

LOW POWER VERSION
DUAL RANGE CARBON DIOXIDE SENSOR
Exd Certified versions

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



MSH2-LS/CO2
MSH2ia-LS/CO2



MSH2-LP/CO2
MSH2ia-LP/CO2

- Use 80% less power than the regular power sensors
- Drop-in replacement
- No loss of performance
- Uses the same well established technology

FEATURES

- ★ Can be configured for 0-5% volume carbon dioxide and 0-10,000ppm carbon dioxide when using the digital output.
- ★ Can be configured for 0-5% volume, or 0-10,000ppm carbon dioxide when using the analogue output.
- ★ Offers reduced response times when compared with earlier versions.
- ★ Contains all the necessary optics, electronics and firmware to provide a linearised, temperature-compensated output.
- ★ 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.
- ★ Analogue output is scaleable in % volume or % FSD.
- ★ 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.

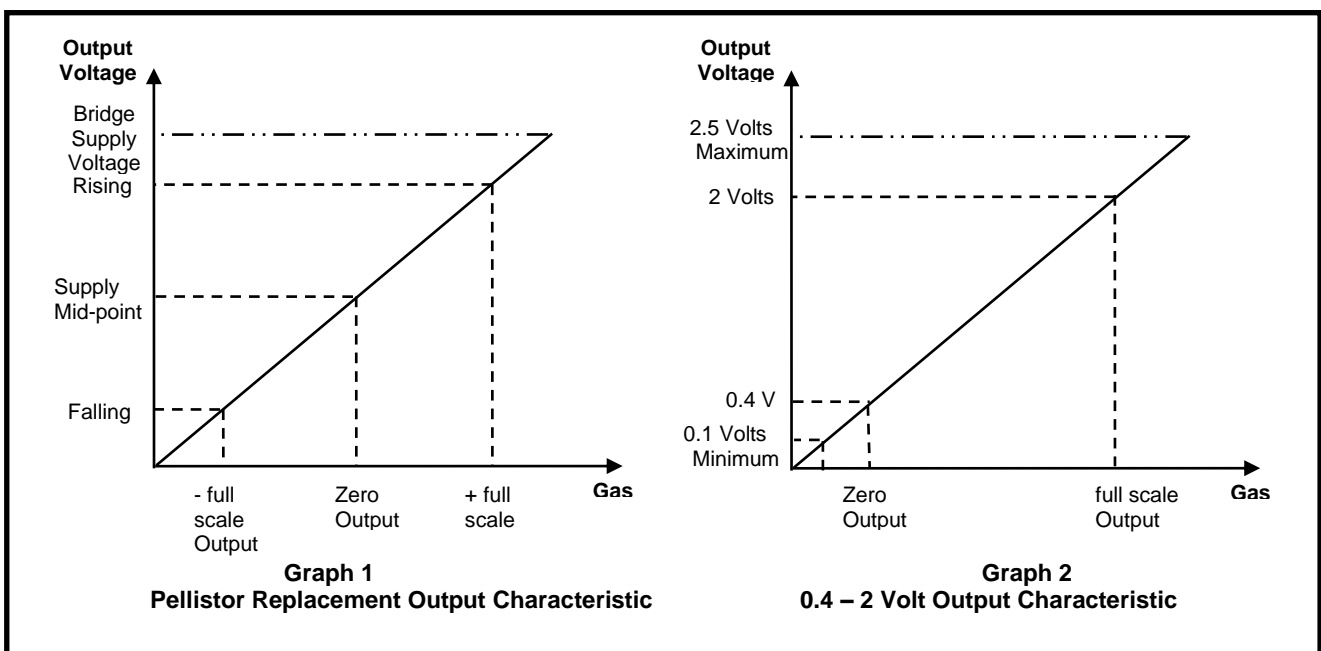
Note that because the sensor supply current varies during operation, it is possible that this version of the sensor may not be suitable for all pellistor based instruments, without some modifications.

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.



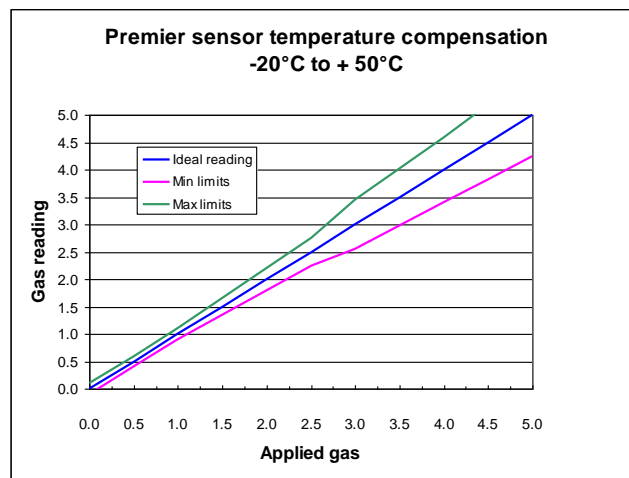
Patent Protection

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] 1544603
Switzerland	EP [CH] 1544603
USA	7, 244, 939
Other World Patents Pending	

Carbon dioxide Temperature Compensation

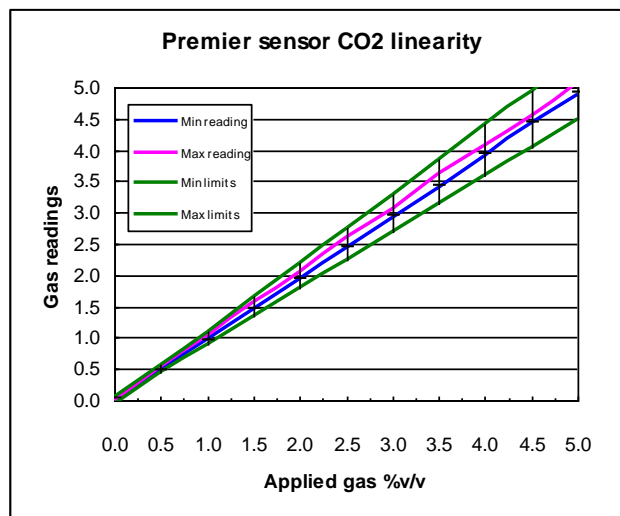
The Premier sensor is temperature compensated over the range of -20°C to +50°C. The output variation is $\pm 0.1\%$ v/v or $\pm 10\%$ of the reading up to 50% full scale and $\pm 15\%$ of the reading from 50% to 100% full scale, which ever is greater.



Carbon dioxide Linearity

The Premier sensor linearity at ambient temperature is $\pm 2\%$ full-scale or $\pm 10\%$ of the reading which ever is greater.

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



Calibration options

Dynamant recommend a maximum interval of 12 months between calibration checks. A small amount of zero drift can be accommodated 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.

The sensor has three ranges allowing the full-scale setting from 500 parts per million up to 5% volume depends on the requirement.

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 Dynamant.
- 3) By using the "Manual Calibration". “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.

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.

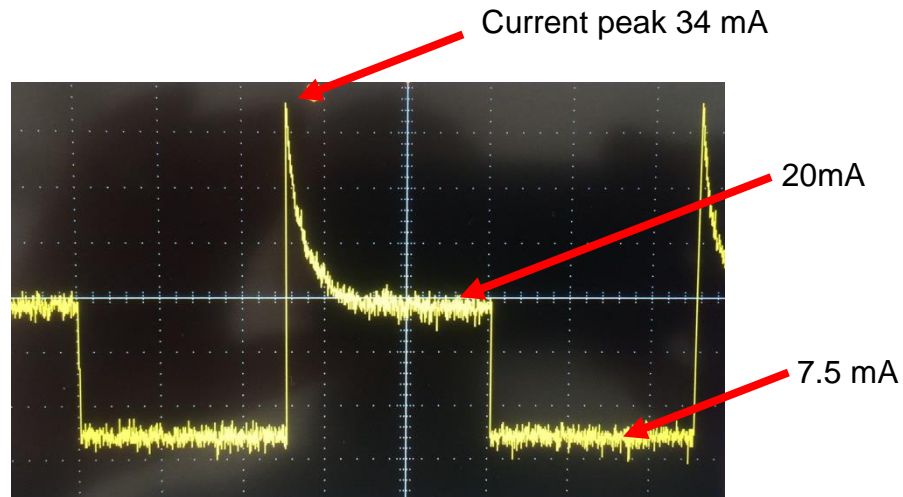
The Premier sensor employs a pyroelectric detector, the output from which can be disrupted by sudden changes in temperature. If there is an excessive change in the ambient temperature, gas sample temperature or flow rate, then the output signal will be momentarily frozen. Correct operation is restored 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 at a rate of 2Hz. The peak current is 34mA, the current whilst the infrared source is powered is 20mA and the current whilst the source is turned off is 7.5mA.

The average current with a 3V power supply is 15mA.



Current waveform for Premier low power 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 - $0.8 V_{DD} = 2.24V$

RX - VIL: Input ‘Low’ maximum voltage - $0.2 V_{DD} = 0.56V$

TX - VOH: Output ‘High’ minimum voltage - $V_{DD} - 0.7 = 2.1$

TX - VOL: Output ‘Low’ maximum voltage - $0.6V$

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

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:	Average current 15mA. See graph on page 5
Programmable Output Voltage Ranges:	Voltage Output Types – 0.1V to 2.7V d.c. Bridge Output Types – 0v to Bridge Supply Voltage
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. Output voltage resolution 42.7 μV.
Linearity:	The output is linear within ± 10% of the gas reading
Warm up time:	To final zero ± 2% full-scale: approximately 1 minute, some sensors may take longer.
Accuracy:	± 10% of the reading, 1 bar pressure, applied gas.
Pressure	± 5% of the calibration pressure to maintain the accuracy limits
Carbon dioxide response Time T₅₀:	<15s
Carbon dioxide response Time T₉₀:	<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 reading up to 50% of the full scale and ± 15% of reading 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 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 MSH2-LP, MSH2-LS	Sensor types MSH2ia-LP, MSH2ia-LS
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 50303:2000	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-LP, MSH2-LS	Sensor types MSH2ia-LP, MSH2ia-LS
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 IEC60079-1:2007-04, Edition 6	IEC60079-0:2011, Edition 6 IEC60079-1:2007-04, Edition 6 IEC60079-11:2011, Edition 6
Certification Codes	Ex d I Mb Ex db IIC Gb	Ex d 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-LP	Sensor type MSH2ia-LP
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.		
Note 2 SIL Certificate number for all variants is SIRA FSP 14002/01		

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

MSH2 – LP / CO2 / 3 / B / P / F

Option

FILTER : BLANK = OMITTED
F = FITTED

SUPPLY POLARITY : P = Positive
N = Negative

OUTPUT TYPE : B = Bridge
V = Voltage

NUMBER OF PINS : 3, 4 or 5

SENSOR TYPE : CO2

LOW POWER: LP = Non SIL
LS = SIL1

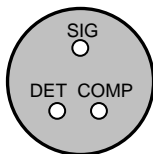
TYPE MSH2 or MSH2ia (For Mining M1 applications only)

CONFIGURATION OPTIONS

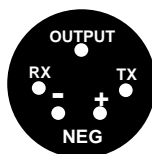
(To be stated on customer order in addition to the Order Code)

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 CH₄ for "Bridge" outputs, 0.4 – 2.4V = 100% volume methane 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

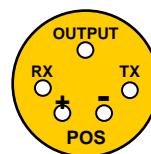


Typical Pellistor Pinout



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.