Gas Analysis

Modbus TCP

Multi Component Gas Analyser

BA 3 select

Installation and Operation Instructions

Original instructions

BE550021
06/2022

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

Document information
Document No.....BE550021
Version..... 06/2022

Contents

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

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

Warning signs

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

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.
- Do not install damaged or defective spare part. If necessary, visually inspect prior to installation to determine any obvious damage to the 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 O_2 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 and/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:

Symbol	Explanation
O2-ZrOx	Oxygen measurement via zirconium dioxide cell
O2-EC	Oxygen measurement via electrochemical cell
O2-Para	Oxygen measurement via paramagnetic cell

Output signals

All gas concentration values as well as status, limit and alarm messages necessary for effective monitoring are supplied in analog and/or digital form (Modbus TCP) at the back of the housing (see chapterSignal 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 device for the 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.

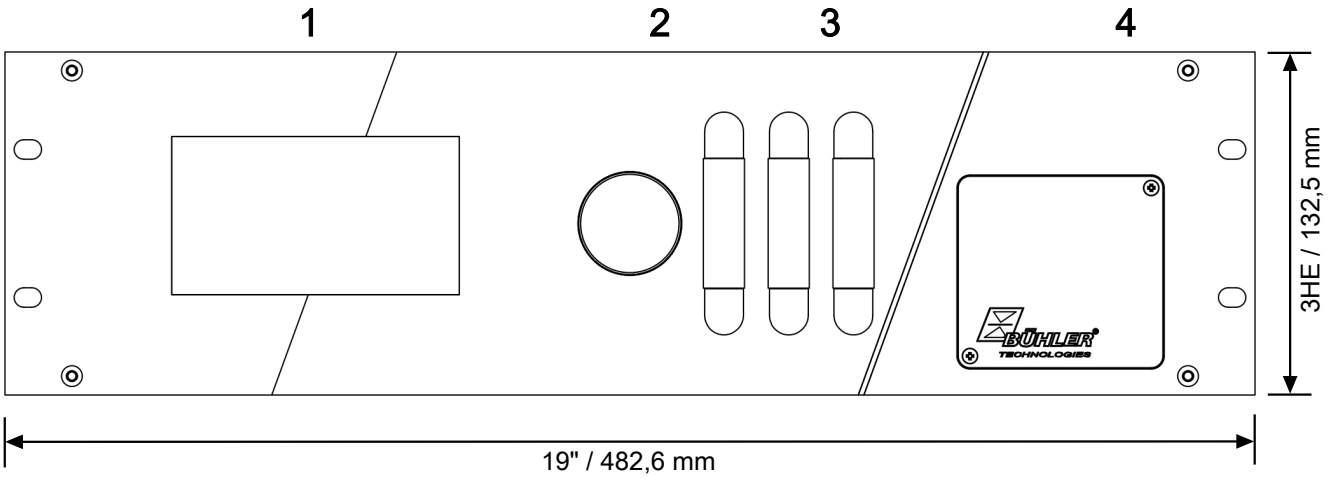


Fig. 1: BA 3 select, front view

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

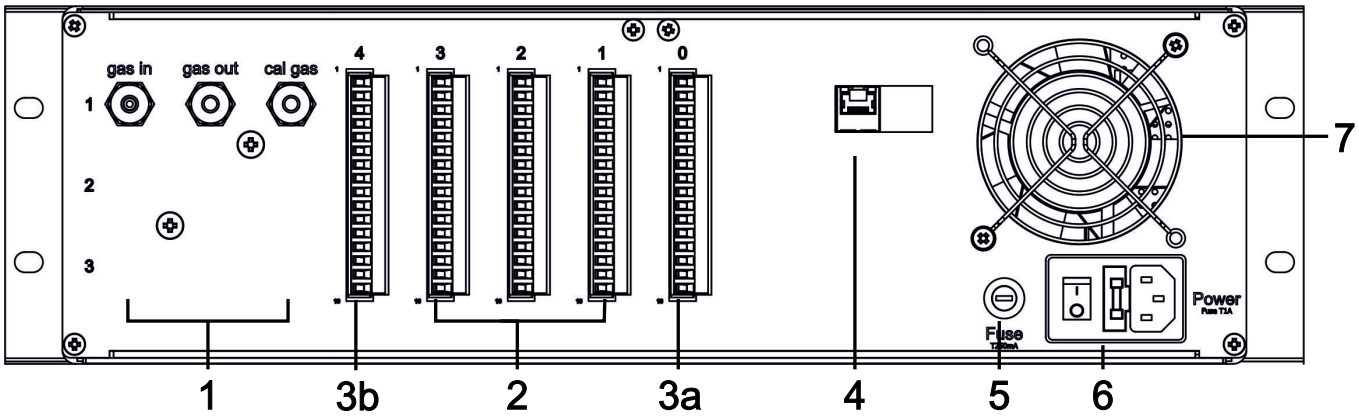


Fig. 2: BA 3 select, rear view

1	gas in	Sample gas input	4	Modbus TCP	Modbus interface (optional)
	gas out	Gas outlet	5	Fuse	Fuse 1
	cal. gas	Calibrating gas inlet	6	Power	Power supply with built-in fuse and ON/OFF switch
2	ST1 to ST3	Signal output Ch. 1 to Ch. 3			
3a	ST0	Error/service signal	7		Fan
3b	ST4	Measuring range signal Ch. 1 to 3			

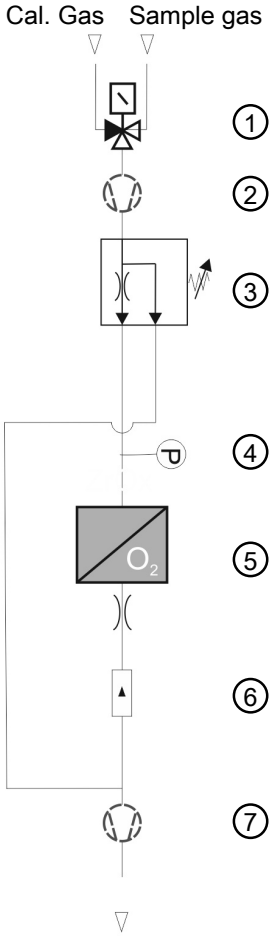
3.3 Gas flow diagrams

The analyser may be equipped with up to three O_2measuring 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.

Legend	
1	3/2 way solenoid valve (optional with auto cal. function)
2	Internal pump for EC and paramagnetic cell + IR cell
3	Flow regulator
4	Pressure sensor
5	Measuring cell
6	Flow meter (optional)
7	Internal pump for ZrOx cell

Flow diagram



Pressure:	With internal pump	Max. 1200 mbar absolute
	Without internal pump	Max. 1800 mbar absolute
Flow (gas in):		120 L/h, constant due to internal pump
Cell flow**:**	ZrOx	approx. 8 L/h, internal control
	Paramagnetic	approx. 8 L/h, internal control
	EC	approx. 12 L/h
	IR	approx. 30 L/h
T_{amb}:		10 °C ... 45 °C
	IR	10 °C ... 40 °C

Tab. 1: Gas flow diagram for the equipment base version

Sample gas or calibrating gas is assigned through the solenoid valve (1, optional). 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.

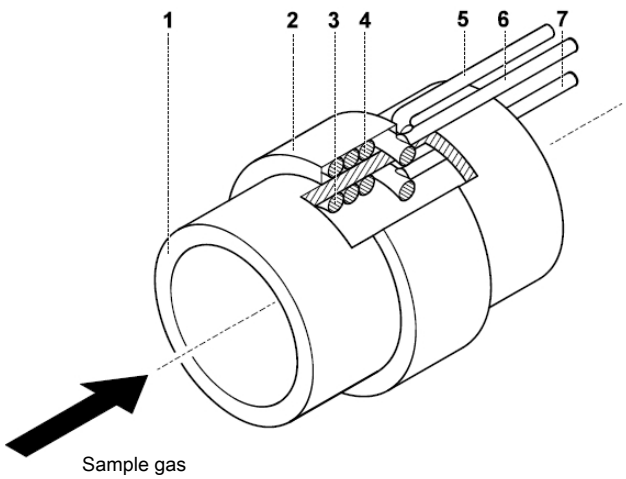
The barometric pressure sensor (4) compensates the results based on barometric variations. The flow meter (6, optional) or the optional bar graph in the display shows the gas flow through the measuring cell.

3.4 Principles of 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 ZrO_2 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.



1	Zirconium dioxide tube
2	Ceramic cover for the reference electrode
3	Measuring electrode
4	Reference electrode
5	Thermal element
6	Reference electrode connecting wire
7	Measuring electrode connecting wire

The NERNST equation is the basis for determining the concentration of oxygen in gases by ZrO_2 measuring cell.

$$U = \frac{R \cdot T}{4F} \ln \frac{p_{O_2,\,air}}{p_{O_2,\,sample\ gas}}$$

Where:	
$U =$	Cell voltage in mV
$R =$	Molar gas constant; R = 8.31 J mol^{-1} K^{-1}
$T =$	Measuring temperature in K
$F =$	Faraday's constant; F = 9.64 · 10^4 C mol^{-1}
$p_{O2,\,air} =$	Partial pressure of the oxygen on the reference electrode in dry air in Pa
$p_{O2,\,sample\ gas} =$	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 Ψ corresponds with the partial pressure p. After solving (eq. I) with $p_{O2,\,sample\ gas}$ (or $\Psi_{O2,\,sample\ gas}$) 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.%:

$$\Psi_{O2,\,sample\ gas} = 20.64 \cdot e^{-46.42 \cdot U/T}$$

Where:	
$\Psi_{O2,\,sample\ gas}$ =	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 O_2 measuring cell (EC cell), simplified, represents a battery. However, on the EC cell there will only be flow if the gas (O_2) 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.

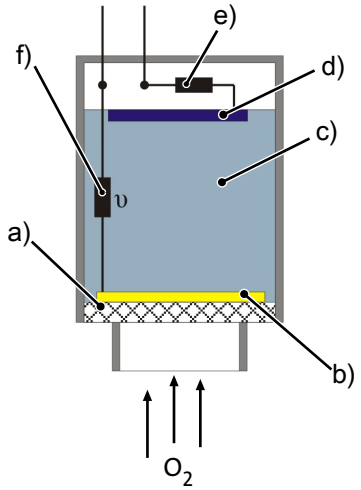


Fig. 3: Diagram of an EC cell

a)	Semi-permeable membrane	b)	Gold electrode
c)	Electrolyte	d)	Lead electrode
e)	Measuring resistance	f)	Thermistor

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 O_2 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):	$2Pb + 2H_2O \Rightarrow 2PbO + 4H^+ + 4e^-$
Cathode (4):	$O_2 + 4H^+ + 4e^- \Rightarrow 2H_2O$
Brutto reaction:	$O_2 + 2Pb \Rightarrow 2PbO$

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 O_2 concentration. Due to this property the O_2 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).

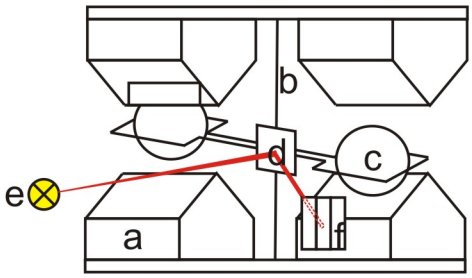


Fig. 4: Schematic diagram of a cell

a	Permanent magnet with pointy pole shoes	d	Mirror
b	Torsion strap	e	LED
c	Nitrogen-loaded glass handle	f	Photocell

If oxygen enters the chamber, the 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 O_2+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 β for common carrier gases (values for other gases upon request) [> page 13]". **These β 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 O_2 concentration using the formula

$C = C_{meas} - C_{adj}$
With $C_{adj} = (\beta_{adj,1} \times C_{carrier,1} + \beta_{adj,2} \times C_{carrier,2} + \ldots + \beta_{adj,n} \times C_{carrier,n})$
and

C	Adjusted O_2 volume concentration
C_{adj}	Total adjusted value
C_{meas}	Measured (unadjusted) O_2 volume concentration
$C_{carrier,1...n}$	Volume concentration of carrier gas components 1 to n
$\beta_{adj,1...n}$	Adjustment factor from table 1 for the 1st to nth carrier gas component

Example 1:

Calibration conditions:		- Ambient temperature Ta = 50 °C 20.9% O_2 in N_2	
		- (O_2 + N_2) as span gas	
Sample gas:		0 % O_2	
		Carrier gas: 100% CO_2	
Measurement result:	C_{meas}	-0.29 % O_2	
Adjustment:	$C_{adj,CO2}$	= 100 * -0.0029	= -0.29%
Adjusted result:	$C = C_{meas} - C_{adj}$	**= -0.29 % – (-0.29%)**	**= -0.29 % + 0.29 % = 0**

Example 2:

Calibration conditions:		Ambient temperature Ta = 50 °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_{meas}	4.13 % O_2	
Adjustments:			
10 % CO_2	$C_{adj,CO2}$	= **10** x (-0.0029)	= -0.029
5 % CO	$C_{adj,CO}$	= **5** x (+0.0007)	= +0.004
5 % NO	$C_{adj,NO}$	= **5** x (+0.4296)	= 2.150
78 % N_2	$C_{adj,N2}$	= **78** x (00.00)	= 0.00
Total: C_{adj}=	$C_{adj,CO2}$ + $C_{adj,CO}$ + $C_{adj,NO}$ + $C_{adj,N2}$	**= +2.125**	**≈ +2.13**
Adjusted result:	$C = C_{meas} - C_{adj}$	**= 4.13 – 2.13 = 2 % O2**	

Gas	Formula	β_{adj} (at T_a=20°C)	β_{adj} (at T_a= 50°C)
Acetylene	HCCH	-0.0025	-0.0028
Ammonia	NH_3	-0.0017	-0.0019
Benzol	C_6H_6	-0.0124	-0.0136
Nitrous oxide	N_2O	-0.0020	-0.0022
Ethanol	C_2H_5OH	-0.043	-0.047
Ethyl acetate	$CH_3COOC_2H_5$	-0.122	-0.134
Ethylene	C_2H_4	-0.020	-0.022
Helium	He	+0.0029	+0.0032
Carbon dioxide	CO_2	-0.0026	-0.0029
Carbon monoxide	CO	+0.0006	+0.0007
Methane	CH_4	-0.0016	-0.0017
Ozone	O_3	+0.0054	+0.0060
Hydrogen sulphide	H_2S	-0.0039	-0.0043
Nitrogen	N_2	0	0
Nitrogen dioxide	NO_2	+0.05	+0.16
Nitric oxide	NO	+0.4256	+0.4296
Hydrogen	H_2	+0.0023	+0.0026

Tab. 3: Adjustments β 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 β_{adj}.

The paramagnetic cell is factory thermostated to 50 °C. Therefore use the values β_{adj} at T_a = 50 °C.

If you're unsure if your paramagnetic cell is thermostated, please contact our technical service (see chapter "Service and repair [> page 50]").

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 O_2 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 type plate 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
Internal solenoid valves for auto calibration Function	Optional for each measuring channel (zero gas + 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	
Analog 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 + 2x per device designed for 24 V, potential-free
24 Volt output:	1x per channel (to supply binary inputs), with T250 mA fuse
Digital interface:	Modbus TCP (optional)

Parts in contact with sample gas

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

Measuring cells

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

* 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

Unit with specially cleaned gas paths

Protect parts in contact with media, e.g. bulkhead couplings, from recontamination. Use clean work cloves, clothing and clean tools when connecting, particularly when connecting the gas paths. Only charge specially cleaned gas paths with oil-free inert gases or oil-free compressed air apart from the gas for the actual measuring task.

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 [> page 39]).

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

ZrO_2 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. SO_2) 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 O_2 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, SO_2, 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]").

5.2.3 Gas connections

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.

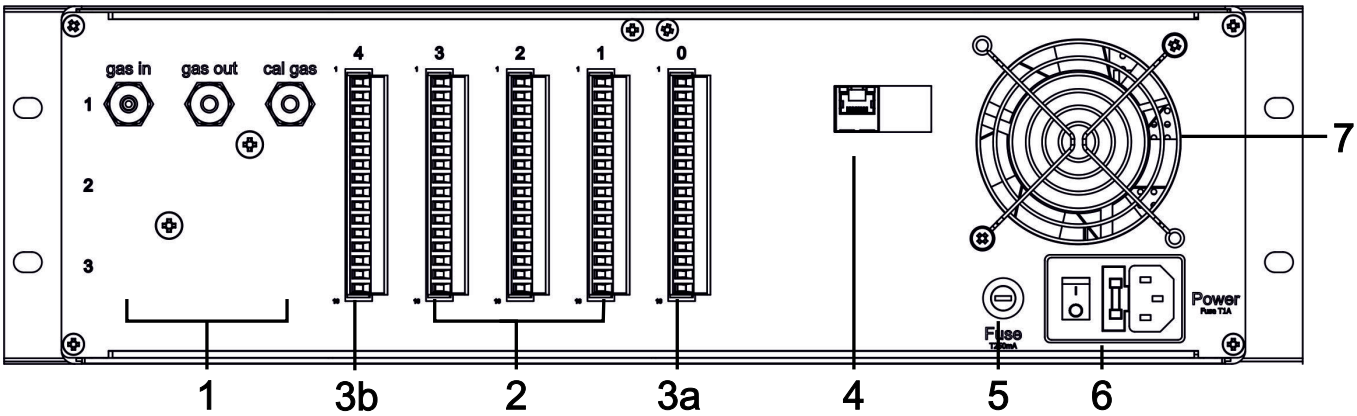


Fig. 5: BA 3 select, rear view

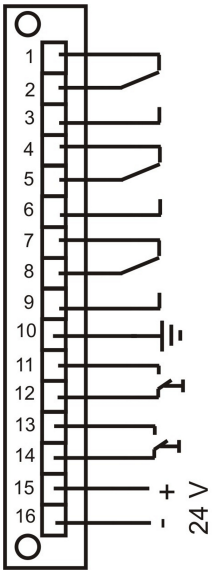
1	gas in	Sample gas input	4	Modbus TCP	Modbus interface (optional)
	gas out	Gas outlet	5	Fuse	Fuse 1
	cal. gas	Calibrating gas inlet	6	Power	Power supply with built-in fuse and ON/OFF switch
2	ST1 to ST3	Signal output Ch. 1 to Ch. 3			
3a	ST0	Error/service signal	7		Fan
3b	ST4	Measuring range signal Ch. 1 to 3			

5.2.4 Electrical connections

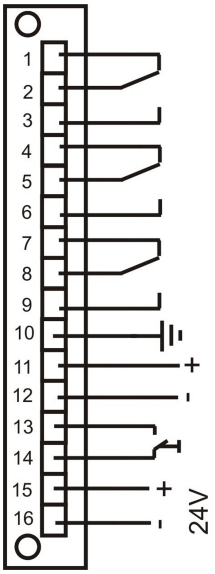
5.2.4.1 Signal outputs

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

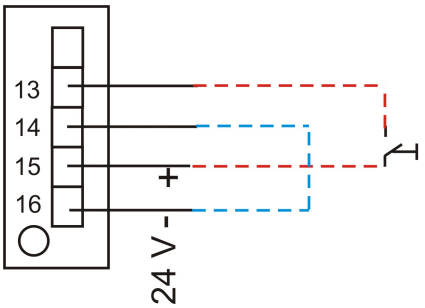
Tab. 4: Plug 0, system connection, 16-pin PHÖNIX connection terminals

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

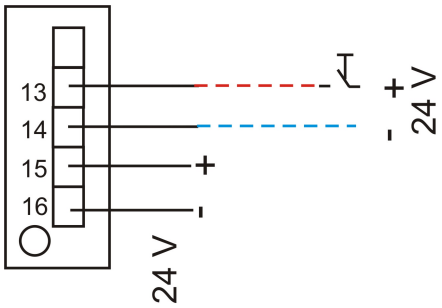
Tab. 5: Plug ST1 to ST4, measuring ch. 1 to 4, 16-pin PHÖNIX connection terminals

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.

Control 24 V DC internal



Control 24 V DC external



5.2.4.2 Modbus TCP interface

The Modbus interface allows direct access to process and diagnostic data and parameters during operation based on VDI4201.

The analyser takes on the role of the server in communication.

Modbus TCP:

Connects at the back of the device via RJ45 port.

5.2.4.3 Modbus TCP configuration

The settings below are the defaults and can be adjusted.

IP: 192.168.15.168

Subnet: 255.255.254.0

Gateway: 192.168.15.1

DHCP: Enabled

When configuring the address, be sure they are stored in the registers in .hex syntax.

E.g. IP: 192.168.15.168 -> C0 A8 0F A8

After changing a setting, a "1" must be written to address "45500" to apply it. The interface will then automatically restart with the new configuration.

5.2.4.4 Modbus Communication

Communication via Modbus is always initiated by the client (request). The server (typically) responds to the request with a response. A Modbus frame for a request/response always has the following structure:

Address field (A)	Function code (FC)	Data	CRC
1 byte	1 byte	1 ... 252 bytes	2 bytes

Register addresses and data are transferred in Big Endian format.

Every register stands for a 16 bit value, with the information represented in various data types. The data type and required function code are assigned to the respective registers in an attached table.

To read/write data types with sizes larger than an individual register, multiple registers must be addressed.

Supported function codes:

Function code (FC)	FC values
Read Coil Status	1
Read Holding Registers	3
Write Single Coil	5
Write Multiple Coils	15
Write Multiple Registers	16

Data types:

Description	Number of bytes	Number of registers
Bit	1	1
Float	4	2
Int16	2	1
Uint16	2	1
Int32	4	2
Uint32	4	2

For the Modbus manual with the available registers see Chapter Attached documents. There are registers which are read only (R), write only (W), read and write (RW). To write the registers, the respective password based on the password level must be entered. Once the respective password has been entered correctly, the register entries are available until it has been entered incorrectly or the device has been restarted.

By default, the new value will be applied to the write registers during writing without any other interaction. For some registers, simply writing them will not suffice. Once written, the change must be confirmed with another entry in a different register.

After one or more Modbus interface parameters have been changed, a "1" must be written to address "45500" to apply the setting. The interface will then automatically be restarted and the device must be reconnected. Without writing "1" the change will not be applied.

The logbooks can only be read once they have been refreshed. This refresh is triggered by entering a "1" under the addresses "45501" (error), "45502" (service) and "45503" (calibration). Entering "0" will erase the oldest entry from the respective logbook. The respective logbook will then need to be refreshed so it can be read.

5.2.4.5 Power supply

DANGER

Electric voltage

Risk of electric shock if the unit is connected to the supply incorrectly.

a) The unit must be connected by trained, expert personnel.

b) Ensure the correct supply voltage.

c) Only use the included power cord or a power cord with the specifications indicated.

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 due to turbulences**
	To avoid turbulences, only charge the analyser by slowly opening the fittings. **Adiabatic compression** To avoid potential adiabatic compression, operation with closed gas outputs prohibited.

6.1 Process

Preparation

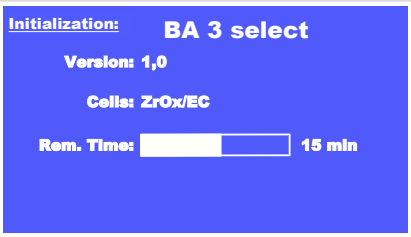
Please ensure

- 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 for a ZrOx cell + EC cell has a concentration of 20.9 Vol.% oxygen, and
- the span gas supplied has the correct concentration (adapted to the measuring range).

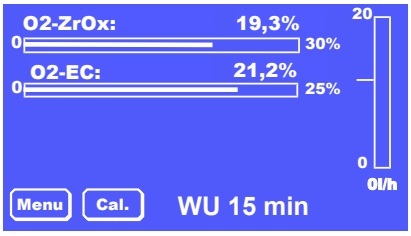
Switching on

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

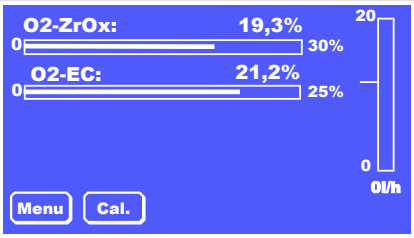


During initialisation you may touch the display to switch to measurement view, e.g. to configure the unit. The initialization progress is also displayed in measurement view: **WU 15 min** flashing



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:

Menu item	Submenu	Factory Setting
Channel settings	Measuring ranges	Meas. range MR1 and MR2 (customer-specific per order) Auto Switchover: OFF
	Limits	No limit presets
	Outputs	– Analog outputs: 4-20 mA / on cal.: current value / on error: current value – Modbus TCP (optional)
	Adjustment	No carrier gas adjustment set (Value 0)
	Damping	For all measuring cells 1 sec (time constant)
	Units	Custom, as ordered
Base settings	Language	For delivery to Germany "German". For delivery to other countries "English".
	Passwords	Password 1: 111 Password 2: 222
	Pumps	If applicable: Off
	Date / Time	Date: Day.Month.Year, current date Time: hh:mm:ss current time CET (h:min)
	Pressure sensor (optional)	Not set (pressure sensor calibrated prior to delivery)
Calibration	Auto	Off / Time Period: 24 h
	Manual	No preset
	Deviation	Span gas: 10% from setpoint / zero gas: 1 Vol. % O_2 fixed
	Period	– Cal. period: 2 min – Purging Time: 5 min

Check if the factory settings are suitable for your measurement task. If necessary, change these as described in chapter "Menu > Base Settings [> page 31]".

7 Operation and Control

NOTICE

The device must not be operated beyond its specifications.

7.1 Menu overview and operating principle

The analyser is controlled via the touch display.

NOTICE

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:

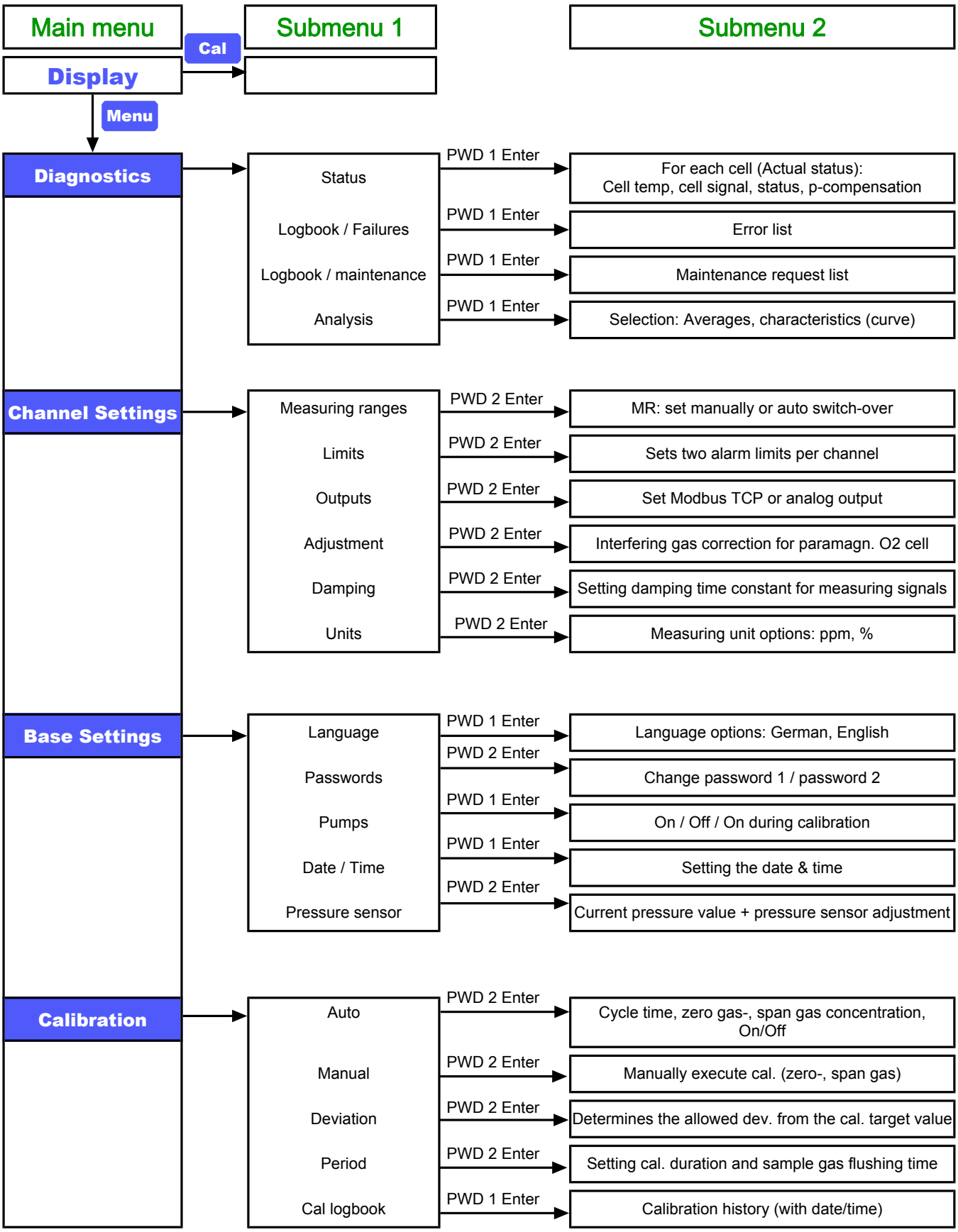


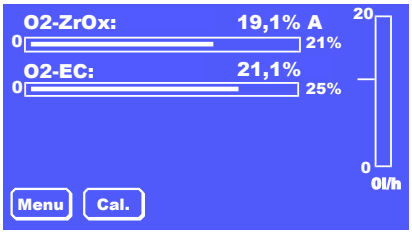
Fig. 6: BA 3 select menu overview

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. Where:

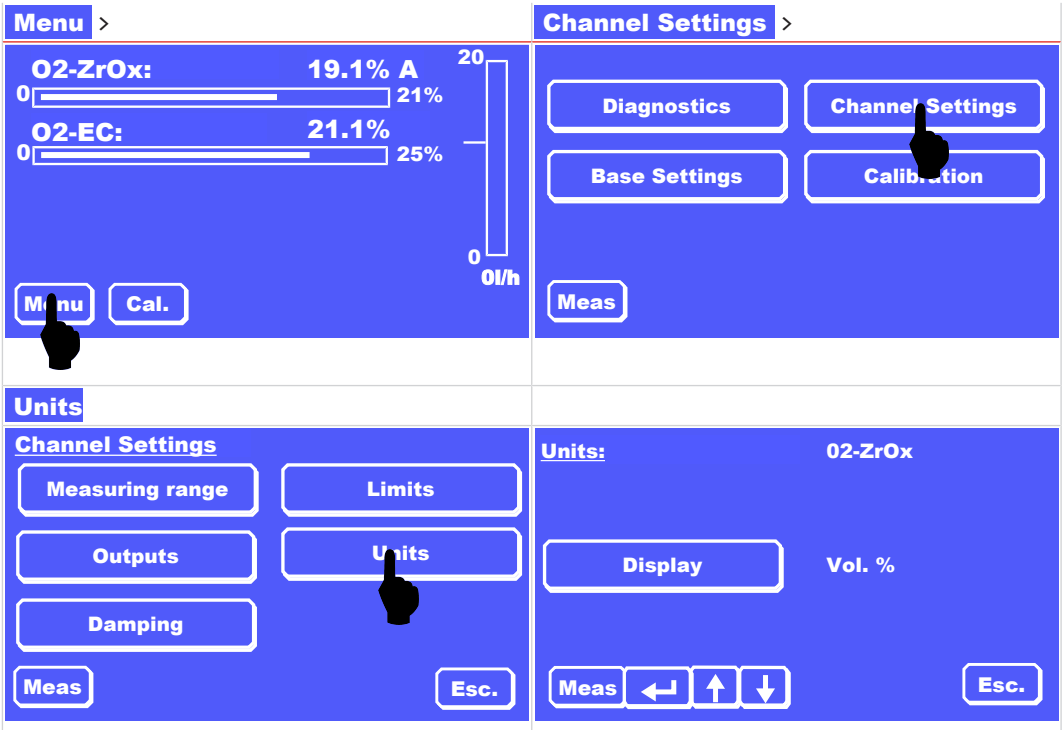
A	An event (alarm or error) was detected and recorded in the "Failure" log. The event may apply to one channel or the entire unit.
°!°,	An event (failure or alarm) occurred but was automatically reset. This is for example the case if a low temperature alarm is temporarily triggered. In this case an entry 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 29] or Menu > Calibration [> page 39].

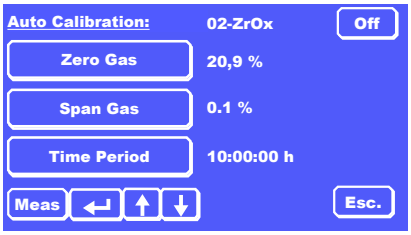
Opening the submenu

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.

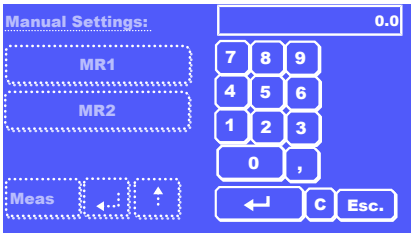
Values are not automatically saved upon exiting.

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

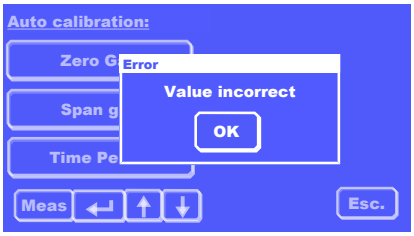
Use the on-screen keyboard to enter a value directly. Here you will see a keypad and context-specific extra keys (e.g. **:**, **,**, **<** or **>**).



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

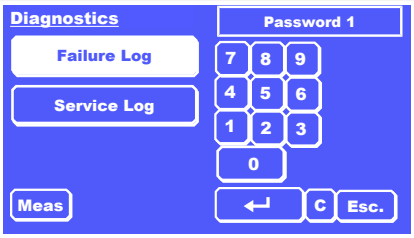
Use the return key ↵ to apply the entry.

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) before a parameter can be changed.



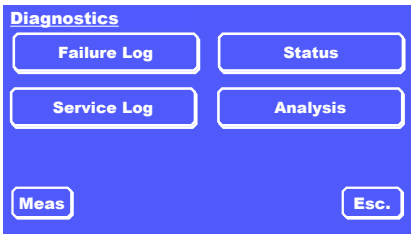
Enter the password with the on-screen keyboard and press ↵ to confirm your input.

Please refer to chapter Menu > Base Settings > Passwords [> page 32] for how to enable and disable password protect.

7.2 Menu > Diagnostics

The Diagnostics menu contains the following menu items:

Failure/ logbook	This logbook lists all failures which have occurred including channel number, date, time and error message in plain text.
Maintenance/ logbook	Outstanding service is recorded in the service log. **Note: Not all service will be listed. Please also refer to chapter** Maintenance [> page 45].
Status	This menu shows the status of each measuring cell along with the cell voltage, cell temperature and the compensation type.
Analysis	This shows the average values – over 24 h and 1/2 h. The characteristics can also be displayed in a graph.



NOTICE

Calibration Log

The **Calibration** menu also contains a logbook with records on all calibrations.

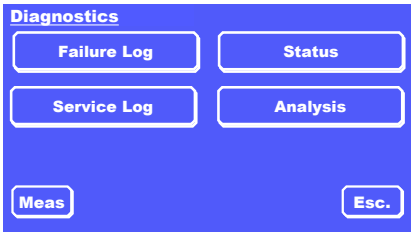
7.2.1 Menu > Diagnostics > Failure Log

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 50]" 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.

Service Log

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 Maintenance [> page 45].

NOTICE

Maintenance Schedule

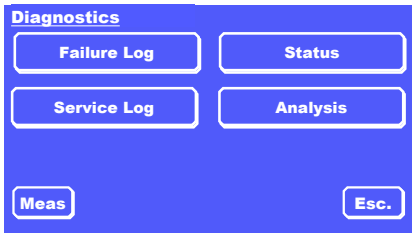
Not all required service is indicated in the logbook. Please also follow the service schedule in chapter "Maintenance".

7.2.3 Menu > Diagnostics > Status

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

Status

Open **Menu** > **Diagnostics** > **Status** and enter the password.



Select the respective channel with the buttons **↑** and **↓**.

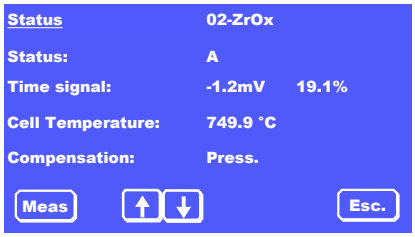
It will show:

- 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 Replacing the EC cell [> page 47])
- the cell temperature
- the compensation type



7.2.4 Menu > Diagnostics > Analysis

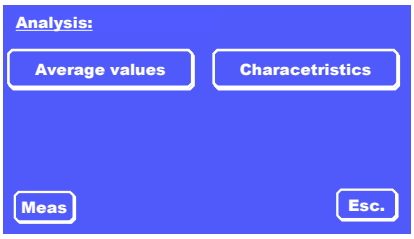
The characteristics are continuously analysed. The system records

– 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**.

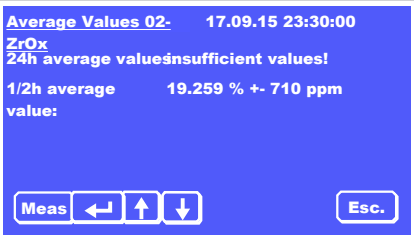


Average Values

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

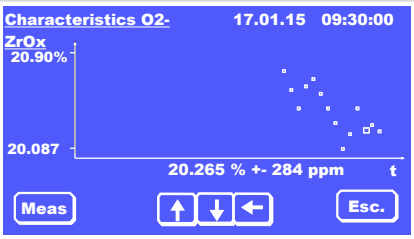
Use the ↑ and ↓ keys to select the channel.



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.

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

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

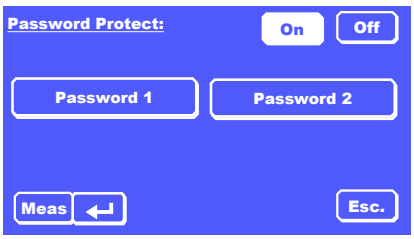
Depending on the parameter relevance these are protected by password 1 or 2.

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

Passwords

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

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

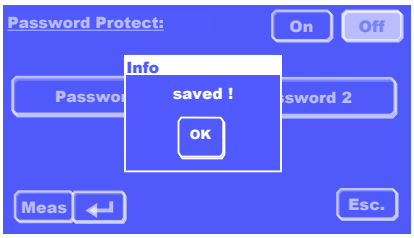


Enable/disable password protect

– To disable the passwords, press **Off** and press ↵ to save this setting.

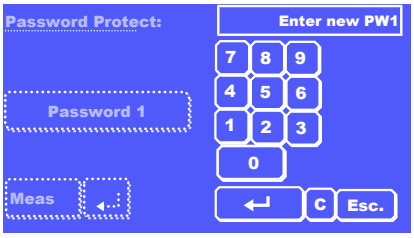
NOTICE! All parameters can now be accessed at all times!

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



Change password

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



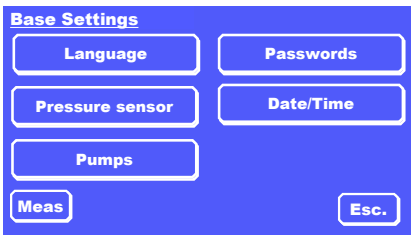
The information will be saved.

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 ↵ to confirm your input.

Press **OK** to acknowledge the message "Data saved".

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.

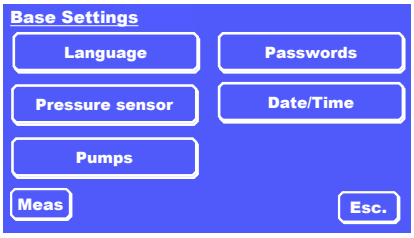
To calibrate the internal pressure sensor:

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

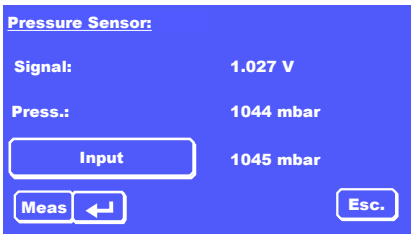
If the pressure output by the analyser significantly deviates from your measurement value, select **Menu** > **Base Setting** > **Pressure Sensor** and enter password 2.



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

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

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



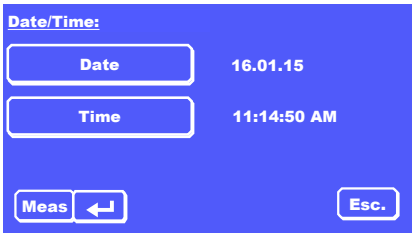
7.3.4 Menu > Base Settings > Date/Time

To set the current date and (local) time:

Setting the date / time

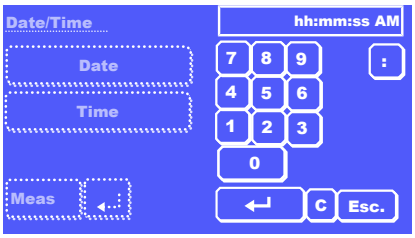
Press **Menu** > **Base settings** > **Date/Time**

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 ↵ 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**.

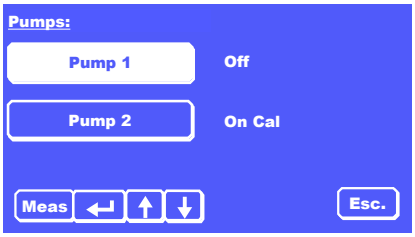
Select the pump for which you wish to change the settings. The selected entry will be displayed inverted.

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 ↵ to confirm your input. The settings will be saved.



7.4 Menu > Channel Settings

The following settings can be configured for each channel:

Menu	Description
Measuring ranges	Define the measuring range and the switchover points.
Limits	Define the gas concentration limits which will trigger a signal at the relay output.
Outputs	Parametrise the outputs.
Units	Select the unit to display the result in.
Damping	Define the damping constant for the measurement.
Adjustment	This menu item is only relevant when using the paramagnetic O_2 cell. Here you will define the adjustment for carrier gases which may be present.

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.

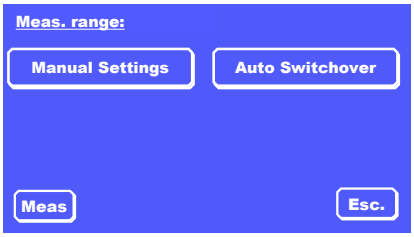
Depending on the setting under **Auto Switchover** two scenarios should be distinguished:

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**.



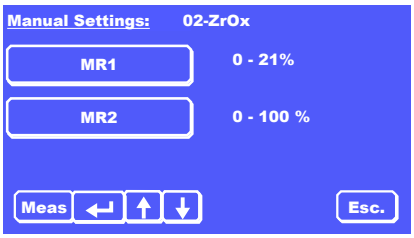
Select **Man. Setting**.

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

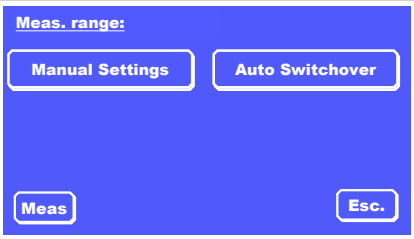
Enter the lower measuring range end value using the on-screen keyboard. Press ↵ to confirm your input. This value will be applied to both measuring ranges.

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.



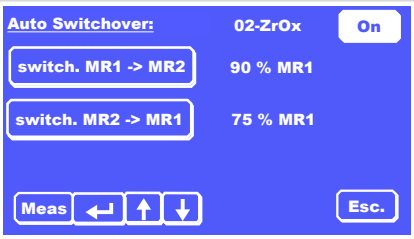
Press ↵ to apply the new parameters and **Esc** to return to the next higher menu.



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.



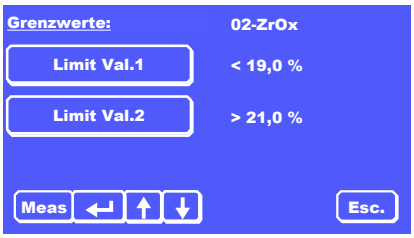
7.4.2 Menu > Channel Settings > Limits

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.

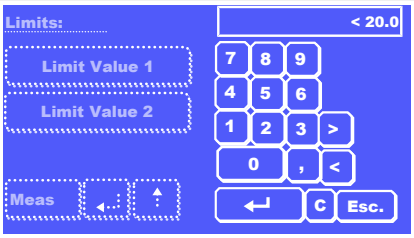
Limits

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.



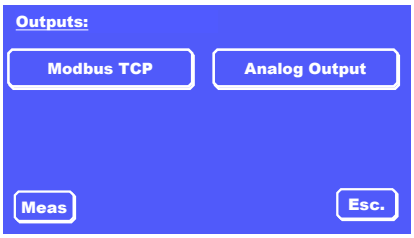
Lastly, press **↵** to apply the new parameters and press **OK** to confirm the message.

7.4.3 Menu > Channel Settings > Outputs

In this menu you can define how the analog output behaves for each channel and the parameters for the Modbus TCP interface.

Analog output

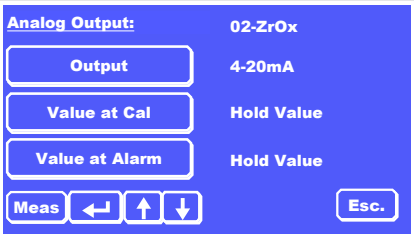
Press **Menu** > **Channel settings** > **Outputs** and select **Analog Output**.



Output

Select the Channel.

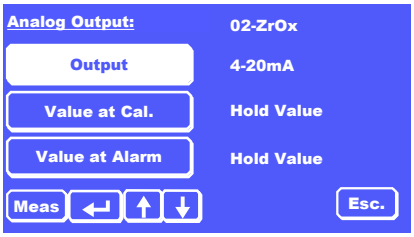
Tap to select **Output** and define which signal the measurement output for the channel should output.



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 analog 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 analog value. The upper analog 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 analog signal.



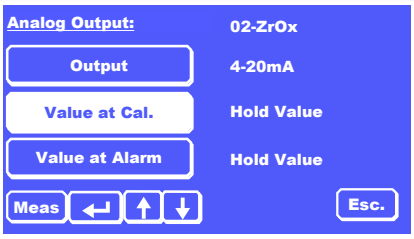
Cal./Error

You can further define the behaviour of the analog 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

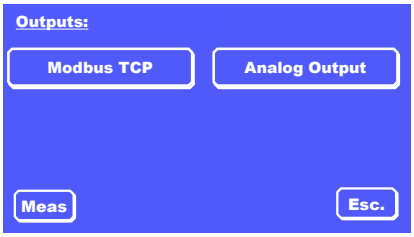
- Hold Value (factory setting)
- Zero
- Current value

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".



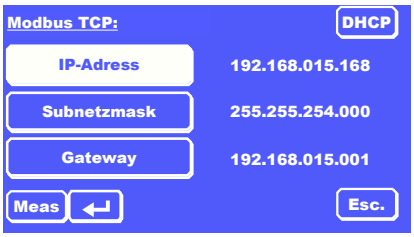
Modbus TCP

Press **Menu** > **Channel settings** > **Outputs** and select **Modbus-TCP**.



Select the corresponding option:
IP address, **Subnet mask** or **Gateway**

When enabling **DHCP** the router will automatically assign an IP address.



Tap the respective option to go to the input field. Here you can enter and save addresses.

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 O_2.

Units

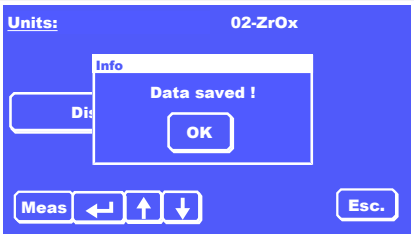
Open **Menu** > **Channel Settings** > **Units**.

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.

delta t

Press **Menu** > **Channel Settings** > **Damping**.

Select **delta t** and set the time constant using the ↑ and ↓ buttons.

Press ↵ to accept the setting.

7.4.6 Menu > Channel Settings > Adjustment

This menu item only pertains to O_2measurements by paramagnetic cell.

Here you can enter the values from the table Adjustments β for common carrier gases (values for other gases upon request) [> page 13].

NOTICE

Adjustment prefix

When entering the adjustment be sure to add the **opposite sign** from the table!

Adjustment value

Press **Menu** > **Channel Settings** > **Adjustment**.

Select **Influence Carr. Gas** and enter the adjustment (including opposite sign).

Press ↵ 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:

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

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 accurate 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.

NOTICE **Calibration results**

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.

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.%. When using an IR cell, both clean compressed air (free of oil, grease and particles) and nitrogen can be used as zero gas

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. Die 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 the O_2 zero gas and 10 % (from the target value) for the O_2 span gas. With IR cells the permitted zero and range gas deviance is set to 10 % of the MBEW.

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

Period

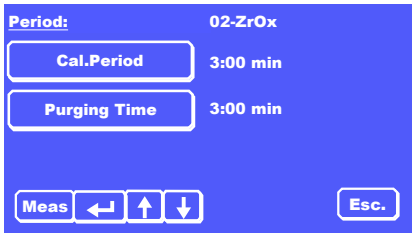
Select **Menu** > **Calibration** > **Period**.

Enter password 2 and press ↵ to confirm.

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**.

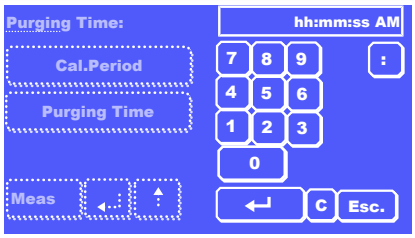
Enter the new time in the format minutes:seconds, e.g. **05 : 30** for 5 min, 30 sec.

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

Press ↵ 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.

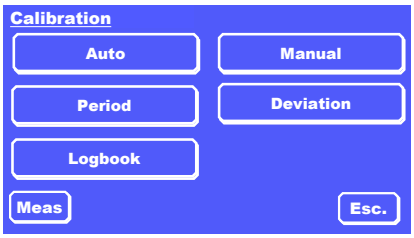


7.5.3 Menu > Calibration > Deviation

Calibration Deviation

Select **Menu** > **Calibration** > **Deviation**.

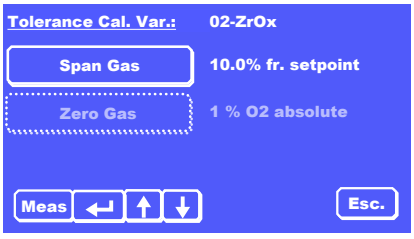
Enter password 2 and press ↵ to confirm.



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

Use the ↑ and ↓ keys to select the channel **Span Gas** to define the span gas concentration.

Confirm each input with ↵.

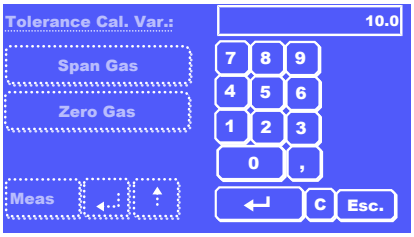


Span Gas

Enter the new limit value as "% from setpoint" under **Span Gas**.

Input range: 0.5 % to 20 % from setpoint

Press ↵ to confirm your input.

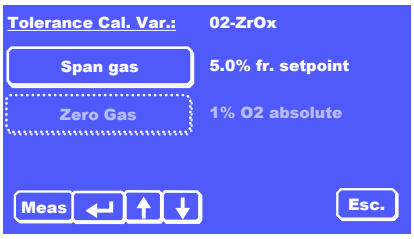


Zero Gas

(Inert gas or clean air permissible)

Here, the calibration deviation factory setting is 1 Vol% O_2. This value cannot be changed.

Press **Esc** to return to the next higher menu.

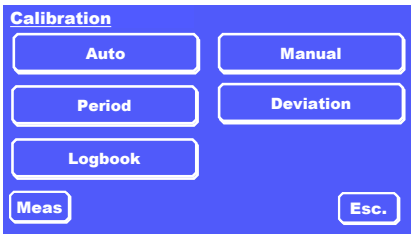


7.5.4 Menu > Calibration > Auto

Auto-calibration

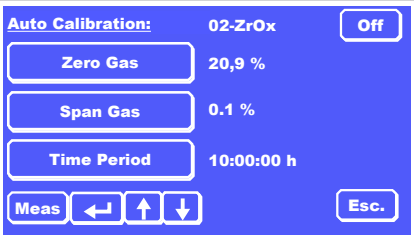
Select **Menu** > **Calibration** > **Auto**.

Enter password 2 and press ↵ to confirm.



The zero gas concentration for the paramagnetic cell, the EC cell and the IR 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).



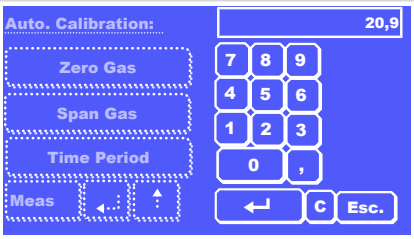
Span Gas

To define the span gas concentration, first select the channel using the keys ↑ and ↓.

Then mark **Span Gas**.

Enter the desired concentration using the on-screen keyboard.

Press ↵ to apply the value.

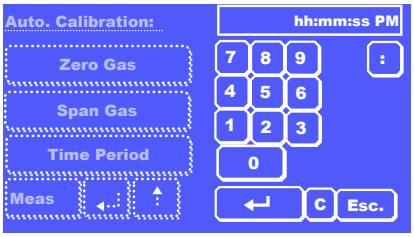


Time Period

Now select **Time Period**.

Enter the auto calibration interval in the format hours:minutes:seconds.

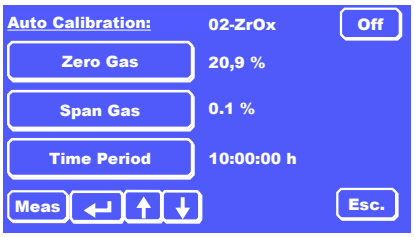
Press ↵ to confirm your input.



Auto. calibration: Off / On

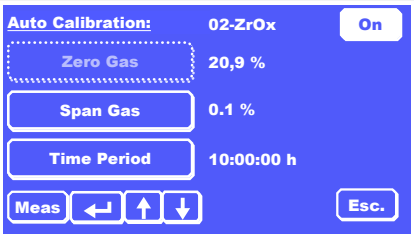
To enable/disable auto calibration, toggle the mode with the **Off** or **On** key.

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

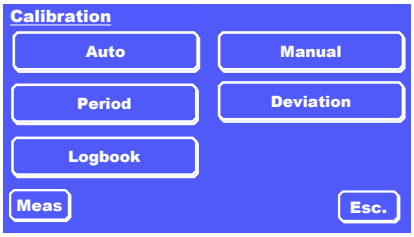
A manual calibration may be performed at any time.

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.

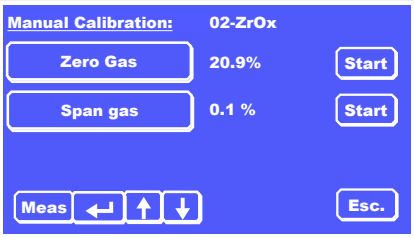


When selecting **Zero Gas**, select the concentration for the zero gas and press ↵ to continue.

The zero gas concentration for the paramagnetic cell, the EC cell and the IR 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).

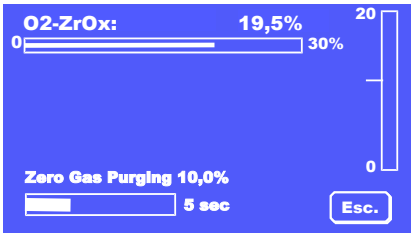
First press **Start** for the zero gas. The analyser will begin the zero gas calibration.



Purge zero gas

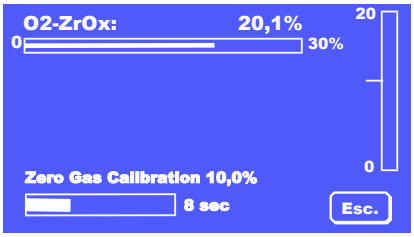
– This process will take the amount of time specified under **Purging Time**. The process may be stopped at any time with **Esc.**.

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.**.

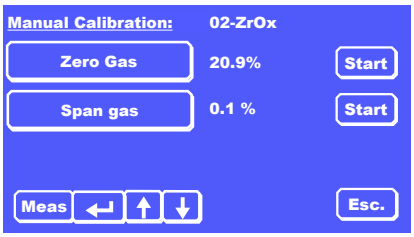


Span Gas

Now select **Span Gas**, enter the concentration for the span gas and press ↵ 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.

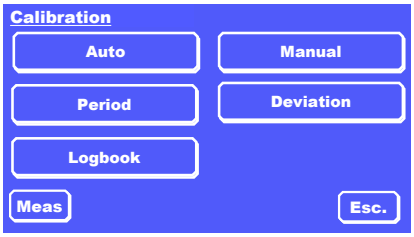
7.5.6 Menu > calibration > Logbook

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

View Logbook

– Select the messages with **Menu** > **Calibration** > **Logbook**.

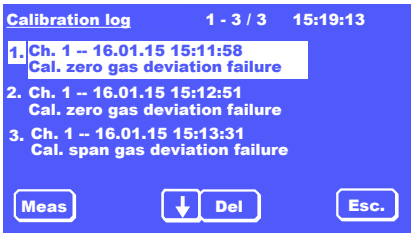
Enter password 2.



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 Status messages and troubleshooting [> page 50] or contact our service (see chapter Service and repair).

8 Maintenance

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.
- Observe the respective safety regulations and operating specifications when performing any type of maintenance.
- Always use genuine spare parts.

DANGER

Electric voltage

Risk of electric shock

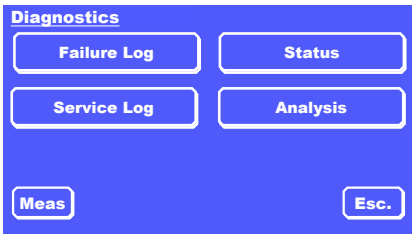
a) Disconnect the unit from the mains when performing any maintenance.

b) Secure the equipment from accidental restarting.

c) The unit may only be maintained and opened by instructed, competent personnel.

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.

NOTICE

Leaks when using corrosive gases

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 "".

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

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

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

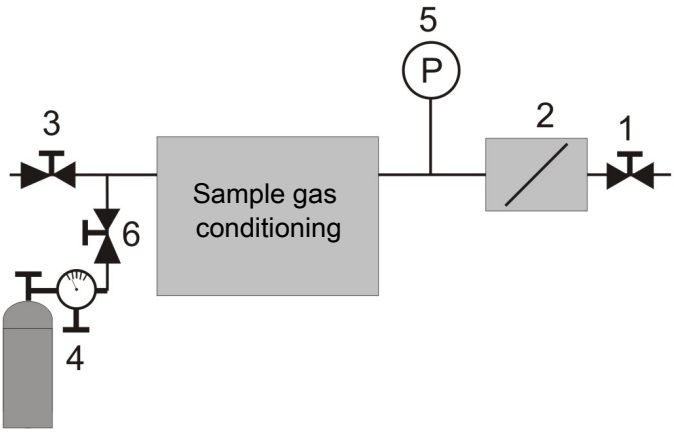


Fig. 7: Leak test set-up

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 N_2 gas supply gas-tight (e.g. using a shut-off cock (6)).

The leak rate Q for your measuring system is determined from

$Q = (\Delta p \times V) / \Delta t$

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 < 5×10^{-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:

Item no.	Description
411509910	Type FE-E2, 5 count

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% O_2). 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% O_2).
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.

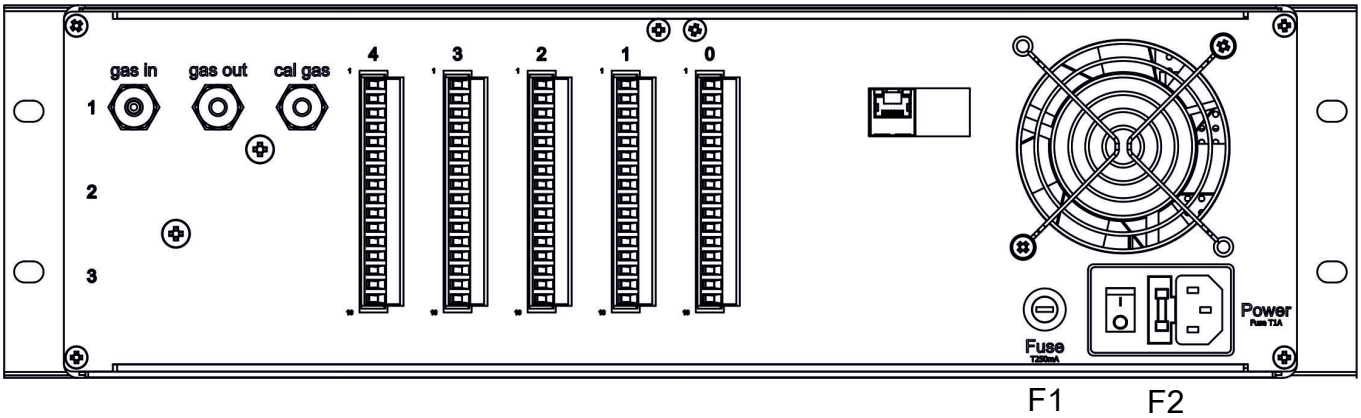


Fig. 8: BA 3 select, rear view, fuses

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

8.8 Service list

Service list	BA 3 select
Serial number	
Location	

Date	Service performed	Name	Signature

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

For further information about our services and customised maintenance visit http://www.buehler-technologies.com/service.

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 Signal outputs [> page 20].

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 logbook.

Open: **Menu** > **Diagnostics** > **Service Logbook**

Logbook message	Symbol	Possible cause	Action
Replacing the EC cells	W	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.	– The worn measuring cell should be replaced with a new cell; contact Bühler Service or send the unit to Bühler.
> 20000h operating hours	W	The unit has been operating for over 20000 hours. The measuring accuracy specified in the technical documentation is no longer guaranteed.	– Device service by Bühler Technologies GmbH recommended. Please contact our Service.

9.1.2 Failure Log messages

Errors which occur during operation are saved to the failure log

Open: **Menu** > **Diagnostics** > **Failure Log**

Logbook message	Symbol	Possible cause	Action
<Cell Type> low temp	!	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 Service
	A	Defective temperature sensor or measuring cell heater	– Take unit out of service, contact 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 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 Service
<Cell Type> Limit value over/ underrun	A	Alarm due to over/underrrunning the concentration values set by the customer	– Adjust limits to process conditions
	!	Alarm was automatically reset.	
<Cell Type> Heater failure	A	Measuring cell heater defective	– Take unit out of service, contact Service
<Cell Type> out of tolerance	A	Incorrect measuring cell signal drift or defective measuring cell	– Take unit out of service, contact Service
<Cell Type> T-Sensor failure	A	Measuring cell temperature sensor defective	– Take unit out of service, contact Service
Low gas flow	A	The minimum gas flow through the measuring cell is significantly underrun due to – leaks, – defective gas supply, – defective sample gas pump, – clogged gas paths (e.g. filter, lines, etc.)	– 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
Baro pressure comp. failure	A	Barometric pressure sensor defective	– Take unit out of service, contact Service

9.1.3 Calibration Log messages

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

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

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

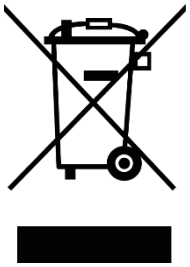
9.2 Spare parts

Item no.	Description
55360300	ZrOx measuring cell
55100000046	Electrochemical measuring cell
55360401	Paramagnetic cell
9148000211	3/2 Solenoid valve
5536003	Bypass regulator
4346067	PVDF bulkhead coupling
9008525	VA bulkhead coupling
9124030115	Brushless pump
4067002	Flow meter 2-20 l/h
9146030235	Plug connector 16 pin
9110000051	Fuse 4 A delayed action for main board
9110000002	Fuse 1 A delayed action for power connector
9110000017	Fuse 250mA delayed action for back of housing

10 Disposal

The applicable national laws must be observed when disposing of the products. Disposal must not result in a danger to health and environment.

The crossed out wheelie bin symbol on Bühler Technologies GmbH electrical and electronic products indicates special disposal notices within the European Union (EU).



The crossed out wheelie bin symbol indicates the electric and electronic products bearing the symbol must be disposed of separate from household waste. They must be properly disposed of as waste electrical and electronic equipment.

Bühler Technologies GmbH will gladly dispose of your device bearing this mark. Please send your device to the address below for this purpose.

We are obligated by law to protect our employees from hazards posed by contaminated devices. Therefore please understand that we can only dispose of your waste equipment if the device is free from any aggressive, corrosive or other operating fluids dangerous to health or environment. **Please complete the "RMA Form and Decontamination Statement", available on our website, for every waste electrical and electronic equipment. The form must be applied to the packaging so it is visible from the outside.**

Please return waste electrical and electronic equipment to the following address:

Bühler Technologies GmbH
WEEE
Harkortstr. 29
40880 Ratingen
Germany

Please also observe data protection regulations and remember you are personally responsible for the returned waste equipment not bearing any personal data. Therefore please be sure to delete your personal data before returning your waste equipment.

11 Attached documents

- Declaration of Conformity KX550012
- Modbus manual BA 3 select
- RMA - Decontamination Statement

EU-Konformitätserklärung
EU-declaration of conformity

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

Herewith declares Bühler Technologies GmbH that the following products correspond to the essential requirements of Directive

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

in ihrer aktuellen Fassung entsprechen.

in its actual version.

Folgende Richtlinien wurden berücksichtigt:

The following directives were regarded:

2014/30/EU (EMV/EMC)

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

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 61326-1:2013 **EN 61010-1:2010/A1:2019/AC:2019-04**

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

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

Ratingen, den 17.02.2023

Stefan Eschweiler
Geschäftsführer – *Managing Director*

Frank Pospiech
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UK Declaration of Conformity

The manufacturer Bühler Technologies GmbH declares, under the sole responsibility, that the product complies with the requirements of the following UK legislation:

Electrical Equipment Safety Regulations 2016

The following legislation were regarded:

Electromagnetic Compatibility Regulations 2016

Product: Multi component gas analyser
Types: BA 3 select
BA 3 MA

The equipment is used to continuously measure the gas concentration in industrial process gas.

The object of the declaration described above is in conformity with the relevant designated standards:

EN 61010-1:2010/A1:2019/AC:2019-04

EN 61326-1:2013

Ratingen in Germany, 17.02.2023

Stefan Eschweiler
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Gas Analysis

Modbus TCP

Modbus TCP manual BA 3 select

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Modbus TCP interface

The Modbus interface allows direct access to process and diagnostic data and parameters during operation based on VDI4201.

The analyser takes on the role of the server in communication.

Modbus TCP:

Connects at the back of the device via RJ45 port.

Modbus TCP configuration

The settings below are the defaults and can be adjusted.

IP: 192.168.15.168

Subnet: 255.255.254.0

Gateway: 192.168.15.1

DHCP: Enabled

When configuring the address, be sure they are stored in the registers in .hex syntax.

E.g. IP: 192.168.15.168 -> C0 A8 0F A8

After changing a setting, a "1" must be written to address "45500" to apply it. The interface will then automatically restart with the new configuration.

Modbus Communication

Communication via Modbus is always initiated by the client (request). The server (typically) responds to the request with a response. A Modbus frame for a request/response always has the following structure:

Address field (A)	Function code (FC)	Data	CRC
1 byte	1 byte	1 ... 252 bytes	2 bytes

Register addresses and data are transferred in Big Endian format.

Every register stands for a 16 bit value, with the information represented in various data types. The data type and required function code are assigned to the respective registers in an attached table.

To read/write data types with sizes larger than an individual register, multiple registers must be addressed.

Supported function codes:

Function code (FC)	FC values
Read Coil Status	1
Read Holding Registers	3
Write Single Coil	5
Write Multiple Coils	15
Write Multiple Registers	16

Data types:

Description	Number of bytes	Number of registers
Bit	1	1
Float	4	2
Int16	2	1
Uint16	2	1
Int32	4	2
Uint32	4	2

For the Modbus manual with the available registers see Chapter Attached documents. There are registers which are read only (R), write only (W), read and write (RW). To write the registers, the respective password based on the password level must be entered. Once the respective password has been entered correctly, the register entries are available until it has been entered incorrectly or the device has been restarted.

By default, the new value will be applied to the write registers during writing without any other interaction. For some registers, simply writing them will not suffice. Once written, the change must be confirmed with another entry in a different register.

After one or more Modbus interface parameters have been changed, a "1" must be written to address "45500" to apply the setting. The interface will then automatically be restarted and the device must be reconnected. Without writing "1" the change will not be applied.

The logbooks can only be read once they have been refreshed. This refresh is triggered by entering a "1" under the addresses "45501" (error), "45502" (service) and "45503" (calibration). Entering "0" will erase the oldest entry from the respective logbook. The respective logbook will then need to be refreshed so it can be read.

Modbus Register

Description	FC	Address	No. register	Access	Data type	Default	Min	Max	Selection	Resolution	Unit	Password	Comment
Measurement value ch. 1	3	2000	2	R	Float							No	
Measurement value ch. 1 - status	3	2002	2	R	Int32							No	
Measurement value ch. 2	3	2004	2	R	Float							No	
Measurement value ch. 2 - status	3	2006	2	R	Int32							No	
Measurement value ch. 3	3	2008	2	R	Float							No	
Measurement value ch. 3 - status	3	2010	2	R	Int32							No	
Measurement value ch. 4	3	2012	2	R	Float							No	
Measurement value ch. 4 - status	3	2014	2	R	Int32							No	
Min. Measuring range 1 ch. 1	3, 16	6000	2	R/W	Float							UP2	
Max. Measuring range 1 ch. 1	3, 16	6002	2	R/W	Float							UP2	
Min. Measuring range 1 ch. 2	3, 16	6004	2	R/W	Float							UP2	
Max. Measuring range 1 ch. 2	3, 16	6006	2	R/W	Float							UP2	
Min. Measuring range 1 ch. 3	3, 16	6008	2	R/W	Float							UP2	
Max. Measuring range 1 ch. 3	3, 16	6010	2	R/W	Float							UP2	
Min. Measuring range 1 ch. 4	3, 16	6012	2	R/W	Float							UP2	
Max. Measuring range 1 ch. 4	3, 16	6014	2	R/W	Float							UP2	
Min. Measuring range 2 Ch. 1	3, 16	6016	2	R/W	Float							UP2	

Description	FC	Address	No. register	Access	Data type	Default	Min	Max	Selection	Resolution	Unit	Password	Comment
Max. Measuring range 2 Ch. 1	3, 16	6018	2	R/W	Float							UP2	
Min. Measuring range 2 Ch. 2	3, 16	6020	2	R/W	Float							UP2	
Max. Measuring range 2 Ch. 2	3, 16	6022	2	R/W	Float							UP2	
Min. Measuring range 2 Ch. 3	3, 16	6024	2	R/W	Float							UP2	
Max. Measuring range 2 Ch. 3	3, 16	6026	2	R/W	Float							UP2	
Min. Measuring range 2 Ch. 4	3, 16	6028	2	R/W	Float							UP2	
Max. Measuring range 2 Ch. 4	3, 16	6030	2	R/W	Float							UP2	
Auto switchover (MR1->MR2) Ch. 1	3, 16	6040	1	R/W	Int16		50	100			%	UP2	% of active measuring range end
Auto switchover (MR1->MR2) Ch. 2	3, 16	6041	1	R/W	Int16		0	95			%	UP2	% of active measuring range end
Auto switchover (MR1->MR2) Ch. 3	3, 16	6042	1	R/W	Int16		50	100			%	UP2	% of active measuring range end
Auto switchover (MR1->MR2) Ch. 4	3, 16	6043	1	R/W	Int16		0	95			%	UP2	% of active measuring range end
Auto switchover (MR2->MR1) Ch. 1	3, 16	6044	1	R/W	Int16		50	100			%	UP2	% of active measuring range end
Auto switchover (MR2->MR1) Ch. 2	3, 16	6045	1	R/W	Int16		0	95			%	UP2	% of active measuring range end
Auto switchover (MR2->MR1) Ch. 3	3, 16	6046	1	R/W	Int16		50	100			%	UP2	% of active measuring range end
Auto switchover (MR2->MR1) Ch. 4	3, 16	6047	1	R/W	Int16		0	95			%	UP2	% of active measuring range end
Auto switchover EA Ch. 1	3, 16	6048	1	R/W	Int16							UP2	
Auto switchover EA Ch. 2	3, 16	6049	1	R/W	Int16							UP2	
Auto switchover EA Ch. 3	3, 16	6050	1	R/W	Int16							UP2	

Description	FC	Address	No. register	Access	Data type	Default	Min	Max	Selection	Resolution	Unit	Password	Comment
Auto switchover EA Ch. 4	3, 16	6051	1	R/W	Int16							UP2	
Limit value 1 Ch. 1	3, 16	6060	2	R/W	Float							UP2	
Limit value 1 Ch. 2	3, 16	6062	2	R/W	Float							UP2	
Limit value 1 Ch. 3	3, 16	6064	2	R/W	Float							UP2	
Limit value 1 Ch. 4	3, 16	6066	2	R/W	Float							UP2	
Limit value 2 Ch. 1	3, 16	6068	2	R/W	Float							UP2	
Limit value 2 Ch. 2	3, 16	6070	2	R/W	Float							UP2	
Limit value 2 Ch. 3	3, 16	6072	2	R/W	Float							UP2	
Limit value 2 Ch. 4	3, 16	6074	2	R/W	Float							UP2	
Limit value 1-function Ch. 1	3, 16	6076	1	R/W	Int16				1 = large 2 = small			UP2	
Limit value 1-function Ch. 2	3, 16	6077	1	R/W	Int16							UP2	
Limit value 1-function Ch. 3	3, 16	6078	1	R/W	Int16							UP2	
Limit value 1-function Ch. 4	3, 16	6079	1	R/W	Int16							UP2	
Limit value 2-function Ch. 1	3, 16	6080	1	R/W	Int16							UP2	
Limit value 2-function Ch. 2	3, 16	6081	1	R/W	Int16							UP2	
Limit value 2-function Ch. 3	3, 16	6082	1	R/W	Int16							UP2	
Limit value 2-function Ch. 4	3, 16	6083	1	R/W	Int16							UP2	
Unit Ch. 1	3, 16	6090	1	R/W	Int16	4			- 1 = mg/m3 - 2 = ppm - 4 = % - 8 = ppm/%			UP2	
Unit Ch. 2	3, 16	6091	1	R/W	Int16				see above			UP2	
Unit Ch. 3	3, 16	6092	1	R/W	Int16				see above			UP2	
Unit Ch. 4	3, 16	6093	1	R/W	Int16				see above			UP2	
Damping Ch. 1	3, 16	6100	1	R/W	Int16	1	1	20			s	UP2	
Damping Ch. 2	3, 16	6101	1	R/W	Int16	1	1	20			s	UP2	

Description	FC	Address	No. register	Access	Data type	Default	Min	Max	Selection	Resolution	Unit	Password	Comment
Damping Ch. 3	3, 16	6102	1	R/W	Int16	1	1	20			s	UP2	
Damping Ch. 4	3, 16	6103	1	R/W	Int16	1	1	20			s	UP2	
Adjustment ch. 1	3, 16	6110	2	R/W	Float						%	UP2	Paramagnetic cell only
Correction ch. 2	3, 16	6112	2	R/W	Float						%	UP2	Paramagnetic cell only
Correction ch. 3	3, 16	6114	2	R/W	Float						%	UP2	Paramagnetic cell only
Correction ch. 4	3, 16	6116	2	R/W	Float						%	UP2	Paramagnetic cell only
Config. analog output Ch. 1	3, 16	6130	1	R/W	Int16	0x2202			Bit15-Bit12: Value at alarm 1 = Hold value 2 = Current value 4 = Value 0 Bit11-Bit8: Value on calibration 1 = Hold value 2 = Current value 4 = Value 0 Bit7-Bit0: Output types - 1 = 0-20mA - 2 = 4-20mA - 4 = 0-10V - 8 = 2-10V			UP2	
Config. analog output Ch. 2	3, 16	6131	1	R/W	Int16				see above			UP2	
Config. analog output Ch. 3	3, 16	6132	1	R/W	Int16				see above			UP2	
Config. analog output Ch. 4	3, 16	6133	1	R/W	Int16				see above			UP2	
Pumps 1	3, 16	6140	1	R/W	Int16	0			0 = Off 4 = On 8 = On during Cal			UP1	
Pumps 2	3, 16	6141	1	R/W	Int16				see above			UP1	
Pumps 3	3, 16	6142	1	R/W	Int16				see above			UP1	
Zero gas manual calibration Ch. 1	3, 16	6150	2	R/W	Float							UP2	
Zero gas manual calibration Ch. 2	3, 16	6152	2	R/W	Float							UP2	

Description	FC	Address	No. register	Access	Data type	Default	Min	Max	Selection	Resolution	Unit	Password	Comment
Zero gas manual calibration Ch. 3	3, 16	6154	2	R/W	Float							UP2	
Zero gas manual calibration Ch. 4	3, 16	6156	2	R/W	Float							UP2	
Zero gas manual calibration all cells	3, 16	6158	2	R/W	Float							UP2	
Span gas manual calibration Ch. 1	3, 16	6160	2	R/W	Float							UP2	
Span gas manual calibration Ch. 2	3, 16	6162	2	R/W	Float							UP2	
Span gas manual calibration Ch. 3	3, 16	6164	2	R/W	Float							UP2	
Span gas manual calibration Ch. 4	3, 16	6166	2	R/W	Float							UP2	
Span gas 2 manual calibration Ch. 1	3, 16	6168	2	R/W	Float							UP2	
Span gas 2 manual calibration Ch. 2	3, 16	6170	2	R/W	Float							UP2	
Span gas 2 manual calibration Ch. 3	3, 16	6172	2	R/W	Float							UP2	
Span gas 2 manual calibration Ch. 4	3, 16	6174	2	R/W	Float							UP2	
Zero gas auto calibration all cells	3, 16	6218	2	R/W	Float							UP2	
Span gas auto calibration Ch. 1	3, 16	6220	2	R/W	Float							UP2	
Span gas auto calibration Ch. 2	3, 16	6222	2	R/W	Float							UP2	
Span gas auto calibration Ch. 3	3, 16	6224	2	R/W	Float							UP2	
Span gas auto calibration Ch. 4	3, 16	6226	2	R/W	Float							UP2	
Zero gas calibration time period Ch. 1-4	3, 16	6236	2	R/W	Uint32	90	300	86400			s	UP2	
Cal. period Ch. 1	3, 16	6240	1	R/W	Uint16	90	1	600			s	UP2	
Cal. period Ch. 2	3, 16	6241	1	R/W	Uint16	90	1	600			s	UP2	

Description	FC	Address	No. register	Access	Data type	Default	Min	Max	Selection	Resolution	Unit	Password	Comment
Cal. period Ch. 3	3, 16	6242	1	R/W	Uint16	90	1	600			s	UP2	
Cal. period Ch. 4	3, 16	6243	1	R/W	Uint16	90	1	600			s	UP2	
Cal. period all cells	3, 16	6244	1	R/W	Uint16	90	1	600				UP2	
Purging time Ch. 1	3, 16	6245	1	R/W	Uint16	90	1	600			s	UP2	
Purging time Ch. 2	3, 16	6246	1	R/W	Uint16	90	1	600			s	UP2	
Purging time Ch. 3	3, 16	6247	1	R/W	Uint16	90	1	600			s	UP2	
Purging time Ch. 4	3, 16	6248	1	R/W	Uint16	90	1	600			s	UP2	
Purging time all cells	3, 16	6249	1	R/W	Uint16	90	1	600			s	UP2	
Span gas calibration deviation Ch. 1	3, 16	6260	2	R/W	Float		0.5	100			%	UP2	% of target concentration
Span gas calibration deviation Ch. 2	3, 16	6262	2	R/W	Float		0.5	100			%	UP2	% of target concentration
Span gas calibration deviation Ch. 3	3, 16	6264	2	R/W	Float		0.5	100			%	UP2	% of target concentration
Span gas calibration deviation Ch. 4	3, 16	6266	2	R/W	Float		0.5	100			%	UP2	% of target concentration
Zero gas calibration deviation Ch. 1	3, 16	6268	2	R/W	Float		0.2	100			%	UP2	% of target concentration
Zero gas calibration deviation Ch. 2	3, 16	6270	2	R/W	Float		0.2	100			%	UP2	% of target concentration
Zero gas calibration deviation Ch. 3	3, 16	6272	2	R/W	Float		0.2	100			%	UP2	% of target concentration
Zero gas calibration deviation Ch. 4	3, 16	6274	2	R/W	Float		0.2	100			%	UP2	% of target concentration
Authenticate (user level 1)	16	6280	1	W	Int16		0	999				No	
Authenticate (user level 2)	16	6285	1	W	Int16		0	999				No	
Temperature Ch. 1	3	6500	2	R	Float						°C	No	
Temperature Ch. 2	3	6502	2	R	Float						°C	No	
Temperature Ch. 3	3	6504	2	R	Float						°C	No	
Temperature Ch. 4	3	6506	2	R	Float						°C	No	
Flow Ch. 1	3	6508	2	R	Float						L/h	No	
Flow Ch. 2	3	6510	2	R	Float						L/h	No	
Flow Ch. 3	3	6512	2	R	Float						L/h	No	

Description	FC	Address	No. register	Access	Data type	Default	Min	Max	Selection	Resolution	Unit	Password	Comment
Flow Ch. 4	3	6514	2	R	Float						L/h	No	
Pressure Ch. 1	3	6516	2	R	Float						mbar	No	
Pressure Ch. 2	3	6518	2	R	Float						mbar	No	
Pressure Ch. 3	3	6520	2	R	Float						mbar	No	
Pressure Ch. 4	3	6522	2	R	Float						mbar	No	
Alarm logbook entry number	3	6550	1	R	Struct							UP1	
Alarm logbook entry 1	3	6551	3	R	Struct				Register 1 = Channel and error code Bit15-Bit8: Channel number 0 to 3 same as 1 to 4 Bit7-Bit0: Error code Registers 2 + 3 = time (Unix timestamp)			UP1	
Alarm logbook entry 2	3	6554	3	R	Struct							UP1	
Alarm logbook entry 3	3	6557	3	R	Struct							UP1	
Alarm logbook entry 4	3	6560	3	R	Struct							UP1	
Alarm logbook entry 5	3	6563	3	R	Struct							UP1	
Alarm logbook entry 6	3	6566	3	R	Struct							UP1	
Alarm logbook entry 7	3	6569	3	R	Struct							UP1	
Alarm logbook entry 8	3	6572	3	R	Struct							UP1	
Alarm logbook entry 9	3	6575	3	R	Struct							UP1	
Alarm logbook entry 10	3	6578	3	R	Struct							UP1	
Alarm logbook entry 11	3	6581	3	R	Struct							UP1	
Alarm logbook entry 12	3	6584	3	R	Struct							UP1	
Alarm logbook entry 13	3	6587	3	R	Struct							UP1	
Alarm logbook entry 14	3	6590	3	R	Struct							UP1	
Alarm logbook entry 15	3	6593	3	R	Struct							UP1	
Alarm logbook entry 16	3	6596	3	R	Struct							UP1	
Alarm logbook entry 17	3	6599	3	R	Struct							UP1	
Alarm logbook entry 18	3	6602	3	R	Struct							UP1	
Alarm logbook entry 19	3	6605	3	R	Struct							UP1	
Alarm logbook entry 20	3	6608	3	R	Struct							UP1	
Alarm logbook entry 21	3	6611	3	R	Struct							UP1	

Description	FC	Address	No. register	Access	Data type	Default	Min	Max	Selection	Resolution	Unit	Password	Comment
Alarm logbook entry 22	3	6614	3	R	Struct							UP1	
Alarm logbook entry 23	3	6617	3	R	Struct							UP1	
Alarm logbook entry 24	3	6620	3	R	Struct							UP1	
Alarm logbook entry 25	3	6623	3	R	Struct							UP1	
Alarm logbook entry 26	3	6626	3	R	Struct							UP1	
Alarm logbook entry 27	3	6629	3	R	Struct							UP1	
Alarm logbook entry 28	3	6632	3	R	Struct							UP1	
Alarm logbook entry 29	3	6635	3	R	Struct							UP1	
Alarm logbook entry 30	3	6638	3	R	Struct							UP1	
Alarm logbook entry 31	3	6641	3	R	Struct							UP1	
Alarm logbook entry 32	3	6644	3	R	Struct							UP1	
Alarm logbook entry 33	3	6647	3	R	Struct							UP1	
Alarm logbook entry 34	3	6650	3	R	Struct							UP1	
Alarm logbook entry 35	3	6653	3	R	Struct							UP1	
Alarm logbook entry 36	3	6656	3	R	Struct							UP1	
Alarm logbook entry 37	3	6659	3	R	Struct							UP1	
Alarm logbook entry 38	3	6662	3	R	Struct							UP1	
Alarm logbook entry 39	3	6665	3	R	Struct							UP1	
Alarm logbook entry 40	3	6668	3	R	Struct							UP1	
Service logbook entry number	3	6680	1	R	Struct							UP1	
Service logbook entry 1	3	6681	3	R	Struct				Register 1 = Channel and error code Bit15-Bit8: Channel number 0 to 3 same as 1 to 4 Bit7-Bit0: Error code Registers 2 + 3 = time (Unix timestamp)			UP1	
Service logbook entry 2	3	6684	3	R	Struct							UP1	
Service logbook entry 3	3	6687	3	R	Struct							UP1	
Service logbook entry 4	3	6690	3	R	Struct							UP1	
Service logbook entry 5	3	6693	3	R	Struct							UP1	
Service logbook entry 6	3	6696	3	R	Struct							UP1	
Service logbook entry 7	3	6699	3	R	Struct							UP1	

Description	FC	Address	No. register	Access	Data type	Default	Min	Max	Selection	Resolution	Unit	Password	Comment
Service logbook entry 8	3	6702	3	R	Struct							UP1	
Service logbook entry 9	3	6705	3	R	Struct							UP1	
Service logbook entry 10	3	6708	3	R	Struct							UP1	
Service logbook entry 11	3	6711	3	R	Struct							UP1	
Service logbook entry 12	3	6714	3	R	Struct							UP1	
Service logbook entry 13	3	6717	3	R	Struct							UP1	
Service logbook entry 14	3	6720	3	R	Struct							UP1	
Service logbook entry 15	3	6723	3	R	Struct							UP1	
Service logbook entry 16	3	6726	3	R	Struct							UP1	
Service logbook entry 17	3	6729	3	R	Struct							UP1	
Service logbook entry 18	3	6732	3	R	Struct							UP1	
Service logbook entry 19	3	6735	3	R	Struct							UP1	
Service logbook entry 20	3	6738	3	R	Struct							UP1	
Service logbook entry 21	3	6741	3	R	Struct							UP1	
Service logbook entry 22	3	6744	3	R	Struct							UP1	
Service logbook entry 23	3	6747	3	R	Struct							UP1	
Service logbook entry 24	3	6750	3	R	Struct							UP1	
Service logbook entry 25	3	6753	3	R	Struct							UP1	
Service logbook entry 26	3	6756	3	R	Struct							UP1	
Service logbook entry 27	3	6759	3	R	Struct							UP1	
Service logbook entry 28	3	6762	3	R	Struct							UP1	
Service logbook entry 29	3	6765	3	R	Struct							UP1	
Service logbook entry 30	3	6768	3	R	Struct							UP1	
Service logbook entry 31	3	6771	3	R	Struct							UP1	
Service logbook entry 32	3	6774	3	R	Struct							UP1	
Service logbook entry 33	3	6777	3	R	Struct							UP1	
Service logbook entry 34	3	6780	3	R	Struct							UP1	
Service logbook entry 35	3	6783	3	R	Struct							UP1	
Service logbook entry 36	3	6786	3	R	Struct							UP1	
Service logbook entry 37	3	6789	3	R	Struct							UP1	
Service logbook entry 38	3	6792	3	R	Struct							UP1	
Service logbook entry 39	3	6795	3	R	Struct							UP1	
Service logbook entry 40	3	6798	3	R	Struct							UP1	

Description	FC	Address	No. register	Access	Data type	Default	Min	Max	Selection	Resolution	Unit	Password	Comment
Calibration logbook entry number	3	6810	1	R	Struct							UP1	
Calibration logbook 1	3	6811	3	R	Struct				Register 1 = Channel and error code Bit15-Bit8: Channel number 0 to 3 same as 1 to 4 Bit7-Bit0: Error code Registers 2 + 3 = time (Unix timestamp)			UP1	
Calibration logbook 2	3	6814	3	R	Struct							UP1	
Calibration logbook 3	3	6817	3	R	Struct							UP1	
Calibration logbook 4	3	6820	3	R	Struct							UP1	
Calibration logbook 5	3	6823	3	R	Struct							UP1	
Calibration logbook 6	3	6826	3	R	Struct							UP1	
Calibration logbook 7	3	6829	3	R	Struct							UP1	
Calibration logbook 9	3	6832	3	R	Struct							UP1	
Calibration logbook 8	3	6835	3	R	Struct							UP1	
Calibration logbook 10	3	6838	3	R	Struct							UP1	
IP address	3, 16	9950	2	R/W	Uint32	0xC0A80FA8	0x00	0xffffffff				UP2	confirm changed values with address 45500
Subnet	3, 16	9952	2	R/W	Uint32	0xfffffe00	0x00	0xffffffff				UP2	confirm changed values with address 45500
IP gateway	3, 16	9954	2	R/W	Uint32	0xC0A80F01	0x00	0xffffffff				UP2	confirm changed values with address 45500
DHCP	3, 16	9956	1	R/W	Int16							UP2	confirm changed values with address 45500
Date/time (Linux time)	3, 16	9960	2	R/W	Int32						s	UP1	Unix timestamp
TEST	3	9990	2	R	Uint32	12648430	-	-	-	1	-	No	
TEST_UINT16	3, 16	9992	1	R/W	Uint16	206	0	65535	-	1	-	No	
TEST_INT16	3, 16	9993	1	R/W	Int16	-206	-32768	32767	-	1	-	No	
TEST_UINT32	3, 16	9994	2	R/W	Uint32	2766	0	4294967295	-	1	-	No	

Description	FC	Address	No. register	Access	Data type	Default	Min	Max	Selection	Resolution	Unit	Password	Comment
TEST_INT32	3, 16	9996	2	R/W	Int32	-2766	0x80000000	0xffffffff	-	1	-	No	
TEST_Float	3, 16	9998	2	R/W	Float	-10.5			-	-	-	No	
Enable limit value 1 Ch. 1	1, 5, 15	45010		R/W	Bit				1 = Enable 0 = Disable			UP2	
Enable limit value 2 Ch. 1	1, 5, 15	45011		R/W	Bit				1 = Enable 0 = Disable			UP2	
Enable limit value 1 Ch. 2	1, 5, 15	45012		R/W	Bit				1 = Enable 0 = Disable			UP2	
Enable limit value 2 Ch. 2	1, 5, 15	45013		R/W	Bit				1 = Enable 0 = Disable			UP2	
Enable limit value 1 Ch. 3	1, 5, 15	45014		R/W	Bit				1 = Enable 0 = Disable			UP2	
Enable limit value 2 Ch. 3	1, 5, 15	45015		R/W	Bit				1 = Enable 0 = Disable			UP2	
Enable limit value 1 Ch. 4	1, 5, 15	45016		R/W	Bit				1 = Enable 0 = Disable			UP2	
Enable limit value 2 Ch. 4	1, 5, 15	45017		R/W	Bit				1 = Enable 0 = Disable			UP2	
Autocal enabled/ disabled Ch. 1	1, 5, 15	45024		R/W	Bit				1 = Enable 0 = Disable			UP2	
Apply new IP address	5, 15*	45500		W	Bit				1 = apply network setting 0 = reserved			UP2	Write with function code 15 only with quantity = 1
Alarm logbook (update&refresh)	5, 15*	45501		W	Bit				1 = Update logbook 0 = Erase oldest entry			UP1	Write with function code 15 only with quantity = 1
Service logbook (update&erase)	5, 15*	45502		W	Bit				1 = Update logbook 0 = Erase oldest entry			UP1	Write with function code 15 only with quantity = 1
Cal. Logbook (update&erase)	5, 15*	45503		W	Bit				1 = Update logbook 0 = Erase oldest entry			UP1	Write with function code 15 only with quantity = 1
Calibrate zero gas (all)	5, 15*	45504		W	Bit				1 = Start calibration 0 = Cancel calibration			UP2	Write with function code 15 only with quantity = 1

Description	FC	Address	No. register	Access	Data type	Default	Min	Max	Selection	Resolution	Unit	Password	Comment
Calibrate zero gas Ch. 1	5, 15*	45505		W	Bit				1 = Start calibration 0 = Cancel calibration			UP2	Write with function code 15 only with quantity = 1
Calibrate zero gas Ch. 2	5, 15*	45506		W	Bit				1 = Start calibration 0 = Cancel calibration			UP2	Write with function code 15 only with quantity = 1
Calibrate zero gas Ch. 3	5, 15*	45507		W	Bit				1 = Start calibration 0 = Cancel calibration			UP2	Write with function code 15 only with quantity = 1
Calibrate zero gas Ch. 4	5, 15*	45508		W	Bit				1 = Start calibration 0 = Cancel calibration			UP2	Write with function code 15 only with quantity = 1
Calibrate span gas Ch. 1	5, 15*	45509		W	Bit				1 = Start calibration 0 = Cancel calibration			UP2	Write with function code 15 only with quantity = 1
Calibrate span gas Ch. 2	5, 15*	45510		W	Bit				1 = Start calibration 0 = Cancel calibration			UP2	Write with function code 15 only with quantity = 1
Calibrate span gas Ch. 3	5, 15*	45511		W	Bit				1 = Start calibration 0 = Cancel calibration			UP2	Write with function code 15 only with quantity = 1
Calibrate span gas Ch. 4	5, 15*	45512		W	Bit				1 = Start calibration 0 = Cancel calibration			UP2	Write with function code 15 only with quantity = 1
Calibrate span gas 2 Ch. 1	5, 15*	45513		W	Bit				1 = Start calibration 0 = Cancel calibration			UP2	Write with function code 15 only with quantity = 1
Calibrate span gas 2 Ch. 2	5, 15*	45514		W	Bit				1 = Start calibration 0 = Cancel calibration			UP2	Write with function code 15 only with quantity = 1
Calibrate span gas 2 Ch. 3	5, 15*	45515		W	Bit				1 = Start calibration 0 = Cancel calibration			UP2	Write with function code 15 only with quantity = 1
Calibrate span gas 2 Ch. 4	5, 15*	45516		W	Bit				1 = Start calibration 0 = Cancel calibration			UP2	Write with function code 15 only with quantity = 1
Para_temperature low	1	47008		R	Bit							No	

Description	FC	Address	No. register	Access	Data type	Default	Min	Max	Selection	Resolution	Unit	Password	Comment
Para_limit_1_exceeded	1	47009		R	Bit							No	
Para_limit_1_underrun	1	47010		R	Bit							No	
Para_limit_2_exceeded	1	47011		R	Bit							No	
Para_limit_2_underrun	1	47012		R	Bit							No	
Para_heater_defective	1	47013		R	Bit							No	
Para_signal_outside_tolerance	1	47014		R	Bit							No	
Para_T-sensor_defective	1	47015		R	Bit							No	
Para_cell_maintenance	1	47016		R	Bit							No	
reserved	1	47017		R	Bit							No	
reserved	1	47018		R	Bit							No	
reserved	1	47019		R	Bit							No	
reserved	1	47020		R	Bit							No	
reserved	1	47021		R	Bit							No	
reserved	1	47022		R	Bit							No	
reserved	1	47023		R	Bit							No	
ZrOx_temperature low	1	47032		R	Bit							No	
ZrOx_limit_1_exceeded	1	47033		R	Bit							No	
ZrOx_limit_1_underrun	1	47034		R	Bit							No	
ZrOx_limit_2_exceeded	1	47035		R	Bit							No	
ZrOx_limit_2_underrun	1	47036		R	Bit							No	
ZrOx_heater_defective	1	47037		R	Bit							No	
ZrOx_signal_outside_tolerance	1	47038		R	Bit							No	
ZrOx_T-sensor_defective	1	47039		R	Bit							No	
reserved	1	47040		R	Bit							No	
reserved	1	47041		R	Bit							No	
reserved	1	47042		R	Bit							No	
reserved	1	47043		R	Bit							No	
reserved	1	47044		R	Bit							No	
reserved	1	47045		R	Bit							No	
reserved	1	47046		R	Bit							No	
reserved	1	47047		R	Bit							No	

Description	FC	Address	No. register	Access	Data type	Default	Min	Max	Selection	Resolution	Unit	Password	Comment
EC_limit_1_exceeded	1	47064		R	Bit							No	
EC_limit_1_underrun	1	47065		R	Bit							No	
EC_limit_2_exceeded	1	47066		R	Bit							No	
EC_limit_2_underrun	1	47067		R	Bit							No	
EC_signal_outside_tolerance	1	47068		R	Bit							No	
reserved	1	47069		R	Bit							No	
reserved	1	47070		R	Bit							No	
reserved	1	47071		R	Bit							No	
Baro_pressure_compensation_outside_tolerance	1	47104		R	Bit							No	
Baro_pressure_compensation_defective	1	47105		R	Bit							No	
Device_temperature_outside_tolerance	1	47106		R	Bit							No	
reserved	1	47107		R	Bit							No	
reserved	1	47108		R	Bit							No	
reserved	1	47109		R	Bit							No	
reserved	1	47110		R	Bit							No	
reserved	1	47111		R	Bit							No	
Cal_variation_high	1	47112		R	Bit							No	
Cal_deviation_span_gas_high	1	47113		R	Bit							No	
Cal_deviation_zero_gas_high	1	47114		R	Bit							No	
Cal_successful	1	47115		R	Bit							No	
Cal_invalid_error	1	47116		R	Bit							No	
reserved	1	47117		R	Bit							No	
reserved	1	47118		R	Bit							No	
reserved	1	47119		R	Bit							No	
reserved	1	47120		R	Bit							No	
reserved	1	47121		R	Bit							No	
reserved	1	47122		R	Bit							No	

Description	FC	Address	No. register	Access	Data type	Default	Min	Max	Selection	Resolution	Unit	Password	Comment
reserved	1	47123		R	Bit							No	
reserved	1	47124		R	Bit							No	
reserved	1	47125		R	Bit							No	
reserved	1	47126		R	Bit							No	
reserved	1	47127		R	Bit							No	
Gas_flow_low	1	47128		R	Bit							No	
high_T-Drift	1	47129		R	Bit							No	
Reorder_EC	1	47130		R	Bit							No	
>_20000h_operating_hours	1	47131		R	Bit							No	
reserved	1	47132		R	Bit							No	
reserved	1	47133		R	Bit							No	
reserved	1	47134		R	Bit							No	
reserved	1	47135		R	Bit							No	
Measuring range status Ch. 1	1	47136		R	Bit	0			0 = Measuring range 1 1 = Measuring range 2			No	
Measuring range status Ch. 2	1	47137		R	Bit	0						No	
Measuring range status Ch. 3	1	47138		R	Bit	0						No	
Measuring range status Ch. 0	1	47139		R	Bit	0						No	
reserved	1	47140		R	Bit							No	
reserved	1	47141		R	Bit							No	
reserved	1	47142		R	Bit							No	
reserved	1	47143		R	Bit							No	

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

RMA-Nr./ RMA-No. _____

Die RMA-Nr. bekommen Sie von Ihrem Ansprechpartner im Vertrieb oder Service. Bei Rücksendung eines Altgeräts zur Entsorgung tragen Sie bitte in das Feld der RMA-Nr. "WEEE" ein./ You may obtain the RMA number from your sales or service representative. When returning an old appliance for disposal, please enter "WEEE" in the RMA number box.

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

Firma/ Company

Firma/ Company	
Straße/ Street	
PLZ, Ort/ Zip, City	
Land/ Country	

Ansprechpartner/ Person in charge

Name/ Name	
Abt./ Dept.	
Tel./ Phone	
E-Mail	

Gerät/ Device	
Anzahl/ Quantity	
Auftragsnr./ Order No.	

Serien-Nr./ Serial No.	
Artikel-Nr./ Item No.	

Grund der Rücksendung/ Reason for return

- ☐ Kalibrierung/ Calibration
- ☐ Modifikation/ Modification
- ☐ Reklamation/ Claim
- ☐ Reparatur/ Repair
- ☐ Elektroaltgerät/ Waste Electrical & Electronic Equipment (WEEE)
- ☐ andere/ other

bitte spezifizieren/ please specify

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

☐ Nein, da das Gerät nicht mit gesundheitsgefährdenden Stoffen betrieben wurde./ No, because the device was not operated with hazardous substances.

☐ Nein, da das Gerät ordnungsgemäß gereinigt und dekontaminiert wurde./ No, because the device has been properly cleaned and decontaminated.

☐ Ja, kontaminiert mit:/ Yes, contaminated with: _____

☐	☐	☐	☐	☐	☐	☐	☐	☐
explosiv/ explosive	entzündlich/ flammable	brandfördernd/ oxidizing	komprimierte Gase/ compressed gases	ätzend/ caustic	giftig, Lebensgefahr/ poisonous, risk of death	gesundheitsgefährdend/ harmful to health	gesundheitsschädlich/ health hazard	umweltgefährdend/ environmental hazard

Bitte Sicherheitsdatenblatt beilegen!/ Please enclose safety data sheet!

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

Diese Erklärung wurde korrekt und vollständig ausgefüllt und von einer dazu befugten Person unterschrieben. Der Versand der (dekontaminierten) Geräte und Komponenten erfolgt gemäß den gesetzlichen Bestimmungen.

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

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

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

Firmenstempel/ Company Sign

Datum/ Date _____

rechtsverbindliche Unterschrift/ Legally binding signature

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

Vermeiden von Veränderung und Beschädigung der einzusendenden Baugruppe

Die Analyse defekter Baugruppen ist ein wesentlicher Bestandteil der Qualitätssicherung der Firma Bühler Technologies GmbH. Um eine aussagekräftige Analyse zu gewährleisten muss die Ware möglichst unverändert untersucht werden. Es dürfen keine Veränderungen oder weitere Beschädigungen auftreten, die Ursachen verdecken oder eine Analyse unmöglich machen.

Umgang mit elektrostatisch sensiblen Baugruppen

Bei elektronischen Baugruppen kann es sich um elektrostatisch sensible Baugruppen handeln. Es ist darauf zu achten, diese Baugruppen ESD-gerecht zu behandeln. Nach Möglichkeit sollten die Baugruppen an einem ESD-gerechten Arbeitsplatz getauscht werden. Ist dies nicht möglich sollten ESD-gerechte Maßnahmen beim Austausch getroffen werden. Der Transport darf nur in ESD-gerechten Behältnissen durchgeführt werden. Die Verpackung der Baugruppen muss ESD-konform sein. Verwenden Sie nach Möglichkeit die Verpackung des Ersatzteils oder wählen Sie selber eine ESD-gerechte Verpackung.

Einbau von Ersatzteilen

Beachten Sie beim Einbau des Ersatzteils die gleichen Vorgaben wie oben beschrieben. Achten Sie auf die ordnungsgemäße Montage des Bauteils und aller Komponenten. Versetzen Sie vor der Inbetriebnahme die Verkabelung wieder in den ursprünglichen Zustand. Fragen Sie im Zweifel beim Hersteller nach weiteren Informationen.

Einsenden von Elektroaltgeräten zur Entsorgung

Wollen Sie ein von Bühler Technologies GmbH stammendes Elektroprodukt zur fachgerechten Entsorgung einsenden, dann tragen Sie bitte in das Feld der RMA-Nr. „WEEE“ ein. Legen Sie dem Altgerät die vollständig ausgefüllte Dekontaminierungserklärung für den Transport von außen sichtbar bei. Weitere Informationen zur Entsorgung von Elektroaltgeräten finden Sie auf der Webseite unseres Unternehmens.

Avoiding alterations and damage to the components to be returned

Analysing defective assemblies is an essential part of quality assurance at Bühler Technologies GmbH. To ensure conclusive analysis the goods must be inspected unaltered, if possible. Modifications or other damages which may hide the cause or render it impossible to analyse are prohibited.

Handling electrostatically conductive components

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

Fitting of spare parts

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

Returning old electrical appliances for disposal

If you wish to return an electrical product from Bühler Technologies GmbH for proper disposal, please enter "WEEE" in the RMA number box. Please attach the fully completed decontamination declaration form for transport to the old appliance so that it is visible from the outside. You can find more information on the disposal of old electrical appliances on our company’s website.

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