DYNAMENT
INFRARED GAS SENSORS

Technical data sheet TDS0142

PREMIER *PLATINUM* INFRARED

HIGH RANGE CARBON DIOXIDE SENSOR

Exd Certified versions

*** Available in EN50271 / SIL1 Certified versions ***

SIL1

MSH-PS/HCO2
MSHia-PS/HCO2

Non - SIL

MSH-P/HCO2P
MSHia-P/HCO2P

FEATURES

- ★ **Combines all the features of the well-proven range of Premier CO2 sensors.**
- ★ **Offers reduced response times when compared with earlier versions.**
- ★ **Contains all the necessary optics, electronics and firmware to provide a linearised, temperature-compensated output for high range carbon dioxide.**
- ★ **Choice of output format – digital output (floating point and binary), direct pellistor replacement or industry standard 0.4 to 2 volts. Manual calibration option can be performed without digital commands.**
- ★ **User configurable using USB powered Premier Configuration Unit.**
- ★ **Internal Flash memory allowing sensor firmware updates via configuration equipment.**
- ★ **Enhanced EMC protection.**

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DESCRIPTION

Dynament infrared sensors operate by using the NDIR principle to monitor the presence of the target gas. The sensor contains a long life tungsten filament infrared light source, an optical cavity into which gas diffuses, a dual temperature compensated pyroelectric infrared detector, an integral semiconductor temperature sensor and electronics to process the signals from the pyroelectric detector .

Two versions are available:-

3 Pin Version - Pellistor Replacement Infrared

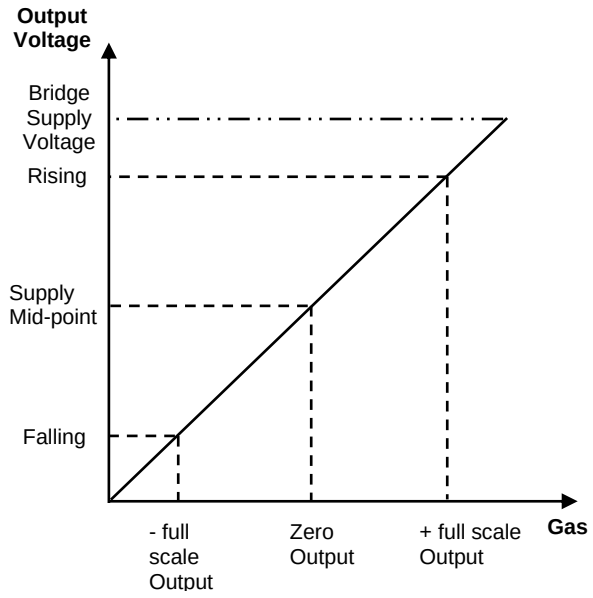
These sensors provide a pellistor style linearised, temperature-compensated output as shown in Graph 1.
They can either be supplied pre-set to customer specification or may be configured by the user by means of a configuration unit available from Dynament Ltd. The output signal can be set to rise or fall with increase in the gas level.

5 Pin Version - Multi-Purpose Range

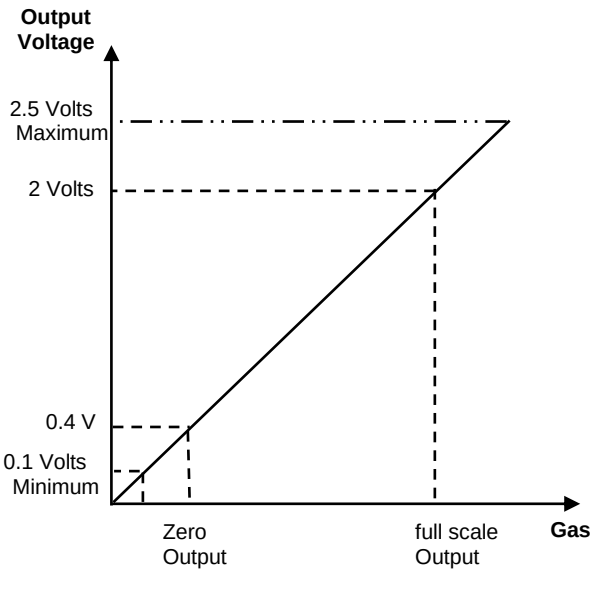
This version of the sensor provides maximum user flexibility by providing the following output options:-

- ★ Industry Standard 0.4 to 2 volt linearised, temperature-compensated output as shown in Graph 2, or alternative voltages for zero and full-scale outputs.
- ★ Digital output for direct communications with instrument electronics.
- ★ Rising or falling output with increasing gas level for the pellistor replacement, bridge output as shown in graph 1.

The digital output is a UART format comprising 8 data bits, 1 stop bit and no parity.
Refer to specification for available baud rates. Contact Dynament Ltd for protocol details.



Graph 1
Pellistor Replacement Output Characteristic



Graph 2
0.4 – 2 Volt Output Characteristic

Patent Protection

The sensor design is protected by the following Patents

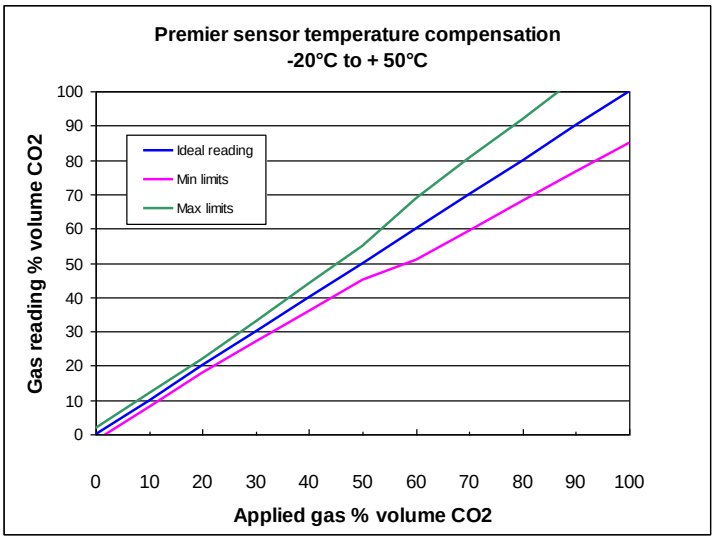
Great Britain	**GB 2 401 432 & GB 2 403 291**
Europe	**EP 1544603 & EP 1818667-Pending**
France	**EP [FR] 1544603**
Germany	**EP [DE] 1544603**
Italy	**EP [I] I1544603**
Switzerland	**EP [CH]1544603**
USA	**7, 244, 939**

Other World Patents Pending

Temperature Compensation

The Premier sensor is temperature compensated over the range of -20°C to +50°C.
The output variation is ± 2% full scale or ±10% of the reading up to 50% full scale and ± 15% of the reading from 50% to 100% full scale, which ever is greater.

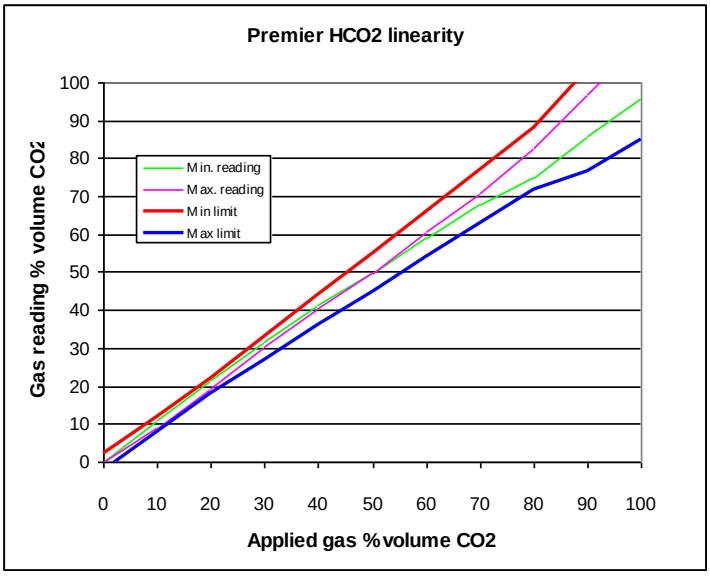
The following graph is based on the hydrocarbon sensor being characterised for propane.



Linearity

The Premier sensor linearity at ambient temperature is ± 3% full scale or ± 10% of the reading up to 80% full scale and ± 15% of the reading from 80% to 100% full scale, whichever is greater.

The following graph is based on the 0-100% v/v sensor, data for 24 sensors.



Calibration options

Dynament recommends a maximum interval of 12 months between calibration checks. A small amount of zero drift can be accomodated by re-zeroing the gas detector against the sensor. The degree of drift that is acceptable should be determined by the user. Note that the subsequent change in gas reading will be greater than the change in zero reading. If the sensor requires either a “Zero” or “Span” adjustment, there are three methods that can be used:

1. By using the “Premier Configuration Unit”
   When used in conjunction with dedicated PC software, this device uses the data communication pins on the sensor to provide a means of calibration.
   Refer to data sheet TDS0130 “Platinum_IR_Sensor_Configuration” and TDS0129 “Platinum Sensor User Manual” for additional information.

2. By using the data communications pins and software written in accordance with the communications protocol supplied by Dynament. “TDS0045”.

3. By using the "Manual Calibration" feature.
   “Zero” and “Span” operations can be performed by momentarily connecting the data communication pins to the negative supply pin. Refer to data sheet TDS0064 for full instructions. The “Manual Calibration” option must be specified when the sensors are ordered.

In all cases ensure that the sensor has been powered long enough for the temperature to have stabilised before starting the calibration. This time will vary in accordance with the way in which the sensor is mounted.
Note: a zero calibration must always be carried out before a span calibration.

Sensor warm-up time

Analogue output behaviour:
When power is first applied to the sensor, the voltage at the output pin is held at a pre-determined level. The default setting for this start-up value is the “zero gas” value for bridge output sensors and 0.2V for voltage output sensors. This condition is maintained for a default “warm-up” time of 45 seconds, after this time the output voltage represents the calculated gas value. Sensors can take up to 1 minute to indicate the correct gas reading.

Digital output behaviour:
When power is first applied to the sensor, the digital output is held at -250% of the full scale for the duration of the “warm-up” time.

Note: Both the voltage at the output pin during the “warm-up” time, and the duration of the “warm-up” time can be pre-programmed to alternative values at the time of ordering sensors.

Temperature transients and gas flow rates.

The Premier sensor employs a pyroelectric detector, the output from which can be disrupted by sudden changes in temperature. If there is an excessive change in the ambient temperature, gas sample temperature or flow rate, then the output signal will be momentarily frozen. Correct operation is restored when the effects of the transient have settled. Rates of change in the ambient temperature should be restricted to 2°C/minute and gas flow rates kept below 600 cc/minute.

Power supply considerations

The sensor power supply rise time must be less than 50 mS to ensure correct operation. Operation outside the range of 3 – 5 V dc will result in either fault indication, or the sensor will not function correctly.

Sensor over-range condition

The sensor will continue to provide an output up to a pre-determined percentage of the full scale value; at this point the reading is clamped, regardless of any further increase in detected gas level. The over-range value should be specified when ordering; choose from the following values 100%, 125%, 150% and 200% The linearity of the output is only guaranteed up to the full scale for the sensor; the over-range condition for the host instrument should therefore be determined by the user.

Sensor fault indication

The sensor constantly performs checks on the internal memory contents, the incoming supply voltage and the analogue signal values. These checks are used to ensure that the sensor is operating within its correct parameters, and that no internal faults have developed.

If a fault condition is detected:

1) the output will be set to 0V.
2) The output value that is read when using the communications pins, instead of the voltage output pin, will be set to -250% full-scale.

As mentioned in the “Sensor warm-up time” section above, the voltage at the output pin during the warm-up time can be specified when ordering sensors.

Digital interface

The digital communication pins “RX” and “TX” operate at a 2.8V logic level. When interfacing to external circuitry that uses a higher voltage level it is necessary to limit the current that can flow. The external voltage level should be 5V maximum and a 3K3 resistor should be used in series with each communication pin.

The Rx and Tx voltage limits are as follows:

RX - VIH: Input ‘High’ minimum voltage - 0.8 VDD = 2.24V
RX - VIL: Input ‘Low’ maximum voltage - 0.2 VDD = 0.56V

TX - VOH: Output ‘High’ minimum voltage - VDD - 0.7 = 2.1
TX - VOL: Output ‘Low’ maximum voltage - 0.6V

Contact Dynament Ltd for details of the required protocol.

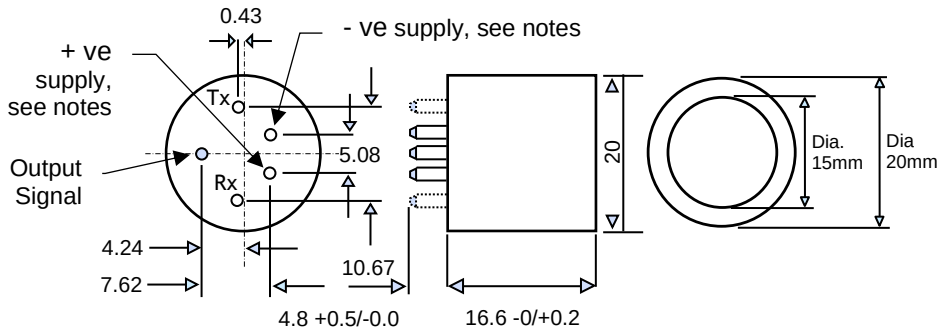
Known Bugs (SIL Only)

SIL1 (firmware version 07.17.00U) certified sensors are not suitable for use with 4800 baud rate.

SPECIFICATION @ 20°C (68°F) ambient temperature	
Operating Voltage Range:	3.0 – 5.0 V d.c.
Operating Current:	Constant current operation, current range 75 – 85mA
Programmable Output Voltage Ranges:	Voltage Output Types – 0.1V to 2.7V d.c. Bridge Output Types – 0v to Bridge Supply Voltage
Measuring range:	0-10% volume up to 0-100% volume
Resolution:	0.1%
Linearity:	The linearity at ambient temperature is ± 3% full scale or ± 10% of the reading up to 80% full scale and ± 15% of the reading from 80% to 100% full scale, whichever is greater.
Warm up time:	To final zero ± 2% full-scale: approximately 1 minute, some sensors may take longer.
Accuracy: **At 20°C, 1 bar atmospheric pressure, calibration gas applied**	± 2%
Pressure	Accuracy limits are maintained at pressures within ± 5% of the calibration pressure.
CO_2 response Time T_{50}:	<15s
CO_2 response Time T_{90}:	<30s
Zero Repeatability:	± 2% of full scale
Span Repeatability:	± 2% at 20°C, 1 bar atmospheric pressure, calibration gas applied.
Long term zero drift:	± 1% volume CO2 per month
Operating temperature range:	-20°C to +50°C (-4°F to 122°F)
Temperature performance over the range -20°C to +50°C (-4°F to 122°F):	± 10% of reading up to 50% full scale, ± 15% of reading from 50% to 100% full scale, or 2% full scale whichever is greater over the range -20°C to +50°C (-4°F to 122°F)
Storage temperature range:	-20°C to +50°C (-4°F to 122°F)
Humidity range:	0 to 95% RH non-condensing.
Digital signal format:	8 data bits, 1 stop bit, no parity. 2.8V logic level
Standard baud rates:	38,400, 19,200, 9600, 4800
User configurable parameters and functions:	Zero output voltage Full-scale output voltage Positive or negative going output Sensor ‘zero’ function Sensor ‘span’ function Over-range value
MTBF:	> 5 years
Weight:	15 grams

CERTIFICATION DETAILS		
European ATEX Certification	**Sensor types MSH-P, MSH-PS**	**Sensor types MSHia-P, MSHia-PS**
Approval body	**SIRA**	
Certificate Number	**SIRA 04ATEX1357U (Ex & EN50271 / SIL1)**	
Test Standards	**EN60079-0:2012+A11:2013, EN60079-1:2014, EN60079-11:2012, EN60079-26:2015 EN 50271:2010**	
Certification Codes	**I M2 Ex db I Mb II 2 G Ex db IIC Gb**	**I M2 Ex db I Mb II 2 G Ex db IIC Gb**
Input parameters	**0.8W max, 30V max. (See footnote)**	**0.8W max, 30V max. (See footnote)**
Operating temperature	**-20°C to +60°C (See footnote)**	
International IECEx Certification	**Sensor types MSH-P, MSH-PS**	**Sensor types MSH-P, MSH-PS**
Approval body	**SIRA**	
Certificate Number	**IECEx SIR 05.0053U**	
Test Standards	**IEC 60079-0:2011 IEC60079-1:2014 IEC 60079-11:2011 EN 60079-26:2014**	
Certification Codes	**Ex db I and/or Ex db IIC**	**Ex db I and/or Ex db IIC**
Input parameters	**0.8W max, 30V max.**	**0.8W max, 30V max.**
Operating temperature	**-20°C to +60°C (See footnote)**	
North American Certification	**Sensor type MSH-P**	**Sensor type MSHia-P**
Approval body	**Underwriters Laboratory Inc.**	**Underwriters Laboratory Inc.**
File Reference	**E336365**	**E336365**
Test Standards	**UL 60079 – 0, 4th Edition UL 60079 - 1, 6th Edition CAN/CSA-C22.2 No. 60079-0-1-7 CAN/CSA-C22.2 No. 60079-1 part 1, 1st Edition**	**UL913 7th, Edition UL 60079 – 0, 4th, Edition UL 60079 – 11, 2nd , Edition CAN/CSA-C22.2 No. 157-92**
Hazardous Locations	**Class 1, Zone 1, AEx d IIC and Ex d IIC Hazardous Locations**	**Class I, II, III, Division 1** **Class 1, Zone 0, AEx ia IIC, T4 with 60°C ambient**
Input/Entity parameters	**0.8W max, 30V max.**	**Ui=6V dc, Pi=0.8W, Ci=4.105µF, Li=0 mH**
Input parameters are defined for certification purposes only, refer to the "Specification" table for the sensor operating voltage and temperature range.		

MECHANICAL DETAIL



NOTES

1. TOLERANCE: +/- 0.15 UNLESS OTHERWISE STATED.
2. RECOMMENDED PCB SOCKET WEARNES CAMBION LTD CODE: 450-3326-01-06-00.
3. USE ANTI-STATIC PRECAUTIONS WHEN HANDLING
4. DO NOT CUT PINS
5. DO NOT SOLDER DIRECTLY TO PINS
6. THE LABELLING ADDS UP TO 0.2 TO THE OUTER DIAMETER, AND UP TO 0.2 TO THE OVERALL HEIGHT

All dimensions are in millimetres. Pins viewed from underside
Diameter of pins = 1.5 +/- 0.05
Tx & Rx communication connections are available as either pads or pins

NOTE – The above pin configuration is shown for the POSITIVE version of the sensor. The NEGATIVE version has the +ve and –ve supply pin positions exchanged. See ordering details.

Warranty information

All Dynament Platinum sensors carry a five-year warranty against defects in materials and workmanship. The warranty is invalidated if the sensors are used under conditions other than those specified in this data sheet.

Particular attention should be paid to the following criteria:

- **Observe the correct supply polarity**
- **Do not exceed the maximum rated supply voltage of 5V**
- **Do not solder directly to the sensor pins**
- **Do not expose the sensor to corrosive gases such as hydrogen sulphide**
- **Do not allow condensation to take place within the sensor**

Dynament reserve the right to alter technical specifications, without prior notice, when it is appropriate to implement a technical enhancement that leads to improved performance.
Should any changes be required that could affect the customer's use of the product, Dynament will endeavour to contact customers directly to inform them of the changes.

Ordering Details

In order to completely specify the type of sensor that is required, the customer needs to provide the following information:-

- An Order Code (see below) that specifies the sensors' basic physical and electrical characteristics.
- The sensor configuration requirements, including the required gas measurement ranges.

EXAMPLE OF ORDER CODES

MSH – PS / HCO2 / 3 / B / P / F

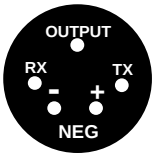
- FILTER :
  BLANK = OMITTED,
  F = FITTED
- SUPPLY POLARITY :
  P = Positive,
  N = Negative
- OUTPUT TYPE :
  B = Bridge,
  V = Voltage
- NUMBER OF PINS :
  3, 4 or 5
- GAS TYPE :
  HCO2 = High Range Carbon Dioxide, SIL1
  HCO2P = High Range Carbon Dioxide, Non-SIL1
- PLATINUM SENSOR:
  P = Non SIL1
  PS = SIL1
- MSHia
  (For Mining M1applications only)

CONFIGURATION OPTIONS
(To be stated on customer order in addition to the Order Code)

1. Output voltage for zero.
2. Output voltage for span.
3. Rising or falling output voltage with increasing gas level (for "Bridge" outputs)
4. Sensitivity e.g. 100 mV = 100 % volume CO_2 for "Bridge" outputs, 0.4 – 2.4V = 100% volume carbon dioxide for "Voltage" output sensors.
5. Communication speed – 38,400 baud (default), specify alternative rate if required.
6. Over-range value: 100%, 125%, 150% and 200% of full-scale value.

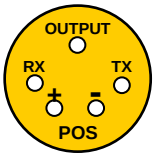
Pellistor Replacement - Explanation of Positive & Negative Polarity

Typical Pellistor Pinout



Premier Negative Polarity Option

Use where the DET pin of the existing pellistor is connected to the Negative of the pellistor bridge supply.



Premier Positive Polarity Option

Use where DET pin of the existing pellistor is connected to the Positive of the pellistor bridge supply.

Note – On the 3 pin version of the sensor, the RX and TX connections are pads, not pins.