Wind Transmitter >>First Class<<
Advanced X

Instruction for Use

Classified according to IEC 61400-12-1 EDITION 2.0 (2017-03)

4.3352.00.400 / 401

4.3352.10.400 / 401

Dok. No. 021814/08/18

THE WORLD OF WEATHER DATA

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 **Adolf Thies GmbH & Co. KG**. Only components and spare parts supplied and/or recommended by **Adolf Thies GmbH & Co. KG** should be used for repairs.
- Electrical devices/products must be mounted and wired only in a voltage-free state.
- **Adolf Thies GmbH & Co KG** 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 **Adolf Thies GmbH & Co KG** .
- Recommendation: As it is possible that each measuring system / device / product may, under certain conditions, and in rare cases, may also output erroneous measuring values, it is recommended using redundant systems with plausibility checks for **security-relevant applications**.

Environment

- As a longstanding manufacturer of sensors Adolf Thies GmbH & Co KG is committed to the objectives of environmental protection and is therefore willing to take back all supplied 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 Thies products concerned free of charge if returned to Thies 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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- 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.

Table of contents

Patent

This device is protected by patents.

Patent no.: EP 1 398 637

Patent no.: DE 103 27 632

Patent no.: EP 1 489 427

1 Device versions

Order no.	Measuring range	Serial interface / Data format	Supply	Heater
4.3352.00.400	0,3 ... 75m/s	RS 485 / ASCII	3,7 … 42V DC	24V AC/DC, 25W
4.3352.10.400	0,3 ... 75m/s	RS 485 / ASCII	3,7 … 42V DC	without
4.3352.00.401	0,3 ... 75m/s	RS 485 / MODBUS	3,7 … 42V DC	24V AC/DC, 25W
4.3352.10.401	0,3 ... 75m/s	RS 485 / MODBUS	3,7 … 42V DC	without

The following parts are included in the scope of delivery:

1 x Wind transmitter.
1 x Connection plug.
1 x Instructions for use.

2 Application

The wind transmitter is intended for use in the wind energy, meteorology and environmental measuring technology. Primarily developed for position evaluation and measurement of power curves of wind turbines, the anemometer gathers the following measured variables:

- Horizontal component of the wind velocity.
- Absolute and relative air pressure.
- Inclination angle between the Z-axis and the vertical.
- Inclination angle between the X-axis and the horizontal.
- Inclination angle between the Y-axis and the horizontal.
- Frequency and amplitude of the vibration measurement in the X-, Y- and Z-axis.
- Housing interior temperature.

Further characteristics include a defined and optimized dynamic behavior even at highly intense turbulences, minimal over velocitying, a low starting value and an optimized oblique inflow behavior.

An integrated compensation of the effect of the air density on the rotation velocity of the cup star distinguishes this sensor especially in its characteristics.

There is a digital interface to the device in form of an RS485 interface in half-duplex mode. Together with the ID-based communication, the interface enables the operation of the wind transmitter in a bus. Tow data protocols are available:

- ASCII (THIES format).
- Binary (MODBUS-RTU).

For operation in winter, the device can be equipped optionally with an electronically controlled heater which provides a hardly measurable friction moment of the ball bearings in low temperatures and provides any ice build-up on shaft and on the gap.

3 Setup and mode of operation

The wind transmitter can be supplied with direct voltages from 3.7V up to 42V at very low power consumption. Supply of the optional heater is provided separately with a direct or alternate voltage of 24V. The heater will most probably prevent the wind transmitter First Class even under extreme meteorological icing conditions.

The external parts of the device are made from corrosion resistant anodized aluminum. Highly efficient labyrinth seals and O-rings protect the sensitive parts on the inside of the device from humidity and dust influences. It is assembled on a mast pipe, the electric connection is in the lower part of the sensor.

Wind velocity:

A cup star with ball bearing and low inertia and 3 cups from carbon fiber reinforced plastic is rotated by the wind. The velocity is sensed opto-electronically, translated into a square signal with frequency proportional to the velocity and measured 4 times per second. The measured frequency is converted into a wind velocity with the standard curve. An adaptation of this standard curve can be done with calibration values from a programmable calibration table (**Standard curve and calibration tables).**

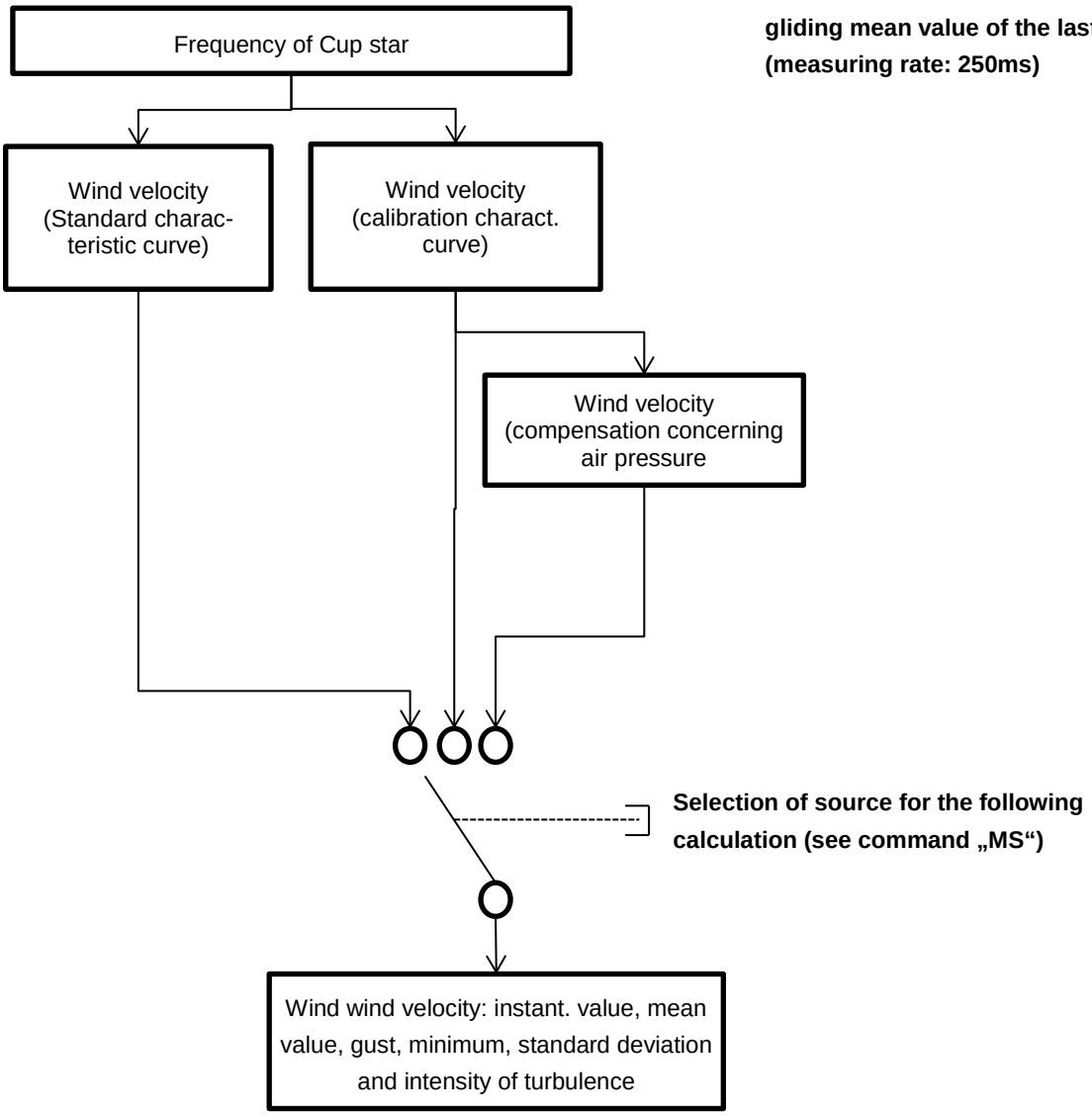
The compensation depending on the air pressure which is calculated with the help of the calibration table.

All corrected wind velocity values are available as instantaneous values. The Instantaneous value is the gliding mean value of the last second.

For the calculation of mean value, gust, minimum value, standard deviation and intensity of turbulence the source can be selected by the command „MS“.

The following figures show the described connection.

The following figure shows the described relationships.



When there is no calibration characteristic curve existing the calibration, characteristic curve equals the standard characteristic curve.

Instantaneous value:

The instantaneous value is the gliding mean value of the last second. The scanning of the measuring values is carried out every 0.25s, and is not alterable. The measuring value, queried at any time, includes always the data of the last second measured in the moment of query.

Remark:

From firmware version V02.09, is the interval of the gliding mean value one second. All older versions work with an interval of 3 seconds.

Mean value:

The mean value is the gliding mean value of the last ‚n' seconds. ‚n' is defined by the parameter MI.

Minimum:

The minimum specifies the minimum instantaneous value of the last minute.

Gust:

The gust is the maximum instantaneous value of the last minute.

Air pressure:

A highly precise digital pressure sensor (piezoresistive) is used to measure the absolute air pressure. The wind transmitter will calculate the relative air pressure from that and the set altitude (**Command SH**).

Remark: The absolute air pressure is used for application of the wind velocity compensation by means of air pressure. Indicating the sensor height by parameter SH is not required.

Inner Housing temperature:

An integrated, digital temperature sensor measures the housing interior temperature.

Inclination/vibration:

The measurement of the acceleration in space is done via a 3-axis acceleration sensor. The wind transmitter will calculate the inclination angle and vibrations (frequency and amplitude).

The inclination measurement is basing on the measurement of the acceleration of gravity. The three sensitive axes of the sensor are sensitive each only in one direction, thus only that value of the gravity acceleration is measured which affects in direction of these axes. The slope of the sensor in space is calculated from these three measuring values.

The angle ρ is defined as angle between the x-axis (north – south axis), and the horizontal.

The angle ϕ is defined as angle between the y-axis (west – east axis), and the horizontal.

The angle θ is the angle between the z-axis, and the vertical.

Oscillations or vibrations of the mast can be acquired (mast monitoring). The measuring values of the three sensitive axis undergo a frequency analysis.

Here, each axis is considered separately, and the frequency with the highest amplitude is used as measuring value.

Housing interior temperature

An integrated digital temperature sensor measures the housing interior temperature.

Frequency output:

In the pre-setting the incorrected pulse values of the sensor are delivered on the frequency output. It behaves according to 4.3351.x0.000. The behavior of the frequency output is set by parameter FO.

Intensity of turbulence:

The intensity of turbulence is calculated from the instantaneous values of the wind velocity.

$$SD = \sqrt{\frac{1}{n} * \sum_{i=1}^{n} (v_i - \overline{v})^2}$$

SD: Standard deviation wind velocity
xi: instantaneous value wind velocity
/x: mean value wind velocity
T: Intensity of turbulence

$$T = \frac{SD}{\overline{v}}|$$

4 Standard curve and calibration tables

The measured frequency is converted into a wind velocity (in proportion to the velocity of the cup star) with the standard curve:

$y = 0{,}0462 \bullet f + 0{,}21$ y: Wind velocity in [m/s]

f: Frequency in [Hz]

Remark:

At frequencies less then 2Hz will be set the wind velocity to 0m/s.

The standard curve can be corrected via a programmable calibration table with 32 entries.

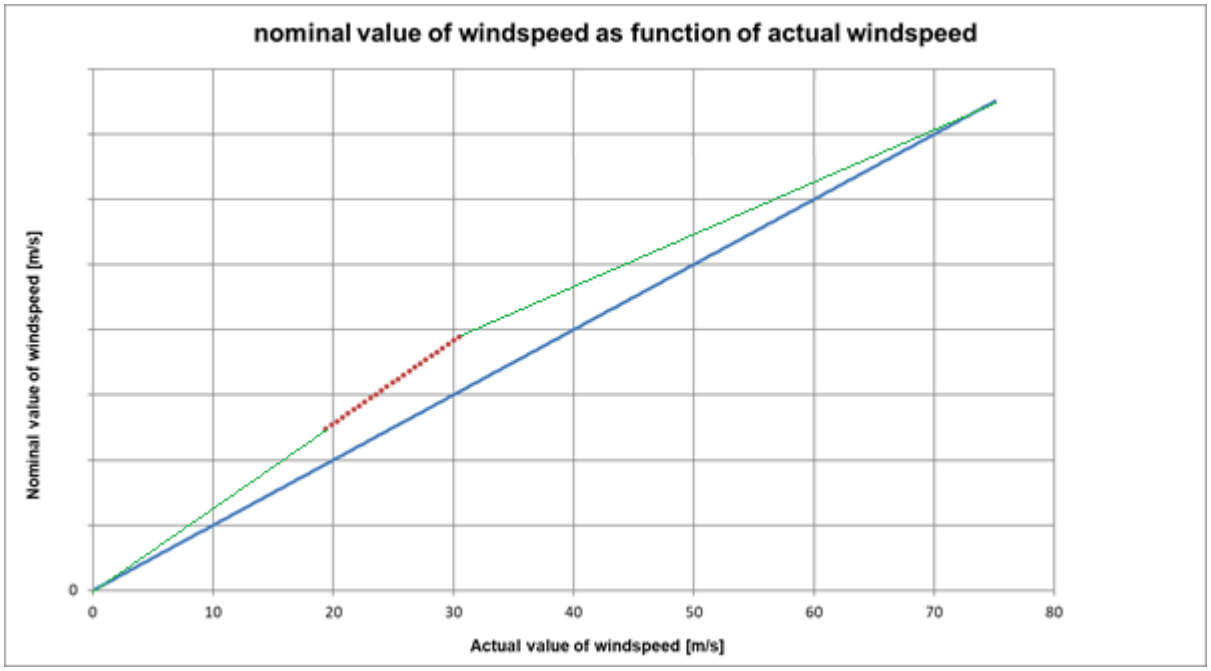
The wind transmitter can save up to 10 calibration tables, including calibration certificate number, user-defined text, date and time of the calibration.

The entries within the calibration table are in form of X/Y value pairs. The X-values correspond to the actual wind velocity in m/s with 2 decimal places and the Y-values correspond to the related target wind velocity, also in m/s with 2 decimal places.

All entries of a non-programmed, i.e. unfilled table, are set on 0xffff.

It's not required to fill all 32 places in the table. The characteristic curve must represent part of the measuring range. The entries in the calibration tables have to start with the first index and must be continuing.

The following figure shows the relationship between a calibration table, the normal curve and the approximation outside the calibration area.



Curve of a calibration table and normal curve

Blue: standard characteristic curve, red: calibration curve, green: interpolation outside the calibration curve

If the measured actual wind velocity is between 2 entries of the table, the wanted target wind velocity is determined by linear interpolation.

If the measured actual wind velocity is outside the table range, the Bit2 is set in the status word and the standard curve is interpolated as follows:

- Is the measurement below the curve range, we have to interpolate between the starting point of the standard curve and the first table value.
- Is the measurement above the curve range, we have to interpolate between the last table value and the wind velocity 75m/s at the standard curve.

For the calculation of the corrected wind velocity, the calibration table last created is used.

Remark:

After setting the time stamp, the calibration table can no longer changed.

4.1 Determine occupied calibration tables

In order to query the free and the already occupied calibration tables, the **Command RC** can be used with parameter 99. In the response string for the command “RC99”, the wind transmitter will output the time stamp of all 10 calibration tables. The time stamps are divided by the semicolon.

Example:

01RC99\r

2016.04.12;11:12:00;2010.00.00;00:00:00;2010.00.00;00:00:00;2010.00.00;00:00:00;2010.00.00;00:00:00;2010.00.00;00:00:00;2010.00.00;00:00:00;2010.00.00;00:00:00;2010.00.00;00:00:00;

4.2 Read calibration table

Reading the data from the calibration tables is done with the **Command RC**. The parameter will indicate the calibration table to be read (0: standard curve, 1 ... 10: Calibration tables). In the response for the command “RC<parameter>”, the wind transmitter will output all 32 table entries and calibration certificate number, user-defined text and time stamp of the table.

Example:

01RC1\r

00000;00000;00242;00242;00484;00484;00726;00726;00968;00968;01210;01210;01452;01452;01694;01694;01936;01936;02178;02178;02420;02420;02662;02662;02904;02904;03146;03146;03388;03388;03630;03630;03872;03872;04114;04114;04356;04356;04598;04598;04840;04840;05082;05082;05324;05324;05566;05566;05808;05808;06050;06050;06292;06292;06534;06534;06776;06776;07018;07018;07260;07260;07502;07502;0000001234;Test;2016.04.12;11:12:00

4.3 Write calibration table

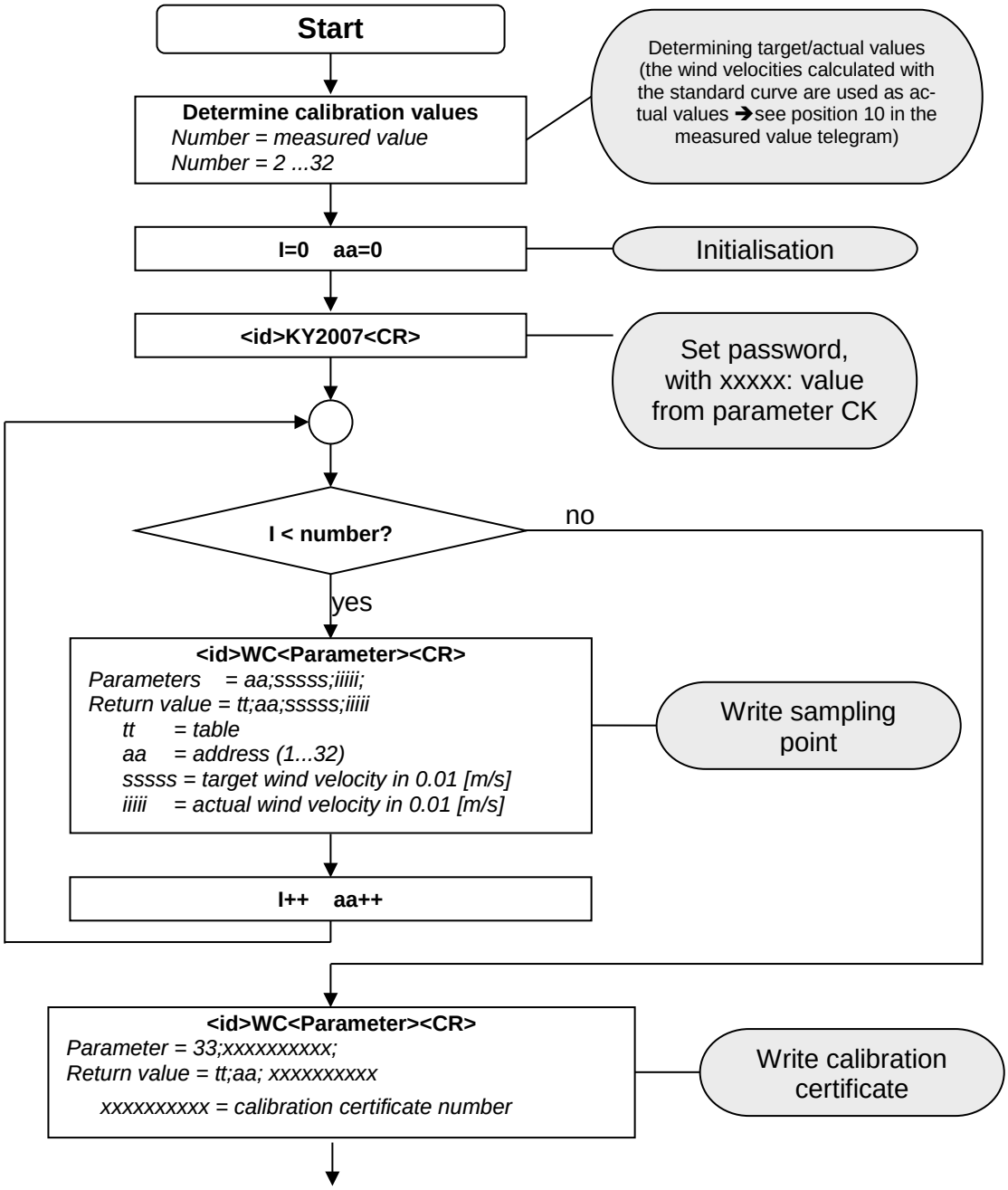
Writing a calibration table is done with the **command WC**. With the parameter, the address to be written, and target and actual value of the sampling point (or calibration certificate number or user string or date/time) will be specified.

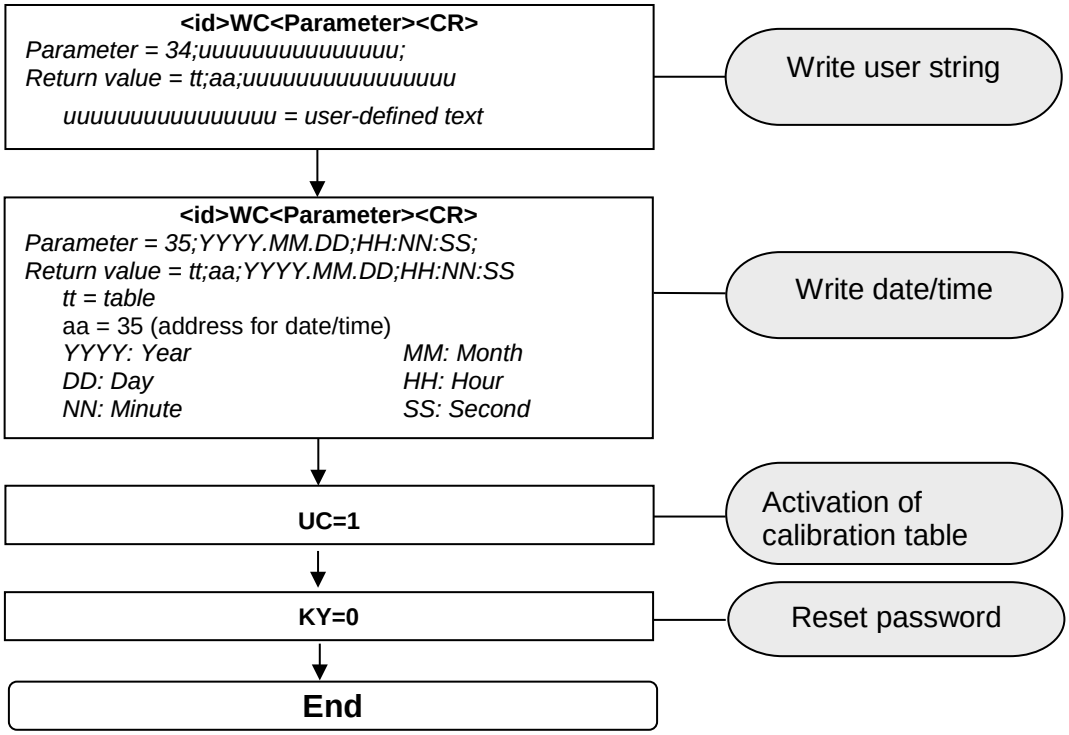
The written table entry is delivered back with the response telegram.

When writing in a calibration table, the next free table is always used. Writing into the memory of a table can be repeated as often as required as long as the memory for date/time is still empty.

A table is only used for the calculations if it has been completed with the date/time information.

The following flow diagram shows the process of writing a calibration table:





5 Integrated corrections

The measured values for wind velocity and air pressure are corrected in the transmitter and can be queried with the measured value telegram 3.

The following corrections are implemented:

- Correction of the wind velocity depending on the air pressure.

5.1 Correction of the wind velocity depending on the air pressure

The rotational velocity of the cup star depends on the air density and thus on the air pressure. The correction of this dependency is done in a pressure range of 700hPa to 1100hPa.

6 Recommendation Side Selection / Standard Installation

In general, wind measuring instruments are supposed to record wind conditions over a large area. According to international regulations, the surface wind should be measured at a height of 10m above even open terrain, in order to achieve comparable values. An open terrain is defined as terrain where the distance between the wind-measuring instrument and the next obstacle is at least ten times the height of this obstacle (acc. to VDI 3786 sheet 2 as well as Guide to Meteorological Instruments and Methods of Observation, Sixth Edition, WMO-No. 8). If this regulation cannot be fulfilled, the measuring instrument should be installed at a height at where the measurement values are not influenced by any local obstacles. In any case, the measuring instruments should be installed at a height of 6 … 10m above the mean height of the buildings or trees in the vicinity. If it is necessary to install the instrument on a roof, it should be installed in the center of the roof in order to avoid any preferential directions.

7 Installation

Attention:

Storing, mounting, and operation under weather conditions is permissible only in vertical position, as otherwise water can get into the instrument.

Remark:

When using fastening adapters (angle, traverses, etc.) please take a possible effect to the measuring values by shading into consideration.

Caution:

The device may only be supplied with a power supply of the "Class 2, limited power".

7.1 Mechanical Mounting

The wind transmitter must be mounted on an instrument carrier, which is suited for the measurement. For dimensions of wind direction transmitter please refer to chapter 8.

Tools:

Hexagon socket wrench SW3 (Allen key).

Procedure:

1. Lead a prepared cable with assembled plug through the bore hole of mast, tube, arm etc., and connect it to the wind transmitter.
2. Put wind transmitter on mast, tube, arm etc.
3. Align wind transmitter to “north”. (**procedure see chapter 7.1.1**)
4. Safeguard the wind transmitter by two M6-Allen head screws.

Remark:

Suitable instrument carriers are masts, tubes, traverses, arms, adapters, adapters of POM for isolated mounting, which correspond to the mounting dimensions of the wind transmitter, and to the static requirements.

The inner diameter of the instrument carrier should be ≥ 20mm based on plug- and cable feed-through.

7.1.1 North Alignment

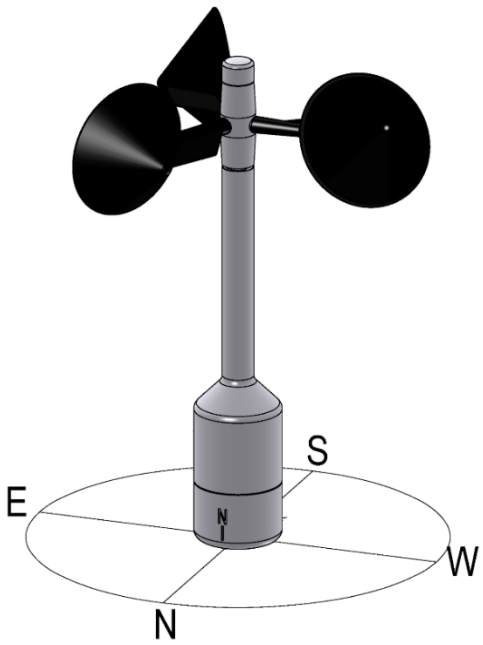
For the precise determination of the **Inclination angle** the Wind Transmitter must be aligned **northwards** (geographical north).

Tools:

Hexagon socket wrench size 3 (Allen key).

Procedure:

1. Detect a prominent object in the surrounding area (tree, building etc.) in north direction by means of a compass.
2. Via the north marking (N) and an imaginary north-south axis the Wind Transmitter is to be located on the prominent object.
3. Align Wind Transmitter.
   The north marking must indicate to the geographic north.
4. In case of match the Wind transmitter is to be secured by an M6- hexagon socket screw.



Remark:

If the north alignment is carried out by compass, please consider the local declination (= deviation of direction of the magnetic needle from the true north), and local magnetic interferences (e.g. hardware, electric cable).

For installation and north alignment of the wind transmitter please use the optional *north ring* art. no. 509619.

When aligning the Wind Transmitter on a moving object (e.g. vehicle, wind wheel, ship etc.) please consider that the “north point” to be determined, might possibly be located on the object.

7.2 Electrical Mounting

7.2.1 Cable

Solder a shielded cable with diameter 7-8mm and a core cross-section of 0.5...0.75mm² to the enclosed coupling socket.

- The number of necessary wires is given in the connection diagram (chapter 7.3).

7.2.1.1 Cable Recommendation

No. of wires/ diameter / type / cable diameter
CABLE 8x0.5mm² LIYCY BLACK, UV- resistant, Ø 7.6mm

7.2.2 Cable Shield

The connection of the cable shield between sensor and data acquisition device should be selected in way, that in case of over-voltages no equalizing currents will flow that might destroy the electronic components.

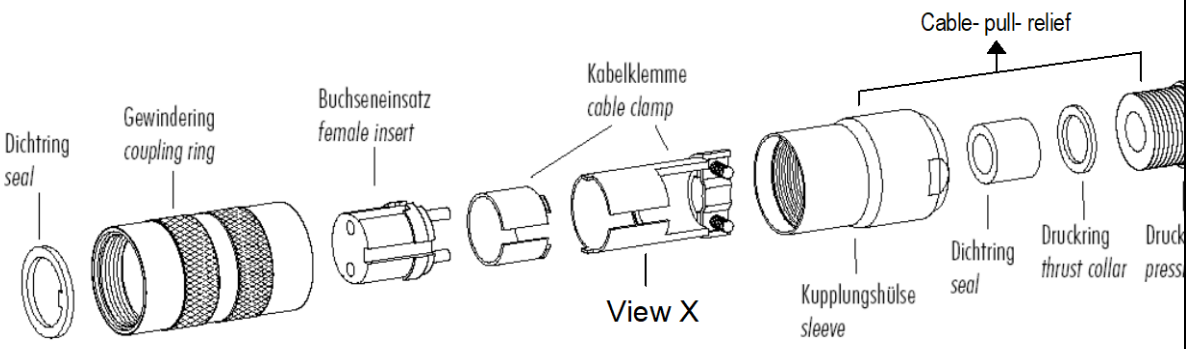
The connection of the cable shield should depend on the selected isolated, or respectively, non-isolated mounting of the sensors.

7.2.2.1 Connection recommendation for the cable shield

	Sensor Carrier	Sensor	Shielding / Ground	Lightning Protection
1.	Metallic measurement mast, grounded	**Isolated** mounting at the measuring mast (e.g. by non-metallic brackets, holder etc. or by metallic brackets, holder etc. with isolated plastic adaptors).	Apply the cable shield between sensor and data acquisition device (e.g. datalogger) both-sided. Ground data acquisition device.	Mount metallic lightning protection rod on the mast. Alternatively: Install separate lightning protection rod beside the measurement mast.
2.	Metallic measurement mast, grounded	**Non-isolated** mounting at the measurement mast (e.g. by metallic brackets, holders etc.).	Apply cable shield between sensor and data acquisition device (e.g. datalogger) only one-sided at the acquisition device. Ground data acquisition device.	Mount metallic lightning protection rod on the mast in **isolated condition**, and ground lightning protection rod. Alternatively: Install separate lightning protection rod beside the measurement mast.
3.	Metallic measurement mast, not grounded (mounted in isolated condition, e.g. on the attic)	**Non-isolated** mounting at the measurement mast (e.g. by metallic brackets, holders etc.).	Apply the cable shield between sensor and data acquisition device (e.g. datalogger) both-sided. Ground data acquisition device.	Mount metallic lightning protection rod on the mast in **isolated condition**, and ground lightning protection rod. Alternatively: Install separate lightning protection rod beside the measurement mast.
4.	Non-metallic measuring mast (=isolated)	Mounting at the measurement mast (e.g. by metallic brackets, holders etc.).	Apply the cable shield between sensor and data acquisition device (e.g. datalogger) both-sided. Ground data acquisition device.	Mount metallic lightning protection rod on the mast, and ground lightning protection rod. Alternatively: Install separate lightning protection rod beside the measurement mast.

7.2.3 Plug and cable mounting

Coupling socket, Type: Binder, Serial 423, EMC with cable clamp



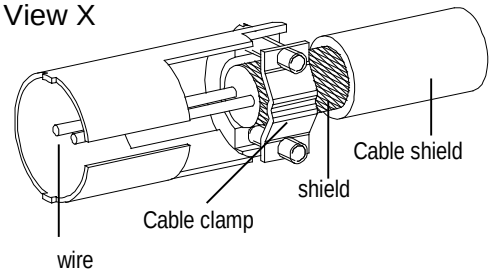
Cable connection: **with** cable shield

1. Stringing parts on cable acc. to plan given above.
2. Stripping cable sheath 20mm
   Cutting uncovered shield 15mm
   Stripping wire 5mm.

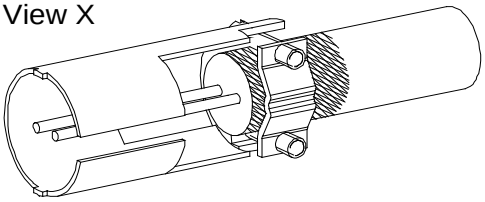
   Cable mounting 1
   Putting shrink hose or insolating tape between wire and shield.

   Cable mounting 2
   If cable diameter permits, put the shield backward on the cable sheath.
3. Soldering wire to the insert, positioning shield in cable clamp.
4. Screwing-on cable clamp.
5. Assembling remaining parts acc. to upper plan.
6. Tightening pull-relief of cable by screw-wrench (SW16 und 17).

Cable mounting 1
View X

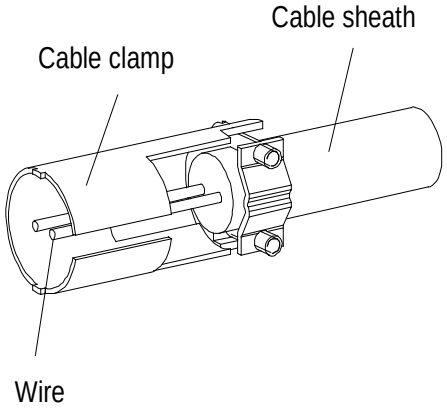


Cable mounting 2
View X



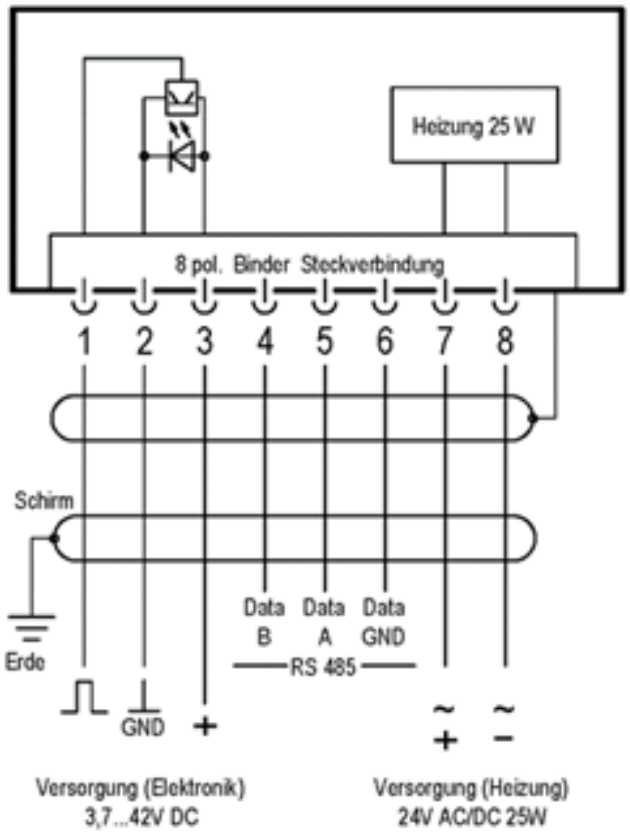
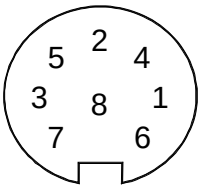
Cable connection: **without** cable shield

1. Stringing parts on cable acc. to plan given above.
2. Stripping cable sheath 20mm
3. Cutting uncovered shield 20mm
4. Stripping wire 5mm.
5. Soldering wire to the insert.
6. Positioning shield in cable clamp.
7. Screwing-on cable clamp.
8. Assembling remaining parts acc. to upper plan.
9. Tightening pull-relief of cable by screw-wrench (SW16 und 17).



7.3 Connecting Diagram

Connection diagram acc. to chapter 7.2.2.1 no.1, 3 and 4:

Order– No.		View on the soldered joint of the counter plug
4.3352.00.400 4.3352.00.401 4.3352.10.400* 4.3352.10.401*		
*Order-No. 4.3352.**10**.. (without heating) Pin 7 u. 8 are not connected		

Contact	Name	Function
1	SIG	Signal (rectangle)
2	GND	Ground
3	+Us	Supply 3.7 ... 42V DC
4	Data-	RS485 Data -
5	Data+	RS485 Data +
6	Data GND	RS485 GND
7	HZG	Heating supply: voltage: 24V AC/DC power: 25W
8	HZG	

8 Maintenance

If properly installed, the instrument requires no maintenance. Heavy pollution can lead to blockage of the slot between the rotating and the stable parts of the transmitter. Thus, it is advisable to remove the accumulated dirt from the instrument.

Cleaning
For the cleaning of the device should use a damp cloth without chemical cleaning agents are used.

Certain symptoms of wear and tear can appear on the ball bearings after years of use. These symptoms are expressed in a lowered sensitivity of response, standstill or run-noises of the ball bearings. In case that such disturbances might occur, we recommend to return the instrument - in original package - to the factory for maintenance work.

Remark:
Please use original packing during transport of instrument.

9 Interface

The interface to the wind transmitter consists of an RS485 connection (half duplex mode) with the following data format:

- 9600 baud (the baud rate can be set with the **Command BR**).
- 8 data bits.
- No parity.
- 1 stop bit.
- Data in ASCII format (command interpreter: THIES).
- Data in binary format (command interpreter: MODBUS RTU).

The behavior (configuration) of the wind transmitter can be changed with the commands available (see **Commands and description**). For the command interpreter of the type THIES, the query of the measured values is done with the **Command TR.**

For the start of the wind transmitter, the character string “WG, software version and serial number” is output.

Example: WG THIES ADV X
v01.09
0007140006

9.1 Command interpreter THIES

The wind transmitter is equipped with the command interpreter from the type THIES that can change the behavior of the device. E.g. the averaging period for the wind velocity can be changed. Basically, the command has the following structure:

- <id><Command><CR> (No parameter: is used for querying the set parameter).
- <id><Command><Parameter><CR> (With parameter: is used to set a new parameter).

id:	identification number (“00” to “99”)
Command:	command with 2 characters (see command list)
Parameter:	parameter value with 1 to 10 characters (decimal value in ASCII representation)
<CR>:	Carriage Return (13_{dec}; 0x0D)

With the identification number ‘id’, several devices can be operated together with a bus. For this purpose, each device receives an individual ‘id’ (see **Command ID**).

A sent command is acknowledged with a corresponding echo telegram. The echo telegram starts wit a “!”, followed by the id, the command and the set value. In the end, there are the characters “carriage return” and “new line”.

Commands can either be sent with or without parameters. When no parameter is entered, the set value is output.

Example: 00BR<CR>
!00BR00005<CR>

If a command is sent with parameter, the parameter is checked. If the parameter is valid, it is saved and indicated in the “echo telegram”. If the parameter is invalid, the parameter is ignored and the set value is output in the “echo telegram”.

Examples:

00BR00005<CR>	sending command.
!00BR00005<CR>	Echo telegram (parameter valid and password OK).
00BR00004<CR>	sending command.
!00BR00005<CR>	Echo telegram (Parameter valid but wrong key).

Remark:

With the command TR, the measured sensor values can be queried. Then, the wind transmitter will not respond with the echo telegram but with the queried data telegram!

In order to avoid an accidental parameter setting, some commands (see command list) are protected by a password. This password must be sent prior to the actual command.

Example: Change of the baud rate

00KY234<CR>	enable commands of the user level
00BR4<CR>	set baud rate to 4800
!00BR00004<CR>	baud rate set to 4800

The wind transmitter supports 3 different password levels.

- User level (password: “234”).
- Calibration value level.
- Administrator level.

> ***Attention:***
>
> ***The commands protected by a password are enabled until one of the following conditions is fulfilled:***
>
> ***- switching of the supply voltage***
> ***- the command 00KY0<CR> is sent***
> ***- no new command is sent for at least 120s***

9.1.1 Telegram formats

Data is output on request by the command TR. The following telegrams can be selected:

- Measured value telegram (parameter = 1).
- Measured value telegram 2 (parameter = 2).
- Measured value memory telegram (parameter = 30).

The calculation of the check sum, the composition of the status word and the control / separation characters used in the telegrams are listed below:

Control characters:

CR – Carriage Return (13_{dec}; 0x0D)
LF – Line Feed (10_{dec}; 0x0A)
STX – Start of Text (2_{dec}; 0x02)
ETX – End of Text (3_{dec}; 0x03)

Separation characters:

Separation character between the single measured values in the string is the semicolon ‘;’.
The check sum separation character is the asterisk ‘*’.

9.1.2 Check sum:

The check sum is the XOR link of all characters between <XTX> and the byte <*>.
The asterisk is the separation character of the check sum and is not contained in the check sum.

9.1.3 Status information:

Within the wind transmitter, the status word (32bit) is available which provides information about the condition of the transmitter. The measured values are submitted to a plausibility check and shown in the status word.

Bit number	Function	Description
Bit 0	Wind velocity jump	= 1 if the difference between the wind velocity between 2 subsequent measured values in the second interval exceeds 10m/s.
Bit 1	Calm	= 1 if the wind velocity remains for at least 3 hours at 0m/s without interruption.
Bit 2	Measured value correction	= 1 if the measured wind velocity is outside the defined table range.
Bit 3	Watchdog Reset	= 1 after a reset conditioned by the watchdog.
Bit 4	Filling level averaging buffer < 100%	= 1, averaging buffer has not yet filled completely. After a restart of the wind transmitter, this bit remains set until the averaging buffer has been filled completely.
Bit 5..8	Calibration table	Bits 5 to 8 show the calibration table used for the calculation of the wind velocity. 0000 : Standard curve 0001 : Calibration table 1 0010 : Calibration table 2 0011 : Calibration table 3 0100 : Calibration table 4 0101 : Calibration table 5 0110 : Calibration table 6 0111 : Calibration table 7 1000 : Calibration table 8 1001 : Calibration table 9 1010 : Calibration table 10
Bit 9	Vcc voltage	=1, Vcc voltage outside admissible range.
Bit 10	3V voltage	=1, 3V voltage outside admissible range.
Bit 11	Pressure sensor	=1, measured values from the pressure sensor are faulty.
Bit 12	Acceleration sensor	=1, measured values from the acceleration sensor are faulty.
Bit 13	EEPROM parameter	=1, internal EEPROM parameters invalid.
Bit 14	EEPROM parameter	=1, internal EEPROM parameters contain the standard values.
Bit 15	New FW	=1, last restart was done with new firmware.
Bit 16	-	Internal use
Bit 17..19	Source mean value calculation	The bits 17 to 19 show the wind velocity used for the calculation of the mean values. 000: Wind velocity calculated by the standard characteritic curve. 001: Wind velocity calculated by the calibration charact. curve. 010: Wind velocity calculated by the calibration table and compensated concerning air pressure.
Bit 20...31	-	-

Table 1 : Status word

9.2 Commands and description

The following table lists the available commands and the corresponding password for reading and writing:

Command	Initial value Factory setting	MODBUS Register address	Description	Password Reading[1] / Writing[2]	
Command BR	96	40005	Baud rate	Without	User
Command BT	0	40019	Bus termination	Without	User
Command CI	0/1[1]	40013	Command interpreter	Without	User
Command CK	137	-	Password for writing access to calibration tables	Without	User or CK
Command FB	1	40001	Quick start mode	Without	User
Command FO	7	40025	Frequency output	Without	User
Command HP	500	40041	Target value for the temperature control unit	Without	User
Command HT	0	40017	Mode of the heater control	Without	User
Command ID	0/1[2]	40003	ID number	Without	User
Command KY	0	40009	Key/password	Without	Without
Command MS	1	-	Source mean value calculation	Without	User
Command MI	10	40027	Averaging interval	Without	User
Command OH	-	40021	Read operating parameters	Without	Without
Command RC	-	[3]	Read entry from calibration table	Without	Without
Command SH	0	40039	Station height	Without	User
Command SM	0	-	Power saving mode	Without	User
Command SN	-	40007	Read serial number	Without	Without
Command SR	0	40029	Scanning rate (1s, 1/2s, 1/4s)	Without	User
Command SV	-	45005	SW version	Without	Without
Command TR	-	-	Telegram query	Without	Without
Command UC	0[4]	40031	Selection calibration table	Without	User
Command WC	-	-	Write entry into calibration table	Without	Calibration data or CK

Table 2 : Command list

[1] The device version 4.3352.x0.400 is delivered with 0 (THIES- Interpreter), the version 4.3352.x0.401 is delivered with 1 (MODBUS RTU).

[2] The device version 4.3352.x0.400 is delivered with ID0, the version 4.3352.x0.401 is delivered with ID1. If the sensor includes an additional label with the ID, the ID of the label is valid.

[3] For reading the entries of the calibration table please see chapter 9.3.3 Calibration table in the MODBUS-RTU Interpreter.

[4] When a calibration table is archived in the sensor, the parameter UC must be set to one for activaing the table. This can be carried out in a calibration laboratory with the calibration.

9.2.1 Command BR

<id>BR<parameter><CR> Setting the baud rate

Access: reading / writing

Description: With the command BR, the desired baud rate is set.

Parameter type: unsigned integer

Parameter:

Parameter	Description
12	1200baud (8n1)
24	2400baud (8n1)
48	4800baud (8n1)
96	9600baud (8n1)
192	19200baud (8n1)
384	38400baud (8n1)
576	57600baud (8n1)

Type return value: unsigned integer

Return value: see parameter

Value range: 12 / 24 / 48 / 96 / 192 / 384 / 576

Initial value: 96

9.2.2 Command BT

<id>BT<parameter><CR> Bus termination

Access: reading / writing

Description: With the command, the RS485 interface can be interconnected with a 120 Ohm wave terminating resistor (bus termination).

Parameter type: unsigned integer

Parameter: 0: Termination off
1: Termination enabled (120 Ohm)

Type return value: unsigned integer

Return value: see parameter

Value range: 0 / 1

Initial value: 0

9.2.3 Command CI

<id>CI<parameter><CR> Selection of the command interpreter.

Access: reading / writing

Description: With the command CI, the desired command interpreter is set.

> ***Remark:***
>
> ***If the identification number (ID) is bigger than 98, it is automatically set to 0 when switching over into the THIES interpreter!***

> ***Remark:***
>
> ***If the identification number (ID) equals 0, a switch-over into the MODBUS-RTU interpreter is not possible!***

Parameter description:

Parameter	Description
0	THIES
1	MODBUS RTU

Value range: 0 to 1

Initial value: 0/1 depending on device version

0 for 4.3352.x0.400, 1 for 4.3352.x0.401

9.2.4 Command CK

<id>CK<parameter><CR> Password for writing access to calibration tables.

Access: writing

Description: With the command, the password is set for writing access to the calibration tables (see command WC). The password must be set 2 consecutive times within a time frame of 60 seconds.
If the password has been changed once, the current password must be set before changing it again.

Parameter type: unsigned integer

Parameter: 1…4294967295

Type return value: unsigned integer

Return value: see parameter

Value range: 1…4294967295

Initial value: 137

9.2.5 Command FB

<id>FB<parameter><CR>	Quick start mode
Access:	reading / writing
Description:	The command selects the quick start mode or the set mode is queried.
Parameter type:	unsigned integer
Parameter:	0: Quick start mode off 1: Quick start mode on
Type return value:	unsigned integer
Return value:	see parameter
Value range:	0...1
Initial value:	1

9.2.6 Command FO

<id>FO<parameter><CR>	Frequency output
Access:	reading / writing
Description:	The command enables or disables the frequency output. When no parameter is entered, the set value is queried.
Parameter type:	unsigned integer
Parameter:	0: deactivate frequency output 1: Output of measured frequency. The pulses from the internal processor are acquired and re-output. The delivered frequency is identical with the setting 7, with the difference that the pulse-interval-ratio and the Jitter of the single current pulse are optimized. 2: Output of the wind velocity by using the standard characteristic curve (f_a= WV* 10) Example: WV=10,1m/s ➔fout=101Hz 3: Output of the wind velocity by using the latest calibration table (f_a= WG* 10) Example: WV=10,1m/s ➔fout=101Hz 4: Output of the wind velocity by using the current calibration table compensated concerning air pressure (f_a= f_{mess}* 10) Example: WV=10,1m/s ➔fout=101Hz 5: reserved 6: reserved 7: Direct output of the measured pulse signals without application of the calibration table or correction. In this mode the pulse output behaves identically to 4.3351.X0.000
Type return value:	unsigned integer
Return value:	see parameter
Value range:	0...7
Initial value:	7

9.2.7 Command HP

<id>HP<parameter><CR>	Reference variable Sensor temperature control unit.
Access:	reading / writing
Description:	The pressure and acceleration sensors are thermally coupled and can be heated. The "HP" command sets the setpoint for the Sensor temperature controller. The information is given in °C with one decimal place.
Parameter type:	unsigned integer
Parameter:	0...600: Reference variable 0...60.0°C 65535: Temperature control unit disabled
Type return value:	unsigned integer
Return value:	see parameter
Value range:	0…600 / 65535
Initial value:	500

9.2.8 Command HT

<id>HT<parameter><CR>	Mode of the housing heater control.
Access:	reading / writing
Description:	The command sets the mode for the housing heater (only possible at 4.3352.00.400 / 401)
Parameter type:	unsigned integer
Parameter:	0: Heater off 1: Heater on (controlled to ~ 4°C)
Type return value:	unsigned integer
Return value:	see parameter
Value range:	0...1
Initial value:	1

9.2.9 Command ID

<id>ID<parameter><CR>	Identification number.
Access:	reading / writing
Description:	This command sets the identification number (THIES interpreter) or the slave address (MODBUS RTU interpreter). Only if the id included in the command corresponds to the one set in the wind transmitter, a response telegram is sent. One exception is the generic 'id' where all wind transmitters respond (THIES interpreter). After changing the 'id', the device responds immediately with the new 'id'.
Parameter type:	unsigned integer
Parameter:	99 generic 'id' (THIES interpreter) 0 Broadcast slave address (MODBUS RTU interpreter)
Type return value:	unsigned integer
Return value:	see parameter
Value range:	0 to 99 (THIES interpreter) 1 to 247 (MODBUS RTU Interpreter)
Initial value:	0 (THIES interpreter) for sensor 4.3352x0.400 1 (MODBUS RTU Interpreter) for sensor 4.3352.x.0.401

9.2.10 Command KY

<id>KY<parameter><CR>	Key/password
Access:	reading / writing
Description:	With this command, the value for the key (password) is set. The following 3 password levels are possible: User (only reading access) Settings (general settings) Calibration data (access to the calibration data sets) Administrator (access to the factory and commissioning parameters)
Parameter type:	unsigned integer
Parameter:	

Parameter	Description
0	Query
234	User
137	Calibration data (see command CK)

Type return value:	unsigned integer
Return value:	see parameter
Value range:	0, 137, 234
Initial value:	0

9.2.11 Command MI

<id>MI<parameter><CR>	Averaging interval
Access:	reading / writing
Description:	With this command, the averaging interval for floating averaging of the wind velocity is set in seconds (see Bit4 in the sensor status). Wind velocity values are logged 4 times per second (4 Hz) for averaging.
Parameter type:	unsigned integer
Parameter:	e.g. 60 ➔ 60[s]
Type return value:	unsigned integer
Return value:	see parameter
Value range:	0...600
Initial value:	10

9.2.12 Command MS

<id>MS<parameter><CR>	Source mean value calculation
Access:	read / write
Description:	This command is used to set the source for the calculation of the following values: - mean value - gust - minimum - standard deviation - intensity of turbulence
Parameter type:	unsigned integer
Parameter:	

Parameter	Description
0	Wind velocity calculated by means of standard characteristic curve.
1	Wind velocity calculated by means of calibration table. When no calibration table is available, the value is output, which was calculated by means of the standard characteristic curve.
2	Wind velocity calculated by means of calibration table and compensated concerning air pressure. When no calibration table is available, the value is output, which was calculated by means of the standard characteristic curve.
3	reserved
4	reserved

Type return value:	unsigned integer
Return value :	see parameter
Value range:	0...4
Initial value:	0

9.2.13 Command OH

<id>OH<CR> Read operating parameters

Access: reading

Description: With this command, the following operating parameters can be read:

- Number of the operating hours.
- Number of revolutions.
- Operating time since the last reset.

Parameter type: unsigned integer

Parameter:

Parameter	Description
1	Number of the operating hours.
2	Query of the number of revolutions.
3	Query of the operating time in seconds since the last reset.

Type return value: unsigned integer / character string

Return value:

Return value	Type	Description
xxxxxxxxxx	unsigned integer	Operating hours.
xxxxxxxxxxxxxxxx	Character string	Number of revolutions (64bit value in hexadecimal representation.
xxxxxxxxxx	unsigned integer	Operating time in seconds since the last reset.

Value range: -

Initial value: -

Example:

00OH1
!00OH0000003987 (=3978 hours)

00OH2
!00OH000000000000A43B (=42043 revolutions)

00OH3
!00OH0000123887 (=123887 seconds)

9.2.14 Command RC

<id>RC<parameter><CR> Read calibration table.

Access: reading

Description: With the command, the table indicated in the parameter is read. The value returned by the command RC depends on the parameter:

Parameter type: unsigned integer

Parameter:

Parameter	Description
0 ... 10	Table (0 ... 10) 0: Standard curve 1: Table 1 2: Table 2 ... 9: Table 9 10: Table 10
99	Time stamp (date/time) of all tables (empty tables, i.e. unfilled tables give the following time stamp: tt;2010.00.00;00:00:00;)

Type return value: Character string

Return value:

Transfer parameter	Return value	
	ASCII representation	Description
1...10	<STX> sssss[1];iiiii[1]; sssss[2];iiiii[1]; ... sssss[32];iiiii[32]; xxxxxxxxxx; uuuuuuuuuuuuuuuu; YYYY.MM.DD;HH:NN:SS <ETX>	32 sampling points in the table + calibration certificate number + date/time sssss: Target value in 0.01[m/s] iiiii: Actual value in 0.01[m/s] xxxxxxxxxx: Calibration certificate number uuuuuuuuuuuuuuuu: User string with 16 characters YYYY: Year MM: Month DD: Day HH: Hour NN: Minute SS: Second

Transfer parame-ter	Return value	
	ASCII representation	Description
99	<STX> tt;YYYY.MM.DD;HH:NN:SS; tt;YYYY.MM.DD;HH:NN:SS; tt;YYYY.MM.DD;HH:NN:SS; tt;YYYY.MM.DD;HH:NN:SS; tt;YYYY.MM.DD;HH:NN:SS; tt;YYYY.MM.DD;HH:NN:SS; tt;YYYY.MM.DD;HH:NN:SS; tt;YYYY.MM.DD;HH:NN:SS; tt;YYYY.MM.DD;HH:NN:SS; <ETX>	Date/time of all tables (1...10) tt: Table YYYY: Year MM: Month DD: Day HH: Hour NN: Minute SS: Second
unequal 1...10 / 99	<STX>error<ETX>	

Value range: -

Initial value: -

Example: 00RC01

<STX>0000;0000;0242;0242;0484;0484;0726;0726;0968;0968;
1210;1210;
1452;1452;1694;1694;1936;1936;2178;2178;2420;2420;
2662;2662;2904;2904;3146;3146;3388;3388;3630;3630;3872;3872;
4114;4114;4356;4356;4598;4598;4840;4840;5082;5082;5324;5324;
5566;5566;5808;5808;6050;6050;6292;6292;6534;6534;6776;6776; 7018;7018;
7260;7260;7502;7502 ;0000022228;2013.09.03;16:00:00
<ETX>

00RC99

<STX>2013.09.09;12:00:00;2010.00.00;00:00:00;2010.00.00;00:00:00;2010.00.00;00:00:00;2010.00.00;00:00:00;2010.00.00;00:00:00;2010.00.00;00:00:00;2010.00.00;00:00:00;2010.00.00;00:00:00;2010.00.00;00:00:00;<ETX>

9.2.15 Command SH

<id>SH<parameter><CR> Station height

Access: reading / writing

Description: With the command, the station height on the site is set on the site of the anemometer.
This value is used for the calculation of the relative air pressure. The information of the height is given in meter. Indication of station height is not necessary for air pressure compensation of wind velocity.

Parameter type: unsigned integer

Parameter:	Height above sea level in meters 0...3000: Station height in meters (basis for the calculation of the relative air pressure)
Type return value:	unsigned integer
Return value:	see parameter
Value range:	0...3000
Initial value:	0

9.2.16 Command SM

<id>SM<parameter><CR>	Power saving mode
Access:	reading / writing
Description:	The command enables reading and setting the power saving mode.
Parameter type:	unsigned integer
Parameter:	0: all modules active 1: µC and interfaces disabled (frequency output active, when FO = 7) After activation of power-saving mode the sensor cannot be operated via the serial interface after approx. 30sec. After a restart the interface is active for 30 sec. Parameter HT0 should be set in the power-saving mode. 2: reserved
Type return value:	unsigned integer
Return value:	see parameter
Value range:	0...2
Initial value:	0

9.2.17 Command SN

<id>SN<parameter><CR>	Serial number
Access:	reading
Description:	The command enables reading the serial number.
Parameter type:	-
Parameter:	-
Type return value:	unsigned integer
Return value:	xxxxxxxxxx: Serial number
Value range:	xxxxxxxxxx
Initial value:	-

9.2.18 Command SR

<id>SR<CR>	Scanning rate
Access:	reading / writing
Description:	With the command SR, the scanning rate for the measured value logging is read or set. This command refers exclusively to the scanning interval of the measuring values for the measuring value telegram, **see 10.3** and not to the instantaneous values.
Parameter type:	unsigned integer
Parameter:	0: 1s 1: 0.5s 2: 0.25s
Type return value:	unsigned integer
Return value:	see parameter
Value range:	0...2
Initial value:	1

9.2.19 Command SV

<id>SV<CR>	SW version
Access:	reading
Description:	With the command SV, the software version number can be read.
Parameter type:	-
Parameter:	-
Type return value:	unsigned integer
Return value:	xxyy (xx: main version number, yy: Secondary version number)
Value range:	-
Initial value:	-

9.2.20 Command TR

<id>TR<parameter><CR>	Measured value request.
Access:	reading
Description:	The command activates the one-time transfer of the current data telegram.
Parameter type:	unsigned integer
Parameter:	1: Query measured value telegram 1 2: Query measured value telegram 2 30: Query measured value memory telegram
Type return value:	Character string
Return value:	Character string (see **Telegram**)
Value range:	1 / 2 / 30
Initial value:	-

9.2.21 Command UC

<id>UC<parameter><CR>	Selection calibration table.
Access:	reading / writing
Description:	The command selects between the standard curve and the (most recent) calibration table with the highest value. Parameter UC can be set to one only when a calibration table is available.
Parameter type:	unsigned integer
Parameter:	0: Standard curve 1: (most recent) calibration table with the highest value
Type return value:	unsigned integer
Return value:	see parameter
Value range:	0 / 1
Initial value:	0

9.2.22 Command WC

<id>WC<parameter><CR>	Describe calibration table.
Access:	writing
Description:	With the command, the memories of the next free table are written. After writing date/time (address 35), the table is complete and no longer be changed. The table is selected automatically for writing access, in ascending order from table 1 to table 10.

Parameter type: Character string

Parameter:

Transfer parameter	Return value	
	ASCII representation	Description
aa;sssss;iiiii; (aa: 1...32)	tt;aa;sssss;iiiii	Sampling points of the table tt: Table aa: Address sssss: Target value in 0.01[m/s] iiiii: Actual value in 0.01[m/s]
33;xxxxxxxxxx;	tt;aa;xxxxxxxxxx	Calibration certificate number tt: Table aa: Address xxxxxxxxxx: Calbration certificate number
34;uuuuuuuuuuuuuuu;	tt;aa;uuuuuuuuuuuuuuuu	Date/time tt: Table aa: Address uuuuuuuuuuuuuuu: User string with 16 characters
35;YYYY.MM.DD;HH:NN:SS;	tt;aa;YYYY.MM.DD;HH:NN:SS	Date/time tt: Table aa: Address YYYY: Year MM: Month DD: Day HH: Hour NN: Minute SS: Second

Type return value: Character string

Return value: see parameter

Value range: -

Initial value: -

Example: 00WC35;2013.09.02;11:24:00
!00WC01; 35;2013.09.02;11:24:00

9.3 Command interpreter MODBUS RTU

If the command interpreter MODBUS RTU is selected, the transferred bytes are interpreted according to the MODBUS specification (http://www.modbus.org/). In this case, the wind transmitter represents a MODBUS slave.

The data is transferred in packages in so called frames with max. 256 bytes. Each package contains a 16bit CRC check sum (initial value: 0xffff).

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

Table 3 : MODBUS Frame

The following MODBUS functions are supported:

- 0x04 (Read Input Register).
- 0x03 (Read Holding Registers).
- 0x10 (Write Multiple Registers).
- 0x2B (Read Device Identification with MEI-Type 0x0E).

The wind transmitter supports writing accesses for the slave address 0 (“broadcast”).

All received MODBUS requirements are checked for their validity before execution. In case of an error, the wind transmitter responds with one of the following exceptions (➔MODBUS Exception Responses).

Code	Name	Meaning
0x01	ILLEGAL FUNCTION	The functional code in the request is not admissible for the register address.
0x02	ILLEGAL DATA ADDRESS	The register address in the request is not valid.
0x03	ILLEGAL DATA VALUE	The specified data in the request is not admissible.

Table 4: MODBUS Exceptions

9.3.1 Measured values (Input Register)

All measured values of the wind transmitter occupy 32bit, i.e. 2 MODBUS register addresses. The table below shows the assignment of measured value to register address, whereby the measured values are sorted as follows:

- According to measured value type (30001 to 34999).
- In uninterrupted sequence (35001 to 39999).

Register address	Parameter name	Unit	Multiplicator	Explanation	Data type
30001	Wind velocity	m/s	10	Value / 10 (1 decimal place, e.g. 101=10.1m/s)	U32
30003	Average wind velocity	m/s	10	Value / 10 (1 decimal place, e.g. 101=10.1m/s)	U32
30005	Wind velocity uncorrected	m/s	10	Value / 10 (1 decimal place, e.g. 101=10.1m/s)	U32
30007	Standard deviation wind velocity	m/s	10	Value / 10 (1 decimal place, e.g. 101=10.1m/s)	U32
30009	Minimum value wind velocity	m/s	10	Value / 10 (1 decimal place, e.g. 101=10.1m/s)	U32
30011	Maximum value wind velocity (gust)	m/s	10	Value / 10 (1 decimal place, e.g. 101=10.1m/s)	U32
30013	Wind velocity (compensated for air pressure)	m/s	100	Value / 100 (1 decimal place, e.g. 101=1.01m/s)	U32
30015	Reserved				U32
30017	Reserved				U32
30403	Housing interior temperature	°C	10	Value / 10 (1 decimal place, e.g. 355=35.5°C)	S32
30801	Absolute air pressure	hPa	100	Value / 100 (2 decimal places e.g. 105000=1050.00hPa)	U32
30803	Relative air pressure based on the sea level	hPa	100	Value / 100 (2 decimal places e.g. 105000=1050.00hPa)	U32
34811	Sensor status		1	Value (no decimal place, bit coded, depending on sensor)	U32
34813	Main loop run per 1s	1/s	1	Value (no decimal place, e.g. 2550=2550 1/s)	U32

Register address	Parameter name	Unit	Multiplicator	Explanation	Data type
34815	Operating time	s	1	Value (no decimal place, e.g. 255=255s)	U32
34819	Inclination value θ	°	10	Value / 10 (1 decimal place, e.g. 240=24.0°)	S32
34821	Inclination value ρ	°	10	Value / 10 (1 decimal place, e.g. 240=24.0°)	S32
34823	Inclination value ϕ	°	10	Value / 10 (1 decimal place, e.g. 240=24.0°)	S32
34825	Frequency vibration measurement, X-axis	Hz	100	Value / 100 (2 decimal places e.g. 2400=24.00Hz)	U32
34827	Amplitude vibration measurement, X-axis	mg (1g=9.81m/s^2)	1	Value (no decimal place, e.g. 24=24mg)	U32
34829	Frequency vibration measurement, Y-axis	Hz	100	Value / 100 (2 decimal places e.g. 2400=24.00Hz)	U32
34831	Amplitude vibration measurement, Y-axis	mg (1g=9.81m/s^2)	1	Value (no decimal place, e.g. 24=24mg)	U32
34833	Frequency vibration measurement, Z-axis	Hz	100	Value / 100 (2 decimal places e.g. 2400=24.00Hz)	U32
34835	Amplitude vibration measurement, Z-axis	mg (1g=9.81m/s^2)	1	Value (no decimal place, e.g. 24=24mg)	U32
35001	Wind velocity (30001)[1]	m/s	10	Value / 10 (1 decimal place, e.g. 101=10.1m/s)	U32
35003	Average wind velocity (floating) (30003) [1]	m/s	10	Value / 10 (1 decimal place, e.g. 101=10.1m/s)	U32
35005	Wind velocity uncorrected (30005) [1]	m/s	10	Value / 10 (1 decimal place, e.g. 101=10.1m/s)	U32
35007	Standard deviation wind velocity (30007) [1]	m/s	10	Value / 10 (1 decimal place, e.g. 101=10.1m/s)	U32
35009	Minimum value wind velocity (30009) [1]	m/s	10	Value / 10 (1 decimal place, e.g. 101=10.1m/s)	U32
35011	Maximum value wind velocity / gust (30011) [1]	m/s	10	Value / 10 (1 decimal place, e.g. 101=10.1m/s)	U32
35013	Wind velocity (compensated for air pressure)	m/s	100	Value / 100 (1 decimal place, e.g. 101=1.01m/s)	U32

Register address	Parameter name	Unit	Multiplicator	Explanation	Data type
35015	Reserved				U32
35017	Reserved				U32
35019	Housing interior temperature (30403) [1]	°C	10	Value / 10 (1 decimal place, e.g. 355=35.5°C)	S32
35021	Absolute air pressure	hPa	100	Value / 100 (2 decimal places e.g. 105000=1050.00hPa)	U32
35023	Relative air pressure based on the sea level	hPa	100	Value / 100 (2 decimal places e.g. 105000=1050.00hPa)	U32
35025	Sensor status (34811) [1]		1	Value (no decimal place, bit coded, depending on sensor)	U32
35027	Main loop run per 1s	1/s	1	Value (no decimal place, e.g. 2550=2550 1/s)	U32
35029	Operating time after reset (34815) [1]	s	1	Value (no decimal place, e.g. 255=255s)	U32
35031	Inclination value θ (Angle between the Z-axis and the vertical) (34819) [1]	°	10	Value / 10 (1 decimal place, e.g. 240=24.0°)	S32
35033	Inclination value ρ (Angle between the X-axis and the horizontal) (34821) [1]	°	10	Value / 10 (1 decimal place, e.g. 240=24.0°)	S32
35035	Inclination value ϕ (Angle between the Y-axis and the horizontal) (34823) [1]	°	10	Value / 10 (1 decimal place, e.g. 240=24.0°)	S32
35037	Frequency vibration measurement, X-axis (34825) [1]	Hz	10	Value / 10 (1 decimal place, e.g. 240=24.0Hz)	U32
35039	Amplitude vibration measurement, X-Axis (34827) [1], (1g=9.81m/s^2)	mg	1	Value (no decimal place, e.g. 24=24mg)	U32
35041	Frequency vibration measurement, Y-axis (34829) [1]	Hz	10	Value / 10 (1 decimal place, e.g. 240=24.0Hz)	U32
35043	Amplitude vibration measurement, Y-axis (34831) [1], (1g=9.81m/s^2)	mg	1	Value (no decimal place, e.g. 24=24mg)	U32

Register address	Parameter name	Unit	Multiplicator	Explanation	Data type
35045	Frequency vibration measurement, z-axis (34833) [1]	Hz	10	Value / 10 (1 decimal place, e.g.. 240=24.0Hz)	U32
35047	Amplitude vibration measurement, Z-axis (34835) [1], (1g=9.81m/s^2)	mg	1	Value (no decimal place, e.g. 24=24mg)	U32
35049	Measured frequency	Hz	10	Value (no decimal place, e.g. 255=25.5Hz)	U32
35051	Number of revolutions of the cup star		1	Value (no decimal place, e.g. 255=255)	U64
35055	Operating hours	h	1	Value (no decimal place, e.g. 255=255h)	U32
35057	Degree of turbulence	-	100	Value (2 decimal places e.g. 255=2,55)	U32
35059	Temperature of the pressure sensor	°C	10	Value / 10 (1 decimal place, e.g. 355=35.5°C)	S32
35100	Time since the last measured value query	ms	1	Value (no decimal place, e.g. 2550=2550ms)	U32
35102	Measured value[2] [0] (most recent) according to UC	m/s	10	Value / 10 (1 decimal place, e.g. 101=10.1m/s)	U16
35103	Measured value[2] [1] according to UC	m/s	10	Value / 10 (1 decimal place, e.g. 101=10.1m/s)	U16
35104	Measured value[2] [2] according to UC	m/s	10	Value / 10 (1 decimal place, e.g. 101=10.1m/s)	U16
35105	Measured value[2] [3] according to UC	m/s	10	Value / 10 (1 decimal place, e.g. 101=10.1m/s)	U16
35106	Measured value[2] [4] according to UC	m/s	10	Value / 10 (1 decimal place, e.g. 101=10.1m/s)	U16
35107	Measured value[2] [5] according to UC	m/s	10	Value / 10 (1 decimal place, e.g. 101=10.1m/s)	U16
35108	Measured value[2] [6] according to UC	m/s	10	Value / 10 (1 decimal place, e.g. 101=10.1m/s)	U16
35109	Measured value[2] [7] according to UC	m/s	10	Value / 10 (1 decimal place, e.g. 101=10.1m/s)	U16
35110	Measured value[2] [8] according to UC	m/s	10	Value / 10 (1 decimal place, e.g. 101=10.1m/s)	U16

Register address	Parameter name	Unit	Multiplicator	Explanation	Data type
35111	Measured value[2] [9] according to UC	m/s	10	Value / 10 (1 decimal place, e.g. 101=10.1m/s)	U16
35112	Measured value[2] [10] according to UC	m/s	10	Value / 10 (1 decimal place, e.g. 101=10.1m/s)	U16
35113	Measured value[2] [11] according to UC	m/s	10	Value / 10 (1 decimal place, e.g. 101=10.1m/s)	U16
35114	Measured value[2] [12] according to UC	m/s	10	Value / 10 (1 decimal place, e.g. 101=10.1m/s)	U16
35115	Measured value[2] [13] according to UC	m/s	10	Value / 10 (1 decimal place, e.g. 101=10.1m/s)	U16
35116	Measured value[2] [14] according to UC	m/s	10	Value / 10 (1 decimal place, e.g. 101=10.1m/s)	U16
35117	Measured value[2] [15] (oldest) according to UC	m/s	10	Value / 10 (1 decimal place, e.g. 101=10.1m/s)	U16

Table 5 : MODBUS Input Register

[1]: The numbers in brackets designate the register addresses which represent the same s. For example, the wind velocity is on address 30001 and on address 35001.

[2]: Measuring values of the wind velocity (without compensation) acquired by means of standard characteristic curve.

Remark:

Due to the uninterrupted sequence of the measured values from address 35001, the MODBUS Master can read all measured values with one request!

9.3.2 Commands (Holding Register)

All commands of the wind transmitter occupy 32bit, i.e. 2 MODBUS register addresses and represent unsigned integers. The following example shows the change of the baud rate to 19200 baud.

1. Set password for the user level (KY=234)

Slave address	Functional code	Start address	Number register	Number byte(s)	Data	CRC	
0x01	0x10	0x9C 49	0x00 02	0x04	0x00 00 00 EA	0x4F 7C	
						CRC low-byte	CRC high-byte

2. Set command baud rate to 19200 baud (BR=6)

Slave address	Functional code	Start address	Number register	Number byte(s)	Data	CRC	
0x01	0x10	0x9C 45	0x00 02	0x04	0x00 00 00 06	0x4E A4	
						CRC low-byte	CRC high-byte

The commands available for parameter setting are listed in the chapter 9.2 commands and description.

9.3.3 Calibration tables in the MODBUS-RTU interpreter

The following table shows the registers available for reading out the calibration table:

Register-address	Parameter Name	Value range	Meanig	File type	Authorization type
41000 … 41075	standard characteristic	152 Bytes	Read standard characteristic		Read
41076 … 41151	Newest Calibration table	152 Byte(s)	Read calibration data		Read
41152 … 41227	2. Newest Calibration table	152 Byte(s)	Read calibration data		Read
41228 … 41303	3. Newest Calibration table	152 Byte(s)	Read calibration data		Read
41304 … 41379	4. Newest Calibration table	152 Byte(s)	Read calibration data		Read
41380 … 41455	5. Newest Calibration table	152 Byte(s)	Read calibration data		Read
41456 … 41531	6. Newest Calibration table	152 Byte(s)	Read calibration data		Read
41532 … 41607	7. Newest Calibration table	152 Byte(s)	Read calibration data		Read
41608 … 41683	8. Newest Calibration table	152 Byte(s)	Read calibration data		Read
41684 … 41759	9. Newest Calibration table	152 Byte(s)	Read calibration data		Read
41760 … 41835	Oldest Calibration table	152 Byte(s)	Read calibration data		Read
41836 … 41855	Timestamp of all tables	40 Byte(s)	Read calibration data		Read

9.3.4 Reading Time Stamp of all Calibration Tables

Reading out the MODBUS register of addresses 41836 to 41855 delivers the time stamps of all calibration tables. Each time stamp comprises 32bit, and is coded as follows:

Byte	bit location	time information
Byte 0[1]	31	Year
	30	
	29	
	28	
	27	
	26	
	25	Month
	24	
Byte 1	23	
	22	
	21	Day
	20	
	19	
	18	
	17	
	16	Hours
Byte 2	15	
	14	
	13	
	12	
	11	Minutes
	10	
	9	
	8	
Byte 3[2]	7	
	6	
	5	Seconds
	4	
	3	
	2	
	1	
	0	

[1] : The first transmitted byte.
[2] : The last transmitted byte.

9.3.5 Reading Calibration Tables

Reading out the MODBUS register of addresses 41000 to 41835 delivers the calibration tables (41006-41075 standard characteristic line). Each table comprises 152 bytes, and is coded as follows:

Byte	Parameter
Byte 0	Target-Wind-Velocity-Adress 1 (Resolution: 0.01m/s) [1]
Byte 1	
Byte 2	Actual-Wind-Velocity-Adress 1 (Resolution: 0.01m/s) [1]
Byte 3	
Byte 4	Target-Wind-Velocity-Adress 2 (Resolution: 0.01m/s) [1]
Byte 5	
Byte 6	Actual-Wind-Velocity-Adress 2 (Resolution: 0.01m/s) [1]
Byte 7	
Byte 8	Target-Wind-Velocity-Adress 3 (Resolution: 0.01m/s) [1]
Byte 9	
Byte 10	Actual-Wind-Velocity-Adress 3 (Resolution: 0.01m/s) [1]
Byte 11	
Byte 12	Target-Wind-Velocity-Adress 4 (Resolution: 0.01m/s) [1]
Byte 13	
Byte 14	Actual-Wind-Velocity-Adress 4 (Resolution: 0.01m/s) [1]
Byte 15	
Byte 16	Target-Wind-Velocity-Adress 5 (Resolution: 0.01m/s) [1]
Byte 17	
Byte 18	Actual-Wind-Velocity-Adress 5 (Resolution: 0.01m/s) [1]
Byte 19	
Byte 20	Target-Wind-Velocity-Adress 6 (Resolution: 0.01m/s) [1]
Byte 21	
Byte 22	Actual-Wind-Velocity-Adress 6 (Resolution: 0.01m/s) [1]
Byte 23	
Byte 24	Target-Wind-Velocity-Adress 7 (Resolution: 0.01m/s) [1]
Byte 25	
Byte 26	Actual-Wind-Velocity-Adress 7 (Resolution: 0.01m/s) [1]
Byte 27	
Byte 28	Target-Wind-Velocity-Adress 8 (Resolution: 0.01m/s) [1]
Byte 29	
Byte 30	Actual-Wind-Velocity-Adress 8 (Resolution: 0.01m/s) [1]
Byte 31	
Byte 32	Target-Wind-Velocity-Adress 9 (Resolution: 0.01m/s) [1]
Byte 33	
Byte 34	Actual-Wind-Velocity-Adress 9 (Resolution: 0.01m/s) [1]
Byte 35	
Byte 36	Target-Wind-Velocity-Adress 10 (Resolution: 0.01m/s) [1]
Byte 37	
Byte 38	Actual-Wind-Velocity-Adress 10 (Resolution: 0.01m/s) [1]
Byte 39	
Byte 40	Target-Wind-Velocity-Adress 11 (Resolution: 0.01m/s) [1]

Byte	Parameter
Byte 41	
Byte 42	Actual-Wind-Velocity-Adress 11 (Resolution: 0.01m/s) [1]
Byte 43	
Byte 44	Target-Wind-Velocity-Adress 12 (Resolution: 0.01m/s) [1]
Byte 45	
Byte 46	Actual-Wind-Velocity-Adress 12 (Resolution: 0.01m/s) [1]
Byte 47	
Byte 48	Target-Wind-Velocity-Adress 13 (Resolution: 0.01m/s) [1]
Byte 49	
Byte 50	Actual-Wind-Velocity-Adress 13 (Resolution: 0.01m/s) [1]
Byte 51	
Byte 52	Target-Wind-Velocity-Adress 14 (Resolution: 0.01m/s) [1]
Byte 53	
Byte 54	Actual-Wind-Velocity-Adress 14 (Resolution: 0.01m/s) [1]
Byte 55	
Byte 56	Target-Wind-Velocity-Adress 15 (Resolution: 0.01m/s) [1]
Byte 57	
Byte 58	Actual-Wind-Velocity-Adress 15 (Resolution: 0.01m/s) [1]
Byte 59	
Byte 60	Target-Wind-Velocity-Adress 16 (Resolution: 0.01m/s) [1]
Byte 61	
Byte 62	Actual-Wind-Velocity-Adress 16 (Resolution: 0.01m/s) [1]
Byte 63	
Byte 64	Target-Wind-Velocity-Adress 17 (Resolution: 0.01m/s) [1]
Byte 65	
Byte 66	Actual-Wind-Velocity-Adress 17 (Resolution: 0.01m/s) [1]
Byte 67	
Byte 68	Target-Wind-Velocity-Adress 18 (Resolution: 0.01m/s) [1]
Byte 69	
Byte 70	Actual-Wind-Velocity-Adress 18 (Resolution: 0.01m/s) [1]
Byte 71	
Byte 72	Target-Wind-Velocity-Adress 19 (Resolution: 0.01m/s) [1]
Byte 73	
Byte 74	Actual-Wind-Velocity-Adress 19 (Resolution: 0.01m/s) [1]
Byte 75	
Byte 76	Target-Wind-Velocity-Adress 20 (Resolution: 0.01m/s) [1]
Byte 77	
Byte 78	Actual-Wind-Velocity-Adress 20 (Resolution: 0.01m/s) [1]
Byte 79	
Byte 80	Target-Wind-Velocity-Adress 21 (Resolution: 0.01m/s) [1]
Byte 81	
Byte 82	Actual-Wind-Velocity-Adress 21 (Resolution: 0.01m/s) [1]
Byte 83	
Byte 84	Target-Wind-Velocity-Adress 22 (Resolution: 0.01m/s) [1]
Byte 85	
Byte 86	Actual-Wind-Velocity-Adress 22 (Resolution: 0.01m/s) [1]

Byte	Parameter
Byte 87	
Byte 88	Target-Wind-Velocity-Adress 23 (Resolution: 0.01m/s) [1]
Byte 89	
Byte 90	Actual-Wind-Velocity-Adress 23 (Resolution: 0.01m/s) [1]
Byte 91	
Byte 92	Target-Wind-Velocity-Adress 24 (Resolution: 0.01m/s) [1]
Byte 93	
Byte 94	Actual-Wind-Velocity-Adress 24 (Resolution: 0.01m/s) [1]
Byte 95	
Byte 96	Target-Wind-Velocity-Adress 25 (Resolution: 0.01m/s) [1]
Byte 97	
Byte 98	Actual-Wind-Velocity-Adress 25 (Resolution: 0.01m/s) [1]
Byte 99	
Byte 100	Target-Wind-Velocity-Adress 26 (Resolution: 0.01m/s) [1]
Byte 101	
Byte 102	Actual-Wind-Velocity-Adress 26 (Resolution: 0.01m/s) [1]
Byte 103	
Byte 104	Target-Wind-Velocity-Adress 27 (Resolution: 0.01m/s) [1]
Byte 105	
Byte 106	Actual-Wind-Velocity-Adress 27 (Resolution: 0.01m/s) [1]
Byte 107	
Byte 108	Target-Wind-Velocity-Adress 28 (Resolution: 0.01m/s) [1]
Byte 109	
Byte 110	Actual-Wind-Velocity-Adress 28 (Resolution: 0.01m/s) [1]
Byte 111	
Byte 112	Target-Wind-Velocity-Adress 29 (Resolution: 0.01m/s) [1]
Byte 113	
Byte 114	Actual-Wind-Velocity-Adress 29 (Resolution: 0.01m/s) [1]
Byte 115	
Byte 116	Target-Wind-Velocity-Adress 30 (Resolution: 0.01m/s) [1]
Byte 117	
Byte 118	Actual-Wind-Velocity-Adress 30 (Resolution: 0.01m/s) [1]
Byte 119	
Byte 120	Target-Wind-Velocity-Adress 31 (Resolution: 0.01m/s) [1]
Byte 121	
Byte 122	Actual-Wind-Velocity-Adress 31 (Resolution: 0.01m/s) [1]
Byte 123	
Byte 124	Target-Wind-Velocity-Adress 32 (Resolution: 0.01m/s) [1]
Byte 125	
Byte 126	Actual-Wind-Velocity-Adress 32 (Resolution: 0.01m/s) [1]
Byte 127	
Byte 128	Kalibrierscheinnummer[2]
Byte 129	
Byte 130	
Byte 131	
Byte 132	Beutzerdefinierter String[3]

Byte	Parameter
Byte 133	
Byte 134	
Byte 135	
Byte 136	
Byte 137	
Byte 138	
Byte 139	
Byte 140	
Byte 141	
Byte 142	
Byte 143	
Byte 144	
Byte 145	
Byte 146	
Byte 147	
Byte 148	Datum / Uhrzeit[4]
Byte 149	
Byte 150	
Byte 151	

[1] : Wind velocity as unsigned 16Bit value with 2 decimal places (for ex.. 1234 = 12,34m/s).
[2] : Number as unsigned 32Bit value.
[3] : 16 characters comprising String.
[4] : Time stamp (format see chapter 4.4.1).

9.3.6 Device identification (Read Device Identification)

The wind transmitter supports the MODBUS function 0x2B (Read Device Identification) with the MEI type 0x0E. This enables the MODBUS Master to recognize the wind transmitter.

Function: 0x2B / 0x0E (Read Device Identification)

MEI type: 0x0E

Read Device ID code: 1, 2, 3 (stream access)

Supported objects:

Object Id	Object name / description	Type	Category	Value[1, 2]
0x00	VendorName	ASCII string	Basic	“Adolf Thies GmbH &CO. KG”
0x01	ProductCode	ASCII string		“4.3352.00.400”
0x02	MajorMinorRevision	ASCII string		“V01.04”
0x03	VendorUrl	ASCII string	Regular	“www.thiesclima.com”
0x04	ProductName	ASCII string		“WIND VELOCITY TRANSMITTER”
0x05	ModelName	ASCII string		“WIND TRANSMITTER FIRST CLASS ADVANCED X”
0x80	HW-ID	ASCII string	Extended	“304A37393634110B000700”[3]

[1]: The maximum length of a value is 32 bytes.

[2]: The quotation marks are not part of the character string.

[3]: The HW-ID (object id: 0x80) consists of 22 bytes which represent 11 binary bytes.

10 Appendix 1 Data Telegrams

10.1 Measured value telegram

The wind transmitter responds with the measured value telegram to the command “00TR1\r”. The table below shows the telegram structure:

Position	Length	Example	Description
1	1	STX	Start character (start of text)
2	2	xx	Identification number (ID) xx: 0..99
4	1	;	Separation character (';')
5	4	xx.x	Momentary value of the wind velocity, calculated with the current calibration table; unit: m/s; resolution: 0.1m/s. When there is no calibration table existing the calculated measuring value of the standard characteristic curve is output.
9	1	;	Separation character (';')
10	4	xx.x	Momentary value of the wind velocity, calculated with the standard curve; unit: m/s; resolution: 0.1m/s
14	1	;	Separation character (';')
15	6	xxxx.x	Measured frequency; unit: Hz; resolution 0.1Hz
21	1	;	Separation character (';')
22	4	xx.x	Current gust of the wind velocity of the last 1min., calculated with the current calibration table; unit: m/s; resolution: 0.1m/s
26	1	;	Separation character (';')
27	4	xx.x	Current minimum value of the wind velocity of the last 1min., calculated with the current calibration table; unit: m/s; resolution: 0.1m/s
31	1	;	Separation character (';')
32	4	xx.x	Current average value of the wind velocity, calculated with the current calibration table; unit: m/s; resolution: 0.1m/s; period: Averaging interval (➔Command MI)
36	1	;	Separation character (';')
37	4	xx.x	Current standard deviation of the wind velocity, calculated with the current calibration table; unit: m/s; resolution: 0.1m/s; period: Averaging interval (➔Command MI).
41	1	;	Separation character (';')
42	5	xx.xx	Momentary value of the wind velocity, calculated with the current calibration table; unit: without dimension; resolution: 0.01
47	1	;	Separation character (';')
48	5	yxx.x	Housing interior temperature of the wind transmitter (unit: °C) y: Sign (+ or -) xx.x: Temperature value; resolution: 0.1°C

Position	Length	Example	Description
53	1	;	Separation character (';')
54	5	yxx.x	Temperature of pressure and acceleration sensor (unit: °C) y: Sign (+ or -) xx.x: Temperature value; resolution: 0.1°C
59	1	;	Separation character (';')
60	6	xxxx.x	Absolute air pressure (unit: hPa) xxxx.x: Pressure value; resolution: 0.1hPa
66	1	;	Separation character (';')
67	6	xxxx.x	Relative air pressure (unit: hPa) xxxx.x: Pressure value; resolution: 0.1hPa
73	1	;	Separation character (';')
74	6	yxxx.x	Inclination value θ Angle between the Z-axis and the vertical, unit: ° y: Sign (+ or -) xxx.x: Angle; resolution: 0.1
80	1	;	Separation character (';')
81	6	yxxx.x	Inclination value ρ Angle between the X-axis and the horizontal, unit: ° y: Sign (+ or -) xxx.x: Angle; resolution: 0.1°
87	1	;	Separation character (';')
88	6	yxxx.x	Inclination value ϕ Angle between the Y-axis and the horizontal, unit: ° y: Sign (+ or -) xxx.x: Angle; resolution: 0.1°
94	1	;	Separation character (';')
95	5	xxx.x	Frequency vibration measurement, X-axis (unit: Hz) xxx.x: Frequency; resolution: 0.1Hz
100	1	;	Separation character (';')
101	4	xxxx	Amplitude vibration measurement, X-axis (unit: mg, 1g=9.81m/s^2) xxxx: Amplitude; resolution: 1mg
105	1	;	Separation character (';')
106	5	xxx.x	Frequency vibration measurement, Y-axis (unit: Hz) xxx.x: Frequency; resolution: 0.1Hz
111	1	;	Separation character (';')
112	4	xxxx	Amplitude vibration measurement, Y-axis (unit: mg, 1g=9.81m/s^2) xxxx: Amplitude; resolution: 1mg
116	1	;	Separation character (';')
117	5	xxx.x	Frequency vibration measurement, Z-axis (unit: Hz) xxx.x: Frequency; resolution: 0.1Hz
122	1	;	Separation character (';')
123	4	xxxx	Amplitude vibration measurement, Z-axis (unit: mg, 1g=9.81m/s^2) xxxx: Amplitude; resolution: 1mg

Position	Length	Example	Description
127	1	;	Separation character (';')
128	8	abcdefgh	32-bit sensor status in hexadecimal representation a: high nibble in high byte in HEX (Bit 31 … 28) b: low nibble in high byte in HEX (Bit 27 … 24) c: high nibble in byte 2 in HEX (Bit 23 … 20) d: low nibble in byte 2 in HEX (Bit 19 … 16) e: high nibble in byte 3 in HEX (Bit 15 … 12) f: low nibble in byte 3 in HEX (Bit 11 … 8) g: high nibble in low byte in HEX (Bit 7 … 4) h: low nibble in low byte in HEX (Bit 3 … 0)
136	1	*	Separation character ('*')
137	2	xy	Exclusive or linked check sum in hexadecimal representation x: high nibble check sum in HEX y: low nibble check sum in HEX
139	1	ETX	End character (end of text)
140	1	CR	Carriage Return
141	1	LF	Line feed

Table 6: Measured value telegram

Pressure and acceleration sensors are thermally coupled.

Measured values

If the wind velocity exceeds the measured range specified by the calibration table, the standard curve will be used for the further calculation and the corresponding bit is set in the status word.

10.2 Measured value telegram 2

The wind transmitter responds with the measured value telegram 2 to the command "00TR2\r". The table below shows the telegram structure:

Position	Length	Example	Description
1	1	STX	Start character (start of text).
2	2	xx	Identification number (ID) xx: 0..99
4	1	;	Separation character (';')
5	5	xx.xx	Momentary value of the wind velocity, calculated with the current calibration table; unit: m/s; resolution: 0.01m/s.
10	1	;	Separation character (';')
11	5	xx.xx	Momentary value of the wind velocity, calculated with the standard curve; unit: m/s; resolution: 0.01m/s.
16	1	;	Separation character (';')
17	5	xx.xx	Momentary value of the wind velocity, corrected depending on the air pressure (wind velocity calculated with the current calibration table) unit: m/s; resolution: 0.01m/s.

Position	Length	Example	Description
22	1	;	Separation character (';')
23	5	xx.xx	reserved
28	1	;	Separation character (';')
29	5	xxx.x	reserved
34	1	;	Separation character (';')
35	5	yxx.x	Housing interior temperature of the wind transmitter (unit: °C) y: Sign (+ or -) xx.x: Temperature value; resolution: 0.1°C
40	1	;	Separation character (';')
41	5	xxxx.x	Temperature of pressure- and acceleration sensor (unit: °C) y: Sign (+ or -) xx.x: Temperature value; resolution: 0.1°C
46	1	;	Separation character (';')
47	6	xxxx.x	Absolute air pressure (unit: hPa) xxxx.x: Pressure value; resolution: 0.1hPa
53	1	;	Separation character (';')
54	6	xxxx.x	Absolute air pressure, corrected depending on the wind velocity (unit: hPa) xxxx.x: Pressure value; resolution: 0.1hPa
60	1	;	Separation character (';')
61	6	xxxx.x	Relative air pressure (unit: hPa) xxxx.x: Pressure value; resolution: 0.1hPa
67	1	;	Separationszeichen (';')
68	8	abcdefgh	32Bit Sensorstatus in hexadezimaler Darstellung a: high nibble in high byte in HEX (Bit 31 … 28) b: low nibble in high byte in HEX (Bit 27 … 24) c: high nibble in byte 2 in HEX (Bit 23 … 20) d: low nibble in byte 2 in HEX (Bit 19 … 16) e: high nibble in byte 3 in HEX (Bit 15 … 12) f: low nibble in byte 3 in HEX (Bit 11 … 8) g: high nibble in low byte in HEX (Bit 7 … 4) h: low nibble in low byte in HEX (Bit 3 … 0)
76	1	*	Separation character (';')
77	2	xy	Exclusive or linked check sum in hexadecimal representation x: high nibble check sum in HEX y: low nibble check sum in HEX
79	1	ETX	End character (end of text)
80	1	CR	Carriage Return
81	1	LF	Line feed

Table 7 : Measured value telegram 2

Pressure and acceleration sensors are thermally coupled.

10.3 Measured value memory telegram

The measuring values of the wind velocity (without compensation) acquired by means of standard characteristic curve) are buffered in a ring memory comprising 16 values. The time distance between the measured values is defined by parameter SR. The wind transmitter responds with the measured value memory telegram to the command “00TR30\r”. The table below shows the telegram structure:

Position	Length	Example	Description
1	1	STX	Start character (start of text)
2	5	xxxxx	Time since the last query in (unit: ms)
7	1	;	Separation character (‘;’)
8	5	xxx.x	Most recent measured value (0); unit: m/s; resolution: 0.1m/s
13	1	;	Separation character (‘;’)
14	5	xxx.x	Measured value (1); unit: m/s; resolution: 0.1m/s
19	1	;	Separation character (‘;’)
20	5	xxx.x	Measured value (2); unit: m/s; resolution: 0.1m/s
25	1	;	Separation character (‘;’)
26	5	xxx.x	Measured value (3); unit: m/s; resolution: 0.1m/s
31	1	;	Separation character (‘;’)
32	5	xxx.x	Measured value (4); unit: m/s; resolution: 0.1m/s
37	1	;	Separation character (‘;’)
38	5	xxx.x	Measured value (5); unit: m/s; resolution: 0.1m/s
43	1	;	Separation character (‘;’)
44	5	xxx.x	Measured value (6); unit: m/s; resolution: 0.1m/s
49	1	;	Separation character (‘;’)
50	5	xxx.x	Measured value (7); unit: m/s; resolution: 0.1m/s
55	1	;	Separation character (‘;’)
56	5	xxx.x	Measured value (8); unit: m/s; resolution: 0.1m/s
61	1	;	Separation character (‘;’)
62	5	xxx.x	Measured value (9); unit: m/s; resolution: 0.1m/s
67	1	;	Separation character (‘;’)
68	5	xxx.x	Measured value (10); unit: m/s; resolution: 0.1m/s
73	1	;	Separation character (‘;’)
74	5	xxx.x	Measured value (11); unit: m/s; resolution: 0.1m/s
79	1	;	Separation character (‘;’)
80	5	xxx.x	Measured value (12); unit: m/s; resolution: 0.1m/s
85	1	;	Separation character (‘;’)
86	5	xxx.x	Measured value (13); unit: m/s; resolution: 0.1m/s
91	1	;	Separation character (‘;’)
92	5	xxx.x	Measured value (14); unit: m/s; resolution: 0.1m/s
97	1	;	Separation character (‘;’)
98	5	xxx.x	Measured value (15); unit: m/s; resolution: 0.1m/s
103	1	;	Separation character (‘;’)
104	1	*	Separation character (‘*’)

Position	Length	Example	Description
105	2	xy	Exclusive or linked check sum in hexadecimal representation x: high nibble check sum in HEX y: low nibble check sum in HEX
107	1	ETX	End character (end of text)
108	1	CR	Carriage Return
109	1	LF	Line feed

Table 8 : Measured value memory telegram

In the order interpreter “MODBUS RTU”, the ring buffer is readable via one of the following addresses:

Register address	Description
35100	Time since the last measured value query in ms
35102	Most recent measured value (0)
35103	Measured value (1)
35104	Measured value (2)
35105	Measured value (3)
35106	Measured value (4)
35107	Measured value (5)
35108	Measured value (6)
35109	Measured value (7)
35110	Measured value (8)
35111	Measured value (9)
35112	Measured value (10)
35113	Measured value (11)
35114	Measured value (12)
35115	Measured value (13)
35116	Measured value (14)
35117	Oldest measured value (15)

After reading the ring buffer, independent from the number of the read measured values, all 16 memory cells are set to 0xffff.

Deleted measured values or not yet recorded measured values are initialized with 0xffff.

Remark:

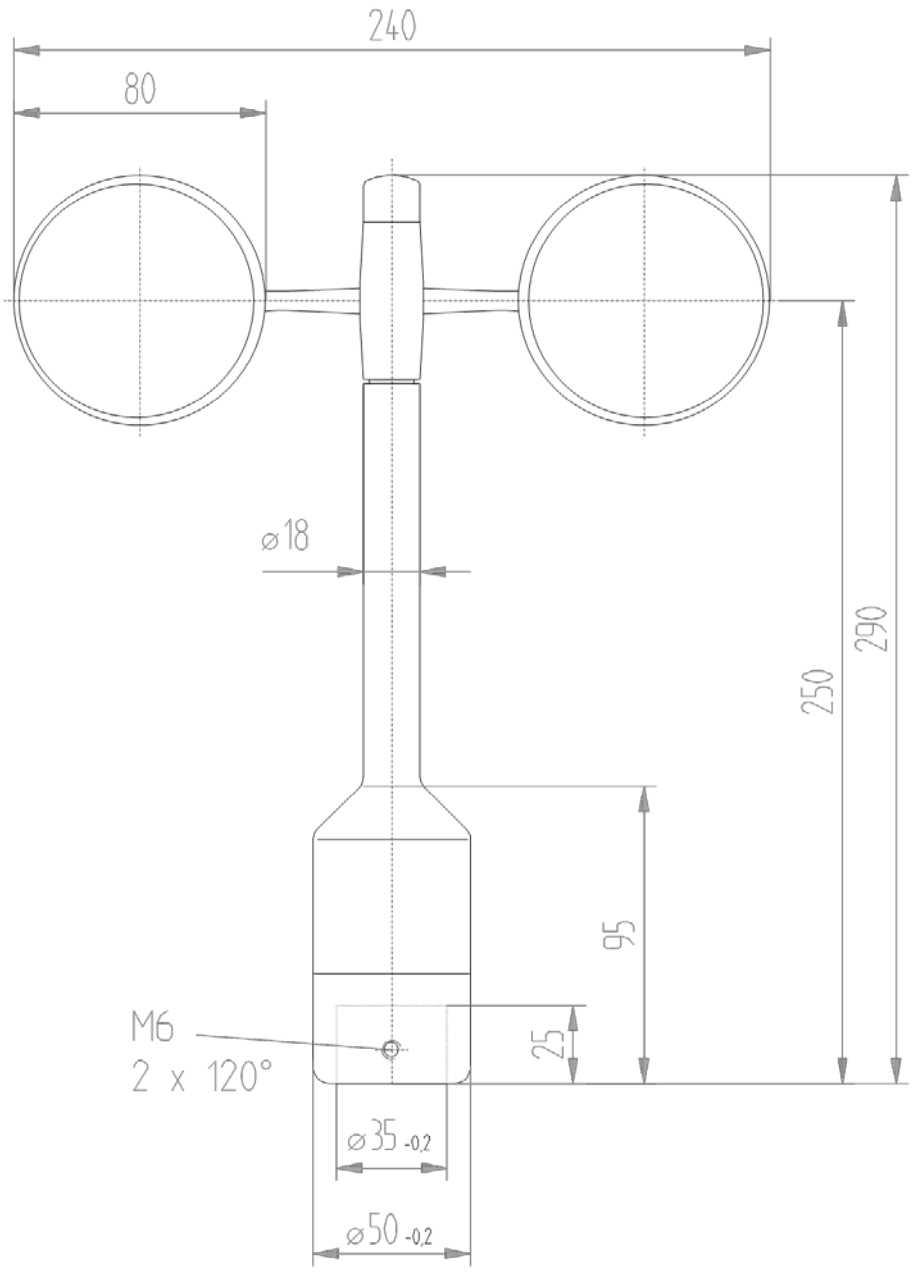
With each reading of the ring buffer, it will be cleared.

11 Specifications

Characteristics	Description
Measurement range	0.3 ... 75m/s
Measurement uncertainty	±1% from the measured value or < ±0,2m/s @ 0,3 ... 50m/s
Survival velocity	80m/s (min. 30 minutes)
Admissible environmental conditions	-40 ... +80°C 0 ... 100% relative humidity, including condensation
Housing inside temperature measurement	Measurement range: -40 … +80°C Precision: ±1°C
Air pressure measurement	Measurement range: 300 … 1100hPa Precision: ±1.0hPa @ 20°C
Inclination measurement (X, Y, Z) Vibration (X, Y, Z) Acceleration	Measurement range: -89.9 ... +89.9° Precision: +/-1° Measurement range: 0 … 50Hz Precision: ±0.4Hz Measurement range: ±8g Precision: ±30mg @ -3g … +3g
Temperature control for air pressure sensor, acceleration sensor.	Precision: ±0.5K Setting range: 0 ... +60°C The target temperature is set with a command with a resolution of 0.1K
Frequency output	Type open-drain or push-pull Form rectangle Frequency 1082Hz @ 50m/s without using calibration data Amplitude corresponds to supply voltage, max. 15V Load Ra > 1 kΩ (Push-pull output with 200Ω in series) Approx. <200nF (corresponds to a cable length ~ 1km)
Serial interface	Type RS485 Operating mode Half duplex mode Data format 8N1 Baud rate 2400, 4800, 9600, 19200, 38400, 57600
Linearity	Correlation factor r between frequency and wind velocity r > 0.999 99 (4 … 20m/s)
Start-up velocity	<0.3m/s
Resolution	0.05m wind travel
Distance constant	<3m (according to ASTM D 5096 – 96), 3 m according to ISO 17713-1
Turbulent flow into cups	Deviation Δv turbulent compared to stationary horizontal flow -0.5% < Δv <+2% Frequency < 2Hz
Classification	According to IEC 61400-12-1 edition 2.0 Wind Turbine Power Performance Testing 2017-03
Wind load	Approx. 100 N @ 75m/s

Characteristics	Description
Heater	Surface temperature of the housing neck >0°C at 20 m/s to -10°C air temperature, at 1 0m/s to -20°C Use of the Thies icing standard 012002 on the housing neck Heater controlled with temperature sensor.
Electric supply for electronic	Voltage: 3.7 ... 42V DC (galvanically separated from the housing) Current: 40mA typ. 100mA max. approx. 3.3mA in power saving mode SM1, HT0
Electric supply for Housing heater	Voltage: 24V AC/DC, 45 ... 65Hz (galvanically separated from the housing) Open circuit voltage: max. 30V AC, max. 42V DC Wattage: 25W Proportional control, control temperature: 5°C, Heater can be enabled disabled via interface, galvanically separated to the housing and the measured value logging
Type of connection	8-pin connector for shielded conductor in shaft (see connection diagram)
Mounting	Mounting on mast R 1", e.g. DIN 2441 1½ " with separate adapter (option)
Dimensions	see dimensional drawing
Weight	approx. 0.5kg
Type of protection	IP 55 (DIN 40050)
Material Housing, vane Mast-adaptor	 Aluminum (AlMgSi1) Stainless steel V4A (1.4571)

12 Dimensional Drawing



13 Accessories (optional)

Traverse 0.6 m For mounting the wind velocity and wind direction transmitter jointly onto a mast.	4.3174.00.000	Horizontal sensor distance: 0.6m Vertical sensor distance: 0.2m Mast receptacle: 48 … 50mm Material: Aluminum, anodized Dimensions: tube Ø 34x4mm, 668mm long, 756mm high
Hanger –FIRST CLASS- 1m For the lateral mounting of a wind velocity and wind direction transmitter onto a mast tube.	4.3184.01.000	Sensor distance to mast: 1m Mast clamp: 40 … 80mm Tube diameter: 34mm Material: Aluminum
Lightning rod For mounting the a/m traverse or hanger.	4.3100.98.000	Dimension: Ø 12mm, 500mm long, 1050mm high Material: Aluminum
Adaptor For isolated mounting of each wind transmitter and wind direction transmitter on the traverse (4.3174.0.000).	509077	Dimension: A:Ø 34mm, outside 25mm high B:Ø 35mm, inside 45mm high Material: POM

Please contact us for other accessories such as cables, power supply units, masts, as well as for additional mast- or system-constructions.

Example: Wind transmitter with traverse 4.3174.00.000 and lightning rod 4.3100.98.000

14 EC-Declaration of Conformity

Document-No.: 001575 **Month: 08 Year: 18**

Manufacturer: **A D O L F T H I E S G m b H & C o. K G**
Hauptstr. 76
D-37083 Göttingen
Tel.: (0551) 79001-0
Fax: (0551) 79001-65
email: Info@ThiesClima.com

This declaration of conformity is issued under the sole responsibility of the manufacturer

Description of Product: **Windsensor First Class Advanced II, Windsensor First Class Advanced X**

Article No.	**4.3352.00.000**	**4.3352.10.000**	**4.3352.00.400**	**4.3352.10.400**
	4.3352.00.401	**4.3352.10.401**		

specified technical data in the document: **021813/08/18, 021818/10/17**

The indicated products correspond to the essential requirement of the following European Directives and Regulations:

2014/30/EU	DIRECTIVE 2014/30/EU OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 26 February 2014 on the harmonisation of the laws of the Member States relating to electromagnetic compatibility
2014/35/EU	DIRECTIVE 2014/35/EU OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 26 February 2014 on the harmonisation of the laws of the Member States relating to the making available on the market of electrical equipment designed for use within certain voltage limits
552/2004/EC	Regulation (EC) No 552/2004 of the European Parliament and the Council of 10 March 2004 on the interoperability of the European Air Traffic Management network (the interoperability Regulation)
2011/65/EU	DIRECTIVE 2011/65/EU OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 8 June 2011 on the restriction of the use of certain hazardous substances in electrical and electronic equipment
2012/19/EU	DIRECTIVE 2012/19/EU OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 4 July 2012 on waste electrical and electronic equipment (WEEE)

The indicated products comply with the regulations of the directives. This is proved by the compliance with the following standards:

EN 61000-6-2	Electromagnetic compatibility Immunity for industrial environment
EN 61000-6-3	Electromagnetic compatibility Emission standard for residential, commercial and light industrial environments
EN 61010-1	Safety requirements for electrical equipment for measurement, control, and laboratory use. Part 1: General requirements
EN 50581	Technical documentation for the assessment of electrical and electronic products with respect to the restriction of hazardous substances

Place: Göttingen Date: 17.08.2018
Signed for and on behalf of:

Legally binding signature: issuer:

.....
Thomas Stadie, General Manager

.....
Joachim Beinhorn, Development Manager

This declaration certificates the compliance with the mentioned directives, however does not include any warranty of characteristics.
Please pay attention to the security advises of the provided instructions for use.

Please contact us for your system requirements.
We advise you gladly.

ADOLF THIES GMBH & CO. KG
Meteorology and environmental metrology
Hauptstraße 76 · 37083 Göttingen · Germany
Phone +49 551 79001-0 · Fax +49 551 79001-65
info@thiesclima.com

www.thiesclima.com