3D STEREO Distrometer

Instruction for Use – Preliminary Draft Version

5.4120.xx.xxx

Dok. No. 021849/11/18

THE WORLD OF WEATHER DATA

Safety Instructions

- Before operating with or at the device/product, read through the operating instructions.
  This manual contains instructions which should be followed on mounting, start-up, and operation.
  A non-observance might cause:
  - failure of important functions
  - endangerment of persons by electrical or mechanical effect
  - damage to objects
- Mounting, electrical connection and wiring of the device/product must be carried out only by a qualified technician who is familiar with and observes the engineering regulations, provisions and standards applicable in each case.
- Repairs and maintenance may only be carried out by trained staff or **Adolf Thies GmbH & Co. KG**. Only components and spare parts supplied and/or recommended by **Adolf Thies GmbH & Co. KG** should be used for repairs.
- Electrical devices/products must be mounted and wired only in a voltage-free state.
- **Adolf Thies GmbH & Co KG** guarantees proper functioning of the device/products provided that no modifications have been made to the mechanics, electronics or software, and that the following points are observed:
- All information, warnings and instructions for use included in these operating instructions must be taken into account and observed as this is essential to ensure trouble-free operation and a safe condition of the measuring system / device / product.
- The device / product is designed for a specific application as described in these operating instructions.
- The device / product should be operated with the accessories and consumables supplied and/or recommended by **Adolf Thies GmbH & Co KG.**
- Recommendation: As it is possible that each measuring system / device / product may, under certain conditions, and in rare cases, may also output erroneous measuring values, it is recommended using redundant systems with plausibility checks for **security-relevant applications**.
- Infrared LED light source: IEC 62471:2006,modified EN 62471:2008 Lamp classification exempt group tested by VDE

GPL Code Statement

The software included in this device / product contains copyrighted software that is licensed under the GNU General Public License (“GPL”) or GNU Lesser General Public License (“LGPL”). For details see Page 38.

Environment

- As a longstanding manufacturer of sensors Adolf Thies GmbH & Co KG is committed to the objectives of environmental protection and is therefore willing to take back all supplied products governed by the provisions of "*ElektroG*" (German Electrical and Electronic Equipment Act) and to perform environmentally compatible disposal and recycling. We are prepared to take back all Thies products concerned free of charge if returned to Thies by our customers carriage-paid.

- Make sure you retain packaging for storage or transport of products. Should packaging however no longer be required, please arrange for recycling as the packaging materials are designed to be recycled.

Documentation

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- Although these operating instruction has been drawn up with due care, **Adolf Thies GmbH & Co KG** can accept no liability whatsoever for any technical and typographical errors or omissions in this document that might remain.
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- Subject to modification in terms of content.
- The device / product should not be passed on without the/these operating instructions.

Explanation of Symbols

- Warning for hot surface

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Scope of delivery

- **Instruction for use**

1 Models available

Designation	Order number	Euquipments
3D STEREO DISDROMETER	5.4120.00.000	RS 485/422; 24 V AC/DC; 25 W
3D STEREO DISDROMETER	5.4120.01.000	RS 485/422; 24 V AC/ DC ; 125 W
3D STEREO DISDROMETER	5.4120.10.000	RS 485/422; 85...264VAC 47...63HZ; 25 W
3D STEREO DISDROMETER	5.4120.11.000	RS 485/422; 115/230 V 50..60 HZ; 250 W

2 Application

The actual version of the 3D Disdrometer measures particles such as drizzle, rain, and hail.

In near future, it will be well-suited for the measurement and detection of precipitation such as snow, and mixed precipitation. Furthermore, it will identify non-hydrometeors. Due to its three dimensional particle detection, it will show a reduced error under windy conditions.

The acquisition will comprise the types of precipitation, intensity, and size-speed-distribution. All measuring values will available for the user via an Ethernet and RS 485 interface. In addition, the instrument will be equipped with two digital outputs, which indicate amount and state of precipitation.

Instruments with „optional measuring channels" will be able to connect temperature, relative humidity, wind speed, and wind direction sensors. These values will also be available via the RS 485 interface and Ethernet connection. For sites with rough climates, a version with "extended heating" will be available.

Various ways for data output:

- Ethernet
- RS485
- Stored on an internal SD card

The instrument is especially suited for application in the fields of

- Meteorology
- Climatology
- Regenerative energy, wind power plants
- Traffic engineering, aviation and navigation
- Hydrology

3 Mode of operation

3.1 General principle

The instrument consists of a light source and a stereo camera. Particles pass through the measurement volume defined by the viewing angles of the cameras as well as minimum and maximum distance from the cameras.

All particles cause extinction of the light seen by the cameras. Particle sizes are deduced from the area seen by the cameras and their position within the measurement volume. Particle speeds are deduced from the movement of the particle during a predefined time. Liquid clear particles image the light source and its surrounding. Opaque particle just lead to extinction of light. This will allow distinction between rain, snow, hail, graupel, seeds and insects.

4 Preparation for operation

4.1 Installation

4.1.1 Installation site requirements

Depending on the wind speed and wind direction the precipitation particles are swirled by the 3D Disdrometer so that the fall speed is changed. This might cause a deterioration of the sensor quality. Therefore, you should avoid an installation in the open country (particularly mountain tops) or directly in the lee of an obstacle. Well-suited are flat locations with wind breaks (e.g. hedges).

According to the WMO-directive for precipitation measuring instruments the distance between the installed sensors and the next obstacle should be at least four times the height of this obstacle.
If this is not practicable, at least keep an azimuth angle of < 45° with regard to the surrounding plants, buildings etc. Logically consistent would be also to mount the sensor on a mast top. We recommend a measuring height of at least 1 m or rather 1.5 to 2 m in snowy sites. Other devices should be mounted with a distance of at least 1 m on the same mast. The side distance to other objects should be greater than 2 m.

It is not advisable to install the 3D Disdrometer directly on a street, because it is, for example, possible that water particles, whirled up by the vehicles, might lead to erroneous measurements. In this case, we recommend installing the instrument with a respective distance and height.

4.1.2 Mounting on Mast

The delivered mast holder of the 3D Disdrometer is designed for a mast diameter of 48... 102 mm (1.9... 4 inch). The mast should be electro-conductive, and be connected to the ground potential (foundation/grounding bound).Otherwise, the sensor is to be connected to the ground potential by a cable with minimum 6mm² diameter.

Remark: For models with supply 115 VAC / 230 VAC

The mast should be electro-conductive, and be connected with the ground potential (base/ground strip).Apart from that the sensor is to be connected to the ground potential by means of a cable (> 6mm²).

4.1.3 Mounting Angle

First, the mounting angle should be fastened at the mast. Because of the shading effect of the mast the angle should to be mounted at the highest possible place. Align the angle to the north acc. to **Figure 2** (± 1°, Northern hemisphere), and fasten it at the top of the mast. It is advisable to have a second person holding the Disdrometer during the mounting.

Does only apply to the models with supply 115 VAC / 230 VAC:

In case an electro-conductive mast is used, the straps should be fastened directly, i.e. without insulator. If the mast is not electro-conductive, a potential equalization should be established between ambiance (for ex. fundament) and sensor by means of a cable (> 6 mm²).

1. Cut 2 pieces of the necessary length off the strap (1 meter) acc. to the table below.

   Note: The cut surfaces could after cutting have sharp edges. Risk of injury.
2. Insert the strap into the housing from the screw head side, and bend a projection of 20 mm over the ridge **(Figure 1).**
3. Put the free end of the prepared clamp around the mast and the mounting angle, and screw it on **(Figure 2).**
4. 2 Straps are provided for each mounting angle.

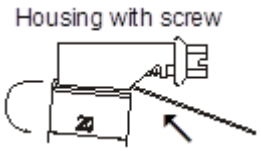
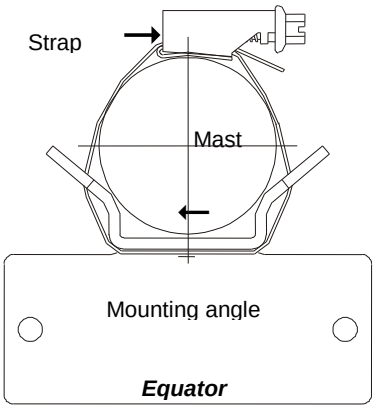


Figure 1: Strap housing



Mast Ø	Mast Ø	Length strap
48 mm	1.9 inch	250 mm (10 inch)
60 mm	2.4 inch	310 mm (12.2 inch)
80 mm	3.2 inch	370 mm (14.6 inch)
90 mm	3.5 inch	400 mm (15.8 inch)
102 mm	4 inch	440 mm (17.3 inch)

Figure 2: Strap, Mast, Mounting angle

4.1.4 Electrical Installation

Attention:

The instrument must be mounted and wired only by a qualified expert, who knows and observes the generalities of technics, and applicable regulations and norms.

4.1.5 Electrical installation with cable glands

In order to carry out an EMC-compatible installation the cable screen/shielding (except the supply cable, which, in general, is not shielded) is to be connected to the contact spring of the screwed cable gland **(Figure 3).**

1. With the Standard Contacting (see Figure 3.1)

- Strip back the outer sheath and screen (shielding)
- Make a round cut in the outer sheath approx. 15 mm along but do not remove the sheath
- Guide the cable through the cable gland
- Pull off the outer sheath
- Pull back the cable until the connection is made between the cable screen and contact spring
- Turn shut… and it is ready for use!

2. With thin Wires without an Inner Sheath (see Figure 3.2)

- Strip back the outer sheath
- Pull back the screen braid approx. 15-20 mm over the outer sheath
- Insert the cables into the cable gland until the contact is made between the cable screen and contact spring
- Turn shut ….and it is ready for use!

3. When Routing the Cable Screen to another Connection (see Figure 3.3)

- Expose the screen braid approx. 10 mm
- Guide the cable through the cable gland until the connection is made between the cable screen and contact spring
- Turn shut…and it is ready for use!

-

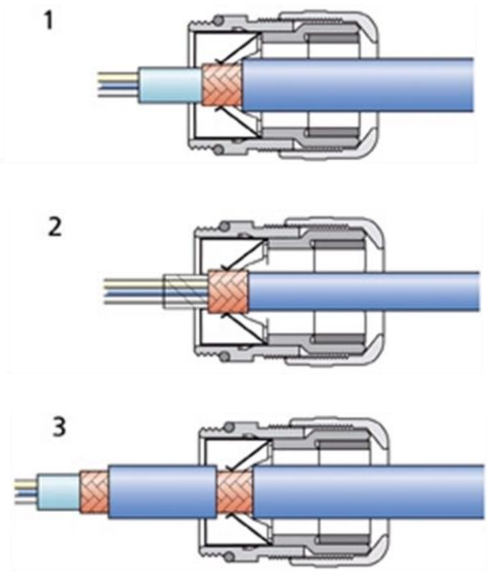


Figure 3: Screen cable connection to the cable gland

After all connections have been established the supply can be switched on:

NOTE:
All supply voltages must be potential-free (exception 115 / 230 VAC).
For example, with the 24 VAC power supply there must be used a separate winding of the transformer only for this sensor. In addition, we recommend to provide for a separator in the installation (for example switch or fuse), and to mark this.

When the instrument operates properly the cover should be fastened and the instrument can be configured now.

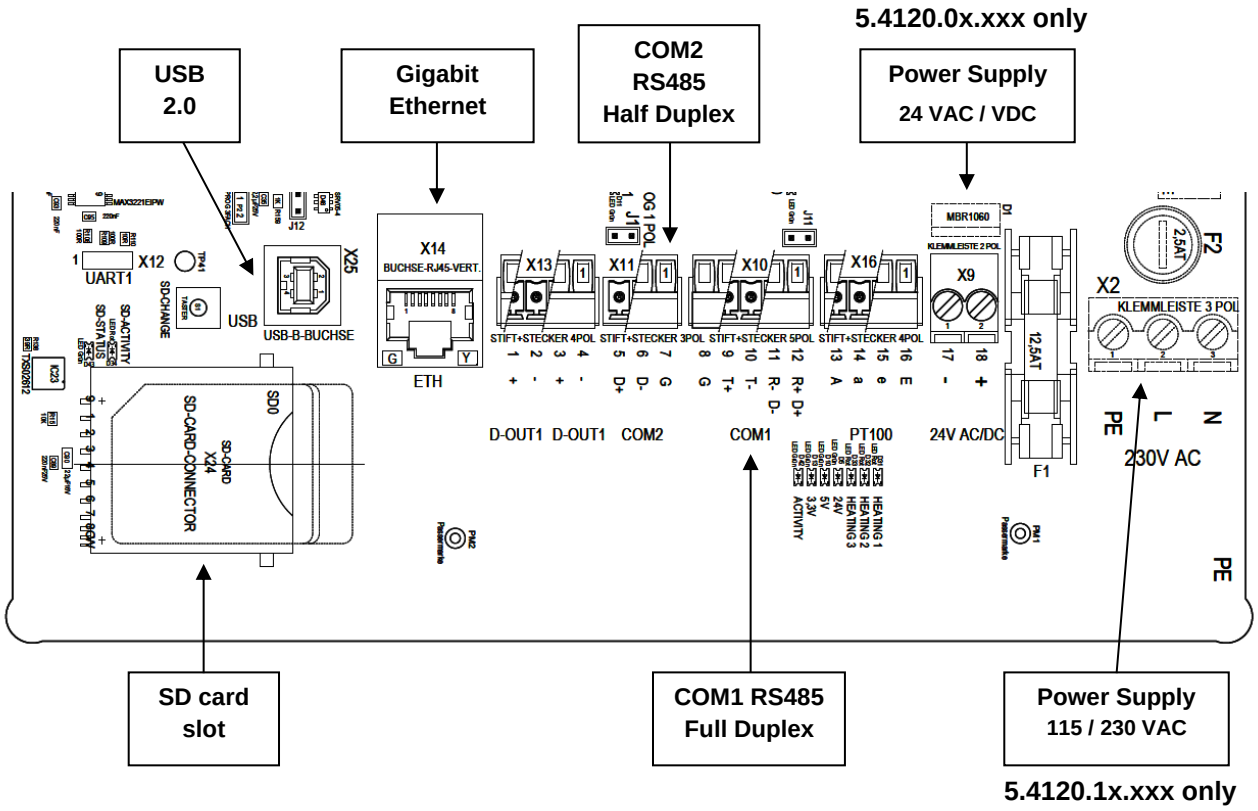


Figure 4: Interface diagram

4.1 System configuration

The system is pre-configured for plug-and-play use. It is equipped with a variety of interfaces like Ethernet, USB, RS485 and a SD card slot. The measured data can be stored on the SD card or transmitted via the serial interfaces.

4.1.6 Connect to the system

The system has an embedded Linux running. The system can be accessed by the user with Secure Shell (SSH), Secure Copy (SCP) or Secure File Transfer Protocol (SFTP). The Linux command line terminal can be accessed with a SSH connection via Ethernet or a standard terminal connection via UART1. The default network settings for the Ethernet connection are preconfigured at factory and can be changed via a script file by the user (see section 4.1.7).

Default (factory) Ethernet network setting[1]:

- IP address: 10.0.0.2
- IP netmask: 255.255.255.0

Connect a PC to the system using Ethernet. Then adjust the network settings of the PC to the network settings. It is important to adjust the netmask as well as a corresponding IP address for the PC to match the system settings (e.g. IP address 10.0.0.10 and netmask 255.255.255.0 when system has factory settings).

Then the user can access the system with SSH, SFTP, SCP or Telnet. For this purpose there exist clients like WinSCP or PuTTY.

There is one login account pre-configured for accesses by the setup user. The setup user is like an administrator with restricted access to configure the system at the customer site. The setup user can additionally create other user accounts with restricted access to the generated telegram data of the system. The predefined setup user account is:

Login: setup

Password: YucQ7RRe

The password can be changed by the setup user itself in the group and user configuration files (see section #).

4.1.7 Change network settings

The network settings (i.e. IP address, netmask and gateway) can be changed by the setup user in the configuration file “static_ip.conf”. Here is the default file content:

```
# Static IP configuration file
#
# Uncomment and change the following lines to setup static IP configuration
#
#IP 10.0.0.10   255.255.255.0
#GATEWAY 10.0.0.1
```

For a dynamic IP address assignment with the Dynamic Host Configuration Protocol (DHCP) the line of text starting with “IP” has to be replaced (comment out) with “#IP”. For the assignment of a static IP address the comment character has to be removed from this line. In

[1] unless otherwise specified

the same way, a standard gateway address can be specified with the “GATEWAY” line if required.

Here are the steps to change these settings:

1. Start the system (power on)
2. Wait until system has started (takes about 15 seconds)
3. Connect a PC to the system (see 4.1.6)
4. Use SSH to login to the system with user name and password (see 4.1.6)
5. Open the configuration file “*/media/setup/static_ip.conf*” for editing, for example with “*vi*” text editor
6. Change the “IP” line to specify the IP address and netmask accordingly
7. (Optionally change the “GATEWAY” line to specify the default gateway IP address)
8. Save the file
9. Restart the system with command “reboot”

4.1.8 Manage user accounts

tbd

4.1.9 Set system time

1. Start the system (power on)
2. Wait until system has started (takes about 15 seconds)
3. Connect a PC to the system (see 3.2.1)
4. Use SSH to login to the system with user name and password (see 3.2.1)
5. Set system time with “*date –s YYYY.MM.DD-hh:mm:ss”*
6. Set real time clock to system time with “*hwclock --systohc -f /dev/rtc0*“

4.2 Updating the 3D Disdrometer

There are two kinds of updates:

1. Update of the operating system
2. Update of the program and system settings

4.2.1 Updating the 3D operating system

The operating system is delivered as an installation package file named “*os_install_package_YYYY_MM_DD.tar.gz*”.

1. Start the system (power on)
2. Wait until system has started (takes about 15 seconds)
3. Connect a PC to the system (see 3.2.1)
4. Use SFTP or SCP with user name and password (see 3.2.1) to copy the installation package file to the directory “*/media/setup/*”
5. Use SSH to login to the system with user name and password (see 3.2.1)

6. Extract the installation package file:

- Change to install package directory:
  - "*cd /media/setup/*"
- Verify install package integrity:
  - "*md5sum –c os_install_package_YYYY_MM_DD.tar.gz.md5*"

  If the program outputs "*os_install_package_YYYY_MM_DD.tar.gz: OK*", then you can continue with next step. Otherwise, repeat the copying of the installation package file.
- Extract installation package archive:
  - "*tar –xvzf os_install_package_YYYY_MM_DD.tar.gz*"

  After this step, the files "*BOOT.BIN*" and "*image.ub*" should be present in the current directory.

7. Apply the update file BOOT.BIN:

- Programming of the file "*BOOT.BIN*".

```
@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@
@@
@@ Please do NOT abort this process or power of the
@@
@@ System until the command has finished!!!
@@
@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@
@@
@@ Otherwise, the system is destroyed and makes a repair
@@
@@ necessary!!!
@@
@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@
@@
```

  - "*flashcp –v BOOT.BIN /dev/mtd0*"

  If the program outputs "Verify data: … (100%)" then you can continue with next step. Otherwise, try to repeat the command. If this does not work, there is probably a system defect!

8. Apply the update file image.ub:

- Copy the file "*image.ub*" to the system directory:
  - "*mv –f image.ub /media/system/*"

9. Restart the system with "reboot"

10. Wait until system has started (takes about 15 seconds)

11. Use SSH to login to the system with user name and password (see 3.2.1)

12. Check operating system version information:

- "*uname – a*"

  The operating system date should correspond to the date (YYYY_MM_DD) of the installation package.

13. Removing the old files:
    - "*rm os_install_package_YYYY_MM_DD.tar.gz**"
    - *"rm BOOT.BIN"*
    - *"rm image.ub"*

4.2.2 Update of the program and system settings

The program and / or system settings are delivered as an installation package file named "*install_package_YYYY_MM_DD.tar.gz*".

1. Start the system (power on)
2. Wait until system has started (takes about 15 seconds)
3. Connect a PC to the system (see 3.2.1)
4. Use SFTP or SCP with user name and password (see 3.2.1) to copy the installation package file to the directory "*/media/setup/*"
5. Use SSH to login to the system with user name and password (see 3.2.1)
6. Extract the installation package file:
   - Change to install package directory:
     - "*cd /media/setup/*"
   - Verify install package integrity:
     - "*md5sum –c install_package_YYYY_MM_DD.tar.gz.md5*"

     If the program outputs "*install_package_YYYY_MM_DD.tar.gz: OK*", then you can continue with next step. Otherwise, repeat the copying of the installation package file.
   - Extract installation package archive:
     - "*tar –xvzf install_package_YYYY_MM_DD.tar.gz*"

     After this step, the files "*config.bin*" and / or "*3d_disdro_app.elf*" should be present in the current directory.
7. Apply the program update if present:

   If the update contains a program update, then the file "*3d_disdro_app.elf*" should be present and must be copied:
   - Copy the file "3d_disdro_app.elf" to the system application directory:
     - "*mv –f* 3d_disdro_app.elf */media/setup/system/*"
   - Removing the old files:
     - "*rm 3d_disdro_app.elf*
8. Apply the system settings update if present:

   If the update contains a system settings update, then the file "config*.bin*" should be present and must be copied:

- Copy the file “config.*bin*” to the system application directory:
  - “*mv –f* config.*bin* */media/setup/system/*“
- Removing the old files:
  - “*rm* config.*bin*

9. Restart the system with ”reboot”
10. Wait until system has started (takes about 15 seconds)

5 Running the system

5.1 Starting the system

The system automatically mounts the SD card and starts the measurement software as a background process. The SD card is elementary needed for storage of information evaluated by the measurement software. The following file systems for the SD card are accepted:

- FAT32
- ext2

Where and which information is written to the SD card is described in section 0

All status and error messages in the normal operation are stored in a logging file on the SD card (see section 5.5). Additionally when the measurement software starts all corresponding status and error messages are redirected to an output text file in the home directory. This file is necessary to solve start problems of the measurement software due to hardware or configuration errors file (see section 4.1). The folder and name convention[2] is the following:

- Folder: /media/setup/
- File name: 3d_disdro_output.txt

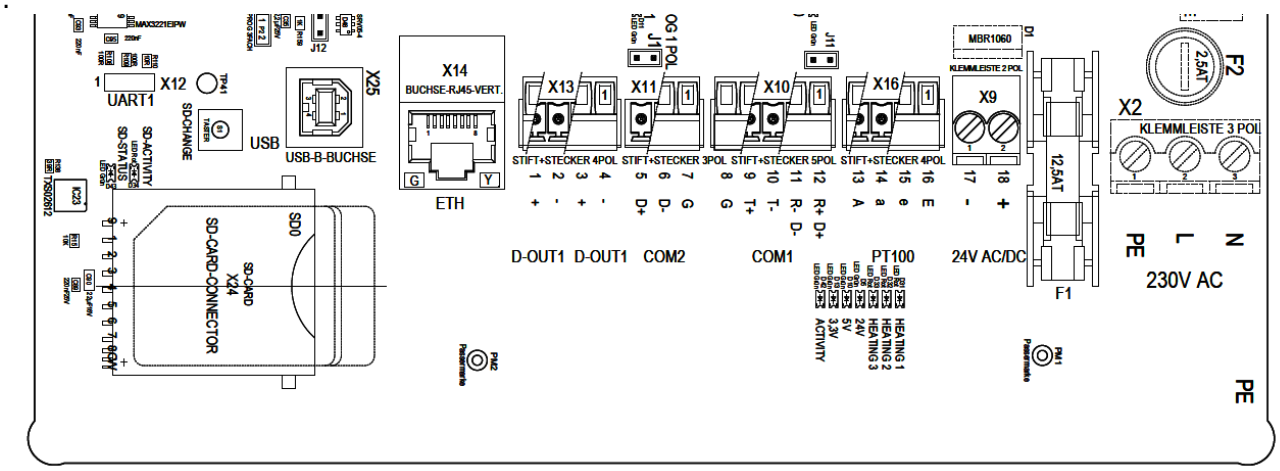
In the case of start-up problems of the measurement software due to errors in the configuration file, e.g. after a change of settings by the user, the output file gives information to solve the problem. The only way to check the configuration file is to restart the system with the command “*reboot*”. If there are any more errors you must repeat the check and restart process.

This process will be simplified in future versions.

5.2 System status LEDs

The system has some status LEDs. These show the status of the operating voltages, SD card and the current operating state of the 3D Disdrometer.

[2] YYYY – placeholder for year, MM – placeholder for month, DD – placeholder for day



5.3 Shut down (stop) the system

Before the device can be switched off, it should be shut down. Currently this can only be done per command line with a SSH connection. Connect to the system via SSH (see 3.2.1) and issue the command "*poweroff*". Then it takes about 30 seconds for the system to shut down the linux system. When no SSH connection can be established the system is robust enough to be switched off directly.

In the future, the system can be shut down by pressing button S1 for more than 10 seconds.

5.4 Using the SD card

The SD card is used to store day logging files and optionally measurement data (telegrams). This can be configured with the user configuration settings (see section 5.7). The status of the SD card interface is indicated by two LEDs on the board, next to the SD card slot (see Figure 4). The red LED (named SD-ACTIVITY) blinks when the system accesses the SD card. The green LED (named SD-STATUS) is active when a valid SD card was detected and is in use by the system.

WHEN THE SD-STATUS LED IS ON (IN USE BY THE SYSTEM) THE SD CARD SHOULD NOT BE REMOVED! THE STEPS TO SAFELY REMOVE A SD CARD IS DESCRIBED BELOW.

When the system starts it checks if a valid SD card is inside the slot. If a SD card is inside, it will be activated and the SD-STATUS LED lights up. If not, the LED will be dark. In both cases the measurement process will start normally. If configured, measurement data will be stored on the SD card if present.

If no SD card is present, the data is lost but this is NOT handled by the system as an error condition. It is possible to insert or remove a SD card when the system is running. The insertion is strait forward. When the system detects an SD card with a supported file system (FAT or ext2), it will be automatically mounted and used by the system. Then the SD-STATUS LED light up.

When an active SD card should be removed, it must be deactivated by an ejection request. To do so, press the button SD-CHANGE near the SD card slot (see Figure 4) until the SD-STATUS LED starts blinking fast. Then release the button. The LED starts

to blink slower and the system waits until the SD card is removed. Then the LED turns off. All other (not SD card based) measurements will continue.

5.5 Measurement software logging

At the start of the system and during the normal operation the measurement software writes status and error messages to a logging file. Every day a new log file is created. The folder and name convention is the following:

- Folder: /media/sd/YYYY/MM/
- File name: YYYYMMDD.log

In normal operation without errors there are only a few status and information messages per minute.

5.6 Basic functions of the operating system

The Linux distribution is based on PetaLinux 2015.4 from Xilinx and many standard Linux commands and programs are available:

- Busybox
- vi-Editor

poweroff	Shutdown the system to turn power off
reboot	Reboot the system
ls	See directory entry
top	Enter task manager
cp, mv, rm	Copy, move, remove files
mkdir	Create directory
cd <directory>, cd ..	Change to <directory>, to parent directory
vi	Text editor
flashcp	Apply update file BOOT.BIN

Table 1: Important linux shell commands

See the following webpage for introductions to linux shell:

http://www.cyberciti.biz/tips/linux-unix-commands-cheat-sheets.html

5.7 Change user configuration settings

The user configuration settings allow the user to change and parameterize the measurement system. The corresponding parameters are grouped in sections and stored in an Extensible Markup Language (XML) file ("*user_config.xml*") in the setup directory ("*/media/setup/*").

There a two basic classes of sections, system configuration and telegram configuration. The system configuration sections allow the user to change special measurement behavior and the system location information. The telegram configuration configures the formats and output interfaces of the measurement result data generated by the system. For more information see the detailed sections bellow.

The configuration file is loaded and applied ONLY when the program starts/restarts. While the configuration file is loaded, the syntax and validity of the parameters and values is checked. If the file contains errors, the program is terminated and gives appropriate error messages in the log file (see section 5.1).

5.7.1 User system configuration

The system configuration sections allow the user to specify system location information and special setup of the measurement system. Currently only the information part is available. The default system configuration section looks as follows

```
<System>
  <Configuration>
    <Info>
      <location_string>""</location_string>
      <latitude_string>""</latitude_string>
      <longitude_string>""</longitude_string>
      <altitude_float>100.0</altitude_float>
      <direction_float>0.0</direction_float>    </Info>
    <Setup>
    </Setup>
  </Configuration>
</System>
```

The system configuration sections allow the user to specify system location information and special measurement configuration settings.

Parameter	Decrisption
`Info`	System location (place) information settings
`location_string`	String which describes the location (place) of the system. This string should be included in the telegram data in future releases as an additional information part. For example: "Munich"
`latitude_string`	String which describes the geographic coordinate of latitude of the system location. This string should be included in the telegram data in future releases as an additional information part. For example: "48_8'13.94N"

longitude_string	String, der die geographische Länge des Systemstandorts beschreibt. Dieser String wird in zukünftigen Versionen in den Telegrammdaten als Zusatzinformation enthalten sein. Zum Beispiel: „11_34'31.98O“
altitude_float	Floating point number of the system location altitude in meters. This value is used for measurement calculation. For example: 100.0 → System location with an altitude of 100 meters.
Setup	Measurement configuration settings Used in future versions

5.7.2 Summarizing (standard) telegram

No longer supported! It was replaced by new standard 3D Disdrometer output telegram (TDD).

See section 5.7.3 for more details.

5.7.3 3D Disdrometer (standard) telegram

For a detailed description of the telegram see section 6.1.2.

The default configuration section (factory setting) is telegram output via RS485 serial communication interface COM1 (see Figure 4) at 9600 baud:

```
<TddTelegram>
  <Configuration>
    <Setup>
      <telegram_enabled>1</telegram_enabled>
      <telegram_interval>60</telegram_interval>
      <telegram_1>
        <identifier>1</identifier>
        <ports>com</ports>
        <dsd_cfg>
          <diameter_cfg>
            <x_start_class_width>1</x_start_class_width>
            <x_start_class_index>0</x_start_class_index>
            <x_doubling_index_delta>5</x_doubling_index_delta>
            <x_num_classes>22</x_num_classes>
          </diameter_cfg>
          <velocity_cfg>
            <x_start_class_width>2</x_start_class_width>
            <x_start_class_index>0</x_start_class_index>
```

```
            <x_doubling_index_delta>4</x_doubling_index_delta>
            <x_num_classes>20</x_num_classes>
          </velocity_cfg>
        </dsd_cfg>
        <com_settings>
          <port>1</port>
          <baudrate>9600</baudrate>
        </com_settings>
      </telegram_1>
    </Setup>
  </Configuration>
</TddTelegram >
```

An example configuration section for telegram output to file looks as follows:

```
<TddTelegram>
  <Configuration>
    <Setup>
      <telegram_enabled>0</telegram_enabled>
      <telegram_interval>60</telegram_interval>
      <telegram_1>
        <identifier>1</identifier>
        <ports>file</ports>
        < dsd_cfg>
          <diameter_cfg>
            <x_start_class_width>1</x_start_class_width>
            <x_start_class_index>0</x_start_class_index>
            <x_doubling_index_delta>5</x_doubling_index_delta>
            <x_num_classes>22</x_num_classes>
          </diameter_cfg>
          <velocity_cfg>
            <x_start_class_width>2</x_start_class_width>
            <x_start_class_index>0</x_start_class_index>
            <x_doubling_index_delta>4</x_doubling_index_delta>
            <x_num_classes>20</x_num_classes>
```

```
          </velocity_cfg>
        </ dsd_cfg>
      </telegram_1>
    </Setup>
  </Configuration>
</TddTelegram >
```

Parameter	Description
telegram_enabled	Enables or disables the summarizing telegram. Value Description 0 Disabled 1 Enabled
telegram_interval	Specifies the telegram interval time in seconds. When the interval has elapsed, a new telegram file is created. The interval is applied to all selected telegram ports.
telegram_1	Telegram output configuration section 1. This section encapsulated all parameters for the first telegram output writer. The standard telegram can have one or more telegram output configurations. For each output configuration the output destination and telegram data format can be specified. However, the default use case will be the use of a single output configuration.
identifier	Specifies the telegram output identifier for this telegram output section (telegram_1).
ports	Specifies the output port for this telegram output section (telegram_1). An output port can be a file OR a serial connection. Only ONE output port can be specified. For multiple output ports please use several telegram output configurations (telegram_2 and so on). The configuration parameter should be ONE of the following types. **Type:** *file* **Description:** Create one telegram file per telegram interval. The telegram files are sorted by year, month and day in a structured directory tree. This directory tree and telegram files are created inside the SD card mount point /media/sd/. **Type:** *com* **Description:** Sends one telegram over serial communication port COMx per telegram interval. The serial communication parameters can be changed with com_settings.

	Only ONE serial communication port can be used with ONE telegram. It is NOT possible to output multiple telegrams on ONE serial communication port! **If a serial communication port is to be set for serveral telegrams, the measurement software will report an error and NOT start any measurements!**
com_settings	Specifies the parameters for serial connection output port. **This section is ignored when telegram_ports is NOT set to "com"!** **Paramter:** *port* **Description:** Specifies the serial communication port number for the telegram data. That is: **1 → COM1**, 2 → COM2 **Parameter:** baudrate **Description:** Specifies the baud rate for the serial communication port. This can be standard communication rates like **9600**, …, 115200. The data configuration is always 8 bit with one stop bit and no parity.
dsd_cfg	Particle spectrum configuration section. This section encapsulated all parameters for the particle spectrum output (distribution of the particles over the diameter and speed class binning) for this telegram output section (telegram_1).
enabled	Enables or disables the particle spectrum in the telegram output. Values Description 0 Disabled 1 Enabled
diameter_cfg	Specifies the parameters for the diameter classes of the particle spectrum configuration for this telegram output section (telegram_1). The diameter classes were defined by start class width (x_start_class_width), start class index (x_start_class_index), class width doubling index delta (x_doubling_index_delta) and the number of classes (x_num_classes). The bin width can be increased for subsequent (greater) bins. **The max. value for diameter is 40 mm. Every class limits will be clipped at this value!** For details see the corresponding parameters. Example:

	`x_start_class_width:` 2 `x_start_class_index:` 1 `x_doubling_index_delta:` 5 `x_num_classes:` 26 results in the following diameter class binning: Start class width = x_start_class_width * 0.1 mm = 0.2 mm First lower limit = x_start_class_index * Start class width = 0.2 mm Class width(index) = $\text{Start class width} * 2^{\left\lfloor \frac{index}{x\_doubling\_index\_delta} \right\rfloor}$ with $\lfloor x \rfloor := max\{k \in \mathbb{Z} \mid k \leq x\}$, $\mathbb{Z}$ is the set of integer numbers Example: $\lfloor 1.3 \rfloor = 1, \lfloor 0.9 \rfloor = 0,\ \lfloor 2.5 \rfloor = 2, \lfloor 3.7 \rfloor = 3, \ldots\ etc.$

Index	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Lower limit (mm)	0,2	0,4	0,6	0,8	1,0	1,2	1,6	2,0	2,4	2,8	3,2	4,0	4,8	5,6	6,4
Class width (mm)	0,2					0,4					0,8				
Index	15	16	17	18	19	20	21	22	23	24	25				
Lower limit (mm)	7,2	8,8	10,4	12,0	13,4	15,2	18,4	21,6	24,8	28,0	31,2				
Class width (mm)	1,6					3,2					6,4				

`x_start_class_width`	Specifies the start width of the first diameter class bin. The width is specified as a factor of the minimal class bin width, which is **0.1 mm**. Therefore a value of 2 will result in a start class width of 0.2 mm. The minimal value for start width is 1. The term “start class width” results from the fact that the class bin width is increased by a factor of two at a fixed interval (see x_doubling_index_delta).
`x_start_class_index`	Specifies the start diameter class bin at which the spectrum will begin. All diameters smaller than this class will belong to this bin. The minimal value for start diameter class bin is 1
`x_doubling_index_delta`	Specifies the number of classes before doubling the class width.

	0 ➔ disables class width doubling, equal class width for all classes. 1 ➔ doubled class width from class to class 2 ➔ doubled class width every second class etc.
`x_num_classes`	Specifies the total number of diameter classes
`velocity_cfg`	Specifies the parameters for the velocity classes of the particle spectrum configuration for this telegram output section (telegram_1). The velocity classes were defined by start class width (x_start_class_width), start class index (x_start_class_index), class width doubling index delta (x_doubling_index_delta) and the number of classes (x_num_classes). The bin width can be increased for subsequent (greater) bins. **The max. value for velocity is 20 m/s. Every class limits will be clipped at this value!** For details see the corresponding parameters: Example: `x_start_class_width:` 2 `x_start_class_index:` 1 `x_doubling_index_delta:` 4 `x_num_classes:` 20 results in the following velocity class binning: Start class width = x_start_class_width * 0.1 m/s = 0.2 m/s First lower limit = x_start_class_index * Start class width = 0.0 m/s Class width(index) = $\text{Start class width} * 2^{\left\lfloor \frac{index}{x\_doubling\_index\_delta} \right\rfloor}$ with $\lfloor x \rfloor := max\{k \in \mathbb{Z} \mid k \leq x\}$, $\mathbb{Z}$ is the set of integer numbers Example: $\lfloor 1.3 \rfloor = 1, \lfloor 0.9 \rfloor = 0,\ \lfloor 2.5 \rfloor = 2, \lfloor 3.7 \rfloor = 3, \ldots\ etc.$

Index	0	1	2	3	4	5	6	7	8	9	10	11
Lower limit (m/s)	0,0	0,2	0,4	0,6	1,0	1,4	1,8	2,2	2,6	3,4	4,2	5,0

Class width (m/s)	0,2				0,4			0,8
Index	12	13	14	15	16	17	18	19
Lower limit (m/s)	5,8	7,4	9,0	10,6	12,2	15,4	18,6	20,0[3]
Class width (m/s)	1,6				3,2			

`x_start_class_width`	Specifies the start width of the first velocity class bin. The width is specified as a factor of the minimal class bin width, which is **0.1 m/s**. Therefore a value of 2 will result in a start class width of 0.2 m/s. The minimal value for start width is 1. The term “start class width” results from the fact that the class bin width is increased by a factor of two at a fixed interval (see x_doubling_index_delta).
`x_start_class_index`	Specifies the start velocity class bin at which the spectrum will begin. All velocity smaller than this class will belong to this bin. The minimal value for start diameter class bin is 1
`x_doubling_index_delta`	Specifies the number of classes before doubling of the class width. 0 ➔ disables class width doubling, equal class width for all classes. 1 ➔ doubled class width from class to class 2 ➔ doubled class width every second class etc.
`x_num_classes`	Specifies the total number of velocity classes

5.7.4 LNM compatible telegram

For a detailed description of the telegram see section 6.4.1.

The complete default configuration section for the telegram looks as follows:

```
<LnmTelegram>
```

[3] - Der theoretische Wert für Klasse 19 ist 21,8 m/s, dieser wird jedoch auf den max. Wert von 20 m/s begrenzt!

```
  <Configuration>
    <Setup>
      <telegram_enabled>1</telegram_enabled>
      <telegram_interval>60</telegram_interval>
      <telegram_ports>com</telegram_ports>
      <com_settings>
        <port>1</port>
        <baudrate>9600</baudrate>
      </com_settings>
    </Setup>
  </Configuration>
</LnmTelegram>
```

Parameter	Description
telegram_enabled	Enables or disables the summarizing telegram. Value Description 0 Disabled 1 Enabled

telegram_interval	Specifies the telegram interval time in seconds. When the interval has elapsed, a new telegram file is created. The interval is applied to all selected telegram ports. **The default value is 60 seconds. For THIES LNM View software compatibility the interval SHOULD NOT be changed!**
telegram_ports	Specifies one or more telegram output ports. An output port can be a file or a serial connection. The configuration parameter should be at least one of the following types. **Typen:** *file* **Description:** Create one telegram file per telegram interval. The telegram files are sorted by year, month and day in a structured directory tree. This directory tree and telegram files are created inside the SD card mount point /media/sd/. **Typen:** *com* **Description:** Sends one telegram over serial communication port COMx per telegram interval. The serial communication parameters can be changed with com_settings.

	Only ONE serial communication port can be used with ONE telegram. It is NOT possible to output multiple telegrams on ONE serial communication port! **If a serial communication port is to be set for serveral telegrams, the measurement software will report an error and NOT start any measurements!**
com_settings	Specifies the parameters for serial connection output port. **This section is ignored when telegram_ports is NOT set to "com"!** **Parmeter:** *port* **Description:** Specifies the serial communication port number for the telegram data. That is: 1 → COM1, 2 → COM2 **Parameter:** *baudrate* **Description:** Specifies the baud rate for the serial communication port. This can be standard communication rates like 9600, …, 115200.

6 Data telegrams

6.1.1 Image data

Configurable measurement volume image capturing is a planned feature and not yet available!

6.1.2 3D Disdrometer standard telegram

The standard telegram contains precipitation information and optional particle spectrum information for a fixed time interval. Depending on the configuration, the telegram data is stored as file on SD card and / or transmitted on a serial communication port. By default one telegram is stored on SD coard or sent via serial communication port every minute without request of receiver.

The folder and name convention is the following:

- Folder: /media/sd/*YYYY/MM/DD/hh*/
- File name: *YYYYMMDDThhmmss*tdd.dat
- T : separator

6.2 General format description

- Data delimiter is semicolon, comma or space

- Checksum delimiter is asterisk
- Variable length telegram marking with question mark, „NAN“, „-INF“ or „+INF“
- End of line with CRLF

6.3 File output specific

- Two additional lines prior the data lines with extra informations for data import in Microsoft Excel™:
    - Head line 1: Column headings
    - Head line 2: Column units
    - Data lines (see description below)

6.4 Data line format

- Startzeichen „$“ (NMEA kompatibel, kein Trennzeichen zur folgenden Kennung)
- Kennung „3DD“
- Länge des gesamten Datentelegrammes (inkl. CRLF)
- Telegrammversion (hier: 1)
- ID (2Stellen), Seriennummer etc.
- Zeitstempel, Messdauer[s: 10,15,20,30, min: 1,2,3,4,5,6,10], Diagnosedaten, Fehler-/Warnmeldungen etc.

Ausgabe Diagnosedate und Fehler/Warnmeldungen (falls konfiguriert)

- Start-Kennung: „DIA0“
- Daten tbd.

Ausgabe Partikelspektrum (falls konfiguriert):

- Start-Kennung: „DSD0“
- Durchmesser-Klassen Beschreibung (Meßbereich: 0.1 ... 40mm t.b.d.):
    1. Dia-Start-Breite [0.2mm]
    2. Dia-Beginn-Klasse [0 .... n] 2 ---→ 1.Klasse beginnt mit 2 * Dia-Start-Breite
    3. Dia-Breite-Verdoppelung [0 ... n]
    4. Dia-Anzahl

- Geschwindigkeits-Klassen Beschreibung (Mb.: 0.1 ... 20 m/s t.b.d.)
    1. Vel-Start-Breite [0.2 m/s]
    2. Vel-Beginn-Klasse [0 .... n] 2 ---→ 1.Klasse beginnt mit 2 * Dia-Start-Breite
    3. Vel-Breite-Verdoppelung [0 ... n]
    4. Vel-Anzahl

- Ausgabe der DSD-Daten normiert [mm^{-1} m^{-3}] als Floatingpoint-Ausgabe:

- Dia[0], Vel[0]
- Dia[0], Vel[1]
- Etc. .....

- Dia[0], Vel[Vel-Anzahl - 1]
- Dia[1], Vel[0]
-
- Etc. .....
-
- Dia[Dia-Anzahl – 1], Vel[Vel-Anzahl - 1]

Ende:

- NMEA-Checksum („*xx“)
  Berechnung entsprechend NMEA 0183
  (Init:0 XOR Verknüpfung über alle Zeichen, exklusive Startzeichen „$“ und „*“ und folgende Zeichen, Ausgabe Hex mit 2 Zeichen)
- CRLF Endekennung CSV-Datei

6.4.1 LNM compatible telegram

The LNM compatible telegram contains precipitation information and diameter speed distribution according to LNM telegram 5 (5.4110.xx.xxx). .By default, a telegram file is generated and one telegram sent via serial communication port COM1 every minute.

This telegram can be visualized with the LNM View software (9.1700.99.000). This can be accomplished in two ways:

- Offline → Import telegram files from SD card with LNM View File converter
- Online→Setup 3D Disdrometer as physical LNM device with serial connection in LNM View software

For a detailed description of the necessary steps see the instructions for use of LNM View.

The LNM compatible telegram is only a subset of the LNM telegram 5. Especially the telegram is ONLY controllable via configuration file. There is no implemented command interpreter.

The following table shows the differences between the telegrams:

No.	Column	Len	Description LNM	Description 3D-Disdrometer
1	1	1	STX (start identifier)	
2	2-3	2	Device address (factory setting „00“) (NN)	unused
3	5-8	4	Serial number (NNNN)	unused
4	10-13	5	Software-Version (N.NN)	“2.03” (for compatibility reasons)
5	15-22	8	Date of the sensor (tt.mm.jj)	Date of the sensor (tt.mm.jj)

6	24-31	8	Time of the sensor (on request) (hh:mm:ss)	Time of the sensor (on request) (hh:mm:ss)
7	33-34	2	5M SYNOP Tab.4677 (5 minutes mean value) (NN)	unused
8	36-37	2	5M SYNOP Tab.4680 (5 minutes mean value) (NN)	unused
9	39-43	5	5M METAR Tab.4678 (5 minutes mean value) (AAAAA)	unused
10	45-51	7	5M Intensität [mm/h] (5 minutes mean value) (NNN.NNN)	unused
11	53-54	2	1M SYNOP Tab.4677 (1 minute value) (NN)	unused
12	56-57	2	1M SYNOP Tab.4680 (1 minute value) (NN)	1M SYNOP Tab.4680 (1 minute value) (NN)
13	59-63	5	1M METAR Tab.4678 (1 minute value) (AAAAA)	unused
14	65-71	7	1M Intensity [mm/h] total precipitation (1 minute value) (NNN.NNN)	Precipitation in z-Direction
15	73-79	7	1M Intensity [mm/h] liquid precipitation (1 minute value) (NNN.NNN)	Precipitation in z-Direction
16	81-87	7	1M Intensity [mm/h] solid precipitation (1 minute value) (NNN.NNN)	unused
17	89-95	7	Precipitation amount [mm] (Reset with command „RA“) (NNNN.NN)	Precipitation amount in z-Direction (command “RA” not available)
18	97-101	5	1M Visibility in precipitation [0...99999m] (1 minute value) (NNNNN)	unused
19	103-106	4	1M Radar reflectivity [-9.9...99.9dBZ] (1 minute value) (NN.N)	unused
20	108-110	3	1M Measuring quality [0...100%] (1 minute value) (NNN)	unused
21	112-114	3	1M Maximum diameter hail [mm] (1 minute value) (N.N))	unused
22	116	1	Status Laser (OK/on:0, off:1)	unused
23	118	1	Static signal (OK:0, Error:1)	unused
24	120	1	Status Laser temperature (analogue) (OK:0, Error:1)	unused
25	122	1	Status Laser temperature (digital) (OK:0, Error:1)	unused

26	124	1	Status Laser current (analogue) (OK:0, Error:1)	unused
27	126	1	Status Laser current (digital) (OK:0, Error:1)	unused
28	128	1	Status Sensor supply (OK:0, Error:1)	unused
29	130	1	Status Current pane heating laser head (OK:0, warning:1)	unused
30	132	1	Status Current pane heating receiver head (OK:0, warning:1)	unused
31	134	1	Status Temperature sensor (OK:0, warning:1)	unused
32	136	1	Status Heating supply (OK:0, warning:1)	unused
33	138	1	Status Current heating housing (OK:0, warning:1)	unused
34	140	1	Status Current heating heads (OK:0, warning:1)	unused
35	142	1	Status Current heating carriers (OK:0, warning:1)	unused
36	144	1	Status Control output laser power (OK:0, warning:1)	unused
37	146	1	Reserve Status (0)	unused
38	148-150	3	Interior temperature [°C] (NNN)	Interior temperature
39	152-153	2	Temperature of laser driver 0-80°C (NN)	unused
40	155-158	4	Mean value laser current [1/100 mA] (NNNN)	unused
41	160-163	4	Control voltage [mV] (reference value: 4010±5) (NNNN)	unused
42	165-168	4	Optical control output [mV] (2300 … 6500) (NNNN)	unused
43	170-172	3	Voltage sensor supply [1/10V] (NNN)	unused
44	174-176	3	Current pane heating laser head [mA] (NNN)	unused
45	178-180	3	Current pane heating receiver head [mA] (NNN)	unused
46	182-186	5	Ambient temperature [°C] (NNN.N)	Ambient temperature
47	188-190	3	Voltage Heating supply [1/10 V] (only 5.4110.x1.xxx, otherwise “999”) (NNN)	unused

48	192-195	4	Current heating housing [mA] (only 5.4110.x1.xxx, otherwise “9999”) (NNNN)	unused
49	197-200	4	Current heating heads [mA] (only 5.4110.x1.xxx, otherwise “9999”) (NNNN)	unused
50	202-205	4	Current heating carriers [mA] (only 5.4110.x1.xxx, otherwise “9999”) (NNNN)	unused
51	207-211	5	Number of all measured particles (NNNNN)	Number of all measured particles (not corrected by detection probability)
52	213-221	9	„00000.000“ (internal data)	unused
53	223-227	5	Number of particles < minimal speed (0.15m/s) (NNNNN)	unused
54	229-237	9	„00000.000“ (internal data)	unused
55	239-243	5	Number of particles > maximal speed (20m/s) (NNNNN)	unused
56	245-253	9	„00000.000“ (internal data)	unused
57	255-259	5	Number of particles < minimal diameter (0.15mm) (NNNNN)	unused
58	261-269	9	„00000.000“ (internal data)	unused
59	271-275	5	Number of particles no hydrometeor	unused
60	277-285	9	Total volume (gross) of this class	unused
61	287-291	5	Number of particles with unknown classification	unused
62	293-301	9	Total volume (gross) of this class	unused
63	303-307	5	Number of particles class 1	unused
64	309-317	9	Total volume (gross) of class 1	unused
65	319-323	5	Number of particles class 2	unused
66	325-333	9	Total volume (gross) of class 2	unused
67	335-339	5	Number of particles class 3	unused
68	341-349	9	Total volume (gross) of class 3	unused
69	351-355	5	Number of particles class 4	unused
70	357-365	9	Total volume (gross) of class 4	unused
71	367-371	5	Number of particles class 5	unused
72	373-381	9	Total volume (gross) of class 5	unused
73	383-387	5	Number of particles class 6	unused
74	389-397	9	Total volume (gross) of class 6	unused
75	399-403	5	Number of particles class 7	unused

76	405-413	9	Total volume (gross) of class 7	unused
77	415-419	5	Number of particles class 8	unused
78	421-429	9	Total volume (gross) of class 8	unused
79	431-435	5	Number of particles class 9	unused
80	437-445	9	Total volume (gross) of class 9	unused
81	447-449	3	From here (447) to the end(2205): precipitation spectrum (distrometer data) (NNN) Number of particles 0.125mm<diameter <0.25mm and speed <0.2m/s	Precipitation spectrum (number of particles are corrected by their detection probability)
...	....	3	Remaining 439 classes (first all speeds, then the next diameter class) Diameter and speed (NNN)	Precipitation spectrum (number of particles are corrected by their detection probability)
520	2203-2205	3		
521	2207-2208	2	Checksum (AA)	
522	2210-2211	2	CRLF	
523	2212	1	ETX (End identifier)	

7 Maintenance

As the instrument does not have moving parts, i.e. is not subject to wear during operation, only minimal servicing is required. Given that the sensor surfaces are normally kept clean by rain, it will only be necessary to occasionally remove residues from the camera filter and lamps surfaces. Cleaning can be carried out as required using non-aggressive cleaning agents in water and a soft cloth during routine checks.

Attention:

During storage, installation, de-installation, transport or maintenance it must be ensured that no water gets into the system.

8 Calibration

Is done at A. Thies GmbH & Co KG.

Important:

Mechanical deformation of the measuring arms results in errors in the measured values, which involve the output of error telegrams / error signals to the analog interfaces.

9 Warranty

Damage caused by improper handling or external influences, e.g. lightning, do not fall under the warranty provisions. The warranty entitlement expires if the instrument is opened (exempt user interface opening).

Important:

The instrument must be returned in the original packaging as the warranty entitlement otherwise expires.

10 Technical data

General:			
Ambient conditions	-40... +50 °C, 0... 100% r.h.		
Dimensions	0.24 x 0.39 x 0.72 m (9.5 x 15.4 x 28.4 inch)		
Housing electronics and LEDs	Aluminium die-casting, varnished		
Housing cameras	Aluminium die-casting, varnished		
Protection	IP65		
EMC Immunity Radiation	Not tested yet		
Mounting	Mast mounting (∅ 48... 102mm, 1.9... 4 inch) Stainless steel		
Power supply:			
5.4120.00.000: Supply voltage: AC / DC current (max):	 24 VAC +15% -15% / 20...30 VDC 1A		
5.4120.01.000: Supply voltage: AC / DC current (max):	 24 VAC +15% -15% / 20...30 VDC 5.2A		
5.4120.10.000: Supply voltage: Frequency range: AC current (max): AC inrush current	 85~264 VAC, 120~370 VDC 47~63 Hz 1.6 A / 115 VAC, 0.8 A / 230 VAC Cold Start 45 A / 230 VAC		
5.4120.11.000: Supply voltage: Frequency range: AC current (max): AC inrush current	 85~264 VAC, 120~370 VDC 47~63 Hz 0.4 A / 115 VAC, 0.2 A / 230 VAC Cold Start 45 A / 230 VAC		
Heating:			
	Camera housing	LED housing	Camera arm
5.4120.00.000	tbd	tbd	tbd

5.4120.01.000	tbd	tbd	tbd
5.4120.10.000	tbd	tbd	tbd
5.4120.11.000	tbd	tbd	tbd
Detector: **Emitter:** Measurement base area: Pressure sensor: Ambient temperature sensor:	752x480 px, 8 bit, max. 58 fps, day light filter (< 830 nm) 32 LEDs, 850 nm, classified by VDE as exempt group ca. 100 cm² (instrument-specific, will be increased for later version to 200 cm²) 300 ... 1100 hPa (+/-6 hPa) (+9000 m to -500 m relating to sea level) Pt100, -40... +80 °C, +- 0.2 K		
Electronics for evaluation:			
Processing system	Xilinx Zynq™-7000 AP SoC (Dual ARM® Cortex®-A9 with FPGA fabric)		
RAM-memory	1 GB		
Flash-memory	4 GB		
Data output:			
SD card	Type: SD (2 GB), SDHC (max. 32 GB) Format: fat32, ext2		
Ethernet	10 / 100 / 1000 Mbit/s (10 / 100 / 1000BASE-T)		
Console (UART1) (only for maintenance purposes)	RS232: 115200 baud, 1 start bit, 8 data bits, 1 stop bit, no parity, no flow control		
Serial Port 1 (COM1)	RS485 Full Duplex: • Data parameter configurable • Potential isolation up to 1KV • termination resistor (220 Ω), pull up/down (1 KΩ), switchable		
Serial Port 2 (COM2)	RS485 Half Duplex: • Data parameter configurable • Potential isolation up to 1KV • termination resistor (220 Ω), pull up/down (1 KΩ), switchable		
Digital output (currently NOT used)	2 Optocouplers: • max. 24 VDC, max. 1 mA • Potential isolation up to 1 KV		

11 GNU GPL Code Statement

The software included in this device / product contains copyrighted software that is licensed under the GNU General Public License (“GPL”) or GNU Lesser General Public License (“LGPL”). Please see the GNU GPL[4] and LGPL[5] for the exact terms and conditions of the licenses.

11.1 GNU GPL and LGPL written offer

Adolf Thies GmbH & Co KG hereby offers to deliver or make available, upon request, for a charge no more than the cost of physically performing source distribution, a complete machine-readable copy of the applicable GPL and LGPL source code on a medium customarily used for software interchange.

Please direct all inquiries to:

Adolf Thies GmbH & Co KG
Hauptstr. 76
37083 Göttingen.

This offer is valid for a period of three years after the date of purchase of this product.

[4] GPL v2 http://www.gnu.de/documents/gpl-2.0.en.html
GPL v3: http://www.gnu.de/documents/gpl-3.0.en.html

[5] LGPL v2.1: http://www.gnu.de/documents/lgpl-2.1.en.html
LGPL v3 http://www.gnu.de/documents/lgpl-3.0.en.html

12 Change history

12.1 Documentation

Version	Date	Changes
	2016/04/18	- Improve program update guide (section 4.2.2) - Modify / Add description for program settings (section 5.7)
	2016/04/21	- Add installation package integrity verification step (section 4.2.2)
	2016/06/09	- Add description for zipped installation packages (section 5.7) - Change description for default configuration settings - Change date format
	2016/06/15	- Update COM1 connection details (Figure 4) - Update COM1 specification details (section 10)
	2016/12/09	- Switch to new system hardware: - Change system configuration description (section 4.1) - Change update description (section 4.2) - Update technical data (section 10) - Update cover picture and dimension drawing - Remove currently unused digital outputs and UART1 details, add SD card slot (Figure 4)
	2017/03/24	- Correct wrong SD card path description from /mnt/sd to /media/sd. - Update software version table in section 12.2.
	2017/08/08	- Add description for **new standard telegram** type 3D Disdrometer output telegram (abbreviation **TDD**) - Remove old summarizing (standard) telegram. Was replaced by the new TDD telegram - Change title “Generated data” to numbered section “Data telegrams”

12.2 Software

Version	Type	Date	Changes
	system	2016/12/01	- New operating system for new system hardware
0.90	application	2016/12/01	- Improved image processing - Ambient temperature measurement - Precipitation type classification (SYNOP 4680) - Extended LNM telegram - Precipitation type SYNOP 4680 included - Interior and ambient temperature - SD card change request handling
	system	2017/01/16	- Changed operating system configuration
0.91	application	2017/03/01	- Extended camera control - Improved particle matching
0.92	application	2017/03/03	- Fixes - Improved logging for maintenance
	system	2017/03/24	- Add new system drivers - Add persistent setup scripts
0.95	application	2017/03/24	- Improved particle matching - Improved particle probability calculations - Improved particle speed calculations
0.96-rc1	application	2017/04/12	- Improved system error handling

			- Fix issue with SD_CHANGE button - Added basic support for light source VER-09-16
	system	2017/04/12	- Some cleanups
0.96-rc2	application	2017/04/28	- Improved system stability - Improved error handling
	system	2017/07/05	- Add support for configurable user accounts - Default setup user account - Add network configuration file for setup user - Add support for IP gateway settings
0.96-rc6	application	2017/08/04	- Refine particle type dependent speed calculations - Improve particle matching - Add new configurable 3D Disdrometer output telegram type TDD

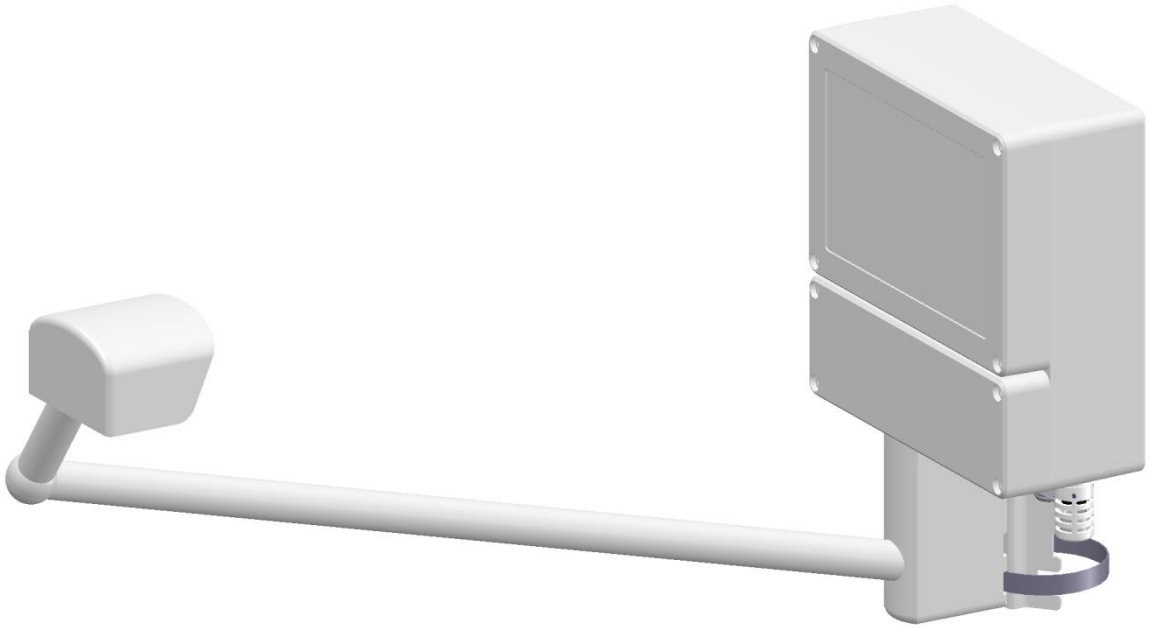
12.3 Hardware

Version	Type	Date	Changes
04-16	system	2016/12/01	- New system hardware platform - Improved system camera - Improved light source - SD card change request button

12.4 Known issues

Id	Type	Date	Description
#001	application	2016/12/12	There is currently no automatic removal for logging files in /media/sd.

13 Dimension Drawing



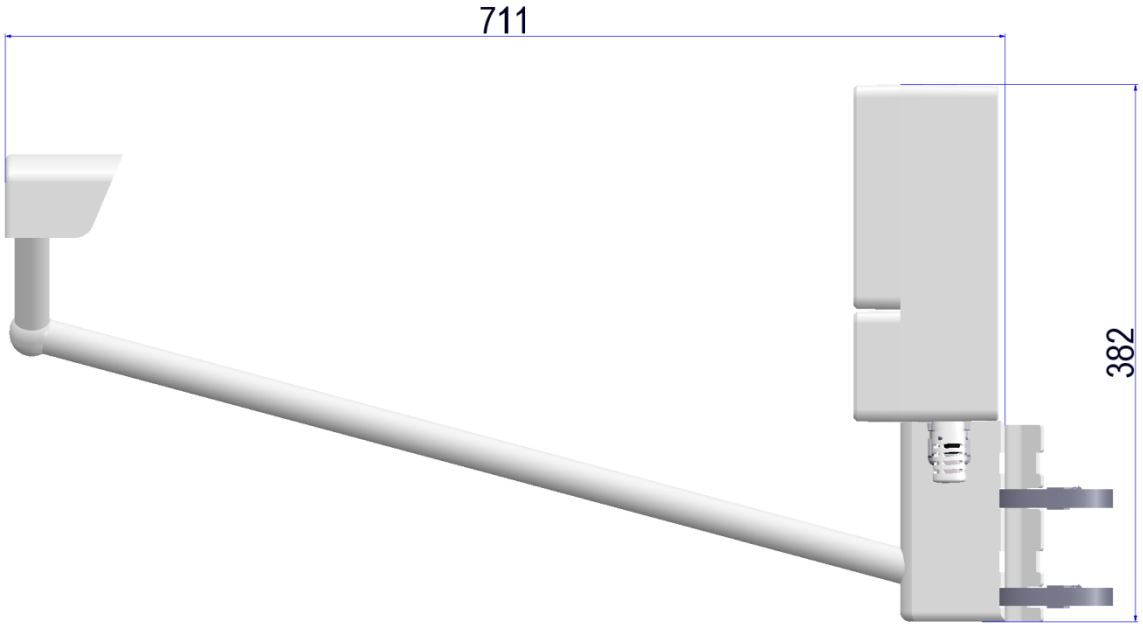


Figure 5: Dimensional drawing

14 EC-Declaration of Conformity

Attention: The instrument is a protoype without EC-Declaration of Conformity.

Please contact us for your system requirements.
We advise you gladly.

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