DYNAMENT
INFRARED GAS SENSORS

Technical data sheet TDS0175

LOW POWER 2 VERSION

CARBON DIOXIDE SENSOR

Exd Certified versions

MSH2-LP2/CO2
MSH2ia-LP2/CO2

- ★ ***Current consumption 8mA at 3V dc***
- ★ ***Uses the same proven technology as the existing Dynament sensor range***
- ★ ***Drop-in replacement***
- ★ ***No loss of performance***

FEATURES

- ★ **Measures Carbon Dioxide 0-5% volume, lower ranges also available.**
- ★ **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 CO2.**
- ★ **Choice of output format – digital output (floating point and binary), or industry standard 0.4 to 2 volts.**
- ★ **User configurable using USB powered Premier Configuration Unit.**
- ★ **Enhanced EMC protection**
- ★ **Internal Flash memory allowing sensor firmware updates via configuration equipment.**

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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

DESCRIPTION

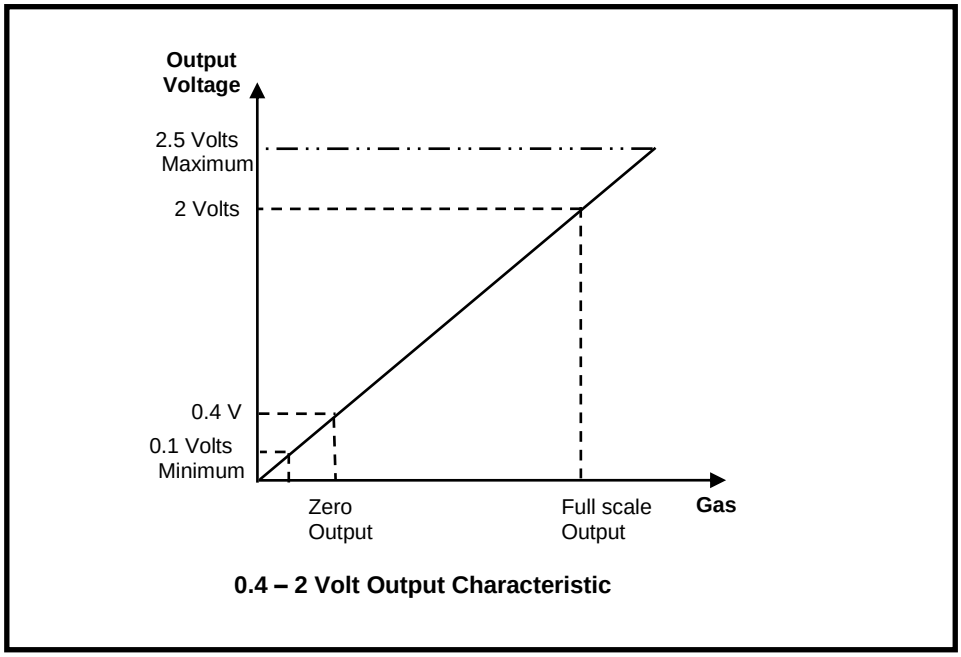
Dynament infrared sensors operate by using the NDIR principle to monitor the presence of the target gas. The sensor contains a long life tungsten filament infrared light source, an optical cavity into which gas diffuses, a dual temperature compensated pyroelectric infrared detector, an integral semiconductor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

Outputs

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 below, or alternative voltages for zero and full-scale outputs.
- Digital output for direct communications with instrument electronics.

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.

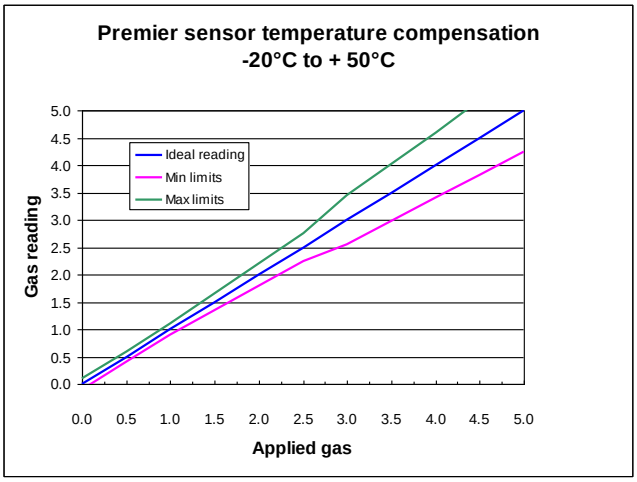


0.4 – 2 Volt Output Characteristic

Carbon dioxideTemperature Compensation

The Premier sensor is temperature compensated over the range of -20°C to +50°C.

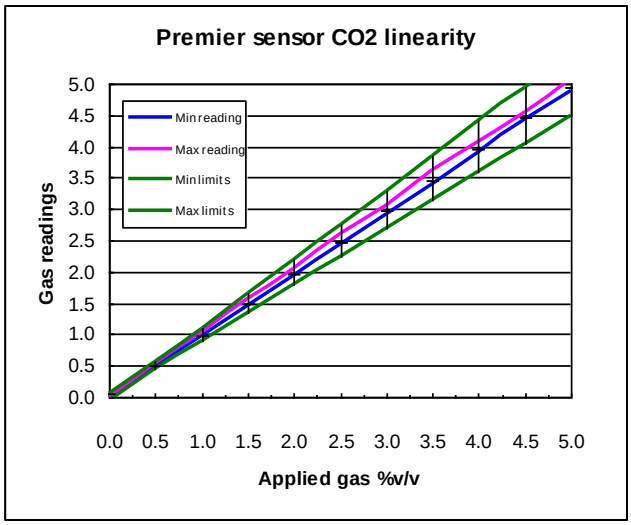
The output variation is ± 0.1% v/v or ± 10% of the applied gas up to 50% full scale and ± 15% of the applied gas from 50% to 100% full scale, whichever is greater.



Carbon dioxide Linearity

The Premier sensor linearity at ambient temperature is ± 2% full scale or ± 10% of the applied gas which ever is greater.

The following graph is based on the 0-5% v/v sensor, data for 24 sensors.



Calibration options

Dynament recommend 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 two 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.

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

   Gas calibration is best carried out at 50% of the range. Other calibration levels, between 10% and 100% of the range can be used but may affect the accuracy of the readings.

   If the calibration gas level is entered incorrectly for any range, there will be an error in the calibration. It is the user’s responsibility to ensure that the calibration procedure is correctly applied. Checks on the correct calibration gas level that are used during span operations should be implemented within the calibration routine of the host gas detector’s firmware.

Note: a zero calibration must always be carried out before a span calibration.

Sensor warm-up time

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. 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.

Note: the sensor can calculate any reading from -100% FSD to +200% FSD in the first minute.
The output value that is read using the communications pins is always held at -250% FSD during the “warm-up” time.

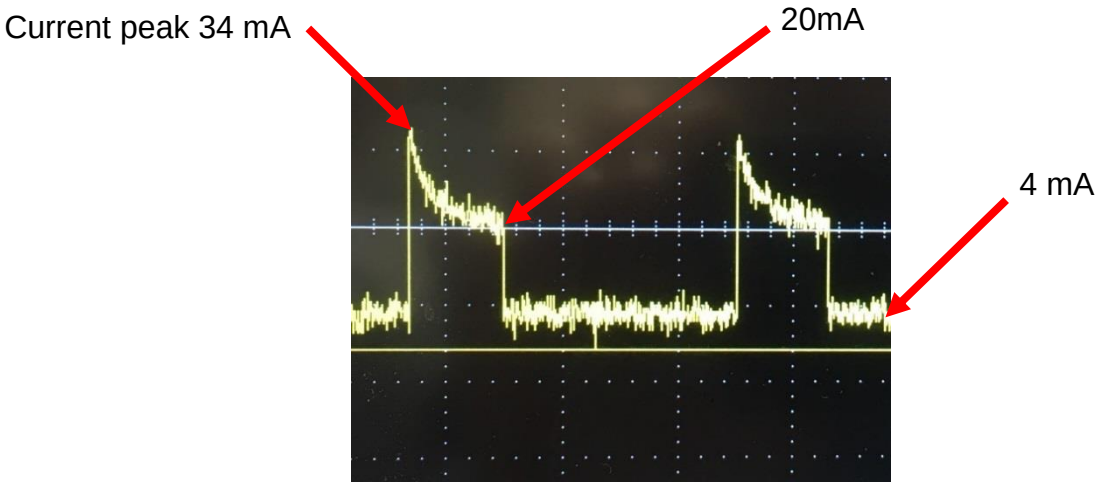
Both the voltage at the output pin during the “warm-up” time, and the duration of the “warm-up” time can be pre-programmed to alternative values at the time of ordering sensors.

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.
The current consumption varies during the program cycle as shown below. The peak current is around 34mA whilst the infrared source is powered, falling to around 20mA, and the current whilst the source is turned off is around 4mA.
The net average current with a 3V power supply is 8mA. The average power consumption is 24mW.



Current waveform for Premier Low Power 2 sensor

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

Refer to tds0045 Communication Protocol for further details.
Contact Dynament Ltd. to obtain the document.

SPECIFICATION @ 20°C (68°F) ambient temperature	
Operating Voltage Range:	3.0 – 5.0 V d.c.
Operating Current:	Average current 8mA. See graph on page 6
Programmable Output Voltage Ranges:	0.1V to 2.5V d.c.
Volume measuring ranges:	0 - 5%, 0-4%, 0-3%, 0-2%, 0-1% volume CO_2
Parts per million measuring ranges:	0-500ppm up to 0-10000ppm CO_2
Resolution:	0.01% for volume readings. 10ppm for parts per million readings.
Linearity:	The output is linear within ± 10% of the applied gas.
Warm up time:	To final zero ± 2% full-scale: approximately 1 minute, some sensors may take longer.
Accuracy:	± 10% of the applied gas, 1 bar pressure.
Pressure	± 5% of the calibration pressure to maintain the accuracy limits
Carbon dioxide response Time T_{50}:	<15s
Carbon dioxide response Time T_{90}:	<30s
Zero Repeatability:	± 2% of full scale
Span Repeatability:	± 2% of full scale
Long term zero drift:	± 1% of full scale / 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 the applied gas up to 50% of the full scale and ± 15% of the applied gas from 50% to 100% of the full scale.
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 Sensor ‘zero’ function Sensor ‘span’ function Over-range value
MTBF:	> 5 years
Weight :	15 grams

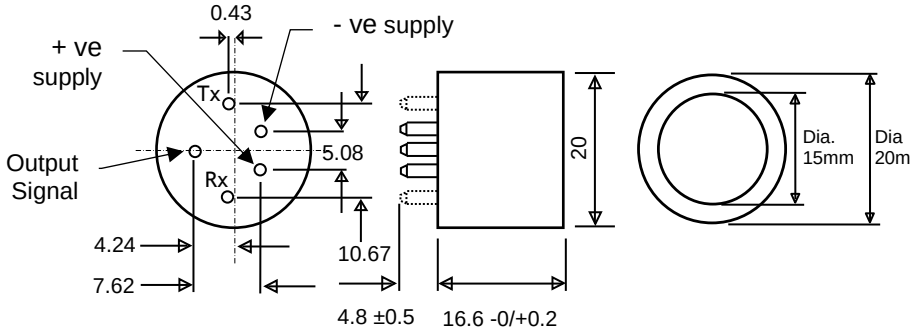
CERTIFICATION DETAILS

European ATEX Certification	Sensor types MSH2-LP2	Sensor types MSH2ia-LP2
Approval body	FTZU	FTZU
Certificate Number	FTZU 14 ATEX 0213U (See footnote 2)	FTZU 14 ATEX 0213U (See footnote 2)
Test Standards	EN 60079-0:2012 + A11:2013 EN 60079-1:2014 EN 60079-11:2012	EN 60079-0:2012 + A11:2013 EN 60079-1:2014 EN 60079-11:2012 EN 50303:2000
Certification Codes	I M2 Ex db I Mb II 2 G Ex db IIC Gb	I M1 Ex db ia I Ma II 2 G Ex db IIC Gb
Input parameters	0.8W max, 30V max. (See footnote)	Ui=6V dc, Pi=0.8W (See footnote)
Operating temperature	-20°C to +60°C (See footnote 1)	
International IECEx Certification	Sensor types MSH2-LP2	Sensor types MSH2ia-LP2
Approval body	FTZU	FTZU
Certificate Number	IECEx FTZU 15.0002U (See footnote 2)	IECEx FTZU 15.0002U (See footnote 2)
Test Standards	IEC60079-0:2011, Edition 6 IEC60079-1:2014-06, Edition 7	IEC60079-0:2011, Edition 6 IEC60079-1:2014-06, Edition 7 IEC60079-11:2011, Edition 6
Certification Codes	Ex db I Mb, Ex db IIC Gb	Ex db ia I Ma, Ex db IIC Gb
Input parameters	0.8W max, 30V max.	Ui=6V dc, Pi=0.8W
Operating temperature	-20°C to +60°C (See footnote 1)	

North American Certification	Sensor type MSH2-LP2	Sensor type MSH2ia-LP2
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

Note1 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

Warranty information

All Dynament Premier 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**

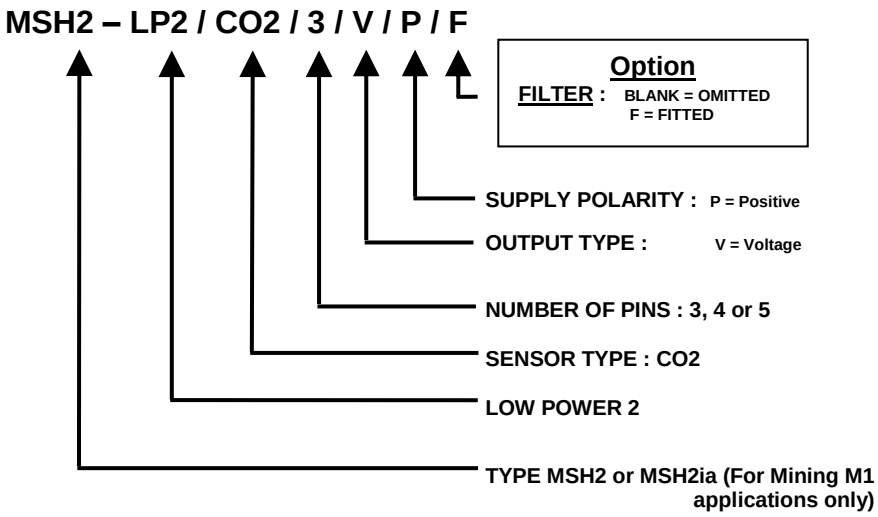
Dynament reserve the right to alter technical specifications, without prior notice, when it is appropriate to implement a technical enhancement that leads to improved performance.
Should any changes be required that could affect the customer's use of the product, Dynament will endeavour to contact customers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

EXAMPLE OF ORDER CODES



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. Sensitivity e.g. 0.4 – 2.4V = 5% volume CO2
4. Communication speed – 38,400 baud (default), specify alternative rate if required.
5. Over-range value: 100%, 125%, 150% and 200% of full-scale value.