IR15TT-R
Miniature Infrared Gas Sensor for Monitoring Carbon Dioxide and Methane up to 100% Vol.

FEATURES

- Two active gas channels for simultaneous detection of carbon dioxide and methane (or other hydrocarbons)
- 0 to 100% vol. carbon dioxide
- 0 to 100% vol. methane (also suitable for 0 to 5% vol. methane)
- Internal thermistor for temperature monitoring
- Long life
- Low power
- Fast response
- Reference channel for self-compensation
- Special gold-plated optical/gas cavity for stable signal levels
- Rugged stainless steel construction
- 20 mm body height
- Immune from “poisoning”
- Resistance to corrosion
- Reliable fail-safe operation
- No moving parts
- Low maintenance
- Suitable for fixed and portable instrumentation
- ATEX Certified Ⓔx II 2G Ex d IIC Gb (T_a = -20 to +55 °C)
- IECEx Certified Ex d IIC Gb (T_a = -20 to +55 °C)
- CSA Certified – File 107498
- UL Recognised – File E186043

DESCRIPTION

The IR15TT-R sensor uses the proven non-dispersive (NDIR) principle to detect and monitor the presence of carbon dioxide and methane gas up to concentrations of 100% volume simultaneously, by incorporating two internal active detectors and a reference detector. With an infrared source and specific filtering on the pyroelectric detectors mounted inside the optical/gas cavity, the carbon dioxide and methane gas concentrations can be determined.

OPERATION

To operate as an NDIR gas sensor, the IR15TT-R must be interfaced to a suitable electronics, for power, lamp pulsing, amplifying and signal processing. Signal processing, in its simplest terms, involves the linearisation and temperature compensation using algorithms in the system software.

The IR15TT-R also contains a thermistor for use with temperature compensation. In certain applications where relatively large changes in ambient pressures are found, a pressure sensor may be required for compensation.

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

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.

CERTIFICATIONS

SIRA Certification Services, EU Notified Body No. 0518, have certified the IR15TT-R 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 6). 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 IR15TT-R 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 IR15TT-R 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.

e2v technologies (uk) limited, Waterhouse Lane, Chelmsford, Essex CM1 2QU United Kingdom Telephone: +44 (0)1245 493493 Facsimile: +44 (0)1245 492492
e-mail: enquiries@e2v.com Internet: www.e2v.com Holding Company: e2v technologies plc
e2v technologies inc. 520 White Plains Road, Suite 450, Tarrytown, NY10591 USA Telephone: (914) 592-6050 Facsimile: (914) 592-5148 e-mail: enquiries@e2vtechnologies.us

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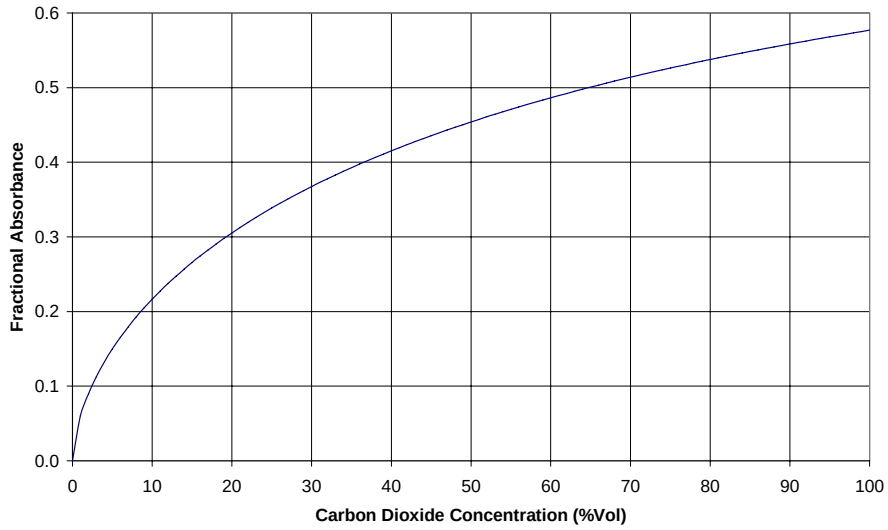
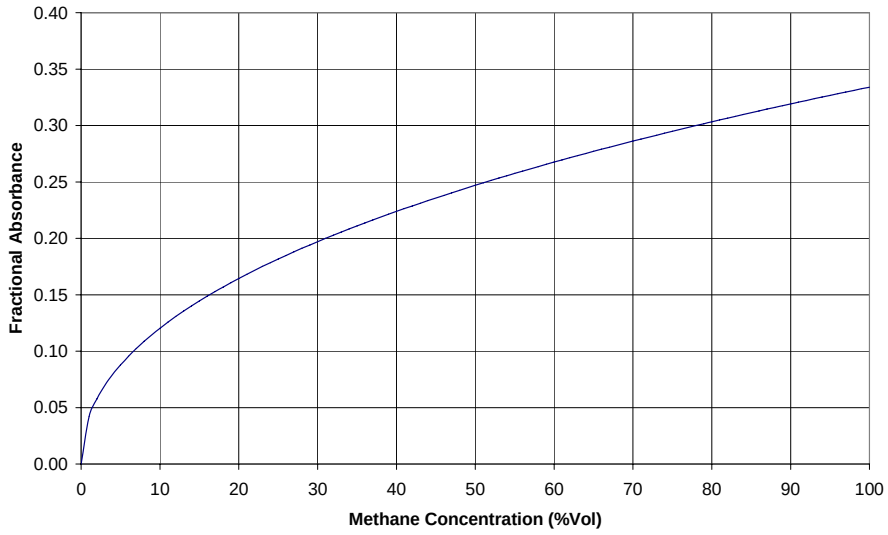
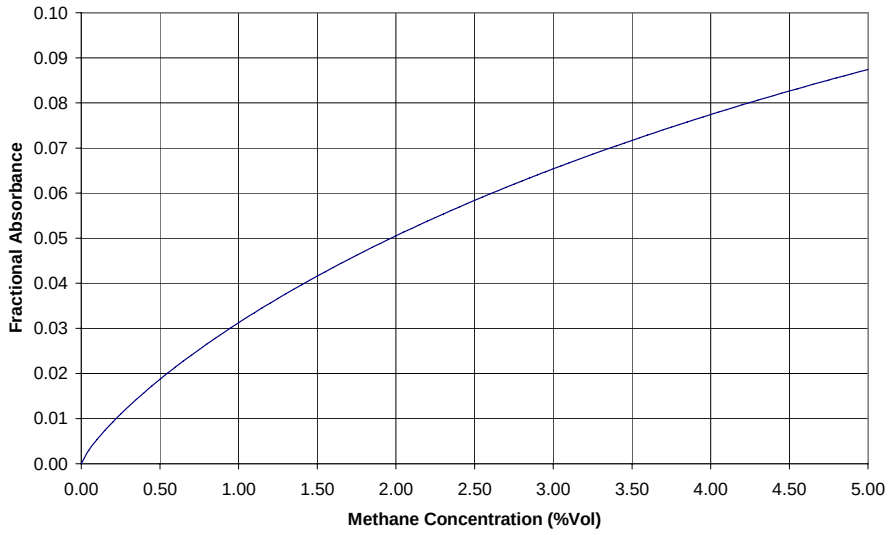
ABSORBANCE CURVES

These graphs show the sensitivity versus concentration before linearisation. For further explanation, refer to the Infrared Sensor Application Notes.







TECHNICAL SPECIFICATION

General

Gas types	carbon dioxide (CO_2) and methane (CH_4)
Concentration range	0 to 100% vol.

Mechanical

Dimensions	see outline
Body material	stainless steel
Weight	27 g

Environmental

Ambient temperature range:	
for operation	-20 °C to +55 °C
for storage	-25 °C to +85 °C
Ambient pressure range:	
for operation	80 kPa to 120 kPa
for storage	80 kPa to 120 kPa
Ambient humidity range:	
for operation	0 to 99% (non-condensing)
for storage	0 to 99% (non-condensing)
Ingress protection	requires extra protection depending upon application

Electrical

DC supply to detectors:	
minimum	+3 V
recommended	+5 V
maximum	+15 V
Maximum sensor power with lamp max:	
@3 V	100 mW
@5 V	180 mW
Lamp supply:	
“On” voltage	3 V to 5 V
“On” current	60 mA (@5 V)
frequency	4 Hz
duty cycle	50%
pulse	square wave
Warm-up time (@20 °C):	
to operate	<20 seconds
to specification	<30 minutes
MTBF	>5 years

PERFORMANCE SPECIFICATION

All measurement data taken using:

- **e2v electronics and hardware**
- **e2v linearisation and temperature compensation algorithms (see Infrared Gas Sensor Application Notes).**
- **Lamp modulation 0.4 V to 5.0 V, square wave at 4 Hz and 50% duty cycle.**
- **Ambient temperature (except for temperature tests) and pressure (except for pressure tests)**
- **All gases diluted with dry nitrogen.**
- **All sensors purged with dry nitrogen throughout tests, except for periodic exposures to carbon dioxide and methane.**

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

Carbon Dioxide (0 to 100% Vol.)

Parameter	Min	Typical	Max	Units
Active detector output voltage in N_2 (pk-pk)	15	25	35	mV
Reference detector output voltage in N_2 (pk-pk) (see note 1)	10	13	20	mV
Absorbance to (100 % vol. CO_2)	0.50	0.58	0.65	
Deviation from linearity (accuracy)	-2	0	2	% vol.
Response time	-	-	20	s
Short-term stability in 0% vol. CO_2 (see note 2)	-1	0	1	% vol.
Short-term stability in 100% vol. CO_2 (see note 2)	97	100	103	% vol.
Vibration (see note 3)	-3	0	3	% vol.
Temperature effects in 0% vol. CO_2 (see note 4)	-1	0	1	% vol.
Temperature effects in 100% vol. CO_2 (see note 4)	90	100	110	% vol.
Pressure effects in 100% vol. CO_2 (see note 5)	95	100	105	% vol.
Humidity effects in 0% vol. CO_2 (see note 6)	0	0	0.05	% vol.
Humidity effects in 100% vol. CO_2 (see note 6)	100	100	100.5	% vol.
Long-term variation in 0% vol. (see note 7)	TBD	TBD	TBD	% vol. / month
Long-term variation in 100% vol. (see note 7)	TBD	TBD	TBD	% vol. / month
Minimum resolution (see note 8)	0.5	-	-	% vol.

Methane (0 to 100% Vol.)

Parameter	Min	Typical	Max	Units
Active detector output voltage in N_2 (pk-pk)	8	11	18	mV
Reference detector output voltage in N_2 (pk-pk) (see note 1)	10	13	20	mV
Absorbance to (5% vol. CH_4)	0.06	0.08	0.10	
Deviation from linearity	-2	0	2	% vol.
Response time	-	-	20	s
Short-term stability in 0% vol. CH_4 (see note 2)	-1	0	1	% vol.
Short-term stability in 100% vol. CH_4 (see note 2)	97	100	103	% vol.
Vibration (see note 3)	-3	0	3	% vol.
Temperature effects in 0% vol. CH_4 (see note 4)	-1	0	1	% vol.
Temperature effects in 100% vol. CH_4 (see note 4)	90	100	110	% vol.
Pressure effects in 100% vol. CH_4 (see note 5)	95	100	105	% vol.
Humidity effects in 0% vol. CH_4 (see note 6)	0	0	0.05	% vol.
Humidity effects in 100% vol. CH_4 (see note 6)	100	101	102	% vol.
Long-term variation in 0% vol. (see note 7)	TBD	TBD	TBD	% vol. / month
Long-term variation in 100% vol. (see note 7)	TBD	TBD	TBD	% vol. / month
Minimum resolution (see note 8)	1	-	-	% vol.

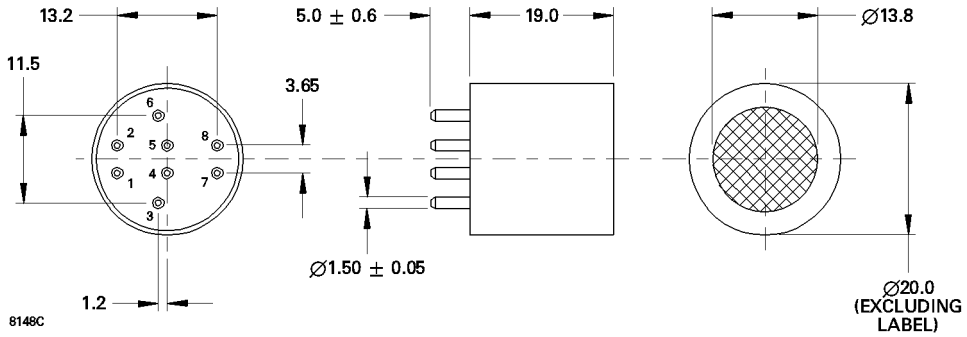
Methane (0 to 5% Vol.)

Parameter	Min	Typical	Max	Units
Active detector output voltage in N_2 (pk-pk)	8	11	18	mV
Reference detector output voltage in N_2 (pk-pk) (see note 1)	10	13	20	mV
Absorbance to (5% vol. CH_4)	0.06	0.08	0.10	
Deviation from linearity	-0.10	0.00	0.10	% vol.
Response time	-	-	20	s
Short-term stability in 0% vol. CH_4 (see note 2)	-0.05	0.00	0.05	% vol.
Short-term stability in 5% vol. CH_4 (see note 2)	4.85	5.00	5.15	% vol.
Vibration (see note 3)	-0.10	0.00	0.10	% vol.
Temperature effects in 0% vol. CH_4 (see note 4)	-0.10	0.00	0.10	% vol.
Temperature effects in 5% vol. CH_4 (see note 4)	4.50	5.00	5.50	% vol.
Pressure effects in 5% vol. CH_4 (see note 5)	4.5	5.00	5.5	% vol.
Humidity effects in 0% vol. CH_4 (see note 6)	0.00	0.03	0.10	% vol.
Humidity effects in 5% vol. CH_4 (see note 6)	5.00	5.08	5.25	% vol.
Long-term variation in 0% vol. (see note 7)	TBD	TBD	TBD	% vol. / month
Long-term variation in 5% vol. (see note 7)	TBD	TBD	TBD	% vol. / month
Minimum resolution (see note 8)	0.05	-	-	% vol.

NOTES

1. Only one reference channel per sensor. Reference channel is shared with both active detectors.
2. Range of readings over an 8-hour period, allowing the sensor to stabilise for at least 30 minutes prior to testing.
3. The changes in output after vibration at the following conditions: 10 Hz to 30 Hz, 1.0 mm total excursion; 31 Hz to 150 Hz, 2g acceleration peak (rate of change = 10 Hz/min); 1 hour period in each of the three mutually perpendicular planes, in air.
4. Using e2v algorithms and average alpha and average beta temperature compensation coefficients. Sensor allowed to stabilise at each temperature prior to measurements being taken.
5. With pressure compensation algorithm.
6. Humidity effects can only cause a positive increase in calculated concentration.
7. Average variation per month, tested over a minimum 3-month period.
8. Minimum resolution will be at full-scale (5% vol. or 100% vol.). The resolution will significantly improve as the concentration decreases. Resolution is calculated as twice the standard deviation of measurements taken at full-scale % volume over a 1-hour period, allowing time for the sensor to stabilise before test commences.

OUTLINE (All dimensions in millimetres; see note 1)



Pin	Connection
1	Lamp
2	Reference detector output
3	Lamp return
4	Carbon dioxide detector output
5	+ V DC detector input
6	Hydrocarbon detector output
7	Thermistor
8	0 V input (connected internally to sensor body)

Outline Notes

1. Body dimensional tolerances ±0.1 mm. Pin dimensional tolerances as indicated.
2. The IR15TT-R sensor is designed to press-fit into a pcb socket. 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.

INSTRUCTIONS SPECIFIC TO HAZARDOUS AREA INSTALLATIONS
(Ref. EU ATEX Directive 94/9/EC, Annex II, 1.0.6)

1. The IR15TT-R Gas Sensing Head is component-approved only and may not be used as stand-alone items in a hazardous area without further protection.
2. The IR15TT-R Gas Sensing Head 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 IR15TT-R Gas Sensing Head 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 IR15TT-R Gas Sensing Head has 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 IR15TT-R Gas Sensing Head 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 IR15TT-R Gas Sensing Head may encounter. This is to ensure that the IR15TT-R Gas Sensing Head is not subjected to conditions that may cause degradation of these materials.
7. The IR15TT-R Gas Sensing Head is only certified for use in ambient temperatures between -20 °C and +55 °C and should not be used outside this range.
8. The maximum input power of the IR15TT-R Gas Sensing Head shall not exceed 2.5 W.