



# e2v

## IR1xxx Series 2, IR2xxx Series 2 Miniature Infrared Gas Sensors for Hazardous Areas and Intrinsic Safety in Mining

### FEATURES

- Configured for carbon dioxide (IR11EJ, IR11GJ, IR11EM, IR11GM, IR21EJ, IR21GJ, IR21EM, IR21GM) and hydrocarbons (IR12EJ, IR12GJ, IR12EM, IR12GM, IR22EJ, IR22GJ)
- Sensing ranges: 0 - 0.5%, 0 - 2% and 0 - 5% vol. conc. for CO<sub>2</sub>, 0 - 100% LFL (0 - 100% vol. conc.) for hydrocarbons
- Diffused gas sampling via mesh
- Low power
- Reference channel for self-compensation
- Embedded temperature sensors - thermistor or linearised IC options
- 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
- Two size options 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 and concentration ranges
- 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 2 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.

The IR1xxx Series 2 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. They are derived from the IR1xxx Series 1 but offer extra features and improvements:



- Two height options are available - 16.6 mm (code M) and 19.0 mm (code J) for versatility of fitting into instrumentation
- An extra pin-out is provided for an embedded temperature sensor. There are two types to choose from - thermistor (code E) with non-linearised output, or IC (code G) with linearised output
- New dual-packaged IR detectors permit greater accuracy when compensating for changes in ambient conditions
- A new versatile design gas cavity enables the internal geometry to be adjusted for optimum sensing over a wider range of gas concentrations

The IR2xxx Series 2 share the same build and performance standard as the IR1xxx Series 2, 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 2 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. The embedded temperature sensor facilitates this compensation. Further 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 (overleaf) 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 2

SIRA Certification Services, EU Notified Body No. 0518, have certified the IR1xxx Series 2 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 2 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 2 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 2

SIRA Certification Services, EU Notified Body No. 0518, have certified the IR2xxx Series 2 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.

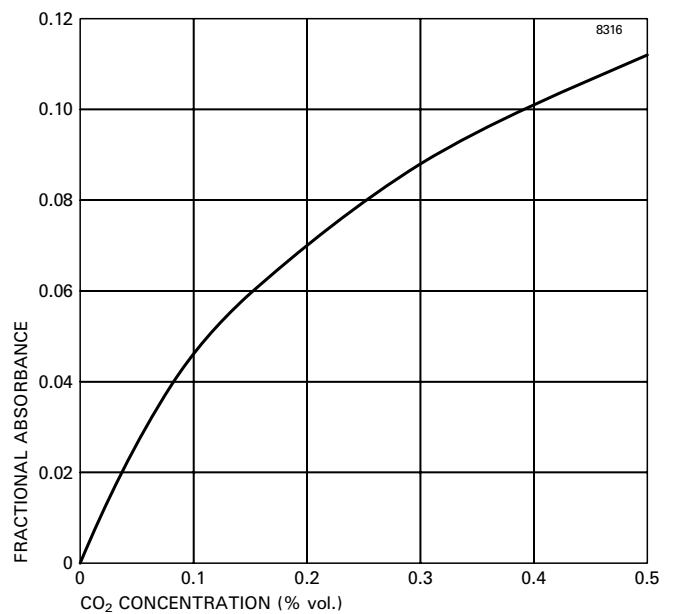
## HANDLING PRECAUTIONS

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.

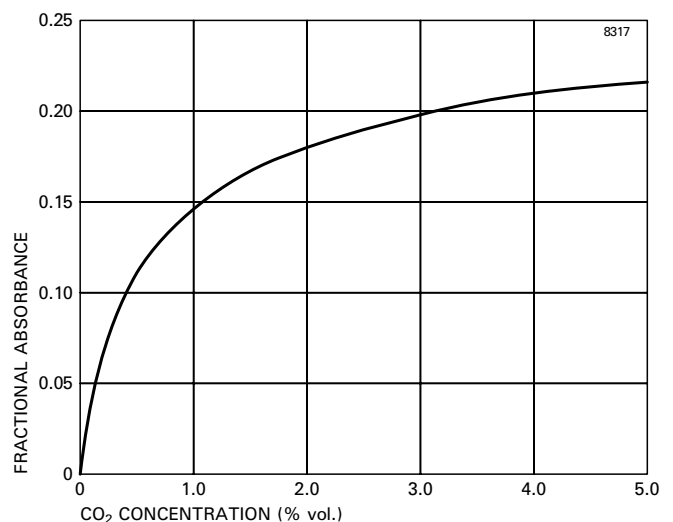
## FRACTIONAL ABSORBANCE CURVES

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

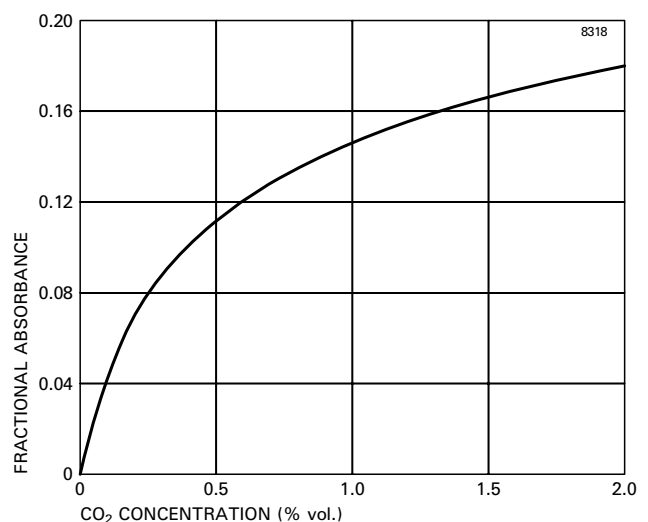
### IR11EJ, IR21EJ, IR11GJ, IR21GJ Carbon Dioxide (0 - 0.5% vol. conc.)



### Carbon Dioxide (0 - 5% vol. conc.)

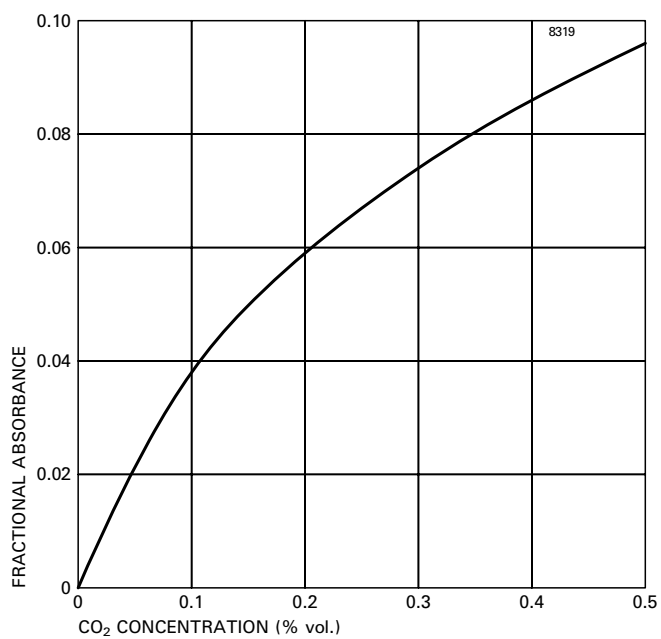


### Carbon Dioxide (0 - 2% vol. conc.)

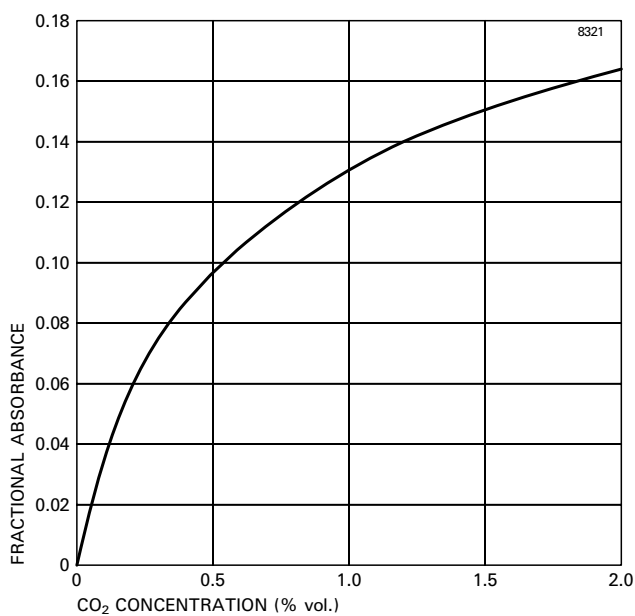


**IR11EM, IR21EM, IR11GM, IR21GM**

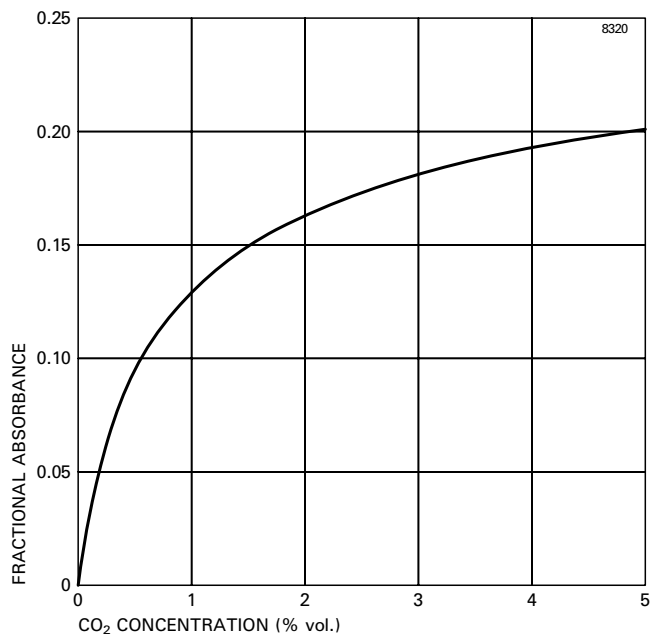
**Carbon Dioxide (0 - 0.5% vol. conc.)**



**Carbon Dioxide (0 - 2% vol. conc.)**

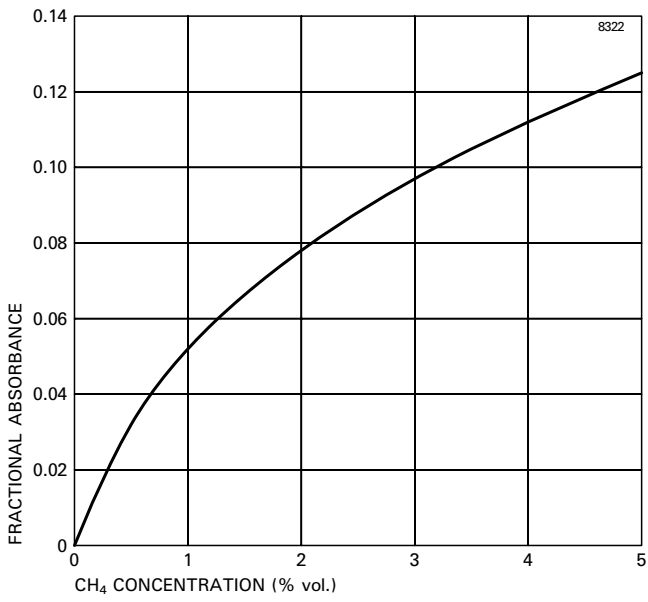


**Carbon Dioxide (0 - 5% vol. conc.)**

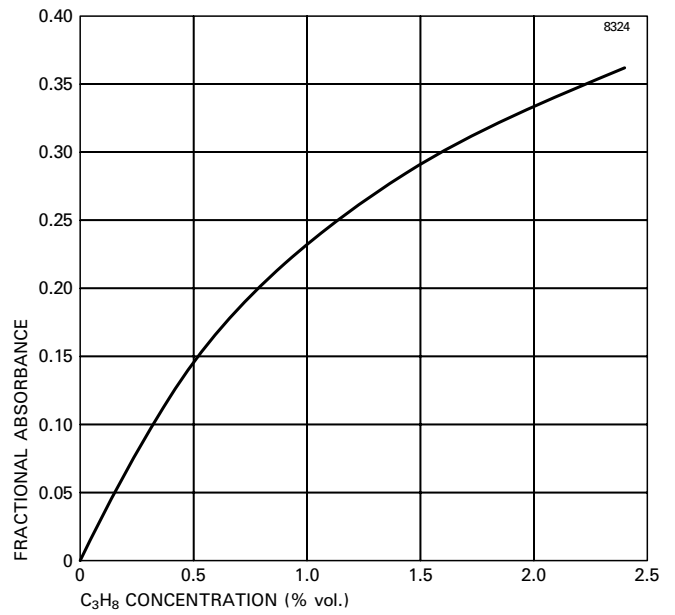


**IR12EJ, IR22EJ, IR12GJ, IR22GJ**

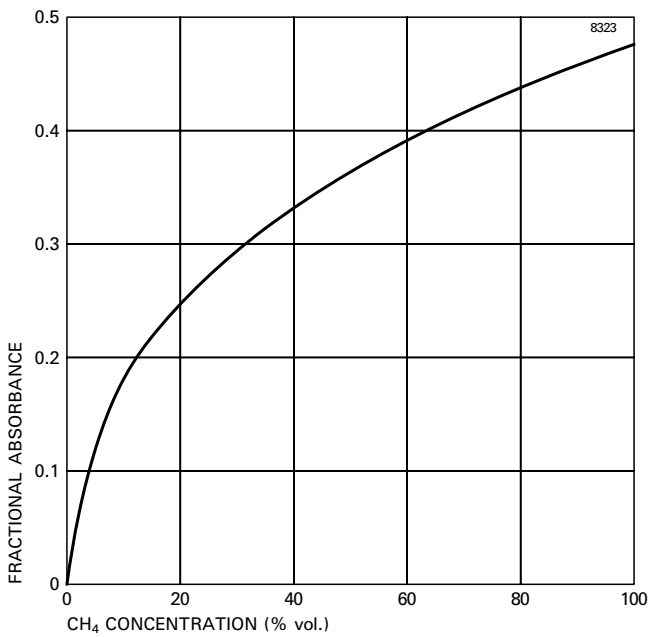
**Methane (0 - 5% vol. conc.)**



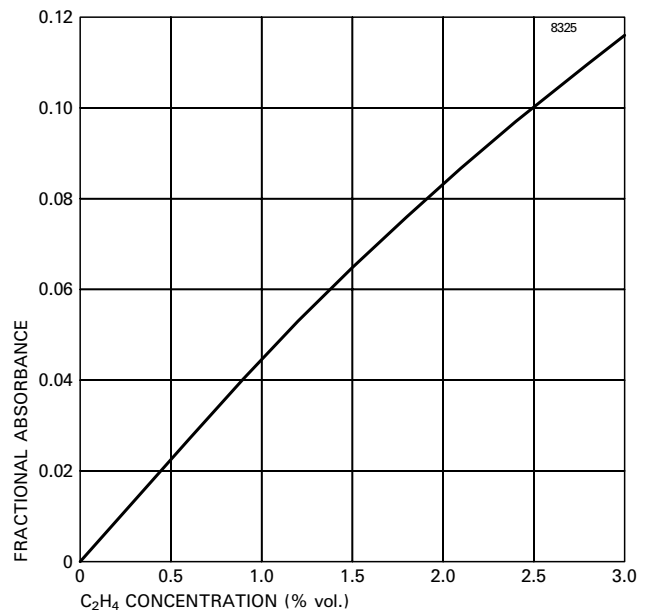
**Propane (0 - 2.5% vol. conc.)**



**Methane (0 - 100% vol. conc.)**



**Ethylene (0 - 3% vol. conc.)**



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

## INSTRUCTIONS SPECIFIC TO HAZARDOUS AREA INSTALLATIONS

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

1. The IR1xxx Series 2 and IR2xxx Series 2 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 2 and IR2xxx Series 2 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 2 and IR2xxx Series 2 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 2 and IR2xxx Series 2 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 2 and IR2xxx Series 2 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 2 and IR2xxx Series 2 Gas Sensing Heads may encounter. This is to ensure that the IR1xxx Series 2 and IR2xxx Series 2 Gas Sensing Heads are not subjected to conditions that may cause degradation of these materials.
7. The IR1xxx Series 2 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 2 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 2 Gas Sensing Head shall not exceed 2.5 W.
10. The IR2xxx Series 2 is a galvanically isolating device with infallible separations between the lamp and detector circuits up to 10 V. The IR2xxx Series 2 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  
 Detector Circuit . . . . .  $P_i = 1.2$  W
11. The IR2xxx Series 2 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.

## TECHNICAL SPECIFICATION

### Mechanical

Dimensions	see outline, page 7
Body material	stainless steel
Weight	21 g (code M), 24 g (code J)

### Environmental

Ambient temperature range: for operation for storage	$-30$ to $+75$ °C $-40$ 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 $+10$ V (code G); $+3$ to $+15$ V (code E); $+5$ 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:

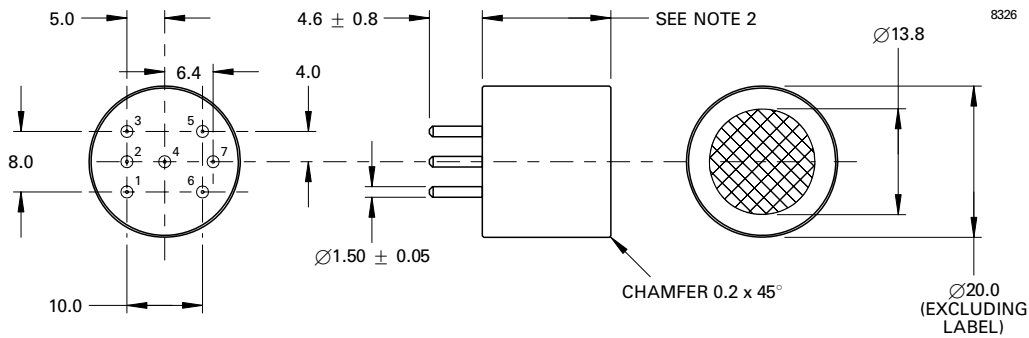
- e2v linearisation and temperature compensation algorithms; see Infrared Sensor Application Notes.
- Lamp modulation 0.4 - 5.0 V, square wave, at 4 Hz and 50% duty cycle.
- Ambient temperature (20 °C) and pressure (1010 hPa).
- All gases diluted in nitrogen.

Note: Any variation from these conditions may affect sensor performance.

Sensor type	IR12EM/IR12GM IR12EJ/IR22EJ, IR12GJ/IR22GJ		IR11EJ/IR21EJ, IR11GJ/IR21GJ, IR11EM/ IR21EM, IR11GM/IR21GM		
Gas	Methane		Carbon Dioxide		
Concentration range	0 - 5% vol.	0 - 100% vol.	0 - 0.5% vol.	0 - 2% vol.	0 - 5% vol.
Maximum response time	< 20 s				
Limits of detector output voltage in nitrogen: active channel	22 - 65 mV		12 - 36 mV		
reference channel	9 - 29 mV				
Typical % fall in active detector voltage for exposure to stated target gas (reference detector is unchanged)	12%	48%	11%	18%	22%
Sensitivity to gas over full concentration range (before linearisation)	see Fractional Absorbance Curves				
Maximum deviation from linearity	0.1%	1%	0.015%	0.1%	0.2%
Maximum variation of zero from -20 to +55 °C	± 20 ppm/°C		± 10 ppm/°C		
Maximum variation of span from -20 to +55 °C	± 0.3% vol.	not available	± 0.15% vol.	± 0.8% vol. *	not suitable
Typical resolution	0.01%	1%	0.003% vol.	0.01% vol.	0.03% vol.
Short-term drift on zero/8 hr at 20 °C	± 0.01% vol.		± 0.003% vol.		
Short-term drift on span/8 hr at 20 °C	± 0.15% vol.	not available	± 0.01% vol.	± 0.05% vol.	± 0.15% vol.
Long-term drift/month (zero)	± 0.01% vol.		± 0.003% vol.		
Long-term drift/month (span)	± 0.05% vol.	not available	± 0.012% vol.	± 0.05% vol.	± 0.20% vol.
Maximum response to 0 - 90% change in RH at 20 °C (in target gas)	+ 0.25% vol.	+ 1.5% vol.	Negligible		
MTBF (lamp dependent only)	> 10 years for 5 V operation, > 20 years for 3 V operation				

\* Can be improved by calculating individual Alpha and Beta coefficients. See Infrared Sensor Application Notes.

## OUTLINE (All dimensions in millimetres; see note 1)



Pin	Connection
1	+ V DC detector input
2	Lamp
3	Lamp return
4	Active detector output
5	Reference detector output
6	0 V input
7	Temperature sensor Thermistor (code E); IC (code G)

### Outline Notes

1. Body dimensional tolerances  $\pm 0.1$  mm. Pin dimensional tolerances as indicated.
2. For code J devices, this length is 19.0 mm; for code M devices it is 16.6 mm.
3. IR1xxx Series 2 and IR2xxx Series 2 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.

Whilst e2v technologies has taken care to ensure the accuracy of the information contained herein it accepts no responsibility for the consequences of any use thereof and also reserves the right to change the specification of goods without notice. e2v technologies accepts no liability beyond that set out in its standard conditions of sale in respect of infringement of third party patents arising from the use of tubes or other devices in accordance with information contained herein.