Manual WS1000 Series

Climate Reference Sensor WS3000 / WS3100

Contents

1 Read before commissioning

1.1 Symbols used

Important notice of possible risks to the user

Important notice for correct operation of the device

1.2 Safety notices

- Installation and commissioning may only be carried out by adequately qualified specialists.
- Never measure or touch parts that are under voltage.
- Observe the technical data, the position requirements, and operating conditions.

1.3 Use as intended

- 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.
- If modified or converted, operating reliability and functionality can no longer be guaranteed.

1.4 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

1.5 Guarantee

The guarantee period is 24 months from the date of delivery. If the device is not used as intended, the guarantee becomes void.

1.6 Brand names used

All brand names used remain subject to the applicable trade mark law and are the property of their respective owners.

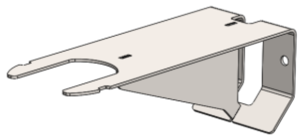
2 Scope of delivery

Device

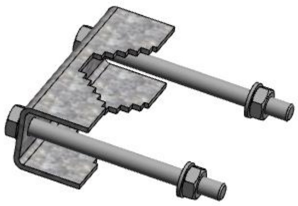
WS3000

WS3100

Connecting cable, 10 m



Mounting bracket



Mast clamp

Operating instructions

3 Order numbers

WS3000-UMB 8390.U01
with 2 pressure sensors 8390.U02

- temperature
- relative humidity
- atmospheric pressure

WS3000-UMB 8391.U01
with 2 pressure sensors 8391.U02

- temperature
- relative humidity
- atmospheric pressure
- global radiation

3.1 Accessories

Power supply unit 24V/100VA...8366.USV1
ISOCON-UMB 8160.UISO
Surge protection 8379.USP

3.2 Spare parts

Connecting cable 10m .... on request

3.3 Further documents and software

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

Operating instructions	this document
ConfigTool .NET	Software for Windows for testing, firmware update and configuring the UMB devices
UMB protocol	communication protocol of the UMB devices
Firmware	current firmware of the device

4 Device description

Devices of the WS3000 series are a combination of high-precision sensors to record the air temperature, the relative humidity and the atmospheric pressure. The measurement uncertainties of the sensors meet the requirements of the WMO to the extent that this is realisable with available sensors. In the design of the WS3000 series, particular emphasis was laid on the radiation protection (housing) and minimising the influence of wind on the pressure measurement. The variants of the WS3000 series differ with regard to the sensors used. The table that follows gives an overview of the variants.

Table: Variants, WS3000 series

Designation	Order number	temperature	Relative humidity	Pressure	Overall radiation	Precipitation
WS3000	8390.U01	x	x	1x	-	-
WS3000r	8390.U02	x	x	2x	-	-
WS3100	8391.U01	x	x	1x	x	-
WS3100r	8391.U01	x	x	2x	x	-

Connection to the device is made by means of an 8-pin screw connector with the corresponding connecting cable (standard length 10m).

The measured values are queried via the RS485 interface (half duplex) in accordance with the available protocols.

The configuration and measured value query when commissioning is by means of the ConfigTool .NET (Windows PC software)

4.1 Air temperature

The air temperature is determined by measuring a high-precision PT100 resistance. The relationship between resistance and temperature in the range from -80°C to +60°C is determined for each sensor and stored in the device to guarantee a precise temperature measurement. To minimise external influences on the temperature measurement, such as solar irradiation, a special tube system was developed. This consists of four tubes in total, through which the air flows. This construction reduces the radiation influence to < 0.1°K for a temperature difference of about 40°K between the housing and ambient.

4.2 Relative humidity

The sensor for determining the relative humidity is a heated capacitive sensor. In addition to the humidity, the temperature in the sensor is measured so that the measured humidity can be corrected to the ambient temperature. If the humidity rises above a certain value, the heating power is increased to avoid over-saturation of the sensor.

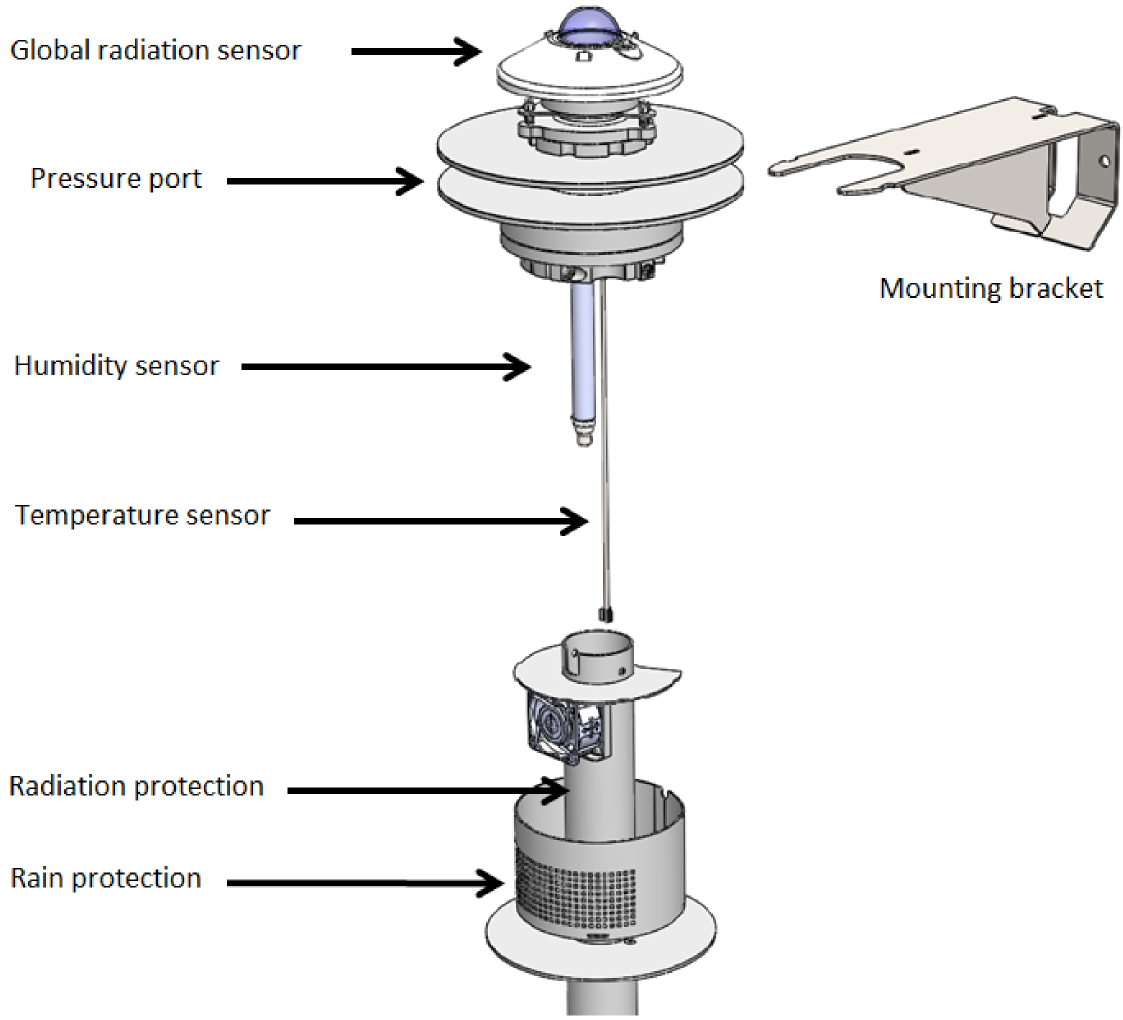
4.3 Atmospheric pressure

This is measure by means of a silicon resonant pressure sensor (TERPS). The precision of these sensors is an order of magnitude better than more traditional sensors. The measuring range of the sensors used in the WS3000 is from 300 to 1200 hPa. As a rule, measurements of the atmospheric pressure are influenced by the wind. To minimise this influence, the WS3000 has a special “pressure port”. This prevents wind speeds of up to about 30m/s from significantly influencing the pressure measurement.

4.4 Global radiation

As an option, the sensor can be equipped with a Kipp&Zonen CMP11 global radiation meter.

4.5 Sensors, taking the WS3100 as example



5 Measured value processing

5.1 Current measured value (act)

When the current measured value is queried, it is the value of the last measurement according to the specified measuring rate that is output. Each measured value is stored in a ring buffer for the further calculation of minimum, maximum and average values.

5.2 Minimum and maximum values (min and max)

When the minimum and maximum values are queried, the corresponding value is calculated via the ring buffer with the interval specified in the configuration (1 – 10 minutes) and output.

5.3 Average value (avg)

When the average value is queried, the corresponding value is calculated via the ring buffer with the interval specified in the configuration (1 – 10 minutes) and output. This also enables sliding averages to be formed.

Note: as delivered, the calculation interval for minimum, maximum and average is 10 minutes. If need be, the ConfigTool .NET can be used to adjust this as required (1 – 10 minutes) (see chapter 10.2, Configuration with ConfigTool .NET on page23).

6 Measured value output

As delivered, the measured values are output with the UMB binary protocol. For an example of a query in the various protocols and a full summary of the channel list, see the appendix. The range of values given in the tables is required for the calculation of the measured values when using the ASCII protocol (see appendix).

6.1 Air and dew point temperatures

Measuring rate 1/minute
Averaging interval ....1 – 10 minutes
Units ....°C; °F

Query channels:

UMB channel					Value range		
act	**min**	**max**	**avg**	**Measured quantity (float32)**	**min**	**max**	**Units**
100	120	140	160	Air temperature	-80.0	60.0	°C
105	125	145	165	Air temperature	-112.0	140.0	°F
161				Air temperature avg. standard deviation	-100	100	°C
110	130	150	170	Dew point temperature	-80.0	60.0	°C
115	135	155	175	Dew point temperature	-112.0	140.0	°F

6.2 Humidity

Measuring rate 1/minute
Averaging interval ....1 – 10 minutes
Units ....%r.H.; g/m³; g/kg

Query channels:

UMB channel					Value range		
act	**min**	**max**	**avg**	**Measured quantity (float32)**	**min**	**max**	**Units**
200	220	240	260	Relative humidity	0.0	100.0	%
205	225	245	265	Absolute humidity	0.0	1000.0	g/m³
261				Relative humidity avg. standard deviation	-100	100	%
210	230	250	270	Mixing ratio	0.0	1000.0	g/kg

6.3 Atmospheric pressure

Measuring rate 1/minute
Averaging interval ....1 – 10 minutes
Units ....hPa

Query channels:

UMB channel					Value range		
act	**min**	**max**	**avg**	**Measured quantity (float32)**	**min**	**max**	**Units**
300	320	340	360	Absolute atm. pressure, sensor 1	300	1200	hPa
362				Absolute atm. prs. avg. std. dev., sensor 1	100	100	hPa
305	325	345	365	Relative atm. pressure, sensor 1	300	1200	hPa

301	321	341	361	Absolute atm. pressure, sensor 2	300	1200	hPa
363				Absolute atm. prs. avg. std. dev., sensor 2	100	100	hPa
306	326	346	366	Relative atm. pressure, sensor 2	300	1200	hPa

Note: For correct determination of the relative atmospheric pressure, the altitude of the device location must be entered in the device configuration. In the factory settings, 200m is entered as location altitude.

6.4 QFE

Measuring rate 1/minute
Units ....hPa, inHg

Query channels:

UMB channel					Value range		
act				**Measured quantity (float32)**	**min**	**max**	**Units**
370				QFE Sensor 1	300	1200	hPa
371				QFE Sensor 1	9	35	inHg
375				QFE Sensor 2	300	1200	hPa
376				QFE Sensor 2	9	35	inHg

6.5 QNH

Measuring rate 1/minute
Units ....hPa, inHg

Query channels:

UMB channel					Value range		
act				**Measured quantity (float32)**	**min**	**max**	**Units**
380				QNH Sensor 1	300	1200	hPa
381				QNH Sensor 1	9	35	inHg
385				QNH Sensor 2	300	1200	hPa
386				QNH Sensor 2	9	35	inHg

6.6 Wet bulb temperature

Measuring rate 1/minute
Units ....°C; °F

Query channels:

UMB channel					Value range		
act				**Measured quantity (float32)**	**min**	**max**	**Units**
114				Wet bulb temperature	-80.0	60.0	°C
119				Wet bulb temperature	-112.0	140.0	°F

6.7 Specific enthalpy

Measuring rate 1/minute
Units ....kJ/kg

Query channels:

UMB channel					Value range		
act				Measured quantity (float32)	min	max	Units
215				Specific enthalpy	-100.0	1000.0	kJ/kg

6.8 Air density

Measuring rate 1/minute
Units ....kg/m³

Query channels:

UMB channel					Value range		
act				Measured quantity (float32)	min	max	Units
310				Air density, sensor 1	0.0	3.0	kg/m³
311				Air density, sensor 2	0.0	3.0	kg/m³

6.9 Global radiation

Measuring rate 1/minute
Averaging interval ....1 – 10 minutes *)
Units ....W/m²

Query channels:

UMB channel					Value range		
act	min	max	avg	Measured quantity (float32)	min	max	Units
900	920	940	960	Global radiation	0.0	4000.0	W/m²
961				Global radiation avg. standard deviation	-100	100	W/m²

*) **Note:** Average, maximum and minimum values are derived from the 1-minute averages of the 1-second instantaneous value. Exception for atm. pressure: 4-second instantaneous value.

6.10 Service messages

For monitoring the operation of the intelligent weather sensors, service channels are availa-ble

Query channels:

UMB channel					Value range		
act	min	max	avg	Measured quantity	min	max	Units
4008				TFF Humidity raw (float32)	0	100	%
4009				TFF Temperature (float32)	-40	80	ºC
4049				Fan speed (uint16)	0	65535	Rpm
10000				Operating voltage (float32)	0.0	50	V

7 Installation instructions

The WS3000 can be installed on a mast with a diameter of 60 – 80mm. Included in the delivery is a suitable mounting bracket, including clamp. The following tools are required for installation:

- 2 open-ended or ring spanners, SW17
- Allen keys, 4mm and 5mm

7.1 Fixing clamp

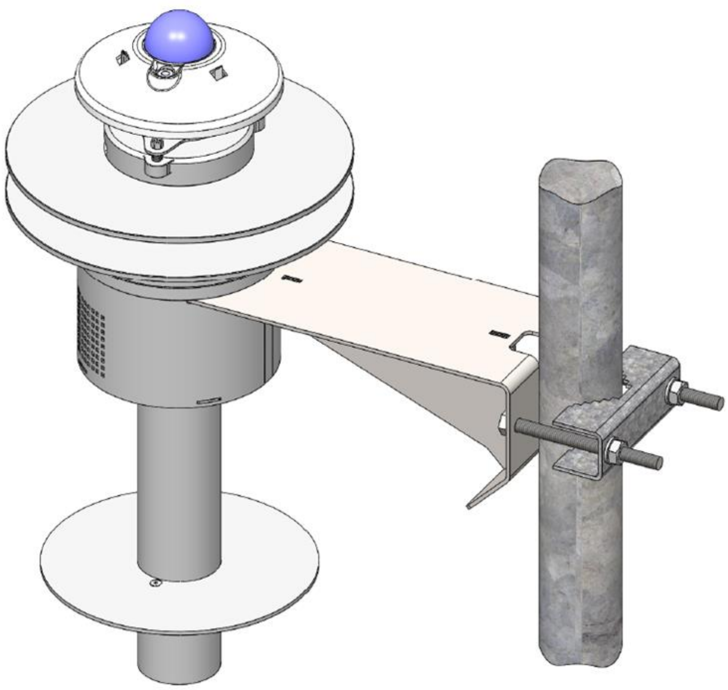


Fig. fixing clamp, WS3000

To install the WS3000 on a mast, the mounting bracket is first attached to the mast by means of the fixing clamp at the desired height (about 2m above ground level). On the WS3000, the rain protection must first be loosened. To do this, loosen the Allen screw on the rain protection clamping ring. This can then be pushed downwards. The two clamping bolts for the mounting bracket must then be loosened. The WS3000 can then be pushed onto the mounting bracket (see fig. below) and fixed in place by means of the clamping bolts. Now plug in the 8-pin connecting cable, push up the rain protection and clamp it in place. The connecting cable should be fed upwards, in the direction of the mounting bracket and out through the cut-out in the rain protection. The cable should make a U shape in the rain protection to avoid damage. On the mounting bracket are two bolts which serve as cable supports.

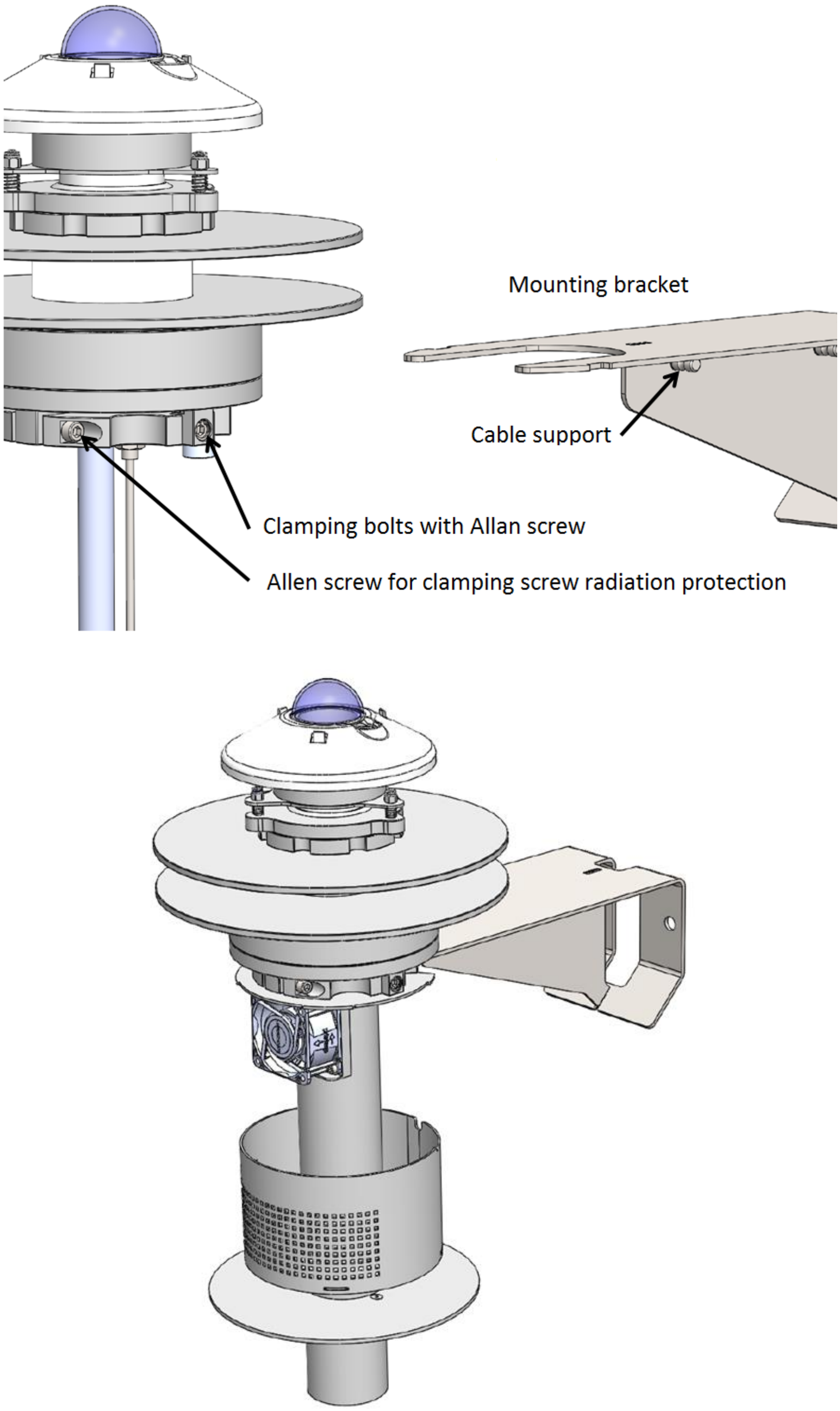


Fig. installation, WS3000

7.2 Installation summary

- Fasten mounting bracket to mast with clamp
- Loosen rain protection clamping ring and push rain protection downwards
- Loosen clamping bolts (bolts move outwards)
- Push WS3000 onto mounting bracket
- Clamp to mounting bracket with clamping bolts
- Plug in connecting cable
- Push rain protection up and feed the cable in a U-shape through the upper edge of the rain protection
- Fix the rain protection in place with its clamping ring (underside of rain protection).
- Fasten the cable to the mounting bracket

7.3 Selection of the installation position

To guarantee long-term and correct operation of the device, the following points are to be observed in selecting the installation position.

7.3.1 General points

- stable subsoil for fixing the mast
- free access to the installation for maintenance
- reliable mains supply for continuity of operation
- good network coverage for transmission via mobile phone network

Note: The measured values apply only to the place of installation. No deductions can be made for the wider environs or a whole area.

ATTENTION:

- For mast installation, only approved and tested aids (ladder, steps etc.) may be used.
- All applicable regulations for work at this height must be observed.
- The mast must be adequately sized and anchored.
- The mast must be earthed in accordance with regulations.
- When working at the edge of or near a roadway, the appropriate safety regulations are to be observed.

If incorrectly installed,

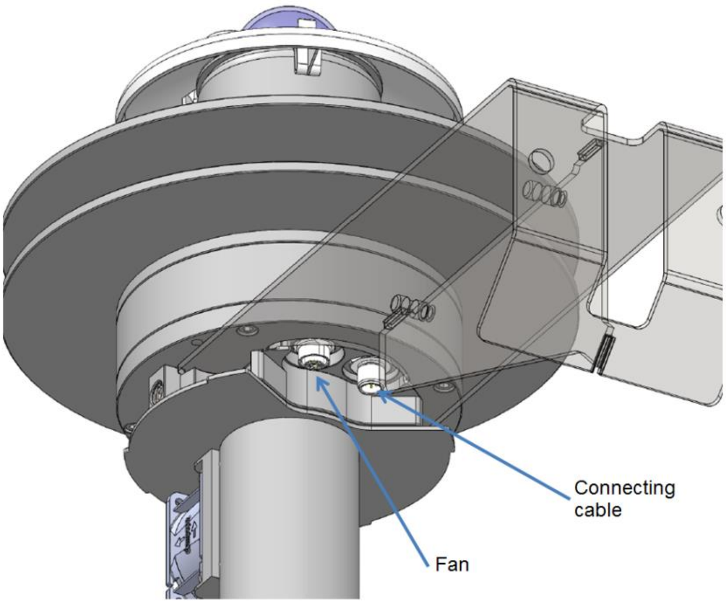
- the device may fail to operate
- the device may be permanently damaged
- there can be a risk of injury by the device falling from its mounting

7.3.2 Global radiation measurement

- Unshaded position; if possible, a free view all round at the height of the pyra-nometer
- The global radiation sensor has to be horizontally adjusted with the level

8 Connections

On the underside of the device is an 8-pin screw-lock connector. This is for connection of the supply voltage and the interface with the connecting cable supplied.

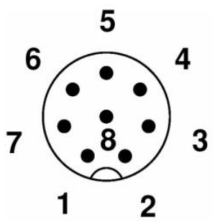


Device connector:

End-on view of connector

Pin assignment:

1	white	Supply voltage ground and SDI12 GND
2	brown	Positive supply voltage
3	green	RS485_A (+)
4	yellow	RS485_B (-) or SDI-12 Data line
5	grey	External sensor; RS485_a
6	pink	External sensor; RS485_b
7	blue	not connected
8	red	not connected



The cable is colour coded in accordance with DIN 47100.

Note: to connect the device plug, the yellow protective cap must be removed.

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

The supply voltage connections are protected against polarity reversal.

Note: For SDI12 operating mode, core 3 (green) must not be connected.

8.1 Supply voltage

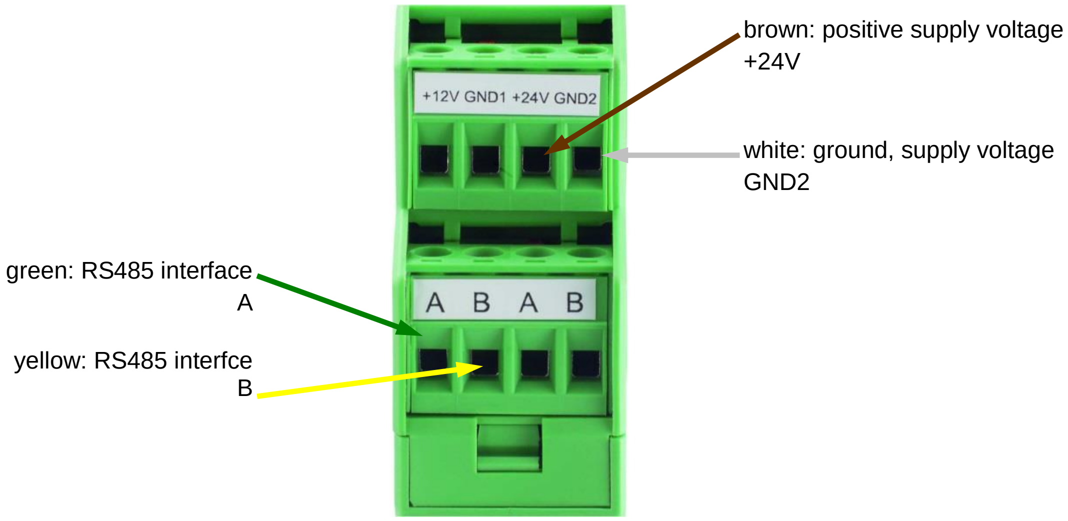
The intelligent weather sensing system is to be supplied with a direct voltage of 24 VDC. The power supply unit used must be approved for the operation of devices with protection class III (SELV).

8.2 RS485 interface

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

For technical details, see chapter 0

8.3 Connection to ISOCON-UMB (8160.UISO)



When setting up the system, please observe the operating instructions for the ISOCON-UMB.

8.4 Using the surge protection (8379.USP)

When using the surge protection (order No: 8379.USP), please take note of the connection example in the operating instructions of the surge protection!

9 Commissioning

Once the device is mounted and correctly connected, the intelligent weather sensor system starts measuring independently. For configuration and testing, a Windows® PC with serial interface, the ConfigTool .NET software and an interface cable (DUB-D 9-pin; male – female; 1:1) are required.

The following points are to be noted:

- Correct operation of the device should be checked on the spot with a measured value query using ConfigTool .NET (see chapter 10.3 Functional test with ConfigTool .NET on page 27).
- For correct calculation of the relative atmospheric pressure, the local altitude must be entered in the configuration (see chapter 10.2.5, Humidity on page 26).
- If several intelligent weather sensing systems are operated in a UMB network, each device must be assigned its own device ID (see chapter 10.2.2, Configuration on page 24)

On the intelligent weather sensor system itself, there is no transport protection or the like that must be removed.

10 Configuration and testing

For configuration, Lufft provides a Windows® PC software package (ConfigTool .NET). Using this software, the intelligent weather sensor system can also be tested and its firmware updated.

Not all functions described here are available for all derivatives.

10.1 Factory settings

As delivered, the intelligent weather sensor system has the following settings:

Class ID:... 7 (cannot be changed)
Device ID:... 1 (results in address 7001h = 28673d)
Baud rate:... 19200
RS485 protocol: .... UMB binary
Calculation interval for averages:........ 10 minutes
Local altitude: .... 200 m

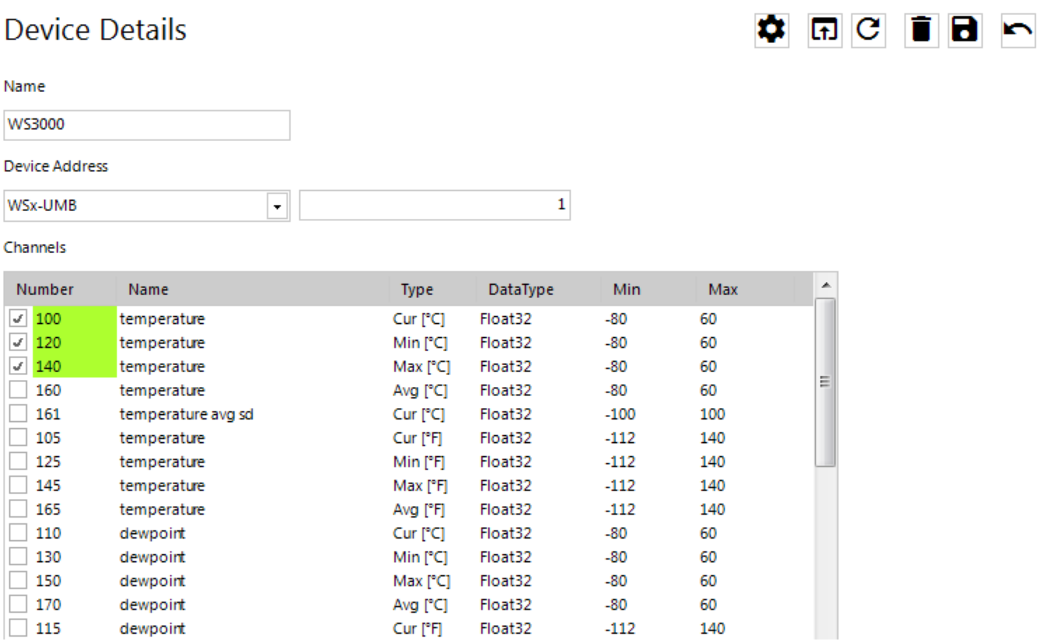
Note: If multiple intelligent weather sensing systems are operated in a UMB network, the device ID must be changed, since each device requires a unique ID. A good choice would be IDs from 1 upwards.

10.2 Configuration with ConfigTool .NET

The operation of ConfigTool .NET is described in detail in the software instructions. Therefore, it is only the device-specific menus and functions of the intelligent weather sensor system that are described here.

10.2.1 Sensor selection

The intelligent weather sensor system is shown in the sensor selection as WSx-UMB (class ID 7). A click on the button takes you to the settings window of the weather sensor system.



Number	Name	Type	DataType	Min	Max
☑ 100	temperature	Cur [°C]	Float32	-80	60
☑ 120	temperature	Min [°C]	Float32	-80	60
☑ 140	temperature	Max [°C]	Float32	-80	60
☐ 160	temperature	Avg [°C]	Float32	-80	60
☐ 161	temperature avg sd	Cur [°C]	Float32	-100	100
☐ 105	temperature	Cur [°F]	Float32	-112	140
☐ 125	temperature	Min [°F]	Float32	-112	140
☐ 145	temperature	Max [°F]	Float32	-112	140
☐ 165	temperature	Avg [°F]	Float32	-112	140
☐ 110	dewpoint	Cur [°C]	Float32	-80	60
☐ 130	dewpoint	Min [°C]	Float32	-80	60
☐ 150	dewpoint	Max [°C]	Float32	-80	60
☐ 170	dewpoint	Avg [°C]	Float32	-80	60
☐ 115	dewpoint	Cur [°F]	Float32	-112	140

Note: To configure the intelligent weather sensor system, you need the latest version of ConfigTool .NET.

Note: During configuration, all other querying devices, such as modems / LCOM, must be separated from the UMB network!

10.2.2 Configuration

After uploading a configuration, all relevant settings and values can be adjusted. According to the type of device, only the settings for the sensors actually present are relevant.

downloads the current configuration from the sensor.

uploads the configuration to the sensor.

loads a previously saved configuration from hard disk.

saves the configuration to hard disk for later use.

10.2.3 Device identification / device parameters

Device type	WS3100R-UMB
Device identification	
Class-ID	7
Device-ID	1
Name	WSx-UMB
Description	**compact weather station**
Device parameters	
Baudrate	19200 Bd
Protocol	UMB-Binary
Timeout for protocol change	10
RS485 parity	8N1
XDR auto transmit interval	60
XDR air pressure mode	abs.
XDR telegram prefix	WIXDR
SDI-12 US Units	Metric
Tunnel timeout	100
UMB-ASCII 2.0	

Device ID: .... Factory setting 1; assign increasing IDs to further devices.

Description: .... To differentiate devices, a description, e.g. the geographical location, can be entered here.

Baud rate: .... Transmission rate of the RS485 interface (factory setting 19200 Bd; **for operation with ISOCON-UMB DO NOT CHANGE!**).

Protocol: .... Communication protocol of the device (UMB binary, UMB ASCII, Terminal mode, SDI-12, XDR, UMB-ASCII 2.0)

Timeout: .... In the event of a temporary change of communication protocol, the device switches back to the configured protocol after this time

RS485 parity: .... Parity setting of the serial interface, only active for SDI-12 and Modbus.

XDR interval: .... Time in seconds for automatic sending of a telegram if XDR is selected as protocol.

XDR atmospheric pressure mode: ... In XDR telegrams, atmospheric pressure should be given as relative or absolute.

XDR prefix: .... 5 characters for sensor recognition in XDR telegrams.

SDI-12 units: .... Metric or US units in SDI-12 protocol

Important note: if the Baud rate is changed then, after upload of the configuration and restart of the device, the intelligent weather sensor system communicates using the new Baud rate. When operating the intelligent weather sensor system in a UMB network with ISOCON-UMB, **this Baud rate may not be changed**; otherwise, the device is **no longer accessible** and can no longer be configured!

10.2.4 UMB-ASCII 2.0

The structure of the telegrams of the UMB-ASCII 2.0 protocol is largely configurable and can thus be adapted to the requirements of a measured data capture system.

Auto dispatch: ...... If one of the standard sets is selected, dispatch takes place at the specified intervals.

Interval:................. Time in seconds between automatic telegram dispatches.

Start character:..... ASCII character marking the start of a response telegram; factory setting is 2 / 02h (STX)

End character:...... ASCII character marking the end of a response telegram; factory setting is 4 / 04h (STX)

Decimal separator: Decimal separator character; factory setting is a decimal point 46 / 2Eh (‘.‘)

Parameter separator: Separator character for parameters in the telegram; factory setting is a semicolon 59 / 3Bh (‘;‘)

Block separator: ... Separator character for the individual blocks of a telegram; factory setting is a colon 58 / 3Ah (‘:‘)

Line end:............... End of line character sequence for a telegram; factory setting is CRLF (0Dh, 0Ah); alternatives are CR (0Dh) or LF (0Ah)

10.2.5 Humidity

Calibration: When “User adjustment” is selected, measurement data is corrected by a user supplied correction table. See chapter 10.4 for detail.

Interval: Time in minutes for the interval used in calculating the minimum, maximum and average values.

10.2.6 Air pressure

Local altitude: .. For correct calculation of the relative atmospheric pressure (referred to sea level), the local altitude in metres must be entered here.

Runway difference: For correct calculation of QFE/QNH measurements, the altitude difference between the weather sensor and the runway must be specified in meters.

Calibration: When “User adjustment” is selected, measurement data is corrected by a user supplied correction table. See chapter 10.4 for detail.

Interval: Time in minutes for the interval used in calculating the minimum, maximum and average values.

10.2.7 Global radiation

Calibration: When “User adjustment” is selected, measurement data is corrected by a user supplied correction table. See chapter 10.4 for detail.

Interval: Time in minutes for the interval used in calculating the minimum, maximum and average values.

10.2.8 Temperature,

Calibration: When “ITS-90” is selected, the calculation of temperature measurement data is done using formulas specified by ITS-90, using the factory calibration. When “DIN EN 60751” is selected, standard calculation according to DIN EN 60751 is used. When “User adjustment” is selected, measurement data is corrected by a user supplied correction table. See chapter 10.4 for detail.

Interval: Time in minutes for the interval used in calculating the minimum, maximum and average values.

Note: the measured temperature data are then only within the range stated in the specification if *ITS-90 factory calibration* is selected.

10.2.9 WLAN (WS V15+)

The weather stations of the WS1000 series are equipped with a WLAN module, which enables wireless querying of the measurement data and configuration of the sensor. The WLAN interface is completely independent of the RS485 interface and its communication protocol. To be able to use the WLAN interface, this must first be configured via RS485. If the standard settings are retained, the weather sensor system behaves as a so-called. Soft-AP and permits *one* terminal, e.g. laptop, mobile phone or tablet, to establish a connection, in order, for instance, to use ConfigTool .NET for Microsoft Windows or Android to make a measurement data query.

10.2.9.1 Soft-AP Mode

In Soft-AP mode, the WLAN module establishes a network with SSID “WSx-UMB_WiFi-xxx”. The last three characters match the first three characters of the device’s serial number (see sticker on housing). The key to access this network is the device’s serial number in the format “aaa.bbbb.cccc.ddd”. The weather station has an IP address of 192.168.1.1 and acts as a DHCP server. The port for measurement queries is 9750.

10.2.9.2 Station Mode

In Station mode, the weather sensor may connect to an existing network. The necessary information may be provided in the configuration:

IP Mode: DHCP or static. In case static is selected, IP address, subnet mask and gateway address must to be provided

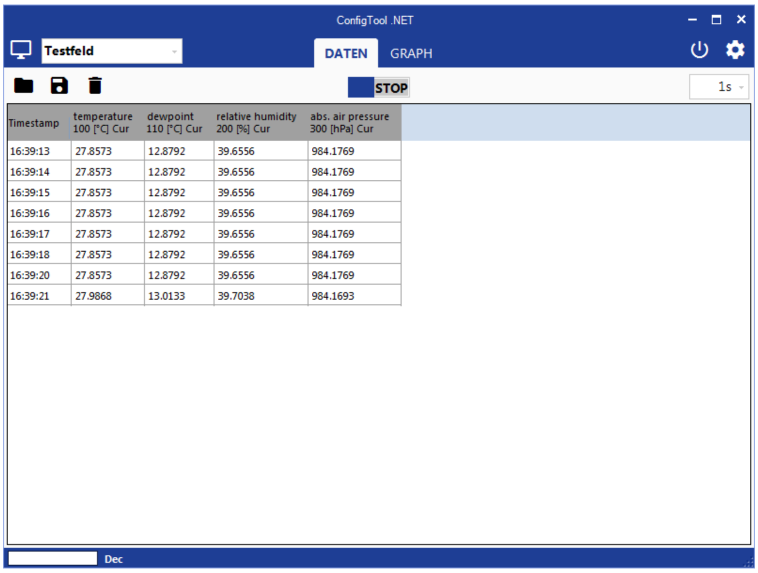
SSID: The SSID for the network to be connected to

Key: Access key for the network

Note: For your safety, the WLAN module must be activated by configuration.

10.3 Functional test with ConfigTool .NET

With ConfigTool .NET, the operation of the intelligent weather sensor system can be checked by querying various channels. For further information, please see the instructions for ConfigTool .NET, under the item “First steps”.

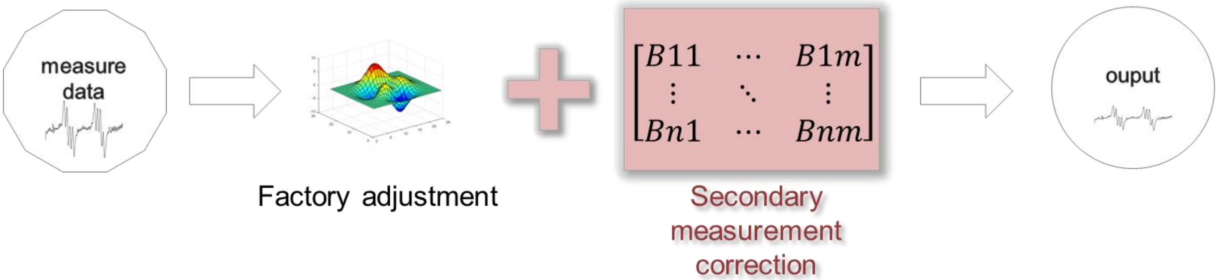


Note: During the functional test, all other querying devices, e.g. modems / LCOM, must be separated from the UMB network!

Note: ConfigTool .NET is intended only for testing and configuration purposes. It is not suitable for continuous operation for measured value capture. For this purpose, professional software solutions such as Lufft SmartView3 are recommended.

10.4 User adjustment with ConfigTool .NET (SW V15+)

The sensors of the WS3000 Series are delivered with a factory calibration and do not require any adjustments within their maintenance interval. However, if desired the output of the measured values can be adapted to suit special requirements of the customer. These corrections are always added to the calibrated measured value.



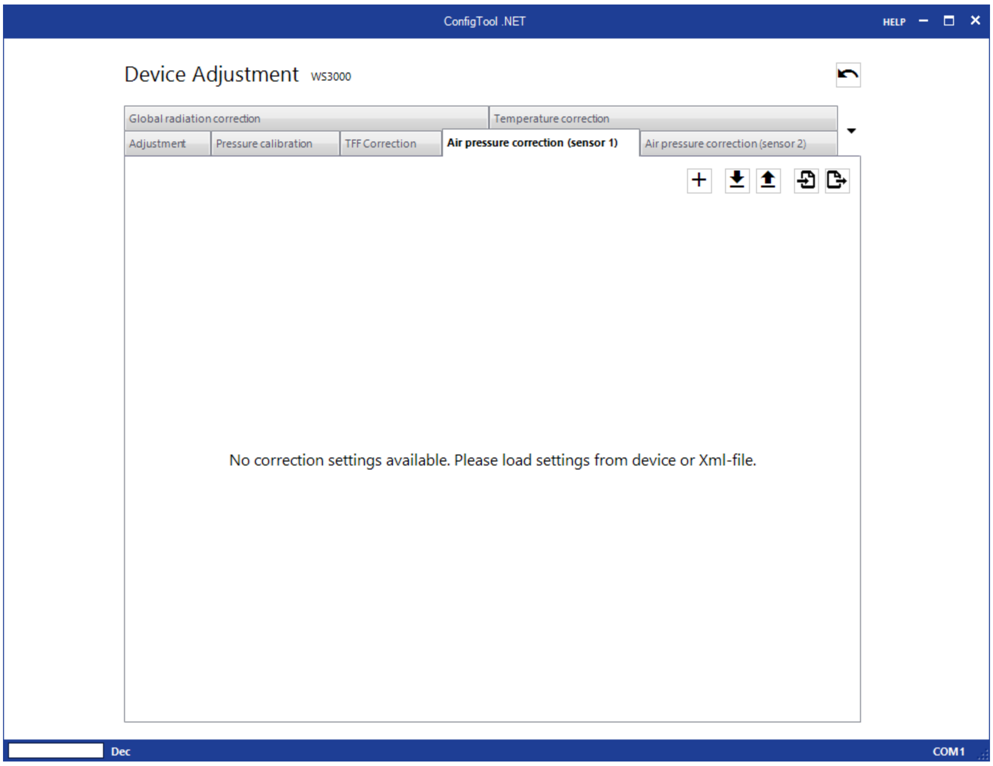
The customized correction function is based on an interpolation matrix which can consist of up to ten grid points with their related correction values. An indication of one grid point only equals a simple offset correction. If a second grid point is included, this equals a correction consisting of offset and gradient.

A correction of a measured value is calculated by linear interpolation between the two grid points given. If a measured value is higher or lower than the last given grid point, the correction value of this grid point is used.

The programme automatically checks whether the correction values entered are plausible. If, for example, the grid points are not entered in an ascending order, this will be recognized and highlighted in colour. The correction values can only be entered within sensible limits in relation with the measured value. If one of the above faults persists, the correction table cannot be transmitted to the device.

For measured values that are interlinked with an additional value (e.g. relative humidity is dependent on temperature) two-dimensional tables are used.

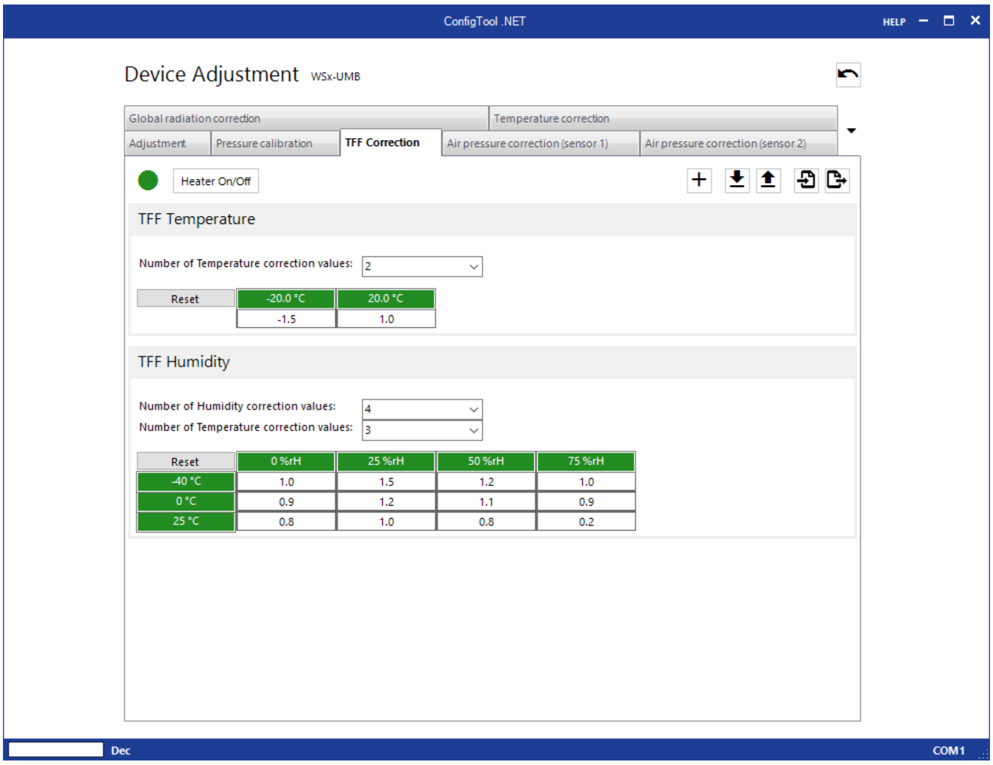
10.4.1 Adjustment



When the adjustment dialogue is accessed for the first time there is no adjustment set available. A new set can be created offline, so that a correction can be generated without a sensor connected. In the upper right corner there are icons for loading, saving and transmitting the correction functions:

- New: creates a {new correction table}
- {Import correction}: opens a previously saved correction table (XML-file)
- {Export correction}: saves the correction table in a file (XML-file)
- { Read from device}: loads the correction table from the sensor
- { send to device} writes the correction table into the sensor

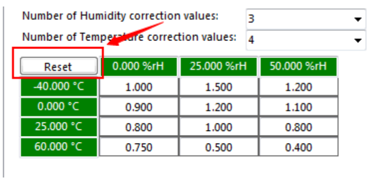
There is a maximum of 10 available grid points. It is not required to use all of them.



Please note that the grid points can only be defined in an ascending order. When entering data into the table this is automatically checked, and any deviations are marked in red.

10.4.2 Resetting the correction table

In the upper left corner of the table there is a „Reset" button with which the values can be reset to neutral values.



10.4.3 Saving the correction table to the sensor

Use the button "Send" to transfer the table to the device. Before sending, the table will be checked for plausibility by the ConfigTool.NET.

Note: You must first enable the user comparison in the configuration menu and then restart the sensor for the correction table to become effective.

11 Firmware update

To keep the intelligent weather sensor system up to the latest technical standard, a firmware update can be carried out on site, without needing to dismantle the device and send it back to the manufacturer. A firmware update is carried out using ConfigTool .NET.

Just download the latest firmware and ConfigTool.NET from www.lufft.de and install it on a Windows® PC. Follow the instructions under Start→All programs→Lufft→ConfigTool .NET

There is single firmware for the whole product family (WS1000_Release_Vxx.bin) that supports all variants.

Important note: Please read the text file included in WSx_Release_Vxx.zip; it contains important information about the update!

12 Maintenance

In principle, the device is maintenance-free.

It is, however, recommended to carry out an annual functional test. In so doing, the following points deserve attention:

- visual inspection regarding soiling of the device
- checking the sensors with a measured value query
- checking the operation of the fan

Furthermore, an annual test of the sensors by the manufacturer is recommended. For devices with global radiation measurement, regular cleaning of the glass dome with water or spirit is recommended. The cleaning interval is to be adjusted to the local pollution conditions.

12.1 Cleaning

The WS3000 has a modular structure. For cleaning purposes, the rain and radiation protection can be removed and cleaned with water (see also the Installation chapter). The use of chemical cleaning agents like spirit or similar must be limited strictly to the glass dome of the global radiation sensor since the sensible sensor system could be damaged through direct contact with the agent or its vapours.

The radiation protection (tube system with fan) is easily removed. To this end, the fan connector is disconnected and the clamping ring is released. The radiation protection can then be removed together with the rain protection. Both can then readily be cleaned.

12.2 Testing/changing the sensors

12.2.1 Temperature sensor

To test the temperature sensor, it can be connected to a cable, max. length 2m, and immersed in a water bath with known temperature. Since the WS1000 family is equipped with high precision sensors all calibration procedures must follow a correspondingly high standard.

The sensor is held in place with screw connectors and thus easily removed. If the temperature sensor is changed, use ConfigTool .NET to upload the supplied coefficients file to the weather sensor.

12.2.2 Humidity sensor

The humidity sensor can be connected to a cable for being tested. The high precision sensors of the WS1000 require correspondingly high standards for all calibration procedures.

The sensor is held in place with screw connectors and thus easily removed. It can be changed locally and doesn’t need to be re-adjusted.

12.2.3 Pressure sensor

The pressure sensor is located inside the pressure port. To test or replace the sensor, the cover or top sensor must be removed. The standard cover can be removed by undoing the Allen screw in the cover. The pressure sensor is fastened to a plastic bracket and connected to the base board with a flat cable. If the sensor is to be replaced, undo the screw on the bracket and lift out the sensor together with the pressure sensor board after releasing the cable connector. If the sensor is changed, use ConfigTool .NET to upload the supplied coefficients file to the weather sensor.

For testing/calibration of the pressure sensor, there is a hose adapter. A reference pressure can be applied via a hose of 6 mm outer diameter. There is thus no need to place the entire WS3000 in a pressure chamber for a pressure test.

Fig: Pressure sensor connections

13 Technical data

Supply voltage: .... 24 VDC

Sensor current consumptions:

Designation	Voltage V	Current consumption mA
WS3000	24	400
WS3000 (U02)	24	400
WS3100	24	400
WS3100 (U02)	24	400

Dimensions: Height .... 500 – 550 mm (s. chap. 13.2)
Diameter: 250mm
Weight: .... approx. 6kg

Fixation: .... mounting bracket
Protection class: .... III (SELV)
Protection type: IP68

Storage conditions
permissible storage temperature: -50°C ... +70°C
permissible rel. humidity: .... 0 ... 100% r.h., non condensing

Operating conditions
permissible operating temperature: -50°C ... +60°C
permissible rel. humidity: .... 0 ... 100% r.h., non condensing

Interface RS485, 2-wire, half duplex
Data bits: .... 8 (in SDI-12 mode: 7)
Stop bit: 1
Parity: .... none (in SDI-12 mode: even)
Tri-state: .... 2 bits after stop bit edge
Settable Baud rates: .... 1200, 2400, 4800, 9600, 14400, 19200[1], 28800, 57600

(In SDI-12 mode, the interface is changed to meet the requirements of the standard.)

Housing: .... Aluminium, anodised

[1] Factory setting; Baud rate for operation with ISOCON-UMB and firmware update

13.1 Measuring range / precision

13.1.1 Air temperature

Measuring method: .... PT 100
Measuring range: .... -40°C ... +60°C
Resolution: .... 0.01°C(-40°C...+60°C),
Sensor accuracy: .... +/- 0.1°C (-40°C ... +60°C),
Measurement rate: 1/minute
Units: .... °C; °F

13.1.2 Relative humidity

Measuring method: .... capacitive
Measuring range: .... 0 ... 100% r.h.
Resolution: .... 0.1% r.h.
Accuracy:.. +/- 2% r.h.
Measurement rate: 1/minute
Units: .... % r.h.; g/m³; g/kg

13.1.3 Dew point temperature

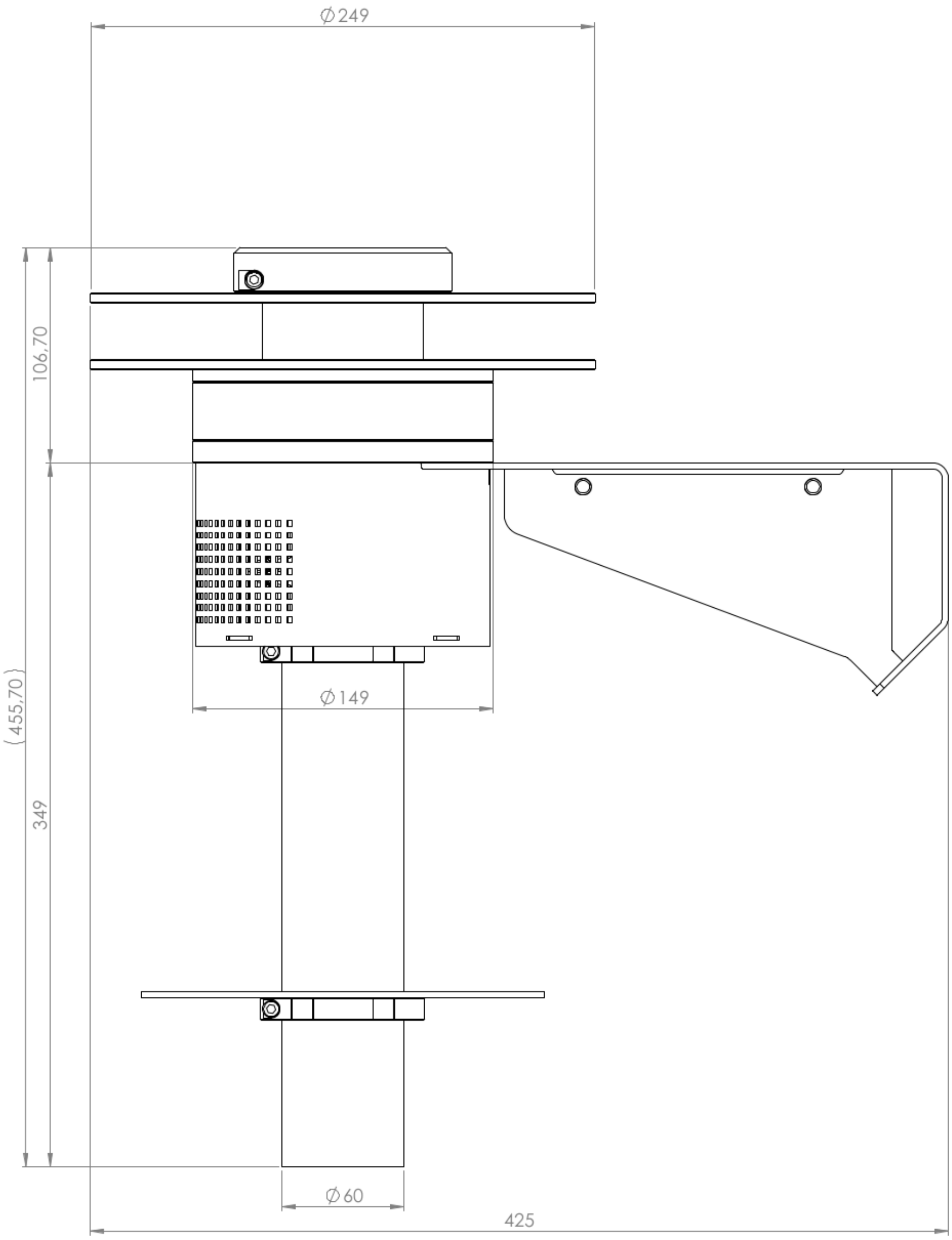
Measuring method: .... passive, calculated from air temperature & humidity
Measuring range: .... -50°C ... +60°C
Resolution: .... 0.1°C
Accuracy:.. calculation +/- 0.7°C
Units: .... °C; °F

13.1.4 Atmospheric pressure

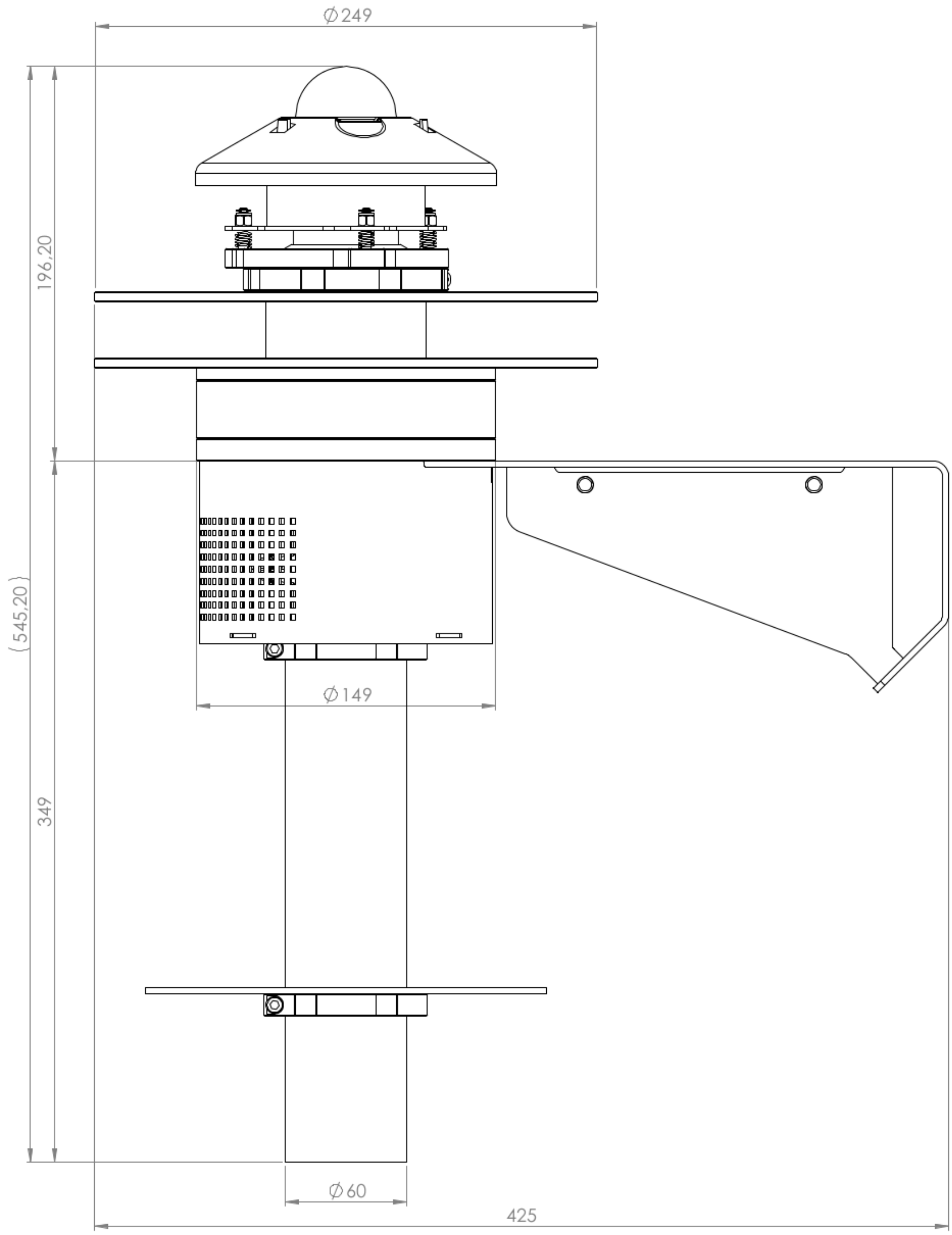
Measuring method: .... TERPS, resonance pressure transducer
Measuring range: .... 500 ... 1100 hPa
Resolution: .... 0.01 hPa
Accuracy:.. +/- 0.1 hPa (-40 … +60°C)
Measurement rate: 1/minute
Units: .... hPa

13.2 Drawings

13.2.1 WS3000



13.2.2 WS3100



14 EC Declaration of Conformity

Product: **Intelligent weather sensor system**

Typ: **WS3000-UMB (Order no.: 8390.U01, 8390.U02),**
WS3100-UMB (Order no.: 8391.U01, 8391.U02)

We,

G. Lufft Mess- und Regeltechnik GmbH
Gutenbergstraße 20
70736 Fellbach, Germany

declare in sole responsibility for issuing this declaration of conformity regarding compliance with essential requirements and preparation of technical documentation for the above specified product that it complies with the essential requirements of the directives mentioned below if used as intended:

DIRECTIVE 2014/53/EU OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL
of 16 April 2014 on the harmonization of the laws of the Member States relating to the making available on the market of radio equipment and repealing Directive 1999/5/EC:

15 Appendix

15.1 Summary channel list, UMB

UMB channel					Value range		
act	**min**	**max**	**avg**	**Measured quantity (float32)**	**min**	**max**	**units**
100	120	140	160	Air temperature	-80.0	60.0	°C
105	125	145	165	Air temperature	-112.0	140.0	°F
110	130	150	170	Dew point temperature	-80.0	60.0	°C
114				Wet bulb temperature	-80.0	60.0	°C
115	135	155	175	Dew point temperature	-112.0	140.0	°F
119				Wet bulb temperature	-112.0	140.0	°F
act	**min**	**max**	**avg**	**Measured quantity (float32)**	**min**	**max**	**units**
200	220	240	260	relative humidity	0.0	100.0	%
205	225	245	265	absolute humidity	0.0	1000.0	g/m³
210	230	250	270	Mixing ratio	0.0	1000.0	g/kg
215				Specific Enthalpy	-100.0	1000.0	kJ/kg
act	**min**	**max**	**avg**	**Measured quantity (float32)**	**min**	**max**	**units**
300	320	340	360	absolute air pressure sensor 1	300	1200	hPa
305	325	345	365	relative air pressure sensor 1	300	1200	hPa
301	321	341	361	Absolute air pressure sensor 2	300	1200	hPa
306	326	346	366	Relative air pressure sensor 2	300	1200	hPa
act				**Measured quantity (float32)**	**min**	**max**	**units**
310				Air density sensor 1	0,0	3,0	kg/m³
311				Air density sensor 2	0,0	3,0	kg/m³
370				QFE Sensor 1	300	1200	hPa
371				QFE Sensor 1	9	35	inHg
375				QFE Sensor 2	300	1200	hPa
376				QFE Sensor 2	9	35	inHg
380				QNH Sensor 1	300	1200	hPa
381				QNH Sensor 1	9	35	inHg
385				QNH Sensor 2	300	1200	hPa
.386				QNH Sensor 2	9	35	inHg
act	**min**	**max**	**avg**	**Measured quantity (float32)**	**min**	**max**	**units**
900	920	940	960	Global radiation	0,0	4000,0	W/m²
act	**min**	**max**	**avg**	**Measured quantity (float32)**	**min**	**max**	**units**
4008				TFF Humidity raw (float32)	0	100	%
4009				TFF Temperature (float32)	-40	80	°C
4049				Fan speed (uint16)	0	65535	rpm
10000				Operating voltage	0.0	40.0	V

15.2 Communication in Binary Protocol

Only one example of an online data request is described in this operating manual. Please refer to the current version of the UMB Protocol for all commands and the exact mode of operation of the protocol (available for download at www.lufft.com).

Note: Communication with the sensor takes place in accordance with the master-slave principle, i.e. there may only be ONE requesting unit on a network.

15.2.1 Framing

The data frame is constructed as follows:

1	**2**	**3 - 4**	**5 - 6**	**7**	**8**	**9**	**10**	**11 ... (8 + len) optional**	**9 + len**	**10 + len 11 + len**	**12 + len**
SOH	<ver>	<to>	<from>	<len>	STX	<cmd>	<verc>	<payload>	ETX	<cs>	EOT

SOH	Control character for the start of a frame (01h); 1 byte
<ver>	Header version number, e.g.: V 1.0 →<ver> = 10h = 16d; 1 byte
<to>	Receiver address; 2 bytes
<from>	Sender address; 2 bytes
<len>	Number of data bytes between STX and ETX; 1 byte
STX	Control character for the start of payload transmission (02h); 1 byte
<cmd>	Command; 1 byte
<verc>	Version number of the command; 1 byte
<payload>	Data bytes; 0 – 210 bytes
ETX	Control character for the end of payload transmission (03h); 1 byte
<cs>	Check sum, 16 bit CRC; 2 bytes
EOT	Control character for the end of the frame (04h); 1 byte

Control characters: SOH (01h), STX (02h), ETX (03h), EOT (04h).

15.2.2 Addressing with Class and Device ID

Addressing takes place by way of a 16-bit address. This breaks down into a Class ID and a Device ID.

Address (2 bytes = 16 bit)				
Bits 15 – 12 (upper 4 bits)		**Bits 11 – 8 (middle 4 bits)**	**Bits 7 – 0 (lower 8 bits)**	
Class ID (0 to 15)		**Reserve**	**Device ID** (0 – 255)	
0	Broadcast		0	Broadcast
7	Smart Weather Sensor (WS200-UMB – WS600-UMB)		1 - 255	Available
15	Master or control devices			

ID = 0 is provided as broadcast for classes and devices. Thus, it is possible to transmit a broadcast on a specific class. However, this only makes sense if there is only one device of this class on the bus; or in the case of a command, e.g. reset.

15.2.3 Examples for Creating Addresses

If, for example, you want to address WS400-UMB with the device ID 001, this takes place as follows:

The class ID for the Smart Weather Sensor is 7d = 7h;
the device ID is e.g. 001d = 001h

Putting the class and device IDs together gives the address 7001h (28673d).

15.2.4 Example of a Binary Protocol Request

If, for example, a Smart Weather Sensor with the device ID 001 is to be polled from a PC for the current temperature, this takes place as follows:

Sensor:

The class ID for the Smart Weather Sensors 7 = 7h;

The device ID is 001 = 001h

Putting the class and device IDs together gives a target address of 7001h.

PC:

The class ID for the PC (master unit) is 15 = Fh;
the PC ID is e.g. 001d = 01h.

Putting the class and device IDs together gives a sender address of F001h.

The length <len> for the online data request command is 4d = 04h;

The command for the online data request is 23h;

The version number of the command is 1.0 = 10h.

The channel number is in <payload>; as can be seen from the channel list (see Summary channel list, UMB, page 39), the current temperature in °C in the channel is 100d = 0064h.

The calculated CRC is D961h.

The request to the device:

SOH	<ver>	<to>		<from>		<len>	STX	<cmd>	<verc>	<channel>		ETX	<cs>		EOT
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**
01h	10h	01h	70h	01h	F0h	04h	02h	23h	10h	64h	00h	03h	61h	D9h	04h

The response from the device:

SOH	<ver>	<to>		<from>		<len>	STX	<cmd>	<verc>	<status>	<channel>		<typ>
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
01h	10h	01h	F0h	01h	70h	0Ah	02h	23h	10h	00h	64h	00h	16h

<value>				ETX	<cs>		EOT
15	**16**	**17**	**18**	**19**	**20**	**21**	**22**
00h	00h	B4h	41h	03h	C6h	22h	04h

Interpretation of the response:

<status> = 00h device o.k. (≠ 00h signifies error code)

<typ> = Data type of the following value; 16h = float (4 bytes, IEEE format)

<value> = 41B40000h as a float value corresponds to 22.5

The temperature is therefore 22.5°C.

The correct data transmission can be checked with the aid of the check sum (22C6h).

Note: Little Endian (Intel, low byte first) applies when transmitting word and float variables of addresses or the CRC, for example. This means first the LowByte and then the HighByte.

15.2.5 Status and Error Codes in Binary Protocol

If a measurement request delivers the <status> 00h, the sensor is working correctly. You can find a complete list of additional codes in the description of the UMB protocol.

Extract from list:

<status>	Description
00h (0d)	Command successful; no error; all o.k.
10h (16d)	Unknown command; not supported by this device
11h (17d)	Invalid parameter
24h (36d)	Invalid channel
28h (40d)	Device not ready; e.g. initialization / calibration running
50h (80d)	Measurement variable (+offset) is outside the set display range
51h (81d)	
52h (82d)	Measurement value (physical) is outside the measuring range (e.g. ADC over range)
53h (83d)	
54h (84d)	Error in measurement data or no valid data available
55h (85d)	Device / sensor is unable to execute valid measurement due to ambient conditions

15.2.6 CRC Calculation

CRC is calculated according to the following rules:

Norm: CRC-CCITT

Polynomial: 1021h = $x^{16} + x^{12} + x^5 + 1$ (LSB first mode)

Start value: FFFFh

You can find further information in the description of a CRC calculation in UMB Protocol.

15.3 Summary, UMB-ASCII 2.0 Standard Sets

The UMB ASCII 2 protocol allows to query measured values and the configuration of the sensor in a human readable form. The exact specification can be found in the UMB ASCII 2 protocol description.

15.3.1 Device specific commands

The following chapter describes the commands that are specific for the sensors of the WS3000 series.

15.3.1.1 Local altitude

Command <cmd>: ALT
Parameters: none
Call: ALT ALT=<altitude>
Response: ALT=<altitude>
Description: this command reads / sets the current local altitude in metres above datum. This value must be adjusted for the location so that the calculation of relative air pressure can be carried out correctly.

15.3.1.2 Altitude difference to runway (from SW V15 on)

Command <cmd>: ALD
Parameters: keine
Call: ALD ALD=<difference>
Response: ALD=<difference>
Description: this command reads / sets the altitude difference in meters between the sensor and the runway. This value must be adjusted for the location so that the calculation of tue QFE and QNH channels can be carried out correctly.

15.3.1.3 Temperature averaging interval

Command <cmd>: TMI
Parameters: none
Call: TMI TMI=<interval>
Response: TMI=<interval>
Description: this command reads / sets the interval in minutes for the averaging for temperature channels.

15.3.2 Humidity averaging interval

Command <cmd>: RHI
Parameters: none
Call: RHI RHI=<interval>
Response: RHI=<interval>
Description: this command reads / sets the interval in minutes for the averaging for humidity channels.

15.3.3 Air pressure averaging interval

Command <cmd>: PRI
Parameters: none
Call: PRI PRI=<interval>
Response: PRI=<interval>
Description: this command reads / sets the interval in minutes for the averaging for air pressure channels.

15.3.4 Standard Set S1

<STX><Add>:<Nr>:SS;1=<TelNo>;<SerNo>;<Tavg>;<Tmin>;<Tmax>;<Tdev>;<TN>;<rHavg>;<rHmin>;<rHmax>;<rHdev>;<rHN>;<pavg>;<pmin>;<pmax>;<pdev>;<pN>;<rpm>;<Error>:<Status>:CheckSum><CR><LF><EOT>

<TelNo> is counted up per measuring cycle, <SerNo> serves to clearly identify the WS <Error> is a Hex-4 binary error status for specifiying occurring errors. Invalid channels are presented by “/” in the respective quantity.

Byte	Value	Description
0	<STX>	02 Hex
1-4	<Add>	Device address Hex, e.g. 7001 for WSx-UMB with device ID 1
5	:	3A Hex
6-7	<Nr>	Request number Hex, on automated sending always 00
8	:	3A Hex
9-10	SS	<Cmd>, Standard Set
11	;	3B Hex
12	1	31 Hex
13	=	3D Hex
14-16	<TelNo>	Number of automated messages from start on
17	;	3B Hex
18-34	<SerNo>	Lufft serial no.
35	;	3B Hex
36-41	-**.**	Temperature average, [°C], signed
42	;	3B Hex

43-48	-**.**	Temperature minimum, [°C], signed
49	;	3B Hex
50-55	-**.**	Temperature maximum, [°C], signed
56	;	3B Hex
57-62	-*.***	Standard deviation of the temperature average [°C], signed
63	;	3B Hex
64-66	***	Number of temperature samples for averaging
67	;	3B Hex
68-73	***.**	Rel. humidity average, [%]
74	;	3B Hex
75-80	***.**	Rel. humidity, minumum, [%]
81	;	3B Hex
82-87	***.**	Rel. humidity maximum, [%]
88	;	3B Hex
89-94	-*.***	Standard deviation oft he rel. Humidity average, [%], signed
95	;	3B Hex
96-98	***	Number of relative humidity samples for averaging
99	;	3B Hex
100-106	****.**	Abs.atm. pressure, average, [hPa]
107	;	3B Hex
108-114	****.**	Abs. atmospheric pressure, minimum [hPa]
115	;	3B Hex
116-122	****.**	Abs. atmospheric pressure, maximum, [hPa]
123	;	3B Hex
124-129	-*.***	Standard deviation of the absolute atmospheric pressure, [hPa], signed
130	;	3B Hex
131-133	***	Number of pressure samples for averaging
134	;	3B Hex
135-139	*****	Fan speed, [rpm]
140	;	3B Hex

141-148	<Error>	Device status, Hex
149	:	3A Hex
150-151	<Status>	Command status, Hex
152	:	3A Hex
153-154	<Check-Sum>	Checksum, Hex, Two's complement of the sum of Bytes 0-157, without Bytes 153 and 154
155	<CR>	0D Hex
156	<LF>	0A Hex
157	<EOT>	04 Hex

15.3.5 Standard Set S10 (scaled)

<STX><Add>:<Nr>:SS;10=<TelNo>;<SerNo>;<Tavg>;<Tmin>;<Tmax>;<Tdev>;<TN>; <rHavg>;<rHmin>;<rHmax>;<rHdev>;<rHN>;<pavg>;<pmin>;<pmax>;<pdev>;<pN>; <rpm>;<Error>:<Status>:CheckSum><CR><LF><EOT>

<TelNo> is counted up per measuring cycle, <SerNo> serves to unambigously identify the WS, <Error> is a Hex-4 binary error status for specifiying occurring errors. Invalid channels are presented by "/" in the respective quantity.

The values are scaled in order to allow a presentation without decimal separators.

Byte	Value	Description
0	<STX>	02 Hex
1-4	<Add>	Device address Hex, e.g. 7001 for WSx-UMB with device ID 1
5	:	3A Hex
6-7	<Nr>	Request number Hex, on automated sending always 00
8	:	3A Hex
9-10	SS	<Cmd>, Standard Set
11	;	3B Hex
12	1	31 Hex
13	0	30 Hex
14	=	3D Hex
15-17	<TelNo>	Number of automated messages from start on
18	;	3B Hex
19-35	<SerNo>	Lufft serial number
36	;	3B Hex

37-41	-****	Temperature average, [°C], factor 100, signed
42	;	3B Hex
43-47	-****	Temperature minimum, [°C], factor 100, signed
48	;	3B Hex
49-53	-****	Temperature maximum, [°C], factor 100, signed
54	;	3B Hex
55-59	-****	Standard deviation of the temperature average, [°C], factor 1000, signed
60	;	3B Hex
61-63	***	Number of temperature samples for averaging
64	;	3B Hex
65-69	*****	Relative humidity average, [%], factor 100
70	;	3B Hex
71-75	*****	Relative humidity minimum, [%],factor 100
76	;	3B Hex
77-81	*****	Relative humidity maximum, [%],factor 100
82	;	3B Hex
83-87	-****	Standard deviation of the rel. humidity average, [%], factor 1000, signed
88	;	3B Hex
89-91	***	Number of rel. humidity samples for averaging
92	;	3B Hex
93-98	******	Absolute atmospheric pressure average, [hPa], factor 100
99	;	3B Hex
100-105	******	Absolute atmospheric pressure minimum, [hPa], factor 100
106	;	3B Hex
107-112	******	Absolute atmospheric pressure maximum, [hPa], factor 100
113	;	3B Hex
114-118	-****	Standard deviation of the absolute pressure, [hPa], factor 1000, signed
119	;	3B Hex
120-122	***	Number of pressure samples for averaging

123	;	3B Hex
124-128	*****	Fan speed, [rpm]
129	;	3B Hex
130-137	<Error>	Device status, Hex
138	:	3A Hex
139-140	<Status>	Command status, Hex
141	:	3A Hex
142-143	<Check-Sum>	Checksum, Hex, Two's complement of the sum of Bytes 0-45, without Bytes 141 and 142
144	<CR>	0D Hex
145	<LF>	0A Hex
146	<EOT>	04 Hex

15.4 Summary, SDI-12

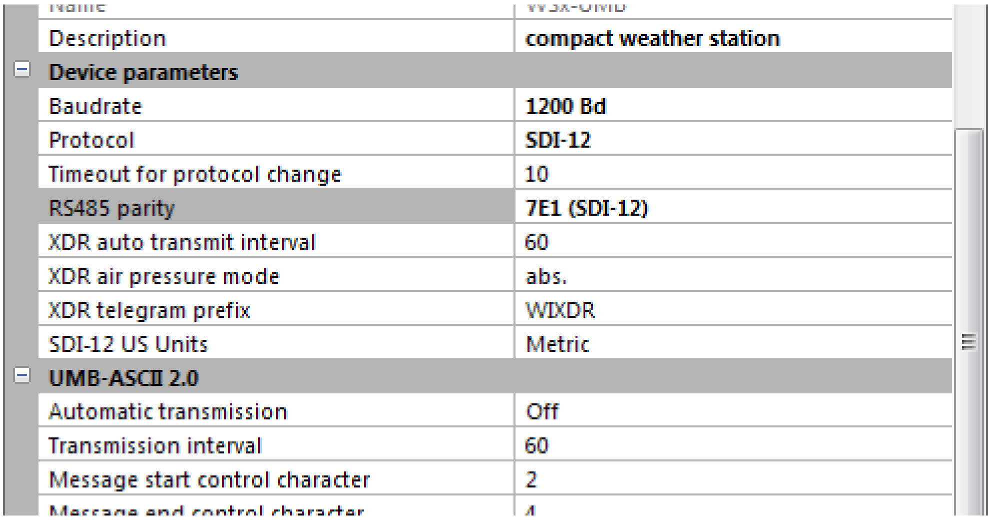
15.4.1 Communication in SDI-12 Mode

The communication in the SDI-12 mode of the Smart Weather Sensor is conforming to the standard defined in ‚SDI-12 A Serial-Digital Interface Standard for Microprocessor-Based Sensors Version 1.3 January 12, 2009‘ and is compatible to version 1.4 of this standard. The WS3000 series Smart Weather Sensor may be operated in bus mode together with other SDI-12 sensors, connected to one SDI master (logger).

15.4.2 Preconditions for SDI-12 Operation

As the interface settings defined in the SDI-12 standard are significantly different from the UMB default settings the related parameters must be set properly by ConfigTool.NET (latest version!).

The protocol mode of the device must be set to “SDI-12”. Additionally, the baud rate must be set to 1200 baud and parity to 7E1.



Description	compact weather station
Device parameters	
Baudrate	1200 Bd
Protocol	SDI-12
Timeout for protocol change	10
RS485 parity	7E1 (SDI-12)
XDR auto transmit interval	60
XDR air pressure mode	abs.
XDR telegram prefix	WIXDR
SDI-12 US Units	Metric
UMB-ASCII 2.0	
Automatic transmission	Off
Transmission interval	60
Message start control character	2

Measurement data can be transmitted alternatively in metric or US units. The selection is done by the UMB Config Tool.

Note: Please observe drawings on next page and notes in chapter 8, Connections when connecting a SDI12 data logger!

Up to SW V15: When operating the device in SDI-12 mode it is basically no more possible to access the device with the UMB Config Tool, due to the different interface parameter settings. To enable configuration access nevertheless the interface is operated in standard UMB mode (19200 8N1) for the first 5 seconds* after reset / power on. The UMB device ID is the configured device ID (see chapter 15.4.4). If a valid UMB telegram is received within these 5 seconds, the device will stay in UMB mode for the configured time out (10 minutes) so that the configuration can be modified.

- Connect the PC to the Smart Weather Sensor through an RS-485 converter
- Start the UMB Config Tool and create a WSxxx-UMB with the address of the device and activate at least one sensor. Start the measurement (will report connection error at first)
- Reset the device (Power off / on)
- When measurement values are received, the measurement can be terminated, the interface is now open for configuration.

From SW V15 on: If the intelligent weather sensor system is used in SDI 12 mode it is basically impossible to access it with the ConfigTool.NET due to the different interface parameter settings. To enable access anyway the interface is operated in standard UMB mode (19200 8N 1) in the first 5 seconds (*) after power on / reset. If the UMB device ID is unequal to 1 it is changed to 200, so access will be possible even if the device ID is unknown. If a valid UMB telegram is received within these 5 seconds, the device will stay in UMB mode for the configured time out (10 minutes) so that the configuration can be modified.

- PC über RS-485 Konverter an die Intelligente Wettersensorik anschließen
- UMB-Config-Tool starten und WSxxx-UMB mit der Adresse des Gerätes (1 oder 200) anlegen und mindestens einen Sensor aktivieren, Messung starten (bringt zunächst nur Fehlermeldungen)
- Reset des Gerätes auslösen (Betriebsspannung aus/ein)
- Wenn sich die Intelligente Wettersensorik meldet, kann die Messung beendet werden, die Schnittstelle ist jetzt für Konfiguration offen

(*) Remark: The 5 seconds UMB communication are available from program start. Under consideration of the operating system start, where no communication is possible, the device will be ready for SDI12 requests after 7.0 – 7.5 seconds.

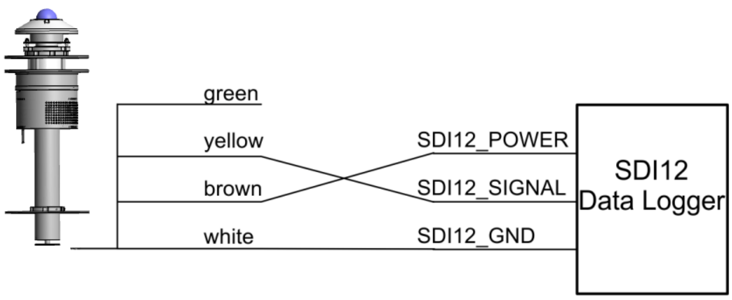


Figure. 1: Connecting to a logger with integrated power supply

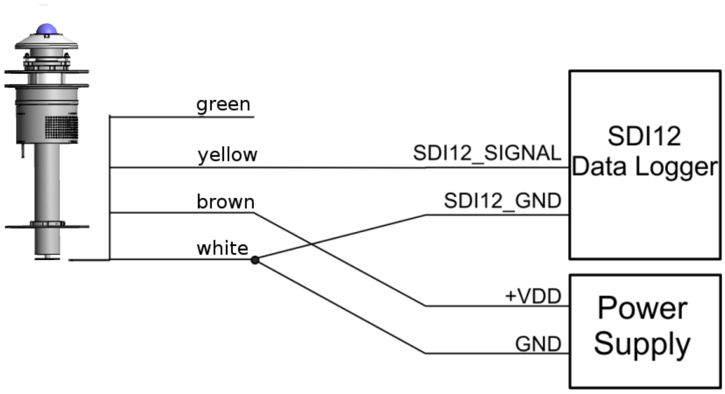


Figure. 2: Connecting to a logger and a separate power supply

15.4.3 Command Set

For details of the SDI-12 protocol please refer to the above mentioned standard document.

Following commands are available for devices of the WS family:

Note: The examples in the following sections use italics to print the requests from the logger (*0V!*)

Command	Function
?!	Address search (Wildcard request, one device only on bus!)
a!	Request device active?
aI!	Request device identification
aAb!	Address change to b (0 … 9, A …Z, a … z)
aM!	Measurement basic minimal data set
aM1!	Measurement temperatures
aM2!	Measurement humidity
aM3!	Measurement air pressure
aM7!	Measurement global radiation
aM9!	Measurement air pressure, 2nd sensor
aMC!	Measurement, basic minimal data set, transmit values with CRC
aMC1! ... aMC9!	Measurement (assignment of values as for aMn! commands), transmit values with CRC
aC!	Concurrent measurement, full basic data set
aC1! ... aC9!	Concurrent measurement, assignment of values as for aMn! commands, partly extended data sets
aCC!	Concurrent measurement, transmit values with CRC
aCC1! ... aCC9!	Concurrent measurement, assignment of values as for aMn! commands, partly extended data sets, transmit values with CRC
aD0!	Data request buffer 0
aD1!	Data request buffer 1
aD2!	Data request buffer 2
aD3!	Data request buffer 3
aD4!	Data request buffer 4
aR0!	Data request from continuous measurement, data set 0
aR1!	Data request from continuous measurement, data set 1
aR2!	Data request from continuous measurement, data set 2
aR3!	Data request from continuous measurement, data set 3
aR4!	Data request from continuous measurement, data set 4
aRC0!	Data request from continuous measurement, data set 0 with CRC
aRC1!	Data request from continuous measurement, data set 1 with CRC
aRC2!	Data request from continuous measurement, data set 2 with CRC
aRC3!	Data request from continuous measurement, data set 3 with CRC
aRC4!	Data request from continuous measurement, data set 4 with CRC
aV!	Command verification: Evaluate sensor status and heating temperatures, data request with aD0!, aD1!
aXU<m/u>!	Change the unit system for SDI data
aXH+nnnn!	Set local altitude of the device for calculation of rel. air pressure

Command	Function
aXA<t/p>+nn!	Integration time for average and min/max evaluation
aXR!	Device reset

The composition of the minimal and the full basic data set depends on the variant (WS3000-UMB / WS3100-UMB) of the device in question (see below). The same applies to the availability of the additional measurement commands (aM1!, aC1! etc.)

Due the applied measurement processes the devices of the WS3000 series will, different from other sensors described in the SDI-12 document, always measure continuously. This causes some special properties:

- The device does not need a "Wakeup" and does not have a sleep mode.
- Data requested with M- or C- commands are always available immediately. The device will always respond with `a000n` resp. `a000nn`. This means the device will not send any service request and will ignore measurement abort signals. The logger should request the data immediately.
- M- and C- command only differ in the number of values made available in the buffers (in both cases the maximum permitted by the standards of 9 resp. 20).
- We recommend to use the commands for continuous measurement (R-commands) to request the data.

15.4.4 Address Configuration

UMB Device-ID and SDI-12 Address are connected, but the different address ranges and the fact, that UMB ID's are integer numbers, while SDI-12 addresses are ASCII characters, have to be considered.

The SDI-12 address is built from the UMB device ID as follows:

UMB Device ID 1 (default) corresponds to SDI-12 Address '0' (SDI-12 default).

Changing the SDI12 address by SDI12 setting command also modifies the UMB device ID accordingly.

Valid Address Ranges:

UMB (dec)			SDI-12 (ASCII)		
1	to	10	'0'	to	'9'
18	to	43	'A'	to	'Z'
50	to	75	'a'	to	'z'

15.4.5 Data Messages

In the interest of simplified evaluation the assignment of measurement values to data buffers ‘0’ ... ‘9’ has been defined unified for all measurement commands. For this reason the responses to C-requests have been restricted to 35 characters, not using the 75 characters permitted for these requests

Currently buffers ‘0’ to ‘4’ are in use.

As with M-requests max. 9 values may be transmitted; the base data set of 9 values has been assigned to buffers ‘0’ and ‘1’. Buffers ‘2’ to ‘4’ contain further measurement values. This definition guaranties the compatibility to loggers designed according to older versions of the SDI-12 standard.

The buffer assignment depends on the device variant (WS3000-UMB / WS3100-UMB).

The complete set of measurement values, as defined for the UMB protocol has been made available also in the SDI-12 environment. They can be accessed using the additional M and C commands (aM1! ... aM9!, aMC1! ... aMC9!, aC1! ... aC9!, aCC1! ... aCC9!) (see below).

If the measurement value is not available for some reason, e.g. sensor failure, this is indicated by a value of +999.0. or -999.9 The logger can then evaluate the reason of failure by a aV! Verification request. The following tables show the measurement values in the sequence they are arranged in the telegram (see example).

Depending on the configuration of the device the values will be transmitted in metric or US units.

Note: The configured system of units is not indicated in the data messages. The logger may request this setting with the I-command and adjust the evaluation of the data messages accordingly

Example: M Request from a WS3000

0M!

00009<CR><LF> 9 measurement values are available

0D0!

0+13.5+85.7+9.5+1014.0+1017.0<CR><LF>

Air temperature 13.5°C, rel. humidity 85.7%,dew point temperature 9.5°C
abs. air pressure 1014.0hPa, rel. air pressure 1017.0hPa

0D1!

0+12.5+13.6+13.3+86.3<CR><LF>

Min air temperature 12.5°C, max air temperature 13.6°C,
average air temperature 13.3°C, average rel. humidity 86.3%

Example: C Request from a WS3000

0M!

`000019<CR><LF>` 19 measurement values are available

0D0!

`0+13.5+85.7+9.5+1014.0+1017.0<CR><LF>`

Air temperature 13.5°C, rel. humidity 85.7%,dew point temperature 9.5°C
abs. air pressure 1014.0hPa, rel. air pressure 1017.0hPa

0D1!

`0+12.5+13.6+13.3+86.3<CR><LF>`

Min air temperature 12.5°C, max air temperature 13.6°C,
average air temperature 13.3°C, average rel. humidity 86.3%

0D2!

`0+84.2+88.6+1016.0+1017.5+1017.4<CR><LF>`

Min rel. humidity 84.2%, max rel. humidity 88.6%, min rel. air pressure 1016.0hPa,
max rel. air pressure 1017.5hPa, average rel. air pressure 1017.4hPa

0D3!

`0+10.0+11.0+10.6<CR><LF>`

Min abs. humidity 10.0g/m3, max abs. humidity 11.0g/m3, average abs. humidity 10.6g/m3

0D4!

`0+12.1+34.5<CR><LF>`

Wetbulb temperature 12.1°C, specific enthalpy 34.5kJ/kg

15.4.5.1 Buffer Assignment Basic Data Set WS3000-UMB

Note: The device variants with two air pressure sensors do not include the measurement values of the second sensor in the basic data set. These have to be requested separately using the additional measurement command M9 / C9

15.4.5.1.1 Device configured for measurement in metric units:

Measurement Value	UMB Channel	Min	Max	Unit
Buffer ‘0’				
Air Temperature (act)	100	-80.0	60.0	°C
Rel. Humidity (act)	200	0.0	100.0	%
Dew Point (act)	110	-80.0	60.0	°C
Abs. Air Pressure(act)	300	300.0	1200.0	hPa
Rel. Air Pressure (act)	305	300.0	1200.0	hPa
Buffer ‘1’				
Air Temperature (min)	120	-80.0	60.0	°C
Air Temperature (max)	140	-80.0	60.0	°C
Air Temperature (avg)	160	-80.0	60.0	°C
Rel. Humidity (avg)	260	0.0	100.0	%
Buffer ‘2’				
Rel. Humidity (min)	220	0.0	100,0	%
Rel. Humidity (max)	240	0.0	100,0	%
Rel. Air Pressure (min)	325	300.0	1200.0	hPa
Rel. Air Pressure (max)	345	300.0	1200.0	hPa
Rel. Air Pressure (avg)	365	300.0	1200.0	hPa
Buffer ‘3’				
Abs. Humidity (min)	225	0.0	1000.0	g/m³
Abs. Humidity (max)	245	0.0	1000.0	g/m³
Abs. Humidity (avg)	265	0.0	1000.0	g/m³
Buffer ‘4’				
Wet Bulb Temperature (act)	114	-80.0	60.0	°C
Specific Enthalpy (act)	215	-100.0	1000.0	kJ/kg

Example: Request buffer ‘0’

0D0!

`0+13.5+85.7+11.2+1017.0+1001.0`

Air temperature 13.5°C, rel. humidity 85.7%, dew point 11.2°C, rel. air pressure 1017.0hPa, abs. pressure 1001.0hPa

15.4.5.1.2 Device configured for measurement in US units:

Measurement Value	UMB Channel	Min	Max	Unit
Buffer '0'				
Air Temperature (act)	105	-112.0	140.0	°F
Rel. Humidity (act)	200	0.0	100.0	%
Dew Point (act)	115	-112.0	140.0	°F
Abs. Air Pressure(act)	300	300.0	1200.0	hPa
Rel. Air Pressure (act)	305	300.0	1200.0	hPa
Buffer '1'				
Air Temperature (min)	125	-112.0	140.0	°F
Air Temperature (max)	145	-112.0	140.0	°F
Air Temperature (avg)	165	-112.0	140.0	°F
Rel. Humidity (avg)	260	0.0	100.0	%
Buffer '2'				
Rel. Humidity (min)	220	0.0	100,0	%
Rel. Humidity (max)	240	0.0	100,0	%
Rel. Air Pressure (min)	325	300.0	1200.0	hPa
Rel. Air Pressure (max)	345	300.0	1200.0	hPa
Rel. Air Pressure (avg)	365	300.0	1200.0	hPa
Buffer '3'				
Abs. Humidity (min)	225	0.0	1000.0	g/m³
Abs. Humidity (max)	245	0.0	1000.0	g/m³
Abs. Humidity (avg)	265	0.0	1000.0	g/m³
Buffer '4'				
Wet Bulb Temperature (act)	119	-112.0	140.0	°F
Specific Enthalpy (act)	215	-100.0	1000.0	kJ/kg

15.4.5.2 Buffer Assignment Basic Data Set WS301-UMB, WS302-UMB, WS303-UMB, WS304-UMB, WS310-UMB

Note: The device variants with two air pressure sensors do not include the measurement values of the second sensor in the basic data set. These must be requested separately using the additional measurement command M9 / C9

15.4.5.2.1 Device configured for measurement in metric units:

Measurement Value	UMB Channel	Min	Max	Unit
Buffer ‘0’				
Air Temperature (act)	100	-80.0	60.0	°C
Rel. Humidity (act)	200	0.0	100.0	%
Dew Point (act)	110	-80.0	60.0	°C
Global Radiation(act)	900	0.0	4000.0	W/m²
Rel. Air Pressure (act)	305	300.0	1200.0	hPa
Buffer ‘1’				
Air Temperature (min)	120	-80.0	60.0	°C
Air Temperature (max)	140	-80.0	60.0	°C
Air Temperature (avg)	160	-80.0	60.0	°C
Rel. Humidity (avg)	260	0.0	100.0	%
Buffer ‘2’				
Rel. Humidity (min)	220	0.0	100,0	%
Rel. Humidity (max)	240	0.0	100,0	%
Rel. Air Pressure (min)	325	300.0	1200.0	hPa
Rel. Air Pressure (max)	345	300.0	1200.0	hPa
Rel. Air Pressure (avg)	365	300.0	1200.0	hPa
Buffer ‘3’				
Abs. Humidity (act)	205	0.0	1000.0	g/m³
Wet Bulb Temperature (act)	114	-80.0	60.0	°C
Specific Enthalpy (act)	215	-100.0	1000.0	kJ/kg
Buffer ‘4’				
Global Radiation (min)	920	0.0	4000.0	W/m²
Global Radiation (max)	940	0.0	4000.0	W/m²
Global Radiation (avg)	960	0.0	4000.0	W/m²

Example: Request buffer ‘0’

0D0!

`0+13.5+85.7+11.2+1017.0+780.0`

Air temperature 13.5°C, rel. humidity 85.7%, dew point 11.2°C, rel. air pressure 1017.0hPa, global radiation 780.0W/m²

15.4.5.2.2 Device configured for measurement in US units:

Measurement Value	UMB Channel	Min	Max	Unit
Buffer ‘0’				
Air Temperature (act)	105	-112.0	140.0	°F
Rel. Humidity (act)	200	0.0	100.0	%
Dew Point (act)	115	-112.0	140.0	°F
Global Radiation(act)	900	0.0	4000.0	W/m²
Rel. Air Pressure (act)	305	300.0	1200.0	hPa
Buffer ‘1’				
Air Temperature (min)	125	-112.0	140.0	°F
Air Temperature (max)	145	-112.0	140.0	°F
Air Temperature (avg)	165	-112.0	140.0	°F
Rel. Humidity (avg)	260	0.0	100.0	%
Buffer ‘2’				
Rel. Humidity (min)	220	0.0	100,0	%
Rel. Humidity (max)	240	0.0	100,0	%
Rel. Air Pressure (min)	325	300.0	1200.0	hPa
Rel. Air Pressure (max)	345	300.0	1200.0	hPa
Rel. Air Pressure (avg)	365	300.0	1200.0	hPa
Buffer ‘3’				
Abs. Humidity (act)	205	0.0	1000.0	g/m³
Wet Bulb Temperature (act)	119	-112.0	140.0	°F
Specific Enthalpy (act)	215	-100.0	1000.0	kJ/kg
Buffer ‘4’				
Global Radiation (min)	920	0.0	4000.0	W/m²
Global Radiation (max)	940	0.0	4000.0	W/m²
Global Radiation (avg)	960	0.0	4000.0	W/m²

15.4.6 Additional Measurement Commands

With the additional measurement commands

aM1! … aM9!

aMC1! … aMC9! (M-Command, data transmission with CRC)

aC1! … aC9!

aCC1! … aCC9! (C- Command, data transmission with CRC)

the complete data sets of the Smart Weather Sensor, as defined for the UMB protocol are available in a SDI-12 environment as well.

The measurement values are ordered according to sensor types.

Equally to the base data sets max. 9 values can be requested with an additional M command, while an additional C request allows for up to 20 values.

The buffer assignment as documented in the following paragraphs has consequently been structured in a way that with each M command the buffers D0 and D1 are used. If the respective sensor type has more values available, the buffers D2 up to D4 will be occupied if required.

M1 / C1	Temperature	M: 9 Values	C: 9 Values
M2 / C2	Humidity	M: 9 Values	C: 13 Values
M3 / C3	Air Pressure	M: 9 Values	C: 9 Values
M7 / C7	Global Radiation	M: 4 Values	C: 4 Values
M9 / C9	Air Pressure 2nd sensor	M: 9 Value	C: 9 Value

If the sensor type requested with the measurement command is not available with the actual variant of the Smart Weather Sensor (WS3000-UMB ... WS3100-UMB) the device will respond with

`a0000<CR><LF>` resp.

`a00000<CR><LF>`

15.4.6.1 Buffer Assignment Additional Measurement Commands M1 / C1: Temperature

15.4.6.1.1 Device configured for measurement values in metric units:

Measurement Value	UMB Channel	Min	Max	Unit
Buffer '0'				
Air Temperature (act)	100	-80.0	60.0	°C
Air Temperature (min)	120	-80.0	60.0	°C
Air Temperature (max)	140	-80.0	60.0	°C
Air Temperature (avg)	160	-80.0	60.0	°C
Dew Point (act)	110	-80.0	60.0	°C
Buffer '1'				
Dew Point (min)	130	-80.0	60.0	°C
Dew Point (max)	150	-80.0	60.0	°C
Dew Point (avg)	170	-80.0	60.0	°C
Wet Bulb Temperature (act)	114	-80.0	60.0	°C

Example: Request with M command

```
0M1!
00009<CR><LF>

0D0!
0+12.5+10.7+13.5+11.8+5.3<CR><LF>

0D1!
0+4.2+5.9+5.6+9.8<CR><LF>
```

15.4.6.1.2 Device configured for measurement values in US units:

Measurement Value	UMB Channel	Min	Max	Unit
Buffer '0'				
Air Temperature (act)	105	-112.0	140.0	°F
Air Temperature (min)	125	-112.0	140.0	°F
Air Temperature (max)	145	-112.0	140.0	°F
Air Temperature (avg)	165	-112.0	140.0	°F
Dew Point (act)	115	-112.0	140.0	°F
Buffer '1'				
Dew Point (min)	135	-112.0	140.0	°F
Dew Point (max)	155	-112.0	140.0	°F
Dew Point (avg)	175	-112.0	140.0	°F
Wet Bulb Temperature (act)	119	-112.0	140.0	°F

15.4.6.2 Buffer Assignment Additional Measurement Commands M2 / C2: Humidity

15.4.6.2.1 Device configured for measurement values in metric or US units:

Measurement Value	UMB Channel	Min	Max	Unit
Buffer ‘0’				
Rel. Humidity (act)	200	0.0	100.0	%
Rel. Humidity (min)	220	0.0	100.0	%
Rel. Humidity (max)	240	0.0	100.0	%
Rel. Humidity (avg)	260	0.0	100.0	%
Buffer ‘1’				
Abs. Humidity (act)	205	0.0	1000.0	g/m³
Abs. Humidity (min)	225	0.0	1000.0	g/m³
Abs. Humidity (max)	245	0.0	1000.0	g/m³
Abs. Humidity (avg)	265	0.0	1000.0	g/m³
Specific Enthalpy (act)	215	-100.0	1000.0	kJ/kg
Buffer ‘2’				
Mixing Ratio(act)	210	0.0	1000.0	g/kg
Mixing Ratio (min)	230	0.0	1000.0	g/kg
Mixing Ratio (max)	250	0.0	1000.0	g/kg
Mixing Ratio (avg)	270	0.0	1000.0	g/kg

Example: Request with M command

```
0M2!
00009<CR><LF>

0D0!
0+48.5+48.2+48.8+48.5<CR><LF>

0D1!
0+5.7+5.5+5.9+5.7+29.3<CR><LF>
```

Example: Request with C command

```
0C2!
000013<CR><LF>

0D0!
0+48.5+48.2+48.8+48.5<CR><LF>

0D1!
0+5.7+5.5+5.9+5.7+29.3<CR><LF>

0D2!
0+4.6+4.4+5.0+4.6<CR><LF>
```

15.4.6.3 Buffer Assignment Additional Measurement Commands M3 / C3: Air Pressure and M9 / C9 Air Pressure 2nd Sensor

15.4.6.3.1 Device configured for measurement values in metric or US units:

Measurement Value	UMB Channel	Min	Max	Unit
Buffer ‘0’				
Abs. Air Pressure(act)	300	300.0	1200.0	hPa
Abs. Air Pressure (min)	320	300.0	1200.0	hPa
Abs. Air Pressure (max)	340	300.0	1200.0	hPa
Abs. Air Pressure (avg)	360	300.0	1200.0	hPa
Air Density (act)	310	0.000	3.000	kg/m3
Buffer ‘1’				
Rel. Air Pressure (act)	305	300.0	1200.0	hPa
Rel. Air Pressure (min)	325	300.0	1200.0	hPa
Rel. Air Pressure (max)	345	300.0	1200.0	hPa
Rel. Air Pressure (avg)	365	300.0	1200.0	hPa

Example: Request with M command

```
0M3!
00009<CR><LF>

0D0!
0+1001.0+1000.0+1002.0+1001.0+1.119<CR><LF>

0D1!
0+1017.0+1016.0+1018.0+1017.0<CR><LF>
```

Example: Request with C command

```
0C3!
000009<CR><LF>

0D0!
0+1001.0+1000.0+1002.0+1001.0+1.119<CR><LF>

0D1!
0+1017.0+1016.0+1018.0+1017.0<CR><LF>
```

15.4.6.4 Buffer Assignment Additional Measurement Commands M7 / C7: Global Radiation

15.4.6.4.1 Device configured for measurement values in metric units:

Measurement Value	UMB Channel	Min	Max	Unit
Buffer '0'				
Global Radiation (act)	900	0.0	4000.0	W/m²
Global Radiation (min)	920	0.0	4000.0	W/m²
Global Radiation (max)	940	0.0	4000.0	W/m²
Global Radiation (avg)	960	0.0	4000.0	W/m²

Example: Request with M Command

```
0M7!
00004<CR><LF>

0D0!
0+780.0+135.0+920.0+530.0<CR><LF>
```

15.4.6.4.2 Device configured for measurement values in US units:

Measurement Value	UMB Channel	Min	Max	Unit
Buffer '0'				
Global Radiation (act)	900	0.0	4000.0	W/m²
Global Radiation (min)	920	0.0	4000.0	W/m²
Global Radiation (max)	940	0.0	4000.0	W/m²
Global Radiation (avg)	960	0.0	4000.0	W/m²

15.4.7 Message Device Identification

The device responds to the identification request with following message (example for SDI-12 device address ‘0’:

0I!
`013Lufft.deW30xynnn`

x: device variant

0: WS3000-UMB
1: WS3000-UMB with 2nd air pressure sensor
2: WS3100-UMB
3: WS3100-UMB with 2nd air pressure sensor

y: Metric / US units (m = metric, u = US)

nnn: Software version

i.e. for a WS3100-UMB with 2 air pressure sensors, configured for US units:

0I!
`013Lufft.deW303u022`

15.4.8 Message Verification

The command verification aV! is used to evaluate status information of the device. The device responds with

`a0004<CR<LF>`

to the request, i.e. 4 values are available in the buffers.

The measurement values transmitted in buffer ‘0’ contain the status information of the measurement channels.

The status data of the channels are assembled to form “fake measurement values”, where each digit represents one status. See below for the coding of states. Generally each sensor has two status values, one for the direct value and another for the measurement value buffer used for the evaluation of the average, min, and max values.

The last two values, transmitted in buffer ‘1’, show the heating temperatures of wind and precipitation sensor.

The positions marked as “reserved” in the table are transmitted as ‘0’

Buffer ‘0’	
Status group1: +nnnn	Air temperature, air temperature buffer, dew point, dew point buffer
Status group 2: +nnnnnn	Rel. Humidity, rel. Humidity buffer, abs. Humidity, abs humidity buffer, mixing ratio, mixing ratio buffer
Status group 3: +nnnnnn	Air pressure, air pressure buffer, reserved, reserved, reserved, reserved
Status group 4: +nnnn	Global radiation status, global radiation buffer status, 2nd air pressure status, 2nd air pressure buffer status

Sensor status codes:

Sensor status	Code
OK	0
UNGLTG_KANAL	1
E2_CAL_ERROR E2_CRC_KAL_ERR FLASH_CRC_ERR FLASH_WRITE_ERR FLASH_FLOAT_ERR	2
MEAS_ERROR	3
MEAS_UNABLE	4
INIT_ERROR	5
VALUE_OVERFLOW CHANNEL_OVERRANGE	6
VALUE_UNDERFLOW CHANNEL_UNDERRANGE	7
BUSY	8
other sensor status	9

Example (WS3100-UMB, SDI-12 Address ‘0’, no error):

```
0V!
00004<CR><LF>
0D0!
0+0000+000000+00000+0000<CR><LF>
```

Example (WS3100-UMB, SDI-12 Address ‘0’, global radiation failure):

```
0V!
00004<CR><LF>
0D0!
0+0000+000000+000000+3300<CR><LF>
```

15.4.9 Message Change of Unit System

The command is used to change the unit system used for the SDI12 data between metric and US units. It is implemented as manufacturer specific X command.

The parameter modification is directly applied and additionally transferred to the configuration memory of the device. A device reset is **not** required for activation of the modification.

Command: `aXU<u/m>!`
Response: `aU<u/m><CR><LF>`

u : US units
m: metric units

Example: change to metric units, SDI-12 address ‘0’
`0XUm!`
`0Um<CR><LF>`

15.4.10 Message: Setting of the Averaging Interval Length

The avg, min, max and vct values of the measurement values are evaluated over a floating interval with a length of 1 to 10 min. The length of this interval can be adjusted separately for the groups temperature / humidity and air pressure.

The parameter modification is transferred to the configuration memory of the device. **A device reset is required to activate the modification.**

Command: `aXA<t/p>+nn!`
t : Temperature and Humidity
p: Air pressure
nn: Interval in minutes, valid range: 1 bis 10

Response: `aXA<t/p>+nn<CR><LF>`

The response to the attempt of setting of an invalid interval length is
`aXAf<CR><LF>`

Example: Setting the interval for temperature and humidity to 5 minutes
`0XAt+5!`
`0XAt+5<CR><LF>`

15.4.11 Message: Setting of the Local Altitude

For the calculation of the relative air pressure the local altitude of the device is required.

The parameter modification is transferred to the configuration memory of the device. **A device reset is required to activate the modification.**

Command: `aXH+nnnn!`
nnnn: local altitude of the sensor in m
Response: `aXH+nnnn<CR><LF>`

The response to the attempt of setting of an invalid altitude (-100 < altitude < 5000) is
`aXHf<CR><LF>`

Example: The altitude of the installation location is 135m above sea level
`0XH+135!`
`0XH+135<CR><LF>`

15.4.12 Message: Device Reset

The command initiates a device reset.

Command: `aXR!`
Response: `aXRok<CR><LF>`

The response is followed by the device reset, i.e. the device will be offline for a few seconds.

Example:

```
0XR!
0XRok<CR><LF>
```

15.5 Communication in ASCII Protocol

Note: UMB-ASCII protocol is not recommended for new projects.

Text-based communication with devices is possible using ASCII protocol.

To do this, in the device configuration, interface settings, the protocol mode must be set to ASCII (see chapter “Configuration and testing”).

ASCII protocol is network-compatible and serves exclusively for online data requests. The device will not respond to incomprehensible ASCII commands.

Note: The use of binary protocol is recommended for lengthy transmission routes (e.g. network, GPRS/UMTS), as ASCII protocol is unable to detect transmission errors (not CRC-secured).

Note: TLS channels are not available in ASCII protocol.

15.5.1 Structure

An ASCII command is introduced by the ‘&’ character and completed by the CR (0Dh) sign. There is a space character (20h) between the individual blocks in each case; this is represented by an underscore character ‘_’. Characters that represent an ASCII value are in ordinary inverted commas.

15.5.2 Summary of ASCII Commands

Command	Function	BC	AZ
M	Online data request		l
X	Switches to binary protocol		k
R	Triggers software reset	●	k
D	Software reset with delay	●	k
I	Device information		k

These operating instructions describe the online data request only. You can find the description of the other commands in the UMB protocol.

15.5.3 Online Data Request (M)

Description: By way of this command, a measurement value is requested from a specific channel.

Request: ‘&’_<ID>^{5}_‘M’_<channel>^{5} CR

Response: ‘$’_<ID>^{5}_‘M’_<channel>^{5}_<value>^{5} CR

<ID>^{5} Device address (5 decimal places with leading zeros)

<channel>^{5} Indicates the channel number (5 decimal places with leading zeros)

<value>^{5} Measurement value (5 decimal places with leading zeros); a measurement value standardized to 0 – 65520d. Various error codes are defined from 65521d – 65535d.

Example:

Request: &_28673_M_00100

By way of this request, channel 100 of the device with address 28673 is interrogated (Smart Weather Sensor with device ID 001).

Response: $_28673_M_00100_34785

This channel outputs a temperature from –50 to +60°C, which is calculated as follows:

0d	corresponds to	-50°C
65520d	corresponds to	+60°C
36789d	corresponds to	[+60°C – (-50°C)] / 65520 * 34785 +(-50°C) = 8.4°C

Note: TLS channels are not available in ASCII protocol.

15.5.4 Standardization of Measurement Values in ASCII Protocol

The standardization of measurement values from 0d – 65520d corresponds to the measuring range of the respective measurement variable.

Measurement Variable	Measuring Range		
	Min	Max	Unit
Temperature			
Temperature Dew point Wet Bulb Temperature	-80.0 -112.0	60.0 140.0	°C °F
Humidity			
Relative humidity	0.0	100.0	%
Absolute humidity Mixing ratio	0.0	1000.0	g/m³ g/kg
Specific Enthalpy	-100.0	1000.0	kJ/kg
Pressure			
Relative air pressure Absolute air pressure	300.0	1200.0	hPa
Air Density			
air density	0.0	3.0	kg/m³
Global Radiation			
Global Radiation	0.0	4000.0	W/m²

15.5.5 Error Codes in the ASCII Protocol

Various error codes are defined from 65521d – 65535d in addition to the standardisation for the transmission of measurement values.

<code>	Description
65521d	Invalid Channel
65523d	Value Overflow
65524d	Value Underflow
65525d	Error in measurement data or no valid data available
65526d	Device / sensor is unable to execute valid measurement due to ambient conditions
65534d	Invalid Calibration
65535d	Unknown Error

15.6 Communication in Terminal Mode

It is possible to communicate with a device in a very simple text-based manner using the terminal mode.

To do this, in the device configuration, interface settings, the protocol mode must be set to terminal (see chapter 10.2.2, Configuration page 24.).

Note: In the case of communication in the terminal mode, only one single unit may be connected to the interface, as this protocol is **NOT** network-compatible. It is used for very simple measurement value requests.

Note: The use of binary protocol is recommended for lengthy transmission routes (e.g. network, GPRS/UMTS), as it is not possible to detect transmission errors in terminal mode (not CRC-secured).

Note: In the terminal mode, measurement values are not available in all units. Furthermore, status and error messages are not transmitted.

15.6.1 Structure

A terminal consists of an ASCII character and a numeric character. The command is completed with the <CR> sign. There is no echo on entry.

The individual values in the response are separated by a semi-colon (;). The response is completed with <CR><LF>.

An invalid terminal command is acknowledged with ‘FAILED’. Control commands are acknowledged with ‘OK’.

The command to which the response relates is given at the beginning of each response.

Note: No response times are specified in the terminal mode.

Note: For compatibility with older weather sensors, some E/M measurement commands contain measurements that are not provided by this sensor. These measurements are represented as empty values.

15.6.2 Terminal Commands

The terminal commands transmit the following values or have the following functions:

E0<CR>	Temperature in °C	Ta	C	(Channel 100)
	Dew point temperature in °C	Tp	C	(Channel 110)
	Wind chill temperature in °C	Tw	C	(Channel 111)
	Relative humidity in %	Hr	P	(Channel 200)
	Relative air pressure in hPa	Pa	H	(Channel 305)
	Wind speed in m/s	Sa	M	(Channel 400)
	Wind direction in °	Da	D	(Channel 500)
	Precipitation quantity in mm	Ra	M	(Channel 620)
	Precipitation type	Rt	N	(Channel 700)
	Precipitation intensity in mm/h	Ri	M	(Channel 820)
E1<CR>	Temperature in °F	Ta	F	(Channel 105)
	Dew point temperature in °F	Tp	F	(Channel 115)
	Wind chill temperature in °F	Tw	F	(Channel 116)
	Relative humidity in %	Hr	P	(Channel 200)
	Relative air pressure in hPa	Pa	H	(Channel 305)
	Wind speed in mph	Sa	S	(Channel 410)
	Wind direction in °	Da	D	(Channel 500)
	Precipitation quantity in inches	Ra	I	(Channel 640)
	Precipitation type	Rt	N	(Channel 700)
	Precipitation intensity in inches/h	Ri	I	(Channel 840)
E4<CR>	Act. Compass heading in °	Ca	D	(Channel 510)
	Act. Global Radiation in W/m^2	Ga	W	(Channel 900)
	Min. Global Radiation in W/m^2	Gn	W	(Channel 920)
	Max. Global Radiation in W/m^2	Gx	W	(Channel 940)
	Avg. Global Radiation in W/m^2	Gg	W	(Channel 960)
	Act. Specific Enthalpy in KJ/Kg	Ea	J	(Channel 215)
	Act. Wet Bulb Temperature in °C	Ba	C	(Channel 114)
	Act. Wet Bulb Temperature in °F	Ba	F	(Channel 119)
	Act. Air Density in kg/m^3	Ad	G	(Channel 310)

Mx<CR>	Displays the same values as Ex<CR>, but without additional information such as the measurement variable and unit
I0<CR>	Serial number; date of manufacture; project number; parts list version; SPLAN version; hardware version; firmware version; E2 version; device version
I1<CR>	Outputs the device description
R0<CR>	Executes a device reset
R1<CR>	Resets the accumulated rain quantity and executes a device reset
X0<CR>	Temporarily switches to UMB binary protocol

Examples:

```
E0<CR>     E0;Ta+024.9C;Tp+012.2C;Tw+026.8C;Hr+045.0P;Pa+0980.6H;
           Sa+005.1M;Da+156.6D;Ra+00042.24M;Rt+060N;Ri+002.6M;

M0<CR>     M0;+024.9;+012.2;+026.8;+045.0;+0980.6;
           +005.1;+156.6;+00042.24;+060;+002.6;

E2<CR>     E2;Sa+005.1M;Sn+001.1M;Sx+007.1M;Sg+005.1M;Sv+005.0M;
           Da+156.6D;Dn+166.6D;Dx+176.6D;Dv+156.6D;

M2<CR>     M2;+005.1;+001.1;+007.1;+005.1;+005.0;
           +156.6;+166.6;+176.6;+156.6;

I0<CR>     I0;001;0109;0701;004;005;001;016;011;00002;<CR><LF>

R0<CR>     R0;OK;<CR><LF>
```

15.7 Communication in Modbus Mode[2]

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.

15.7.1 Modbus Communication Parameters

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.

Modbus operating modes:	MODBUS-RTU, MODBUS-ASCII
Baud rate:	19200 (9600, 4800 or lower)
Interface Setting	8E1, 8N1, 8N2

NOTE: 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 >= 10sec. However, for most of the weather data, significant changes should be expected in the range of minutes.

15.7.2 Addressing

The Modbus address is deducted from the the UMB device ID (see Chap. 15.2.2).

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.

15.7.3 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)

[2] Preliminary description; protocol available January 2018

15.7.3.1 Function 0x03 Read Holding Registers

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.

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
3	2	Averaging Interval TFF	Interval for averaging and min/max evaluation in minutes Value range 1 … 10	1.0
4	3	Averaging Interval Air Pressure	Interval for averaging and min/max evaluation in minutes Value range 1 … 10	1.0
6	5	Averaging Interval Global Radiation	Interval for averaging and min/max evaluation in minutes Value range 1 … 10	1.0
9	8	Device reset	(Function only when writing to the register, reading will give 0 always)	

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

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

Register assignment see 15.7.3.1

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.

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

Setting of the heating mode:

The wind sensor heating mode is coded into the high byte of the 16bit register no. 7, the precipitation sensor heating mode into the low byte of this register

Example:

Heating mode wind: Mode 1 (Code 1)

Heating mode precipitation: Off (Code 2)

Write to register 7 (reg. addr. 6): 0x0102 (=258d)

Setting for minimum power consumption, both heatings off (Code 2):

Write to register 7 (reg. addr. 6): 0x0202 (=514d)

The factory setting for a WS600-UMB is automatic mode for both heatings, i.e. 0x0000.

When attempting to set a heating mode not supported by the individual device variant, e.g. activating the precipitation heating of a device without precipitation sensor, the device will automatically adjust the value written to the register, so that the value read back from the register might be different from the written value.

15.7.3.3 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 the 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 channels (Chapters 6, Measured value output and 15.1, Summary channel list, UMB.)

Reg. No.	Reg. Addr.	Value (UMB Channel)	Range	Scaling Factor, Remarks
		Status Information		
1	0	Identification	High Byte: WS-Type (2,3,4,5,6) Low Byte: Software Version	Type coding, see below
2	1	Device Status		
3	2	Sensor Status 1	Air temperature buffer, air temperature, dew point buffer, dew point(high byte -> low byte, see table below)	Coding 4 bit per status, see below
4	3	Sensor Status 2	Rel. humidity buffer, rel. humidity, abs. humidity buffer, abs. humidity(high byte -> low byte, see table below)	Coding 4 bit per status, see below
5	4	Sensor Status 3	Mixing ratio buffer, mixing ration, air press. buffer, air press. (high byte -> low byte, see table below)	Coding 4 bit per status, see below
7	6	Sensor Status 5	Global radiation buffer, global radiation, reserved, reserved (high byte -> low byte, see table below)	Coding 4 bit per status, see below
9	8	Reserve		
10	9		Diagnostic: run time in 10sec steps	

Reg. No.	Reg. Addr.	Value (UMB Channel)	Range	Scaling Factor, signed/unsigned, Remarks
		Values Independent of the Unit System		
11	10	200	Relative Humidity (act.)	Factor 10, s
12	11	220	Relative Humidity (min.)	Factor 10, s
13	12	240	Relative Humidity (max.)	Factor 10, s
14	13	260	Relative Humidity (avg.)	Factor 10, s
15	14	305	Rel. Air Pressure (act.)	Factor 10, s
16	15	325	Rel. Air Pressure (min.)	Factor 10, s
17	16	345	Rel. Air Pressure (max.)	Factor 10, s
18	17	365	Rel. Air Pressure (avg.)	Factor 10, s
28	27	900	Global Radiation (act.)	Factor 10, s
29	28	920	Global Radiation (min.)	Factor 10, s
30	29	940	Global Radiation (max.)	Factor 10, s
31	30	960	Global Radiation (avg.)	Factor 10, s

Reg. No.	**Reg. Addr.**	**Value (UMB Channel)**	**Range**	**Scaling Factor, signed/unsigned Remarks**
		Values in Metric Units		
32	31	100	Air Temperature °C (act.)	Factor 10, s
33	32	120	Air Temperature °C (min.)	Factor 10, s
34	33	140	Air Temperature °C (max.)	Factor 10, s
35	34	160	Air Temperature °C (avg.)	Factor 10, s
36	35	110	Dew Point °C (akt.)	Factor 10, s
37	36	130	Dew Point °C (min.)	Factor 10, s
38	37	150	Dew Point °C (max.)	Factor 10, s
39	38	170	Dew Point °C (avg.)	Factor 10, s

Reg. No.	Reg. Addr.	Value (UMB Channel)	Range	Scaling Factor, signed/unsigned Remarks
		Values in US Units		
52	51	105	Air Temperature °F (act.)	Factor 10, s
53	52	125	Air Temperature °F (min.)	Factor 10, s
54	53	145	Air Temperature °F (max.)	Factor 10, s
55	54	165	Air Temperature °F (avg.)	Factor 10, s
56	55	115	Dew Point °F (act.)	Factor 10, s
57	56	135	Dew Point °F (min.)	Factor 10, s
58	57	155	Dew Point °F (max.)	Factor 10, s
59	58	175	Dew Point °F (avg.)	Factor 10, s

Reg. No.	**Reg. Addr.**	**Value (UMB Channel)**	**Range**	**Scaling Factor, signed/unsigned, Remarks**
		Further Values		
72	71	205	Absolute Humidity (act.)	Factor 10, s
73	72	225	Absolute Humidity (min.)	Factor 10, s
74	73	245	Absolute Humidity (max.)	Factor 10, s
75	74	265	Absolute Humidity (avg.)	Factor 10, s
76	75	210	Mixing Ratio (act.)	Factor 10, s
77	76	230	Mixing Ratio (min.)	Factor 10, s
78	77	250	Mixing Ratio (max.)	Factor 10, s
79	78	270	Mixing Ratio (avg.)	Factor 10, s
80	79	300	Abs. Air Pressure (act.)	Factor 10, s
81	80	320	Abs. Air Pressure (min.)	Factor 10, s
82	81	340	Abs. Air Pressure (max.)	Factor 10, s
83	82	360	Abs. Air Pressure (avg.)	Factor 10, s
99	98	114	Wet Bulb Temp. °C (act)	Factor 10, s
100	99	119	Wet Bulb Temp. °F (act)	Factor 10, s
101	100	215	Specific Enthalpy (act)	Factor 10, s
102	101	310	Air Density (act)	Factor 1000, s
103	102	710	reserved	Factor 1, s
104	103	730	reserved	Factor 1, s
105	104	750	reserved	Factor 1, s
106	105	770	reserved	Factor 1, s
107	106	711	reserved	Factor 1, s
		Reserved		

Smart Weather Sensor Type Code

WS100-UMB	1	WS303-UMB	33
WS200-UMB	2	WS304-UMB	43
WS300-UMB	3	WS310-UMB	93
WS400-UMB	4	WS501-UMB	15
WS500-UMB	5	WS502-UMB	25
WS600-UMB	6	WS503-UMB	35
WS700-UMB	7	WS504-UMB	45
WS800-UMB	8	WS510-UMB	95
WS301-UMB	13	WS401-UMB	14
WS302-UMB	23	WS601-UMB	16

Sensor Status:
Each register hoIds 4 sensor status coded with 4 bits per status, so that together they build one 16bit number. The sequence defined in the table above is to understand as from most significant half byte to least significant half byte. Most of the sensors have two status values, one for the sensor itself and the current measurement value, another one for the buffer, from which average, min. And max values are evaluated.

Assignment of Status Information to Status Register

Register	Byte	Half-Byte	Status
Sensor Status 1	High	High	Temperature Buffer
		Low	Temperature
	Low	High	Dewpoint Buffer
		Low	Dewpoint
Sensor Status 2	High	High	Rel. Humidity Buffer
		Low	Rel. Humidity
	Low	High	Abs. Humidity Buffer
		Low	Abs. Humidity
Sensor Status 3	High	High	Mixing Ratio Buffer
		Low	Mixing Ratio
	Low	High	Air Pressure Buffer
		Low	Air Pressure
Sensor Status 5	High	High	Global Radiation Buffer
		Low	Global Radiation
	Low	High	reserved
		Low	reserved

Example Sensor Status 1:

Temperature buffer status, temperature status, dewpoint buffer status, dewpoint status

High Byte		Low Byte	
High	Low	High	Low
Tempera-ture-Buffer	Tempera-ture	Dew point-Buffer	Dew point
5	3	0	7

The example values above (for illustration only, the given combination will not occur in reality) are combined to the register value 0x5307 = 21255.

The status is retrieved from the register as integer part of

Status 1 = register / 4096

Status 2 = (register / 256) AND 0x000F

Status 3 = (register / 16) AND 0x000F

Status 4 = register AND 0x000F

Following table shows the status coding:

Coding of Sensor Status:

Sensor State	Code
OK	0
UNGLTG_KANAL	1
E2_CAL_ERROR E2_CRC_KAL_ERR FLASH_CRC_ERR FLASH_WRITE_ERR FLASH_FLOAT_ERR	2
MEAS_ERROR, MEAS_UNABLE	3
INIT_ERROR	4
VALUE_OVERFLOW CHANNEL_OVERRANGE VALUE_UNDERFLOW CHANNEL_UNDERRANGE	5
BUSY	6
Other Sensor State	7

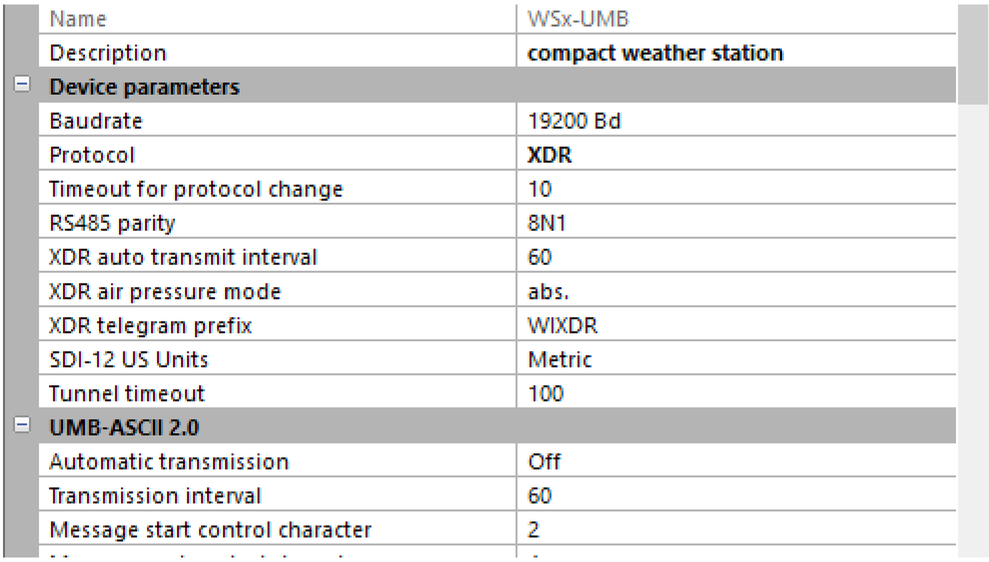
15.8 Communication: XDR Protocol

Note: XDR protocol is not available for WS100-UMB.

The XDR protocol allows to transmit a selected data set of the Smart Weather Sensor in a NMEA compatible format. The data telegram can be transmitted on request, or the Smart Weather Sensor can be set into auto transmit mode, where the data telegram will be triggered automatically at a selectable interval.

A set of ASCII configuration messages allows to apply some configuration settings without leaving the XDR protocol.

For configuration settings exceeding this command set use ConfigTool .NET. To change into the UMB protocol a UMB message must be addressed to the device within 5 seconds after power up or reset.



Name	WSx-UMB
Description	**compact weather station**
Device parameters	
Baudrate	19200 Bd
Protocol	**XDR**
Timeout for protocol change	10
RS485 parity	8N1
XDR auto transmit interval	60
XDR air pressure mode	abs.
XDR telegram prefix	WIXDR
SDI-12 US Units	Metric
Tunnel timeout	100
UMB-ASCII 2.0	
Automatic transmission	Off
Transmission interval	60
Message start control character	2

Figure 1 Sensor Configuration XDR

Protocol	XDR protocol selected
XDR auto transmit interval	Interval for cyclical data transfer in seconds
XDR air pressure mode	select absolute or relative air pressure
XDR telegram prefix	Select the Talker ID part of the XDR telegram header

15.8.1 Basic Interface Properties

- Baud rate configurable from 1200bps to 57600bps, character format 8 bits, no parity, 1 stop bit (8N1).
- Unit ID equal to UMB device ID, but limited to 98. 99 is the broadcast ID
- Data output on request or continuously (configurable)
- Commands and messages use strictly ASCII text mode

15.8.2 Message Format for Commands and Responses

Byte		
0	'*'	Start Character
1,2	'01'	Destination ID
3,4	'00'	Source ID
5 ... n		Command Data (min. 2)
n+1, n+2	<CR><LF>	Termination Characters

The command data field always starts with the 2-character command identifier, optionally followed by a parameter, starting with '='.

Currently implemented commands are

- P9 single measurement XDR format
- PP start continuous measurement XDR format
- PB single measurement PWSD format
- PC start continuous measurement PWSD format
- GW option: add MWD sentence (wind data) to XDR format
- MI continuous measurement interval
- J3 pressure mode (absolute air pressure / relative air pressure)
- JS pressure sensor elevation
- JW spot or average output of wind data
- BR baud rate
- ID unit ID
- NH message prefix

If the device receives an invalid command (missing start or termination character, invalid ID, invalid structure etc.), it will not respond.

If a setting command contains an invalid parameter value, the device will not respond.

Setting commands must usually be preceded by the “Write Enable” command EW. This command does not generate a response, and may be, different from other commands, transmitted without message terminators (<CR><LF>). I.e. the write enable and the set command may be concatenated without terminators between the commands.

Example:

0100EW*0100J3=1<CR><LF>

and

0100EW<CR><LF>*0100J3=1<CR><LF>

are both valid command sequences for setting the pressure mode.

Setting commands not requiring a preceding write enable are marked in the command description.

15.8.3 Message Format for Measurement Data XDR

The message format for P9 / PP measurement data follows the definition for NMEA WI (weather instrument) XDR messages.

The message is field oriented, with variable length. The fields are separated by ','.

Message format:

$hhhhh,P,x.xxxx,B,0,C,yy.y,C,0,H,zz.z,P,0<CR><LF>

$hhhhh	Message header, default $WIXDR (WI : Talker identifier “weather instruments”, XDR: sentence identifier “transducer measurements”) *)
,	separator
P	transducer type “pressure”
,	separator
x.xxxx	air pressure value in Bar
,	separator
B	unit: bars (= hPa)
,	separator
0	Transducer ID, set to 0
,	separator
C	transducer type temperature
,	separator
yy.y	temperature in °C
,	separator
C	unit: °C
,	separator
0	Transducer ID, set to 0
,	separator
H	transducer type humidity
zz.z	relative humiditiy in %
,	separator
P	unit: %
,	separator
0	Transducer ID, set to 0
<CR><LF>	sentence terminator

*) The message header can be modified. The UMB config tool allows modifying the talker ID bytes. The XDR setting command NH allows changing the complete message header. The leading '$' is fixed and cannot be modified

15.8.4 Message Format for Measurement 0R0

The 0R0 sentence format is a proprietary format matching NMEA 0183 specification. The 0R0 sentence contains essential measurement values of the compact weather station and is designed for compatibility with existing installations.

The sentence is requested by the PB command for single measurement and PC for cyclic transmission.

If certain measurement values are not available for the subtype of the individual weather station the related value will be replaced by 999999. The same applies for measurement values with status not “OK”.

The message is field oriented, with variable length. The fields are separated by ','.

Message Format:

0R0,Dm=aaaD,Sm=bb.bM,Ta=cc.cC,Ua=dd.dP,Pa=e.eeeeB,Rc=f.ffM, Pt=ggN<CR><LF>

0R0	message header
,	separator
Dm	identifier wind direction
=	separator
aaa	wind direction in °
D	unit °
,	separator
Sm	identifier wind speed
=	separator
bb.b	wind speed in m/s
M	unit m/s
,	separator
Ta	identifier air temperature
=	separator
cc.c	air temperature in °C
C	unit: °C
,	separator
Ua	identifier relative humidity
=	separator
dd.d	relative humidity in %

P	unit %
,	separator
Pa	identifier air pressure
=	separator
e.eeee	air pressure in Bar
B	unit Bar
,	separator
Rc	identifier precipitation difference
=	separator
ff.ff	precipitation difference (related to last transmission) in mm
M	unit mm
,	separator
Pt	identifier precipitation type
=	separator
gg	precipitation code (00 no precip., 60 rain, 70 snow)
C	unit Code
<CR><LF>	sentence terminator

15.8.5 Measurement Commands

Command Examples are shown for unit ID 01

15.8.5.1 Single Measurement XDR format

Command identifier: **P9**

Parameter: none

Command example:

Command: *0100P9<CR><LF>

Response (wind data not activated):

$WIXDR,P,<pressure in bar>,B,0,C,<air temperature °C>,C,0,H,<rel. Humidity %>,P,0<CR><LF>

Response (wind data activated):

$WIXDR,P,<pressure in bar>,B,0,C,<air temperature °C>,C,0,H,<rel. Humidity %>,P,0<CR><LF>

$WIMWD,<wind direction °>,T, < wind direction °>,M,<wind speed kts>,N ,< wind speed m/s>,M<CR><LF>

Serial numbers of pressure and T/H sensor are not available and set to 0.

15.8.5.2 Continuous Measurement XDR format

Command identifier: **PP**

Parameter: none

Command example:

Command *0100PP<CR><LF>

After this command the device will start to transmit the result message as defined in for the single measurement automatically with the interval defined by the transmission interval command (see 15.8.6.1) or set by the UMB Config Tool.

The default interval is 60 seconds, minimum allowed interval is 10sec, maximum interval is 43200sec (=12h).

The continuous mode will be stored in the E2PROM of the device, so that after a reset the device will continue to transmit automatically.

The continuous mode is terminated by a Single Measurement Command (15.8.5.1, 15.8.5.3).

15.8.5.3 Single Measurement 0R0 Format

Command identifier: **PB**

Parameter: none

Command example:

Command *0100PB<CR><LF>

Response:

0R0,Dm=<wind dir.>D,Sm=<wind speed>M,Ta=<air temp.>C,Ua=<rel. humidity>P,Pa=<air press.>B,Rc=<precip. diff.>M, Pt=<precip. type>N<CR><LF>

15.8.5.4 Continuous Measurement 0R0 Format

Command identifier: **PC**

Parameter: none

Command example:

Command *0100PC<CR><LF>

After this command the device will start to transmit the result message as defined in for the single measurement automatically with the interval defined by the transmission interval command (see 15.8.6.1) or set by the UMB Config Tool.

The default interval is 60 seconds, minimum allowed interval is 10sec, maximum interval is 43200sec (=12h).

The continuous mode will be stored in the E2PROM of the device, so that after a reset the device will continue to transmit automatically.

The continuous mode is terminated by a Single Measurement Command (15.8.5.1, 0).

15.8.6 Configuration Commands

Command Examples are shown for unit ID 01

15.8.6.1 Transmission Interval for Continuous Measurement

Command identifier: **MI**

Parameter: interval in seconds (min. 10, max. 43200, default 60)

Request command example:

Command: *0100MI<CR><LF>

Response: *0001MI=60<CR><LF>

The command requests the current setting of the result transmission interval

Setting command example (to be preceded by the write enable command)

Command: *0100MI=60<CR><LF>

Response: *0001MI=60<CR><LF>

The command sets the interval for automatic measurement result transmission (15.8.5.2) in seconds.

15.8.6.2 Pressure Mode Selection Command

Command identifier: **J3**

Parameter: 0 = absolute pressure, 1 = relative pressure

Selects, if the absolute or relative (sea level) air pressure is transmitted in the measurement value message (0). For correct function of the conversion to relative (sea level) pressure it is essential, that the sensor elevation has been set correctly (JS command (15.8.6.3) or ConfigTool .NET)

Request command example:

Command: *0100J3<CR><LF>

Response: *0001J3=1<CR><>LF>

Requests the current pressure mode

Setting command example (to be preceded by the write enable command):

Command: *0100J3=0<CR><LF>

Response: *0100J3=0<CR><LF>

Sets the pressure mode:

0 absolute air pressure

1 relative air pressure

15.8.6.3 Sensor Elevation Setting Command

Command identifier: **JS**

Parameter: sensor elevation (above sea level) in m

Remark: the sensor elevation may be entered as integer value or as fixed point value, the sensor will round the value for internal storage to integer (full meters).

Request command example:

Command: *0100JS<CR><LF>

Response: *0001JS=353<CR><LF>

Requests the current elevation setting

Setting command example (to be preceded by the write enable command):

Command: *0100JS=82<CR><LF> or *0100JS=82.3<CR><LF>

Response: *0001JS=82<CR><LF>

Sets the elevation of the sensor above sea level in m (range -100m to 5000m)

15.8.6.4 NMEA Message Prefix Setting Command

Command identifier: **NH**

Parameter: complete NMEA Header ('$' + max. 6 char)

Note: The parameter must always start with the '$' character. This character is nevertheless fixed and will not be modified.

Request command example:

Command: *0100NH<CR><LF>

Response: *0001NH=$WIXDR<CR><LF>

Requests the current header of the NMEA measurement value sentence

Setting command example (to be preceded by the write enable command):

Command: *0100NH=$WIXDR<CR><LF>

Response: *0001NH=$WIXDR<CR><LF>

Sets the prefix of the NMEA measurement value

15.8.6.5 Baud Rate Setting Command

Command identifier: **BR**

Parameter: Baudrate (1200, 2400, 4800, 9600, 19200, 28800, 38400, 57600)

Note: this command only provides the set mode and is only valid with the broadcast destination ID 99.

After execution of the command the Smart Weather Sensor will perform a reset and then start with the new baudrate.

The command does not require to be preceded by the write enable command.

Setting command example:

Command: *9900BR=9600<CR><LF>

Response: *9900BR=9600<CR><LF>

Sets the baud rate

15.8.6.6 Unit ID Setting Command

Command identifier: **ID**

Parameter: none

Note: This command does not accept a separate parameter, but uses the source ID of the address fields as input. The ID of the device is set to (source ID + 1). Source ID values 0 ... 97 are allowed.

The command only provides the set mode and is only valid with the broadcast destination ID 99.

After execution of the command the Smart Weather Sensor will perform a reset and then start with the new unit ID.

The command does not require to be preceded by the write enable command.

Setting command example:

Command: *9900ID<CR><LF>

Response: *9901ID<CR><LF>

Sets the unit ID to source ID + 1

15.8.6.7 Write Enable Command

Command identifier:	**EW**
Parameter:	none

This command is intended to protect the device from accidental setting modifications and must precede most of the setting commands.

The command is not available as request command and does not generate a response.

This command is valid with and without termination characters.

Command example:

*0100EW

or

*0100EW<CR><LF>

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Subject to technical modifications