

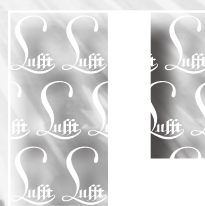
USER MANUAL

SMART WEATHER SENSOR WS10

... a passion for precision · passion pour la précision · pasión por la precisión · passione per la precisione · a p



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Change log

| Version | Date | Change |
|---------|------------|---|
| V1.0 | 2018/04/03 | Fist version (pre-series) |
| V1.1 | 2018/07/23 | <ul style="list-style-type: none">• Manual alignment description of the WS10• Various screenshots for device settings added• Modbus register description added and corrected• Added new UMB channel descriptions (for example, daily rainfall)• Description of configuration mode revised• Added sketch for manual wind direction• Inserting the manual setting option of the precipitation radar• Adjustable behavior of the wind direction in calm conditions documented |
| V1.2 | 2018/07/25 | <ul style="list-style-type: none">• Final review and minor corrections (typing and presentation) |

1 Read before commissioning



This manual is part of the device. It must be stored close to the device, so people in need find it quickly.
This manual must be read and understood by the people installing and operating the device. This is valid especially for the chapter safety.

1.1 Used symbols



Important notice for correct operation of the device

Necessary step

- ▶ Safety note








2 Safety

2.1 Safety notices

- ▶ Installation and commissioning may only be carried out by adequately qualified specialists.
- ▶ Never measure or touch parts that are under voltage.
- ▶ Disconnect the power before working on the device.
- ▶ Do not open the device. Operate it only in working and undamaged condition.
- ▶ If modified or converted, operating reliability and functionality can no longer be guaranteed.
- ▶ The electrical cables must be checked regularly for damage. Operation of the device with defective or manipulated electrical components is prohibited.
- ▶ In addition to these operating instructions, the generally applicable legal rules and other binding guidelines for occupational safety, accident prevention and environmental protection must be observed.
- ▶ The device may only be operated within its specifications.
- ▶ The device may only be used under the conditions and for the purpose for which it was designed.
- ▶ Please observe the warnings attached to the device (→ windmeter)
- ▶ Observe technical data, storage and operating conditions.

2.2 Warning signs

| Symbol | Meaning |
|---|--|
|  | Important notice of possible risks to the user |
|  | Warning of hot surfaces |
|  | Warning of dangerous electrical voltage |
|  | Fall hazard |
|  | Warning of damaging the device |

2.3 Warning signs on the device



Wind measurement dome:
Warning of hot surfaces

2.4 Intended use

- This device shall be used to measure and transmit meteorological data.
- This device shall be operated within the specified technical data
- This device shall be used only for the intended use
- The safety and functionality of the device may be compromised by changes or modifications

2.5 Incorrect use

If incorrectly installed

- the device may be operable to a limited extent or not at all
- the device may be permanently damaged
- there can be a risk of injury by the device falling from its mounting

If the device is not properly connected

- the device may fail to operate
- the device may be permanently damaged
- under some circumstances, there is a risk of electric shock

3 Scope of delivery

Weather station WS10



Connector



3.1 Further documents and software

You will find the following documents and software available to download online at www.lufft.de:

- | | |
|----------------------|--|
| • Manual | this document |
| • UMB*-Protocol 1.0 | Specification and description of the UMB (Binary) protocol |
| • UMB-ASCII 2.0 | Communication protocol for meteorological sensors |
| • Firmware | latest firmware for this device |
| • UMB ConfigTool.Net | UMB-Configuration-Software** for UMB-Sensors |
| • UMB Config Tool | Manual for UMB-Configuration-Software** |

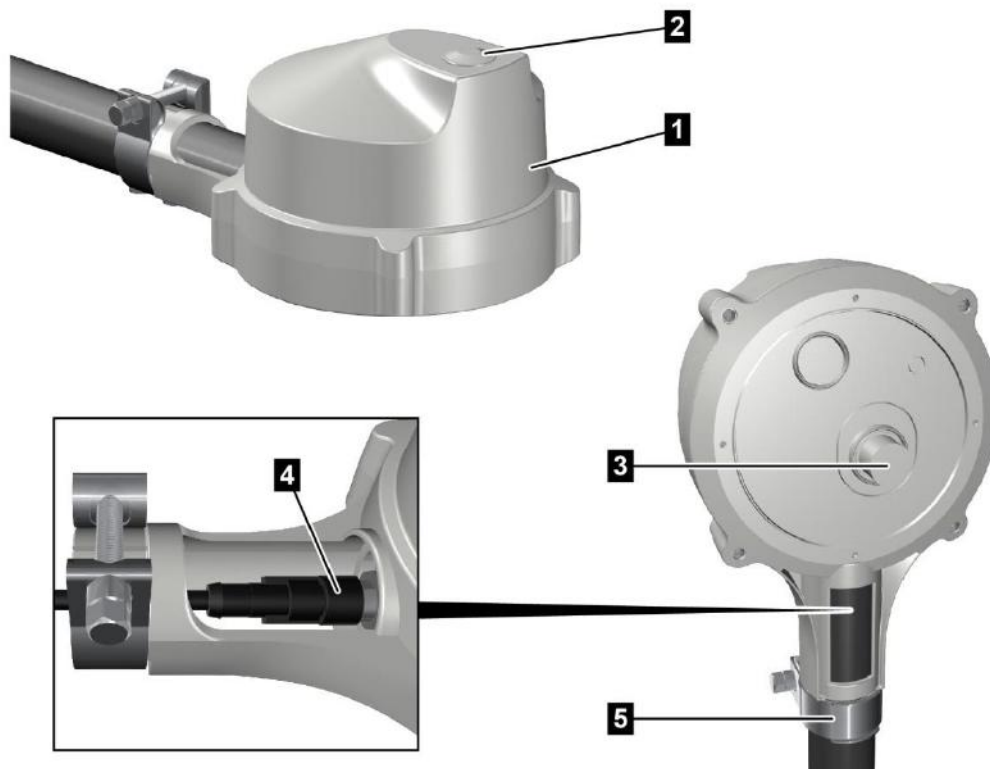
* UMB = Universal-Measurement-Bus

** PC-Software for Microsoft® Windows® Operating system

4 Device description

The WS 10 weather station is a device to measure different meteorological data to be used mainly but not exclusive for home automation.

4.1 Overview



| | | | |
|---|-----------------------|---|------------------|
| 1 | Weather station WS10 | 4 | Connector |
| 2 | Transparent glass | 5 | Mounting bracket |
| 3 | Wind measurement dome | | |



Connection

- 1 5-pin connector

4.2 Air temperature and humidity

The air temperature is measured by a high accuracy NTC-Resistor. The humidity is measured by a capacitive humidity sensor. External influence on the measurement (like sun radiation) is eliminated by a compensation algorithm.

4.3 Air Pressure

The absolute air pressure is measured by an integrated sensor (MEMS) within the device. The barometric altitude formula is used to calculate the relative air pressure in relation to sea level (NN) using the GPS altitude (the altitude that can be set by the user in the device).

4.4 Precipitation

Latest radar technology is used to measure precipitation. The precipitation sensor works with a 24GHz Doppler radar, which measures the drop speed and calculates precipitation quantity and type by correlating drop size and speed.

4.5 Wind

The wind meter uses a heated thermal element. Depending on the wind speed and direction the temperature of the thermal element changes. This temperature change is used to calculate the wind speed and direction.

4.6 Global Radiation

The global radiation is measured by a pyranometer mounted in the top cover of the WS10.

4.7 Position of the sun

The position of the sun is calculated by the geographical position of the weather station plus the current date and time.

4.8 Brightness

The illuminance is measured from the visible light.

4.9 Twilight

Twilight illuminance is measured by the illuminance sensor driven with a different attenuation.

4.10 Compass

The integrated electronic compass can be used to check the north – south adjustment of the sensor housing for wind direction measurement. It is also used to calculate the compass corrected wind direction.

Therefore, it is not necessary to adjust the WS10 to the north.

If there are misdirections in the compass due to surrounding magnetic fields, the electronic compass can be switched off and manual alignment can be specified instead. See configuration

4.11 GPS (Global Positioning System)

An integrated GPS-Modul is used to measure the geographical position of the WS10, date and time.

4.12 UV-Index

The UV-Index is a standard measurement value of the strength of sunburn-producing ultraviolet (UV) radiation. The UV radiation is measured with an integrates sensor and the UV-Index is calculated.

Note: The measured UV-Index must not be used for medical applications.

| UV-Index | Risk | Schutz |
|----------|-----------|---|
| 0-2 | low | A UV Index reading of 0 to 2 means low danger from the sun's UV rays for the average person. Wear sunglasses on bright days. If you burn easily, cover up and use broad spectrum SPF 30+ sunscreen. Bright surfaces, such as sand, water and snow, will increase UV exposure. |
| 3-5 | moderate | A UV Index reading of 3 to 5 means moderate risk of harm from unprotected sun exposure. Stay in shade near midday when the sun is strongest. If outdoors, wear sun protective clothing, a wide-brimmed hat, and UV-blocking sunglasses. Generously apply broad spectrum SPF 30+ sunscreen every 2 hours, even on cloudy days, and after swimming or sweating. Bright surfaces, such as sand, water and snow, will increase UV exposure. |
| 6-7 | high | A UV Index reading of 6 to 7 means high risk of harm from unprotected sun exposure. Protection against skin and eye damage is needed. Reduce time in the sun between 10 a.m. and 4 p.m. If outdoors, seek shade and wear sun protective clothing, a wide-brimmed hat, and UV-blocking sunglasses. Generously apply broad spectrum SPF 30+ sunscreen every 2 hours, even on cloudy days, and after swimming or sweating. Bright surfaces, such sand, water and snow, will increase UV exposure. |
| 8-10 | very high | A UV Index reading of 8 to 10 means very high risk of harm from unprotected sun exposure. Take extra precautions because unprotected skin and eyes will be damaged and can burn quickly. Minimize sun exposure between 10 a.m. and 4 p.m. If outdoors, seek shade and wear sun protective clothing, a wide-brimmed hat, and UV-blocking sunglasses. Generously apply broad spectrum SPF 30+ sunscreen every 2 hours, even on cloudy days, and after swimming or sweating. Bright surfaces, such as sand, water and snow, will increase UV exposure. |
| ≥11 | extreme | A UV Index reading of 11 or more means extreme risk of harm from unprotected sun exposure. Take all precautions because unprotected skin and eyes can burn in minutes. Try to avoid sun exposure between 10 a.m. and 4 p.m. If outdoors, seek shade and wear sun protective clothing, a wide-brimmed hat, and UV-blocking sunglasses. Generously apply broad spectrum SPF 30+ sunscreen every 2 hours, even on cloudy days, and after swimming or sweating. Bright surfaces, such as sand, water and snow, will increase UV exposure |

Source: Wikipedia.org

5 Measurement Output

Measurements are transmitted in accordance with UMB binary protocol (Factory Settings).



It is recommended to set up and poll the station with ConfigTool.NET.

You can find an example of a measurement request in different protocols and a complete summary of the list of channels in the Appendix.

The measurement range listed in the table is used for the UMB ASCII protocol.

5.1 Air and Dewpoint Temperature

Sampling rate 1 Minute

Units °C; °F

Request channels:

| UMB Channel | | Measuring range | | |
|-------------|--------------------------------|-----------------|-----|------|
| act | Measurement variable (float32) | min | max | unit |
| 100 | Air temperature | -40 | 60 | °C |
| 105 | Air temperature | -40 | 140 | °F |
| 110 | Dewpoint temperature | -40 | 60 | °C |
| 115 | Dewpoint temperature | -40 | 140 | °F |

5.2 Humidity

Sampling rate 1 Minute

Units %r.F.; g/m³

Request channels:

| UMB Channel | | Measuring range | | |
|-------------|--------------------------------|-----------------|------|------------------|
| act | Measurement variable (float32) | min | max | unit |
| 200 | Relative humidity | 0 | 100 | % |
| 205 | Absolute humidity | 0 | 1000 | g/m ³ |

5.3 Air pressure

Sampling rate 1 Minute

Units hPa

Request channels:

| UMB Channel | | Measuring range | | |
|-------------|--------------------------------|-----------------|------|------|
| act | Measurement variable (float32) | min | max | unit |
| 300 | Absolute air pressure | 300 | 1100 | hPa |
| 305 | Relative air pressure | 300 | 1100 | hPa |

5.4 Wind Speed

Sampling rate 1sec
 Units m/s; km/h; mph; kts
 Response threshold 0,1 m/s
 Request channels:

| UMB Channel | | Measuring range | | |
|-------------|--------------------------------|-----------------|---------|------|
| act | Measurement variable (float32) | min | max | unit |
| 400 | Wind speed | 0 | 40 | m/s |
| 405 | Wind speed | 0 | 144 | km/h |
| 410 | Wind speed | 0 | 89,4775 | mph |
| 415 | Wind speed | 0 | 77,7538 | kts |

5.5 Wind Direction

Sampling rate 1sec
 Units °
 Response threshold 0,1 m/s
 Request channels:

| UMB Channel | | Measuring range | | |
|-------------|--------------------------------|-----------------|-----|------|
| act | Measurement variable (float32) | min | max | unit |
| 500 | Wind direction | 0 | 359 | ° |
| 502 | Wind direction, compass | 0 | 359 | ° |

Note: Ch. 500 the wind direction measured by the wind sensor adjusted by the value of the manual adjustment to the north (see chapter **Manual adjustment to the north**).

Note: Ch. 502 wind direction is calculated from the wind direction measured by the wind sensor and the heading measured by the compass.

Note: During calm wind situations the WS10 will keep the last measured wind direction. This can be adjusted in the ConfigTool.NET (see chapter **Wind direction at calm winds**).

5.6 Compass

Sampling rate 1 sec (mean value over 16 measurements)
 Units °
 Request channels:

| UMB Channel | | Measuring range | | |
|-------------|--------------------------------|-----------------|-----|------|
| act | Measurement variable (float32) | min | max | unit |
| 510 | Compass heading | 0 | 360 | ° |

5.7 Precipitation Quantity - Absolute

Sampling rate Event-dependent on reaching the response threshold

Units l/m²; mm; in; mil

Response threshold 0,01mm (Radar)

Request channels:

| UMB Channel | | Measuring range | | |
|-------------|-----------------------------------|-----------------|----------|------------------|
| act | Measurement variable (float32) | min | max | unit |
| 600 | Precipitation Quantity - Absolute | 0 | 100000 | l/m ² |
| 620 | Precipitation Quantity - Absolute | 0 | 100000 | mm |
| 640 | Precipitation Quantity - Absolute | 0 | 3937,008 | inch |
| 660 | Precipitation Quantity - Absolute | 0 | 3937008 | mil |

Note: This measurement indicates the accumulated precipitation quantity since the last device reboot. The measurement is retained for the duration of a short power failure. To reset this value, use the corresponding function in the UMB-Config-Tool or disconnect the device from the power supply for at least one hour.

5.8 Precipitation Quantity - Daily

Sampling rate Event-dependent on reaching the response threshold

Units l/m²; mm; in; mil

Response threshold 0,01mm (Radar)

Request channels:

| UMB Channel | | Measuring range | | |
|-------------|--------------------------------|-----------------|----------|------------------|
| act | Measurement variable (float32) | min | max | unit |
| 601 | Precipitation Quantity - Daily | 0 | 100000 | l/m ² |
| 621 | Precipitation Quantity - Daily | 0 | 100000 | mm |
| 641 | Precipitation Quantity - Daily | 0 | 3937,008 | in |
| 661 | Precipitation Quantity - Daily | 0 | 3937008 | mil |

5.9 Precipitation Quantity - Differential

Sampling rate Event-dependent on reaching the response threshold

Units l/m²; mm; in; mil

Response threshold 0,01mm (Radar)

Request channels:

| UMB Channel | | Measuring range | | |
|-------------|---------------------------------------|-----------------|----------|------------------|
| act | Measurement variable (float32) | min | max | unit |
| 605 | Precipitation Quantity - Differential | 0 | 100 | l/m ² |
| 625 | Precipitation Quantity - Differential | 0 | 100 | mm |
| 645 | Precipitation Quantity - Differential | 0 | 3,937 | in |
| 665 | Precipitation Quantity - Differential | 0 | 3937,008 | mil |

Note: Each request from a differential channel sets the accumulated quantity back to zero!

5.10 Precipitation Intensity

Sampling rate 1 Minute
 Units l/m²/h; mm/h; in/h; mil/h; mm/min; in/min
 Response threshold 0,1 mm/h
 Request channels:

| UMB Channel | | Measuring range | | |
|-------------|--------------------------------|-----------------|----------|---------------------|
| act | Measurement variable (float32) | min | max | unit |
| 800 | Precipitation intensity | 0 | 100 | l/m ² /h |
| 820 | Precipitation intensity | 0 | 100 | mm/h |
| 825 | Precipitation intensity | 0 | 1,6667 | mm/m |
| 840 | Precipitation intensity | 0 | 3,937 | in/h |
| 845 | Precipitation intensity | 0 | 0,0656 | in/m |
| 860 | Precipitation intensity | 0 | 3937,008 | mil/h |

Note: The WS10 calculate the precipitation intensity from the accumulated precipitation differences of the last 6 minutes before the measurement data request.

5.11 Precipitation Type

Sampling rate Event-dependent on reaching the response threshold
 Response threshold 0,002mm (Radar)
 Follow-up time 2 minutes
 Request channels:

| UMB Channel | Measurement Value (uint8) | Coding |
|-------------|---------------------------|---|
| 700 | Precipitation type | 0 = no precipitation 60 = liquid precipitation, e.g. rain 70 = solid precipitation, e.g. snow 67: freezing rain 69: sleet 90: hail |

Note: A detected precipitation type remains valid for 2 minutes after the end of the precipitation event. In order to record precipitation types which only occur for a short period (e.g. short-term rain), the request interval should be 1 minute or shorter.

5.12 Global radiation

Sampling rate 1 sec

Unit W/m²

Request channels:

| UMB Channel | | Measuring range | | |
|-------------|--------------------------------|-----------------|------|------------------|
| act | Measurement variable (float32) | min | max | unit |
| 900 | Global radiation | 0 | 1500 | W/m ² |

5.13 UV-Index

Sampling rate 1 sec

Unit digits

Request channels:

| UMB Channel | | Measuring range | | |
|-------------|------------------------------|-----------------|-----|--------|
| act | Measurement variable (uint8) | min | max | unit |
| 902 | UV-Index | 0 | 20 | digits |

5.14 Brightness

Sampling rate 5 sec

Unit klx

Request channels:

| UMB Channel | | Measuring range | | |
|-------------|--------------------------------|-----------------|-----|------|
| act | Measurement variable (float32) | min | max | unit |
| 903 | Brightness | 0 | 160 | klx |

5.15 Twilight

Sampling rate 5 sec

Unit lx

Request channels:

| UMB Channel | | Measuring range | | |
|-------------|--------------------------------|-----------------|-----|------|
| act | Measurement variable (float32) | min | max | unit |
| 904 | Twilight | 0 | 500 | lx |

5.16 Position Of The Sun

Sampling rate 10 sec

Unit °

Request channels:

| UMB Channel | | Measuring range | | |
|-------------|---------------------------------|-----------------|-----|------|
| act | Measurement variable (float32) | min | max | unit |
| 910 | Position of the sun - azimuth | 0 | 360 | ° |
| 911 | Position of the sun - elevation | 0 | 90 | ° |

5.17 Position

Sampling rate 10 sec

Request channels:



| UMB Channel | | Measuring range | | |
|-------------|----------------------------------|-----------------|------------|--------|
| act | Measurement variable (float32) | min | max | unit |
| 3900 | Position longitude | -180 | 180 | ° |
| 3901 | Position latitude | -90 | 90 | ° |
| 3902 | Position height | -1000 | 10000 | m |
| 3903 | UTC timestamp (uint32) | 0 | 4294967295 | s |
| 4071 | GPS number of satellites (uint8) | 0 | 255 | digits |
| 4072 | GPS Position locked (uint8) | 0 | 255 | digits |



5.18 Service Channels

Request channels:

| UMB Channel | | Measuring range | | |
|-------------|--------------------------------|-----------------|------------|--------|
| act | Measurement variable (float32) | min | max | unit |
| 4060 | Wi-Fi status (uint16) | 0 | 65535 | digits |
| 4061 | Wi-Fi signal strength (sint16) | -32767 | 32767 | digits |
| 4700 | Device runtime (uint32) | 0 | 4294967295 | s |
| 4701 | Attended time (uint32) | 0 | 4294967295 | s |
| 4702 | Number boot cycles (uint32) | 0 | 4294967295 | digits |
| 4703 | UTC timestamp (uint32) | 0 | 4294967295 | s |
| 4704 | Local timestamp (uint32) | 0 | 4294967295 | s |
| 10000 | Supply voltage (float32) | 0 | 50 | V |

6 Montage

|  Caution | |
|--|--|
|  | <p>Fall hazard while working in heights</p> <p>For installation, only approved and tested aids (ladder, steps, etc.) may be used.</p> <p>All applicable regulations for work in heights must be observed.</p> |

|  Caution | |
|--|--|
|  | <p>Hazard of falling objects.</p> <p>Make sure the device is mounted correctly and save.</p> <p>During installation make sure no objects can fall down.</p> |

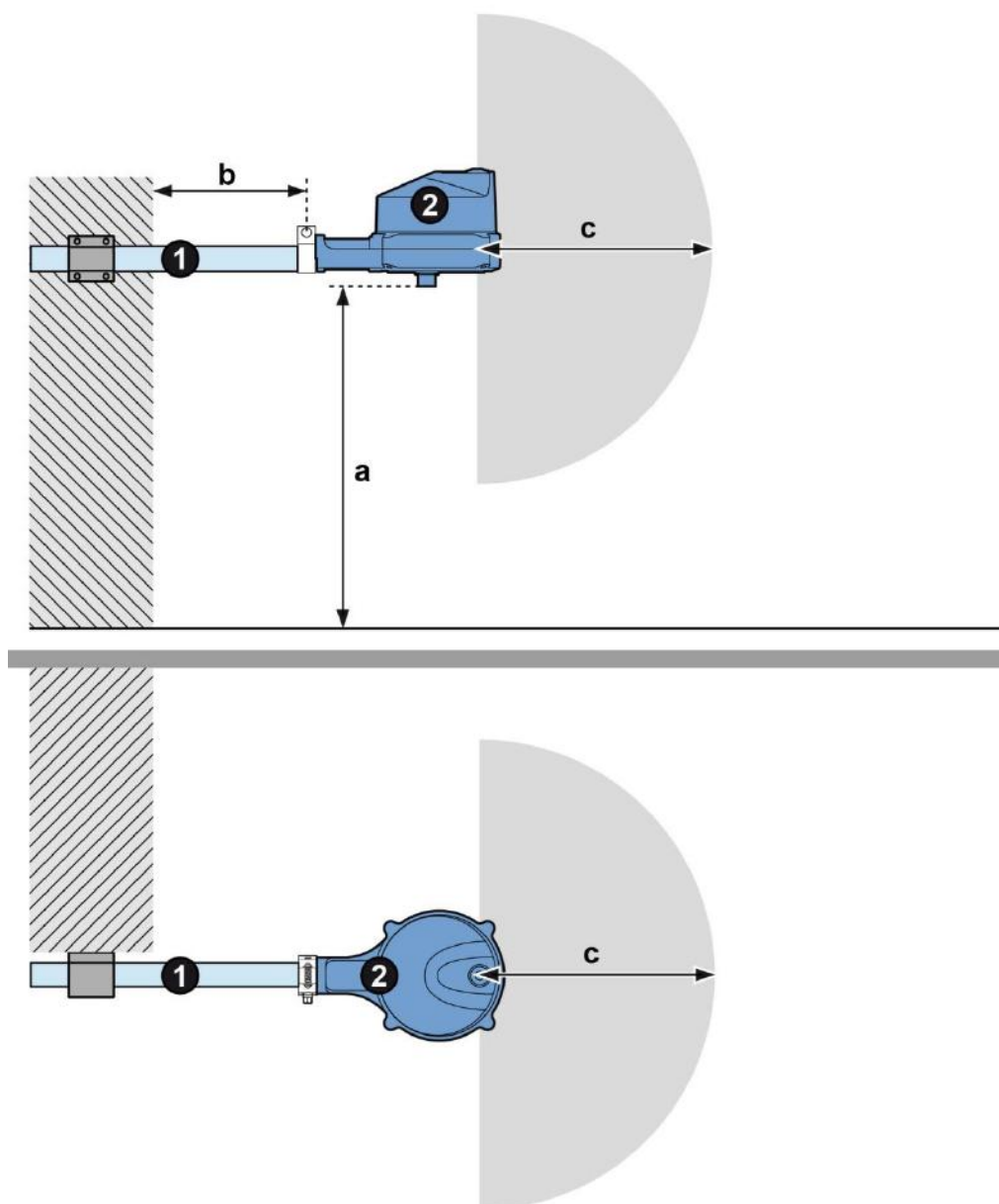
Important notices for installing

- ▶ Installation and commissioning may only be carried out by adequately qualified specialists .
- ▶ Never measure or touch parts that are under voltage.
- ▶ Observe technical data, storage and operating conditions.
- ▶ The intended location is outdoors. The device must not be operated in closed rooms.
- ▶ The building-side holding device must be sufficiently dimensioned and firmly anchored.
- ▶ The device must be secured in such a way that there are no objects, trees or other objects in the immediate vicinity that could affect the acquisition of the measured data.
- ▶ The direct measuring range in front of the device must be kept clear of all obstacles in any case.
- ▶ All work must be carried out when the device is de-energized. Only connect the power supply to the mains once all assembly work has been completed correctly.
- ▶ The cables to and from the device must be fastened in such a way that no tension is exerted on the plug connection during operation.
- ▶ Lay the cables so that they can not be damaged.
- ▶ Lay the cables so that nobody can trip over them.
- ▶ To ensure a reliable rain radar measurement, the WS10 must be at least 8 m apart.

The following tools are required for installation:

- fork or ring spanner SW10

6.1 Installation Sketch



| | | | |
|---|----------------|---|---------------------------|
| 1 | Tube (Ø 35 mm) | a | Proposed height 2000 mm |
| 2 | WS10 | b | Proposed distance 500 mm |
| | | c | Free surrounding >1000 mm |



To achieve a correct measurement of global radiation, make sure the WS 10 is in all directions horizontally aligned.



To ensure the correct functionality of the WS10 the notes below concerning the place of installation must be followed:

- Free sight to the sky – for the correct function of the GPS module and the precipitation measurement the WS10 must have a free sight to the sky.
- To ensure correct measurements of any kind of sun imposed radiation make sure that there is never shade on the WS10.
- To ensure correct wind measurements there should be no bigger obstacle (tree, building, etc.) within 5m around the WS10.

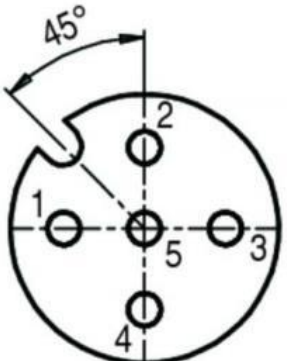




Not following the above mentioned notes may lead to wrong measurements.

6.2 Connections

The WS 10 is to be supplied with a direct voltage of typ. 24 VDC (9-36VDC). The power supply unit used must be approved for the operation of devices with protection class III (SELV).

The power supply must serve at least 35W @ 24V. The power connection must be fused by a 2.5A (slow-blow) fuse.

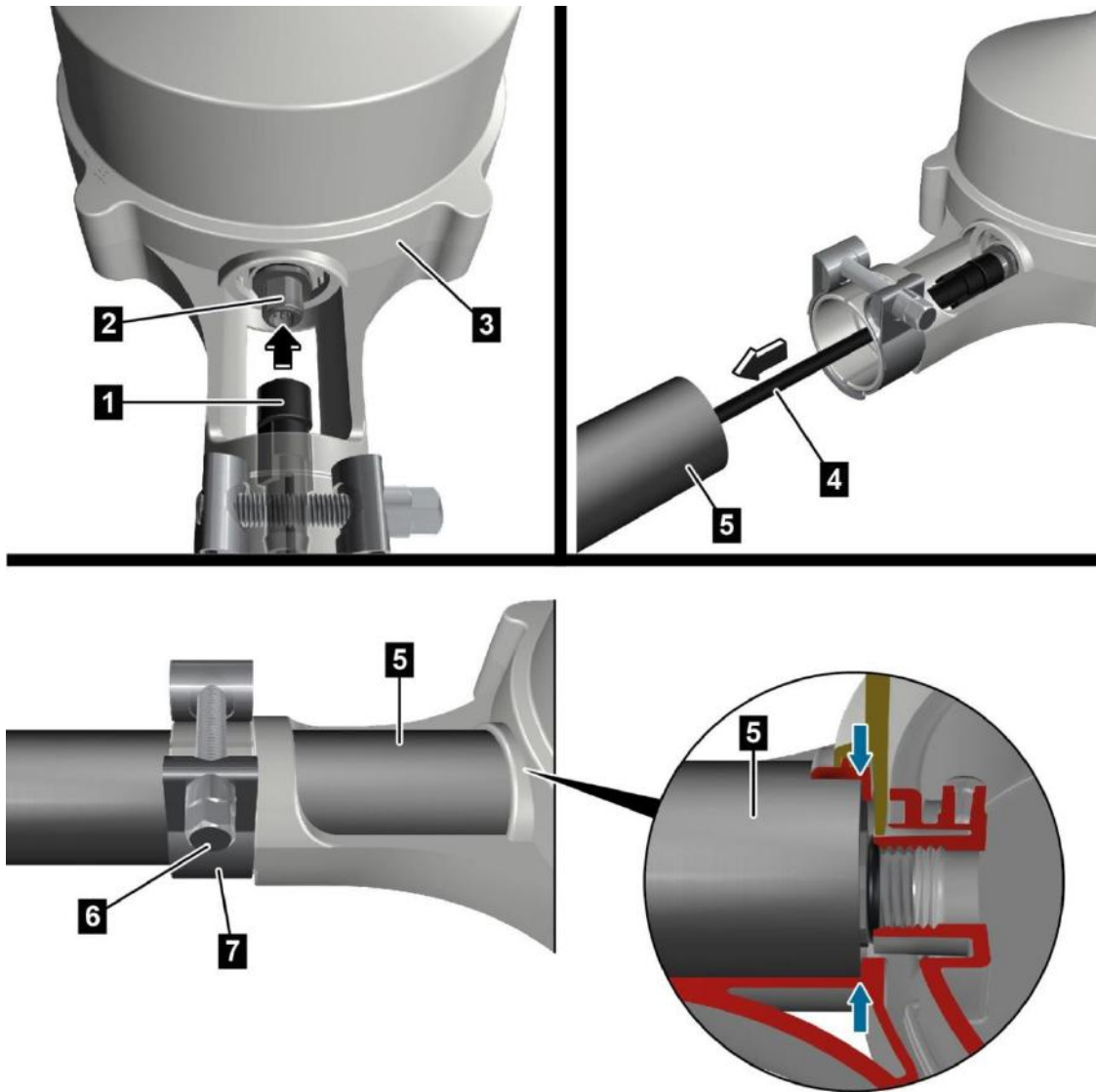
The connecting cable must be resistant to UV radiation. The cable must have an external diameter of 4-6mm and a wire gauge of at least 0,3mm².

| Pin assignment | PIN | Usage | Cable color |
|---|-----|--|---|
|  | 1 | +V _{in} |  |
| | 2 | GND | |
| | 3 | RS 485 A (+) |  |
| | 4 | RS 485 B (-) |  |
| | 5 | Configuration (pos) Only used for Wi-Fi AP mode |  |

The device has a half-duplex, 2-wire RS485 interface for configuration, measured value query and firmware update.

Positive voltage (+V_{in} 9..36V) at the configuration pin forces the WS10 into Wi-fi access point mode. This is independent of any other setting within the WS10 configuration.

6.3 Fastening



| | | | |
|---|------------|---|------------------|
| 1 | Connector | 5 | Tube |
| 2 | Connection | 6 | Screw |
| 3 | WS10 | 7 | Mounting bracket |
| 4 | Cable | | |

⇒

⇒

⇒

⇒

The WS10 is mounted on a tube in horizontal position. Make sure the tube is mounted safely at a fixed mounting point (e.g. mast, building, etc.)

⇒

Put the connector (1) of the connecting cable into the connector (2) of the WS10 (3).

Pull the connecting cable (4) through the tube (5).



Loosen the screw (6) at the bracket (7).

Push the tube (5) into the WS10 bracket until the very end.

Make sure you do not damage the connecting cable.

Tighten the screw (6) at the bracket (7).

7 Commissioning

|  Caution | |
|--|---|
|  | <p>Warning of hot surfaces.</p> <p>Do not touch the wind measurement dome.</p> |

7.1 Configuration

After connecting the supply voltage the WS10 will start automatically.

If there is no WiFi configured, the WS10 starts in WiFi access point mode. By using the UMB-ConfigTool.NET you can now configure the WS10.



Be aware, that the configuration mode is limited to 30 min.

Configuration mode will be indicated by LED blinking green

To ensure a stable WiFi connection you should be within 10m around the WS10 with your device running the UMB-ConfigTool.NET.

⇒ To configure the WS10 you need a WiFi capable device running Windows®-PC Software or Android® operating system and the Lufft ConfigTool.NET. The Lufft ConfigTool.NET can be downloaded on the Lufft internet web site or installed directly from the Android® Playstore.

⇒ Connect your device with the WS10 WiFi access point

⇒ SSID: WS10_Wifi-<serial number>

⇒ Password: <serial number> (to be found on the label)


⇒ **Note:** During the connection to the WS10 there is no connection to the Internet possible.

⇒ Start the Lufft UMB-ConfigTool.NET

⇒ Please check the Windows® firewall configuration to allow connections to a public network.

⇒ In the Lufft UMB-ConfigTool.NET please select “Add device” > “WSX-UMB”

Configure the WiFi login credentials of the WLAN which the WS10 should use.

Through the  Button you get to the configuration menu.

Insert your WiFi SSID and WiFi key.



| | | |
|---|-----------------|---|
| ⇒ | WiFi | |
| | Wifi | Enabled |
| | Mode | DHCP |
| | IPv4 address | 0.0.0.0 |
| | Subnet mask | 0.0.0.0 |
| | Gateway address | 0.0.0.0 |
| | DNS address | 0.0.0.0 |
| ⇒ | WiFi encryption | WPA2 |
| ⇒ | WiFi SSID | |
| | WiFi key | |
| | WiFi TCP port | 9750 |

With “Save” the configuration will be written to the WS10 and the WS10 will automatically restart with the new parameters.

Connect your device to the local WiFi you configured the WS10 for.

Now you should be able to connect to the WS10 through your local WiFi and continue the configuration of the WS10 if needed.



If you do not need the Wifi connection, please disable the WiFi in the configuration menu of the ConfigTool.NET. Under **WiFi – WiFi** you can disable the WiFi.



Due to the integrated electrical compass a manually north alignment is not necessary and therefore must not be configured.

The complete functionality of the ConfigTool .NET is described in a separate documentation to be found on the Lufthansa internet web site.


7.1.1 Adjustment to the local time zone

The system time (UTC) of the WS10 is adjusted automatically by the GPS-Modul. To adjust the WS10 to the local time zone where the WS10 is installed, you need to enter the respective offset value.



Please be aware – the offset value may change with the change of summer- and wintertime (daylight saving time).

E.g. For central Europe the time zone is UTC +1h (wintertime) and UTC +2h (summertime). The respective offset would be 3600s or 7200s.

Through the  Button in the ConfigTool.NET you get to the configuration menu. Under **GPS – UTC local time offset** you may adjust your desired time offset in seconds.

| GPS | |
|--------------------------|------------|
| UTC local time offset | 0 |
| Location height setting | Auto (GPS) |
| Location height in meter | 275 |
| Station latitude | 48.8296967 |
| Station longitude | 9.259797 |

7.1.2 Adjustment of location height

Through the  Button in the ConfigTool.NET you get to the configuration menu.

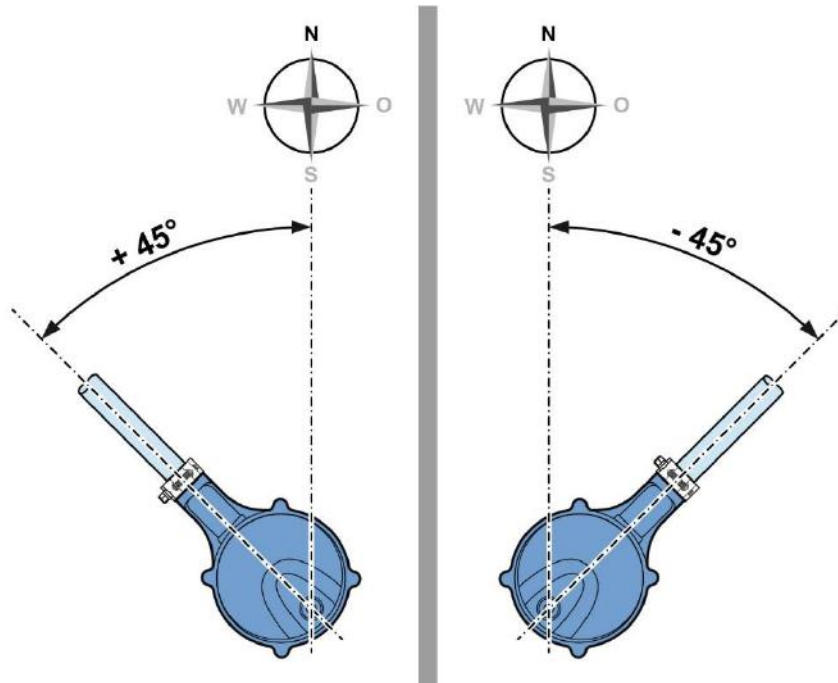
Under **GPS – Location height** you can select between Manual and Auto configuration. Using **Auto (GPS)** mode, WS10 will retrieve the altitude from its internal GPS sensor. In **Manual** mode you can specify your location height manually.

| GPS | |
|--------------------------|------------|
| UTC local time offset | 0 |
| Location height setting | Manual |
| Location height in meter | Auto (GPS) |
| Station latitude | Manual |
| Station longitude | 9.259797 |

7.1.3 Manual adjustment to the north

In rare occasions there is a need to manually adjust the WS10 to the north. This could be the case if the WS10 is mounted close to a strong magnetic field or large steel constructions.

To manually adjust the WS10 to the north, you must enter the difference in degree between the WS10 connector and the magnetic north.



Through the  Button in the ConfigTool.NET you get to the configuration menu.

Under **Wind – Manual angle alignment in degrees** you can enter the direction of the WS10.

| Wind | |
|-----------------------------------|--------------------------------|
| Wind direction at inactivity | Freeze (Home Automation) |
| Manual angle alignment in degrees | <input type="text" value="0"/> |


7.1.4 Wind direction at calm winds

The WS10 offers two ways to report wind direction at calm winds.

1. Freeze – means the WS10 reports the last measured wind direction
2. North – means the WS10 reports 0° as wind direction

Through the  Button in the ConfigTool.NET you get to the configuration menu.

Under **Wind – Wind direction at inactivity** you can make your choice what should be reports at calm winds.

| Wind | |
|------------------------------|--|
| Wind direction at inactivity | Freeze (Home Automation)  |
| Freeze (Home Automation) | |
| North (Meteo) | |


7.1.5 Manual activation of precipitation radar

Because of country individual regulation the precipitation radar is switched of automatically by a geofencing algorithm in countries where there is no approval.

If you want to manually switch on the precipitation radar, you can use the ConfigTool.NET to do so.

Through the  Button in the ConfigTool.NET you get to the configuration menu.

Under **Radar rain sensor – Radio regulations** you need to select **Manual** and under **Manual setting** you need to choose the country standard you want to comply to.

| | |
|----------------------------|---|
| Radar rain sensor | |
| Rainfall correction factor | 1 |
| Radio regulations | Manual |
| Manual setting | EU (ETSI)  |
| | Off |
| | EU (ETSI) |
| | USA/Canada (FCC) |

Caution



The operation of precipitation radar outside the approved countries is not permitted by law. The operator acts at his own risk and is responsible for a possible criminal liability itself. Lufft rejects any liability for the operation of precipitation radar outside the countries approved by Lufft.

7.1.6 Reset into configuration mode

If the WS10 is due to miss configuration not accessible anymore through the WLAN, you can reset the WS10 to the configuration mode in two ways.

1. Position a magnet close to the housing where you can read 'Reed' on the housing.
2. Connect B+ to Pin 5 of the WS10 connector

Switching to the configuration mode is indicated by a short blue flashing of the status LED.

As long as the WS10 is in configuration mode, this is indicated by a green flashing every 10s of the status LED.

Please note that configuration mode is only active for 30min.

7.2 Communication through WLAN

The WLAN module is automatically activated and is sending measurement data.

7.3 Communication with Weather Underground

In order to see the WS10 measurement values online in the public internet a Weather Underground connection is necessary.

Call the Weather Underground site <https://www.wunderground.com>

Choose "More" and "Add Weather Station"

"Step 1: Register Your Station choose "Join"

Enter your email-Address and choose a password

Read the 'Terms of Service' and agree to them by checking the respective box



Click the button 'Sign up for free' to finalize the registration



After a successful registration you can register your weather station in some additional simple steps



Step 1:

Push the red point to the geographical location of your WS10 weather station

If the WS10 weather station is close to a house with a postal address, you can also find your location by adding this address



The coordinates and the height above sea level is automatically generated by the map



Step 2:

On the next page, please add additional information. The only thing necessary is an entry in 'neighborhood'



'Station hardware' has to be set to 'other'



After a successful registration of your WS10 weather station, Weather Underground will send you a Station ID and a Station Password.

For your convenience and later use, you can note it here:

| | |
|------------------|--|
| Station ID | |
| Station Password | |



Station ID and Station Password will be needed for the WS10 configuration.

7.4 Communication through COM1 / RS485

For the communication to the weather station WS10 you'll need the UMB-ConfigTool.Net software tool from Lufft.

The functionality and configuration of the UMB-ConfigTool.Net software tool is described in the online help of the tool. The online help can be used without internet connection.

With the UMB-ConfigTool.NET software tool you can completely configure the WS10.

7.5 Communication Protocols

The command "PRT=<value>" reads/sets the used communication protocol based on the values shown in the table below:

| <value> | protocol |
|---------|---------------|
| 0*) | UMB-binary |
| 5 | MODBUS-RTU |
| 6 | MODBUS-ASCII |
| 9 | UMB-ASCII 2.0 |

*) factory setting



The change to another communication protocol will need a restart of the WS10 to take effect.

7.5.1 UMB binary

UMB binary is the standard protocol used for configuration of the WS10 with the ConfigTool.NET.

You'll find to documentation for download on the Lufft internet web site www.Lufft.com.

7.5.2 UMB-ASCII 2.0

The messages of the UMB-ASCII 2.0 protocol is highly customizable. Therefore you can change your messages to fit most of the data logger hardware.

| | |
|---------------------|--|
| auto sending | Send a message automatically in the configured interval |
| interval | Time in seconds between the automated sending of messages |
| start character | ASCII-char used as start sequence for a message Factory setting: 2 / 02h (STX) |
| end character | ASCII-char used as end sequence for a message Factory setting: 4 / 04h (EOT) |
| decimal separator | Char used as decimal separator Factory setting: Point 46 / 2 Eh (".") |
| parameter separator | Char used as parameter separator Factory setting: Semicolon 5B / 3 Bh (";") |
| block separator | Char used as block separator Factory setting: Colon 5C / 3Ah (":") |
| line end | Char used for line end Factory setting: CRLF (0Dh, 0Ah) alternative CR (0Dh) or LF (0Ah) |

7.5.3 Modbus

For a simpler integration of WS family Smart Weather Sensors into a PLC environment the Modbus communication protocol has been made available.

Measurement values are mapped to Modbus Input Registers. The range of values available is basically the same as for the UMB protocol, including different unit systems.

In the interest of simple and safe integration the use of register pairs for floating point values or 32 bit integers, which is not part of the Modbus standard, has not been applied. All measurement values are mapped to 16bit integers using suitable scaling factors.

Modbus communication parameter

The Smart Weather Sensor can be configured for MODBUS-RTU or for MODBUS-ASCII.

The base configuration must be done using the UMB Config Tool.

When selecting MODBUS RTU or MODBUS-ASCII with the UMB Config Tool, communication parameters 19200 Bd, even parity, will be preselected.

7.5.3.1

Modbus operating modes: MODBUS-RTU, MODBUS-ASCII

Baud rate: 19200 (9600, 4800 or lower)

Interface Setting 8E1, 8N1, 8N2



The Modbus communication has been tested for a poll rate of 1 sec. The proper function of the Smart Weather Sensor with higher Modbus poll rates has not been tested.

We suggest to set the poll rate to 10 sec or slower, as, with the exception of the channels „wind speed / wind directions fast“, which are provided for special purposes, the update rate of the data is ≥ 10 sec. However, for most of the weather data, significant changes should be expected in the range of minutes.

Addressing

7.5.3.2

The Modbus address is deducted from the UMB device ID.

A device with UMB device ID 1 also has the UMB address 1, etc..

The valid address range of Modbus from 1 to 247 is smaller than that of the UMB device IDs. If a UMB device ID > 247 has been selected, the Modbus address will be set to 247.

7.5.3.3

Modbus functions

The functions of conformance class 0 and 1 have been implemented as far as they are applicable for the Smart Weather Sensor, i.e. all functions operating on register level.

| | Conformance Class 0 | |
|------|--------------------------|---|
| 0x03 | Read Holding Registers | Selected configuration settings |
| 0x16 | Write Multiple Registers | Selected configuration settings |
| | Conformance Class 1 | |
| 0x04 | Read Input Registers | Measurement values and status information |
| 0x06 | Write Single Register | Selected configuration settings |
| 0x07 | Read Exception Status | Currently not used |
| | Diagnostics | |
| 0x11 | Report Slave ID | (responds also to broadcast address) |

Function 0x03 Read Holding Register

The Holding Registers are used to make a selected set of adjustable parameters available for Modbus access. As for the measurement values the parameters are mapped to 16bit integers.

7.5.3.4

| Reg. No. | Reg. Addr | Function | Values | Scale |
|----------|-----------|----------------|---|-------|
| 1 | 0 | Local Altitude | Altitude in m, for calculation of relative air pressure Value range -100 ... 5000 | 1.0 |
| 2 | 1 | Deviation | Local deviation for the correction of compass heading. Value range -3599 ... 3599 (equalling -359.9° ... +359.9°) | 10.0 |
| 8 | 7 | Reset rainfall | Function only when writing to the register, reading will give 0 always | - |
| 9 | 8 | Device reset | Function only when writing to the register, reading will give 0 always | - |

Function 0x06 Write Holding Register, 0x10 Write Multiple Registers

7.5.3.5

By writing into the holding registers selected parameters of the Smart Weather Sensor can be adjusted through Modbus.

Register assignment see 7.5.3.4

Local altitude, compass deviation and averaging intervals are set by writing the new values into the related registers. Depending on the selected register the value must be scaled by the factor given in the table:

Example: for compass deviation, the table shows a scaling factor of 10.0. If the deviation is 4.8° a value of 48 shall be written into register 2 (reg.addr. 1).

The transmitted values will be checked for plausibility. Illegal values will not be accepted and cause a Modbus exception.

When writing the value 0x3247 (12871d) to register no. 8 (reg. addr. 7) the stored absolute rain amount will be set to 0. Subsequently a device reset will be initiated.

7.5.3.6

When writing the value 0x3247 (12871d) to register no. 9 (reg. addr. 8) a device reset will be initiated.

Function 0x04 Read Input Registers

The input registers are containing the measurement values of the Smart Weather Sensor and the related status information.

The measurement values are mapped to the 16bit registers using scaling factors (0 ... max. 65530 for unsigned values, -32762 ... 32762 for signed values).

Values 65535 (0xffff) resp. 32767 are used for the indication of erroneous or not available measurement values. A more detailed specification of the error can be evaluated from the status registers.

The assignment of values to the available register addresses (0 ... 124) has been arranged in a way so that the user can read the most frequently used data with few (ideally only one) register block requests

Following blocks have been defined:

- Status information
- Frequently used values which are independent of the unit system (met./ imp.) in use
- Frequently used values in metric units
- Frequently used values in imperial units
- Other measurement values

When using the metric unit system, the first three blocks can supply all data usually required with one request.

There is no difference in the register assignment between the sub types of the WS family. If, dependent on the type, some value is not available, this will be indicated by setting the register to the error value.

For detailed information about measurement ranges, units etc. please refer to the related description of the UMB.

Modbus register

7.5.3.7.1 Measurement values - Status

| Reg. Nr. | Reg. Adr. | Value (UMB Channel) | Range | Scaling | <u>s</u> igned/ <u>u</u> nsigned, Remarks |
|----------|-----------|--------------------------------|----------|---------|---|
| 1 | 0 | Identification | | 1 | unsigned |
| 2 | 1 | Device status (low) | 0..65535 | 1 | unsigned |
| 3 | 2 | Device status (high) | 0..65535 | 1 | unsigned |
| 4 | 3 | Sensor status Temperature | 0..255 | 1 | |
| 5 | 4 | Sensor status Humidity | 0..255 | 1 | unsigned |
| 6 | 5 | Sensor status Air pressure | 0..255 | 1 | unsigned |
| 7 | 6 | Sensor status Wind | 0..255 | 1 | unsigned |
| 8 | 7 | Sensor status Precipitation | 0..255 | 1 | unsigned |
| 9 | 8 | Sensor status Global radiation | 0..255 | 1 | unsigned |
| 10 | 9 | Sensor status UV-Index | 0..255 | 1 | unsigned |
| 11 | 10 | Sensor status Brightness | 0..255 | 1 | unsigned |
| | | | | | |
| 15 | 14 | Status Wifi | 0..255 | 1 | unsigned |
| 16 | 15 | GPS Position erfasst | 0..255 | 1 | unsigned |
| 17 | 16 | UTC Time (low) | 0..65535 | 1 | [s], unsigned |
| 18 | 17 | UTC Time (high) | 0..65535 | 1 | [s*65535], unsigned |
| 19 | 18 | Run time | 0..65535 | 10 | [s], unsigned |

7.5.3.7.2 Measurement values - Metric

| Reg. Nr. | Reg. Adr. | Value (UMB Channel) | Range | Scaling | <u>signed/unsigned</u> , Remarks |
|----------|-----------|--|---------------------|---------|----------------------------------|
| 20 | 19 | Air Temperature | -40..60 °C | 10 | signed |
| | | | | | |
| 24 | 23 | Dewpoint Temperature | -40..60 °C | 10 | signed |
| | | | | | |
| 30 | 29 | Relative Humidity | 0..100 % | 10 | unsigned |
| | | | | | |
| 32 | 31 | Absolute Humidity | 0..100 g/m³ | 10 | unsigned |
| | | | | | |
| 38 | 37 | Absolute Air Pressure | 300..1100 hPa | 10 | unsigned |
| | | | | | |
| 40 | 39 | Relative Air Pressure | 300..1100 hPa | 10 | unsigned |
| | | | | | |
| 46 | 45 | Wind Speed | 0..40 m/s | 10 | unsigned |
| | | | | | |
| 50 | 49 | Wind Speed | 0..144 km/h | 10 | unsigned |
| | | | | | |
| 54 | 53 | Wind Direction | 0..360° | 10 | unsigned |
| 55 | 54 | Wind Direction (compass correction) | 0..360° | 10 | unsigned |
| 56 | 55 | Compass Direction | 0..360° | 10 | unsigned |
| | | | | | |
| 60 | 59 | Precipitation | 0..655,3 mm | 100 | unsigned |
| 61 | 60 | Precipitation diff. | 0..100 mm | 100 | unsigned |
| 62 | 61 | Precipitation Type | 0..255 | 1 | unsigned |
| 63 | 62 | Precipitation Intensity | 0..100 mm/h | 100 | unsigned |
| 64 | 63 | Precipitation Intensity | 0..1,6667 mm/min | 10000 | unsigned |
| | | | | | |
| 69 | 68 | Global Radiation | 0..1500 W/m² | 10 | unsigned |
| | | | | | |

| Reg. Nr. | Reg. Adr. | Value (UMB Channel) | Range | Scaling | <u>s</u> igned/ <u>u</u> nsigned, Remarks |
|----------|-----------|-------------------------------|------------|---------|---|
| 71 | 70 | Position of the sun Azimuth | 0..360 ° | 10 | Unsigned |
| 72 | 71 | Position of the sun Elevation | 0..90 ° | 10 | Unsigned |
| | | | | | |
| 75 | 74 | UV-Index | 0..20 | 1 | unsigned |
| 76 | 75 | Brightness | 0..160 klx | 10 | unsigned |
| 77 | 76 | Twilight | 0..500 lx | 10 | unsigned |

7.5.3.7.3 Measurement values - Imperial

| Reg. Nr. | Reg. Adr. | Value (UMB Channel) | Range | Scaling | <u>s</u> igned/ <u>u</u> nsigned, Remarks |
|----------|-----------|-------------------------------------|----------------|---------|---|
| 80 | 79 | Air Temperature | -40..140 °F | 10 | signed |
| | | | | | |
| 84 | 83 | Dewpoint Temperature | -40..140 °F | 10 | signed |
| | | | | | |
| 90 | 28 | Relative Humidity | 0..100 % | 10 | unsigned |
| | | | | | |
| 92 | 91 | Absolute Humidity | 0..100 g/m³ | 10 | unsigned |
| | | | | | |
| 98 | 97 | Absolute Air Pressure | 300..1100 hPa | 10 | unsigned |
| | | | | | |
| 100 | 99 | Relative Air Pressure | 300..1100 hPa | 10 | unsigned |
| | | | | | |
| 106 | 105 | Wind Speed | 0..89,4775 mph | 10 | unsigned |
| | | | | | |
| 110 | 109 | Wind Speed | 0..77,7538 kts | 10 | unsigned |
| | | | | | |
| 114 | 113 | Wind Direction | 0..360° | 10 | unsigned |
| 115 | 114 | Wind Direction (compass correction) | 0..360° | 10 | unsigned |
| 116 | 115 | Compass Direction | 0..360° | 10 | unsigned |
| | | | | | |

| Reg. Nr. | Reg. Adr. | Value (UMB Channel) | Range | Scaling | <u>s</u> igned/ <u>u</u> nsigned, Remarks |
|----------|-----------|-------------------------------|-------------------|---------|---|
| 120 | 119 | Precipitation | 0..65,53 in | 1000 | unsigned |
| 121 | 120 | Precipitation diff. | 0..3,973 in | 10000 | unsigned |
| 123 | 122 | Precipitation Intensity | 0..3,973 in/h | 10000 | unsigned |
| 124 | 123 | Precipitation Intensity | 0..0,06561 in/min | 100000 | unsigned |
| | | | | | |
| 129 | 128 | Global Radiation | 0..1500 W/m² | 10 | unsigned |
| | | | | | |
| 131 | 130 | Position of the sun Azimuth | 0..360 ° | 10 | Unsigned |
| 132 | 131 | Position of the sun Elevation | 0..90 ° | 10 | Unsigned |
| | | | | | |
| 135 | 134 | UV-Index | 0..20 | 1 | unsigned |
| 136 | 135 | Brightness | 0..160 klx | 10 | unsigned |
| 137 | 136 | Twilight | 0..500 lx | 10 | unsigned |

7.5.3.7.4 Measurement values - Service

| Reg. Nr. | Reg. Adr. | Value (UMB Channel) | Range | Scaling | <u>s</u> igned/ <u>u</u> nsigned, Remarks |
|----------|-----------|---------------------------------|----------------|---------|---|
| 140 | 139 | Supply Voltage | 0..50 V | 10 | unsigned |
| 141 | 140 | Run Time (overall) | 0..3931800 s | 1/60 | unsigned |
| | | | | | |
| 143 | 142 | Position Longitude | -180..180 ° | 100 | signed |
| 144 | 143 | Position Latitude | -90..90 ° | 10 | signed |
| 145 | 144 | Position Height Above Sea Level | -1000..10000 m | 1 | signed |
| | | | | | |
| 148 | 147 | GPS satellites received | 0..255 | 1 | unsigned |
| 149 | 148 | GPS Position locked | 0..255 | 1 | unsigned |

7.6 Maintenance

There is no need to regularly service the WS10.

However, if there is an accumulation of dirt on the WS10 surface, especially on the glass you should clean the surface.



To clean the glass you must only use water and dishwashing detergent. Don't use any other detergent containing alcohol or any other acid.

8 Declaration of Conformity

8.1 WS100 FCC Compliance Statement (US)

Product: Smart Weather Sensor

Type: WS10 (Order No.: 8368.WS10P)

This device contains FCCID: UF9WS010.

This device complies with part 15 of the FCC Rules.

Operation is subject to the following two conditions:

- (1) This device may not cause harmful interference, and
- (2) this device must accept any interference received, including interference that may cause undesired operation.

Changes and modifications not expressly approved by manufacturer could void the user's authority to operate the equipment.

8.2 WS100 IC Compliance Statement (CA)

Product: Smart Weather Sensor

Type: WS10 (Order No.: 8368.WS10P)

This equipment contains equipment certified under ICID: 6650A-WS010.

This device complies with Industry Canada licence-exempt RSS standard(s).

Operation is subject to the following two conditions:

- (1) This device may not cause interference, and
- (2) this device must accept any interference received, including interference that may cause undesired operation of the device.

Le présent appareil est conforme aux CNR d'Industrie Canada applicable aux appareils radio exempts de licence.

L'exploration est autorisée aux deux conditions suivantes:

- (1) l'appareil ne doit pas produire de brouillage, et
- (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

9 Disposal

The disposal of this device has to be according to the European Union directive 2012/19/EU. The disposal through household waste is applicable. The device should be recycled according to the electronic waste guidelines of the respective country.

10 Error handling and Error Codes

10.1 Error handling

| Error | Action |
|--------------------------|--|
| Device does not start up | Check if you connected the device according to the specification. Check pinout and polarity of your supply voltage. |

10.2 Status LED

| LED | Meaning |
|---------------------------------------|--|
| Red – Green – Blue - White | Normal start up |
| Red slowly blinking | Hardware defect → Send the device to the manufacturer |
| White slowly blinking | Configuration error → Check the device configuration |
| Green short blink every 10 sec | WS10 in Wi-Fi access mode |
| Blue - Green short blink every 10 sec | WS10 in Wi-Fi access mode forced through configuration pin |

10.3 Error codes UMB

| Status | Definition | Description |
|--------|---------------|-----------------|
| 00h | OK | No Error |
| 20h | LESE_ERR | Reading Error |
| 23h | UNGLTG_ADRESS | Invalid Address |
| ... | ... | ... |

A detailed UMB documentation can be found on the internet under www.Lufft.com

11 Technical Data

11.1 Electrical Data

| | |
|---------------------|----------------------------------|
| Supply Voltage | 9...36 V DC |
| Current Consumption | 850 mA bei 9 V / 230 mA bei 24 V |
| Fuse supply Voltage | 2,5 A (slow blow) |
| Protection Class | IP 67 |

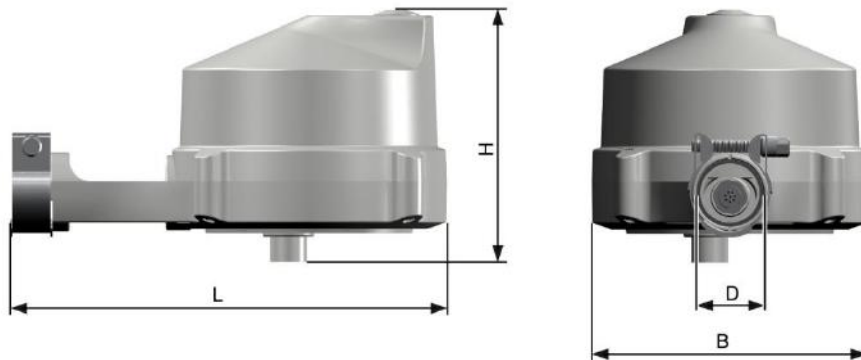
11.2 Measurements

| | | |
|--------------------|----------|--|
| Air Temperature | Range | - 40 ... 60 °C |
| | Accuracy | ±1,0 °C (+5 ... +60 °C), otherwise < ±2,0 °C |
| Relative Humidity | Range | 0 ... 100 % |
| | Accuracy | ±5% (@ 20°C and < 80% rH) |
| Air Pressure | Range | 300 ... 1100 hPa |
| | Accuracy | ±0,5 hPa (at room temperature 25 °C) |
| Wind Speed | Range | 0 ... 40 m/s |
| | Accuracy | ±1 m/s or 5 %, the larger value is valid |
| Wind Direction | Range | 0 ... 359° |
| | Accuracy | ± 10° |
| Precipitation | Range | 0 ... 100 mm/h |
| | Accuracy | 20 % under laboratory environment |
| Precipitation Type | Range | Rain, Snow, Sleet, Freezing Rain, Hail |
| Global Radiation | Range | 0 ... 1500 W/m ² |
| | Accuracy | 10% or ±120 W/m ² , larger value is valid |
| UV-Index | Range | 1 ... 15 |
| Brightness | Range | 0 ... 167 klx |
| | Accuracy | ±5 % of measured value |
| Twilight | Range | 0 ... 500 lx |
| | Accuracy | ±10 lx |

11.3 Interfaces

| | |
|---------------|--|
| Wired | RS485 2-wire, 5 V |
| Baud rate | 9600...115200 Baud (Standard 19200 Baud) |
| WLAN | 802.11:b/g/n |
| WLAN Security | WPA2/WPA Personal, WPA2 WPA Enterprise und WEP |

11.4 Mechanical data



| | |
|------------------------|--------------------------|
| Dimensions (L x B x H) | 227 mm x 145 mm x 130 mm |
| Weight | 0,5 kg |
| Tube size (D) | 35 mm |

11.5 Environmental Conditions

| | |
|----------------------|-------------------------------|
| Operating Conditions | -40 °C...+60 °C |
| Storage Conditions | -60 °C...+85 °C |
| Humidity | 0...100 % rH (non condensing) |

12 Appendix

12.1 Approved Countries for precipitation radar

EU all members of the European Union

Swiss

Island

Norway

USA

Canada

13 Contact

For warranty and repair, please contact:

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Subject to Technical Modifications