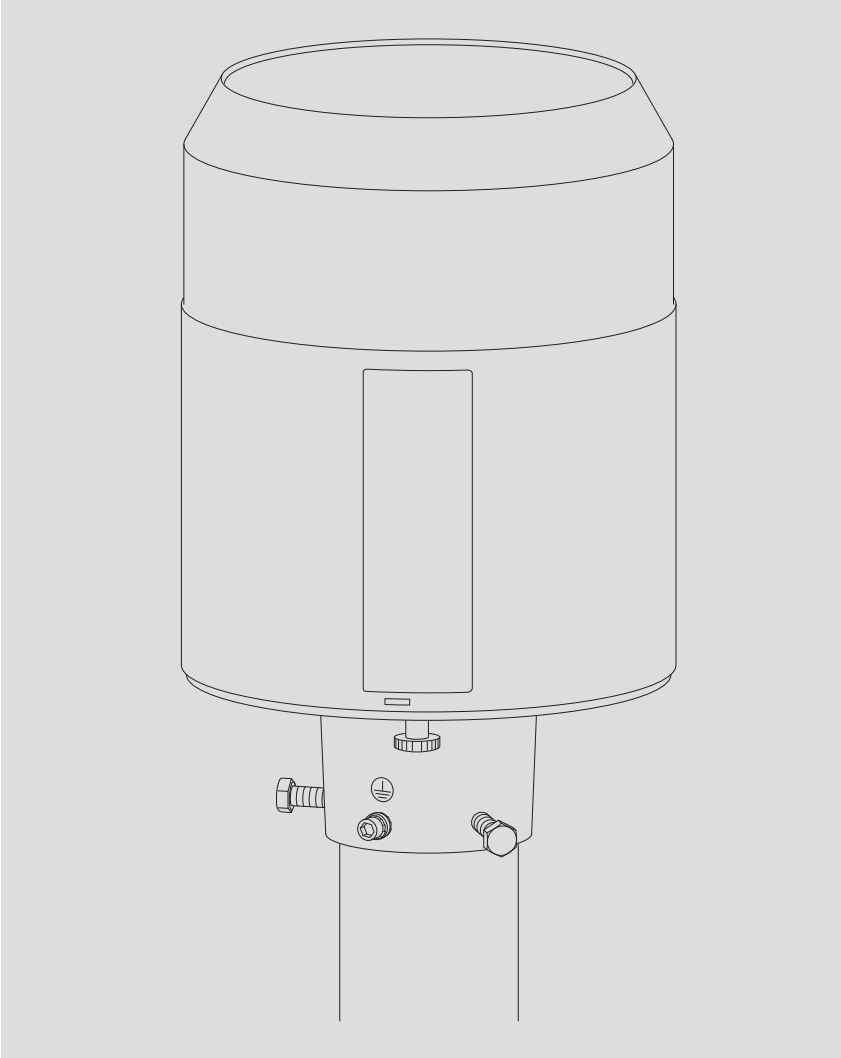
Operating Instructions

Precipitation gauge OTT WAD 200



English

We reserve the right to make technical changes and improvements without notice.

Table of Contents

1 Scope of Delivery

- **OTT WAD 200** sensor with collecting vessel
- USB cable for configuration; L = 1 m
- Short operating instructions in 4 languages

2 Order Codes

OTT WAD 200 Nr. 70.110.000.9.5

3 Safety Instructions

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!

4 Dimensional Drawing and Product Drawing

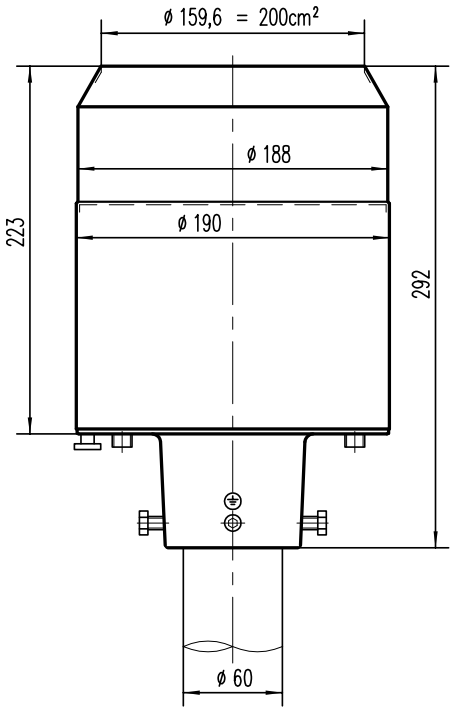


Fig. 1

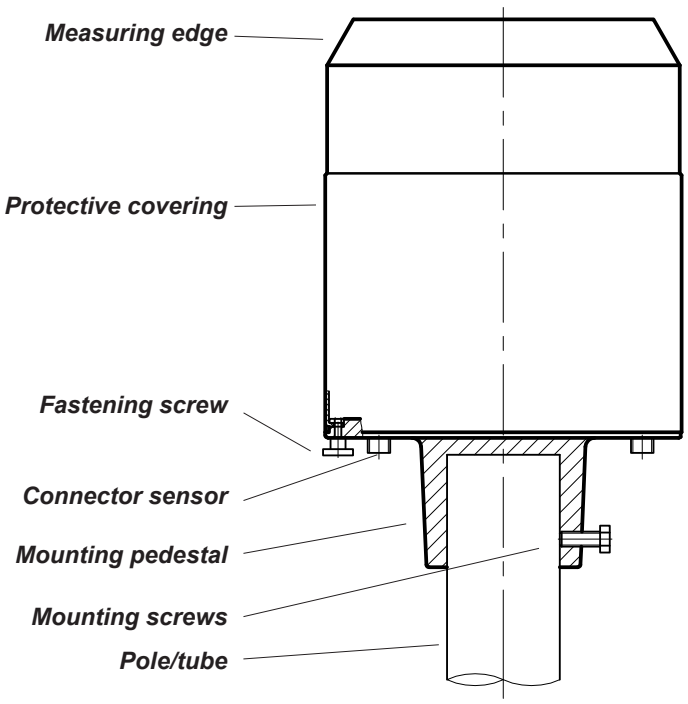


Fig. 2

5 Introduction

Features

- **Latest weighing technology · overflow proof**
- **High resolution of 0.001 mm (amount) and 0.001 mm/h (intensity)**
- **Measurement of precipitation, amount and intensity**
- **Wide range of signal outputs:**
  - **2 independently configurable pulse outputs**
  - **SDI-12**
  - **RS485 (SDI-12 protocol, ASCII protocol, TALKER protocol)**
  - **Analogue output**
- **All-metal housing · weatherproof and long durability**
- **The compact housing reduces the influence of wind**
- **200 cm² collecting area**

The precipitation sensor **OTT WAD 200** measures precipitation amount and intensity. The **OTT WAD 200** combines the advantages of the latest weighing technology and a self-emptying collecting vessel, allowing a high resolution and high precision at a very small total volume. Therefore the **OTT WAD 200** 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 **OTT WAD 200** calculates the following values:

- Amount of precipitation (Pulse or Analogue Output)
  The **OTT WAD 200** gives the amount of precipitation in real time via the Pulse or Analogue Output with a maximum resolution of 0.01 mm.
- Intensity within the last minute (SDI-12 or RS485 interface)
  The **OTT WAD 200** 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 (SDI-12 or RS485 interface)
  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 **OTT WAD 200** will use the “intensity within the last minute” value.
- Amount since last retrieval (SDI-12 or RS485 interface)
  The difference in the amount of precipitation between the current and the last retrieval.
- Minimum intensity within the last x minutes (SDI-12 or RS485 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 (SDI-12 or RS485 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.
- Average intensity within the last x minutes (SDI-12 or RS485 interface)
  Counts the amount of precipitation in steps of 0.01 mm for x minutes and divides the result by x minutes.
- Variance (SDI-12 or RS485 interface)
  Variance of measured values over 4 s

The two pulse outputs can be configured to return the amount of precipitation with resolutions between 0.01 and 1 mm and closing times between 10 and 500 ms (see ch. 7 and 8.3). Alternatively they can be configured to return the status Rain YES/NO.

The analogue output can be used in the two modes 0/4...20 mA or 0...2.5/5 V DC to return the amount of precipitation. For further details on the functioning of the analogue output and the reset function see chapter 8.4.

For further details on the way the values will be returned using SDI-12 protocol via SDI-12 or RS485 interface and the available commands see chapter 8.1 and 8.2.1. For further information regarding the configuration see chapter 7.

In addition to SDI-12, the RS485 interface can be used in Talker or ASCII mode. For descriptions of these modes please see chapters 8.2.2 and 8.2.3.

6 Installation

6.1 Site Selection

To minimise 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. In general the sensor should not been 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 have to be clipped regularly to the height of the sensor to prevent them from disturbing the measurement and at the same time reduce wind influence.

6.2 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 **OTT WAD 200**.
- 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 **OTT WAD 200**. 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.

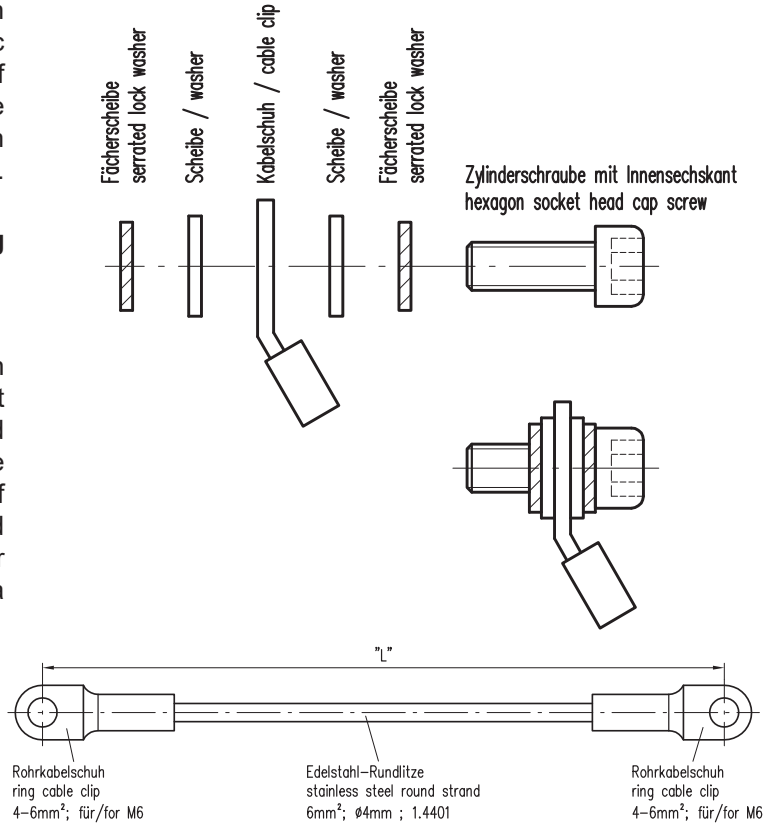


Fig 3

6.3 Integrated Collecting System

Fig. 4

- 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!

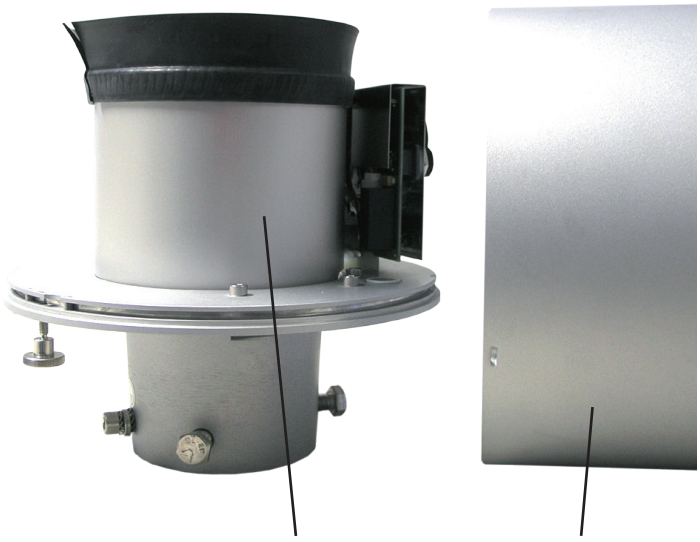
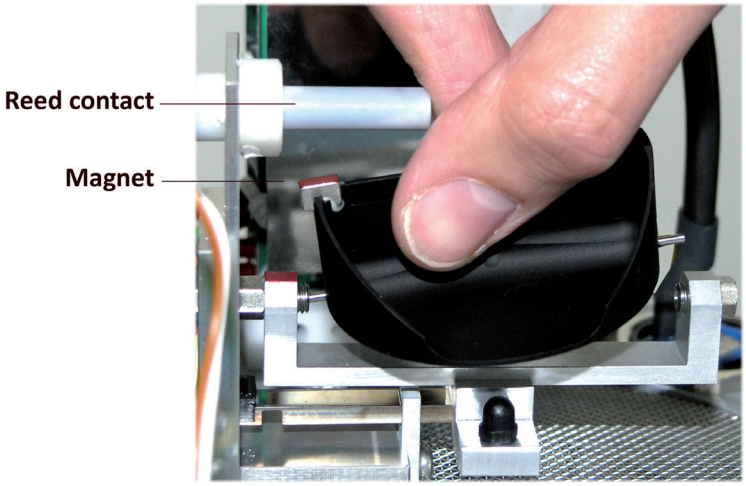


Fig. 5

- Place the housing aside.
- Lift inner protection cylinder.

Inner workings of the **OTT WAD 200** without collecting vessel.

Fig. 6



- 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 (Fig. 7)
  - Insert the other axis into the other bearing.
  - **Test for flawless tipping.**

Fig. 7

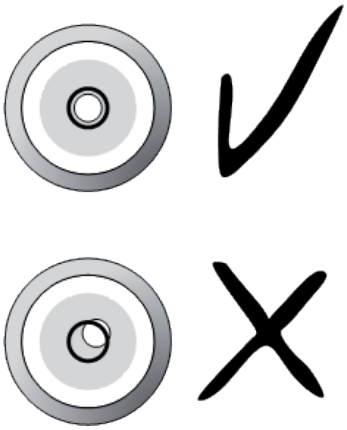


Fig. 8

Level the device with the assistance of the spirit level (Fig. 8) by tightening the hexagon head screws in the base evenly.

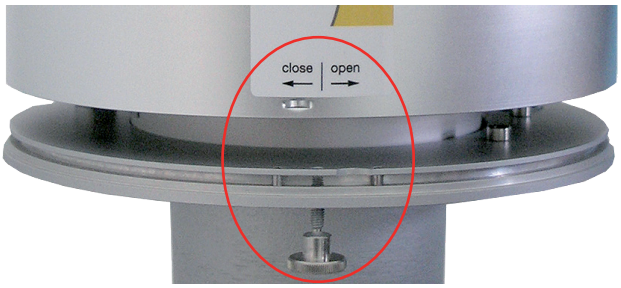


Fig. 9

- Reassembly
  - Cautiously put the inner protection cylinder back into place.
  - Put the casing onto the device – embossings into notches (Fig. 8).
  - Press down on the housing and turn it clockwise towards “close”.
  - Fasten the knurled screw.
  - Insert the enclosed dirt trap spiral into the funnel (Fig. 10).

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.

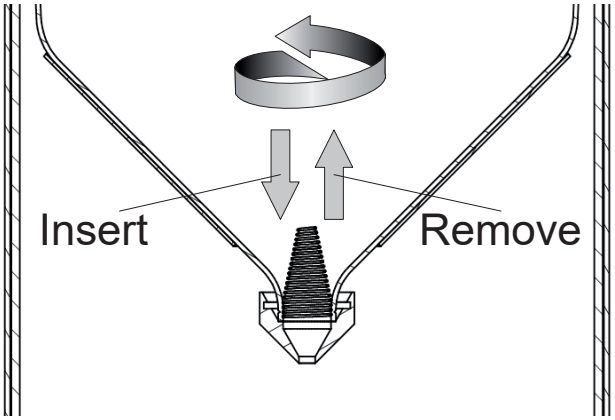


Fig. 10

- **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.

6.4 Power and Signal Connection

To connect the **OTT WAD 200** to a data acquisition system a M12 connecting cable is required. Connect the cable according to the connecting diagram (see Fig. 12).

The maximum distance between the **OTT WAD 200** and the data acquisition system depends on the interfaces being used. The values for SDI-12 and RS485 are obtained from the respective definitions of these standards.

- SDI-12 70 m
- RS485 1000 m
- Pulse output 1000 m

Note: Shielded cables must generally be used for connection.
The USB cable for the service interface should not be longer than 3 m.

6.5 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.

Overview status LED (green) on main board:	
System start	Permanent lighting of the LED for approx. 3 seconds
In operation	Fast flashing of the LED

6.6 Available In- and Outputs

The **OTT WAD 200** 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
- RS485 (Talker protocol, WL ASCII protocol, SDI-12 protocol)

6.7 Factory Settings

The factory settings of the **OTT WAD 200** according to the standard connecting diagram (see Fig. 11) are:

- Galvanically isolated output as pulse output

  Resolution: 0.1 mm
  Closing time: 300 ms
  Duty cycle: 1:1

- SDI-12 protocol activated
  (via the galvanically isolated RS485 or SDI-12 interface, 1200 Bd)

  Attention: Only one interface can be used at a time. Parallel operation is not possible.

- Analogue output OFF

6.8 Terminal Assignment

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

The following connecting diagrams can be used to connect the wires to the correct pins on both sides corresponding to the Quick Configurations in the software **OTT WAD** Commander (see Fig. 20). If you want to use a customised configuration, feel free to use the empty connection diagram for your notes.

Connecting diagram

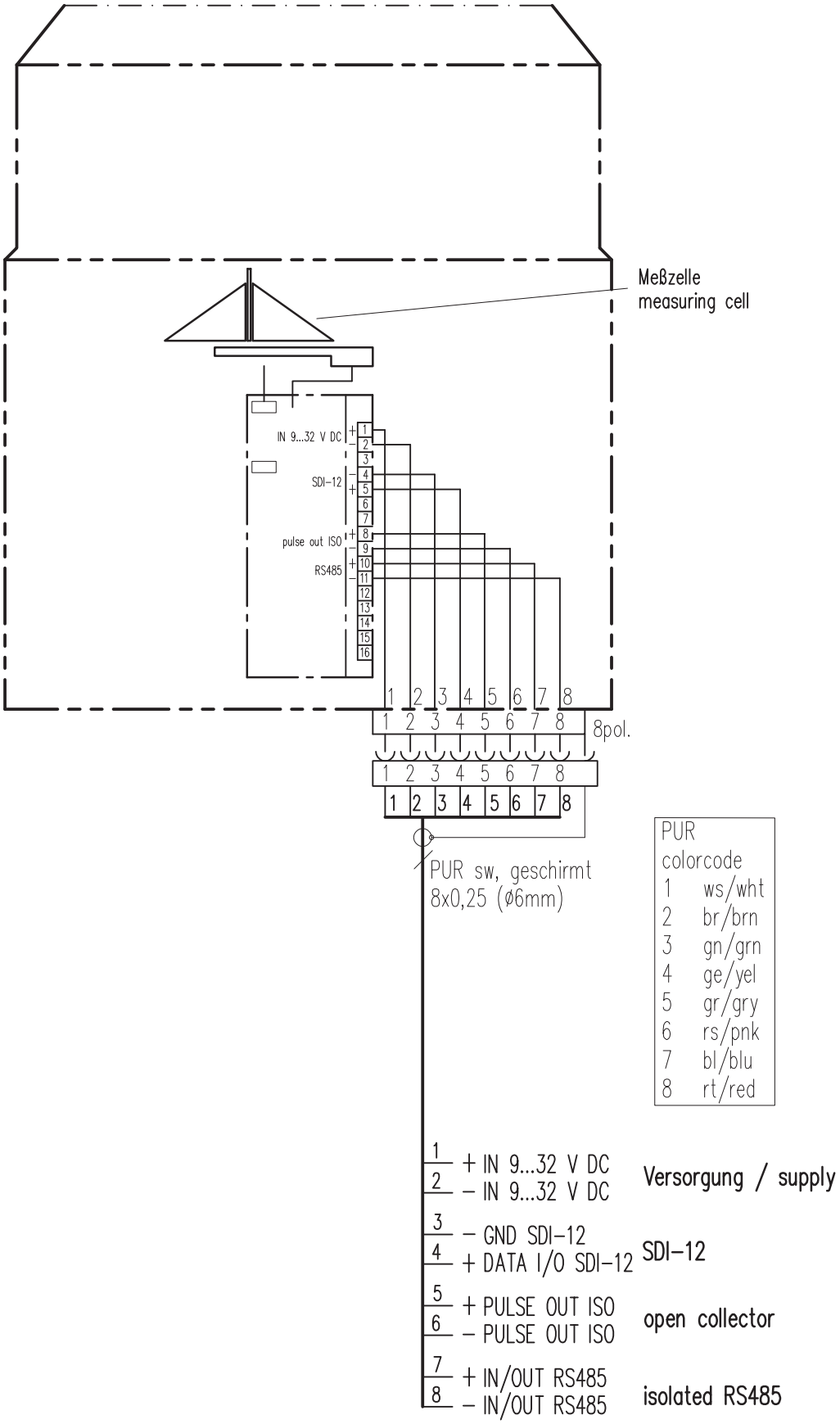


Fig. 11

Connecting Diagram for Quick Configuration ‘Digital Output’

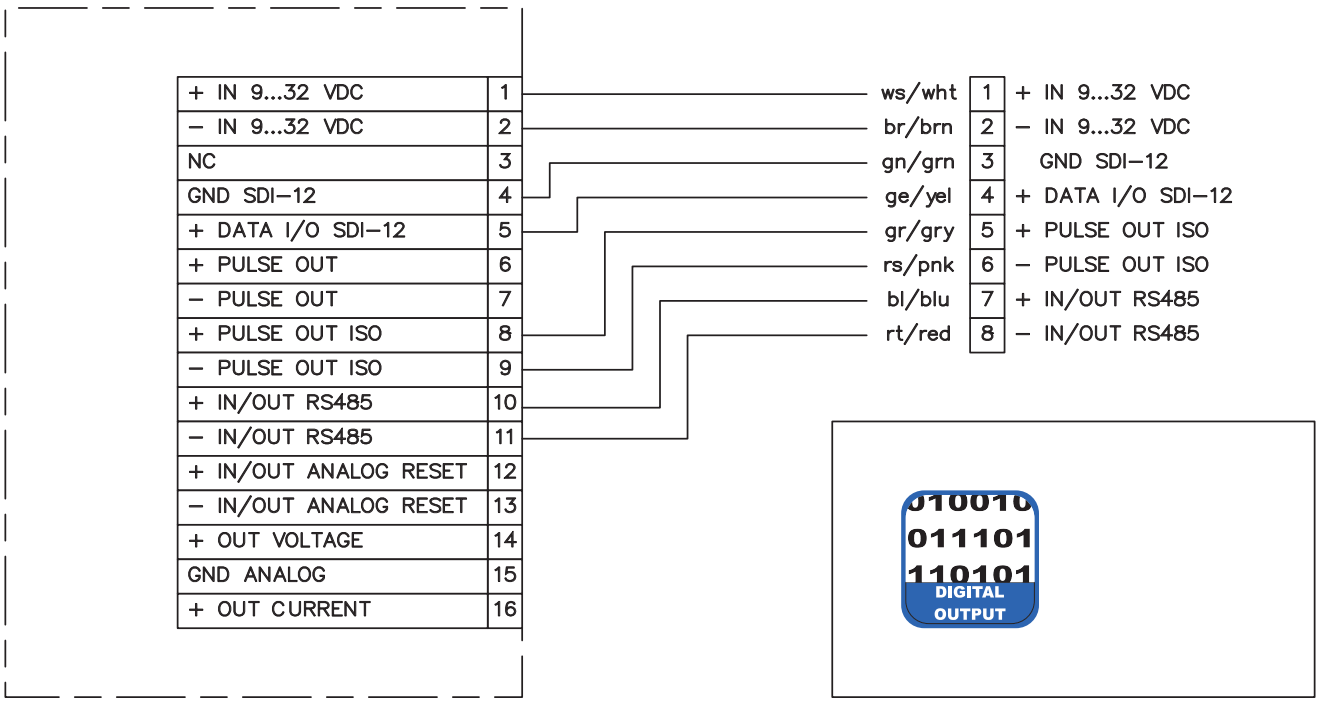


Fig 12

Connecting Diagram for Quick Configuration ‘Analog Output 4...20 mA’

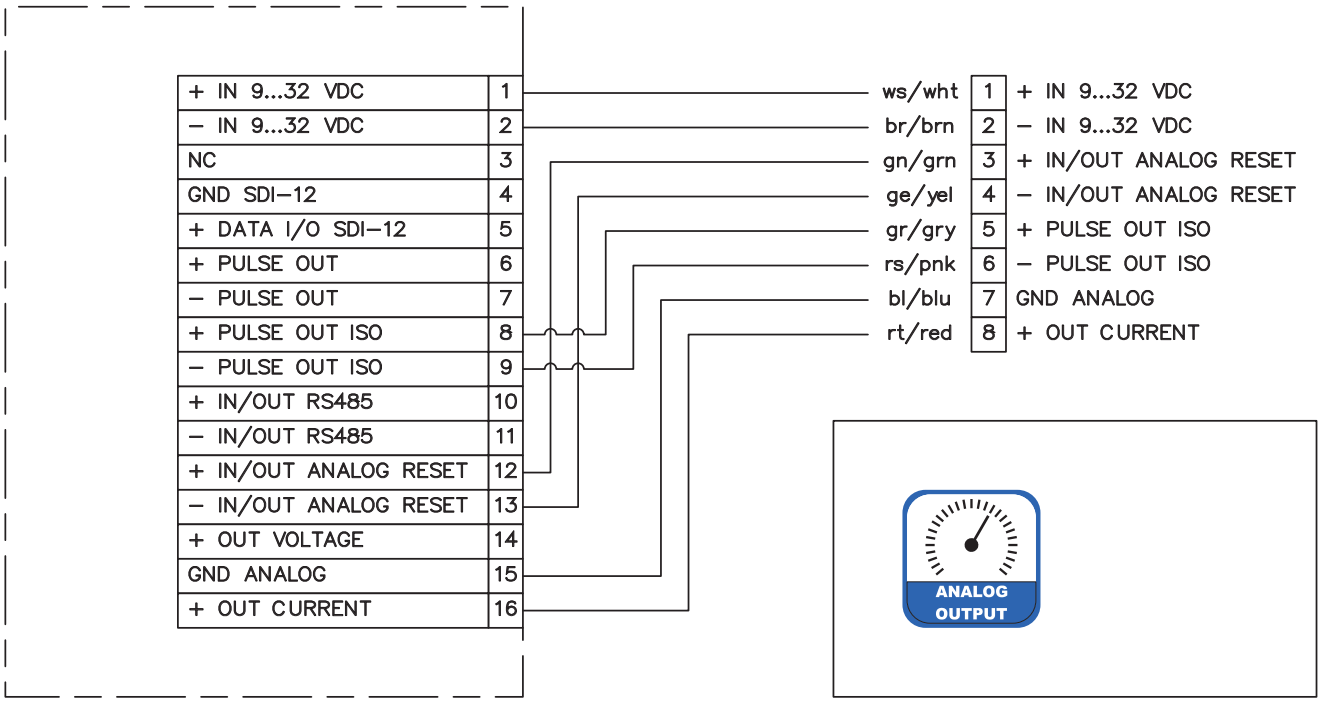


Fig. 13

Connecting Diagram for Quick Configuration ‘Analogue Output 0...2,5 V’

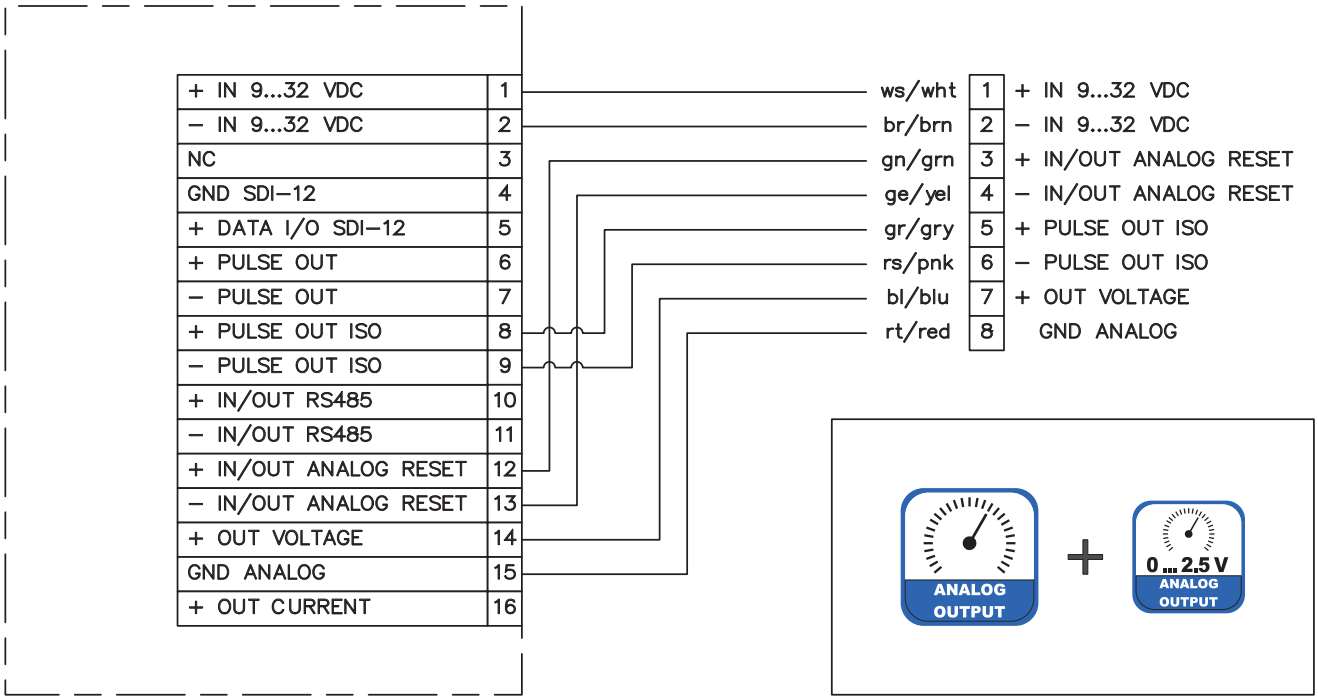


Fig. 14

Connecting Diagram for Quick Configuration ‘Analogue 4...20 mA / Digital Output’

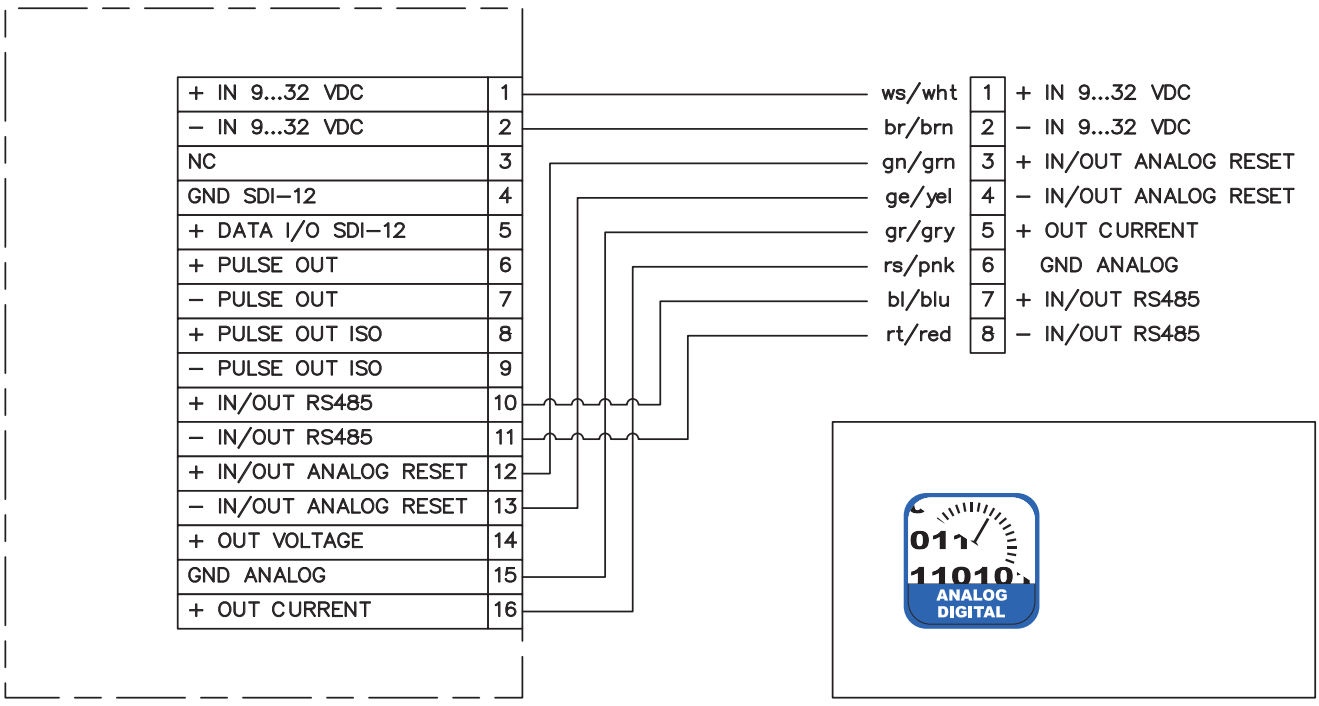


Fig. 15

Connecting Diagram for Quick Configuration ‘Analogue 0...2.5 V / Digital Output’

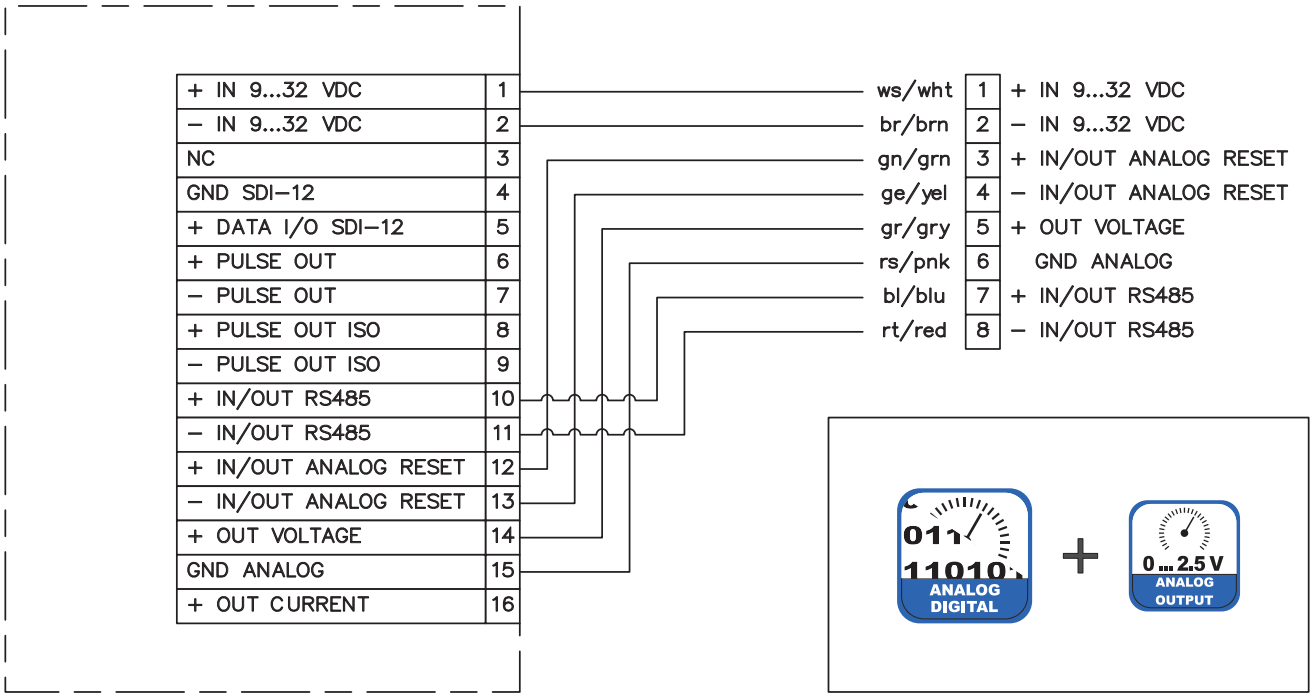


Fig. 16

Connecting Diagram for Quick Configuration ‘Pulse Output’

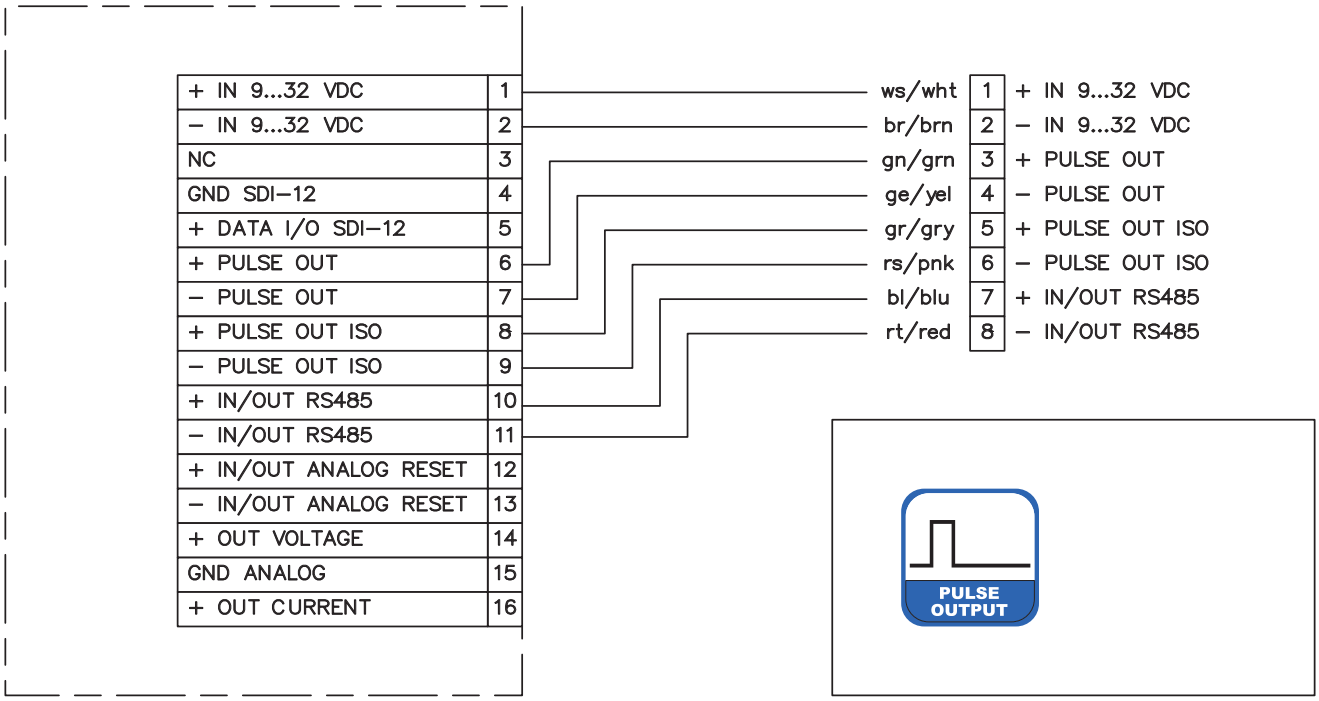


Fig. 17

7 Configuration Software - OTT WAD Commander

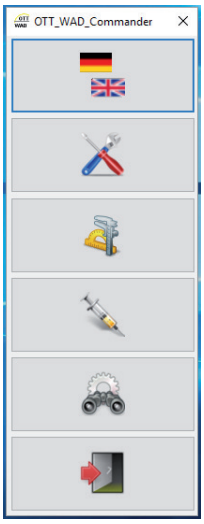


Fig. 18

The **OTT WAD** Commander is the configuration tool of the **OTT WAD 200**. It can be used to configure the output signals of the **OTT WAD 200**. Furthermore the load cell can be adjusted with the help of a reference weight. The software also has an update function for the **OTT WAD 200** firmware and a diagnosis function to control the readiness for use of the **OTT WAD 200** (see Fig. 18). To configure the **OTT WAD 200** it has to be connected via the USB service interface in the device interior to a PC with installed **OTT WAD** Commander.

It is recommended to unplug the power plug and the sensor connector before opening the OTT WAD 200 case to prevent it from mismeasuring. In addition, please use the 'service function', if your data logger has one.

OTT WAD 200 Setup

When entering the Setup area it requests that the user first selects the COM port to which the **OTT WAD 200** is connected (from the drop-down menu) and retrieve the settings from the **OTT WAD 200** (gear wheel icon). After retrieving the data from the **OTT WAD 200** the setup screen shows the product ID, serial number, hardware revision and firmware version of the device. In the 'Quick Configuration' section the program provides buttons for the most common combination to configure the **OTT WAD 200** with a few clicks. The 'Expert Configuration' section allows to customise the output signals in any desired way.

Quick Configuration

To configure the **OTT WAD 200** with the Quick Configuration screen click on the buttons representing the desired options and sub-options. After each selection the changes will be send to the **OTT WAD 200**. The output field shows the current **OTT WAD 200** settings. It will be updated automatically after sending new settings to the **OTT WAD 200**.

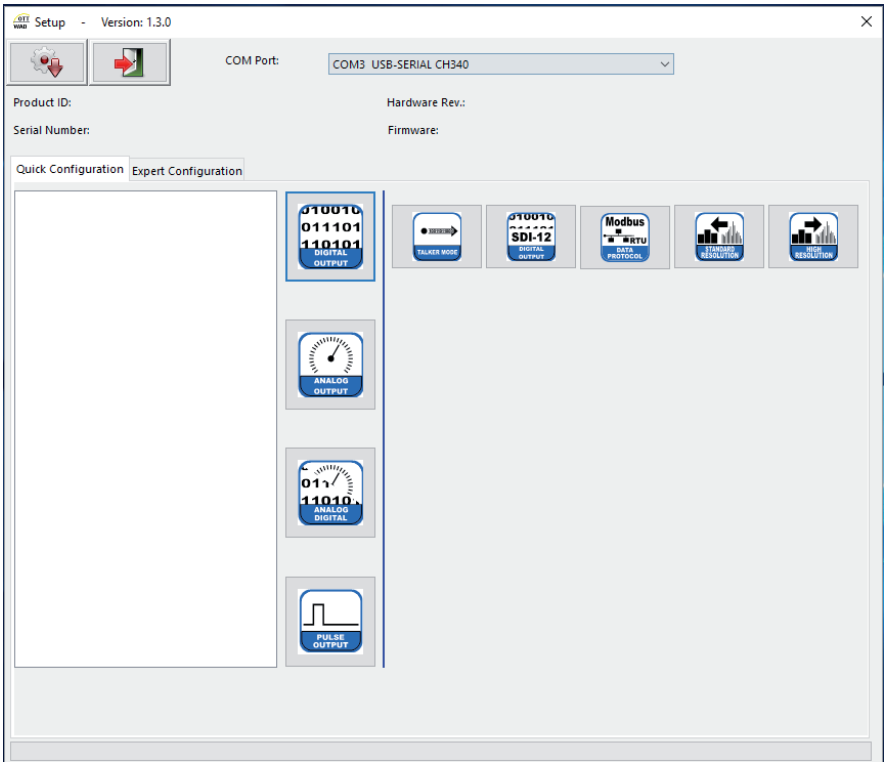


Fig. 19

Following are the respective settings listed which will be implemented by the quick configuration buttons. For the buttons of the sub-options only the changes are listed

Digital Output (standard)

SDI-12	ON
RS485	SDI-12 ON
Pulse Output (isolated)	ON
Operating Mode	Pulse
Resolution	0.10 mm/m²
Closing Time	300 ms
Analog Output	OFF
Pulse Output (not isolated)	ON
Operating Mode	Rain YES/NO

- Talker Mode

SDI-12	OFF
RS485	Talker ON
Talker Interval	10 s

- SDI-12 Digital Output

SDI-12	ON
RS485	SDI-12 ON

- Standard Resolution

Pulse Output (not isolated)	ON
Operating Mode	Pulse
Resolution	0.10 mm/m²
Closing Time	300 ms

- High Resolution

Pulse Output (not isolated)	ON
Operating Mode	Pulse
Resolution	0.01 mm/m²
Closing Time	10 ms

Analogue Output

SDI-12	ON
RS485	SDI-12 ON
Pulse Output (isolated)	ON
Operating Mode	Pulse
Resolution	0.10 mm/m²
Closing Time	300 ms
Analogue Output	ON
Effective Range	4...20 mA
Scale	20 mm/m²
Pulse Output (not isolated)	ON
Operating Mode	Rain YES/NO

- 4...20 mA

Analogue Output	ON
Effective Range	4...20 mA
Scale Maximum	200 mm/m²

- 0...2.5 V

Analogue Output	ON
Effective Range	0...2.5 V DC
Scale Maximum	200 mm/m²

- Standard resolution

Pulse Output (not isolated)	ON
Operating Mode	Pulse
Resolution	0.10 mm/m²
Closing Time	300 ms

- High Resolution

Pulse Output (not isolated)	ON
Operating Mode	Pulse
Resolution	0.01 mm/m²
Closing Time	10 ms

Analogue / Digital Output

SDI-12	ON
RS485	SDI-12 ON
Pulse Output (isolated)	ON
Operating Mode	Pulse
Resolution	0.10 mm/m²
Closing Time	300 ms
Analogue Output	ON
Effective Range	4...20 mA
Scale	20 mm/m²
Pulse Output (not isolated)	ON
Operating Mode	Rain YES/NO

- 4...20 mA

Analogue Output	ON
Effective Range	4...20 mA
Scale Maximum	200 mm/m²

- 0...2.5 V

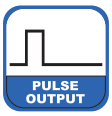
Analogue Output	ON
Effective Range	0...2.5 V DC
Scale Maximum	200 mm/m²

- Talker Mode

SDI-12	OFF
RS485	TALKER ON
Talker Interval	10 s

- SDI-12 Digital Output

SDI-12	ON
RS485	SDI-12 ON



Pulse Output

SDI-12	OFF
RS485	ASCII ON
Pulse Output (isolated)	ON
Operating Mode	Pulse
Resolution	0.10 mm/m²

Closing Time	300 ms
Analogue Output	OFF
Pulse Output (not isolated)	ON
Operating Mode	Rain YES/NO

- Standard Resolution

Pulse Output (isolated)	ON
Resolution	0.10 mm/m²
Closing Time	300 ms

- High Resolution

Pulse Output (isolated)	ON
Resolution	0.01 mm/m²
Closing Time	10 ms

Expert Configuration

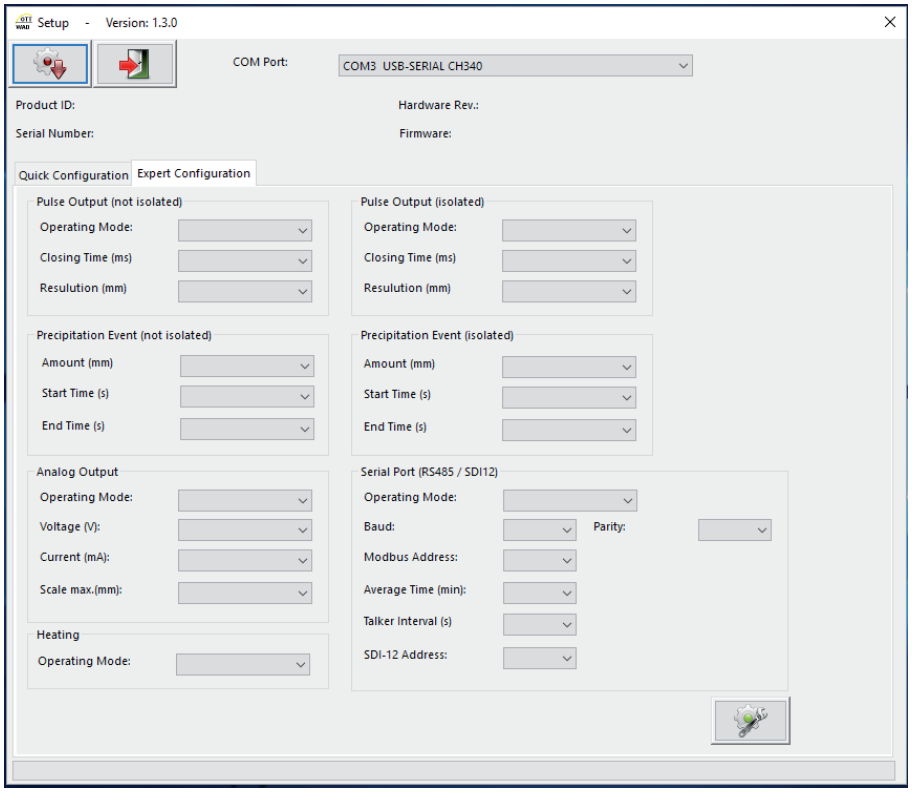


Fig. 20

The Expert Configuration screen (Fig. 20) is an easy to use tool to completely customise the configuration of the **OTT WAD 200** output signals. Options are visible depending on the selected output modes. The following list shows the available options, sub-options and value ranges.

Pulse Output (non-isolated) / (isolated)
- Operating Mode
  - Pulse
    - ► Closing Time — 10...500 ms in steps of 5 ms
    - ► Resolution — 0.01...1 mm in steps of 0.01 mm

- Rain YES / NO
  - ⇨ Precipitation Event (non-isolated) / (isolated)
    - ► Amount — 0.10...1 mm in steps of 0.10 mm
    - ► Start Time — 20...60 s in steps of 1 s
    - ► End Time — 20...600 s in steps of 1 s

Analogue Output
- Operating Mode
  - Voltage — 0...2.5 / 5 V
  - Current — 0 / 4...20 mA
  - Scale Maximum — 1...200 mm/m² in steps of 1 mm/m²

Serial Port (RS485)
- Operating Mode
  - ASCII
    - ► Average Time — 1...60 min in steps of 1 min
  - SDI-12
    - ► Average Time — 1...60 min in steps of 1 min
  - Talker
    - ► Average Time — 1...60 min in steps of 1 min
    - ► Talker Interval — 10...60 s in steps of 1 s
  - Modbus
    - ► Modbus address — 1...247 (default 3)

SDI-12 - Address — 0...9, A...Z, a...z

Load Cell Adjustment

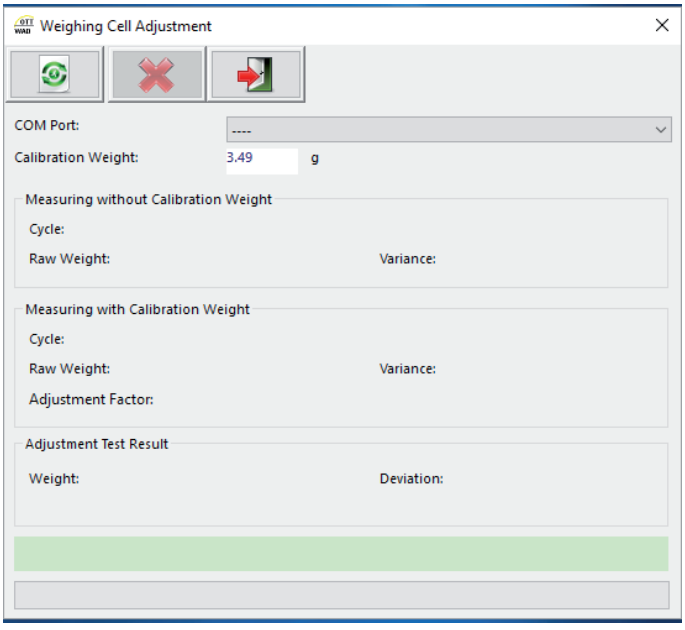


Fig. 21

The Load Cell Adjustment screen (Fig. 21) may be used to adjust the load cell. It will give the number of cycles the program has carried out, the mean value of the measured weight and the variance of the values. If a calibration weight is used, a calibration factor will be given.

To adjust the load cell first select the COM port of the **OTT WAD 200** from the drop-down menu. If desired, put a calibration weight in the collecting vessel and enter the weight into the corresponding text box. To start the adjustment click the green Start Adjustment button.
Pressing the button with the red 'X' will stop the running adjustment.

Adjustment has to done again if the deviations in the diagnostics are higher than ± 30 mg.

Firmware Update

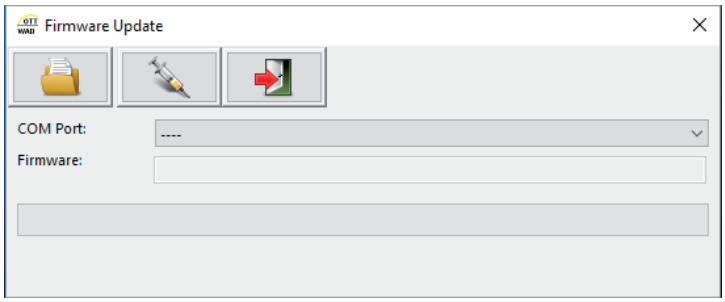


Fig. 22

If an update or modification of the firmware is needed e.g new features are available or the requirements of the output signals have changed, you shall receive a firmware file via email.

To update your **OTT WAD 200** firmware use the Firmware Update screen (Fig. 22). Select the COM port of the connected **OTT WAD 200** 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 **OTT WAD 200** (syringe icon).

Diagnostics

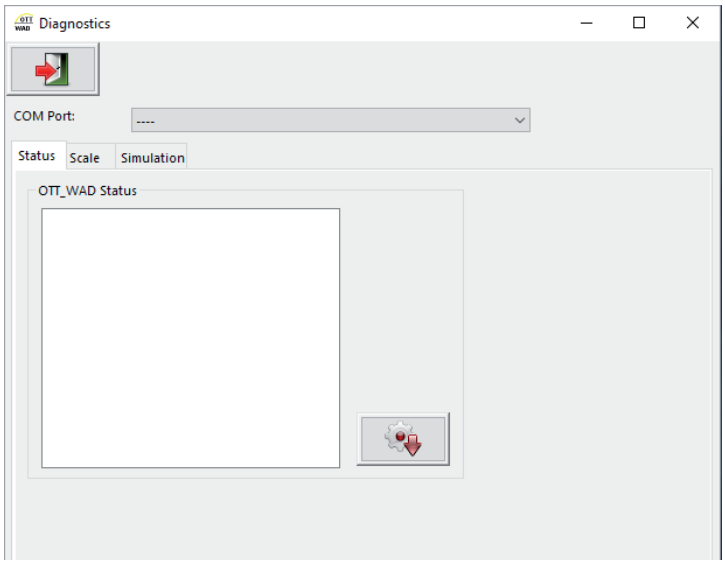


Fig. 23

The "**Diagnostics**" mask is divided into three tabs: "**Status**" - to check the system status, "**Scale**" - to test the load cell and "**Simulation**" - to simulate precipitation amounts to check the output signals of the impulse and analogue outputs (Fig. 23).

To use any of these functions the COM port of the connected **OTT WAD 200** has to be selected from the drop-down menu.
To check the system status one has to click "**Retrieve OTT WAD 200 Status**" (gear wheel icon) in the tab "**Status**". The program will return the following status message:

Temperature Sensor Bottom - OK / Malfunction	Temperature sensor inside works
Status 6-9	Only relevant for OTT service

To test the weighing scale one has to put a (known) weight into one pan of the collecting vessel and click “**Test Scale**” (blue gear wheel icon) in the tab “**Scale**”.

To simulate precipitation amounts to check the output signals of the pulse and analogue outputs, one has to select the desired amount from the drop-down menu in the tab “**Simulation**” and click “**Simulate Precipitation**” (cloud icon). The analogue and pulse outputs will return signals according to the applied settings in the **OTT WAD 200** Setup.

8 In- and Output

8.1 SDI-12 Interface

The communication using SDI-12 protocol via SDI-12 interface is based on the ‘SDI-12 A Serial-Digital Interface Standard for Microprocessor-Based Sensors, Version 1.3, 2012’. The **OTT WAD 200** can be used in bus mode parallel to other **OTT WAD 200** sensors.

The following subset of SDI-12 commands were implemented into the **OTT WAD 200**.
For further details to the SDI-12 protocol we recommend the afore-mentioned standard document or the website 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>
aI!	Send Identification	allccccccccmmmmmmvvvxx...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)	a<values<CR><LF> a<values><CRC><CR><LF> resp. with CRC checksum
aM1!	Measurement in inch	atttn<CR><LF>
aMC1!	Measurement in inch with CRC	atttn<CR><LF>
aC1!	Measurement in inch	atttnn<CR><LF>
aCC1!	Measurement in inch with 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<CR><LF>**
a – Sensor address	**a** – Sensor address
! – End of command	**<CR><LF>** – End of answer

Example:

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

Send Identification - aI!

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

Syntax

Command	Answer
aI!	**a 13OTT_GMBHWAD2001.000000001041<CR><LF>**
a – Sensor address	**a** – Sensor address
I – Command 'Send Identification'	
	13OTT_GMBHWAD2001.000000001041
	13 – 2 characters SDI-12 version-No. 13 = version 1.3
	OTT_GMBH – 8 characters manufacturer's name (= OTT Hydromet GmbH)
	WAD200 – 6 characters sensor type (= precipitation sensor **OTT WAD 200**)
	1.0 – Sensor version (= version 1)
	00000001041 – 11 characters serial No.
! – End of command	**<CR><LF>** – End of answer

Example:

Command	Answer
0I!	**013OTT_GMBHWAD2001.000000001041<CR><LF>**
1I!	**113OTT_GMBHWAD2001.000000001042<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 is 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!	**b<CR><LF>**
a – Old sensor address	**b** – New sensor address
A – Command 'Change Address'	
b – New sensor address	
! – End of command	<**CR><LF>** – End of answer

Example:

Command	Answer
0A1!	**1<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 **OTT WAD 200** 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 **OTT WAD 200** always responds with 'a003x'. This is also the reason why the **OTT WAD 200** 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!	**a0036<CR><LF>**
a – Sensor address	**a** – Sensor address
M – Command 'Start Measurement'	**003** – Seconds the sensor needs until the measured data can be returned (= 3 s)
	06 – Number of provided measured data
! – End of command	**<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! **a** – Sensor address **M** – Command 'Start Measurement and Request CRC' **C** – Request for transmission of the CRC checksum **!** – 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
2MC!	**20036<CR><LF>**

Start Concurrent Measurement - aC!

The **Concurrent Measurement** enables the data logger to measure simultaneously with multiple **OTT WAD 200** sensors 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 **OTT WAD 200** 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) **6** – 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 Version1.3, 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 Version1.3, 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/m²
Precipitation amount total	mm/m²

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><CRC><CR><LF>** **a** – Sensor address **<values>** – Requested data separated by resp sign ('+' or '-') **<CRC>** – 3-digit CRC checksum **<CR><LF>** – End of answer

Measurement in Inch

The following commands can be used to request further measurement data from the **OTT WAD 200** in imperial units (inches) and retrieve them with "**aD0!**".

The measurement commands "**aM1!**" and "**aMC1!**" have the same format as the commands "**aM!**" and "**aMC!**". The same applies for the commands "**aC1!**" and "**aCC1!**", which have the same format as the commands "**aC!**" and "**aCC!**" respectively.

Command	Answer
aM1!	a0033<CR><LF>
aC1!	a00303<CR><LF>
aMC1!	a0033<CR><LF>
aCC1!	a00303<CR><LF>

Send data – aD0! after measurement in inches

The data requested by the sensor with the commands "**C1**" or "**M1**" can be retrieved with the command "**aD0**". The sensor uses the corresponding sign („+" or"-") as field separator. If the data was requested with a "**CC1**" or "**MC1**" command, a CRC checksum is also returned. For more information on generating this CRC checksum, see „SDI-12 Standard, Version 1.3, 2012, chapter 4.4.12".

The measurement data are output in imperial units.

Measuring data	Unit	Decimal places
Buffer 0		
Precipitation intensity of the last minute in inch/h	inch/h	0.000000
Precipitation since last retrieval	inch/inch²	0.000000
Total precipitation	inch/inch²	0.000000

Remark to SDI-12 ‘Break’ signal

Since the **OTT WAD 200** does not have a sleeping mode it does not need to be awoken. This means that the **OTT WAD 200** ignores the “Break“ command. Therefore all regulations associated to the ‘break’ command do not have to be considered.

8.2 Modbus Protocol

The OTT WAD 200 sensors follow the specification of the Modbus organization: “MODBUS APPLICATION PROTOCOL SPECIFICATION V1.1b3 “. (See www.modbus.org).

Data Encoding

MODBUS uses the “Big-Endian” format for addresses and data. This means that if a value is transmitted with a number format larger than a single byte, the “most significant byte” is transmitted first. For values that exit through a register (e. g. 32 bit), this is not clearly specified on the Modbus. In these cases, the OTT WAD sensors (32 bit or 64 bit) follow the Big-Endian number format.

Example Big-Endian:

Register size value
16 - bits 0x1234 is transmitted in the sequence: 0x12 0x34.

Example Big-Endian (32bit or 64bit):

Register size value
32 - bits 0x12345678 is transmitted in the sequence: 0x12 0x34 0x56 0x78.

8.2.1 Device Sddress

Addresses 1... 247 are allowed with Modbus, address 0 can be used for messages to all devices (broadcast), if the selected function supports this.

8.2.2 Standard Configuration - Default

Baud rate: 19200 Baud

Default address: 3

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

8.2.3 Reading out the Measured Values

The measured values of the OTT WAD 200 sensors are read out with the function code: 0x04.

Except for precipitation amount, all measured values are to be read in as instantaneous values.

8.2.3.1 (Note) Data Retrieval and Storage in Low-power Mode

In low-power operation with Modbus sensors, it can be useful to limit the data communication and, for example, to read out the mean values, min. and max. values from the sensors directly once a minute. The instantaneous values can only be queried for visualization.

8.2.3.2 Standard Register with Instantaneous Values

The following table lists all available instantaneous values. By precipitation this register area contains the total amount of precipitation instead of the instantaneous value (which does not exist).

Register Address	Parameter Name	Unit	Factor	Description	
31001	Total amount of precipitation	mm	10	1 decimal	INT
31101	Total amount of precipitation (High-WORD)	mm	1000	3 decimal The register 31101 + 31102 can be read out only together (functional code 0x04)	uLONG
31102	Total amount of precipitation (Low-WORD)				
31201	Intensity of precipitation in the last minute (floating)	mm/min	1000	= average (1-min.) 3 decimal Time base = 1 Min. Rate of measurement = 6 x per min.	INT

8.2.3.3 Special Case: Amount of Precipitation

Except for precipitation, all measured values are to be read as instantaneous values. The precipitation amount must be imported as a total quantity and the difference of the amount of rainfall displayed and stored compared to the previous data retrieval must be calculated, since values can be lost if the quantity from retrieval to retrieval is evaluated and a log or data record is lost.

Note: The value overflow of the total amount of precipitation must be taken into account and must be considered upon calculating the difference.

8.2.3.4 Modbus Command Set (Minimum)

The OTT WAD 200 sensors support the following commands:

- Command: 0x03 Address range: 40000+ (sensor characteristics)
- Command: 0x04 Address range: 30000+ (measured data)

8.2.3.5 Measured Value and Parameter Register OTT WAD Sensors

The registers addresses 30001 to 35000 are valid for all PTT WAD 200 sensors but are only valid if the respective sensor supports the corresponding values.

The error code or invalid value is 0xFFFF (0xFFFFFFFFFFFFFF).

Individual reading of contiguous registers (e. g. 31101 and 31102) is not permitted.

8.2.3.6 Modbus OTT WAD 200 Register

310		Precipitation amount					
31001		Total amount of precipitation	mm	10	1 decimal	INT	0xFFFF
311		Precipitation amount High Resolution					
31101		Total amount of precipitation (High-WORD)	mm	1000	3 decimal The register 31101 + 31102 can be read out only together (functional code 0x04)	uLONG	0xFFFF
31102		Total amount of precipitation (Low-WORD)					0xFFFF
31103		Total amount of precipitation since last retrieval (High-WORD)	mm	1000	3 decimal The register 31103 + 31104 can be read out only together (functional code 0x04)	uLONG	0xFFFF
31104		Total amount of precipitation since last retrieval (Low-WORD)					0xFFFF
312		Precipitation intensity					
31201		Total amount of precipitation of the last minute (sliding)	mm/min	1000	= average (1-min.) 3 decimal Time base = 1 min. Rate of measurement = 6 x per min.	INT	0xFFFF

8.3 RS485 Interface

8.3.1 SDI-12 Protocol

This is exactly the same protocol with the same commands as the SDI-12 protocol via SDI-12 interface (described in ch. 8.1).

8.3.2 ASCII Protocol

As an alternative to the SDI-12 protocol the **OTT WAD 200** can also answer with a OTT defined ASCII protocol via the RS485 interface. It may be addressed every 10 s. It is recommended to work with 60 s intervals.
Commands in the 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 **OTT WAD 200** and not in a bus.

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 **OTT WAD 200** 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}** – for OTT service (default = "1") **t_{in}** – Temperature in °C **<CR><LF>** – End of answer

Example: Retrieval after 10 min with constant intensity.

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

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

Example:

Command	Answer
<STX>i<CR><LF>	**00000001041;1.3v;V1.00 v. 12.11.2013;2C096/0420000000;<CR><LF>**

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 "**Expert Configuration**" in the **OTT WAD** Commander.

Syntax

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

8.3.3 Talker Protocol

The Talker protocol is the third available mode of the RS485 interface. It sends an ASCII string in a defined interval. The interval can be adjusted between 10...60 s using the **OTT WAD** Commander.

Syntax

+int_{min};+int_{h};+am_{tot};+s_{he};+t_{in};+s_{sys}<CR><LF>

int_{min} – Intensity in mm/min
int_{h} – Intensity in mm/h
am_{tot} – Total amount in mm
s_{he} – for OTT service
t_{in} – Temperature in °C
s_{sys} – Status System
<CR><LF> – End of answer

Temperature sensor **indoor** in °C
Output e.g. +21.06 acc. 21.06 °C

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 = Only for OTT service
1	1 = Only for OTT service
2	1 = Error interior temperature sensor
3	1 = Only for OTT service

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>

8.4 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 **OTT WAD** Commander along with the closing time / pulse width. The duty cycle is 1:1 - 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.

8.5 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 **OTT WAD** Commander (see chapter 7).

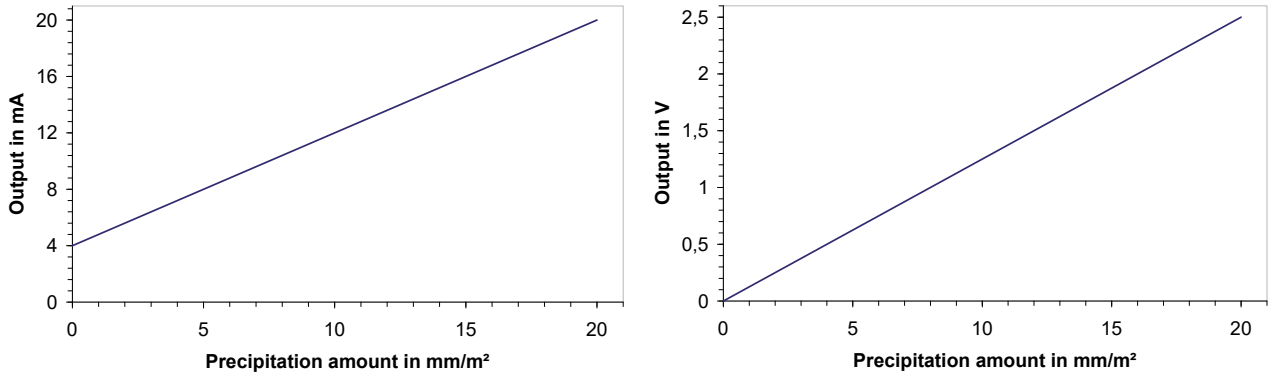


Fig. 24

Reset of analog output signal

By an external switch at the pins "**RESET ANALOG OUTPUT**" (see Fig. 14) the analogue output can be reset to the lower end (starting value) of the output range.
This means that e. g. at the range of 4...20 mA the output will be reset to 4 mA. The summation of precipitation amount starts at zero again.

9 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.

Pull the power plug and sensor connector before cleaning the device interior to prevent it from erroneous measurements.

- All water-bearing parts should be cleaned regularly. Rinsing should be sufficient to clean the sensor from most contamination. Dirt clinging to the collecting funnel 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 cleaning agent.
- 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 protection has to be removed before the frost period.

Please be careful while cleaning the collecting vessel to prevent it from taking damage. The OTT WAD 200 and the collecting vessel must not be cleaned with steel brushes or similar tools or aggressive detergents.

Troubleshooting

Error message, when trying to retrieve data from the OTT WAD 200 with the OTT WAD Commander:

Please reconnect the USB cable and restart the **OTT WAD** Commander.

OTT WAD Commander returns 'COM port not found' or 'OTT WAD 200 does not respond!':

- Check if the **OTT WAD 200** is correctly connected to the Laptop/Tablet and the correct COM port is selected.
- Restart the **OTT WAD** Commander.

10 Maintenance and Repair

In case you should be faced with any specific problems please contact the OTT Hydroservice on:

Phone **+49 831 5617-433**
Fax **+49 831 5617-439**
E-Mail **hydroservice@ott.com**

Connecting Diagram for Customized Configuration

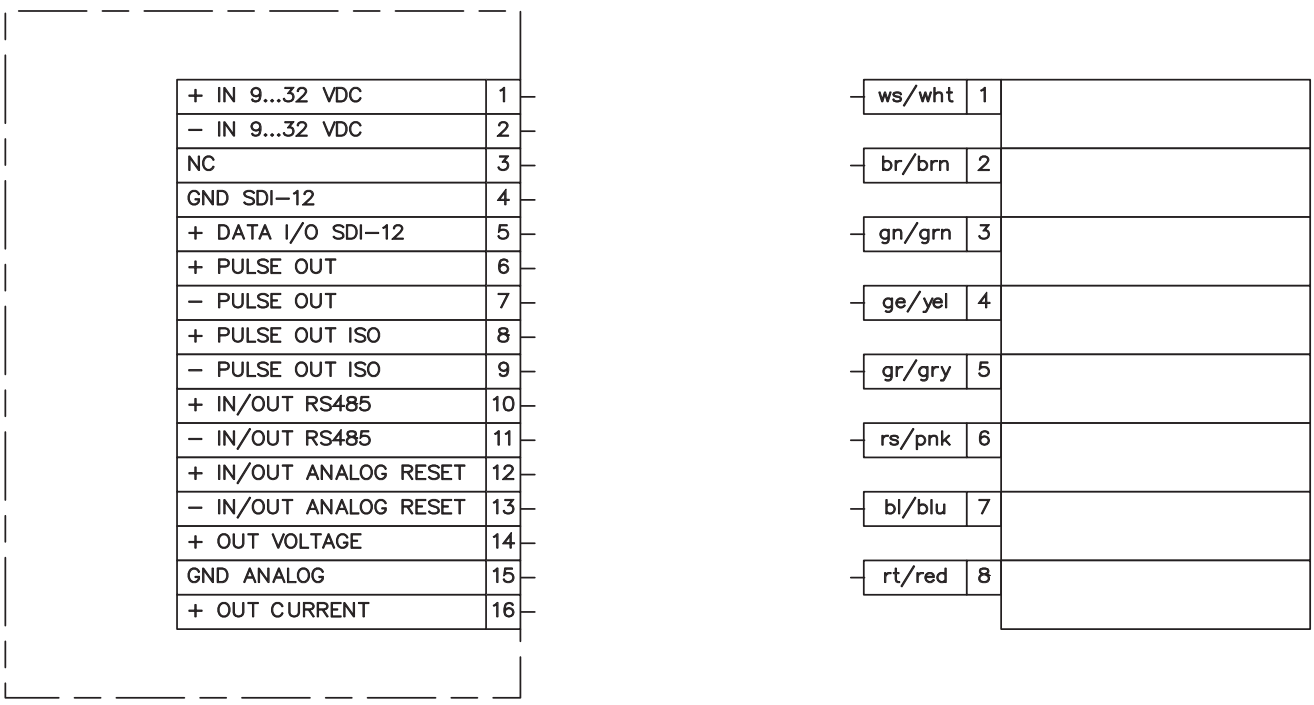


Fig. 25

11 Technical Data

OTT WAD 200 · No. 70.110.000.9.5	
Measurable precipitation types:	liquid (solid, mixed – with heated sensor)
Measurement principle:	weighing with automatic self emptying
Operating temperature:	0...+70 °C
Storage temperature:	-50...+70 °C
Collecting area:	200 cm²
Amount measurement range:	without limitation (0.005…∞ mm)
Amount resolution:	0.001 mm (pulse output: 0.01 mm)
Amount accuracy:	± 0.1 mm or ± 3 %
Intensity range:	0…12 mm/min resp. 0…720 mm/h
Intensity resolution:	0.001 mm/min resp. 0.001 mm/h
Intensity accuracy:	± 0.1 mm/min resp. ± 6 mm/h or ± 3 %
Dimensions:	292 mm x 190 mm (h x d), see dimensional drawing (Fig. 1)
Suitable for mounting:	Ø 60 mm
Weight:	approx. 2.5 kg
Standards:	WMO-No. 8 • VDI 3786 Bl. 7 • EN 61000-2, -4 EN 61000-4-2, -3, -4, -5, -6, -11 • NAMUR NE-21
Protection class load cell:	IP67
Current consumption:	Analogue output: max. 1000 mW or 45 mA at 24 VDC SDI-12/pulse output: max. 160 mW, typ. 10.4 mA at 12 VDC
Supply voltage:	9.8...32 VDC

Signal outputs:

- SDI-12
- RS485 (SDI-12 protocol, ASCII protocol and TALKER protocol)
- linearised, bounce-free pulse output signal **or** status output (e.g. “Rain YES/NO”)
  - Pulse 1 (galvanically isolated, open collector): Max. 24 V DC / max. 0.05 A / max. 0.5 W
  - Pulse 2 (open collector): Max. 24 V DC / max. 0.1 A / max. 0.5 W
- Analogue output
  0/4…20 mA - max. load 500 Ω at 24 V DC • or 0…2.5/5 V
  with reset output function

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