INSTRUCTION MANUAL

OPTICAL DISDROMETER
ODM 470
DESIGN PROF. DR. LUTZ HASSE

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EIGENBRODT GmbH & Co. KG
ENVIRONMENTAL MEASUREMENT SYSTEMS
Baurat-Wiese-Straße 68
D-21255 Königsmoor

Telefon +49 (0) 4180 - 732 - Telefax +49 (0) 04180 - 259
E-mail :goto@eigenbrodt.de
Internet: www.eigenbrodt.de

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I. TO OUR CUSTOMERS – READING THIS MANUAL

This manual is designed to provide a comprehensive guide for a proper operation and service of your EIGENBRODT instrument. It belongs to the operation- and service people as reference.

The information contained in this manual is believed to be accurate but only applies to the machine type indicated on the previous page. If in doubt, please contact Eigenbrodt with the type and serial number of the machine. Errors and omissions expected.

Do not set the device into operation, until the operation- and service people have studied the instruction manual carefully and are familiar with all details. Operation and maintenance of the device has to be done in accordance with the details of this instruction manual.

Please read this operation manual carefully before commissioning and attend to the instructions of the chapter "Safety instructions" and chapter "Installation". Since it is about your safety you must have read this operation manual before you start operating the unit.

For damages arising through non-observances of this details or through improper procedure , we do not take over any Liability !

In case of dysfunctions which cannot be settled by your side: Before contact company EIGENBRODT, try to detect the reason of the dysfunction with the help of this instruction manual.

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Liability: Any claims against company EIGENBRODT relating to the hard- and/or software products described in this manual can only be made in accordance with the warranty term. Further claims are excluded; particularly company EIGENBRODT takes over no liability about the correctness of the instruction manual contents. Changes are reserved and can be done anytime without any further notification.

Descriptions for reading the manual: All pages of this instruction manual are serially numbered within chapters in passages.

EXAMPLE:	III	chapter 3
	1.	paragraph 1
	1.1.	point 1
	1.1.1.	subitem 1

The position numbers of the illustrations are referring to the contents of the passages. If there is a position of an illustration named in the text, it is placed in () brackets.

To avoid any doubling of descriptions in this instruction all content referred connections are done with the help of cross-references.

EXAMPLE: ..... in accordance with instruction ..... or ..... see point .....

II. INSTRUCTIONS

1. GENERAL

The instrument may only be deployed for the designated usage described in the operation manual and only with the supplied software (if applicable).
Any usage in a manner not specified in this manual is not according to the directions and forbidden. Eigenbrodt GmbH & Co. KG will take over no liability for resulting damages. The risk is to be carried solely by the operator.
Only qualified personnel may be entrusted with installation, start-up, maintenance and further operation. The operation manual must be kept constantly available on site.

Warning!:
Before you start with maintenance and service that may lead to direct contact with electrical power, disconnect the device from mains supply. Otherwise there is danger of death or serious injury. Disconnect the mains plug from the power outlet (if applicable).

Note!:
If you should contact Eigenbrodt for help, please have the serial number of your unit available. The numbers are to be found on the disdrometer and the DCPS unit.

Attention!:
During installation, maintenance and transport you must carry the obligatory protective clothing when applicable.

2. INTENDED USE

The technical regulations for operation and ambient conditions [see chapter 2.1] are to be regarded. Otherwise we do not guarantee for proper function and achievement of the stated performance data. Operation in explosive atmospheres is absolutely forbidden!

Intended use also refers to observance of the prescribed maintenance and service instructions.

2.1. PERMITTED AMBIENT CONDITIONS

The following ambient conditions apply to the stationary instruments of EIGENBRODT® :

- The relative humidity must not exceed 90%.
- Ambient temperatures:
  - operation: –30°C up to + 42°C.
  - transport/storage: –35°C up to + 55°C
- Fluids complying with the instrument: wet deposition (precipitation), like rain, hail, snow, etc..
- In–/outdoor operation (Ex-free), during all weather conditions.

A possible installation site must be examined for the following risks:

Caution!:
Is personal safety guaranteed?
Is the underground solid?
Can danger of explosion be excluded?
Can presence of toxic gases be excluded?
Can low atmospheric oxygen content be excluded?

If one these conditions cannot be ensured the location is not appropriate for installation. In cases of doubt, please contact the EIGENBRODT GmbH & Co. KG.

Inexpert Use / Predictable Misapplication

- Measuring of fluids which do not comply with the above described specifications.
- Operation of the instrument in explosive atmosphere

Descriptions for using the manual:

All pages of this instruction manual are serially numbered within chapters in passages.

EXAMPLE: III chapter 3
1. passage 1
1.1. under passage 1
1.1.1. under point 1

The position numbers of the illustrations are referring to the contents of the passages.

If there is a position of an illustration named in the text, it is placed in ( ) brackets.

To avoid any doubling of descriptions in this instruction all content referred connections are done with the help of cross-references.

EXAMPLE: ..... in accordance with instruction .....
..... see point .....

III. DESCRIPTION AND PRINCIPLE OF OPERATION

1. SUMMARY – MEASURING PRECIPITATION ON SEAS

A new optical disdrometer has been developed that is optimised for use in high wind speeds, e.g. on board of ships. Minimal detectable size of droplets is 0.35 mm. Each drop is measured separately and recorded with a with a logarithmic scale n diameter to form a droplet size distribution (details please find in the Annex). From the available information, for a given size the number of drops per volume can be calculated. Rain rates may be determined from the droplet spectra by assuming terminal fall velocity of the drops according to their size. A numerical modelling of disdrometer measurements has been performed that allows determining side effects that occur during disdrometer measurements. Based on these studies an iterative procedure has been developed to eliminate the impact of the side effects on the calculated drop size distributions. [1]

2. TECHNICAL DESCRIPTION

The principle of operation is light extinction of rain drops passing through a cylindrical active volume of 120 *mm* length and 21 *mm* diameter. The cylinder is kept perpendicular to the local flow direction by aid of a wind vane. The cylindrical form makes the measurement independent from the incidence angle of the rain drops. Hence, local u~ and downdrafts do not influence the measurements.

The light source of this disdrometer is a 100 *mWatts* IR-diode, emitting light of 880 *nm* wavelength. Due to technical reasons this diode is chopped with a frequency of 20 *kHz.* In order to achieve a mogeneously illuminated active volume, collector lenses and an optical blend are used. Thus, only the portion of light that is parallel to the optical axis can reach the receiver diode.

This disdrometer simultaneously measures the size and the time of flight of the drops through the volume.

Measurement of the drop size
If there is no drop within the active volume the light reaching the receiver diode causes an electrical current of 5 volts. Each drop passing through the active volume results in a reduction of light received at the end of the path. The depth of the pulse is proportional to the quotient between the drops cross sectional area and the cross-sectional area of the active volume. In order to enhance the resolution of the disdrometer with respect to small drops, the electronic signal produced by a drop is amplified. The amount of amplification is chosen so that the largest expected particle produces a signal the amplitude of which equals the reference current. Two versions of the instrument have been built. The original one was designed to measure rain drop size distributions and rain rates. lt resolves rain drops up to 6.0 mm with a resolution of 0.05 mm. Recently and actual standard is a version, that was additionally developed the for use in cold areas featuring a logarithmic resolution between 0.3 and 22 mm.

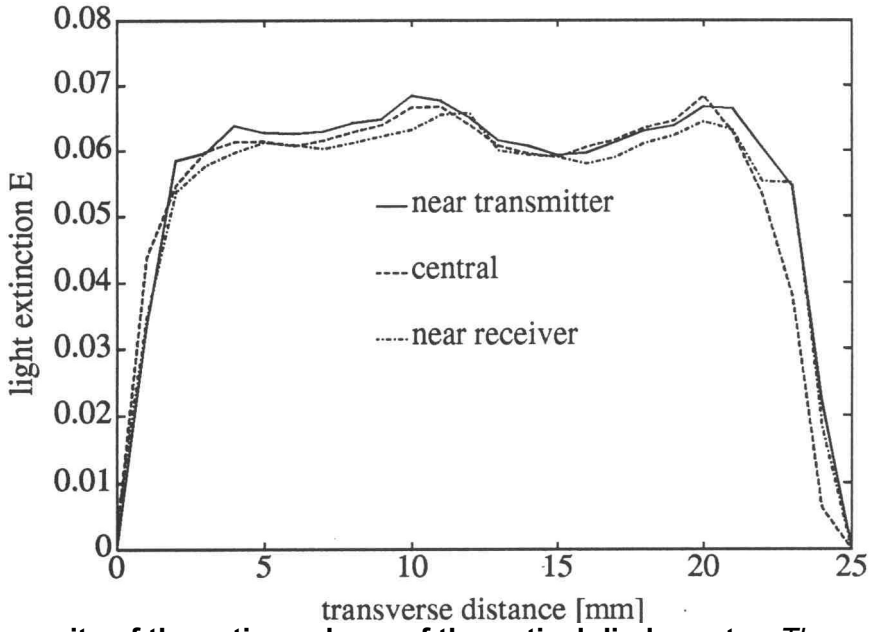


Figure 2: **Homogeneity of the active volume of the optical disdrometer.** *The recorded intensity of light extinction of a calibrated sphere at three transvere sections*

Experience shows that homogeneity and isotropy of the light in the active volume is essential for tlie interpretation of data. The combination of relative wind speed and fall velocity of drops makes tlie angle of incidence rather variable. Hence, disdrometer designs, that are optimized for airplane use or ground based operation in bw wind speed conditions, may exhibit anisotropy that makes them unsuitable for use at high wind speeds (e.g. on moving ships). Unfortunately, most liglit sources show some anisotropy as well as inhomogeneity. Also, inhomogeneity along the length of the optical volume (due e.g. to divergence of light) needs to be minimized. Figure 2 shows an example of the calibration of the optical volume. This calibration had been performed using balls of ball bearings (1.45 *mm* as ‚drops' of calibrated size.

Light extinction *E* is proportional to the quotient between the cross-sectional area of a drop and the area of the active volume.

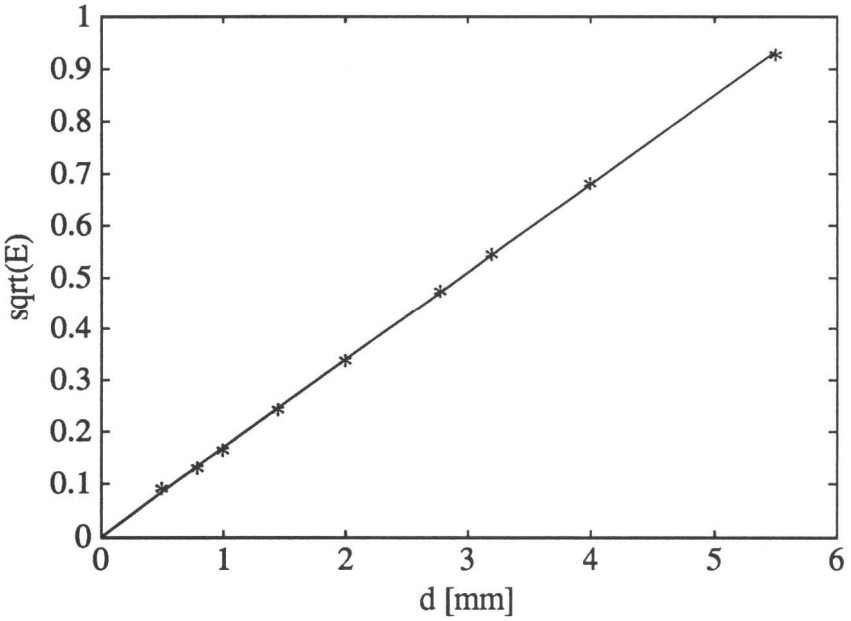


Figure 3: Relation between light extinction *E* and the diameter of spheres that penetrate the sensitive volume.

On board of a ship the disdrometer is exposed to mechanical vibrations that may result in an electronic signal. Such signals typically are misinterpreted as droplets with diameters of 0.3 *mm* or smaller. Therefore drops smaller than 0.35 *mm* are ignored.

Measurement of the signal duration

Drops penetrating the active volume are detected as soon as the amplitude of the electronic signal exceeds a definite threshold. In that moment a 100 *kHz* (=10 *~sek)* counter is activated. This counting stops immidiately after the signal is below the threshold again. Hence, the accuracy of time measurement would be 10 *~sek* if a continuously emitting light source were used. The emitting diode of this disdrometer however, is switched on and off every 25 *psec.* Therefore the accuracy of the time measurements decreases to 10 *~sec* + 25 *psec* = 35 *~sec.* This is the maximum delay in the detection of a drop entering or leaving the active volume, so that the determination of the signal duration (i.e. time of leaving minus time of entering the volume) has an error of ~ 35 *~sek.* This error can be regarded as non systematically. [1]

3. SAFETY INSTRUCTIONS

PLEASE READ THE INFORMATION OF THIS COMPLETE PARAGRAPH BEFORE PUTTING THE INSTRUMENT INTO OPERATION!

This device is manufactured in accordance with safety regulations and controlled and has left the factory in safety controlled perfect condition.

The perfect function and operational Liability of the device can only be guaranteed, if during use the general local safety regulations receive attention and attention is paid to the special references to safety in this instruction manual.

The operating safety and proper function of the instrument is only ensured with observance of the generally applied safety precautions and the specific security advice of this operation manual.

The staff assigned to installing, commissioning, maintaining and operating the instrument must carefully read and understand the operation manual.

Generally the personnel must have the adequate qualification for the specific work.

The operation manual must be kept constantly available on site.

- Before connecting the device with the electricity supply system ensure that the circuit voltage which is marked on the appliance is in accordance with the supply voltage.
- The perfect function and the operational Liability of the appliance can only be ensured under the climate conditions specified in chapter II.2.1 “permitted ambient conditions “ of this instruction manual.
- Alignment-, service- and repair works should only be done by an authorized expert.
- If the device is thought to be damaged or broken in such a way as to be dangerous. It should be taken out of service and prominently labelled of unserviceable.
- The safety of the user could be reduced , for example, if the device
    - shows visible damaged parts,
    - does not work as described,
    - was stored under wrong conditions,
    - was forwarded under difficult transport conditions.

- In case of doubt send the device generally to the manufacturer for service or repair, respectively it should be controlled through an authorized expert.
- In case of electrical disturbances contact exclusively an authorized expert.
- There is a **higher risk** of accident during service- and maintenance works.

3.1. SYMBOL AND HINT EXPLANATION

This instruction manual utilizes following signs to draw the attention to difficulties and dangerous situations for the appliance and the operational staff:

	This symbol gives important tips for the **appropriate work** and stands for technical peculiarities, which requires attention from the user.		**Caution!** This Symbol means a possible **dangerous situation!** Stands for directions which must absolutely be obeyed to exclude risk of fatal injury.
	Stands for working- and operation methods which have to be followed exactly to prevent damages of persons, the device or environment.		This symbol means a **possible imminent danger** for the live and health persons Draws attention to correct procedures acting with electrical power.
	**Mandatory sign!** Wear Safety shoes		**Mandatory sign!** Use safety glasses
	**Mandatory sign!** Wear gloves		**Mandatory sign!** Use safety helmet

3.2. SAFE WORKING WITH THE INSTRUMENT

Only apply the instrument under the described conditions (chapter II.2.1).
Operation beyond these conditions is not intended.

- The operator of the instrument has to assure that the valid EEC guidelines and national laws for occupational health and safety will be observed.
- The same applies to the regulations for accident prevention.
- The operating instruction manual is meant not only for beginners. It is also intended as a reference book containing tips, hints and suggestions.

- Note: Please employ only spare parts, accessories and special equipment which have been approved by EIGENBRODT.
- When passing on the instrument to someone else, please assure to also pass on the complete technical documentation.
- Please see to connect the potential equalisation (connection via foot bar) Operate the instrument only under the ambient conditions specified under „Technical Data“ (chapter 1.6)

- **Caution:** Only employ the instrument for measuring of liquid hydrous solutions in a non-explosive environment. Further employment exceeding this purpose is not intended.

4. DISPOSAL

Packaging:
The packaging materials wood, cardboard box and PE can be disposed at the regular disposal points.

Device:
Please consider environmental compatibility, health risks and local disposal directions. Thus you should clean and disinfect the instrument and dispose it at one of the authorised disposal points. Detailed information should be available at the responsible authority.

Warning:
Disconnect the instrument from mains and other supply lines.

Separate the material groups in order to dispose the materials in an environmentally compatible way.
Batteries are to be disposed according to the local regulations.

IV. TECHNICAL DATA

1. ELECTRICAL DATA

1.1. SENSOR-ELECTRONICS

Power supply	V AC	100-240
Power consumption	Watt	approx. 50

2. RATINGS

2.1. DIMENSIONS OPTICAL DIDROMETER

Length	mm	1270
Wide	mm	570
Depth	mm	470

2.2. WEIGHT

…….....	kg	8,8

2.3. DIMENSIONS AND WEIGHT DCPS UNIT

Overall	mm	320 x 260 x 110
.....	Kg	3,5

2.4. WORKING TEMPERATURE ODM

.....	°C	- 30...+42

V. INSTALLATION

In order to guarantee a safe operation please make sure before installing that:

- there is no transport damage.
- the unit has not been stored in inappropriate conditions for a longer time.
- the unit does not have any visible damage.

In case of doubt please contact EIGENBRODT

1. LOCATION - SITING THE SENSORS

Shipboard installation:

- The disdrometer shall be installed high, so the influence of sea spray can be avoided
- If possible, install the instrument in the front central section of the vessel in order to allow an optimal inflow of precipitation.
- The wind sensor shall be sited close to the disdrometer also at a location with the most possible free inflow of wind in order to provide good wind data to the processing unit.
- Siting of the precipitation sensor is not as critical as for the disdrometer and wind sensor. The siting shall only allow an sufficient detection of the occurance of precipitation events and suppress the detection of seaspray in harsh weather conditions.

VI. TRANSPORT AND INSTALLATION

1. TRANSPORT

packing sizes		
length x width x height	m	0,80x0,80x0,60
weights:		
total weight including box and additional sensors (max)	kg	30
total weight excluding box (max)	kg	26

Control and note if there is any transport damage to the device or the accessories. Damage and other defects for example incompleteness have to be notified in written form to the forwarder or to company EIGENBRODT immediately.

Inform the carrier and EIGENBRODT immediately.

2. ELECTRICAL CONNECTIONS TO THE SUPPLY MAINS

The regulations of the power supply company should to be followed.

The electrical connections are to be carried out in accordance with the relevant local codes and regulations by an expert.

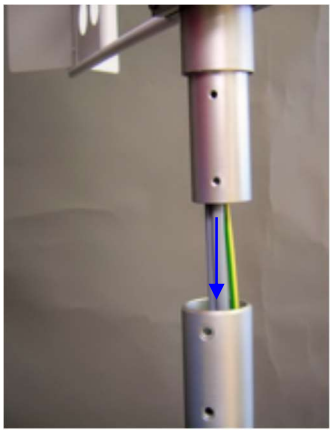
The power supply of the ODM 470 is being done through a safety plug connection with supply mains.

3. MECHANICAL ASSEMBLY OF THE DISDROMETER

The disdrometer is being delivered semi assembled. There are only few actions to be taken for assembly:

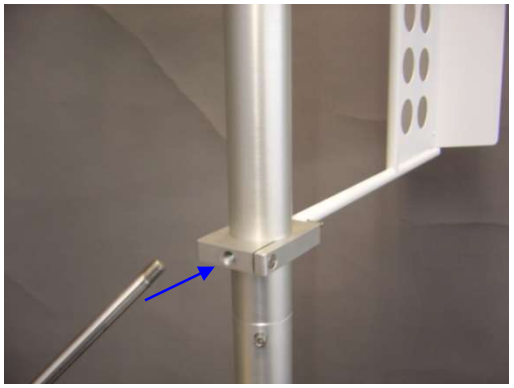
Mount the moving tube (1.4) with the disdrometer body (1.3) onto bottom tubing (1.11):

- Guide the transmitter cable, receiver cable and the ground wire through the bottom tubing (1.11).
- Slide the moving tube (1.4) into the bottom tubing (1.11).
- In both tubes there are holes/threads. The tubes are fastened with 3x2 screws M4x10



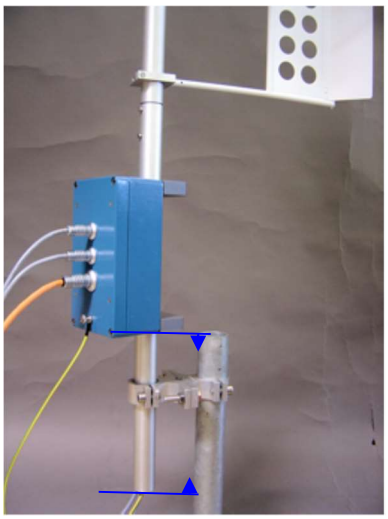
Assembly of wind fane (1.5) and counter weight (1.6)

- Slide the wind fane onto 2 bar ends on the disdrometer body (1.3) and clamping piece (1.7)
- Fasten the wind fane with 2 screws M3x16 and 2 nuts M3
- Screw the counter weight (1.6) into the clamping piece (1.7)



Mount the bottom tubing (1.11) with pipe clips (not in delivered content) to a stand or mast:

- The outer diameter of the rod is Ø 35 mm.
- Please take care, that fastening only takes place in the below marked area of the rod.
- Since the upper part of the disdrometer is free to rotate, take care to keep the upper part of the disdrometer free from any obstacles.

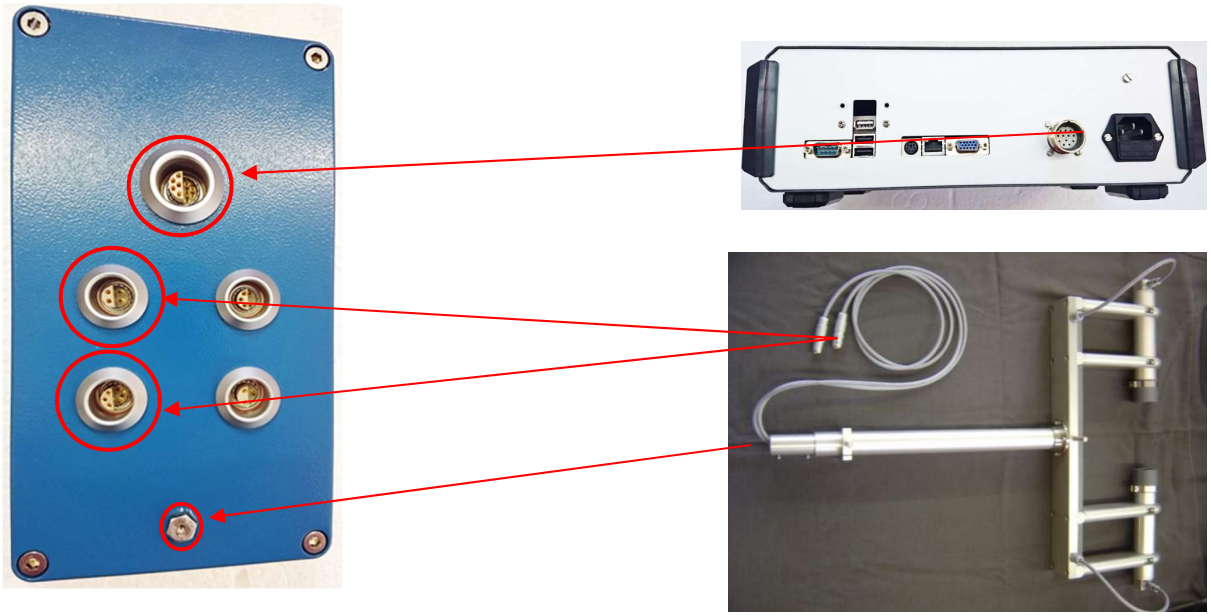


In opposite to the picture above we recommend to mount the disdrometer with 2 fixing points to e.g. a mast.

4. CABLE CONNECTIONS - SIGNALS

All connectors used with the ODM application are unique and cannot be mixed up

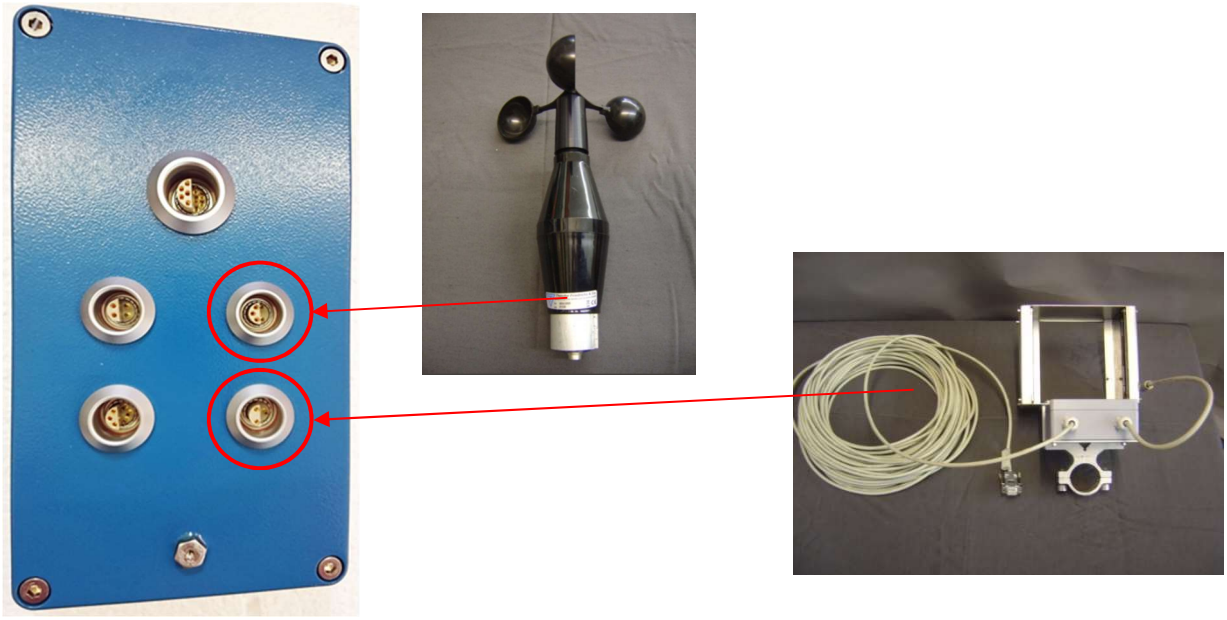
4.1. CONNECTING THE TRANSMITTER AND RECEIVER TO THE MEASURING ELECTRONICS AND DCPS UNIT (2)



The receiver and also the transmitter are being connected to the measuring electronics via unique plugs as shown on the pictures above. Protector ground is being fastened with the screw to the measuring electronics.

The measuring unit (1.9) is being connected to the DCPS unit (2) with cable C1.

4.2. CONNECTING EXTERNAL SENSORS



The wind speed sensor and also the IRSS88 are being connected to the measuring electronics via unique plugs as shown on the pictures above.

4.3. EXTERNAL PRECIPITATION SIGNAL (OPTIONAL)

The DCPS unit features (optional) an external input for signal precipitation yes/no → digital closer
The external precipitation signal is connected to a 9-pin sub-D connector on the back-site of the DCPS unit. In order to connect this signal follow the settings on connection diagram No.470.6.210

4.4. EXTERNAL WIND SIGNAL (OPTIONAL)

The DCPS unit features (optional) an external input for wind speed
The external precipitation signal is connected to a 9-pin sub-D connector on the back-site of the DCPS unit. In order to connect this signal follow the settings on connection diagram No.470.6.210

5. SET-UP OPERATION CHECK-LIST AND START UP

Set into operation only by an expert following this check-list:

- Verify the correct line up and that the DISDROMETER mounting is secure.
- Check, that the area with the swept volume of disdrometer is secured against unattended trespassing.
- Plug in all cables from/to computer, sensors and electronics.
- Turn on main switch on the DCPS unit (2.1)

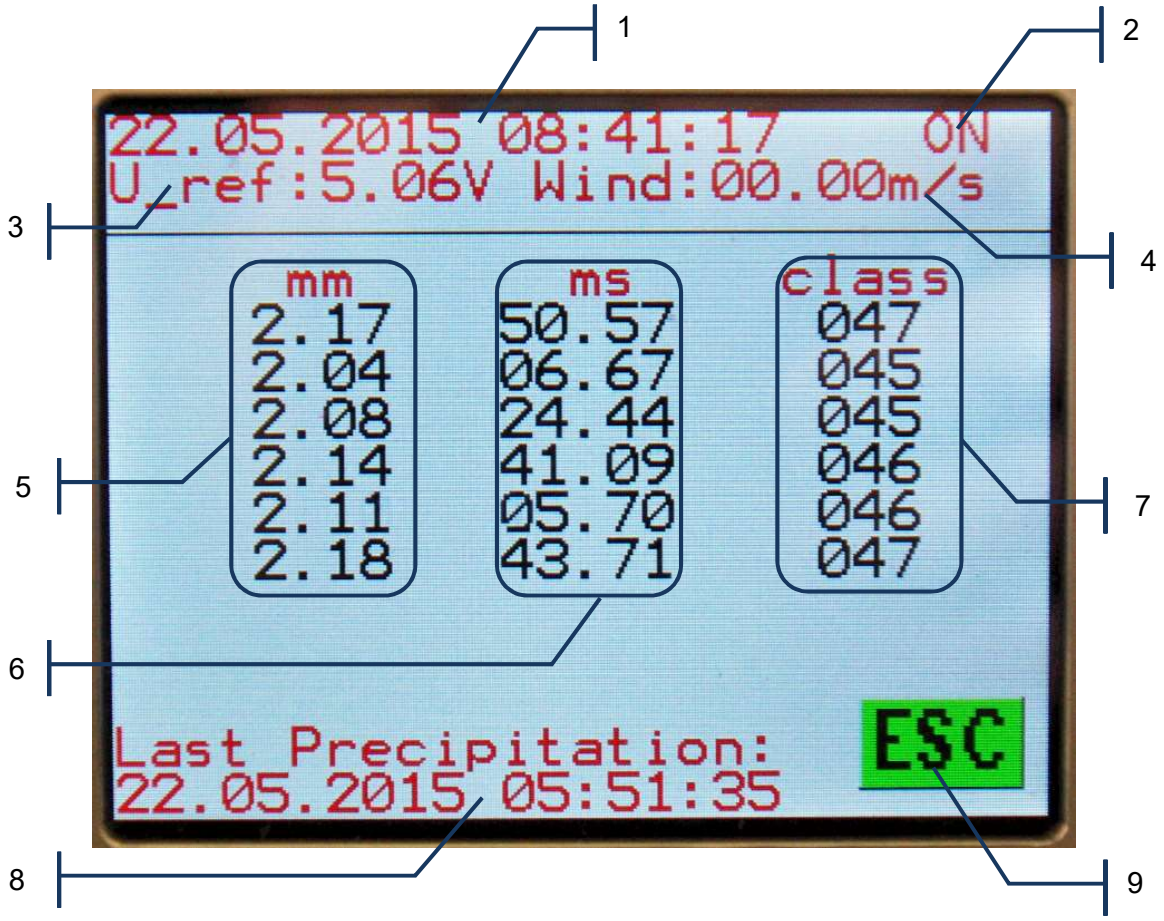
VII. OPERATION

1. DCPS UNIT

The processing part of the DCPS unit is a ingle-board-computer operating with a Debian 8 LINUX operational software. This unit handles:

- Power supply of connected sensors
- Processing incoming data from external signals as well as from connected sensors
- Logging data internally and externally on SD-card
- Displaying actual instrument status and information

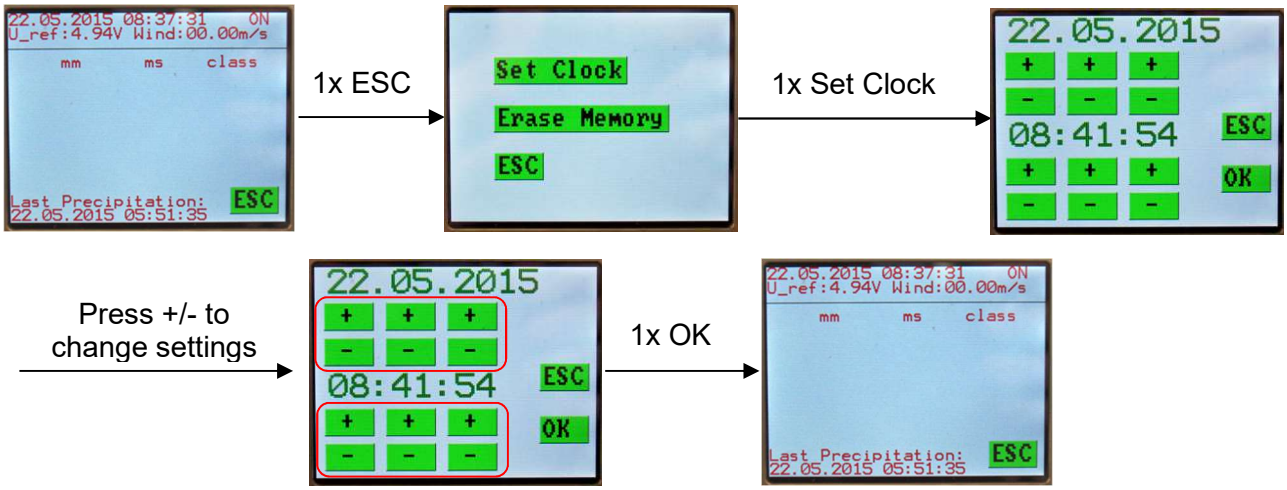
1.1. TOUCH SCREEN DISPLAY – MAIN WINDOW



No.	Description
1	System time and date
2	ON/OFF detection of external precipitation sensor. (Always on, if no sensor is connected) ➔ ON – precipitation present ➔ OFF – no precipitation present
3	U_ref – reference voltage of the sending diode – is to kept at 3,4 - 5,2 V
4	Actual wind seed, is being updated in 60 second intervals
5	Actual diameter of a detected particle (rain drop, snow flake,…)
6	Passing time - time detected particle (rain drop, snow flake,…) has been detected within the IR-beam (not used in this version)
7	Assigned bin (drop size class)
8	Last precipitation detected
9	Button to get to the menu for programming time/date and erase internal memory

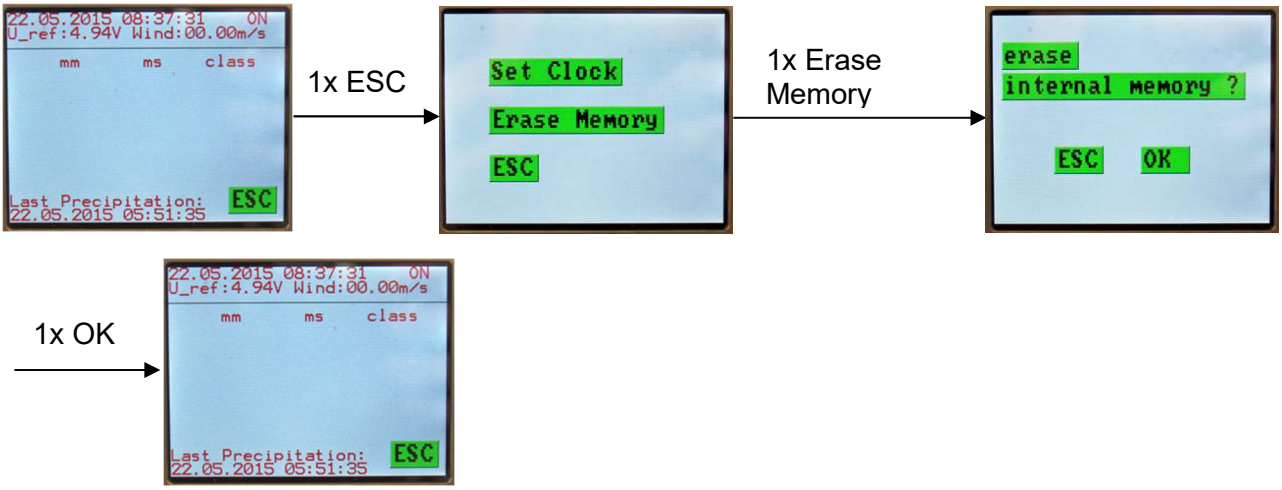
1.1.1 Setting time and date

To change time and/or date proceed as follows:



1.1.2 Erase stored internal data

The data should be retrieved from the instrument on a frequent basis. Upon downloading the data, the internal memory shall be reset. Therefore proceed as follows:



Please erase also all data from the SD-card when erasing the internal data as the SD-card might fill up

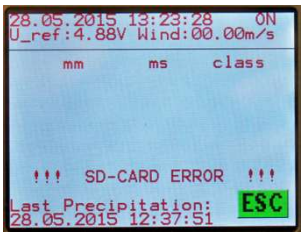
1.2. ERASE STORED DATA FROM SD CARD

The data should be retrieved from the instrument on a frequent basis. The SD-card can be used with any regular file commander as known from other memory cards. Therefore use your common PC-system to download and erase data from the SD-card.

Please erase also all data from the internal memory when erasing the data from the SD-card as upon inserting the blank card into the instrument all internal data will be copied to the SD-card.

1.2.1 Alarm “SD-card Memory error” / “INTERNAL MEMORY FULL”

“SD-card Memory error”

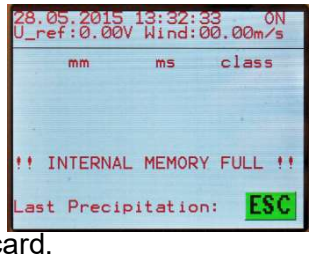


This Alarm is shown in case:

- There is no SD-card in the according slot (2.2)
- SD-card is full

- If this warning is shown, all upcoming data will be stored to the internal memory.
- A new SD-card can be inserted at any time. The required data format is: FAT, FAT32
- The data is being logged to a folder named “ODM_DATA”. This folder will be automatically created by the system.

“INTERNAL MEMORY FULL”



This alarm is shown, if:

- The internal memory is filled

- If this warning is shown, all upcoming data will be stored to the SD-card.

1.3. REBOOTING THE DCPS UNIT

The system can reboot in the unlikely event of system failure – or if the software has been shut down manually by an administrator within the internal software (access rights required for internal software)
Therefore press the reboot button (2.3) for 1-2 seconds. The DCPS unit will reboot the embedded, which might take 2-3 minutes.
An indicator for successful starting up is the green LED inside the reboot button plus the standard window with time/date, U_ref, wind speed, aso.

2. HANDLING DATA AND MEMORY

The precipitation data will only be stored to the memory in case of a rain event (so when drops are present). All data being logged internally will be copied as it is to the SD-card once a hour or when starting up the instrument. Therefore do not remove the external sd-card for longer periods of time. The internal memory for data is approx 16 GB.
Therefore the external SD-card needs to be at least 16 GB size.

2.1. FILE STRUCTURE

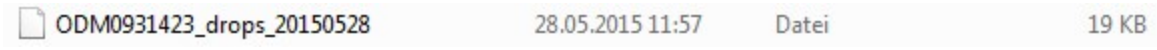
There are 2 different data files to be found in the memory:

ODM0931423_151_rd_20150528	28.05.2015 11:22	Datei	2 KB
ODM0931423_drops_20150528	28.05.2015 11:57	Datei	19 KB

with:

1	ODM[Serial number of the disdrometer]	ODMxxxxxx
2	Internal calibration coefficient	xxx
3	RD (rain data) – standing for precipitation data	
4	Day the file was created	YYYYMMDD

And:



This data is internal raw data and shall be ignored by the regular user.

2.1.1 When are files being created?

- There will be one data file created with every start up of the software.
- One new data file will be created at midnight each day

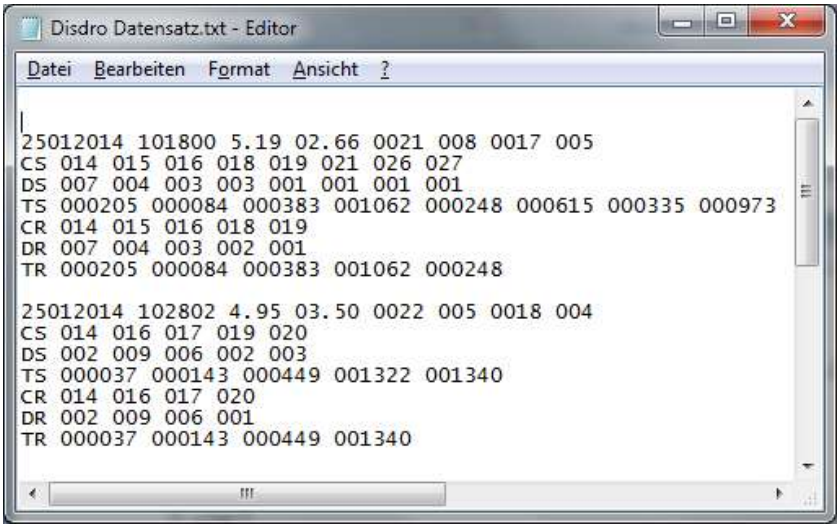
The same day all upcoming data (in case there is rain only) will be written into this file on a minute basis

2.2. BASIC CONVENTIONS FOR THE DATA FILE

- Blank is the separator
- All data has the same length if necessary with a leading zero
- All lines are closed with [CRLF]
- Every dataset is being follow by an blank line

2.3. ODMXXXXX_XXX_RD_XXXXXXXX – CONTENT EXPLANATION

The file is a text file and can be opened by script editors like e.g. Microsoft “Editor”

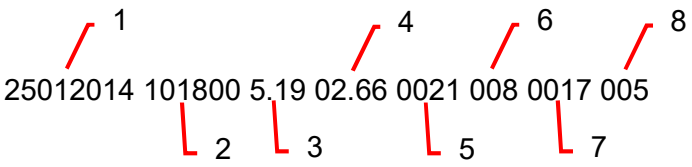


2.3.1 Complete data set

25012014 101800 5.19 02.66 0021 008 0017 005
CS 014 015 016 018 019 021 026 027
DS 007 004 003 003 001 001 001 001
TS 000205 000084 000383 001062 000248 000615 000335 000973
CR 014 015 016 018 019
DR 007 004 003 002 001
TR 000205 000084 000383 001062 000248

2.3.2 Dataset line by line with explanations

1st line:



1	Date as day month year	ddmmyyyy	[-]
2	Time as hours minute seonds	Hhmmss	[-]
3	Actual reference voltage	x.xx	[V]
4	Wind speed	xx.xx	[m/s]
5	Number of particles “snow”	xxxx	[-]
6	Number of occupied bins (classes) “snow”	xxx	[-]
7	Number of particles “snow”	xxxx	[-]
8	Number of occupied bins (classes) “snow”	xxx	[-]

2nd line – occupied classes snow:
The line indicator CS (classes snow) is been followed by a list of 3 digit blocks in the following example classes 14,15,16,18,19,21,26 and 27 have had drops.

CS 014 015 016 018 019 021 026 027

3rd line– number of drops per class in snow algorithm (droplets snow):
Here there were:
7 droplets class 14
4 droplets class 15
3 droplets class 16
3 droplets class 17
1 droplets class 18
1 droplets class 19
1 droplets class 21
1 droplets class 26
1 droplets class 27

DS 007 004 003 003 001 001 001 001

4th line – Accumulated passing time per droplet class in snow algorithm
Ancient data, which is not been used in this actual software version

TS 000205 000084 000383 001062 000248 000615 000335 000973

5th line – occupied classes rain:
The line indicator CS (classes snow) is been followed by a list of 3 digit blocks in the following example classes 14,15,16,18,19 have had drops.

CR 014 015 016 018 019

6th line – number of drops per class in rain algorithm (droplets snow):
Here there were:
7 droplets class 14
4 droplets class 15
3 droplets class 16
2 droplets class 18
1 droplets class 19

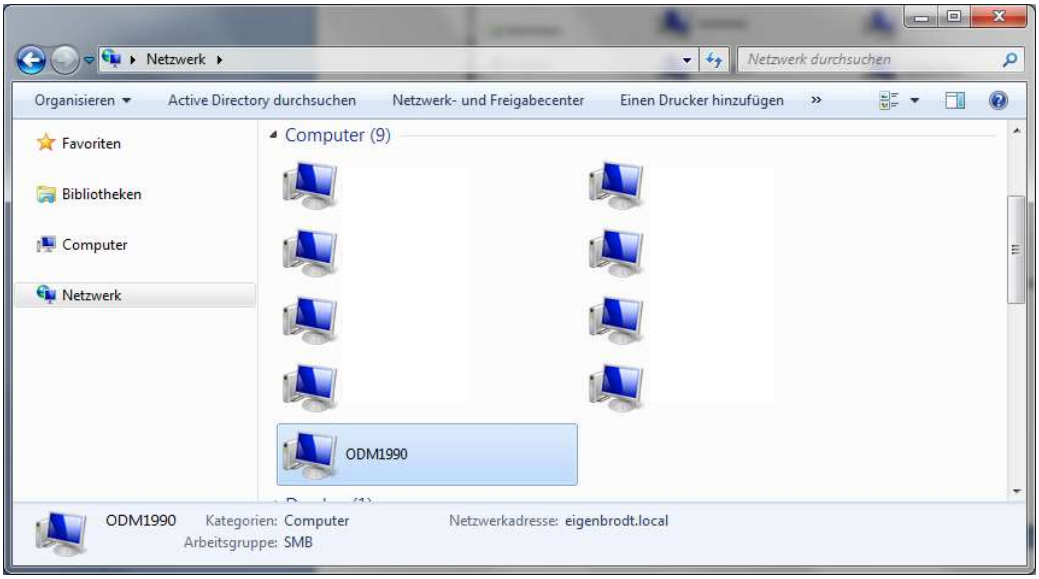
DR 007 004 003 002 001

7th line – Accumulated passing time per droplet class
Ancient data, which is not been used in this actual Software version

TR 000205 000084 000383 001062 000248

2.4. EXTERNAL DATA ACCESS VIA LAN

- Activate DHCP (Dynamic Host Configuration Protocol)
- In your file commander window, there will appear a network computer named ODMxxxx with xxxx= last 4 numbers of the DCPS serial number.
- Open the computer explorer:



- Click on the ODMxxxx computer and proceed LOGIN with:
  Login: user
  Password: 'last 4 digits of the DCPS serial number'
- Then the data can be downloaded from folder: ODM_DATA

VIII. MAINTENANCE AND TROUBLE SHOOTING

1. REPAIR AND MAINTENANCE WORKS, DISASSEMBLY – SECURITY ADVISES

All work on life parts have to be carried out by an authorised expert.

Always disconnect the apparatus before working on any life parts.
Danger of accident!

Do not stay in the swept volume of the disdrometer. Work on the disdrometer shall only be executed during low wind speeds.
DANGER TO ACCIDENT!

2. MAINTENANCE WORKS

The service works has to be done at set intervals to ensure a perfect operation of the device.

Interval	Maintenance schedule
weekly	Check U_ref with: **3,4 [V] < U_{ref} [V] < 5,2 [V].** • Check if optics are clean – if necessary clean with a smooth towel • Adjust the reference voltage. • Replace transmitting diode, if necessary
weekly	Check, if wind data is realistic
weekly	Check functionality of the precipitation sensor and clean at demand
weekly	Check, if time/data is OK
at demand	Check, if wind vane turning is freely in the wind?
at demand	**Clean both optical lens glasses** within grey plastic hoods with clean cloth or paper tissue

2.1. OUTSIDE INSTRUMENT MAINTENANCE:

How to simulate rain to check instrument performance after cleaning:

- Precipitation sensor: Put hand into squared detector volume 8 times (red LED on left inside will flash each time) → This switches on the disdrometer
- Within one minute go to disdrometer and spray or drop water through the area of the optical lenses (they are hidden in the grey plastic hoods)
  → While doing a red LED will blink on the blue box under the disdrometer
- Check DCPS unit (2) if “Last Precipitation: Date, Time” is updated

- •Check U_ref value: must be within 3,4V and 5,2V on average

Note: Blocking optical disdrometer volume with hand results in short time 0.00V value. Use real water for the test and you get 3 to 5 V values

Note: Very large rain drops or snowflakes can temporarily cause U_ref to be below 3 V, that's ok.

Note: In order to avoid confusion, please execute these previous actions and tests with the absence of precipitation.

3. TROUBLE SHOOTING SHORT ADVICE

Error	**Remedy**
Wind vane is not turning freely in the wind.	Check if cables are curled up and uncurl by tuning instrument
DCPS unit freezes of shows unusual behaviour	Follow "rebooting" routine
Precipitation is always ON, even when there is no rain	On the left of the squared volume is a red LED (light emitting diode) ➔ Correct: LED is off when no precipitation ➔ Correct: LED flashes red when precipitation occurs or hand is held in volume ➔ Error: LED is constantly red Clean the sensing surfaces of the precipitation sensor
Time/date incorrect	Adjust time/date
U_ref is outside the preset limits	• Check if optics are clean – if necessary clean with a smooth towel • Adjust the reference voltage. • Replace transmitting diode, if necessary

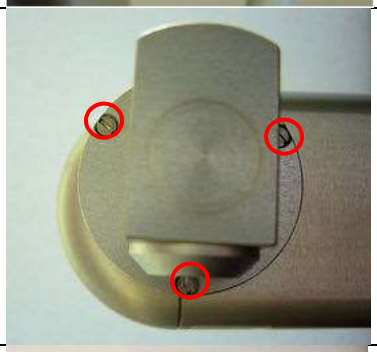
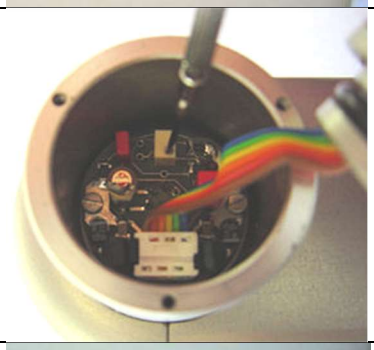
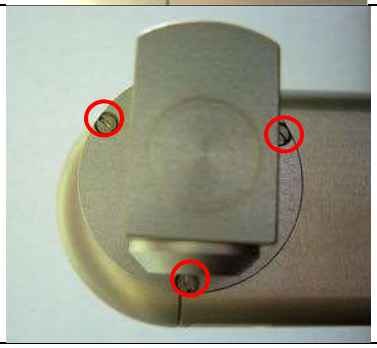
3.1. ADJUSTING THE REFERENCE VOLTAGE

The reference voltage is an indicator for the brightness of the transmitter diode. In order to ensure a proper operation of the disdrometer, the reference voltage must be in the following interval: 3,4 [V] < U_{ref} [V] < 5,2 [V].

When executing the adjustment, please aim: **4,8 [V] < U_{ref} [V] < 5,1 [V].**

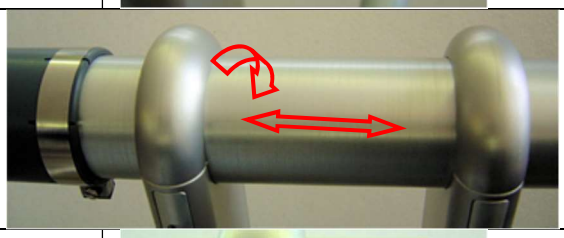
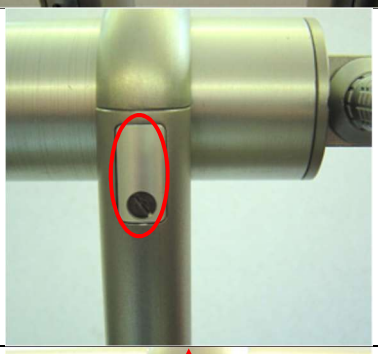
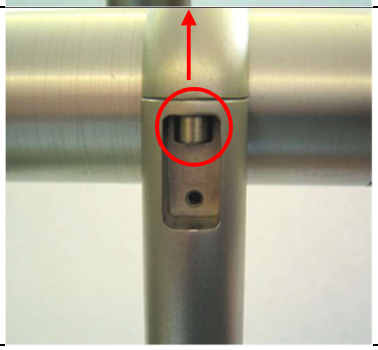
The actual reference voltage can be checked in the top line of the computer screen of the software.

In order to adjust the reference voltage, please proceed as follows:

Disconnect the 6pole plug from the receiver (1.2)	
Unscrew 3 pieces screw (M2 x 8) from the cap and pull the cap to the front	
When pulling the cap from the transmitter it might happen, that the white plug inside the transmitter electronics is also being pulled of. Plug the white plug again into the white socket.	
U_{ref} now can be adjusted by rotating the adjusting screw with a small screw driver: **= U_{ref} up** **= U_{ref} down** The actual U_{ref} can be seen on the computer screen.	
After adjusting the voltage closed the receiver unit by inserting the cap and fastening the 3 screws (M2 x 8) And finally connect the according plug with the receiver socket.	

3.2. DISASSEMBLING THE TRANSMITTER

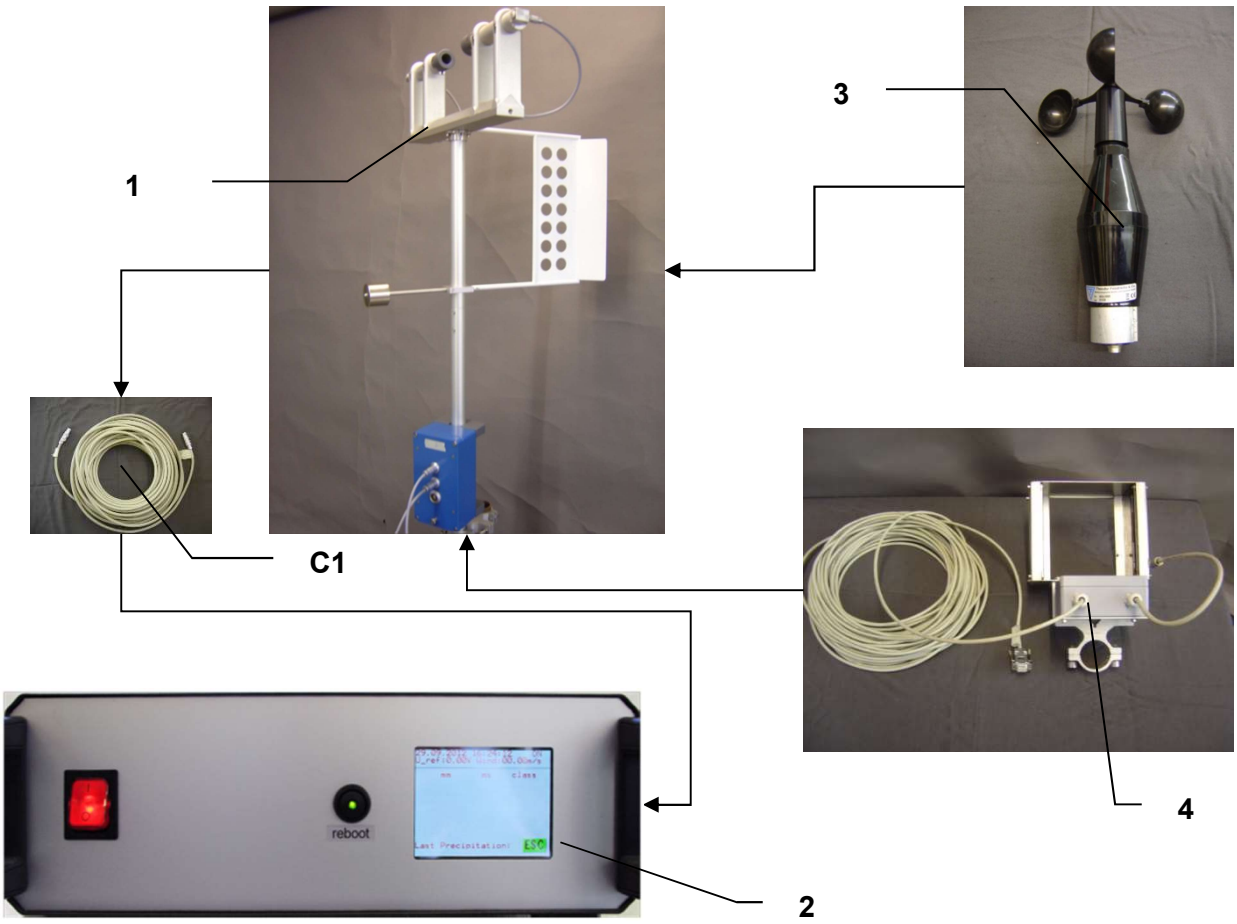
In case the reference voltage cannot be adjusted into the operating interval, the transmitter section needs to be sent to the supplier to replace the sending diode. To disassemble the transmitter please acts as follows:

Disconnect the 6pole plug from the transmitter (1.1)	
Before removing the transmitter, mark the position (rotation as well as the horizontal position).	
Remove 4 pieces protection cap	
Unscrew the inner socket screws below the protection caps and remove the half-rings and the transmitter to the top.	

IX. TECHNICAL DOCUMENTATION

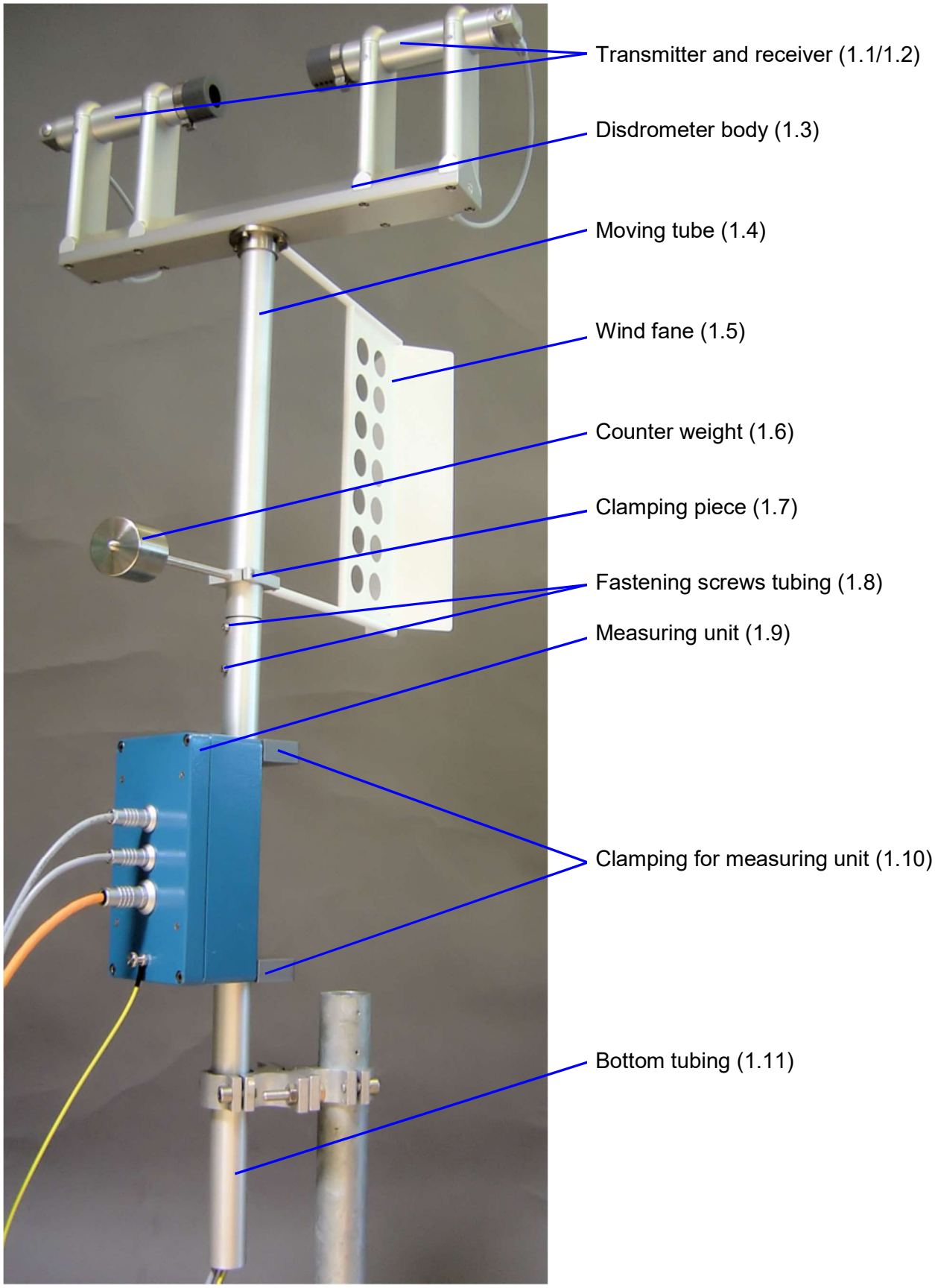
1. EXPLANATION OF COMPONENTS

1.1. SET UP



No.	Name	No.	Name
1	Disdrometer	2	Data Converter and Power Supply unit (DCPS unit)
C1	Disdrometer – DCPD unit; max length: 50m	4	Precipitation Sensor IRSS 88
3	Anemometer (optional)		

1.2. FIGURE DISDROMETER



1.3. DETAILS DISDROMETER

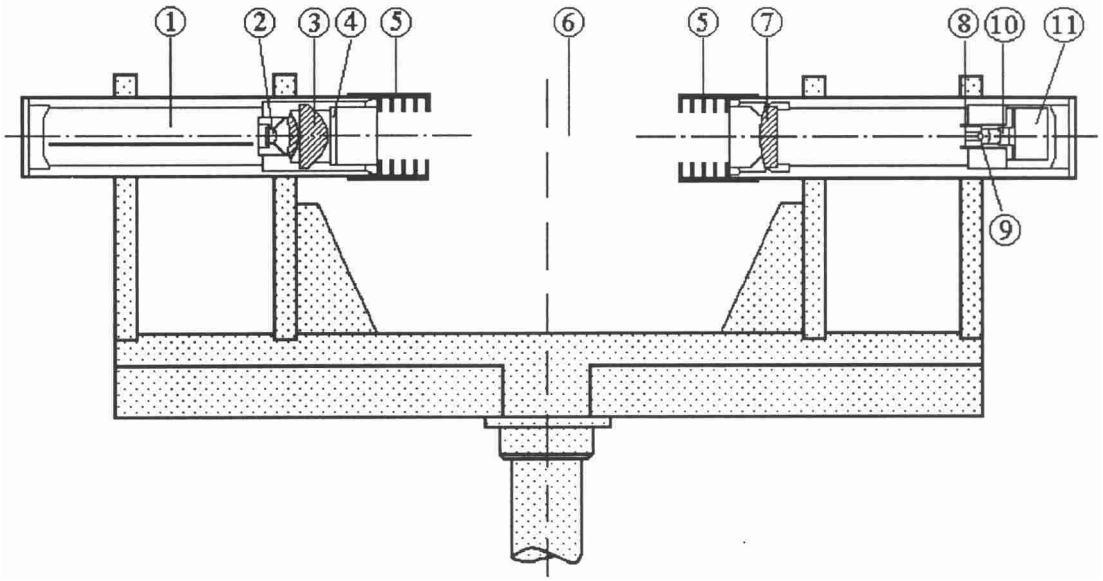
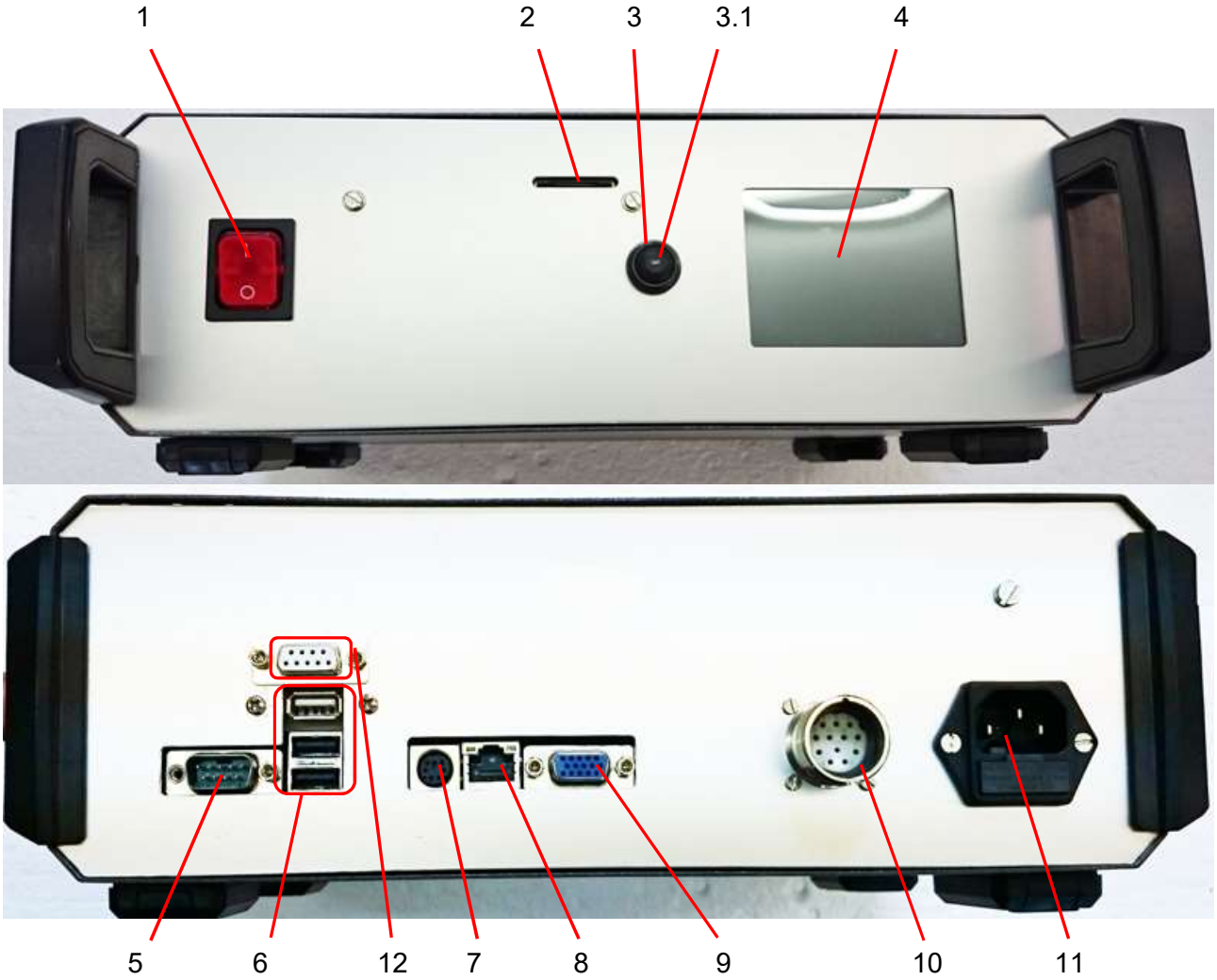


Figure 1: Cross-section of the I~-optical-disdrometer. *From left to right: electronics (1), light emitting diode (2), lens system (3), window (4), baffles (5), sensitive volume (6), collector lens (7), optical blend (8), achromatic collector lens (9), photo diode (10), electronics compartment (11)*

1.4. DCPS UNIT (2)



2.1	Main switch (on/off)	2.6	3x USB 2.0 port
2.2	SD-card slot	2.7	PS2-port for key board
2.3	Reset (reboot) button	2.8	LAN port
2.3.1	LED for status indication of instrument	2.9	VGA-port
2.4	Touchscreen display	2.10	Connector for disdrometer cable
2.5	COM-port	2.11	External power supply
2.12	External precipitation and or wind signal (optional)		

2. SOURCES

[1] An optical Disdrometer for use in high Wind Speeds, MARTIN GROSSKLAUS, KLAUS UHLIG AND LUTZ HASSE INSTITUT FUER MEERESKUNDE, KIEL, GERMANY, submitted to Journal of Atmospheric and Oceanic Technology November 1996, page 2

3. ANNEX

- Declaration of conformity

- Theoretical distribution of drop size classes (standard – logarithmic scale / optional – linear for special applications)

- WIRING DIAGRAMS
  1. CONNECTION OVERVIEW ODM 470 .....NO. 470.6.220
  2. TRANSMITTER-CABLE .....NO. 470.6.030
  3. RECEIVER-CABLE .....NO. 470.6.040
  4. DATA/POWER CABLE (C1) .....NO. 470.6.100
  5. IRSS88 CONNECTION PLAN .....NO. 470.6.120
  6. CONNECTION PLAN WIND SENSOR 4035 .....NO. 470.6.110
  7. EXTERNAL WIND / PRECIPITATION SIGNAL .....NO. 470.6.210

- Technical information wind speed sensor

Theoretical distribution of drop size classes – logarithmic scale (standard)

Class / bin [-]	Interval from: [mm]	Interval to: [mm]
000	0,0000	0,0124
001	0,0125	0,0375
002	0,0376	0,0632
003	0,0633	0,0896
004	0,0897	0,1166
005	0,1167	0,1443
006	0,1444	0,1727
007	0,1728	0,2018
008	0,2019	0,2316
009	0,2317	0,2621
010	0,2622	0,2934
011	0,2935	0,3255
012	0,3256	0,3583
013	0,3584	0,3920
014	0,3921	0,4266
015	0,4267	0,4619
016	0,462	0,4982
017	0,4983	0,5353
018	0,5354	0,5734
019	0,5735	0,6124
020	0,6125	0,6524
021	0,6525	0,6934
022	0,6935	0,7354
023	0,7355	0,7784
024	0,7785	0,8225
025	0,8226	0,8677
026	0,8678	0,9140
027	0,9141	0,9615
028	0,9616	1,0101
029	1,0102	1,0600
030	1,0601	1,1111
031	1,1112	1,1634
032	1,1635	1,2171
033	1,2172	1,2720
034	1,2721	1,3284
035	1,3285	1,3861
036	1,3862	1,4453
037	1,4454	1,5059
038	1,506	1,5681
039	1,5682	1,6318
040	1,6319	1,6970
041	1,6971	1,7639
042	1,764	1,8324
043	1,8325	1,9027
044	1,9028	1,9747
045	1,9748	2,0484
046	2,0485	2,1240
047	2,1241	2,2015
048	2,2016	2,2809
049	2,281	2,3622
050	2,3623	2,4456
051	2,4457	2,5311
052	2,5312	2,6186
053	2,6187	2,7084
054	2,7085	2,8003
055	2,8004	2,8946
056	2,8947	2,9911
057	2,9912	3,0901
058	3,0902	3,1915
059	3,1916	3,2955
060	3,2956	3,4020
061	3,4021	3,5112
062	3,5113	3,6230
063	3,6231	3,7377
064	3,7378	3,8552
065	3,8553	3,9755
066	3,9756	4,0989
067	4,099	4,2254
068	4,2255	4,3550
069	4,3551	4,4877
070	4,4878	4,6238
071	4,6239	4,7633
072	4,7634	4,9062
073	4,9063	5,0527
074	5,0528	5,2028
075	5,2029	5,3566
076	5,3567	5,5142
077	5,5143	5,6758
078	5,6759	5,8413
079	5,8414	6,0110
080	6,0111	6,1848
081	6,1849	6,3630
082	6,3631	6,5456
083	6,5457	6,7327
084	6,7328	6,9244
085	6,9245	7,1210
086	7,1211	7,3223
087	7,3224	7,5287
088	7,5288	7,7402
089	7,7403	7,9570
090	7,9571	8,1791
091	8,1792	8,4067
092	8,4068	8,6400
093	8,6401	8,8790
094	8,8791	9,1240
095	9,1241	9,3750
096	9,3751	9,6323
097	9,6324	9,8960
098	9,8961	10,1662
099	10,1663	10,4431
100	10,4432	10,7269
101	10,727	11,0177
102	11,0178	11,3157
103	11,3158	11,6211
104	11,6212	11,9341
105	11,9342	12,2548
106	12,2549	12,5835
107	12,5836	12,9203
108	12,9204	13,2655
109	13,2656	13,6193
110	13,6194	13,9818
111	13,9819	14,3533
112	14,3534	14,7341
113	14,7342	15,1242
114	15,1243	15,5241
115	15,5242	15,9339
116	15,934	16,3538
117	16,3539	16,7841
118	16,7842	17,2251
119	17,2252	17,6771
120	17,6772	18,1402
121	18,1403	18,6149
122	18,615	19,1013
123	19,1014	19,5998
124	19,5999	20,1106
125	20,1107	20,6341
126	20,6342	21,1706
127	21,1707	21,7204
128	21,7205	22,2838

Theoretical distribution of drop size classes –linear scale for special applications (optional)

Class / bin [-]	Interval from: [mm]	Interval to: [mm]
000	0,0000	0,0124
001	0,000	0,047
002	0,048	0,094
003	0,095	0,141
004	0,142	0,188
005	0,189	0,234
006	0,235	0,281
007	0,282	0,328
008	0,329	0,375
009	0,376	0,422
010	0,423	0,469
011	0,470	0,516
012	0,517	0,563
013	0,564	0,609
014	0,610	0,656
015	0,657	0,703
016	0,704	0,750
017	0,751	0,797
018	0,798	0,844
019	0,845	0,891
020	0,892	0,938
021	0,939	0,984
022	0,985	1,031
023	1,032	1,078
024	1,079	1,125
025	1,126	1,172
026	1,173	1,219
027	1,220	1,266
028	1,267	1,313
029	1,314	1,359
030	1,360	1,406
031	1,407	1,453
032	1,454	1,500
033	1,501	1,547
034	1,548	1,594
035	1,595	1,641
036	1,642	1,688
037	1,689	1,734
038	1,735	1,781
039	1,782	1,828
040	1,829	1,875
041	1,876	1,922
042	1,923	1,969
043	1,970	2,016
044	2,017	2,063
045	2,064	2,109
046	2,110	2,156
047	2,157	2,203
048	2,204	2,250
049	2,251	2,297
050	2,298	2,344
051	2,345	2,391
052	2,392	2,438
053	2,439	2,484
054	2,485	2,531
055	2,532	2,578
056	2,579	2,625
057	2,626	2,672
058	2,673	2,719
059	2,720	2,766
060	2,767	2,813
061	2,814	2,859
062	2,860	2,906
063	2,907	2,953
064	2,954	3,000

Class / bin [-]	Interval from: [mm]	Interval to: [mm]
065	3,001	3,047
066	3,048	3,094
067	3,095	3,141
068	3,142	3,188
069	3,189	3,234
070	3,235	3,281
071	3,282	3,328
072	3,329	3,375
073	3,376	3,422
074	3,423	3,469
075	3,470	3,516
076	3,517	3,563
077	3,564	3,609
078	3,610	3,656
079	3,657	3,703
080	3,704	3,750
081	3,751	3,797
082	3,798	3,844
083	3,845	3,891
084	3,892	3,938
085	3,939	3,984
086	3,985	4,031
087	4,032	4,078
088	4,079	4,125
089	4,126	4,172
090	4,173	4,219
091	4,220	4,266
092	4,267	4,313
093	4,314	4,359
094	4,360	4,406
095	4,407	4,453
096	4,454	4,500
097	4,501	4,547
098	4,548	4,594
099	4,595	4,641
100	4,642	4,688
101	4,689	4,734
102	4,735	4,781
103	4,782	4,828
104	4,829	4,875
105	4,876	4,922
106	4,923	4,969
107	4,970	5,016
108	5,017	5,063
109	5,064	5,109
110	5,110	5,156
111	5,157	5,203
112	5,204	5,250
113	5,251	5,297
114	5,298	5,344
115	5,345	5,391
116	5,392	5,438
117	5,439	5,484
118	5,485	5,531
119	5,532	5,578
120	5,579	5,625
121	5,626	5,672
122	5,673	5,719
123	5,720	5,766
124	5,767	5,813
125	5,814	5,859
126	5,860	5,906
127	5,907	5,953
128	5,954	6,000