CO2 OR HYDROCARBONS

INFRARED SENSOR WITH INTEGRATED TRANSMITTER

INSTRUCTION MANUAL

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1. INTRODUCTION

The C/M/P4 series of infrared gas detection sensors utilise NDIR (Non Dispersive Infrared) to monitor the presence of Carbon Dioxide or hydrocarbons. This technique is based on the fact that the gas has an unique and well defined light absorption curve in the infrared spectrum, that can be used to identify the specific gas. The gas concentration can be determined by using a suitable infrared source and analysing the optical absorption of the light that passes through the gas.

The sensors contains the necessary optics, electronics and firmware to provide an output that is linearised and temperature compensated, proportional to the concentration of the target gas. The standard version is provided with both analogue (voltage or dynamic pellistor) and digital output.

The pellistor replacement version is provided additionally with features that make it available for use in hazardous classified areas.

Infrared CO2, CH4 or C3H8 sensor in 4 or 7 series sizes with integrated analogue (standard 0.4-2.0V) or bridge dc transmitter. Output on request.

Part nos.: 2112BC/M/P4-V (4 and 7 series sizes) or 2112BC/M/P4A-V for ATEx approved version (4 series size)

Measuring ranges:
Carbon Dioxide CO2: 0-30% vol, 0-5% vol, 0-2% vol, 0-1% vol, 0-5000ppm
Methane CH4 & Propane C3H8: 0-100% LEL or 0-100% vol

2. FUNCTION

The sensor consists of an infrared light source, an optical cavity, a dual output pyroelectric detector, a thermistor to monitor the temperature and the appropriate electronic circuits.

The gas diffuses into the optical cavity through a special PTFE membrane designed to enhance the ingress protection (IP) of gasket enclosures. Inside the cavity, the lamp emits an infrared pulsing radiation that is partially absorbed by the gas present.

The pyroelectric detector is sensitive to the changes in thermal energy and returns two outputs in response to the pulsed light from the infrared light source:

- an active output signal that decreases in amplitude when the target gas is present in the cavity (the thermal energy of the light is absorbed by the gas).

- a reference output signal that measures the light intensity of the infrared source (this signal remains unaffected by the presence of target gas).

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The thermistor measures the internal temperature of the sensor and corrects the temperature deviations of the sensor's components.

Inside the sensor, an electronic front-end processes these signals and gives out a signal proportional to the target gas.

Standard 5-pin version

In the standard **5** pin version of the infrared sensor, the sensor provides an analogue output (voltage or dynamic pellistor, linearised and temperature compensated) and digital communication (serial protocol available on request). Digital output is a UART format, comprising 8 data bits, 1 start bit, 1 stop bit and no parity.

The output signal of zero and full scale can be customised at customer's request.

Contact Euro-Gas for protocol details.

3-pin version

The 3-pin version is a direct pellistor replacement. It has no communication pins and provides only the analogue output (voltage or dynamic pellistor, linearised and temperature compensated). The output signal of zero and full scale can be customised at customer's request.

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5. ORDERING DETAILS

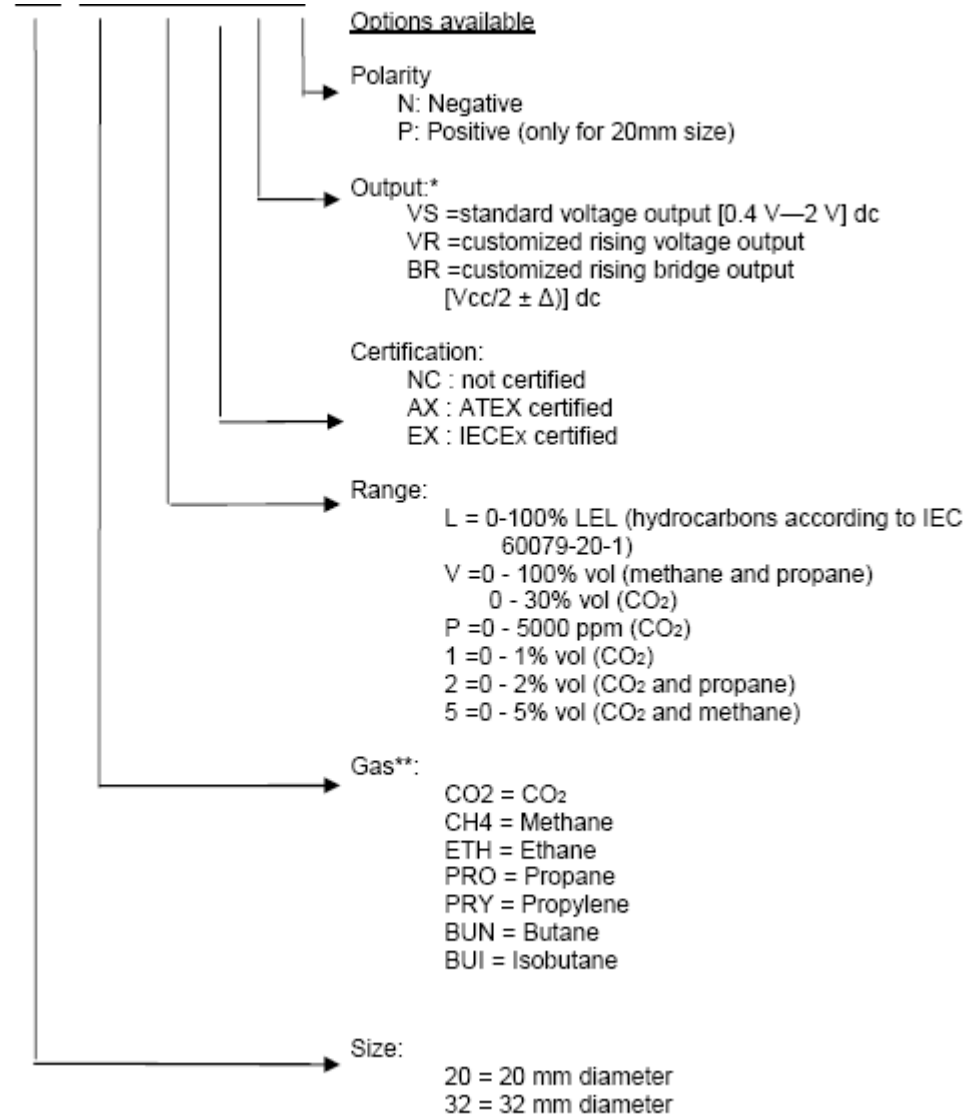
When ordering, please confirm the basic physical and electrical properties that are needed for the specific application. This is made through the part number selection below. The squared fields of the part number below can be modified according to the options on the right.

Main gas sensor product codes:

CO2 = 2112BC4-V or 2112BC4A-V (ATEx version)
CH4 = 2112BM4-V or 2112BM4A-V (ATEx version)
C3H8 = 2112BP4-V or 2112BP4A-V (ATEx version)

With following options available:

20 – CO21-NCVSN



* In case of customised VR output, the requested zero and full range voltage must be indicated in the order. In case of customized BR output, the requested sensitivity voltage must be indicated in the order (e.g. 100mV = 100% sensor full scale).

** Sensors are fully characterised for these gases and calibration is performed with the specific gas.

For other hydrocarbons on request, Euro-Gas can verify feasibility and provide a correction factor based on response of a Propane sensor for each target gas.

4. TECHNICAL DATA

General	Operating temperature range	-40 to +60 °C
	Storage temperature range	-40 to +85 °C
	Operating humidity range	0-95% non condensing
	Gas types	CH4, C3H8 or CO2
	Weight	44 g (32mm – 7 series) 22 g (20mm – 4 series)
	MTBF	≥ 5 years
	Patent information	Patent pending (request no. MI2013A000478)
	Software and digital technology	Designed for use in a detector that complies to EN 50271
	Electromagnetic Compatibility (EMC)	Designed for use in a detector that complies to EN 50270
	Optics	Metal optics treated to increase brightness and prevent oxidation
	Enclosure	Stainless steel
	Calibration	Individually calibrated with temperature compensation. Test report supplied.
Measurement	Sensing method	NDIR (active and reference signal)
	Measurement ranges	0 - 100% LEL (available for hydrocarbons (4,4% vol for Methane, 1,7% for Propane) 0 - 2% vol (available for Propane (0-100 % LEL outside of EU)) 0 - 5% vol (available for Methane (0-100 % LEL outside of EU)) 0 - 100% vol (available for Methane and Propane) 0 - 5000 ppm (available for CO2) 0 - 1% vol (available for CO2) 0 - 2% vol (available for CO2) 0 - 5% vol (available for CO2) 0 - 30% vol (available for CO2)
	Repeatability	±2% of FS range
	Accuracy	±2% of FS range for readings below 50% of range ±5% of FS range above 50% of range
	Resolution	0.5% of FS range
	Long Term Drift	±3% of FS range/year
	Temperature Performance	± 2% of FS range for readings below 50% of range ± 5% of FS range above 50% of range
	Response time T90	<30 s (only for Hydrocarbons sensors) <60 s for all other gases (EN 60079-29-1 compliance requires <60 s)

4. TECHNICAL DATA

Electrical	Power voltage	3.0-5.5 Vdc (20mm – 4 series) 3.5-5.5 Vdc (32mm – 7 series)
	Operating current	75-85 mA Idc (20mm – 4 series) 110-120 mA Idc (32mm – 7 series)
	Warm up time	60 s for full operation @ 25 °C At least 30 min for full specification @ 25 °C
	Max output current	± 7.5 mA
	DC output impedance	0,05 Ω (typical) 0,15 Ω (max)
	Max capacitance load	1000 pF
	Analogue output (standard for voltage mode)	Standard voltage [0.4 V—2 V] dc (other voltages available on request)
	Analogue output (standard for bridge mode)	[Vcc/2 — Δ)] dc (Δ value is to be specified by the customer)
	Digital communication	MODBUS protocol communication (available on request)
Certification	SIL certification number	C-IS-192972-01
	Reference standards	EN 50402 and IEC EN 61508
	Systematic and random integrity	SIL3 capable, SIL2 or SIL3 depending on configuration
	Performance approval	Designed for use in a detector that complies to IEC EN 60079-29-1
ATEx certification	Certificate number	CESI11ATEX039U by Notified Body CESI
	Reference standards	EN60079-0:2009, EN60079-1:2007, EN60079-11:2007, EN50303:2000
	ATEX marking:	II 2G Ex d IIC Gb I M2 Ex d I Mb I M1 Ex d + ia I Ma
	Rating	Vmax=5.5 V, Imax=100 mA, Ui=5.5 V, Ii=100 mA
IECEx certification	Certificate number	IECEx CES 12.0008U by Notified Body CESI
	Reference standards	IEC60079-0:2011, IEC60079-1:2007, IEC60079-11:2011, IEC60079-26:2006
	IECEx marking	Ex d IIC Gb Ex d I Mb Ex d+ia I Ma
	Rating	Vmax=5.5 V, Imax=100 mA, Ui=5.5 V, Ii=100 mA

5. ELECTRICAL CONNECTIONS

5.1 Power supply (V+ and V- pins)

These pins must be connected to the voltage power supply in the correct manner. Positive version has the two pins switched in respect to the Negative version.

The operative voltage range of the sensors are:

- 32mm version can be powered at 3.5V-5.5V (only available in the negative version)

- 20mm version can be powered at 3V-5.5V (available in both negative and positive versions).

Operation outside the above limits will results in a fault indication or wrong functionality of the sensor.

5.2 Digital interface (TX / RX pins)

Serial communication protocol is available on request. The standard (5 pins version) sensor is provided with 2 pins for TX and RX communication.

Communication speed: 4800bps

The digital communication pins TX/ RX operate at a 2.8V logic level.

The TX and RX voltage limits are as follow:

TX- VOH: output “High” minimum voltage= 2.4V

TX- VOL: output “Low” minimum voltage= 0.4V

RX- VIH: input “High” minimum voltage= 2.0V

RX- VIL: input “Low” minimum voltage= 0.8V

5.3 Output (signal pin)

The sensor provides a linearised and temperature compensated analogue voltage output that is proportional to the gas concentration. Standard voltage output is 0.4 – 2Vdc (see fig. 1 below). Otherwise the zero and full scale voltage level can be configured to customer specification. In case of customised voltage output, select the VR order code and indicate the corresponding zero and full scale levels.

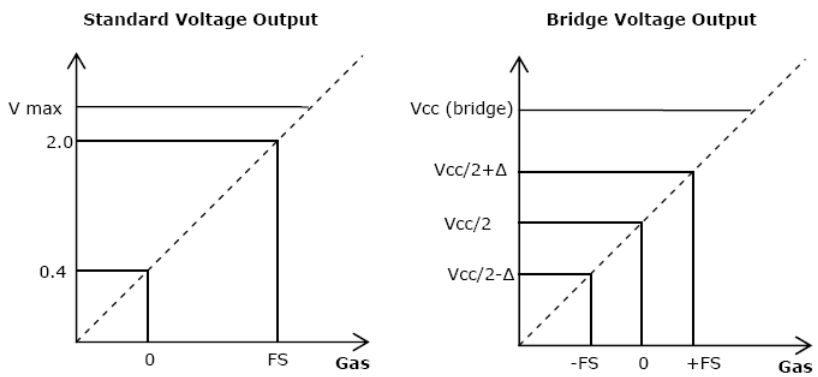


Fig. 1: Characteristics of output voltage

Bridge output

Bridge voltage output should be selected when replacing a pellistor type sensor. In this case, the output voltage levels are Vcc/2 – (Vcc/2 + Δ) dc (see fig.1 in previous page).

The default level for Δ is 100mV otherwise this value can be configured to customer specification. In the order, select the BR code and indicate the Δ level.

5.4 Sensor calibration

Sensors are factory calibrated with the target gas at various temperatures, in order to set the various internal coefficients for the gas concentration calculations and the correct functionality in the temperature range.

A calibration report is supplied. A maximum interval of 12 months between calibration checks is recommended. The sensors carry a warranty of 12 months from the despatch date.

5.5 Warm-up time

When powered-on, the voltage at the signal pin is held at “zero voltage” value. This condition is maintained for a default “warm-up” time of 60 seconds; after this time the output voltage represents the calculated gas value. Sensors may take up to 2 minutes to indicate the correct gas reading.

The output level that is read using the digital communication is held at zero and the corresponding warm-up condition is indicated in the register.

5.6 Target gas

Sensors are fully characterised for a number of gases and calibration is performed with the specified gas from a choice of:

Standard gases:

CO2 (CO2): 0-5000ppm, 0-1% vol, 0-2% vol, 0-5% vol, 0-30% vol

CH4 (Methane): 0-100% LEL (0-4.4% vol, 0-5% vol), 0-100% vol

PRO (Propane): 0-100% LEL (0-1.7% vol, 0-2.1% vol), 0-100% vol

Optional gases on request:

ETH (Ethane): 0-100% LEL (0-2.4% vol)

PRY (Propylene): 0-100% LEL (0-2% vol)

BUN (n-Butane): 0-100% LEL (0-1.4% vol)

BUI (Iso-Butane): 0-100% LEL (0-1.3% vol)

5.7 Fault status

The sensor constantly controls the status of internal components, like active and reference signals levels, power supply, etc. These controls ensure that the sensor is operating within its correct parameters and that no internal faults have developed.

If any fault condition is detected, the output value is set to 50% of the zero value (e.g. in the case of a standard voltage output configuration, the output will be set to 0.2V under fault conditions).

This means that, in order to clearly identify the fault status, the minimum voltage for the customised output zero level is 0.2V.

If the digital communication is used, in case of fault, the concentration is set to zero and the corresponding error is shown in the register.

5.8 Over range

If the gas concentration exceeds the full scale range, the sensor's output will be blocked at 120% of the full range value (for standard voltage, 2.32V). The sensor will return to normal behaviour as the gas concentration decreases. The linearity of the output is only guaranteed up to the full scale of the sensor.

5.9 Cross sensitivity

Cross reference factors to detect other hydrocarbons using the Propane sensor with range 0-2.1% vol are available on request. These coefficients should be set as a correction of the detector's gas reading. Cross reference factors for the following gases are available on request (LEL values are set according to IEC 60079-20-1):

Ethanol: 0-100%LEL (0-3.1%vol)

Acetone: 0-100%LEL (0-2.5%vol)

Ethane: 0-100%LEL (0-2.4%vol)

Propylene: 0-100%LEL (0-2%vol)

n-Butane: 0-100%LEL (0-1.4%vol)

Iso-Butane: 0-100%LEL (0-1.3%vol)

n-Pentane: 0-100%LEL (0-1.1%vol)

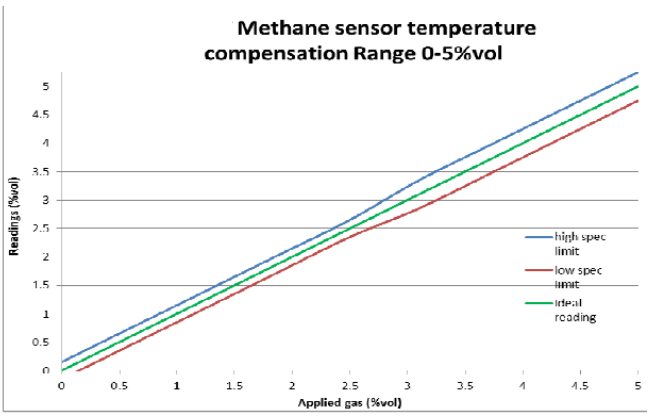
n-Hexane: 0-100%LEL (0-1%vol)

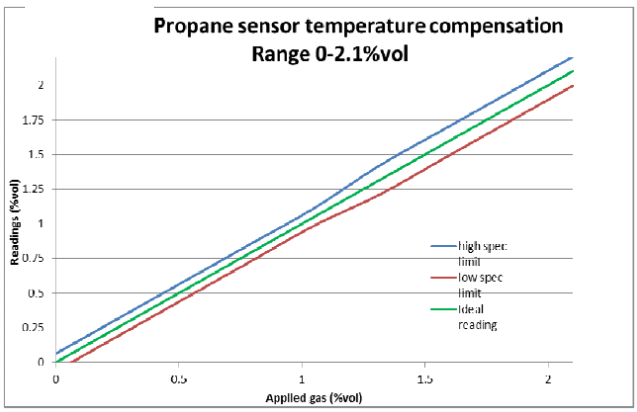
n-Heptane: 0-100%LEL (0-0.85%vol)

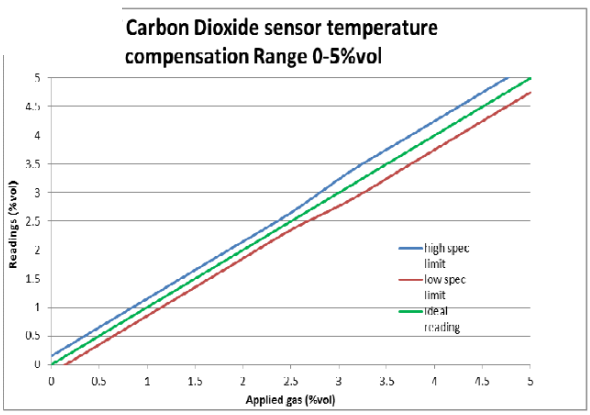
5.10 Temperature compensation

Sensors are tested individually in climatic chambers at temperature extremes (-40°C and +60°C) to adjust the internal thermistor compensation. Performances in the temperature range are ±2% of FS range for readings below 50% of the range and ±5% of FS range above 50% of the range.

When using a calibration correction factor, the temperature performances defined in the datasheet may not be valid because the temperature compensation is based on the propane sensor and there may be errors in the cross-referred readings at temperatures different from the calibration temperature.







The following graphs show data of Methane and Propane sensors applying 50% FS gas at different temperatures (-40°C,-20°C, 0°C , 25°C and 60°C).

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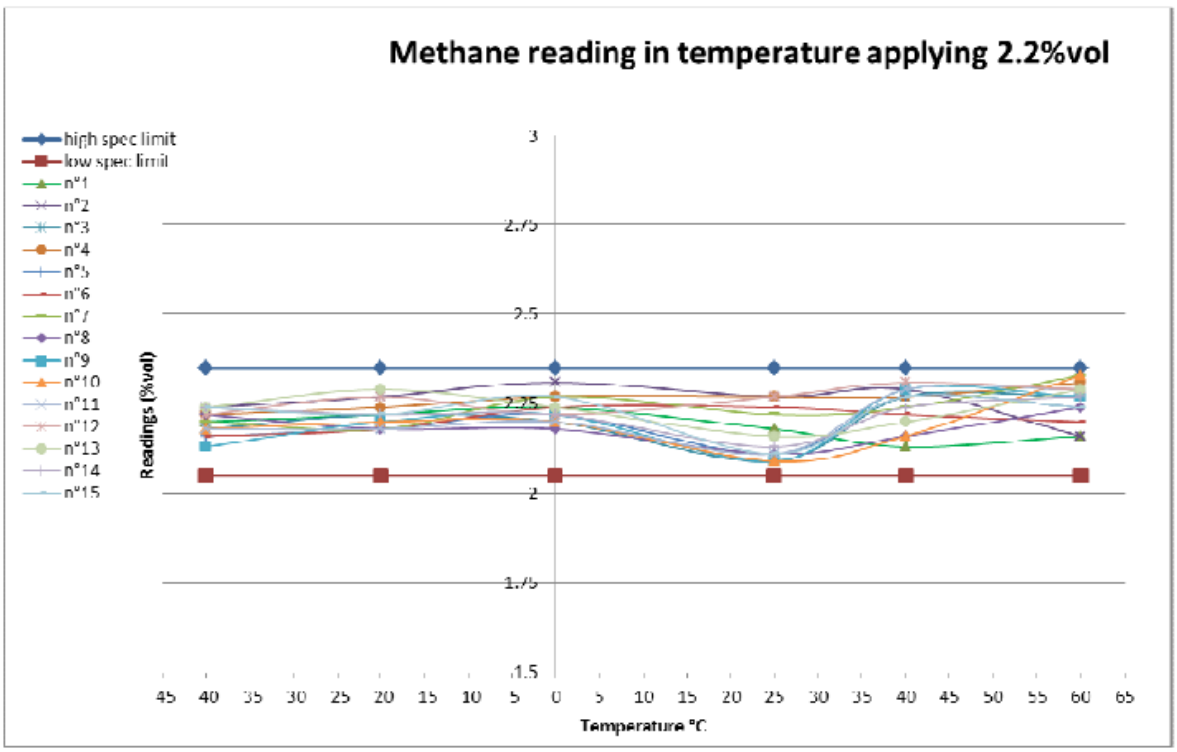
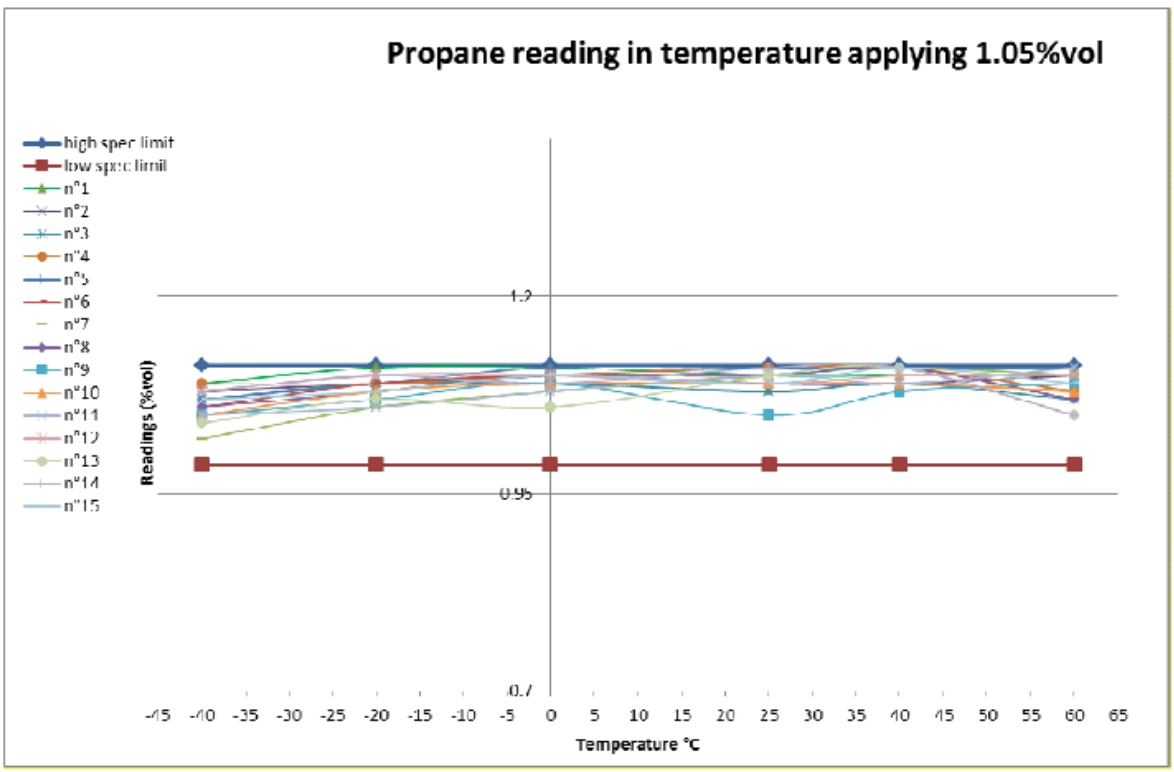
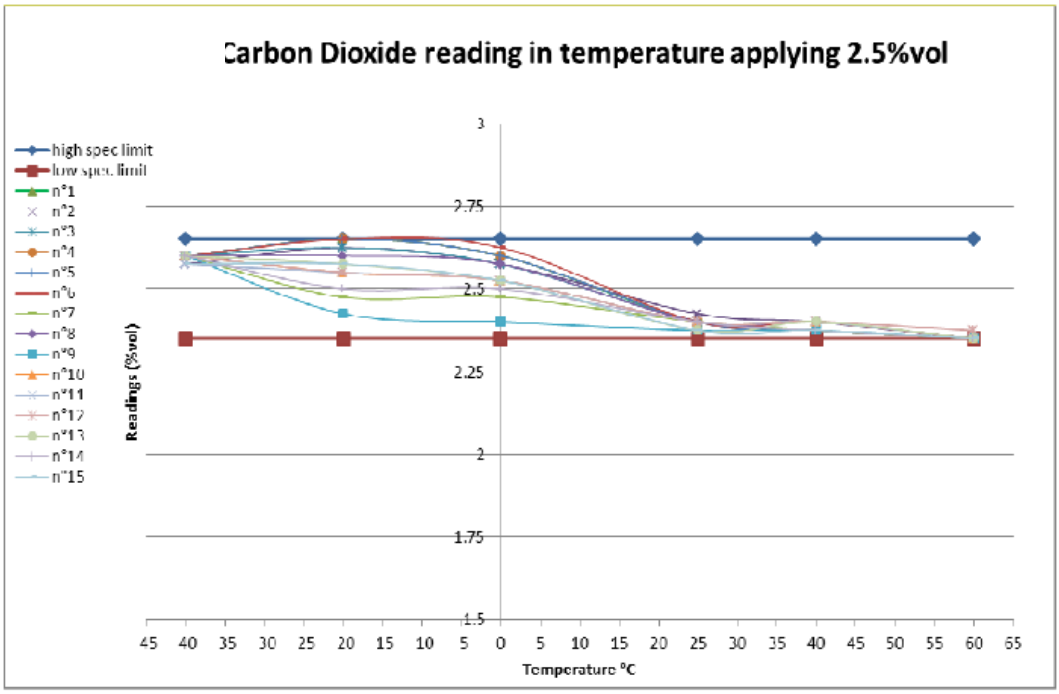


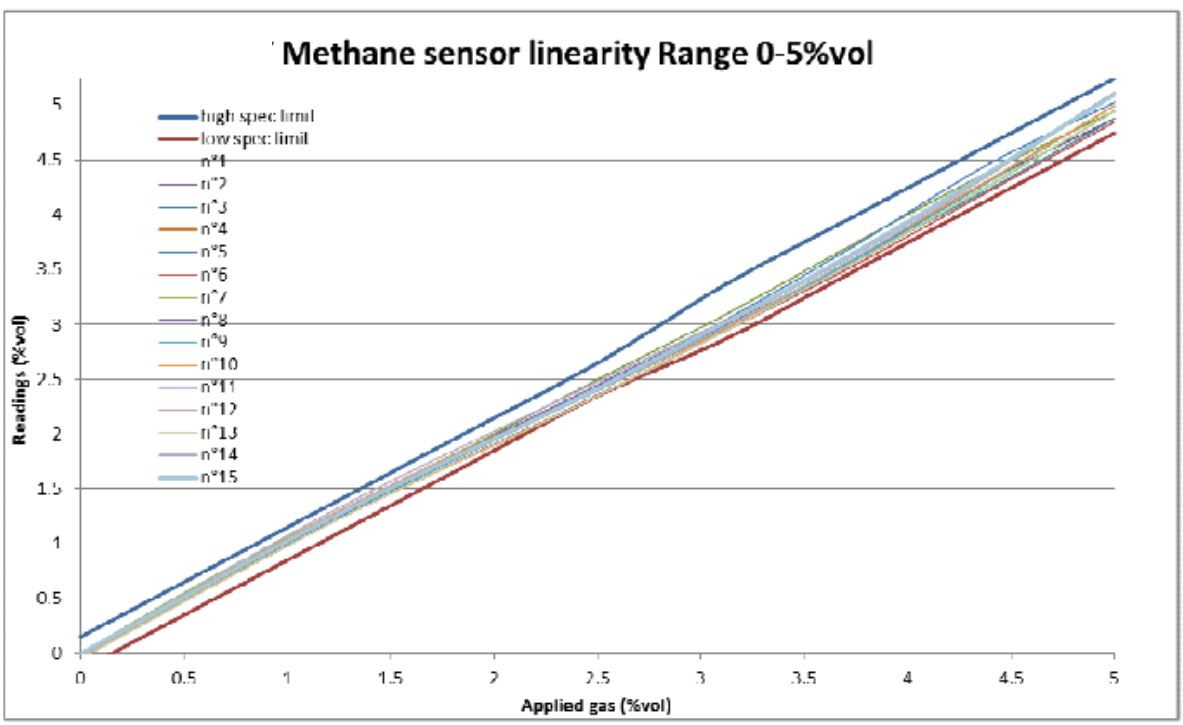




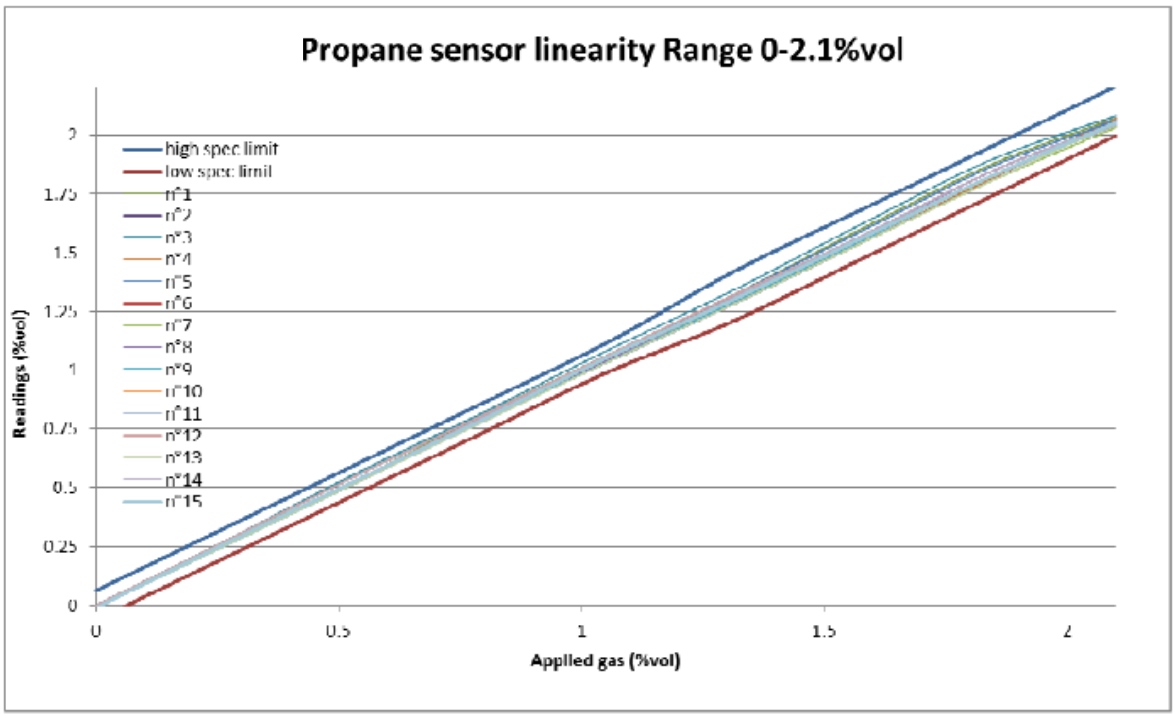
5.11 Linearity

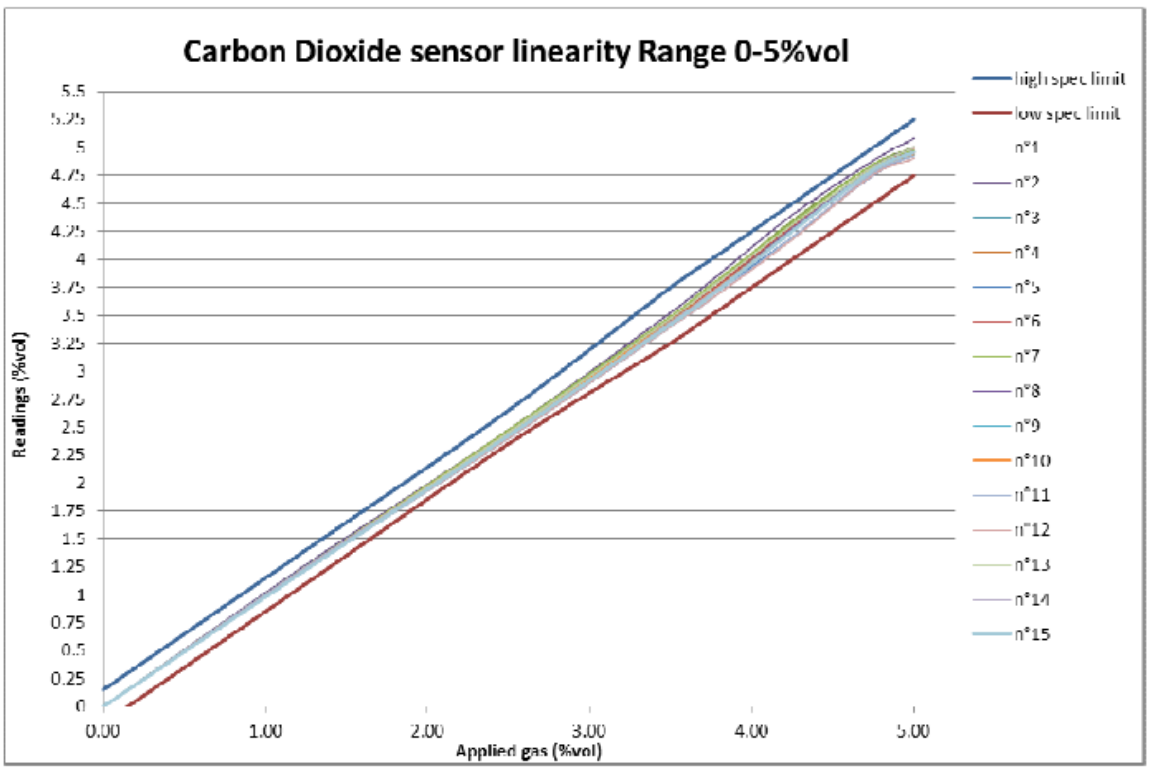
The linearity at room temperature is ±2% of FS range for readings below 50% of range and ±5% of FS range above 50% of range.

The following graphs show the linearity data for sensors of Methane 5%vol and Propane 2.1%vol.

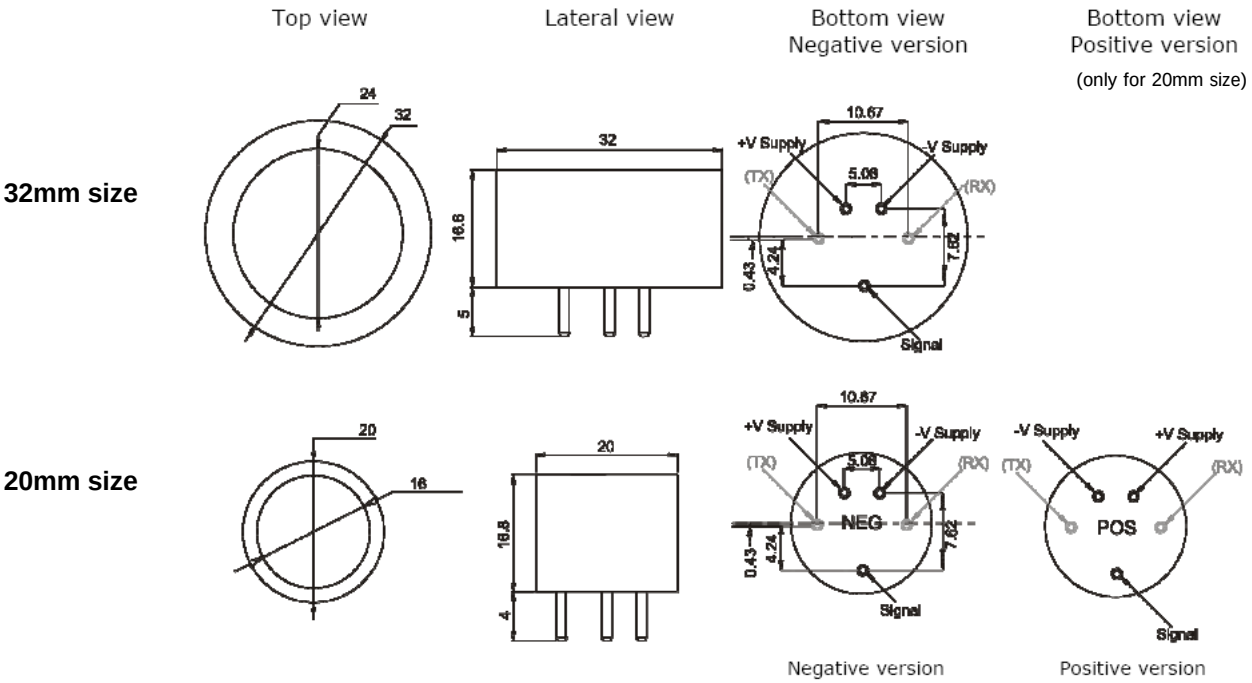


CO2 OR HYDROCARBONS INFRARED SENSOR WITH INTEGRATED TRANSMITTER





6. DIMENSIONS



All the dimensions in the figures are indicated in millimetres.

The two pins RX and TX for MODBUS protocol communication, are available on request.

7. MAINTENANCE

Repair, alteration or recalibration of the sensors should only be carried out by the manufacturer and should not be performed by the customer. The manufacturer will guarantee that after any repair, the product will work under the same safety conditions as when it was first released.

All industrial gas detection systems, both for flammable and toxic gas need to be periodically checked using calibration gas. A small zero drift can be compensated by re-zeroing the instrument against the sensor. The degree of drift that is acceptable should be determined by the end user. Please note that the subsequent change in gas reading will be greater than the change in zero reading.

A maximum time of 12 months between calibration checks is recommended. Depending on the application and use of the end product, the calibration time span will vary from 3 months to 12 months. It is recommended to record calibration checks/verifications results.

Before performing any test, flow nitrogen or dry air across the sensor for at least 5 minutes before testing the detector with calibration gas. Gas flow rates are recommended at below 500 SCCM (0.5 liters per minute).

To guarantee correct linearity and functionality of the sensor, the installation and power up of the sensor (especially for hydrocarbon sensors) must be performed in a clean environment.

For Carbon dioxide sensors, the factory zero calibration is performed in nitrogen so it is normal that they'll measure a gas concentration (usually 400-600ppm) when exposed to air. Hence, it is recommended that zero calibration on a detector is performed only in nitrogen.

8. PACKAGING & WARRANTY

The device should be kept in the supplied container until use. This will guarantee protection against dust and impact damage during transportation.

All sensors are supplied with three years warranty from the date of production against defects in materials or production. This warranty however is not valid for articles that have been broken, repaired by a third person or not used according to the instructions contained in this document or supplied with the products, related to the storage, installation, operation, maintenance, or servicing of the products. The calibration of the sensor is guaranteed for one year from the despatch date.

Please pay particular attention to:

- Power the sensor observing the correct voltage and polarity (positive or negative).

- Never solder directly on the pin - please use PCB sockets.

- Never cut or remove any of the pins.

- Use anti-static precautions when handling the sensor.

- Never let water or other liquids to enter inside the sensor.

- Never expose the sensor to corrosive gases.

- Avoid sudden temperature changes, above 1°C per minute, when testing the sensor.

- The gas flow used for testing should be ≤500 SCCM.

Defective products can be returned to Euro-Gas only after a previous agreement and with a description of the fault. Euro-Gas has the right to replace or repair all the products that, according to his unquestionable judgement, are found to be defective, without being held responsible for any possible direct or indirect damages suffered by the Customer.

According to the above-mentioned warranty, shipping and packaging charges and any other incidental expenses for the products returned to Euro-Gas will be at the Customer's own risk and charged to them.

Euro-Gas reserves the right to change the technical specifications without notice for technical enhancement and improved performance.

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