HORIBA

Ambient Air Analyzers

APDA-372 / APDA-372 E

FINE-DUST MONITOR SYSTEM

Instruction Manual
Firmware

Version: HE0050419, valid as of firmware version 100449

APDA-372 / APDA-372 E
Firmware Instruction Manual

Preface

These instructions describe the operation of the firmware for the Fine-Dust Monitor Systems, APDA-372 and APDA-372 E. Be certain to read this manual before using the product in order to ensure that the device is operated properly and safely. You should also save the manual in a reliable manner so that it is readily available whenever required. The product specifications and the appearance as well as the contents of this manual may be altered without advance notification.

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1. Important information concerning switching the APDA-372 / APDA-372 E on and off

Because the APDA-372 firmware runs on a dynamic operating system based on Windows XP Embedded for industrial applications, APDA-372 models should never be switched off by means of the mains power switch.

Instead, the "shut down" button on the APDA-372 must be pressed. The mains switch must only be used once the operating system has shut down automatically!

Caution:
If the measuring system is not shut down by means of the firmware using the "shut down" function and instead the on/off switch is merely actuated, data can be lost!

The APDA-372 is a powerful optical aerosol spectrometer with a 1.7 GHz Intel® Atom™ processor. This allows the information concerning the measured particle size to be assessed in real time. The APDA-372 starts automatically after the start switch is actuated.

After switching on, the Windows operating system boots and then the Start-Up Manager is launched automatically. The firmware (software for the user interface) with the highest number is loaded automatically, however, at this point it is also possible to load an older version of the firmware.

Note: If "Ver.exe" is chosen, the user then has immediate access to the Windows user interface.

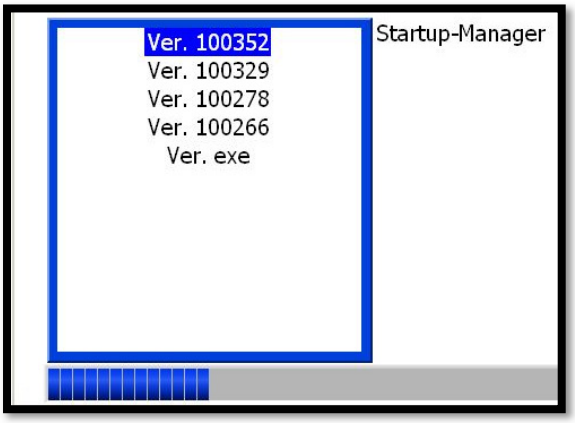

Figure 1: Initial screen of the APDA-372 Start-Up Manager

During start-up, the aerosol pump begins to operate and the volumetric flow rate is set to 4.8 l/min. Then the APDA-372 begins the measurement automatically and saves the data in the internal memory. The main menu appears once the start-up procedure has been completed (Figure 2).

2. APDA-372 / APDA-372 E user interface

2.1. Main menu

The main menu appears automatically when the device is started or when ***menu*** is pressed in the status bar.

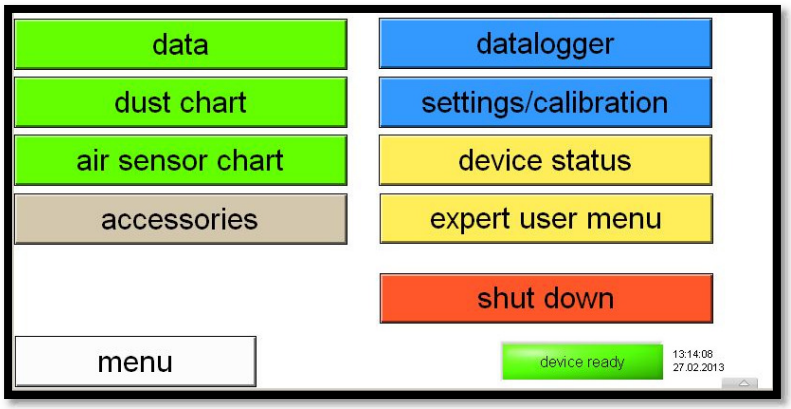

Figure 2: Main menu of the APDA-372 user interface

The main menu is structured as follows:

The buttons with a green background deal with the measured data:

data	Shows a data overview with the current measured values for PM_1, $PM_{2,5}$, PM_4, PM_{10}, PMtot (TSP) and the Cn number concentration. In addition, the weather station values for relative humidity, ambient temperature and air pressure are shown.
dust chart	Shows the chronological history of the APDA-372 measured values
air sensor chart	Shows the chronological history of the weather station measured values

The button with a gray background offers additional information and options:

accessories	Shows the accessories menu, i.e. IADS, GPS, weather station, Nano sizer add-on, filter system, particle size distributions, alarm setting.

The buttons with a blue background deal with data storage and data quality:

datalogger	Allows the input of comments that are saved along with the data record as well as the transfer of data from the internal memory to, for example, a USB flash drive. In addition, it is also possible to create a text file here in which data are saved continuously in a text format and for which an additional separate comment can be entered.
settings/calibration	For checking the calibration of the APDA-372 sensor and recalibration if necessary. Continuous online monitoring of the calibration is also shown here.

The buttons with a yellow background deal with hardware functions of the measuring instrument:

device status	Shows an overview of critical system parameters, such as volumetric flow rate, coincidence, pump performance, weather station, IADS, calibration, LED temperature and operating mode.
expert user menu	Allows entry into the expert mode. Note: Access here is password protected so that only trained personnel can obtain access to the associated functions.

The button with the red background terminates the measurement:

shut down	This shuts down both the APDA-372 as well as the Windows operating system and is to be used to shut down the APDA-372.

Caution:
Switching off the APDA-372 without first using the "shut down" button can lead to corruption of the data structure!

The "menu" button is located at the lower left edge and allows navigation to this main menu at any time.
The system status display ("device ready" or "check device status") and the system time and day's date are displayed at the lower right edge. The time and the date can be changed in the Windows operating system.

2.2. "data" – Data overview

This data overview displays all measured PM fractions and the Cn number concentration as well as the weather station values for relative humidity, ambient temperature and air pressure.

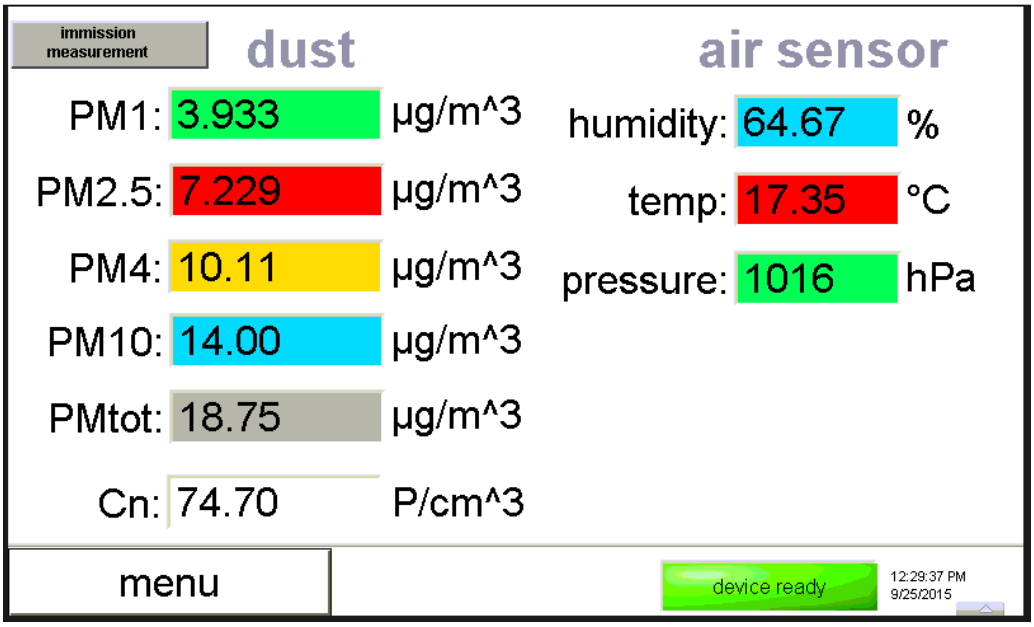

Figure 3: "data" – Data overview

The number concentration is displayed in real time, while the PM fractions show the moving average value over 900 s (entry in the promo.ini file), updated every 30 seconds. The weather station data are updated once per minute.
All data are saved with a chronological resolution of 1 minute, provide that no other setting has been made in the datalogger using the expert mode.

The display at the top left, "immission measurement," indicates that the immission function for converting the measured data for particle size and particle number emission to the PM fractions is in use (further information on the measurement technology can be found in the manual for the APDA-372 / APDA-372 E FINE DUST MONITOR SYSTEM). This algorithm was verified in the context of a qualification test (TÜV report 936/21226418/C).

2.3. Dust chart – Chronological history of the fine-dust measurement values

The dust chart displays the chronological history of all measured PM values (in color, right ordinate) and the number concentration (white line, left ordinate).

This display can be restarted using “clear charts” (this has no effect on the saved data).

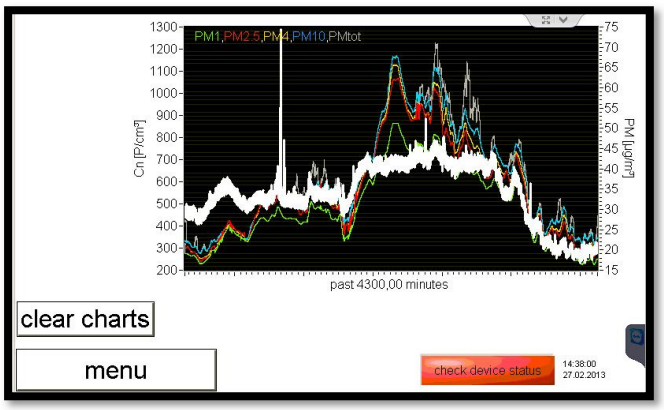

Figure 4: Chronological history of the fine-dust measurement values

2.4. Air sensor chart – Chronological history of the weather station measured values

This chart shows the color-coded weather station values for the measured humidity (h [%]), the temperature T [°C] and the pressure [hPa]. This chart is updated once per minute and shows the chronological history for one week.

Blue	relative humidity	left ordinate
Red	ambient temperature	right ordinate
Green	air pressure	right ordinate

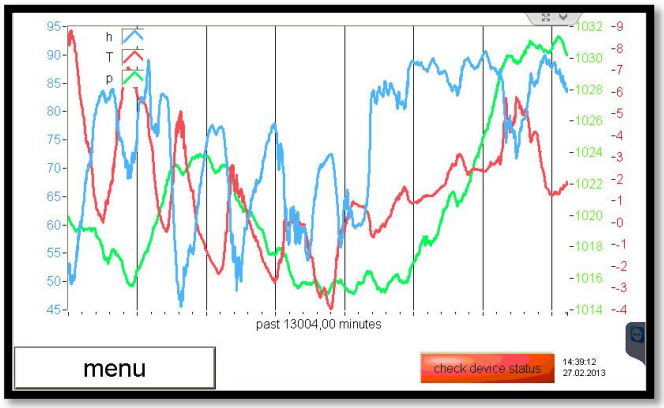

Figure 5: Chronological history of the weather station measured values

Note: If the weather station in use provides additional values (e.g. Lufft WS600-UMB) such as amount of precipitation, wind direction and wind speed, these are also saved. These are then displayed under “accessories -> weather station”.

2.5. accessories – Accessories and additional information

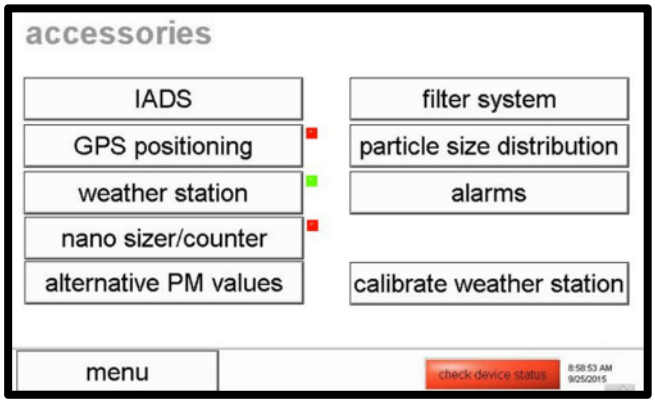

Figure 6: Accessories and additional information

This menu shows accessories and provides additional information including specifically:

IADS	Stands for “intelligent aerosol drying system” and refers to the regulated heater integrated in the sampling. The basic settings for the IADS can be changed here.
GPS positioning	Note: This option is no longer supported!
weather station	Shows all of the values measured by the weather station. The wind speed, wind direction and amount of precipitation are displayed graphically if they are measured by the weather station, e.g. Lufft Weather Station WS 600-UMB.
nano sizer/ counter	A DiSCmini made by Matter/Testo can be connected to the Fidas via USB.
alternative PM values	Displays the PM values and the algorithm used (e.g. PM2.5_ambient #11). These are the same as those displayed under “data”. Then come the PM values (e.g. PM2.5_classic) that are based on the density individually defined under the “expert user menu”. The last values to come are the PM values (e.g. PMthoracic) that are calculated according to EN 481 and are most frequently used for indoor air quality measurements.
filter system	Assists the user during a manual filter replacement. The time and date of the filter insertion and removal as well as the weight of the filter before and after the measurement can be entered.
particle size distribution	Shows two charts with the current measured particle size distributions according to the number concentration (top) and the mass concentration (bottom). The discrete distribution is shown in red and the cumulative distribution is in blue.
Alarms	Here it is possible to activate the feature which instructs the APDA-372 to send an email to the email address entered if one of the status parameters (see “device status”) exceeds the limits. A limit value for a PM fraction can be defined in the lower part (the limit value is specified in the promo.ini file) at which a digital alarm is triggered (at the digital output).
Calibrate weather station	Starting with Firmware version 100389, the weather station sensors for temperature, ambient pressure and rel. humidity can be adjusted.

2.5.1. IADS – Settings for the intelligent aerosol drying system

The IADS serves to remove the moisture from the aerosol so that the particles can be measured at their actual size and, for example, fog droplets are not interpreted as particles.

This regulated heater integrated in the sampling has three basic settings:

off:	The IADS is switched off. The internal tube of the IADS, however, is heated to +1 K relative to the ambient temperature in order to avoid condensation inside the IADS and the optical sensor.
remove volatile / moisture compensation:	The IADS removes volatile particles (water droplets) and compensates for the condensation of the water and the associated particle growth. The temperature of the IADS is controlled in dependence on the ambient temperature and humidity (measured by the weather station). The minimum temperature is 23 °C. The humidity compensation is accomplished by means of a dynamic adaptation of the IADS temperature utilizing up to a maximum of 90 watts of heating power.
remove volatile and semi-volatile:	The IADS removes volatile and semi-volatile particles (water droplets, hydrocarbon droplets) and compensates for the influence of the humidity on the particle size. The internal heater of the IADS is set to a constant temperature of 75 °C.

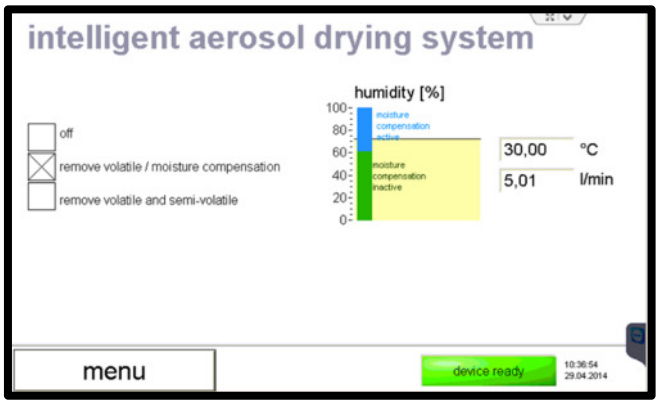

Figure 7: Settings for the intelligent aerosol drying system

2.5.2. GPS positioning – Coordinates of the GPS mouse

Note:
This option is no longer supported!

When a GPS mouse is connected, the data are transferred and displayed automatically.

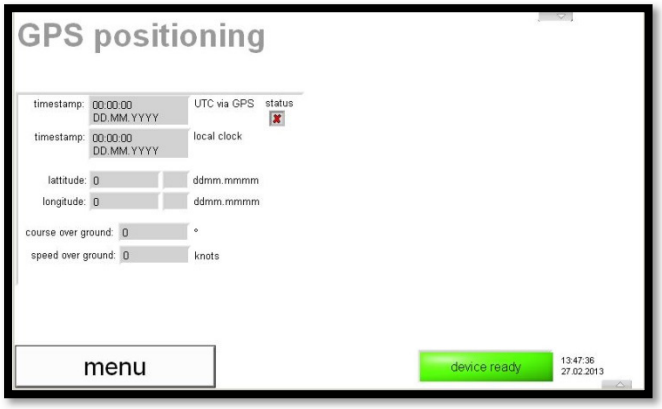

Figure 8: Settings for the intelligent aerosol drying system

Note:
This menue item can be completely suppressed by request. For this the following setting in the promo.ini must be done: „GPS_connected=no“

2.5.3. Weather station – Measurement data of the weather station

This shows all of the values measured by the weather station (they are also components of the data record). The wind speed, wind direction and amount of precipitation are displayed graphically if the weather station that is connected supports this (e.g. Lufft WS600-UMB).

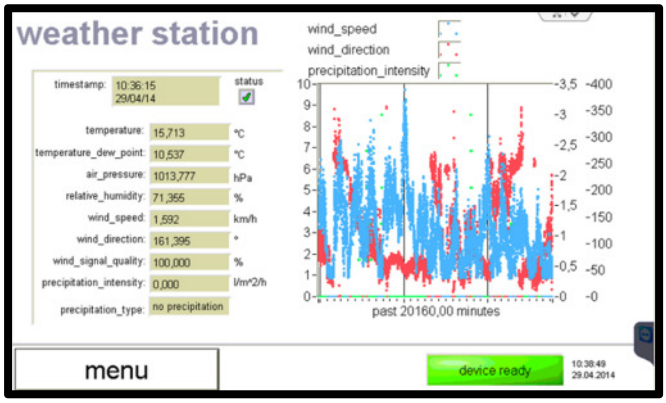

Figure 9: Measurement data of the weather station

2.5.4. Nano sizer/counter – Add-on for smaller particle sizes

A DiSCmini made by Matter/Testo can be connected to the Fidas via USB; then these data are automatically saved in the APDA-372 and displayed here graphically.

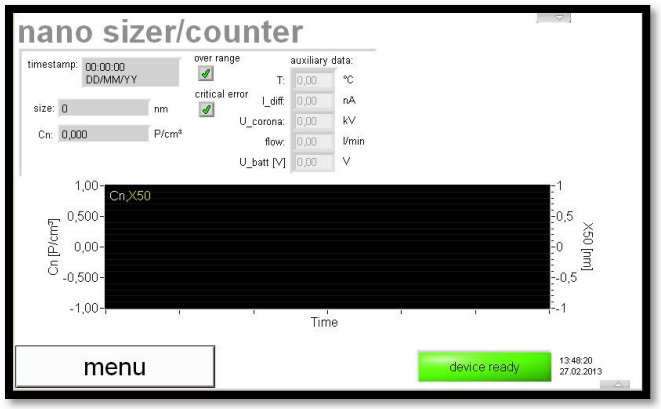

Figure 10: Add-on for smaller particle sizes

Note: It is possible that the COM port that is assigned automatically by the USB adapter may need to be reassigned in the Windows operating system.

Note:
This menue item can be completely suppressed by request. For this the following setting in the promo.ini must be done: „discmini_connected=no“

2.5.5. Alternative PM values

Displays the PM values and the algorithm used (e.g. PM2.5_ambient #11), meaning that algorithm number 11 that is TÜV certified is used here. The PM values are the same as those displayed under “data”.

Then come the PM values (e.g. PM2.5_classic) that are based on the density, individually defined in the “expert user menu”.

The last values to come are the PM values (e.g. PMthoracic) that are calculated according to EN 481 and are most frequently used for indoor air quality measurements.

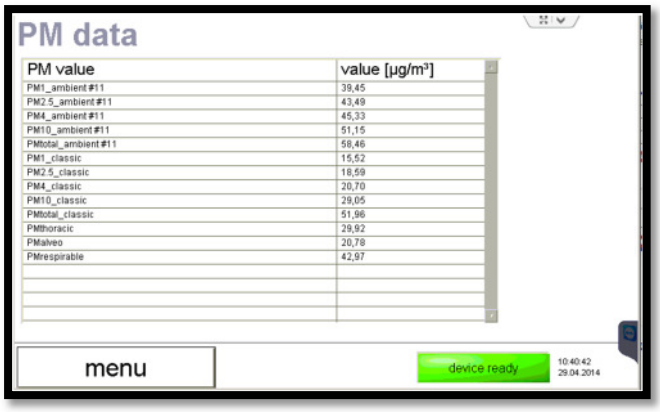

Figure 11: Display of alternate particle size fractions

2.5.6. Filter system – Manual filter measurement

When the filter holder of the APDA-372 is used to perform a gravimetric filter measurement, then the timestamp can be marked here as to when the filter was installed and removed. Moreover, the net (weight in) and gross weight (weight out) of the filter can be indicated.

After all necessary values have been entered, the ***save to datalogger*** field appears and the filter data can be saved in a file.

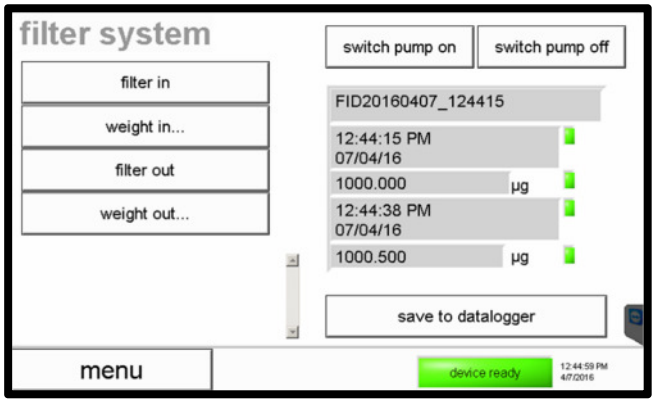

Figure 12: Manual filter measurement

This specifically includes:

switch pump on | switch pump off — Switch on/off of sampling pump

filter in — The actual time is selected automatically as the time at which the filter was installed. In addition, a filter identification number (FID) is generated and shown at the top.

weight in... — A dialog box opens for the entry of the net weight of the total filter. The net weight must reference the timestamp for “filter in”.

filter out — The actual time is selected automatically as the time at which the filter was removed.

weight out... — A dialog box opens for the entry of the gross weight of the total filter. The gross weight must reference the timestamp for “filter out”.

save to datalogger — The data generated for a total filter are saved to the datalogger and are available during the analysis of the data using PDAnalyze.

2.5.7. Particle size distribution

Here, two charts are shown with the current measured particle size distributions according to the number concentration (top) and the mass concentration (bottom). The discrete distribution is shown in red and the cumulative distribution is in blue.

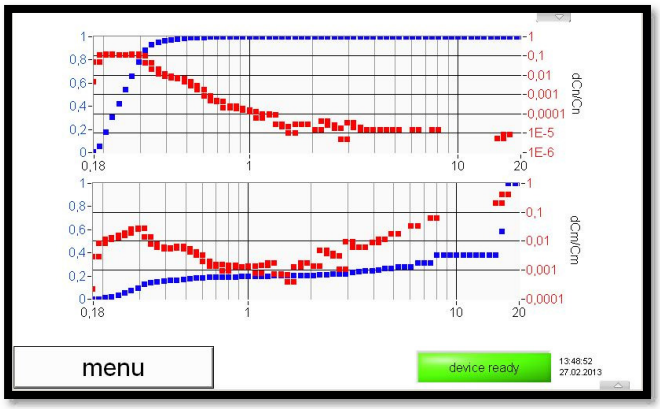

Figure 13: Particle size distributions

2.5.8. Alarm – Email notification

Here it is possible to activate the feature which instructs the APDA-372 to send an email to the email address entered if one of the status parameters (see “device status”) exceeds the limits.

A limit value for a PM fraction can be defined in the lower part (the limit value is specified in the promo.ini file) at which a digital alarm is triggered (at the digital output).

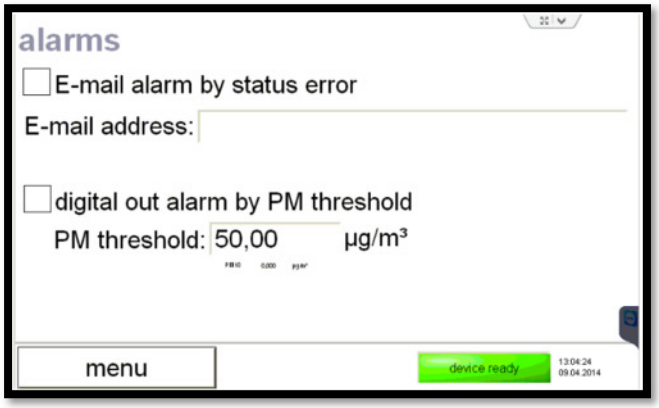

Figure 14: Email notification

The following entry must be contained in the promo.ini file:
In the [Fidas] section:
alarm_threshold=50 (or a different value)
alarm_value=PM10 (or e.g. PM2.5)

2.5.9. "calibrate weather station" – Adjusting the weather station

As of firmware version 100389, the sensors for temperature, air pressure and relative humidity of the weather station that is connected (WS300-UMB or WS600-UMB) can be adjusted by comparing the measured values with the measured values of a transfer standard and determining the corresponding linear equation.

1-Point-Adjustment (typically under field conditions):

→ Determination of slope factor (Scale), offset remains at 0

2 oder Multiple-Point-Adjustment (e.g. in calibration lab):

→ Determination of slope factor (Scale) and offset by regression analysis

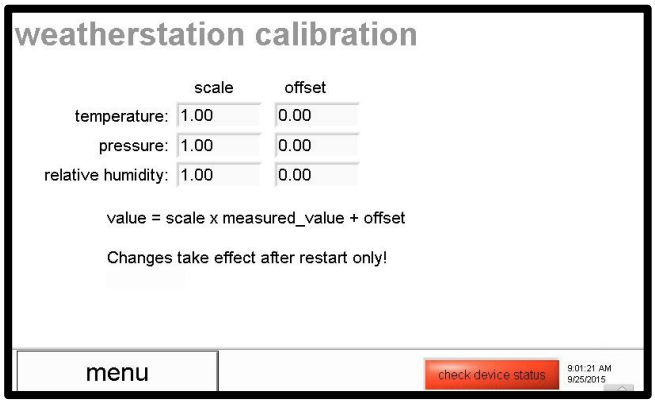

Figure 15: „calibrate weather station" – Adjustment of weather station

Note: Modifications only take effect after a reboot of the system.

2.6. Datalogger – Measurement data memory

The APDA-372 saves the measurement data continuously internally in a file. It creates a new file for every day. The files can be copied to a USB flash drive (copy data files to D:\). When a USB flash drive is connected to the APDA-372, it automatically copies the files to the USB flash drive at midnight.

copy datafiles to D:\	Copies the files of the internal memory to the USB flash drive (drive D:\ is the USB port on the front).

A comment can be entered manually at any time that is then automatically saved along with every data save operation. This continues indefinitely until the comment is deleted or a different comment is entered.

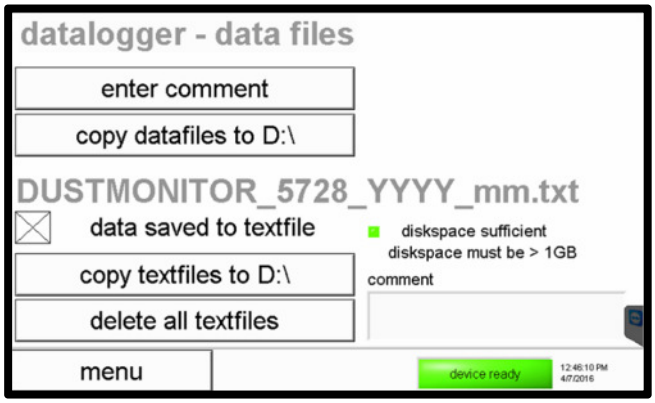

Figure 16: Measurement data memory

In addition, an option can be enabled that causes the data to be saved continuously (with a time resolution of typically 1 minute) to a text file using a text format. The name of this file is “dustmonitor_serial_number_year_month.txt (example: dustmonitor_0117_2014_04.txt). When in continuous operation, this file is generated new every month and saved on the harddisk of the panel PC in the folder “Fidas\textfiles” (Precondition: At least 1 GB of available diskspace).

The text-files can be copied to a USB flash drive (copy textfiles to D:\).

The columns of this text file are labeled as follows:

Columns A-L

Date	Time	Comment	PM1	PM2.5	PM4	PM10	PMtotal	Number Concentration	Humidity	Temperature	Pressure

Columns M-U

Flag for status parameters								
Flow	Coincidence	Pumps	Weather station	IADS	Calibration	LED	Operating mode	Device status

Columns V-AE

PM1	PM2.5	PM4	PM10	PMtotal	PM1_classic	PM2.5_classic	PM4_classic	PM10_classic	PMtotal_classic

Columns AF-AH

PMthoraic	PMalveo	PMrespirable

Columns AI-AO

Numerical values for status parameters						
Flowrate	Velocity	Coincidence	Pump_output	IADS_temperature	Raw channel deviation	LED temperature

Columns AP-AR

Temperature*	Humidity*	Pressure*

* only relevant, if optional sensor for temperature, pressure and rel. Humidity is connected.

device status means the operating mode of the APDA-372. This is a numerical value that is assigned as follows:

Scope	**0**
Auto	**1**
Manual	2
Idle	**3**
Calib	**4**
Offset	**5**
PDControl	6

Note: only the operating modes in bold letters are relevant for the APDA-372.

Note: if the text file is moved or deleted, the APDA-372 will automatically create a new text file for the current month. If a text file exists for the current month, the data are simply appended.

2.7. Settings/calibration – Calibration/verification of the APDA-372

Calibration of the APDA-372 is monitored online by means of a patented measurement signal analysis and displayed in a graph called “immission estimated channel deviation – trend 40h”.

If the calibration drifts slowly, this can be observed due to a sloping curve of the individual points within two red horizontal lines. The points result from a measurement made every half hour. When there is a mean deviation of more than 3.5 raw data channels over 40 hours, an error is set (see also 2.8) and the APDA-372 needs to be verified with MonoDust 1500.

Note: Individual points may lie outside of the limit values; this can happen and is no cause for concern. The calibration is also still in order in these cases.

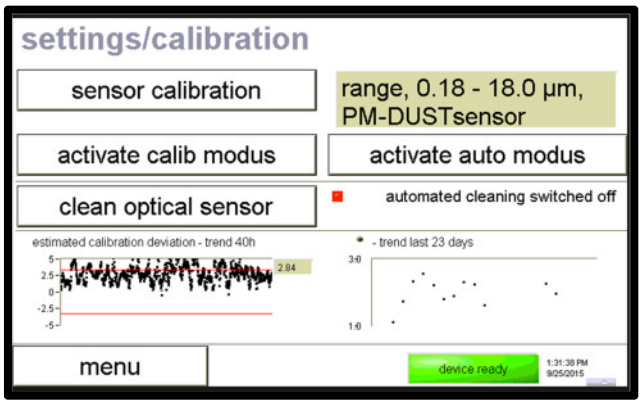

Figure 17: Calibration/verification of the APDA-372

To calibrate the APDA-372, press “optical sensor calibration”. A screen then appears in which the calibration can be carried out using calibration dust (further information on this can be found in the APDA-372 manual).

When **activate calib mode** is used, all subsequent data are marked as if they had been measured during the calibration procedure and are consequently not included in an evaluation except if this is expressly selected in PDAnalyze. This mode can also be used to ensure that the intermediate data measured during maintenance activities are not used any further.

Caution:

Because activate calib mode activates the calibration mode manually, it must also be deactivated manually, also using activate auto mode, meaning that the APDA-372 must be reset to the Auto mode. If this is not done, the status remains set to device not ready because the operating mode in device status is not set to auto.

The **clean optical sensor** option starts a routine which heats the IADS up to 75 °C and at the same time alternates the pumps from 0 l/min to the maximum volumetric flow rate. The objective here is to essentially “shake loose” any material deposits in the sampling tube. Automatic activation of this routine can be set in the promo.ini file.

Note: If there is no problem with frequent entry of material or insects, automatic activation is not recommended because this is an additional load on the pumps and reduces their service life.

2.8. Device status – Status overview

Various items of sensor information are shown here which are required for correct operation of the APDA-372. This information is also saved along with every data record in the form of an error byte.

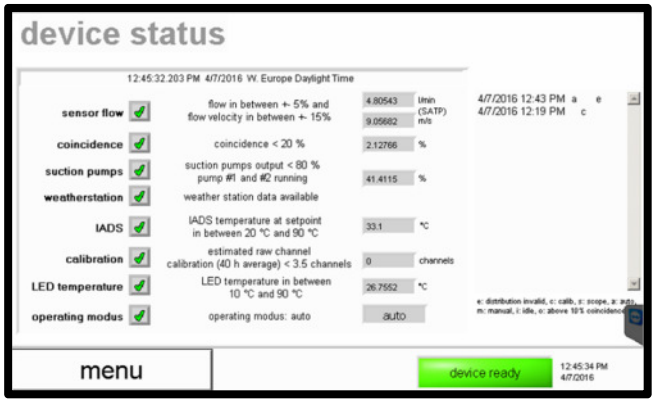

Figure 18: Status overview

This specifically includes:

sensor flow

The APDA-372 regulates the volumetric flow rate at 4.8 l/min by means of a control circuit with mass flow meters and inclusion of the values measured for temperature and air pressure. This volumetric flow rate is then standardized for “standard atmospheric temperature and pressure” (SATP), that is, with reference to 25 °C and 1013 hPa. An error is displayed if the volumetric flow rate deviates from the setpoint value by more than 5%.

Note: Older models regulated the flow at 5.0 l/min and displayed it accordingly.

The second value indicates the velocity (flow velocity) of the particles through the optical detection volume. An error is displayed if the velocity of the particles deviates from the setpoint value by more than 15%. The setpoint value corresponds to the velocity entered in the promo.ini file which is determined at the installation site in accordance with section 5.5. An error message indicates a possible leak after the sensor.

IMPORTANT:

The result of the velocity measurement has **no** influence on the calculation of the PM values, but is instead only used as an indicator for the leak tightness.

coincidence

Detection of more than one particle in the optical detection volume. An error is output if this occurs with a frequency of greater than 20%.

suction pumps	The volumetric flow in the APDA-372 is generated by two pumps that are connected in parallel. If one pump fails, the other can assume its role; the power consumption is then accordingly higher, which leads to an error. If both pumps should age uniformly, an error is also triggered when 80% is exceeded. It is important to note that the device still continues to measure and the data are valid, however, the user must see to it that the pumps are replaced soon.
weather station	This indicates that a weather station is correctly connected and is transmitting values.
IADS	This indicates that the IADS is correctly connected and the temperature corresponds to the prescribed regulation point.
calibration	This monitors the calibration online. If this deviates by more than 3.5 raw data channels, an error is set. **Note: In individual cases, this value might be out of tolerance for brief periods while the device is nonetheless still operating properly. Need for action (i.e. a field calibration using calibration dust) only arises if this is a longer-term trend (>40 hours).**
LED temperature	The LED light source is subject to temperature control. If a problem arises in this control circuit, this error bit is set.
operating mode	The operating mode should be set to “auto” because otherwise it is possible that the data will not be saved correctly or the device will not restart again on its own after a power outage.

The **status log** displays activities of the APDA-372 with the date and time:

a	auto mode	The standard operating mode of the APDA-372.
c	calibration mode	While the APDA-372 is undergoing calibration, the data are marked with the letter “c” and are not included in the evaluation.
i	idle	The APDA-372 has been set to the “idle” operating mode and is not measuring any data.
m	manual mode	The APDA-372 has been set to the “manual” operating mode.
s	scope mode	The electronic oscilloscope with which individual signals can be analyzed has been activated, but no measurement is currently underway.
e	distribution invalid	The measured particle size distribution is invalid.
o	above 10% coincidence	The concentration was so high that more than 10% of the measured values were measured in coincidence, meaning that in these cases there was more than one particle in the detection volume.

2.9. Expert user menu – Expert mode

For further functions and information, the user may enter the expert mode. Doing so requires the entry of a code, which is “1” followed by “-” followed by “accept” (Figure 19: Expert user menu).

Note: It is possible to set the password yourself. To do so, the following entry must be made in the promo.ini file in the section [Fidas]: password_service=-1 (-1 is the default password; select your own here then).

Further information on the expert mode can be found in the expert mode manual.

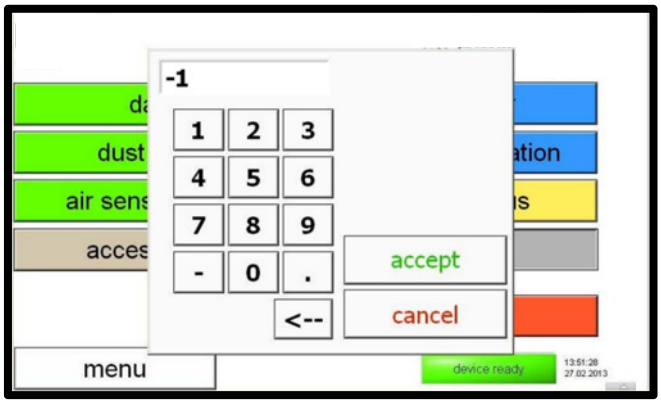

Figure 19: Expert user menu

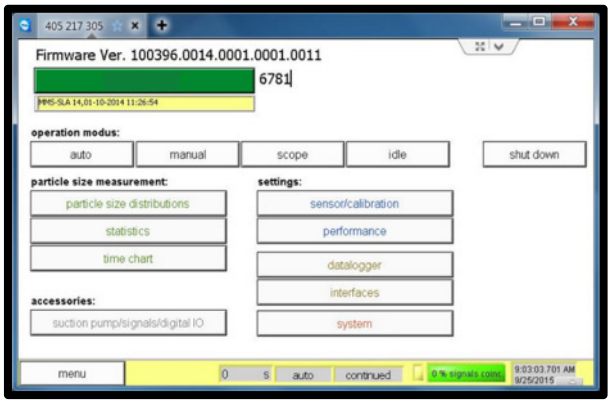

Figure 20: Expert user menu – Main menu

Note: The string for the firmware version is composed of the following:

Position 1:	100396	Firmware version of the panel PC (touchscreen)
Position 2:	0014	Firmware version of the SCA circuit board
Position 3:	0001	Firmware version of the MIO circuit board
Position 4:	0001	Firmware version of the Pt100 circuit board
Position 5:	0011	Method

2.10. Shut down – Switching off the APDA-372

Always use the "shut down" button to switch off the APDA-372.

Because the APDA-372 firmware runs on a dynamic operating system based on Windows XP Embedded for industrial applications, APDA-372 models should never be switched off by means of the mains power switch because otherwise the data system can become corrupt.

Once the “shut down” has been activated, you will see the following pop-up:

After the touchscreen is off (green power indicator at the top edge of the touchscreen), the mains switch on the back of the device should be switched off because otherwise the internal fan continues to run.