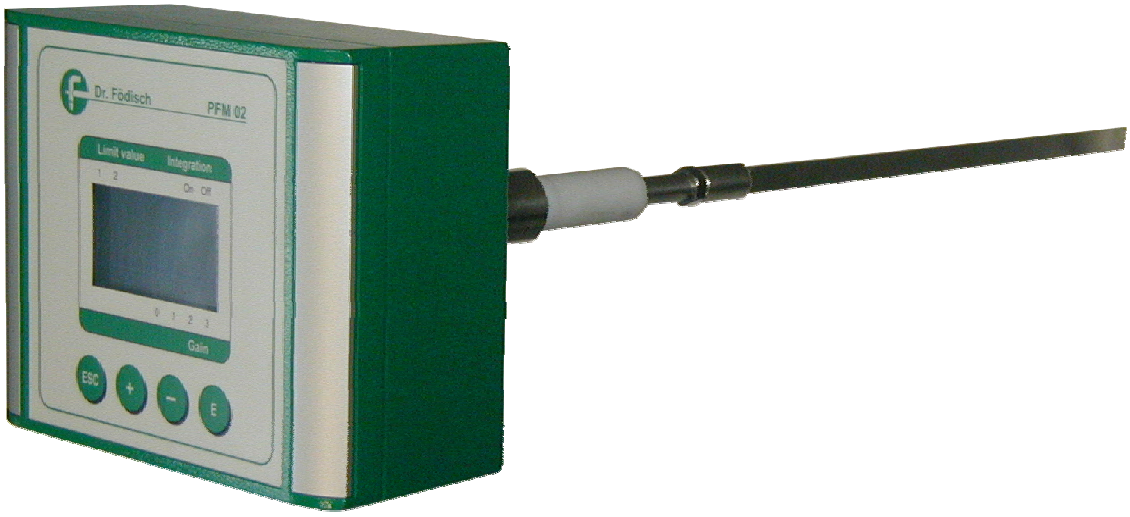
Dr. Födisch
Umweltmesstechnik
AG

Particle Flow Meter PFM 02 V



Operation manual

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1 General remarks

1.1 General advices

The product described by this manual has left the factory in a safety-related proper and checked state. In order to keep this state and to achieve a perfect and safe product running it is only allowed to be used in that way described by the manufacturer. Moreover the perfect and safe running of this device demands a correct transportation, storage and installation as well as a careful operation and maintenance.

This manual contains the necessary information for the determined use of the described product. It is directed towards technically-qualified staff which have been specially educated or have knowledge about measuring and control technology - called automation technology further on.

The knowledge and the technically – correct realisation of the safety hints and warnings contained in this manual are the precondition for safe installation and putting into operation as well as for safety during operation and maintenance of the product described. Only professional staff have the required knowledge to interpret as well as to realise in each case the safety hints and warnings correctly due to the general description in this manual.

This manual is within the scope of delivery even if the option for a separated order respectively delivery had been planned due to logistic reasons. In order to preserve clarity neither all details for all types of the described product are contained, nor each possible case of installation, operation, maintenance and use in systems can be considered. If you need further information or if problems arise which are not treated explicitly in this manual please contact the respective agency of Dr. Födisch Umweltmesstechnik AG being responsible for you.

1.2 Advices for handling the manual

In the manual it is described how you can mount, put into operation, control and maintain the measuring device. Please pay especially attention to texts of **warning and advices**.

1.3 Warning advices

Safety hints and warnings serve the avoidance of dangers for life and health of users or staff respectively damages to property. In the manual they are marked by here defined signal words. Moreover they are marked by symbols at the place of their appearance. The used signal words mean in this manual and on the product itself the following :

WARNING
means, that death, heavy injuries and / or substantial damages to property **can** occur, if necessary precautions are not taken.

Thereby the following risks are differentiated:

WARNING
Danger by electric current

WARNING
Danger by hot surface

ATTENTION
Means that an event or state which is not desired can occur, if the corresponding advice is not observed.

HINT
Is an important information about the product itself, its handling or that chapter of manual where special attention shall be paid to.

EINVIRONMENTAL PROTECTION ADVICE
Contains an important information for environmental protection

1.4 Approved Use

The product described in this manual has been developed, manufactured, tested and documented taking into account the appropriate safety standards. No danger therefore exists in the normal case with respect to damage to property or the health of persons if the handling guidelines and safety information described for configuring, assembly, approved use and maintenance are observed. This device has been designed such that safe isolation is guaranteed between the primary and secondary circuits. Low voltages which are connected must also be generated using safe isolation. Correct and safe operation of this analyser is additionally dependent on proper transport, storage, installation and assembly, as well as careful operation and maintenance.

WARNING
Danger of injury by electric current!
This device is operated by electricity. Following removal of the housing or guard, or after opening the system cabinet, certain parts of the device/system are accessible which may carry dangerous voltages. Therefore only suitably qualified personnel shall work on this device. This must be thoroughly acquainted with all sources of danger and the maintenance measures as described in this manual.

1.5 Qualified Personnel

Severe personal injury and/or extensive damage to property may occur following unqualified work on the device/system or the failure to observe the warnings described in

the instructions or on the device/system cabinet. Therefore only suitably qualified personnel may work on this device/system.

Qualified persons in the sense of the safety information present in this instructions or on the product itself are persons who

- ⇨ are either familiar as project engineers with the safety concepts of automation technology
- ⇨ or have been trained as operators in the use of automation technology equipment and are acquainted with the contents of these instructions which refer to operation
- ⇨ or have been appropriately trained as commissioning and/or maintenance personnel for such automation technology equipment or are authorised to energise, ground and tag circuits and devices/systems in accordance with established safety practices.

1.6 Warranty Information

Your attention is drawn to the fact that the contents of these instructions are not part of a previous or existing agreement, commitment or statutory right and do not change them. All commitments are contained in the respective sales contract which also contains the complete and solely applicable warranty conditions. These warranty conditions in the contract are neither extended nor limited by the contents of this manual.

Changes in design or construction of the filter controller are not allowed. Any intervention lead to a termination of the warranty.

1.7 Supply and Delivery

The respective scope of delivery according to the valid contract is listed on the shipping documents accompanying the delivery. When opening the packaging, please check that the delivery is complete and undamaged. Please keep the packaging material in order to return the device, if necessary.

1.7.1 Scope of supply

The filter controller PFM 02 V consists in standard version of the following components:

- ⇨ 1 Probe
- ⇨ 1 1“-Weld-in sleeve with screwing
- ⇨ 1 Operation manual

Optional accessories

- ⇨ Power supply (110/230 VAC in 24 VDC)

HINT

Depending on the order configuration deviations in the technical design are possible.

1.8 Standards and Regulations

The harmonised European standards have been applied to the specification and production of this device as far as possible. If no harmonised European standards have been applied, the standards and regulations for the Federal Republic of Germany apply.

1.9 Declaration of Conformity

CE-symbol:

The filter controller PFM 02 V complies with the requirements of the EU guidelines listed below.

EMC guideline:

The Particle Flow Meter PFM 02 V complies with the requirements of the EU guideline 89/336/EEC “Electromagnetic Compatibility” in the product family norm EN 61326.

The Particle Flow Meter PFM 02 V is designed for the use in industrial applications.

Requirements for:		
Emitted interference	**Interference immunity**	
EN 50081-1	**EN 61000-6-2**	
Emitted interference	**Interference field intensity according to**	**EN 55022 (CISPR 22)**
Emitted interference	**Interference voltage according to**	**EN 55022 (CISPR 22)**
Interference immunity	**ESD according to**	**EN 61000-4-2**
Interference immunity	**HF radiated according to**	**EN 61000-4-3**
Interference immunity	**Burst according to**	**EN 61000-4-4**
Interference immunity	**Surge according to**	**EN 61000-4-5**
Interference immunity	**HF streamed into according to**	**EN 61000-4-6**
Interference immunity	**Power loss**	**EN 61000-4-11**

Declaration of conformity

In line with the above-mentioned EU guidelines, the EU declarations of conformity are available at the following address for inspection by appropriate authorities:

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2 Safety advices

2.1 General remarks

WARNING

Risk of injury due to non-observance of safety advices!

Operate the measuring device PFM 02 V only in perfect state and under strict observance of the safety hints!

- ⇨ The filter controller PFM 02 V is only allowed to be connected to the supply voltage written on the type plate (Standard: 24 VDC).
- ⇨ The PFM 02 V is only to be allowed to be operated at a power supply with ground contact. The protective effect must not be revoked by an extension cable without protective ground. Each interruption of the protective ground inside or outside the device is dangerous and not permitted.
- ⇨ The PFM 02 V has to be secured by 2 A on input side..
- ⇨ Before opening any component of the device the dust measuring device PFM 02 V has to be made free of voltage by pulling the power connector.
- ⇨ Neither it is allowed to use the PFM 02 V in potential explosive rooms nor to measure in explosive gaseous mixtures.
- ⇨ Cables and gas pipes should be assembled in a way that a danger of accident by stumbling or getting caught on the pipes can be excluded.
- ⇨ Parts of the probe can get into contact with hot measuring gas and can, therefore, be heated up. Therefore please never touch these parts without temperature-resistant gloves or under voltage.
- ⇨ The PFM 02 V as whole as well as the single components are only allowed to be operated in the original state. If elements are changed the manufacturer's original parts shall be used.
- ⇨ Changes in the configuration of the PFM 02 V, that means the mis-adjustment of parameters which usually are not at the user's disposal, can endanger the safety and functioning of the filter controller and are done at one's own risk! Therefore changes in configuration shall be executed by authorised service technicians or by manufacturer's staff.
- ⇨ Coverings of PFM 02 V are only allowed to be removed in the state free of voltage.
- ⇨ Elements are device-typically configured and, therefore, cannot be changed among various PFMs.

WARNING

Risk of injury due to lack of expertise!

Installation, operation, maintenance and all kind of repair have to be done solely by skilled staff referring to the corresponding regulations. (Zentralverband der Elektrotechnik- und Elektroindustrie e.V.).

3 Structure and function

3.1 Structure

The dust measuring device PFM 02 V consists of:

- ⇨ 1 in-situ-probe
- ⇨ 1 weld-in sleeve

3.1.1 Probe

The probe PFM 02 consists of a probe rod and a probe head. The probe rod is assembled in a sleeve and an insulator which insulate it electrically from the case. This system is completely turnable at the probe head.

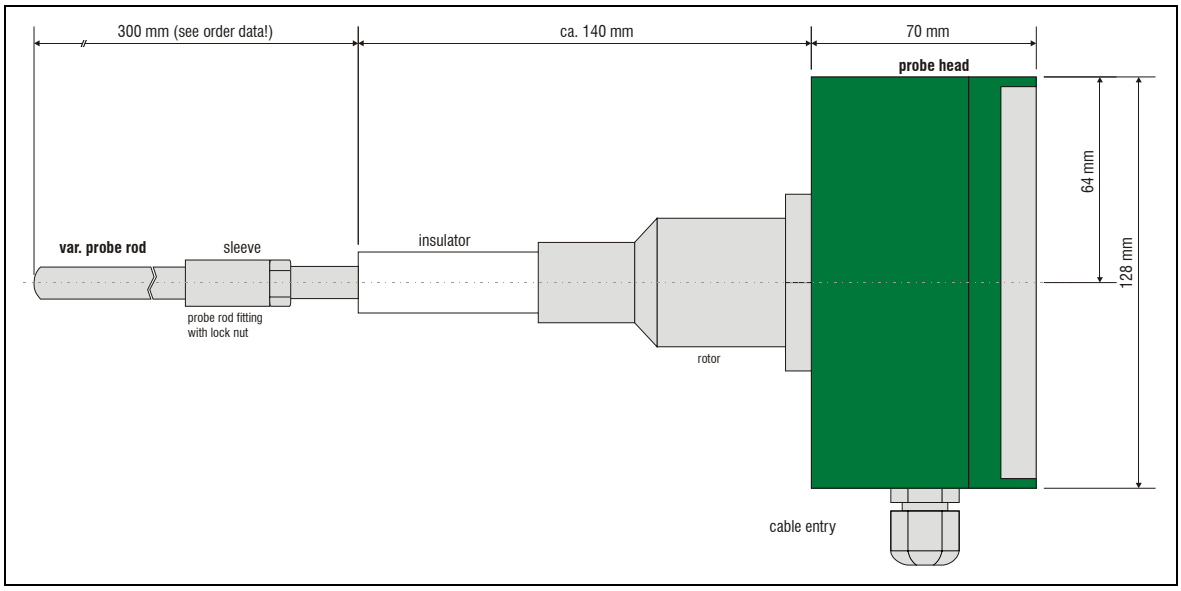


Fig. 3.1: Side view PFM 02 V

The probe rod can have different cross-sections depending on order (caused e.g. by the dust content, exhaust gas velocity …). Possible cross-sections are:

- ⇨ Round profile
- ⇨ Rectangular profile
- ⇨ Wing profile

The probe rod has to be adjusted to the incoming flow of the measuring gas during installation *(see Fig. 4.3: Incoming flow measuring gas page 17)*.

ATTENTION
Risk of measuring failures and device errors.
The probe rod is screwed with the probe at factory. It is not allowed to remove or change it without authorisation.

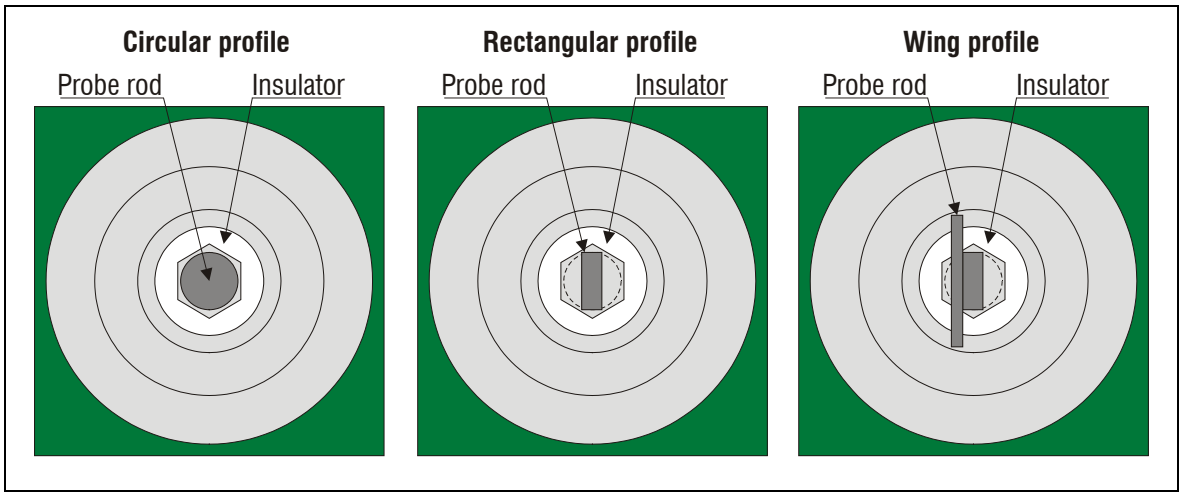


Fig. 3.2: Probe profiles

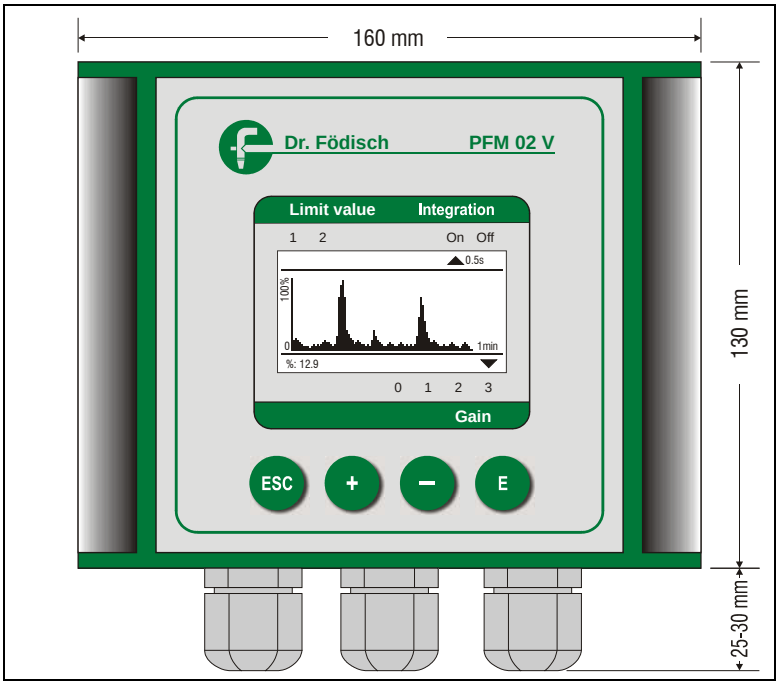


Fig. 3.3: Control and display unit PFM 02 V

The control and display unit is integrated in the probe head. All measuring values, status information and parameters are shown on the high-quality display. By means of the keyboard the display can be configured and device-specific parameters can be adapted.

Adjustments of the output signal with regard to the real dust content can be made by parameters (e.g. after gravimetric calibration).

3.2 Function

The filter controller PFM 02 V is a highly sensitive system for continuous, triboelectric in-situ dust concentration measuring device. The qualitative monitoring of the exhaust gas is done hereby. The measuring gas is measured triboelectrically in the exhaust gas flow by means of the probe rod of the PFM 02 V *(see 3.2.1 measuring principle page 14)*.

The signal resulting from the derived current is a degree for the exhaust gas' dust content.

The micro controller integrated in the control unit produces a dust proportional signal which is provided as 4 … 20 mA – signal. Moreover the present measuring value and a line diagram are shown on the display of the control unit. By means of the keyboard different parameters (e.g. with regard to the display) can be entered and adjusted.

3.2.1 Measuring principle

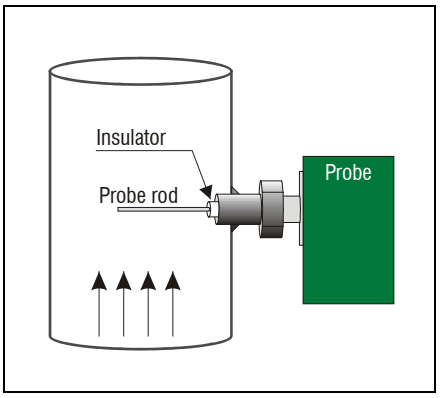


Fig. 3.4: measuring principle

Triboelectricity:

If 2 bodies get into contact with each other by friction or touch, a charge transfer will occur. The charge difference arises by the exchange of electrons between atoms on the surfaces. So a boundary layer with a positive and negative surface charge within a very low molecular distance from each other is formed.

This charge difference, also called charge fluctuation, is the basis for triboelectric dust meters which use the charge exchange between measuring probe and nearby streaming or direct impacting dust particles.

The triboelectric signal depends on the mechanical and electric properties of the dusts.

$$cal \sim c_{i.B.}$$

$C_{i.B.}$	= dust concentration [mg/m³]
Cal	= triboelectric measuring signal [V]
At constant velocity!	

Apart from the dust concentration it seems that the gas velocity has the most important influence on the triboelectric charge transfer. That means the triboelectric measuring signal has to be compensated by velocity in order to show the dust concentration. The mathematical correlation of the variables is the following:

$$c_{i.B.} = A \cdot cal \cdot v^{Exp.} + D$$

$C_{i.B.}$	= dust concentration [mg/m³]
Cal	= Measuring signal [V]
A, D	= constants
v	= velocity of exhaust gas [m/s]
Exp	= velocity exponent

4 Installation

4.1 Selection of the measuring point

WARNING
Risk of measuring failures.
The point of installation of the weld-in sleeve must be grounded Therefore the weld-in sleeve has to be integrated into the local potential equalisation!

The place of installation of the probe has to meet the requirements of local valid guidelines (e.g. EN 13284-1, in Germany: VDI 2066 page 1). In case of doubts it is recommended to let have determined the measuring point by a responsible measuring institute (in Germany according to §§ 26/28 BImSchG). We recommend to realise at least 5 times the diameter of the exhaust gas channel as entry and exit section.

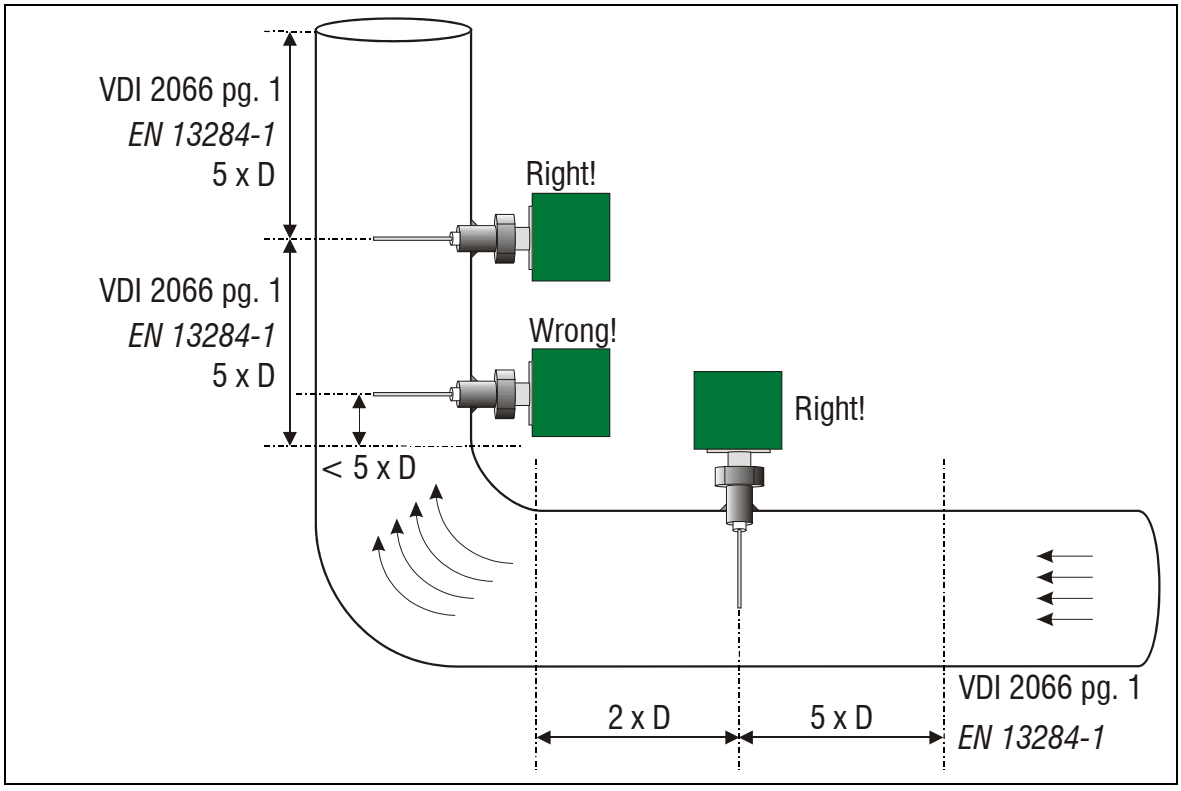


Fig. 4.1: Entry and exit section

Basically it has to be considered that the dust and smoke gas distribution must prevail as homogeneously as possible at the measuring point in order to get a representative measurement of the dust content across the channel cross – section.

4.2 Installation of the weld-in sleeve

The weld-in sleeve of the PFM 02 V is installed according to *Fig. 4.2: Weld-in sleeve* . The installation position of the probe is horizontal or vertical from top.

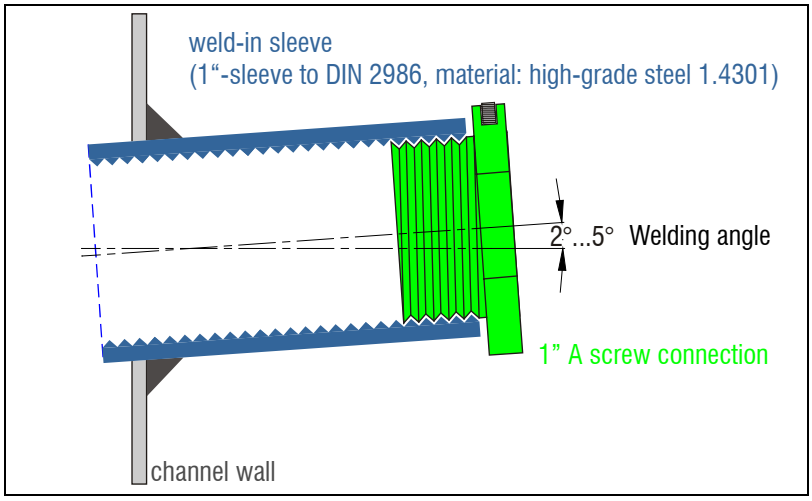


Fig. 4.2: Weld-in sleeve

4.3 Assembly of the probe

The probe is inserted in the weld-in sleeve and mounted by the socket spanner (contained in the scope of delivery) according to *Fig. 4.4: Installation rule.* At the assembly the probe rod has to be aligned according to *Fig. 4.3: Incoming flow measuring gas*. After screwing the probe tightly by means of the socket spanner the probe head can be turned into the right direction.

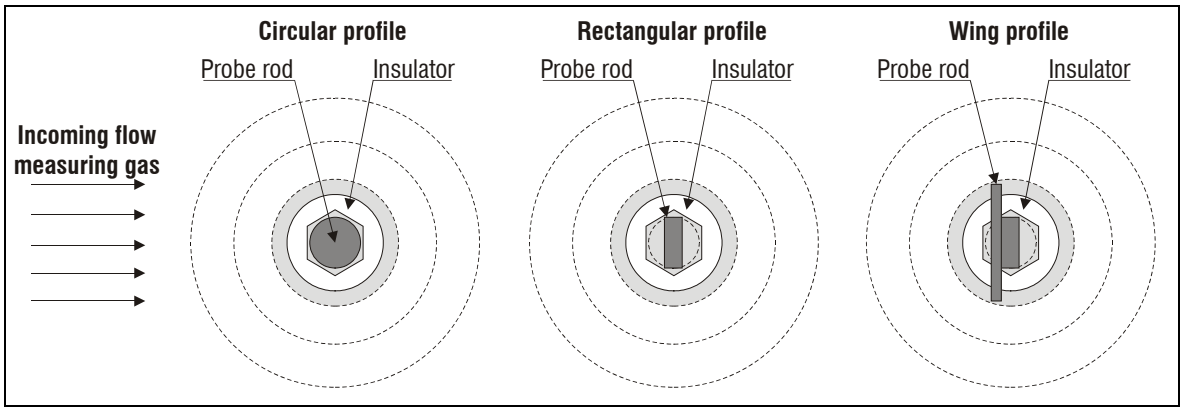


Fig. 4.3: Incoming flow measuring gas

ATTENTION

Risk of measuring failures because signal is too low.

If the rectangular or wing profile is used, the flow direction of the measuring gas has to be observed. The measuring gas has to flow against the wide side of the probe rod.

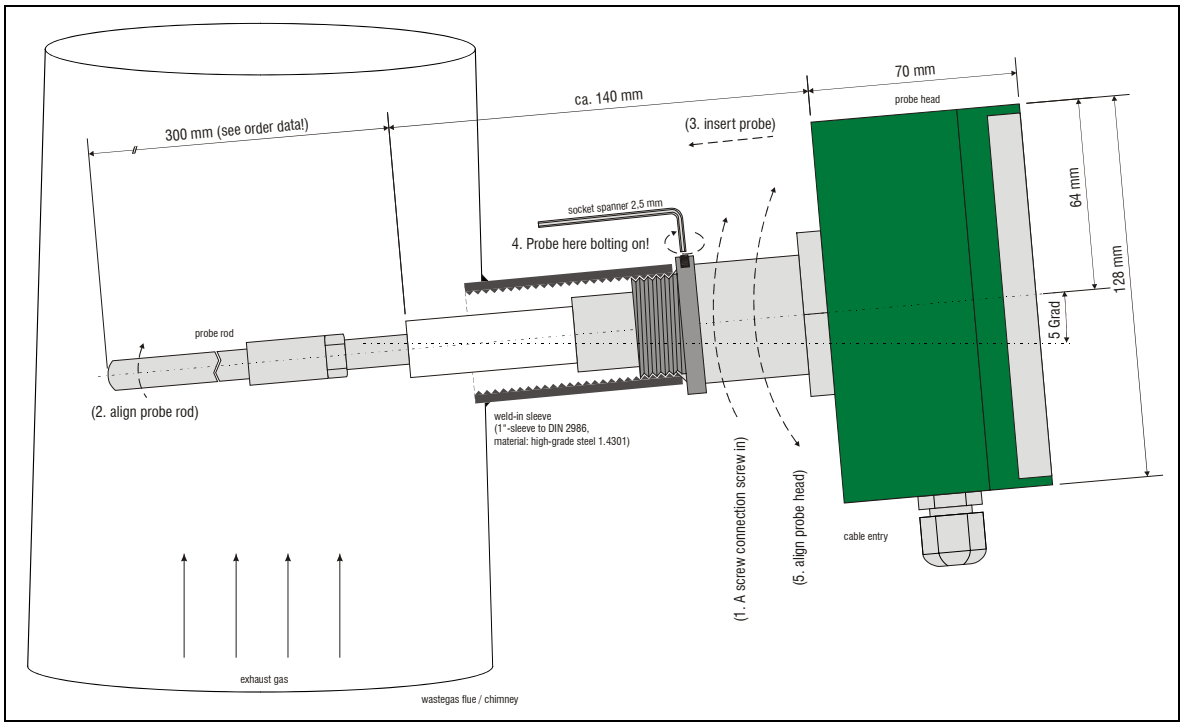


Fig. 4.4: Installation rule

4.4 Electric Connection

The electric connections of the PFM 02 V are inside the probe head. The terminals are arranged in 2 terminal strips which can be seen after removal of the cover. For that both decorative panels on the keyboard's left and right side shall be taken off. Then 4 screws have to be removed (the cover is protected against possible falling down).

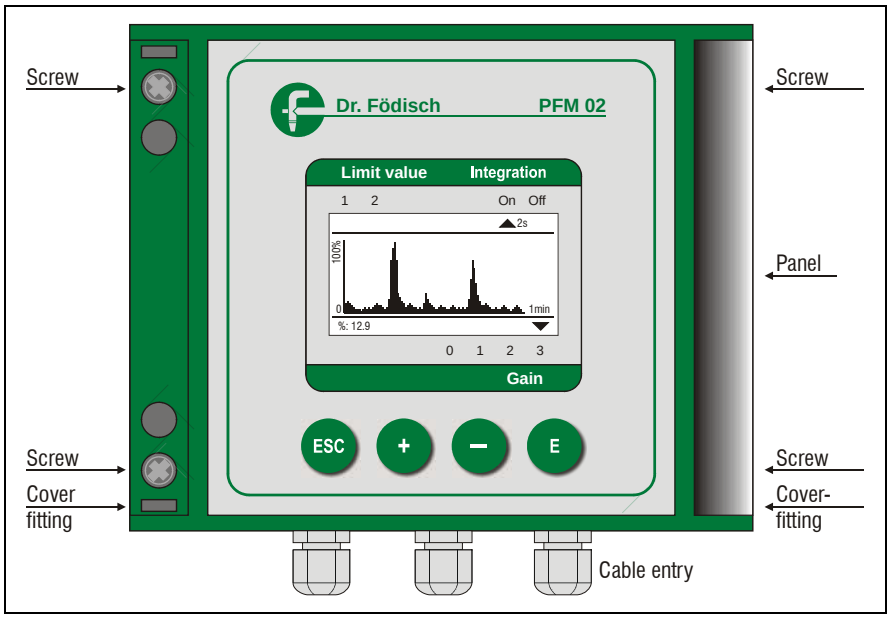


Fig. 4.5: Probe head

4.4.1 Operational voltage (24 VDC)

The terminals are designed as plug terminals. For connecting the cable no special tool is required.

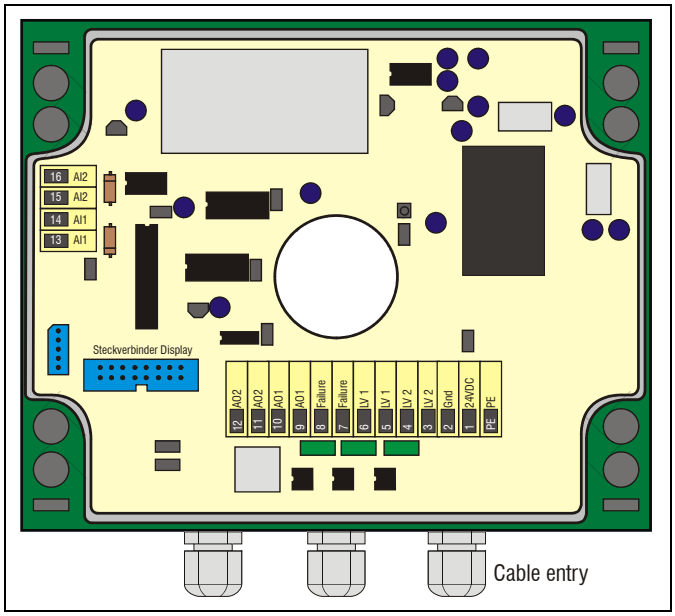


Fig. 4.6: Electrical connection 24 VDC

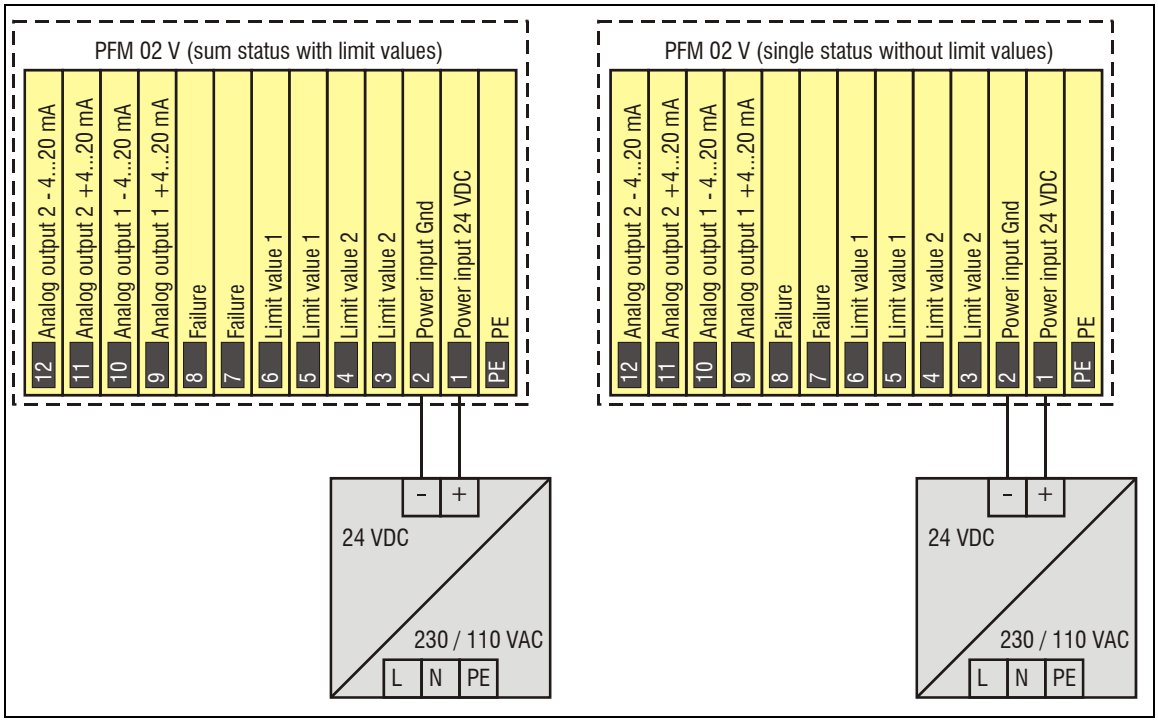


Fig. 4.7: Terminal strip: feeding 24 VDC, status signals and analogue outputs

The operational voltage 24 VDC is connected to the terminals 1 and 2. In addition it is possible, to connect the cable shield or a potential equalisation to the terminal PE.

HINT

In order to connect it to another operating voltage (110 VAC or 230 VAC) the optional power supply unit shall be used.

4.4.2 Operational voltage (230 / 110 VAC)

The terminals are designed as plug terminals. For connecting the cable no special tool is required.

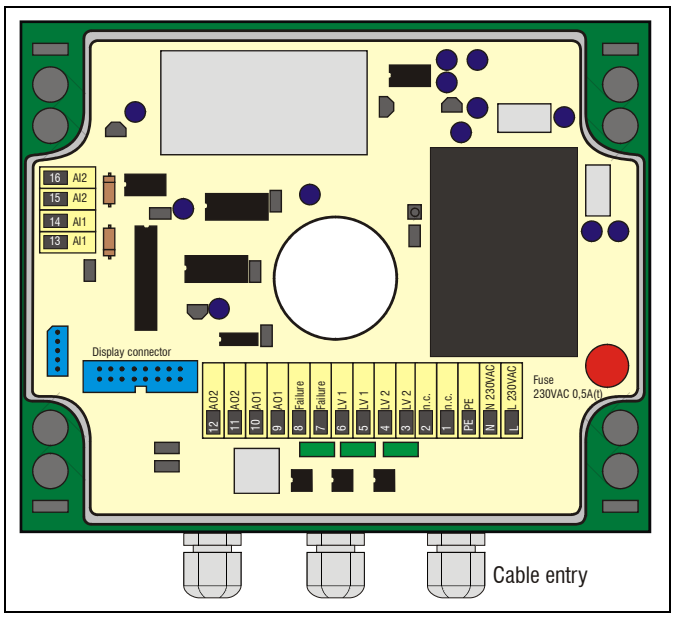


Fig. 4.8: Electrical connection 230/110 VAC

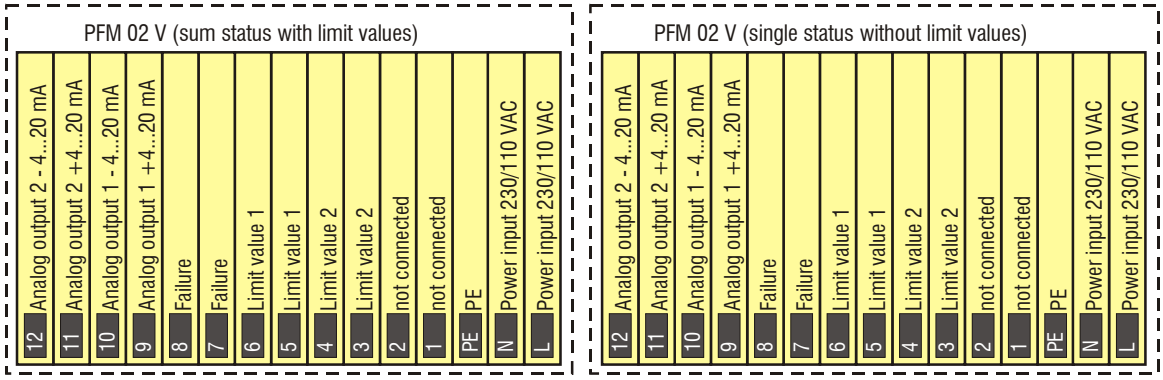


Fig. 4.9: Terminal strip: feeding 230/110 VAC, status signals and analogue outputs

The operational voltage 230/110 VAC is connected to the terminals L, N and PE.

HINT

The terminals 1 and 2 (24 VDC feeding) are not occupied at the 230/110 VAC type.

4.4.3 Status signals

The status signals are made as potential-free contacts. They can be supplied either as single status signals or as sum status signals with limit values. The change-over between single and sum status signals is done in the menu under *item 6.4.1.5.1 Setup | Digital contacts | Output mode page 31*. The following status signals are provided at the PFM 02 V:

Sum status signals with limit values	
Signals	**Contact position**
⇨ Maintenance/Failure *see 11 Error messages and* error elimination *Page 55*	⇨ Normally closed, in case of Maintenance/Failure opened
⇨ Limit value 1	⇨ Contact position adjustable (NCC or NOC)
⇨ Limit value 2 / maintenance request *see 11 Error messages and* error elimination *Page 55*	⇨ Contact position adjustable (NCC or NOC)
Single status signals without limit values	
Signals	**Contact position**
⇨ Failure *see 11 Error messages and* error elimination *Page 55*	⇨ Normally closed, in case of Failure opened
⇨ Maintenance *see 11 Error messages and* error elimination *Page 55*	⇨ Contact position adjustable (NCC or NOC)
⇨ Maintenance request *see 11 Error messages and* error elimination *Page 55*	⇨ Contact position adjustable (NCC or NOC)

Table 4.1: Status signals

4.4.4 Analogue outputs

The analogue outputs of the PFM 02 V are made as 4 ... 20 mA outputs. The following signal can be provided by the PFM 02 V:

- ⇨ Analogue output 1 -> dust in [%] or [mg/m³]
- ⇨ Analogue output 2 -> velocity in [m/s] or flow in [Tm³/h] (Advice: 1 Tm³/h = 1.000 m³/h)

HINT

The analogue output 2 is an option – see ordering data.

4.4.5 Analogue inputs

The PFM 02 V allows by means of the analogue inputs the registration of additional signals. Thereby the analogue input 1 is reserved for the signal gas velocity.

The assignment of the terminals depends on the selection of the signal type for the analogue input *see 6.4.2.3 Analogue input | Input Typ page 35.*

Signal type	Kind of connection
⇨ Differential pressure	2-wire connection (transmitter connection)
⇨ Velocity (standard)	4-wire connection (4 ... 20 mA connection)

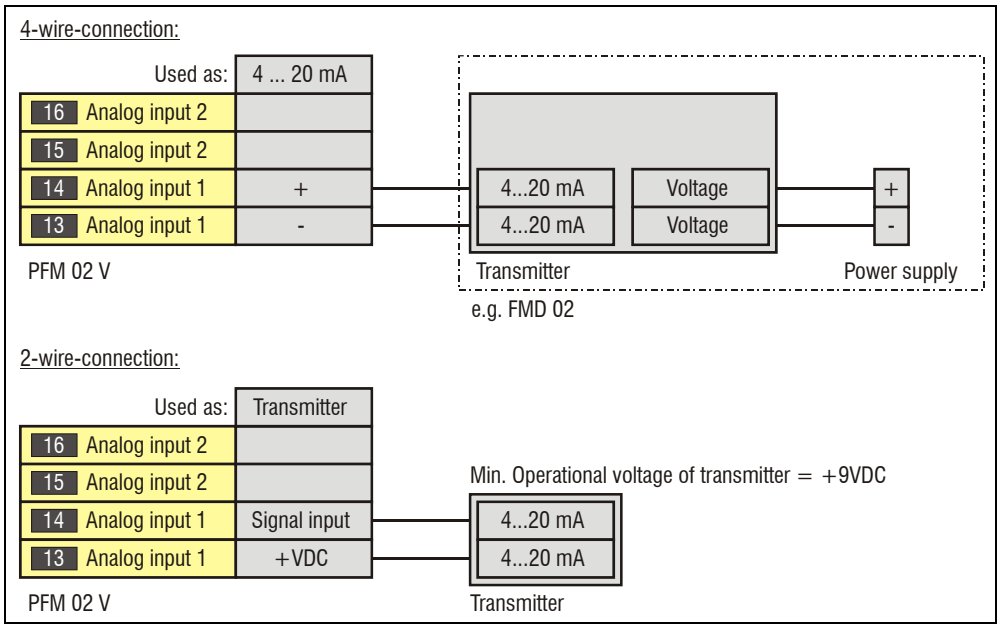


Fig. 4.10: Connection variants analogue input

HINT

The electronic in the PFM 02 V is modified for the respective application. A change later on would lead to high expenses.

HINT

The analogue input 2 is currently not used.

5 Set up

1. Switch on pre-fuse
2. Check measuring values shown for plausibility
3. Adjust measuring ranges respectively amplification, if necessary
4. Calibrate the device ➔ probe calibration *(see 8 Device calibration page 46)*
5. Adjust limit values, if necessary

5.1 Amplification | Adjust Gain

1. Switch off integration *(see 6.4.1.2 Setup | Integration page 28)*
2. **Set output mode** on **dust in [%]** (note down prior adjustments for the **display mode** and **output range !**) *(see 6.4.1.3 Setup | Output Mode page 28)*
3. If possible, test all operation states of the plant and chose the amplification of the PFM in a way that all measuring values are < 100 % display value
4. Adjust amplification level, if necessary *(see 6.4.1.1 Setup | Gain page 27)*
5. If desired, switch on integration again *(see 6.4.1.2 Setup | Integration page 28)*
6. **If desired, set output mode***(see 6.4.1.3 Setup | Output Mode page 28)* again on **dust in [mg/m³]** and adjust **output range** *(see 6.4.1.4 Setup | Output ranges page 29)*

6 Operation and handling

6.1 Display

The PFM 02 V shows in a Point-Matrix Display (128 x 64 Pixel) all information necessary for operating the measuring device:

- ⇨ Present measuring value (text and graphic mode)
- ⇨ Line diagram (ongoing display only in graphic mode)
- ⇨ Present gain
- ⇨ Limit value exceeding
- ⇨ Measuring value integration

The display is differentiated between text and graphic mode. The change between text and graphic mode is done by pressing key +.

6.1.1 Graphic mode

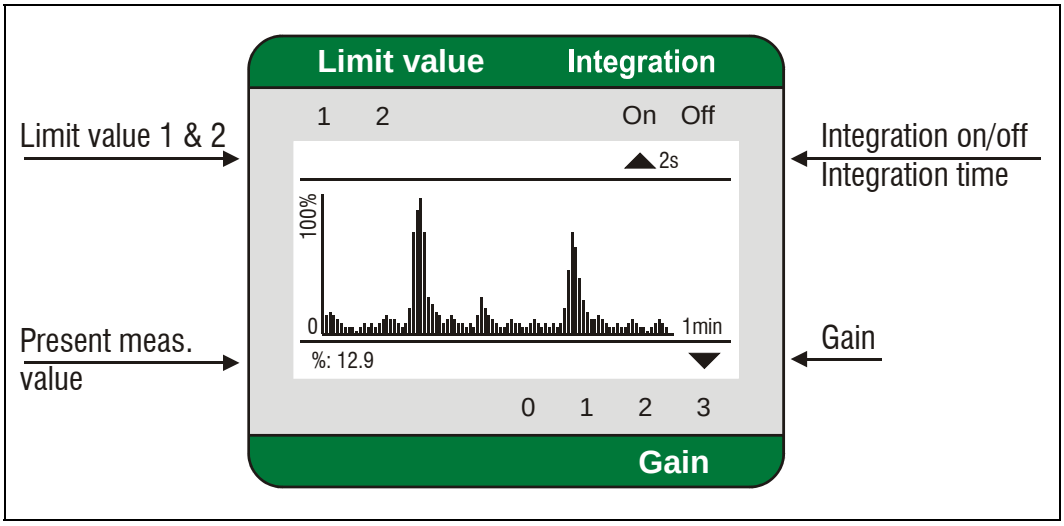


Fig. 6.1: Display in graphic mode

In graphic mode the dust content of the exhaust gas is shown as line diagram presenting the measuring values of the last 60 seconds.

The measuring value can be shown in % as well as in mg/m³.

6.1.2 Text mode

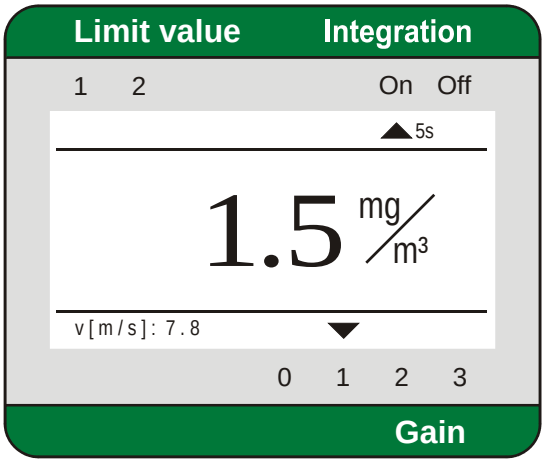


Fig. 6.2: Display in text mode

In the text mode the momentary value of the dust content in the exhaust gas is shown as numerical value. The measuring value can be shown and provided in % and in mg/m³.

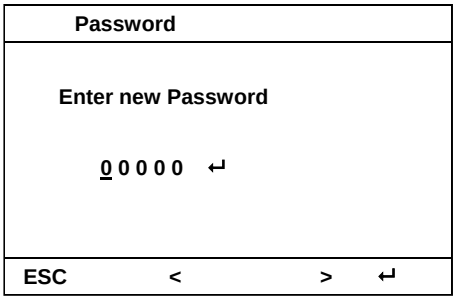
6.2 Operation

6.2.1 Keys

The operation of PFM 02 V is done via the keyboard. The keys have the following meaning:

ESC	Escape ->to leave menu, to quit input
+	Plus –> to increase value, to set cursor left, to change mode, etc
−	Minus -> to decrease value, to set cursor right, etc.
E	Enter -> to chose menu, to confirm value, to save value, etc.

6.2.2 Enter numbers



Entering numbers , e.g. password:

- ⇨ Set the cursor with + or − at the respective digit
- ⇨ Chose the digit with E and adjust the desired value with + and −
- ⇨ Save digit with E
- ⇨ Same procedure with the other digits
- ⇨ Set the cursor with + or − at ↵and save with E

6.3 Enter parameters

The PFM 02 V has a control respectively parametry level for entering specific parameters and for calibrating the device. You can get there by entering the valid device password:

E	press
	Enter valid password -> standard: 00000
E	Press again
	Parameter menu is shown

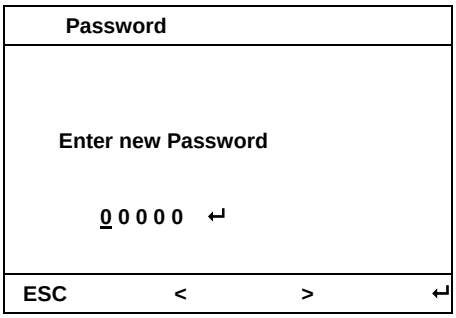


Fig. 6.3: enter password

6.4 Main menu

The **Main Menu** allows the choice and change of the device parameters. The parameters are divided into 6 sub menus:

- ⇨ Setup
- ⇨ Analogue input
- ⇨ Adjust
- ⇨ Calibration Parameter
- ⇨ Error
- ⇨ Info

The desired sub menu is chosen by the keys + and −.

Via E you can get to the chosen sub menu.

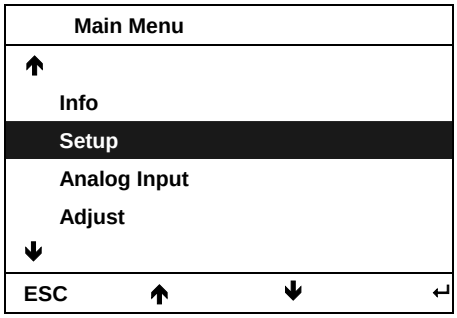


Fig. 6.4: main menu

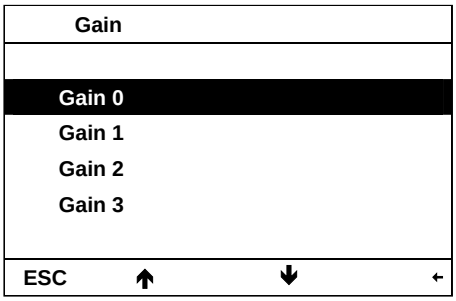
The sub items are selected in equivalence to the main menu.

6.4.1 Setup

Under menu item **Setup** device-specific parameters can be configured:

- ⇨ Gain
- ⇨ Integration on/off & time of integration
- ⇨ Output mode
- ⇨ Output ranges
- ⇨ Digital outputs
- ⇨ Language
- ⇨ Password

6.4.1.1 Setup | Gain



In this menu the **gain** of PFM 02 V's electronic is adjustable. The value adjusted is shown either in text or in graphic mode.

The amplification is chosen with regard to the dust content in the exhaust gas:

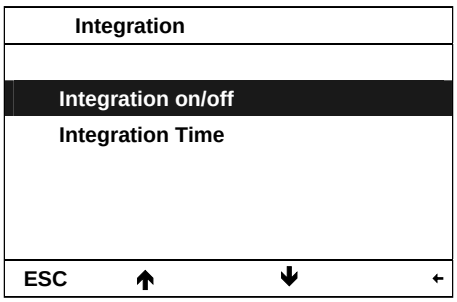
⇨ Standard: Gain 0

⇨ high dust content: amplification = 0 (low)

⇨ medium dust content: amplification = 1 or 2

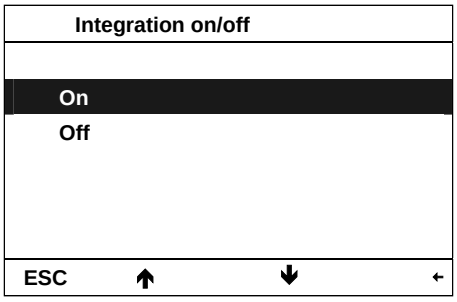
⇨ low dust content: amplification = 3 (high)

6.4.1.2 Setup | Integration



By means of point **integration on/off** the smoothing of the measuring values can be switched on or off.

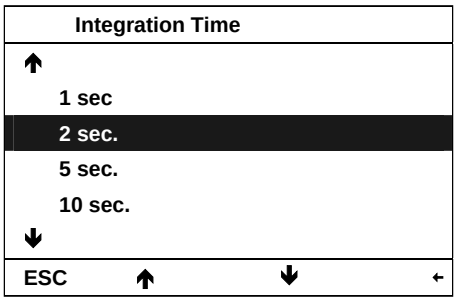
By means of the point **integration time** the time interval for integration is freely selectable. The average values of the measured values are continuously calculated and provided as measuring value.



In case of mode **integration on** an integration of the measuring value is executed for that time of integration adjusted.

The status of **integration** is shown in the upper part of the display (text and graphic mode).

⇨ Standard: Integration On



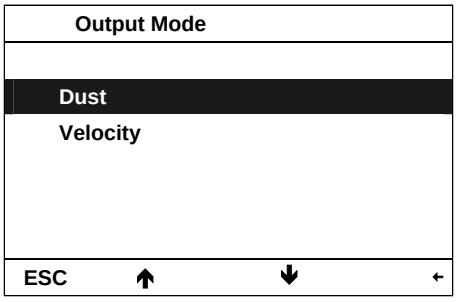
The time interval for the **integration time** can be chosen out of 6 predefined values:

0,5 – 1 – 2 – 5 – 10 – 30 seconds

The chosen value for **integration time** is shown in the upper part of the display (text and graphic mode).

⇨ Standard. 2 Seconds

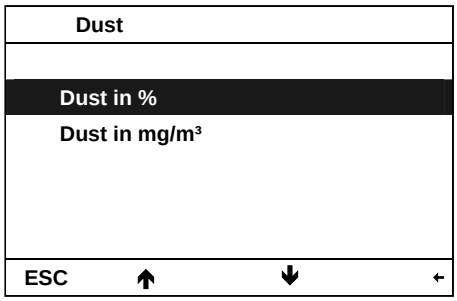
6.4.1.3 Setup | Output Mode



The **output mode** determines how the display and the analogue outputs of dust and velocity shall be done:

⇨ Dust: in [%] or [mg/m³]

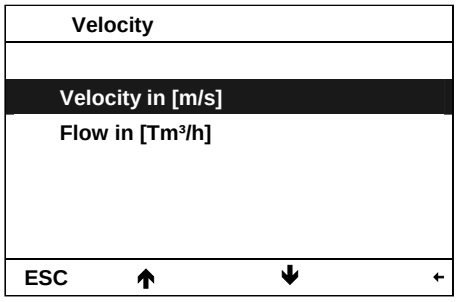
⇨ Velocity: in [m/s] or as Flow in [Tm³/h] (means thousand m³/h)



Dust can be shown and provided in % or in mg/m³.

Observe *9 Dust calibration page 48* for display of the measuring values in mg/m³ !

⇨ Standard: Dust in [%]



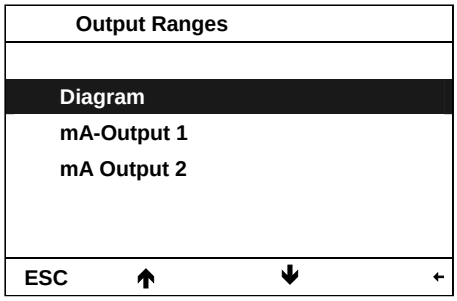
The **velocity** of the measuring gas can be shown and provided either as **velocity** or as **flow**.

⇨ Standard: Velocity in [m/s]

HINT

The adjusted output mode is for the display and the analogue output!

6.4.1.4 Setup | Output ranges



The **output range** determines the value ranges of the

⇨ display diagram and both

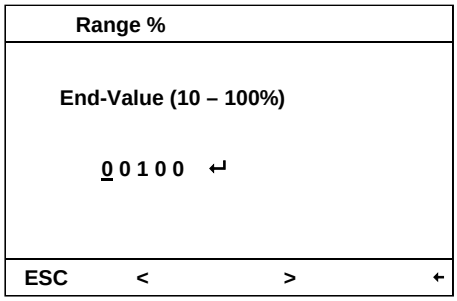
⇨ analogue outputs

The **output range** is adjusted in % or in mg/m³ depending on the chosen **output mode** (for velocity in m/s bzw. Tm³/h).

The analogue outputs are assigned in the following way:

⇨ mA-output 1: output dust

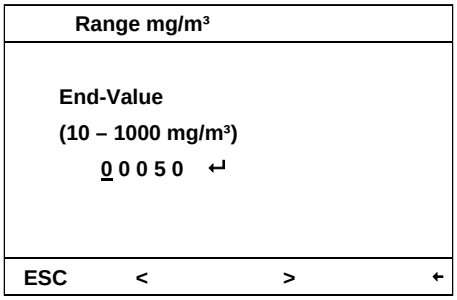
⇨ mA-output 2: output velocity or flow in op. state



Example **enter diagram as Dust in [%]:**

The span value of the diagram measuring range is freely selectable within the range of 10 % ... 100 % or 10 ... 1000 mg/m³.

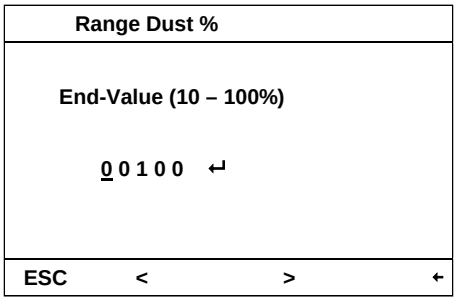
⇨ Standard: 100 %



Example **enter diagram as Dust in [mg/m³]:**

The span value of the diagram range is freely selectable within the range of 10 ... 1.000 mg/m³.

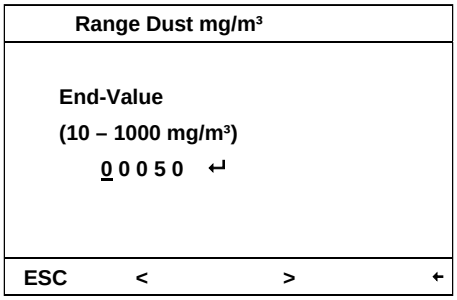
⇨ Standard: 50 mg/m³



Example enter mA-output 1 as Dust in [%]:

The span value of the measuring range is freely selectable within the range of 10 ... 100 %

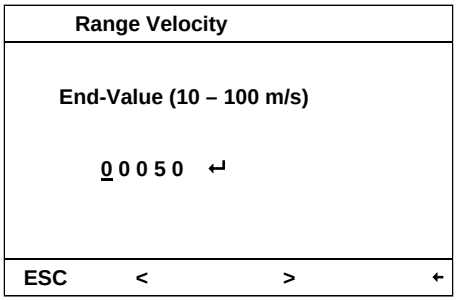
⇨ Standard: 100 %



Example enter mA-output 1 as Dust in [mg/m³]:

The span value of the measuring range is freely selectable within the range of 10 ... 1.000 mg/m³.

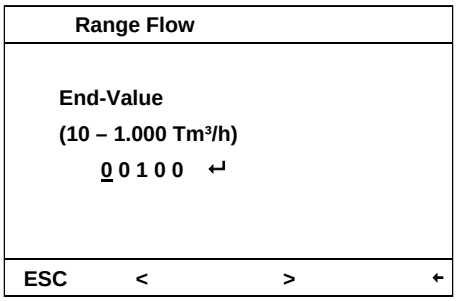
⇨ Standard: 50 mg/m³



Example enter mA-output 2 as Velocity in [m/s]:

The span value of the measuring range is freely selectable within the range of 10 ... 100 m/s.

⇨ Standard: 50 m/s



Example enter mA-output 2 as Flow measured in [Tm³/h]:

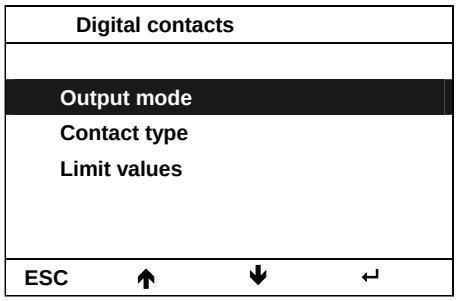
The span value of the measuring range is freely selectable within the range of 10 ... 1.000 Tm³/h.

⇨ Standard: 100 Tm³/h = 100.000 m³/h

HINT

1 Tm³/h = 1.000 m³/h, 1.000 Tm³/h = 1.000.000 m³/h

6.4.1.5 Setup | Digital contacts

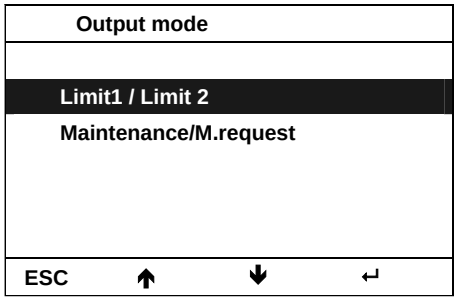


Output mode defines the kind of output of the status signals.

Contact type determines the switch direction of the digital outputs for both limit values.

The **limit values** fix from which measuring value onwards the limit value shall be regarded as exceeded.

6.4.1.5.1 Setup | Digital contacts | Output mode



Output mode defines the kind of output of the status signals.

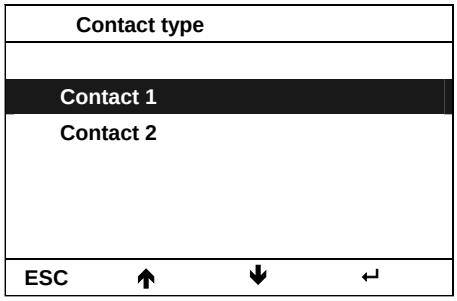
It is differentiated in

- ⇨ **Limit Value 1 / Limit Value 2** sum status signals with limit values and
- ⇨ **Maintenance/Maintenance request** single status signals without limit values

see 4.4.3 Status signals page 21

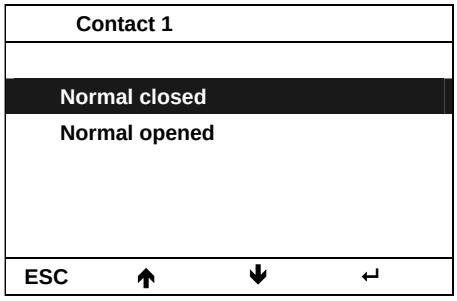
- ⇨ Standard: Limit1 / Limit2

6.4.1.5.2 Setup | Digital contacts | Contact type



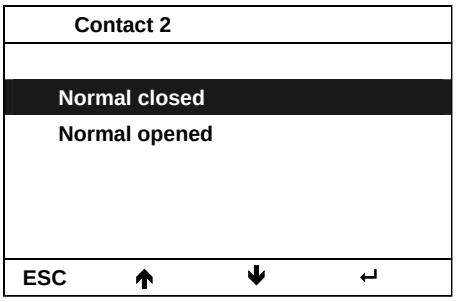
Contact type fixes the switch direction of the digital outputs for the outputs 1 and 2. It can be selected::

- ⇨ N.C. = Normally closed
- ⇨ N.O. = Normally opened



Example **Contact type Contact 1**

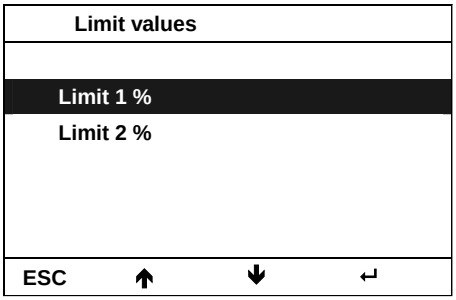
- ⇨ Standard: N.C.



Example **Contact type Contact 2**

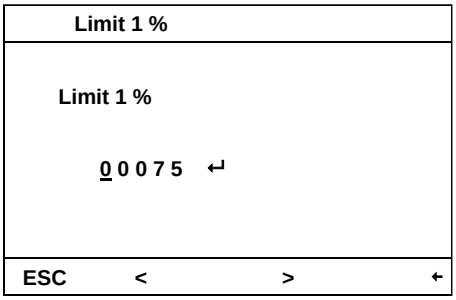
⇨ Standard: N.C.

6.4.1.5.3 Setup | Digital contacts | Limit values



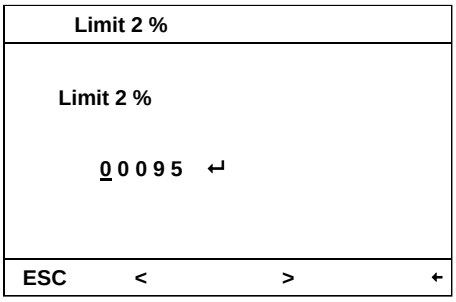
The **limit values** determine from which measuring value onwards the limit value shall be exceeded. The exceeding of a limit value is shown on the display (text and graphic mode) top left and the corresponding status contact is opened.

The **limit values** are provided in % or in mg/m³ depending on the selected **output mode**.



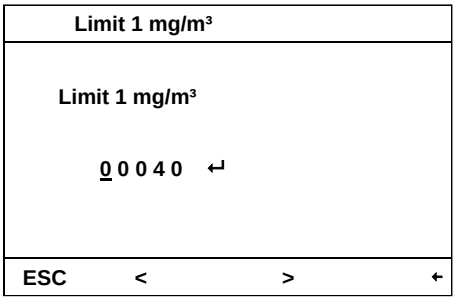
Example: Enter **Limit value 1 in [%]**

⇨ Standard: 75 %



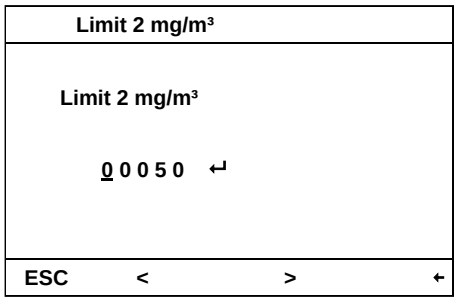
Example: Enter **Limit value 2 in [%]**

⇨ Standard: 95 %



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

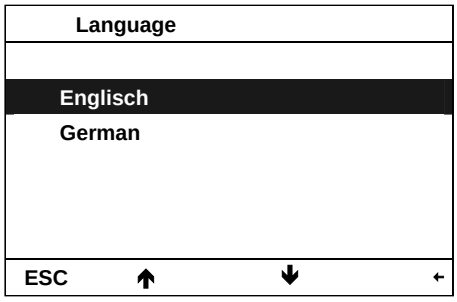
⇨ Standard: 40 mg/m³



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

⇨ Standard: 50 mg/m³

6.4.1.6 Setup | Language

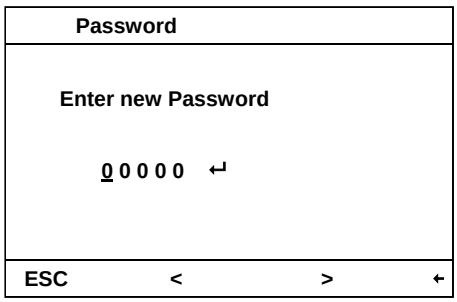


Under item **language** the menu and display language is chosen. The following languages are selectable:

⇨ German

⇨ English

6.4.1.7 Setup | Password



Under item **password** it is possible to change the pre-adjusted **password** in order to protect it against unauthorised changes.

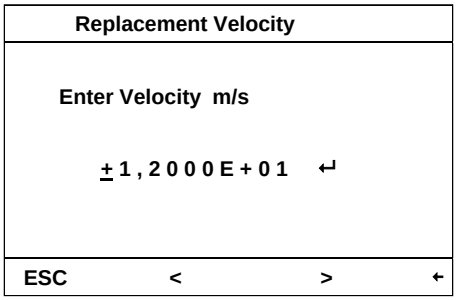
⇨ Standard: 00000

6.4.2 Analogue input

In the menu item **analogue input** the analogue input is configured. The analogue input is used to receive an external analogue signal – *which describes the velocity of the measuring gas* – by means of PFM 02 V. The measuring value can be either in proportion to the velocity or to the signal of a directly connected Δp-transmitter.

⇨ Replacement velocity	
⇨ Analogue input on/off	
⇨ Input type	*Only in case of analogue input = on!*
⇨ Measuring range	*Only in case of analogue input = on!*
⇨ Flue gas density	*Only in case of analogue input = on!*
⇨ Probe factor	*Only in case of analogue input = on!*
⇨ Velocity factor	*Only in case of analogue input = on!*
⇨ Cross section	*Only in case of analogue input = on!*

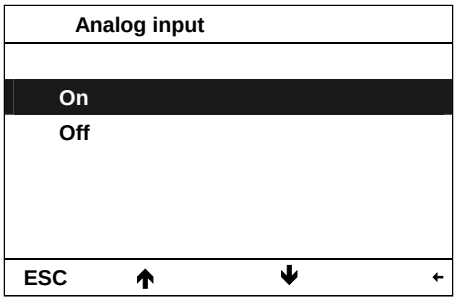
6.4.2.1 Analogue input | Replacement velocity



Under this item the **alternative value velocity** of the exhaust gas is entered at average mode of operation. So the dust content can be calculated in mg/m³ device-internally in case of a defect in the velocity measurement or in case of no use of the additional analogue input.

⇨ Standard: 12 m/s

6.4.2.2 Analogue input | Analogue input



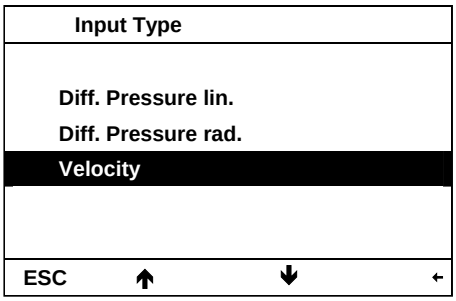
The additional **analogue input** of PFM 02 V can be switched on /off hereby.

Via the additional analogue input it is i.e. possible to compensate the triboelectric dust signal for the velocity of the measuring gas.

HINT

The function of further menu items can depend thereon *(see 6.4.2 Analogue inputPage 34)*!

6.4.2.3 Analogue input | Input Type



The sort of signal (**signal type**) at the additional analogue input of PFM 02 V has to be determined here. It can be chosen among the following points:

- ⇨ differential pressure (linear)
- ⇨ differential pressure (root extracting)
- ⇨ Standard: velocity in [m/s]

HINT

For using the analogue input with differential pressure the following parameters shall be entered in PFM 02 V:

Measuring range	⇨ *Page 36*
Flue gas density	⇨ *Page 37*
Probe factor	⇨ *Page 37*
Velocity factor	⇨ *Page 38*

Signal type: differential pressure linear

If the **analogue signal** is fed into PFM 02 V as **differential pressure linear** the calculation into an equivalent velocity will be done according to the following formula:

$$v = \text{velocityfactor} \cdot \sqrt{\frac{2 \cdot \Delta p}{k_{Probe} \cdot \rho}}$$

V	velocity of the measuring gas in [m/s]
Velocity-factor.	adjustment factor for the velocity measurement
Δp	differential pressure measured in [Pa]
k_{Probe}	probe factor of the back pressure probe
ρ	Density of smoke gas in operating state in [kg/m³]

Signal type: differential pressure root extracting

If the **analogue signal** is fed into PFM 02 V as **differential pressure root extracting** the calculation into an equivalent velocity will be done according to the following formula:

$$v = velocityfactor \cdot \sqrt{\frac{2}{k_{Probe} \cdot \rho}} \cdot \sqrt{\Delta p}$$

V	velocity of the measuring gas in [m/s]
Velocity-factor.	adjustment factor for the velocity measurement
Δp	differential pressure measured in [Pa]
k_{Probe}	probe factor of the back pressure probe
ρ	Density of smoke gas in operating state in [kg/m³]

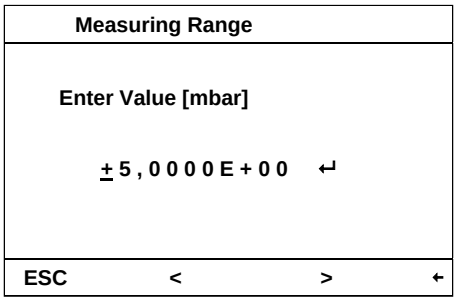
Signal type: velocity

If the **analogue signal** is fed into PFM 02 V as velocity the measuring value will be only compensated for the **velocity factor** according to the following formula:

$$v = velocityfactor \cdot v'$$

v	Corrected velocity of the measuring gas in [m/s]
Velocity-factor.	adjustment factor for the velocity measurement
v'	velocity of the measuring gas in [m/s]

6.4.2.4 Analogue input | Measuring Range

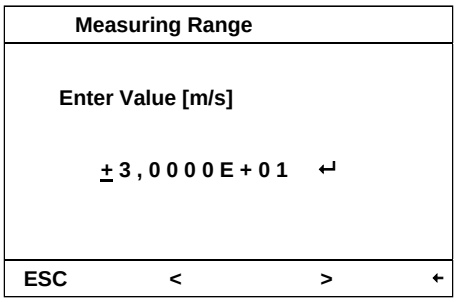


Under this item the **measuring range** of the additional analogue input is entered.

⇨ Standard: 5 mbar

The **measuring range** is shown in mbar or in m/s depending on the chosen **signal type**.

Example: input **measuring range differential pressure** in [mbar]



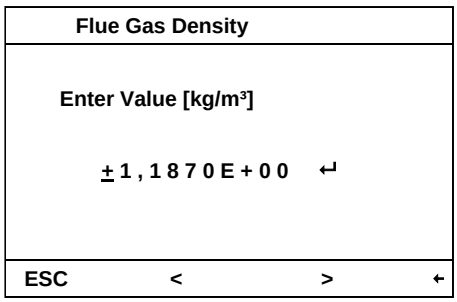
Under this item the **measuring range** of the additional analogue input is entered.

⇨ Standard: 30 m/s

The **measuring range** is shown in mbar or in m/s depending on the chosen **signal type**.

Example: input **measuring range velocity** in [m/s]

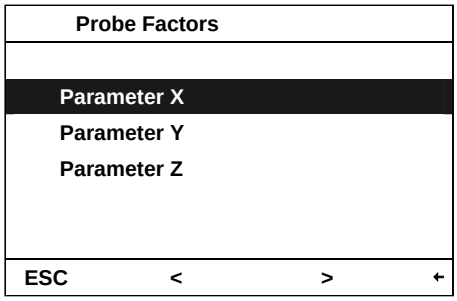
6.4.2.5 Analogue input | Flue Gas Density



Under this item the **flue gas density** of the exhaust gas is entered under operating state humid and average exhaust gas temperature.

⇨ Standard: 1,187 kg/m³ (corresponds to the density of air at 20°C)

6.4.2.6 Analog input | Probe Factor

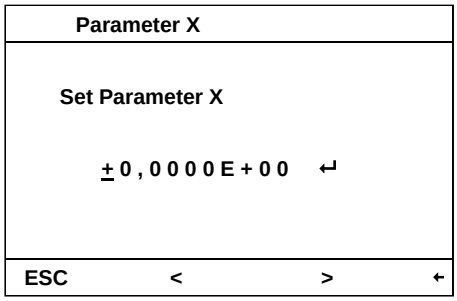


In this item the **probe factor k_{Probe}** of the additional analogue input are entered.

The **probe factor** is the specific probe coefficient ξ of a flow probe.

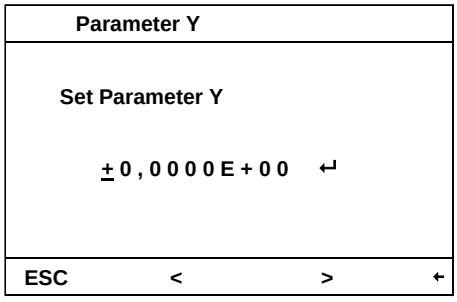
$$k_{Probe} = X \cdot v^2 + Y \cdot v + Z$$

K_{Probe}	Probe factor or probe value
v	Corrected velocity of the measuring gas in [m/s]
X, Y, Z	Probe factors (Z = linear portion)



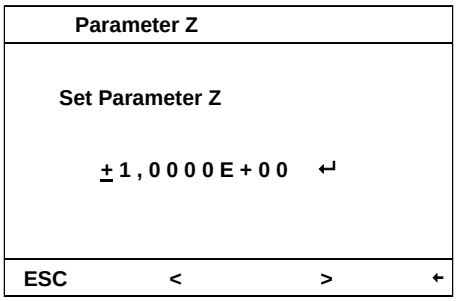
Example enter **Parameter X***:*

⇨ Standard: X = 0



Example enter **Parameter Y***:*

⇨ Standard: Y = 0



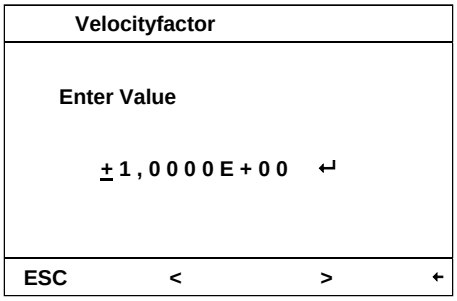
Example enter **Parameter Z***:*

⇨ Standard: Z = 1

HINT

The probe factor is disclosed by the manufacturer of the flow probe.

6.4.2.7 Analogue input | Velocity factor

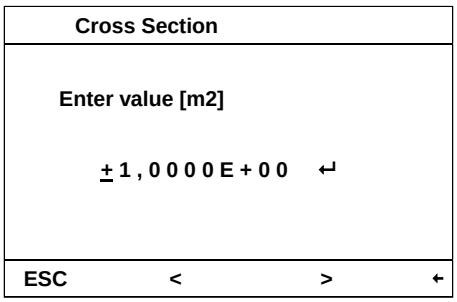


Under this item the **velocity factor** of the additional analogue input is entered.

⇨ Standard: 1,0

An adjustment of the measuring signal *velocity* to the local conditions is possible by the velocity factor. *see 6.4.2.3 Analogue input | Input Typ Page 35*. (e.g. adjustment of the velocity measuring value to the average velocity in the measuring cross-section).

6.4.2.8 Analog input | Cross Section



In this item the **channel cross section** at the measuring point is provided.

⇨ Standard: 1,0 m²

By means of the channel **cross-section** the flow of the exhaust gas is calculated.

$$\dot{V} = v \cdot A$$

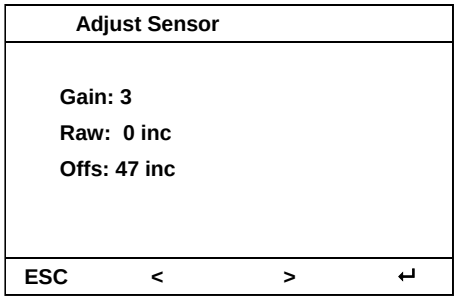
$\dot{V}$	Flow in [m³/h]
v	Velocity of measuring gas in [m/s]
A	Cross section in [m²]

6.4.3 Adjust

In the menu item **Adjust** the triboelectric sensor as well as the analogue input/output and the digital output can be adjusted respectively checked:

- ⇨ Adjust Sensor
- ⇨ Check Outputs

6.4.3.1 Adjust | Adjust Sensor



It starts the internal device calibration where the electronic is adjusted manually at the zero point. All 4 amplifications (Gain 3, 2, 1 and 0) are checked *(see 8 Device calibration page 46)*

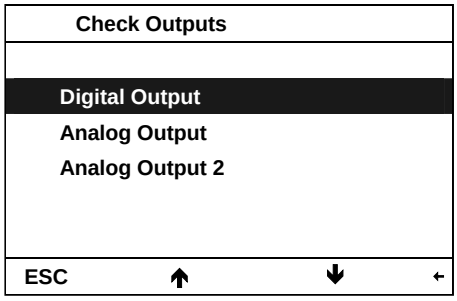
Adjust:

- ⇨ wait 5 seconds till **Raw (raw value)** does not change any longer
- ⇨ increase or decrease the value **Offs (Offset)** by 1 increment with + and − -> **Raw** value changes!
- ⇨ So adjust the **Raw** value up to **0.**
- ⇨ Confirm the value with E and change to the next amplification (Gain 3 to 0).

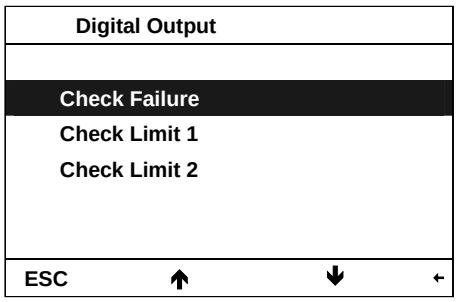
ATTENTION

Danger of wrong calibration and by that danger of measuring failures!
For the device calibration the probe has to be put into a zero tube.

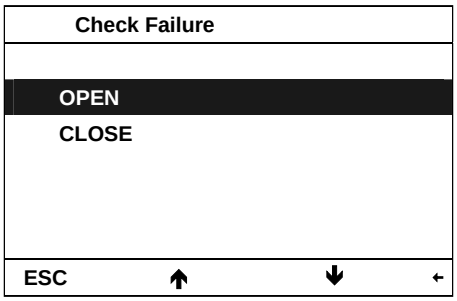
6.4.3.2 Adjust | Check Outputs



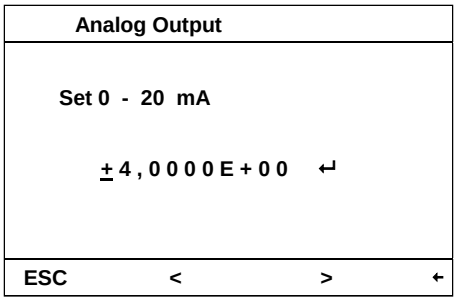
The **analogue** and **digital outputs** can be checked here.



The switching contacts of **digital outputs** can be opened or closed separately.

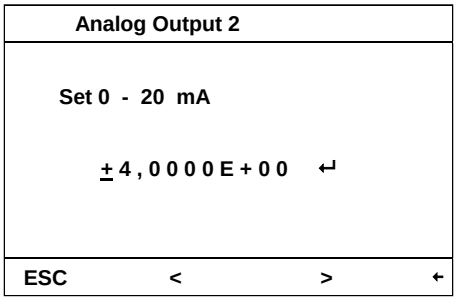


Example: Digital Output **Failure**



By means of this item the **analogue output** can be checked. The adjusted power value in mA is provided at the analogue output. *(see 4.4 Electric Connection Page 18)*.

In order to provide the adjusted current value at the **analogue output,** set the Cursor on ↵ and press E.



By means of this item the **analogue output 2** can be checked. The adjusted power value in mA is provided at the analogue output. *(see 4.4 Electric Connection Page 18)*.

In order to provide the adjusted current value at the **analogue output 2,** set the Cursor on ↵ and press E.

6.4.4 Calibration Parameter

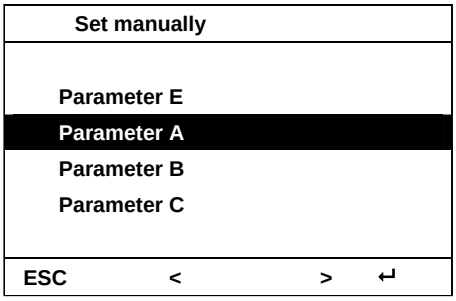
In the menu item **calibration parameter** the exhaust gas to be measured can be assigned to a media already known. Moreover it is possible to enter manually parameters resulting from gravimetric reference measurements.

- ⇨ Enter manually calibration parameters
- ⇨ Target value calibration

6.4.4.1 Calibration Parameter | Set Manually

For an exact compliance of the shown measuring values with the dust content a gravimetric calibration is required.. The determined parameter A ... E can be entered under item **Set manually**.

If the item **manual input** is chosen, the entered parameters A to E are used for the dust calculation *(see 9 Dust calibration page 48).*



If the manual input is chosen, the parameters A, B, C, D, E can be entered here.

(see 9.2 Mathematical correlation page 48)

Factory defaults:

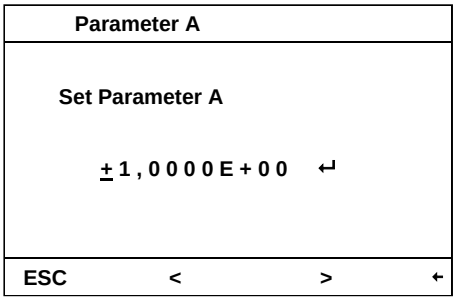
A = 1

B = 0

C = 0,002

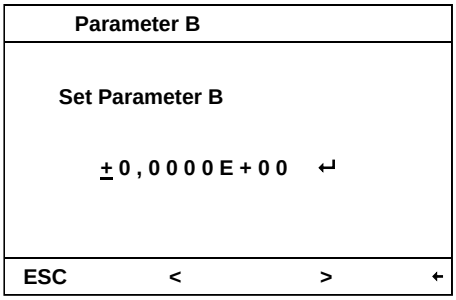
D = 0

E = -1,25



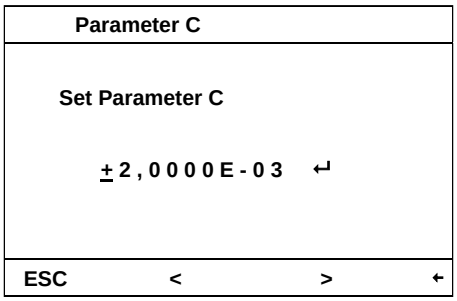
Example: enter **parameter A**

- ⇨ Standard: A = 1



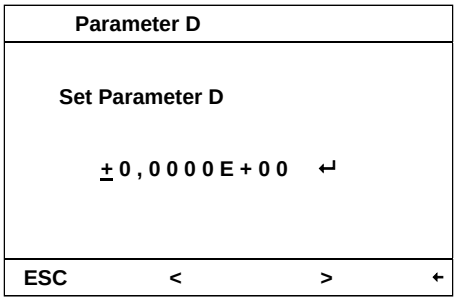
Example: enter **parameter A**

- ⇨ Standard: B = 0



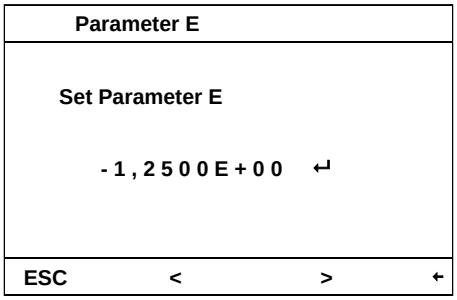
Example: enter **parameter C**

⇨ Standard: C = 0,002



Example: enter **parameter D**

⇨ Standard: D = 0

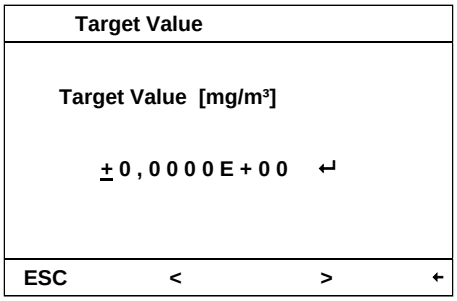


Example: enter **parameter E**

⇨ Standard: E = - 1,25

6.4.4.2 Calibration Parameter | Target Value

Entering a **target value** allows a simple adjustment of the dust content displayed in mg/m³ to the dust content existing in the measuring gas stream. For that purpose a known average value of dust content is entered. Then the PFM 02 V calculates independently valid calibration parameters. For the calculation the last 10 minutes-average value of the PFM 02 V is used.



Target value calibration:

⇨ Enter average dust content in operational state in [mg/m³]

⇨ Wait for display

⇨ Ready.

HINT

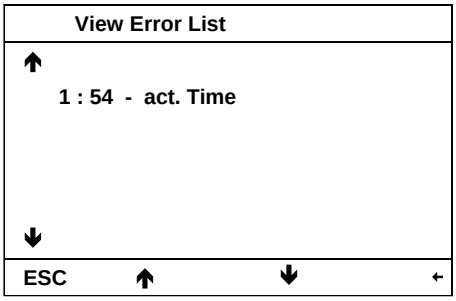
After restart the target value calibration is available after 15 minutes.

6.4.5 Error

In the menu point **error** the last 15 errors can be seen and deleted:

- ⇨ View error list
- ⇨ Clear error list

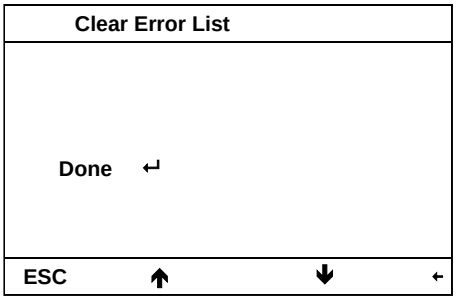
6.4.5.1 Error | View Error List



All **recorded errors** of PFM 02 V are saved in the **error list**. The messages get a time stamp starting with the last power on (hour:minute). The last 15 recorded errors since the last set up are shown in the list.

⇨ 1 : 54 – act. Time: call of the error list 1h54min since last power on

6.4.5.2 Error | Clear Error List



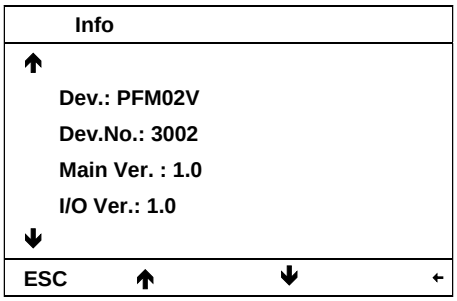
It deletes the error list.

When the key E is pressed, the error list is completely deleted.

6.4.6 Info

In the menu item **Info** all device and software versions can be regarded:

- ⇨ Serial number PFM 02 V
- ⇨ Software versions



7 Shut down

WARNING
Danger of burn!
The probe rod can be heated up extremely by the measuring gas! Don't touch the probe rod. Wear protective gloves during works at the probe.

⇨ switch off pre-fuse

7.1 Disassembly

The probe is de-installed according to *Fig. 7.1*. Thereby the power supply has to be interrupted first. Then the screws are unscrewed and the probe can be taken out.

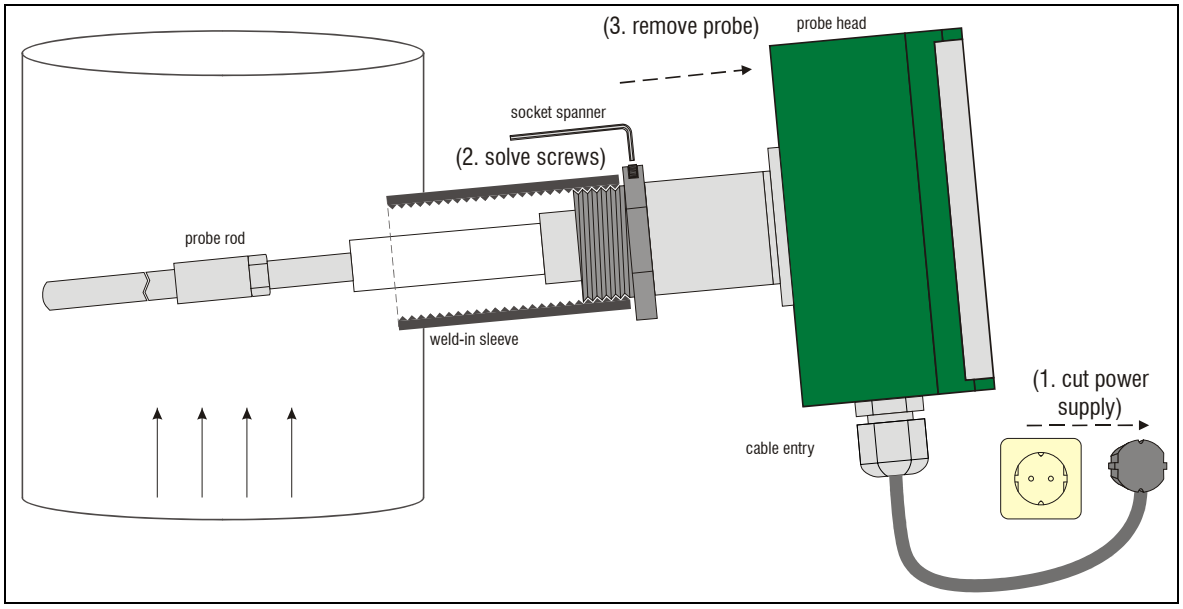


Fig. 7.1: Disassembly

7.2 Disposal

HINT
The disposal of the PFM 02 V has to be done according to locally valid environmental protection regulations.

In case of disposal the PFM 02 V has to be treated as hazardous waste.

8 Device calibration

8.1 General remarks

As highly sensitive measuring device the PFM 02 V is subject to slight variations of the used elements and materials. Therefore the PFM 02 V has to be calibrated for the zero point before the first putting into operation as well as after cleaning and reconstructing works at the probe.

HINT

This calibration refers exclusively to the electronic of PFM 02 V and not to a gravimetric calibration. This is left to the customer's discretion.

HINT

At delivery the PFM 02 V has already been pre-calibrated.

8.2 Zero and reference point

The PFM 02 V checks regularly every 5 hours beginning with the last power on the zero and reference point of the electronic. The zero point is at 4 mA and the reference point is at 15,2 mA during check.

HINT

During the cyclic zero and reference point control maintenance is provided. *(see 4.4.3 Status signals page 21)*.

In case of deviations +/- 2 % (+/- 0,32 mA) from the zero respectively reference point maintenance request is provided *(see 11.1 Maintenance request page 55).*

In case of deviations +/- 4 % (+/- 0,64 mA) from zero respectively reference point error is provided *(see 11.2 Maintenance/Failure page 55).*

8.3 Execution of the calibration

In order to execute the calibration a zero tube is needed *(see Fig. 8.1:PFM 02 V in the zero tube page 47)*. This is a grounded, metallic tube with a probe connection (the zero tube is not within the scope of supply).

An appropriate zero tube can be ordered at the manufacturer *Dr. Födisch Umweltmesstechnik AG*.

First of all the PFM 02 V is installed in the zero tube. Then the PFM 02 V is connected. The device calibration is done according to the instructions under item *6.4.3.1 Adjust | Adjust Sensor page 39*. After having finished the calibration the PFM 02 V shall be switched off. The probe can be installed in the weld-in sleeve at the measuring place and switched on again.

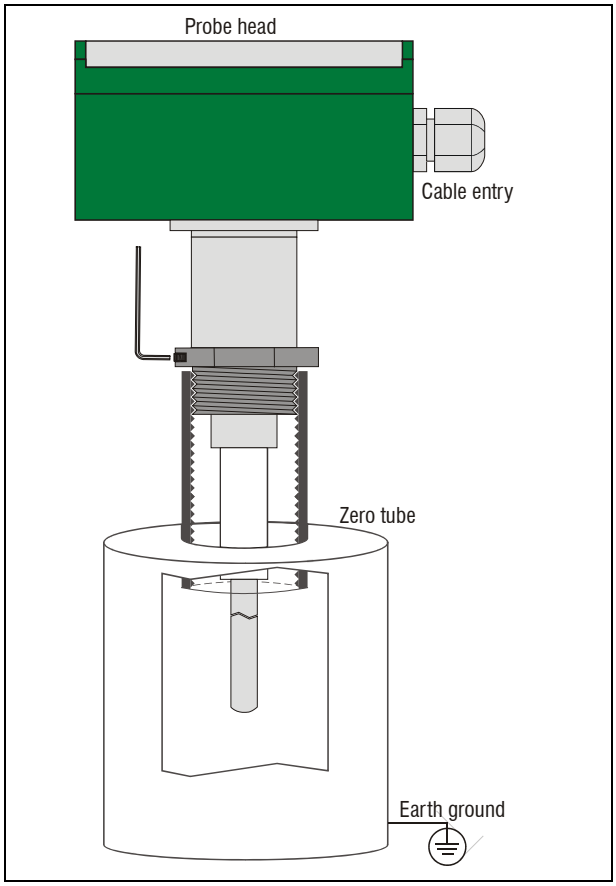


Fig. 8.1: PFM 02 V in the zero tube

1. Install PFM 02 V in a zero tube
2. Switch on PFM 02 V
3. Start device calibration *(see 6.4.3.1 Adjust | Adjust Sensor Page 39)*
4. Switch off PFM 02 V
5. Install PFM 02 V in the weld-in sleeve at the measuring place
6. Switch on PFM 02 V again

9 Dust calibration

9.1 Generally

Due to different, technological conditions at the concerning measuring places the detection of the measuring values is subject to most various influences. Variable influencing factors are e.g. sort of dust, gas velocity and temperature. The dusts to be measured vary i.e. in particle size, particle form, charge and other dust and gas properties. So for each case of application of PFM 02 V another curve of the output signal results referring to the dust content. Therefore it is required that the PFM signals are calibrated by means of gravimetric reference measurements (in Germany according to VDI 2066 and VDI 3950). The results of the calibration, that means the parameters, can be directly entered into PFM 02 V. Then the PFM 02 will provide a signal which is proportional to the dust content.

HINT

This chapter contains the manual calibration - dust calibration - of PFM 02 V.

9.2 Mathematical correlation

The calculation of the dust signal is done according to the following mathematical correlation:

$$dust = A \cdot S \cdot v^{B \cdot v^2 + C \cdot v + E} + D$$

$$S = P \cdot G$$

dust	Dust content in [mg/m³]
S	Dust raw signal in [%]
v	Velocity of the measuring gas in [m/s]
A	Ascent of the calibration graph
D	Offset of the calibration graph
B, C and E	Parameters of the exponents
P	Dust raw signal in [%]
G	Gain in [mg/m³/%]

The dust raw signal S can be determined out of the dust raw signal P by means of the following table:

Gain	G	S_{max}
3	1	100
2	2,14	214
1	3,46	346
0	15	1500

Table 9.1: Calculation dust raw signals / Gain

The exponent contains the mathematical compensation of the velocity influence on the triboelectric signal.

9.2.1 Calculation elements

9.2.1.1 Flue gas density

The flue gas density is used as input value for the calculation *(see 6.4.2.5 Analogue input | Flue Gas Density page 37).*

9.2.1.2 Velocity of the measuring gas

The velocity of the measuring gas is continuously imported as measuring value in [m/s] at the analogue input and directly considered for the calculation.

9.2.1.3 Dust concentration in operating state

The dust concentration in operating state results from the following formula:

$$Dust = A \cdot S \cdot v^{Exp} + D$$

$$Exp = B \cdot v^2 + C \cdot v + E$$

dust	Dust content in [mg/m³]
S	Dust raw signal in [%]
A, B, C, D, E	Calibration constants
v	Velocity of the measuring gas in [m/s]
Exp	Exponent

The exponent contains the mathematical compensation of the velocity influence on the triboelectric signal.

9.3 Execution of the calibration

9.3.1 Generally

The basis of the triboelectric dust measurement is the measurement of the charge intensity of the dust particles. Apart from diverse physical effects the intensity is defined by the plant itself, e.g. fabric filters are substantial. Therefore do not increase the dust concentration by external dosing. Try to increase the frequency of cleaning impulses, use bypasses of the filter or use defective filter bags. In any case the differential pressure control of the filter plant has to work actively.

9.3.2 Velocity

Before the gravimetric dust calibration can be done, the velocity measurement must be checked first. We recommend to execute a reference measurement according to VDI 2066 and 3950 and to adapt the measuring system in a corresponding way.

HINT

In the following description of the dust calibration an aligned velocity measurement is supposed!

9.3.3 Dust content

In order to execute the gravimetric calibration the following steps are recommended:

1. Calibrate the probe electronic *(see 8 Device calibration page 46)*.
2. Determine and enter in PFM 02 V the following parameters for continuous calculation of velocity *(see 6.4.2 Analogue input Page 34):*

Input Type	⇨ *Page 35*
Measuring Range	⇨ *Page 37*
Flue Gas Density	⇨ *Page 36*
Probe Factor	⇨ *Page 37*
Velocity factor	⇨ *Page 38*

3. Record analogue signal CiB and form average values for the period of the gravimetric reference measurements. The calibration parameters have to be adjusted at the following standard values for calibration:

A	⇨ *1*
B	⇨ *0*
C	⇨ *0,002*
D	⇨ *0*
E	⇨ *-1,25*

4. **Note** the values for **output mode** and **output range** for **analogue output 1** and **analogue output 2!**
5. Set the **analogue output 1** in the **output mode** on **dust in [%] (= raw signal)** *(see 6.4.1.3 Setup | Output Mode page 28)*
6. Set the **output range 1** at **0 ... 100 %** *(see 6.4.1.4 Setup | Output ranges page 29)*
7. Set the **analogue output 2** in the **output mode** on **velocity v in [m/s]** *(see 6.4.1.3 Setup | Output Mode page 28*
8. Set the **output range 2** at **0 ... 30 m/s** *(see 6.4.1.4 Setup | Output ranges page 29)*
9. **Record both analogue outputs** during the gravimetric reference measurements with a suitable measuring data acquisition and **form average values**
10. **Set back** the values for **output mode** and **output range** for **analogue output 1** and **analogue output 2** after the gravimetric reference measurement**!**

11. Enter calibration factors after evaluation of the gravimetric reference measurements!

$$Dust_{grav} = A \cdot S \cdot v^{Exp} + D$$

$Dust_{grav}$	Dust content in [mg/m³]
S	Dust raw signal PFM 02 V in [%]
v	Velocity of meas. gas in [m/s]
Exp	Exponent

HINT

The remaining parameters of the above mentioned formula [in angular brackets] are not allowed to be changed.

⇨ Determine parameter A and D out of the correlation.

⇨ Enter parameter A and D *(see 6.4.4 Calibration Parameter page 41)*.

9.3.4 Determination of exponent

At the beginning of the evaluation the parameters of the exponent have to be determined. Depending on measuring point one of 3 possible cases can result:

⇨ Exponent = quadratic function

⇨ Exponent = linear function

⇨ Exponent = constant

Determination of the exponents:

$$Exp = \frac{\ln\left(\frac{Dust_{grav.}}{S}\right)}{\ln(v)}$$

$Dust_{grav}$	Dust content in [mg/m³]
S	Dust raw signal PFM 02 V in [%]
v	Velocity of measuring gas in [m/s]
Exp	Exponent

Regarding the resulting curve progression in the diagram 3 cases become clearly. The following examples show possible results:

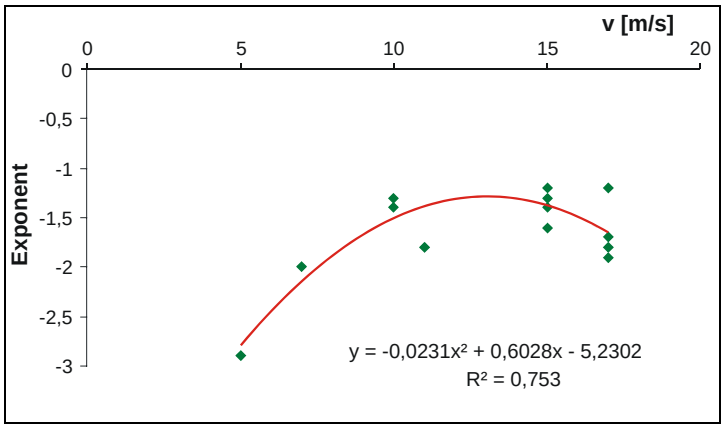


Fig. 9.1: Exponent (quadratic function)

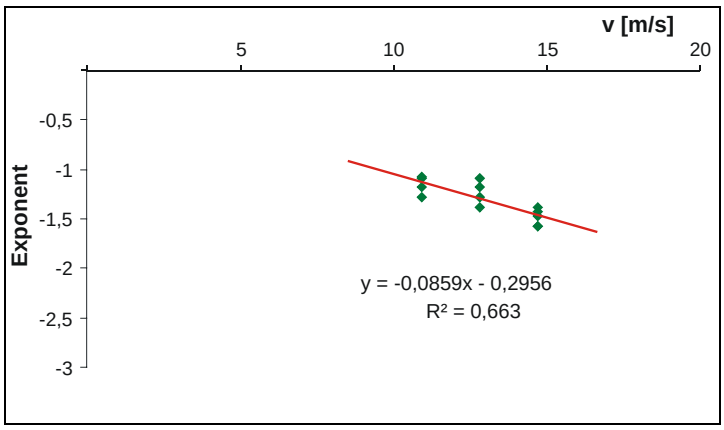


Fig. 9.2: Exponent (linear function)

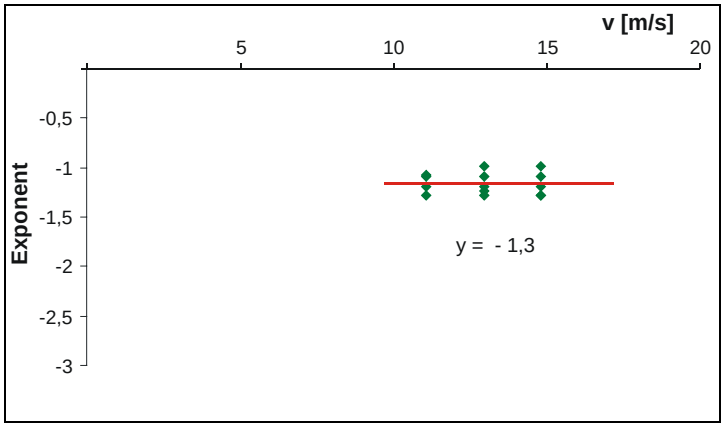


Fig. 9.3: Exponent (constant)

The Parameter B, C and E can be derived from the function.

By means of the auxiliary parameter $C'_{i.B.}$ the parameter A (ascent) and D (Offset) can be determined.

$$C'_{i.B.} = S \cdot v^{Exp}$$

$C'_{i.B.}$	Auxiliary parameter in [mg/m³]
S	Dust raw signal PFM 02 V in [%]
v	Velocity of measuring gas in [m/s]
Exp	Exponent

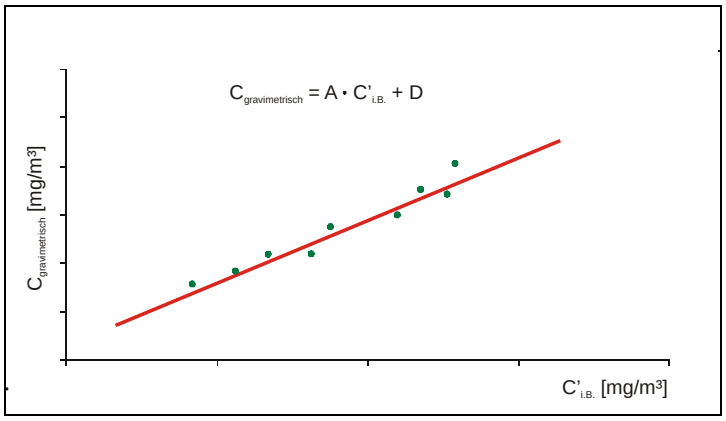


Fig. 9.4: Determination A and D

The Parameter A and D can be derived from the resulting function.

10 Maintenance

10.1 Maintenance

HINT

Warranty claims can only be granted if maintenance works have been done in accordance with the instructions.

The maintenance works aim at:

- ⇨ Preserving the measuring exactness of PFM 02 V,
- ⇨ Granting the operating safety,
- ⇨ Increasing the lifetime of the measuring device.

Moreover maintenance works are a basis for guarantee items.

10.1.1 Maintenance works

Minimum period	Activity
6 months	⇨ Cleaning of the probe

Table 10.1: Maintenance works

10.2 Cleaning

The dust measuring device PFM 02 V has to be cleaned at least every 6 months. The frequency of cleaning works to be done depends on the chosen measuring position respectively the measuring media (especially the dust content) and on the environmental and climatic conditions.

For all cleaning works at PFM 02 V it is valid:

WARNING

Danger of burn!

Wear protective gloves!

Before the PFM 02 is de-installed and cleaned, it must be switched off and the probe rod has to be cooled down.

The probe rod can be cleaned, brushed or blown off depending on the degree of pollution.

11 Error messages and error elimination

HINT
If failures or errors occur, which cannot be eliminated by the measurements described hereinafter, contact the Dr. Födisch Umweltmesstechnik AG (see cover inside).

The PFM 02 V supplies status signals for monitoring, signalling error states and error search. These are provided at the display and at the status contacts as potential-free contact. All errors are written in chronological order into the error list *(see 6.4.5 Error page 43).*

11.1 Maintenance request

The operating state Maintenance request occurs under the following points:

Message	Meaning	Measures
⇨ Maintenance request	⇨ The zero or the reference point deviated by +/- 2% of the target value at the automatic control see *8.2 Zero and reference point Page 46*	⇨ Calibrate device *⇨ 8.3 page 46* ⇨ Delete error entry *⇨ 6.4.5.2 page 43*

Table 11.1: Error messages

11.2 Maintenance/Failure

The operating state Maintenance/Failure occurs under the following points:

Error	Meaning	Measures
⇨ 0 : 0 – act. Time	⇨ is the present time of PFM 02 V (is set back to 0 : 0 when it is switched on) – no error, only message	⇨ none
⇨ Restart	⇨ Time for switch on PFM 02 V no error, only message	⇨ none
⇨ Com. TO	⇨ TimeOut for communication inside of the device	⇨ Check the cables in the device for fixed fit ⇨ Call service
⇨ Com. R	⇨ Delivery error for communication inside of the device	⇨ Check the cables in the device for fixed fit ⇨ Call service
⇨ Com. W	⇨ Reception error for communication inside of the device	⇨ Check the cables in the device for fixed fit ⇨ Call service
⇨ mA-Inp1	⇨ error at analogue input 1, current signal < 4 mA or current signal > 20 mA	⇨ Check wiring ⇨ Check current signal

Error	Meaning	Measures
⇨ mA-Inp2	⇨ error at analog input 2, current signal < 4 mA or current signal > 20 mA	⇨ Check wiring ⇨ Check current signal
⇨ v-min	⇨ velocity of measuring gas < 3 m/s	⇨ Wait for increase of velocity
⇨ Zero point	⇨ The zero point deviated by +/- 4% from the target value at the automatic control ⇨ *8.2 Zero and reference point Page 46*	⇨ Calibrate device ⇨ *8.3 page 46* ⇨ Delete error entry ⇨ *6.4.5.2 page 43*
⇨ Reference point	⇨ The reference point deviated by +/-4 % of the target value at the automatic control ⇨ *8.2 Zero and reference* point *Page 46*	⇨ Calibrate device ⇨ *8.3 page 46* ⇨ Delete error entry ⇨ *6.4.5.2 page 43*
⇨ 5-hourly zero and reference point control	⇨ the zero and reference point of the PFM 02 is just checked	⇨ none

Table 11.2: Error messages

12 Technical Data

Feeding		230 / 110 VAC, 50 – 60 Hz, 24 VDC, 3 VA
Degree of protection		1
Ready for operation		after 5 to 15 minutes
Probe		
dimensions (B x H x T)		160 x 130 x 480 mm
Immersion depth		300 mm (Standard -> **see order data!**)
weight		appr. 2,5 kg
Kind of protection		IP 65
Ambient temperature		- 20 °C ... + 50 °C
Ambient humidity		n.a. (no explicit sensitivity)
Measuring ranges		
dust (qualitative)		0 … 100 %
dust (quantitative)		0 .... 10 (max. 1000) mg/m³
Electric connections		
Analogue signals (outputs)		4 ... 20 mA
Analogue signals (inputs)		4 ... 20 mA or twowire-transmitter connection 12 VDC
load		max. 500 Ω
Status signals		max. 24 VDC at 0,1 A
Sum status	*Single status*	
⇨ Maintenance/Failure	⇨ Failure	Contact normal closed (in case of failure or maintenance opened)
⇨ Limit value 1	⇨ Maintenance	NC or NO selectable
⇨ Limit value 2 / Maintenance request	⇨ Maintenance request	NC or NO selectable

Table 12.1: Technical data

13 Menu guide

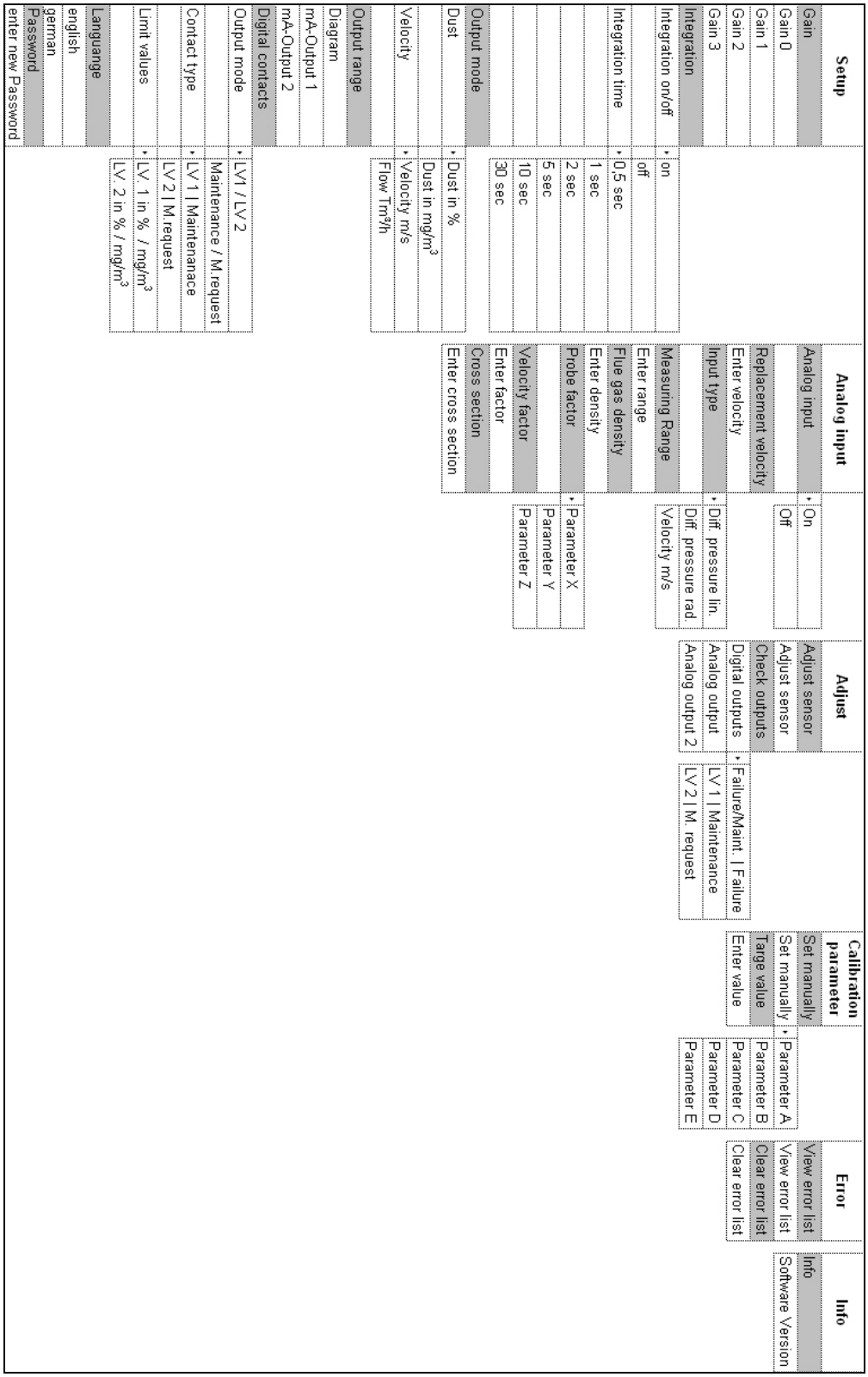


Fig. 13.1: Menu guide PFM 02 V

14 Spare parts & consumables

In order to purchase spare parts and consumables please contact Dr. Födisch Umweltmesstechnik AG (see cover inside).

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