Particle Counter ABAKUS

Equipment Description
Edition 11/06 (Version 2.AB)

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1. Setup

The particle counter ABAKUS comes in a metal housing. All display and operating elements are arranged at the front panel under a protective membrane; the plug connections for connecting, the sensor, printer, etc. are at the rear panel.

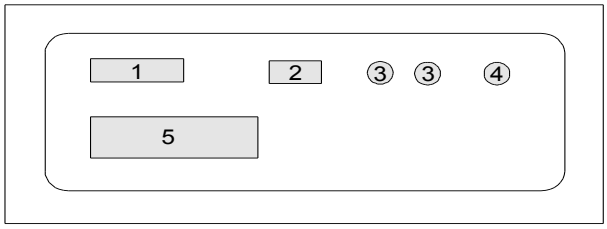

Figure 1: Ports at the rear panel of the device

Number	Description
1	Port SF/DPS (15-pin SUB D jack)
2	Serial interface (9-pin SUB D connector)
3	Service ports, do not use
4	Port sensor (10-pin LEMOSA plug connector)
5	Mains connection, main switch, fuse

Abakus, new model; Abakus old model

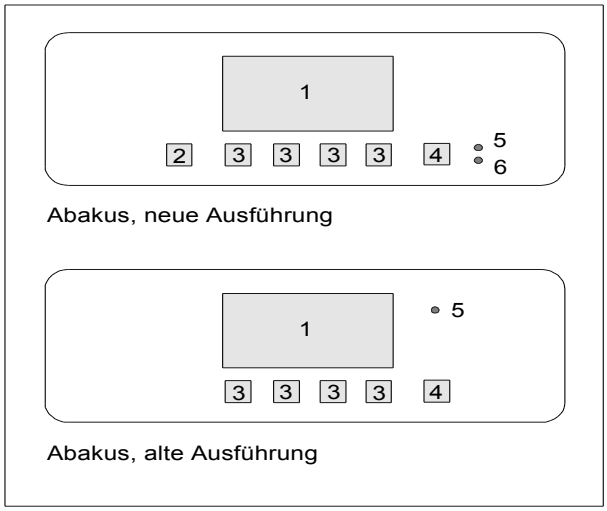

Figure 2: Operating and display elements

Number	Description
1	LCD
2	On/off switch (for devices with accumulator operation)
3	Keys for operating the device
4	Contrast LCD (5 levels)
5	Operation indicator of device
6	Alert accumulator voltage (for devices with accumulator operation)

1.1. Devices with mains voltage supply

The power switch of devices with mains voltage supply is located at the rear panel of the device. The housing of the measuring device is connected with the protective conductor.

1.2. Devices with low-voltage supply / accumulator operation

The measuring device is equipped with a plug-in power supply or accumulator pack. The on/off switch for these devices is located at the front panel. A low standby current flows in off-mode.

2. Operating the Equipment

2.1. Language switching

You can switch between two languages. As soon as you power the device, the company logo will appear. Keep one of the keys for operating the device pressed down until the menu for language selection appears. After selection (key SEL), you return to the operating surface by using the key BACK.

Currently, following language combinations are available:

- German / English
- German / French
- German / Spanish

For each language combination, the appropriate software is loaded (state of delivery).

The language last set will be automatically loaded again the next time you power the device.

2.2. Keyboard input

You operate the device with the help of the keys located at the front panel. The whole operating surface is divided into individual menus (see the section on menu structure), which you call up or quit by using these keys. You can also modify the parameters within the menus.
The last display line of the LCD in the current menu determines, in each case, the functions of the operating keys.
An additional key allows you to adjust the contrast of the display in 5 levels.
The following table explains the meaning of the key codes appearing on the last line of the display.

Key	Meaning
Menu control/general:	
----	Key has no function
CUR	Sets cursor to next position
BACK	Back to previous menu
ENT	Calls up a submenu selected with the cursor; selects and accepts parameters
Parameter input:	
SET0	Sets selected parameter to zero
+VAL	Sets flashing decimal place of the selected parameter
←DIG	Selects decimal place for modification of parameters (flashes)
SEL	Selects parameter from a list
Measured value memory:	
MEM+	Selects next entry in measured value memory
MEM-	Selects previous entry in measured value memory
PRN	Printout of the memory place selected with the cursor
Measurements:	
.BREAK.	Interrupts by simultaneously pressing both keys located beneath it
PRN	Printout of current measuring results
MEM	Writes current measuring results into the measured value memory
KAN+ KAN-	Scrolls the display during measurement
Output of messages:	
CONT	Continues function interrupted by the message or cancels interrupted function

Table 1: Meaning of the key codes

2.3. Menu structure

For clear and easy operation of the equipment, you call up, with the help of the keys, the desired function via a menu structure. In the following sections, you will find a short description of the menu path for reaching the described functions.
The following table illustrates an overview of the menu structure going from the main menu.

Measurements		
	DPS Measurement	
	Autostart	
	Particle number	
	Measurement	
	Time interval	
	Start/Stop via keys or external	
Settings		
	Measurement settings	
		SF/DPS settings
		Particle sizes
		Measuring time
		Particle number
	Device settings	
		Set clock
		Printer
		Measured value output
		Limit values
		Analog outlet
	Autostart	
Calibration		
	Security code prompt	
		Characteristic line oil
		Characteristic line
		Voltage Sensor
		Noise (auto)
		Noise (manual
		Service
Measured value memory		
	Display + print	
	Print (setting)	
	Delete (setting)	
	Delete (global)	
	Organization	

3. Measuring Preparations

3.1. Start up

Before power up, connect and check the connections to the sensor and all other devices used for the measurement (as e.g. printer, sample feeder (SF), or pumps). The ports are located at the rear panel of the device (see figure).

In addition, check the whole measuring setup especially the flexible tube connections, which are under pressure during the measurement.
If the measuring setup is without flaws, then power the device; for approx. 5 seconds, the company logo will appear on the display with the output status of the software, as well as the current date and time.
Then the main menu or the measuring menu will appear (in case the device was in this operation mode at the time of power out).

3.2. Calibration

Before initial start up of the equipment be sure to check the settings of this menu because else you might get false measuring results.
All entered values remain stored in the device and are available after next power up.

☞ ***The instruments adjustment should be modified by authorized service persons only!***
*The input and calibration functions have been protected against unintended modifications and can only be reached by entering the code "**4123**".*

3.2.1. Noise voltage

This adjustment should be modified by authorized service persons only!
The noise voltage must be set so that it is higher than the noise of the connected sensor. The default setting of the noise voltage is done with an 8 bit D/A converter so that the voltage actually set (and displayed when entering into the menu) may deviate from the entered one by several millivolts.

Menu:
calibration→noise (manual)
noise voltage
(in mV)
[voltage]
[voltage] – noise voltage 60mV..2.5V

If the noise voltage of the sensor is not known, an automatic adjusting may be done; however, its success depends on the noise spectrum and may have to be corrected.

Menu:
calibration→noise (auto)

After activating the key ENT, the adjusting process runs until the limit voltage is reached; the respective voltage being tested is displayed.

☞ *Make sure that the sensor is particle-free during the automatic adjusting process.*

3.2.2. Characteristic line of sensor

These settings should be modified by authorized service persons only!
Before starting the measurements, the measuring device requires the non-recurring input of the characteristic line of the sensor, which you will find on the data sheet of the connected sensor. The coordinate source (0µm, 0mV) is the first pair of values you must input.

Menu:
calibration→characteristic line

size/µm	voltage/mV
0	0
[size]	*[voltage]*
:	:

[size] – particle size in µm
[voltage] – appropriate sensor voltage in mV

3.2.3. Characteristic line of oil

This adjustment must be done by authorized service persons only!
For measurements in oil, you can use the self-calibration function, which has been prepared for the calibration with fine dust (5mg/l oil). In any case, however, you should review the determined characteristic line (e.g., by a subsequent measurement, default ISO classes must be reached).

Menu:
calibration→characteristic line oil

3.2.4. Voltage of sensor

This function should be used by authorized service persons only!
This function is for calibrating the device with standardized particles. It indicates the mean voltage of all incoming particles and their number. For example, this enables recording of characteristic line points for a sensor.

☞ *For this function the noise voltage must be increased in such a way that contamination with smaller particles is suppressed.*

3.3. Settings for measuring

3.3.1. Particle sizes

For displaying and storing the measuring results, it is necessary to input the particle sizes (for at least one of the 32 channels).

Menu:
settings→measuring settings→particle sizes

channel no.	particle
1	*[particle size]*
2	*[particle size]*
:	:

[particle size] – particle size in µm

3.3.2. Measuring volume

For measurements with the Double Pump System (DPS), the measuring volume and, if necessary, the flushing volume must be set. The working volume of the system has been permanently set at 10ml and cannot be modified by the user.

For measurements with a sample feeder (SF), the measuring volume must be accordingly set at the measuring dome.
If you wish to have a cyclic measurement, the cycle time must have a value other than zero. Input the period from one measuring start to the next.

Menu:
settings→meas. settings →SF/DPS settings
flushing vol. *[volume]*
working vol. 10
meas. vol. *[volume]*
container 0
cycle *(time)*
[volume] – volume 10...260ml (10ml-steps)
[time] – cycle time in minutes

3.3.3. Measuring time

For measurements with time limit, the measurement starts after the waiting time. The measuring time determines the duration of the measurement; input it in minutes and seconds.
If you wish to have a cyclic measurement, the cycle time must have a value other than zero. Input the period from one measuring start to the next.

Menu:
settings→meas. settings →measuring time
cycle time *[minutes]*
meas. time *[minutes]*
[seconds]
waiting time *[seconds]*
[minutes] – 0...99
[seconds] – 0...59

3.3.4. Particle number

If you want the measurement to be stopped after reaching a determined particle number, input this value.

Menu:
settings→meas. settings →particle number
stop measurement
>part. *[number]*
[number] – 0...16.777.216

3.3.5. Representation of measuring results

The measured values may be displayed in distributive or cumulative form. A menu lets you select the form of representation.
The output of the particle sizes on the display depends on the option you have selected; the measured values remain on the display until the next measurement starts.
Note that when displaying in accordance to ISO, the class ≥ 2µm is also displayed.

Menu:
settings→device settings→meas. value output
Display at the end of measurement: *[standard]*
Output of measuring results: *[output]*
[standard] – normal/ISO/NAS
[output] – cumulative/distributive

If you, however, select a measured value output in accordance with NAS1638 or ISO4406, this option will be automatically adjusted.

Output on the display according to standard	Measured value representation
ISO 4406	always cumulative
NAS 1638	always distributive
normal (no standard)	cumulative / distributive

Table 2: Output of measured values

3.4. Other settings

3.4.1. Clock

The built-in real-time clock is meant to allocate the measuring results in timely manner and appears on the printout when printing the measuring results.

Menu:
settings→device settings→clock

3.4.2. Analog outlet

If you need a certain flow rate for feeding the samples, you can use the analog outlet of the device for regulating purposes. In the menu you program which particle flow rate per second corresponds to an outlet voltage of 10V.
The analog outlet generates a floating mean value (PI-behavior) with a sensing time of 100ms.

Menu:
settings→device settings →analog outlet
max. number particle per second:
[number]
[number] –particle per second for 10V outlet voltage

3.4.3. Limit values

☞ *The switched contact outputs for limit values are not available in the standard device. They must be ordered separately.*

3.4.3.1. Limit values for ISO / NAS

For the measurement of liquids according to ISO4406 or NAS1638, you can input upper or lower limit values for each class. As soon as the

measured values fall below or exceed these limits, a potential-free contact is switched (relay outlet).

Menu:
settings→device settings→limit values
Upper: ON / OFF
[classes]
Lower: ON / OFF
[classes]
[classes] - xx/yy/zz (ISO) or
vv/ww/xx/yy/zz (NAS)

3.4.3.2. Limit values for

For the measurement of liquids without the selection of any measuring standard there is one selectable pair of limit values for one particle size. As soon as the measured values for this particle size fall below or exceed the limits (cumulative particle values will be compared), a potential-free contact is switched (relay outlet)..

Menü:
Einstellungen→Geräteeinstellungen→Grenzwerte
Size/µm [*size*]
Upper: ON / OFF
[limit value]
Lower: ON / OFF
[limit value]
[size] – particle size in µm
[limit value] – 0...65535

Ist die eingegebene Partikelgröße nicht als Messkanal vorhanden, erfolgt keine Überwachung.

4. Measurements

Do not start measurements before checking the measuring setup (especially flexible tubes and sealings) and making sure that there are no flaws.
For executing the measurement, you may opt between various operation modes::

- Measurement of a sample with sample feeder (SF) or pump (DPS):
  - Start measurement immediately (via key or inlet In2)
  - Autostart (DPS measurement after comparing time)
- Measurement via time interval
- Measurement of a total particle number

The measurements are executed in cycles in so far as the parameter ”cycle time” (see section “Settings for measuring”) in the menu measurement settings is greater than 0. Allocation is as follows:

Entered cycle time (min)	Meaning
0	single measurement
1	continuous measurement with 5 sec pause between the measurements
2...99	cycle time in min

Table 3: Cycle time

The menu settings/autostart allows you to enter additionally the number of cyclic measurements for a series of measurements.

After the start of measurements a flushing process takes place (flushing volume or time must be entered as parameter) before the counting channels are activated. The measurement remains active up until the selected interrupt criterion is reached.
The status of the measurement is displayed in the next to the last line of the display.

4.1. Start manually

The measurement will be startet by the function key MES.
With BREAK, you can interrupt a measurement at any time. The measured values are deleted. (In the case of cyclic measurements the BREAK key must be pressed twice while a running measurement.)

4.2. Start by 24V-input

Time controlled measurements may be started from separate 24V input (Not for all device versions!). Therefore the input I4 must be used as a gate for input I3 which starts the measurement (e.g. I4 must be connected to 24V if only I3 should be used).
The measurement will be done with the current device settings.

5. Measured Value Memory

5.1. Function

The internal measured value memory of the equipment can archive more than 1,200 measurements in up to 100 data records. You can limit the number of measurements per data record.
Each measurement may be recorded in the data record previously selected. If a data record is full with measured values, the respective oldest value in the memory is replaced by the current measurement (ring memory) as soon as a further measurement is being recorded.
The device will also go into the operation mode ring memory as soon as all available measured value memory is full (currently 1389).

5.2. Setting

Before using the measured value memory, you must set the organization of the memory.
With the setting of the data records, you determine if you need one data record (=1) or several data records (>1). If you selected several data records, you must select a data record before each start of measurements and before printing from the measured value memory. A number with up to four digits may mark each data record.
The entry ”measurements" determines the maximum number of entries (measurements) for a data record. If no limit is defined, the internal memory is allocated to the individual data records as needed. When the total memory is full, all record memory is in the operation mode ”ring memory”.

Menu:
measured value memory→organization
data records =1 (or >1)
measurements 1...1398

5.3. Taking over the measured values

The measurements are taken over into the measured value memory when you press the key MEM after a measurement, or automatically when a measurement is finished in the operation mode cyclic measurement.

5.4. Printing

You can output on a printer all stored data in the measured value memory. When printing out a single measurement, all stored measured values are printed on one page.

Menu:
measured value memory→display + print

When printing out a complete data record, the first six measured values of a measurement are printed out on one line together with the start time of the measurement.

Menu:
measured value memory→print (record)

5.5. Taking over data into the PC

To transfer the data from the measured value memory into the PC, you use the Windows Program “Log&Show”. From this program, you can also transfer the measured data to MS-Excel.
For this program, no settings are required at the device.

☞ *The printer must remain switched off when a PC is connected at the serial interface.*

5.6. Deleting

The deleting of the recorded measured values can be done separately for each data record or for the total measured value memory. For security reasons, you will be prompted before deleting is executed. Answer with ”YES”.

Menu:
measured value memory→delete (record)
measured value memory → delete (global)

The deleted measured value memory is immediately available for further measurements.

6. Printing

6.1. General facts

Presently, printers in text mode with EPSON compatible instruction record are supported, as for example the Deskjet series from HP (HP-DJET) as well as a thermal printer (DPU-411).
For single measurements or single printouts from the measured value memory, all set particle sizes are printed on one page.
In the operation mode ”cyclic measurement” (cycle time is greater than 0) as well as for the printout of the complete measured value memory each measurement is printed in one line. For the measured value output ”normal”, the measured values for the first 6 entered particle sizes are printed out.
Measuring in accordance to ISO or NAS means, that independent of the channel entry there is a printout of the size classes significant for the measurement.
When printing out the measured values on one page, the volume percents for each range are printed out in addition. As is the case with the measured value output, representation is done cumulative or distributive.

6.2. Printout at the serial interface

Printout via the serial interface is possible if a printer with serial RS232 interface is connected with the device by way of a null modem cable.

Menu:
setting→device setting→printer
printer: *[type]*
port: COM1
[type] – set printer type

☞ *Make sure that the signals RTS/CTS of the serial interface are connected correct-*

ly or bridged in the connector; else there will be no printout of characters.

6.3. Printout at the parallel interface

For printout via the parallel interface, a printer with Centronics interface can be connected to the device by using a commercial PC printer cable.

☞ *The parallel interface is not available with every equipment model.*

Menu:
setting→device setting→printer
Printer: *[Type]*
Port: LPT1

7. Remote Control

The serial interface allows remote control of the equipment. This enables you, for example, to start the measurements at the PC and then to collect the measured values.

☞ *If the device is operated in remote control mode, the measured values are not stored in the measured value memory!*

To obtain as simply as possible an interface protocol, data exchange is done completely via ASCII strings. The PC sends a through "Carriage Return" (CR, ASCII-Code 0Dh) closed command. The device answers with an ASCII string which ends as positive acknowledgement with "Acknowledge" (ACK, ASCII-Code 06h) or negative acknowledgement with "Not Acknowledge" (NAK, ASCII-Code 15h).
A negative acknowledgement is sent when an unknown command is recognized or the command cannot be executed at this time.
In Appendix A you will find an overview of the presently available commands.

8. Monitoring Functions

The monitoring functions are constantly active if they have been programmed. However, in the case of devices with 10 bit A/D converters, no monitoring during measurements can take place.

8.1. Sensor monitoring

8.1.1. Control voltage laser diode

The laser diode of the sensor is regulated in order to keep the light intensity constant during measurements. If the sensor is contaminated, the regulating voltage increases. If the regulating voltage exceeds 8V, the regulating can not work with sufficient accuracy. Measuring errors may occur.
To prevent this, the regulating voltage in the device can be monitored. As soon as the programmed upper limit is exceeded, an alert message ("sensor cleaning") will appear on the display before the measurement.
You program the monitoring in the menu "calibration".

Menu:
calibration→service
W_SENSOR: *[voltage]*
[voltage] – limit regulating voltage in mV

☞ *There are sensors, which do not support the monitoring of the regulating voltage. You will find information on this in the data sheet of the sensor.*

8.1.2. Connecting the sensor

Before each measurement, there is a sensor check to determine if it is connected to the device. For this purpose, the noise of the sensor is evaluated.
If no sensor is connected, an alert message will appear on the display.

8.2. Monitoring accumulator pack

☞ *You must activate monitoring if the device is operated with an* accumulator *pack. Else low discharging of the connected* accumulator *pack (decrease of battery life) or even its destruction may occur.*
In the case of devices with 10 bit A/D converter the set measuring time should not exceed 3 minutes or else you might not be able to power off the device in time.

Monitoring of the accumulator pack is done in two steps.

1. **Warning**: After falling below the voltage threshold W_ACCU, the flashing red LED signals that the device will shortly power off.
2. **Error**: After falling below the voltage threshold E_ACCU, the device will automatically power off.

Menu:
calibration→service
W_ACCU: *[voltage]*
E_ACCU: *[voltage]*
[voltage] – limit voltage monitoring in mV

There will be no monitoring of the limits if both voltages have been set to zero.

8.3. Particle size with decimal point

For particle sizes input and display the use of a decimal point may be selected. If the dedicated value is set to 1 the particle size format is 10.0 instead of 10, for instance.

Menu:
calibration→service
Dec_Pt: 0 oder 1

8.4. Reverse rinsing

Devices which are working with the Double Pump System (DPS) may use the reverse rinsing. The goal of this feature is the cleaning of the sensors flow channel from jammed flakes.
The reverse rinsing option is available inside this menu only as long as the dedicated value is set to "1".

Menu:
calibration→service
R_Rinse: 0 oder 1

8.5. Throw counter

If the device works with a Douple Pump System (DPS) every throw of the pump will be counted. This counter is read only. The reset of this counter can only be done at the factory.

Menu:
calibration→service
Strokes: *Number*

9. Port Allocation

9.1. Plug connector sensor

Plug connector: LEMOSA, 10-pin

Pin	Signal	Comment
1	A+	Input differential amplifier
2	+15V	Voltage supply sensor
3	-15V	Voltage supply sensor
4	VR	Regulating voltage laser diode
5	GND	
6	n.c.	not reserved
7	GND	
8	+VLaser	Voltage supply laser
9	GND	
10	A-	Input differential amplifier

9.2. Serial interface

Plug connector: SUB-D, 9-pin, connector
Signal level: RS232

Pin	Signal	Comment
1	-	Connection to pin 4 und 6
2	RxD	Receive data
3	TxD	Transmit data
4	-	Connection to pin 1 and 6
5	GND	
6	-	Connection to pin 1 and 4
7	RTS	
8	CTS	
9	n.c.	not reserved

9.3. Plug connector SF/DPS

Plug connector: SUB-D, 15-pin, jack

Pin	Signal	Comment
1	VOut	Input supply voltage outputs (+12V)
2	Out1	Output 1 (triggering SF or DPS)
3	Out2	Output 2 (spare)
4	In1	Input 1 (5V, acknowledgement SF or. DPS)
5	In2	Input 2 (5V, spare)
6	-	not reserved
7	AOut	Analog output 0...10V, particle monitor
8	AIn	Analog output (spare)
9	GND	Supply voltage
10	GND	Supply voltage
11	+12V	Supply voltage
12	+12V	Supply voltage
13	-	not reserved
14	AGND	Analog GND
15	AGND	Analog GND

9.4. 24V inputs / limit value switches

(Not available in standard devices!)
Plug connector: SUB-D, 9-pin, jack
Signal level: 24V (inputs)

Pin	Signal	Bemerkung
1	K2S	upper limit value – closer
2	K2O	upper limit value – opener
3	K2	upper limit value – common
4	K1S	lower limit value – closer

5	K1O	lower limit value – opener
6	24M	GND
7	I4	input I4 (24V)
8	I3	input I3 (24V)
9	K1	lower limit value – common

10. Important Remarks

- The equipment should always be supervised when in operation and only operated by qualified staff.
- During measurements always make sure that the medium to be measured is safely lead away in big enough containers whose filling status must constantly be checked.
- Inappropriate handling will exclude all liability and warranty claims.
- Klotz Company staff members or authorized service persons shall be the only persons to interfere in equipment of Klotz Company. Tampering by other persons will exclude all liability and warranty claims.
- Measurements of particles in aggressive medium are prohibited. If need be, ask Klotz Company for information before doing so.
- Connecting devices other than those recommended will be at your own risk. Liability claims for any possible defects will not be excepted.
- We reserve the rights to modifications in the sense of technical improvements.

11. Technical Specifications

Power connection (for equipment with mains supply):	
Voltage supply	230V~
Power frequency	50Hz
Current consumption	max. 100mA
Voltage supply (for accumulator operated equipment):	
Voltage supply	12V-
Power supply unit	Plug power supply 230V~ / 12V, 1A
Accumulator pack	13,2V, 2Ah
Operation time with accumulator	appr. 3h (with DPS connected)
Measuring value memory:	
Number of data records	> 1.200 (liquids) > 500 (particle meas.)
Number of series of measurements	1 or 2...100
Allocation	optional
Characteristic quantities particle counter:	
Particle sizes	1µm...9999µm (dependant on sensor)
Input voltage range sensor	0mV...9999mV
Setting range Noise voltage	0mV...2500mV
Maximal particle number per display range for each measurement	16.777.216
Maximal total number of particles per measurement	16.777.216
Equipment models:	
12 bit A/D converter	
Counting channels	4096
Display range	Max. 32, optionally definable
Pract. processing speed	< 200.000 particle/s
10 bit A/D converter	
Counting channels	1024
Display range	Max. 32, optionally definable
Pract. processing speed	< 63.000 particle/s

12. Accessories

- Devices
  - Sample Feeder SF (measuring dome with attached particle sensor; pressure regulation
  - Double Pump System DPS (wear- and abrasion-free double piston pump with integrated particle sensor; especially for liquids with high viscosities
  - Particle sensors (various models)
  - Equipment case

- PC Software
  Log & Show, evaluation and operation program for particle counters, runs under Windows 98/2000/XP

- Other
  - Connection cables
  - Thermal printer DPU-411 with serial interface

13. Appendix A

Meaning of the characters:
♠ - ACK
§ - NAK
_ - Blank character (space, ASCII-Code 20h)
[] – Repetition for all channels and/or values
If not described otherwise, the number values are output as 8 digit ASCII-character chain.

Command	Response	Description	to comm.
Remote control switch on/off			
C0000	C0000♠ or C0000§	Enters into remote control mode, keyboard of device is powered off	-
C0001	C0001♠ or C0001§	Leaves remote control mode (if the command C0000 interrupts a measurement, it will now be restarted)	-
Start / stop measurements, settings			
C0002	C0002♠ or C0002§	Interrupts current measurement	-
C0003	C0003[_particle size_number]♠ or C0003§	Collects measuring results	M0xxx, M1xxx
C0004	C0004[_particle size_number_volume percent]♠ or C0004§	Collects the measuring results (Value for volume percent must be divided by 100)	M0xxx, M1xxx
C0005	C0005♠ or C0005§	Start measurement	C0006, C0007
C0006	C0006♠ or C0006§	Stop measurement	C0005, C0007
C0007	C0007[_particle size_number_vol-ume percent]♠ or C0007§	Transfer of measuring values, response format like C0004	C0005, C0006
C0008	C0008_volume♠ or C0008§	Queries total volume in mm³ (for calculation purposes spherical particles are presumed)	
C0009	C0009♠ oder C0009§	Stop measurement and restart immediately (combination of commands C0006 and C0005)	
C0010	C0010_ decimal places♠ or C0010§	Queries decimal places of particle size	
C0011	C0011_volume♠ or C0011§	Queries total volume in µm³ with exponent; answer looks like: [-]1.2345E[-]09	free from V2.90
C0012	C0012[_particle size_number]♠ or C0012§	Queries current measuring values on running measurement; answer looks like command C0003	free from V2.96
M00xx		Start SF measurement xx – meas. volume / 10 (max. 260ml)	
M10xx		Start DPS measurement xx – meas. volume / 10 (max. 260ml)	
S00xx		Sets flushing volume xx – flushing volume / 10 (max. 260ml)	M10xx
S1xxx		Sets waiting time in seconds (0...999)	
S2xxx		Sets meas. time in seconds (0...999)	

Read out measuring value memory			
A0000	A0001♠ for a data record or A0xxx[_record number] ♠ for several data records or A0000§	Queries the data records xxx – number of data records in the memory The corresponding record number is output for each data record, the telegram length is variable.	
Bxxxx	Bxxxx♠ or Bxxxx§	Selects a data record, xxxx is one of the record numbers, which may be queried with command A0000.	A0000
Txxxx	Txxxx_JJ_MM_TT_hh_mm_vvvv[_particle size_number]♠ or Txxxx§	Reads out measuring value memory (of the specified data record), xxxx is the memory position in the data record JJ – year MM – month TT – day hh – hour mm - minute vvvv – measuring volume (x 10ml)	
T9999	[Txxxx_JJ_MM_TT_hh_mm_vvvv[_particle size_number]♠ or T9999§	Transfers entire measuring value memory	
Switch off device			
Yyyyy	Yyyyy♠ oder Yyyyy§	Switch off the device with the DeviceID yyyy (command is available for devices which may be switched on by the serial interface only) .	
Switch RTS-signal of the serial interface (network connection of multiple devices)			
Zzzzz	Zzzzz♠ (Answer from device comes if zzzz is equal to the DeviceID programmed to the device!)	Select device via the serial interface; if zzzz does not match the DeviceID all following incoming commands will be ignored except of next Zzzzz.	
Other			
U0003	U0003_buffer voltage♠	RAM-buffer voltage in mV, must be greater than 2,4V	
U0004	U0004_regulating voltage♠	Regulating voltage of laser diode in mV, with voltages greater than 8V the sensor must be cleaned by all means	
X0001	X0001_device number♠ or X0001§	The programmed device number (DeviceID) if available.	free from V2.80
X0002	X0002_counter♠	Counter for all measurement and rinsing cycles (throw counter for the pump in DPS).	free from V2.80
X0003	X0003_version string♠	Version string of the devices software with format “name.v_h.uu_yy/mm/dd” (h-main version, uu-subversion).	free from V2.91