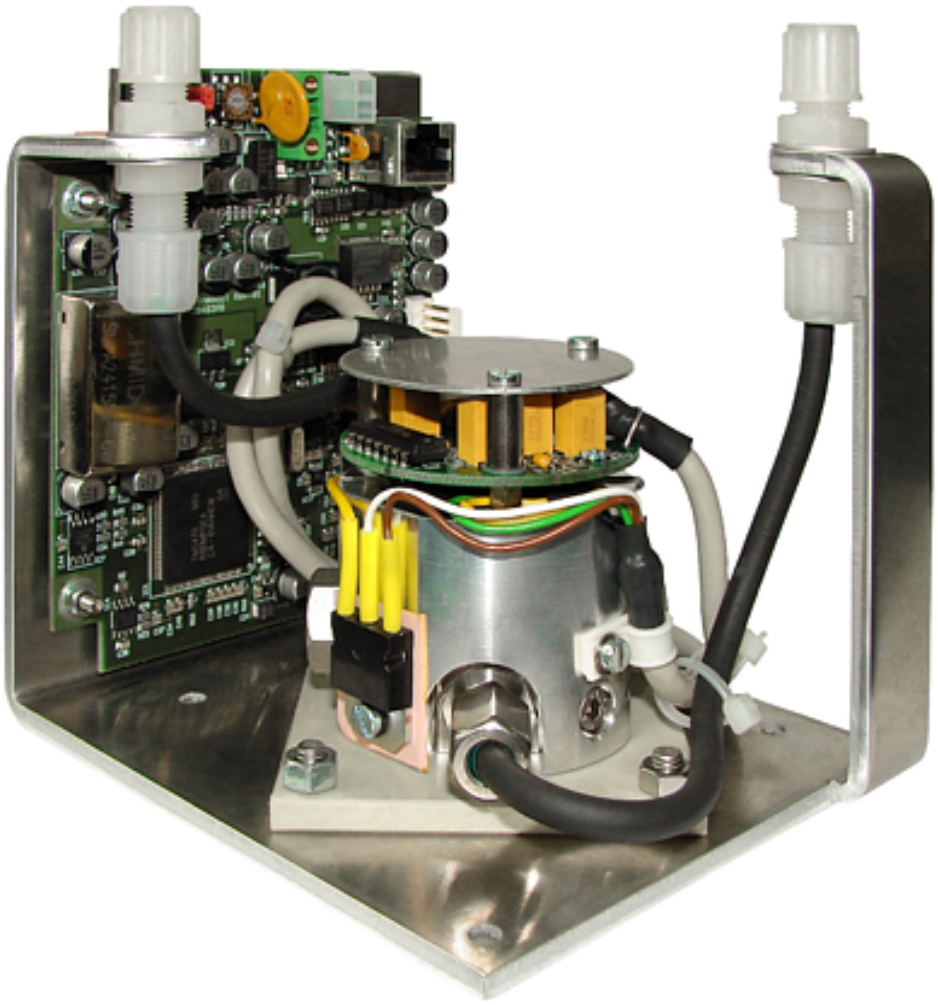
Operating Instructions
Analyzer Module THERMOR

for Series GMS800



Endress+Hauser
People for Process Automation

Described product
Product name: Analyzer Module THERMOR
Basic device: Series GMS800 gas analyzers

Manufacturer
Endress+Hauser SICK GmbH+Co. KG
Bergener Ring 27
01458 Ottendorf-Okrilla
Germany

Legal information

Original document
This document is an original document of Endress+Hauser SICK GmbH+Co. KG.

CE

Glossary

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.

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

THERMOR

1 Important information

Additional documentation

1.1 Additional documentation/information

This document supplements the Operating Instructions for GMS800 gas analyzers. It extends the “GMS800“ Operating Instructions with technical information on the THERMOR.

► Observe the Operating Instructions delivered with the “GMS800”.

The “GMS800” Operating Instructions also specify all further documents belonging to the individual device.

NOTICE:

► Pay primary attention to any individual information provided.

► Check whether technical information was delivered specifying the test gases required for adjustment. Retain such information together with this document (usage → p. 18, § 4.2).

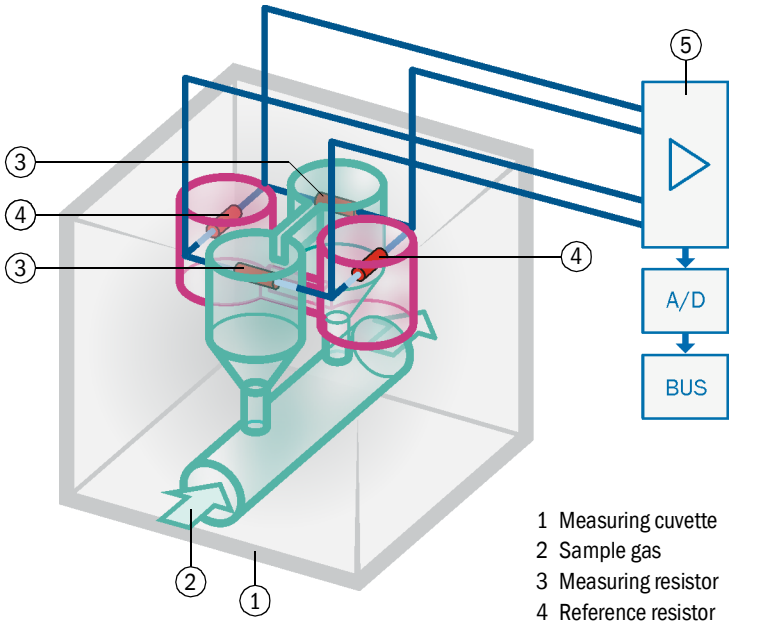
THERMOR

2 Product description

Measuring principle
Application area

2.1 Measuring principle

Fig. 1 THERMOR measuring cuvette (schematic)



1 Measuring cuvette
2 Sample gas
3 Measuring resistor
4 Reference resistor
5 Measurement amplifier

Sample gas flows around the measuring resistors in the THERMOR measuring cuvette. The cooling effect of the sample gas on the measuring resistors is measured. The higher the thermal conductivity of the sample gas, the more the measuring resistor is cooled.

This measuring principle is basically suitable for gas mixtures consisting of two individual gas components whose specific thermal conductivity differs considerably (binary gas mixtures). The higher the concentration of the gas component with high specific thermal conductivity, the stronger the measuring effect. This results directly in the concentration of this gas component. The measuring principle serves usually for measuring gases with a particularly high specific thermal conductivity.

2.2 Application area

The Analyzer module THERMOR can measure the concentration of Ar, CH_4, CO_2, H_2, He, NH_3 and other gases in binary or quasi-binary gas mixtures.

Non-binary gas mixtures can be measured when the influence of interfering gas components is automatically compensated (cross-sensitivity compensation). For this purpose, the concentration of these gas components must be measured with different Analyzer modules or different gas analyzers. The parameters for cross-sensitivity compensation are set individually for each case (option).

Cross-sensitivity to a certain gas component is automatically minimized when the concentration of this gas component is measured with a different Analyzer module in GMS800.

Possible measuring ranges → p. 21, § 5.5

THERMOR

3 Functions in SOPAS ET

Operating functions in the PC program “SOPAS ET”
Menu tree
Explanations

- Instructions for the PC program “SOPAS ET” → User Information for the program
- Exemplary menu representations → Technical Information “Basic Control Unit (BCU)” (contains information for operating with SOPAS ET)

3.1 Menu tree in SOPAS ET

User level:	O	Operator (standard)	A	Authorized operator
Access rights:	○	Viewing	●	Setting up/starting

Directory	Menu contents	O	A	Explanation
S800_THERMOR		○	○	
Measuring value display		○	○	
Measuring component 1	Component	○	○	→ p. 12 [1]
	Measured value	○	○	→ p. 12 [2]
	Unit	○	○	→ p. 12 [3]
Measuring component 2 [1]		○	○	
Measuring component 3 [1]		○	○	
Measuring component 4 [1]		○	○	
Diagnosis		○	○	
Module state	Failure	○	○	
	Maintenance request	○	○	→ p. 12 [4]
	Function(s) active	○	○	
	Uncertain state	○	○	
Logbook	Pos. | Date | Source | ...	○	○	→ p. 14, § 3.3.1
Operating hours	h	–	○	→ p. 12 [5]
Measuring component 1		○	○	
Name / unit	Component	○	●	→ p. 12 [1]
	Unit	○	○	→ p. 12 [2]
State	Failure	○	○	
	Maintenance request	○	○	→ p. 12 [4]
	Function(s) active	○	○	
	Uncertain state	○	○	
Validation measurement (QAL3)	Zero point	○	○	
	Date	○	○	
Measuring component 2 [1]		○	○	
Measuring component 3 [1]		○	○	
Measuring component 4 [1]		○	○	
Parameter		○	○	
Sampling point	Description	–	●	→ p. 12 [6]
RS485 interface	Module address	–	○	→ p. 12 [7]
	Baud rate	–	●	
	Data bits	–	●	→ p. 12 [8]
	Stop bits	–	●	
	Parity	–	●	
Measuring component 1		○	○	
Physical meas. range	Component	○	●	→ p. 12 [1]
	Unit	○	○	→ p. 12 [3]
	Start value	○	○	→ p. 12 [9]
	End value	○	○	→ p. 12 [10]
	Base value	○	○	→ p. 12 [11]
	Measuring channel	○	○	→ p. 12 [12]
	Precision	○	○	→ p. 12 [13]
Damping		–	●	
Damping (el. T90%)	Time constant [s]	–	●	
Dynamic damping	Status [On/Off]	–	●	→ p. 15, § 3.3.3
	Time constant [s]	–	●	
	Threshold	–	●	
Measuring component 2 [1]		○	○	
Measuring component 3 [1]		○	○	
Measuring component 4 [1]		○	○	

Directory	Menu contents	O	A	Explanation
Adjustment		○	○	
Measuring component 1		○	○	
Drift limit value	Zero point	–	○	→ p. 16, § 3.3.4
	Reference point	–	○	
Adjustment results		○	○	
Adjustment result	Zero point	○	○	
	Reference point	○	○	
Drift values	Zero point	○	○	→ p. 12 [14]
	Reference point	○	○	
Delete results	[Delete]	–	●	→ p. 16, § 3.3.5
Measuring component 2 [1]		○	○	
Measuring component 3 [1]		○	○	
Measuring component 4 [1]		○	○	
Maintenance		–	○	
Maintenance flag	[On]/[Off]	–	●	→ p. 12 [15]
Configurations		–	○	
User settings	[Backup]	–	●	
	[Restore last user settings]	–	●	→ p. 12 [16]
	[Restore next to last user settings]	–	●	
Factory settings	[Restore]	–	●	→ p. 12 [17]
Factory settings		○	○	
Identification		○	○	
ID numbers	Serial number	○	○	
	Material number	○	○	
	Hardware version	○	○	→ p. 13 [18]
	Software version	○	○	
	Software date	○	○	
Production release	Year | Month | Day	–	○	→ p. 13 [19]

[1] If fitted.

3.2 Explanation of the menus in SOPAS ET

[No.] refer to menu structure (→ p. 10, § 3.1)

No.	Description	Explanation
1	Component	Name of measuring component
2	Measured value	Actual measured value of measuring component
3	Unit	Physical unit of measured value
4	Failure	LED symbol ● *Significance:* Module not ready for operation ● *Possible causes:* Malfunction, defect
	Maintenance request	LED symbol ● *Significance:* Advance warning before internal technical limits reached. ● *Possible causes:* Drift limit, operating hours, lamp intensity
	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
	Uncertain state	LED symbol ● *Significance:* Actual measured values are unreliable. ● *Possible causes:* Heating up phase, internal over/under temperature, adjustment procedure programming not plausible
5	Operating hours	Number of operating hours of Analyzer module
6	Description	Freely selectable text for module name
7	Module address	Internal CAN bus address of module (defined by hardware setting in module)
8	Baud rate	Transfer speed (standard: 9600)
	Data bits	Number of data bits (standard: 8) The GMS800 only uses the 7-bit range (ASCII code 0 ... 127) but can also communicate in 8-bit format.
	Stop bits	Number of stop bits (1 or 2; standard: 2)
	Parity	Additional identification for automatic monitoring of character transfers; [Even], [Odd], [None]. – Standard: None
9	Start value	Start value of physical measuring range
10	End value	End value of physical measuring range
11	Base value	Internal physical base value of measuring range
12	Measuring channel	Internal measuring channel for measuring component
13	Precision	[On] = higher measuring precision is available for measuring range 2 (effective in range 0 ... 20% of physical measuring range)
14	Drift values	● Last = since last adjustment ● Total = since last drift calculation initialization
15	Maintenance flag	[On] = Status “Maintenance” is activated (here as signal for active maintenance work)
16	User settings	● Backup = Save a copy of the actual module settings. ● Restore = Overwrite the actual module settings by a saved copy. [1]
17	Factory settings	Overwrite the actual module settings with the original settings from the factory.[1] ► *Recommendation:* Save the actual module settings first (→ “User settings”).

No.	Description	Explanation
18	Serial number	Individual module serial number
	Material number	Identification number of module version
	Hardware version	Module electronics version number
	Software version	Module software version number
	Software date	Module software revision
19	Production release	Module date of manufacture

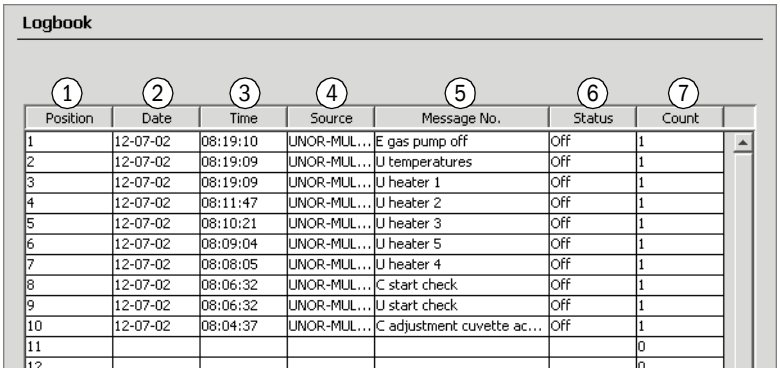
[1] A warm start is then done automatically.

3.3 Explanation of functions

3.3.1 Logbook in SOPAS ET

The Logbook Table shows the last 20 internal messages.

Fig. 2 Menu "*[Module-Name]*/Diagnosis/Logbook" in the PC program "SOPAS-ET" (example) n



Position	Date	Time	Source	Message No.	Status	Count
1	12-07-02	08:19:10	UNOR-MUL...	E gas pump off	Off	1
2	12-07-02	08:19:09	UNOR-MUL...	U temperatures	Off	1
3	12-07-02	08:19:09	UNOR-MUL...	U heater 1	Off	1
4	12-07-02	08:11:47	UNOR-MUL...	U heater 2	Off	1
5	12-07-02	08:10:21	UNOR-MUL...	U heater 3	Off	1
6	12-07-02	08:09:04	UNOR-MUL...	U heater 5	Off	1
7	12-07-02	08:08:05	UNOR-MUL...	U heater 4	Off	1
8	12-07-02	08:06:32	UNOR-MUL...	C start check	Off	1
9	12-07-02	08:06:32	UNOR-MUL...	U start check	Off	1
10	12-07-02	08:04:37	UNOR-MUL...	C adjustment cuvette ac...	Off	1
11						0
12						0

Column	Meaning
1	Sequential number in Logbook
2	Time of last message change
3	
4	"System" = measuring system (hardware) "MV" = measuring component (measurement)
5	Short message text, e.g. "F measured value". The character prefix classifies the message: F = Failure C = Check (adjustment/validation) U = Uncertain (extra information) M = Maintenance E = Extended (status message)
6	Current message status
7	Total count of activations

3.3.2 Upload (data synchronization)

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

The new data are not transferred automatically to "SOPAS ET" after settings for a module have been changed with the menu functions of the control unit. "SOPAS ET" continues using the previous data.

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

3.3.3 Damping

Constant damping

When "damping" has been programmed, 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 Analyzer 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 reset 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 limit, 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 limit again (which means measured values changes remain slight).

Dynamic damping also affects all measured value displays and outputs.

3.3.4 Drift limit values

Purpose

Analyzer 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 total drift through computation. Inspect and reset the Analyzer module when total drift has become very large.

Drift limit values monitor total drift automatically. These also protect against erroneous adjustments.

Functionality

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

- Status “M” (Maintenance request) is activated when the total drift reaches 100 ... 120% of the drift limit value.
- Status “F” (Failure) 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.

- The drift limit values are set in the factory (standard value: 10%).
- A Service function is available to reset all drift values to “0” (Drift reset). This is useful after Analyzer module maintenance when this has established a new original state.

3.3.5 Deleting adjustment results

The “Delete results” function deletes all determined drift values of a measuring component. Drift limit values then refer to new drift values.

The data of the previous adjustment which was performed before are then no longer displayed. Test gas settings (e. g. nominal value) are not changed.

CAUTION: Risk of incorrect adjustment

If very large drift values are displayed after a manual adjustment procedure (→ Operating Instructions “Basic Control Unit (BCU)”), a test gas used probably did not match the relevant test gas setting or gas feed was interrupted – and the adjustment result was still accepted.

► Do not delete incorrect adjustment results, but repeat the adjustment carefully.

► Do not use the deletion of adjustment results to nullify large drift values caused by extensive physical changes of an Analyzer module. Instead, clean the Analyzer module or perform an adjustment.[1]

► *After an Analyzer module has been cleaned, altered or exchanged:* Delete the relevant adjustment results and perform an adjustment.

[1] By the manufacturer's Customer Service or authorized skilled persons with appropriate training.

THERMOR

4 Adjustment information

Parameter setting
Control
Test gases

4.1 Parameter settings and control of adjustments

The control unit controls the adjustments.

- ► Individual adjustment of each shown measuring component and each measuring range.
- ► Information concerning purpose, prerequisites and frequency of adjustments → Operating Instructions “Series GMS800”
- ► Programming of the adjustment parameters for each measuring component of the GMS800 → Technical Information “Basic Control Unit (BCU)”
- ► Manual start of an adjustment procedure → Operating Instructions of the control unit

4.2 Test gases for the Analyzer module THERMOR

Basic information on the test gases → Operating Instructions “Series GMS800”

Composition of the test gases for the Analyzer module THERMOR

Test gas	Composition (recommended)	Nominal value (recommended)
Zero gas:	Gas or gas mixture which represents the sample gas at the start value of the measuring range as exactly as possible	Measuring range start value [1]
Span gas:	Gas or gas mixture which represents the sample gas at the end value of the measuring range as exactly as possible	65 ... 100% of measurement span [1]

[1] Observe “Test gases for measurements with physical reference value”[].

Test gases for measurements with physical reference value

For measuring ranges with the end value “100% by volume” or close to 100% by volume (example: 80 ... 100% by volume), the physical zero point can be “100% by volume”; i.e. metrologically, the measuring range starts at 100% by volume and reaches from there to the start value of the measuring range. This means, the measuring range function is inverted.

In such cases:

- ► Select the zero gas so that the nominal value is equivalent to the *end value* of the measuring range.
- ► Select the span gas so that the nominal value is at the *start* of the measuring range (in the range of 0 ... 35% of the measurement span).

- This can also be valid for measuring ranges with “suppressed zero point” (example: 80 ... 90% by volume).
- In special versions, the physical reference value can also be a certain concentration of the measuring component.

► Pay primary attention to the provided information on the test gases.

THERMOR

5 Technical data

Ambient conditions
Metrological specifications
Technical gas specifications

5.1 Installation location requirements

Geographic height at installation location:	≤ 2500 m altitude [1]
Ambient air pressure:	700 ... 1200 hPa
Jolts:	No requirements for installation location
Oscillations:	
Fitting position influence (tilted position influence)	No influence for constant tilted position up to ±15° [2]

[1] Higher altitudes can be realized when ordered (option)
[2] Perform an adjustment after changing the fitting position

5.2 Metrological specifications

Measured variable:	Volume concentration of a gas component
Possible measuring ranges: [1]	→ p. 21, 5.5
Detection limit (3σ): [2]	< 0.5% of measurement span
Linearity deviation:	≤ 1% of measurement span
Zero point drift – Standard measuring ranges: – Small measuring ranges: [3]	 ≤ 1% of smallest measurement span per week ≤ 2% of smallest measurement span per week
Reference point drift:	≤ 1% per week
Sample gas volume flow influence (throughflow dependency) [4] – Standard measuring ranges: – Small measuring ranges:	 < 0.2% of measured value per 10 l/h change < 0.3% of measured value per 10 l/h change
Ambient temperature influence: – Zero point, standard measuring ranges: – Zero point, small measuring ranges: [3] – Reference point, standard measuring ranges: – Reference point, small measuring ranges: [3]	 ≤ 1% of smallest measurement span per 10 K change ≤ 2% of smallest measurement span per 10 K change ≤ 1% of measured value per 10 K change ≤ 2% of measured value per 10 K change
Air pressure influence	–
Mains voltage/mains frequency influence: [5]	≤ 0.5% of smallest measurement span
Display delay, T_{90}:	< 20 s [6]
Run-in time:	Approx. 60 minutes

[1] Actual measuring range, see specification of individual device.
[2] With constant electronic damping with time constant $T_{90, el.}$ = 15 s.
[3] Valid for measuring ranges < 2x smallest measuring range (→ p. 21, § 5.5).
[4] In range 10 ... 80 l/h.
[5] Within the specified voltage and frequency ranges.
[6] For sample gas volume flow = 60 l/h and constant electronic damping with time constant $T_{90, el.}$ = 1 s.

5.3 Gas technical requirements

Allowable sample gas temperature: [1]	0 ... 45 °C (32 ... 113 °F)
Allowable sample gas dew point:	Below ambient temperature
Particles in the sample gas:	Sample gas should be free from dust and aerosols [2]
Allowable sample gas pressure [3]	
– With sample gas paths with hoses:	–200 ... +300 hPa (–0.2 ... +0.3 bar)
– With sample gas paths with pipes:	–200 ... +1000 hPa (–0.2 ... +1.0 bar)
Sample gas volume flow [1]	
– Recommended:	30 ... 60 l/h (500 ... 1000 cm^3/min)
– Standard:	30 l/h
– Without built-in sample gas pump:	5 ... 100 l/h (83 ... 1666 cm^3/min)
– With built-in sample gas pump:	30 ... 60 l/h (500 ... 1000 cm^3/min)

[1] Keep constant during operation; check and observe regulations in approvals when available.
[2] When entering the gas analyzer.
[3] Relative to ambient pressure (700 ... 1200 hPa).

5.4 Materials with sample gas contact

Component	Material
Measuring cuvette	Stainless steel 1.4571, stainless steel 1.4541, measuring resistor (Pt100)
Connections	Heat conductive adhesive

5.5 Measuring ranges

Measuring component	in	Smallest measuring range	Largest measuring range
Ar	O_2	5 % by vol.	100 % by vol.
	N_2		
CH_4	Biogas	60 % by vol.	100 % by vol.
CO_2	Air	10 % by vol.	100 % by vol.
H_2	Ar	1 % by vol.	100 % by vol.
	CH_4		
	CO_2		
	N_2		
	O_2		
	Furnace gas		
	Air		
He	N_2	1 % by vol.	100 % by vol.
NH_3	CO_2	15 % by vol.	100 % by vol.
	Air	75 % by vol.	100 % by vol.

5.6 Auxiliary power supply for the module

Voltage supply:	24 VDC
Power input:	≤ 30 W

8029906/W793/V2-0/2012-12

www.addresses.endress.com

Endress+Hauser

People for Process Automation