



USER MANUAL

rain[e]H3

Precipitation Sensor



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1 Scope of Delivery

- rain[e]H3 sensor
- Collecting vessel (part of the self-emptying collecting system)
- USB cable for configuration, length = 1 m
- Software rain[e]H3 Commander (country-specific, available as a CD or download)

Check the delivery for transport damage and document it extensively to lodge claims for damage against the shipper. Afterwards contact the LAMBRECHT service department on **+49-(0)551-4958-0**

2 Order Code

rain[e]H3 heated **Id-No. 00.15184.540020**

The order codes for accessories and spare parts can be found in chapter "Equipment and Spare Parts".

3 Safety Instructions and Warranty

This system is designed according to the state-of-the-art accepted safety regulations. However, please note the following rules:

1. Before putting into operation please read all respective manuals!
2. Please observe all internal and state-specific guidelines and/or rules for the prevention of accidents. If necessary ask your responsible safety representative.
3. Use the system only as described in the manual.
4. Always have the manual at hand at the installation site.
5. Use the system within the specified operating condition. Eliminate influences, which might impair the safety.
6. Prevent the ingress of unwanted liquids into the devices.
7. Funnel heating and drain heating can be very hot if the heating is operated with the housing open. There is a risk of being burnt! It is therefore recommended that the connector of the heating supply be disconnected during cleaning and maintenance work.
8. The measuring edge of the upper part of the housing is quite sharp. There is a risk of cuts. It is therefore recommended that the measuring edge not to be pressed on and/or that gloves are worn!

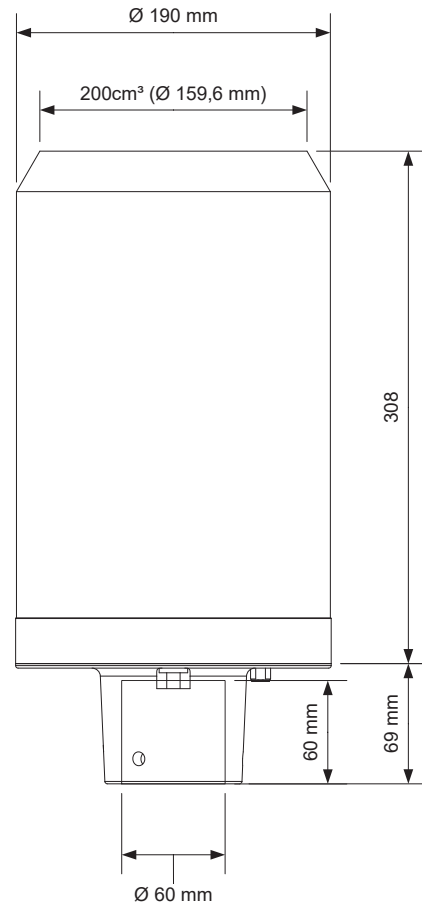
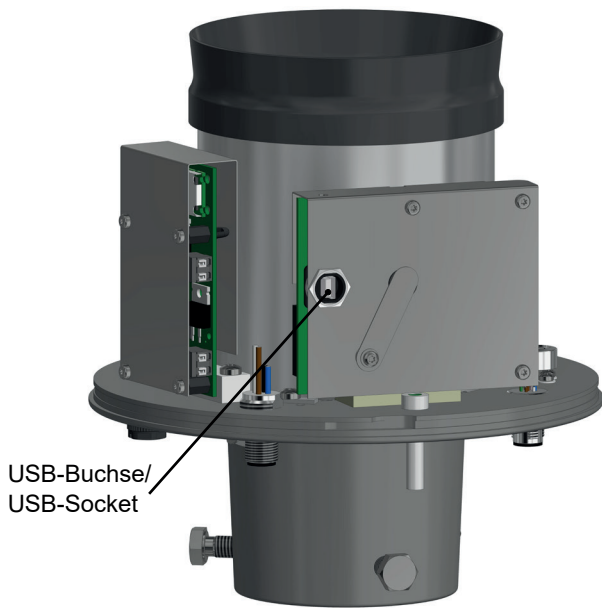
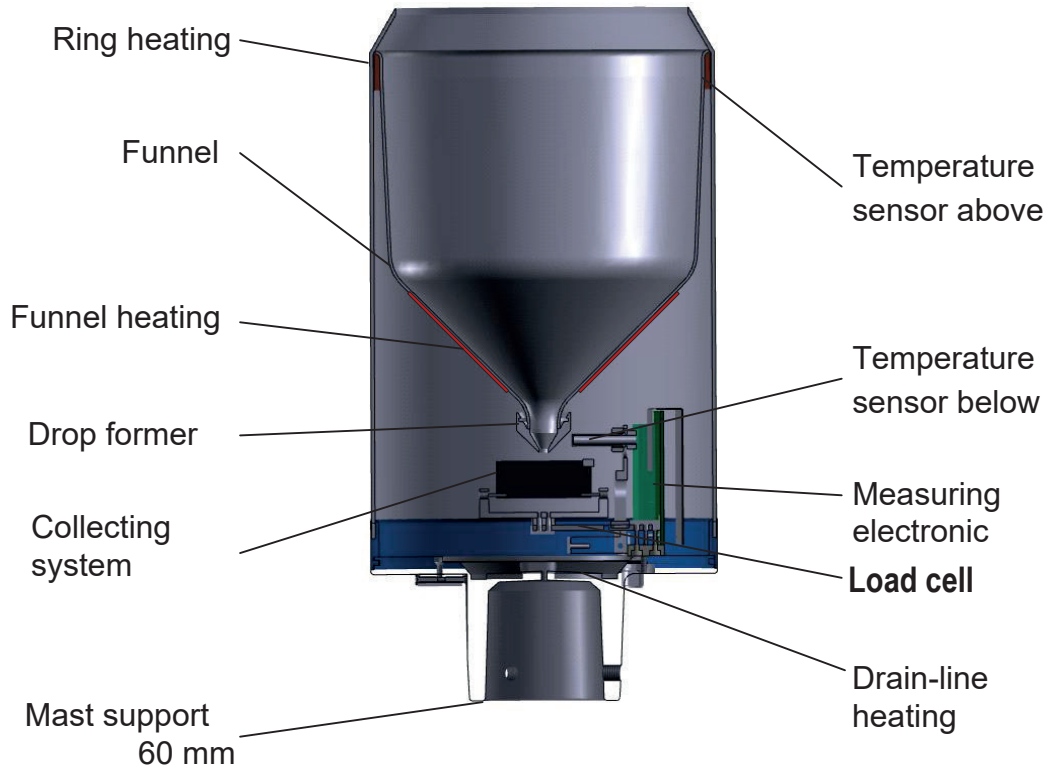
Please note the loss that unauthorized manipulation of the system shall result in the loss of warranty and non-liability. Changes to system components require express written permission from LAMBRECHT meteo GmbH. These activities must be performed by a qualified technician.

The warranty does not cover:

1. Mechanical damage caused by external impacts (e.g. icefall, rockfall, vandalism).
2. Impacts or damage caused by over-voltage or electromagnetic fields which are beyond the standards and specifications of the device.
3. Damage caused by improper handling, e.g. by using the wrong tools, incorrect installation, incorrect electrical installation (e.g. incorrect polarity) etc.
4. Damage caused by using the device outside the specified operation conditions.



4 Dimensional Drawing and Product Drawing



5 Introduction

The precipitation sensor rain[e]H3 measures precipitation amount and intensity. The rain[e]H3 combines the advantages of the latest weighing technology and a self-emptying system, allowing a high resolution and high precision at a very small total volume. Therefore the rain[e]H3 has a higher resolution and precision than common tipping bucket sensors and at the same time is much smaller than common weighing sensors, since there is no need for a collecting container.

The main sensor is a highly precise load cell with overload protection. Its temperature coefficient can be determined using a temperature sensor in the interior space if necessary. The pulses from the reed contact generated by tipping the collecting vessel are used for error correction during periods of high intensity precipitation. Furthermore, the self-emptying system allows weighing without interruption.

The rain[e]H3 calculates the following values:

- **Amount of precipitation:** The rain[e]H3 gives the amount of precipitation in real time with a maximum resolution of 0.001 mm.
- **Intensity within the last minute:** The rain[e]H3 measures 6 times per minute and sums these values up in a moving sum - that is, every time a new value is measured, it is summed to the previous 5 values and thus generates the new value for the intensity within the last minute.
- **Intensity since last retrieval:** The difference in the amount of precipitation since the last retrieval is divided by the time since the last retrieval. If the time is smaller than 30 s, the rain[e]H3 will use the "intensity within the last minute" value.
- **Amount since last retrieval:** The difference in the amount of precipitation between the current and the last retrieval.
- **Minimum intensity within the last x minutes (RS-485 interface):** Every minute the value of the intensity within the last minute is compared to the current minimum value. If the new value is smaller, it replaces the former minimum value.
- **Maximum intensity within the last x minutes (RS-485 interface):** Every minute the value of the intensity within the last minute is compared to the current maximum value. If the new value is bigger, it replaces the former maximum value.
- **Variance:** Variance of measured values over 4 s

The RS-485 interface can be used in Talker or WL ASCII mode.

6 Heating

The rain[e]H3 is best suited to applications in regions with seasonal or permanent cold climate. The internal heating is separated into three parts: A 70 W heater which is installed on the inner side of the funnel, melts sublimates, a 70 W ring heater heats the funnel opening and a 60 W heating foil under the protection grid and the collecting funnel prevent complete icing of the outlet. Within its operating temperature of -40...+70 °C the target temperature of the funnel surface of the heated rain[e]H3 is 2 °C. The operational readiness is checked continuously and can be requested via the RS-485 interface. The heating can be switched off via the configuration software rain[e]H3 Commander. In the factory settings the heating is switched on. The heating uses a separate power cable.





Funnel heating and drain heating can be very hot if the heating is operated with the housing open. There is a risk of being burnt! It is therefore recommended that the connector of the heating supply be disconnected during cleaning and maintenance work.

7 Installation

7.1 Site Selection

SUBSOIL CONDITIONS

To minimize the entry of splash water it is recommended that sites with hard ground like concrete are avoided. Place the precipitation sensor on grass or other soft ground instead.

CONDITION OF THE SURROUNDING

In general the precipitation sensor should not be placed on slopes or roofs.

We recommend installation of the precipitation sensor at a distance of at least 2 m from any obstacle or the obstacle height (above the gauge's orifice), as defined by the German Meteorological Service (DWD) or twice the obstacle height as defined by the WMO and preferably at a distance of four times the obstacle height.

Vegetation around the site should be clipped regularly to the height of the precipitation sensor to prevent them from disturbing the measurement and at the same time reduce wind influence. An additional minimum distance to high-voltage power lines and cell towers is not necessary.

ACCURACY OF THE HOUSING ALIGNMENT

The housing can be aligned with an integrated spirit level at $\pm 0,7^\circ$ (blister within the edge of the ring marking). This accuracy is sufficient for the rain[e]H3. The additional error at 3° inclination is approx. 0.14 %.

7.2 Mounting

NECESSARY TOOLS

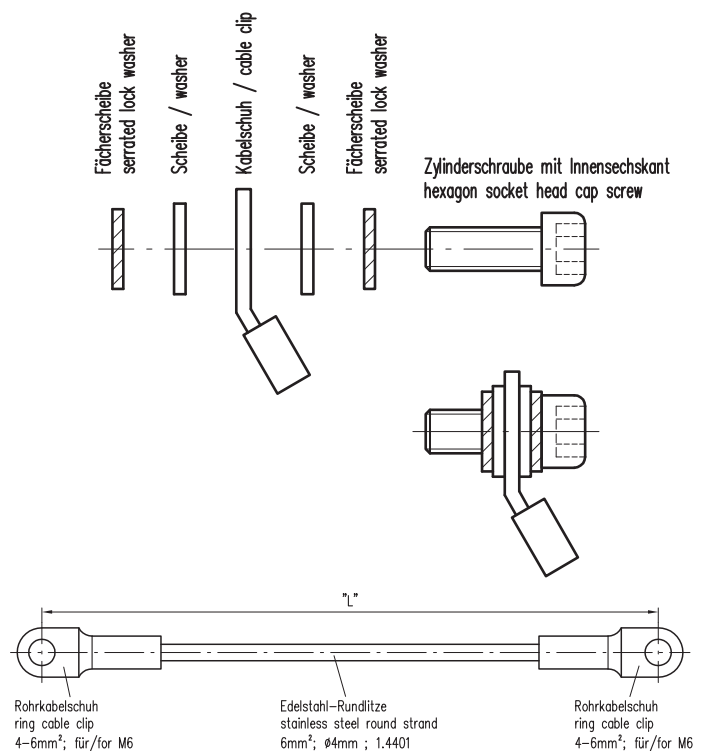
- Wrench (13 mm)
- Allen key (6 mm)
- Slotted screwdriver (approx. 2.5 blade width)

- Unpack the device.
- Take the box of the collecting vessel out of the funnel of the rain[e]H3.
- Check the collecting vessel for transport damage and put it back into its box for later installation.
- Place the sensor on a tube or pole with an outer diameter of 60 mm. A metallic extension tube with a minimum length of 100 mm is recommended if a wooden pole is used. Use a Wrench (13 mm) to tighten the screws in the mounting pedestal evenly.



Do not damage the measuring edge.

- To improve the operating security in lightning-prone areas it is suggested that the sensor be earthed via the integrated earthing screw of the rain[e]H3. The illustration shows the steps of installation of an earthing connection with a cable clip and earthing screws onto the sensor. The other end of the cable should be connected to a ground nail.



The warranty for the device is excluded if damage occurs due to improper handling. This particularly includes the absence of proper grounding. Correct grounding according to DIN VDI/VDE 0100 is essential for the safety and functionality of the device. If you have any questions regarding installation, please contact us.

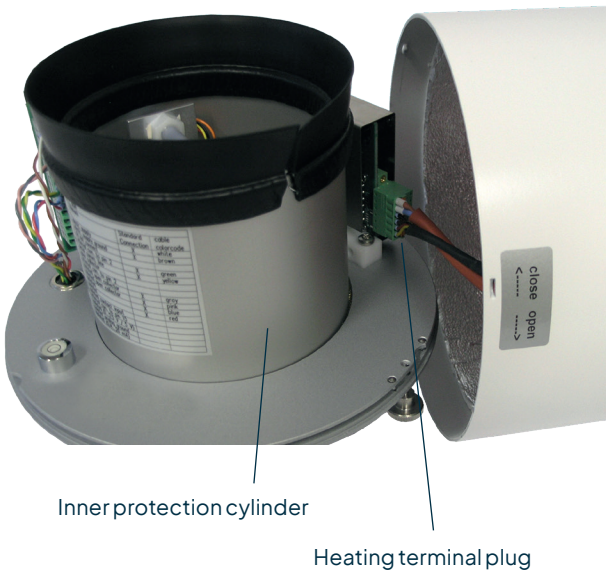




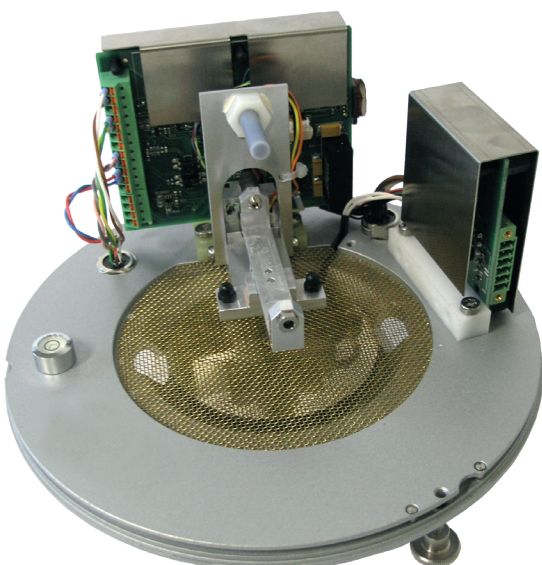
Open the device.

- Unscrew the knurled screw at the bottom.
- Take hold of the casing and base and turn the casing in the “open” direction (anti-clockwise).
- Lift the casing with caution. Mind the heater's terminal plug.

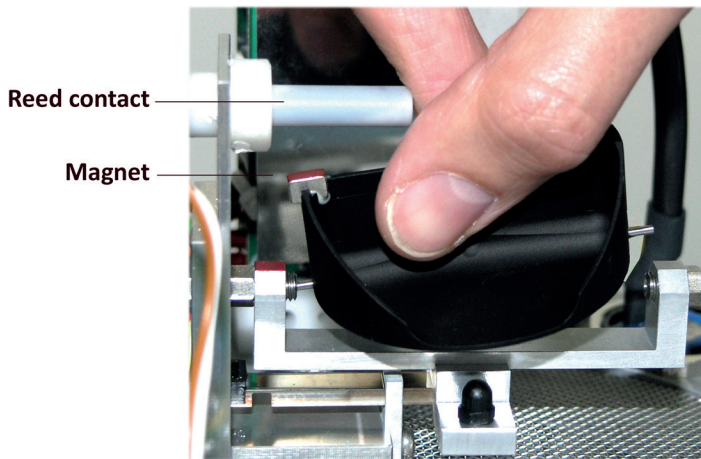
 **The measuring edge of the upper part of the housing is quite sharp. There is a risk of cuts. It is therefore recommended that the measuring edge not be pressed on and/or that gloves are worn!**



- Remove the terminal connector.
- Set the housing aside.
- Lift off the inner protective cylinder.



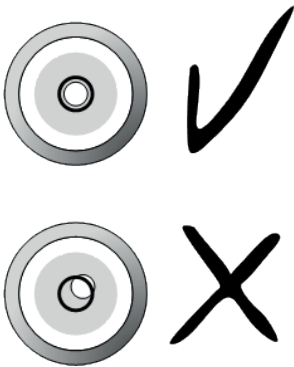
rain[e]H3 internal components without collection system



Unpack the collecting vessel.

Insert the collecting vessel:

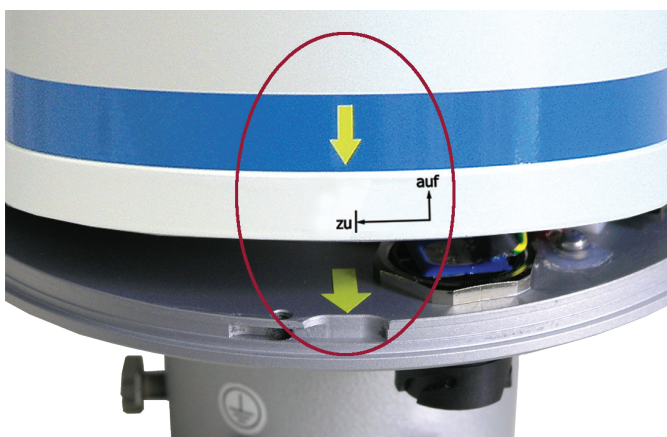
- Insert collecting vessel against the bearing spring with the site of the magnet facing towards the reed contact
- Insert the other axis into the other bearing.
- **Test for flawless tipping.**



Use the spirit level to level the device by tightening the hex screws in the base evenly.

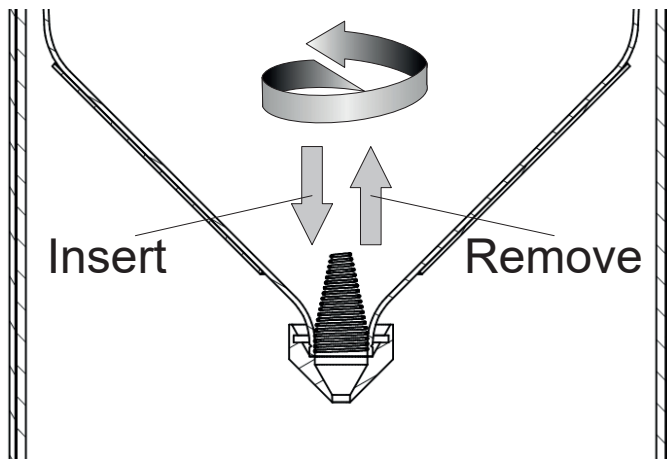
Reassembly

- Cautiously put the inner protection cylinder back into place.
- Plug in the terminal plug of the heating.
- Reinstall the housing on the device, aligning the embossings with the recesses:
- Press down on the housing and turn it clockwise towards “close”.
- Fasten the knurled screw.
- Insert the enclosed dirt trap spiral into the funnel



! The measuring edge of the upper part of the housing is quite sharp. There is a risk of cuts. It is therefore recommended that on the measuring edge not be pressed on and/or that gloves are worn!

! In order to protect the collecting vessel the dirt trap spiral must be inserted into the collecting funnel.



- **Inserting of the dirt trap spiral**
Insert the enclosed dirt trap spiral in the funnel. The spiral should be held in such a way that a complete turn in the anti-clockwise direction is possible. Push the dirt trap spiral in circular motion from above into the funnel opening.
- **Removing the dirt trap spiral**
Grab the dirt trap spiral in such a way that a complete turn in the anti-clockwise direction is possible and pull it in a circular motion towards the funnel opening.

7.3 Power and Signal Connection

To connect the rain[e]H3 to a data acquisition system a M12 connecting cable is required. Connect the cable according to the connecting diagram. For the power supply of the heating, a power cable should be connected to the power supply unit according to the connecting diagram.

Sensor connection signal and supply

M12 sleeve A-coded

Id.-No. Cable 32.15184.060000 (10 m)

Heating connection supply

M12 sleeve T-coded (heating)

Id.-No. Cable 32.15184.061000 (1 m)

Ethernet connection

M12 sleeve D-coded (Ethernet)

Id.-No. Cable 32.05304.000200 (2 m)



It is important to plug in the power plug of the heating first – before the terminal plug of the funnel heating and the sensor connector. Otherwise the automatic heating control will shut down the heating.

The maximum distance between the rain[e]H3 and the data acquisition system depends on the interfaces being used. The values for RS-485 and Ethernet are obtained from the respective definitions of these standards.

- **RS-485** **1000 m**
- **Ethernet 100 MBit** **100 m (CAT-S)**

$$P_a = \frac{U_N^4}{P_N \left(\frac{U_N^2}{P_N} + 2\rho \frac{l}{A} \right)^2}$$

If a power cable longer than 3 m at 0.75 mm² is used for heating supply, this formula can be used to calculate the actual power P_a with the nominal voltage $U_N = 24$ VDC, the nominal power $P_N = 200$ W, the specific electrical resistance $\rho = 0.017 \Omega \text{mm}^2/\text{m}$ for copper, the length of the cable l and the cross section of the cable A .

The heating requires an actual power P_a of higher than 180 W to operate.

The USB cable for the service interface should not be longer than 3 m.



7.4 System Start

The system starts automatically after connecting all plugs. After ~15 s the system starts collecting data and sends them to the attached data logger according to the device configuration.

The table below lists the LEDs and their functions.

Color	LED Function
Green	Blinks for about 5 seconds at start and goes off when no connection can be made.
Red	LED is ON, when connection is active
Green	Blinks non-cyclically during communication.

7.5 Available In- and Outputs

The rain[e]H3 provides the following outputs:

PULSE OUTPUT

- 1 galvanically isolated open-collector and
- 1 non-isolated open-collector

selectable as

- Pulse Output
 - Resolution: 0.01...1 mm
 - Closing time: 10...500 ms (duty cycle of 1:1)
- Status Output (heating ON/OFF; rain YES / NO)

ANALOGUE OUTPUT

- 0/4...20 mA
- 0...2.5/5 V

SERIAL OUTPUT

- SDI-12
- RS-485 (Talker-, WL ASCII protocol)
- Ethernet 100 MBit

7.6 Factory Settings

The factory settings of the rain[e]H3 according to the standard connecting diagram are:

- Galvanically isolated output as pulse output
 - Resolution: 0.1 mm
 - Closing time: 300 ms
 - Duty cycle: 1:1
- Non-isolated output as state output
 - State "Heating ON/ OFF"
- SDI-12 protocol activated (on SDI-12 Interface, 1200 Bd)
- Analogue output OFF
- Heating activated

7.7 Connections

CONNECTION POWER SUPPLY / RS-485

Via the A-coded 8-pole M12 plug the power supply and outputs are connected. For the connection several cables with different lengths are available. These cables have a unidirectional M12 cable sleeve and only have to be plugged on. The pin-assignment is shown in the wiring diagram.

CONNECTION ETHERNET INTERFACE

The Ethernet interface is connected by a D-coded M12 plug. For the connection several cables with different lengths are available. These cables have a unidirectional M12 cable sleeve and only have to be plugged on. Alternatively a D-coded cable sleeve that can be assembled is available. The pins of the Ethernet cable will be assigned by insulation displacement technique. Thus, no special tools are needed.

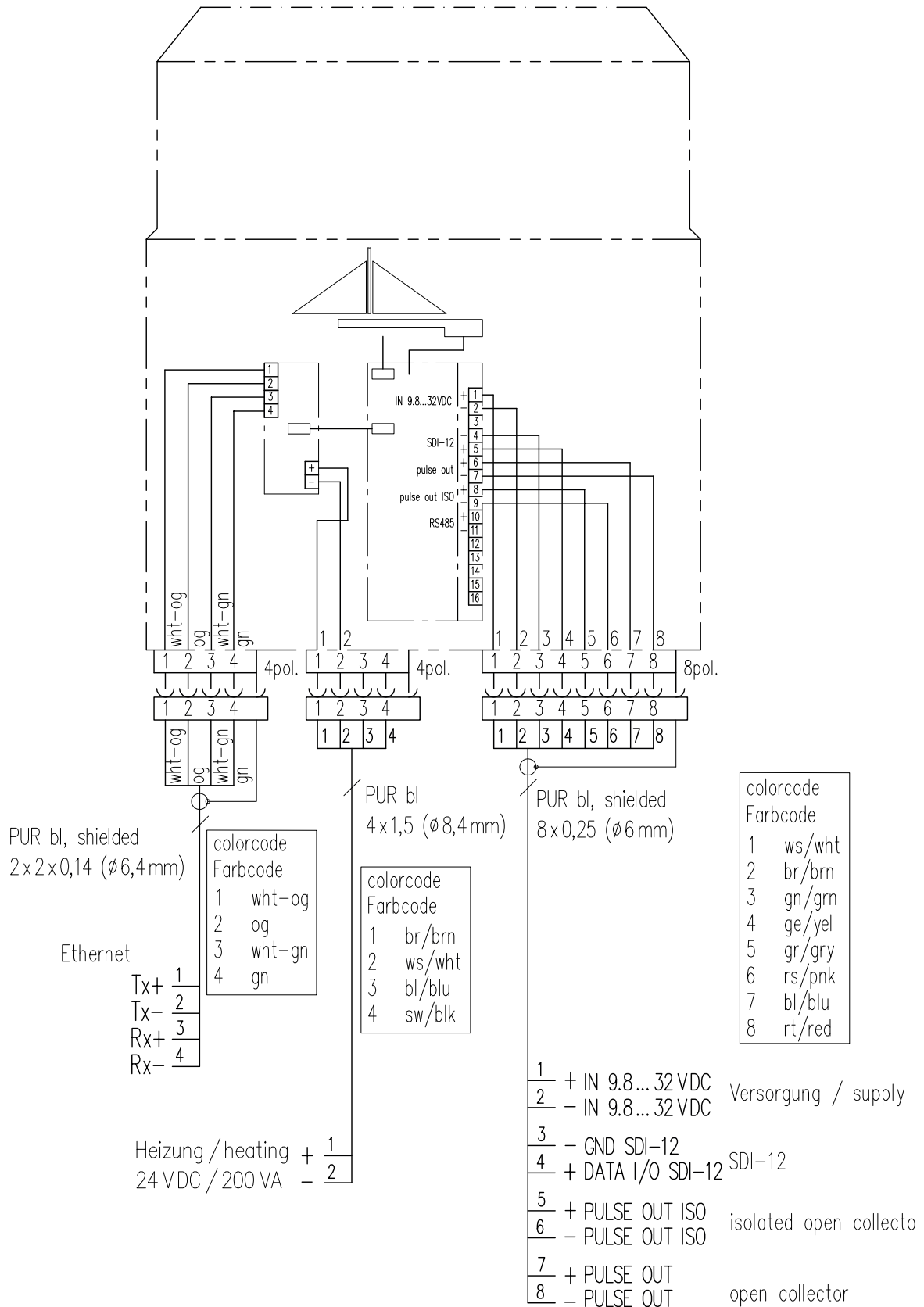
7.8 Terminal Assignment



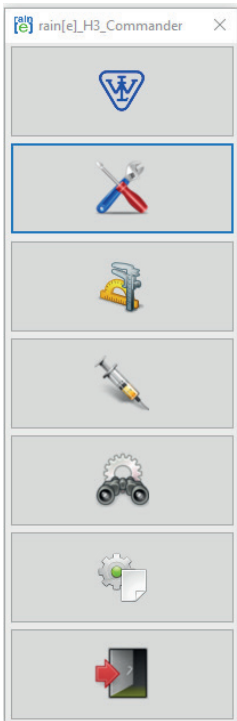
All unused wires must be connected to unused pins or insulated to avoid malfunctions.



Connecting diagram/Pin assignment



8 Configuration Software rain[e]H3 Commander



Lambrecht.net

Setup

Adjust rain[e]
load cell

Upload firmware
to rain[e]

rain[e]H3 Diagnostics

Receive data

Exit program

The rain[e]H3 Commander is the configuration tool of the rain[e]H3. It can be used to configure the output signals of the rain[e]H3. Furthermore the load cell can be adjusted with the help of a reference weight. The software also has an update function for the firmware and a diagnosis function to control the readiness for use of the rain[e]H3.

To configure the rain[e]H3 it has to be connected via the USB service interface in the device interior to a PC with installed rain[e]H3 Commander.

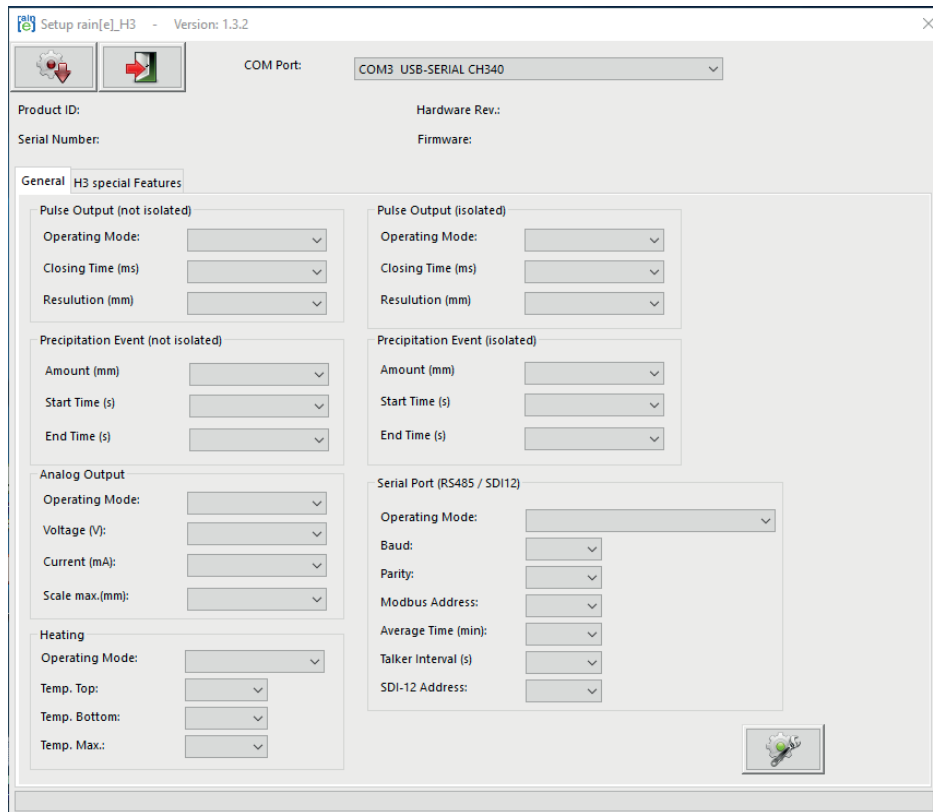


It is recommended that the power plug and the sensor connector are unplugged before opening the rain[e]H3 case to prevent it from mismeasuring. In addition, the “service function” of the data logger in use should be used wherever possible.

RAIN[E]H3 SETUP

When entering the Setup area it requests that the user first select the COM port to which the rain[e]H3 is connected (from the drop-down menu) and retrieve the settings from the rain[e]H3 (gear wheel icon). After retrieving the data from the rain[e]H3 the setup screen shows the product ID, serial number, hardware revision and firmware version of the device. In the ‘Setup’ section the program provides buttons for the most common combination to configure the rain[e]H3 with a few clicks.

SETUP



The “Setup” mask (figure above) is an easy to use tool to configure the rain[e]H3 to the desired application. The following list shows the available options and ranges:

Pulse output (non-isolated) / (isolated)

- Operating type
 - Impulse
 - ▶ Closing time 10...500 ms in 5 ms steps
 - ▶ Resolution 0.01...1 mm in 0.01 mm steps
 - Rain YES / NO
 - ⇒ Rain event (pulse output 1) / (pulse output 2)
 - ▶ Amount 0.10...1 mm in 0.10 mm steps
 - ▶ Start time 20...60 s in 1 s steps
 - ▶ End time 20...600 s in 1 s steps
 - Heating ON / OFF

Analog output

- Operating type
 - Voltage 0...2.5 / 5 V
 - Power 0 / 4...20 mA
 - Max. scale 1...200 mm/m² in 1 mm/m² steps

Heating - operating type

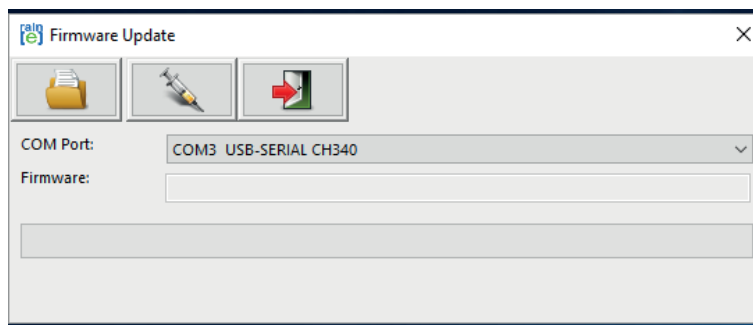
ON / OFF

Serial interface (RS-485)

- Operating type
 - WL ASCII
 - ▶ Averaging time 1...60 min in 1 min steps
 - SDI-12
 - ▶ Averaging time 1...60 min in 1 min steps
 - Talker
 - ▶ Averaging time 1...60 min in 1 min steps
 - ▶ Talker interval 10...60 s in 1 s steps

SDI-12 address 0...9, A...Z, a...z

8.1 Firmware Update



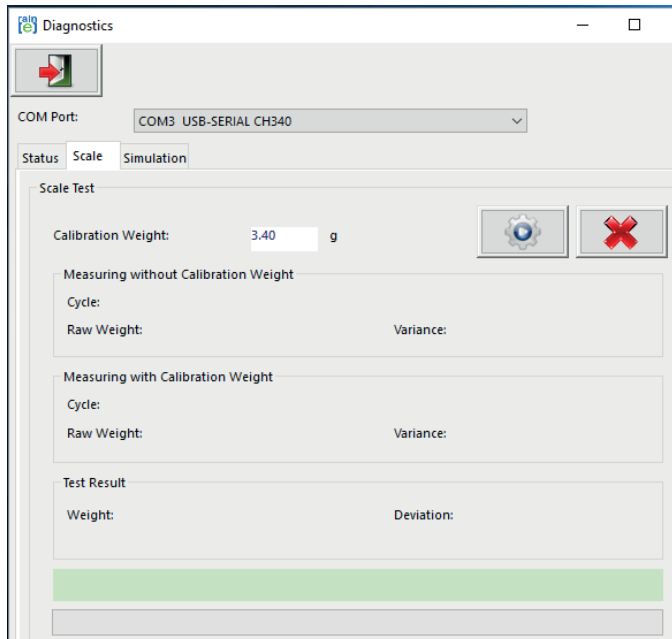
If firmware updates are necessary, e.g. for new functions or because the signal output requirements have changed, please download these via our homepage (www.lambrecht.net - see also chapter "Download of Updates").

To update your rain[e]H3 firmware use the Firmware Update screen (see fig. above). Select the COM port of the connected rain[e]H3 from the drop-down menu, click "Browse for Firmware File" (folder icon) and select the firmware file on your computer or tablet. Then click "Load Firmware to rain[e]H3" (syringe icon).

8.2 Diagnostics

8.2.1 Calibration of the Precipitation Value

For the calibration of the rain[e]H3 with the calibration ball as a proxy precipitation, the tab “Scale” is available in the diagnostic tool of the rain[e] Commander. Select the used COM port (USB Serial Port) and press the gear button to start the calibration.

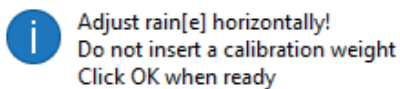


Avoid vibrations during the calibration of the rain[e]H3 as this could lengthen the process or in extreme cases even hinder it!

Follow the instructions of the program.

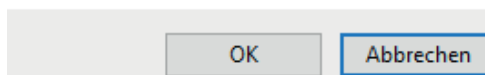
For the calibration, the rain[e]H3 must be aligned correctly horizontally!

rain[e]_Cmd

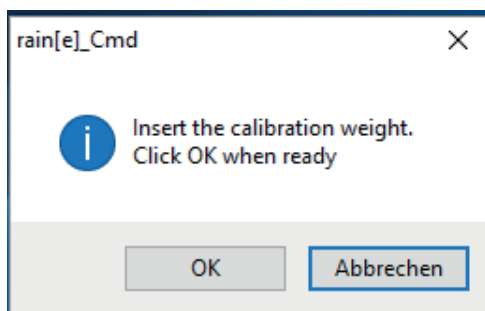


In the first step, the rain[e]H3 carries out an empty measurement. The collecting vessel must therefore be completely empty.

Confirm the query after ensuring that the collecting vessel is empty.

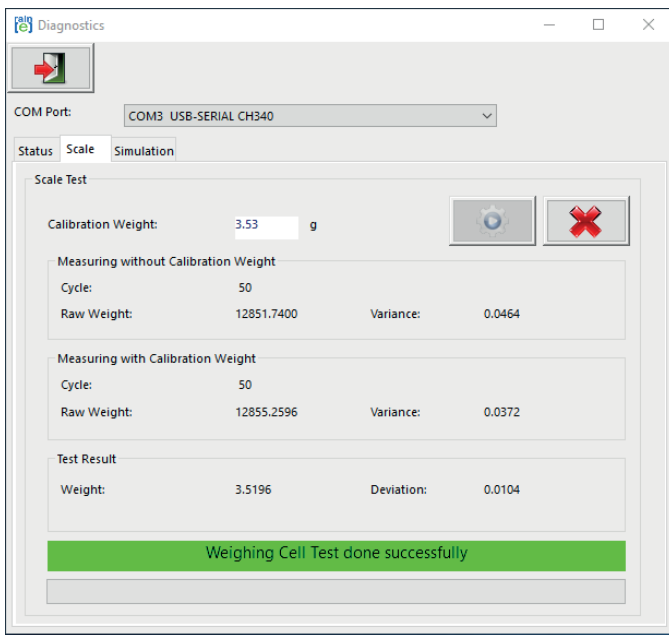


After the empty measurement, the rain[e]H3 measures the weight of the calibration ball from the calibration set.



Place the ball in the collecting vessel and confirm the query.

The measured weight is indicated by the rain[e]H3. Compare the weight with the weight of the calibration ball from the calibration set.



The deviation from the test weight should be less than ± 0.03 g. Deviations can be caused by external influences, e.g. wind. In the case of significant deviations, the test should be repeated at least once. For a deviation of $>\pm 0.03$ g, the rain[e]H3 should be adjusted (see “Load Cell Adjustment”).

After calibration, please take the test weight (calibration ball) and put it back in the packaging. Check the correct position of the blank jacket before putting on the round blank.

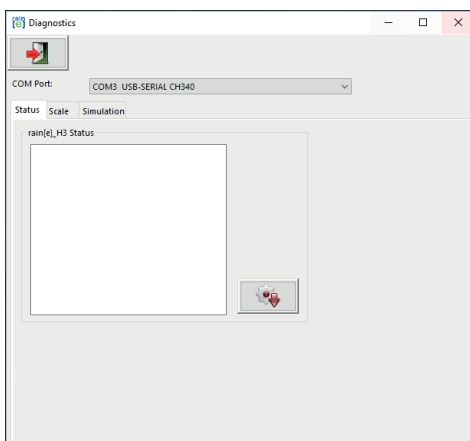
8.2.2 Call of Status and Error Messages

The status and error messages can be retrieved by calling the command `<STX>USR8<CR><LF>` “Get Error String” or by using the diagnostic tool of the rain[e]H3 Commander.

Open the tab “Status” in the diagnostic tool. To check the general sensor readiness of the rain[e]H3. Select the COM port you are using and press the gear wheel button. **As long as the sensor is connected to an external power supply, it can not be reached via the USB interface.**



The drain heating can be very hot if the heater is operated with the housing open. There is a risk of burning!



rain[e]H3 can issue the following errors:

- Overheating error
- Heating error
- Lower temperature sensor (in the interior) error
- Upper temperature sensor (at funnel and ring) error
- Initialisation RTC (real time clock) error
- Outer temperature sensor error
- Power supply error

OVERHEATING ERROR

This error occurs when one of the internal temperature sensors detects a temperature in excess of the configured “maximum heating temperature”. The factory-provided threshold of the maximum heating temperature is 15 °C. In this case rain[e]H3 switches automatically OFF until the temperature falls below the error threshold.

HEATING ERROR

This error occurs when insufficient heating capacity is available and the heating current (measured internally) falls below the threshold of 5.1A.

LOWER TEMPERATURE SENSOR ERROR

This error occurs when the lower temperature sensor for heater monitoring stops sending data.

UPPER TEMPERATURE SENSOR ERROR

This error occurs when the upper temperature sensor for heater monitoring stops sending data.

INITIALIZATION RTC (REAL TIME CLOCK) ERROR

This error occurs when the initialisation the RTC (real time clock) fails.

OUTER TEMPERATURE SENSOR ERROR

This error occurs when the outer temperature sensor for heater monitoring stops sending data.

POWER SUPPLY ERROR

This error occurs when the quality of the supply voltage varies extremely.

To simulate precipitation amounts, and consequentially to check the output signals at the analogue and impulse outputs, choose the desired precipitation amount in the rider “simulation” and click “simulate precipitation” (nimbus symbol). After this, the outputs give the desired amount according to the settings.

LOAD CELL ADJUSTMENT

With the mask “**Load Cell Adjustment**” and a reference weight the load cell can be adjusted. It indicates the number of passages that the program has done, the average value of the measured weight and the variance of the measuring values. Additionally the calibration factor is given. To adjust the load cell at first the COM interface where the rain[e]H3 is connected has to be chosen in the menu. After that place the calibration weight in the collecting vessel and enter it’s weight in the appropriate box. Start the adjustment process by clicking the green “**Start adjustment**” button.

By clicking the red “**X**” button a running adjustment will be interrupted. The adjustment has to be started again in case the diagnosis shows deviations of $>\pm 30$ mg.

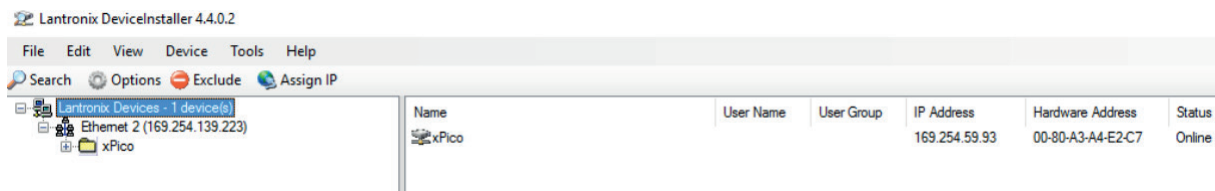
9 Configuration of Ethernet Interface with Lantronix Device-Installer

The rain[e]H3 Ethernet has a built-in device server (port server) from Lantronix. The “Lantronix Device-Installer” is required for configuring the Ethernet interface. This can be downloaded at:

<https://www.lantronix.com>

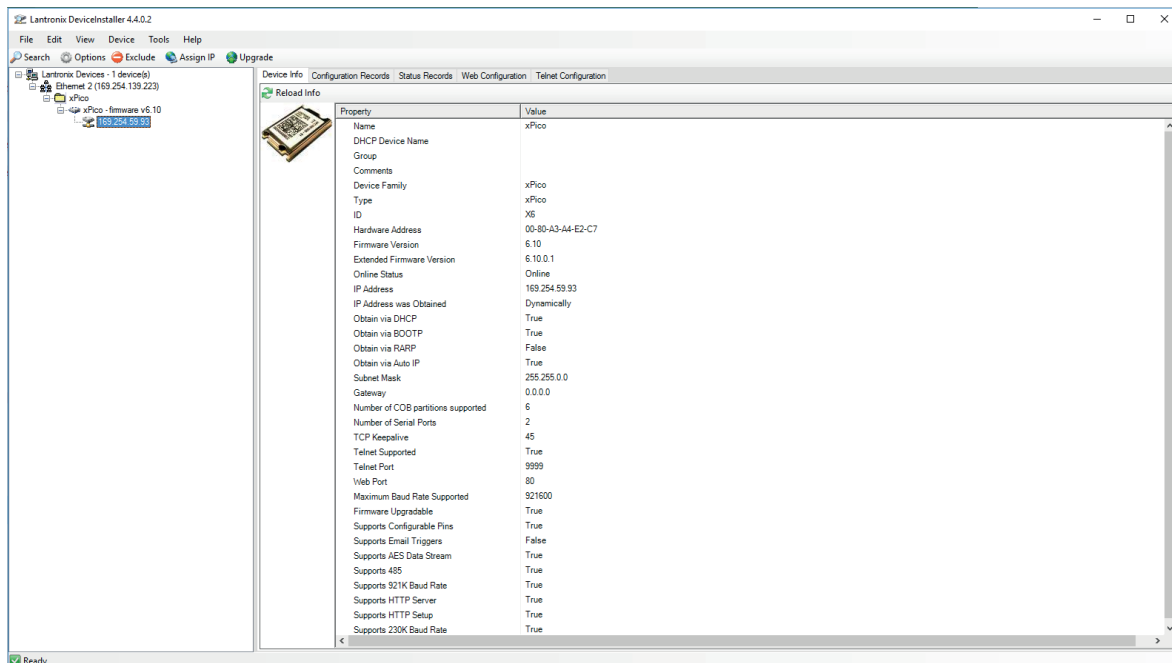
(Status April 2017)

The Lantronix DeviceInstaller is a Windows-based GUI application. With this application the device can be found in the network and the Ethernet interface or the port server can be configured. After the DeviceInstaller has been installed, connect the Ethernet interface to the PC and start the DeviceInstaller.

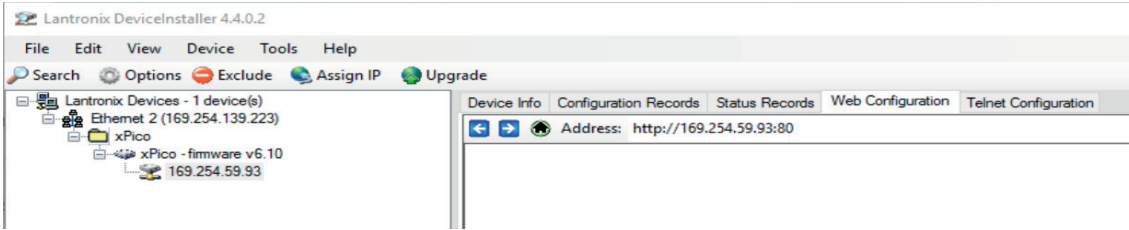


By pressing the “Search“ button the network is searched for existing devices. If no device is found, try to change the Windows network settings to “Obtain an IP address automatically“.

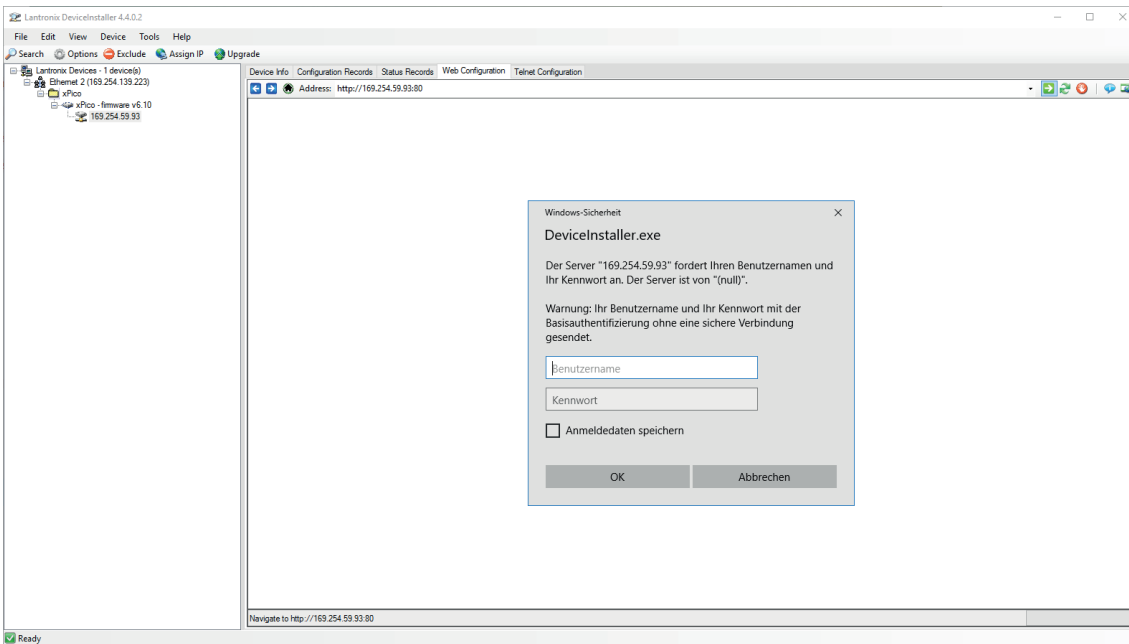
The devices found are displayed.



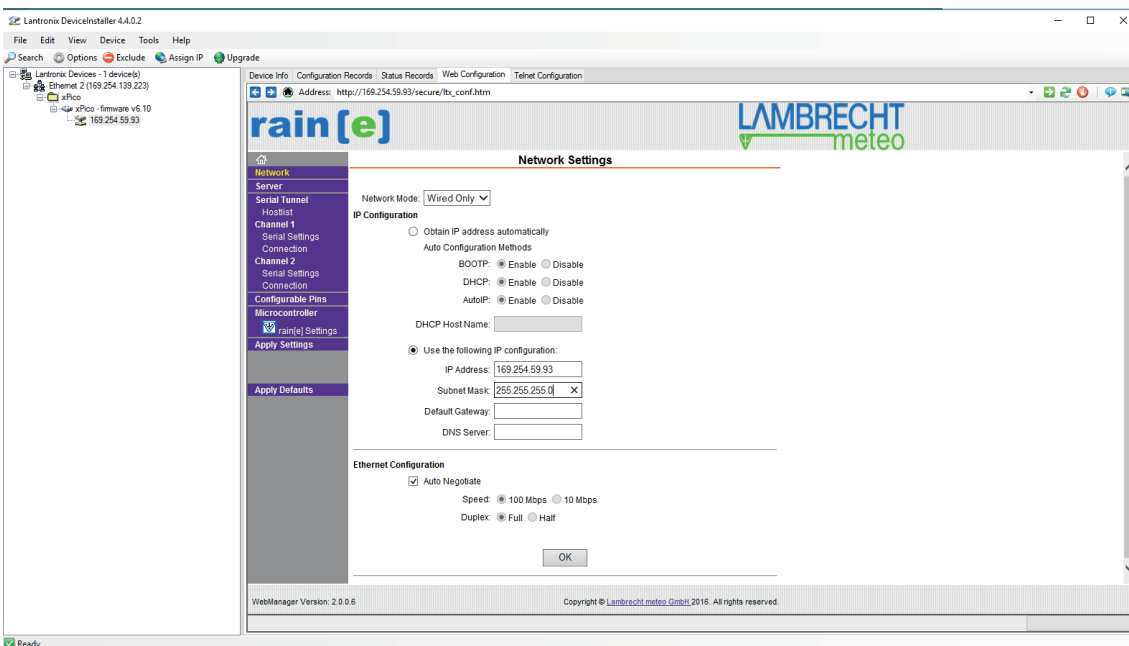
Select the tab “Web Configuration”.



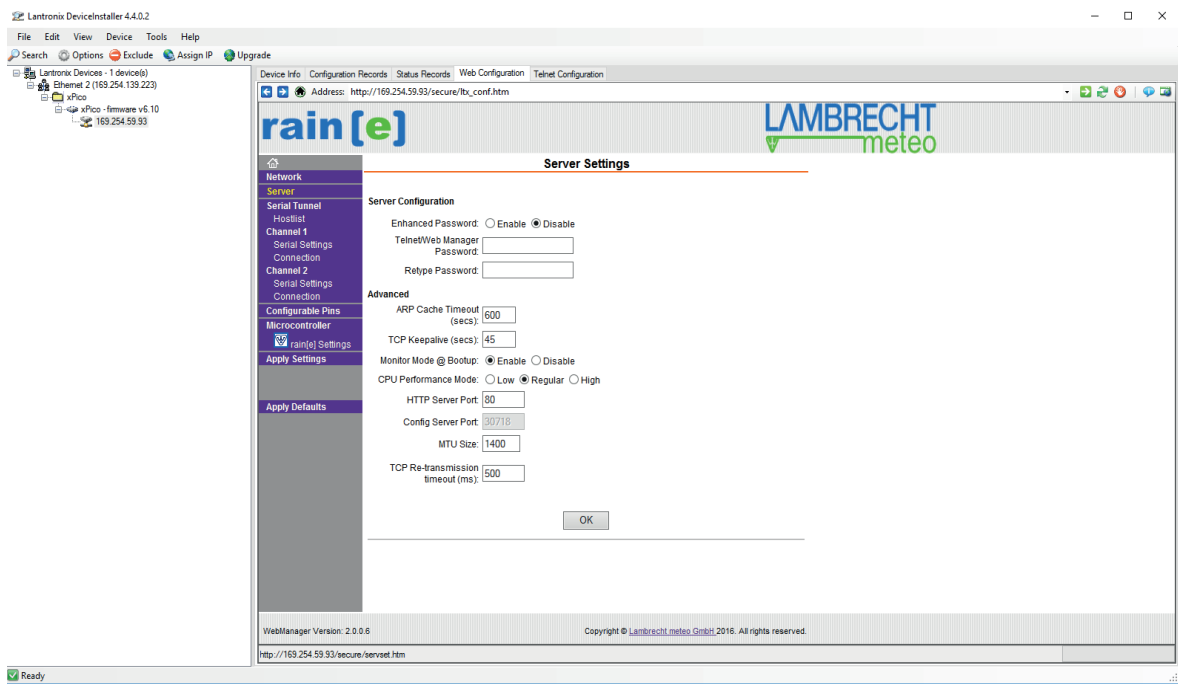
Use the green arrow to establish the connection and then confirm the login window with “OK”.



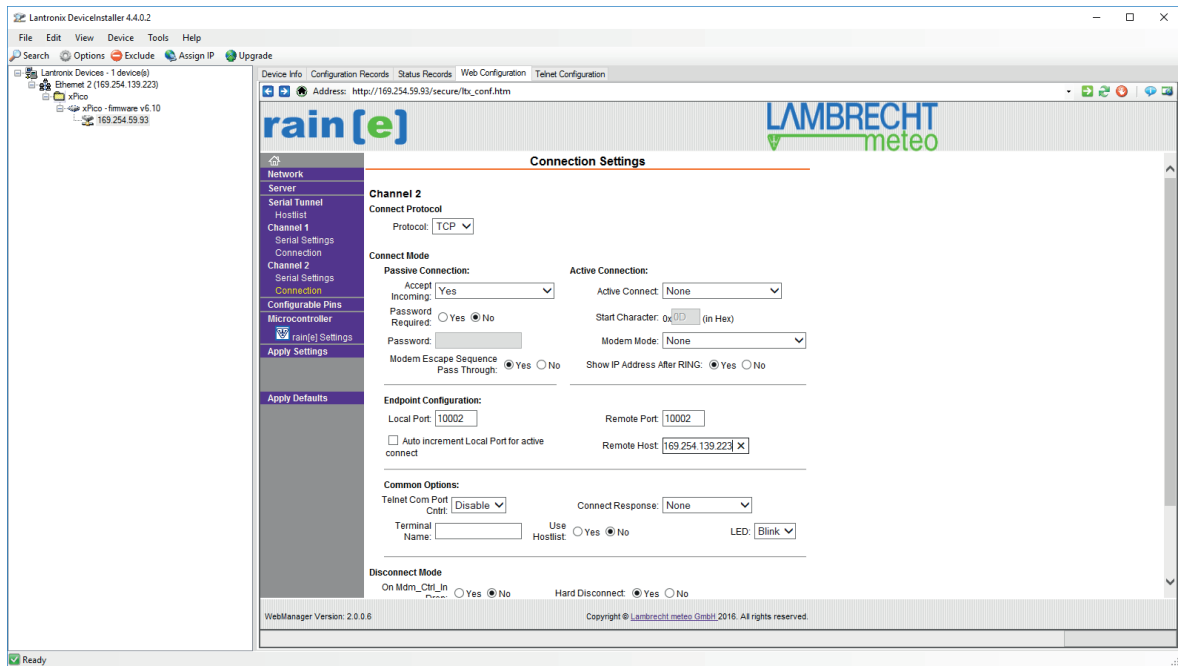
Now the web interface appears. Click “Network” on the left of web interface. Enter the computer IP under “IP Configuration” and confirm with “OK”.



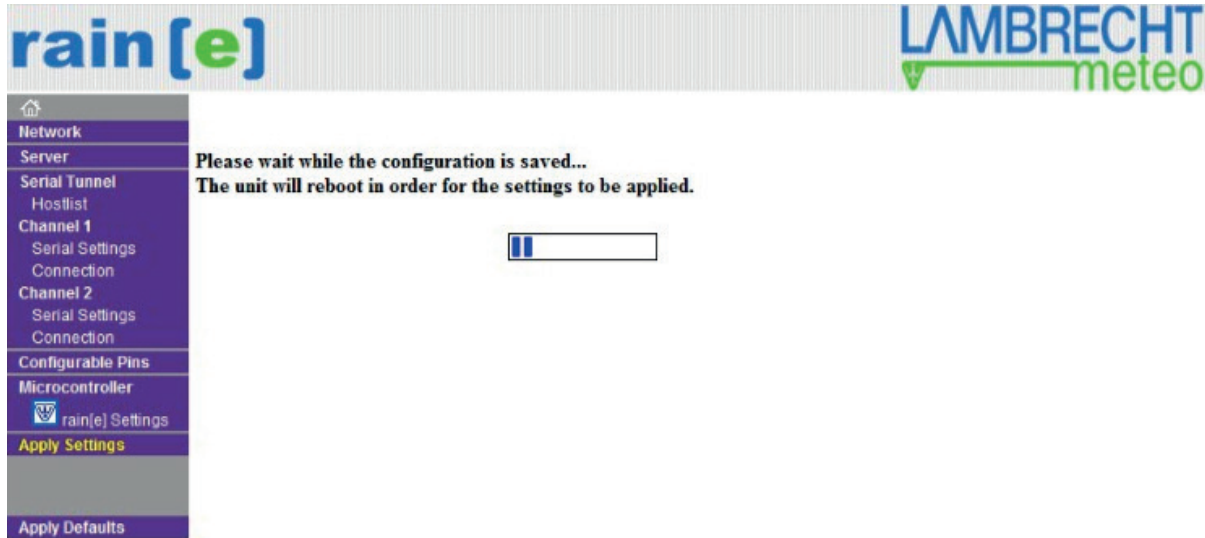
Now click on "Server" in the menu on the left. The port can be set under "HTTP Server Port".



Now open the "Channel 2/ Connection" menu item. There you can set the port and the IP address under "Endpoint Configuration". Then confirm with "OK".



Click “Apply Settings” to accept the settings. The remaining settings have already been configured at the factory.

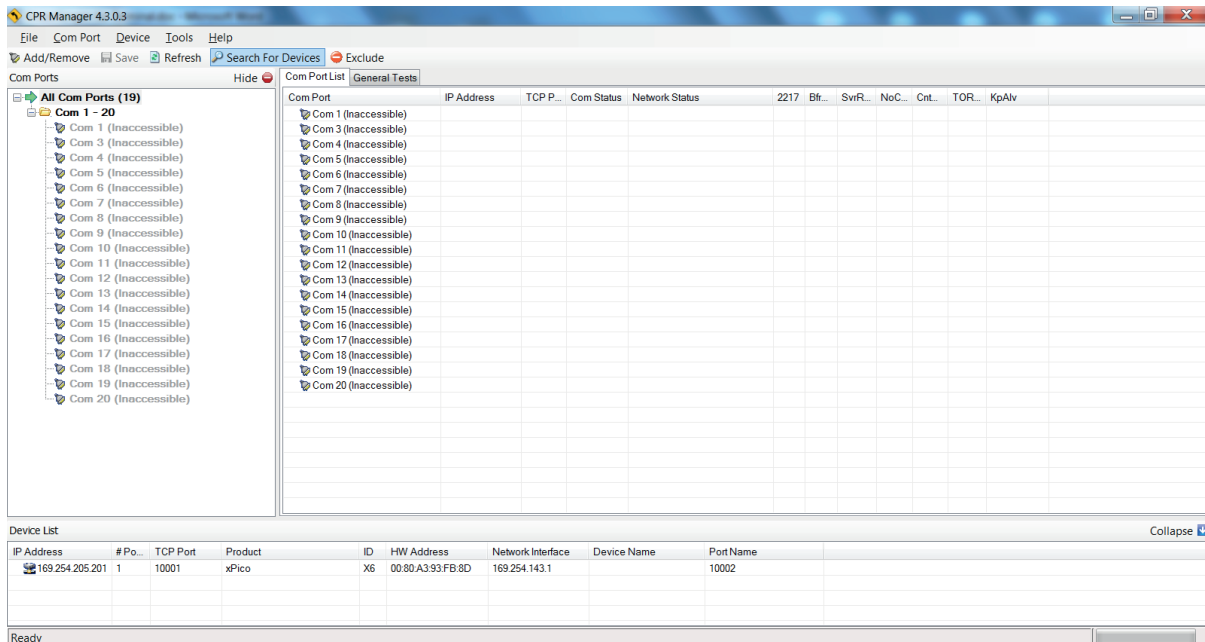


SETTINGS FOR TERMINAL

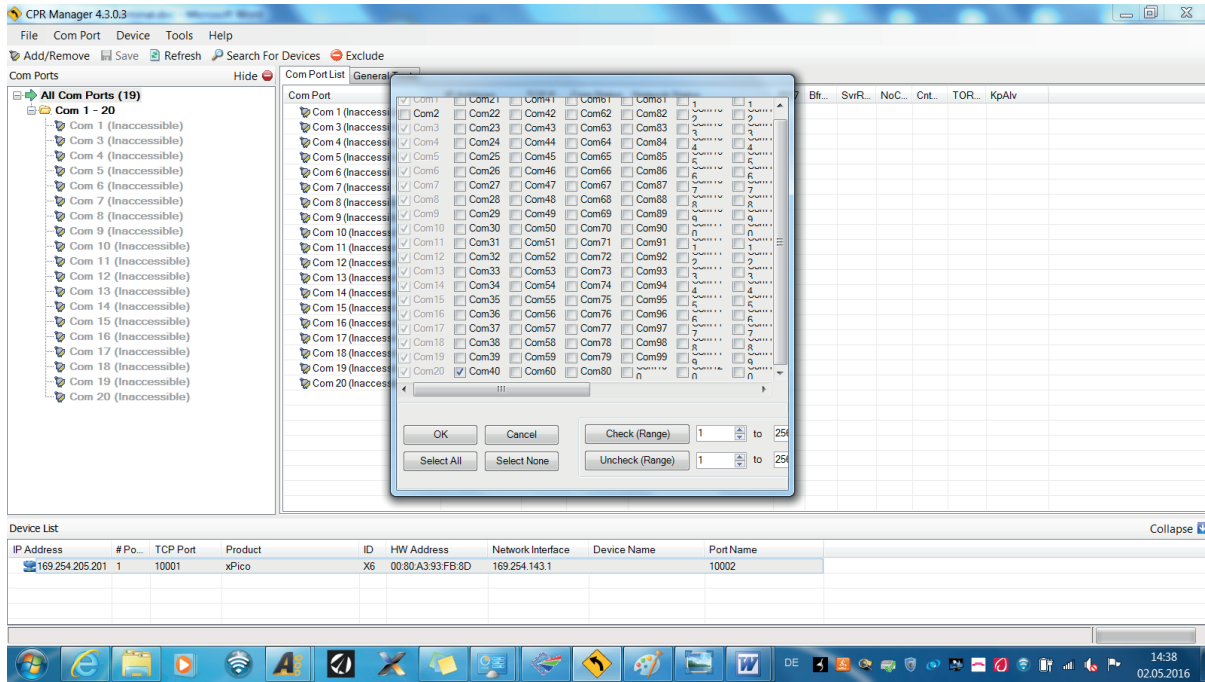
The following describes how data can be displayed on a terminal.

First install the Lantronix “Com Port Redirector“. The Lantronix “Com Port Redirector“ can be downloaded from the webpage: <https://www.lantronix.com/products/com-port-redirector/>.

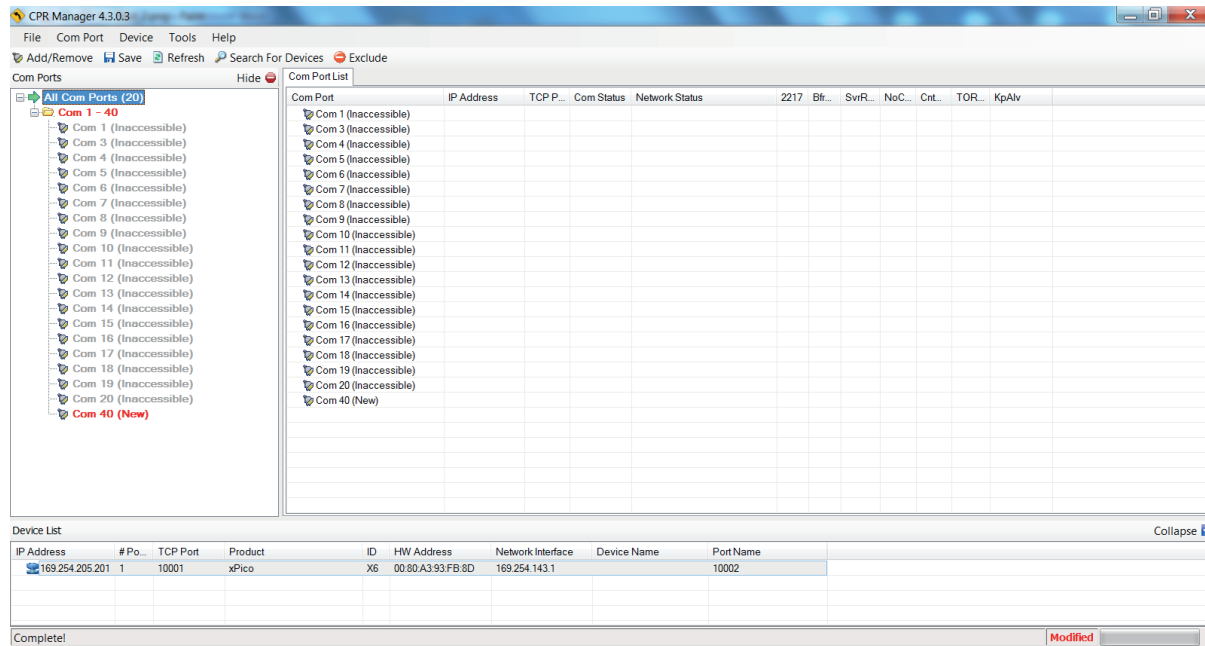
Then open the program and use the “Search“ button to search the device.



The available devices are given in the "Device List." Use the button "Add/Remove" to add and/or remove COM-Ports. Confirm by clicking "OK."

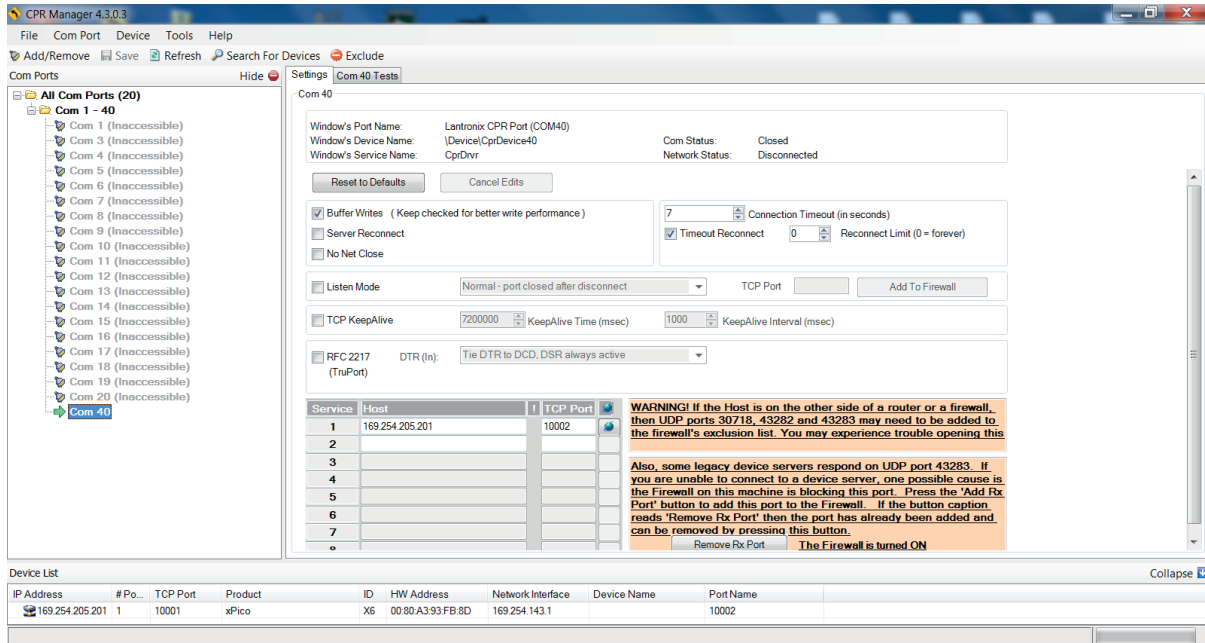


A new COM port will appear.



Now please select the COM port. Set the IP address of the device as well as the TCP port under “Host”. Save the settings with the “Save” button.

The COM port can now be used by any terminal for data output / input.



CONFIGURATION OF THE RAIN[E]H3 VIA THE WEB INTERFACE OF THE ETHERNET INTERFACE

It is possible to configure the rain[e]H3 via the web page stored in the Embedded Device Server. The web page provides a simple terminal for configuring the rain[e]H3 using the ASCII commands. The IP address of the deposited web page can be determined with the DeviceInstaller from Lantronix.

10 In- and Outputs

10.1 SDI-12 Interface

Communication using the SDI-12 protocol via the SDI-12 interface is based on the 'SDI-12 A Serial-Digital Interface Standard for Microprocessor-Based Sensors, Version 1.3, 2012'. The rain[e]H3 can be used in bus mode parallel to other rain[e]H3 sensors.

The following subset of SDI-12 commands are implemented in the rain[e]H3. For further details to the SDI-12 protocol we recommend the afore mentioned standard document or the web page www.SDI-12.org.

IMPLEMENTED SDI-12 COMMANDS

Command	Function	Answer of the sensor
a!	Acknowledge Active	a<CR><LF>
?!	Address Query Command	a<CR><LF>
al!	Send Identification	allccccccmmmmmmvvvxx...xx<CR><LF>
aAb!	Change Address	b<CR><LF>
aM!	Start Measurement	atttn<CR><LF>
aMC!	Start Measurement and Request CRC	atttn<CR><LF>
aC!	Start Concurrent Measurement	atttnn<CR><LF>
aCC!	Start Concurrent Measurement and Request CRC checksum	atttnn<CR><LF>
aD0! aD1!	Send Data (Puffer 0) Send Data (Puffer 1) resp. with CRC checksum	a<values><CR><LF> a<values><CRC><CR><LF>
aM1!	Generate Variance	atttn<CR><LF>
aM2!	Generate Heating Data	atttn<CR><LF>
aM3!	Start Intensity Measurement (Average Value, Maximum and Minimum)	atttn<CR><LF>
aMC1!	Generate Variance and Request CRC	atttn<CR><LF>
aMC2!	Generate Heating Data and Request CRC	atttn<CR><LF>
aMC3!	Start Intensity Measurement (Average Value, Maximum and Minimum and Request CRC)	atttn<CR><LF>
aC1!	Generate Variance	atttnn<CR><LF>
aC2!	Generate Heating Data	atttnn<CR><LF>
aC3!	Start Intensity Measurement (Average Value, Maximum and Minimum)	atttnn<CR><LF>
aCC1!	Generate Variance and Request CRC	atttnn<CR><LF>
aCC2!	Generate Heating Data and Request CRC	atttnn<CR><LF>
aCC3!	Start Intensity Measurement (Average Value, Maximum and Minimum and Request CRC)	atttnn<CR><LF>
aV!	Start Verification	atttn<CR><LF>

a = address of the respective sensor; standard sensor address = 0

SDI-12 commands always start with the address of the appropriate sensor. Therefore all other sensors on the same bus will ignore these commands. SDI-12 commands end with '!'. All answers from sensors start with its address, too, but end with the ASCII characters 'Carriage Return' <CR> and 'Line Feed' <LF>.

The SDI-12 protocol is based on the ASCII character set. The baud rate of the SDI-12 protocol is 1200 Bd and has the byte frame format:

- 1 start bit
- 7 data bits (least significant bit transmitted first)
- 1 parity bit (even parity)
- 1 stop bit.

Acknowledge Active - a!

This command ensures that the sensor responds to requests from the master. Basically it asks the sensor to confirm it is connected to the bus.

The sensor returns its address and <CR><LF>.

Syntax:

Command	Answer
a! a - Sensor address ! - End of command	a<CR><LF> a - Sensor address <CR><LF> - End of answer

Example:

Command	Answer
0!	0<CR><LF>
1!	1<CR><LF>

Send Identification - a!

The command **a!** is used to ask the sensor for its model number and firmware version.

Syntax:

Command	Answer
a! a - Sensor address ! - Command 'Send Identification'	a 13LMGmbH1515184x1.0781129.0001<CR><LF> a - Sensor address 13LMGmbH1515184x1.0781129.0001 13 - 2 characters SDI-12 version-No. 13 = version 1.3 LMGmbH15 - 8 characters manufacturer's name (= Lambrecht meteo GmbH) 15184x - 6 characters sensor type (= precipitation sensor rain[e]) 1.0 - Sensor version (= version 1) 781129.0001 - 11 characters serial No. <CR><LF> - End of answer
! - End of command	



Example:

Command	Answer
O! I!	013LMGmbH1515184x1.0781129.0001<CR><LF> 113LMGmbH1515184x1.0781129.0002<CR><LF>

Change Address - aAb!

The factory setting of the address is '0'. If there are several sensors connected to one bus, the sensor address can be changed with the command **aAb!**. The address is always a single ASCII character. Standard for addresses are the ASCII characters '0' to '9' (decimal 48 to 57). If there are more than 10 sensors connected to one bus, using the characters 'A' to 'Z' (decimal 65 to 90) and 'a' to 'z' (decimal 97 to 122) is allowed. The sensor answers with its new address and <CR><LF>. After the address changed, one should not send further commands to the sensor for a period of one second (see also 'SDI-12 Standard, Version 1.3, 2012').

Syntax:

Command	Answer
aAb! a – Old sensor address A – Command 'Change Address' b – New sensor address ! – End of command	b<CR><LF> b – New sensor address <CR><LF> – End of answer

Example:

Command	Answer
OAI!	I<CR><LF>

Start Measurement - aM!

The command **aM!** requests that the sensor process the returning string and provide the available measured data. In contrast to standard sensors described in the SDI-12 documentation the rain[e] measures continuously. Thus the measured values from the continuous measurement are stored in a buffer while the string is being processed. These values are processed after the string processing. Therefore the rain[e] always responds with 'a003x'. This is also the reason why the rain[e] does not send a Service Request and ignores signals to interrupt the measurement. Prior to the returned waiting time (3 s) the data logger must not send further commands. After expiration of the waiting time the data can be requested with the commands **aD0!** and **aD1!** (see **Send Data**).

The data will not be overwritten until the next **C**, **M**, or **V** command and can be read several times until then.

Syntax:

Command	Answer
aM! a – Sensor address M – Command 'Start Measurement' ! – End of command	a0036<CR><LF> a – Sensor address 003 – Seconds the sensor needs until the measured data can be returned (= 3 s) 6 – Number of provided measured data <CR><LF> – End of answer

Example:

Command	Answer
---------	--------

1M!	10036<CR><LF>
------------	----------------------------------

The measured data can be requested with the commands **aD0!** and **aD1!**. (see **Send Data**).

Start Measurement and Request CRC – aMC!

Same command as **aM!** but in addition to the generated data the sensor returns a 3-digit CRC checksum. For information on how the CRC checksum is generated, please consult 'SDI-12 Standard, Version 1.3, 2012, chapter 4.4.12'.

Syntax:

Command	Answer
---------	--------

aMC!	a0036<CR><LF>
a – Sensor address	a – Sensor address
M – Command 'Start Measurement and Request CRC'	003 – Seconds the sensor needs until the measured data can be returned (= 3 s)
C – Request for transmission of the CRC checksum	6 – Number of provided measured data
! – End of command	<CR><LF> – end of answer

Example:

Command	Answer
---------	--------

2MC!	20036<CR><LF>
-------------	----------------------------------

Start Concurrent Measurement – aC!

The **Concurrent Measurement** enables the data logger to measure simultaneously with multiple rain[e]s on the same bus.

The command **aC!** requests that the sensor process the returned string and to provide the available measured data.

In contrast to standard sensors described in the SDI-12 documentation, the rain[e] measures continuously. Thus the values during continuous measuring are stored in buffer while the string is being processed. These values are processed after the string processing. Prior to the return waiting time (3 s) the data logger must not send further commands. After expiration of the waiting time the data can be requested with the commands **aD0!** and **aD1!** (see **Send Data**).

The data will not be overwritten until the next **C**, **M**, or **V** command and can be read several times in the mean time.



Syntax:

Command	Answer
aC! a – Sensor address C – Command ‘Start Concurrent Measurement’ ! – End of command	a00306<CR><LF> a – Sensor address 003 – Seconds the sensor needs until the measured data can be returned (= 3 s) 06 – Number of provided measured data <CR><LF> – End of answer

Example:

Command	Answer
2C!	200306<CR><LF>

The measured data can be requested with the commands **aD0!** and **aD1!**. (see **Send Data**).

Start Concurrent Measurement and Request – CRC aCC!

Same command as **aC!** but in addition to the generated data the sensor returns a 3–digit checksum. For information on how the CRC checksum gets generated, please consult ‘SDI-12 Standard Version 1.3, 2012, chapter 4.4.12’.

Syntax:

Command	Answer
aCC! a – Sensor address C – Command ‘Start Concurrent Measurement’ C – Request for transmission of the CRC checksum ! – End of command	a00306<CR><LF> a – Sensor address 003 – Seconds the sensor needs until the measured data can be returned (= 3 s) 06 – Number of provided measured data <CR><LF> – End of answer

Example:

Command	Answer
2CC!	200306<CR><LF>

Send Data – aD0! and aD1!

Data generated by the commands **C**, **M**, or **V** are requested from the sensor with **aD0!** and **aD1!**. The sensor uses the respective arithmetic sign (+ or -) to separate the values. If the data was requested with a **CC** or **MC** command, it will be returned with the CRC checksum. For information on how the CRC checksum gets generated, please consult ‘SDI-12 Standard Version 1.3, 2012, chapter 4.4.12’.

The measured data is returned in metric units.

Measured data	Unit
Buffer 0	
Precipitation intensity within the last minute	mm/min
Precipitation intensity within the last minute in mm/h	mm/h
Precipitation intensity since last request	mm/min

Measured data	Unit
Buffer 1	
Precipitation intensity since last request in mm/h	mm/h
Precipitation amount since last request	mm/m ²
Precipitation amount total	mm/m ²

Syntax for measurements with aC! or aM!

Command

Answer

aD0!

a – Sensor address

D – Command ‘Send Data’

0 – Request for the data in buffer 0

or

1 = buffer 1

! – End of command

a<values><CR><LF>

a – Sensor address

<values> – Requested data separated by
resp. sign (‘+’ or ‘-’)

<CR><LF> – End of answer

Example:

Command

Answer

0C!

000306<CR><LF>

0D0!

0+0.100+6.000+0.100<CR><LF>

0D1!

0+6.000+12.000+25.231<CR><LF>

Syntax for measurement with aCC! or aMC!

Command

Answer

aD0!

a – Sensor address

D – Command ‘Send Data’

0 – Request for the data in buffer 0

or

1 = buffer 1

! – End of command

a<values><CR><LF>

a – Sensor address

<values> – Requested data separated by
resp sign (‘+’ or ‘-’)

<CRC> – 3-digit CRC checksum

<CR><LF> – End of answer



Additional Measurements

With the following commands additional information can be generated by the rain[e]H3 and requested with **aD0!**. The additional measurement commands **aMn!** and **aMCn!** have the same format as the commands **aM!** and **aMC!**. The same applies to the commands **aCn!** and **aCCn!** which have the same format as **aC!** and **aCC!**.

n	Function		Command	Answer										
1	Generation of the variance (period 4 s)		aM1!	a0031<CR><LF>										
			aC1!	a00301<CR><LF>										
			with CRC checksum	aMC1!	a0031<CR><LF>									
			aCC1!	a00301<CR><LF>										
2	Generation of the heating data <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th>Measured variable</th> <th>Unit</th> </tr> </thead> <tbody> <tr> <td>Buffer 0</td> <td></td> </tr> <tr> <td>Temperature interior</td> <td>°C</td> </tr> <tr> <td>Heating ON (1) / OFF (0)</td> <td></td> </tr> <tr> <td>Heating power total</td> <td>%</td> </tr> </tbody> </table>	Measured variable	Unit	Buffer 0		Temperature interior	°C	Heating ON (1) / OFF (0)		Heating power total	%		aM2!	a0033<CR><LF>
		Measured variable	Unit											
		Buffer 0												
		Temperature interior	°C											
		Heating ON (1) / OFF (0)												
		Heating power total	%											
aC2!	a00303<CR><LF>													
with CRC checksum	aMC2!	a0033<CR><LF>												
aCC2!	a00303<CR><LF>													
3	Generation of the data: precipitation intensity, average value, max. / min. intensity of the last x minutes*. <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th>Measured variable</th> <th>Unit</th> </tr> </thead> <tbody> <tr> <td>Buffer 0</td> <td></td> </tr> <tr> <td>Average value over x minutes*</td> <td>mm/min</td> </tr> <tr> <td>Max. intensity of the last x minutes*</td> <td>mm/min</td> </tr> <tr> <td>Min. intensity of the last x minutes*</td> <td>mm/min</td> </tr> </tbody> </table> The default value for the period x is 10 min. The value can be changed with the rain[e]H3 Commander.	Measured variable	Unit	Buffer 0		Average value over x minutes*	mm/min	Max. intensity of the last x minutes*	mm/min	Min. intensity of the last x minutes*	mm/min		aM3!	a0033<CR><LF>
		Measured variable	Unit											
		Buffer 0												
		Average value over x minutes*	mm/min											
Max. intensity of the last x minutes*	mm/min													
Min. intensity of the last x minutes*	mm/min													
aC3!	a00303<CR><LF>													
with CRC checksum	aMC3!	a0033<CR><LF>												
aCC3!	a00303<CR><LF>													

* The acquisition of these values starts with the command and they have to be requested after exactly x minutes with the aD0! command.

Start Verification – aV! (Error string)

For service purposes the command **aV!** can be used to do a system analysis and generate an error string. The command **aV!** has the same format as the command **aM!** (see above). The rain[e]H3 answers to the command **aV!** with 'a0039'.

Syntax:

Command	Answer
aV!	a0039<CR><LF>
a – Sensor address	a – Sensor address
V – Command 'Start Verification'	003 – Seconds the sensor needs until the measured data can be returned (= 3 s)
	9 – Number of provided data
! – End of command	<CR><LF> – End of answer

Example:

Command

Answer

IV!**10039<CR><LF>**

The measured data can be requested with the command **aD0!**. (see **Send Data**).

Data output	Value range
Buffer 0	
For internal use	0...99
Error due to exceeding of the heating temperature by 10° C	0 or 1
Error heating	0 or 1
Error interior temperature sensor	0 or 1
Error funnel temperature sensor	0 or 1
For internal use	0 or 1
For internal use	0 or 1
For internal use	0 or 1
For internal use	0 or 1

+0 = ok; +1 = error

The data will not be overwritten until the next **C**, **M**, or **V** command and can be read several times until then.

Remark to SDI-12 “Break” signal

Since the rain[e]H3 does not have a sleeping mode it does not have to be “awakened”. This means that the rain[e]H3 ignores the “**Break**” command. Therefore all regulations associated to the “**Break**” command do not have to be considered.

10.2 RS-485 Interface

In the following the available protocols of the RS-485 interface are described.

SDI-12 to RS-485, WL ASCII protocol, WL ASCII protocol with checksum.

10.2.1 SDI-12 Protocol

This is exactly the same protocol with the same commands as the SDI-12 protocol via RS-485 interface.

10.2.2 WL ASCII Protocol

As an alternative to the SDI-12 protocol the rain[e]H3 can also answer with a LAMBRECHT defined ASCII protocol via the RS-485 interface. It may be addressed every 10 s. It is recommended to work with 60 s intervals.

Commands in the WL ASCII protocol start with **<STX>** 'Start Text' and end with 'Carriage Return' **<CR>** and 'Line Feed' **<LF>**. Since addressing is not possible with the WL ASCII protocol, it can only be used with a single **rain[e]H3** and not in a bus.

The baud rate is 19200 Bd and has the byte frame format 8N1:
8 data bits · no parity bit (no parity) · 1 stop bit

Start Measuring <STX>m<CR><LF>

The command **<STX>m<CR><LF>** requests the sensor to process the returning string and to provide the available measured data. The **rain[e]H3** measures continuously. Thus measured values from the continuous measuring get stored into a buffer while the string is being processed. These values will be processed after the string processing.

Syntax:

Command	Answer
<STX>m<CR><LF> <STX> - Start of command m - Command 'Start Measuring' <CR><LF> - End of command	int_{min};int_h;int_{ret_min};int_{ret_h};am_{ret};am_{tot};s_{he};t_{in}<CR><LF> int_{min} - Intensity in mm/min int_h - Intensity in mm/h int_{ret_min} - Average intensity since last retrieval in mm/min int_{ret_h} - Average intensity since last retrieval in mm/h am_{ret} - Amount since last retrieval in mm am_{tot} - Total amount since system start in mm s_{he} - Heating Status (1 = ON, 0 = OFF) t_{in} - Temperature in °C <CR><LF> - End of answer

Command	Answer
<STX>m<CR><LF>	1.120;67.200;1.120;67.200;11.200;25.400;0;12<CR><LF>

Return Error String <STX>e<CR><LF>

For service purposes the command **<STX>e<CR><LF>** can be used to do a system analysis and generate an error string.

Syntax:

Command	Answer
<STX>e<CR><LF> <STX> - Start of command e - Command 'Return Error String' <CR><LF> - End of command	1;2;3;4;5;6;7;8;9;<CR><LF> 1 - For internal use 2 - Error exceeding of 10 °C at heating ON 3 - Error heating 4 - Error temperature sensor interior 5 - Error temperature sensor at the funnel 6 - Error initialisation RTC 7 - Error temperature sensor outside temperature 8 - Poor quality of supply voltage 9 - For internal use <CR><LF> - End of answer

+0 = ok; +1 = error

Example: Heating check failed

Command	Answer
<code><STX>e<CR><LF></code>	<code>3;0;1;0;0;0;0;0;<CR><LF></code>

Return Device Information <STX>i<CR><LF>

For service purpose the command `<STX>i<CR><LF>` can be used to ask the sensor for its serial number, board version, software version and serial number of the load cell.

Syntax:

Command	Answer
<code><STX>i<CR><LF></code>	<code>No;P;S;Serial;<CR><LF></code>
<code><STX></code> – Start of command	No – Serial No. of the device
<code>i</code> – Command 'Return Error String'	P – Board version
<code><CR><LF></code> – End of command	S – Firmware version
	Serial – Serial No. of the load cell
	<code><CR><LF></code> – End of answer

Example:

Command	Answer
<code><STX>i<CR><LF></code>	<code>801456.0010;1.3v;V1.00 v. 12.11.2013;2C096/0420000000;<CR><LF></code>

Read device information

The rain[e]H3 offers different status messages that can be read out with the following command:

Syntax:

`<STX>COM:02<CR><LF>`

Answer:

```
<STX>st1:LAMBRECHT meteo GmbH<CR><LF>
<STX>st2:METEOROLOGICAL INSTRUMENTS GERMANY<CR><LF>
<STX>st3:Sensor name : rain[e]H3<CR><LF>
<STX>st4:Sensor type : 15184<CR><LF>
<STX>st5:Serial numb.: xxxxxx.xxxx<CR><LF> Example: 820145.0001
<STX>st6:Art numb.: 00.15184.xxxxxx<CR><LF> Example: 00.15184.900004
<STX>st7:HW-Revision: x.xx<CR><LF> Example: 1.05
<STX>st8:Load_Cell_num.: xxxxxxxxxxxxxxxx<CR><LF> Example: 1234567890abcdef
<STX>st9:Firmware: V1.30 v. 01.05.2016<CR><LF>
```

Read out of the operating hours counter

The operating hours counter of rain[e]H3 can be read out with following command:

`<STX>COM:27<CR><LF>`

Answer:

`<STX>X<CR><LF>` with X = operating hours



Start Measurement Intensity <STX>a<CR><LF>

The command <STX>a<CR><LF> can be used to ask the sensor for the average, maximum and minimum intensity over a selected time frame. This time frame has to be selected in the “Setup” of the rain[e]H3 Commander.

Syntax:

Command	Answer
<STX>a<CR><LF>	int_{avr};int_{max};int_{mini};<CR><LF>
<STX> – Start of command	int_{avr} – Average intensity in mm/min
a – Command ‘Measurement Intensity’	int_{max} – Maximum intensity in mm/min
<CR><LF> – End of command	int_{mini} – Minimum intensity in mm/min
	<CR><LF> – End of answer

Example:

Command	Answer
<STX>a<CR><LF>	0.059;0.073;0.031;<CR><LF>

10.2.3 Talker Protocol

The Talker protocol is the third available mode of the RS-485 interface. It sends an ASCII string in a defined interval. The interval can be adjusted between 10...60 s using the rain[e]H3 Commander.

The baud rate is 19200 Bd and has the byte frame format 8N1:

- 8 data bits
- no parity bit (no parity)
- 1 stop bit

Syntax:

+int_{min};+int_h;+am_{tot};+s_{he};+t_{in};+s_{sys}<CR><LF>	<i>Temperature sensor indoor in °C</i>
int_{min} –	<i>Output e.g. +21.06 acc. 21.06 °C</i>
int_h –	<i>At heated sensors the heating test has to</i>
am_{tot} –	<i>be successful in order to assure that the</i>
s_{he} –	<i>temperature sensor will be initialized.</i>
t_{in} –	<i>If not, 0.00 will be shown.</i>
s_{sys} –	
<CR><LF> –	<i>End of answer</i>

The returned value of **s_{sys}** is a decimal representation of a binary number. In binary representation the positions correspond to the following status messages:

Bit position	Status message
0	1 = Error due to exceeding the heating temperature of 15°C
1	1 = Error heating
2	1 = Error interior temperature sensor
3	1 = Error funnel temperature sensor

Example: 15 °C ambient temperature, but heating is ON and defect interior temperature sensor

+0.059;+3.545;+7.701;+1;+15;+1<CR><LF>

10.2.4 Talker Protocol Normal

The normal talker string is structured as follows:

```
<STX>tn:A;B;C;D;E;F;G;H;I;J;K*CS<CR><LF>
```

- A = date in format YYYY.MM.DD (Y = year, M = month, D = day)
- B = time in format hh:mm:ss (h = hour, m = minute, s = second)
- C = precipitation intensity in mm/h
- D = total amount since system start in mm (accumulated precipitation)
- E = measurement Start / Stop (1 = Stop and 0 = Start (running))
- F = inner temperature above in °C
- G = inner temperature below in °C
- H = status of heating (1 = ON, 0 = OFF)
- I = error code
- J = Talker interval in seconds
- K = outside temperature in °C (no measured value = /)
- * = delimiter checksum
- CS = checksum (see chapter "Checksum")

10.2.5 Talker Protocol Extended

The extended talker string is structured as follows:

```
<STX>te:A;B;C;D;E;F;G;H;I;J;K;L;M;N;O*CS<CR><LF>
```

- A = date in format YYYY.MM.DD (Y = year, M = month, D = day)
- B = time in format hh:mm:ss (h = hour, m = minute, s = second)
- C = precipitation intensity in mm/h
- D = total amount since system start in mm (accumulated precipitation)
- E = measurement Start / Stop (1 = Stop and 0 = Start (running))
- F = inner temperature above in °C
- G = inner temperature below in °C
- H = status of heating (1 = ON, 0 = OFF)
- I = error code
- J = Talker interval in seconds
- K = device manufacturer: LAMBRECHT meteo
- L = device type: rain[e]H3
- M = user data storage 1
- N = firmware version number
- O = outside temperature in °C (no measured value = /)
- * = delimiter checksum
- CS = checksum (see chapter "Checksum")

The returned error code is a decimal representation of an originally binary number. In binary representation, the digits correspond to the following error messages:

Bit position	Status message
0	error maximum heating temperature threshold exceeded
1	1 = error heating
2	1 = error temperature sensor interior
3	1 = error temperature sensor at the funnel
4	1 = error initialization RTC
5	1 = error external temperature sensor
6	1 = poor quality of supply voltage

11 Modbus Protocol

The Lambrecht meteo Modbus sensors and the met[LOG] follow the specification of the Modbus organization: "MODBUS APPLICATION PROTOCOL SPECIFICATION V1.1b3" (see www.modbus.org).

11.1 Data Encoding

MODBUS uses the "big-endian" format for addresses and data. This means that if a value is transmitted with a number format that is larger than a single byte, the "most significant byte" is sent first. For values that go beyond one register (e.g. 32 bit) this is not clearly specified for the Modbus. In these cases (32 bit or 64 bit) the LAMBRECHT Modbus sensors follow the big-endian number format.

Example Big-Endian:

Register size value

16 - bits 0x1234 is transmitted in the order: 0x12 0x34.

Example big-endian (32 bit or 64 bit):

Register size value

32 - bits 0x12345678 is transmitted in the order: 0x12 0x34 0x56 0x78.

To obtain the real measuring value, divide the received register value by the divisor.

Values of -9999 (16 bit value) or -9999999 (32 bit value) indicate an internal sensor error.

11.2 Device Address

The addresses 1...247 are permitted for Modbus.

11.3 Standard Configuration - Default

Baud rate: 19200 Baud

Address: Each sensor type (or family) has its own default address.

Default addresses of the LAMBRECHT sensors:

Address	Sensor
1	Wind speed
2	Wind direction
3	Precipitation rain[e]
4	THP
5	EOLOS IND · u[sonic]WS6
6	com[b]
7	PREOS
8	ARCO
9	u[sonic]
10	Pyranometer 2nd Class
11	Secondary standard Pyranometer
12	PT100 to Modbus converter (temperature)
13	u[sonic]WS7

Byte frame according to MODBUS standard for RTU mode: 8E1 (1 start bit, 8 data bits, 1 parity bit (even parity), 1 stop bit)

11.4 Modbus Command Set

The LAMBRECHT Modbus sensors support the following commands:

- “Read Holding Register” command: 0x03 (descriptive sensor data registers)
- “Read Input Register” command: 0x04 (measured values registers, every measured value is to be requested individually)
- “Write Multiple Register” command: 0x10 (write to configuration registers)

11.5 Measured Value and Parameter Register Lambrecht Sensors

The register range 30001 to 35000 of the Lambrecht sensors is intended for measured values.

The following measured values are provided by the rain[e] precipitation sensors.

Register	Parameter name	Unit	Divisor	Quantity of registers	Access type	
31001	Precipitation amount total (standard resolution)	mm	10	1	Read only	INT
31101	Precipitation amount total (high resolution)	mm	1000	2	Read only	LONG
31103	Precipitation amount since last retrieval (high resolution)	mm	1000	2	Read only	LONG
31201	Precipitation intensity 1-minute sliding	mm/min	1000	1	Read only	LONG
34901	Status of sensor	-	1	1	Read only	LONG
34921	Status of heater	-	1	1	Read only	INT
34922	Internal temperature	°C	10	1	Read only	INT
34931	Total heating power in %	%	1	1	Read only	INT

The registers addresses 30001 to 35000 apply to all LAMBRECHT meteo Modbus sensors, but are only available or valid if the respective sensor supports the corresponding values. (e.g. a pure wind sensor does not provide any air humidity).

The LAMBRECHT sensors give 0xD8F1=-9999(16 bit) or 0xFF676981=-9999999 (32 bit) as error code or invalid value.

Example: Precipitation amount total (standard resolution)

03	04	79	19	00	01	F8	B3	03	04	02	00	01	01	30
----	----	----	----	----	----	----	----	----	----	----	----	----	----	----

LEN 6	Transmission Query =>	Source Master	Dest Slave 3	Function Read Input Register (4)	Func Desk Address=31001, Quantity of Register=1	Checksum OK:B3F8
LEN 5	Transmission Response <=	Source Slave 3	Dest Master	Function Read Input Register (4)	Func Desk Byte count=2	Data 00 01 Checksum OK:3001

Example: Precipitation amount total (high resolution)

03	04	79	7D	00	02	F9	6D	03	04	04	00	00	00	91	19	E8
----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----

LEN 6	Transmission Query =>	Source Master	Dest Slave 3	Function Read Input Register (4)	Func Desk Address=31101, Quantity of Register=2	Checksum OK:6DF9	
LEN 7	Transmission Response <=	Source Slave 3	Dest Master	Function Read Input Register (4)	Func Desk Byte count=4	Data 00 00 00 91	Checksum OK:E819

11.5.1 Special Case of Precipitation

Except for the amount of precipitation, all measured values are to be read in as instantaneous values. The amount of precipitation must be read in as a total amount. And the difference to the previous call must be formed for the displayed and the precipitation quantity to be stored.

! **Note:** The value overflow of the precipitation sum must be considered when calculating the difference. The value overflow occurs at 60,000 g of collected liquid. This results in a value overflow at 3,000 mm for sensors with a collecting surface of 200 cm² and a value overflow at 1,500 mm for sensors with a collecting surface of 400 cm².

11.6 Descriptive Sensor Parameter Registers (Holding Register)

Register	Parameter name	Quantity of registers	Remark	Access type
40050	Device identification number (15 characters)	8 (2 characters in each register)	The returned data are in form of a 16 byte null terminated string	Read only
40100	Serial number (11 characters)	6 (2 characters in each register)	The returned data are in form of a 12 byte null terminated string	Read only
40150	Firmware version (up to 25 characters)	13 (2 characters in each register)	The returned data are in form of a 26 byte null terminated string	Read only

Example: Retrieve the device identification number. (The identification number shown in the example is sensor-dependent. It is only used here for demonstration purposes.)

															ASCII	
05	03	9C	72	00	08	CB	C3	05	03	10	30	30	2E	31	36	□□□□□□□□□□□□□□
34	38	30	2E	30	30	30	31	33	30	00	37	CA				00.16480.000130□□

LEN 6	Transmission Query =>	Source Master	Dest Slave 5	Function Read Holding Register (3)	Func Desk Address=40050, Quantity of Register=8	Checksum OK:C3CB	
LEN 19	Transmission Response <=	Source Slave 5	Dest Master	Function Read Holding Register (3)	Func Desk Byte count=16	Data 30 30 2E 31 36 34 38 30 2E 30 30 30 31 33 30 00	Checksum OK:CA37

11.7 Sensor Parameters / Configuration Parameters

Register	Parameter name	Allowed values	Quantity of registers	Access type
40001	Modbus device address		1	Write only
40200	Baud rate	96 = 9600 192 = 19200	1	Write only
40201	Parity	1 = even 0 = none	1	Write only

The device must be restarted after each change of a setting!

Example: Change the RTU address from 3 to 1



LEN 9	Transmission Query =>	Source Master	Dest Slave 3	Function Write Multiple Register (16)	Func Desk Address=40001, Quantity=1	Byte count 2	Register values 00 01	Checksum OK:E82D
----------	-----------------------	---------------	--------------	---------------------------------------	-------------------------------------	--------------	-----------------------	------------------

LEN 6	Transmission Response <=	Source Slave 3	Dest Master	Function Write Multiple Register (16)	Func Desk Address=40001, Quantity=1	Checksum OK:6F7E
----------	--------------------------	----------------	-------------	---------------------------------------	-------------------------------------	------------------

11.8 Autoconfiguration

All Lambrecht Modbus sensors offer the experienced user the possibility to implement an auto-configuration in his Modbus master based on additional information stored in the sensor. The necessary information can be found in the document “General Manual for LAMBRECHT meteo Modbus Sensors”.

12 Total Precipitation

For the measurement of the precipitation amount from data set to data set via the serial protocols (e.g. SDI12, Talker, Modbus) the difference of the total precipitation amount to the previous value must be calculated.



Note: The value overflow of the precipitation total must be taken into account in the calculation of the difference. The value overflow occurs at 60000 g of collected liquid. This results in a value overflow at 3,000 mm for sensors with a collecting surface of 200 cm² and a value overflow at 1,500 mm for sensors with a collecting surface of 400 cm².

13 Output WL ASCII Protocol with Checksum

The measured values and data of rain[e]H3 can be called in polling mode with different commands or sent with a configurable output interval in talker mode automatically from rain[e].

In this protocol the sensor can be called every 10 s. We suggest intervals of 60 s. Commands in WL ASCII protocol start with "<STX>" (start text) and end with "<CR>" (carriage return) and "<LF>" (line feed). As in the protocol no addressing is possible it can not be used in RS-485 bus but only with single rain[e]H3.

rain[e]H3 knows the following call commands:

- read out user data
- read out status
- call data / polling
- call of the last talker protocol
- read out operation-hour counter

The data call commands request that the sensor create the output string from the existing measurement data. As rain[e]H3 measures continuously all measured values during a creation of output strings are saved in a buffer. When the string is ready the values from the buffer are processed.

The following description contains the following control characters:

<STX> = Start of Text

<CR> = Carriage return

<LF> = Line feed

13.1 Data Telegram Type 1

Syntax:

<STX>USR1<CR><LF>

Answer:

<STX>t1:A;B;C;D;E;F;G;H*CS<CR><LF>

- A = precipitation intensity in mm/min
- B = precipitation intensity in mm/h
- C = average intensity since last call in mm/min
- D = average intensity since last call in mm/h
- E = amount since last call in mm
- F = total amount since system start in mm
- G = status of heating (1 = ON, 0 = OFF)
- H = inner temperature below in °C
- * = delimiter checksum
- CS = checksum (see chapter "Checksum")

13.2 Data Telegram Type 2

Syntax:

<STX>USR2<CR><LF>

Answer:

<STX>t2:A;B;C;D;E;F;G;H;I;J*CS<CR><LF>

- A = date in format YYYY.MM.DD (Y = year, M = month, D = day)
- B = time in format hh:mm:ss (h = hour, m = minute, s = second)
- C = precipitation intensity in mm/h
- D = total amount since system start in mm (accumulated precipitation)
- E = measurement Start / Stop (1 = Stop and 0 = Start (running))
- F = inner temperature above in °C
- G = inner temperature below in °C
- H = status of heating (1 = ON, 0 = OFF)
- I = error code
- J = outside temperature in °C (no measured value = /)
- * = delimiter checksum
- CS = checksum (see chapter "Checksum")

The returned error code is a decimal representation of an originally binary number. In binary representation, the digits correspond to the following error messages:

Bit position	Status message
0	error maximum heating temperature threshold exceeded
1	1 = error heating
2	1 = error temperature sensor interior
3	1 = error temperature sensor at the funnel
4	1 = error initialization RTC
5	1 = error external temperature sensor
6	1 = poor quality of supply voltage



13.3 Data Telegram Type 3

Syntax:

<STX>USR3<CR><LF>

Answer:

<STX>t3:A;B;C;D;E;F;G;H;I;J;K;L;M;N*CS<CR><LF>

- A = date in format YYYY.MM.DD (Y = year, M = month, D = day)
- B = time in format hh:mm:ss (h = hour, m = minute, s = second)
- C = precipitation intensity in mm/h; range of values: 0.000–30.000
- D = total amount since system start in mm (accum. precipitation), range of values: 0.000–9999.000
- E = measurement Start / Stop (1 = Stop and 0 = Start (running)); range of values: 0–1
- F = inner temperature above in °C; range of values: -55.00–125.00
- G = inner temperature below in °C; range of values: -55.00–125.00
- H = status of heating (1 = ON, 0 = OFF); range of values: 0–1
- I = error code; range of values: 0–255
- J = device manufacturer: LAMBRECHT meteo
- K = device type: rain[e]H3
- M = firmware version number; range of values: 0.00–9.99
- N = outside temperature in °C (no measured value = /); range of values: -55.00–125.00
- * = delimiter checksum
- CS = checksum (see chapter “Checksum”)

The returned error code is a decimal representation of an originally binary number.

In binary representation, the digits correspond to the following error messages:

Bit position	Status message
0	error maximum heating temperature threshold exceeded
1	1 = error heating
2	1 = error temperature sensor interior
3	1 = error temperature sensor at the funnel
4	1 = error initialization RTC
5	1 = error external temperature sensor
6	1 = poor quality of supply voltage

13.4 Get Error String

With the following command a separate error string with the current errors can be called.

Value 0 = OK; Value 1 = Error.

Syntax:

<STX>USR8<CR><LF>

Answer:

<STX>e:A;B;C;D;E;F;G;H;I*CS<CR><LF>

- A = for internal use
- B = error exceeding of 10 °C at heating ON
- C = error heating
- D = error temperature sensor interior
- E = error temperature sensor at the funnel
- F = error initialization RTC
- G = error temperature sensor outside temperature
- H = poor quality of supply voltage
- I = for internal use
- * = delimiter checksum
- CS = checksum (see chapter “Checksum”)

13.5 Read User Data

The user data is read out in the block (all 8 values) with the following command. Each value is returned in a separate line with its own checksum per line.

Syntax:

```
<STX>COM:31<CR><LF>
```

Answer:

```
<STX>USR_MEM_ 1:abcdefghijklmnop<CR><LF>
```

```
1 = User data storage 1
2 = User data storage 2
3 = User data storage 3
4 = User data storage 4
5 = User data storage 5
6 = User data storage 6
7 = User data storage 7
8 = User data storage 8
```

13.6 Checksum

The checksum of a data telegram is calculated from the sum of all signs (alphanumeric signs and control codes like STX until "*" but without the checksum bytes themselves). The control characters <CR> and <LF> that follow the checksum are not part of the calculation.

The checksum will be calculated as follows:

1. From the sum the two's complement is calculated
2. From the two's complement the lower byte is considered
3. The upper and lower half-byte, changed to readable ASCII signs, are the checksum.

Example:

```
<STX>1234567890*C7<CR><LF>
```

```
<STX>1234567890* ist C7
```

13.7 Pulse Output

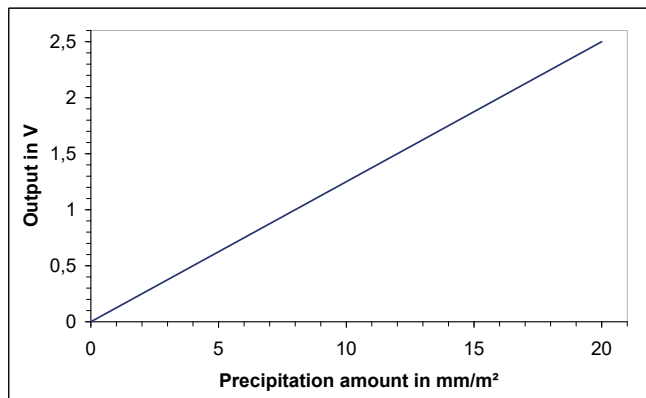
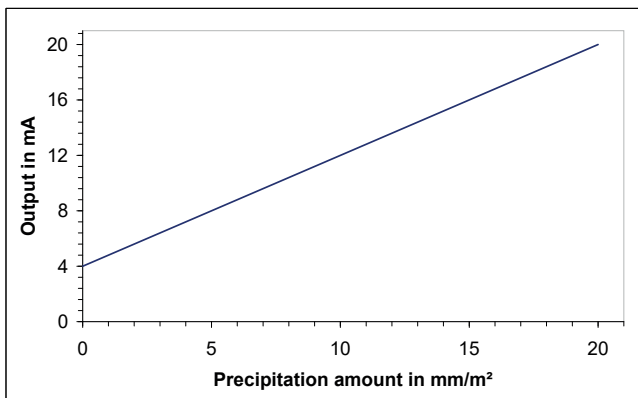
Each pulse corresponds to a predefined amount of measured precipitation. The resolution factor range is 0.01...200 mm per pulse. This resolution factor can be configured with the rain[e]H3 Commander along with the closing time / pulse width. The duty cycle is 50%, in other words the closing time has the same length as the pause time.

If more pulses have to be returned than possible with the given resolution and closing time, the remaining pulses will be queued and returned as soon as there are no new pulses added. This means e. g. that if a closing time of 200 ms and a resolution factor of 0.01 is chosen - equivalent to 300 pulses per minute - and it is raining with an intensity of 4 mm/min for two minutes and 1.9 mm/min thereafter - equivalent to 190 pulses per minute, the pulse output will return 300 pulses in each of the first two minutes and another 200 pulses will be queued. In the third minute again 300 pulses will be returned - 190 for the intensity in that minute and 110 from the queue. Accordingly 280 pulses will be returned in the fourth minute and 190 pulses in the following minutes, since there are no further pulses left in the queue.

13.8 Analog Output

ABSOLUTE SUM OF PRECIPITATION

In this operating mode the accumulated amount of precipitation is returned as an increasing analogue signal corresponding to the amount of precipitation. The output can be configured to return the amount as an increasing current or an increasing voltage. If the maximum value of the selected range, e. g. 20 mA for a range of 4...20 mA is exceeded, a new summation starts, i. e. the analogue signal starts again on the lower end of the scale - resulting in a sawtooth diagram. The resolution is defined by the chosen scale maximum corresponding to the maximum of the output signal. The scale maximum as well as the output mode and output signal range can be configured with the rain[e]H3 Commander.



14 Inspection and Troubleshooting

- Visual checks for contamination should be done on a regular basis - depending on the environment and seasonal situation (spider and bird population, pollen, leaf fall). According to chapter 6 of the “VDI Guidelines – Environmental meteorology – Meteorological measurements – Precipitation, VDI 3786 Part 7 (December 2010)” we recommend monthly checks. In areas with high air pollution weekly checks might be necessary to ensure correct measuring results.
- All water-bearing parts should be cleaned regularly. Rinsing should be sufficient to clean the sensor from most contamination. Dirt clinging to the collecting vessel or outlet pipe has to be removed carefully. Slight pollution of the collecting vessel is not critical. The collecting vessel can be cleaned with water and a mild detergent.
- Make sure the instrument is in a stable and perpendicular position and check the ring, the funnel surface and the sensor for damages.
- Keep the measurement site free from overgrowing vegetation.
- The bird defense ring has to be removed before the frost period.



Please be careful while cleaning the collecting vessel to prevent it from taking damage.

The rain[e]H3 and the collecting vessel must not be cleaned with steel brushes or similar tools or aggressive detergents.

Funnel heating and drain heating can be very hot if the heating is operated with the opened housing.

There is a risk of being burnt! It is therefore recommended to disconnect the connector of the heating supply during cleaning and maintenance work.

14.1 Cleaning

The rain[e]H3 and the collecting vessel must not be cleaned with a steel brush or similar equipment or aggressive detergents.

All water-bearing parts should be cleaned regularly. Rinsing with clear water is sufficient in most cases to remove contamination. It is necessary to be carefully to remove the dirt in the collecting funnel or in the discharge. Slight contamination of the collecting vessel is not critical (for example, pollen or dust). The collecting vessel can be cleaned with water and a mild detergent.

Keep the measuring station free from overgrown scrubs and trees.

Caution is required when cleaning the collecting vessel to avoid damage.

14.1.1 Cleaning of the Top of the Housing (Funnel)

Open the housing as described.

Pull the connector to the upper heater.

Hold the upper part of the housing with one hand and hold with the same hand the cable with the clamping connector so that no dirt or water can run into the clamping connector during cleaning. Rinse the funnel with plenty of clear water. Solid dirt can be removed with a mild detergent and a cleaning cloth.

If a mild detergent has been used for cleaning, rinse the funnel with plenty of clear water.

If necessary, remove the dirt trap spiral for cleaning and then reinsert it.

When handling with the upper part of the housing, ensure that the housing edge of the collecting surface is not damaged!

After cleaning, reinsert the plug connector to the upper heating on the heating board.

Close the housing as described.

14.1.2 Cleaning of the Dirt Trap Spiral

To do this, grasp the dirt trap spiral in such a way that you can turn it counterclockwise a whole turn, and pull the dirt trap spiral upwards out of the mouth of the funnel.

Clean the dirt trap spiral with a small brush and/or put it in some water with a mild detergent to rinse off the dirt. Finally rinse the dirt trap spiral with plenty of clear water.

Reinsert the dirt trap spiral into the funnel. Try to hold the dirt trap spiral in such a way, that a full counter clockwise turn is possible and push the dirt trap spiral from above into the mouth of the funnel.



14.1.3 Cleaning of the Protective Grid

Open the housing as described. Carefully lift off the inner protective cylinder. When lifting the protective cylinder, be careful not to bump it against the load cell.

Press the protective grid slightly upwards through one of the drain holes with the small finger or a suitably dull object (e.g., wooden stick) and remove it with the other hand.

Clean the protective grid with a small brush and/or place it in some water with detergent to rinse off the dirt.

Insert the cleaned protective grid lateral to the load cell into the provided gap.

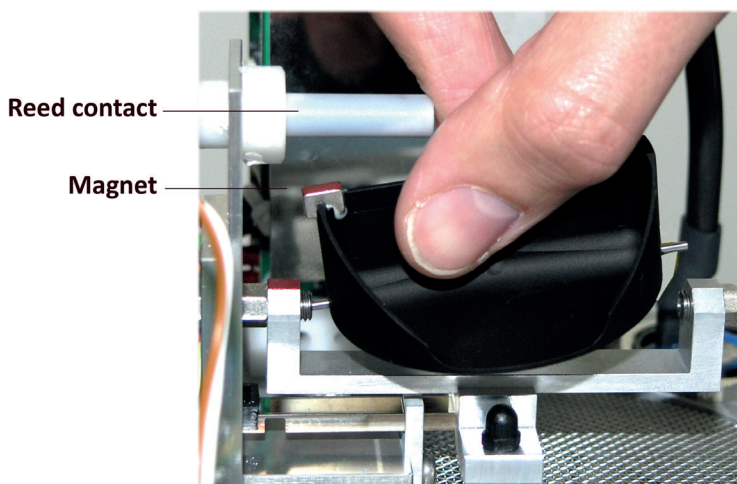
Avoid contact with the load cell when inserting the protective grid!

Be careful not to cant the protective cylinder with the cables between the load cell and the main board. Close the housing as described.

14.1.4 Cleaning of the Collecting Vessel

Open the housing as described.

Carefully lift off the inner protective cylinder. When lifting the protective cylinder, be careful not to bump it against the load cell. Remove the collecting vessel by gently pushing the axle pin of the collecting vessel with the magnetic side in the direction of the reed contact against the bearing spring and tipping the axle pin on the other bearing side.



The collecting vessel can be cleaned with water and a mild detergent.

No sharp objects should be used to clean the collecting vessel!

Rinse the collecting vessel with plenty of clear water.

Insert the cleaned collecting vessel into the axle bearing. To do so, slide the axle pin of the collecting vessel into the bearing spring with the magnetic side in the direction of reed contact and insert the other axle pin into the other bearing side. **Be careful when inserting!**

Check that the collecting vessel is tilted correctly.

Be careful not to damage the protective cylinder with the cables between the load cell and the main board. Close the housing as described.

14.2 Troubleshooting

rain[e]H3 no longer reacts via the RS-485 interface

Only hieroglyphs are received or the rain[e]H3 no longer reacts via the RS-485 interface.

Possible cause: RS-485 interface configuration such as baud rate, data bits, parity, stop bits have been adjusted.

Troubleshoot:

Check the communication configuration of the terminal.

The rain[e]H3 can always be reached and configured via the USB interface and the rain[e]H3 Commander.

Alternatively, the rain[e]H3 can be reached and configured via the Ethernet interface at a known IP address.

Error message when retrieving data from the rain[e]H3 with the rain[e]H3 Commander

The rain[e]H3 can not be reached with the rain[e]H3 Commander.

Possible cause: The USB driver has triggered an internal error.

Troubleshoot:

Please disconnect the USB cable, reconnect it and restart the rain[e]H3 Commander.

rain[e]H3 Commander shows “COM port not found!” or “rain[e]H3 does not answer”

Possible cause:

1) The USB cable is not connected.

Troubleshoot:

Check that the rain[e]H3 is properly connected to the PC. If necessary, connect the USB cable to rain[e]H3 and PC.

2) The correct COM interface has not been selected.

Troubleshoot: Check whether the correct COM interface has been selected.

3) Main board defective

Check the LED: In normal operation, it flashes at 20 Hz, which is perceived as “flicker”. If the rain[e]H3 transmits a data string, the LED is permanently on for a short time and then flashes again.

If, however, the LED lights up permanently, goes out again, remains lit permanently, a hardware defect is present

Troubleshoot: The weighing unit (main board with load cell and collecting vessel) must be replaced.

14.3 Error Codes

rain[e]H3 knows the following errors:

- Error: the maximum heating temperature threshold was exceeded
- Error heating
- Error temperature sensor below (interior)
- Error temperature sensor above (funnel and ring)
- Error initialization RTC (Real-Time-Clock)
- Error external temperature sensor
- Error poor quality of supply voltage



14.3.1 Error Heating Temperature Exceeded

The error is raised if one of the internal temperature sensors has registered a temperature in excess of the configured "Maximum heating temperature". On the factory side, the threshold of the maximum heating temperature is 10 °C.

In this case the rain[e]H3 switches the heating OFF until the maximum heating temperature is reached.

Possible cause	Troubleshoot
The target temperature above or below is set too high.	The values of the maximum heating temperature and the target temperature above or below are too close together. Either the Maximum heating temperature must be raised or the target temperature above resp. below should be lowered (maximum permissible value in each case 40 °C).
Heating board defective!	Replacement heating board

After troubleshooting, please restart the rain[e]H3.

14.3.2 Error Heating

The error is raised if there is not enough heating power available and the heating current (internally measured) falls below the threshold of 5.1 A.

Possible cause	Troubleshoot
Cable too long	The heating works nevertheless, but does not work with the full power. Replace the cable with a larger wire cross-section or multiple wires.
Cable cross section too small	The heating works nevertheless, but does not work with the full power. Replace the cable with a larger wire cross-section or multiple wires.
Power supply defective	Replace the power supply.
Heating cable defective or not connected	Replace the defective cable or connect the cable according to the connection diagram.
Internal heating connector (above) not plugged in	Then the error flag "Fault temperature sensor above" is also set. Plug the heating connector to the heating board.
Heating element defective	Check the resistance of the heating elements on the terminals. If this is high-impedance, replace the heating element. In order to determine whether the heating element is defective, you can also set in the laboratory the maximum heating temperature and the target temperatures (above and below) to 10 °C above the ambient temperature and feel which heating does not heat up.

After troubleshooting, please restart the rain[e]H3.

14.3.3 Error Temperature Sensor Below

The error is raised when the lower temperature sensor no longer supplies data for monitoring the heating.

Possible cause	Troubleshoot
Internal heating connector (small plug at the bottom) not plugged in	Check the plug and, if necessary, plug it into the heating board.
The temperature sensor below is defective	The temperature sensor below does not provide any data. The temperature sensor must be exchanged together with the weighing unit.

After troubleshooting, please restart the rain[e]H3.

14.3.4 Error Temperature Sensor Above

The error is raised when the upper temperature sensor no longer supplies data for monitoring the heating.

Possible cause	Troubleshoot
Internal heating connector (top) not plugged in	Then the error flag "Fault heating" is also set. Plug the heating connector to the heating board.
The upper temperature sensor is defective	The temperature sensor above does not provide any data. The temperature sensor must be exchanged together with the upper housing (including ring and funnel heating).

After troubleshooting, please restart the rain[e]H3.

14.3.5. Error Initialization RTC (Real-Time Clock)

The error is raised if the initialization of the RTC (Real-Time Clock) fails.

Possible cause	Troubleshoot
Connecting cable between main board and heating board not plugged in	Reconnect the connecting cable of the main board to the heating board. The plug snaps into place with a click sound.
Heating board defective!	Replacement heating board

After troubleshooting, please restart the rain[e]H3.

14.3.6. Error External Temperature Sensor

The error is raised if the external temperature sensor no longer provides data for estimating the type of precipitation.

Possible cause	Troubleshoot
Internal heating connector (top) not plugged in	Then the error flag "Fault heating" is also set. Plug the heating connector to the heating board.
The outside temperature sensor is defective	The outside temperature sensor does not provide any data. The temperature sensor must be replaced.

After troubleshooting, please restart the rain[e]H3.

14.3.7 Error Quality of Supply Voltage

The error is raised if the quality of the voltage supply fluctuates strongly.

Possible cause	Troubleshoot
External power supply defective!	Check the external power supply and replace the power supply unit if necessary.
Cable defective (loose contact)	Check the supply cable and the connection terminals, or replace the cable if necessary.

After troubleshooting, please restart the rain[e]H3.

15 Repair

Before any repairs on the electronics, it is recommended that the sensor be switched off. The rain[e]H3 has an internal switch via which the sensor detects whether the sensor housing is open. When the housing is open or not locked, the rain[e]H3 stops the measurement until the housing is closed again.

15.1 Repairs on Site

The following repairs can be carried out on site:

- Replacing the dirt trap spiral
- Replacing the protective grid
- Replacing the collecting vessel
- Replacing the upper part of the housing, including upper heating and upper temperature sensor
- Replacing the protective cylinder
- Replacing the mounting screws (M8x20)
- Replacing the knurled screw
- Replacing the level

15.1.1 Replacing the Dirt Trap Spiral

REMOVE THE DIRT TRAP SPIRAL

To do this, grasp the dirt trap spiral (Id-No. 33.15180.049000) such that you can turn it counterclockwise a whole turn, and pull the dirt trap spiral upwards out of the mouth of the funnel.

INSERT THE DIRT TRAP SPIRAL

Reinsert the dirt trap spiral into the funnel. Try to hold the dirt trap spiral such that you can perform one counter clockwise turn and push the dirt trap spiral from above into the mouth of the funnel.

15.1.2 Replacing the Protective Grid

Open the housing as described. Carefully lift off the inner protective cylinder. When lifting the protective cylinder, be careful not to bump it against the weighing unit.

Press the protective grid (Id-No. 33.15184.016000) slightly upwards through one of the drain holes with the small finger or a suitable dull object (e.g., wooden stick) and remove it with the other hand. Insert the cleaned or a new protective grid on the side of the weighing unit into the provided gaps.

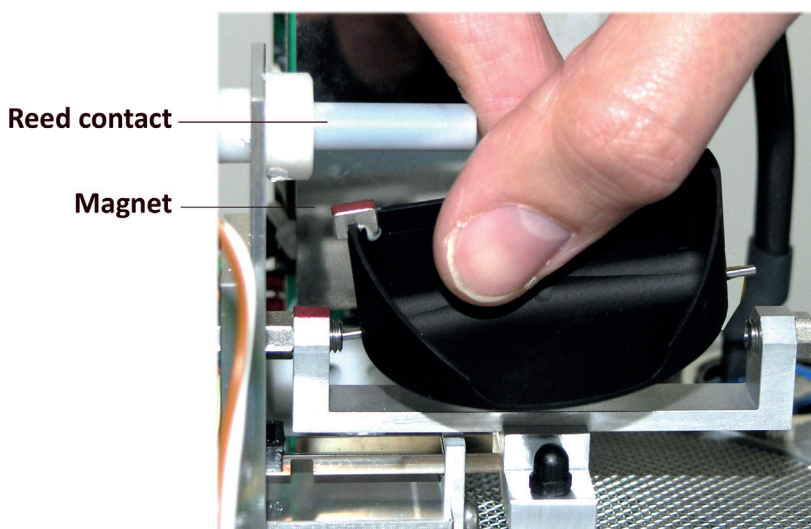
Avoid contact with the weighing unit when inserting the protective grid!

Close the housing as described.

15.1.3 Replacing the Collecting Vessel

Open the housing as described.

Carefully lift off the inner protective cylinder. When lifting the protective cylinder, be careful not to bump it against the weighing unit.



Remove the collecting vessel (Id-No. 32.15184.004000) by gently pushing the axle pin of the collecting vessel with the magnetic side in the direction of the reed contact against the bearing spring and tipping the axle pin on the other bearing side. Insert the cleaned or a new collecting vessel into the axle bearing. To do so, slide the axle pin of the collecting vessel into the bearing spring with the magnetic side in the direction of reed contact and insert the other axle pin into the other bearing side.

Be careful when inserting!

Be careful not to cant the protective cylinder with the cables between the load cell and the main board. Close the housing as described.

15.1.4 Replacing the Upper Part of the Housing, including Upper Heating, and Upper Temperature Sensor

Open the housing as described.

Unplug the clamping connector to the upper heater and set the old housing aside. Take the new housing (Id-No. 32.15184.011010) and plug the clamping connector to the heating unit back onto the heating board.

When handling with the upper part of the housing, make sure that the housing edge is not damaged. Close the housing as described.

15.1.5 Replacing the Protective Grid

Open the housing as described.

Carefully lift off the inner protective cylinder (Id-No. 32.15184.006010). When lifting the protective cylinder, be careful not to bump it against the weighing unit. Carefully position the new protective cylinder. Do not allow the protective cylinder to be jammed with the cables between the load cell and the main board.

Close the housing as described.

15.1.6 Replacing the Mounting Screws (M8x20)

Tools required: 13 mm jaw, ring or socket wrench

Remove the 3 old hexagon socket screws M8x20 (Id-No. 35.09331.540300) and replace with new ones.

Open the housing as described.

Level the device by means of the spirit level and fix the sensor by evenly tightening the hexagon screws on the base of the mast.

Close the housing as described.

15.1.7 Replacing the Knurled Screw

Remove the old knurled screw (Id-No. 35.04641.525000) and replace with a new one.

15.1.8 Replacing the Level

Tools required: Pliers

Adjuvant: Loctite 274

Open the housing as described.

The spirit level has a screw thread and can be turned using a pliers.

Wet the screw thread of the new level with some Loctite 274 and screw in the level by hand.

Close the housing as described.

15.2 Repairs in the Workshop

The following repairs are much more complex than those described above and must therefore be carried out in a specialist workshop.

- Replacing the heating board
- Replacing the external temperature sensor
- Replacing the M12 connector, 4-pin, A-coded
- Replacing the M12 connector, 4-pin, T-coded
- Replacing the M12 connector, 4-pin, D-coded

Before all maintenance work, the sensor must be disconnected from the power supply.

If screws or small parts are lost during repair, they can be bought as a whole packaging unit at LAMBRECHT meteo.

15.2.1 Replacing the Heating Board

Tools required: Torque wrench with Torx bit Tx20 length 80mm, Torx wrench Tx10

Adjuvants: Loctite 274, Elastosil E41

In the case of damage to one of the components of the heating board, only the entire unit can be replaced economically (Id-No. 37.15184.003000). (See also chapter "Equipment and Spare Parts")

The set includes:

- 1x Heating board mounted on bracket with spacer
- 2x Torx cylinder screw M4x16 (for mounting on sensor foot)
- 1x Protective sheet
- 4x Torx cylinder screws M3x6

Open the housing as described and remove the protective cylinder. Pull the clamping connector toward the upper heating and place the housing aside. Loosen all the wires from the clamps on the heating board by pressing the white release buttons. (Press the button, pull out the cable).

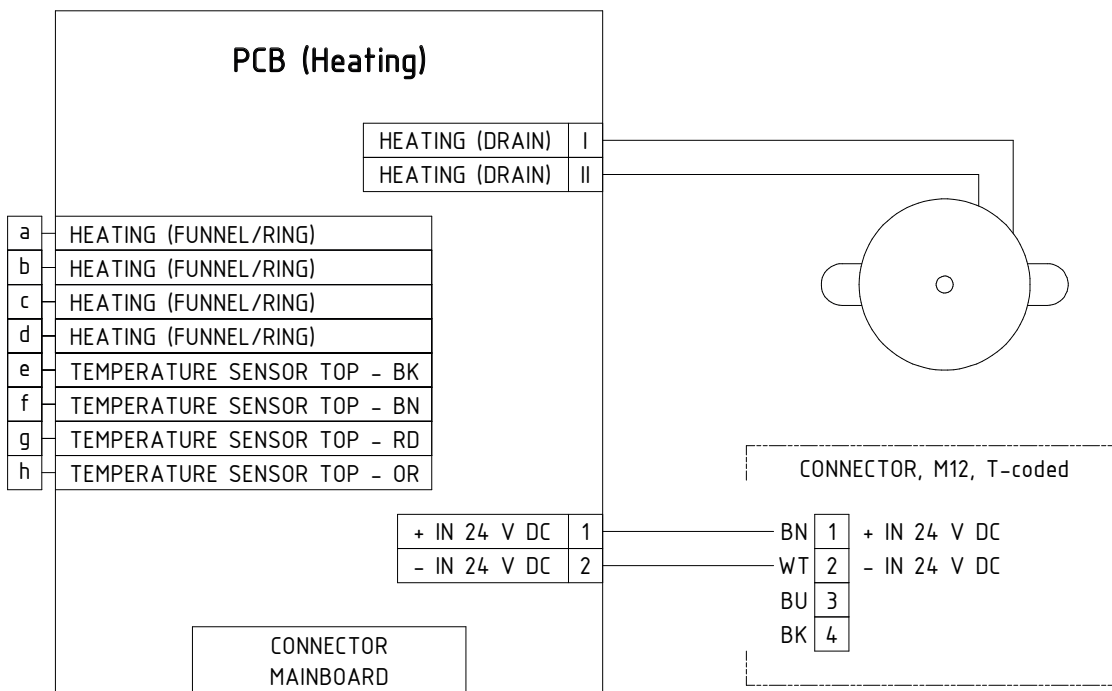
Remove the heating plate cover by unscrewing the 4 Torx screws M3x6 using a Torx key size Tx10. Disconnect the connector of the connection cable to the main board by pressing the removal lug.

Loosen the two Torx fixing screws on the old heating board. The drives of the two screws are filled with silicone. The silicone can be easily removed.

Place the new heating board with the bracket on the two mounting holes.

Wet the screw threads of the new mounting screws with a drop of Loctite 274 and insert the mounting bolts into the holes provided. Tighten the mounting bolts with a torque of 1.2 Nm. Then fill the drives of the two screws with a drop of silicone rubber Elastosil E41. Reconnect the connection cable of the main board to the new heating board. The plug snaps into place with a click. Screw the protective plate back onto the columns of the heating board.

Reconnect the previously released wires according to the following circuit diagram.



Carry out a functional test of the weighing unit and the heating, as described in the chapter “Functional Test”.

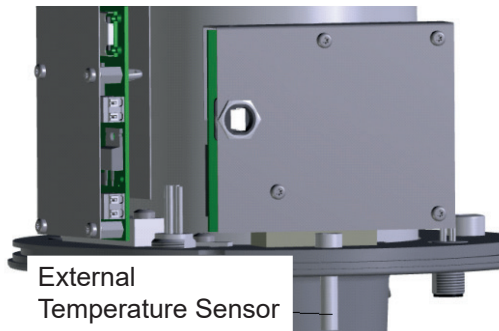
Be careful not to cant the protective cylinder with the cables between the load cell and the main board.

Close the housing as described.

15.2.2 Replacing the External Temperature Sensor

Tools required: Torx key Tx10, pliers

Adjuvant: Loctite 274



Open the housing as described and remove the protective cylinder.

Remove the protective plate from the main board by unscrewing the 4 Torx M3x6 screws with a Torx key size Tx10. Disconnect the circuit board connector of the outside temperature sensor from the heating board. Using the pliers, unscrew the defective external temperature sensor from the sensor foot. Wet the thread of the new temperature sensor with some Loctite 274 and screw it in by hand. Reconnect the connection cable of the new temperature sensor to the heating board. The plug snaps into place with a click sound. Screw the protective plate back onto the columns of the main board. Perform a functional test, as described in the chapter “Functional Test”.

Be careful not to cant the protective cylinder with the cables between the load cell and the main board.

Close the housing as described. Alternatively, the outer temperature sensor can be exchanged for a version in a stainless steel sleeve with a 0.5 m cable and a small protective shelter (Id-No. 32.15184.020100).

15.2.3 Replacing the M12 Connectors

Tools required: Socket size 17, crimping tool, Torx key Tx20, Torx key Tx10, slotted screwdriver, blade width 2 mm

All M12 connectors used are inserted from the front and have an M16 mounting thread. The mounting plugs are delivered with straight cut-off wire and must be stripped to 10 mm before installation and fitted with wire end ferrules. (We recommend wire end ferrules with plastic collars.)

The connectors can each be screwed with a size 17 socket wrench.

To change the connectors in the rain[e]H3, the housing of the rain[e]H3 must be opened as described. Loosen the corresponding wires from the terminals of the circuit boards and unscrew the old plug. After the new plug has been screwed, the wires are re-installed according to the connection diagram. Then close the housing as described.



15.3 Functional Test

Plug the terminal block of the heating of the housing's upper part onto the heating board. Connect the power supply to the sensors and heating. Connect the rain[e]H3 to the PC via the USB service socket and start the rain[e]H3 Commander on the PC. Start the Diagnostic Tool (remote control with gear wheel).

Select the tab "Status" – To check the general operational readiness of the rain[e]H3. Select the used COM serial port and press the gear wheel button.

If the heating and sensor supply are connected, the connection between the main board and the heating board has been carried out correctly and the housing heater has been plugged in, all status messages should be acknowledged with OK. If the heating supply and/or the housing heater are not connected, the heating status indicates an error. In this case, check all connections and repeat the status check.

16 Maintenance and Repair

In case you should be faced with any specific problems please contact the LAMBRECHT service on:

Tel: +49-(0)551-4958-0

E-mail: support-lambrecht@aem.eco

17 Equipment and Spare Parts

GENERAL ACCESSORIES

32.15184.060000	Connecting cable with M12 connector (sensor – data logger); length 10 m (8-core)
65.53090.160100	USB cable (sensor configuration)
36.15184.000000	rain[e]H3 Commander
00.15180.400000	Stainless steel mast for concrete foundation
00.15180.800050	Stainless steel mast for concrete foundation with base plate
32.15180.022020	Bird defense ring
33.15189.049010	Dirt trap spiral (spare part)
32.15184.080010	Calibration set
00.14966.500000	Power supply unit
32.14622.220000	Holder for power supply unit on the mast
33.15184.016000	Protective grid

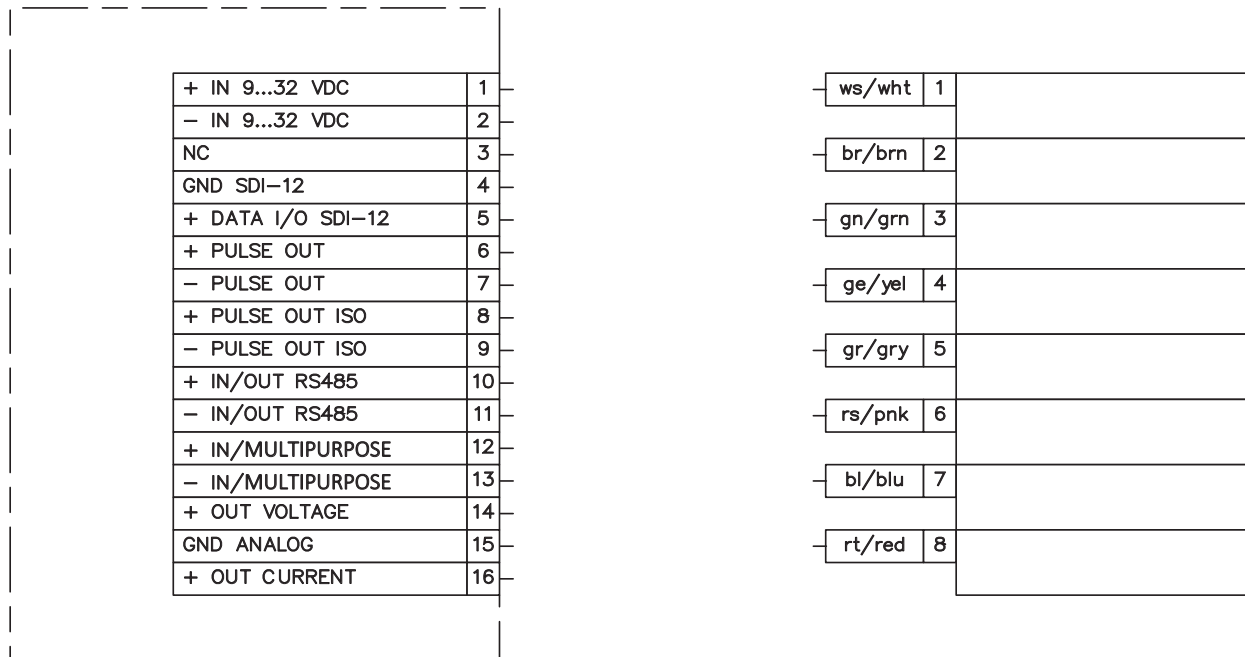
CABLE

32.15184.060000	Sensor signal and power connection; M12 female connector, A-coded; 8-pin; length 10 m
32.15184.061000	Power supply connection cable for heater with M12 T-coded female connector, length 1 m
32.05304.000200	Ethernet connection cable with M12 D-coded female connector, length 2 m

SERVICE

97.15180.000000	Custom configuration
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Connecting Diagram for Customized Configuration



The SDI-12 interface and the RS-485 interface cannot be used simultaneously. Furthermore, it is recommended to apply only one of the two interfaces to the cable used at the same time.

18 Download of Updates

On our website (<https://www.lambrecht.net>), you will find the category **Free Software Tools & Firmware** under **Service** in the **Resources** section. There, you can easily download the latest firmware versions and software tools for your product and benefit from continuous improvements and new features.

19 Disposal

LAMBRECHT meteo GmbH is listed and registered at the Stiftung Elektro-Altgeräte Register ear under:

WEEE-Reg.-Nr. DE 45445814

In the category of monitoring and control instruments, device type: "Monitoring and control instruments for exclusively commercial use".

Within the EU



The device has to be disposed according to the European Directives 2002/96/EC and 2003/108/EC (Waste Electrical and Electronic Equipment). Do not dispose the old device in the household waste! For an environmentally friendly recycling and disposal of your old device, contact a certified disposal company for electronic waste.

Outside the EU

Please follow the regulations in your country regarding the appropriate disposal of waste electronic equipment.



20 Technical Data

Precipitation Sensor rain[e]H3 · ID 00.15184.540020	
Measurable precipitation types	Liquid, solid, mixed
Measuring principle	Weighing with automatic self-emptying
Operating temperature	-40...+70 °C (no icing or snow drift)
Storage temperature	-40...+70 °C
Collecting area	200 cm ²
Measuring range (amount)	Without limitation (0.005...∞ mm)
Resolution (amount)	0.001 mm
Accuracy (amount)	± 0.1 mm or ± 1 % at < 6 mm/min and ± 2 % at ≥ 6 mm/min
Measuring range (intensity)	0...20 mm/min resp. 0...1200 mm/h
Resolution (intensity)	0.001 mm/min resp. 0.001 mm/h
Accuracy (intensity)	± 0.1 mm/min resp. ± 6 mm/h
Integrated outside temperature sensor*	Measuring range: -35...+45 °C; basic accuracy: < 0.5 °C
Dimensions	377 x 190 mm (H x D)
Mountable on	Ø 60 mm
Material	Enclosure: Anodized aluminum, painted white Funnel: Anodized aluminum Device base component: Die-cast aluminum, painted Collection vessel: Aluminum, black anodized
Weight	Approx. 4 kg
Standards	WMO-No. 8; VDI 3786 Bl. 7; EN 61000-2, -4; EN 61000-4-2, -3, -4, -5, -6, -11; NAMURNE-21
Protection class load cell	IP67
Protection class housing	IP64
Power consumption	Typ. 7.5 mA at 24 V power supply, without Ethernet with RS-485 Typ. 12.5 mA at 12 V; max. 150 mA at 12 V power supply with Ethernet
Supply voltage	9.8...32 V DC
Heating data	Electronically controlled; ring -, funnel - and drain-line heating
Target temperature	+2 °C funnel surface temperature
Accuracy	± 1 °C
Heating power	70 W (funnel); 60 W (discharge/ collecting vessel); 70 W (ring heating)
Signal output	RS-485 (ASCII protocol, TALKER protocol); Modbus RTU; Ethernet 100 MBit/s

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*) without influence of solar radiation

rain[e]H3_Ethernet_b-de.indd 11.26

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