SGX SENSORTECH

An Amphenol Company

INIR7-CO2

Safety | Industrial Health | Agriculture

Carbon Dioxide sensor

Datasheet

Key applications

- Agriculture
- Automation & Control
- EV Battery application
- Indoor Air Quality
- Industrial Health & Safety
- Waste Management

The **INIR7** is a user-friendly digital Gas Sensor, which is based on the Non-Dispersive Infra-Red (NDIR) technology. It has been primarily designed for the purpose of gas leakage detection in both industrial and residential environments. Designed with the latest generation of power efficient CORTEX microcontrollers allows for high flexibility and functionality. Temperature compensation, good accuracy and simple implementation into end-user system make this sensor a perfect solution for gas leakage detection.

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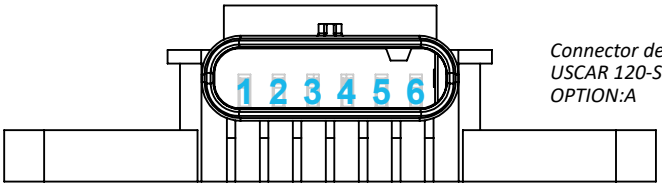
Functional specifications

Power Supply	Min	Typical	Max
Supply Voltage	4.5 VDC	24 VDC	30 VDC
Current Consumption			
Average Current Consumption	-	-	45mA @ 5V **(MAX for TTL)** 25mA @ 12V 15mA @ 24V
Inrush Current Consumption	-	-	90mA @ 5V 45mA @ 12V 30mA @ 24V
Measurement			**0-100 LEL**
Humidity (non-condensing)			
Operating Humidity	0%	50%	100%
Storage Humidity	0%	50%	90%
Temperature			
Operating Temp.	-40°C	+20°C	+75°C
Storage Temp.	-10°C	+20°C	+40°C
Temp. Cycle Limits			<1.3°C/min
Pressure (Compensation will be required)			
Operating Pressure	80kPa	-	120kPa
Serial communication CAN 2.0			
Digital signal format	11 identifier bit (CAN 2.0A)		
Standard baud rate	500Kbps as default		
Serial communication RS-485 (Modbus)			
Digital signal format	8 data bits, 1 stop bit, no parity		
Standard baud rate	38400bps as default		
Body Material		**PP-GF20**	
Dimensions			
Length (L)	67.0 mm		
Width (W)	76.0 mm		
Height (H)	20.5 mm		
Weight	26 g		

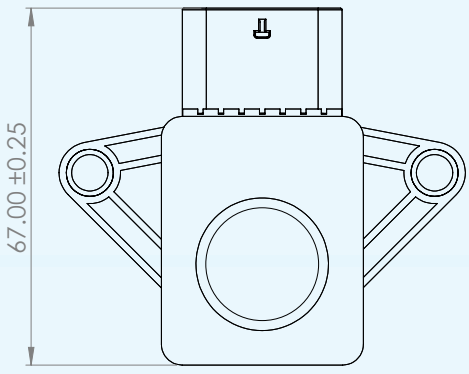


Connector designe according to USCAR 120-S-006-1-Z02 KEYING OPTION:A

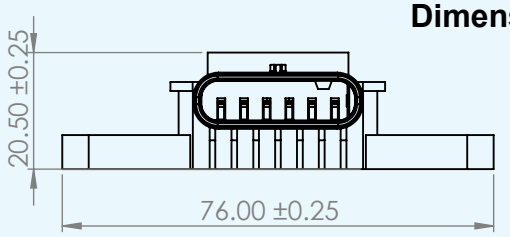
Pin	INIR7-CO2-CAN	INIR7-CO2-RS485	INIR7-CO2-TTL
Pin 1	Vsupply	Vsupply	Vsupply
Pin 2	GND	GND	GND
Pin 3	WakeUp / Alarm	WakeUp / Alarm	WakeUp / Alarm
Pin 4	Request	Request	Request
Pin 5	CAN_H[1]	RS485_B[2]	RXD
Pin 6	CAN_L[1]	RS485_A[2]	TXD

Features

- CO2 detection **in range 0-5%,**
- **Calibration - FREE**
- **CAN / RS-485 / TTL communication**
- **High Resolution** up to 10ppm,
- **Detectivity Level** at 100ppm,
- Full **Faults Diagnostics** & **Error Generation,**
- Cyclic Redundancy Check (**CRC**),
- **Typical Low power** consumption < 100mW (Average)
- **Factory calibrated** for up to 5% Carbon Dioxide
- **PC software** for RS485 version - easy testing and production calibration functions
- Design for use in Hazardous Areas



Dimensions



NOTE: All Dimensions in mm. All tolerances Linear +/- 0.25mm and Angular 0.5° unless otherwise stated.

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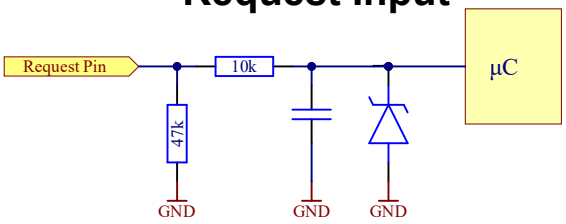
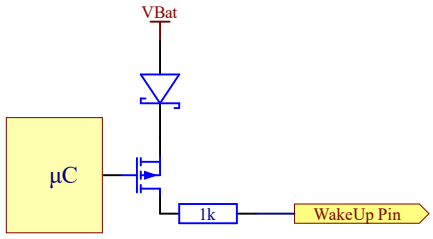
Request Input



WakeUp Output



Design Considerations & Applications

Warm-Up Time

The Warm-Up Time for the INIR7 sensor is 60 seconds after each power "ON" or every time when changing from Configuration to Measurement Mode. During this time data is not valid.
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 higher error than stated in specifications.

Calibration

For calibration process please read the appropriate Application Note 1, "INIR7 Protocol & Calibration".
For optimum performance please use following cylinders:

INIR7-CO2 (Carbon Dioxide)
2.0% CO2 for Span Cal.

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 INIR7.

Faults Monitoring/Error States

The Error monitoring and Fault generation happens every second transmitted by the CAN/RS485. Regularly check all the Faults generated from the INIR7 to ensure errorless communication and rise appropriate alarms depending on the Fault code.

Alarm Level

Alarm level can be configured withing the software provided with the sensor. The default alarm level is 20% LEL (0.42% volume Propane).

Condensation, Dust & Extreme Conditions

Using the INIR7 in extreme environmental conditions may affect its performance. Typically, the module has a high corrosion resistance and temperature compensated linearized output.

Pressure Compensation

INIR7 is not equipped with pressure compensation. Based on application environment external pressure compensation might be required.

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 12 values, unless otherwise stated.

Test	INIR7-CO2
Stabilisation or Warm-up Time (EN)*1	0%vol. ±0.1%vol. in 45 seconds
Calibration Curve (EN) or Basic Error (AQ)	0 to 100% of full range ± 0.06%vol. or ±6% of Reading whichever is greater
Short Term Stability (EN) of the Displayed Value(AQ)	0%vol. ±0.002%vol.5%vol. ±0.05%vol.
Minimum Resolution (AQ)	From 0 to 2% vol. ±0.004%vol. From 2 to 5% vol. ±0.01%vol.
Long Term Stability (EN) or Working Stability (AQ)	0-2%vol. ±0.05%vol. / Month 5%vol. ±0.1%vol. / Month
Temperature Error (with Compensation) (-40°C to +75°C, relative to 20°C)	0%vol. to 2%vol. ±0.01%vol. 2%vol. to 4%vol. ±0.02%vol. 4%vol. to 5%vol. ±0.05%vol.
Humidity Error (10%RH to 90%RH, relative to 45%RH)	0%vol. ±0.01%vol. 5%vol. ±0.05%vol.
Pressure error (90kPa - 110kPa)	0%vol. = ±0.2%vol. 5%vol. = ±1%vol.
Response Time*2 (without dust filter)	Max T_{90} ≈ 20 sec, Average 20
Power Supply Variations (at ±5% of Nominal Voltage)	The Performance of the INIR7 is not affected by power supply variations as long as the power supply provides DC Regulated voltage according to specifications.
Power Supply Rejection Ration (PSRR) (at ±5% of Nominal Voltage)	at 1 MHz -> 50 dB, at 100 kHz -> 68 dB, at 10 kHz -> 88 dB
Temperature Cycling or Ramping Drift (Maximum at 1.3°C/min.)	0%vol. ±0.05%vol. 2%vol. ±0.1%vol. 5%vol. ±0.25%vol.
Thermal Shock Drift	0%vol. ±0.05%vol. (max)
Uncertainty Error of Calibration	±0.15% Error of the Actual Reading

*1. Wait for 45 mins for the Sensor to warm up and reach the Ambient Temperature after power on.

*2. 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".

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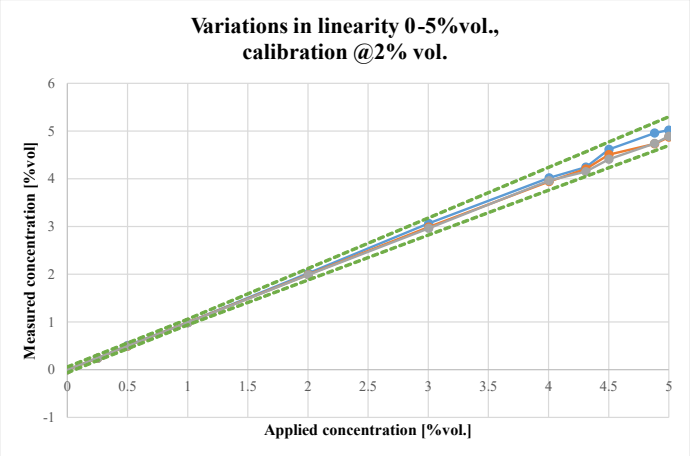
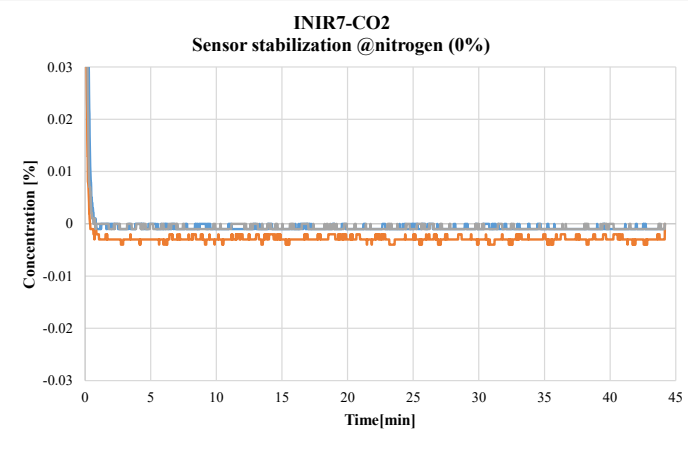
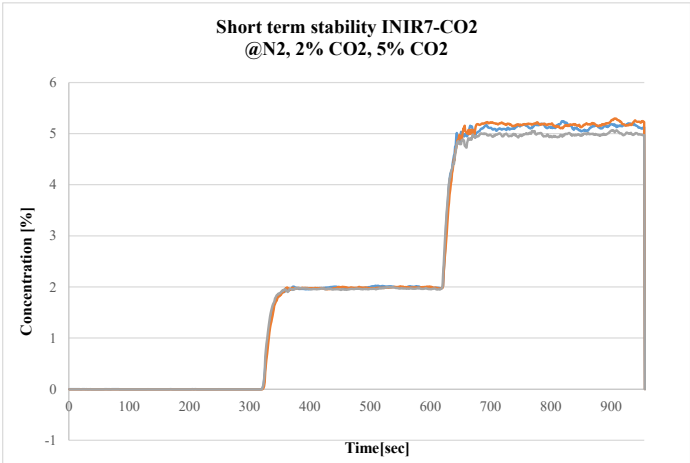
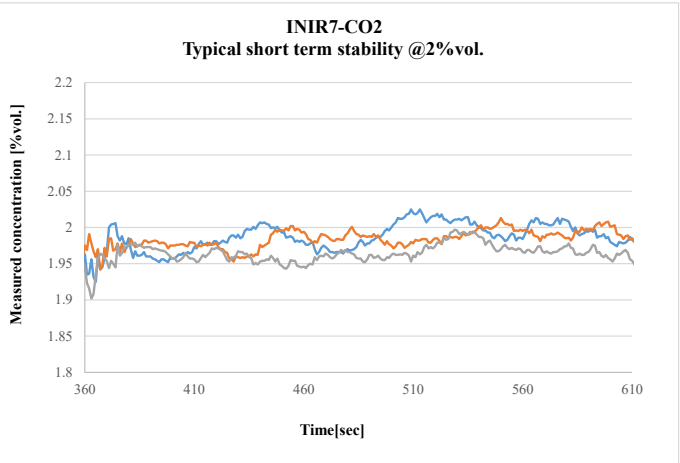




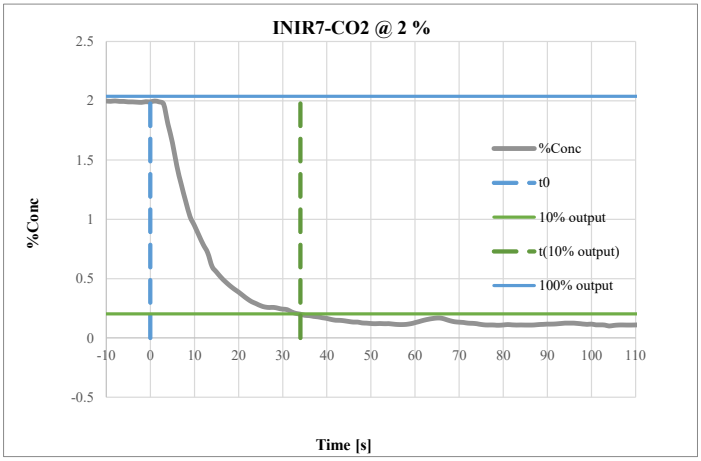
Typical Short Term Stability @ Nitrogen



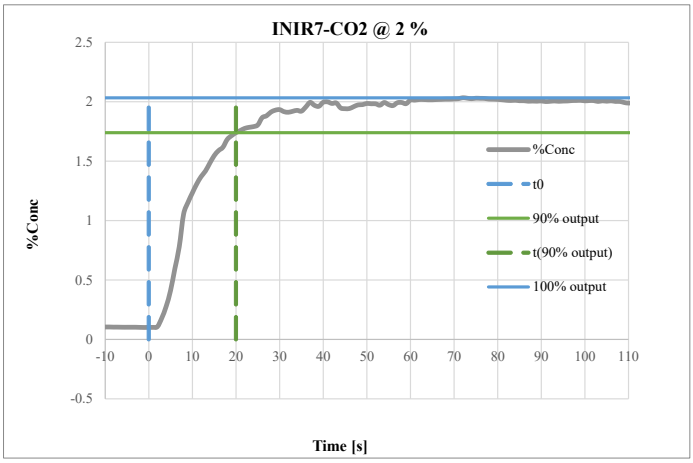
Typical Short Term Stability @1.05% Propane



Typical t10 response @2% Carbon Dioxide (averaging 20)



Typical t90 response @2% Carbon Dioxide (averaging 12s)



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CAN frame description

The default ID is 0x256 and CAN frame layout is as shown below:

	7	6	5	4	3	2	1	0
0	Temperature_u8 msb 7	6	5	4	3	2	1	lsb 0
1	msb 15	14	13	12	11	10	9	8
2	CO2_u16 23	22	21	20	19	18	17	lsb 16
3	Low_Power_bit 31	Sensor_replacement 30	undervoltage 29	Temperature_issue 28	CO2_out_of_range 27	Lamp_issue 26	Detector_issue 25	overvoltage 24
4	Voltage_u8 msb 39	38	37	36	35	34	33	lsb 32
5	msb 47	46	45	44	43	42	41	lsb 40
6	msb 55	54	53	52	Roll_Counter_u8 msb 51	50	49	lsb 48
7	Pressure msb 63	62	61	60	59	58	57	56

Signal factor and offset are described below:

Name	Message	Start bit	Length	Byte Order	Value Type	Initial Value	Factor	Offset	Unit
Temperature (u8)	Sensor_Status_1	0	8	Intel	Unsigned	-55	1	-55	°C
CO2 percent (u16)	Sensor_Status_1	16	16	Motorola	Unsigned	0	0.01	0	%
Overvoltage	Sensor_Status_1	24	1	Intel	Unsigned	0	1	0	
Detector issue	Sensor_Status_1	25	1	Intel	Unsigned	0	1	0	
Lamp issue	Sensor_Status_1	26	1	Intel	Unsigned	0	1	0	
CO2 out of range	Sensor_Status_1	27	1	Intel	Unsigned	0	1	0	
Temperature issue	Sensor_Status_1	28	1	Intel	Unsigned	0	1	0	
Undervoltage	Sensor_Status_1	29	1	Intel	Unsigned	0	1	0	
Sensor replacement	Sensor_Status_1	30	1	Intel	Unsigned	0	1	0	
Low power bit	Sensor_Status_1	31	1	Intel	Unsigned	0	1	0	
Voltage (u8)	Sensor_Status_1	32	8	Motorola	Unsigned	0	0.05	0	V
Pressure (u8)	Sensor_Status_1	56	8	Motorola	Unsigned	0	2	1000	hPa
Roll Counter (u4)	Sensor_Status_1	48	4	Motorola	Unsigned	0	1	0	

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Modbus registers description (for *-RS485* and *-TTL* versions)

Sensor always responds at address 0x00 and the address that is set in parameters.

Supported modbus functions	
Function	Name
0x03	Read Holding Registers
0x10	Preset Multiple Registers

Mesurement results						
Value name	Unit	Example	Data type	Word (16 bits)	Register address	Acces
Gas Concentration	% vol.	1.234	float32_t	Low Word	0x00	R
				High Word	0x01	R
Temperature	K	297.15	float32_t	Low Word	0x02	R
				High Word	0x03	R
Faults	N/A	0xAAAAAAAA	uint32_t	Low Word	0x04	R
				High Word	0x05	R
Ref_Average	N/A	30000	float32_t	Low Word	0x06	R
				High Word	0x07	R
Act_Average	N/A	30000	float32_t	Low Word	0x08	R
				High Word	0x09	R
Reserved	N/A		float32_t	Low Word	0x0A	R
				High Word	0x0B	R
Operating mode	N/A		uint32_t	Low Word	0x0C	R
				High Word	0x0D	R
Concentration Range	N/A		uint32_t	Low Word	0x0E	R
				High Word	0x0F	R

Operating mode	
3	Config Mode
6	Modbus Mode

Sensor Info						
Value name	Unit	Example	Data type	Word (16 bits)	Register address	Acces
Sensor type	N/A	40	uint32_t	Low Word	0x100	R
				High Word	0x101	R
Gas type	N/A	1	uint32_t	Low Word	0x102	R
				High Word	0x103	R
Serial number	N/A	0xC7123401	uint32_t	Low Word	0x104	R
				High Word	0x105	R
Firmware_version	N/A	42	uint32_t	Low Word	0x106	R
				High Word	0x107	R
Calibration_time	hhmmss	140531	uint32_t	Low Word	0x108	R
				High Word	0x109	R
Calibration_date	ddmmyy	270323	uint32_t	Low Word	0x10A	R
				High Word	0x10B	R

Gas Types	
0	Methane
1	R290
2	R600a
3	CO2
4	R32

User parameters						
Value name	Unit	Example	Data type	Word (16 bits)	Register address	Acces
Concentration range	% vol.	5%	float32_t	Low Word	0x200	R/W
				High Word	0x201	R/W
Span gas concentration	% vol.	2%	float32_t	Low Word	0x202	R/W
				High Word	0x203	R/W
Alarm gas concentration	% vol.	0.42%	float32_t	Low Word	0x204	R/W
				High Word	0x205	R/W
Averaging time	s	20	uint32_t	Low Word	0x206	R/W
				High Word	0x207	R/W
Reserved	N/A		uint32_t	Low Word	0x208	R/W
				High Word	0x209	R/W
Reserved	N/A	0x00	uint8_t	Low byte	0x20A	R/W
Reserved	N/A	0x00	uint8_t	High byte		R/W
AutoZero algorithm	N/A	0x01	uint8_t	Low byte	0x20B	R/W
Modbus Device Address	N/A	0x05	uint8_t	High byte		R/W

Commands		
Value name	Register address	Acces
Enter Config Mode	0x300	R/W
Enter Modbus Mode	0x301	R/W
Calculate NEW Zero	0x302	R/W
Calculate NEW Span	0x303	R/W
Reset to Factory Default	0x304	R/W
Software reset	0x305	R/W

Write 1 to execute command

Command result	
Value	Description
1	not performed yet
2	Done without errors
3	Error during execution of command

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Intended use

This device has been designed to be used as a gas detection component, but it the design is not certified for use in explosive atmospheres.

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. INIR7 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.

Handling precautions

A. Do not drop the sensor on the floor as this could cause damage to the pins or internal components.

B. Avoid mechanical force against pins. Protect from dust and sprayed acidic particles.

C. Do not immerse in water or other fluids.

ESD precaution

ESD (Electrostatic Discharge) sensitive device. Charged devices and circuit boards can discharge without detection. Although this product features patented or proprietary subjected 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.

Warranty & Warning

The WARRANTY for all the INIR7 Gas Sensors is 1 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 change label or cover it with other stickers.
3. Do not over voltage or overcurrent the sensor; always observe the correct polarity of the input.
4. Do not solder directly onto the pins, pads or the external body of the sensor.
5. Do not drop on the floor or hit it with tools.
6. Do not open, cut or break sensor apart.
7. Do not expose the sensor to high levels of dust.
8. Do not expose the sensor to corrosive gases or operate under corrosive environments.
9. Do not paint or mark the sensor externally.
10. Do not use in acid environment or operate under gases containing acid vapours or particles.
11. Do not custom modify the sensor.
12. Do not clean the with acid.

Order Information

INIR7-CO2-Y

Target Gas

Comunication

CAN (CAN 2.0)
RS485 (TIA/EIA-485)
TTL

DISCLAIMER:
SGX Europe Sp. z o.o. reserves the right to change design features and specifications without prior notification. We do not accept any legal responsibility for customer applications of our sensors. SGX Europe Sp. z o.o. accepts no liability for any consequential losses, injury or damage resulting from the use of this document, the information contained within or from any omissions or errors herein. This document does not constitute an offer for sale and the data contained is for guidance only and may not be taken as warranty. Any use of the given data must be assessed and determined by the user thereof to be in accordance with federal, state and local laws and regulations. All specifications outlined are subject to change without notice.
SGX Europe Sp. z o.o. sensors are designed to operate in a wide range of harsh environments and conditions. However, it is important that exposure to high concentrations of solvent vapours is to be avoided, both during storage, fitting into instruments and operation. When using sensors on printed circuit boards (PCBs), degreasing agents should be used prior to the sensor being fitted. SGX Europe Sp. z o.o. makes every effort to ensure the reliability of its products. Where life safety is a performance requirement of the product, we recommend that all sensors and instruments using these sensors are checked for response to gas before use.