Integrated IR FEATURES

- Gas Sensor with Automatic Switchover between ranges,
- High Resolution up to 20ppm,
- Detectivity Level at 100ppm,
- Multi-sensor mode,
- Analog Output of gas concentration,
- Serial port communication,
- Internal Temperature sensor
- Active & Reference Signals Monitored
- Full Faults Diagnostics & Error Generation
- Cyclic Redundancy Check (CRC)
- Typical Low power consumption < 100mW (Average)
- Factory calibrated for Butane
- Evaluation Kit available including PC software for easy testing and production calibration functions
- Easy implementation into Sensors Network
- Design for use in Hazardous Areas
- Certified Sensor for use in Explosive Atmospheres (EX)

GENERAL DESCRIPTION

The Integrated IR (INIR) sensor has been designed with the latest technology, using a microcontroller with an ARM7 core and via software design the necessary techniques have been implemented to increase the reliability of the device therefore minimize the probability of faults.

The INIR is a user friendly digital Gas Sensor, which is designed to use the latest SGX Sensortech’s Infrared technology.

The sensor is designed to decrease the implementation time therefore increase productivity. The Integrated IR sensor incorporates the necessary electronics and embedded software to operate from a low voltage DC power supply. The sensor will process the raw signals to output a linear, temperature compensated signal proportional to the gas concentration applied. The output signal is available in digital and analogue forms.

The SGX Sensortech Integrated IR Gas Sensor provides users with a simple method of incorporating an Infrared Sensor into their gas detection instrument which will significantly reduce the development time and expertise required during the design and implementation phase. The Integrated IR can also be factory calibrated to allow installation without the need for recalibration.

RECOMMENDED APPLICATIONS

- Automation & Control
- Indoor Air Quality
- Industrial Health & Safety
TECHNICAL SPECS

ABSOLUTE MAXIMUM RATINGS

<table>
<thead>
<tr>
<th>Power Supply</th>
<th>Min</th>
<th>Typical</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply Voltage</td>
<td>3.2 VDC</td>
<td>3.3 VDC</td>
<td>5.25 VDC</td>
</tr>
<tr>
<td>Average Current Consumption</td>
<td>30mA</td>
<td>32mA</td>
<td>35 mA*</td>
</tr>
</tbody>
</table>

*Peak Current can be up to 65mA

Logic Outputs Level
- LOW Voltage Level(VOL): 0.6V Maximum
- HIGH Voltage Level(VOH): 2.0V Minimum
  1.6mA source current maximum

Logic Inputs Level
- LOW Voltage Level(VINL): 0.4V Maximum
- HIGH Voltage Level(VINH): 2.0V Minimum

Humidity
- Operating Humidity: 0% 50% 99%
- Storage Humidity: 0% 50% 90%

Condensation (>100% Humidity)
Sensor’s Detection Limit, Stability & Linearity would be affected, algorithms are implemented to minimize as the effect.

Temperature
- Operating Temp.: -40 °C +20 °C +75 °C
- Storage Temp.: -20 °C +20 °C +55 °C
- Temp. Cycle Limits: 0.8°C/min 1.3°C/min

Pressure (Compensation will be required)
- Operating Pressure: 80kPa - 120kPa
- Storage Pressure: 80kPa - 120kPa

Performance
- DAC Resolution: 12-Bit at 0.0-2.5 Volts DC Max
  Scalable according to Gas Conc.
  Operating Range
- Digital signal format: 8 data bits, 1 stop bit, no parity
- Standard baud rate: 38400 as default, 115200, 9200, 9600

Dimensions
- Diameter (D): 19.9mm 20mm 20.1mm
- Height (H): 16.50mm 16.60mm 16.70mm
- Pins Height (pH): 4.0mm 4.8mm 5.6mm
- Body Material: Stainless Steel
- Weight: 25 g 29 g 33 g
- Gas Sensor Sockets: 51 5-Pin, Polygon Topology

PIN CONFIGURATION

<table>
<thead>
<tr>
<th>Pin</th>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>TXD</td>
<td>Data transmitted from the Integrated IR.</td>
</tr>
<tr>
<td>2</td>
<td>+VCC</td>
<td>3.2 Volts – 5.25 Volts DC input to Integrated IR.</td>
</tr>
<tr>
<td>3</td>
<td>GND</td>
<td>GND Plane, 0 Volts reference for Integrated IR.</td>
</tr>
<tr>
<td>4</td>
<td>RXD</td>
<td>Data received by the Integrated IR.</td>
</tr>
<tr>
<td>5</td>
<td>OUT</td>
<td>Analog Output. Scalable range, see Application Note 1 Integrated IR Protocol &amp; Calibration for details.</td>
</tr>
<tr>
<td>Pad</td>
<td>Pad</td>
<td>Bootloader Pad. Not used by the customer.</td>
</tr>
</tbody>
</table>

NOTE1: All Dimensions in mm. All tolerances Linear +/- 0.1mm and Angular 0.5° unless otherwise stated.

NOTE2: Do not solder pins. INIR Series 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. SGX Sensortech recommend the Wearns Cambion type 450-1813-01-03-00 single-pole solder mount socket with through hole, or a suitable equivalent.
DESIGN CONSIDERATIONS & APPLICATIONS

Warm-Up Time

The Warm-Up Time for the INIR sensor is 45 seconds after each power “ON” or every time when we are changing from Configuration to Normal/Engineering Mode. During this time data are not valid. Please read Fault codes in Application Note 1, “Integrated IR Protocol & Calibration”.

The Warm-Up time is not including the period that the sensor needs to reach the ambient temperature. The sensor though is capable of producing readings during the Warm-Up but with a much higher error than specifications.

Calibration

For calibration process please read the appropriate Application Note 1, “Integrated IR Protocol & Calibration”. For optimum performance please use following cylinders:

<table>
<thead>
<tr>
<th>INIR-RF-R600 (Butane)</th>
<th>100% Nitrogen for Zero calibration</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1.3% C₃H₈ for High Span Cal.</td>
</tr>
</tbody>
</table>

Always do Zero Calibration first followed by High Span.

Gas Flow Rate

For valid evaluation and to keep tests consistent it is recommended to use 450 – 500 cc/min. flow rate to minimize any effects due to pressure variations in the INIR.

Digital Interface/Communication

In terms of the Software implementation, we will need a way to read the Digital Output by using a Microcontroller (MCU) or a Personal Computer (PC) is required. The Software with the Evaluation Kit is compatible with Windows Operating System only and at the moment is not possible to read the Analogue output by using the Evaluation Software.

Faults Monitoring/Error States

The Error monitoring and Fault generation happens every second transmitted by the UART. Regularly check all the Faults generated from the INIR to ensure errorless communication and rise appropriate alarms depending on the Fault code. For further information on the different Faults and how to translate them, please read the Application Note 1, “Integrated IR Protocol & Calibration”.

Analogue Output

The Analogue Output is updated every one second. Analogue voltage is directly related with the Concentration.

Condensation, Dust & Extreme Conditions

Using the INIR in extreme environmental conditions may affect its performance. Typically, the module has a high corrosion resistance and temperature compensated linearized output. The INIR implements a Condensation Compensation Algorithm to minimize the effect especially after power “ON”, eliminating the problem with false alarm. The Sensor can withstand multiple thermal shocks that don’t exceed 1.3°C/min temperature slopes. In applications like mining where dust or other particles are present is recommended to use a dust filter firmly attached to the inlet of the INIR Gas Sensor. The filter tends to increase response times T90, T10 and T50 therefore ensure correct installation and evaluation to comply with regulations in your country. If your device is intended to be used in a hazardous environment, please seek advice from a certification body.

Pressure Compensation

The INIR will definitely need pressure compensation irrelevant if the pressure is within the operating pressure. Re-Zero the INIR Gas Sensor under operating conditions is recommended; this will minimize the pressure effects, temperature differential effects but will not eliminate the weather effects like extreme wind velocity, rain or lighting.
Fig. 1 - Example schematic for Interfacing Integrated IR (INIR)

### Typical Performance Characteristics

(All Characteristics are related to a calibrated sensor and conditions, Temperature 20°C, Relative Humidity 10%RH, Pressure 101kPa, 500 to 1000 ml/min Gas Flow, Averaging of 20 values, unless otherwise stated.)

<table>
<thead>
<tr>
<th>Test</th>
<th>INIR-RF-R600</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stabilisation or Warm-up Time (EN) *1</td>
<td>0%v.v ±0.1%Vol in 45 seconds</td>
</tr>
<tr>
<td>Calibration Curve (EN) or Basic Error (AQ)</td>
<td>0 to 100% of full range -&gt; 0.06%v.v or ±6% of Reading whichever is greater.</td>
</tr>
<tr>
<td>Short Term Stability (EN) of the Displayed Value (AQ)</td>
<td>0%v.v = ±0.005%v.v or ±0.05%v.v</td>
</tr>
<tr>
<td>Minimum Resolution (AQ)</td>
<td>From 0 to 1.8%v.v ± ±0.002%v.v</td>
</tr>
<tr>
<td>Long Term Stability (EN) or Working Stability (AQ)</td>
<td>0%v.v = ±0.03%v.v / Month</td>
</tr>
<tr>
<td>Temperature Error (with Compensation) *2</td>
<td>1.8%v.v = ±0.1%v.v / Month</td>
</tr>
<tr>
<td>Humidity Error (10%RH to 90%RH, relative to 45%RH)</td>
<td>0%v.v to 1.8%v.v ± ±0.05%v.v</td>
</tr>
<tr>
<td>Response Time *3 (without dust filter)</td>
<td>T90 &lt; 40 sec</td>
</tr>
<tr>
<td>Power Supply Variations (at ±5% of Nominal Voltage)</td>
<td>The Performance of the INIR is not affected by power supply variations as long as the power supply provides DC Regulated voltage according to specifications.</td>
</tr>
<tr>
<td>Power Supply Rejection Ratio (PSRR) (at ±5% of Nominal Voltage)</td>
<td>at 1 MHz -&gt; 50 dB  , at 100 kHz -&gt; 68 dB , at 10 kHz -&gt; 88 dB</td>
</tr>
<tr>
<td>Temperature Cycling or Ramping Drift (Maximum at 1.3°C/min.)</td>
<td>0%v.v = ±0.05%v.v or ±0.2%v.v</td>
</tr>
<tr>
<td>Thermal Shock Drift</td>
<td>0%v.v = ±0.05%v.v (max)</td>
</tr>
<tr>
<td>Uncertainty Error of Calibration</td>
<td>±0.15% Error of the Actual Reading</td>
</tr>
</tbody>
</table>

*1 Wait for 45 mins for the Sensor to warm up and reach the Ambient Temperature after power on. 
*2 NOTE: Additional errors caused by relatively high boiling point of Butane (-1°C) might cause additional measurement errors at negative temperatures. 
*3 NOTE: All data and tests are relating to EN 60079-29-1 and AQ 6211, European and Chinese standards. For more information about Average please read the Application Note 1, “Integrated IR Protocol & Calibration”. Response time at lower temperatures might be affected due to low vapor pressure.
CERTIFICATIONS DETAILS

<table>
<thead>
<tr>
<th></th>
<th>ATEX</th>
<th>IECEx</th>
</tr>
</thead>
<tbody>
<tr>
<td>Certificate</td>
<td>Sira 99ATEX1121U</td>
<td>IECEx SIR 04.0031U</td>
</tr>
<tr>
<td>Product Marking</td>
<td>II 2G</td>
<td>Ex db IIC Gb</td>
</tr>
<tr>
<td></td>
<td>Ex db IIC Gb</td>
<td></td>
</tr>
<tr>
<td>Special Conditions for</td>
<td>Power Input: 1.5W Maximum</td>
<td>Ambient temperature range: -40°C to +75°C</td>
</tr>
<tr>
<td>Safe Use</td>
<td>Condition 1: The thermal resistance of the Gas Sensing Heads do not exceed 25K/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. Tests indicated that an internal ignition increases the temperature of the mesh by further 4.2K (including a 1.2 safety factor). Condition 2: The Gas Sensing Heads shall be protected from impact in service. The Gas Sensing Head shall be mounted in a protective enclosure such that an impact of 7J in accordance with IEC 60079-0:2007 clause 26.4.2 from any direction shall not cause the impact head to make contact with the Sensing Head. Condition 3: The Gas Sensing Heads are dust-proof (IP5X) but offers no protection against the ingress of water. Where protection in excess of IP50 is required, then the apparatus into which the Gas Sensing Head is installed shall provide the necessary ingress protection (for example by fitting an external semi-permeable membrane).</td>
<td></td>
</tr>
</tbody>
</table>

Manufacturing & Certificate Address

SGX Europe sp. z o.o., 40-568 Katowice, 103 Ligocka str., Poland

TYPICAL PERFORMANCE DATA

(All Data are related to a calibrated sensor and conditions: Temperature 20°C, Relative Humidity 10%RH, Pressure 101kPa, 500 to 1000 ml/min Gas Flow, Averaging of 13 values, unless otherwise stated.)

INTENDED USE

This device has been designed to be used as component together with instruments to detect flammable gas of certain concentrations.

WARRANTY & WARNING

The WARRANTY for all the INIR Gas Sensors is 2 years from the purchased date based on use according to this document and the INIR Application Note. Warranty period or any extended warranties would be confirmed with the order confirmation.

The warranty is invalidated if the sensor is used under conditions other than those specified in this datasheet. In addition, please pay attention to the following conditions as they will void immediately the WARRANTY:

1. Do not allow water condensing into the sensor or deep the sensor into water.
2. Do not vandalize the sensor.
3. Do not change label or cover it with other stickers.
4. Do not over voltage or overcurrent the sensor; always observe the correct polarity of the input.
5. Do not solder directly onto the pins, pads or the external body of the sensor.
6. Do not drop on the floor or hit it with tools.
7. Do not open, cut or break sensor apart.
8. Do not expose the sensor to high levels of dust.
9. Do not expose the sensor to corrosive gases or operate under corrosive environments.
10. Do not paint or mark the sensor externally.

11. Do not use in acid environment or operate under gases containing acid vapours or particles.
12. Do not custom modify the sensor.
13. Do not clean the sensor with acid.
14. Recalibrating the sensor will only void the calibration certificate not the warranty.

ESD PRECAUTION

ESD (Electrostatic Discharge) sensitive device. Charged devices and circuit boards can discharge without detection. Although this product features patented or proprietary subjectied circuitry, damage may occur on devices subjected to high energy ESD. Therefore, proper ESD precautions should be taken to avoid performance degradation or loss of functionality.

Warning! Plugging or Unplugging the Sensor while in operation may damage the device beyond repair. Always power down the instrument when performing maintenance.

HANDLING PRECAUTIONS

A. Do not drop the Integrated IR on the floor as this could cause damage to the pins or internal components.
B. Avoid mechanical force against pins or sockets. Protect from dust and sprayed acidic particles.
C. Do not immerse in water or other fluids.
D. Do not solder the module directly onto a pcb or to wires. Excessive heat could cause damage.

Whilst SGX Europe Sp. z o.o. 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. SGX Europe accepts no liability beyond the 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. In case of modification of the product, SGX disclaims all liability.

Copyright © SGX Europe Sp. z o.o. 2012-2020

DS-0315 INIR-RF-R600, ISSUE 1, March 2020
**ROHS COMPLIANCE**

Under the EU Directives, compliance testing is necessary for Pb, Cd, Hg, Cr (VI) and Br. The RoHS directive is effective since July 1, 2006. The regulations prohibit the use of these hazardous substances in new products sold after July 2003.

**WEEE DIRECTIVE**

WEEE (Waste from Electrical and Electronic Equipment) is a directive that controls how electric and electronic equipment is handled and recycled effective since August 13, 2005. INIR clustered as component and SGX do not need to have a recycling scheme in place but manufacturers may need to ensure WEEE compliance for their systems.

**ATEX/IECEx CERTIFICATIONS**

The ATEX directive consists of two EU directives describing what equipment is allowed in an environment with an explosive atmosphere. The Integrated IR is certified for ATEX (Sira 99ATEX1121U) and IECEx (Sira 04.0031U), see page 5 for more details.

II 2G
Ex db IIC Gb
Ta -40°C to +75°C

Whilst SGX Europe Sp. z o.o. 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. SGX Europe accepts no liability beyond the 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. In case of modification of the product, SGX disclaims all liability.

Copyright © SGX Europe Sp. z o.o. 2012-2020

DS-0315 INIR-RF600, ISSUE 1, March 2020
Whilst SGX Europe Sp. z o.o. 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. SGX Europe accepts no liability beyond the 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. In case of modification of the product, SGX disclaims all liability.