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 CO₂, 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)
  \( T_a = -20 \text{ to } +55 \text{ °C} \)
- ATEX certified I M1 Ex ia I Ma (IR2xxx Series)
  \( T_a = -20 \text{ to } +60 \text{ °C} \)
- IECEx certified Ex d IIC Gb (IR1xxx Series)
  \( T_a = -20 \text{ to } +65 \text{ °C} \)
- IECEx certified Ex ia I Ma (IR2xxx Series)
  \( T_a = -20 \text{ to } +60 \text{ °C} \)
- CSA certified - File 107408 (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.

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 EN60303:2000. 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)

![Fractional Absorbance Curve for CO2](image)

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

![Fractional Absorbance Curve for CH4](image)
Typical Sensitivity to Ethylene (100% LFL = 3% vol.) (IR12BD, IR22BD, IR13BD, IR23BD)

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

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

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

Note: Other Fractional Absorbance curves are available from Gas Sensor Engineering at SGX Sensortech.
**TECHNICAL SPECIFICATION**

### Mechanical

<table>
<thead>
<tr>
<th>Dimensions</th>
<th>see outline, page 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Body material</td>
<td>stainless steel</td>
</tr>
<tr>
<td>Weight</td>
<td>27 g</td>
</tr>
</tbody>
</table>

### Environmental

Ambient temperature range:
- for operation: 7 to 20°C to +55°C
- for storage: 7 to 25°C 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

Note: 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:
- SGX 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.

<table>
<thead>
<tr>
<th>Sensor type</th>
<th>IR11BD, IR21BD</th>
<th>IR12BD, IR22BD</th>
<th>IR13BD, IR23BD</th>
<th>IR14BD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gas</td>
<td>Carbon Dioxide</td>
<td>Hydrocarbons</td>
<td>Hydrocarbons</td>
<td>Acetylene</td>
</tr>
<tr>
<td>Sensing range</td>
<td>0 - 3000 ppm</td>
<td>0 - 100% LFL</td>
<td>0 - 100% vol.</td>
<td>0 - 100% vol.</td>
</tr>
<tr>
<td></td>
<td>0 - 2.0% vol.</td>
<td>0 - 100% vol.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>0 - 5.0% vol.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maximum response time (T90)</td>
<td>&lt;20 s</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Limits of detector output voltage in nitrogen (x 165 pre-amplifier gain):</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>active channel</td>
<td>1.5 to 3.8 V</td>
<td>1.8 to 6.0 V</td>
<td>3.3 to 8.2 V</td>
<td>1.5 to 4.0 V</td>
</tr>
<tr>
<td>reference channel</td>
<td>2.4 to 5.8 V</td>
<td>2.4 to 5.8 V</td>
<td>2.4 to 5.8 V</td>
<td>2.4 to 5.8 V</td>
</tr>
<tr>
<td>Typical % fall in active detector voltage for exposure to stated target gas (reference detector is unchanged):</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>conc. carbon dioxide</td>
<td>32% for 2.0% vol.</td>
<td>9.5% for 5% vol.</td>
<td>11% for 5% vol.</td>
<td>12.5% for 2.3% vol.</td>
</tr>
<tr>
<td>conc. methane</td>
<td></td>
<td></td>
<td>conc. methane</td>
<td>conc. acetylene</td>
</tr>
<tr>
<td>Maximum deviation from linearity</td>
<td>±0.1% vol.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maximum variation of zero from:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-20 to +55°C</td>
<td>±10 ppm/°C</td>
<td>±10 ppm/°C</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Resolution (dependent on electronics)</td>
<td>100 ppm</td>
<td>500 ppm</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maximum non-reproducibility of zero at 20°C</td>
<td>±100 ppm</td>
<td>±500 ppm</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maximum non-reproducibility of sensitivity at 20°C</td>
<td>±200 ppm</td>
<td>±1000 ppm</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Long-term zero drift/month at 20°C</td>
<td>±100 ppm</td>
<td>±500 ppm</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Response to 0 – 90% change in RH at 20°C (in target gas)</td>
<td>0% vol.</td>
<td>+0.1% vol.</td>
<td>+0.3% vol.</td>
<td>+0.5% vol.</td>
</tr>
<tr>
<td>(in 2% vol.)</td>
<td>(2.5% vol.)</td>
<td>(2.5% vol.)</td>
<td>(2.3% vol.)</td>
<td></td>
</tr>
<tr>
<td>MTBF (lamp dependent only)</td>
<td>&gt;10 years for 5 V operation, &gt;20 years for 3 V operation</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
OUTLINE (All dimensions in millimetres; see note 1)

<table>
<thead>
<tr>
<th>Pin</th>
<th>Connection</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>+ V DC detector supply</td>
</tr>
<tr>
<td>2</td>
<td>Lamp</td>
</tr>
<tr>
<td>3</td>
<td>Lamp return</td>
</tr>
<tr>
<td>4</td>
<td>Active detector output</td>
</tr>
<tr>
<td>5</td>
<td>Reference detector output</td>
</tr>
<tr>
<td>6</td>
<td>0 V input</td>
</tr>
</tbody>
</table>

Outline Notes

1. Body dimensional tolerances ±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 Wearns Cambion type 450-1813-03-00 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 IP60 is required, the apparatus into which the IR Head is installed shall provide the necessary ingress protection.