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

THE SGX 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.

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 SGX 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 short-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 SGX Sensortech 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.

DATA SHEETS
The following product data sheets are available from SGX 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

<table>
<thead>
<tr>
<th>Gas</th>
<th>Concentration Range</th>
<th>Non-Certified</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carbon Dioxide</td>
<td>0 - 0.3, 0 - 2, 0 - 5% vol.</td>
<td>IR31SC IR31SE</td>
</tr>
</tbody>
</table>

### MINIATURE SENSORS - SINGLE GAS/DUAL CHANNELS

<table>
<thead>
<tr>
<th>Gas</th>
<th>Concentration Range</th>
<th>IR3xxx Series</th>
<th>IR4xxx Series</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carbon Dioxide</td>
<td>0 - 0.3, 0 - 2, 0 - 5% vol.</td>
<td>IR31BC</td>
<td>IR31CE</td>
</tr>
<tr>
<td>Methane and Hydrocarbons</td>
<td>0 - 100% LEL, 0 - 100% vol.</td>
<td>IR32BC</td>
<td>IR42BC</td>
</tr>
<tr>
<td>Broadband Hydrocarbons</td>
<td>0 - 100% LEL, 0 - 100% vol.</td>
<td>IR33BC</td>
<td></td>
</tr>
<tr>
<td>Acetylene</td>
<td>0 - 100% LEL, 0 - 100% vol.</td>
<td>IR34BC</td>
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</tr>
</tbody>
</table>

### MINIATURE SENSORS - SINGLE GAS/DUAL CHANNELS CERTIFIED FOR HAZARDOUS AREAS

<table>
<thead>
<tr>
<th>Gas</th>
<th>Concentration Range</th>
<th>IR1xxx Series 1</th>
<th>IR2xxx Series 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carbon Dioxide</td>
<td>0 - 0.3, 0 - 2, 0 - 5% vol.</td>
<td>IR11BD</td>
<td>IR21BD</td>
</tr>
<tr>
<td>Methane and Hydrocarbons</td>
<td>0 - 100% LEL, 0 - 100% vol.</td>
<td>IR12BD</td>
<td>IR22BD</td>
</tr>
<tr>
<td>Broadband Hydrocarbons</td>
<td>0 - 100% LEL, 0 - 100% vol.</td>
<td>IR13BD</td>
<td>IR23BD</td>
</tr>
<tr>
<td>Acetylene</td>
<td>0 - 100% LEL, 0 - 100% vol.</td>
<td>IR14BD</td>
<td>IR24BD</td>
</tr>
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</table>

### MINIATURE SENSORS - SINGLE GAS/DUAL CHANNELS CERTIFIED FOR HAZARDOUS AREAS

<table>
<thead>
<tr>
<th>Gas</th>
<th>Concentration Range</th>
<th>IR1xxx Series 2</th>
<th>IRxxx Series 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carbon Dioxide</td>
<td>0 - 0.3, 0 - 2, 0 - 5% vol.</td>
<td>IR11EJ / IR11GJ</td>
<td>IR21EJ / IR21GJ</td>
</tr>
<tr>
<td>Methane and Hydrocarbons</td>
<td>0 - 100% LEL, 0 - 100% vol.</td>
<td>IR12EJ / IR12GJ</td>
<td>IR22EJ / IR22GJ</td>
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### MINIATURE SENSORS – TWIN GAS/TRIPLET CHANNELS

<table>
<thead>
<tr>
<th>Gas</th>
<th>Concentration Ranges</th>
<th>IR15T Series</th>
<th>IR25T Series</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carbon Dioxide and</td>
<td>0 - 0.3, 0 – 2, 0 - 5% vol.</td>
<td>IR15TT</td>
<td>IR25TT</td>
</tr>
<tr>
<td>Broadband Hydrocarbons</td>
<td>0 - 100% LEL, 0 - 100% vol.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Carbon Dioxide, Methane and Hydrocarbons</td>
<td>0 - 0.3, 0 – 2, 0 - 5% vol.</td>
<td>IR15TT-M</td>
<td>IR25TT-M</td>
</tr>
</tbody>
</table>

### SENSOR HEADS - SINGLE GAS/DUAL CHANNEL CERTIFIED FOR HAZARDOUS AREAS

<table>
<thead>
<tr>
<th>Gas</th>
<th>Concentration Ranges</th>
<th>IR600 Series</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carbon Dioxide</td>
<td>0 - 0.3, 0 - 2, 0 - 5% vol.</td>
<td>IR601</td>
</tr>
<tr>
<td>Methane and Hydrocarbons</td>
<td>0 - 100% LEL, 0 - 100% vol.</td>
<td>IR602</td>
</tr>
<tr>
<td>Broadband Hydrocarbons</td>
<td>0 - 100% LEL, 0 - 100% vol.</td>
<td>IR603</td>
</tr>
<tr>
<td>Acetylene</td>
<td>0 - 100% LEL, 0 - 100% vol.</td>
<td>IR604</td>
</tr>
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