Particle monitor

BDA 02

Installation and Operation Instructions

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

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Document information
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Version............................................................ 11/2017
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**

Dangerous voltage

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 11]).

**CAUTION** Risk of measuring errors and equipment malfunction

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

Fig. 2: Probe profiles
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.

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 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
- General information
- Warns of voltage
- Unplug from mains
- Warns 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.
Maintenance, Repair

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

Always observe the applicable safety and operating regulations in the respective country of use when performing any type of maintenance.

DANGER

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 and flue gas 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 and secured inside the sleeve or the flange per Fig. Installation instructions [page 12]. When installing, align the probe rod per Fig. Incoming flow probe rod [page 11]. After fastening the probe by hex key, the probe head can be turned to adjust the orientation.

CAUTION
Risk of measuring errors due to weak signal
When using a square or leaf profile, please note the sample gas flow direction. The sample gas must flow toward the wide end of the probe rod.
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).
### 4.3.1 Operating voltage 24 V DC

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

![Diagram](image)

**Fig. 10: Electrical connection 24 VDC**

<table>
<thead>
<tr>
<th>Terminal</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>12</td>
<td>not used</td>
</tr>
<tr>
<td>11</td>
<td>not used</td>
</tr>
<tr>
<td>10</td>
<td>Analogue output 1 - 4.20 mA -</td>
</tr>
<tr>
<td>9</td>
<td>Limit value 1</td>
</tr>
<tr>
<td>8</td>
<td>Limit value 1</td>
</tr>
<tr>
<td>7</td>
<td>Service/Failure</td>
</tr>
<tr>
<td>6</td>
<td>Supply grid</td>
</tr>
<tr>
<td>5</td>
<td>Supply 24 V DC</td>
</tr>
<tr>
<td>4</td>
<td>PE</td>
</tr>
</tbody>
</table>

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

Terminals 11 and 12 are not used 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](image1)

![Fig. 13: Terminal strip: Input 230/110 V AC, status signals and analogue outputs](image2)

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

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

<table>
<thead>
<tr>
<th>Signals</th>
<th>Contact Position</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maintenance/failure</td>
<td>– Normally closed, open during maintenance/failure</td>
</tr>
<tr>
<td>see chapter &quot;Error messages and troubleshooting&quot;</td>
<td></td>
</tr>
<tr>
<td>Limit value 1</td>
<td>– Contact position variable</td>
</tr>
<tr>
<td></td>
<td>(NC contact or NO contact)</td>
</tr>
<tr>
<td>Limit value 2 / service required</td>
<td>– Contact position variable</td>
</tr>
<tr>
<td>see chapter &quot;Error messages and troubleshooting&quot;</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(NC contact or NO contact)</td>
</tr>
</tbody>
</table>

### Individual status signals without limits

<table>
<thead>
<tr>
<th>Signals</th>
<th>Contact Position</th>
</tr>
</thead>
<tbody>
<tr>
<td>Failure</td>
<td>– Normally closed, open on failure</td>
</tr>
<tr>
<td>see chapter &quot;Error messages and troubleshooting&quot;</td>
<td></td>
</tr>
<tr>
<td>Service</td>
<td>– Contact position variable</td>
</tr>
<tr>
<td>see chapter &quot;Error messages and troubleshooting&quot;</td>
<td></td>
</tr>
<tr>
<td>Service required</td>
<td>– Contact position variable</td>
</tr>
<tr>
<td>see chapter &quot;Error messages and troubleshooting&quot;</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(NC contact or NO contact)</td>
</tr>
</tbody>
</table>

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

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:

<table>
<thead>
<tr>
<th>Key</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>ESC</td>
<td>Escape</td>
</tr>
<tr>
<td>+</td>
<td>Plus</td>
</tr>
<tr>
<td>−</td>
<td>Minus</td>
</tr>
<tr>
<td>E</td>
<td>Enter</td>
</tr>
</tbody>
</table>

**ESC**  Exit menu, delete entry

**Plus**  Increase value, move cursor to the left, switch mode, etc.

**Minus**  Reduce value, move cursor to the right, etc.

**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:

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

---

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  to open the selected submenu.

---

Select subitems the same way as the main menu.
5.5.1 Settings

Use menu item Settings to configure 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 input [%]**
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

<table>
<thead>
<tr>
<th>Contact type</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Output 1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Output 2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ESC</td>
<td>⬆</td>
<td>⬇</td>
<td>⬣</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Adjust Sensor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gain: 3</td>
</tr>
<tr>
<td>Raw: 0 inc</td>
</tr>
<tr>
<td>Offs: 47 inc</td>
</tr>
</tbody>
</table>

**ESC** ← → ⏯

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 ⏯ 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

<table>
<thead>
<tr>
<th>Check Outputs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Digital Output</td>
</tr>
<tr>
<td>Analog Output</td>
</tr>
</tbody>
</table>

**ESC** ↑ ↓ ⏯

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 E to calculate the dust (see chapter "Dust calibration").

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

---

<table>
<thead>
<tr>
<th>Set manually</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter A</td>
</tr>
<tr>
<td>Parameter D</td>
</tr>
</tbody>
</table>

Example: Input **Parameter A**

- Default: A = 1

---

<table>
<thead>
<tr>
<th>Set Parameter A</th>
</tr>
</thead>
<tbody>
<tr>
<td>± 1,0000E+00</td>
</tr>
</tbody>
</table>

Example: Input **Parameter D**

- Default: D = 0

---

<table>
<thead>
<tr>
<th>Set Parameter D</th>
</tr>
</thead>
<tbody>
<tr>
<td>± 0,0000E+00</td>
</tr>
</tbody>
</table>

| ESC | < | > | ↓ |
5.5.3.2 Calibration Parameters | Target Value

Entering the target value allows you to easily adjust the dust content displayed \( \text{mg/m}^3 \) 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 \( \text{[mg/m}^3 \) ]
- 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 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

<table>
<thead>
<tr>
<th>Info</th>
</tr>
</thead>
<tbody>
<tr>
<td>Device.No.: 2003</td>
</tr>
<tr>
<td>Main Ver.  : 1.1</td>
</tr>
<tr>
<td>I/O Ver.   : 1.0</td>
</tr>
<tr>
<td>Listen Ver.: 0</td>
</tr>
</tbody>
</table>

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.

![Removal Diagram]

*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 output will be 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*) 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.

![Particle monitor inside zero tube](image-url)
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:

\[ \text{Dust} = \frac{\text{Dust}}{16} \times \text{S}_{\text{max}} + \text{D} \]

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_{\text{max}} | Conversion factor in [mg/m³/mA]

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

<table>
<thead>
<tr>
<th>Gain</th>
<th>G</th>
<th>( S_{\text{max}} )</th>
<th>Measuring range (with ( A = 1, D = 0 ))</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>1</td>
<td>100</td>
<td>0 ... 100 mg/m³</td>
</tr>
<tr>
<td>2</td>
<td>2.14</td>
<td>214</td>
<td>0 ... 214 mg/m³</td>
</tr>
<tr>
<td>1</td>
<td>3.46</td>
<td>346</td>
<td>0 ... 346 mg/m³</td>
</tr>
<tr>
<td>0</td>
<td>15</td>
<td>1500</td>
<td>0 ... 1500 mg/m³</td>
</tr>
</tbody>
</table>

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"):  

<table>
<thead>
<tr>
<th>Gain</th>
<th>Output ranges</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>100</td>
</tr>
<tr>
<td>2</td>
<td>200</td>
</tr>
<tr>
<td>1</td>
<td>300</td>
</tr>
<tr>
<td>0</td>
<td>1000</td>
</tr>
</tbody>
</table>

– 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 Cᵢ 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:

<table>
<thead>
<tr>
<th>A</th>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td>D</td>
<td>0</td>
</tr>
</tbody>
</table>

– 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 Cᵢ in [%] and form average values over the gravimetric comparison measurement period. The calibration parameters A and D must have the following calibration defaults:

<table>
<thead>
<tr>
<th>A</th>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td>D</td>
<td>0</td>
</tr>
</tbody>
</table>

– 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.
- When performing maintenance of any type, observe the respective safety and operation regulations.
- 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

<table>
<thead>
<tr>
<th>Minimum interval</th>
<th>Work</th>
</tr>
</thead>
<tbody>
<tr>
<td>6 months</td>
<td>Cleaning the probe</td>
</tr>
</tbody>
</table>

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

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 attached 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:

<table>
<thead>
<tr>
<th>Error message</th>
<th>Meaning</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Svc.req.</td>
<td>The zero or reference point deviated from the setpoint by +/- 2 % (see chapter &quot;Zero and reference point&quot;).</td>
<td>– Calibrate the device, see chapter “Calibrating the device”. – Delete error entry, see chapter “Errors”.</td>
</tr>
</tbody>
</table>

Tab. 3: Error messages
### 7.1.2 Service/Failure

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

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

Tab. 4: Error messages
8 Disposal

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

The device must be disposed of as hazardous waste.
## 9 Appendices

### 9.1 Technical data

<table>
<thead>
<tr>
<th>Technical Data</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Housing</strong></td>
<td>IP 65 compact unit</td>
</tr>
<tr>
<td><strong>Weight</strong></td>
<td>approx. 2.5 kg</td>
</tr>
<tr>
<td><strong>Probe</strong></td>
<td>triboelectric probe consisting of probe rod and probe head</td>
</tr>
<tr>
<td><strong>Probe rod</strong></td>
<td>insulated from housing, length: variable (mechanically trimmable)</td>
</tr>
<tr>
<td><strong>Probe material</strong></td>
<td>Stainless steel 1.4571 (Isolator PTFE)</td>
</tr>
<tr>
<td><strong>Immersion depth</strong></td>
<td>Varies by application (max. 1000 mm)</td>
</tr>
<tr>
<td><strong>Display / Operation</strong></td>
<td>2.5&quot; graphics display, 4 control keys</td>
</tr>
<tr>
<td><strong>Ambient temperature</strong></td>
<td>-20...+50 °C</td>
</tr>
<tr>
<td><strong>Humidity</strong></td>
<td>not particularly sensitive</td>
</tr>
<tr>
<td><strong>Dew point difference</strong></td>
<td>min. +5 K</td>
</tr>
<tr>
<td><strong>Sample gas temperature</strong></td>
<td>max. 250 °C (higher temperatures on request)</td>
</tr>
<tr>
<td><strong>Flow rate</strong></td>
<td>approx. 3 m/s and up</td>
</tr>
<tr>
<td><strong>Dust measuring range</strong></td>
<td>qualitative: 0...100 %; quantitative: 0...10 mg/m³ (0...1000 mg/m³)</td>
</tr>
<tr>
<td><strong>Amplification levels</strong></td>
<td>arbitrary from 0 to 3</td>
</tr>
<tr>
<td><strong>Calibration</strong></td>
<td>by gravimetric comparison measurements</td>
</tr>
<tr>
<td><strong>Analogue output</strong></td>
<td>4...20 mA, galvanically isolated from equipment earth, max. load impedance 500 Ω</td>
</tr>
<tr>
<td><strong>Digital outputs</strong></td>
<td>3 relays, max. 24 V DC at 0.1 A (for failure, service, required service)</td>
</tr>
<tr>
<td><strong>Process connection</strong></td>
<td>1&quot; Easyjust installation kit serial / flange DN25 PN6 optional</td>
</tr>
<tr>
<td><strong>Cable fitting</strong></td>
<td>2x M20 x 1.5 / 9...13 mm, 1x dummy plug</td>
</tr>
<tr>
<td><strong>Power supply</strong></td>
<td>230/110 V AC, 50-60 Hz, 24 V DC</td>
</tr>
<tr>
<td><strong>Performance test</strong></td>
<td>Technology suitability-tested to TA Luft</td>
</tr>
<tr>
<td>Setup</td>
<td>Adjust</td>
</tr>
<tr>
<td>-------</td>
<td>--------</td>
</tr>
<tr>
<td>Gain</td>
<td>Adjust sensor</td>
</tr>
<tr>
<td>Gain 0</td>
<td>Adjust sensor</td>
</tr>
<tr>
<td>Gain 1</td>
<td>Check outputs</td>
</tr>
<tr>
<td>Gain 2</td>
<td>Digital outputs</td>
</tr>
<tr>
<td>Gain 3</td>
<td>Analog output</td>
</tr>
<tr>
<td>Integration on/off</td>
<td>on</td>
</tr>
<tr>
<td>Integration on/off</td>
<td>off</td>
</tr>
<tr>
<td>Integration time</td>
<td>0.5 sec</td>
</tr>
<tr>
<td></td>
<td>1 sec</td>
</tr>
<tr>
<td></td>
<td>2 sec</td>
</tr>
<tr>
<td></td>
<td>5 sec</td>
</tr>
<tr>
<td></td>
<td>10 sec</td>
</tr>
<tr>
<td></td>
<td>30 sec</td>
</tr>
<tr>
<td>Output mode</td>
<td>Dust</td>
</tr>
<tr>
<td>Dust</td>
<td>Dust in %</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Output range</th>
<th>Diagram</th>
<th>mA-Output 1</th>
<th>Digital contacts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diagram mА-Output 1</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Digital contacts</th>
<th>Output mode</th>
<th>Contact type</th>
<th>Limit values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Output mode</td>
<td>LV 1 / LV 2</td>
<td>Maintenance / M.request</td>
<td>LV 1 in % / mg/m³</td>
</tr>
<tr>
<td>Contact type</td>
<td>LV 1</td>
<td>LV 1 in % / mg/m³</td>
<td></td>
</tr>
<tr>
<td>Limit values</td>
<td>LV 2</td>
<td>LV 2 in % / mg/m³</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Language</th>
<th>Password</th>
</tr>
</thead>
<tbody>
<tr>
<td>english</td>
<td>enter new Password</td>
</tr>
<tr>
<td>german</td>
<td></td>
</tr>
</tbody>
</table>
10 Attached documents BDA 02

- Declaration of Conformity KX08F001
- RMA - Decontamination Statement
Hiermit erklärt Bühler Technologies GmbH, dass die nachfolgenden Produkte den wesentlichen Anforderungen der Richtlinie in ihrer aktuellen Fassung entsprechen.

Folgende Richtlinie wurde berücksichtigt: The following directive was regarded:

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

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

Das Betriebsmittel dient der Überwachung von Filtern und Abscheider 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 61326-1:2013 EN 61000-6-2:2011

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 06.06.2016

Stefan Eschweiler
Geschäftsführer - Managing Director

Frank Pospiech
Geschäftsführer - Managing Director

KX 08 F001

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
Um eine schnelle und reibungslose Bearbeitung Ihres Anliegens zu erreichen, füllen Sie bitte diesen Rücksendeschein aus. Eine genaue Fehlerbeschreibung ist für die Ursachen-Analyse nötig und hilft bei der schnellen Bearbeitung des Vorgangs. Die Aussage „Defekt“ hilft bei der Fehlersuche leider nicht.

Die RMA-Nummer bekommen Sie von Ihrem Ansprechpartner im Vertrieb oder Service.


Bringen Sie den Rücksendeschein mit der Dekontaminierungs-Gerklärung bitte zusammen mit den Versandpapieren in einer Klarsichthülle außen an der Verpackung an. Ansonsten ist eine Bearbeitung Ihres Reparaturauftrages nicht möglich!

Angaben zum Absender:

<table>
<thead>
<tr>
<th>Firma / Company</th>
<th>Ansprechpartner / Contact person</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anschrift / Address</td>
<td>Abteilung / Department</td>
</tr>
<tr>
<td></td>
<td>E-Mail / E-Mail:</td>
</tr>
<tr>
<td></td>
<td>Tel. / Phone</td>
</tr>
<tr>
<td></td>
<td>Fax / Fax:</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Artikelnummer / Item number</th>
<th>RMA-Nr. / RMA no.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Auftragsnummer / Order number</td>
<td></td>
</tr>
<tr>
<td>Anzahl / Quantity</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Rücksendegrund / Return reason</th>
<th>Vorgangsnummer des Kunden / Customer transaction number:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reparatur / Repair</td>
<td></td>
</tr>
<tr>
<td>Garantie / Warranty</td>
<td></td>
</tr>
<tr>
<td>Zur Prüfung / For inspection</td>
<td></td>
</tr>
<tr>
<td>Rückgabe / Return</td>
<td></td>
</tr>
</tbody>
</table>

Fehlerbeschreibung / Description of the problem:

<table>
<thead>
<tr>
<th>Ort, Datum / Place, Date</th>
<th>Unterschrift / Stempel / Signature / Stamp:</th>
</tr>
</thead>
</table>
Bitte füllen Sie diese Dekontaminierungserklärung für jedes einzelne Gerät aus.

<table>
<thead>
<tr>
<th>Gerät / Device</th>
<th>RMA-Nr. / RMA no:</th>
</tr>
</thead>
</table>

Ich bestätige hiermit, dass das oben spezifizierte Gerät ordnungsgemäß gereinigt und dekontaminiert wurde und keinerlei Gefahren im Umgang mit dem Produkt bestehen.

Ansonsten ist die mögliche Gefährdung genauer zu beschreiben:

Aggregatzustand (bitte ankreuzen):

- [ ] Flüssig / Liquid
- [ ] Fest / Solid
- [ ] Pulvrig / Powdery
- [ ] Gasförmig / Gaseous

Folgende Warnhinweise sind zu beachten (bitte ankreuzen):

- Explosiv / Explosive
- Giftig / Tödlich / Toxic / lethal
- Entzündliche Stoffe / Flammable substances
- Brandfördernd / Oxidizing
- Komprimierte Gase / Compressed gasses
- Gesundheitsgefährdend / Hazardous to health
- Gesundheitsschädlich / Harmful to health
- Umweltgefährdend / Harmful to the environment

Bitte legen Sie ein aktuelles Datenblatt des Gefahrenstoffes bei!

Bitte füllen Sie diese Dekontaminierungserklärung für jedes einzelne Gerät aus.

<table>
<thead>
<tr>
<th>Gerät / Device</th>
<th>RMA-Nr. / RMA no:</th>
</tr>
</thead>
</table>

I herewith declare that the device as specified above has been properly cleaned and decontaminated and that there are no risks present when dealing with the device.

In other cases, please describe the hazards in detail:

Aggregate state (please check):

- [ ] Flüssig / Liquid
- [ ] Fest / Solid
- [ ] Pulvrig / Powdery
- [ ] Gasförmig / Gaseous

Please note the following warnings (please check):

- Explosiv / Explosive
- Giftig / Tödlich / Toxic / lethal
- Entzündliche Stoffe / Flammable substances
- Brandfördernd / Oxidizing
- Komprimierte Gase / Compressed gasses
- Gesundheitsgefährdend / Hazardous to health
- Gesundheitsschädlich / Harmful to health
- Umweltgefährdend / Harmful to the environment

Bitte legen Sie ein aktuelles Datenblatt des Gefahrenstoffes bei!

Place, Date: __________________________

Signature / Stamp: __________________________