

Overview



Up to four gas components can be measured simultaneously with the ULTRAMAT 23 gas analyzer: up to three infrared-active gases such as CO, CO₂, NO, SO₂, CH₄, plus O₂ with an electrochemical oxygen sensor.

ULTRAMAT 23 basic versions for:

- 1 infrared gas component with/without oxygen measurement
- 2 infrared gas components with/without oxygen measurement
- 3 infrared gas components with/without oxygen measurement
- With the ULTRAMAT 23 gas analyzer for use in biogas plants, up to four gas components can be measured continuously: two infrared-sensitive gases (CO₂ and CH₄), plus O₂ and H₂S with electrochemical measuring cells.
- With the ULTRAMAT 23 gas analyzer with paramagnetic oxygen cell, up to four gas components can be measured continuously: three infrared-active gases, plus O₂ ("dumbbell" measuring cell).

Benefits

- AUTOCAL with ambient air (dependent on the measured component)
Highly cost effective because calibration gases are not required
- High selectivity thanks to multi-layer detectors, e.g. low cross-sensitivity to water vapor
- Sample chambers can be cleaned as required on site
Cost savings due to reuse after contamination
- Menu-assisted operation in plaintext
Operator control without manual, high level of operator safety
- Service information and logbook
Preventive maintenance; help for service and maintenance personnel, cost savings
- Coded operator level 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 important components, including H₂S
- Long service life of the H₂S sensor even at increased concentrations; no diluting or backflushing necessary
- Introduction and measurement of flammable gases as occurring in biogas plants (e.g. 70 % CH₄), is permissible (TÜV certificate)

Continuous Gas Analyzers, extractive

ULTRAMAT 23

General information

Application

Areas of 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-potentially-explosive atmospheres

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 systems 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 QAL 1 qualification test, i.e. certification of the complete measuring system 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 also issued by the German Federal Environment Agency (Umweltbundesamt - UBA) in the Federal Gazette as well as by the German Technical Inspectorate (TÜV) on www.qal1.de/en.

In Britain, the QAL 1 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 CEM CERT set (7MB1957) have undergone qualification testing according to German standards of EN 15267. These German Technical Inspectorate versions of the ULTRAMAT are suitable for measurement of CO, NO, SO₂ and O₂ according to 13th and 27th BImSchV as well as TA Luft. Smallest measuring ranges tested and approved by the German Technical Inspectorate:

- 1 and 2-component analyzer

CO: 0 to 200 mg/m³
NO: 0 to 150 mg/m³
SO₂: 0 to 400 mg/m³

- 3-component analyzer

CO: 0 to 250 mg/m³
NO: 0 to 400 mg/m³
SO₂: 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
SO₂: 0 to 7 000 mg/m³

Determination of the analyzer drift according to EN 14181 (QAL 3) can be carried out manually or 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.

In countries in which QAL 1 certificates according to MCERTS/SIRA are (also) accepted, the ULTRAMAT 23 7MB233X versions can be used as an alternative to 7MB235X as analyzer modules in an MCERTS certification-compliant measuring instrument.

The smallest permissible measuring ranges here are:

- 1 and 2-component analyzer

CO: 0 to 150 mg/m³
NO: 0 to 100 mg/m³
SO₂: 0 to 400 mg/m³

- 3-component analyzer

CO: 0 to 250 mg/m³
NO: 0 to 400 mg/m³
SO₂: 0 to 400 mg/m³

- Version with reduced 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 compartment flushing: consumption 100 ml/min (upstream pressure: approx. 3 000 hPa)

Design

- 19" rack unit with 4 HU for installation
 - in hinged frame
 - in cabinets, with or without telescopic rails
- 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 1/4"
- Gas and electrical connections at the rear (portable version: sample gas inlet at front)

Display and control panel

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

Inputs/outputs

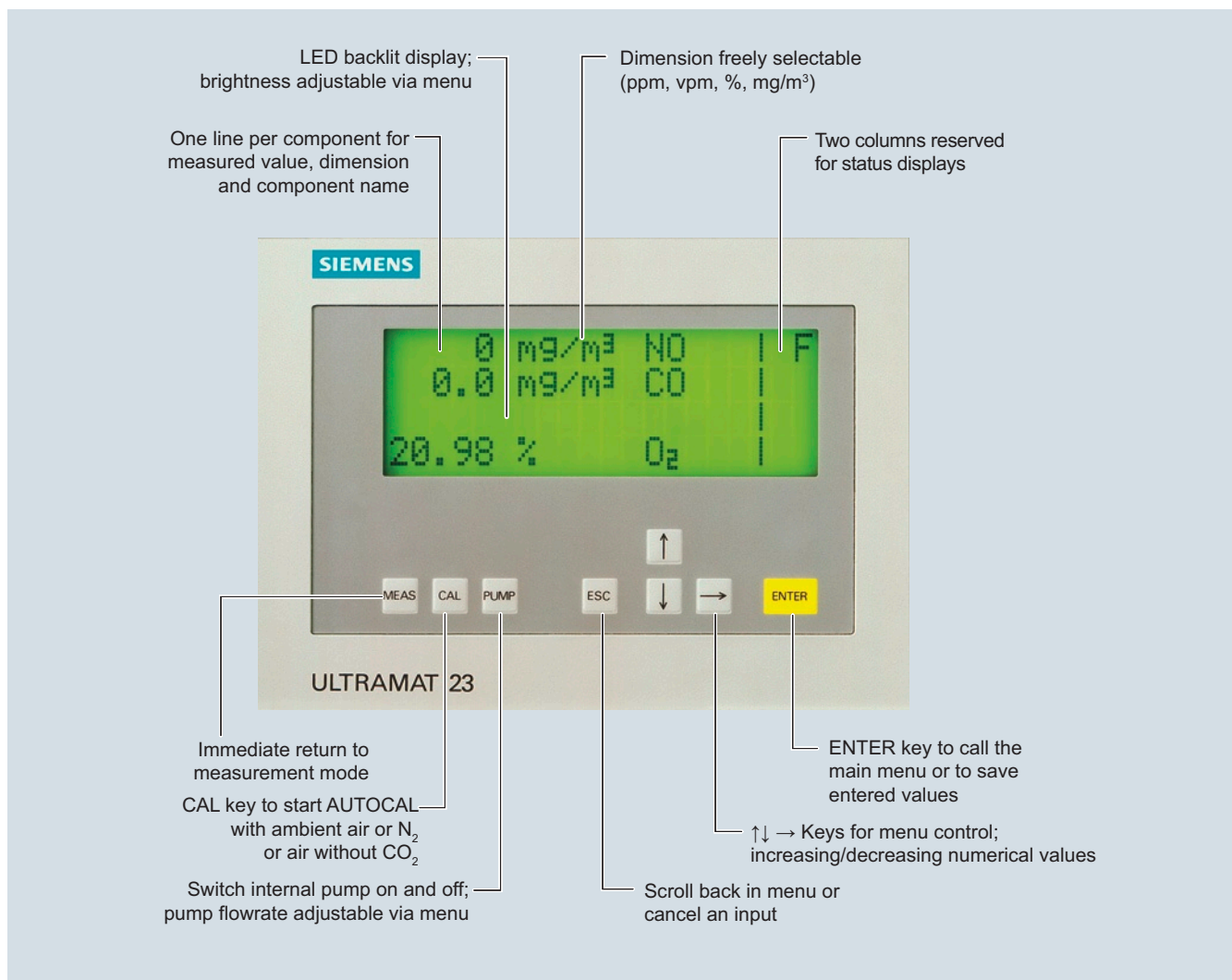
- Three binary inputs for sample gas pump On/Off, triggering of AUTOCAL and synchronization of several devices
- Eight relay outputs can be freely configured for fault, maintenance request, maintenance switch, limits, measuring range identification and external solenoid valves
- Eight additional binary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



ULTRAMAT 23, membrane keyboard and graphic display

Continuous Gas Analyzers, extractive

ULTRAMAT 23

General information

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
	Elbows/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
	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	
• Fitting	Stainless steel, mat. no. 1.4571	Stainless steel, mat. no. 1.4571	
• Window	CaF ₂	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)		

ULTRAMAT 23 also available as bench-top unit:

- 2 handles on top cover
- 4 rubber feet for setting up
- No mounting frame

80-digit display
(4 lines/20 characters)

Also available
with slide rails

Dust-tight and washable
membrane keypad

Flowmeter in conjunction with
pressure switch for monitoring
the sample gas flow

Gas and electrical
connections on rear
panel (portable version
simple gas at front)



Control keys
for menus

Optional O₂ sensor,
removable from front

3 function keys for
measurement, pump On/Off
and AUTO CAL

ULTRAMAT 23, design

Continuous Gas Analyzers, extractive

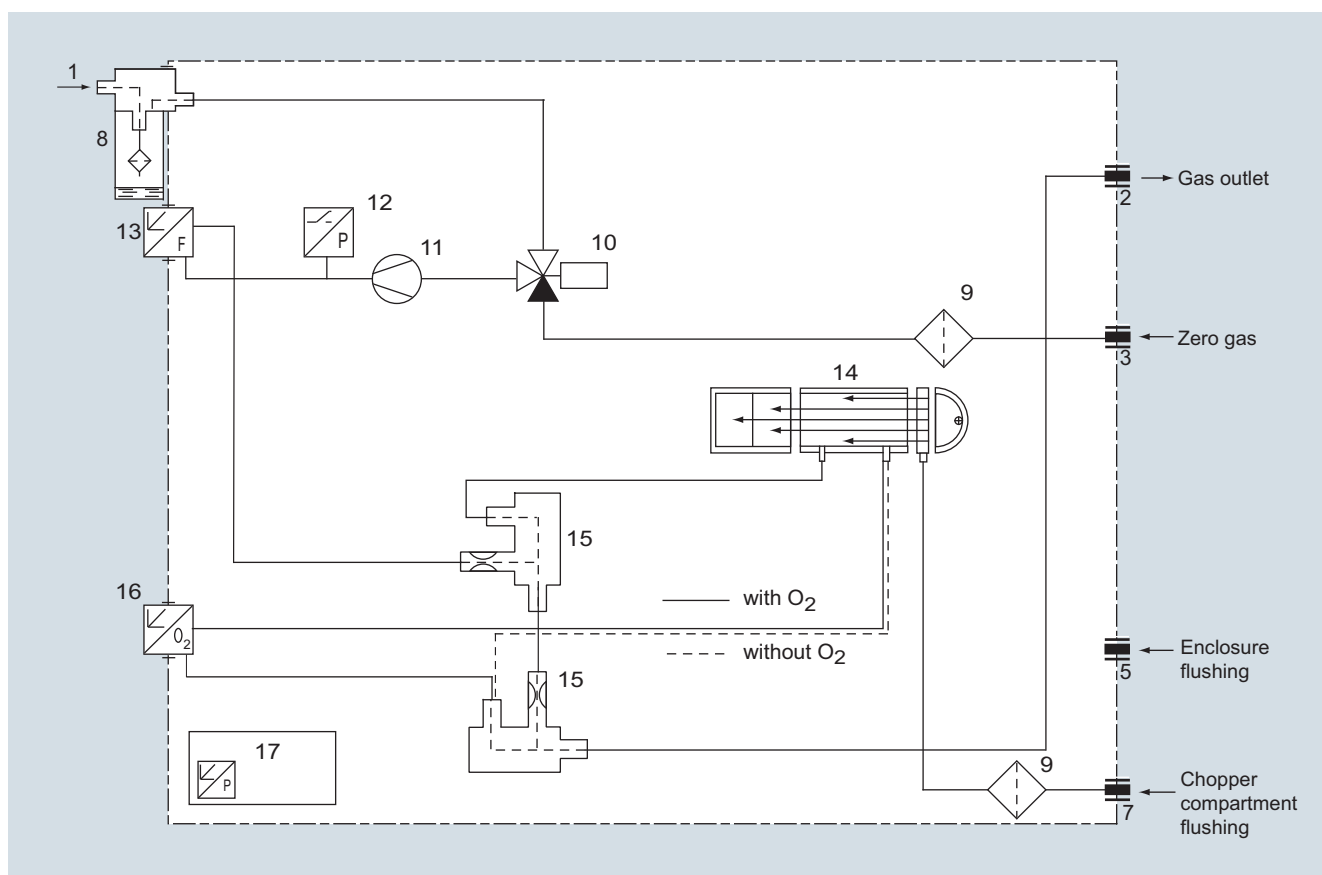
ULTRAMAT 23

General information

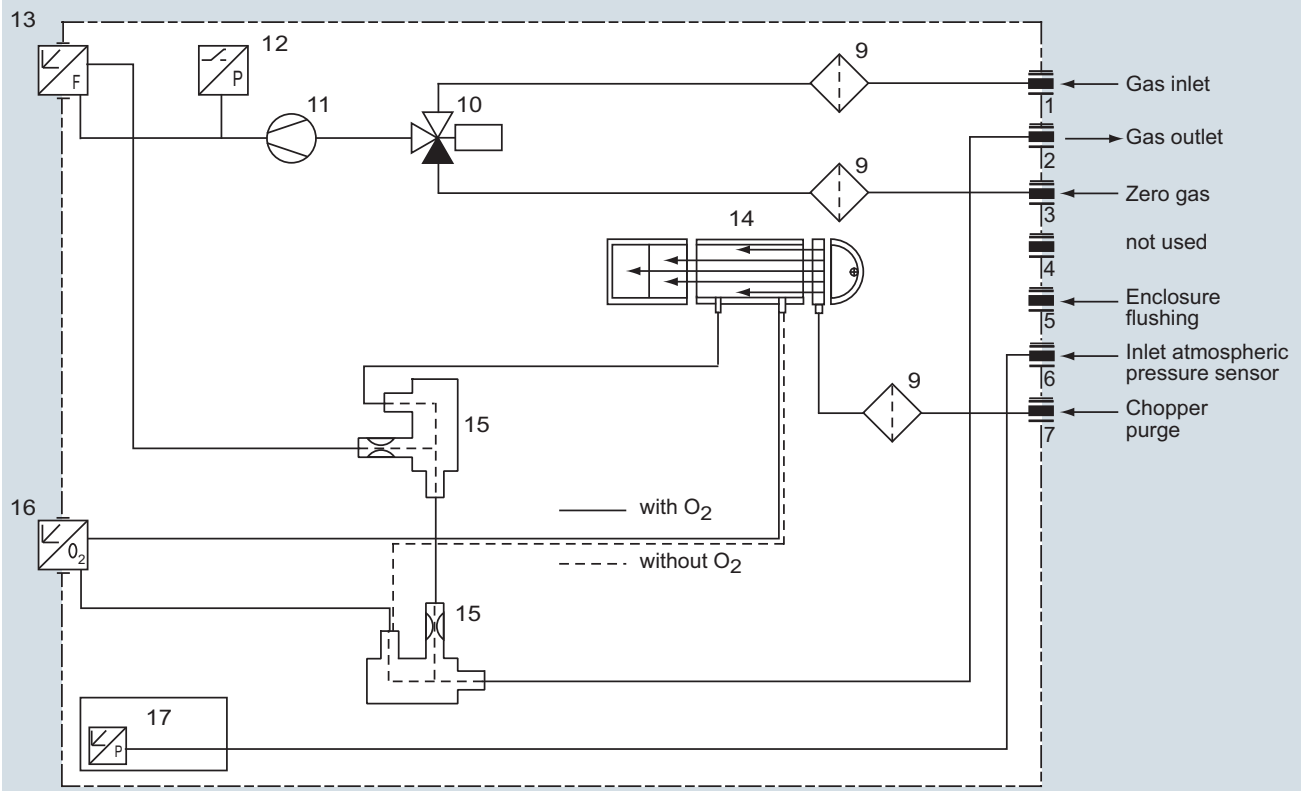
Gas path

Legend for the gas path figures

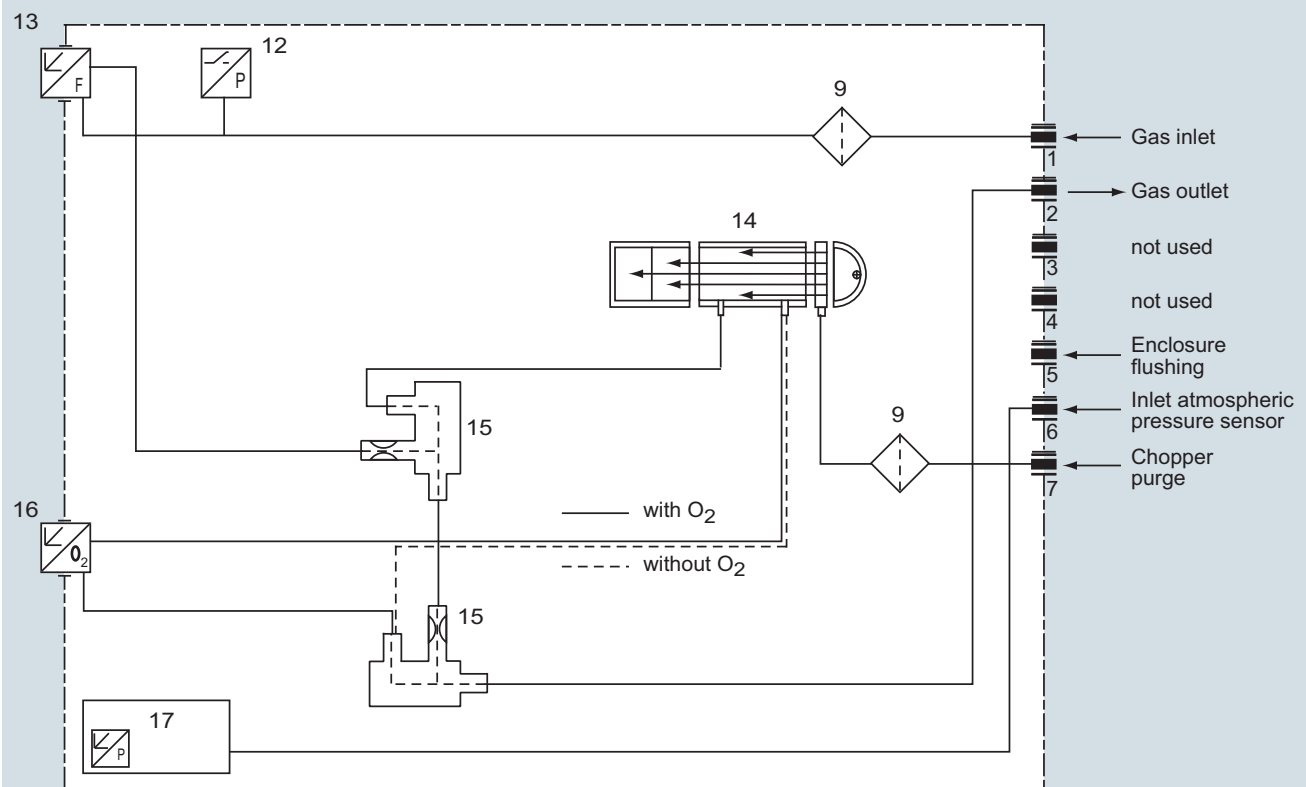
1	Inlet for sample gas/calibration gas	10	Solenoid valve
2	Gas outlet	11	Sample gas pump
3	Inlet for AUTOCAL/zero gas or inlet for sample gas/calibration gas (channel 2)	12	Pressure switch
4	Gas outlet (channel 2)	13	Flow indicator
5	Enclosure flushing	14	Analyzer unit
6	Inlet of atmospheric pressure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



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



ULTRAMAT 23, 19" rack unit enclosure with internal sample gas pump, optional oxygen measurement



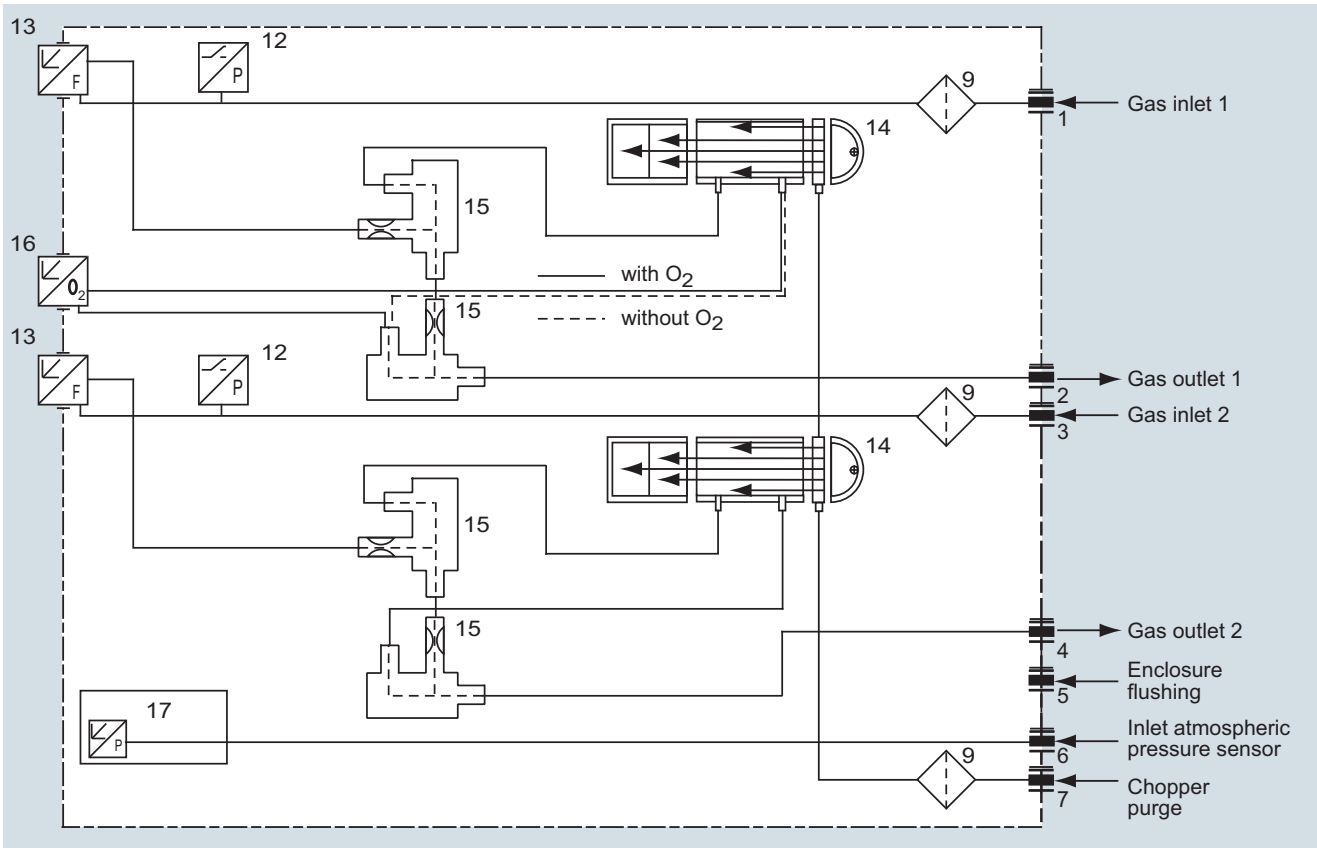
ULTRAMAT 23, 19" rack unit enclosure without internal sample gas pump, optional oxygen measurement

Continuous Gas Analyzers, extractive

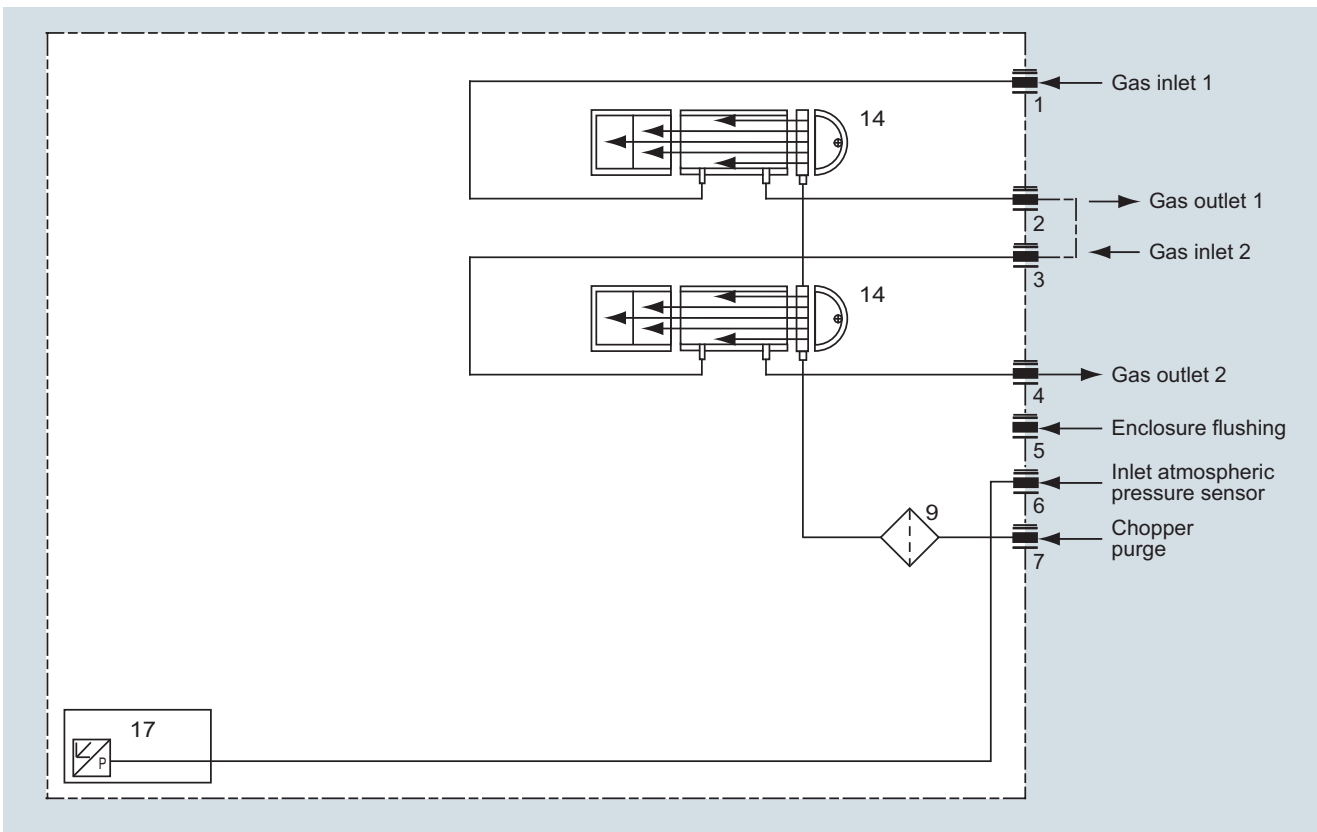
ULTRAMAT 23

General information

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



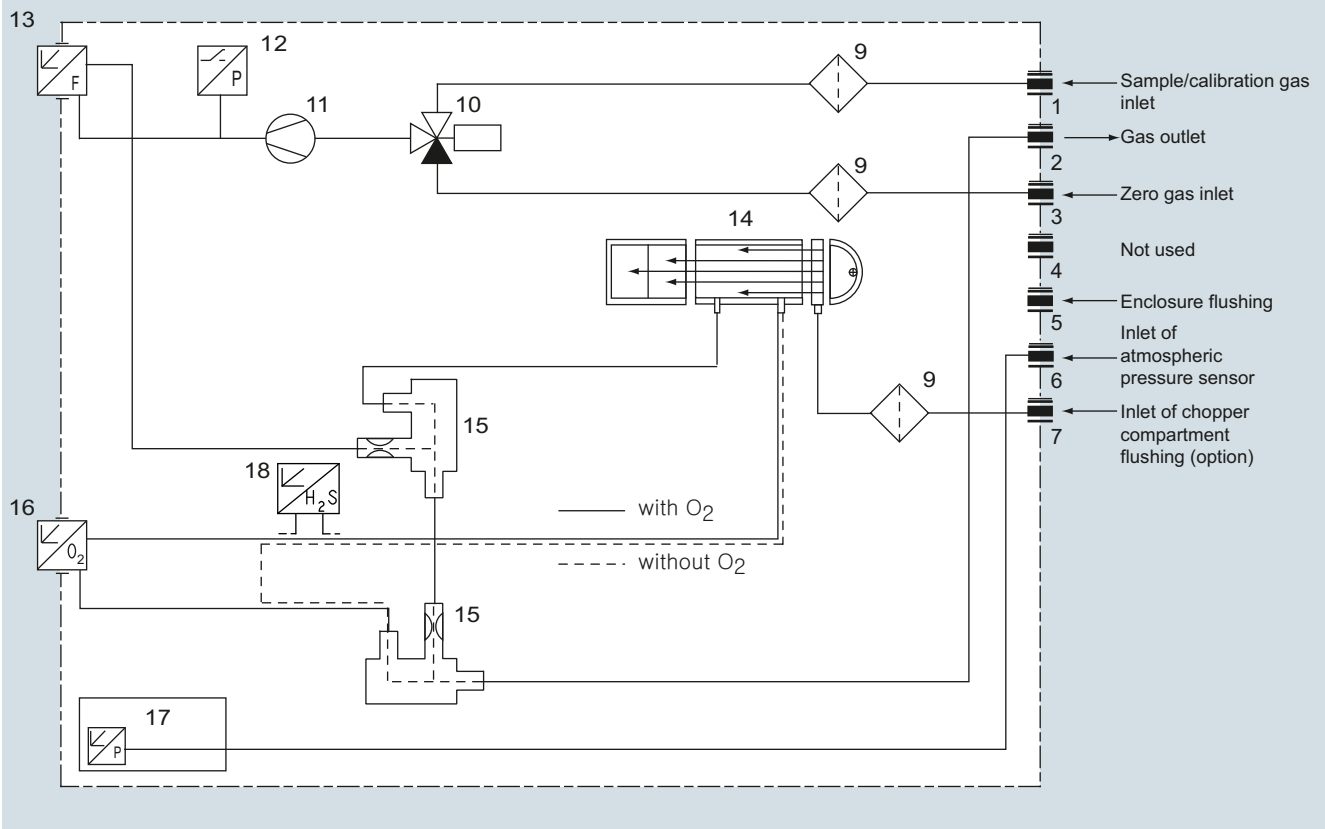
ULTRAMAT 23, 19" rack unit enclosure, sample gas path version in pipes, separate gas path, always without sample gas pump, without safety filter and without safety condensation trap

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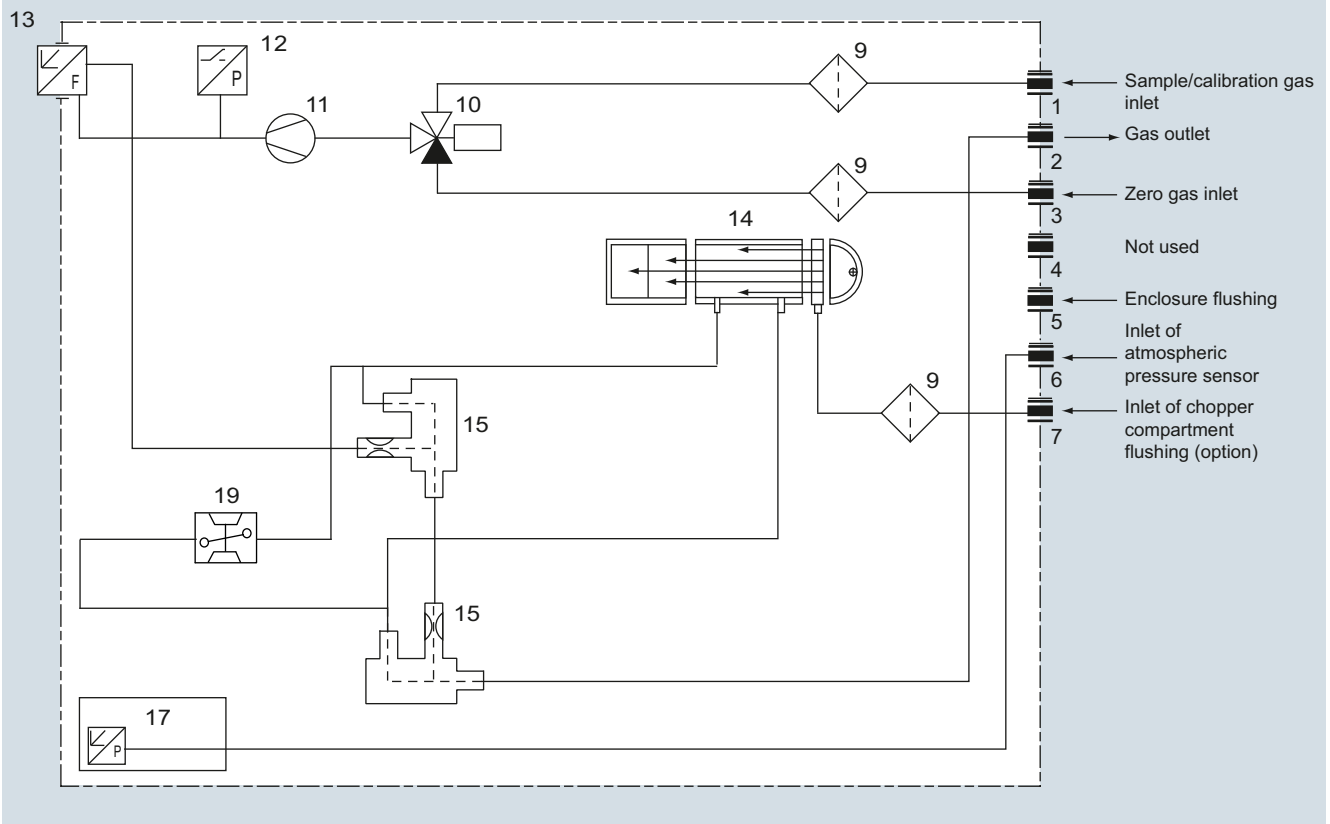
ULTRAMAT 23

General information

1



ULTRAMAT 23, 19" rack unit enclosure with internal sample gas pump and H₂S sensor



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

Continuous Gas Analyzers, extractive

ULTRAMAT 23

General information

Function

The ULTRAMAT 23 uses two 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 receiver chamber - set up as a two- or three-layer detector - 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 layer 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.

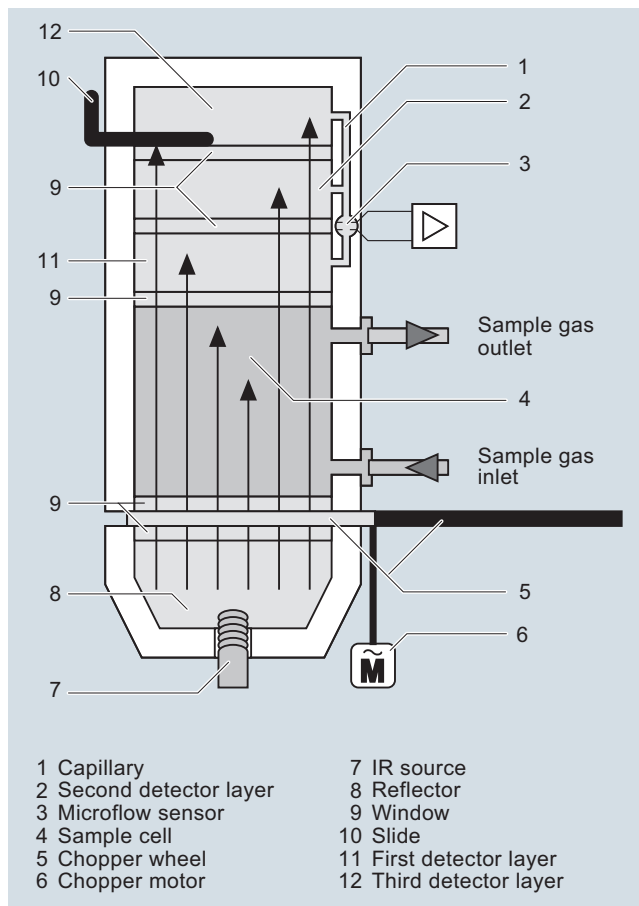
The rotating chopper (5) generates a pulsating flow in the receiver chamber that the microflow sensor (3) converts into an electrical signal.

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 should not have a large concentration of the gas components to be measured.



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

Automatic calibration with air (AUTOCAL)

The ULTRAMAT 23 can be calibrated using, for example, ambient air. During this process (between 1 and 24 hours (adjustable), 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 preabsorption, 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:

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

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 tracks the total characteristic until the currently valid value, thereby compensating for temperature and pressure influences.

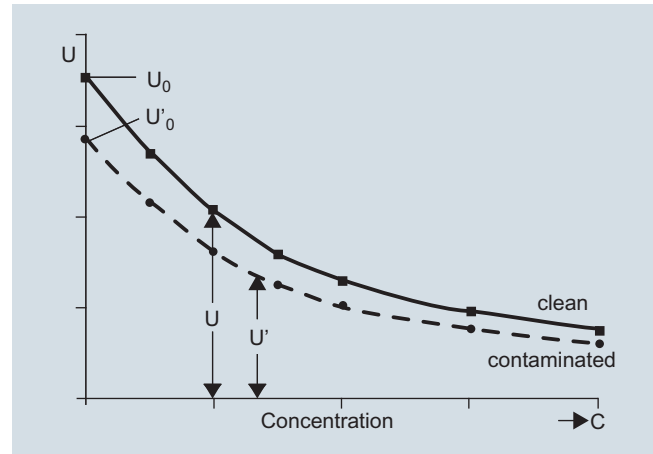
The influences of contamination and aging, as mentioned above, will have a negligible influence on the measurement as long as U' remains in a certain tolerance range monitored by the unit.

The tolerance "clamping width" between two or more AUTOCALs can be individually parameterized on the ULTRAMAT 23 and an alarm message output. A fault 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 units 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'_0 and the device-specific parameters stored as default values. It is recommendable to check the calibration point once a year using a calibration gas. (For details on 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 of the O_2 sensor is sufficiently stable following the single-point calibration such that the zero point of the electrochemical sensor needs only be checked once a year by connecting nitrogen.



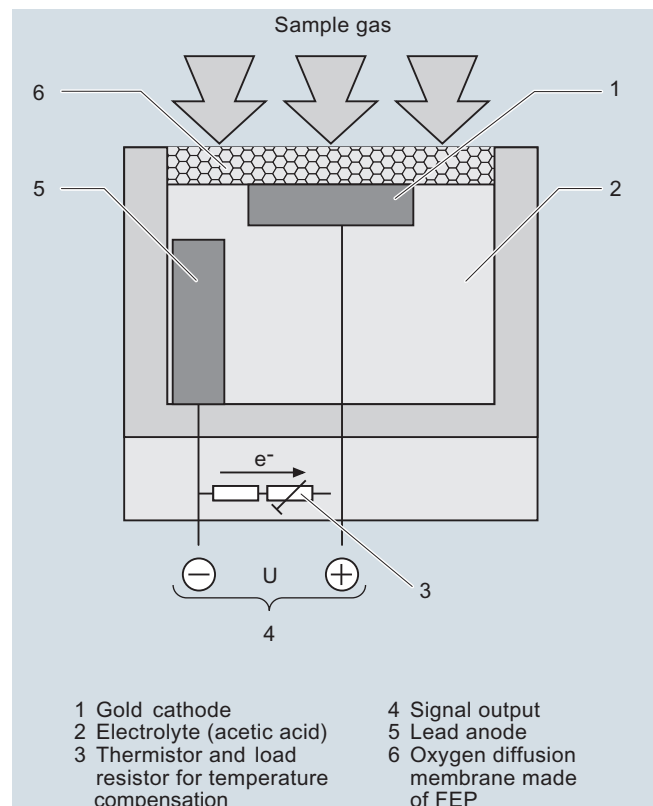
Calibration

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 resistor, 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 rinsing times are to be set.



ULTRAMAT 23, principle of operation of the oxygen sensor

Continuous Gas Analyzers, extractive ULTRAMAT 23

General information

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

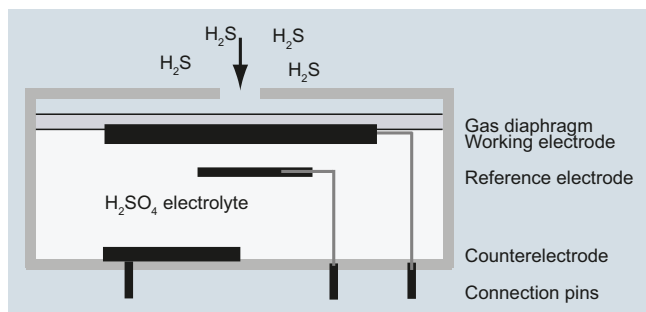
The zero point is automatically recalibrated by the AUTOCAL function when connecting e.g. nitrogen or air. It is recommendable to check the calibration point monthly using calibration gas (1 000 to 3 000 vpm).

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

Should this not be constantly guaranteed with dry ambient air, the adjustment gas is to be fed through a moisture vessel and subsequently through a cooler (dew point 11 °C).

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
- $NH_3 > 5$ vpm



Operating principle of the H_2S sensor

Paramagnetic oxygen cell

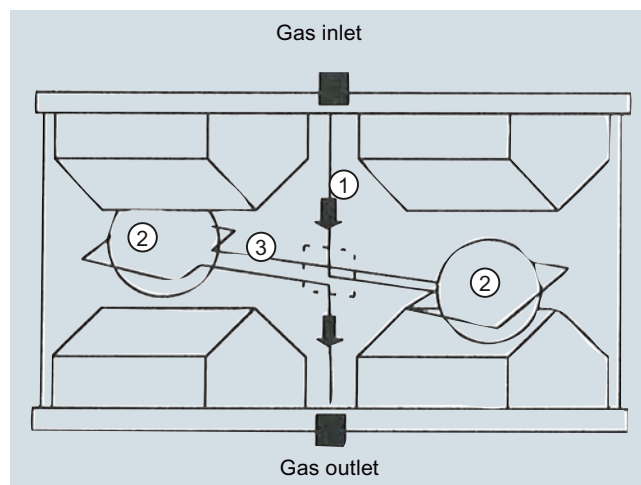
In contrast to other gases, oxygen is highly paramagnetic. This property is used as the basis for the method of measurement.

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 (in a similar way 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.



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 ₂ H ₄ O	-0.31	-0.34
Acetone	C ₃ H ₆ O	-0.63	-0.69
Acetylene, ethyne	C ₂ H ₂	-0.26	-0.28
Ammonia	NH ₃	-0.17	-0.19
Argon	Ar	-0.23	-0.25
Benzene	C ₆ H ₆	-1.24	-1.34
Bromine	Br ₂	-1.78	-1.97
Butadiene	C ₄ H ₆	-0.85	-0.93
n-butane	C ₄ H ₁₀	-1.1	-1.22
Iso-butylene	C ₄ H ₈	-0.94	-1.06
Chlorine	Cl ₂	-0.83	-0.91
Diacetylene	C ₄ H ₂	-1.09	-1.2
Dinitrogen monoxide	N ₂ O	-0.2	-0.22
Ethane	C ₂ H ₆	-0.43	-0.47
Ethyl benzene	C ₈ H ₁₀	-1.89	-2.08
Ethylene, ethene	C ₂ H ₄	-0.2	-0.22
Ethylene glycol	C ₂ H ₆ O ₂	-0.78	-0.88
Ethylene oxide	C ₂ H ₄ O	-0.54	-0.6
Furan	C ₄ H ₄ O	-0.9	-0.99
Helium	He	0.29	0.32
n-hexane	C ₆ H 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 ₄ O	-0.27	-0.31
Methylene chloride	CH ₂ Cl ₂	-1	-1.1
Monosilane, silane	SiH ₄	-0.24	-0.27
Neon	Ne	0.16	0.17
n-octane	C ₈ H ₁₈	-2.45	-2.7
Phenol	C ₆ H ₆ O	-1.4	-1.54
Propane	C ₃ H ₈	-0.77	-0.85
Propylene, propene	C ₃ H ₆	-0.57	-0.62
Propylene chloride	C ₃ H ₇ Cl	-1.42	-1.44
Propylene oxide	C ₃ H ₆ O	-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 ₂ S	-0.41	-0.43
Nitrogen	N ₂	0	0

Accompanying gas	Formula	Deviation at 20 °C	Deviation at 50 °C
Nitrogen dioxide	NO ₂	5	16
Nitrogen monoxide	NO	42.7	43
Styrene	C ₈ H ₈	-1.63	-1.8
Toluene	C ₇ H ₈	-1.57	-1.73
Vinyl chloride	C ₂ H ₃ Cl	-0.68	-0.74
Vinyl fluoride	C ₂ H ₃ F	-0.49	-0.54
Water (vapor)	H ₂ O	-0.03	-0.03
Hydrogen	H ₂	0.23	0.26
Xenon	Xe	-0.95	-1.02

Cross-sensitivities (with accompanying gas concentration 100 %)

ULTRAMAT 23 essential characteristics

- Practically maintenance-free thanks to AUTOCAL with ambient air (or with N₂, only for units 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 request alert
- Two freely configurable undershooting or overshooting limit values per measured component

Continuous Gas Analyzers, extractive

ULTRAMAT 23

19" rack unit and portable version

Technical specifications

General information

Measured components	Maximum of 4, comprising three infrared-sensitive gases and oxygen
Measuring ranges	Two 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 symbol EN 61000-6-2, EN 61000-6-4

Design, enclosure

Weight	Approximately 10 kg
Degree of protection, 19" rack unit and desktop model	IP20 according to EN 60529

Electrical characteristics

EMC (E lectromagnetic C ompatibility) (safety extra-low voltage (SELV) with safety isolation)	In accordance with standard requirements of NAMUR NE21 (08/98) or EN 50081-1, EN 50082-2
Power supply	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 up to 20 mA, NAMUR, isolated, max. load 750 Ω
Relay outputs	8, with changeover contacts, freely parameterizable, e.g. for measuring range identification; 24 V AC/DC/1 A load, potential-free, non-sparking
Digital inputs	3, dimensioned for 24 V, potential-free <ul style="list-style-type: none"> • Pump • AUTOCAL • Synchronization
Serial interface	RS 485
AUTOCAL function	Automatic unit 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 for e.g. triggering of automatic calibration and for PROFIBUS PA or PROFIBUS DP

Climatic conditions

Permissible ambient temperature	
• During operation	5 ... 45 °C
• During storage and transportation	-20 ... +60 °C
Permissible ambient humidity	< 90 % RH (relative humidity) during storage and transportation
Permissible pressure fluctuations	600 ... 1 200 hPa

Gas inlet conditions

Sample gas pressure	
• Without pump	Unpressurized (< 1 200 hPa, absolute)
• With pump	Depressurized suction mode, set in factory with 2 m hose at sample gas outlet; full-scale value calibration necessary under different venting conditions (800 ... 1 050 hPa, absolute)
Sample gas flow	72 ... 120 l/h (1.2 ... 2 l/min)
Sample gas temperature	Min. 0 to max. 50 °C, but above the dew point
Sample gas humidity	< 90 % RH (relative humidity), non-condensing

Technical data, infrared channel

So that the technical data can be complied with, 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 SO₂ measuring ranges (≤ 400 mg/m³) on TÜV/QAL-certified systems.

Measuring ranges	See ordering data
Chopper compartment flushing	Upstream pressure approximately 3 000 hPa; purging gas consumption approximately 100 ml/min

Time response

Warm-up period	Approximately 30 min (at room temperature) (the technical specification will be met after 2 hours)
Delayed display (T ₉₀ time)	Dependent on length of analyzer chamber, sample gas line and parameterizable attenuation
Attenuation(electrical time constant)	Parameterizable from 0 ... 99.9 s

Measuring response

(relating to 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 rating plate)
Detection limit	1 % of the current measuring range
Linearity error	<ul style="list-style-type: none"> • In largest possible measuring range: < ± 1 % of the full-scale value • In smallest possible measuring range: < ± 2 % of the full-scale value
Repeatability	≤ ± 1 % of the current measuring range

Drift

Zero point	
• With AUTOCAL	Negligible
• Without AUTOCAL	< 2 % of the current measuring range/week
Full-scale value drift	
• With AUTOCAL	Negligible
• Without AUTOCAL	< 2 % of the current measuring range/week

Influencing variables

(relating to 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 rating plate per 10 K with an AUTOCAL cycle time of 6 h
Atmospheric pressure	< 0.2 % of the current measuring range per 1 % pressure variation
Power supply	< 0.1 % of the current measuring range with a change of ± 10 %

Technical data, oxygen channel (electrochemical)

Measuring ranges	0 ... 5 % ... 0 ... 25 % O ₂ , parameterizable
Service life	Approximately 2 years at 21 % O ₂
Detection limit	1 % of the current measuring range

Time response

Delayed display (T ₉₀ time)	Dependent on dead time and parameterizable attenuation, not > 30 s at approximately 1.2 l/min sample gas flow
--	---

Measuring response

(relating to 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
Repeatability	≤ 0.05 % O ₂
Drift	
• With AUTOCAL	Negligible
• Without AUTOCAL	1 % O ₂ /year in air, typical

Influencing variables

(relating to 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
Carrier 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 ₂ O dew point ≥ 2 °C; the oxygen sensor must not be used with dry sample gases (however, no condensation either)

Technical data, H₂S channel for measuring ranges of 5 ... 50 vpm

Measured components	Maximum of 4, comprising 1 or 2 infrared-sensitive gases, 1 oxygen component and 1 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)
Operating mode	Continuous measurement between 0 and 12.5 vpm Discontinuous measurement between 12.5 and 50 vpm

Influencing variables

Carrier gases	The hydrogen sulfide sensor must not be used if the accompanying gas contains the following components: <ul style="list-style-type: none"> • Compounds containing chlorine • Compounds containing fluorine • Heavy metals • Aerosols • Alkaline components (e.g. NH₃ > 5 %)
Cross-inferences (interfering gases)	1 360 vpm SO ₂ result in a cross-interference of < 20 vpm H ₂ S 180 vpm NO result in a cross-interference of < 150 vpm H ₂ S No cross-interference of CH ₄ , CO ₂ and H ₂ (1 000 vpm)
Drift	< 1 % of the current measuring range per month
Temperature	< 3 %/10 K relating to full-scale value
Atmospheric pressure	< 0.2 % of the measured value per 1 % pressure variation

Measuring response

Delayed display (T ₉₀ time)	< 40 s with sample gas flow of approx. 1 ... 1.2 l/min
Output signal noise	< 2 % of smallest measuring range with an attenuation constant of 30 s
Display resolution	< 0.01 vpm H ₂ S
Output signal resolution	< 1 % of smallest measuring range with an attenuation constant of 30 s
Repeatability	< 4 % of smallest measuring range

Continuous Gas Analyzers, extractive

ULTRAMAT 23

19" rack unit and portable version

Technical data, paramagnetic oxygen cell

Measured components	Maximum of 4, comprising up to 3 infrared-sensitive gases and an oxygen component
Measuring ranges	2 per component <ul style="list-style-type: none"> • Min. 0 ... 2 % vol O₂ • Max. 0 ... 100 % vol O₂ • Suppressed measuring range possible; e.g. 95 ... 100 %
Permissible atmospheric pressure	700 ... 1 200 hPa
Permissible operating temperature	5 ... 45 °C (41 ... 113 °F)
Cross-inferences (interfering gases)	See Table "Cross-sensitivities"
Zero point drift	<ul style="list-style-type: none"> • Measuring range 2 %: max. 0.1 % with weekly zero adjustment • Measuring range 5 %: max. 0.1 % with weekly zero adjustment • Measuring range 25 % or greater: max. 0.5 % with monthly zero adjustment
Measured-value drift	Negligible with AUTOCAL
Temperature error	<p>< 2 %/10 K referred to measuring range 5 %</p> <p>< 5 %/10 K referred to measuring range 2 %</p>
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 (T ₉₀ time)	< 60 s
Output signal noise	< 1 % of smallest measuring range
Repeatability	< 1 % of smallest measuring range

Continuous Gas Analyzers, extractive ULTRAMAT 23

19" rack unit and portable version

1

Selection and ordering data		Article No.	
ULTRAMAT 23 gas analyzer For measuring 1 infrared component, oxygen and hydrogen sulfide		7MB2335- - - AA	
↗ Click on the Article No. for the online configuration in the PIA Life Cycle Portal.		Cannot be combined	
Enclosure, version and gas paths 19" rack unit for installation in cabinets			
<u>Gas connections</u>	<u>Gas path</u>	<u>Internal sample gas pump</u>	
6 mm pipe	Viton	Without ²⁾	0
¼" pipe	Viton	Without ²⁾	1
6 mm pipe	Viton	With	2
¼" pipe	Viton	With	3
6 mm pipe	Stainless steel, mat. no. 1.4571	Without ²⁾	6
¼" pipe	Stainless steel, mat. no. 1.4571	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
<u>Measured component</u>	<u>Possible with measuring range identification</u>		
CO	D, E, F, G ... R, U, X	A	
CO ₂ ¹⁾	D ⁶⁾ , G ⁶⁾ , H ⁶⁾ , J ⁶⁾ , K ... R	C	
CH ₄	E, H, L, N, P, R	D	
C ₂ H ₄	K	F	
C ₆ H ₁₄	K	M	
SO ₂	B ¹⁰⁾ , F ... L, T ¹¹⁾ , W	N	
NO	E, G ... J, T, V, W	P	
N ₂ O ⁷⁾	E	S	
SF ₆	H	V	
<u>Smallest measuring range</u>	<u>Largest measuring range</u>		
0 ... 200 mg/m ³	0 ... 1 000 mg/m ³	B	
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/m ³	0 ... 750 mg/m ³	T	
0 ... 150 mg/m ³	0 ... 750 mg/m ³	U	
0 ... 250 mg/m ³	0 ... 1 250 mg/m ³	V	
0 ... 400 mg/m ³	0 ... 2 000 mg/m ³	W	
0 ... 50 vpm	0 ... 2 500 vpm	X	
} Prepared for QAL1 (MCERTS)			
<u>Oxygen measurement⁵⁾</u>			
Without O ₂ sensor			0
With electrochemical O ₂ sensor			1
With paramagnetic oxygen measuring cell			8
<u>Hydrogen sulfide measurement</u>			
Without			0
With H ₂ S sensor 0 ... 5/50 vpm			1
<u>Power supply</u>			
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
<u>Operating software, documentation³⁾</u>			
German			0
English			1
French			2
Spanish			3
Italian			4

Footnotes: See next page.

Continuous Gas Analyzers, extractive

ULTRAMAT 23

19" rack unit and portable version

Selection and ordering data

<i>Additional versions</i>	Order code
Add "-Z" to Article No. and specify Order code	
Add-on electronics with 8 digital inputs/outputs, PROFIBUS PA interface	A12
Add-on electronics with 8 digital inputs/outputs, PROFIBUS DP interface	A13
Telescopic rails (2 units), 19" rack unit version only	A31
IEC plug, 37-pin sub-D connector, 9-pin sub-D connector	A33
TAG labels (specific lettering based on customer information)	B03
Gas path for short response time ⁹⁾	C01
Chopper compartment purging for 6 mm gas connection	C02
Chopper compartment purging for 1/4" gas connection	C03
Presetting to reference temperature 0 °C for conversion into mg/m ³ , applies to all components	D15
Certificate FM/CSA Class I, Div. 2, ATEX II 3 G	E20
Calibration interval 5 months (QAL), measuring ranges: CO: 0 ... 150/750 mg/m ³ NO: 0 ... 100/750 mg/m ³	E50
Measuring range indication in plain text ⁴⁾	Y11
Measurement of CO ₂ in forming gas ⁸⁾ (only in conjunction with measuring range 0 to 20/0 to 100 %)	Y14
<i>Accessories</i>	Article No.
CO ₂ absorber cartridge	7MB1933-8AA
RS 485/Ethernet converter	A5E00852383
RS 485/RS 232 converter	C79451-Z1589-U1
RS 485/USB converter	A5E00852382
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

¹⁾ For measuring ranges below 1 %, a CO₂ absorber cartridge can be used for setting the zero point (see accessories)

²⁾ Without separate zero gas input or solenoid valve

³⁾ User language can be changed

⁴⁾ Standard setting: smallest measuring range, largest measuring range

⁵⁾ O₂ sensor/O₂ measuring cell in gas path of infrared measured component 1

⁶⁾ With chopper compartment purging (N₂ approx. 3 000 hPa required for measuring ranges below 0.1 % CO₂), to be ordered separately (see order code C02 or C03)

⁷⁾ Not suitable for use with emission measurements since the cross-sensitivity is too high

⁸⁾ CO₂ measurement in accompanying gas Ar or Ar/He (3:1); forming gas

⁹⁾ Only for version with Viton hose

¹⁰⁾ Not checked for suitability, maximum possible AUTOCAL cycle ≤ 6 h, constant ambient conditions (max. deviation ±1 °C (1.8 °F))

¹¹⁾ Not checked for suitability, maximum possible AUTOCAL cycle ≤ 3 h, constant ambient conditions (max. deviation ±1 °C (1.8 °F))

Selection and ordering data		Article No.	
ULTRAMAT 23 gas analyzer		7MB2337-	
For measuring 2 infrared components, oxygen and hydrogen sulfide		Cannot be combined	
Click on the Article No. for the online configuration in the PIA Life Cycle Portal.			
Enclosure, version and gas paths			
19" rack unit for installation in cabinets			
Gas connections	Gas paths	Internal sample gas pump	
6 mm pipe	Viton, not separate	Without ²⁾	0
1/4" pipe	Viton, not separate	Without ²⁾	1
6 mm pipe	Viton, not separate	With	2
1/4" pipe	Viton, not separate	With	3
6 mm pipe	Viton, separate	Without ²⁾	4
1/4" pipe	Viton, separate	Without ²⁾	5
6 mm pipe	Stainless steel, mat. no. 1.4571, separate	Without ²⁾	6
1/4" 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
1. infrared measured component			
Measured component	Possible with measuring range identification		
CO	D, E, F, G ... R, U, X		
CO ₂ ¹⁾	D ⁶⁾ , G ⁶⁾ , H ⁶⁾ , J ⁶⁾ , K ... R	A	
CH ₄	E, H, L, N, P, R	C	
C ₂ H ₄	K	D	
C ₆ H ₁₄	K	F	
SO ₂	B ¹¹⁾ , F ... L, T ¹²⁾ , W	M	
NO	E, G ... J, T, V, W	N	
N ₂ O ⁷⁾	E	P	
SF ₆	H	S	
		V	
<u>Smallest measuring range</u>	<u>Largest measuring range</u>		
0 ... 200 mg/m ³	0 ... 1 000 mg/m ³	B	
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/m ³	0 ... 750 mg/m ³	T	
0 ... 150 mg/m ³	0 ... 750 mg/m ³	U	
0 ... 250 mg/m ³	0 ... 1 250 mg/m ³	V	
0 ... 400 mg/m ³	0 ... 2 000 mg/m ³	W	
0 ... 50 vpm	0 ... 2 500 vpm	X	
<div style="display: flex; align-items: center;"> <div style="font-size: 2em; margin-right: 10px;">}</div> <div>Prepared for QAL1 (MCERTS)</div> </div>			
<u>Oxygen measurement⁵⁾</u>			
Without O ₂ sensor			0
With electrochemical O ₂ sensor			1
With paramagnetic oxygen measuring cell			8
<u>Hydrogen sulfide measurement</u>			
Without			0
With H ₂ S sensor 0 ... 5/50 vpm			1
<u>Power supply</u>			
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

Continuous Gas Analyzers, extractive ULTRAMAT 23

19" rack unit and portable version

1

Selection and ordering data

Article No.

ULTRAMAT 23 gas analyzer

7MB2337- -

For measuring 2 infrared components, oxygen and hydrogen sulfide

Cannot be combined

2. infrared measured component

Measured component	Possible with measuring range identification
CO	D, E, F, G ... R, U, X
CO ₂ ¹⁾	D ⁶⁾ , G ⁶⁾ , H ⁶⁾ , J ⁶⁾ , K ... R
CH ₄	E, H, L, N, P, R
C ₂ H ₄	K
C ₆ H ₁₄	K
SO ₂	B ¹¹⁾ , F ... L, T ¹²⁾ , W
NO	E, G ... J, T, V, W
N ₂ O	E ⁷⁾ , Y ¹⁰⁾
SF ₆	H

A
C
D
F
M
N
P
S
V

Smallest measuring range Largest measuring range

0 ... 200 mg/m ³	0 ... 1 000 mg/m ³
0 ... 50 vpm	0 ... 250 vpm
0 ... 100 vpm	0 ... 500 vpm
0 ... 150 vpm	0 ... 750 vpm
0 ... 200 vpm	0 ... 1 000 vpm
0 ... 500 vpm	0 ... 2 500 vpm
0 ... 1 000 vpm	0 ... 5 000 vpm
0 ... 2 000 vpm	0 ... 10 000 vpm
0 ... 0.5 %	0 ... 2.5 %
0 ... 1 %	0 ... 5 %
0 ... 2 %	0 ... 10 %
0 ... 5 %	0 ... 25 %
0 ... 10 %	0 ... 50 %
0 ... 20 %	0 ... 100 %
0 ... 100 mg/m ³	0 ... 750 mg/m ³
0 ... 150 mg/m ³	0 ... 750 mg/m ³
0 ... 250 mg/m ³	0 ... 1 250 mg/m ³
0 ... 400 mg/m ³	0 ... 2 000 mg/m ³
0 ... 50 vpm	0 ... 2 500 vpm
0 ... 500 vpm	0 ... 5 000 vpm

}

Prepared for QAL1 (MCERTS)

B
D
E
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P
Q
R
T
U
V
W
X
Y

Operating software, documentation³⁾

- German
- English
- French
- Spanish
- Italian

0
1
2
3
4

Footnotes: See next page.

Selection and ordering data

<i>Additional versions</i>	Order code
Add "-Z" to Article No. and specify Order code	
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 (mat. no. 1.4571) connection pipe, 6 mm, complete with screwed gland (cannot be combined with Viton hose)	A27
Stainless steel (mat. no. 1.4571) connection pipe, 1/4", complete with screwed gland (cannot be combined with Viton hose)	A29
Telescopic rails (2 units, 19" rack unit version only)	A31
IEC plug, 37-pin sub-D connector, 9-pin sub-D connector	A33
TAG labels (specific lettering based on customer information)	B03
Gas path for short response time ⁹⁾	C01
Chopper compartment purging for 6 mm gas connection	C02
Chopper compartment purging for 1/4" gas connection	C03
Application with paramagnetic oxygen measuring cell and separate gas path	C11
Presetting to reference temperature 0 °C for conversion into mg/m ³ , applies to all components	D15
Measuring range indication in plain text ⁴⁾	Y11
Measurement of CO ₂ in forming gas ⁸⁾ (only in conjunction with measuring range 0 to 20/0 to 100 %)	Y14
Certificate FM/CSA Class I, Div. 2, ATEX II 3 G	E20
Calibration interval 5 months (QAL), measuring ranges: CO: 0 ... 150/750 mg/m ³ NO: 0 ... 100/750 mg/m ³	E50
Accessories	Article No.
CO ₂ absorber cartridge	7MB1933-8AA
RS 485/Ethernet converter	A5E00852383
RS 485/RS 232 converter	C79451-Z1589-U1
RS 485/USB converter	A5E00852382
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

¹⁾ For measuring ranges below 1 %, a CO₂ absorber cartridge can be used for setting the zero point (see accessories)

²⁾ Without separate zero gas input or solenoid valve

³⁾ User language can be changed

⁴⁾ Standard setting: smallest measuring range, largest measuring range

⁵⁾ O₂ sensor/O₂ measuring cell in gas path of infrared measured component 1

⁶⁾ With chopper compartment purging (N₂ approx. 3 000 hPa required for measuring ranges below 0.1 % CO₂), to be ordered separately (see order code C02 or C03)

⁷⁾ Not suitable for use with emission measurements since the cross-sensitivity is too high

⁸⁾ CO₂ measurement in accompanying gas Ar or Ar/He (3:1); forming gas

⁹⁾ Only for version with Viton hose

¹⁰⁾ Only in conjunction with CO₂ measuring range 0 to 5 % to 0 to 25 % (CP)

¹¹⁾ Not checked for suitability, maximum possible AUTOCAL cycle ≤ 6 h, constant ambient conditions (max. deviation ±1 °C (1.8 °F))

¹²⁾ Not checked for suitability, maximum possible AUTOCAL cycle ≤ 3 h, constant ambient conditions (max. deviation ±1 °C (1.8 °F))

Continuous Gas Analyzers, extractive

ULTRAMAT 23

19" rack unit and portable version

1

Selection and ordering data

ULTRAMAT 23 gas analyzer

For measuring 3 infrared components and oxygen

➤ Click on the Article No. for the online configuration in the PIA Life Cycle Portal.

Enclosure, version and gas paths

19" rack unit for installation in cabinets

Gas connections	Gas paths	Internal sample gas pump	
6 mm pipe	Viton, not separate	Without ⁽²⁾	0
¼" pipe	Viton, not separate	Without ⁽²⁾	1
6 mm pipe	Viton, not separate	With	2
¼" pipe	Viton, not separate	With	3
6 mm pipe	Viton, separate	Without ⁽²⁾	4
¼" pipe	Viton, separate	Without ⁽²⁾	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
			8

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

1. and 2nd infrared measured components

Measured component	Smallest measuring range	Largest measuring range	
CO	0 ... 500 vpm	0 ... 2 500 vpm	AA
NO	0 ... 500 vpm	0 ... 2 500 vpm	
CO	0 ... 2 000 vpm	0 ... 10 000 vpm	AB
NO	0 ... 1 000 vpm	0 ... 5 000 vpm	
CO	0 ... 1 000 vpm	0 ... 5 000 vpm	AC
NO	0 ... 1 000 vpm	0 ... 5 000 vpm	
CO	0 ... 1 %	0 ... 5 %	AD
NO	0 ... 1 000 vpm	0 ... 5000 vpm	
CO	0 ... 250 mg/m ³	0 ... 1 250 mg/m ³ TÜV version	AK
NO	0 ... 400 mg/m ³	0 ... 2 000 mg/m ³ TÜV version	
CO	0 ... 10 %	0 ... 50 %	BA
CO ₂	0 ... 10 %	0 ... 50 %	
CO	0 ... 10 %	0 ... 50 %	BB
CO ₂	0 ... 0.5 %	0 ... 2.5 %	
CO	0 ... 20 %	0 ... 100 %	BD
CO ₂	0 ... 20 %	0 ... 100 %	
CO ₂	0 ... 5 %	0 ... 25 %	BJ
CO	0 ... 100 vpm	0 ... 500 vpm	
CO ₂	0 ... 10 %	0 ... 50 %	BK
CO	0 ... 0.5 %	0 ... 2.5 %	
CO ₂	0 ... 5 %	0 ... 25 %	CA
CH ₄	0 ... 1 %	0 ... 5 %	
CO ₂	0 ... 5 %	0 ... 25 %	CB
CH ₄	0 ... 2 %	0 ... 10 %	
CO ₂	0 ... 5 %	0 ... 25 %	DC
NO	0 ... 500 vpm	0 ... 2 500 vpm	

Oxygen measurement⁽⁵⁾

Without O₂ sensor

With electrochemical O₂ sensor

With paramagnetic oxygen measuring cell

Power supply

100 V AC, 50 Hz

120 V AC, 50 Hz

200 V AC, 50 Hz

230 V AC, 50 Hz

100 V AC, 60 Hz

120 V AC, 60 Hz

230 V AC, 60 Hz

Footnotes: See page 1/59.

Article No.

7MB2338-

0 -

Cannot be combined

4 → A27, A29

5 → A27, A29

6

7

8 → E20

AA

AB

AC

AD

AK

BA

BB

BD

BJ

BK

CA

CB

DC

0

1

8

1

8 8

0

1

2

3

4

5

6

Selection and ordering data		Article No.	
ULTRAMAT 23 gas analyzer		7MB2338-	0 -
For measuring 3 infrared components and oxygen			Cannot be combined
3. infrared measured component			
<u>Measured component</u>	<u>Possible with measuring range identification</u>		
CO	D, E, F, G ... R, U, X		
CO ₂ ¹⁾	D ⁶⁾ , G ⁶⁾ , H ⁶⁾ , J ⁶⁾ , K ... R		
CH ₄	E, H, L, N, P, R		
C ₂ H ₄	K		
C ₆ H ₁₄	K		
SO ₂	B ¹¹⁾ , F ... L, T ¹²⁾ , W		
NO	E, G ... J, V, W		
N ₂ O	E ⁷⁾ , Y ¹⁰⁾		
SF ₆	H		
<u>Smallest measuring range</u>	<u>Largest measuring range</u>		
0 ... 200 mg/m ³	0 ... 1 000 mg/m ³		
0 ... 50 vpm	0 ... 250 vpm		
0 ... 100 vpm	0 ... 500 vpm		
0 ... 150 vpm	0 ... 750 vpm		
0 ... 200 vpm	0 ... 1 000 vpm		
0 ... 500 vpm	0 ... 2 500 vpm		
0 ... 1 000 vpm	0 ... 5 000 vpm		
0 ... 2 000 vpm	0 ... 10 000 vpm		
0 ... 0.5 %	0 ... 2.5 %		
0 ... 1 %	0 ... 5 %		
0 ... 2 %	0 ... 10 %		
0 ... 5 %	0 ... 25 %		
0 ... 10 %	0 ... 50 %		
0 ... 20 %	0 ... 100 %		
0 ... 100 mg/m ³	0 ... 750 mg/m ³	} Prepared for QAL1 (MCERTS)	
0 ... 150 mg/m ³	0 ... 750 mg/m ³		
0 ... 250 mg/m ³	0 ... 1 250 mg/m ³		
0 ... 400 mg/m ³	0 ... 2 000 mg/m ³		
0 ... 50 vpm	0 ... 2 500 vpm		
0 ... 500 vpm	0 ... 5 000 vpm		
<u>Operating software, documentation³⁾</u>			
German			0
English			1
French			2
Spanish			3
Italian			4

Footnotes: See page 1/28.

Continuous Gas Analyzers, extractive

ULTRAMAT 23

19" rack unit and portable version

Selection and ordering data

<i>Additional versions</i>	Order code
Add "-Z" to Article No. and specify Order code	
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 (mat. no. 1.4571) connection pipe, 6 mm, complete with screwed gland (cannot be combined with Viton hose)	A27
Stainless steel (mat. no. 1.4571) connection pipe, 1/4", complete with screwed gland (cannot be combined with Viton hose)	A29
Telescopic rails (2 units, 19" rack unit version only)	A31
IEC plug, 37-pin sub-D connector, 9-pin sub-D connector	A33
TAG labels (specific lettering based on customer information)	B03
Gas path for short response time ⁹⁾	C01
Chopper compartment purging for 6 mm gas connection	C02
Chopper compartment purging for 1/4" gas connection	C03
Application with paramagnetic oxygen measuring cell and separate gas path	C11
Presetting to reference temperature 0 °C for conversion into mg/m ³ , applies to all components	D15
Certificate FM/CSA Class I, Div. 2, ATEX II 3 G	E20
Measuring range indication in plain text ⁴⁾	Y11
Measurement of CO ₂ in forming gas ⁹⁾ (only in conjunction with measuring range 0 to 20/0 to 100 %)	Y14
<i>Accessories</i>	Article No.
CO ₂ absorber cartridge	7MB1933-8AA
RS 485/Ethernet converter	A5E00852383
RS 485/RS 232 converter	C79451-Z1589-U1
RS 485/USB converter	A5E00852382
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

¹⁾ For measuring ranges below 1 %, a CO₂ absorber cartridge can be used for setting the zero point (see accessories)

²⁾ Without separate zero gas input or solenoid valve

³⁾ User language can be changed

⁴⁾ Standard setting: smallest measuring range, largest measuring range

⁵⁾ O₂ sensor/O₂ measuring cell in gas path of infrared measured component 1

⁶⁾ With chopper compartment purging (N₂ approx. 3 000 hPa required for measuring ranges below 0.1 % CO₂), to be ordered separately (see order code C02 or C03)

⁷⁾ Not suitable for use with emission measurements since the cross-sensitivity is too high

⁸⁾ CO₂ measurement in accompanying gas Ar or Ar/He (3:1); forming gas

⁹⁾ Only for version with Viton hose

¹⁰⁾ Only in combination with CO₂/NO, measuring range 0 to 5/25 %, 0 to 500/5 000 vpm [-DC-]

¹¹⁾ Not checked for suitability, maximum possible AUTOCAL cycle ≤ 6 h, constant ambient conditions (max. deviation ±1 °C (1.8 °F))

¹²⁾ Not checked for suitability, maximum possible AUTOCAL cycle ≤ 3 h, constant ambient conditions (max. deviation ±1 °C (1.8 °F))

Continuous Gas Analyzers, extractive

ULTRAMAT 23

19" rack unit and portable version

1

Selection and ordering data**Gas analyzer ULTRAMAT 23 - TÜV version**

For measuring 1 infrared component, oxygen and hydrogen sulfide

[Click on the Article No. for the online configuration in the PIA Life Cycle Portal.](#)
Enclosure, version and gas paths

19" rack unit for installation in cabinets

Gas connections

6 mm

Gas paths

FPM (Viton)

Internal sample gas pump

without

Measured component

CO

SO₂

NO

Possible with measuring range identification

G

F, G, H, W

F, G, U, V, W

Smallest measuring range

0 ... 150 vpm

0 ... 200 vpm

0 ... 500 vpm

0 ... 150 mg/m³0 ... 250 mg/m³0 ... 400 mg/m³Largest measuring range

0 ... 750 vpm

0 ... 1 000 vpm

0 ... 2 500 vpm

0 ... 750 mg/m³0 ... 1 250 mg/m³0 ... 2 000 mg/m³
 } TÜV: see table "TÜV, 1 and
2-component analyzer"
page 1/32
Oxygen measurementWithout O₂ sensorWith electrochemical O₂ sensor

With paramagnetic oxygen measuring cell

Power supply

230 V AC, 50 Hz

Operating software, documentation

German

English

French

Spanish

Italian

Article No.

7MB2355-

0

-

A

A

A

A

A

A

A

A

A

A

A

A

A

A

A

A

A

Cannot be combined

0

A

N

P

F

G

H

U

V

W

0

1

8

3

0

1

2

3

4

Selection and ordering data**Additional versions**

Add "-Z" to Article No. and specify Order code

Add-on electronics with 8 digital inputs/outputs, PROFIBUS PA interface

Add-on electronics with 8 digital inputs/outputs, PROFIBUS DP interface

Telescopic rails (2 units)

IEC plug, 37-pin sub-D connector, 9-pin sub-D connector

O₂ Paramagnetic, qualification test EN 15267, IR measuring range in mg/m³O₂ Electrochemical, qualification test EN 15267, IR measuring range in mg/m³Without O₂, qualification test EN 15267, IR measuring range in mg/m³SO₂ with measuring range 0 ... 400/7000 mg/m³**Order code**

A12

A13

A31

A33

T13

T23

T33

Y15

Continuous Gas Analyzers, extractive

ULTRAMAT 23

19" rack unit and portable version

1

Selection and ordering data

Gas analyzer ULTRAMAT 23 - TÜV version

For measuring 2 infrared components, oxygen and hydrogen sulfide

➤ Click on the Article No. for the online configuration in the PIA Life Cycle Portal.

Enclosure, version and gas paths

19" rack unit for installation in cabinets

Gas connections

6 mm

Gas paths

FPM (Viton, not separate)

Internal sample gas pump

without

1st infrared measured component

Measured component

Possible with measuring range identification

CO

G

SO₂

F, G, H, W

NO

F, G, U, V, W

Smallest measuring range

Largest measuring range

0 ... 150 vpm

0 ... 750 vpm

0 ... 200 vpm

0 ... 1 000 vpm

0 ... 500 vpm

0 ... 2 500 vpm

TÜV: see table "TÜV, 1 and 2-component analyzer" page 1/32

0 ... 150 mg/m³

0 ... 750 mg/m³

0 ... 250 mg/m³

0 ... 1 250 mg/m³

0 ... 400 mg/m³

0 ... 2 000 mg/m³

Oxygen measurement

Without O₂ sensor

With electrochemical O₂ sensor

With paramagnetic oxygen measuring cell

Power supply

230 V AC, 50 Hz

2nd infrared measured component

Measured component

Possible with measuring range identification

CO

G

SO₂

F, G, H, W

NO

F, G, U, V, W

Smallest measuring range

Largest measuring range

0 ... 150 vpm

0 ... 750 vpm

0 ... 200 vpm

0 ... 1 000 vpm

0 ... 500 vpm

0 ... 2 500 vpm

TÜV: see table "TÜV, 1 and 2-component analyzer" page 1/32

0 ... 150 mg/m³

0 ... 750 mg/m³

0 ... 250 mg/m³

0 ... 1 250 mg/m³

0 ... 400 mg/m³

0 ... 2 000 mg/m³

Operating software, documentation

German

English

French

Spanish

Italian

Article No.

7MB2357-

0 -

Cannot be combined

0

A

N

P

F

G

H

U

V

W

0

1

8

3

A

N

P

F

G

H

U

V

W

0

1

2

3

4

Selection and ordering data

Additional versions

Add "-Z" to Article No. and specify Order code

Add-on electronics with 8 digital inputs/outputs, PROFIBUS PA interface

Add-on electronics with 8 digital inputs/outputs, PROFIBUS DP interface

Telescopic rails (2 units)

IEC plug, 37-pin sub-D connector, 9-pin sub-D connector

O₂ Paramagnetic, qualification test EN 15267, IR measuring range in mg/m³

O₂ Electrochemical, qualification test EN 15267, IR measuring range in mg/m³

Without O₂, qualification test EN 15267, IR measuring range in mg/m³

SO₂ with measuring range 0 ... 400/7000 mg/m³

Order code

A12

A13

A31

A33

T13

T23

T33

Y15

Continuous Gas Analyzers, extractive ULTRAMAT 23

19" rack unit and portable version

TÜV, 1 and 2-component analyzer

(only in conjunction with order code T13/T23/T33)

Component Measuring range identification	CO (TÜV)		SO ₂ (TÜV)		NO (TÜV)	
	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/m ³	2 000 mg/m ³	200 mg/m ³	1 000 mg/m ³
G	200 mg/m ³	1 250 mg/m ³	500 mg/m ³	2 500 mg/m ³	250 mg/m ³	1 250 mg/m ³
H			1 400 mg/m ³	7 000 mg/m ³		

Ordering example

ULTRAMAT 23, TÜV

IR component: CO

Measuring range: 0 to 200 / 1 250 mg/m³

with electrochem. O₂ sensor

230 V AC; German

7MB2355-0AG10-3AA0-Z +T23

TÜV, 3-component analyzer

(only in conjunction with order code T13/T23/T33)

Component Measuring range identification	CO (TÜV)		SO ₂ (TÜV)		NO (TÜV)	
	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/m ³	2 000 mg/m ³		
G			500 mg/m ³	2 500 mg/m ³		
H			1 400 mg/m ³	7 000 mg/m ³		

Ordering example

ULTRAMAT 23, TÜV

IR component: CO/NO + SO₂

Measuring range: CO: 0 to 250 / 1 250 mg/m³, NO: 0 to 400 / 2 000 mg/m³, SO₂: 0 to 400 / 2 000 mg/m³

with paramagnetic oxygen measuring cell

230 V AC; German

7MB2358-0AK80-3NF0-Z +T13

Ordering notes

Special selection rules must be observed when measuring some components.

Measured component N₂O

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

- Measuring range 0 to 100 / 500 vpm (MB designation "E")
- Can only be used to measure N₂O 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 CO₂ for correction of cross-interference

7MB2337-*CP*0-*SY* or

7MB2338-*DC*0-*SY* (including NO measurement)

7MB2337 and 7MB2338

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

7MB2337-4**80-**** - Z + C11

7MB2337-5**80-**** - Z + C11

7MB2338-4**80-**** - Z + C11

7MB2338-5**80-**** - Z + C11

Measured component SF₆

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 SF₆ in inert gases

Calibration interval ((MCERTS versions 7MB2335, 7MB2337, 7MB2338))

Component	Smallest measuring range	Calibration interval	Remarks	Z suffix
CO	0 ... 150 mg/m ³	5 months	IED 2010/75/EC	E50
CO	0 ... 250 mg/m ³	12 months	IED 2010/75/EC	
NO	0 ... 100 mg/m ³	5 months	IED 2010/75/EC	
NO	0 ... 250 mg/m ³	12 months	IED 2010/75/EC	
SO ₂	0 ... 400 mg/m ³	12 months	IED 2010/75/EC	
N ₂ O	0 ... 500 vpm		Kyoto protocol	
N ₂ O	0 ... 50 mg/m ³	6 months	IED 2010/75/EC	

Calibration interval (TÜV versions 7MB2355, 7MB2357, 7MB2358)

Component	Smallest measuring range	Calibration interval	Remarks	Z suffix
CO	0 ... 200 mg/m ³	1 month	13th/27th BlmSchV	T13/T23/T33
NO	0 ... 150 mg/m ³	1 month	13th/27th BlmSchV	T13/T23/T33
SO ₂	0 ... 400 mg/m ³	1 month	13th/27th BlmSchV	T13/T23/T33

	AUTOCAL (ambient air)		AUTOCAL (inert gas e.g. N ₂)		Calibration with calibration gas		Comment (keep to technical specs)
	Zero point	Calibration point	Zero point	Calibration point	Zero point	Calibration point	
	Hours				Weeks		
IR components	3 ... 24		3 ... 24		o	52	
O ₂ - electrical chemical sensor	Stable	3 ... 24	Stable	-	52	o	
O ₂ paramagnetic Cell	-	3 ... 24	x	x	1	o	at MB < 5 %
	-	3 ... 24	x	x	8	o	at MB > 5 %
O ₂ paramagnetic Cell	x	x	3 ... 24	-	o	52	at MB < 5 %
	x	x	3 ... 24	-	o	52	at MB > 5 %
H ₂ S sensor	3	-	3	-	o	4	

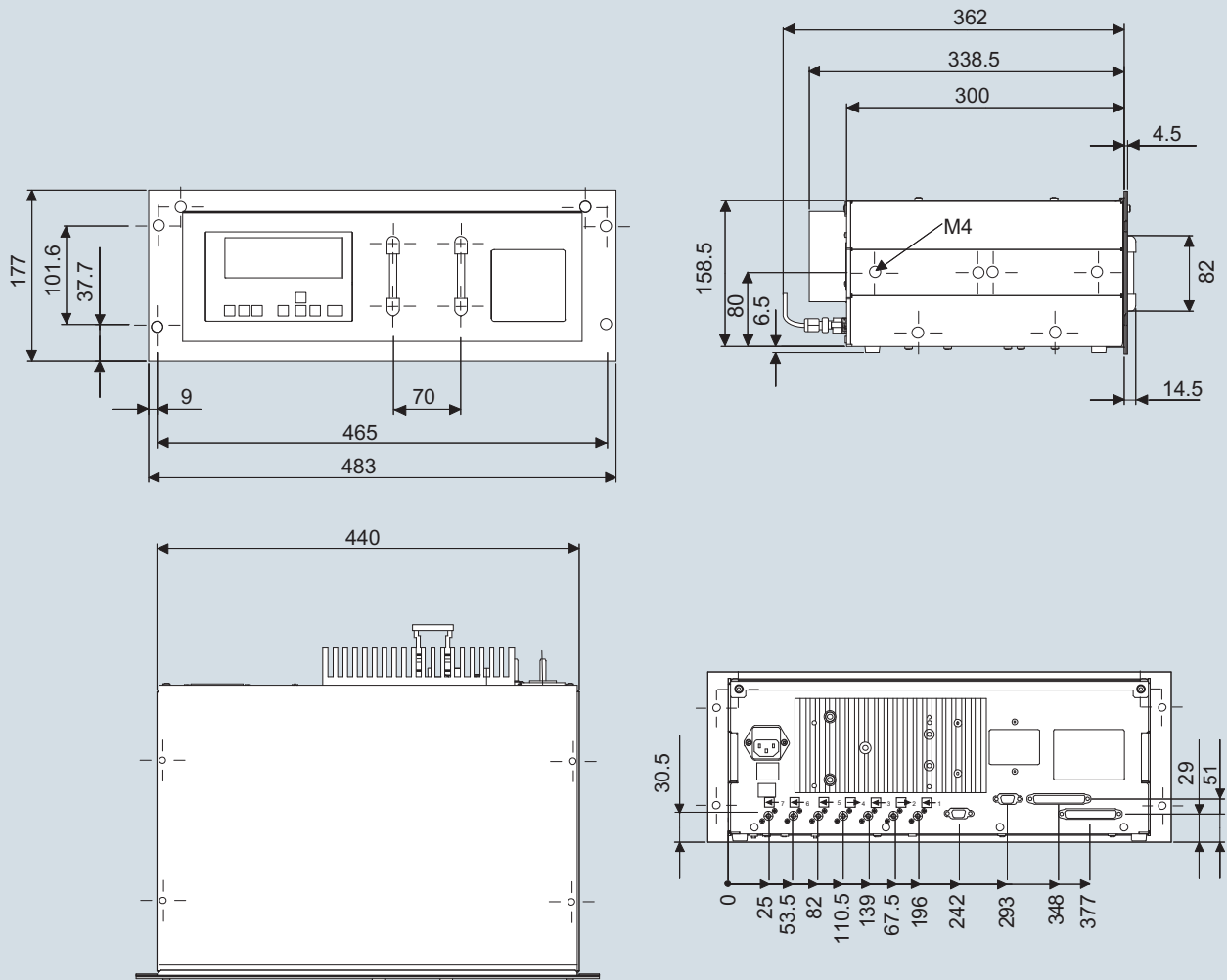
o = with AUTOCAL, x = not applicable

Calibration intervals, standard devices

Continuous Gas Analyzers, extractive ULTRAMAT 23

19" rack unit and portable version

Dimensional drawings



Gas connections: stubs diam. 6 mm or ¼"

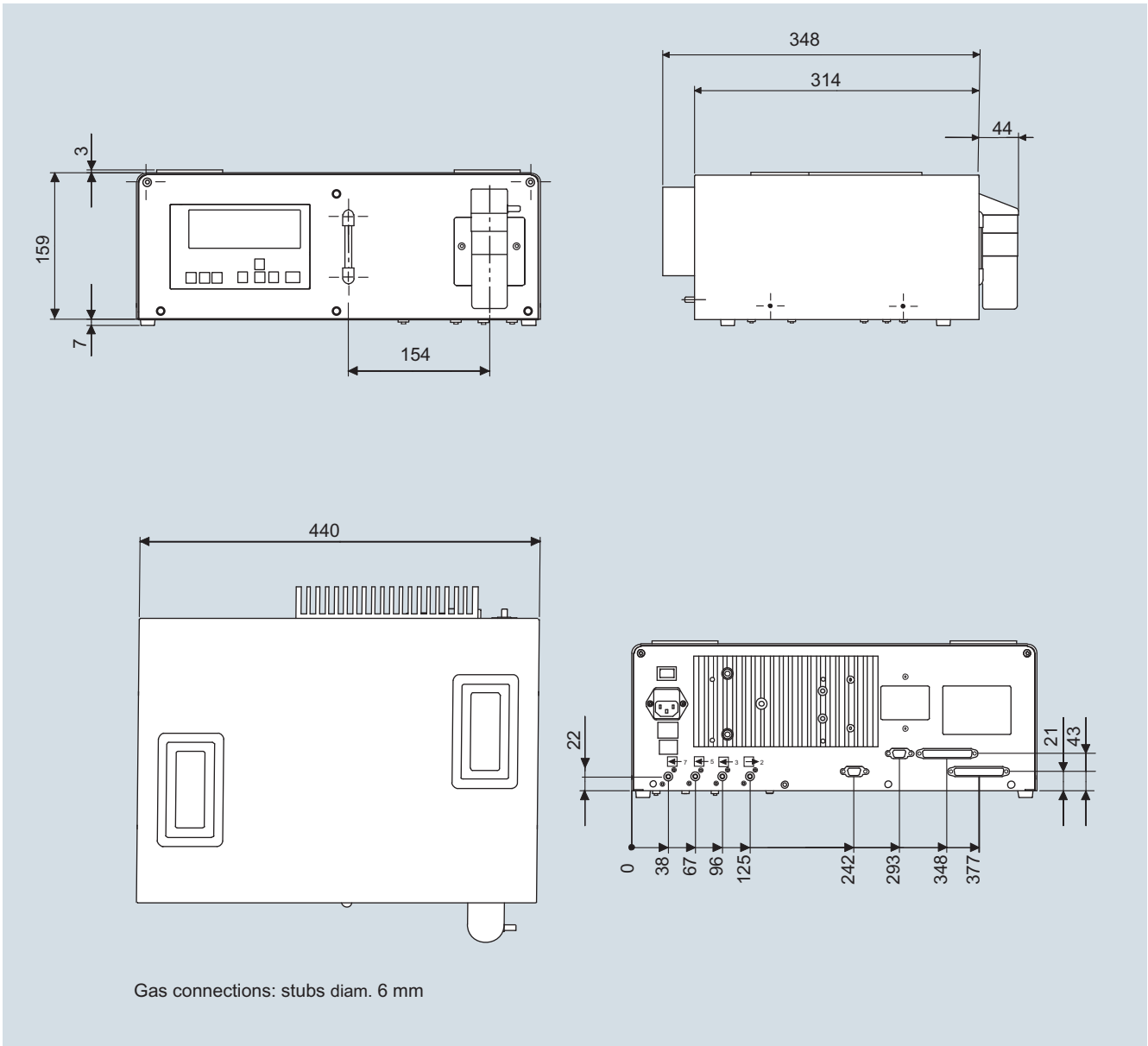
Caution: always install on supporting rails when mounted in bench-top housing or in cabinet

ULTRAMAT 23, 19" unit, dimensions in mm

Continuous Gas Analyzers, extractive ULTRAMAT 23

19" rack unit and portable version

1



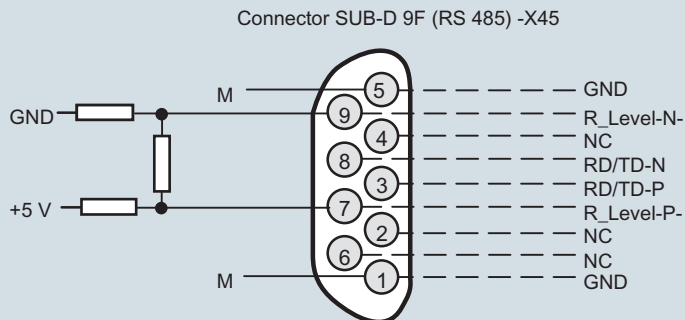
ULTRAMAT 23, desktop unit, dimensions in mm

Continuous Gas Analyzers, extractive ULTRAMAT 23

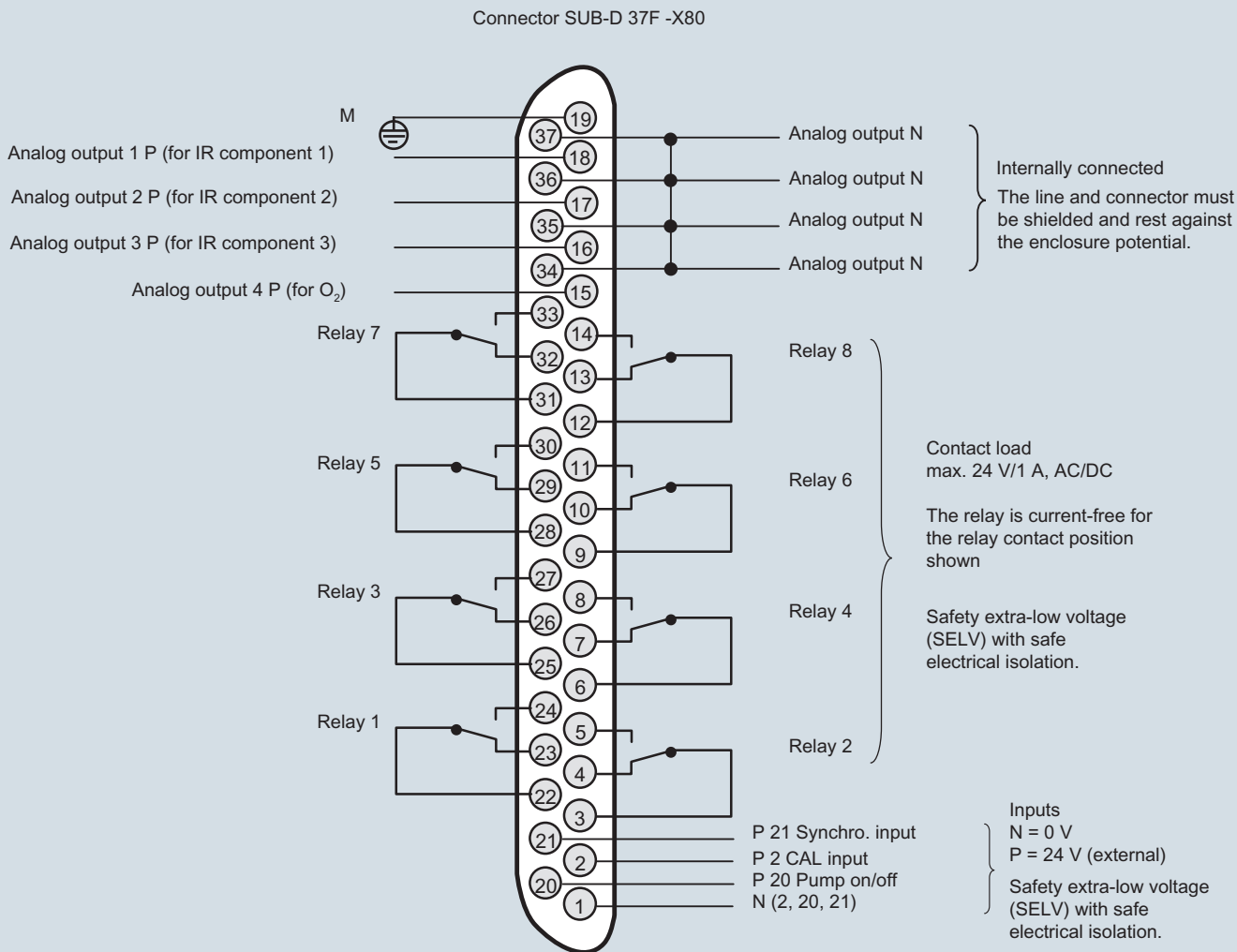
19" rack unit and portable version

Schematics

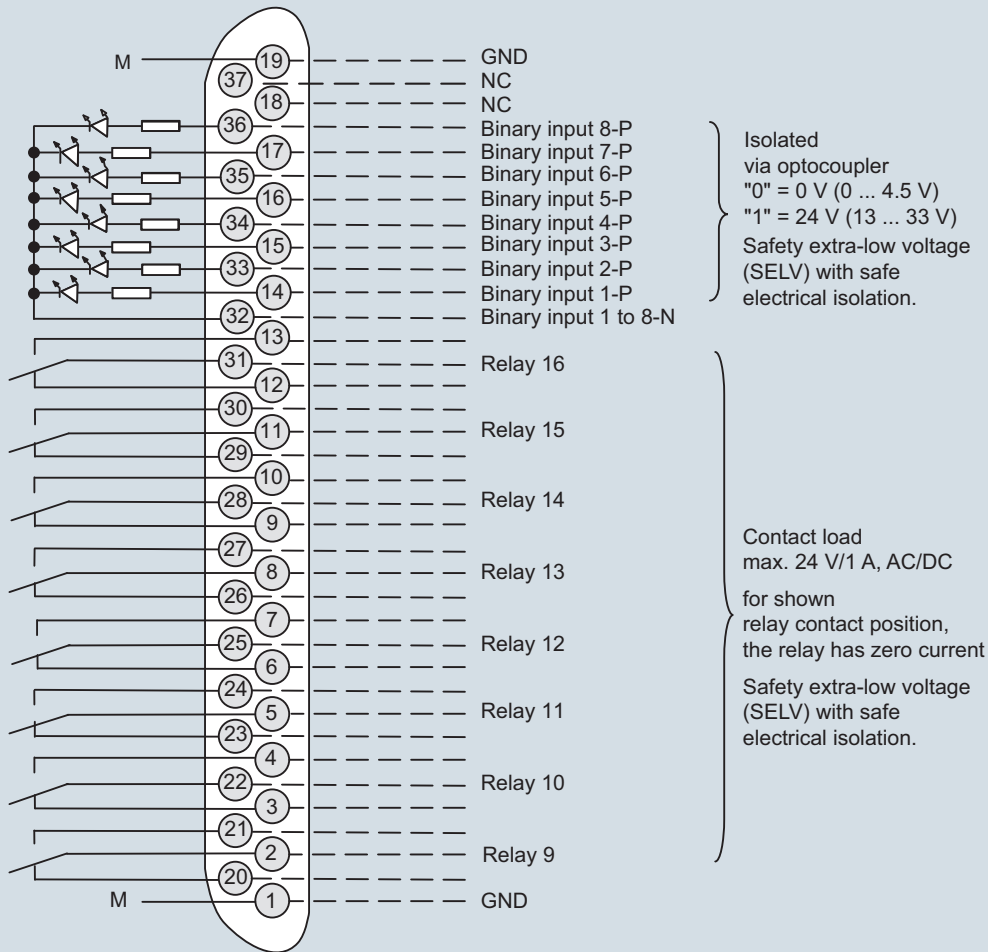
Pin assignment (electrical and gas connections)



It is possible to connect bus terminating resistors to pins 7 and 9.



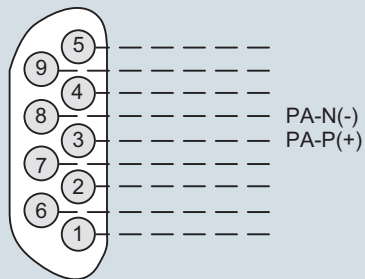
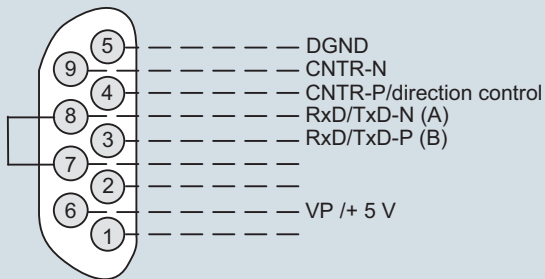
Connector SUB-D 37F (option) -X50



Connector SUB-D 9F-X90
PROFIBUS DP

optional

Connector SUB-D 9M-X90
PROFIBUS PA



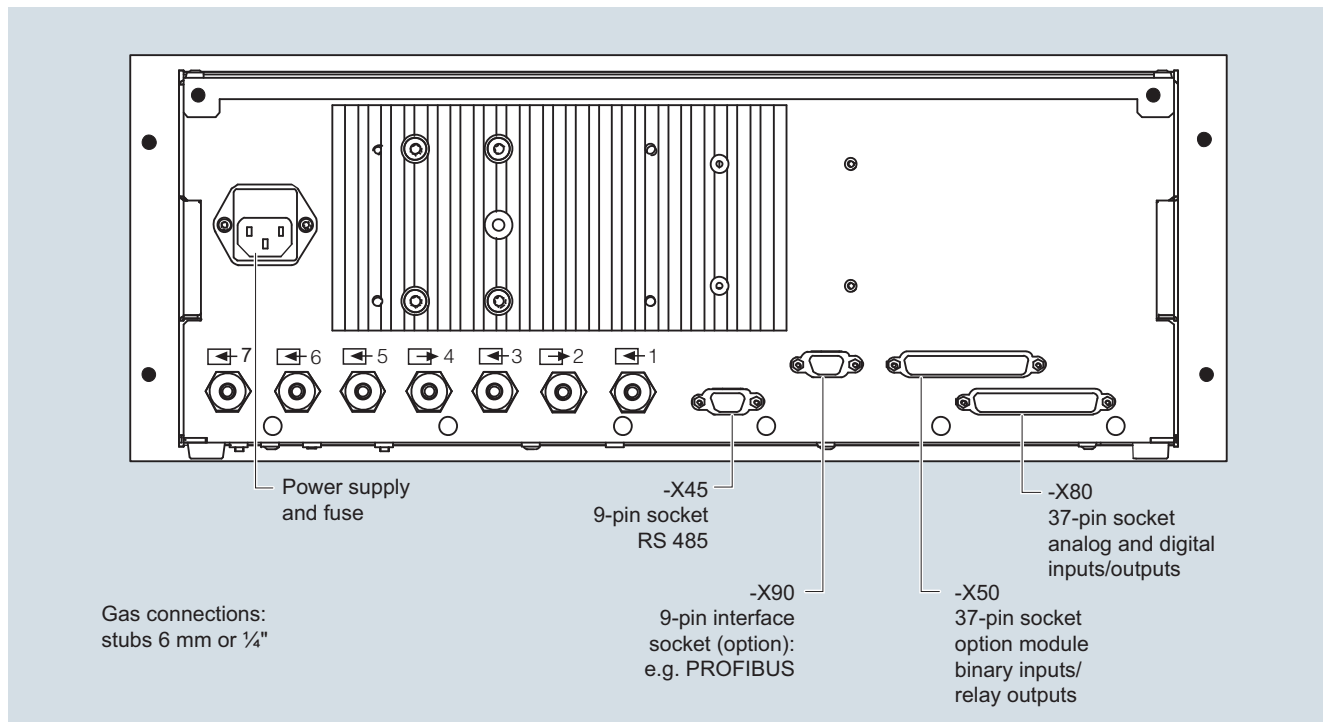
Note:
All cables to the connectors or terminal blocks must be shielded and rest against the enclosure potential.

ULTRAMAT 23, pin assignment of the optional PROFIBUS interface board

Continuous Gas Analyzers, extractive ULTRAMAT 23

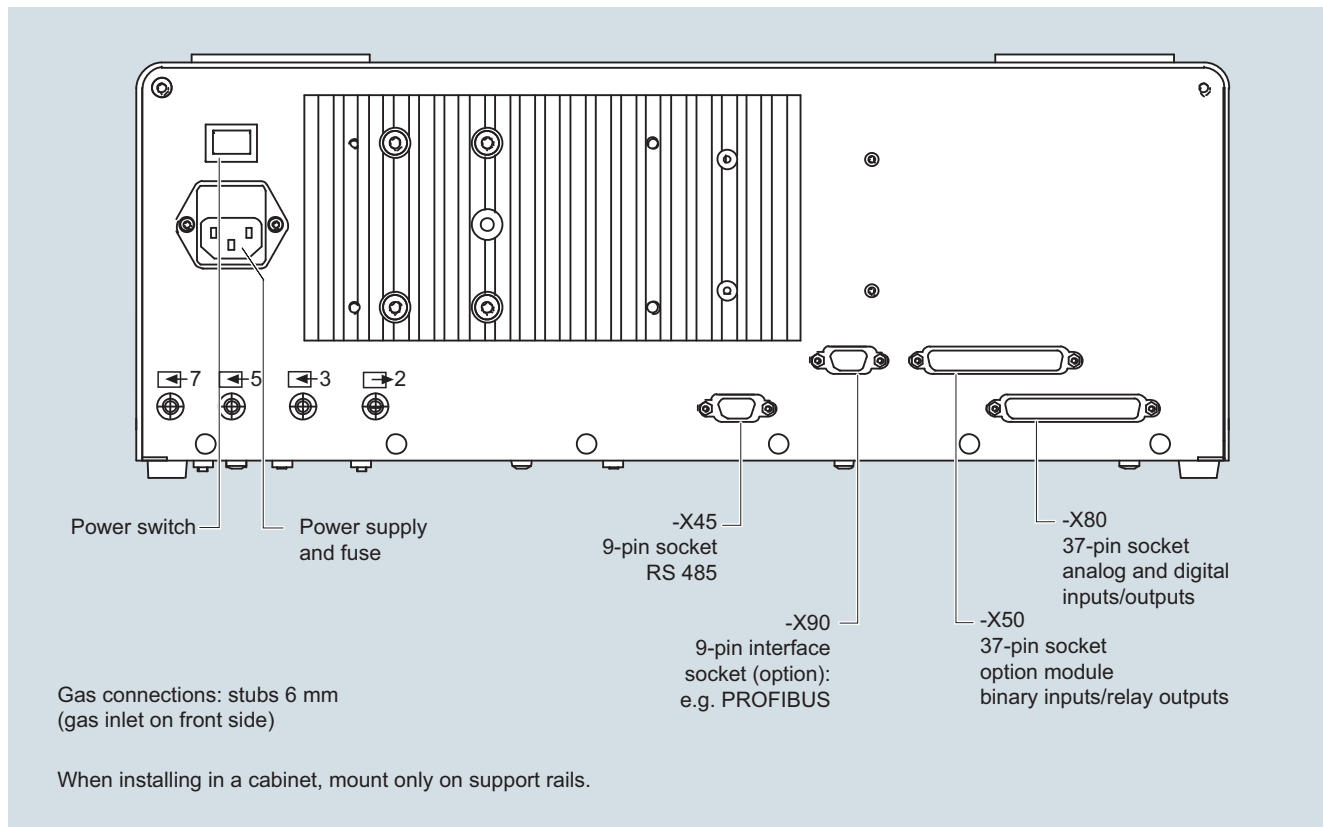
19" rack unit and portable version

19" unit



ULTRAMAT 23, 19" unit, e.g. one infrared component with oxygen measurement

Desktop unit



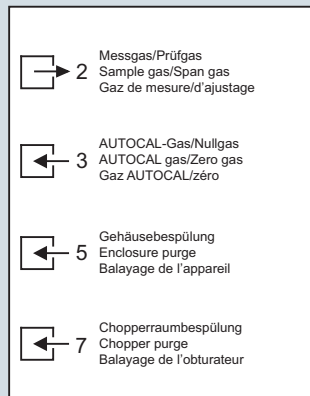
ULTRAMAT 23, portable unit, in sheet-steel housing, gas and electrical connections

Continuous Gas Analyzers, extractive

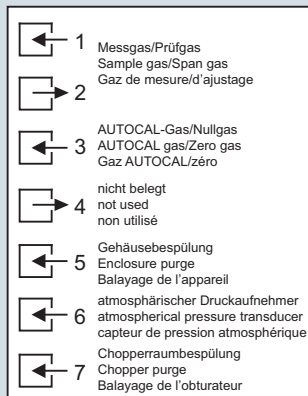
ULTRAMAT 23

19" rack unit and portable version

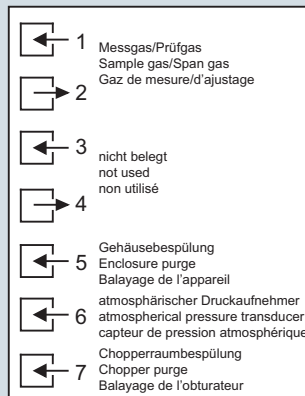
1



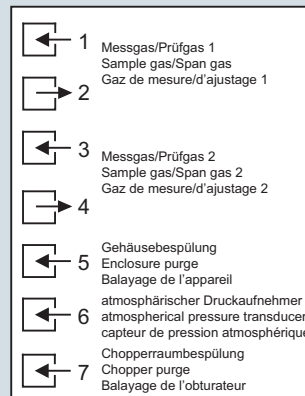
Key to symbols
 ULTRAMAT 23
 portable, in sheet-steel housing



Key to symbols
 ULTRAMAT 23
 19" rack unit
 with sample gas pump



Key to symbols
 ULTRAMAT 23
 19" rack unit
 without sample gas pump



Key to symbols
 ULTRAMAT 23
 19" rack unit
 with two separate
 gas paths or pipe version

ULTRAMAT 23, designation of the different labels

Continuous Gas Analyzers, extractive

ULTRAMAT 23

Documentation

1

Selection and ordering data

Operating instructions	Article No.
ULTRAMAT 23	
Gas analyzer for IR-absorbing gases and oxygen	
• German	C79000-B5200-C216
• English	C79000-B5276-C216
• French	C79000-B5277-C216
• Spanish	C79000-B5278-C216
• Italian	C79000-B5272-C216

Suggestions for spare parts

Selection and ordering data

Description	Quantity for 2 years	Quantity for 5 years	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 (7MB2335-...)	1	1	C79451-A3468-B515
• With motor, for 2 IR channels (7MB2337-..., 7MB2338-...)	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
Connector 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 unit, in sheet steel enclosure)	1	2	C79451-A3008-B43
Filter (for portable unit, 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