TECHNICAL INFORMATION

Series S800 Gas Analyzers: Sensor Module OXOR-P

Description
Operating Functions
Technical Data

These Instructions are intended exclusively for trained personnel.
Unauthorized intervention voids the manufacturer's warranty.

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Document Information

Described Product

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Basic device:	Series S800 gas analyzers
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Glossary

Firmware: Internal device software; mainly stored in volatile memory (EEPROMs)

PC: Personal Computer

SOPAS (SICK Open Portal for Applications and Systems): Family of computer programs to set parameters, capture and calculate data.

SOPAS ET (SOPAS Engineering Tool): PC application program to configure modular system components.

Susceptibility: Magnetic susceptibility is the parameter for the magnetizability of a substance in a magnetic field.

Warning Symbols

Hazard (general)

Warning levels / Signal words

CAUTION
Hazard or unsafe practice which *could* result in personal injury or property damage.

NOTICE
Hazard which *could* result in property damage.

Information Symbols

Important technical information for this product

Nice to know

Supplementary information

Link to information at another place

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Sensor Module OXOR-P

1 Important Information

Application limitations
Additional documentation

1.1 Application limitations

Suitability

► Do not use the standard version to measure corrosive sample gases or those containing solvents (alternative versions → p. 9, § 2.5).

Measuring precision

Measurement errors can occur when the sample gas contains gas components that have a considerable magnetic susceptibility.

- Explanation → p. 8, § 2.2
- Quantitative specifications → p. 25, § 5.4

Cross-sensitivity against a particular gas component is minimized automatically when the Series S800 also measures the concentration of this gas component.

1.2 Additional documentation/information

This document supplements the Operating Instructions for S800 series gas analyzers. It extends the “S800 series” Operating Instructions with technical information on the Sensor Module OXOR-P.

► Observe the Operating Instructions delivered with the “S800 series”.

The "S800 series" Operating Instructions also specify all further documents belonging to the individual device.

NOTICE:

► Pay primary attention to the individual information provided.

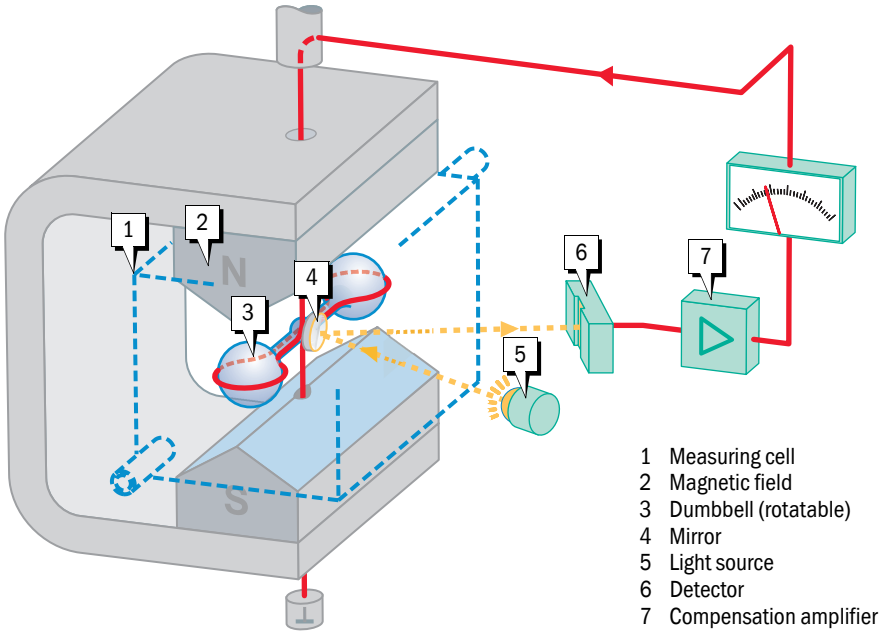
Sensor Module OXOR-P

2 Product Description

Measuring principle
Measuring ranges

2.1 Measuring principle

Fig. 1 OXOR-P measuring cell (schematic)



The measuring cell of the OXOR-P module has a magnetic field in which a diamagnetic dumbbell is suspended. An opto-electronic compensation device ensures the dumbbell is continuously kept in the home position.

Sample gas flows through the measuring cell. When the sample gas contains O_2, the paramagnetic property of the O_2 changes the magnetic field. The change required for opto-electronic compensation is the measuring effect evaluated by the software.

2.2 Selectivity

The selectivity of the OXOR-P module is based on the extraordinary large magnetic susceptibility of oxygen. In comparison, the magnetic properties of other gases are so low that these need not be considered in the normal case. Measurement errors can occur when the sample gas contains gas components that have a considerable magnetic susceptibility. There are several methods available for compensation (→ p. 22, § 4.2).

2.3 Physical measuring range

The “physical measuring range” corresponds to the measurement signals range created selectively by the measuring system for a gas component. These measurement signals are corrected metrologically (linearized), converted to physical units and then displayed as measured value. Further output ranges can be calculated from the physical measuring range.

The metrological specifications are valid for the respective physical measuring range. A measuring range with higher measuring precision (option) can be created in the range 0 ... 20% of the physical measuring range.

For information on the measuring components and measuring ranges of your S800, see the order and delivery documents.

2.4 Extended options for measuring components

Several “measuring components” can be setup at the factory for a single gas component with the respective measured value processing (linearization) and adjustment. This offers the following options:

- A unique “measuring component” is created for each measuring range to support several measuring ranges. This means each measuring range functions with own, precise measured value processing parameters and the measuring ranges can (and must) be adjusted independent of each other.
- Several measured value computations can be setup for a single gas component. For example, the gas concentration can be displayed with or without cross-sensitivity compensation. This means displays and menu functions contain several “measuring components” originating from one measured gas component.

2.5 Product variants

Standard version:	Measuring cell made of standard materials (→ p. 26, § 5.6) – not resistant against corrosive substances or those containing solvents
Option:	Corrosion resistant measuring cell
Option:	Measuring cell resistant against gases containing solvents

► See the delivery documents for the product variant delivered.

Sensor Module OXOR-P

3 Menu Functions

Menu tree
Explanations
Availability at user levels

3.1 Menu structure (menu tree)

User level:	O Operator (standard)	A Authorized operator	
Access rights:	❍ Viewing	● Setting up/starting	
Symbols:	Folder	Menu	◎ LED symbol

Directory	Menu contents	O	A	Explanation [No.]
OXOR				
Login	User level	●	●	[1] (→ p. 14)
	Password	●	●	[2] (→ p. 14)
Upload all parameters from device				[3] (→ p. 14)
Measured value display				
Measuring component 1	Component	❍	●	[4] (→ p. 14)
	Measured value	❍	❍	[5] (→ p. 14)
	Physical unit	❍	❍	[6] (→ p. 14)
Measuring components 2 ... 4				
Diagnosis				
State of module	Failure ◎	❍	❍	[8] (→ p. 14)
	Request for maintenance ◎	❍	❍	[9] (→ p. 14)
	Function(s) active ◎	❍	❍	[10] (→ p. 14)
	Unsafe state ◎	❍	❍	[11] (→ p. 15)
Logbook	Pos. | Date | Source | ...	–	❍	→ p. 17, § 3.3.2
Operating hours	h	–	❍	[12] (→ p. 15)
Measuring component 1				
Name / Unit	Component	❍	❍	[4] (→ p. 14)
	Physical unit	❍	❍	[6] (→ p. 14)
	Measuring channel	❍	❍	[7] (→ p. 14)
State	Failure ◎	❍	❍	[8] (→ p. 14)
	Request for maintenance ◎	❍	❍	[9] (→ p. 14)
	Function(s) active ◎	❍	❍	[10] (→ p. 14)
	Unsafe state ◎	❍	❍	[11] (→ p. 15)
Validation measurement (QAL3)	Zero point			
	Date	❍	❍	[13] (→ p. 15)
	Time	❍	❍	[14] (→ p. 15)
	Nominal value	❍	❍	[15] (→ p. 15)
	Measured value	❍	❍	[16] (→ p. 15)
	Reference point			
	Date	❍	❍	
	Time	❍	❍	
	Nominal value	❍	❍	
	Measured value	❍	❍	
Measuring components 2 ... 4				

Directory	Menu contents	O	A	Explanation [No.]
Parameter setting				
Sampling point	Name	–	●	[17] (→ p. 15)
RS485 parameters	Module address	–	❍	[18] (→ p. 15)
	Baud rate	–	●	[19] (→ p. 15)
	Data bits	–	●	[20] (→ p. 15)
	Stop bits	–	●	[21] (→ p. 15)
	Parity	–	●	[22] (→ p. 15)
Measuring component 1				
Physical measuring range	Component	❍	●	[4] (→ p. 14)
	Physical unit	❍	❍	[6] (→ p. 14)
	Start value	❍	❍	[23] (→ p. 15)
	End value	❍	❍	[24] (→ p. 15)
	Basic value	❍	❍	[25] (→ p. 15)
	Measuring channel	❍	❍	[7] (→ p. 14)
	Measuring range 2 [On]/[Off]	❍	❍	[26] (→ p. 15)
Damping				
Damping (el. T90%)	Time constant [s]	–	●	→ p. 19, § 3.3.4
Dynamic damping	Status [On]/[Off]	–	●	→ p. 19, § 3.3.4
	Time constant [s]	–	●	
	Threshold	–	●	
Measuring components 2 ... 4				
Adjustment				
Measuring component 1				
Drift limit value	Zero point	–	❍	→ p. 18, § 3.3.3
	Reference point	–	❍	→ p. 18, § 3.3.3
Adjustment result				
Adjustment result	Zero point			
	Date	❍	❍	[13] (→ p. 15)
	Time	❍	❍	[14] (→ p. 15)
	Nominal value	❍	❍	[15] (→ p. 15)
	Measured value	❍	❍	[16] (→ p. 15)
	Reference point			
	Date	❍	❍	
	Time	❍	❍	
	Nominal value	❍	❍	
	Measured value	❍	❍	
Drifts	Zero point			[29] (→ p. 15)
	Last	❍	❍	
	Total	❍	❍	
	Reference point			[29] (→ p. 15)
	Last	❍	❍	
	Total	❍	❍	
Measuring components 2 ... 4				

Directory	Menu contents	O	A	Explanation [No.]
Maintenance				
Maintenance identification	[On]/[Off]	–	●	[30] (→ p. 15)
Fuses				
User settings	Saving	–	●	[31] (→ p. 15)
	Loading	–	●	[31] (→ p. 15)
Factory settings	Loading	–	●	[32] (→ p. 15)
Factory settings				
Identification				
ID numbers	Serial number	❍	❍	[33] (→ p. 15)
	Material No.	❍	❍	[34] (→ p. 15)
	Hardware version	❍	❍	[35] (→ p. 15)
	Software version	❍	❍	[36] (→ p. 15)
Date of manufacture	Year	–	❍	[37] (→ p. 15)
	Month	–	❍	
	Day	–	❍	

3.2 Menu explanation

[No.] see menu structure (→ p. 12, §3.1); further explanations → p. 16, §3.3

No.	Name	Explanation
[1]	User level	*Only present in the SCU operating unit* – Password entry to set desired user level (→ see SCU Operating Instructions). ● In the BCU operating unit, a Login function valid for all modules is used instead (→ see BCU Operating Instructions *[in preparation]*). ● These functions are realized as menu functions in the "SOPAS ET" PC software.
[2]	Password	
[3]	Upload all parameters from device	*Only present in the SCU operating unit* → p. 16, §3.3.1
[4]	Component	Name of measuring component
[5]	Measured value	Current measured value of measuring component
[6]	Physical unit	Physical unit of measured value
[7]	Measuring channel	Internal measurement signal source
[8]	Failure	LED symbol ● *Significance:* Module not ready for operation ● *Possible causes:* Malfunction, defective
[9]	Request for maintenance	LED symbol ● *Significance:* Advance warning before internal technical limits reached. ● *Possible causes:* Drift limit value, operating hours, lamp intensity
[10]	Function(s) active	LED symbol ● *Significance:* At least one internal function active that impairs or hinders normal module measuring function. ● *Possible causes:* Adjustment procedure running, validation measurement running

No.	Name	Explanation
[11]	Unsafe state	LED symbol ● *Significance:* Current measured values are unreliable. ● *Possible causes:* Heating up phase, internal over/under temperature, adjustment procedure programming not plausible
[12]	h	Number of hours of operation (after start of internal counter)
[13]	Date	Day/time when last adjustment procedure was ended
[14]	Time	
[15]	Nominal value	Nominal value for adjustment
[16]	Measured value	Measured value from last adjustment
[17]	Name	Freely selectable text for module name
[18]	Module address	Internal CAN bus address of module (defined by hardware setting in module)
[19]	Baud rate	Transfer speed (standard: 9600)
[20]	Data bits	Number of data bits (standard: 8) The S800 only uses the 7-bit range (ASCII code 0 ... 127) but can also communicate in 8-bit format.
[21]	Stop bits	Number of stop bits (1 or 2; standard: 2)
[22]	Parity	Additional identification for automatic monitoring of character transfers; [Even], [Odd], [None]. – Standard: None
[23]	Start value	Start value of physical measuring range
[24]	End value	End value of physical measuring range
[25]	Basic value	Standard: “0"; with flowing reference gas (UNOR): Average or typical concentration in reference gas
[26]	Measuring range 2 [On]/[Off]	[On] = higher measuring precision is available for measuring range 2 (effective in range 0 ... 20% of physical measuring range)
[27]	Zero point	Drift limit value for zero point drift
[28]	Reference point	Drift limit value for reference point drift
[29]	Drifts	● Last = since last adjustment ● Total = since last drift calculation initialization
[30]	Maintenance identification	[On] = Status “Request for maintenance" is activated (here as signal for active maintenance work)
[31]	User settings	[Save] = stores a copy of current module settings in the module data memory (EEPROM) [Load] = replaces current module settings with the “saved" settings
[32]	Factory settings	[Load] = replaces current module settings with original factory settings (a copy of these settings is stored in the module)
[33]	Serial number	Individual module serial number
[34]	Material No.	Module version identification
[35]	Hardware version	Module electronics version number
[36]	Software version	Module firmware version number
[37]	Date of manufacture	Module date of manufacture (factory specification)

3.3 Menu functions explanations

3.3.1 Upload function

Only applicable when the "SOPAS ET" PC software is used. Not applicable for systems without operating unit (special versions).

Upload function in the "SOPAS ET" PC software

The new data are not transferred automatically to "SOPAS ET" after settings for a module have been changed on the operating unit. "SOPAS ET" continues using the "old" data.

► *To transfer the current data of a module to "SOPAS ET":* Start the "Upload all parameters from device" function in "SOPAS ET" once.

Upload function in the SCU operating unit

The new data are not transferred automatically to the SCU after parameters for a module have been changed. The SCU continues using the "old" data. The "Upload all parameters from device" function serves to transfer the module data with the exception of certain alphanumeric data (e.g. names of measuring components and measuring point).

► *To transfer the current numeric parameters of a module to the SCU:* Start the "Upload all parameters from device" function in the SCU once.

► *To transfer all the current parameters of a module to the SCU:* Switch the S800 off and then switch it on again after a few seconds.

Upload function in the BCU operating unit

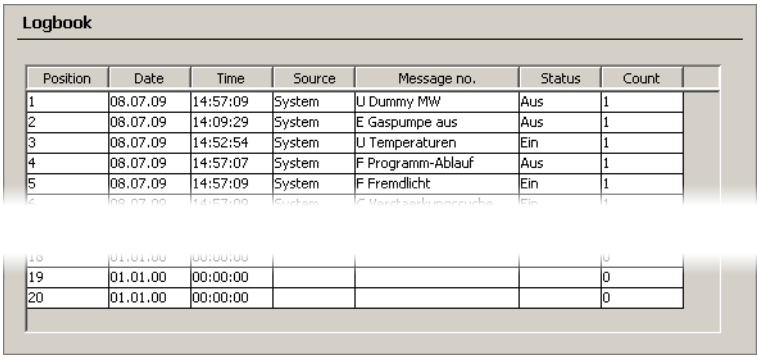
The BCU operating unit loads the current parameters of a module automatically when a corresponding menu function is called. However, certain alphanumeric data are excluded (e.g. names of measuring components and measuring point).

► *To transfer the current alphanumeric parameters of a module to the BCU:* Start the "Parameter upload" function in the SCU once (→ Operating Instructions of BCU operating unit *[in preparation]*).

3.3.2 Logbook

The Logbook Table shows the last 20 internal malfunction messages.

Fig. 2 “Logbook” menu in “SOPAS ET” (example)



Logbook

Position	Date	Time	Source	Message no.	Status	Count
1	08.07.09	14:57:09	System	U Dummy MW	Aus	1
2	08.07.09	14:09:29	System	E Gaspumpe aus	Aus	1
3	08.07.09	14:52:54	System	U Temperaturen	Ein	1
4	08.07.09	14:57:07	System	F Programm-Ablauf	Aus	1
5	08.07.09	14:57:09	System	F Fremdlicht	Ein	1
19	01.01.00	00:00:00				0
20	01.01.00	00:00:00				0

Column	Meaning
Position	Sequential number in Logbook
Date/Time	Time of last malfunction message change
Source	“System” = measuring system (hardware) “MV” = measuring component (measurement)
Message No.	Short message text, e.g. “F measured value”. The character prefix classifies the message: F = Failure C = Check (adjustment/validation) U = Uncertain (extra information) E = Extended (status message) M = Maintenance
Status	Current malfunction status (on/off)
Count	Total count of activations

3.3.3 Drift limit values

Purpose

Sensor module drifts are caused, for example, by contamination, mechanical changes or aging effects. The total drift (i.e. the deviation from original state) increases gradually. It is not practical to keep compensating an ever increasing overall drift through computation. Inspect and reset the Sensor module when total drift has become very large.

Drift limit values monitor total drift automatically; and protect against erroneous adjustments.

Functionality

After every adjustment, a Sensor module compares the calculated total drift with the drift limit value. Drift limit value violation is reported in two stages:

- Status “Maintenance requirement” is activated when the total drift reaches 100 ... 120% of the drift limit value.
- A “Failure message” is activated when the total drift reaches more than 120% of the drift limit value.
- When an adjustment procedure shows that a calculated drift has reached more than 150% of the drift limit value, the result from this adjustment procedure is ignored and the previous adjustment remains valid.

A Service function is available to reset all drift values to “0” (Drift reset). This is useful after Sensor module maintenance when this has established a new original state.

3.3.4 Damping

Constant damping

When you program a “damping”, the average value from the current measured value and the previous measured values (floating averaging) are displayed instead of the current measured value.

Possible uses include:

- Damping metrological measured value fluctuations (noise)
- Smoothing fluctuating measured values when only the average value is relevant

Damping is done in the Sensor module and therefore affects all measured value displays and outputs. It is also active during an adjustment procedure.

- Increasing damping normally increases the reaction time (90% time) of the gas analysis system accordingly.
- Reducing damping can possibly increase the measurement signal “noise” (measuring turbulence).
- Time constant = 0 s means: No damping.

CAUTION: Risk of incorrect adjustment

The “Measuring time, test gas” must be at least 150% of the set damping time constant during adjustments.

► *When damping has been setup anew or increased:* Check whether adjustment settings need to be adapted.

Dynamic damping

“Dynamic damping” serves to compensate measured value fluctuations without significantly increasing the reaction time. Dynamic damping is automatically deactivated when the measured value changes rapidly and strongly as against “normal” damping. This allows “smoothing” continuous minor measured value fluctuations but rapid measured value changes are still displayed without delay. Dynamic behavior is determined with the “Threshold” parameter:

- When the measured values change only slowly, dynamic damping functions as constant damping.
- When the difference of successive measured values is greater than the set threshold, dynamic damping is terminated automatically and remains disabled as long as the measured values continue to change rapidly.
- Dynamic damping is active again when measured value differences are below the threshold again (which means measured values changes remain slight).

Dynamic damping also affects all measured value displays and outputs.

Sensor Module OXOR-P

4 Adjustment

Test gases
Cross-sensitivity compensation
Adjustment interval

4.1 Test gases for adjustments

4.1.1 Basic information on adjustment gases

➜ “Series S800" Operating Instructions

4.1.2 Special zero gas (when required)

The zero gas to be measured by the Sensor Module OXOR-P may also contain the measuring components – up to a concentration corresponding to 80% of the physical measurement span. The zero and test gas nominal values must differ by at least 10% (relative to the physical measurement span).

In applications where large cross-sensitivities occur, the zero gas or a gas mixture representing the average sample gas composition can be used as »interfering gas«. This means the cross-sensitivities can be considered physically during adjustments (→ § 4.2).

4.2 Cross-sensitivity compensation

Physical interfering effect

Measurement errors can occur when the zero point of the OXOR-P module is adjusted using nitrogen but the sample gas mainly comprises other gases having significant paramagnetic or diamagnetic susceptibility. In this case, the S800 could possibly display a certain O_2 value even when the sample gas contains no oxygen at all.

Compensation methods

a) *Adapted zero gas:* Use the respective »interfering gas« or an O_2-free gas mixture representing the average sample gas composition as zero gas.
   → The zero point is adjusted more or less under measuring conditions – this »adjusts« the cross-sensitivity effect.

b) *Manual compensation:* Use normal zero gas to adjust the zero point and do not set the nominal value for zero gas to »0« but to a value that exactly counters the cross-sensitivity effect.
   → This shifts the zero point so that the cross-sensitivity effect is compensated.

c) *Automatic compensation (option):* The S800 measures the interfering gas component(s) simultaneously with own Sensor modules and compensates the cross-sensitivity effects automatically using these measured values.
   → The cross-sensitivity effects are minimized metrologically.

4.3 Adjustment interval

- ► Adjust the Sensor Module OXOR-P in regular intervals.
- ► *Recommendation:* Adjust weekly.

4.4 Adjustment procedure

➜ “Series S800" Operating Instructions.

Sensor Module OXOR-P

5 Technical Data

Ambient conditions
Sample gas specifications
Metrological specifications

5.1 Installation location requirements

Geographic height at installation location:	≤ 2500 m above sea level [1]
Ambient air pressure:	700 ... 1200 hPa
Fitting position influence (tilted position influence)	< 0.05 percent by volume O_2 per 1° position change

1 higher altitudes can be realized when ordered (option)

5.2 Metrological specifications

Measured variable:	O_2 volume concentration
Possible measuring ranges: [1] – Standard: – Option:	 0 ... 1 percent by volume O_2 up to 0 ... 100 percent by volume O_2 Suppresses measuring range (up to 95 ... 100 percent by volume O_2)
Smallest measuring range:	0 ... 1 percent by volume O_2
Detection limit (3σ): [2]	< 0.5% of measurement span
Linearity deviation:	< 1% of measurement span
Zero point drift – Measurement span ≥ 3 percent by volume O_2: – Measurement span < 3 percent by volume O_2:	 < 1% of smallest measurement span per week < 0.05 percent by volume O_2 per week
Reference point drift:	< 1% of measured value per week
Ambient temperature influence: – Measurement span ≥ 5 percent by volume O_2: – Measurement span < 5 percent by volume O_2:	 < 2% of measurement span per 10 K < 0.1 percent by volume O_2 per 10 K
Air pressure influence [3] – Without pressure compensation: – With automatic pressure compensation: [4] [5]	 < 1% of measured value per 1% pressure change < 0.1% of measured value per 1% pressure change
Sample gas volume flow influence (throughflow dependency)[6]	< 0.2 percent by volume O_2
Mains voltage/mains frequency influence: [7]	< 0.5% of smallest measurement span
Display delay ($T_{90\ ges}$):	< 4 s[8]
Run-in time:	60 minutes as typical

1 Actual measuring range, see specification of individual device
2 With constant electronic damping with time constant $T_{90,\ el.}$ = 15 s
3 *When the sample gas outlet is open*: Atmospheric air pressure influence;
when the sample gas outlet is fed back to the process: Process gas pressure influence
4 *When the sample gas outlet is open*: Option »Baro-correction«;
when the sample gas outlet is fed back to the process: Option »sample gas pressure correction«
5 Effective range: 700 ... 1300 hPa
6 Volume flow change 10 ... 60 l/h
7 Within the specified voltage and frequency ranges
8 For sample gas volume flow = 60 l/h and constant electronic damping $T_{90,\ el.}$ = 1 s (adjustable 1 ... 600 s)

5.3 Measuring ranges

Measuring component	Chemical formula	Smallest measurement span	Largest measurement span
Oxygen	O_2	1 Percent by volume	100 Percent by volume

5.4 Influence effects

Theoretical cross-sensitivities due to magnetic susceptibility

Gas components (100 percent by volume)	Chemical formula	Zero point shift [Percent by volume O_2]
Argon	Ar	–0.22
Acetylene	C_2H_2	–0.01
Benzole	C_6H_6	–1.24
Ethane	C_5H_6	–0.34
Ethanol	C_2H_5OH	–0.63
Ethylene	C_2H_4	0.00
Carbon dioxide	CO_2	–0.23
Carbon monoxide	CO	+0.06
Methane	CH_4	–0.01
Neon	He	+0.15
N-octane	C_8H_{18}	–2.45
Sulphur dioxide	SO_2	–0.18
Hydrogen sulfide	H_2S	–0.39
Nitrogen oxide	NO	+42.71
Hydrogen	H_2	+0.23
Water vapor	H_2O	–0.03
Xenon	Xe	–0.92

5.5 Gas technical requirements

Sample gas properties	
Allowable sample gas temperature: [1]	0 ... 45 °C (32 ... 113 °F) [2]
Allowable sample gas dew point:	Below ambient temperature
Particles in the sample gas:	Free from dust and aerosols [3]
Allowable sample gas pressure [4] – For gas paths with hoses: – For gas paths with pipes:	 –200 ... +300 hPa (–0.2 ... +0.3 bar) –200 ... +1000 hPa (–0.2 ... +1.0 bar)
Sample gas volume flow [1] – Minimum: – Maximum: – With built-in gas pump:[6] – Standard:	 5 l/h (83 cm^3/min) 100 l/h (1660 cm^3/min)[5] 30 ... 60 l/h (500 ... 1000 cm^3/min) 30 l/h (500 cm^3/min)

1 Keep constant during operation
2 When a sample gas cooler is used: Always above the cooler temperature (dew point)
3 When entering the gas analyzer
4 Relative to the ambient/atmospheric air pressure
5 Potentially explosive atmospheres: Observe approval requirements
6 Option in Gas module

5.6 Materials with sample gas contact

Version	Component	Material
Standard:	Measuring cell:	Stainless steel 1.3952, SiO_2, platinum/iridium; magnet pole gold-plated
	Adhesive:	2-component epoxy adhesive
	Gas connections:	Stainless steel 1.4301 (clamping rings: 1.4571)
Option:[1]	*please inquire*	

[1] Non-corrosive or solvent resistant

5.7 Auxiliary power supply

Electrical supply for module	
Power supply:	24 VDC
Power input:	≤ 30 W

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