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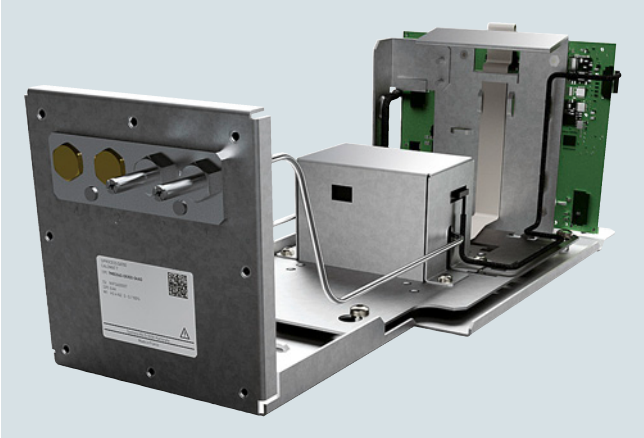
Overview



The CALOMAT 7 module is primarily used for quantitative determination of H_2 or He in digital or quasi-digital non-corrosive gas mixtures.

Concentrations of other gases can also be measured if their thermal conductivity differs significantly from their accompanying gases, such as Ar, CO_2, CH_4.

Benefits

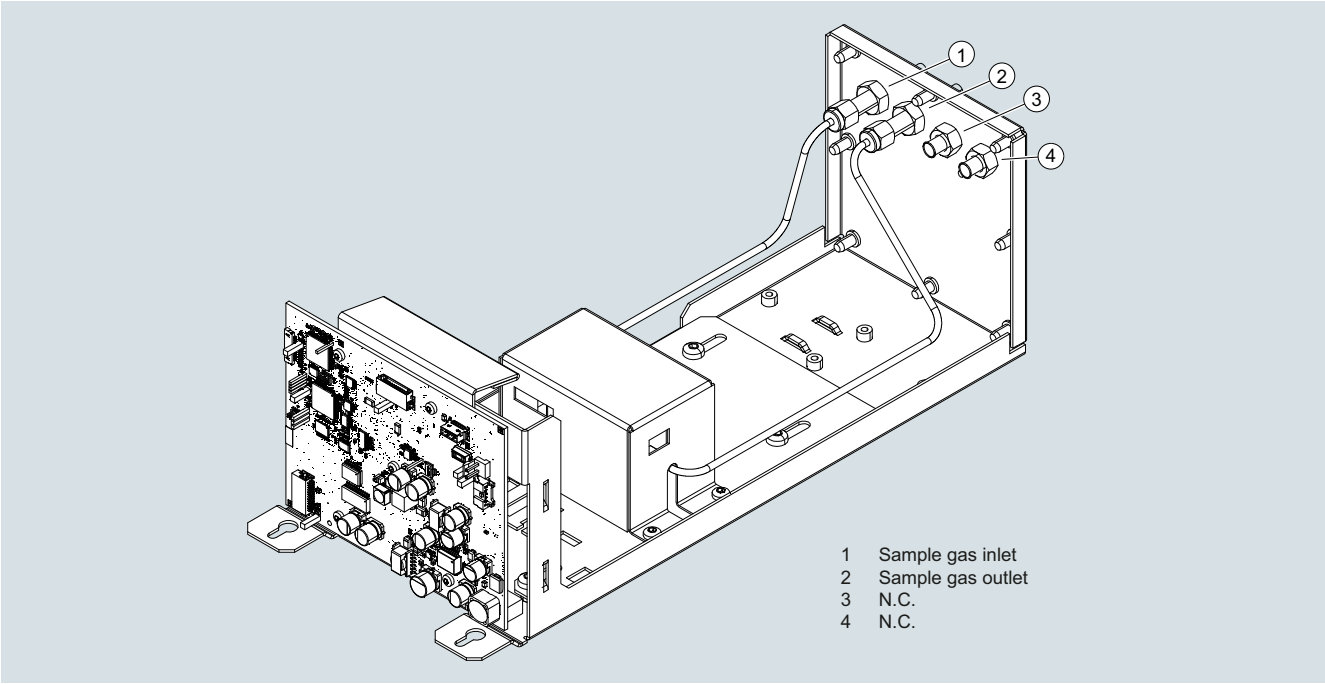
- Small T_{90} time due to micromechanical-produced Si sensor
- Universally applicable hardware basis, high measuring range dynamics (e.g. 0 to 0.5%, 0 to 100%, 95 to 100% H_2)
- Open interface architecture (analog, digital, Ethernet)
- SIMATIC PDM network for maintenance and servicing information (optional)
- Introduction of flammable gas possible

Application

Application areas

- Pure gas monitoring (0 to 0.5 % H_2 in Ar)
- Protective gas monitoring (0 to 2 % He in N_2)
- Hydroargon gas monitoring (0 to 25 % H_2 in Ar)
- Forming gas monitoring (0 to 25 % H_2 in N_2)
- Gas production:
  - 0 to 2 % He in N_2
  - 0 to 10 % Ar in O_2
- Chemical applications:
  - 0 to 2 % H_2 in NH_3
  - 50 to 70 % H_2 in N_2
- Wood gasification (0 to 30 % H_2 in $CO/CO_2/CH_4$)
- Blast furnace gas (0 to 5 % H_2 in $CO/CO_2/CH_4/N_2$)
- Bessemer converter gas (0 to 20 % H_2 in CO/CO_2)

Design



Structure of CALOMAT 7

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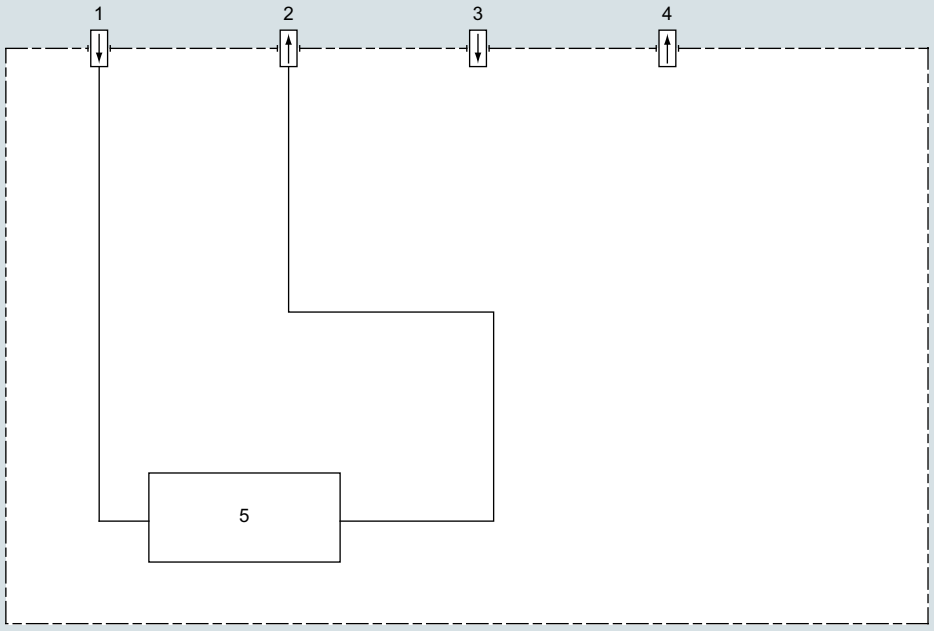
CALOMAT 7 module

Gas path



1 Sample gas inlet
2 Sample gas outlet
3 N. C.
4 N. C.
5 Sensor module

CALOMAT 7, gas path

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Mode of operation

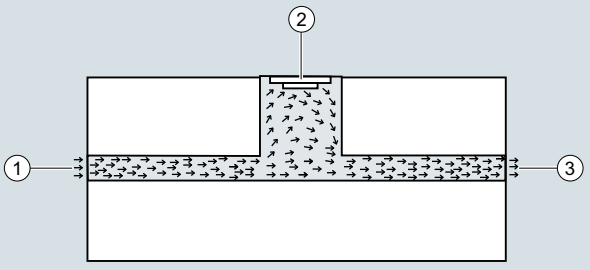
The measuring method is based on the different levels of thermal conductivity of gases. CALOMAT 7 modules work with a micromechanically produced Si chip, the measuring membrane of which is equipped with thin-film resistors.

The resistors contained in the diaphragm are regulated for constant temperature. The amperage required fluctuates in accordance with the thermal conductivity of the sample gas. This raw value determined in this way is processed further electronically to calculate the gas concentration.

The sensor is in a thermostatically controlled stainless steel enclosure in order to suppress the effect of the ambient temperature. To rule out flow influences, the sensor is mounted in a bore hole next to the flow channel.

Note

The sample gases must be fed into the analyzers free of dust. Condensation (dew point sample gas < ambient temperature) is to be avoided in the sample chambers. Therefore, the use of gas modified for the measuring tasks is necessary in most application cases.



1 Sample gas inlet
2 Measuring membrane with thin-film resistors
3 Sample gas outlet

CALOMAT 7, mode of operation

Essential characteristics

- Four measuring ranges which can be freely configured, even with suppressed zero point, all measuring ranges are linear
- Smallest spans down to 0.5% H_2 (with suppressed zero: 95 to 100% H_2) possible
- Autoranging or manual measurement range switchover possible; remote switching is also possible
- Storage of measured values possible during adjustments
- Time constants can be selected within wide ranges (static/dynamic noise suppression); i.e. the response time of the device can be adapted to the respective measuring task.
- Short response time
- Low long-term drift
- Measuring point switchover for up to 6 measuring points (programmable)
- Measuring range identification
- Measuring point identification
- External pressure sensor can be connected – for correction of variations in sample gas pressure
- Automatic measuring range calibration can be configured
- Operation based on the NAMUR recommendation

Cross-interferences

To determine the cross-interferences of accompanying gases with several interfering gas components, you must know the sample gas composition. The following table contains the zero offsets for the carrier gas N_2 as H_2 equivalent values with 10% interference gas

Interference gas	H_2 equivalent values with 10% interference gas
CH_4	+1.77%
C_2H_6	+0.47%
C_3H_8	-0.28%
CO	-0.10%
CO_2	-0.84%
O_2	+0.19%
N_2O	-0.83%
NH_3	+1.45%
Ar	-1.22%
He	+6.32%
SF_6	-2.15%
SO_2	-1.47%
Synth. Air	+0.40%
H_2O (3%)	+0.38%

Zero offset in the system H_2 in N_2

If you are using accompanying gas concentrations ≠ 10%, you can use the corresponding multiples of the respective table value as an approximation. This procedure applies depending on the type of gas for an accompanying gas concentration range up to approx. 25%.

The thermal conductivity of most gas mixtures has a non-linear response. Even ambiguous results can occur in specific concentration ranges, e.g. with H_2 in He mixtures.

In addition to the zero offset, the accompanying gas also affect the characteristic curve. For most gases, however, the effect on the characteristic curve is negligible.

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Technical specifications

The technical specifications are based on the definitions of DIN EN 61207-1.

Unless specified otherwise, the data listed below relates to the following measurement conditions:

Ambient temperature	25 °C
Atmospheric pressure	Atmospheric (approx. 1 000 hPa)
Sample gas flow	0.6 l/min (or Nl/min)
Reference application	H_2 in N_2*
Site of installation	Vibration- and impact-free

* The technical specifications for time and measuring response as well as for the influencing variables can sometimes differ significantly for other gas mixtures

General information	
Weight	Approx. 3 kg
Measuring ranges	
Number of measuring ranges	Max. 4; parameters can be assigned freely
Parameters can be assigned in the measuring ranges	
• Smallest possible span	0.5% H_2 in N_2
• Largest possible span	100% H_2 in N_2
• Smallest possible span with suppressed zero point	5% (e.g. 95% to 100%) H_2 in N_2
Gas inlet conditions	
Sample gas pressure	700 to 1200 hPa (abs.)
Pressure drop between sample gas inlet and sample gas outlet	< 50 hPa at 1.5 l/min
Sample gas flow	30 to 90 l/h (0.5 to 1.5 l/min)
Sample gas temperature	0 to 70 °C
Sample gas humidity (rel. humidity)	< 90% (condensation inside the gas path is to be avoided)
Sample chamber temperature	
Standard version	Approx. 72 °C
Time response	
Warm-up period at room temperature	< 30 min (max. accuracy after 2 h)
Response characteristics	
• Delay display T_{90} with device-internal signal damping (low pass filter) of 1 s	< 2.5 s
• Dead time (T_{10}) at 1 l/min	< 0.5 s
• Adjustable signal damping range	0 to 100 s
Measuring response	
Output signal fluctuation with device-internal signal damping of 1 s	≤ ± 0.5% of the smallest span acc. to nameplate (σ < ± 8.33 vpm H_2)
Detection limit	≤ 1% of the smallest measuring span according to nameplate
Measured-value drift	≤ ± 1%/week of smallest span according to nameplate or ≤ 50 vpm H_2 / week, whichever is greater
Repeatability	≤ ± 1% of the current measuring span or 100 vpm H_2
Linearity error	≤ ± 1% of the current measuring span or 100 vpm H_2

Influencing variables	
Ambient temperature	≤ ± 0.5%[1]/10 K of the current measuring span or ≤ ± 50 vpm H_2 / 10 K
Sample gas pressure	≤ ± 0.5 %[1] of the current measuring span/1% pressure variation or ≤ ± 50 vpm H_2 / 1% pressure change
Sample gas flow	≤ ± 0.2% of the smallest possible measuring span with a change in flow of 1 dl/min within the permissible flow range
Accompanying gases (interference gases)	The interference gas sensitivity depends on the application and must be determined in each case except for applications with blast furnace gas / converter gas / wood gasification (pre-adjusted).
Supply voltage	≤ ± 0.1% of full-scale value (within the nominal range of use)
Electrical inputs and outputs	
Analog and digital interfaces	See base unit
Climatic conditions	
Storage and transport	-30 ... 70 °C
Permissible ambient temperature (during operation in base unit)[2]	0 ... 50 °C
Relative humidity (RH) during storage, transport or operation	< 90% (condensation from the installed components is to be avoided)
Gas connections	
Connection fittings	Pipe connection with 6 mm outer diameter
Materials of wetted parts	
Gas connection	Stainless steel material no. 1.4571
Clamping rings and union nut (set)	Stainless steel material no. 1.4401
Sample gas pipes	Stainless steel material no. 1.4404
Sensor mounting block	Stainless steel material no. 1.4571
Sensor	Si, SiO_xN_y, Au, epoxy resin, glass
Gasket, contained in the sensor module	Perfluorelastomere FFKM

[1] Values less than the detection limit are not useful
[2] Restriction for installing an ULTRAMAT 7 module: 5 ... 45 °C

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Selection and ordering data		Article No.			
CALOMAT 7 module		↗ **7MB3040-** ■■■■■ **- 0** ■■■	Cannot be combined		
For the measurement of gases in binary or quasi-binary gas mixtures					
↗ Click on the Article No. for the online configuration in the PIA Life Cycle Portal.					
Module version					
Standard module for 19" rack unit and wall housing		**0**			
Measuring components, corrosive gas mixtures					
Only non-corrosive mixtures		**X**			
Measuring range, corrosive gas mixtures					
Only non-corrosive mixtures		**X**			
Material of gas path					
Stainless steel		**0**			
Reference chamber					
None		**0**			
Measuring components, non-corrosive mixtures					
H_2 in N_2		**A**			
H_2 in Ar		**B**			
He in N_2		**C**	**C**		
He in Ar		**D**	**D**		
He in H_2		**E**		**E**	
Ar in N_2		**F**			**F**
Ar in O_2		**G**			**G**
CH_4 in N_2		**H**			**H**
CH_4 in Ar		**J**			**J**
CO_2 in N_2		**K**			**K**
Special version: H_2 in N_2 (for blast furnace gas, converter gas, wood gasification)		**Q**			**Q**
Smallest measuring range	Largest measuring range				
0 ... 0.5 %	0 ... 100 %	**A**	**A**	**A**	**A**
0 ... 1 %	0 ... 100 %	**B**		**B**	**B**
0 ... 2 %	0 ... 100 %	**C**		**C**	**C**
0 ... 5 %	0 ... 100 %	**D**		**D**	
0 ... 10 %	0 ... 100 %	**E**		**E**	
0 ... 10 %	0 ... 80 %	**F**			
Version					
Standard		**0**			

Selection and ordering data	
Additional versions	**Order code**
Add "-**Z**" to Article No. and specify Order code	
Settings	
Clean for O_2 service (specially cleaned gas path)	**B06**
Measuring range indication in plain text, if different from the default setting	**Y11**
Base unit module assignment number	**D00 ... D99**

Ordering example

CALOMAT 7 module installed in wall enclosure
7MB3000-3FX00-1AA0-Z+D12
7MB3040-0XX00-0BB0-Z+D12

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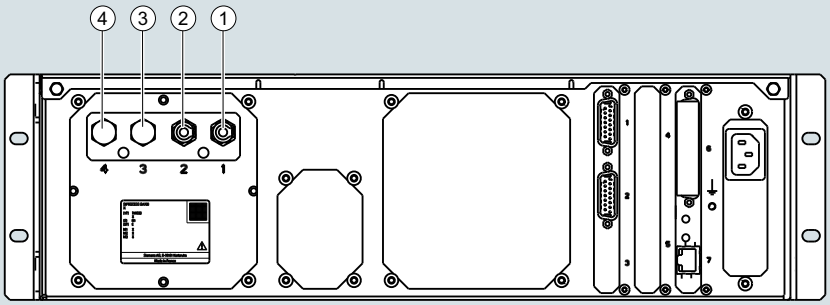
Circuit diagrams

Gas connections

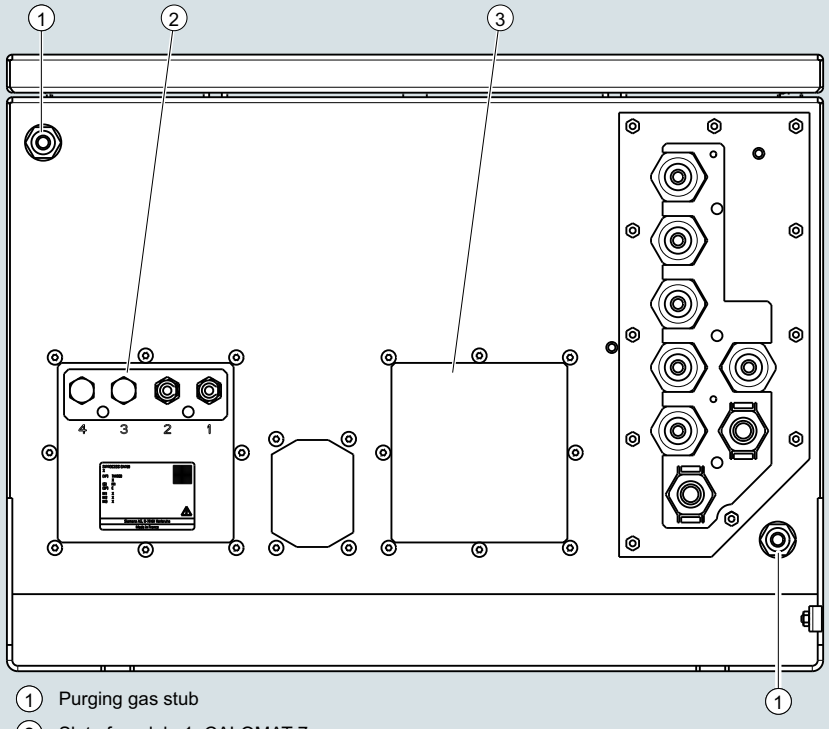


1 Sample gas inlet
2 Sample gas outlet
3 N.C.
4 N.C.

CALOMAT 7 gas connections

The sample gas connections are made of stainless steel with material no. 1.4571 and are designed as connecting fittings with a pipe diameter of 6 mm.

Wall-mounted device



(1) Purging gas stub
(2) Slot of module 1: CALOMAT 7
(3) Slot of module 2

Wall-mounted device, bottom

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Design

Gas path		ULTRAMAT 7	OXYMAT 7	CALOMAT 7
With hoses (Viton)	Bushing	–	PVDF	–
	Hose	–	FKM (Viton)	–
	Sample chamber	–	Stainless steel 1.4571	–
	Nozzle (sample chamber)	–	Stainless steel 1.4571	–
	Restrictor	–	PTFE (Teflon)	–
	O-ring	–	FKM (Viton)	–
With pipes (stainless steel)	Bushing	Stainless steel 1.4571	Stainless steel 1.4571	Stainless steel 1.4571
	Pipe	Stainless steel 1.4571	Stainless steel 1.4404	Stainless steel 1.4404
	Sample chamber			
	• Body	Aluminum	Stainless steel 1.4571	–
	• Lining	Aluminum or tantalum	–	–
	• Window	CaF2, adhesive: E353	–	–
	Sensor mounting block	–	–	Stainless steel 1.4571
	Sensor	–	–	Si, SiO_xN_y, AU, epoxy resin, glass
	Sample gas restrictor	–	Stainless steel 1.4571	–
	O-rings	FKM (Viton) or FFKM (Kalrez 6375)	FKM (Viton) or FFKM (Kalrez 6375)	FFKM (Kalrez 6375)
With pipes (Hastelloy)	Bushing	Hastelloy C22	Hastelloy C22	–
	Pipe	Hastelloy C22	Hastelloy C22	–
	Sample chamber			
	• Body	Aluminum	Hastelloy C22	–
	• Lining	Tantalum	–	–
	• Window	CaF2, adhesive: E353	–	–
	Sample gas restrictor	–	Hastelloy C22	–
	O-rings	FKM (Viton) or FFKM (Kalrez 6375)	FFKM (Kalrez 6375)	–