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Overview



The ULTRAMAT 23 is an innovative multi-component gas analyzer for measuring up to three infrared-sensitive gases using the NDIR principle. Use of a UV photometer enables you to measure even smaller concentrations of SO2 and NO2.

Measurement of oxygen (O2) is also possible through the use of electrochemical oxygen sensors or measuring cells operating according to the paramagnetic measuring principle ("dumbbell"). The use of an additional electrochemical H2S measuring cell permits use in biogas applications.

Up to four gas components can be measured continuously at the same time with the ULTRAMAT 23 gas analyzer. The device can be equipped with the following sensors:

- IR detector for IR-active gases
- UV photometer for UV-active gases
- H_2S sensor (electrochemical)
- O_2 sensor (electrochemical)
- O_2 sensor (paramagnetic)
- With the ULTRAMAT 23 gas analyzer for use in biogas plants, up to four gas components can be measured continuously: Two infrared-sensitive gases (CO_2 and CH_4), plus O_2 and H_2S with electrochemical measuring cells.
- Up to four gas components can be measured continuously using the ULTRAMAT 23 gas analyzer with paramagnetic oxygen cell: Three infrared-sensitive gases, plus O_2 ("dumbbell" measuring cell).
- With the ULTRAMAT 23 gas analyzer with UV photometer, one infrared-sensitive gas, UV-active gases (SO_2, NO_2) as well as O_2 can be measured with an electrochemical sensor.

Benefits

- AUTOCAL with ambient air (depending on the measured component)
  - Highly cost-effective as calibration gases are not required
- High selectivity thanks to multi-layer detectors, e.g. low cross-sensitivity to water vapor
- Analyzer cells can be cleaned on site as required
  - Cost savings due to reuse after contamination
- Menu-assisted operation in plain text
  - No manual required for operation, high level of operator safety
- Service information and logbook
  - Preventive maintenance; help for service and maintenance personnel; cost savings
- Coded input levels protect against unauthorized access
  - Increased safety
- Open interface architecture (RS 485, RS 232, PROFIBUS, SIPROM GA)
  - Simplified process integration; remote operation and control

Special benefits when used in biogas plants

- Continuous measurement of all four key components, including H_2S
- Long service life of the H_2S sensor even at increased concentrations; no diluting or backflushing necessary
- Introduction and measurement of flammable gases as occurring in biogas plants (e.g. 70% CH_4) is permissible (German Technical Inspectorate/TÜV certificate)

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Application

- Optimization of small firing systems
- Monitoring of exhaust gas concentration from firing systems with all types of fuel (oil, gas and coal) as well as operational measurements with thermal incineration plants
- Room air monitoring
- Monitoring of air in fruit stores, greenhouses, fermenting cellars and warehouses
- Monitoring of process control functions
- Atmosphere monitoring during heat treatment of steel
- For use in non-hazardous areas

Application areas in biogas plants

- Monitoring of fermenters for generating biogas (input and pure sides)
- Monitoring of gas-driven motors (power generation)
- Monitoring of feeding of biogas into the commercial gas network

Application area of paramagnetic oxygen sensor

- Flue gas analysis
- Inerting plants
- Room air monitoring
- Medical engineering

Further applications

- Environmental protection
- Chemical plants
- Cement industry

Special versions

Separate gas paths

The ULTRAMAT 23 with 2 IR components without pump is also available with two separate gas paths. This allows the measurement of two measuring points as used e.g. for the NO_x measurement before and after the NO_x converter.
The ULTRAMAT 23 gas analyzer can be used in emission measuring devices and for process and safety monitoring.

Versions conforming to EN 14181 and EN 15267

According to EN 14181, which is standardized in the EU and required in many European countries, a QAL1 qualification test, i.e. certification of the complete measuring device including gas paths and conditioning, is required for continuous emission monitoring systems (CEMS). In accordance with EN 15267, this must be performed by an independent accredited authority. In Germany, for example, the test is performed by the German Technical Inspectorate (TÜV) and the test report is submitted to the Federal/State Workgroup for Emission Control (Bund/Länder-Arbeitsgemeinschaft für Immissionsschutz - LAI) for examination/approval. Notification is then issued by the German Federal Environment Agency (Umweltbundesamt - UBA) in the Federal Gazette (Bundesanzeiger) as well as by the German Technical Inspectorate (TÜV) here:
https://www.qal1.de/en.

In the UK, the QAL1 test reports are prepared by Sira Environmental of the Environmental Agency in accordance with the MCERTS scheme and submitted for approval and publication on the SIRA Environmental websites. The other European countries rely either on the German or English certification scheme.

For use in EN 14181 applications, the devices with the article numbers 7MB235X in the Set CEM CERT (7MB1957) have undergone

Application (continued)

qualification testing according to German standards of EN 15267. These German Technical Inspectorate (TÜV) versions of ULTRAMAT are suitable for measurement of CO, NO, SO_2 and O_2 according to sections 13, 17 and 27 of the BImSchV (Federal Emission Law of Germany) and TA Luft. Smallest measuring range tested and approved by the German Technical Inspectorate:

1 and 2-component analyzer

- CO: 0 to 50 mg/m³
- NO: 0 to 50 mg/m³
- SO_2: 0 to 400 mg/m³

3-component analyzer

- CO: 0 to 250 mg/m³
- NO: 0 to 250 mg/m³
- SO_2: 0 to 400 mg/m³

Also tested as additional measuring ranges in accordance with EN 15267-3:

- CO: 0 to 1 250 mg/m³
- NO: 0 to 2 000 mg/m³
- SO_2: 0 to 7 000 mg/m³

Determination of the analyzer drift according to EN 14181 (QAL3) can be carried out manually or also with a PC using the SIPROM GA maintenance and servicing software. In addition, selected manufacturers of emission evaluation computers offer the possibility to read the drift data via the analyzer's serial interface and automatically record and process it in the evaluation computer. For devices in applications requiring a certified measuring range of less than 0 ... 100 mg/m³, compensation of the CO_2 cross-interference for CO and NO and of the O_2 cross-interference for NO is necessary.

Version with faster response time

The connection between the two condensation traps is equipped with a stopper to lead the complete flow through the measuring cell (otherwise only 1/3 of the flow), i.e. the response time is 2/3 faster. The functions of all other components remain unchanged.

Chopper purge

Consumption 100 ml/min (upstream pressure setting: approx. 3 000 hPa).

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Design

- 19" rack unit with 4 U for installation
  - In hinged frame
  - In cabinets
- Flow indicator for sample gas on front plate;
  option: integrated sample gas pump (standard for bench-top version)
- Gas connections for sample gas inlet and outlet as well as zero gas; pipe diameter 6 mm or ¼"
- Gas and electrical connections at the rear of the device (portable version: sample gas inlet at front)

Display and operator panel

- Operation based on NAMUR recommendation
- Simple, fast parameterization and commissioning of analyzer
- Large, backlit LCD for measured values
- Menu-driven operator functions for parameterization, test functions and calibration
- Washable membrane keyboard
- User help in plain text
- 6-language operating software

Inputs/outputs

- Three digital inputs for sample gas pump On/Off, triggering of AUTOCAL and synchronization of several devices
- Eight relay outputs can be freely configured for fault, maintenance demanded, maintenance switch, limits, measuring range identification and external solenoid valves
- Eight additional digital inputs and relay outputs as an option
- Electrically isolated analog outputs

Communication

RS 485 present in basic unit (connection from the rear).

Options

- RS 485/RS 232 converter
- RS 485/Ethernet converter
- RS 485/USB converter
- Incorporation in networks via PROFIBUS DP/PA interface
- SIPROM GA software as service and maintenance tool

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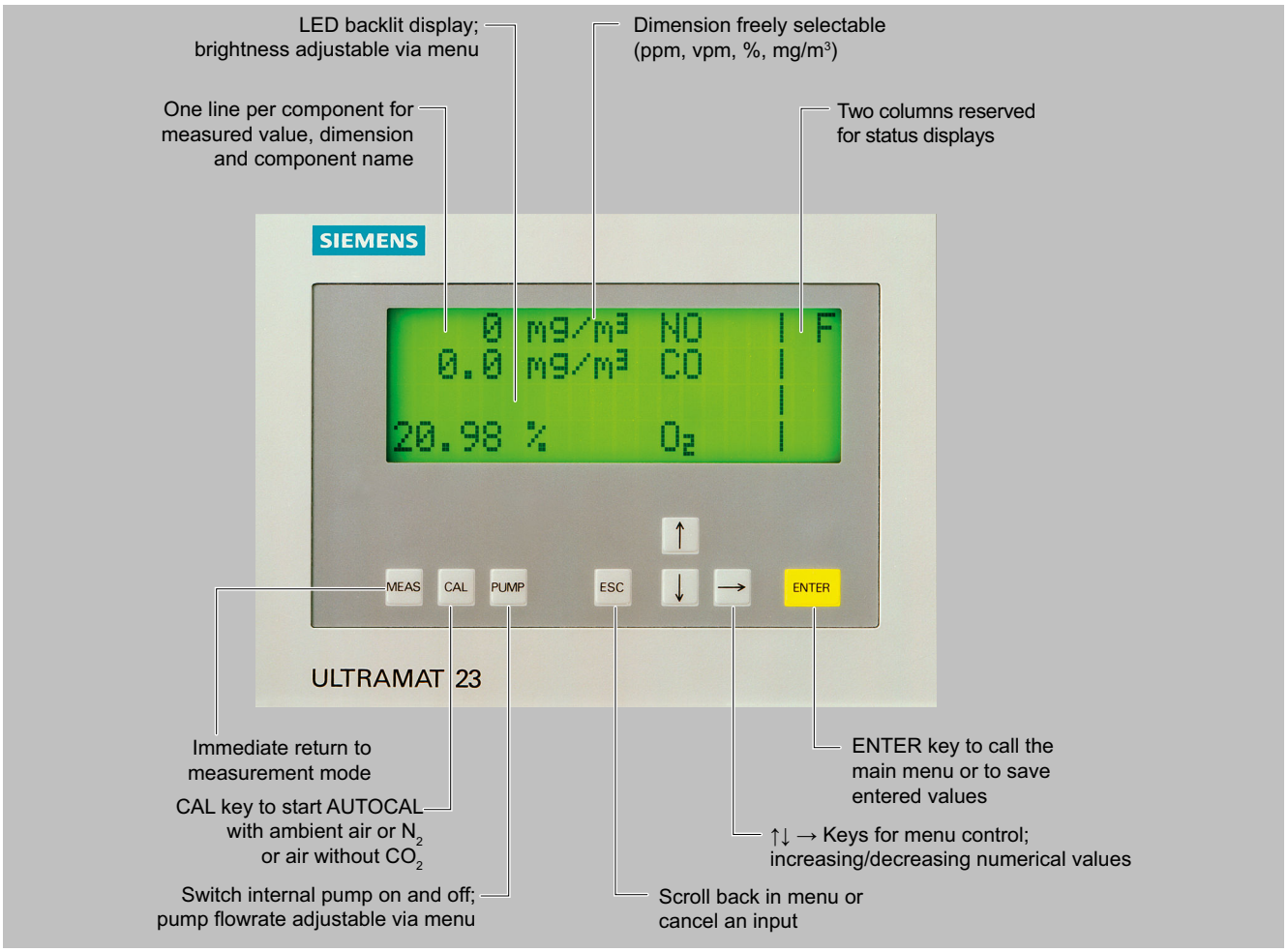
Design (continued)



ULTRAMAT 23, membrane keyboard and graphic display

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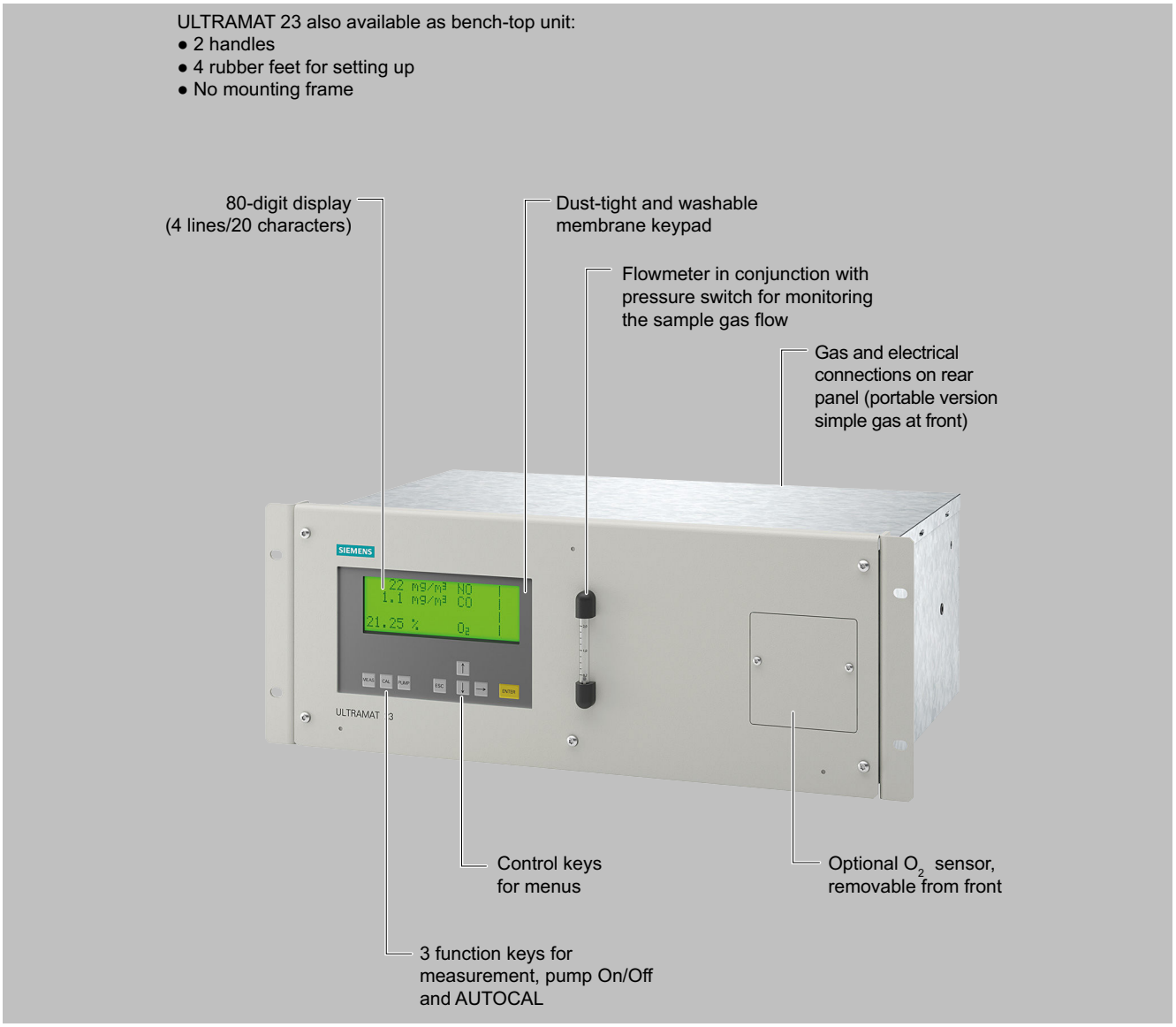
Design (continued)



ULTRAMAT 23, design

Designs – parts wetted by sample gas Gas path		19" rack unit	Desktop unit
With hoses	Condensation trap/gas inlet	-	PA (polyamide)
	Condensation trap	-	PE (polyethylene)
	Gas connections 6 mm	PA (polyamide)	PA (polyamide)
	Gas connections ¼"	Stainless steel, mat. no. 1.4571	Stainless steel, mat. no. 1.4571
	Hose	FPM (Viton)	FPM (Viton)
	Pressure switch	FPM (Viton) + PA6-3-T (Trogamide)	FPM (Viton) + PA6-3-T (Trogamide)
	Flowmeter	PDM/Duran glass/X10CrNiTi1810	PDM/Duran glass/X10CrNiTi1810
	Angle units/T-pieces	PA6	PA6
	Internal pump, option	PVDF/PTFE/EPDM/FPM/Trolene/stainless steel, mat. no. 1.4571	PVDF/PTFE/EPDM/FPM/Trolene/stainless steel, mat. no. 1.4571

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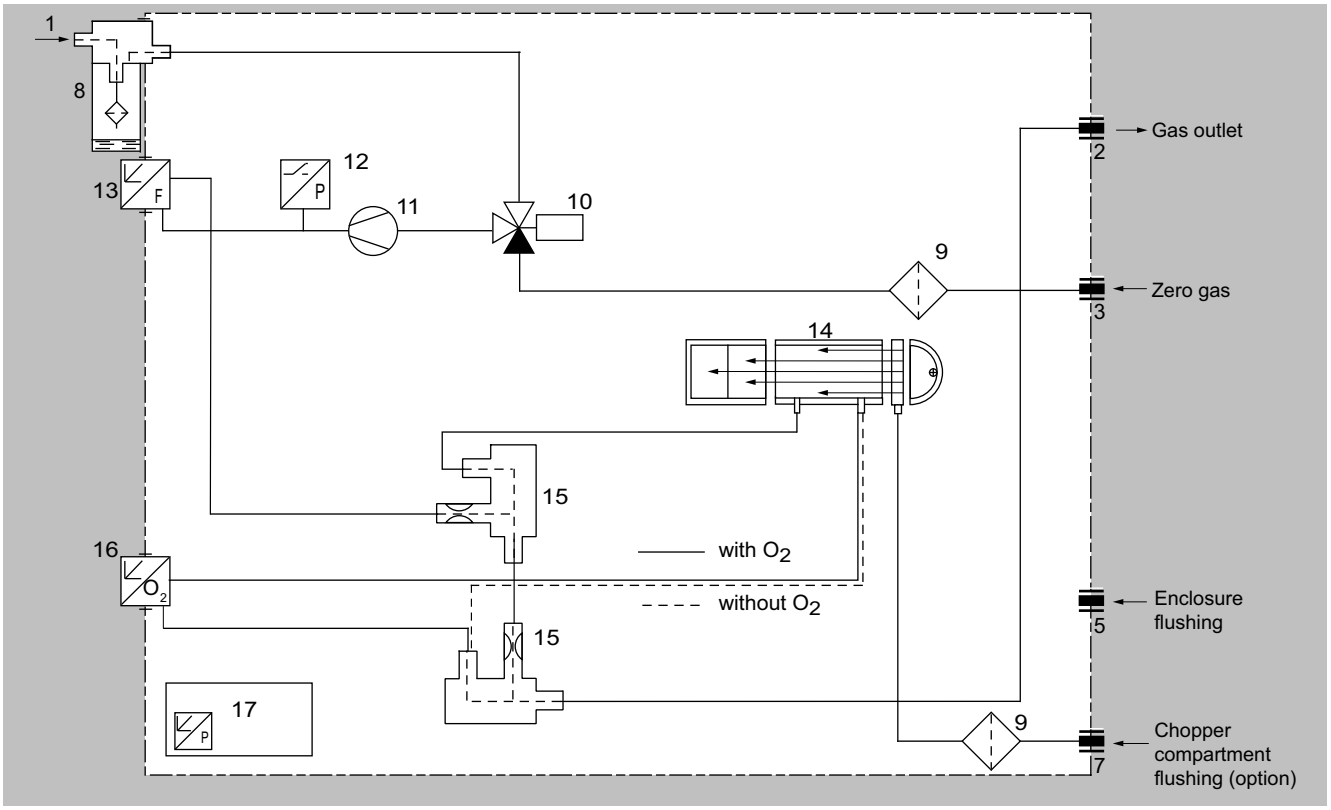
Design (continued)

Designs – parts wetted by sample gas Gas path		19" rack unit	Desktop unit
With hoses	Solenoid valve	FPM70/Ultramide/stainless steel, mat. no. 1.4310/1.4305	FPM70/Ultramide/stainless steel, mat. no. 1.4310/1.4305
	Safety condensation trap	PA66/NBR/PA6	PA66/NBR/PA6
	Analyzer chamber		
	• Body	Aluminum	Aluminum
	• Lining	Aluminum	Aluminum, black anodized
	• Fitting	Stainless steel, black anodized, mat. no. 1.4571	Stainless steel, mat. no. 1.4571
	• Window	CaF_2, quartz	CaF_2
	• Adhesive	E353	E353
	• O-ring	FPM (Viton)	FPM (Viton)
With pipes, only available in version "without pump"	Gas connections 6 mm/¼"	Stainless steel, mat. no. 1.4571	-
	Pipes	Stainless steel, mat. no. 1.4571	-
	Analyzer chamber		-
	• Body	Aluminum	-
	• Lining	Aluminum	-
	• Fitting	Stainless steel, mat. no. 1.4571	-
	• Window	CaF_2	-
	• Adhesive	E353	-
	• O-ring	FPM (Viton)	-

Gas path



ULTRAMAT 23, portable, in sheet-steel housing with internal sample gas pump, condensation trap with safety filter on front plate, optional oxygen measurement

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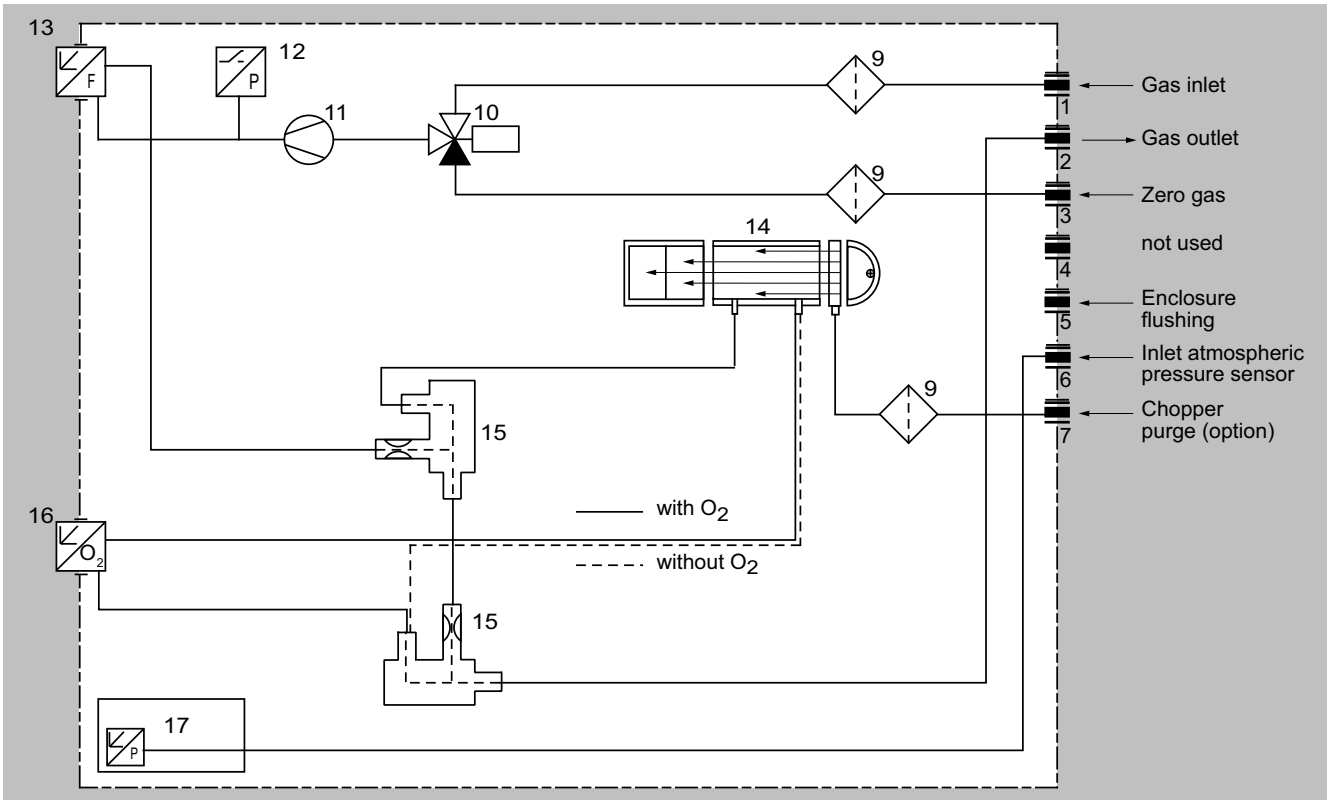
Design (continued)



ULTRAMAT 23, 19" rack-mounted enclosure with internal sample gas pump; optional oxygen measurement

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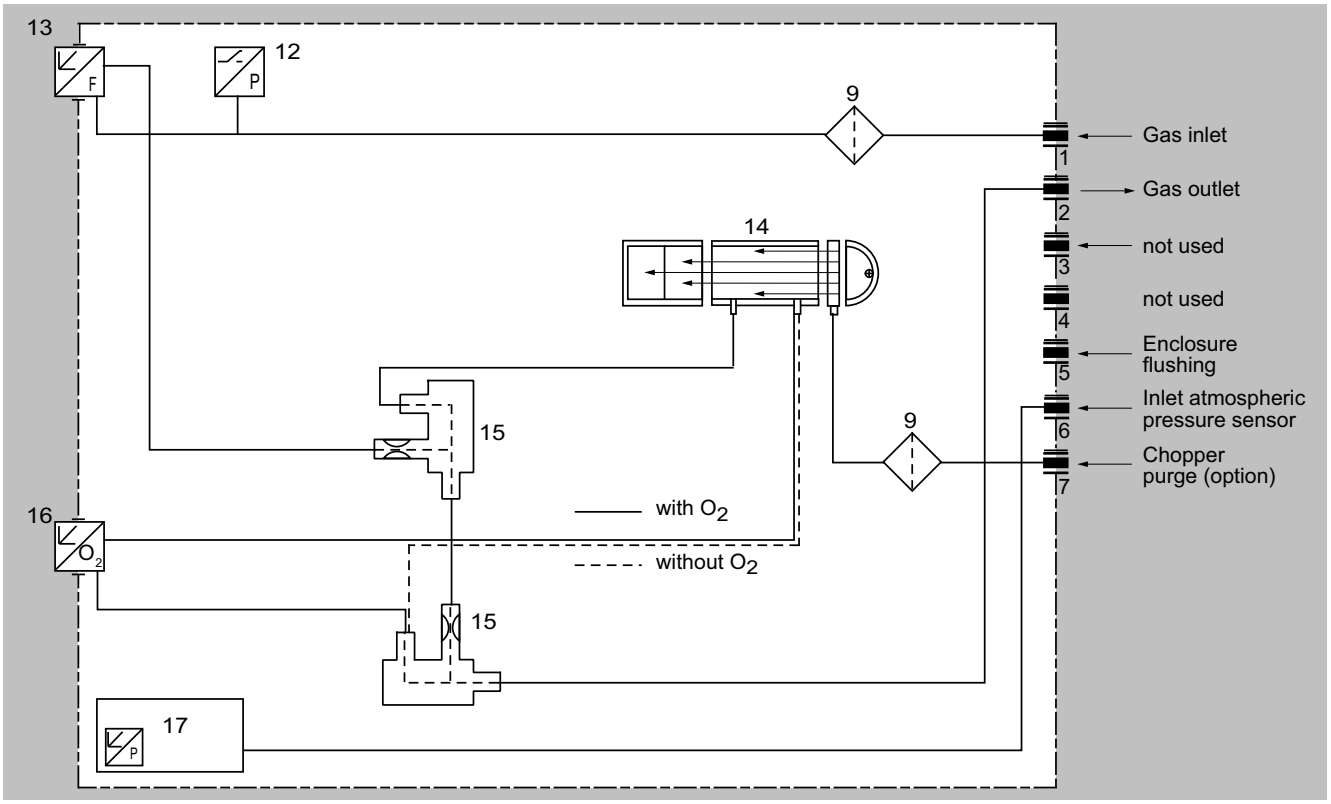
Design (continued)



ULTRAMAT 23, 19" rack-mounted enclosure without internal sample gas pump; optional oxygen measurement

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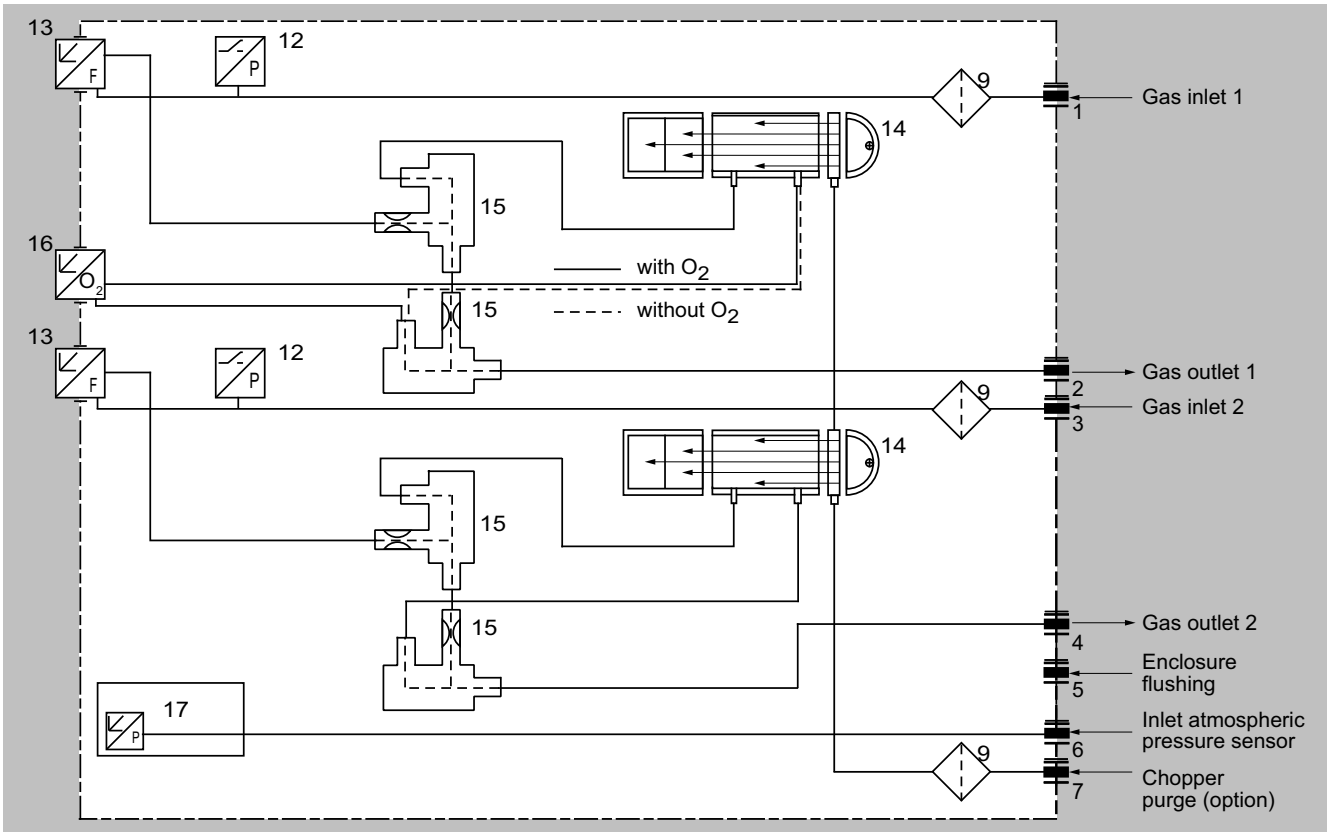
Design (continued)



ULTRAMAT 23, 19" rack unit housing without internal sample gas pump, with separate gas path for the 2nd measured component or for the 2nd and 3rd measured component, optional oxygen measurement

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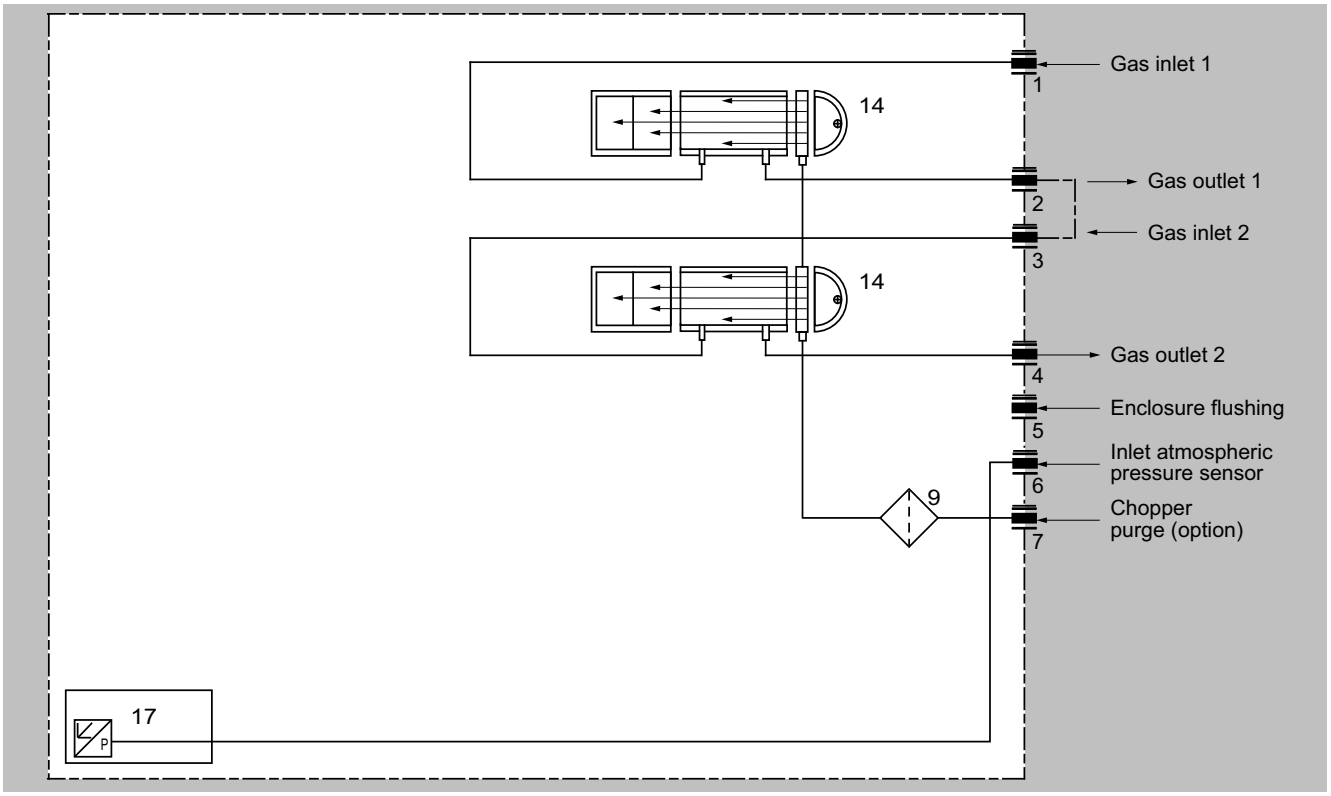
Design (continued)



ULTRAMAT 23, 19" rack-mounted enclosure, sample gas path version in pipes, separate gas path, always without sample gas pump, without safety filter and without safety condensation trap

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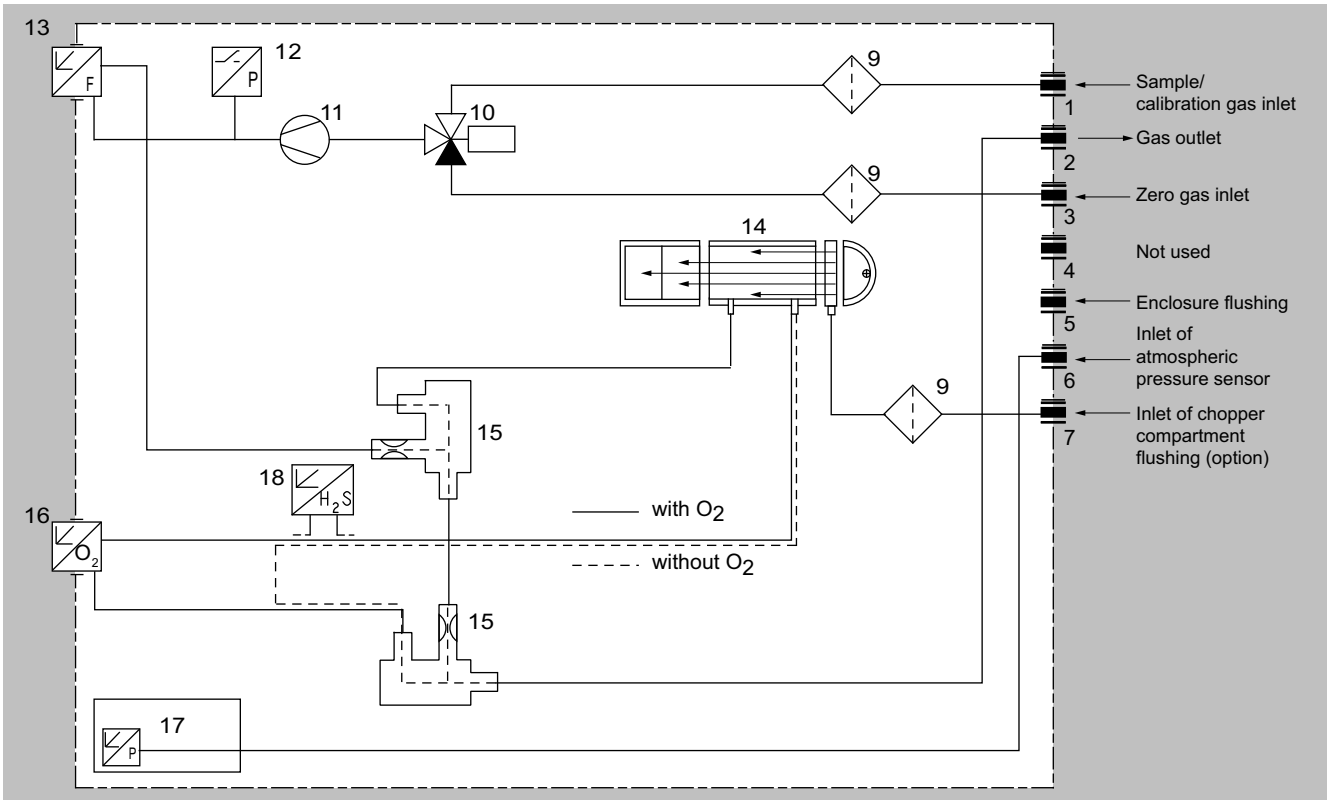
Design (continued)



ULTRAMAT 23, 19" rack-mounted enclosure with internal sample gas pump and H_2S sensor

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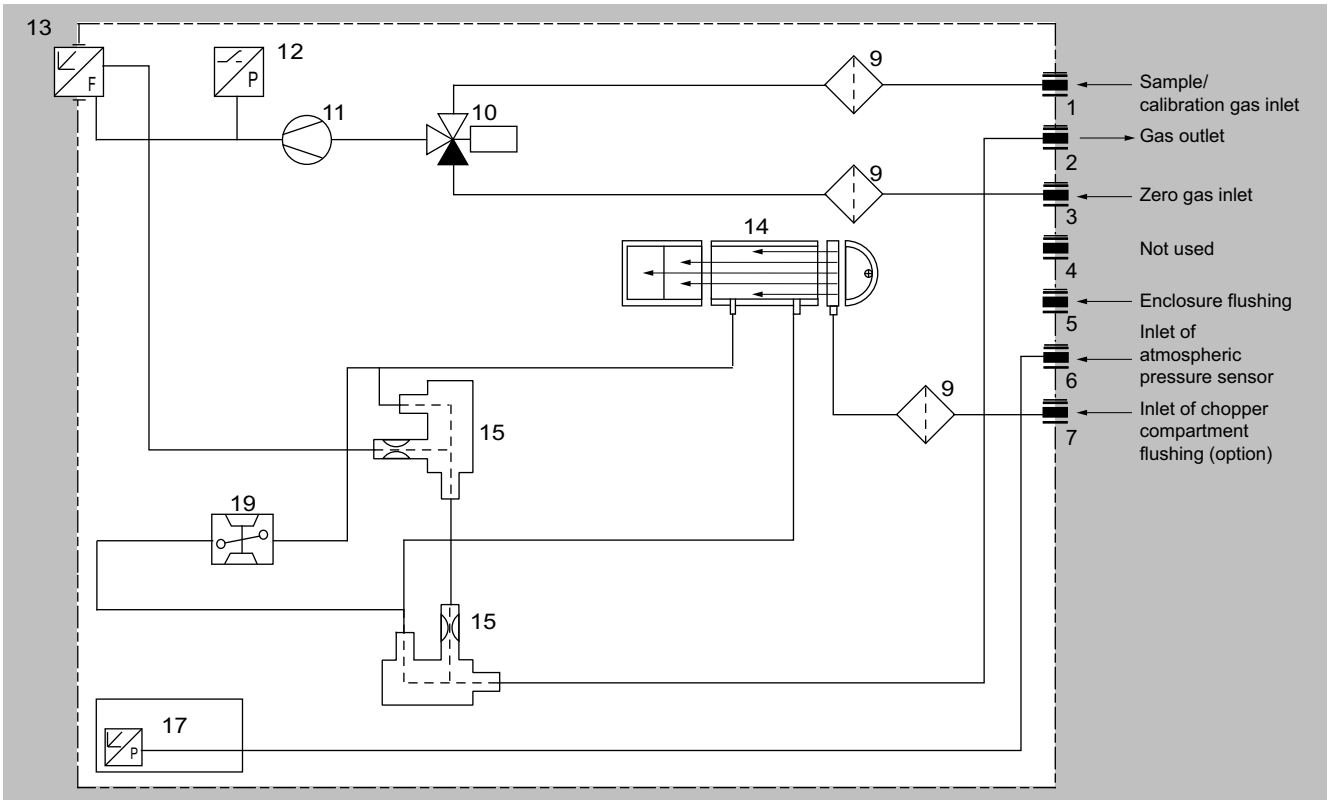
Design (continued)



ULTRAMAT 23, 19" rack-mounted enclosure with internal sample gas pump and paramagnetic oxygen measurement

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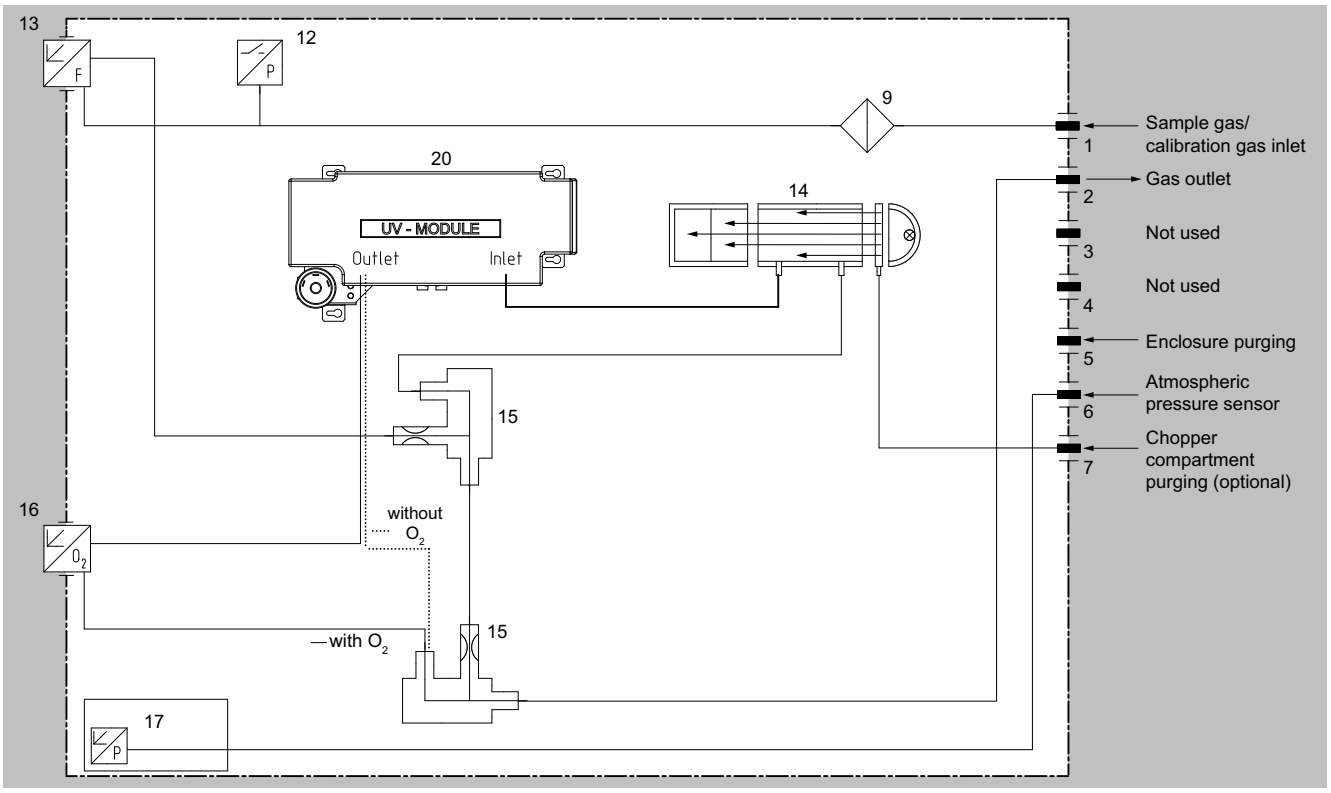
Design (continued)



ULTRAMAT 23, 19" rack unit enclosure with IR detector, UV photometer (UV module); optional oxygen measurement

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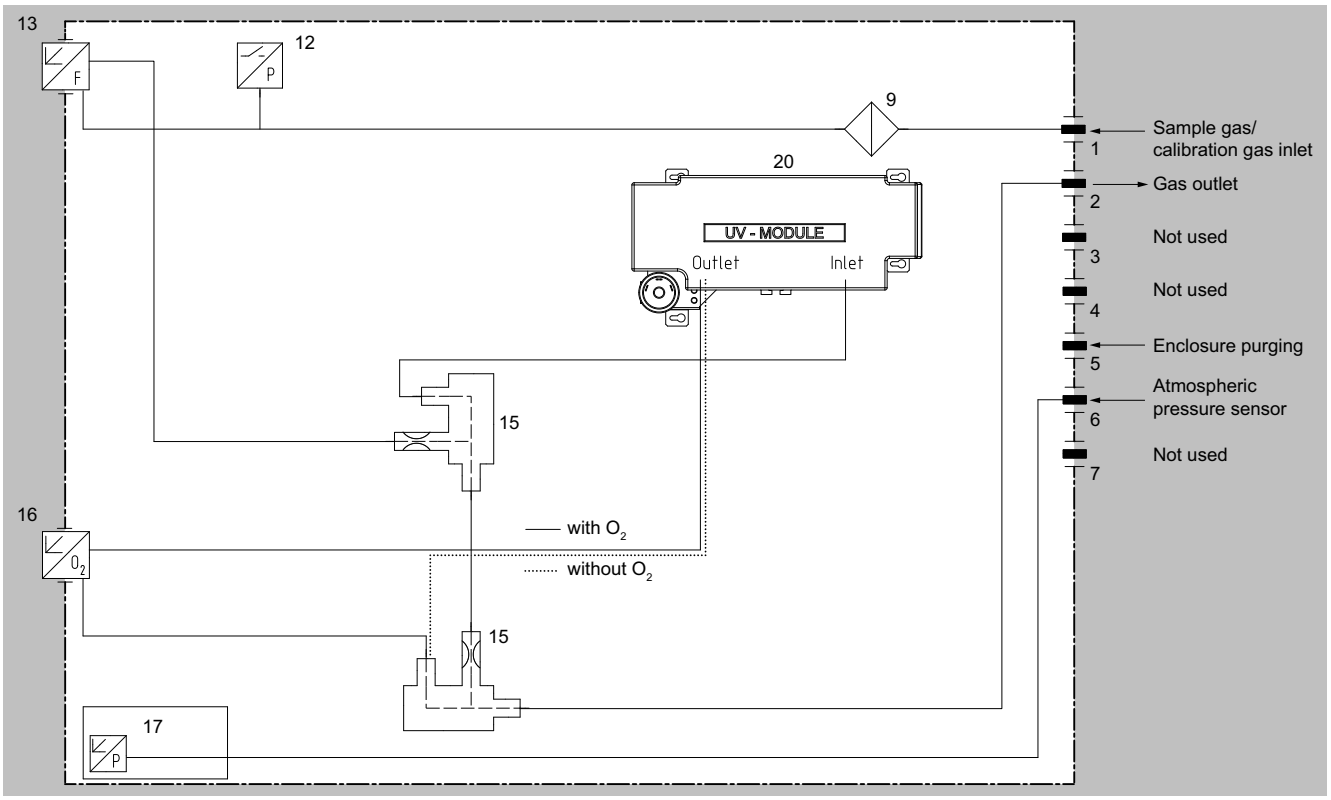
Design (continued)



ULTRAMAT 23, 19" rack-mounted enclosure with UV photometer (UV module); optional oxygen measurement

Legend for the gas path figures			
1	Inlet for sample gas/calibration gas	11	Sample gas pump
2	Gas outlet	12	Pressure switch
3	Inlet for AUTOCAL/zero gas or inlet for sample gas/calibration gas (channel 2)	13	Flow indicator
		14	Analyzer unit
4	Gas outlet (channel 2)	15	Safety condensation trap
5	Enclosure purging	16	Oxygen sensor (electrochemical)
6	Inlet of atmospheric pressure sensor	17	Atmospheric pressure sensor
7	Inlet/chopper purge	18	Hydrogen sulfide sensor
8	Condensation trap with filter	19	Oxygen measuring cell (paramagnetic)
9	Safety fine filter	20	UV photometer (UV module)
10	Solenoid valve		

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Mode of operation

The ULTRAMAT 23 uses multiple independent measuring principles which work selectively.

Infrared measurement

The measuring principle of the ULTRAMAT 23 is based on the molecule-specific absorption of bands of infrared radiation, which in turn is based on the "single-beam procedure". A radiation source (7) operating at 600 °C emits infrared radiation, which is then modulated by a chopper (5) at 8 1/3 Hz.

The IR radiation passes through the sample chamber (4), into which sample gas is flowing, and its intensity is weakened as a function of the concentration of the measured component.

The detector chamber - set up as a two- or three-layer detector chamber - is filled with the component to be measured.

The first detector layer (11) primarily absorbs energy from the central sections of the sample gas IR bands. Energy from the peripheral sections of the bands is absorbed by the second (2) and third (12) detector layers.

The microflow sensor generates a pneumatic connection between the upper layer and the lower layers. Negative feedback from the upper and lower layers leads to an overall narrowing of the spectral sensitivity band. The volume of the third layer and, therefore, the absorption of the bands, can be varied using a "slide switch" (10), thereby increasing the selectivity of each individual measurement.

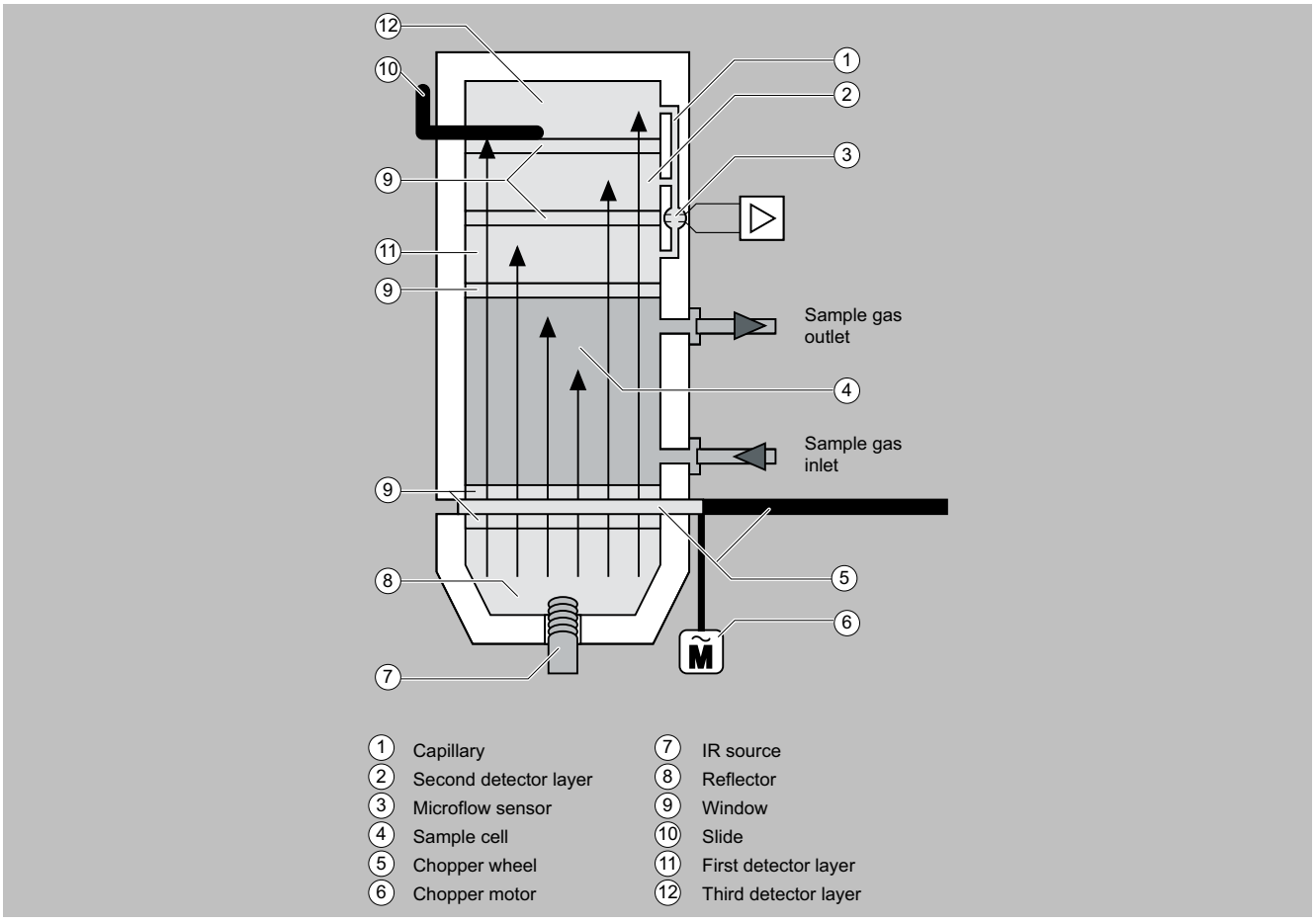
The rotating chopper (5) generates a pulsating flow in the detector chamber that the microflow sensor (3) converts into an electrical signal.

The microflow sensor consists of two nickel-plated grids heated to approximately 120 °C, which, along with two supplementary resistors, form a Wheatstone bridge. The pulsating flow together with the dense arrangement of the Ni grids causes a change in resistance. This leads to an offset in the bridge, which is dependent on the concentration of the sample gas.

Note

The sample gases must be fed into the analyzers free of dust. Condensation in the sample chambers must be prevented. Therefore, the use of gas modified for the measuring task is necessary in most application cases.

As far as possible, the ambient air of the analyzer unit should also not have a large concentration of the gas components to be measured.



ULTRAMAT 23, mode of operation of the infrared channel (example with three-layer detector)

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Mode of operation (continued)

Automatic calibration with air (AUTOCAL)

The ULTRAMAT 23 can be calibrated using, for example, ambient air. During this process (adjustable between 1 and 24 hours, 0 = no AUTOCAL), the chamber is purged with air. The detector then generates the largest signal U_0 (no pre-absorption in the sample chamber). This signal is used as the reference signal for zero point calibration, and also serves as the initial value for calculating the full-scale value in the manner described below.

As the concentration of the measured component increases, so too does absorption in the sample chamber. As a result of this pre-absorption, the detectable radiation energy in the detector decreases, and thus also the signal voltage. For the single-beam procedure of the ULTRAMAT 23, the mathematical relationship between the concentration of the measured component and the measured voltage can be approximately expressed as the following exponential function:

$U = U_0 \cdot e^{-kc}$

Legend	
c	Concentration
k	Device-specific constant
U_0	Basic signal with zero gas (sample gas without measured component)
U	Detector signal

Changes in the radiation power, contamination of the sample chamber, or aging of the detector components have the same effect on both U_0 and U, and result in the following:

$U' = U'_0 \cdot e^{-kc}$

Apart from being dependent on concentration c, the measured voltage thus changes continuously as the IR source ages, or with persistent contamination.

Each AUTOCAL thus tracks the total characteristic curve according to the currently valid value. Temperature and pressure influences are also compensated in this way.

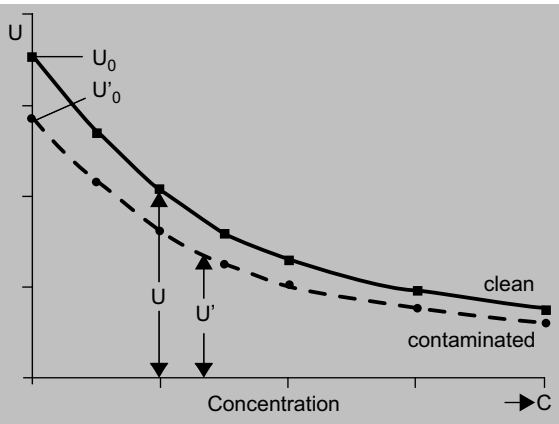
The influences of contamination and aging, as mentioned above, have a negligible influence on the measurement as long as U' remains in a certain tolerance range monitored by the device.

The tolerance range between two or more AUTOCALs can be individually configured on the ULTRAMAT 23 and an alarm message output. An alarm message is output when the value falls below the original factory setting of $U_0 < 50\%$ U. In most cases, this is due to the sample chamber being contaminated.

Calibration

The devices can be set to automatically calibrate the zero point every 1 to 24 hours, using ambient air or nitrogen. The calibration point for the IR-sensitive components is calculated mathematically from the newly determined U'_o and the device-specific parameters stored as default values. We recommend checking the calibration point once a year using a calibration gas. (For details on German Technical Inspectorate/TÜV measurements, see Table "Calibration intervals (TÜV versions)" under Selection and ordering data).

If an electrochemical sensor is installed, it is recommendable to use air for the AUTOCAL. In addition to calibration of the zero point of the IR-sensitive components, it is then also possible to simultaneously calibrate the calibration point of the electrochemical O_2 sensor automatically. The characteristic curve of the O_2 sensor is sufficiently stable following the single-point calibration. The zero point of the electrochemical sensor only needs be checked once a year by connecting nitrogen.



Calibration

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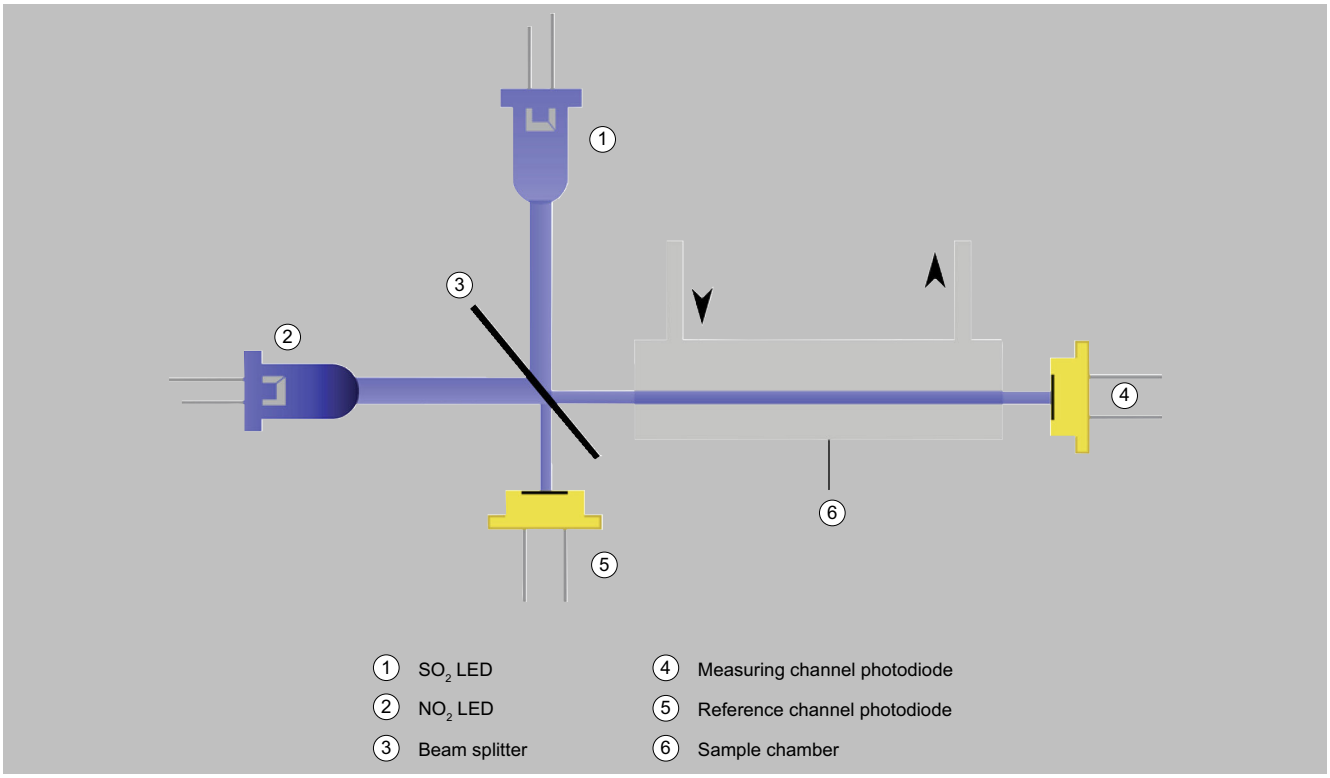
Mode of operation (continued)

Ultraviolet measurement



ULTRAMAT 23, ultraviolet measurement mode of operation

This measuring principle is also based on the molecule-specific absorption of bands of ultraviolet radiation using a double-beam photometer.

The light source is a solid-state diode (LED) based on AlGaN or InGaN semiconductors (1). To improve the signal evaluation, the light source is operated as a pulsed light source.

The ultraviolet radiation is collimated and first passes through a beam splitter (3), which generates two identically sized ray bundles (measuring and reference radiation). The measuring ray bundle passes through the sample chamber (6) into which the sample gas is flowing, and is attenuated as a function of the concentration of the measured component. This attenuation is evaluated according to the Lambert-Beer absorption law.

The measuring radiation is recorded by a photodiode (4) downstream of the sample chamber into which the sample gas is flowing (measuring signal). Likewise, the reference radiation is recorded by a second photodiode (5, reference signal). The ratio of measured signal and reference signal is used to calculate the concentration of the gas component.

The beam splitter also enables the coupling of a second light source (2) for measuring a second gas component. In this way, the absorption of sulfur dioxide (SO_2) and nitrogen dioxide (NO_2) is measured in alternating cycles and converted into continuous concentration values in sensor-level electronics. Additional sample gas applications are possible through a suitable selection of LEDs.

Oxygen measurement

The oxygen sensor operates according to the principle of a fuel cell. The oxygen is converted at the boundary layer between the cathode and electrolyte. An electron emission current flows between the lead anode and cathode and via a resistance, where a measured voltage is present. This measured voltage is proportional to the concentration of oxygen in the sample gas.

The oxygen electrolyte used is less influenced by interference influences (particularly CO_2, CO, H_2 and CH_4) than other sensor types.

Note

The oxygen sensor can be used for concentrations of both > 1% and < 1% O_2. In the event of sudden changes from high concentrations to low concentrations (< 1%), the sensor will, however, require longer running-in times to get a constant measured value. This is to be taken into consideration when switching between measuring points in particular, and appropriate purging times are to be set.

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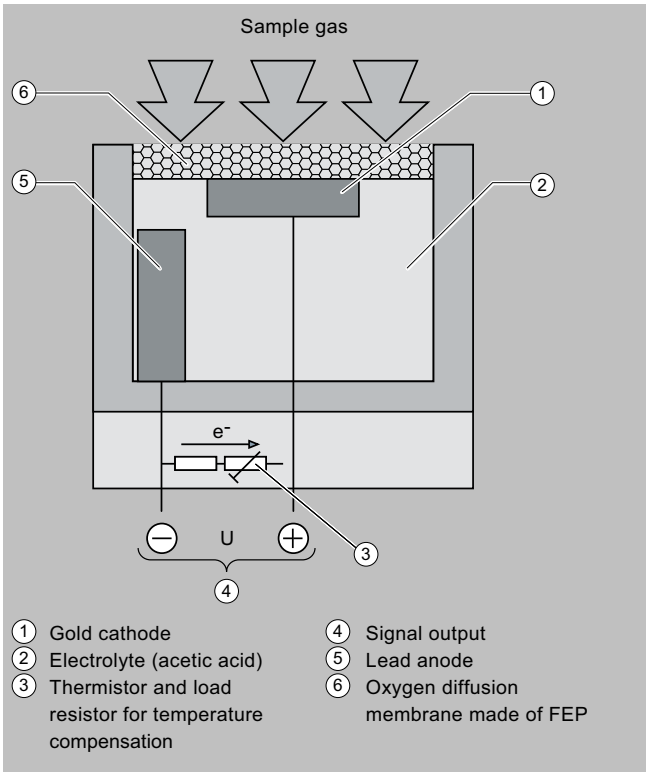
Mode of operation (continued)



ULTRAMAT 23, oxygen sensor mode of operation

Electrochemical sensor for H_2S determination

The hydrogen sulfide enters through the diffusion barrier (gas diaphragm) into the sensor and is oxidized at the working electrode. A reaction in the form of a reduction of atmospheric oxygen takes place on the counter electrode. The transfer of electrons can be tapped on the connector pins as a current which is directly proportional to the gas concentration.

Calibration

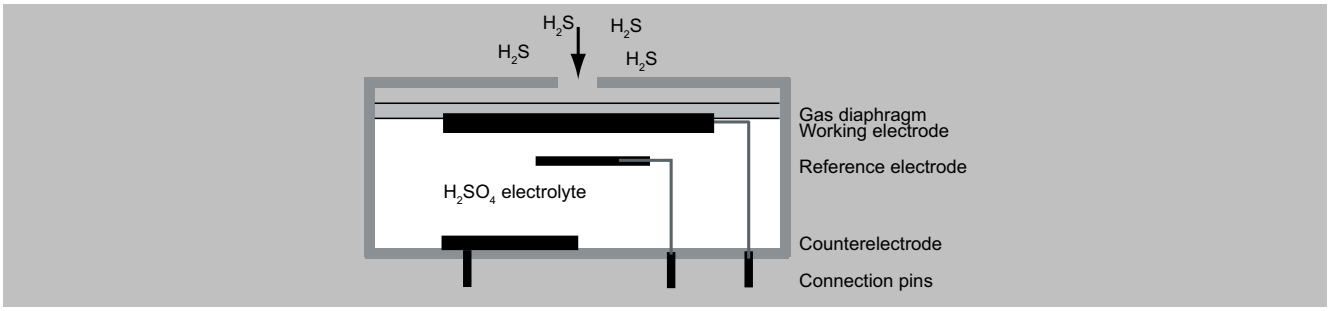
The zero point is automatically recalibrated by the AUTOCAL function when connecting e.g. nitrogen or air. It is recommendable to check the calibration point monthly using calibration gas (45 to 50 vpm).

The AUTOCAL (with ambient air, for example) must be performed every hour. In so doing, you must ensure that the ambient air is saturated in accordance with a dew point of 11 °C.

If this cannot be constantly ensured with dry ambient air, the adjustment gas must be fed through a humidifier and subsequently through a cooler (dew point 11 °C).

If the accompanying gas contains the following components, the hydrogen sulfide sensor must not be used:

- Compounds containing chlorine
- Compounds containing fluorine
- Heavy metals
- Aerosols
- Alkaline components
- NH_3 > 5 vpm



Operating principle of the H_2S sensor

Paramagnetic oxygen cell

In contrast to other gases, oxygen is highly paramagnetic. This property is used as the basis for the method of measurement.

Two permanent magnets generate an inhomogeneous magnetic field in the measuring cell. If oxygen molecules flow into the measuring cell (1), they are drawn into the magnetic field. This results in the two diamagnetic hollow spheres (2) being displaced out of the magnetic field. This rotary motion is recorded optically, and serves as the input variable for control of a compensation flow. This generates a torque opposite to the rotary motion around the two hollow spheres by means of a wire loop (3). The compensation current is proportional to the concentration of oxygen.

Calibration

The calibration point is calibrated with the AUTOCAL function when processing air (corresponding to calibration with the electrochemical O_2 sensor). In order to comply with the technical data, the zero point of the paramagnetic measuring cell must be calibrated with nitrogen weekly in the case of measuring ranges < 5% or every two months in the case of larger measuring ranges.

Alternatively, inert gases (such as nitrogen) can be used for AUTOCAL. As the limit point of the measuring range remains largely stable, an annual limit point adjustment will suffice.

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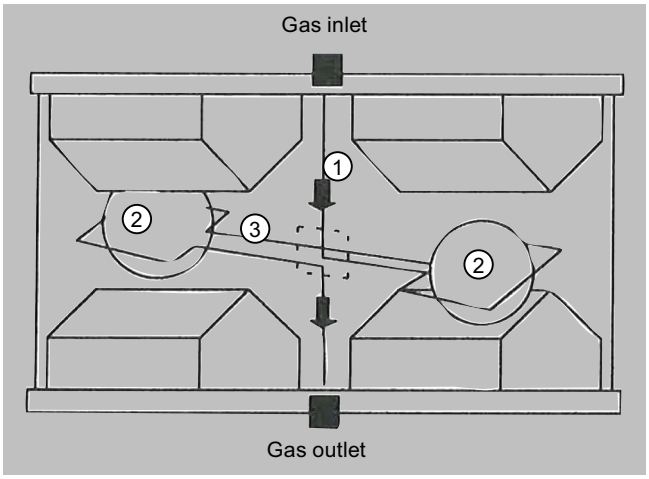
Mode of operation (continued)



Operating principle of the paramagnetic oxygen cell

Cross-interferences, paramagnetic oxygen cells

Accompanying gas	Formula	Deviation at 20 °C	Deviation at 50 °C
Acetaldehyde	C_2H_4O	-0.31	-0.34
Acetone	C_3H_6O	-0.63	-0.69
Acetylene, ethyne	C_2H_2	-0.26	-0.28
Ammonia	NH_3	-0.17	-0.19
Argon	Ar	-0.23	-0.25
Benzene	C_6H_6	-1.24	-1.34
Bromine	Br_2	-1.78	-1.97
Butadiene	C_4H_6	-0.85	-0.93
n-butane	C_4H_{10}	-1.1	-1.22
Isobutylene	C_4H_8	-0.94	-1.06
Chlorine	Cl_2	-0.83	-0.91
Diacetylene	C_4H_2	-1.09	-1.2
Dinitrogen monoxide	N_2O	-0.2	-0.22
Ethane	C_2H_6	-0.43	-0.47
Ethyl benzene	C_8H_{10}	-1.89	-2.08
Ethylene, ethene	C_2H_4	-0.2	-0.22
Ethylene glycol	$C_2H_6O_2$	-0.78	-0.88
Ethylene oxide	C_2H_4O	-0.54	-0.6
Furan	C_4H_4O	-0.9	-0.99
Helium	He	0.29	0.32
n-hexane	C_6H_{14}	-1.78	-1.97
Hydrogen chloride, hydrochloric acid	HCl	-0.31	-0.34
Hydrogen fluoride, hydrofluoric acid	HF	0.12	0.14
Carbon dioxide	CO_2	-0.27	-0.29
Carbon monoxide	CO	-0.06	-0.07
Krypton	Kr	-0.49	-0.54
Methane	CH_4	-0.16	-0.17
Methanol	CH_4O	-0.27	-0.31
Methylene chloride	CH_2Cl_2	-1	-1.1
Monosilane, silane	SiH_4	-0.24	-0.27
Neon	Ne	0.16	0.17
n-octane	C_8H_{18}	-2.45	-2.7
Phenol	C_6H_6O	-1.4	-1.54

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Mode of operation (continued)

Accompanying gas	Formula	Deviation at 20 °C	Deviation at 50 °C
Propane	C_3H_8	-0.77	-0.85
Propylene, propene	C_3H_6	-0.57	-0.62
Propylene chloride	C_3H_7Cl	-1.42	-1.44
Propylene oxide	C_3H_6O	-0.9	-1
Oxygen	O_2	100	100
Sulfur dioxide	SO_2	-0.18	-0.2
Sulfur hexafluoride	SF_6	-0.98	-1.05
Hydrogen sulfide	H_2S	-0.41	-0.43
Nitrogen	N_2	0	0
Nitrogen dioxide	NO_2	5	16
Nitrogen monoxide	NO	42.7	43
Styrene	C_8H_8	-1.63	-1.8
Toluene	C_7H_8	-1.57	-1.73
Vinyl chloride	C_2H_3Cl	-0.68	-0.74
Vinyl fluoride	C_2H_3F	-0.49	-0.54
Water (vapor)	H2O	-0.03	-0.03
Hydrogen	H_2	0.23	0.26
Xenon	Xe	-0.95	-1.02

Cross-sensitivities (with accompanying gas concentration 100%)

Function

Main features

- Practically maintenance-free thanks to AUTOCAL with ambient air (or with N_2, only for devices without an oxygen sensor); both the zero point and the sensitivity are calibrated in the process
- Calibration with calibration gas only required every twelve months, depending on the application
- Two measuring ranges per component can be set within specified limits; all measuring ranges linearized; autoranging with measuring range identification
- Automatic correction of variations in atmospheric pressure
- Sample gas flow monitoring; error message output if flow < 1 l/min (only with Viton sample gas path)
- Maintenance demanded
- Two freely configurable undershooting or overshooting limits per measured component

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Selection and ordering data

ULTRAMAT 23 gas analyzer For measuring 1 infrared component, UV components, oxygen and hydrogen sulfide			Article No. 7MB2335-	●	●	●	●	●	-	●	A	A	●
Click on the Article No. for online configuration in the PIA Life Cycle Portal.													
Unavailable combinations are shown in PIA Life Cycle Portal as "not permitted".													
Enclosure, version and gas paths 19" rack unit for installation in cabinets[12]													
Gas connections	***Gas paths***	***Internal sample gas pump***											
6 mm pipe	Viton	Without[2)]		0									
¼" pipe	Viton	Without[2), 14)]		1									
6 mm pipe	Viton	With		2									
¼" pipe	Viton	With [13)]		3									
6 mm pipe	Stainless steel, mat. No. 1.4571, separate	Without[2)]		6									
¼" pipe	Stainless steel, mat. No. 1.4571, separate	Without[2)]		7									
Portable, in sheet-steel enclosure, 6 mm gas connections, Viton gas path, with integrated sample gas pump, condensation trap with safety filter on the front plate.				8									
Infrared measured component													
Measured component	**Possible with measuring range identification**												
CO	A, C, D, E, F, G ... R, T, U, X				A								
CO_2[1)]	D[5)], G[5)], H[5)], J[5)], K ... R				C								
CH_4	E, H, L, N, P, R				D								
C_2H_4	K				F								
C_6H_{14}	K				M								
SO_2 [10)]	B[7)], F ... L, S[9)], T[8)], W				N								
NO	A, C, E, G ... J, T, U, V, W				P								
N_2O[6)]	E				S								
SF_6	H				V								
Smallest measuring range	**Largest measuring range**												
0 ... 50 mg/m³	0 ... 500 mg/m³					A							
0 ... 200 mg/m³	0 ... 1 000 mg/m³					B							
0 ... 100 mg/m³	0 ... 1 000 mg/m³					C							
0 ... 50 vpm	0 ... 250 vpm					D							
0 ... 100 vpm	0 ... 500 vpm					E							
0 ... 150 vpm	0 ... 750 vpm					F							
0 ... 200 vpm	0 ... 1 000 vpm					G							
0 ... 500 vpm	0 ... 2 500 vpm					H							
0 ... 1 000 vpm	0 ... 5 000 vpm					J							
0 ... 2 000 vpm	0 ... 10 000 vpm					K							
0 ... 0.5%	0 ... 2.5%					L							
0 ... 1%	0 ... 5%					M							
0 ... 2%	0 ... 10%					N							
0 ... 5%	0 ... 25%					P							
0 ... 10%	0 ... 50%					Q							
0 ... 20%	0 ... 100%					R							
0 ... 50 mg/m³ [11)]	0 ... 1 250 mg/m³ [11)]					S							
0 ... 100 mg/m³	0 ... 750 mg/m³					T							
0 ... 150 mg/m³	0 ... 750 mg/m³					U							
0 ... 250 mg/m³	0 ... 1 250 mg/m³					V							
0 ... 400 mg/m³	0 ... 2 000 mg/m³					W							
0 ... 50 vpm	0 ... 2 500 vpm					X							
Oxygen measurement[4)]													
Without O_2 sensor							0						
With electrochemical O_2 sensor							1						
With paramagnetic oxygen measuring cell							8						
Hydrogen sulfide measurement													
Without								6					
With H_2S sensor 0 ... 5 / 50 vpm								7					
Auxiliary power													
100 V AC, 50 Hz										0			
120 V AC, 50 Hz										1			

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Selection and ordering data (continued)

ULTRAMAT 23 gas analyzer For measuring 1 infrared component, UV components, oxygen and hydrogen sulfide	Article No. 7MB2335-	●	●	●	●	●	-	●	A	A	●
200 V AC, 50 Hz								2			
230 V AC, 50 Hz								3			
100 V AC, 60 Hz								4			
120 V AC, 60 Hz								5			
230 V AC, 60 Hz								6			
Language of the operating software[3]											
German											0
English											1
French											2
Spanish											3
Italian											4

1) For measuring ranges below 1%, a CO_2 absorber cartridge can be used for zero point adjustment (see Accessories).
2) Without separate zero gas input or solenoid valve.
3) Language for operation can be changed.
4) O_2 sensor/O_2 measuring cell in gas path of infrared measured component 1.
5) With chopper compartment purging (N_2 approx. 3 000 hPa required for measuring ranges below 0.1% CO_2), to be ordered separately (see order code C02 or C03).
6) Not suitable for use with emission measurements since cross-sensitivity too high.
7) Maximum possible AUTOCAL cycle ≤ 6 h, constant ambient conditions (max. deviation ±1 °C (1.8 °F)): see table "Calibration intervals, standard devices" under "More information".
8) Maximum possible AUTOCAL cycle ≤ 3 h, constant ambient conditions (max. deviation ±1 °C (1.8 °F)): see table "Calibration intervals, standard devices" under "More information".
9) Measured with UV technology
10) When measuring range identification "S" selected: Parallel measurement of SO_2 and NO_2 with UV photometer.
11) The measuring ranges of the two components differ slightly: For SO_2: 0 ... 50/1 250 mg/m³, for NO_2: 0 ... 50/1 000 mg/m³.
12) E21 only for options 1, 3 and 5
13) In combination with the E21 option (CSA for measuring flammable gases) without pump, flow indicator, pressure switch and S-vessel. The solenoid valve is present. However, the gas path corresponds to this setup.
14) In combination with the E21 option (CSA for measuring flammable gases) without flow indicator, pressure switch and S-vessel. However, the gas path corresponds to this setup.

Options	Order code
Add "-**Z**" to article number and then add order code	
Settings	
Add-on electronics with 8 digital inputs/outputs, PROFIBUS PA interface	**A12**
Add-on electronics with 8 digital inputs/outputs, PROFIBUS DP interface	**A13**
IEC plug, 37-pin D-sub connector, 9-pin D-sub connector	**A33**
Tag plates (customized inscription)	**B03**
Clean for O_2 service (specially cleaned gas path)	**B06**
Gas path for short response time[3]	**C01**
Chopper compartment purging for 6 mm gas connection	**C02**
Chopper compartment purging for ¼" gas connection	**C03**
Selection of the conversion mg/m³ in ppm at 293K or 273K	**D15**
ATEX: II 3G Ex ec ic nC IIC T4 Gc; BVS 16 ATEX E 061 X IECEx: Ex ec ic nC IIC T4 Gc; IECEx BVS 16.0041X FM/CSA: Class I, Zone 2 A/Ex ec ic nC IIC T4 Gc Class I, Division 2, Groups A, B, C, D T4	**E20**
CSA: Class I, Zone 2 A/Ex ec ic nC IIC T4 Gb/Gc Class I, Division 2, Groups A, B, C, D T4	**E21**

Options	Order code
Calibration interval 5 months (TÜV, QAL) measuring ranges: CO 0 - 150/750 mg/m³; NO 0 - 100/750 mg/m³	**E50**
Measuring range indication in plain text[1]	**Y11**
Measurement of CO_2 in forming gas[2] (only in conjunction with measuring range 0 ... 20 / 0 ... 100%)	**Y14**

1) Default setting: smallest measuring range, largest measuring range.
2) CO_2 measurement in accompanying gas Ar or Ar/He (3:1); forming gas.
3) Only for version with Viton hose.

Accessories	Article No.
CO_2 absorber cartridge	**7MB1933-8AA**
RS 485/Ethernet converter	**A5E52327218**
RS 485/RS 232 converter	**A5E52327214**
RS 485/USB converter	**A5E52327216**
Add-on electronics with 8 digital inputs/outputs and PROFIBUS PA	**A5E00056834**
Add-on electronics with 8 digital inputs/outputs and PROFIBUS DP	**A5E00057159**
Set of Torx screwdrivers	**A5E34821625**

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Selection and ordering data (continued)

ULTRAMAT 23 gas analyzer For measuring 2 infrared components, UV components, oxygen and hydrogen sulfide			Article No. 7MB2337-	●	●	●	●	●	-	●	●	●	●
Click on the Article No. for online configuration in the PIA Life Cycle Portal.													
Unavailable combinations are shown in PIA Life Cycle Portal as "not permitted".													
Enclosure, version and gas paths													
19" rack unit for installation in cabinets[14]													
Gas connections	***Gas paths***	***Internal sample gas pump***											
6 mm pipe	Viton, not separate	Without[2]		0									
¼" pipe	Viton, not separate	Without[2], [16]		1									
6 mm pipe	Viton, not separate	With		2									
¼" pipe	Viton, not separate	With [15]		3									
6 mm pipe	Viton, separate	Without[2]		4									
¼" pipe	Viton, separate	Without[2], [16]		5									
6 mm pipe	Stainless steel, mat. No. 1.4571, separate	Without[2]		6									
¼" pipe	Stainless steel, mat. No. 1.4571, separate	Without[2]		7									
Portable, in sheet-steel enclosure, 6 mm gas connections, Viton gas path, with integrated sample gas pump, condensation trap with safety filter on the front plate.				8									
1st infrared measured component													
Measured component	**Possible with measuring range identification**												
CO	A, C, D, E, F, G ... R, T, U, X				A								
CO_2[1]	D[5], G[5], H[5], J[5], K ... R				C								
CH_4	E, H, L, N, P, R				D								
C_2H_4	K				F								
C_6H_{14}	K				M								
SO_2	B[8], F ... L, T[9], W				N								
NO	A, C, E, G ... J, T, U, V, W				P								
N_2O[6]	E				S								
SF_6	H				V								
Smallest measuring range	**Largest measuring range**												
0 ... 50 mg/m³	0 ... 500 mg/m³					A							
0 ... 200 mg/m³	0 ... 1 000 mg/m³					B							
0 ... 100 mg/m³	0 ... 1 000 mg/m³					C							
0 ... 50 vpm	0 ... 250 vpm					D							
0 ... 100 vpm	0 ... 500 vpm					E							
0 ... 150 vpm	0 ... 750 vpm					F							
0 ... 200 vpm	0 ... 1 000 vpm					G							
0 ... 500 vpm	0 ... 2 500 vpm					H							
0 ... 1 000 vpm	0 ... 5 000 vpm					J							
0 ... 2 000 vpm	0 ... 10 000 vpm					K							
0 ... 0.5%	0 ... 2.5%					L							
0 ... 1%	0 ... 5%					M							
0 ... 2%	0 ... 10%					N							
0 ... 5%	0 ... 25%					P							
0 ... 10%	0 ... 50%					Q							
0 ... 20%	0 ... 100%					R							
0 ... 100 mg/m³	0 ... 750 mg/m³					T							
0 ... 150 mg/m³	0 ... 750 mg/m³					U							
0 ... 250 mg/m³	0 ... 1 250 mg/m³					V							
0 ... 400 mg/m³	0 ... 2 000 mg/m³					W							
0 ... 50 vpm	0 ... 2 500 vpm					X							
Oxygen measurement[4]													
Without O_2 sensor							0						
With electrochemical O_2 sensor							1						
With paramagnetic oxygen measuring cell							8						
Hydrogen sulfide measurement													
Without								6					
With H_2S sensor 0 ... 5 / 50 vpm								7					

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Selection and ordering data (continued)

ULTRAMAT 23 gas analyzer For measuring 2 infrared components, UV components, oxygen and hydrogen sulfide		Article No. 7MB2337-	●	●	●	●	●	-	●	●	●	●
Auxiliary power												
100 V AC, 50 Hz									0			
120 V AC, 50 Hz									1			
200 V AC, 50 Hz									2			
230 V AC, 50 Hz									3			
100 V AC, 60 Hz									4			
120 V AC, 60 Hz									5			
230 V AC, 60 Hz									6			
2nd infrared measured component												
Measured component	**Possible with measuring range identification**											
CO	A, C, D, E, F, G ... R, T, U, X									A		
CO_2 [1]	D[5], G[5], H[5], J[5], K ... R									C		
CH_4	E, H, L, N, P, R									D		
C_2H_4	K									F		
C_6H_{14}	K									M		
SO_2 [11]	B[8], F ... L, S[10], T[9], W									N		
NO	C, E, G ... J, T, U, V, W									P		
N_2O	E[6], Y[7]									S		
SF_6	H									V		
Smallest measuring range	**Largest measuring range**											
0 ... 50 mg/m³ [12]	0 ... 500 mg/m³ [12]										A	
0 ... 200 mg/m³	0 ... 1 000 mg/m³										B	
0 ... 100 mg/m³	0 ... 1 000 mg/m³										C	
0 ... 50 vpm	0 ... 250 vpm										D	
0 ... 100 vpm	0 ... 500 vpm										E	
0 ... 150 vpm	0 ... 750 vpm										F	
0 ... 200 vpm	0 ... 1 000 vpm										G	
0 ... 500 vpm	0 ... 2 500 vpm										H	
0 ... 1 000 vpm	0 ... 5 000 vpm										J	
0 ... 2 000 vpm	0 ... 10 000 vpm										K	
0 ... 0.5%	0 ... 2.5%										L	
0 ... 1%	0 ... 5%										M	
0 ... 2%	0 ... 10%										N	
0 ... 5%	0 ... 25%										P	
0 ... 10%	0 ... 50%										Q	
0 ... 20%	0 ... 100%										R	
0 ... 50 mg/m³ [13]	0 ... 1 250 mg/m³ [13]										S	
0 ... 100 mg/m³	0 ... 750 mg/m³										T	
0 ... 150 mg/m³	0 ... 750 mg/m³										U	
0 ... 250 mg/m³	0 ... 1 250 mg/m³										V	
0 ... 400 mg/m³	0 ... 2 000 mg/m³										W	
0 ... 50 vpm	0 ... 2 500 vpm										X	
0 ... 500 vpm	0 ... 5 000 vpm										Y	
Language of the operating software [3]												
German												0
English												1
French												2
Spanish												3
Italian												4

1) For measuring ranges below 1%, a CO_2 absorber cartridge can be used for zero point adjustment (see Accessories).
2) Without separate zero gas input or solenoid valve.
3) Language for operation can be changed.
4) O_2 sensor/O_2 measuring cell in gas path of infrared measured component 1.
5) With chopper compartment purging (N_2 approx. 3 000 hPa required for measuring ranges below 0.1% CO_2), to be ordered separately (see order code C02 or C03).
6) Not suitable for use with emission measurements since cross-sensitivity too high.
7) Only in conjunction with CO_2 measuring range 0 to 5% to 0 to 25% (CP).
8) Maximum possible AUTOCAL cycle ≤ 6 h, constant ambient conditions (max. deviation ±1 °C (1.8 °F)): see table "Calibration intervals, standard devices" under "More information".
9) Maximum possible AUTOCAL cycle ≤ 3 h, constant ambient conditions (max. deviation ±1 °C (1.8 °F)): see table "Calibration intervals, standard devices" under "More information".

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Selection and ordering data (continued)

10) Measured with UV technology
11) When measuring range identification "S" selected: Parallel measurement of SO_2 and NO_2 with UV photometer.
12) For devices in applications requiring a certified measuring range of less than 0 ... 100 mg/m³, compensation of the CO_2 cross-interference for CO and NO and of the O_2 cross-interference for NO is necessary.
13) The measuring ranges of the two components differ slightly: For SO_2: 0 ... 50/1 250 mg/m³, for NO_2: 0 ... 50/1 000 mg/m³.
14) E21 only for options 1, 3 and 5
15) In combination with the E21 option (CSA for measuring flammable gases) without pump, flow indicator, pressure switch and S-vessel. The solenoid valve is present. However, the gas path corresponds to this setup.
16) In combination with the E21 option (CSA for measuring flammable gases) without flow indicator, pressure switch and S-vessel. However, the gas path corresponds to this setup.

Options	Order code
Add "-**Z**" to article number and then add order code	
Settings	
Add-on electronics with 8 digital inputs/outputs, PROFIBUS PA interface	**A12**
Add-on electronics with 8 digital inputs/outputs, PROFIBUS DP interface	**A13**
Stainless steel connection pipe (mat. No. 1.4571), 6 mm, complete with screw connection (cannot be combined with Viton hose)	**A27**
Stainless steel connection pipe (mat. No. 1.4571), ¼", complete with screw connection (cannot be combined with Viton hose)	**A29**
IEC plug, 37-pin D-sub connector, 9-pin D-sub connector	**A33**
Tag plates (customized inscription)	**B03**
Clean for O_2 service (specially cleaned gas path)	**B06**
Gas path for short response time[3)]	**C01**
Chopper compartment purging for 6 mm gas connection	**C02**
Chopper compartment purging for ¼" gas connection	**C03**
Application with paramagnetic oxygen measuring cell and separate gas path	**C11**
Selection of the conversion mg/m³ in ppm at 293K or 273K	**D15**
ATEX: II 3G Ex ec ic nC IIC T4 Gc; BVS 16 ATEX E 061 X IECEx: Ex ec ic nC IIC T4 Gc; IECEx BVS 16.0041X FM/CSA: Class I, Zone 2 A/Ex ec ic nC IIC T4 Gc Class I, Division 2, Groups A, B, C, D T4	**E20**
CSA: Class I, Zone 2 A/Ex ec ic nC IIC T4 Gb/Gc Class I, Division 2, Groups A, B, C, D T4	**E21**

Options	Order code
Calibration interval 5 months (TÜV, QAL) measuring ranges: CO 0 - 150/750 mg/m³; NO 0 - 100/750 mg/m³[3)]	**E50**
DNV-GL statement of conformity for use in marine CEMS according to MEPC.259(68)	**E60**
Measuring range indication in plain text[1)]	**Y11**
Measurement of CO_2 in forming gas[2)] (only in conjunction with measuring range 0 ... 20 / 0 ... 100%)	**Y14**

1) Default setting: smallest measuring range, largest measuring range.
2) CO_2 measurement in accompanying gas Ar or Ar/He (3:1); forming gas.
3) Only for version with Viton hose.

Accessories	Article No.
CO_2 absorber cartridge	**7MB1933-8AA**
RS 485/Ethernet converter	**A5E52327218**
RS 485/RS 232 converter	**A5E52327214**
RS 485/USB converter	**A5E52327216**
Add-on electronics with 8 digital inputs/outputs and PROFIBUS PA	**A5E00056834**
Add-on electronics with 8 digital inputs/outputs and PROFIBUS DP	**A5E00057159**
Set of Torx screwdrivers	**A5E34821625**

ULTRAMAT 23 gas analyzer **For measuring 3 infrared components, UV components, oxygen or 2 infrared components and UV components**			**Article No.** **7MB2338-**	● ● ● ● 6 - ● ● ● ●
Click on the Article No. for online configuration in the PIA Life Cycle Portal.				
Unavailable combinations are shown in PIA Life Cycle Portal as "not permitted".				
Enclosure, version and gas paths 19" rack unit for installation in cabinets[13]				
Gas connections	***Gas paths***	***Internal sample gas pump***		
6 mm pipe	Viton, not separate	Without[2)]		0
¼" pipe	Viton, not separate	Without[2), 15)]		1
6 mm pipe	Viton, not separate	With		2
¼" pipe	Viton, not separate	With [14)]		3
6 mm pipe	Viton, separate	Without[2)]		4
¼" pipe	Viton, separate	Without[2), 15)]		5
6 mm pipe	Stainless steel, mat. No. 1.4571, separate	Without[2)]		6

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Selection and ordering data (continued)

ULTRAMAT 23 gas analyzer For measuring 3 infrared components, UV components, oxygen or 2 infrared components and UV components			Article No. 7MB2338-	●	●	●	●	6	-	●	●	●	●
¼" pipe	Stainless steel, mat. No. 1.4571, separate	Without[2]		7									
Portable, in sheet-steel enclosure, 6 mm gas connections, Viton gas path, with integrated sample gas pump, condensation trap with safety filter on the front plate.				8									
1st and 2nd infrared measured component													
Measured component	**Smallest measuring range**	**Largest measuring range**											
CO and NO	0 ... 500 vpm	0 ... 2 500 vpm			A	A							
CO and NO	0 ... 2 000 vpm (CO) 0 ... 1000 vpm (NO)	0 ... 10 000 vpm (CO) 0 ... 5000 vpm (NO)			A	B							
CO and NO	0 ... 1 000 vpm	0 ... 5 000 vpm			A	C							
CO and NO	0 ... 1% (CO) 0 ... 1000 vpm (NO)	0 ... 5% (CO) 0 ... 5000 vpm (NO)			A	D							
CO and NO	0 ... 250 mg/m³ (CO) 0 ... 400 mg/m³ (NO)	0 ... 1 250 mg/m³ (CO) 0 ... 2 000 mg/m³ (NO)			A	K							
CO and NO	0 ... 50 vpm (CO) 0 ... 100 vpm (NO)	0 ... 250 vpm (CO) 0 ... 500 vpm (NO)			A	P							
CO and NO	0 ... 100 vpm	0 ... 500 vpm			A	R							
CO and CO_2	0 ... 10%	0 ... 50%			B	A							
CO and CO_2	0 ... 10% (CO) 0 ... 0.5% (CO_2)	0 ... 50% (CO) 0 ... 2.5% (CO_2)			B	B							
CO and CO_2	0 ... 20%	0 ... 100%			B	D							
CO and CO_2	0 ... 100 vpm (CO) 0 ... 5% (CO_2)	0 ... 500 vpm (CO) 0 ... 25% (CO_2)			B	J							
CO and CO_2	0 ... 0.5% (CO) 0 ... 10% (CO_2)	0 ... 2.5% (CO) 0 ... 50% (CO_2)			B	K							
CO and CO_2	0 ... 75 mg/m³ (CO) 0 ... 5% (CO_2)	0 ... 750 mg/m³ (C0) 0 ... 25% (CO_2)			B	L							
CO and CO_2	0 ... 50 mg/m³ (CO) 0 ... 5% (CO_2)	0 ... 500 mg/m³ (CO) 0 ... 25% (CO_2)			B	M							
CO_2 and CH_4	0 ... 5% (CO_2) 0 ... 1% (CH_4)	0 ... 25% (CO_2) 0 ... 5% (CH_4)			C	A							
CO_2 and CH_4	0 ... 5% (CO_2) 0 ... 2% (CH_4)	0 ... 25% (CO_2) 0 ... 10% (CH_4)			C	B							
CO_2 and NO	0 ... 5% (CO_2) 0 ... 500 vpm (NO)	0 ... 25% (CO_2) 0 ... 2500 vpm (NO)			D	C							
Oxygen measurement[4]													
Without O_2 sensor							0						
With electrochemical O_2 sensor							1						
With paramagnetic oxygen measuring cell							8						
Auxiliary power													
100 V AC, 50 Hz									0				
120 V AC, 50 Hz									1				
200 V AC, 50 Hz									2				
230 V AC, 50 Hz									3				
100 V AC, 60 Hz									4				
120 V AC, 60 Hz									5				
230 V AC, 60 Hz									6				
3rd infrared measured component													
Measured component	**Possible with measuring range identification**												
CO	A, C, D, E, F, G ... R, U, X										A		
CO_2[1]	D[5], G[5], H[5], J[5], K ... R										C		
CH_4	E, H, L, N, P, R										D		
C_2H_4	K										F		
C_6H_{14}	K										M		
SO_2 [10]	PIA B[8], F ... L, S, T[9], W										N		
NO	C, E, G ... J, T, U, V, W										P		
N_2O	E[6], Y[7]										S		
SF_6	H										V		
Smallest measuring range	**Largest measuring range**												
0 ... 50 mg/m³[11]	0 ... 500 mg/m³[11]											A	
0 ... 200 mg/m³	0 ... 1 000 mg/m³											B	

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Selection and ordering data (continued)

ULTRAMAT 23 gas analyzer For measuring 3 infrared components, UV components, oxygen or 2 infrared components and UV components		Article No. 7MB2338-												
		●	●	●	●	6	-	●	●	●	●			
0 ... 100 mg/m³	0 ... 1 000 mg/m³										C			
0 ... 50 vpm	0 ... 250 vpm										D			
0 ... 100 vpm	0 ... 500 vpm										E			
0 ... 150 vpm	0 ... 750 vpm										F			
0 ... 200 vpm	0 ... 1 000 vpm										G			
0 ... 500 vpm	0 ... 2 500 vpm										H			
0 ... 1 000 vpm	0 ... 5 000 vpm										J			
0 ... 2 000 vpm	0 ... 10 000 vpm										K			
0 ... 0.5%	0 ... 2.5%										L			
0 ... 1%	0 ... 5%										M			
0 ... 2%	0 ... 10%										N			
0 ... 5%	0 ... 25%										P			
0 ... 10%	0 ... 50%										Q			
0 ... 20%	0 ... 100%										R			
0 ... 50 mg/m³ [12]	0 ... 1 250 mg/m³ [12]										S			
0 ... 100 mg/m³	0 ... 750 mg/m³										T			
0 ... 150 mg/m³	0 ... 750 mg/m³										U			
0 ... 250 mg/m³	0 ... 1 250 mg/m³										V			
0 ... 400 mg/m³	0 ... 2 000 mg/m³										W			
0 ... 50 vpm	0 ... 2 500 vpm										X			
0 ... 500 vpm	0 ... 5 000 vpm										Y			
Language of the operating software [3]														
German												0		
English												1		
French												2		
Spanish												3		
Italian												4		

1) For measuring ranges below 1%, a CO_2 absorber cartridge can be used for zero point adjustment (see Accessories).
2) Without separate zero gas input or solenoid valve.
3) Language for operation can be changed.
4) O_2 sensor/O_2 measuring cell in gas path of infrared measured component 1.
5) With chopper compartment purging (N_2 approx. 3 000 hPa required for measuring ranges below 0.1% CO_2), to be ordered separately (see order code C02 or C03).
6) Not suitable for use with emission measurements since cross-sensitivity too high.
7) Only in conjunction with CO_2/NO, measuring range 0 to 5/25%, 0 to 500/5 000 vpm [-DC-].
8) Maximum possible AUTOCAL cycle ≤ 6 h, constant ambient conditions (max. deviation ±1 °C (1.8 °F)): see table "Calibration intervals, standard devices" under "More information".
9) Maximum possible AUTOCAL cycle ≤ 3 h, constant ambient conditions (max. deviation ±1 °C (1.8 °F)): see table "Calibration intervals, standard devices" under "More information".
10) When measuring range identification "S" selected: Parallel measurement of SO_2 and NO_2 with UV photometer.
11) For devices in applications requiring a certified measuring range of less than 0 ... 100 mg/m³, compensation of the CO_2 cross-interference for CO and NO and of the O_2 cross-interference for NO is necessary.
12) The measuring ranges of the two components differ slightly: For SO_2: 0 ... 50/1 250 mg/m³, for NO_2: 0 ... 50/1 000 mg/m³.
13) E21 only for options 1, 3 and 5
14) In combination with the E21 option (CSA for measuring flammable gases) without pump, flow indicator, pressure switch and S-vessel. The solenoid valve is present. However, the gas path corresponds to this setup.
15) Present in combination with the E21 option (CSA for measuring flammable gases) without flow indicator, pressure switch and S-vessel. However, the gas path corresponds to this setup.

Options	Order code
Add "**-Z**" to article number and then add order code	
Settings	
Add-on electronics with 8 digital inputs/outputs, PROFIBUS PA interface	**A12**
Add-on electronics with 8 digital inputs/outputs, PROFIBUS DP interface	**A13**

Options	Order code
Stainless steel connection pipe (mat. No. 1.4571), 6 mm, complete with screw connection (cannot be combined with Viton hose)	**A27**
Stainless steel connection pipe (mat. No. 1.4571), ¼", complete with screw connection (cannot be combined with Viton hose)	**A29**
IEC plug, 37-pin D-sub connector, 9-pin D-sub connector	**A33**
Tag plates (customized inscription)	**B03**
Clean for O_2 service (specially cleaned gas path)	**B06**
Gas path for short response time [3]	**C01**

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Selection and ordering data (continued)

Options	Order code
Chopper compartment purging for 6 mm gas connection	**C02**
Chopper compartment purging for ¼" gas connection	**C03**
Application with paramagnetic oxygen measuring cell and separate gas path	**C11**
Selection of the conversion mg/m³ in ppm at 293K or 273K	**D15**
ATEX: II 3G Ex ec ic nC IIC T4 Gc; BVS 16 ATEX E 061 X IECEx: Ex ec ic nC IIC T4 Gc; IECEx BVS 16.0041X FM/CSA: Class I, Zone 2 A/Ex ec ic nC IIC T4 Gc Class I, Division 2, Groups A, B, C, D T4	**E20**
CSA: Class I, Zone 2 A/Ex ec ic nC IIC T4 Gb/Gc Class I, Division 2, Groups A, B, C, D T4	**E21**
Measuring range indication in plain text[1)]	**Y11**
Measurement of CO_2 in forming gas[2)] (only in conjunction with measuring range 0 ... 20 / 0 ... 100%)	**Y14**

1) Default setting: smallest measuring range, largest measuring range.

2) CO_2 measurement in accompanying gas Ar or Ar/He (3:1); forming gas.
3) Only for version with Viton hose.

Accessories	Article No.
CO_2 absorber cartridge	**7MB1933-8AA**
RS 485/Ethernet converter	**A5E52327218**
RS 485/RS 232 converter	**A5E52327214**
RS 485/USB converter	**A5E52327216**
Add-on electronics with 8 digital inputs/outputs and PROFIBUS PA	**A5E00056834**
Add-on electronics with 8 digital inputs/outputs and PROFIBUS DP	**A5E00057159**
Set of Torx screwdrivers	**A5E34821625**

ULTRAMAT 23 gas analyzer - German Technical Inspectorate version For measuring 1 infrared component, UV components and oxygen			**Article No. 7MB2355-**	●	●	●	●	6	-	●	A	A	●
Click on the Article No. for online configuration in the PIA Life Cycle Portal.													
Unavailable combinations are shown in PIA Life Cycle Portal as "not permitted".													
Enclosure, version and gas paths 19" rack unit for installation in cabinets													
Gas connections	***Gas path***	***Internal sample gas pump***											
6 mm	FPM (Viton)	Without		0									
Measured component	**Possible with measuring range identification**												
CO	G, J				A								
CO_2	P				C								
SO_2[1)]	F, G, H, S, W				N								
NO	A, F, G, H, U, V, W				P								
Smallest measuring range[3)]	**Largest measuring range[3)]**												
NO: 0 ... 50 mg/m³[3)4)]	NO: 0 ... 500 mg/m³[3)4)]					A							
SO_2: 0 ... 400 mg/m³ NO: 0 ... 200 mg/m³	SO_2: 0 ... 2 000 mg/m³ NO: 0 ... 1 000 mg/m³					F							
CO: 0 ... 200 mg/m³ SO_2: 0 ... 500 mg/m³ NO: 0 ... 250 mg/m³	CO: 0 ... 1 250 mg/m³ SO_2: 0 ... 2 500 mg/m³ NO: 0 ... 1 250 mg/m³					G							
NO: 0 ... 600 mg/m³ SO_2: 0 ... 1 400 mg/m³	NO: 0 ... 3 000 mg/m³ SO_2: 0 ... 7 000 mg/m³					H							
0 ... 1 250 vpm	0 ... 6 000 vpm					J							
0 ... 5%[2)]	0 ... 25% [2)]					P							
0 ... 50 mg/m³ [2)5)]	0 ... 1 250 mg/m³ [2)5)]					S							
0 ... 150 mg/m³ [2)]	0 ... 750 mg/m³ [2)]					U							
0 ... 250 mg/m³ [2)]	0 ... 1 250 mg/m³ [2)]					V							
0 ... 400 mg/m³ [2)]	0 ... 2 000 mg/m³ [2)]					W							
Oxygen measurement													
Without O_2 sensor							0						
With electrochemical O_2 sensor							1						
With paramagnetic oxygen measuring cell							8						
Auxiliary power													
230 V AC, 50 Hz										3			
Language of the operating software													
German													0
English													1

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Selection and ordering data (continued)

ULTRAMAT 23 gas analyzer - German Technical Inspectorate version For measuring 1 infrared component, UV components and oxygen	Article No. 7MB2355-	●	●	●	●	6	-	●	A	A	●
French											2
Spanish											3
Italian											4

1) When measuring range identification "S" selected: Parallel measurement of SO_2 and NO_2 with UV photometer.
2) Only in conjunction with order code T13/T23/T33.
3) German Technical Inspectorate: see table "TÜV/German Technical Inspectorate, 1 and 2-component analyzer" under "More information".
4) For devices in applications requiring a certified measuring range of less than 0 ... 100 mg/m³, compensation of the CO_2 cross-interference for CO and NO and of the O_2 cross-interference for NO is necessary.
5) The measuring ranges of the two components differ slightly: For SO_2: 0 ... 50/1 250 mg/m³, for NO_2: 0 ... 50/1 000 mg/m³.

Options	Order code
Add "-**Z**" to article number and then add order code.	
Settings	
Add-on electronics with 8 digital inputs/outputs, PROFIBUS PA interface	**A12**
Add-on electronics with 8 digital inputs/outputs, PROFIBUS DP interface	**A13**
IEC plug, 37-pin D-sub connector, 9-pin D-sub connector	**A33**
O_2 paramagnetic, suitability-tested EN 15267, IR measuring range in mg/m³	**T13**
O_2 paramagnetic, suitability-tested EN 15267, IR measuring range in mg/m³, wide measuring range	**T14**

Options	Order code
O_2 electrochemical, suitability-tested EN 15267, IR measuring range in mg/m³	**T23**
O_2 electrochemical, suitability-tested EN 15267, IR measuring range in mg/m³, wide measuring range	**T24**
O_2 electrochemical cell	**T25**
Without O_2, suitability-tested EN 15267, IR measuring range in mg/m³	**T33**
Without O_2, suitability-tested EN 15267, IR measuring range in mg/m³, wide measuring range	**T34**
No O_2 cell integrated	**T35**
Measuring range indication in plain text	**Y11**
SO_2 with measuring range 0 ... 400/7 000 mg/m³	**Y15**

ULTRAMAT 23 gas analyzer - German Technical Inspectorate version For measuring 2 infrared components, UV components and oxygen	Article No. 7MB2357-	●	●	●	●	0	-	●	●	●	●
Click on the Article No. for online configuration in the PIA Life Cycle Portal.											
Unavailable combinations are shown in PIA Life Cycle Portal as "not permitted".											
Enclosure, version and gas paths 19" rack unit for installation in cabinets											
Gas connections	***Gas path***	***Internal sample gas pump***									
6 mm	FPM (Viton, not separate)	Without		0							
1st infrared measured component											
Measured component	**Possible with measuring range identification**										
CO	G, J				A						
CO_2	P				C						
SO_2	F, G, H, W				N						
NO	A, F, G, H, U, V, W				P						
Smallest measuring range[3]	**Largest measuring range**[3]										
NO: 0 ... 50 mg/m³[4]	NO: 0 ... 500 mg/m³[4]					A					
SO_2: 0 ... 400 mg/m³ NO: 0 ... 200 mg/m³	SO_2: 0 ... 2 000 mg/m³ NO: 0 ... 1 000 mg/m³					F					
CO: 0 ... 200 mg/m³ SO_2: 0 ... 500 mg/m³ NO: 0 ... 250 mg/m³	CO: 0 ... 1 250 mg/m³ SO_2: 0 ... 2 500 mg/m³ NO: 0 ... 1 250 mg/m³					G					
NO: 0 ... 600 mg/m³ SO_2: 0 ... 1 400 mg/m³	NO: 0 ... 3 000 mg/m³ SO_2: 0 ... 7 000 mg/m³					H					
0 ... 1 250 vpm	0 ... 6 000 vpm					J					
0 ... 5% [2]	0 ... 25% [2]					P					
0 ... 150 mg/m³ [2]	0 ... 750 mg/m³ [2]					U					
0 ... 250 mg/m³ [2]	0 ... 1 250 mg/m³ [2]					V					
0 ... 400 mg/m³ [2]	0 ... 2 000 mg/m³ [2]					W					
Oxygen measurement											
Without O_2 sensor							0				
With electrochemical O_2 sensor							1				

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Selection and ordering data (continued)

ULTRAMAT 23 gas analyzer - German Technical Inspectorate version For measuring 2 infrared components, UV components and oxygen		Article No. 7MB2357-	●	●	●	●	0	-	●	●	●	●
With paramagnetic oxygen measuring cell						8						
Auxiliary power												
230 V AC, 50 Hz									3			
2nd infrared measured component												
Measured component	**Possible with measuring range identification**											
CO	A, G, J									A		
CO_2	P									C		
SO_2 [1]	F, G, H, S, W									N		
NO	F, G, H, U, V, W									P		
Smallest measuring range [3]	**Largest measuring range** [3]											
CO: 0 ... 50 mg/m³ [4]	CO: 0 ... 500 mg/m³ [4]										A	
SO_2: 0 ... 400 mg/m³ NO: 0 ... 200 mg/m³	SO_2: 0 ... 2 000 mg/m³ NO: 0 ... 1 000 mg/m³										F	
CO: 0 ... 200 mg/m³ SO_2: 0 ... 500 mg/m³ NO: 0 ... 250 mg/m³	CO: 0 ... 1 250 mg/m³ SO_2: 0 ... 2 500 mg/m³ NO: 0 ... 1 250 mg/m³										G	
NO: 0 ... 600 mg/m³ SO_2: 0 ... 1 400 mg/m³	NO: 0 ... 3 000 mg/m³ SO_2: 0 ... 7 000 mg/m³										H	
0 ... 1 250 vpm	0 ... 6 000 vpm										J	
0 ... 5% [2]	0 ... 25% [2]										P	
0 ... 50 mg/m³ [2] [5]	0 ... 1 250 mg/m³ [2] [5]										S	
0 ... 150 mg/m³ [2]	0 ... 750 mg/m³ [2]										U	
0 ... 250 mg/m³ [2]	0 ... 1 250 mg/m³ [2]										V	
0 ... 400 mg/m³ [2]	0 ... 2 000 mg/m³ [2]										W	
Language of the operating software												
German												0
English												1
French												2
Spanish												3
Italian												4

1) When measuring range identification "S" selected: Parallel measurement of SO_2 and NO_2 with UV photometer.
2) Only in conjunction with order code T13/T23/T33.
3) German Technical Inspectorate: see table "TÜV/German Technical Inspectorate, 1 and 2-component analyzer" under "More information".
4) For devices in applications requiring a certified measuring range of less than 0 ... 100 mg/m³, compensation of the CO_2 cross-interference for CO and NO and of the O_2 cross-interference for NO is necessary.
5) The measuring ranges of the two components differ slightly: For SO_2: 0 ... 50/1 250 mg/m³, for NO_2: 0 ... 50/1 000 mg/m³.

Options	Order code
Add "-**Z**" to article number and then add order code.	
Settings	
Add-on electronics with 8 digital inputs/outputs, PROFIBUS PA interface	**A12**
Add-on electronics with 8 digital inputs/outputs, PROFIBUS DP interface	**A13**
IEC plug, 37-pin D-sub connector, 9-pin D-sub connector	**A33**
O_2 paramagnetic, suitability-tested EN 15267, IR measuring range in mg/m³	**T13**
O_2 paramagnetic, suitability-tested EN 15267, IR measuring range in mg/m³, wide measuring range	**T14**

Options	Order code
O_2 electrochemical, suitability-tested EN 15267, IR measuring range in mg/m³	**T23**
O_2 electrochemical, suitability-tested EN 15267, IR measuring range in mg/m³, wide measuring range	**T24**
O_2 electrochemical, suitability-tested EN 15267, measuring range in mg/m³ with UV photometer	**T25**
Without O_2, suitability-tested EN 15267, IR measuring range in mg/m³	**T33**
Without O_2, suitability-tested EN 15267, IR measuring range in mg/m³, wide measuring range	**T34**
Suitability-tested EN 15267, measuring range in mg/m³ with UV photometer	**T35**
Measuring range indication in plain text	**Y11**
SO_2 with measuring range 0 ... 400/7 000 mg/m³	**Y15**

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Selection and ordering data (continued)

ULTRAMAT 23 gas analyzer - German Technical Inspectorate version For measuring 3 infrared components, UV components, oxygen or 2 infrared components and UV components			Article No. 7MB2358-	●	●	●	●	6	-	●	●	●	●
Click on the Article No. for online configuration in the PIA Life Cycle Portal.													
Unavailable combinations are shown in PIA Life Cycle Portal as "not permitted".													
Enclosure, version and gas paths 19" rack unit for installation in cabinets													
Gas connections	***Gas path***	***Internal sample gas pump***											
6 mm	FPM (Viton, not separate)	Without		0									
1st and 2nd infrared measured component													
Measured component	**Smallest measuring range**	**Largest measuring range**											
CO and NO	0 ... 250 mg/m³ (CO) 0 ... 400 mg/m³ (NO)	0 ... 1 250 mg/m³ (CO) 0 ... 2 000 mg/m³ (NO)			A	K							
CO and NO	0 ... 200 mg/m³ (CO) 0 ... 150 mg/m³ (NO)	0 ... 1 250 mg/m³ (CO) 0 ... 750 mg/m³ (NO)			A	S							
CO and CO_2	0 ... 50 mg/m³ (CO) 0 ... 5% (CO_2)	0 ... 500 mg/m³ (CO) 0 ... 25% (CO_2)			B	M							
Oxygen measurement													
Without O_2 sensor							0						
With electrochemical O_2 sensor							1						
With paramagnetic oxygen measuring cell							8						
Auxiliary power													
230 V AC, 50 Hz									3				
3rd infrared measured component													
Measured component	**Possible with measuring range identification**												
SO_2[1]	F, G, H, S, W									N			
Smallest measuring range[2]	**Largest measuring range**[2]												
0 ... 400 vpm	0 ... 2 000 vpm										F		
0 ... 500 vpm	0 ... 2 500 vpm										G		
0 ... 1 400 vpm	0 ... 7 000 vpm										H		
0 ... 50 mg/m³ [3]	0 ... 1 250 mg/m³ [3]										S		
0 ... 400 mg/m³	0 ... 2 000 mg/m³										W		
Language of the operating software													
German													0
English													1
French													2
Spanish													3
Italian													4

1) When measuring range identification "S" selected: Parallel measurement of SO_2 and NO_2 with UV photometer.
2) German Technical Inspectorate: see table "TÜV/German Technical Inspectorate, 3-component analyzer" under "More information".
3) The measuring ranges of the two components differ slightly: For SO_2: 0 ... 50/1 250 mg/m³, for NO_2: 0 ... 50/1 000 mg/m³.

Options	Order code
Add "**-Z**" to article number and then add order code.	
Settings	
Add-on electronics with 8 digital inputs/outputs, PROFIBUS PA interface	**A12**
Add-on electronics with 8 digital inputs/outputs, PROFIBUS DP interface	**A13**

Options	Order code
IEC plug, 37-pin D-sub connector, 9-pin D-sub connector	**A33**
O_2 paramagnetic, suitability-tested EN 15267, IR measuring range in mg/m³	**T13**
O_2 electrochemical, suitability-tested EN 15267, IR measuring range in mg/m³	**T23**
Without O_2, suitability-tested EN 15267, IR measuring range in mg/m³	**T33**
Without O_2, suitability-tested EN 15267, IR measuring range in mg/m³, with UV photometer	**T35**
Measuring range indication in plain text	**Y11**
SO_2 with measuring range 0 ... 400/7 000 mg/m³	**Y15**

Note

See tables for German Technical Inspectorate (TÜV), component analyzer and order examples under "More information".

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Technical specifications

ULTRAMAT 23, 19" rack unit and portable version	
General information	
Measured components	Maximum of 4
Measuring ranges	2 per measured component
Display	LCD with LED backlighting and contrast control; function keys; 80 characters (4 lines/20 characters)
Operating position	Front wall, vertical
Conformity	CE marking EN 61000-6-2, EN 61000-6-4
Design, enclosure	
Weight	Approximately 10 kg
Degree of protection, 19" rack unit and desktop model	• 7MB2335, 7MB2337 and 7MB2338: IP20 according to EN 60529 • 7MB2355, 7MB2357 and 7MB2358: IP40 according to EN 60529
Electrical characteristics	
EMC interference immunity (electromagnetic compatibility) Safety extra-low voltage (SELV) with safe isolation	In accordance with standard requirements of NAMUR NE21 or EN 61326-1
Auxiliary power	• 100 V AC, +10%/-15%, 50 Hz • 120 V AC, +10%/-15%, 50 Hz • 200 V AC, +10%/-15%, 50 Hz • 230 V AC, +10%/-15%, 50 Hz • 100 V AC, +10%/-15%, 60 Hz • 120 V AC, +10%/-15%, 60 Hz • 230 V AC, +10%/-15%, 60 Hz
Power consumption	Approx. 60 VA
Electrical inputs and outputs	
Analog output	Per component, 0/2/4 ... 20 mA, NAMUR, floating, max. load 750 Ω
Relay outputs	8, with changeover contacts, freely configurable, e.g. for measuring range identification; 24 V AC/DC/1 A load rating, floating, non-sparking
Digital inputs	3, dimensioned for 24 V, potential-free • Pump • AUTOCAL • Synchronization
Serial interface	RS 485
AUTOCAL function	Automatic device calibration with ambient air (depending on measured component); adjustable cycle time from 0 (1) ... 24 hours
Options	Add-on electronics, each with 8 additional digital inputs and relay outputs, e.g. for triggering of automatic calibration and for PROFIBUS PA or PROFIBUS DP
Climatic conditions	
Permissible ambient temperature	
• During operation	• +5 ... 45 °C (IR detector, O_2) • +5 ... 40 °C (H_2S sensor) • +15 ... 35 °C (UV photometer)
• During storage and transportation	• -25 ... 60 °C (IR detector, O_2, UV photometer) • -10 ... 60 °C (H_2S sensor)
Permissible ambient humidity	< 90% RH (relative humidity) during storage and transportation
Permissible pressure fluctuations	• 600 ... 1 200 hPa (IR detector, O_2, UV photometer) • 750 ... 1 200 hPa (H_2S sensor)
Gas inlet conditions	
Sample gas pressure	
• Without pump	Depressurized (< 1 200 hPa, absolute)

Technical specifications (continued)

ULTRAMAT 23, 19" rack unit and portable version	
• With pump	Depressurized suction mode, factory preset with 2 m hose at sample gas outlet; measuring range end value calibration necessary under different restrictor conditions (800 ... 1 050 hPa, absolute)
Sample gas flow	72 ... 120 l/h (1.2 ... 2 l/min)
Sample gas temperature	Min. 0 ... max. 50 °C, but above the dew point
Sample gas humidity	< 90% RH (relative humidity), non-condensing

ULTRAMAT 23, infrared channel[1)]	
Measuring ranges	See ordering data
Chopper purge	Primary pressure approximately 3 000 hPa; purging gas consumption approximately 100 ml/min
Time response	
Warm-up period	Approx. 30 min (at room temperature), (the technical specification will be met after 2 h)
Delayed display (T_{90} time)	Dependent on length of analyzer chamber, sample gas line and configurable damping
Damping (electrical time constant)	Configurable from 0 ... 99.9 s
Measuring response	Based on sample gas pressure 1 013 hPa absolute, 1.0 l/min sample gas flow and 25 °C ambient temperature
Output signal fluctuation	< ± 1% of the current measuring range (see nameplate)
Detection limit	1% of the current measuring range
Linearity error	• In the largest possible measuring range: < ± 1% of the measuring range end value • In the smallest possible measuring range: < ± 2% of the measuring range end value
Repeatability	≤ ± 1% of the current measuring range
Drift	
Zero point	≤ 1% of the current measuring range/week
Full-scale value drift	≤ 1% of the current measuring range/week
Influencing variables	Based on sample gas pressure 1 013 hPa absolute, 1.0 l/min sample gas flow and 25 °C ambient temperature
Temperature	Max. 2% of the smallest possible measuring range according to nameplate per 10 K with an AUTOCAL cycle time of 6 h
Atmospheric pressure	< 0.2% of the current measuring range per 1% pressure variation
Auxiliary power	< 0.1% of the current measuring range with a change of ± 10%

[1)] To ensure compliance with the technical specifications, a cycle time of ≤ 24 hours must be activated for the AUTOCAL. The cycle time of the AUTOCAL function must be ≤ 6 hours when measuring small NO and SO_2 measuring ranges (≤ 400 mg/m³) on German Technical Inspectorate/QAL-certified systems.

ULTRAMAT 23, oxygen channel (electrochemical)	
Measuring ranges	0 ... 5% to 0 ... 25% O_2, configurable
Service life	Approx. 2 years with 21% O_2
Detection limit	1% of the current measuring range
Time response	
Delayed display (T_{90} time)	Dependent on dead time and configurable damping, not > 30 s at approximately 1.2 l/min sample gas flow
Measuring response	Based on sample gas pressure 1 013 hPa absolute, 1.0 l/min sample gas flow and 25 °C ambient temperature
Output signal fluctuation	< ± 0.5% of the current measuring range
Linearity error	< ± 0.2% of the current measuring range

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Technical specifications (continued)

ULTRAMAT 23, oxygen channel (electrochemical)	
Repeatability	≤ 0.05% O_2
Drift	
• With AUTOCAL	Negligible
Influencing variables	Based on sample gas pressure 1 013 hPa absolute, 1.0 l/min sample gas flow and 25 °C ambient temperature
Temperature	< ± 0.5% O_2 per 20 K, relating to a measured value at 20 °C
Atmospheric pressure	< 0.2% of the measured value per 1% pressure variation
Accompanying gases	The oxygen sensor must not be used if the accompanying gas contains the following components: Chlorine or fluorine compounds, heavy metals, aerosols, mercaptans, alkaline components (such as NH_3 in % range)
Typical combustion exhaust gases	Influence: < 0.05% O_2
Humidity	H_2O dew point ≥ 2 °C; the oxygen sensor must not be used with dry sample gases (however, no condensation either)

ULTRAMAT 23, ultraviolet photometer[2)]	
Measuring ranges	The measuring ranges are calibrated with a certified calibration gas, whereby a concentration specification in ppm in accordance with EN 1343 must be converted to the unit mg/m³ at a reference temperature of 0 °C and a reference pressure of 1 013 hPa.
SO_2	
• Smallest measuring range	0 ... 50 mg/m³
• Largest measuring range	0 ... 1 250 mg/m³
NO_2	
• Smallest measuring range	0 ... 50 mg/m³
• Largest measuring range	0 ... 1 250 mg/m³
Time response	
Warm-up period	30 min The technical specification will be met after 2 h
Delayed display (T_{90} time)	Dependent on the external gas preparation, the length of the sample gas line and the configurable damping (see below) of the device. **Note:** SO_2 is highly soluble in water! ≤ 30 s after sample gas inlet at a damping of ≤ 12 s
Damping (electronic time constant)	0 ... 99.9 s, can be set
Measuring response	
Output signal fluctuation	≤ 1% of set full-scale value
Detection limit	1% of set full-scale value or: • 1 mg/m³ (SO_2) • 0.8 mg/m³ (NO_2) This corresponds to 0.4 ppm for both components
Linearity error	
• In the largest measuring range	≤ 1% of set full-scale value
• In the smallest measuring range	≤ 2% of set full-scale value
Repeatability	≤ 1% of set full-scale value
Influencing variables	
Temperature error	≤ 4% of smallest full-scale value/10 K in ambient temperature range of 5 ... 45 °C
Atmospheric pressure	≤ 1% of set full-scale value per 1% pressure variation
Auxiliary power	≤ 0.1% of set full-scale value with a change of ±10%
Drift (zero point and full-scale value)	
• AUTOCAL activated	Negligible depending on the cycle time setting

Technical specifications (continued)

ULTRAMAT 23, ultraviolet photometer[2)]	
• AUTOCAL deactivated	
- NO_2	3% of the smallest measuring range
- SO_2	3% of the smallest measuring range
	Note It can take up to 12 hours after the device is put into operation before these values are reached.
Accompanying gases	
• Humidity up to 20 °C dew point	Negligible
• CO_2 ≤ 16% vol	Negligible
• Exclusions	• Sulfur compounds other than SO_2 • Halogen compounds • Chlorine • Acetone • Ozone

[3)] To ensure compliance with the technical specifications, a cycle time of ≤ 24 hours must be activated for the AUTOCAL. The technical specifications are based on a sample gas pressure of 1 013 ±5 hPa absolute, a sample gas flow of 1.2 ±0.2 l/min and an ambient temperature of 25 ±2 °C. They apply to the SO_2 and NO_2 sample gas components.

ULTRAMAT 23, H_2S channel for measuring ranges of 5 ... 50 vpm	
Measured components	Maximum of 4, comprising up to 2 infrared-sensitive gases, an oxygen component and a hydrogen sulfide component
Measuring ranges	
• Smallest measuring range	0 ... 5 vpm
• Largest measuring range	0 ... 50 vpm
Service life of the sensor	Approx. 12 months
Permissible atmospheric pressure	750 ... 1 200 hPa
Permissible operating temperature	5 ... 40 °C (41 ... 104 °F)
Operation mode	• Continuous measurement between 0 and 12.5 vpm • Discontinuous measurement between 12.5 and 50 vpm
Influencing variables	
Accompanying gases	The hydrogen sulfide sensor must not be used if the accompanying gas contains the following components: • Compounds containing chlorine • Compounds containing fluorine • Heavy metals • Aerosols • Alkaline components (e.g. NH_3 > 5 vpm)
Interference gases	1 360 vpm SO_2 result in a cross-interference of < 20 vpm H_2S 180 vpm NO result in a cross-interference of < 150 vpm H_2S No cross-interference of CH_4, CO_2 and H_2 (1 000 vpm)
Temperature	< 3%/10 K referred to full-scale value
Atmospheric pressure	< 0.2% of the measured value per 1% pressure variation
Measuring response	
Delayed display (T90 time)	< 40 s with sample gas flow of approx. 1 ... 1.2 l/min
Output signal noise	< 2% of smallest measuring range with a damping constant of 30 s
Display resolution	< 0.01 vpm H_2S
Output signal resolution	< 1% of smallest measuring range with a damping constant of 30 s
Repeatability	< 4% of smallest measuring range
Drift	< 1% of the current measuring range per month

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Technical specifications (continued)

ULTRAMAT 23, paramagnetic oxygen cell	
Measured components	Maximum of 4, comprising up to 3 infrared-sensitive gases and an oxygen component
Measuring ranges	2 per component • Min. 0 ... 2% vol O_2 • Max. 0 ... 100% vol O_2 • Suppressed measuring range possible; e.g. 95 ... 100%
Permissible operating temperature	5 ... 45 °C (41 ... 113 °F)
Interference gases	See "Paramagnetic oxygen cell cross-interference" table
Zero point drift	• Measuring range 2%: max. 0.1% with weekly zero-point calibration • Measuring range 5%: max. 0.1% with weekly zero-point calibration • Measuring range 25% or more: max. 0.5% with monthly zero-point calibration
Measured-value drift	Negligible with AUTOCAL
Temperature error	< 2%/10 K referred to measuring range 5% < 5%/10 K referred to measuring range 2%
Humidity error for N_2 with 90% relative humidity after 30 min	< 0.6% at 50 °C
Atmospheric pressure	< 0.2% of measured value per 1% pressure variation
Delayed display (T90 time)	< 60 s
Output signal noise	< 1% of smallest measuring range
Repeatability	< 1% of the current measuring range

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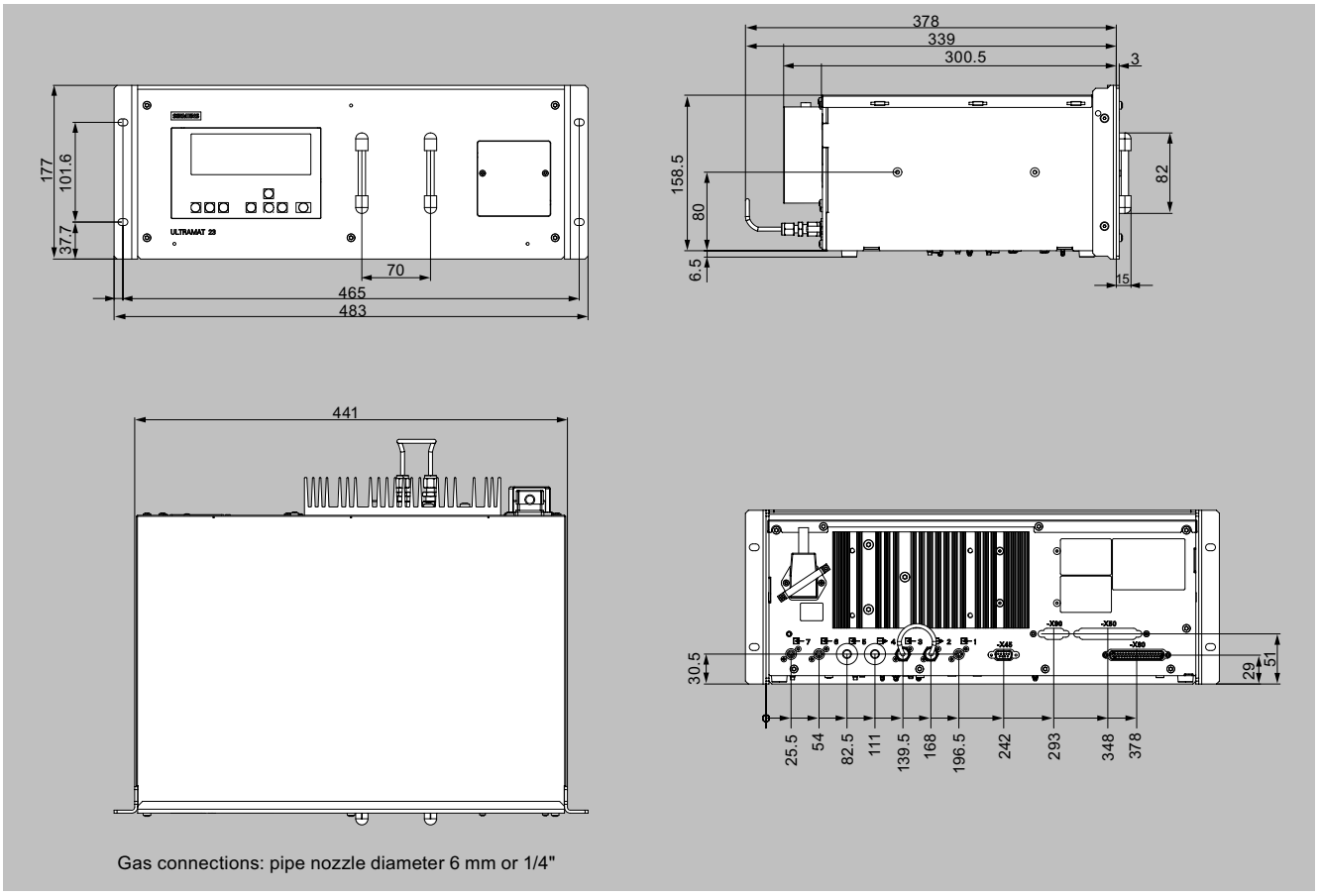
Dimensional drawings



ULTRAMAT 23, 19" rack unit, dimensions in mm

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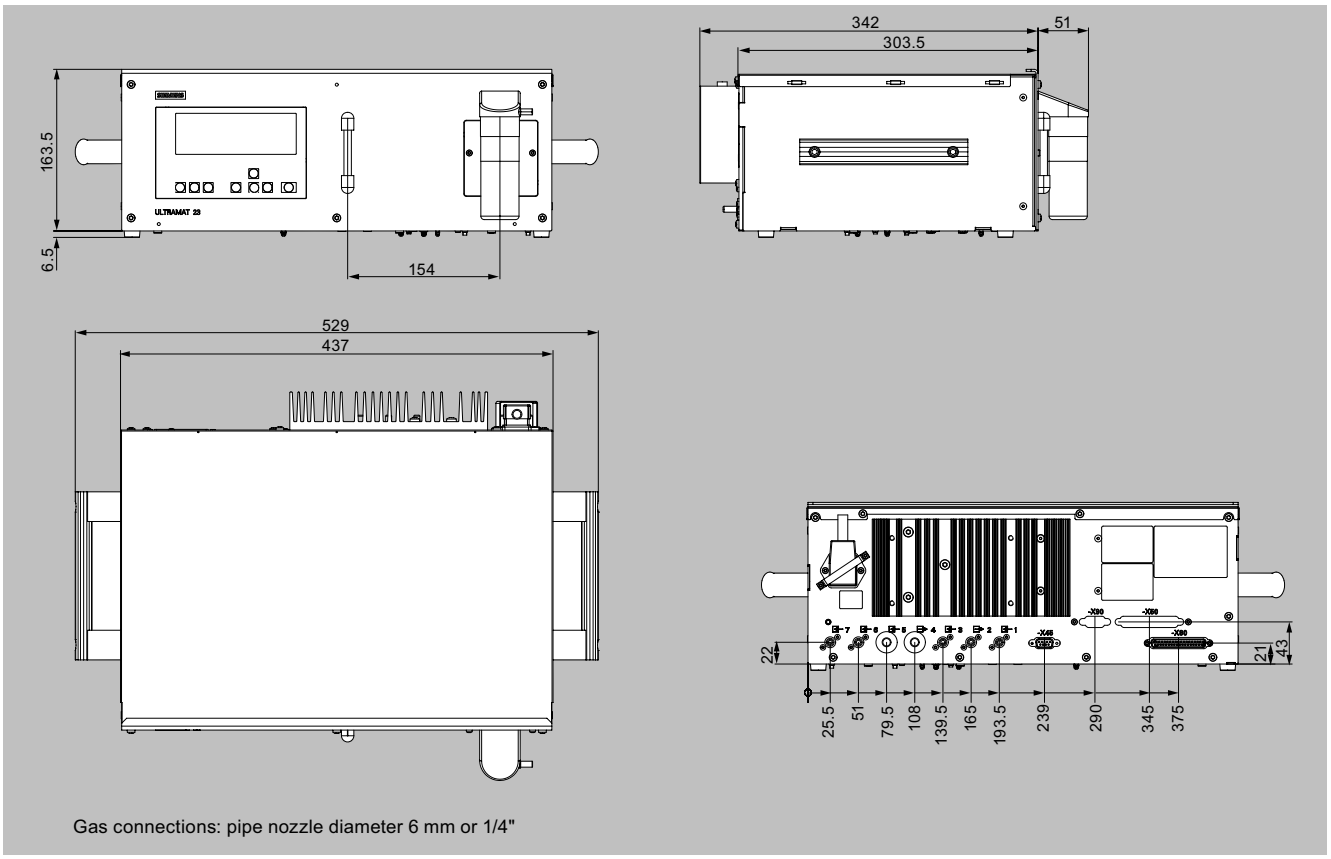
Dimensional drawings (continued)



ULTRAMAT 23, bench-top unit, dimensions in mm

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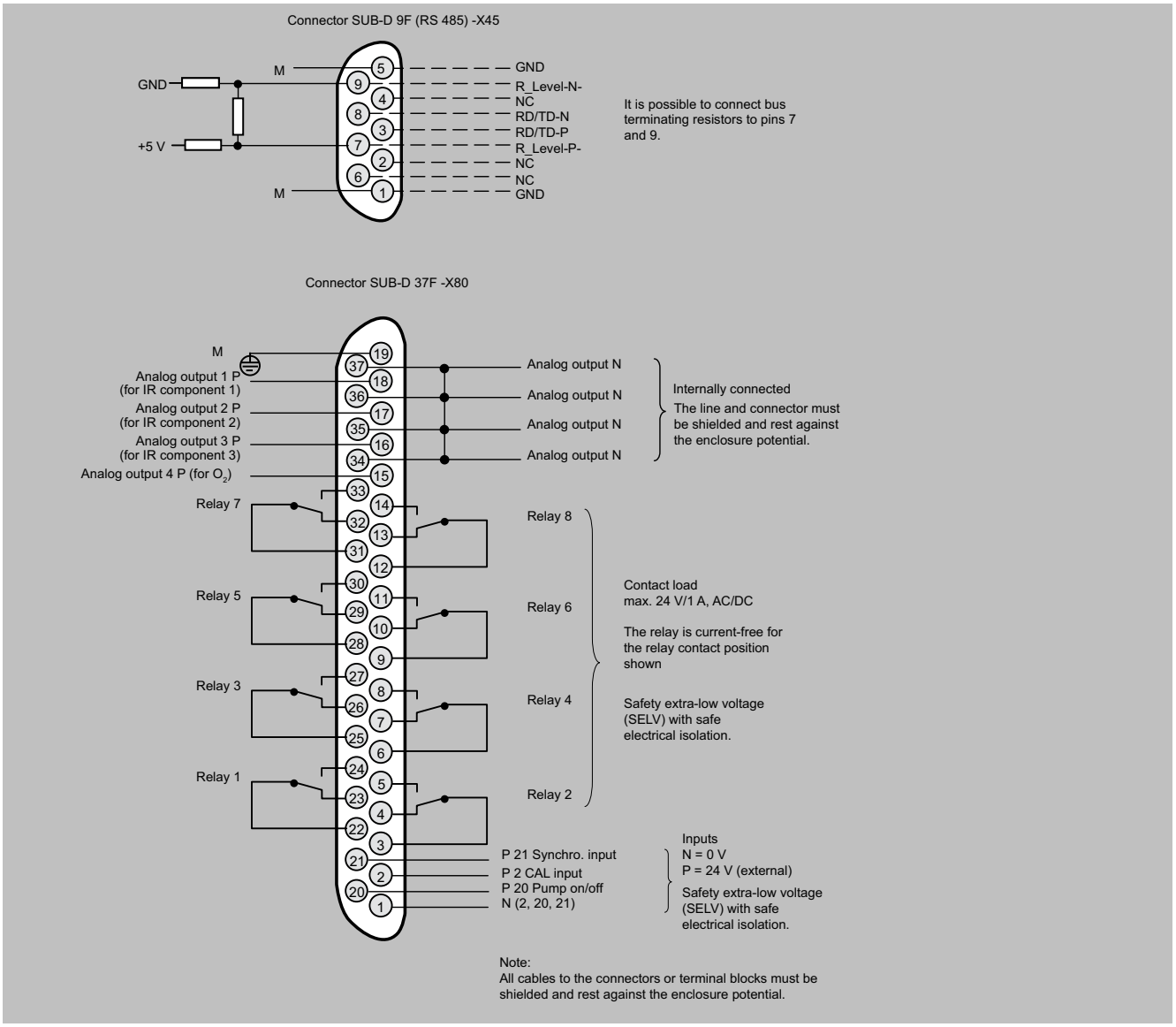
Circuit diagrams



ULTRAMAT 23, pin assignment (standard)

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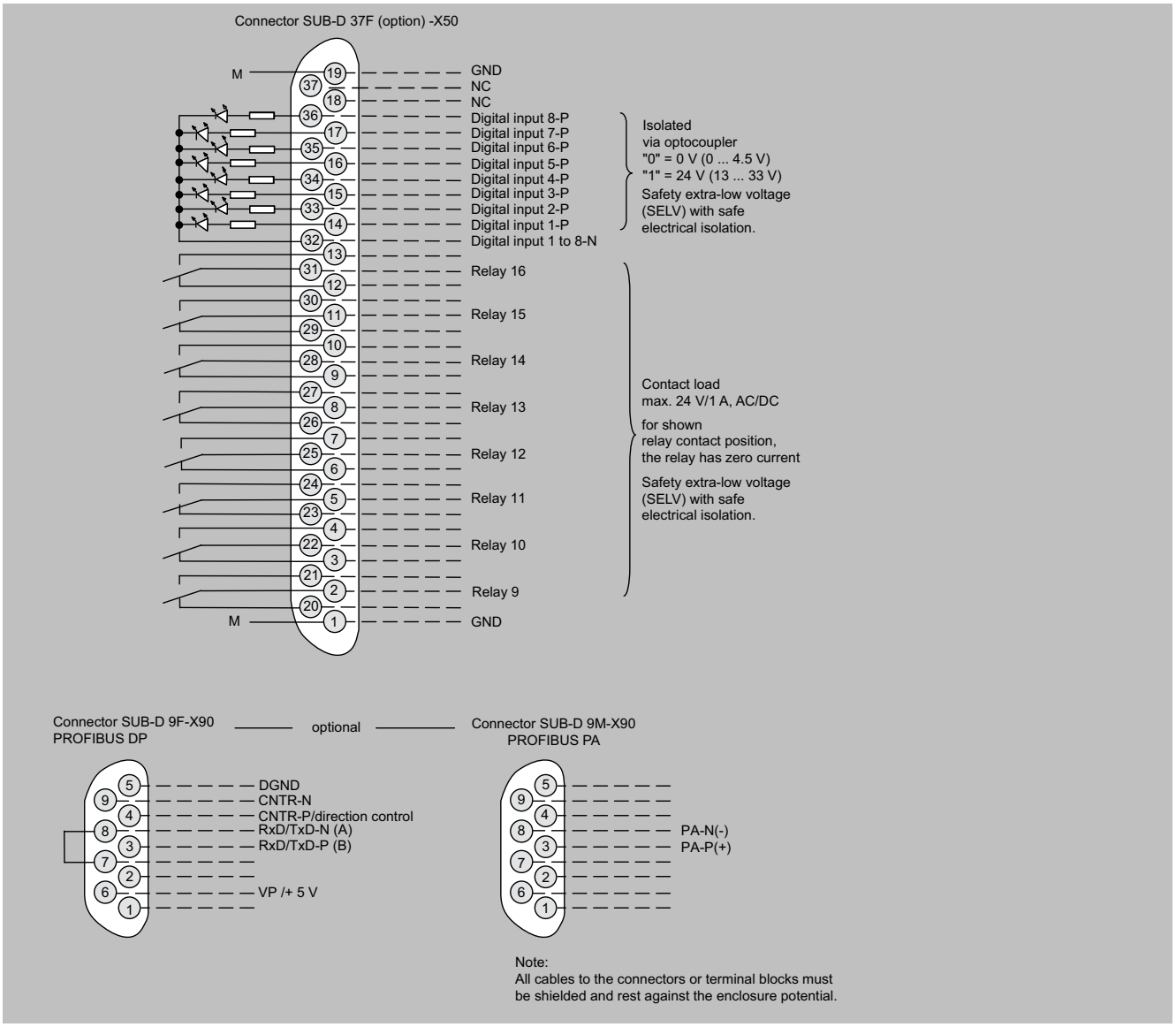
Circuit diagrams (continued)



ULTRAMAT 23, pin assignment of optional PROFIBUS interface card

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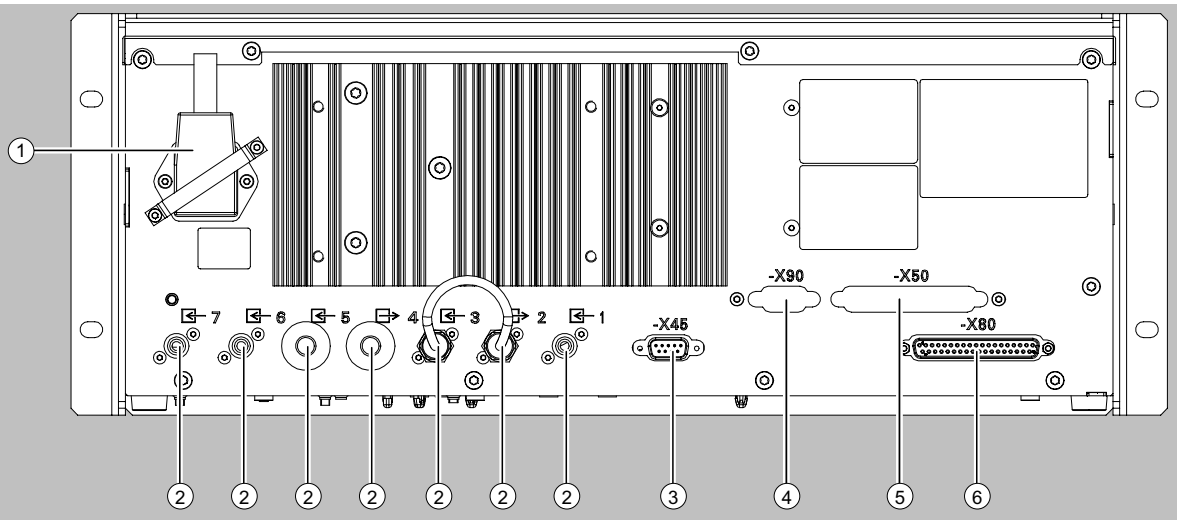
Circuit diagrams (continued)



1. Auxiliary power and fine fuse
2. Gas connections: nozzles 6 mm or ¼"
3. -X45: ELAN (RS485) 9-pin connector
4. -X90: 9-pin interface connector (option board with PROFIBUS-DP/PA)
5. -X50: 37-pin connector: Option board; digital inputs/relay outputs
6. -X80: 37-pin connector: Analog and digital inputs and outputs

When installing in a cabinet: mount analyzer on support rails.

ULTRAMAT 23, 19" rack unit, e.g. an IR measured component with oxygen measurement

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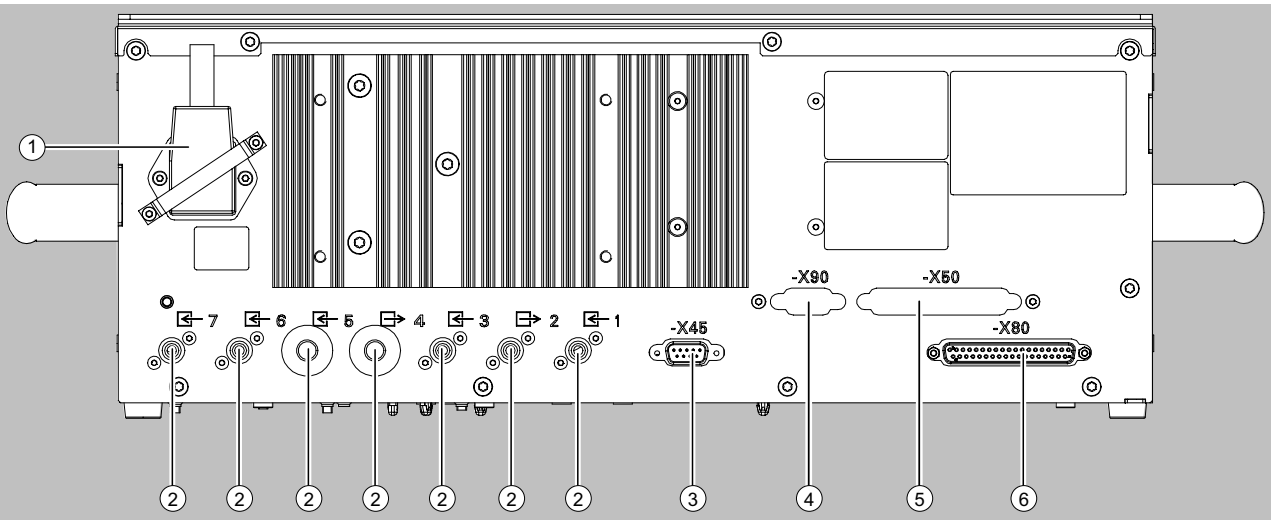
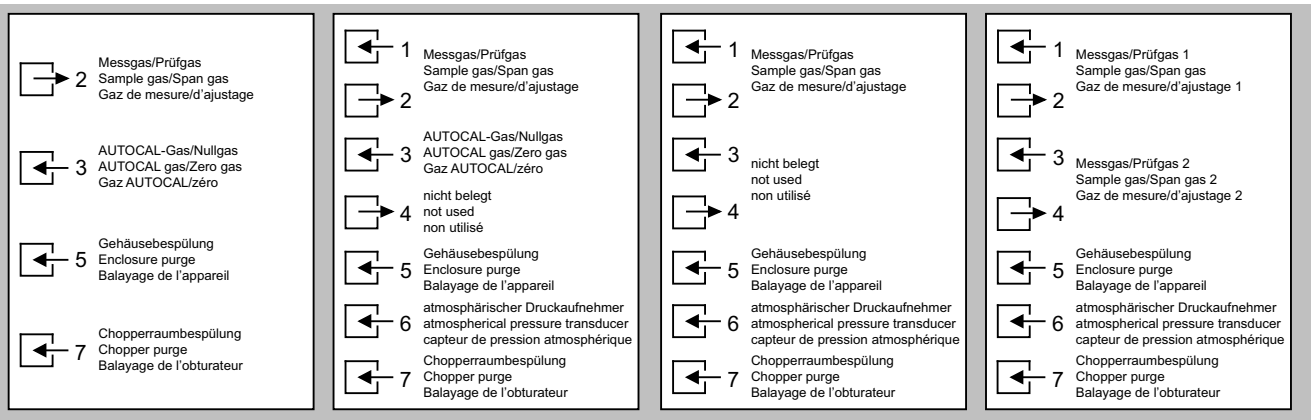
Circuit diagrams (continued)



1 Power connector
2 Gas connections: nozzles 6 mm or ¼"
3 -X45: ELAN (RS485) 9-pin connector
4 -X90: 9-pin interface connector (option board with PROFIBUS-DP/PA)
5 -X50: 37-pin connector: Option board; digital inputs/relay outputs
6 -X80: 37-pin connector: Analog and digital inputs and outputs

ULTRAMAT 23 portable, in sheet-steel enclosure, gas connections and electrical connections



ULTRAMAT 23, designation of the different labels

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More information

German Technical Inspectorate (TÜV), 1 and 2-component analyzer

Only in conjunction with order code T13/T23/T33

Component	CO (TÜV)		SO_2 (TÜV)		NO (TÜV)	
Measuring range identification	**Smallest measuring range from 0 to ...**	**Largest measuring range from 0 to ...**	**Smallest measuring range from 0 to ...**	**Largest measuring range from 0 to ...**	**Smallest measuring range from 0 to ...**	**Largest measuring range from 0 to ...**
F	-	-	400 mg/m³	2 000 mg/m³	200 mg/m³	1 000 mg/m³
G	200 mg/m³	1 250 mg/m³	500 mg/m³	2 500 mg/m³	250 mg/m³	1 250 mg/m³
H	-	-	1 400 mg/m³	7 000 mg/m³	-	-
S	-	-	75 mg/m³	1 250 mg/m³	-	-

Only in conjunction with order code T14/T24/T34

Component	CO (TÜV)		SO_2 (TÜV)		NO (TÜV)	
Measuring range identification	**Smallest measuring range from 0 to ...**	**Largest measuring range from 0 to ...**	**Smallest measuring range from 0 to ...**	**Largest measuring range from 0 to ...**	**Smallest measuring range from 0 to ...**	**Largest measuring range from 0 to ...**
H	-	-	-	-	600 mg/m³	3 000 mg/m³
J	1 250 mg/m³	6 000 mg/m³	-	-	-	-

Ordering example

ULTRAMAT 23, German Technical Inspectorate (TÜV)
IR component: CO
Measuring range: 0 to 200 / 1 250 mg/m³
with electrochemical O_2 sensor
230 V AC; German
7MB2355-0AG16-3AA0-Z +T23

German Technical Inspectorate (TÜV), 3-component analyzer

Only in conjunction with order code T13/T23/T33

Component	CO (TÜV)		SO_2 (TÜV)		NO (TÜV)	
Measuring range identification	**Smallest measuring range from 0 to ...**	**Largest measuring range from 0 to ...**	**Smallest measuring range from 0 to ...**	**Largest measuring range from 0 to ...**	**Smallest measuring range from 0 to ...**	**Largest measuring range from 0 to ...**
F	-	-	400 mg/m³	2 000 mg/m³	-	-
G	-	-	500 mg/m³	2 500 mg/m³	-	-
H	-	-	1 400 mg/m³	7 000 mg/m³	-	-

Ordering example

ULTRAMAT 23, German Technical Inspectorate (TÜV)
IR component: CO/NO + SO_2
Measuring range: CO: 0 to 250 / 1 250 mg/m³, NO: 0 to 400 / 2 000 mg/m³, SO_2: 0 to 400 / 2 000 mg/m³
with paramagnetic oxygen measuring cell
230 V AC; German
7MB2358-0AK86-3NF0-Z +T13

Ordering notes

Special selection rules must be observed when measuring some components.

Measured component N_2O

7MB2335, 7MB2337 and 7MB2338
(application: Si chip production)

- Measuring range 0 to 100 / 500 vpm (MB designation "E")
- Can only be used to measure N_2O in ultra-pure gases

7MB2337 and 7MB2338
(application: measurement in accordance with the requirements of the Kyoto protocol)

- Measuring range 0 to 500 / 5 000 vpm (MB designation "Y")
- Requires simultaneous measurement of CO_2 for correction of cross-interference

7MB2337-*CP*6-*SY* or
7MB2338-*DC*6-*SY* (incl. NO measurement)

7MB2337 and 7MB2338 (application with paramagnetic oxygen measuring cell and separate gas path)

7MB2337-4**86-**** - Z + C11
7MB2337-5**86-**** - Z + C11

7MB2338-4**86-**** - Z + C11
7MB2338-5**86-**** - Z + C11

Measured component SF_6

7MB2335, 7MB2337 and 7MB2338
(application: SI chip production)

- Measuring range 0 to 500 / 2 500 vpm (MB designation "H")
- Can only be used to measure SF_6 in ultra-pure gases

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More information (continued)

Calibration intervals, standard devices

	Calibration with calibration gas [weeks]		Comments
	Zero point	Calibration point	(Comply with technical specifications)
IR components	●	52	-
O_2 - electrochemical sensor	52	●	-
O_2 paramagnetic cell	1	●	At MB < 5%
	8	●	At MB > 5%
O_2 paramagnetic cell	●	52	At MB < 5%
	●	52	At MB > 5%
H_2S sensor	●	4	-

● = with AUTOCAL, with ambient air or N_2, 3 ... 24h – depending on measuring range.

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Selection and ordering data

Description	2 years (unit)	5 years (unit)	Article No.
Analyzer unit			
O-ring for analyzer chamber: 180, 90, 60, 20 mm	2	4	C71121-Z100-A99
Chopper			
• With motor, for 1 IR channel (7MB23X5-...)	1	1	C79451-A3468-B515
• With motor, for 2 IR channels (7MB23X7-..., 7MB23X8-...)	1	1	C79451-A3468-B516
Electronics			
Motherboard, with firmware	-	1	C79451-A3494-D501
Keypad	1	1	C79451-A3492-B605
LCD module	1	1	C79451-A3494-B16
Plug-in filter	-	1	W75041-E5602-K2
Line switch (portable analyzer)	-	1	W75050-T1201-U101
Fusible element 220 ... 240 V	2	4	W79054-L1010-T630
Fusible element 100 ... 120 V	2	4	W79054-L1011-T125
Other			
Safety filter (zero gas), internal	2	2	C79127-Z400-A1
Safety filter (sample gas), internal	2	3	C79127-Z400-A1
Pressure switch	1	2	C79302-Z1210-A2
Flowmeter	1	2	C79402-Z560-T1
Set of gaskets for sample gas pump	2	5	C79402-Z666-E20
Condensation trap (for portable device, in sheet steel enclosure)	1	2	C79451-A3008-B43
Filter (for portable device, in sheet steel enclosure)	1	2	C79451-A3008-B60
Oxygen sensor	1	1	C79451-A3458-B55
Sample gas pump 50 Hz	1	1	C79451-A3494-B10
Sample gas pump 60 Hz	1	1	C79451-A3494-B11
Solenoid valve	1	1	C79451-A3494-B33