



FuehlerSysteme eNET International  
The Brand for Sensor Technology

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# Instructions for Use

# *Weather Station*

## FS6002

From Softwareversion V5.08 Stand: 02/2023



FS6002-MBRU-A1B1H1R1T1W1W2-G

FS6002-MBRU-A1H1T1W1W2



FS6002-MBRU-B1R1W1W2-G

FS6002-MBRU-W1W2

## Safety Instructions

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

## Environment

- Products governed by the provisions of "*ElektroG*" (German Electrical and Electronic Equipment Act) and to perform environmentally compatible disposal and recycling. We are prepared to take back all products concerned free of charge if returned to us by our customers carriage-paid.
- Make sure you retain packaging for storage or transport of products. Should packaging however no longer be required, please arrange for recycling as the packaging materials are designed to be recycled.



## Documentation

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- Although these operating instruction has been drawn up with due care, **FuehlerSysteme eNET International GmbH** can accept no liability whatsoever for any technical and typographical errors or omissions in this document that might remain.
- We can accept no liability whatsoever for any losses arising from the information contained in this document.
- Subject to modification in terms of content.
- The device / product should not be passed on without the/these operating instructions.

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## 1 Models available

Article No.	Parameters	Output / Interfaces / Features
FS6002-MBRU-A1B1H1R1T1W1W2-G	Wind speed Wind direction Precipitation Brightness Temperature Humidity Pressure	- 0...10V - RS485 / 422 - Magnetic compass - GPS receiver - 19-pin plug connection - Data protocol, adjusted: - BINARY (Modbus RTU) in half duplex mode
FS6002-MBRU-A1H1T1W1W2	Wind speed Wind direction Temperature Humidity Pressure	- 0...10V - RS485 / 422 - Magnetic compass - 19-pin plug connection - Data protocol, adjusted: - BINARY (Modbus RTU) in half duplex mode
FS6002-MBRU-B1R1W1W2-G	Wind speed Wind Direction Precipitation Brightness	- 0...10V - RS485 / 422 - Magnetic compass - GPS receiver - 19-pin plug connection - Data protocol, adjusted: - BINARY (Modbus RTU) in half duplex mode)
FS6002-MBRU-W1W2	Wind speed Wind direction	- 0...10V - RS485 / 422 - Magnetic compass - 19-pin plug connection - Data protocol, adjusted: - BINARY (Modbus RTU) in half duplex mode

## 2 Application

The Weather Station is used for acquisition of the most important meteorological parameters. Depending on the development level the device supplies measured data for:

- Wind speed and direction, averaging acc. to WMO- recommendations.
- Precipitation
- Air temperature
- Brightness
- Twilight
- Relative humidity
- Barometric air pressure
- Global radiation
- Rain temperature

For a correct determination of the wind direction in mobile use of the Weather Station there is a magnetic compass integrated in all models available. Furthermore, an integrated GPS-receiver serves for the determination of the exact Universal Time, and geographic position.

For an exact north alignment at stationary installation it is used the difference angle between the brightness direction – measured by the instrument at cloudless sky – and the sun position angle – calculated via Universal Time and geographic position of the GPS.

In addition to the meteorological sensors there is integrated a GPS-receiver, an electronic magnetic compass, and an acceleration sensor in the instrument.

The options for data output are

- analogue, as a standard signal or / and in
- binary (MODBUS RTU protocol).

The compact design, simple mounting and different options for data output permit operation with numerous applications.

The device is particularly suitable for use in the following sectors:

- Building services management.
- Traffic control.
- Meteorology.
- Industry.
- Energy Supply.
- Environmental monitoring.

The **wind speed** and **wind direction** are determined through the acquisition of 2-dimensional horizontal components of ultrasonic measurement paths positioned at right angles in relation to each other. The speed of sound can be additionally used to calculate and output the **acoustic virtual temperature**.

The principle of measuring the ultrasonic propagation time means that the device is ideal for the inertia-free measurement of gusts and peak values.

The **air temperature** and **relative humidity** are measured via a built-in precision combination sensor. It is protected from harmful environmental influences by a micropore filter that is impermeable to water but open to water vapour. The built-in **pressure sensor** based on MEMs (micro-electro-mechanical system) technology is also protected with such a filter.

When measuring the **precipitation intensity**, the precipitation is contactless via the back-reflected signal of a Doppler radar measured and calculated. The intensity of the last minute is extrapolated to one hour for the output. Any averages of the precipitation intensity can be formed by the user using the difference in the total precipitation at the desired times. The midnight transition is to be observed.

**Brightness** is captured by 4 photo sensors with spectral sensitivity curve, which is ideally suited to the sensitivity of the human eye. The direction of the light source is calculated using the prevailing intensity conditions. The logarithmic intensity characteristic of the photo sensors allows light intensities to be measured and output in a wide range between 1 – 150,000lux.

The real direction of the maximum brightness can be calculated via the 4 photo sensors, and can be output as brightness direction. With unclouded sky this direction corresponds to the azimuth angle of the sun position.

With diffuse light conditions it might deviate from the real azimuth angle of the sun position. Therefore, a threshold of 10kLux has been determined. Below this threshold the brightness direction is output with 0°.

In weather situations with quickly travelling clouds the direction of the measured maximum brightness can steadily change, which might result in an irregular control of connected clouding devices. Here, it makes more sense to use the azimuth angle of the sun position, which is calculated via GPS information, for external control.

**Remark:**

The components of the single brightness sensors can be measured correctly only when the Weather Station is aligned mechanically to the north direction. The electronic north correction affects only the vectorial brightness direction (see command BO).

A **GPS receiver**, which is built-in with certain models, is used for the determination of position and as a real-time source. This data is additionally used to calculate the current position of the sun. The **position, time and position of the sun** are output via the e RS485/422 interfaces.

An electronic compass which is integrated, detects the horizontal aspecular angle of the north marking of the instrument to the magnetic north pole in angular degrees.

The analogue and digital interfaces are electrically isolated from the power supply and the housing potential. This means that there is no conductive connection that might result in the output signals being superposed by interference currents or voltages.

**Digital output:**

A RS485/422 interface is available for serial communication. It can be operated in full or half duplex mode. Predefined data telegrams are available for outputting measured values (e.g. VD, VDT, NMEA, etc.).

A **MODBUS RTU protocol** is additionally implemented for extended standardised communication. The device can be switched to MODBUS-RTU mode with the relevant command.

**Analogue outputs:**

8 voltage outputs 0...10V are available.

The first 3 outputs are set to:

1. Wind speed.
2. Wind direction.
3. Temperature.

The other 5 voltage outputs are predefined for:

4. Relative humidity,
5. air pressure,
6. brightness,

7. brightness direction,
8. precipitation intensity.

Individual output scaling of the measuring ranges is possible; see **Command OL, Output Link**.

These outputs are either active or inactive depending on the model.

Serial and analogue output of the data can take the form of an instantaneous value or a sliding mean.

Device models without GPS nevertheless have a battery-backed real-time clock, which can be used to output a date and time stamp in the data telegrams.

### ***Heating***

The Weather Station has a built-in heater (see available models). This largely prevents ice and snow from accumulating on the device cover.

## **3 Construction and Mode of Operation**

---

### **3.1 Wind Measurement:**

The wind speed measuring module of the **Weather Station** consists of 4 ultrasonic converters, arranged in pairs of two facing each other via a reflector. The two resulting measurement paths are at right angles to each other. The converters function both as acoustic transmitters and acoustic receivers.

The electronic control system is used to select the respective measurement path and its measuring direction. When measurement starts, a sequence of 4 individual measurements is performed in all 4 directions of the measurement paths in a basic measuring cycle of one millisecond.

The measuring directions (sound propagation directions) rotate clockwise. Mean values are calculated from the 4 individual measurements of the path directions and then used for further calculations. The time required for a measuring sequence at the maximum measuring speed is exactly 10.0 milliseconds (measuring sequence 8ms + 2ms for analysis).

#### **3.1.1 Measuring Principle: Wind Speed and Direction**

The propagation speed of sound in calm air is superposed by the speed components of an airflow in the direction of the wind. A wind speed component in the propagation direction of the sound supports its speed of propagation, so causing it to increase. On the other hand, a wind speed component against the propagation direction reduces the speed of propagation. The propagation speed resulting from superposition results in different propagation times of the sound at different wind speeds and directions over a fixed measurement path.

As the speed of sound greatly depends on the temperature of the air, the sound propagation time is measured on each of the two measurement paths in both directions. These rules out the measurement result being influenced by temperature.

By combining two measuring paths at right angles to each other, the sum and angle of the wind speed vector are obtained in the form of rectangular components. After the rectangular



speed components have been measured, they are converted to polar coordinates by the Weather Station microprocessor and then output as a sum and angle of wind speed.

**Moving averaging** of the wind velocity and wind direction acc. to the **WMO-recommendations**:

The wind data can be averaged moving over a time span of up to 10 minutes on a base of 100 millisecond values. This averaging is calculated according the recommendation of the WMO as the FIFO-method. That means, that all data are kept in the memory up to the end of the averaging period. Thus, a data outlier can be identified as such, and - contrary to a first-order averaging – does not lead to a settling of its influence for a longer period.

### 3.1.2 Measuring Principle: Acoustic Virtual Temperature

The thermodynamic interrelationship between the propagation speed of sound and the absolute air temperature is defined by a root function. The speed of sound is also more or less independent of the air pressure and only depends on the absolute air humidity to an insignificant extent.

This physical relationship between the speed of sound and temperature can be used to measure the temperature of the air as long as its chemical composition is known and remains constant. The levels of gases in the atmosphere are constant and, with the exception of the content of water vapour, vary by no more than a few 100ppm (CO<sub>2</sub>) even over lengthy periods.

The determination of gas temperature via its speed of sound is performed directly from measurement of its physical properties without the indirect step of thermal coupling of this gas to a sensor, which would otherwise be necessary.

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**Note:**

*The acoustic-virtual temperature is the air temperature which refers to dry air without any water vapour. It is detected by sonic logging of acoustic pulses .*

*The acoustic temperature is not suitable for the exact measurement of air temperature. It serves exclusively for the verification of the acquired wind measuring values.*

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## 3.2 Temperature and Humidity Measurement

A built-in hygro-thermo sensor with an I<sup>2</sup>C interface is used to measure temperature and humidity levels. The sensor's power consumption is so low that even when actively performing measurement, the increase in temperature through heat loss can hardly be measured.

The hygro-thermo sensor is protected from the ingress of water by a miniature housing with a vapour-permeable membrane. The very small air exchange volume means that the sensor responds to changes in air humidity in a matter of seconds.

The sensor is mounted on a plug-in board equipped with weather and radiation protection and therefore supplies accurate values for air temperature and humidity even when exposed to solar irradiation.

### **3.3 Air Pressure**

Air pressure is measured with a MEMs sensor, based on piezoresistive technology, and output via an I<sup>2</sup>C interface.

The sensor is mounted on the same plug-in board as the hygro-thermo sensor. The air pressure sensor is likewise protected from the ingress of water by a protective element equipped with a vapour-permeable membrane.

### **3.4 Brightness**

Brightness is measured using 4 individual photo sensors facing the 4 points of the compass at an elevation angle of 50°. They are soldered onto a printed board in the cover of the device as SMD components.

The elevation angle of 40° corresponds to the mean vertical position of the sun (equinox) in our latitudes.

For meaningful mapping of the intensity dynamic for brightness with 5 orders of magnitude the photo sensors output a current, which is logarithmically dependent on the brightness level.

The current reading is converted to a digital measured value by an A/D converter. After further processing as a digital value by the CPU, it is then output in the telegram or as an analogue linear value in a pre-selectable range of measured values.

### **3.5 Twilight**

The twilight is measured by measuring the brightness. With this measuring device, the brightness is output in lux and kLux. To measure and determine twilight, you should use the brightness values in lux; the typical measuring range for twilight is between 0 ... 250lux.

### **3.6 Precipitation at all Device Types**

A Doppler radar module is used to detect precipitation and determine its intensity. This radar module operates with radiated RF power of a few milliwatts at a frequency, which has international clearance for this purpose.

Like the brightness sensors, the radar module is mounted on top of the printed board in the device cover and is protected from environmental influences by an optically and electromagnetically transparent cover.

The sending and receiving aerial points vertically upwards, towards precipitation from above.

## 3.7 Measuring Principle Precipitation

The Doppler radar beams a very small (mW range) electromagnetic signal via an array of sending aerials. A receiving aerial array receives both the transmitted signal and the signal reflected by tiny particles or droplets.

Where there is a difference in frequency between the send and receive signal, combining the transmitted signal with the reflected signal will generate the difference frequency of the two signals.

This difference frequency is an accurate measure for the relative speed at which the particle is moving towards or away from the Doppler radar module.

The speed at which rain drops fall is roughly proportional to the square root of the drop diameter (Gunn and Kinzer 1949).

The precise relationship between the speed at which rain falls and the diameter / volume of the rain drops can be used to calculate individual volumes and thus the rainfall intensity based on the frequency rate and the frequency of the Doppler frequencies.

### 3.7.1 Type of Precipitation (Synop Code)

The type of precipitation can be roughly determined from the measured values of rainfall speed, intensity, temperature and humidity.

The following table shows the codes for the identifiable types of precipitation based on the Synop Table 4680, VuB Vol. D Supplement 6 applicable to automatic stations:

#### **Attention:**

***Attention: The full synoptic resolution, especially at the transition from rain to snow and vice-versa, can only be reached in the fully extended version with integrated thermo-hygro-sensor. In rare cases, the synop code may differ from the human observer.***

Synop Code $w_a w_a$	Meaning
0	No precipitation.
40	Precipitation present.
51	Light drizzle.
52	Moderate drizzle.
53	Heavy drizzle.
61	Light rain.
62	Moderate rain.
63	Heavy rain.
67	Light rain and/or drizzle with snow.
68	Moderate rain and/or drizzle with snow.
70	Snowfall.
71	Light snow.
72	Moderate snow.
73	Heavy snow.

74	Ice pallets.
89	Heavy hail.

**Table 1: Synop Code table**

**Attention:**

*The synoptic key serves only for differentiating the precipitation types. In addition, the intensity must be considered for control purposes in order to avoid unnecessary operation of e.g. shading equipment.*

## **4 Recommendation Side Selection/Standard Installation**

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An exposed location should be chosen for the location. Slipstream, reflection of light and casting shadows could influence the measurement properties.

Above the Weather Station should be no large moving objects (e.g. trees or moving cars) within a radius of 10 meters in the field of view of the doppler radar. This applies in particular to moving objects at sensor height, as well as to gas discharge lamps, e.g. street lighting.

The radar signals reflected from these objects could generate doppler frequencies that could be interpreted as precipitation events.

Overvoltage and lightning protection as well as any necessary suitable grounding measures in accordance with local regulations should be taken into account on site.

## 5 Installation

### **Caution:**

*The working position of the Weather Station is vertical (plug connection at bottom).*

*During installation, dismantling, transport or servicing of the Weather Station, it must be ensured that no water gets into the base of the device or plug connector.*

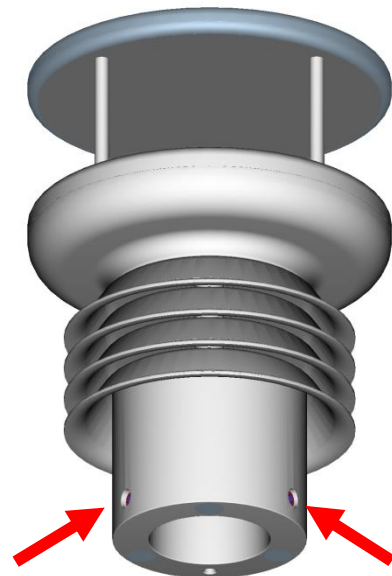
*The instrument must be mounted and wired only by qualified personnel, who knows and observes the generalities of techniques, and applicable regulations and norms.*

### 5.1 Mechanical Mounting

Proper installation of the Weather Station is carried out using a tube socket  $\text{Ø } 48 - 49\text{mm}$  and at least 30mm in length. The inside diameter of the tube socket must be at least 30mm as the electrical connection of the Weather Station is carried out at the bottom of the device. After connection the Weather Station is then mounted on the tube or mast socket. The marking for north on the device must be aligned to north (see section 4.2.1). The device is fixed to the shaft with the two Allen screws (AF 4mm).

### **Caution:**

*The allen screws must be tightened to 2Nm*



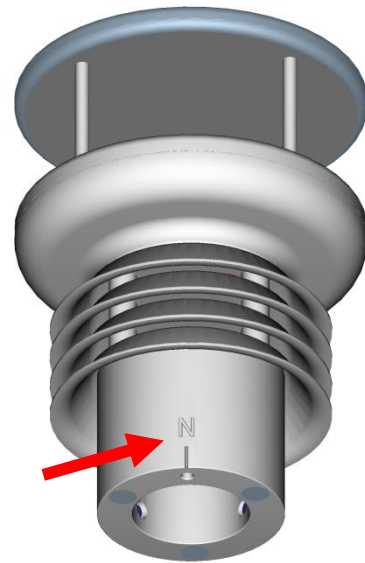
## 5.2 Electrical Mounting

For exact determination of the wind and Brightness direction the Weather Station must be installed aligned to **north** (true north).

When aligning the device, the **marking for north (N)** must point to **north** (true north). To do so, select a conspicuous feature of the landscape to the north or south with a compass and turn the mast or sensor until the marking for north points to true north.

When aligning the device to north using a compass, bear in mind the magnetic variation (= deviation in the direction of the compass needle from true north) and possible interference from magnetic fields (e.g. iron parts, electric cables).

The lower edge of the sensor base is equipped with a **bore for north** aligned to the marking for north. This bore allows a mast adapter with a pin for north to be used here. The mast adapter is not included in the scope of supply.



## 5.3 Electrical Installation

The Weather Station is equipped with a 19-pin plug for electrical connection. A socket outlet (mating connector) is included in the scope of supply. If we supplied with a prepared connecting cable, the socket outlet (mating connector) is not included in the scope of delivery.

### 5.3.1 Cable, Cable preparation, Connector installation

The connecting cable should have the following properties depending on the model of the device:

16 cores, core cross-section for supply and data communications 0,25mm<sup>2</sup>, cable diameter max. 8.0mm, resistant to ultraviolet rays, overall shielding.

#### **Note:**

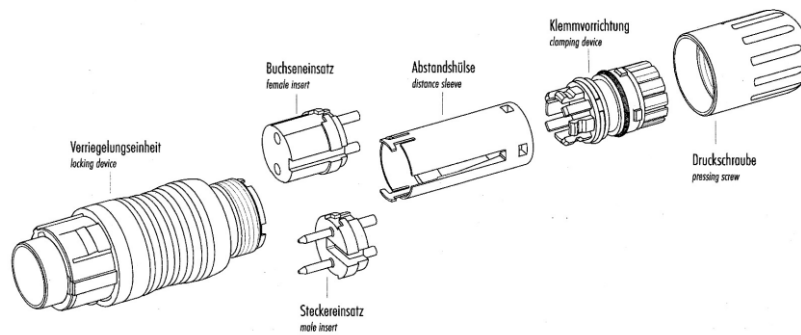
*A prepared connecting cable is available for the Weather Station as an optional accessory (see accessories).*

#### **Attention:**

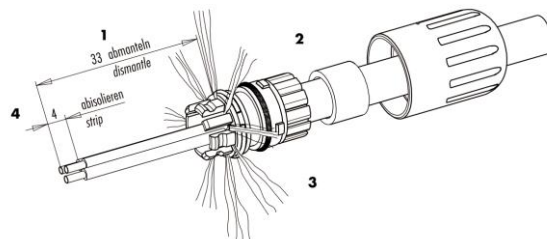
***A short-circuit at the analogue output may lead to malfunction of the serial communication, falsification of measuring values, and in the long term, may damage the instrument!***

***Outputs which are not used, should be applied to unused terminals, in order to avoid a short-circuit among each other, with the housing/analogue ground, or with other lines.***

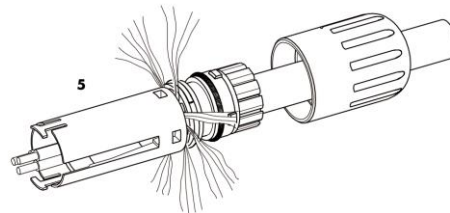
Socket outlet 212812, 19-pin, (Binder, Series 440), EMC



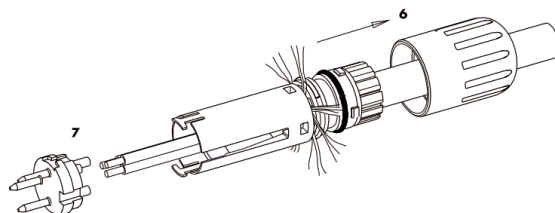
1. Strip over L = 33mm.  
Do not remove sheath.
2. Slip on pressing screw and clamping device. Remove sheath.
3. Strip wire strands and tin-coat.
4. Fan / comb out shielding. Thread shield wires into crown all round.



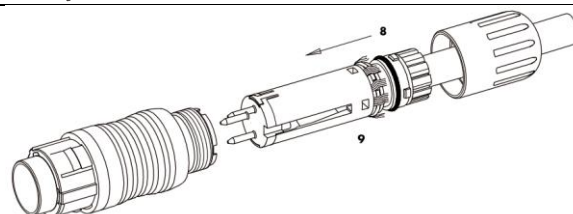
5. Engage distance sleeve and clamping device.



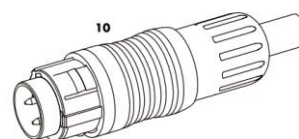
6. Slide assembled unit backwards over cable (approx. 10mm).
7. Solder inserts in place.



8. Slide assembled unit forwards until it engages in the contact insert.
9. Draw shield wires towards shielding ring and shorten.  
Too long: wires on packing ring – no seal.  
Too short: no contact with shaft ring.



10. Insert assembled unit in carrier sleeve.



### 5.3.2 Connection Diagram for 16-core Cable (function example)

**Note:**

- See the supplementary sheet "Werkseinstellung" with the factory settings for precise function assignment.
- The pins A,B,C,H,I,K,L,M,N,O,P,R,S,T,U are electrically isolated from the supply voltage.

Electrical connection				View of solder terminal of socket outlet
PIN	Colour coding**	Assignment	Function	
T	PINK	Analogue 0..10V	Wind speed (m/s).	
S	VIOLET	Analogue 0..10V	Wind direction (°).	
O	RED-BLUE	Analogue 0..10V	Air temperature (°C).	
N	GREY-PINK	Analogue 0..10V	Relative humidity (%).	
C	BROWN-GREEN	Analogue 0..10V	Air pressure (hPA).	
B	WHITE-YELLOW	Analogue 0..10V	Brightness (lux).	
A	WHITE-GREEN	Analogue 0..10V	Brightness direction (°).	
P	YELLOW-BROWN	Analogue 0..10V	Precipitation intensity.	
H	BLUE	GND isolated	Analogue earth.	
I	GREY	GND isolated	Analogue earth.	
L	YELLOW	TXD+, RXD+ (HD)	Serial interface (RS485).	
K	GREEN	TXD-, RXD- (HD)	Serial interface (RS485).	
U	BROWN	RXD+ (full duplex)	Serial interface (RS485).	
M	WHITE	RXD- (full duplex)	Serial interface (RS485).	
R	not assigned	(-)24V feedback	(-) Power supply*.	
E	RED	(+)24V AC/DC nom.	(+) Power supply*.	
F	not assigned	(+)24V AC/DC nom.	(+) Power supply*.	
D	BLACK	(-)24V AC/DC nom.	(-) Power supply*.	
G	not assigned	(-)24V AC/DC nom.	(-) Power supply*.	
SH	GREEN/YELLOW	CABLE SHIELD	Shielding from electric fields.	

\* Reverse voltage protection.

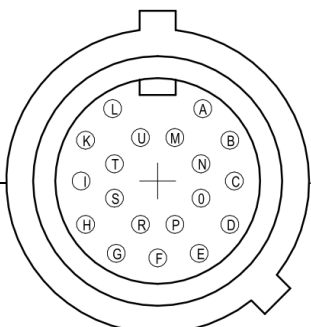
\*\* The above colour coding scheme only applies to cables of the type SABIX D315 FRNC 16 x 0.25.



### 5.3.3 Connection with optional 16-core Cable ZM/O-90

The optional ZM/O-90 cable is a ready prepared 16-core cable, which has a plug connector on the transmitter side, and open, colour-coded wire ends on the user side. See section 5.3.2 for cable assignment.

### 5.3.4 Connection Diagram for 8-core Cable (function example)

Electrical connection				View of solder terminal of socket outlet
PIN	Colour coding	Assignment	Function	
T	-	-	-	
S	-	-	-	
O	-	-	-	
N	-	-	-	
C	-	-	-	
B	-	-	-	
A	-	-	-	
P	-	-	-	
H	-	-	-	
I	GREY	GND isolated	Interface GND.	
L	YELLOW	TXD+, RXD+ (HD)	Serial interface (RS485).	
K	GREEN	TXD-, RXD- (HD)	Serial interface (RS485).	
U	BROWN	RXD+ (full duplex)	Serial interface (RS485).	
M	WHITE	RXD- (full duplex)	Serial interface (RS485).	
R	-	-	-	
E	RED	(+)24V AC/DC nom.	(+) Power supply*.	
F	-	-	-	
D	BLUE	(-)24V AC/DC nom.	(-) Power supply*.	
G	-	-	-	
SCH	GREEN/YELLOW	CABLE SHIELD	Shielding from electric fields.	

\* Reverse voltage protection.

### 5.3.5 Connection with optional 8-core Cable ZM/O-90/10-8

The optional ZM/O-90/10-8 cable is a ready prepared 8-core cable, which has a plug connector on the transmitter side, and open, colour-coded wire ends on the user side. See section 5.3.4 for cable assignment.

## 6 Maintenance

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As the device does not have moving parts, i.e. is not subjected to wear during operation, only minimal servicing is required.

The device may become soiled depending on its installation site. Cleaning should be carried out using water, non-aggressive cleaning agents and a soft cloth.

The surface of the instrument cover is roughened for measurement technique reasons, and must not be polished, by no means. The cover is to be cleaned with soft cloth and brushes only, without polishing effect, and by a fat-dissolving cleaning agent (dish liquid, no aggressive solvents such as Acetone).

### **Caution:**

***During storage, installation, dismantling, transport or servicing of the Weather Station, it must be ensured that no water gets into the device or plug connector.***

***The cover surface should not be touched with palms or fingers, in order to avoid a contamination through skin-fat***

### 6.1 Calibration

The Weather Station does not contain any adjustable components such as mechanical or electrical trimming elements. All components and materials are invariant over time. There is thus no need for regular calibration due to ageing. Only major mechanical deformation of the device and a resulting change in the measurement path length of the ultrasonic converters can cause errors in measured values.

The acoustic virtual temperature can be used to check the effective length of the acoustic measurement path. A change of approx. 1% in the measurement path length and thus a measuring error of approx. 1% of the wind speed corresponds to a deviation of the acoustic temperature of approx. 6K at 20°C. A deviation in the acoustic temperature of 2 Kelvin from the real acoustic air temperature could lead to a measuring error of the wind speed of approx. 0,34%.

Due to the construction of the instrument a significant change in the measurement path length without mechanical damage of the housing can be excluded.

The calibration of humidity and air temperature corresponds to the calibration of conventional sensors.

We recommend the following procedure for humidity calibration:

1. Storage of the device for several hours at rather low humidity levels
2. Carrying out the calibration in accordance with DKD guideline 5-8 "Calibration of hygrometers for direct measurement of relative humidity"; Procedure A1, A2, B1 or B2
3. Consideration of the adjustment time also according to the DKD guideline 5-8 "Calibration of hygrometers for the direct recording of the relative humidity"

**Important:**

*Mechanical damage involving deformation of the device may lead to errors in measured values.*

## 6.2 Warranty

Damage caused by improper handling or external influences, e.g. strike by lightning, are not covered by the warranty provisions. The warranty is void if the device is opened.

## 7 Storage and Handling

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Recommendation:

The Weather Station should be stored in the original packing dry (relative humidity <60%), and at moderate temperatures (5°C...25°C).

Remark: The storing temperature must not fall below or exceed the range of -55°C...80°C.

**Important:**

*The Weather Station must be returned in the original packaging.*

### **Special requirements by the electronic magnetic field compass:**

Please take care that the instrument is not exposed to **strong static magnetic fields > 1m Tesla** with storing, handling, and of course also in operation, as else the calibration of the magnetic compass might be changed permanently.

Otherwise, a demagnetization with subsequent re-calibration might be necessary.

## 8 Functional Description

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The functions of the Weather Station are described below.

### 8.1 Command Interpreter MODBUS RTU

If the command interpreter MODBUS RTU has been selected, the transmitted bytes will be interpreted according to the MODBUS specification (<http://www.modbus.org/>). The Weather Station acts as a MODBUS slave here.

Data is transmitted in packets, so-called frames, max. 256 bytes in length. Every packet includes a 16-bit CRC check sum (initial value: 0xffff).

Slave address	Function code	Data	CRC	
1 byte	1 byte	0...252 byte(s)	2 bytes	
			CRC low-byte	CRC high-byte

Table 2: MODBUS frame

The following MODBUS functions are supported:

- 0x04 (read input register).
- 0x03 (read holding registers).
- 0x06 (write single register).
- 0x10 (write multiple registers).

The sensor supports write access for the slave address 0 ("Broadcast").

All MODBUS requests received are checked for validity before execution. With any error the weather station responds with one of the following exceptions (→MODBUS Exception Responses).

Code	Name	Meaning
0x01	ILLEGAL FUNCTION	The function code in the request is not permissible for the register address.
0x02	ILLEGAL DATA ADDRESS	The register address in the request is invalid.
0x03	ILLEGAL DATA VALUE	The data given in the request are not allowed, or the parameter is write-protected.

Table 3: MODBUS exceptions

### 8.1.1 Measured Values (input register)

All measured values of the Weather Station occupy 32 bits, i.e. 2 MODBUS register addresses. The following table shows the assignment of measured values to the register address, with the measured values being sorted as follows:

- By type of measured value (30003 to 34999).
- In an unbroken sequence (35001 to 39999).

The measuring values are available also under protocol addresses 2 to 4998 resp. 5000 to 9998.

The protocol addresses arise from the register address less an offset of 30001.

#### **Remark:**

**Please note the following with the further processing of the measuring values: In the data output the following types of erroneous measuring values are reported: type S32 (signed integer 32Bit) by „0x7FFFFFFF“, type U32 (unsigned integer 32Bit) by „0xFFFFFFFF“. These outputs must be identified, and be discarded!**

Register-address	Parameter name	Unit	Multiplier	Explanation	Data type
30003 0x7533	Average wind speed	m/s	10	Value / 10 (to 1 decimal place, e.g. 101=10.1m/s)	U32
30011 0x753B	Maximum value Wind velocity (gust)	m/s	10	Value / 10 (1 decimal place, e.g. 101=10.1m/s)	U32
30019 0x7543	Average wind speed	m/s	100	Value / 100 (2 decimal place, e.g. 1012=10.12m/s)	U32
30021 0x7545	True wind	m/s <sup>1</sup>	100	Value / 100 (2 decimal place, e.g. 1012=10.12m/s)	U32
30203 0x75FB	Mean wind direction	°	10	Value / 10 (to 1 decimal place, e.g. 1010=101.0°)	U32
30211 0x7603	Wind direction of the gust	°	10	Value / 10 (1 decimal place, e.g. 1010=101.0°)	U32
30213 0x7605	True wind direction	m/s <sup>1</sup>	10	Value / 10 (1 decimal place, e.g. 1010=101.0°)	U32

Register-address	Parameter name	Unit	Multiplier	Explanation	Data type
30401 0x76C1	Air temperature	°C	10	Value / 10 (to 1 decimal place, e.g. 255=25.5°C)	S32
30403 0x76C3	Internal temperature of housing	°C	10	Value / 10 (to 1 decimal place, e.g. 355=35.5°C)	S32
30405 0x76C5	Acoustic temperature	°C	10	Value / 10 (to 1 decimal place, e.g. 255=25.5°C)	S32
30407 0x76C7	Air temperature uncorrected	°C	10	Value / 10 (to 1 decimal place, e.g. 255=25.5°C)	S32
30409 0x76C9	Wind Chill Temperature Valid if the air temperature <10°C.	°C	10	Value / 10 (1 decimal place, e.g. 255=25.5°C)	S32
30411 0x76CB	Heat Index Temperature Just valid if the air temperature >26°C and rel. humidity >40%	°C	10	Value / 10 (1 decimal place, e.g. 255=25.5°C)	S32
30413 0x76CD	Rain temperature Valid if air temperature >5°C and precipitation	°C	10	Value / 10 (1 decimal place, e.g. 255=25.5°C)	S32
30601 0x7789	Relative humidity	%rh	10	Value / 10 (to 1 decimal place, e.g. 355=35.5%rh)	U32
30603 0x778B	Absolute humidity	g/m <sup>3</sup>	100	Value/ 100 (2 decimal places, e.g. 923=9.23g/m <sup>3</sup> )	U32
30605 0x778D	Dew-point temperature	°C	10	Value / 10 (to 1 decimal place, e.g. 115=11.5°C)	S32
30607 0x778F	Rel. humidity uncorrected	%r.h.	10	Value/ 10 (1 decimal place, e.g. 355=35.5%r.F.)	U32
30801 0x7851	Absolute air pressure	hPa	100	Value / 100 (to 2 decimal places, e.g. 105000=1050.00hPa)	U32
30803 0x7853	Relative air pressure referred to standard elevation zero (NHN)	hPa	100	Value / 100 (to 2 decimal places, e.g. 105000=1050.00hPa)	U32
31001 0x7919	Global radiation <sup>2</sup>	W/m <sup>2</sup>	10	Value / 10 (1 decimal places, e.g. 10000=1000.0W/m <sup>2</sup> )	S32
31201 0x79E1	Brightness north (fixed device assignment)	klux	10	Value / 10 (to 1 decimal place, e.g. 1200=120.0klux)	U32
31203 0x79E3	Brightness east (fixed device assignment)	klux	10	Value / 10	U32

Register-address	Parameter name	Unit	Multiplier	Explanation	Data type
				(to 1 decimal place, e.g. 1200=120.0klux)	
31205 0x79E5	Brightness south (fixed device assignment)	klux	10	Value / 10 (to 1 decimal place, e.g. 1200=120.0klux)	U32
31207 0x79E7	Brightness west (fixed device assignment)	klux	10	Value / 10 (to 1 decimal place, e.g. 1200=120.0klux)	U32
31211 0x79EB	Direction of brightness Attention: under diffuse radiation conditions please use the parameters of the sun azimuth, address 34807	°	1	Value (no decimal place, e.g. 120=120°)	U32
31213 0x79ED	Brightness, maximum value of 4 single sensors	kLux	10	Value / 10 (to 1 decimal place, e.g. 1200=120.0klux)	U32
31215 0x79EF	Brightness North (fixed device assignment)	Lux	1	Value (no decimal place, e.g. 12000=12000Lux)	U32
31217 0x79F1	Brightness East (fixed device assignment)	Lux	1	Value (no decimal place, e.g. 12000=12000Lux)	U32
31219 0x79F3	Brightness South (fixed device assignment)	Lux	1	Value (no decimal place, e.g. 12000=12000Lux)	U32
31221 0x79F5	Brightness West (fixed device assignment)	Lux	1	Value (no decimal place, e.g. 12000=12000Lux)	U32
31223 0x79F7	Brightness, maximum value of 4 single sensors	Lux	1	Value (no decimal place, e.g. 12000=12000Lux)	U32
31225 0x79F9	Brightness, vector sum	Lux	1	Value (no decimal place, e.g. 12000=12000Lux)	U32
31401 0x7AA9	Precipitation status		1	Value (no decimal place, (0=no precipitation, 1=precipitation))	U32
31403 0x7AAB	Precipitation intensity (for last minute extrapolated to an hour)	mm/h	1000	Value (3 decimal places, e.g. 12345=12.345mm/h)	U32
31405 0x7AAD	Amount of precipitation (is reset at 24:00 h)	mm/d	1000	Value (3 decimal places, e.g. 12345=12.345mm/d)	U32
31407 0x7AAF	Type of precipitation	Synop Code	1	Value (no decimal place, e.g. 61=Light rain, see table 1, section 3.5.2)	U32
34601 0x8729	Date		1	Value	U32

Register-address	Parameter name	Unit	Multiplier	Explanation	Data type
				(no decimal place, YYYYMMDD, e.g. 20121210=10.12.2012)	
34603 0x872B	Time of day		1	Value (no decimal place, HHMMSS, e.g. 121035=12:10:35)	U32
34801 0x87F1	Degree of longitude	°	1000000	Value / 1000000 (6 decimal places, e.g. 9876543 = ±009.876543 Decimal degree)	S32
34803 0x87F3	Degree of latitude	°	1000000	Value / 1000000 (6 decimal places, e.g. 51509153 = ±51.509153 Decimal degree).	S32
34805 0x87F5	Position of the sun elevation	°	10	Value / 10 (to 1 decimal place, e.g. 900=90.0°, from 0 .. 90° and 0 .. - 90°)	S32
34807 0x87F7	Position of the sun azimuth	°	10	Value / 10 (to 1 decimal place, e.g. 1800=180.0°/ 0°=north, 180°=south, clockwise 0...360°)	S32
34809 0x87F9	Height above mean sea level	m	1	Value (no decimal place, e.g. 240=240m amsl)	S32
34811 0x87FB	Sensor status wind measurement		1	See sensor status chap. 8.2.4	U32
34837 0x8815	Magnetic compass Aspecular angle Instrument north marking to magnetic North Pole	°	10	Value (1 decimal place, e.g. 1234=123.4°)	U32
34839 0x8817	Pitch from magnetic compass angle between north-south to horizontal	°	10	Value (1 decimal place, e.g. 1234=123.4°)	S32
34841 0x8819	Roll from the magnetic compass angle between west-east to horizontal	°	10	Value (1 decimal place, e.g. 1234=123.4°)	S32
34847 0x8925	Speed Over Ground vom GPS <sup>2</sup>	m/s	100	Value / 100 (2 decimal place, e.g. e.g 1012=10.12m/s)	U32
34849 0x8927	Track Angle vom GPS <sup>2</sup>	°	10	Value / 10 (1 decimal place, e.g. e.g 2700=270.0°)	U32
34995 0x88B3	Sensor power supply	V	10	Value /10 (to 1 decimal place, e.g. 241=24.1V)	U32
34997 0x88B5	Live Counter	ms	1	Value.	U32



Register-address	Parameter name	Unit	Multiplier	Explanation	Data type
				(no decimal place, internal ms counter)	
34999 0x88B7	Error status of last measured value		1	Value (no decimal place, 0=no error, 1= measured value was incorrect)	U32
	Complete sequence of measuring values from 35001				
35001 0x88B9	Mean wind speed (30003) <sup>2</sup>	m/s <sup>1</sup>	10	Value / 10 (to 1 decimal place, e.g. 101=10.1m/s)	U32
35003 0x88BB	Mean wind direction (30203) <sup>2</sup>	°	10	Value / 10 (to 1 decimal place, e.g. 1010=101.0°)	U32
35005 0x88BD	Air temperature (30401) <sup>2</sup>	°C	10	Value / 10 (to 1 decimal place, e.g. 255=25.5°C)	S32
35007 0x88BF	Internal temperature of housing (30403) <sup>2</sup>	°C	10	Value / 10 (to 1 decimal place, e.g. 355=35.5°C)	S32
35009 0x88C1	Acoustic temperature (30405) <sup>2</sup>	°C	10	Value / 10 (to 1 decimal place, e.g. 255=25.5°C)	S32
35011 0x88C3	Air temperature uncorrected (30407) <sup>2</sup>	°C	10	Value / 10 (to 1 decimal place, e.g. 255=25.5°C)	S32
35013 0x88C5	Relative humidity (30601) <sup>2</sup>	%rh	10	Value / 10 (to 1 decimal place, e.g. 355=35.5%rh)	U32
35015 0x88C7	Dew-point temperature (30605) <sup>2</sup>	°C	10	Value / 10 (to 1 decimal place, e.g. 115=11.5°C)	S32
35017 0x88C9	Absolute air pressure (30801) <sup>2</sup>	hPa	100	Value / 100 (to 2 decimal places, e.g. 105000=1050.00hPa)	U32
35019 0x88CB	Relative air pressure referred to sea level (30803) <sup>2</sup>	hPa	100	Value / 100 (to 2 decimal places, e.g. 105000=1050.00hPa)	U32
35021 0x88CD	Brightness north (fixed device assignment) (31201) <sup>2</sup>	klux	10	Value / 10 (to 1 decimal place, e.g. 1200=120.0klux)	U32
35023 0x88CF	Brightness east (fixed device assignment) (31203) <sup>2</sup>	klux	10	Value / 10 (to 1 decimal place, e.g. 1200=120.0klux)	U32
35025 0x88D1	Brightness south (fixed device assignment) (31205) <sup>2</sup>	klux	10	Value / 10 (to 1 decimal place, e.g. 1200=120.0klux)	U32
35027 0x88D3	Brightness west (fixed device assignment)	klux	10	Value / 10	U32

Register-address	Parameter name	Unit	Multiplier	Explanation	Data type
	(31207) <sup>2</sup>			(to 1 decimal place, e.g. 1200=120.0klux)	
35029 0x88D5	Brightness direction (31211) <sup>2</sup> Attention: under diffuse radiation conditions please use the parameters of the sun azimuth, address 35051	°	1	value (no decimal place, e.g. 120=120°)	U32
35031 0x88D7	Brightness, maximum value of 4 single sensors (31213) <sup>2</sup>	klux	10	Value / 10 (to 1 decimal place, e.g. 1200=120.0klux)	U32
35033 0x88D9	Precipitation status (31401) <sup>2</sup>		1	Value (no decimal place, (0=no precipitation, 1=precipitation))	U32
35035 0x88DB	Precipitation intensity (31403) <sup>2</sup> (for last minute extrapolated to an hour)	mm/h	1000	Value (3 decimal places, e.g.. 12345=12.345mm/h)	U32
35037 0x88DD	Amount of precipitation (is reset at 24:00 h) (31405) <sup>2</sup>	mm/d	1000	Value (3 decimal places, e.g. 12345=12.345mm/d)	U32
35039 0x88DF	Type of precipitation (31407) <sup>2</sup>	Synop Code	1	Value (no decimal place, e.g. 61=Light rain, see table 1, section 3.5.2)	U32
35041 0x88E1	Date (34601) <sup>2</sup>		1	Value (no decimal place, YYYYMMDD, e.g. 20121210=10.12.2012)	U32
35043 0x88E3	Time of day (34603) <sup>2</sup>		1	Value (no decimal place, HHMMSS, e.g. 121035=12:10:35)	U32
35045 0x88E5	Degree of longitude (34801) <sup>2</sup>	°	1000000	Value / 1000000 (6 decimal places, e.g. 9876543 = ±009.876543 Decimal degree)	S32
35047 0x88E7	Degree of latitude (34803) <sup>2</sup>	°	1000000	Value / 1000000 (6 decimal places, e.g. 51509153 = ±51.509153 Decimal degree)	S32
35049 0x88E9	Position of the sun elevation (34805) <sup>2</sup>	°	10	Value / 10 (to 1 decimal place, e.g. 900=90.0°, from 0 .. 90° and 0 .. - 90°)	S32
35051 0x88EB	Position of the sun azimuth (34807) <sup>2</sup>	°	10	Value / 10 (to 1 decimal place, e.g. 1800=180.0°/	S32

Register-address	Parameter name	Unit	Multiplier	Explanation	Data type
				0°=north,180°=south, clockwise 0...360°)	
35053 0x88ED	Height above mean sea level (34809) <sup>2</sup>	m	1	Value (no decimal place, e.g. 240=240m amsl)	S32
35055 0x88EF	Sensor status wind measurement (34811) <sup>2</sup>		1	see sensor status chapter 8.2.4	U32
35057 0x88F1	Sensor power supply (34995) <sup>1</sup>	V	10	Value /10 (to 1 decimal place, e.g. 241=24.1V)	U32
35059 0x88F3	Live counter (34997)	ms	1	Value (no decimal place, internal ms counter)	U32
35061 0x88F5	Error status of last measured value (34999) <sup>2</sup>		1	Value (no decimal place, 0=no error, 1= measured value was incorrect)	U32
35063 0x88F7	Brightness North (fixed device assignment)	Lux	1	Value (no decimal place, e.g. 12000=12000Lux)	U32
35065 0x88F9	Brightness East (fixed device assignment)	Lux	1	Value (no decimal place, e.g. 12000=12000Lux)	U32
35067 0x88FB	Brightness South (fixed device assignment)	Lux	1	Value (no decimal place, e.g. 12000=12000Lux)	U32
35069 0x88FD	Brightness West (fixed device assignment)	Lux	1	Value (no decimal place, e.g. 12000=12000Lux)	U32
35071 0x88FF	Brightness, maximum value of 4 single sensors (31223) <sup>2</sup>	Lux	1	Value (no decimal place, e.g. 12000=12000Lux)	U32
35073 0x8901	Maximum value of the wind velocity (gust) (30011) <sup>2</sup>	m/s	10	Value / 10 (1 decimal place, e.g. 101=10.1m/s)	U32
35075 0x8903	Wind direction of the gust (30211) <sup>2</sup>	°	10	Value / 10 (1 decimal place, e.g. 1203=120.3°)	U32
35077 0x8905	Absolute humidity (30603) <sup>2</sup>	g/m <sup>3</sup>	100	Value / 100 (2 decimal places , e.g. 923=9.23g/m <sup>3</sup> )	U32
35079 0x8907	Rel. humidity, uncorrected (30607) <sup>2</sup>	%r.h.	10	Value / 10 (1 decimal place, e.g. 234=23.4%rh)	U32
35081 0x8909	Magnetic compass Aspecular angle Instrument north marking to magnetic North Pole (34837) <sup>2</sup>	°	10	Value (1 decimal place, e.g. 1234=123.4°)	U32
35083 0x890B	Brightness, vector sum (31225) <sup>2</sup>	Lux	1	Value	U32

Register-address	Parameter name	Unit	Multiplier	Explanation	Data type
				(no decimal place, e.g. 12000=12000Lux)	
35085 0x890D	Wind chill temperature Valid if the air temperature <10°C (30409) <sup>2</sup>	°C	10	Value / 10 (1 decimal place, e.g. 255=25.5°C)	S32
35087 0x890F	Heat index temperature Valid if the air temperature >26°C and rel. humidity >40% (30411) <sup>2</sup>	°C	10	Value / 10 (1 decimal place, e.g. 255=25.5°C)	S32
35089 0x8911	Absolut precipitation (Overflow at 1000.000) (31409) <sup>2</sup>	mm	1000	Value (3 decimal place, e.g. 12345=12.345mm/d)	U32
35091 0x8913	Global radiation <sup>3</sup> (31001) <sup>2</sup>	W/m <sup>2</sup>	10	Value / 10 (1 decimal place, e.g. 10000=1000.0W/m <sup>2</sup> )	S32
35093 0x8915	Pitch from magnetic compass angle between north-south to horizontal (34839) <sup>2</sup>	°	10	Value (1 decimal place e.g. 1234=123.4°)	S32
35095 0x8917	Roll from magnetic compass angle between west-east to horizontal (34841) <sup>2</sup>	°	10	Value (1 decimal place e.g. 1234=123.4°)	S32
35097 0x8919	Rain temperature Valid if air temperature >5°C and precipitation (30413) <sup>2</sup>	°C	10	Value / 10 (1 decimal place, e.g. 255=25.5°C)	S32
35101 0x891D	Average wind speed (30019) <sup>2</sup>	m/s	100	Value / 100 (2 decimal place, e.g. 1012=10.12m/s)	U32
35105 0x8921	True wind (30021) <sup>2</sup>	m/s <sup>1</sup>	100	Value / 100 (2 decimal place , e.g. 1012=10.12m/s)	U32
35107 0x8923	True wind direction (30213) <sup>2</sup>	°	10	Value / 10 (1 decimal place , e.g. 2700=270.0°)	U32
35109 0x8925	Speed Over Ground from GPS (34847) <sup>2</sup>	m/s <sup>1</sup>	100	Value / 100 (2 decimal place , e.g. 1012=10.12m/s)	U32
35111 0x8927	Track Angle from GPS (34849) <sup>2</sup>	°	10	Value / 10 (1 decimal place , e.g. 2700=270.0°)	U32

**Table 4: MODBUS input register**

<sup>1)</sup> The unit can be changed with the command OS (Output Scale), see command "OS".

<sup>2)</sup> The figures in brackets specify register addresses representing the same measured values. The mean value for wind speed can for example be found at address 30003 and 35001.

<sup>3)</sup> The global radiation is calculated from the measured values of the brightness and the elevation angle of the position of the sun.

An incorrect measured value of the type S32 (signed integer 32-bit) is reported with "0x7FFFFFFF". An incorrect measured value of the type U32 (unsigned integer 32-bit)

is reported accordingly with "0xFFFFFFFF ". Alternatively, the error status can be queried via the register address 34999 or 35061 following a request for an individual measured value.

**Note:**

***Due to uninterrupted listing of the measured values from address 35001 the MODBUS Master can read out several measured values with one request!***

### 8.1.2 Commands (holding register)

All commands of the Weather Station occupy 32bits, i.e. 2 MODBUS register addresses and represent whole numbers with no leading sign except the TA command (64bit). The following example illustrates changing the baud rate to 19200 baud, with permanent storing of parameter, afterwards.

1. Set password for user level "ADMIN" (KY=4711)

Slave-address	Function code	Start address		No. of registers		No. of byte(s)	Data		CRC	
0x01	0x10	0x9C 49		0x00 02		0x04	0x00 00 12 67		0x83 B9	
		high-Byte	low-Byte	high-Byte	low-Byte		high-Byte	low-Byte	low-byte	high-byte

2. Command to set baud rate to 19200 baud (BR=192)

Slave-address	Function code	Start address		No. of registers		No. of byte(s)	Data		CRC	
0x01	0x10	0x9C 45		0x00 02		0x04	0x00 00 00 C0		0xCE F6	
		high-Byte	low-Byte	high-Byte	low-Byte		high-Byte	low-Byte	low-byte	high-byte

3. Storing of Parameter with Change-over to user-level „READ ONLY“ (KY=0)

Slave-address	Function code	Start address		No. of registers		No. of byte(s)	Data		CRC	
0x01	0x10	0x9C 49		0x00 02		0x04	0x00 00 00 C0		0xCE F3	
		high-Byte	low-Byte	high-Byte	low-Byte		high-Byte	low-Byte	low-Byte	high-Byte

### 8.1.3 Commands and Descriptions

The following table shows the available commands and associated passwords for read and write:

Command	MODBUS register address Protocol address	Description	Password	
			Read <sup>1</sup>	Write <sup>2</sup>
Command AV	40015 / 14	Averaging interval for wind speed and wind direction. 0..6000 (x100ms).	Without	Admin
Command BP	40031 / 30	Parität, s. Command „BP“	Without	Admin
Command BR	40005 / 4	Baud rate (see Command "BR").	Without	Admin
Command CI	40013 / 12	Command interpreter (see Command "CI").	Without	Admin
Command DM	40011 / 10	Duplex mode (see Command "DM").	Without	Admin
Command HC	40023 / 22	Heating conditions.	Without	Admin
Command HS	40025 / 24	Height setting.	Without	Admin
Command HT	40027 / 26	Heating control.	Without	Admin
Command ID	40003 / 2	Identification number / slave address.	Without	Admin
Command KY	40009 / 8	Set key / password (admin = 4711).	Without	Without
Command MC	40029 / 28	Magnetic Compass correction, housing for sensor(0..359°).	Without	Admin
Command NC	40017 / 16	North correction of the wind direction (0..359°) / 1000 = automatic direction correction acc. to magnetic compass.	Without	Admin
Command OS	40033 / 32	Unit of wind speed (Output Scale), see command "OS"	Without	Admin
Command RT	40035 / 34	Automatic synchronization with GPS See command "RT". Valid values: 0..3 (RT), 1hhmmss (RTT), 2ddmmyy (RTD)	Without	Admin
Command RS	40253 / 252	Reset: 1 -> Warm start. 2 -> Daily total precipitation = 0.	Without	Admin
Command SH	40019 / 18	0...9000: Station height in m above sea level 10001.10500: Station altitude 1...500 m below sea level	Without	Admin
Command SN	40007 / 6	Serial number.	Without	Not permitted
Command SV	45005 / 5004	Software Version e.g.: 160 = V1.60.	Without	Not permitted
Command TZ	40021 / 20	Time zone (see Command "TZ").	Without	Admin

**Table 5: List of commands**

<sup>1</sup>: Command without parameter (used to read the selected parameter).

<sup>2</sup>: Command with parameter used to write a new parameter).

### 8.1.4 Sensor Status

Explanation:

Bit-Number	Function	Description
Bit 0	General error	Averaging time < 30sec (s. command ET) An error is outputted in case that for a time period of 30sec (s. command ET) no new measuring value can be detected.
		Averaging time >= 30sec (s. command ET) An error is outputted in case that the averaging buffer includes no new values. Example: at an averaging time of 60 seconds, an error is messaged after 60 seconds.
Bit 1	User Averaging memory	Indicates the used averaging memory. Bit1 to bit3 indicates the space usage of the averaging buffer in binary format.  0: Buffer $0 < x \leq 1/8$ . 1: Buffer $1/8 < x \leq 1/4$ gefüllt. 2: Buffer $1/4 < x \leq 3/8$ gefüllt. 3: Buffer $3/8 < x \leq 1/2$ gefüllt. 4: Buffer $1/2 < x \leq 5/8$ gefüllt. 5: Buffer $5/8 < x \leq 3/4$ gefüllt. 6: Buffer $3/4 < x \leq 7/8$ gefüllt. 7: Buffer $7/8 < x \leq 1$ gefüllt.
Bit 2		
Bit 3		
Bit 4	Plausibility on	Is set when plausibility is activated.
Bit 5	Static error	Is set when a static error occurred. for ex. the general error lasts more than 60 seconds.
Bit 6	Heating release	Is on, when the heating control is activated.
Bit 7	Heating status	Is on, when the heating is activated.

**Table 6: Sensor Status**

## 8.2 Analogue Outputs

Eight connections provide the output of analog voltage values:

1. Windvelocity,
2. Wind Direktion,
3. Air Temperature,
4. Rel. humidity,
5. Air Pressure,
6. Brightness,
7. Direction of brightness (or 4 individual direction values for brightness)
8. Precipitation intensity (or precipitation status)

The measured values

1. Wind speed, 2. Wind direction and 3. Air temperature are permanently assigned to the analogue outputs T, S and O (T,S,O = PIN designation of plug connector); see **section 5.3.2**.

Command "OL" can be used to switch the optional measured values to any of the remaining 5 analogue outputs; see Command "OL".

Scaling of certain measured values to the voltage output is also possible. Wind direction, direction of brightness and precipitation status are fixed values, which are not scalable. By default, the analog channels are linked always in the same way. Measuring values, missing by partial configuration level, and erroneous measuring values are treated acc. to the command "EI" (Error Inversion).

The following table lists the selectable parameters and factory-set scaling:

Parameter	Measured value	Scaling	Analogue output
AB80106	Air pressure	800...1060hPa	0...10V
AH00100	Relative humidity	0...100%	0...10V
AL00120	Brightness	0...120klux	0...10V
AP00100	Precipitation intensity	0...100mm/h	0...10V
AQ00100	Daily sum of precipitation	0...100mm/d	0...10V
AP00000	Präzipitation Status	0 / 1	0 / 10V
AT14060	Air temperature	-40...+60°C	0...10V
AR00060	Wind speed	0...60m/s	0...10V
Fixed scale	Wind direction	0°...360°	0...10V
Fixed scale	Brightness direction	0°...360°	0...10V

**Table 7: Factory-set Scaling of analogue outputs**

### 8.2.1 North Correction

The command NC can be used to shift the angle measured for wind direction by an angle offset in a positive direction. The device adds the value input to the angle measured for the wind direction. If the resulting value is greater than 360°, 360° is subtracted from the corrected angle value. This setting is used whenever it is not possible to align the Weather Station exactly to north and this angle needs to be electronically corrected afterwards. See also **Command NC**.

If a wind speed < 0.1m/s is calculated, the wind direction is set to zero. The wind direction 0° is reserved for no wind.

In contrast to no wind, the precise wind direction north, i.e. 0°, is output as 360° with wind speeds > 0.1m/s.



## 8.3 Instantaneous Values and Output of Raw Measured Values

The output of instantaneous values is generally a special case. Given the high acquisition speed for the measured values averaging of the data is advisable in most cases. If instantaneous values are to be output, averaging must not be switched on. The parameter AV should be set to '0'; see **Command AV**.

The OR parameter is used to adjust the output rate with autonomous output.

### 8.3.1 Averaging

Given the high data acquisition rate averaging is recommended in most cases. The averaging period is freely selectable from 100ms to 600 seconds. See also **Table 12** under **Command AV**.

Wind velocity and wind direction are averaged according to the recommendations of the WMO and to the FIFO storage method.

The measuring values: air temperature, relative humidity and air pressure are averaged via first-order averaging (a first-order averaging corresponds to the integrating characteristic of natural time constants of most sensors).

The brightness is averaged moving over 4 seconds, independently from the setting of AV always via a first-order averaging.

Independently of command AV, the precipitation intensity is always the moving average of the last minute and is output as an hourly intensity with the unit mm / h.

For detecting the gust and wind direction of the gust the averaging period must be set at least to 3 seconds ( ,AV' >= 30 )

It is a basic principle that only valid values are written to the averaging puffer. The size of the buffer is not determined by the number of data records but by the difference in the time stamp between the first and last data record. As a result any missing measured values do not influence the averaging result.

The Weather Station 2D offers two practical procedures for averaging:

- A **procedure for generating vectorial mean values** from the wind components and
- a **procedure for generating scalar mean values** from the wind components.

These different procedures can each be selected for averaging wind speed as well as wind direction depending on the actual application.

Vectorial averaging takes into account the wind direction for averaging the wind speed, and the wind speed when averaging the wind direction. Both averaged variables, wind speed and wind direction, are thus evaluated together with the other measured variable. This averaging procedure is very suitable e.g. for measuring and analysing the spread of pollutants.

Scalar averaging averages the two variables, wind speed and wind direction, independently of each other. This averaging procedure leads to comparable results with mechanical pickups for wind speed and wind direction. The scalar averaging procedure is suitable e.g.

for analysing sites for wind turbines where only the wind vector variable relevant to energy generation is of interest and not its direction.

The vectorial and scalar averaging procedure for wind velocity and wind direction can be selected via the command **AM** like **Average Method**.

**Command for selecting the averaging procedure:**

- AM00000 vectorial averaging of velocity and direction.
- AM00001 scalar averaging of velocity and direction.

## 8.4 Serial Data Output

Data transmission via the RS485 interface is referred to as serial data output. Two modes are available for transmission of the data:

- Autonomous transmission of data.
- Transmission of data via request telegram.

Autonomous transmission of the data is selected using the command 00TT000XX, with XX standing for the relevant telegram number. In this case the Weather Station transmits its data cyclically at the repeat rate selected with the parameter OR.

### 8.4.1 Data Request

Command TR is used to request data from the Weather Station. This command has no access protection. After processing the command the device sends back a response telegram. The time between the last sign in the request telegram and the first sign in the data telegram is pre-set for the „full-duplex“ operation to at least 5ms, and for the „half-duplex“ operation to at least 20ms, see also command RD.

The telegrams as described under ‚Fixed Telegram Format‘ are available as data telegrams.

### 8.4.2 Autonomous Telegram Output

Autonomous telegram output is selected with the command TT. After a valid telegram type has been input, the Weather Station autonomously transmits the data telegram selected. The transmission interval is set in ms using the command OR. By default, one telegram each second is sent. If the selected baud rate exceeds the output cycle (the time for data transmission is greater than the interval), telegram output may not be possible.

### 8.4.3 Fixed Telegram Formats

A number of predefined telegrams are available for autonomous output (**Command TT**) and data request (**Command TR**). The detailed structure is described in Appendix 1 (Predefined data telegrams). A reference list of telegram formats can be found in **Table 1**.

Telegram name	Telegram number	Telegram structure
VDT	00001	(STX)VVV.V DDD ±TT.T *CC(CR)(ETX)
VDTHP	00002	(STX)VVV.V DDD ±TT.T hhh pppp.p *CC(CR)(ETX)

VDTBDRE	00003	(STX)VVV.V DDD ±TT.T bbbbbb ddd RRR.RRR E *CC(CR)(ETX)
VDTHPBDRE	00004	(STX)VVV.V DDD +TT.T hh pppp bbbbbb ddd RRR.RRR E *CC(CR)(ETX)
NMEA 0183 V 2.0	00005	1-4 NMEA Telegramm: \$WIMWV, \$WIXDR, \$GPRMC and \$HCHDT Please see <b>command NM</b> .
EXTENDED	00006	(STX)VVV.V DDD ±TT.T hhh pppp.p nnnnnn eeeeeee ssssss wwwwww bbbbbb ddd E RRR.RRR SUM.RR SS *CC(CR)(ETX)
EXTENDED WITH GUST	00007	(STX)VVV.V BVV.V DDD BDD ±TT.T hhh pppp.p nnnnnn eeeeeee ssssss wwwwww bbbbbb ddd E RRR.RRR SUM.RR SS *CC(CR)(ETX)
Scientific telegram	00014	See Appendix (section 10)

**Table 1: List of predefined data telegrams**

Key:

- V: Wind speed (see **Command OS**).
- BV: Wind speed of gust.
- D: Wind direction.
- BD: Wind direction of gust.
- T: Temperature.
- h: Relative humidity.
- p: Air pressure.
- b: Brightness (see **Command BO**).
- d: Direction of brightness.
- R: Precipitation intensity.
- E: Precipitation event.
- C: Check sum (EXOR linking).
- X: Identifier for scaling wind speed (K, N, M, S = km/h, knots, m/s, mph).
- n: Brightness north.
- e: Brightness east.
- s: Brightness south.
- w: Brightness west.
- SUM.RR: Total precipitation.
- S: Synop (see table 1, section 3.5.2).

#### 8.4.4 Generation of Check Sum

The check sum is the result of the bitwise EXOR-link of the bytes output in the telegram, between the telegram start sign "STX" or resp. "\$" with the NMEA-telegram, and the byte "\*" as identification for the beginning of the check sum.

The bytes „STX“ or resp. „\$“ and „\*“ are not considered with the check sum calculation!

## 8.5 Device behaviour under extreme Measuring Conditions

It is a basic rule that the measured values output are always valid and can be used by the target system. In case of error, i.e. when individual sensors are unable to supply valid measured values over a certain period of time, the data in the telegram is no longer updated and 'freezes up'. If the error lasts for more than 30s (see also Command ET), the values concerned are replaced in the telegram by an "F" instead of the outdated value, and a defined voltage value is transmitted to the analogue outputs (see also Command EI).

### 8.5.1 Occurrence of Errors:

An error may occur under the following circumstances:

Averaging time(AV) < 30sec Error Timeout, see <b>Command ET</b>	An error is outputted (s. " ET"), when no new wind data could be acquired over 30sec.
Averaging time(AV) >= 30sec Error Timeout, see <b>Command ET</b>	An error is outputted, when the averaging buffer runs out of data.

### 8.5.2 Behaviour of analogue Outputs

If the analogue outputs are active, they are switched to the minimum or maximum value in case of error. The parameter EI determines which of the two values is output; see **Command EI**.

### 8.5.3 Behaviour of telegram Output

In case of error the relevant error telegram is output; see **Fixed Telegram Formats**.

## 8.6 Output of all System Parameters

Most parameters of the Weather Station are stored internally in an EEPROM. The command SS can be used to output all stored parameters.

Before editing parameters it is recommended making a backup copy of existing settings and storing them in a text file; see also **Command SS**.

## 8.7 Query Software Version

The software version is queried using the command SV. For further details see **Command SV**.

## 8.8 Force Restart

The command RS can be used to force a restart of the Weather Station. The commands

00RS00001 <cr> Warm boot

00RS00002 <cr> Reset daily total of precipitation

are only possible with ADMIN rights; see Command KY.

## 8.9 Plausibility

In order to recognize erroneously measured wind values, the Weather Station includes an internal plausibility test, assessing the measuring values on the basis of the history. Erroneous measuring values can be caused, for example, by foreign objects in the ultrasonic measuring distance.

## 8.10 Online Help

For a short description of commands the Weather Station includes an Online Help feature which provides information about individual commands. The Help text for the command is returned by inputting the command and '?'.

If the following commands are input:

00HH <cr>    <cr> stands for Carriage return (Enter key)

or

00?? <cr>    <cr> stands for Carriage return (Enter key)

the Weather Station will list all commands with the relevant Help.

Example:

Help with setting the baud rate is required: see **Command BR**.

If the command

00BR?<cr>    <cr> stands for Carriage return (Enter key)

is input, the Weather Station responds as follows:

Baud rate in baud per second Only admin authorised!

12:	1200 baud
24:	2400 baud
48:	4800 baud
96:	9600 baud
192:	19200 baud
384:	38400 baud
576:	57600 baud
1152:	115200 baud
2304:	230400 baud
4608:	460800 baud
9216:	921600 baud

## 9 Configuration of Weather Station by Customer

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The Weather Station is factory-set before delivery to the customer.

- This is described in the supplementary sheet with the factory settings ("*Werkseinstellung*").

The customer can alter the factory settings of the Weather Station or adapt them to new requirements. It should be borne in mind here that if settings are changed, the order number allocated at the factory can then no longer help with identification.

The Weather Station can be configured via its serial data interface using commands.

See sections:

- *Access mode.*
- *List of commands.*

Any standard terminal program such as "Telix" or a Windows terminal program, e.g. Hyper Terminal or "TeraTerm", can be used here.

Recommendation:

After performing configuration please amend the supplementary sheet for the factory settings and send in to the manufacturer when the device is returned for servicing or repair.

## 10 List of Commands

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	Command	Description
<b>Command AB</b>	<id>AB<para5>	Measuring range analogue output of air pressure (Analogue Barometer).
<b>Command AD</b>	<id>AD<para5>	Delay of runtime measurement (Acquisition Delay).
<b>Command AH</b>	<id>AH<para5>	Measuring range analogue output of relative humidity (Analogue Humidity).
<b>Command AL</b>	<id>AL<para5>	Measuring range analogue output of brightness (Analogue Luminance).
<b>Command AM</b>	<id>AM<para5>	Setting of averaging method (Averaging Mode).
<b>Command AO</b>	<id>AO<para5>	Switch the analogue outputs on/off (Analogue On).
<b>Command AP</b>	<id>AP<para5>	Measuring range analogue output of precipitation intensity (Analogue Precipitation).
<b>Command AQ</b>	<id>AQ<para5>	Measuring range analogue output of daily sum of precipitation (Analogue Qty).
<b>Command AR</b>	<id>AR<para5>	Scale the analogue wind speed output (Analogue Range).
<b>Command AS</b>	<id>AS<para5>	Set the analogue outputs to preselected values (Analogue Static).
<b>Command AT</b>	<id>AT<para5>	Measuring range analogue output of temperature (Analogue Temperature).
<b>Command AV</b>	<id>AV<para5>	Averaging period (Average).
<b>Command BO</b>	<id>BO<para5>	Selection calculation mode for total brightness (Brightness Option).
<b>Command BP</b>	<id>BP<para5>	Select parity for the interfaces (Baud Parity).

	<b>Command</b>	<b>Description</b>
<b>Command BR</b>	<id>BR<para5>	Select baud rate for the interfaces (Baud Rate).
<b>Command BT</b>	<id>BT<para5>	Activating termination of RS485 – bus (Bus Termination).
<b>Command CI</b>	<id>CI<para5>	Select command interpreter (Command Interpreter).
<b>Command CS</b>	<id>CS<para5>	Saving configuration (Configuration Save).
<b>Command DM</b>	<id>DM<para5>	Duplex mode (Duplex Mode).
<b>Command DO</b>	<id>DO<para5>	Selecting measured or calculated brightness direction as analogue value.
<b>Command DT</b>	<id>DT<para5>	Date and time stamp (Date and Timestamp).
<b>Command EI</b>	<id>EI<para5>	Analogue values in case of error (Error Inversion).
<b>Command ET</b>	<id>ET<para5>	Time until a measuring value error sets the generic error bit (Error Timeout).
<b>Command GP</b>	<id>GP<para5>	Query the GPS data and the position of the sun.
<b>Command HC</b>	<id>HC<para5>	Defines the lower threshold for heating operation (Heating Condition).
<b>Command HH</b>	<id>HH<para5>	Output Help (Help, identical to: <id>??<para5>).
<b>Command HP</b>	<id>HP<para5>	Lowest heating level in % (Heating Power).
<b>Command HS</b>	<id>HS<para5>	Selecting mode for setting the station height (Height Setting).
<b>Command HT</b>	<id>HT<para5>	Heating control ON/OFF/automatic (Heating).
<b>Command ID</b>	<id>ID<para5>	Weather Station ID (IDentifier).
<b>Command II</b>	<id>II<para5>	Identifier Index
<b>Command KY</b>	<id>KY<para5>	Access key (Key).
<b>Command MC</b>	<id>MC<para5>	Magnetic compass correction optional.
<b>Command MD</b>	<id>MD>>para5>	Measuring interval for the wind measurement (Measurement Delay).
<b>Command NC</b>	<id>NC<para5>	Correction to north (North Correction).
<b>Command NM</b>	<id>NM<para5>	NMEA Options (Selection of the NMEA telegram output)
<b>Command OL</b>	<id>OL<para5>	Linking analogue measuring values with the outputs (Output Link).
<b>Command OP</b>	<id>OP<para5>	For extending the output telegrams by optional parameters.
<b>Command OR</b>	<id>OR<para5>	Telegram output interval (Output Rate).
<b>Command OS</b>	<id>OS<para5>	Scale wind speed output (Output Scale).
<b>Command PE</b>	<id>PE<para5>	Precipitation events lower precipitation threshold (Precipitation Events).
<b>Command PH</b>	<id>PH<para5>	Precipitation threshold single volume (Precipitation High).
<b>Command PN</b>	<id>PN<para5>	Precipitation events upper precipitation threshold (Precipitation Number).
<b>Command PT</b>	<id>PT<para5>	Precipitation threshold for the precipitation-flag (Precipitation Threshold).
<b>Command RD</b>	<id>RD<para5>	Delayed response (Response Delay).
<b>Command RS</b>	<id>RS<para5>	Warm-boot Weather Station (ReSet).
<b>Command RT</b>	<id>RT<para7>	Set real-time clock (Real Time Clock).
<b>Command SH</b>	<id>SH<para5>	Station height for reducing the air pressure on sea level (Station Height).
<b>Command SM</b>	<id>SM<para5>	Energy saving mode (Sleep Mode).
<b>Command SN</b>	<id>SN<para8>	Output serial number.
<b>Command SS</b>	<id>SS<para5>	System status (System Status).
<b>Command ST</b>	<id>ST<para5>	Threshold for Synop Status (Synop status Threshold).
<b>Command SU</b>	<id>SU<para5>	Preparation for “software upload” (firmware update).

	Command	Description
<b>Command SV</b>	<id>SV<para5>	Version of software (Software Version).
<b>Command TI</b>	<id>TI<para5>	Short information about the telegram (Telegram Info).
<b>Command TR</b>	<id>TR<para5>	Telegram Request.
<b>Command TT</b>	<id>TT<para5>	Autonomous telegram output (Telegram Transmission).
<b>Command TZ</b>	<id>TZ<para5>	Select the hourly offset to GPS time for the time zone.

## 10.1 Commands and Descriptions

### Command AB

<id>AB<para5> Adjust the measuring range of the air pressure for analogue output.  
Access: Configuration mode (ADMIN).  
Description: This command is used to specify the analogue measuring range.  
Call-up e.g. 00ABxxyy  
The first two parameters (xx) specify the lower measured value and the last 3 parameters (yyy) the upper measured value (resolution 10hPA).

Parameter description:

	00AB80106	Sets the measuring range of the analogue output to 800...1060hPa.
	00AB60100	Sets the measuring range of the analogue output to 600...1000hPa.
Value range(xx):	60..80	(10hPA)
Value range(yyy):	100..150	(10hPA)
Initial value(xxyy):	80106	

### Command AD

<id>AD<para5> Setting delay of runtime single measurement for ultrasonic wind measurement (Acquisition Delay).

Description: This command can be used to select the time from the start of a propagation time measurement (time of flight, TOF) to the start of the following TOF (TOF repeat rate).

Value range: 2..25[ms]  
Initial value: 5

### Command AH

<id>AH<para5> Adjust the measuring range of relative humidity for analogue output  
Access: Configuration mode (ADMIN).  
Description: This command is used to specify the analogue measuring range for relative humidity.  
Callup e.g. with 00AHxxyy .  
The first two parameters (xx) specify the lower measured value and the last 3 parameters (yyy) the upper measured value (resolution %).

Parameter description:

	00AH10100	Sets the measuring range of the analogue output to 10...100%.
	00AH00100	Sets the measuring range of the analogue output to 0...100%.
Value range(xx):	0..20	[%]
Value range(yyy):	50..100	[%]
Initial value(xxyy):	00100	



## Command AL

<id>AL<para5> Adjust the measuring range of brightness for analogue output  
Access: Configuration mode (ADMIN)  
Description: This command is used to specify the terminal value of the analogue output.

Parameter description:

00AL00150 Sets the measuring range of the analogue output to 0...150klux  
Value range: 10..150[klux]  
Initial value: 120

## Command AM

<id>AM<para5> Select the averaging method of wind measurement (Average Method).  
Access: Configuration mode (ADMIN).  
Description: This command can be used to select the **averaging method. Averaging can be either vectorial or scalar; see also section 8.3.1.**

Parameter description:

0: Vectorial averaged velocity and vectorial averaged direction.  
1: Scalar averaged velocity and scalar averaged direction.  
Value range: 0..1  
Initial value: 1

## Command AO

<id>AO<para5> Switch the analogue outputs on/off (Analogue On).  
Access: Configuration mode (ADMIN).  
Description: Command used to switch the analogue outputs on/off.

Parameter description:

0: Analogue outputs switched off  
1: Analogue outputs switched on  
Value range: 0..1  
Initial value: 1

## Command AP

<id>AP<para5> Adjust the measuring range of the precipitation intensity [mm/h] for analogue output.  
Access: Configuration mode (ADMIN)  
Description: This command determines the measuring range final value of the precipitation intensity.  
Special case: with AP=0 applies, when precipitation status=1, then final value.

Parameter description:

00AP00000 Sets the analogue output to final value with precipitation status = 1.  
00AP00100 Sets the measuring range of the precipitation intensity to 0...100mm/h.  
00AP01000 Sets the measuring range of the precipitation intensity to 0...1000mm/h.  
00AP09999 Sets the analog output of the precipitation intensity to 0 ... 10V with a segmented measuring range as follows:

Segment	Measuring range	Output	Function <sup>1)</sup>
-	no release by ceramics	= 1.5 V	-

1	0 ... 0,01mm/min	= 2 ... 4V	0,005 *x[V] - 0,01
2	0,01 ... 0,1mm/min	= 4 ... 6V	0,045 *x[V] - 0,17
3	0,1 ... 1,0mm/min	= 6 ... 8V	0,45 *x[V] - 2,6
4	1,0 ... 10,0mm/min	= 8 ... 10V	4,5 *x[V] - 35

If the measured value is incorrect, < 1V output.

<sup>1)</sup> Depending on which segment the measured current fits into, the corresponding function must be used, whereby the measured value in V is used for "x".

Value range: 0..1000[mm/h], 9999 (logarithmically segmented measuring range)  
Initial value: 100

### Command AQ

<id>AQ<para5> Sets measuring range of daily sum of precipitation [mm/d] for the analogue output.

Access: Configuration mode (ADMIN).

Description: This command determines the final value of measuring range of the precipitation daily sum. With exceeding the final value the automatic summation occurs again from „0“. The sum is reset at 00:00:00h.

Parameter description:

00AP00010 Sets the measuring range of the precipitation daily sum to 0..10 mm/d.

Value range: 10..100 [mm/d]  
Initial value: 100

### Command AR

<id>AR<para5> Scale the analogue wind speed output (Analogue Range).

Access: Configuration mode (ADMIN).

Description: Determines the measuring range final value for the analogue wind velocity output. The standard Weather Station scales the wind speed as follows:  
0..10V corresponds to 0..60m/s.  
It may however also be advisable to scale the wind speed of 0..30m/s:  
0..10V correspond to 0..30m/s.  
The end of the measuring range is specified with this parameter. Specification is made in m/s.

Parameter description:

1..80: Specifies of the end of the measuring range for wind speed (WS).  
If the command AR00045 is input for example, 10V corresponds to a wind speed of 45m/s.

Value range: 1..80[m/s]  
Initial value: 60

### Command AS

<id>AS<para6> Test the analogue outputs (Analogue Static output).

Access: Configuration mode (ADMIN).

Description: By means of this command the analogue outputs can be set temporarily, e.g. for a test, to a required fixed value.

Parameter description:

00AS902500 Sets the analogue outputs to 2500mV.  
00AS105000 Sets the analogue WS output to 5000mV.  
00AS210000 Sets the analogue WD output to 10000mV.  
00AS900000 Sets the analogue outputs to 0mV.  
00AS Resets the analogue outputs to normal mode.

Value range: 0..910000

## Command AT

<id>AT<para5> Adjust the measuring range of the air temperature [°C] for analogue output.  
Access: Configuration mode (ADMIN).

Description: This command is used to specify the output range for the air temperature.

Parameter description:

00APsxyy s : leading sign of lower temperature  
xx: lower terminal value of temperature  
yy: upper terminal value of temperature  
00AP14060 Sets the measuring range of the temperature to -40...+60°C  
00AP13070 Sets the measuring range of the temperature to -30...+70°C

Value range: s 0..1 1 = negative leading sign  
xx 0..50  
yy 50..90

Initial value: 14060 output range -40°C..+60°C

## Command AV

<id>AV<para5> Averaging period (Average).

Access: User mode.

Description: With the help of this command the period of time over which Weather Station averages all measured values (except for the precipitation intensity). The wind measuring values are gliding-averaged, corresponding to WMO-regulation acc. to the FIFO method. No gust is calculated for averaging times below 3s!

Parameter description:

Parameter for AV	Selected averaging time
0	No averaging
1	Averaging over 100ms
10..6000	Averaging over 1..600.0s

**Table 8: Selection of averaging periods with parameter AV**

The averaging memory is designed as a sliding memory. On start-up the data of the averaging memory is instantly valid. Averaging is performed immediately using the measured values available.

Value range: 0..6000

Initial value: 10

## Command BO

<id>BO<para5> Calculation method of the total brightness (Brightness Option).

Access: Configuration mode (ADMIN).

Description: Defines the calculation of the total brightness from the values of the 4 single sensors.

Parameter description:

0: Greatest value of the four sensors.  
1: Vectorial sum from both adjacent sensors with the maximum measured brightness.

Value range: 0..1

Initial value: 0

### **Command BP**

<id>BP<para5> Determines the parity of the serial interface (Baud Parity)  
Access: Configuration mode (ADMIN)  
Description: Parameter 8: parity 8N1-  
Parameter 9: Parity 8E1  
Parameter 10: Parität 8N2  
Value range: 8..10  
Initial value: 8

### **Command BR**

<id>BR<para5> Select baud rate (Baud Rate)  
Access: Configuration mode (ADMIN)  
Description: Weather Station communication can take place at different baud rates.  
The following baud rates are defined for BR:

Parameter description:

12:	1200 baud
24:	2400 baud
48:	4800 baud
96:	9600 baud
192:	19200 baud
384:	38400 baud
576:	57600 baud
1152:	115200 baud
2304:	230400 baud
4608:	460800 baud
9216:	921600 baud

**Table 9: List of baud rates with telegram BR**

If the baud rate is changed, the Weather Station will return the value of the new baud rate selected in the baud rate set previously to show command acceptance.

When the baud rate is queried with Command BR, the Weather Station returns the baud rate last programmed and the selected parity.

See also Command BP.

Example: 00BR

!00BR00096

Actual baud rate -> 9600 8N1

Initial value: 96

### **Command BT**

<id>BT<para5> Activating and deactivating of the 120-ohms load resistance on the serial interface (Bus Termination)  
Access: Configuration mode (ADMIN)  
Description: Command for connecting / disconnecting a load resistance of approx 120ohms on the RS485-wire

Parameter description:

0: Bus termination off.  
1: Bus termination on.

Initial value: 0

## Command CI

<id>CI</id>  
Access: Configuration mode (ADMIN)  
Description: This command is used to select the required command interpreter.  
Parameter description:

Parameter	Description
1	MODBUS RTU

Value range: 1  
Initial value: 1

## Command CS

<id>CS</id>  
Access: Configuration mode (ADMIN).  
Description: Command to save the configuration without leaving configuration mode. A new configuration will only be written to the EEPROM when the command "CS1" or "KY0" is executed.  
Parameter: 1: Save configuration.

## Command DM

<id>DM</id>  
Access: Configuration mode (ADMIN)  
Description: Duplex mode decides the type of physical connection of the serial data interface. In full duplex mode the send and receive signals are transmitted via separate pairs of cables. This means it is possible to send and receive signals simultaneously.  
In half duplex mode transmission of the send and receive signals is via the same pair of cables. (Time multiplex).

Parameter description:  
0: Half duplex mode (RS485).  
1: Full duplex mode (RS485 transmission drivers are switched off if no data is transmitted).  
2: Full duplex mode (RS422 transmission drivers are not switched off).

Value range: 0..2  
Initial value: 1

## Command DO

<id>DO</id>  
Access: Configuration mode (ADMIN).  
Description: The parameter determines the calculation of the analogously output brightness direction. The brightness direction 0...360° is output respectively as 0...10V. (see chap. 6.3, table 8).

Parameter description:  
0: Output of the brightness direction calculated from the measuring values of the 4 brightness sensors.  
1: Azimuth of sun position from the GPS data.

- 2: When no brightness direction can be determine because of too low intensities, the azimuthal sun position, calculated from the GPS data, shall be output instead.

Value range: 0..2  
Initial value: 1

## Command DT

<id>DT<para5> Date and time stamp (Date and Timestamp).  
Access: Configuration mode (ADMIN).  
Description: Adds the date and/or time from the internal real-time clock (see Command RT) to the output telegrams as well as the GPS position (optional). This information is always found at the end of the telegram before the check sum. With this parameter, the parameters listed below can also be output for each telegram, with the exception of the NMEA telegrams (TR5 / TT5).

Examples of telegrams:

TR1 with DT0: 000.1 338 +22.1 \*03  
TR1 with DT1: 000.1 315 +21.8 21.02.13 08:07:45 \*0B  
TR1 with DT2: 000.2 360 +22.0 08:09:41 \*28  
TR1 with DT3: 000.1 349 +22.1 21.02.13 \*26  
TR1 with DT4: 000.2 031 +22.3 +51.509193 +009.957118 0186 21.02.13 08:10:33 \*04  
TR1 with DT5: 000.8 310 +22.5 +51.509180 +009.957146 0186 \*0B  
TR1 with DT6: 000.2 285 +28.4 +51.509153 +009.956990 0165 006.9 114.4 25.02.13 08:10:15 \*13  
TR1 with DT7: 000.2 279 +28.5 006.9 114.4 25.02.13 08:10:41 \*0E  
TR1 mit DT8: 005.4 091 +20.2 +51.493125 +010.011390 0214 001.99 060.0 003.88 106.6 \*17

Parameter description:

- 0: No date and time stamp.  
1: With date and time stamp.  
2: With time stamp.  
3: With date stamp.  
4: With GPS position (optional) and with date and time stamp.  
5: With GPS position (optional).  
6: With GPS position, position of the sun (elevation, azimuth) (optional) and with date and time stamp.  
7: With position of the sun (elevation, azimuth) (optional) and with date and time stamp.  
8: GPS Position, Speed Over Ground, Track Angle, True Wind, True Angle (optional). For Speed Over Ground and True Wind unit, see command OS.

Value range: 0 ... 8  
Initial value: See factory setting on supplemental sheet.

## Command EI

<id>EI<para5> Analogue value in case of error (Error inversion).  
Access: Configuration mode (ADMIN).  
Description: Specifies whether 0 or maximum value is output at the analogue outputs in case of error. If the Weather Station determines a static error during a measurement, it will output an error under certain conditions. This output prevents the user from interpreting incorrect measured values. If the analogue signals of wind direction and wind speed are used for analysis, the Weather Station switches the outputs to the maximum or minimum output value in case of error. This parameter is used to specify whether it is the minimum or maximum value that is output in such case.

Parameter description:

- 0: Analogue outputs are set to maximum in case of error.

- 1: Analogue outputs are set to 0 in case of error.
- 2: Analogue outputs: The wind speed and all optional measured values are set to minimum (0V) in case of error, and the analogue output for wind direction is set to maximum (10V) in this case.
- 3: Analogue outputs: The wind speed and all optional measured values are set to maximum (10V) in case of error, and the analogue output for wind direction is set to minimum (0V) in this case.

Value range: 0..3  
Initial value: 0

### Command ET

<id>ET<para5> Time in ms, until the generic error bit is set (Error Timeout).  
Access: Configuration mode (ADMIN).  
Description: Determines, after which time span the generic error bit is set.  
The static error bit is always set when the generic error exists more than 60s.  
*Special case: With output rates (OR) < 100ms the error basis reduces by the ratio OR/100.*

Value range: 10..60 [s]  
Initial value: 30

### Command GP

<id>GP<para5> Request GPS data and position of the sun (optional) (GPS).  
Access: Configuration mode (ADMIN).  
Description: Query global position (degree of latitude/longitude, height) in the following format:  
"±DD.MMMMMM ±DDD.MMMMMM HHHH VVV.VV AAA.AA " if available.  
DD.MMMMMM = decimal degrees.  
HHHH = height in metres.  
VVV.VV = Speed Over Ground  
AAA.AA = Track Angle

Parameter description:

- 1: Output of sensor position in degrees.
- 2: Output of sun's position calculated as azimuth 0..360° and elevation +/- 90°.
- 3: New request for GPS data.

Value range: 0..3

### Command HC

<id>HC<para5> Heating Condition.  
Access: Configuration mode (ADMIN).  
Description: This command defines the lower threshold of supply voltage, when the heating is no more activated.

Parameter description:

When the supply voltage drops below the set value, the heating is no more activated. Only when the voltage exceeds the set value by 2 volts, the heating is reactivated. A request without parameters outputs the currently measured peak value of the supply voltage in the extended help.

Value range: 5..48 (Volt)  
Initial value: 10

## Command HH

<id>HH<para5> Help  
Access: Configuration mode (ADMIN).  
Description: The command HH allows detailed Help to be switched off (Verbose Mode).

Parameter description:

- 0: Detailed messages in command mode on (Verbose Mode on).  
With restart a start-up message is outputted (see chapter 6.1), main program starts afterwards.
- 1: Messages switched off, only command echo with '!' e.g. !00TT00001 (verbose mode off).
- 2: No restart messages output (silent boot mode).
- 3: All messages and restart-messages deactivated (s. 1+2).
- a: The pin assignment is outputted in the standard configuration.
- ??: A detailed help text is outputted about all available commands.

Value range: 0..3, a, ??  
Initial value: 0

## Command HP

<id>HP<para5> Lowest heating level (Heating Power) at which the heating system starts up.  
Access: Configuration mode (ADMIN).  
Description: This command is used to specify the minimum heating power level in %. This command is only active when heating control (see Command HT) is switched on.

Parameter description:

- 0: The heating capacity starts at 1%, and increases depending on the wind velocity and falling temperature.
- 10: The heating capacity starts always at minimum 10%, and increases depending on the wind velocity and falling temperature.

Value range: 0..100  
Initial value: 10

## Command HS

<id>HS<para5> Height Settings.  
Access: Configuration mode (ADMIN).  
Description: This command determines if the station height is set manually by the command "SH", or automatically acc. to GPS level. The station height is necessary for the calculation of the air pressure on sea level.

Parameter description:

- 0: The station height is set to "SH", and is not readjusted by GPS.
  - 1: The station height is averaged, and is stored after 14 days as fixed "SH" parameter, the parameter "HS" is reset afterwards.
  - 2: As 1, however the parameters are not stored permanently, the height averaging starts again after each re-start.
  - 3: Sets the station height acc. to the instantaneous value of the GPS receiver.
- Value range: 0..3

Initial value: 1 (only article: FS6002-MBRU-A1B1H1R1T1W1W2-G  
and FS6002-MBRU-B1R1W1W2-G)

## Command HT

<id>HT<para5> Heating control (Heating).  
Access: Configuration mode (ADMIN).



Description: In order to avoid a malfunction of the precipitation radar and the brightness sensors, caused by snowfall and ice formation, the Weather Station is equipped with a cover heating.

Parameter description:

- 0: Heating always off.
- 1: Heating switches on with air temperatures below 5°C.
- 2: Heating permanently on with a heating power level of 50%.  
This setting should only be used for testing and switches back automatically to "1" when parameters are saved.
- 3: Heating switches to 100% for 60s (test mode only)
- 4: Heating including converter switches to 100% for 60s (test mode only)

Value range: 0 ... 4

Initial value: 1

### **Command ID**

<id>ID<para5> Weather Station devices (Identifier)

Access: Configuration mode (ADMIN)

Description: This command is used to specify the identification number of the Weather Station.

The ID is required to address the Weather Station with every command.

Whenever its ID is changed, the Weather Station will respond to its new identifier immediately.

The ID 99 is an universal ID. Every Weather Station will always respond to commands with the ID 99 (with the correct baud rate).

The ID 99 must not be used in bus mode under any circumstances.

Example:

00KY04711	Open with user key.
00ID00023	Change ID from 0 to 23.
!00ID00023	Weather Station acknowledges change.
23DM	Query of duplex mode with new ID.
!23DM00000	Response from Weather Station.
23ID00000	Change ID from 23 to 0.
!23ID00000	Weather Station acknowledges change.

Value range: 0..99

Initial value: 0

### **Command II**

<id>II<para5> Device identification in the telegram output (Identifier Index)

Access: Configuration mode (ADMIN)

Description: To switch on the device ID output in the response telegrams.

This allows an unambiguous assignment of the response telegrams. s.a. Command "ID".

This function applies to the standard telegrams 1,2,3,4,6,7.

Parameter description:

- 0: no additional ID at the beginning of the message
- 1: Device identification is output at the beginning of the telegram after the STX
- 2: the serial number is output at the telegram end
- 3: Device identification is output at the beginning and the serial number at the end of a standard telegram

Initial value: 0

## Command KY

<id>KY<para5> Access mode (Key).  
Access: Query mode.  
Description: When editing the parameters of the Weather Station access authorisations are required for most commands. This prevents any accidental change in parameters. Access consists of three levels:

- Query mode "0"
- User mode "1"
- Configuration mode "4711"

Parameter description:

0: Query mode  
Parameters which have no access restrictions are those not stored in the EEPROM, e.g. cyclic telegram enquiry or output of system status.

1: User mode (USER ACCESS)  
The user key protects parameters, which influence the behaviour of the Weather Station, e.g. averaging period and baud rate. The user can change these parameters but should realise that this will modify the behaviour of the Weather Station.  
Before any change it is recommended using the command SS to output and then save the current configuration.

4711: Configuration mode (ADMIN ACCESS)  
Parameters protected with this key are only available to the administrator. They were set as defaults at the factory.  
If the user switches from a higher access mode to the query mode by command, e.g.: with "00KY0", the edited parameters will be permanently stored in the EEPROM. Query mode is always switched on after a restart.

Value range: 0,1,4711  
Initial value 0

## Command MC

<id>MC<para5> Magnetic compass correction optional.  
Access: Configuration mode (ADMIN).  
Description: With the magnetic compass correction a constant angle is added to the measured direction of the magnetic compass.  
The parameter serves for compensating a magnetic variation. The direction of the magnetic compass can be used for automatic north correction of wind direction and direction of brightness. See also **command NC**.

Value range: 0..359 [°]  
Initial value: 0

## Command MD

<id>MD>>para5> Measuring interval of the complete wind measurement (Measurement Delay).  
Access: Configuration mode (ADMIN).  
Description: Specifies the time in increments of 10ms from the start of one measuring cycle (4 TOF) to the start of the next. In standard mode the time is 20ms so that a complete data record is generated from all sensors every 20ms.

Value range: 0..30000  
Initial value: 2

## Command NC

<id>NC<para5> North Correction of the wind direction and direction of brightness.  
Access: Configuration mode (ADMIN).

Description: With the north correction a constant angle is added to the measured wind direction. The parameter is used to correct electronically a possible alignment error subsequently after mounting. If the Weather Station, for example, is not aligned directly to north but to northeast, the wind direction always indicates 45° too little. In this case a north correction of 45 must be set. North correction influences the wind directions output in the data telegrams as well as the analogue output values.

Parameter description:

1000 : Automatic north correction via magnetic compass (optional), see also **command MC**.

0..359: Set north correction in °.

Value range: 0..359 / 1000

Initial value: 0

### **Command NM**

<id>NM<para5> NMEA options

Access: Configuration mode (ADMIN).

Description: This parameter defines which NMEA telegrams and in which order the telegrams with TT / TR 5 are output one after the other. If the parameter NM = 13, first the telegram \$WIMWV and then the Telegram \$GPRMC output if TT5 is set.

Parameter description:

1: \$WIMWV  
2: \$WIXDR  
3: \$GPRMC  
4: \$HCHDT  
5: \$WIMWV (true wind)

Value range: 0001 ... 55555

Initial value: 1

Sample with NM=12345:

\$WIMWV,234.1,R,000.1,M,A\*25

\$WIXDR,P,0.98844,B,baro,C,025.4,C,temp,H,045.1,P,hum\*1C

\$GPRMC,114115,A,5129.59232,N,01000.67080,E,000.01,105.79,270721,,\*1E

\$HCHDT,279.3,T\*26

\$WIMWV,234.1,T,000.1,M,A\*23

### **Command OL**

<id>OL<para5> Output link (Output Link).

Access: Configuration mode (ADMIN).

Description: This command can be used to link optional measured values to the analogue outputs 4-8.

Parameter: 1: Linked to relative humidity  
2: Linked to air pressure  
3: Linked to brightness from north  
4: Linked to brightness from east  
5: Linked to brightness from south  
6: Linked to brightness from west

- 7: Linked to brightness see **Command BO**
- 8: Linked to direction of brightness or resp. azimuth, see **command DO**
- 9: Linked to precipitation intensity or precipitation status, see **command AP**
- 0: Linked to precipitation sum

The position of the parameter from left to right describes the numbers 4-8 of the relevant output.

Example: OL=12789 means:     output 4 (PIN:N) = relative humidity  
                                   output 5 (PIN:C) = air pressure  
                                   output 6 (PIN:B) = brightness  
                                   output 7 (PIN:A) = direction of brightness  
                                   output 8 (PIN:P) = precipitation intensity

Note:     The first 3 measured values have fixed linking to the analogue outputs, cannot be changed and are linked as follows:  
                                   output 1 (PIN:T) = wind speed  
                                   output 2 (PIN:S) = wind direction  
                                   output 3 (PIN:O) = temperature / virtual

temperature

Value range:     0...99999

Initial value:    12789

### **Command OP**

<id>OP<para5>     Possible parameter for the output of calculated values (Optional Param.)

Access:            Configuration mode (ADMIN).

Description:       By means of this parameter, it is possible to output additionally to each telegram – excepted the NMEA telegram (TR5/TT5) the parameters stated below. The output is carried out always after the measuring values, and before date/time resp. before the checksum, see parameter DT. The order is defined by the position from left to right in the parameter. When the parameter OP=14, first, the value „absolute humidity“ is added to the measuring values, and then the value “heat index temperature”.

Parameter description:

- 0:     No additional values in the output telegram (off)
- 1:     Output of the calculated absolute humidity
- 2:     Output dew point temperature
- 3:     Output of wind-chill temperature (valid if the air temperature <10°C)
- 4:     Output of heat index temperature (valid if the air temperature >26°C and rel. humidity >40%)
- 5:     Output of direction of magnetic compass (optional)

Value range:     00000...65534

Initial value:    0 (see factory setting: supplement sheet)

### **Command OR**

<id>OR<para5>     Telegram output interval (Output Rate).

Access:            Configuration mode (ADMIN).

Description:       When the telegram output is autonomous, the time distance between the telegrams is specified by means of this parameter. The selection is carried out in increments of milliseconds. If the output rate is higher than the data transmission speed, the upcoming output is rejected. If the output repetition rate

is several times faster than the measuring value acquisition, the available measuring values are double- or multiple-output.

Parameter description:

Specifies the output interval in milliseconds.  
 Value range: 20 ... 60000 [ms]  
 Initial value: 1000 (see factory setting: supplement sheet).

### Command OS

<id>OS<para5> Meas. Unit of the wind speed output (Output Scale)  
 Access: Configuration mode (ADMIN)  
 Description: This command specifies the unit used for output of the wind speed in the serial telegram. Different units of measurement are available for this purpose.

Parameter description:

Parameter	Meas. unit	Conversion factor referred to m/s
0	m/s	1
1	Km/h	1m/s => 3.6km/h
2	miles/h	1m/s => 2.237 miles/h
3	Knots	1m/s => 1.94 knots

**Table 10: Conversion factors between different wind speeds**

Value range: 0..3  
 Initial value: 0

### Command PE

<id>PE<para5> Minimum number of drops or particles (Precipitation Events), to recognize begin of precipitation.

Precipitation events above precipitation-intensity-threshold (Precipitation Events).

Access: Configuration mode (ADMIN).  
 Description: Determines the number of precipitation events above threshold within the last minute, above which precipitation is reported. (s. command PT).  
 Value range: 2..30  
 Initial value: 16

### Command PH

<id>PH<para5> Precipitation-volume-threshold of drops or hail high single volume (Precipitation High).

Access: Configuration mode (ADMIN).  
 Description: Sets the threshold for a 2-second-volume in  $\mu\text{m}$ . This threshold is required for the precipitation start detection for ex. at rain with big drops at rare intervals or hail (see also command PN).

Value range: 100..600      Volume of single particle in  $\mu\text{m}$ .  
 Initial value: 260

### Command PN

<id>PN<para5> Number of precipitation events with high single volume (Precipitation Number).  
 Access: Configuration mode (ADMIN).

Description: Determines the number of threshold within the last minute, which are required before precipitation is reported. (s. command PH).  
Value range: 1..15  
Initial value: 2

### **Command PT**

<id>PT<para5> Precipitation-intensity-threshold for the precipitation status flag.  
Access: Configuration mode (ADMIN).  
Description: Sets the threshold of the precipitation intensity in  $\mu\text{m}$ , when the status flag is set to "1". In addition, the status flag can be linked to a precipitation event counter. This threshold is required for the precipitation start detection for ex. with drizzle (see also command PE).

Parameter description:

1..200 Threshold of intensity in  $\mu\text{m}/\text{h}$ . The status flag is set at this threshold or by the event counter.

Initial value: 10

### **Command RD**

<id>RD<para5> Delayed response (Response Delay).  
Access: Configuration mode (ADMIN).  
Description: The response of the Weather Station is delayed by the time specified in ms with a command via the serial interface. The minimum delay time from the end of the last character of the request telegram until transmission of the first character of the response telegram is 5ms. For the half duplex mode we recommend RD=20 in order to guarantee a smooth communication with diverse interface converters.

Value range: 5...1000 [ms]

Initial value: 5

### **Command RS**

<id>RS<para5> Warm-boot Weather Station (Reset).  
Access: Configuration mode (ADMIN).  
Description: The Weather Station is restarted on transmission of this command.

Parameter description:

1: The Weather Station performs a warm boot, behaving as if the supply voltage had just been connected.  
2: Resets the precipitation sum.

Value range: 1..2

### **Command RT**

<id>RT<para7> Used to set the real-time clock of the Weather Station (Real Time).  
Access: Configuration mode (ADMIN).  
Description: Output and setting of time and date of Weather Station.

Parameter description:

0: Synchronization of date and time deactivated by GPS information.  
1: Synchronizes seconds acc. to GPS every day at 3:30:30h.  
2: Synchronizes seconds and minutes by GPS every day at 3:30:30h.  
3: Synchronizes time and date by GPS every day at 3:30:30h.

Initial value: 2

Manual commands which do not affect the parameter, these commands can be used for the following situation.

The customer switched off the time synchronization (RT = 0) and would like to set the time manually: RTT or / and RTD

The customer switched from RT0 to RT> 0 and would like to synchronize immediately after GPS: RTG or RTS

Command	Function
T:	System time of Weather Station output in the format: " <b>hh:mm:ss</b> ". Example for setting the system time to 12 noon: "00RTT120000"
D:	System date of Weather Station output in the format: " <b>dd:mm:yy</b> ". Example for setting the date to 25.09.2012: "00RTD250912"
G:	One-off setting of the time and date acc. to GPS information (optional). Time and date are set automatically if a valid GPS time is received (see also Command "TZ" Time Zone).
S:	Minutes and seconds synchronised to GPS time. Time and date are set automatically if a valid GPS time is received.

### Command SH

<id>SH<para5> Station height to calculate the air pressure at standard elevation zero (NHN).  
Access: Configuration mode (ADMIN).  
Description: Input of the station height in meters above sea level for conversion of the air pressure to sea level.  
For an automatic setting of the station height see parameter "HS".

Parameter description:

0...9000:	Station altitude in 0...9000 meters above sea level (Base for converting air pressure to sea level).
10001 ... 10500	Station altitude in 1...500 meters below sea level (Base for converting air pressure to sea level).

Value range: 0

### Command SM

<id>SM<para5> Energy saving mode (Sleep Mode).  
Access: Configuration mode (ADMIN).  
Description: Entry of the alarm interval for measurement and telegram output.  
The Weather Station is called up by the RTC in a specified interval, measures once, and outputs afterwards the current measuring values via the set telegram. The heating is deactivated for the sleep mode, and the averaging „AV“ is switched off, in order to receive actual measuring values.  
Normally the analog data outputs will be switched off at entry of sleep mode. However the analog outputs can be reactivated by the command AO=2.  
Important: Even at running sleep mode the daily total and intensity of precipitation will be kept and actualized.

Parameter description:

0:	Energy saving mode off.
1...600:	Alarm interval in seconds.

Initial value: 0

### **Command SN**

<id>SN Output of 8-digit serial number (Serial Number).  
Access: Query mode.  
Description: During factory setting of the device every Weather Station is given a serial number. This serial number is a unique identifier for the Weather Station.

Parameter description:

The Weather Station responds e.g. with the serial number "12345678":

!00SN12345678

Serial number: 12345678 (see also **Command HH** "Verbose ON")

Value range: 0..99999999

### **Command SS**

<id>SS<para5> System status (System Status).  
Access: Query mode.  
Description: Outputs the selected parameters of all commands. All parameters stored in the EEPROM are output here.  
Before editing parameters of the Weather Station, this command should be used to generate and save a list of the selected parameters, e.g. by copying the parameters to a text file.

Parameter description:

No parameter is necessary when using the command SS. Call-up with the selected device ID 00 is as follows:

00SS<cr> with <cr> Carriage return (Enter key)

### **Command ST**

<id>ST<para5> Synop status Threshold.  
Access: Configuration mode (ADMIN).  
Description: Determines the lower precipitation intensity threshold from on which the Synop status is output.

Parameter description:

Causes the output of the Synop status not before exceeding the set intensity threshold. The Synop code is detected already with an intensity of 0,001mm/h. Downstream displays, which output the intensity for ex. only with one decimal place, could, therefore, indicate a Synop although when the intensity is displayed with 0,0mm/h.

Setting the threshold to ST=100[µm/h] would output a Synop code only when the intensity exceeds 0,1mm/h.

Value range: 0...1000 [µm/h]

Initial value: 0

### **Command SU**

<id>SU<para5> Preparation for firmware upload (Software Upload).  
Access: Configuration mode (ADMIN).  
Description: Starts the bootloader for the firmware update.  
The upload must be started within the stated time period, otherwise the previous firmware restarts. A started upload must not be interrupted, for ex. by disconnecting the power supply or interrupting the communication, as otherwise the firmware is not loaded completely, and the firmware of the Weather Station



would possibly be no longer executable. It should then be sent to the manufacturer.  
The baud rate should be within a range from 4800Bd to 115200Bd 8N1, and with upload should correspond to the upper pc board (top) of the communication baud rate (see BR).  
With the firmware upload of the lower pc board (bottom), the baud rate is arranged through the upload program "FlashMagic", regardless of the communication baud rate.  
For a firmware update in bus mode all other instruments should be removed from the bus, in order to avoid an interference of the upload.

**Important:**            **The power supply and the communication must not be disconnected or interrupted during the firmware upload.  
For the firmware update in half-duplex mode the echo mode of the interface converter must be activated.**

Parameter description:

B4711:    Starts the bootloader for firmware update of the lower pc board  
          Timeout for starting the upload 6min.  
T4711:    Starts the bootloader for firmware update of the upper pc board  
          Timeout for starting the upload 2min.

### **Command SV**

<id>SV<para5>        Version of software (Software Version).  
Access:                Query mode.  
Description:          Without parameter the command outputs the software version.

Parameter description:

1:            Output of the detailed start message included the software version.

### **Command TI**

<id>TI<para5>        Telegram information.  
Access:                Query mode.  
Description:          Telegram information about the type of measured value is output in abbreviated form.

Value range:        1,2,3,4,5,6,14    valid telegrams; see also **Command TR**.

### **Command TR**

<id>TR<para5>        Telegram request (Telegram Request).  
Access:                Query mode.  
Description:          The command TR can be used to specifically request a telegram from the Weather Station. The device offers a series of predefined telegrams.  
With a telegram request the response time of the Weather Station is the delay time from the last character of the request telegram until transmission of the first character of the response telegram. The minimum delay is 5msec and can be selected from 5...1000 ms using Command RD.

Parameter description:

1:            VDT telegram (wind speed, wind direction and temperature).  
2:            VDTHP telegram (wind speed, wind direction, temperature, relative humidity and air pressure).  
3:            VDTBDRE telegram (wind speed, wind direction, temperature, brightness, Brightness direction, precipitation intensity / status).

- 4: VDTHPBDRE (wind speed, wind direction, temperature, relative humidity, air pressure, brightness, brightness direction, precipitation intensity / status).
- 5: NMEA telegram see command NM
- 6: Extended telegram.
- 7: Same as telegram 6 with additional gust.
- 14: Scientific diagnostics telegram.

Value range: 1,2,3,4,5,6,7,14  
 Initial value: No initial value.

### **Command TT**

<id>TT<para5> Autonomous telegram output (Telegram Transmission).  
 Access: User mode.  
 Description: Specifies the number of the telegram that the Weather Station autonomously transmits on a cyclic basis. The same telegrams are available as described under **Command TR**. The time interval in which telegrams are transmitted is specified with **Command OR**.  
 Autonomous transmission is only possible in full duplex mode; see **Command DM**.  
 If TT = 0, autonomous telegram output is switched off.

Value range: 0,1,2,3,4,5,6,7,14  
 Initial value: See factory settings on the supplement sheet.

### **Command TZ**

<id>TZ<para5> Setting of the instrument on local time by entering the time difference to UTC.  
 Access: Configuration mode (ADMIN).  
 Description: Selects an hourly offset of the local time to the UTC time of the GPS time signal.  
 Is required for automatic time / date setting with the command "RTG".

Parameter description:

- 0: No time correction.
- 23: UTC time -1 hour.
- 24: UTC time.
- 25: UTC time +1hour.

Value range: 0..47  
 Initial value: 0

## 11 Appendix 1 Predefined data telegrams

### Note:

*The date and time stamp, see also command „DT“, this information is always found at the end of the telegram before the check sum.*

*If you are using the command "II", the telegram shifts by 3 to 9 characters from the position of the command "II" depending on which parameter is executed by command "II".*

### 11.1 Telegram 1 VDT

#### Wind speed, Wind direction and Temperature

Command: TR1 / Command: TT1 (with DT=0, see also Command DT and OP=0, see also Command OP and Command II=0; see also Command II).

Telegram structure:

Position	Length	Example	Description	Meas. error
1	1	<STX>	Start of Text character (HEX 02).	<STX>
2	5	###.#	Wind speed unit [m/s], see Command OS.	FFF.F
7	1	' '	Blank character (HEX 20).	' '
8	3	###	Wind direction [°].	FFF
11	1	' '	Blank character (HEX 20).	' '
12	5	###.#	Temperature [°C].	FFF.F
17	1	' '	Blank character (HEX 20).	' '
18	1	*	Asterisk (identifier for following check sum).	'*'
19	2	CC	Check sum (XOR).	CC
21	1	<CR>	Carriage return (HEX 0D).	<CR>
22	1	<ETX>	End of TeXt character (HEX 03).	<ETX>

Extension of telegram possible to include date and time; s. section 9, Command DT.

### 11.2 Telegram 2 VDTHP

#### Wind speed, Wind direction, Temperature, Relative humidity and Air pressure

Command: TR2 / Command: TT2 (with DT=0, see also Command DT and OP=0, see also Command OP and Command II=0; see also Command II).

Telegram structure:

Position	Length	Example	Description	Meas. error
1	1	<STX>	Start of Text character (HEX 02).	<STX>
2	5	###.#	Wind speed unit [m/s], see Command OS.	FFF.F
7	1	' '	Blank character (HEX 20).	' '
8	3	###	Wind direction [°].	FFF
11	1	' '	Blank character (HEX 20).	' '
12	5	###.#	Temperature [°C].	FFF.F
17	1	' '	Blank character (HEX 20).	' '

18	3	###	Relative humidity [%].	FFF
21	1	' '	Blank character (HEX 20).	' '
22	6	####.#	Air pressure [hPa].	FFF.F
28	1	' '	Blank character (HEX 20).	' '
29	1	*	Asterisk (identifier for following check sum).	'*'
30	2	CC	Check sum (XOR).	CC
32	1	<CR>	Carriage return (HEX 0D).	<CR>
33	1	<ETX>	End of Text character (HEX 03).	<ETX>

Missing measuring values by partial expansion stage are marked by „F“ as „measuring value error“.

Extension of telegram possible to include date and time; s. section 9, Command DT.

### 11.3 Telegram 3 VDTBDRE

#### Wind speed, Wind direction, Temperature, Brightness, Brightness direction, Precipitation intensity / status

Command: TR3 / Command: TT3 (with DT=0, see also Command DT and OP=0, see also Command OP and Command II=0; see also Command II).

Telegram structure:

Position	Length	Example	Description	Meas. error
1	1	<STX>	Start of Text character (HEX 02).	<STX>
2	5	####.#	Wind speed unit [m/s], see Command OS.	FFF.F
7	1	' '	Blank character (HEX 20).	' '
8	3	###	Wind direction [°].	FFF
11	1	' '	Blank character (HEX 20).	' '
12	5	####.#	Temperature [°C].	FFF.F
17	1	' '	Blank character (HEX 20).	' '
18	6	#####	Brightness max. / vectorial sum [lux] (s. Command BO).	FFFFFF
24	1	' '	Blank character (HEX 20).	' '
25	3	###	Direction of brightness [°].	FFF
28	1	' '	Blank character (HEX 20).	' '
29	7	####.###	Precipitation intensity [mm/h].	FFF.FFF
36	1	' '	Blank character (HEX 20).	' '
37	1	#	Precipitation event [0/1].	F
38	1	' '	Blank character (HEX 20).	' '
39	1	*	Asterisk (identifier for following check sum).	'*'
40	2	CC	Check sum (XOR).	CC
42	1	<CR>	Carriage return (HEX 0D).	<CR>
43	1	<ETX>	End of Text character (HEX 03).	<ETX>

Missing measuring values by partial expansion stage are marked by „F“ as „measuring value error“.

Extension of telegram possible to include date and time; s. section 9, Command DT.

## 11.4 Telegram 4 VDTHPBDRE

**Wind speed, Wind direction, Temperature, Relative humidity, Air pressure, Brightness, Brightness direction, Precipitation intensity / status**

Command: TR4 / Command: TT4 (with DT=0, see also Command DT and OP=0, see also Command OP and Command II=0; see also Command II).

Telegram structure:

Position	Length	Example	Description	Meas. error
1	1	<STX>	Start of Text character (HEX 02).	<STX>
2	5	###.#	Wind speed unit [m/s], see Command OS.	FFF.F
7	1	' '	Blank character (HEX 20).	' '
8	3	###	Wind direction [°].	FFF
11	1	' '	Blank character (HEX 20).	' '
12	5	###.#	Temperature [°C].	FFF.F
17	1	' '	Blank character (HEX 20).	' '
18	3	###	Relative humidity [%].	FFF
21	1	' '	Blank character (HEX 20).	' '
22	6	####.#	Air pressure [hPa].	FFFF.F
28	1	' '	Blank character (HEX 20).	' '
29	6	#####	Max. brightness / vectorial sum [lux] (s. Command BO).	FFFFF
35	1	' '	Blank character (HEX 20).	' '
36	3	###	Direction of brightness [°].	FFF
39	1	' '	Blank character (HEX 20).	' '
40	7	###.###	Precipitation intensity [mm/h].	FFF.FFF
47	1	' '	Blank character (HEX 20).	' '
48	1	#	Precipitation event [0/1].	F
49	1	' '	Blank character (HEX 20).	' '
50	1	*	Asterisk (identifier for following check sum).	'*'
51	2	CC	Check sum (XOR).	CC
53	1	<CR>	Carriage return (HEX 0D).	<CR>
54	1	<ETX>	End of Text character (HEX 03).	<ETX>

Missing measuring values by partial expansion stage are marked by „F“ as „measuring value error“.

Extension of telegram possible to include date and time; s. section 9, Command DT.

## 11.5 Telegram 5 NMEA - Telegram

### NMEA 0183 V 2.0

Command: TR5 / Command: TT5

only with default setting: NM1, see **command NM**

Telegram structure:

Position	Length	Example	Description
1	6	\$WIMWV	NMEA identifier.
7	1	,	Comma (HEX 2C).
8	5	DDD.D	Wind direction [°].
13	1	,	Comma (HEX 2C).

14	1	R	(HEX 52).
15	1	,	Comma (HEX 2C).
16	5	VVV.V	Wind speed.
21	1	,	Comma (HEX 2C).
22	1	U	Unit: K, N, M, S = km/h, knots, m/s, mph.
23	1	,	Comma (HEX 2C).
24	1	A	A, V A = valid, V = invalid.
25	1	*	Check sum identifier (HEX 2A).
26	2	CC	Check sum in hexadecimal format.
28	1	<CR>	Carriage return (HEX 0D).
29	1	<LF>	Line feed (HEX 0A).

Telegram structure in case of error:

Position	Length	Example	Description
1	6	\$WIMWV	NMEA identifier.
7	1	,	Comma (HEX 2C).
8	1	,	Comma (HEX 2C).
9	1	R	(HEX 52).
10	1	,	Comma (HEX 2C).
11	1	,	Comma (HEX 2C).
12	1	U	Unit: K, N, M, S = km/h, knots, m/s, mph.
13	1	,	Comma (HEX 2C).
14	1	A	A, V A = valid, V = invalid.
15	1	*	Check sum identifier (HEX 2A).
16	2	CC	Check sum in hexadecimal format.
18	1	<CR>	Carriage return (HEX 0D)
19	1	<LF>	Line feed (HEX 0A)

The complete description of the NMEA telegrams can be found in the document "NMEA 0183 Protocol" on the WEB page:

[https://www.nmea.org/content/STANDARDS/NMEA\\_0183\\_Standard](https://www.nmea.org/content/STANDARDS/NMEA_0183_Standard)

## 11.6 Telegram 6

**Wind speed, Wind direction, Temperature, Relative humidity, Air pressure, Brightness, Brightness direction, Precipitation status / intensity and Daily total**

Command: TR6 / Command: TT6 (with DT=0, see also Command DT and OP=0, see also Command OP and Command II=0; see also Command II).

Telegram structure:

Position	Length	Example	Description	Meas. error
1	1	<STX>	Start of Text character (HEX 02)	<STX>
2	5	###.#	Wind speed unit [m/s], see Command OS	FFF.F
7	1	' '	Blank character (HEX 20)	' '
8	3	###	Wind direction [°]	FFF
11	1	' '	Blank character (HEX 20)	' '
12	5	###.#	Temperature [°C]	FFF.F
17	1	' '	Blank character (HEX 20)	' '

18	3	###	Relative humidity [%]	FFF
21	1	' '	Blank character (HEX 20)	' '
22	6	####.#	Air pressure [hPa]	FFFF.F
28	1	' '	Blank character (HEX 20)	' '
29	6	#####	Brightness north [lux]	FFFFFF
35	1	' '	Blank character (HEX 20)	' '
36	6	#####	Brightness east [lux]	FFFFFF
42	1	' '	Blank character (HEX 20)	' '
43	6	#####	Brightness south [lux]	FFFFFF
49	1	' '	Blank character (HEX 20)	' '
50	6	#####	Brightness west [lux]	FFFFFF
56	1	' '	Blank character (HEX 20)	' '
57	6	#####	Brightness max. value / vectorial sum [lux] (s. Command BO)	FFFFFF
63	1	' '	Blank character (HEX 20)	' '
64	3	###	Direction of brightness [°]	FFF
67	1	' '	Blank character (HEX 20)	' '
68	1	#	Precipitation event [0/1]	F
69	1	' '	Blank character (HEX 20)	' '
70	7	###.###	Precipitation intensity [mm/h]	FFF.FFF
77	1	' '	Blank character (HEX 20)	' '
78	6	###.##	Total precipitation [mm/d]	FFF.FF
84	1	' '	Blank character (HEX 20)	' '
85	2	##	Synop (Table 1, section 3.5.2)	FF
87	1	' '	Blank character (HEX 20)	' '
88	1	*	Asterisk (identifier for following check sum)	*
89	2	CC	Check sum (XOR)	CC
91	1	<CR>	Carriage return (HEX 0D)	<CR>
92	1	<ETX>	End of TeXt character (HEX 03)	<ETX>

The precipitation sum [mm/d] is reset at 00:00 o'clock the next day!

Missing measuring values by partial expansion stage are marked by „F“ as „measuring value error“.

Extension of telegram possible to include date and time; s. section 9, Command DT.

### **Wind speed, Wind direction, Temperature, Relative humidity, Air pressure, Brightness, Brightness direction, Precipitation status / Intensity and Daily total with GPS position and Time of day**

Command: TR6 / Command: TT6 (preselected telegram with DT=6, see also Command DT and OP=0, see also Command OP)

Telegram structure:

Position	Length	Example	Description	Meas. error
1	1	<STX>	Start of Text character (HEX 02)	<STX>
2	5	###.#	Wind speed unit [m/s], see Command OS	###.#
7	1	' '	Blank character (HEX 20)	' '
8	3	###	Wind direction [°]	###
11	1	' '	Blank character (HEX 20)	' '

Position	Length	Example	Description	Meas. error
12	5	###.#	Temperature [°C]	###.#
17	1	' '	Blank character (HEX 20)	' '
18	3	###	Relative humidity [%]	###
21	1	' '	Blank character (HEX 20)	' '
22	6	####.#	Air pressure [hPa]	####.#
28	1	' '	Blank character (HEX 20)	' '
29	6	#####	Brightness north [lux]	#####
35	1	' '	Blank character (HEX 20)	' '
36	6	#####	Brightness east [lux]	#####
42	1	' '	Blank character (HEX 20)	' '
43	6	#####	Brightness south [lux]	#####
49	1	' '	Blank character (HEX 20)	' '
50	6	#####	Brightness west [lux]	#####
56	1	' '	Blank character (HEX 20)	' '
57	6	#####	Brightness max. value / vectorial sum [lux] (s. Command BO)	#####
63	1	' '	Blank character (HEX 20)	' '
64	3	###	Direction of brightness [°]	###
67	1	' '	Blank character (HEX 20)	' '
68	1	#	Precipitation event [0/1]	#
69	1	' '	Blank character (HEX 20)	' '
70	7	###.###	Precipitation intensity [mm/h]	###.###
77	1	' '	Blank character (HEX 20)	' '
78	6	###.##	Total precipitation [mm/d]	###.##
84	1	' '	Blank character (HEX 20)	' '
85	2	##	Synop (Table 1, section 3.5.2)	##
87	1	' '	Blank character (HEX 20)	' '
88	10	###.#####	Degree of latitude [°] (GPS position)	###.#####
98	1	' '	Blank character (HEX 20)	' '
99	11	####.#####	Degree of longitude [°] (GPS position)	####.#####
110	1	' '	Blank character (HEX 20)	' '
111	4	####	Height of sensor referred to sea level [m]	####
115	1	' '	Blank character (HEX 20)	' '
116	5	###.#	Position of the sun, elevation [°] (-90°...+90°=zenith)	###.#
121	1	' '	Blank character (HEX 20)	' '
122	5	###.#	Position of the sun, azimuth [°] (0° = north ; 180° = south)	###.#
127	1	' '	Blank character (HEX 20)	' '
128	8	##.##.##	Date, day.month.year (dd.mm.yy)	##.##.##
136	1	' '	Blank character (HEX 20)	' '
137	8	##:##:##	Time of day, hour:minute:second (hh:mm:ss)	##:##:##
145	1	' '	Blank character (HEX 20)	' '
146	1	*	Asterisk (identifier for following check sum)	*
147	2	CC	Check sum (XOR, initial value HEX 00)	CC
149	1	<CR>	Carriage return (HEX 0D)	<CR>
150	1	<ETX>	End of Text character (HEX 03)	<ETX>



## 11.7 Telegram 7

### Like telegram 6 with additional gust

Command: TR7 / command: TT7 (with DT=0, s. a. command DT and OP=0, see also command OP and Command II=0; see also Command II).

Telegram construction:

Position	Length	Example	Description	Meas. value error
1	1	<STX>	Start of text signs (HEX 02)	<STX>
2	5	###.#	Wind velocity unit [m/s], s. command OS	FFF.F
7	1	' '	space (HEX 20)	' '
8	5	###.#	Gust unit like wind velocity	FFF.F
13	1	' '	space (HEX 20)	' '
14	3	###	Wind direction [°]	FFF
17	1	' '	space (HEX 20)	' '
18	3	###	Wind direction of gust [°]	FFF
21	1	' '	space (HEX 20)	' '
22	5	###.#	Temperature [°C]	FFF.F
27	1	' '	space (HEX 20)	' '
28	3	###	relative humidity [%]	FFF
31	1	' '	space (HEX 20)	' '
32	6	####.#	Air pressure [hPa]	FFFF.F
38	1	' '	space (HEX 20)	' '
39	6	#####	Brightness north [lux]	FFFFFF
45	1	' '	space (HEX 20)	' '
46	6	#####	Brightness east [lux]	FFFFFF
52	1	' '	space (HEX 20)	' '
53	6	#####	Brightness south [lux]	FFFFFF
59	1	' '	space (HEX 20)	' '
60	6	#####	Brightness west [lux]	FFFFFF
66	1	' '	space (HEX 20)	' '
67	6	#####	Brightness max. value/vectorial sum [lux] (s. command BO)	FFFFFF
73	1	' '	space (HEX 20)	' '
74	3	###	Direction of brightness [°]	FFF
77	1	' '	space (HEX 20)	' '
78	1	#	Precipitation event [0/1]	F
79	1	' '	space (HEX 20)	' '
80	7	###.###	Precipitation intensity[mm/h]	FFF.FFF
87	1	' '	space (HEX 20)	' '
88	6	###.##	Precipitation total [mm/d]	FFF.FF
94	1	' '	space (HEX 20)	' '
95	2	##	Synop (table 1, chapter 3.5.2)	FF
97	1	' '	space (HEX 20)	' '
98	1	*	Star (marking for following checksum)	*
99	2	CC	Checksum (XOR)	CC
101	1	<CR>	Carriage Return (HEX 0D)	<CR>
102	1	<ETX>	End of Text signs (HEX 03)	<ETX>

The precipitation total [mm/d] is reset at 00:00 o'clock of the next day!  
 Missing measuring values by partial expansion stage are marked with „F“ like „measuring value error“.

Extension of telegram by time and date is possible s. chapter 9. command DT.

## 11.8 Telegram 14 Scientific telegram

### Scientific diagnostics telegram

Command: TR14 / Command: TT14 (with DT=0, s. a. Command DT and OP=0, see also Command OP)

Telegram structure: Position	Length	Example	Description
1	5	VV.VV	Wind speed unit [m/s], see Command OS
6	1	;	Semicolon (HEX 3B)
7	5	DDD.D	Wind direction [°]
12	1	;	Semicolon (HEX 3B)
13	5	+VT.x	Virtual temperature [°C]
18	1	;	Semicolon (HEX 3B)
19	5	SNxxx	Propagation time converter 3 towards converter 1 (south to north)
24	1	;	Semicolon (HEX 3B)
25	5	WExxx	Propagation time converter 4 towards converter 2 (west to east)
30	1	;	Semicolon (HEX 3B)
31	5	NSxxx	Propagation time converter 1 towards converter 3 (north to south)
36	1	;	Semicolon (HEX 3B)
37	5	EWxxx	Propagation time converter 2 towards converter 4 (east to west)
42	1	;	Semicolon (HEX 3B)
43	2	BU	Measured value buffer content level 0..99%
45	1	;	Semicolon (HEX 3B)
46	1	H	Heating capacity .0 = off, 1..8 = 10..80%, 9 = 90..100%
47	1	;	Semicolon (HEX 3B)
48	5	+RT.C	Calculated air temperature [°C]
53	1	;	Semicolon (HEX 3B)
54	5	+TT.S	Temperature uncompensated [°C]
59	1	;	Semicolon (HEX 3B)
60	5	HUM.S	Relative humidity uncompensated [%]
65	1	;	Semicolon (HEX 3B)
66	5	HUM.C	Calculated relative humidity [%]
71	1	;	Semicolon (HEX 3B)
72	6	PRESS.B	Air pressure [hPa]
78	1	;	Semicolon (HEX 3B)

Position	Length	Example	Description
79	6	brighN	Brightness north [lux]
85	1	;	Semicolon (HEX 3B)
86	6	brighE	Brightness east [lux]
92	1	;	Semicolon (HEX 3B)
93	6	brighS	Brightness south [lux]
99	1	;	Semicolon (HEX 3B)
100	6	brighW	Brightness west [lux]
106	1	;	Semicolon (HEX 3B)
107	6	br_sum	Brightness max. value / vectorial sum [lux] (s. Command BO)
113	1	;	Semicolon (HEX 3B)
114	3	ddd	Direction of brightness [°]
117	1	;	Semicolon (HEX 3B)
118	8	RRRR.RRR	Precipitation intensity [mm/h]
126	1	;	Semicolon (HEX 3B)
127	1	#	Precipitation event [0/1]
128	1	;	Semicolon (HEX 3B)
129	5	+TT.n	Temperature in housing [°C]
134	1	;	Semicolon (HEX 3B)
135	4	VC.C	Supply voltage [V]
139	1	;	Semicolon (HEX 3B)
140	7	LCxxxxxx	Internal counter [ms]
147	1	*	Asterisk (identifier for following check sum)
148	2	CC	Check sum (XOR, initial value HEX 00)
150	1	<CR>	Carriage return (HEX 0D)
151	1	<LF>	Line feed (HEX 0A)

Example of a telegram:

```
02.42;242.5;+24.8;20451;20380;20538;20530;99;0;+24.1;+24.3;022.2;022.4;1000.4;000924;
000583;000331;000423;000924;015;000.000;0;+25.8;23.8;3210198*2F<CR><LF>
```

Extension of telegram possible to include date and time; s. section 9, Command DT:

```
00.21;320.8;+23.5;20548;20497;20533;20511;99;0;+22.8;+24.3;022.2;024.3;1000.4;000895;
000561;000338;000442;000895;012;000.000;0;+25.8;23.8;3250229;20.02.13;14:28:33*21
```

Incorrect values are indicated by : "???.?" or "!!!." in the telegram.

## 11.9 Telegram Addition by Parameter OP

By means of this parameter, it is possible to output additionally to each telegram – excepted the NMEA telegram (TR5/TT5) – the absolute humidity and/or the dew point temperature, wind chill, heat index and direction of magnetic compass and rain temperature. The output is carried out always after the measuring values, and before date/time resp. before the checksum if DT=0.

By “OP=12345“, all parameters are delivered in the order of the following table.

The order of the optional parameters can be freely defined with the OP command under the following conditions:

The number of additional optional parameters is limited to 5 and the Parameter value must not exceed 65534..

Telegram construction:

Length	Example	Description	Meas. value error
---	s. Telegram	Last measuring value of set telegram.	s. Telegram
1	' ' or ;	space (pre-set telegram separator).	'' or ;
4	###.#	Absolute humidity [g/m <sup>3</sup> ].	FF.F
1	' ' or ;	space (pre-set telegram separator).	'' or ;
5	###.#	Dew point temperature [°C].	FFF.F
1	' ' or ;	space (pre-set telegram separator).	'' or ;
5	###.#	Wind chill temperature [°C].	FFF.F
1	' ' or ;	space (pre-set telegram separator).	'' or ;
5	###.#	Heat Index Temperatur [°C].	FFF.F
1	' ' or ;	space (pre-set telegram separator).	'' or ;
5	###.#	Direction from magnet compass [°] (optional).	FFF.F
1	' ' or ;	space (pre-set telegram separator).	'' or ;
5	###.#	Heat index temperature [°C].	FFF.F
1	' ' or ;	space (pre-set telegram separator).	'' or ;
6	####.#	Globalradiation [W/m <sup>2</sup> ].	FFFF.F
1	' ' or ;	space (pre-set telegram separator).	'' or ;
5	###.#	Rain temperature with sign [°C] (optional).	FFF.F
1	' ' or ;	space (pre-set telegram separator).	'' or ;
---	s. Telegram	Date/time if DT>0, or checksum.	s. Telegram

## 12 Technical Data

### **Attention:**

*For the actual scaling of the analogue outputs, please refer to the supplementary sheet "Factory setting" on delivery or Table 9.*

Parameter		
<b>Wind velocity</b> <sup>1</sup>	Measuring range	0.01 ... 60 m/s Scaling of analogue output freely selectable.
	Accuracy	≤ 10 m/s: ±0.25 m/s (rms - mean over 360 °)
		≤ 30 m/s: ±2.5 m/s (rms - mean over 360 °)
		30 ... 60 m/s: ±3.5 % (rms - mean over 360 °)
Resolution	0.1 m/s: in telegrams 1, 2, 3, 5, 6	
	0.01 m/s: in telegram 14	
<b>Wind direction</b> <sup>1</sup>	Measuring range	0 ... 360 °
	Accuracy	±2.0 ° (rms - mean over 360°) with WS > 2 m/s ±3.0 ° (rms - mean over 360°) with WS > 35 m/s
	Resolution	1 °: in telegrams 1, 2, 3, 4, 6
0.1 °: in telegrams 5, 14		
<b>Acoustic virtual temperature</b> <sup>2</sup>	Measuring range	-50 ... +80 °C
	Accuracy	±0,5 K at absolutely dry air in the range of 20 °C. The acoustic temperature is not suitable for the exact measurement of air temperature. It serves exclusively for the verification of the acquired wind measuring values
	Resolution	0.1 K
<b>Air temperature</b> <sup>3</sup>	Measuring range	-50 ... +80 °C
	Accuracy	±0.3 K @ 25 °C ±0.5 K @ -45 ... +60 °C ±1.0 K @ -50 ... +80 °C
	Resolution	0.1 K
	Long-term stability	< 0.04 K per year
<b>Air humidity, relative</b> <sup>3</sup>	Measuring range	0 ... 100 % relative humidity
	Accuracy	±1.8 % of 10 ... 90 %, ±3.0 % of 0 ... 100 %
	Long-term stability	<0.5 % per year
	Resolution	0.1 %
<b>Air pressure</b> <sup>3</sup>	Measuring range	260 ... 1260 hPa
	Accuracy	typ. ± 0,25hPa @ -20 ... +80°C @ 800...1100hPa
		typ. ± 0,50hPa @ -20 ... +80°C @ 600...1100hPa
		typ. ± 1,00hPa @ -50 ... -20°C @ 600...800hPa
Resolution	0,1 hPa	
Long-term stability	typ. ± 0,3 hPa pro Jahr	
<b>Brightness</b> <sup>4</sup>	Measuring range	1 ... 150.000 Lux
	Accuracy	3 % of relative measured value.
	Resolution	Approx. 0.3 % of measuring value.
<b>Brightness direction</b> <sup>4</sup>	Measuring range	0 ... 360 °, 0 ° ≙ Brightness <10.000 Lux
	Accuracy	Typically < 2° in direct sunlight without clouds
<b>Twilight</b> <sup>4</sup>	Measuring range:	0 ... 250 Lux

	Accuracy: Resolution:	3 % of relative measured value Approx. 0.3 % of measuring value
<b>Precipitation</b> <sup>5</sup>	Measuring ranges:	
	Intensities	0.001 ... 999 mm/h
	Resolution intensity	0.001 mm/h
	Daily total	0.01 ... 999 mm
	Resolution daily total	0.01 mm
	Droplet size	0.25 ... 5.0 mm, large as hail.
	Accuracy with precipitation	With 95% of the precipitations deviations less than 10% compared with Laser Precipitation Monitor (Reference)
	Type of precipitation	Rain, snow, sleet, ice crystals, hail
<b>Rain Temperature</b> <sup>9</sup>	Measuring range	5 ... 50 °C
	Resolution	0,1 °C
	Accuracy	0,5 °C
<b>Electr. compass</b> <sup>6</sup> Differential angle of instrument north marking to magnetic north pole	Measuring range	1 ... 360 °
	Accuracy	Typically <2 ° in magnetically undisturbed environment
	Resolution	0.1 °
<b>Derivative Parameter</b>		
<b>Absolute Humidity</b> <sup>3</sup>	Measuring Range:	0 ... 10,00 g/m <sup>3</sup>
	Resolution:	0.01 g/m <sup>3</sup>
<b>Dew point temperature</b> <sup>3</sup>	Measuring range:	Data see „Air Temperature“
	Accuracy:	
	Resolution:	
<b>Windchill temperature</b> <sup>3</sup> Remark: measuring value valid only from ≤10°C	Measuring range:	Data see „Air Temperature“
	Accuracy:	
	Resolution:	
<b>Heat index temperature</b> <sup>3</sup> Remark: measuring value valid only from ≥26°C	Measuring range:	Data see „Air Temperature“
	Accuracy:	
	Resolution:	
<b>Direction of magnetic compass (optionally)</b> <sup>6</sup>	Measuring range:	1 ... 360 °
	Accuracy:	Typ. <2 ° in magnetically undisturbed surroundings.
	Resolution:	0.1 °
<b>Global radiation</b> <sup>8</sup> is calculated with the brightness measurement.	Measuring range:	0 ... 2000 W/m <sup>2</sup>
	Accuracy:	Typ. ± 30 W/m <sup>2</sup> compared to a Class B pyranometer
	Resolution:	1 W/m <sup>2</sup>

<b>Data output digital</b> <sup>7</sup>	Interface	RS 485 / RS 422 Electrically isolated from supply
	Baud rate	1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200, 230400, 460800, 921600 selectable
	Output	Instantaneous values, sliding means from 100msec to 10 min in increments of 100msec freely selectable.  The mean value of the last minute is always output for the precipitation intensity. Precipitation totals are reset at the beginning of the next day "00:00:00".
	Output rate	One per 20 msec to one per 60 seconds in increments of 1 msec freely selectable.
	Protocol	MODBUS RTU
	Parameter	All a/m parameters, including derivative parameters, are depending on the respective model.
<b>Data output analogue</b> <sup>7</sup>	Electrical outputs	0 ... 10 V Electrically isolated from supply. Please see table 9. selectable parameters with scaling.
<p>Attention: For the actual scaling of the analogue outputs, please refer to the supplementary sheet "Factory setting" on delivery or Table 9.</p>		
	Quantity	max. 8
	Burden	Permissible burden on voltage output: $\geq 2000 \Omega$ .
	Output	Instantaneous values, sliding means from 100msec to 2min in increments of 100msec freely selectable.
	Output rate	Update rate at an output rate (see command OR) $\geq 250$ msec always 250 msec. For output rates $< 250$ msec applies: update rate = output rate. Recommended output rates $\geq 100$ msec with an average AV1 = 100 msec
	Resolution	16 bit
	Parameter	@ FS6002-MBRU-A1B1H1R1T1W1W2-G : WV, WD, Temp., Rel. H., Air Pressure; Brightness, Direction of brightness, Precipitation
		@ FS6002-MBRU-A1H1T1W1W2: WV, WD, Temp., Rel. H., Air Pressure
		@ FS6002-MBRU-B1R1W1W2-G: WV, WD, Brightness, Precipitation
		@ FS6002-MBRU-W1W2 : WV, WD,
<b>GPS reception</b>	Low power consumption GPS receiver, integrated RTC and antenna	
	Service life of the RTC (buffered by battery)	Ca. 10 years.

<b>General</b>	Internal measuring rate	Wind: up to 500 propagation time measurements per second, up to 125 complete measuring sequences/second incl. calculations. Temperature, humidity, pressure, precipitation, brightness: updated 1x a second.
	Bus mode	Bus mode with up to 99 devices possible.
	Firmware update	Firmware update via RS422/485 with 4800 Bd..115200 Bd 8N1 in full duplex and half duplex mode.
	Temperature range	Operating temperature -50 ... +80°C Storage temperature -55 ... +80°C
Operating voltage	Supply without cover heating	6 ... 40V DC or 10 ... 28V AC 50Hz / 60Hz typ. 50mA @ 24V
Housing	Wheather Station	Plastic: LEXAN (polycarbonate, UV-stabilised) impact and weather-resistant.
	Mounting	e.g. on mast tube outer-Ø 48 ... 49mm, inner-Ø >30mm
	Type of connection	19 pin plug connection.
	Weight	Approx. 900 g (full version).

1),2), 3), 4), 5), 6), 7), 8)

@ FS6002

1), 2), 3), 6), 7)

@ FS6002-MBRU-A1H1T1W1W2

1), 2), 4), 5), 6), 7) 8)

@ FS6002-MBRU-B1R1W1W2-G

1), 2), 6) 7)

@ FS6002-MBRU-W1W2

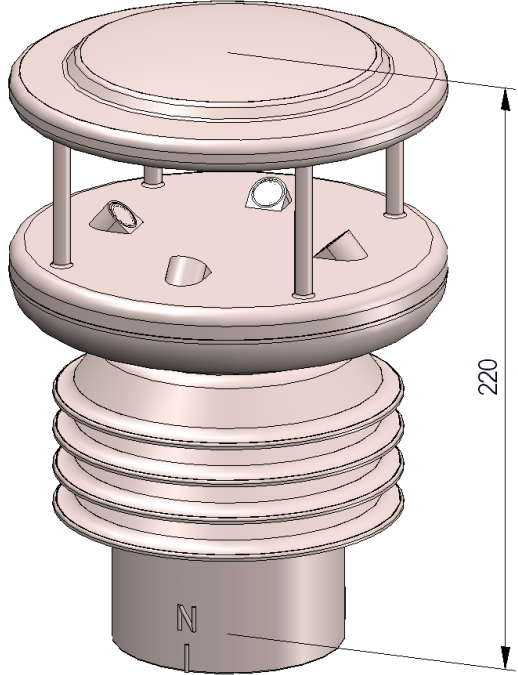
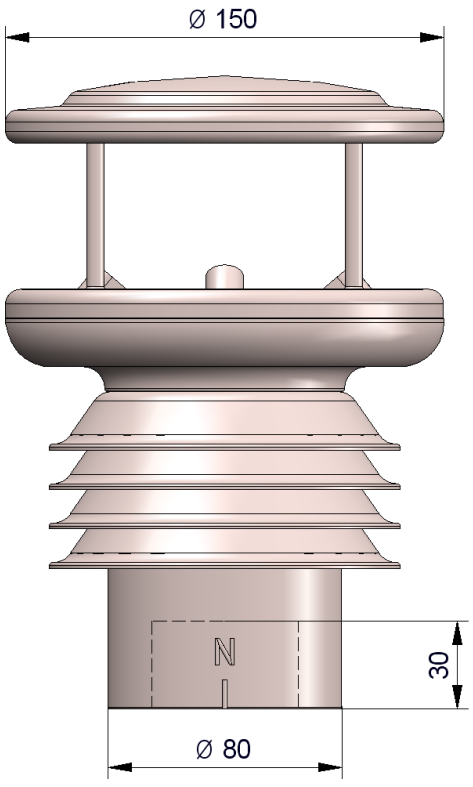
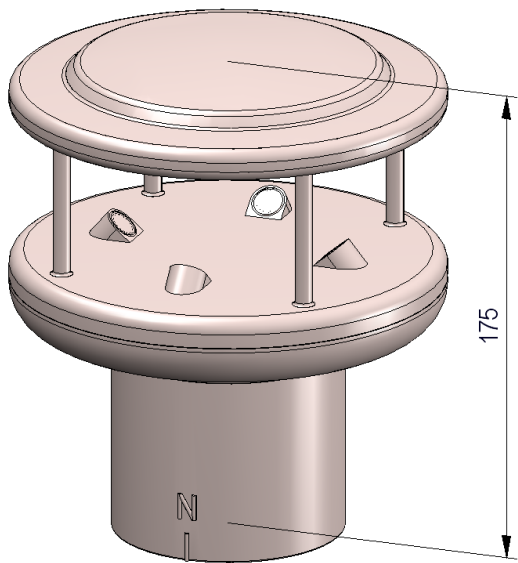
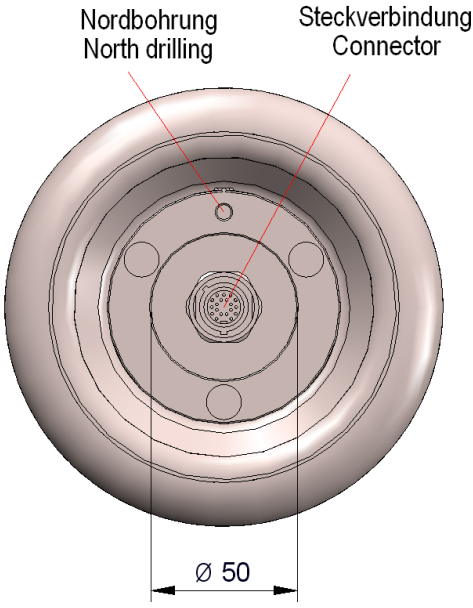
## 13 Accessories (available as optional features)

<b>Connecting cable, complete</b>	<b>ZM/O-90</b>	10m, 16-pin cable (16x0.25) with socket outlet on transmitter side.
<b>Connecting cable, complete</b>	<b>ZM/O-90/10-8</b>	10m, 8-pin cable (8x0.25) with socket outlet on transmitter side.
<b>Lightning rod</b>	<b>ZM/O-81</b>	To protect the sensors.

Other accessories available on request.



# 14 Dimension Drawing



## Factory Settings FS6002

Function	Parameters	Value	Customer adjustment
Analog barometric pressure range	AB	80106	
Analog humidity output range	AH	00100	
Analog brightness output range	AL	00120	
Average mode	AM	00001	
Analog on	AO	00001	
Analog precipitation output scale	AP	00100	
Analog output range	AR	00060	
Analog Temperature output range	AT	14060	
Brightness option	BO	00000	
Baud parity	BP	00008	
Baudrate in baud per second	BR	00096	
Bus termination	BT	00000	
Command interpreter	CI	1	
Duplex mode	DM	00000	
Direction output analogue	DO	00001	
Date and timestamp	DT	00006	
Help	HH	00000	
Heating power minimum at start condition	HP	00010	
Height setting	HS	00001	
Heating mode	HT	00001	
North correction	NC	00000	
Output link of optional values to the analog outputs 4-8	OL	12789	
Output rate	OR	01000	
Output scale of wind velocity	OS	00000	
Response delay	RD	00020	
Real time clock	RT	00003	
Station height in meters for calculation of pressure at sea level	SH	00000	
Serial number	SN	<i>individual</i>	
Software version	SV	<i>individual</i>	
Time zone	TZ	00000	
Transmit Telegram cyclic output	TT	00000	
Optional Parameter	OP	00000	

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*\* 14 ct/min. from german network -  
max. 42 ct/min. from german mobile phone*

- Änderungen vorbehalten -