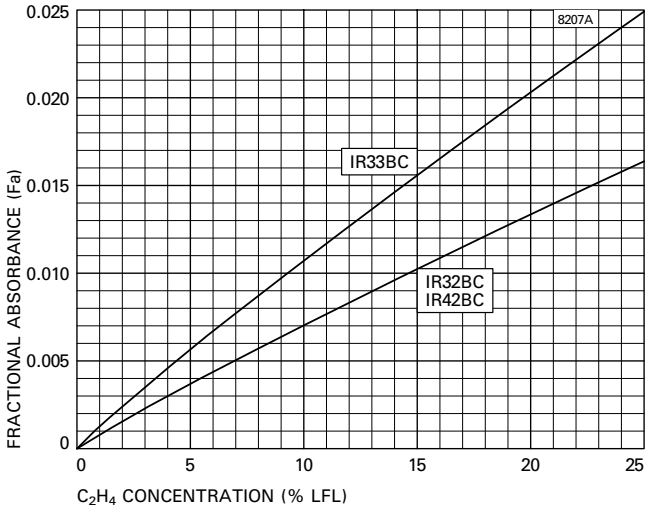
Typical Sensitivity to Methane (100% LFL = 5% vol.) (IR32BC, IR42BC)



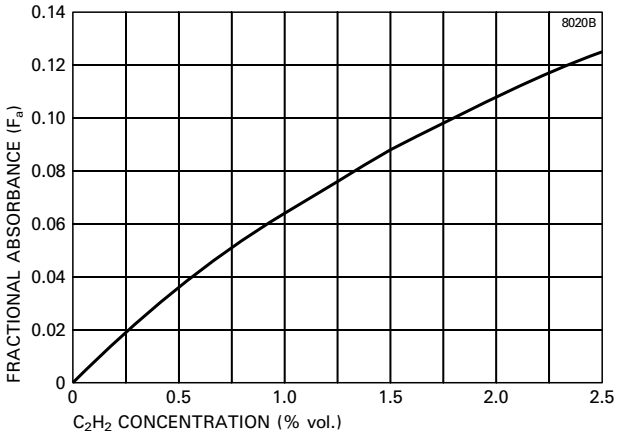
Typical Sensitivity to Benzene (100% LFL = 1.5% vol.) (IR33BC)



Typical Sensitivity to Ethylene (100% LFL = 3% vol.) (IR32BC, IR42BC, IR33BC)

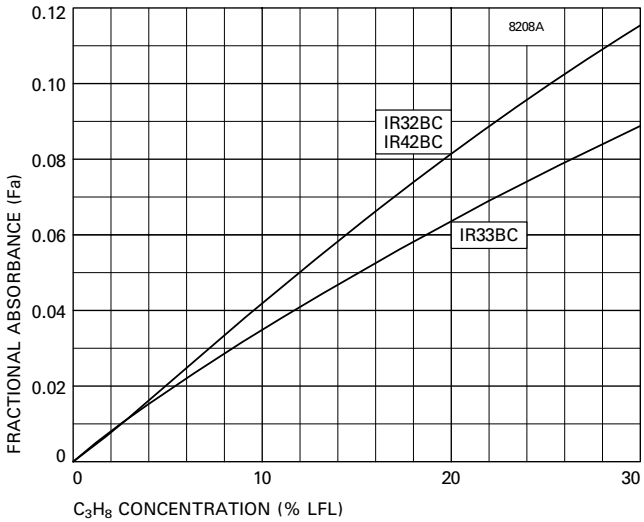


Typical Sensitivity to Acetylene (100% LFL = 2.5% vol.) (IR34BC)



Note Other Fractional Absorbance curves are available from Gas Sensor Engineering at e2v technologies.

Typical Sensitivity to Propane (100% LFL = 2.4% vol.) (IR32CD, IR42BC, IR43BC)



TECHNICAL SPECIFICATION

Mechanical

Dimensions	see outline, page 5
Body material	stainless steel
Weight	27 g

Environmental

Ambient temperature range: for operation for storage	 −20 to +55 °C −25 to +85 °C
Operational pressure range	700 to 1300 hPa
Humidity range for operation and storage	0 to 95% non-condensing
Vibration	complies with EN61779-1
Ingress protection	requires extra protection depending on application

Electrical

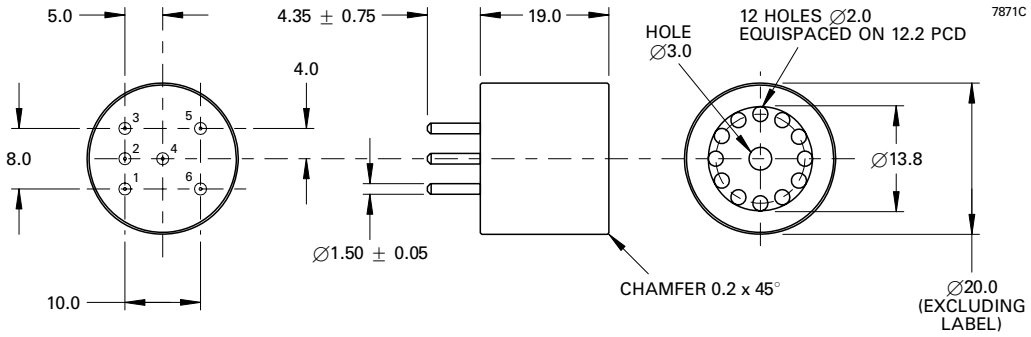
DC supply to detectors	+3 to +15 V; +5 V recommended
Maximum power supply	180 mW (IR3xxx Series), 300 mW (IR4xxx Series)
Lamp supply	3 to 5 V, 60 mA max (IR3xxx), 115 mA max (IR4xxx), modulation 4 Hz, 50% duty cycle recommended **Note:** Applying >5 V will reduce the lamp lifetime
Warm-up time	<20 s to operate, <30 s min. to full specification at 20 °C

PERFORMANCE

All measurement data taken using:
- e2v linearisation and temperature compensation algorithms; see Infrared Sensor Application Notes.
- Lamp modulation 0.4 - 5.0 V, square wave, at 4 Hz and 50% duty cycle.
- Ambient temperature (20 °C) and pressure (1010 hPa).
- All gases diluted in nitrogen.
Note: Any variation from these conditions may affect sensor performance.

Sensor type	**IR31BC**	**IR32BC**	**IR42BC**	**IR33BC**	**IR34BC**
Gas	Carbon Dioxide	Hydrocarbons			Acetylene
Sensing range	0 - 3000 ppm 0 - 2.0% vol. 0 - 5.0%vol.	0 - 100% LFL 0 - 100% vol.			0 - 100% LFL 0 - 100% vol.
Maximum response time (T90)	<20 s				
Limits of detector output voltage in nitrogen (x 165 pre-amplifier gain): active channel reference channel	 1.0 to 2.7 V 1.6 to 4.2 V	 1.3 to 4.2 V 1.6 to 4.2 V	 4.0 to 7.0 V 4.0 to 7.0 V	 2.1 to 5.5 V 1.6 to 4.2 V	 1.0 to 2.5 1.6 to 4.2
Typical % fall in active detector voltage for exposure to stated target gas (reference detector is unchanged)	32% for 2.0% vol. conc. carbon dioxide	9.5% for 5% vol. conc. methane	9.5% for 5% vol. conc. methane	11% for 5% vol. conc. methane	12.5% for 2.3% vol. conc. acetylene
Maximum deviation from linearity	±0.1% vol.				
Maximum variation of zero from −20 to +55 °C	±10 ppm/°C	±20 ppm/°C			
Resolution (dependent on electronics)	100 ppm	500 ppm			
Maximum non-reproducibility of zero at 20 °C	±100 ppm	±500 ppm			
Maximum non-reproducibility of sensitivity at 20 °C	±200 ppm	±1000 ppm			
Long-term zero drift/month at 20 °C	±100 ppm	±500 ppm			
Response to 0 - 90% change in RH at 20 °C (in target gas)	0% vol.	+0.1% vol.	<0.1% vol.	+0.3% vol.	+0.5% vol.
MTBF (lamp dependent only)	>10 years for 5 V operation, >20 years for 3 V operation				

OUTLINE (All dimensions in millimetres; see note 1)



Pin	Connection
1	+ V detector supply
2	Lamp
3	Lamp return
4	Active detector output
5	Reference detector output
6	0 V input (connected internally to sensor body)

Outline Notes

1. Body dimensional tolerances ±0.1 mm. Pin dimensional tolerances as indicated.
2. IR3xxx and IR4xxx Series sensors are designed to press-fit into pcb sockets. The end-user should choose a socket to accommodate the full sensor pin length. This will ensure a stable mechanical location as well as good electrical contact. e2v technologies recommend the Wearns Cambion type 450-1813-01-03-00 single-pole solder mount socket with through hole, or a suitable equivalent.