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Operating Manual

Fine Dust Monitor System

Fidas®

Fidas® 100
Fidas® 200/200 S
Fidas® 300/300 S

Model 100/200/300

Model 200 S/300 S

CONTENTS

IMPORTANT NOTES !!!

- Please check immediately after unpacking the instrument if there are obvious transportation damages. If any damages of the instrument are visible, don't connect it to mains and don't switch it on. Call the manufacturer to check if the instrument can be operated safely.

- It is essential to read the operating instructions thoroughly before operating Fidas®!!

- The manufacturer is not liable for damages caused by improper operating, incorrect cleaning or the measurement of aerosols with a gas condition or composition the instrument is not specified for.

- The instrument may only be operated in dry rooms under atmospheric environmental pressure at temperatures between 0°C and +40°C.
  The manufacturer will not be liable with regard to the operating guarantee, if operating takes place under different environmental conditions, such as corrosive or explosive environment, electric or electromagnetic fields, operating within areas of ionising radiation, within areas conductive to shock or vibration.

- **To switch-off Fidas®, use the "shut down" button; Fidas® shuts down then automatically. Do not switch-off the mains switch, before the operating system shut down automatically!!!**

- Fidas® was manufactured for the system voltage defined in the correspondent order. Please check if the system voltage indicated on the identification plate corresponds to the system voltage at the place of operation.

Only use original spare parts! Please contact the manufacturer to order spare parts.

- **Attention:** Aerosols might be dangerous to your health. That's why they ought not to be inhaled. It might also be necessary to wear protective clothes (dust mask). Please pay attention to the correspondent standards and safety rules.

- General information on optical particle counters, such as resolution capacity, detection limit and counting efficiency, can be found in the VDI-guideline 3489, Part 3.

1 Installation and first operation

1.1 Mains voltage check

The Fidas® was set by the manufacturer to the mains voltage requested in the order. Please verify, if the mains voltage indicated on the type label corresponds to the mains voltage at the respective place of the installation.

The manufacturer is not liable for damages resulting from operation with improper mains voltage!!!

1.2 Check of the completeness of delivery

For the transport by a forwarding company, the Fidas® system was decomposed in its components. Before the first operation, the system has to be recomposed. The following parts should be available:

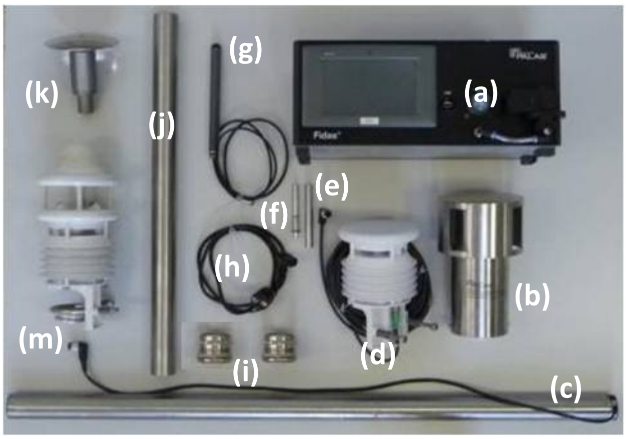


Fig. 1 A+B: on the left components of a Fidas® system, on the right IP-65 weather protective housing

For all versions, the following components and documentation should be available (the letters in parenthesis refer to the indications in figure 1):

- Fidas® control unit (a)
- Aerosol inlet tube (f)
- Power cable (h)
- Plastic tube ca. 30 cm for calibration and verification
- 1 bottle CalDust 1100 for calibration and verification
- Refill pack CalDust 1100
- Cleaning kit with optical wipes

- Manual Fidas® Fine Dust Monitor System (printed)
- Description Fidas® Firmware (printed)
- Manual PDAnalyze (printed)
- Manual weather station WS300-UMB
- Calibration certificate (printed)
- CD or USB flash drive with evaluation software PDAnalyze
- Serial cable (null-modem)
- Pointer for touchscreen

Depending on the model, the following components are additionally included in the delivery:

Only Fidas® 100:

- Sensor for temperature, relative humidity and pressure

Only Fidas® 200:

- Weather station WS300-UMB (d) – optional instead also WS600-UMB (m)
- Sampling tube with IADS (c)
- Connection sampling head to sampling tube (e)
- Sampling head Sigma-2 (b) – optional instead or additional also PM-10 or PM-2,5 sampling head (k)
- Fixing of the sampling tube at the housing (i)

Only Fidas® 200 S:

- Weather station WS300-UMB (d) – optional instead also WS600-UMB (m)
- Sampling tube with IADS (c)
- Connection sampling head to sampling tube (e)
- Sampling head Sigma-2 (b) – optional instead or additional also PM-10 or PM-2,5 sampling head (k)
- 2x Fixing of the sampling tube and the weather station tube at the housing (i)
- Tube for weather station (j)
- Antenna (g)
- IP-65 weather-protective housing

Only Fidas® 300:

- Weather station WS300-UMB (d) – optional instead also WS600-UMB (m)
- Sampling tube with IADS (c)
- Connection sampling head to sampling tube (e)
- Sampling head Sigma-2 (b) – optional instead or additional also PM-10 or PM-2,5 sampling head (k)

- Fixing of the sampling tube at the housing (i)
- Big pump for volume flow 2,3 m^3/h

Only Fidas® 300 S:

- Weather station WS300-UMB (d) – optional instead also WS600-UMB (m)
- Sampling tube with IADS (c)
- Connection sampling head to sampling tube (e)
- Sampling head Sigma-2 (b) – optional instead or additional also PM-10 or PM-2,5 sampling head (k)
- 2x Fixing of the sampling tube and the weather station tube at the housing (i)
- Tube for weather station (j)
- Antenna (g)
- Big pump for volume flow 2.3 m^3/h
- IP-65 weather-protective housing

1.3 Equipment overview

1.3.1 Front panel of the Fidas® control unit

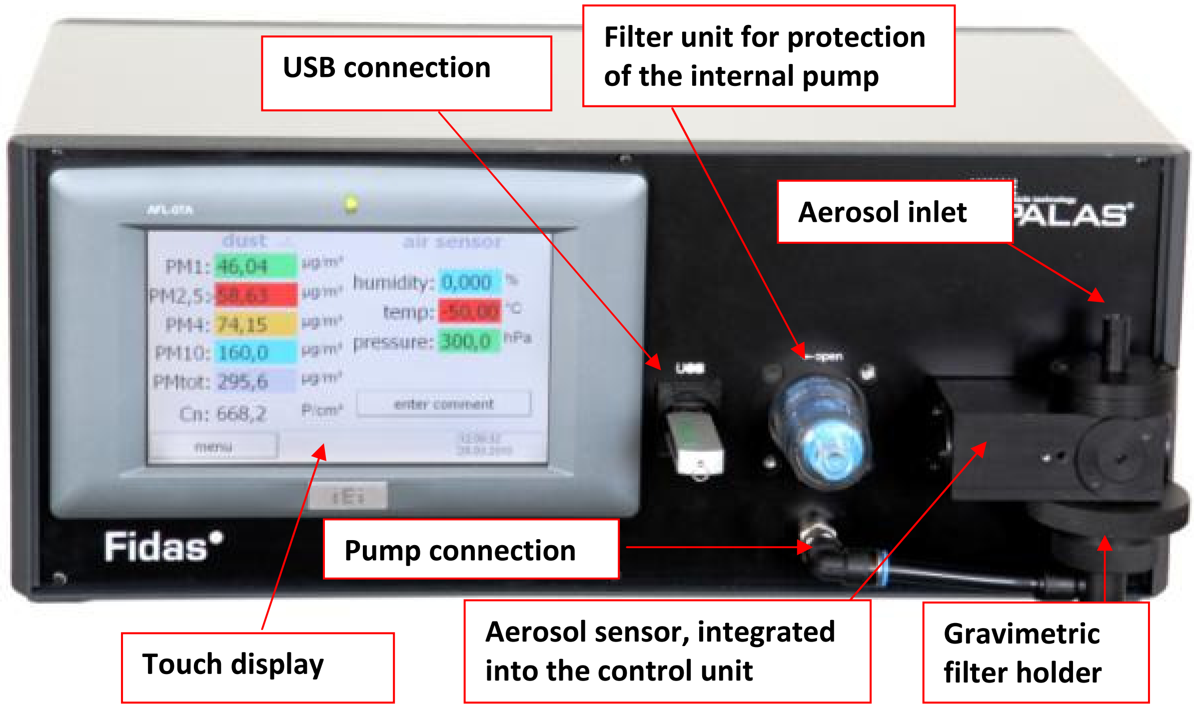


Fig. 2: Front panel of the Fidas® control unit

The Fidas® system is operated via the touch display (please see separate manual Fidas® Firmware for detailed information).

The data can be readout via the USB connection and processed further on an external PC with the additional PDAnalyze software (included in the delivery).

1.3.2 Back side of the Fidas® control unit

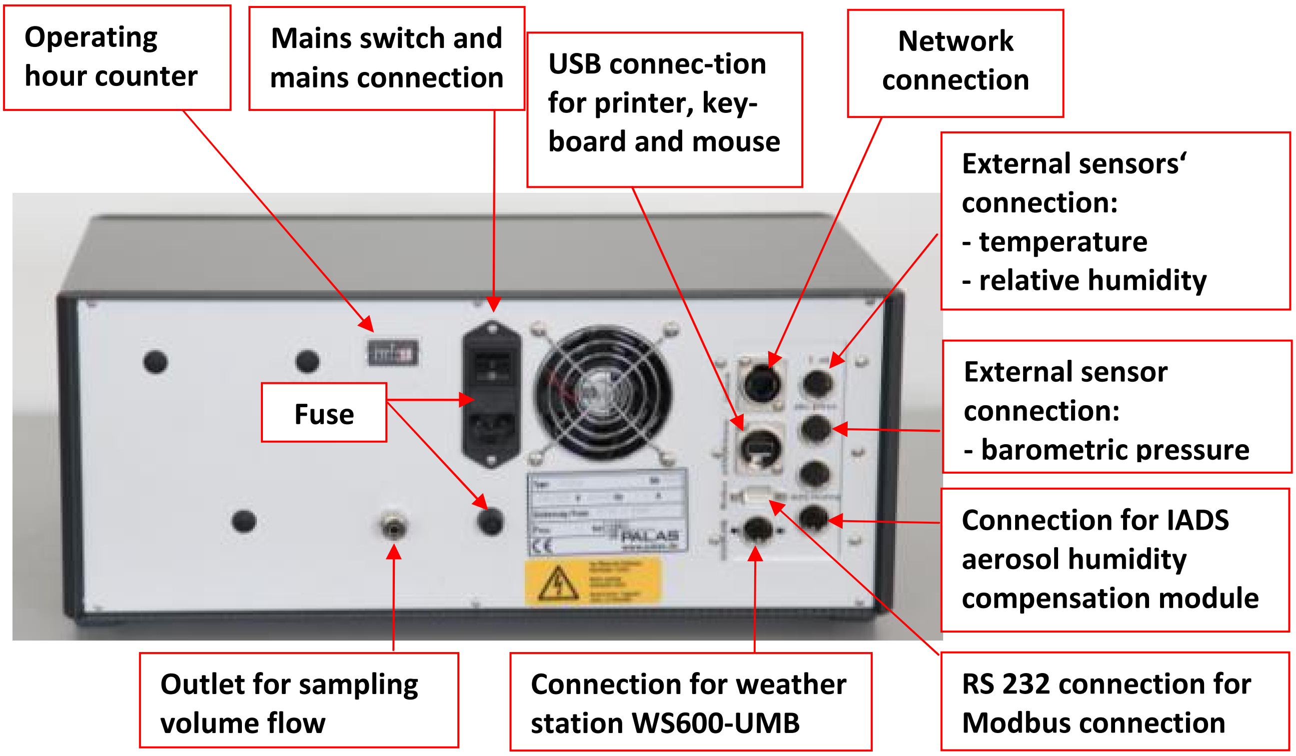


Fig. 3: Back side of the Fidas® control unit

The control unit is switched on and off with the mains switch.
There are two fuses, T 2 A / 250 V, at the back side.

The LED is switched on by the mains switch. The operating hour counter runs as long as the device is switched on. The lamp has a life cycle of > 20,000 operating hours.

1.3.3 Connections on the back side of the Fidas® control unit

On the right, there are the following connection possibilities:

- **Network**, to connect the Fidas® System to a network, e.g. for remote service and for transfer of software updates.
- **USB connection**, e.g. for a printer, keyboard, mouse or USB stick.
- Modbus via **RS 232** connection for remote enquiry of the measured values and external control of the measurement device (WebAccess).
- **Connection for weather station WS600-UMB** (Fidas® 200 S and Fidas® 300 S systems) for recording of**:**
    - wind speed
    - wind direction
    - precipitation quantity
    - type of precipicitation
    - temperature
    - humidity
    - pressure
- **Connection for external sensors** for recording the temperature and relative humidity
- **Connection for external sensor** for recording the barometric pressure
- **Connection for aerosol humidity compensation module IADS** (Intelligent Aerosol Drying System)

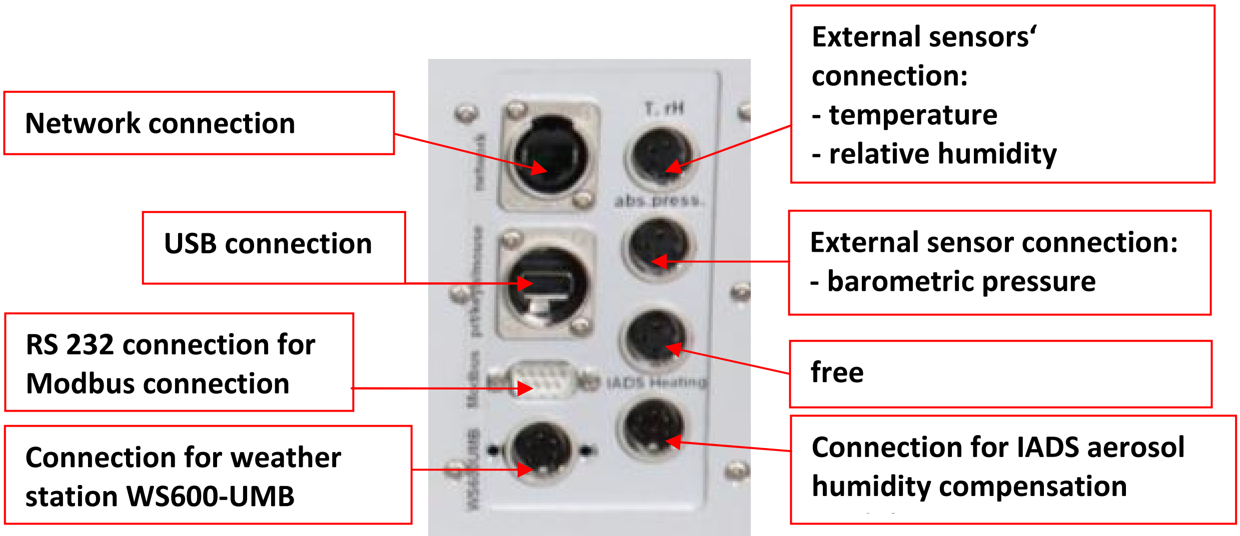


Fig. 4: Connection possibilities on the back side of the Fidas® control unit

1.4 First measurement

Switch on the instrument with the I/0 switch on the back side of the Fidas® control unit.
By switching on the instrument, the measurement procedure automatically starts. After the start, the start screen appears (see Fig. 1).

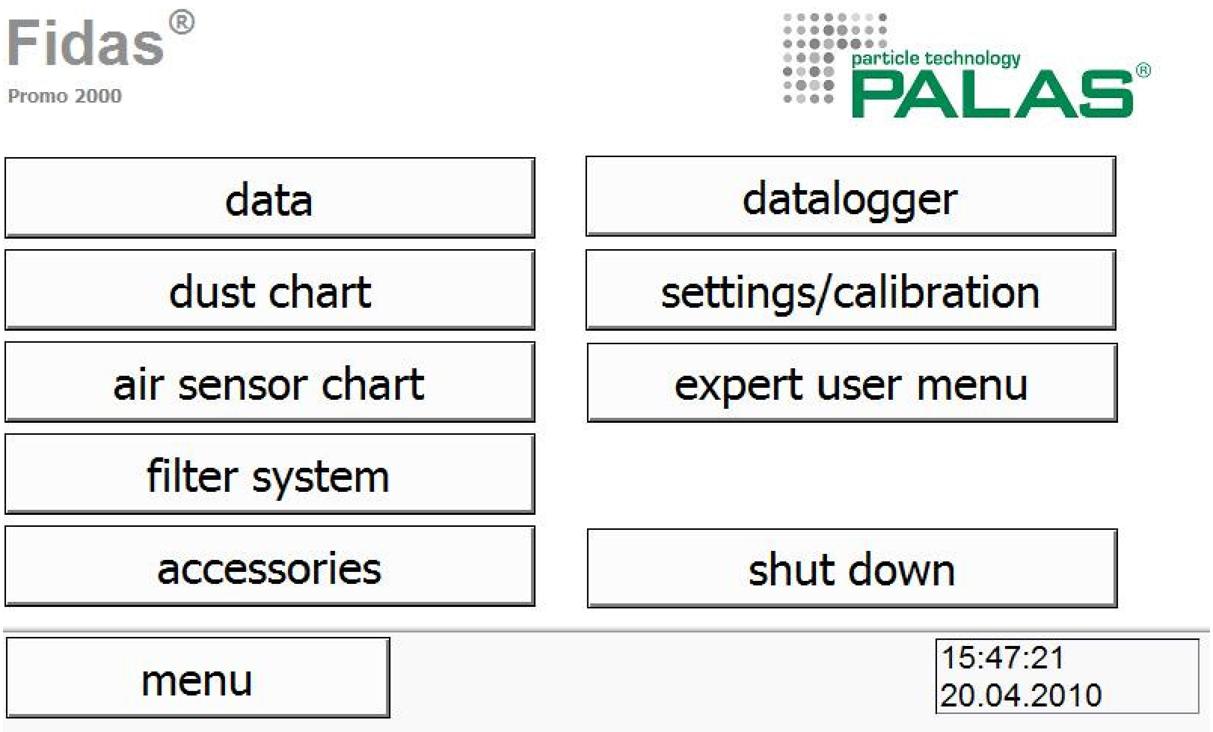


Fig. 5: Start screen

The user can now change from one display option to another by using the touch display.
Figure 6 shows for example an overview of the dust values:

- PM 1
- PM 2,5
- PM 4
- PM 10
- PM total (total mass concentration)
- Cn: Particle concentration in P/cm^3

Air sensors:

- Relative humidity
- Temperature
- Barometric pressure

Fig. 6: Data overview, e.g. PM values

Please see separate manual Fidas® Firmware for detailed information.

2 Fidas 200 S / Fidas 300 S – Implementation of the components in the IP-65 weather-protective housing

2.1 Mounting of the weather station

The shorter stainless steel tube is the mounting of the weather station. You need the following components:

- Short stainless steel tube
- Fixing of the tube at the housing
- Weather station WS300-UMB – or optional instead WS600-UMB

You need the following tools:

- 13 mm open-end wrench
- 40 mm open-end wrench or adjustable tongs

Figure 7 shows the components of the fixing. Please take care that the sealing rings are also used and that they are in an undamaged condition. These rings serve as sealing in order to avoid that water enters the housing. If water enters from outside the housing, it is possible that the control unit is damaged or even that the Fidas® breaks down.
Palas® assumes no liability for damages arising from a leak in the fixing.

Fig. 7: Components of the fixing of the weather station tube

Please make sure that all components are available. Then, combine the first 5 components (from left to right in figure 7) and move them over the tube (there is a cover on the top and under it there is the passage for the cable to the weather station. Then proceed with this part of the fixing and the lower part of the tube from the outside through the left rear opening of the weather-protective housing.
Then attach from inside first the sealing ring (shown in Figure 7, far right) and then the thin nut (second from right in figure 7). Then screw tightly both the inner and outer nut with a wrench or adjustable tongs.

Fig. 8: Fixing of the weather station tube

Figure 8 shows how the fixing of the weather station tube should look like.

Before mounting the weather station at the tube, please verify that the tube has a cover on the top. Then slide the weather station on the tube (figure 9) and tighten the nuts slightly (the weather station must rotate easily!).

Fig. 9: Mounting of the weather station at the tube

Set up the weather station to the north of.
Then tighten the two nuts on alternate so tight that the weather station can no longer move.
<u>Attention:</u> if you tighten the nuts too tight, the mounting of the weather station can split!
Then, connect the cable with the weather station (hand-tight!) as shown in figure 10.

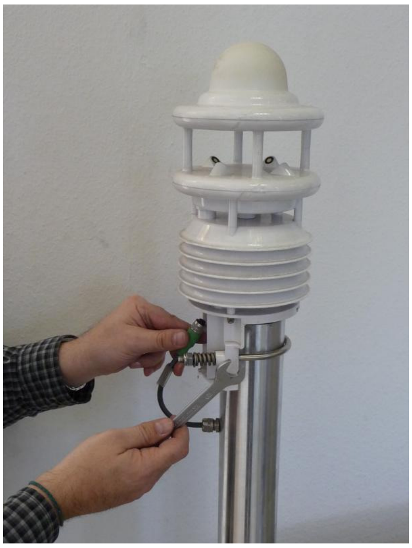


Fig. 10: Connection of the cable with the weather station

2.2 Mounting of the antenna

The antenna consists of a plastic part that has to be mounted at the outside of the housing, a sealing ring, a serrated washer, a nut and a cable as shown in figure 11.

Fig. 11: The antenna

Direct the cable from the outside through the small hole on the top of the housing. Then attach the antenna from the inside by means of the serrated washer and the nut.
Make also sure that the sealing ring seals the opening, but do not tighten the nut too tight as the plastic may crack then.

2.3 Mounting of the sampling tube

For the mounting of the sampling tube at the weather-protective housing, the same fixing is used than for the mounting of the weather station tube. Figure 6 shows the components. The sampling tube includes the heating for the IADS (intelligent aerosol drying system), therefore a cable is connected.
First, direct the bottom end with the cable from the outside through the hole on the right front (see figure 12). Then place the first sampling tube on the base of the control unit (not on the control unit itself).

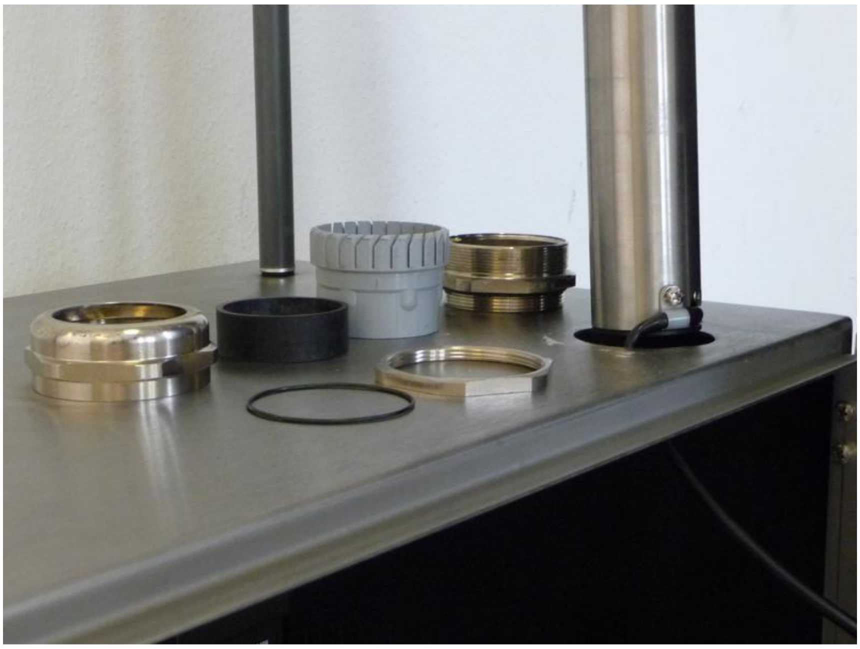


Fig. 12: Insert the sampling tube

Then slide the outer parts of the fixing on the sampling tube.
Figure 13 shows how the rubber gasket is directed from the top in the gray sleeve. What remains are still the big outer nut which is mounted only at the very end, and the sealing ring and the nut, which are inserted from the inside.

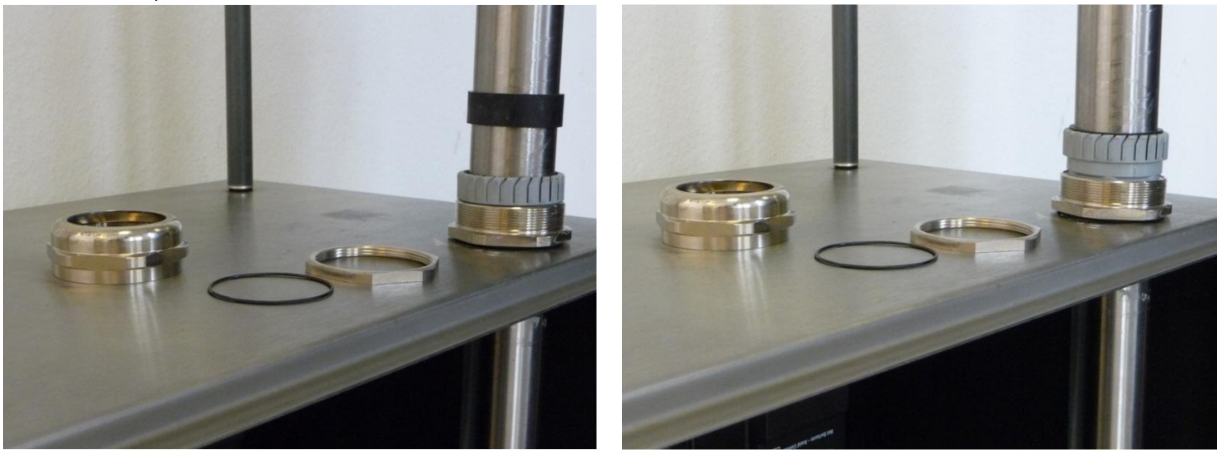


Fig. 13 A+B: Outer fixing of the sampling tube

Then attach first the remaining thin ring via the cable from the inside and then the thin nut at the rest of the fixing. Tighten the nut.
However, please take care that sampling tube can still move for the later installation of the Fidas® control unit.

2.4 Insertion of the Fidas® control unit

First, plug the aerosol inlet tube into the opening on the sensor head (figure 14).

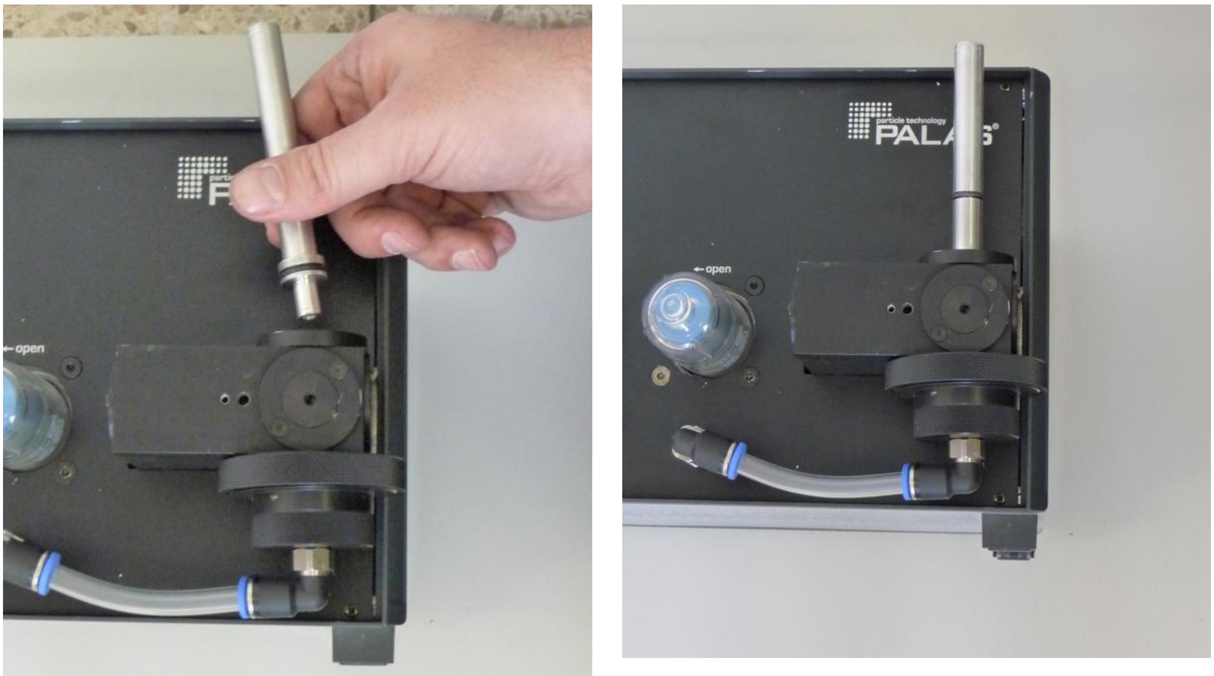


Fig. 14 A+B: Mounting of the aerosol inlet tube

Lift the Fidas® control unit carefully and insert it as shown in figure 15 into the weather-protective housing and place it on the platform.


Fig. 15: Insertion of the Fidas® control unit

Then connect the cables from the weather station and the IADS (sampling tube) with the appropriate and designated ports (places shown in figure 16 can vary depending on model). Also, connect the power cable (and possibly a network cable), but do not switch the Fidas® on!

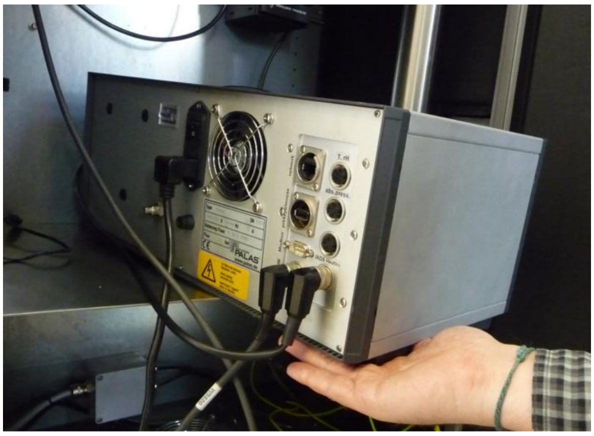


Fig. 16: Connection of the weather station, IADS with the ports on the back side

Then place the control unit so that you are exactly under the sampling tube with the opening of the sampling inlet tube. You must have previously lifted the sampling tube. Then direct carefully (!) the sampling tube through the sampling inlet guide tube as shown in Figure 17. The sampling tube should be as vertical as possible, if necessary, please change the position of the control unit accordingly.

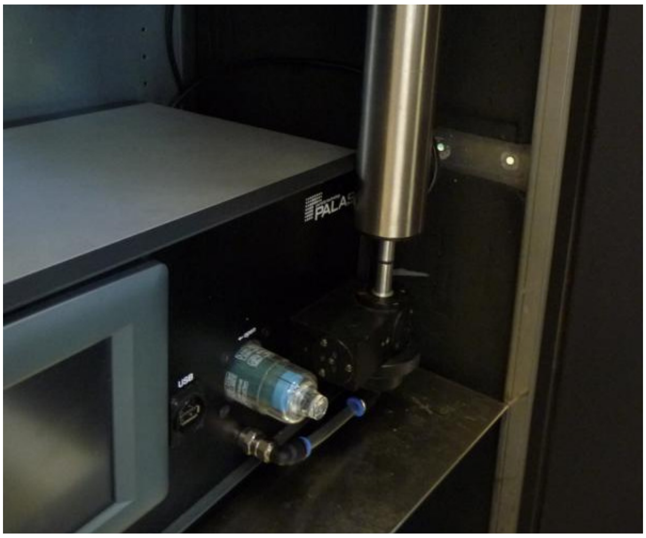


Fig. 17: Connection of the sampling tube with the sampling inlet tube and the control unit

Continue like this until the sampling tube rests on the sensor unit, i.e. there should be no gap. Figure 18 B shows the correct position.

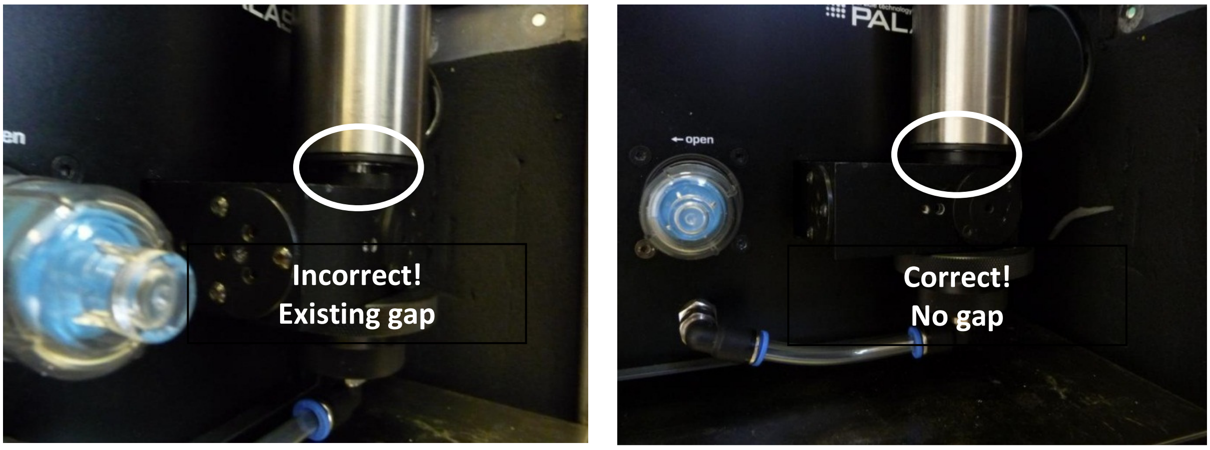


Fig. 18 A+B: on the left wrong position of the sampling tube, on the right correct position

Then mount carefully the brackets of the mounting:

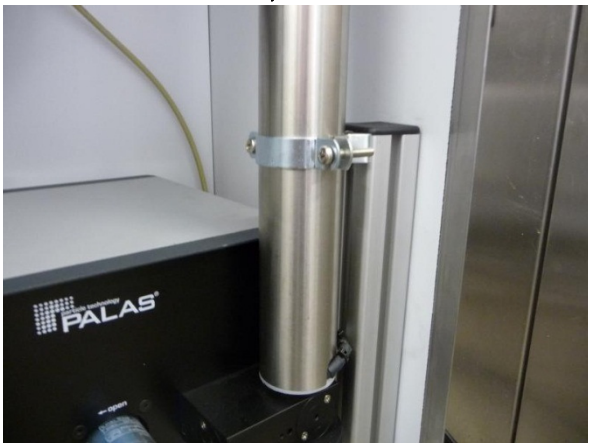


Fig. 19: Internal fixing of the sampling tube

Then slide the large remaining nut of the fixation of the sampling tube over the rest and tighten it (figure 20). Make also sure that sealing ring seals the opening.

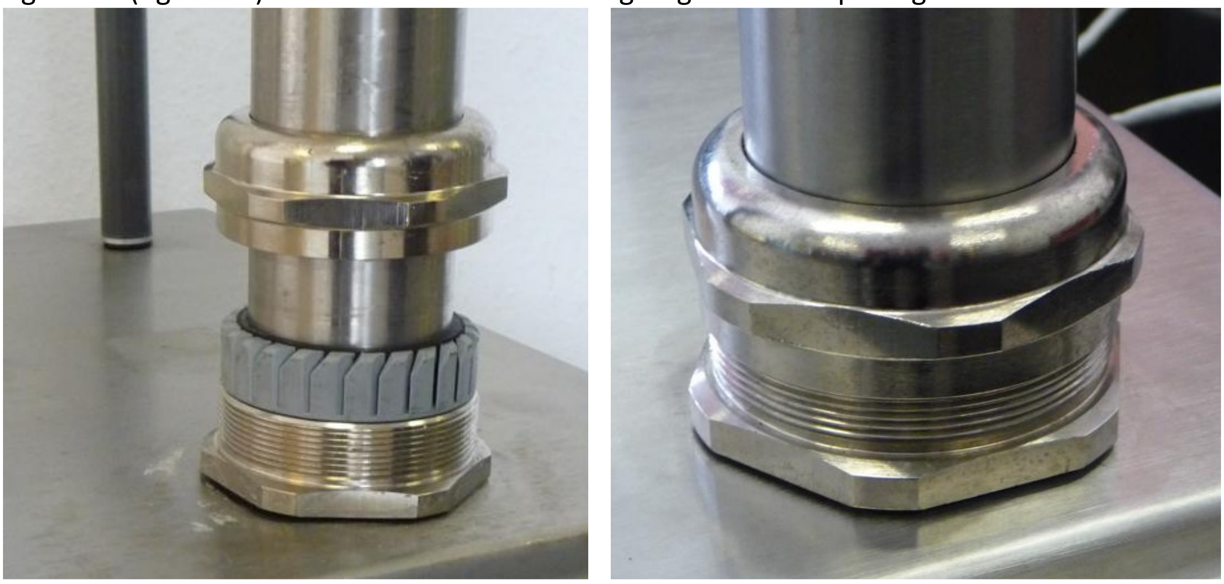


Fig. 20 A+B: Final fixing of the sampling tube

2.5 Mounting of the Sigma-2 sampling head

First, please place the connection piece sampling head to sampling tube as shown in figure 21:

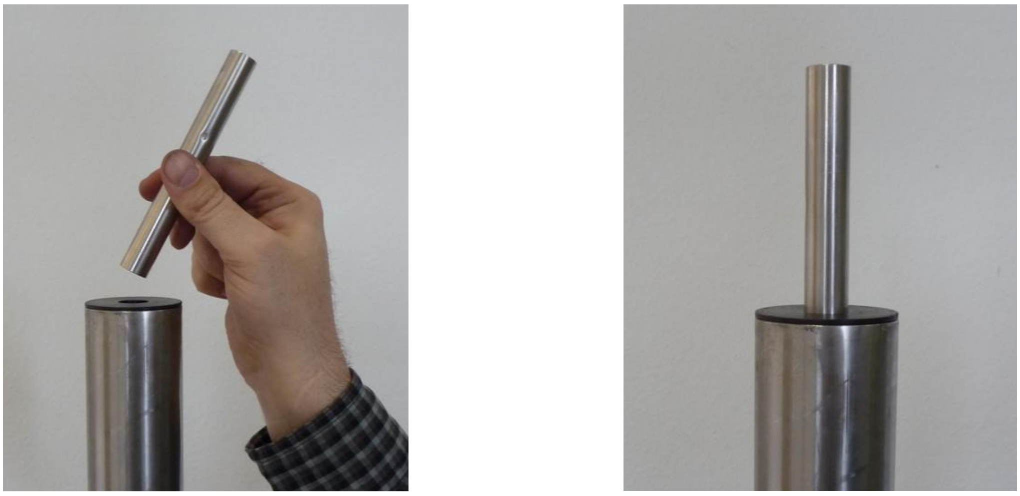


Fig. 21 A+B: Placing of the connection piece

Then slide the sigma-2 sampling head on this connection piece (it should be rest on the sampling tube) and then fix the sampling head with the size 2 Allen key (see figure 22).

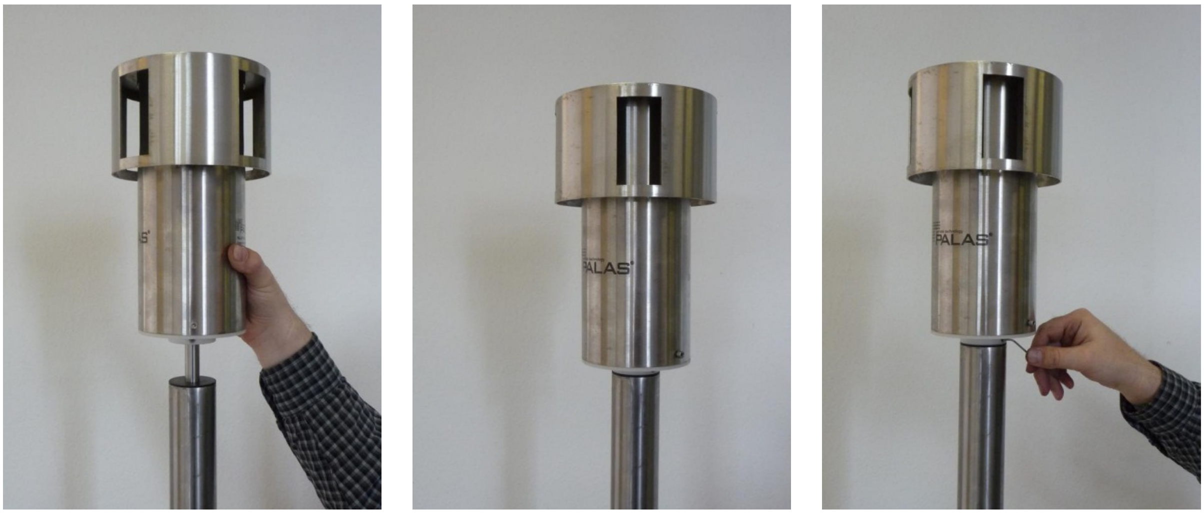


Fig. 22 A-C: Mounting of the Sigma-2 sampling head

If you use a PM-10 or PM2,5 sampling head instead of the Sigma-2 sampling head, then you can proceed accordingly.

2.6 Final handholds

Please connect the power cable on the spot with the corresponding port of the weather-protective housing. Then slide the cover over this port (figure 23).

Fig. 23 A+B: Power connection of the weather-protective housing

Then press the power button on the back of Fidas ® control unit.
After booting up the Windows operating system and the Fidas ® start-up manager, you can see the screen with the various PM fractions, particle number concentration and the ambient conditions (temperature, relative humidity, atmospheric pressure). For the first values of the PM fractions you must wait about 4 minutes due to the averaging.

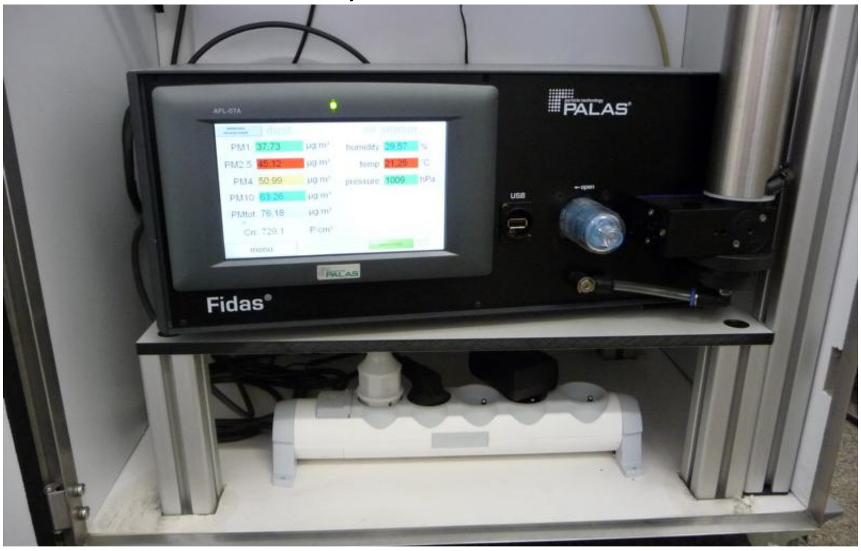


Fig. 24: Fidas® during operation

3 Calibration/ Verification of the Fidas®

A calibration of the instrument should always be performed before the beginning of a measurement campaign. During an actual measurement campaign, the calibration should be performed every 6 months.
Before calibration, the instrument must be in operation for at least one hour so that it is in a thermally stable condition. The ambient temperature must be within 10 and 25°C. To calibrate, the device has to be in the calibration mode. At the beginning of the calibration procedure, first the IADS (drying system) is heated up or cooled down to 35 °C so that the volume flow and the gas dynamics are always the same and the dust that is used for calibration is conditioned. Usually, you have to wait at least ten minutes. During this procedure the temperature is displayed and the calibration begins if the user sees that the temperature is stable at 35°C (+- 0.1°C).
The complete calibration consists of 5 steps:

1.) Automatic offset adjustment
2.) Check of the tightness of the total system
3.) Adjustment of the sensitivity of the particle sensor
4.) Check of the particle flow in the particle sensor
5.) Check of the volume flow

The different steps are described in the following:

3.1 Automatic offset adjustment

The electronical zero point of the system is aligned at the offset adjustment (see figure 26). Thus, the inherent noise of the instrument is minimized. The offset adjustment is performed fully automatically and is started via the button „adjust offset“. The adjustment lasts about two minutes. The minimum of the measured offset voltage must be less than 0.2 mV, the offset adjustment voltage must be within 2 and 3 V.

3.2 Check of the tightness of the total system

The tightness of the whole system is a precondition for a successful calibration. The Fidas® 200 has a sensor that is directly in front of the pump (see figure 25). To check the tightness of the whole system, it is sufficient to seal the inlet for example with the thumb. The measured volume flow must then decrease to 0 l/min (+- 0.1 l/min).

3.3 Adjustment of the sensitivity of the particle sensor

For the adjustment of the sensitivity of the particle sensor, the dust (CalDust 1100 which is included in the delivery) is applied with particles of a defined size. The particle size distribution of this dust is monodisperse. The instrument shows the raw data distribution of the measurement (see figure 26). The peak of this raw data distribution must be in channel 130. This corresponds to a particle size of 0.93 µm. If this is not the case, the voltage of the photomultiplier has to be changed and the procedure must be repeated then. The voltage can be changed via the button „calibrate PM amplification“. If the peak is < 130, the voltage of the photomultiplier must be increased. If the peak is > 130, the voltage of the photomultiplier must be decreased. Through this adjustment of the photomultiplier voltage at a particle size, the sensitivity of the measurement device for all particle sizes is automatically adjusted as the instruments works - unlike other manufacturers of aerosol spectrometers - with only one A/D converter. Please repeat this procedure until the peak of the raw data distribution is at 130 (+- 0.5).

3.4 Check of the particle flow in the particle sensor

In addition to the signal amplitude for each individual particle, the sensor also measures the signal length for each individual particle. This signal length is directly proportional to the velocity of the particles in the sensor, since the height of the optical measuring volume is known. If the velocity of the particles in the sensor is not correct, the flow rate in the sensor is also not correct or the flow guide in the sensor is disturbed. For this reason, the velocity must be checked; otherwise the concentration is determined incorrectly. If the reason for the wrong velocity calibration is no leakage, the device must be returned to the manufacturer. To calibrate the velocity also CalDust 1100 is used since particles of different sizes show slightly different velocities. By using CalDust 1100, the same particle size is always used also for the velocity calibration. The lower diagram (see figure 26) in the calibration mode shows the signal length distribution. Two maxima can be seen.
The left maximum is the length of the signals in the border zone of the sensor (T-aperture), the right maximum is at the length of the signals through the core zone. If you use the arrow keys to direct the crosshair in the right maximum, you get the velocity with this signal length ("measured velocity"). This velocity must match the velocity set by the factory (+ - 0.2 m / s). Due to manufacturing tolerances in the nozzle, the velocities in individual units are slightly different.

3.5 Check of the volume flow

The volume flow of the instrument must be 4.8 l/min (+- 0.15 l/min) at 23 °C and 1013 hPa. This can be verified for example with a „Bubble-flow-meter“. If the device is tight (point 2) and if the velocity of the particle flow in the sensor is correct (point 4), then a check of the volume flow is not necessary.

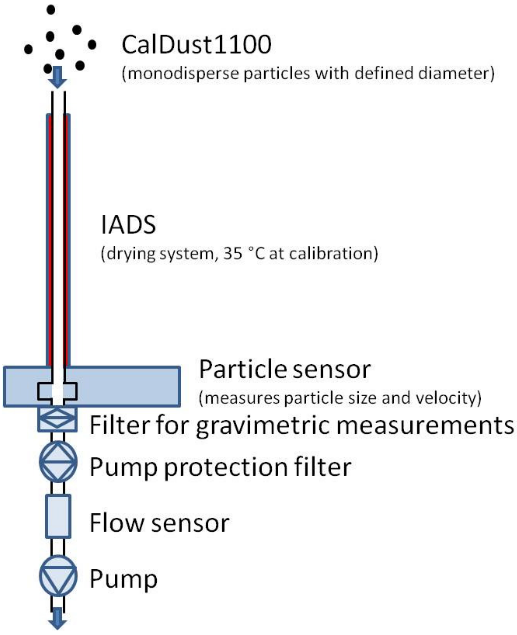


Fig. 25: Schematic set-up of the flow of the sampling volume flow

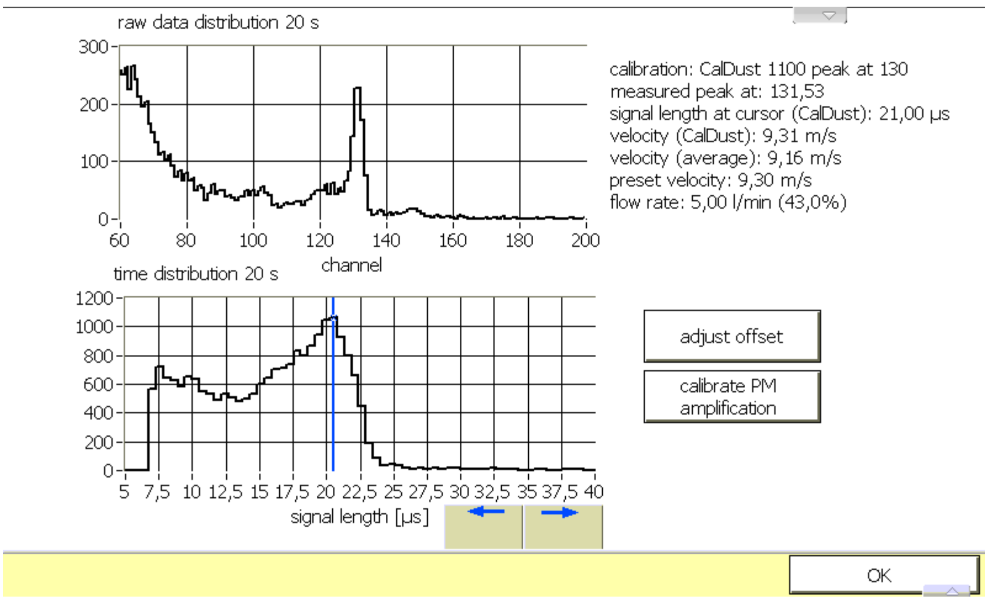


Fig. 26: Screen display during calibration (on the top: raw data distribution of channel 60 to 250 with maximum at 131.53; at the bottom: measured signal length distribution with accordingly determined velocity – here 9.31 m/s)

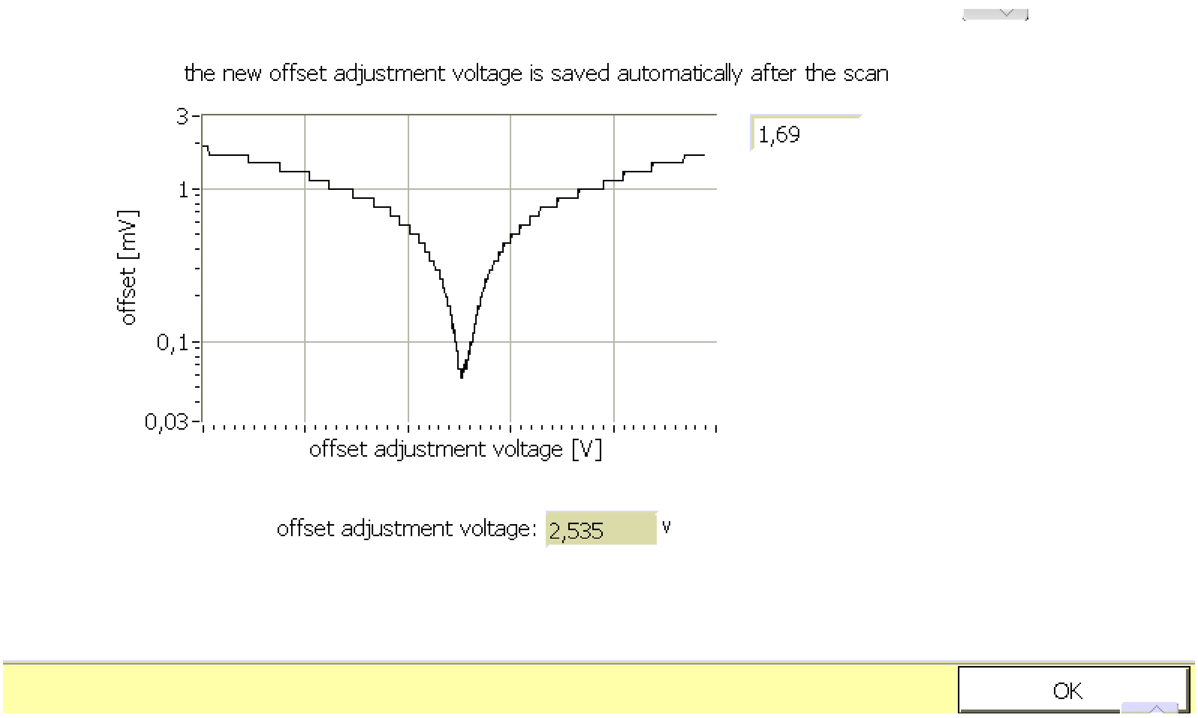


Fig. 27: Screen display during automatic offset adjustment

Procedure	**Size to be calibrated**	**Limits**	**Remark**
Automatic offset adjustment	offset	< 0.2 mV	fully automated
	offset adjustment voltage	> 2 V; < 3V	fully automated
Check of the tightness of the total system	flow rate	< 0.1 l/min	by sealing the inlet
Adjustment of the sensitivity of the particle sensor	measured peak	130 +- 0.5	with calibration dust CalDust1100
Check of the particle flow in the particle sensor	velocity (CalDust)	+- 0.2 m/s of the factory setting	with calibration dust CalDust1100 by marking the right maximum
Check of the volume flow		4.8 l/min +- 0.15 l/min referring to 23 °C and 1013 hPa	with gauged volume flow measurement device

Table1: Calibration procedure

4 Demounting / exchanging the gravimetric filter

To demount the gravimetric filter, the gravimetric filter holder at the bottom side of the aerosol sensor must be removed.

Fig. 28 A-C: Removing the filter holder

The filter holder (Fig. 28 A) can easily be detached by a downward movement (Fig. 28 B). Then, the plug connection of the suction tube can be loosened. Therefore, press the plug connection backwards and at the same time remove the tube with your other hand (Fig. 28 C).

Now, the filter holder can easily be opened by a counter-clockwise rotation.

Fig. 29 A: Setup of the filter holder

The filter holder consists of an upper and a lower part which are connected to each other by a screw closure (see Fig. 29 A and B).
Additionally, on the bottom side, a little fence serves as support for the gravimetric filter.

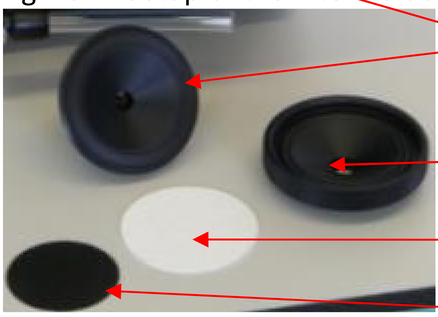


Fig. 29B: Setup of the filter holder

Lower part of the filter holder with connection for the suction tube

Upper part of the filter holder with connection for the aerosol sensor

Gravimetric filter

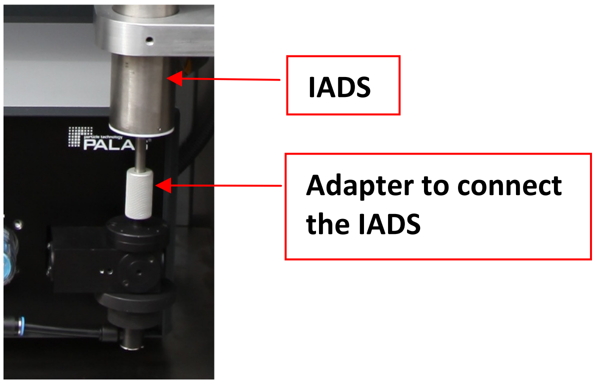
Support fence for the gravimetric filter

5 Cleaning the Fidas® System

5.1 How to clean the sensor

5.1.1 For Fidas® 200/200 S and Fidas® 300/300 S Systems

In case of using an aerosol humidity compensation module IADS, firstly, it has to be removed from the aerosol inlet of the sensor in order to move the control unit with the integrated sensor sideways.



Move the adapter for the connection of the IADS to the aerosol inlet downwards. Then, the IADS can be completely moved upwards, so that the aerosol inlet can easily be accessed.

Fig. 30: Connection of the aerosol inlet with the IADS

5.1.2 For all Fidas® Systems

To clean the internal optical glasses of the aerosol sensor, the filter holder has to be removed from the sensor outlet. Additionally, the plug connection between the filter holder and the inlet of the suction pump has to be removed.

Fig. 31 A-C: Removing the filter holder

The filter holder (Fig. 31 A) can now easily be detached by a downward movement (Fig. 31 B). Then, the plug connection of the suction tube can be loosened. Therefore, press the plug connection backwards and at the same time remove the tube with your other hand (Fig. 31 C).

Then, loosen the two M3 cross-head screws with an adequate screwdriver.

Loosening the two M3 cross-head screws

Then, the cuvette can carefully be removed upwards from the aerosol sensor by simultaneous pushing at the bottom side and pulling at the upper side.

Fig. 32: Loosening the M3 cross-head screws

Fig. 33: Removing the cuvette

<u>Attention:</u>
When removing the cuvette, take care that the optical glasses lying inside the aerosol sensor are not scratched or damaged with the cuvette!

Now, the two optical glasses inside the aerosol inlet can be cleaned. The must only be done with an optical wipe (included in the delivery)!

The two optical glasses inside the aerosol inlet

<u>Attention:</u>
Do not touch the glasses with your fingers!
Cleaning only with optical wipes!

Optical wipe to clean the optical glasses

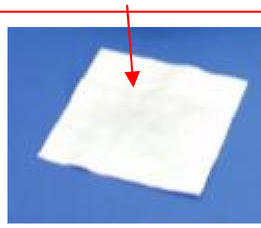


Fig. 34: Optical glasses inside the aersol sensor

Fig. 13: Optical wipe

The cuvette can be cleaned with compressed air.

5.2 How to clean the suction filter of the internal pump

Loosen the protection cap of the suction filter (Fig. 36) by a counter clockwise rotation and remove it.

To be loosen by a left rotation

The filter itself can be removed the same way (Fig. 38)

Fig. 36: Removing the protection cap

Fig. 37: Filter without protection cap

The filter can either be cleaned with compressed air or be exchanged, if it is too soiled.

Filter of the internal suction pump

Protection cap

Fig. 38: Removing the filter

Fig. 39: Deinstalled filter and protection cap

For installation of filter and protection cap, please proceed vice versa.

6 Particle measurement with the Fidas® System

6.1 Special features of the Fidas® system

- Due to white light source and 90° scattered light detection:
  - clear calibration curve (also in the so called Mie-range)

- Due to the patented T-aperture technology:
  - measurements without border zone error
  - automatic coincidence detection and correction according to Dr. Umhauer and Prof. Dr. Sachweh

- Very high resolution
  - high number of measuring channels,
  - display of 32 classes per decade (≅ 60 classes per measurement range)

- Very high classification accuracy

- Measurement range 0.18 – 18 µm

- Ability to measure even in high concentrations due to
  - polychromatic light (LED)
  - 90° scattered light detection
  - even intensity distribution of light inside the measurement volume
  - T-aperture technology
  - optically defined measurement volume
  - coincidence detection

- Sophisticated single particle scattering sensor: max. concentration up to 20.000 P/cm³

Advantage:
The advantage of a counting measurement procedure compared to a collective procedure is that the particle number and particle size are measured at the same time, but separately.

6.2 Clear calibration curve

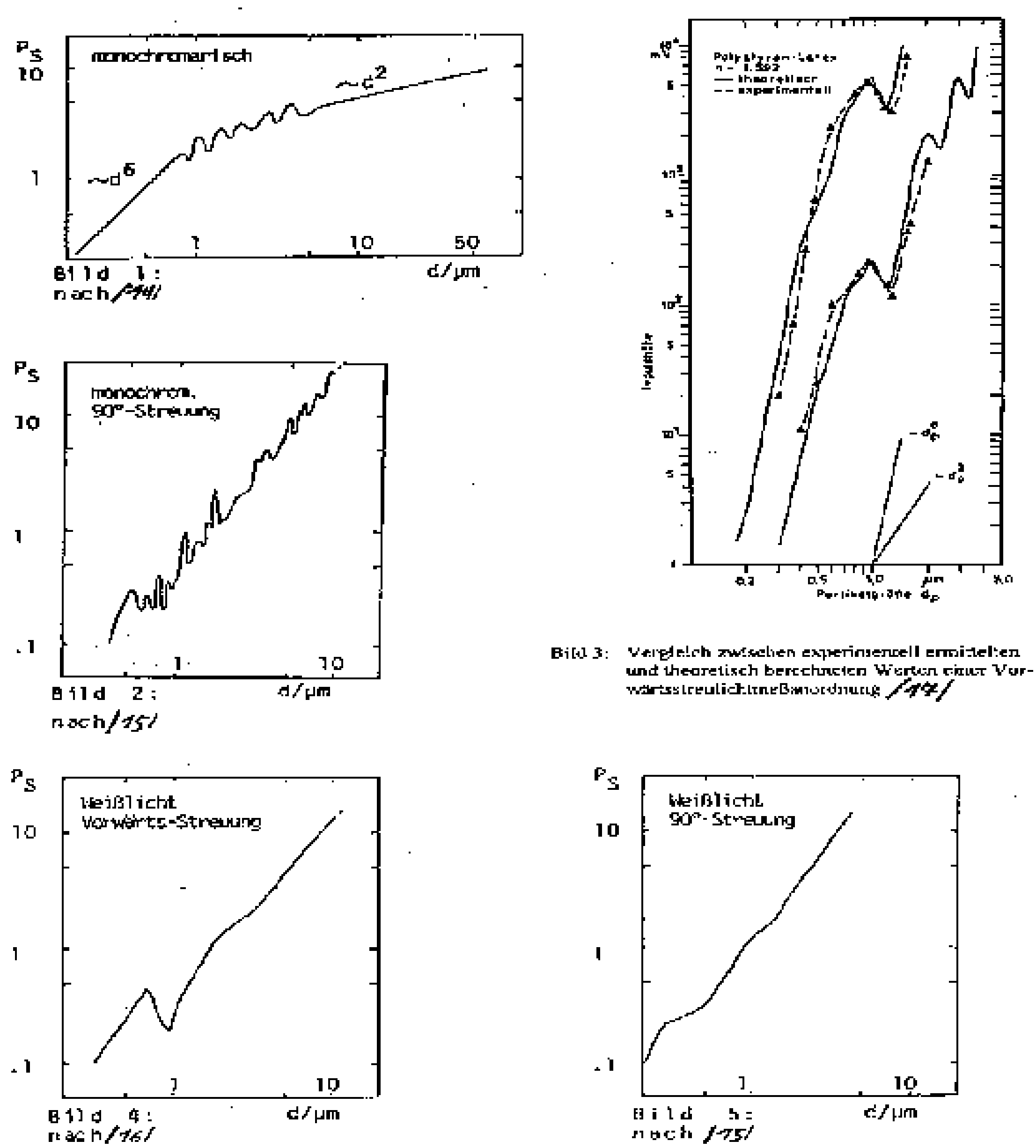


Fig. 40: Calibration curves of different measurement systems

These curves show that a measurement device that works with laser light (graphics 1 and 2 in figure 40) does not supply a clear calibration curve within the wave length of the light.

Fidas® works with a polychromatic light source and with a 90° light-scattering. This guarantees a clear calibration curve (see graphic 5 in figure 40).

6.3 High resolution capacity

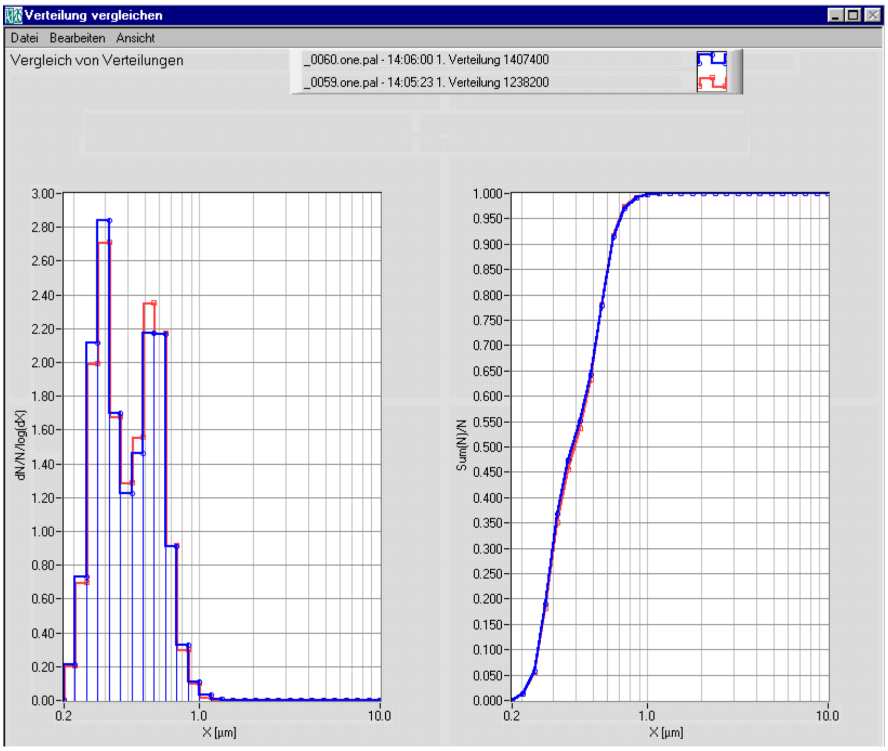


Fig. 41: Distributions

These curves show that the measurement device can identify a bi-modal distribution in the range between 0.3 µm and 0.6 µm. This is only possible due to the high-quality resolution capacity of this device.

6.4 Basic definitions in measurement technology

Classification accuracy

How exact is the measurement of the testing aerosol? Does the determined particle size distribution meet the actual particle size distribution of the testing aerosol?

Resolution capacity

How exact is the resolution of the device? Does the optical particle counter even determine the difference between very close particle sizes?

Ambiguity

Does the optical particle counter determine unambiguously the particle sizes within the range of wave length of the laser light?
There even 180° white light forward scattering delivers ambiguous results.

Border zone error

Does the device consider the tolerances in the border zones caused by the Gaussian distribution of laser light?

Counting efficiency
How many particles of the testing aerosol are really measured at a known concentration?

Coincidence error
How do you assure that the light impulse is caused by only one particle?

6.5 Effects of the device's characteristics

Border Zone Error
The particle size spectrum is measured with too many fines. The broader the particle size spectrum is measured, the more important becomes the border zone error.

Coincidence Error
The particle size spectrum is measured too coarse, the particle concentration is measured too small. According to the definition, a coincidence of 10% is tolerable.

Counting Efficiency
The lower counting efficiency results in a shifting of the particle size distribution towards coarse particles because the fines are undervalued. The upper counting efficiency similarly undervalues the coarse particles. The quantity is determined incorrectly. When measuring with several particle counters, the counting efficiency difference between the used counters has to be known. Only then, the results are comparable!

Classification Accuracy
During correlation measurements (e.g. with impactors), the correlation factor becomes better, the higher is the classification precision.
Instruments with a good classification precision over the total measurement range supply reliable distributions.

Resolution Capacity
During correlation measurements (e.g. with impactors), the correlation factor becomes better, the higher is the resolution capacity. Instruments with a high resolution capacity are able to measure bi- and tri-modal distributions that are located close to each other.

7 Ensuring correct measurement conditions

In case of disadvantageous test conditions, the measuring result, i.e. the determined particle size distribution of the single measurements, can considerably differ from the actual existing values in the aerosol flow.

Therefore, please pay attention to:
- Representative sample taking
- Isokinetic sampling
- Minimal particle losses through the aerosol transport
- No coincidence error

Please note: Palas® regularly offers training courses about these topics.

As a basic principle, the Fidas® System can only measure and display data it has been registred in its optical measuring volume. That means, the aerosol sampling flow should be lead there as straight as possible.
Therefore, please pay attention to:
- short tubes for the aerosol
- if possible, metal tubes, in no case longer plastic tubes (high particle separation due to electrostatic charging)
- vertical aerosol guiding, as bigger particles (> 5 µm) sediment respectively the aerosol seperates

As basic principle of all counting scattered light measuring technologies, just one single particle may be in the optically limited measuring volume of the sensor at the same time. This due to the fact, that the scattered light of the single particle is being evaluated for the determination of the particle size.

If more than one particles are in the measuring volume at the same time, these particles are measured as one, i.e. the particle is being measured too big and the number to small.

To measure correctly, one has to dilute. The Palas® dilution systems have proven themselves in practice at the market. If requested, they can be heated and be used in overpressure and underpressure.

If a measurement has been done correctly with a dilution, this measurement supplies a finer particle size distribution and a higher particle concentration as result, compared to a measurement in coincidence. A separation efficiency that was measured in coincidence is always worse compared to one being measured under correct conditions.

The advices given here are surely not sufficient to ensure a correct measurement in any case. In case of particular problems, please contact Palas® directly.

8 Technical data Fidas® System:

Size of optical measuring volume (WxDxH)	approx. 262 µm x 262 µm x 164 µm*	
Maximum concentration for 10 % coincidence error	Sensor integrated into the control unit max.concentration up to 4 x 10^3 P/cm^3	
Communication between control unit and evaluation PC	USB or Modbus	
Suction volume flow	Standard value, depending on the model	
Cleaning	The housings can be cleaned with non-aggressive detergents (e.g. household detergent) or spirit. For cleaning of the optical lenses, see correspondent chapter in operation manual.	
Mains connections (see identification plate!) mains voltage: mains fuse:	230 V, +/-10% 2 pieces T 2 A / 250 V	115 V, +/-10% 2 pieces T 4 A / 130 V
Power consumption **frequency**	200 W 47-63 Hz	
Environmental conditions	Temperature range from 0 °C to 40 °C Sound emission << 85 dBA	
Dimensions (HxWxD)	Control unit incl. integrated sensor: 195 mm x 450 mm x 310 mm Weather protective housing with IADS and weather station: 1810 mm x 600 mm x 400 mm	
Weight	Control unit incl. integrated sensor: 10 kg Weather protective housing with IADS, Sigma-2 and weather station: 48 kg	

Technical data are subject to change.

*** The real size of the measuring volume is indicated in the software.**

9 Annexes:

9.1 IP-65 weather-protective housing for Fidas® System:

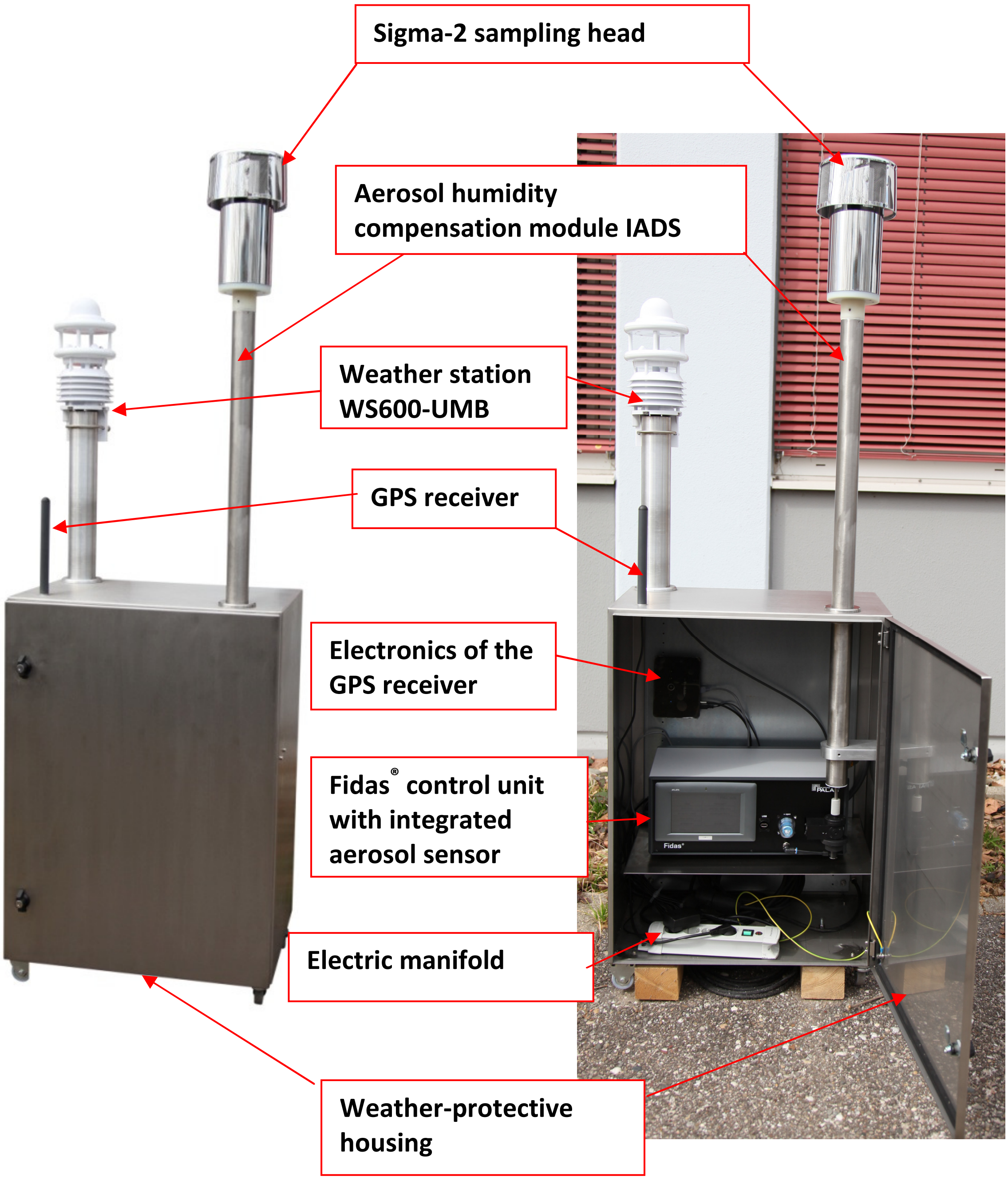


Fig. 42: Weather-protective housing closed

Fig. 43: Weather-protective housing open

9.2 Aerosol humidity compensation module IADS

With high ambient humidity, water condensates onto the particles and thus falsifies the particle size. This effect can be avoided by use of the aerosol humidity compensation module IADS.

The aerosol humidity compensation module IADS is connected with an adapter to the aerosol sensor of the Fidas® system. For cleaning of the aerosol sensor, the adapter is pushed downwards, so that the IADS can be pushed upwards completely. Then, the aerosol inlet of the sensor is easy to access.

The aerosol humidity compensation module is controlled via the Fidas® Firmware (see separate manual Fidas® Firmware for detailed information).

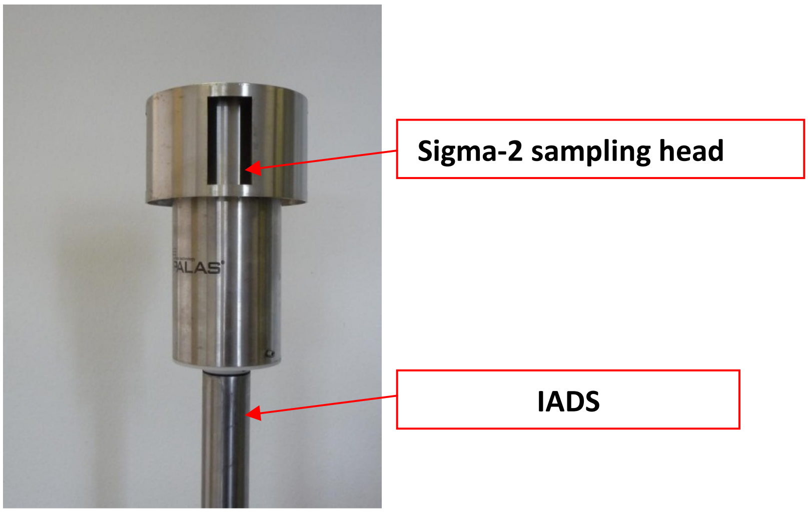


Fig. 44: Sigma-2 sampling head with IADS

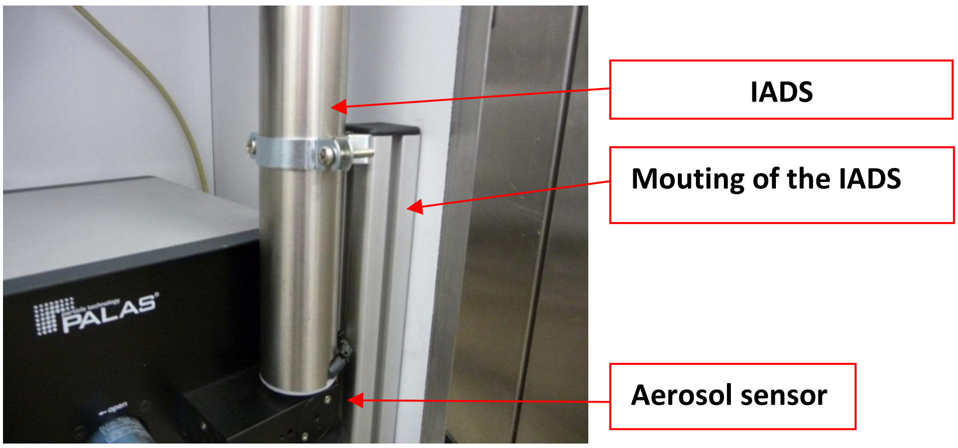


Fig. 45: Fidas® control unit, aerosol sensor with IADS

9.3 Sigma-2 sampling head

The Sigma-2 sampling head according to VDI 2119-4 for measurements widely independent of winds is simply put on the aerosol inlet of the Fidas® sensor or, if there is one, on the aerosol humidity compensation module IADS.
Using a hexagon socket screw key, it can be fixed by the locking screw.

Fig. 46: Sigma-2 sampling head

9.4 Compact weather station WS600-UMB

Fig. 47: Compact weather station WS600-UMB

The weather station WS600-UMB is readout by the Fidas® Firmware (see separate manual Fidas® Firmware for detailed information).

Special features:

- All in One
- Aspirated temperature/humidity measurement
- Maintenance-free operation
- Open communication protocol

Description country version: EU, USA and Canada:

WS600-UMB compact weather station for air temperature, relative humidity, precipitation intensity, precipitation type, precipitation quantity, air pressure, wind direction and wind speed. Relative humidity is measured by means of a capacitive sensor element; a precision NTC measuring element is used to measure air temperature. Precipitation is measured by way of a 24 GHz Doppler radar, which measures the drop speed of an individual drop of rain/snow. Precipitation quantity and intensity are calculated from the correlation between drop size and speed. The difference in drop speed determines the type of precipitation (rain/snow). Maintenance-free measurement offers a major advantage over the common tipping spoon and tipping bucket processes. Ultrasound sensor technology is used to take wind measurements. Measurement data are available for further processing in the form of a standard protocol (Lufft-UMB protocol).

9.4.1 Technical data WS600-UMB

Dimensions	Ø ca. 150mm, height ca. 345mm
Weight	ca. 2,2kg
Interface	RS485, 2-wire, half-duplex
Power supply	24 VDC ± 10 % <4 VA (without heating)
Operating temperature	-50...60 °C
Operating rel. humidity	0...100 % r.H.
Heating	40 VA at 24 VDC
Cable length	10 m
Sensor for temperature:	
Principle	NTC
Measuring range	-50 .. 60 °C
Unit	°C
Accuracy	± 0,2 °C (-20...50 °C), otherwise ± 0,5 °C (> -30 °C)
Sensor for relative humidity:	
Principle	capacitive
Measuring range	0 .. 100 % r.H.
Unit	% r.H.
Accuracy	± 2 % r.H.
Sensor for air pressure:	
Principle	MEMS capacitive
Measuring range	300 .. 1200 hPa
Unit	hPa
Accuracy	± 1.5 hPa
Sensor for wind direction:	
Principle	Ultrasonic
Measuring range	0 .. 359.9 °
Unit	°
Accuracy	± 3 °
Sensor for wind speed:	
Principle	Ultrasonic
Measuring range	0 .. 60 m/s
Unit	m/s
Accuracy	± 0,3 m/s or 3 % (0...35 m/s)
Sensor for precipitation amount:	
Resolution	0.01 mm
Reproducibility	Typical > 90 %
Measuring range drop size	0,3...5mm
Type of precipitation	Rain/snow
Accessories of the WS600-UMB compact weather station:	
UMB Interface converter ISOCON	
Mast 4.5m, hot-dip galvanized, tiltable	
Power supply 24V/4A	

10 Reader's comments sheet

In order to improve our manuals continuously we kindly ask you to fill in this questionnaire and to return it to Palas®. Thank you for your cooperation.

How to contact us:

Address: Greschbachstraße 3 b, 76229 Karlsruhe, Germany
Phone: +49 721 96213-0 Fax: +49 721 96213-33 E-mail: mail@palas.de

This evaluation concerns: Fidas fine dust monitor systems, V0020312
Please inform us about your contact data:
Company: ____
Name: ____
Address: ____
Telephone or e-mail: ____

Were the procedures clearly written and easy to understand?
☐ yes ☐ no
If not, please explain: ____
____

Did you miss some information?
☐ yes ☐ no
If yes, please explain: ____
____

Have you been satisfied with the structure of the manual? Did you quickly find the required information?
☐ yes ☐ no
If not, please explain: ____
____

In case of technical problems, have you been satisfied with the telephone support?
☐ yes ☐ no
If not, please explain: ____
____

Please feel free to add any comments you may find necessary or helpful:
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