



Gas analyzer for measurement of IR-absorbing gases and oxygen

BA 5000

Installation and Operation Instructions

Original instructions





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Read this instruction carefully prior to installation and/or use. Pay attention particularly to all advises and safety instructions to prevent injuries. Bühler Technologies can not be held responsible for misusing the product or unreliable function due to unauthorised modifications.

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1 Introduction

1.1 Intended Use

Proper use within the context of this manual, means that the product may be used only for the applications described in the catalog or the technical description, and only in combination with the equipment, components and devices of other manufacturers recommended or permitted by us. The product described in this manual has been developed manufactured, tested and documented in compliance with relevant safety standards. When the handling rules described for the configuration, installation, proper operation and maintenance, as well as the safety guidelines are adhered to, therefore, there is normally no risk to the health of persons or in respect to damage to property. This device was designed to ensure safe isolation of the primary and secondary circuits. Low voltages that are connected must therefore also be generated with safe isolation.

WARNING



Dangerous contact voltage

After removing the housing or protection against direct contact or after opening the system cabinet, certain parts of this device/system will be exposed that can carry hazardous voltage. Therefore, only appropriately qualified persons are permitted to perform work within this device. These persons must be thoroughly familiar with all sources of danger and service activities in accordance with these operating instructions.

NOTICE



Observe the environmental conditions for the rack unit and bench-top unit

Ensure compliance with the environmental conditions listed in the technical specifications

- During operation
- In the event of maintenance

NOTICE



Environmental conditions for bench-top unit in accordance with IEC 61010-1-2010

According to IEC 61010-1-2010, the bench-top unit may only be used indoors.

1.2 Product versions

The BA 5000 gas analyzer is suitable for a wide variety of measurements and is therefore available in different versions. The data on the label, among others, indicates which device version you have.

1. Data matrix code
2. CE conformity symbol
3. Name and address of manufacturer
4. Designation of origin
5. Measuring range(s)
6. Serial number
7. Order No. (MLFB number) of the device
8. Device name

1.3 General information

This device left the factory in a safe and proper condition and has been tested. In order to maintain this condition and to ensure safe operation, it should only be used in the manner described by the manufacturer. Furthermore, proper transportation, storage, installation, operation and maintenance of the device are vital for ensuring correct and safe operation.

This manual contains the information required for the intended use of the described product.

It is addressed to technically qualified personnel who are specially trained or who have the relevant knowledge of automation technology (measuring and control systems).

Knowledge and technically correct implementation of the safety notes and warnings contained in this manual are required for safe installation and commissioning, as well as for safety during the operation and maintenance of the described product. Only qualified personnel have the required professional knowledge for correctly interpreting the generally valid safety notes and warnings in this manual in each specific case and to act accordingly.

This manual is an inherent part of the scope of delivery, despite the fact that it can be ordered separately for logistic reasons.

Due to the variety of technical details, it is not possible to consider every single detail for all versions of the described product and for every conceivable case in the set-up, operation, maintenance and use in systems. For further information, or in the case of problems which are not covered in enough detail in this document, please request the required information from your local or responsible regional office.

NOTICE



In particular, before using the device for new research and development applications, we recommend that you first contact us to discuss the application in question.

2 Safety instructions

2.1 Important notices

Operation of the device is only valid if:

- the product is used under the conditions described in the installation- and operation instruction, the intended application according to the type plate and the intended use. In case of unauthorized modifications done by the user Bühler Technologies GmbH can not be held responsible for any damage,
- when complying with the specifications and markings on the nameplates.
- the performance limits given in the datasheets and in the installation- and operation instruction are obeyed,
- monitoring devices and safety devices are installed properly,
- service and repair is carried out by Bühler Technologies GmbH,
- only original spare parts are used.

This manual is part of the equipment. The manufacturer keeps the right to modify specifications without advanced notice. Keep this manual for later use.

Signal words for warnings

DANGER	Signal word for an imminent danger with high risk, resulting in severe injuries or death if not avoided.
WARNING	Signal word for a hazardous situation with medium risk, possibly resulting in severe injuries or death if not avoided.
CAUTION	Signal word for a hazardous situation with low risk, resulting in damaged to the device or the property or minor or medium injuries if not avoided.
NOTICE	Signal word for important information to the product.

Warning signs

These instructions use the following warning signs:

	Warns of a general hazard		Unplug from mains
	Voltage warning		Wear respiratory equipment
	Warns not to inhale toxic gasses		Wear a safety mask
	Warns of corrosive liquids		Wear gloves
	General information		

2.2 General hazard warnings

The equipment must be installed by a professional familiar with the safety requirements and risks.

Be sure to observe the safety regulations and generally applicable rules of technology relevant for the installation site. Prevent malfunctions and avoid personal injuries and property damage.

The operator of the system must ensure:

- Safety notices and operating instructions are available and observed,
- The respective national accident prevention regulations are observed,
- The permissible data and operational conditions are maintained,
- Safety guards are used and mandatory maintenance is performed,
- Legal regulations are observed during disposal,
- compliance with national installation regulations.

DANGER

Toxic, corrosive gases



The measuring gas led through the equipment can be hazardous when breathing or touching it.

- a) Check tightness of the measuring system before putting it into operation.
- b) Take care that harmful gases are exhausted to a safe place.
- c) Before maintenance turn off the gas supply and make sure that it cannot be turned on unintentionally.
- d) Protect yourself during maintenance against toxic / corrosive gases. Use suitable protective equipment.



DANGER

Electrical voltage



Electrocution hazard.

- a) Disconnect the device from power supply.
- b) Make sure that the equipment cannot be reconnected to mains unintentionally.
- c) The device must be opened by trained staff only.
- d) Regard correct mains voltage.



DANGER

Danger to life from oxygen deficiency



Oxygen is vital to humans. The breathable air should contain over 17 Vol.% oxygen. Significantly lower concentrations will sooner or later result in death from suffocation. System users and operators must ensure personal protection measures are taken in accordance with legal requirements if the oxygen concentration is too low.

CAUTION

Damage to the unit



The sensor on the oxygen measurement system contains zirconium dioxide and platinum and contaminants/catalyst poisons will destroy it (see chapter contaminants). These therefore must not be present in the gas mixture being measured!

WARNING

Improper use



A device in the standard version must never be used in hazardous areas. Explosive gas mixtures (e.g. flammable gases together with air or oxygen in a potentially explosive ratio) must not be measured with this analyzer.

2.3 Analyzers in biogas plants

DANGER

Danger of poisoning



This device is designed to measure hydrogen sulfide and dihydrogen sulfide, H₂S! Hydrogen sulfide is highly toxic even in small concentrations! The odor threshold for hydrogen sulfide is very low at 0.02 vpm (20 vpb), but higher concentrations result in numbing of the olfactory receptors in the nose so that the odor is no longer perceived. Persons exposed to this gas in concentrations up to 100 vpm for several hours exhibit symptoms of poisoning such as fatigue, headaches, lack of appetite, lack of concentration, irritation of the mucous membranes of eyes and respiratory tract, and throat irritations.

Inhalation of H₂S concentrations of 500 vpm longer than 30 minutes can cause fatal poisoning. Concentrations above 1 000 vpm cause death within a few minutes, concentrations above 5 000 vpm cause death within a few seconds!

When using this device in plant where there may be high concentrations of H₂S and you therefore need to take following continual precautions to prevent the effects of poisoning:

- Connect the gas outlet of the analyzer to a gas exhaust unit so that no gas can escape into the environment!
- Before you begin maintenance on the analyzer, make sure that the H₂S concentration in the analyzer is close to 0 vpm. Before beginning work, always flush the gas path of the analyzer and the gas sampler with ambient air or nitrogen for a duration of about 10 minutes .
- Check for leaks in the analyzer at regular intervals!

DANGER

Danger of explosion



This device is used in biogas plants, among other places. When it is used in biogas plants, you should expect that the sample gas will contain methane, which forms explosive mixtures with oxygen or air in certain concentrations. These conditions are possible with certain operating states of the plant.

2.4 Analyzers in hazardous areas

WARNING

Unsuitable device for the hazardous area



Danger of explosion

Only use equipment that is approved for use in the intended hazardous area and labelled accordingly.

3 Transport and storage

Transport

The unit is sensitive to shock and vibration. Therefore, where possible, transport in the original packaging or large, sturdy packaging at a minimum consisting of 3 layer carton, plastic or aluminium sheet. Line the inside of the packaging with padding at least 10 cm thick on all sides.

The unit should be marked fragile for shipping.

Storage

During extended periods of non-use, protect the analyzer against moisture and heat.

Store the unit in a dry, ventilated, dust-free room. Cover the unit with suitable packaging to protect it from liquids and dirt

4 Installation and connection

4.1 Description

4.1.1 Area of application

Overview

Up to 4 gas components can be measured continuously and simultaneously with the BA 5000 gas analyzer. The device can be equipped with the following sensors:

- IR detector for IR-active gases
- UV photometer for UV-active gases
- H₂S sensor (electrochemical)
- O₂ sensor (electrochemical)
- O₂ sensor (paramagnetic)



Fig. 1: Figure 1: Front view of BA 5000 for measurement of CO, NO, and O₂ (example of rack unit)

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
- Monitoring of ship emissions
- Atmosphere monitoring during heat treatment of steel

Areas of application with hydrogen sulfide sensor:

- 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
- Sewage plants
- Drinking water treatment

Areas of application with paramagnetic oxygen sensor

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

Further applications:

- Environmental protection
- Chemical plants
- Cement industry

Special versions

- The BA 5000 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.
- Only IR components are available for 19" rack units with piped gas paths.
- H₂S sensors and O₂ sensors are available for bench-top units.
- The BA 5000 gas analyzer can be used in emission measuring systems and for process and safety monitoring.
- For measurement of CO, NO, SO₂ and O₂ according to 13th BImSchV and TA Luft, TÜV- approved versions of the BA 5000 are available.
- The analyzers of the BA2355, BA2357 and BA2358 series are suitability-tested in accordance with EN 15267 (emission measurements).
- Version with faster response time: There is no connection between the two condensation traps, so that the complete sample gas flow passes through the detector (only 1/3 of the flow in the normal version of the analyzers), i.e. the response time is 2/3 faster. The functions of all other components remain unchanged.
- Version with IR detector with chopper compartment purging: This version consumes approx. 100 ml/min of purging gas; you must set an inlet pressure of 300 kPa (3 bar).
- Version with specially cleaned gas path: This version is intended for applications requiring 'Cleaned for O₂ service'.
- Version with UV photometer for small SO₂ measuring ranges and NO₂ measurements.

Benefits

- AUTOCAL can be carried out with ambient air (dependent on the measured component) and is therefore highly cost effective because calibration gases and accessories are not required
- High selectivity thanks to multi-layer IR detectors, low cross-sensitivity to water vapor
- Sample chambers can be cleaned (dependent on the version), resulting in cost savings through reuse following contamination
- Menu-assisted operation in plain text, thus high operational safety
- Service information and logbook, cost savings through preventive maintenance and help for service and maintenance personnel
- Increased safety through coded operator levels, thus protection against unauthorized access or clumsy working
- Open interface architecture (ELAN (RS485), PROFIBUS-DP/PA), thus simplified process integration
- Communication software. SIMATIC PDM and SIPROM GA.
- Remote operation and control (via SIPROM GA and PROFIBUS)

Special benefits when used in biogas plants

- Continuous measurement of all 4 important components, including H₂S
- Long service life of the H₂S sensor even at increased concentrations; no diluting or backflushing necessary

4.1.2 Design



Fig. 2: Design of the BA 5000 as 19" rack unit

1. Available as bench-top or rack unit.
2. 80-digit display panel (4 lines with 20 characters each).
3. Dust-tight and washable membrane keyboard.
4. Flowmeter for monitoring the sample gas flow.
5. Gas and electrical connections at the rear.
6. O₂ sensor (option) can be removed from the front after taking off the cover.
7. Control and function keys for operation.

The BA 5000 is also available as a bench-top unit. This version differs from the rack unit shown here as follows:

- Closed housing without mounting frame.
- 2 handles on the sides.
- 4 rubber feet for setting up.
- The bench-top unit is not available with Ex approval.

Enclosure

- Bench-top unit or
- 19" rack unit with 4 HU for installation in
 - Hinged frame
 - Cabinets
- Flow indicator for sample gas on front plate (not with piped gas paths).
- Integrated sample gas pump with bench-top unit, available as option for rack unit (not with piped gas paths).
- Gas connections for sample gas inlet and outlet as well as zero gas possible with pipe diameter 6 mm or ¼".
- Gas and electrical connections at the rear.

Display and operator panel

- Operation based on NAMUR recommendation.
- Simple, fast parameterization and commissioning of analyzer.
- Large backlit LCD for measured values.
- Menu-prompted input functions for parameterization, configuration, test functions, calibration.
- Washable membrane keyboard. User help in plain text.
- User software available in 6 languages.

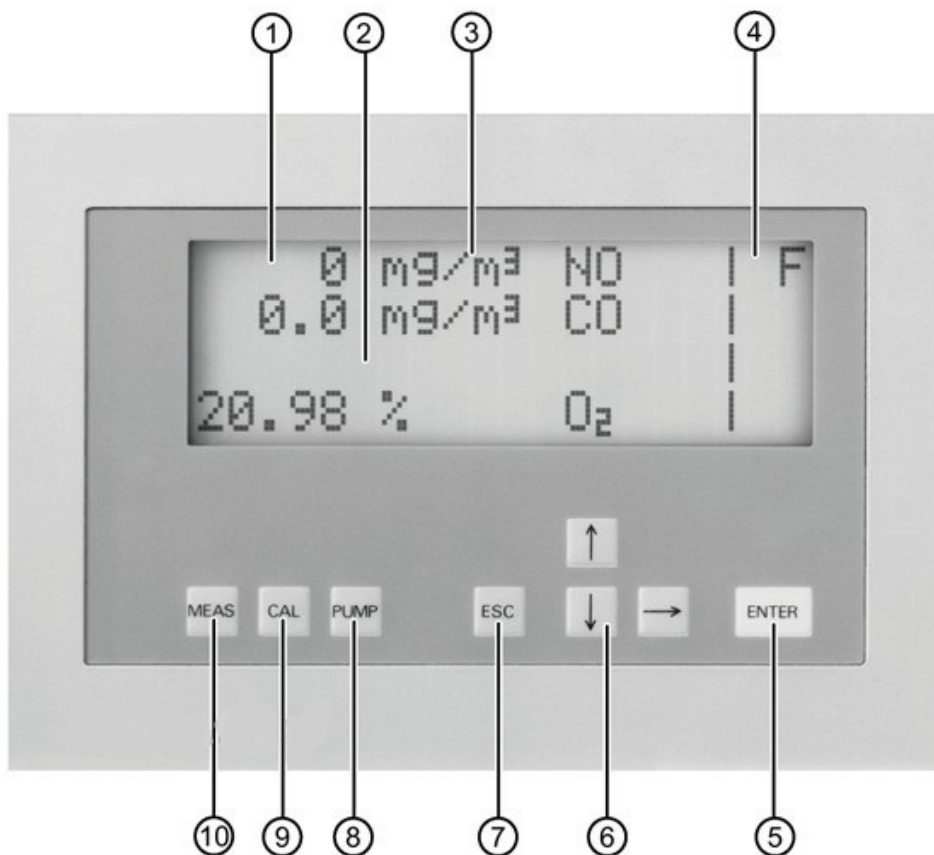


Fig. 3: Operator panel of the BA 5000

1. One line per component for measured value, dimension and ID.
2. LED-backlit display; contrast adjustable using menu.
3. Freely-selectable dimension (ppm, vpm, mg/m³, %).
4. Two columns are reserved for status displays.
5. ENTER key for calling the main menu or saving the input values.
6. $\uparrow\downarrow\rightarrow$ keys for menu control and for incrementing/decrementing numerical values.
7. Scrolling back in menu or cancellation of an input.
8. Switching on and off of internal pump, pumping capacity adjustable using menu.
9. Key for starting AUTOCAL.
10. Immediate return to measuring mode

NOTICE

Energy saving



The display brightness is reduced after approx. 30 minutes without an operation. This serves for energy saving and has no influence on the other properties of the device. The display becomes bright again when you continue with operation.

Inputs and outputs

- Three binary inputs for switching the sample gas pump on and off, triggering of AUTOCAL, and synchronization of several devices.
- Eight freely-configurable relay outputs for faults, maintenance requests, maintenance switches, limits, measuring range identifications, and external solenoid valves.
- Analog outputs for each component electrically isolated from analyzer ground.
- Optional: 8 additional relay outputs.
- Optional: 8 additional binary inputs.

Communication

ELAN (RS485) present in basic unit.

Options:

- RS485/USB converter
- RS485/RS232 converter
- RS485/Ethernet converter
- Incorporation in networks via PROFIBUS DP/PA interface (via option board)
- SIPROM GA software as servicing and maintenance tool

4.1.3 Function

Several independent measuring principles which work selectively may be present in the BA 5000. These are described below.

Infrared measurement

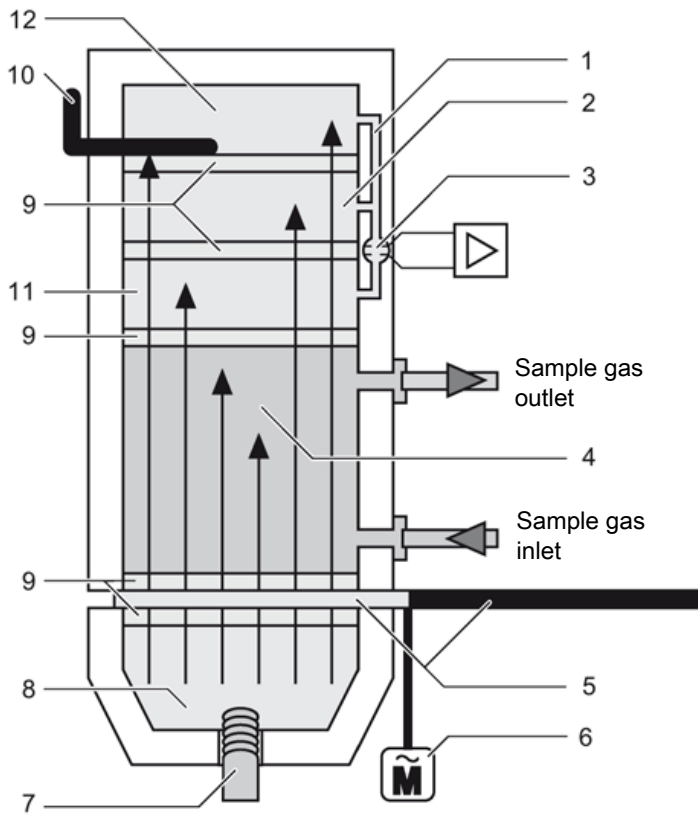


Fig. 4: Operating principle of infrared measurement

1. Capillary
2. Second detector layer
3. Microflow sensor
4. Analyzer chamber
5. Chopper wheel
6. Synchronous motor
7. IR source
8. Reflector
9. Window
10. Slide
11. First detector layer
12. Third detector layer

This measuring principle 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 (1111 °F) emits infrared radiation, which is then modulated by a chopper (5) at 8 1/3 Hz. The infrared radiation passes through the analyzer 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 (detector) - 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 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 (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 (248 °F), which, along with two supplementary resistors, form a Wheatstone bridge. The pulsating flow together with the dense arrangement of the nickel grids causes a change in resistance. This leads to an offset in the bridge which is proportional to the concentration of sample gas.

NOTICE

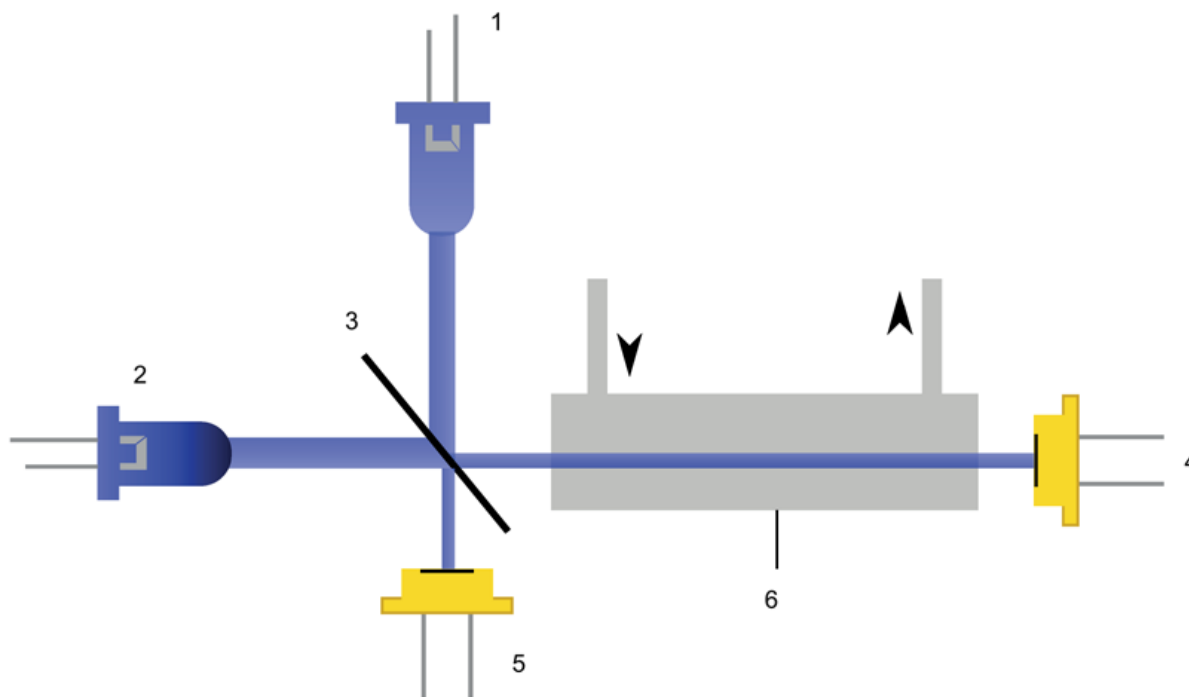


Contamination of the analyzer chambers

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

Furthermore, the ambient air of the sensor must not have large concentrations of the components to be measured.

Ultraviolet measurement



1. SO₂ LED
2. NO₂ LED
3. Beam splitter
4. Measuring channel photodiode
5. Reference channel photodiode
6. Sample chamber

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 AlGaIn or InGaIn 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 (2), which generates two identically sized ray bundles (measuring and reference radiation). The measuring ray bundle passes through the sample chamber (3), into which 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 sample gas is flowing (measuring signal). Likewise, the reference radiation is recorded by a second photodiode (5, reference signal). The ratio of measuring 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 for measuring a second gas component. In this way, the absorption of sulfur dioxide (SO₂) and nitrogen dioxide (NO₂) 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.

For stabilization of the measurement procedure, the measurement of the two gas concentrations using the reference signal is supplemented by a thermostatic control of the overall optical setup.

NOTICE



Falsification of measuring results

The signal strength of the measuring channel and reference channel must be recorded with zero gas (ambient air) before the measurements. This zero gas measurement can be repeated in the specified cycle to compensate for measurement drift (AUTOCAL function).

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 1013 hPa absolute, sample gas flow of 1.2 l/min and an ambient temperature of 25 °C (77 °F).

The sample gases must be fed to the analyzer module in dust-free and aerosol-free condition because any particles present in the sample gas will scatter the UV radiation, resulting in increased concentration values. Therefore, the use of gas modified for the measuring task is necessary in most application cases.

Due to the open design of the photometer, the ambient air of the analyzer should be largely free of the gas component to be measured.

Also to be avoided are pressure differences between the ambient air and the sample gas in the analyzer chamber, for example, due to direct discharge of the sample gas to the atmosphere.

Electrochemical oxygen measurement

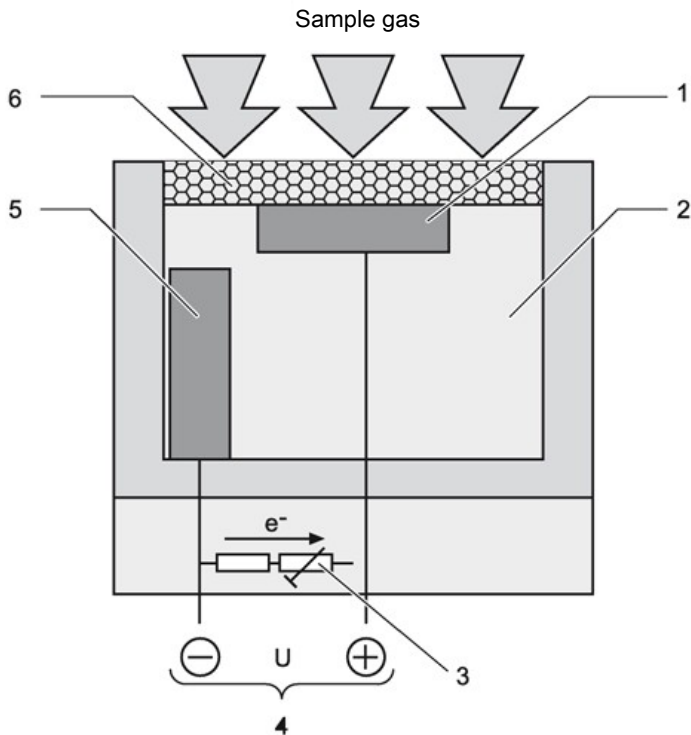


Fig. 5: Operating principle of the electrochemical O_2 sensor

1. Gold cathode
2. Electrolyte (acetic acid)
3. Thermistor and load resistor for temperature compensation
4. Signal output
5. Lead anode
6. Oxygen diffusion membrane made of FEP

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

Paramagnetic oxygen measurement

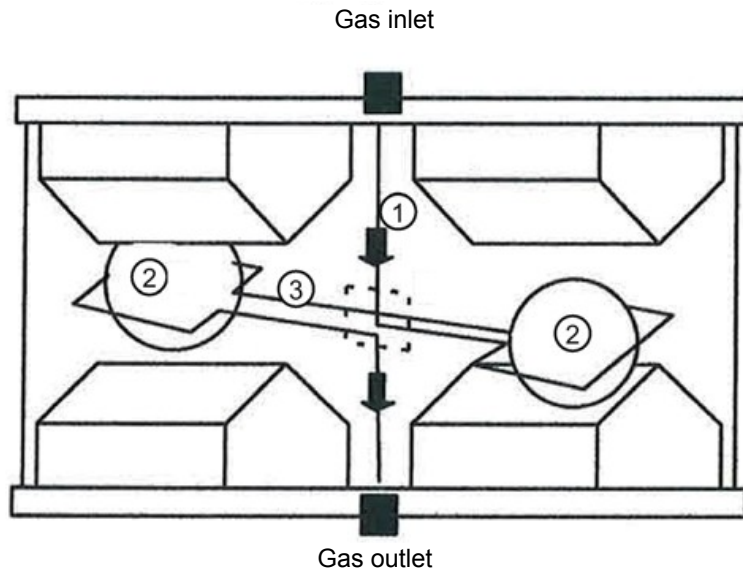


Fig. 6: Operating principle of the paramagnetic O₂ sensor

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

The calibration point is calibrated using the AUTOCAL function by connecting oxygen (analogous to calibration of the electrochemical O₂ 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 all measuring ranges < 5 % or every two months in the case of all larger measuring ranges.

Electrochemical hydrogen sulfide measurement

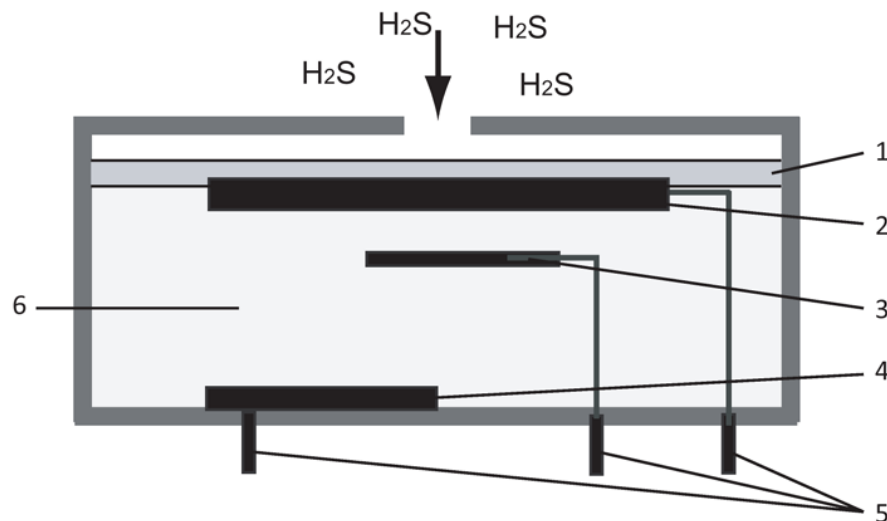


Fig. 7: Operating principle of H₂S sensor

1. Gas membrane
2. Working electrode
3. Reference electrode
4. Counter electrode
5. Terminal posts
6. Electrolyte (H₂SO₄)

The hydrogen sulfide (H_2S) enters the sensor through the diffusion barrier (gas membrane (1)) and is oxidized on the working electrode (2). The reduction of oxygen in air takes place on the counter electrode (4) as a counter reaction. The transfer of electrons can be tapped at the terminal posts (5) as a current that is directly proportional to the gas concentration.

The zero point is automatically recalibrated by the AUTOCAL function when connecting e.g. nitrogen or air.

Automatic calibration of the IR and UV components with air (AUTOCAL)

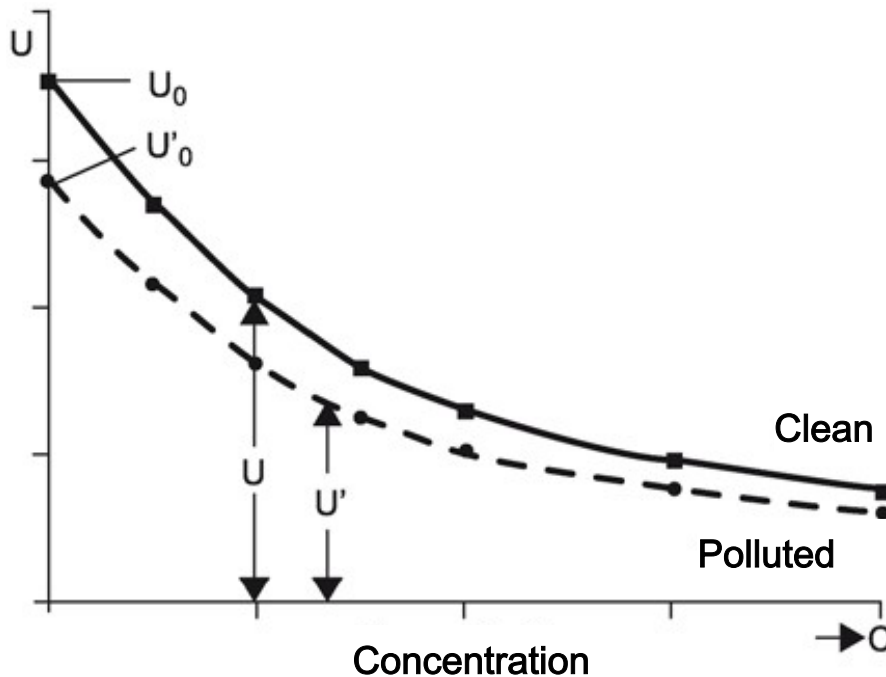


Fig. 8: Calibration

The BA 5000 can be calibrated using, for example, ambient air. During this process (can be set between 1 and 24 hours, 0 = no AUTOCAL), the analyzer chamber is purged with air by way of an internal or external 3-way valve. The detector then generates the largest signal U_0 (no pre-absorption in the analyzer chamber). This signal is used as the reference signal for zero point calibration. The signal U_0 also serves as the initial value for calculating the full-scale value.

As the concentration of the measured component increases, so too does absorption in the analyzer 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 BA 5000, the mathematical relationship between the concentration of the measured component and the measured voltage can be approximately expressed as the following exponential function:

$U = U_0 \cdot e^{-kc}$ with the following parameters:

- 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 analyzer 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 according to the currently valid value, thereby also compensating 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 within a certain tolerance range monitored by the unit. The tolerance range between two or more AUTOCAL procedures can be individually parameterized on the BA 5000 and a warning output in the event of deviations. 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 analyzer chamber being contaminated.

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-active and UV-active components is calculated mathematically from the newly determined U'0 and the device-specific parameters entered at the factory. An annual check of the calibration point with calibration gas is recommended. For details on TÜV measurements, see Table "Calibration intervals (TÜV versions)" in section AUTOHOTSPOT.

If an electrochemical O₂ 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, automatic calibration of the calibration point of the electrochemical O₂ sensor is carried out simultaneously. The characteristic of the O₂ sensor is sufficiently stable following the single-point calibration such that the zero point of the electrochemical O₂ sensor need only be checked once a year by connecting nitrogen.

4.1.4 Technical specifications

4.1.4.1 General technical data

General information

Measured components	Maximum of 4
Measuring ranges	2 per component
Characteristics	Linearized
Operator panel	LCD with LED backlighting and contrast control, 80 characters (4 lines à 20 characters); function keys
Operating position	Front panel vertical
Vibrations	
– During operation	No vibrations
– During transport	Maximum vibration 5 m/s ²
Software release of TÜV version (BA235x)	3.00.09

Enclosure

Weight	Approx. 10 kg (22 lbs.) The weight varies according to the ordered variant.
Degree of protection	IP40 in accordance with EN 60529 for the versions BA235x (TÜV) IP20 in accordance with EN 60529 for the versions BA233x (standard)

Electrical characteristics

EMC interference immunity (with safety extra-low voltage (SELV) with safe isolation)	In accordance with standard requirements of NAMUR NE21 or EN 61326-1
Auxiliary power supply	AC 100 V, +10%/-15%, 50 Hz, AC 120 V, +10%/-15%, 50 Hz, AC 200 V, +10%/-15%, 50 Hz, AC 230 V, +10%/-15%, 50 Hz, AC 100 V, +10%/-15%, 60 Hz, AC 120 V, +10%/-15%, 60 Hz, AC 230 V, +10%/-15%, 60 Hz
Power consumption	max. 60 VA depending on ordered version

Electrical inputs and outputs

Analog outputs	1 analog current output per component, 0/2/4/NAMUR ... 20 mA, floating, max. load 750 Ω
Relay outputs	8, with changeover contacts, freely selectable, e.g. for fault, loading capacity 24 V AC/DC/1 A, floating, non-sparking

Electrical characteristics

Binary inputs	<ul style="list-style-type: none"> – 3, dimensioned for 24 V, floating – Pump – AUTOCAL – Synchronization
Serial interface	ELAN (RS485), PROFIBUS-PA/DP as option
AUTOCAL function	Automatic calibration with ambient air or nitrogen (depending on measured component), adjustable cycle time from 0 (1) ... 24 hours
Options	Add-on electronics, with 8 additional digital inputs and 8 additional relay outputs, for e.g. triggering of automatic calibration, PROFIBUS PA/DP

Climatic conditions

Permissible ambient temperature	
<ul style="list-style-type: none"> – During operation – During transport and storage 	<p>See specific technical specifications for IR detector (Infrared detector/ UV photometer (Ultraviolet photometer/sensors))</p> <p>See specific technical specifications for IR detector (Infrared detector)/ UV photometer (Ultraviolet photometer/sensors))</p>
Permissible ambient humidity	< 90% RH (relative humidity) during transportation and storage (Delivery information)
Permissible ambient pressure	See specific technical specifications for IR detector (Infrared detector) / UV photometer (Ultraviolet photometer)/sensors
Maximum operating altitude	2000 m above sea level
Pollution degree	2

Gas inlet conditions

Sample gas pressure	
<ul style="list-style-type: none"> – Without pump – With pump 	<p>Unpressurized (< 1200 hPa (17.4 psi) absolute)</p> <p>Unpressurized suction mode, set in factory with 2 m (6 1/2 ft) hose at sample gas outlet; full-scale value calibration necessary under different venting conditions</p>
Sample gas flow	72 ... 120 l/h (1,2 .. 2 l/min)
Sample gas temperature	0 ... 50 °C (32 ... 122 °F)
Sample gas humidity	< 90% RH (relative humidity), non-condensing

NOTICE

Since measuring ranges can be changed, all accuracy data applies to the ranges specified on the label!

4.1.4.2 Parts in gas path wetted by sample gas

Gas path		19" rack unit	Bench-top unit
With hoses	Condensation trap at gas inlet	--	PA6 (polyamide)
	Condensation trap	--	PE (polyethylene)
	Gas connections 6 mm	PA6 (polyamide)	PA6 (polyamide)
	Gas connections ¼"	Stainless steel 1.4571	Stainless steel 1.4571
	Hose	FKM	FKM
	Pressure switch	PTFE + PA6 (polyamide)	PTFE + PA6 (polyamide)
	Flowmeter	Borosilicate glass/steel 1.4878	Borosilicate glass/steel 1.4878
	Elbows/T-pieces	PA6	PA6
	Internal pump (optional)	PVDF/PTFE/FKM/HD-PE/ stainless steel 1.4571	PVDF/PTFE/FKM/HD-PE/ stainless steel 1.4571
	Solenoid valve (optional)	FPM70/PA6/ stainless steel 1.4310/1.4305	FPM70/PA6/ stainless steel 1.4310/1.4305
	Safety condensation trap	PA66/NBR/PA6	PA66/NBR/PA6
	Analyzer chamber		
	– Body	Aluminum	Aluminum
	– Lining	Aluminum	Aluminum
– Nozzle	Stainless steel 1.4571	Stainless steel 1.4571	
– Window	CaF ₂	CaF ₂	
– Adhesive	Epoxy resin-based adhesive	Epoxy resin-based adhesive	
– O-Ring	FKM	FKM	
Piped (only possible without pump)	Gas connections 6 mm / ¼"	Stainless steel 1.4571	
	Pipes	Stainless steel 1.4571	
	Analyzer chamber		
	– Body	Aluminum	Aluminum
	– Lining	Aluminum	Aluminum
	– Nozzle	Stainless steel 1.4571	Stainless steel 1.4571
	– Window	CaF ₂	CaF ₂
	– Adhesive	Epoxy resin-based adhesive	Epoxy resin-based adhesive
	– O-Ring	FKM	FKM

4.1.4.3 Infrared detector

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 1013 ± 5 hPa absolute, a sample gas flow of 1.2 ± 0.2 l/min and an ambient temperature of 25 ± 2 °C.

General information

Measuring ranges	See ordering data
Chopper section purging	
– Inlet pressure	Approx. 3000 hPa (43.5 psi) absolute
– Purging gas consumption	Approx. 100 ml/min

Time response

Warm-up period	Approx. 30 minutes at room temperature. The measured values are invalid for the first 30 minutes following switch-on. The maximum accuracy is achieved after approx. 2 hours
Response time (T_{90} -time)	Dependent on length of analyzer chamber, sample gas feed line and parameterizable attenuation
Damping (electronic time constant)	0...99,9 s, can be set

Measuring response

Output signal noise	$< \pm 1\%$ of the current measuring range (see rating plate)
Display resolution	Depends on the selected measuring range
Output signal resolution	$< 0.1\%$ of the output signal span
Linearity error	In the largest possible measuring range: $< \pm 1\%$ of the full scale value In the smallest possible measuring range: $< 2\%$ of the full scale value
Repeatability	$\leq \pm 1\%$ of the current measuring range

Climatic conditions

Permissible ambient temperature	
– During operation	+5 ... +45 °C (41 ... 113 °F)
– During transportation and storage	-20 ... +60 °C (-4 ... 140 °F)
Permissible ambient humidity	$< 90\%$ RH (relative humidity) during transportation and storage
Permissible ambient pressure	600 ... 1200 hPa absolute
Maximum operating altitude	2000 m above sea level

Influencing variables

Drift	At an ambient temperature of 25 ± 2 °C
– With AUTOCAL	Negligible
– Without AUTOCAL	$< 2\%$ of smallest measuring range/week
-SO ₂ measuring ranges (infrared)	– Under constant ambient conditions, the drift values are kept at $< 2\%$ of the smallest measuring range/week after an equalization time of approximately 8 weeks.
Temperature	Max. 2% of the smallest possible measuring range according to rating plate per 10 K with an AUTOCAL cycle time of 6 h
Air pressure	$< 1\%$ of the measuring range per 1% pressure change
Auxiliary power supply	$< 0.1\%$ of the output signal span with a change of $\pm 10\%$
Line frequency	$\pm 2\%$ of full-scale value with a frequency variation of $\pm 5\%$

Deviations with measuring range 0 ... 200 mg/m³ SO₂ (analyzer versions BA2335-xNBxx-xAAx, BA2337-xNBxx, BA2337-xxxxx-xNBx, BA2338-xxxxx-xNBx)

Availability	max. 95%
AUTOCAL cycle time	max. 6 h
Temperature variations	Max. 1 °C (1.8 °F) The device must not be operated in an area subject to drafts. This is especially valid for the rear panel with large cooling element.
Other	This measuring range has not been suitability-tested.

NOTICE**Device series BA235x**

Maintenance intervals: Refer to the current certificates in accordance with EN 15267.

4.1.4.4 Ultraviolet photometer

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 1013 ± 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 both the sample gas component SO₂ and NO₂.

Measuring-ranges

SO ₂	
– Smallest measuring range	0 ... 50 mg/m ³
– Largest measuring range	0 ... 1250 mg/m ³
NO ₂	
– Smallest measuring range	0 ... 100 mg/m ³
– Largest measuring range	0 ... 500 mg/m ³

The measuring ranges are calibrated with a certified calibration gas, in which case 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 1013 hPa.

Time response

Warm-up period	30 min, the technical specification will be met after 2 hours
Response time (T ₉₀ time)	Dependent on the external gas preparation, the length of the sample gas feed line and the configurable damping (see below) of the analyzer Note: SO ₂ is highly soluble in water! ≤ 30 s after sample gas input at a damping of ≤ 12 s
Damping (electronic time constant)	0 ... 99,9 s, can be set

Messverhalten

Output signal fluctuation	≤ 1% of set full-scale value
– Detection limit	1% of set full-scale value or
– SO ₂	1 mg/m ³
– NO ₂	0,8 mg/m ³
	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

Climatic conditions

– Permissible ambient temperature	
– During operation	+15 ... +35 °C (59 ... 95 °F)
– During transportation and storage	-20 ... +60 °C (-4 ... 140 °F)
Permissible ambient humidity	< 90 % RH (relative humidity) during transportation and storage
Permissible ambient pressure	600 ... 1200 hPa

Influencing variables

Temperature error	≤ 4 % of smallest full-scale value/10 K in ambient temperature range of 15 °C ... 35 °C
Air pressure	≤ 1 % of set full-scale value per 1% pressure change
Auxiliary power supply	≤ 0.1% of set full-scale value with a change of ±10%
Drift (zero point and full-scale value)	Negligible depending on the cycle time setting
– AUTOCAL activated	
– AUTOVAL deactivated	≤ 0,85 mg/m ³ /day
– NO ₂	≤ 1,25mg/m ³ /day
– SO ₂	
	Note
	It can take up to 12 hours after the device is put into operation before these values are reached.
Accompanying gases	Negligible
– Humidity up to 20 °C dew point	– Negligible
– CO ₂ ≤ 16 % vol	– Other sulfur compounds than SO ₂
– Exclusions	– Halogen compounds
	– Chlorine
	– Acetone
	– Ozone
	In case of doubt, please contact CGA Help Desk

4.1.4.5 Electrochemical oxygen sensor**Allgemeines**

Measuring ranges	0 ... 5% to 0 ... 25% O ₂ , parameterizable
Associated gases	The oxygen sensor must not be used if the associated gas contains the following components: <ul style="list-style-type: none"> – Chlorine or fluorine compounds – Heavy metals – Aerosols – Mercaptans – Alkaline components (e.g. NH₃ in % range)
Service life	Approx. 2 years with 21% O ₂

Time response

Response time (T ₉₀ time)	Dependent on dead time and parameterizable damping, <30 s with sample gas flow of approx. 1.2 l/min
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Measuring response

Output signal noise	< 0.5% of the full-scale value
Display resolution	< 0.2% of the full-scale value
Output signal resolution	< 0.2% of the output signal span
Reproducibility	≤0,05 % O ₂

Climatic conditions

– Permissible ambient temperature	
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Climatic conditions

– During operation	+5 ... +45 °C (41 ... 113 °F)
– During transportation and storage	-20 ... +60 °C (-4 ... 140 °F)
Permissible ambient humidity	< 90% RH (relative humidity) during transportation and storage
Permissible ambient pressure	600 ... 1200 hPa absolute
Maximum operating altitude	2000 m above sea level

Influencing variables

Oxygen content	In the case of occasional operation < 1% O ₂ , the measuring accuracy below 1% O ₂ is limited. An improvement in the measuring accuracy at concentrations <1% O ₂ is possible under the following conditions: <ul style="list-style-type: none"> – Permanent measurement of concentrations <1% – No mixed operation with occasionally high concentrations and occasionally low concentrations (brief high concentrations e.g. by means of an AUTOCAL with air at intervals of at least 3 hours are permissible)
Typical combustion exhaust gases	Influence: < 0.05% O ₂
Humidity	H ₂ O dew point ≥ 2 °C (36 °F); the oxygen sensor must not be used with dry sample gases (no condensation)
Drift	
– With AUTOCAL	Negligible
– Without AUTOCAL	1% O ₂ /year in air, typical
Temperature	<0.5% O ₂ per 20 K, relating to a measured value at 20 °C (68 °F)
Air pressure	< 0.2% of measured value per 1% pressure change

4.1.4.6 Paramagnetic oxygen sensor**General information**

Measuring ranges	2 Min. 0 ... 2% vol O ₂ (limited accuracy) max. 0 ... 100% vol O ₂
Permissible ambient pressure	700 ... 1 200 hPa absolute
Permissible operating temperature	5 ... 45 °C (41 ... 113 °F)

Measuring response

Response time (T ₉₀ time)	<60 s
Output signal noise	< 1% of smallest measuring range
Reproducibility	≤ 1% of smallest measuring range

Climatic conditions

– Permissible ambient temperature	
– During operation	+5 ... +45 °C (41 ... 113 °F)
– During transportation and storage	-20 ... +60 °C (-4 ... 140 °F)
Permissible ambient humidity	< 90% RH (relative humidity) during transportation and storage
Permissible ambient pressure	600 ... 1200 hPa absolute
Maximum operating altitude	2000 m above sea level

Influencing variables

Cross-inferences (interfering gases)	See table of cross-sensitivities
Zero drift (vol % O ₂)	MR 2% vol: Max. 0.1% vol with weekly zero adjustment MR 5% vol: Max. 0.1% vol with weekly zero adjustment MR 25% vol or greater: Max. 0.5% vol with monthly zero adjustment
Temperature error (vol % O ₂)	< 2% vol /10 K relative to measuring range 5% vol < 5% vol /10 K relative to measuring range 2% vol
Humidity error (vol % O ₂) for N ₂ with 90% relative humidity after 30 min	< 0.6% vol at 50 °C (122 °F)
Air pressure	< 0.2% vol of measured value per 1% pressure change

Cross-sensitivities

All values in this table refer to a zero calibration with nitrogen and a full-scale calibration with 100% vol. oxygen. The deviations apply to 100% vol of the relevant gas and must be considered proportionally for the zero adjustment.

Gas	Formula	Deviation at 20 °C	Deviation at 50 °C
Acetyl aldehyde	C ₂ H ₄ O	-0,31	-0,34
Acetone	C ₃ H ₆ O	-0,61	-0,69
Acetylene, ethine	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	-1,10	-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	-1,20
Dinitrogen monoxide	N ₂ O	-0,20	-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	-0,20	-0,22
Ethylene glycol	C ₂ H ₆ O ₂	-0,78	-0,88
Ethylene oxide	C ₂ H ₄ O	-0,54	-0,60
Furane	C ₄ H ₄ O	-0,90	-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	-1,00	-1,10
Monosilane, silane	SiH ₄	-0,24	-0,27
Neon	Ne	+0,16	+0,17
n-octane	C ₈ H ₁₈	-2,45	-2,70
Phenol	C ₆ H ₆ O	-1,40	-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	-0,90	-1,00

Gas	Formula	Deviation at 20 °C	Deviation at 50 °C
Oxygen	O ₂	+100,00	+100,00
Sulfur dioxide	SO ₂	-0,18	-0,20
Sulfur hexafluoride	SF ₆	-0,98	-1,05
Hydrogen sulfide	H ₂ S	-0,41	-0,43
Nitrogen	N ₂	0,00	0,00
Nitrogen dioxide	NO ₂	+5,00	+16,00
Nitrogen monoxide	NO	+42,70	+43,00
Styrene	C ₈ H ₈	-1,63	-1,80
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

4.1.4.7 Hydrogen sulfide sensor

General information

Measuring ranges	
– Smallest measuring range	0 ... 5 vpm
– Largest measuring range	0 ... 50 vpm
Service life of the sensor	Approx. 12 months after first use in the BA 5000
Shelf life	Maximum of 12 months after date of manufacture
Operation mode	Continuous measurement between 0 and 12.5 vpm Discontinuous measurement between 12.5 and 50 vpm
AUTOCAL	Cyclic adjustment (see H ₂ S sensor with 'small' measuring range)

Climatic conditions

Permissible ambient temperature	
– During operation	+5 ... +40 °C (41 ... 104 °F)
– During transportation and storage	-10 ... +55 °C (14 ... 131 °F)
Permissible ambient pressure	750 ... 1200 hPa absolute
Maximum operating altitude	2000 m above sea level

Influencing variables

Associated gases	The hydrogen sulfide sensor cannot be used if the associated 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 mg/m³)
Cross-interference (interfering gases)	1360 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 (1000 vpm)
Drift	< 1% per month
Temperature	< 3%/10 K referred to full-scale value
Air pressure	< 0.2 % of measured value per 1% pressure change

NOTICE**Measuring ranges**

The exact specification of the largest and smallest H₂S ranges can be found on the label!

4.1.5 Wiring diagrams

4.1.5.1 Gas flow diagram

Legend for the gas flow diagrams

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

The variant with specially cleaned gas path (BA06- Cleaned for O₂) does not contain a fine safety filter in the sample gas path.

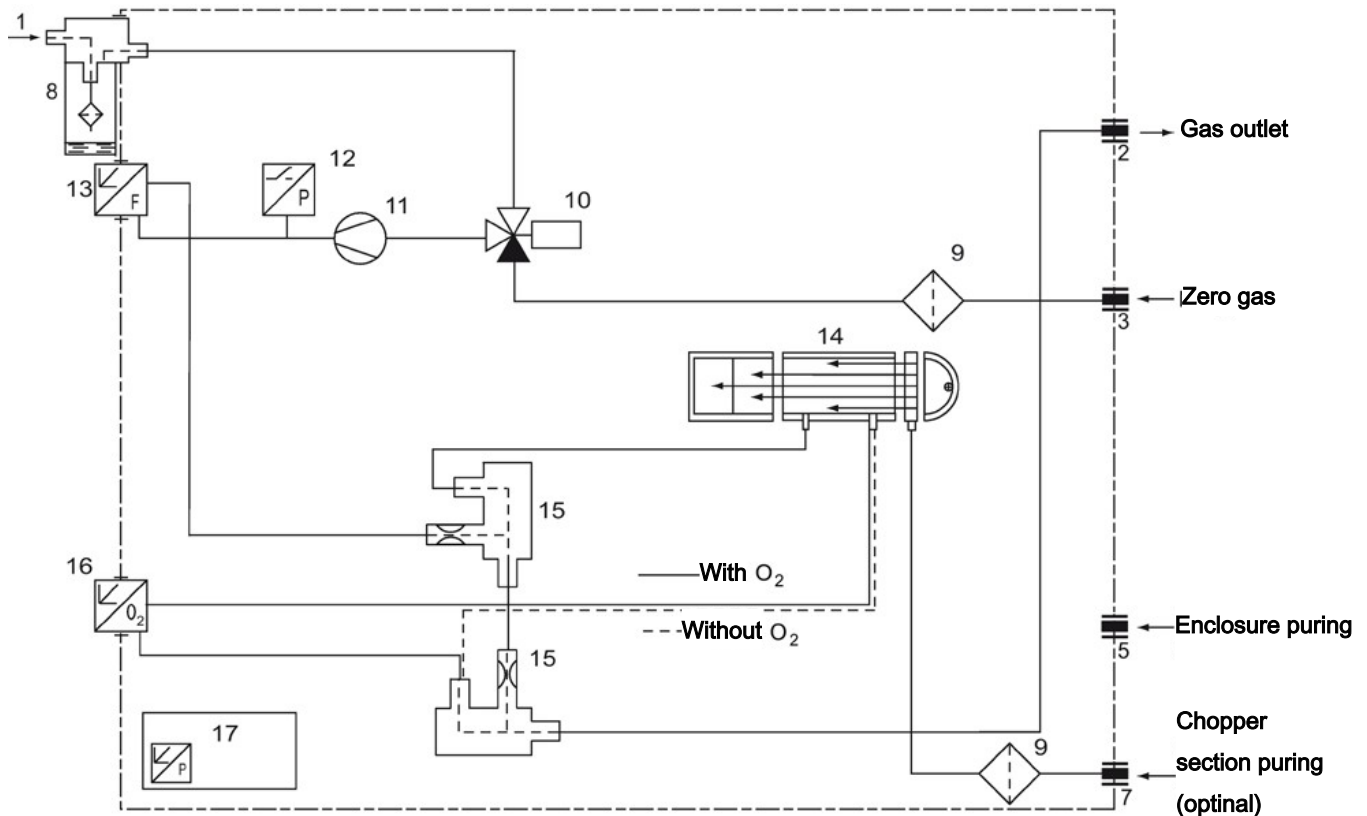


Fig. 9: BA 5000, bench-top unit with IR detector, internal sample gas pump, condensation trap and fine safety filter on front plate; optional oxygen measurement

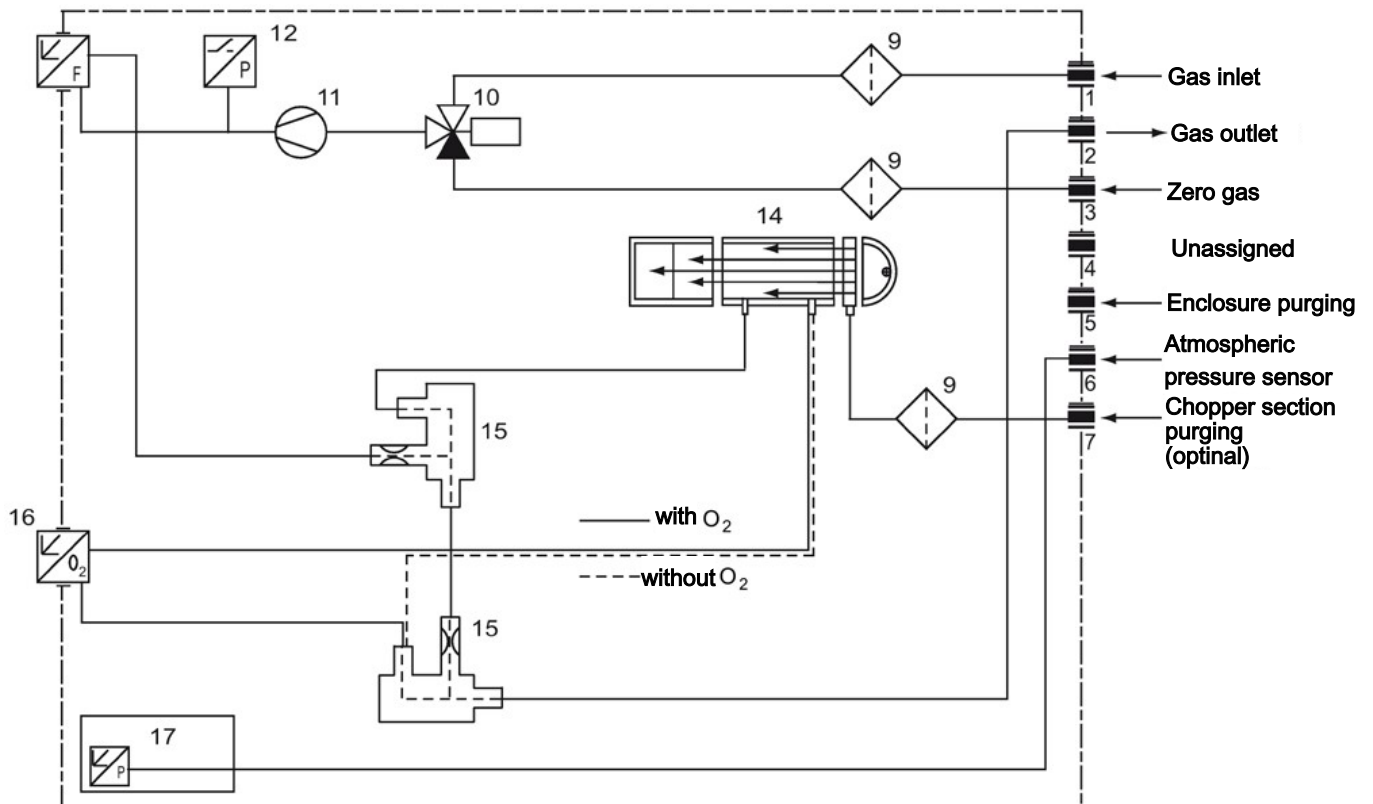


Fig. 10: BA 5000 19" rack unit enclosure with IR detector, internal sample gas pump; optional oxygen measurement

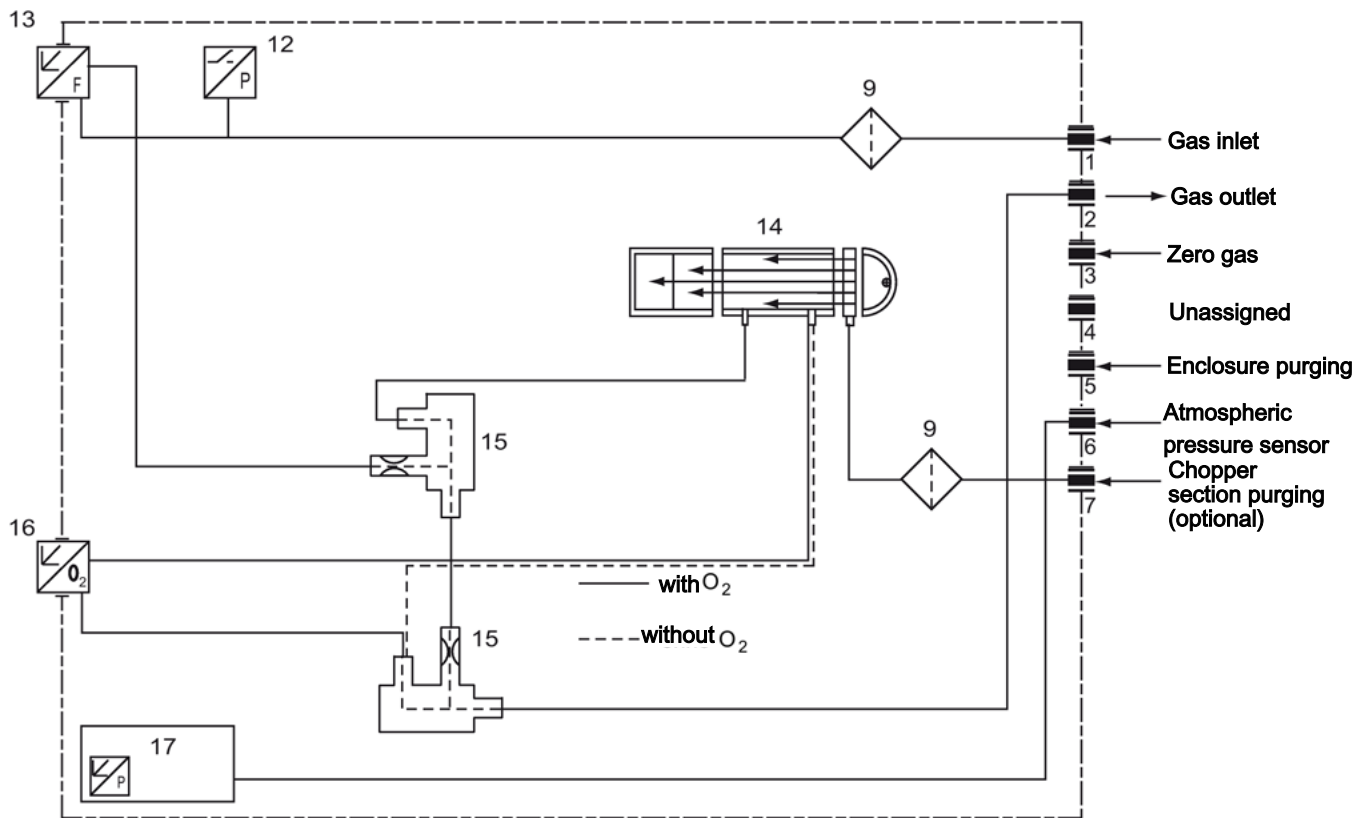


Fig. 11: Ba 5000, 19" rack unit enclosure with IR detector without internal sample gas pump; optional oxygen measurement

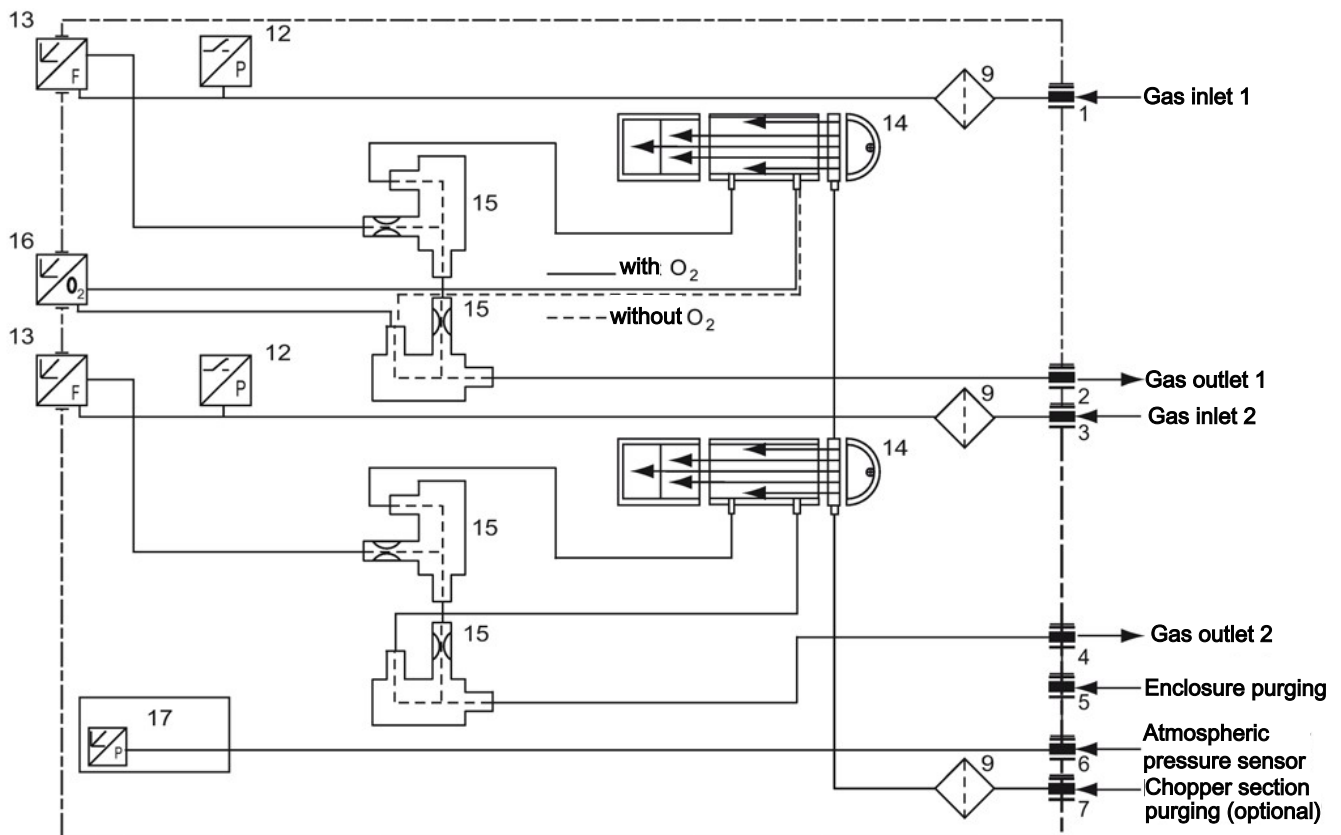


Fig. 12: Ba 5000, 19" rack unit enclosure without internal sample gas pump; with separate gas path for further IR components; optional oxygen measurement

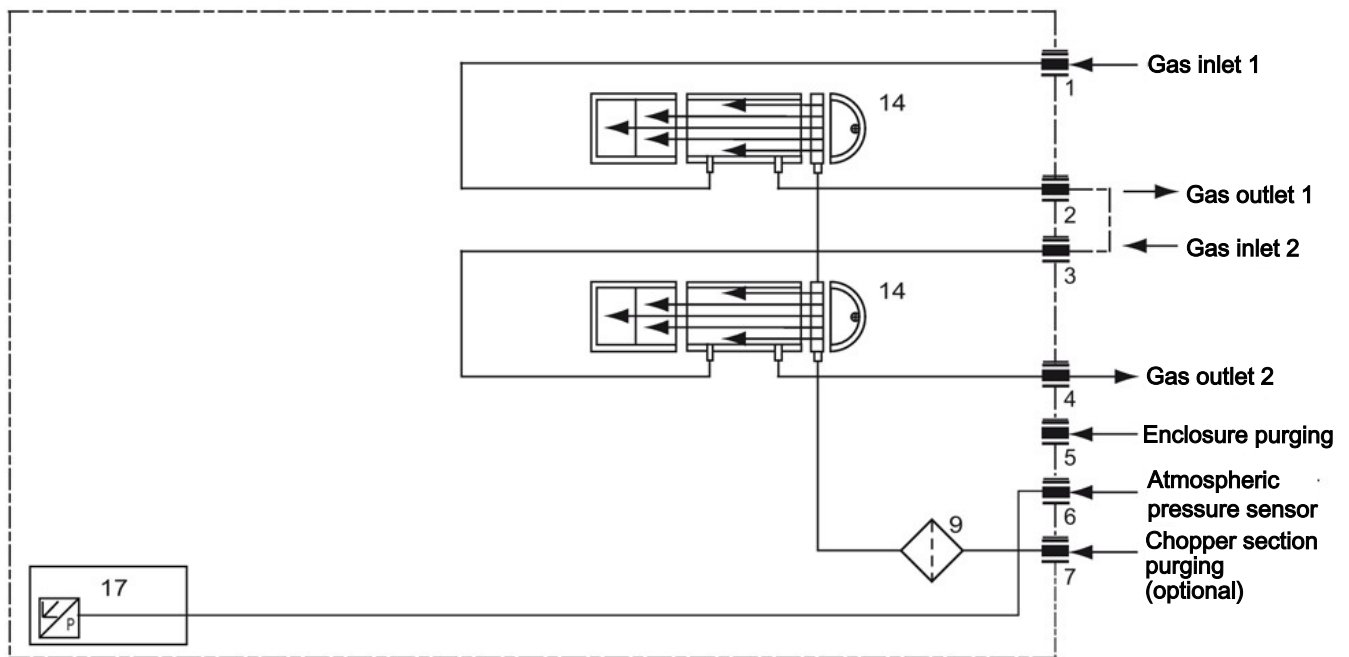


Fig. 13: BA 5000, 19" rack unit enclosure with IR detector without internal sample gas pump; sample gas path in a pipe without safety filter or safety condensation trap; optional separate gas path

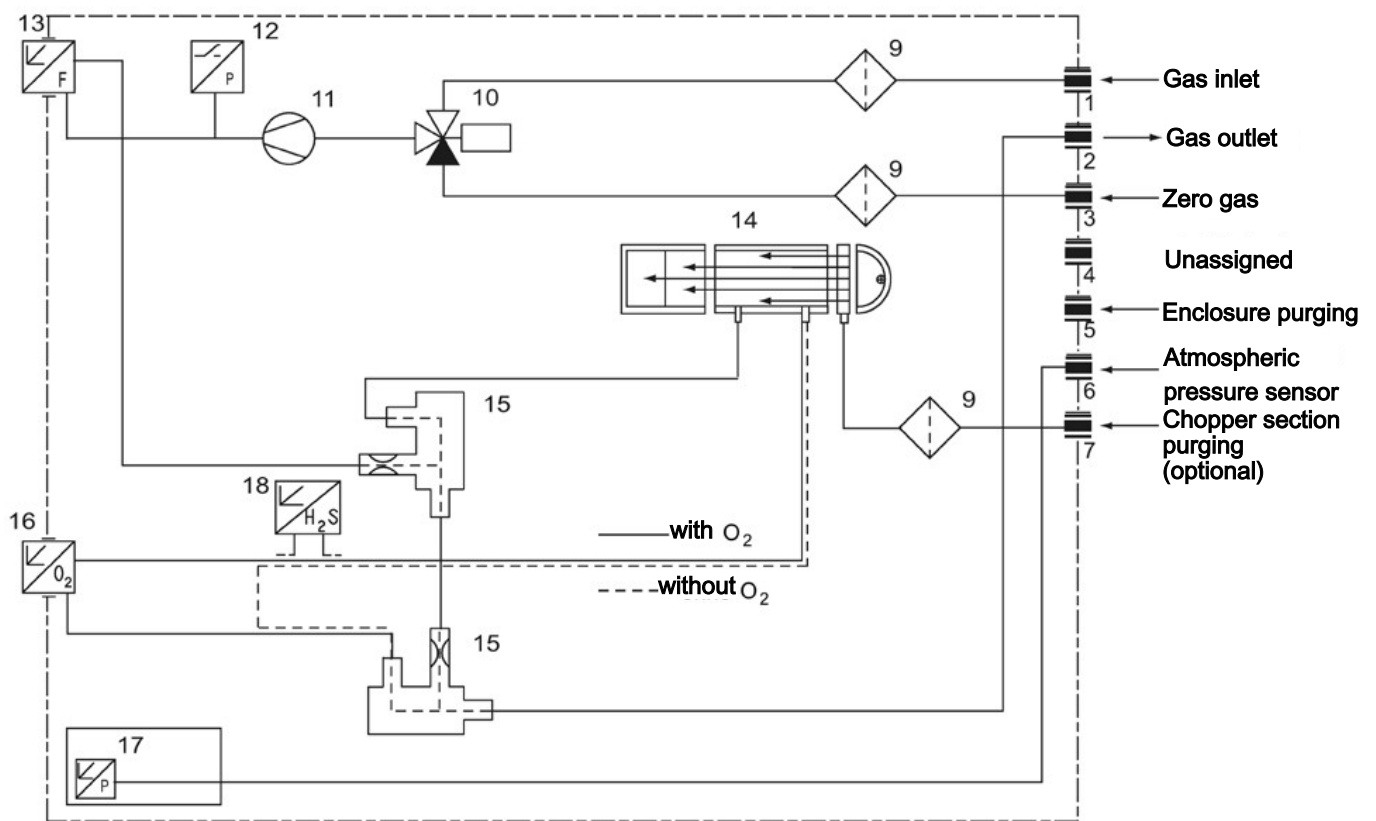


Fig. 14: Ba 5000, 19" rack unit enclosure with IR detector, internal sample gas pump and hydrogen sulfide sensor; optional oxygen measurement

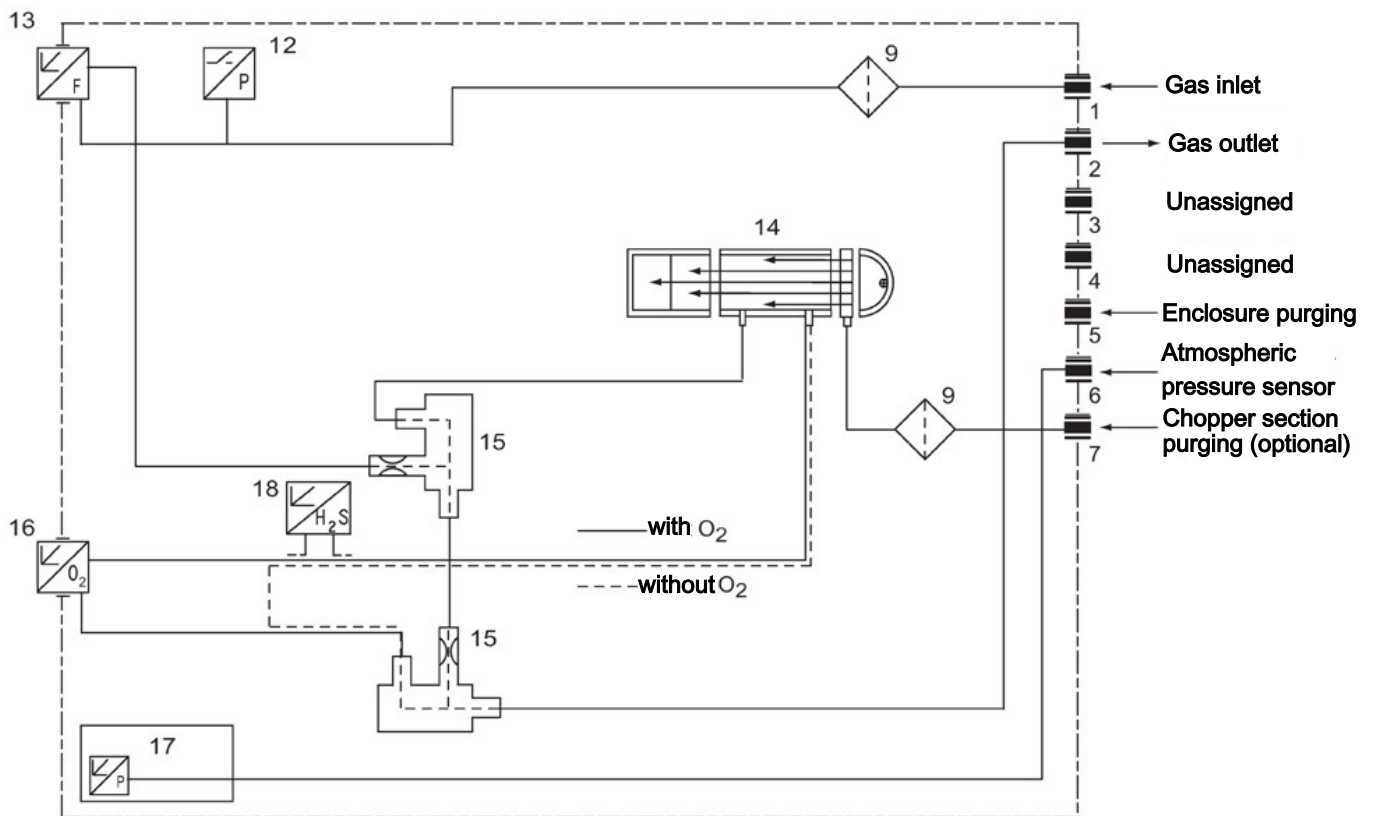


Fig. 15: BA 5000, 19" rack unit enclosure with IR detector, hydrogen sulfide sensor without internal pump; optional oxygen measurement

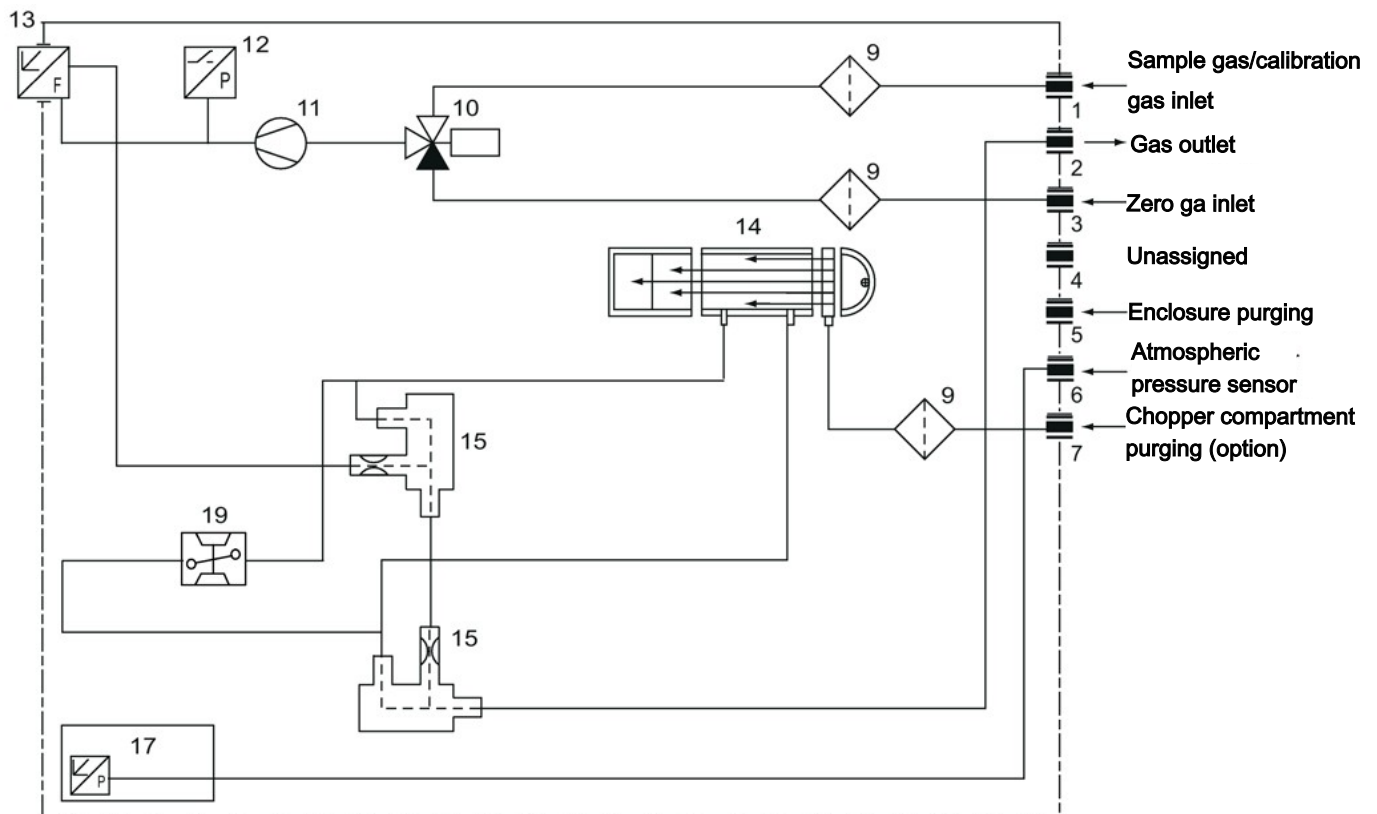


Fig. 16: BA 5000, 19" rack unit enclosure with IR detector, internal sample gas pump and paramagnetic oxygen sensor

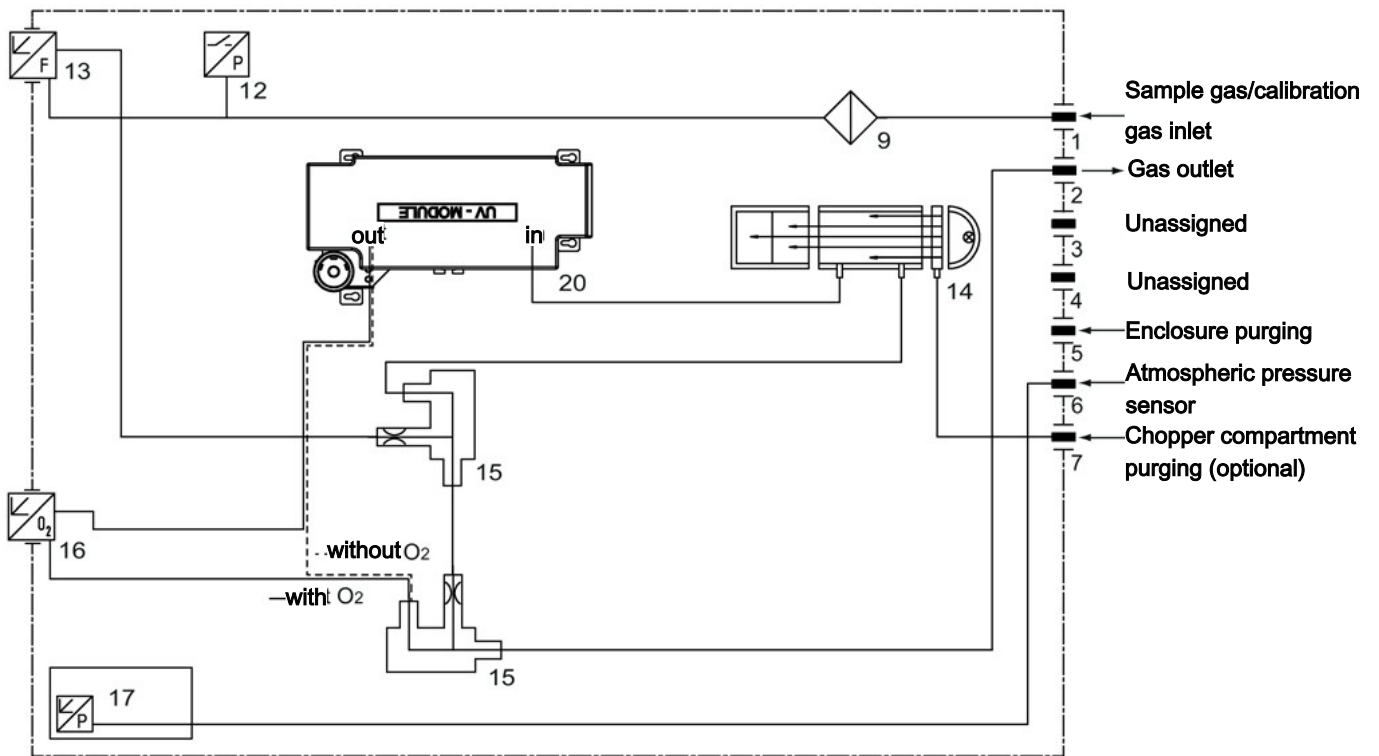


Fig. 17: BA 5000, 19" rack unit enclosure with IR detector, UV photometer (UV module); optional oxygen measurement

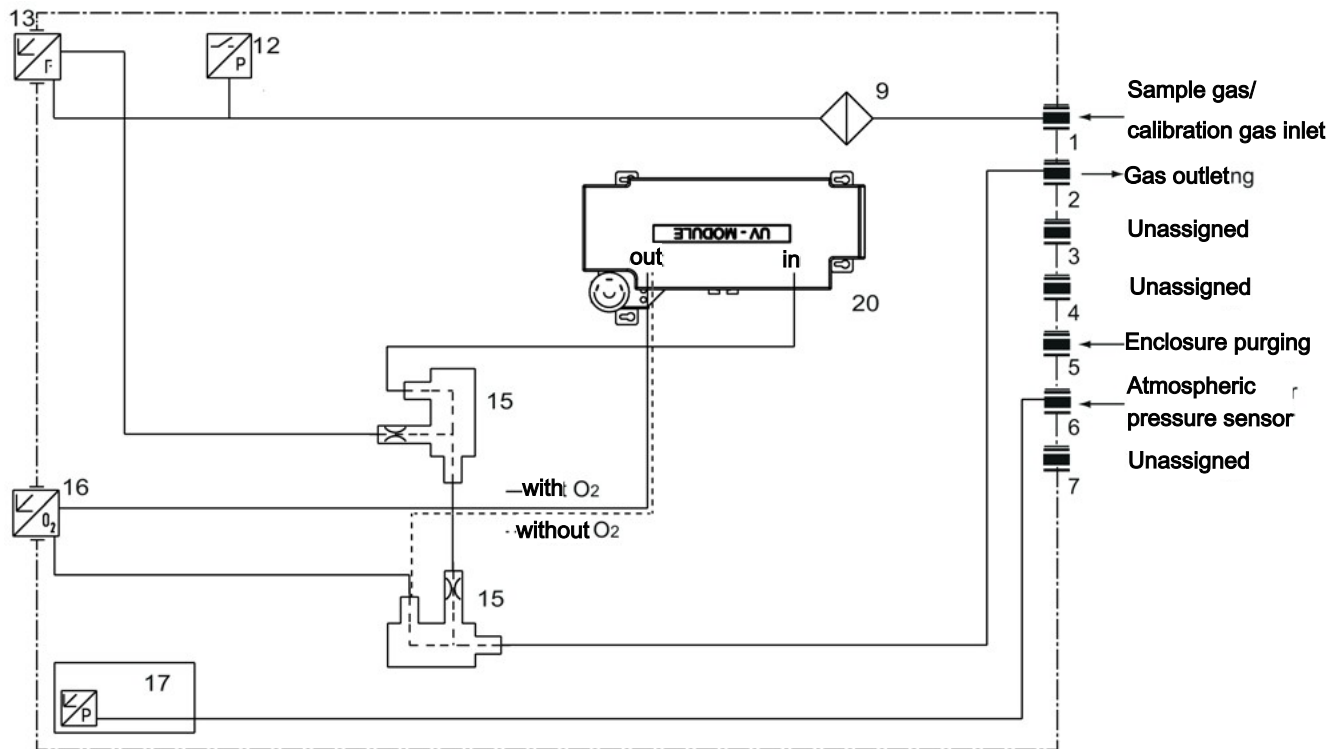


Fig. 18: BA 5000, 19" rack unit enclosure with UV photometer (UV module); optional oxygen measurement

4.1.5.2 Gas connections

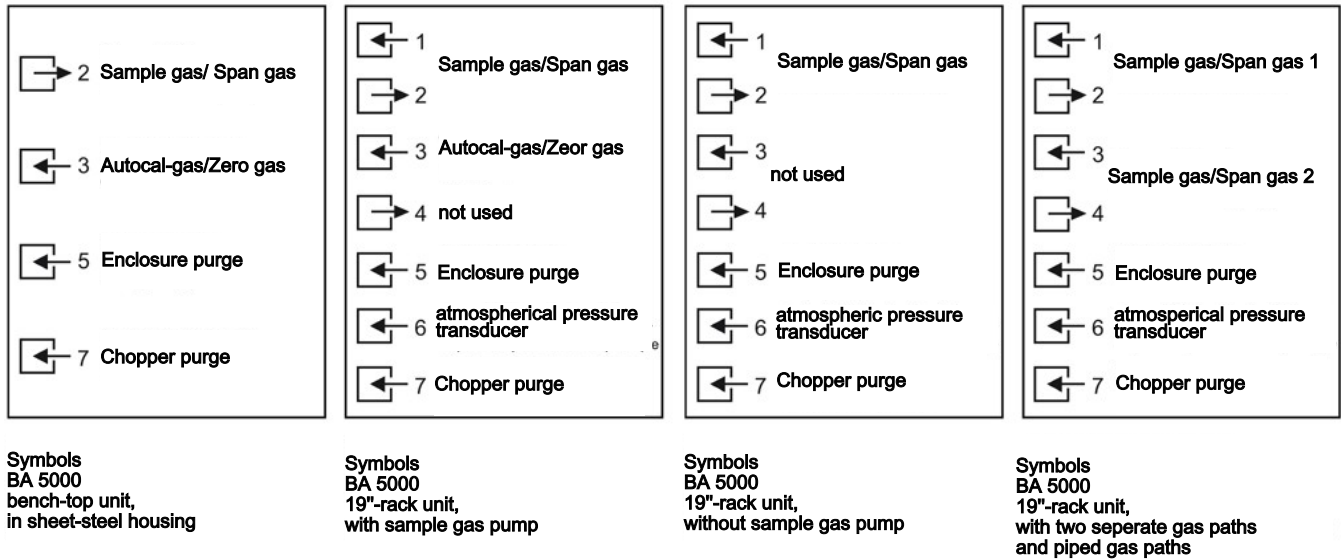


Fig. 19: Gas connections of BA 5000 versions

The positions of the connections on the devices are shown in the connection diagrams in section Connection diagrams.

4.1.5.3 Connection diagrams

Bench-top unit

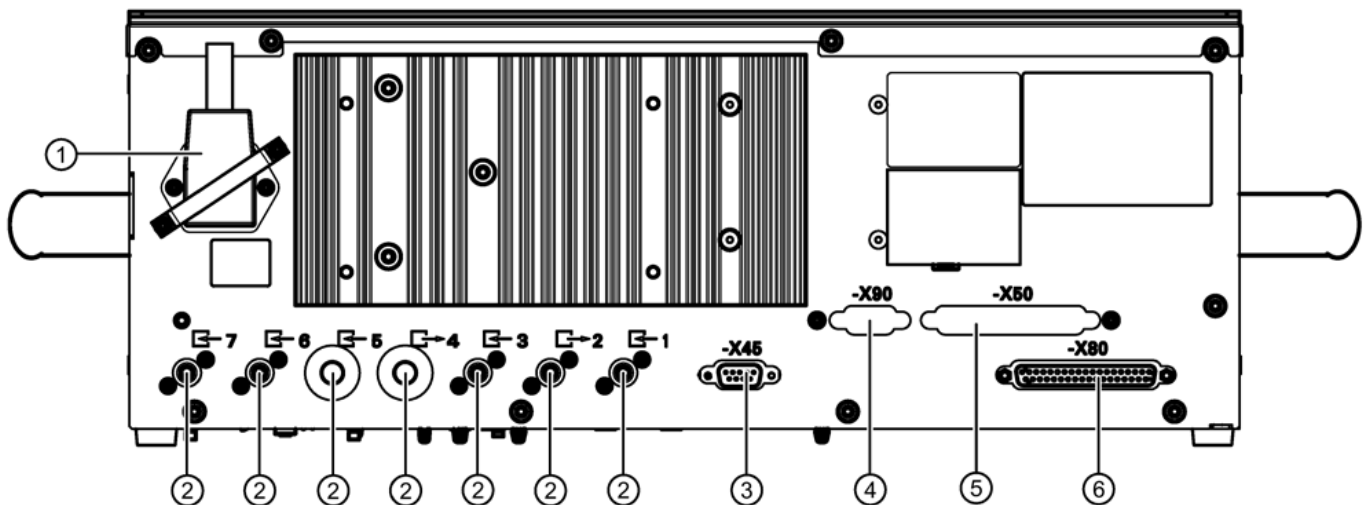


Fig. 20: Connections of bench-top unit

1. Power connector
2. Gas connections: 6mm nozzles; see Gas connections
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; binary inputs/relay outputs
6. -X80: 37-pin connector: Analog and digital inputs and outputs

19"-rack unit

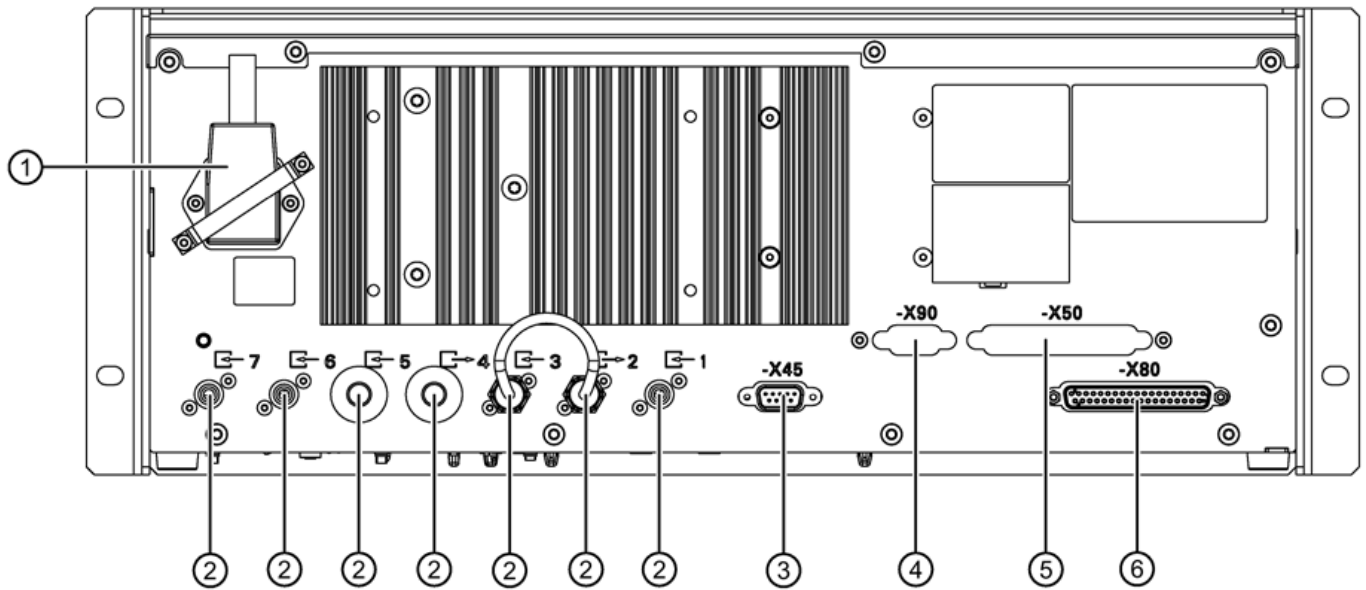


Fig. 21: Connections of rack device

1. Auxiliary power and fine fuse
2. Gas connections: 6 mm nozzles; see section gas connections
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; binary inputs/relay outputs
6. -X80: 37-pin connector: Analog and digital inputs and outputs

When installing in a cabinet, mount analyzer on support rails or telescopic rails

4.1.5.4 Pin assignments

Pin-assignments of the motherboard

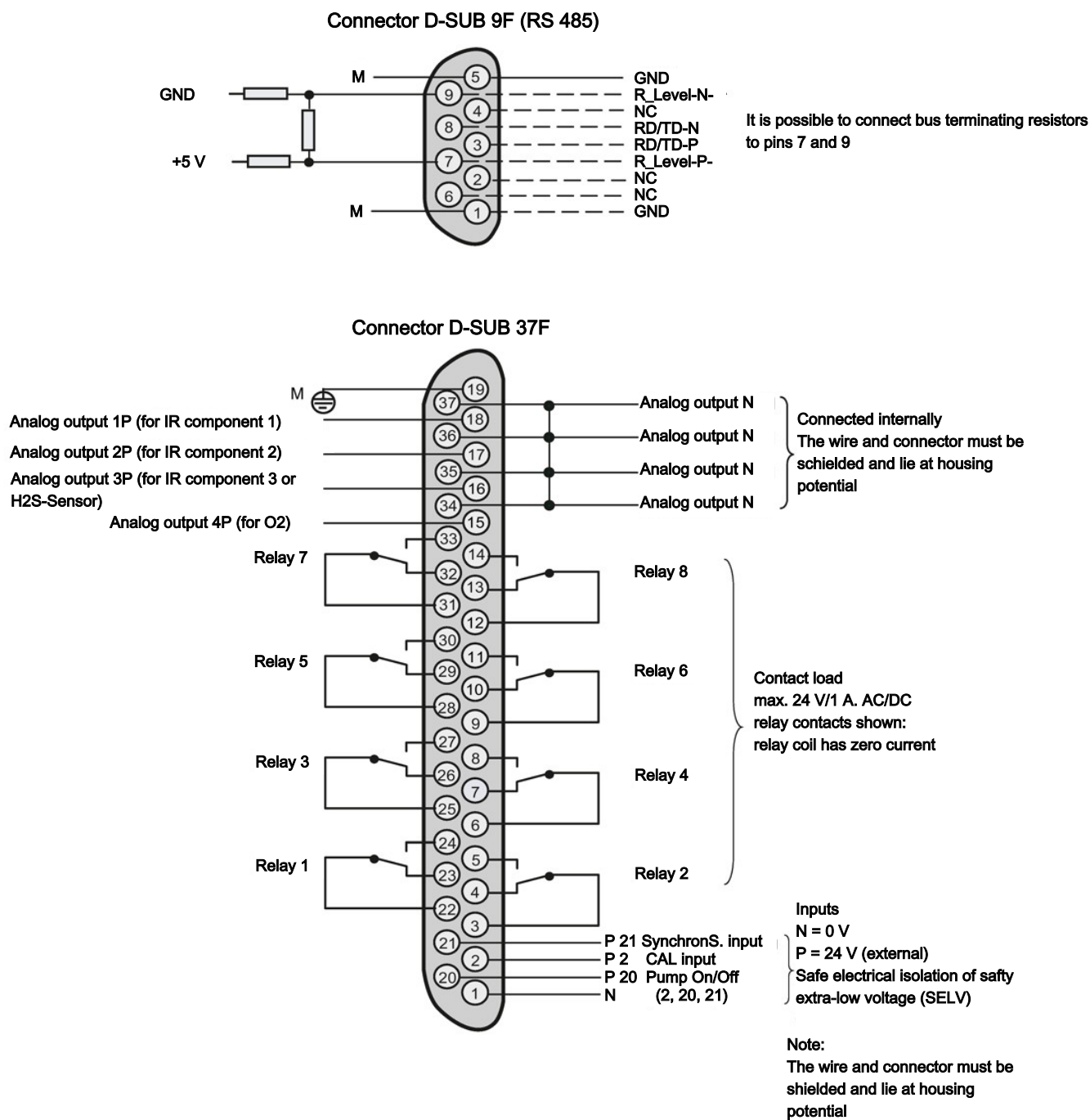
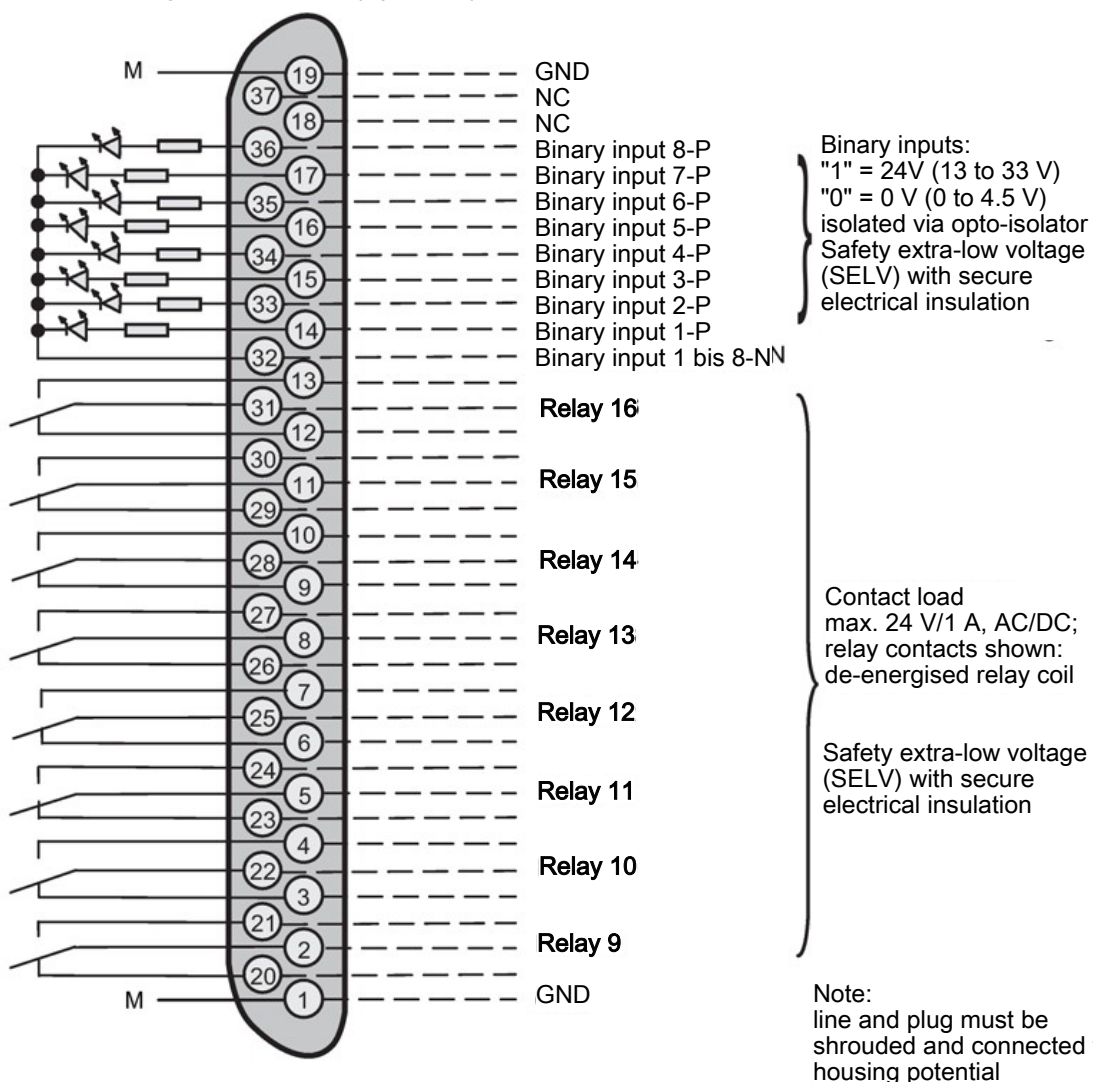


Fig. 22: BA 5000 motherboard

Add-on board

Plug D-SUB 37F (optional)



Plug D-SUB 9F -X90 PROFIBUS-DP

optional

Plug D-SUB 9M -X90 PROFIBUS-PA

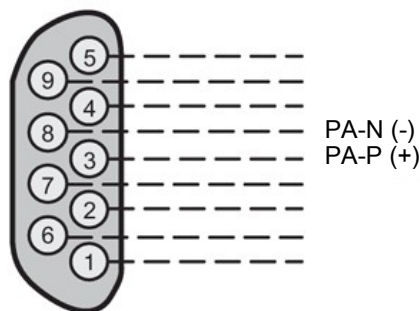
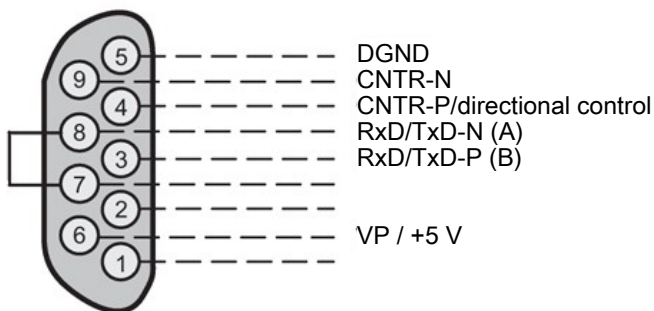


Fig. 23: BA 5000 Add-on board

4.1.6 Dimensional drawings

Rack unit



Fig. 24: Dimension drawings for rack unit

Gas connections: Pipe nozzle diameter \varnothing 6mm or 1/4"

Important: When installing in a bench-top enclosure or cabinet, only mount analyzer on support rails.

Bench-top unit

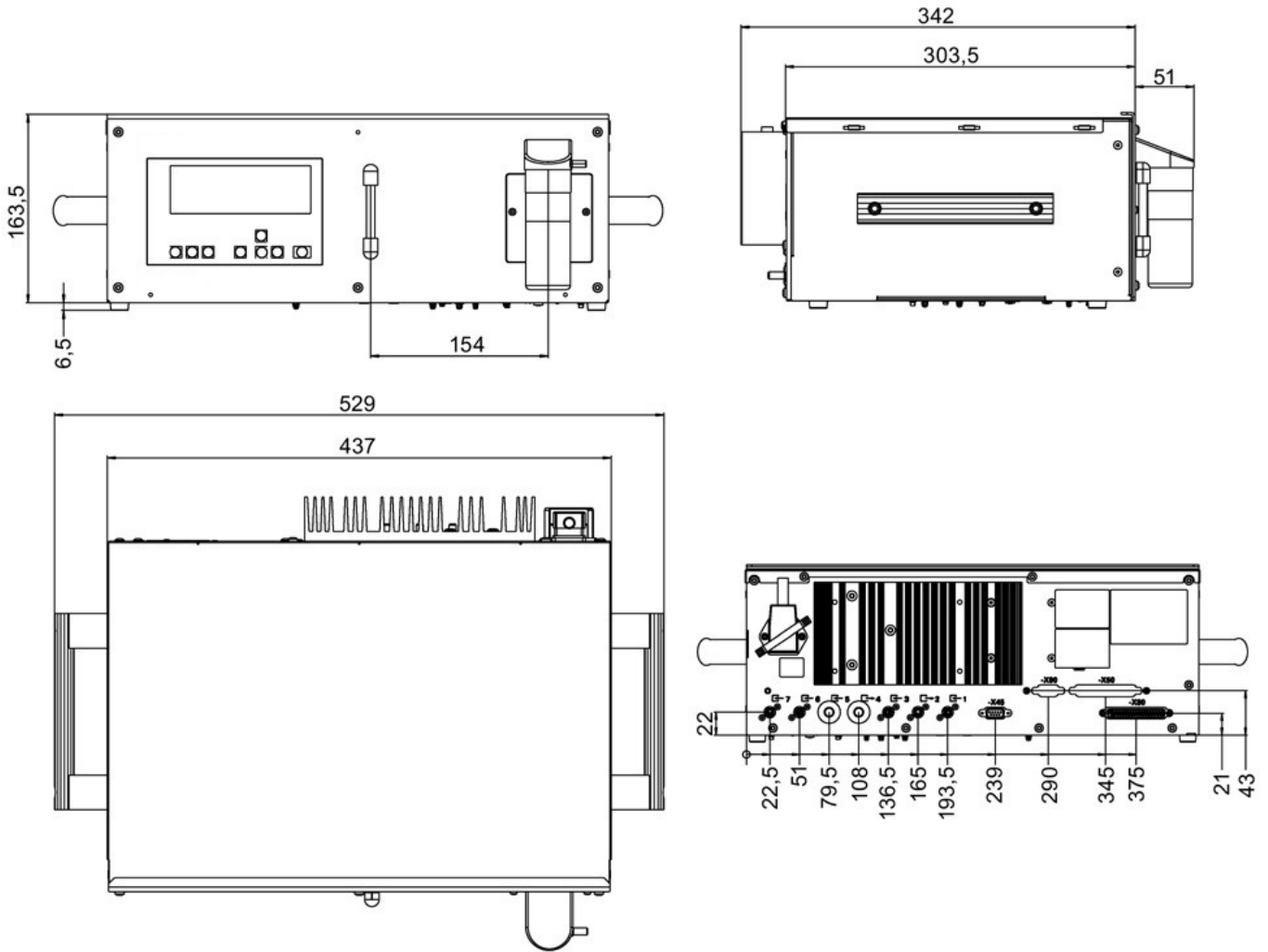


Fig. 25: Dimension drawings of bench-top unit

Gas connections: Pipe nozzle diameter \varnothing 6mm or 1/4"

4.1.7 Communication

4.1.7.1 PROFIBUS DP/-PA

PROFIBUS DP/PA is the leading fieldbus on the market. All gas analyzers with an optional – also retrofittable – plug-in card are Profibus-compatible and comply with the binding "Device profile for analyzers" defined by the PNO (PROFIBUS International). Central access to the system analyzers is possible with the SIMATIC PDM software tool.

"Fieldbus" is the name of a digital communication system with which distributed field devices of a system are linked to each other over a single cable and are simultaneously connected to programmable controllers or a process control system.

The PROFIBUS-DP version is widespread in factory automation due to its high transmission speed per device, while PROFIBUS-PA takes the required properties of process engineering into account, such as use in hazardous areas.

The benefit is the considerable savings potential in all areas of the system, covering project planning and commissioning, operation and maintenance, up to subsequent system extensions.

Operation of the gas analyzers from a control system or a separate PC is possible with the SIMATIC PDM software tool (Process Device Manager). This software executes under Windows XP/Windows 2000 as well as Windows 7 and can also be integrated in the SIMATIC PCS 7 process control system. With this, the integration of the devices in the system as well as the complex parameter structure of the analyzers can be clearly illustrated. Operating becomes simply a matter of "clicking".

PROFIBUS International (PNO) is an independent institution and represents the interests of many manufacturers and users. This organization offers services such as consulting, training and device certification, and understands its primary job as the further development, standardization and promotion of PROFIBUS technology. The binding functionality definition for a device class in the form of a profile is the condition for standardized device behavior from various manufacturers, the so-called interoperability. The binding profile for analyzers was defined at the end of 1999. With this, the interaction of all PROFIBUS-compatible devices of a system is guaranteed.

In this profile, the functionalities of the analyzers are defined in a block model: for example, the physical block describes the measuring procedure, analyzer and manufacturer name, serial number and the operating state (operation, maintenance).

Different functional blocks contain the execution of certain functions, such as measured value and alarm processing. The transducer blocks describe the function of the actual measuring process, as well as its control, e.g. the pre-processing of a measured value, correction of cross-interferences, characteristics, measuring ranges, as well as switching and control processes. The data transmission between the bus participants is defined in protocols. A distinction is made between cyclic and acyclic services.

Time-critical data, such as measured values and status, are transmitted with cyclic services. The acyclic services allow device parameters to be queried or changed during operation.

The gas analyzers of Series BA 5000 are PROFIBUS-compatible with an optional plug-in card, which can also be retrofitted.

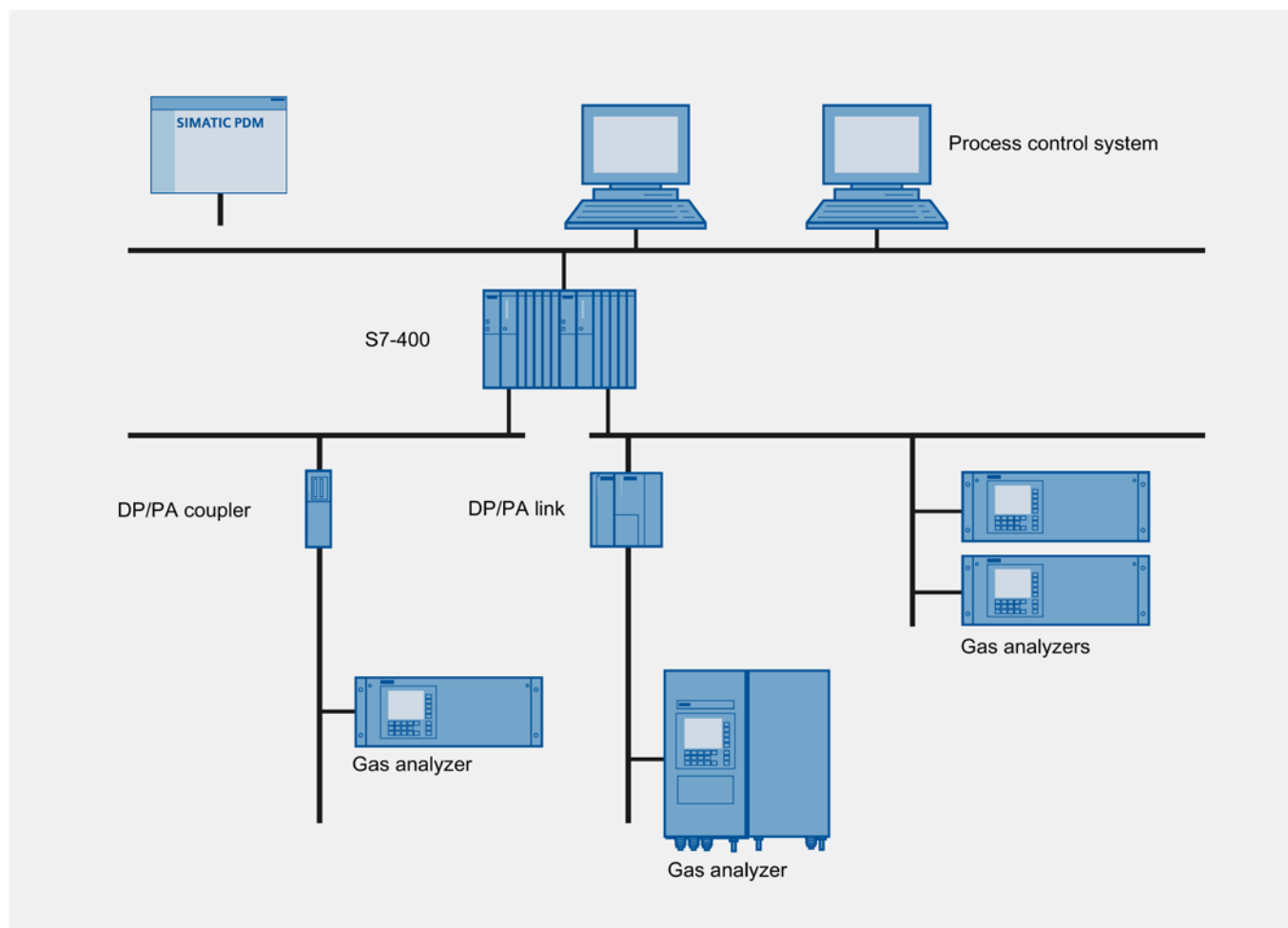


Fig. 26: Typical structure of a PROFIBUS system

4.1.7.2 General information

All gas analyzers of series BA 5000 offer the following communication facilities:

- ELAN interface (RS485)
- SIPROM GA
- PROFIBUS DP/-PA

4.1.7.3 ELAN interface

ELAN interface

ELAN is a standard integrated serial interface (RS 485) which allows communication with several analyzers. You can network up to 12 analyzers.

The functional principle of the ELAN interface is shown in the following figure:

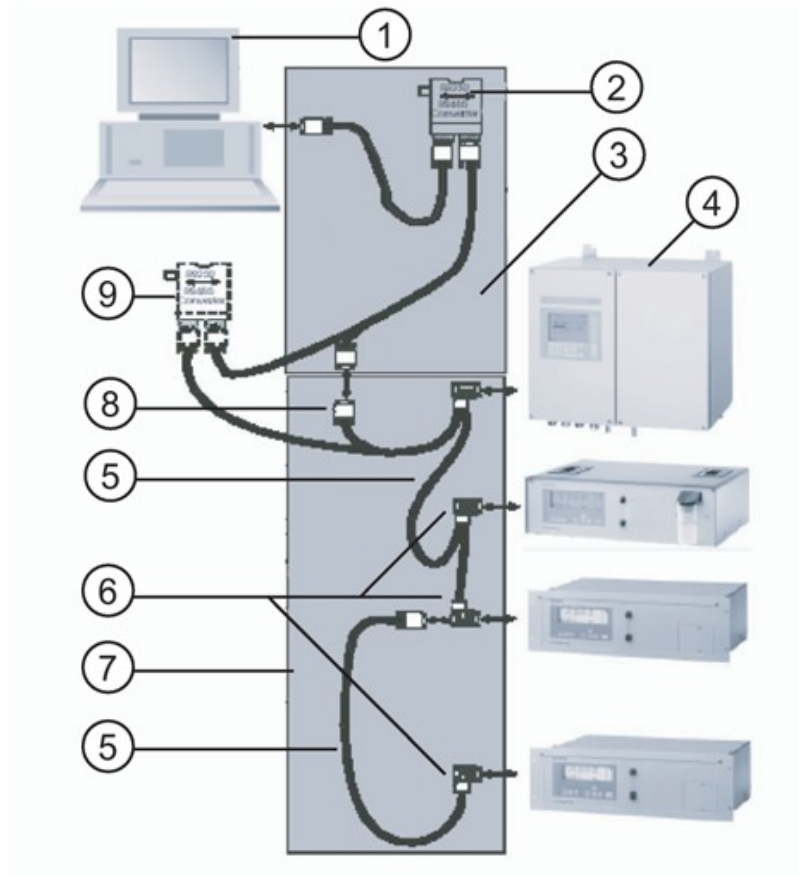


Fig. 27: Typical structure of an ELAN network (RS485)

1. Computer
2. RS485 to RS232/USB/Ethernet converter with connecting cable
3. RS485 bus connector with jumper
4. Analyzer
5. RS485 cable
6. RS485 bus connector
7. RS485 network
8. 9-pin D-Sub plug
9. Optional: RS485 repeater

Interface parameters

Parameter	Value
Level	RS485
Baud rate	9600
Data bit	8
Stop bit	1
Start bit	1
Parity	None
No information feedback	
Ordering information	Article No.
Interface description	C79000-B5200-C176
RS485-RS232 converter including SIPROM GA	C79451-Z1589-U1
RS485/Ethernet converter	A5E00852383
RS485/USB converter	A5E00852382
SIMATIC cable / bus line	6XV1 830-0EH10
SIMATIC bus connector	6ES7 972-0BB11-0XA0
9-pin Sub-D plug	6ES7 972-0BB11-0XA0
Repeater	6ES7 972-0AA01-0XA0

Further information can be found in the ELAN interface description:

Article numbers:

- C79000-B5200-C176 German
- C79000-B5274-C176 English

4.1.7.4 SIPROM GA**4.1.7.4.1 SIPROM GA functions**

SIPROM GA is a software tool especially for service and maintenance tasks. All analyzer functions, whether as a single device or several linked together, can be remotely operated and monitored this way.

Functions:

- Display and storage of device data
- Remote operation of device functions
- Parameter and configuration settings
- Comprehensive diagnostics information
- Remote calibration
- Online help
- Cyclic storage of measured values
- Status on hard disk and export to commercially available user programs
- Download of new software
- Drift values according to QAL 3, DIN EN 14181

Hardware requirements:

- PC/laptop Pentium 133 MHz, RAM 32 MB, CD-ROM drive
- At least 35 MB free disk space
- VGA graphics card supported by Windows
- Printer supported by Windows
- Vacant COM port for direct coupling to ELAN RS485 network
- For connection of the Ethernet/485 interface converter, a standard network of 10 Mbit or 100 Mbit (RJ 45 connection) with TCP/IP is necessary.
- In the case of an RS485 network, the distance should not exceed 500 m. If this distance is exceeded, a repeater must be used.

Software requirements:

- Windows 98
- Windows 2000
- Windows XP
- Windows Vista

The SIPROM GA software is available on the Internet and can be downloaded.

4.1.7.4.2 Upgrading options

It is possible to upgrade the device firmware of older gas analyzers using the SIPROM GA software. Details can be found in the following table.

Firmware upgrades for older analyzers	Article No.
BA 5000 (prior to SW version 2.06) (all languages)	C79451-A3494-S501

4.2 Installation

Make sure when mounting the analyzer that the environment is as free as possible of the gas components to be measured!

In order to achieve the highest possible measuring quality, also observe the following information concerning the location for mounting an analyzer!

WARNING**Insufficient ventilation**

The device may overheat or start burning in the case of insufficient ventilation.

- Ensure sufficient ventilation between the devices when installing in control cabinets. The heat sinks at the rear must remain free for air circulation.
- Make sure during operation that the permissible ambient temperature range is always observed (see Technical specifications).

WARNING**Incorrect mounting**

The device can be damaged, destroyed, or its functionality impaired through improper mounting.

- Before installing ensure there is no visible damage to the device.
- Make sure that process connectors are clean, and suitable gaskets and glands are used.
- Mount the device using suitable tools. Refer to the information in Technical specifications for installation torque requirements.

CAUTION**Strong vibrations**

Strong vibrations could loosen connections or damage sensors, resulting in free passage of the sample gas into the environment. Even weaker vibrations influence the result! The analyzer must therefore only be used at a location which is free of vibration. Please observe the data in the Technical specifications.

CAUTION**Direct sunlight**

Device damage

The device can overheat or materials become brittle due to UV exposure.

- Protect the device from direct sunlight.
- Make sure that the maximum permissible ambient temperature is not exceeded. Refer to the information in Technical specifications.

NOTICE**Installation in cabinets**

The dead weight of the analyzer could result in deformation of the frame when only secured at the front.

- Therefore place the analyzer on support rails when mounting in control cabinets!

DANGER**Explosion hazard**

If a flammable or ignitable atmosphere exists, plugs must never be disconnected or lamps/fuses replaced when the analyzer is supplied with power.

ATEX Zone 2

The following applies to devices (special versions) which are operated according to ATEX in Ex zone 2:

DANGER**Explosion hazard**

The BA 5000 gas analyzers for use in Ex zone 2 must be installed in a lockable enclosure. This enclosure must comply with the requirements of EN 60079-15 and must be designed for all ambient conditions which can occur during operation. This enclosure only be opened using a tool (e.g. a key).

The maximum ambient temperature is 50 °C.

Suitable measures must additionally be applied to ensure that

- the generation of potentially explosive gas mixtures inside the analyzer does not exceed the level of Zone 2
- interferences cannot lead to a deviation of more than 40% from the rated voltage.

4.3 Connecting

4.3.1 Safety instructions

4.3.1.1 General information

NOTICE



Condensation in the device

Damage to device through formation of condensation if the temperature difference between transportation or storage and the mounting location exceeds 20 °C (36 °F).

- Before taking the device into operation let the device adapt for several hours in the new environment.

Observe the safety rules, provisions and laws applicable in your country during connection, assembly and operation. These include, for example:

- National Electrical Code (NEC - NFPA 70) (USA)
- Canadian Electrical Code (CEC) (Canada)

Further provisions for hazardous area applications are for example:

- IEC 60079-14 (international)
- EN 60079-14 (EG)

WARNING



Wetted parts unsuitable for the process media

Risk of injury or damage to device.

Hot, toxic and corrosive media could be released if the process medium is unsuitable for the wetted parts.

- Ensure that the material of the device parts wetted by the process medium is suitable for the medium. Refer to the information in Technical specifications

WARNING



Hazardous contact voltage

Risk of electric shock in case of incorrect connection.

For the electrical connection specifications, refer to the information in Electrical connection. At the mounting location of the device observe the applicable directives and laws for installation of electrical power installations with rated voltages below 1000 V.

WARNING



Missing PE/ground connection

Risk of electric shock.

Depending on the device version, connect the power supply as follows:

- **Power plug:** Ensure that the used socket has a PE/ground conductor connection. Check that the PE/ground conductor connection of the socket and power plug match each other.
- **Connecting terminals:** Connect the terminals according to the terminal connection diagram. First connect the PE/ground conductor.

NOTICE



Electrical circuit breaker in accordance with IEC 60947-1 and IEC 60947-3

In accordance with IEC 60947-1 "Standard for low-voltage switchgear and controlgear" and IEC 60947-3 "Switches, disconnectors, fuses" you require an electrical circuit breaker for the device.

We recommend commercially available automatic circuit breakers.

NOTICE**Separator**

The supply cable also serves as separator. Ensure the supply cable

- is clearly identifiable
- easy to reach.

The cable must not be longer than 3 m.

4.3.1.2 Analyzers in hazardous areas

DANGER**Explosion hazard**

If a flammable or ignitable atmosphere exists, plugs must never be disconnected or lamps/fuses replaced when the analyzer is supplied with power.

ATEX Zone 2

The following applies to devices (special versions) which are operated according to ATEX in Ex zone 2:

DANGER**Explosion hazard**

The BA 5000 gas analyzers for use in Ex zone 2 must be installed in a lockable enclosure. This enclosure must comply with the requirements of EN 60079-15 and must be designed for all ambient conditions which can occur during operation. This enclosure only be opened using a tool (e.g. a key).

The maximum ambient temperature is 50 °C.

Suitable measures must additionally be applied to ensure that

- the generation of potentially explosive gas mixtures inside the analyzer does not exceed the level of Zone 2
- interferences cannot lead to a deviation of more than 40% from the rated voltage.

4.3.1.3 Analyzers in biogas plants

DANGER**Explosion hazard**

This device is used in biogas plants, among other places. When it is used in biogas plants, you should expect that the sample gas will contain methane, which forms explosive mixtures with oxygen or air in certain concentrations. These conditions are possible with certain operating states of the plant.

4.3.1.4 Variant with specially cleaned gas path (Cleaned for O₂)

In the version with the order suffix -B06 (Cleaned for O₂), all parts wetted by the sample gas are cleaned and absolutely grease-free.

CAUTION

Ignition hazard



Because of the danger of ignition, all parts coming into contact with oxygen must be clean. This means they must be free of loose parts or parts which could become loose during operation and of foreign particles, especially oil, grease and solvents.

Observe the following when working on analyzers with specially cleaned gas path:

- No clothing which is contaminated by oil or grease may be worn.
- The installation site must be clean and dust-free.
- Only parts which are packed and marked accordingly may be assembled.
- Always wash your hands before commencing work.
- The cleaned parts must only be handled on the surfaces which do not come into contact with the sample gas.
- New filters, new connecting hoses, and oil-free mixing equipment must always be used to check the analyzer function.

4.3.2 Gas connections and internal gas path

4.3.2.1 Gas connections

Sample gas line

A pipe with a outer diameter of 6 mm or 1/4" is present as the gas connection. The materials used in the gas path must be suitable for the respective measurement.

If you wish to exit the sample gas into a collective exhaust line, observe the following points:

- The exhaust line must be free of rapid changes in pressure. If this is not possible, either a separate exhaust line must be installed, or a damping vessel with a capacity > 1 l must be installed between the analyzer and the exhaust line.
- The exhaust gas line must always be routed with a falling gradient away from the device since moisture can condense in it.

Path for AUTOCAL/zero gas

The gases for the AUTOCAL calibration must be sucked in via a fine filter. The amount of the measured gas component must be negligibly small in the AUTOCAL gas (zero gas). In particular when carrying out an AUTOCAL for CO₂ ranges <1%, the air must be routed via a CO₂ absorber (e.g. soda lime).

Path for chopper section purging

With CO₂ ranges < 0.1%, the chopper section is purged with clean nitrogen or CO₂-free synthetic air at an inlet pressure of 300 ... 350 kPa (43 ... 51 psi).

Path for pressure sensor

The internal atmospheric pressure sensor is routed via a hose to connection 6. It is therefore possible to connect the pressure sensor (e.g. when using analyzer cabinets or houses) such that it is guaranteed that only changes in atmospheric pressure are recorded.

4.3.2.2 Gas preparation

The sample gas must be sufficiently conditioned to prevent contamination of the parts through which it flows. The BA 5000 is usually preceded by the following elements:

- Gas sampling device with filter
- Sample gas cooler

Analysis filter (approx. 1-2 μm)

External gas suction pump (with sample gas lines >20 m/65 1/2 ft)

NOTICE



In the analyzer version with the sample gas path as pipes, there is no safety filter and no condensation trap in the internal gas path.

• Therefore correct gas preparation must always be ensured.

• Depending on the composition of the sample gas, additional equipment may be necessary such as e.g.

- A washbottle
- Additional filters
- Pressure reducer

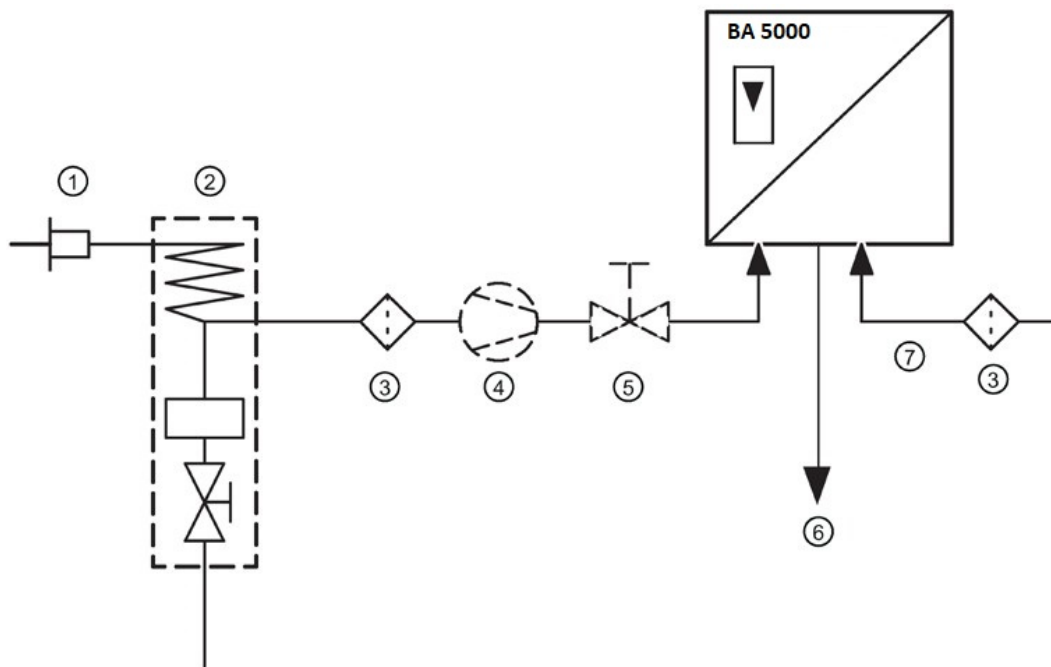


Fig. 28: Example of gas preparation for the BA 5000

1. Gas sampling probe
2. Gas cooler
3. Analyzer filter
4. Sample gas pump (option)
5. Flow regulator (option)
6. Gas outlet
7. AUTOCAL/zero gas supply

4.3.3 Electrical connection

4.3.3.1 Connection of the signal lines

NOTICE

Incorrect power supply



The 24 V/1 A power supply must be a power-limited safety extra-low voltage with safe electrical isolation (SELV).

Only connect the signal lines to devices which also have reliable electric isolation from their power supply.

- The connection lines to the relay outputs, binary inputs, and analog outputs must be shielded.
- The analog outputs are floating, but have a common negative pole.
- As a measure to suppress sparking across the relay contacts (e.g. limit relays), RC elements must be connected as shown in the following figure. Note that the RC element results in a drop-out delay for an inductive component (e.g. solenoid valve). The RC element should be sized according to the following rule of thumb:
 - $R = R_L/2$; $C = 4L/R^2$, where $R = 100 \Omega$ und $C = 200 \text{ nF}$ sufficient.
 - You must use a non-polarized capacitor for the RC element.

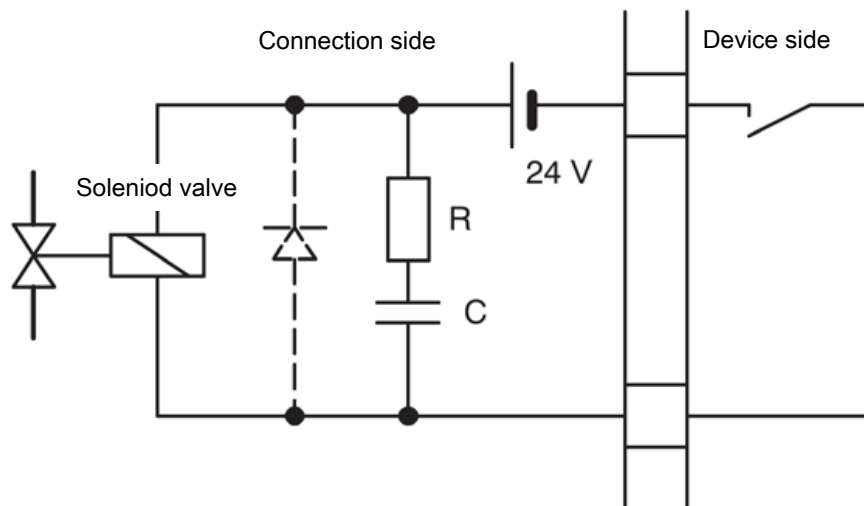


Fig. 29: Measure to suppress sparks on a relay contact

When operated with direct current, a spark suppression diode can be installed instead of the RC element. Connect the signal lines to the Sub-D plugs at the rear of the device.

Refer to the ELAN interface description (Order No. C79000-B5200-C176 German, C79000- B5276-C176 English) for details on the interface cable.

4.3.3.2 Power connection

NOTICE

Incorrect power supply



Check before connecting that the existing supply voltage corresponds to that specified on the label of the device. Install the power line separately from the signal lines.

A power supply cable or an appliance plug is enclosed with the device, and must only be connected by qualified personnel (see Qualified Personnel) The cable is connected to the appliance socket at the rear of the device. At the power supply end, the cable is inserted into a mains socket.

19"- rack unit

A flexible cable suitable for power supply cords must be connected to the appliance plug. The cross-section of each conductor must be at least 1 mm². The cross-section of the PE conductor must not be smaller than that of the L and N conductors. The cable must be suitable for a temperature of at least 70 °C (158 °F) and must be approved for the country of use or the location.

A readily accessible facility for mains disconnection must be provided in the immediate vicinity of the analyzer.

Bench-top unit

A power supply cable must be used which is approved for the country of use or the location. The minimum cross-section of each conductor must be at least 0.75 mm² as long as the maximum length of the cable does not exceed 2 m (6 1/2 ft). Longer cables require larger conductor cross-sections than 0.75 mm². The cable must at least be suitable for a temperature of 70 °C (158 °F).

When positioning the analyzer, make sure that the power connector at the rear is accessible at all times.

NOTICE**Disconnecting means**

The power supply cable also serves as the disconnecting means. Make sure that the cable is

- clearly recognizable
- easy to reach.

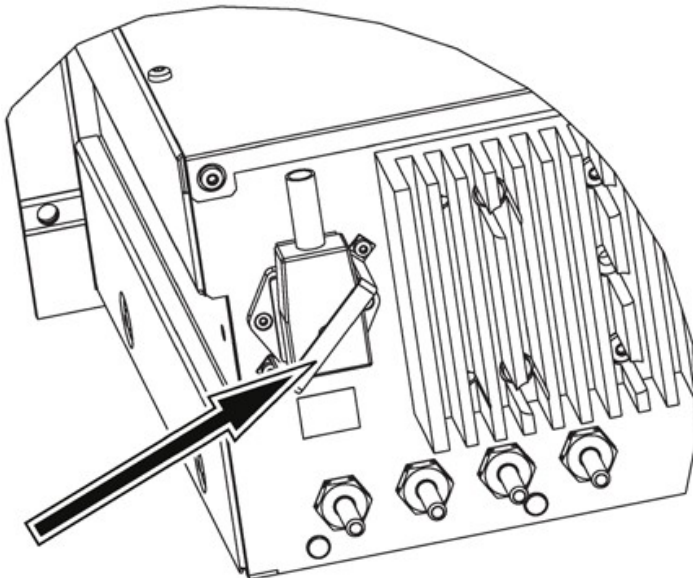
The cable length must not exceed 3 m.

Electrical circuit breaker in accordance with IEC 60947-1 and IEC 60947-3

In accordance with IEC 60947-1 "Standard for low-voltage switchgear and controlgear" and IEC 60947-3 "Switches, disconnectors, fuses" you require an electrical circuit breaker for the device. We recommend commercially available automatic circuit breakers.

**Ex analyzer**

The following applies to all devices in the hazardous area:



Analyzers envisaged for use in hazardous areas in accordance with CSA Class I Div. 2 must be provided with a safety bracket which protects the power connector from being unintentionally disconnected (see arrow in above picture). This bracket is enclosed loose with the analyzer and must be attached before switching on.

5 Operation and control

5.1 Commissioning

5.1.1 General information

The analyzer has been parameterized and calibrated prior to delivery. However, a large number of parameters can be subsequently adapted to specific requirements using enubased functions.

The following sections provide you with information on the display and operator panel as well as the operating modes. You will learn how to scan analyzer statuses, how to calibrate the analyzer, and how you can enter or modify parameters.

The input sequences are described using the maximum configuration. If your analyzer has a different configuration (different measured components, number of infrared ranges, UV photometer without infrared measurement, no oxygen sensor, no pump, no serial interface, etc.), the explanations can be applied accordingly.

The used numbers must be considered as examples. They therefore probably differ from the values displayed on your analyzer. The corresponding line remains empty if components are not present in your analyzer.

If analyzers are installed in closed analysis cabinets, opening the cabinet door may result in brief drifting of the measured values. This is a result of the temperature exchange which then takes place.

5.1.2 Safety instructions

5.1.2.1 General information

WARNING



Hazardous contact voltage

Risk of injury through hazardous contact voltage when the device is open or not completely closed.

The degree of protection specified on the nameplate or in Technical specifications is no longer guaranteed if the device is open or not properly closed.

- Make sure that the device is securely closed.

CAUTION



Loss of type of protection

Damage to device if the enclosure is open or not properly closed. The type of protection specified on the nameplate or in Technical specifications is no longer guaranteed.

- Make sure that the device is securely closed.

WARNING



Commissioning and operation with pending error

If an error message appears, correct operation in the process is no longer guaranteed.

- Check the gravity of the error.
- Correct the error.
- If the error still exists:
 - Take the device out of operation.
 - Prevent renewed commissioning.

5.1.2.2 Use in hazardous areas

DANGER

Explosion hazard

If a flammable or ignitable atmosphere exists, plugs must never be disconnected or lamps/fuses replaced when the analyzer is supplied with power.

CSA Class I Div. 2 and ATEX Zone 2

The following safety and warning information applies to analyzers (special versions) which are operated in accordance with CSA Class I Div. 2 (hazardous locations) and ATEX Zone 2:

WARNING

Potentially explosive atmosphere

Do not open, service or repair in an area in which a potentially explosive atmosphere may be present.

ATEX Zone 2

The following applies to devices (special versions) which are operated according to ATEX in Ex zone 2:

DANGER

Explosion hazard

The BA 5000 gas analyzers for use in Ex zone 2 must be installed in a lockable enclosure. This enclosure must comply with the requirements of EN 60079-15 and must be designed for all ambient conditions which can occur during operation. This enclosure only be opened using a tool (e.g. a key).

The maximum ambient temperature is 50 °C.

Suitable measures must additionally be applied to ensure that

- the generation of potentially explosive gas mixtures inside the analyzer does not exceed the level of Zone 2
- interferences cannot lead to a deviation of more than 40% from the rated voltage.

5.1.2.3 Use in biogas plants

DANGER

Danger of poisoning



This device is designed to measure hydrogen sulfide and dihydrogen sulfide, H₂S! Hydrogen sulfide is highly toxic even in small concentrations! The odor threshold for hydrogen sulfide is very low at 0.02 vpm (20 vpb), but higher concentrations result in numbing of the olfactory receptors in the nose so that the odor is no longer perceived. Persons exposed to this gas in concentrations up to 100 vpm for several hours exhibit symptoms of poisoning such as fatigue, headaches, lack of appetite, lack of concentration, irritation of the mucous membranes of eyes and respiratory tract, and throat irritations.

Inhalation of H₂S concentrations of 500 vpm longer than 30 minutes can cause fatal poisoning. Concentrations above 1 000 vpm cause death within a few minutes, concentrations above 5 000 vpm cause death within a few seconds!

When using this device in plant where there may be high concentrations of H₂S and you therefore need to take following continual precautions to prevent the effects of poisoning:

- Connect the gas outlet of the analyzer to a gas exhaust unit so that no gas can escape into the environment!
- Before you begin maintenance on the analyzer, make sure that the H₂S concentration in the analyzer is close to 0 vpm. Before beginning work, always flush the gas path of the analyzer and the gas sampler with ambient air or nitrogen for a duration of about 10 minutes .
- Check for leaks in the analyzer at regular intervals!

DANGER

Danger of explosion



This device is used in biogas plants, among other places. When it is used in biogas plants, you should expect that the sample gas will contain methane, which forms explosive mixtures with oxygen or air in certain concentrations. These conditions are possible with certain operating states of the plant.

5.1.3 Preparation for commissioning

5.1.3.1 Leaks in the gas paths

Checking for leaks is most easily performed by connecting a U-tube manometer to the sample gas inlet. You can check for leaks as follows:

1. Block the sample gas outlet
2. Create an overpressure of around 150 hPa (rel.) at the sample gas inlet.
3. Wait for about 60 seconds for the temperature of the incoming gas to be compensated.
4. Read the pressure on the manometer and note it
5. Wait a further 15 minutes and note the pressure again after this period.
6. Compare the two pressure values.

The sample gas path is sufficiently tight when the pressure has changed by no more than 2 hPa (2 mbar) over 15 minutes.

For analyzers with H₂S sensors:

The sample gas path is sufficiently tight when the pressure has changed by no more than 5 hPa (5 mbar) over 15 minutes.

NOTICE**Damage to the analyzer chambers**

If you apply a pressure above the maximum value, the bonding of the analyzer chamber windows could be broken. Discharge of sample gas is possible. Please observe the pressure data in the section Technical specifications.

5.1.3.2 Gas preparation

Make all gas preparation elements upstream of the analyzer (gas sampling devices, gas cooling devices, condensation vessels, filters, and any connected controllers, recorders or indicators) ready for operation. Refer to the associated operating instructions.

5.1.3.3 Device interfaces

Check that all device interfaces (see Communication) are properly assigned and configured.

5.1.4 Commissioning

Once all preparatory work for commissioning has been completed, go through the following checklist:

- The analyzer is set to the correct operating voltage
- All gas preparation elements are connected and ready for operation, and have been checked for leaks
- All required connections to and from the analyzer have been established

Following successful checking, connect the analyzer to the power supply and switch it on.

Wait for the warm-up phase to elapse (see Warm-up phase).

5.1.4.1 AUTOCAL

The analyzer carries out an automatic calibration with the connected medium during the warm-up phase following switching-on. This AUTOCAL adjusts the zero point and sensitivity of the IR and UV sample gas components. If an O₂ sensor is present, its sensitivity is additionally calibrated using the ambient air (20.95 % O₂).

NOTICE**Analyzers with H₂S sensor**

The hydrogen sulfide sensor is not calibrated during the course of this first AUTOCAL. The zero point of the H₂S sensor is only calibrated starting from the second AUTOCAL of the analyzer.

NOTICE**Analyzers without electrochemical O₂ sensor**

In the case of analyzers without an electrochemical O₂ sensor, the AUTOCAL can be carried out with nitrogen, but in the case of analyzers with an electrochemical O₂ sensor, it is essential to use air. The correct medium is selected depending on the used configuration (gas connections) and cannot be parameterized using the software.

NOTICE**Analyzers with paramagnetic O₂ sensor**

In the case of analyzers with a paramagnetic O₂ sensor, the input menu can be used to select whether the AUTOCAL is to be carried out with air or N₂, and thus whether the sensitivity (20.95 % O₂) or the zero point of the sensor is calibrated.

NOTICE**Analyzers with small CO₂ measuring ranges**

In the case of analyzers with small CO₂ measuring ranges, it is necessary to connect the chopper section purging. This can be carried out with nitrogen or synthetic air with an inlet pressure of 300 ... 350 kPa (3 ... 3.5 bar). The purging equipment must be connected at least 30 min before switching on in order to guarantee good purging of the analyzer unit.

You can manually trigger an AUTOCAL during operation by pressing the CAL key or also activate an AUTOCAL via the binary input or the communication interface. The analyzer can also execute an AUTOCAL cyclically, i.e. at regular intervals.

Duration

The duration of the AUTOCAL depends on various factors. It is

- Approx. 12 minutes for analyzers with H₂S sensor
- Approx. 3 minutes for analyzers with O₂S sensor
- Approx. 2 minutes for analyzers that measure IR and UV components exclusively

This is made up as follows:

- Twice the set purging time (see Calibration: AUTOCAL/drift values: Purge time)
- Duration of the internal electronic adjustment (corresponds to two and a half times the time constant T₉₀ within (see Parameters: Time constants).

NOTICE



An AUTOCAL is carried out twice during the warm-up phase; the first time approx. 5 min after switching on, and the second time after approx. 30 min.

5.1.4.2 Initial calibration

Initial calibration with calibration gas

Following installation of the analyzer, we recommend a calibration using calibration gas (see Calibration). The calibration should be carried out with a gas containing a sufficient concentration of the measured component (between 70 and 100 % of the full-scale value in nitrogen or synthetic air).

NOTICE



The calibration gas is connected via the sample gas path.

The analyzer must have been in operation for at least 30 minutes before commencing with measurements since a good stability of the analyzer unit is only guaranteed after this time (99% value).

Make sure that the gas flow is between 1.2 and 2.0 l/min.

Any noise which may occur can be suppressed by adjusting various time constants (see Parameters: Time constants).

The calibration should be repeated every six to twelve months depending on the ambient conditions.

5.1.5 System setup with several analyzers in parallel

Example 1

Both analyzers with internal pump and solenoid valve switching between sample gas and zero gas for AUTOCAL

The cyclic AUTOCAL of the master device triggers an AUTOCAL in parallel for the slave device via its digital output SYNC and the digital input SYNC of the slave device.

The simultaneous connection between the digital output SYNC of the slave device and the digital input SYNC of the master device guarantees that zero gas is always passed simultaneously through both analyzers.

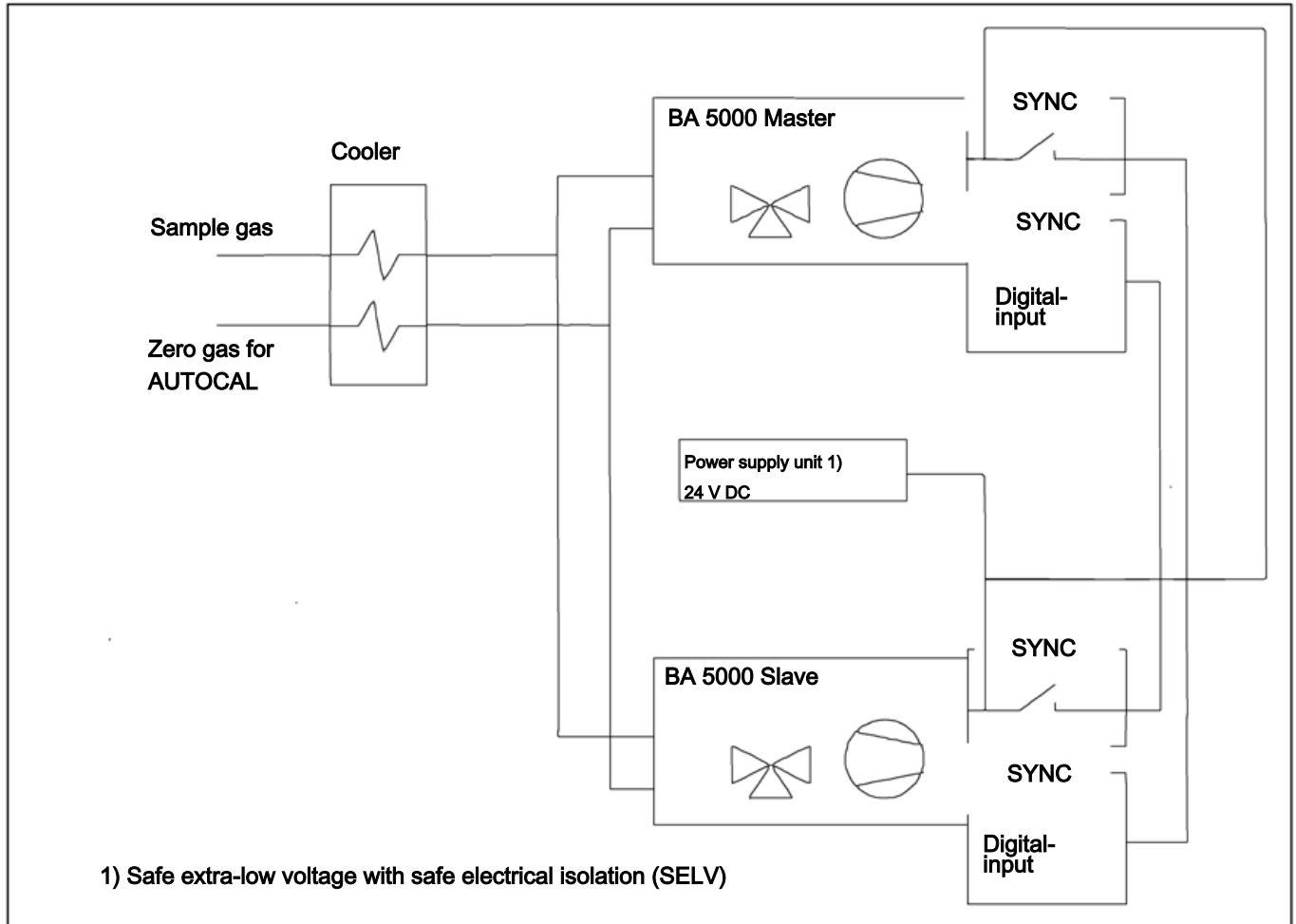


Fig. 30: Parallel connection without internal pump and solenoid valve switching

Parameter assignments

The two analyzers must be parameterized as follows:

Master:

- Enter the AUTOCAL cycle time, e.g.: 6 hours (see Calibration: AUTOCAL/drift values: Cycle time).
- Assign the "Sync." function to a relay (see Calibration: AUTOCAL/drift values: Cycle time).
- Assign the "Only CAL contact" function to the digital input SYNC (see Configuration: Inputs/outputs/pump: Binary/sync inputs).

Slave:

- Set the AUTOCAL cycle time to "0" to prevent a cyclic AUTOCAL from being triggered (see Calibration: AUTOCAL/drift values: Cycle time).
- Assign the "Sync." function to a relay (see Configuration: Inputs/outputs/pump: Assign relays).
- Assign the "AUTOCAL" function to the digital input SYNC (see Configuration: Inputs/outputs/pump: Binary/sync inputs).

Example 2**Both analyzers without internal pump and without solenoid valve switching between sample gas and zero gas for AUTOCAL**

Via a digital output, the master controls a solenoid valve for switching between sample gas and zero gas for the AUTOCAL.

The cyclic AUTOCAL of the master device triggers an AUTOCAL in parallel for the slave device via its digital output SYNC and the digital input SYNC of the slave device.

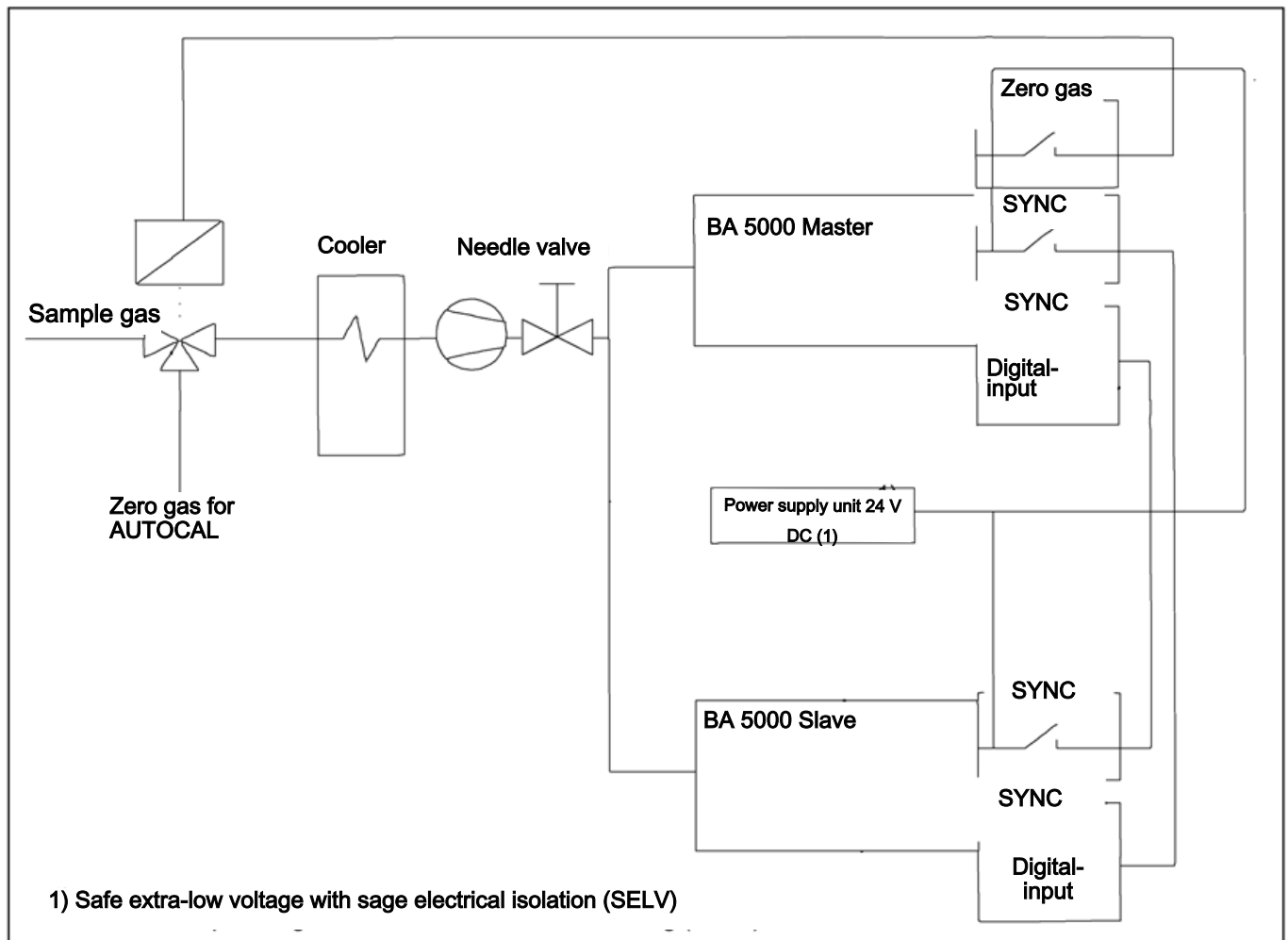


Fig. 31: Parallel connection without internal pump and solenoid valve switching

Parameter assignments**Master:**

- Enter the AUTOCAL cycle time, e.g.: 6 hours (see Calibration: AUTOCAL/drift values: Cycle time).
- Assign the "Sync." function to a relay (see Configuration: Inputs/outputs/pump: Assign relays).
- Assign the "Zero gas" function to a relay (see Configuration: Inputs/outputs/pump: Assign relays).
- Assign the "Only CAL contact" function to the digital input SYNC (see Configuration: Inputs/outputs/pump: Binary/sync inputs).

Slave:

- Set the AUTOCAL cycle time to "0" to prevent a cyclic AUTOCAL from being triggered (see Calibration: AUTOCAL/drift values: Cycle time).
- Assign the "Sync." function to a relay (see Configuration: Inputs/outputs/pump: Assign relays).
- Assign the "AUTOCAL" function to the digital input SYNC (see Configuration: Inputs/outputs/pump: Binary/sync inputs).

5.2 Operation

5.2.1 General information

The analyzer has been parameterized and calibrated prior to delivery. However, a large number of parameters can be subsequently adapted to specific requirements using menu-based functions.

The following sections provide you with information on the display and operator panel as well as the operating modes. You will learn how to scan analyzer statuses, how to calibrate the analyzer, and how you can enter or modify parameters.

The input sequences are described using the maximum configuration. If your analyzer has a different configuration (different measured components, number of infrared ranges, UV photometer without infrared measuring ranges, no oxygen sensor, no pump, no serial interface, etc.), the explanations can be applied accordingly.

The used numbers must be considered as examples. They therefore probably differ from the values displayed on your analyzer. The corresponding line remains empty if components are not present in your analyzer.

If analyzers are installed in closed analysis cabinets, opening the cabinet door may result in brief drifting of the measured values. This is a result of the temperature exchange which then takes place.

CSA Class I Div. 2 and ATEX Zone 2

WARNING



Potentially explosive atmosphere

The analyzer keys must not be pressed if a potentially explosive atmosphere may be present. If operation using the keyboard is necessary, a hot work permit is absolutely essential.

5.2.2 User prompting

In the next sections, operation of the BA 5000 is explained according to the following scheme:

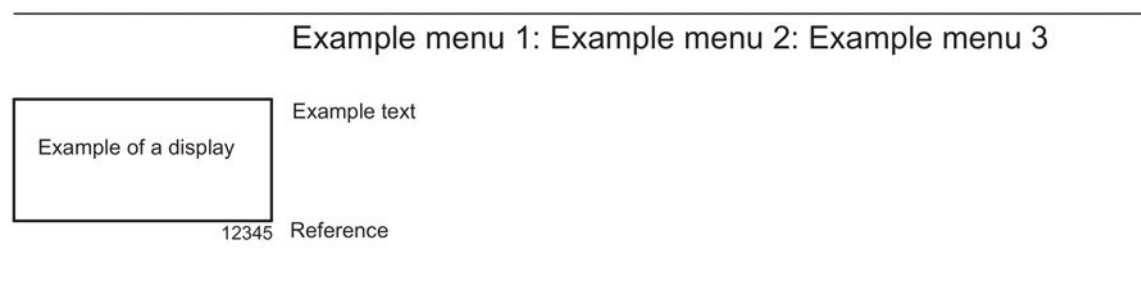


Fig. 32: User prompting

The heading of the respective section indicates the complete menu path, starting from the main menu, on which the shown display can be reached (see section Display and control panel). The various menu levels are separated from one another by colons. The display, as it appears on the analyzer, is shown to the left of the text. The accompanying text explains the display, including inputs and instructions if necessary, e.g.:

- You can start the function using the <ENTER> key.
- You can terminate the function using the <ESC> key.

You can recognize the position of the cursor in the display in these instructions in that the corresponding character is printed in bold type and underlined (in this display: Example).

The number on the right below the display, (12345 in this case) is used as a cross-reference to the summaries of all menus and dialogs which precede sections Diagnostics to Configuration in order to facilitate the locating of the described display in these overviews. A reference may be made that the respective function is protected by a code level (see section Code levels) or is specific to a component. In the case of functions specific to a component, you must enter the measured components (up to four) for which you wish to call the respective function.

5.2.3 Display and control panel

5.2.3.1 Display and operator panel

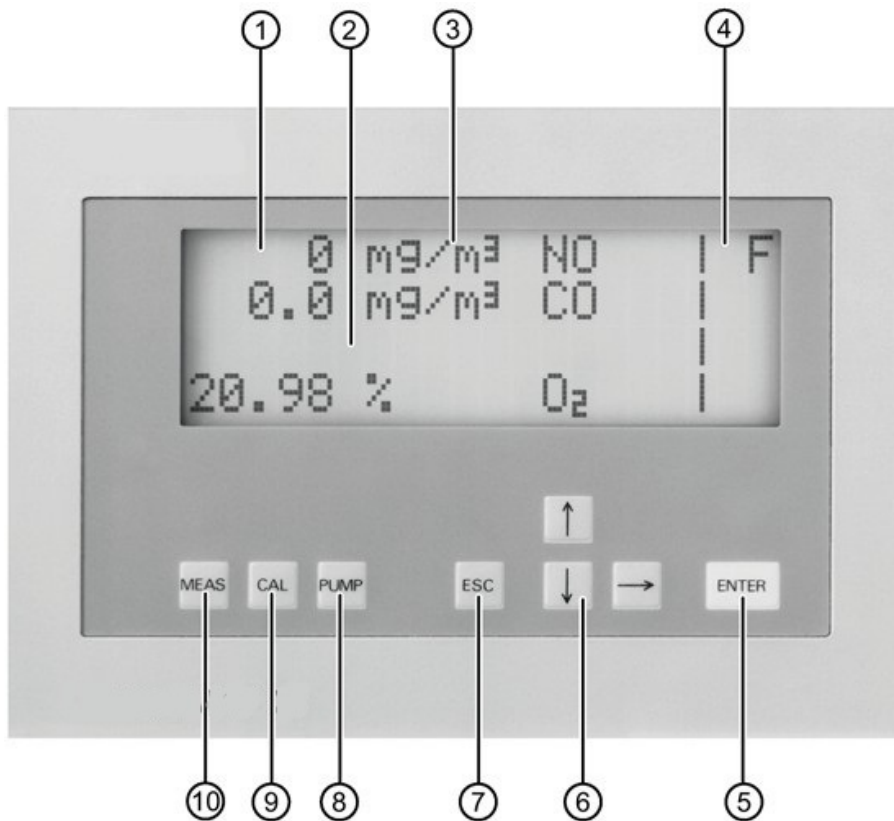


Fig. 33: Operator panel

1. One line per component for measured value, dimension and ID
2. LED-backlit display; contrast adjustable using menu
3. Freely-selectable dimension (ppm, vpm, mg/m³, %)
4. Two columns are reserved for status displays
5. ENTER key for calling the main menu or saving the input values
6. ↑↓→ keys for menu control and for incrementing/decrementing numerical values
7. Scrolling back in menu or cancellation of an input
8. Switching on and off of internal pump, pumping capacity adjustable using menu
9. Key for starting AUTOCAL
10. Immediate return to measuring mode

NOTICE

Energy saving



The display brightness is reduced after approx. 30 minutes without an operation. This serves for energy saving and has no influence on the other properties of the device. The display becomes bright again when you continue with operation.

The display is a backlit liquid crystal display with four lines with 20 characters each (5 x 8-dot matrix) and is covered by a foil. One line is reserved for each measured component in the display. The line displays from left to right: measured value, dimension, and name of component. The last two positions of each line are reserved for displaying certain analyzer statuses. The meanings of these characters depend on the set language. The meanings are as follows:

Description	German	English	French.	Spanish	Italian	Polish
Maintenance request (display lights up permanently)	A	M	D	P	R	S
Fault present (display lights up permanently)	S	F	F	A	E	U
Limit violated (display lights up permanently)	G	L	L	L	S	O
Fault logged which is no longer present * (display lights up permanently)	!	!	!	!	!	!
Remote control (display lights up permanently)	R	R	R	R	F	Z
Function control: • Analyzer is uncoded • Access via RS485 serial interface • AUTOCAL or warm-up phase running (display flashes)	F	C	C	F	C	C
Pump running (display lights up permanently) or flow fault (display flashes)	P	P	P	B	P	P
Analyzer is uncoded (display flashes)	U	U	U	D	N	K
* In the case of analyzers with an H ₂ S probe, the following statuses can be displayed at the position for the fault which is no longer present						
Protection function of H ₂ S probe running (display lights up permanently)	H	H	H	H	H	H
Protection function of H ₂ S probe running, H ₂ S measured value is invalid (display flashes)	V	V	V	V	V	V

5.2.3.2 User interface

The BA 5000 has a menu-based user interface. The menu structures can always be represented as follows:

MAIN MENU → Submenu 1 → Submenu 2 → Submenu 3 → Submenu 4. The following Fig. shows a diagram of the basic configuration of the user interface.

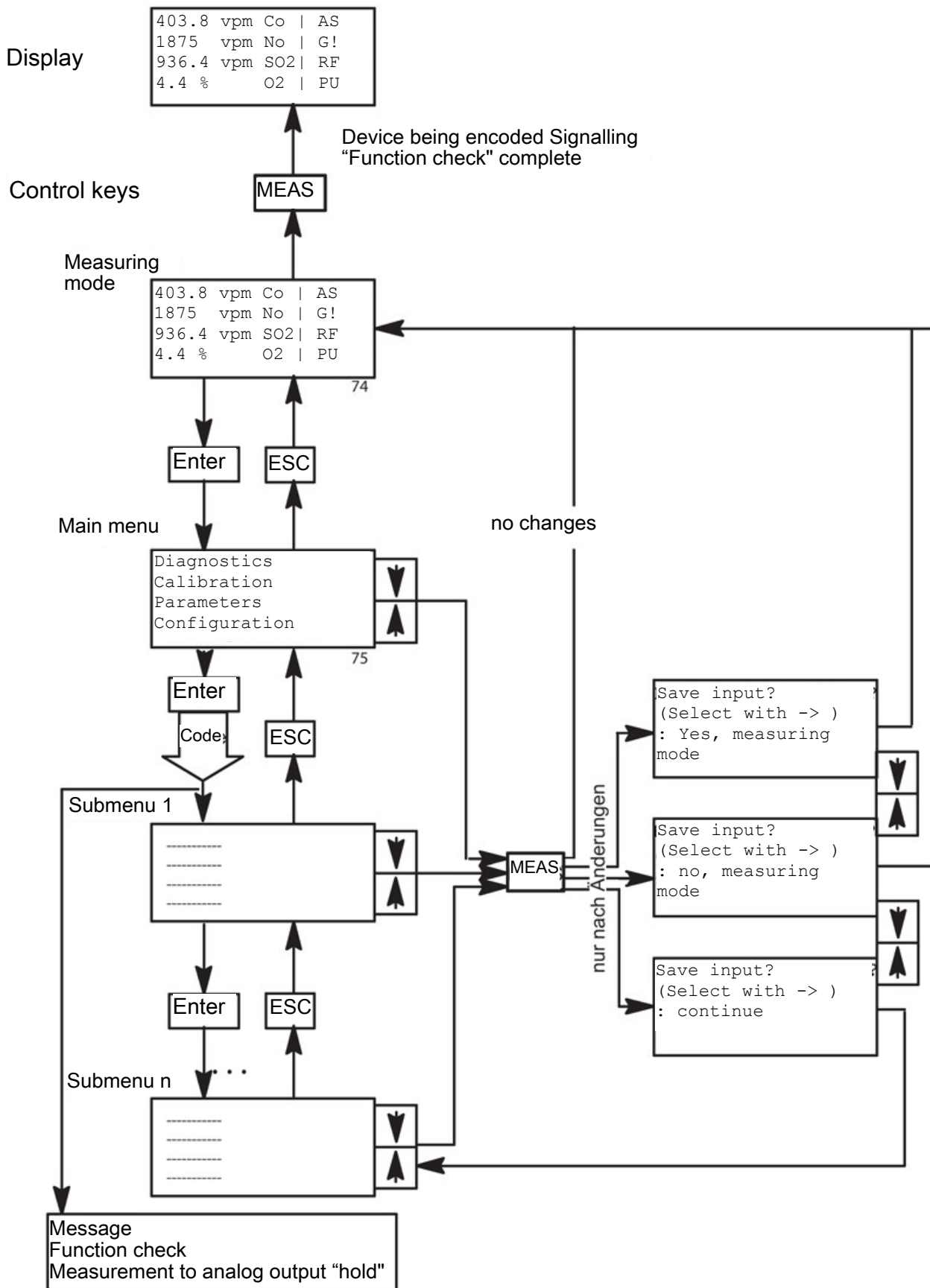


Fig. 34: Menu structure of the BA 5000

5.2.3.3 Key assignments

Eight keys are available for operating the BA 5000. These keys have the following meanings:

No.	Designation	Description	Function
1*	MEAS	Measure	Measure; abort input operations; leave input mode (from any menu level); switch from input mode to measuring mode and code analyzer again
2	CAL	AUTOCAL	Automatic calibration: activation of calibration with ambient air or nitrogen
3*	PUMP	Pump	Switch internal sample gas pump on/off
4	ESC	Escape	In input mode: return by one menu level or cancel current input or cancel calibration*
5	↑	Up arrow	Increase selected digit; select previous menu item
6	↓	Down arrow	Reduce selected digit; select next menu item
7	→	Right arrow	Move input cursor by one position to right (cyclic, i.e. the cursor is set to the left edge when the right edge has been reached)
8	ENTER	Enter	In measuring mode: switch over to input mode; in input mode: import entered parameters or call a menu item

* The input is suppressed if certain conditions are fulfilled. A corresponding message is then output briefly on the display.

You can use the arrow keys to modify numerical values by increasing or decreasing the digit at which the cursor is located. The digits are modified continuously, i.e. 0 follows again after digit 9. You can also decrement to 9, 8... following digit 0. The analyzer outputs the value FFF... if incorrect numbers are entered.

Use of the <MEAS>, <ESC>, and <ENTER> keys is described using examples in section Key operations step by step. Use of the <CAL> key is described in section The CAL key, use of the <PUMP> key in section The PUMP key.

5.2.4 Operating modes

During operation, the analyzer is always in one of following operating modes:

- In the **warm-up phase** (see section Warm-up phase)
- In **measuring mode** (see section Measuring mode)
- In **input mode** (see section Input mode)

5.2.4.1 Warm-up phase

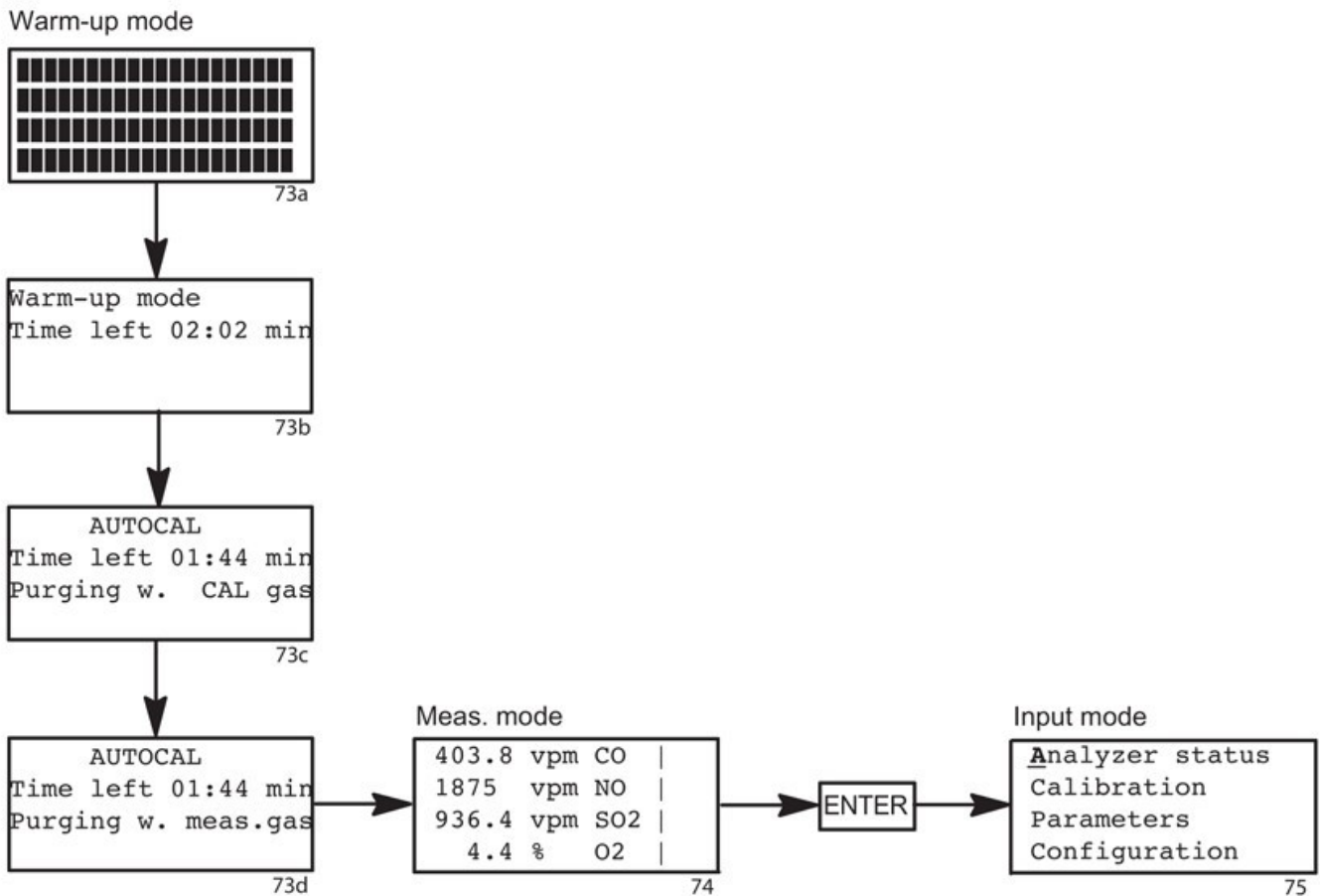
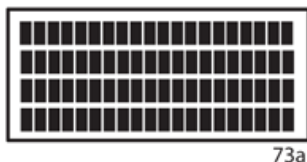
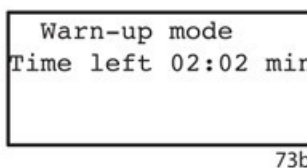


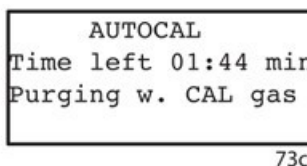
Fig. 35: Warm-up phase, measuring mode, and input mode



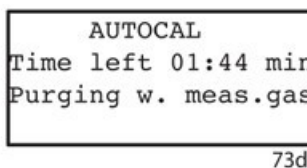
Immediately following switching-on, the BA 5000 tests the display elements. During this test, all elements light up simultaneously for approx. five seconds.



The adjacent display subsequently appears with the remaining warm-up period which is counted down in seconds to 00:00 (minutes:seconds).



The analyzer initially carries out an AUTOCAL during the warm-up phase. The flow of AUTOCAL gas (nitrogen or air) is displayed in the bottom line, and the remaining time is shown in the line above this. This calibration cannot be interrupted.



Following the calibration, the analyzer switches to purging with sample gas. At the end of the purging phase, the analyzer switches to measuring mode; however, full measuring accuracy is only reached after approx. 30 min if a further AUTOCAL has been automatically carried out by the analyzer. The warmup phase is then finished.

5.2.4.2 Measuring mode

403.8 vpm CO		
1875 vpm NO		
936.4 vpm SO2		
4.4 % O2		P

74

The measured components are output on the display together with their values and the units in mg/m³, vpm or volume percent. With a change in the analyzer status, the corresponding letter appears in the last two columns ("P" in the example; see also Display and control panel). The analyzer remains in measuring mode until an AUTOCAL (automatic, remote-controlled or manual) is carried out or until you manually switch the analyzer to input mode. If analyzers are installed in closed analysis cabinets, opening the cabinet door may result in brief drifting of the measured values. This is a result of the temperature exchange which then takes place.

***** vpm CO		
1875 vpm NO		
936.4 vpm SO2		
4.4 % O2		P

74a

If "*****" is displayed in measuring mode without a fault being present, this means:

- Concentration in sample gas more than 5% higher than the largest measuring range
- Signal saturation resulting from excessively high sample gas concentrations

5.2.4.3 Input mode

In input mode, you can view instrument parameters or calibrate and parameterize the analyzer.

CAUTION



Unauthorized operation

The analyzer must only be calibrated and/or parameterized by trained specialists with adherence to these operating instructions.

Analyzer status
Calibration
Parameters
Configuration

75

Once you have selected input mode, the first menu to appear is the main menu which displays four menu items. You can use these to select the individual input functions of the BA 5000:

Analyzer status

With these functions you can call submenus which provide information on the analyzer status, e.g. entries in the logbook, diagnostics data, and factory data (see Diagnostics for menu structure).

Calibration

With these functions you can calibrate the zero and sensitivity of the analyzer using calibration gas (see Calibration for menu structure).

Parameters

With these functions you can match the analyzer functions to your specific application, e.g. by entering limits, measuring ranges, and time constants (see Parameter for menu structure).

Configuration

With these functions you can define the assignments of the analyzer interfaces etc., e.g. the assignments of relays and current outputs (see Configuration for menu structure).

5.2.4.3.1 Code levels

The BA 5000 is provided with two code levels to protect against unauthorized or unintentional inputs. As soon as you call a function protected by a code for the first time, you will be requested to enter the three-digit code. With the introduction of firmware version 2.15.06, you can now use letters and special characters for the code in addition to numbers.

NOTICE



You should change the factory-set codes once you have become acquainted with operation of the BA 5000 (see section Configuration: Special functions: Changing the codes/language).

The lowest code level (level 1) is factory-set to "111", and the higher level (level 2) to "222".

The following are protected by code level 1:

- The dialogs "Logbook/faults" and "Maintenance requests" in the menu "Analyzer status", submenu "Status",
- the menu "Calibration", and
- the menu "Parameters".

The following is protected by code level 2:

- The menu "Configuration".

NOTICE



If the analyzer requests that you enter code level 1, you can enter the code for level 2 instead to release this level. Level 1 is then enabled simultaneously. Level 1 is automatically enabled as soon as the higher code level 2 has been enabled.

Following input of a code, inputs are possible until the analyzer is recoded.

NOTICE



In order to code the analyzer again when the input procedures have been finished (to protect against unauthorized and unintentional interventions), press the **<MEAS>** key in measuring mode.

5.2.4.3.2 Key operations step by step

This section describes operation of the analyzer with the keys of the operator panel using an example.

```
403.8 vpm CO |
1875 vpm NO  |
936.4 vpm SO2|
 4.4 %   O2  |
```

The analyzer is in measuring mode (see section Measuring mode).

```
ENTER
```

Change from measuring mode to input mode by pressing the **<ENTER>** key.

```
Analyzer status
Calibration
Parameters
Configuration
```

You first access the main menu. A cursor flashes on the character "A" at the left edge of the first line.

- You can set the cursor to the start of each line using the **<↑>** and **<↓>** keys. Cursor movements are cyclic, i.e. if you move above the top edge of the display, the cursor appears again in the bottom line, and vice versa.
- Call the respective menu item by pressing the **<ENTER>** key.



The cursor is located at "P" when you have pressed the **<↓>** key twice.

```
Analyzer status
Calibration
PParameters
Configuration
```

ENTER

Now call the "Parameters" submenu by pressing the <ENTER> key.

```
Level 1 required
Please enter code
: 000
```

The adjacent display appears in which you will be requested to enter the code number for code level 1.

- You can change the value of the code digit to which the cursor is pointing using the <↑> and <↓> keys.
- Move to the next position of the code number using the <→> key. This function is also cyclic, and the cursor appears at the first position again when you move it beyond the last position.
- • Close the code input by pressing the <ENTER> key.

```
Level 1 required
Please enter code
: 111
```

```
Measuring ranges
Limit values
Time constants
Pump/LCD contrast
```

The initial display of the "Parameters" submenu appears.

ENTER

Press the <ENTER> again to call the "Measuring ranges" submenu.

```
Select component
: NO 1
```

Now select components 1 to 4 for which the subsequently set ranges are to apply. Up to four components can be present.

```
Select component
: CO 3
```

If your analyzer is configured accordingly, you can select another component by pressing one of the <↑> or <↓> keys. In this example, this is component 3.

Press the <ENTER> key. The analyzer switches one level lower and now offers functions applicable to the selected measuring range.

The adjacent display appears with the functions selectable for this range (MR). You can select these by pressing the <↑> or <↓> key, and branch to the selected function by pressing the <ENTER> key.

ENTER

```
Switch ranges CO
Change ranges CO
Hysteresis CO
```

```
Switch ranges CO
Actual range :1
MR 1:0. 250 mg/m3
MR 2:0. 1250 mg/m3
```

In this example, the adjacent display appears following selection of the function "Switch ranges CO".

The first line contains the heading, the second line the parameter and its value to be changed; the cursor is positioned in this line. Only supplementary information is present in lines 3 and 4.

To switch over the measuring range, proceed as follows:

- Press the <ENTER> key. The cursor jumps to the measuring range number which you can change using one of the <↑> and <↓> keys.
- The range definition is imported when you press the <ENTER> key again, and you return to the start of the line.

You cannot carry out any further settings here. To do so, you must leave the menu display again. This is possible:

ESC

By pressing the <ESC> key. You then return by one step in the menu sequence

MEAS

by pressing the <MEAS> key. You then have the following possibilities:

Accept input?
(select using ->)
: Back to the menu

To process the previous menu item further using
<ENTER>

Accept input?
(select using ->)
: Yes, meas. mode

- or return to measuring mode using <↑> or <-> and subsequently <ENTER>, where all modifications are imported which you have made since the last decoding operation,
- or return to measuring mode using <↓> and <ENTER> without importing the modifications...

Accept input?
(select using ->)
: NO, meas. mode

Accept input?
(select using ->)
: Back to the menu

Once you have carried out the above sequence on the analyzer, you are already acquainted with the important points for operation of the BA 5000.

5.2.4.3.3 The ESC key

You can trigger two different functions by pressing the <ESC> key:

- Firstly, you can cancel a commenced procedure, e.g.:
 - The input of a number
 - A calibration procedure with calibration gas
 - Any function if a fault occurs, e.g. if the flow of sample gas to the analyzer is missing.
- Secondly, you can use the <ESC> key to move to the next higher level in menu structure ("scroll back"). This procedure is the opposite to selection of a submenu using the <ENTER> key ("scroll forwards"). If you repeatedly press the <ESC> key, you return back to the main menu step-by-step. If you press the <ESC> key again in the main menu, the analyzer switches over from input to measuring mode. All inputs are imported at the same time. However, you will not be asked to confirm the inputs.

An example will clarify this:

```
403.8 vpm CO |
1875 vpm NO |
936.4 vpm SO2 |
 4.4 % O2 | U
```

The analyzer is in measuring mode and is uncoded.

```
Analyzer status
Calibration
Parameters
Configuration
```

Switch from measuring mode to input mode using <ENTER>, select the menu item "Parameters" using the <↑> or <↓> key, and press <ENTER> to confirm

```
Measuring ranges
Limit values
Time constants
Pump/LCD contrast
```

In this manner, you enter the first submenu. Now press <ESC> and then <ENTER> again. You have returned by one level and then moved forwards by one level again; you are therefore in the same menu again. Press the <ESC> key twice, you are back in measuring mode again.

```
403.8 vpm CO |
1875 vpm NO |
936.4 vpm SO2 |
 4.4 % O2 | U
```

5.2.4.3.4 The CAL key

If the analyzer is in measuring mode, pressing the <CAL> key triggers a single, automatic calibration with ambient air or nitrogen (AUTOCAL). The <CAL> key cannot be used during the warm-up phase.

If the flow is too low during a zero calibration triggered by pressing the key, the analyzer remains in this status until either the flow is sufficient or the zero calibration is aborted by pressing the <ESC> key. In addition to the <CAL> key, an AUTOCAL can also be triggered via the binary input. The binary input has priority over the key.

5.2.4.3.5 The PUMP key

If the analyzer is equipped with an internal sample gas pump, this can be switched on and off using the <PUMP> key. If the pump is switched off while the analyzer is in input mode, it is also switched on again by pressing the <MEAS> key if parameterized accordingly (see Configuration: Inputs/outputs/pump: Pump at CAL/MEAS). In addition to use of the <PUMP> key, the pump can also be switched on and off via the binary input. The binary input has priority over the key.

5.3 Functions

5.3.1 Diagnostics

In this function group you can view all analyzer data. The menu sequence in the following Fig. shows all submenus which can be accessed from the "Analyzer status" menu. The arrows lead by one menu item to the next lower menu level which is called by this menu item.

This display applies to analyzers without an H₂S sensor and without a paramagnetic O₂ sensor. The differences when using analyzers with one of these sensors are described in section Diagnostics: Diagnostic values. Dashed lines apply to analyzers with a UV photometer.

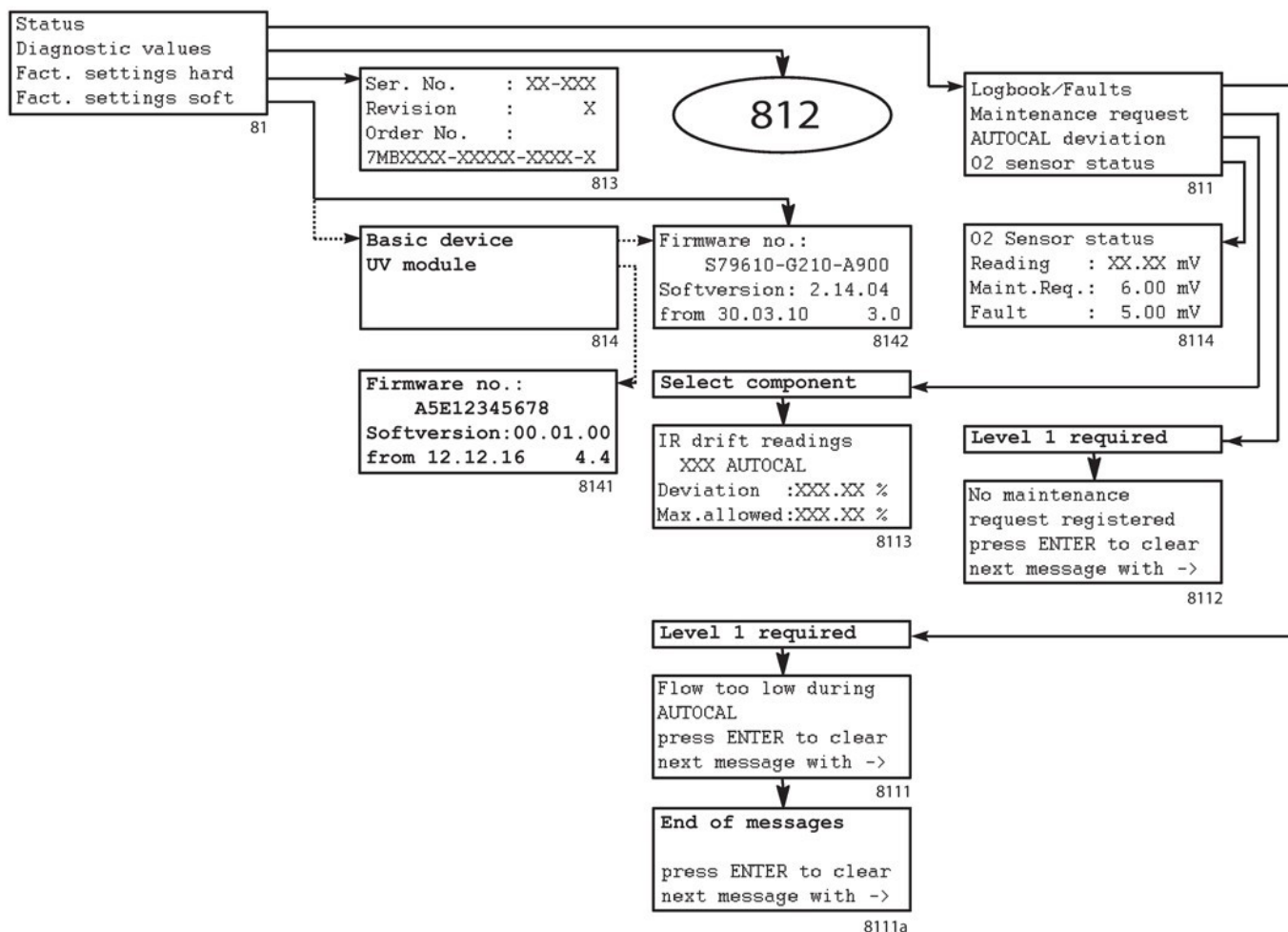


Fig. 36: Overview of diagnostic parameters

This overview contains all parameters of an analyzer that has both an IR detector and a UV photometer. If only one of these detectors is present, this overview begins at menu screen 812b (IR) or menu screen 812c (UV). Parameters marked with a footnote (*) are contained here in the display for the IR detector. The differences in the display for the UV photometer are described there (section Diagnostics: Diagnostic values: UV).

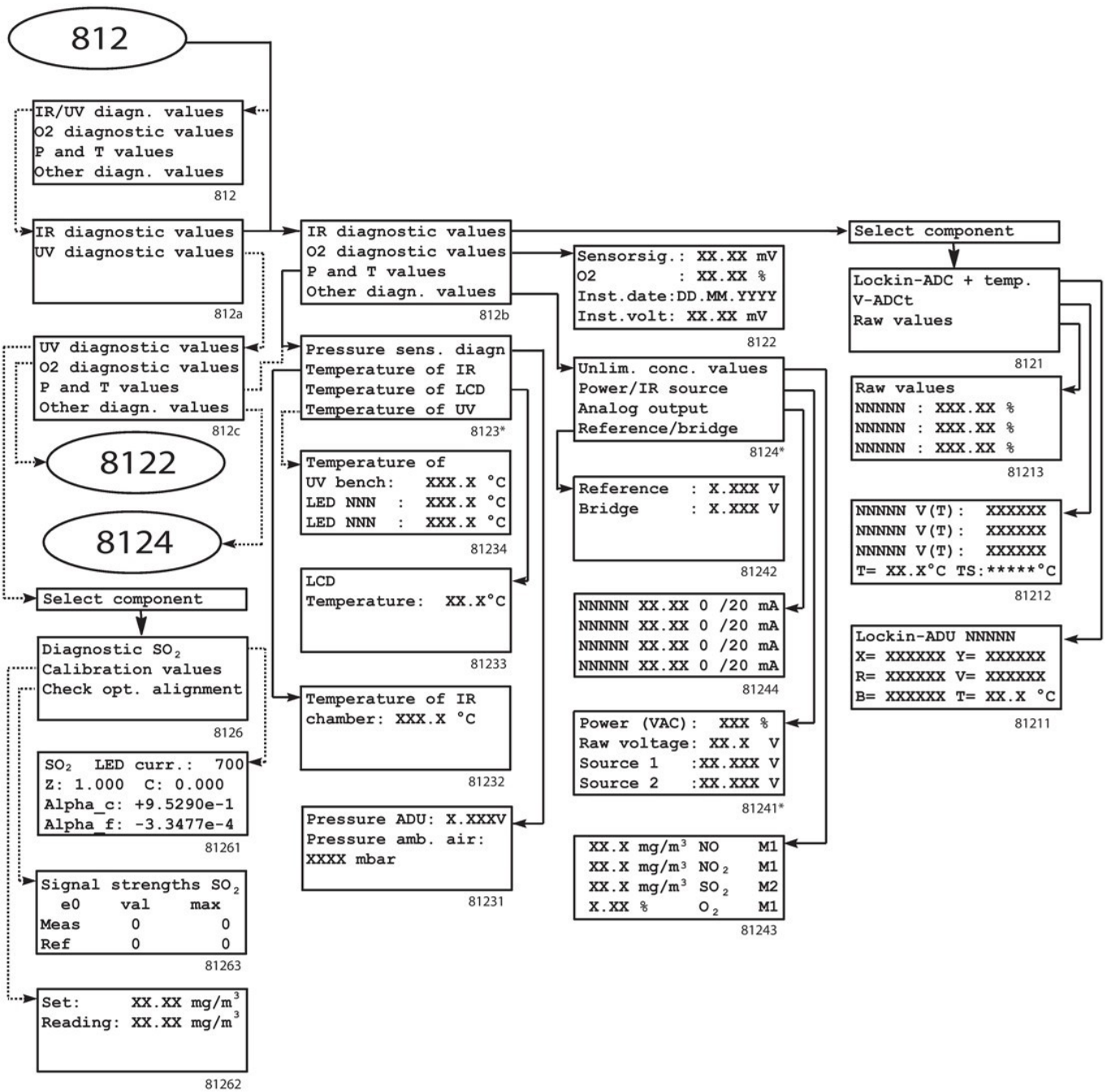


Fig. 37: Overview of diagnostic values submenu

5.3.1.1 Diagnostics: Status

```
Logbook/faults
Maintenance request
AUTOCAL deviation
O2 sensor status
```

In this menu you can call all status messages of the BA 5000 via further submenu items.

In this example, the status of the O₂ sensor is shown in the last line. If the analyzer is equipped with software for operating an H₂S sensor, the text 'Probe status' is shown in the last line with the following options:

- 811 • Only H₂S sensor: The analyzer calls this function directly.
- H₂S and O₂ sensors: You will be requested to select the associated sensor.

5.3.1.1.1 Analyzer status: Status: Logbook/faults

```
Mains voltage
beyond tolerance
Press ENTER to clear
Next message with ->
```

dialog displays the contents of a logbook. This contains all recorded faults. Each type of fault only appears once in the logbook and is output in plain text (an overview of the possible faults can be found in section Faults).

Viewing the logbook is protected by code level 1.

8111 Following access to the logbook you can:

- Delete the currently displayed fault using the <ENTER> key. If further faults are present, these appear in succession. You should delete all fault messages whose causes have been eliminated.
- Display all recorded faults in succession using the <-> key.

Note

By deleting the fault message you do not eliminate the cause of the fault (see section Faults). A corresponding text is output when all stored faults have been displayed. Terminate display of the logbook using the <-> key.

```
End of messages
press ENTER to clear
next message with ->
```

Note

8111a If the analyzer is in measuring mode, you can recognize the occurrence of a fault in that an "F" appears at the right edge. A "!" at the right edge signals that a fault has been logged which is no longer present.

5.3.1.1.2 Analyzer status: Status: Maintenance request

```
AUTOCAL drift
beyond tolerance
Press ENTER to clear
Next message with ->
```

This dialog indicates the logged maintenance requests. A maintenance request is set if the values of certain parameters have reached defined limits, but the analyzer is still able to measure (e.g. AUTOCAL deviation or O₂ sensor status; see also section Analyzer status: Status: O₂ sensor status). A corresponding message is output in alphanumeric text.

8112 Access is protected by code level 1.

Following access to the maintenance request list you can:

- Display all recorded faults in succession using the <-> key
- Delete the currently displayed fault message using the <ENTER> key. If present, the next maintenance request is then displayed. You should delete all maintenance requests whose causes have been eliminated.

Note

If the analyzer is in measuring mode, you can recognize the occurrence of a maintenance request in that an "M" appears at the right edge.

5.3.1.1.3 Analyzer status: Status: AUTOCAL deviation

```
IR drift readings
1 AUTOCAL
Deviation      : 2.22 %
Max. allowed: 6.00 %
```

8113

This dialog indicates the deviation in setpoint between several AUTOCAL procedures. The parameters have the following meanings:

- The text in the two top lines provides information on the number of AUTOCAL procedures which have been carried out since the reference value for AUTOCAL was last set (see section Configuration: Special functions: AUTOCAL deviation).
- Deviation is the measured deviation of the actual value from the reference value, displayed in % of the set measuring range (with autoranging, range 1 is assumed). This deviation must not be above the set maximum value.
- Max. allowed is the maximum permissible value for the deviation. Refer to section Configuration: Special functions: AUTOCAL deviation for setting the maximum value.
- This function is specific to the component.

5.3.1.1.4 Analyzer status: Status: O2 sensor status

```
O2 sensor status
Reading:      11.11 mV
Maint. req:   6.00 mV
Fault:        5.00 mV
```

8114

The probe voltage of the O₂ sensor is reduced during use due to its aging process. Therefore the probe voltage is measured with each AUTOCAL. A warning (maintenance request) is output if the value drops below 6.0 mV. The oxygen sensor should therefore be replaced when this value is reached. An exact measurement is no longer possible if the probe voltage falls below the minimum value of 5.0 mV (fault message "Sensitivity of O₂ sensor too low").

- The reading (actual value) is the probe voltage measured on the sensor during the last AUTOCAL.
- The warning (maintenance request) and fault are the two minimum values where a maintenance request or fault message is output when fallen below.

5.3.1.1.5 Analyzer status: Status: H2S sensor status

```
H2S sensor status
Reading:      747.00 nA
Maint. req : 373.50 nA
Fault:        298.80 nA
```

8115

The H₂S sensor ages with increasing operating time, thereby steadily decreasing its sensitivity. If a value below the minimum value for a warning is determined during calibration of the sensitivity, the service life of the sensor has almost been reached (maintenance request). If the sensitivity drops further below the value for a fault, the fault message "Sensitivity of H₂S sensor too low" is output. The sensor must then be replaced.

- The reading (actual value) is the sensor sensitivity measured during the last sensitivity calibration.
- The warning (maintenance request) and fault are the two minimum values where a maintenance request or fault message is output when fallen below.

5.3.1.2 Diagnostics: Diagnostics values

The diagnostic values provide important information for troubleshooting and adjustments. Depending on your analyzer version, the starting menu may be different.

```
IR/UV diagn. values
O2 diagnostic values
P and T values
Other diagn. values
```

812

If the analyzer has an IR detector and a UV photometer, the adjacent menu screen appears. After selection of the 'IR/UV diag. values' parameter, the following prompt appears::

```
IR Diagnostic values
UV Diagnostic values
```

812a

This prompt asks whether the diagnostic values apply to IR-active or UV-active components.

- IR diagnostic values: After the prompt, the menu branches to section Analyzer status: Diagnostics values: IR.
- UV diagnostic values: After the prompt, the menu branches to section Diagnostics: Diagnostic values: UV.

```
IR diagnostic values
Sensor diagn. values
P and T values
Other diagn. values
```

812d

If the analyzer contains software for H₂S measurement, the adjacent display appears. The following versions are possible following selection of the 'Probe diagnostic values' parameter in the 2nd line:

- Only H₂S sensor: After selection of this item, the menu branches to the diagnostic values of the H₂S sensor (section Analyzer status: Diagnostics values: H₂S sensor).
- H₂S and O₂ sensors: A query is made for the component, and a branch then made to the called sensor.

5.3.1.2.1 Analyzer status: Diagnostics values: IR

```
IR diagnostic values
O2 diagnostic values
P and T values
Other diagn. values
```

812b

This menu screen appears in the following cases:

- The analyzer has no UV photometer.
- In response to the prompt for whether the diagnostics applies to IR-active or UV-active components, IR-active components were selected.

```
Choose component
: NO2 2
```

You must first identify the component to which the diagnostic values are to apply. After the <ENTER> key is pressed, the following selection menu appears:

```
Lockin-ADU + temp.
V-ADUt
Raw values
```

8121

In this submenu you can call the diagnostics values of the infrared measuring ranges. These are:

```
Lockin-ADU S02
X= 408399 Y= 103444
R= 444912 V= 444872
B= 100116 T= 41.0°C
```

81211

ADU are voltage and signal values of the analog-to-digital onverter prior to temperature compensation. These values are specific to the component.

```
NO    V(T): 440206
CO    V(T): 505577
SO2   V(T): 494135
T: 42.2°C TS: ****°C
```

81212

V-ADUt are voltage and signal values of the analog-todigital converter following temperature compensation. T in the bottom line corresponds to the temperature of the analyzer unit, TS the temperature of the IR source (empty field = function not yet implemented, "*****" = no measured value present).

```
Raw values
NO    : 1.99 %
CO    : 0.27 %
SO2   : 5.08 %
```

81213

Raw values are the measured values in % of the full-scale value (= 100%).

5.3.1.2.2 Diagnostics: Diagnostic values: UV

```
UV diagnostic values
O2 diagnostic values
P and T values
Other diagn. values
```

812c

This menu screen appears in the following cases:

- The analyzer has no IR detector.
- In response to the prompt for whether the diagnostics applies to IR-active or UV-active components, UV-active components were selected.

```
Choose component
: SO2 1
```

UV diagnostic values:

Here you must first identify the component to which the diagnostic values are to apply. After the <ENTER> key is pressed, the following selection menu appears:

```
Diagnostic XXXX
Calibration values
Check opt. alignment
```

8126

Once you have selected the relevant component, the adjacent screen appears with further selection parameters.

```
SO2 LED curr.: 700
Z: 1.000 C: 0.000
Alpha_c: +9.5290e-1
Alpha_f: -3.3477e-4
```

81261

Diagnostic values

Here you can read out various diagnostic values, which have the following meaning:

- SO₂: The relevant component
- LED current: The LED amperage in DAW units (in the example: 700)
- Z: The signal ratio between the measuring channel and reference channel (in the example: 1)
- C: Cross-sensitivity: This value maps the proportional cross-correction of the respective channel (here: SO₂) onto the second UV channel (e.g. NO₂).

Note:

In the example, the value of C for the SO₂ component is 0.000, because SO₂ does not cause any cross-sensitivity on the second channel (NO₂). For NO₂ the value of C is 0.160, because NO₂ causes a cross-sensitivity of about 16% on the SO₂ channel.

- Alpha_c and Alpha_f These values are linearization parameters that are used to convert measured intensity values I(C) to concentration values C based on the Lambert-Beer absorption law:

$$I(C) = I(0)[\alpha e^{\beta C} + 1 - \alpha]$$

Alpha_f is the factory setting and Alpha_c is the value last set by the customer.

```
Set:      XX.XX mg/m³
Reading: XX.XX mg/m³
```

81262

Calibration values

The calibration values in this screen show the values determined for the analyzer when it was manufactured. They cannot be actively changed.

```
Signal strengths SO2
e0  val  max
Meas:  0    0
Ref.:  0    0
```

81263

Optical alignment

This screen shows the signal strengths of the measuring channel (3rd line) and reference channel (4th line). The first column (val) shows the current values and the last column (max) shows the maximum signals ever measured.

5.3.1.2.3 Analyzer status: Diagnostics values: (Electrochemical) O₂ sensor

```
Sensorsig : 11.11 mV
O2         : 20.77 %
Date: 30.11.2012
Inst.volt.: 12.10 mV
```

8122

This dialog displays the diagnostics values of the electrochemical oxygen sensor (option). Meaning:

- Sensorsig is the current pressure-compensated voltage of the O₂ sensor in mV
- O₂ is the current oxygen value. Negative values are also possible here
- Inst. date is the installation date of the O₂ sensor (see section Calibration: O₂ measuring range: Sensor inst. Date)
- Inst.volt is the pressure-compensated voltage of the O₂ sensor when it was installed.

5.3.1.2.4 Analyzer status: Diagnostics values: (Paramagnetic) O₂ sensor

```
Sensorsig: 1339 mV
O2         : 20.77 %
```

8125

This dialog displays the diagnostics values of the paramagnetic oxygen sensor (option). Meaning:

- Sensorsig is the current voltage of the O₂ sensor in mV
- O₂ is the current oxygen value. Negative values are also possible here

5.3.1.2.5 Analyzer status: Diagnostics values: H₂S sensor

```
Sensorsig.: 884 nA
H2S        : 0.78 vpm
Inst.Date: 30.11.2012
Inst.Curr.: 500 nA
```

8127

This dialog displays the diagnostics values of the optional H₂S sensor. Meaning:

- Sensorsig. is the actual current of the H₂S sensor in nA
- H₂S is the current H₂S measured value in vpm. Negative values are also possible here.
- Inst. date is the installation date of the H₂S sensor (see section Calibration: H₂S sensor: Defining the installation)
- Inst. cur is the pressure-compensated current per vpm H₂S of the sensor when it was installed.

5.3.1.2.6 Diagnostics: Diagnostic values: Pressure and temperature

```
Pressure sens. diagn
Temperature of IR
Temperature of LCD
Temperature of UV
```

8123

This dialog shows various diagnostic values for pressure and temperature. The parameters for the IR measurement and UV measurement are shown in the adjacent screen. Depending on the device version, one of these two options might be omitted.

You can select between the following parameters:

```
Pressure ADU: X.XXXV
Pressure amb. air:
XXXX mbar
```

81231

Pressure sensor

This dialog displays the diagnostic values of the pressure sensor (see section Calibration: Pressure sensor). The displayed values have the following meaning:

- ADC pressure is the actual voltage of the pressure sensor measured at the output of the A/D converter.
- Air pressure is the actual atmospheric pressure in mbar.

```
Temperature of IR
chamber: XXX.X °C
```

81232

IR sample chamber

The temperature of the IR sample chamber is shown here.

```
LCD
Temperature: 33.9°C
```

81233

LCD temperature.

The temperature that determines the display contrast. Setting of the LCD contrast is described in section AUTOHOTSPOT.

```
Temperature of
UV bench : 52.0 °C
LED SO2: 35.0 °C
LED NO2: 35.0 °C
```

81234

UV sample chamber

The following temperature values are displayed here:

- UV sample chamber itself
- LED 1 (SO₂)
- LED 2 (NO₂)

5.3.1.2.7 Analyzer status: Diagnostics values: Other diagnostics values

The type and scope of these diagnostic values differs depending on whether they were selected from the IR branch or UV branch.

IR measuring ranges

```
Power/IR Source
Reference/Bridge
Unlim. conc. values
Analog output
```

8124

This menu is used to call further diagnostic functions. You can call the following values:

```
18 mg/m3 NO    M1
 2 mg/m3 CO    M1
11 mg/m3 SO2 M1
20.77 %      02  M2
```

81243

Unlimited concentration values

Measured values that have not yet been linearized are displayed here. Negative measured values can also be output here.

```
Power (VAC): XXX %
Raw voltage: XX.X V
Source 1    :XX.XXX V
Source 2    :XX.XXX V
```

81241

Power/IR source

– Power: Data on the supply voltage in % of the nominal value of the respective supply voltage (e.g.: 100% corresponds to 230 V or 120 V).

– Raw voltage: This is the raw voltage following the rectification

– Source 1, Source 2: Data on the IR source voltage(s), in Volt. An empty value indicates that the corresponding source does not exist.

```
NO    3.11 4 /20mA
CO    4.25 4 /20mA
SO2  4.04 4 /20mA
O2   20.02 4 /20 mA
```

81244

Analog output

For each gas component to be measured, the current value of the output current in mA is shown (the unit is not shown for space reasons) as well as the start-of-scale value (either 0, 2 or 4 mA) and the full-scale value (20 mA) of the output current range. For information on setting the start-of-scale values, see section Configuration: Inputs/outputs/pump: Analog outputs.

```
Reference : 2.229 V
Bridge    : 3.379 V
```

81242

Reference/bridge

– Reference: The reference voltage for the electronics of the analyzer.

– Bridge: The supply voltage to the measuring bridge.

UV measuring ranges

```
Unlim. conc. values
Power/IR Source
```

8124a

This menu is used to call further diagnostic functions. You can call the following values:

```
18 mg/m3 NO M1
 2 mg/m3 CO M1
11 mg/m3 SO2 M1
20.77 % O2 M2
```

81243

Unlimited concentration values

Measured values that have not yet been linearized are displayed here. Negative measured values can also be output here.

```
Power (VAC): XXX %
Raw voltage: XX.X V
```

81241a

Power/IR source

– Power: Data on the supply voltage in % of the nominal value of the respective supply voltage (e.g.: 100% corresponds to 230 V or 120 V).

– Raw voltage: This is the raw voltage following the rectification.

See also

Parameter: Pump/LCD contrast.

5.3.1.3 Analyzer status: Factory settings hardware

```
Ser. No. : IK-001
Revision : 2
Order No. :
7MB2335-1ADE3-A001-X
```

813

Factory settings are parameters which are already set on delivery such as

- Serial No.
- Revision
- Order No.

The hardware configuration and release version can be read here.

5.3.1.4 Analyzer status: Factory settings software

```
Base module
UV module
```

814

If the analyzer has a UV detector, this detector has its own firmware version. In this case, the adjacent prompt appears first:

If the analyzer does not have a UV detector, the following menu screen (8141) indicating the software version of the basic unit appears immediately.

```
Firmware No. :
S79610-G210-A900
Softversion: 3.51.01
from 15.12.16 4.4
```

8141

Factory settings are parameters that are set on the delivered device at the factory, such as

- Software/firmware version

The software version of the basic unit can be read out here.

```
Firmware No. :
A5E12345678
Softversion: 00.01.01
from 15.12.16 4.4
```

8142

Factory settings are parameters that are set on the delivered device at the factory, such as

- Software/firmware version

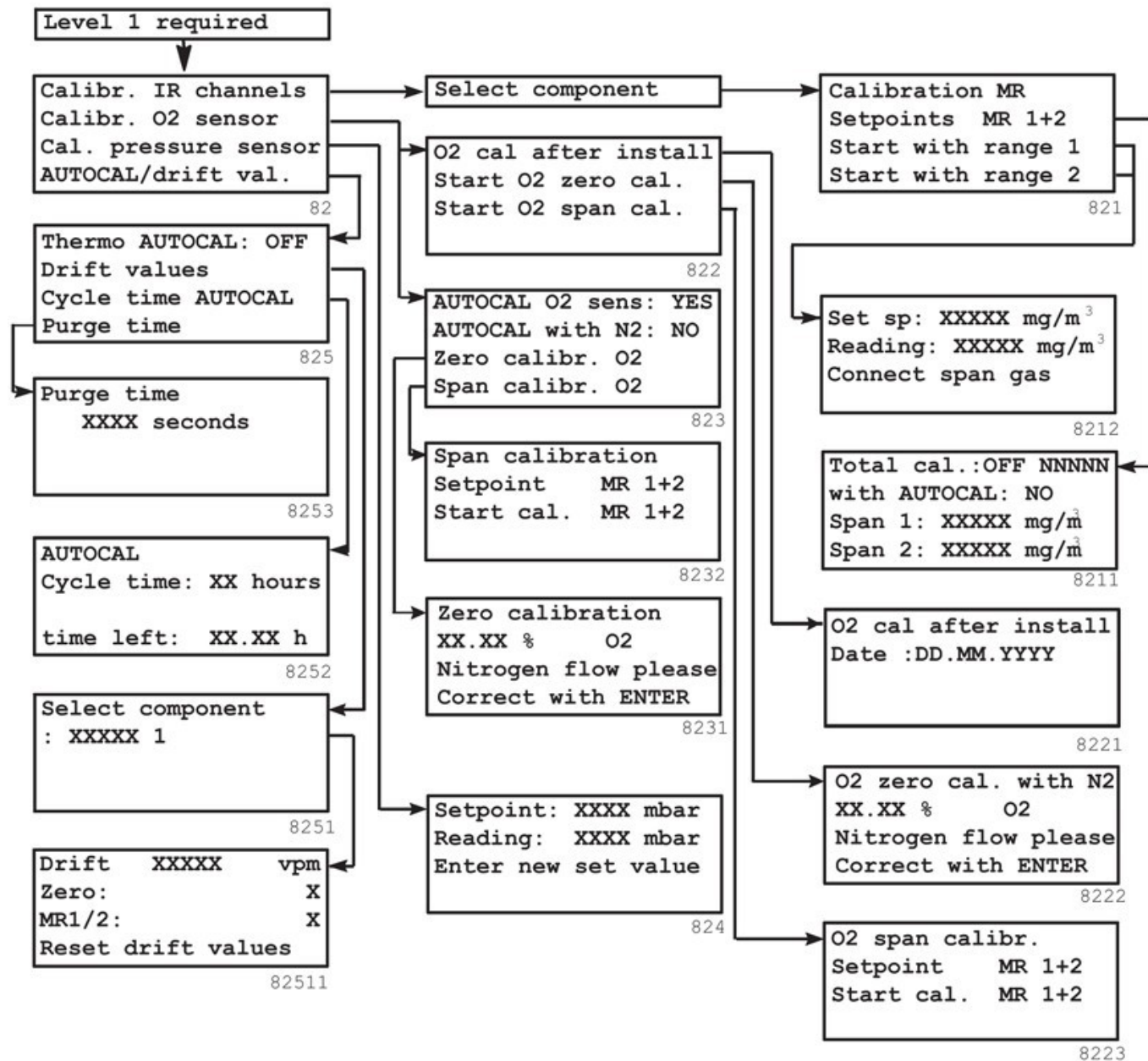
If the analyzer has a UV detector, the software version of the UV detector can be read out here.

5.3.2 Calibration

5.3.2.1 Calibration

In this function group you can use one or more calibration gases to calibrate the IR channels of the BA 5000 and to readjust the zero point and sensitivity. In addition, you can calibrate the oxygen sensor and the pressure sensor and also define the AUTOCAL parameters. The figure below shows the menu sequence for an analyzer without a UV detector or H₂S sensor. The menu displays and their functions are described in the following sections.

The calibration functions can only be addressed if you have enabled code level 1.



H₂S sensor

If the analyzer has an H₂S sensor, the starting menu for the calibration functions is changed. The following overview shows the menu sequence for the calibration functions of the H₂S sensor. The calibration functions of the H₂S sensor are described in section Calibration: H₂S sensor.

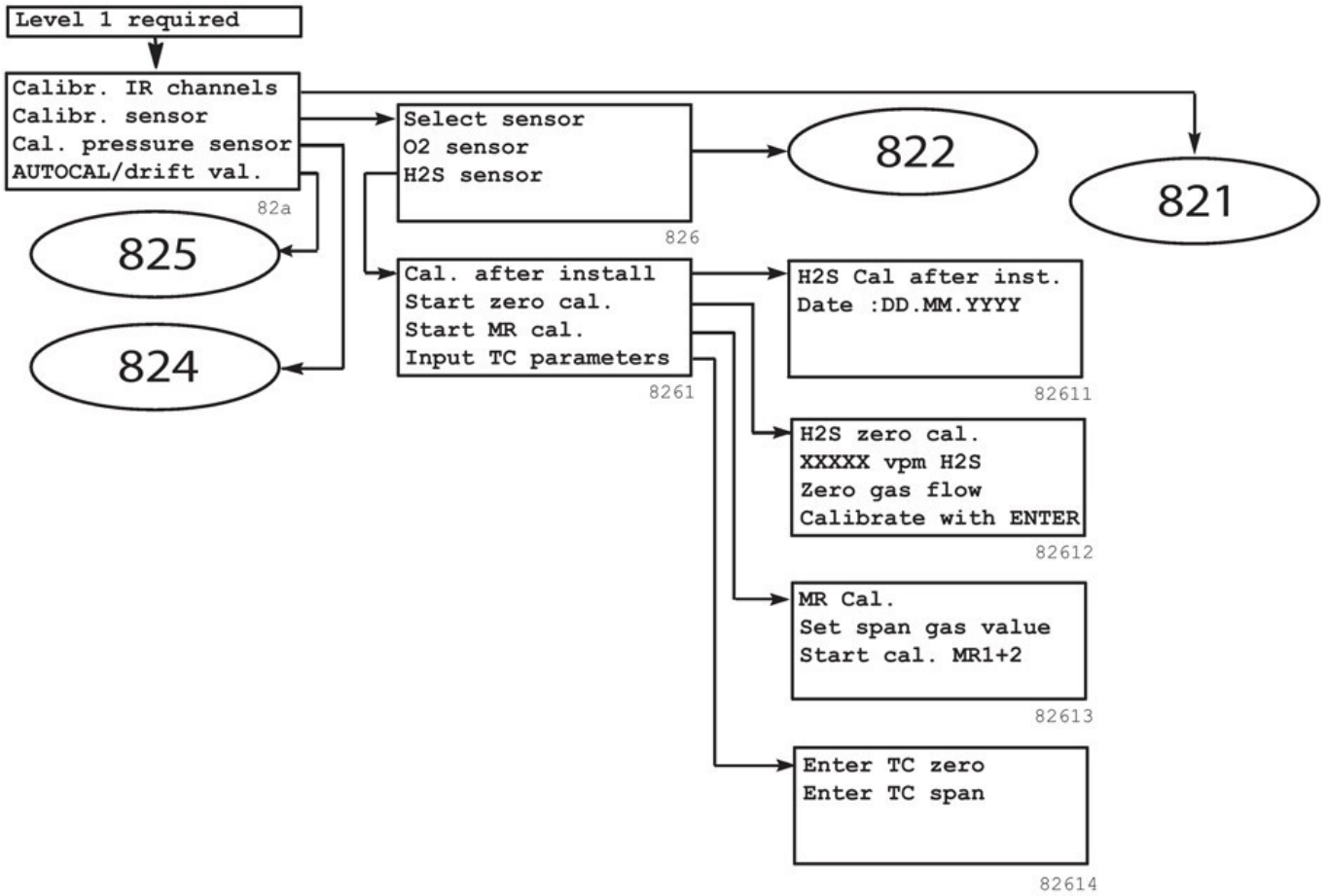


Fig. 38: Overview: Calibration with H₂S sensor

UV measuring ranges

If the analyzer has a UV photometer, the starting menu for the calibration functions is changed. The following overview shows the menu sequence for the calibration functions of the UV photometer. The calibration functions of the UV photometer are described in section Calibration of ultraviolet measuring ranges.

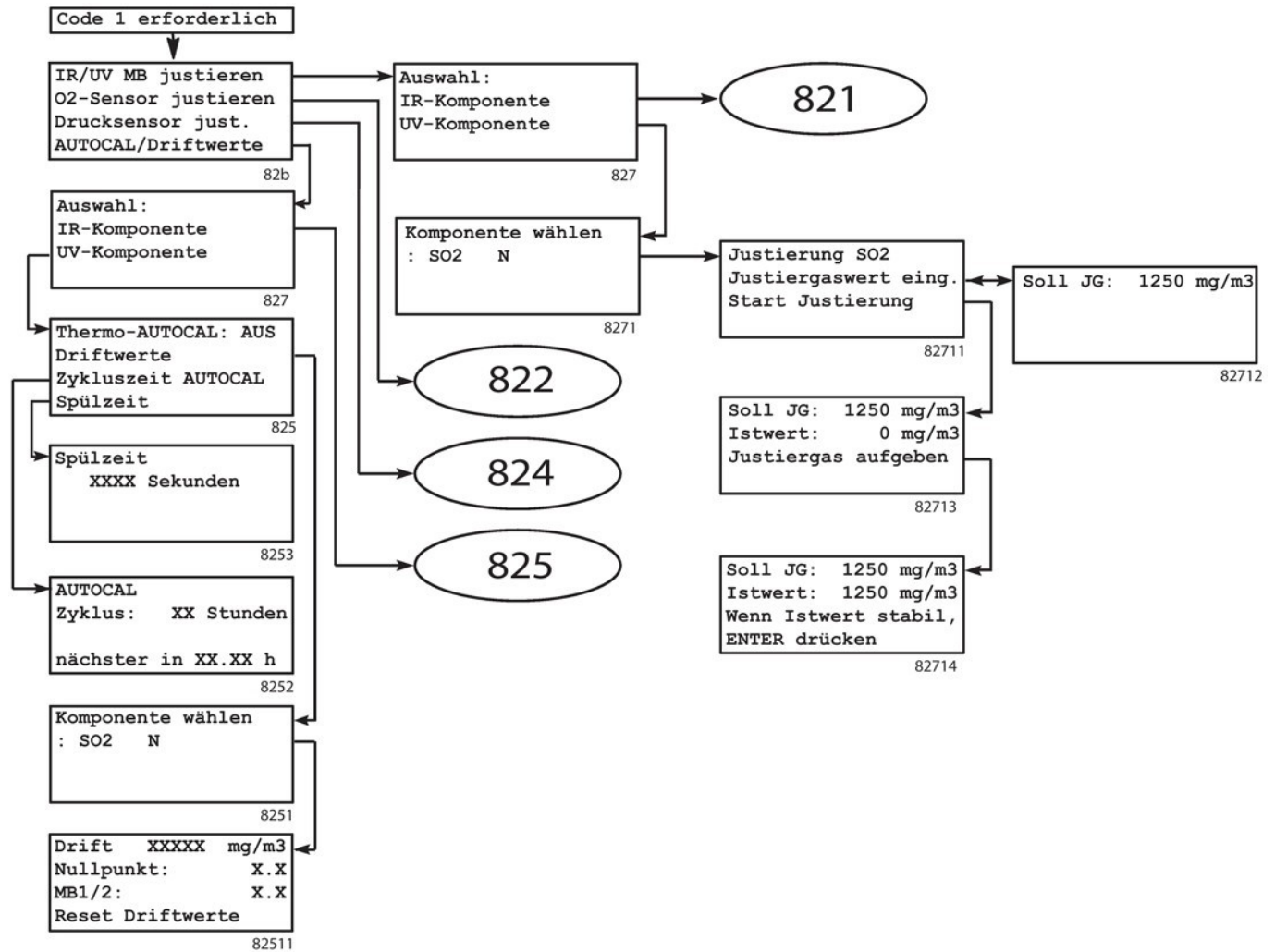


Fig. 39: Overview: Calibration of the UV measuring ranges

5.3.2.2 Calibration: Infrared measuring range

```
Calibration MR SO2
Set span gas values
Start with range 1
Start with range 2
```

821

In this menu you can:

- In line 2:
 - Set the setpoints of the calibration gases for the individual ranges
 - Select a total or single calibration
- In lines 3 and 4: Start a calibration procedure. This function is specific to the component.

5.3.2.2.1 Calibration: Infrared measuring range: Set span gas values

```
Total cal.:OFF SO2
vorher AUTOCAL: NEIN
MB1 : 386 mg/m3
MB2 : 1920 mg/m3
```

8211

The parameters have the following meanings:

- Total cal.: In the first line of this dialog, you can select either a total or single calibration.
 - ON means that one range is calibrated and that this calibration is used for the other ranges (total calibration).
 - OFF means that each range is calibrated separately (single calibration, e.g. with different calibration gases).
- With AUTOCAL: You can define here whether you wish to carry out an AUTOCAL prior to the calibration procedure (YES or NO). An AUTOCAL is not necessary if it has already been carried out shortly before the calibration procedure, e.g. a calibration procedure has taken place directly previously.
- Span1, Span2: Here you can enter the setpoints for the individual measuring ranges. These are usually the concentrations of the measured components in the respective calibration gas. They should be set to a value which is between 70% and 100% of the full-scale value. If Total cal.: ON has been selected, the analyzer automatically uses the setpoint of range 2 for range 1. With Total cal.: OFF any input is possible between the start-ofscale and full-scale values of the respective range.

```
Total cal.:OFF SO2
with AUTOCAL: NO
Span 1 : 12 %
Span 2 : 12 %
```

8211a

5.3.2.2.2 Calibration: Infrared measuring range: Start with Range MR 1/2

```
Set span: 386 mg/m3
Reading: 1 mg/m3
Connect span gas
```

8212

The analyzer interrupts the current measurement if you call one of these two dialogs. If the parameter 'With AUTOCAL'

- was set to OFF, the analyzer expects an immediate flow of calibration gas;
- if the value is set to ON, an AUTOCAL is carried out prior to the flow of gas. The values of the setpoint and actual-value calibrations are displayed in the first two lines.

```
Set span: 386 mg/m3
Reading: 1 mg/m3
If the reading is
stable, press ENTER
```

8212a

If the analyzer recognizes a flow of calibration gas, the display changes as shown. If the measured value in the second line remains constant for more than approx. 10 s or does not change significantly, press the <ENTER> key.

```
Set span: 386 mg/m3
Reading: 380 mg/m3
Calibration o.k.
Press ESC to return
```

8212b

The analyzer then compares the setpoint and actual value (measured value) of the calibration. If the deviation between the values is within the tolerance, the adjacent message 'o.k.' is output.

```
Set span: 386 mg/m3
Reading: 121 mg/m3
Tolerance not o.k.
Press ESC to return
```

8212c

If the actual value deviates by more than approx. 20% from the setpoint determined in the factory, the message 'not o.k.' appears instead (no calibration possible).

By pressing the <ESC> key you can exit the calibration procedure.

5.3.2.3 Calibration: Electrochemical oxygen measuring range

```
O2 cal after install
Start O2 zero cal.
Start O2 span cal.
```

822

In this menu you can call the following functions for the electrochemical oxygen sensor in order to:

- Enter the installation date of the electrochemical O₂ sensor
- Recalibrate the zero point of the electrochemical O₂ sensor
- Recalibrate the measuring range of the electrochemical O₂ sensor

5.3.2.3.1 Calibration: O2 measuring range: Sensor inst. date

```
O2 cal after install
Date: 30.11.2012
```

821

You must enter the date every time a new sensor is installed.

The entered date is checked for plausibility. A calibration (AUTOCAL) with ambient air is subsequently carried out.

A check is also carried out during this procedure that the probe voltage is greater than 9 mV. If this is not the case, a fault message "Probe voltage too low" is output.

5.3.2.3.2 Calibration: O2 measuring range: Calibrating the O2 zero point

```
O2 zero cal. with N2
0.18 % O2
Nitrogen flow please
Correct with ENTER
```

8222

You can use this function to re-adjust the zero point of the H₂S sensor with nitrogen. Connect nitrogen to the sensor and commence the calibration with <ENTER>.

```
O2 zero cal. with N2
1.25 % O2
>1% => default value
Press ESC to return
```

8222a

Following calling of the correction function, the current oxygen value is displayed in the second line. If the displayed value does not deviate by more than 1% from the set value, it is used as the new zero point.

If the deviation is greater than 1% (as is the case in the example on the left, see third line), a fixed default value is used instead..

NOTICE



The gas exchange takes place very slowly with low oxygen concentrations. In such cases we recommend flow periods of approx. 30 minutes before you use the current value.

5.3.2.3.3 Calibration: O₂ measuring range: Calibrate measuring range

You can calibrate the sensitivity of the electrochemical O₂ sensor using this function.

```
O2 span calibr.
Setpoint      MR 1+2
Start cal.   MR 1+2
```

8223

The adjacent menu display appears when you select the function.

Start the calibration procedure by positioning the cursor to the 3rd line and pressing the <ENTER> key.

```
Set sp.:      1.25 %
Reading:      0.11 %
Connect span gas
```

82231

The analyzer interrupts the current measurement when the calibration procedure is selected and expects a flow of calibration gas.

The entered setpoint is displayed in the first line and the actually measured value in the second line.

```
Set sp.:      1.25 %
Reading:      0.11 %
If the reading is
stable, press ENTER
```

82231a

If the analyzer recognizes a flow of calibration gas, the display changes as shown. If the measured value in the second line remains constant for more than approx. 10 s or does not change significantly, press the <ENTER> key.

```
Set sp.:      1.25 %
Reading:      1.21 %
Calibration o.k.
Press ESC to return
```

82231b

The analyzer then compares the setpoint and actual value (measured value) of the calibration. If the deviation between the values is within the tolerance, the adjacent message 'o.k.' is output.

```
Set sp.:      1.25 %
Reading:      3.21 %
Calibration not o.k.
Press ESC to return
```

82231c

If the actual value deviates by more than approx. 20 % from the setpoint determined in the factory, the message 'not o.k.' appears instead (no calibration possible). The causes of this message can include:

- Incorrectly entered setpoint
- Calibration gas concentration does not agree with entered value
- The flow of calibration gas is insufficient

By pressing the <ESC> key you can exit the calibration procedure.

5.3.2.4 Calibration: Paramagnetic oxygen sensor

```
AUTOCAL O2 sens: YES
AUTOCAL with N2: NO
Start cal. O2 zero
Start cal. O2 span
```

823

In this menu you can call the following functions for the paramagnetic oxygen sensor:

- "AUTOCAL O₂ sens."
 - YES (factory setting): The zero point or sensitivity of the paramagnetic oxygen sensor is set with each AUTOCAL. Selection of zero point or sensitivity is carried out using the parameter in the 2nd line 'AUTOCAL with N₂'.
 - NO: No calibration of the paramagnetic oxygen sensor during an AUTOCAL.
- "AUTOCAL with N₂"
 - YES: The AUTOCAL is carried out with nitrogen, where the zero point of the sensor is calibrated.
 - NO: (factory setting) No calibration of the paramagnetic oxygen sensor during an AUTOCAL
- "Calib. O₂ zero point" This function is used to calibrate the zero point of the paramagnetic sensor
- "Calib. O₂ range" This function is used to calibrate the full-scale value or sensitivity of the paramagnetic sensor and to set the setpoint.

5.3.2.4.1 Calibration: O₂ paramagnetic: Calibrating the zero point

You can calibrate the zero point of the paramagnetic oxygen sensor using this function. You must use nitrogen as the zero gas.

```
Zero calibration
0.18 % O2
Nitrogen flow please
Correct with ENTER
```

8231

If the adjacent display appears, start the flow of nitrogen and wait until the displayed value has stabilized. Subsequently begin the calibration by pressing the **<ENTER>** key.

Calibration of the zero point must be carried out regularly to guarantee the accuracy of the paramagnetic oxygen sensor. Information on the achievable accuracy and the calibration cycles can be found in section Technical specifications.

5.3.2.4.2 Calibration: O₂ paramagnetic: Calibrating the measuring range

You can calibrate the sensitivity of the paramagnetic oxygen sensor and set the setpoint using this function.

Calibrating the sensitivity

```
Set sp.: 1.25 %
Reading: 0.11 %
Connect span gas
```

82321

If the adjacent display appears, perform the full-scale calibration as follows:

1. Connect the sample gas inlet to the calibration gas
2. Inject calibration gas with a flow rate of 1 ... 1.2 l/min
3. Position the cursor at the beginning of the 3rd line (Start calibration) and press the **<ENTER>** key. Once the intended flow rate has been reached, the message 'Correction with ENTER' appears in the 4th line of the display.
4. Wait until the displayed measured value has stabilized.
5. Start the calibration by pressing the **<ENTER>** key.
6. To exit the menu, press the **<ESC>** key.

The measuring range of the paramagnetic oxygen sensor is calibrated as standard with ambient air during each AUTOCAL. However, individual calibration with a freely selectable setpoint between 2 % and 100 % O₂ is also possible.

NOTICE



If an individual calibration has been carried out using calibration gas, the next AUTOCAL overwrites this calibration. The AUTOCAL must be deactivated if this is not required. To do this:

1. Navigate to the input menu (823) and
2. Set the "Autocal O₂ sens." parameter there to the value 'NO'.

Adjust setpoint

You can use this function to adjust the setpoint of the calibration gas for calibration of the measuring range.

```
MR cal.
Setpoint   MR 1+2
Start cal. MR 1+2
```

8232

If the adjacent display appears, adjust the setpoint as follows: Position the cursor at the beginning of the 2nd line (Setpoint) and press the <ENTER> key.

```
MR 1+2   10.00 %
```

82613a

The adjacent display appears.

- Now enter the desired setpoint using the arrow keys, and then press the <ENTER> key.
- Exit the menu by pressing the <ESC> key.

5.3.2.5 Calibration: H₂S sensor

You first need to select the H₂S sensor in order to adjust it. To do this, navigate in the operator menu as follows:

Calibration -> Please enter code -> Calibrate sensor -> Select sensor -> H₂S sensor.

```
Cal after install
Start zero cal.
Start MR cal.
Input TC parameters
```

8261

The adjacent display appears.

You can now adjust the H₂S sensor as described in the following sections. The following sequence must be observed when calibrating the sensor:

1. Enter correction factors for temperature compensation of zero point
2. Enter correction factors for temperature compensation of sensitivity
3. Calibrate zero point of the H₂S sensor
4. Calibrate measuring range of the H₂S sensor
5. Enter installation date.

Steps 1, 2 and 5 are only carried out following installation of a new sensor. The deflection signal of the sensor is subject to drift. This drift can only be detected through regular checking and corrected as necessary. This involves using a calibration gas with a defined concentration of hydrogen sulfide. We recommend monthly calibration with a calibration gas to keep potential measurement uncertainty within strict limits: The hydrogen sulfide concentration of this calibration gas should correspond to the concentration of the sample gas, having a concentration of at least 10 % of the largest full-scale value.

5.3.2.5.1 Calibration: H₂S sensor: Defining the installation

You have to re-enter the date of installation after installing a new sensor.

```
H2S Cal after inst.
Date :DD/MM/YYYY
```

82611

The adjacent display appears when you select the 'Installation date' menu item:

Now you can enter the date of installation in the form:

'DD.MM.YYYY'.

NOTICE



Prior to entering the installation date, you must perform a zero point and measuring range calibration of the H₂S sensor, otherwise the new date will not be accepted.

5.3.2.5.2 Calibration: H2S sensor: Calibrating the zero point

You can use this function to re-adjust the zero point of the H₂S sensor. As the zero gas you can use:

- Nitrogen or
- Air free of H₂S.

To do this, navigate as follows: Calibration -> Please enter code -> Calibrate probe -> Choose component -> H₂S -> Calibrate zero.

```
H2S Zero cal.
 3.3 vpm H2S
Nitrogen flow please
Correct with ENTER
```

82612

The adjacent display appears.

In the case of analyzers with an internal sample gas pump, selecting this function switches from the sample gas inlet (inlet 1) to the zero gas inlet (inlet 3).

Calibrate the zero point as follows:

- Connect zero gas to the analyzer and observe the display.
- Wait until the displayed value has stabilized.
- Commence with correction of the zero point by pressing the <ENTER> key.
- Exit the calibration by pressing the <ESC> key.

The message "Tolerance not o.k." appears if an error occurs during the calibration.

5.3.2.5.3 Calibration: H2S sensor: Calibrating the measuring range

You can enter the setpoint and calibrate the sensitivity of the sensor using this function. Navigate as follows to select this function: Calibration -> Please enter code -> Calibrate sensor -> Select component -> H₂S -> Calibrate MR.

```
MR Cal.
Set span gas value
Start Cal. MR 1+2
```

82613

The adjacent display appears.

Proceed as follows to enter the setpoint:

1. Position the cursor on the 2nd line of the display (Setpoint MR 1+2)
2. Press the <ENTER> key

```
MR 1+2 10.00 %
```

82613a

The adjacent display appears. You can now enter the setpoint of the calibration gas:

```
MR Cal.
Set span gas value
Start Cal. MR 1+2
```

82613

Calibrate the sensitivity as follows:

1. Position the cursor on the 3rd line of the display (Start cal. MR 1+2).
2. Press the <ENTER> key.

```
Set sp.: 50 vpm
Reading: 41 vpm
Connect span gas
```

82613b

The adjacent display appears. Now carry out the following steps for the sensitivity calibration:

1. Connect the sample gas inlet to the calibration gas.
2. Inject calibration gas to the sensor with a flow rate of 1.2 ... 2.0 l/min.
3. Wait until the measured value has stabilized.
4. Then press the <ENTER> key.
5. Exit the calibration by pressing the <ESC> key.

The message "Tolerance not o.k." appears if an error occurs during the calibration.

5.3.2.5.4 Calibration: H₂S sensor: Enter TC parameters

You use this function to enter the temperature compensation parameters for calibration of the zero point and sensitivity. You can read these parameters from the sensor.

To do this, navigate as follows: Calibration -> Please enter code -> Calibrate probe -> Choose component -> H₂S -> Calibrate TC parameters. The following screen appears:

```
Enter TC zero
Enter TC span
```

82614

Temperature compensation (TC) of zero point

```
A: -3.0817e+1
B: +2.2517e+0
C: -1.1050e-1
D: +2.8011e-3
```

82614a

To do this, proceed as follows:

1. Position the cursor on the first line
2. Then press the <ENTER> key. The adjacent display appears.

You can now view the factors of the temperature compensation parameters for the zero point, and change them if necessary.

Temperature compensation of sensitivity

```
Enter TC zero
Enter TC span
```

82614

Proceed as follows for this (from menu display 'Enter TC parameters'):

1. Position the cursor on the second line.
2. Then press the <ENTER> key.

```
A: +4.2117e+0
B: -2.8547e-1
C: +5.5451e-3
D: -2.0077e-5
```

82614b

The adjacent display appears.

You can now view the factors of the TC parameters for the sensitivity, and change them if necessary.

5.3.2.6 Calibration of ultraviolet measuring ranges

```
Choose component
: SO2 2
```

8271

After selection of the UV measuring range calibration, the component to be calibrated must be selected first: Select the desired component with the arrow keys and confirm this with <ENTER>.

The subsequent calibration steps are performed for the SO₂ component by way of example.

```
Calibration SO2
Set span gas value
Start calibration
```

87211

After selection of the component to be calibrated, the adjacent menu screen appears. You can now use the cursor to select one of the lower lines and:

- Enter the calibration gas value in line 2.
- Start the calibration in line 3.

```
Span gas: 1250 mg/m3
```

87212

You can now enter the calibration gas value. You can use the arrow keys to change the displayed value and confirm the entered calibration gas value with the <ESC> key.

```
Span:    1250 mg/m3
Reading:  0 mg/m3
Connect span gas
```

82713

If the entered calibration gas value is okay, the analyzer waits for the inflow of calibration gas.

```
Span:    1250 mg/m3
Reading:  0.0 mg/m3
If the reading is
stable, press ENTER
```

82714

When the analyzer detects the inflow of calibration gas, the display changes as shown. When the measured value in the second line remains constant or no longer changes significantly for more than approx. 10 s, press the <ENTER> key.

By pressing the <ESC> key you can exit the calibration procedure.

AUTOCAL drift values

```
Drift SO2 1250 mg/m3
Zero:      0.0
MR 1/2    0.0
Reset Drift values
```

82511

This function is used to display the drift values of the zero point and sensitivity and to reset them if necessary. The execution of this function is identical to the AUTOCAL calibration of the IR measuring ranges. This is described in section Calibration: AUTOCAL/drift values. However, the drift parameters of the UV measuring ranges are different from those of the IR measuring ranges, as shown in the adjacent screen.

5.3.2.7 Calibration: Pressure sensor

```
Setpoint: 1017 mbar
Reading : 999 mbar
Enter new set value
```

824

In the first line of this menu display, you can re-enter the setpoint of the pressure sensor. To do this, measure a reference value, e.g. using an accurate barometer, and change the setpoint in the first line if necessary.

5.3.2.8 Calibration: AUTOCAL/drift values

```
Thermo AUTOCAL: OFF
Drift values
Cycle time AUTOCAL
Purge time
```

825

It is possible to change the following parameters in this dialog:

- Thermo-AUTOCAL
 - OFF: An automatic AUTOCAL only takes place when the cycle time has expired (see there).
 - ON: An automatic AUTOCAL only takes place when the cycle time has expired. In addition, an automatic AUTOCAL is triggered if the operating temperature has changed by more than 8 °C compared to that measured during the last AUTOCAL. This AUTOCAL it started with a delay of 280 minutes.
- Drift values
- Cycle time
- Purge time

These three parameters are described separately.

5.3.2.8.1 Calibration: AUTOCAL/drift values: Drift values

This function is used to display the drift values of the zero point and sensitivity, and to change them if necessary. The drift values are the total of the deviations in measured values for the zero and sensitivity calibrations. This parameter is specific to the component.

```
Select component
: SO2  1
```

8251

This menu display appears following selection of the drift values and allows selection of the desired component. You can switch between the individual components by pressing an arrow key. You can select the displayed component using the <ENTER> key.

```
Drift  SO2  515 vpm
Zero:           0
MR1/2:         0
Reset drift values
```

82511

You can now view the drift values and reset them if necessary. To do this, position the cursor on the 4th line (reset) of the display and press the <ENTER> key.

5.3.2.8.2 Calibration: AUTOCAL/drift values: Cycle time

Use this function to set or change the cycle time. This is the time between two AUTOCAL procedures triggered automatically by the analyzer.

```
AUTOCAL
Cycle time: 24 hours
Time left:  11.11 h
```

8252

Valid cycle times are from 0 to 24 hours. A cyclic AUTOCAL is not carried out if 0 hours is set. The cycle time must not be more than 6 h if the analyzer is used in German systems subject to TA Luft and 13.BImSchV. The fourth line indicates when the next AUTOCAL will take place.

If the flow during a cyclic zero adjustment is too low, this adjustment is aborted and a fault is displayed. This procedure is entered in the logbook.

5.3.2.8.3 Calibration: AUTOCAL/drift values: Purge time

Use this function to set or change the purge time. This is the duration of flow with sample gas during an AUTOCAL procedure.

```
Purge time
  240 seconds
```

8253

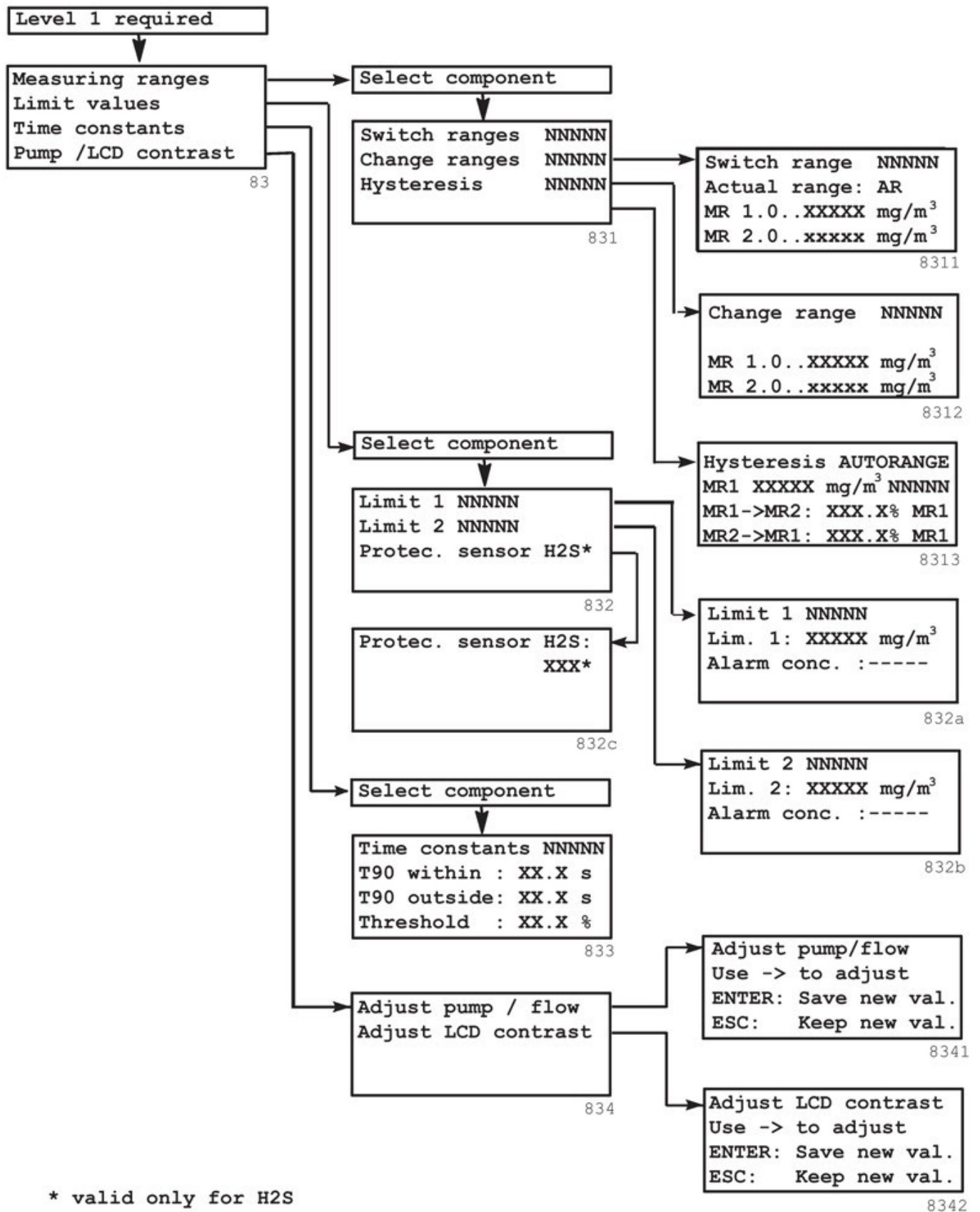
Following calling of the purge time you can set or change the purge time in the second line of the menu display. Valid purge times are:

- 60 to 600 seconds for analyzers with oxygen sensor
- 300 to 600 seconds for analyzers with hydrogen sulfide sensor
- 0 to 600 seconds for all other analyzer versions.

There are minimum purge times depending on the measured component, and shorter times should not be used.

5.3.3 Parameter

In this function group you can change various analyzer parameters. These modifications can only be made within the limits which have been preset for your analyzer. The analyzer checks parameter changes for plausibility and rejects them if applicable. The following figure shows the menu sequence of this function group. The display elements are described in section Input mode. Access to the "Parameters" menu is protected by code level 1.



5.3.3.1 Parameter: Measuring ranges

Switch ranges	SO2
Change ranges	SO2
Hysteresis	SO2

831

In this menu you can:

- Permit or cancel the switching over between measuring ranges
- Set the full-scale values
- Define a hysteresis.

NOTICE



Please note that the range parameters only refer to the measuring ranges at the analog outputs (see section Configuration: Inputs/outputs/pump: Analog outputs). The display always shows the complete, physically possible range.

5.3.3.1.1 Parameters: Measuring ranges: Switch ranges

Switch range	SO2
Actual range:	1
MR 1.0...400	mg/m ³
MR 2.0...2000	mg/m ³

8311

In the second line of this dialog you can set the measuring range 1 or 2 or permit autoranging (automatic switching over between these two ranges).

The 'Actual range' parameter can have the following values:

- 1: The analyzer is set to the smaller range (MR 1).
- 2: The analyzer is set to the larger range (MR 2).
- 1/2: The analyzer is set to the larger range (MR 2). The start-ofscale value of the analog output corresponds in this case to the full-scale value of the smaller range (MR 1), the fullscale value of the analog output corresponds to that of the larger range (MR 2). The result is that the analog output of the analyzer has a range with zero offset (e.g. 90 ... 100%).
- AR: The analyzer switches over automatically from one range to the other (AR = autoranging). Setting of the switchover criteria is described in section Parameters: Measuring ranges: Hysteresis.

5.3.3.1.2 Parameters: Measuring ranges: Setting measuring ranges

Change range	SO2
MR 1.0...400	mg/m ³
MR 2.0...2000	mg/m ³

8312

The full-scale values of the measuring ranges can be set in the third and fourth lines of this dialog. They must lie within the factory settings, i.e. if an analyzer is factory-set for a total range from 0 to 2000 mg/m³, modifications are only possible within this range. The following definitions also apply:

- The smaller MR must not be greater than the higher MR.
- The following input limits apply to the ranges:
 - Lower limit: 0.01 times the smaller MR according to factory setting (label)
 - Upper limit: 1.1 times the higher MR according to factory setting (label)

In the example:

- Smallest MR 1: 0 to 4 mg/m³
- Highest MR 2: 4 to 2200 mg/m³

5.3.3.1.3 Parameters: Measuring ranges: Hysteresis

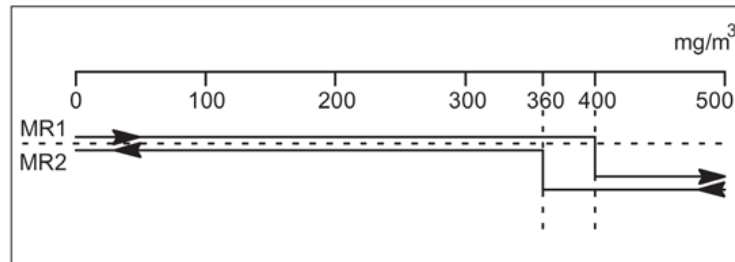
Hysteresis AUTORANGE	
MR1	400 mg/m ³ SO ₂
MR1->MR2:	100.0% MR1
MR2->MR1:	90.0% MR1

8313

In the third and fourth lines of this dialog, you can set the value at which the analyzer switches from one range to the other. The values are specified in % of the full-scale value of range 1 (MR1) (see section Parameters: Measuring ranges: Setting measuring ranges).

Note

The hysteresis is only active if the "Actual range" parameter has been set to the value "AR" (autoranging) in the dialog "Switch ranges"(Parameters: Measuring ranges: Switch ranges). The two switchover points should be as far apart as possible, and the switchover point from MR1 to MR2 must be greater than that from MR2 to MR1.



The following conditions have been assumed in the display:

- Your analyzer has two ranges:
 - MR1 from 0 to 400 mg/m³
 - MR2 from 0 to 2000 mg/m³
- The hystereses are defined as:
 - MR1->MR2 at 100%
 - MR2->MR1 at 90%

This means:

- If your analyzer is working in the smaller range (MR1), it switches over to the larger range (MR2) when a value greater than 400 mg/m³ SO₂ is measured
- If your analyzer is working in the larger range (MR2), it switches over to the smaller range (MR1) when a value less than 360 mg/m³ SO₂ is measured (=90% of 400 mg/m³).

5.3.3.2 Parameters: Limits

```
Limit 1 SO2
Limit 2 SO2
```

Two limits are assigned to each component, and can be set using this menu. A relay is triggered when the limits are violated (see section Configuration: Inputs/outputs/pump: Assign relays). Limit 1 is the lower limit, Limit 2 the upper limit.

832

NOTICE



A set limit only triggers a relay contact if a relay has previously been assigned to the corresponding limit signal (see section Configuration: Inputs/outputs/pump: Assign relays). The limits are not updated:

- During the first warm-up phase
- During an AUTO CAL
- During the message: Function control and analog output at 'Hold measured value' (see section Configuration: Inputs/outputs/pump: Analog outputs)

```
Limit 1 SO2
Lim. 1: 2000 mg/m3
Meldung bei :-----
```

If you have selected "Limit 1" or "Limit 2", a menu display appears in which you can enter the lower or upper limit for each component. You can define the value in the second line, and the condition under which a contact is to be triggered in the third (Alarm at conc.):

- High: with upward violation
- Low: with downward violation
- -----: no signal.

832a

5.3.3.3 Parameters: Limits: H₂S sensor protection

```
Limit 1 H2S
Limit 2 H2S
Protec. sensor H2S
```

If 'H₂S' is selected as the component in the higher-level menu display, the 'H₂S sensor protection' function is selected in addition to the limits. The 'Limit' function is described in section Parameters: Limits..

832

```
Protec. sensor H2S :
ON
```

In the 3rd line you can select the 'H₂S sensor protection' function.

The adjacent menu display appears when you select the function in which you can switch the 'H₂S sensor protection' function on and off.

Hydrogen sulfide (H₂S) is a corrosive gas, especially in wet condition and in combination with other gases. This function prevents damage occurring to the H₂S sensor from high concentrations of H₂S. This function is enabled by default (ON). Execution of this function is described in section Probe protection function.

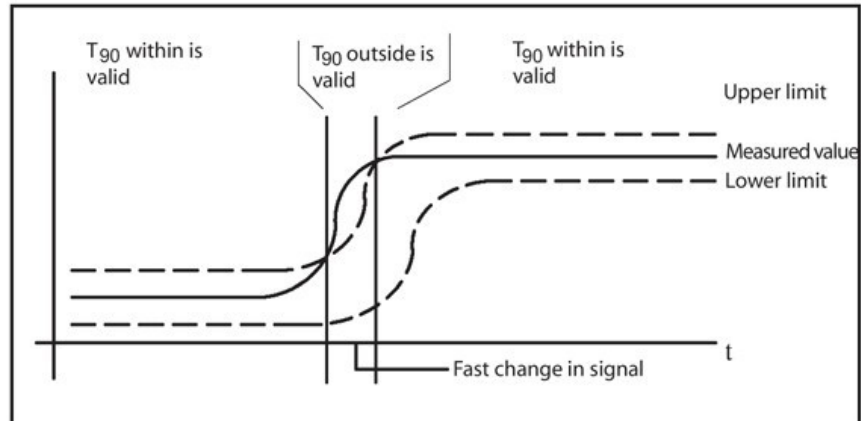
832c

5.3.3.4 Parameters: Time constants

```
Time constants   SO2
T90 within : 12.0 s
T90 outside:  3.5 s
Threshold   :  3.0 %
```

833

You can use this function to set various time constants to suppress noise in the measured signal. During processing of the measured signals, these time constants reduce the noise by delaying the signal. The time constant "T₉₀ within" is effective within an adjustable interval whose threshold values are defined as a percentage of the smallest measuring range. The time constant dampens small changes in signal (e.g. noise), but becomes immediately ineffective if a fast change in signal exceeds a threshold. If the threshold is exceeded, the signal is dampened by the time constant "T₉₀ outside" until it falls below the threshold value again. "T₉₀ within" then becomes effective again.



The following values are possible for the time constants:

- T90 within: 0.1 to 99.9 (s)
- T90 outside: 0.1 to 99.9 (s)
- Threshold (data in %): 0 ... 100% of smallest range

5.3.3.5 Parameter: Pump/LCD contrast

```
Adjust pump / flow
Adjust LCD contrast
```

834

You can use this menu to select two dialogs via which the pump capacity and the contrast of the LCD can be changed.

5.3.3.5.1 Parameters: Pump/LCD contrast: Pump

```
Adjust pump/flow
Use -> to adjust
ENTER: Save new val.
ESC:  Keep new val.
```

8341

In this menu you can:

- Increase the pump capacity using the <→> or <↑> key
- Decrease the pump capacity using the <↓> key
- Store the set pump capacity using the <ENTER> key
- Cancel the input using the <ESC> key.

Changes to the pump capacity are shown on the flowmeter and directly in the menu display by the message "o.k." or "not o.k.".

5.3.3.5.2 Parameters: Pump/LCD contrast: LCD contrast

LCD contrast
 Use -> to adjust
 ENTER: Save new val.
 ESC: Keep new val.

8342

In this menu you can:

- Increase the contrast using the <=> or <↑> key. This darkens the characters.
- Decrease the contrast using the <↓> key. This brightens the characters.
- Store the set contrast using the <ENTER> key.
- Cancel the input using the <ESC> key.

NOTICE

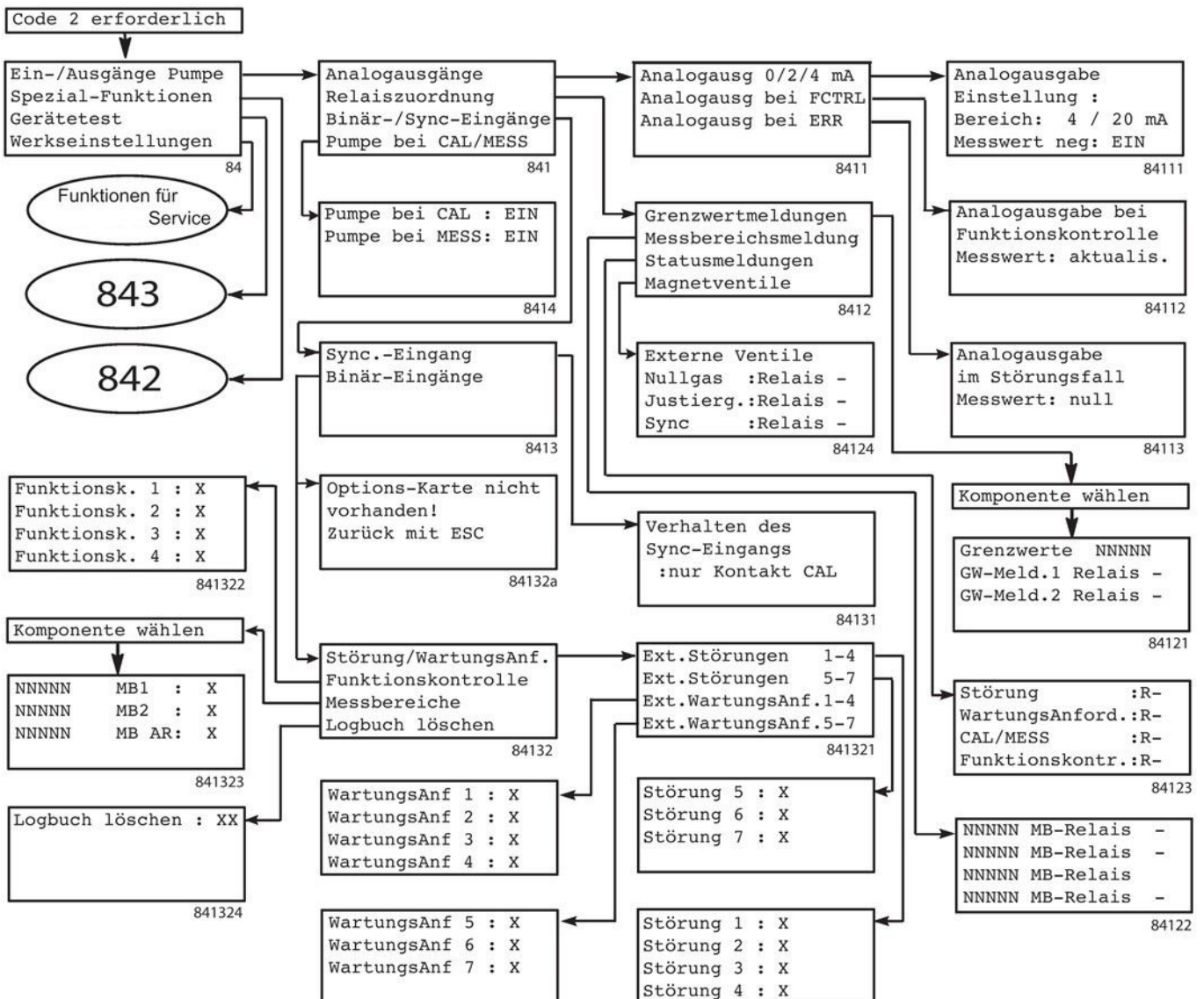


Simultaneous pressing of the three keys <↑>, <↓> and <=> sets an average contrast again.

5.3.4 Configuration

With this function group you can assign relays and inputs/outputs and use special functions and test functions. The following figure shows the associated menu sequence, further menu sequences are shown under '842' and '843'. An explanation of the display elements can be found in section Input mode.

Access to the "Configuration" menu is protected by code level 2.



The special functions (menu display 842) are described in section Configuration: Special functions, the analyzer tests (menu display 843) in section Configuration: Device test.

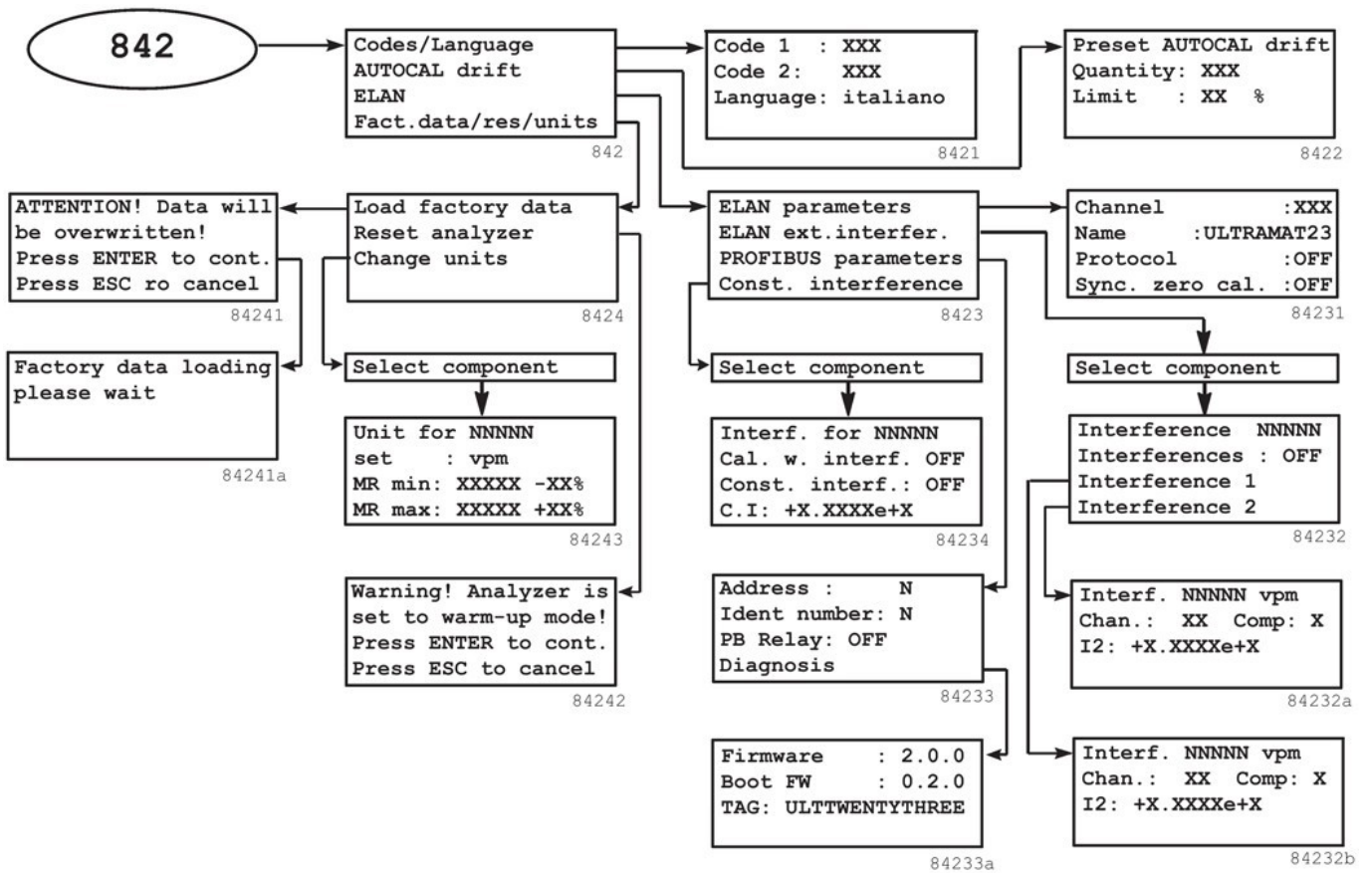


Fig. 40: Overview of configuration of special functions

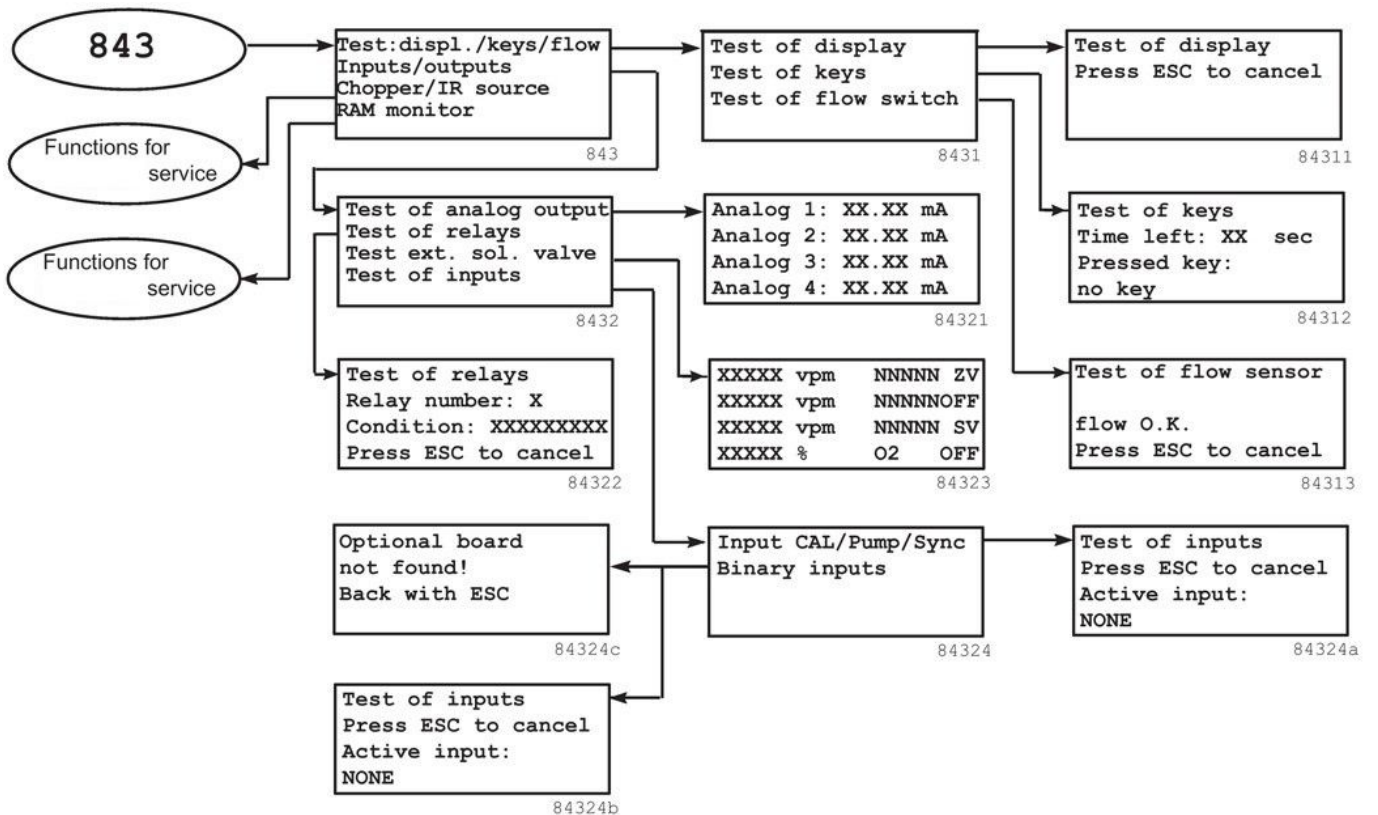


Fig. 41: Overview of configuration of analyzer tests

5.3.4.1 Configuration: Inputs/outputs/pump

```

Analog outputs
Assign relays
Sync input
Pump ON/OFF modes

```

841

You can use this menu to assign certain functions to the following elements:

- Relays
- Inputs and outputs

Furthermore, the following settings can be made using this menu:

- Synchronization of several analyzers
- • Pump response with AUTOCAL and in measuring mode

5.3.4.1.1 Configuration: Inputs/outputs/pump: Analog outputs

```

Analog output ranges
Output during FCTRL
Output during faults

```

8411

You can use this menu to parameterize the analog outputs. This input always refers equally to all components.

Analogausg 0/2/4/NAM mA (Anfangswert der Analogausgabe)

```

Analog output
Set value:
Range: 4 / 20 mA
Meas value neg: ON

```

84111

You can set the following start-of-scale values for the analog current range in the 3rd line:

- 0 mA
- 2 mA
- 4 mA
- NAMUR

You can switch suppression of negative measured values on or off in the 4th line. The "ON" option is preset, and means that negative measured values can also be output. With a setting of 2 or 4 mA as the lower limit, values below this down to 0 mA can therefore be output, i.e. negative measured values can be displayed (live zero).

```

Analog output
Set value :
Range: 4 / 20 mA
Meas. value neg: OFF

```

84111a

If the output of negative measured values is switched off ("OFF" position), the current output is limited to the start-ofscale value. If 2 or 4 mA is set as the lower limit, the output is now indeed limited to 2 or 4 mA. In the adjacent display, the start-of-scale value of the analog current range is set to 4 mA.

The following tables represent the correlation between analog current outputs and measuring range limits.

Selectable	Analog current (neg. MV on)	Analog current (neg. MV off)
0 - 20 mA	0 mA	0 mA
2 - 20 mA	2 mA	2 mA
4 - 20 mA	4 mA	4 mA
NAMUR - 20 mA	4 mA	4 mA

Start-of-scale value of the analog current output

Selectable	Analog current (neg. MV on)	Analog current (neg. MV off)
0 - 20 mA	0,0 mA	0,0 mA
2 - 20 mA	0,0 mA	2,0 mA
4 - 20 mA	0,0 mA	4,0 mA
NAMUR - 20 mA	3,8 mA	4,0 mA

Start-of-scale value of the analog output current for downward limiting of measured value

Selectable	Analog current (neg. MV on)	Analog current (neg. MV off)
0 - 20 mA	21,0 mA	21,0 mA
2 - 20 mA	21,0 mA ¹⁾	21,0 mA ¹⁾
4 - 20 mA	21,0 mA ¹⁾	21,0 mA ¹⁾
NAMUR - 20 mA	20,5 mA	20,5 mA

Full-scale value of the analog output current for upward limiting of measured value

1) If measuring range 2 is set to the maximum possible value, the limiting value of range 2 ... 20 mA is at 20.9 mA and of range 4 ... 20 mA at 20.8 mA.

Analog output during FCTRL (analog output during function control)

NOTICE



If a fault is present on the analyzer, only the values of the setting "Output during faults" apply. Simultaneous occurrence of values of the setting "Output during FCTRL" are ignored in this case.

Analog output during
function control
Meas. value: actual

84112

The status "FCTRL" (function control) is set

- During an AUTOCAL procedure
- During the warm-up phase
- During a calibration procedure
- During remote control via the communication interface
- In the uncoded state::

Output of the following measured values is possible here:

- Hold: The value measured directly prior to commencement of a function control is output unchanged. This also applies to the limits which are output (see section Parameters: Limits).
- Actual: The measured value is continuously updated.
- Zero:

See following table:

Selectable	Analog current
0 - 20 mA	0 mA
2 - 20 mA	2 mA
4 - 20 mA	4 mA
NAMUR - 20 mA	3 mA

– **21 mA:**

see following table:

Selectable	Analog current
0 - 20 mA	21,0 mA
2 - 20 mA	21,0 mA
4 - 20 mA	21,0 mA
NAMUR - 20 mA	21,5 mA

Analog output during fault

Analog output during faults Meas. value: ZERO
--

Here, you can define the type of measured value output during a fault.

84113

Output of the following measured values is possible here:

- Hold: The value measured directly prior to commencement of a fault is output unchanged. This also applies to the limits which are output (see section Parameters: Limits).
- Actual: The measured value is continuously updated.
- Zero:

See following table:

Selectable	Analog current
0 - 20 mA	0 mA
2 - 20 mA	2 mA
4 - 20 mA	4 mA
NAMUR - 20 mA	3 mA

- **21 mA:**

see following table:

Selectable	Analog current
0 - 20 mA	21,0 mA
2 - 20 mA	21,0 mA
4 - 20 mA	21,0 mA
NAMUR - 20 mA	21,5 mA

5.3.4.1.2 Configuration: Inputs/outputs/pump: Assign relays

```
Relays for limits
Relays for MR
Relays for status
Relays for valves
```

8412

You can use this menu to assign different functions to up to eight relays which are installed in the analyzer, such as signals or functions of external solenoid valves. If an option module is present in the analyzer, eight additional relays, which means a total of 16 relays, can be assigned corresponding functions.

Each function may only be assigned once, i.e. to one single relay. The analyzer outputs an error message if you attempt a second assignment for a relay. A relay to which a function has not been assigned is shown on the display by a dash.

The following table shows an overview of the possible relay assignments..

Function	Relay de-energized	Relay energized	Signaling
Measuring range	Range 2	Range 1	-
Status messages			
Fault	Fault present		
Maintenance request	Maintenance request present		
CAL/MESS	Measuring; warm-up phase (5 minutes); purging function of H ₂ S sensor; protection function of H ₂ sensor	AUTOCAL; all calibrations	AUTOCAL; all calibrations Remote operation
Function control	Function control is present		During warm-up phase (approx. 30 min), AUTOCAL, uncoded
External solenoid valves			
Zero gas	Zero gas flows; AUTOCAL gas flows (not during AUTOCAL sample gas pre-purging phase); purging function of H ₂ S sensor; protection function of H ₂ sensor		Ext. solenoid valve open
Calibration gas (sample gas inlet)		Calibration gas/scan gas flows (valid for IR components and all sensors)	Ext. solenoid valve open
Sync.		Synchronization signal is output	AUTOCAL only "Zero gas flow" and adjustment (not during sample gas pre-purging phase); AUTOCAL gas flows (not during the sample gas pre-purging phase)

The pin assignments of the relays in the de-energized state are described in section Pin assignments.

The functions which can be assigned to the relays have the following meanings:

```
Limits SO2
Limit 1 Relay 1
Limit 2 Relay 2
```

84121

Limits

Upper and lower limits can be defined as events for energizing relays. Select the desired relay(s) in the second and third lines of this menu. This function is specific to the component.

```
NO MR relay 3
CO MR relay -
SO2 MR relay 4
O2 MR relay -
```

84122

Measuring range

A relay for measuring range switchover can be assigned to each measured component. This guarantees reliable assignment of the analog output signal to the currently active range, especially with autoranging (see section Parameter: Measuring ranges).

```
Fault           :R-
Maintenance req.:R5
CAL/MEAS       :R6
FunctionControl:R-
```

84123

Status messages

You can use this menu to apply the signaling of various operating states of the analyzer as an event for relay control (R in the display means Relay). The following signals are possible:

- Fault: Occurrence of a fault and output of a fault message
- Maintenance request: Occurrence of maintenance request (assigned to relay 5 in Fig.)
- CAL/MEAS: Switching over from measuring mode to AUTOCAL (applied to relay 6 in Fig.)
- Service switch: Occurrence of a function control.

```
External valves
zero gas : relay -
span gas : relay 7
Sync     : relay 8
```

84124

In this menu you can trigger external solenoid valves via relay contacts:

- Zero gas: The zero gas supply which is triggered with AUTOCAL
- Span gas: The calibration gas supply (assigned to relay 7 in Fig.)
- Sync: Synchronization of an AUTOCAL with other devices within a system (assigned to relay 8 in Fig.; see section System setup with several analyzers in parallel).

5.3.4.1.3 Configuration: Inputs/outputs/pump: Binary/sync inputs

```
Sync input
Binary inputs
```

8413

You can use this dialog to set the response of the synchronization input and the binary inputs. Select one of the adjacent options:

```
Mode of
Sync input
:activate CAL only
```

84131

Sync input

You can use this dialog to set the response of the synchronization input. This function allows an AUTOCAL procedure to be triggered simultaneously for several analyzers within a system. You can select between the following settings in the third line (see also section System setup with several analyzers in parallel):

- AUTOCAL: The analyzer carries out an AUTOCAL and activates its sync output up to the end of the electronic adjustment. If the flow becomes too low during a zero adjustment triggered via the sync input, this zero adjustment is aborted, and an error status set. This aborted zero adjustment is entered in the logbook.
- Activate CAL relay (set in Fig.): The analyzer enters the CAL status, but does not carry out an AUTOCAL. The analyzer waits until the Sync input becomes inactive. It then enters the status 'Purge sample gas' and subsequently selects measuring mode.

```
Optional board not
found!
Return with ESC
```

84132a
84324c**Binary inputs**

You can use this dialog to freely configure 8 floating binary inputs ["0" = 0 V (0...4.5 V); "1" = 24 V (13...33 V)] in analyzers with an add-on board. The pin assignments of the 37-contact plug are described in section Pin assignments. No inputs are preset on delivery.

The adjacent error message occurs if an attempt is made to call this function for a device without add-on board.

```
Fault/MaintenanceReq
Function control
Measuring ranges
Clear logbook
```

84132

The adjacent display appears if an add-on board is present. You can then assign the following functions to the eight binary inputs in a submenu:

- Seven different messages for faults/maintenance requests
- Four different messages for function control
- Switch ranges
- Delete the logbook.

The functions are shown in the following table:

Function	Control with		Effect
	0 V	24 V	
- (vacant)			
External fault 1 ... 7		x	e.g. signaling of a fault in gas conditioning (cooler, flow, condensation trap, ...)
External maintenance request 1 ... 7		x	e.g. signaling of a maintenance request in gas conditioning (filter, flow, ...)
Function control 1 ... 4		x	e.g. signaling of maintenance
Measuring range 1,2		x	The corresponding range is selected (autoranging OFF)
Autorange		x	Autoranging is switched on
Delete logbook		x	Delete all fault and maintenance request entries

5.3.4.1.4 Configuration: Inputs/outputs/pump: Pump at CAL/MEAS

```
Pump at CAL: ON
Pump at MEAS: ON
```

8414

- You can use this menu to define the response of the pump. The following parameters and values are possible:
- Pump at CAL: Pump switched ON or OFF during an AUTOCAL
- Pump at MEAS: Pump switched ON or OFF during measuring mode.

5.3.4.2 Configuration: Special functions

```
Codes/Language
AUTOCAL drift
ELAN
Fact. data/res/units
```

842

Following selection of the special functions, the adjacent menu is displayed with the following options:

- Change codes
- Change language
- Setting of AUTOCAL tolerances
- Parameterization of interfaces
- Change physical units in which the measured values are output
- Changing the factory settings

5.3.4.2.1 Configuration: Special functions: Changing the codes/language

```
Code 1 : 111
Code 2 : 222
Language: italiano
```

8421

In the first two lines of this dialog, you can change the codes of the two code levels 1 and 2 (see also section Code levels).

The factory settings for the two code levels are:

- Code level 1: 111
- Code level 2: 222

You can also reduce the number of code levels by assigning the same code to both levels.

With the introduction of firmware version 2.15.06, you can now use letters and special characters for the code in addition to numbers. With all older firmware versions, you could only enter numbers.

The modified codes are effective immediately. You should therefore make a note of the changed codes and keep this at a safe place.

In third line of this dialog you can change the language of the input dialogs. The analyzer is designed for the following languages:

- German
- English
- Spanish
- French
- Italian
- Polish

A change is immediately effective when you leave this dialog.

5.3.4.2.2 Configuration: Special functions: AUTOCAL deviation

```
Preset AUTOCAL drift
Quantity: 4
Limit : 6 %
```

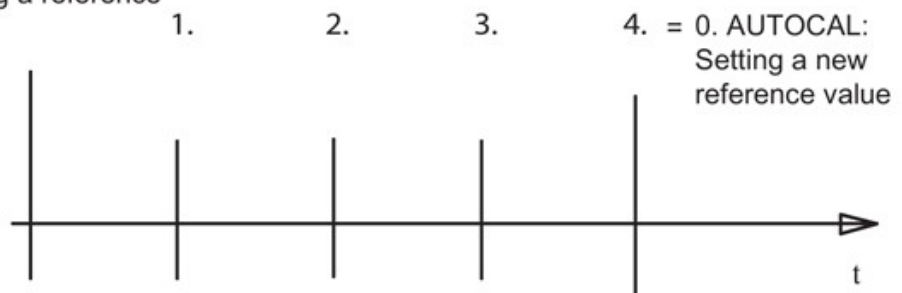
8422

You can use this dialog to define the conditions under which a drift from the value of an AUTOCAL procedure triggers a maintenance request. The adjustable parameters are:

- Quantity: The number of AUTOCAL procedures up to setting of a new reference value (in this example: 4),
- Limit: The largest possible value in % of the set measuring range. In the case of autoranging, range 1 is assumed with max. 99% of the full-scale value. The deviation from the last AUTOCAL must not exceed this value (in this example: 6%, see also section), otherwise a maintenance request is triggered.

0. AUTOCAL:

Setting a reference value



Number of AUTOCAL procedures until a reference is set again (set number: 4)

The previous deviation is still displayed with the 4th AUTOCAL; at the same time the value of the 4th AUTOCAL is used as the new reference value.

If a maintenance request 'AUTOCAL deviation too large' is acknowledged, the values are reset during the next AUTOCAL, and counting commences at 1 again.

5.3.4.2.3 Configuration: Special functions: ELAN/PROFIBUS/external interference

```
ELAN parameters
ELAN ext. interfer.
PROFIBUS parameters
Const. interference
```

8423

You can use this dialog to configure the analyzer for use in an ELAN or PROFIBUS network. The adjacent menu display appears when you select the function from the higher-level menu.

Parameter Configuration: Special functions: ELAN/PROFIBUS/external interference: ELAN parameters

```
Channel      : 1
Name : ULTTWENTYTHREE
Protocol     : OFF
Sync. zero cal. : OFF
```

84231

You can use this dialog to set the parameters for an ELAN network. These are:

Channel

- You must set the channel addresses for the analyzers present in an ELAN network. Addresses from 1 to 12 can be set, where each address may only be used once.

Name

- You can set an analyzer name here. During communication with ELAN, it can be used for the plain text identification of the analyzers. An analyzer name may have up to 10 alphanumeric characters.

Protocol (ON/OFF)

- The automatic transmission of measured values can be switched on/off. With 'ON', the analyzer sends a measured value frame cyclically every 500 ms.

Note

- To avoid considerably hindering communication within an ELAN network, this function should only be set to 'ON' when required (e.g. with correction of cross-interference).

Sync. zero cal. (ON/OFF)

- This function is not yet available. Therefore only 'OFF' is the currently valid value.

NOTICE



For further details on operation of the analyzer in an ELAN network, please refer to the ELAN interface description (C79000-B5274-C176 German/English).

Configuration: Special functions: ELAN/PROFIBUS/external interference: ELAN external interference

```
Interference CO2
Interferences : OFF
Interference 1
Interference 2
```

84232

This function can be used for a correction calculation by measuring the influence of an interfering gas by means of another analyzer connected in the ELAN network.

The parameterization of two analyzers for correction of cross-interference is demonstrated using the following example. Analyzer 1 delivers the measured values, analyzer 2 uses these values for a correction calculation.

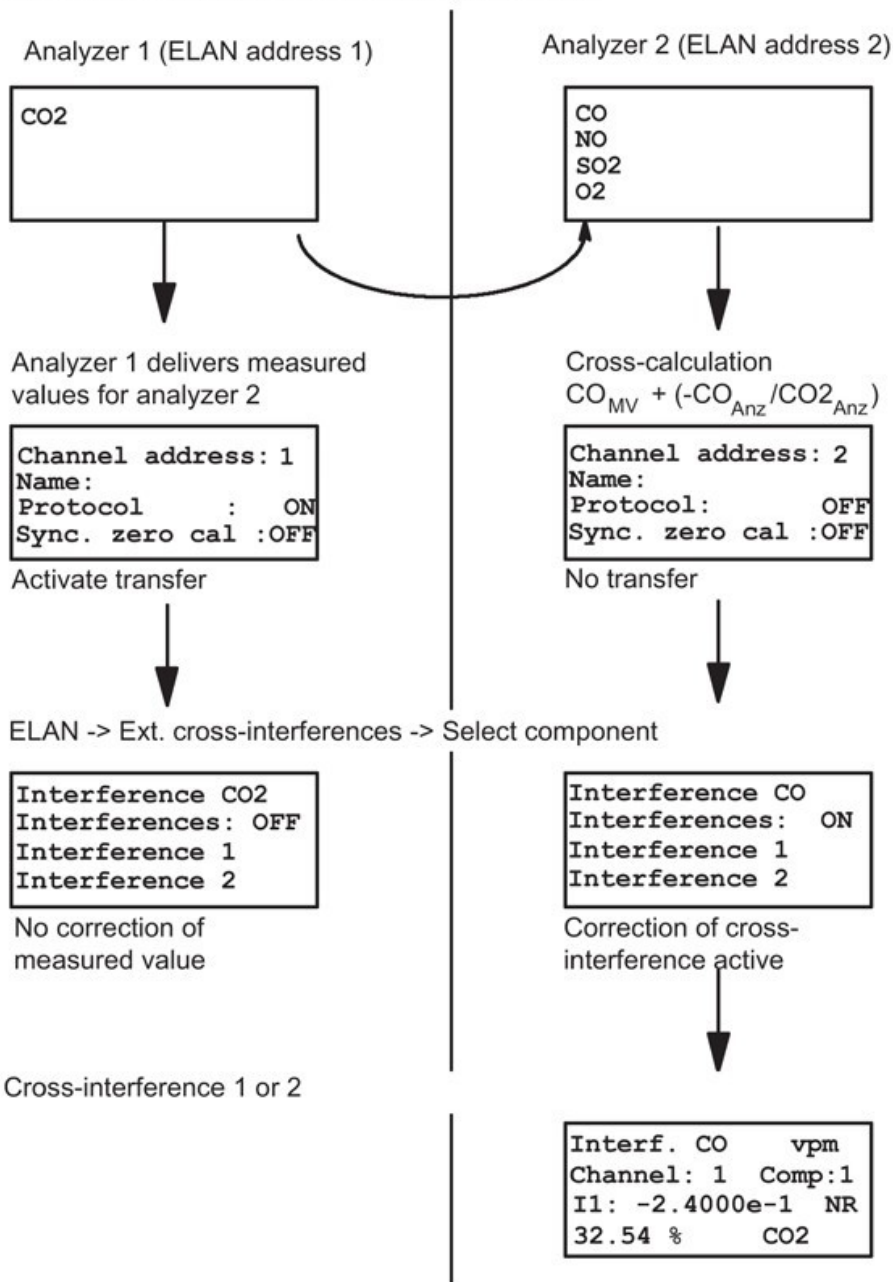
NOTICE



Neither analyzer is capable of measurements during the AUTOCAL. Therefore it may be necessary to evaluate signals for the function control.

Example of correction of cross-interference of CO₂ on CO with 6 vpm CO at 25% CO₂ via ELAN

1. Connect two analyzers to the ELAN interface using a cable.
(see ELAN interface description (C79000-B5274-C176 Section 2))
2. Select a component using the ELAN menu (8423)



Meaning of the parameters:

Channel 1 = analyzer with address 1 in the ELAN network
 Component 1 = component 1 of the analyzer addressed under 'Channel'
 -2.4000e-1 = cross-interference of CO2 on CO is 6 vpm CO with 25% CO2 => correction is - 6 / 25
 32.54% CO2 = measured values sent over ELAN from analyzer 1 component 1 for calculation
 of correction of cross-interference of CO

Fig. 42: Meaning of the parameters

Configuration: Special functions: ELAN/PROFIBUS/external interference: PROFIBUS parameters

```
Address      : 126
Ident number : 1
PB Relay    : OFF
Diagnosis
```

84233

You can use this function to set the following PROFIBUS parameters:

Address

This function can be used to set a PROFIBUS station address to all numerical values between 0 and 126.

Ident number

This parameter is used to set the configuration response of the device. The values 0, 1 and 3 can be set as valid parameters. They have the following meanings:

- **0:**
Only the 'Profile ID number' is positively acknowledged.
- **1:**
Only the device-specific 'ID number' is positively acknowledged. Note: In order to work with the provided GSD and DD, the 'ID number' parameter must have the value 1.
- **3:**
Only the 'Profile ID number' for multi-variable devices (complex analyzers) is positively acknowledged.

PB relay

You can use this function to enable the 8 relays of the addon card for control via PROFIBUS. To allow activation, none of these relays must already be occupied by a device internal function.

Note:

The function 'PB relay' is only possible as of PROFIBUS card firmware version 2.0.0 (shown as Firmware in the figure).

Diagnosis

If the 'Diagnosis' parameter is selected, the 'Firmware' display appears with, for example, the following parameters:

- **Firmware**
The firmware version is displayed here.
- **Boot FW**
The version of the boot firmware is displayed here.
- **TAG**
The name assigned to this analyzer in the network (or the first 16 characters).

```
Firmware     : 2.0.0
Boot FW     : 0.2.0
TAG: ULTRAMATDREIUND
```

84233a

Configuration: Special functions: ELAN/PROFIBUS/external interference: Cross-interference

```
Interf. for CO2 vpm
Cal. w. interf. OFF
Const. interf. OFF
C.I: +0.0000e+0
```

84234

- The adjacent menu display appears when you select this parameter. You can use this function to:
- Switch the correction of cross-interference on or off for the duration of the calibration. To do this, you must select the 2nd line and switch the parameter on or off there.
- OFF (factory setting) means that the correction of cross-interference is switched off during the calibration.
- ON means that the corrections of cross-interference remain active during the calibrations. It is thus possible to use gas combinations as calibration gases.
- Switch the correction of a constant cross-interference on or off. To do this, you must select the 3rd line and switch the parameter on or off there. If the constant crossinterference is switched ON, the measured value of the selected component is corrected with the entered value by adding.

5.3.4.2.4 Configuration: Special functions: Factory data/reset/units

Configuration: Special functions: Factory data/reset/units

```
Load factory data
Reset analyzer
Change units
```

8424

You can use this menu to select a number of items with which e.g. inappropriate configurations and analyzer settings can be cancelled: The adjacent menu display appears when you select the function from the higher-level menu.

Configuration: Special functions: Factory data/reset/units: Load factory data

```
ATTENTION! Data will
be overwritten!
Press ENTER to cont.
Press ESC to cancel
```

84241

In this menu you can reestablish the original parameters present when the analyzer was delivered.

Note:

All modifications (parameters and configuration) which you have made since then are deleted. The adjacent display appears when you select this function. You define the further sequence by pressing either the <ENTER> or <ESC> key.

```
Factory data loading
please wait
```

84241a

When you select this function, the adjacent display appears for the duration of the load procedure.

Configuration: Special functions: Factory data/reset/units: Reset

```
Warning! Analyzer is
set to warm-up mode!
Press ENTER to cont.
Press ESC to cancel
```

84242

You can use this function to restart the analyzer.. When you select this function, you will be warned (see adjacent display) that the analyzer initially runs through a warmup phase following the restart and is thus unavailable for measurements for a certain time. The <ENTER> key initiates the restart with the warm-up phase. Triggering of the restart can be prevented here using the <ESC> key.

Configuration: Special functions: Factory data/reset/units: Change units

```
Unit for SO2
set:   mg/m3
MR min: 400 - 10%
MR max: 2000 + 10%
```

84243a

In the second line of this menu display, you can change the factory-set units of the measured components.

```
Unit for SO2
set   : vpm
MR min: 148 - 3%
MR max: 757 + 3%
```

84243a

After changing the unit, the display of the 'MB min' and 'MB max' parameters is adapted accordingly. This dialog is specific to the component.

NOTICE



The full-scale values may assume unusual values as a result of the component-specific conversion factors. Subsequent adaptations can be carried out as described in section Parameters: Measuring ranges: Setting measuring ranges. In addition, you should also check these parameters following this change:

- Setpoints of the calibration gases (section Calibration: Infrared measuring range: Set span gas values)
- Settings for the limits (section Parameters: Limits).

5.3.4.3 Configuration: Device test

5.3.4.3.1 Configuration: Device test: RAM monitor

Servicing engineers can use this function to view the contents of certain memory areas.

CAUTION



Device failure

Incorrect execution of this function may make the analyzer permanently incapable of measuring! Therefore this function must only be carried out by qualified servicing personnel.

```
Test: displ/keys/flow
Inputs/outputs
Chopper/IR source
RAM monitor
```

843

Following selection of the special functions, the adjacent menu is displayed with options for the following device tests:

- Menu display
- Keys
- Flow switch
- Inputs and outputs
- Various internal components Testing of chopper, IR source, and RAM monitor can only be carried out by servicing personnel.

5.3.4.3.2 Configuration: Device test: Display/keys/flow

```
Test of display
Test of keys
Test of flow switch
```

8431

You can select the following three tests in this menu.

- **Test of display**
 - In this test, all characters in the character set of this analyzer are output in succession at every position of the display. The display remains empty if characters are output which cannot be displayed. This is a cyclic test, i.e. once the complete character set has been processed, it starts from the beginning again. The test is repeated continuously until terminated by pressing the <ESC> key. A corresponding message will inform you of this before the test is started.
- **Test of keys**
 - This test takes 30 s, and the time remaining up to the end of the test is output on the display. During this time you can press all input keys in succession. The analyzer normally recognizes that a key has been pressed and indicates this. This test cannot be prematurely cancelled.
- **Test of flow switch**
 - This indicates whether the sample gas flow is correct or not. Depending on the type of gas supply, it may be necessary to switch on the pump using the <PUMP> key.

5.3.4.3.3 Configuration: Device test: Inputs/outputs

```
Analog test
Relay test
External valve
Input test
```

8432

In this menu you can call the tests of the electric inputs and outputs of the analyzer. You require the following equipment to carry out these tests:

- Ammeter
- Ohmmeter
- Power supply (24 V DC)
- Test plugs

Configuration: Device test: Inputs/outputs: Test analog outputs

```

Analog 1: 0.20 mA
Analog 2: 0.40 mA
Analog 3: 1.55 mA
Analog 4: 3.33 mA

```

84321

The analyzer has four analog outputs and an output current range of 0/2/4 ... 20 mA. You can test these by setting any value of the output current between 0 and 20 mA in this menu display. To test these outputs, connect an ammeter to the corresponding analog outputs on plug X80 and measure the output current. The pin assignments of plug X80 are described in section Pin assignments.

Configuration: Device test: Inputs/outputs: Test of relays

```

Test of relays
Relay number 1
Condition: not act
Press ESC to cancel

```

84322

You can use this function to test the status of the relays controlled by this analyzer. First enter the relay to be tested in this dialog. The analyzer can control up to eight relays, or up to 16 relays with an add-on board, whose contacts you can test. Connect an ohmmeter to the corresponding relay outputs on the plug. You can process the following parameters:

– Relay number:

One of the relays 1 to 8 (relays 1 to 16 in the case of analyzers with add-on board).

– Condition:

The current state of the selected relay (active or inactive; inactive in the Fig.).

The pin assignments of plug X80 (motherboard) und X50 (addon board) are described in section Pin assignments. You can exit the test by pressing the <ESC> key.

Configuration: Device test: Inputs/outputs: Test external solenoid valve

```

130 mg/m3 NO ZV
89 mg/m3 CO OFF
249 mg/m3 SO2 SV
20.77 % O2 OFF

```

84323

You can use this function to operate external solenoid valves for the zero gas (AUTOCAL gas) and calibration gas supplies via the relay contacts. Use the arrow keys <↑> and <↓> to select the zero gas valve (ZV) in the first line or the calibration (span) gas valve (SV) in the third line, and call the selected valve using the <ENTER> key. Switch the previously assigned relay using any arrow key in the second or fourth line (the value on the right edge of the line toggles between OFF and ON). The currently measured values are output in the menu displayed during the test.

Configuration: Device test: Inputs/outputs: Test of inputs

```

Input CAL/pump/sync
Binary inputs

```

84324

You can use this function to test the status of the analyzer inputs. You can test the following inputs:

- CAL, pump, SYNC (on the motherboard)
- Binary inputs (on add-on board)

After calling this dialog, apply a voltage of 24 V DC to one of the three inputs to be tested. The result is displayed in the fourth line (here: "No active input"). The pin assignments of plug X80 (motherboard) und X50 (addon board) are described in section Pin assignments.

```

Test of inputs
active input:
NONE
Press ESC to cancel

```

84324a

Result of the CAL, pump, SYNC inputs test

```
Test binary inputs
active input:
NONE
Press ESC to cancel
```

84324b

Result of the binary inputs test

```
Optional board not
found!
Return with ESC
```

84132a
84324c

The adjacent error message occurs if an attempt is made to call this function for a device without add-on board.

5.3.4.3.4 Configuration: Device test: Chopper/IR source

You can use this function to switch the chopper and IR source off for test purposes.

CAUTION



Device failure

Incorrect execution of this function may make the analyzer permanently incapable of measuring! Therefore this function must only be carried out by qualified servicing personnel.

NOTICE



The analyzer is not ready for measurements for a certain period if the IR source or chopper has been switched off. To reestablish the measuring capability, you must therefore provide a sufficiently long warm-up phase depending on the switch-off period, e.g. by restarting the analyzer.

5.3.4.4 Configuration: Factory configuration

```
Factory configur. !
Enter special code
: 0000
```

844

These are factory settings made especially for your analyzer. Since incorrect modifications to these parameters may permanently influence the functions of your analyzer, access to these functions is only possible by specially trained and authorized servicing engineers using a special access code.

5.3.5 Automatically executed functions of the H₂S sensors

5.3.5.1 Probe protection and purging function

A protection and purging function is implemented by means of software since H₂S concentrations above the specified continuous concentration impair the functionality and service life of the H₂S probes. In addition, a purging function is implemented for the 50 ppm H₂S probe in order to allow an intermittent measurement above the permissible continuous concentration. These functions are executed automatically when certain operating states occur.

5.3.5.2 Probe protection function

Definition of probe protection function

A value 1.1 times the specified range can be considered as the maximum continuous concentration. Although a measurement above such a concentration is still correct, the probe is damaged by longer exposure. The maximum continuous concentration remains constant even when changing the measuring range. The protection function is also implemented with the 50 vpm probe for compatibility reasons even though its maximum continuous concentration is 12.5 vpm. The protection function is executed above this value. Execution of this function is the same for all probes. The function test is set during execution of the protection function in order to signal that the displayed value is incorrect.

How the protection function works

The protection function is triggered if the continuous measured value of H₂S is greater than the maximum continuous concentration (110 % of full-scale value) in measuring mode for a period of 3 seconds.

The following occurs when the protection function starts:

- The H₂S measured value display is set to "*****"
- An "H" (H₂S protection function running) is displayed in the measurement screen at the right edge where the test letter "!" appears (fault no longer pending has been logged).
- The zero gas valve is opened
- The "Function control" status is set.

As long as the protection function is active, the zero gas valve remains open during the zero gas purge time. The device then switches to purging of the sample gas path with sample gas. This process is repeated if the maximum continuous concentration is exceeded within the sample gas purge time.

This process is repeated up to 6 times. If after the 6th repeat the sample gas concentration is still too high, the zero gas valve remains permanently open and the fault 28 "H₂S probe protection" is entered in the logbook. If the maximum continuous concentration is not exceeded again, the protection state is terminated and the H₂S measured value is displayed again. Furthermore, the function control and the test letter "H" are deleted.

Return to measuring mode

An active protection function can be interrupted as follows:

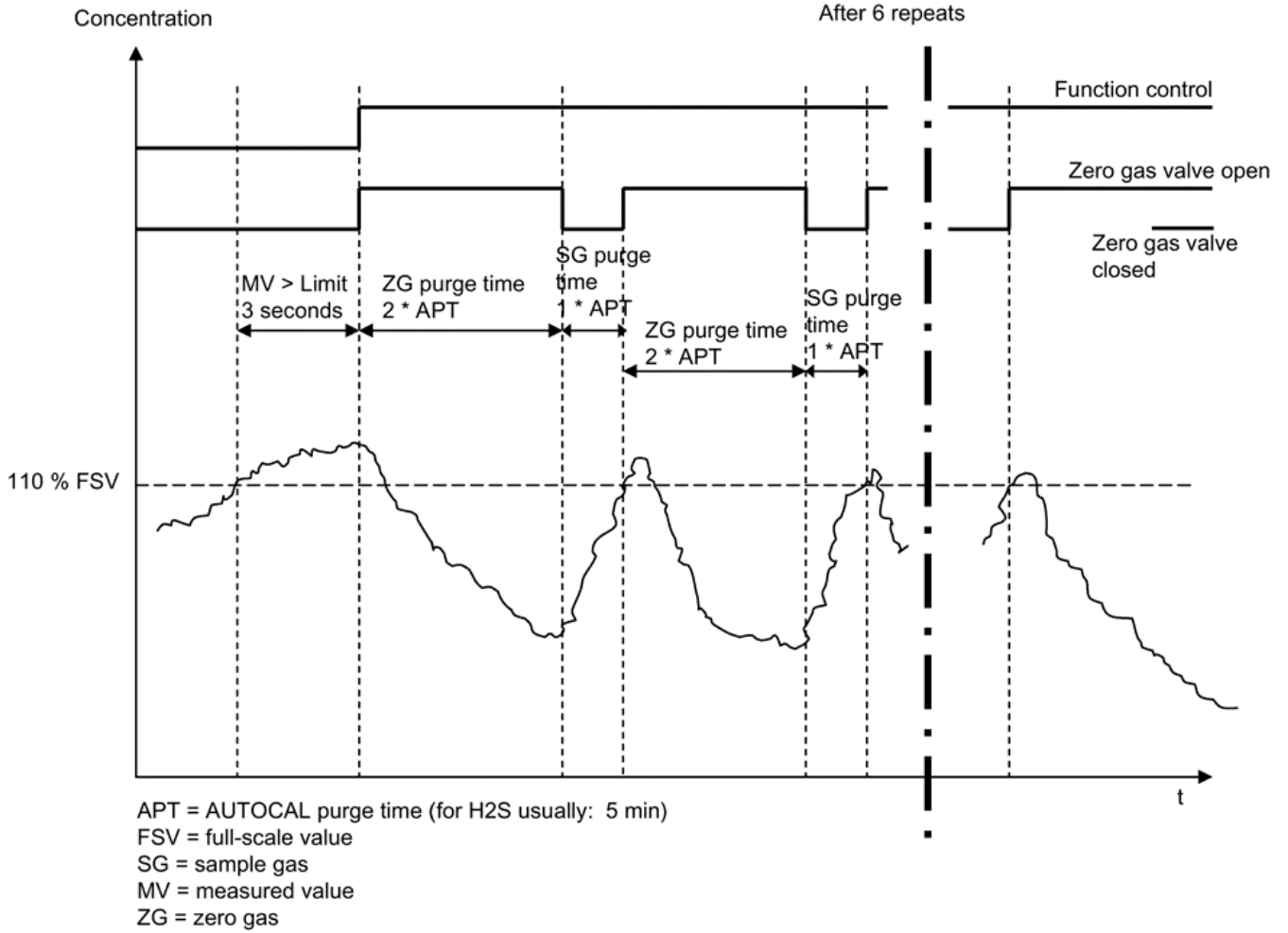
- Automatic: Prior to completion of the 6th repeat, the measured value in the sample gas purge time remains permanently below the maximum continuous concentration.
- Set the protection function to 'OFF' by changing the parameter in the limit display or via ELAN
- Start a different state such as calibrate, AUTOCAL, etc.
- Acknowledgment of the fault "H₂S probe protection" in the logbook

Sequence parameter

The zero gas purge time is twice the AUTOCAL purge time. The sample gas purge time is equal to the AUTOCAL purge time. The AUTOCAL purge time is an adjustable parameter whose setting is described in section Calibration: AUTOCAL/drift values: Purge time.

The protection function can be enabled and disabled using the menu item 'H₂S probe protection' (see section Parameters: Limits: H₂S sensor protection). The function is ON with the factory setting.

The device remains in measuring mode while the protection function is running. You can read out via ELAN or PROFIBUS whether the protection function of the analyzer is being processed, and in which step.



5.3.5.3 Probe purging function

Hydrogen sulfide measurement: Purging function of 50 vpm probe

Hydrogen sulfide (H₂S) is a corrosive gas, especially in wet condition and in combination with other gases. A selectable protection function has been implemented (see section Probe protection function) since H₂S concentrations above the permissible continuous concentration impair the functionality and service life of the H₂S probes. A purging function has additionally been integrated for the 50 vpm probe, enabling a discontinuous measurement above its permissible continuous concentration. The permissible continuous concentration is 12.5 vpm. Although a measurement above such a concentration is still correct, the probe is damaged after a certain period. This period can be set in accordance with the experience gained using the sensor between 10 und 20 minutes using the AUTOCAL purge time (the purging duration corresponds to twice the AUTOCAL purge time). For this reason measurements above a concentration of 12.5 vpm must be carried out discontinuously and alternately with purging gas. The probe can be used for a measurement again following a purging time of equal duration with air. The function test is set during execution of the purging function in order to signal that the displayed value is incorrect.

How the purging function works

The purging function is triggered if the continuous measured value of H₂S is greater than the permissible continuous concentration (12.5 vpm) in measuring mode for a period equal to the duration of the zero gas purge time. Following triggering of the purging function:

- The last measured values of all components are 'frozen' if the 'Analog outputs with FCTRL' parameter has been set to 'Hold', or the current measured values are still displayed for all other settings.
- A "V" (H₂S purging function running) is displayed flashing in the measurement screen at the right edge where the test letter "!" appears (fault logged, no longer pending).
- The zero gas valve is opened.
- The "Function control" status is set.

As long as the purging function is active, the zero gas valve remains open during the zero gas purge time. The device then switches to the sample gas path. The status 'Function control (FCTRL)' remains set and the test letter "V" flashes during the zero gas purge time and the subsequent pre-purging phase. This signals that the displayed measured values are incorrect. The status 'Function control' and the test letter are deleted following the prepurging phase, and the current re-measured values displayed again. Monitoring of the H₂S threshold for the permissible continuous concentration is already re-activated during the prepurging phase.

Return to measuring mode

An active purging function can be exited or interrupted if:

- The H₂S measured value remains permanently below the threshold for the permissible continuous concentration during the pre-purging phase
- The probe protection function is triggered
- A different device status is started such as calibration, AUTOCAL, etc.

Sequence parameter

The zero gas purge time is twice the AUTOCAL purge time. The pre-purging phase is equal to the AUTOCAL purge time. The AUTOCAL purge time is an adjustable parameter whose setting is described in section Calibration: AUTOCAL/drift values: Purge time. The device remains in measuring mode while the protection function is running. You can read out via ELAN or PROFIBUS whether the protection function of the analyzer is being processed, and in which step. The following illustration shows how the purging function runs over time:

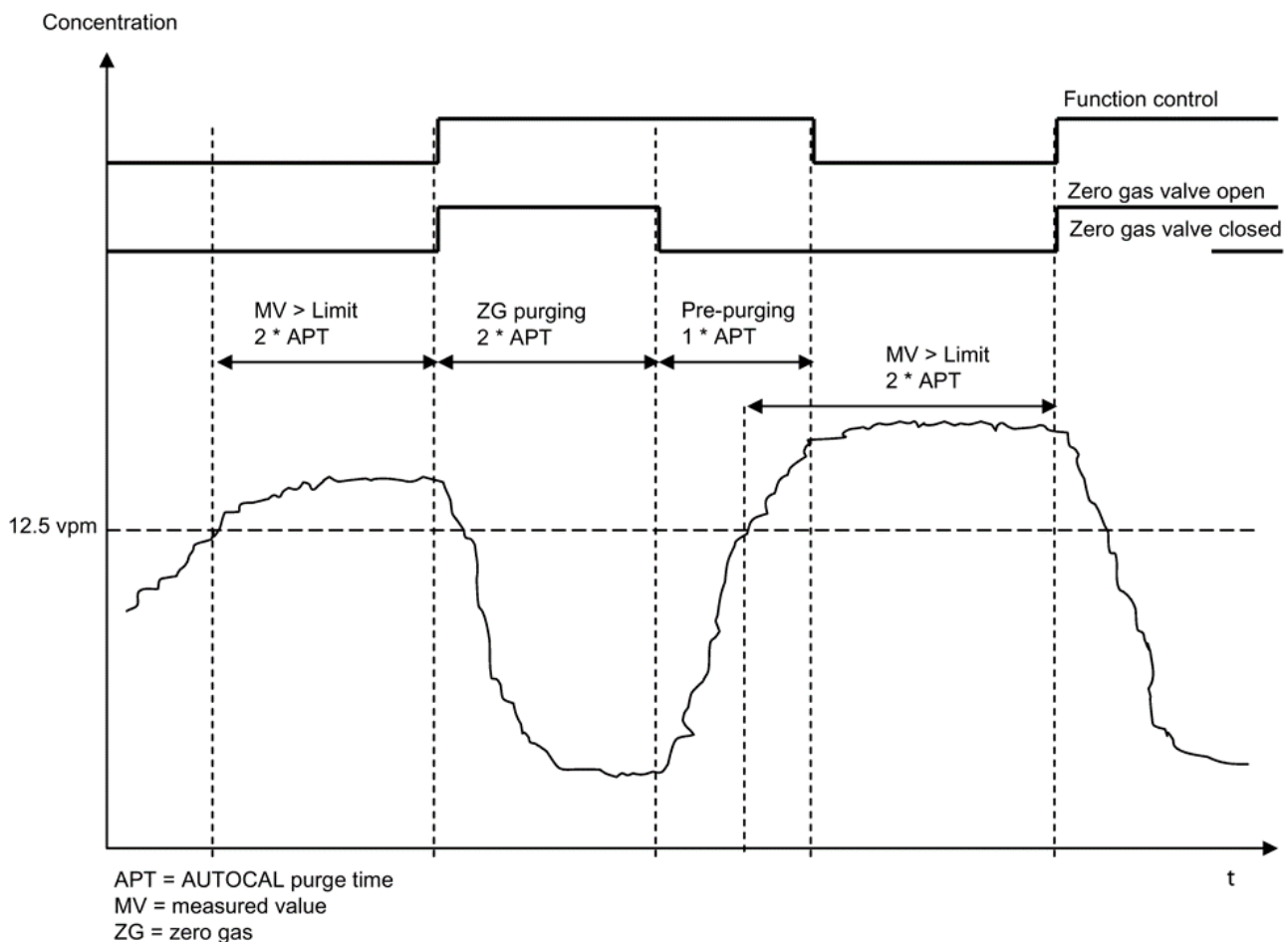


Fig. 43: The H₂S purging function over time

5.4 Application note

5.4.1 H₂S sensor with 'small' measuring range

This section reflects the experiences gained with operation of a sensor for a measuring range of 5/50 vpm H₂S.

Packaging

The transport packaging is not gas-tight. To prevent drying-out of the sensor and the possibility of malfunctions, the sensor must be used in the BA 5000 within 1 year of the date of manufacture.

Spare part

For logistical reasons, a period of 9 months can elapse between the date of manufacture of the sensor and its arrival at the location of use. This duration is not harmful for the subsequent use of the sensor. The service life is still 12 months in this case.

Storage and transport

Storage at an excessively high humidity (tropics, several months) results in swelling of the electrolyte which could damage the electrolyte vessel. As a rule of thumb: The sensor can be used for 12 months following manufacture and storage.

Battery

The BA 5000 must be operated continuously since the H₂S sensor has its own battery whose voltage is retained through operation of the BA 5000. With the analyzer switched off, the power supply to the sensor is from its own battery. The resulting discharging of the battery impairs the sensor functionality and results in zero and span drifts as well as increased signal noise. This malfunction may last for 2 days or longer.

Materials used in the sample gas path

As a result of its polarity and good solubility in water, H₂S accumulates on various materials. These adsorption and desorption effects lead to increases in the response times. Therefore, the inlet piping for the sample gas should be made of PTFE. Other materials should only be used for short gas lines.

Ambient temperature

The influence of ambient temperature on the sensor is 3 %/10 °C, referred to the full-scale value; this corresponds to 1.5 vpm/10 °C.

Sample switchover between raw gas / pure gas

The sensor only functions correctly if the values at the measuring point do not greatly differ from one another. We cannot recommend switching over between measuring points on the raw gas side (high H₂S concentration) and the pure gas side (low H₂S concentration), since the difference between the H₂S concentrations of the two gas flows is too large for a reliable measurement.

Pressure influence

Abrupt changes in pressure must be avoided. Although the sensor compensates pressure variations within approx. 20 seconds, it cannot handle pressure surges which may occur when switching over between samples.

Flow

The sample gas should flow continuously and at a constant rate, also during an AUTOCAL. While an AUTOCAL is being carried out, the sample gas flow must be diverted by means of appropriate valve switching. Reason: H₂S is highly soluble in water and accumulates in the condensate. This accumulation increases as the sample gas pressure increases. This effect can result in significant delays in the response time.

Gas moisture

The calibration gas must have the same moisture as the sample gas. If the sensor is used with a very dry gas for a longer period, e.g. when feeding biogas into the natural gas network, it is necessary to carry out an AUTOCAL with ambient air every 60 minutes. The dew point of the air should be in the range of approx. 9 °C ... 12 °C (48 °F ... 54 °F). The AUTOCAL purge time should be at least 5 minutes. This prevents premature drying-out of the sensor.

H₂ influence

The internal design of the 5/50 ppm sensor means that it is immune to the influence of H₂.

NH₃ influence

Loading of 300 vpm NH₃ results in destruction of the H₂S sensor within 2 to 3 days.

AUTOCAL / zero

An AUTOCAL of the zero point should be carried out every 60 minutes. On the one hand, this is used to protect the sensor, but it also compensates the influence of temperature variations during the day.

Calibration of the measured value drift

The deflection signal of the sensor is subject to drift. This drift can be detected only through regular review and corrected as needed. This involves using a calibration gas with a defined concentration of hydrogen sulfide. To keep potential measurement uncertainty within strict limits, we recommend a monthly calibration with a calibration gas with a concentration of 50 vpm H₂S.

6 Maintenance and repair

6.1 Safety instructions

6.1.1 General safety instructions

CAUTION**Dangerous voltage at open device**

Danger of electric shock when the enclosure is opened or enclosure parts are removed.

- Before you open the enclosure or remove enclosure parts, de-energize the device.
- If maintenance measures in an energized state are necessary, observe the particular precautionary measures. Have maintenance work carried out by qualified personnel.

WARNING**Hot, toxic or corrosive process media**

Danger of injury during maintenance work.

When working on the process connection, hot, toxic or corrosive process media could be released.

- As long as the device is under pressure, do not loosen process connections and do not remove any parts that are pressurized.
- Before opening or removing the device ensure that process media cannot be released.

WARNING**Impermissible repair and maintenance of the device**

Repair and maintenance must be carried out by authorized personnel only.

CAUTION**Electrostatic discharges**

The electronic components and modules fitted in this device can be destroyed by electrostatic discharging.

Comprehensive measures (such as the wearing of protective clothing by the maintenance personnel) must therefore be made to prevent electrostatic discharging wherever they are manufactured, tested, transported and installed.

WARNING**Dangerous materials**

Switch off the supply of sample gas before commencing maintenance work, and purge the gas paths with air or nitrogen! During maintenance work, protect yourself against contact with toxic or corrosive condensate. Wear appropriate protective gear.

6.1.2 Safety information for analyzers used in hazardous areas

WARNING

Impermissible repair and maintenance of the device

Repair and maintenance must be carried out by authorized personnel only.

WARNING

Electrostatic charge

Danger of explosion in hazardous areas if electrostatic charges develop, for example, when cleaning plastic surfaces with a dry cloth.

- Prevent electrostatic charging in hazardous areas.

WARNING

Maintenance during continued operation in a hazardous area

There is a danger of explosion when carrying out repairs and maintenance on the device in a hazardous area.

- Isolate the device from power.
- or -
- Ensure that the atmosphere is explosion-free (hot work permit).

WARNING

Impermissible accessories and spare parts

Danger of explosion in areas subject to explosion hazard.

- Only use original accessories or original spare parts.
- Observe all relevant installation and safety instructions described in the instructions for the device or enclosed with the accessory or spare part.

WARNING

Improper connection after maintenance

Danger of explosion in areas subject to explosion hazard.

- Connect the device correctly after maintenance.
 - Close the device after maintenance work.
- Refer to Connecting.

6.2 Cleaning the device

Cleaning the surface

Only use a moist cloth to clean the display.

The front panels and doors are washable. Use a sponge or cloth soaked in water containing washing-up liquid.

The surface in the display area must only be cleaned using gentle pressure to prevent damage to the foil.

Cleaning the interior

After opening the device, you can blow out the interior carefully with a compressed air gun, if necessary.

6.3 Maintenance of the gas path

Depending on the corrosivity of the sample gas, check the state of the gas path at regular intervals.

Servicing may be necessary.

6.4 Replacing spare parts

WARNING



Incorrect fitting of replacement parts

Special work is required when replacing spare parts, especially on the IR analyzer unit, which can only be carried out at CSC Haguenau or by qualified, specially trained personnel. Incorrect interventions can result in a reduction in measuring accuracy or malfunctioning of the analyzer.

To maintain the measuring accuracy of the BA 5000, it may be necessary to carry out a temperature compensation following the replacement of certain parts. Parts to which this statement apply are identified in the spare parts list (see) by "***".

This particularly applies if brief temperature fluctuations > 5 °C (9 °F) occur at the installation location. This temperature dependence will not occur if you use an "AUTOCAL" cyclic zero point adjustment of e.g. 3 hours.

We recommend having temperature compensation performed at CSC Haguenau.

6.5 Replacing fuses

DANGER



Explosion hazard

If a flammable or ignitable atmosphere exists, plugs must never be disconnected or lamps/fuses replaced when the analyzer is supplied with power.

- Make sure when replacing fuses that an explosive atmosphere is not present (fire permit)!

To replace the fuses, proceed as follows:

1. Remove the fuse holder above the appliance plug. Use a small screwdriver to do this.
2. Remove the blown fuse from the holder.
3. Insert a new fuse.
4. Insert the fuse holder into the compartment again.

NOTICE



Only fuses of the type printed on the rear of the analyzer may be used (see also section Electronics).

6.6 Replacing the fine safety filter

To replace the filter, proceed as follows:

- Unscrew the four screws of the top housing cover, and remove the cover to the rear.
- Determine the contaminated filter according to its type (see Gas path).
- Remove the hoses from the filter.
- Remove the old filter. The filter must be disposed of as residual waste.
- Insert the new filter. When installing the filter, make sure that the arrow on the filter points in the gas flow direction.
- Push the cover back onto the housing and screw tight.

6.7 Maintenance work on the bench-top unit

6.7.1 Emptying the condensation trap

Proceed as follows:

1. Switch off the pump by pressing the <PUMP> key.
2. Disconnect the analyzer from the power supply.
3. Loosen the condensation trap on the front of the analyzer by tilting it slightly, and pull downwards carefully.
4. Empty the trap and dispose of the condensate according to the composition of the sample gas.
5. Push the condensation trap on again from below.

CAUTION



Condensate in the analyzer

If condensate is spilled onto the analyzer during this process, it can penetrate into the analyzer through gaps in the housing. Such an analyzer is not suitable for measurements, and therefore must not be used any longer!

6.7.2 Replacing the coarse filter

Proceed as follows for this:

1. Switch off the pump by pressing the <PUMP> key.
2. Loosen the condensation trap on the front of the analyzer as described in section Emptying the condensation trap.
3. Remove the contaminated filter.
4. Insert the new filter.
5. Push the condensation trap on again from below.

6.8 Replacement of the UV module

Only specially trained personnel are permitted to replace individual components of the UV photometer. For this reason, only the replacement of the complete UV module or complete UV photometer is described here.

WARNING



Improper installation of replacement parts

Special work is required when replacing spare parts, especially on the UV module, which can only be carried out at CSC Haguenau or by qualified, specially trained personnel. Improper interventions can result in a reduction in measuring accuracy or malfunctioning of the analyzer.

Before removal, you must ensure that the analyzer no longer contains any sample gas. To ensure this, purge the analyzer with zero gas (ambient air) for several minutes. Proceed as follows to remove the old UV module (the numbers refer to the position of the components in the figure below):

1. Disconnect the device from the power supply.
2. Unscrew the two screws of the rear cover and remove the cover.
3. Detach all gas supply lines and plug-in connections from the UV module.
4. Loosen the 4 retaining screws from the foot of the base ① and move the base in such a way that the screw heads fit into the openings. You can now completely remove the UV module.
5. Remove the cover of the insulation ⑥.
6. Loosen the 4 retaining screws ⑤ with the plug-in sleeves ④ and remove both from the UV photometer.
7. Remove the UV photometer ③ from the bottom part of the insulation ②. The new UV photometer is installed and the UV module is assembled in the reverse order.

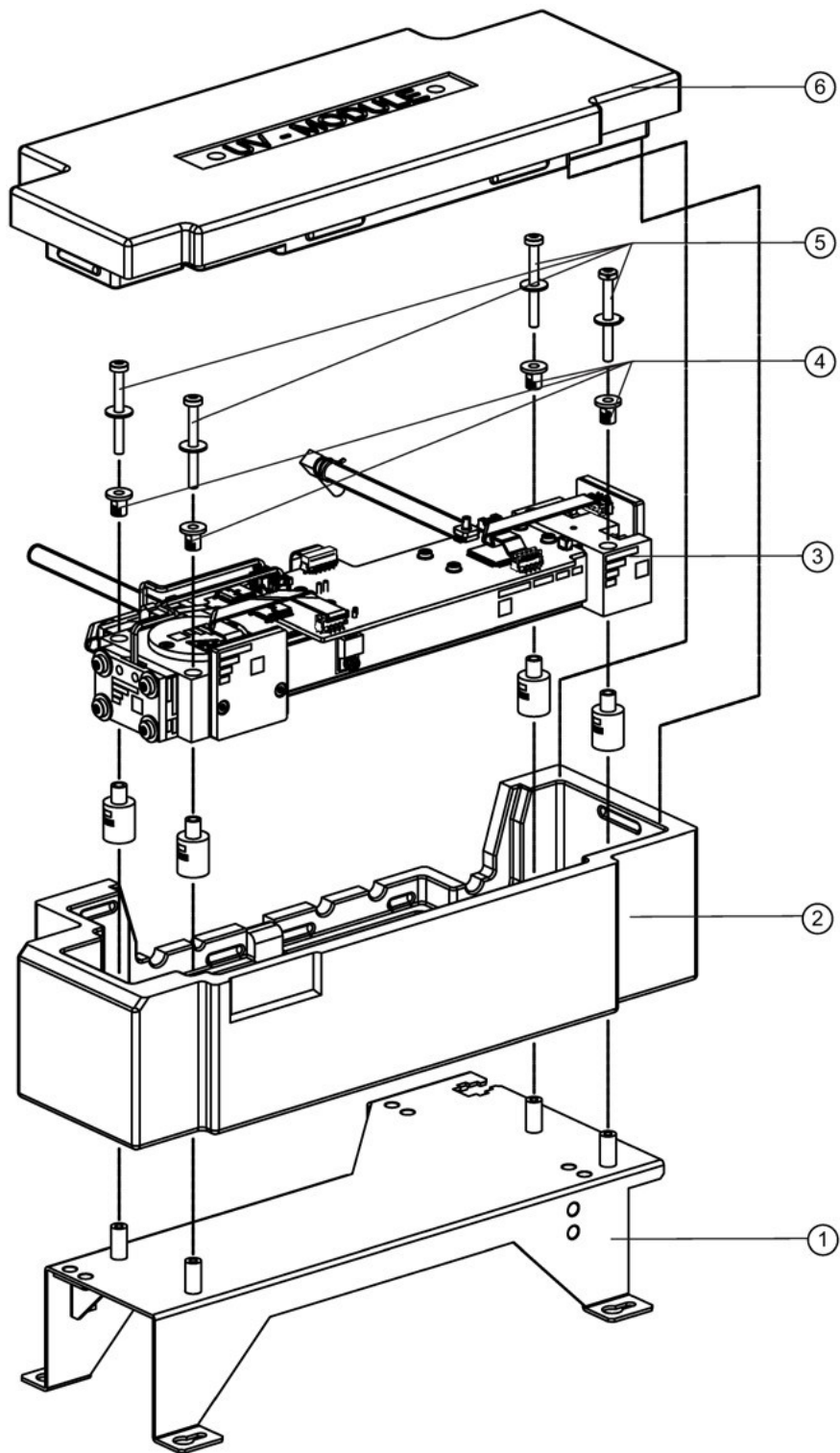


Fig. 44: UV module, disassembled

6.9 Replacing the electrochemical oxygen sensor

WARNING

Danger of chemical burns



The O₂S sensor contains acetic acid, which leads to burns on unprotected skin. When replacing the sensor, its enclosure must not be damaged. If contact with the acid occurs despite great care being taken, rinse the affected skin immediately with plenty of water! Also note that an exhausted or faulty O₂ sensor is hazardous waste and must be packed and disposed of accordingly!

To replace the sensor, proceed as follows:

1. Unscrew the two screws of the front cover and remove the cover.
2. Unlock the plug of the sensor connection, and remove.
3. Unscrew the O₂ sensor out of its holder.
4. Remove the gasket of the O₂ sensor.

The exhausted O₂ sensor must be disposed of as electronic waste with the code number 160215 "Dangerous component removed from used equipment". It must therefore be disposed of correctly and in an environmentally-friendly manner by a local waste disposal company.

1. Insert the new gasket.
2. Screw in the new O₂ sensor and tighten hand-tight.
3. Reconnect the plug.
4. Enter the date of installation of the new sensor in the menu item "O₂ cal. after install" as described in section Calibration: O₂ measuring range: Sensor inst. date.
5. Calibrate the zero point of the new sensor as described in section Calibration: O₂ measuring range: Calibrating the O₂ zero point.

6.10 Replacing the hydrogen sulfide sensor

DANGER

Danger of poisoning



The replacement of the sensor module represents interference in the gas path. The sample gas circulating therein may contain toxic components that lead to death in certain concentrations.

To ensure that the sample gas path is free of toxic material when replacing the sensor module, the gas path must be flushed with ambient air or nitrogen for a period of about 10 minutes before performing the task.

WARNING

Danger of electric shock



The device will be open when the sensor is being replaced. This means present dangerous contact voltage will be present, which can lead to electric shock. For this reason, the sensor module may only be replaced when power is off.

WARNING

Danger of chemical burns



The H₂S sensor contains sulfuric acid, which leads to burns on unprotected skin. Therefore do not use any tools when replacing the sensor module which could damage the sensor due to sharp edges or squeezing. If contact with the acid occurs nevertheless, rinse the affected skin immediately with plenty of water!

NOTICE**Improper disposal**

The exhausted or faulty H₂ sensor is hazardous waste and must be packed and disposed of accordingly!

The exhausted H₂S sensor is electronic waste with the code number 160215, that is, a "dangerous component removed from used devices". It must therefore be disposed of correctly and in an environmentally-friendly manner by a local waste disposal company. Environmental damage may occur if this stipulation is not followed. The polluter is also threatened with criminal action!

NOTICE

The H₂S sensor only has a limited service life depending on the operating mode and is therefore excluded from the analyzer guarantee.

Proceed as follows to remove the old sensor:

1. Flush the gas path for about 10 minutes with zero gas (AUTOCAL)
2. When sample gas is no longer present in the gas path, disconnect the analyzer from the supply voltage.
3. Open the unit by removing the four bolts on the cover.
4. Remove the connector from the H₂S sensor (arrow).
5. Unscrew the H₂S sensor out of the holder.

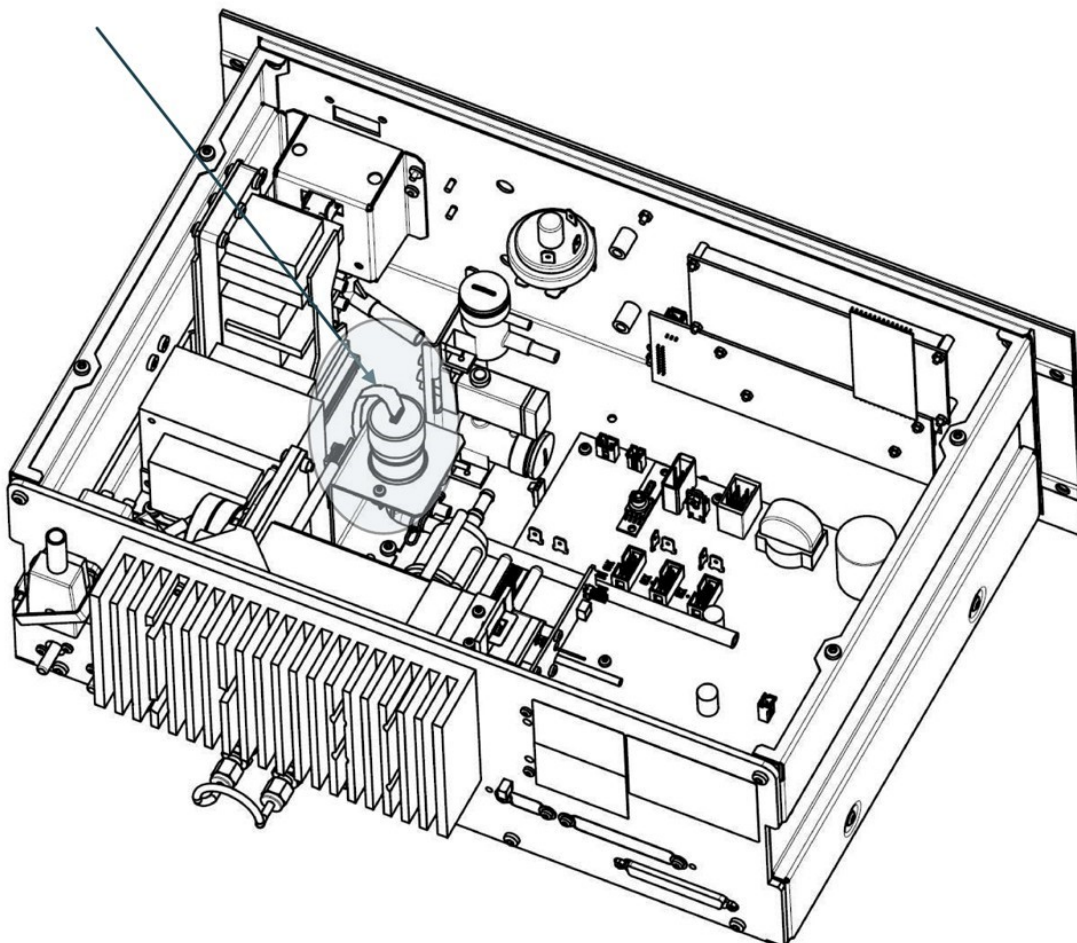


Fig. 45: Position of the H₂S sensor in the analyzer (arrow; in shaded area)

Proceed as follows to install the new sensor:

1. Tighten the screws of the new H₂S sensor to the holder by hand up to the mechanical stop (arrow).

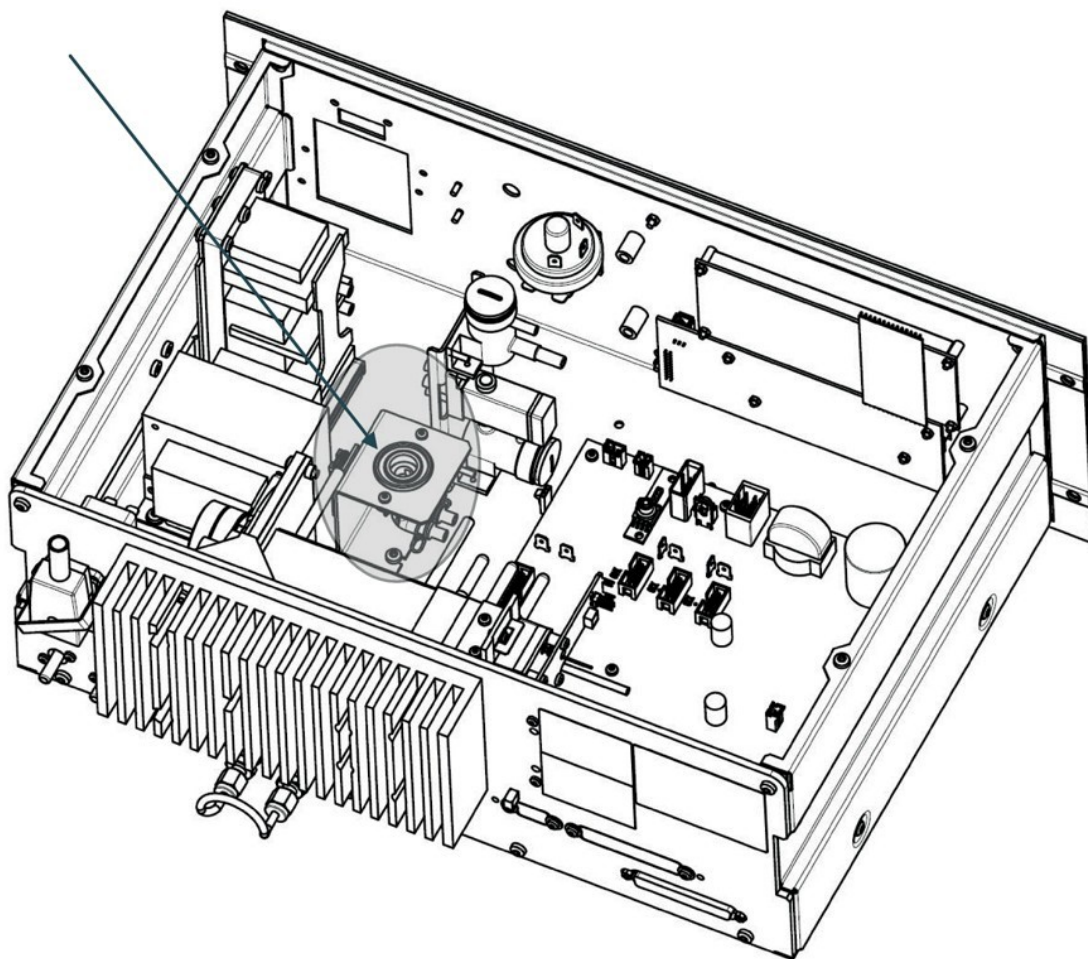


Fig. 46: Position of the H₂S sensor in the analyzer (arrow; in shaded area)

2. Plug the cable with the connector onto the sensor.
3. Close the analyzer by screwing tight the cover.
4. Switch the analyzer on and wait for the warming-up phase.
5. Check for leaks in the device This is described in section Leaks in the gas paths.
6. Calibrate the H₂S sensor as described in section Calibration: H₂S sensor.
7. Enter the installation date with the menu command "H₂S Installation date". The analyzer is then ready for use again.

6.11 Replacing the paramagnetic oxygen sensor

The sensor may only be replaced by specially trained personnel. We therefore recommend that you return the analyzer to the factory in order to replace the sensor. If replacement is carried out on site nevertheless, you must expect limitations in the measuring accuracy.

Details for returning devices can be found in section Service and repair.

7 Service and repair

This chapter contains information on troubleshooting and correction should an error occur during operation.

Repairs to the unit must be performed by Bühler authorised personnel.

Please contact our Service Department with any questions:

Tel.: +49-(0)2102-498955 or your agent

If the equipment is not functioning properly after correcting any malfunctions and switching on the power, it must be inspected by the manufacturer. Please send the equipment inside suitable packaging to:

Bühler Technologies GmbH

- Reparatur/Service -

Harkortstraße 29

40880 Ratingen

Germany

Please also attach the completed and signed RMA decontamination statement to the packaging. We will otherwise be unable to process your repair order.

You will find the form in the appendix of these instructions, or simply request it by e-mail:

service@buehler-technologies.com.

7.1 Error and system messages

The analyzer can detect and display various fault statuses. These fault statuses are divided into maintenance requests and faults.

7.1.1 Maintenance requests

Maintenance requests are references to certain changes in the analyzer which - at the time of occurrence - have no influence on the analyzer measurements. However, remedial measures are recommended to guarantee that measurements remain possible. If the analyzer is in measuring mode, you can recognize the occurrence of a maintenance request in that an "M" appears at the right edge of the measurement screen.

```
AUTOCAL drift
beyond tolerance
Press ENTER to clear
Next message with ->
```

8112

Maintenance requests are logged and can be called in input mode using the menu path "Analyzer status - Status - Maintenance requests" (see section Analyzer status: Status: Maintenance request). The corresponding message texts are stored. You can delete the messages by pressing the <ENTER> key. However, they appear again if the cause has not been eliminated.

The analyzer outputs a maintenance request in the following cases:

- Message "**AUTOCAL drift beyond tolerance**" The zero drift of a component is too large during the AUTOCAL procedure. The AUTOCAL parameters can be entered as described in section Calibration: AUTOCAL/drift values. Using the conditions defined for the AUTOCAL deviation (see section Configuration: Special functions: AUTOCAL deviation), the actual deviation may deviate from the maximum permissible value. In such cases it may be meaningful to set a shorter interval between two AUTOCAL procedures. If this does not improve the situation, contact the servicing department.
- Message "**O₂ sensor**" The measured voltage of the O₂ sensor has dropped as a result of aging, but is still within the permissible range. This means that it is not necessary to replace the O₂ sensor immediately, but this will soon be exhausted. This would be the correct time to order a new O₂ sensor.
- Message "**Temperature beyond tolerance**" The contrast control is no longer guaranteed if the LCD temperature is outside the permissible tolerance. It may then be difficult to read the display, or it could remain dark in the worst case. If this fault occurs because of an excessively high ambient temperature, provide sufficient ventilation or air conditioning. If the fault still occurs, contact the servicing department.

- Message "**H₂S sensor status**" If this message occurs, the measuring reserve of the H₂S sensor is almost used up. We recommend that you then replace the sensor. If the measuring reserve of the H₂S sensor is used up completely, the fault message "Measured value channel 3 beyond tolerance" is displayed. A measurement is no longer possible.
- Message "**LED temperature beyond tolerance**"
- External maintenance requests
These are signaled via the binary inputs. The analyzer must be equipped with an add-on board for this.

7.1.2 Faults

Fault messages are references to certain changes in the analyzer which influence its ability to measure correctly. In such cases remedial measures are required. If the analyzer is in measuring mode, you can recognize the occurrence of a fault in that an "F" appears at the right edge of the measurement screen.

```
Mains voltage
beyond tolerance
Press ENTER to clear
Next message with ->
```

8111

Faults are logged and can be called in input mode using the menu path "Analyzer status - Status - Logbook/faults" (see section Diagnostics: Diagnostics values). The corresponding message texts are stored as alphanumeric text in the logbook. You can delete the messages by pressing the <ENTER> key. However, they appear again if the cause has not been eliminated.

The following table provides a summary of fault messages, their causes, and measures to eliminate the faults. If nothing is specified for a fault message in the 'Remedy' column, you must contact the servicing department when this message occurs.

Message	Possible causes	Remedy
Measured value channel 1 beyond tolerance, Measured value display: *****	Concentration of sample gas above the measuring range IR analyzer unit of the first measured component is faulty	Reduce the sample gas concentration
Measured value channel 2 beyond tolerance, Measured value display: *****	Concentration of sample gas above the measuring range IR analyzer unit of the second measured component is faulty	Reduce the sample gas concentration
Measured value UV component 2 beyond tolerance, Measured value display: *****	Concentration of sample gas above the measuring range UV analyzer unit of the second measured component is faulty	Reduce the sample gas concentration Error in optical component. Replace the LED.
Measured value channel 3 beyond tolerance, Measured value display: *****	Concentration of sample gas above the measuring range IR analyzer unit of the third measured component is faulty	Reduce the sample gas concentration
Measured value UV component 3 beyond tolerance, Measured value display: *****	Concentration of sample gas above the measuring range UV analyzer unit of the third measured component is faulty	Reduce the sample gas concentration Error in optical component. Replace the LED.
Measured value channel 3 (H ₂ S sensor) beyond tolerance, Measured value display: *****	Concentration of sample gas above the measuring range Sensor faulty	Reduce the sample gas concentration Replace the H ₂ S sensor as described in section Replacing the hydrogen sulfide sensor.
Measured value O ₂ beyond tolerance, Measured value display: *****	Concentration of sample gas above the measuring range Electrochemical O ₂ sensor faulty or no longer usable as result of aging	Reduce the sample gas concentration Replace the electrochemical O ₂ sensor as described in section Replacing the electrochemical oxygen sensor.
Supply voltage beyond tolerance	Supply voltage varies Power supply unit on motherboard faulty	Correct such that the supply voltage remains stable within the tolerance values permissible for the analyzer.
Temperature of analyzer beyond tolerance	Ambient temperature too high or too low	Provide sufficient ventilation or air conditioning.

Temperature of UV module beyond tolerance	Ambient temperature is too high or too low	Provide sufficient ventilation or air conditioning.
	Heating elements of the UV module faulty	
	Cooling elements of the UV module faulty	
Pressure of ambient air beyond tolerance	Pressure sensor faulty	
Flow too low during measuring	Sample gas path blocked or leaky	Clean or replace the blocked parts (hose, filter etc.). If the problem is still present: Inform the service department
	Pump not running	Start the pump as described in section Configuration: Inputs/outputs/pump.
	Pump capacity too low	Increase the pump capacity as described in section Parameters: Pump/LCD contrast: Pump.
	Pump faulty	Pump must be replaced. Inform the service department
	Pressure switch faulty	Pump must be replaced. Inform the service department
No data for temperature compensation	Temperature compensation not completed successfully	
	New components have been loaded	
	EEPROM has been initialized	Download the factory data as described in section Configuration: Special functions: Factory data/reset/units: Load factory data
Flow too low during AUTO CAL	Sample gas path blocked or leaky	Clean or replace the blocked parts (hose, filter etc.). If the problem is still present: Inform the service department
	Pump not running	Start the pump as described in section Configuration: Inputs/outputs/pump: Pump at CAL/MEAS
	Pump capacity too low	Increase the pump capacity as described in section Parameters: Pump/LCD contrast: Pump
	Pump faulty	Pump must be replaced. Inform the service department
	Pressure switch faulty	Pressure switch must be replaced. Inform the service department
Concentration of O ₂ too low Measured value display: *****	O ₂ sensor faulty or no longer usable as result of aging	Replace the O ₂ sensor as described in section Replacing the electrochemical oxygen sensor
	O ₂ sensor zero not calibrated	Calibrate the zero point of the O ₂ sensor as described in section Calibration: Electrochemical oxygen measuring range
Fault at analog output	Output component could not be initialized when switching on	
	Limits were violated when calibrating the analog section	
General fault of all IR channels, Measured value display: *****	Chopper faulty	
Fault of addresses for IR channels	Plug-in jumper on detector for detection of components not OK	
	The cable of the detector has no contact	Check that the plug is correctly connected to the detector (the plug must latch in twice).
	Cable of detector faulty	
AUTO CAL drift beyond tolerance (IR components)	Detector contaminated	
	Receiver chamber faulty	
	IR source power too low	

AUTOCAL drift beyond tolerance (UV components)	UV photometer is dirty or defective	
EEPROM error	Checksum not OK	
	Read character does not correspond to written character	
UV EEPROM error	Checksum not OK	
	Read character does not correspond to written character	
Channel 1 not calibrated	Calibration of full-scale value/ sag missing	
Channel 2 not calibrated (IR) Component 2 selected but not calibrated (UV)	Calibration of full-scale value/ sag missing	
Channel 3 not calibrated (IR) Component 3 selected but not calibrated (UV)	Calibration of full-scale value/ sag missing	
Source voltage beyond tolerance (IR)	IR source not OK	
	Motherboard faulty	
Voltage of UV module beyond tolerance	Supply voltage varies	Take appropriate measures so that the supply voltage remains stable within the tolerance values permissible for the analyzer.
	Power supply unit faulty	
	Cables of the UV module faulty	
	Power supply of the UV module faulty	
Current of light source (LED) beyond tolerance (UV)	Light source (LED) faulty	Error in optical component. Replace the LED.
Bridge supply voltage outside tolerance	Channel amplifier of IR receiver faulty	
	Motherboard faulty	
Half-bridge voltage outside tolerance	Channel amplifier of IR receiver faulty	
	Motherboard faulty	
Lockin error	Channel amplifier of IR receiver faulty	
	Motherboard faulty	
Sensitivity of O ₂ sensor too low	O ₂ sensor faulty or no longer usable as result of aging	Replace the O ₂ sensor as described in section Replacing the electrochemical oxygen sensor
External ADC error	Electronics faulty	
External fault	Signaling of an external fault (systemspecific)	Check the connected devices for faults as described in section Configuration: Inputs/ outputs/pump: Binary/sync inputs.
H ₂ S protection function	Sample gas concentration too high	Check sample gas, see also section Probe protection function
Zero point of the H ₂ S sensor beyond tolerances	Purge time too short for calibration	Repeat calibration
Sensitivity of H ₂ S sensor too low	Sensor exhausted	Replace sensor

7.2 Spare parts/accessories

This spare parts list corresponds to the technical status at the time of printing.

NOTICE

Improper repair work



Repairs noted with a * in this section must only be repaired in the service center because a temperature compensation for the device has to be subsequently executed. Depending on the replaced component, it may also be necessary to carry out additional adjustment work (e.g. basic electronic adjustment, checking of cross-sensitivities).

7.2.1 Gas path

The parts with numbers are available as spare parts. They are described in the corresponding table.

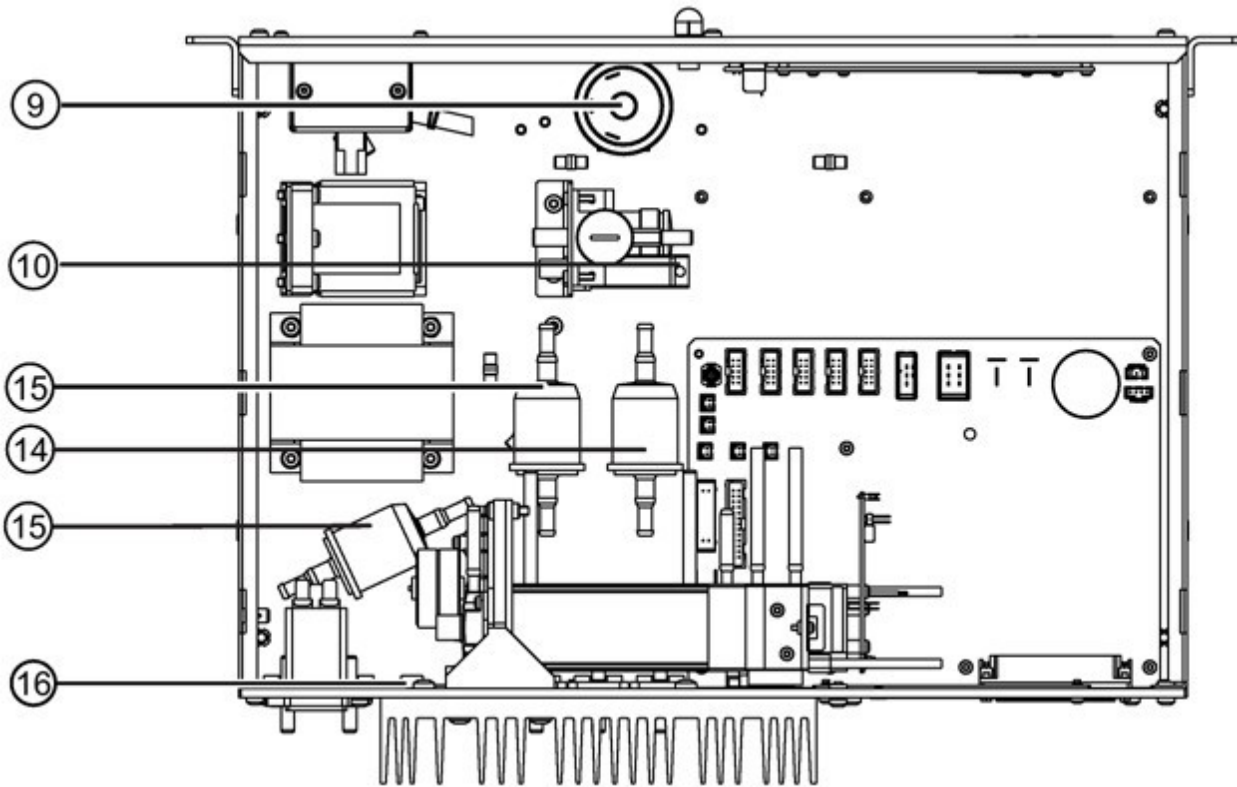


Fig. 47: 19" rack unit

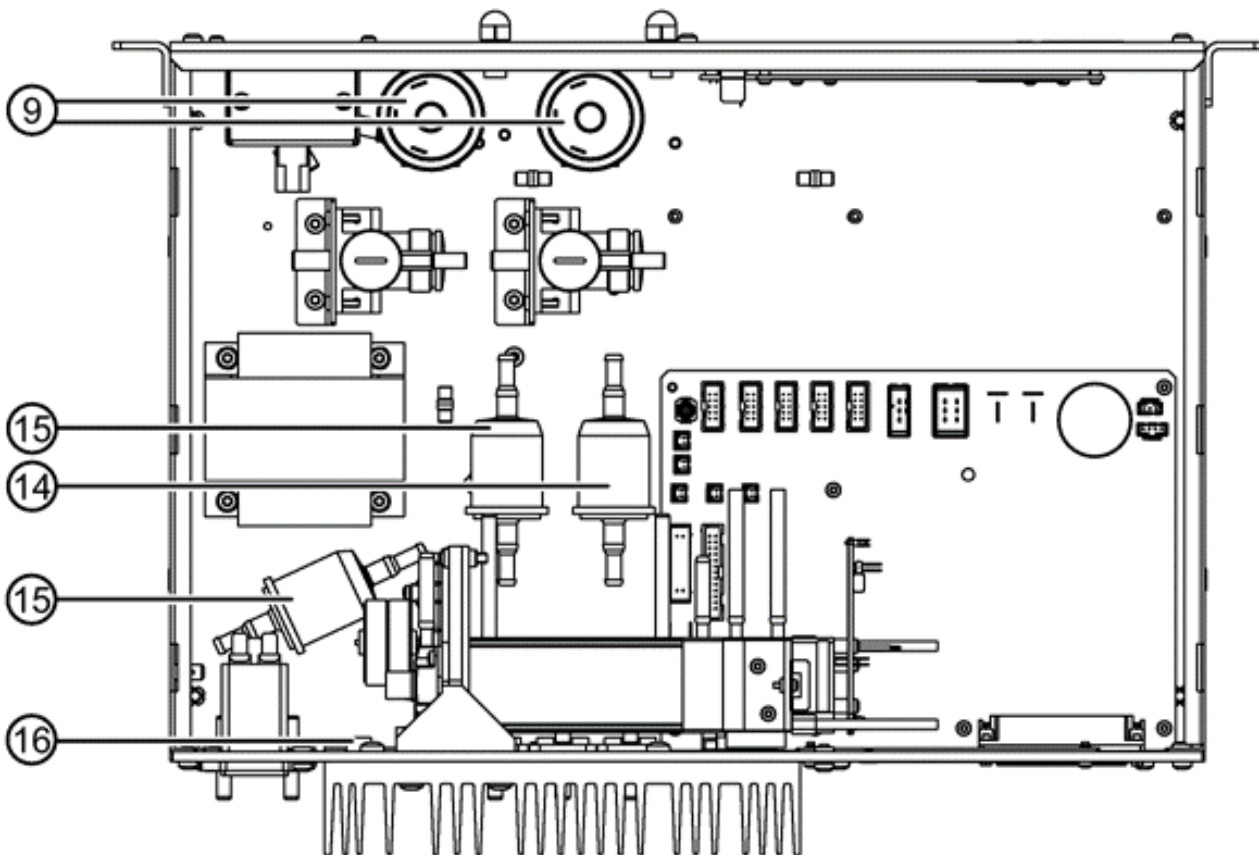


Fig. 48: 19" rack unit with separate gas paths

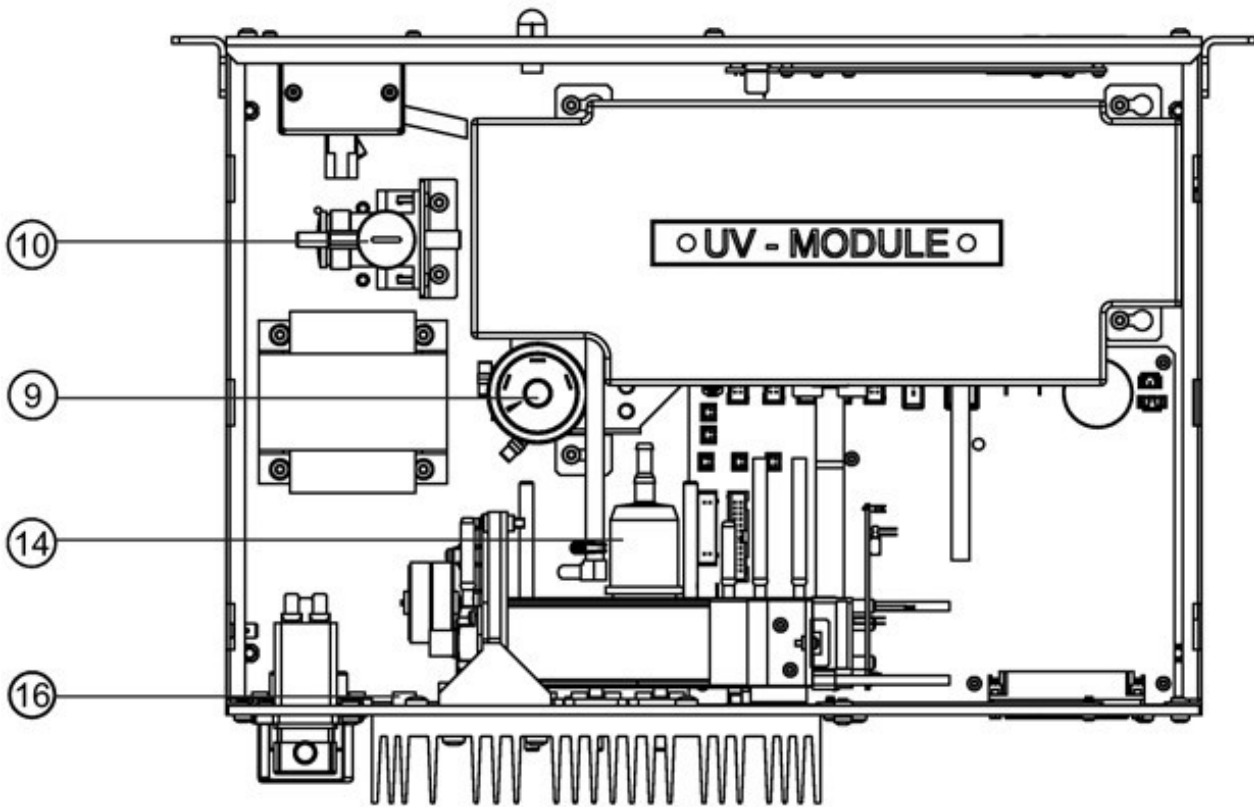


Fig. 49: 19" rack unit with UV module

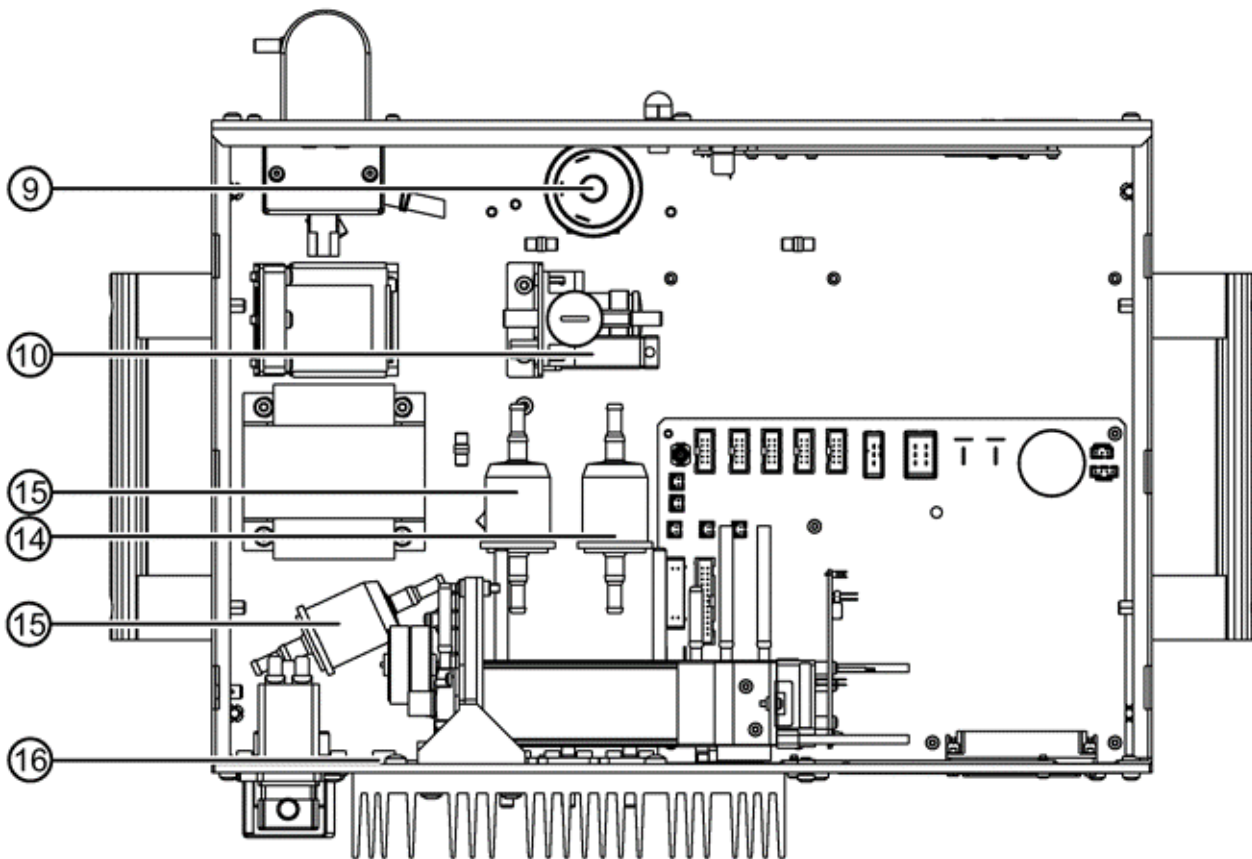


Fig. 50: Bench-top unit

Part No.	Designation	Order No.	Remarks
9	Pressure switch	C79302-Z1210-A2	
9	Pressure switch	A5E37371678	Variant -B06 'Cleaned for O ₂ '
10	Solenoid valve	A5E35105570	
10	Solenoid valve	C79451-A3494-B33	Variant -B06 'Cleaned for O ₂ '
14	Safety filter for sample gas	C79127-Z400-A1	
15	Safety filter for zero gas/chopper purging	C79127-Z400-A1	
16	Connecting socket	A5E36448145	
16	Connecting socket	A5E36448926	Variant -B06 'Cleaned for O ₂ '

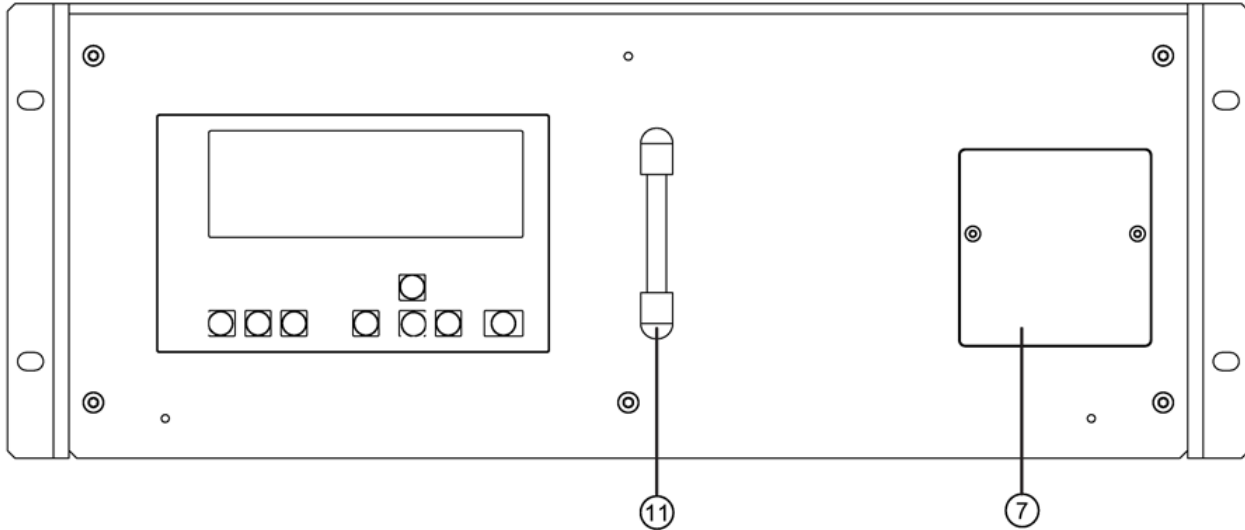


Fig. 51: Gas path elements at front, 19" rack unit

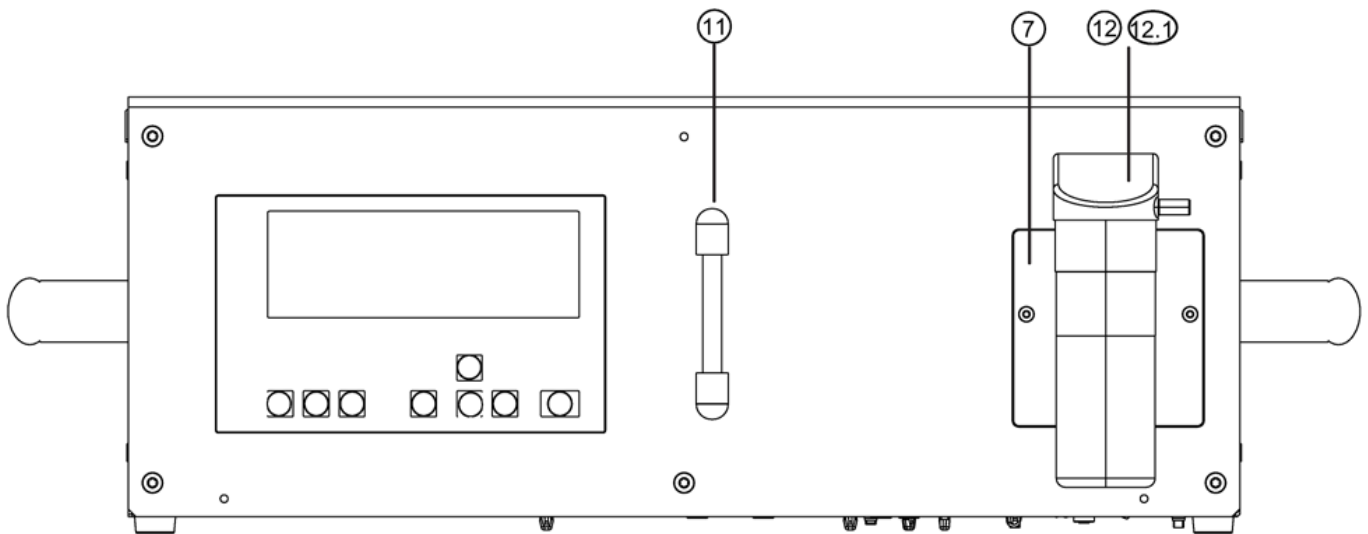


Fig. 52: Gas path elements at front, bench-top unit

Part No.	Designation	Order No.	Remarks
7	Electrochemical oxygen sensor	C79451-A3458-B55	
7	Electrochemical oxygen sensor	A5E35951900	Variant -B06 'Cleaned for O ₂ '
11	Flowmeter	C79402-Z560-T1	With mounting bracket
11	Flowmeter	A5E35980458	With mounting bracket, only variant -B06 'Cleaned for O ₂ '
12	Condensation trap	C79451-A3008-B43	With mounting bracket
12.1	Filter	C79451-A3008-B60	In the condensation trap, package size: 3 units

7.2.2 Electronics

Positions of the replaceable electronics modules in example of rack unit

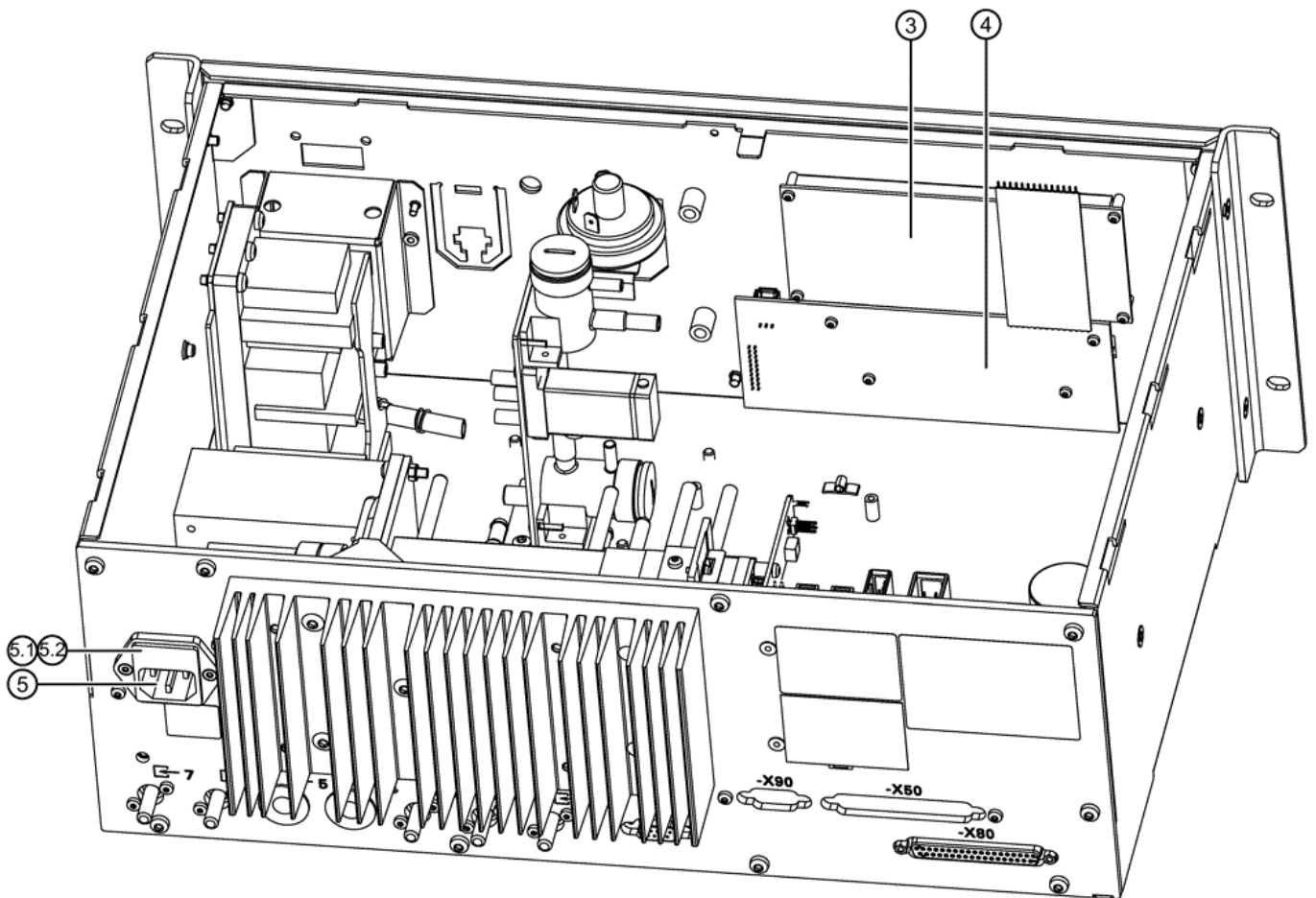


Fig. 53: Rack unit

Part No.	Designation	Order No.	Remarks
3	LCD module	C79451-A3494-B16	
4	Keypad	C79451-A3492-B605	
5	Plug filter	W75041-E5602-K2	
5.1	Fuse	W79054-L1010-T630	200 V/230 V AC; T 630 mA/L 250 V see inscription on rear of device
5.2	Fuse	W79054-L1011-T125	100 V/120 V AC; T 1.25 A/L 250 V see inscription on rear of device
	Set of connectors (accessory)	A5E33941970	Appliance plug, Sub-D connector
	Set of screwdrivers (accessory)	A5E34821625	

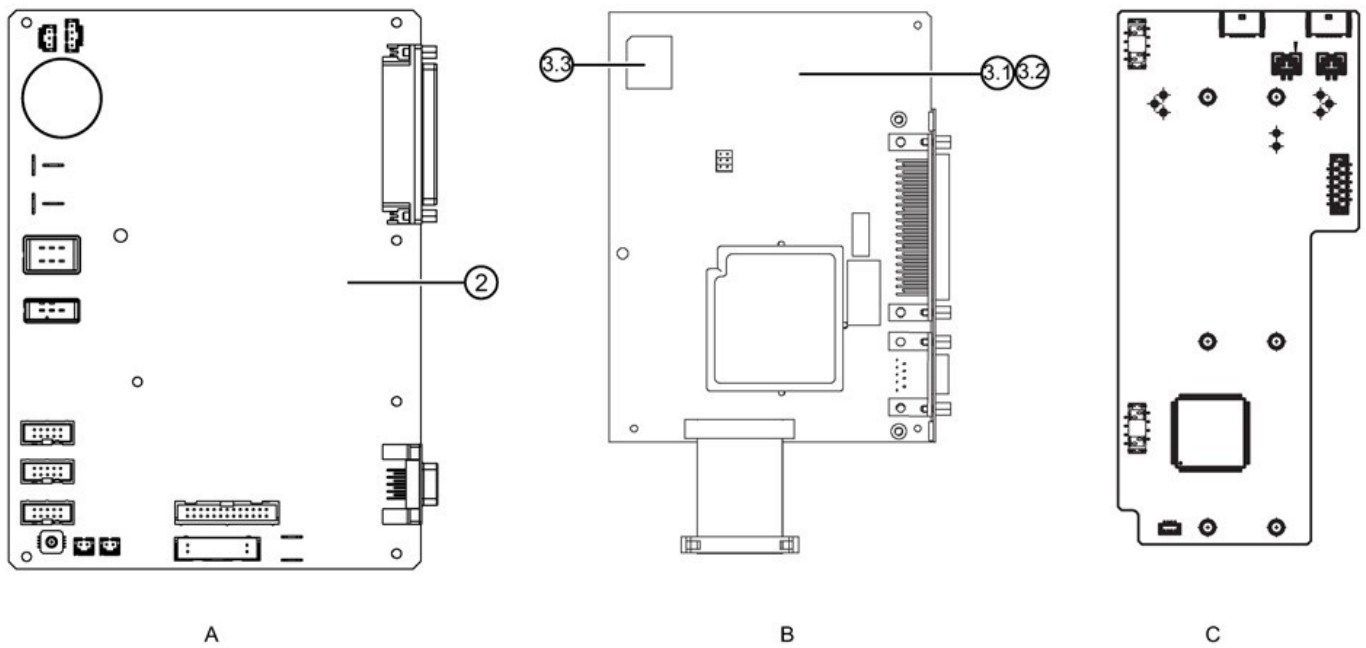


Fig. 54: Motherboard (A), option board (B) and UV module motherboard (C)

Part No.	Designation	Order No.	Remarks
2 *)	Motherboard	A5E37100242	Motherboard with firmware
3.1	Add-on board DP	A5E00057159	PROFIBUS DP
3.2	Add-on board PA	A5E00056834	PROFIBUS PA
3.3	Firmware (PROFIBUS)	A5E00057164	
Ohne	Motherboard of UV module	A5E40781471	see section UV module
Ohne	Detector board of UV module	A5E40781494	see section UV module

*) Following replacement of this part, special work is required which can only be carried out by qualified personnel trained for this task, for example temperature compensation, basic electronic adjustment etc.

As a result of an update in the device firmware, please contact the responsible service engineer.

7.2.3 Pump

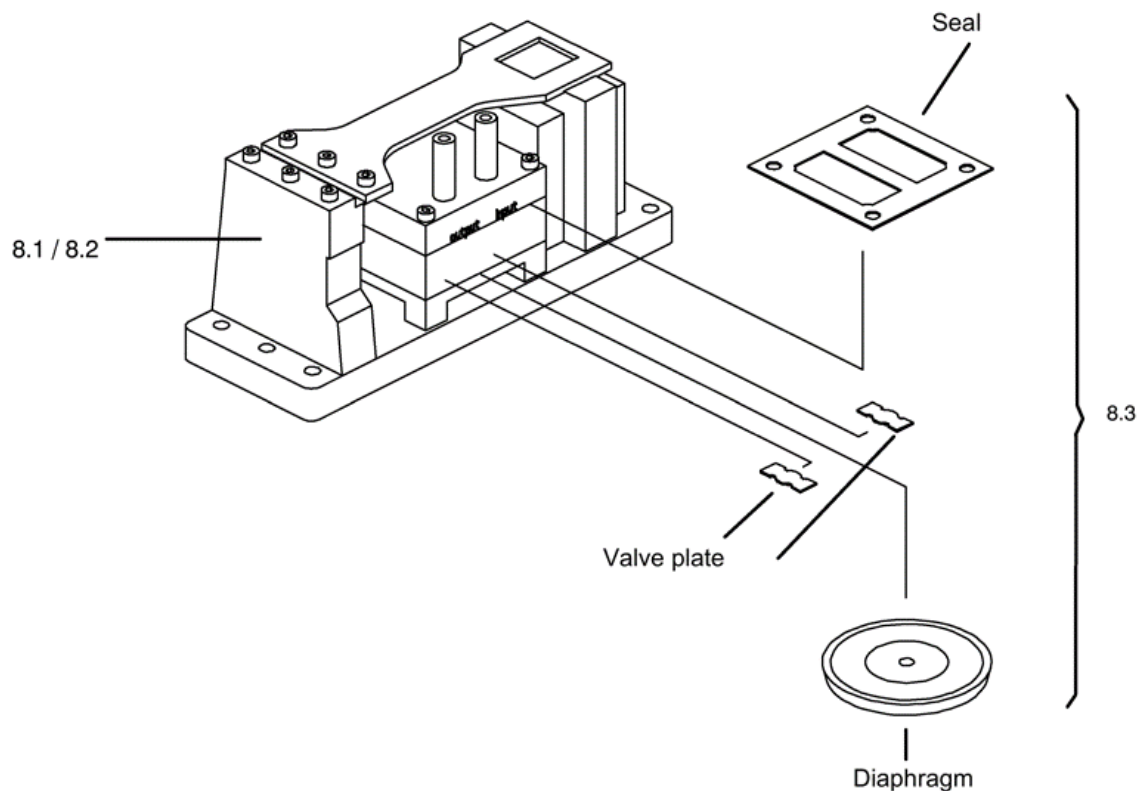


Fig. 55: Pump

Part No.	Designation	Order No.	Remarks
8.1	Sample gas pump	C79451-A3494-B10	50 Hz
8.1	Sample gas pump	A5E35980470	50 Hz; for variant -B06 'Cleaned for O ₂ '
8.2	Sample gas pump	C79451-A3494-B11	60 Hz
8.2	Sample gas pump	A5E35980528	60 Hz; for variant -B06 'Cleaned for O ₂ '
8.3	Sealing set	C79402-Z666-E20	For sample gas pumps 8.1 and 8.2
8.3	Sealing set	A5E35980531	For sample gas pumps 8.1 and 8.2; variant -B06 'Cleaned for O ₂ '

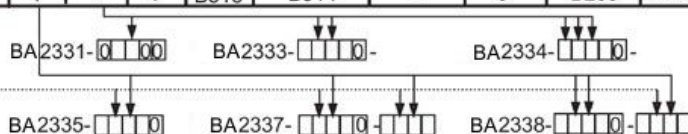
7.2.4 IR analyzer units

7.2.4.1 Overview

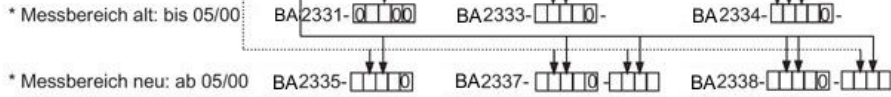
Measured component	Measuring range		Item Order No. Measured component	Item Order No. Measuring range new*	Item Order No. Measuring range old*	IR source C79451-A3468-B206	Chopper C79451-A3468-	Plate with threaded bolts and windows C79451-A3468-	Opt. filter	Analyzer chamber 1		Gas filter 1 C79451-	Receiver chamber 1	
	Min.	Max.								Length (mm)	C79451-A3468-		Type	C79451-A3468-
CO	50 vpm	250 vpm	A	D	S	✓	B515/B516	B513/B514	-	180	B231	A3458-B500	2-layer HC	B525
	100 vpm	500 vpm	A	E	A	✓		B513/B514	-	180	B231			B525
	150 mg/m ³	750 mg/m ³	A	U	N	✓		B513/B514	-	180	B231			B525
	150 vpm	750 vpm	A	F	-	✓		B513/B514	-	180	B231			B525
	200 vpm	1000 vpm	A	G	C	✓		B513/B514	-	180	B231			B525
	500 vpm	2500 vpm	A	H	D	✓		B513/B514	-	180	B231			B525
	50 vpm	2500 vpm	A	X	T	✓		B513/B514	-	180	B231			B525
	1000 vpm	5000 vpm	A	J	E	✓		B513/B514	-	90	B232			B525
	2000 vpm	10000 vpm	A	K	F	✓		B513/B514	-	60	B233			B525
	0,5 %	2,5 %	A	L	G	✓		B513/B514	-	20	B234			B525
	1 %	5 %	A	M	H	✓		B513/B514	-	6	B235			B525
	2 %	10 %	A	N	J	✓		B513/B514	-	2	B236			B525
	5 %	25 %	A	P	K	✓		B513/B514	-	6	B235			B528
	10 %	50 %	A	Q	L	✓		B513/B514	-	2	B236			B528
20 %	100 %	A	R	M	✓	B513/B514	-	2	B236	B528				
CO ₂	50 vpm	250 vpm	C	D	-	✓	B515/B516 Purged	B513/B514	-	180	B231	A3468-B541	2-layer HC	B536
	200 vpm	1000 vpm	C	G	-	✓		B513/B514	-	180	B231			B536
	500 vpm	2500 vpm	C	H	-	✓		B513/B514	-	90	B232			B536
	1000 vpm	5000 vpm	C	J	-	✓		B513/B514	-	20	B234			B536
	2000 vpm	10000 vpm	C	K	F	✓		B513/B514	-	90	B232			B526
	0,5 %	2,5 %	C	L	G	✓		B513/B514	-	60	B233			B526
	1 %	5 %	C	M	H	✓		B513/B514	-	20	B234			B526
	2 %	10 %	C	N	J	✓		B513/B514	-	20	B234			B526
	5 %	25 %	C	P	K	✓		B513/B514	-	6	B235			B526
	10 %	50 %	C	Q	L	✓		B513/B514	-	2	B236			B526
	20 %	100 %	C	R	M	✓		B513/B514	-	2	B236			B526
NO	100 mg/m ³	750 mg/m ³	P	T	-	✓	B515/B516	B513/B514	C75285-Z1491-C5	180	B231	-	3-layer	Channel 1: B520 Channel 2: B522
	100 vpm	500 vpm	P	E	-	✓		B513/B514		180	B231			
	200 vpm	1000 vpm	P	G	C	✓		B513/B514		180	B231			
	250 mg/m ³	1250 mg/m ³	P	V	P	✓		B513/B514		180	B231			
	400 mg/m ³	2000 mg/m ³	P	W	Q	✓		B513/B514		180	B231			
	500 vpm	2500 vpm	P	H	D	✓		B513/B514		180	B231			
	1000 vpm	5000 vpm	P	J	E	✓		B513/B514		90	B232			
SO ₂	150 vpm	750 vpm	N	F	B	✓	B515/B516	B513/B514	C75285-Z1302-A4	180	B231	A3458-B508	3-layer	Channel 1: B521 Channel 2: B523
	200 mg/m ³	1000 mg/m ³	N	-	-	✓		B513/B514		?	B231			
	400 mg/m ³	2000 mg/m ³	N	W	Q	✓		B513/B514		180	B231			
	200 vpm	1000 vpm	N	G	C	✓		B513/B514		180	B231			
	500 vpm	2500 vpm	N	H	D	✓		B513/B514		180	B231			
	1000 vpm	5000 vpm	N	J	E	✓		B513/B514		60	B233			
	2000 vpm	10000 vpm	N	K	F	✓		B513/B514		20	B234			
	0,5 %	2,5 %	N	L	G	✓		B513/B514		20	B234			
CH ₄	100 vpm	500 vpm	D	E	-	✓	B515/B516	B513/B514	-	180	B231	A3468-B542	2-layer HC	B527
	500 vpm	2500 vpm	D	H	D	✓		B513/B514		180	B231			B527
	0,5 %	2,5 %	D	L	G	✓		B513/B514		20	B234			B527
	2 %	10 %	D	N	J	✓		B513/B514		6	B235			B527
	5 %	25 %	D	P	K	✓		B513/B514		2	B236			B527
	20 %	100 %	D	R	M	✓		B513/B514		2	B236			B529
N ₂ O	50 mg/m ³	500 mg/m ³	S	S	-	✓	B516	B514	-	180	B231	-	2-layer HC	B581
	100 vpm	500 vpm	S	E	-	✓	B515/B516	B513/B514		90	B232			B581
	500 vpm	5000 vpm	S	Y	-	✓	B516	B514		6	B235			B581

* Measuring range old: Up to 05/00

* Measuring range new: From 05/00



Measured component	Measuring range		Item Order No. Measured component	Item Order No. Measuring range new*	Item Order No. Measuring range old*	IR source C79451-A3468-B206	Chopper C79451-A3468-B515/B516	Plate with threaded bolts and windows C79451-A3468-B513/B514	Opt. filter	Analyzer chamber 1		Gas filter 1 C79451-A3468-B553	Receiver chamber 1	
	Min.	Max.								Length (mm)	C79451-A3468-B231		Type	C79451-A3468-B535
R22	500 vpm	2500 vpm	U	H	D	✓		B513/B514	-	180	B231	-	2-layer HC	B535
C2H4	2000 vpm	10000 vpm	F	K	F	✓		B513/B514	C79285-Z1491-C2	180	B231	-	2-layer HC	B537
C6H14	2000 vpm	10000 vpm	M	K	-	✓		B513/B514	A5E00069310	20	B234	A3468-B553	2-layer without mirror	B538
SF6	500 vpm	2500 vpm	V	H	-	✓		B513/B514	C79451-A3182-C161	90	B232	-	2-layer HC	B539
CO2/CO	5%/100 vpm	25%/500 vpm		BJ	-	✓			-	6	B235	-	Irradiated	B531
	5%/75 mg/m ³	25%/750 mg/m ³		BL	-	✓			-	6	B235	-		B531
	10%/0,5 %	50%/2,5 %		BK	-	✓			-	2	B236	-		B531
CO2/CH4	5%/1 %	25%/5 %		CA	1B	✓			-	6	B235	-		B531
	5%/2 %	25%/10 %		CB	2B	✓			-	6	B235	-		B531
CO2/NO	5%/500 vpm	25%/2500 vpm		DC	-	✓			-	6	B235	-		B531
CO/CO2	10%/0,5%	50%/2,5 %		BB	8A	✓			-	2	B236	-		B532
	10%/10 %	50%/50 %		BA	6A	✓			-	2	B236	-	B532	
	20%/20 %	100%/100 %		BD	-	✓			-	2	B236	-	B532	
CO/NO	250/400 mg/m ³	1250/2000 mg/m ³		AK	1A	✓			-	180	B231	A3458-B500	B530	
	500/500 vpm	2500/2500 vpm		AA	2A	✓			-	180	B231		B530	
	2000/1000 vpm	10000/10000 vpm		AB	3A	✓			-	60	B233		B530	
	1000/1000 vpm	5000/5000 vpm		AC	-	✓			-	90	B232		B530	
	1%/1000 vpm	5%/5000 vpm		AD	-	✓			-	6	B235		B530	



Measured component	Measuring range		Item Order No. Measuring range new*	Item Order No. Measuring range old*	Opt. filter With holder	Analyzer chamber 2		Gas filter 2	Opt. filter C79451-A3458-B103	Type	Receiver chamber 2	
	Min.	Max.				Length (mm)	C79451-A3468-B231				Type	C79451-A3468-B525
CO2/CO	5%/100 vpm	25%/500 vpm		BJ	-	180	B231	A3458-B500	-	2-layer HC	B525	
	5%/75 mg/m ³	25%/750 mg/m ³		BL	-	180	B231	A3458-B500	-	2-layer HC	B525	
	10%/0,5 %	50%/2,5 %		BK	-	20	B234	A3458-B500	-	2-layer HC	B528	
CO2/CH4	5%/1 %	25%/5 %		CA	1B	6	B235	-	-	2-layer HC	B527	
	5%/2 %	25%/10 %		CB	2B	-	-	-	-	-	-	
CO2/NO	5%/500 vpm	25%/2500 vpm		DC	-	A5E00502911	180	B231	-	3-layer	B 520 channel 1	
CO/CO2	10%/0,5%	50%/2,5 %		BB	8A	20	B234	-	-	2-layer HC	B526	
	10%/10 %	50%/50 %		BA	6A	-	-	-	-	-	-	
	20%/20 %	100%/100 %		BD	-	-	-	-	-	-	-	
CO/NO	250/400 mg/m ³	1250/2000 mg/m ³		AK	1A	-	-	-	B103	3-layer	B520 channel 1	
	500/500 vpm	2500/2500 vpm		AA	2A	-	-	-	B103	3-layer	B520 channel 1	
	2000/1000 vpm	10000/10000 vpm		AB	3A	-	-	-	B103	3-layer	B520 channel 1	
	1000/1000 vpm	5000/5000 vpm		AC	-	-	-	-	B103	3-layer	B520 channel 1	
	1%/1000 vpm	5%/5000 vpm		AD	-	60	B233	A3468-B542	B103	3-layer	B520 channel 1	

7MB235x

Measured component	Measuring range mg/m		Item Order No. Measured component	Item Order No. Measuring range	IR source C79451-A3468-B206	Chopper C79451-A3468-B515/B516	Plate with threaded bolts and windows C79451-A3468-B513/B514	Opt. filter C75285-Z1491-C4	Analyzer chamber 1		Receiver chamber 1		Opt. filter 2 C79451-A3458-B103	Receiver chamber 2	
	Min.	Max.							Length (mm)	C79451-A3468-B231	Type	Order No.		Type	C79451-A3468-B520 channel 1
CO	200	1250	A	✓			C4	180	B231	Gas filter 1 C79451-A3458-B500	2-layer sel.	A5E34729715 (channel 1), A5E34778179 (channel 2)			
	150	750	✓												
NO	250	1250	✓												
	400	2000	✓												
SO2	200	1000	✓												
CO/NO	250/400	1250/2000	✓		B516	B514	-					B103	3-layer	B520 channel 1	

7.2.4.2 Analyzer unit BA2335-, BA2355-

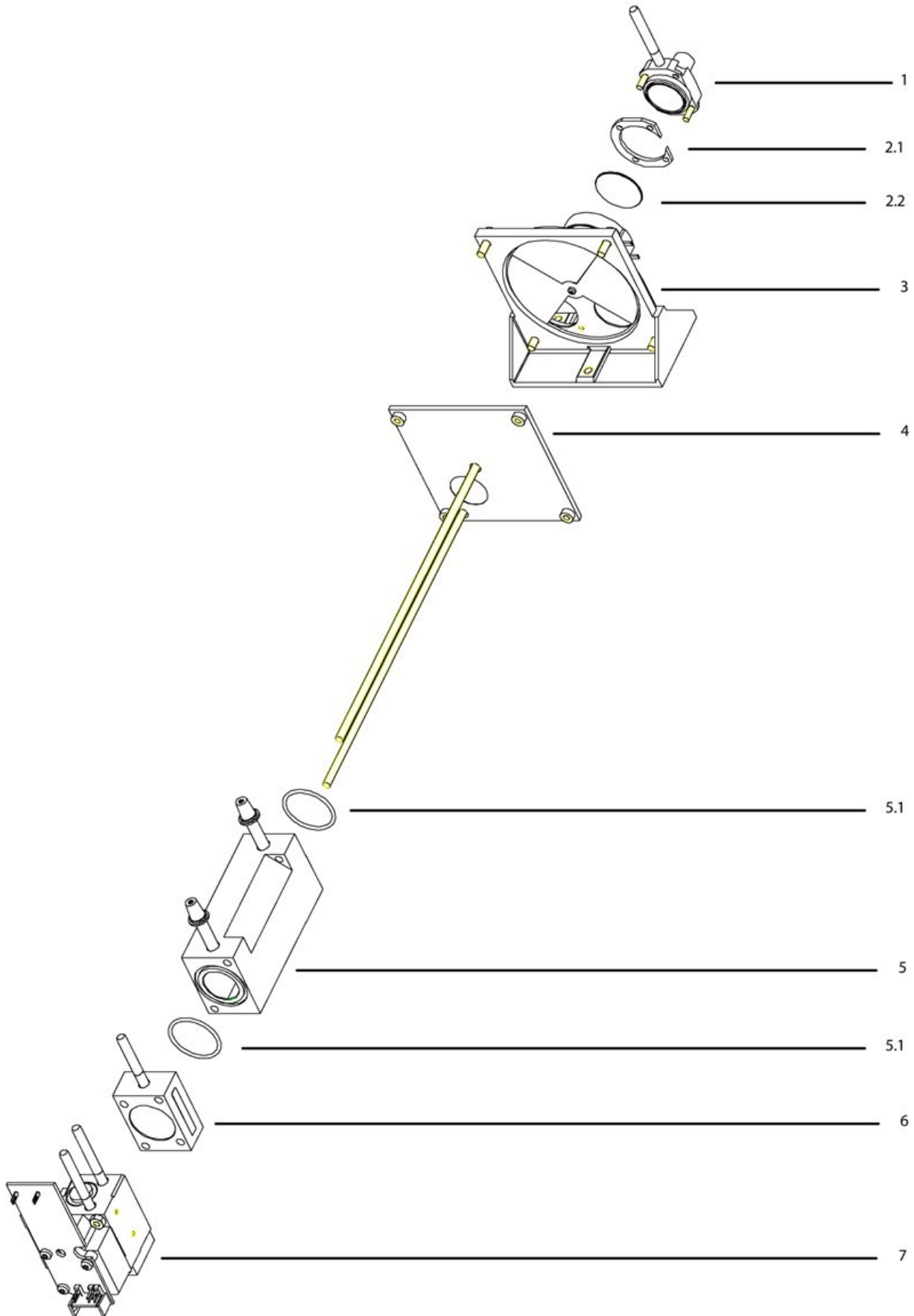


Fig. 56: Analyzer unit BA2335-, BA2355-

Part No.	Designation	Order No.	Remarks
1*)	IR source	C79451-A3468-B206	
2.1	Spacer	C79451-A3468-C20	
2.2	Optical filter	C79285-Z1491-C5	for NO **)
2.2	Optical filter	C79285-Z1302-A4	for SO ₂ **)
2.2	Optical filter	C75285-Z1491-C2	for C ₂ H ₄
2.2	Optical filter	A5E00069310	for C ₆ H ₁₄
2.2	Optical filter	C79451-A3182-C161	for SF ₆
2.2	Optical filter	C75285-Z1491-C4	For CO, measuring range 0...200/0...1250 mg/m ³ , MLFB BA2355
2.2	Optical filter	A5E36461324	
2.2	Optical filter with filter support	A5E36367217	
3*)	Chopper	C79451-A3468-B515	
3*)	Chopper	A5E35980538	Only variant -B06 'Cleaned for O ₂ '
4	Plate with threaded bolts and windows	C79451-A3468-B513	
4	Plate with threaded bolts and windows	A5E35980542	Only variant -B06 'Cleaned for O ₂ '
5.1	O-ring	C71121-Z100-A99	
5.1	O-ring	A5E35980590	Only variant -B06 'Cleaned for O ₂ '
5	Analyzer chamber with O-ring	C79451-A3468-B231	180 mm
5	Analyzer chamber with O-ring	A5E35982142	180 mm; only variant -B06 'Cleaned for O ₂ '
5	Analyzer chamber with O-ring	C79451-A3468-B232	90 mm
5	Analyzer chamber with O-ring	A5E35982156	90 mm; only variant -B06 'Cleaned for O ₂ '
5	Analyzer chamber with O-ring	C79451-A3468-B233	60 mm
5	Analyzer chamber with O-ring	A5E35982163	60 mm; only variant -B06 'Cleaned for O ₂ '
5	Analyzer chamber with O-ring	C79451-A3468-B234	20 mm
5	Analyzer chamber with O-ring	A5E35982170	20 mm; only variant -B06 'Cleaned for O ₂ '
5	Analyzer chamber	C79451-A3468-B235	6 mm
5	Analyzer chamber	A5E35982178	6 mm; only variant -B06 'Cleaned for O ₂ '
5	Analyzer chamber	C79451-A3468-B236	2 mm
5	Analyzer chamber	A5E35982182	2 mm; only variant -B06 'Cleaned for O ₂ '
6	Gas filter	C79451-A3458-B500	for CO
6	Gas filter	A5E35983013	for CO; only variant -B06 'Cleaned for O ₂ '
6	Gas filter	C79451-A3458-B508	for SO ₂
6	Gas filter	A5E35983026	For SO ₂ ; only variant -B06 'Cleaned for O ₂ '
6	Gas filter	C79451-A3468-B541	for CO ₂ ; smallest MB <5 %
6	Gas filter	A5E35983032	For CO ₂ ; smallest MR <5%; only variant -B06 'Cleaned for O ₂ '
6	Gas filter	C79451-A3468-B542	for CH ₄ , smallest MB <2 %
6	Gas filter	A5E35983036	for CH ₄ ; smallest MR <2%;only variant -B06 'Cleaned for O ₂ '
6	Gas filter	C79451-A3468-B553	for C ₆ H ₁₄
6	Gas filter	A5E35983044	for C ₆ H ₁₄ ; only variant -B06 'Cleaned for O ₂ '
7*)	Receiver chamber	C79451-A3468-B525	for CO, smallest MB <5 %
7*)	Receiver chamber	A5E35983110	for CO; smallest MR ≥5%; only variant -B06 'Cleaned for O ₂ '
7*)	Receiver chamber	C79451-A3468-B528	for CO, smallest MB ≥5 %
7*)	Receiver chamber	A5E35983122	for CO; smallest MR ≥5%;only variant -B06 'Cleaned for O ₂ '
7*)	Receiver chamber	A5E34729715	for CO, measuring range 0...200/0...1250 mg/m ³ , MLFB BA2355
7*)	Receiver chamber	C79451-A3468-B525	for CO, measuring range 0...1250/0...6000 mg/m ³ , MLFB BA2355
7*)	Receiver chamber	C79451-A3468-B536	for CO ₂ ; smallest MR <1000 vpm
7*)	Receiver chamber	A5E35983141	For CO ₂ ; smallest MR <1000 vpm; only variant -B06 'Cleaned for O ₂ '
7*)	Receiver chamber	C79451-A3468-B526	for CO ₂ , MLFB 7MB2355

7*)	Receiver chamber	A5E35983146	for CO ₂ ; smallest MR ≥1000 vpm; only variant -B06 'Cleaned for O ₂ '
7*)	Receiver chamber	C79451-A3468-B527	for CH ₄ ; smallest MB <20 %
7*)	Receiver chamber	A5E35983151	For CH ₄ ; smallest MR <20%; only variant -B06 'Cleaned for O ₂ '
7*)	Receiver chamber	C79451-A3468-B529	for CH ₄ ; smallest MB ≥20 %
7*)	Receiver chamber	A5E35983152	for CH ₄ ; smallest MR ≥20%; only variant -B06 'Cleaned for O ₂ '
7*)	Receiver chamber	C79451-A3468-B537	for C ₂ H ₄
7*)	Receiver chamber	A5E35983172	For C ₂ H ₄ ; only variant -B06 'Cleaned for O ₂ '
7*)	Receiver chamber	C79451-A3468-B520	for NO
7*)	Receiver chamber	A5E35983178	for NO; only variant -B06 'Cleaned for O ₂ '
7*)	Receiver chamber	A5E34729727	for NO, MLFB BA2355
7*)	Receiver chamber	C79451-A3468-B520	for NO, measuring range 0...600/0...3000 mg/m ³ , MLFB BA2355
7*)	Receiver chamber	C79451-A3468-B521	for SO ₂
7*)	Receiver chamber	A5E35983183	for SO ₂ ; only variant -B06 'Cleaned for O ₂ '
7*)	Receiver chamber	C79451-A3468-B581	for N ₂ O
7*)	Receiver chamber	A5E35983192	for N ₂ O; only variant -B06 'Cleaned for O ₂ '
7*)	Receiver chamber	C79451-A3468-B539	for SF ₆
7*)	Receiver chamber	A5E35983196	for SF ₆ ; only variant -B06 'Cleaned for O ₂ '
7*)	Receiver chamber	C79451-A3468-B538	for C ₆ H ₁₄
7*)	Receiver chamber	A5E35983203	for C ₆ H ₁₄ ; only variant -B06 'Cleaned for O ₂ '

*) Following replacement of this part, special work is required which can only be carried out by qualified personnel trained for this task, for example temperature compensation, basic electronic adjustment etc.

**) Following replacement of this part, the water vapor cross-sensitivity must be checked.

7.2.4.3 Analyzer unit BA2337-, BA2357-

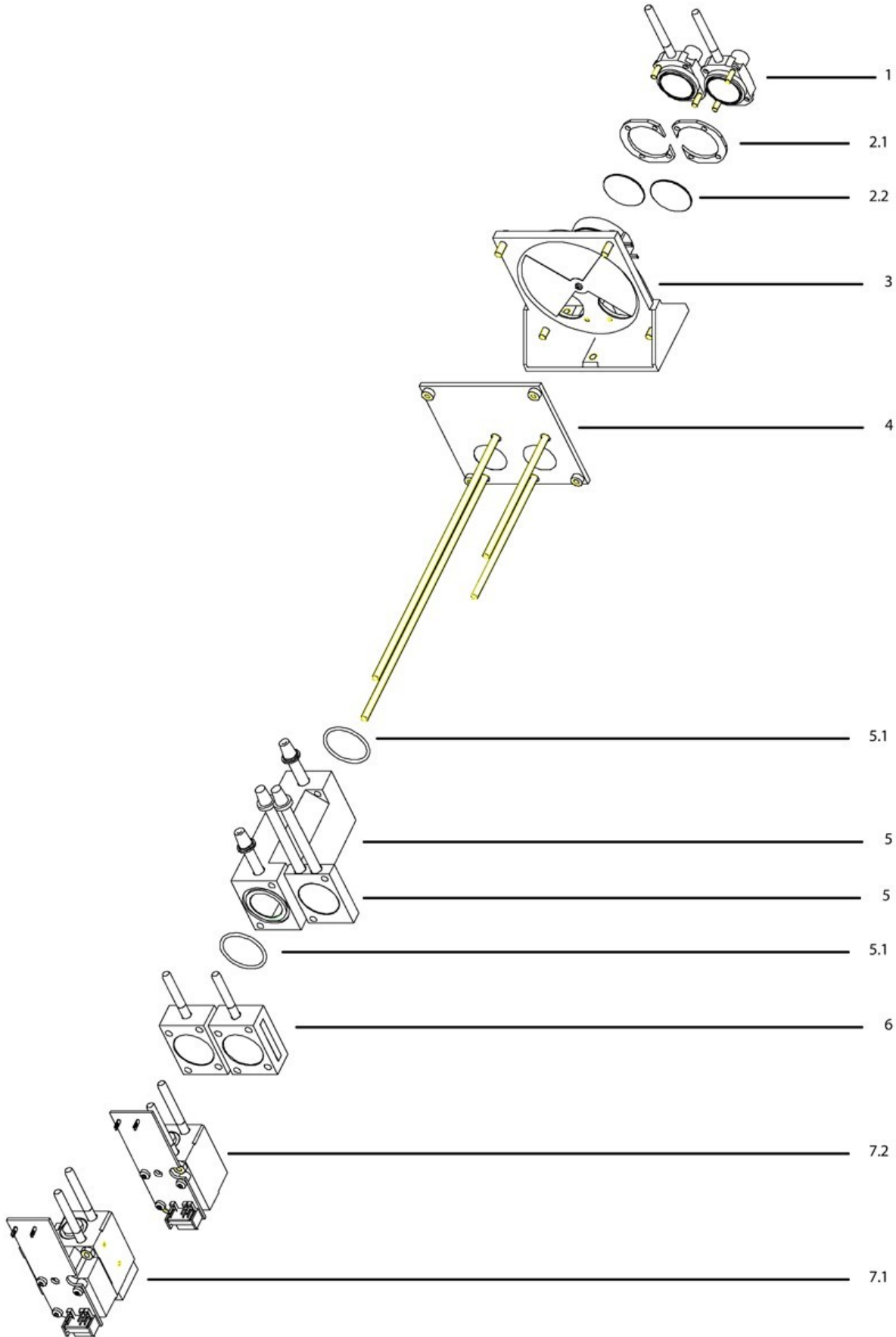


Fig. 57: Analyzer unit BA2337-, BA2357-

Part No.	Designation	Order No.	Remarks
1*)	IR source	C79451-A3468-B206	
2.1	Spacer	C79451-A3468-C20	
2.2	Optical filter	C79285-Z1491-C5	for NO **)
2.2	Optical filter	C79285-Z1302-A4	for SO ₂ **)
2.2	Optical filter	C75285-Z1491-C2	for C ₂ H ₄
2.2	Optical filter	A5E00069310	for C ₆ H ₁₄
2.2	Optical filter	C79451-A3182-C161	for SF ₆
2.2	Optical filter	C75285-Z1491-C4	for CO, measuring range 0...200/0...1250 mg/m ³ , MLFB BA2355
2.2	Optical filter	A5E36461324	
2.2	Optical filter with filter support	A5E36367217	
3*)	Chopper	C79451-A3468-B515	
3*)	Chopper	A5E35980538	Only variant -B06 'Cleaned for O ₂ '
4	Plate with threaded bolts and windows	C79451-A3468-B513	
4	Plate with threaded bolts and windows	A5E35980542	Only variant -B06 'Cleaned for O ₂ '
5.1	O-ring	C71121-Z100-A99	
5.1	O-ring	A5E35980590	Only variant -B06 'Cleaned for O ₂ '
5	Analyzer chamber with O-ring	C79451-A3468-B231	180 mm
5	Analyzer chamber with O-ring	A5E35982142	180 mm; only variant -B06 'Cleaned for O ₂ '
5	Analyzer chamber with O-ring	C79451-A3468-B232	90 mm
5	Analyzer chamber with O-ring	A5E35982156	90 mm; only variant -B06 'Cleaned for O ₂ '
5	Analyzer chamber with O-ring	C79451-A3468-B233	60 mm
5	Analyzer chamber with O-ring	A5E35982163	60 mm; only variant -B06 'Cleaned for O ₂ '
5	Analyzer chamber with O-ring	C79451-A3468-B234	20 mm
5	Analyzer chamber with O-ring	A5E35982170	20 mm; only variant -B06 'Cleaned for O ₂ '
5	Analyzer chamber	C79451-A3468-B235	6 mm
5	Analyzer chamber	A5E35982178	6 mm; only variant -B06 'Cleaned for O ₂ '
5	Analyzer chamber	C79451-A3468-B236	2 mm
5	Analyzer chamber	A5E35982182	2 mm; only variant -B06 'Cleaned for O ₂ '
6	Gas filter	C79451-A3458-B500	for CO
6	Gas filter	A5E35983013	for CO; only variant -B06 'Cleaned for O ₂ '
6	Gas filter	C79451-A3458-B508	for SO ₂
6	Gas filter	A5E35983026	For SO ₂ ; only variant -B06 'Cleaned for O ₂ '
6	Gas filter	C79451-A3468-B541	for CO ₂ ; smallest MB <5 %
6	Gas filter	A5E35983032	For CO ₂ ; smallest MR <5%; only variant -B06 'Cleaned for O ₂ '
6	Gas filter	C79451-A3468-B542	for CH ₄ , smallest MB <2 %
6	Gas filter	A5E35983036	for CH ₄ ; smallest MR <2%;only variant -B06 'Cleaned for O ₂ '
6	Gas filter	C79451-A3468-B553	For C ₆ H ₁₄ , N ₂ O 500/5000 vpm
6	Gas filter	A5E35983044	For C ₆ H ₁₄ , N ₂ O 500/5000 vpm; only variant -B06 'Cleaned for O ₂ '
7.1/7.2 *)	Receiver chamber	C79451-A3468-B525	for CO, smallest MB <5 %
7.1/7.2 *)	Receiver chamber	A5E35983110	for CO; smallest MR ≥5%; only variant -B06 'Cleaned for O ₂ '
7.1/7.2 *)	Receiver chamber	C79451-A3468-B528	for CO, smallest MB ≥5 %
7.1/7.2 *)	Receiver chamber	A5E35983122	for CO; smallest MR ≥5%;only variant -B06 'Cleaned for O ₂ '
7.1/7.2 *)	Receiver chamber	A5E34729715	for CO, measuring range 0...200/0...1250 mg/m ³ , MLFB BA2355
7.1/7.2 *)	Receiver chamber	C79451-A3468-B525	for CO, measuring range 0...1250/0...6000 mg/m ³ , MLFB BA2355
7.1/7.2 *)	Receiver chamber	C79451-A3468-B536	for CO ₂ ; smallest MR <1000 vpm
7.1/7.2 *)	Receiver chamber	A5E35983141	For CO ₂ ; smallest MR <1000 vpm; only variant -B06 'Cleaned for O ₂ '
7.1/7.2 *)	Receiver chamber	C79451-A3468-B526	for CO ₂ , MLFB BA2355

7.1/7.2 *)	Receiver chamber	A5E35983146	for CO ₂ ; smallest MR ≥1000 vpm; only variant -B06 'Cleaned for O ₂ '
7.1/7.2 *)	Receiver chamber	C79451-A3468-B527	for CH ₄ ; smallest MB <20 %
7.1/7.2 *)	Receiver chamber	A5E35983151	For CH ₄ ; smallest MR <20%; only variant -B06 'Cleaned for O ₂ '
7.1/7.2 *)	Receiver chamber	C79451-A3468-B529	for CH ₄ ; smallest MB ≥20 %
7.1/7.2 *)	Receiver chamber	A5E35983152	for CH ₄ ; smallest MR ≥20%; only variant -B06 'Cleaned for O ₂ '
7.1/7.2 *)	Receiver chamber	C79451-A3468-B537	for C ₂ H ₄
7.1/7.2 *)	Receiver chamber	A5E35983172	For C ₂ H ₄ ; only variant -B06 'Cleaned for O ₂ '
7.1 *)	Receiver chamber	C79451-A3468-B520	For NO (channel 1)
7.1 *)	Receiver chamber	A5E35983178	For NO (channel 1); only variant -B06 'Cleaned for O ₂ '
7.1 *)	Receiver chamber	A5E34729727	For NO (channel 1), MLFB BA2357
7.1 *)	Receiver chamber	C79451-A3468-B520	For NO (channel 1), measuring range 0...600/0...3000 mg/m ³ , MLFB BA2357
7.2 *)	Receiver chamber	C79451-A3468-B522	For NO (channel 2)
7.2 *)	Receiver chamber	A5E35984186	For NO (channel 2); only variant -B06 'Cleaned for O ₂ '
7.2 *)	Receiver chamber	A5E34778179	For NO (channel 2), MLFB BA2357
7.2 *)	Receiver chamber	C79451-A3468-B522	For NO (channel 2), measuring range 0...600/0...3000 mg/m ³ , MLFB BA2357
7.1 *)	Receiver chamber	C79451-A3468-B521	for SO ₂ (channel 1)
7.1 *)	Receiver chamber	A5E35983183	For SO ₂ (channel 1); only variant -B06 'Cleaned for O ₂ '
7.1 *)	Receiver chamber	C79451-A3468-B523	For SO ₂ (channel 2)
7.1 *)	Receiver chamber	A5E35984197	For SO ₂ (channel 2); only variant -B06 'Cleaned for O ₂ '
7 *)	Receiver chamber	C79451-A3468-B581	for N ₂ O
7 *)	Receiver chamber	A5E35983192	for N ₂ O; only variant -B06 'Cleaned for O ₂ '
7 *)	Receiver chamber	C79451-A3468-B539	for SF ₆
7 *)	Receiver chamber	A5E35983196	for SF ₆ ; only variant -B06 'Cleaned for O ₂ '
7 *)	Receiver chamber	C79451-A3468-B538	for C ₆ H ₁₄
7 *)	Receiver chamber	A5E35983203	for C ₆ H ₁₄ ; only variant -B06 'Cleaned for O ₂ '

*) Following replacement of this part, special work is required which can only be carried out by qualified personnel trained for this task, for example temperature compensation, basic electronic adjustment etc.

**) Following replacement of this part, the water vapor cross-sensitivity must be checked.

7.2.4.4 Analyzer unit 1 BA2338-, BA2358-

7.2.4.4.1 .AA.-, -.AK.-, -.AB.-, -.AC.- for CO/NO

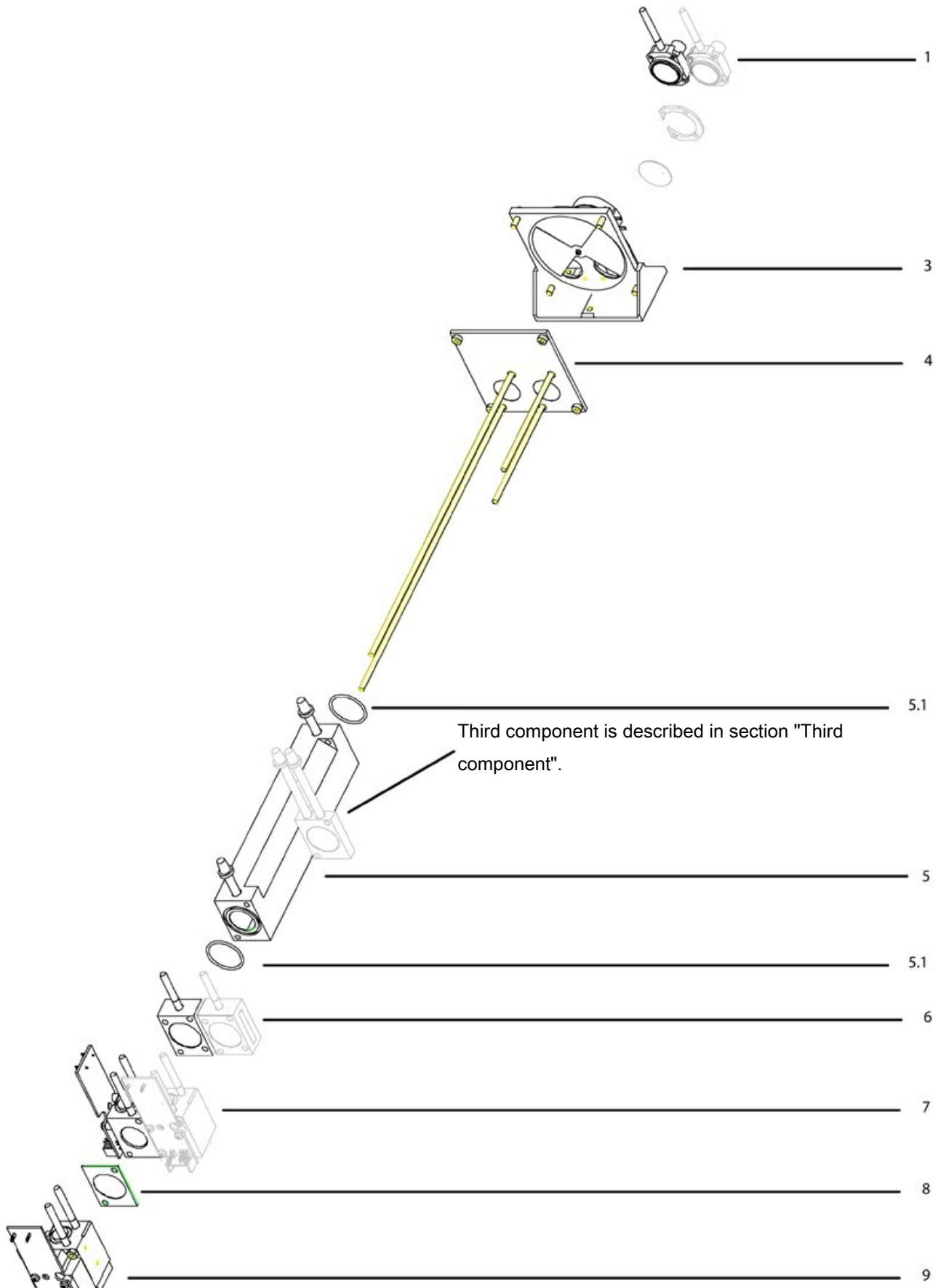


Fig. 58: Analyzer unit BA2338-, BA2358-.AA.-, -.AK.-, -.AB.-, -.AC.-, configuration for CO/NO

Part No.	Designation	Order No.	Remarks
1*)	IR source	C79451-A3468-B206	
3*)	Chopper	C79451-A3468-B516	
3*)	Chopper	A5E35984159	Only variant -B06 'Cleaned for O ₂ '
4	Plate with threaded bolts and windows	C79451-A3468-B514	
4	Plate with threaded bolts and windows	A5E35984162	Only variant -B06 'Cleaned for O ₂ '
5.1	O-ring	C71121-Z100-A99	
5.1	O-ring	A5E35980590	Only variant -B06 'Cleaned for O ₂ '
5	Analyzer chamber with O-ring	C79451-A3468-B231	Analyzer chamber -.AA., -.AK.; 180 mm
5	Analyzer chamber with O-ring	A5E35982142	Analyzer chamber -.AA., -.AK.; 180 mm; only variant -B06 'Cleaned for O ₂ '
5	Analyzer chamber with O-ring	C79451-A3468-B232	Analyzer chamber -.AC., 90 mm
5	Analyzer chamber with O-ring	A5E35982156	Analyzer chamber -.AC., 90 mm; only variant -B06 'Cleaned for O ₂ '
5	Analyzer chamber with O-ring	C79451-A3468-B233	Analyzer chamber -.AB., 60 mm
5	Analyzer chamber with O-ring	A5E35982163	Analyzer chamber -.AB., 60 mm; only variant -B06 'Cleaned for O ₂ '
6	Gas filter	C79451-A3458-B500	For CO
6	Gas filter	A5E35983013	For CO; only variant -B06 'Cleaned for O ₂ '
7*)	Receiver chamber	C79451-A3468-B530	For CO
7*)	Receiver chamber	A5E35984307	For CO; only variant -B06 'Cleaned for O ₂ '
7*)	Receiver chamber	A5E33463532	For CO, MLFB BA2358
8	Optical filter	C79451-A3458-B103	For NO **)
9*)	Receiver chamber	C79451-A3468-B520	For NO (channel 1)
9*)	Receiver chamber	A5E35983178	For NO (channel 1); only variant -B06 'Cleaned for O ₂ '

*) Following replacement of this part, special work is required which can only be carried out by qualified personnel trained for this task, for example temperature compensation, basic electronic adjustment etc.

**) Following replacement of this part, the water vapor cross-sensitivity must be checked.

7.2.4.4.2 .AD..- for CO/NO

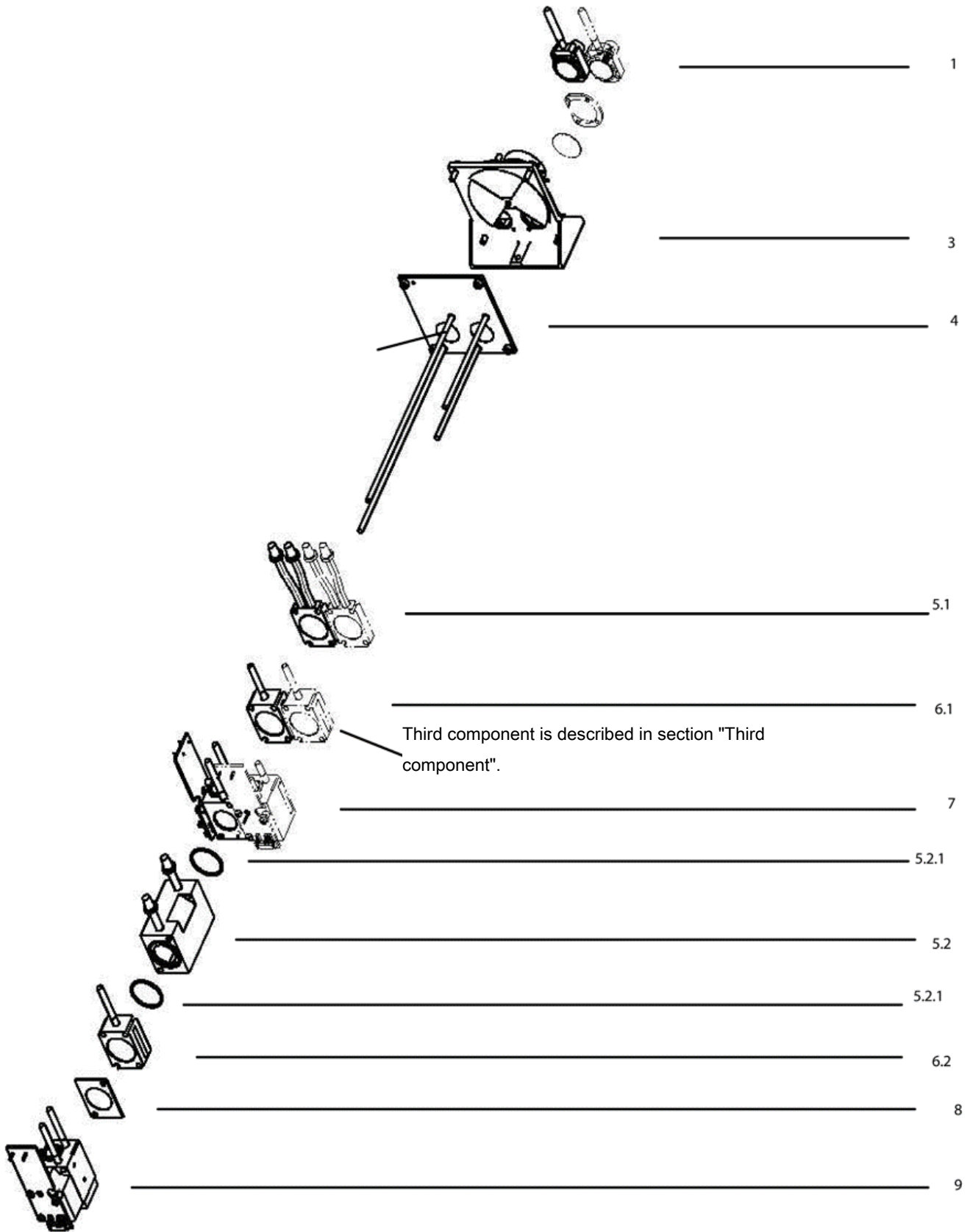


Fig. 59: Analyzer unit BA2338-, BA2358.AD.., configuration for CO/NO

Teil-Nr.	Bezeichnung	Bestell-Nr.	Bemerkung
1*)	IR source	C79451-A3468-B206	
3*)	Chopper	C79451-A3468-B516	
3*)	Chopper	A5E35984159	Only variant -B06 'Cleaned for O ₂ '
4	Plate with threaded bolts and windows	C79451-A3468-B514	
4	Plate with threaded bolts and windows	A5E35984162	Only variant -B06 'Cleaned for O ₂ '
5.1	Analyzer chamber	C79451-A3468-B235	Analyzer chamber 6 mm
5.1	Analyzer chamber	A5E35982178	Analyzer chamber 6 mm; only variant -B06 'Cleaned for O ₂ '
6.1	Gas filter	C79451-A3458-B500	For CO
6.1	Gas filter	A5E35983013	For CO; only variant -B06 'Cleaned for O ₂ '
7*)	Receiver chamber	C79451-A3468-B530	For CO
7*)	Receiver chamber	A35984307	For CO; only variant -B06 'Cleaned ₂ for O'
5.2	Analyzer chamber with O-ring	C79451-A3468-B233	Analyzer chamber 60 mm
5.2	Analyzer chamber with O-ring	A5E35982163	Analyzer chamber 60 mm; only variant -B06 'Cleaned for O ₂ '
5.2.1	O-ring	C71121-Z100-A99	
5.2.1	O-ring	A5E35980590	Only variant -B06 'Cleaned for O ₂ '
6.2	Gas filter	C79451-A3468-B542	For NO
6.2	Gas filter	A5E35983036	For NO; only variant -B06 'Cleaned for O ₂ '
8	Optical filter	C79451-A3458-B103	For NO (**)
9*)	Receiver chamber	C79451-A3468-B520	For NO (channel 1)
9*)	Receiver chamber	A5E35983178	For NO (channel 1); only variant -B06 'Cleaned for O ₂ '

*) Following replacement of this part, special work is required which can only be carried out by qualified personnel trained for this task, for example temperature compensation, basic electronic adjustment etc.

**) Following replacement of this part, the water vapor cross-sensitivity must be checked.

7.2.4.4.3 .DC..- for CO₂/NO

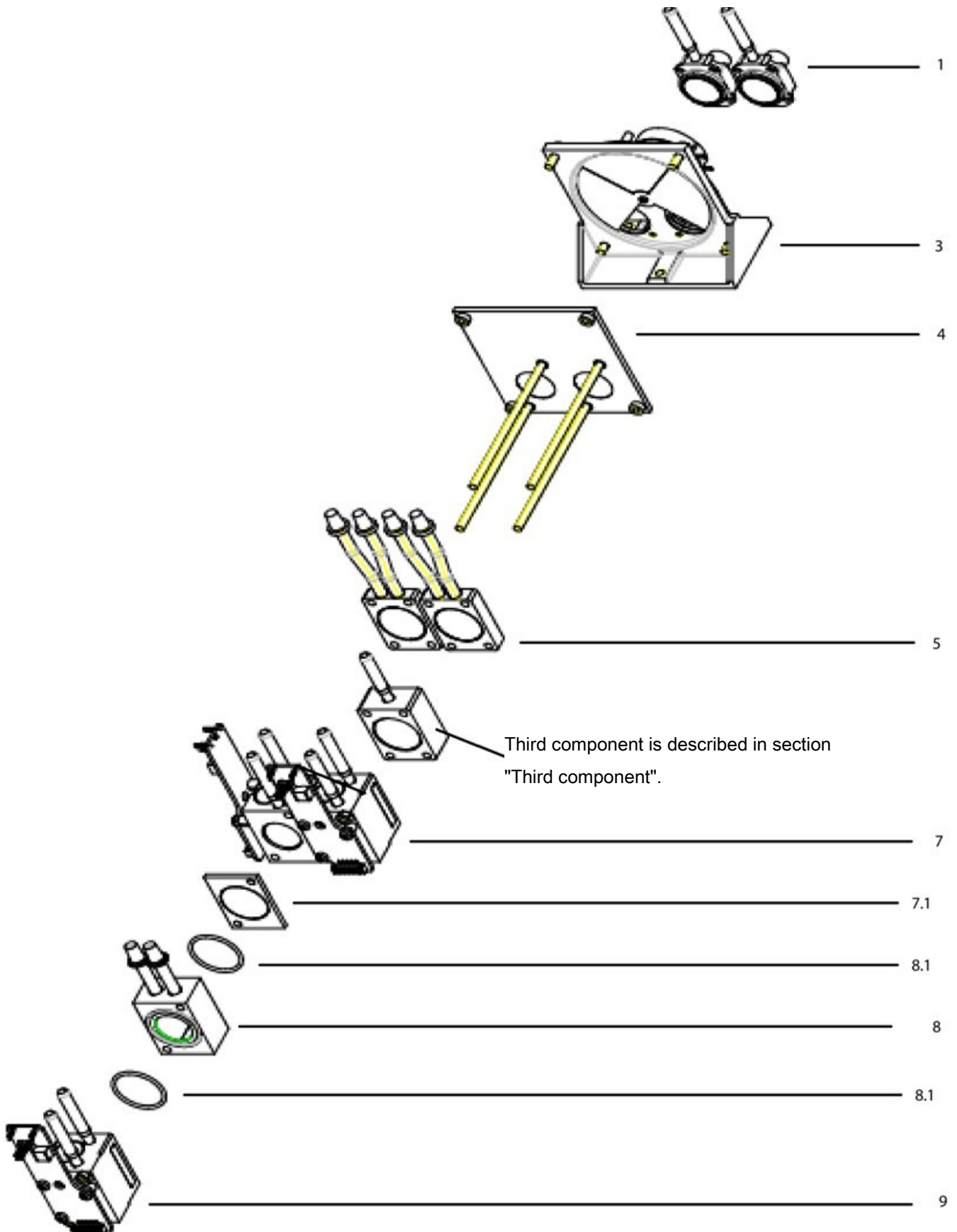


Fig. 60: Analyzer unit BA2338-, BA2358-.DC., configuration for CO₂/NO

Teil-Nr.	Bezeichnung	Bestell-Nr.	Bemerkung
1*)	IR source	C79451-A3468-B206	
3*)	Chopper	C79451-A3468-B516	
3*)	Chopper	A5E35984159	Only variant -B06 'Cleaned for O ₂ '
4	Plate with threaded bolts and windows	C79451-A3468-B514	
4	Plate with threaded bolts and windows	A5E35984162	Only variant -B06 'Cleaned for O ₂ '
5	Analyzer chamber	C79451-A3468-B235	Analyzer chamber 6 mm
5	Analyzer chamber	A5E35982178	Analyzer chamber 6 mm; only variant -B06 'Cleaned for O ₂ '
7*)	Receiver chamber	C79451-A3468-B531	For CO ₂
7*)	Receiver chamber	A5E35984315	For CO ₂ ; only variant -B06 'Cleaned for O ₂ '
7.1	Optical filter with filter support	A5E00502911	
7.1	Optical filter with filter support	A5E35984319	Only variant -B06 'Cleaned for O ₂ '
8	Analyzer chamber with O-ring	C79451-A3468-B231	Analyzer chamber 180 mm
8	Analyzer chamber with O-ring	A5E35982142	Analyzer chamber 180 mm; only variant -B06 'Cleaned for O ₂ '
8.1	O-ring	C71121-Z100-A99	
8.1	O-ring	A5E35980590	Only variant -B06 'Cleaned for O ₂ '
9*)	Receiver chamber	C79451-A3468-B520	For NO (channel 1)
9*)	Receiver chamber	A5E35983178	For NO (channel 1); only variant -B06 'Cleaned for O ₂ '

*) Following replacement of this part, special work is required which can only be carried out by qualified personnel trained for this task, for example temperature compensation, basic electronic adjustment etc.

7.2.4.4.4 .BA., .BD., .CB.- for CO/CO₂ and CO₂/CH₄

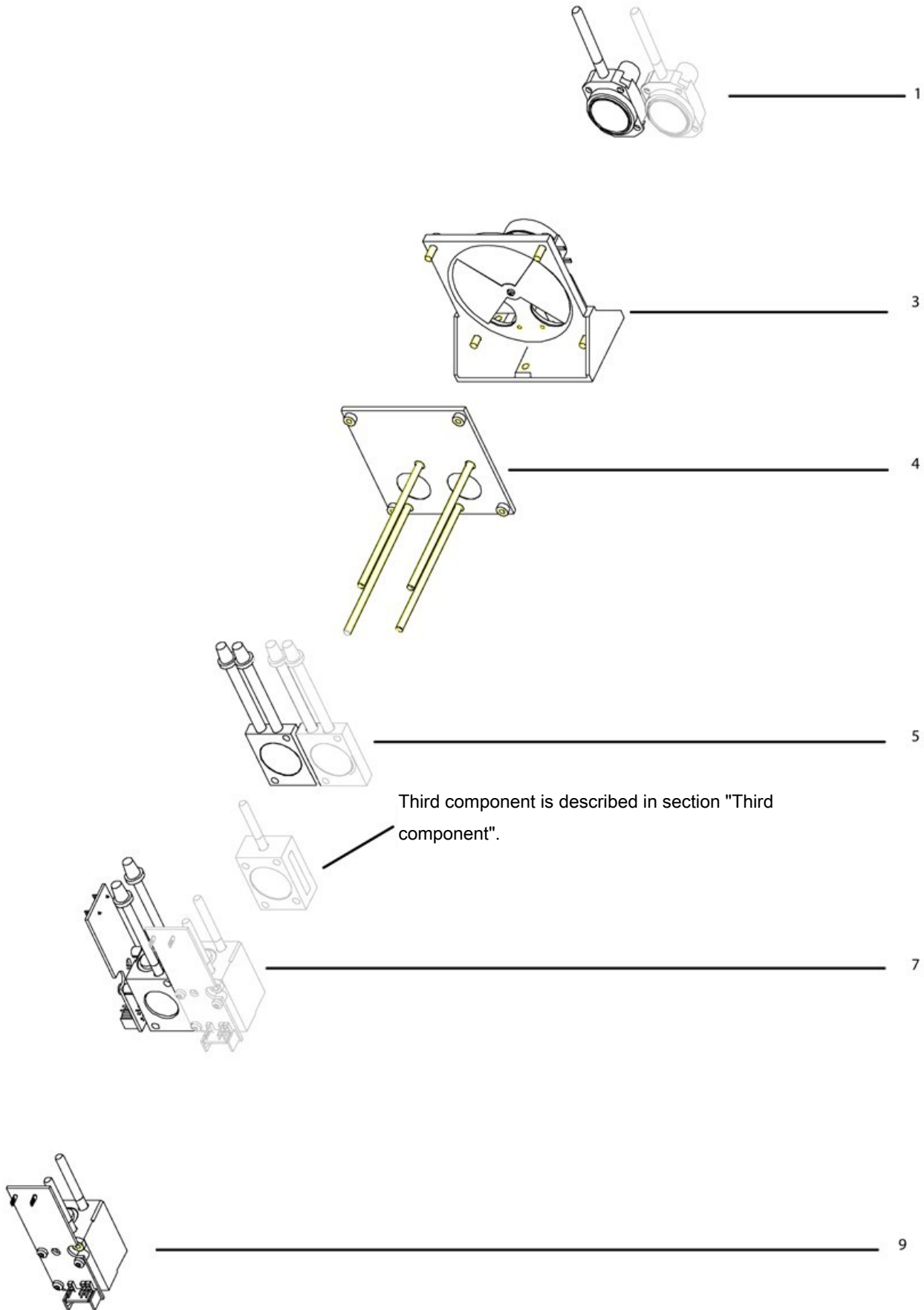


Fig. 61: Analyzer unit BA2338-, BA2358-.BA., -.BD.-, -.CB.-, analyzer unit 1 CO/CO₂ and

BA2338-, BA2358-.BA.-, -.BD.-, -.CB.-

Part No.	Designation	Order No.	Remarks
1*)	IR source	C79451-A3468-B206	
3*)	Chopper	C79451-A3468-B516	
3*)	Chopper	A5E35984159	Only variant -B06 'Cleaned for O ₂ '
4	Plate with threaded bolts and windows	C79451-A3468-B514	
4	Plate with threaded bolts and windows	A5E35984162	Only variant -B06 'Cleaned for O ₂ '

BA2338-, BA2358-.BA.-, -.BD.-

Part No.	Designation	Order No.	Remarks
5	Analyzer chamber	C79451-A3468-B236	Analyzer chamber 2 mm
5	Analyzer chamber	A5E35982182	Analyzer chamber 2 mm; only variant -B06 'Cleaned for O ₂ '
7*)	Receiver chamber	C79451-A3468-B532	For CO
7*)	Receiver chamber	A5E35984327	For CO; only variant -B06 'Cleaned for O ₂ '
9*)	Receiver chamber	C79451-A3468-B526	For CO ₂
9*)	Receiver chamber	A5E35983146	For CO ₂ ; only variant -B06 'Cleaned for O ₂ '

BA2338-, BA2358-.CB.-

Part No.	Designation	Order No.	Remarks
5	Analyzer chamber	C79451-A3468-B235	Analyzer chamber 6 mm
5	Analyzer chamber	A5E35982178	6 mm; only variant -B06 'Cleaned for O ₂ '
7*)	Receiver chamber	C79451-A3468-B531	For CO ₂
7*)	Receiver chamber	A5E35984315	For CO ₂ ; only variant -B06 'Cleaned for O ₂ '
9*)	Receiver chamber	C79451-A3468-B527	For CH ₄
9*)	Receiver chamber	A5E35983151	For CH ₄ ; only variant -B06 'Cleaned for O ₂ '

*) Following replacement of this part, special work is required which can only be carried out by qualified personnel trained for this task, for example temperature compensation, basic electronic adjustment etc.

7.2.4.4.5 .BB.., .CA..- for CO/CO2 and CO2/CH4

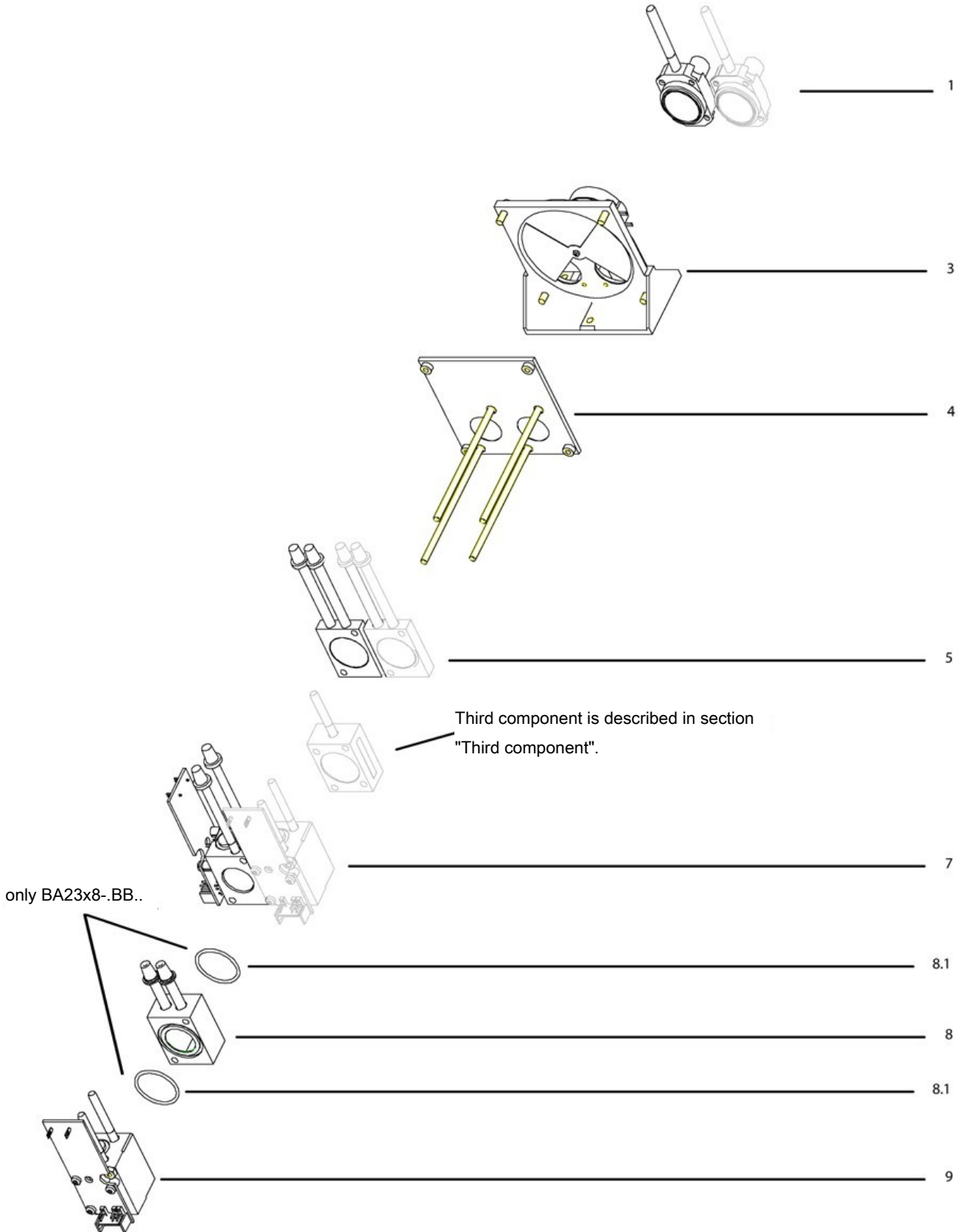


Fig. 62: Analyzer unit BA2338-, BA2358-.BB..-, .CA..-

BA2338-, BA2358-.BB.-, -.CA.-

Part No.	Designation	Order No.	Remarks
1 *)	IR source	C79451-A3468-B206	
3 *)	Chopper	C79451-A3468-B516	
3 *)	Chopper	A5E35984159	Only variant -B06 'Cleaned for O ₂ '
4	Plate with threaded bolts and windows	C79451-A3468-B514	
4	Plate with threaded bolts and windows	A5E35984162	Only variant -B06 'Cleaned for O ₂ '

BA2338-, BA2358-.BB.-

Part No.	Designation	Order No.	Remarks
5	Analyzer chamber	C79451-A3468-B236	Analyzer chamber 2 mm
5	Analyzer chamber	A5E35982182	Analyzer chamber 2 mm; only variant -B06 'Cleaned for O ₂ '
7 *)	Receiver chamber	C79451-A3468-B532	For CO
7 *)	Receiver chamber	A5E35984327	For CO; only variant -B06 'Cleaned for O ₂ '
8.1	O-ring	C71121-Z100-A99	
8.1	O-ring	A5E35980590	Only variant -B06 'Cleaned for O ₂ '
8	Analyzer chamber	C79451-A3468-B234	Analyzer chamber 20 mm
8	Analyzer chamber	A5E35982170	Analyzer chamber 20 mm; only variant -B06 'Cleaned for O ₂ '
9 *)	Receiver chamber	C79451-A3468-B526	For CO ₂
9 *)	Receiver chamber	A5E35983146	For CO ₂ ; only variant -B06 'Cleaned for O ₂ '

BA2338, BA2358-.CA.-

Part No.	Designation	Order No.	Remarks
5	Analyzer chamber	C79451-A3468-B235	Analyzer chamber 6 mm
5	Analyzer chamber	A5E35982178	Analyzer chamber 6 mm; only variant -B06 'Cleaned for O ₂ '
7 *)	Receiver chamber	C79451-A3468-B531	For CO ₂
7 *)	Receiver chamber	A5E35984315	For CO ₂ ; only variant -B06 'Cleaned for O ₂ '
8	Analyzer chamber	C79451-A3468-B235	Analyzer chamber 6 mm
8	Analyzer chamber	A5E35982178	Analyzer chamber 6 mm; only variant -B06 'Cleaned for O ₂ '
9 *)	Receiver chamber	C79451-A3468-B527	For CH ₄
9 *)	Receiver chamber	A5E35983151	For CH ₄ ; only variant -B06 'Cleaned for O ₂ '

*) Following replacement of this part, special work is required which can only be carried out by qualified personnel trained for this task, for example temperature compensation, basic electronic adjustment etc.

7.2.4.4.6 .BJ., .BK., .BL.- for CO₂/CO

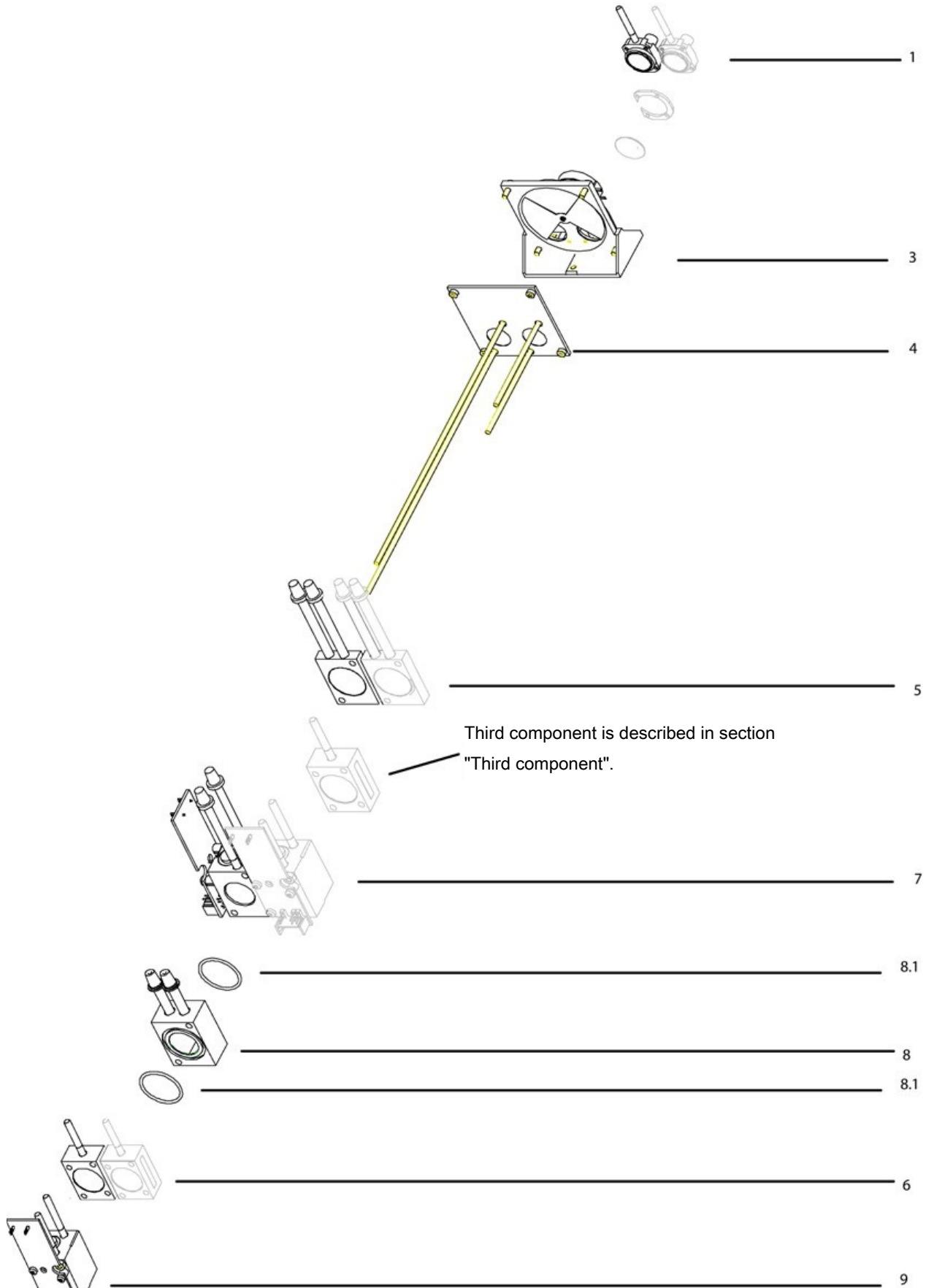


Fig. 63: Analyzer unit BA2338-, BA2358-.BJ.-, -.BK.-, -.BL.-, analyzer unit 1 for CO₂/CO

BA2338-, BA2358-.BJ.-, -.BK.-, -.BL.- für CO₂/CO

Part No.	Designation	Order No.	Remarks
1*)	IR source	C79451-A3468-B206	
3*)	Chopper	C79451-A3468-B516	
3*)	Chopper	A5E35984159	Only variant -B06 'Cleaned for O ₂ '
4	Plate with threaded bolts and windows	C79451-A3468-B514	
4	Plate with threaded bolts and windows	A5E35984162	Only variant -B06 'Cleaned for O ₂ '

BA2338-, BA2358-.BK..-

Part No.	Designation	Order No.	Remarks
5	Analyzer chamber	C79451-A3468-B236	Analyzer chamber 2 mm
5	Analyzer chamber	A5E35982182	Analyzer chamber 2 mm; only variant -B06 'Cleaned for O ₂ '
7*)	Receiver chamber	C79451-A3468-B531	For CO ₂
7*)	Receiver chamber	A5E35984315	For CO ₂ ; only variant -B06 'Cleaned for O ₂ '
8.1	O-ring	C71121-Z100-A99	
8.1	O-ring	A5E35980590	Only variant -B06 'Cleaned for O ₂ '
8	Analyzer chamber with O-ring	C79451-A3468-B234	Analyzer chamber 20 mm
8	Analyzer chamber with O-ring	A5E35982170	Analyzer chamber 20 mm; only variant -B06 'Cleaned for O ₂ '
6	Gas filter	C79451-A3458-B500	For CO
6	Gas filter	A5E35983013	For CO; only variant -B06 'Cleaned for O ₂ '
9*)	Receiver chamber	C79451-A3468-B528	For CO
9*)	Receiver chamber	A5E35983122	For CO; only variant -B06 'Cleaned for O ₂ '

BA2338, BA2358-.BJ..-, -.BL..-

Part No.	Designation	Order No.	Remarks
5	Analyzer chamber	C79451-A3468-B235	Analyzer chamber 6 mm
5	Analyzer chamber	A5E35982178	6 mm; only variant -B06 'Cleaned for O ₂ '
7*)	Receiver chamber	C79451-A3468-B531	For CO ₂
7*)	Receiver chamber	A5E35984315	For CO ₂ ; only variant -B06 'Cleaned for O ₂ '
8.1	O-ring	C71121-Z100-A99	
8.1	O-ring	A5E35980590	Only variant -B06 'Cleaned for O ₂ '
8	Analyzer chamber with O-ring	C79451-A3468-B231	Analyzer chamber 180 mm
8	Analyzer chamber with O-ring	A5E35982142	180 mm; only variant -B06 'Cleaned for O ₂ '
6	Gas filter	C79451-A3458-B500	For CO
6	Gas filter	A5E35983013	For CO; only variant -B06 'Cleaned for O ₂ '
9*)	Receiver chamber	C79451-A3468-B525	For CO

9 *)	Receiver chamber	A5E35983110	For CO; only variant -B06 'Cleaned for O ₂ '
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*) Following replacement of this part, special work is required which can only be carried out by qualified personnel trained for this task, for example temperature compensation, basic electronic adjustment etc.

7.2.4.5 Analyzer unit BA2338-, BA2358- third component

The parts shown in light gray in the following diagram are examples of component 1.

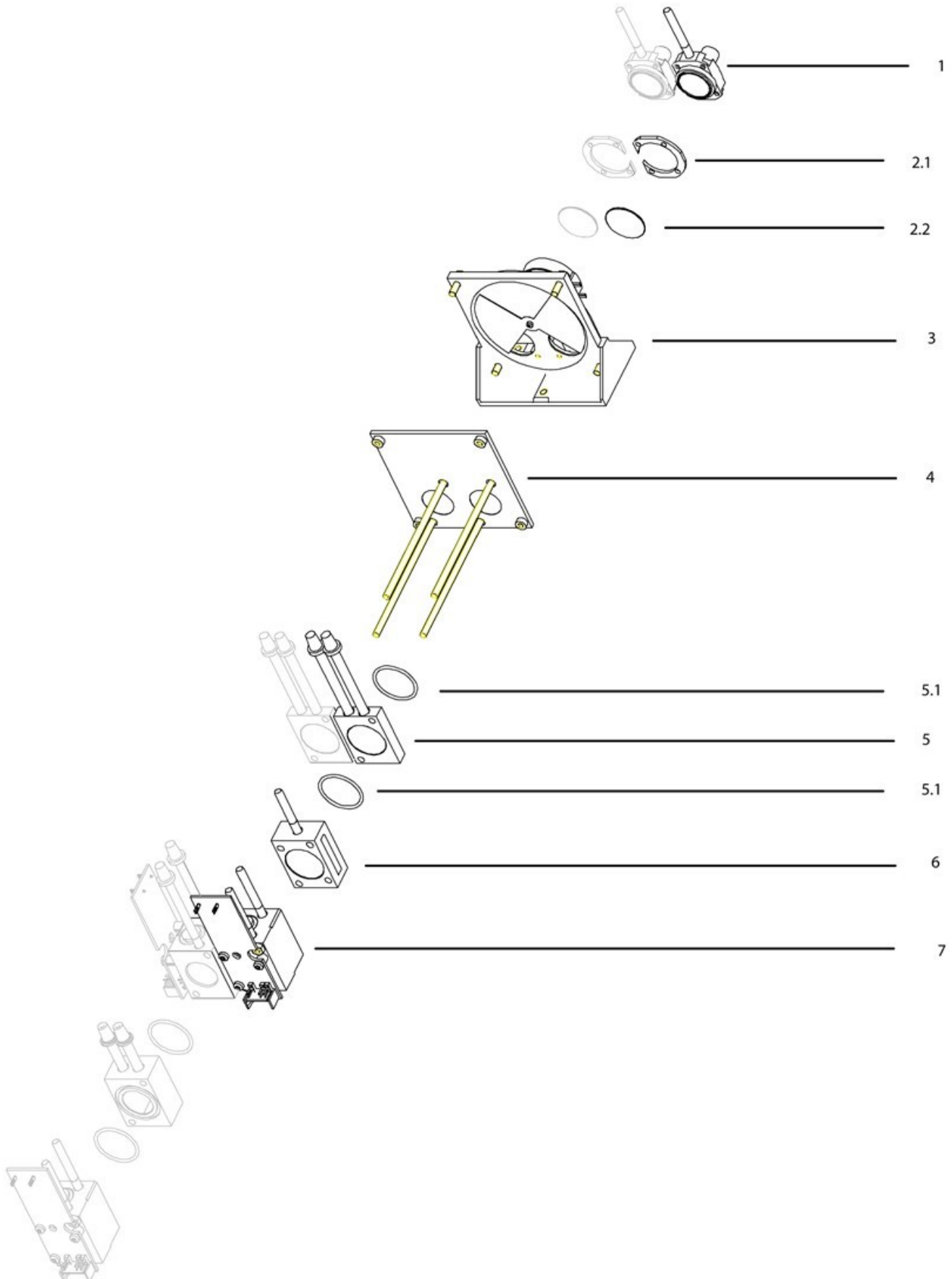


Fig. 64: Analyzer unit BA2338-, BA2358-, analyzer unit 2 (third component)

Part No.	Designation	Order No.	Remarks
1 *)	IR source	C79451-A3468-B206	
2.1	Spacer	C79451-A3468-C20	
2.2	Optical filter	C75285-Z1491-C5	For NO **)
2.2	Optical filter	C79285-Z1302-A4	For SO ₂ **)
2.2.	Optical filter	C79285-Z1491-C2	For C ₂ H ₄
2.2.	Optical filter	A5E00069310	For C ₆ H ₁₄
2.2	Optical filter	C79451-A3182-C161	For SF ₆
3 *)	Chopper	C79451-A3468-B516	
4	Plate with threaded bolts and windows	C79451-A3468-B514	
5.1	O-ring	C71121-Z100-A99	
5	Analyzer chamber with O-ring	C79451-A3468-B231	180 mm
5	Analyzer chamber with O-ring	C79451-A3468-B232	90 mm
5	Analyzer chamber with O-ring	C79451-A3468-B233	60 mm
5	Analyzer chamber with O-ring	C79451-A3468-B234	20 mm
5	Analyzer chamber	C79451-A3468-B235	6 mm
5	Analyzer chamber	C79451-A3468-B236	2 mm
6	Gas filter	C79451-A3458-B500	For CO
6	Gas filter	C79451-A3458-B508	For SO ₂
6	Gas filter	C79451-A3468-B541	For CO ₂ ; smallest MB <5 %
6	Gas filter	C79451-A3468-B542	For CH ₄ , smallest MB <2 %
6	Gas filter	C79451-A3468-B553	For C ₆ H ₁₄ , N ₂ O 500/5000 vpm
7.1/7.2 *)	Receiver chamber	C79451-A3468-B525	For CO, ; smallest MB <5 %
7.1/7.2 *)	Receiver chamber	C79451-A3468-B528	For CO, ; smallest MB ≥5 %
7.1/7.2 *)	Receiver chamber	C79451-A3468-B536	For CO ₂ , ; smallest MB <1000 vpm
7.1/7.2 *)	Receiver chamber	C79451-A3468-B526	For CO ₂ , ; smallest MB ≥1000 vpm
7.1/7.2 *)	Receiver chamber	C79451-A3468-B527	For CH ₄ , ; smallest MB <20 %
7.1/7.2 *)	Receiver chamber	C79451-A3468-B529	For CH ₄ , ; smallest MB ≥20 %
7.1/7.2 *)	Receiver chamber	C79451-A3468-B537	For C ₂ H ₄
7.2 *)	Receiver chamber	C79451-A3468-B522	For NO (channel 2)
7.1 *)	Receiver chamber	C79451-A3468-B523	For SO ₂ (channel 2)
7 *)	Receiver chamber	C79451-A3468-B581	For N ₂ O
7 *)	Receiver chamber	C79451-A3468-B539	For SF ₆
7 *)	Receiver chamber	C79451-A3468-B538	For C ₆ H ₁₄

*) Following replacement of this part, special work is required which can only be carried out by qualified personnel trained for this task, for example temperature compensation, basic electronic adjustment etc.

**) Following replacement of this part, the water vapor cross-sensitivity must be checked.

7.2.4.6 UV module

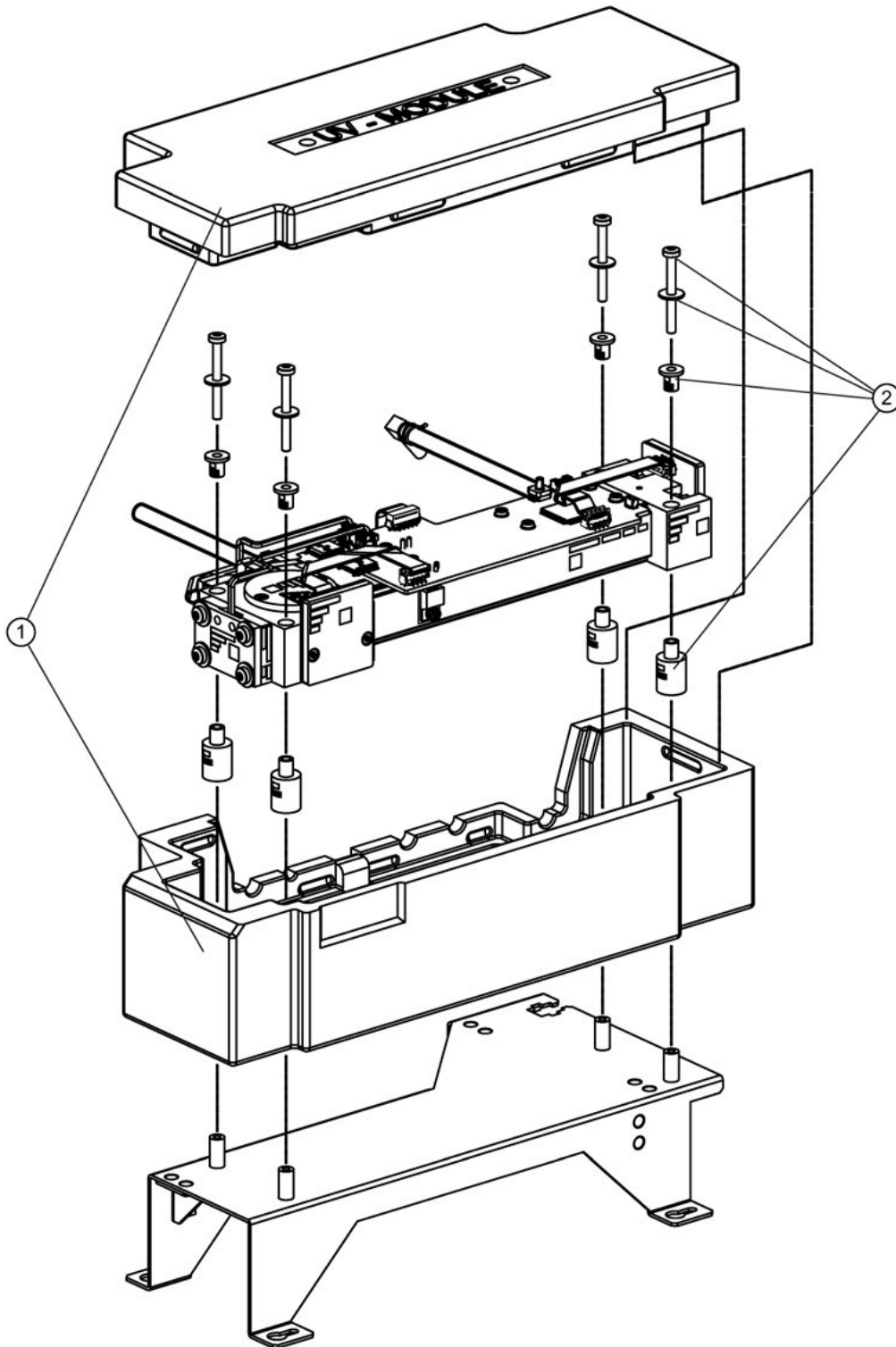


Fig. 65: UV module, complete

Part No.	Designation	Order No.	Remarks
	UV module, complete	A5E40781382	Complete module installed as finished spare part. Includes all parts shown in the figure plus 4 screws for fastening the base to the bottom of the enclosure.
1	Insulation	A5E40781385	2 loose parts to be put together
2	Assembly parts for UV module	A5E40781387	Set of loose parts; total of 4 sets

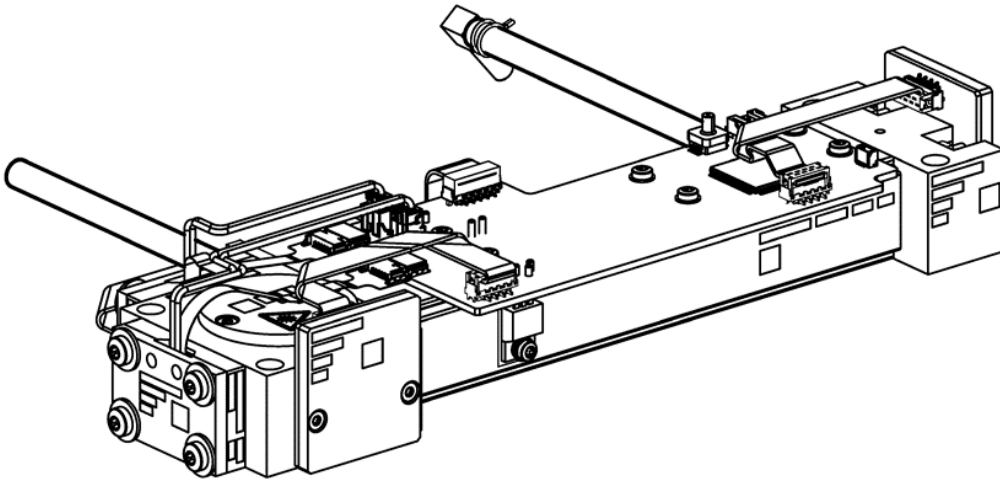


Fig. 66: UV photometer, fully assembled

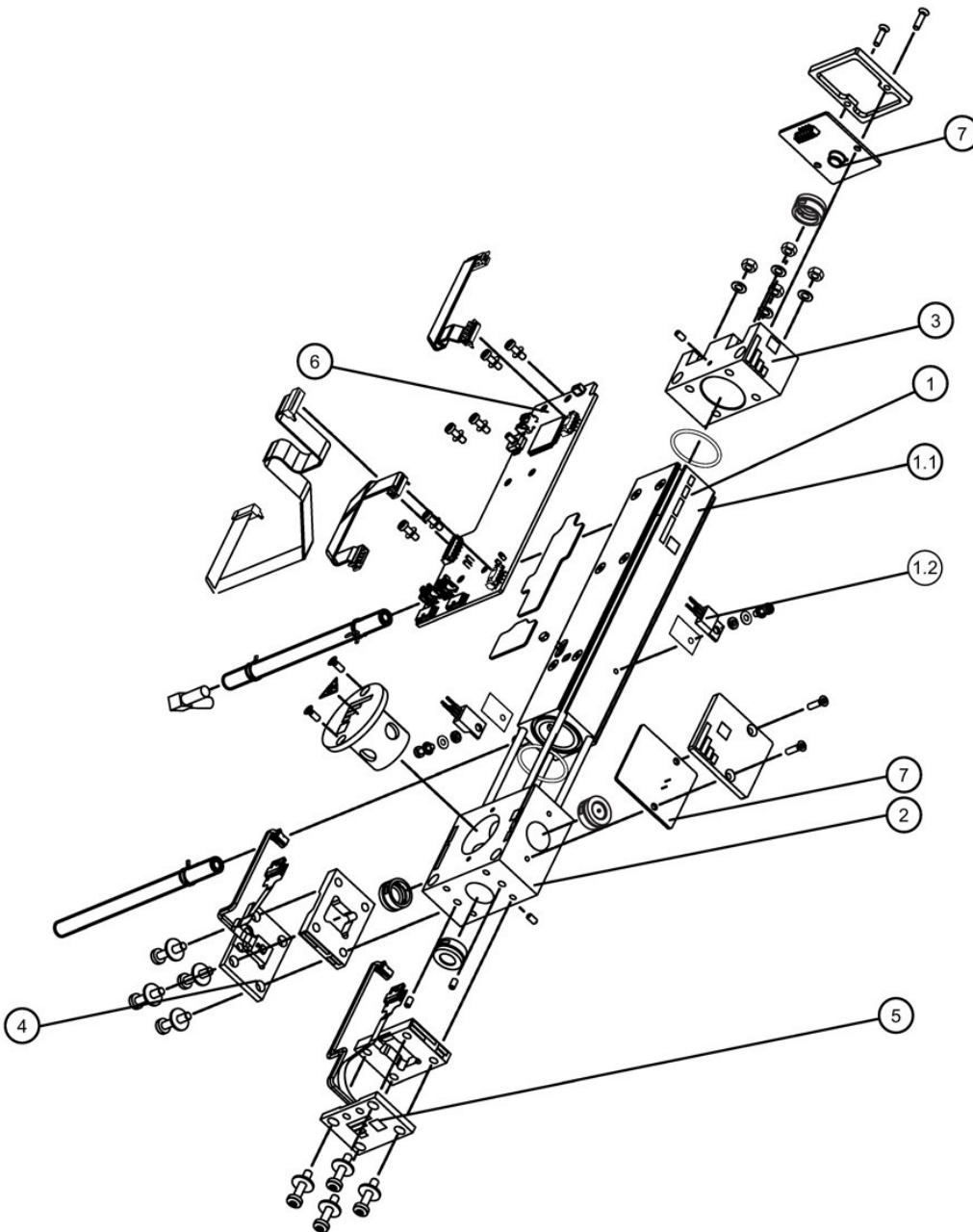
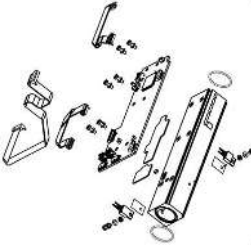

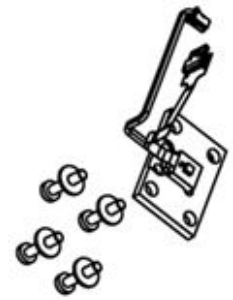


Fig. 67: UV photometer, sum of all individual parts (items 1 to 7)

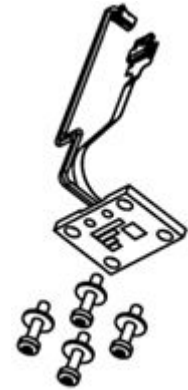
Because the individual spare parts are made up of several smaller parts, the sets of parts belonging to a spare part are shown again separately for the respective spare part.

Part No.	Designation	Order No.	Remarks	Individual parts
1*)	Analyzer chamber, complete including UV motherboard, heating elements, cables and assembly material	A5E40781406	Preassembled	
1.1*	Analyzer chamber without UV motherboard including assembly parts	A5E40781402	Set of loose parts	
1.2*	Assembly parts for analyzer chamber	A5E40781409	Set of loose parts	
2*	Optics holder, complete including assembly material	A5E40781397	Preassembled	
3*	Photodiode holder, complete, including assembly material	A5E40781448	Preassembled	

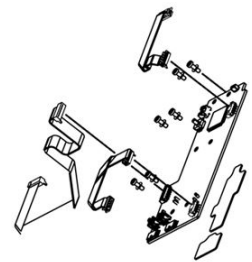
4* Calibrator holder DUV including assembly material A5E40781393 Preassembled



5* Calibrator holder BUV including assembly material A5E40781395 Preassembled



6 UV motherboard including assembly material and cable A5E40781471 Set of loose parts



7* UV detector board including assembly material and cable A5E40781494 Set of loose parts



* After replacement of this part, special work is required that can only be carried out by qualified personnel trained for this task, for example, three-point calibration, temperature compensation, basic electrical adjustment, etc.

7.2.4.7 Sensors

Hydrogen sulfide sensors

Part No.	Designation	Order No.	Remarks
-	H ₂ S sensor	A5E03858060	Measuring range 0 ... 50 ppm
-	H ₂ S sensor	A5E35984634	Measuring range 0 ... 50 ppm; for variant -B06 'Cleaned for O ₂ '

Paramagnetic oxygen sensor

Part No.	Designation	Order No.	Remarks
-	Paramagnetic oxygen sensor	A5E03347537	
-	Paramagnetic oxygen sensor	A5E35984641	For variant -B06 'Cleaned for O ₂ '
-	Preamplifier board	A5E03347540	

Electrochemical oxygen sensor

Part No.	Designation	Order No.	Remarks
-	Electrochemical oxygen sensor	C79451-A3458-B55	
-	Electrochemical oxygen sensor	A5E35951900	For variant -B06 'Cleaned for O ₂ '

7.2.4.8 Comparison of spare part Order Nos. BA 5000 and BA 06 clean for O₂ analyzer version

The following table shows a comparison between all spare parts for the variant -B06 (Cleaned for O₂) and the corresponding parts in the other variants.

Part No. (Section)	Designation	Order no. -B06 'Cleaned for O ₂ '	Order no. for all other variants
9 (13.2)	Pressure switch	A5E37371678	C79302-Z1210-A2
11 (13.2)	Flowmeter	A5E35980458	C79402-Z560-T1
16 (13.2)	Connecting socket	A5E36448926	A5E36448145
8.1 (13.4)	Sample gas pump 50 Hz	A5E35980470	C79451-A3494-B10
8.2 (13.4)	Sample gas pump 60 Hz	A5E35980528	C79451-A3494-B11
8.3 (13.4)	Sealing set	A5E35980531	C79402-Z666-E20
3 (13.5.n)	Chopper	A5E35980538	C79451-A3468-B515
3 (13.5.n)	Chopper	A5E35984159	C79451-A3468-B516
4 (13.5.n)	Plate with threaded bolts and windows	A5E35980542	C79451-A3468-B513
4 (13.5.n)	Plate with threaded bolts and windows	A5E35984162	C79451-A3468-B514
	Optical filter with filter support	A5E35984319	A5E00502911
5.1 (13.5.n)	O-ring	A5E35980590	C71121-Z100-A99
8.1 (13.5.n)			
5/8 (13.5.n)	Analyzer chamber with O-ring 180 mm	A5E35982142	C79451-A3468-B231
5/8 (13.5.n)	Analyzer chamber with O-ring 90 mm	A5E35982156	C79451-A3468-B232
5/8 (13.5.n)	Analyzer chamber with O-ring 60 mm	A5E35982163	C79451-A3468-B233
5/8 (13.5.n)	Analyzer chamber with O-ring 20 mm	A5E35982170	C79451-A3468-B234
5/8 (13.5.n)	Analyzer chamber with O-ring 6 mm	A5E35982178	C79451-A3468-B235
5/8 (13.5.n)	Analyzer chamber with O-ring 2 mm	A5E35982182	C79451-A3468-B236

6 (13.5.n)	Gas filter	A5E35983013	C79451-A3468-B500
6 (13.5.n)	Gas filter	A5E35983026	C79451-A3468-B508
6 (13.5.n)	Gas filter	A5E35983032	C79451-A3468-B541
6 (13.5.n)	Gas filter	A5E35983036	C79451-A3468-B542
6 (13.5.n)	Gas filter	A5E35983044	C79451-A3468-B553
7/9 (13.5.n)	Receiver chamber	A5E35983178	C79451-A3468-B520
7/9 (13.5.n)	Receiver chamber	A5E35983183	C79451-A3468-B521
7/9 (13.5.n)	Receiver chamber	A5E35984186	C79451-A3468-B522
7/9 (13.5.n)	Receiver chamber	A5E35984197	C79451-A3468-B523
7/9 (13.5.n)	Receiver chamber	A5E35983110	C79451-A3468-B525
7/9 (13.5.n)	Receiver chamber	A5E35983146	C79451-A3468-B526
7/9 (13.5.n)	Receiver chamber	A5E35983151	C79451-A3468-B527
7/9 (13.5.n)	Receiver chamber	A5E35983122	C79451-A3468-B528
7/9 (13.5.n)	Receiver chamber	A5E35983152	C79451-A3468-B529
7/9 (13.5.n)	Receiver chamber	A5E35984307	C79451-A3468-B530
7/9 (13.5.n)	Receiver chamber	A5E35984315	C79451-A3468-B531
7/9 (13.5.n)	Receiver chamber	A5E35984327	C79451-A3468-B532
7/9 (13.5.n)	Receiver chamber	A5E35983141	C79451-A3468-B536
7/9 (13.5.n)	Receiver chamber	A5E35983172	C79451-A3468-B537
7/9 (13.5.n)	Receiver chamber	A5E35983203	C79451-A3468-B538
7/9 (13.5.n)	Receiver chamber	A5E35983196	C79451-A3468-B539
7/9 (13.5.n)	Receiver chamber	A5E35983192	C79451-A3468-B581
-	H ₂ S sensor, measuring range 0 ... 50 ppm	A5E35984634	A5E03858060
-	Paramagnetic oxygen sensor	A5E35984641	A5E03347537
-	Electrochemical oxygen sensor	A5E35951900	C79451-A3458-B55

8 Disposal

The applicable national laws must be observed when disposing of the products. Disposal must not result in a danger to health and environment.

The crossed out wheellie bin symbol on Bühler Technologies GmbH electrical and electronic products indicates special disposal notices within the European Union (EU).



The crossed out wheellie bin symbol indicates the electric and electronic products bearing the symbol must be disposed of separate from household waste. They must be properly disposed of as waste electrical and electronic equipment.

Bühler Technologies GmbH will gladly dispose of your device bearing this mark. Please send your device to the address below for this purpose.

We are obligated by law to protect our employees from hazards posed by contaminated devices. Therefore please understand that we can only dispose of your waste equipment if the device is free from any aggressive, corrosive or other operating fluids dangerous to health or environment. **Please complete the "RMA Form and Decontamination Statement", available on our website, for every waste electrical and electronic equipment. The form must be applied to the packaging so it is visible from the outside.**

Please return waste electrical and electronic equipment to the following address:

Bühler Technologies GmbH
 WEEE
 Harkortstr. 29
 40880 Ratingen
 Germany

Please also observe data protection regulations and remember you are personally responsible for the returned waste equipment not bearing any personal data. Therefore please be sure to delete your personal data before returning your waste equipment.

8.1 Taking out of operation and disposal

The BA 5000 may be taken out of operation for the following reasons:

- Repair
- New location of use
- Scrapping

8.1.1 Repair or changing of location

If the BA 5000 is shut down for repair or for changing the location of use, proceed as follows:

Rack unit

1. Make sure that gas is no longer flowing through the analyzer. If external pumps are present, switch all of them off.
2. Purge the sample gas path with air or nitrogen.
3. Switch the analyzer off.
4. Disconnect the power plug.
5. Disconnect all hose connections from the rear of the analyzer. With pipe versions, unscrew all pipes.

Bench-top unit

1. Make sure that gas is no longer flowing through the analyzer. If external pumps are present, switch all of them off.
2. Purge the sample gas path with air or nitrogen.
3. Switch the analyzer off.
4. Disconnect the power plug.
5. Empty the condensation trap (see section Emptying the condensation trap).
6. Disconnect the supply hose from the condensation trap.

7. Disconnect all hose connections from the rear of the analyzer.

8.1.2 Scrapping the analyzer

If the BA 5000 is to be scrapped, take it of operation as follows:

Rack unit

1. Make sure that gas is no longer flowing through the analyzer. If external pumps are present, switch all of them off.
2. Purge the sample gas path with air or nitrogen.
3. Switch the analyzer off.
4. Disconnect the power plug.
5. Disconnect all hose connections from the rear of the analyzer. With pipe versions, unscrew all pipes.
6. In the case of analyzers with an electrochemical oxygen sensor, remove this from the analyzer (see section Replacing the electrochemical oxygen sensor).
7. In the case of analyzers with a hydrogen sulfide sensor, remove this from the analyzer (see section Replacing the hydrogen sulfide sensor).

Bench-top unit

1. Make sure that gas is no longer flowing through the analyzer. If external pumps are present, switch all of them off.
2. Purge the sample gas path with air or nitrogen.
3. Switch the analyzer off.
4. Disconnect the power plug.
5. Empty the condensation trap (see section Emptying the condensation trap).
6. Disconnect the supply hose from the condensation trap.
7. Disconnect all hose connections from the rear of the analyzer.

Product disposal

The analyzer to be disposed of as electronic waste with the code number 160213 is a 'product containing dangerous components'. It must therefore be disposed of correctly and in an environmentally-friendly manner by a local waste disposal company.

Disposal of the electrochemical oxygen sensor

The exhausted or faulty O₂ sensor is hazardous waste and must be packed and disposed of accordingly! The exhausted O₂ sensor is electronic waste with the code number 160215, that is, a 'dangerous component removed from used devices'. It must therefore be disposed of correctly and in an environmentally-friendly manner by a local waste disposal company.

WARNING



Danger of chemical burns

The O₂S sensor contains acetic acid, which leads to burns on unprotected skin. Therefore do not use any tools when replacing the sensor module which could damage the sensor due to sharp edges or squeezing. If contact with the acid occurs nevertheless, rinse the affected skin immediately with plenty of water!

Disposal of hydrogen sulfide sensor

The exhausted or faulty H₂ sensor is hazardous waste and must be packed and disposed of accordingly! The exhausted H₂S sensor is electronic waste with the code number 160215, that is, a "dangerous component removed from used devices". It must therefore be disposed of correctly and in an environmentally-friendly manner by a local waste disposal company.

WARNING



Danger of chemical burns

The H₂S sensor contains sulfuric acid, which leads to burns on unprotected skin. Therefore do not use any tools when replacing the sensor module which could damage the sensor due to sharp edges or squeezing. If contact with the acid occurs nevertheless, rinse the affected skin immediately with plenty of water!

9 Attached documents

- Declaration of Conformity KX550018
- RMA - Form decontamination statement

EU-Konformitätserklärung
EU-declaration of conformity



Hiermit erklärt Bühler Technologies GmbH,
dass die nachfolgenden Produkte den
wesentlichen Anforderungen der Richtlinie

*Herewith declares Bühler Technologies GmbH
that the following products correspond to the
essential requirements of Directive*

2014/35/EU
(Niederspannungsrichtlinie / low voltage directive)

in ihrer aktuellen Fassung entsprechen.

in its actual version.

Folgende Richtlinien wurden berücksichtigt:

The following directives were regarded:

2014/30/EU (EMV/EMC)

Produkt / products: Gasanalysator / Gas analyser
Typ / type: BA 5000

Das Betriebsmittel dient zur Messung von IR-absorbierende Gasen und Sauerstoff.
The equipment is used to measure IR-absorbing gases and oxygen.

Das oben beschriebene Produkt der Erklärung erfüllt die einschlägigen
Harmonisierungsrechtsvorschriften der Union:
*The object of the declaration described above is in conformity with the relevant Union harmonisation
legislation:*

EN 61000-6-3:2007/A1:2011
EN 61000-3-3:2013
EN 61010-1:2010/A1:2019/AC:2019-04

EN 61000-6-2:2005/AC:2005
EN 55011:2009/A1:2010

EN 61000-3-2:2014
EN 61326-1:2013

Die alleinige Verantwortung für die Ausstellung dieser Konformitätserklärung trägt der Hersteller.
This declaration of conformity is issued under the sole responsibility of the manufacturer.

Dokumentationsverantwortlicher für diese Konformitätserklärung ist Herr Stefan Eschweiler mit
Anschrift am Firmensitz.
*The person authorized to compile the technical file is Mr. Stefan Eschweiler located at the company's
address.*

Ratingen, den 17.02.2023

Stefan Eschweiler
Geschäftsführer – *Managing Director*

Frank Pospiech
Geschäftsführer – *Managing Director*

UK Declaration of Conformity



The manufacturer Bühler Technologies GmbH declares, under the sole responsibility, that the product complies with the requirements of the following UK legislation:

Electrical Equipment Safety Regulations 2016

The following legislation were regarded:

Electromagnetic Compatibility Regulations 2016

Product: Gas analyser
Type: BA 5000

The equipment is used to measure IR-absorbing gases and oxygen.

The object of the declaration described above is in conformity with the relevant designated standards:

EN 61000-6-3:2007/A1:2011
EN 61000-6-2:2005/AC:2005
EN 61000-3-3:2013
EN 55011:2009/A1:2010

EN 61010-1:2010/A1:2019/AC:2019-04
EN 61000-3-2:2014
EN 61326-1:2013

Ratingen in Germany, 17.02.2023

A handwritten signature in black ink, appearing to read 'Stefan Eschweiler', written over a horizontal line.

Stefan Eschweiler
Managing Director

A handwritten signature in blue ink, appearing to read 'Frank Pospiech', written over a horizontal line.

Frank Pospiech
Managing Director

RMA-Formular und Erklärung über Dekontaminierung

RMA-Form and explanation for decontamination



RMA-Nr./ RMA-No.

Die RMA-Nr. bekommen Sie von Ihrem Ansprechpartner im Vertrieb oder Service. Bei Rücksendung eines Altgeräts zur Entsorgung tragen Sie bitte in das Feld der RMA-Nr. "WEEE" ein./ You may obtain the RMA number from your sales or service representative. When returning an old appliance for disposal, please enter "WEEE" in the RMA number box.

Zu diesem Rücksendeschein gehört eine Dekontaminierungserklärung. Die gesetzlichen Vorschriften schreiben vor, dass Sie uns diese Dekontaminierungserklärung ausgefüllt und unterschrieben zurücksenden müssen. Bitte füllen Sie auch diese im Sinne der Gesundheit unserer Mitarbeiter vollständig aus./ This return form includes a decontamination statement. The law requires you to submit this completed and signed decontamination statement to us. Please complete the entire form, also in the interest of our employee health.

Firma/ Company

Firma/ Company	<input type="text"/>
Straße/ Street	<input type="text"/>
PLZ, Ort/ Zip, City	<input type="text"/>
Land/ Country	<input type="text"/>

Gerät/ Device	<input type="text"/>
Anzahl/ Quantity	<input type="text"/>
Auftragsnr./ Order No.	<input type="text"/>

Ansprechpartner/ Person in charge

Name/ Name	<input type="text"/>
Abt./ Dept.	<input type="text"/>
Tel./ Phone	<input type="text"/>
E-Mail	<input type="text"/>

Serien-Nr./ Serial No.	<input type="text"/>
Artikel-Nr./ Item No.	<input type="text"/>

Grund der Rücksendung/ Reason for return

- Kalibrierung/ Calibration Modifikation/ Modification
 Reklamation/ Claim Reparatur/ Repair
 Elektroaltgerät/ Waste Electrical & Electronic Equipment (WEEE)
 andere/ other

bitte spezifizieren/ please specify

Ist das Gerät möglicherweise kontaminiert?/ Could the equipment be contaminated?

- Nein, da das Gerät nicht mit gesundheitsgefährdenden Stoffen betrieben wurde./ No, because the device was not operated with hazardous substances.
 Nein, da das Gerät ordnungsgemäß gereinigt und dekontaminiert wurde./ No, because the device has been properly cleaned and decontaminated.
 Ja, kontaminiert mit:/ Yes, contaminated with:



explosiv/
explosive



entzündlich/
flammable



brandfördernd/
oxidizing



komprimierte
Gase/
compressed
gases



ätzend/
caustic



giftig,
Lebensgefahr/
poisonous, risk
of death



gesundheitsge-
fährdend/
harmful to
health



gesund-
heitsschädlich/
health hazard



umweltge-
fährdend/
environmental
hazard

Bitte Sicherheitsdatenblatt beilegen!/ Please enclose safety data sheet!

Das Gerät wurde gespült mit:/ The equipment was purged with:

Diese Erklärung wurde korrekt und vollständig ausgefüllt und von einer dazu befugten Person unterschrieben. Der Versand der (dekontaminierten) Geräte und Komponenten erfolgt gemäß den gesetzlichen Bestimmungen.

This declaration has been filled out correctly and completely, and signed by an authorized person. The dispatch of the (decontaminated) devices and components takes place according to the legal regulations.

Falls die Ware nicht gereinigt, also kontaminiert bei uns eintrifft, muss die Firma Bühler sich vorbehalten, diese durch einen externen Dienstleister reinigen zu lassen und Ihnen dies in Rechnung zu stellen.

Should the goods not arrive clean, but contaminated, Bühler reserves the right, to commission an external service provider to clean the goods and invoice it to your account.

Firmenstempel/ Company Sign

Datum/ Date

rechtsverbindliche Unterschrift/ Legally binding signature



Vermeiden von Veränderung und Beschädigung der einzusendenden Baugruppe

Die Analyse defekter Baugruppen ist ein wesentlicher Bestandteil der Qualitätssicherung der Firma Bühler Technologies GmbH. Um eine aussagekräftige Analyse zu gewährleisten muss die Ware möglichst unverändert untersucht werden. Es dürfen keine Veränderungen oder weitere Beschädigungen auftreten, die Ursachen verdecken oder eine Analyse unmöglich machen.

Umgang mit elektrostatisch sensiblen Baugruppen

Bei elektronischen Baugruppen kann es sich um elektrostatisch sensible Baugruppen handeln. Es ist darauf zu achten, diese Baugruppen ESD-gerecht zu behandeln. Nach Möglichkeit sollten die Baugruppen an einem ESD-gerechten Arbeitsplatz getauscht werden. Ist dies nicht möglich sollten ESD-gerechte Maßnahmen beim Austausch getroffen werden. Der Transport darf nur in ESD-gerechten Behältnissen durchgeführt werden. Die Verpackung der Baugruppen muss ESD-konform sein. Verwenden Sie nach Möglichkeit die Verpackung des Ersatzteils oder wählen Sie selber eine ESD-gerechte Verpackung.

Einbau von Ersatzteilen

Beachten Sie beim Einbau des Ersatzteils die gleichen Vorgaben wie oben beschrieben. Achten Sie auf die ordnungsgemäße Montage des Bauteils und aller Komponenten. Versetzen Sie vor der Inbetriebnahme die Verkabelung wieder in den ursprünglichen Zustand. Fragen Sie im Zweifel beim Hersteller nach weiteren Informationen.

Einsenden von Elektroaltgeräten zur Entsorgung

Wollen Sie ein von Bühler Technologies GmbH stammendes Elektroprodukt zur fachgerechten Entsorgung einsenden, dann tragen Sie bitte in das Feld der RMA-Nr. „WEEE“ ein. Legen Sie dem Altgerät die vollständig ausgefüllte Dekontaminierungserklärung für den Transport von außen sichtbar bei. Weitere Informationen zur Entsorgung von Elektroaltgeräten finden Sie auf der Webseite unseres Unternehmens.

Avoiding alterations and damage to the components to be returned

Analysing defective assemblies is an essential part of quality assurance at Bühler Technologies GmbH. To ensure conclusive analysis the goods must be inspected unaltered, if possible. Modifications or other damages which may hide the cause or render it impossible to analyse are prohibited.

Handling electrostatically conductive components

Electronic assemblies may be sensitive to static electricity. Be sure to handle these assemblies in an ESD-safe manner. Where possible, the assemblies should be replaced in an ESD-safe location. If unable to do so, take ESD-safe precautions when replacing these. Must be transported in ESD-safe containers. The packaging of the assemblies must be ESD-safe. If possible, use the packaging of the spare part or use ESD-safe packaging.

Fitting of spare parts

Observe the above specifications when installing the spare part. Ensure the part and all components are properly installed. Return the cables to the original state before putting into service. When in doubt, contact the manufacturer for additional information.

Returning old electrical appliances for disposal

If you wish to return an electrical product from Bühler Technologies GmbH for proper disposal, please enter "WEEE" in the RMA number box. Please attach the fully completed decontamination declaration form for transport to the old appliance so that it is visible from the outside. You can find more information on the disposal of old electrical appliances on our company's website.

