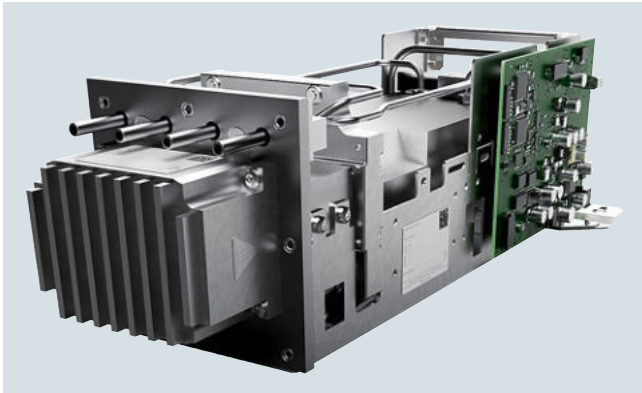## Overview

The ULTRAMAT 7 module functions according to the NDIR dual-beam differential mode process and measures gases whose absorption bands in the infrared wavelength range are between 2 and 9 µm, such as CO, CO_2, CH_4, SO_2 or NO. Up to two components can be measured per module.

Benefits

High selectivity due to double-layer detector
• Reliable measurements even in complex gas mixtures

Low detection limits
• Measurements with low concentrations

Analyzer cells can be cleaned as required on site
• Cost savings due to reuse after contamination

Corrosion-resistant materials in gas path (option)
• Measurement of highly corrosive gases possible

Application

Application areas

• Measurement for boiler control in incineration plants
• Process gas concentrations in chemical plants
• Trace measurements in pure gas processes
• Environmental protection
• TLV (Threshold Limit Value) monitoring at the workplace
• Quality monitoring
• introduction of flammable gases possible

Special versions

Flow-type reference compartment

The flow through the reference compartment should be adapted to the sample gas flow.

Design
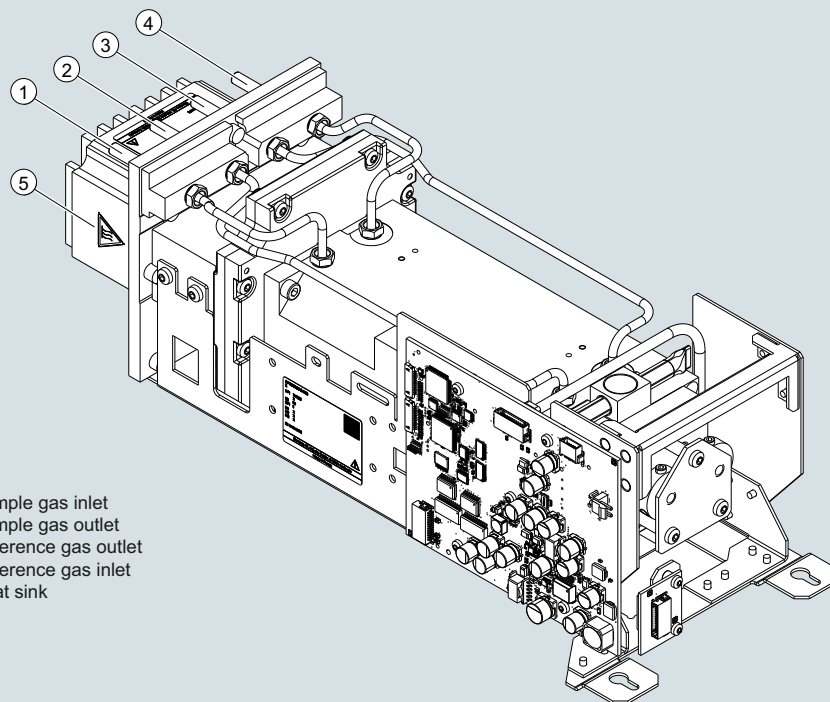
1   Sample gas inlet
2   Sample gas outlet
3   Reference gas outlet
4   Reference gas inlet
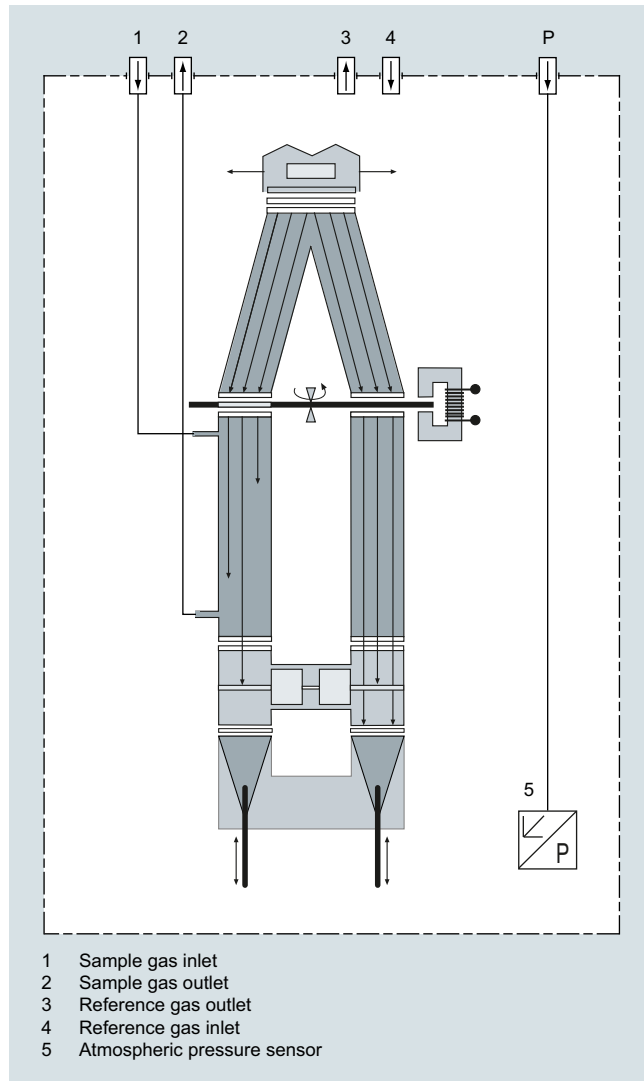5   Heat sink

Structure of ULTRAMAT 7

Extractive continuous process gas analysis
SIPROCESS GA700

Gas path

1	Sample gas inlet
2	Sample gas outlet
3	Reference gas outlet
4	Reference gas inlet
5	Atmospheric pressure sensor

ULTRAMAT 7, gas path, without flow-type reference side

1	Sample gas inlet
2	Sample gas outlet
3	Reference gas outlet
4	Reference gas inlet
5	Atmospheric pressure sensor
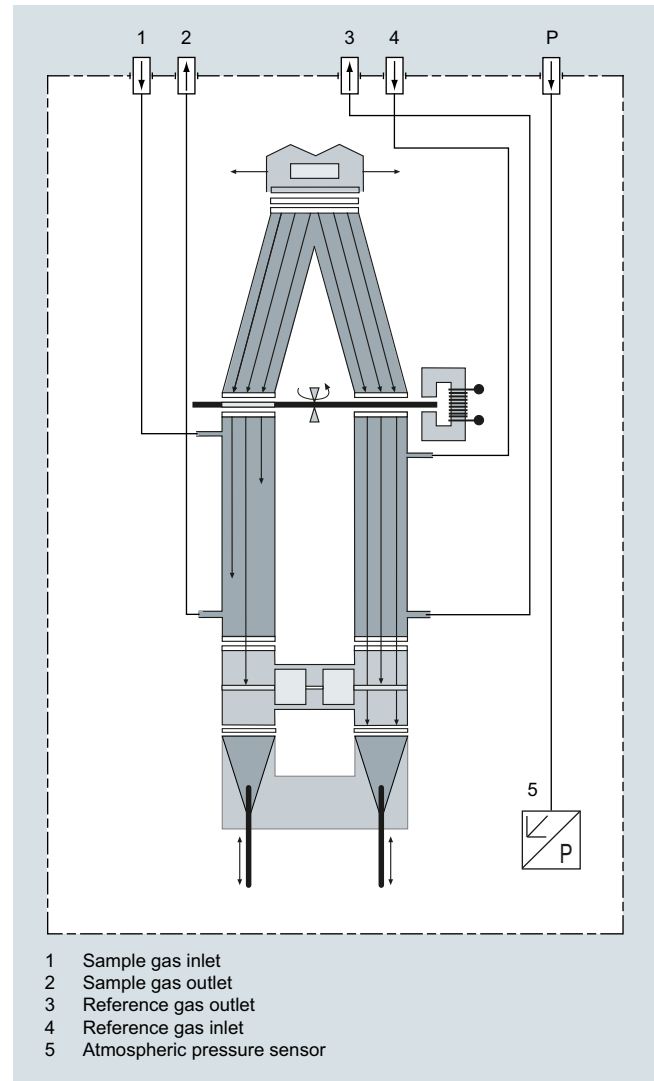
ULTRAMAT 7, gas path, with flow-type reference side

Mode of operation

Measuring principle

The measurements are based on the molecular-specific absorption of infrared radiation bands (absorption bands).

ULTRAMAT 7 modules use a spectral range which includes wavelengths of 2 to 9 µm. Although the absorbing wavelengths are characteristic of individual gases, they may partially overlap. This results in cross-sensitivities which are reduced to a minimum by the following measures:

- Beam splitter (gas filter)
- Double-layer detector, each gas compartment with adjustable weighting between the first and second detector layer
- Application-specific pre-installed interference filter

Principle of operation

ULTRAMAT 7 modules operate according to the infrared push-pull chopped radiation principle and are equipped with a double-layer detector.

A source with a temperature of approx. 600 °C generates infrared radiation which is emitted in the beam splitter. The beam splitter acts as a filter chamber and divides the beam equally between the sample gas and reference gas compartments.
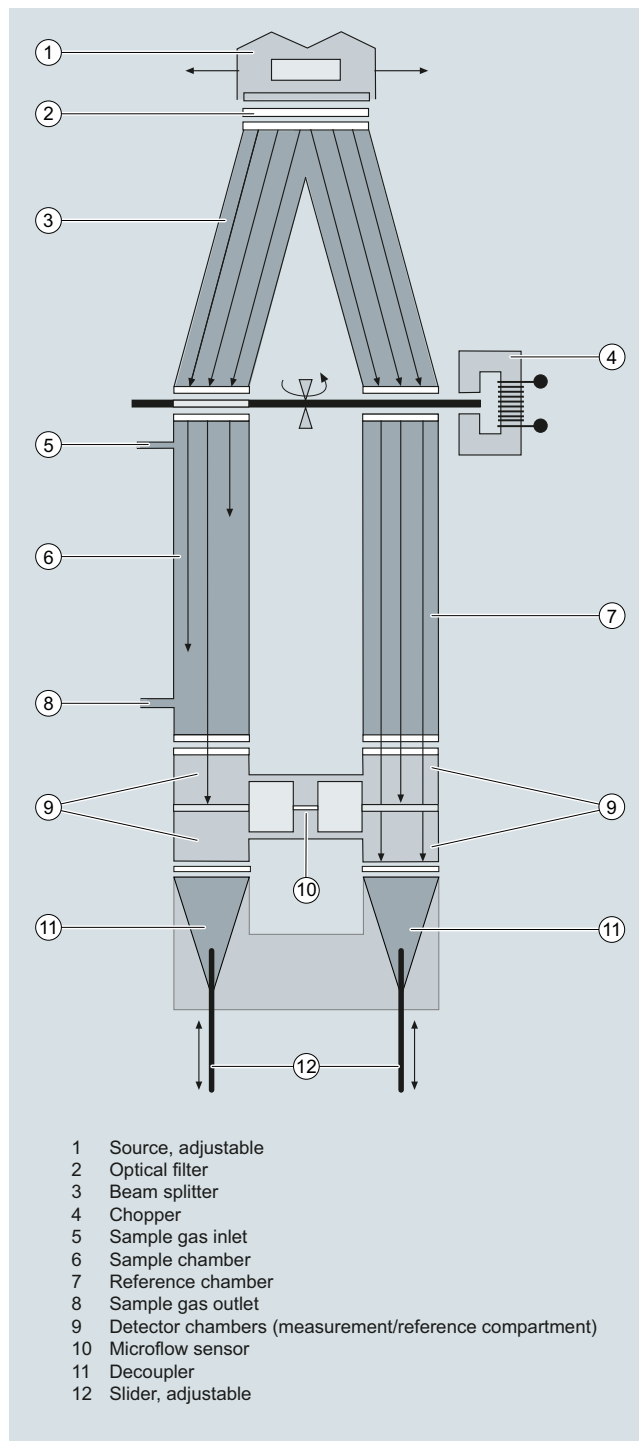
The chopper produces a periodic modulation of the infrared radiation, and thus enables relaxation of the detector.

The reference beam passes through the reference chamber and enters the detector chamber virtually unattenuated. The detector chamber is filled with a precisely defined concentration of the gas component to be measured. The sample beam, in contrast, passes through the sample chamber filled with sample gas and enters the detector chamber attenuated to various degrees. The degree of attenuation depends on the respective sample gas concentration.

The detector is designed as a double-layer detector. The detector layer at the source end serves primarily to absorb the middle of the band. The band edges, however, are absorbed equally by both of the layers.

The detector layers at both compartments of the detector are pneumatically connected to each other via a microflow sensor. This sensor element converts the pressure difference in the detector into an electrical signal.

The weighting between the first and second detector layer is preset at the factory depending on the application. The influence of interfering components is minimized as a result. To ensure the long-term stability of the measured value, the ULTRAMAT 7 module supports the predictive self-diagnostics of the analyzer. This function enables you to plan maintenance measures in a timely manner.

1	Source, adjustable
2	Optical filter
3	Beam splitter
4	Chopper
5	Sample gas inlet
6	Sample chamber
7	Reference chamber
8	Sample gas outlet
9	Detector chambers (measurement/reference compartment)
10	Microflow sensor
11	Decoupler
12	Slider, adjustable

ULTRAMAT 7, principle of operation of the infrared channel

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ULTRAMAT 7 module

Essential characteristics

- Dimension of measured value freely selectable (e.g. vpm, mg/m^3)
- Four freely-configurable measuring ranges per component
- Measuring ranges with suppressed zero point possible
- Measuring range identification
- Autoranging or manual measurement range switchover possible; remote switching is also possible
- Differential measuring ranges with flow-type reference cell
- Storage of measured values possible during adjustments
- Time constants selectable within wide limits (static/dynamic noise suppression); i.e. the response time of the analyzer or component can be matched to the respective measuring task
- Short response time
- Low long-term drift
- Measuring point switchover for up to 4 measuring points (programmable)
- Measuring point identification
- Internal pressure sensor for correction of atmospheric pressure fluctuations in the range 700 to 1 200 hPa absolute
- Automatic measuring range calibration can be configured
- Operation based on NAMUR recommendation
- Preventive maintenance / IR source monitoring
- Sample chamber for use in presence of highly corrosive sample gases, e.g. tantalum inlay sheet or Hastelloy C22 (special application)

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)
Sample gas humidity	Dew point < -40 °C
Site of installation	Vibration- and impact-free

General information	
Weight	Max. 5.2 kg (standard version)

Measuring ranges	
Number of measuring ranges	Max. 4; parameters can be assigned freely
Parameters can be assigned in the measuring ranges	
• Smallest possible measuring span	CO: 0 ... 10 vpm
	CO$_2$: 0 ... 5 vpm
	CH$_4$: 0 ... 50 vpm
	C$_2$H$_4$: 0 ... 300 vpm
	SO$_2$: 0 ... 50 vpm
	NO: 0 ... 100 vpm
	N$_2$O: 0 ... 50 vpm
	NH$_3$: 0 ... 100 vpm
	CO/NO: 0 ... 100 vpm
	CO$_2$/CO: 0 ... 100 vpm
• Largest possible measuring span	CO: 0 ... 100%
	CO$_2$: 0 ... 100%
	CH$_4$: 0 ... 100%
	C$_2$H$_4$: 0 ... 100%
	SO$_2$: 0 ... 100%
	NO: 0 ... 30 000 vpm
	N$_2$O: 0 ... 100%
	NH$_3$: 0 ... 100%
	CO/NO: 0 ... 10 000 vpm
	CO$_2$/CO: 0 ... 100%

Gas inlet conditions	
Sample gas pressure	
• Standard pressure (atmospheric pressure compensation)	500 to 1 500 hPa (absolute)
Pressure drop between sample gas inlet and sample gas outlet	< 10 hPa at 1.5 l/min
Sample gas flow	18 … 90 l/h (0.3 … 1.5 l/min)
Sample gas temperature	0 to 50 °C
Sample gas humidity (rel. humidity)	< 90% (condensation inside the gas path is to be avoided)

Dynamic response	
Warm-up period at room temperature	< 2 h
Response characteristics	
• Dead time (T_{10})	Application-specific (max. 3.6 s)
• Signal rise time (T_r) or fall time (T_f) with application-specific electronic damping of 10 s	Application specific < 14 s
• Time for device-internal signal processing T_v	Approx. 1 s
• Delayed display T_{90}	Rule: $T_{90} < T_{10} + T_{r/f} + T_v$

Measuring response	
Output signal fluctuation	≤ ± 1% of smallest measuring range acc. to nameplate
Zero point drift	< ± 1%/week of smallest measuring range acc. to nameplate
Measured-value drift	≤ 1% of the current measuring range per week
Repeatability	≤ ± 1% of the current full-scale value
Linearity error	< ± 0.5% of the current full-scale value
Influencing variables	
Ambient temperature	
• Measured value	≤ 1% of the current measuring range/ 10 K (at constant receiver cell temperature)
Sample gas pressure	
• Without pressure compensation	≤ 1.5% of the current measuring range/1% pressure variation
• With pressure compensation switched on	≤ 0.15% of the current measuring range/1% pressure variation
Sample gas flow	≤ 1% of the current full-scale value/ 0.1 l/min change in flow
Supply voltage	≤ 0.1% of the current measuring range (with the nominal range of use)
Electrical outputs	
Analog and digital interfaces	See base unit
Climatic conditions	
Storage and transport	-30 ... 70 °C
Permissible ambient temperature (during operation in base unit)[1]	5 ... 45 °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	
Bushing	Stainless steel mat. no. 1.4571, Hastelloy C22
Pipe	Stainless steel mat. no. 1.4571, Hastelloy C22, O-ring: FKM (e.g. Viton) or FFKM (Kalrez 6375)
Sample chamber	
• Body	Aluminum
• Lining	Aluminum, tantalum
• Window	CaF_2, adhesive: E353, O-ring: FKM (e.g. Viton) or FFKM (Kalrez 6375)

[1] Applies also in combination with OXYMAT 7 or CALOMAT 7 modules

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ULTRAMAT 7 module

Selection and ordering data		Article No.	Cannot be combined
ULTRAMAT 7 module		↗ **7MB3010-**▪▪▪▪▪ -▪A▪▪	Cannot be combined
For measuring IR-absorbing gases			
↗ Click on the Article No. for the online configuration in the PIA Life Cycle Portal.			

Module version

	Code
Standard module for 19" rack unit and wall housing	0

Measured components[1]

Measured components[1]	Possible with measuring range identification	Code	Cannot be combined
CO	B[2], C ... P	A	A
CO_2	A[2], B ... P	C	
CH_4	D[2], E ... P	D	D
C_2H_4	F[2], G... P	E	E
SO_2	D[2], E... P	F	F
NO	E[2], F ... P	G	G
N_2O	D[2], E ... P	H	H
NH_3 (dry)	E[2], F ... P	J	J
CO, NO	E[2], F, H, R, S	Q	
CO_2, CO	E, F, H, J, L, M, P	R	

Smallest measuring range / Largest measuring range

Smallest measuring range	Largest measuring range	Code	Cannot be combined
0 ... 5 vpm	0 ... 100 vpm	A	A A A A A A A
0 ... 10 vpm	0 ... 200 vpm	B	B B B B B B
0 ... 20 vpm	0 ... 400 vpm	C	C C C C C C
0 ... 50 vpm	0 ... 1 000 vpm	D	D D D
0 ... 100 vpm	0 ... 1 000 vpm	E	E
0 ... 300 vpm	0 ... 3 000 vpm	F	
0 ... 500 vpm	0 ... 5 000 vpm	G	
0 ... 1 000 vpm	0 ... 10 000 vpm	H	
0 ... 3 000 vpm	0 ... 30 000 vpm	J	
0 ... 5 000 vpm	0 ... 50 000 vpm	K	K
0 ... 1 %	0 ... 10 %	L	L
0 ... 3 %	0 ... 30 %	M	M
0 ... 5 %	0 ... 50 %	N	N
0 ... 10 %	0 ... 100 %	P	P
0 ... 100 vpm (CO), 0 ... 300 vpm (NO)	0 ... 1 000 vpm CO, NO	R	R
0 ... 300 vpm (CO), 0 ... 500 vpm (NO)	0 ... 3 000 vpm CO, NO	S	S

Gas path

Material of gas path	Material of sample chamber	Code
Pipe made of stainless steel	with aluminum lining	1
Pipe made of stainless steel	with tantalum lining[3]	2
Pipe made of Hastelloy	with tantalum lining[3]	3

Reference chamber

	Code
Non-flow-type	0
Flow-type	1

Pressure compensation

	Code
Atmospheric pressure compensation	0

Module variant

	Code
For rack-mounted enclosure	A
For wall enclosure	B

Version

	Code
Standard	0

[1] C_2H_2, C_2H_6, C_3H_6, C_3H_8, C_4H_6, C_4H_{10}, C_6H_{14}, H_2O, possible as special application 7MB3017..

[2] Not possible in combination with an OXYMAT 7 module.

[3] Only for cell length 20 ... 180 mm.

Selection and ordering data

Additional versions	Order Code
Add "-**Z**" to Article No. and specify Order code	
Settings	
Kalrez (6375) seals in sample gas path	**B04**
Clean for O_2 service (specially cleaned gas path)	**B06**
Measuring range indication in plain text, if different from the default setting	**Y11**
Special setting (only together with an application no., e.g. extended measuring range)	**Y12**
Extended special setting (only together with an application no., e.g. determination of cross-interferences)	**Y13**
Base unit module assignment number	**D00 ... D99**

Ordering example

ULTRAMAT 7 module installed in rack unit enclosure
7MB3000-0BX00-1AA0-Z+D03
7MB3010-0AB10-0AA0-Z+D03

ULTRAMAT 7 module and rack unit enclosure supplied separately
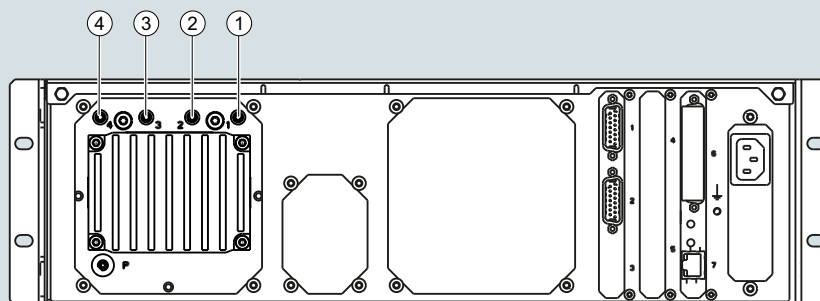**7MB3000-0BX00-1AA0**
7MB3010-0AB10-0AA0

# Extractive continuous process gas analysis
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ULTRAMAT 7 module

Circuit diagrams

Gas connections

1   Sample gas inlet
2   Sample gas outlet
3   Reference gas outlet
4   Reference gas inlet
P   Atmospheric pressure sensor

The sample gas connections and the reference gas connections are made of stainless steel, mat. no. 1.4404. The gas connections are designed as connection fittings with a pipe diameter of 6 mm.

Wall-mounted device
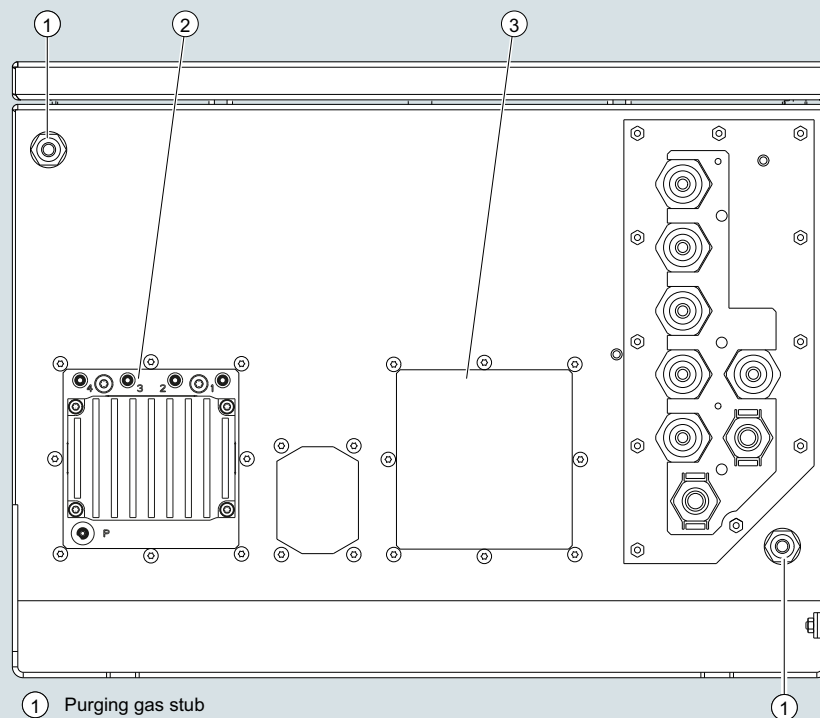
1   Purging gas stub

2   Slot of module 1: ULTRAMAT 7

3   Slot of module 2

Wall-mounted device, bottom