Gas Analysis

Zirconia Oxygen Analyser

BA 1LT

Installation and Operation Instructions

Original instructions

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

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Contents

1 Introduction

1.1 Intended Use

The BA 1LT oxygen measurement system was designed specifically for automatic control of furnaces and to measure oxygen in hard to reach areas, or self-contained systems (ventilation pipes, containers, etc.). The BA 1LT oxygen measurement system may only be used to:

– determine concentrations of residual oxygen content in the flue gas of furnaces (with a maximum flue gas temperature of +350°C)
– measure the oxygen concentration in air and inert gas mixtures (N2, CO2, noble gases)

The device must not be used:

– in explosive atmospheres.
– in ambient conditions outside the technical data

1.2 Scope of delivery

– Analyser
– Product documentation

1.3 Product Description

The oxygen sensor is located inside the head of a stainless steel rod sensor (diameter 12 mm), protected by a stainless steel sinter. The plastic housing is mechanically connected with the rod sensor and contains the transmitter.

1.4 Functional principle

The BA 1LT oxygen analyser measures the oxygen partial pressure directly in the gas mixture, the absolute oxygen content. At a constant pressure the measurement value equals the oxygen concentration in Vol.%. The measuring method is based on a dynamic process using two zirconium dioxide discs forming a hermetically sealed chamber.

The entire measuring range is linear.

The sinter protects the sensor element from dust. Available in two styles:

– Full sinter, with enlarged surface, thus faster response time.
– Internal sinter, enhanced draining properties (condensate protection), slower response time.

Since the measuring system monitors the function during operation and alerts to hardware and sensor malfunctions and further features a diagnostic function, it can be operated safely as needed. No second oxygen sensor required for this purpose!

Can be calibrated without reference gas, using atmospheric air.

Measurement values are output via analogue 4-20 mA channel, and error messages via digital channel.

1.5 Equipment overview

The transmitter contains:

- A signal amplifier
- A control unit for the ion pump with analogue part
- A test piece
- The internal monitoring logic
- The power supply for the probe heater, for the analogue and the digital part
- The reset and the voltage monitor
- A 4-20 mA analogue output

A downstream unit reads and processes the output signals from the oxygen measurement system per user specifications.

1.6 Ordering Instructions

Item no.	Description
55015001	BA 1LT O_2 Analyser, 24V DC, L: 220mm, internal sinter
55015002	BA 1LT O_2 Analyser, 24V DC, L: 220mm, full sinter
55015001-SEN	Replacement probe for BA 1 LT O2 analyser, L: 220mm, internal sinter
55015002-SEN	Replacement probe for BA 1 LT O2 analyser, L: 220mm, full sinter

2 Safety instructions

2.1 Important notices

Operation of the device is only valid if:

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

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

Signal words for warnings

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

Warning signs

These instructions use the following warning signs:

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

2.2 General hazard warnings

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

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

The operator of the system must ensure:

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

DANGER

Toxic, corrosive gases

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

a) Check tightness of the measuring system before putting it into operation.

b) Take care that harmful gases are exhausted to a 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

Electrical voltage

Electrocution hazard.

a) Disconnect the device from power supply.

b) Make sure that the equipment cannot be reconnected to mains unintentionally.

c) The device must be opened by trained staff only.

d) Regard correct mains voltage.

DANGER

Danger to life from oxygen deficiency

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

WARNING

Fire and explosion hazard

The BA 1LT oxygen measurement system must not be used in areas where flammable or explosive gas mixtures. The gas measurement system is not approved for use in explosive areas.

CAUTION

Damage to the unit

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

3 Installation and connection

3.1 Installation site requirements

Avoid the following positions when selecting the installation site:

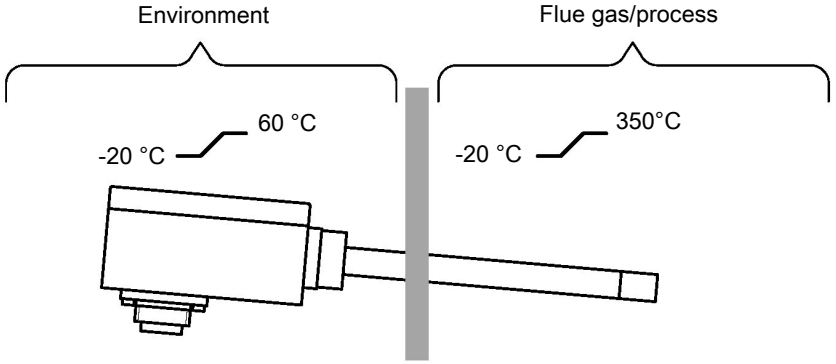
- Where the probe is exposed to strong vibration, e.g. due to shock, etc.
- Where it is directly exposed to weather.
- Where turbulence occurs in the gas flow, which may cause measurement errors.
- Where the probe cannot be installed or removed due to obstacles.
- Where the sinter can clog at the tip of the probe due to dusty atmospheres.
- Where strong electric or magnetic fields occur.
- Where the oxygen measurement system is continuously in contact with water
- Where the process heat will be exceeded due to the maximal approved ambient temperature of the transmitter. If necessary build a shield, or if the rod is long enough increase the clearance between the electronics housing and the wall.
- Installation in wet rooms or explosive areas is prohibited.

3.2 Installation

Ensure the sensor element at the tip of the rod comes in contact with the gas to be measured. At the tip of the rod the sinter must be freely exposed to gas.

If condensation may occur, select an installation position with a slight downward angle. This allows the medium to drain better.

The oxygen measurement system can be installed so the probe tube extends through a barrier and into the gas mixture being measured (e.g. into the gas line, the flue or the container) but the housing with the transmitter remains on the other side of the barrier. A fitting is available to aid with installation.



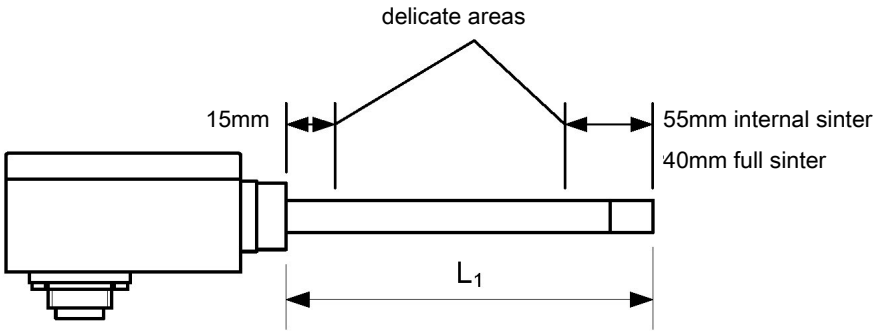
During installation, be sure to observe the ambient conditions for the transmitter and the rod sensor, see section Technical Data

CAUTION

Sunlight

Do not expose the measuring system to direct sunlight.

Be sure not to damage delicate areas when installing the measuring system, see below. This may occur e.g. when tightening the clamping collars when installing with a fitting. The interior could become damaged if crushed, causing a system failure.



DANGER

Risk of burns and fire

The probe tube is hot (200°C). Wear safety gloves. Install a touch guard (perforated metal plate, not included) around the probe tube if it could accidentally be touched. Maintain a sufficient safety distance between the probe tube and flammable material.

NOTICE

Maintaining the power supply for the measuring system in condensing processes may be beneficial to the system life.

3.3 Electrical connection

DANGER

Electrical voltage

Electrocution hazard.

a) Disconnect the device from power supply.

b) Make sure that the equipment cannot be reconnected to mains unintentionally.

c) The device must be opened by trained staff only.

d) Regard correct mains voltage.

The connection between the measuring system and the downstream unit must use a six-core, shielded cable. Do not run this line next to a high voltage line due to the risk of interference. The cable must be able to withstand the expected mechanical, chemical, and thermal stress. The cable cross-section must be sized so the plug connection is not less than the minimum power supply.

The power supply must be configured to guarantee the maximum starting current of 1.25A (for cold oxygen measurement system at 19.2V) and the charge pulse of the input capacities of approx. 10A (at 28.9V).

Inside, the probe rod is connected to the functional earth of pin 7. It's advisable to earth the probe rod separately for better interference suppression and to ensure less electric charge in the process.

For simple operation, connect the oxygen measurement system to the power circuit via pin 1, pin 2 and pin 7, and read the measured data via pin 5 (4-20 mA). This can for example be carried out using a measuring instrument, a display, or an PLC (programmable logic controller).

For safe operation, also connect pin 4 (test) and pin 6 (K2, digital output). The measurement signals will then be analysed and processed by the user's downstream logic.

There must be at least 40Ω between the connections pin 4 (test), pin 5 (K1) and pin 6 (K2) and the direct current circuit.

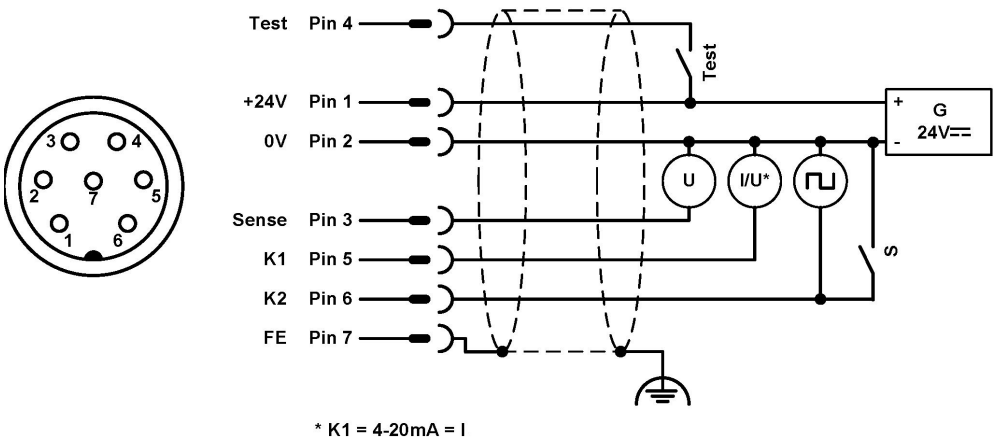
The present sensor supply voltage can be monitored externally using the Sense signal (pin3).

The output signal of the oxygen measurement system is 4-20 mA.

WARNING

Damage/destruction of the unit

Always supply the oxygen measurement system with current to prevent condensation, which may damage the unit beyond repair.



Ill. BA 1LT pin assignment

WARNING

Taking into account the relevant safety regulations, the oxygen measurement system may only be connected to suitable power supply units meeting the applicable technical regulations. Fusing suitable for the power supply units must be used (SECURE POTENTIAL ISOLATION)!

3.3.1 Output K1

The K1 signal outputs the oxygen concentration based on the measuring range used, which can be converted per the chart. K1 can be a 4-20mA current loop.

Measuring range	Current 4-20mA
0.1 – 25Vol.% O2 at 1013.25hPa	$c[Vol.\%] = \frac{I[mA] - 4mA}{16mA} * 24{,}9 vol.\% + 0{,}1 Vol.\%$
1 – 253.31hPa O2	$c[Vol.\%] = \frac{U[V]}{10V} * 24{,}9 vol.\% + 0{,}1 Vol.\%$
0.1 – 100Vol.% O2 at 1013.25hPa	$c[hPa] = \frac{I[mA] - 4mA}{16mA} * 252{,}31 hPa + 1 hPa$
1 -1013.25hPa O2	$c[hPa] = \frac{U[V]}{10V} * 253{,}31 hPa + 1 hPa$
c = measured concentration	

3.3.2 Digital I/O K2

K2 supplies a bidirectional signal. It indicates the status and a reference value for K1 and as an input signal can activate electric calibration.

Output signal	Information
High	'Electric calibration' failed
Alternating	OK, probe operating, dynamic process active. The Low phase corresponds to the oxygen concentration
Low	Failure, the system monitors have detected an error.

The duration of the signal low phase indicates the oxygen concentration. The maximum low phase of a functional system is less than 1.5s. The entire cycle of the alternating system in a functioning system is less than 4s.

The parameters for converting to a concentration is system-specific. It can be taken from the additional label as x0 and x100 value in [ms]. The low time tL measured can be converted to concentration as follows.

$$c = \frac{(t_L[ms] - xo)}{(x100 - x0)} * Measuring\ range\ value$$

NOTICE

The K2 measured value is less accurate and affected more by interfering factors than the measured value K1.

K2 signal	Min	Type	Max	
UHigh Output	4V	5V	5.5V	Signal during K2 high phase or if 'electric calibration' fails
IHigh Output			3mA	
ULow Output			1V	Signal during K2 low phase or on failure.
ULow Input	-0.5V		0.6V	Short-circuit signal during electric calibration
IHigh short-circuit			10mA	

3.3.2.1 Determining parameters for conversion

Determining parameters for converting K2 into a concentration requires assigning two different test gases within the measuring range and the time.

The concentration c1 for calibration can be used as the first measuring point, which will measure the time TC1. We recommend using a value of approx. 20% of the measuring range as the concentration c2. Example: For the measuring range 25Vol.% a concentration of approx. 5Vol.%. The TC2 low phase is determined for this purpose.

These values are used to determine the parameters x0 and x100 as follows.

$$x0 = T_{c1} - \frac{T_{c1} - T_{c2}}{c_1 - c_2} * c_1$$

$$x100 = \frac{t_{c1} - T_{c2}}{c_1 - c_2} * Measuring\ range\ value + x0$$

3.3.3 Test (external test)

The oxygen measurement system is designed to also test proper function during operation. The external test is used to specifically change the sensor signal, and the measuring system must show this change in the output signals. During the external test the system continues to also measures the concentration, i.e. changes in concentration also affect the signal output. Pin 4 (test) must be connected for the external test.

External test procedure:

- Note the K1 concentration and the time of K2.
- Charge pin 4 with +24 V. The probe will be simulated a lower oxygen concentration than present.
- The output signal has a delay of approx. 6 clock cycles.
- The concentration indicated by the analogue output K1 must therefore drop by approx. 20%.
- The measurement signal indicated by the digital output K2 must therefore drop by over approx. 10%.
- If this is not the case, the measuring system is defective and will need to be replaced.
- After the test, switch off the +24 V at pin 4.
- The output signal has a delay of approx. 6 clock cycles before it returns.

The function test is ideally cyclical. A bandwidth of 0.76x and 0.84x the previous measurement value is specified as the tolerance for K1.

NOTICE

The criterion for channel comparison may cause errors during the test.

NOTICE

The concentration must be constant during testing. Changes in the gas concentration will cause variances which will affect the result.

Test signal	Min	Type	Max	
UHigh Input	18.0V		24.0V	Test function active
IHigh Input			13mA	
ULow Input	-5V	0V	3V	Test function disabled. Moved to low due to internal resistance.
ILow Input	-1mA		1.0mA	

3.3.4 Sense

The 'Sense' signal is used to check if the supply voltage in a downstream analysis unit is within the required range.

4 Operation and control

4.1 Initial operation

Prior to initial operation, use the list below to verify all requirements for failure-free operation have been met:

- Oxygen measurement system installed?
- Separation when installed in a separate process room tight?
- Oxygen measurement system housing accessible and visible?
- Ambient conditions taken into account?
- Connecting cable not run next to high voltage line?
- Oxygen measurement system connected?
- Power supply on?
- Test measurement value after breaking in the system.

NOTICE

The measuring system shows the correct oxygen partial pressure, taking into account the altitude. Due to the lower overall pressure the concentration indicated in Vol.% is lower at higher sites, as calibration uses a pressure of 1013.25 hPa.

4.2 Measurement value check

The measuring system must be charged with a defined gas concentration when checking the measurement value, verifying the measurement output corresponds with this concentration.

E.g. fresh atmospheric air can be used for this check.

If the measured value is within the tolerance range, the unit is ready for operation again. If the measured value is outside of this range, contact either the manufacturer or the dealer or, if possible, calibrated and perform an external test.

4.3 Calibration

The measuring system is designed to not require additional calibration, even with extended operation. Manual or electric calibration may be carried out if necessary, however the latter only with pin 6 connected.

NOTICE

The measuring system measures the oxygen partial pressure. According to Dalton's law, this depends on the air pressure and the relative humidity. Great fluctuations in these parameters affect calibration!

4.4 Manual Calibration

NOTICE

Changing the potentiometer setting will change the parameters x0 and x100 for K2

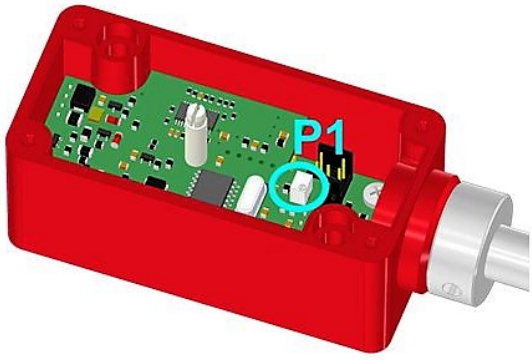
Manual calibration utilises a potentiometer inside the housing.

– Purge the sensor with a defined oxygen concentration. To ensure good results a concentration greater than half the measuring range is recommended. This can be e.g. fresh atmospheric air, which typically has a concentration of 20.7Vol.% oxygen.
– Verify the power supply is safe and does not pose a hazard. Only then open the housing.
– The potentiometer P1 is used to set the output signal K1.

Measuring range	Current 4-20mA
0.1 – 25Vol.% O2 at 1013.25hPa	$I[mA] = \frac{c - 0{,}1Vol.\%}{24{,}9Vol.\%} * 16mA + 4mA$
1 – 253.31hPa O2	$I[mA] = \frac{c - 1hPa}{252{,}31hPa} * 16mA + 4mA$
0.1 – 100Vol.% O2 at 1013.25hPa	$I[mA] = \frac{c - 0{,}1Vol.\%}{99{,}9Vol.\%} * 16mA + 4mA$
1 -1013.25hPa O2	$I[mA] = \frac{c - 1hPa}{1013{,}25hPa} * 16mA + 4mA$
c = defined oxygen concentration in the required unit	

At a measuring range up to 25 Vol.% and a concentration of 20.7 Vol.% at 1013.25 hPa the current signal must be set to 17.24 mA or the voltage signal to 8.27 V.

– Close housing.
– When using K2 to compare concentrations, you will need to define the new parameters for conversion.
– You can now stop purging the measuring system with a defined concentration.



Ill. 9 Potentiometer for configuring the concentration

4.5 Electric calibration

The BA 1LT features simple K1 calibration with a fixed concentration, the

'electric calibration'. This function requires connecting pin 6 and purging the gas with calibrating gas. The concentration varies by the system's measuring range.

Measuring range	Calibration concentration
0.1 – 25Vol.% O2 at 1013.25hPa	20.7Vol.% O2, corresponds to the typical concentration of atmospheric air
1 -253.31 hPa O2	209.7hPa O2
0.1 -100 Vol.% O2 at 1013.25hPa	82.75Vol.%
1-1013.25hPa O2	838.4hPa O2

Adjustments will redefine the conversion value for the output signal. The conversion value may only change by ±20% compared to the hardware setting of the potentiometer.

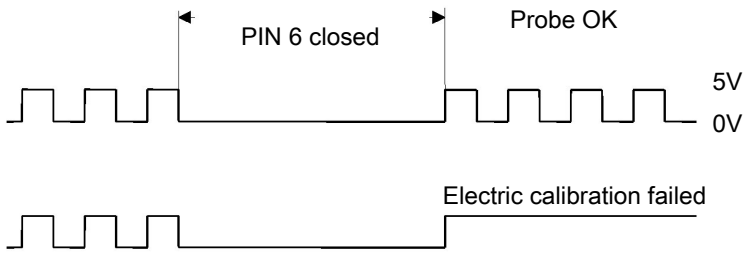
The system must not be malfunctioning to use 'electric calibration'.

Steps for electric calibration:

- Charge the BA 1LT with calibrating gas for at least 30sec plus the T95 response time.
- Close switch S (pin 6 or K2) for at least 10 seconds using e.g. a downstream device. The oxygen measurement system will now calibrate.
- Open switch S again
- To clearly indicate the system calibrated successfully, the output signal of K1 will output the test gas concentration, taking into account a tolerance, and K2 will output an alternating signal.
- If the system could not be adjusted, signal K1 will not change and K2 will output a high signal.
- You can stop purging with calibrating gas.

If electric calibration failed, this is because the required conversion value is outside the maximum tolerances. Causes include among others:

Cause	Possible error detection	Action
Incorrect calibrating gas concentration set	Checking the calibrating gas	If necessary, use the correct calibrating gas and repeat.
The system has not been charged with calibrating gas for an adequate amount of time.	The K1 measurement signal still falls or rises over time.	Repeat electric calibration.
The conversion value is consistently outside the maximum tolerance	'Electric calibration' failed despite steady K1 signal.	calibrate manually



Ill. K2 output signals during electric calibration

4.5.1 Error detection

How does the oxygen measurement system detect errors?

The oxygen measurement system outputs two measurement signals via two different channels:

– signal K1 is the measured value as analogue signal (4-20 mA),

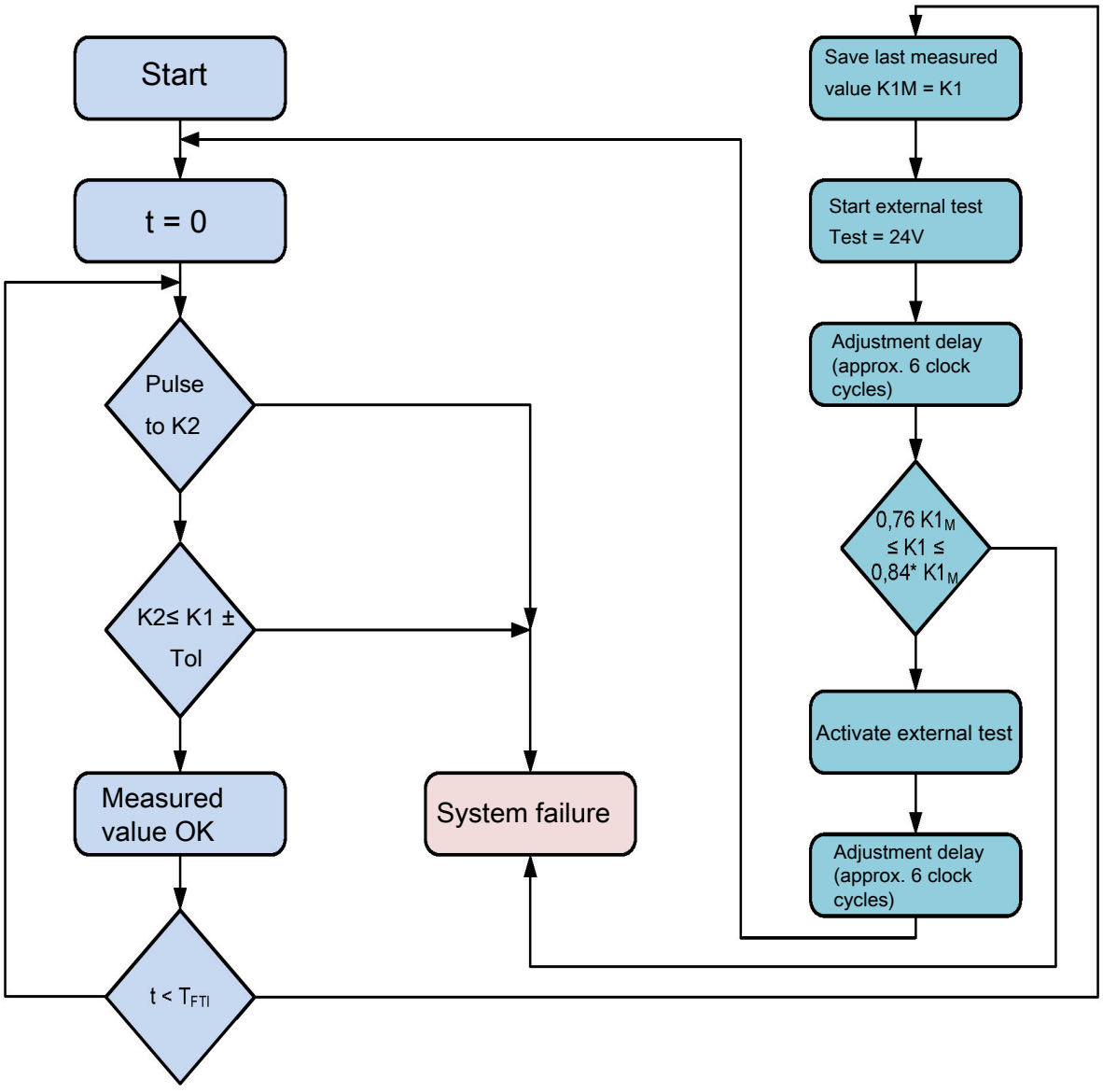
– the bidirectional signal K2 is a digital, pulse length modulated alternating signal.

The oxygen measurement system is working properly if the K1 analogue signal corresponds with the signal of digital channel K2 (maximum deviation 4% full scale). If the alternating signal (Low+High) is outside a time window of 0.05 to 4 s, or on static Low or High output, an error is present.

Since the measuring method is dynamic, the proper function of the measurement system can be tested at any time, including during operation, using the so-called “external test” and will ideally be carried out cyclically.

NOTICE

When comparing signals, particularly with signal jumps, the signal time difference between K1 and K2 of approx. 6 clock cycles must be taken into account.



Ill. Flow chart: External test for monitoring the function of the oxygen measurement system. K1 = Signal K1 U(M); K2 = Signal K2 f(M); TFTI = interval for the external system test. The interval varies by application; K1M = K1 measured value prior to starting the external test.

This test sequence allows errors to not only be detected by the measuring system hardware, but also the sensor itself, so the zirconium dioxide chamber!

4.5.2 Proper function

When is the oxygen measurement system working properly?

The oxygen measurement system monitors the entire system during operation and can further do with only one oxygen sensor.

It is working properly when:

– the analogue and the digital output signal match,
– the measurement signal for K2 is within a defined time window and not static,
– the external test is cyclic and correct.

Oxygen measurement system ready			
	Measurement signal channel K1	Measurement signal channel K2	Measurement signal difference (K1-K2)
normal operation (Test Low)	linear (4-20 mA or 0-10 V)	digital and length of Low+High phase 0.05-4 s	Difference < 4% full scale
External test active (Test High)	The concentration output drops by approx. 20%	Measured value [ms] drops by at least 10%	
Oxygen measurement system failure			
	Measurement signal channel K1	Measurement signal channel K2	Measurement signal difference (K1-K2)
normal operation (Test Low)		no pulse or Low+High phase length <0.05 or >4 s.	Difference > 4% full scale
External test (Test High)	Change in the concentration output outside the range	Measurement value does not drop more than 10%	

4.5.3 External monitoring unit

User external monitoring unit

An external downstream unit installed by the user must analyse the measurement signals and carry out and monitor the cyclical external test.

The response to the error message is based on user specifications and will also be managed by his external monitor.

It must therefore meet specific requirements:

– The unit must be working properly, meaning the processes below must complete error-free, the input signals be imported error-free and the output signals be output error-free.
– The measurement values of signals K1 and K2 must be constantly compared during the error tolerance time permissible for the application.
– Constantly check the K2 output signal duration plausibility. Static signals should be considered internal errors.
– Start an external test at cyclic intervals and record and analyse how it affects the measurement signal. The interval between two test cycles must not be longer than the time required for the application.
– An error message must cause the process to enter safe mode.

4.6 Measured value conversion

The system variable is the oxygen partial pressure. In systems with constant pressure the oxygen partial pressure is proportional to the concentration in Vol.%. With the processes used, check if the oxygen partial pressure is the more relevant measured variable. The systems are set to an oxygen concentration at an air pressure of 1013.25hPa.

This allows converting the variable c[hPa] into the Vol.% concentration c[Vol.%] as follows:

$$c[Vol.\%] = \frac{c[hPa]}{absolute\ pressure} * 100$$

When interpreting the measured value as oxygen concentration cmeas[Vol.%] in [Vol.%], the pressure can be compensated as follows:

$$c_{Pressure\text{-}compensated}\ [Vol.\%] = \frac{1013{,}25}{Pressure} * c_{measure}[Vol.\%]$$

4.6.1 Altitude adjustment

The air pressure increases with the altitude. The system shows the correct oxygen partial pressure. If the measured value is displayed as Vol.% concentration, it will show less as the altitude increases. The error can be estimated e.g. with the 'barometric formula' and the pressure compensation.

$$p_h = p_0 * \left(1 - \frac{0{,}0065 * h}{288{,}15}\right)^{5{,}255}$$

The height h is specified in [m].

4.6.2 Assumption for fresh atmospheric air

Why is 'electric calibration' carried out at 20.7Vol.% oxygen?

Literature specifies the oxygen content of atmospheric air to be 20.95Vol.%. This information only applies to dry air. However, the air present is often humid.

Using a temperature of 21°C and a relative humidity of 40%r.H., the oxygen concentration of the air is only 20.7Vol.%.

4.7 Diagnostic function

The oxygen measurement system can be operated with self-diagnosis if necessary.

4.8 Contaminants

Since the oxygen sensor contains zirconium dioxide and platinum, the following substances can damage it beyond repair:

Heavy metals	Phosphate ester
Sulphur compounds	Halogenated hydrocarbons (100 ppm and higher)
Silicon vapours	Chlorine
Fluorine	SF6
NH3 (1000 ppm and higher)	Carbons
Salts	long exposure to reduced atmosphere

Dust, vibration, dirt, moisture, oils, greases, boiler cleaners, heavy fuel, pyrolysis gases and silicon oxide shorten the life of the oxygen sensor. This list is not guaranteed to be complete.

5 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.

NOTICE

Storage information

Do not store substances containing silicone in the same room, or substances containing heavy metals or salt in the immediate vicinity of the oxygen measurement system, as these substances may damage the sensor beyond repair.

6 Service

The gas measurement system requires regular professional inspections and maintenance. Repairs to the gas measurement system must be performed by the manufacturer.

6.1 Maintenance 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.

Service intervals:

- Semi-annual measurement check.
- Five year replacement cycle

DANGER **Electrical voltage**

Electrocution hazard.

a) Disconnect the device from power supply.

b) Make sure that the equipment cannot be reconnected to mains unintentionally.

c) The device must be opened by trained staff only.

d) Regard correct mains voltage.

NOTICE

The oxygen measurement system is a safety device and must be repaired by the manufacturer. Do not alter or modify the oxygen measurement system. Gas concentration measurements may otherwise be unreliable.

DANGER **Risk of burns and fire**

The probe tube is hot (200°C). Wear safety gloves. Install a touch guard (perforated metal plate, not included) around the probe tube if it could accidentally be touched. Maintain a sufficient safety distance between the probe tube and flammable material.

Maintain a sufficient safety distance between the probe tube and flammable material. Have the oxygen measurement system and connecting cable professionally inspected (see) at least semi-annually, including the respective report. Always adjust service intervals to technical safety requirements! Check the measurement values (see) after every service interruption. If the measurement check fails and the system cannot be calibrated, contact the manufacturer or the dealer. After every error, conduct a measurement check, calibration, and, if possible, a functional test (see). Take appropriate measures to ensure the oxygen measurement system and its environment are always clean, accessible, and visible. Apart from this the oxygen measurement system is maintenance-free.

6.2 Probe or transmitter replacement

Replacing the probe rod and the transmitter requires manual calibration.

7 Service and repair

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

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

Please contact our Service Department with any questions:

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

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

Bühler Technologies GmbH

- Reparatur/Service -

Harkortstraße 29

40880 Ratingen

Germany

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

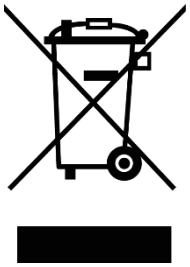
You will find the form in the appendix of these instructions, or simply request it by e-mail:

service@buehler-technologies.com.

8 Disposal

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

The crossed out 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.

9 Appendices

9.1 Technical Data

Transmitter		
Power supply	7-pin plug contact	IP 67 round plug
	Voltage / tolerance	24 V DC ± 20 %
	Output	< 13 W
Signal transmission	Up to 300 metre distance	For cables with 1.5 mm^2 strands
Connections	Pin 1	24 V DC
	Pin 2	0 V
	Pin 3	Sense
	Pin 4	Test
	Pin 5	K1 analogue output 4-20 mA
	Pin 6	K2 digital I/O impulse and error, electric calibration
	Pin 7	Functional earth
Transmitter ambient temperature	-20 °C to +60 °C	Please note sunlight!
Permissible humidity	5 to 95 % relative humidity	not condensed
Output	4-20 mA, max. burden 500 W	
Resolution	DAC resolution 12 bit	
Housing	Makrolon 8030 (30 % GV), UL94 V-1	red
Housing degree of protection	IP 65	
Housing weight	approx. 150 g	without rod sensor
Housing dimensions	approx. 105L x 42W x 62.3H mm	without rod sensor

Sensor/rod sensor	Full sinter	Internal sinter
Measuring ranges	0.1 – 25 Vol.% oxygen at 1013.25 hPa 1 – 253.31 hPa (O_2)	0.1 – 25 Vol.% oxygen at 1013.25 hPa 1 – 253.31 hPa (O_2)
Gas ingress	Via diffusion through full sinter or internal sinter	Via diffusion through full sinter or internal sinter
Heat-up time	approx. 10 min (at a flow rate of 0 m/s)	approx. 10 min (at a flow rate of 0 m/s)
Accuracy K1	±2% full scale at 25 °C and 1013.25 hPa	±2% full scale at 25 °C and 1013.25 hPa
Reproducibility K1	±1% full scale at 25 °C and 1013.25 hPa	±1% full scale at 25 °C and 1013.25 hPa
Temperature	up to +350°C	up to +350°C
Flue gas speed	up to 5 m/s	up to 5 m/s
Sensor degree of protection	IP40	IP40
Response times		
T20	10 s	15 s
T60	12 s	26 s
T90	18 s	50 s
T95	25 s	60 s
Probe length L1 (±4 mm)		
200 (350 °C)	197 mm	211.5 mm
Diameter	approx. 12 mm	approx. 12 mm
Material	Tube stainless steel 1.4301 Sinter stainless steel 1.4404	Tube stainless steel 1.4301 Sinter stainless steel 1.4404

10 Attached documents

– Declaration of Conformity KX550016
– 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

2014/30/EU (EMV/EMC)

in ihrer aktuellen Fassung entsprechen.

in its actual version.

Produkt / products: Zirkonium Sauerstoffanalysator / Circonia oxygen analyser
Typ / type: BA 1LT

Das Betriebsmittel dient zur Analyse des Sauerstoffanteils von Gasgemischen.
The equipment is for analysing the proportion of oxygen in gaseous mixtures.

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 50270:2015/AC:2016-08 **EN 61326-1:2013**

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

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

Ratingen, den 01.11.2022

Stefan Eschweiler
Geschäftsführer – *Managing Director*

Frank Pospiech
Geschäftsführer – *Managing Director*

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

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:

Electromagnetic Compatibility Regulations 2016

Product: Circonia oxygen analyser
Type: BA 1LT

The equipment is for analysing the proportion of oxygen in gaseous mixtures.

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

EN 50270:2015/AC:2016-08

EN 61326-1:2013

Ratingen in Germany, 01.11.2022

Stefan Eschweiler
Managing Director

Frank Pospiech
Managing Director

Bühler Technologies GmbH, Harkortstr. 29, D-40880 Ratingen,
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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.

Bühler Technologies GmbH, Harkortstr. 29, D-40880 Ratingen
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