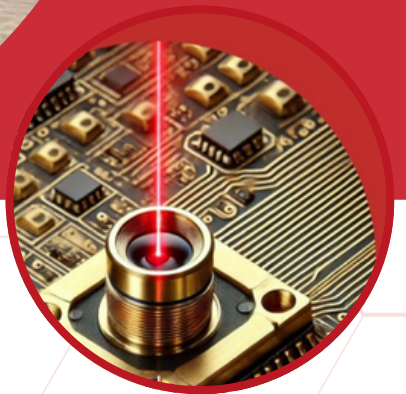


Preliminary Datasheet

OEM GAS SENSORS MIRCHIPX



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1.1 Metrics definition

We define below the main performance metrics used in the current datasheet.

- **Limit of Detection (LOD):** The LOD is defined according to the ISO-11843 standards. Applied to our technology characterized by a Rician statistic noise floor, it corresponds to approximately 6 times the standard deviation σ , evaluated over a time period of a 2minutes measurement at stable reference conditions with set point 0ppm and without any baseline. The LOD of the system can be improved by mean of averaging.
- **Averaging time:** A noise smoothing method using an Infinite Impulse Response (IIR) filter is applied on measured concentration values. The averaging time expresses the period of time of past measurements considered to compute the next averaged value. The averaging time can be set up to 600s. Note that the averaging duration constitutes a lower limit to the response time of the sensor.
- **Precision:** The precision is defined as the standard deviation of a 2minutes measurement at stable reference conditions over the full measuring range. The precision of the system can be improved by mean of averaging.
- **Accuracy:** The accuracy is defined as the difference between the mean response during a 2 minutes time interval and the reference value at reference conditions. Variations of the operating temperature and pressure can affect the accuracy of the system.

Detection CH₄

1.2 Gas detection for MirchipX CH₄

Reference conditions (if not otherwise specified): operating temperature 20°C, pressure 1013hPa and humidity 50%r.H., power supply 12 : - 24 VDC, gas matrix : Ambient Air (see 2.1 for more details).

Parameter	Unit	Value / Range	
Principle of Measurement	-	PhotoAcoustic Spectroscopy (PAS)	
Target Gas	-	CH ₄	
Measuring Range	ppm	0 – 200 (Linear Range=LR ¹)	0 – 40 000 (Full Scale=FS)
Response Time (T 10-90)	s	Down to 4 (1l/min 1s averaging)	
Limit Of Detection	ppm	≤ 0.3 with 1s averaging time ≤ 0.04 with 60s averaging time	
Precision σ	-	Max 1% of read value or LOD/3	
Accuracy	-	± 1	
Linearity and Repeatability	-	Included in the accuracy	
Recommended Calibration	-	Frequency 12 month	
Start-up Time	s	≤ 300	

A known limitation of laser spectroscopy is absorption cross interference : molecules other than the target in the gas matrix can absorb laser light. We provide below known relevant cross interferent coefficients for most common interfering molecules:

Interfering molecule	Cross interference coefficient [ppm/[% interferent]]
H ₂ O	<0.033
N ₂ O	<1000

¹ Can be improved with additional optional tests.
Please contact Mirsense for more details.

Detection NH₃

1.3 Gas detection for MirchipX NH₃

Reference conditions (if not otherwise specified): operating temperature 20°C, pressure 1013hPa and humidity 50% r.H., power supply 12 : - 24 VDC, gas matrix : Ambient Air (see 2.1 for more details).

Parameter	Unit	Value / Range	
Principle of Measurement	-	PhotoAcoustic Spectroscopy (PAS)	
Target Gas	-	NH ₃	
Measuring Range	ppm	0 – 40 (Linear Range=LR ³)	0 – 100 (Full Scale=FS)
Response Time (T10-90)	s	Down to 10 (1l/min 1s averaging) ⁴	
Limit Of Detection	ppb	≤ 25 with 10s averaging time	
Precision σ	-	Max 1% of read value or LOD/3	
Accuracy	-	±1	
Linearity and Repeatability	-	Included in the accuracy	
Recommended Calibration	-	Frequency 12 month	
Start-up Time	s	≤ 300	

A known limitation of laser spectroscopy is absorption cross interference : molecules other than the target in the gas matrix can absorb laser light. We provide below known relevant cross interferent coefficients for most common interfering molecules:

Interfering molecule	Cross interference coefficient [ppm/[% interferent]]
None	-

³ Can be improved with additional optional tests.

⁴ The response time is limited by adsorption of the NH₃ molecule to the surfaces of the analyzer. While MirchipX accurately measure the concentration within its cavity, calculating the actual flux of ammonia will be convolved by the adsorption dynamics within the integrator's system.

Detection N₂O

1.4 Gas detection for MirchipX N₂O

Reference conditions (if not otherwise specified): operating temperature 20°C, pressure 1013hPa and humidity 50% r.H., power supply 12 : - 24 VDC, gas matrix : Ambient Air (see 2.1 for more details).

Parameter	Unit	Value / Range	
Principle of Measurement	-	PhotoAcoustic Spectroscopy (PAS)	
Target Gas	-	N ₂ O	
Measuring Range	ppm	0 – 180 (Linear Range=LR ⁵)	0 – 1000 (Full Scale=FS)
Response Time (T10-90)	s	Down to 4 (1l/min 1s averaging)	
Limit Of Detection	ppb	≤ 200 with 4s averaging time ≤ 50 with 60s averaging time	
Precision σ	-	Max 1% of read value or LOD/3	
Accuracy	-	±1	
Linearity and Repeatability	-	Included in the accuracy	
Recommended Calibration	-	Frequency 12 month	
Start-up Time	s	≤ 300	

A known limitation of laser spectroscopy is absorption cross interference : molecules other than the target in the gas matrix can absorb laser light. We provide below known relevant cross interferent coefficients for most common interfering molecules:

Interfering molecule	Cross interference coefficient [ppm/[% interferent]]
H ₂ O	<0.06
CH ₄	<400

⁵ Can be improved with additional optional tests.

Detection CO₂

1.5 Gas detection for MirchipX CO₂

Reference conditions (if not otherwise specified): operating temperature 20°C, pressure 1013hPa and humidity 50% r.H., power supply 12 : - 24 VDC, gas matrix : Ambient Air (see 2.1 for more details).

Parameter	Unit	Value / Range	
Principle of Measurement	-	PhotoAcoustic Spectroscopy (PAS)	
Target Gas	-	CO ₂	
Measuring Range	ppm	0 – 1000 (Linear Range=LR ⁶)	0 – 5000 (Full Scale=FS)
Response Time (T10-90)	s	Down to 4 (1l/min 1s averaging)	
Limit Of Detection	ppm	≤ 1 with 4s averaging time	
Precision σ	-	Max 1% of read value or LOD/3	
Accuracy	-	+/-0,5 ppm or +/-0,2% of the reading, whichever is greater	
Linearity and Repeatability	-	Included in the accuracy	
Recommended Calibration	-	Frequency 12 month	
Start-up Time	s	≤ 300	

A known limitation of laser spectroscopy is absorption cross interference : molecules other than the target in the gas matrix can absorb laser light. We provide below known relevant cross interferent coefficients for most common interfering molecules:

Interfering molecule	Cross interference coefficient [ppm/% interferent]
H ₂ O	<0.15

⁶ Can be improved with additional optional tests.

Detection H₂O

1.6 Gas detection for MirchipX H₂O

Reference conditions (if not otherwise specified): operating temperature 20°C, pressure 1013hPa and humidity 50% r.H., power supply 12 : - 24 VDC, gas matrix : Biomethane (see 2.2 for more details).

Parameter	Unit	Value / Range	
Principle of Measurement	-	PhotoAcoustic Spectroscopy (PAS)	
Target Gas	-	H ₂ O	
Measuring Range	ppm	0 – 300 (Linear Range=LR ⁷)	0 – 1000 (Full Scale=FS)
Response Time (T10-90)	s	Down to 10 (1l/min 1s averaging) ⁸	
Limit Of Detection	ppb	≤ 200 with 1s averaging time ≤ 80 with 60 s averaging time	
Precision σ	-	Max 1% of read value or LOD/3	
Accuracy	-	+/-0,5 ppm or +/-2,5% of the reading, whichever is greater	
Linearity and Repeatability	-	Included in the accuracy	
Recommended Calibration	-	Frequency 12 month	
Start-up Time	s	≤ 300	

A known limitation of laser spectroscopy is absorption cross interference : molecules other than the target in the gas matrix can absorb laser light. We provide below known relevant cross interferent coefficients for most common interfering molecules:

Interfering molecule	Cross interference coefficient [ppm/[% interferent]]
CO ₂	<0.2
CH ₄	<0.1

⁷ Can be improved with additional optional tests.

⁸ The response time is limited by adsorption of the H₂O molecule to the surfaces of the analyzer. While MirchipX accurately measure the concentration within its cavity, calculating the actual flux of ammonia will be convolved by the adsorption dynamics within the integrator's system.

2. Gas Matrix limitations

2.1 Ambient Air

We provide below the matrix composition of ambient air.

If your application is not covered by the below ranges, please contact Mirsense to assess its feasibility.

Parameter	Unit	Value / Range
Gas Matrix Composition	-	<ul style="list-style-type: none"> • O₂ : ~ 78% O₂ : ~ 21% Ar • : < 1% • Ne, He, Kr : <100 ppm • Other molecules < 1ppm <ul style="list-style-type: none"> • CO₂ : between 0ppm and 2000 ppm • H₂O: between 0 and 75000 ppm

2.2 Biomethane

We provide below the typical matrix composition of biomethane. If your application is not covered by the below ranges, please contact Mirsense to assess its feasibility.

Parameter	Unit	Value / Range
Gas Matrix Composition	-	<ul style="list-style-type: none"> • CH₄ : between 95% and 100% • N₂ : between 0% and 5% • O₂ : between 0% and 2% • CO₂ : between 0% and 5% • H₂S : between 0 and 20ppm • H₂O: between 0 and 1000ppm • Other molecules < 1ppm

3. General Characteristics

3.1 Gas sampling conditions

The supplied gas should be clean.

Parameter	Unit	Value / Range
Gas Temperature Limitation	°C	0 to +85, non-condensing
Gas Pressure Limitation	Bar	0.5 to 2 absolute
Gas Flow (min - max)	ml / min	10 - 1'000

3.2 Environnement conditions

Parameter	Unit	Value / Range
Ambient Temperature	°C	0 - 50
Ambient Humidity	%	0 – 99
Storage Temperature	°C	-40 - 80
Storage Humidity	%	0 – 99

3.3 Mechanical characteristics

Parameter	Unit	Value / Range
Dimensions of sensor module (LxWxH)	mm	150 x 100 x 75
Approx. weight sensor module	g	1500
Fluid connectors		Festo QS- G1/8-4-I

3.4 Communication interface

Parameter	Unit	Value / Range
Connector type Interface	-	DB15
Physical Standard	-	Serial RS 232
Communication protocol	-	MODBUS RTU protocol
Sampling rate	Hz	≤ 10
Resolution	ppb	≤ 1

3.5 Electrical characteristics

Parameter	Unit	Value / Range
Voltage supply (min. – max)	VDC	12 - 24 (max. current 4A)
Power consumption in operation	W	≤ 10
Power consumption at startup (min. – max)	W	Between 10 and 50, can be adjusted depending on the need for quick startup.

4 Norms and Regulations

Type	Standard / Directive	Limits / description
Platform conformity	REACH, CE RoHS,	
Electronics conformity	WEEE EN/IEC	
EMC*	61326-1 EN/IEC 61000-6-2 EN/IEC 61000-6-3	
Shock*	EN60068-2-27	
Vibration*	EN60068-2-6	
Drop Test*	EN 22248	Free fall with packaging
Safety of laser products - Part 1 : classification requirements	SN EN 60825:1:2014- 08 Safety of laser products - Part 1: Equipment classification and requirements	CLASS 3 LASER PRODUCT

* Under certification process