GRIMM AEROSOL Technik GmbH & Co. KG

Manual

Mobile Dust Monitor

ENVIRON CHECK 180

GRIMM Aerosol Technik GmbH & Co. KG
Dorfstrasse 9, D-83404 Ainring, Germany
Tel: 0049-8654-578-0
Fax: 0049-86540-578-35
E-Mail: sales@grimm-aerosol.com
www.grimm-aerosol.com

Index

INDEX 3

1 GENERAL 6

1.1 ANNOTATION 6
1.2 MEANING OF THE USED SYMBOLS....7

2 IMPORTANT HINTS FOR THE CUSTOMER 8

2.1 SAFETY REGULATIONS 8
2.2 ELECTRIC SAFETY 9
2.3 LASER SAFETY....9
2.4 TRANSPORTATION 10
2.5 EXTREME AMBIENT CONDITIONS....11
2.6 TEST KIT 186....13

3 EDM 180 14

3.1 INTRODUCTION 14
3.2 SAMPLE HEAD....14
3.3 THE MEASURING PRINCIPLE 15
3.4 CALIBRATION 17
3.5 GAS FLOW CONCEPT....21
3.6 DRYING 21
3.7 ACCESSORY 22
3.8 SPECIFICATIONS EDM 180 23
3.9 RS-232 INTERFACE....25
3.10 CALIBRATION LABEL....25
3.11 ALARM AND ERROR MESSAGES 25

4 CONTROL ELEMENTS 26

4.1 LCD-DISPLAY 26
4.2 FLAP WITH LIFT LEVER 26
4.3 ON / OFF SWITCH....27
4.4 STATUS-LED....27
4.5 KEY PAD 28
4.6 KEY FUNCTIONS – QUESTION REGARDING FILTER YES/ NO? 28
4.7 KEYS FUNCTIONS WITHIN OPERATION MODE 29
4.8 KEY FUNCTIONS WITHIN THE STAND-BY MODE 30
4.9 DATA STORAGE (INTERNAL / EXTERNAL)....31

5 MEASUREMENT 33

5.1 INSTALLATION 33
Installation sample pipe 182 and sample pipe 181 34
Installation 180 36
5.2 TAKING THE EDM 180 INTO OPERATION 37
5.3 ILLUSTRATION OF THE MEASURED VALUES 38

6 HYPERTERMINAL VIA RS-232 INTERFACE 39

6.1 HYPER TERMINAL 39
6.2 WORK WITH HYPER TERMINAL 42

7 SWITCHING POSSIBILITIES OF THE GRIMM 190 46

7.1 WITH A TERMINAL PROGRAM 46
7.2 WITH GRIMM SOFTWARE 1177 VERSION 3.30 47

8 RS-232 INTERFACE 48

8.1 RS-232 INTERFACE 48
8.2 TRANSMISSION PROTOCOL 48
8.3 RS-232 COMMANDS 48
8.4 RS-232 TRANSMISSION OF MEASURED VALUES 53
8.5 ADDITIONAL INFORMATION WITHIN SERVICE MODE: CRC SUM 54
8.6 DISPLAY MEASURED VALUES OF THE ADDITIONAL CLIMATIC SENSORS 54
8.7 SERVICE MODE SETTINGS 55

9 SPECIAL DATA PROTOCOL “GESYTEC“ 56

9.1 CHANGE OF MODE FROM STANDARD TO GESYTEC 56
9.2 SETTING WITHIN NORMAL OPERATION 57
9.3 GESYTEC STRUCTURE 58

10 SENSORS 61

10.1 ANALOG INPUT 61
10.2 BAROMETER (INTERNAL) 61
10.3 BASIC SENSORS 61
10.4 WEATHER STATION 62

11 SYSTEM MESSAGES 63

11.1 ALARM AND ERROR MESSAGES ON THE LCD 63
11.2 WARNINGS ON THE LCD 64

12 MAINTENANCE AND CLEANING 65

12.1 SAMPLE AIR DUCT INSIDE THE OPTICAL CHAMBER OF THE SPECTROMETER 187 65
12.2 FLY SCREEN ON THE SAMPLE PIPE 182 65
12.3 CHANGE DUST FILTER 65
12.4 INTERNAL RINSING AIR FILTER 65

13 ACCESSORY **66**
13.1 SENSOR FOR TEMPERATURE AND HUMIDITY (MODEL 1.153FH180) 66
13.2 ANALOG ADAPTER FOR PM 10 + PM 2.5 AND PM 1 (MODEL 160) 66
13.3 MEMO CARD READER (MODEL 1155B) 66

14 WARRANTY **67**

15 TRANSPORT AND REPAIR **69**
15.1 TRANSPORT 69
15.2 REPAIR 69
15.3 DIMENSIONS 70

16 INDEX **73**

1 General

1.1 Annotation

Put hard- and software only after precise study of this manual into operation! The producer is not liable for damages which are caused through inappropriate initial operation, usage, cleaning, or operating errors.

Many soft- and hardware denominations which will be mentioned within this manual are registered trademarks and have to be treated this way. The author's intention is to give you complete and accurate information by this manual. Grimm Aerosol Technik does not guarantee completeness and accuracy of the following available information which therefore excludes entitlement to damages that result either collateral or directly from the usage of this manual and/ or the usage of the soft- and hardware. Grimm Aerosol Technik moreover is not responsible for damages, which result from patent infringement or abuse of a third's party rights.

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GRIMM Aerosol Technik GmbH & Co. KG
Dorfstrasse 9
D-83404 Ainring

Phone: ++49 / 86 54 / 5 78 – 0
Fax: ++49 / 86 54 / 5 78 – 35
Email: service@grimm-aerosol.com
Homepage: www.grimm-aerosol.com

This manual refers to:

Environmental Dust Monitor EDM 180

We reserve the right to change or improve the instruments described in this manual without previous announcement, simply in accordance to the technical progress. Therefore insignificant deviations between the descriptions in this instruction and your measuring instrument are possible.

1.2 Meaning of the used symbols

In this manual following symbols will be used in order to ease locating important hints, advices, and situations.

This symbol indicates useful hints which facilitate and optimize your working process.

This symbol indicates potential dangers, which may lead to malfunctions or even damage of the hardware and how those dangers can be avoided.

2 Important hints for the customer

2.1 Safety regulations

The manufacturer declines any direct or indirect liability if the operator opens the instrument or manipulates the instrument! This instrument is built and tested in accordance with EN-61010 (DIN VDE 0411 T1) to assure proper protection of the electronic material and measurement function of the instruments. All units have left the factory with regard to safeguarding in a perfect condition. In order to keep this state and to guarantee a safe operation, the customer must follow the references and warning notes which are contained in this manual.

If a safe operation is no longer possible, the instrument has to be taken out of operation and to be protected against unintentional operation. A safe operation is not possible anymore.

- if the instrument shows visible harm,
- if the instrument does not work anymore,
- after longer storage under unfavourable conditions,
- after heavy-duty transportation.

If the instrument was stored or transported at low temperatures and an acclimatisation period prior start up of minimum 1 hour is not kept, the internal pump may not even start (due to possible inner condensation). In this case the electronic protection fuse will activate and disconnect the instruments power supply.

Do not operate the device without the condensate bottle!

2.2 Electric Safety

Before the first use of the instrument you need to check whether the main voltage is in the allowed specifications. Operate the dust monitor only with the designated voltage and the original external power supply.

- The Lithium battery (SL-389; 3,6V; 1AH) on the digital circuit board is necessary to the operation of the real-time clock. This battery must not be charged and only changed in an emptied state by an authorised personal. The normal operation period is several years.
- The recharge of the Lithium battery inside the memory card (CR-2016 with 3V and 60mAh or CR-2325 with 3 and 200mAh) is not permitted.
- Fuses built into the instrument may only be changed by trained service personnel

All fuses are to be replaced only by the same type!

.

Since the instrument has its internal electronic protection, the fuses will react only at a serious fault!

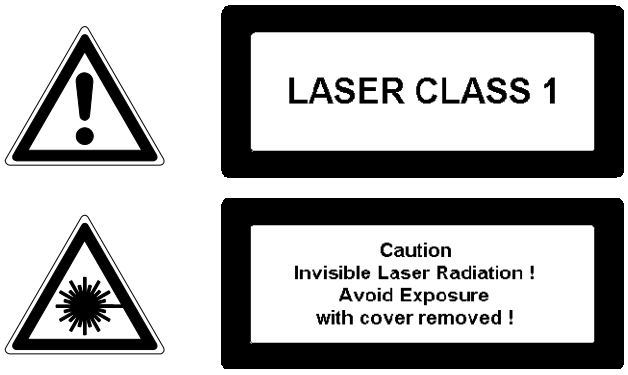
2.3 Laser safety

Caution! Optical laser class 3 B inside!

The instrument may only be opened by GRIMM trained service personnel. During the opening of the laser unit, especially the measuring chamber, a laser radiation of the class 3 B can be released. The direct look into the laser beam or a reflexion can lead to damage of the eyes even at a short exposure time.

You will find references in the EN 60825 (DIN VDE 0837 T1), but also in the corresponding VBG 93 "Laser radiation" prevention regulation for possible accidental exposure!

Caution! Laser class 3B at a open instrument!



All stickers shown are on the bottom of the instrument and warn the operator for laser light radiation in case the covers of the instrument have been dismounted!

Laser class 1 in closed state of the measurement unit! Laser of class 1 are not dangerous and safe for eyes even in case of malfunction due to manipulation or usage of optical additives (e.g. binocular, microscope etc.)

The glass fuses built in the instrument (Pico fuse 2A, quick-type, and switching capacity 300A /32V DC) must only be replaced by trained service staff with the type specified in the circuit documents. Because the devices are secured by electronically excess-current cut-out the fuse will only respond at a severe malfunction.

2.4 Transportation

The instrument may be transported only in the original packing and in the switched off mode. The aerosol inlet and output have to be closed with provided covers.

2.5 Extreme ambient conditions

Altitude correction

The pressure altitude formula describes the vertical distribution of the (gaseous) particles in the Earth´s atmosphere, means the change of the barometric pressure related to height. This is also called the vertical pressure gradient. However, within the lower atmosphere because of the high weather dynamics it can mathematically only be described with approximations. A noticeable change of the air density is proportional to increasing height. The air pressure decreases because the air column is „shorter“ and thus lighter. The rule of thumb here is: The air pressure decreases with increasing height by 12mBar per 100 meters.

Because of the low barometric pressure the volume flow accelerates with increasing altitude. That means that the signal amplitude of the detected particles changes – it decreases and thus bigger particles will be wrongly assigned to low channels which results in a wrong mass.

Thus the display of the flow meter, which is dependent on the barometric pressure, has to be corrected.

Displayed values = $\sqrt{\frac{p_{vorOrt}}{p_{referenz}}} \cdot Scale\,value$

$P_{Reference}$ = 1013mbar

Scale value is the value which equals to 1.2 l/Min Mass - Flow at 1013mbar – here 60mm (Flow meter ANALYT)

Pressure [mbar] Altitude[m]	740 2500	790 2000	840 1500	860 1300	870 1200	890 1075	905 900	910 850	920 775	930 675	940 600	950 500	960 425	970 350	980 250	990 175	1000 100	1013 0
Display	51,3	53	54,6	55,3	55,6	56,2	56,7	56,9	57,2	57,5	57,8	58,1	58,4	58,7	59	59,3	59,6	60

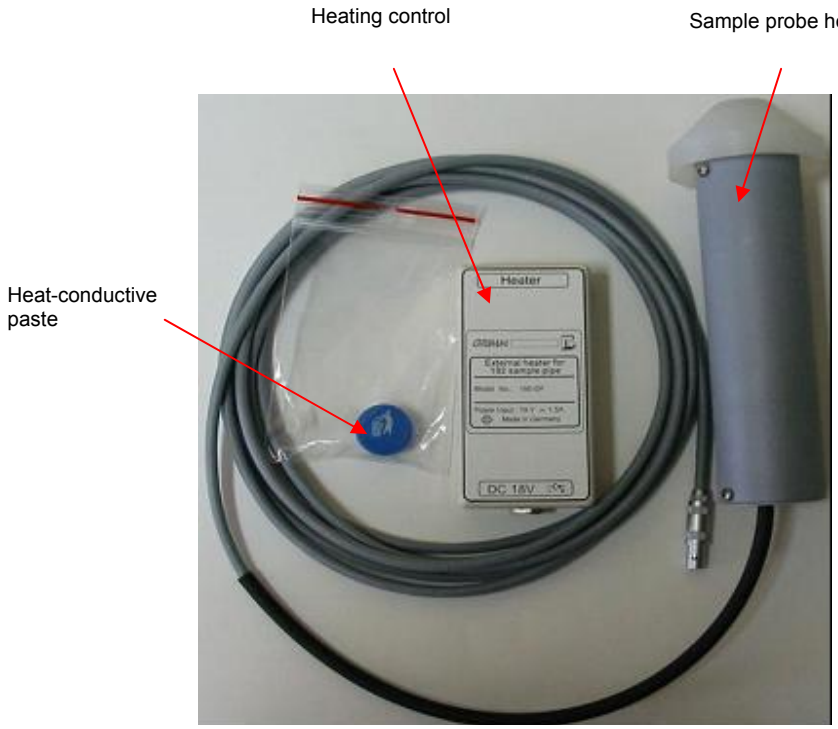
Hint: The float of the flow meter has to be flexible, i.e. an exact vertical and horizontal adjustment of the flow meter is very important.

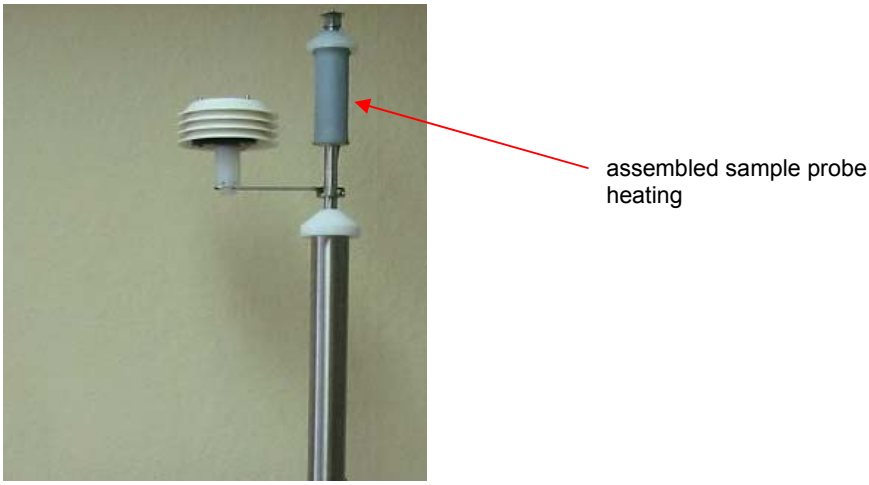
For adjusting the flow see 8.7 (Flow adjust with ^F in HYPER TERMINAL – The adjustment then happens via + / -).

Ice and snow

The external probe head heating model 180-DF is an accessory for the Enviro product line of the company **GRIMM** (165, 365, 180, 190, 565). It keeps the probe head ice free when having frost and thus enables failure-free measurements. The heating heats up to a maximum of 10°C.

Accessory





2.6 Test kit 186

The **EDM Test kit model Nr. 186** is an accessory part for the Enviro product line of the company Grimm (165, 365, 180, 190, 565).

It controls the correct installation and function of the systems.

Here 3 basic functions are to be considered:

- Zero filter test
- Leakage test
- Flow test

Source of supply

Accessories and consumables are available at you local dealer or at:

GRIMM Aerosol Technik GmbH & Co. KG
Dorfstrasse 9
83404 Ainring
Tel.: +49 (0) 8654-578-0

3 EDM 180

3.1 Introduction

The measuring device for airborne dust of the series 180 is a stationary instrument which has been designed for the continuous measurement of airborne dust and its particle size distribution. The measured values will be output as mass concentration in the unit µg/m³ and distinguished according the fractions PM10, PM2.5, and PM1. The measuring principle here is the scattering light measurement of the single particles, where a semiconductor laser serves as light source. The 90° scattered light with an opening angle of ca. 60° is being lead via a mirror onto a receiver diode. When particles cross the laser beam they emit a light pulse. This electric signal of the diode will be classified into 31 different size channels after an adequate amplification. This enables a size determination of the particles and also let realize also a weighting curve, e.g. PM10 acc. to EN 12341. The sample air is being volume controlled sucked through the optical measurement chamber and a fine filter. The pump also provides the rinsing air which is generated via the pumps exhaust air and a subsequent fine filter. It is being held constant by a rinsing air controller. The rinsing air prevents the laser optics and measurement chamber from pollution and furthermore being used as particle-free reference air during the self-test.

3.2 Sample head

The used sample head is a TSP head. There is no size selective segregation happening inside the TSP sample head. In order to protect the device from bigger materials such as leaves or insects there is a wire fence around the sample head.

Figure 1: Sample head

3.3 The measuring principle

The sample air is led directly into the measuring cell via the aerosol inlet or other custom-designed air inlets, e.g. for high wind speeds or overpressure. The particles in the sample air are being detected by light scattering inside the measuring cell. The scattering light pulse of every single particle is being counted and the intensity of its scattering light signal classified to a certain particle size. The measuring principle is schematically shown in figure 2.

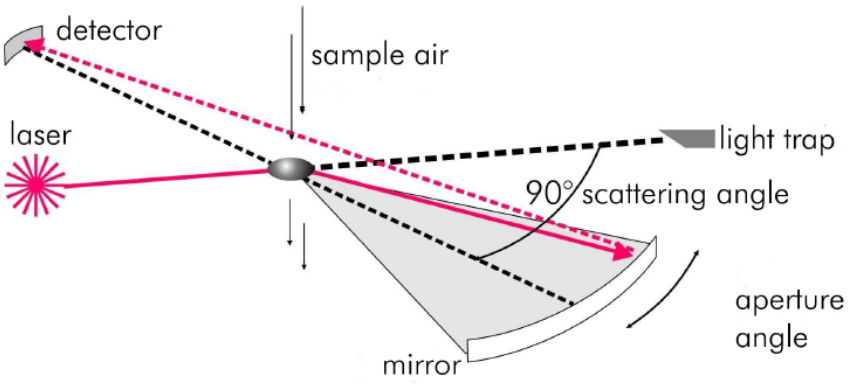
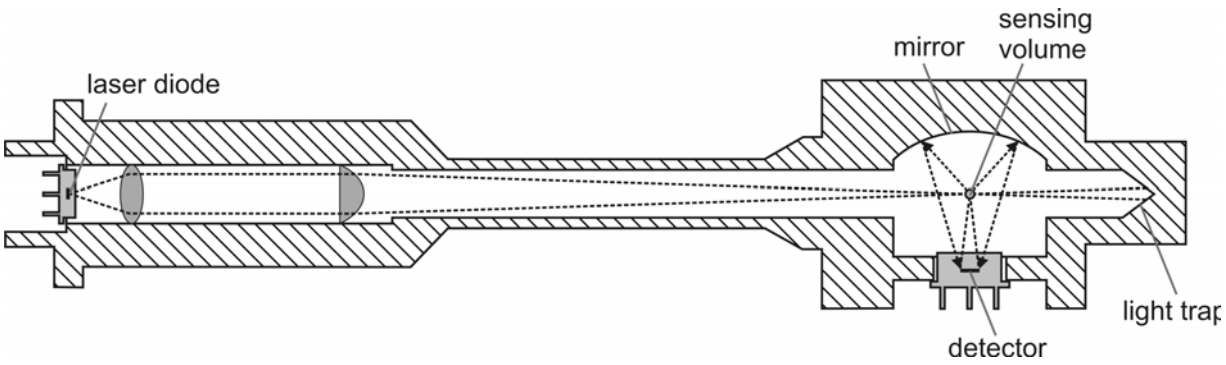


Figure 2: Measuring principle

All Grimm laser aerosol spectrometers and dust monitors use a laser diode as light source. The wavelength is for model 365 in visible range at 655 nm. The laser diode can be operated in a so-called Multiplex Mode, i.e. the intensity of the laser beam is being modulated. This way particles can be detected over a very wide size range from 0.25 µm up to 32 µm. The laser beam is focused to a flat elliptical strip by means of an illumination optics. Inside the focus the laser beam lights a small measuring volume evenly and subsequently is being led into a light trap. The sample air is focused aerodynamically and then led as particle flow through the inner area of the measuring volume. When doing environmental measurements, the particle concentration of the sample air is normally so low, that statistically seen only one particle is in the measuring volume. Measuring at particle sources, technical particulate matters, or working places, very high particle concentrations can appear which require a previous dilution of the sample air. Due to the fact that the entire sampling volume of 1.2 liter/minute is analyzed, all Grimm aerosol spectrometers reach a very good counting statistic. The scattering light emitted by every particle is being detected by a second optics under a scattering angle of 90° and then directed onto a receiver diode via a wide-angle mirror. The signal of the detector will be classified into size channels after amplification subject to its intensity. Figure 2 shows the assembly of the laser measuring chamber. The sample air duct occurs perpendicular to the perspective into the measuring volume.



The count rate results from the number of particles divided by volume flow rate. The particle size is proportional to the intensity of the detected scattering light signal whereas the scattering light intensity is also being influenced by the particles refractive index, particle shape, and orientation of the particle within the measuring volume. Positioning the detector into a 90° direction enables minimizing the influence of the aerosol particles refractive index for determining the particle size. The opening angle of the detector optics was chosen in a way so that an ambiguousness of the scattering light intensity due to MIE scattering undulations caused by monochromatic illumination is being compensated. Thus a distinct detection of the particle size in sufficient narrow size classes is possible. Model 1.109 provides 31 size channels. By detection of the particle concentration and particle size, the size distribution of the aerosol particles can be determined which in turn is the basis of the evaluation of the particle mass. Within measuring mode “particle mass” an additional size channel is arithmetically adjoined below the smallest size channel. So the 365 outputs within mass mode 32 size channels. The additional size channel is primarily useful when calculating the standardized mass fractions and leads to an improved accuracy measuring fine aerosols.

For a precise and reproducible particle counting and particle sizing the accurate sampling volume of 1.2 liter/minute is absolutely fundamental. The sampling volume affects the conversion of the raw counts in the actual sampling volume in the selected unit, like liter or m³ and secondly the particles speed in the optical chamber, which must be in the given tolerance range for a correct particle sizing.

Chart 1 Channel tresholds of the internal dust collection of the test device in µm

0,25	0,28	0,30	0,35	0,40	0,45	0,50	0,58	0,65	0,70	0,80	1,0	1,3	1,6	2,0	2,5
3,0	3,5	4,0	5,0	6,5	7,5	8,0	10,0	12,5	15,0	17,5	20,0	25,0	30,0	32,0	

3.4 Calibration

The particle size detection is calibrated with traceable NIST-certified (National Institute of Standards and Technology) mono disperse latex. The dust mass calculation is being calibrated with dolomite dust compared to a reference device. The instrument will be delivered with a certificate of calibration!

The condition of the spectrometer should be checked annually. Therefore the device has to be sent to the manufacturer where it will be inspected and calibrated by means of a reference device. Alternatively the customer him/herself can do the calibration. Therefore a calibration tower and a reference device are necessary. In order to be able to handle this calibration tower in a correct way, two specific trainings are preliminary! The reference device itself has to be inspected and then certified annually by the manufacturer using mono disperse latex.

How does Grimm Aerosol Technik calibrate?

The calibration of aerosol spectrometers is done by each manufacturer in a different way. Such a method can be denominated as “house-standard“ – Why? Because there is no worldwide standard for calibration of aerosol spectrometers, but every manufacturer is supposed to use the standard aerosol particles for size calibration (poly-styrene latex, PSL). The Grimm “calibration-house-standard“ is based upon a comparison between a “mother device” calibrated with PSL and a “candidate”.

What is a Grimm ”mother device“?

For the mother device there was a certain calibration response curve calculated containing all relevant parameters of the aerosol spectrometer (laser wave length, position of the detector, opening angle of the detector, PSL refractive index m = 1,60 +i0, etc..). Hereupon the mother device will be „feeded“ with different mono-disperse PSL samples and so validates the particle size measurement for this standard material. The first Grimm mother device, sort of “grandmother”, moreover was being compared to a reference device, viz. the laser aerosol spectrometer model LAS-X by PMS, Boulder, Colorado. By this procedure we ensure the correct particle size measurement in the specified channel, e.g. for model 1.108 15 and for model 1.109 31 channels.

Calibration, physics background

Particle sizing is calibrated with NIST traceable Poly-Styrene Latex (PSL), Duke Scientific. So we measure optical latex equivalent diameters. The size channels are related to electronic thresholds. A single particle passing the laser beam will scatter the incident laser light. This scattered light is collected by a mirror in a given angle and focused to the detector. The photons collected by the detector will give a "raw-signal" which will be amplified and classified in a particle size channel. So number concentration and size of the aerosol particles can be measured.

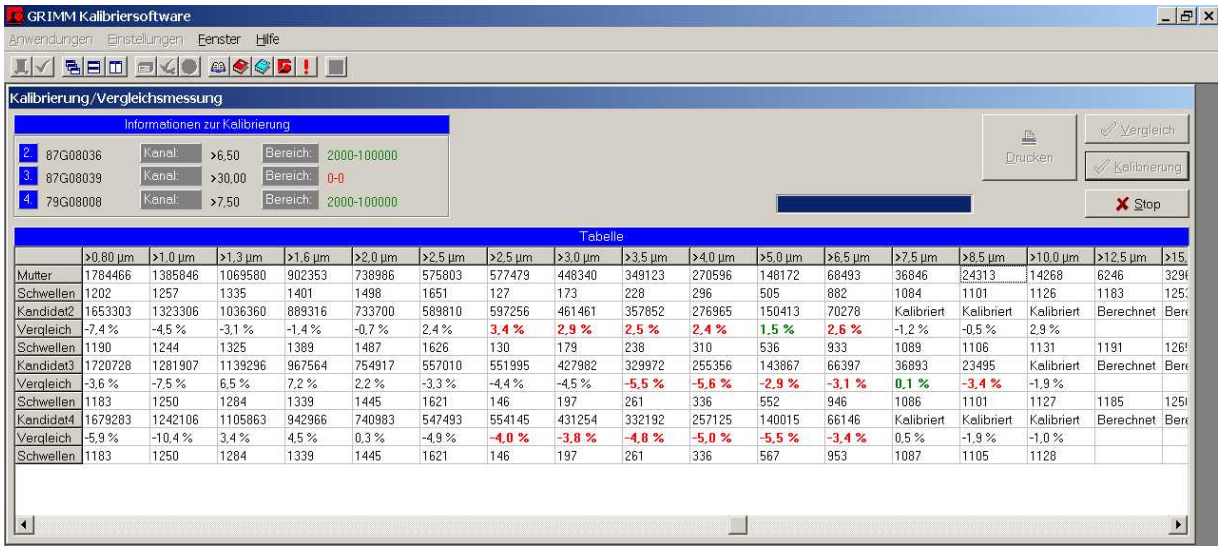
Grimm Calibration procedure

The calibration between a candidate and the mother unit is done by use of a "Grimm Calibration Tower" that isfully computer-controlled and -automated and poly disperse dolomite dust as a standard aerosol. Why dolomite dust? Dolomite dust is cheap, anoxic, not hygroscopic, poly disperse and very stable during storage. The dolomite dust covers the entire sizing range for all Grimm spectrometer from app. 0.2µm up to >30µm. Due to the fact that both the mother unit and the candidate are manufactured identically, the dolomite dust must lead to identical results in both spectrometers. The dolomite dust is injected by a 40msec pulse of particle-free compressed air at the top of the cylindrical calibration tower and dispersed homogeneously over the whole round cross-section. At the bottom of the calibration tower up to three candidates and one mother unit are attached at identical aerosol inlets. A reverse flow of particle-free compressed air from the bottom to the top of the cylindrical tower guaranties a well-defined and reproducible aerosol particle distribution during the whole calibration procedure.

During the calibration the counts in every single size channel, starting from the biggest, are compared between the mother unit and the candidate simultaneously. The calibration software is able to compare six size channels at the same time. The statistical comparison is based on a mean value calculated by a set of 15 single values. A single value is displayed every 6 seconds. Depending on the measured particle concentration, the calibration software can adjust the electronically thresholds of the candidate.

Threshold lower = more particles in the channel

Threshold higher = less particles in the channel



	>0,80 µm	>1,0 µm	>1,3 µm	>1,6 µm	>2,0 µm	>2,5 µm	>2,5 µm	>3,0 µm	>3,5 µm	>4,0 µm	>5,0 µm	>6,5 µm	>7,5 µm	>8,5 µm	>10,0 µm	>12,5 µm	>15,
Mutter	1784466	1385846	1069580	902353	738986	575803	577479	448340	349123	270596	148172	68493	36846	24313	14268	6246	329
Schwellen	1202	1257	1335	1401	1498	1651	127	173	228	296	505	882	1084	1101	1126	1183	125
Kandidat2	1653303	1323306	1036360	889316	733700	589810	597256	461461	357852	276965	150413	70278	Kalibriert	Kalibriert	Kalibriert	Berechnet	Ber
Vergleich	-7,4 %	-4,5 %	-3,1 %	-1,4 %	-0,7 %	2,4 %	**3,4 %**	**2,9 %**	**2,5 %**	**2,4 %**	**1,5 %**	**2,6 %**	-1,2 %	-0,5 %	2,9 %		
Schwellen	1190	1244	1325	1389	1487	1626	130	179	238	310	536	933	1089	1106	1131	1191	126
Kandidat3	1720728	1281907	1139296	967564	754917	557010	551995	427982	329972	255356	143867	66397	36893	23495	Kalibriert	Berechnet	Ber
Vergleich	-3,6 %	-7,5 %	6,5 %	7,2 %	2,2 %	-3,3 %	-4,4 %	-4,5 %	**-5,5 %**	**-5,6 %**	**-2,9 %**	**-3,1 %**	**0,1 %**	**-3,4 %**	-1,9 %		
Schwellen	1183	1250	1284	1339	1445	1621	146	197	261	336	552	946	1086	1101	1127	1185	125
Kandidat4	1679283	1242106	1105863	942966	740983	547493	554145	431254	332192	257125	140015	66146	Kalibriert	Kalibriert	Kalibriert	Berechnet	Ber
Vergleich	-5,9 %	-10,4 %	3,4 %	4,5 %	0,3 %	-4,9 %	**-4,0 %**	**-3,8 %**	**-4,8 %**	**-5,0 %**	**-5,5 %**	**-3,4 %**	0,5 %	-1,9 %	-1,0 %		
Schwellen	1183	1250	1284	1339	1445	1621	146	197	261	336	567	953	1087	1105	1128		

Figure 1: Screenshot of the Grimm calibration software during a running calibration with one mother unit and three candidates (in this example: Grimm Environmental dust monitors with 31 channels).

The columns in the table in Figure 1 show the 31 size channels. The lines in the table in Figure 1 show from top to bottom: the counts of the reference unit, and for each candidate the electronically settings of the threshold, the counts of the candidate and the calculated relative error. To indicate the meaning of the relative errors three different colours are used:

Red values indicate a running calibration of a size channel out of range. Green values mean a running calibration within the range. Black values means, that the relative error is saved for quality assurance, the channel threshold is fixed and the channel is labelled with "Kalibriert" in the software table.

The mean value comparison is repeated approximately 10 times for each size channel, till all readings of the candidate are repeatedly within a given range with a accuracy of ± 2%, compared to the mother unit. The certified accuracy for the mass mode is ± 5%, because of the fact that the particle diameter affects the particle mass by the third power. The calibration software controls all relevant parameters plus the amount of calibration dust, I order to assure that the measured concentrations are above a fixed minimum. All results are stored electronically and are activated in a data bank for quality assurance.

After the tower calibration, a further comparison at indoor conditions is done.

To illustrate the described procedure, the following two screenshots, so called "ramp" from the Grimm calibration software CalSoft, show two examples of a measured particle number concentration of a candidate compared to a reference unit before and after a calibration.

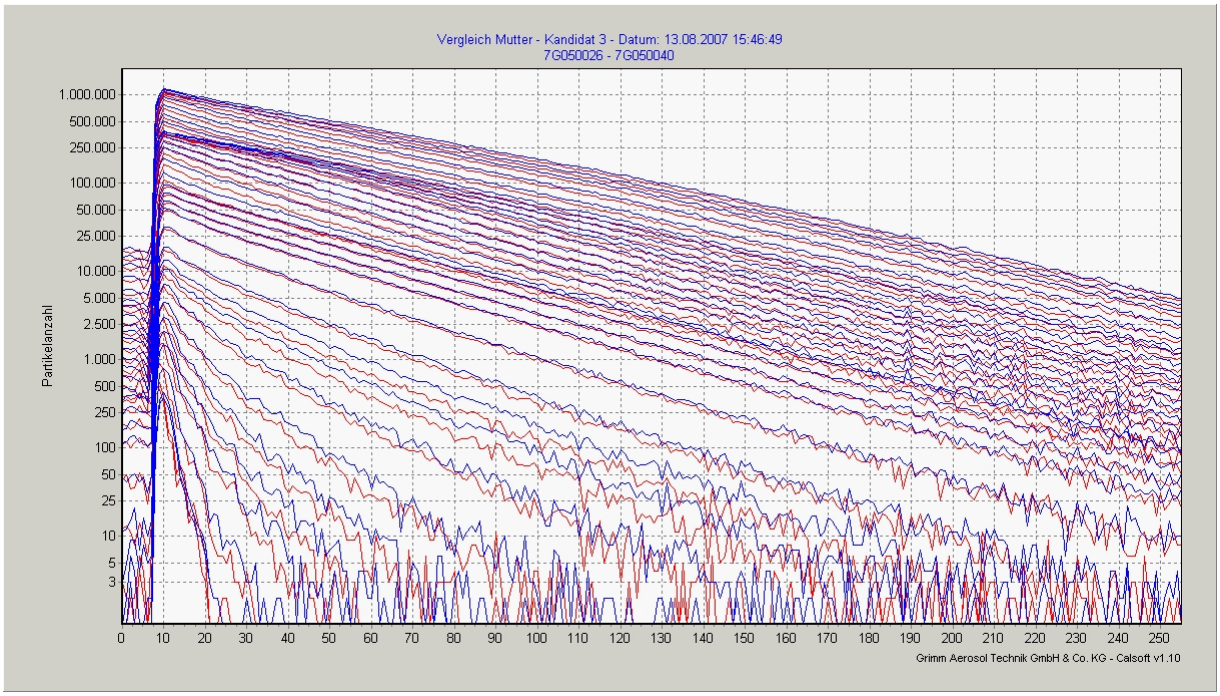


Figure 2: Before calibration: Simultaneously measured particle number concentration for all 31 size channels of the candidate (red) and the mother unit (blue) vs. time.

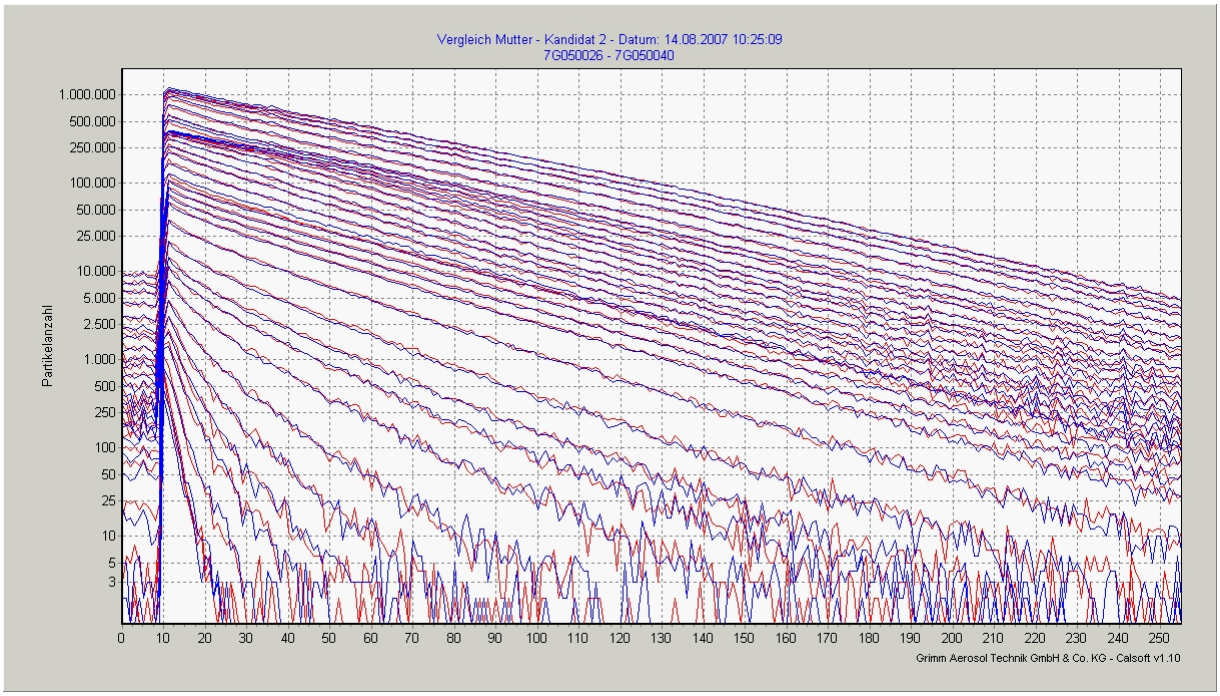


Figure 3: After calibration: Simultaneously measured particle number concentration for all 31 size channels of the candidate (red) and the mother unit (blue) vs. time

At all enviro products (107, 180, 365) a continuous test of the complete system follows with an own sample probe and housing. The models 107 are being operated for ca. 2 days inside a weather housing. There all functions are being checked like as sensors for temperature, humidity, and humidity-controlled mixer operation or temperature control. The continuous test of the models 365 occurs in a similar way where at the complete system instead of the mixer operation the automatic sample air dehumidification (nafion tube and vacuum pump) is being tested.

Models 180 run a test inside a special container for about one week. The data recorded during the continuous test afterwards will be statistically evaluated and stored in a data base.

3.5 Gas flow concept

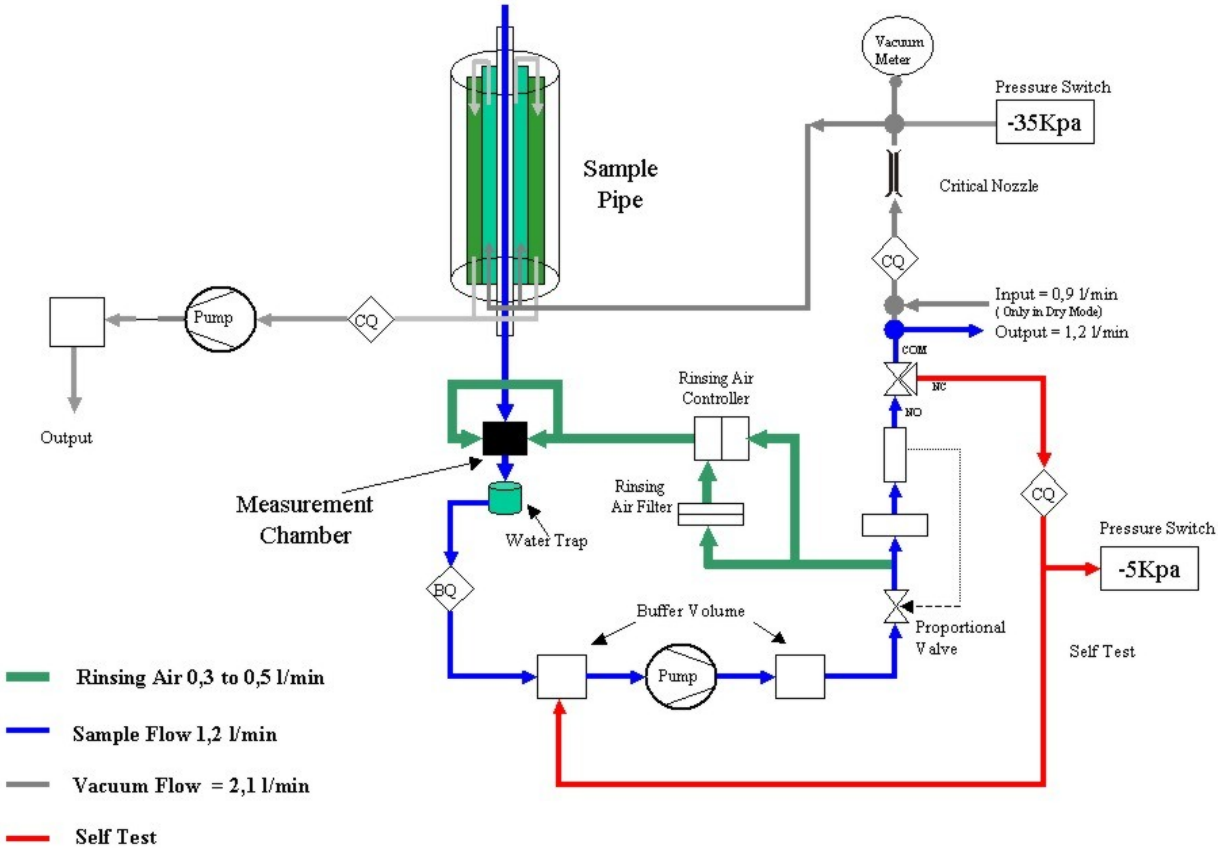


Figure 3: Flow-Schema

3.6 Drying

The air humidity and the ambient temperature are being measured by the sensor 1.153 FH. Is the relative air humidity above 55%, then the dryer circuit automatically switches on. The sample air flow passes after entering the sample head a nafion membrane. The opposite flow (with an active dryer circuit) is dried air on the outer side. The opposite dried air flow exists out of 1.2 l/min exhaust air (Sample Out) and 0.9 l/min ambient. Those 2.1 l/min total air will be brought into the opposite air flow via the vacuum filter, a critical nozzle and sample pipe holder. Because of this vacuum on the outer side the dehumidification occurs under usage of a nafion membrane. This membrane enables the removal of humidity out of the sample air because of a water specific chemical process. Hereby water molecules are being transported via ion channels through the membrane. Afterwards the vacuum pump removes the humidity via the protection filter and the condensate outlet. Decreases the humidity below 50%, the dryer shuts off automatically.

3.7 Accessory

180	Mobile Dust Monitor Enviro Check
180	19“ rack with sample air and vacuum pump; space for spectrometer 187
187	Stationary spectrometer for PM10, PM 2.5 and PM1
181	19“ sample pipe holder
182	1.5m sample pipe with nafion dryer, stainless steel
183	1.5m extension for sample pipe
X180DFL45	Roof flange for PNR 180
1143 E	Connection cable RS-232
177	32-bit software for model 180 with PM values
188	Spare part kit for 2nd year
117	Small spare part kit only for the # 187
160	Analog adapter for PM10+PM2.5 and PM1
1141	USB to RS 232 Converter with 1m cable and driver
1118 A	Printed manual and manual on CD-ROM
190	Update package from 180 to 190 with 31 channels -software
1142. M1	Tel.-Modem-Box, for data transmission
1155 B	External storage card reader
1142.A2	Data storage card 1MB
1142.A4	Data storage card 4MB
158	Wind direction and velocity sensor
159	Rain gauge
180-DF	Defrosting system for extreme cold areas
186	Testkit
1.142.M5	Data logger

Source of supply

Accessory, consumables and spare parts can be ordered at your local dealer or at

GRIMM Aerosol Technik GmbH & Co. KG
Dorfstrasse 9
83404 Ainring
Tel.: +49 (0) 8654-578-0

3.8 Specifications EDM 180

Measuring principle	90° scattering light measurement
Light source	Semi-conductive laser, wave length 660 nm
Laser power	Pmax 60 mW, normal 0.5/32mW (Multiplex)
Opening angle	30 °
Sample volume flow	1.2 l/min ± 5 % constant through control
Rinsing air flow	0.3 – 0.5 l/min
Smallest detectable particle size	0.25 µm
Classification	31 channels internal, the given channel tresholds [µm] are valid for a count efficiency of 50% with mono disperse latex aerosol. 0.25 – 0.28 – 0.3 – 0.35 – 0.4 – 0.45 – 0.5 – 0.58 – 0.65 – 0.7 - 0.8 – 1.0 – 1.3 – 1.6 – 2.0 – 2.5 – 3.0 – 3.5 – 4.0 – 5.0 – 6.5 - 7.5 – 8.5 – 10.0 – 12.5 – 15.0 – 17.5 – 20.0 – 25.0 – 30.0 – 32.0
Mass calculation	Through extrapolation an additional channel below the smallest measured channel is being calculated. The mass calculation is optimized to the best correlation with gravimetric reference filter collectors (EN12341, EN14907).
Mass concentration range in µg/m³	0.1 –6,000
Displayed values	PM10, PM 2.5, PM1 PM coarse TSP
Reproducibility	± 5% over the whole measuring range.
Scan time	From 1 minute to continuous operation
Main filter	Balston 993305 BQ
Data interface	ASCII: RS-232 (9600 Baud, 8 Bit, no parity, 1 Stop-Bit, protocol: X-ON/X-OFF) Caution: Because of alarm control there is a special alignment of the 9 pin D-Subminiature socket! Only use the original cable 1.143E. GESYTEC: 19200 .. 1200 Baud; Number and serial number selectable
Data protocol	ASCII-characters or GESYTEC
Self test:	At every start-up and automatically if Autocal >0
Operation:	Via key pad or RS232 interface or modem
LCD display:	2 * 16 alpha numerical characters, illuminated
Data output LCD display:	Measurands as gliding average over a minute or averages with their sample volume. Alarm values, date and time, measurands of the optional devices.

Analog inputs:	3 inputs (0-10V), resolution 10 Bit (ca. 10 mV). Display with adjustable factors and offsets, selectable and editable texts
Data storage card:	1MB - 4MB SRAM, battery buffered. Selectable interval 6 seconds to 60 minutes. Data: date, time measurement location number, error code, magnetic valve current, sensor data and analog voltages
Power supply: Power:	230V/ 50Hz on request also 110V/ 60Hz max. P= 150W, I (max.) = 1.4A
Operational temperature range:	+4°C to +40°C, r.H. < 95% (non-condensing)
Transport temperature range:	-20°C to +50 °C, r.H. < 95% (non-condensing)
Sample air:	-20°C bis +60 °C, r.F. < 95% non corrosive
Pressure range sample air:	0 to -30 mbar (short-time).
Dimensions:	266 * 483 * 380 mm
Weight:	20 kg
Memory function while power black out	The last set display mode within stand-by mode remains stored in the device. Alarm values, calculated filter weight and sample volume remain stored when switching off or a power black out. During a measurement also all measurands with their according sample volume are kept, so that in case of return of power the measurement continues automatically.

3.9 RS-232 interface

The serial interface exists out of a 9 pin socket which is located on the rear side of the device (labelled with “RS-232 to PC”). Via this interface the communication of a PC with the instrument happens. The second interface is behind the front door and is supposed for the service. Above the interface is an LED which indicates an established connection when shining green. Red signalizes data transfer. Only the RS-232 cable (catalogue number 1.141 or1.143E) must be used for the connection. The service socket will be treated preferably when the handshake lines are put on high (CTS or DTS) by the terminal program.

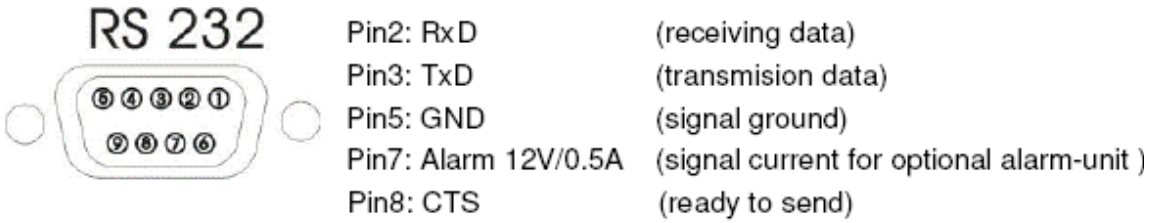


Figure 4: Pin alignment of the socket at the dust monitor „RS-232 to PC“

Only use the original GRIMM data cable due to the alarm output at the 9 pin RS-232 Subminiatur-socket!

3.10 Calibration label

The calibration label on the rear side of the device shows how long the calibration is valid. After expiration of validity GRIMM does not warrant any accuracy of the measurements. This is also applicable if the calibration sticker is damaged or removed.

3.11 Alarm and error messages

Exceeding the set alarm treshold and at occurring device errors (e.g. volume flow control „not ok“) an error text will be output on the LCD display and a warning sound will resound. The errors will also be stored with the data sets on the storage card and output via the RS-232 interface. For the meaning of the error messages see also chapter 9 (RS-232 interface).

4 Control elements

Read this manual carefully BEFORE taking the device into operation!

Please inspect every single part of the measurement unit after unpacking. If you expect that the device cannot be run safely anymore put it out of operation and ensure it cannot be run accidentally anymore. Expect a not safe operation, if

- the device shows apparent damages,
- the device does not work anymore,
- the device was being long-term stored under inappropriate conditions,
- the device suffered under heavy-duty transportation.

The following chapter explicates the different control elements of your dust monitor.

4.1 LCD-display

The optical display on the unit consists out of a LCD (Liquid-Crystal-Display) with 2 lines of 16 characters, therefore 32 characters. The display is illuminated. On this display the measurement results of two channels, or date, time, location (a two-digit number, that can be assigned to a certain area), values of the analog inputs are shown. Additional, also all necessary system messages.

4.2 Flap with lift lever

On the right side of the front plate there is a flap which can be opened. Behind this flap there is the lever for the lift which connects the modules of the EDM 180 and the sample pipe holder. In delivery condition the lever is in the lower position. In order to connect both modules, pull out the lever and subsequently push it upwards until the connection is established. Then push the lever into the instrument again as far as it will go. In this position the lever activates a micro-switch. Is the lever not correctly inserted, the measurement will not start (error message “LIFT NOT OK”).

Below that there is a glass bottle for recepting condensate and abrasive particles. In the lower right corner of the opening is a manometer which indicates the low-pressure within the dryer circuit. During the self-test and the operation of the dryer circuit the manometer has to show a low-pressure of – 550 hPa. Via the connection modules the sample air, the dryer circuit, and the sensors are being connected to the measurement device.

4.3 On / Off switch

With the main switch (Power – lower left side of the front panel) the device is being switched on or off. Do not switch off the unit out during operation- (measurement-) mode but first enter stand-by-mode (press key Stand-by). Otherwise data loss of the storage card might happen.

After switching on the display shows: „**Model 180, Version 7.80 E”**, afterwards date and time (Date/Time). Devices of the 180 series will ask you now **„filter changed ?“.** Implicitly press [-] (no)! Subsequently the self-test will start automatically. It ends with **„Self test OK“**. Should an error occur during the self-test the message **„New Selftest“** will show up. This process will be done four times. Should this error still be existent the message **„Fatal Error Please Check“** will show up..

4.4 Status-LED

Left next to the display on the front panel are two LED located labelled with “Status” and “Dryer”. These LED´s can have 4 conditions: Off, shining red, shining yellow, and shining green. The status LED is off within the stand-by mode. While normal operation it is shining green. If a device error occurs it will shine red. During the self-test it is shining yellow. The LED Dryer (dry-circuit) is off if the dryer-circuit is not being activated. It is also green while dryer circuit is working

4.5 Key pad

Between operation- and stand-by-mode a partly different reaction of the device due to the handling of the keys might occur. Your entry will be confirmed by a short signal tone.

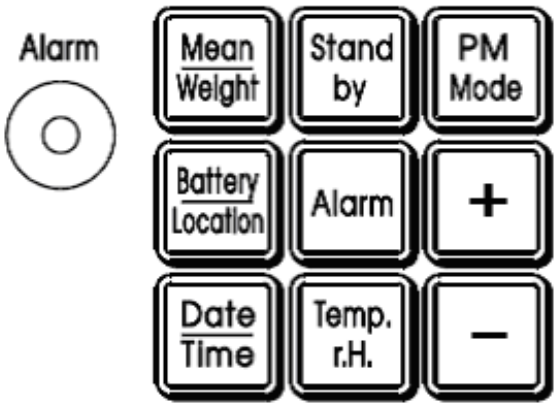


Figure 5: Key pad spectrometer

4.6 Key functions – question regarding filter yes/ no?

After turning on the device

Mean/Weight	Display of the filter weight of all measurements and its according sample volume. It will remain on the display as long as the key is being pressed
Stand-by	Display of the serial number and the operation time
+	Filter changed. The filter weight and averages will be deleted. The device starts the self-test.
-	Filter not changed. The averages will be deleted. The device starts the self-test.

All other keys analog to stand-by mode.

4.7 Keys functions within operation mode

Mean/Weight	Displays the averages of the dust concentration of all valued measurements (PM10, PM2.5, PM1) after switching on the device or deleting the averages with the related sample volume. The averages related sample volume appears after approximately 5 seconds and remains displayed as long as the key is being pressed. By pressing the [Mean Value] key and the [+] key at the same time the filter weight and its related sample volume can be displayed.
Stand-by	Pressing this key the current measurement will be interrupted and the device switches into the stand-by mode.
PM Mode	Stoppage of the measurand output as long as the key is being pressed.
Battery/Location	Pressing this key will show the set measuring location number. This number can be changed by pressing + and – at the same time. For the device can only be operated by line voltage the battery capacity will constantly be shown with 130%.
Alarm	Press this key if you want to request the current alarm state.
+	The cyclic display of the sensor values is being switched on by pressing this key. In the first line of the display the sensor values will be shown next to the set measurand.
Date/Time	Pressing this key will show the current date and time.
Temp./r.H.	Display the current state of temperature and relative humidity by pressing this key.
-	Press this key to disable the cyclic display of the sensor values.

4.8 Key functions within the stand-by mode

Mean/Weight	Like within the measuring mode – with additional resetting of the averages and the average measurement volume by pressing the keys [Mean/Weight] and [-] at the same time.
Stand-by	Press this key to leave the stand-by mode and to begin a new measurement row.
PM Mode	Additional pressing of the key [+] or [-] enables to choose 2 favored PM-values out of PM10, PM2.5 or PM1 for being shown directly on the display.
Battery/Location	Pressing the keys [Battery/Location] and [+] or [-] at the same time lets you change the measurement location number. It serves the identification of different measurements and can be set from 1 through 99.
Alarm	Pressing this key in connection with the [+] or [-] key the mass level can be set from which on the alarm will be going off (0 means Off).
+	Enhance the memory interval (only with installed storage card) respectively displaying the mailbox and scroll up (only with installed modem).
Date/Time	Short pressing: Display of date and time. Longer pressing: Set date and time. The blinking cursor can be moved by the keys [+] or [-]. Pressing Date/Time again will move the cursor on. Pressing no key for a longer period of time will switch the device back into the stand-by mode. Changing the minutes will zero the seconds.
Temp./r.H	Pressing this key will display the current sensor values on the display (upper line) and the time (lower line). Second pressing ends the displaying. In this mode it is possible to switch on the vacuum pump with pressing [-] and the sample pumpe with pressing [+].
-	Decrease the storage interval (only with installed storage card) respectively displaying the mailbox and scrolling down (only with installed modem).

4.9 Data storage (internal / external)

Storage capacity

Depending on the device´s setting – means the set interval and the storage card capacity - different storage times will be reached. Only PCMCIA SRAM data storage cards can be used. Data will be stored using the First in First out (circular buffer) method. This will transcribe the oldest values when having a full storage card.

The data storage card has to be installed before beginning a measurement!

The data storage card has to be inserted into the small black slot (Data card inlet) on the front side of the dust monitor (beneath the display) until you can hear it clicking. Insert it with arrow facing up (facing the display) into the slot. A correct inserted card protrudes from the device about 0.4“ (1cm).

A storage card will only be accepted by the device if it is deleted or already has been used inside the same device without a change of the version and number of the additional sensors.

With a valid storage card the LCD will show after inserting it about 3 seconds the card size and version. Afterwards the interval and the spare storage time. With the keys „+“ and „-“ the interval can be changed during this information and the spare storage time will be refreshed.

A not accepted storage card does not show storage times!

Is the storage card not accepted the measurement will not start. Please make sure the write protection is deactivated. All measured values will now be stored onto the data storage card automatically.

If you don´t use a data storage card the message **NO MEMOCARD** will show up.

With the beginning of a measurement a warning signal (beep-tone) resounds.

Caution! It is not possible to use cards with stored data of a certain device inside a different device!

Deleting the data memory (internal/ external)

If you press both [Mean/Weight] and [Temp./r.H.] at the same time then all data will be deleted from the internal memory after confirming by pressing the key [+]. This is only possible within the stand-by mode. Having a storage card inside the device the internal memory will not be deleted (version ”F” and younger). The data memory then will be tested and formatted.

Data preservation/ storage card battery

The data on the storage card is being preserved by a buffer battery. If the storage card is inside the EDM 180 the power supply happens via the device. Please read out the stored data before changing the battery or otherwise data loss might happen. If the error message **„PLEASE REPLACE MEMORYCARD-BATT.“** shows up the data storage card battery has to be changed.

Storage times of the storage cards

Data storage cards with a size of 4 MB are available. During „Normal“ operation the interval is to be set to 5 or 10 minutes. Setting the interval to 60 minutes the data of the last 59 minutes might miss! Excessing the specified time leads to transcription of the in each case oldest values. The card remains operable.

Some inportant hints:

- If the data storage card has previously been used inside an dust monitor with a different device version having a different version number, then the data storage card will automatically be formatted, i.e. all previous data will be deleted.
- The data storage card should only be changed within stand-by mode, otherwise data loss might happen.
- If the data storage card has not been inserted into the dust monitor before starting the measurement (key „Standby“), then the device has to be switched into the stand-by mode and the storage card has to be re-inserted.
- The average battery life expectancy for the 1MB data storage card is more than one year. When not using for a longer period of time the battery should be taken out of the device.
- The storage card can only be read out either directly on the GRIMM aerosol spectrometer or via an external card reader. Not possible via PC with PCSI card reader.

Storage times of the data storage cards version 7.80

INTERVALL	1min	5min	10min	15min	30min	60min
INTERN	2d 17h	13d 13h	27d 2h	40d 15h	81d 6h	162d 12h
4Mbyte	138d	1Y 325d	3Y 285d	5Y 245d	11Y 125d	22Y 250d

Connecting further sensors next to 1...4 will lower the storage times shown above.

Storage times of the data storage cards version 12.30

INTERVALL	1 min	5 min	10 min	15 min	30 min	60 min
INTERN	12h	2d 13h	5d 2h	7d 15h	15d 7h	30d 15h
1 Mbyte	6d 12h	32d 16h	65d 8h	98d 0h	196d 0h	1y 27d
4 Mbyte	26d 3h	130d 16h	261d 8h	1y 27d	2y 54d	4y 108d

Write protection

The storage card has got a write protection which is supposed to preserve the measured values from transcription. The write protection can be activated with the slider next to the battery case. Please deactivate the write protection if you want to record new measurement values onto the storage card. If necessary please save the existing data first and then delete the storage card.

5 Measurement

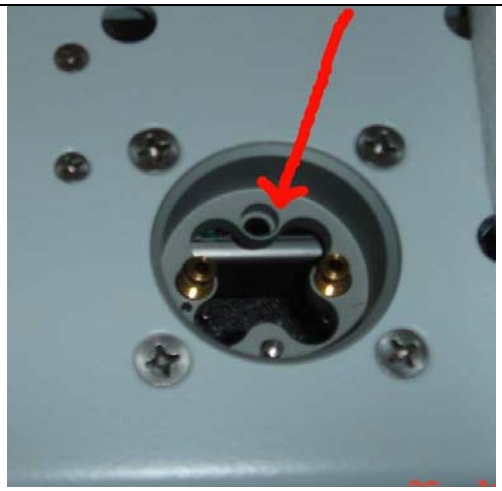
5.1 Installation

The measuring system ENVIRON*check* 180/181 has to be installed in the 19“ rack as the topmost unit. The space needed is 6 HU (180: 4HU, 181: 2HU). Erecting the 19” rack please mind, that the sample pipe 182 is to be inserted directly through the ceiling / roof construction into the sample pipe holder 181. For the exact fitting of the roof penetration a drilling gauge is available at the manufacturer. The outer diameter of the sample pipe is 45 mm.

Mounting and demounting the measuring device 180 can take place without having to disassemble the sample pipe and the sample pipe holder. The connection of the electronic unit 180 with the sensors and the sample pipe happens via a connection module inside the sample pipe holder 181. The ports for the sample air, the dryer circuit, and the electrical connections are each being lead to a plug module. This is fix installed in the 181 and mobile via a lift. Taking the device into operation these modules are being connected. Previous to disassemble the instrument 180 this connection has to be loosened and the device can be pulled out again, without having to dismount sensors and sample pipe.

Installation sample pipe 182 and sample pipe 181

	Install the sample pipe holder at the topmost position of the 19” rack. Screws and further mounting parts are not included in the scope of delivery)
	The temperature/ humidity sensor with carrier (separate delivery) has to be built onto the sample pipe and thread the connection cable through the sample pipe. (The cable must not be deviated so you always have to watch the notch while insertion!).
	Carefully insert the sample pipe through the roof conduit. Before inserting the sample pipe into the receptacle at the sample pipe holder mind the position of the sample pipe holder. The red dot at the bottom of the pipe and the screw have to point to the front. First lead the connection cable through the notch and connect it to the analog socket. Then tighten the sample pipe by dint of the stud screw (located at the inner front of the sample pipes´ receptacle) in the sample pipe holder.

	
	Within the final position the screw must not be visible anymore, but the red dot. Now tighten the safety screw.

Installation 180

	The slide bars provided by the customer for the 19“ drawer have to be mounted. Subsequently mount the EDM180 and connect it to the power cable. The power cable has to be provided by the customer When tightening the 180 and the sample pipe holder 181 please mind, that the connections of 180 and 181 with the lift have to be connectable without any interferences. 180 and 181 have to be exactly on each other with their front plates.
	Behind the flap there is a glass bottle for receiving abrasive particles. Also there is the lever for the lift which connects the modules of the EDM 180 and the sample pipe holder. In delivery condition the lever is in the lower position. In order to connect both modules, pull out the lever and subsequently push it upwards until the connection is established. Then push the lever into the instrument again as far as it will go. In this position the lever activates a micro-switch. Is the lever not correctly inserted, the measurement will not start (error message “LIFT NOT OK”) When demounting follow these steps vice versa.

5.2 Taking the EDM 180 into operation

Please choose previous to the measurement how the data shall be gathered and processed (Online data collection via network and storage onto the PCMCIA data storage card / only storage of the data onto the PCMCIA data storage card without online data collection).
In order to collect data via network or connected PC via the RS 232 interface see chapter 8.4.
The PCMCIA storage card has to be inserted into the spectrometer 187 previous to the measurement. Here the storage card has to be accepted by the device. Please mind the information in chapter 4.8 for installation and operation of the storage card.

An inappropriate installation of the data storage card might lead to loss of data!

After switching on the device the LCD display shows the model designation and software version number. After app. 5 seconds date and time will be shown.

With an installed data storage card the size of the card (Card), the version number (Version), the set data storage interval (interval can only be changed within stand-by mode with the keys + and -) and the remaining storage space will be shown.

By pressing the key [Standby] (only if „filter changed? Press +:yes -:no“ is on the display) lets you request the serial number and number of operation ours. Operation hours are the hours of pump and laser service life. The other keys have the same function like described in chapter 5. Now you will be asked if the filter has been changed (filter changed?). Answer with [-] if the filter has not been changed. If you answer with yes [+] the calculated filter weight and its according sample volume will be set to zero. These values are important for the service (judgment of the filter loading). In order to avoid an accidental deletion of the values, a delayed keyboard inquiry is installed. You have to press the key for at least one second until a beep tone resounds. Now the measurement starts beginning with a ca. 30 seconds lasting self-test.

Every measurement is being introduced by a self-test at which the optical chamber is being rinsed with pure air. There several different internal measurements are being done which reveal the status and condition of the device.

An faultless device shows the message: **SelfTest OK**, otherwise: **New SelfTest**.

Should this error message appear more than once a device error is present which has to be remedied. The instrument tries five times to execute the self-test successfully, then the message „Fatal Error Please Check!“ appears. See also chapter 12.

Possible reasons are:

• a fluff which hangs at the inlet nozzle and extends into the laser
• a heavy polluted measuring chamber
• device temperature above 40°C
• a failed laser or another hardware failure (humidity sensor)

Moreover one of the two status LED might shine red. If a failure of the vacuum dryer circuit is present, the LED “Dryer” shines red. In this case exactly control the correct position / installation of the sample pipe (see also chapter 6).
After a successful self test the actual measurement starts. After every 6 seconds the measured values after being refreshed. After about one minute the values will stabilize, because in order to have a stable display always the moving mean (last 10 measurements) will be displayed.

5.3 Illustration of the measured values

Within stand-by mode the kind of illustration of the measured values can be changed by pressing the keys [PM Mode] and [+] or [-]. Due to the two-lined display only two measurands can be displayed. Pressing the key [+] within the operation mode, the measurands of the connected climatic sensors can additionally be displayed cyclically (see chapter 5.6).

6 HyperTerminal via RS-232 interface

6.1 Hyper Terminal

Every GRIMM spectrometer can be operated online via HyperTerminal with the according control commands. HyperTerminal is a text based communication program which is part of Windows (version 2.0 and higher). Windows Vista does not contain HyperTerminal anymore, but can be downloaded from the website of Hilgraeve with costs.

The program is in ACCESSORIES- KOMMUNICATION of the WINDOWS PROGRAM.
Connect your DUSTMONITOR with the PC on a free serial port.
Switch on the unit.
Use the GRIMM serial cable 1.143E or a GRIMM USB converter 1.141

Start hypertrm.exe.

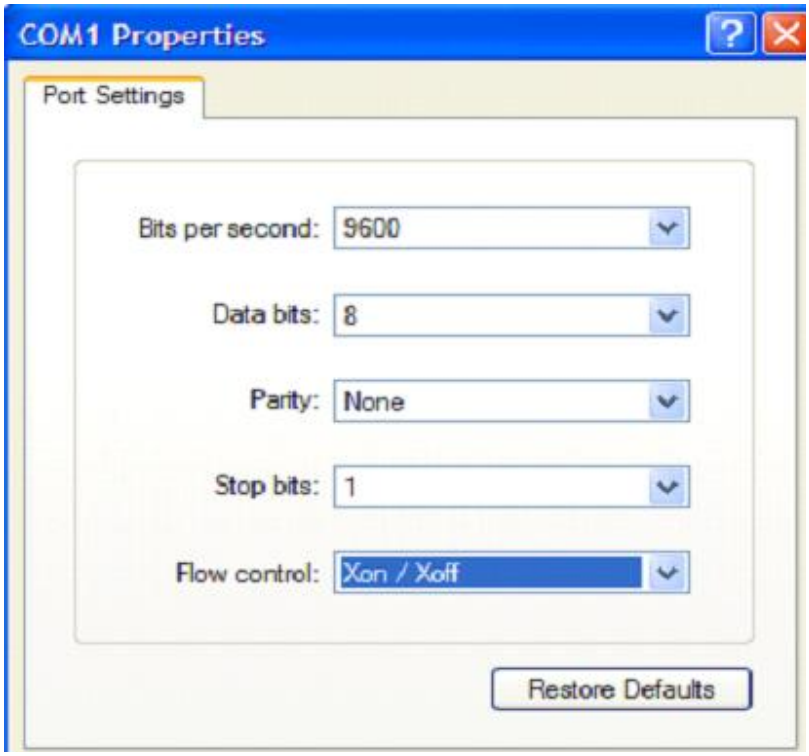
Put in a name for the connection, for example the date or serial number or measurement location.

Press ok

Change your serial interface number in the line connection to whatever port you are using, com1, com2…….

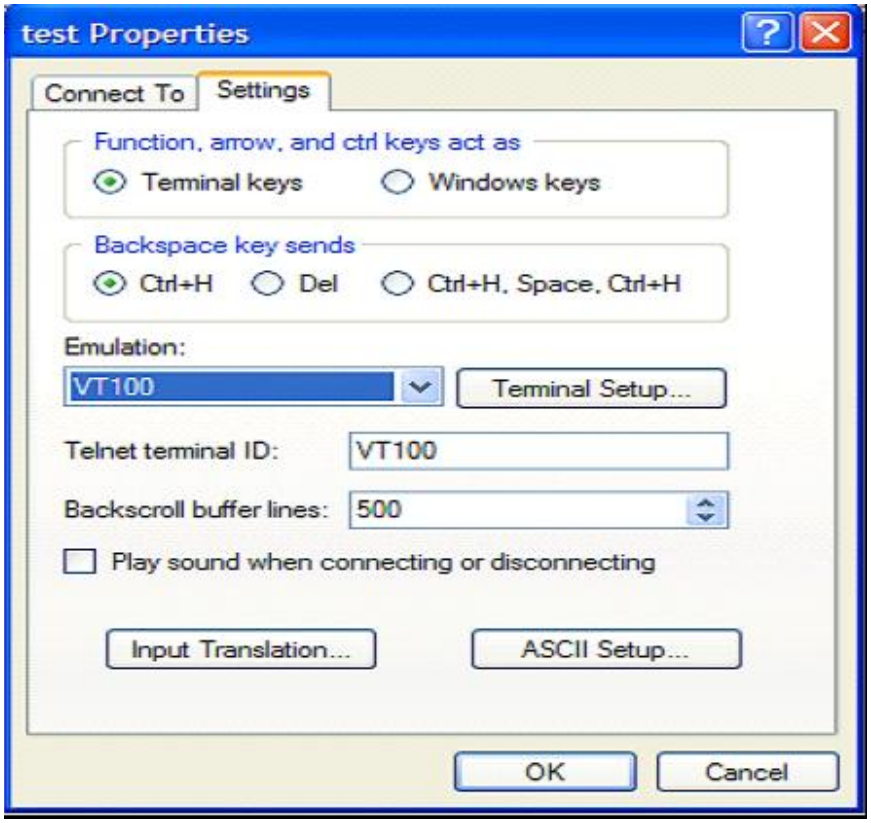
Press OK

Now you have to change the properties of the connection



Press OK.

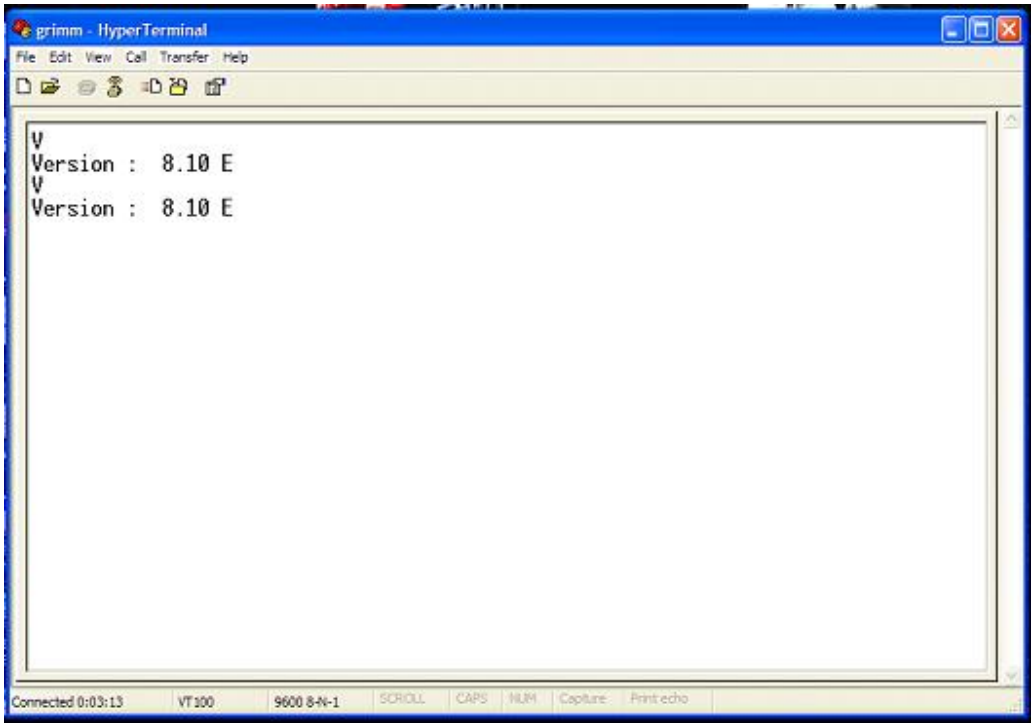
Further are following adjustments important:



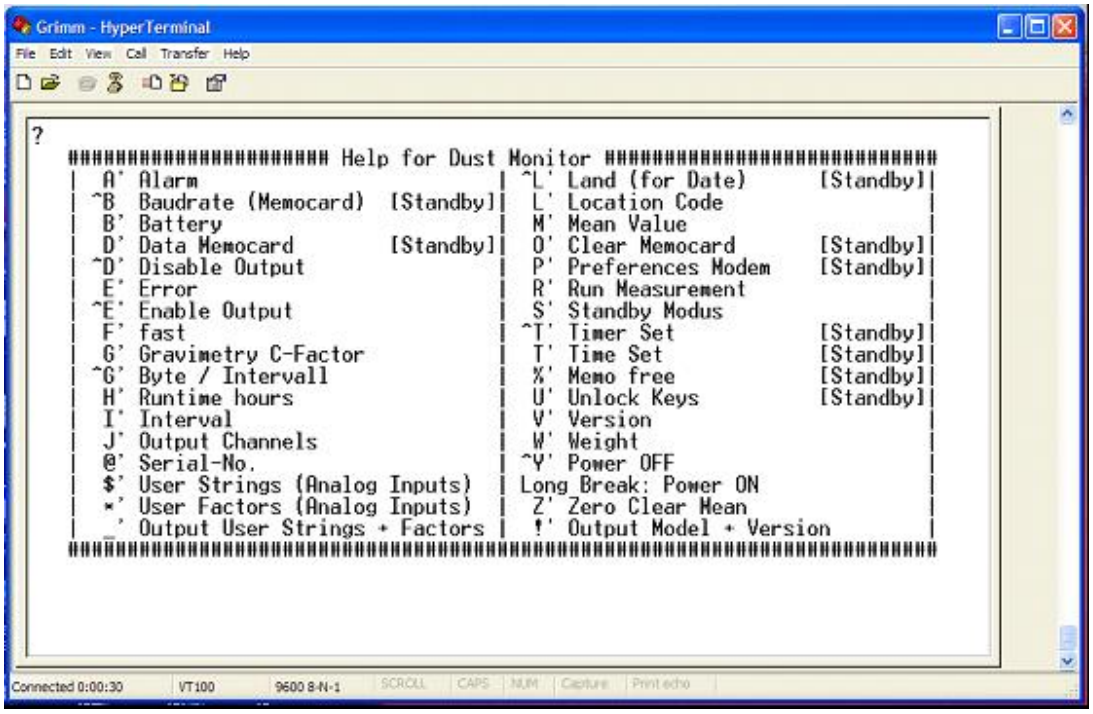
These are properties / adjustments of the connection

6.2 Work with Hyper Terminal

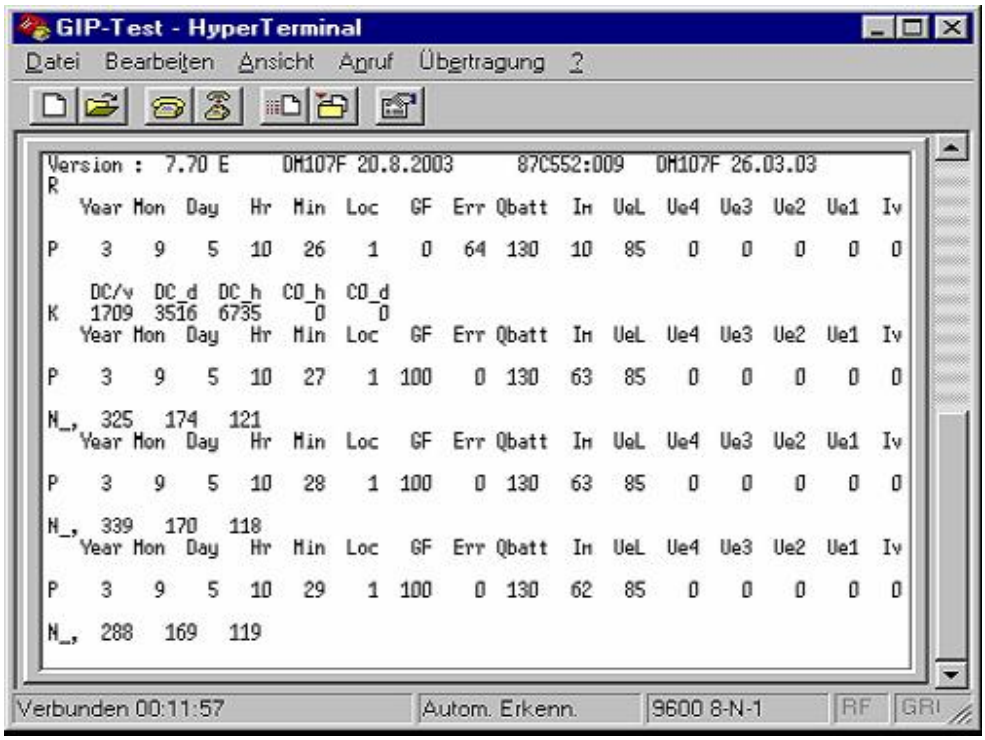
Check the connection with the order “v”. You should see the version of the unit.



The sign “?” will show you a help window.



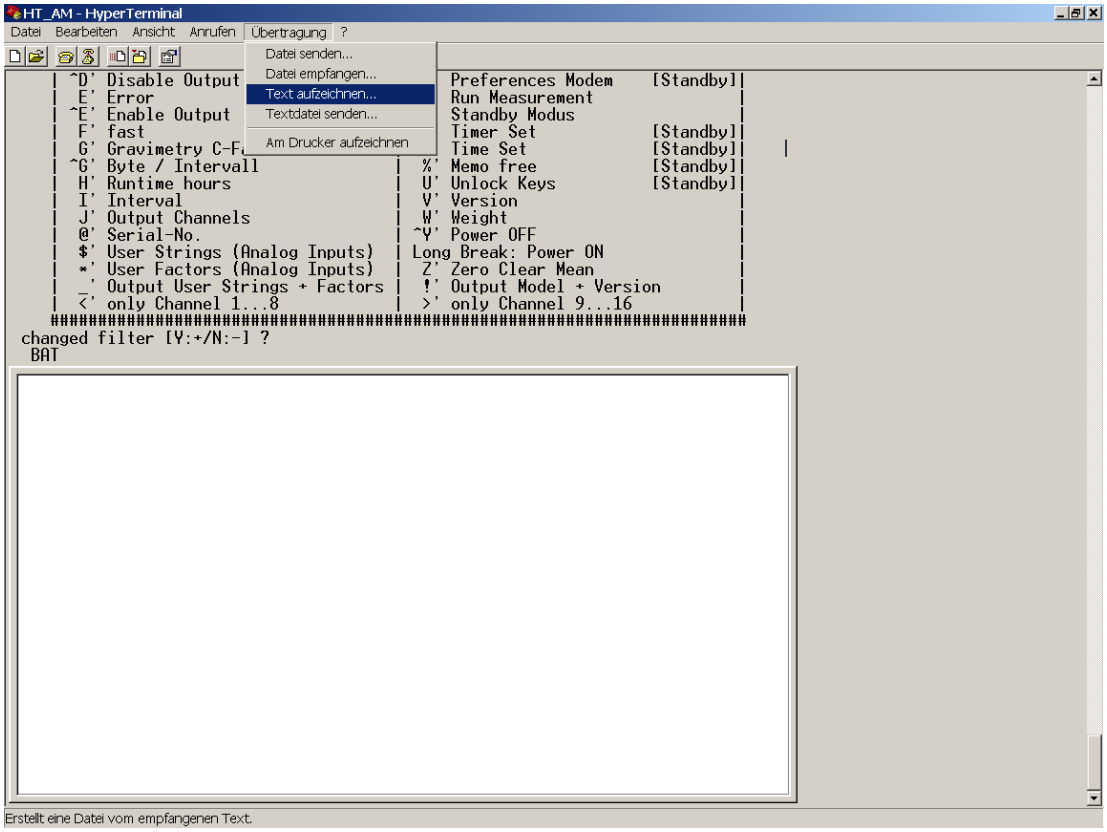
With the sign ”|” and then the tabulator key you switch the unit in the service mode.
Now you can see a helpful text, like the version date and explanation for the P-LINE after start measurement.
Pressing ’r’ will set it running, after a few minutes the screen will look like this



The picture shows the data from an environmental DUSTMONITOR 107.

It is helpful; you print the help window for your work.

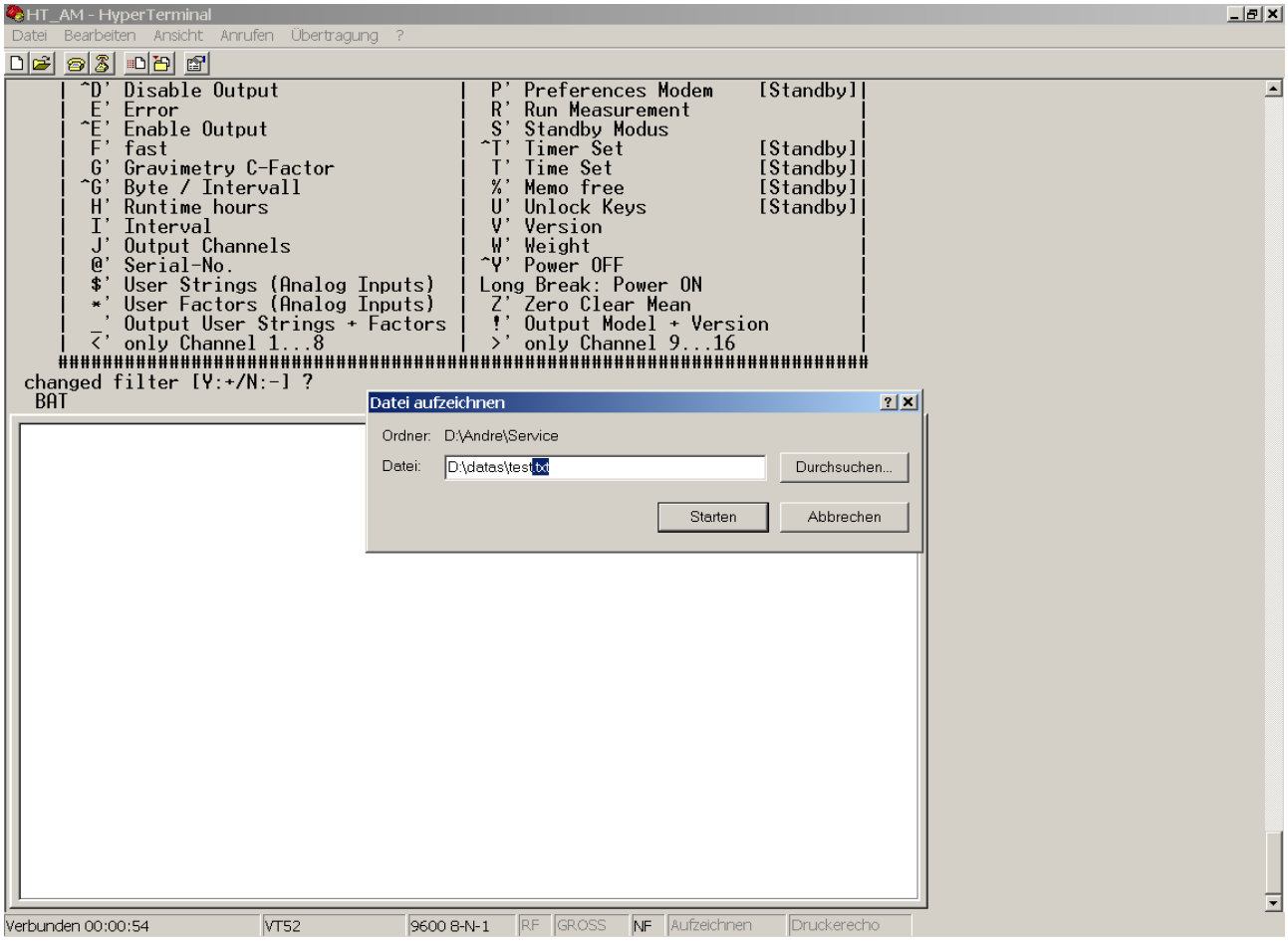
DATA TRANSFER:



To download the Data Card and Capture the file you have to be in STANDBY then go to the TRANSFER Menu at the top of the HYPERTERMINAL screen, clicking on it will bring up a SUB Menu, click on CAPTURE TEXT.
Now you have to give the File a name and a Folder to go into, the default is

C:\Documents andSettings\xxxxxx\StartMenu\Programs
\Accessories\Communications\HyperTerminal\CAPTURE.TXT

But you can save it anywhere you like and call it anything you like. Always ensure the last 3 letters are .TXT (this will save it as a TEXT file).



Press START

Now type in the command 'd', than you have to see:

D

Memo card : 8.60 from: 8F050061

Location : 1 :

-After enter will read only data of the adjusted location 1

If you want to read out all locations (1-99) you have to press 0 before Enter.

- put in another number will read only the data from this number

Press Enter and the transfer will start.

When the Data Card is finished downloading you should see a little heart ♥ or Ok

Then go to TRANSFER MENU again, CAPTURE TEXT and you will have an extra Menu that allows you to stop, click on Stop.

7 Switching possibilities of the GRIMM 190

7.1 With a terminal program

Previous to switching the device it has to be within service mode 0. Therefore a terminal program is necessary.

Following versions are possible:

Version 7.80

PM10, PM 2.5, PM1 in storage, LCD and via the RS.232 interface.

Version 12.30

31 channels particle counts/ size distribution in storage, LCD and via the RS.232 interface

Switching into service mode 0 following steps are to be done:

- Send the character | (possible by Alt Gr and the key < >, or by Alt 124 on the NumBlock. I.e. the ASCII code 124 is decimal).
- Press „TAB“
- Press „v“ for control
- Next to the firmware also the date of the firmware has to be visible

Example Grimm 190:

without service mode

V
Version : 7.80 E
with service mode
|
V
Version : 7.80 E DM180G 23.1.2008 87C552:011 DM180GL 23.01.2008
or
|
V
Version : 12.30 E DM180G 23.1.2008 87C552:011 DM180GL 23.01.2008

With Ctrl and v and then { (brace open, ASCII 123) the device switches into version 7.80

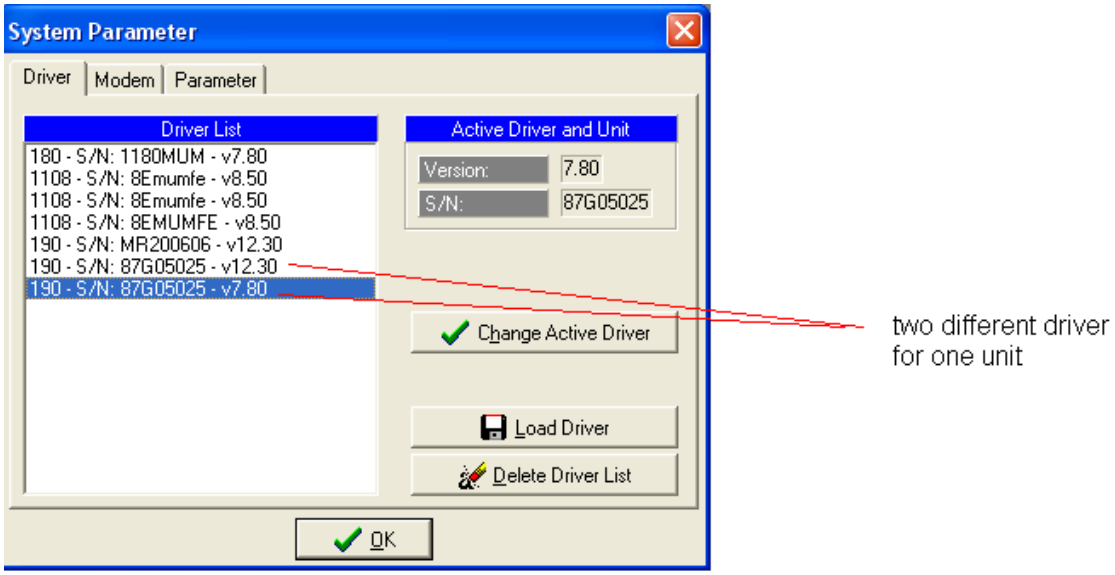
With Ctrl and v and then } (brace closed, ASCII 125) the device switches into version 12.30

IMPORTANT:
Read out the data storage card BEFORE you change the version, because the storage re-initializes after converting.

7.2 With GRIMM software 1177 version 3.30

For use both version with GRIMM software it is necessary to load both drivers and activate one of them.

With OPTION SYSTEM open follow window



with EXTRAS SWITCH VERSION it is possible to switch between both versions

Important:

Before changing of the version should the memory/ the memory card to be read out, because the memory must be reinitialized after the changeover.

8 RS-232 interface

8.1 RS-232 interface

The serial interface exists out of a 9 pin socket: one is located on the rear side of the device (labelled with „RS232 to PC“). Via this interface the communication between the PC and the device takes place. The second one is behind the front door and intended for the service. Above the socket is an LED which shines green at an established connection. Red signalizes the data transfer. Only use the GRIMM data cable RS-232 with the catalogue number 1.143E. The service socket is treated prior-ranking when the terminal program sets the handshake lines (CTS or DSR) to high.

.

8.2 Transmission protocol

The baud rate for normal data transmission is **9.6 kBd**. **Eight data bits without parity** and **one stop bit** are being used. The software protocol **XON/XOFF** is being supported. At the Quick Data transmission additionally the **CTS-line** is being requested. Here the baud rate can be up to **57.6 kBd**. If no CTS line is being connected, the interface will be regarded as free.

8.3 RS-232 commands

The following commands can be sent via the RS-232 interface to the airborne dust monitor. The device confirms the receiving by an echo. The commands can exist out of capital or lower case letters. Numeric values, which can only be sent within the stand-by mode, have to be concluded by the key Carriage Return. For testing you can use every terminal program which supports the **XON/XOFF-protocol** (e.g. HyperTerminal). The according settings of the interface parameters have to be done previously. The function keys can be backed up with commands for the dust monitor.

A	Output of the current alarm value. Changeable within stand-by mode.
B	Output of the battery capacity (always 130%)
D	ASCII-data transmission from the storage card (only within stand-by mode) Location „0“ for all locations D Memocard : 7.80 from: 87F03017 Sensor: FHE20603 Location : 13 : P: 4 8 2 13 56 13 0 64 130 8 85 1 0 0 0 0 K:. 2395 4021 4460 P: 4 8 2 13 57 13 100 0 130 31 149 1 0 0 0 0 N:, 316 105 83 P: 4 8 2 13 58 13 100 0 130 31 149 1 0 0 0 0 N:, 212 103 82 OK
E	Output error code (**E**RROR). See chart next page.

Error-Code	LCD	Meaning	Solution
128	NEW SELFTEST	Self test faulty	Connect the instrument to HyperTerminal, start the instrument and wait until you see fatal error on the LCD display of the instrument. At the same time you will see in HyperTerminal the K- and P- line. Compare now the DC values of the K-line to the DC values of your QC report or contact your service department for further help
64	NO MEMOCARD	No storage card or wrong version or card with data of a different device	Check proper position of the storage card, clear data of the memory card
32			Not used
16		Restart after power blackout	Only information
8	VACUUM ERROR PLEASE CHECK	Vacuum insufficient	Check pneumatical connection of the 180 and sample pipe holder 181
4			Not used
3	FLOW-ERROR	Volume flow control out of control range	Check sample air inlet for pollution, clean optical chamber with compressed air. If that doesn´t work pump might have to be replaced
2			Not used
1	CHECK FILTER	Low pressure > 50 mbar	Change main dust filter (BQ-filter)

F	Switch on fast mode. Measured data will be output every 6 seconds
G	Output gravimetric factor. Within stand-by mode changeable. At the model 365 the gravimetric factor can be changed between 0.5 and 2.5 in steps of 0.01.
H	Output operation hours
I	**I**nterval for the normal output and storage. Changeable within stand-by mode. Interval settings of the storage: 0 = 1 minute 1 = 5 minutes 2 = 10 minutes 3 = 15 minutes 4 = 30 minutes 5 = 60 minutes 6 = 6 seconds
J	Output of the segregation characteristics of the data chart (e.g. PM10). J J: PM10 PM2.5 PM1.0
L	Output location number and changing within stand-by mode
M	Output averages and its sample volume
O	Output data storage size (only within stand-by mode). If you send a + after the capacity output, the data storage will be completely deleted.
P	**P**references modem submenu
R	**R**un. Starting measurements from the stand-by mode.
S	Switch into stand-by mode
T	Output of time. Time can be set within stand-by mode. Changing the minutes will zero the seconds.
U	Key pad lock. U=0 Key pad unlocked U=1 Stand-by mode cannot be entered U=2 Key pad locked
V	Output version number of the device software V Version : 7.80 E
W	

	Output filter weight and its according sample volume
Z	Output and subsequent resetting of the averages and volume
!	Output model and version number of the device ! Model 365 Version 7.80 E

@	Output serial number @ Ser.No. 87F03017
^A	Output calibration factors for the analog input voltages
^B	Set baud rate for data transmission: 0 = 9,600 Baud 1 = 19,200 Baud 3 = 57,600 Baud
^D	Disables transmission of the measured values
^Ê	Request for transmission of measured values / switching off fast mode
^L	Country settings (E or U) for date format of the dust monitor (only within stand-by mode).
^T	Timer operation for automatic switching on and off the dust monitor.
^Y	Switching off the dust monitor.
Long Break	Switching on the dust monitor (only if switched off by ^Y).

Underline	Output of the user texts and analog input factors (only within stand-by mode). Example: `_$(1..3):Temp.:  .  _C|Input 2:.  V |Input 3:.  V |` `*(1..3): 1 | 10 | 1 |` 4.36 V | 0.00 V | 0.00 V |`  The first line shows the three user texts, the second line the three multiplication factors for the analog voltages, and then the offset values.  `###################### Help for Dust Monitor ############################` `| A Alarm | ^L Land (for Date) [Standby]|` `| ^B Baudrate (Memocard) [Standby]| L Location Code |` `| B Battery | M Mean Value |` `| D Data Memocard [Standby]| O Clear Memocard [Standby]|` `| ^D Disable Output; no Fast P | P Preferences Modem [Standby]|` `| E Error | R Run Measurement |` `| ^E Enable Output; no Fast | S Standby Modus |` `| F Fast | ^T Timer Set [Standby]|` `| G Gravimetry C-Factor | T Time Set [Standby]|` `| ^G Byte / Intervall | % Memo free [Standby]|` `| H Runtime hours | U Unlock Keys [Standby]|` `| I Interval | V Version |` `| J Output Channels | W Weight |` `| @ Serial-No. | ^Y Power OFF |` `| $ User Strings (Analog Inputs) | Long Break: Power ON |` `| * User Factors (Analog Inputs) | Z Zero Clear Mean |` `| _ Output User Strings + Factors | ! Output Model + Rev + Version |` `| # Fast P (Intervall=6) | " Commentary until CR |` `| & Mixer Humidity Threshold | ' Echo until CR |` `| ; Autocal | : Gesytecs [Standby]|` `###`
$	Selection or change of the user texts as well as the factors for analog voltage outputs on the LCD display (only within stand-by mode). Special characters (via ASCII 127) cannot be input. When outputting, the character '°'(ASCII 248) will be displayed as '_'. By the key TAB predetermined texts can be chosen which are to be confirmed by the key RETURN. They can also be transcribed by any texts. The number output is always five digit and begins with the 9th digit. Entering here characters, except of a decimal point, an acoustic warning resounds. The multiplication factor which is relating to 1V can be input after the text. This can also be changed by the command `*`. Example: Temperature sensor: 0°C = 3.0V and 50°C:=:8.0V User-Text: Temp.: °C User-factor: 10.0 [°C/V] Offset: 3.00V The sensor data will be directly read out from the climatic sensor (sensors version “E” on the third place of the serial number and higher are equipped with an EEPROM for the sensor data). The adoption of the EEPROM data, inculding the user text, happens only if the user factors inside the device are set to 1.0 and the offset values to 0.0. A recalibration through the user thus is furthermore possible (positive offset are not possible)
*****	Change user factors and offset (only within stand-by mode).
?	Help for commands
%	Displaying the size of the data storage and the free storage space if not transcribed.

8.4 RS-232 transmission of measured values

The firmware 7.xx outputs the mass concentration values because of its resolution of 0.1 µg/m^3 with the multiplication factor of 10! At each intervals´ end happens the output of the measured values with their according measurement pre-information. When illustrating the mass, the averages of the storage interval will be transmitted. The measured values are being designated with "N" for mass, with "_" for the averages, and "," for the factor 10. Allocation of the columns see command "J".

The measurement pre-information in the with „P“ beginning line accord to the bytes which are being stored in the data storage. The resolution of the external voltage is 10 Bit, so that the Bytes designated with Ue1...Ue4 embody only the more significant part. The two low order Bits are both located in UeL. Bits 6 and 7 belong to Ue4, Bits 0 and 1 to Ue1. Because the maximum value of these voltages is 10V, the 10Bit-value has to be multiplied with the factor 9.776E3 in order to reach the voltage value as Volts. Since different user texts and factors can be set on the device, they should be requested and regarded by the analysis software. The user factors always relate to the voltage value in Volts. At the version 7.xx the gravimetric factor is 100, so that the resolution is 1%. The supply voltage as well as the magnetic valve current will be output as percentage. The order is like following:

```
Year Mon  Day   Hr  Min  Loc   GF  Err Qbatt  Im  UeL  Ue4  Ue3  Ue2  Ue1  Iv
```

Year – Month – Day – Hour – Minute – Location (1..99) – Gravimetric factor *100 – Error code - Supply voltage [%] – Magnetic valve current [%] – Sensor LowBits – Sensor 1 to 4 – Storage interval
Sensor4 (Ue4) is always the barometric sensor.
After the measurement pre-information follow the measurands. The measurands are designated with „N_,“.

Version : 7.80

```
   Year Mon  Day   Hr  Min  Loc   GF  Err Qbatt  Im  UeL  Ue4  Ue3  Ue2  Ue1  Iv
P     4    8    2   13   56   13    0   64  130   8   85    1    0    0    0   0
K.  2395  4021  4460    5    0
P     4    8    2   13   57   13  100    0  130  31  149    1    0    0    0   0
N_,  316  105   83
P     4    8    2   13   58   13  100    0  130  31  149    1    0    0    0   0
N_,  212  103   82
```

Within Fast Mode the measured values are being sent every 6 seconds

```
F
R
   Year Mon  Day   Hr  Min  Loc   GF  Err Qbatt  Im  UeL  Ue4  Ue3  Ue2  Ue1  Iv
P     4    8    2   14    7   13    0   64  130   8  149    1    0    0    0   0
   Flow: 100 %
    DC/v  DC_d  DC_h  C0_h  C0_d
K   2559  4207  4640     0     0
N0,  159    91    74
N1,  114   110    87
N2,   95    95    78
N3,  111    93    76
N4,  230   106    82
N5,  173   104    82
N6,   99    96    78
N7,  199   105    79
N8,  109   102    80
N9,  138    96    77
P     4    8    2   14    8   13  100    0  130   31  149    1    0    0    0   0
N0,  184   103    81
S
```

8.5 Additional information within service mode: CRC sum

In order to retrieve additional information the device can be switched into the simple service mode. Therefore send via the terminal program Alt 124 and Alt 09 (TAB) to the dust monitor. Sending the character „!“ you will receive the device´s model number, version number and the CRC sum of the internal calculation algorithm. This has been optimized based upon long-time field tests.

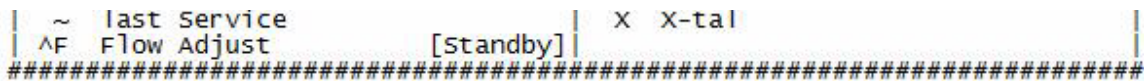
```
!
Model 365  F Version7.80 E      Mathe-Modul CRC(CA00H..DFFFH) = AAE3H
```

8.6 Display measured values of the additional climatic sensors

If there are climatic sensors connected, then additionally to the previous output a further line beginning with S(A) appears. Subsequent the measured values for the via One-Wire Bus connected sensors will be displayed.

8.7 Service mode settings

With service mode 0



Outputting the data via the RS-232 interface also additional data and explaining texts will be output. Several control commands are available, e.g. the request for the last service by "~" last Service, or the request for the volume flow by "^F" Flow Adjust.

Example 1:

Pressing V within user mode will display the version number of the software:

V

Version : 12.30 E

Pressing V within service mode will display additionally to the version number of the software following:

Year of manufacture of the device, processor type, year of manufacture of the base part.

(Date: DD.MM.YYYY)

V

Version : 12.30 E DM109G 17.12.2007 87C552:011 DM109G 14.12.2007

Example 2:

Normal data presentation within user mode:

```
P    8   12   10   18   48   1   20   0   130   23   193  1 0  0  0  0
C_: 132940  77350  48435  22270  9325  4610  3210  1795
C_;   1305   1050    765    575   385   280   195   131
c_:    131     82     68     49    33    20    13    10
c_;      7      4      2      1     1     0     0     0
```

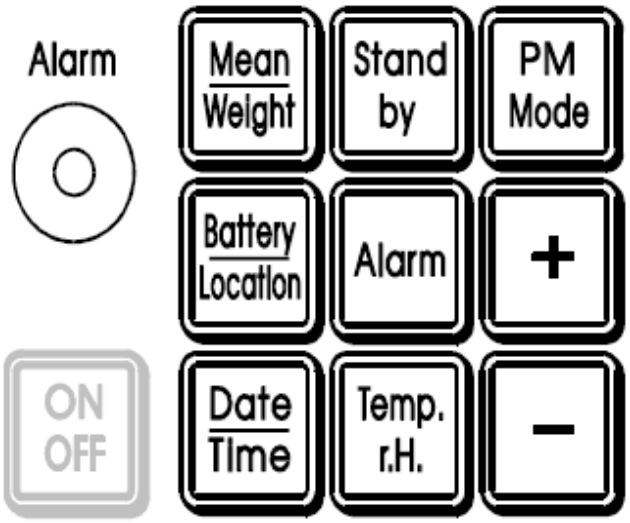
Data presentation within service mode with short explanation of P-line values:

```
   Year Mon Day  Hr  Min Loc  GF  Err Qbatt  Im   UeL Ue4 Ue3 Ue2 Ue1 Iv
P    8   12   10   18   48   1   20   0   130   23   193  1    0    0    0    0
C_: 132940  77350  48435  22270  9325  4610  3210  1795
C_;   1305   1050    765    575   385   280   195   131
c_:    131     82     68     49    33    20    13    10
c_;      7      4      2      1     1     0     0     0
```

9 Special data protocol “GESYTEC“

9.1 Change of mode from Standard to Gesytec

The change from the STANDARD to the Gesytec-mode (which is similar to the German Bayern-Hessen protocol) is only possible via the key pad of the dust monitor. Turn the 365 dust monitor off by pushing the main power switch. Then press on the instrument the two keys ON (which is a hidden key, not ot see but to feel, left near the key Date/Time) and „+“- key at the same time and keep both keys pressed. Then turn the instrument on again. On the LCD-Display the model and firmware version is shown. The instrument will directly change over to the Gesytec-mode. This is shown on the display with an extra „S“ at the end.
To return to the STANDARD mode start the instrument by pressing the „ON“- and the „-“- key at the same time. Now the instrument return to the reselected mode, in Europe as „E“ or in America as „US“ version.



9.2 Setting within normal operation

The only extension to this manual affects the additional RS-232 command „:“ which lets you execute the GESYTEC pre-settings. Sending within stand-by mode the character „:“ (ASCII-Code 58) will call up following sub-menu:

-- Settings Gesytec --

Kennung Geraet: 250
Serialnumber : 0
Baudrate RS22: 9600
Count 4.Geraet: OFF
1 Minuten Mean: OFF
Auto-Cal. [h] : OFF
Timer-Cal. : OFF
[K] [S] [B] [C] [M] [A] [T] [Esc] [ENTER] ?

After sending the character „K“, the device designation can be changed. Allowed are numbers from 0 to 255. The Gesytec serial number can be input from 0 to 997 after sending the character „S“.
The help text can be called up via sending the character „B“ and an input of a number between 0 and 4 is awaited:

```
Baud Eingabe:  0=1200: 1=2400: 2=4800: 3=9600: 4=19200
Baudrate RS232:  9600 ?_
```

Auto-Cal is the time in hours after which the device executes a self-test. Timer-Cal is the activation for a self-test to a set full hour. There you have to enter for midnight 24. Either Auto-Cal or Timer-Cal can be activated. The actual point of time can delay for one storage interval, because the activation happens after the storage. The value 0 switches off both possibilities. By the key Escape the sub-menus can be left without saving. By [ENTER] (ASCII-Code 13) all settings will be saved.

9.3 GESYTEC Structure

RS-232 data transmission within Gesytec mode

For 3 parameters (PM10, PM2.5, PM1)

Byte-Nr.	Data format	Field description
1	<STX>	start of text
2-3	MD	telegram code
4-6	03#	number of measuring parameters
7-10	nnn#	instrument identification
11-19	±nnnn±ee#	value of PM10 in ng/m3
20-22	hh#	operational status
23-25	hh#	error status
26-29	nnn#	serial number
30-36	hhhhhh#	temperature in 1/10°C (F=Minus)
37-40	nnn#	instrument identification + 1
41-49	±nnnn±ee#	value of PM2.5 in ng/m3
50-52	hh#	operational status
53-55	hh#	error status
56-59	nnn#	serial number
60-66	hhhhhh#	relative humidity in 1/10 %
67-70	nnn#	instrument identification + 2
71-79	±nnnn±ee#	value of PM1 in ng/m3
80-82	hh#	operational status
83-85	hh#	error status
86-89	nnn#	serial number
90-96	hhhhhh#	valve voltage in %
97	<ETX>	end of text
98	<BCC1>	block symbol upper nibble
99	<BCC2>	block symbol lower nibble

For 4 parameters (PM10, PM2.5, PM1, total count)

Byte-Nr.	Data format	Field description
1	<STX>	start of text
2-3	MD	telegram code
4-6	04#	amount of measuring places
7-10	nnn#	instrument identification
11-19	±nnnn±ee#	value of PM10 in ng/m3
20-22	hh#	operational status
23-25	hh#	error status
26-29	nnn#	serial number
30-36	hhhhhh#	temperature in 1/10°C (F=Minus)
37-40	nnn#	instrument identification + 1
41-49	±nnnn±ee#	value of PM2.5 in ng/m3
50-52	hh#	operational status
53-55	hh#	error status
56-59	nnn#	serial number
60-66	hhhhhh#	relative humidity in 1/10%
67-70	nnn#	instrument identification + 2
71-79	±nnnn±ee#	value of PM1 in ng/m3
80-82	hh#	operational status
83-85	hh#	error status

86-89	nnn#	serial number
90-96	hhhhhh#	valve voltage in %
97-100	nnn#	instrument identification + 3
101-109	±nnnn±ee#	value of count in particles/litre
110-112	hh#	operational status
113-115	hh#	error status
116-119	nnn#	serial number
120-126	hhhhhh#	internal temperature in 1/4°C
127	<ETX>	end of text
128	<BCC1>	block symbol upper nibble
129	<BCC2>	block symbol lower nibble

Operation status – switched off 1 minute average value

Bit 128	64	32	16	8	4	2	1
mv for 48 s	mv for 24 s	mv for 12 s	mv for 6 s	dryer on	self-test	standby	already fetched

mv = mean value

Operation status – switched on 1 minute average value

Bit 128	64	32	16	8	4	2	1
Minute 8	minute 4	minute 2	minute 1	dryer on	self-test	standby	already fetched

Error status:

Bit 128	64	32	16	8	4	2	1
Self-Test not ok			after power loss	vacuum not ok	I mot >100%	flow-error	under-pressure > -35 mbar

The “DA”-Telegram:

Byte-Nr.	Data format	Field description
1	<STX>	start of text
2-3	DA	telegram code
4	<ETX>	end of text
5	<BCC1>	block symbol upper nibble
6	<BCC2>	block symbol lower nibble

The "ST"-Telegram (ASCII-format):

Byte-Nr.	Data format	Field description
1	<STX>	start of text
2-3	ST	telegram code
4-6	nnn	instrument identification
7-8	#A	empty space key, (mostly a letter)
9	<ETX>	end of text
10	<BCC1>	block symbol upper nibble
11	<BCC2>	block symbol lower nibble

The following "ST"-telegrams has been incorporated:
"R" (Run) start of measurement
"S" (Standby) stop of measurement
"N" (Zero (Null)) acts like in Run
"K" (Calibration) the status bit 3 will be set

For the control only (instrument identification), (instrument identification +1), and (instrument identification +2) are permissible.(Instrument identification +3)is NOT permissible, not even for 4 parameters.

Hex-Format:

Byte-Nr.	Data format	Field description
1	<STX>	tart of text
2-3	ST	telegram code
4-6	nnn	instrument identification
7-8	hh	upper nibble, lower nibble
9	<ETX>	end of text
10	<BCC1>	block symbol upper nibble
11	<BCC2>	block symbol lower nibble

is the synonym for a blank character

The sign „#“ symbols the space key, „nnn“ the numbers, „ee“ s the exponent and „hh“ is the hexadecimal presentation of one Byte.

To get the block checksum, the Exclusive-Or sum is calculated by adding the bytes of all transmitted symbols (incl. STX and EXT, starting from Zero) . The result is shown as two nibble hexadecimal signal and transmitted.

10 Sensors

10.1 Analog input

The dust monitor has 3 analog inputs at the 6 pin socket. This is located on the inner side of the connection module in the sample holder 181. It can be connected to any suitable analog sensor with an output voltage between 0 and 10 Volts. The connection socket can also provide the external voltag of +10 Volts up to 40mA.

The analog sensors do not need an additional data storage. All measured analog values will be stored onto the data storage card and sequentially being displayed on the display. The resolution is 10 Bits (ca. 10mV). Texts and factors for the LCD display can be changed.

Configuration of the basic sensors input socket

1	Input 1
2	Input 2
3	Input 3
4	Ground
5	+10V/40mA
6	1-wire BUS

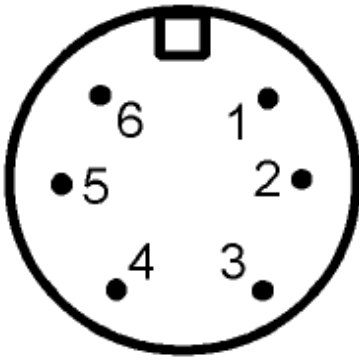


Figure 6: Analog socket

10.2 Barometer (internal)

Inside the device is a barometric sensor. Its values its values will be stored and output as Ue4. The display shows the value as **Pressure**.

10.3 Basic sensors

The sensors for ambient temperature and humidity are to be connected by default. They are necessary for the proper operation.

10.4 Weather station

Via the optional „one-wire“ connection it is possible to connect additional climatic sensors such as

1. Wind direction
2. Wind speed
3. rain fall.

These sensors need additional space on the storgae card and thus decrease the storage times. In order to connect the climatic sensors switch off the device and then simply connect the sensors. After restarting the device the firmware version changes. E.g. when connecting a rain sensor the version changes from 7.80 to 7.81. After connecting the data storage has to be deleted. If the operation then happens without an additional sensor the storage space however remains reserved.

The additional sensor can be removed by:

- Switching on the device without additional sensor and afterwards
- Deleting the device´s data storage.
  Then switch off and on again the device. Now the the desired firmware version will be displayed.

Now the instrument and data storage are capable to record data like under chapter Kapitel 4.9.

11 System messages

The operation safety of the system is permanently being controlled. If errors occur, the undermentioned status messages can be activated. When exceeding the set alarm treshold of having a device failure such as a defect of the volume flow control, the LCD will show a warning message and a warning signal resounds.

11.1 Alarm and error messages on the LCD

NO SENSOR! PLEASE CHECK	No climatic sensor (temp., r.H.) connected or sensor defect. Measurement terminates
CARD ERROR! PLEASE CHECK	Data storage card has been inserted/removed during the measurement or write protection is active
NEW SELF TEST	This error can only be released during the self test phase of the dust monitor due to various reasons. If the error cannot be resolved by cleaning the sample air duct, the device has to be sent in for service
SELF TEST NOT OK!	Dryer LED shines red if the low pressure for the dryer is insufficient
VACUUM NOT OK! PLEASE CHECK	Vacuum insufficient for the dryer. Measurement terminates. Please check the manometer
VACUUM SWITCH! PLEASE CHECK	Vacuum switch has contact without existing vacuum. Measurement terminates. Please contact the service department of the manufacturer
FILTER SWITCH! PLEASE CHECK	Low-pressure too high behind the dust filter without sample flow. Please contact the service department of the manufacturer
PLEASE REPLACE MEMORYCARD BATT.	Flat battery inside the memory card. Please change battery AFTER reading out and saving the data
AIR FLOW NOT OK CHECK AIR INLET	Sample flow not 1.2 l/min. The volume flow control cannot keep the flow constant. Measurements terminates

PLEASE CHECK MEMORAYCARD	Write protection activated
WRONG SERIAL NO. Ser.No.xxxxxxxx	Memory card contains data from a different device. Read out data and then format the card
WRONG VERSION! CLEAR MEMORYCARD	Memory card contains data from a different device. Read out data and then format the card
FATAL ERROR! PLEASE CHECK	Self test faulty several times. Please contact the service department of the manufacturer
CLEAR MAILBOX & INTERN MEMORY	Internal data storage erroneous and has been deleted

11.2 Warnings on the LCD

NO MEMOCARD	Operation without data storage card. Data is being buffered in the internal storage
CHECK DUST FILTER AND AIR PASSAGE	The low-pressure behind the dust filter is too high. The dust filter has to be changed. Please contact the service department of the manufacturer

12 Maintenance and cleaning

It is recommended to annually execute following points!

12.1 Sample air duct inside the optical chamber of the spectrometer 187

Switch off the device. Demount sample pipe as well as the glass bottle and then blow the sample air duct with oil-free and clean compressed air with an maximum pressure of **3Bars** upwards down. **NEVER bottom-up!**

With screwed bottle use max. 1bar for cleaning!

After cleaning rescrew the bottle accurately in order to avoid leaks.

12.2 Fly screen on the sample pipe 182

In order to not constrict the particles please make sure the fly screen is free from pollution. Should the fly screen be polluted, please sparge it with compressed air.

Never pull something through the sampling pipe and never blow through with compressed air!

12.3 Change dust filter

Once a year the BQ filter (dust filter) which contains the whole sucked in dust, should be changed. This is be done at the annual inspection.

12.4 Internal rinsing air filter

In order to protect the laser optics from pollution and also for the self-test of the device, particle-free air is being generated by an internal fine filter. This filter is only to be changed by trained service staff, however the life expectancy even at continuous operation is several years. Should the message "CHECK NOZZLE AND AIR INLET" appear more than once, although the sample inlet is free and having no over pressure, this is a sign of a failure at the rinsing air supply. For this case please ask your local dealer or the manufacturer.

13 Accessory

13.1 Sensor for temperature and humidity (model 1.153FH180)

This sensor is necessary for the standard cubic meter correction.

Size:	Diameter 15mm, length 130mm, cable ca. 2m
Plug:	6 pin
Power supply:	10V +-5% < 5mA
Temperature range:	-20° to +50°C
Resolution:	0.1K
Accuracy:	typ. 0.3K
Humidity range:	0 to 100% r.H.
Resolution:	0.1%
Accuracy:	typ. 1%

Chart 2: Specifications 1.153

13.2 Analog adapter for PM 10 + PM 2.5 and PM 1 (model 160)

This adapter has to be connected via the RS-232 socket. The digital PM output values will be converted into analog signal from 4mA up to 20mA. The PM values will be refreshed within the set interval. The unit measures 11x7x2 cm (4,5x2,5x0,8 inches) and is self-power-supplied with 18VDC and 40mA.

13.3 Memo card reader (model 1155B)

If you do not want to read out the data on location, you can use the card reader model 1155B. This device has all functions of the RS-232 interface which are necessary for the storage card. With the corresponding software it is possible to read out the data ten times faster. Reading out the data of a full 1MB storage card thus reduces from about 1.5 hours to only 10 minutes.

14 Warranty

GRIMM Aerosol Technik guarantees every customer that the in this document described device is developed, constructed, and manufactured according to the best technical requirements for the described application. Furthermore is guaranteed that this device has no material defect and was delivered free of assembly errors after passing a severe quality check. However no further warranty is given for an application-specific function not for damages emerged from material or assembly faults. Every device is seized by the production and journalized most accurately especially the calibration and validation data.

Should the device fail during the 1-year warranty or not being up the standard GRIMM Aerosol Technik has the right to replace the faulty parts or the device apart from operating errors.

GRIMM Aerosol Technik will fix the device at the factory exempt from charges; only the transport fees just as the accordant additional charges are for the customers account. On-site repair will only be done for refunding the travel and service costs. The company GRIMM is not in charge for further claims, which can be educed from the warranty.

GRIMM takes over the warranty of the sold goods only if those are being used under normal conditions and according to the instructions in this manual. The warranty expires after 12 months, beginning with the day of delivery. Return consignment charges for repair under warranty are to the customers account.

This warranty has following exceptions:

a) For spare parts, which will be replaced or repaired under warranty in order to make operation possible again we take over warranty for 90 days, normal use preconditioned.
b) The supplier is not liable for third's party products or batteries of consumables; only the original warranty is held up.
c) Without written confirmation GRIMM does not give warranty on third's party products which have been modified or built in or out by untrained service staff.
d) Everything mentioned above substitutes other warranty agreements respectively restrictions. No further liability claims will be given especially beyond normal usage.
e) Usage and operation is within the customers RESPONSIBILITY. He has to obey the legal restraints and claims and has to operate the device according to the lawful and operational purpose. Deviations lead to warranty exclusion.
f) Legal measures against the company GRIMM no matter from which side after a time-period of 12 months is baseless without exception.

g) The buyer just as the seller both agree that this WARRANTY RESTRICTION, which form the claims, and restrictions shall not being questioned. Both parties are registered traders under German Commercial Code.

h) In case of a legal action the place of jurisdiction is Traunstein, Germany.

15 Transport and Repair

15.1 Transport

The product described in here is delivered in three cardboard boxes. Please assure yourself that the shipment is complete and without visible damages. If you spot damages due to the transport, you have to reclaim them immediately. In this case you must not take the device into operation for safety reasons. In order to protect the device from future transport damages we recommend to keep the original packaging. Especially after transport at low temperatures the device needs a sufficient acclimatization phase previous to taking the device into operation, otherwise device damages might result.

If the device is equipped with a transit support, they have to be reinstalled previous to the transport.

Particularly after transport under low temperatures a sufficient acclimatization phase has to be maintained, otherwise damages can result.

15.2 Repair

Having knowledge that defect or inactive devices cause disprofit, it is Grimm's politics to care as fast as possible about those customer issues. If an idleness/ breakdown is ascertained, we kindly ask you to immediately contact the next GRIMM selling agency or you local dealer.

Please contact the service department of the company GRIMM via Email before you send one of our devices back for service:

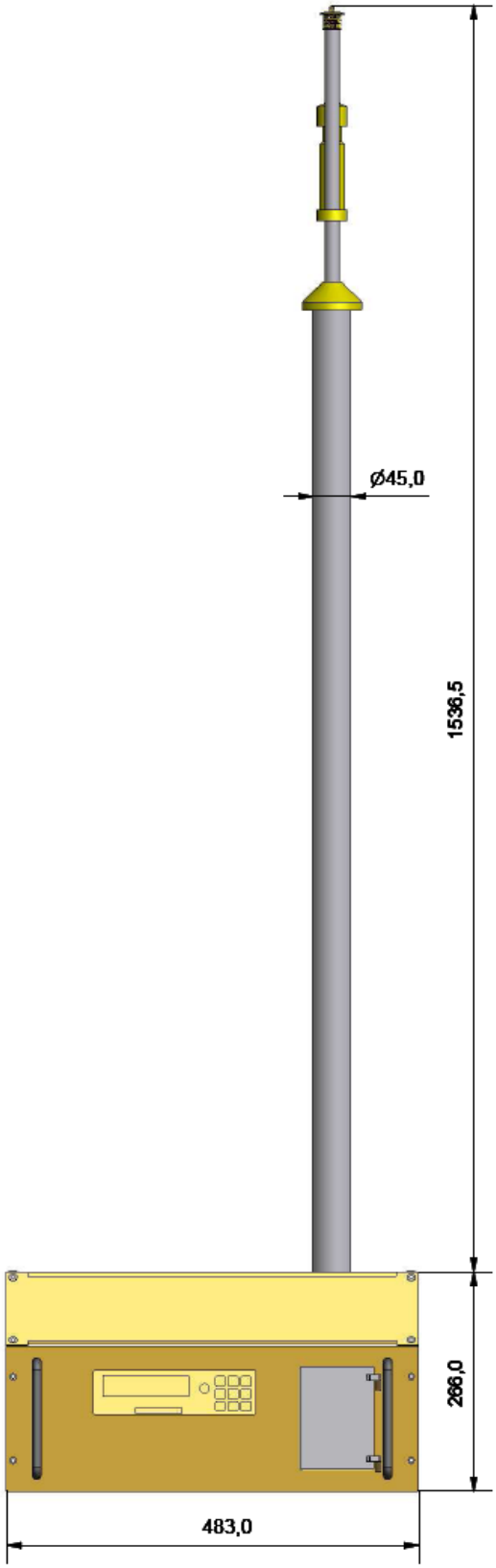
Service@grimm-aerosol.com

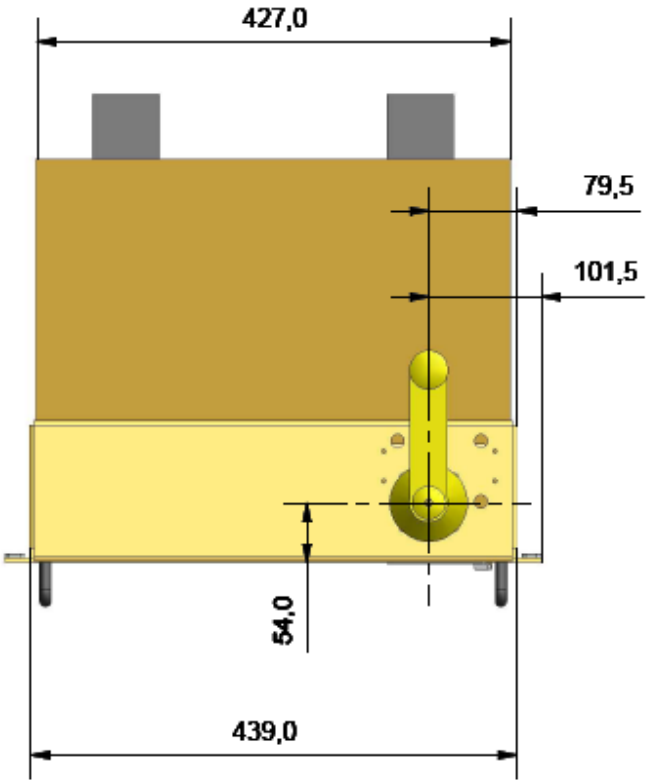
Please specify with following details:

- Device's model number
- Serial number and year of manufacture (see name plate on the back of the device)
- Date of purchase order and your order number (except in a case of warranty)
- Your invoice address
- Your shipping address

Please make sure that the device or devices are free of any contamination dangerous to health before shipping the device or devices!

15.3 Dimensions

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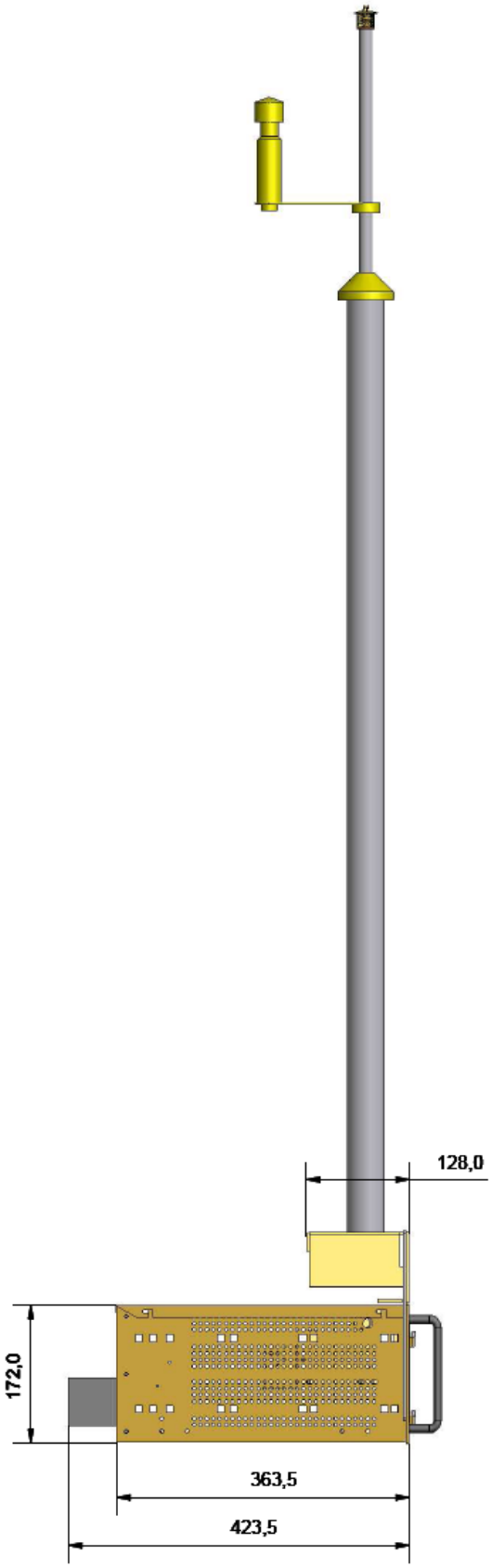
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16 Index

Analog adapter 63
Analog input 58
Analog inputs 24
Analog voltages 49
Barometer 58
Battery capacity 46
Baud rate 45, 48
Calibration 16
Channel tresholds 16, 23
Climatic sensor 59
Commands 45
Control elements 26
Country settings 48
CTS-Line 45
Data bit 45
Data storage card 24, 37
Data transmission 45, 48
Device temperature 38
Dimensions 24
Drying 21
Error code 50
Fast mode 48
Filter weight 47
GESYTEC 53
Glass fuse 10
Gravimetric factor 50
Index 3
Initiation 37
Installation 33, 34
Installation 180 36
Key pad lock 47
Laser radiation (safety) 9
LCD- display 23
LCD-display 26
Light pulse 14
location 26
Maintenance and cleaning 62
Mass concentration range 23
Measuring chamber 38
Measuring principle 14, 15
Multiplication factors 49
Offset values 49
Operation 23
Parity 23, 45
Pre-information 50
Pressure range sample air 24
Receiver diode 14, 15
Rinsing air filter 62
RS-232 ..... 45, 50
Sample air 24
Sample volume 47
Scattering light measurement 14
Self test 23, 37
Semi-conductive laser 15
Semiconductor laser 14
Stand-by mode 47
Status LED 27
Stop bit 45
Storage time 59
System messages 60
Time output 47
Transmission of measured values 50
Transmission protocol 45
Transport 66
User factor 49
Version number 47
Warranty 64
Weather station 59
Weight 24
Weighting curve 14
XON/XOFF 45