

# e2v

## IR1xxx Series 1, IR2xxx Series 1 Miniature Infrared Gas Sensors for Hazardous Areas and Intrinsic Safety in Mining

### FEATURES

- Configured for carbon dioxide (IR11BD, IR21BD), hydrocarbons (IR12BD, IR13BD, IR22BD, IR23BD) or acetylene (IR14BD)
- Sensing ranges: 0 - 2% vol. (optional 0 - 5% vol.) for CO<sub>2</sub>, 0 - 100% LFL (optional 0 - 100% vol.) for hydrocarbons
- Diffused gas sampling via mesh
- 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
- 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
- ATEX certified  II 2G Ex d IIC Gb (IR1xxx Series) (T<sub>a</sub> = -20 to +55 °C)
- ATEX certified  I M1 Ex ia I Ma (IR2xxx Series) (T<sub>a</sub> = -20 to +60 °C)
- IECEx certified Ex d IIC Gb (IR1xxx Series) (T<sub>a</sub> = -20 to +55 °C)
- IECEx certified Ex ia I Ma (IR2xxx Series) (T<sub>a</sub> = -20 to +60 °C)
- CSA certified - File 107498 (IR1xxx Series)
- UL recognised - File E186043 (IR1xxx Series)

### DESCRIPTION

The IR1xxx and IR2xxx Series 1 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.



(Photograph shows device approximately 2 1/2 x actual size)

The IR1xxx Series 1 are suitable for reliable monitoring of gas levels in general safety applications where the infrared sensor size is restricted and requires flameproof/explosion-proof certification. The IR11BD is filtered specifically for carbon dioxide, whereas the IR12BD and IR13BD are cross-sensitive to a range of hydrocarbons. The IR13BD covers the wider range but has a slight response to water vapour when the RH is high. The IR12BD is filtered to a narrower waveband, more specific to methane and shows less response to the water levels typically found in mining applications. The IR14BD 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 IR2xxx Series 1 share the same build standard as the IR1xxx Series 1, but are labelled as being intrinsically safe for methane monitoring in mining applications.

### OPERATION

To operate as NDIR gas sensors, the IR1xxx and IR2xxx Series 1 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 (facilitated by the inbuilt thermistor) by 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

## CERTIFICATIONS

### IR1xxx Series 1

SIRA Certification Services, EU Notified Body No. 0518, have certified the IR1xxx Series 1 under the ATEX Directive, 94/9/EC, and the IECEx Scheme. Certificate number SIRA 99ATEX1121U certifies it as a flameproof component to EN60079-0:2006 (including amendments A1 and A2) and EN60079-1:2007. **Instructions specific to hazardous area installations apply.** See page 5. Certificate number IECEx SIR 04.0031U certifies it as a flameproof component to IEC60079-0 Ed. 5 and IEC60079-1 Ed. 6.

The Canadian Standards Association has issued a component certification for the IR1xxx Series 1 for use as part of an intrinsically safe portable combustible gas detector or housed in a remote sensor housing. It has satisfied the requirements of CSA standard C22.2 No. 30-M 1986. File No. 107498.

Underwriters Laboratories Inc. recognise the IR1xxx Series 1 as components in intrinsically safe single- or multi-gas detectors for use in Class 1, Division 1, Groups A, B, C and D hazardous locations. It has satisfied the requirements of UL913, fifth edition. File E186043.

### IR2xxx Series 1

SIRA Certification Services, EU Notified Body No. 0518, have certified the IR2xxx Series 1 under the ATEX Directive, 94/9/EC, and the IECEx Scheme. Certificate number SIRA 02ATEX2015U certifies it as an intrinsically safe component for mining applications, category M1, to EN60079-0:2006 (including amendments A1 and A2), EN60079-11:2007 and EN50303:2000. **Instructions specific to hazardous area installations apply.** See page 5. Certificate number IECEx SIR 03.0003U certifies it as a flameproof component to IEC60079-0 Ed. 5 and IEC60079-11 Ed. 5.

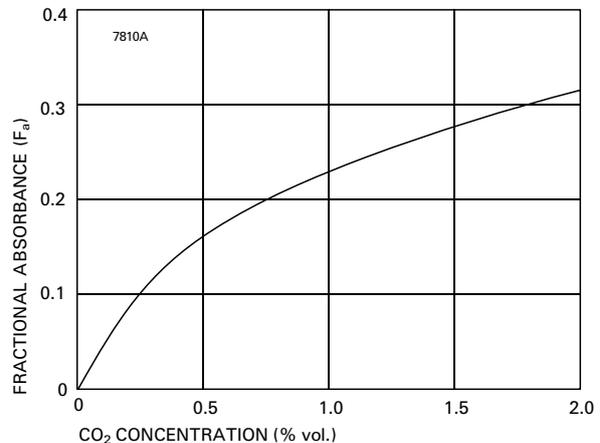
## HANDLING PRECAUTIONS

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 irreparable damage to the pyroelectric detectors.

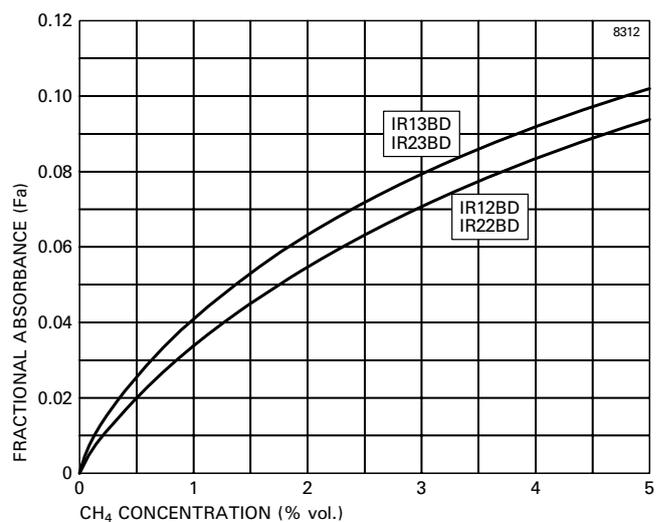
## FRACTIONAL ABSORBANCE CURVES

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

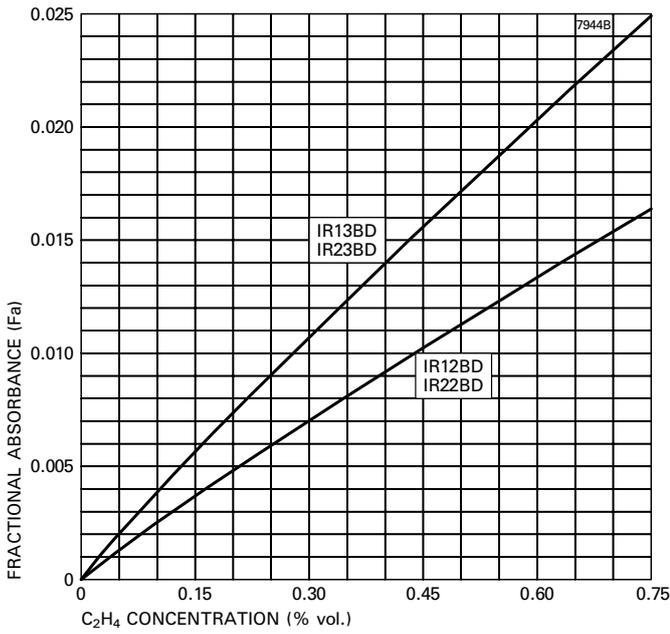
### Typical Sensitivity to 0 to 2% vol. Carbon Dioxide (IR11BD, IR21BD)



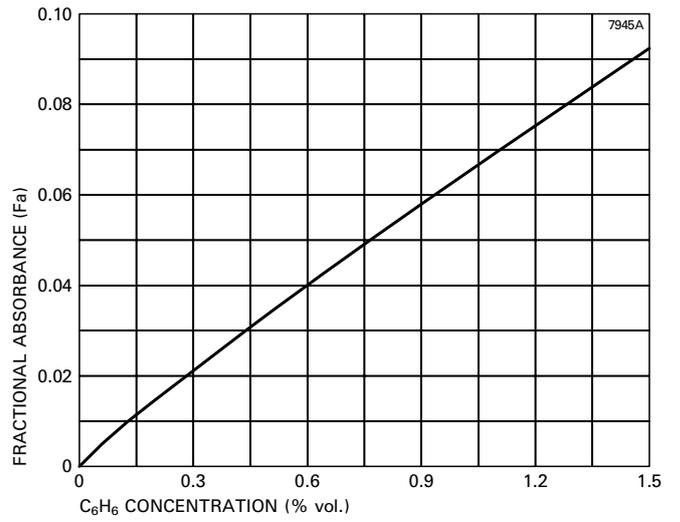
### Typical Sensitivity to Methane (100% LFL = 5% vol.) (IR12BD, IR22BD, IR13BD, IR23BD)



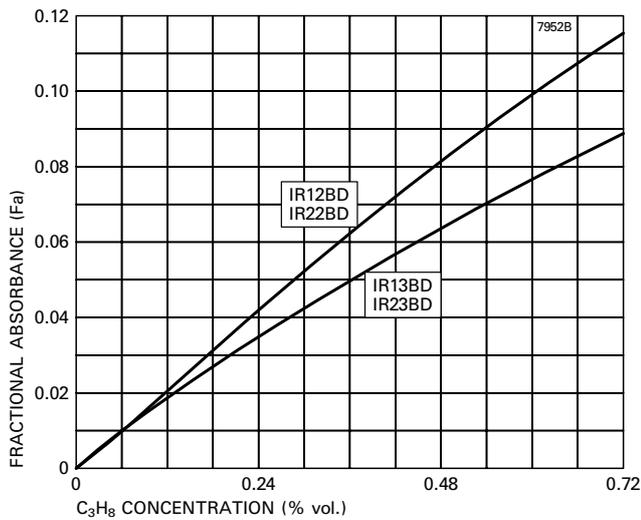
**Typical Sensitivity to Ethylene (100% LFL = 3% vol.) (IR12BD, IR22BD, IR13BD, IR23BD)**



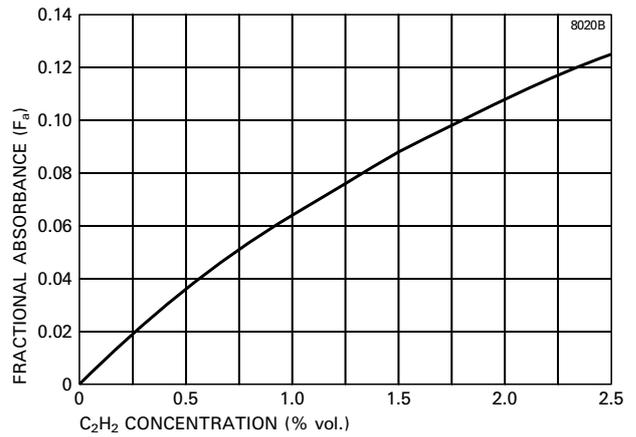
**Typical Sensitivity to Benzene (100% LFL = 1.5% vol.) (IR13BD, IR23BD)**



**Typical Sensitivity to Propane (100% LFL = 2.4% vol.) (IR12BD, IR22BD, IR13BD, IR23BD)**



**Typical Sensitivity to Acetylene (100% LFL = 2.5% vol.) (IR14BD)**



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

## 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
Lamp supply	3 to 5 V (60 mA), modulation 4 Hz, 50% duty cycle recommended <b>Note:</b> Applying >5 V will reduce the lamp lifetime
Warm-up time	<20 s to operate, <30 min. to full specification at 20 °C

## PERFORMANCE

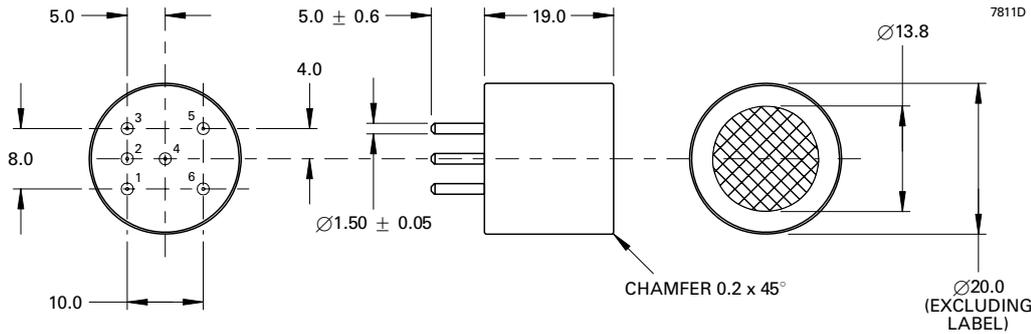
All measurement data taken using:

- 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	IR11BD, IR21BD	IR12BD, IR22BD	IR13BD, IR23BD	IR14BD
Gas	Carbon Dioxide	Hydrocarbons	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.	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	1.5 to 3.8 V 2.4 to 5.8 V	1.8 to 6.0 V 2.4 to 5.8 V	3.3 to 8.2 V 2.4 to 5.8 V	1.5 to 4.0 V 2.4 to 5.8 V
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	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. (in 2% vol.)	+0.1% vol. (2.5% vol.)	+0.3% vol. (2.5% vol.)	+0.5% vol. (2.3% 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 DC detector supply
2	Lamp
3	Lamp return
4	Active detector output
5	Reference detector output
6	0 V input

### Outline Notes

1. Body dimensional tolerances  $\pm 0.1$  mm. Pin dimensional tolerances as indicated.
2. IR1xxx Series 1 and IR2xxx Series 1 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 Wearn's Cambion type 450-1813-01-03-00 single-pole solder mount socket with through hole, or a suitable equivalent.

## INSTRUCTIONS SPECIFIC TO HAZARDOUS AREA INSTALLATIONS

### (Ref. EU ATEX Directive 94/9/EC, Annex II, 1.0.6)

1. The IR1xxx Series 1 and IR2xxx Series 1 Gas Sensing Heads are component-approved only and may not be used as stand-alone items in a hazardous area without further protection.
2. The IR1xxx Series 1 and IR2xxx Series 1 Gas Sensing Heads shall be protected in service. The Sensing Head shall be mounted in a protective enclosure such that an impact of 7 J in accordance with EN60079-0:2006 clause 23.4.3.1 from any direction shall not cause the impact head to make contact with the Sensing Head.
3. The thermal resistance of the IR1xxx Series 1 and IR2xxx Series 1 Gas Sensing Heads does not exceed 25 K/W; this shall be taken into account when considering its surface temperature and the temperature classification of the equipment into which it is to be incorporated.
4. The IR1xxx Series 1 and IR2xxx Series 1 Gas Sensing Heads have not been assessed as a safety device (EHSR 1.5).
5. There are no user-serviceable parts in the component.
6. The end-user/installer shall be aware that the certification of the IR1xxx Series 1 and IR2xxx Series 1 Gas Sensing Heads relies on the following materials used in its construction, which are suitable for most common applications:  
 Enclosure. . . . . Stainless steel  
 Mesh . . . . . Stainless steel  
 Bushing. . . . . Epoxy resin  
 In accordance with the Note in EN60079-0:2006 clause 6.1(a), the end-user/installer shall inform the manufacturer of any adverse conditions that the IR1xxx Series 1 and IR2xxx Series 1 Gas Sensing Heads may encounter. This is to ensure that the IR1xxx Series 1 and IR2xxx Series 1 Gas Sensing Heads are not subjected to conditions that may cause degradation of these materials.
7. The IR1xxx Series 1 Gas Sensing Head is only certified for use in ambient temperatures between  $-20$  and  $+55$  °C and should not be used outside this range.
8. The IR2xxx Series 1 Gas Sensing Head is only certified for use in ambient temperatures between  $-20$  and  $+60$  °C and should not be used outside this range.
9. The maximum input power of the IR1xxx Series 1 Gas Sensing Head shall not exceed 2.5 W.
10. The IR2xxx Series 1 is a galvanically isolating device with infallible separations between the lamp and detector circuits up to 10 V. The IR2xxx Series 1 has the following safety description:  
 Lamp Circuit: . . . . .  $U_i = 7.2$  V  
 Detector Circuit: . . . . .  $U_i = 10$  V  
 Lamp + Detector Circuits . . . . .  $P_i = 2.71$  W
11. The IR2xxx Series 1 Head is dust-proof (IP5x) but offers no protection against the ingress of water. Where protection in excess of IP50 is required, the apparatus into which the IR Head is installed shall provide the necessary ingress protection.

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