SIEMENS

Continuous gas analysis ULTRAMAT 23

Gas analyzer for measuring IR-absorbing gases, UV-absorbing gases, oxygen and hydrogen sulfide

Equipment Manual

ULTRAMAT 23
7MB2335, 7MB2337, 7MB2338
7MB2355, 7MB2357, 7MB2358

01/2023
A5E37100388-AB

Legal information

Warning notice system

This manual contains notices you have to observe in order to ensure your personal safety, as well as to prevent damage to property. The notices referring to your personal safety are highlighted in the manual by a safety alert symbol, notices referring only to property damage have no safety alert symbol. These notices shown below are graded according to the degree of danger.

⚠ DANGER

indicates that death or severe personal injury **will** result if proper precautions are not taken.

⚠ WARNING

indicates that death or severe personal injury **may** result if proper precautions are not taken.

⚠ CAUTION

indicates that minor personal injury can result if proper precautions are not taken.

NOTICE

indicates that property damage can result if proper precautions are not taken.

If more than one degree of danger is present, the warning notice representing the highest degree of danger will be used. A notice warning of injury to persons with a safety alert symbol may also include a warning relating to property damage.

Qualified Personnel

The product/system described in this documentation may be operated only by **personnel qualified** for the specific task in accordance with the relevant documentation, in particular its warning notices and safety instructions. Qualified personnel are those who, based on their training and experience, are capable of identifying risks and avoiding potential hazards when working with these products/systems.

Proper use of Siemens products

Note the following:

⚠ WARNING

Siemens products may only be used for the applications described in the catalog and in the relevant technical documentation. If products and components from other manufacturers are used, these must be recommended or approved by Siemens. Proper transport, storage, installation, assembly, commissioning, operation and maintenance are required to ensure that the products operate safely and without any problems. The permissible ambient conditions must be complied with. The information in the relevant documentation must be observed.

Trademarks

All names identified by ® are registered trademarks of Siemens AG. The remaining trademarks in this publication may be trademarks whose use by third parties for their own purposes could violate the rights of the owner.

Disclaimer of Liability

We have reviewed the contents of this publication to ensure consistency with the hardware and software described. Since variance cannot be precluded entirely, we cannot guarantee full consistency. However, the information in this publication is reviewed regularly and any necessary corrections are included in subsequent editions.

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Introduction

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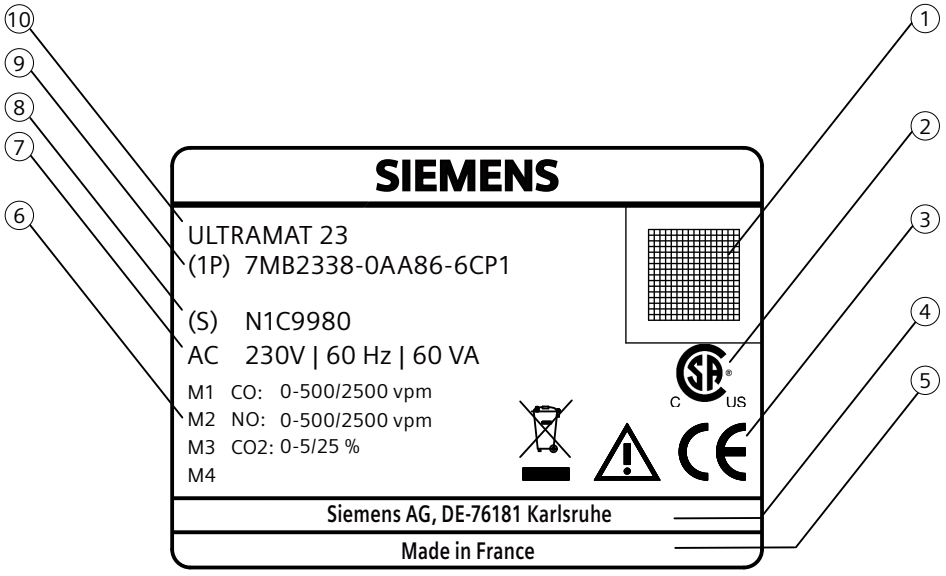
1.1 Information for our customers

Before beginning work with this device, please read this manual! It contains important information and data whose observation ensures proper device function and saves you servicing costs. The manual will help you to operate the device more easily and efficiently, allowing you to achieve reliable results.

1.2 Product versions

The ULTRAMAT 23 gas analyzer is suitable for a wide variety of measurements and is therefore available in different versions. The information on the nameplate indicates among others which device version you have.



1 Data matrix code
2 CSA conformity mark (only for 120V/60Hz and 230V/60Hz)
3 CE conformity mark
4 Name and address of manufacturer
5 Designation of origin
6 Measuring range(s)
7 Auxiliary power supply
8 Serial number
9 Order No. (MLFB number) of the device
10 Device name

Figure 1-1 ULTRAMAT 23 nameplate (example)

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 not included in the scope of delivery for the device. It can be downloaded under: Process analytics manuals (https://support.industry.siemens.com/cs/products?dtp=Manual&mfn=ps&pnid=17702&lc=en-WW)

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 Siemens regional office.

Note

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.

1.4 Special information and warnings

This manual provides you with information on using, installing, operating, and maintaining the device.

Pay particular attention to all special information and warnings. Information of this type is set apart from the rest of the text and is marked with the corresponding pictograms. This information provides you with useful tips and helps avoid maloperations.

1.5 Proper 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 Siemens.

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 at

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 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.

Note

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

Ensure compliance with the environmental conditions listed in the technical specifications (Page 34).

- During operation
- In the event of maintenance

Note

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.

1.6 Qualified Personnel

Qualified personnel are individuals who are familiar with the installation, mounting, commissioning, and operation of the product. These people have the following qualifications:

- They are authorized, trained or instructed in operating and maintaining devices and systems according to the safety regulations for electrical circuits, high pressures and aggressive as well as hazardous media.
- For explosion-proof devices: They are authorized, trained, or instructed in carrying out work on electrical circuits for hazardous systems.
- They are trained or instructed in the maintenance and use of appropriate safety equipment according to the safety regulations.

1.7 Warranty conditions

We expressly point out that the product quality is exclusively and conclusively described in the sales contract. The content of this product documentation is neither a part of a previous or existing agreement, promise or legal relationship, nor is it intended to modify these. All obligations on the part of Siemens AG are contained in the respective sales contract, which also contains the complete and solely applicable liability provisions. The provisions defined in the sales contract for the responsibility for defects are neither extended nor limited by the remarks in this document.

1.8 Delivery information

The respective scope of delivery is listed on the shipping documents in accordance with the valid sales contract. These are enclosed with the delivery.

When opening the packaging, please observe the corresponding information on the packaging material. Check the delivery for completeness and undamaged condition. In particular, the Order No. on the labels, if present, must be compared with the ordering data.

If possible, please keep the packaging material since you can reuse it for return deliveries if necessary.

1.9 Standards and regulations

As far as possible, the harmonized European standards have been applied to the specification and production of this device. If no harmonized European standards have been referred to, the standards and regulations for the Federal Republic of Germany are valid.

When this product is used beyond the scope of these standards and regulations, the standards and regulations applicable in the operating company's country must be observed.

As per CSA, the ULTRAMAT 23 is classified as C225206 and C225286 and certified according to CSA accreditation to ISO/IEC 17065 by the "Standards Council of Canada (SCC)". The certificate is valid for the versions with 120V/60Hz and 230V/60Hz.

1.10 Conformity with European directives

The product described in this document complies with the relevant harmonisation laws and its amendments of the European Union.

Electromagnetic compatibility EMC 2014/30/EU	Directive of the European Parliament and of the Council on the harmonisation of the laws of the Member States relating to electromagnetic compatibility
Explosion protection directive ATEX 2014/34/EU	Directive of the European Parliament and of the Council on the harmonisation of the laws of the Member States relating to equipment and protective systems intended for use in potentially explosive atmospheres

Low voltage directive LVD 2014/35/EU	Directive of the European Parliament and of the Council on the harmonisation of the laws of the Member States relating to electrical equipment designed for use within certain voltage limits on the market
Restriction of hazardous substances directive RoHS 2011/65/EU	Directive of the European Parliament and of the Council on the restriction of the use of certain hazardous substances in electrical and electronic equipment

The applicable directives can be found in the EU declaration of conformity of the specific device.

See also

Certificates (https://www.siemens.com/analytics/certificates)

Safety instructions 2

2.1 General

2.1.1 Security information

Siemens provides products and solutions with industrial security functions that support the secure operation of plants, systems, machines and networks.

In order to protect plants, systems, machines and networks against cyber threats, it is necessary to implement – and continuously maintain – a holistic, state-of-the-art industrial security concept. Siemens' products and solutions constitute one element of such a concept.

Customers are responsible for preventing unauthorized access to their plants, systems, machines and networks. Such systems, machines and components should only be connected to an enterprise network or the internet if and to the extent such a connection is necessary and only when appropriate security measures (e.g. firewalls and/or network segmentation) are in place.

For additional information on industrial security measures that may be implemented, please visit
https://www.siemens.com/industrialsecurity.

Siemens' products and solutions undergo continuous development to make them more secure. Siemens strongly recommends that product updates are applied as soon as they are available and that the latest product versions are used. Use of product versions that are no longer supported, and failure to apply the latest updates may increase customer's exposure to cyber threats.

To stay informed about product updates, subscribe to the Siemens Industrial Security RSS Feed under
https://www.siemens.com/cert.

⚠ 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.

WARNING

Improper device modifications

Danger to personnel, system and environment can result from modifications to the device, particularly in hazardous areas.

- Only carry out modifications that are described in the instructions for the device. Failure to observe this requirement cancels the manufacturer's warranty and the product approvals.

WARNING

Toxic and/or corrosive gases

When measuring toxic or corrosive gases, it could occur that sample gas accumulates in the analyzer because of leaks in the gas path.

To prevent the danger of poisoning or damage to parts of the analyzer, the analyzer or the system must be purged with inert gas (e.g. nitrogen). The gas displaced by purging must be collected using appropriate equipment and disposed of environmentally-friendly via an exhaust line.

WARNING

Risk of explosion due to 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.

If the sample gas could contain flammable components above the lower explosion limit (LEL), we recommend that you only use analyzers with piped gas paths.

WARNING

Wetted parts unsuitable for the process medium

Danger of injury or damage to device.

Hot, toxic and aggressive process media may be released if the media is not suitable for wetted parts of the analyzer.

- Ensure that the material of the device parts wetted by the process medium is suitable for the medium. Read the information in the technical specifications of the respective manual!

⚠ WARNING

Harmful gases

Danger to personnel, system and the environment can result from introducing harmful (corrosive, flammable and/or poisonous) gases into the device. If this should be required for the measuring task of the device, you must take the following measures:

- Take into account the safety measures according to the German Occupational Safety Act (Arbeitsschutzgesetz - ArbSchG) or similar international regulations. These safety measures must be coordinated with a local specialist. In particular, this includes measures to prevent any potential release of gases from the internal gas path (containment system) as well as their monitoring and disposal.
- Ensure that the discharged gas is treated according to the applicable local laws.
- When you measure gases with flammable components at concentrations above the lower explosion limit (LEL), we recommend that you only use piped devices (see also report BB-EG1-KAR Gr02X from TÜV Süddeutschland).
- Purge the device or the plant with a purging gas (inert gas). The gas displaced by purging must be collected using appropriate equipment and disposed of environmentally-friendly via an exhaust line.

⚠ WARNING

Harmful substances in the condensate

The condensate at the sample gas cooler or condensation trap can be corrosive, depending on the composition of the sample gas (e.g.: through SO_2, NO, H_2S, HCl, etc.). When you dip litmus paper into the condensate it will turn red.

- Wear protective clothing, protective goggles and protective gloves when handling the condensate!
- Prior to its disposal, dilute the condensate with tap water until it turns neutral and the litmus paper does not change color. Alternatively, you can also neutralize the condensate with a weak sodium carbonate solution (Na_2CO_3).

NOTICE

Manipulation of the device

Physical access to the device enables undesired manipulations of the device. As a result of this, the device can lose its measuring properties and become unusable.

- Ensure that the device is located in a protected area to which only authorized persons have access.
- If no settings need be carried out, lock the device.

2.1.2 Information on industrial use

NOTICE

Use in home environment

This Class A Group 1 device according to CISPR 11 is intended for industrial use.

If used in homes, the device may cause radio interference.

NOTICE

Insufficient protection during storage

The packaging only provides limited protection against moisture and infiltration.

- Provide additional packaging as necessary.

WARNING

Incorrect disassembly

The following risks may result from incorrect disassembly:

- Injury through electric shock

- Risk through emerging media when connected to the process

- Risk of explosion in hazardous area

In order to disassemble correctly, observe the following:

- Before starting work, make sure that you have switched off all physical variables such as pressure, temperature, electricity etc. or that they have a harmless value.
- If the device contains hazardous media, it must be emptied prior to disassembly. Make sure that no environmentally hazardous media are released.
- Secure the remaining connections so that no damage can result if the process is started unintentionally.

2.2 Analyzers in biogas plants

⚠ DANGER

Danger of poisoning

This device is designed to measure hydrogen sulfide and dihydrogen sulfide, H_2S)!

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 H_2S 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 H_2S 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 H_2S 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.

2.3 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.

Description

3

3.1 Area of application

Overview

Up to 4 gas components can be measured continuously and simultaneously with the ULTRAMAT 23 gas analyzer. The device can be equipped with the following measurement modules:

- IR analyzer unit for IR-active gases
- UV module for UV-active gases
- H_2S sensor (electrochemical)
- O_2 sensor (electrochemical)
- O_2 sensor (paramagnetic)

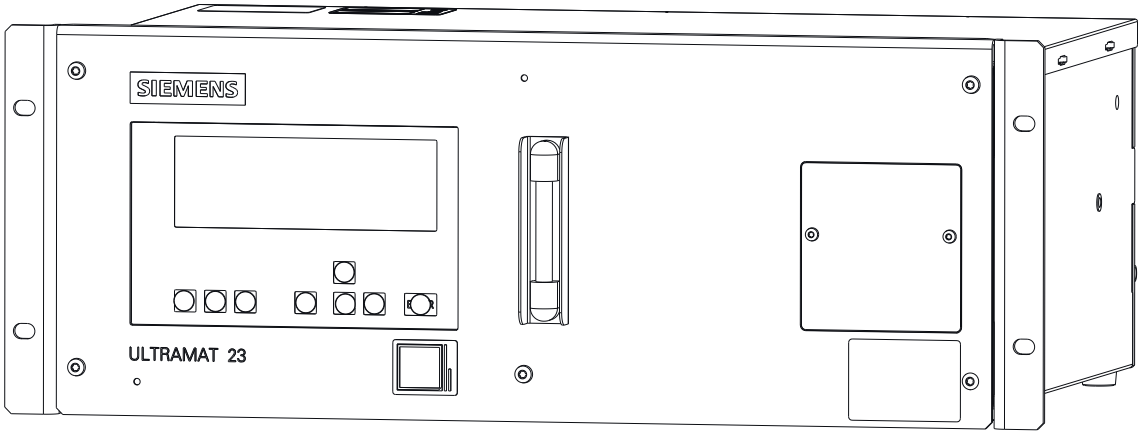


Figure 3-1 Front view ULTRAMAT 23 (example rack unit)

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
- Emissions from livestock facilities

Special versions

- The ULTRAMAT 23 with 2 IR components without pump is also available with two separate gas paths. This allows 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
- The ULTRAMAT 23 gas analyzer can be used in emission measuring systems and for process and safety monitoring.
- The devices of the 7MB2355, 7MB2357 and 7MB2358 series are part of a suitability-tested emission measuring system (CEMS - Continuous Emission Monitoring System) according to EN15267, which adjusts the sample gas to a constant dew point by means of a sample gas cooler.
  The device must be operated in a closed cabinet to counteract rapid and large temperature fluctuations.
  The components tested for suitability by TÜV Rheinland are CO, CO_2, NO, NO_2, SO_2 and O_2.
  The certificate covers applications according to the 13th BImSchV (German Federal Immission Protection Regulations), 17th BImSchV, 27th BImSchV and 44th BImSchV in accordance with the regulation TA Luft (for Germany) or IED and MCPD (for Europe).
- For devices with UV module (from revision state AC - see module label on UV module) and infrared component SO_2 with a minimum measuring range ≤ 400mg/m³, SO_2 drift compensation is factory activated via the switched-on AUTOCAL cycle time (≥ 6h).
- The current certificates and approvals can be found on the Internet at: Approvals and certificates (https://support.industry.siemens.com/cs/de/en/ps/17728)

- Version with faster response time:
  There is no connection between the two condensation traps, so that the complete sample gas flow passes through the analyzer chambers (only 1/3 of the flow in the standard version of the analyzers), i.e. the response time is 2/3 faster. The functions of all other components remain unchanged. Any condensate that forms cannot be removed with this device version.
- 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 UV absorption photometer for small SO_2 measuring ranges and NO_2 measurements

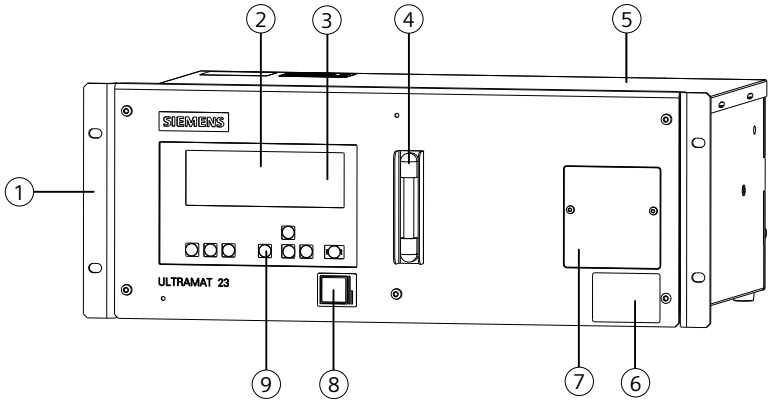
Benefits

- AUTOCAL can be carried out with ambient air (zero-point calibration for the IR and UV components and full-scale calibration as well as calibration point for oxygen sensors) and is therefore highly cost effective as no calibration gases and accessories are required
- Monitoring of the flow rate using a pressure switch, alarm when the flow rate falls below the nominal flow rate
- High selectivity thanks to multi-layer IR detectors,
  low cross-sensitivity to water vapor
- Sample chambers can be cleaned (for analysis chamber lengths of 20mm and more), 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 H_2S
- Long service life of the H_2S sensor even at increased concentrations;
  no diluting or backflushing necessary

3.2 Design



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 sample gas flow monitoring
⑤ Gas and electrical connections at the rear
⑥ Warning label
⑦ O_2 sensor (option) can be removed from the front after the cover has been taken off
⑧ Machine-readable product designation
⑨ Control and function keys for operation

Figure 3-2 Design of ULTRAMAT 23 as 19" rack unit

The ULTRAMAT 23 is also available as a bench-top unit. This version differs from the rack unit shown here as follows:

- Closed housing without mounting bracket.
- 2 handles on the sides.
- The bench-top unit is not available with Ex approval.
- Condensation trap with safety filter.

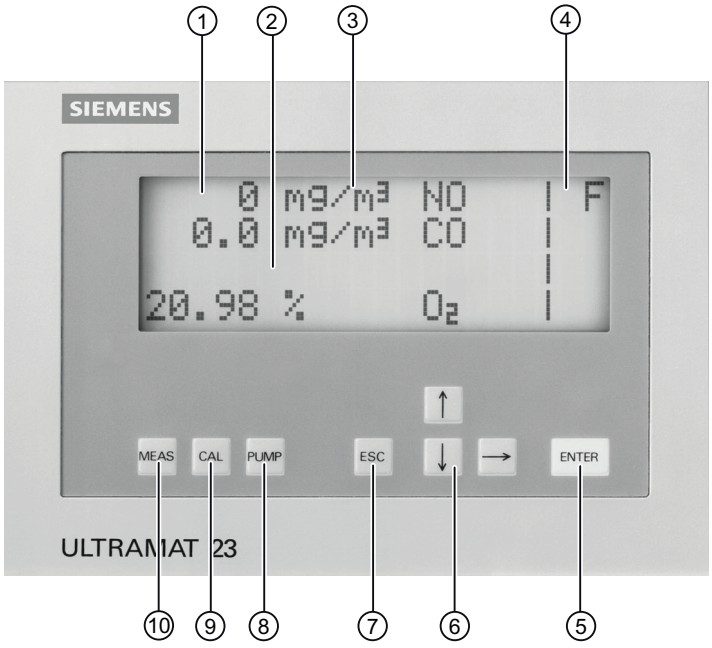
Enclosure

- 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 and not in combination with the UV module).
- 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.
- Piped gas paths not possible in combination with the UV module, electrochemical and paramagnetic oxygen sensor und H_2S sensor.

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.



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.

Figure 3-3 Operator panel of the ULTRAMAT 23

Note

Energy saving

Display brightness is reduced after approx. 30 minutes of inactivity. 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.

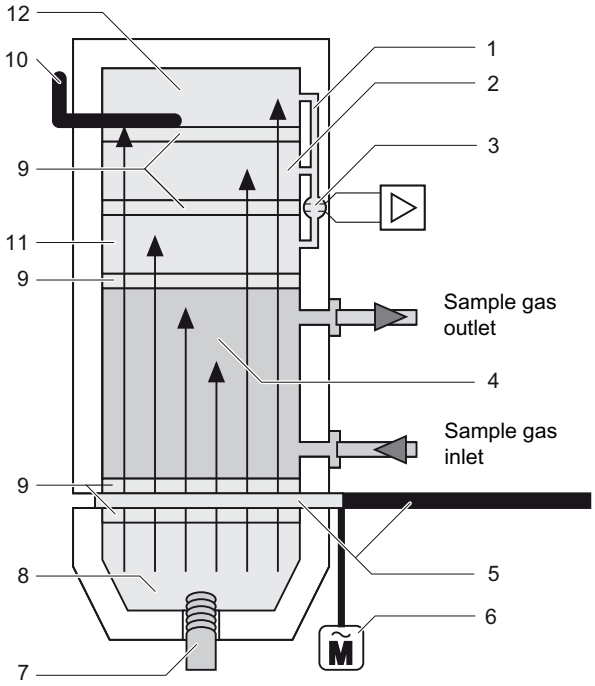
Options:

- 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, also applicable for continuous digital data acquisition

3.3 Function

Several independent measuring principles which work selectively may be present in the ULTRAMAT 23. These are described below.

Infrared measurement



1	Capillary	7	Infrared source
2	Second detector layer	8	Reflector
3	Microflow sensor	9	Window
4	Analyzer chamber	10	Slide
5	Chopper wheel	11	First detector layer
6	Synchronous motor	12	Third detector layer (only for some versions)

Figure 3-4 Operating principle of infrared measurement

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 ingress of the IR radiation in 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.

Note

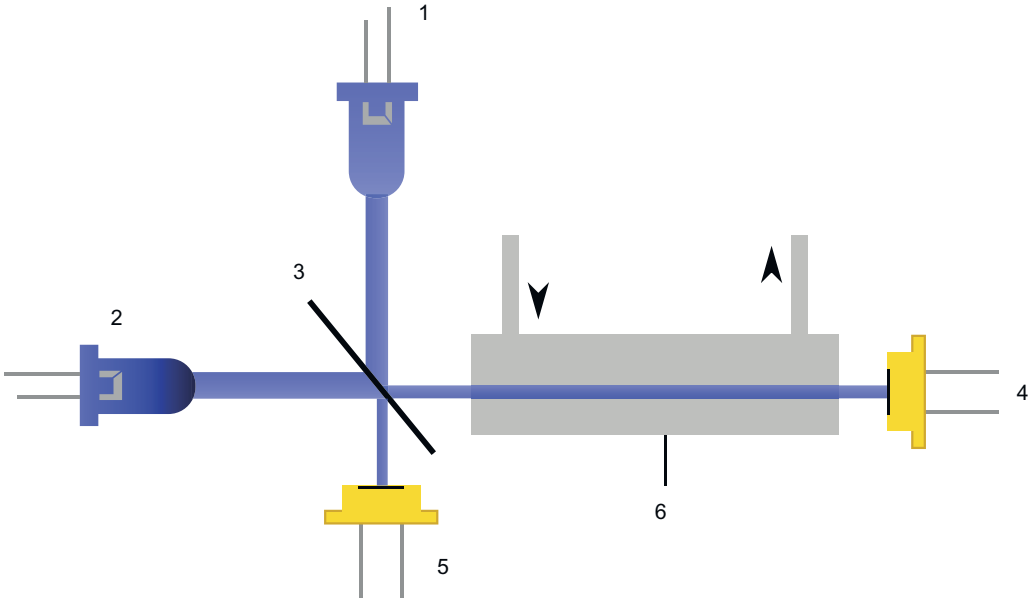
Contamination of the analyzer chambers

The sample gases fed to the analyzers must be 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.

Device versions with a certificate for emission measurements have a calculated drift compensation activated for the SO_2 component if the cycle time during AUTOCAL is set to ≥ 6 hours. The drift compensation is only active after 3 AUTOCAL cycles.

Ultraviolet measurement



1	SO_2 LED	4	Measuring channel photodiode
2	NO_2 LED	5	Reference channel photodiode
3	Beam splitter	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 two light-emitting diodes (LEDs) based on AlGaN or InGaN semiconductors (1). The two light sources are operated in alternating cycles for signal evaluation.

The ultraviolet radiation is collimated by one lens each and first passes through a beam splitter (3), which generates two ray bundles of the same intensity (measuring and reference radiation). The measuring ray bundle passes through the sample chamber (6), 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) after passing through the sample chamber into which sample gas is flowing (measured signal). Likewise, the reference radiation is recorded by a second photodiode (5, reference signal). The ratio of measured signal and reference signal is used to calculate the concentration of the gas component.

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

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 to a constant temperature of 57 °C (135°F).

Note

Falsification of measuring results

The signal strength of the measuring channel and reference channel must be recorded with zero gas (i.e. ambient air) before the measurements. This zero gas measurement can be repeated in the specified cycle to compensate for a continuously progressing measurement drift (activation takes place via the cyclic AUTOCAL function). Devices with a certificate for emission measurements have a calculated drift compensation activated for the SO_2 component if the cycle time during AUTOCAL is set to ≥ 6 hours. The drift compensation is only active after 3 AUTOCAL cycles.

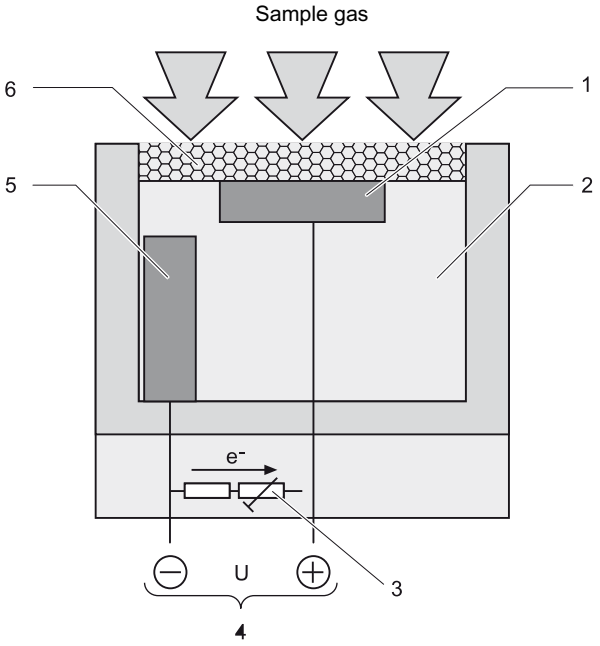
To ensure compliance with the technical specifications, a cycle time of ≤ 24 hours must be activated for the AUTOCAL. The technical specifications are based on a sample gas pressure of 1013 hPa absolute, sample gas flow of 1.2 l/min and an ambient temperature of 25 °C.

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 UV module, 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



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

Figure 3-5 Operating principle of the electrochemical O_2 sensor

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

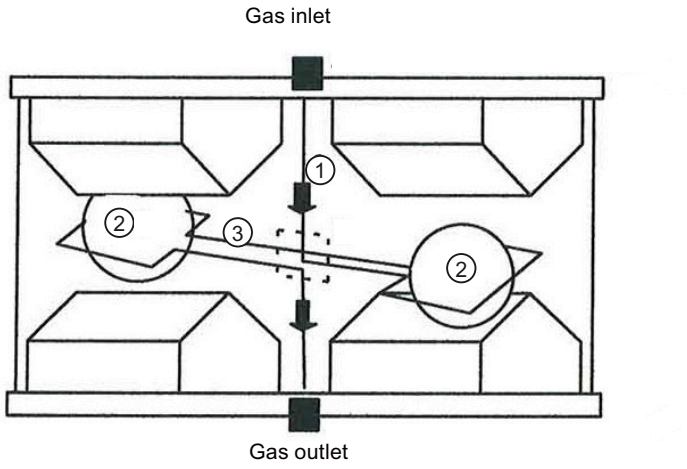


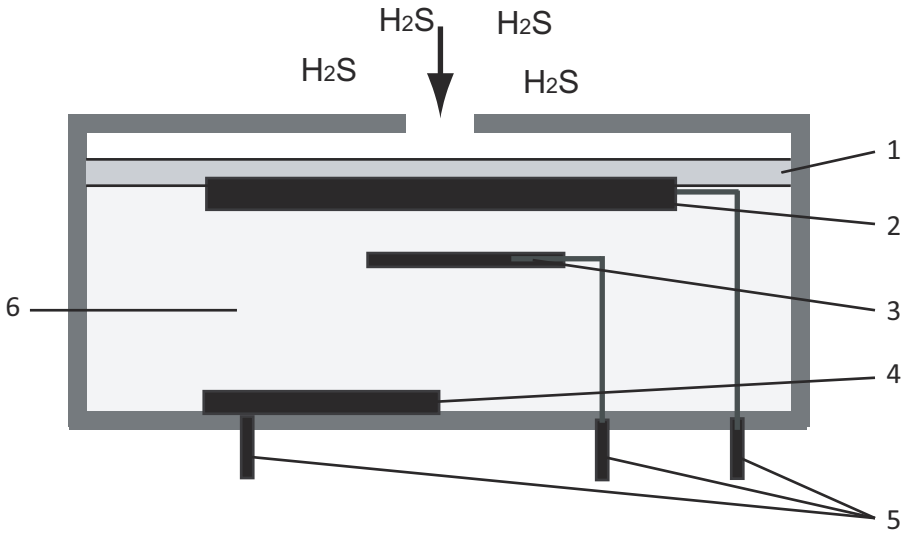
Figure 3-6 Operating principle of the paramagnetic O_2 sensor

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 O_2 sensor). In order to comply with the technical data, the zero point of the paramagnetic measuring cell must be calibrated with nitrogen weekly in the case of all measuring ranges < 5% or every two months in the case of all larger measuring ranges.

Electrochemical hydrogen sulfide measurement



1	Gas membrane	4	Counter electrode
2	Working electrode	5	Terminal posts
3	Reference electrode	6	Electrolyte (H_2SO_4)

Figure 3-7 Operating principle of H_2S sensor

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 or nitrogen (AUTOCAL)

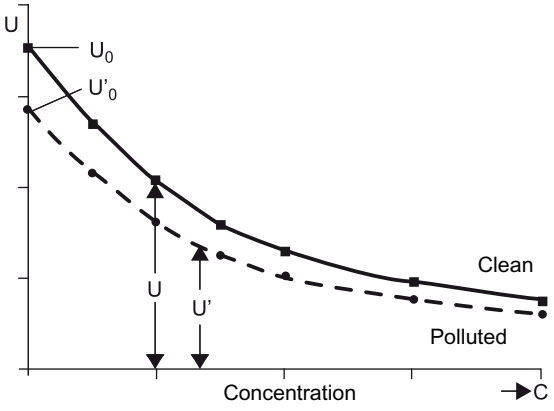


Figure 3-8 Calibration with air

The ULTRAMAT 23 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 ULTRAMAT 23, the mathematical relationship between the concentration of the measured component and the measured voltage can be approximately expressed as the following exponential function:

$U = U_0 \cdot e^{-kc}$ 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 ULTRAMAT 23 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 or windows 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.

If an electrochemical O_2 sensor is installed, air or synthetic air must be used 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 O_2 sensor is carried out simultaneously. The characteristic of the O_2 sensor is sufficiently stable following the single-point calibration such that the zero point of the electrochemical O_2 sensor need only be checked once a year by connecting nitrogen.

3.4 Technical specifications

3.4.1 General technical data

General information	
Measured components	Maximum of 4
Measuring ranges	2 per component, freely adjustable between smallest and largest measuring range
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
Warm-up phase (function check activated)	30 minutes if no UV module is installed 60 minutes if UV module is installed

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 7MB235x (TÜV) IP20 in accordance with EN 60529 for the versions 7MB233x (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	100 V AC, +10%/-15%, 50 Hz, 120 V AC, +10%/-15%, 50 Hz, 200 V AC, +10%/-15%, 50 Hz, 230 V AC, +10%/-15%, 50 Hz, 100 V AC, +10%/-15%, 60 Hz, 120 V AC, +10%/-15%, 60 Hz, 230 V AC, +10%/-15%, 60 Hz
Power consumption	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	3, dimensioned for 24 V, floating • Pump • AUTOCAL • Synchronization
Serial interface	ELAN (RS485), PROFIBUS-PA/DP as option
AUTOCAL function	Automatic calibration (adjustment) of all channels with ambient air (in case oxygen is present as measured component) or nitrogen (depending on measured component), adjustable cycle time from 1 ... 24 hours. If 0 hours is entered, the cycle is deactivated. AUTOCAL cycle must be activated for certified emission measurements
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	
• During operation	+5 ... +45 °C (+41 ... +113 °F) (limited when used with H_2S sensor, cf. Hydrogen sulfide sensor (Page 42))
• During transportation and storage	-20 °C ... + 60 °C (-4 ... +140 °F)
Permissible ambient humidity	< 90% RH (relative humidity) during transportation and storage (Delivery information (Page 12))
Permissible ambient pressure	600 ... 1200 hPa (absolute)
Maximum operating altitude	2000 m above sea level
Pollution degree	2

Gas inlet conditions	
Sample gas pressure	
• Without pump	before device: On the inlet side, the overpressure of the gas with respect to ambient pressure must not exceed 45 hPa. after device: On the outlet side, the gas outlet must be depressurized against ambient pressure.
• With pump	before device: Depressurized suction mode after device: On the outlet side, the gas outlet must be depressurized against ambient pressure.
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

Note

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

See also

IR analyzer unit (Page 36)

UV module (Page 38)

WARNING

Operation of analyzers in hazardous areas

For safe operation of the analyzer in hazardous areas, it is essential to observe the information and conditions referred to in the "ATEX compact operating instructions for ULTRAMAT 23".

3.4.2 IR analyzer unit

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	
Measured components	Maximum of 3
Measuring ranges	See ordering data
Display resolution	Dependent on the selected measuring range
Chopper compartment purging	
• Inlet pressure	Approx. 3000 hPa (43.5 psi) absolute
• Purging gas consumption	Approx. 100 ml/min

Time response	
Stabilization phase	After the warm-up phase, depending on the measured component and measuring range, up to 5 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, adjustable

Measuring behavior at analog output	
Output signal noise	<1% of current measuring range (or smallest possible measuring range according to nameplate)
Output signal resolution	< 0.1% of the output signal span
Linearity error	In the largest measuring range: < ±1% of the full scale value In the smallest measuring range: < 2% of the full scale value
Repeatability	≤ 1% of the current measuring range

Climatic conditions (restrictions)	
Permissible ambient humidity	
• During operation	30% ... 85% RH (relative humidity); influence on measurement of SO_2 and NO exists

Influencing variables	
	Note: After longer periods of storage or transport, the device should be switched on for 48 hours to meet the drift specification.
Drift	At an ambient temperature of 25 ±2 °C
• AUTOCAL cycle activated	Drift with 24 h Autocal <3% based on the smallest measuring range according to the nameplate
• AUTOCAL cycle deactivated	Drift <3% based on the smallest measuring range according to the nameplate per 24 h
Temperature	Max. 2% of the smallest 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 ±10%
Line frequency	±2% of full-scale value with a frequency variation of ±5%

Limitations of the measuring range 0 ... 200 mg/m³ SO_2 (analyzer versions 7MB2335-xNBxx-xAAx, 7MB2337-xNBxx, 7MB2337-xxxxx-xNBx, 7MB2338-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.

Note

Device series 7MB235x

- Maintenance intervals: Refer to the current certificates in accordance with EN 15267.
- The current certificates can always be found on the Internet at: Approvals and certificates (https://support.industry.siemens.com/cs/de/en/ps/17728)

3.4.3 UV module

To ensure compliance with the technical specifications, a cycle time of ≤ 24 hours must be activated for the AUTOCAL.

Measuring ranges	
SO_2	
• Smallest measuring range	0 ... 50 mg/m³ (70 mg/m³ certified according to EN15267)
• Largest measuring range	0 ... 1250 mg/m³
NO_2	
• Smallest measuring range	0 ... 50 mg/m³
• Largest measuring range	0 ... 1000 mg/m³
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	
Stabilization phase	After the warm-up phase, at least 3 hours. After longer periods of storage or transport, the device should be switched on for 48 hours to meet the drift specification.
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 and NO_2 are highly soluble in water! ≤ 30 s after sample gas input at a damping of ≤ 12 s
Damping (electronic time constant)	0 ... 99.9 s, adjustable

Measuring behavior at analog output	
Output signal noise	≤ 1% of set full-scale value (or smallest possible measuring range according to nameplate)
Detection limit	
• SO_2	0.25 mg/m³
• NO_2	0.5 mg/m³
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 (restrictions)	
Permissible ambient humidity	30 ... 85% RH (relative humidity) during operation

Influencing variables	
Temperature error	≤ 3% of smallest full-scale value/10 K in ambient temperature range of 5 °C ... 45 °C (34 ... 113°F) **Note** Significant temperature changes can cause a drift in the SO_2 component, which is only compensated for in the AUTOCAL cycle (≥ 6 h).
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%
	Note After longer periods of storage or transport, the device should be switched on for 48 hours to meet the drift specification.
Drift	At an ambient temperature of 25 ±2 °C
• AUTOCAL cycle activated	Drift with 24 h Autocal <3% based on the smallest measuring range according to the nameplate
• AUTOCAL cycle deactivated	Drift <3% based on the smallest measuring range according to the nameplate per 24 h
Accompanying gases	
• Humidity up to 20 °C dew point	Negligible
• CO_2 ≤ 16 vol%	Negligible
• Exclusions	• Other sulfur compounds than SO_2 • Halogen compounds • Chlorine • Acetone • Ozone In case of doubt, please contact: Support Request (https://support.industry.siemens.com/My/ww/en/requests#createRequest)

3.4.4 Electrochemical oxygen sensor

To comply with the technical data, Autocal must be activated and the cycle time must be ≤ 24 hours. Autocal must be performed with ambient or synthetic air.

General	
Measuring ranges	0 ... 5 vol% to 0 ... 25 vol% O_2, parameterizable
Associated gases	The oxygen sensor must not be used if the associated gas contains the following components: • Chlorine or fluorine compounds • Heavy metals • Aerosols • Mercaptans • Alkaline components (e.g. NH_3 in vol% range)
Service life	Approx. 2 years with 21 Vol. % O_2

Time response	
Response time (T_{90} time)	Dependent on dead time, IR and UV measured components, measuring ranges and configurable damping, <30 s at approximately 1.2 l/min sample gas flow

Measuring behavior at analog output	
Output signal noise	< 0.5 vol% of the full-scale value
Display resolution	< 0.2 vol% of the full-scale value
Output signal resolution	< 0.2 vol% of the output signal span
Repeatability	≤0.05 vol% O_2

Influencing variables	
Oxygen content	In the case of occasional operation < 1 vol% O_2, the measuring accuracy below 1 vol% O_2 is limited. An improvement in the measuring accuracy at concentrations <1 vol% O_2 is possible under the following conditions: • Permanent measurement of concentrations <1 vol% • 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 vol% O_2
Humidity	H_2O dew point ≥ 2 °C (36 °F); the oxygen sensor must not be used with dry sample gases (no condensation)
Drift	At an ambient temperature of 25 ±2 °C
• AUTOCAL cycle activated	Negligible
• AUTOCAL cycle deactivated	1 vol% O_2/year in air, typical
Temperature	<0.5 vol% O_2 per 20 K, relating to a measured value at 20 °C (68 °F)
Air pressure	< 0.2 vol% of measured value per 1% pressure change

3.4.5 Paramagnetic oxygen sensor

To comply with the technical data, Autocal must be activated and the cycle time must be ≤ 24 hours. AUTOCAL must be performed with ambient or synthetic air.

General information	
Measuring ranges	Quantity 2, Min. 0 ... 2 vol% O_2 (limited accuracy) Max. 0 ... 100 vol% O_2

Measuring behavior at analog output	
Response time (T_{90} time)	<60 s
Output signal noise	< 1% of smallest measuring range
Repeatability	≤ 1% of smallest measuring range

Influencing variables	
Interference gases	See table of cross-sensitivities
Zero point drift	Measuring range 2 vol%: max. 0.1 vol% with weekly zero-point calibration (with nitrogen)
End point drift	Measuring range 5 vol%: max. 0.1 vol% with weekly zero-point calibration (with nitrogen) Measuring range 25 vol% or greater: max. 0.5 vol% with monthly zero point calibration (with nitrogen) negligible
Temperature error	< 2%/10K based on the measuring range ≥ 5 vol% < 5%/10K based on the measuring range 2 vol% minimum 0.1 vol%/10K
Humidity error 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_2H_4O	- 0.31	- 0.34
Acetone	C_3H_6O	- 0.63	- 0.69
Acetylene, ethine	C_2H_2	- 0.26	- 0.28
Ammonia	NH_3	- 0.17	- 0.19
Argon	Ar	- 0.23	- 0.25
Benzene	C_6H_6	- 1.24	- 1.34
Bromine	Br_2	- 1.78	- 1.97
Butadiene	C_4H_6	- 0.85	- 0.93
n-butane	C_4H_{10}	- 1.10	- 1.22
Iso-butylene	C_4H_8	- 0.94	- 1.06
Chlorine	Cl_2	- 0.83	- 0.91
Diacetylene	C_4H_2	- 1.09	- 1.20
Dinitrogen monoxide	N_2O	- 0.20	- 0.22
Ethane	C_2H_6	- 0.43	- 0.47
Ethyl benzene	C_8H_{10}	- 1.89	- 2.08
Ethylene, ethene	C_2H_4	- 0.20	- 0.22
Ethylene glycol	$C_2H_6O_2$	- 0.78	- 0.88
Ethylene oxide	C_2H_4O	- 0.54	- 0.60

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
Furane	C_4H_4O	- 0.90	- 0.99
Helium	He	+ 0.29	+ 0.32
n-hexane	C_6H_{14}	- 1.78	- 1.97
Hydrogen chloride, hydrochloric acid	HCl	- 0.31	- 0.34
Hydrogen fluoride, hydrofluoric acid	HF	+ 0.12	+ 0.14
Carbon dioxide	CO_2	- 0.27	- 0.29
Carbon monoxide	CO	- 0.06	- 0.07
Krypton	Kr	- 0.49	- 0.54
Methane	CH_4	- 0.16	- 0.17
Methanol	CH_4O	- 0.27	- 0.31
Methylene chloride	CH_2Cl_2	- 1.00	- 1.10
Monosilane, silane	SiH_4	- 0.24	- 0.27
Neon	Ne	+ 0.16	+ 0.17
n-octane	C_8H_{18}	- 2.45	- 2.70
Phenol	C_6H_6O	- 1.40	- 1.54
Propane	C_3H_8	- 0.77	- 0.85
Propylene, propene	C_3H_6	- 0.57	- 0.62
Propylene chloride	C_3H_7Cl	- 1.42	- 1.44
Propylene oxide	C_3H_6O	- 0.90	- 1.00
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_2S	- 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_8H_8	- 1.63	- 1.80
Toluene	C_7H_8	- 1.57	- 1.73
Vinyl chloride	C_2H_3Cl	-0.68	- 0.74
Vinyl fluoride	C_2H_3F	- 0.49	- 0.54
Water (vapor)	H_2O	- 0.03	- 0.03
Hydrogen	H_2	+ 0.23	+ 0.26
Xenon	Xe	- 0.95	- 1.02

3.4.6 Hydrogen sulfide sensor

The cyclic Autocal must be switched on, see also Application notes for H2S measurements (Page 165).

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 ULTRAMAT 23
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	Cycle time: 1 hour (see Application notes for H2S measurements (Page 165))

Climatic conditions (restrictions)	
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

Influencing variables	
Accompanying gases	The hydrogen sulfide sensor cannot be used if the accompanying gas contains the following components: • Compounds containing chlorine • Compounds containing fluorine • Heavy metals • Aerosols • Alkaline components (e.g. NH_3 >5 mg/m³)
Interference gases	1360 vpm SO_2 result in a cross-interference of <20 vpm H_2S, 180 vpm NO result in a cross-interference of <150 vpm H_2S, no cross-interference of CH_4, CO_2 and H_2 (1000 vpm)
Drift	< 1% per month
Temperature	< 3%/10 K based on full-scale value
Air pressure	< 0.2 % of measured value per 1% pressure change

Measuring behavior at analog output	
Output signal noise	< 2% of smallest measuring range with a damping constant of 30 s

Note

Measuring ranges

The exact specification of the largest and smallest H_2S ranges can be found on the nameplate!

See also

General technical data (Page 34)

3.4.7 Parts in gas path wetted by sample gas

Gas path		19" rack unit
With hoses	Gas connections 6 mm	PA6 (polyamide)
	Gas connections ¼"	Stainless steel 1.4571
	Fine safety filter	Enclosure material: PA6 (polyamide) Filter material: Cellulose
	Hose	FKM
	Pressure switch	PTFE + PA6 (polyamide)
	Flowmeter	Borosilicate glass/steel 1.4878
	Elbows/T-pieces	POM
	Internal pump (optional)	PVDF/PTFE/FKM/HD-PE/ stainless steel 1.4571
	Solenoid valve (optional)	FKM/PA6/ stainless steel 1.4310/1.4305
	Safety condensation trap	PA66/NBR/PA6
	Analyzer chamber	
	● Body IR	Aluminum
	● Body UV	Aluminum
	● Lining	Pure aluminum (not with UV module)
	● Nozzle	Stainless steel 1.4571
	● Window IR	CaF_2
	● Window UV	Synthetic quartz glass
	● Adhesive	Epoxy resin-based adhesive
	● O-ring	FKM

Gas path		19" rack unit
Piped (only possible without pump)	Gas connections 6 mm/¼"	Stainless steel 1.4571
	Pipes	Stainless steel 1.4571
	Analyzer chamber (only IR)	
	● Body	Aluminum
	● Lining	Pure aluminum (not with UV module)
	● Nozzle	Stainless steel 1.4571
	● Window	CaF_2
	● Adhesive	Epoxy resin-based adhesive
	● O-ring	FKM
Bench-top unit (only IR + optionally available with ec O_2 versions)	Condensation trap at gas inlet	PA6 (polyamide)
	Condensation trap	PE (polyethylene)

3.5 Wiring diagrams

3.5.1 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 purging
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)
20 UV module

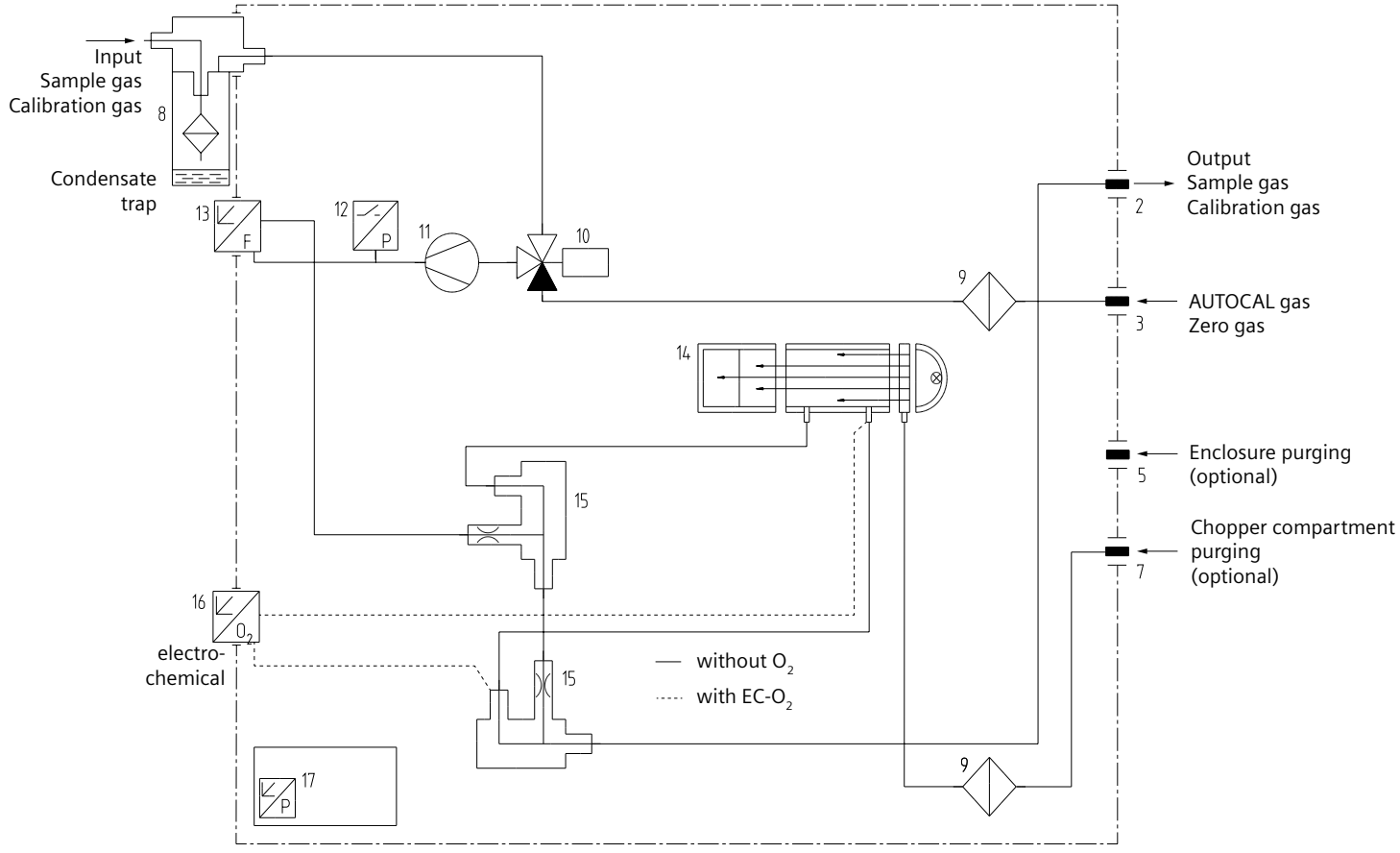


Figure 3-9 ULTRAMAT 23, bench-top unit with IR measured component, internal sample gas pump, condensation trap and fine safety filter on front plate; optional electrochemical oxygen sensor (optional)

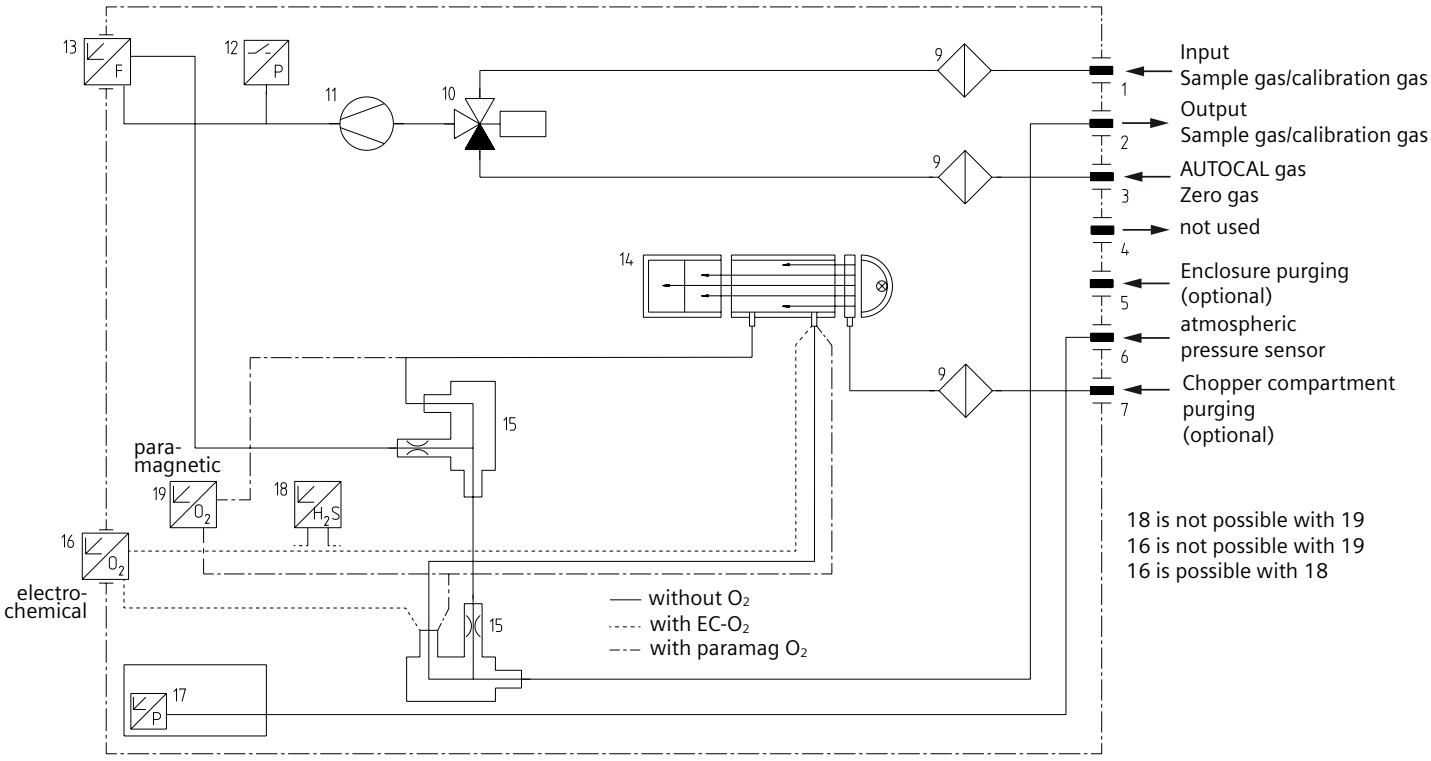


Figure 3-10 ULTRAMAT 23, 19" rack mount enclosure with IR measured component, internal sample gas pump, hydrogen sulfide sensor (optional), paramagnetic oxygen sensor (optional), electrochemical oxygen sensor (optional)

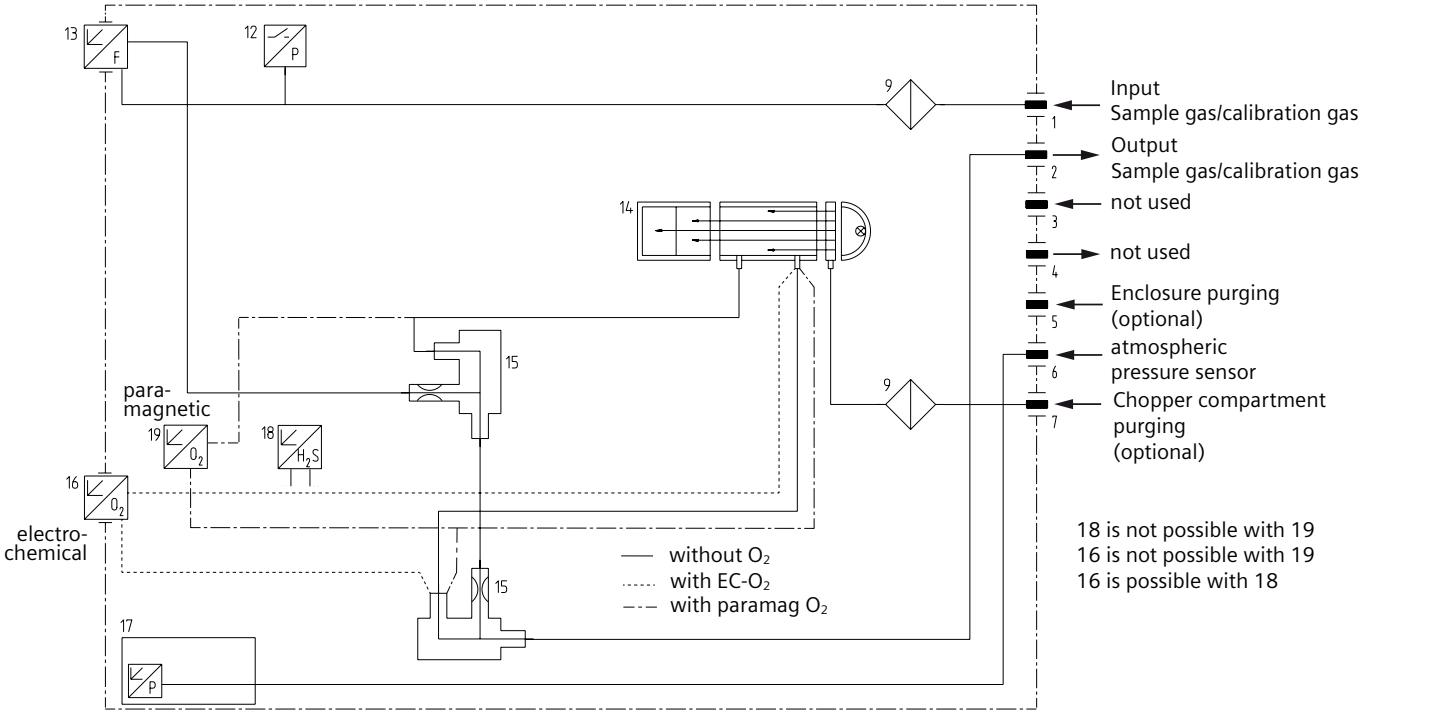


Figure 3-11 ULTRAMAT 23, 19" rack mount enclosure with IR measured component, without internal sample gas pump, hydrogen sulfide sensor (optional), paramagnetic oxygen sensor (optional), electrochemical oxygen sensor (optional)

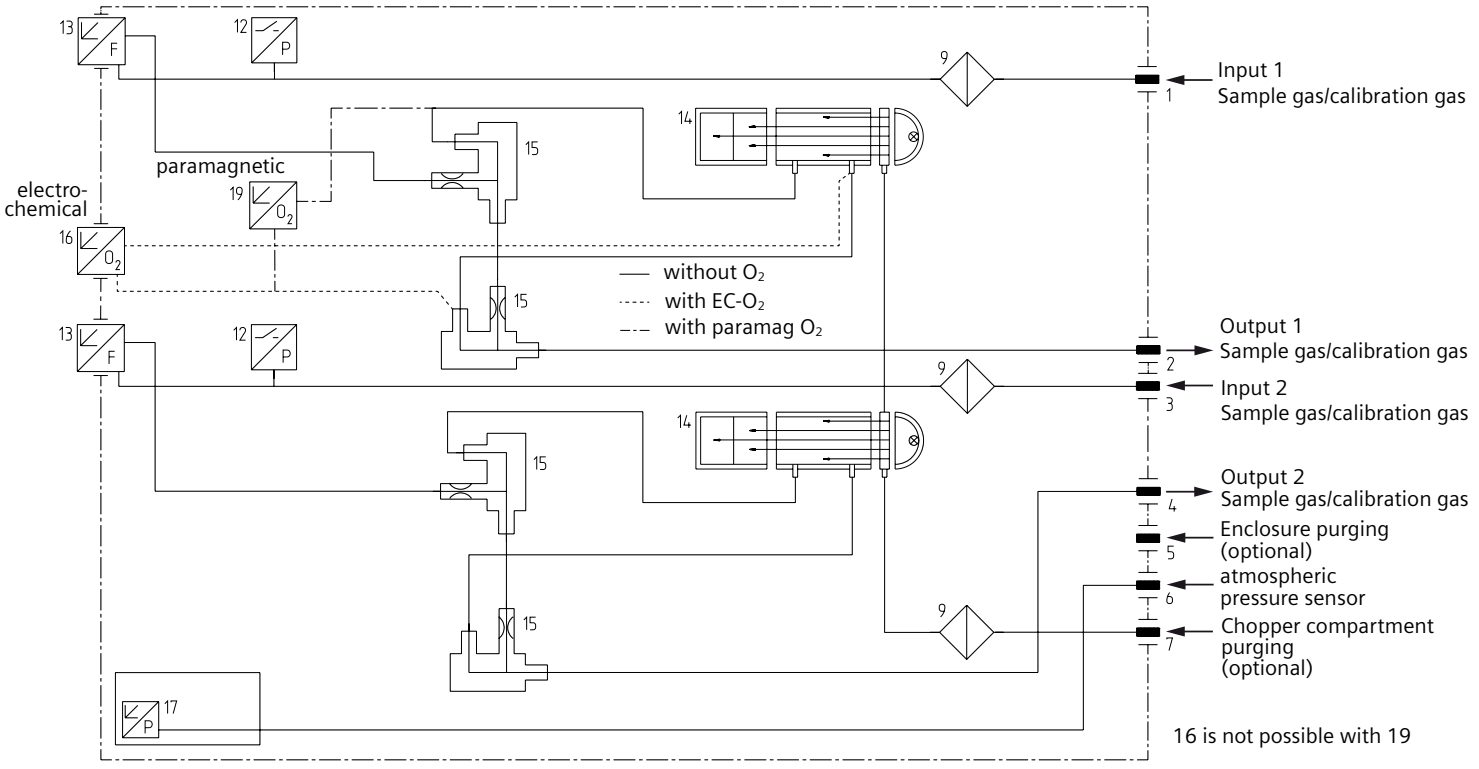


Figure 3-12 ULTRAMAT 23, 19" rack mount enclosure for multiple IR measured components, without internal sample gas pump, with separate gas path, paramagnetic oxygen sensor (optional), electrochemical oxygen sensor (optional)

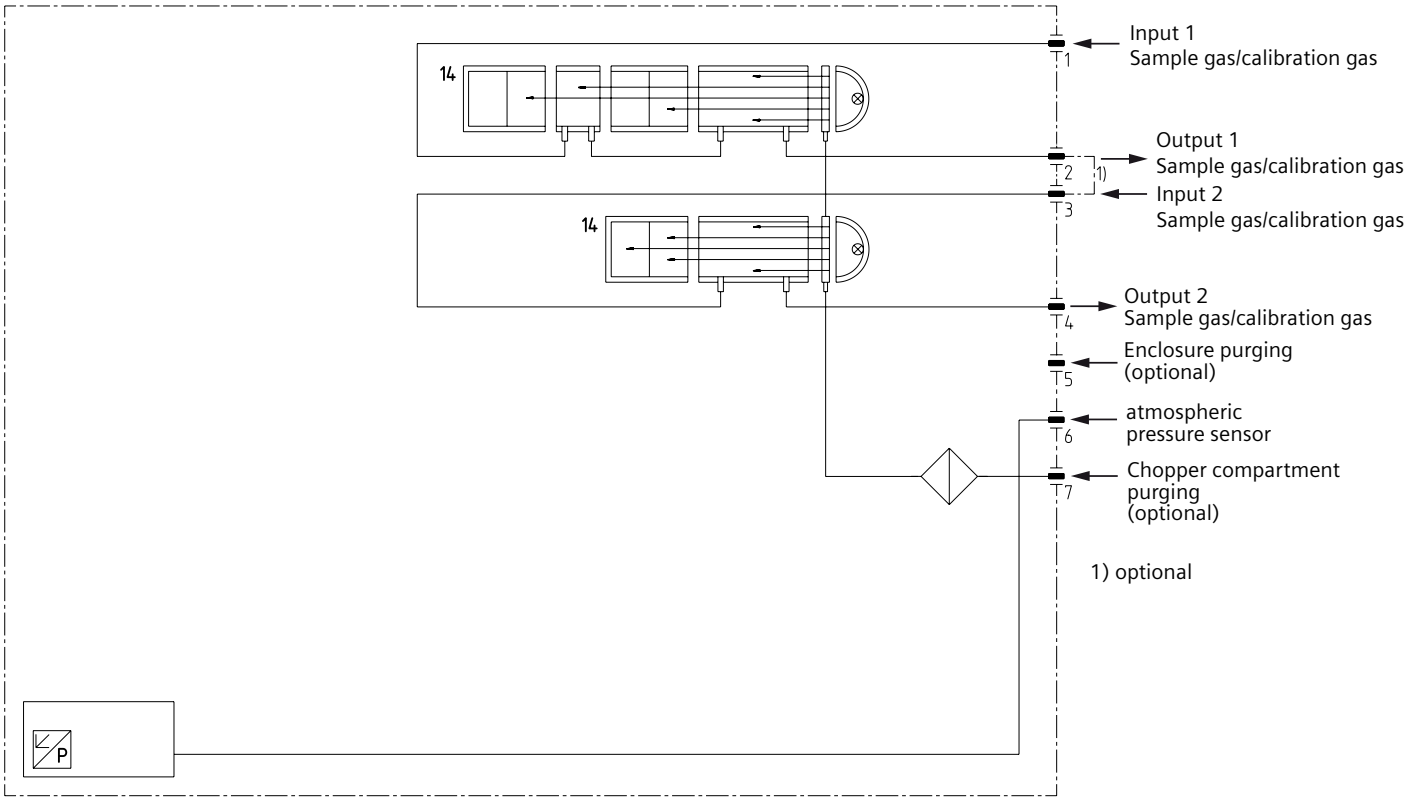


Figure 3-13 ULTRAMAT 23, 19" rack mount enclosure for multiple IR measured components, without internal sample gas pump; sample gas path in a pipe without safety filter or safety condensation trap, with separate gas path, non-separated gas path (optional)

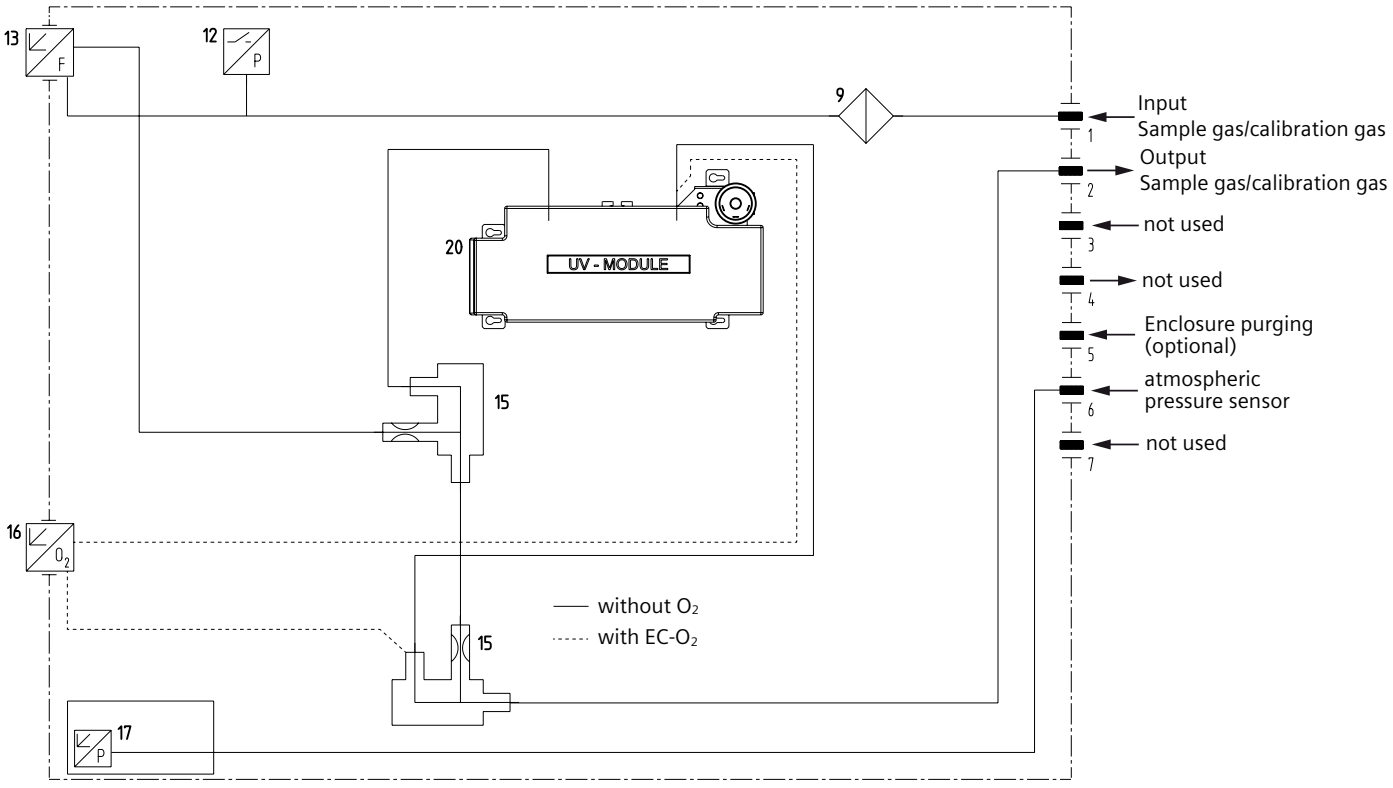


Figure 3-14 ULTRAMAT 23, 19" rack mount enclosure with UV module, electrochemical oxygen sensor (optional)

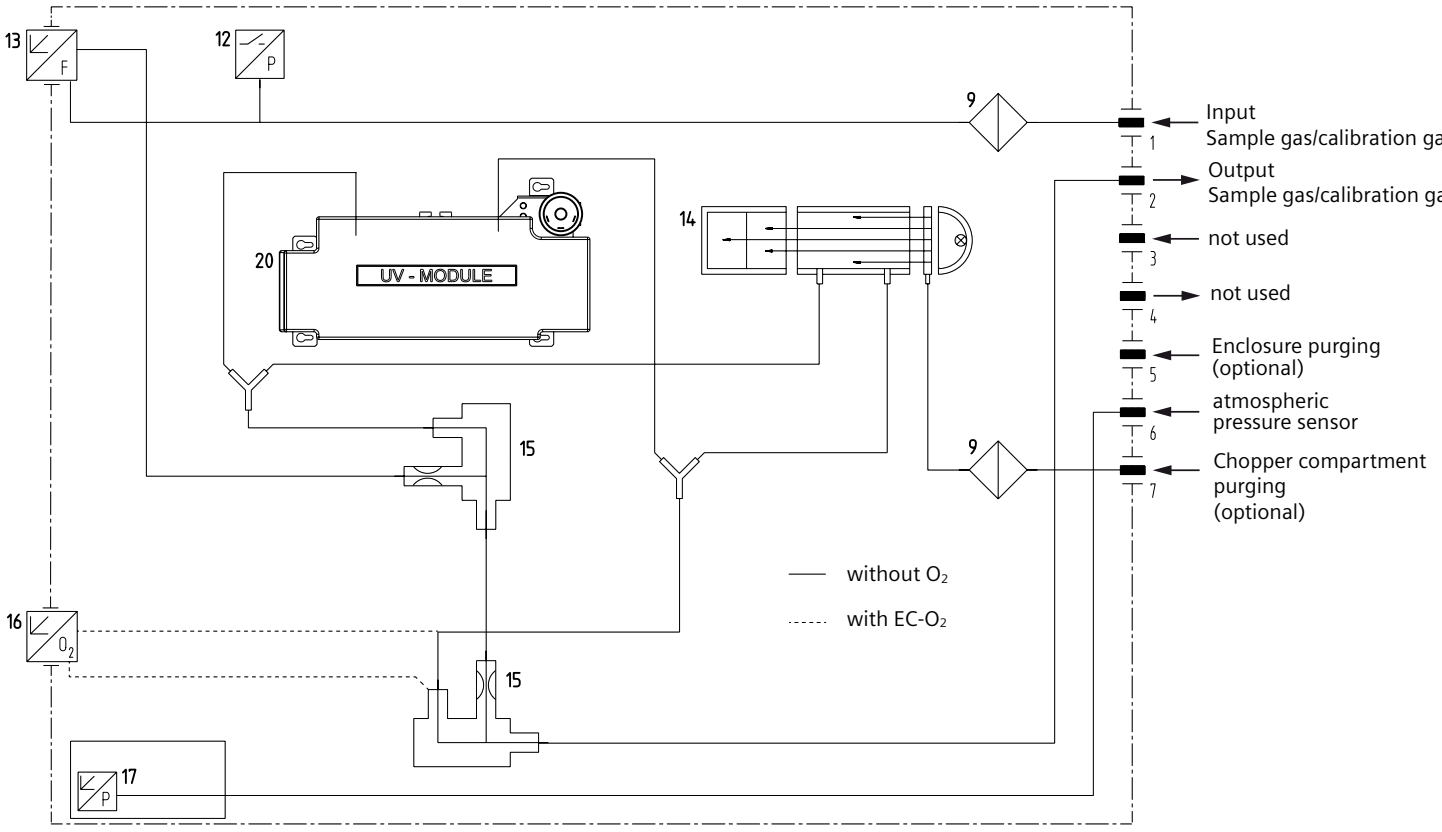


Figure 3-15 ULTRAMAT 23, 19" rack mount enclosure with IR measured component and UV module, electrochemical oxygen sensor (optional)

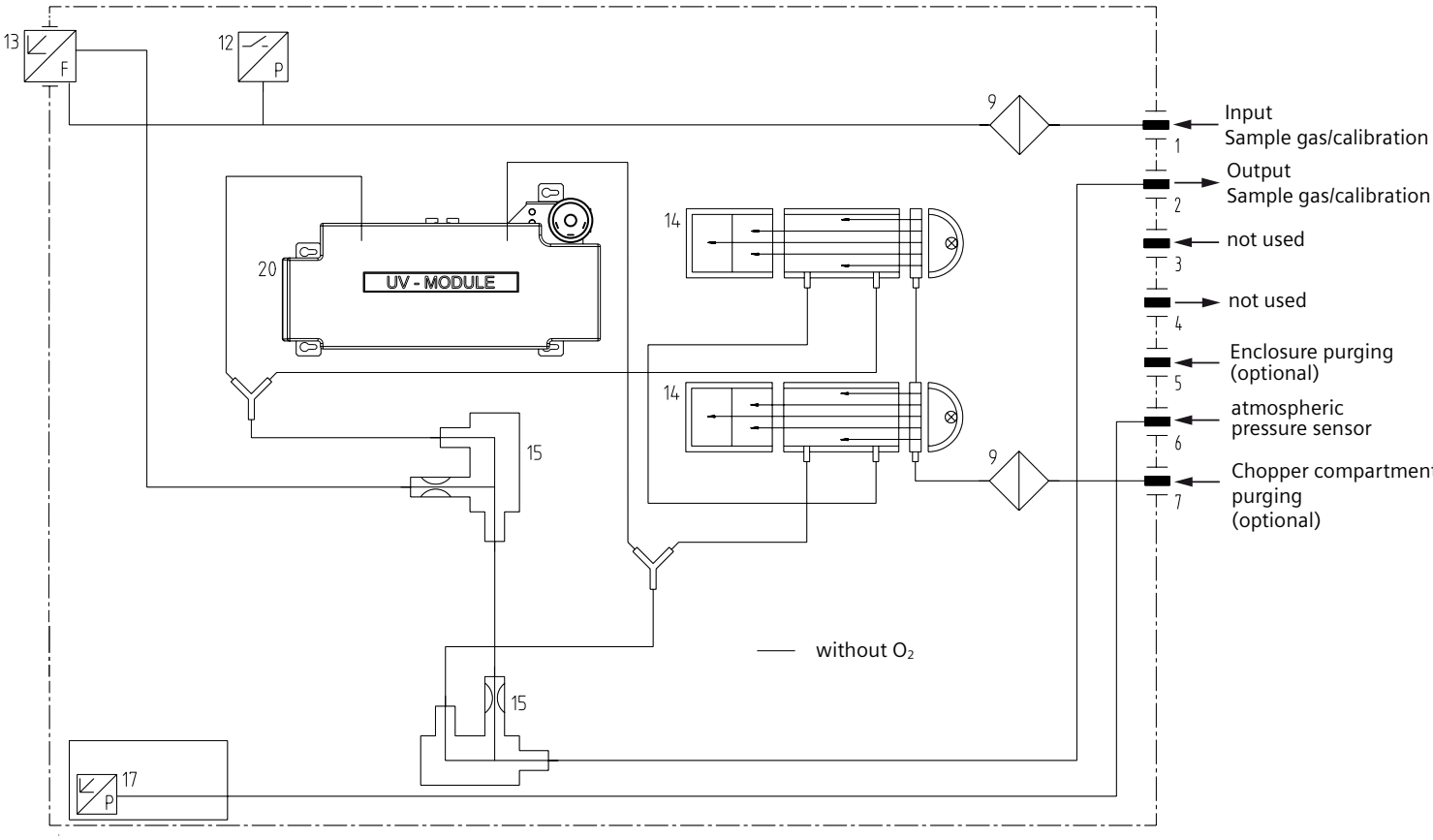
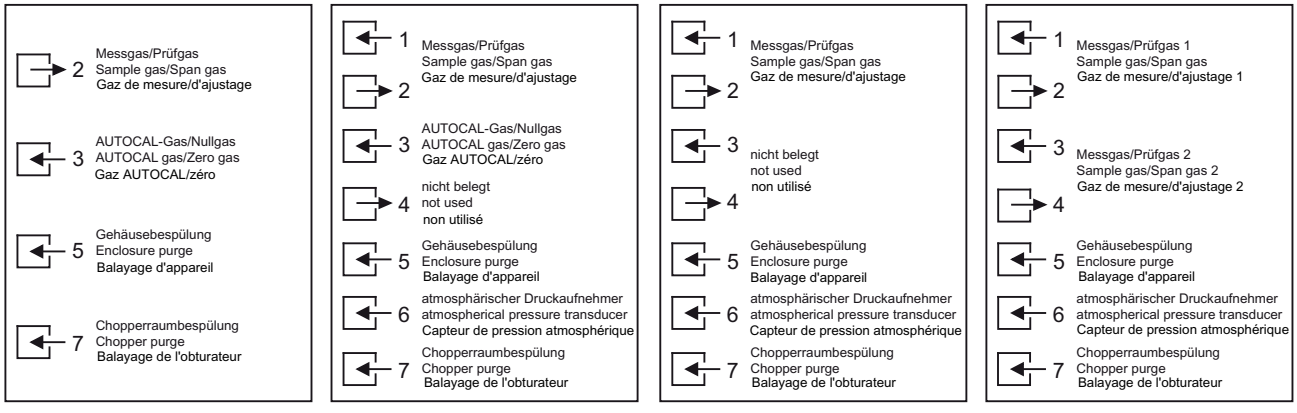


Figure 3-16 ULTRAMAT 23, 19" rack mount enclosure for multiple IR measured components and UV module

3.5.2 Gas connections



Symbols on ULTRAMAT 23 bench-top unit, in sheet-steel housing

Symbols on ULTRAMAT 23 19" rack unit, with sample gas pump

Symbols on ULTRAMAT 23 19" rack unit, without sample gas pump

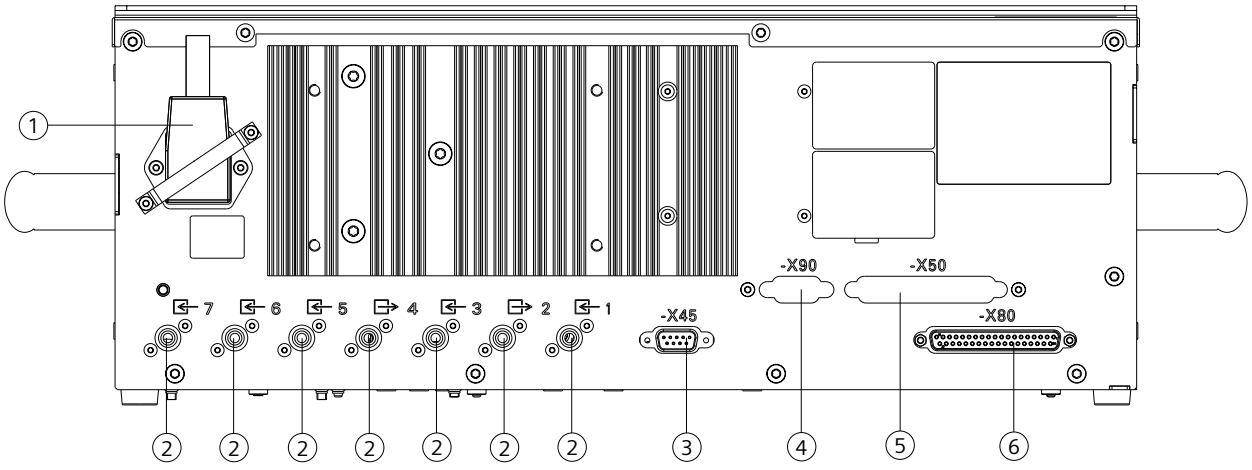
Symbols on ULTRAMAT 23 19" rack unit, with two separate gas paths and piped gas paths

Figure 3-17 Gas connections of ULTRAMAT 23 versions

The positions of the connections on the devices are shown in the connection diagrams in section Connection diagrams (Page 53).

3.5.3 Connection diagrams

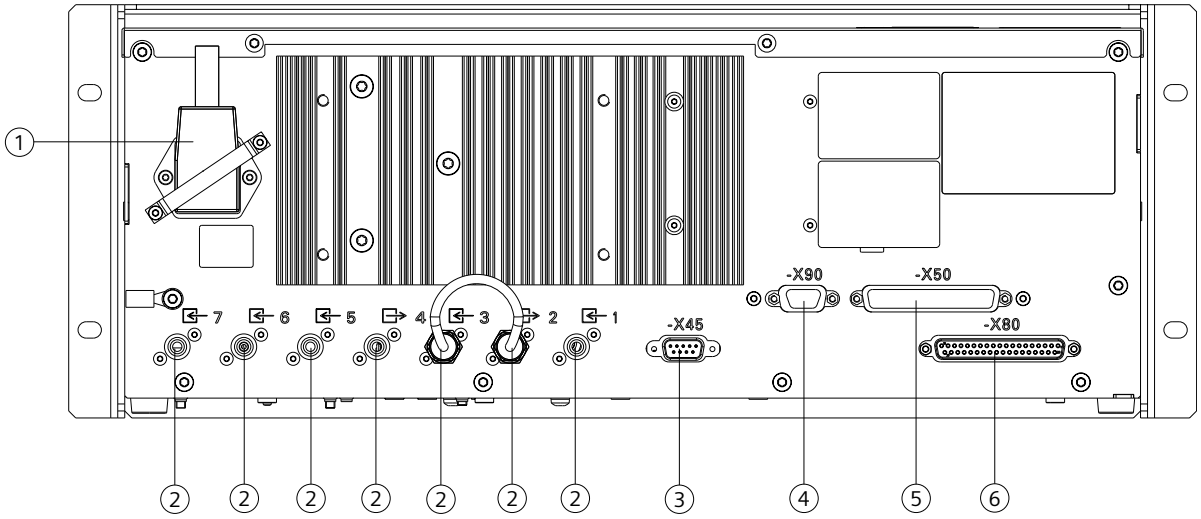
Bench-top unit



① Power connector
② Gas connections: 6 mm nozzles; see section Gas connections (Page 52)
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

Figure 3-18 Connections of bench-top unit

19" rack unit



① Auxiliary power and fine fuse
② Gas connections: 6 mm or 1/4" nozzle; see section Gas connections (Page 52)
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

Figure 3-19 Connections of rack device

3.5.4 Pin assignments

Pin assignments of the motherboard

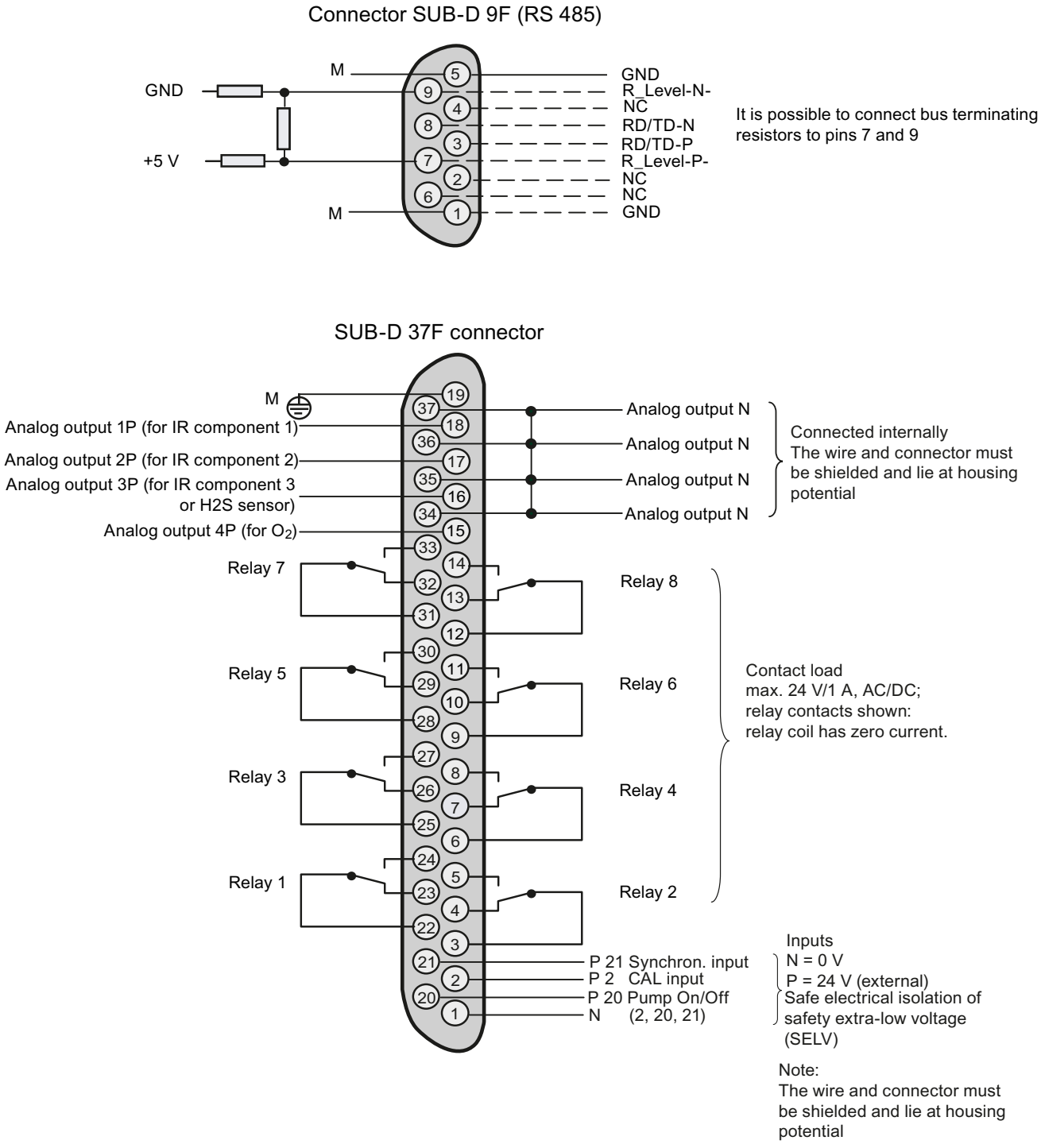


Figure 3-20 ULTRAMAT 23 motherboard

Add-on board

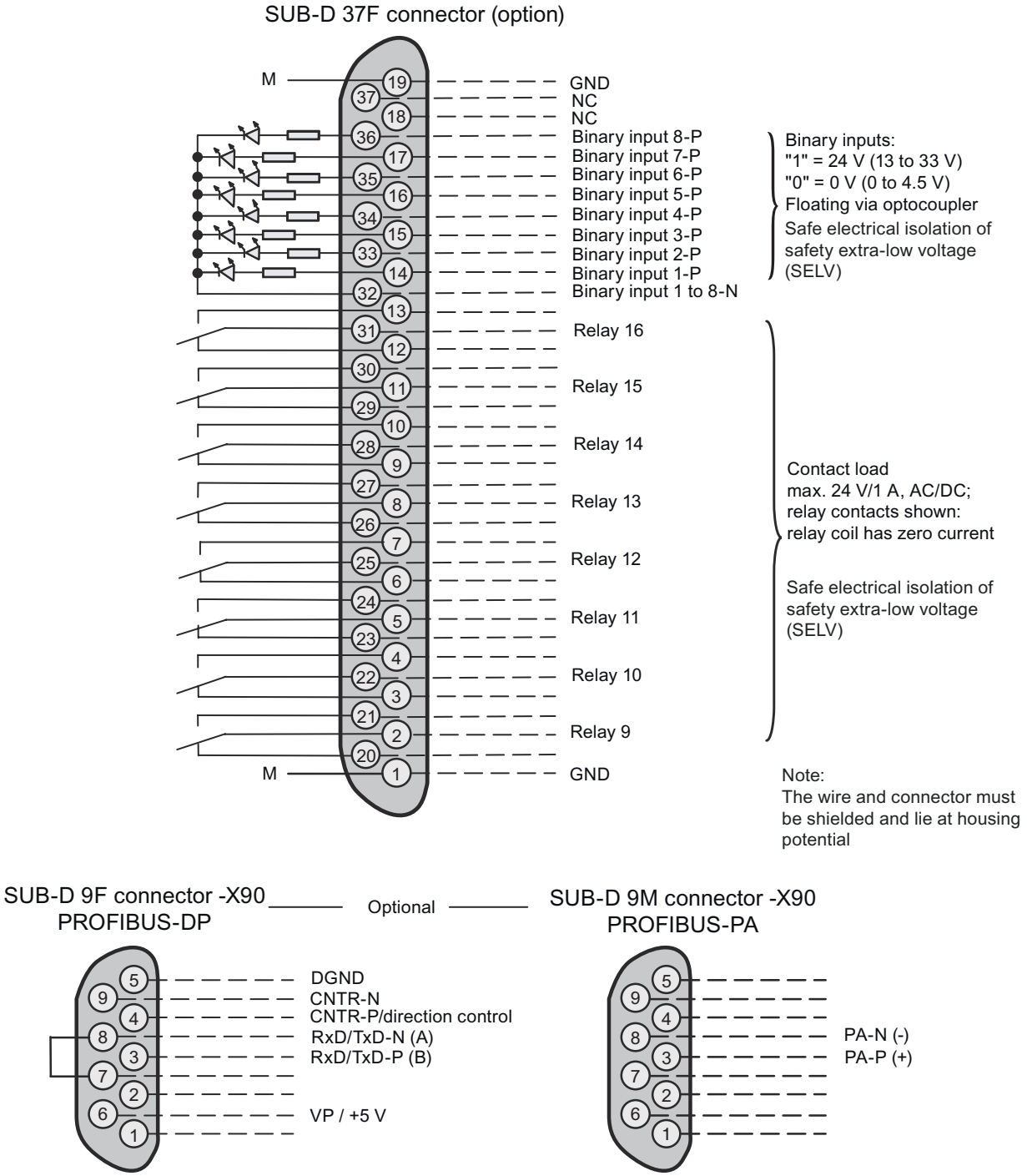


Figure 3-21 ULTRAMAT 23 add-on board

3.6 Dimensional drawings

Rack unit

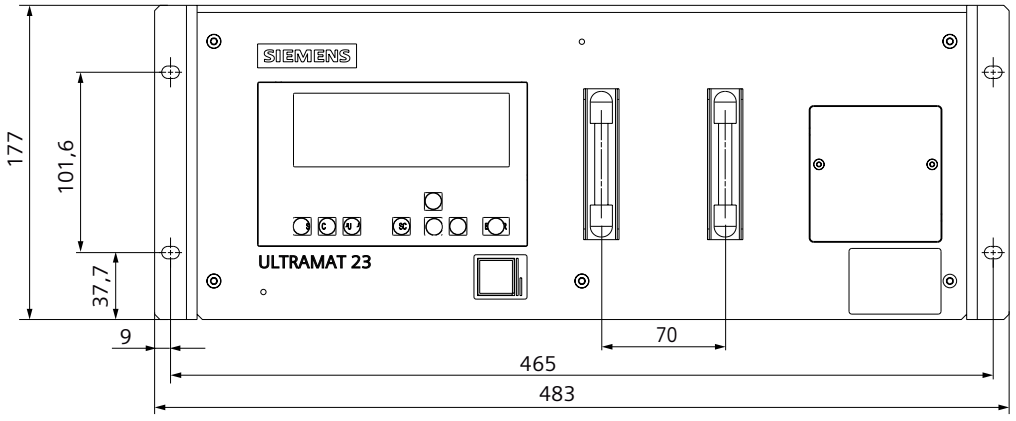


Figure 3-22 Dimension drawing rack unit - front view

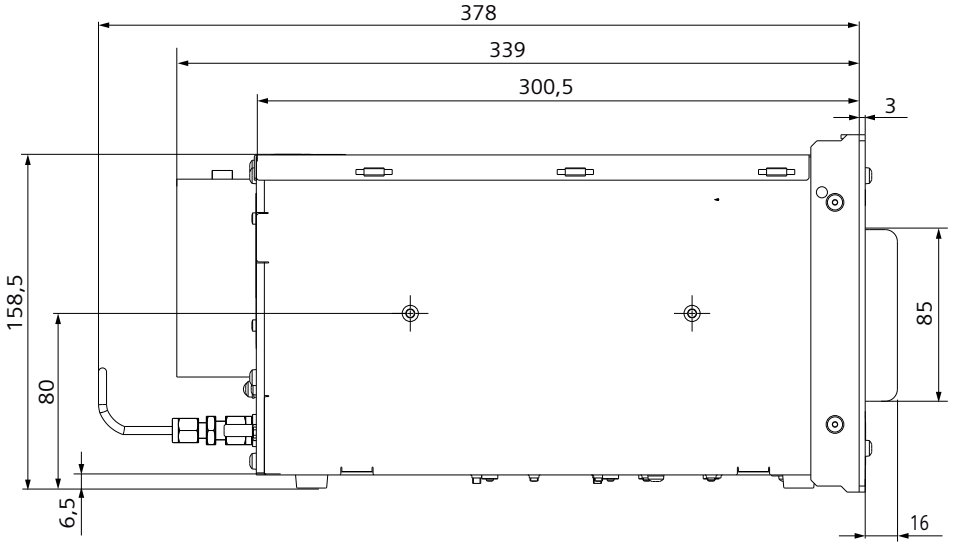


Figure 3-23 Dimension drawing rack unit - side view

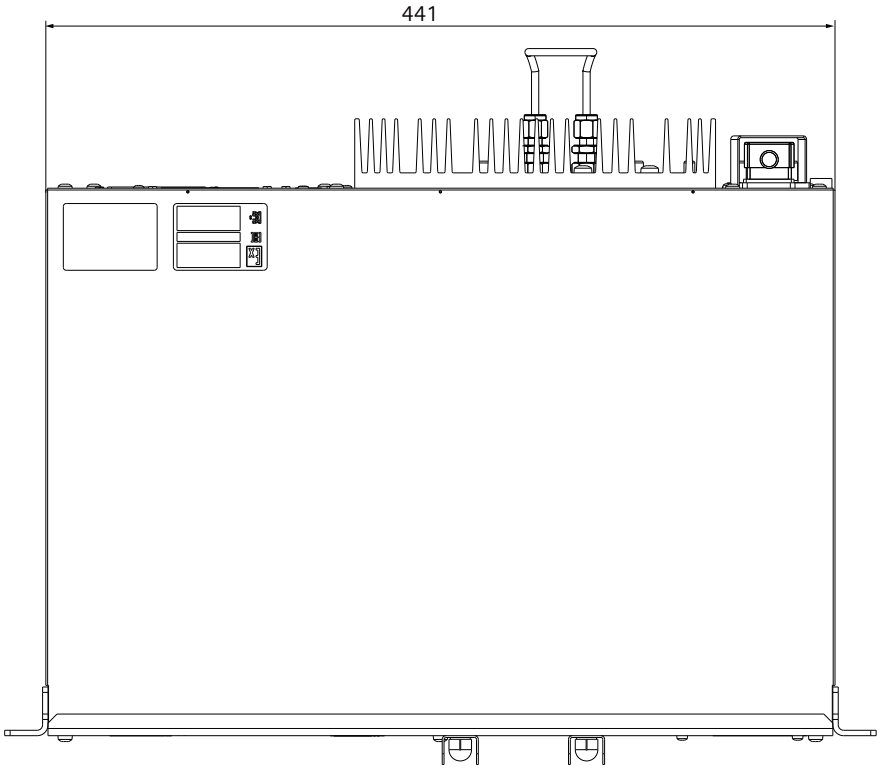
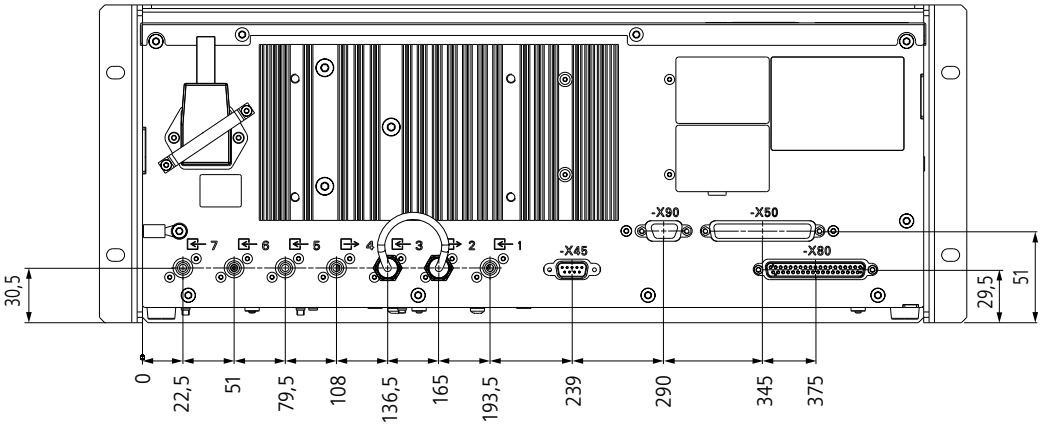


Figure 3-24 Dimension drawing rack unit - top view



Gas connections:	Pipe nozzle diameter 6 mm or 1/4"
Important:	When installing in a bench-top enclosure or cabinet, only mount analyzer on support rails.

Figure 3-25 Dimension drawing rack unit - rear view

Bench-top unit

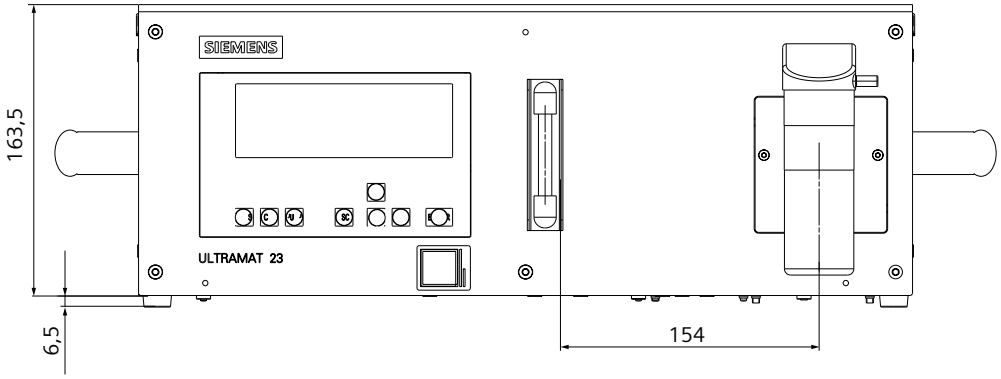


Figure 3-26 Dimension drawing bench-top unit - front view

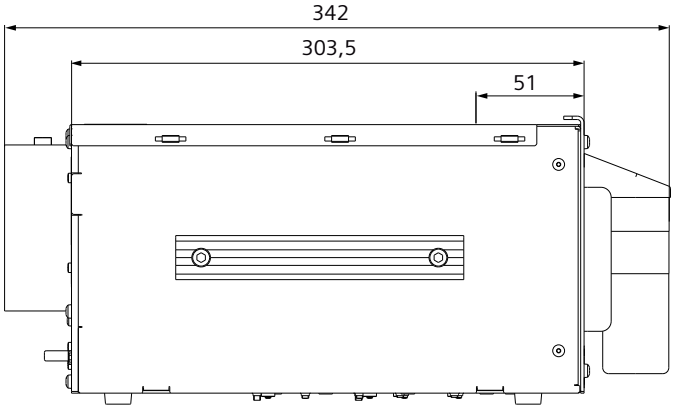


Figure 3-27 Dimension drawing bench-top unit - side view

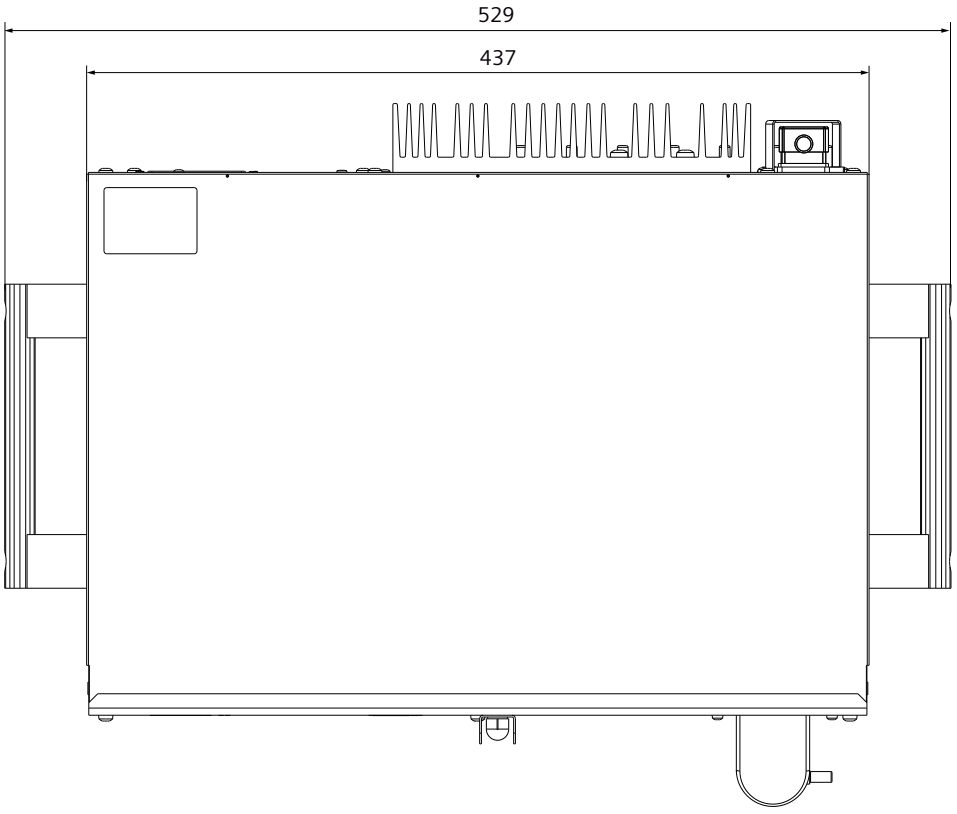
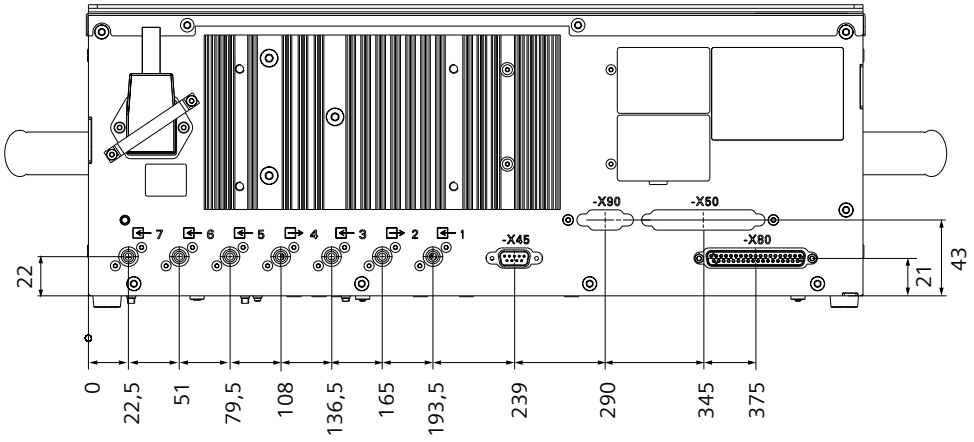


Figure 3-28 Dimension drawing bench-top unit - top view



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

Figure 3-29 Dimension drawing bench-top unit - rear view

3.7 Communication

3.7.1 General information

The ULTRAMAT 23 offers the following communication options:

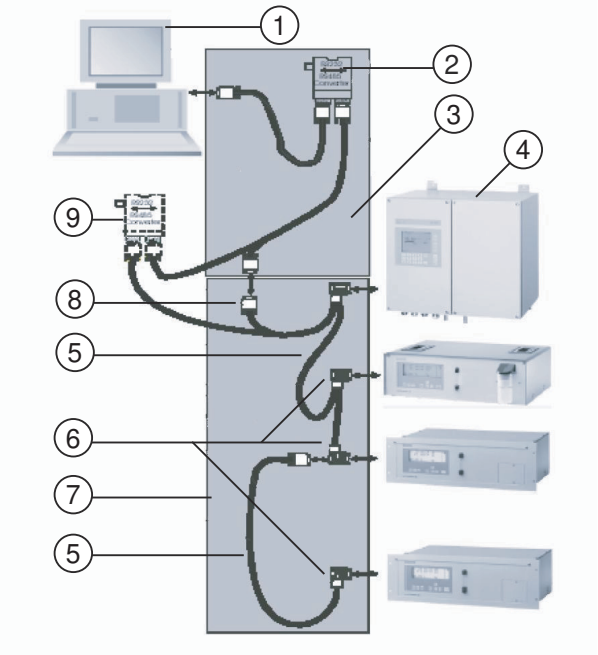
- ELAN interface (RS485)
- SIPROM GA
- PROFIBUS DP/PA

3.7.2 ELAN interface

ELAN interface

ELAN is a standard integrated serial interface (RS485) which allows communication with several analyzers. It networks up to 12 analyzers.

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



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

Figure 3-30 Typical structure of an ELAN network (RS485)

Interface parameters

	Value
Level	RS485
Baud rate	9600
Data bit	8
Stop bit	1
Start bit	1
Parity	None
No information feedback	

3.7.3 PROFIBUS DP/PA

PROFIBUS DP/PA is the leading fieldbus on the market. All Siemens 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 runs on Windows 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.

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 ULTRAMAT 23 is available with an optional PROFIBUS plug-in card - which can also be retrofitted.

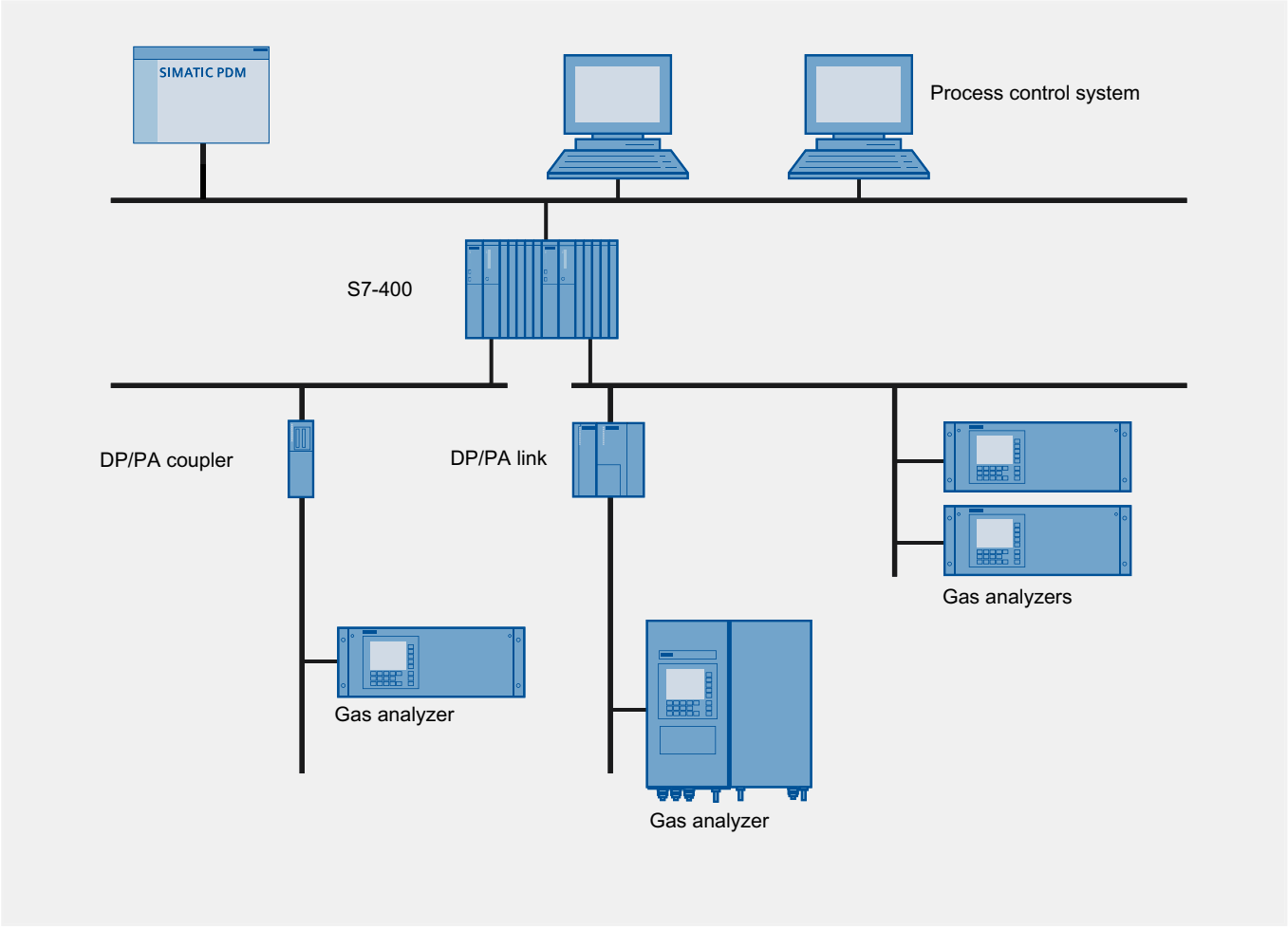


Figure 3-31 Typical structure of a PROFIBUS system

3.7.4 SIPROM GA

3.7.4.1 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
- Trigger device functions
- Perform parameter and configuration settings
- Obtain comprehensive diagnostic information
- Trigger calibrations
- Online help
- Cyclic saving of measured values and status signals in text format
- Download of new firmware
- Option 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 XP
- Windows Vista
- Windows 7
- Windows 10

The SIPROM GA software is available on the Internet and can downloaded from the following address: SIPROM GA download (https://support.industry.siemens.com/cs/ww/en/ps/17702/dl)

installation

4

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 (Page 34)).

NOTICE

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 (Page 34) 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. (Page 34)

⚠ 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 (Page 34).

Note

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 ULTRAMAT 23 gas analyzers for use in Ex zone 2 must be installed in a lockable enclosure with IP54 degree of protection. 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.

Note

In the case of device versions for use in Ex zone 2, it is also essential to observe the Compact Operating Instructions according to EN 61010-1 and EN 60079-0 for the ULTRAMAT 23!

Connecting

5

5.1 Safety instructions

5.1.1 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 (EC)

⚠ 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 (Page 34).

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 (Page 74).
- 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.

WARNING

Unsuitable cables, cable glands and / plug-in connectors

Risk of electric shock and material damage

- Only use cable glands/plug connectors that meet the requirements for electrical safety.
- Tighten the cable glands according to the instructions in the respective manuals / operating instructions.
- Close unused cable openings for electrical connections.
- When replacing cable glands, only use ones of the same type.
- Make sure the cables are tight after installation.

Note

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.

Note

Disconnecting means

Die 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.

5.1.2 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 ULTRAMAT 23 gas analyzers for use in Ex zone 2 must be installed in a lockable enclosure with IP54 degree of protection. 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.

WARNING

Operation of analyzers in hazardous areas

For safe operation of the analyzer in hazardous areas, it is essential to observe the information and conditions referred to in the "ATEX compact operating instructions for ULTRAMAT 23".

5.1.3 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.

5.2 Gas connections and internal gas path

5.2.1 Gas connections

Note

The overpressure at the sample gas inlet must not exceed 45 hPa.

Sample gas line

A pipe with an 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 must be sucked in via a fine filter. The proportion of the measured gas component in the gas for the AUTOCAL (zero gas) must be negligible. In particular when carrying out an AUTOCAL for CO_2 ranges <1 vol%, the air must be routed via a CO_2 absorber (e.g. soda lime).

Path for chopper compartment purging

With CO_2 ranges <0.1 vol%, a chopper compartment purging with clean nitrogen or CO_2-free synthetic air at an inlet pressure of 300 ... 350 kPa (43 ... 51 psi) is to be carried out.

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.

5.2.2 Gas preparation

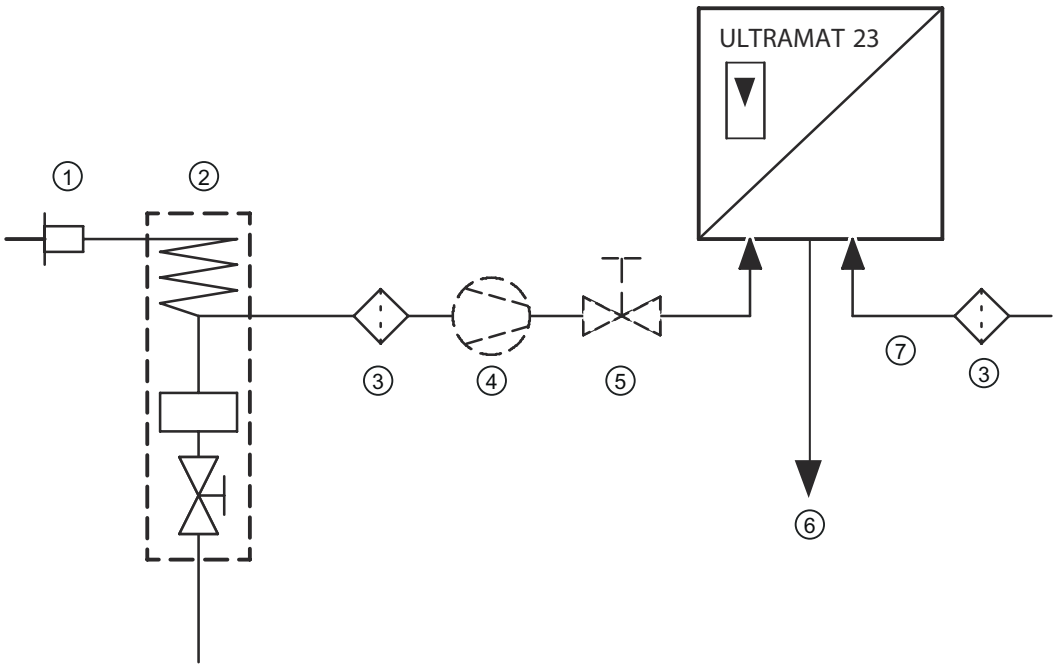
The sample gas must be sufficiently conditioned to prevent contamination of the parts through which it flows. The ULTRAMAT 23 is usually preceded by the following elements:

- Gas sampling device with particle filter
- Sample gas cooler
- Analysis filter (approx. 1-2 µm)
- External gas suction pump (with sample gas lines >20 m/65 1/2 ft)

Note

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.



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

Figure 5-1 Example of gas preparation for the ULTRAMAT 23

5.3 Electrical connection

5.3.1 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:
  - $R = R_L/2$; $C = 4L/R^2_L$,
    where R = 100 Ω and C = 200 nF are sufficient.
  - You must use a non-polarized capacitor for the RC element.

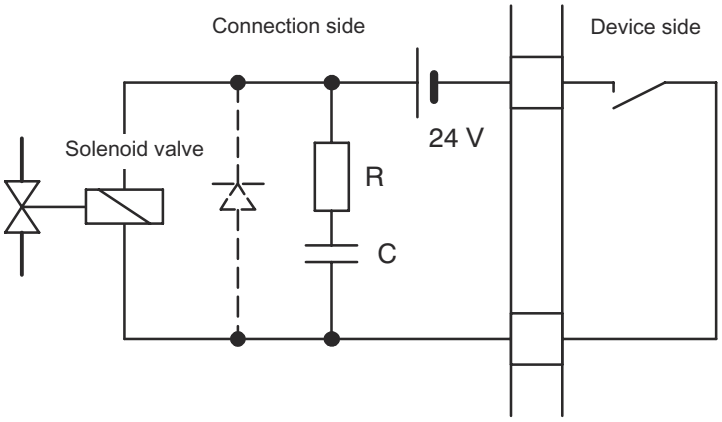


Figure 5-2 Measure to suppress sparks on a relay contact

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.

5.3.2 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 (Page 11)). 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 mm^2. 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 mm^2 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 mm^2. 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.

Note

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.

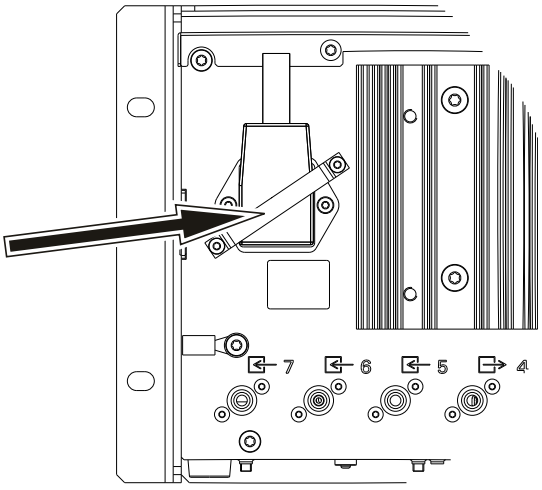
Electrical circuit breaker in accordance with IEC 60947-1 and IEC 60947-3

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 analyzers

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.

Commissioning

6

6.1 Safety instructions

6.1.1 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 (Page 34) 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 (Page 34) 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.

⚠ CAUTION

Loss of degree of protection

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

- Make sure that the device is securely closed.

⚠ WARNING

Violation of the maximum permissible operating pressure

Danger of injury or poisoning.

The maximum permissible operating pressure depends on the device version and the pressure and temperature limits. The device can be damaged if the maximum permissible operating pressure is exceeded. Hot, toxic and corrosive process media can be released.

- Ensure that the maximum allowable operating pressure of the device is not exceeded.
- Take note of the information on the nameplate and/or in the technical specifications of the manual/operating instructions of the respective device!

⚠ WARNING

Humid environment

Danger of electrocution.

- Avoid working on the device if it is under voltage.
- If working under voltage is required, ensure a dry environment.
- Make sure when performing cleaning and maintenance work that no moisture penetrates the inside of the device.

⚠ CAUTION

Penetration of moisture into the device

Device damage.

- Make sure when performing cleaning and maintenance work that no moisture penetrates the inside of the device.

⚠ CAUTION

Danger to eyesight when disassembling the UV module in the device enclosure.

This device emits UV radiation.

- Never look directly into the light beam, otherwise there is a risk of injury to the eye, especially when using focusing devices (e.g. lenses or magnifying glasses).
- Use protective goggles when working on the open device.

6.1.2 For 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 ULTRAMAT 23 gas analyzers for use in Ex zone 2 must be installed in a lockable enclosure with IP54 degree of protection. This enclosure must comply with the requirements of EN 60079-15 and must be designed for all ambient conditions which can occur during operation.

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.

WARNING

Operation of analyzers in hazardous areas

For safe operation of the analyzer in hazardous areas, it is essential to observe the information and conditions referred to in the "ATEX compact operating instructions for ULTRAMAT 23".

6.1.3 Use in biogas plants

⚠ DANGER

Danger of poisoning

This device is designed to measure hydrogen sulfide and dihydrogen sulfide, H_2S)!

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 H_2S 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 H_2S 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 H_2S 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.

6.2 Preparation for commissioning

6.2.1 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 4 hPa (4 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 (Page 34).

See also

Replacing the hydrogen sulfide sensor (Page 176)

6.2.2 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.

6.2.3 Device interfaces

Check that all device interfaces (see Communication (Page 61)) are properly assigned and configured.

6.3 Commissioning

6.3.1 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 (Page 95)).

6.3.2 AUTOCAL

After switching on and after a short warm-up phase (5 minutes), the analyzer performs an initial automatic calibration with the connected medium. This AUTOCAL adjusts the zero point of all IR and UV measured gas components. If an O_2 sensor is present, its sensitivity is additionally calibrated using the connected ambient air (20.95% O_2).

At the end of the complete warm-up phase (minimum 30 minutes), a second automatic calibration is performed. Zero gas should be connected during the entire warm-up phase.

Note

Analyzers with H_2S sensor

The hydrogen sulfide sensor is **not** calibrated during the course of this first AUTOCAL. The zero point of the H_2S sensor is only calibrated starting from the second AUTOCAL of the analyzer.

Note

Analyzers without electrochemical O_2 sensor

In the case of analyzers without an electrochemical O_2 sensor, the AUTOCAL can be carried out with nitrogen, but in the case of analyzers with an electrochemical O_2 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.

Note

Analyzers with paramagnetic O_2 sensor

In the case of analyzers with a paramagnetic O_2 sensor, the input menu can be used to select whether the AUTOCAL is to be carried out with air or N_2, and thus whether the sensitivity (20.95% O_2) or the zero point of the sensor is calibrated.

Note

Analyzers with small CO_2 measuring ranges

In the case of analyzers with small CO_2 measuring ranges (useful below 1000 vpm), the chopper compartment purging must be connected. 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.

The device performs an AUTOCAL at regular intervals. You can manually trigger an AUTOCAL during operation by pressing the CAL key, or activate an AUTOCAL via the binary input or the communication interface, for example via Siprom GA. 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 H_2S sensor
- Approx. 3 minutes for analyzers with O_2S sensor
- Approx. 2 minutes for analyzers that measure IR and UV components exclusively

It represents the sum of the following durations:

- Twice the set purging time (see Calibration: AUTOCAL/drift values: Purge time (Page 128))
- Duration of the internal electronic damping (corresponds to two and a half times the time constant T_{90} within (see Parameters: Time constants (Page 134))).

Note

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.

Analyzers with UV module

If a UV module is present in the analyzer, a check is carried out after the first AUTOCAL as to whether the UV module has reached its setpoint temperature. As soon as this is the case, there is a waiting period of 55 minutes before the second AUTOCAL is conducted. This means the warm-up phase is at least 60 minutes; it can increase to more than 120 minutes in case of cold ambient temperatures.

6.3.3 Initial calibration

Initial calibration with calibration gas

Following installation of the analyzer, we recommend a calibration using calibration gas (see Calibration (Page 115)). The calibration must 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).

Note

The calibration gas is connected via the sample gas path.

After the initial calibration, the analyzer must have been in operation for at least 180 minutes (for UV components) or 120 minutes (for all other components) before commencing with measurements since a good stability of the sensors 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 (Page 134)).

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

6.4 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.

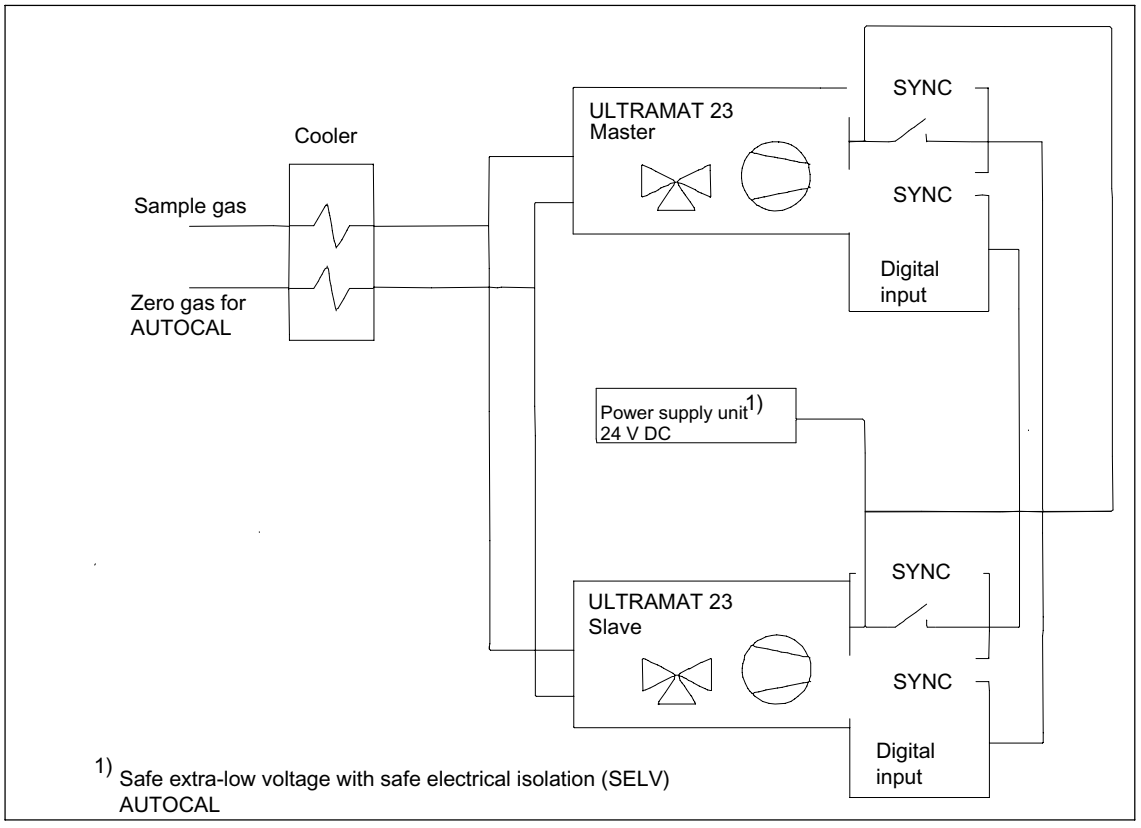


Figure 6-1 Parallel connection, example with internal pump and solenoid valve switching

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 (Page 128)).
- Assign the "Sync." function to a relay (see Calibration: AUTOCAL/drift values: Cycle time (Page 128)).
- Assign the "Only CAL contact" function to the digital input SYNC (see Configuration: Inputs/outputs/pump: Binary/sync inputs (Page 145)).

Slave:

- Set the AUTOCAL cycle time to "0" to prevent a cyclic AUTOCAL from being triggered (see Calibration: AUTOCAL/drift values: Cycle time (Page 128)).
- Assign the "Sync." function to a relay (see Configuration: Inputs/outputs/pump: Assign relays (Page 142)).
- Assign the "AUTOCAL" function to the digital input SYNC (see Configuration: Inputs/outputs/pump: Binary/sync inputs (Page 145)).

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.

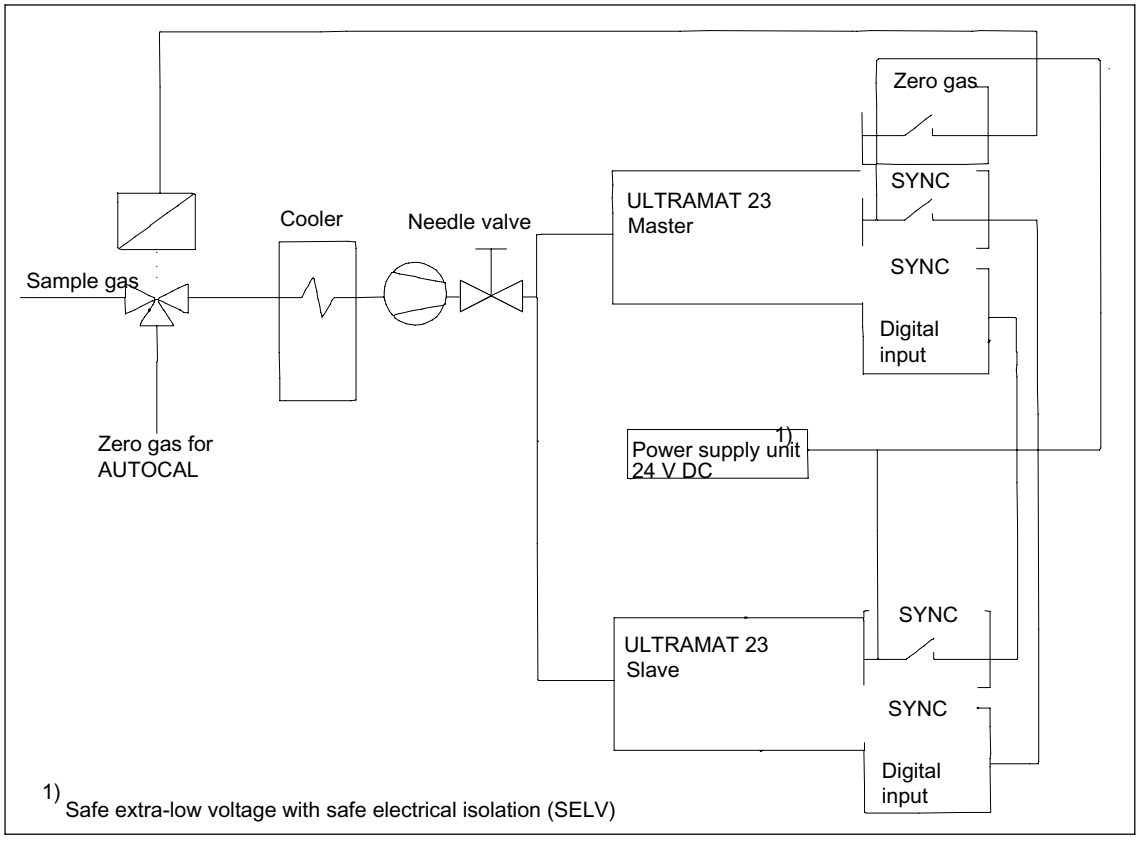


Figure 6-2 Parallel connection without internal pump and solenoid valve switching

Parameter assignments

Master:

- Enter the AUTOCAL cycle time, e.g.: 6 hours (see Calibration: AUTOCAL/drift values: Cycle time (Page 128)).
- Assign the "Sync." function to a relay (see Configuration: Inputs/outputs/pump: Assign relays (Page 142)).
- Assign the "Zero gas" function to a relay (see Configuration: Inputs/outputs/pump: Assign relays (Page 142)).
- Assign the "Only CAL contact" function to the digital input SYNC (see Configuration: Inputs/outputs/pump: Binary/sync inputs (Page 145)).

Slave:

- Set the AUTOCAL cycle time to "0" to prevent a cyclic AUTOCAL from being triggered (see Calibration: AUTOCAL/drift values: Cycle time (Page 128)).
- Assign the "Sync." function to a relay (see Configuration: Inputs/outputs/pump: Assign relays (Page 142)).
- Assign the "AUTOCAL" function to the digital input SYNC (see Configuration: Inputs/outputs/pump: Binary/sync inputs (Page 145)).

Operation 7

7.1 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 as shown in the sample figures (different measured components, number of infrared measured components, UV module without infrared measured components, no oxygen sensor, no internal pump, no PROFIBUS interface, etc.), the explanations are applicable accordingly.

The used numbers must be considered as examples. They therefore probably differ from the values displayed on your analyzer. The corresponding display 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.

7.2 User prompting

In the next sections, operation of the ULTRAMAT 23 is explained according to the following scheme:

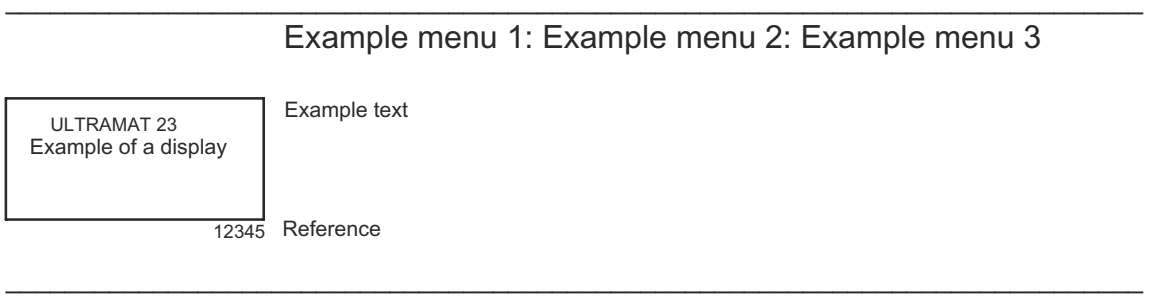


Figure 7-1 User prompting

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 (Page 91)). 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.:

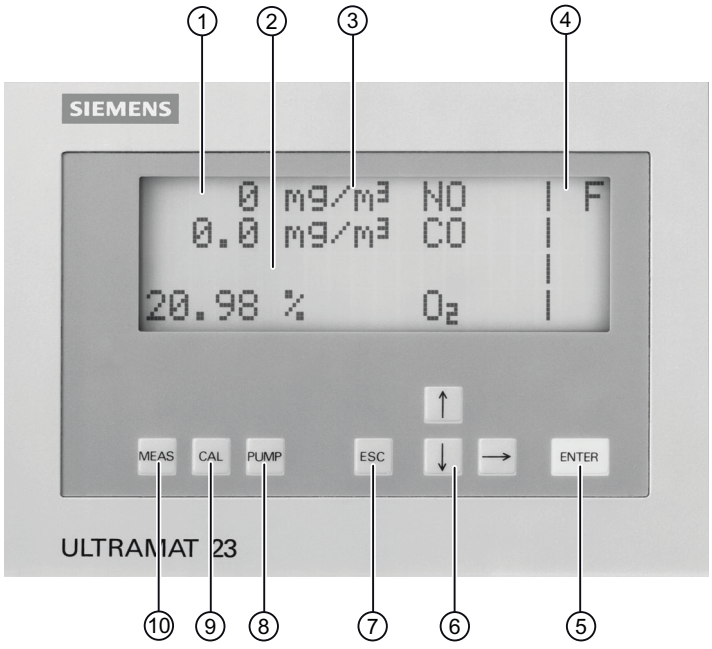
- You can start the function using the <**ENTER**> key.
- You can terminate the function using the <**ESC**> key.

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: **E**xample).

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 (Page 103) to Configuration (Page 135) 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 (Page 97)) 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.

7.3 Display and control panel

7.3.1 Display and 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

Figure 7-2 Operator panel

Note

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 and PROFIBUS interface • AUTOCAL or warm-up phase running (display flashes) • Measured values for the influence of interference gas via ELAN not valid	**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_2S probe, the following statuses can be displayed at the position for the fault which is no longer present						
Protection function of H_2S probe running (display lights up permanently)	**H**	**H**	**H**	**H**	**H**	**H**
Protection function of H_2S probe running, H_2S measured value is invalid (display flashes)	**V**	**V**	**V**	**V**	**V**	**V**

7.3.2 User interface

The ULTRAMAT 23 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.

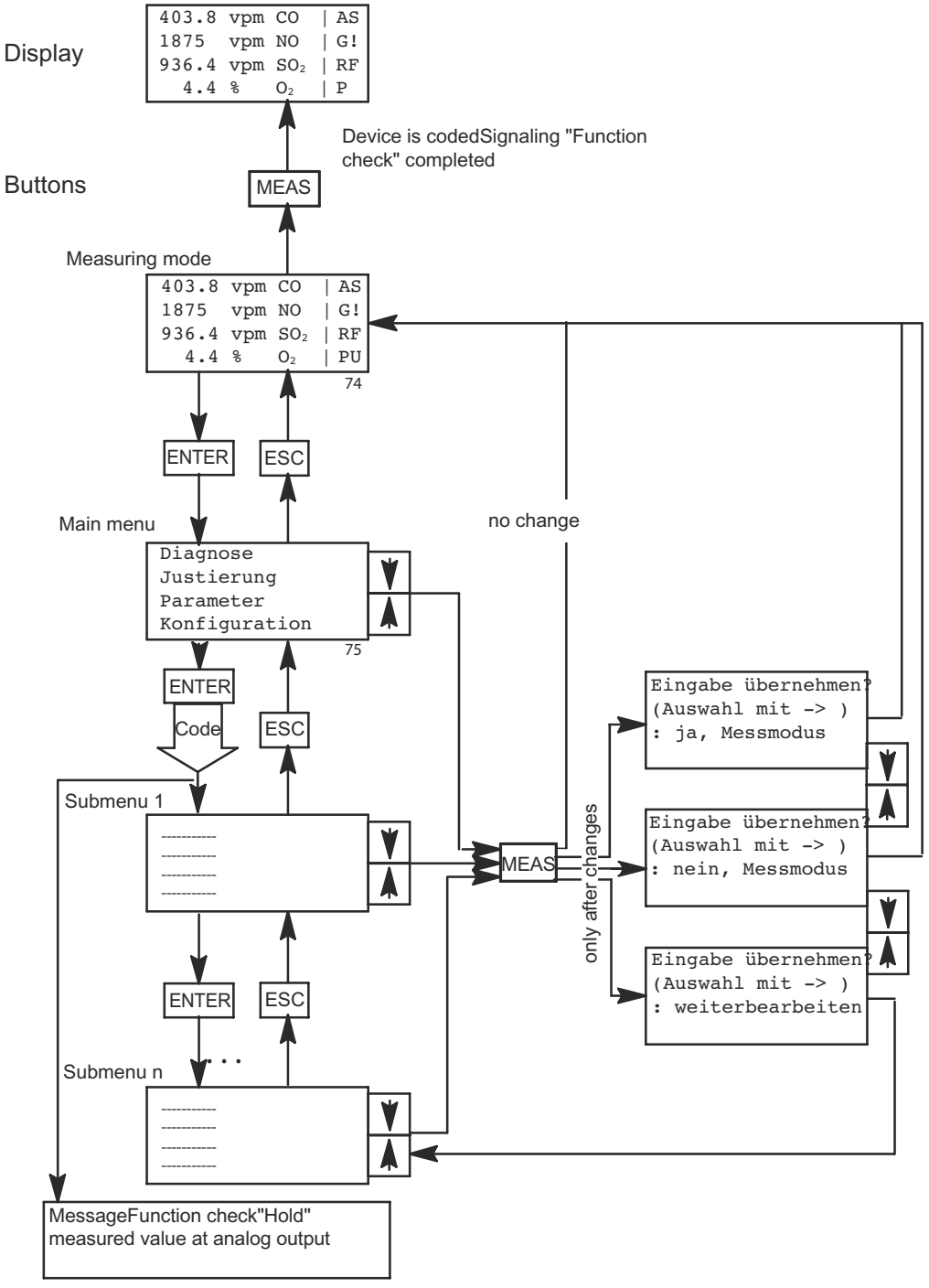


Figure 7-3 Menu structure of the ULTRAMAT 23

7.3.3 Key assignments

Eight keys are available for operating the ULTRAMAT 23. 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 and subsequent adjustment: activation of calibration with ambient air or nitrogen
3 *	PUMP	Pump	Switch internal sample gas pump on/off
4	ESC	Escape	In input mode: go back one menu level or cancel current input or cancel AUTOCAL or cancel an adjustment*
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. On numerical inputs outside the valid range, the device reacts outputting the value FFF...

Use of the <**MEAS**>, <**ESC**>, and <**ENTER**> keys is described using examples in section Key operations step by step (Page 98) . Use of the <**CAL**> key is described in section The CAL key (Page 101), use of the <**PUMP**> key in section The PUMP key (Page 102).

7.4 Operating modes

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

- In the **warm-up phase** (see section Warm-up phase (Page 95))
- In **measuring mode** (see section Measuring mode (Page 96))
- In **input mode** (see section Input mode (Page 97))

7.4.1 Warm-up phase

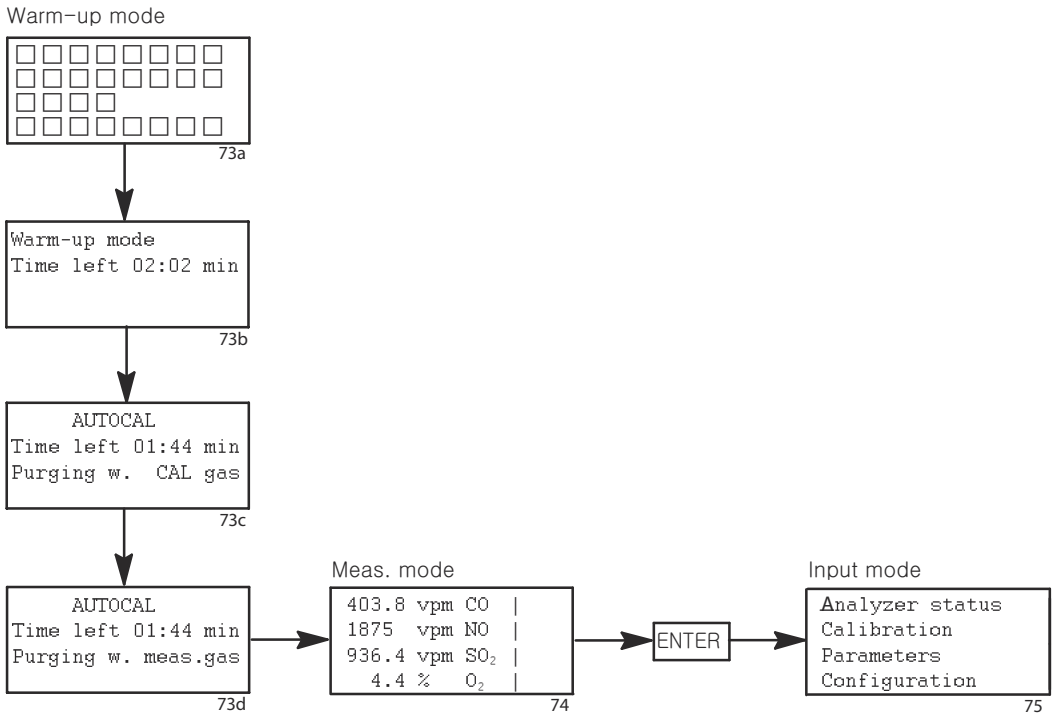
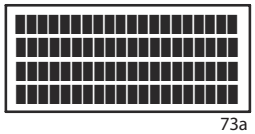
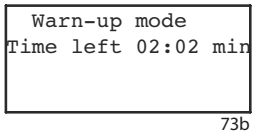


Figure 7-4 Warm-up phase, measuring mode, and input mode

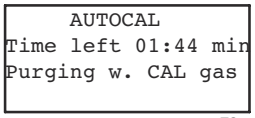


Immediately following switching-on, the ULTRAMAT 23 tests the display elements. During this test, all elements light up simultaneously for approx. five seconds.

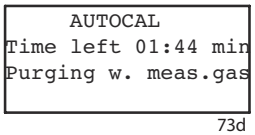


The adjacent display subsequently appears with the remaining warm-up period which is counted down in seconds to 00:00 (minutes:seconds).

In the first 5 minutes of the warm-up phase, the 4 mA value is always transferred over the analog interface and the 'Function control (FCTRL)' status is set. This does not represent an error.



73c

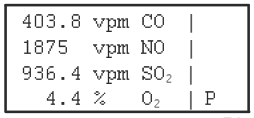


73d

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 AUTOCAL cannot be interrupted.

Following the calibration, the analyzer switches to purging with sample gas. After the purging phase is complete, the analyzer switches to measuring mode and remains in the warm-up phase for about 30 minutes. For analyzers with installed UV module, there is a constant check during the warm-up phase to determine whether the UV module has reached its setpoint temperature. As soon as this is the case, there is a waiting period of 55 minutes. Once this time has expired, an additional AUTOCAL is automatically conducted by the analyzer. The warm-up phase is then finished and the full measuring accuracy has been reached.

7.4.2 Measuring mode

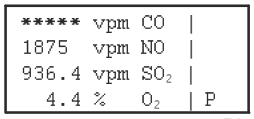


74

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 (Page 91)). 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.

For devices without O_2 measurement, the 4th line of the display remains empty.

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.



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

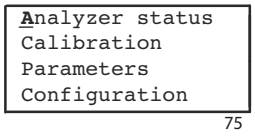
7.4.3 Input mode

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.



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 ULTRAMAT 23:

Analyzer status

With these functions you can call up submenus which provide information about the analyzer status, e.g. entries in the logbook, diagnostics data (various measured values of internal sensors, pressure, temperature, etc.) (for menu structure, see Diagnostics (Page 103)).

Calibration

With these functions you can calibrate the zero and sensitivity of the analyzer using calibration gas (for menu structure, see Calibration (Page 115)).

Parameters

With these functions you can match the analyzer functions to your specific application, e.g. by entering limits, measuring ranges, time constants and capacity of the internal pump if installed (for menu structure, see Parameter (Page 128)).

Configuration

With these functions you can define the assignments of the analyzer interfaces etc., e.g. the assignments of relays and current outputs and to perform tests of various components (for menu structure, see Configuration (Page 135)).

7.4.3.1 Code levels

The ULTRAMAT 23 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 of the basic device, you can now use letters and special characters for the code in addition to numbers.

Note

You should change the factory-set codes once you have become acquainted with operation of the ULTRAMAT 23 (see section Configuration: Special functions: Changing the codes/language (Page 147)).

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".

Note

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.

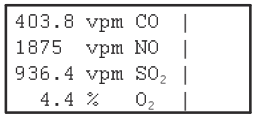
Following input of a code, inputs are possible until the analyzer is recoded. If no input is registered during a time period of 30 minutes, the analyzer automatically returns to the (coded) measuring mode.

Note

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.

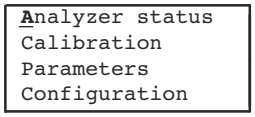
7.4.3.2 Key operations step by step

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



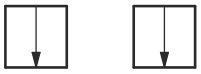
The analyzer is in measuring mode (see section Measuring mode (Page 96)).

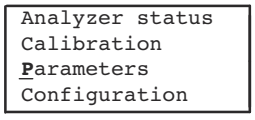
Change from measuring mode to input mode by pressing the <**ENTER**> key.



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

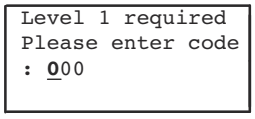
- You can set the cursor to the start of each line using the <↑> and <↓> keys. Cursor movements are cyclic, i.e. if you move above the top edge of the display, the cursor appears again in the bottom line, and vice versa.
- Call the respective menu item by pressing the <**ENTER**> key.

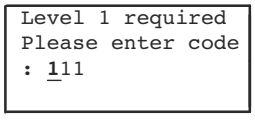




The cursor is located at "**P**" when you have pressed the <↓> key twice.

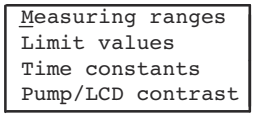
Now call the "Parameters" submenu by pressing the<**ENTER**> key.





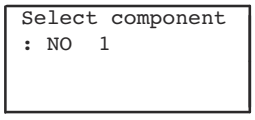
The adjacent display appears in which you will be requested to enter the code number for code level 1.

- 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.

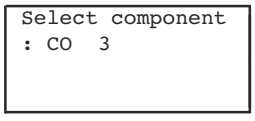


The initial display of the "Parameters" submenu appears.

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

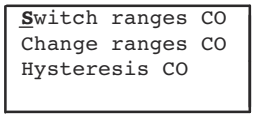


Now select components 1 to 4 for which the subsequently set ranges are to apply. Up to four components can be present.



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.

```
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:
  - To process the previous menu item further using <**ENTER**>

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

  - or return to measuring mode using <↑> or <→> and subsequently <**ENTER**>, where all modifications are imported which you have made since the last decoding operation,

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

  - 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
```

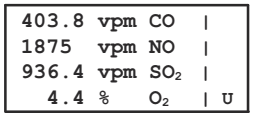
Once you have carried out the above sequence on the analyzer, you are already acquainted with the important points for operation of the ULTRAMAT 23.

7.4.3.3 The ESC key

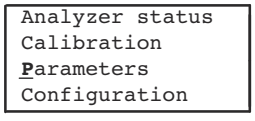
You can trigger two different functions by pressing the <**ESC**> key:

- 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.

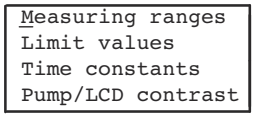
An example will clarify this:



The analyzer is in measuring mode and is uncoded.

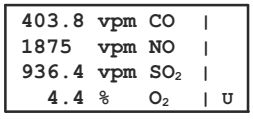


Switch from measuring mode to input mode using <**ENTER**>, select the menu item "Parameters" using the <↑> or <↓> key, and press <**ENTER>** to confirm.



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.

7.4.3.4 The CAL key

If the analyzer is in measuring mode, pressing the <**CAL**> key triggers a single, automatic calibration (zero-point 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.

7.4.3.5 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 (Page 146)).
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.

Functions

8

8.1 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 H_2S sensor and without a paramagnetic O_2 sensor. The differences when using analyzers with one of these sensors are described in section Diagnostics: Diagnostics values (Page 107). Dashed lines apply to analyzers with UV module.

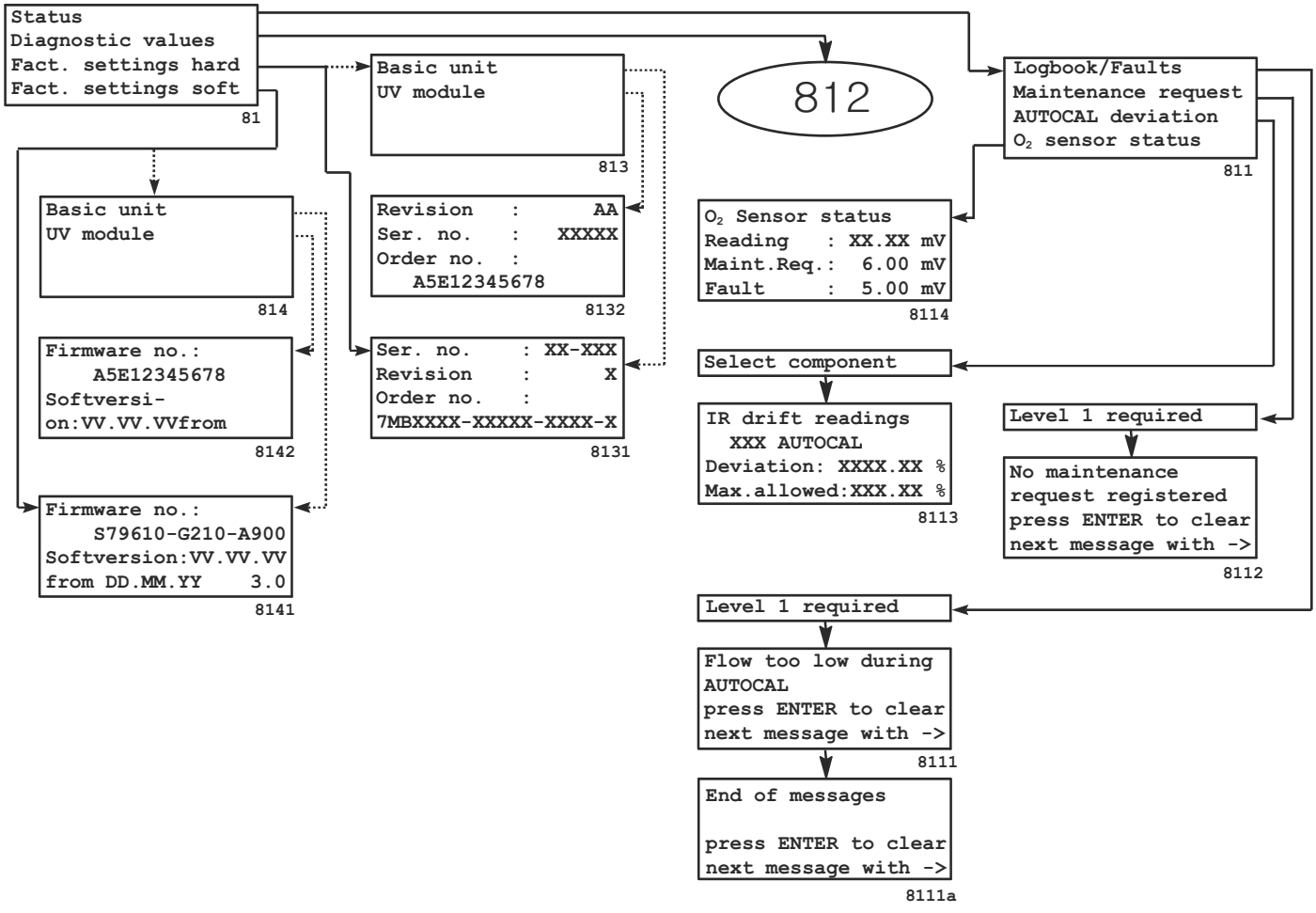


Figure 8-1 Overview of diagnostic parameters

This overview contains all parameters of an analyzer that has both an IR detector and a UV module. 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 module are described there (section Diagnostics: Diagnostic values: UV (Page 109)).

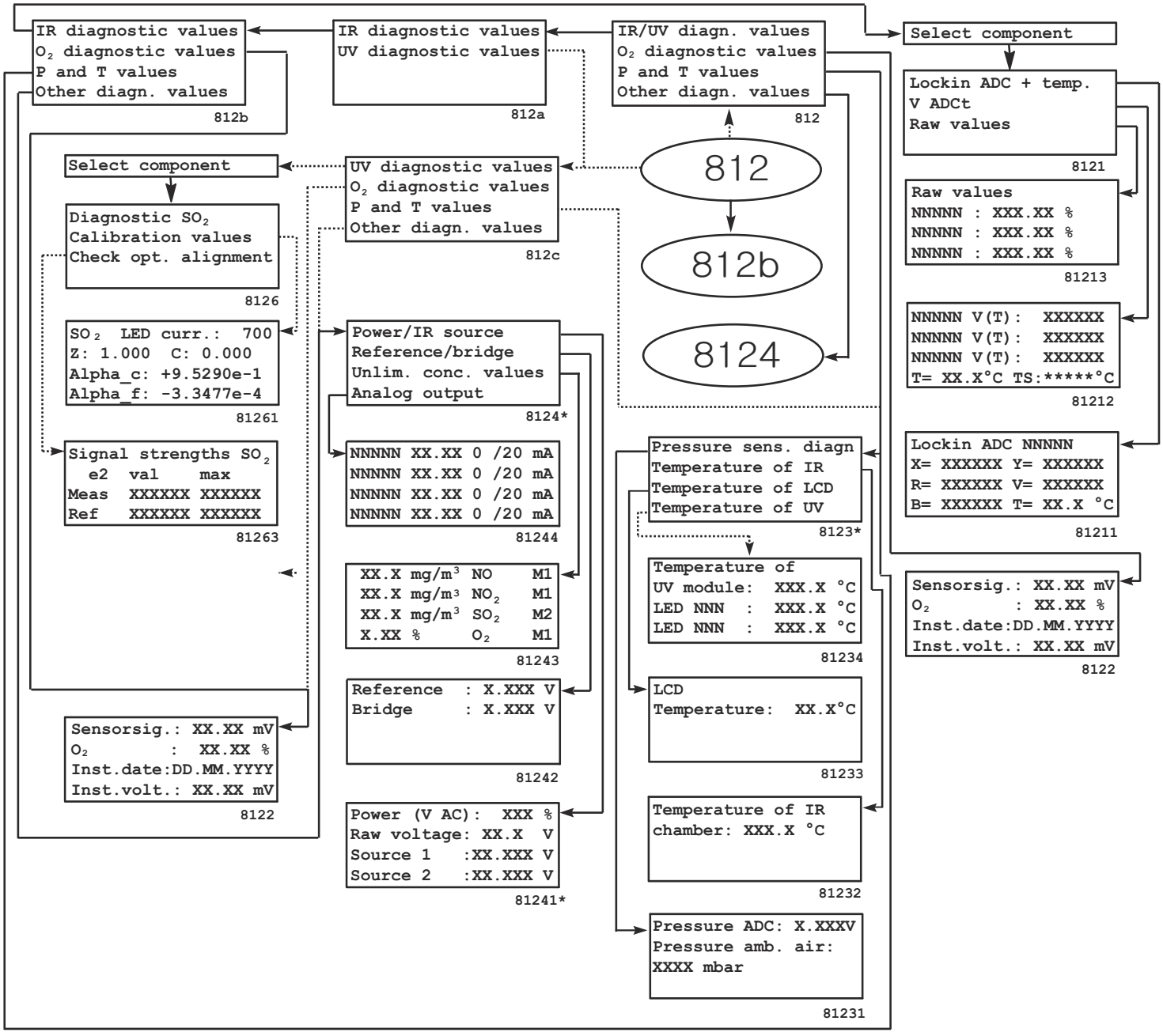
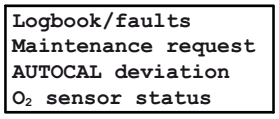


Figure 8-2 Overview of diagnostic values submenu

8.1.1 Diagnostics: Status



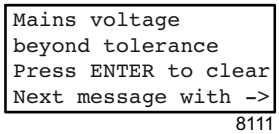
811

In this menu you can call all status messages of the ULTRAMAT 23 via further submenu items.

In this example, the status of the O_2 sensor is shown in the last line. If the analyzer is equipped with an H_2S sensor, the text 'Probe status' is shown in the last line with the following options:

- Only H_2S sensor:
  The analyzer calls this function directly.
- H_2S and O_2 sensors:
  You will be requested to select the associated sensor.

8.1.1.1 Analyzer status: Status: Logbook/faults



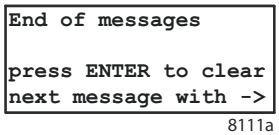
8111

This 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 (Page 182)).

Viewing the logbook is protected by code level 1.

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.



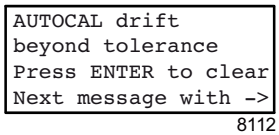
8111a

Note
By deleting the fault message you do not eliminate the cause of the fault (see section Faults (Page 182)).

A corresponding text is output when all stored faults have been displayed. Terminate display of the logbook using the **<→>** key.

Note
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.

8.1.1.2 Analyzer status: Status: Maintenance request



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 O_2 sensor status; see also section Analyzer status: Status: O2 sensor status (Page 107)). A corresponding message is output in alphanumeric text.

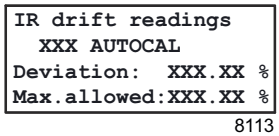
Access is protected by code level 1.

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.

8.1.1.3 Analyzer status: Status: AUTOCAL deviation



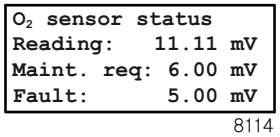
This dialog indicates the deviation in setpoint between several AUTOCAL procedures. The parameters have the following meanings:

- 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 (only for IR components) (Page 148)).
- **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 (only for IR components) (Page 148) for setting the maximum value.

Note

This function is component-specific, but only available for the IR measured components (not for the UV measured components).

8.1.1.4 Analyzer status: Status: O2 sensor status

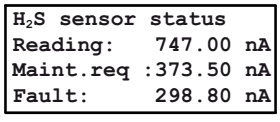


8114

The probe voltage of the O_2 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 O_2 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.

8.1.1.5 Analyzer status: Status: H2S sensor status



8115

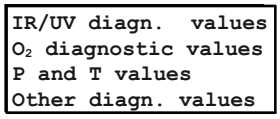
The H_2S sensor ages with increasing operating time, thereby steadily decreasing its sensitivity. If a value below the minimum value for a warning is determined during calibration of the sensitivity, the service life of the sensor has almost been reached (maintenance request). If the sensitivity drops further below the value for a fault, the fault message "Sensitivity of H_2S 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.

8.1.2 Diagnostics: Diagnostics values

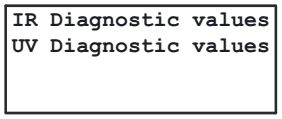
The diagnostic values provide important information for troubleshooting and adjustments.

Depending on your analyzer version, the starting menu may be different.



812

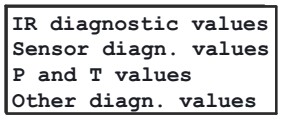
If the analyzer has an IR detector and a UV module, the adjacent figure appears. After selection of the 'IR/UV diag. values' parameter, the following prompt appears:



812a

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

- IR diagnostic values: After the prompt, the menu switches to section Analyzer status: Diagnostics values: IR (Page 108).
- UV diagnostic values: After the prompt, the menu switches to section Diagnostics: Diagnostic values: UV (Page 109).

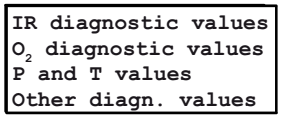


812d

If the analyzer has an H_2S sensor, the adjacent figure appears. The following versions are possible following selection of the 'Probe diagnostic values' parameter in the 2nd line:

- Only H_2S sensor: After selection of this item, the menu switches to the diagnostic values of the H_2S sensor (section Analyzer status: Diagnostics values: H2S sensor (Page 111)).
- H_2S and O_2 sensors: A query is made for the component, and a switch then made to the called sensor.

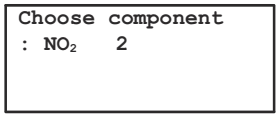
8.1.2.1 Analyzer status: Diagnostics values: IR



812b

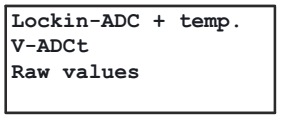
This menu screen appears in the following cases:

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



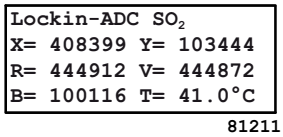
You must first identify the component to which the diagnostic values are to apply.

After the <**ENTER**> key is pressed, the following selection menu appears:



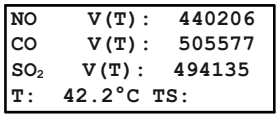
8121

In this submenu you can call up the diagnostic values of the selected infrared component. These are:



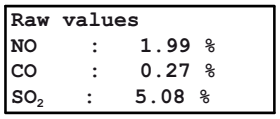
81211

- **ADU** are voltage and signal values of the analog-to-digital converter prior to temperature compensation.



81212

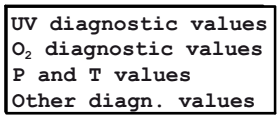
- **V-ADUt** are voltage and signal values of the analog-to-digital converter following temperature compensation.
  T in the bottom line corresponds to the temperature of the analyzer unit, **TS** to the temperature of the first IR source (since 2019 IR sources always come with a temperature sensor, therefore, for new U23 units with IR, temperature is always displayed or "*****" in case of error).



81213

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

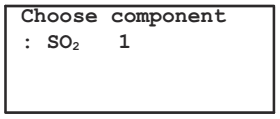
8.1.2.2 Diagnostics: Diagnostic values: UV



812c

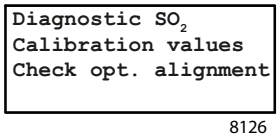
This menu screen appears in the following cases:

- The analyzer has no IR detector, otherwise UV/IR diagnostic values appear in the upper line



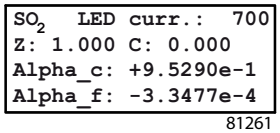
After selecting the UV diagnostic values:
Here you must first identify the UV component to which the diagnostic values should apply.

After the <**ENTER**> key is pressed, the following selection menu appears:



8126

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



81261

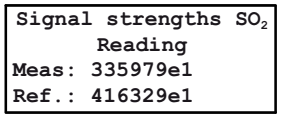
Calibration values

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

- SO_2: The relevant component
- LED current: The LED amperage in DAW units (maximum 2047, here 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: SO_2) onto the second UV channel (NO_2).
  Note:
  In the example, the value of C for the SO_2 component is 0.000, because SO_2 does not cause any cross-sensitivity on the 2nd channel (NO_2). For NO_2 the value of C is 0.160, because NO_2 causes a cross-sensitivity of about 16% on the SO_2 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, Alpha_c is the value which was last determined after the customer calibration.

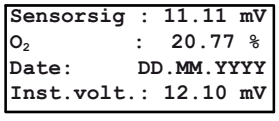


81263

Optical alignment

This screen shows the signal strengths of the measuring channel (3rd line) and reference channel (4th line).

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

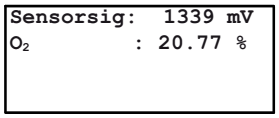


8122

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

- **Sensorsig** is the current pressure-compensated voltage of the O_2 sensor in mV
- **O_2** is the current oxygen value. Negative values are also possible here
- **Inst. date** is the installation date of the O_2 sensor (see section Calibration: O2 measuring range: Sensor inst. date (Page 119))
- **Inst.volt** is the pressure-compensated voltage of the O_2 sensor when it was installed.

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

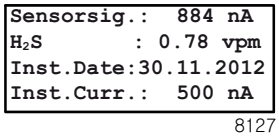


8125

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

- **Sensorsig** is the current voltage of the O_2 sensor in mV
- **O_2** is the current oxygen value. Negative values are also possible here

8.1.2.5 Analyzer status: Diagnostics values: H2S sensor

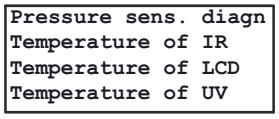


8127

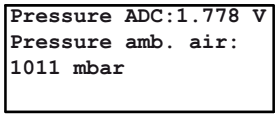
This dialog displays the diagnostics values of the optional H_2S sensor. Meaning:

- **Sensorsig**. is the actual current of the H_2S sensor in nA
- **H_2S** is the current H_2S measured value in vpm. Negative values are also possible here.
- **Inst. date** is the installation date of the H_2S sensor (see section Calibration: H2S sensor: Defining the installation (Page 123))
- **Inst. cur** is the pressure-compensated current per vpm H_2S of the sensor when it was installed.

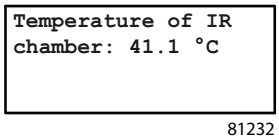
8.1.2.6 Diagnostics: Diagnostic values: Pressure and temperature



8123



81231



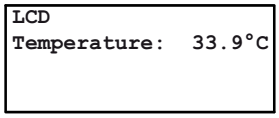
81232

This dialog shows various diagnostic values for pressure and temperature.

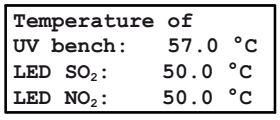
The parameters for the IR measurement and UV measurement are shown in the adjacent screen. Depending on the device version, one of these two options might be omitted.

You can select between the following parameters:

- **Pressure sensor**
  This dialog displays the diagnostic values of the pressure sensor (see section Calibration: Pressure sensor (Page 126)). 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.
- **IR sample chamber**
  The temperature of the first IR detector is shown here.



81233



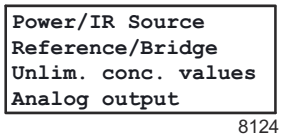
81234

- **LCD temperature.**
  The temperature that determines the display contrast. Setting of the LCD contrast is described in section Parameters: Pump/LCD contrast: LCD contrast (Page 135).
- **UV sample chamber**
  The following controlled temperature values are displayed here:
  - UV measuring chamber
    Corresponds to the temperature of the analyzer chamber of the UV module and the sample gas
  - controlled temperature of the printed-circuit board of LED 1 (SO_2)
  - controlled temperature of the printed-circuit board of LED 2 (NO_2)

8.1.2.7 Diagnostics: Diagnostic values: Other diagnostics:

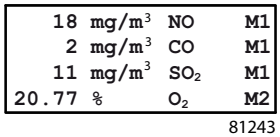
The type and scope of these diagnostic values differ depending on whether they were selected from the IR branch or UV branch.

Versions with IR measuring components



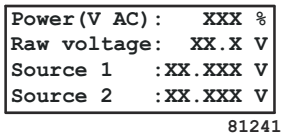
8124

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



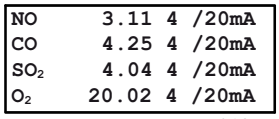
81243

- **Unlimited concentration values**
  Measured values that are not limited by the large measuring range are displayed here. Negative measured values can also be output with this function.



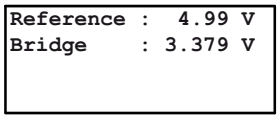
81241

- **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 after rectification of the transformer voltage
  - **Source 1**, **Source 2**: Data on the IR source voltage(s), in Volt. An empty value indicates that the corresponding source does not exist.



81244

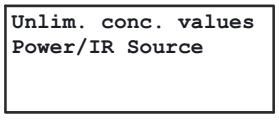
- **Analog output**
  For each gas component to be measured, the current value of the output current in mA is shown (the unit is not shown for space reasons) as well as the start-of-scale value (either 0, 2 or 4 mA) and the full-scale value (20 mA) of the output current range. For information on setting the start-of-scale values, see section Configuration: Inputs/outputs/pump: Analog outputs (Page 139).



81242

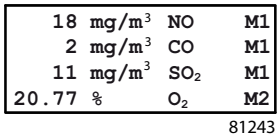
- **Reference/bridge**
  - **Reference:** The reference voltage for the electronics of the analyzer.
  - **Bridge**: The supply voltage to the measuring bridge.

Version with UV module without IR analyzer section



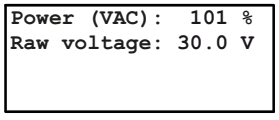
8124a

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



81243

- **Unlimited concentration values**
  Measured values that are not limited by the large measuring range are displayed here. Negative measured values can also be output here.



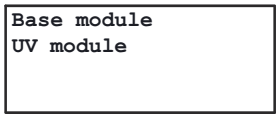
81241a

- **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 after rectification of the transformer voltage

Note

All menu screens are available for IR/UV devices

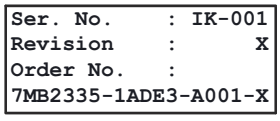
8.1.3 Analyzer status: Factory settings hardware



813

If the analyzer has a UV module, it has its own object status. In this case, the adjacent prompt appears first:

If the analyzer does not have a UV module, the following menu screen (8131) appears immediately with the information on the hardware of the basic unit.

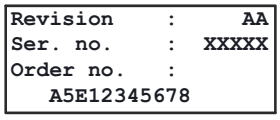


8131

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

- Serial No.
- Revision
- Order No.

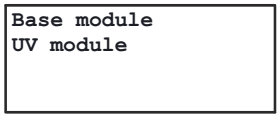
The hardware configuration and release version can be read here.



8132

If the device has a UV module, the fabrication number, the object status and the order number of the UV module can be read out here.

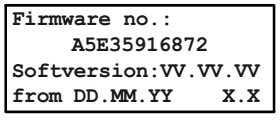
8.1.4 Analyzer status: Factory settings software



814

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

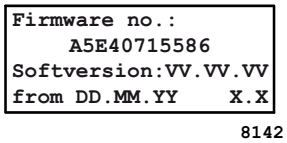
If the analyzer does not have a UV module, the following menu screen (8141) appears immediately with the firmware information of the basic unit.



8141

Software shows for each hardware containing firmware:

- The article number of the respective firmware
- The version and creation date of the software and the bootloader number (bottom right of the menu screen)

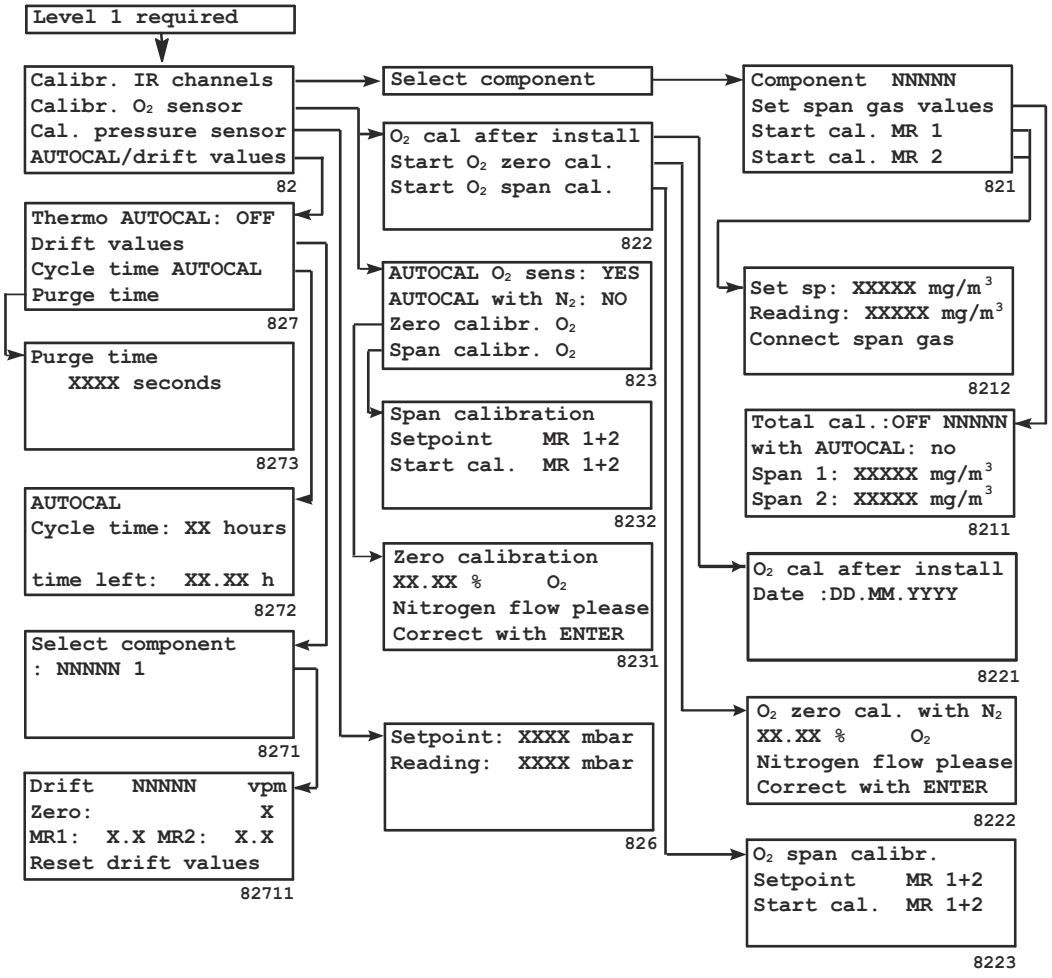


If the device has a UV module, the information about this firmware can be called up in the additional menu screen (8142).

8.2 Calibration

In this function group you can use one or more calibration gases to calibrate the IR channels of the ULTRAMAT 23 and to readjust the zero point and sensitivity (calibrate the full-scale value). In addition, you can calibrate the oxygen sensor and the internal atmospheric pressure sensor and also define the AUTOCAL parameters. The figure shown below indicates the menu sequence for an analyzer without UV module and H_2S 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.



H_2S sensor

If the analyzer has an H_2S sensor, the starting menu for the calibration functions is changed. The following overview shows the menu sequence for the calibration functions of the H_2S sensor. The calibration functions of the H_2S sensor are described in section Calibration: H2S sensor (Page 122).

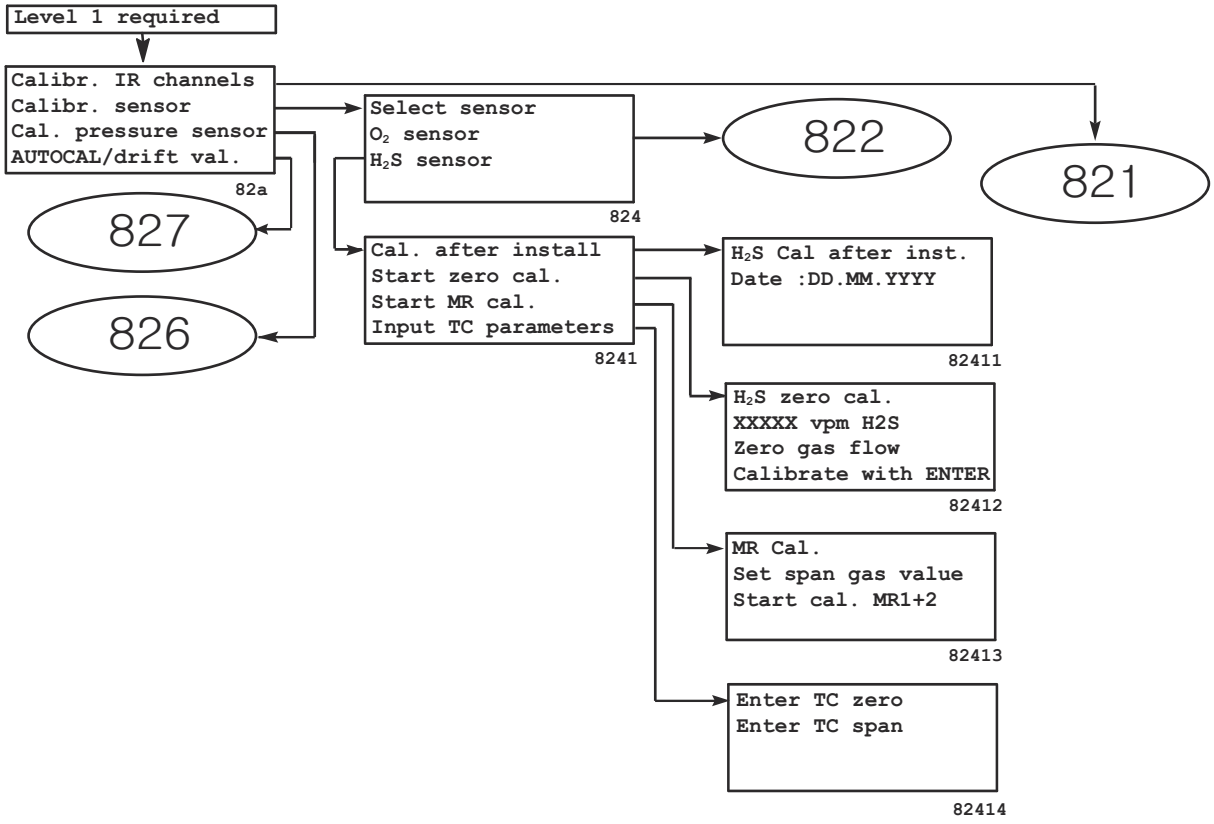


Figure 8-3 Overview: Calibration with H_2S sensor

UV components

If the analyzer has a UV module, the starting menu for the calibration functions is changed. The following overview shows the menu sequence for the calibration functions of the UV module. The calibration functions of the UV module are described in section Calibration: Ultraviolet components (Page 126).

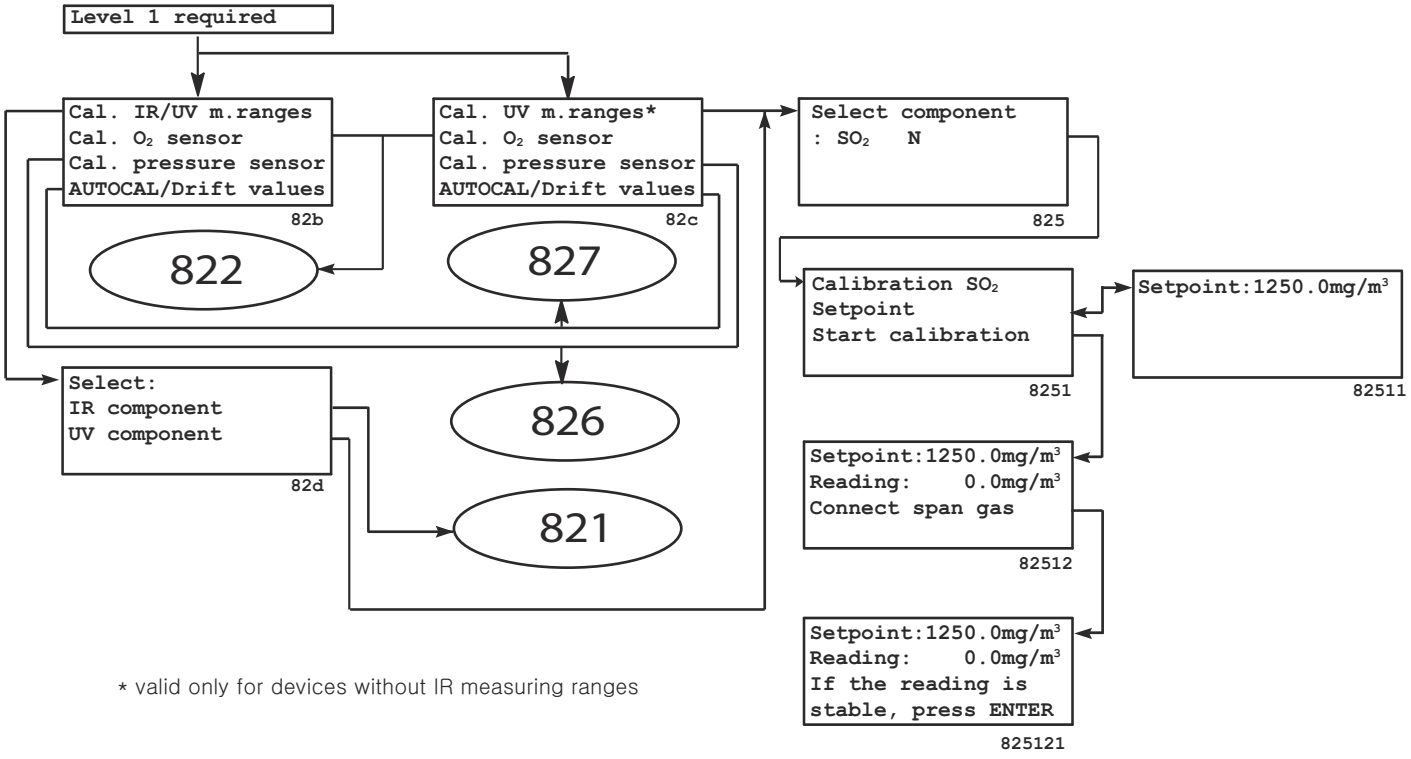
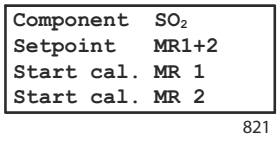


Figure 8-4 Overview: Calibration of the UV components

Note

Two measuring ranges (measuring range 1 and measuring range 2) cannot be individually calibrated for the UV measured components, as is possible for IR measured components.

8.2.1 Calibration: Infrared components

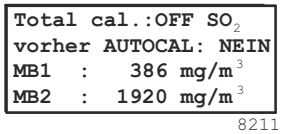


In this menu you can:

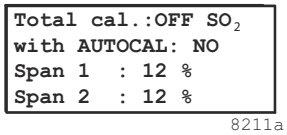
- In line 2:
  - Set the setpoints of the calibration gases for the individual ranges
  - Select a total or single calibration
- In lines 3 and 4: Start a calibration procedure.

This function is specific to the component.

8.2.1.1 Calibration: Infrared component: Set span gas values



8211

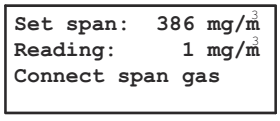


8211a

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-of-scale and full-scale values of the respective range.

8.2.1.2 Calibration: Infrared component: Start with Range MR 1/2

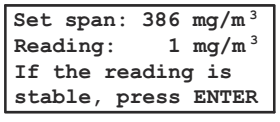


8212

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

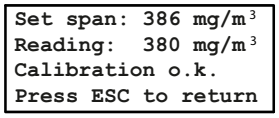
- was set to **OFF**, the analyzer expects an immediate flow of calibration gas;
- if the value is set to **ON**, an AUTOCAL is carried out prior to the flow of gas.

The values of the setpoint and actual-value calibrations are displayed in the first two lines.



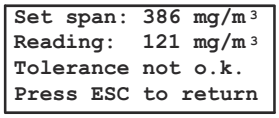
8212a

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.



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 message 'Calibration o.k.' appears.

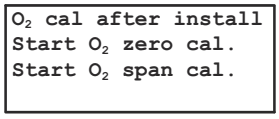


8212c

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

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

8.2.2 Calibration: Electrochemical oxygen measuring range

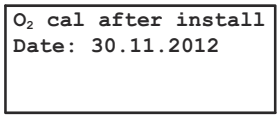


822

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

- Enter the installation date of the electrochemical O_2 sensor
- Recalibrate the zero point of the electrochemical O_2 sensor
- Recalibrate the measuring range of the electrochemical O_2 sensor

8.2.2.1 Calibration: O2 measuring range: Sensor inst. date

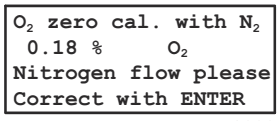


8221

You must enter the date every time a new sensor is installed. The entered date is checked for plausibility. This is followed by a full-scale calibration (AUTOCAL function) with ambient air.

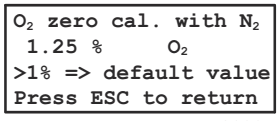
A check is also carried out during this procedure that the probe voltage is greater than 9 mV. If this is not the case, a fault message "Probe voltage too low" is output.

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



8222

You can use this function to re-adjust the zero point of the H_2S sensor with nitrogen. Connect nitrogen to the sensor and commence the calibration with <**ENTER**>.



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.

Note

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.

8.2.2.3 Calibration: O2 measuring range: Calibrate measuring range

You can calibrate the sensitivity of the electrochemical O_2 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

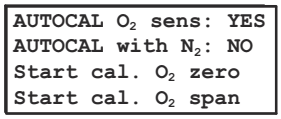
If the actual value deviates by more than approx. 20% from the setpoint determined in the factory, the message '**not o.k.**' appears instead (no calibration possible). The causes of this message can include:

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

Note: If there is no flow of calibration gas, the display in Fig. 82231 remains until the calibration gas flow exceeds the minimum value.

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

8.2.3 Calibration: Paramagnetic oxygen sensor



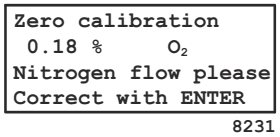
823

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

- "AUTOCAL O_2 sens"
  - YES (factory setting): The zero point or sensitivity of the paramagnetic oxygen sensor is set with each AUTOCAL. The zero point or sensitivity selection is determined by the parameter of the 2nd line 'AUTOCAL with N_2'.
  - NO: No calibration of the paramagnetic oxygen sensor during an AUTOCAL.
- "AUTOCAL with N_2"
  - YES: The AUTOCAL is carried out with nitrogen, where the zero point of the sensor is calibrated.
  - NO: (factory setting) Calibration of the span with ambient air.
- "Start cal. O_2 zero"
  This function is used to calibrate the zero point of the paramagnetic sensor
- "Start cal. O_2 span"
  This function is used to calibrate the span value or the sensitivity of the paramagnetic sensor and to adjust the setpoint.

8.2.3.1 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.



8231

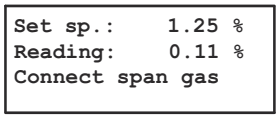
If the adjacent display appears, start the flow of nitrogen and wait until the displayed value has stabilized. Subsequently begin the calibration by pressing the <**ENTER**> key.

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 (Page 34).

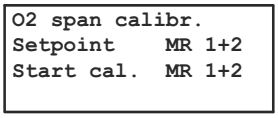
8.2.3.2 Calibration: O2 paramagnetic: Calibrating the measuring range

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

Calibrating the sensitivity



82321



8223

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 vol% and 100 vol% O_2 is also possible.

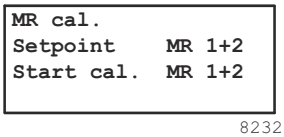
Note

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 O_2 sens" parameter there to value 'NO'.

Adjust setpoint

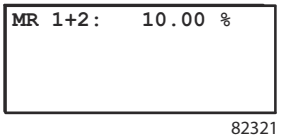
You can use this function to adjust the setpoint of the calibration gas for calibration of the measuring range.



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.



82321

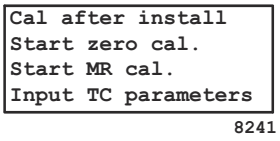
The adjacent display appears.

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

8.2.4 Calibration: H2S sensor

You first need to select the H_2S sensor in order to adjust it. To do this, navigate in the operator menu as follows:

Calibration -> Please enter code -> Calibrate sensor -> Select sensor -> H_2S sensor.



8241

The adjacent display appears.

You can now adjust the H_2S sensor as described in the following sections. The following sequence must be observed when calibrating the sensor:

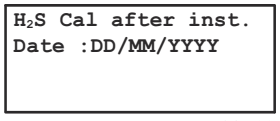
1. Enter correction factors for temperature compensation of zero point
2. Enter correction factors for temperature compensation of sensitivity
3. Caibrate zero point of the H_2S sensor
4. Caibrate measuring range of the H_2S sensor
5. Enter installation date.

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.

8.2.4.1 Calibration: H2S sensor: Defining the installation

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



82411

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'.

Note

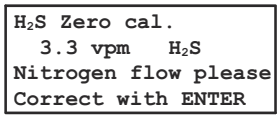
Prior to entering the installation date, you must perform a zero point and measuring range calibration of the H_2S sensor, otherwise the new date will not be accepted.

8.2.4.2 Calibration: H2S sensor: Calibrating the zero point

You can use this function to re-adjust the zero point of the H_2S sensor. As the zero gas you can use:

- Nitrogen
  or
- air free of H_2S.

To do this, navigate as follows: Calibration -> Please enter code -> Calibrate probe -> Choose component -> H_2S -> Calibrate zero.



82412

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:

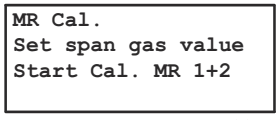
- Connect zero gas to the analyzer and observe the display.
- Wait until the displayed value has stabilized.
- Commence with correction of the zero point by pressing the <**ENTER**> key.
- Exit the calibration by pressing the <**ESC**> key.

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

8.2.4.3 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 -> H_2S -> Calibrate MR.

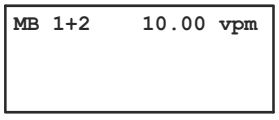


82413

The adjacent display appears.

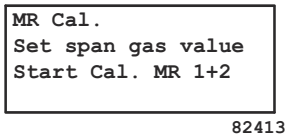
Proceed as follows to enter the setpoint:

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



82413a

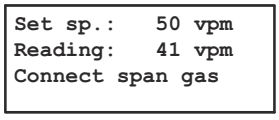
The adjacent display appears. You can now enter the setpoint of the calibration gas:



82413

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.



82413b

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

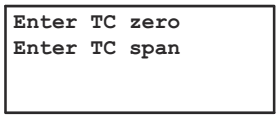
1. Connect the sample gas inlet to the calibration gas.
2. Inject calibration gas to the sensor with a flow rate of 1.2 ... 2.0 l/min.
3. Wait until the measured value has stabilized.
4. Then press the <**ENTER**> key.
5. Exit the calibration by pressing the <**ESC**> key.

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

8.2.4.4 Calibration: H2S sensor: Enter TC parameters

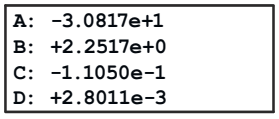
You use this function to enter the temperature compensation parameters for calibration of the zero point and sensitivity. You can read these parameters from the sensor.

To do this, navigate as follows: Calibration -> Please enter code -> Calibrate probe -> Choose component -> H_2S -> Calibrate TC parameters. The following screen appears:



82414

Temperature compensation (TC) of zero point



82414a

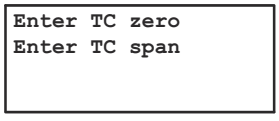
To do this, proceed as follows:

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.

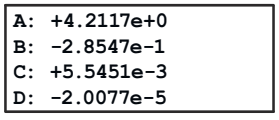
Temperature compensation of sensitivity



82414

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.

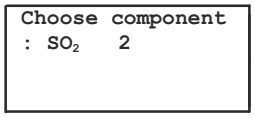


82414b

The adjacent display appears.

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

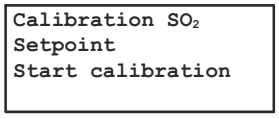
8.2.5 Calibration: Ultraviolet components



825

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**>.

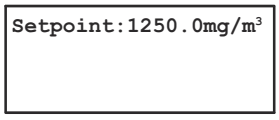
The subsequent calibration steps are performed for the SO_2 component by way of example.



8251

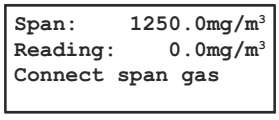
After selection of the component to be calibrated, the adjacent menu screen appears.
You can now use the cursor to select one of the lower lines and:

- Determine the calibration gas in line 2
- Start the calibration in line 3.



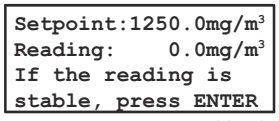
82511

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.



82512

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

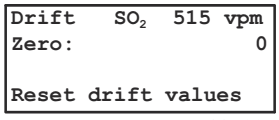


825121

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.

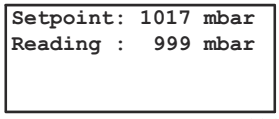
Calibration: AUTOCAL/drift values



82711a

This function is used to display the drift values of the zero point and sensitivity and to reset them if necessary. This function is described in section Calibration: AUTOCAL/drift values (Page 127).

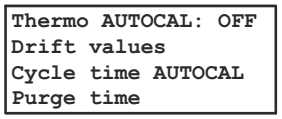
8.2.6 Calibration: Pressure sensor



826

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.

8.2.7 Calibration: AUTOCAL/drift values



827

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

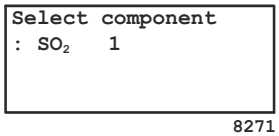
- Thermo-AUTOCAL
  - **OFF**: An automatic AUTOCAL only takes place when the set cycle time has expired (see there).
  - **ON**: An automatic AUTOCAL only takes place when the cycle time has expired. In addition, an AUTOCAL is triggered if the operating temperature has changed by more than 8 °C compared to the temperature 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.

8.2.7.1 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.

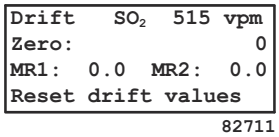
The drift parameters of the UV measuring ranges differ from those of the IR measuring ranges.



8271

This menu display appears following selection of the drift values function 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.

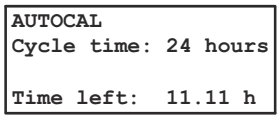


82711

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.

8.2.7.2 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.



8272

Valid cycle times are from 0 to 24 hours. A cyclic AUTOCAL is not carried out if 0 hours is set.

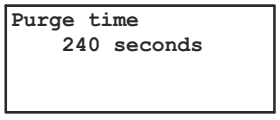
The cycle time between 6 and 24 hours must be set if the analyzer is used in German systems subject to TA Luft and 13. BlmSchV (German Federal Immission Protection Regulations).

The fourth line indicates when the next AUTOCAL will take place.

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

8.2.7.3 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.



8273

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:

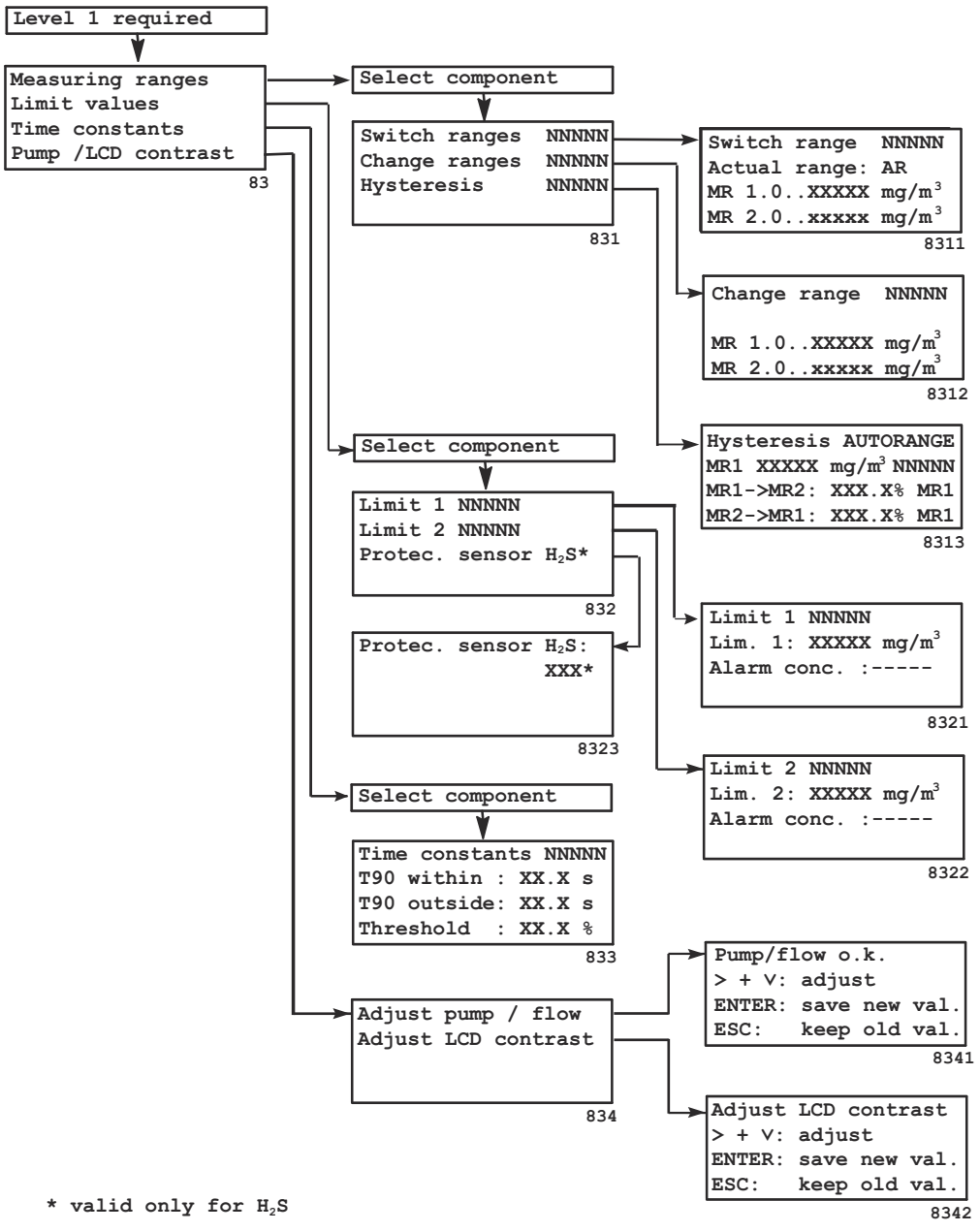
- 60 to 600 seconds for analyzers with oxygen sensor and UV module
- 300 to 600 seconds for analyzers with hydrogen sulfide sensor
- 1 to 600 seconds for all other analyzer versions.

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

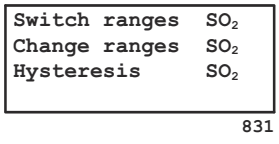
8.3 Parameter

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 (Page 97).

Access to the "Parameters" menu is protected by code level 1.



8.3.1 Parameter: Measuring ranges



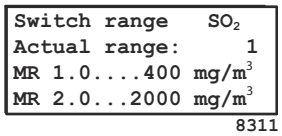
In this menu you can:

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

Note

Please note that the range parameters only refer to the measuring ranges at the analog outputs (see section Configuration: Inputs/outputs/pump: Analog outputs (Page 139)). The display always shows the complete, physically possible range.

8.3.1.1 Parameters: Measuring ranges: Switch ranges

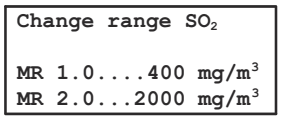


In the second line of this dialog you can set the measuring range 1 or 2 or permit autoranging (automatic switching over between these two ranges).

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-of-scale value of the analog output corresponds in this case to the full-scale value of the smaller range (MR 1), the full-scale 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 (Page 132).

8.3.1.2 Parameters: Measuring ranges: Setting measuring ranges



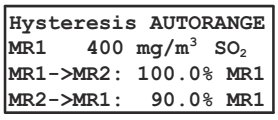
The full-scale values of the measuring ranges can be set in the third and fourth lines of this dialog. They must lie within the factory settings, i.e. if an analyzer is factory-set for a total range from 0 to 2000 mg/m³, modifications are only possible within this range. The following definitions also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

8.3.1.3 Parameters: Measuring ranges: Hysteresis

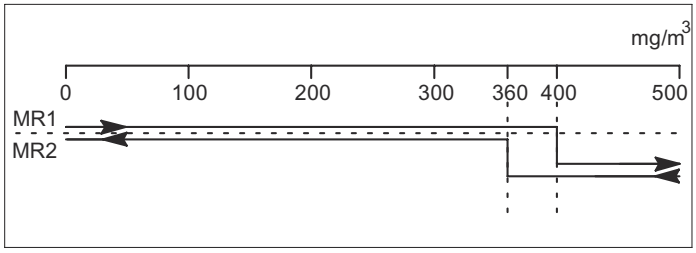


In the third and fourth lines of this dialog, you can set the value at which the analyzer switches from one range to the other. The values are specified in % of the full-scale value of range 1 (MR1) (see section Parameters: Measuring ranges: Setting measuring ranges (Page 131)).

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 (Page 130)).

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.



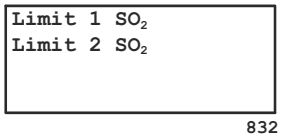
The following conditions have been assumed in the display:

- 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 SO_2 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 SO_2 is measured (=90% of 400 mg/m³).

8.3.2 Parameters: Limits

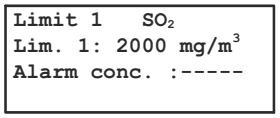


Two limits are assigned to each component, and can be set using this menu. A relay is triggered when the limits are violated (see section Configuration: Inputs/outputs/pump: Assign relays (Page 142)). Limit 1 is the lower limit, Limit 2 the upper limit.

Note

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 (Page 142)). The limits are not updated:

- During the first warm-up phase
- During an AUTOCAL
- During the message: Function control and analog output at 'Hold measured value' (see section Configuration: Inputs/outputs/pump: Analog outputs (Page 139))



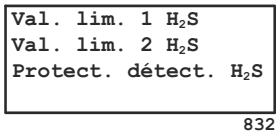
8321

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 be triggered in the third (Alarm at conc.:):

- **High**: with upward violation
- **Low**: with downward violation
- - - - -: no message

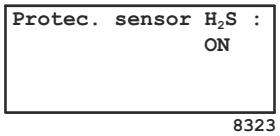
The limit value has a hysteresis of ≤ 2% of the set full-scale value.

8.3.3 Parameters: Limits: H2S sensor protection



832

If 'H_2S' is selected as the component in the higher-level menu display, the 'H_2S sensor protection' function is selected in addition to the limits. The 'Limit' function is described in section Parameters: Limits (Page 132).



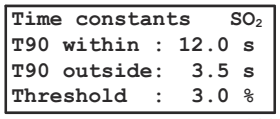
8323

In the 3rd line you can select the 'H_2S sensor protection' function.

The adjacent menu display appears when you select the function in which you can switch the 'H_2S sensor protection' function on and off.

Hydrogen sulfide (H_2S) is a corrosive gas, especially in wet condition and in combination with other gases. This function prevents damage occurring to the H_2S sensor from high concentrations of H_2S. This function is enabled by default (**ON**). Execution of this function is described in section Probe protection function (Page 159).

8.3.4 Parameters: Time constants



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 "**T_{90} 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 "**T_{90} outside**" until it falls below the threshold value again. "**T_{90} within**" then becomes effective again.

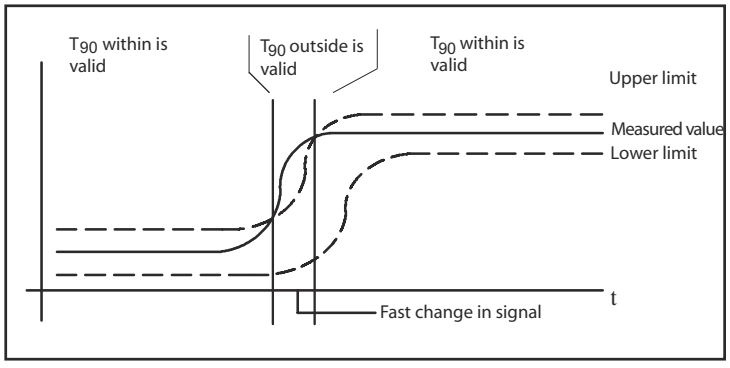
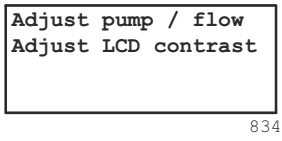


Figure 8-5 Time constants

The following values are possible for the time constants:

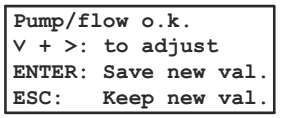
- T_{90} within: 0.1 to 99.9 (s)
- T_{90} outside: 0.1 to 99.9 (s)
- Threshold (data in %): 0 ... 100% of smallest range

8.3.5 Parameter: Pump/LCD contrast



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

8.3.5.1 Parameters: Pump/LCD contrast: Pump



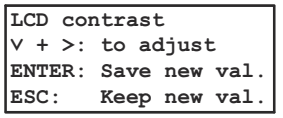
8341

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.**".

8.3.5.2 Parameters: Pump/LCD contrast: LCD contrast



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.

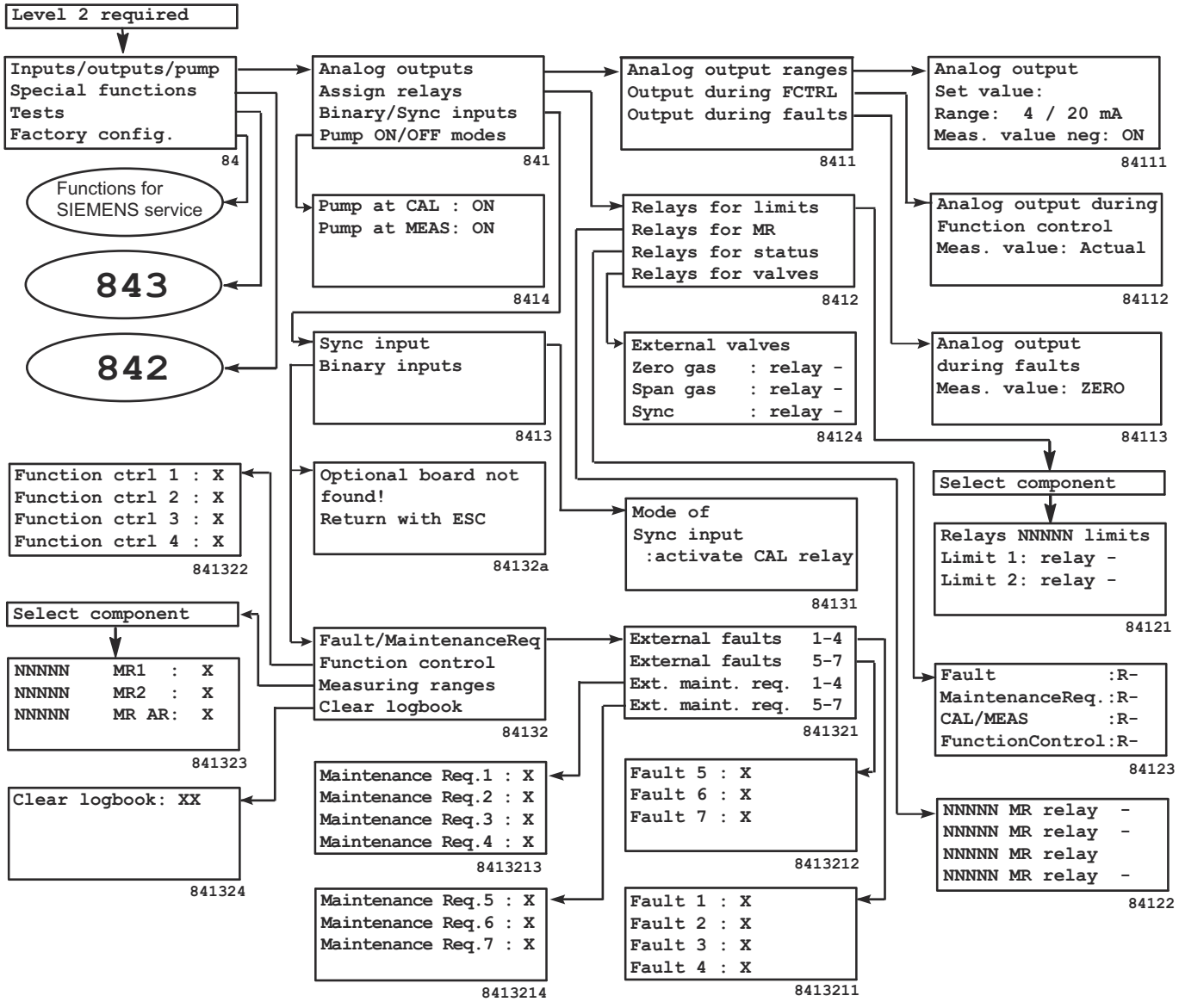
Note

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

8.4 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 (Page 97)).

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



The special functions (menu display 842) are described in section Configuration: Special functions (Page 146), the analyzer tests (menu display 843) in section Configuration: Device test (Page 155).

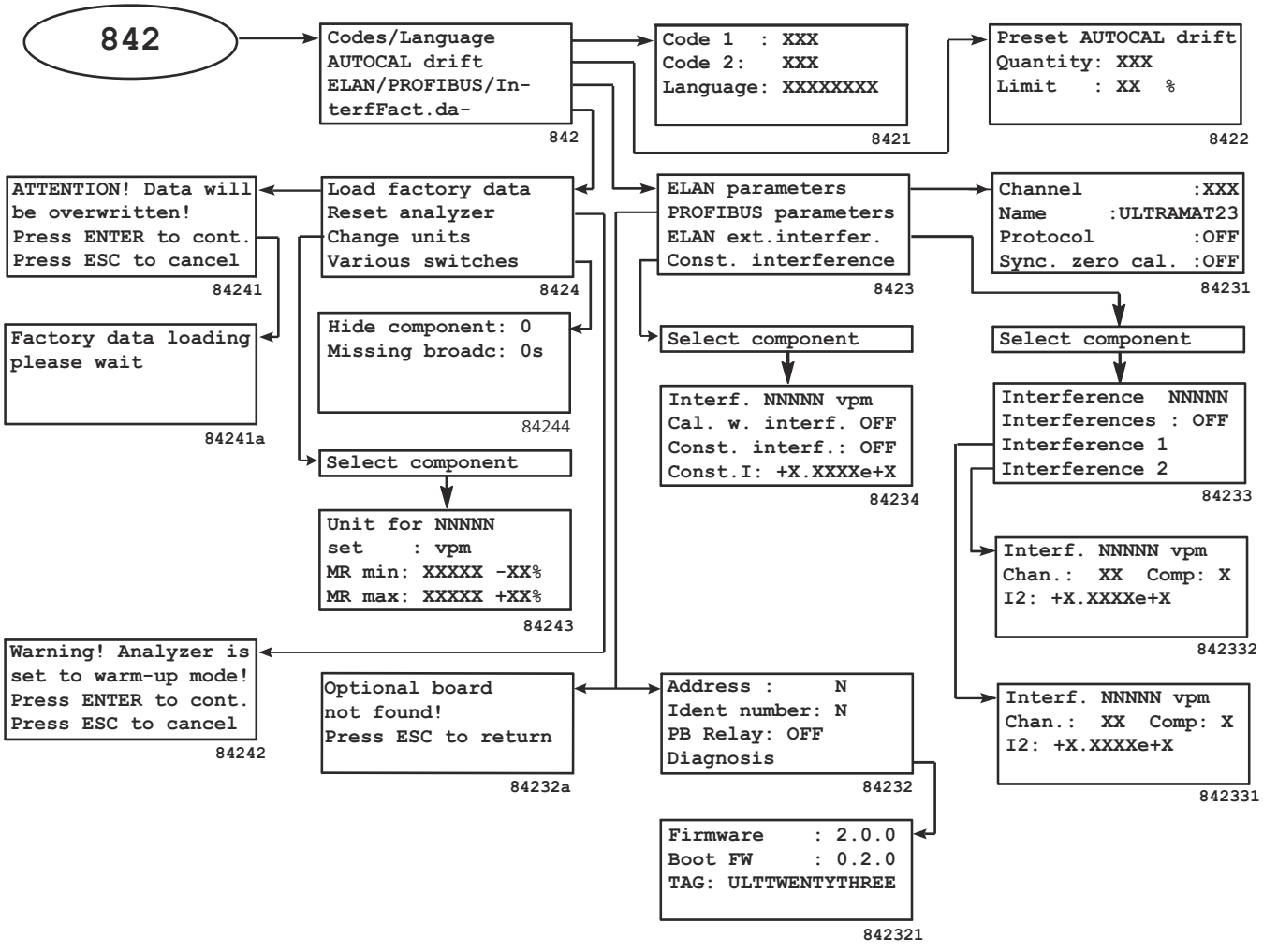


Figure 8-6 Overview of configuration of special functions

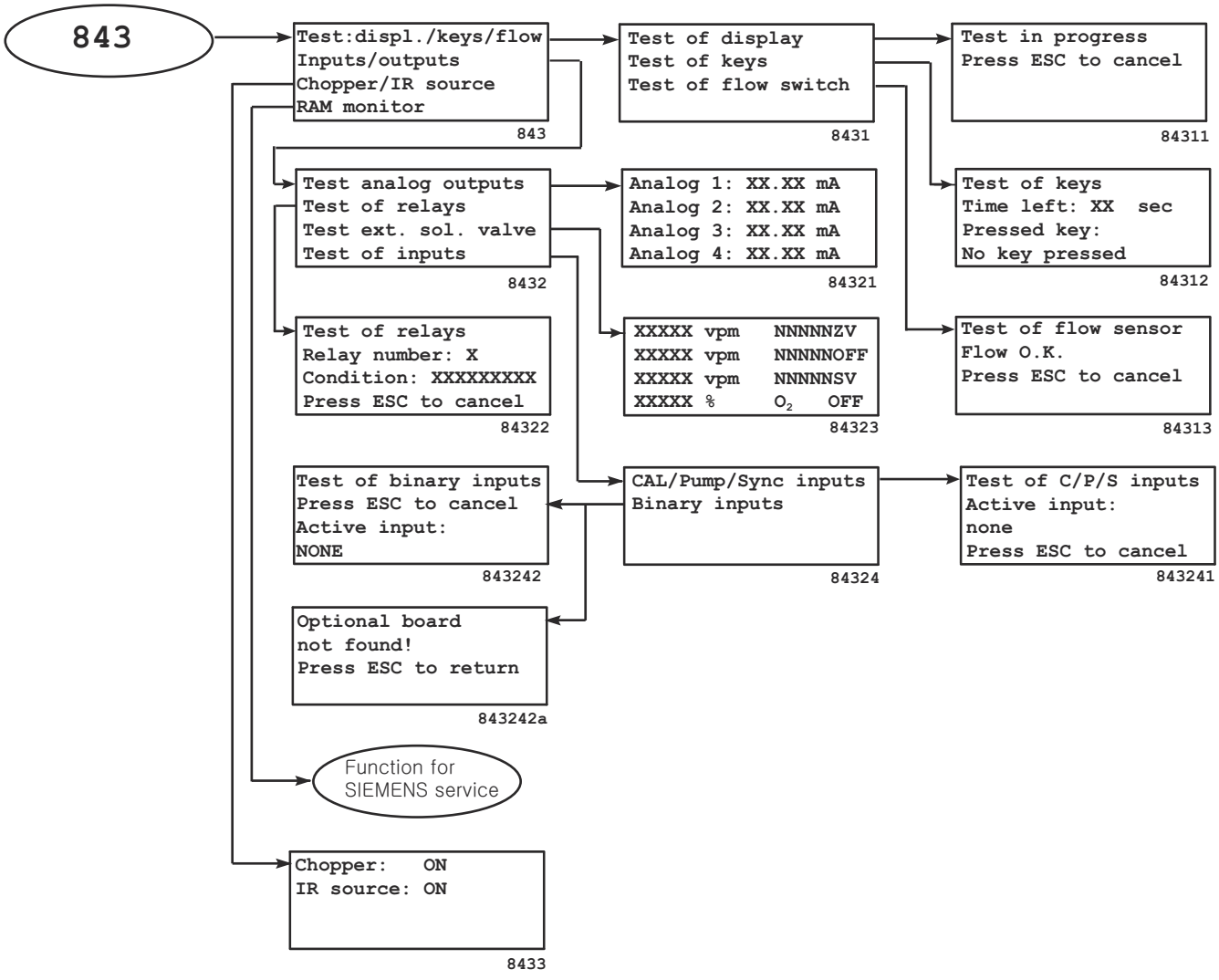
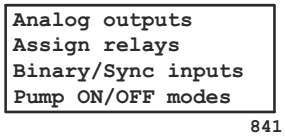


Figure 8-7 Overview of configuration of analyzer tests

8.4.1 Configuration: Inputs/outputs/pump



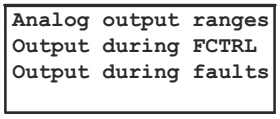
You can use this menu to assign certain functions to the following elements:

- 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

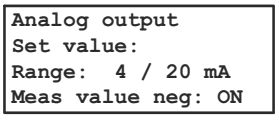
8.4.1.1 Configuration: Inputs/outputs/pump: Analog outputs



8411

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

Analog output 0/2/4/NAM mA (start-of-scale value of analog output)

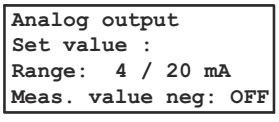


84111

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).



84111a

If the output of negative measured values is switched off ("**OFF**" position), the current output is limited to the start-of-scale 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.

Table 8-1 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

Table 8-2 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	0 mA	0 mA
2 - 20 mA	2 mA	2 mA

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

Table 8-3 Full-scale value of the analog output current for upward limiting of measured value

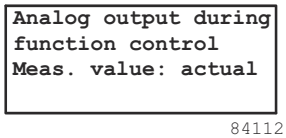
Selectable	Analog current (neg. MV on)	Analog current (neg. MV off)
0 - 20 mA	21.0 mA	21.0 mA
2 - 20 mA	21.0 mA [1)]	21.0 mA [1)]
4 - 20 mA	21.0 mA [1)]	21.0 mA [1)]
NAMUR - 20 mA	20.5 mA	20.5 mA

[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)

Note

If a fault and a function control are present on the analyzer at the same time, 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.



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 (Page 132)).
- **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

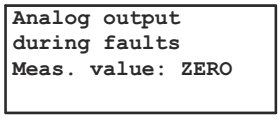
- **21 mA**:
  see following table:

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

Note

If a fault and a function control are present on the analyzer at the same time, 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.



84113

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

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 (Page 132)).
- **Actual**: The measured value is continuously updated.

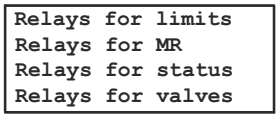
- **Zero**:
  See following table:

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

8.4.1.2 Configuration: Inputs/outputs/pump: Assign relays



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.

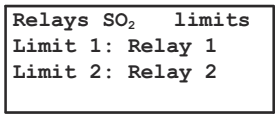
Table 8-4 **Overview of relay assignments**

Function	Relay de-energized	Relay energized	Signaling
Limit	Limit has been triggered		Limit (see section Parameters: Limits (Page 132))
Measuring range	Range 2	Range 1	-
Status messages			
Fault	Fault present		
Maintenance request	Maintenance request present		

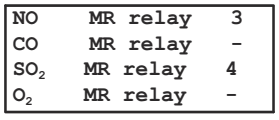
Function	Relay de-energized	Relay energized	Signaling
CAL/MEAS	Measuring; warm-up phase (5 min); purging function of the H_2S sensor; protection function of the H_2S sensor	AUTOCAL; all calibrations	AUTOCAL; all calibrations Remote operation
Function check	Function check is present		During warm-up phase (approx. 30 min without UV module, approx. 60 min with installed UV module), 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_2S 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); calibration gas for the AUTOCAL 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 (Page 55).

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



84121



84122

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.

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 (Page 129)).

```
Fault          :R-
Maintenace 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 figure means Relay).

The following signals are possible:

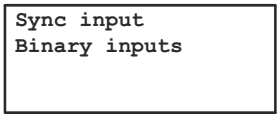
- **Fault**:
  Occurrence of a fault and output of a fault message
- **Maintenance request**:
  Occurrence of maintenance request
  (assigned to relay 5 in the figure)
- **CAL/MEAS**:
  Switching over from measuring mode to AUTOCAL (applied to relay 6 in the figure)
- **Service switch**:
  Occurrence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

```
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:

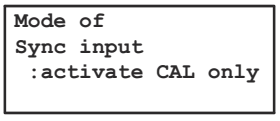
- **Zero gas**:
  The zero gas supply which is triggered with AUTOCAL
- **Span gas**:
  The calibration gas supply (assigned to relay 7 in the figure)
- **Sync**:
  Synchronization of an AUTOCAL with other devices within a system (assigned to relay 8 in the figure; see section System setup with several analyzers in parallel (Page 86)).

8.4.1.3 Configuration: Inputs/outputs/pump: Binary/sync 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:

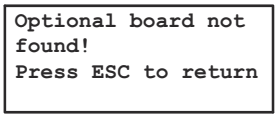


84131

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.

In the third line you can select between the following settings (see also section System setup with several analyzers in parallel (Page 86)):

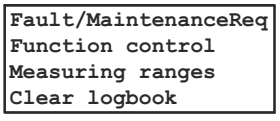
- **AUTOCAL**:
  The analyzer carries out an AUTOCAL and activates its sync output up to the end of the AUTOCAL process.
  If the flow becomes too low during an AUTOCAL triggered via the sync input, this process is aborted, and an error status set. The aborted AUTOCAL is entered in the logbook.
- **Activate 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.



84132a
843242a

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-pin connector are described in section Pin assignments (Page 55). 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.



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.

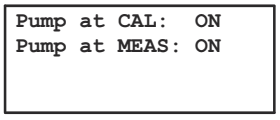
The functions are shown in the following table:

Table 8-5 Overview of binary inputs

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, ...)

Function	Control with		Effect
	0 V	24 V	
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

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

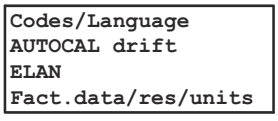


8414

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.

8.4.2 Configuration: Special functions

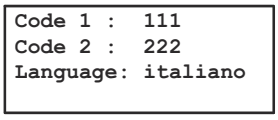


842

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

8.4.2.1 Configuration: Special functions: Changing the codes/language



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 (Page 97)).

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.

Letters and special characters can also be used for the code, in addition to 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 the 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.

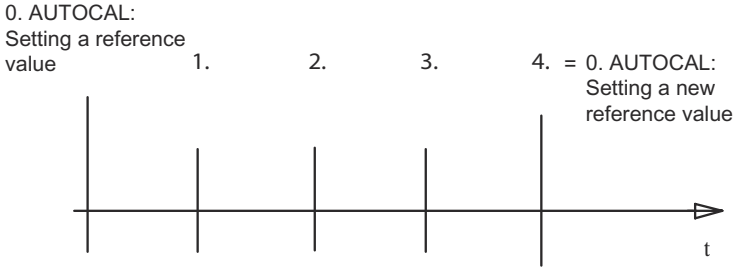
8.4.2.2 Configuration: Special functions: AUTOCAL deviation (only for IR components)

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

8422

You can use this dialog to define the conditions under which a drift from a reference value of a previous AUTOCAL 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 reference value must not exceed this value (in this example: 6%, seeCalibration: AUTOCAL/drift values (Page 127)), otherwise a maintenance request is triggered.



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.

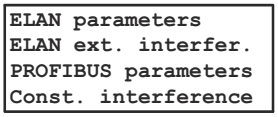
The following parameters are set at the factory:

- Number of AUTOCAL procedures up to setting of a new reference value: 10
- Maximum deviation until a maintenance request is triggered 6%
- Maximum deviation until an error is triggered: 10%

Note

This function only applies to IR components.

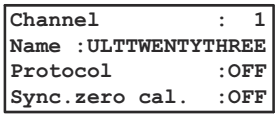
8.4.2.3 Configuration: Special functions: ELAN/PROFIBUS/external interference



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.

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



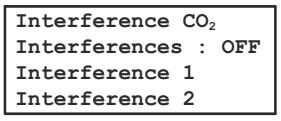
You can use this dialog to set the parameters for an ELAN network. These are:

- **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.

Note

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



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.

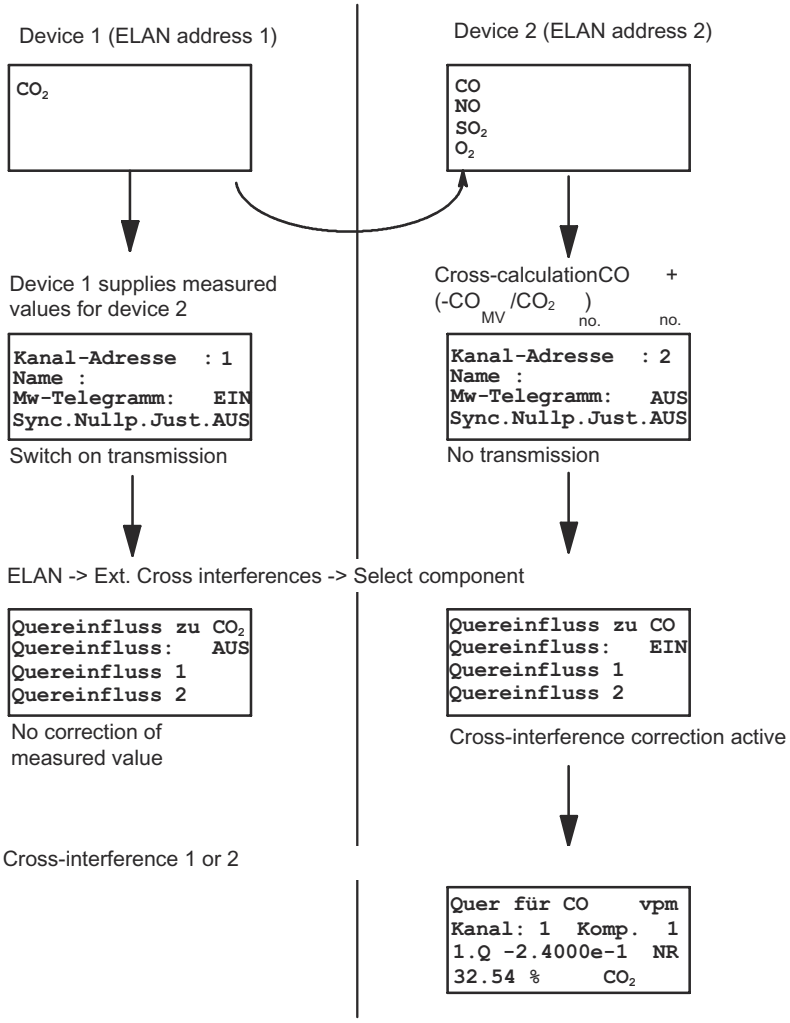
Note

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 CO_2 on CO with 6 vpm CO at 25% CO_2 via ELAN

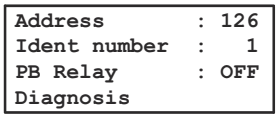
1. Use a cable to connect two analyzers at the ELAN interface.
(see interface description ELAN (C79000-B5274-C176 chap. 2)

2. Select a component via the ELAN menu (8423)

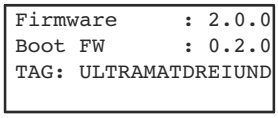


Meaning of the parameters:Channel 1 = device with address 1 in the ELAN networkComponent 1 = component 1 of the device addressed under 'Channel'. -2.4000e-1 = cross-interference of CO_2 on CO is 6 vpm CO at 25% CO_2 => correction is- 6 / 2532.54 % CO_2 = measured value sent via ELAN from device 1 component 1 to calculate the cross correction of CO

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



84233

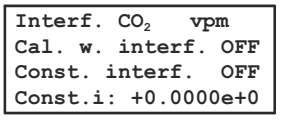


84233a

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 add-on 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).

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



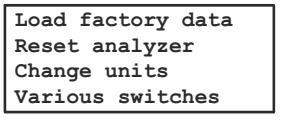
84234

After selecting this parameter, you are initially requested to determine the component for which this function applies. Afterwards, the adjacent menu display appears. 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 cross-interference is switched **ON**, the measured value of the selected component is corrected with the entered value by adding.

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

Configuration: Special functions: Factory data/reset/units

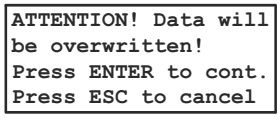


8424

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

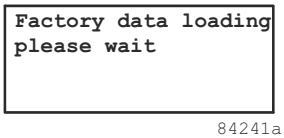


84241

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.

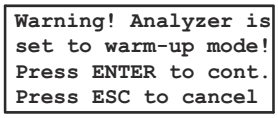
The adjacent display appears when you select this function. You define the further sequence by pressing either the <**ENTER**> or <**ESC**> key.



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

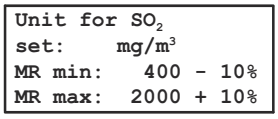


84242

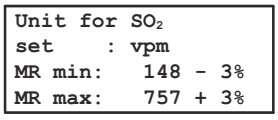
You can use this function to restart the analyzer.. When you select this function, you will be warned (see adjacent display) that the analyzer initially runs through a warm-up phase following the restart and is thus unavailable for measurements for a certain time.

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



84243a



84243a

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

After changing the unit, the display of the '**MB min**' and '**MB max**' parameters is adapted accordingly.

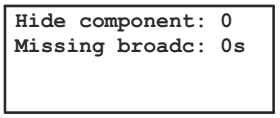
This dialog is specific to the component.

Note

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 (Page 131). In addition, you should also check these parameters following this change:

- Setpoints of the calibration gases (section Calibration: Infrared component: Set span gas values (Page 118))
- Settings for the limits (section Parameters: Limits (Page 132)).

Configuration: Special functions: Fact.data/Reset/Units:Various switches

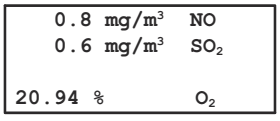


84244

Missing broadcast telegrams

The time value in seconds (1-999) specifies how long an external interference gas value via ELAN (broadcast telegram) may fail until the function check is set and the "Combined maintenance request" is issued. In addition, the overall status of the sending device contained in the broadcast telegram is evaluated. In the event of a fault or when the function check is set, the receiving device switches to the function check and also issues the maintenance request.

If the time value is 0, no broadcast telegram monitoring takes place and the last received value is used.



Hide component

This is used to hide a component (1-4) in the "Measuring mode" display. If the value is 0, no component will be hidden.

Example Display in measuring mode for "Hide comp: 3" + analyzer with NO+SO_2+NO_2+O2 gases

See also

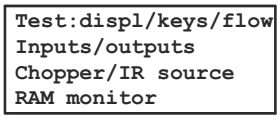
Maintenance requests (Page 181)

8.4.3 Configuration: Device test

8.4.3.1 Configuration: Device test: RAM monitor

Servicing engineers can use this function to view the contents of certain memory areas.

NOTICE
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.

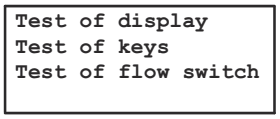


843

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.

8.4.3.2 Configuration: Device test: Display/keys/flow

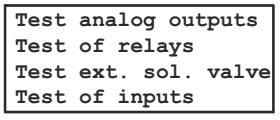


8431

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.

8.4.3.3 Configuration: Device test: Inputs/outputs

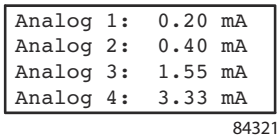


8432

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

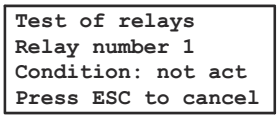


84321

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 (Page 55).

Configuration: Device test: Inputs/outputs: Test of relays



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.

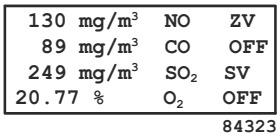
You can process the following parameters:

- **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 (add-on board) are described in section Pin assignments (Page 55).

You can exit the test by pressing the <**ESC**> key.

Configuration: Device test: Inputs/outputs: Test external solenoid valve

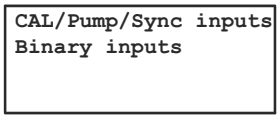


You can use this function to operate external solenoid valves for the zero gas (AUTOCAL gas) and calibration gas supplies via the relay contacts.

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



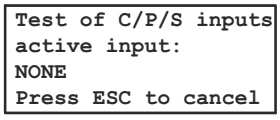
84324

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)

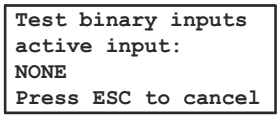
After calling this dialog, apply a voltage of 24 V DC to one of the three inputs to be tested. The result is displayed in the fourth line (here: "No active input").

The pin assignments of plug X80 (motherboard) und X50 (add-on board) are described in section Pin assignments (Page 55).



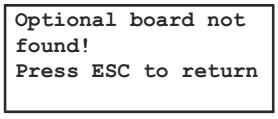
843241

Result of the CAL, pump, SYNC inputs test



843242

Result of the binary inputs test



84132a
843242a

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

8.4.3.4 Configuration: Device test: Chopper/IR source

You can use this function to switch the chopper and IR source off for test purposes.

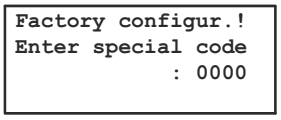
NOTICE
Device failure Incorrect execution of this function may make the analyzer permanently incapable of measuring! Therefore this function must only be carried out by qualified servicing personnel.

Note

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.

8.4.4 Configuration: Factory configuration

Overview



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.

8.5 Automatically executed functions of the H2S sensors

8.5.1 Probe protection and purging function

A protection and purging function is implemented by means of software since H_2S concentrations above the specified continuous concentration impair the functionality and service life of the H_2S probes.

In addition, a purging function is implemented for the 50 ppm H_2S probe in order to allow an intermittent measurement above the permissible continuous concentration.

These functions are executed automatically when certain operating states occur.

8.5.2 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 H_2S 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 H_2S measured value display is set to "*****"
- An "H" (H_2S 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 "H_2S probe protection" is entered in the logbook.

If the maximum continuous concentration is not exceeded again, the protection state is terminated and the H_2S 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 "H_2S 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 (Page 128).

The protection function can be enabled and disabled using the menu item **'H_2S probe protection'** (see section Parameters: Limits: H2S sensor protection (Page 133)). 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.

The following illustration show how the protection function runs over time:

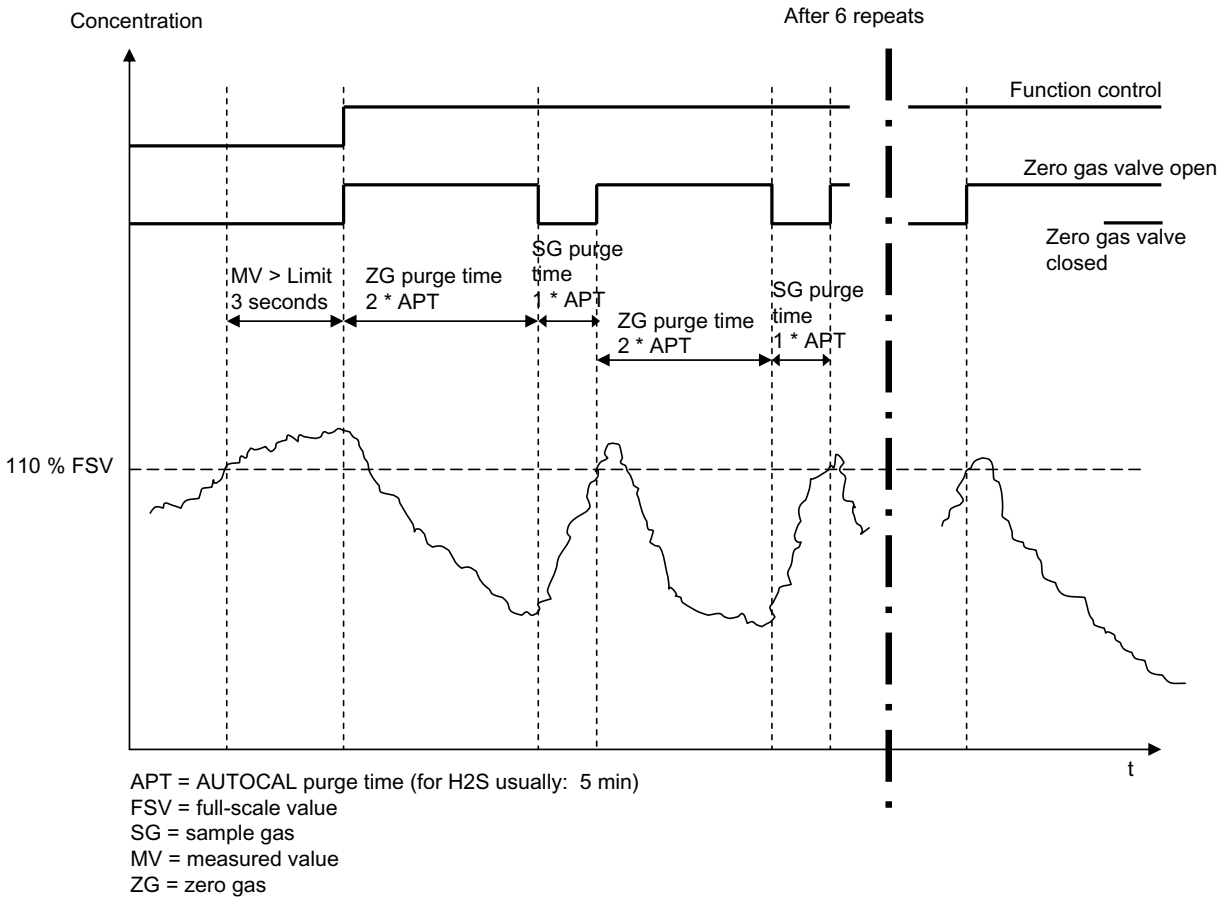


Figure 8-8 The H_2S protection function over time

8.5.3 Probe purging function

Hydrogen sulfide measurement: Purging function of 50 vpm probe

Hydrogen sulfide (H_2S) 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 (Page 159)) since H_2S concentrations above the permissible continuous concentration impair the functionality and service life of the H_2S 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 H_2S 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" (H_2S 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 pre-purging phase, and the current measured values displayed again. Monitoring of the H_2S threshold for the permissible continuous concentration is already re-activated during the pre-purging phase.

Return to measuring mode

An active purging function can be exited or interrupted if:

- The H_2S 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 (Page 128).

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:

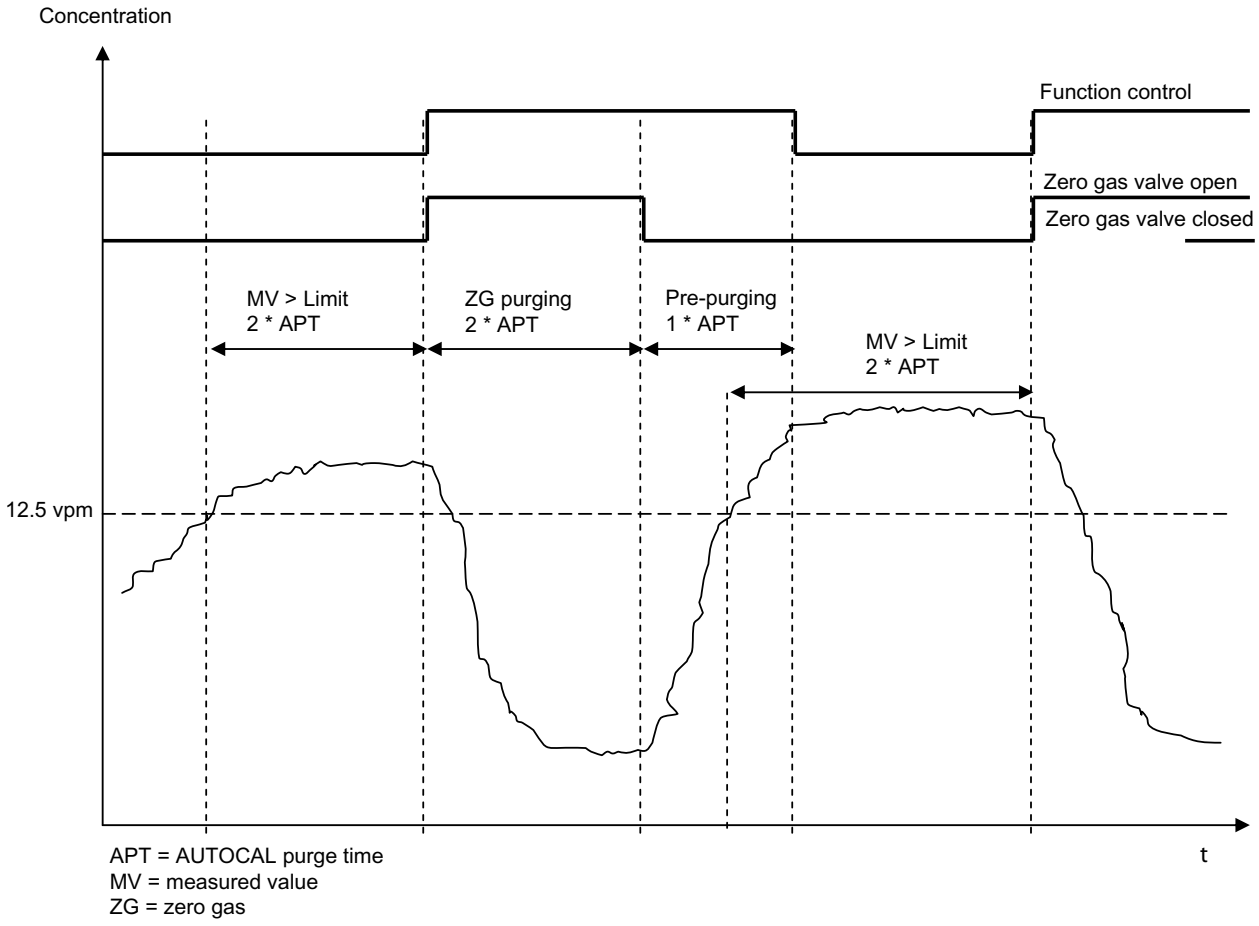


Figure 8-9 The H_2S purging function over time

Application notes for H2S measurements

9

This section reflects the experiences gained with operation of a hydrogen sulfide sensor for a measuring range of 5/50 vpm H_2S.

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 ULTRAMAT 23 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 ULTRAMAT 23 must be operated continuously since the H_2S sensor has its own battery whose voltage is retained through operation of the ULTRAMAT 23.

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, H_2S 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 H_2S concentration) and the pure gas side (low H_2S concentration), since the difference between the H_2S 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: H_2S 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.

H_2 influence

Due to its internal design, the H_2S sensor is immune to the influence of H_2.

NH_3 influence

Loading of 300 vpm NH_3 results in destruction of the H_2S 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 H_2S.

Service and maintenance 10

10.1 Safety instructions

10.1.1 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 Siemens 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.

10.1.2 Safety information for analyzers used in hazardous areas

WARNING

Impermissible repair and maintenance of the device

- Repair and maintenance must be carried out by Siemens 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 (Page 69).

10.2 Maintenance work

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.

10.2.1 Cleaning the device

Cleaning the surface

The front panels and doors are washable. Use a sponge or cloth dipped in water containing dishwashing detergent. Use only solvent-free, commercial detergents.

Clean the display and the membrane keyboard with care and without pressure using a moist cloth. Water must not enter the interior of the device.

Cleaning the interior

WARNING

Dangerous voltage at open device

After opening the analyzer, voltages that are dangerous to the touch are openly accessible.

- Isolate the device from power before you open it.

Open the device. If necessary, you can blow out the interior carefully with a compressed air gun.

10.2.2 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.

10.2.3 Replacing spare parts

⚠ CAUTION

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 by a Siemens certified service center 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 ULTRAMAT 23, 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 (41 °F) occur at the installation location. This temperature dependence will not occur if you activate a cyclic AUTOCAL of e.g. 3 hours.

We recommend having temperature compensation performed by a Siemens certified service center.

10.2.4 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.

Note

Only fuses of the type printed on the rear of the analyzer may be used (see also section Electronics (Page 195)).

10.2.5 Replacing the fine safety filter

To replace the filter, proceed as follows:

- Loosen the two lid screws on the back of the unit. Push the lid about 2 cm towards the rear panel. You can then lift the lid upwards.
- 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.

10.2.6 Maintenance work on the bench-top unit

10.2.6.1 Emptying the condensation trap

Proceed as follows:

1. Switch off the pump by pressing the <**PUMP**> key.
2. Loosen the condensation trap on the front of the analyzer by tilting it slightly, and pull downwards carefully.
3. Empty the trap and dispose of the condensate according to the composition of the sample gas.
4. 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!

10.2.6.2 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 (Page 173).
3. Remove the contaminated filter.

4. Insert the new filter.
5. Push the condensation trap on again from below.

10.2.7 Replacement of the UV module

Only specially trained personnel are permitted to replace individual components of the UV module. For this reason, only the replacement of the complete UV module is described here.

⚠ CAUTION

Improper installation of replacement parts

Special work is required when replacing spare parts, especially on the UV module, which may only be carried out by a Siemens certified service center 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 UV module (the numbers refer to the position of the components in the figure below):

⚠ CAUTION

Danger of burns

The absorption photometer heats up to temperatures of 60 °C (140 °F) during operation. These temperatures will result in burns if you touch the module with your bare skin.

- Before starting work, ensure that the UV module has cooled off sufficiently.
- Use protective gloves.

1. Disconnect the device from the power supply.
2. Wait for at least 30 seconds so that all capacitors are completely de-energized.
3. Unscrew the two screws of the rear cover and remove the cover by pulling it back.
4. Detach all gas supply lines and plug-in connections from the UV module.
5. Remove the pressure switch from the metal wall of the UV module.
6. 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 lift up the UV module.

The UV module is installed in the reverse order.

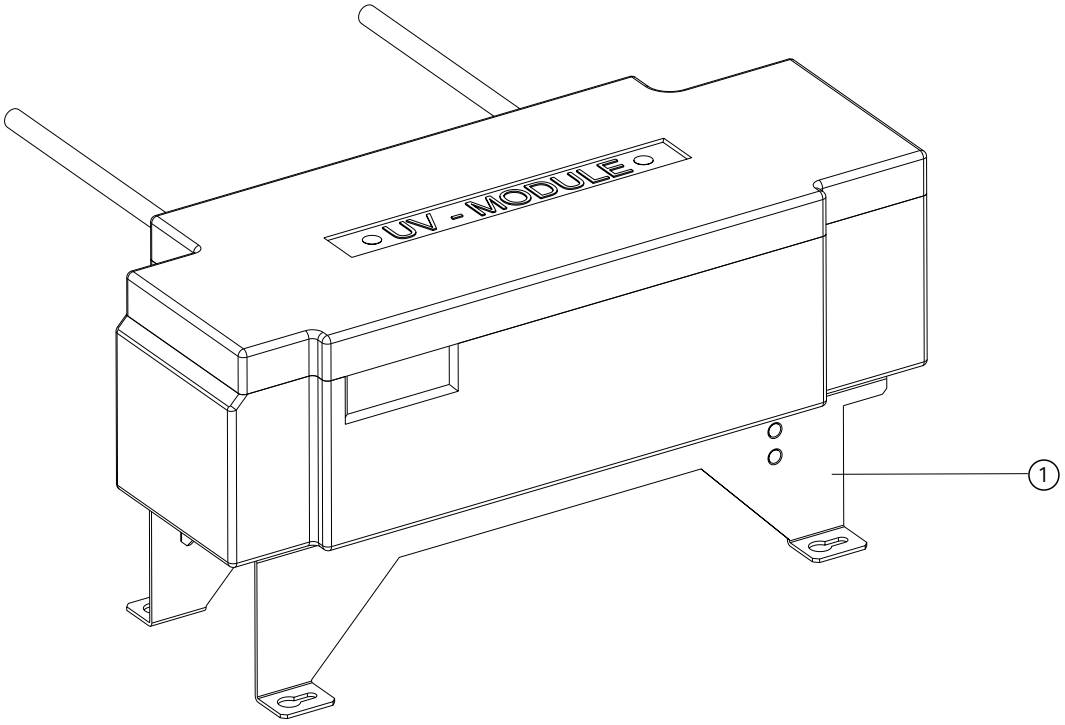


Figure 10-1 UV module

10.2.8 Replacing the electrochemical oxygen sensor

⚠ WARNING

Danger of chemical burns

The O_2S 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 O_2 sensor is hazardous waste and must be packed and disposed of accordingly!

To replace the sensor, proceed as follows:

1. The U23 should be purged beforehand and the sample gas supply must then be turned off.
2. Unscrew the two screws of the front cover and remove the cover.
3. Unlock the plug of the sensor connection, and remove.
4. Unscrew the O_2 sensor out of its holder.

5. Remove the gasket of the O_2 sensor.

   The exhausted O_2 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.

6. Insert the new gasket.
7. Screw in the new O_2 sensor and tighten hand-tight.
8. Reconnect the plug.
9. Enter the date of installation of the new sensor in the menu item "O_2 cal. after install" as described in section Calibration: O2 measuring range: Sensor inst. date (Page 119).
10. Calibrate the zero point of the new sensor as described in section Calibration: O2 measuring range: Sensor inst. date (Page 119).

10.2.9 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 H_2S 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 H_2 sensor is hazardous waste and must be packed and disposed of accordingly!

The exhausted H_2S 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!

Note

The H_2S 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 analyzer by loosening the two screws of the lid, move the lid and lift it upwards
4. Remove the connector from the H_2S sensor.
5. Unscrew the H_2S sensor out of the holder.

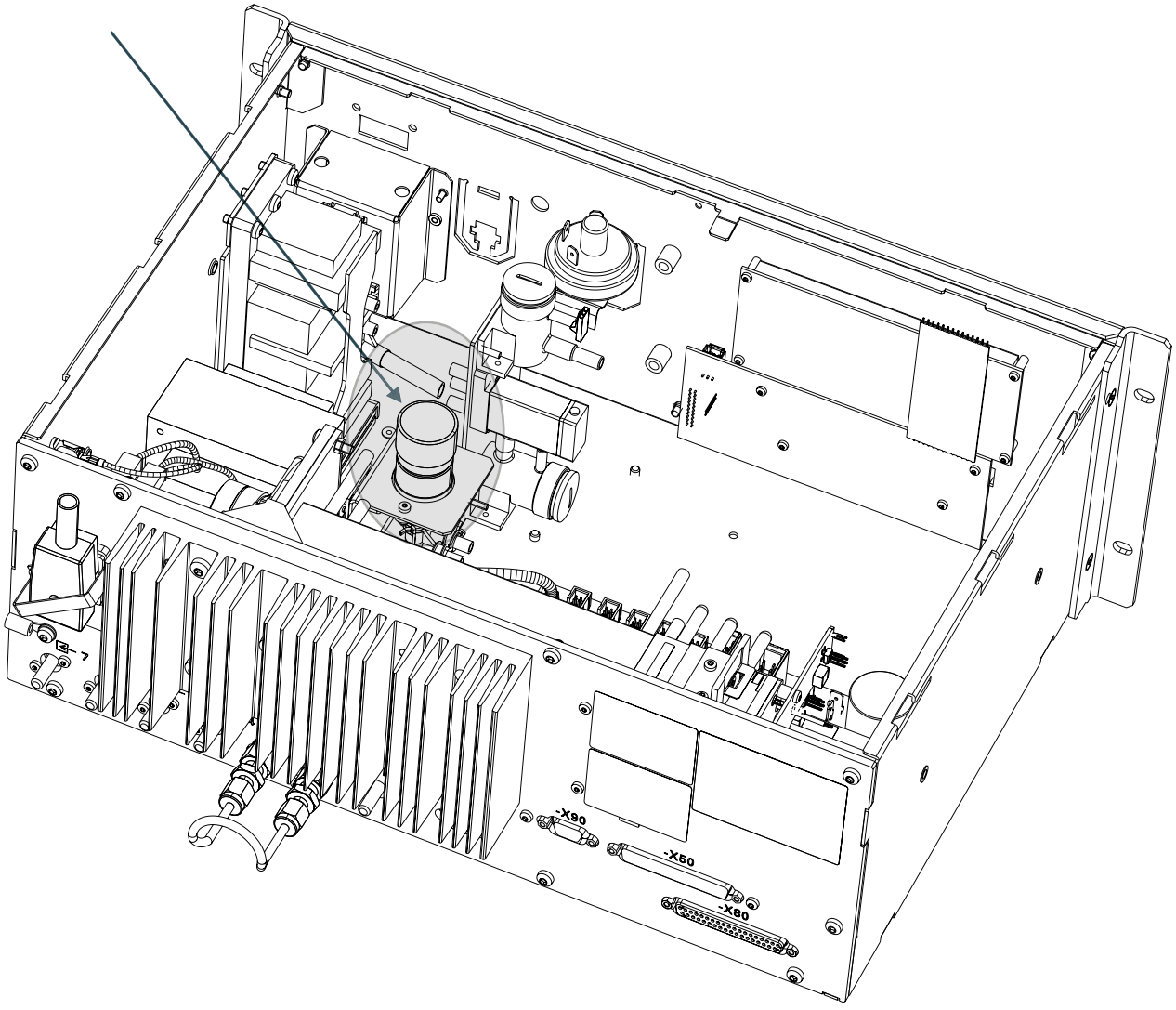


Figure 10-2 Position of the H_2S sensor in the analyzer

Proceed as follows to install the new sensor:

1. Tighten the new H_2S sensor by hand in the holder up to the mechanical limit

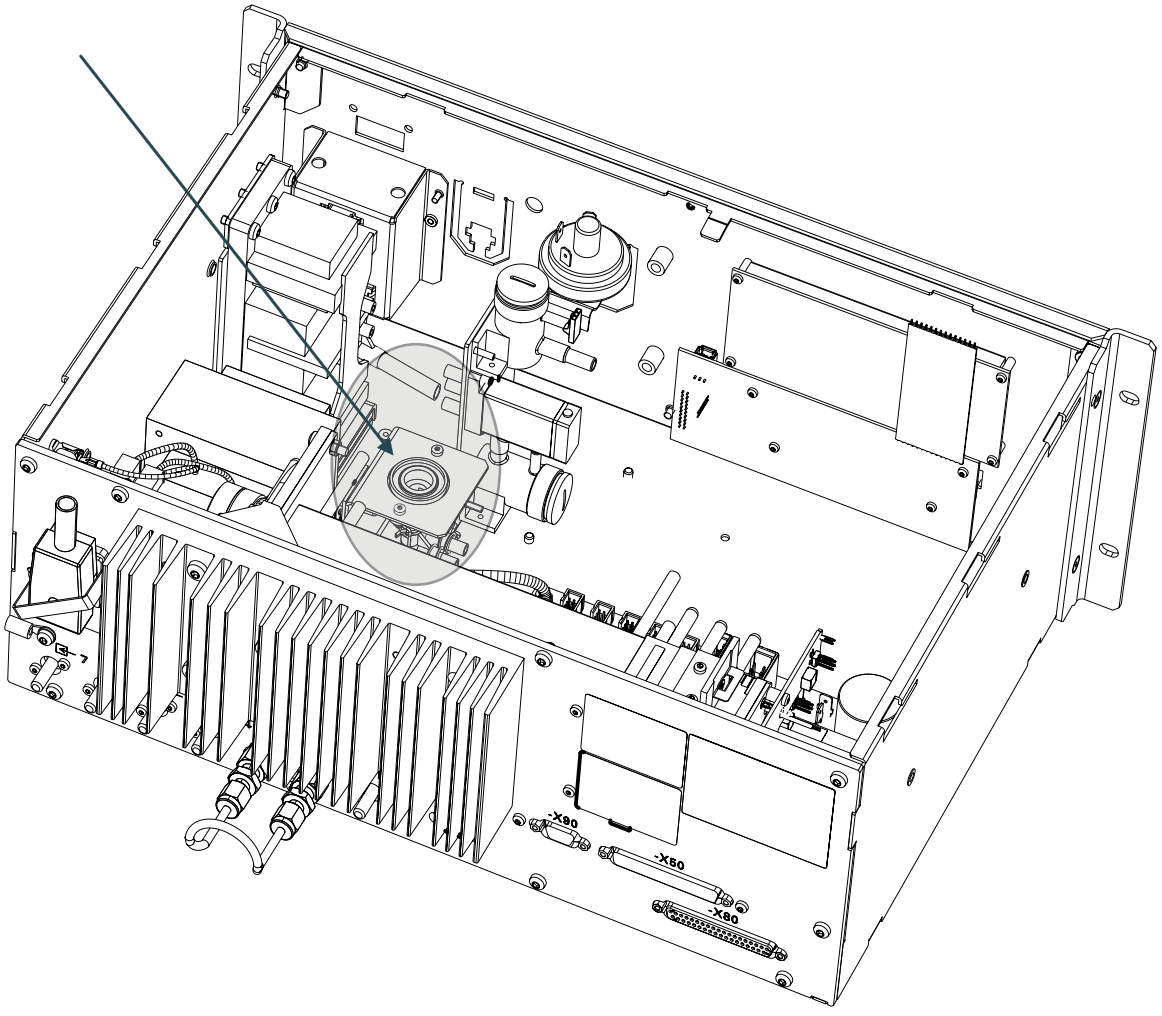


Figure 10-3 Position of the H_2S sensor in the analyzer

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 (Page 82)
6. Calibrate the H_2S sensor as described in section Calibration: H2S sensor (Page 122)
7. Enter the installation date with the menu command "H_2S Installation date".

The analyzer is then ready for use again.

10.2.10 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 Return procedure (Page 219).

Error and system messages

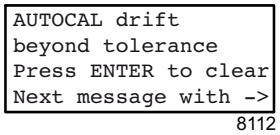
11

The analyzer can detect and display various fault statuses. These fault statuses are divided into maintenance requests and faults.

11.1 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.



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 (Page 106)). 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 (IR)**"
  The zero point of a component has drifted too much between AUTOCAL procedures. The AUTOCAL parameters can be entered as described in section Calibration: AUTOCAL/drift values (Page 127). Using the conditions defined for the AUTOCAL deviation (see section Configuration: Special functions: AUTOCAL deviation (only for IR components) (Page 148)), the actual deviation may drift 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 "**O_2 sensor**"
  The measured voltage of the O_2 sensor has dropped as a result of aging, but is still within the permissible range. This means that there is no immediate need for action, but the O_2 sensor will soon be exhausted if no action is taken. This would be the correct time to order a new O_2 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 "**H_2S sensor status**"
  If this message occurs, the measuring reserve of the H_2S sensor is almost used up. We recommend that you then replace the sensor. If the measuring reserve of the H_2S sensor is used up completely, the fault message "Measured value channel 3 beyond tolerance" is displayed. A measurement is no longer possible.

- Message "**UV LED current beyond tolerance**"
- Message "**External maintenance request**"
  These are signaled via the binary inputs. The analyzer must be equipped with an add-on board for this.
- Message "**Combined maintenance request**"
  Possible causes:
  - External ELAN broadcast timeout
  - External ELAN broadcast status ("Fault" or "Function check")

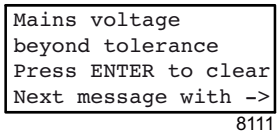
See also

Configuration: Special functions: Fact.data/Reset/Units:Various switches (Page 155)

11.2 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.



Faults are logged and can be called in input mode using the menu path "Analyzer status - Status - Logbook/faults" (see section Diagnostics: Diagnostics values (Page 107)). 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, 2 or 3 beyond tolerance, Measured value display: *****	Concentration of sample gas above the measuring range	Reduce the sample gas concentration
	Corresponding IR or UV channel is faulty	Applies to IR and UV components
Measured value H_2S beyond tolerance, Measured value display: *****	Concentration of sample gas above the measuring range	Reduce the sample gas concentration
	Sensor faulty	Replace the H_2S sensor as described in section Replacing the hydrogen sulfide sensor (Page 176)
Measured value O_2 beyond tolerance, Measured value display: *****	Concentration of sample gas above the measuring range	Reduce the sample gas concentration
	Electrochemical O_2 sensor faulty or no longer usable as result of aging	Replace the electrochemical O_2 sensor as described in section Replacing the electrochemical oxygen sensor (Page 175).

Message	Possible causes	Remedy
Supply voltage 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 on motherboard faulty	
Device temperature beyond tolerance	Ambient temperature too high or too low	Provide sufficient ventilation or air conditioning.
UV module temperature beyond tolerance	Ambient temperature too high or too low	Provide sufficient ventilation or air conditioning.
	Heating elements of the UV module faulty	Replace the UV module
	Cooling elements of the UV module faulty	Replace the UV module
Air pressure beyond tolerance	Pressure sensor faulty	Check the pressure at the connecting socket, pull off the hose if necessary
No flow during 'measuring'	Sample gas path blocked or leaky	Clean or replace the blocked parts (hose, filter etc.). If the problem persists, contact Technical Support.
	Pump not running	Start the pump as described in section Configuration: Inputs/outputs/ pump (Page 138)
	Pump capacity too low	Increase the pump capacity as described in section Parameters: Pump/LCD contrast: Pump (Page 135)
	Pump faulty	Pump must be replaced. Contact Technical Support.
	Pressure switch faulty	Pressure switch must be replaced.
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 (Page 153)
No flow during AUTOCAL	Sample gas path blocked or leaky	Clean or replace the blocked parts (hose, filter etc.). If the problem persists, contact Technical Support.
	Pump not running	Start the pump as described in section Configuration: Inputs/outputs/ pump: Pump at CAL/MEAS (Page 146)
	Pump capacity too low	Increase the pump capacity as described in section Parameters: Pump/LCD contrast: Pump (Page 135)
	Pump faulty	Pump must be replaced. Contact Technical Support.
	Pressure switch faulty	Pressure switch must be replaced.

Message	Possible causes	Remedy
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 (Page 175)
	O_2 sensor zero not calibrated	Calibrate the zero point of the O_2 sensor as described in section Calibration: Electrochemical oxygen measuring range (Page 119)
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	
AUTOCAL drift beyond tolerance	Detector contaminated	
	Receiver chamber faulty	
	IR source power too low	
AUTOCAL drift beyond tolerance (UV)	UV analyzer chamber 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, 2 or 3 not calibrated	Calibration of full-scale value / sag missing	Perform a customer calibration; if the message has not disappeared the service technician **must** perform a 3 point calibration using a calibration gas mixer.
Component 1, 2, 3 or 4 selected but not calibrated	Calibration of full-scale value / sag missing	Perform a customer calibration; if the message has not disappeared the service technician **must** perform a 3 point calibration using a calibration gas mixer.
Source voltage outside tolerance (IR)	IR source not OK	
	Motherboard faulty	
UV module voltage 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	
UV LED current beyond tolerance (1-4)	Light source (LED) faulty	Error in optical component. Replace the UV module.

Message	Possible causes	Remedy
Bridge supply voltage beyond tolerance	Channel amplifier of IR receiver faulty	
	Motherboard faulty	
Half-bridge voltage beyond 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 (Page 175)
External ADC error	Electronics faulty	
External fault	Signaling of an external fault (system-specific)	Check the connected devices for faults as described in section Configuration: Inputs/outputs/pump: Binary/sync inputs (Page 145).
H_2S Probe Protection	H_2S protection function: sample gas concentration too high	Check sample gas, see also section Probe protection function (Page 159)
Zero point of the H_2S sensor too high	Purge time too short for calibration	Repeat calibration
Sensitivity of H_2S sensor too low	Sensor exhausted	Replace sensor
UV module does not respond	Power supply unit faulty Cable of the UV module faulty or not connected Power supply of the UV module faulty	

Taking out of operation and disposal 12

The ULTRAMAT 23 may be taken out of operation for the following reasons:

- Repair
- New location of use
- Scrapping

12.1 Repair or changing of location

If the ULTRAMAT 23 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 (Page 173)).
6. Disconnect the supply hose from the condensation trap.
7. Disconnect all hose connections from the rear of the analyzer.

12.2 Scrapping the analyzer

If the ULTRAMAT 23 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 it from the analyzer (see section Replacing the electrochemical oxygen sensor (Page 175)).
7. In the case of analyzers with a hydrogen sulfide sensor, remove it from the analyzer (see section Replacing the hydrogen sulfide sensor (Page 176)).

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 (Page 173)).
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 O_2 sensor is hazardous waste and must be packed and disposed of accordingly.

The exhausted O_2 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 O_2S 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 H_2S sensor is hazardous waste and must be packed and disposed of accordingly.

The exhausted H_2S 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 H_2S 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!

Spare parts/accessories

13

13.1 Ordering of spare parts

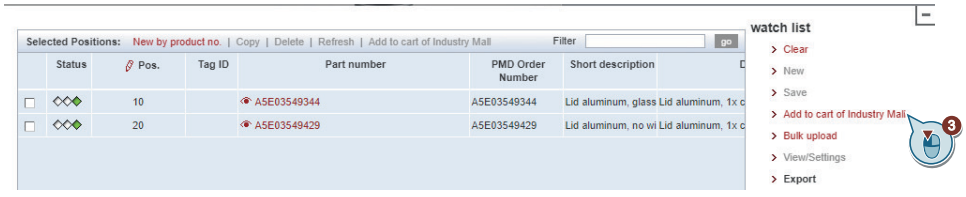
Condition

- You have a Siemens Industry Mall account.

Procedure

1. Open the PIA Life Cycle Portal (https://www.pia-portal.automation.siemens.com).
2. Select the desired language.
3. To find spare parts for your device, do one of the following:
   - Enter the complete order number of your device (e.g. 7ME4633-4KA51-8DC3-Z A05+B11+E06+F11) into the "Product number" field and click "Go".
   - Enter the serial number of your device (e.g. N1KXXXXXXX) in the "Serial number" field and click "Go".
   - If you do not know the product or serial number, search for your device under "Product family".
4. Navigate to the "Spare parts" tab.
   You see the list of spare parts available for your device.

5. Select a spare part and add it to your watch list.
   The watch list opens.
6. Click "Add to cart of Industry Mall".



The Siemens Industry Mall opens and you can order your spare part.

13.2 General note

Note

Improper repair work

Repairs of the components marked with * in this section must only be carried out by a Siemens certified service center or by qualified, specially trained personnel, as individual temperature compensation must subsequently be performed with the device.

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).

The spare parts lists of this analyzer are structured according to:

- Gas path
- Electronics unit
- Pump
- Analyzer parts and sensors

The following parts of this section contain various drawings showing the position of the spare parts in the analyzer. The parts with numbers are available as spare parts, and are described in the corresponding spare parts tables.

13.3 Gas path

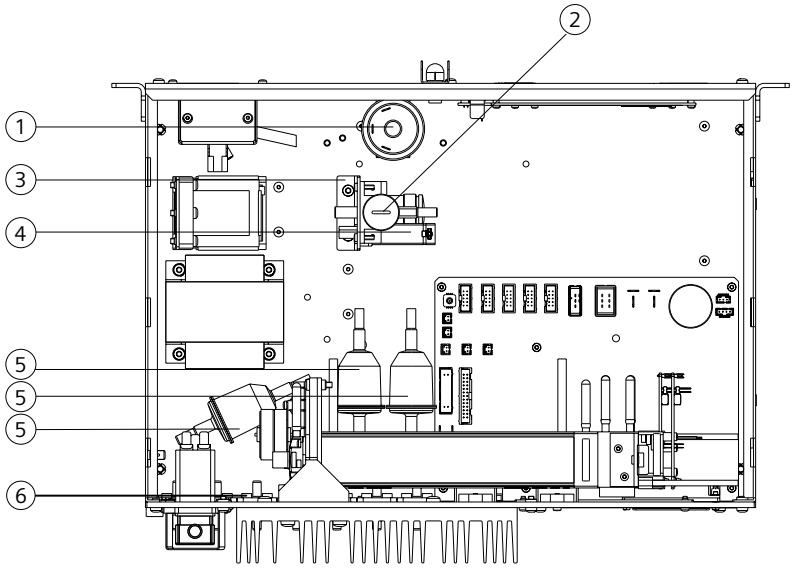


Figure 13-1 19" rack unit

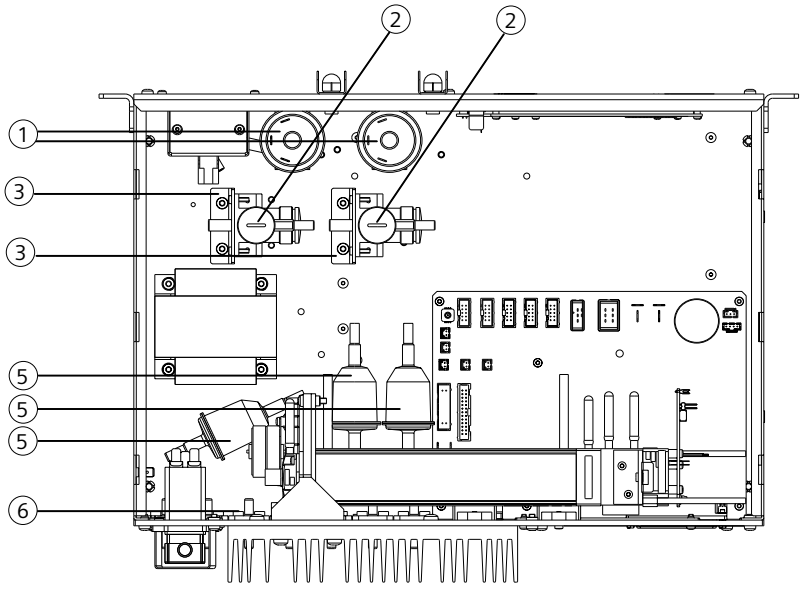


Figure 13-2 19" rack unit with separate gas paths

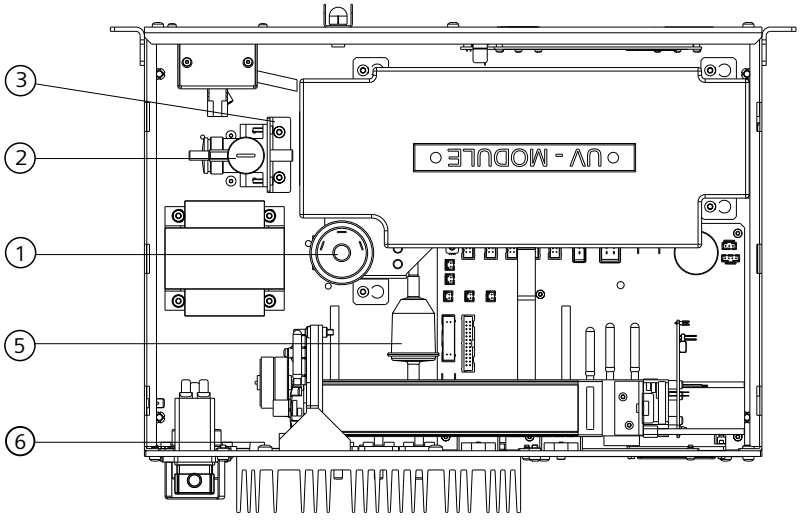


Figure 13-3 19" rack unit with UV module

Note

There are other versions of the 19" rack unit (with and without UV module), where the device socket is installed in the middle of the rear panel of the unit (measuring ranges with analyzer chamber lengths over 180 mm).

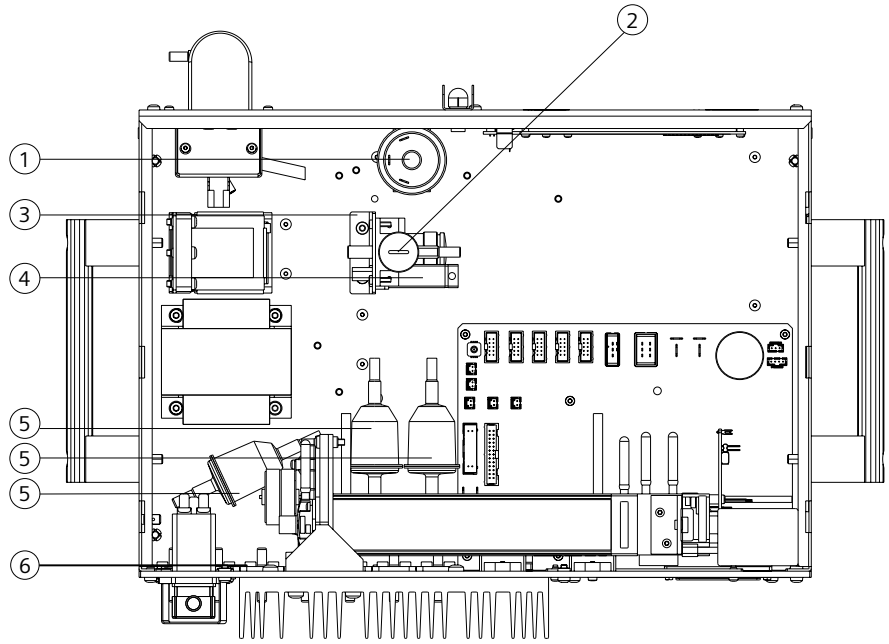


Figure 13-4 Bench-top unit

Part No.	Designation	Remarks
1	Pressure switch	
	Pressure switch cable	not shown
2	S-vessel set	consisting of: S-vessel, sealing plug, hose clamp, epoxy glue, insulating tube
3	Valve holder	
4	Solenoid valve	
5	Fine safety filter	for sample gas, zero gas or chopper compartment purging
6	Connecting socket	device specific for hose or tube 6mm/1/4"
	Set of hose connectors	not shown consisting of: T/90°- hose coupling, reduction nozzle for atm. pressure sensor/chopper compartment purging
	Set of hose clamps	not shown
	Viton hose	not shown

Accessories	Designation	Remarks
	CO_2 absorber cartridge	not shown

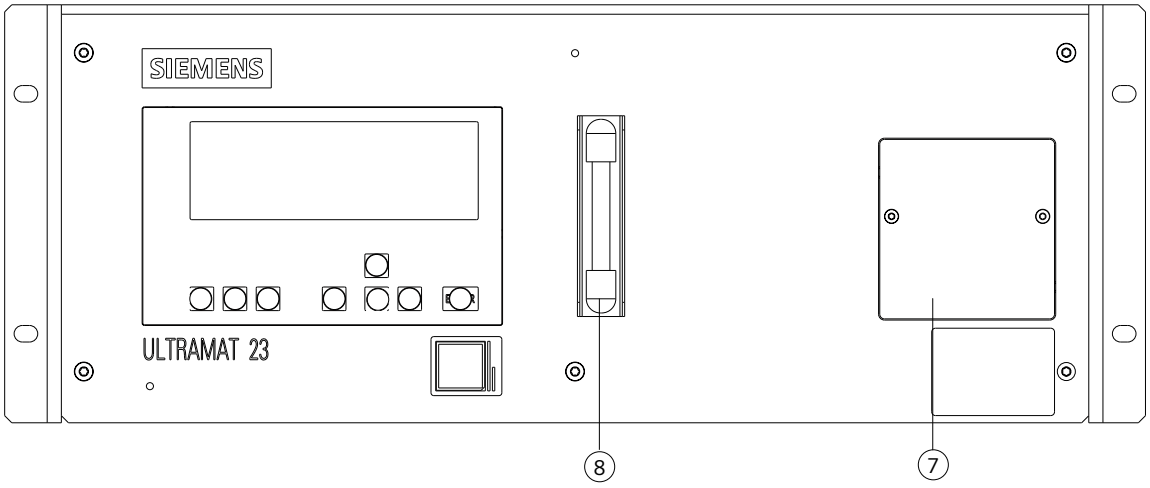


Figure 13-5 Gas path elements at front, 19" rack unit

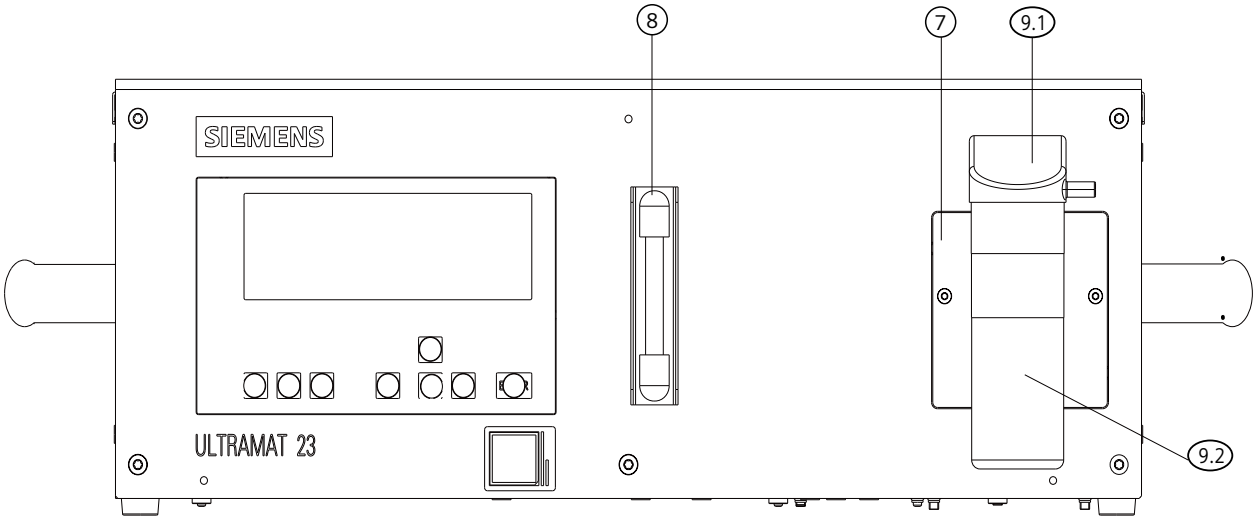


Figure 13-6 Gas path elements at front, bench-top unit

Part No.	Designation	Remarks
7	Electrochemical oxygen sensor	mounted behind the cover
8	Flowmeter	
9.1	Condensation trap	
9.2	Spare filter condensation trap	In the condensation trap, package size: 3 units

13.4 Electronics

Positions of the replaceable electronics modules in example of rack unit

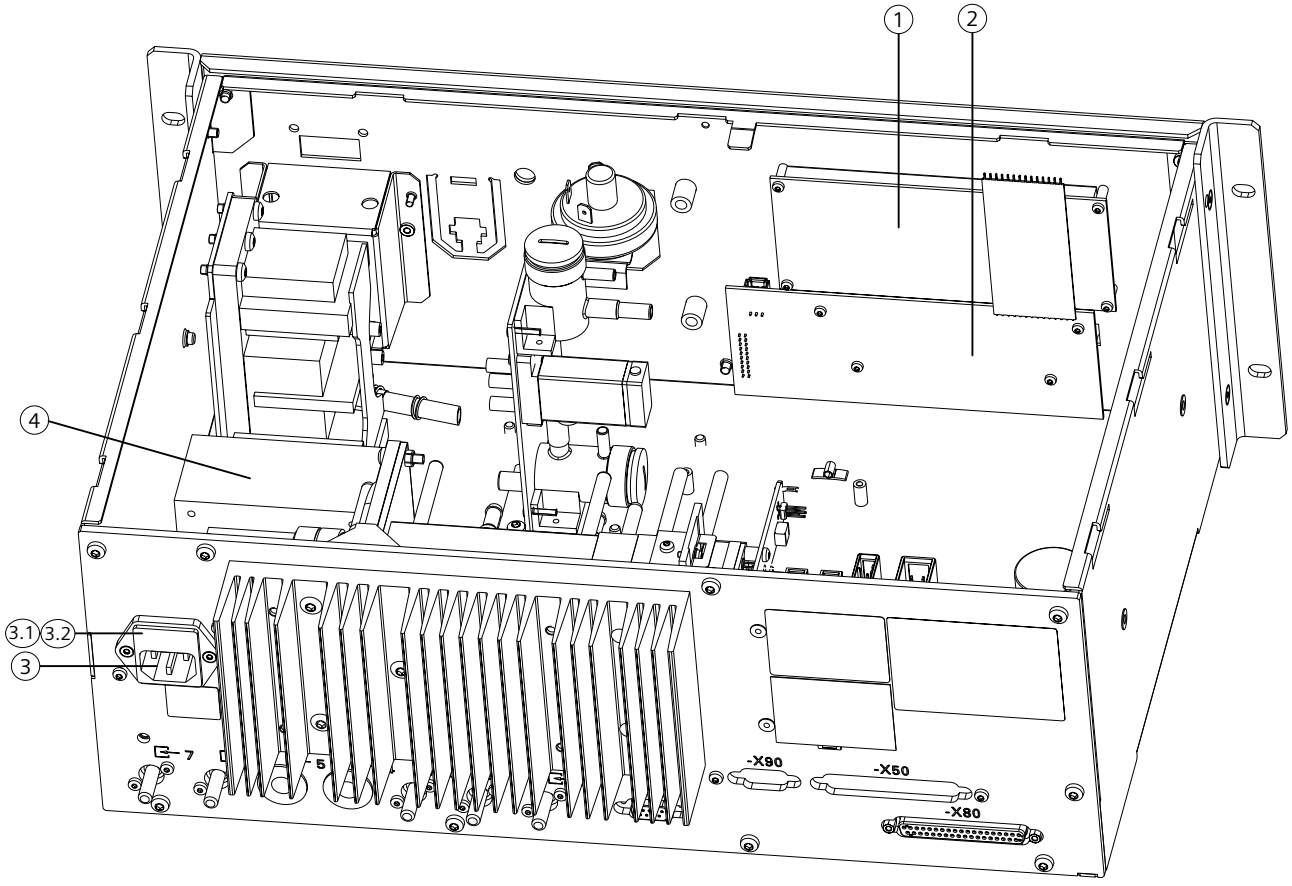


Figure 13-7 19" rack unit

Part No.	Designation	Remarks
1	LCD module	
2	Keypad	
3	Device socket with line filter	
3.1	Fuse	200 V/230 V AC; T 630 mA/L 250 V see inscription on rear of device
3.2	Fuse	100 V/120 V AC; T 1.25 A/L 250 V see inscription on rear of device
4	Mains transformer	
	Cable from receiver chamber to main board	not shown

Accessories	Designation	Remark
	Appliance coupling and SUB-D	not shown
	Tool set screwdriver	not shown
	RS232-RS485 converter	not shown

Accessories	Designation	Remark
	USB-RS485 converter	not shown
	Ethernet-RS485 converter	not shown

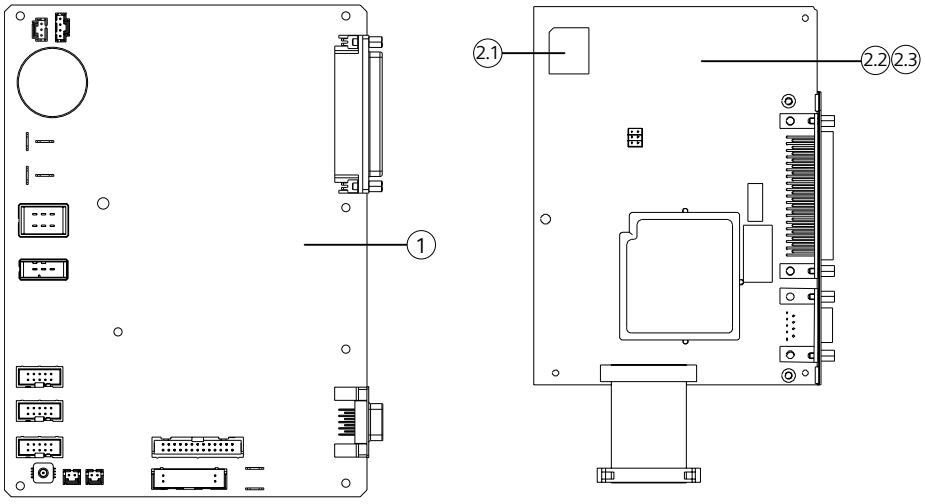


Figure 13-8 Motherboard (A) and option module (B)

Part No.	Designation	Remarks
1 *)	Main board	with firmware
2.1	Profibus firmware	

*) Following replacement of this part, special work is required which can only be carried out by a Siemens certified service center or by qualified, specially trained personnel, for example temperature compensation, basic electronic adjustment, 3-point calibration with calibration gas etc.

Accessories	Designation	Remark
2.2	Profibus DP printed-circuit board	Option module
2.3	Profibus PA printed-circuit board	Option module

For more information on updating the device firmware, see: Technical Support (http://www.siemens.com/automation/csi/service)

13.5 Pump

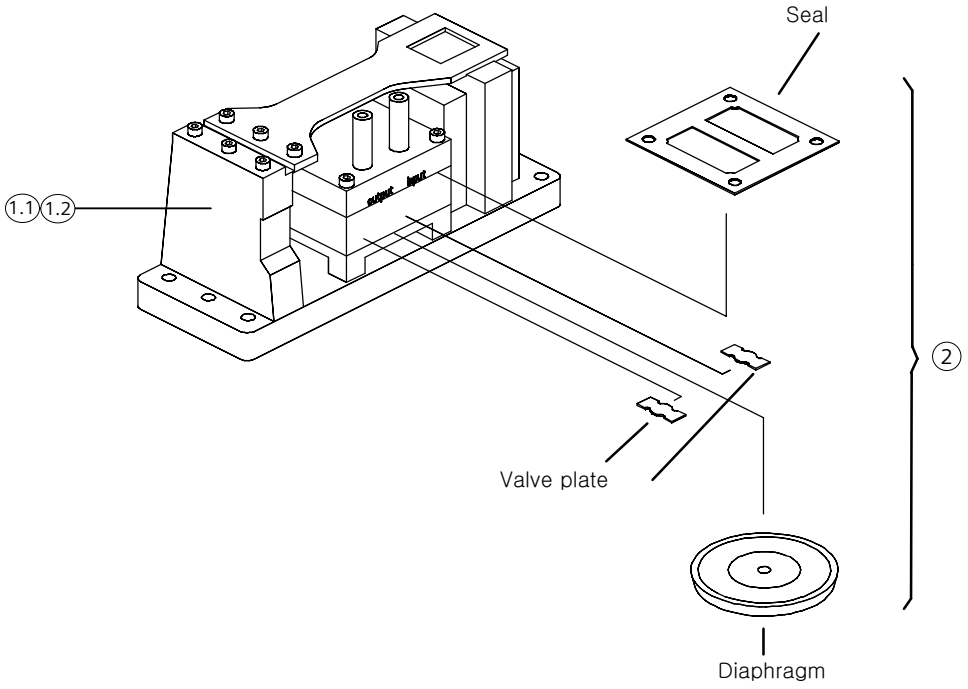


Figure 13-9 Pump

Part No.	Designation	Remarks
1.1	Sample gas pump 50 Hz	
1.2	Sample gas pump 60 Hz	
2	Sealing set	for sample gas pumps 1.1 and 1.2
	Connecting rod joint set	not shown consisting of 2 different screws, 2 metal washers, 2 different rubber dampers
	Pump holder set	not shown Consisting of pump holder, damper, pressure plate for pump holder

13.6 IR analyzer units

13.6.1 IR-analyzer unit 7MB2335-, 7MB2355-, with one measured component on the first IR channel

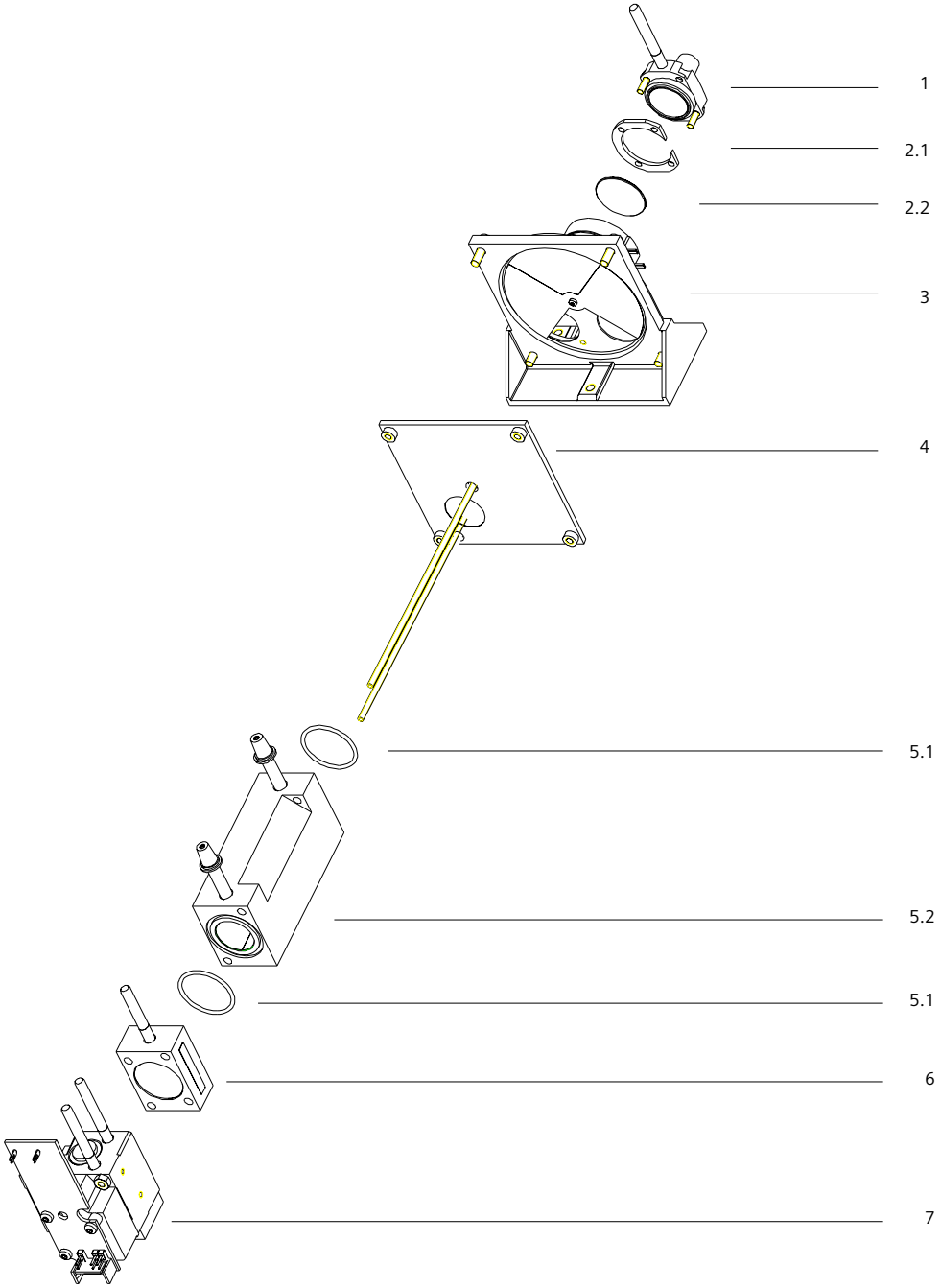


Figure 13-10 IR-analyzer unit 7MB2335-, 7MB2355-, with one measured component on the first IR channel

Part No.	Designation	Remarks
1 *)	IR source with temperature sensor	
2.1	Spacer	For IR source, if optical filter available
2.2 **)	Optical filter	
3 *)	Chopper 1-channel	
4	Chopper plate glued 1-channel	with threaded rods and windows
5.1	O-Ring for analyzer chamber	required for analyzer chamber lengths 20 mm and more
5.2	Analyzer chamber	without O-ring; analyzer chamber length depends on selected measuring range and measured component
6	Gas filter	depends on selected measuring range and measured component
7 * **)	Receiver chamber	depends on the measured component

*) Following replacement of this part, special work is required which can only be carried out by a Siemens certified service center or by qualified, specially trained personnel, for example temperature compensation, basic electronic adjustment, 3-point calibration with calibration gas etc.

**) Following replacement of this part, the water vapor cross-sensitivity must be checked.

13.6.2 IR analyzer unit 7MB2337-, 7MB2357-, with one measured component each on of the first and second IR channel

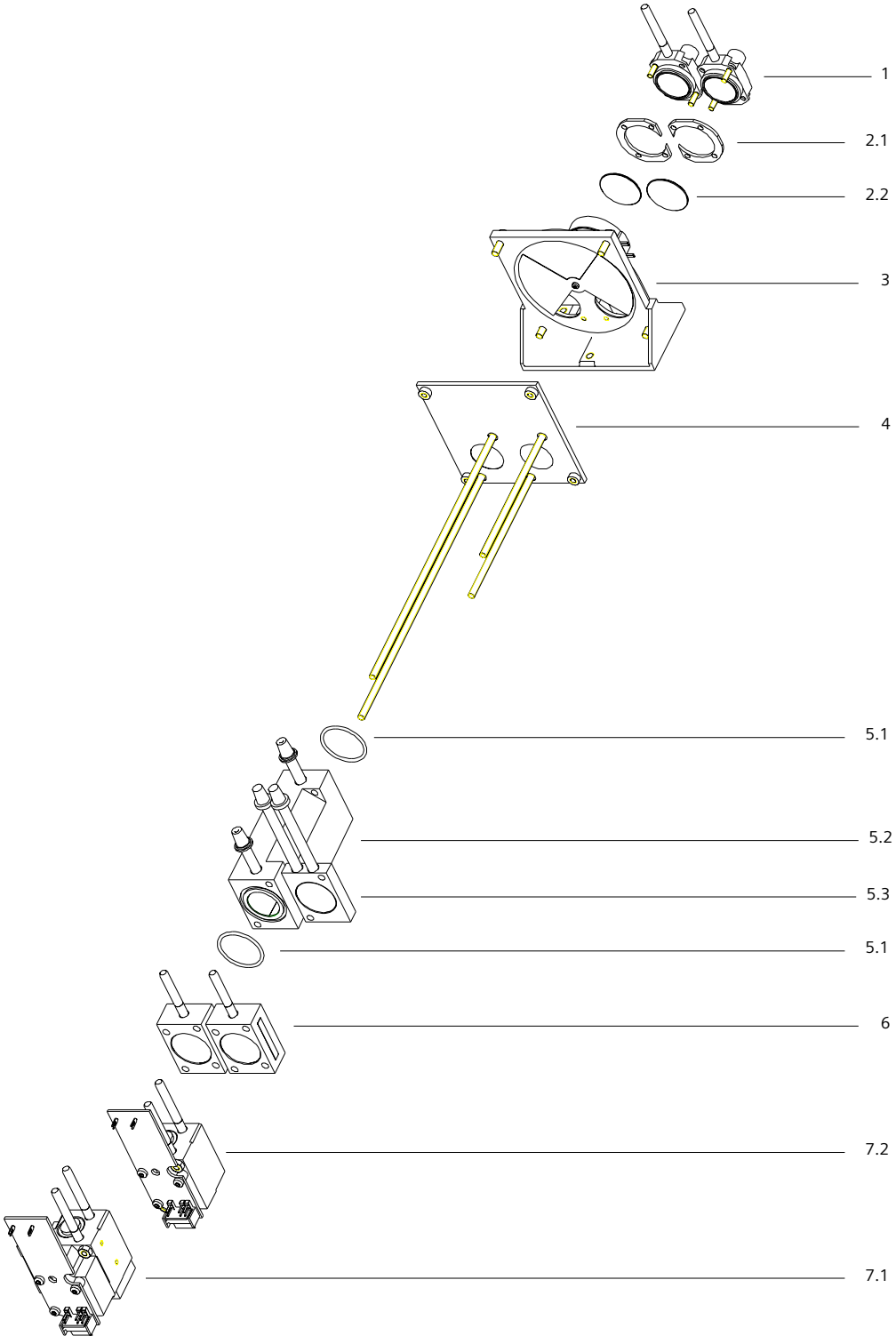


Figure 13-11 IR analyzer unit 7MB2337-, 7MB2357-, with one measured component each on of the first and second IR channel

Part No.	Designation	Remarks
1 *)	IR source with temperature sensor	
2.1	Spacer	For IR source, if optical filter available
2.2 **)	Optical filter	Depends on selected measuring range and measured component
3 *)	Chopper 1-channel or 2-channel	Version depending on the configuration
4	Chopper plate glued 1-channel or 2-channel	Version depending on the configuration with threaded rods and windows
5.1	O-Ring for analyzer chamber	Required for analyzer chamber lengths 20 mm and more
5.2	Analyzer chamber	Without o-Ring Depends on selected measuring range and measured component
5.3	Analyzer chamber	Without o-Ring Depends on selected measuring range and measured component
6	Gas filter	Depends on selected measuring range and measured component
7.1/7.2 * **)	Receiver chamber	Depends on the selected measured component

*) Following replacement of this part, special work is required which can only be carried out by a Siemens certified service center or by qualified, specially trained personnel, for example temperature compensation, basic electronic adjustment, 3-point calibration with calibration gas etc.

**) Following replacement of this part, the water vapor cross-sensitivity must be checked.

13.6.3 IR analyzer unit 7MB2338-, 7MB2358-, setup with two measured components on the first IR channel

13.6.3.1 IR analyzer unit for CO/NO (measured component and measuring range AA, AB, AC, AK)

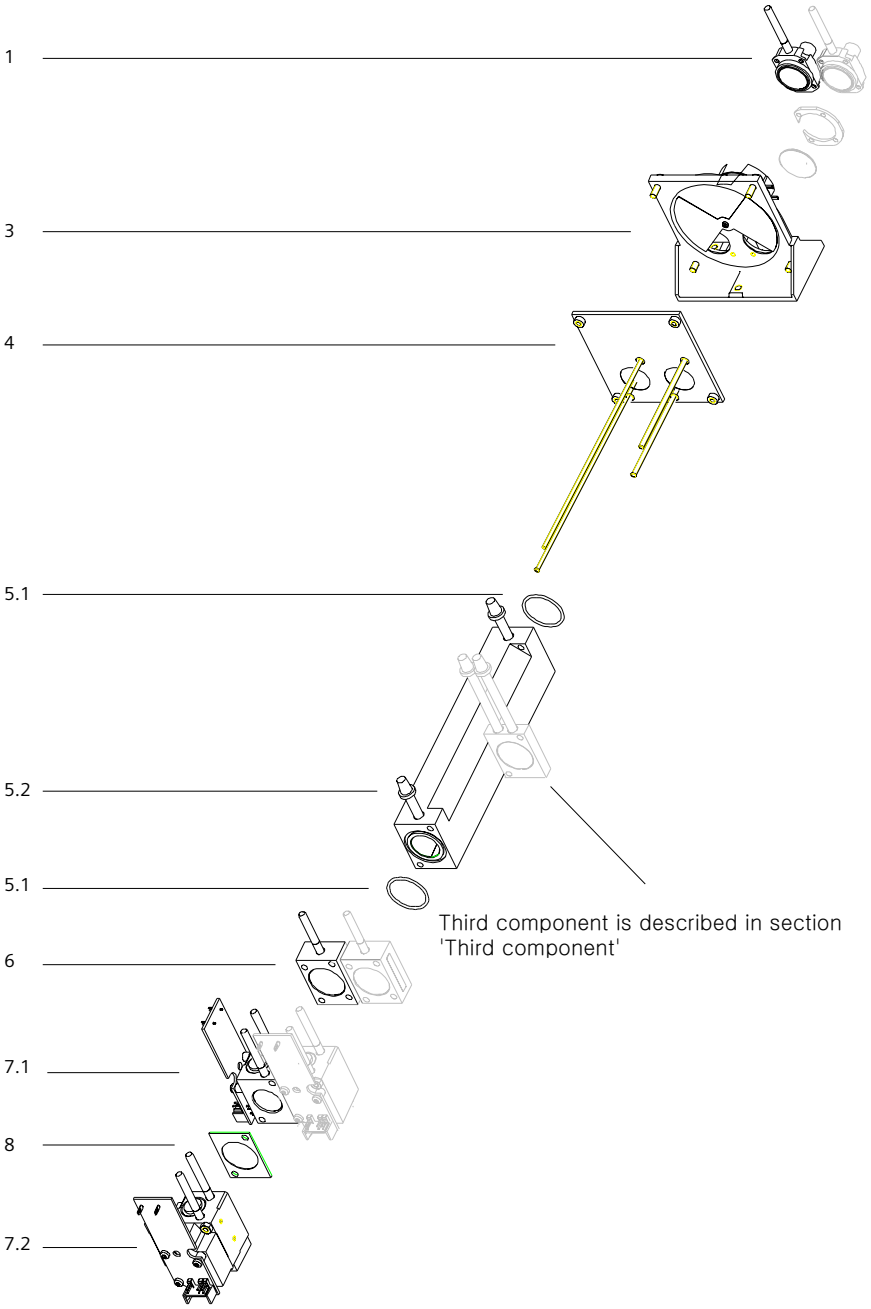


Figure 13-12 IR analyzer unit for CO/NO (measured component and measuring range AA, AB, AC, AK), setup with two measured components on the first IR channel

Part No.	Designation	Remarks
1 *)	IR source with temperature sensor	
3 *)	Chopper 2-channel	
4	Chopper plate glued 2-channel	with threaded rods and windows
5.1	O-Ring for analyzer chamber	required for analyzer chamber lengths 20 mm and more
5.2	Analyzer chamber	without o-Ring Depends on selected measuring range and measured component
6	Gas filter	
7.1,7.2 * **)	Receiver chamber	
8 **)	Optical filter	

*) Following replacement of this part, special work is required which can only be carried out by a Siemens certified service center or by qualified, specially trained personnel, for example temperature compensation, basic electronic adjustment, 3-point calibration with calibration gas etc.

**) Following replacement of this part, the water vapor cross-sensitivity must be checked.

13.6.3.2 IR analyzer unit for CO/NO (measured component and measuring range AD)

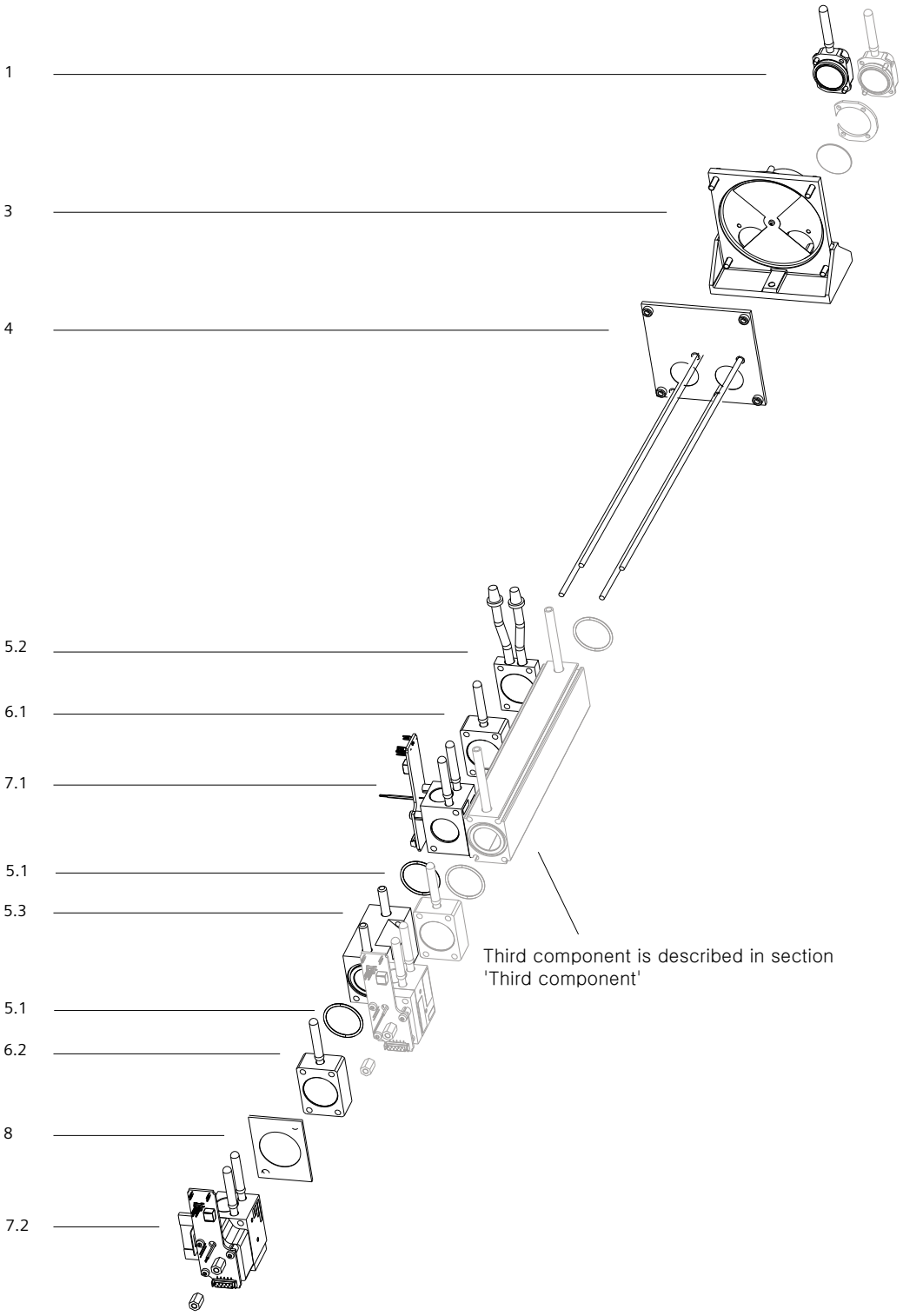


Figure 13-13 IR analyzer unit for CO/NO (measured component and measuring range AD), setup with two measured components on the first IR channel

Part No.	Designation	Remarks
1 *)	IR source with temperature sensor	
3 *)	Chopper 2-channel	
4	Chopper plate glued 2-channel	with threaded rods
5.1	O-Ring for analyzer chamber	
5.2	Analyzer chamber	
5.3	Analyzer chamber	Without o-Ring
6.1	Gas filter	
6.2	Gas filter	
7.1,7.2 * **)	Receiver chamber	
8 **)	Optical filter with filter support	

*) Following replacement of this part, special work is required which can only be carried out by a Siemens certified service center or by qualified, specially trained personnel, for example temperature compensation, basic electronic adjustment, 3-point calibration with calibration gas etc.

**) Following replacement of this part, the water vapor cross-sensitivity must be checked.

13.6.3.3 IR analyzer unit for CO2/NO (measured component and measuring range DC)

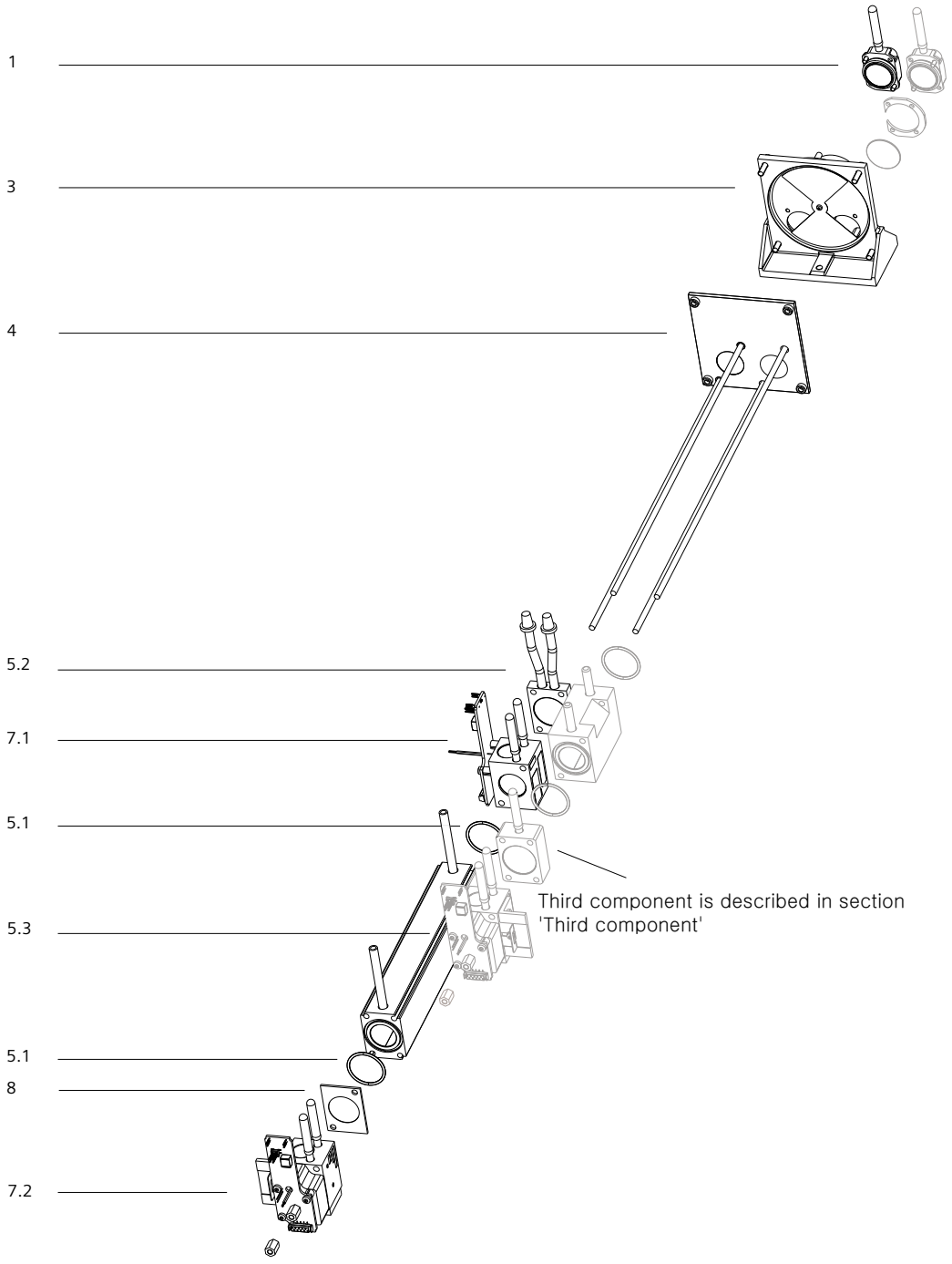


Figure 13-14 IR analyzer unit for CO_2/NO (measured component and measuring range DC), setup with two measured components on the first IR channel

Part No.	Designation	Remark
1 *)	IR source with temperature sensor	
3 *)	Chopper 2-channel	

Part No.	Designation	Remark
4	Chopper plate glued 2-channel	with threaded rods and windows
5.1	O-Ring for analyzer chamber	required for analyzer chamber lengths 20 mm and more
5.2	Analyzer chamber	
5.3	Analyzer chamber	
7.1,7.2 * **)	Receiver chamber	
8 **)	Optical filter with filter support	

*) Following replacement of this part, special work is required which can only be carried out by a Siemens certified service center or by qualified, specially trained personnel, for example temperature compensation, basic electronic adjustment, 3-point calibration with calibration gas etc.

**) Following replacement of this part, the water vapor cross-sensitivity must be checked.

13.6.3.4 IR analyzer unit for CO/CO2 and CO2/CH4 (measured component and measuring range BA, BD, CB)

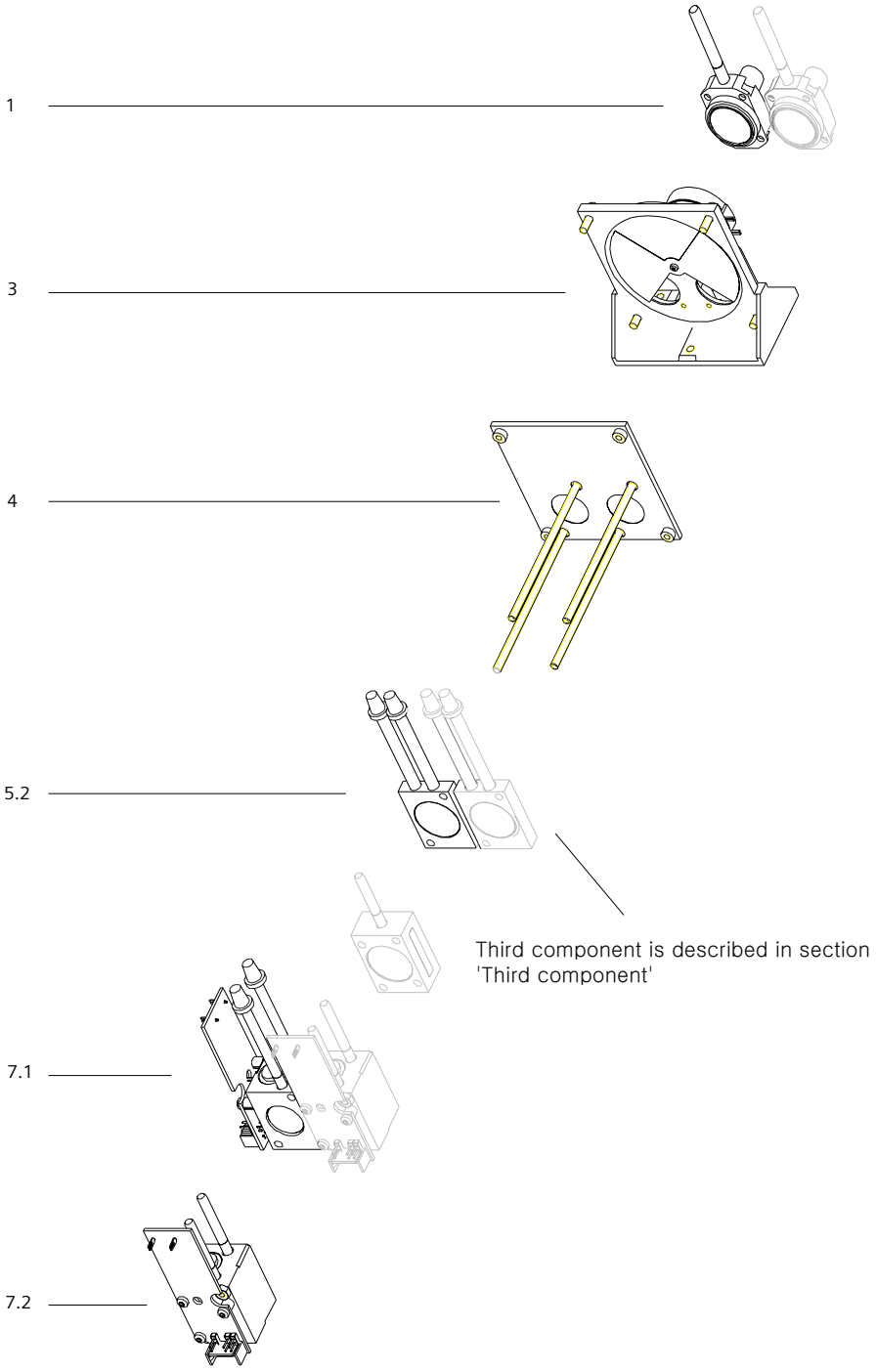


Figure 13-15 IR analyzer unit for CO/CO_2 and CO_2/CH_4 (measured component and measuring range BA, BD, CB), setup with two measured components on the first IR channel

7MB2338-, 7MB2358- (measured component and measuring range BA, BD, CB)

Part No.	Designation	Remark
1 *)	IR source with temperature sensor	
3 *)	Chopper 2-channel	
4	Chopper plate glued 2-channel	with threaded rods and windows

7MB2338-, 7MB2358- (measured component and measuring range BA)

Part No.	Designation	Remark
5.2	Analyzer chamber	Analyzer chamber 2 mm
7.1,7.2 * **)	Receiver chamber	

7MB2338-, 7MB2358- (measured component and measuring range BD)

Part No.	Designation	Remark
5.2	Analyzer chamber	Analyzer chamber 1 mm
7.1,7.2 * **)	Receiver chamber	

7MB2338-, 7MB2358- (measured component and measuring range CB)

Part No.	Designation	Remark
5.2	Analyzer chamber	Analyzer chamber 6 mm
7.1,7.2 * **)	Receiver chamber	

*) Following replacement of this part, special work is required which can only be carried out by a Siemens certified service center or by qualified, specially trained personnel, for example temperature compensation, basic electronic adjustment, 3-point calibration with calibration gas etc.

**) Following replacement of this part, the water vapor cross-sensitivity must be checked.

13.6.3.5 IR analyzer unit for CO/CO2 and CO2/CH4 (measured component and measuring range BB, CA)

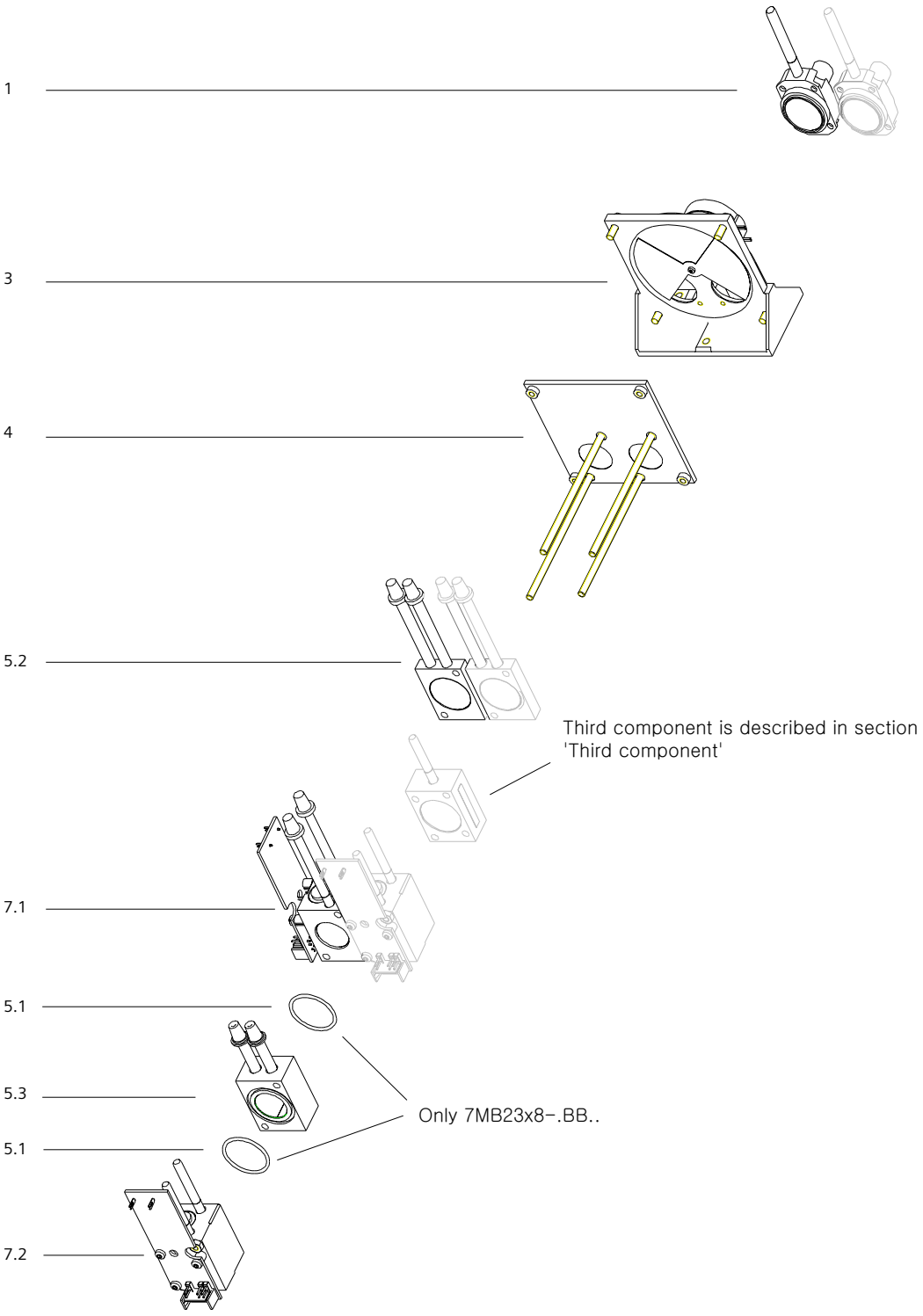


Figure 13-16 IR analyzer unit for CO/CO_2 and CO_2/CH_4 (measured component and measuring range BB, CA), setup with two measured components on the first IR channel

7MB2338-, 7MB2358- (measured component and measuring range BB, CA)

Part No.	Designation	Remark
1 *)	IR source with temperature sensor	
3 *)	Chopper 2-channel	
4	Chopper plate glued 2-channel	with threaded rods and windows

7MB2338-, 7MB2358- (measured component and measuring range BB)

Part No.	Designation	Remark
5.1	O-Ring for analyzer chamber	
5.2	Analyzer chamber	Analyzer chamber 2 mm
5.3	Analyzer chamber	Analyzer chamber 20 mm
7.1,7.2 * **)	Receiver chamber	

7MB2338, 7MB2358- (measured component and measuring range CA)

Part No.	Designation	Remark
5.2	Analyzer chamber	Analyzer chamber 6 mm
5.3	Analyzer chamber	Analyzer chamber 6 mm
7.1,7.2 * **)	Receiver chamber	

*) Following replacement of this part, special work is required which can only be carried out by a Siemens certified service center or by qualified, specially trained personnel, for example temperature compensation, basic electronic adjustment, 3-point calibration with calibration gas etc.

**) Following replacement of this part, the water vapor cross-sensitivity must be checked.

13.6.3.6 IR analyzer unit for CO2/CO (measured component and measuring range BJ, BK, BL)

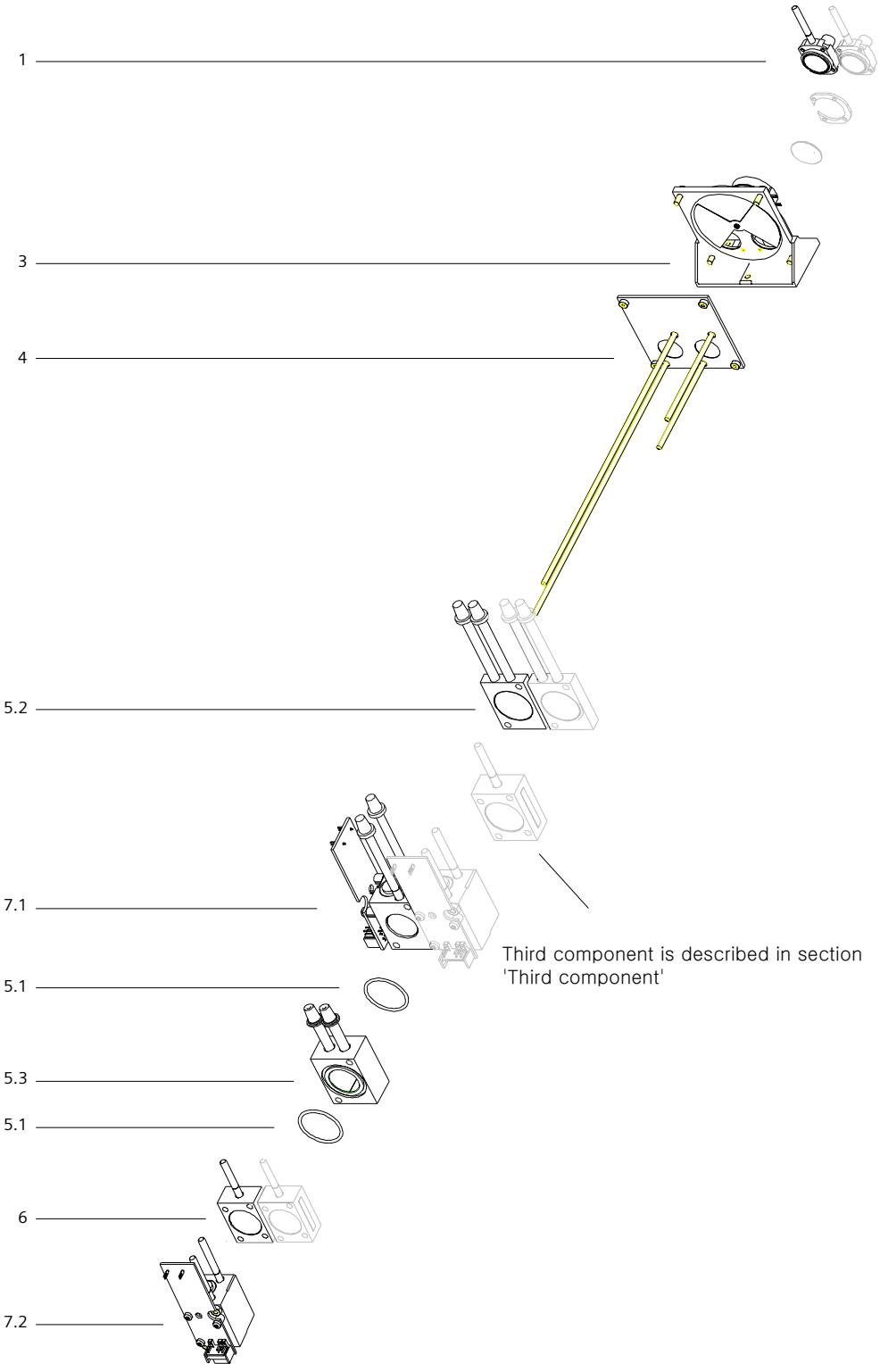


Figure 13-17 IR analyzer unit for CO_2/CO (measured component and measuring range BJ, BK, BL), setup with two measured components on the first IR channel

7MB2338-, 7MB2358- (measured component and measuring range BJ, BK, BL) for CO_2/CO

Part No.	Designation	Remark
1 *)	IR source with temperature sensor	
3 *)	Chopper 2-channel	
4	Chopper plate glued 2-channel	with threaded rods and windows

7MB2338-, 7MB2358- (measured component and measuring range BK)

Part No.	Designation	Remark
5.1	O-Ring for analyzer chamber	required for analyzer chamber lengths 20 mm and more
5.2	Analyzer chamber	Analyzer chamber 2 mm
5.3	Analyzer chamber	Analyzer chamber 20 mm
6	Gas filter	
7.1,7.2 * **)	Receiver chamber	

7MB2338, 7MB2358- (measured component and measuring range BJ, BL)

Part No.	Designation	Remark
5.1	O-Ring for analyzer chamber	required for analyzer chamber lengths 20 mm and more
5.2	Analyzer chamber	Analyzer chamber 6 mm
5.3	Analyzer chamber	Analyzer chamber 180 mm
6	Gas filter	
7.1,7.2 * **)	Receiver chamber	

*) Following replacement of this part, special work is required which can only be carried out by a Siemens certified service center or by qualified, specially trained personnel, for example temperature compensation, basic electronic adjustment, 3-point calibration with calibration gas etc.

**) Following replacement of this part, the water vapor cross-sensitivity must be checked.

13.6.4 IR analyzer unit 7MB2338-, 7MB2358-, third measured component on the second IR channel

The parts shown in light gray in the following diagram are examples of the first and second measured components on the first IR channel.

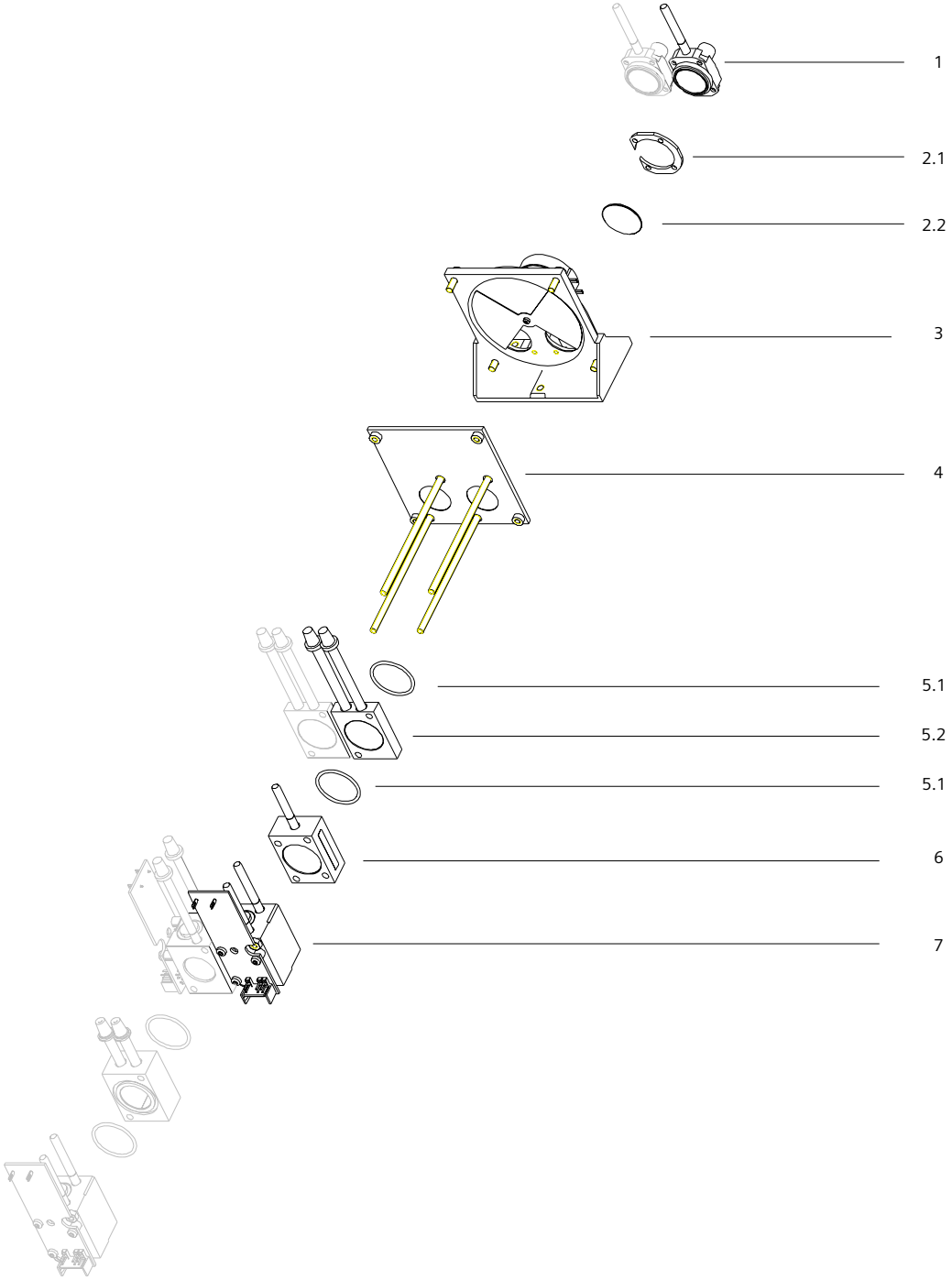


Figure 13-18 IR analyzer unit 7MB2338-, 7MB2358-, Third measured component on the second IR channel

Part No.	Designation	Remarks
1 *)	IR source with temperature sensor	
2.1	Spacer	For IR source, if optical filter available
2.2 **)	Optical filter	Depends on selected measuring range and measured component
3 *)	Chopper 2-channel	
4	Chopper plate glued 2-channel	with threaded rods and windows
5.1	O-Ring for analyzer chamber	required for analyzer chamber lengths 20 mm and more
5.2	Analyzer chamber	Without o-Ring Depends on selected measuring range and measured component
6	Gas filter	Depends on selected measuring range and measured component
7.1,7.2 * **)	Receiver chamber	Depends on the selected measured component

*) Following replacement of this part, special work is required which can only be carried out by a Siemens certified service center or by qualified, specially trained personnel, for example temperature compensation, basic electronic adjustment, 3-point calibration with calibration gas etc.

**) Following replacement of this part, the water vapor cross-sensitivity must be checked.

13.7 UV module

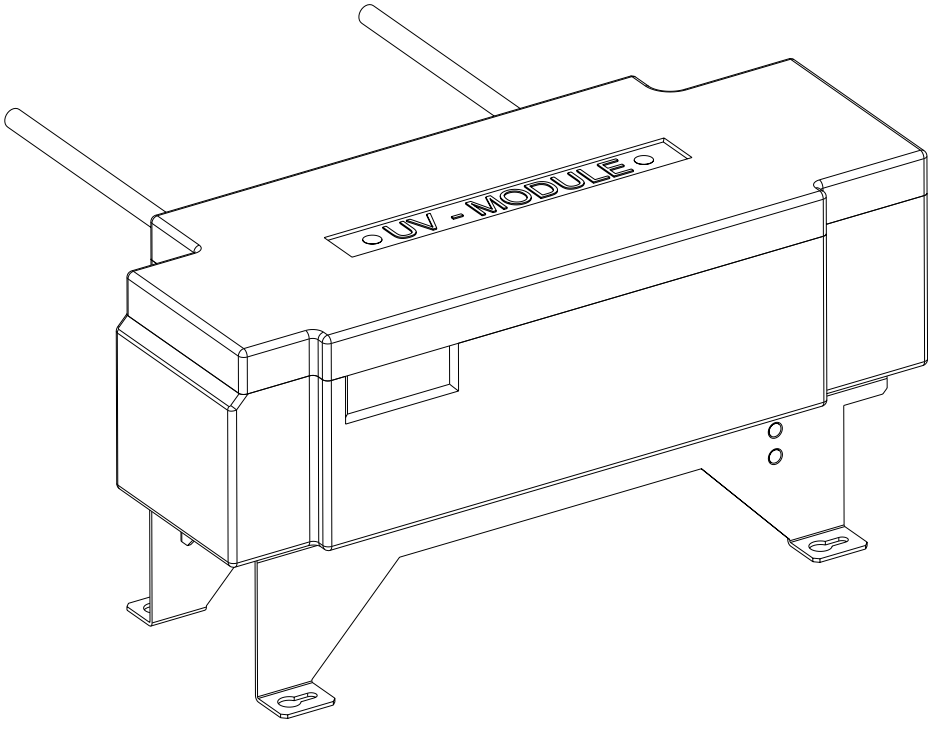


Figure 13-19 UV module on mounting plate

Table 13-1 UV module

Part No.	Designation	Remarks
	UV module, complete	Complete module installed as finished spare part. Included are additional screws for securing the mounting plate on the bottom of the housing.

13.8 Sensors

Table 13-2 Sensors

Part No.	Designation	Remarks
-	H_2S sensor	Measuring range 0 ... 50 ppm (hydrogen sulfide sensor)
-	Electrochemical oxygen sensor	
-	Paramagnetic oxygen sensor	
-	Preamplifier board	

Appendix

A

A.1 Technical support

Technical support

If this documentation does not completely answer your technical questions, you can enter a Support Request (http://www.siemens.com/automation/support-request).

For help creating a support request, view this video here (www.siemens.com/opensr).

Additional information on our technical support can be found at Technical Support (http://www.siemens.com/automation/csi/service).

Service & support on the Internet

In addition to our technical support, Siemens offers comprehensive online services at Service & Support (http://www.siemens.com/automation/serviceandsupport).

Contact

If you have further questions about the device, contact your local Siemens representative at Personal Contact (http://www.automation.siemens.com/partner).

To find the contact for your product, go to "all products and branches" and select "Products & Services > Industrial automation > Process instrumentation".

Contact address for business unit:
Siemens AG
Digital Industries
Process Automation
Östliche Rheinbrückenstr. 50
76187 Karlsruhe, Germany

A.2 Return procedure

To return a product to Siemens, see Returns to Siemens (https://support.industry.siemens.com/cs/ww/en/sc/3098).

Contact your Siemens representative to clarify if a product is repairable, and how to return it. They can also help with quick repair processing, a repair cost estimate, or a repair report/ cause of failure report.

NOTICE
Decontamination The product may have to be decontaminated before it is returned. Your Siemens contact person will let you know for which products this is required.

A.3 Pressure conversion table

	hPa	kPa	MPa	psi	mbar	bar
hPa	1	10	10000	69	1	0.001
kPa	0.1	1	1000	6.9	0.1	0.1
MPa	0.0001	0.001	1	0.0069	0.0001	1
psi	0.0145	0.145	145.04	1	0.0145	14.5
mbar	1	10	10000	69	1	1000
bar	0.001	0.01	10	0.069	0.001	1

ESD directives

B

B.1 ESD guidelines

Definition of ESD

All electronic modules are equipped with large-scale integrated ICs or components. Due to their design, these electronic elements are highly sensitive to overvoltage, and thus to any electrostatic discharge.

The electrostatic sensitive components/modules are commonly referred to as ESD devices. This is also the international abbreviation for such devices.

ESD modules are identified by the following symbol:

NOTICE
ESD devices can be destroyed by voltages well below the threshold of human perception. These static voltages develop when you touch a component or electrical connection of a device without having drained the static charges present on your body. The electrostatic discharge current may lead to latent failure of a module, that is, this damage may not be significant immediately, but in operation may cause malfunction.

Electrostatic charging

Anyone who is not connected to the electrical potential of their surroundings can be electrostatically charged.

The figure below shows the maximum electrostatic voltage which may build up on a person coming into contact with the materials indicated. These values correspond to IEC 801-2 specifications.

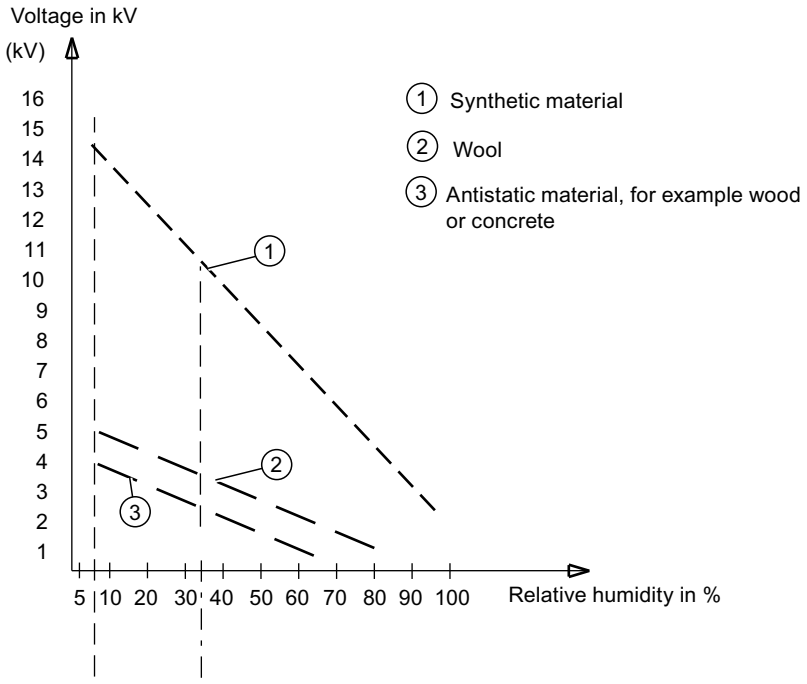


Figure B-1 Electrostatic voltages on an operator

Basic protective measures against electrostatic discharge

- Ensure good equipotential bonding:
  When handling electrostatic sensitive devices, ensure that your body, the workplace and packaging are grounded. This prevents electrostatic charge.
- Avoid direct contact:
  As a general rule, only touch electrostatic sensitive devices when this is unavoidable (e.g. during maintenance work). Handle the modules without touching any chip pins or PCB traces. In this way, the discharged energy can not affect the sensitive devices.
  Discharge your body before you start taking any measurements on a module. Do so by touching grounded metallic parts. Always use grounded measuring instruments.

List of abbreviations

C

C.1 List of abbreviations

Table C-1

Abbreviation/symbol	Description
<	Smaller than
>	Greater than
=	Equal to
≤	Smaller than or equal to
≥	Greater than or equal to
≙	Corresponds to
≈	Approximately
±	Plus/minus
%	Percent; 100th part of whole
% vol.	Volume percent
"	1 inch ≙ 25.4 mm)
°C	Degrees centigrade (1 °C ≙ 1.8 °F)
°F	Degrees Fahrenheit (1 °F ≙ 0.555 °C)
A	**A**mpere
sec.	Section
AC	**A**lternate **C**urrent
ADC	**A**nalog to **D**igital **C**onverter
AlGaN	**Al**uminum **Ga**llium **N**itride, a semiconductor material
Ar	**Ar**gon, a noble gas
AR	**A**uto**r**anging
ATEX	**At**mosphère **ex**plosible (French for explosive atmosphere)
AUTOCAL	Automatic calibration function, derived from **AUTO**MATIC **CAL**IBRATION
Bit	**bi**nary digi**t**
BImSchV	**B**undes**im**missions**sch**utz**v**erordnung (Federal German Emission Protection Directive)
BUV	**B**lue **U**ltra**v**iolet
ca.	approx.
CaF_2	CaF_2 = calcium fluoride
CD	**C**ompact **D**isk, a storage medium
CE	**C**ommunauté **E**uropéenne (French for European Community)
CH_4	CH_4 = methane
C_2H_4	C_2H_4 = ethene, ethylene
C_6H_{14}	C_6H_{14} = hexane
CO	CO = carbon monoxide

Abbreviation/symbol	Description
CS_2	CO_2 = carbon dioxide
COM	**com**mon
DAC	**D**igital to **A**nalog **C**onverter
DC	**D**irect **C**urrent
DD	**D**evice **D**escription
i.e.	In other words
DIN	**D**eutsches **I**nstitut für **N**ormung e. V. (German standards association)
Div.	**Div**ision
DP	**D**istributed **P**eriphery, a PROFIBUS component
D-Sub	**D**-shaped **Sub**miniature connector
DUV	**D**eep **U**ltra**v**iolet
EEPROM	**E**lectrically **E**rasable **P**rogrammable **R**ead **O**nly **M**emory
EC	**E**uropean **C**ommunity
EU	**E**uropean **U**nion
ELAN	**E**conomic **L**ocal **A**rea **N**etwork, a data network
EMC	**E**lectro **M**agnetic **C**ompatibility
EN	**E**uropäische **N**orm (European standard)
EPDM	**E**thylene **P**ropylene **D**iene **M**onomer, a plastic
ESD	**E**lectro**s**tatic **D**ischarge
Serial No.	**Ser**ial **N**umber
ft	**foot**, measure of length; 1 ft ≙ 30.48 cm
FKM	**F**luorinated rubber, a plastics group
FPM	**F**luorinated **P**oly**m**er rubber, a plastic, tradename e.g. Viton
GND	**G**rou**nd**
GSD	**G**eneric **S**tation **D**escription
H_2	H_2 = hydrogen
H_2S	H_2S = hydrogen sulfide
H_2SO_4	H_2SO_4 = sulfuric acid
H_2O	H_2O = water
HC	**H**ydro**c**arbons
HD-PE	**P**oly**e**thylene of high density (**HD** = High density)
He	**He**lium
HU	**H**eight **U**nit
hPa	**h**ecto**pa**scal
Hz	**H**ert**z**
IEC	**I**nternational **E**lectrotechnical **C**ommission
IEEE	**I**nstitute of **E**lectrical and **E**lectronics **E**ngineers
InGaN	**In**dium **Ga**llium **N**itride, a semiconductor material
OK	**OK**
IP	**I**nternal **P**rotection
IR	**I**nfra**r**ed
ISO	International Standards Organization (from Greek: "**iso**s"; in English "equal")
kg	**K**ilo**g**ram

Abbreviation/symbol	Description
kPa	**K**ilo**pa**scal
l	**L**iter
L	**L**ive wire
lb, lbs.	pound(s), 1 lb. ≙ 435.6 g
LCD	**L**iquid **C**rystal **D**isplay
LED	**L**ight **E**mitting **D**iode
m	**M**eter
m^3	Cubic meter
max.	**Max**imum
MR	**M**easuring **R**ange
MB = Mbit	10^6 bit
mbar	**M**illi**bar**, 1 mbar ≙ 1 hPa
mg	**M**illi**g**ram
MHz	**M**ega**h**ert**z**
min	**Min**ute(s)
MLFB	Machine-readable Order No. (German **M**aschinen**l**esbare **F**abrikate**B**ezeichnung)
mm	**M**illi**m**eter
mm^2	Square **m**illi**m**eter
MPa	**M**ega**pa**scal
mA	**M**illi**a**mpere
mV	**M**illi**v**olt
MV	Solenoid valve
MV	**M**easured **V**alue
N	**N**eutral (conductor)
N_2	N_2 = nitrogen
N_2O	N_2O = dinitrogen monoxide, common name laughing gas
nA	**N**ano**a**mpere
NAMUR	**N**ormen**a**rbeitsgemeinschaft für **M**ess- **u**nd **R**egeltechnik in der chemischen Industrie (standardization body for instrumentation and control technology in the chemical industry)
NBR	**N**itrile **B**utadiene **R**ubber , a plastic, common name e.g. Buna
NC	**N**ot **C**onnected
neg.	**neg**ative
nF	**N**ano**f**arad
NFPA	**N**ational **F**ire **P**rotection **A**ssociation, a non-profit fire protection organization in the USA
NH_3	NH_3 = ammonia
NO	NO = nitrogen monoxide
NO_2	NO_2 = nitrogen dioxide
NO_x	Name for total nitrogen oxides
No.	**N**umber
O_2	O_2 = oxygen
or similar	or similar

Abbreviation/symbol	Description
PA	**P**rocess **A**nalytics
PA	**P**oly**a**mide, a plastic
PC	**P**ersonal **C**omputer, a stationary single-user computer
PCS	**P**rocess **C**ontrol **S**ystem
PDM	**P**rocess **D**evice **M**anager, software for operating devices
PE	**P**oly**e**thylene, a plastic
PE	**P**rotective **E**arth (conductor)
PI	PROFIBUS International
ppm	**p**arts **p**er **m**illion (≙ 10^{-6})
PROFIBUS	**Pro**cess **Fi**eld **Bu**s
psi	**p**ounds per **s**quare **i**nch; 1 psi ≈ 69 hPa
PTB	**P**hysikalisch-**T**echnische **B**undesanstalt (German technical inspectorate)
PTFE	**P**oly**t**etra**f**luoro**e**thylene, a plastic, tradename e.g. Teflon
PVDF	**P**oly**v**inyli**d**ene**f**luoride, a plastic, tradename e.g. Kynar
QAL	**Q**uality **A**ssurance **L**evel
R22	Common name for chlorodifluoromethane, $CHClF_2$
RAM	**R**andom **A**ccess **M**emory
rel.	**rel**ative
RH	**R**elative **H**umidity
ROM	**R**ead **O**nly **M**emory
RS	**R**ecommended **S**tandard
RS 232	(also EIA-232) Identifies an interface standard for a sequential, serial data transmission
RS 485	(also EIA-485) Identifies an interface standard for a differential, serial data transmission
s	**S**econd(s)
s.	Refer to
SELV	**S**afety **E**xtra **L**ow **V**oltage
SF_6	SF_6 = sulfur hexafluoride
SIPROM GA	**Si**emens **Pro**cess **M**aintenance for **G**as **A**nalyzers
SO_2	SO_2 = sulfur dioxide
SW	**S**oft**w**are
t	**t**ime
T	**T**emperature
TA Luft	**T**echnical Instructions on Air Quality Control (Germany)
TCP/IP	**T**ransmission **C**ontrol **P**rotocol/**I**nternet **P**rotocol; a reference model for Internet communication
TÜV	**T**echnischer **Ü**berwachungs**v**erein, German Technical Inspectorate
U	Symbol for electric voltage
LEL	**L**ower **E**xplosion **L**imit
USB	**U**niversal **S**erial **B**us
UV	**U**ltra**v**iolet
V	**V**olt

Abbreviation/symbol	Description
V.	**V**ersion
VA	**V**olt**a**mpere
VDE	**V**erband **d**er **E**lektrotechnik, Elektronik und Informationstechnik (German Association for Electrical, Electronic and Information Technologies)
VGA	**V**ideo **G**raphics **A**rray, a graphics card standard
vpb	**v**olume **p**arts per **b**illion (≙ 10^{-9} of a volume)
vpm	**v**olume parts **p**er **m**illion (≙ 10^{-6} of a volume)
e.g.	**F**or **e**xample
µm	Micrometer
Ω	Ohm

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