BÜHLER TECHNOLOGIES

Gas Analysis

Particle monitor

BDA 02

Installation and Operation Instructions

Original instructions

BE08F001
06/2024

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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
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1 Introduction

1.1 Intended Use

The particle monitor is a highly sensitive system for continuous, triboelectric in situ filter monitoring. It monitors the quality of the exhaust gas.

The product outlined in this manual was developed, manufactured, inspected and documented in compliance with the relevant safety standards. When observing the handling instructions and safety information outlined for planning, installation, specified normal operation and service the device therefore normally poses no dangers with respect to property damage or to the personal health.

This device was manufactured to ensure protective separation of primary and secondary circuits. Connected extra-low voltages must also be generated through protective separation.

Proper and safe operation of this device further requires extremely appropriate transport, proper storage, set-up and installation, as well as careful operation and service.

WARNING

Risk of injury due to electric shock
This device is powered by electricity. Removing the housing or protection against contact will allow access to certain parts of the device which may have a dangerous voltage. The device must therefore only be modified by appropriately qualified personnel. This personnel must be thoroughly familiar with all hazard sources and repair measures as outlined in these operating instructions.

1.2 Scope of delivery

The respective scope of delivery according to the purchase agreement is specified in the shipping documents included with delivery. Verify the shipment is complete and intact. Keep the packaging material in the event of a return shipment.

The following components are standard on the BDA 02 particle monitor:

– 1 x Probe
– 1 x 1" welded sleeve with screw connection
– 1 x Product documentation

Optional accessories:

– Power supply (110/230 VAC in 24 VDC)

The technical design may vary depending on the configuration ordered.

1.3 Product description

1.3.1 Layout

The BDA 02 particle monitor consists of:

– 1 x In situ probe
– 1 x Welded sleeve

1.3.1.1 Probe

The particle monitor probe consists of a probe rod and a probe head. The probe rod is installed inside a sleeve and an insulating body, electrically insulated from the housing. This fully rotatable system is attached to the probe head.

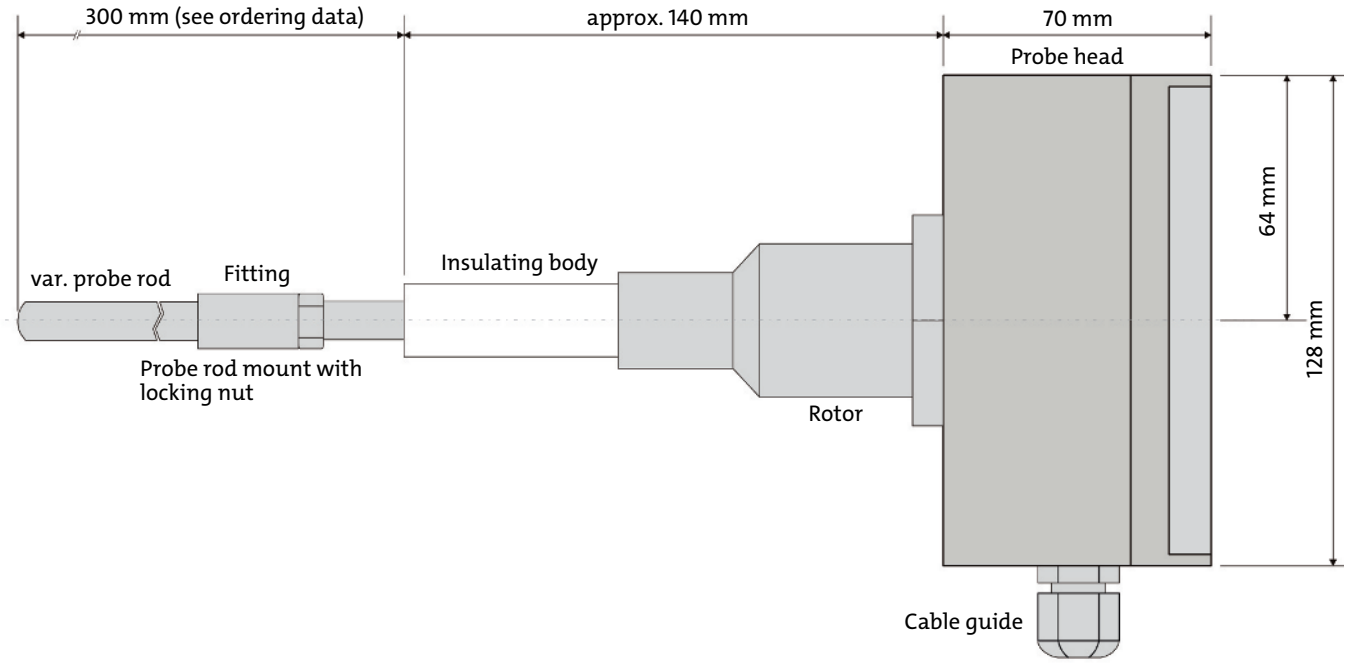


Fig. 1: BDA 02 side view

Depending on the order (varies by e.g. dust content, exhaust gas speed, ...) the probe rod cross-section may vary. Possible cross-sections are:

- Round profile
- Square profile
- Leaf profile

The probe rod must be adjusted to the incident sample gas flow during installation (see Fig. Incoming flow probe rod [> page 12]).

CAUTION

Risk of measuring errors and equipment malfunction

The probe rod is screwed to the probe at the factory. Unauthorised removal or modification prohibited.

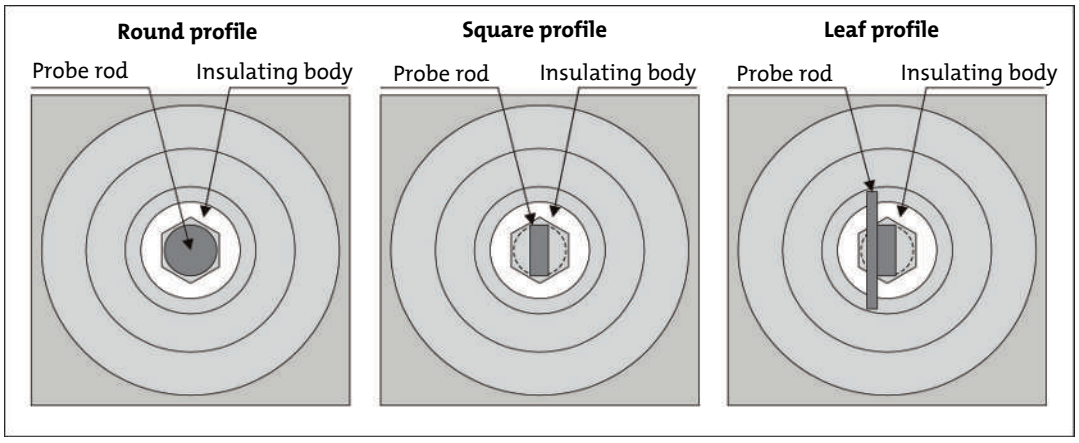


Fig. 2: Probe profiles

The control and display unit is built into the probe head. The high-quality display shows all measurements, statuses and parameters.

The keyboard is used to configure the display and adjust device-specific parameters.

The parameters will e.g. align the output signal with the real dust content (e.g. following gravimetric calibration).

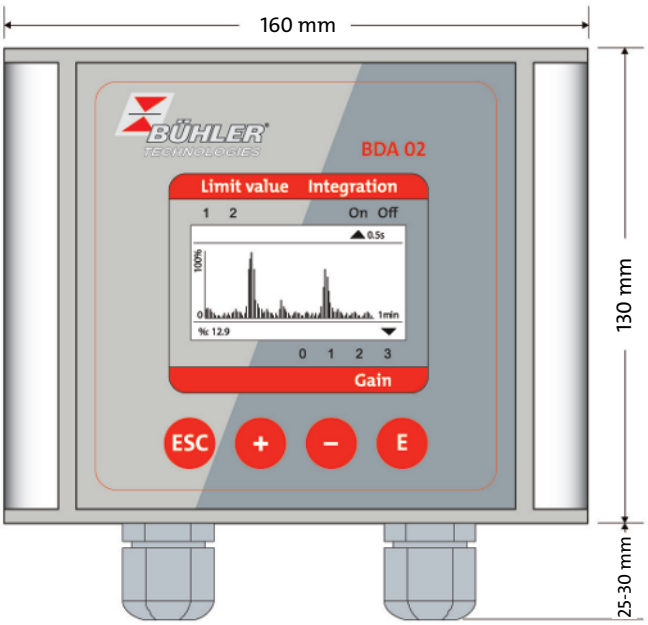


Fig. 3: BDA 02 control and display device

1.3.2 Function

The particle monitor is a highly sensitive system for continuous, triboelectric in situ filter monitoring. It monitors the quality of the exhaust gas.

The probe rod in the particle monitor triboelectrically measures the sample gas in the exhaust gas flow (see chapter "Principle of measurement").

The signal yielding from the stream conveyed measure of the dust content in the exhaust gas.

The microcontroller built into the control device generates a signal proportional to the dust. This is output as a 4 ... 20 mA signal. In addition, the display on the control device shows the current measurement and a line graph. The keypad is used to enter and adjust various parameters (e.g. related to the display).

1.3.2.1 Principle of measurement

Triboelectricity

When two objects are brought into contact through friction or touching, a crossing of electric charge results. The charge difference is produced by atoms exchanging atoms on the surfaces, forming a boundary layer with a positive and a negative surface charge with very close molecular spacing.

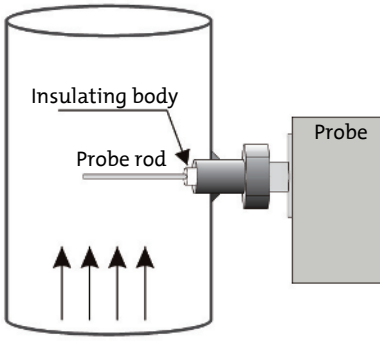


Fig. 4: Principle of measurement

The charge difference produced, also referred to as charge fluctuation, is the basis for dust counters based on the triboelectric principle, which uses the charge exchange between the sensor and circulating as well as impacting dust particles.

The triboelectric signal varies by the mechanical and electric properties of the dust.

$S \sim C_{i.B.}$

$C_{i.B.}$ = dust concentration [mg/m³]
S = triboelectric measurement signal
at a constant speed!

2 Safety instructions

2.1 Important notices

Operation of the device is only permitted 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.

Qualified personnel

Physical injury and/or damage to property may occur if the device is tampered with by unqualified personnel or if the warnings included in this manual or stated on the device are not observed. The device must therefore only be modified by appropriately qualified personnel. Qualified personnel within the meaning of the safety instructions in this manual or on the product itself are persons who are either

- project planning personnel familiar with the safety concepts of automation technology,
- operating personnel who have been instructed in the use of automation technology equipment and are familiar with the contents of this manual relating to operation,
- or commissioning and/or service personnel who have undergone training that enables them to repair such automation technology equipment or who are authorised to commission, ground and label circuits and devices/systems in accordance with safety technology standards.

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 include the following warnings:

 General warning sign	 General mandatory sign
 Voltage warning	 Unplug from mains
 Warning of hot surfaces	 Wear gloves

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.

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 **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.

2.3 Additional notices

WARNING **Risk of injury due to failure to observe the safety notices!**

Only use the measuring device in sound condition and under strict compliance with the safety notices.

- You must read and understand the complete operating instructions before using the BDA 02.
- The BDA 02 as a whole as well as the individual components may only be operated in the original state. When replacing elements, always use genuine manufacturer parts.
- Assemblies are configured specific to the device and are therefore not interchangeable between the different BDAs.
- Do not alter or modify the BDA 02.
- Only connect the BDA 02 particle monitor to supply voltage specified in the nameplate (standard: 24 V DC).
- Only operate the BDA 02 using a power supply with grounding receptacle. Do not use an extension cord without earth conductor, eliminating the protection. Any interruption in the earth conductor inside or outside the device is dangerous and prohibited.
- The BDA 02 must have a 2 A fuse on the input side.
- Before opening any equipment components, the particle monitor BDA 02 must be de-energise via the prefuse.
- Using the BDA 02 in explosive areas and measuring explosive gas mixtures is prohibited.
- Cables should be routed so as to prevent accident hazards due to tripping or getting caught.
- Probe parts may come into contact with hot sample gas and therefore possibly be very hot. Never touch these parts without heat resistant gloves or whilst live.

- Modifying the configuration of the BDA 02, i.e. adjusting parameters the user typically does not have access to may impact the safety and functionality of the filter monitor and are at your own risk! Therefore always have changes to the configuration performed by authorised service technicians or the manufacturer's factory staff.
- Covers on the BDA 02 may only be removed with the device de-energised.

WARNING

Risk of injury when lacking expertise

Installation, operation, service and any repairs must be performed by experts in compliance with the relevant regulations (Zentralverband der Elektrotechnik- und Elektroindustrie e. V.).

3 Transport and storage

Only transport the product inside the original packaging or a suitable alternative.

The equipment must be protected from moisture and heat when not in use. It must be stored in a covered, dry, dust-free room at room temperature.

4 Installation and connection

4.1 Installation site requirements

CAUTION

Risk of measuring errors

The installation site of the welded sleeve must be earthed. The welded sleeve must be included in the potential equalisation on site!

The installation location for the probe must meet the requirements local regulations (e.g. EN 13284-1) (for Germany VDI 2066 Sheet 1). When in doubt we recommend having a competent measuring institute determine the installation location (measurement point per §§ 26/28 Federal Immission Control Act). We recommend using an input and output path at least 5x the diameter of the exhaust gas channel.

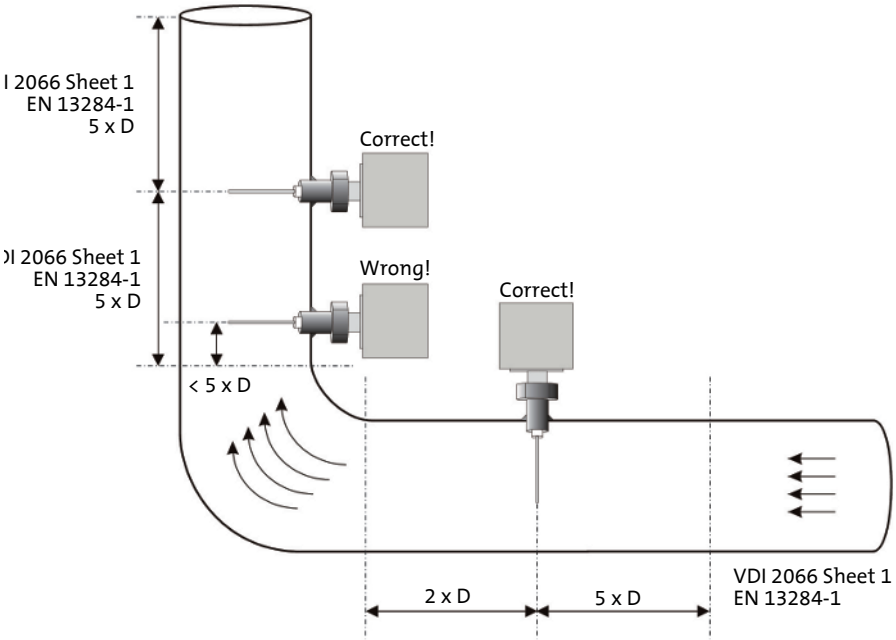


Fig. 5: Input and output path

Generally, note the dust distribution must be as homogeneous as possible for an adequate dust load survey across the channel cross-section.

4.2 Mounting

4.2.1 Installing the welded sleeve (thread)

Install the welded sleeve (thread) as shown . The probe is installed horizontally or vertically, from above.

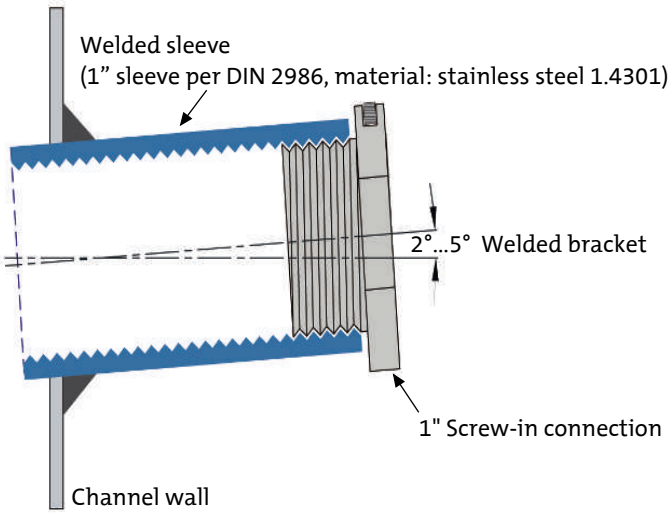


Fig. 6: Welded sleeve (thread)

4.2.2 Installing the probe

Depending on the type of installation, the probe is inserted into the welded sleeve and secured using the supplied hex key per Fig. Installation instructions [> page 13]. When installing, align the probe rod per Fig. Incoming flow probe rod [> page 12]. After fastening the probe by hex key, the probe head can be turned to adjust the orientation.

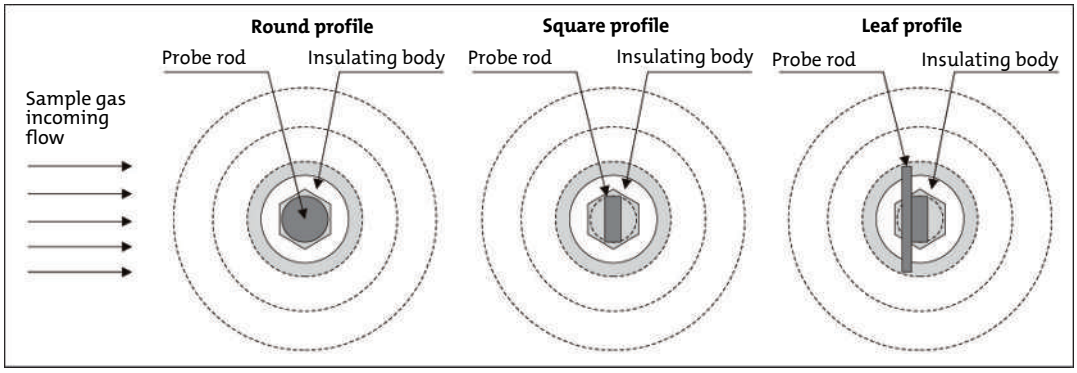


Fig. 7: Incoming flow probe rod

CAUTION

Risk of measuring errors due to weak signal

When using a square profile, please note the sample gas flow direction. The sample gas must flow toward the wide end of the probe rod.

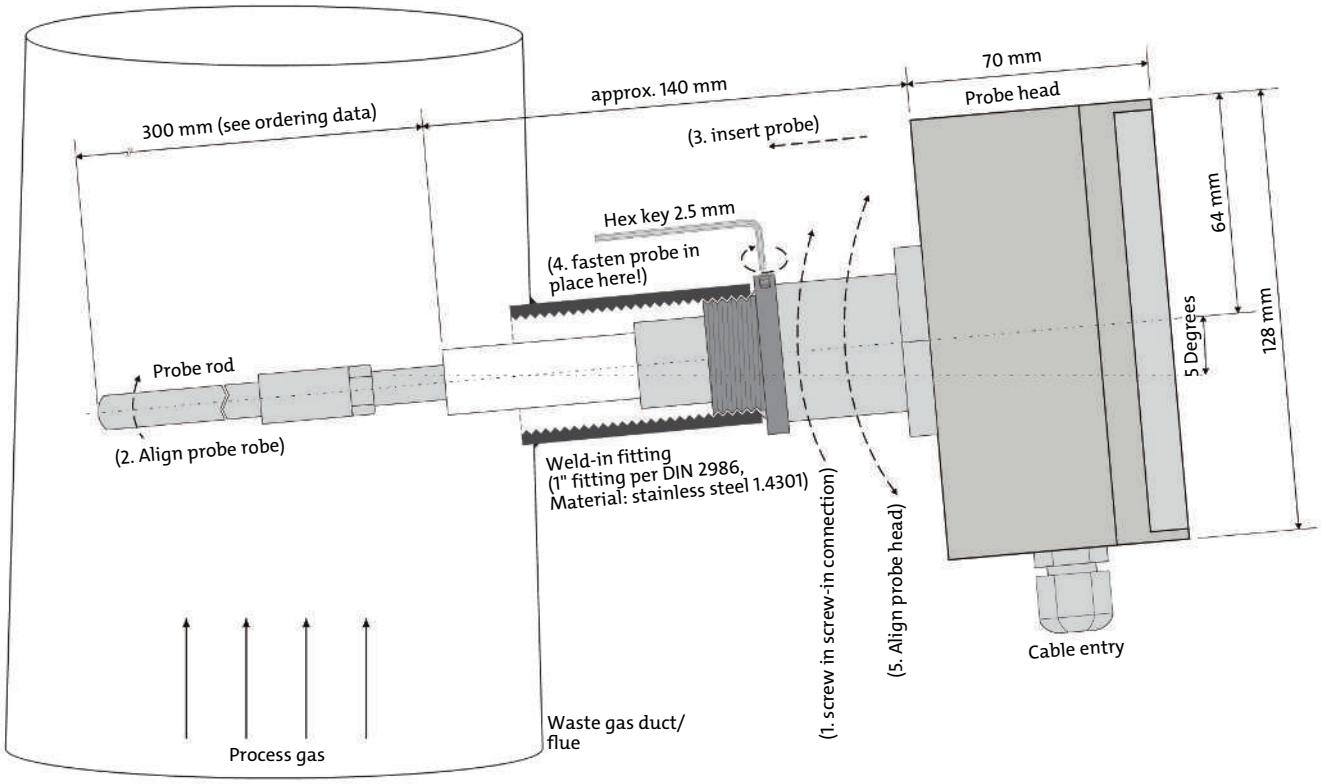


Fig. 8: Installation instructions

4.3 Electrical connections

The device's electrical connections are located inside the probe head. The terminals are located inside two terminal strips. These can be accessed after removing the cover. To do so, first remove the two trim pieces to the left and right of the keypad (lift off). Then loosen the 4 screws (the cover is protected from falling).

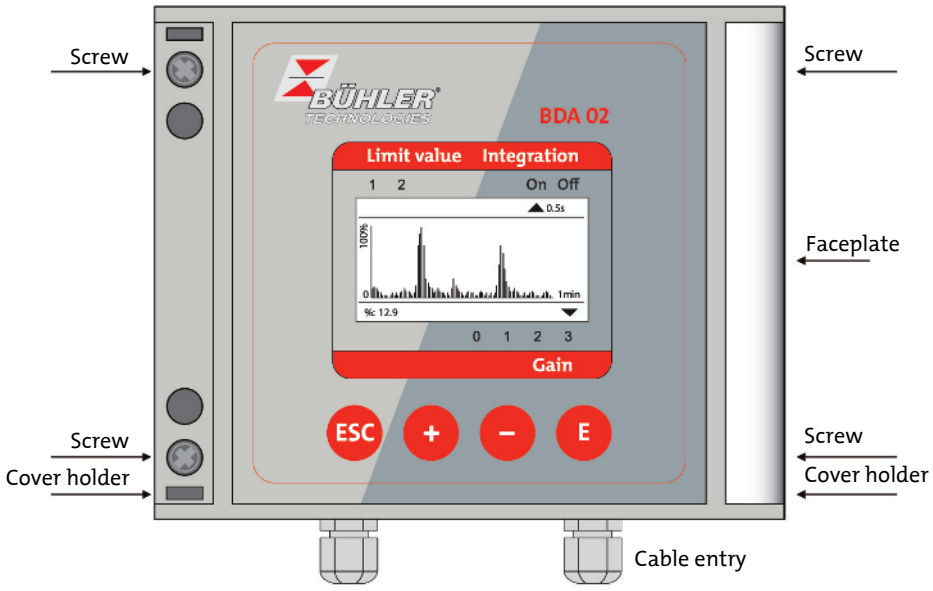


Fig. 9: Probe head

4.3.1 Operating voltage 24 V DC

The terminals are plug-in style. No special tools are required to connect the cables.

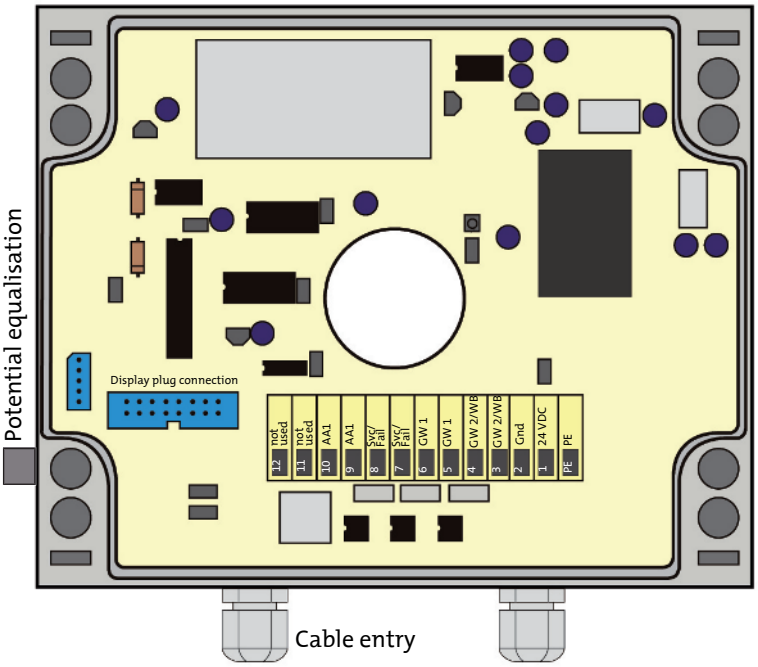


Fig. 10: Electrical connection 24 VDC

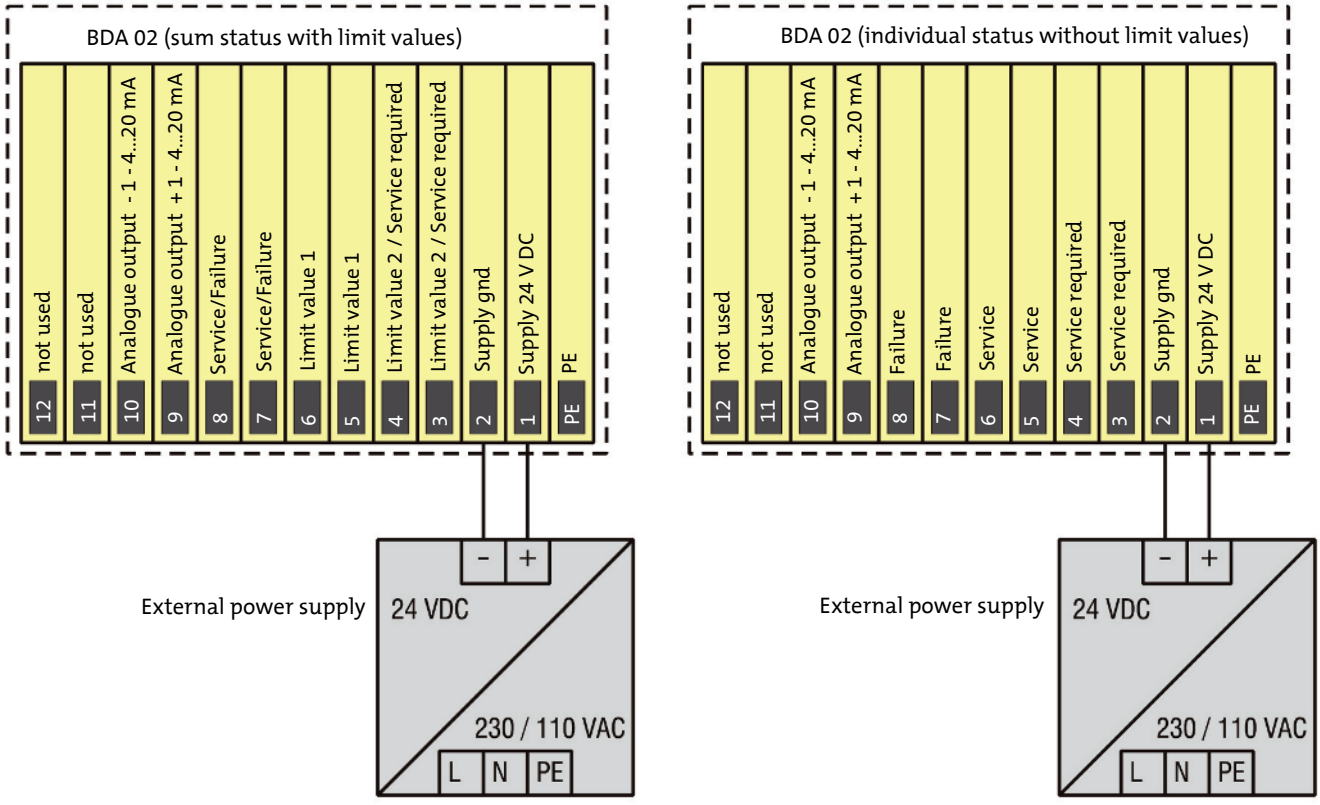


Fig. 11: Terminal strip: Input 24 VDC, status signals and analogue outputs

Connect the 24 V DC supply voltage to terminals 1 and 2. In addition, the shield or a potential equalisation may be connected to terminal PE.

NOTICE

Connecting a supply voltage other than 110 VAC or 230 VAC requires an optional power supply.

NOTICE

Terminals 11 and 12 are not occupied and remain free!

4.3.2 Operating voltage 230/110 V AC

The terminals are plug-in style. No special tools are required to connect the cables.

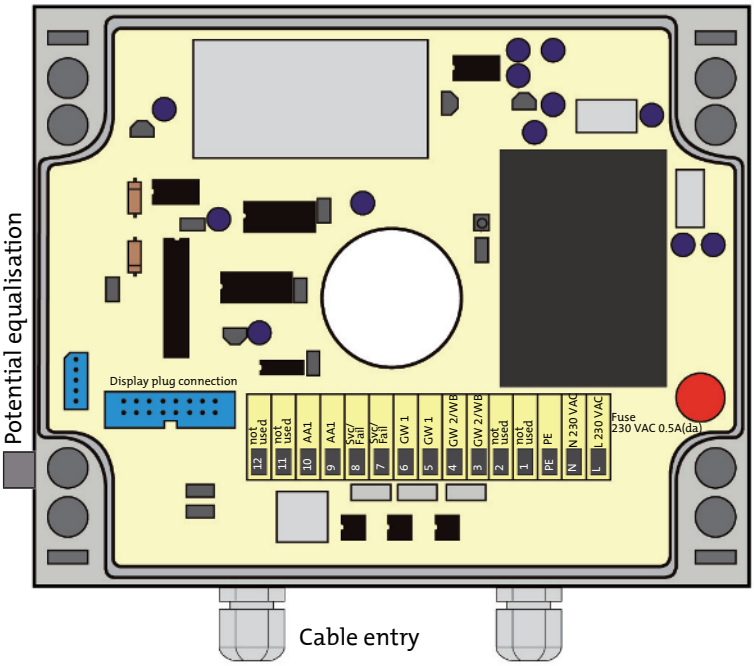


Fig. 12: Electrical connection 230/110 V AC

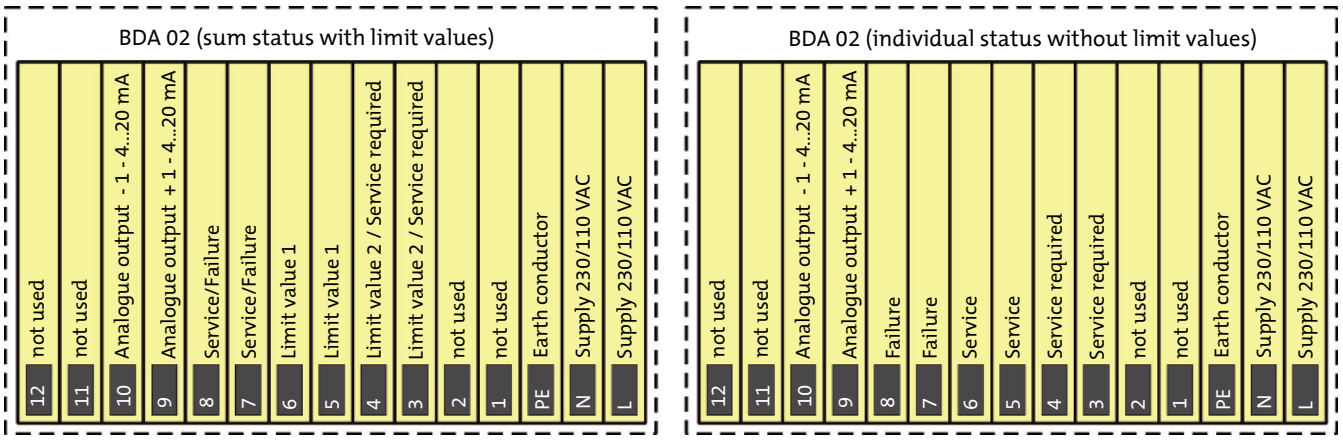


Fig. 13: Terminal strip: Input 230/110 V AC, status signals and analogue outputs

Connect the supply voltage 230/110 VAC to terminals L, N and PE.

NOTICE

Terminals 1 and 2 (24 V DC input) are not used on the 230/110 V AC version.

4.3.3 Status signals

The status signals are potential-free contacts. These can be output either as individual status signals or as sum status signals with limit values. You can switch between individual or sum status signals in the menu under chapter "Settings | Digital Contacts | Output Mode". The status signals output are:

Sum status signals with limit values

Signals	Contact Position
– Maintenance/failure see chapter "Error messages and troubleshooting"	– Normally closed, open during maintenance/failure
– Limit value 1	– Contact position variable (NC contact or NO contact)
– Limit value 2 / service required see chapter "Error messages and troubleshooting"	– Contact position variable (NC contact or NO contact)

Individual status signals without limits

Signals	Contact Position
– Failure see chapter "Error messages and troubleshooting"	– Normally closed, open on failure
– Service see chapter "Error messages and troubleshooting"	– Contact position variable (NC contact or NO contact)
– Service required see chapter "Error messages and troubleshooting"	– Contact position variable (NC contact or NO contact)

For the sum status signals with limit values applies:

Significance	Contact	
	Limit value 1	**Limit value 2**
Limit value 1	responded	not responded
Limit value 2	responded	responded
Maintenance request	not responded	responded
- resting state -	not responded	not responded

4.3.4 Analogue output

The Analogue output is a 4 ... 20 mA output. The following signal can be output:

Analogue output -> Dust in [%] or [mg/m³]

5 Operation and control

5.1 Initial operation

- Connect prefuse
- Check measurements for plausibility
- If necessary, adjust measuring ranges or amplification
- Calibrate device ⇒ Probe calibration (see chapter "Calibrating the device")
- If necessary, set limit values

5.1.1 set amplification level / gain

- Disable integration (see chapter "Settings | Integration").
- Set display mode to dust in [%] (be sure to first note the previous display mode and output range settings!) (see chapter "Settings | Output Mode").
- If possible, test all system statuses and select a device amplification so all measurements remain < 100 % of the displayed values.
- If necessary, adjust amplification level (see chapter "Settings | Amplification/Gain").
- Reactivate the integration, if desired (see chapter "Settings | Integration").
- If desired, switch the display mode (see chapter "Settings | Output Mode") back to dust in [mg/m³] and adjust the output range (see chapter "Settings | Output Ranges").

5.2 Display

The graphic display (128x64 Pixel) will show all the information required to operate the measuring device:

- Current measurement value (text and graphics mode)
- Line graph (trend only displayed in graphics mode)
- Current amplification
- Limit values overrun
- Measurement value integration

The display varies between text and graphics mode. Press the + button to switch between text and graphics mode.

5.2.1 Graphics mode

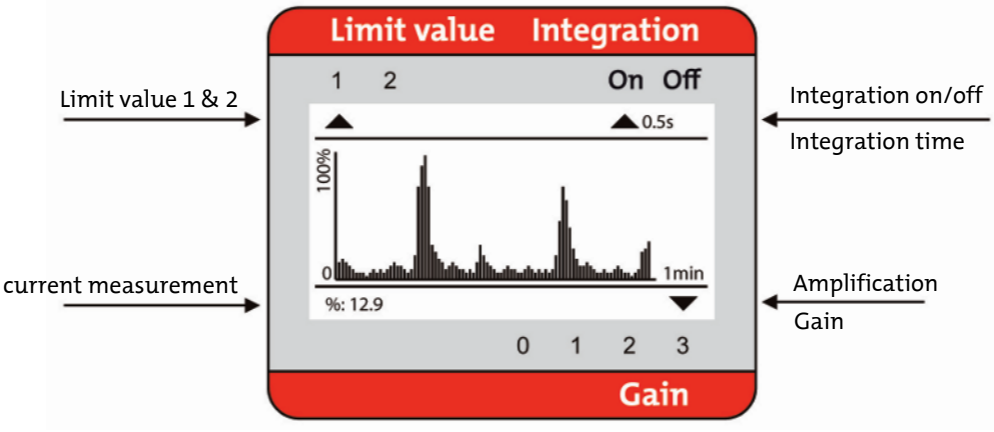


Fig. 14: Graphics mode display

Graphics mode will show the dust content of the exhaust gas as a line graph. It will show the measurements for the past 60 seconds.

The measurement can be displayed in % or mg/m³.

5.2.2 Text mode

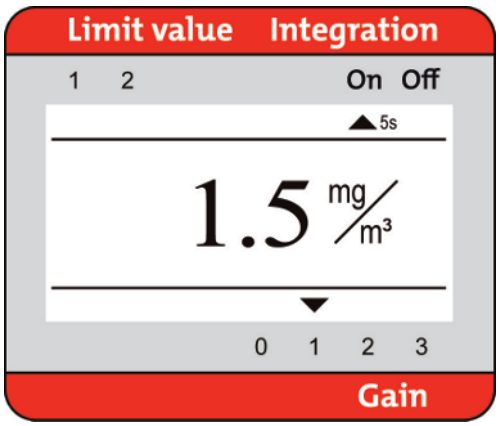


Fig. 15: Text mode display

Text mode will show the instant value of dust content in the exhaust gas as a numerical value. The measurement can be displayed and output in % or in mg/m³.

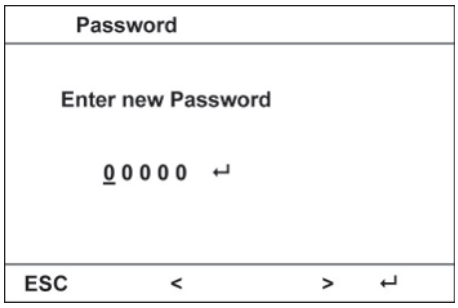
5.3 Operation

5.3.1 Keys

The device is controlled via the keys. The functions of the keys are:

ESC	**Escape**	Exit menu, delete entry
+	**Plus**	Increase value, move cursor to the left, switch mode, etc.
−	**Minus**	Reduce value, move cursor to the right, etc.
E	**Enter**	Select menu, apply value, save value, etc.

5.3.2 Numerical entry



Numerical entry, e.g. password:

- Use + or − to move the cursor to the respective digit.
- Use E to select the digit and + and − to set the desired value
- Use E to save the digit.
- Repeat these steps for the other digits
- Use + or − to move the cursor to ↵ and E to save.

5.4 Entering parameters

The device has a control and parametrisation level for entering specific parameters and for calibration. These can be accessed by entering the correct device password:

E	– Press enter correct password -> default: 00000
E	– press again parameter menu appears

Fig. 16: Password entry

5.5 Main menu

The **Main menu** allows you to select and edit device parameters. The parameters are divided into 5 submenus:

- Settings
- Calibrate
- Calibration parameters
- Errors
- Info

Select the respective submenus with the keys + and −.

Use E to open the selected submenu.

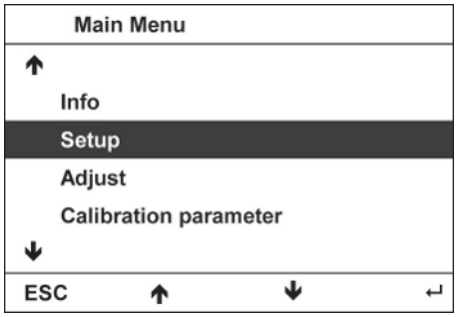


Fig. 17: Main menu

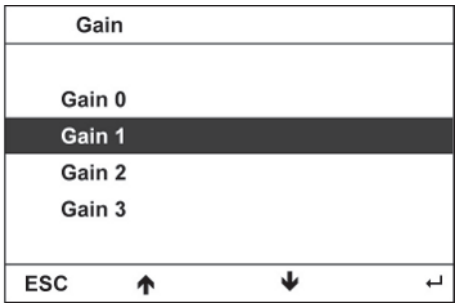
Select subitems the same way as the main menu.

5.5.1 Settings

Use menu item **Settings** to configure device-specific device-specific parameters:

- Amplification (gain)
- Integration on/off & integration time
- Output mode
- Output ranges
- Digital contacts
- Language
- Password

5.5.1.1 Settings | Amplification/Gain

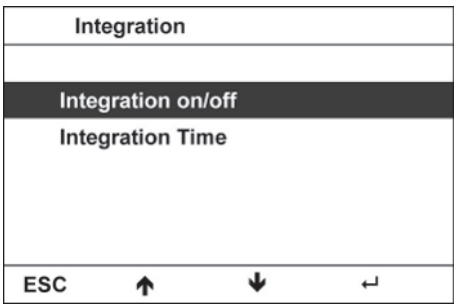


This menu is used to adjust the **Amplification** (gain) of the device's electronics. The set values are displayed in text or graphics mode.

Select the amplification via the dust content in the exhaust gas:

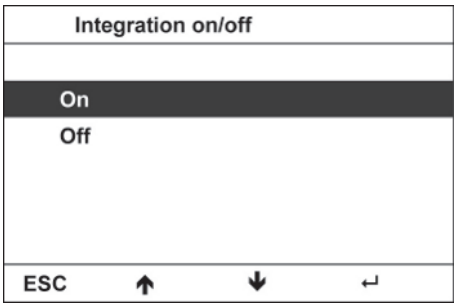
- Default: Gain 0
- High dust content: Amplification = 0 (low)
- Moderate dust content: Amplification = 1 or 2
- Low dust content: Amplification = 3 (high)

5.5.1.2 Settings | Integration



Use item **Integration on/off** to enable/disable measurement smoothing.

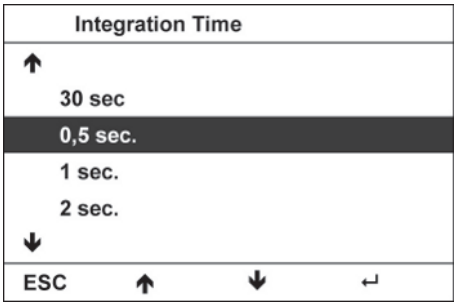
Use item **Integration time** to select the integration time span. This will continuously calculate average values from the measurements and output as a measurement value.



With **Integration** mode enabled the integration of measurements will be performed over the set integration span.

The **Integration** status is indicated at the top of the display (text and graphics mode).

- Default: Integration on



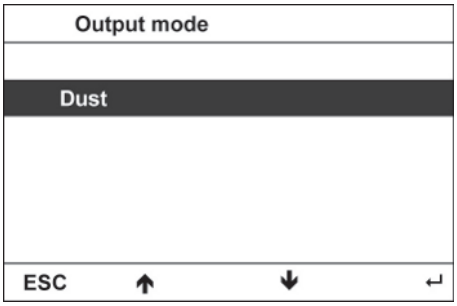
Select the **Integration time** span from 6 default settings:

0.5 – 1 – 2 – 5 – 10 – 30 seconds

The **Integration time** selected is indicated at the top of the display (text and graphics mode).

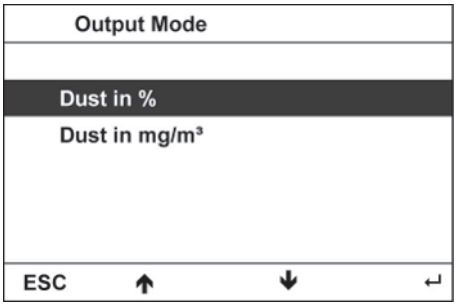
- Default: 2 seconds

5.5.1.3 Settings | Output Mode



The **Output Mode** determines the display and the analogue output for dust:

– Dust: in [%] or [mg/m³]



Dust can be displayed and output in % or mg/m³.

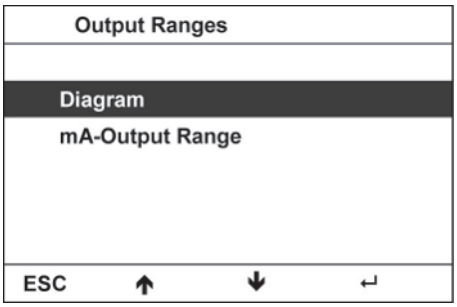
To display measurements in mg/m³ (please note chapter "Dust calibration"!).

– Default: Dust in [%]

NOTICE

The output mode selection applies to the display and the analogue output.

5.5.1.4 Settings | Output Ranges



The **Output ranges** determine the display and output ranges for the

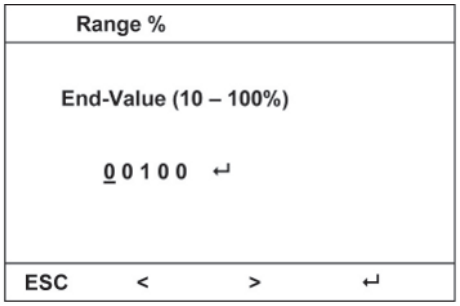
– display chart and

– the analogue output.

Here the ranges are set to % or mg/m³ depending on the selection under **Output Mode**.

The analogue output is configured as:

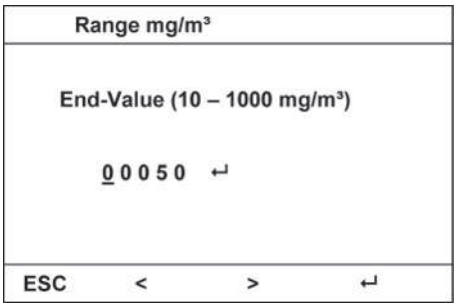
– mA output 1: Dust output



Example **Chart inputin [%]**

The end value for the chart range can set to any value within a range of 10 % ... 100 %.

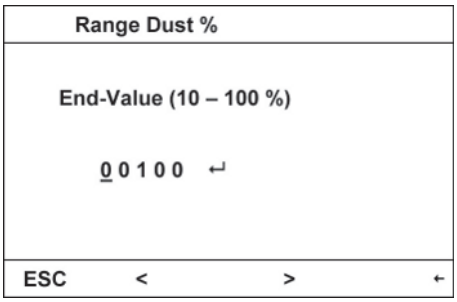
– Default: 100 %



Example **Chart input in [mg/m³]**

The end value for the chart range can be set to any value within a range of 10 ... 1,000 mg/m³.

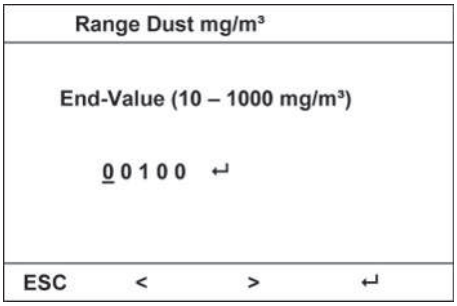
– Default: 50 mg/m³



Example: **mA output 1 input as dust content in [%]**

The end value for the measuring range can be set to any value within a range of 10 ... 100 %.

– Default: 100 %

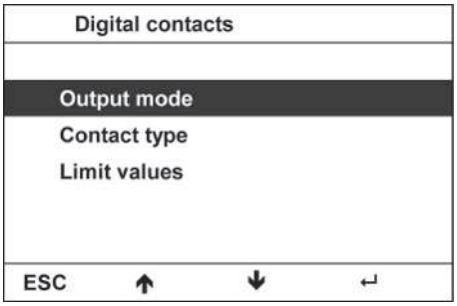


Example: **mA output 1 input as dust content in [mg/m³]**

The end value for the measuring range can be set to any value within a range of 10 ... 1,000 mg/m³.

– Default: 50 mg/m³

5.5.1.5 Settings | Digital Contacts

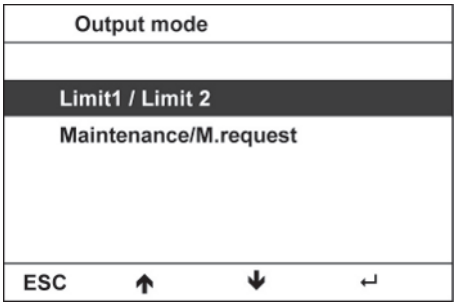


Output mode specifies how the status signal is output.

Contact type specifies the switching direction for the digital outputs for both limit values.

The **Limit values** determine at which measurement value the limit value is overrun.

5.5.1.5.1 Settings | Digital Contacts | Output Mode

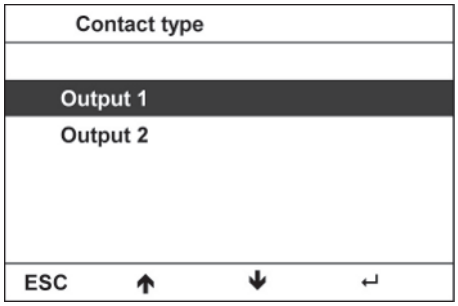


Output mode specifies how the status signal is output.

This is divided into

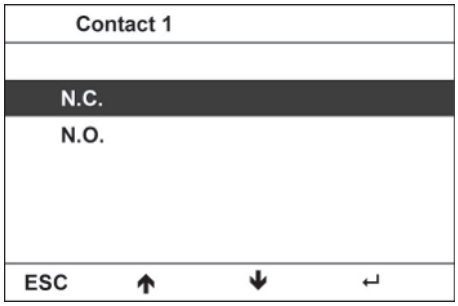
– **GW1 / GW2** sum status signals with limit values and
– **Service/Svc. required**individual status signals without limit values
– Default: GW1 / GW2

5.5.1.5.2 Settings | Digital Contacts | Contact Type



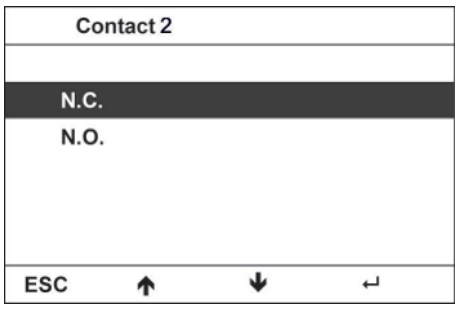
Contact type determines the switching direction for the digital outputs for limit value 1 and limit value 2 or service and service required. Select from:

– Normal closed
– Normal open



Example **Contact type contact 1** on sum status signal output

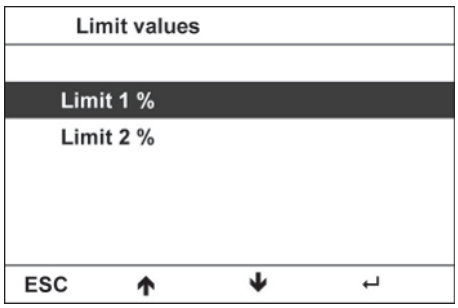
– Default: Normal closed



Example **Contact type contact 2** on sum status signal output

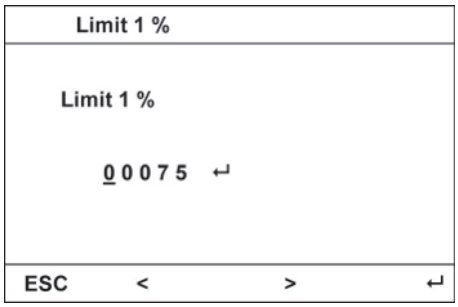
– Default: Normal closed

5.5.1.5.3 Settings | Digital Contacts | Limit Values



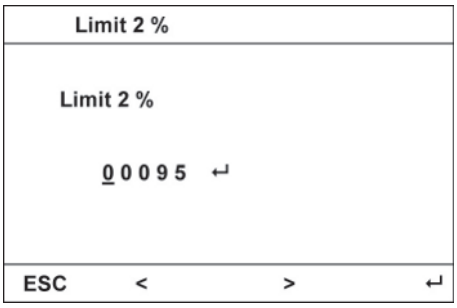
The **Limit values** determine at which measurement value the limit value is overrun. The top left of the display will indicate when a limit value is overrun (text and graphics mode) and the respective status contact opened.

Depending on the setting under **Output Mode** the limit values will be specified in % or mg/m³.



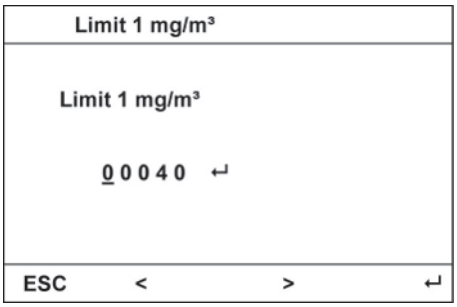
Example: Input **Limit value 1 in [%]**

– Default: 75 %



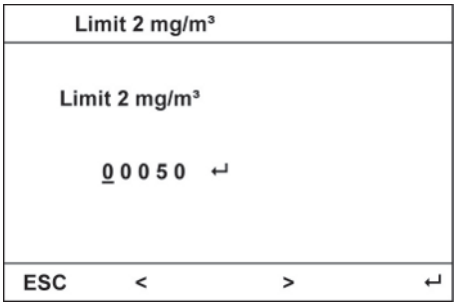
Example: Input **Limit value 2 in [%]**

– Default: 95 %



Example: Input **Limit value 1 in [mg/m³]**

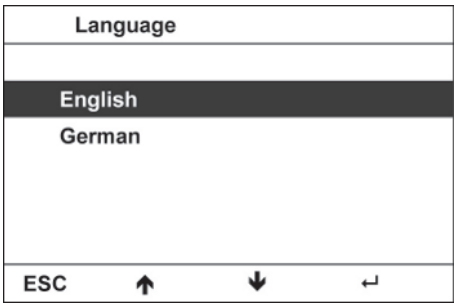
– Default: 40 mg/m³



Example: Input **Limit value 2 in [mg/m³]**

– Default: 50 mg/m³

5.5.1.6 Settings | Language

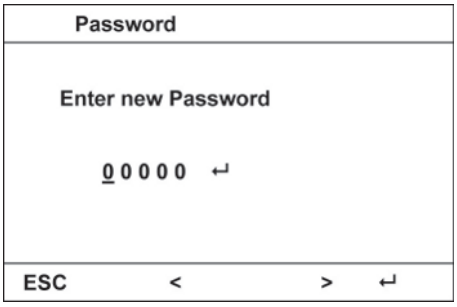


Use **Language** to select the menu and display language. The language options are:

– English

– Deutsch

5.5.1.7 Settings | Password



Use item **Password** to change the default password and protect the parameters from unauthorised changes.

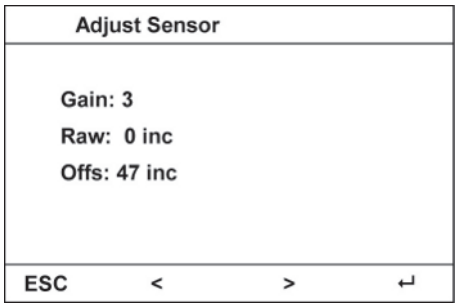
– Default: 00000

5.5.2 Calibrate

Use menu item **Calibration** to calibrate the triboelectric sensor as well as check the analogue output and the digital outputs:

– Calibrate sensor
– Check outputs

5.5.2.1 Calibration | Calibrate Sensor



Will start the internal device calibration. Here the electronics will be manually calibrated to the zero point. All 4 amplifications (gain 3, 2, 1 and 0) will be checked (see chapter "Calibrating the device").

Calibration:

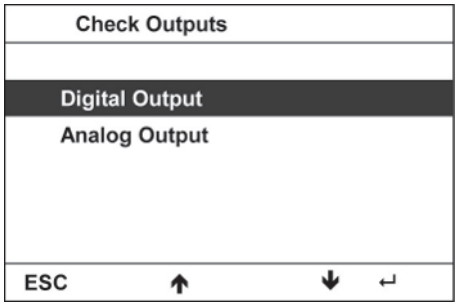
– Wait 5 seconds until **Raw** is steady.
– Use + and − to raise or lower the **Offs (Offset)** -> the **Raw** value will change!
– Use this to set the **Raw** value as close to **0** as possible.
– Use E to apply the value and switch to the next amplification (gain 3 to 0).

CAUTION

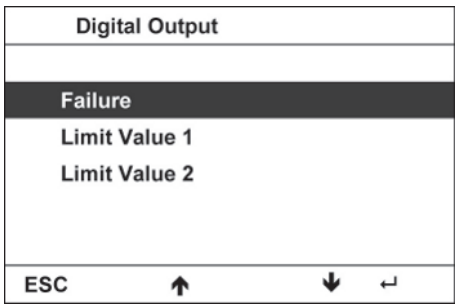
Risk of faulty calibration, therefore risk of measuring errors

The probe must be inside a zero tube to calibrate the device.

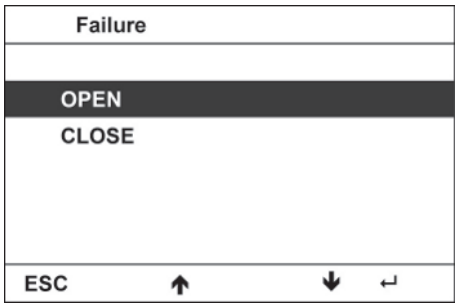
5.5.2.2 Calibration | Check Outputs



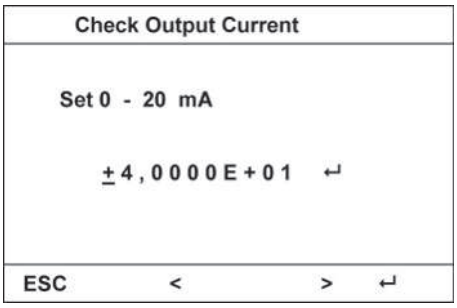
This will check the function of digital and analogue outputs.



The switching contacts on the digital outputs can be opened or closed individually.



Example: Digital output **Failure**



This item will check the **Analogue output**. The current value setting in mA is output at the analogue output (see chapter "Electrical Connection").

To output the individual current value at the analogue output, move the cursor to ↵ and press E.

5.5.3 Calibration parameters

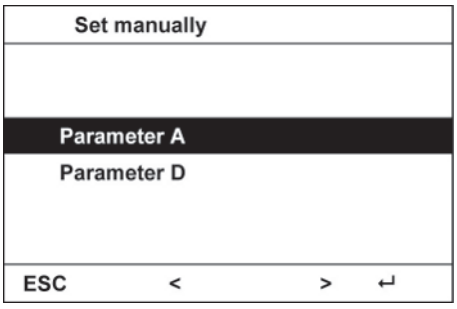
Use **Calibration parameters** to allocate a known medium to the exhaust gas to be measured. In addition, parameters from a gravimetric comparison measurement can be entered manually:

– Entering calibration parameters manually
– Target value input

5.5.3.1 Calibration Parameters | Manual Input

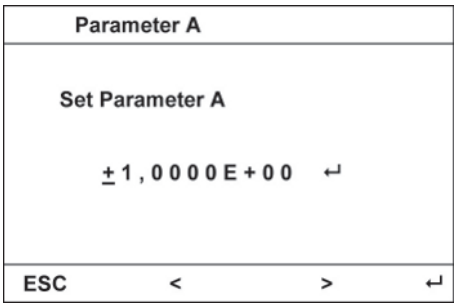
A gravimetric calibration is required for the measurement value displayed to precisely match the dust content. The parameters A and D determined and be entered under item **Manual Input**.

Selecting item **Manual input** will use the parameter inputs A to D to calculate the dust (see chapter "Dust calibration").



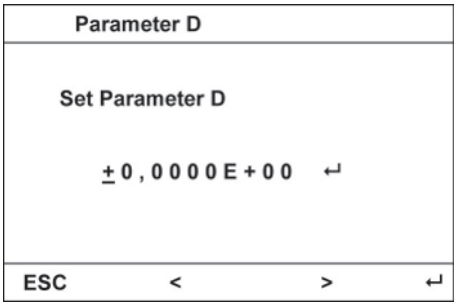
With **Manual input** selected, enter **parameter A and D** here (see chapter "Mathematical relationship").

Factory adjustment:
A = 1
D = 0



Example: Input **Parameter A**

– Default: A = 1

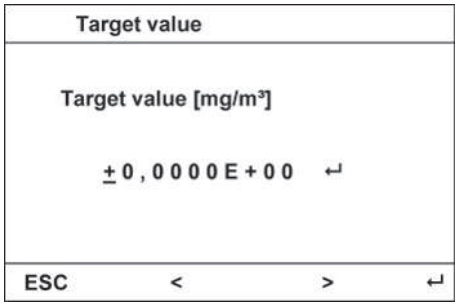


Example: Input **Parameter D**

– Default: D = 0

5.5.3.2 Calibration Parameters | Target Value

Entering the target value allows you to easily adjust the dust content displayed mg/m³ to the dust content in the sample gas flow. A known mean dust content average value is entered and the device will automatically calculate valid calibration parameters. The calculation uses the device's most recent 10 minute average value.



Target value calibration:

- Enter average dust content for the operating mode in [mg/m³]
- Wait for reading
- Finished

NOTICE

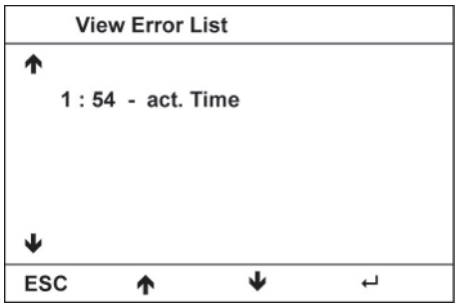
After restarting the target value calibration can only be used after 15 minutes.

5.5.4 Errors

Use menu item **Errors** to view and delete the last 15 errors:

- View error list
- Delete error list

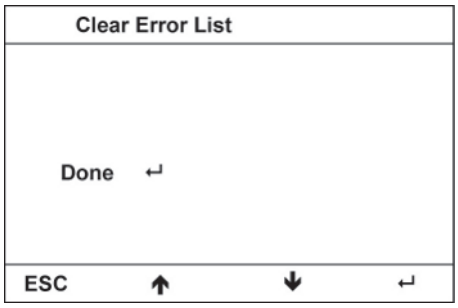
5.5.4.1 Errors | View Error List



All registered device errors are saved to the error list. The messages include a time stamp starting with the last start-up (hour:minute). The last 15 errors registered since the last start-up are output to the list.

- 1 : 54 – curr. time: Opens the error list 1h54 min after start-up

5.5.4.2 Errors | Delete Error List



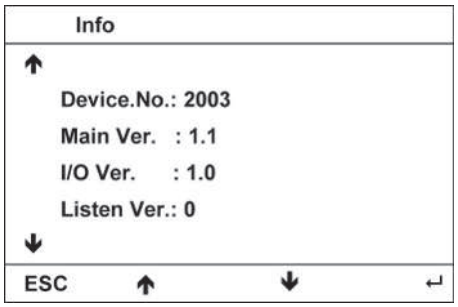
Will clear the error list.

Pressing the E button will clear the entire error list.

5.5.5 Info

Use menu item **Info** to view all device and software versions:

– Serial number
– Software versions



5.6 Shut-down

WARNING	**Risk of burns**
	The probe rod can become very hot due to the sample gas. a) Do not touch the probe rod. b) Wear safety gloves when handling the probe.

– Switch off prefuse

5.6.1 Removal

The probe can be removed as pictured. When doing so, first disconnect the power supply. Then loosen the screws and remove the probe.

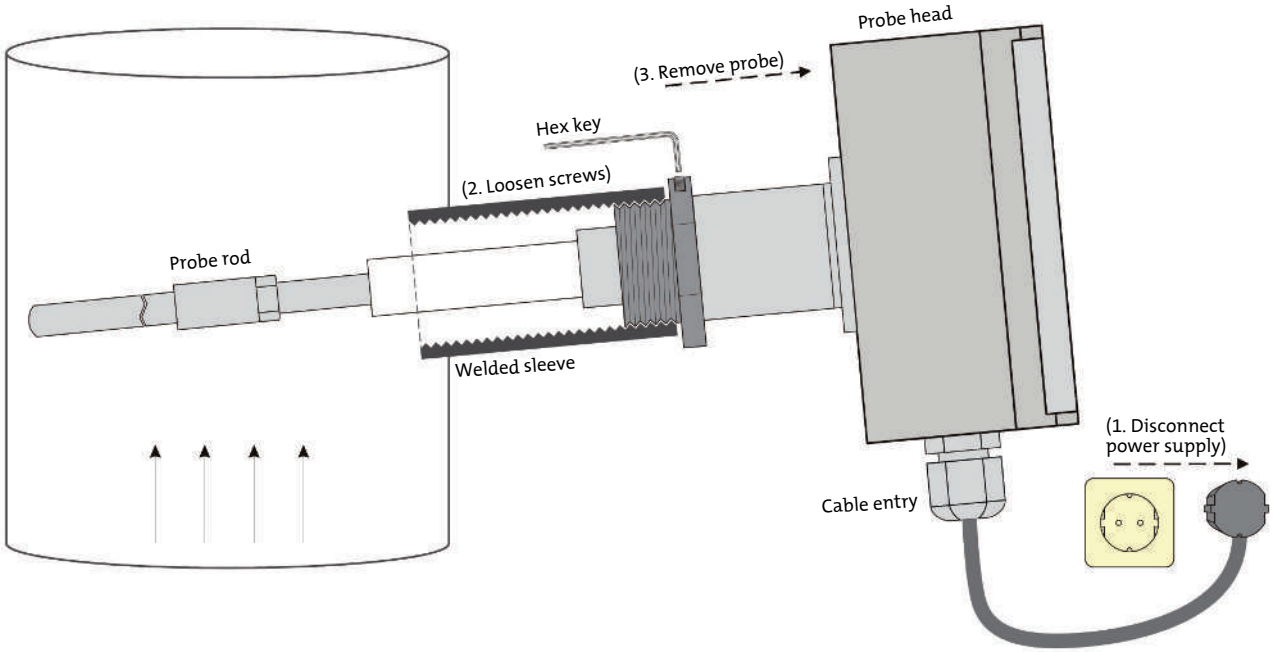


Fig. 18: Removal

5.7 Calibrating the device

As a highly sensitive measuring device, the particle monitor is affected by minimal fluctuations in the components and materials used. The device must therefore be calibrated to the zero point prior to initial use and after cleaning and alterations.

NOTICE

This calibration only affects the device's electronics, not the gravimetric calibration. This is at the customer's discretion.
The device is precalibrated on delivery.

5.7.1 Zero and reference point

The device continuously checks the zero and reference points for the electronics every 5 hours, starting from the last time it was switched on. Here the zero point during testing is 4 mA and the reference point is 15.2 mA.

NOTICE

During the cyclical zero and reference point check the switching contact is switched to service.

For deviations +/- 2 % (+/- 0.32 mA) from the zero or reference point the output will be Service required (see chapter "Service required").

For deviations +/- 4 % (+/- 0.64 mA) from the zero or reference point the output will be Failure (see chapter "Service/Failure").

5.7.2 Calibrating

A zero tube (see Fig. Particle monitor inside zero tube [> page 29]) is required to perform a calibration. This is an earthed metal tube with a probe connection (zero tube not included in delivery).

A suitable zero tube may be ordered from the manufacturer, Bühler Technologies GmbH.

- Install the particle monitor in the zero tube and connect.
- Perform a device calibration (see chapter "Calibration | Calibrating the Sensor").
- Switch off the particle monitor after calibrating.
- Install the particle monitor in the welded sleeve at the measuring point.
- Reconnect the particle monitor.

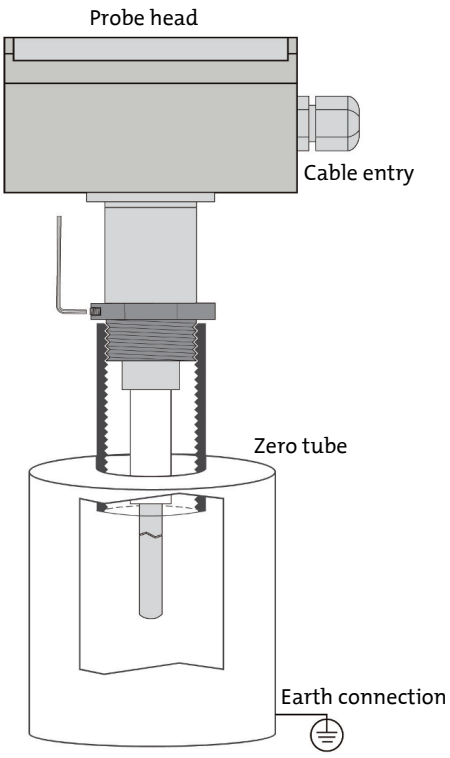


Fig. 19: Particle monitor inside zero tube

5.8 Dust calibration

Detecting measurements are subject to various factors based on the different technological conditions at the respective measuring points. Influencing factors which may change include the type of dust, gas speed and the temperature. The dusts to be measured for example vary in grain size, density, grain size, charge and other dust and gas properties. This results in a different output signal characteristic with respect to the dust content every time a particle monitor is used. It's therefore necessary to calibrate the signals with gravimetric comparison measurements (in Germany per VDI 2066 and VDI 3950). The calibration results, i.e. the parameters, can be entered directly and the particle monitor will output a signal proportional to the dust content.

NOTICE! The chapter addresses manual calibration – dust calibration – of the unit.

5.8.1 Mathematical relationship

The dust signal is calculated using the following mathematical relationship:

$$\text{Dust} = A\frac{(I-4)}{16}\cdot S_{max} + D$$

Dust	Dust content in [mg/m³]
S	Dust raw signal in [mg/m³]
A	Rise in calibration lines
D	Calibration line offset
I	Dust raw signal in [mA] (4 ... 20 mA)
G	Amplification factor in [mg/m³/%]
S_{max}	Conversion factor in [mg/m³/mA]

The dust raw signal S can be determined from dust raw signal I using the following chart:

Gain	G	S_{max}	Measuring range (with A = 1, D = 0)
3	1	100	0 ... 100 mg/m³
2	2.14	214	0 ... 214 mg/m³
1	3.46	346	0 ... 346 mg/m³
0	15	1500	0 ... 1500 mg/m³

Tab. 1: Conversion dust raw signal / gain

CAUTION

Risk of faulty calibration

In the above equation the current signal I at the device output must be set to operating mode [%] and for output range 0 ... 100 % to calculate A and D!

5.8.2 Calibrating

The device's analogue signal must be recorded with suitable data logging to perform a gravimetric calibration. In this case there are two scenarios:

- Recording analogue signal dust in [%]
- Recording analogue signal dust in [mg/m³]

NOTICE

Recording the dust signal in [mg/m³] will make the gravimetric calibration easier.

5.8.2.1 Dust in mg/m³

The following steps are recommended for a gravimetric calibration:

– Calibrating the probe electronics (see chapter "Calibrating the device").
– The following analogue output ranges are recommended for calibration (see chapter "Settings | Output Ranges"):

Gain	Output ranges
3	100
2	200
1	350
0	1000

– Perform a gravimetric dust calibration (in Germany, in the case of an official dust measurement this is performed by an approved test centre).
– Record analogue signal C_{iB} in [mg/m³] and form average values over the gravimetric comparison measurement period. The calibration parameters A and D must have the following calibration defaults:

A	1
D	0

– Determine parameter A and D from the correlation.
– Enter parameter A and D into the device (see chapter "Calibration parameters").

5.8.2.2 Dust in %

The following steps are recommended for a gravimetric calibration:

– Calibrating the probe electronics (see chapter "Calibrating the device").
– Perform a gravimetric dust calibration (in Germany, in the case of an official dust measurement this is performed by an approved test centre).
– Record Analogue signal C_{iB} in [%] and form average values over the gravimetric comparison measurement period. The calibration parameters A and D must have the following calibration defaults:

A	1
D	0

– We recommend setting the output range for the analogue output to 0 ... 100 % for calibration (see chapter "Settings | Output Ranges").
– Determine parameter A and D from the correlation.
– Enter parameter A and D into the device (see chapter "Calibration parameters").

6 Service

During maintenance, remember:

– The equipment must be maintained by a professional familiar with the safety requirements and risks.
– Only perform maintenance work described in these operating and installation instructions.
– Observe the respective safety regulations and operating specifications when performing any type of maintenance.
– Always use genuine spare parts.
– Service must be performed as instructed to have the device repaired under warranty.

The goal of service is:

– Maintaining the measuring accuracy of the device.
– Ensuring safe operation.
– Extending the life of the measuring device.

6.1 Service

Minimum interval	Work
6 months	Cleaning the probe

Tab. 2: Service

6.2 Cleaning

The particle monitor must be cleaned at a minimum every 6 months. The required cleaning frequency is based on the measuring point selected or the medium measured (particularly the dust content) and the environmental and climate conditions.

The following applies to any device cleaning:

WARNING	Risk of burns
	The probe rod can become very hot due to the sample gas. a) Switch off the device before cleaning. b) Allow the probe rod to cool down.

Depending on how dirty it is, the probe rod may be wiped down, brushed or cleaned with compressed air.

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

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.

7.1 Troubleshooting

The device outputs status signals to monitor, indicate errors and troubleshooting. These are output to the display and to the status contacts as potential-free contact. All errors are recorded in the error list in chronological order (see chapter "Errors").

7.1.1 Service required

The status Service required will be triggered by the following events:

Error message	Meaning	Action
Svc.req.	The zero or reference point deviated from the setpoint by +/- 2 % (see chapter "Zero and reference point").	– Calibrate the device, see chapter "Calibrating the device". – Delete error entry, see chapter "Errors".

Tab. 3: Error messages

7.1.2 Service/Failure

The status Service/failure will be triggered by the following events:

Error message	Meaning	Action
0 : 0 – curr. time	Current device time (resets to 0 : 0 upon startup) – no error, message only.	– none
Restart	Device start-up time - no error, message only.	– none
Comm. TO	Internal timeout during communication – service required.	– Check the cable connection inside the device. – Notify service
Comm. R	Internal transmission error during communication – service required	– Check the cable connection inside the device – Notify service
Comm. W	Internal reception error during communication – service required	– Check the cable connection inside the device – Notify service
Zero pt.	The zero point deviated from the setpoint by +/-4 % during auto check (see chapter "Zero and reference point").	– Calibrate the device, see chapter "Calibrating the device". – Delete error entry, see chapter "Errors | Clear Error List".
Ref.Pt.	The reference deviated from the setpoint by +/-4 % during auto check (see chapter "Zero and reference point").	– Calibrate the device, see chapter "Calibrating the device". – Delete error entry, see chapter "Errors | Clear Error List".
5-hour zero and reference point check	The device's zero and reference point are being checked	– none

Tab. 4: Error messages

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

Technical data	
Housing:	Compact unit (integrated control unit); IP65, protection class 1
Dimensions:	Standard approx. 160 mm x 160 mm x 510 mm (B x H x T)
Weight:	approx. 2,5 kg
Probe:	triboelectric probe consisting of probe rod and probe head
Probe rod:	electrically insulated from housing, standard length: 300 mm (other lengths on request); optionally round, square or leaf profile;
Probe material:	Stainless steel 1.4301 (isolator PTFE)
Immersion depth:	application-dependent
Display/operation:	Graphic display (128 x 64 pixels), 4 control keys
Ambient temperature:	-20...+50 °C
Relative humidity:	not particularly sensitive
Dew point difference:	min. +5 K
Sample gas temperature:	max. 280 °C (higher temperatures on request)
Flow rate:	from approx. 3 m/s
Dust measuring range:	qualitative: 0...100 %; quantitative: 0...10 mg/m³ (0...1000 mg/m³)
Amplification levels:	4
Operational readiness:	after approx. 3 min
Calibration:	by gravimetric comparative measurements (not required for trend measurements and filter analyses)
Analogue output:	4...20 mA, galvanically isolated from equipment earth, max. load impedance 500 Ω
Digital outputs:	Status signals max. 24 V DC at 0.1 A (for faults, maintenance, maintenance needs, Limit Value 1 and 2); power rating: max. 60 Vp, max. 75 mA; on-state resistance: max. 10 Ω
Process connection:	1“ welded sleeve
Cable fitting:	2x M20 x 1,5 / 9...13 mm
Power supply:	230/110 V AC, 50-60 Hz, 24 V DC, 3 VA

9.2 Menu Navigation

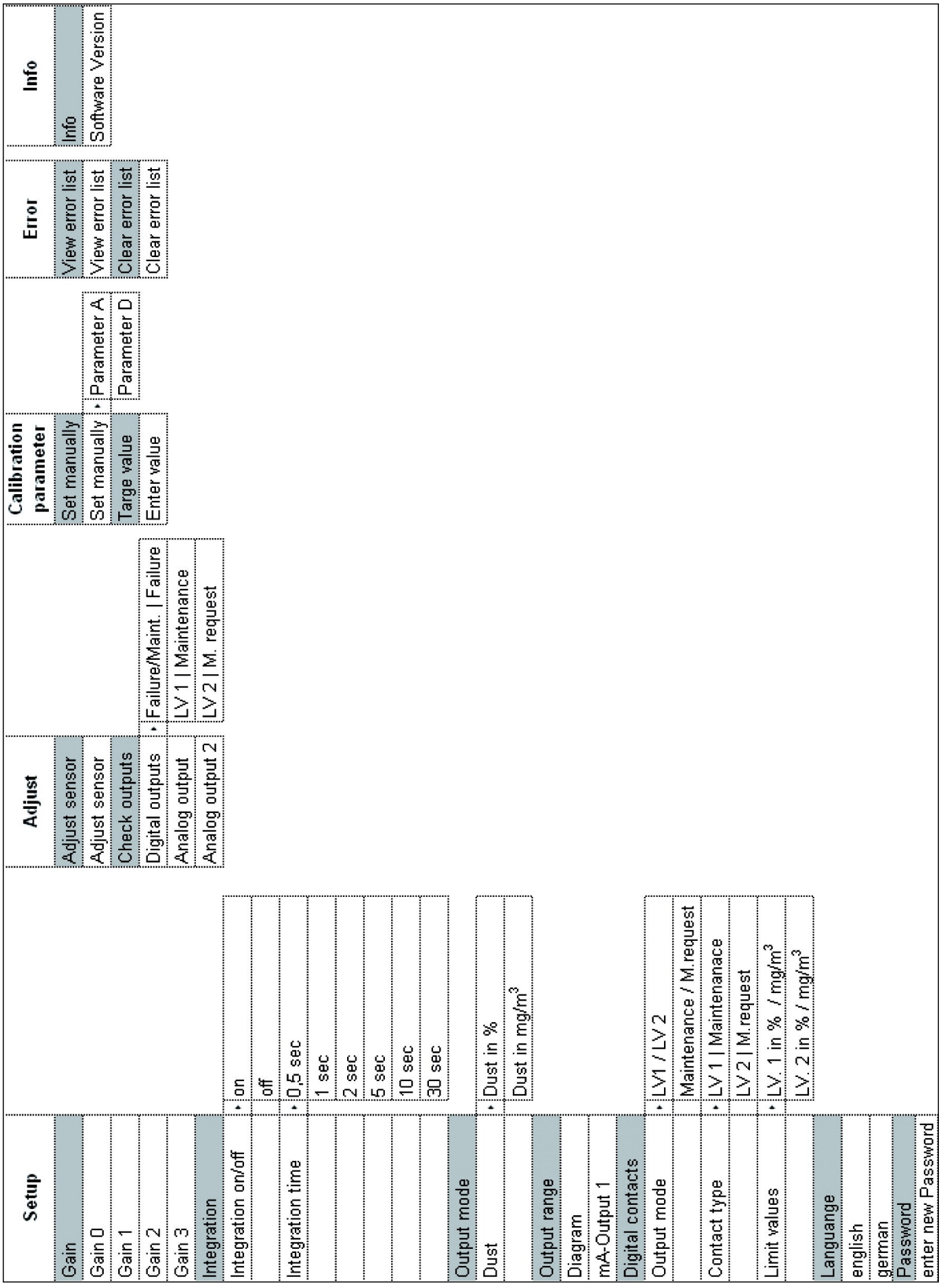


Fig. 20: Menu navigation

10 Attached documents BDA 02

– Declaration of Conformity KX08F001
– 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 Richtlinie wurde berücksichtigt:

The following directive was regarded:

2014/30/EU (EMV/EMC)

Produkt / products: Partikelmonitor / *Particle monitor*
Typ / type: BDA 02

Das Betriebsmittel dient der Überwachung von Filtern und Abscheidern in normal feuchten nicht kondensierenden Abgasen/Prozessen.
The equipment is designed for monitoring filtration systems in usually humid but non-condensing flue gases/processes.

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

EN 61000-6-4:2011
EN 61000-6-2:2005/AC:2005
EN 61010-1:2010/A1:2019/AC:2019-04
EN 61326-1:2013
EN 55011:2009 + A1:2010

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

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

Ratingen, den 17.02.2023

Stefan Eschweiler
Geschäftsführer – *Managing Director*

Frank Pospiech
Geschäftsführer – *Managing Director*

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:

Electrical Equipment Safety Regulations 2016

The following legislation were regarded:

Electromagnetic Compatibility Regulations 2016

Product: Particle monitor
Type: BDA 02

The equipment is designed for monitoring filtration systems in usually humid but non-condensing flue gases/processes.

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 61000-6-4:2011
EN 61326-1:2013

EN 55011:2009 + A1:2010
EN 61000-6-2:2005/AC:2005

Ratingen in Germany, 17.02.2023

Stefan Eschweiler
Managing Director

Frank Pospiech
Managing Director

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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

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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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