

e2v technologies manufacture a range of Infrared (IR) Gas Sensors for a variety of gases and vapours in different applications. These are compact and robust gas diffusion type sensors based on an e2v technologies patented optical design. They run on low power and use well proven Non-Dispersive Infrared (NDIR) detection methods. All the sensors require connection to suitable transmitter systems for their power supply, operation and signal processing.

This note is a brief introduction to the range of e2v sensors with reference to a series of Data Sheets and complementary Application Notes. These describe the sensors' performance capabilities and provide extra technical information aimed at helping the customer choose the most suitable sensor for their particular application.

Furthermore, e2v Gas Sensor Engineering Staff may be contacted to give assistance on all technical enquiries.

THE e2v RANGE OF IR GAS SENSORS

Table 1 is a guide to the full range of sensors, which come in the standard series-4 size or as larger heads. They are divided into different categories, according to the number of detection channels and whether they have certified or non-certified body constructions.

Miniature Sensors – Single Gas/Single Channel, Non-Certified

IR31SC and IR31SE

The **IR31SC** and **IR31SE** are for sensing CO₂ over three gas concentration ranges up to 5% by volume. They are ruggedly built using single active gas channel detection for economy and are best used in areas where monitoring for a few hours is required. The **IR31SE** is essentially the same as the **IR31SC**, but has an integral diffusion mesh cover to protect against particulate entry. Both sensors may be installed in portable or fixed instruments, but they are not certified for use alone in hazardous areas where there is risk of fire or explosions from other combustible gases. However, the **IR31SC** is an open-fronted sensor and should be mounted under a suitable gas sinter/filter within the instrumentation. If this instrumentation is in a hazardous location, then the instrument housing must be of the approved type.

These sensors use IR detectors with in-built compensation for rapid temperature changes of a few degrees around ambient. Sensor variations over a wider range of ambient temperature can only be compensated for with extra software processing, given inputs from an auxiliary temperature sensor. They are not generally suitable for continuous monitoring over the very long term, where the output of the IR lamp might deteriorate with time or if harsh environmental exposure should adversely affect components in the optical cavity.

Typical applications include: Short-term CO₂ monitoring in confined spaces, indoor air quality, CO₂ in packaging materials, respiratory monitoring, school science experiments.

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Miniature Sensors – Single Gas/Dual Channel, Non-Certified

IR3xxx and IR4xxx Series

These sensors are similar to those of the **IR1xxx/IR2xxx Series 1 and 2** (see below) except they do not have meshed flame arrestors and so are not certified for use alone in hazardous locations. With the front entrance partly unprotected, they must be enclosed to define the gas/optical cavity within the instrumentation. This protection should take the form of a microporous membrane, dust filter, or metal sinter firmly set in position with no risk of movement during sensor operation. The sensors are very compatible with mountings inside already certifiable fixed instrumentation enclosures.

The inclusion of a background reference channel with the active gas channel ensures long-term stability during sensor lifetime. The reference signal is used to cater for any deterioration in the output of the IR lamp with time; or with changes in the reflectivity of the optical cavity and transmission of the IR filters, as a consequence of harsh environmental exposure.

Some end-users like to place a 'flow-pass' cap over the front entrance of the **IR3xxx** types, for applications where they wish to forcibly draw gas to the sensor, instead of relying on natural diffusion. This also enhances the response time of the instrument.

The **IR31BC** is a very selective sensor for CO₂ up to 5% vol. concentration with negligible cross sensitivity to other gases. Similarly, the **IR34BC** is a very selective sensor for acetylene up to LFL levels.

The **IR32BC** and **IR33BC** cover a broader range of hydrocarbons and to a large extent their spectral coverages overlap. The data sheets include a family of absorbance curves, showing the comparative sensitivity of both sensors. For example the end-user needing a sensor for propane might choose the **IR32BC** with higher sensitivity. Conversely the **IR33BC** might be preferred for ethylene. The **IR33BC** is also a very exclusive sensor for benzene. Both **IR33BC** and **IR34BC** have some sensitivity to water vapour in high RH conditions.

All IR gas sensors in the e2v range operate at an internal temperature a few degrees above ambient, due to the heat dissipated by the IR lamp (up to 150 mW). This heat is can be useful at offsetting water condensation, but sometimes it is insufficient to deal with more extreme conditions where condensation could be a problem. The **IR42BC** (first in the **IR4xxx** series) is a variant on the **IR32BC**, which dissipates more heat by doubling the current rating of the IR lamp (up to 115 mA). The temperature rise also depends on the level of insulation within the instrument housing, but levels of 15 to 20 °C above ambient can be expected.

Typical applications include: CO₂ and hydrocarbon monitoring as for the **IR1xxx Series**, but with more emphasis on already certified fixed systems.

IR31CE

This is a very specialised sensor for CO₂ monitoring under conditions where the spectral absorption lines may be shifted or broadened.

Typical applications: CO₂ monitoring under high pressure, e.g. sub-aqua.

Miniature Sensors - Single Gas/Dual Channels, Certified

These use active gas and reference channels and are subdivided into two certification classes: Safe for Hazardous Area Locations or Intrinsically Safe for Mining Applications.

IR1xxx and IR2xxx Series 1

These are for long-term and continuous sensing of CO₂ and numerous hydrocarbon gases and vapours in fixed systems, where they are located in hazardous areas. They are also suited for portable instrumentation where shorter-term usage is more usual. The metal-mesh gas entrance aperture is also flame arresting and the whole body structure is explosion proof to ATEX, CSA and UL standards. The series-4 size provides compatibility with other electrochemical and catalytic sensors in multi-gas instrumentation.

The performance of the **IR1xxx Series 1** sensors is equivalent to their counterparts in the **IR3xxx Series**. The equivalent sensor types are:

IR11BD – IR31BC
IR12BD – IR32BC
IR13BD – IR33BC
IR14BD – IR34BC

Typical applications include: CO₂ monitoring in LEL hydrocarbon ambients, methane and hydrocarbon monitoring in mines, petrochemical plants, oil and natural gas installations, landfill sites, semiconductor processing and many others.

The **IR2xxx Series 1** sensors are identical to those of the **IR1xxx Series 1**, except that they are labelled as being intrinsically safe for methane gas environments, specific to mining applications.

IR1xxx and IR2xxx Series 2

The Series 2 sensors are certified to the same standards as the Series 1 sensors and are suited for monitoring hydrocarbons and carbon dioxide in a similar range of gas concentrations. However, Series 2 offers more features and options. In particular, there are two heights available for CO₂ sensors, enabling easier accommodation into instrument cases. Also, an extra pin provides access to an embedded temperature sensor with a choice of non-linearised (thermistor) or linearised (IC) outputs.

The first two hydrocarbon sensors in Series 2 are: **IR12EJ** (height 19.0 mm with thermistor) and **IR12GJ** (height 19.0 mm with IC).

The first four carbon dioxide sensors in Series 2 are: **IR11EJ** (height 19.0 mm with thermistor), **IR11GJ** (height 19.0 mm with IC), **IR11EM** (height 16.6 mm with thermistor) and **IR11GM** (height 16.6 mm with IC).

Typical applications as for Series 1 sensors, but the Series 2 sensor types will be expanded and optimised to meet a wider range of gas sensing applications.

Similarly, the **IR2xxx Series 2** sensors are labelled as being intrinsically safe for methane gas environments, specific to mining applications only.

Miniature Sensors – Twin Gas/Triple Channels, Certified

IR15T and IR25T Series

The **IR15TT** and **IR15TT-M** combine the sensing capability and performance of the certified **IR11BD** and **IR13BD/IR12BD** into one device. With two active channels, one reference channel and one IR source, it can sense CO₂, methane and other hydrocarbons simultaneously while running on the power equivalent of only one sensor. The **IR15TT-M** is the preferred sensor for use in very humid conditions. The unique 8-pin arrangement includes an output for a built-in temperature sensor for temperature compensation.

The **IR25TT** sensor is identical to the **IR15TT** except that it is labelled as being intrinsically safe for methane gas environments, specific to mining applications only.

Typical applications include: Monitoring CO₂ and hydrocarbons in mines, sewers and other areas where power supply considerations and instrument space availability might limit the number of sensors.

Sensor Heads - Single Gas/Dual Channel, Certified

IR600 Series

This series of gas sensing heads covers the same range of gases and vapours as the **IR3xxx** and **IR1xxx Series**, but are constructed in a larger all stainless steel packages to screw fit into fully certified fixed system transmitter housings. Sensor equivalents are:

IR601 - IR31BC - IR11BD
IR602 - IR32BC - IR12BD
IR603 - IR33BC - IR13BD
IR604 - IR34BC - IR14BD

The **IR600 Series** heads are ATEX and CSA certified and meet FM standards. They have an embedded pre-amplifier and buffer to amplify the channel outputs before linking into the transmitter electronics. A temperature sensor is built in for temperature compensation. A transmitter board **TX600** and display board **DX600** are also available separately, in standard sizes, for installation in approved housings.

There are three thread options for fitting into different housings. A set of weather protection accessories is also available.

Typical applications include: Fixed system monitoring for CO₂ and hydrocarbons in hazardous and harsh weather conditions, on and offshore oil and gas, mining, sewerage, landfill sites and many more.

APPLICATION NOTES

Infrared Sensor Application Notes are available from e2v technologies 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.

Infrared Sensor Application Note 7 – Digital Averaging Techniques for Infrared Gas Sensors.

DATA SHEETS

The following product data sheets are available from e2v for the sensors described above:

A1A-IR31SC_IR31SE
A1A-IR3xxx_IR4xxx_SER
A1A-IR31CE
A1A-IR1xxx_IR2xxx_SER_1
A1A-IR1xxx_IR2xxx_SER_2
A1A-IR15T_IR25T_SER
A1A-IR600_SER

TABLES OF IR GAS SENSOR TYPES

MINIATURE SENSORS - SINGLE GAS/SINGLE CHANNEL		NON-CERTIFIED		
Gas	Concentration Range	IR31SC	IR31SE	
Carbon Dioxide	0 - 0.3, 0 - 2, 0 - 5% vol.			
MINIATURE SENSORS - SINGLE GAS/DUAL CHANNELS		<u>IR3xxx Series</u>	<u>IR4xxx Series</u>	IR31CE
Gas	Concentration Range	IR31BC		
Carbon Dioxide	0 - 0.3, 0 - 2, 0 - 5% vol.	IR32BC	IR42BC	
Methane and Hydrocarbons	0 - 100% LEL, 0 - 100% vol.	IR33BC		
Broadband Hydrocarbons	0 - 100% LEL, 0 - 100% vol.	IR34BC		
Acetylene	0 - 100% LEL, 0 - 100% vol.			
MINIATURE SENSORS - SINGLE GAS/DUAL CHANNELS		CERTIFIED FOR HAZARDOUS AREAS	CERTIFIED FOR MINING APPLICATIONS	
Gas	Concentration Range	<u>IR1xxx Series 1</u>	<u>IR2xxx Series 1</u>	
Carbon Dioxide	0 - 0.3, 0 - 2, 0 - 5% vol.	IR11BD	IR21BD	
Methane and Hydrocarbons	0 - 100% LEL, 0 - 100% vol.	IR12BD	IR22BD	
Broadband Hydrocarbons	0 - 100% LEL, 0 - 100% vol.	IR13BD	IR23BD	
Acetylene	0 - 100% LEL, 0 - 100% vol.	IR14BD		
Gas	Concentration Range	<u>IR1xxx Series 2</u>	<u>IR1xxx Series 2</u>	
Carbon Dioxide	0 - 0.3, 0 - 2, 0 - 5% vol.	IR11EJ / IR11GJ	IR21EJ / IR21GJ	
		IR11EM / IR11GM	IR21EM / IR21GM	
Methane and Hydrocarbons	0 - 100% LEL, 0 - 100% vol.	IR12EJ / IR12GJ	IR22EJ / IR22GJ	
		IR12EM / IR12GM	IR22EM / IR22GM	
MINIATURE SENSORS – TWIN GAS/TRIPLE CHANNELS		<u>IR15T Series</u>	<u>IR25T Series</u>	
Gas	Concentration Ranges	IR15TT	IR25TT	
Carbon Dioxide and	0 - 0.3, 0 - 2, 0 - 5% vol			
Broadband Hydrocarbons	0 - 100% LEL, 0 - 100% vol.			
Carbon Dioxide, Methane and	0 - 0.3, 0 - 2, 0 - 5% vol	IR15TT-M	IR25TT-M	
Hydrocarbons	0 - 100% LEL, 0 - 100% vol.			
SENSOR HEADS - SINGLE GAS/DUAL CHANNEL		CERTIFIED FOR HAZARDOUS AREAS		
Gas	Concentration Ranges	<u>IR600 Series</u>		
Carbon Dioxide	0 - 0.3, 0 - 2, 0 - 5% vol.	IR601		
Methane and Hydrocarbons	0 - 100% LEL, 0 - 100% vol	IR602		
Broadband Hydrocarbons	0 - 100% LEL, 0 - 100% vol.	IR603		
Acetylene	0 - 100% LEL, 0 - 100% vol.	IR604		