

Operating manual

Ultrasonic anemometers

HD53LS.A / HD53LS.S

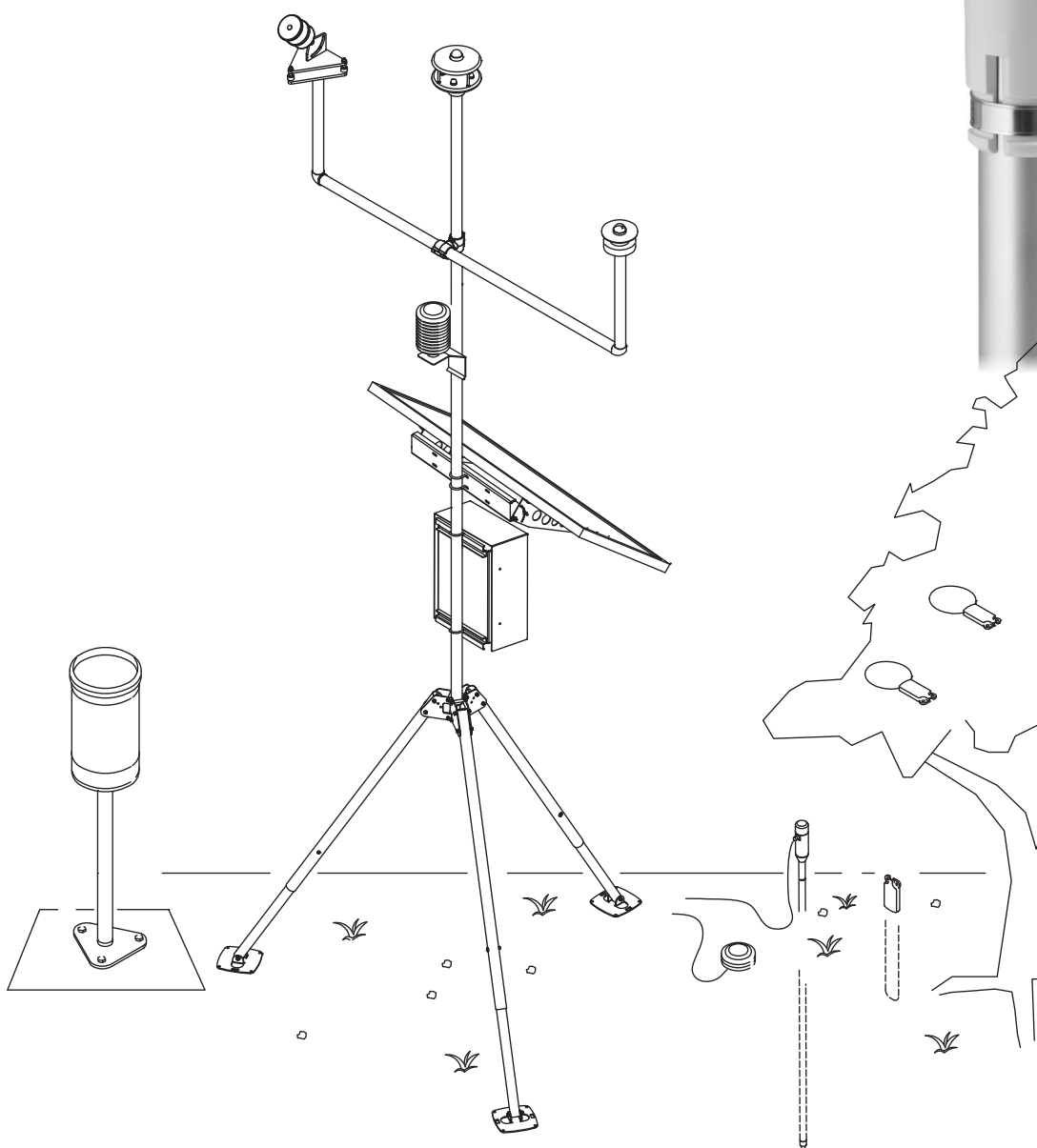


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1 INTRODUCTION

HD53LS.A and **HD53LS.S** are 2-axis ultrasonic static anemometers for the measurement of:

- Wind speed and direction
- U-V Cartesian components of wind speed
- Wind Gust (**only HD53LS.S**)

The average of wind speed and direction over a period configurable up to 10 minutes is calculated.

Wind speed and direction are determined by measuring the transit time of ultrasonic pulses between two pairs of ultrasonic transducers.

HD53LS.A has two analog outputs, for wind speed and direction, which are factory-configurable within 4÷20 mA (standard), 0÷1 V, 0÷5 V or 0÷10 V (**to be specified when ordering**).

HD53LS.S has RS485 MODBUS-RTU output.

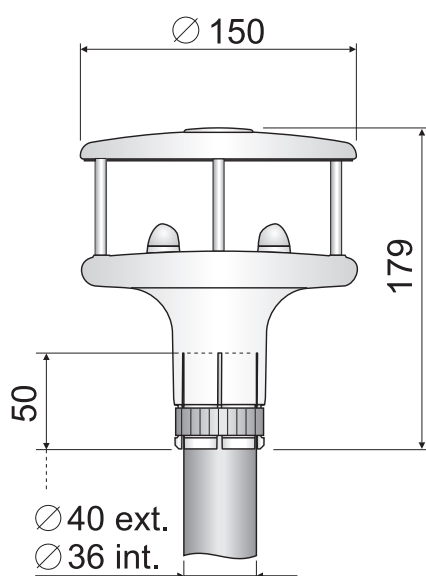
Mounting on \varnothing 40 mm mast. The electric connection is performed through a M23 19-pole connector situated on the bottom of the instrument.

The low power consumption of the instrument allows installation in remote sites, with power supplied by photovoltaic panel and backup battery.

The absence of moving parts minimizes the instrument maintenance.

2 TECHNICAL SPECIFICATIONS

Wind speed	
Used sensor	Ultrasounds
Measuring range	0...50 m/s
Resolution	0.1 m/s
Accuracy	± 0.2 m/s or ± 2%, the greatest (0...35 m/s), ± 3% (> 35 m/s)
Wind direction	
Used sensor	Ultrasounds
Measuring range	0...359°
Resolution	1°
Accuracy	± 2° RMSE from 1.0 m/s
General features	
Power Supply	10...30 Vdc (15...30 Vdc for version with 0÷10 V analog output)
Power consumption	26 mA @ 12 Vdc
Analog output	2 analog outputs: one for wind speed and one for wind direction (only in HD53LS.A). Analog output type is 4...20 mA as standard; 0...1 V, 0...5 V or 0...10 V available on request . Analog output refresh rate 1 Hz.
Digital output	RS485 MODBUS-RTU (only in HD53LS.S)
Averaging interval	Configurable from 1 s to 10 min
Electrical connection	M23 connector
Operating temperature	-20...+55 °C
Survival speed	90 m/s
Protection degree	IP 66
Dimensions	H=179mm, Ø=150mm
Weight	640 g approx.
Case	ASA. Metal parts: AISI 316



3 MEASURING PRINCIPLE OF WIND SPEED AND DIRECTION

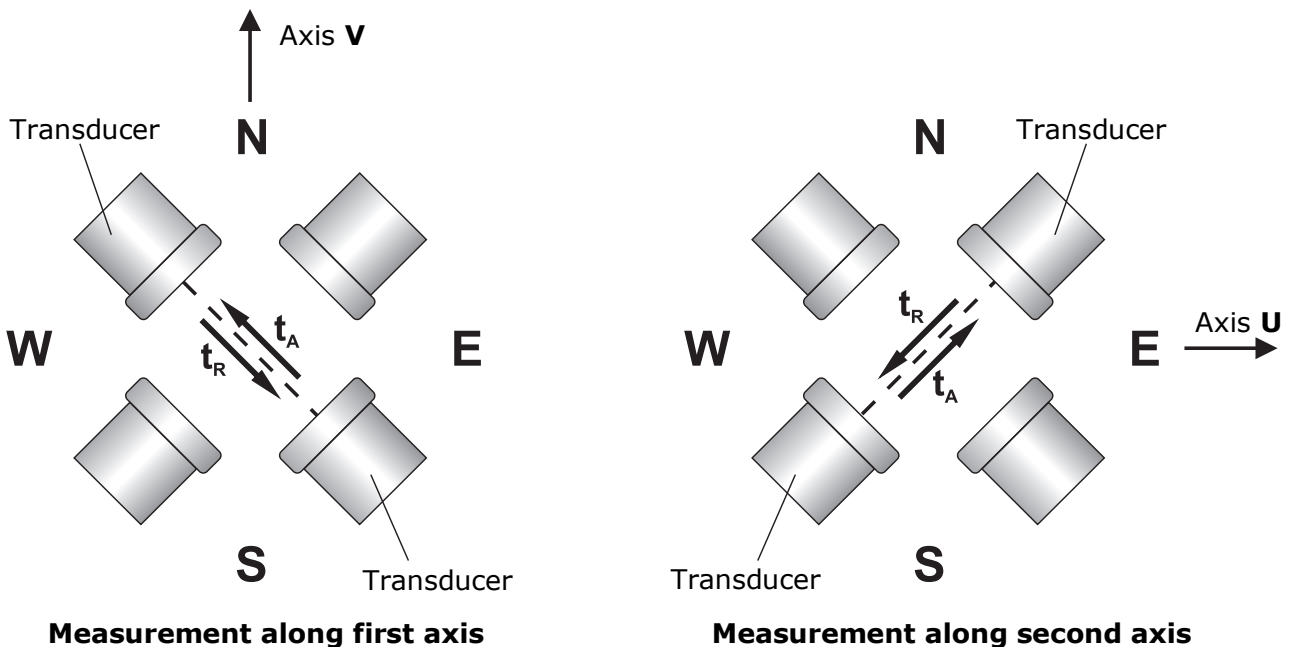
Wind speed and direction are determined by measuring the time taken by ultrasonic pulses to cover the distance from the transducer that generates the pulse to the receiving transducer.

The instrument uses 2 pairs of transducers oriented along two orthogonal axes. Detecting the wind speed along two axes allows determining not only the intensity but also the wind direction.

The instrument measures the travel time of the ultrasonic pulse between the two transducers of the same pair in both directions. The travel times in the two opposed directions are defined as t_A (forward direction time) and t_R (reverse direction time).

If wind speed is zero, t_A and t_R values are the same. In the presence of wind, one of the two time values is greater than the other and the comparison between the two time values allows to determine the direction and the intensity of the wind.

Measuring the travel time in both directions allows to cancel the dependence of the transmission speed of ultrasounds in the air from the environmental conditions of temperature, humidity and barometric pressure.



The travel times of the ultrasonic pulses are given by:

$$t_A = \frac{D}{C + V_w} \quad t_R = \frac{D}{C - V_w}$$

Where:

D = Distance between the two transducers of the same pair

C = Sound speed

V_w = Component of wind speed along the measurement axis

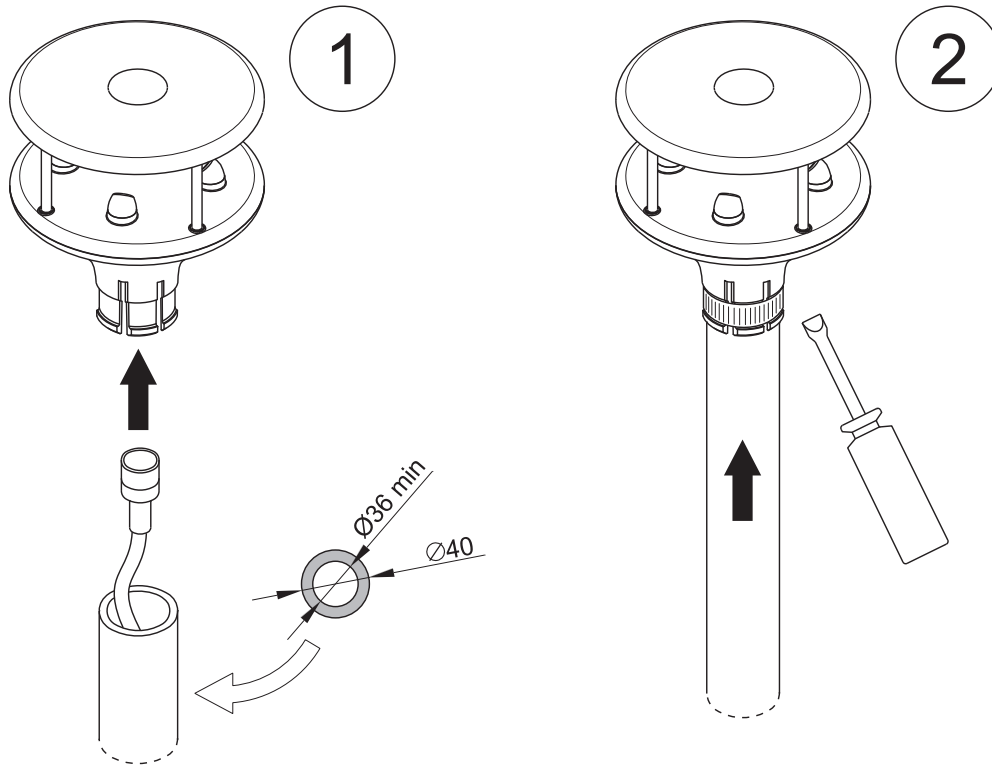
Measuring the two travel times allows determining the wind speed component:

$$V_w = \frac{D}{2} \cdot \left(\frac{1}{t_A} - \frac{1}{t_R} \right)$$

4 INSTALLATION

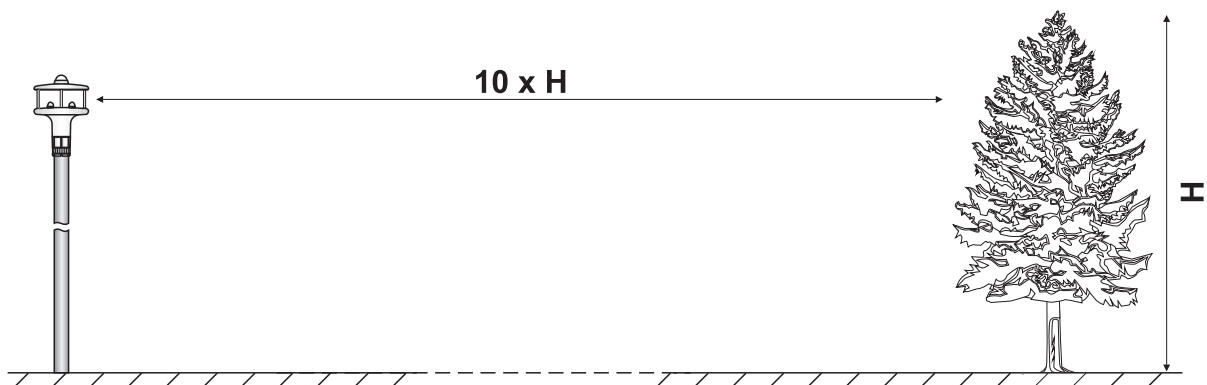
To install the instrument, pass the connection cable inside the support mast and connect the 19-pole M23 female connector of the cable to the 19-pole M23 male connector situated at the bottom of the instrument. Ensure connection stability by tightening the connector external nut.

Align the arrow on the housing of the instrument to the North (see par. 4.1 "Alignment"), then fix it on the support mast by tightening the cable tie at the bottom of the instrument.



The support mast, having 40 mm maximum outer diameter and 36 mm minimum inner diameter, should be positioned on a stable surface.

The instrument should be installed vertically and in an open area, far from obstructions located in the vicinity that might alter the natural air flow. Any close objects (such as buildings, trees, pylons, etc.) should be at a distance equal to at least ten times their height.



In the presence of close objects, it is advisable to place the instrument at a height of 10 m.

For open-space installations, the instrument can be installed using the tripod **HD2005.20** (2 m) or **HD2005.20.1** (3 m).

If the instrument is installed on a building, the height of the instrument should be at least 1.5 times the minimum value between the height of the building and the roof longest diagonal.

In case of mobile installations (for example on a boat), take into account that the instrument measures the relative (apparent) wind speed with respect to the instrument. To determine the absolute (real) wind speed one should consider the movement velocity of the instrument.

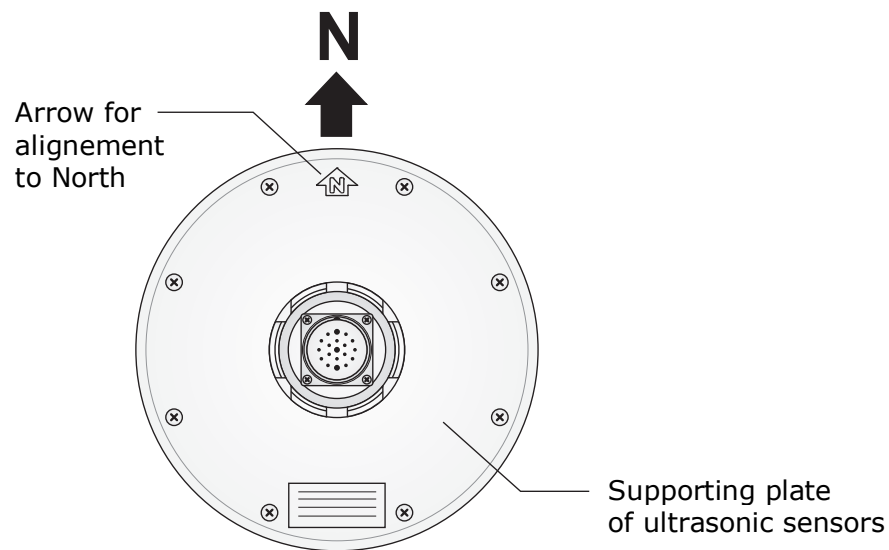
The instrument is factory-calibrated and does not require additional interventions of the user.

For the available configuration parameters, the related factory settings and the commands to modify the parameters, see Chapter 6 "CONFIGURATION".

In the model HD53LS.S, the RS485 MODBUS-RTU mode will be active 10 seconds after power up.

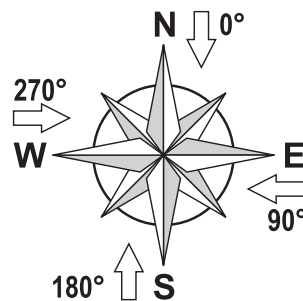
4.1 ALIGNMENT OF THE INSTRUMENT

The arrows on the case will facilitate the alignment. The arrows must be aligned to the North.



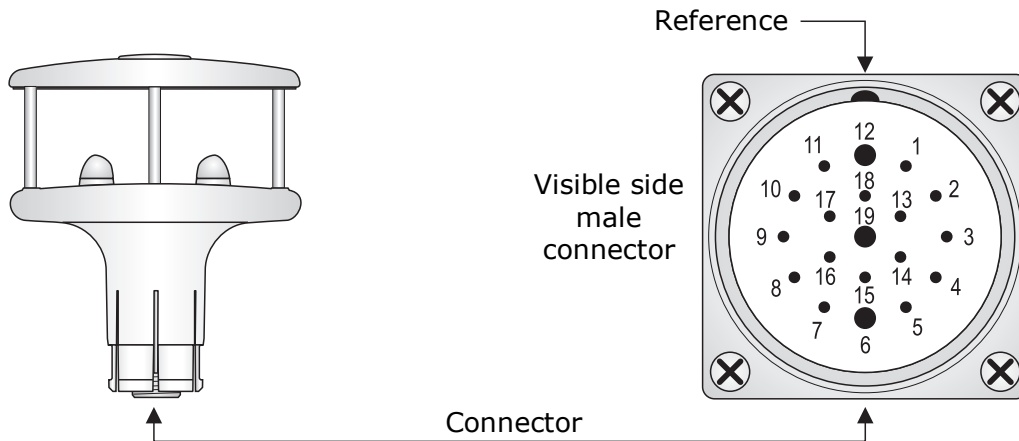
When evaluating the wind direction, one should take into account that the geographic North differs from the magnetic North indicated by a magnetic compass. The difference, named **magnetic declination**, depends on the area where the instrument was installed (for example, about 15° in North-America and less than 3° in Europe).

If wind speed and direction values are given in polar coordinates, 0° angle corresponds to a wind coming from North.



4.2 ELECTRICAL CONNECTIONS

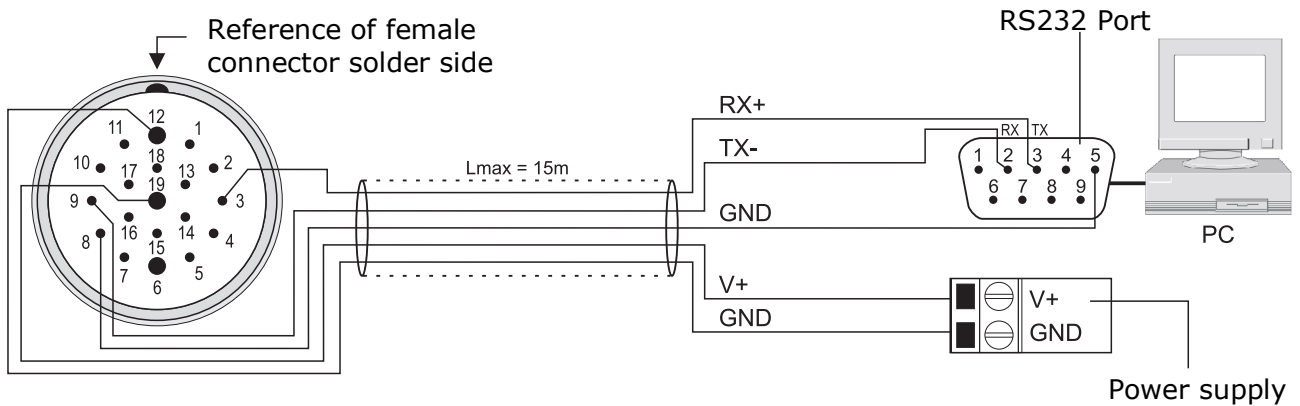
All connections are performed through a 19-pole M23 male connector situated at the bottom of the instrument. The figure and the table below show numbers and function of the connector contacts:



Connector pin number	CP52.x cable wire number	Symbol	Description
1			Not connected
2	2		Not connected
3	3	RX +	RX for RS232 connection
4			Not connected
5			Not connected
6	6		Not connected
7	7		Not connected
8	8	GND	Serial ground
9	9	TX -	DATA - for RS485 connection (only HD53LS.S) TX for RS232 connection
10			Not connected
11			Not connected
12	12	GND	Instrument power supply negative
13	4		Not connected
14	10	OUT 1	Analog output 1 positive (only HD53LS.A)
15		GND	Analog ground (only HD53LS.A)
16	11	OUT 2	Analog output 2 positive (only HD53LS.A)
17	5	TX +	DATA + for RS485 connection (only HD53LS.S)
18		V +	Instrument power supply positive
19	1	V +	Instrument power supply positive

The instrument requires 10...30 Vdc power supply.

4.2.1 RS232 SERIAL CONNECTION

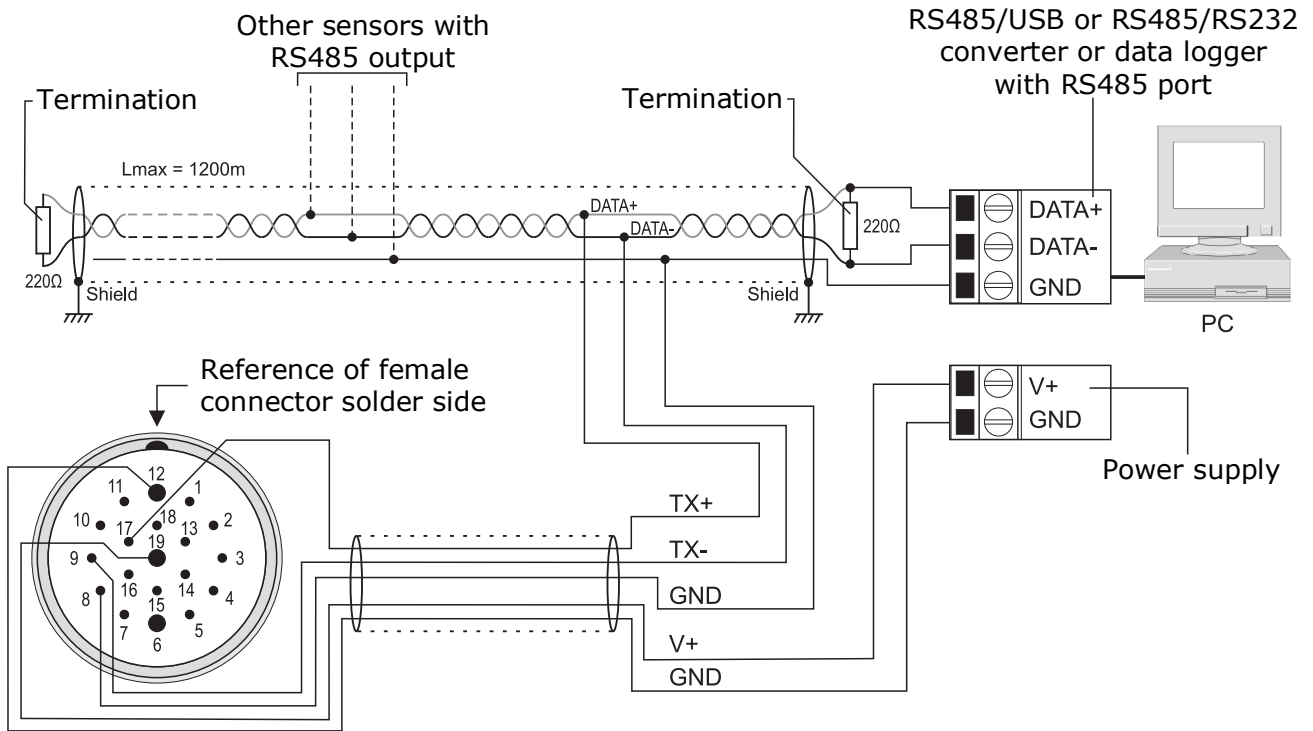


For RS232 connection, TX-, RX+ and serial GND signals (pin 9, 3 and 8 of M23 connector) are used, to be connected respectively to RX, TX and GND signals of RS232 port on PC (pin 2, 3 and 5 of 9-pole SubD connector). The length of RS232 cables should not exceed 15 m.

The RS232 serial connection is used for the instrument configuration (via serial commands or HD52.3D-S software) and for displaying the measurements in real time (via HD52.3D-S software).

If the PC is not equipped with RS232 serial ports, the **RS52** adapting cable (with built-in USB/RS232 converter) can be inserted between the PC and the instrument (see paragraph 4.2.4).

4.2.2 RS485 SERIAL CONNECTION (ONLY HD53LS.S)



Thanks to RS485 connection, multiple instruments can be connected to a multi-point network. Instruments are connected in sequence through a twisted-pair shielded cable for signals and a third wire for ground.

Line terminations should be placed at the two ends of the network. The cable shield should be connected to both ends of the line.

The maximum number of devices that can be connected to the RS485 line (Bus) depends on the load characteristics of the devices to be connected. The RS485 standard requires that the total

load does not exceed 32 unit loads. The load of an HD52.3D... anemometer is equal to $\frac{1}{4}$ of unit load. If the total load is greater than 32 unit loads, divide the network into segments and add a signal repeater between a segment and the successive one. Line termination should be applied at both ends of each segment.

The maximum length of the cable depends on the transmission speed and the cable characteristics. Typically, the maximum length is 1200 m. The data line should be kept separated from any power lines in order to prevent interference with the transmitted signal.

Each instrument on the network is univocally identified by an address. **Multiple transmitters with the same address should not be placed on the network.**

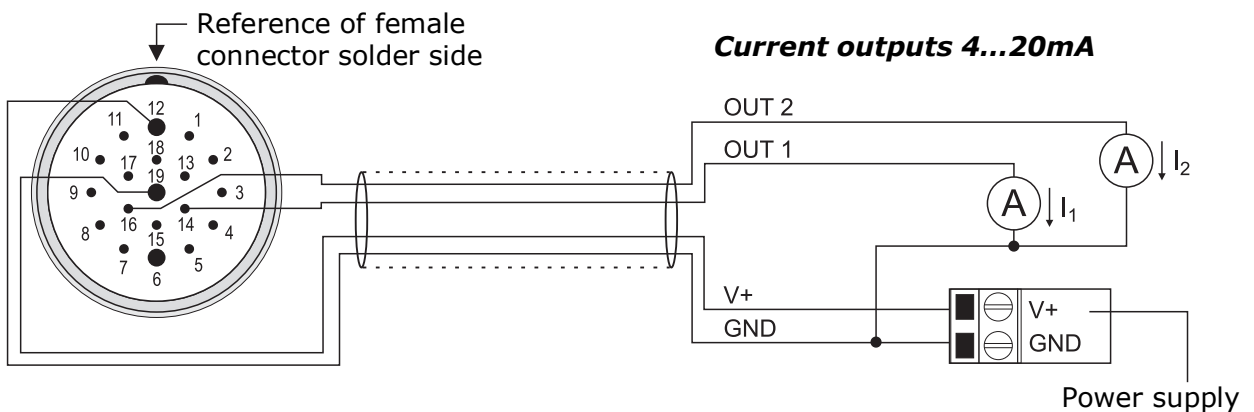
If the instrument is connected to a data logger, the possibility to connect multiple sensors to the network depends on the data logger capacity to manage multiple sensors.

MODBUS-RTU protocol is used with RS485 connection.

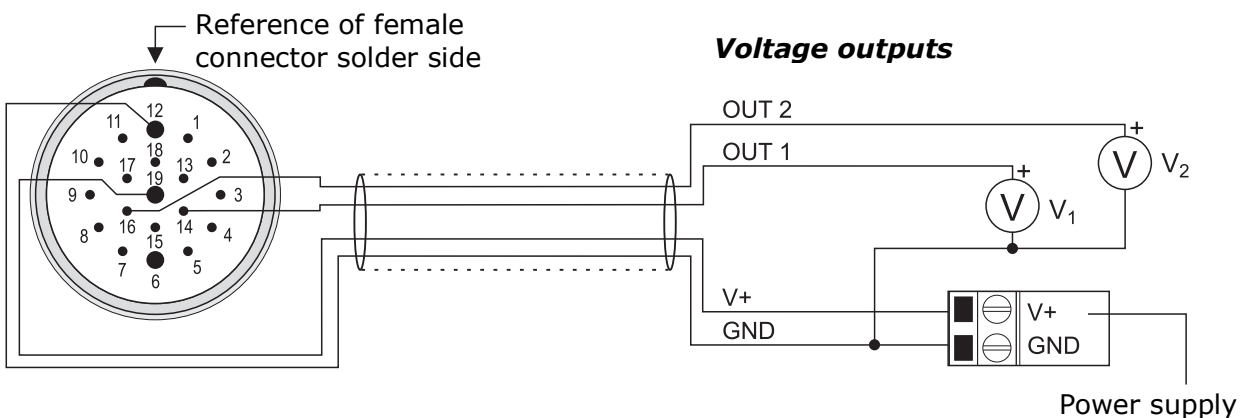
Before connecting the instrument to the network, configure address and Baud Rate (see chapter 6 "CONFIGURATION").

4.2.3 ANALOG OUTPUTS CONNECTION (ONLY HD53LS.A)

Connect the outputs according to one of the two schemes below, depending on the output type, current (standard) or voltage (on request), available in the instrument. **OUT 1** and **OUT 2** are associated to wind speed and direction respectively. To change the type of speed and direction measurements associated to the outputs, see chapter 6 "CONFIGURATION".



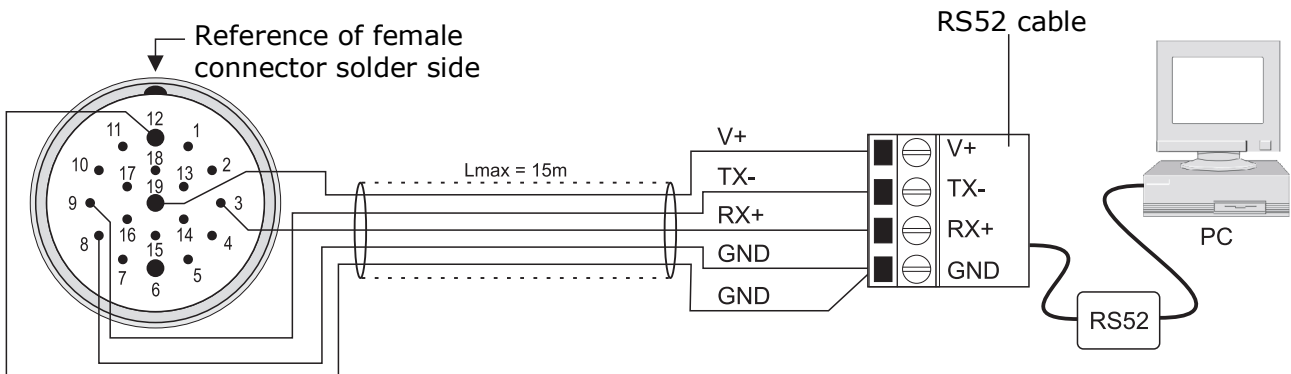
Current outputs are active. Load resistance: $R_L < 300 \Omega$.



Load resistance: $R_L > 10 \text{ k}\Omega$.

4.2.4 CONNECTION OF RS52 CABLE

If the PC is not equipped with RS232 serial ports, but with USB ports only, the **RS52** adapting cable (with built-in USB/RS232 converter) should be interposed between the PC and the instrument.



To use the **RS52** cable, the drivers included in the HD52.3D-S software package should be installed in the PC (see the guide to USB drivers installation included in the software package).

The instrument is powered directly from the USB port of the PC.

5 CONFIGURATION

Configuration mode allows to read the instrument general info (firmware version, calibration date, serial number), to read and set the instrument operation parameters.

To configure the instrument, a RS232 serial connection to a PC should be performed (see paragraph 4.2.1). If your PC is not equipped with RS232 serial ports, the **RS52** adapting cable can be placed between the PC and the instrument (see paragraph 4.2.4).

The instrument configuration can be realized with the aid of the **HD52.3D-S** application software (see the instructions of the software) or by sending serial commands via standard communication programs.

If a standard communication program is used, the program communication parameters should be set as follows:

- Baud rate: 115200
- Data Bits: 8
- Parity: None
- Stop Bit: 2

HD53LS.S:

The serial output of the HD53LS.S model is preset to operate in MODBUS-RTU mode; in order to enter configuration mode after connecting the instrument to the PC via RS232 it is necessary to send **within 10 seconds from power on** (if the instrument is already powered, power cycle the instrument) the serial command @ (if a standard communication program is used) or the request of connection with the **HD52.3D-S** application software, if the application software is used.

To reset the serial output of the HD53LS.S model to MODBUS-RTU mode after the configuration has been carried out, power cycle the instrument: the MODBUS-RTU protocol will become active after 10 seconds from restart.

HD53LS.A:

The serial output of the HD53LS.A model is always in configuration mode.

5.1 SERIAL COMMANDS

The tables below describe the serial commands that allow reading the current instrument configuration and change the operation parameters.

Instrument information

Command	Reply	Description
G1	&Vnn.nn yyyy/mm/dd	Version and date of firmware
RGD	&yyyy/mm/dd hh.mm.ss	Date and time of calibration
RGS	&nnnnnnnn	Serial number of instrument
RGI	&ccc...ccc	User code
CGIccc...ccc	&	Sets user code to ccc...ccc (max. 34 characters)

General parameters:

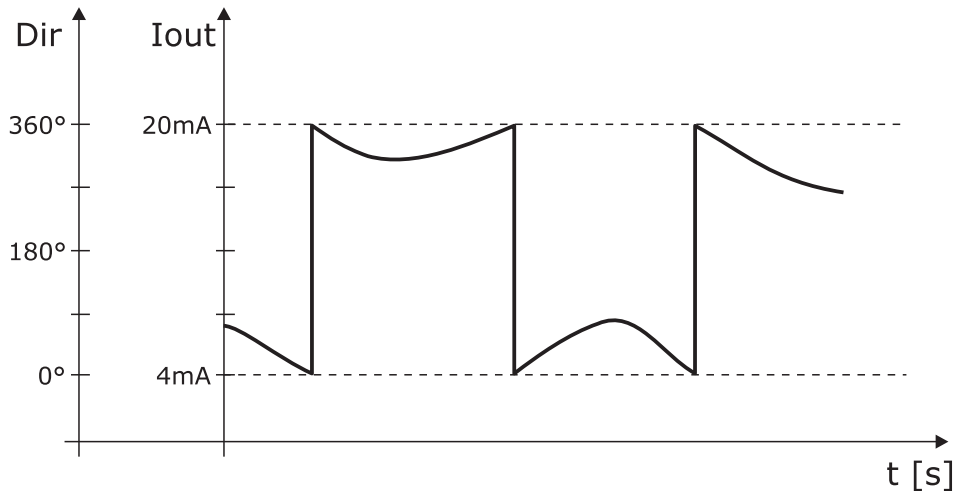
Command	Reply	Description
CGUVn	&	Sets measuring unit of wind speed: <ul style="list-style-type: none"> ▪ m/s if n=1 ▪ cm/s if n=2 ▪ km/h if n=3 ▪ knot if n=4 ▪ mph if n=5 <p><i>Default</i> : m/s (n=1)</p>
RGUV	n	Reads the wind speed measuring unit set in the instrument
CWCnnnn	&	Sets wind speed threshold to nnnn value (in hundredths of m/s) Value should range within 0 and 100 hundredths of m/s (= 0...1 m/s) <p><i>Default</i> : 20 (= 0.2 m/s) (see Note 1)</p>
RWC	& nnnn	Reads the wind speed threshold value set in the instrument (in hundredths of m/s)
CWaLnnn	&	Sets time interval for the calculation of average speed and average direction to nnn value Value should range within 1 and 600 s. If the value is greater than 10 s, it must be an integer multiple of 10. <p><i>Default</i> : 1 s</p>
RWaL	& nnn	Reads the time interval for the calculation of average speed and average direction set in the instrument
CWaMn	&	Sets the method for the calculation of average speed and average direction: <ul style="list-style-type: none"> ▪ If n=0: scalar mean. The average intensity is calculated as average of intensities without consideration of direction. The average direction is calculated as average of directions, and expressed according to the extended characteristic (see Note 2). ▪ If n=1: vector mean. The average of the coordinates along each measurement axis is calculated. The average intensity and the average direction are those determined by the two average coordinates. <p><i>Default</i> : vector mean (n=1)</p>
RWaM	& n	Reads the method for the calculation of the average speed and average direction set in the instrument

NOTE 1 : WIND SPEED THRESHOLD VALUE

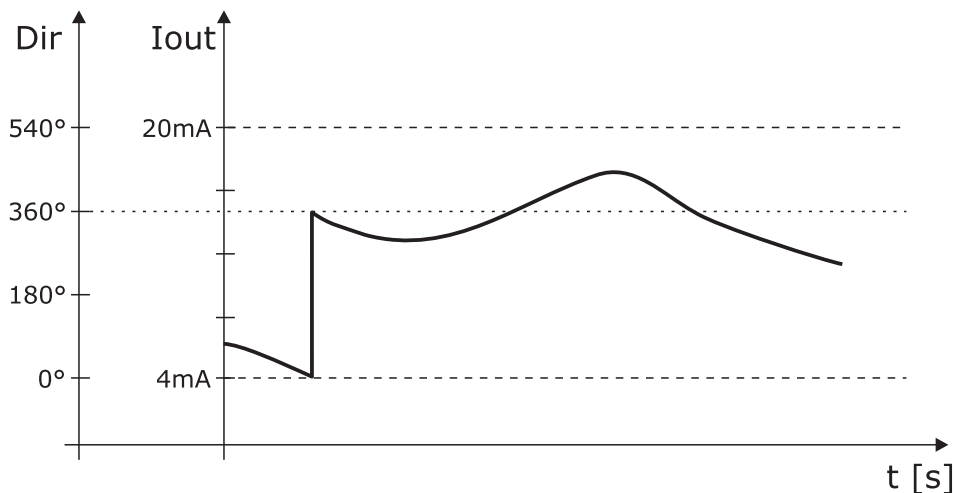
If the wind speed is very low, the determination of the direction can result inaccurate. The instrument allows setting the threshold value of speed below which the direction value is frozen on the last acquired value.

NOTE 2 : WIND DIRECTION EXTENDED CHARACTERISTIC

With 0÷359° wind direction measuring range, the analog output continues to oscillate between maximum and minimum scale if the direction continues to slightly fluctuate around 0°:



This effect can be reduced through the extended ("wrap-around") characteristic of wind direction. In this mode, the wind direction is considered as corresponding to 0÷539° range instead of 0÷359°. The wide output fluctuation occurs the first time that the wind direction goes from 0 to 359°; if later the "physical" direction goes back to 0°, the analog output will always remain around 360°. Using the extended characteristic, the behavior of the above graph changes into the following:



If 539° value is exceeded in extended mode, the output goes to the value corresponding to 180°. The table below shows the correspondence between the value of the analog output and the direction of the wind in the two modes.

Wind direction	4...20mA output		0...1V output		0...5V output		0...10V output	
	standard	extended	standard	extended	standard	extended	standard	extended
0°	4.00	4.00	0.00	0.00	0.00	0.00	0.00	0.00
180°	12.00	9.33	0.50	0.33	2.50	1.67	5.00	3.33
360°	20.00	14.67	1.00	0.67	5.00	3.33	10.00	6.67
540°	--	20.00	--	1.00	--	5.00	--	10.00

Analog outputs (only HD53LS.S):

Command	Reply	Description
CAFxnn	&	<p>Sets offset and direction of the analog output x (x=1 or 2) to:</p> <ul style="list-style-type: none"> ▪ Standard if nn=00 [ex. 4...20mA, 0...1V, 0...5V, 0...10V] ▪ Without offset if nn=01 [ex. 0...20mA] ▪ With offset if nn=02 [ex. 0.2...1V, 1...5V, 2...10V] ▪ Inverted if nn=04 [ex. 20...4mA, 1...0V, 5...0V, 10...0V] ▪ Inverted without offset if nn=05 [ex. 20...0mA] ▪ Inverted with offset if nn=06 [ex. 1...0.2V, 5...1V, 10...2V] <p><i>Default</i> : Standard (nn=00)</p>
RAFx	& nn	<p>Reads offset and direction setting of the analog output x (x=1 or 2)</p>
CAMn	&	<p>Association of the analog outputs:</p> <ul style="list-style-type: none"> ▪ If n= 0: Output 1 = Mean wind speed Output 2 = Mean wind direction ▪ If n= 1 (see Note 3): Output 1 = Instant wind speed component along V-axis Output 2 = Instant wind speed component along U-axis ▪ If n= 2 (Tunnel mode, see Note 4): Output 1 = Instant wind speed component along the direction indicated by the arrow on the instrument case Output 2 = Instant wind direction referred to the direction indicated by the arrow on the instrument case <p><i>Default</i> : n=0</p>
RAM	& n	<p>Reads the association of analog outputs</p>
CAHn	&	<p>Associates full scale of wind speed analog output to:</p> <ul style="list-style-type: none"> ▪ 5 m/s if n=0 ▪ 10 m/s if n=1 ▪ 15 m/s if n=2 ▪ 20 m/s if n=3 ▪ 25 m/s if n=4 ▪ 30 m/s if n=5 ▪ 35 m/s if n=6 ▪ 40 m/s if n=7 ▪ 45 m/s if n=8 ▪ 50 m/s if n=9 <p><i>Default</i> : 50 m/s (n=9)</p>
RAH	& n	<p>Reads the value corresponding to the wind speed analog output full scale</p>

NOTA 3 : U,V COMPONENTS

By selecting the U and V components, the speed value associated to the initial scale of the two analog outputs is equal to the opposite of the speed value associated to the full scale of the outputs.

For example, if the speed full scale value is set to 50 m/s, the speed range associated to the analog outputs is -50...+50 m/s.

NOTA 4 : TUNNEL MODE

The arrow on the instrument case should be aligned with the direction of the tunnel.

The output 2 is set to full scale value if the wind blows in the direction of the arrow, and to initial scale value if the wind blows in the opposite direction.

The initial scale of output 1 is associated to the speed value opposite to that associated to the output full scale.

Parameters for MODBUS-RTU mode (only HD53LS.S):

Command	Reply	Description
CU5Annn	&	Sets MODBUS address to nnn The address should range within 1 and 247 <i>Default</i> : 1
RU5A	& nnn	Reads the MODBUS address setting
CU5Bn	&	Sets the Baud Rate for MODBUS mode to: <ul style="list-style-type: none"> ▪ 9600 if n=3 ▪ 19200 if n=4 ▪ 38400 if n=5 ▪ 57600 if n=6 ▪ 115200 if n=7 <i>Default</i> : 19200 (n=4)
RU5B	& n	Reads Baud Rate setting for MODBUS mode
CU5Mn	&	Sets parity and stop bits for MODBUS mode to: <ul style="list-style-type: none"> ▪ 8N1 if n=0 [No parity, 1 stop bit] ▪ 8N2 if n=1 [No parity, 2 stop bits] ▪ 8E1 if n=2 [Even parity, 1 stop bit] ▪ 8E2 if n=3 [Even parity, 2 stop bits] ▪ 8O1 if n=4 [Odd parity, 1 stop bit] ▪ 8O2 if n=5 [Odd parity, 2 stop bits] The number of bits is fixed to 8 <i>Default</i> : 8E1 (n=2)
RU5M	& n	Reads the setting of parity and stop bits for MODBUS mode
CU5Wn	&	Sets waiting time after transmission in MODBUS mode to: <ul style="list-style-type: none"> ▪ Immediate reception if n=0 (violates protocol) ▪ Waiting 3.5 characters if n=1 (respects protocol) <i>Default</i> : Waiting 3.5 characters (n=1)
RU5W	& n	Reads the setting of waiting time after transmission in MODBUS mode

6 MODBUS-RTU MODE (ONLY HD53LS.S)

In MODBUS-RTU mode, the instrument sends the acquired measurements only if specifically requested by the PC, PLC or data logger.

Communication parameters should be set in the PC or data logger as follows:

- Baud rate: same as the setting in the instrument (default = 19200)
- Data bits: 8
- Parity: same as the setting in the instrument (default = even)
- Stop bits: same as the setting in the instrument (default = 1)

MEASUREMENT READING (function **04h**)

The Modbus function code 04h (Read Input Registers) allows reading the values measured by the instrument. The following table lists the Input Registers available:

Modbus Input Registers

Register number	Quantity	Format
1	Instantaneous wind speed (x10)	unsigned 16 bits
2	Instantaneous wind direction in degrees	unsigned 16 bits
11	Average wind speed (x100)	unsigned 16 bits
12	Average wind direction in degrees (x10)	unsigned 16 bits
15	Wind direction in degrees with extended feature (see page 14)	unsigned 16 bits
16	Wind speed (x10) along V-axis	unsigned 16 bits
17	Wind speed (x10) along U-axis	unsigned 16 bits
18	Status register: bit0=1 ⇒ Speed measurement error	unsigned 16 bits
19	Wind speed unit of measurement 0 ⇒ m/s, 1 ⇒ cm/s, 2 ⇒ km/h, 3 ⇒ knot, 4 ⇒ mph	unsigned 16 bits
22	Wind Gust intensity (x10)	unsigned 16 bits
23	Wind Gust direction in degrees	unsigned 16 bits

Note: the wind speed measurement value is expressed in the unit set in the instrument.

The Wind Gust measurement is determined by continuously calculating the wind speed averages in a time interval equal to 3 seconds, and detecting the maximum value of the calculated averages over the time elapsed between the current reading command and the previous reading command (the Wind Gust measurement is reset after each reading command).

For additional information regarding the protocol, visit the site "www.modbus.org".

7 INSTRUMENT STORAGE

Instrument storage conditions:

- Temperature: -40...+65 °C.
- Humidity: less than 90 %RH no condensation.
- In storing, avoid locations where:
 - There is a high humidity level.
 - The instrument is exposed to direct sunlight.
 - The instrument is exposed to a high temperature source.
 - There are high vibration levels.
 - There is presence of vapor, salt and/or corrosive gas.

8 SAFETY INSTRUCTIONS

General safety instructions

The instrument has been manufactured and tested in accordance with the safety standard EN61010-1:2010 "Safety requirements for electrical equipment for measurement, control and laboratory use" and has left the factory in perfect safety technical conditions.

The instrument proper operation and operating safety can be ensured only if all standard safety measures as well as the specific measures described in this manual are followed.

The instrument proper operation and operating safety can be ensured only in the climatic conditions specified in this manual.

Do not use the instrument in places where there are:

- Rapid ambient temperature variations that may cause condensation.
- Corrosive or flammable gases.
- Direct vibrations or shocks to the instrument.
- High-intensity electromagnetic fields, static electricity.

If the instrument is moved from a cold place to a hot one, or vice versa, condensation formation can cause an instrument malfunction. In this case, you will have to wait for the instrument temperature to reach ambient temperature before turning the instrument on.

User obligations

The instrument operator shall follow the directives and regulations below that refer to the treatment of dangerous materials:

- EEC directives on workplace safety
- National low regulations on workplace safety
- Accident prevention regulations

9 ORDER CODES

- HD53LS.A** 2-axis ultrasonic static anemometer. Analog output factory configurable among 4...20 mA (standard), 0...1 V, 0...5 V, 0...10 V (**to be specified when ordering**). Power supply: 10...30 Vdc (15...30 Vdc for 0...10 V analog output). Installation on a mast: external \varnothing 40 mm, internal \varnothing 36 mm. Input with M23 connector. It includes HD52.3DS software downloadable from Delta OHM website. Supplied with M23 movable connector. **On request CP52... cable.**
- HD53LS.S** 2-axis ultrasonic static anemometer. Digital RS485 MODBUS-RTU output. Power supply: 10...30 Vdc. Installation on a mast: external \varnothing 40 mm, internal \varnothing 36 mm. Input with M23 connector. It includes HD52.3DS software downloadable from Delta OHM website. Supplied with M23 movable connector. **On request CP52... cable.**

ACCESSORIES

- RS52** Serial connection cable with built-in USB/RS232 converter. USB connector for the PC and screw terminals on the instrument side.
- CP52.5** Cable with 19-pole M23 connector on one end, open wires on the other end. Length 5 m.
- CP52.10** Cable with 19-pole M23 connector on one end, open wires on the other end. Length 10 m.
- CP52.15** Cable with 19-pole M23 connector on one end, open wires on the other end. Length 15 m.
- CP52.20** Cable with 19-pole M23 connector on one end, open wires on the other end. Length 20 m.
- CP52.30** Cable with 19-pole M23 connector on one end, open wires on the other end. Length 30 m.
- CP52.50** Cable with 19-pole M23 connector on one end, open wires on the other end. Length 50 m.
- CP52.75** Cable with 19-pole M23 connector on one end, open wires on the other end. Length 75 m.
- HD52.30K** Birds spikes.
- HD2005.20** Tripod with adjustable legs for installing environmental sensors. Material: anodized aluminum. Max. height 2 m. It can be fixed on a flat base with screws or to the ground with pegs. Foldable legs for the transport.
- HD2005.20.1** Tripod with adjustable legs for installing environmental sensors. Material: anodized aluminum. Max. height 3 m. It can be fixed on a flat base with screws or to the ground with pegs. Foldable legs for the transport.

DELTA OHM metrology laboratories LAT N° 124 are ISO/IEC 17025 accredited by ACCREDIA for Temperature, Humidity, Pressure, Photometry / Radiometry, Acoustics and Air Velocity. They can supply calibration certificates for the accredited quantities.