Operating manual

Ultrasonic anemometers
HD52.3D… series

Companies / Brands of GHM

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1 INTRODUCTION

The instruments of the series HD52.3D… are 2-axis ultrasonic static anemometers. The available measurement options combine in a single instrument the main quantities of meteorological interest, making the instrument like a compact and light meteorological station.

Measured quantities:

- Wind speed and direction, U-V Cartesian components of wind speed
- Wind Gust
- Relative Humidity and temperature (**optional**)
- Global solar radiation (**optional**)
- Barometric pressure (**optional**)
- Rainfall (**optional**)

The "Rainfall" and "Global solar radiation" options are alternatives (they can not be both present in the same instrument).

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

All models are equipped with a magnetic compass.

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

RS232, RS485, RS422 and SDI-12 serial interfaces are available with **NMEA**, **MODBUS-RTU** and **SDI-12** communication protocols.

All versions have 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**).

The **heater** option prevents the accumulation of snow and ice formation, allowing precise measurements in all environmental conditions.

Mounting on ∅ 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.

1.1 AVAILABLE VERSIONS

The table below shows the measuring quantities available in the different models of the series:

TAB. 1.A – Available versions

Model	Wind speed	Wind direction	Relative humidity + Temperature	Solar radiation	Rainfall	Barometric pressure
HD52.3D	√	√				
HD52.3D4	√	√				√
HD52.3DP	√	√		√		
HD52.3DP4	√	√		√		√
HD52.3D17	√	√	√			
HD52.3D147	√	√	√			√
HD52.3DP17	√	√	√	√		
HD52.3DP147	√	√	√	√		√
HD52.3DT147	√	√	√		√	√

All the models, except HD52.3DT147, are available with heating option (add **R** at the end of the code).

2   TECHNICAL SPECIFICATIONS

Wind speed

Sensor	Ultrasounds
Measuring range	0...60 m/s (0...50 m/s with rain gauge option)
Resolution	0.01 m/s
Accuracy	± 0.2 m/s or ± 2%, the greatest (0...35 m/s), ± 3% (>35 m/s)

Wind direction

Sensor	Ultrasounds
Measuring range	0...359.9°
Resolution	0.1°
Accuracy	± 2° RMSE from 1.0 m/s

Compass

Sensor	Magnetic
Measuring range	0...360°
Resolution	0.1°
Accuracy	± 1°

Air temperature (*needs option* **17**)

Sensor	Pt100
Measuring range	-40...+70 °C
Resolution	0.1 °C
Accuracy	± 0.15 °C ± 0.1% of measurement

Relative humidity (*needs option* **17**)

Sensor	Capacitive
Measuring range	0...100%RH
Resolution	0.1%
Accuracy (@ T = 15...35 °C)	± 1.5%RH (0...90%RH), ± 2%RH (remaining range)
Accuracy (@ T = -40...+70 °C)	± (1.5 + 1.5% of measurement)%RH

Barometric Pressure (*needs option* **4**)

Sensor	Piezoresistive
Measuring range	300...1100 hPa
Resolution	0.1 hPa
Accuracy	± 0.5 hPa @ 20 °C

Solar radiation (*needs option* **P**)

Sensor	Thermopile
Measuring range	0...2000 W/m^2
Resolution	1 W/m^2
Accuracy	2nd Class Pyranometer

Rainfall (*needs option* **T**)

Sensor	Tipping bucket
Resolution	0.2 mm
Accuracy	99% up to 120 mm/h
Maximum rainfall rate	2000 mm/h
Collector area	127 cm^2

General features

Power Supply	10...30 Vdc
Power consumption	26 mA @ 24 Vdc without heater 8 W @ 24 Vdc with heater
Serial outputs	RS232, RS485 (¼ Unit Load), RS422 and SDI-12

Communication protocols	NMEA, MODBUS-RTU, SDI-12, proprietary RS232 and RS485
Analog outputs	2 analog outputs, for wind speed and direction. Output at choice among 4...20 mA (standard), 0...1 V, 0...5 V and 0...10 V (**option 0...10 V needs 15...30 Vdc power supply**)
Wind speed averaging interval	Configurable from 1 s to 10 min
Electrical connection	19-pole M23 male connector
Operating temperature	-40...+70 °C Minimum temperature for the rainfall sensor 1 °C
Protection degree	IP 66
Survival speed	90 m/s (60 m/s with rain gauge option)
Weight	About 1 kg (version HD52.3DP147) About 1.5 kg (version HD52.3DT147)
Case	Plastic material. Metal parts: AISI 316

Dimensions (mm)

HD52.3D17 / HD52.3D147   HD52.3DP17 / HD52.3DP147

HD52.3D / HD52.3D4

∅ 150
179
50
∅ 40 ext.
∅ 36 int.
Mast

HD52.3DP / HD52.3DP4

∅ 150
200
50
∅ 40 ext.
∅ 36 int.
Mast

∅ 132
547
∅ 150
50
∅ 40 ext.
∅ 36 int.
Mast

HD52.3DT147

3 DESCRIPTION

HD52.3DP17
HD52.3DP147

HD52.3D17
HD52.3D147

HD52.3DP
HD52.3DP4

HD52.3D
HD52.3D4
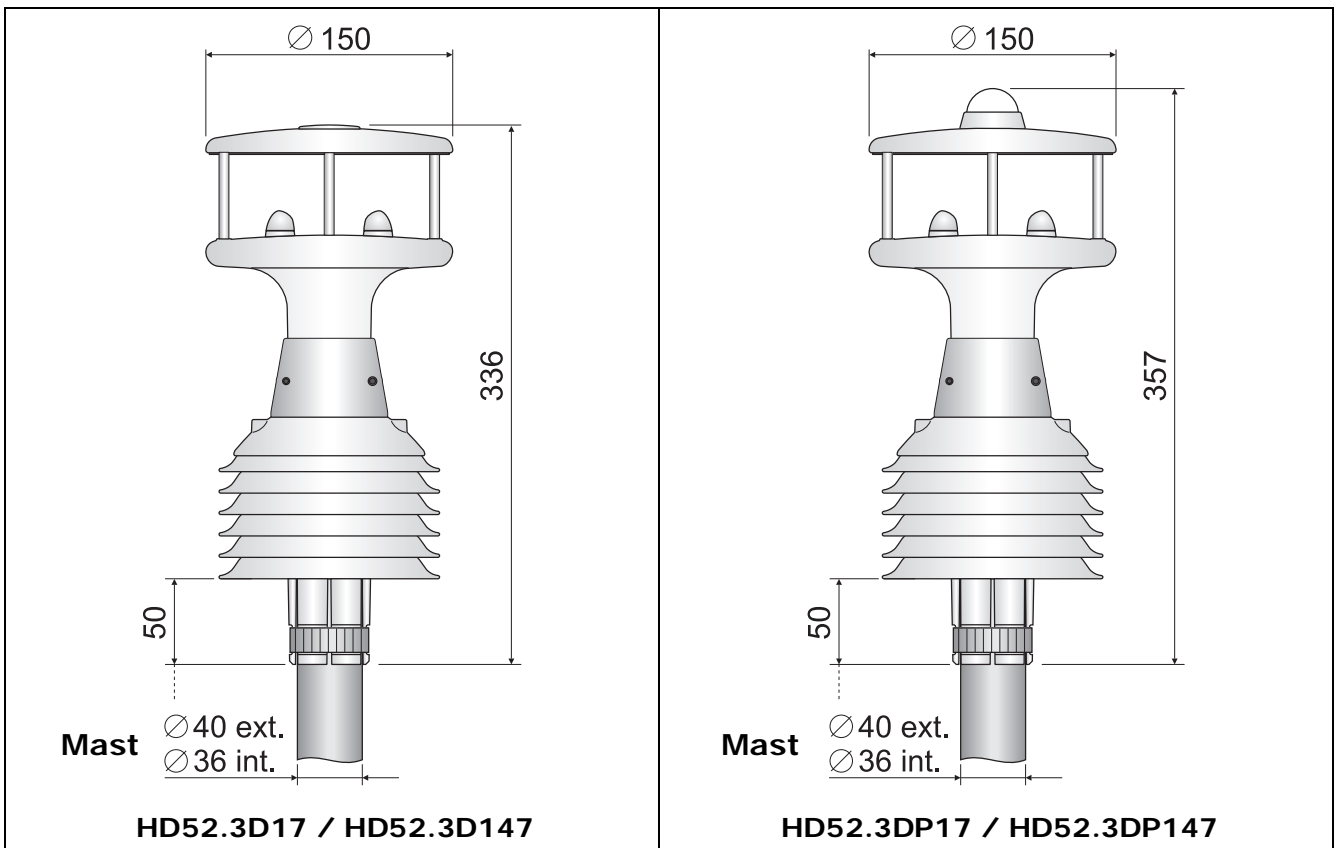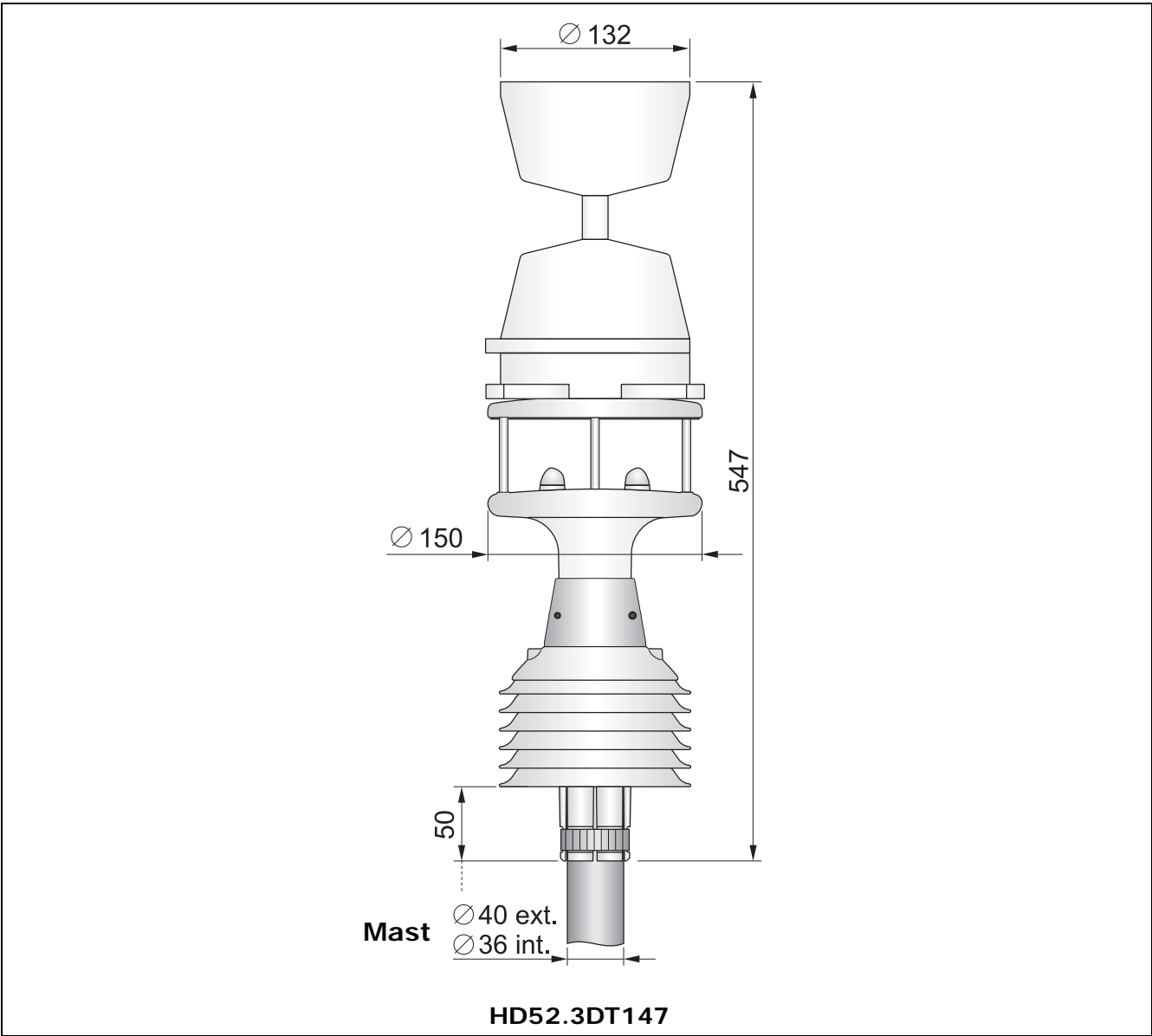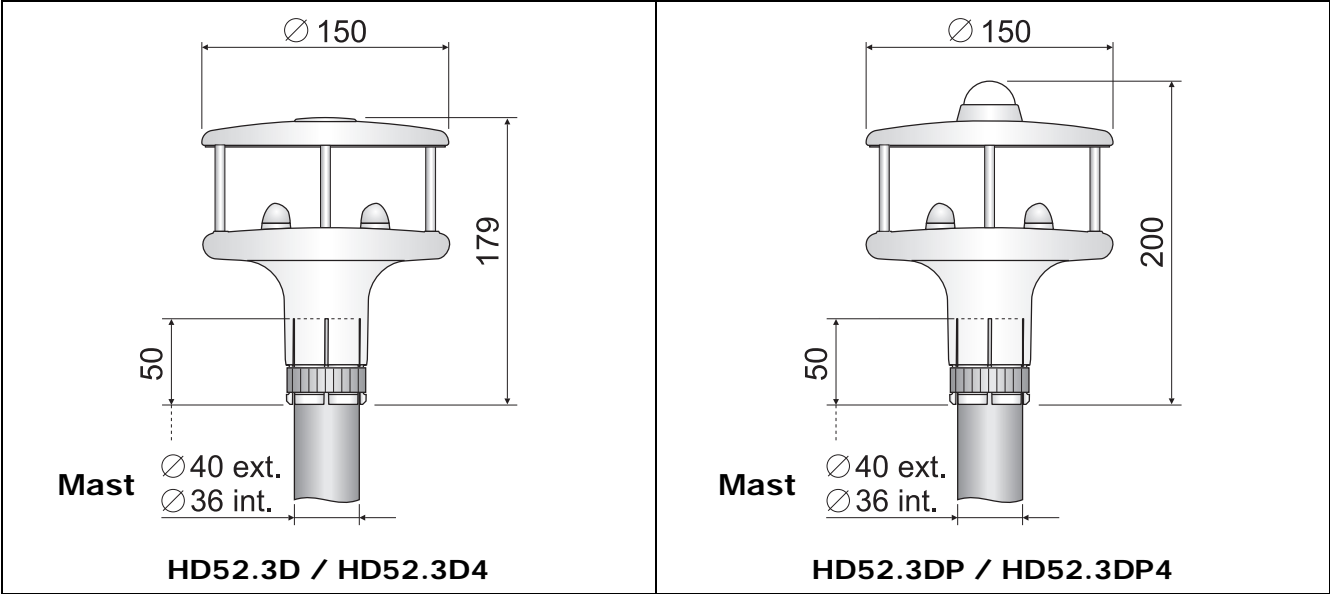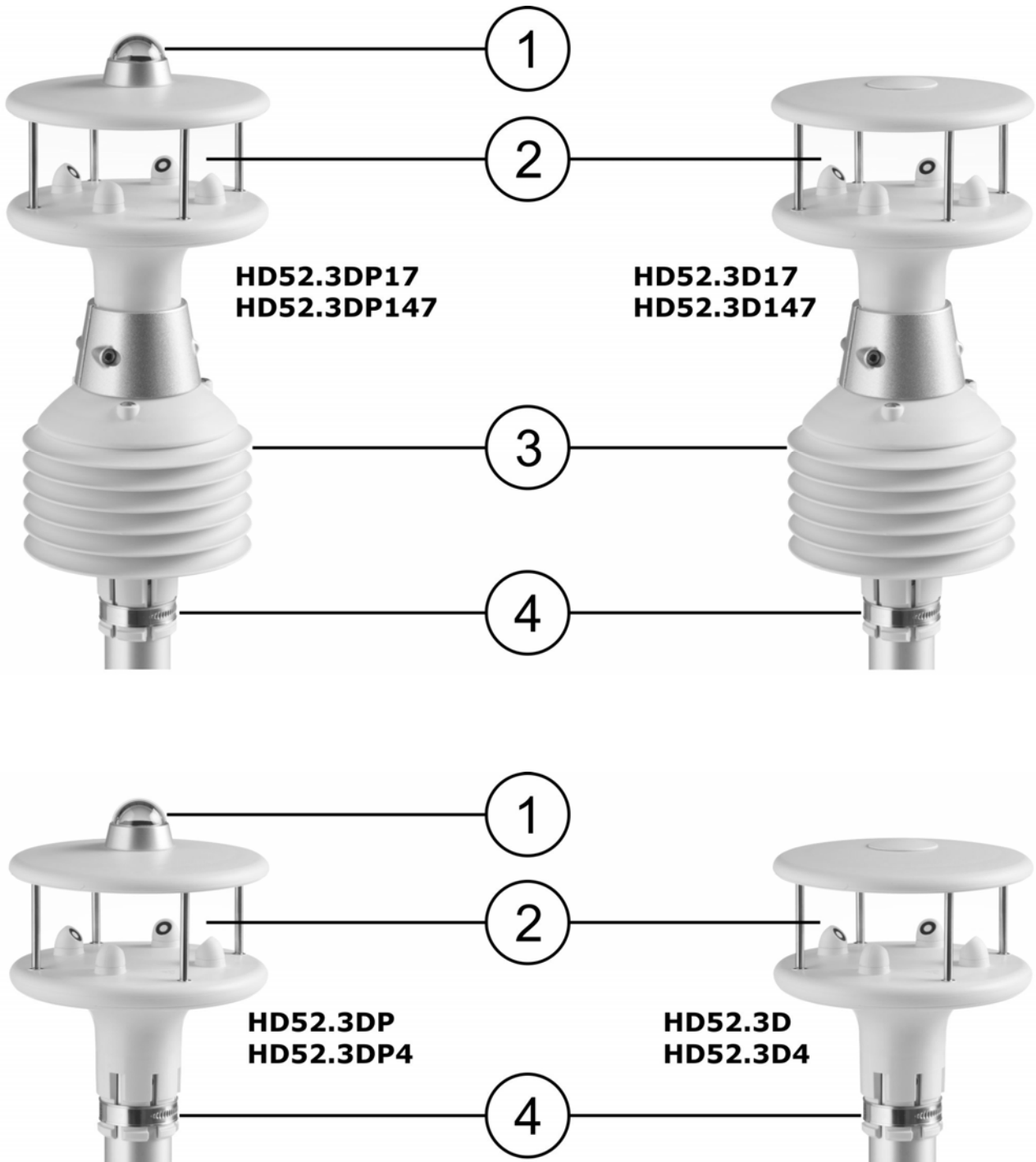
1. Pyranometer

2. Ultrasonic sensors for the measurement of wind speed and direction

3. Protective shield from solar radiation for relative humidity and temperature sensors

4. Fixing clamp to Ø 40 mm mast

Note: in the models measuring barometric pressure, the pressure sensor is inside the instrument.

Version with rain gauge

HD52.3DT147
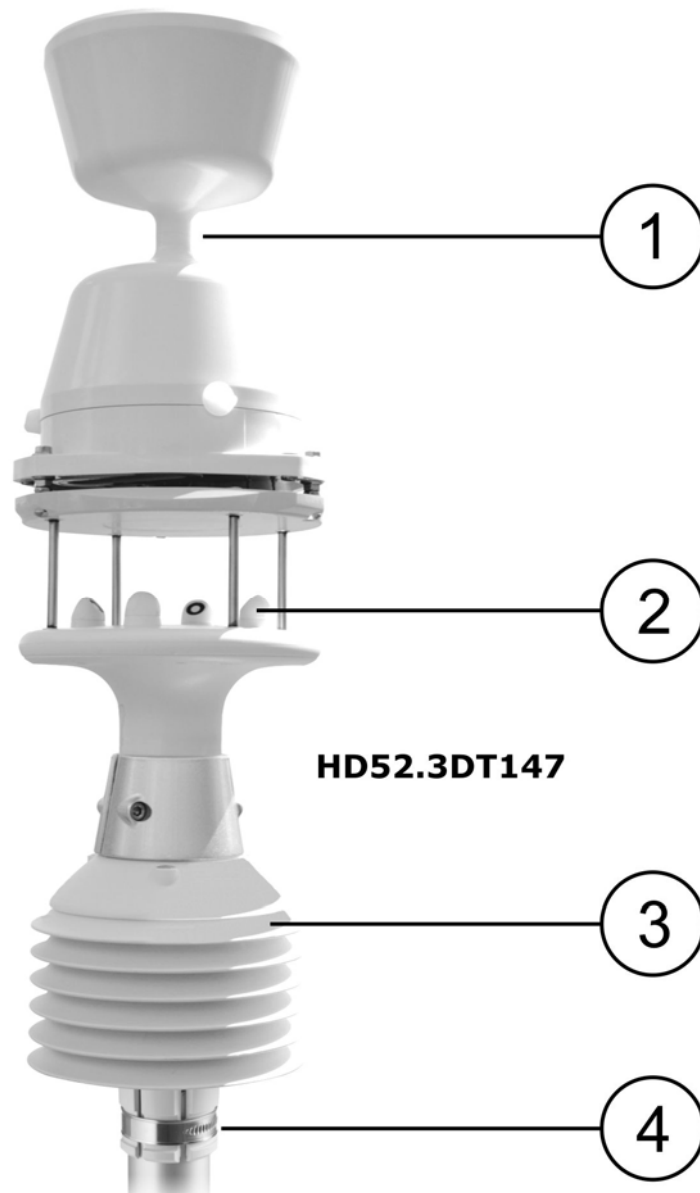
1. Rain gauge

2. Ultrasonic sensors for the measurement of wind speed and direction

3. Protective shield from solar radiation for relative humidity and temperature sensors

4. Fixing clamp to Ø 40 mm mast

# 4 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.

Measurement along first axis   **Measurement along second axis**
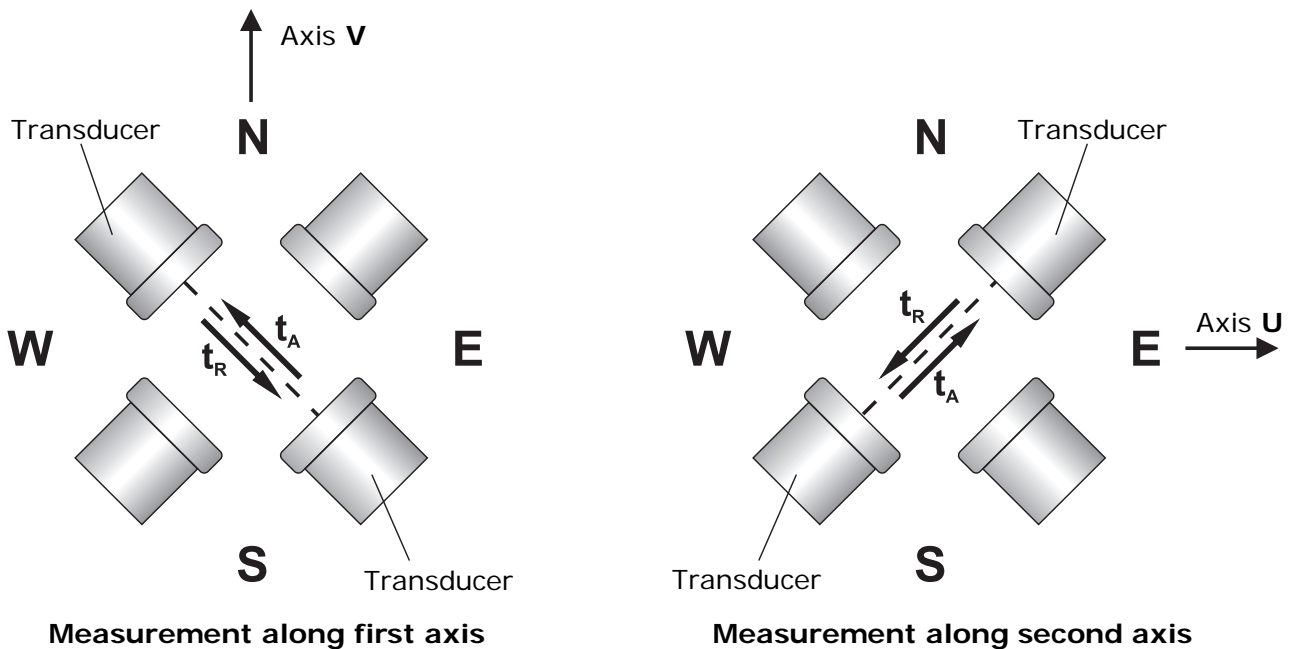
The travel times of the ultrasonic pulses are given by:

$$t_A = \frac{D}{C + V_W} \qquad t_R = \frac{D}{C - V_W}$$

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:

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

5   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 instrument to the desired direction (see par. 5.1 "Alignment"), then fix it on the support mast by tightening the cable tie at the bottom of the instrument.
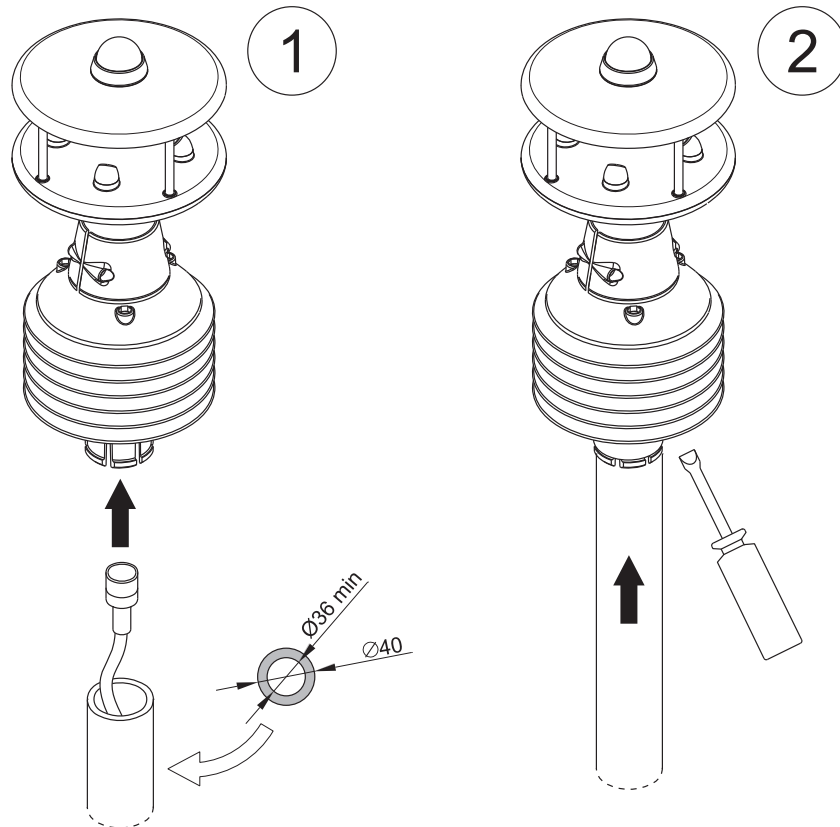
The support mast, having 40 mm maximum outer diameter and 36 mm minimum inner diameter, should be positioned on a stable surface.

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.
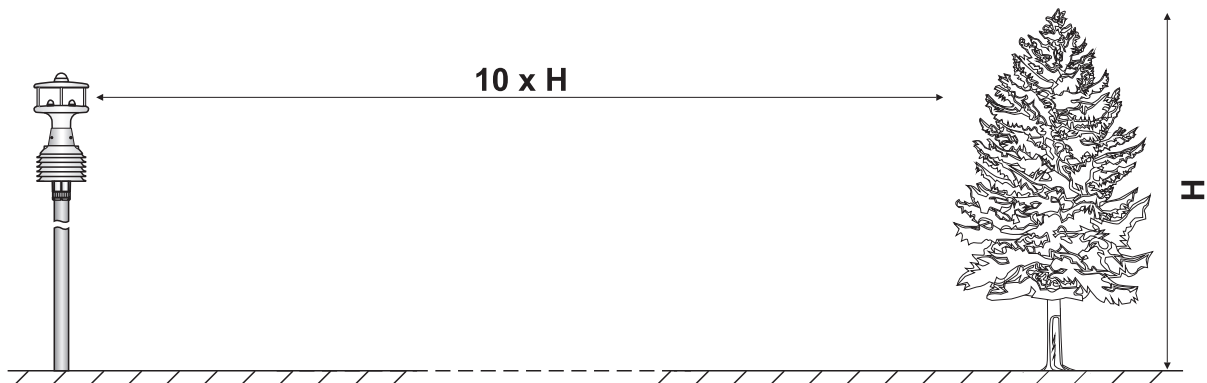
In the presence of close objects, it is advisable to place the instrument at a height of 10 m (except version with rain gauge option).

For version with rain gauge option it is reccomended to place the instrument at a height not exceeding 3 m (the precipitation measurement is standardized at ground level, as it is very affected by the presence of wind). It is very important to place the instrument on a rigid mast, as the oscillation of the mast could cause false detections of the tipping bucket of the rain gauge.

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.

Mount the instrument far from magnetic materials and devices that generate magnetic fields (electric motors, electric power cables, electric transformers, radars, radio transmitters etc.) in order to prevent faulty indications from the magnetic compass.

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.

All instrument sensors are factory-calibrated and do not require additional interventions of the user.

Unless otherwise requested, with factory settings the instrument starts in configuration mode at power up and stands in waiting to receive the commands for the setting of the operating parameters through a RS232 serial connection. To know the available configuration parameters, the related factory settings, the commands to modify the parameters and to select the operating mode, see Chapter 6 "*CONFIGURATION*". If, however, the instrument is already set to operate in one of the available operating modes (SDI-12, NMEA, MODBUS-RTU, proprietary RS232, proprietary RS485), the set mode will be active 10 seconds after power up.

5.1 ALIGNMENT OF THE INSTRUMENT

The instrument is equipped with a magnetic compass, and wind speed and direction measurements are automatically compensated and referred to magnetic North, even if alignment to North is not performed. This allows obtaining accurate measurements even in case of mobile installations.

It is possible to disable the compass compensation of the wind speed and direction measurements. In this case it is necessary to align the instrument during installation. The arrows on the case will facilitate the alignment.
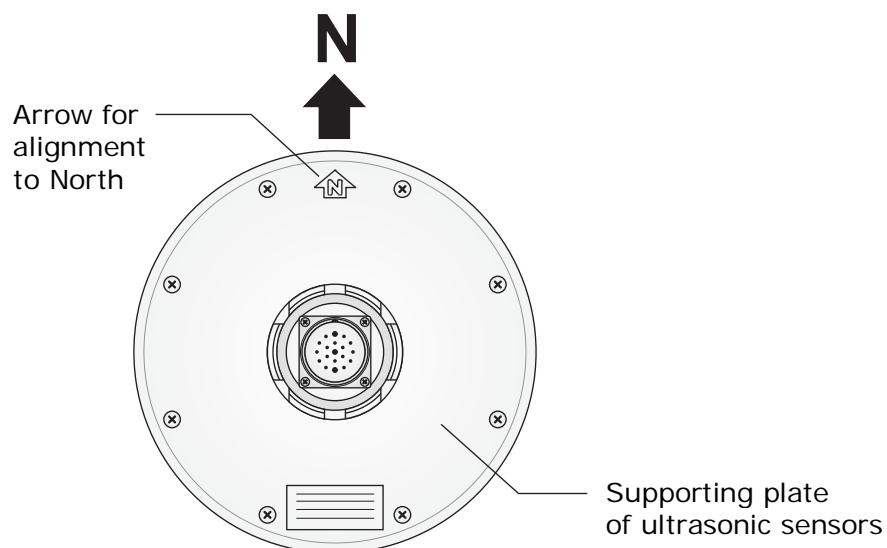
For an accurate alignment, connect the instrument to a PC (see following chapters for communication protocols), then rotate the instrument on its vertical axis until the compass measures 0.0° ± 0.1°.

When evaluating the wind direction, one should take into account that the geographic North differs from the magnetic North indicated by the 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.
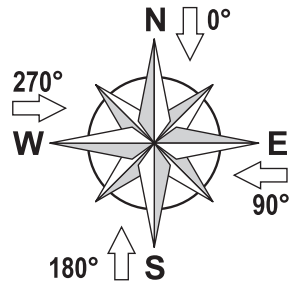
5.2 ELECTRICAL CONNECTIONS

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:
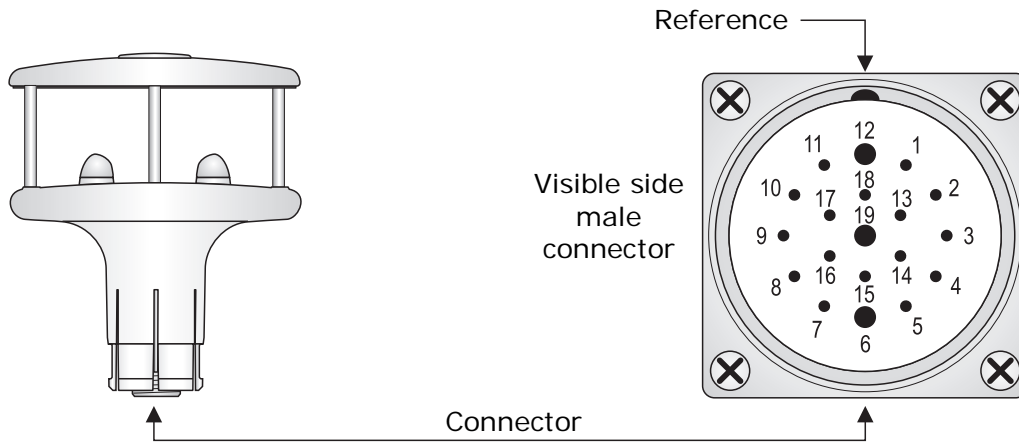

TAB. 5.A – Electrical connections

Pin number	CP52.x cable wire number	Symbol	Description
1			Not connected
2	2	RX SDI	Data line for SDI-12 connection
3	3	RX +	Serial receive (input) positive
4		HEAT -	Heater power supply negative
5		HEAT +	Heater power supply positive (10...30 Vdc)
6	6	HEAT -	Heater power supply negative
7	7	HEAT +	Heater power supply positive (10...30 Vdc)
8	8	GND	Serial ground
9	9	TX -	Serial transmission (output) negative
10			Not connected
11			Not connected
12	12	GND	Instrument power supply negative
13	4	RX -	Serial receive (input) negative
14	10	OUT 1	Analog output 1 positive
15		GND	Analog ground
16	11	OUT 2	Analog output 2 positive
17	5	TX +	Serial transmission (output) positive
18		V +	Instrument power supply positive (10...30 Vdc)
19	1	V +	Instrument power supply positive (10...30 Vdc)

TX and RX signal connection depends on the chosen serial connection type. See next paragraphs for details on serial connections.

ATTENTION: The optional 12-pole CP52.x cable wire number does not always coincide with the M23 connector pin number.

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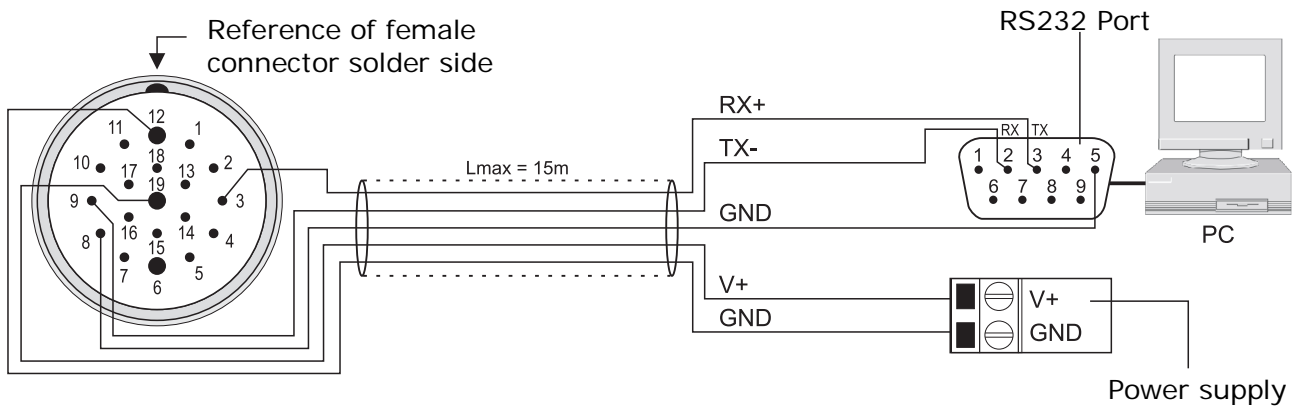
For RS232 connection, TX-, RX+ and serial GND signals (pin 9, 3 and 8 of M23 connector) are used, to be connected respectively to RX, TX and GND signals of RS232 port on PC (pin 2, 3 and 5 of 9-pole SubD connector). The length of RS232 cables should not exceed 15 m.

With RS232 connection, NMEA, MODBUS-RTU and proprietary RS232 protocols can be used.

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 5.2.6).

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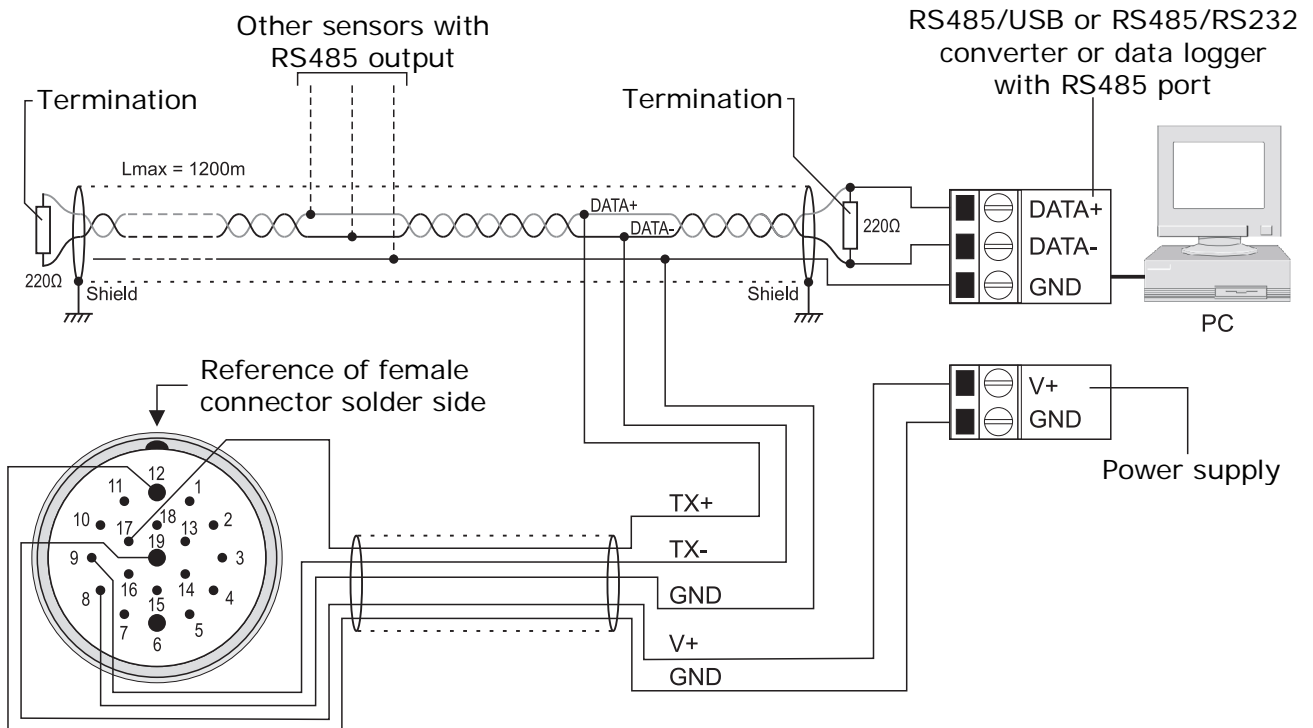
Thanks to RS485 connection, multiple instruments can be connected to a multi-point network. Instruments are connected in sequence through a twisted-pair shielded cable for signals and a third wire for ground.

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 ¼ 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.

NMEA, MODBUS-RTU and proprietary RS485 protocols can be used with RS485 connection.

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

5.2.3 RS422 SERIAL CONNECTION
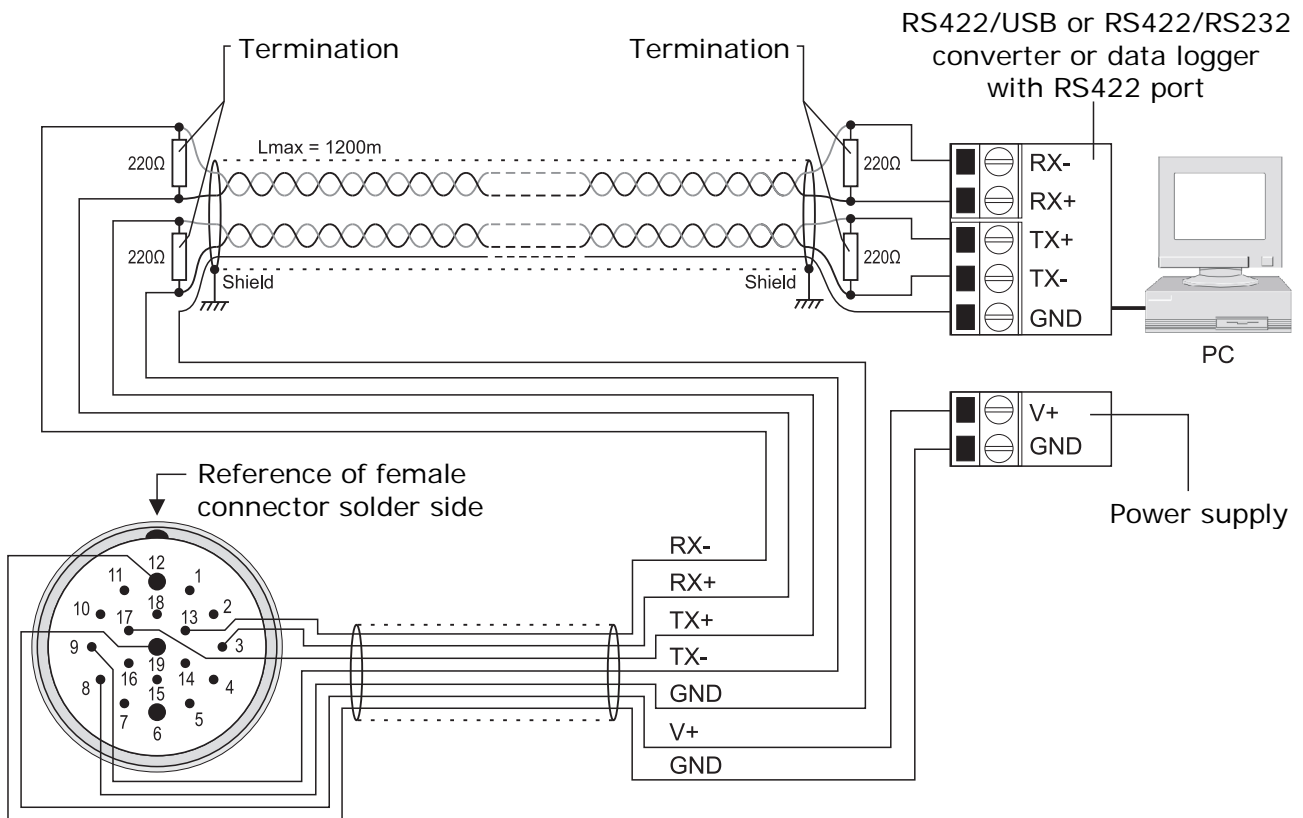
RS422 standard is used for point-to-point connection on long distances. The instrument is connected to a PC/data logger through a shielded cable with two twisted pairs for signals and an additional wire for ground. The extremities of the connections should end with line terminators.

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

NMEA, MODBUS-RTU and proprietary RS485 protocols can be used with RS422 connection.

Before connecting the instrument to the network, configure address and Baud Rate (see chapter 6 "*CONFIGURATION*").
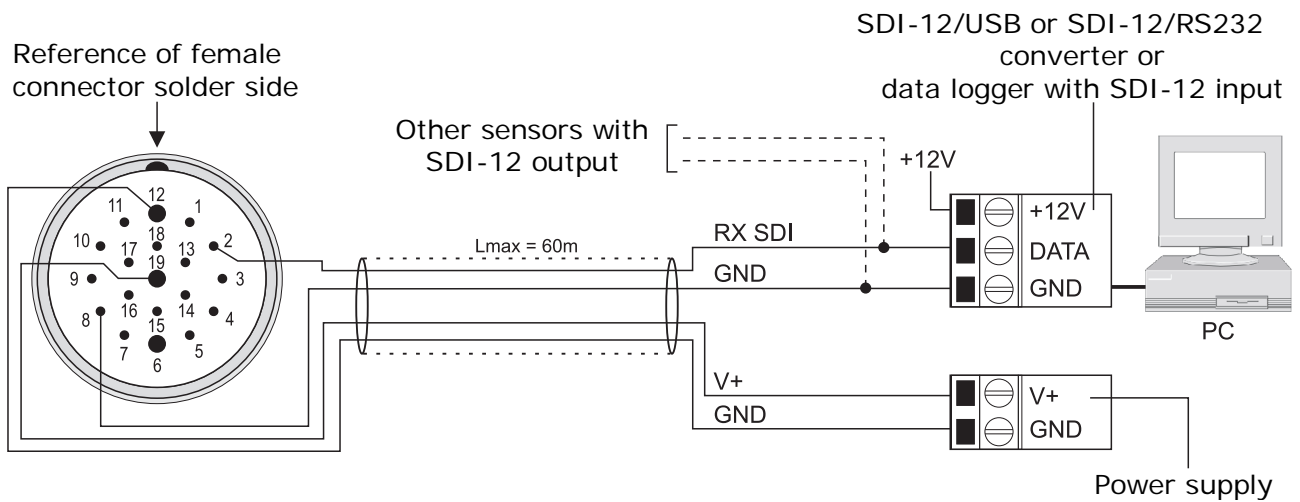
5.2.4 SDI-12 SERIAL CONNECTION

SDI-12 standard has three connection wires: power supply +12V, data line and ground.

Up to 10 sensors can be connected in parallel, each of them identified by its own address. Communication between sensors and PC/datalogger is performed at 1200 baud. Connection cables should not exceed 60 m.

The instrument should be configured to operate in SDI-12 mode. Set the address (see chapter 6 "*CONFIGURATION*") before connecting the instrument to the network.

5.2.5 ANALOG OUTPUTS CONNECTION

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*".
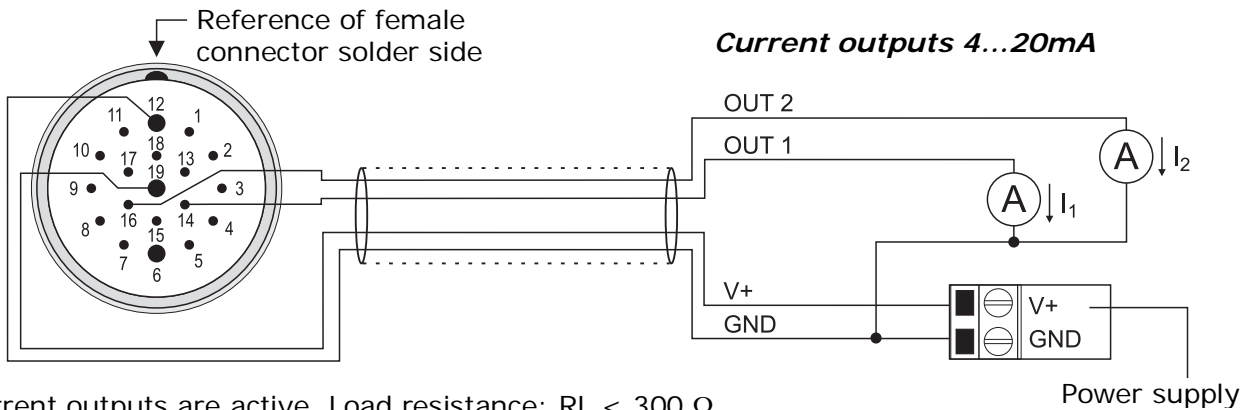
Current outputs are active. Load resistance: RL < 300 Ω.
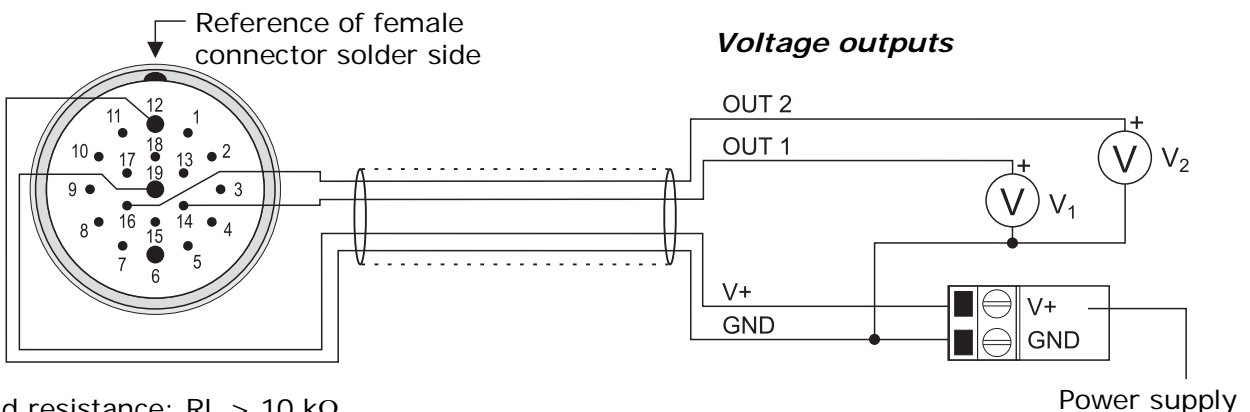
Load resistance: RL > 10 kΩ.

5.2.6 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.
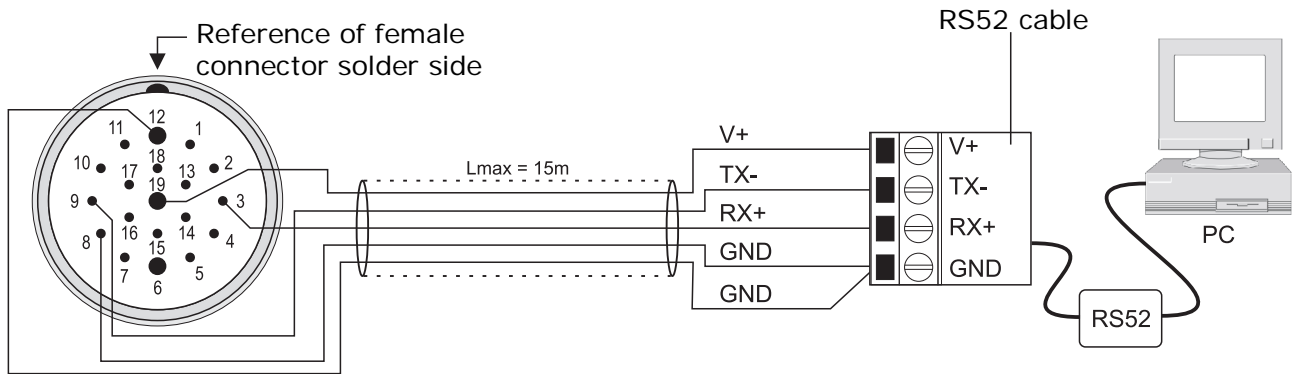
To use the **RS52** cable, the drivers included in the HD52.3D-S software package should be installed in the PC (see the guide to USB drivers installation included in the software package).

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

5.2.7 CONNECTION OF HEATING SYSTEM

Models with heat option (**R** option) have an integrated device that heats sonic transducers in order to prevent ice forming and ensure correct operation even in the presence of snow.

The heater power supply is separated from the instrument's main power supply.
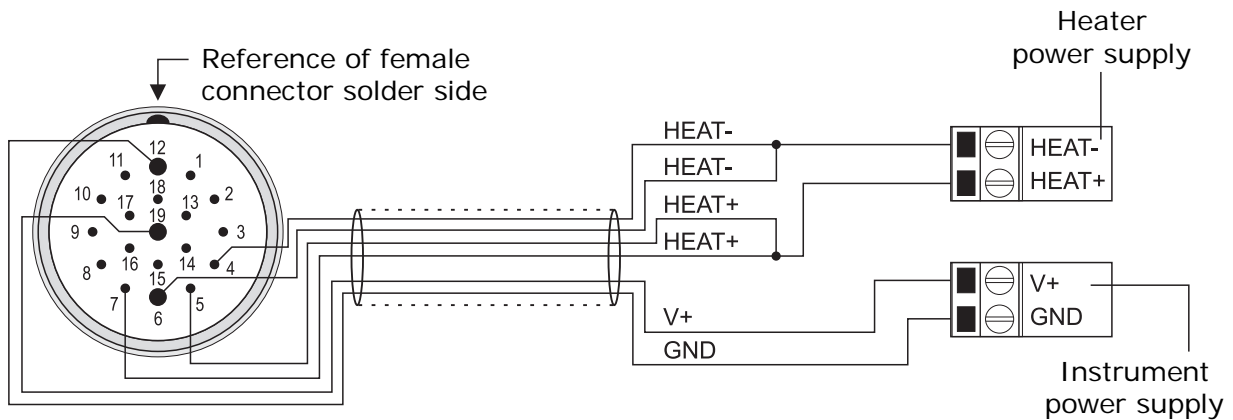
Heating needs 10...30 Vdc power supply and 6 W power. The heat circuit is switched on below +4 °C. After switching on, the heating is switched off when the temperature exceeds +8 °C.

6 CONFIGURATION

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

To configure the instrument, a RS232 serial connection to a PC should be performed (see paragraph 5.2.1). 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 5.2.6).

Communication parameters should be set in the PC as follows:

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

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.

The configuration procedure by sending serial commands slightly differs depending on whether the instrument is set in configuration mode (factory setting, unless otherwise requested), or whether it is set in one of the available operation modes (SDI-12, NMEA, MODBUS-RTU, proprietary RS232, proprietary RS485).

➢ **INSTRUMENT SET IN CONFIGURATION MODE** (factory setting)

If the instrument is set in configuration mode, at power-up it remains waiting to receive the configuration serial commands described in the following tables. To configure and make the instrument operational, the following should be performed:

- Send command for operation mode selection (see table *Operation Mode* described at paragraph 6.1 "Serial Commands").

- Send commands to set the parameters of the selected operation mode (see tables described at paragraph 6.1 "Serial Commands").

- Send commands to set operational general parameters (parameters independent from operation mode)

- Turn the instrument off and on. The selected operation mode will become active after 10 seconds from restart.

Note: configuration commands can be sent in any order, it is not necessary to respect the indicated sequence.

➢ **INSTRUMENT SET IN ONE OF THE AVAILABLE OPERATION MODES**

If the instrument is set in one of the available operation modes, when started up it remains waiting for a serial command for 10 seconds. For instrument configuration, the following should be performed:

- Send the following command to the instrument before 10 seconds have elapsed:

@<CR>

with <CR> = ASCII character *Carriage Return*.

If the instrument doesn't receive the over mentioned command after 10 seconds from start up, the operation mode set in the instrument is immediately activated.

- Send commands to change the desired parameters (see tables described at paragraph 6.1 "Serial Commands").

- Turn the instrument off and on. The selected operation mode will become active after 10 seconds from restart with the new parameter values.

6.1 SERIAL COMMANDS

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

Measuring units:

Command	Reply	Description
CGUVn	&|	Sets measuring unit of wind speed: • m/s if n=1 • cm/s if n=2 • km/h if n=3 • knot if n=4 • mph if n=5 *Default* : m/s (n=1)
RGUV	n|	Reads the wind speed measuring unit set in the instrument
CGUTn	&|	Sets temperature measuring unit: • °C if n=1 • °F if n=2 *Default* : °C (n=1)
RGUT	n|	Reads the temperature measuring unit set in the instrument
CGUPn	&|	Sets pressure measuring unit: • mbar if n=1 [Note: 1 mbar = 1 hPa] • mmHg if n=2 • inchHg if n=3 • mmH_2O if n=4 • $inchH_2O$ if n=5 • atm if n=6 *Default* : mbar (n=1)
RGUP	n|	Reads the pressure measuring unit set in the instrument
CGURn	&|	Sets rainfall measuring unit: • mm if n=1 • inch if n=2 *Default* : mm (n=1)
RGUR	n|	Reads the Rainfall measuring unit set in the instrument

Operation Mode:

Command	Reply	Description
CUMn	&|	Sets instrument in mode: • Configuration if n=0 • proprietary RS485 if n=1 • proprietary RS232 if n=2 • SDI-12 if n=3 • NMEA if n=4 • MODBUS-RTU if n=5 *Default* : Configuration (n=0)
RUM	& n|	Reads mode set in the instrument

Note 1: after sending the command for the selection of the operation mode, the instrument remains in configuration mode. The selected mode will become active at the following restart of the instrument.

Parameters for proprietary RS232 and RS485 modes:

Command	Reply	Description
CU1Ac	&|	Sets the address for proprietary RS485 mode to c value The address is an alphanumeric character ranging within 0...9, a...z, A...Z *Default* : 0
RU1A	& c|	Reads the address for proprietary RS485 mode set in the instrument

CU1Bn	&|	Sets Baud Rate for proprietary RS485 mode to:
		
		   ▪ 9600 if n=3
		   ▪ 19200 if n=4
		   ▪ 38400 if n=5
		   ▪ 57600 if n=6
		   ▪ 115200 if n=7
		
		Default : 115200 (n=7)

RU1B	& n|	Reads Baud Rate setting for proprietary RS485 mode

CU2Bn	&|	Sets Baud Rate for proprietary RS232 mode to:
		
		   ▪ 9600 if n=3
		   ▪ 19200 if n=4
		   ▪ 38400 if n=5
		   ▪ 57600 if n=6
		
		Default : 57600 (n=6)

RU2B	& n|	Reads Baud Rate setting for proprietary RS232 mode

CU1Dcccccccccccc	&|	Sets measurements order in the string sent in proprietary RS232 and RS485 modes
		
		In the sequence cccccccccccc (max. 11 characters) each character identifies a measurement according to the following correspondence:
		
		  0 $\Rightarrow$ Barometric Pressure
		  1 $\Rightarrow$ Temperature (sensor Pt100)
		  2 $\Rightarrow$ Relative Humidity
		  3 $\Rightarrow$ Pyranometer
		  6 $\Rightarrow$ Wind speed (coordinates U,V)
		  7 $\Rightarrow$ Wind speed (intensity)
		  8 $\Rightarrow$ Wind Direction (Azimuth)
		  T $\Rightarrow$ Sonic Temperature
		  C $\Rightarrow$ Compass
		  E $\Rightarrow$ Errors
		
		note: the Wind Gust measurement and the rainfall measurement are not available in proprietary RS232 and RS485 modes
		
		Default : 78
		
		(see **Note 2**)

RU1D	& cccccccccccc|	Reads measurements order in the string sent in proprietary RS232 and RS485 modes

| Command	Reply	Description
CU2Rnnnn	&|	Sets transmission interval of string with measurements in proprietary RS232 mode to nnnn seconds
		The interval should range within 1 and 3600 seconds
		Default : 1 second
RU2R	& nnnn|	Reads transmission interval of string with measurements in proprietary RS232 mode

NOTE 2 : MEASUREMENTS ORDER

In the measurement string sent by the instrument (constantly in proprietary RS232 mode, on request in proprietary RS485 mode), measurements can be set in arbitrary order: one should simply indicate the desired order in the sequence of characters "ccccccccccc" sent by the command C1UD. The sequence of characters "ccccccccccc" can have a variable length up to a maximum of 11 characters.

Example: if the sequence of characters is set to 78012, wind speed, wind direction, barometric pressure, temperature and relative humidity measurements will appear from left to right in the data string sent by the instrument.

If information on error conditions is requested (E character), three numbers with the following meaning will appear in the data string sent by the instrument:

1. *First number* = error code identifying the transducers and the type of error.

    The number is composed by two digits. The first digit indicates the path (that is the transducers pair) that presents the error, according to the numeration indicated in the figure:
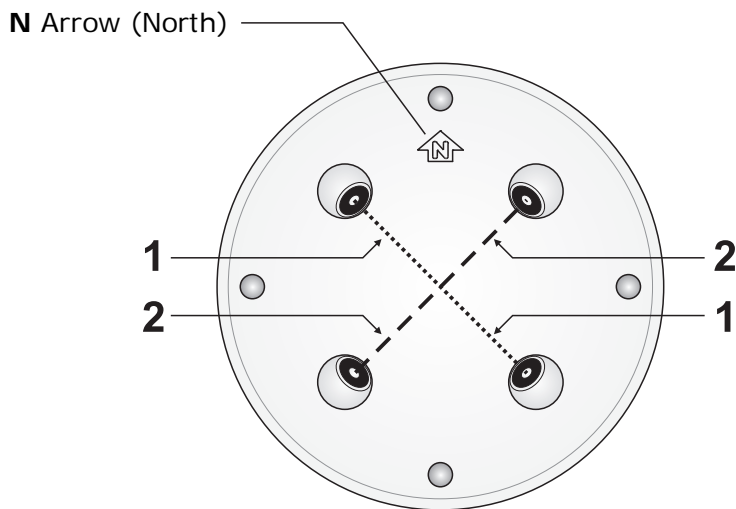
    Digit 7 indicates an error in the compass. Digit 0 indicates that no errors are present in the ultrasonic transducers or in the compass.

    The second digit of the error code indicates the type of error: **0** = no errors; **1** = transducer broken, electric interruption, path obstruction; **Other** = codes reserved to technical service.

2. *Second number* = state of activation of the ultrasonic transducers heating.

    0 = heating turned off,   **1** = heating turned on

3. *Third number* = number of invalid measurements.

Example: if **21 0 2** appears in correspondence to the error condition in the data string sent by the instrument, it means that an error occurred (broken transducer or path obstruction) in the path number 2, that the heating is turned off and that two measurements have been rejected due to the error occurrence.

Parameters for NMEA mode:

Command	Reply	Description
CU4Bn	&|	Sets Baud Rate for NMEA mode to: ▪ 2400 if n=1 ▪ 4800 if n=2 ▪ 9600 if n=3 ▪ 19200 if n=4 ▪ 38400 if n=5 ▪ 57600 if n=6 ▪ 115200 if n=7 *Default* : 4800 (n=2)
RU4B	& n|	Reads Baud Rate setting for NMEA mode
CU4In	&|	Sets interface for NMEA mode to: ▪ RS232 if n=0 ▪ RS485 if n=1 ▪ RS422 if n=2 *Default* : RS485 (n=1)
RU4I	& n|	Reads interface setting for NMEA mode
CU4Mn	&|	Sets parity and stop bits for NMEA mode to: ▪ 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 data bits is fixed to 8 *Default* : 8N1 (n=0)
RU4M	& n|	Reads current setting of parity and stop bits for NMEA mode
CU4Rnnn	&|	Sets transmission interval of string with measurements in NMEA mode to nnn seconds The interval should range within 1 and 255 seconds *Default* : 1 second
RU4R	& nnn|	Reads setting of transmission interval of string with measurements in NMEA mode

Parameters for MODBUS-RTU mode:

Command	Reply	Description
CU5Annn	&|	Sets MODBUS address to nnn The address should range within 1 and 247 *Default* : 1
RU5A	& nnn|	Reads the MODBUS address setting
CU5Bn	&|	Sets the Baud Rate for MODBUS mode to: • 9600 if n=3 • 19200 if n=4 • 38400 if n=5 *(from firmware vers. 2.21)* • 57600 if n=6 *(from firmware vers. 2.21)* • 115200 if n=7 *(from firmware vers. 2.21)* *Default* : 19200 (n=4)
RU5B	& n|	Reads Baud Rate setting for MODBUS mode
CU5In	&|	Sets interface for MODBUS mode to: • RS232 if n=0 • RS485 if n=1 • RS422 if n=2 *Default* : RS485 (n=1) Note: with RS232 option you can connect to PC or datalogger 1 instrument only; option useful to do tests without RS232/RS485 conversion.
RU5I	& n|	Reads interface setting for MODBUS mode
CU5Mn	&|	Sets parity and stop bits for MODBUS mode to: • 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 *Default* : 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: • Immediate reception if n=0 (violates protocol) • Waiting 3.5 characters if n=1 (respects protocol) *Default* : Waiting 3.5 characters (n=1)
RU5W	& n|	Reads the setting of waiting time after transmission in MODBUS mode

Parameters for SDI-12 mode:

Command	Reply	Description
CU3Ac	&|	Sets the SDI-12 address to c value
		The address is an alphanumeric character ranging within 0…9, a…z, A…Z. *Default* : 0
RU3A	& c|	Reads the SDI-12 address set in the instrument

General parameters:

| Command	Reply	Description
CGHn	&|	Enables/disables heating: ▪ Disables if n=0 ▪ Enables if n=1 *Default* : Enabled (n=1)
RGH	n|	Reads heating enabling state 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)
		Default : 20 (= 0.2 m/s) (see **Note 3**)
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.
		note: the value can be greater than or equal to 10 s starting from firmware version 2.20
		Default : 1 s
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: ▪ 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 4**). ▪ 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. *Default* : vector mean (n=1)

Command	Reply	Description
RWaM	& n|	Reads the method for the calculation of the average speed and average direction set in the instrument
CCn note: command available from firmware version 2.06	&|	Enables/disables the compass compensation of wind speed and direction: ▪ Disables if n=N ▪ Enables if n=Y *Default* : Enabled (n=Y)
CRTnnnn	&|	Sets the resolution of the rain gauge tipping bucket to nnnn value (in µm) Value should range within 50 and 1599 µm *Default* : 200 (= 0.200 mm)
RRT	& nnnn|	Reads the rain gauge resolution value set in the instrument (in µm)

NOTE 3 : 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 4 : WIND DIRECTION EXTENDED CHARACTERISTIC

With 0÷359.9° wind direction measuring range, the analog output continues to oscillate between maximum and minimum scale if the direction continues to slightly fluctuate around 0°:
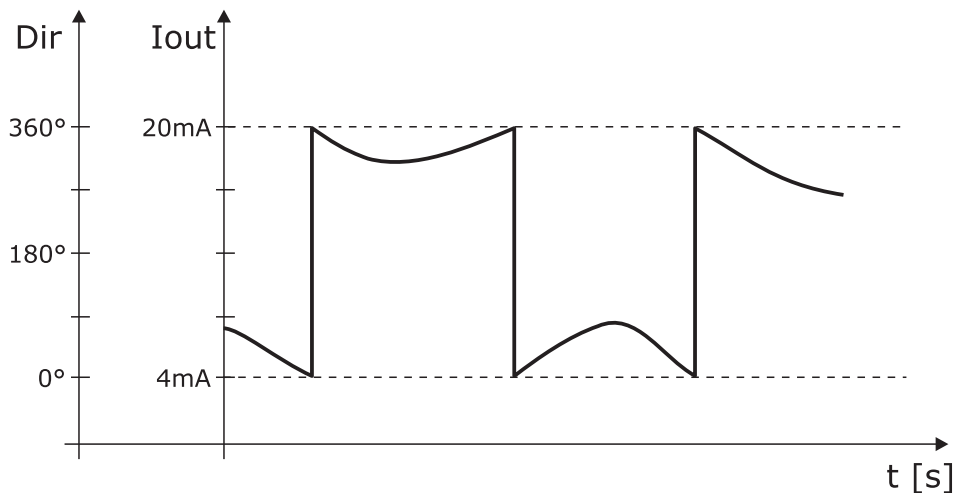
This effect can be reduced through the extended ("wrap-around") characteristic of wind direction. In this mode, the wind direction is considered as corresponding to 0÷539.9° range instead of 0÷359.9°. The wide output fluctuation occurs the first time that the wind direction goes from 0 to 359.9°; if 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:
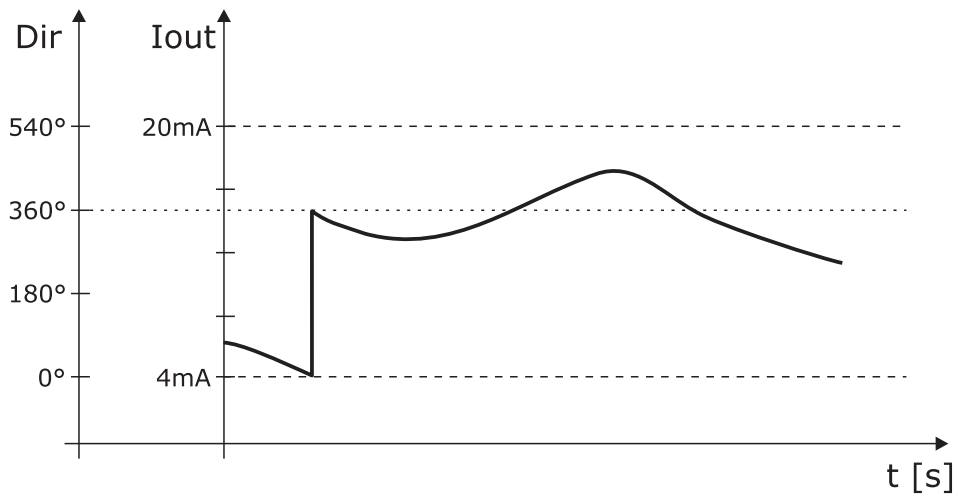
If 539.9° value is exceeded in extended mode, the output goes to the value corresponding to 180°.

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:

Command	Reply	Description
CAFxnn	&|	Sets offset and direction of the analog output x (x=1 or 2) to: ▪ Standard if nn=00 [*ex. 4...20 mA , 0...1 V , 0...5 V , 0...10 V*] ▪ Without offset if nn=01 [*ex. 0...20 mA*] ▪ With offset if nn=02 [*ex. 0.2...1 V , 1...5 V , 2...10 V*] ▪ Inverted if nn=04 [*ex. 20...4 mA , 1...0 V , 5...0 V , 10...0 V*] ▪ Inverted without offset if nn=05 [*ex. 20...0 mA*] ▪ Inverted with offset if nn=06 [*ex. 1...0.2 V , 5...1 V , 10...2 V*] *Default* : Standard (nn=00)
RAFx	& nn|	Reads offset and direction setting of the analog output x (x=1 or 2)
CAMn	&|	Association of the analog outputs: ▪ If n= 0: Output 1 = Mean wind speed Output 2 = Mean wind direction ▪ If n= 1 (see **Note 5**): 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 6**): 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 *Default* : n=0
RAM	& n|	Reads the association of analog outputs
CAHn	&|	Associates full scale of wind speed analog output to: ▪ 5 m/s if n=0 ▪ 50 m/s if n=9 ▪ 10 m/s if n=1 ▪ 55 m/s if n=10 ▪ 15 m/s if n=2 ▪ 60 m/s if n=11 ▪ 20 m/s if n=3 ▪ 65 m/s if n=12 ▪ 25 m/s if n=4 ▪ 70 m/s if n=13 ▪ 30 m/s if n=5 ▪ 75 m/s if n=14 ▪ 35 m/s if n=6 ▪ 80 m/s if n=15 ▪ 40 m/s if n=7 ▪ 85 m/s if n=16 ▪ 45 m/s if n=8 ▪ 90 m/s if n=17 *Default* : 60 m/s (n=11)

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Command	Reply	Description
RAH	& n|	Reads the value corresponding to the wind speed analog output full scale

NOTA 5 : 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 60 m/s, the speed range associated to the analog outputs is -60...+60 m/s.

NOTA 6 : TUNNEL MODE

In tunnel mode the wind direction measurement is not compensated by the magnetic compass, but the measurement is referred to the direction indicated by the arrow on the instrument case.

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.

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

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)

7 PROPRIETARY RS232 MODE

In proprietary RS232 mode, the instrument sends automatically the acquired measurements at regular intervals. The interval is factory-set to 1 second and is configurable from 1 to 3600 seconds. To change the interval, you should enter in configuration mode and send the command **CU2Rnnnn**, where nnnn indicates the interval value in seconds (see chapter 6 "*CONFIGURATION*" for details regarding the setting of operation parameters).

To use this mode, you must connect to a RS232 serial port. Communication parameters should be set in your PC as follows:

- Baud rate: 9600 to 57600 (same as the setting in the instrument)
- Data bits: 8
- Parity: None
- Stop bits: 2

The instrument sends measurements in the following format:

<M1><M2>....<Mn><CR><LF>

with <M1><M2>....<Mn> = values of the first, second,...., nth measurement
    <CR> = ASCII character *Carriage Return*
    <LF> = ASCII character *Line Feed*

Fields <M1><M2>....<Mn> consist of 8 characters each. Measurement values are justified right; spaces can be added to the left margin of the values to obtain the 8 character length requested by the fields.

The sequence of the measurement values <M1><M2>....<Mn> is configurable (see chapter 6 "*CONFIGURATION*").

EXAMPLE
Supposing that the instrument measures the following values (the measuring unit is not considered, being not output by the instrument): M1=2.23, M2=-28.34, M3=0.34, M4=28.30, M5=359.3, M6=-1.3, the data string sent by the instrument takes the form:

2.23 -28.34   0.34   28.30   359.3   -1.3<CR><LF>

8 PROPRIETARY RS485 MODE

In proprietary RS485 mode, the instrument sends the acquired measurements only if requested by the PC.

To use this mode, you must connect to a RS485 or RS422 serial port. Communication parameters should be set in the PC or data logger as follows:

- Baud rate: 9600 to 115200 (same as the setting in the instrument)
- Data bits: 8
- Parity: None
- Stop bits: 2

The instrument is requested to send measurements by generating a *Break Signal*[(*)] on the serial line for at least 2 ms, and then sending the following command, consisting of 4 ASCII characters:

M<Address><x><x>

with <Address> = address of the instrument measurements are requested to
      <x> = any ASCII character

EXAMPLE
To ask the instrument with address 2 to send the acquired measurements, do the following:

1) **Break Signal** for at least 2 ms;

2) Send command: **M2aa**.

The instrument answers with the following string:

IIIIM<Address>I&<M1><M2>....<Mn><SP>&AAAM<Address><CS><CR>

with <Address> = address of the instrument sending measurements
      <M1><M2>....<Mn> = values of the first, second,...., nth measurement
      <SP> = space
      <CS> = checksum (hex value of the 8-bit checksum of all the preceding characters)
      <CR> = ASCII character *Carriage Return*

Fields <M1><M2>....<Mn> consist of 8 characters each. Measurement values are justified right; spaces can be added to the left margin of the values to obtain the 8 character length requested by the fields. The sequence of the measurement values <M1><M2>....<Mn> is configurable (see chapter 6 *"CONFIGURATION")*.

EXAMPLE
Supposing that the instrument with address 2 measures the following values (the measuring unit is not considered, being not output by the instrument): M1=2.23, M2=-28.34, M3=0.34, M4=28.30, M5=359.3, M6=-1.3, the instrument reply takes the following form:

IIIIM2I&   2.23 -28.34   0.34   28.30   359.3   -1.3 &AAAM28C<CR>

A minimum time interval should elapse between two commands, depending on the Baud Rate setting:

Baud Rate	Minimum interval between two commands
9600	200 ms
19200	100 ms
38400	70 ms
57600	40 ms
115200	25 ms

(*) Break Signal means interruption of the serial communication for a given time interval. It is used to inform the devices connected to the network that a command is going to be sent.

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9 NMEA MODE

NMEA protocol, mainly used in the nautical field and in satellite-based navigation systems, specifies that only one of the devices connected can send data, while the others can only act as recipients.

In NMEA mode, the instrument sends automatically the acquired measurements at regular intervals. The interval is factory-set to 1 second and can be configured within 1 and 255 seconds. To change the interval you should access the configuration mode and send **CU4Rnnn** command, where nnn indicates the interval value in seconds (see chapter 6 "*CONFIGURATION*" for details regarding the setting of operation parameters).

This mode is available with RS232, RS485 and RS422 serial connections. Communication parameters should be set in the PC or data logger as follows:

- Baud rate: same as the setting in the instrument (default = 4800)
- Data bits: 8
- Parity: same as the setting in the instrument (default = None)
- Stop bits: same as the setting in the instrument (default = 1)

The instrument is compatible with NMEA 0183 V4.00 protocol.

The protocol establishes that data are sent in the following format:

<p align="center">$<Prefix>,<Data>*<hh><CR><LF></p>

with <Prefix> = field consisting in 5 alphanumeric characters: the first two indicate the type
             of transmitting device, the other three indicate the type of transmitted data
      <Data> = values measured by the instrument, separated by commas
      <hh> = checksum, consisting in two hexadecimal characters
      <CR> = character ASCII *Carriage Return*
      <LF> = character ASCII *Line Feed*

The checksum is calculated by performing the exclusive OR of all characters ranging within **$** and ***** symbols. The 4 most significant bits and the 4 less significant bits of the result are converted in hexadecimal. The hexadecimal value corresponding to the most significant bits is transmitted as the first.

The instrument regularly sends a string in the following general format requested by the protocol:

$IIMDA,x.x,I,x.x,B,x.x,C,x.x,C,x.x,x.x,x.x,C,x.x,T,x.x,M,x.x,N,x.x,M*hh<CR><LF>

Wind speed, m/s
Wind speed, knot
Wind direction with respect to magnetic North, degrees
Wind direction with respect to geographic North, degrees ⇒ not available, empty field

Dew Point, °C
Absolute humidity, g/m^3
Relative humidity, %RH
Water temperature ⇒ not measured, empty field
Air temperature, °C
Barometric pressure, bar
Barometric pressure, inHg (mercury inches)

If the instrument model is not equipped to measure some of the quantities indicated in the general format, the relevant fields will be empty and multiple consecutive commas will appear to indicate the missing fields.

The previous string doesn't include the measurement of solar radiation or amount of rainfall. Models equipped with a pyranometer or a rain gauge provide to send the measurement with a second string continuously alternating to the former:

$IIXDR,a,x.x,a,c--c*hh<CR><LF>

- Type of measurement: PYRA (solar radiation) or RAIN (rainfall)
- Measuring unit: empty field
- Measurement of solar radiation or total amount of rainfall
- Type of transducer: G (generic)
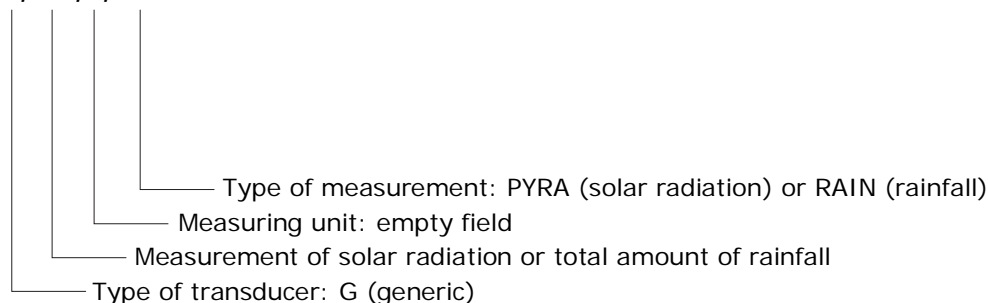
The total amount of rainfall is the amount measured from when the instrument is powered.

Note: the Wind Gust measurement is not available in NMEA mode.

EXAMPLE
Suppose that there are the following environmental conditions:

- o Wind speed = 5.60 m/s (=10.88 knot)
- o Wind direction with respect to magnetic North = 38.7°
- o Barometric pressure = 1014.9 hPa (= 30.0 inHg)
- o Relative humidity = 64.2 %
- o Air temperature = 26.8 °C
- o Solar radiation = 846 W/m^2

Based on the above values, the following can be calculated:

- o Absolute humidity = 16.4 g/m^3
- o Dew Point = 19.5 °C

The strings sent by the instrument in three different cases are indicated below:

• Case 1 – instrument measuring only wind speed and direction:

$IIMDA,,I,,B,,C,,C,,,,C,,T,38.7,M,10.88,N,5.60,M*3A<CR><LF>

• Case 2 - instrument measuring wind speed and direction, temperature, relative humidity and barometric pressure:

$IIMDA,30.0,I,1.0149,B,26.8,C,,C,64.2,16.4,19.5,C,,T,38.7,M,10.88,N,5.60,M*36<CR><LF>

• Case 3 - instrument measuring wind speed and direction, solar radiation, temperature, relative humidity and barometric pressure:

$IIMDA,30.0,I,1.0149,B,26.8,C,,C,64.2,16.4,19.5,C,,T,38.7,M,10.88,N,5.60,M*36<CR><LF>

alternated to:

$IIXDR,G,846,,PYRA*29<CR><LF>

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

10 MODBUS-RTU MODE

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

The mode is available with RS232, RS485 and RS422 serial connections.

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 allows reading the values measured by the instrument. The table below lists the available quantities with the corresponding register number:

TAB. 10.A - Input Registers

Register number	Quantity	Format	From FW version	Note
1	Wind speed (x100)	unsigned 16 bits	1.00	(1)
2	Wind direction in degrees (x10)	unsigned 16 bits	1.00	
3	Sonic temperature measured by the first transducers pair (x10)	16 bits	1.00	(1)
4	Sonic temperature measured by the second transducers pair (x10)	16 bits	1.00	(1)
5	Average of the two sonic temperatures measured by the two transducers pairs (x10)	16 bits	1.00	(1)
6	Temperature measured by Pt100 sensor (x10)	16 bits	1.00	(1)
7	Relative humidity in %RH (x10)	unsigned 16 bits	1.00	
8	Barometric pressure (x1000 if the unit of measurement is atm, x10 in the other cases)	unsigned 16 bits	1.00	(1)
9	Compass angle in degrees (x10)	unsigned 16 bits	1.00	
10	Solar radiation in W/m^2	unsigned 16 bits	1.00	
11	Mean wind speed (x100)	unsigned 16 bits	1.00	(1)
12	Mean wind direction in degrees (x10)	unsigned 16 bits	1.00	
13	Absolute humidity in g/m^3 (x100)	unsigned 16 bits	1.00	
14	Dew point temperature (x10)	16 bits	1.00	(1)
15	Wind direction in degrees (x10) with extended feature (see page 26)	unsigned 16 bits	1.00	
16	Wind speed (x100) along V-axis	unsigned 16 bits	2.00	
17	Wind speed (x100) along U-axis	unsigned 16 bits	2.00	

Register number	Quantity	Format	From FW version	Note
18	Status register bit0=1 ⇒ speed measurement error bit1=1 ⇒ compass measurement error bit2=1 ⇒ temperature meas. error bit3=1 ⇒ humidity measurement error bit4=1 ⇒ pressure measurement error bit5=1 ⇒ solar rad. measurement error	unsigned 16 bits	2.00	
19	Wind speed unit of measurement 0 ⇒ m/s 3 ⇒ knot 1 ⇒ cm/s 4 ⇒ mph 2 ⇒ km/h	unsigned 16 bits	2.00	
20	Temperature unit of measurement 0 ⇒ °C 1 ⇒ °F	unsigned 16 bits	2.00	
21	Atm. pressure unit of measurement 0 ⇒ mbar (=hPa) 3 ⇒ mmH$_2$O 1 ⇒ mmHg 4 ⇒ inchH$_2$O 2 ⇒ inchHg 5 ⇒ atm	unsigned 16 bits	2.00	
22	Wind Gust intensity (x100)	unsigned 16 bits	2.20	(1),(2)
23	Wind Gust direction in degrees (x10)	unsigned 16 bits	2.20	(2)
24,25	Total amount of rainfall (x1000 if the unit of measurement is mm, x10000 if the unit of measurement is inch)	unsigned 16 bits	2.22	(3)
26,27	Partial amount of rainfall (x1000 if the unit of measurement is mm, x10000 if the unit of measurement is inch)	unsigned 16 bits	2.22	(3)
28	Rainfall rate (x10 if the unit of measurement is mm/h, x100 if the unit of measurement is inch/h)	unsigned 16 bits	2.22	
29	Rainfall unit of measurement 0 ⇒ mm 1 ⇒ inch	unsigned 16 bits	2.22	

(1) For quantities with configurable measurement unit, the measurement value is expressed in the unit set in the instrument.

(2) 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).

(3) The **total** amount of rainfall is the amount measured from when the instrument is powered. The **partial** amount of rainfall is the amount measured from the last reading command. The amount of rainfall measurements are 32-bit integer values. Two consecutive 16-bit registers must be accessed to read a measurement. The register with lower address (for example the register with address 24 for the total amount of rainfall) contains the most significant bits.

INSTRUMENT ERROR CONDITIONS (function **07h**)

The Modbus function code 07h allows reading the 8-bit register containing information about error conditions of the instrument.

Each register bit corresponds to an error condition:

- *Bit 0*: Wind speed measurement error;
- *Bit 1*: Compass measurement error;
- *Bit 2*: Temperature measurement error;
- *Bit 3*: Relative humidity measurement error;
- *Bit 4*: Barometric pressure measurement error;
- *Bit 5*: Solar radiation measurement error;
- *Bit 6*: Not assigned;
- *Bit 7*: Not assigned.

There is an error condition if the corresponding bit value is 1.

Note: the register does not include the precipitation measurement error.

READING OF INSTRUMENT GENERAL INFORMATION (function **2Bh / 0Eh**)

The Modbus function code 2Bh / 0Eh allows reading the basic general information of the instrument, consisting of:

- Manufacturer;
- Instrument model;
- Firmware version.

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

11 SDI-12 MODE

In SDI-12 mode, the instrument sends the acquired measurements only if specifically requested by the PC.

To use this mode, an SDI-12 serial connection should be performed. The communication parameters of the protocol are:

- Baud rate: 1200
- Data bits: 7
- Parity: Even
- Stop bit: 1

Communication with the instrument is performed by sending a command in the following format:

<Address><Command>!

with <Address> = address of the instrument the command is sent to.
       <Command> = type of operation requested to the instrument.

The instrument reply is as follows:

<Address><Data><CR><LF>

with <Address> = address of the replying instrument
       <Data> = information sent by the instrument
       <CR> = ASCII character *Carriage Return*
       <LF> = ASCII character *Line Feed*

The instrument is compatible with V1.3 version of the protocol.

The table below shows the available SDI-12 commands. To comply with the SDI-12 standard, the instrument address is indicated in the table with the letter **a**. The instrument comes with a factory address preset to 0. The address can be modified by using the proper SDI-12 command reported in the table.

SDI-12 COMMANDS

Command	Instrument reply	Description
a!	a<CR><LF>	Checks for the presence of the instrument.
aI!	allccccccccmmmmmmvvvx...x<CR><LF> where: a = address of the instrument (1 character) ll = compatible SDI-12 version (2 characters) cccccccc = manufacturer (8 characters) mmmmmm = instrument model (6 characters) vvv = firmware version (3 characters) x...x = instrument version (up to 13 characters) • • • ⇒ Example of reply: 113DeltaOhmHD523D103P147R with: 1 = address of the instrument 13 = compatible SDI-12 version 1.3 DeltaOhm = name of manufacturer HD523D = model of HD52.3D series 103 = firmware version 1.0.3 P147R = instrument version HD52.3DP147R	Request for instrument information.

Command	Instrument reply	Description
aAb! where: b = new address	b<CR><LF> Note: if character b is not an acceptable address, the instrument answers with a in the place of b.	Change of instrument address.
?!	a<CR><LF>	Request for instrument address. If more than a sensor is connected to the bus, a conflict will occur.

aM!	atttn<CR><LF>
	
	where:
	  a = address of the instrument (1 character)
	  ttt = number of seconds needed by the instrument
	      to make measurements available (3 characters)
	  n = number of detected quantities (1 character)
	
	Note: ttt is always equal to 000 because the measuring process is continuous. Measurements can be directly requested (command aD0!) without sending this command before.
		Request to perform the measurement.

aD0! aD1! aD2! aD3! aD4! aD5!	a<WS><WD><T><CR><LF> a<RH><AH><DP><CR><LF> a<P><R><C><CR><LF> a<WSa><WDa><CR><LF> a<WGS><WGD><CR><LF> a<TBT><TBL><RR><CR><LF> where: a = address of the instrument (1 character) <WS> = wind speed <WD> = wind direction in degrees <T> = temperature (sensor Pt100) <RH> = relative humidity in %RH <AH> = absolute humidity in g/m^3 <DP> = dew point temperature <P> = barometric pressure <R> = solar radiation in W/m^2 <C> = compass angle in degrees <WSa> = mean wind speed <WDa> = mean wind direction in degrees <WGS> = wind Gust intensity <WGD>= wind Gust direction in degrees <TBT> = total amount of rainfall <TBL> = partial amount of rainfall <RR> = rainfall rate Notes: The positive values are always preceded by a + sign to identify the beginning of the measurement value.	Request for measured values.

Command	Instrument reply	Description
	As to the quantities with configurable measuring unit (wind speed, temperature, barometric pressure and rainfall), the measurement value is expressed in the unit set in the instrument. <DP> measurement has the same format as temperature. If a quantity measurement is in error condition, a negative value consisting in a series of 9 is sent. The fields corresponding to quantities not measured by that particular model are always present: a negative value consisting in a series of 9 is sent. The Wind Gust measurement is available starting from firmware version 2.20. 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). The **total** amount of rainfall is the amount measured from when the instrument is powered. The **partial** amount of rainfall is the amount measured from the last reading command.	

For additional information regarding the protocol, visit the site "www. sdi-12.org".

12 INSTRUMENT STORAGE

Instrument storage conditions:

- Temperature: -40…+70 °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.

13 SAFETY INSTRUCTIONS

General safety instructions

This instrument has been manufactured and tested in accordance with EN61010-1:2010 safety directives for electronic measuring instruments 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.
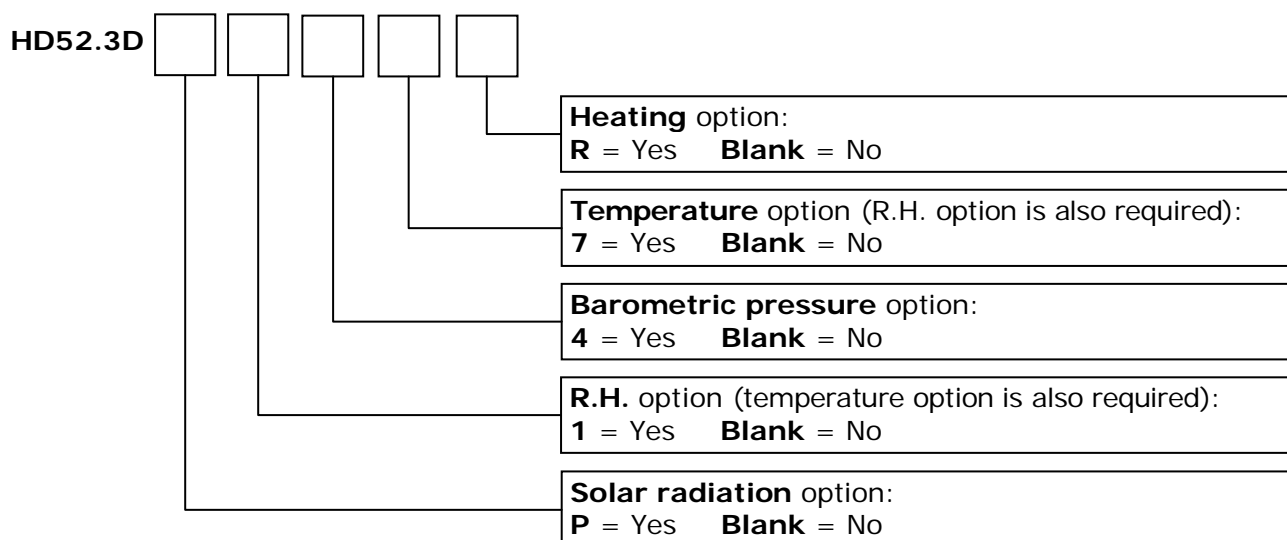
User obligations

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

14 ORDER CODES

HD52.3D... 2-axis ultrasonic static anemometer for the measurement of wind speed and direction, U-V Cartesian components of wind speed, Wind Gust, relative humidity and temperature (**optional**), global solar radiation (**optional**), barometric pressure (**optional**) and rainfall (**optional**). The "rainfall" and "global solar radiation" options are alternatives. Equipped with compass. RS232, RS485, RS422 and SDI-12 serial outputs, **NMEA**, **MODBUS-RTU** and **SDI-12** communication protocols. Two analog outputs, for wind speed and direction, factory-configurable within 4÷20 mA (**standard**), 0÷1 V, 0÷5 V or 0÷10 V (**to be specified when ordering**). **Heater option** available (except for version with rain gauge). Power supply: 10...30 Vdc (15...30 Vdc in case of 0÷10 V analog outputs). Installation on mast ∅ 40 mm external and ∅ 36 mm internal. Input with 19-pole M23 male connector and 19-pole M23 female free connector. Supplied with: **HD52.3D-S** software (downloadable from Delta OHM website) for instrument configuration and monitor, operating manual. **On request, CP52... cable with connector on one end and open wires on the other.**

Ordering scheme for models without rain gauge:

HD52.3D ☐ ☐ ☐ ☐ ☐

Heating option:
R = Yes   **Blank** = No

Temperature option (R.H. option is also required):
7 = Yes   **Blank** = No

Barometric pressure option:
4 = Yes   **Blank** = No

R.H. option (temperature option is also required):
1 = Yes   **Blank** = No

Solar radiation option:
P = Yes   **Blank** = No

With rain gauge, the HD52.3DT147 model is available (measurement of wind speed and direction, rainfall, relative humidity, barometric pressure and temperature).

ACCESSORIES

RS52 Serial connection cable with built-in USB/RS232 converter. USB connector for the PC and screw terminals on the instrument side.

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.

HD2004.22 Kit for fixing 1200 x 530 x 34 mm solar panel to ∅ 40÷50 mm mast. AISI 304 stainless steel.

HD2004.30 80 W single crystal solar panel. Dimensions 1200 x 530 x 34 mm.

CP52.5   12-pole connecting cable with 19-pole M23 female free connector on one end, open wires on the other. Length 5 m.

CP52.10   12-pole connecting cable with 19-pole M23 female free connector on one end, open wires on the other. Length 10 m.

CP52.15   12-pole connecting cable with 19-pole M23 female free connector on one end, open wires on the other. Length 15 m.

CP52.20   12-pole connecting cable with 19-pole M23 female free connector on one end, open wires on the other. Length 20 m.

CP52.30   12-pole connecting cable with 19-pole M23 female free connector on one end, open wires on the other. Length 30 m.

CP52.50   12-pole connecting cable with 19-pole M23 female free connector on one end, open wires on the other. Length 50 m.

CP52.75   12-pole connecting cable with 19-pole M23 female free connector on one end, open wires on the other. Length 75 m.

CP52.C   Additional 19-pole M23 female free connector.

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.

DICHIARAZIONE DI CONFORMITÀ UE
EU DECLARATION OF CONFORMITY

Delta Ohm S.r.L. a socio unico – Via Marconi 5 – 35030 Caselle di Selvazzano – Padova – ITALY

Documento Nr. / Mese.Anno:
Document-No. / Month.Year :   **5024 / 07.2019**

Si dichiara con la presente, in qualità di produttore e sotto la propria responsabilità esclusiva, che i seguenti prodotti sono conformi ai requisiti di protezione definiti nelle direttive del Consiglio Europeo:
We declare as manufacturer herewith under our sole responsibility that the following products are in compliance with the protection requirements defined in the European Council directives:

Codice prodotto:
Product identifier :   **HD52.3D…**

Descrizione prodotto:
Product description :   **Serie di anemometri a ultrasuoni**
Series of ultrasonic anemometers

I prodotti sono conformi alle seguenti Direttive Europee:
The products conform to following European Directives:

Direttive / *Directives*	
2014/30/EU	Direttiva EMC / *EMC Directive*
2014/35/EU	Direttiva bassa tensione / *Low Voltage Directive*
2011/65/EU - 2015/863/EU	RoHS / *RoHS*

Norme armonizzate applicate o riferimento a specifiche tecniche:
Applied harmonized standards or mentioned technical specifications:

Norme armonizzate / *Harmonized standards*	
EN 61010-1:2010	Requisiti di sicurezza elettrica / *Electrical safety requirements*
EN 61326-1:2013	Requisiti EMC / *EMC requirements*
EN 50581:2012	RoHS / *RoHS*

Il produttore è responsabile per la dichiarazione rilasciata da:
The manufacturer is responsible for the declaration released by:

Johannes Overhues

Amministratore delegato
Chief Executive Officer

Caselle di Selvazzano, 22/07/2019

GUARANTEE

DeltaOHM
Member of GHM GROUP

TERMS OF GUARANTEE

All DELTA OHM instruments are subject to accurate testing, and are guaranteed for 24 months from the date of purchase. DELTA OHM will repair or replace free of charge the parts that, within the warranty period, shall be deemed non efficient according to its own judgement. Complete replacement is excluded and no damage claims are accepted. The DELTA OHM guarantee only covers instrument repair. The guarantee is void in case of incidental breakage during transport, negligence, misuse, connection to a different voltage than that required for the appliance by the operator. Finally, a product repaired or tampered by unauthorized third parties is excluded from the guarantee. The instrument shall be returned FREE OF SHIPMENT CHARGES to your dealer. The jurisdiction of Padua applies in any dispute.

The electrical and electronic equipment marked with this symbol cannot be disposed of in public landfills. According to the Directive 2011/65/EU, the european users of electrical and electronic equipment can return it to the dealer or manufacturer upon purchase of a new one. The illegal disposal of electrical and electronic equipment is punished with an administrative fine.

This guarantee must be sent together with the instrument to our service centre.

IMPORTANT: Guarantee is valid only if coupon has been correctly filled in all details.

Instrument Code: **HD52.3D...**

Serial Number _____

RENEWALS

Date _____	Date _____
Inspector _____	Inspector _____
Date _____	Date _____
Inspector _____	Inspector _____
Date _____	Date _____
Inspector _____	Inspector _____

CE

RoHS
2011/65/EU

V2.0
08/11/2019