Multi Component Gas Analyser

BA 3 select

Installation and Operation Instructions

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

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1 Introduction

1.1 Intended Use
The BA 3 select multi-channel gas analyser is used to continuously measure the gas concentration in industrial process gas, such as:
- Monitoring exhaust gas concentration and optimising firing or combustion processes
- Monitoring process flows
- Mixing, producing and processing industrial gas

The device must not be used
- To analyse combustible, inflammable or explosive gas mixtures,
- In explosive areas and
- For applications where equipment failure or malfunction puts persons in immediate danger.
- To convey highly toxic gas.

1.2 Equipment configuration
The order key indicates the configuration.
Please refer to the nameplate for your equipment configuration.

1.3 Scope of delivery
- Analyser
- Product documentation
- Connection/mounting accessories (optional)
2 Safety instructions

2.1 Important notices

This unit may only be used if:

– The product is being used under the conditions described in the operating- and system instructions, used according to the nameplate and for applications for which it is intended. Any unauthorized modifications of the device will void the warranty provided by Bühler Technologies GmbH,

– Complying with the specifications and markings in the type plate,

– Complying with the limits specified in the data sheet and the instructions,

– Service and repair work not described in these instructions are performed by Bühler Technologies GmbH,

– Using genuine replacement parts.

These operating instructions are a part of the equipment. The manufacturer reserves the right to change performance-, specification- or technical data without prior notice. Please keep these instructions for future reference.

Please particularly note the following analyser instructions:

– Always transport the equipment diligently and carefully. Strong impact and shock may damage the measuring cells in the analyser or shorten their life!

– Avoid condensation inside the equipment, as the measurement system could be damaged and become defective. If the sample gas contains condensable components, the analyser must have suitable upstream sample gas conditioning. Our customer service will gladly help you select a system.

– Depending on the application, it may be necessary to regard specific regulations and rules when handling with elevated oxygen concentrations. This must be checked by the operator of the device.

Signal words for warnings

<table>
<thead>
<tr>
<th>DANGER</th>
<th>Signal word for an imminent danger with high risk, resulting in severe injuries or death if not avoided.</th>
</tr>
</thead>
<tbody>
<tr>
<td>WARNING</td>
<td>Signal word for a hazardous situation with medium risk, possibly resulting in severe injuries or death if not avoided.</td>
</tr>
<tr>
<td>CAUTION</td>
<td>Signal word for a hazardous situation with low risk, resulting in damaged to the device or the property or minor or medium injuries if not avoided.</td>
</tr>
<tr>
<td>NOTICE</td>
<td>Signal word for important information to the product.</td>
</tr>
</tbody>
</table>
Warning signs

In this manual, the following warning signs are used:

- Warning against hazardous situations
- General notice
- Warning against electrical voltage
- Disconnect from mains
- Warning against respiration of toxic gases
- Wear respirator
- Warning against acid and corrosive substances
- Wear eye/face protection
- Warning against potentially explosive atmospheres
- Wear protection gloves
- Warning against hot surface

2.2 General hazard warnings

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

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

The operator of the system must ensure:

- Safety notices and operating instructions are available and observed,
- Inspections prior to initial operation and routine inspections according to the Ordinance on Industrial Safety and Health (BettrSichV) are performed,
- The respective national accident prevention regulations are observed,
- The permissible data and operational conditions are maintained,
- Safety guards are used and mandatory maintenance is performed,
- Legal regulations are observed during disposal.

Transport

- Always transport the BA 3 select with care. Strong impact and shock may damage the measuring cells in the analyser or shorten their life!

Sample gas conditioning

- Prevent condensation or particles inside the unit as the measuring system may become defective. If the sample gas contains condensable components, the BA 3 select must have suitable upstream sample gas conditioning. Suitable filters must be installed ahead of the unit’s gas inlet. Our customer service will gladly help you select a sample gas conditioner.

Maintaining the device parameters

- Be sure to maintain the approved operating and ambient temperatures and the technical specifications.

Personnel

- The unit must only be installed, operated and maintained by qualified personnel.

Maintenance, Repair

Please note during maintenance and repairs:

- Repairs to the unit must be performed by Bühler authorised personnel.
- Only perform conversion-, maintenance or installation work described in these operating and installation instructions.
- Always use genuine spare parts.

Always observe the applicable safety and operating regulations in the respective country of use when performing any type of maintenance.
### DANGER: Electric voltage

**Risk of electric shock**

- a) Disconnect all poles of the unit from the mains for any maintenance on electric components.
- b) Secure the equipment from accidental restarting.
- c) The unit may only be opened by trained, competent personnel.
- d) Ensure the correct voltages supply.

### DANGER: Toxic, corrosive gases

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

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

### DANGER: Potentially explosive atmosphere

Explosion hazard if used in hazardous areas.

The device is not suitable for operation in hazardous areas with potentially explosive atmospheres.

Do not expose the device to combustible or explosive gas mixtures.
3 Technical description

3.1 Configuration
The BA 3 select is a gas analyser for 19” rack mounting with a modular design which can be equipped with three different oxygen measuring cells. Up to three parallel gas components can be measured.

There are three different cells available for measuring oxygen:
- Electrochemical O₂ cell for measuring %
- High-precision paramagnetic cells
- Zirconium dioxide cell for measuring traces of oxygen

Display and operation
The analyser is standard equipped with a 4.7” touchscreen display. This display is used to show measurements and operate the unit.

Front plate filter
An optional microfilter is available for the front of the housing to filter particles from the sample gas flow. This requires no tools to change. In all gas paths without front panel filters a safety filter is installed as standard, with the exception of certain special configurations.

Flow measurement
The options for having the unit display the gas flow rate are:
- Float flow meters on the front panel or
- Bar graph in the display

Gas pumps
A pump conveying the sample gas through the unit may optionally be built into each analyser gas path.

Channel markings
The channels on the unit are marked as follows:

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>O₂-ZrOx</td>
<td>Oxygen measurement via zirconium dioxide cell</td>
</tr>
<tr>
<td>O₂-EC</td>
<td>Oxygen measurement via electrochemical cell</td>
</tr>
<tr>
<td>O₂-Para</td>
<td>Oxygen measurement via paramagnetic cell</td>
</tr>
<tr>
<td>IR</td>
<td>Measuring IR-active gas components</td>
</tr>
</tbody>
</table>

Output signals
For effective monitoring, all status, limit and alarm messages are output at the back of the unit in analogue and/or digital form (see chapter "Signal outputs [> page 20]").

Gas connections
The respective number of gas path PVDF hose fittings are located at the back of the housing. Stainless steel bulkhead couplings are optional. (Note: Stainless steel bulkhead couplings are standard on ZrOx measuring cells.) Devices with specially cleaned gas paths are equipped with dummy plugs to prevent recontamination.

Gas Flow Control
The analyser is equipped with internal bypass controllers to keep the gas volume flowing through the cells as consistent as possible. This allows a high, stable sample gas flow to the analyser, hence short equipment response times.

Valves for automatic calibration
The unit may optionally be equipped with 3/2-way solenoid valves. These will automatically switch between the sample gas and calibrating gas input on the unit.

Electric supply
The electric supply is located at the back of the housing.
Your equipment configuration

Please refer to the nameplate on the unit and the explanation in chapter "Equipment configuration [> page 3]" for your specific equipment configuration.

On start-up the unit will further show which measuring cells are installed and the software version. During operation you may view the configuration via Menu > Diagnostics > Status.

3.2 Equipment overview

The following views explain the elements of the analyser.

Fig. 1: BA 3 select, front view

1. Touchscreen and measurement display
2. Sample gas filter (optional)
3. Flow meter, varies by number of channels
4. Service door (for optional EC cell)

Fig. 2: BA 3 select, rear view

1. gas in Sample gas input
   gas out Gas outlet
   cal. gas Calibrating gas inlet
2. ST1 to ST4 Signal output Ch. 1 to Ch. 4
3. ST04 Equipment status
4. RS232 RS232 port (optional)
5. Fuse Fuse 1
6. Power Power supply with built-in fuse and ON / OFF switch
7. Fan
3.3 Gas flow diagrams

The analyser may be equipped with up to three \( \text{O}_2 \) measuring cells and three related, separate gas paths. The flow diagram below shows the equipment base version with one measuring cell or one channel.

The flow diagrams may vary on units with multiple measuring channels (measuring points). A special flow diagram will then be included with your unit.

<table>
<thead>
<tr>
<th>Legend</th>
<th>Flow diagram</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 3/2 way solenoid valve</td>
<td>Cal. Gas</td>
</tr>
<tr>
<td>(optional with auto cal. function)</td>
<td>Sample gas</td>
</tr>
<tr>
<td>2 Internal pump</td>
<td>1</td>
</tr>
<tr>
<td>for EC and paramagnetic cell</td>
<td>3</td>
</tr>
<tr>
<td>3 Flow regulator</td>
<td>4</td>
</tr>
<tr>
<td>4 Pressure sensor</td>
<td></td>
</tr>
<tr>
<td>5 Measuring cell</td>
<td>5</td>
</tr>
<tr>
<td>6 Flow meter (optional)</td>
<td>6</td>
</tr>
<tr>
<td>7 Internal pump</td>
<td>7</td>
</tr>
<tr>
<td>for ( \text{ZrO}x ) cell</td>
<td></td>
</tr>
</tbody>
</table>

Table 1: Gas flow diagram for the equipment base version

<table>
<thead>
<tr>
<th>Pressure:</th>
<th>With internal pump</th>
<th>Max. 1200 mbar absolute</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flow (gas in):</td>
<td>120 L/h, constant due to internal pump</td>
<td></td>
</tr>
<tr>
<td>Cell flow:</td>
<td>( \text{ZrO}x )</td>
<td>approx. 8 L/h, internal control</td>
</tr>
<tr>
<td></td>
<td>Paramagnetic</td>
<td>approx. 8 L/h, internal control</td>
</tr>
<tr>
<td></td>
<td>EC</td>
<td>approx. 12 L/h</td>
</tr>
<tr>
<td>( T_{\text{amb}} ):</td>
<td>10 °C ... 45 °C</td>
<td></td>
</tr>
</tbody>
</table>

Sample gas or calibrating gas is assigned through the solenoid valve (optional) (1). The maximum pressure permitted at the gas inlet varies by version (see above).

On the **standard version** a sample gas pump (2 or 7) built into the gas path produces a constant flow of approx. 120 L/h. The flow regulator (3) keeps the gas flowing through the measuring cell (5) consistent. On the **version with controlled flow** the flow through the unit can be set externally from 40 to 100 L/h. Again, the flow regulator ensures a consistent flow through the measuring cell. Excess gas flows off through the bypass.

The cell flow must not exceed the value permitted for the cell (see above) and should be as consistent as possible.

The barometric pressure sensor (4) compensates the results based on barometric variations. The flow meter (6, optional) or the optional bar graph in the display shows the gas flow through the measuring cell.
3.4 Measuring principles for oxygen measurement

3.4.1 Measuring principle of a zirconium dioxide cell

The following illustration shows the configuration of a zirconium dioxide measuring cell. The measuring cell consists of a zirconium dioxide tube (1) with two platinum wire electrodes. Inside the tube the sample gas flows through is the measuring electrode (3). The electrode outside the tube serves as a reference electrode (4) with a constant electrode potential. The electrodes and the ceramic tube hence form a voltaic cell. Here the ZrO₂ serves as a solid object electrolyte.

To obtain favourable values for the oxide ion conductivity the measuring cell is heated to approx. 750 °C. A thermopile (5) on the measuring cell determines the actual measuring temperature T. An electronic control circuit ensures a constant cell temperature.

The NERNST equation is the basis for determining the concentration of oxygen in gases by ZrO₂ measuring cell.

\[
U = \frac{RT}{4F} \ln \frac{P_{O_2, \text{air}}}{P_{O_2, \text{sample gas}}}
\]

Where:
- \( U \) = Cell voltage in mV
- \( R \) = Molar gas constant; \( R = 8.31 \text{ J mol}^{-1} \text{ K}^{-1} \)
- \( T \) = Measuring temperature in K
- \( F \) = Faraday's constant; \( F = 9.64 \times 10^4 \text{ C mol}^{-1} \)
- \( P_{O_2, \text{air}} \) = Partial pressure of the oxygen on the reference electrode in dry air in Pa
- \( P_{O_2, \text{sample gas}} \) = Partial pressure of the oxygen on the measuring electrode

The calculation requires the total pressures on both electrodes to be about equal. In this case the volume concentration \( \Psi \) corresponds with the partial pressure \( p \). After solving (eq. I) with \( P_{O_2, \text{sample gas}} \) (or \( \Psi_{O_2, \text{sample gas}} \)) and using the values for the constants \( R \) and \( F \) you will have the following conditional equation for the oxygen concentration in the sample gas in Vol.\%:

\[
\Psi_{O_2, \text{sample gas}} = 20.64 \cdot e^{-46.42 \cdot \frac{U}{T}}
\]

Where:
- \( \Psi_{O_2, \text{sample gas}} \) = oxygen concentration of the sample gas in Vol.\%
- \( e \) = Euler's number 2.7182...
- \( U \) = Cell voltage in mV
- \( T \) = Measuring temperature in K
- 20.64 = O₂ concentration for air with a rel. humidity of 50 % in Vol.%
3.4.2 Measuring principle of an electrochemical cell

The electrochemical O₂ measuring cell (EC cell), simplified, represents a battery. However, on the EC cell there will only be flow if the gas (O₂) to be measured is present at the gas inlet.

The cell consists of a cylindrical plastic housing which is closed with a gas permeable membrane (a) at the gas entry point. The housing is filled with a liquid electrolyte (acidic or alkaline solution) (c) where the gold measuring electrode (cathode) (b) and the lead counter-electrode (anode) (d) are located.

![Diagram of an EC cell]

With the external electric circuit closed, the lead electrode is oxidised and the oxygen in the sample gas reduced through the gold cathode. The lead electrode emits electrons to the external electric circuit, oxygen reacts with the H⁺ ions into water, absorbing the electrons. These spatially separate redox reactions produce current flow between the electrodes in the external electric circuit, proportional to the O₂ content of the sample gas.

The voltage drop (mV range) through the resistor (e) in the external electric circuit serves as the test signal. The thermistor (f) in the electrolyte compensates temperature influences.

Four chemical reactions occur at the electrodes:

Anode (2):
\[2\text{Pb} + 2\text{H}_2\text{O} \rightarrow 2\text{PbO} + 4\text{H}^+ + 4\text{e}^-\]

Cathode (4):
\[\text{O}_2 + 4\text{H}^+ + 4\text{e}^- \rightarrow 2\text{H}_2\text{O}\]

Brutto reaction:
\[\text{O}_2 + 2\text{Pb} \rightarrow 2\text{PbO}\]

Tab. 2: Table 2: REDOX reactions in the EC cell

3.4.3 Measuring principle of a paramagnetic cell

The paramagnetic cell uses the distinct paramagnetic properties of oxygen to measure O₂ concentration. Due to this property the O₂ molecules are greatly drawn toward increasing magnetic field intensity. On the other hand, virtually all other gases have diamagnetic properties and are pushed away from a magnetic field. This results in the extraordinarily high selectivity of this oxygen measurement process.

A permanent magnet with wedge-shaped pole shoes (a) produces a highly non-homogeneous magnetic field inside the measuring cell. A freely rotatable handle made up of glass balloons (c) and a torsion strap (b) is suspended between these pole shoes. The balloons are filled with nitrogen, which has slightly diamagnetic properties. A wire loop is located around the handle. At the middle of the handle is a small mirror (d). It directs the light from an LED (e) to a photocell (f).
If oxygen enters the chamber, the \( \text{O}_2 \) molecules are drawn toward the increasing magnetic field force. The magnetic field at the ends of the poles increases. As a result, the nitrogen loaded handle is forced out of the magnetic field and the torsion strap turns with the mirror. This changes the light influx, hence the voltage at the photocell.

This changes the current flow in the wire loop. The induced magnetic moment of this live loop resets the handle to the zero position.

The compensation current measured in the wire loop is proportional to the oxygen concentration and serves as a measurement signal.

### 3.4.3.1 Carrier gas factor

Carrier gases are gas components found in the sample gas in addition to the actual component being measured. Depending on the measuring method these components can interfere with the measurement, resulting in false measured values. To minimise this effect, relevant carrier gases can be added to the calibrating gas (zero gas and span gas) at a concentration which will later occur in the sample gas. This will calibrate out the carrier gas influence.

#### 3.4.3.2 Adjustments for carrier gases

In a paramagnetic cell the very high magnetic susceptibility of oxygen is utilised to detect it. This measuring method is extremely selective, since other gases in the sample gas flow typically have a low magnetic susceptibility, so their impact on the measurement values is negligible.

However, measuring errors could occur if the device was calibrated using \( \text{O}_2 + \text{N}_2 \) as the span gas but **very high concentrations** interfering carrier gases are later present during measurement. In this case, significant measurement errors will occur (also see examples below).

Since calibrating gases typically do not contain the carrier gases, an adjustment value can at least allow for this effect from a calculation perspective.

The respective values are listed in table "Adjustments \( \beta \) for common carrier gases [values for other gases upon request]" [page 13]. These \( \beta \) values correspond with the unit’s zero point deviation if all of the volume flow through the unit consists of the carrier gas listed.

Adjust the measured \( \text{O}_2 \) concentration using the formula

\[
C = C_{\text{meas}} - C_{\text{adj}}
\]

With

\[
C_{\text{adj}} = (\beta_{\text{adj},1} \times C_{\text{carrier,1}} + \beta_{\text{adj},2} \times C_{\text{carrier,2}} + \ldots + \beta_{\text{adj},n} \times C_{\text{carrier,n}})
\]

and

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>( C )</td>
<td>Adjusted ( \text{O}_2 ) volume concentration</td>
</tr>
<tr>
<td>( C_{\text{adj}} )</td>
<td>Total adjusted value</td>
</tr>
<tr>
<td>( C_{\text{meas}} )</td>
<td>Measured (unadjusted) ( \text{O}_2 ) volume concentration</td>
</tr>
<tr>
<td>( C_{\text{carrier,1} \ldots n} )</td>
<td>Volume concentration of carrier gas components 1 to n</td>
</tr>
<tr>
<td>( \beta_{\text{adj},1 \ldots n} )</td>
<td>Adjustment factor from table 1 for the 1st to nth carrier gas component</td>
</tr>
</tbody>
</table>
Example 1:
 Calibration conditions:  
- Ambient temperature $T_a = 50 \, ^\circ\text{C}$  
- $(O_2 + N_2)$ as span gas  
Sample gas:  
- 0 % $O_2$  
Carrier gas: 100% $CO_2$  
Measurement result: $C_{\text{meas}} = -0.29 \, %\, O_2$  
Adjustment: $C_{\text{adj}} = 100 \cdot -0.0029 = -0.29\%$  
Adjusted result: $C = C_{\text{meas}} - C_{\text{adj}} = -0.29 \, % - (-0.29\%) = -0.29\% + 0.29\% = 0$

Example 2:
 Calibration conditions:  
- Ambient temperature $T_a = 50 \, ^\circ\text{C}$ with $N_2$ as zero gas  
- $(O_2 + N_2)$ as span gas  
Sample gas:  
- 2 % $O_2$  
- 98 % carrier gases: 10% $CO_2$, 5% $CO$, 5% $NO$, 78% $N_2$  
Measurement result: $C_{\text{meas}} = 4.13 \, %\, O_2$  
Adjustments:  
- $10 \, %\, CO_2 = C_{\text{adj, CO}_2} = 10 \times (-0.0029) = -0.029$  
- $5 \, %\, CO = C_{\text{adj, CO}} = 5 \times (+0.0007) = +0.004$  
- $5 \, %\, NO = C_{\text{adj, NO}} = 5 \times (+0.4296) = 2.150$  
- $78 \, %\, N_2 = C_{\text{adj, N}_2} = 78 \times (0.00) = 0.00$  
Total: $C_{\text{adj}} = +2.125 = +2.13$  
Adjusted result: $C = C_{\text{meas}} - C_{\text{adj}} = 4.13 - 2.13 = 2 \, %\, O_2$

<table>
<thead>
<tr>
<th>Gas</th>
<th>Formula</th>
<th>$\beta_{\text{adj}}$ (at $T_a=20,^\circ\text{C}$)</th>
<th>$\beta_{\text{adj}}$ (at $T_a=50,^\circ\text{C}$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acetylene</td>
<td>HCCH</td>
<td>-0.0025</td>
<td>-0.0028</td>
</tr>
<tr>
<td>Ammonia</td>
<td>NH$_3$</td>
<td>-0.0017</td>
<td>-0.0019</td>
</tr>
<tr>
<td>Benzol</td>
<td>C$_6$H$_5$</td>
<td>-0.0124</td>
<td>-0.0136</td>
</tr>
<tr>
<td>Nitrous oxide</td>
<td>N$_2$O</td>
<td>-0.0020</td>
<td>-0.0022</td>
</tr>
<tr>
<td>Ethanol</td>
<td>C$_2$H$_5$OH</td>
<td>-0.043</td>
<td>-0.047</td>
</tr>
<tr>
<td>Ethyl acetate</td>
<td>CH$_3$COOC$_2$H$_5$</td>
<td>-0.122</td>
<td>-0.134</td>
</tr>
<tr>
<td>Ethylene</td>
<td>C$_2$H$_4$</td>
<td>-0.020</td>
<td>-0.022</td>
</tr>
<tr>
<td>Helium</td>
<td>He</td>
<td>+0.0029</td>
<td>+0.0032</td>
</tr>
<tr>
<td>Carbon dioxide</td>
<td>CO$_2$</td>
<td>-0.0026</td>
<td>-0.0029</td>
</tr>
<tr>
<td>Carbon monoxide</td>
<td>CO</td>
<td>+0.0006</td>
<td>+0.0007</td>
</tr>
<tr>
<td>Methane</td>
<td>CH$_4$</td>
<td>-0.0016</td>
<td>-0.0017</td>
</tr>
<tr>
<td>Ozone</td>
<td>O$_3$</td>
<td>+0.0054</td>
<td>+0.0060</td>
</tr>
<tr>
<td>Hydrogen sulphide</td>
<td>H$_2$S</td>
<td>-0.0039</td>
<td>-0.0043</td>
</tr>
<tr>
<td>Nitrogen</td>
<td>N$_2$</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Nitrogen dioxide</td>
<td>NO$_2$</td>
<td>+0.05</td>
<td>+0.16</td>
</tr>
<tr>
<td>Nitric oxide</td>
<td>NO</td>
<td>+0.4256</td>
<td>+0.4296</td>
</tr>
<tr>
<td>Hydrogen</td>
<td>H$_2$</td>
<td>+0.0023</td>
<td>+0.0026</td>
</tr>
</tbody>
</table>

Tab. 3: Adjustments $\beta$ for common carrier gases (values for other gases upon request)

If the cell temperature deviates from the $T_a$ values, you can obtain values between 20 °C and 50 °C by linear interpolation of the adjustments $\beta_{\text{adj}}$.

The paramagnetic cell is factory thermostated to 50 °C. Therefore use the values $\beta_{\text{adj}}$ at $T_a = 50 \, ^\circ\text{C}$.

If you’re unsure if your paramagnetic cell is thermostated, please contact our technical service (see chapter “Service and repair [> page 49]”).
Automatic carrier gas adjustment for paramagnetic cell:

You can enter the adjustment in the analyser so you will not always have to manually subtract the O₂ adjustment from your measurement value (see chapter "Menu > Channel Settings > Adjustment [> page 39]"). The analyser will then continuously subtract this adjustment from the measurement value and always display the adjusted measurement value.

3.5 Technical Data

General

Housing

- Dimensions: 19" rack mount housing, 3 HE
- H x W x D, style 1: 132 x 440 x 425 mm
- H x W x D, style 2: 132 x 440 x 335 mm
- Protection class: IP 20
- Weight: max. 7 kg
- Display and control: 4.7" touchscreen display

Electric supply

- Voltage: 230 V AC or 115 V AC (note nameplate on the unit)
- Mains frequency: 50/60Hz
- Max. Power input: 69 W

Ambient parameters

- Ambient temperature: 10 °C ... 45 °C
- Relative humidity: < 75 %
- Ambient pressure: 875 mbar to 1200 mbar
- Transport and storage temperature: 5 °C - 65 °C

AUTO cal. function

Optional for each measuring channel: Zero gas (air) + span gas

Warm up time

Minimum 30 min (up to 2 h recommended for high-precision measurements)

Sample gas connections

Gas paths

- Max. three separate gas paths (with auto cal. function)
- Screw-in connection: 6 mm PVDF for 4/6 tube

Inlet parameters

- Gas inlet temperature: 5 °C to 50 °C
- Sample gas pressure (absolute): 875 mbar to max. 1800 mbar, reduced to max. 1200 mbar with internal pump
- Sample gas conditioning: purified/filtered (<15 µ filtration) sample gas with dew point < 10 °C (always 5 K below ambient temperature).

Signal inputs and outputs

Analogue output: 0-20 mA / 4-20 mA / 0-10 V / 2-10 V inside unit variable by channel
Limit relay: 2x per measuring channel (125 V AC, 0.5 A / 30 V DC, 1 A)
Status relay: Error, service, calibration, measuring range (125 V AC, 0.5 A / 30 V DC, 1 A)
Binary inlets: 1x per channel + 2 x per unit: designed for 24V, potential-free
24 Volt output: 1x per channel (for supply binary inputs), protected by T250mA
Serial port: RS 232
### Parts in contact with sample gas

<table>
<thead>
<tr>
<th>Component</th>
<th>Materials in contact with media</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pump</td>
<td>PET, PPS</td>
</tr>
<tr>
<td>Flow regulator</td>
<td>PTFE, stainless steel (1.4571)</td>
</tr>
<tr>
<td>Gas lines</td>
<td>FPM (Viton), stainless steel (1.4571)</td>
</tr>
<tr>
<td>Solenoid valves</td>
<td>PVDF or stainless steel (1.4571)</td>
</tr>
<tr>
<td>Gas ducts</td>
<td>PVDF or stainless steel (1.4571)</td>
</tr>
<tr>
<td>Flow meter</td>
<td>PVDF, borosilicate glass</td>
</tr>
<tr>
<td>Measuring cell</td>
<td>ZrOx cell</td>
</tr>
<tr>
<td></td>
<td>1.4571, ZrOx ceramic</td>
</tr>
<tr>
<td></td>
<td>1.4401 Borosilicate glass</td>
</tr>
<tr>
<td></td>
<td>Platinum-iridium alloy</td>
</tr>
<tr>
<td></td>
<td>ABS</td>
</tr>
<tr>
<td></td>
<td>Paramagnetic cell</td>
</tr>
<tr>
<td></td>
<td>EC cell</td>
</tr>
</tbody>
</table>

### Measuring cells

<table>
<thead>
<tr>
<th>Measuring cell</th>
<th>ZrOx cell*</th>
<th>Paramagnetic cell</th>
<th>EC cell</th>
</tr>
</thead>
<tbody>
<tr>
<td>Largest measuring range (MR)</td>
<td>0-10000 vpm (0-21 Vol.%)**</td>
<td>0-100 %</td>
<td>0-25 %</td>
</tr>
<tr>
<td>Smallest measuring range</td>
<td>0-10 vpm</td>
<td>0-1 %</td>
<td>0-10 %</td>
</tr>
<tr>
<td>Response time t90***</td>
<td>&lt; 4 sec</td>
<td>&lt; 5 sec</td>
<td>&lt; 15 sec</td>
</tr>
<tr>
<td>Linearity deviation</td>
<td>&lt; 1 % FS (&lt; 2 % FS within the smallest MR)</td>
<td>&lt; 0.2 Vol.%</td>
<td>&lt; 1 % FS</td>
</tr>
<tr>
<td>Zero drift</td>
<td>&lt; 1 % FS /week</td>
<td>&lt; 0.2 Vol.% /week</td>
<td>&lt; 2 % FS /week</td>
</tr>
<tr>
<td>Measurement value drift</td>
<td>&lt; 0.3 % FS /week</td>
<td>&lt; 0.2 % MW /week</td>
<td>&lt; 2 % FS /week</td>
</tr>
<tr>
<td>Repeatability</td>
<td>1 % FS (2 % within the smallest MR)</td>
<td>1 % FS</td>
<td>1 % FS</td>
</tr>
<tr>
<td>Detection limit</td>
<td>0.1 vpm within MR 0-10vpm</td>
<td>0.1 %</td>
<td>0.2 %</td>
</tr>
<tr>
<td>Pressure compensation</td>
<td>optional</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>Thermal stabilisation</td>
<td>yes</td>
<td>yes</td>
<td>-</td>
</tr>
</tbody>
</table>

* Two cell types available: (A) catalytically active cell (CAC) => not for flammable carrier gases. (B) catalytically inactive cell => suitable if traces of flammable gases are present (< 10 vpm H2, CO, CH4)

** Optional for unit with modified calibration routine

*** Signal damping adjustable fr. 1 sec to 20 sec

**Abbreviations:**

FS ...from span

MW ...from measurement

r.F. ...relative error
4 Transport and storage

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

Removal from service and storage
Purge the unit with dry nitrogen or dry air before removing from service for extended periods. Then close the gas inputs and outputs to prevent dirt, dust and moisture from entering the unit.
Store the unit in a dry, ventilated, dust-free room. Cover the unit with suitable packaging to protect it from liquids and dirt.
Storage temperature: 5 °C ... 65 °C
5 Installation and connection

### NOTICE

**Devices with specially cleaned gas paths**

Protect media-contacting components against recontamination, such as Bulkhead fittings. Use clean gloves, clothing and tools when connecting, especially when connecting the gas pipes. Apply specially cleaned gas paths, next to the gas for the actual measuring task, exclusively with oil-free inert gas or oil-free compressed air.

### 5.1 Installation site requirements

#### DANGER

**Potentially explosive atmosphere**

Explosion hazard if used in hazardous areas.

The device is not suitable for operation in hazardous areas with potentially explosive atmospheres.

Do not expose the device to combustible or explosive gas mixtures.

#### CAUTION

**Turbulence in gas paths**

Avoid turbulence in the gas paths of the analyser. Place the pressure unit, e.g. Gas cylinder, not too close to the device and install a damping vessel (> 0.5 l) in front of the gas inlet of the analyser.

---

**19” rack or tabletop:** The unit is suitable for indoor use mounted in a 19” rack or as a tabletop unit. The unit must rest on support rails when installed in a 19” rack. The mechanical strain is too high when mounted solely via the front panel.

**Cooling:** The unit is forced-air cooled via a fan at the back. To ensure air can circulate freely, maintain a distance to other objects or walls of at least 3 cm at the top and 10 cm at the back of the analyser.

**Dust:** The unit must be set up in a low-dust environment. Otherwise dirt can accumulate inside the unit and in the long term result in malfunctions or failure.

**Shock:** Select a preferably low-vibration site. Mechanical oscillation and vibration, particularly low frequency shock (e.g. from traffic or heavy equipment) can interfere with measurements, cause equipment errors or permanent damage.

**Ambient temperature:** The approved ambient temperature of 5 °C to 45 °C must be maintained during operation. The measuring cells can optionally be thermostated or temperature compensated to max. 50 °C. This will largely compensate the effects of temperature fluctuations. Please refer to the key on the nameplate to determine whether your unit features automatic temperature compensation.

**Disturbance sources:** No heat sources or equipment emitting strong magnetic fields (e.g. motors, transformers) may be located near the installation site. Even exposing the unit to sunlight for extended periods and the resulting temperature fluctuations can alter the measurement values.

This also applies to severe temperature fluctuations and barometric variations. Regularly calibrate the unit, including after severe changes in the barometric pressure or temperature.

---

### 5.2 Installation

The unit is delivered in cardboard packaging with filler material. The analyser measuring cells are sensitive to shock and vibration. Therefore, if possible, keep the original packaging for future analyser transport. Otherwise dispose of the packaging materials according to local regulations.

Check the unit for any transport damage. Do not install the unit if it shows any type of damage.

**19” rack mounting**

Place the analyser on support rails and secure the screws to the front face.
5.2.1 Sample gas conditioning

To ensure the least possible interference and low analyser maintenance the gas inlet requirements (Technical Data) must be observed as consistently as possible. Further avoid dirt on any parts the sample gas flows through.

Particularly important sample gas parameters are:

- the gas moisture
- the gas volume flow
- the gas pressure
- the gas temperature
- the particle load in the gas flow
- aggressive and/or gas components altering measurement value

To ensure low maintenance, the analyser typically requires suitable upstream gas conditioning. This greatly affects the quality and correctness of your measurements. The complexity of the required gas conditioning will vary depending on the process and measuring task.

In this context, it’s essential for calibrating gases to flow through the entire gas conditioning system for preferably identical pressure, temperature and flow ratios. This is the only way to compensate the gas conditioning possibly affecting the result. If the gas input and ambient conditions change considerably, always recalibrate the analyser (see chapter “Menu > Calibration”).

**NOTICE**

**Control valve**

We recommend installing a control valve to adjust the gas flow upstream from the gas conditioning system. Installation in the sample gas output will increase the pressure in the analyser and possibly result in measuring errors.

**Damping vessel**

If rapid, high fluctuations of pressure or flow occur in the gas lines (inlet or outlet) we recommend using a damping vessel (> 0.5 L) upstream from the gas inlet.

Please feel free to discuss your specific measuring task with our customer service. Our knowledgeable and experienced staff will be able to recommend modified gas conditioning.

5.2.2 Specific measuring cell requirements

**ZrO₂ measuring cell**

- If the sample gas contains reducing components (e.g. alcohols), install an active carbon filter upstream from the analyser. This will prevent undesirable chemical reactions at the Pt electrodes in the cell which will falsify the measurement values.
- Do not convey aggressive sample gas containing high concentrations of halogen, sulphurous gases (e.g. SO₂) or phosphorous and siliceous gases through the analyser. These types of gases will damage the measuring cell.
- Always use stainless steel tubes as the gas lines for measuring oxygen concentrations below 100 ppm. The O₂ permeability of plastic lines may otherwise significantly alter the measurement values. Particularly ensure all joints in the line system are tight.
- Keep the sample gas paths as short as possible to avoid a shift in the chemical balance along the way.

**EC measuring cell**

- High amounts (> 1 Vol.%) of ammonia, SO₂, hydrogen chlorides or benzol compounds can significantly alter the measurement values. If these substances are present, the calibrating gas used should contain the same concentration of these interfering components to be expected during measurement. This will calibrate out this interfering factor to the greatest possible extent.
- Please further ensure the sample gas conveyed does not fall below the dew point of 4°C. If sample gases are too dry, the cell can lose electrolyte, damaging the cell.

**Paramagnetic cell**

- When using this measuring cell, pay particularly attention to low-vibration, shockproof installation. Otherwise the measurements may be significantly altered or the cell damaged.
- Reduce fluctuations in the pressure and flow in the sample gas lines upstream and downstream from the analyser. Vibration may otherwise be induced in the handle, which will also alter the result.
- Cross-sensitivity to carrier gases is typically very low. Only extremely high concentrations of carrier gases will alter the results (also see chapter “Carrier gas factor [> page 12]”).

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DANGER

Toxic, corrosive gases

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

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

When connecting gas lines to the unit, please note:
– The connection must be made by a qualified professional.
– The substances selected (particularly chemical, thermal and pressure-resistance) must be suitable for the measurement task. Corrosive gases will significantly reduce the life of the measuring cells.
– Limit rapid pressure fluctuations in the gas inlet and outlet pipes to prevent a fluctuation in the measurement values. If rapid, high fluctuations of pressure or flow occur in the gas lines we recommend using a damping vessel (> 0.5 L) upstream from the gas inlet.
– Suitable sample gas conditioning is required upstream from the analyser.
– If the gas inlet or ambient conditions change considerably, always recalibrate the analyser (see chapter "Menu > Calibration" [> page 39]).

PVDF hose couplings for tubes with 4 mm inside diameter (6 mm outside diameter) at the back of the analyser are standard. If the analyser is equipped with stainless steel bulkhead couplings (optional), stainless steel tubes with 6 mm outside diameter may be connected gas tight.

The back of the unit will have the respective number of gas connections and terminal strips for signal outputs based on the number of measuring channels.

<table>
<thead>
<tr>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td>gas in</td>
<td>Sample gas input</td>
<td>4</td>
<td>RS232</td>
<td>RS232 port (optional)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>gas out</td>
<td>Gas outlet</td>
<td>5</td>
<td>Fuse</td>
<td>Fuse 1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>cal. gas</td>
<td>Calibrating gas inlet</td>
<td>6</td>
<td>Power</td>
<td>Power supply with built-in fuse and ON/OFF switch</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>ST1 to ST4</td>
<td>Signal output Ch. 1 to Ch. 4</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>ST04</td>
<td>Equipment status</td>
<td>7</td>
<td>Fan</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
5.2.4 Electrical connections

5.2.4.1 Signal outputs

Two or three 16-pin PHÖNIX plugs (ST0 to ST3) are located at the back of the analyser for the input and output signals. Plug ST4 may optionally be configured to signal the measuring range or the measuring range switchover. To prevent interference, the signal lines should be routed isolated from the power lines.

Refer to the tables below for the plug configuration.

### Plug 0

<table>
<thead>
<tr>
<th>Pin</th>
<th>Function</th>
<th>Description / Status</th>
<th>Connection data</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>NC contact</td>
<td>Operation</td>
<td>Relay, max. switching power</td>
</tr>
<tr>
<td>2</td>
<td>Common</td>
<td>Common</td>
<td>125 V AC / 1 A or 60 V DC / 1 A</td>
</tr>
<tr>
<td>3</td>
<td>NO contact</td>
<td>Malfunction</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>NC contact</td>
<td>Operation</td>
<td>Relay, max. switching power</td>
</tr>
<tr>
<td>5</td>
<td>Common</td>
<td>Common</td>
<td>125 V AC / 1 A or 60 V DC / 1 A</td>
</tr>
<tr>
<td>6</td>
<td>NO contact</td>
<td>Service required</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>NC contact</td>
<td>Measurement</td>
<td>Relay, max. switching power</td>
</tr>
<tr>
<td>8</td>
<td>Common</td>
<td>Common</td>
<td>125 V AC / 1 A or 60 V DC / 1 A</td>
</tr>
<tr>
<td>9</td>
<td>NO contact</td>
<td>Zero gas calibration</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>PE</td>
<td>Protective earth</td>
<td>PE</td>
</tr>
<tr>
<td>11</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12</td>
<td></td>
<td>Start solenoid valve or pumps (optional)</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td></td>
<td>Start calibration (zero gas)</td>
<td></td>
</tr>
<tr>
<td>14</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>+</td>
<td>24 V DC</td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>-</td>
<td>voltage output</td>
<td></td>
</tr>
</tbody>
</table>

*Tab. 4: Plug 0, system connection, 16-pin PHÖNIX connection terminals*

### Plug 1-4

<table>
<thead>
<tr>
<th>Pin</th>
<th>Function</th>
<th>Description / Status</th>
<th>Connection data</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>NC contact</td>
<td>Limit 1</td>
<td>Relay, max. switching power</td>
</tr>
<tr>
<td>2</td>
<td>Common</td>
<td></td>
<td>125 V AC / 1 A or 60 V DC / 1 A</td>
</tr>
<tr>
<td>3</td>
<td>NO contact</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>NC contact</td>
<td>Limit Value 2</td>
<td>Relay, max. switching power</td>
</tr>
<tr>
<td>5</td>
<td>Common</td>
<td></td>
<td>125 V AC / 1 A or 60 V DC / 1 A</td>
</tr>
<tr>
<td>6</td>
<td>NO contact</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>NC contact</td>
<td>Measurement</td>
<td>Relay, max. switching power</td>
</tr>
<tr>
<td>8</td>
<td>Common</td>
<td></td>
<td>125 V AC / 1 A or 60 V DC / 1 A</td>
</tr>
<tr>
<td>9</td>
<td>NO contact</td>
<td>Range calibration</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>PE</td>
<td>Protective earth</td>
<td>PE</td>
</tr>
<tr>
<td>11</td>
<td>+</td>
<td>Gas concentration analogue output; configured in device menu</td>
<td>4 – 20 mA 0 – 20 mA 0 – 10 V 2 – 10 V</td>
</tr>
<tr>
<td>12</td>
<td>-</td>
<td></td>
<td></td>
</tr>
<tr>
<td>13</td>
<td></td>
<td>Start calibration (span gas)</td>
<td>Controls also see Signal outputs [ &gt; page 21]</td>
</tr>
<tr>
<td>14</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>+</td>
<td>24 V DC</td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>-</td>
<td>voltage output</td>
<td></td>
</tr>
</tbody>
</table>

*Tab. 5: Plug ST1 to ST4, measuring channel 1 to 4, 16-pin PHÖNIX connection terminals*

The binary inputs (plug ST0: pin 11/12 and pin 13/14 as well as plug 1-4: pin 13/14) may be controlled internally or externally. The following illustrations show the connection options.
5.2.4.2 RS232 port

The RS-232 serial port can be used to connect a 9-pin SUB-D plug to transfer the error and status messages to a receiver. The transfer speed can be up to 115200 baud.

We recommend a wire cross-section > 0.5 mm² and a maximum cable length of 15 m at a baud rate of 19200 baud. If the transfer speed is slow, the line may be longer, for high transfer speeds the line must be shorter.

<table>
<thead>
<tr>
<th>RS232</th>
<th>Pin</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>N/C</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>TxD</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>RxD</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>N/C</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>GND</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>N/C</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>N/C</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>N/C</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>N/C</td>
<td></td>
</tr>
</tbody>
</table>

*Tab. 6: RS232, 9-pin SUB-D plug*

The following interface parameters may be configured:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baud rate</td>
<td>4800, 9600, 19200, 38400, 115200 baud adjustable</td>
</tr>
<tr>
<td>Stop bits</td>
<td>1</td>
</tr>
<tr>
<td>Data bits</td>
<td>8</td>
</tr>
<tr>
<td>Parity</td>
<td>None</td>
</tr>
<tr>
<td>Handshake</td>
<td>without</td>
</tr>
</tbody>
</table>

The length of the transmission protocol is variable. All characters are transmitted in ASCII format. Every transmission ends with `<CR>+<LF>`. Depending on the number of registered cells, lines with the following values will be transmitted via the port every second, each separated by semicolon:
Parameter | Data string | Description
--- | --- | ---
Channel no. | #1… #4 | always appears, measuring channel number
Concentration unit | xx.xx %, ppm, mg/m³ | always appears, concentration measured + unit
Calibration mode | Zero | during zero gas calibration
Span | during span gas calibration
--- | During normal operation, no calibration mode
Calibration status | CalOK | following successful calibration
CalErr | following failed calibration
----- | During normal operation (no calibration)
Limit value 1 | LM1 | appears when the limit is breached
--- | No limit exceeded
Limit value 2 | LM2 | appears when the limit is breached
--- | No limit exceeded
Alarm | A | if an alarm has been triggered
! | Alarm was automatically reset
- | Alarm deleted from logbook
Maintenance request | W | "W" for maintenance request
! | Maintenance request was automatically reset
- | Maintenance request deleted from logbook
active measuring range | MR1 | Measuring range 1 active
always appears | MR2 | Measuring range 2 active

Tab. 7: Transfer protocol structure

Sample data protocol, unit with two measuring cells:

```
#1; 20.89 % ; ______ ; LM1 ; ___ ; A ; _ ; MR1<CR><LF>
#2; 15.89 ppm ; CalOK ; LM1 ; LM2 ; ! ; _ ; MR1<CR><LF>
```

Tab. 8: Sample plain text transmission protocol

Additional commands can be used to fetch the following information via the interface or to send commands. The commands must be completed with `<CR> + <LF>`:

<table>
<thead>
<tr>
<th>Command</th>
<th>Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>UF&lt;CR&gt;&lt;LF&gt;</td>
<td>The failure logbook will be output in plain text</td>
</tr>
<tr>
<td>UM&lt;CR&gt;&lt;LF&gt;</td>
<td>The maintenance logbook will be output in plain text</td>
</tr>
<tr>
<td>UC&lt;CR&gt;&lt;LF&gt;</td>
<td>The calibration logbook will be output in plain text</td>
</tr>
<tr>
<td>DF&lt;CR&gt;&lt;LF&gt;</td>
<td>Deletes the first entry in the failure logbook</td>
</tr>
<tr>
<td>DM&lt;CR&gt;&lt;LF&gt;</td>
<td>Deletes the first entry in the maintenance logbook</td>
</tr>
<tr>
<td>DC&lt;CR&gt;&lt;LF&gt;</td>
<td>Deletes the first entry in the calibration logbook</td>
</tr>
<tr>
<td>R&lt;CR&gt;&lt;LF&gt;</td>
<td>Continue measurand output</td>
</tr>
</tbody>
</table>

Tab. 9: Queries
Sample logbook query:

Input:UF<CR>
<LF>Failure/Logbook:<CR>
<LF> 1 Channel 3 22.08.16 13:18:46 Para Insufficient temperature <CR>
<LF> 2 Channel 3 22.08.16 13:18:46 Para Heater defective <CR>
<LF> 3 Channel 3 22.08.16 13:18:46 Para T-Sensor defective <CR>
<LF> 4 Channel 1 22.08.16 13:18:59 ZrOx Heater defective <CR>
<LF> 5 Channel 1 22.08.16 13:19:06 ZrOx temperature insufficient <CR>
<LF> 6 Channel 1 22.08.16 13:19:10 ZrOx Limit 1 underrun <CR>
<LF> 7 Channel 1 23.08.16 13:06:05 ZrOx temperature insufficient <CR>
<LF> 8 Channel 1 23.08.16 13:06:05 ZrOx Limit 1 underrun <CR>
<LF> 9 Channel 3 23.08.16 13:06:02 Para Insufficient temperature <CR>
<LF>10 Channel 3 23.08.16 13:06:02 Para T-Sensor defective <CR>
<LF>11 Channel 1 23.08.16 13:15:04 ZrOx Heater defective <CR>
<LF>12 Channel 3 23.08.16 13:15:05 Para Heater defective

Tab. 10: Sample query logbook

5.2.4.3 Power supply

<table>
<thead>
<tr>
<th>DANGER</th>
<th>Electric voltage</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Risk of electric shock if the unit is connected to the supply incorrectly.</td>
</tr>
<tr>
<td></td>
<td>a) The unit must be connected by trained, expert personnel.</td>
</tr>
<tr>
<td></td>
<td>b) Ensure the correct supply voltage.</td>
</tr>
<tr>
<td></td>
<td>c) Only use the included power cord or a power cord with the specifications indicated.</td>
</tr>
</tbody>
</table>

The supply voltage is 230 V AC 50/60 Hz or 115 V AC 50/60 Hz. Verify the available mains voltage matches the required supply voltage per the nameplate.

Use the included power cable to connect the analyser to the DIN EN 60320-2-3 connector at the back marked “power”.
6 Initial operation

**CAUTION**

Heating by turbulence
To avoid turbulence, the analyser should only be applied with slowly opening the mountings.

Adiabatic compression
To avoid a possible adiabatic compression, operation with closed gas outlets is not permitted.

### 6.1 Process

**Preparation**

Please ensure
- The unit was assembled and connected properly. Particularly ensure the voltage supply and the gas connection are correct.
- The gas conditioning system is working properly,
- The zero gas has an oxygen concentration of 20.9 Vol.% and
- The span gas supplied has the correct concentration (adapted to the measuring range).

**Switching on**

Switch on the analyser with the power switch at the back. After the Bühler logo the initialisation screen will display the equipment configuration:
- Software Version
- Installed measuring cells
- As well as the remaining initialization time

During initialisation you may touch the display to switch to measurement view, e.g. to configure the unit. The initialization progress is also displayed in measurement view: **WU 15 min** flashing

After initialization (standard 30 min) the measurement screen will appear.

Here, use **Menu** to open the main menu or **Cal.** to go straight to calibration.

Wait at least 30 minutes for the unit to warm up, then perform the first calibration. To measure very low concentrations it may be helpful to allow the unit to continue to warm up, up to 2 h.

After calibration the unit may be charged with the respective sample gas. Please observe the permissible gas inlet conditions.

To ensure correct operation, the sample gas flow for the respective measuring cell should be set to the values in table "Gas flow diagram for the equipment base version" [page 9]. If the minimal flow rates are underrun, the measurement will be rejected and an error message will appear.

You may now want to configure the analyser settings to your needs. A table with key settings can be found in the next chapter.

If your unit has internal sample gas pumps, these can now be activated under **Menu > Base settings > Pumps**.
# 6.2 Overview of key factory settings

Check if the factory settings are suitable for your measurement task. If necessary, change them as described in chapter "Operation and Control".

The following table lists the key parameters:

<table>
<thead>
<tr>
<th>Menu item</th>
<th>Submenu</th>
<th>Factory Setting</th>
</tr>
</thead>
<tbody>
<tr>
<td>Channel Settings</td>
<td>Measuring ranges</td>
<td>Meas. range MR1 and MR2 (customer-specific per order)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Auto Switchover: OFF</td>
</tr>
<tr>
<td></td>
<td>Limits</td>
<td>No limit presets</td>
</tr>
<tr>
<td></td>
<td>Outputs</td>
<td>Analogue outputs:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4-20 mA / on cal.: current value / on error: current value</td>
</tr>
<tr>
<td></td>
<td></td>
<td>RS 232 (optional):</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Baud rate: 4800, parity: no stop bits: 1</td>
</tr>
<tr>
<td></td>
<td>Adjustment</td>
<td>No carrier gas adjustment set (Value 0)</td>
</tr>
<tr>
<td></td>
<td>Damping</td>
<td>For all measuring cells 1 sec (time constant)</td>
</tr>
<tr>
<td></td>
<td>Units</td>
<td>Custom, as ordered</td>
</tr>
<tr>
<td>Base settings</td>
<td>Language</td>
<td>For delivery to Germany &quot;German&quot;. For delivery to other countries &quot;English&quot;.</td>
</tr>
<tr>
<td></td>
<td>Passwords</td>
<td>Password 1: 111</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Password 2: 222</td>
</tr>
<tr>
<td></td>
<td>Pumps</td>
<td>If applicable: Off</td>
</tr>
<tr>
<td></td>
<td>Date / Time</td>
<td>Date: Day.Month.Year, current date</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Time: hh:mm:ss current time CET (h:min)</td>
</tr>
<tr>
<td></td>
<td>Pressure sensor</td>
<td>Not set (pressure sensor calibrated prior to delivery)</td>
</tr>
<tr>
<td></td>
<td>(optional)</td>
<td></td>
</tr>
<tr>
<td>Calibration</td>
<td>Auto</td>
<td>Off / Time Period: 24 h</td>
</tr>
<tr>
<td></td>
<td>Manual</td>
<td>No preset</td>
</tr>
<tr>
<td></td>
<td>Deviation</td>
<td>Span gas: 10% from setpoint / zero gas: 1 Vol. % O\textsubscript{2} fixed</td>
</tr>
<tr>
<td></td>
<td>Period</td>
<td>Calibration period: 2 min</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Purging Time: 5 min</td>
</tr>
</tbody>
</table>

Check if the factory settings are suitable for your measurement task. If necessary, change these as described in chapter "Menu > Base Settings [page 32]".
7 Operation and Control

7.1 Menu overview and operating principle

The analyser is controlled via the touch display.

NOTICE

The device must not be operated beyond its specifications.

## Notepad

### Delicate display

The touch display is delicate. Do not use sharp or pointy objects such as pens, screwdrivers, etc. to operate it.

Use the **Menu** button to access the main menu. Use the **Cal.** button to access the calibration submenu directly. Start a submenu by pressing the respective button.

Use the **Meas.** button to exit from the menu level and return straight to the measurement display.

All parameters are protected from unauthorised access with a 3 character password. The default passwords at the time of delivery are:

- **Password 1**: 111
- **Password 2**: 222
The following menus are available for parametrisation and diagnostics:

**Main menu**
- **Display**
- **Diagnostics**
- **Channel Settings**
- **Base Settings**
- **Calibration**

**Submenu 1**
- **Status**
- **Logbook / Failures**
- **Logbook / maintenance**
- **Analysis**

**Submenu 2**
- **For each cell (Actual status):**
  - Cell temp, cell signal, status, p-compensation
- **Error list**
- **Maintenance request list**
- **Selection: Averages, characteristics (curve)**

**Channel Settings**
- **Measuring ranges**
- **Limits**
- **Outputs**
- **Adjustment**
- **Damping**
- **Units**

**Base Settings**
- **Language**
- **Passwords**
- **Pumps**
- **Date / Time**
- **Pressure sensor**

**Calibration**
- **Auto**
- **Manual**
- **Deviation**
- **Period**
- **Cal logbook**

**Fig. 6: BA 3 select menu overview**
7.1.1 General information for navigating the menu

**Measurement screen**

The normal mode the analyser will show the measurement screen. It will show:
- the current measurement value of each cell as a bar graph and as a measurement value in the specified unit
- the measuring range
- a bar graph of the flow through the unit (channel 1) (optional)
- the keys [Menu] and [Cal.] used to jump directly to the main or calibration menu.

**Flashing symbols**

A flashing icon in the measurement screen indicates a problem.

- **A**: An event (alarm or error) was detected and recorded in the “Failure” log. The event may apply to one channel or the entire unit.
- **I**: An event (failure or alarm) occurred but was automatically reset. This is for example the case if a low temperature alarm is temporarily triggered. In this case an entry will be made in the failure log.
- **W**: Service is required. A “Service” log entry has been generated.

The symbols will remain active until the associated log entries have been deleted.

Learn how to open the respective log in chapter "Menu > Diagnostics [page 30]" or "Menu > Calibration [page 39]."

**Opening the submenu**

Navigate the menu with the respective button (key). To e.g. change the unit the gas concentration is displayed in, press
Extra buttons

In addition to the buttons, the menus may also have extra buttons:

The buttons ↑ and ↓ have different functions depending on the context:

- Selecting the measuring cell or All Channels
- Browsing a list
- Browsing a selection

Pressing a button:

- Will open the respective submenu,
- Will open a keyboard to enter values
- Will highlight the button (inverted display).

With a button highlighted, use the ↑ and ↓ keys to browse the drop-down menu. To change a parameter, you will first need to press again to deselect the button.

Be sure to save the changes with ← in the respective menu. Values are not automatically saved upon exiting.

Use Esc to cancel the input at any time. The next higher / previous screen will appear.

Use Meas to return directly to the measurement screen. Parameter changes will not be saved!

Entering values

Use the on-screen keyboard to enter a value directly. Here you will see a keypad and context-specific extra keys (e.g. ↓, ↑, ←, or →).

You may correct the input with C or press Esc to cancel.

Use the return key ← to apply the entry.

When entering an invalid value, an error message will appear (see example) and the respective parameter will not be changed.

Password Protect

With password protect enabled, the analyser will require a password (1 or 2, see chapter "Menu overview and operating principle [> page 26]") before a parameter can be changed.

Enter the password with the on-screen keyboard and press ← to confirm your input.

Please refer to chapter "Menu > Base Settings > Passwords" for how to enable and disable password protect.
## 7.2 Menu > Diagnostics

The Diagnostics menu contains the following menu items:

<table>
<thead>
<tr>
<th>Failure/ logbook</th>
<th>This logbook lists all failures which have occurred including channel number, date, time and error message in plain text.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maintenance/ logbook</td>
<td>Outstanding service is recorded in the service log. <strong>Note: Not all service will be listed. Please also refer to chapter Service.</strong></td>
</tr>
<tr>
<td>Status</td>
<td>This menu shows the status of each measuring cell along with the cell voltage, cell temperature and the compensation type.</td>
</tr>
<tr>
<td>Analysis</td>
<td>This shows the average values – over 24 h and 1/2 h. The characteristics can also be displayed in a graph.</td>
</tr>
</tbody>
</table>

### 7.2.1 Menu > Diagnostics > Failure Log

This logbook records all alarms and errors. If this logbook has an entry, the measurement display will flash A or ! at the respective channel. Up to 40 messages can be saved. On the 41st entry the oldest message will automatically deleted and overwritten with the new message.

The ! will appear if the event was reset without user interaction, e.g. for a low temperature alarm.

**Failure Log**

Open the logbook using **Menu > Diagnostics > Failure Log** and enter the password.

The screen will show the following information:
- Messages displayed / total messages
- Current time
- Always 3 messages in plain text

Use the ↓ and ↑ buttons to browse the list.

Take the action required by the respective message. You will find information about this in chapter “Status messages and troubleshooting [> page 49]” and others.

Use the Del key to delete the top (oldest) message (always no. 1).

Once all messages have been deleted, the marker A or ! after the respective measurement display will disappear.
7.2.2 Menu > Diagnostics > Service Log

This logbook lists the required service. If an entry exists, the measurement channel will flash W at the respective channel.

Use Menu > Diagnostics > Service Log to open the logbook and enter the password.

The screen will show the following information:
- Messages displayed / total messages
- Current time
- Always 3 messages in plain text

Use the ↓ and ↑ buttons to browse the list.

Use the Del key to delete the top message (always no. 1).

Once all messages have been deleted, the W after the respective measurement display will disappear.

For information for any required service, refer to chapter "Service".

Notice

Service schedule

Not all required service is indicated in the logbook. Please also follow the service schedule in chapter “Service”.

7.2.3 Menu > Diagnostics > Status

This menu provides an overview with the status of each measuring cell.

Select the respective channel with the buttons ↑ and ↓.

It will show:
- the measuring cell,
- the status: OK, A, ! or W

Alarm messages will appear before maintenance messages.

Note: If a status other than OK appears, please refer to the respective logbook.

In particular, the EC cell must be replaced if worn (also see chapter 8.4)
- the cell temperature
- the compensation type
7.2.4 Menu > Diagnostics > Analysis
The characteristics are continuously analysed. The system records
– the average value over the past 30 min (1/2 h average value)
– the average value over the past 24 h

Analysis
Open analysis with Menu > Diagnostics > Analysis.
You can now choose between viewing the Average Values and the Characteristics.

Average Values
Selecting Average Values will display
– the most recent 1/2 h average value with deviation will be and
(if enough measurement values are available)
– the 24 h average value with deviation
Use the ↑ and ↓ keys to select the channel.

Characteristics
Selecting Characteristics will display a graph of the 1/2 h average values recorded. The last average value recorded will appear at the right edge of the graphic and will be slightly larger than the other measuring points.
Use the ← and → keys to move the marker inside the graphic. The value below the time axis corresponds to the 1/2 h average value of the respective marked point. (The 3rd last measuring point is marked in the example.)

7.3 Menu > Base Settings
Use the base settings menu to configure the device settings.

<table>
<thead>
<tr>
<th>Menu</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Language</td>
<td>Choose from German and English as the menu language.</td>
</tr>
<tr>
<td>Passwords</td>
<td>Add passwords 1 and 2 or enable / disable password protect</td>
</tr>
<tr>
<td>Pressure sensor</td>
<td>Here enter the current air pressure. This serves as a reference value for adjusting the measurement values.</td>
</tr>
<tr>
<td>Date/Time</td>
<td>Set the current date and time.</td>
</tr>
<tr>
<td>Pumps</td>
<td>Define the behaviour for the installed pumps.</td>
</tr>
</tbody>
</table>
### 7.3.1 Menu > Base Settings > Passwords

All parameters are protected from unauthorised access with a 3 character password. The default passwords at the time of delivery are:

- **Password 1**: 111
- **Password 2**: 222

Depending on the parameter relevance these are protected by password 1 or 2.

The passwords may be changed and you can disable / enable password protect.

Press **Menu > Base Settings > Passwords**.

Password protect is enabled on delivery, **On** is selected.

#### Enable/disable password protect

- To disable the passwords, press **Off** and press **+D** to save this setting.

**NOTICE! All parameters can now be accessed at all times!**

To enable the passwords, press **On** and press **+D** to save this setting.

#### Change password

- Select **Password 1** or **Password 2** to change.
- Enter a new password (max. 3 characters).
- Press **+D** to confirm your input.
- Repeat the new password.
- Press **+D** to confirm your input.

The information will be saved.

**NOTICE! Make a note of the new passwords and keep them in a safe location.**

### 7.3.2 Menu > Base Settings > Language

#### Changing the menu language

Use **Menu > Base Settings > Language** to open the drop-down menu.

Select the language and press **+D** to confirm your input.

Press **OK** to acknowledge the message “Data saved”.

**Language:**
- German
- English
7.3.3 Menu > Base Settings > Pressure Sensor

The analyser can be equipped with pressure sensor for compensating the pressure in the results. This will compute the ideal gas compensation for measurement fluctuations due to barometric or process-related pressure fluctuations.

The drift of the internal pressure measurement is low enough for virtually all measuring tasks that an additional recalibration of the pressure sensor is not necessary.

For high-precision measurements within minimal measuring ranges it may be helpful to recalibrate the pressure sensor. This requires a very accurate pressure gauge (0.1 mbar resolution) to measure the current ambient pressure.

To calibrate the internal pressure sensor:

**Preparation**

- Shut off the internal and external sample gas pumps and prevent pressure fluctuations in the sample gas line at the process or gas output end (if necessary, disconnect the unit from the sample gas lines)
- Use your external pressure gauge to measure the current ambient pressure and wait for the measurement value to stabilise.

**Pressure sensor**

If the pressure output by the analyser significantly deviates from your measurement value, select **Menu > Base Setting > Pressure Sensor** and enter password 2.

Now select **Input**, enter the value and press **8** to confirm your input.

- Round your measurement value up or down, enter the new value and press **8** to confirm your input.

Press **8** to confirm again and apply the change. Use **Meas** to return to the measurement screen.

7.3.4 Menu > Base Settings > Date/Time

To set the current date and (local) time:

**Setting the date / time**

Press **Menu > Base settings > Date/Time**

Now select **Date** or **Time**.

Enter the current values using the on-screen keyboard. (The example uses **Time**.)

- Time format: hours:minutes:seconds
- Date format: Day.Month.Year (2-digit)
- Press **8** to confirm your input.
### 7.3.5 Menu > Base Settings > Pumps

Use this menu to specify the pump behaviour (where applicable) for each channel.

**Pumps**

Press **Menu > Base Settings > Pumps**.

Select the pump for which you wish to change the settings. The selected entry will be displayed inverted.

Now change the setting with the **↑** and **↓** keys.

- **Off**: The pump is always off.
- **On**: The pump is always on.
- **On Cal**: The pump is only on during calibration.

Now select the next pump and define its settings.

Finally, press **Esc** to confirm your input. The settings will be saved.

### 7.4 Menu > Channel Settings

The following settings can be configured for each channel:

<table>
<thead>
<tr>
<th>Menu</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measuring ranges</td>
<td>Define the measuring range and the switchover points.</td>
</tr>
<tr>
<td>Limits</td>
<td>Define the gas concentration limits which will trigger a signal at the relay output.</td>
</tr>
<tr>
<td>Outputs</td>
<td>Parametrise the outputs.</td>
</tr>
<tr>
<td>Units</td>
<td>Select the unit to display the result in.</td>
</tr>
<tr>
<td>Damping</td>
<td>Define the damping constant for the measurement.</td>
</tr>
<tr>
<td>Adjustment</td>
<td>This menu item is only relevant when using the paramagnetic O₂ cell. Here you will define the adjustment for carrier gases which may be present.</td>
</tr>
</tbody>
</table>
7.4.1 Menu > Channel Settings > Meas. Range

You can define measuring range MR1 and MR2 for each channel. The settings will affect the output via the analogue output. The measuring range the unit is in can optionally be indicated via relay outputs.

Depending on the setting under **Auto Switchover** two scenarios should be distinguished:

1. **Auto Switchover** is *Off*:
   - The unit will measure in the resolution for measuring range MR1, with arbitrary configuration.
   - The output range of the analogue output corresponds to the range limits of measuring range MR1.

2. **Auto Switchover** is *On*:
   - The unit will now automatically switch between MR1 and MR2 if the current measurement value runs over or under the range limits (switchover points).
   - The output range of the analogue output corresponds to the range limits of the respective active measuring range.
   - The measuring range is displayed based on the **Auto Switchover** settings.

To define the measuring range:

**Measuring ranges**

Select **Menu** > **Channel Settings** > **Meas. Range**.

Select **Man. Setting**.

First use the ↑ and ↓ keys to select the channel, then **MR1**.

Enter the lower measuring range end value using the on-screen keyboard. Press ← to confirm your input. This value will be applied to both measuring ranges.

Then enter the upper measuring range end value for MR1 and press ← again to confirm your input.

Now select **MR2**. Press ← to confirm the lower value, then enter the upper measuring range end value for MR2.

Press ← to apply the new parameters and Esc to return to the next higher menu.

**Auto measuring range switchover**

Now under **Auto Switchover** define whether to enable automatic measuring range switchover.

- Selecting *On* will enable automatic switchover of the measuring range. The analogue output signal will automatically be adjusted to the respective measuring range end values when the measuring range is switched over.

- When selecting *Off*, the desired measuring range must then be manually adjusted under **Manual Settings**.

- If necessary, define the switchover points **MR1 -> MR 2** and **MR2 -> MR1**.

- Press ← to accept the settings.
7.4.2 Menu > Channel Settings > Limits

You may define two limits per channel and choose whether to signal if the respective limit is overrun or underrun. The signal will be output via the RS232 port, the relay outputs at the back of the unit and with notifications in the unit’s display.

How these signals will be handled is the responsibility of the owner.

**Limits**

Press **Menu > Channel Settings > Limits** and select **Limit Value 1** or **Limit Value 2**.

First enter the relational operator **>** or **<**, then the value. (If you only enter one value, the original operator will be used.)

Press **↓** to confirm your input.

Lastly, press **←** to apply the new parameters and press **OK** to confirm the message.

---

7.4.3 Menu > Channel Settings > Outputs

In this menu you can define how the analogue output behaves for each channel and the parameters for the RS232 port.

**Analogue output**

Press **Menu > Channel Settings > Outputs** and select **Analog Output**.

Select the channel.

Tap to select **Output** and define which signal the measurement output for the channel should output.

Use **↑** and **↓** to browse the list and press **←** to confirm the respective setting. Choose from

- 4-20 mA (factory setting)
- 0-20 mA
- 2-10 V
- 0-10 V

The analogue output scaling varies according to the measuring range MR1 or MR2 settings. The lower value under MR1 is identical with that under MR2 and corresponds with the lower analogue value. The upper analogue value corresponds to the end value of
the respective active measuring range. Please note, in automatic switchover the measuring ranges of the end value will automatically be adjusted. This must be considered when analysing the analogue signal.

**Cal. failure**
You can further define the behaviour of the analogue output on calibration and failures. The settings can be configured independently.

Mark **Value at Cal.** or **Value at Alarm**, browse through the list using ↑ and ↓, and press → to confirm the respective setting. Choose from

- Hold Value (factory setting)
- Zero
- Current value

Note: With the setting for “Value at Alarm” taking priority over the setting “Value at Cal.”, i.e.: If an error occurs during calibration, the measurement will be handled as configured in “Value at Alarm”.

### 7.4.4 Menu > Channel Settings > Units
If a ZrOx measuring cell is installed, you can choose whether to display the measurements in Vol.% or ppm for the respective channel. The unit cannot be changed for other measuring cells.

Please note, when selecting “ppm”, the maximal measuring range setting is 10,000 ppm. However, the measured value display will register up to 210,000 ppm. Displaying the measurement values in the unit ppm is only useful when measuring traces of O₂.

**Units**
Open **Menu > Channel Settings > Units**.
Select the channel using ↑ and ↓.
Now select **Display**.

Now select the unit with ↑ and ↓. Depending on the cell type you will be able to choose from various units.

Press → to apply the new parameter and press **OK** to confirm the message.
7.4.5 Menu > Channel Settings > Damping

This submenu item is used to set the time constant (integration time) for damping the measurement display (moving average value). It represents the amount of time over which the measurement values are averaged before being output to the display. The values are 1 s to 20 s. The time constant factory setting is 1 s.

- Press \textbf{Menu} > \textbf{Channel Settings} > \textbf{Damping}.
- Select \textbf{delta }\textbf{t} and set the time constant using the \textbf{↑} and \textbf{↓} buttons.
- Press \textbf{Esc} to accept the setting.

7.4.6 Menu > Channel Settings > Adjustment

This menu item only pertains to \(\text{O}_2\) measurements by paramagnetic cell.

Here you can enter the values from the table \textit{Adjustments }\textbf{β} \textit{for common carrier gases (values for other gases upon request)} [\textit{\textgreater page 13}].

\textbf{NOTICE}

\textbf{Adjustment prefix}

When entering the adjustment be sure to add the \textbf{opposite sign} from the table!

- Press \textbf{Menu} > \textbf{Channel Settings} > \textbf{Adjustment}.
- Select \textbf{Influence Carr. Gas} and enter the adjustment (including opposite sign).
- Press \textbf{Esc} to accept the setting.
- The value will be rounded to 2 decimals.

7.5 Menu > Calibration

The following settings can be configured under menu item Calibration:

<table>
<thead>
<tr>
<th>Menu</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Auto</td>
<td>Here you can define whether to regularly auto-calibrate the unit.</td>
</tr>
<tr>
<td>Manual</td>
<td>This menu item allows you to start a calibration with defined concentrations of zero and span gas.</td>
</tr>
<tr>
<td>Period</td>
<td>Used to define the purging time and calibration period for the calibrating gases.</td>
</tr>
<tr>
<td>Deviation</td>
<td>Enter the maximum concentration deviation to maintain during calibration.</td>
</tr>
<tr>
<td>Logbook</td>
<td>The logbook records both the calibrations performed and events during calibration.</td>
</tr>
</tbody>
</table>
7.5.1 General information

The properties of measuring instruments change over time due to components ageing or due to changes in ambient or process conditions. The resulting change in the measurement values is referred to as drift.

To be able to measure with adequate accuracy the unit regularly needs to be calibrated. This particularly applies when measuring very low gas concentrations. There is no one fit all calibration frequency as it depends on various factors. Important factors could be:

- Changes in the unit’s ambient conditions (e.g. pressure and temperature)
- Changes in the gas input conditions (e.g. gas temperature, gas flow rate, gas pressure)
- Changes to the gas conditioning system (e.g. filter replacement, replaced devices)
- Changes in the unit’s installation site or the installation position
- Changes in the composition of the sample gas (e.g. changes in the concentration of carrier gases, sample gas moisture)
- Switching measuring ranges

Regardless of the above factors, drift will occur due to the age of components or measuring cell wear. Whilst this drift is typically quite minimal, we recommend calibrating the unit at least every 2-4 weeks. The effect of pressure variations can be compensated with the optional pressure sensors installed in the unit.

Calibration is only sensible once the unit has reached a stable operating temperature (approx. 30 min after switching on). We recommend generally repeating the calibration after 60 min.

When measuring very low gas concentrations, allow the unit to warm up approx. 2 h before calibrating it.

<table>
<thead>
<tr>
<th>NOTICE</th>
<th>Calibration results</th>
</tr>
</thead>
<tbody>
<tr>
<td>The best calibration results are achieved if the calibrating gas runs the exact same gas path as the sample gas, so flows to the unit through the entire gas conditioning system. Please also be sure the gas input and ambient conditions during calibration are the same as during measurement.</td>
<td></td>
</tr>
</tbody>
</table>

7.5.1.1 Calibrating gases

In calibration we generally distinguish between zero gas calibration (1st reference point; zero point of the unit) and range calibration (calibrating a second reference point) for greater accuracy. This requires two different gases:

Zero Gas
When using EC cells and paramagnetic cells the zero gas should have a concentration of 20.9 Vol % (e.g. dry, clean ambient air without oil or grease) or 0 Vol. % (inert gases such as N$_2$ or He). When using ZrOx measuring cells the oxygen concentration must be 20.9 Vol.%.

Span gas
A span gas concentration of 60-95 % of the measuring range value of the gas components to be measured is sensible. The best case scenario is a span gas concentration approximately the same as the expected sample gas concentration.

7.5.1.2 Special information about calibrating ZrOx measuring cells

Although the analyser also supports two-point calibration of the ZrOx measuring cells, we generally recommend only one zero point calibration of the ZrOx cell using filtered ambient air or conditioned compressed air free from oil and water.

This is for one due to the cell signal exponential depending on the oxygen concentration. Even minimal inaccuracies in the span gas greatly affect the signal sequence of the cell. Span calibration using gases with little mix accuracy can also result in great inaccuracies in the measurements.

On the other hand this is a measuring principle with a precisely known course of the function. Sole zero point calibration with air will compensate all considerable cross-influences.

Two-point calibration will only minimally improve the measurement accuracy at the lowest ppm measuring range (up to 200 ppm). Here the following is important:

- The span gas used should be considerably more accurate than the desired measurement accuracy.
- The span gas concentration should be as close to the expected application measurement as possible.
## 7.5.1.3 Calibration presets

In addition to the settings for calibrating gas concentrations the **Calibration Period**, the **Purging Time** and the acceptable **Deviation** must be defined. Here these parameters are defined as follows:

### Cal.Period

The required amount of time for which calibrating gas (zero or span gas) should flow through the analyser for good calibrating results. These should be assessed so the calibrating gas flows through the unit (without supply lines) for at least 1 min. The calibration period factory setting is 3 min.

### Purging time

The amount of time for which the analyser is purged with calibrating gas prior to calibration to prevent calibrating gas and sample gas being mixed during calibration. These should be assessed so the calibrating gas flows through the unit (without supply lines) for at least 1 min. Please also remember the amount of time the calibrating gas requires from the sampling point to the analyser. The purging time factory setting is 3 min.

### Deviation

The maximum permissible deviation between the zero gas or span gas setpoint setting and the actual measurement values / displayed values during calibration (in % from setpoint). The factory setting for this parameter is 1 Vol.% O\(_2\) absolute for zero gas and 5 % (from the target value) for the span gas.

### Time period

This corresponds to the time period after which automatic calibration should be repeated cyclically. It is only enabled when set to "Auto Calibration ON".

## 7.5.2 Menu > Calibration > Period

You can now set the calibration period and purging time. The factory setting is 3 min.

First use the ↑ and ↓ keys to select the channel or **All Channels**.

### Cal.Period / Purging Time

Select **Cal.Period** or **Purging Time**:

Enter the new time in the format minutes:seconds, e.g. **05 : 30** for 5 min, 30 sec.

Note: A two-digit input is interpreted as "seconds"; e.g. entering **99** will result in a period of 1:39 min.

Press **Esc.** to confirm your input.

When setting the period please allow for the length of the lines from the calibrating gas delivery point and the analyser.

- The maximum calibration period or purging time setting is 10:00 minutes.
7.5.3 Menu > Calibration > Deviation

Select Menu > Calibration > Deviation
Enter password 2 and press \uparrow\downarrow to confirm.

Now use \downarrow and \uparrow to select the channel or All Channels.

Use the \uparrow and \downarrow keys to select the channel Span Gas to define the span gas concentration.
Confirm each input with \leftarrow\rightarrow\uparrow\downarrow.

Span Gas
Enter the new limit value as ”% from setpoint” under Span Gas.
Input range: 0.5 % to 20 % from setpoint
Press \leftarrow\rightarrow\uparrow\downarrow to confirm your input.

Zero Gas
(Inert gas or 20.9 Vol% O2 allowed)
Here, the calibration deviation is factory-set to 1 Vol% O2. This value cannot be changed
Press Esc to return to the next higher menu.

7.5.4 Menu > Calibration > Auto

Select Menu > Calibration > Auto
Enter password 2 and press \leftarrow\rightarrow\uparrow\downarrow to confirm.

The zero gas concentration for the paramagnetic cell and the EC cell should be set to 0 Vol. % (e.g. nitrogen 5.0) or 20.9 Vol. % (dry, clean ambient air free from oil and grease).
When using the ZrOx cell the setting must be 20.9 Vol. % (dry, clean ambient air free from oil and grease).

Span Gas
To define the span gas concentration, first select the channel using the keys \uparrow and \downarrow.
Then mark Span Gas.
Enter the desired concentration using the on-screen keyboard.
Press \leftarrow\rightarrow\uparrow\downarrow to apply the value.
**Time Period**

Now select **Time Period**.
Enter the auto calibration interval in the format hours:minutes:seconds.
Press ↵ to confirm your input.

**Auto. calibration:**

**Off / On**

To enable/disable auto calibration, toggle the mode with the or **On** key.

- **Off** - auto calibration is disabled.

- **On** - after applying the settings with ↵ the initial calibration will start and will then be repeated after the defined time period.

Press Esc. to return to the next higher menu or Meas to return to the measurement screen.

The logbook records both the calibrations performed and events during calibration.

### 7.5.5 Menu > Calibration > Manual

A manual calibration may be performed at any time.

**Manual Calibration**

Select **Menu** > **Channel Settings** > **Manual**.
Enter password 2.

Now select **All Channels** or use the arrow keys ↑ and ↓ to navigate to the channel to be calibrated.

When selecting **Zero Gas**, select the concentration for the zero gas and press ↵ to continue.

The zero gas concentration for the paramagnetic cell and the EC cell should be set to 0 Vol. % (e.g. nitrogen 5.0) or 20.9 Vol. % (dry, clean ambient air free from oil and grease).

When using the ZrOx cell the setting must be 20.9 Vol. % (dry, clean ambient air free from oil and grease).

First press **Start** for the zero gas. The analyser will begin the zero gas calibration.

**Purge zero gas**

This process will take the amount of time specified under **Purging Time**. The process may be stopped at any time with Esc.

After the purging time calibration with zero gas will automatically start.
**Calibrate zero gas**

This process will take the amount of time specified under **Cal.Period**. The process may be stopped at any time with **Esc.**

**Span Gas**

Now select **Span Gas**, enter the concentration for the span gas and press **Esc.** to confirm.
Press **Start** to begin the calibration sequence for the span gas.
The process may be stopped at any time with **Esc.**

The logbook records both the calibrations performed and events during calibration.

### 7.5.6 Menu > calibration > Logbook

The logbook records all messages triggered during the calibration sequence. Successful calibrations are also recorded.

**View Logbook**

- Select the messages with **Menu > Calibration > Logbook**.
  Enter password 2.

**Plain text**

- Messages are displayed in plain text:
  - Channel no, date and time
  - Plain text message.
  The process may be stopped at any time with **Esc.**

If an error message is triggered, proceed as follows:
Verify
- the unit had adequate time to warm up (at least 30 min) and stable operating conditions were reached.
- Calibrating gases are loaded in the desired concentration,
- the settings under Auto or Manual are correct and correspond with the respective gases.
- the calibrating gas supply is working properly and the purging time and cal.period settings are adequate.
Delete the respective top message (1st) with the Del button until all messages have been deleted.
Restart calibration.
If calibration fails again, you may be able to find information in chapter “” or contact our service (see chapter "Service and repair").
8 Service

During maintenance, remember:
- The equipment must be maintained by a professional familiar with the safety requirements and risks.
- Only perform maintenance work described in these operating and installation instructions.
- When performing maintenance of any type, observe the respective safety and operation regulations.

<table>
<thead>
<tr>
<th>DANGER</th>
<th>Electric voltage</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Risk of electric shock</td>
</tr>
<tr>
<td></td>
<td>a) Disconnect the unit from the mains when performing any maintenance.</td>
</tr>
<tr>
<td></td>
<td>b) Secure the equipment from accidental restarting.</td>
</tr>
<tr>
<td></td>
<td>c) The unit may only be maintained and opened by instructed, competent personnel.</td>
</tr>
</tbody>
</table>

Diagnostics

Please also refer to the “Failure” and “Service” logs for information on failure messages and service.

8.1 Service schedule

The service schedule is only a guide for the required service intervals and work. The owner is responsible for defining the service intervals considering the application conditions.

<table>
<thead>
<tr>
<th>NOTICE</th>
<th>Leaks when using corrosive gases</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>When using corrosive gases, regularly visually inspect the gas paths for damage. The intervals are based on the gases used, their concentration and their corrosiveness. Please also note the information on parts in contact with media in chapter “”.</td>
</tr>
</tbody>
</table>

Further observe the official or company regulations for your application and the failure and service messages output by the unit.

<table>
<thead>
<tr>
<th>Service</th>
<th>Service interval</th>
</tr>
</thead>
<tbody>
<tr>
<td>Visual inspection</td>
<td>1 – 2 days</td>
</tr>
<tr>
<td>Inspect and if necessary replace filter element (if applicable).</td>
<td>1 week</td>
</tr>
<tr>
<td>Calibrate</td>
<td>At least monthly</td>
</tr>
<tr>
<td>Check tightness of gas paths, check built-in gas pump</td>
<td>To be defined by the owner, at least every 6 months</td>
</tr>
</tbody>
</table>

8.2 Measuring the insulation resistance on the complete unit

Never conduct high voltage tests on the unit.

If a insulation resistance must be measured, only test the complete unit using a test voltage of max. 500 VDC.
8.3 Leak test

Interval approx. 6 months (recommended)

Leak test procedure

1. Close the sample gas outlet on the analyser (2) and the sample gas inlet of your gas conditioning system gas tight (e.g. using a shut-off cock (1) + (3)).
2. Connect a nitrogen pressure cylinder with fine control valve (4) between the shut-off cocks anywhere along the sample gas path.
3. Install a pressure gauge (5) in the sample gas path between the two shut-offs. Measuring range approx. 25 kPa = 250 mbar = 250 hPa.
4. Use the fine control valve to carefully set a nitrogen gas pressure of 20 kPa = 200 mbar = 200 hPa and seal the N₂ gas supply gas-tight (e.g. using a shut-off cock (6)).

The leak rate $Q$ for your measuring system is determined from

$$Q = \frac{(Δp \times V)}{Δt}$$

Where:

- $V$ Internal volume of your measuring system in litres
- $Δp$ Pressure loss measured in mbar
- $Δt$ Measuring time in seconds

To ensure high quality oxygen measurement we recommend a leak rate of < $5 \times 10^{-5}$ mbar L/s

With respect to permitted leak rates please note the standards or legal requirements for your application.

**WARNING**

**Toxic gases**

Conveying toxic gases may require the analyser to be tighter. Please observe the applicable national regulations.

**Highly toxic gases must not be used in the unit!**
8.4 Replace filter element

Replacement filter elements:

<table>
<thead>
<tr>
<th>Item no.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>411509910</td>
<td>Type FE-E2, 5 count</td>
</tr>
</tbody>
</table>

Replace the filter element (white fibreglass cartridge) at the latest when noticeably discoloured.
- In the case of new applications, check the filter element daily and
- extend the inspection interval until you are able to determine the ideal service interval.

**NOTICE**

Filter replacement / filter discolouration

Depending on the measuring application the filter will not become discoloured as the dust is colourless. In this case use suitable measures to check the filter.

**Changing the filter:**

1. Before opening the filter, verify there are no toxic or hazardous gases or components in the sample gas filter. If necessary, purge the unit with air.
2. Switch off the built-in or external sample gas pump and stop the sample gas supply (close valve).
3. Unscrew the filter cover counter-clockwise.
4. Remove the filter cover.
5. Remove the filter cartridge and check the condition.
6. If necessary, install a new filter cartridge. Be sure it is seated correctly.
7. Clean the sealing surfaces and seals and replace, if necessary.
8. Reinstall the filter cover without damaging the filter element.
9. Screw on the filter cover, turning clockwise

8.5 Replacing the EC cell

To determine whether the cell needs to be replaced it should be charged with dry, clean air (20.5 -20.9% O₂). If the signal now becomes too weak due to the age of the cell, the maintenance message “Replace EC cell” will appear.

**CAUTION**

Corrosion hazard

EC measuring cells contain an acid or alkaline solution as the electrolyte. These could leak if the cell housing is damaged and corrode unprotected skin or the eyes.

a) Only screw in or unscrew the cell by hand, do not use tools.

b) If necessary, protect yourself from leaking electrolyte. Wear safety gloves and goggles.

To replace an EC cell in the unit:

**Removal**

1. Open the service door in the front face. Unscrew the two screws on the door for this purpose.
2. First squeeze the release to disconnect the plug connection between the cell plug and the mating connector without the need for tools. Now disconnect the cell plug.
3. Carefully unscrew the cylindrical cell body from the holder by hand, turning counter-clockwise.

**Installation**

1. Install a new seal on the new cell.
2. Screw in the cell hand tight, turning clockwise.
3. Push the cell plug into the mating plug.
4. Secure the service door to the front of the device using the designated screws.
5. Record the cell replacement in your service list.
6. Perform a nullification as described in the following section.
Nullification

Any time a cell is replaced the cell signal must be nullified. Proceed as follows:

1. In the Diagnostics menu select the subitem Status.
2. Use the arrow keys to navigate to the EC cell. Here you will see the button ON at the top right in the display.
3. Pressing this will open the special menu Nullification. This functionality is about the same as a calibration.
4. Therefore first add (similar to zero gas calibration) dry, clean, air free from oil and grease (20.9% O₂).
5. If the measurement value is stable, use the Start button to start "zero gas" nullification.
6. Then perform the "span gas" nullification.
7. To do so, add the respective span gas.
8. If the measurement value is stable, use the Start button to start "span gas" nullification.

8.6 Cleaning

Regularly clean the outside of the housing using a soft, damp cloth.

Only use mild cleaners.

8.7 Replacing fuses

The BA3 select has two fuses at the back of the unit, F1 and F2.

Fig. 8: BA 3 select, rear view, fuses

F1 is the fuse for the internal 24 V DC supply. F2 is built into the power socket and fuses the mains supply.

– Disconnect the mains plug before replacing the fuses.
– Only replace defective fuses with the same type.

Fuse ratings:

F1: 250 mA, delayed action
F2: 1 A, delayed action
9 Service and repair

This chapter contains information on troubleshooting and correction should an error occur during operation.

Repairs to the unit must be performed by Bühler authorised personnel.

Please contact our Service Department with any questions:

Tel.: +49-(0)2102-498955 or your agent

If the equipment is not functioning properly after correcting any malfunctions and switching on the power, it must be inspected by the manufacturer. Please send the equipment inside suitable packaging to:

Bühler Technologies GmbH
- Reparatur/Service -
Harkortstraße 29
40880 Ratingen
Germany

Please also attach the completed and signed RMA decontamination statement to the packaging. We will otherwise be unable to process your repair order.

You will find the form in the appendix of these instructions, or simply request it by e-mail:

service@buehler-technologies.com.

9.1 Status messages and troubleshooting

Service notifications and equipment failures are written to the respective logbooks. The event is also indicated by

– flashing icons in the measurement screen,
– a status message from the measuring channel (Plug ST1 – ST4 at the back of the unit) or
– an equipment status message (Plug ST0 at the back of the unit)

Status signals are triggered by the respective relay contact switching over, also see chapter “”.

The following tables provide information on how to handle these messages. Open the respective logbook, take the specified actions and delete the respective logbook entry. Once all messages have been deleted the status signal will reset.

9.1.1 Service Log messages

Information related to the next service is saved to the service log.

Open: Menu > Diagnostics > Service Log

<table>
<thead>
<tr>
<th>Logbook message</th>
<th>Symbol</th>
<th>Possible cause</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Replacing the EC cells</td>
<td>W</td>
<td>The cell signal from the electrochemical measuring cell is too weak due to cell wear. The cell measuring accuracy specified in the technical documentation is no longer guaranteed.</td>
<td>The worn measuring cell should be replaced with a new cell; contact Bühler Service or send the unit to Bühler</td>
</tr>
<tr>
<td>&gt; 20000h operating hours</td>
<td>W</td>
<td>The unit has been operating for over 20000 hours. The measuring accuracy specified in the technical documentation is no longer guaranteed.</td>
<td>Equipment service by Bühler is recommended. Contact Bühler Service</td>
</tr>
</tbody>
</table>
### 9.1.2 Failure Log messages

Errors which occur during operation are saved to the failure log

Open: **Menu** → **Diagnostics** → **Failure Log**

<table>
<thead>
<tr>
<th>Logbook message</th>
<th>Symbol</th>
<th>Possible cause</th>
<th>Action</th>
</tr>
</thead>
</table>
| <Cell Type> low temp                   | ![I]   | The cell temperature was temporarily below the operating temperature (Alarm was automatically reset) | - Delete the log entry  
- For recurring errors check the ambient and service conditions; if necessary, contact Bühler Service |
|                                        | ![A]   | Defective temperature sensor or measuring cell heater                         | - Take unit out of service, contact Bühler Service                                                      |
| Baro pressure comp. out of tolerance   | ![A]   | Negative pressure in the gas path incorrect                                   | - Observe or adjust permissible gas pressure                                                            |
|                                        | ![A]   | Defective internal barometric pressure sensor                                | - Take unit out of service, contact Bühler Service                                                      |
| Gas temperature failure                | ![A]   | Internal equipment temperature > 55°C (e.g. due to excessive ambient temp.)    | - Ensure the ambient temperature is below 50°C                                                          |
|                                        | ![A]   | Defective cell heater (if "Heater failure" message also appears)             | - Take unit out of service, contact Bühler Service                                                      |
| <Cell Type> Limit value over/underrun  | ![A]   | Alarm due to over/underrunning the concentration values set by the customer   | - Adjust limits to process conditions                                                                  |
|                                        | ![I]   | Alarm was automatically reset.                                               |                                                                                                         |
| <Cell Type> Heater failure             | ![A]   | Measuring cell heater defective                                               | - Take unit out of service, contact Bühler Service                                                      |
| <Cell Type> out of tolerance           | ![A]   | Incorrect measuring cell signal drift or defective measuring cell             | - Take unit out of service, contact Bühler Service                                                      |
| <Cell Type> T-Sensor failure           | ![A]   | Measuring cell temperature sensor defective                                | - Take unit out of service, contact Bühler Service                                                      |
| Low gas flow                           | ![A]   | The minimum gas flow through the measuring cell is significantly underrun due to  | - Check sample gas lines and unit for leaks  
- Check gas supply and pump functionality  
- Clean clogged filters, lines, etc.  
- Check any shut-off valves in the gas path |
|                                        | ![A]   | - leaks,                                                                      |                                                                                                         |
|                                        | ![A]   | - defective gas supply,                                                       |                                                                                                         |
|                                        | ![A]   | - defective sample gas pump,                                                  |                                                                                                         |
|                                        | ![A]   | - clogged gas paths (e.g. filter, lines, etc.)                               |                                                                                                         |
| Baro pressure comp. failure            | ![A]   | Barometric pressure sensor defective                                          | - Take unit out of service, contact Bühler Service                                                      |
### 9.1.3 Calibration Log messages

Errors which occur during calibration are saved to the calibration log.

Open: **Menu** > **Calibration** > **Logbook**

<table>
<thead>
<tr>
<th>Logbook message</th>
<th>Symbol</th>
<th>Possible cause</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Variation failure</td>
<td>A</td>
<td>Excessive variation during calibration.</td>
<td>Maintain a stable calibrating gas concentration during calibration, e.g. by:</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>– Stabilising the sample gas flow.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>– Avoiding pressure variations in the gas path.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>– Increase calibrating gas purging times</td>
</tr>
<tr>
<td>Cal. span gas deviation failure</td>
<td>A</td>
<td>The deviation between the defined calibration setpoint and the value measured is greater than the limit set by the customer;</td>
<td>Increase purging times for calibration</td>
</tr>
<tr>
<td></td>
<td></td>
<td>– Incorrect calibrating gas,</td>
<td>Check calibration gas concentration.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>– Insufficient gas flow, pressure ratios changed</td>
<td>Set the gas flow and gas pressure to permissible values</td>
</tr>
<tr>
<td></td>
<td></td>
<td>– Permissible cal deviation set too low</td>
<td>if necessary, increase permissible cal deviation values under menu item “Calibration”</td>
</tr>
<tr>
<td>Cal. span gas deviation failure</td>
<td>A</td>
<td>See “Cal span gas deviation failure”</td>
<td></td>
</tr>
<tr>
<td>Cal successful</td>
<td>A</td>
<td>No error</td>
<td></td>
</tr>
<tr>
<td>Cal failed</td>
<td>A</td>
<td>Error; calibration was rejected as the display currently shows an equipment error and is listed in the failure log.</td>
<td>Correct or have the equipment error corrected, if necessary contact Bühler Service</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>– Delete logbook entries</td>
</tr>
</tbody>
</table>
10 Disposal

Dispose of parts so as not to endanger the health or environment. Follow the laws in the country of use for disposing of electronic components and devices during disposal.
## 11 Appendices

### 11.1 Spare parts

<table>
<thead>
<tr>
<th>Item no.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>553 603 00</td>
<td>ZrOx measuring cell</td>
</tr>
<tr>
<td>551 000 000 46</td>
<td>Electrochemical measuring cell</td>
</tr>
<tr>
<td>553 604 01</td>
<td>Paramagnetic cell</td>
</tr>
<tr>
<td>914 800 021 1</td>
<td>3/2 Solenoid valve</td>
</tr>
<tr>
<td>553 600 3</td>
<td>Bypass regulator</td>
</tr>
<tr>
<td>4346067</td>
<td>PVDF bulkhead coupling</td>
</tr>
<tr>
<td>9008525</td>
<td>VA bulkhead coupling</td>
</tr>
<tr>
<td>553 611 01</td>
<td>Standard pump</td>
</tr>
<tr>
<td>912 403 011 5</td>
<td>Brushless pump</td>
</tr>
<tr>
<td>4067002</td>
<td>Flow meter 2-20 l/h</td>
</tr>
<tr>
<td>9146030235</td>
<td>Plug connector 16 pin</td>
</tr>
<tr>
<td>9110000051</td>
<td>Fuse 4A delayed action for main board</td>
</tr>
<tr>
<td>9110000002</td>
<td>Fuse 1A delayed action for power connector</td>
</tr>
<tr>
<td>9110000017</td>
<td>Fuse 250mA delayed action for back of housing</td>
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</table>
## 11.2 Service list

<table>
<thead>
<tr>
<th>Service list</th>
<th>BA 3 select</th>
</tr>
</thead>
<tbody>
<tr>
<td>Serial number</td>
<td></td>
</tr>
<tr>
<td>Location</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Date</th>
<th>Service performed</th>
<th>Name</th>
<th>Signature</th>
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<tbody>
<tr>
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12 Attached documents
– Declaration of Conformity KXS50012
– RMA - Decontamination statement
EU-Konformitätserklärung
EU-declaration of conformity

Hiermit erklärt Bühler Technologies GmbH, dass die nachfolgenden Produkte den wesentlichen Anforderungen der Richtlinie

2014/35/EU
(Niederspannungsrichtlinie / low voltage directive)

in ihrer aktuellen Fassung entsprechen.

in its actual version.

Folgende Richtlinien wurden berücksichtigt:
The following directives were regarded:

2014/30/EU (EMV/EMC)

Produkt / products: Mehrkanal Gasanalysator / Multi component gas analyser
Typ / type: BA 3 select

Das Betriebsmittel dient zur kontinuierlichen Messung der Gas-Konzentration von industriellen Prozess-Gasen.
The equipment is used to continuously measure the gas concentration in industrial process gas.

Das oben beschriebene Produkt der Erklärung erfüllt die einschlägigen Harmonisierungsrechtsvorschriften der Union:
The object of the declaration described above is in conformity with the relevant Union harmonisation legislation:

EN 61010-1:2011
EN 61326-1:2013

Die alleinige Verantwortung für die Ausstellung dieser Konformitätserklärung trägt der Hersteller.
This declaration of conformity is issued under the sole responsibility of the manufacturer.

Dokumentationsverantwortlicher für diese Konformitätserklärung ist Herr Stefan Eschweiler mit Anschrift am Firmensitz.
The person authorized to compile the technical file is Mr. Stefan Eschweiler located at the company's address.

Ratingen, den 30.01.2017

Stefan Eschweiler
Geschäftsführer – Managing Director

Frank Pospiech
Geschäftsführer – Managing Director

Bühler Technologies GmbH, Harkortstr. 29, D-40880 Ratingen,
Tel. +49 (0) 21 02 / 49 89-0, Fax. +49 (0) 21 02 / 49 89-20
Internet: www.buehler-technologies.com

KX 55 0012
RMA-Formular und Erklärung über Dekontaminierung
RMA-Form and explanation for decontamination

RMA-Nr. / RMA-No. [Blank]

Die RMA-Nummer bekommen Sie von Ihrem Ansprechpartner im Vertrieb oder Service/ You may obtain the RMA number from your sales or service representative.

Zu diesem Rücksendeschein gehört eine Dekontaminierungsanzeige. Die gesetzlichen Vorschriften schreiben vor, dass Sie uns diese Dekontaminierungsanzeige ausfüllen und unterschreiben zurücksenden müssen. Bitte füllen Sie auch diese im Sinne der Gesundheit unserer Mitarbeiter vollständig aus/ This return form includes a decontamination statement. The law requires you to submit this completed and signed decontamination statement to us. Please complete the entire form, also in the interest of our employee health.

<table>
<thead>
<tr>
<th>Firma/ Company</th>
<th>Ansprechpartner/ Person in charge</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name/ Name</td>
<td></td>
</tr>
<tr>
<td>Abt./ Dept.</td>
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<td>Tel./ Phone</td>
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<tr>
<td>E-Mail</td>
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<tr>
<td>Serien-Nr./ Serial No.</td>
<td></td>
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<tr>
<td>Artikel-Nr./ Item No.</td>
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</tbody>
</table>

Grund der Rücksendung/ Reason for return

- [ ] Kalibrierung/ Calibration
- [ ] Modifikation/ Modification
- [ ] Reklamation/ Claim
- [ ] Reparatur/ Repair
- [ ] andere/ Other

Bitte spezifizieren/ please specify

Ist das Gerät möglicherweise kontaminiert?/ Could the equipment be contaminated?

- [ ] Nein, da das Gerät nicht mit gesundheitsgefährdenden Stoffen betrieben wurde/ No, because the device was not operated with hazardous substances.
- [ ] Nein, da das Gerät ordnungsgemäß gereinigt und dekontaminiert wurde/ No, because the device has been properly cleaned and decontaminated.
- [ ] Ja, kontaminiert mit/ Yes, contaminated with:

![Symbol for explosive, flammable, oxidizing, toxic, compressed gas, caustic, poisonous, harmful to health, health hazard, environmental hazard]

Bitte Sicherheitsdatenblatt beiliegen/ Please enclose safety data sheet!

Das Gerät wurde gespült mit/ The equipment was purged with:


Falls die Ware nicht gereinigt, also kontaminiert bei uns eintrifft, muss die Firma Bühler sich vorbehalten, diese durch einen externen Dienstleister reinigen zu lassen und Ihnen dies in Rechnung zu stellen.

Datum/ Date

Firmenstempel/ Company Sign

This declaration has been filled out correctly and completely, and signed by an authorized person. The dispatch of the (decontaminated) devices and components takes place according to the legal regulations.

Should the goods not arrive clean, but contaminated, Bühler reserves the right, to commission an external service provider to clean the goods and invoice it to your account.

rechtsverbindliche Unterschrift/ Legally binding signature

DE000011

Bühler Technologies GmbH, Harkortstr. 29, D-40880 Ratingen
Tel. +49 (0) 21 02 / 49 89-0, Fax: +49 (0) 21 02 / 49 89-20
E-Mail: service@buehler-technologies.com
Internet: www.buehler-technologies.com

06/2018
Die Analyse defekter Baugruppen ist ein wesentlicher Bestandteil der Qualitätsicherung der Firma Bühler Technologies.

Um eine aussagekräftige Analyse zu gewährleisten muss die Ware möglichst unverändert untersucht werden. Es dürfen keine Veränderungen oder weitere Beschädigungen auftreten, die Ursachen verdecken oder eine Analyse unmöglich machen.


Analysing defective assemblies is an essential part of quality assurance at Bühler Technologies.

To ensure conclusive analysis the goods must be inspected unaltered, if possible. Modifications or other damages which may hide the cause or render it impossible to analyse are prohibited.

Electronic assemblies may be sensitive to static electricity. Be sure to handle these assemblies in an ESD-safe manner. Where possible, the assemblies should be replaced in an ESD-safe location. If unable to do so, take ESD-safe precautions when replacing these. Must be transported in ESD-safe containers. The packaging of the assemblies must be ESD-safe. If possible, use the packaging of the spare part or use ESD-safe packaging.

Observe the above specifications when installing the spare part. Ensure the part and all components are properly installed. Return the cables to the original state before putting into service. When in doubt, contact the manufacturer for additional information.