OPERATING MANUAL

HD2003

Ultrasonic anemometer

EN

V5.0

senseca

Contents

1 Introduction

Ultrasonic Anemometers allow detecting **wind speed** and **direction.** The transit time of the ultrasonic pulse between a pair of opposite sonic transducers, in both directions. From the measurement of tA and tR times, you can trace to the wind speed component in the direction of the two transducers, through the formula:

$$V = D/2 \cdot (1/tA - 1/tR)$$

Where:
D = distance between two transducers
tA = forward transit time
tR = backward transit time

This formula ensures that the wind speed does not depend on pressure, temperature and humidity. Three couples of transducers allow to make a three-axis vector measurement of wind.

1.1 Conventions

Definitions of the anemometric quantities

The **wind direction** is established through the calculation of angles:

- **azimuth**

Azimuth is the angle indicating the direction from which the wind comes in the horizontal plane. It is calculated from 0 to 360° clockwise along the horizontal plane. **0° is the direction of geographical North.** The instrument built-in integrated compass measures the magnetic azimuth, with reference to **magnetic North**.

- **elevation**

It is the angle indicating the position of the wind flow along the Vertical Plane. It varies from +/- 60° along the vertical plane, considering positive the inclinations over the Horizontal Plane.

The **wind speed** is calculated in terms of intensity of components or resultants:

- **SoW, SUV and SoS**

The **intensity** of wind speed is indicated by SoW, that of its component along the horizontal plane U-V is indicated by SUV, while that of sound by SoS.

- **U-V-W**

They are the three wind speed **Cartesian components**. If we draw a Cartesian plane with U and V along the horizontal plane, W will be the vertical axis. The "V" direction coincides with geographical North, the "U" coincides with East and the "W" with the vertical.

The ***wind gust*** measurement is determined as follows:

- the wind speed averages in a time interval equal to 3 seconds are calculated continuously;
- the maximum value of the averages calculated in the previous point is detected over a time interval equal to the Average Interval set in the instrument; the maximum value detected is the measure of wind gust.

Note: the wind gust measure is not averaged over the Averaging Interval, but the Averaging Interval is only taken as a reference for the duration of the interval in which to detect the maximum value. The wind gust measurement only reports the wind intensity, not the direction.

Other conventions

- **F.S. and Zero**

F.S. identifies the Full Scale of a quantity, while Zero identifies the Scale Minimum Value.

- **Factory Default**

The Factory Default corresponds to the value of a factory set parameter, when first programming an instrument which comes out of the production department.

- **Internal Refresh**

It represents the automatic frequency by which all the calculations are refreshed according to the set average intervals.

- **Symbols**

The keys of an IBM compatible PC keyboard are identified with a white text on a black background, for example:

[Esc] = Esc key**,** **[Enter]** = Enter key, **[A]** = A key

One ASCII generic character or several ASCII generic characters can be identified with the symbol: <name>, where name is any expression that gives the title to that character.
Example of special characters:
<CR> = Carriage Return
<LF> = Line Feed

- **Output Data**

It is the digital string of all formatted measuring data available for RS232, RS422, AoXnd and RS485 serial communication interfaces.

1.2 Available options

Heaters option

The operation is guaranteed up to –20 °C if ice or snow is absent, without any heating circuits for sonic transducers.
Temperature conditions below –20 °C, or temperatures around 0 °C when snowing or ice forms on the transducers, prevent the instrument from functioning correctly, making the use of the heaters option (indicated by the additional letter **R** in the code) essential.
The heating circuit intervenes at temperatures below +5 °C, with a minimum additional power of 4 W (with temperature no lower than –10 °C), preventing the formation of ice, and ensuring that the instrument functions correctly even during sleet or snow.
The defrosting time depends on the quantity of snow that has deposited on the measurement volume where the ultrasonic sensors are housed.

RS422 option

The RS422 serial communication mode, which provides a 4-wire full-duplex communication, must be requested as an option when ordering.

1.3 General characteristics

- Determination of anemometric quantities with different units of measurement: wind speed and direction, U-V-W Cartesian components, wind gust, sonic speed and temperature.
- Additional quantities (depending on model): pressure, temperature and relative humidity.
- 5 analog outputs in current or voltage, with different ranges.
- Up to *12 extended analog outputs* in current and voltage, at different measuring ranges.
- 5 digital interfaces: RS232, RS422, RS485 Modbus, RS485 proprietary and AoXnd.
- Digital strings of output data at a configurable emission frequency.
- Average intervals for all output quantities, configurable at 1÷60 s or at 1÷60 min.
- Processing algorithms to provide anemometric measurements with ±1% accuracy.
- Operating mode at *High Digital Frequency* with serial data output at *50 Hz*, or *High Analog Frequency* with analog data output from *5Hz to 20Hz*.
- Self-diagnosis with checking and error reporting.
- Reliability and precision in the whole measurement range, without need for further calibrations.
- Setup user interface via RS232, RS422 or RS485.
- Compass with magnetoresistive sensor for automatic alignment to the Magnetic North.
- No moving parts, with reduced maintenance and servicing costs.
- Robust construction, suitable to operate continuously in severe climatic conditions.
- Low power consumption.
- **Optional** integrated heating of sonic transducers, to prevent ice and snow formation, ensuring a correct functioning even when sleeting or snowing.
- **Optional** 4-wire full-duplex RS422 communication integrated circuit.

1.4 Operating modes

The following operating modes are available:

- **RS232 and RS422 Serial Communication Mode** (par. 3.1)

A connection over a RS232 or RS422 Serial line is established between a Host Computer and only one anemometer. The Host Computer (*Slave*) is continuously receiving on its RS232 serial port, Output Data digital strings, which are automatically supplied by the anemometer (*Master*), with its own frequency (configurable at a cadence from 1 to 3600s).
In this mode the *Setup* user interface can be managed from the computer.

- **RS485 Modbus-RTU and RS485 Multidrop Communication Mode** (par. 3.2)

A network with Modbus-RTU protocol over the RS485 line can be established, with a *Master* (typically the PC or PLC) and one or more anemometers together with other sensors, all operating as *Slave* unit. Or a RS485 Multidrop network can be established between a Host Computer and several anemometers (up to 32). The Host Computer (*Master*) sends a command to an univocal *Slave* address. Only the anemometer identified by that address answers on request, giving the Output Data. In this mode the command to activate the *Setup* user interface is available.

- **Digital High Frequency Mode**

When in RS232 or RS422 serial communication mode, the *Digital High Frequency* functioning can be set (see par. *Output rate and digital – analog high frequency* on page 17), by obtaining Output Data of the quantities in RS232 or RS422 at a fixed frequency of *50 Hz* (baud rate=115200 and 4 measurement quantities).
When in RS485 Multidrop communication mode, a command for activating the *Digital High frequency* can be sent (see par. *H and L commands* on page 27). Then, any command for requiring a measurement can be sent to the anemometer up to a maximum frequency of *50 Hz* (baud rate=115200 and 4 measurement quantities).

- **Analog Output Mode** (par. 3.3)

All measurement quantities can be configured to be converted into *5 analog outputs* in current or voltage, available in different measurement ranges, with a refresh of *1 Hz*. This mode is always active, combined with the RS232 Serial, RS422, AoXnd and RS485 Multidrop modes.
The 5 analog outputs are not available if the Digital High Frequency mode is enabled.

- **Analog Output Extended Mode (AoXnd)** - **Analog High Frequency** (par. 3.4)

A single anemometer (Master) sends spontaneously digital strings of command over his RS485 serial line directly connected to a remote module (Slave) ICP DAS I-7024 ® (**provided on Request**). There are 4 extended analog outputs, voltage or current, to the output terminals of the module, related to the measured quantities requested. Up to 3 ICP DAS I-7024® modules can be connected, for a maximum total of 12 extended analog output. In normal operation, cadences are settable from 1 to 3600 s of update of the analog outputs, that is to say a maximum frequency of 1 Hz.
Under this mode, it is possible to get analog outputs at a considerable distance from the place of installation of the anemometer, up to 1200 m, even in routes subject to high electromagnetic interference. The analog signals to the output terminals of the module, placed in proximity of the acquisition device (such as the data logger HD32MT.1), are electrically insulated and are not subject to disturbances and interference in the electrical path forming, as it happens in the analog signals that come directly from anemometer and have a long way before reaching acquisition device.
Under this mode of AoXnd communication, the High Frequency Analog operation can be set, by getting the analog output of the measuring quantities needed, at a frequency of 5 Hz to 20 Hz, depending on the baud rate of the digital strings of command over the RS485 line.

The Serial RS232, RS422, RS485 ModBus RTU, RS485 Multi-drop and AoXnd Communication modes are alternative: only one of them can be active. It is always possible to return to RS232 serial mode by providing a suitable command when switching on.

1.5 Specifications

Output quantities

Anemometric	Wind speed and direction, U-V-W components, wind gust, sound speed, sonic temperature
Meteorological	Pressure, Temperature, Relative Humidity (only versions with additional sensors)
Heading	Compass with magnetic azimuth

- **Wind Speed**

Unit	m/s, cm/s, km/h, knots, mph
Range	0 ÷ 70 m/s (252 km/h)
Resolution	0.01 m/s
Accuracy	± 1% of reading

- **Wind Direction**

Range	Azimuth: 0 ÷ 360° Elevation: ± 60°
Resolution	0.1°
Accuracy	± 1°

- **Sound speed**

Range	300 ÷ 380 m/s
Resolution	0.01 m/s
Accuracy	± 1% of reading

- **Sonic temperature**

Range	-40 +60 °C
Resolution	0.1 °C
Accuracy	± 1 °C

- **Compass**

Range	0÷3600 /10°
Resolution	0.1°
Accuracy	± 1°

- Moving Averages 1÷60 sec / 1÷60 min
- Ultrasonic rate 60 Hz

Digital Outputs

- Quantities: Anemometric and compass. Pressure, Temperature, Relative Humidity (only versions with additional sensors)
- Communications: RS232 and RS422 full-duplex, Modbus-RTU, RS485 Multidrop and AoXnd half-duplex On request when ordering RS422 4-wire full-duplex
- Baud rate: 9600 ÷ 115200 bit/sec
- Output Rate: Normal mode (Slow): 1 ÷ 3600 sec; Digital High Frequency (Fast) : fixed 50 Hz

Analog Outputs

- Quantities: 5 to be selected from output quantities (anemometric, compass, meteo).
- Range: 0-20 mA, 4-20 mA, 0÷1 V, 0÷5 V, 0÷10 V, 1÷5 V
- Resolution: 14 bits max

Analog Outputs Extended (with ICP DAS I-7024® module on request when ordering)

- Quantities: up to 12 to be selected from output quantities (anemometric, compass, meteo).
- Range: 0÷20 mA, 4÷20 mA, 0÷5 V, 0÷10 V
- Resolution: 14 bits
- Output Rate: Normal mode (Slow): 1 ÷ 3600 s; Analog High Frequency (Fast) : from 5 to 20 Hz depending on the baud rate

Power Supply

- Range: 12 ÷ 30 Vdc
- Power: < 2 W (Typically: 110 mA @ 15 Vdc); < 6 W Models with heaters and environment temperature not lower than –10 °C

Operating conditions -40…+60 °C / 0…100% RH / up to 300 mm/h of precipitation

Weight 2.1 kg (version with P/T/RH additional sensors)

Additional sensors specifications

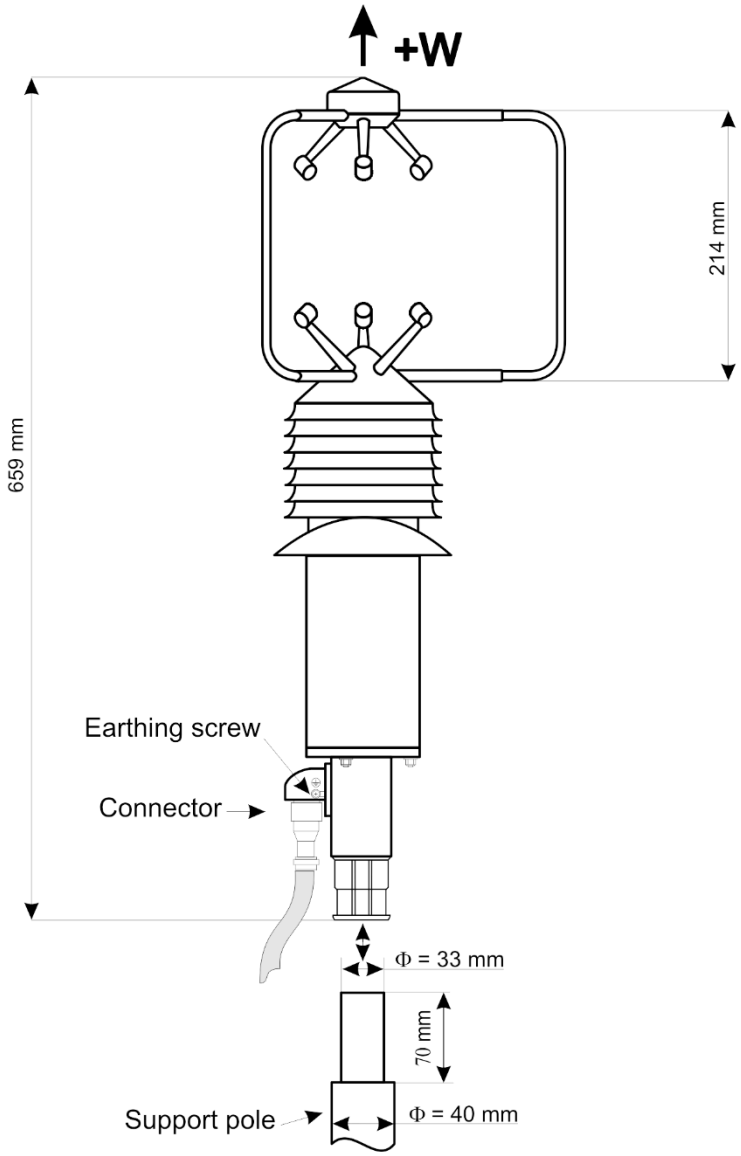
Pressure
Sensor: piezoresistive
Range: 600 ÷ 1100 mbar
Resolution: 0.1 mbar
Accuracy: ± 0.4 mbar @ 20 °C
Temperature Effects: ± 0.8 mbar between –40 °C and +60 °C
Long-term stability: 1 mbar in 6 months @ 20 °C

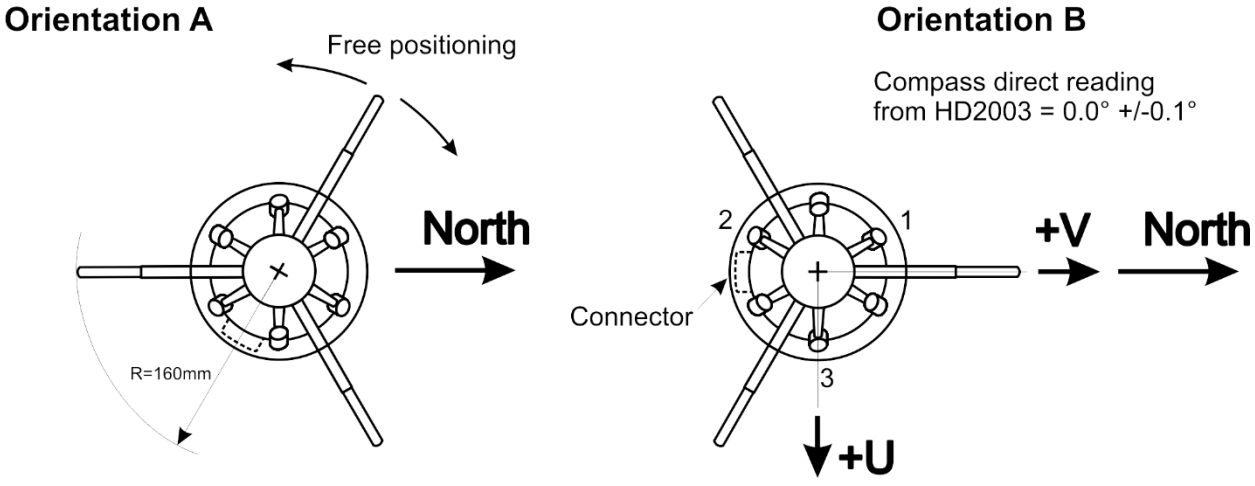
Temperature
Sensor: Pt100
Range : –40 ÷ + 60 °C
Resolution: 0.1 °C
Accuracy: ± 0.2 °C, ± 0.15% of reading

Relative Humidity
Sensor: capacitive
Range: 5÷98% RH
Resolution: 0.1 %
Accuracy: ± 2.5% RH @ 23°C

2 Installation

The instrument will be vertically mounted and positioned on "*open terrain*", far from turbulences due to near trees or buildings. In the presence of buildings, trees or any other obstruction, the anemometer should be positioned at a height of 10 m above the ground; the distance between the instrument and any obstruction should be at least 10 times the relevant height.





2.1 Alignment

Orientation A

Rotating the anemometer on its vertical axis, it can be fixed in any angular position. The built-in magnetoresistive sensor allows to automatically refer angular measurements to magnetic North, independently of its position.

Orientation B

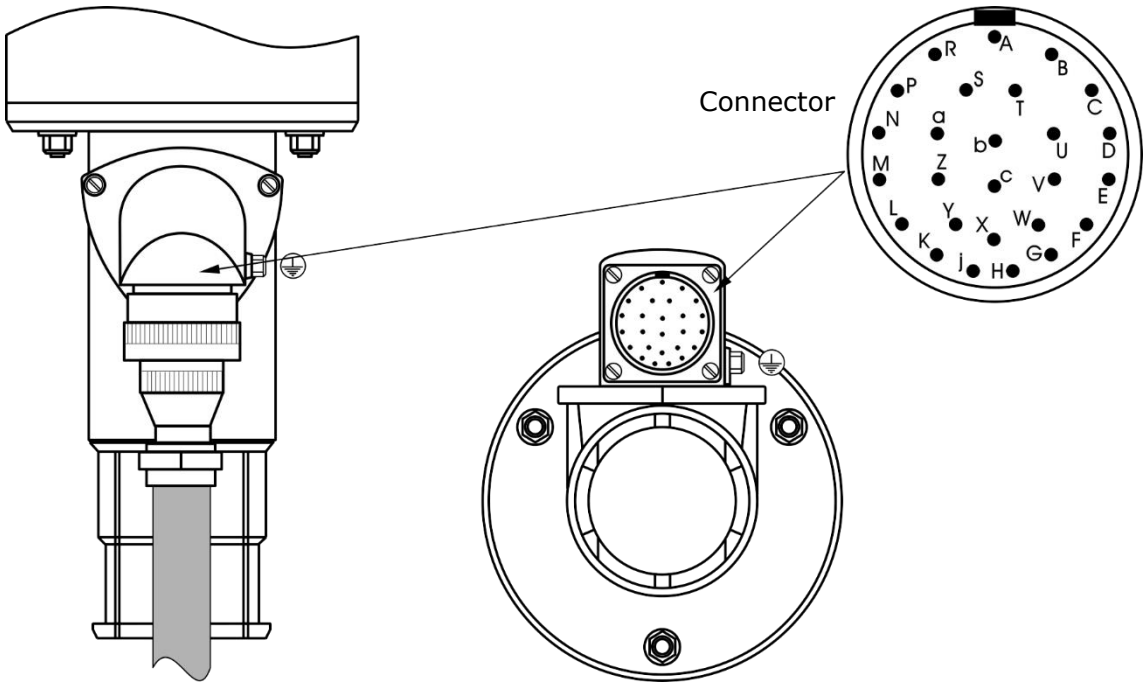
The anemometer is connected to a computer in RS232 Serial, RS422 or RS485 Multidrop communication mode (par. 3.1 and 3.2). Then the anemometer is rotated on its vertical axis until the measurement of the compass shows ***0.0° +/- 0.1°*** on the serial communication program of the computer.
This 'Orientation B' ensures greater precision in angular measurements and U-V-W Cartesian components of wind speed correspond to cardinal points:
V direction**= North**
U direction **= East**
W direction **= Instrument Vertical Axis**.

To refer angular measurements to **Geographical North,** you should consider the **Magnetic Declination** error, which is to be algebraically summed to **Magnetic North.**
Once the alignment is finished, tighten the clamp which fixes the anemometer to the mounting mast.

With strong magnetic fields, (for example radio or telephone antennas are in the same installation), the automatic calculation of the azimuth angle, may be independent from the compass measurement. To do it, make an RS232 serial connection (par. 2.2.2), and if you press **#** on the keyboard of the Host computer, when turning the anemometer on, (auto ranging takes a few seconds), you set it up to work with manual North orientation.
For aligning, rotate the anemometer on its vertical axis, so the Geographical North corresponds to the north side of the anemometer, which is identified by the direction of the metal support opposite the connector.

2.2 Electrical connections

The instrument has 26-pole male connector. Below are the identification and function of the connector pins and the color correspondence with the wires of the optional **CP2003/...** cable.



26-pole connector label	Symbol	Description	CP2003/... wire color
H	PWR-	Negative Power Supply	Brown
J	PWR- (TX+)	Negative Power Supply (Tx B RS422)	Black
G	PWR+	Positive Power Supply	Grey & Brown
K	PWR+ (TX-)	Positive Power Supply (Tx A RS422)	Red
F	DATA+ (RX+)	Pole B RS485 (Rx B RS422)	White & Green
W	DATA- (RX-)	Pole A RS485 (Rx A RS422)	Grey
X	SG	Ground RS232	Yellow
Y	TXD	Tx data RS232	White & Yellow
L	RXD	Rx data RS232	Yellow & Brown
E	OUTV1	Analog Out voltage 1	Pink & Brown
V	OUTV2	Analog Out voltage 2	Red & Blue
c	OUTV3	Analog Out voltage 3	Grey & Red
Z	OUTV4	Analog Out voltage 4	Brown & Green
M	OUTV5	Analog Out voltage 5	Green
D	REF	Analog ground	Blue
U	OUTmA1	Analog Out current 1	Pink
b	OUTmA2	Analog Out current 2	White
a	OUTmA3	Analog Out current 3	White & Grey
N	OUTmA4	Analog Out current 4	White & Red
C	OUTmA5	Analog Out current 5	Violet
T	Q0	Reserved	-
S	Q1	Reserved	-
P	Q2	Reserved	-
B	Q3	Reserved	-
A	Q4	Reserved	-
R	SHIELD	Shielding	Shield

The columns *Symbol* and *Description* indicate, in brackets, the significance of the four PIN used in RS422 4-wire full duplex mode (**On Request**).

The optional **RS2003** cable is available for connection to a PC USB port.

2.2.1 Power supply and earthing

- **Power supply: 12÷30 Vdc**

110mA @ 15Vdc: without Heaters Option
400mA @ 15Vdc and –10°C: with Heaters Option (heating circuit activated)

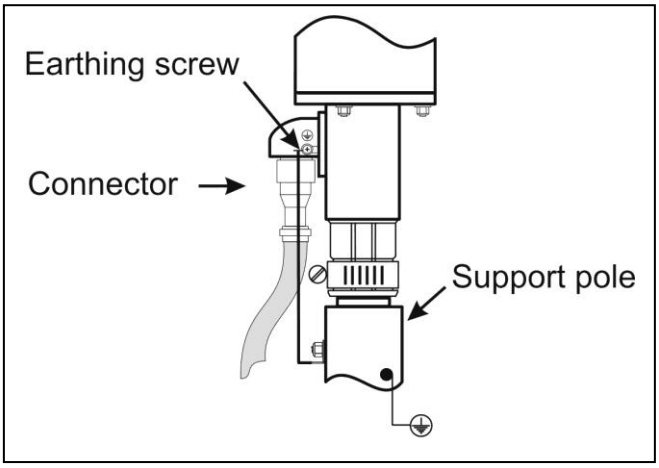
Power Supply 12÷30 Vdc	*Connector label / Symbol*
pole **+**	G / PWR+
pole **–**	H / PWR-

Note for the model with Heaters Option:
When the anemometer has remained off in temperatures below 0 °C, being switched on later will give initial absorption peaks when the heating circuit turns on. These peaks should be planned when dimensioning the power supply circuit used (absorption: from 5 A to 1 A first 5 seconds @ 15 Vdc and –20 °C).

For greater heating effectiveness, it is advisable to use a 30 Vdc power supply, by connecting two pairs of wires, one towards the poles G and K (PWR +) and the other one towards the poles and J and H (PWR-) of the connector. (In RS422 the poles K and J are not available).

- **Earth Connection.**

The earth connection is fundamental to protect against electromagnetic disturbances.
The anemometer is installed on a metallic pole fixed to the ground that must be earthed.
Connect the metallic structure of the pole to the earthing screw provided near the connector with at least a ∅1.5 mm² cable.



The connection in the figure was performed by using a screw on the support pole. It is also possible to make the connection by using a cable tie around the support pole.

2.2.2 RS232 serial communication mode

This mode can be selected via software (par. 3.1.3).
Connect the anemometer cable to a PC RS232 serial port. The anemometer can be also connected to a PC USB port via a RS232/USB converter, e.g. **RS003** (**optional**).
When using extension cables, do not exceed 15 m total, including the anemometer cable

RS232 connections:

RS232 Port (PC side) *9 pole SubD connector*	*Connector label / Symbol*
pin#2	Y / TXD
pin#3	L / RXD
pin#5	X / SG

2.2.3 RS422 serial communication mode

This mode can be selected via software (par. 3.1.3).
Connect the anemometer cable to the RS232/RS422 converter connected to the PC. The cable length can be at maximum 1,200 m.

RS422 connections:

RS422 Port (PC side)	*Connector label / Symbol*
Polo Tx B	J / Tx +
Polo Tx A	K / Tx -
Polo Rx B	F / Rx +
Polo Rx A	W / Rx -

2.2.4 RS485 Modbus-RTU and Multidrop communication mode

This mode can be selected via software (par. 3.1.3).
Make a parallel connection between each anemometer of the network and the RS485 port on the PC, (or the RS485/RS232 converter connected to the PC), by using a shielded *twisted pair* cable.
The maximum cable length between the Anemometers placed in the extreme places of the Modbus or Multidrop RS485 network is 1,200 m.

RS485 Modbus-RTU and Multidrop connections:

RS485 Port (PC side)	*Connector label / Symbol*
pole B	F / DATA + for all the network anemometers
pole A	W / DATA - for all the network anemometers

2.2.5 Analog outputs mode

- 5 **Analog Outputs** at 14 bits in **voltage**, 0…1 V, 0…5 V, 0…10 V ,1…5 V

*Analog Outputs of **voltage***	*Connector label / Symbol*
#1	E / OUTV1
#2	V / OUTV2
#3	c / OUTV3
#4	Z / OUTV4
#5	M / OUTV5
Analog ground of voltage	D / REF

- 5 **Analog Outputs** at 14 bits in **current**, 0-20 mA, 4-20 mA

*Analog Outputs of **current***	*Connector label / Symbol*
#1	U / OUTmA1
#2	b / OUTmA2
#3	a / OUTmA3
#4	N / OUTmA4
#5	C / OUTmA5
Analog ground of current	H / PWR−

The maximum load resistance of the current circuit is 500 Ω at 12 Vdc power supply.

2.2.6 Analog outputs extended mode AoXnd

With ICP DAS I-7024® module on request when placing the order

This mode can be selected via software (par. 3.1.3).
Connect the anemometer and the module ICP DAS I-7024 ® with a shielded *twisted pair*. The cable length between the most extreme points of the RS485 line can be at max. 1,200 m. For a long distance connection, a 240 Ω resistance in parallel between DATA+ and DATA- of the ICP DAS I-7024 ® module is recommended.

- **AoXnd** connections:

ICP DAS I-7024® terminal	*Connector label / Symbol*
DATA**+**	F / DATA +
DATA**-**	W / DATA -

- **Power Supply** ICP DAS I-7024 ® module
  The same power supply can be used for the anemometer.

Power Supply *12÷30 Vdc*	*Terminal* *ICP DAS I-7024®*
polo **+**	(R) +Vs
polo **–**	(B) GND

To use the 5 **voltage** analog outputs of the anemometer together with those of the ICP DAS I-7024 ® module, so to have a single ground reference, you should connect:

Connector label / Symbol	*Terminal* *ICP DAS I-7024®*
D / REF	AGND

3 Programming

The serial communication mode is selected via software (par. 3.1.3).
The *Setup* user interface is available for all modes.

3.1 RS232 and RS422 serial communication mode

3.1.1 Communication settings

Run a standard serial communication program on the PC and set:

Bit per second	Same as set in the anemometer (default 115200)
Data bit	8
Parity	None
Stop bit	2
Flow Control	None

Set the number of rows of the terminal to 24 and enable the echo of the typed characters.

Connect power supply and RS232 or RS422 as shown in par. 2.2. After supplying power, the anemometer starts the *auto ranging* mode for a few seconds and then it will operate in *Measuring* mode, automatically sending the output data, which can be displayed on the terminal.

On the PC keyboard, press the character **?** to enter ***Setup*** mode.

3.1.2 Measuring mode

While in Measuring mode, the anemometer transmits the digital strings of output data, each one in a separate line of ASCII characters which correspond to the last measurement, at an emission frequency and an average interval which may be configured in the *Setup*.

The quantities, max. 16, to be supplied in Output Data are selected in Setup.

Each quantity measured value is formatted into 8 ASCII characters, right justified, with the space character before the sign and a number of decimal positions depending on the unit of measurement.

Each string of data is followed by <LF> + <CR> characters.

3.1.3 Setup

The *Setup* allows the user to configure the anemometer through linked menus, displayed in consecutive pages.

When opening a menu that allows the selection between different values/options, or the setting of a numeric value, the current setting is displayed, proceeded by the "=" character. The change of a parameter is stored permanently, even if the anemometer power is removed.

In any displayed configuration page, it is active a timeout: unless a key is pressed on the PC, the anemometer returns to previous pages until measuring mode. By consecutively pressing up to 5 characters that are not available on the currently displayed menu page, you get the same effect.

Entering Setup, the following main menu is displayed:

Anemometer HD2003 Rel. X.Y (*X.Y is the anemometer firmware revision*)
→→ Menu

S. Setup
L. Logging
Esc. Exit

Sel:

Press **[Esc]** to go back to **Measuring mode**.

Type **L** to display the **Logging** (see par. 3.1.4).

Type **S** to enter the **Setup menu**, with the following options:

→→ Setup

1. Baud	To select the RS232, RS422, RS485, Modbus-RTU or AoXnd baud rate
2. Gain	To set the gain factor for U-V-W, SoW and SUV
3. Threshold	To set the minimum threshold for SoW
4. Average Interval	To set the average interval in seconds or minutes for all output quantities
5. Analog Output	To select the analog range and wind speed range for Analog Outputs and AoXnd
6. Output Quantity	Select of quantities for output data
7. Wind Units	To select the unit of measurement of SoW, SoS, U-V-W and SUV
8. Heating	(**On request**) To enable the heating circuit of sonic transducers
9. COM Mode	To select serial RS232, RS422, RS485, Modbus-RTU or AoXnd communication mode
I. ID	To set the instrument address for RS485 Modbus-RTU and Multidrop mode
R. Output Rate	To set Digital/Analog High/Low Frequency of output quantity transmission in RS232, RS422, RS485 and AoXnd

Esc. Exit

Typing the alphanumeric character next to each menu item, the corresponding submenu is activated.

• Baudrate

Typed Character: 1
(Baud)
Setting of RS232, RS422, RS485 and AoXnd baud rate. The screen page displays:

→→ Baudrate (N,8,2)
1. 9600
2. 19200
3. 38400
4. 57600
5. 115200
Esc. Exit
Enter. Save

= 115200

By typing a number displayed among the menu items, the relevant baud rate will appear. For example, by typing **2** , =19200 will appear.

After selecting the desired baud rate number, press **[ENTER]** to enable the new baud rate in the anemometer (=*115200* factory default).

Changing the baud rate, the serial communication program setting must also be changed with the new baud rate. The new baud rate remains active even when passing to Modbus-RTU, Multidrop RS485 or AoXnd mode.

Note: Press any key to get a new screen page.

• Gain

Typed Character: 2
(Gain)
Setting of the Gain factor. The screen page displays:

Sel: 2
= 10000
Gain [Range= 5000 to 15000]:

It allows to set a gain factor in 1/10000 for U–V–W components and consequently for SoW and SUV (=*10000* factory default).

This gain variation allows aligning the wind speeds measured by the anemometer with the wind speeds measured by any other reference instrument.

To set the desired gain, type it and then press **[ENTER]**, make sure that the number is within the 5000÷15000 range.

• Minimum threshold

Typed Character: 3
(Threshold)
Setting of the minimum threshold displayed. The screen page displays:

Sel: 3
= 20
[cm/s] [Range= 0 to 500]:

It is possible to set a minimum threshold of speed in **cm/s**, below which SoW is considered equal to zero (= *20* factory default).

Type the desired value and press **[ENTER]**, respecting the 0÷500 range.

• Average interval

Typed Character: 4
(Average Interval)
How to set the interval value in seconds or minutes in order to calculate the moving averages of all output quantities. The average interval is also the interval considered for the wind gust measurement (which however is not averaged, see the measurement description on page 3).
The first screen page displays:

→→ Average Interval

1. [sec]
2. [min]
Esc. Exit

= [min]

The time unit of the moving average interval can be chosen, in seconds or minutes (*=[min]* factory default). After typing the number corresponding to the desired unit:

… if you choose seconds:
→→ Average Interval
= 2
[sec] [Range= 1 to 60]:

… if you choose minutes:
→→ Average Interval
= 2
[min] [Range= 1 to 60]:

The interval value should be set between 1 and 60 (=*2* factory default) for calculating the moving average (average calculated by the samples acquiring in the last time interval, equivalent to the set period in seconds or minutes). The moving average is calculated on the U-V-W and SoS components (and consequently on all the other anemometric quantities resulting from them), and for all the remaining available output quantities (Pressure, Temperature, Relative Humidity).

In substance, all quantities chosen as Output Data in RS232, RS422, RS485 or AoXnd as well as those chosen as Analog Outputs, are supplied with values that represent the average calculated on the last time interval. The magnetic azimuth provided by the compass is excluded from moving averages.

Type the desired number respecting the range displayed on the screen and press **[ENTER]**.

After choosing the average interval, the instrument automatically sets its internal refresh. The internal refresh is equal to 1 s if you choose the interval in seconds; if you choose it in minutes, it is equal to as many seconds as the minutes chosen (for example, an average interval of 10 min corresponds to an internal refresh each 10 s).

- **Analog Output Format**

Typed Character: **5**
(Analog Output)
Setting of the analog range and the wind speeds range for Analog Outputs and Analog Output Extended (AoXnd) mode. The screen page displays:

→→ Analog Output

1. mA-V Ranges
2. Speed Ranges
Esc. Exit

○ By typing **1**
(mA-V Ranges)
Selection of the analog range. The screen page displays:

→→ Ranges

1. 0-20 mA
2. 4-20 mA
3. 0-1 V
4. 0-5 V
5. 0-10 V
6. 1-5 V
Esc. Exit
Enter. Save

AoXnd: no option 3 or 6
= 2

After selecting the number corresponding to the desired analog range, press **[ENTER]** to enable the five Anemometer Analog Outputs to suply a voltage/current signal in the selected range (=*4-20 mA* factory default).

By pressing **[ENTER]** , for AoXnd mode, the same current or voltage range set also for ICP DAS I-7024 ® modules used (par. 3.4.1) is stored. For AoXnd mode, the ranges 0-1 V and 1-5 V are excluded.

Example: typing **2**, i.e. choosing 4-20 mA range, and supposing that one of the Analog Outputs is associated with azimuth 0-360°, it is established that: 0° → 4 mA, 360° → 20 mA.

○ By typing **2**
(Speed Ranges)
Setting of the range for wind speeds available for Analog Outputs and AoXnd mode. The following screen page for range setup appears:

Sel: 2
= +/- 70 m/s (U, V, W)
= 0 to 70 m/s (SoW, SUV)

F.S. [Range= 10 to 70]:

Set a positive number in **m/s** between 10 and 70, which represents the F.S. on the scale of measurement for SoW and SUV starting from zero; it also represents the extreme limits on the symmetrical scale of measurement for U-V-W components.

Type the desired number respecting the range displayed on the screen (= *70 m/s* factory default) and then press **[ENTER]**.

Example: typing **45**, having selected 1-5 V from menu *mA-V Ranges*, with one of Analog Outputs associated with the *U* component of wind speed, it is established that: - 45 m/s → 1 V, +45 m/s → 5 V.

In Analog Output and AoXnd mode, the only unit of measurement possible for wind speed is m/s.

• Output quantities

Typed Character: **6**
(Output Quantity)
Selection of output quantities in serial RS232, RS422, RS485 Modbus-RTU, RS485 Multidrop, AoXnd and Analog Output mode. The screen page displays:

→→ Output Quantity

1. User
Esc. Exit
= 1
Sel:

By typing **1**
(User)
The *Custom Format* menu appears:

→→ Custom Format

	Decimal digits	Notes
0. q0	1	
1. q1	1	
2. q2	1	
3. q3	1	
4. q4	1	
5. U-V-W	2 (0 if in cm/s)	Unit of measurement = SoW
6. Speed in U-V	2 (0 if in cm/s)	Unit of measurement = SoW
7. Speed of Wind	2 (0 if in cm/s)	
8. Azimuth	1	
9. Elevation	1	
S. Speed of sound	1 (0 if in cm/s)	Unit of measurement = SoW
T. Sonic temperature	1	
C. Compass	0	Integer value in tenths (ex. 1800=180.0°)
E. Errors	0	
G. Gust	2 (0 if in cm/s)	Unit of measurement = SoW

Esc. Exit
= 78012tce
Sel [max 12]:

You can select the type and order of the measured quantities which will appear in output data, supplied in serial RS232/RS422 mode or obtained after a query in RS485 Multidrop mode. For the RS485 Modbus-RTU mode, the integer 16-bit Modbus registers can be set: number of registers, corresponding quantities and the order in which the quantities appear.

The string of desired output quantities is established by typing in the desired order, the corresponding alphanumeric characters which appear in menu (= *78012tce* factory default, also for Modbus Registers, inclusive of pressure, temperature and RH additional quantities, if available; (= *78tce* if additional quantities are not included). The string may consist of 12 alphanumeric characters at most that correspond, with the selection of "*5. U-V-W"* or "*E. Errors"*, to 14 quantities or Modbus Registers (in RS485 Modbus-RTU mode).

Modbus-RTU mode:
Since the values of the Modbus registers are expressed as integers, to obtain the decimal value you must refer to the table of the *Decimal digits*. Examples: the Wind Speed vv=2.45 [m/s], in the Modbus register is vv=245 [m/s x 100] (2 decimals in the table). The sound speed vs=34891 [cm/s], in the Modbus register is vs=34891 [cm/s] (0 decimals in the table).

Analog output mode:
The first five quantities in the output data string will be available at the analog outputs, in the order given. For example, setting the output string to st78c59, the last two quantities, i.e. 5 (U,V,W) and 9 (Elevation) are ignored, while the first five quantities will be available at the terminals of Analog Outputs:

Output Quantities	*Symbol*
s (Speed of Sound)	OUTV1
t (Sonic Temperature)	OUTV2
7 (Speed of wind)	OUTV3
8 (Azimuth)	OUTV4
c (Compass)	OUTV5

Note: in the example, an analog *voltage* range has been selected.

The sound speed range for analog output is 0÷400 m/s.

Analog output extended mode (AoXnd):
The quantities in the output data string will be available, in group of four in the order given, at the analog outputs available in each ICP DAS I-7024 ® module used (par. 3.4.1). The number of the ICP DAS I-7024 ® modules used can be maximum three, with a sequential address (**00**, **01**, **02**); each module has 4 analog outputs. The output quantities will be available starting from the module with addressed 00. The output quantities which are exceeding with respect to those on the modules, are ignored. If the string of the output quantities has a number of quantities lower than those available on the modules, it means that the remaining analog channels on the modules are unused. For instance, setting the output string *78012tc*, it is necessary to use two ICP DAS I-7024 ® modules, with address 00 and 01. The first four quantities of the string (Wind Speed, Azimuth, Pressure, Temperature) are available at terminals 0,1,2,3 (current or voltage) of module 00; the remaining three quantities (RH, Sonic Temperature, Compass) are available at terminals 0,1,2 (current or voltage) of module 01.

Additional quantities:
Quantities q0, q1, and q2 are associated with pressure, temperature, and relative humidity, respectively, if sensors are included in the anemometer. If requested when ordering, the quantities q3 and q4 can be associated with two external sensors with 0-1 V analog output signal that can be connected to the anemometer. If pressure, temperature, and relative humidity sensors are not included in the anemometer, all quantities q0, q1, q2, q3, and q4, when ordering, can be associated with external sensors with 0-1 V analog output signal connectable to the anemometer.

Errors:
By typing **E** , three numbers will appear in the output data, corresponding, from left to right, to: error code, previous error code, number of invalid measurements.

Note: the option *Errors* should not be used in Analog Output and AoXnd mode.

The error code consists of two digits:
- The one referring to **tens,** identifies the sonic transducers with possible anomaly. Sonic transducers are grouped in pairs of facing elements. For the first pair, the upper transducer is next to the metallic support which indicates the North; the other pairs follow anticlockwise (see figure on page 8 – Orientation B).

  First pair of transducers: code 1 for lower transducer, 2 for the upper one.
  Second pair of transducers: code 3 for lower transducer, 4 for the upper one.
  Third pair of transducers: code 5 for lower transducer, 6 for the upper one.
  Code 7 is associated with the compass.

- The one referring to **units** highlights the kind of anomaly:

Code	*Anomaly*
0	None (combined with 0 for transducer too)
1	Electrical interruption transducer circuit; transducer broken; path obstruction
2,5,7	Time anomaly or wave amplitude anomaly of ultrasonic pulse
Others	Internal codes

Example: if there is an anomaly in transducer 4, due to a physical obstruction in the measurement volume, which caused the rejection of 2 raw measurements in a measuring cycle, in the Output Data string the set of three numbers **41 0 2** appears (without anomalies would be 0 0 0).

- **Unit of measurement**

Typed Character: **7**
(Wind Units)
Selection of the unit of measurement. The screen page will display:

→→ Wind Units
1. m/s
2. cm/s
3. km/h
4. knots
5. mph
Esc. Exit
Enter. Save
= m/s

From the menu, you select the unit for SoW and consequently for SoS, U-V-W and SUV.
After selecting the desired unit, press **[ENTER]** to enable the new unit of measurement; the unit will be stored permanently (=*m/s* factory default). In Analog Output and AoXnd mode, the only unit of measurement possible is *m/s*.

- **Sonic transducers heating**

Only for versions equipped with the optional heating.

Typed Character: **8**
(Heating)

How to enable the sonic transducer heating circuit. The screen page will display:

Sel: 8
= Y
Enable Heat(y/n):

You can enable (by typing **y** or **Y**) or disable (by typing **n** o **N**) the circuit which controls the sonic transducer heating in severe climatic conditions (=*Y* factory default). Heating prevents ice formation or the deposit of sleet on sonic transducers and activates the dissolution of the deposit of snow/sleet in the sonic transducers, guaranteeing their correct functioning.

- **RS232, RS422, RS485, Modbus-RTU and AoXnd communication mode**

Typed Character: **9**
(COMM Mode)
Selection of serial RS232, RS422, RS485 Modbus-RTU, RS485 Multidrop or AoXnd communication mode. The screen page will display:

→→ COMM Mode

1. RS232
2. RS485
3. RS422
4. AoXnd
5. ModBusRTU
Esc. Exit
Enter. Save

=RS232

By typing **1** , **2** , **3** , **4** , **5** the corresponding mode appears. The RS422 mode of entry **3** refers to models equipped with 4-wire full-duplex RS422 integrated communication circuit (on request). After selection, press **[ENTER]** to permanently store the selected mode, which will

be active from the next anemometer power on (=*RS232* factory default).

If **ModBusRTU** mode is selected, the screen page for the selection of the communication parameters appears:

Mode

1. 8N1
2. 8N2
3. 8E1
4. 8E2
5. 8O1
6. 8O2
Esc. Exit
Enter. Save

= 8E1
Sel:

Select the desired setting and press **[ENTER]** to go back to the previous screen.

The Modbus baud rate remains the one set (option **1** of the setup menu).

Whatever the stored communication mode, you can always set RS232 mode by making a RS232 serial connection and by pressing **?** on the PC keyboard during auto ranging, which takes a few seconds, after the anemometer switch on. At the next restart, the anemometer maintains the communication mode it had when it was turned off.

- **Identicode**

Typed Character: **I**
(ID)
Setting of the anemometer address for RS485 Modbus-RTU or Multidrop mode. The screen page will display:

Sel: I
= 1
Identicode

Type any alphanumeric character, (0,1,2…9,a,b,…z,A,B,…Z) which will identify univocally the anemometer (=*1* Factory Default).

- **Output rate and digital – analog high frequency**

Typed Character: **R**
(Output Rate)
Setting of the digital transmission frequency of output quantities in RS232, RS422, RS485 Multidrop, AoXnd mode, and activation of digital or analog high frequency mode. The screen page will display:

→→ Output Rate

1. Slow
2. Fast
Esc. Exit
= Slow 1 sec

By digiting **1** , the digital frequency under normal operation (Slow) or, by digiting **2** the Digital or Analog High Frequency (Fast), of the Output data string is set.

- By typing **1**
  (Slow)

The following screen page displays:

Sel: R
= 1
[sec] [Range= 1 to 3600]:

You can choose a period in seconds from 1 to 3600, which represents the lapse of time between issuing one Output Data string and the next one. Type the desired period value and then press **[ENTER]**.
Below the *Output Rate* menu*,* the set period appears (=*1* factory default):
= Slow 1 sec

The set frequency is independent of the Internal Refresh of the instrument.

In Multidrop RS485 mode, the subsequent queries of the measures towards the anemometer can have a maximum frequency of request not exceeding the one set one here.

In Extended Analog Output (AoXnd) mode, the frequency here set is that of issuing of the command digital strings on the RS485 serial line, connected to an ICP DAS I-7024 ® module (**supplied on request**), and it coincides with the frequency of updating of the analog outputs available at the terminals of the modules connected.

- By typing **2**
  (Fast)

Digital or Analog High Frequency mode is activated, and on the lower screen side appears:
=Fast Digital

In *Digital High Frequency*, the Output Data string in RS232 or RS422 mode is supplied at a fixed **50 Hz** frequency under the following conditions:

Baud rate bit/s	*Frequency / measurement quantities*
115200	50 Hz / 4

A number of quantities higher than four or baud rates lower than 115200 bit/s, determine emission frequencies of Output data, lower than 50 Hz.
Under Multidrop RS485 mode, the option *Fast* has no effect, because the Digital High Frequency under RS485 is achieved by a command (see par. *H and L commands* on page 27).

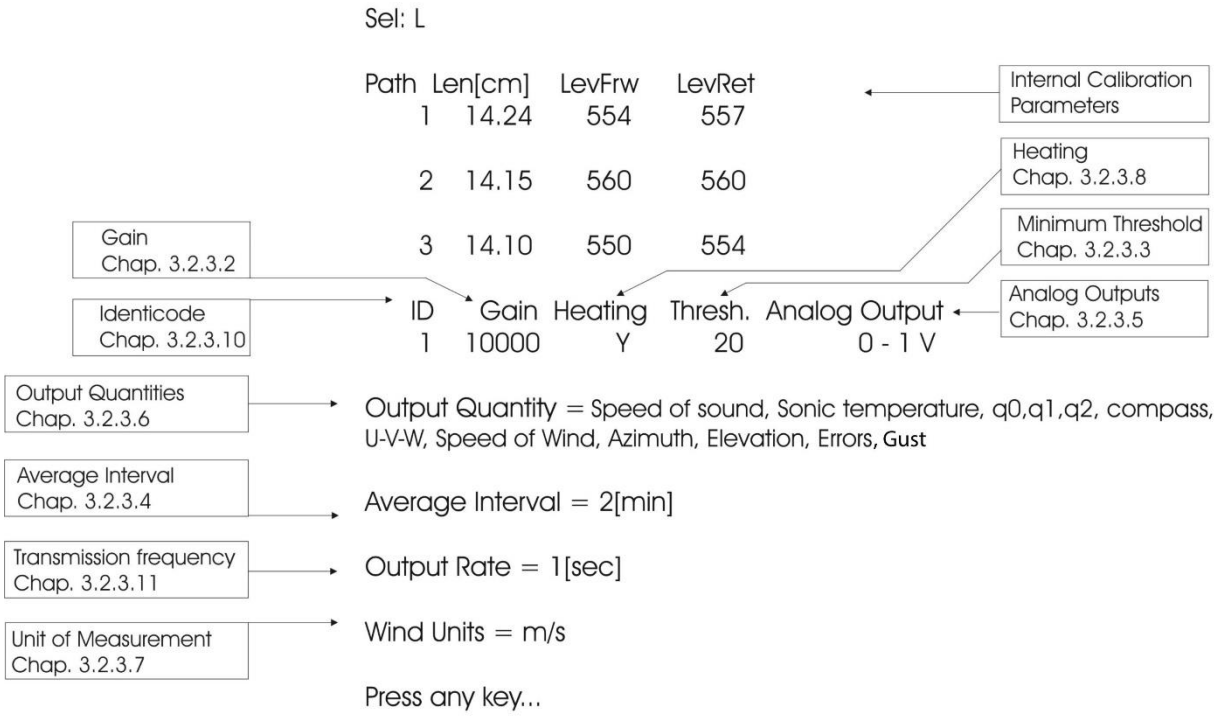
The *Analog High Frequency* is available only in the AoXnd communication mode. It allows obtaining the voltage or current analog output of the measuring quantities under interest, at a frequency from **5 Hz** to **20 Hz** and for a maximum number of requested quantities, according to the baudrate of the command digital strings in the RS485 line:

Baud rate bit/s	*Frequency / measurement quantities*
9600	5Hz / 4
19200	10Hz / 4
38400	10Hz / 10
57600	20Hz / 4
115200	20Hz / 7

The Digital or Analog High Frequency remains active if the instrument is power cycled.

3.1.4 Logging

By typing **L** from the main menu, the following screen page will display:



Here are summarized the values set by the **factory calibration,** as well as the current configuration of the main parameters that can be managed by the user in *Setup*.
Press any key to go back to the main menu.

3.2 Multidrop RS485 and Modbus-RTU RS485 communication mode

3.2.1 RS485 multidrop settings

From the PC, start an *RS485 communication program* able to:

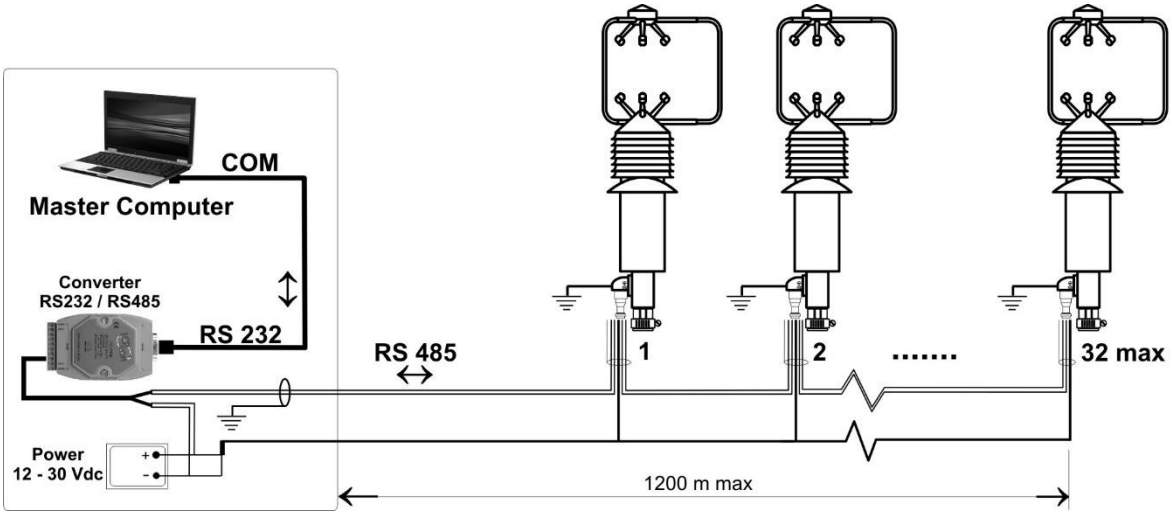
- Transmit to the anemometers the commands of *HD2003 Communication Protocol* (par. 3.2.2).
- Display and record data and menu pages received from the queried anemometers.

The PC must have an RS485 serial interface. Alternatively, use an RS232/RS485 or USB/RS485 converter, to be placed between the PC RS232 or USB port and the network of anemometers. Set the following communication parameters in the *RS485 communication program*:

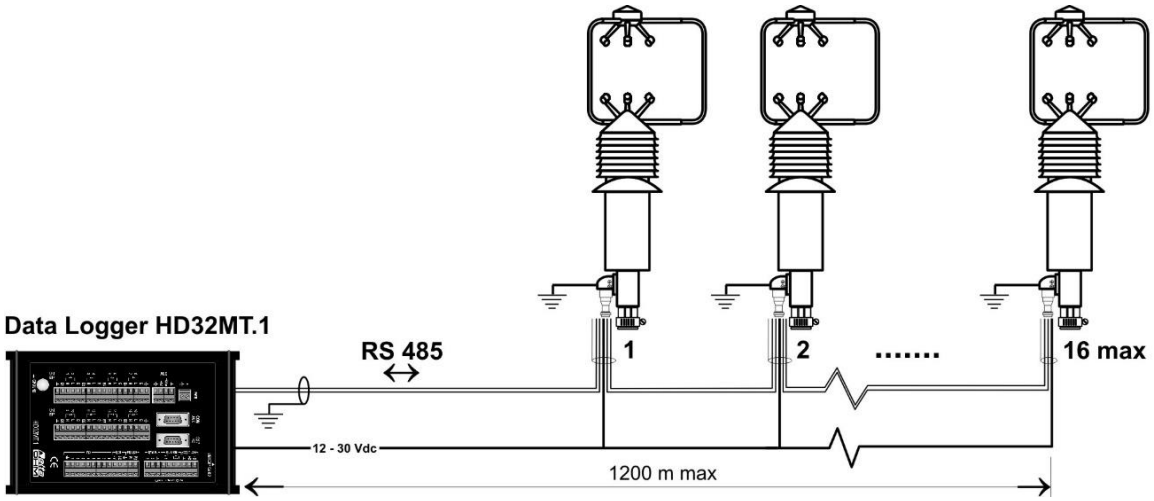
Bit per second	baud rate of the anemometers in the network
Data bit	8
Parity	None
Stop bit	2
Flow Control	None

Before connecting the anemometers in the network, set baud rate and identicode of each one, using the RS232 serial Communication mode. The baud rate must be the same for all the anemometers in the network, while the identicode must be different for each unit in the network.

After connecting the anemometers in the RS485 Multidrop network and supplying power, each anemometer (*Slave*) will operate in *Standby*, executing its normal measurement cycle, waiting for commands from the Computer Host (*Master*).



As an alternative to the Host Computer, it is possible to connect the anemometers (max. 16) to the *HD32MT.1* datalogger, compatible with the *HD2003 Communications Protocol*.



3.2.2 HD2003 communication protocol

The anemometer can receive four types of commands from the *RS485 communication program* of the Computer Host or from the *HD32MT.1* datalogger:

- Output Data Command
- Setup Command
- *Digital High Frequency* Enable/Disable commands (datalogger excluded)

Each command must observe a set protocol:

1. Before sending the *command string*, the *RS485 communication program* must force the serial communication line to the **Break Signal (*)** (*Clearing Mode*) status for at least 2 ms, and then return to the rest condition (*Marking Mode*).
2. Immediately after the Break Signal and return to the rest condition, *the RS485 communication program* must send the command string consisting of 4 ASCII characters:

<C><ID><x><x>

Where:

<C>	*Command Code*	*Description*
	M (ASCII code: 77)	Output Data Command
	S (ASCII code: 83)	Setup Command
	H (ASCII code: 72)	Digital High Frequency Enable Command
	L (ASCII code: 76)	Digital High Frequency Disable Command
<ID>	Identicode of the queried anemometer (character 0,1..9, A…Z, a…z)	
<x>	An indifferent character (Any character)	

In the command string you must then specify the type of command and the Identicode, which identifies univocally the anemometer to which the command refers.

3. Between a command and the next one, a minimum time must elapse, depending on the transmission baud rate:

Baud rate	*ms*
9600	200
19200	100
38400	70
57600	40
115200	25

Only after such time has elapsed, the Computer Host or the *HD32MT.1* datalogger can send a new query to any anemometer of the network, even without having received a response from the queried unit that may possibly be faulty.

(*) Break Signal

The Break Signal suspends the character's transmission on the serial line, setting it to a break status. In this status, the voltage level of the transmission line goes from nominal -12V to +12V. The function which generates the Break Signal is available in program languages or serial communication / terminal emulation programs.

Examples:

The Computer Host requires the addressed unit with Identicode = 1, to provide Output Data, and transmits in sequence:

1. *Break Signal* for at least 2ms
2. Command: *M1tt*

The Computer Host requires the addressed unit with Identicode = T, to enable Digital High Frequency mode, and transmits in sequence:

1. *Break Signal* for at least 2ms
2. Command: *HTgg*

The Computer Host requires the addressed unit with Identicode = G, to manage the Setup, and transmits in sequence:
1. *Break Signal* for at least 2ms
2. Command: *SGaa*

- **S command (setup)**

The *RS485 communication program* after sending the command:

S<ID><x><x>

sets the queried anemometer in Setup and receives the main menu page from it. In substance, the anemometer setup can be managed on the RS485 Multidrop line in the same mode shown for the RS232/RS422 serial communication.

Upon exiting the "Setup", the anemometer returns to Slave in Standby.

- **M command (output data)**

The *RS485 communication program* after sending the command:

M<ID><x><x>

will receive the output data from the queried anemometer.

The output data received correspond to the last measurement carried out by the anemometer, concerning the set average interval. The data refer to the quantities selected in setup.

The data are kept in a package in the following format of ASCII characters:

IIIIM<ID>I&<DATA1><DATA2>….<DATAx><SP>&AAAM<ID>AA<CR>

Where:

I	I character (ASCII code: 73)
M	M character (ASCII code: 77)
<ID>	Identicode of the queried anemometer (only one alphanumeric character)
&	& character (ASCII code: 38)
<DATAx>	8 characters which represent the format of the x-th numeric right justified data with spaces before the sign, numeric digits, decimal point
<SP>	Space
A	A character (ASCII code: 65)
<CR>	Carriage return

Examples:
The Computer Host requires the addressed unit with Identicode = a, to provide Output Data and transmits in sequence:
1. *Break Signal* for at least 2ms
2. Command: *Mann*

It receives Output Data with 6 measurement values from the instrument with Identicode = a:
IIIIMaI& 2.23 -28.34 0.34 28.30 359.3 -1.3 &AAAMaAA<CR>

The Computer Host requires a second unit with Identicode = Z, to provide Output Data and transmits in sequence:
1. *Break Signal* for at least 2ms
2. Command: *MZxx*

It receives the Output Data with 8 measurement values from the instrument with ID=Z:
IIIIMZI& -3.23 -29.17 0.37 29.40 358.4 -1.5 11.13 -1.85 &AAAMZAA<CR>

The Computer Host requires a third unit with Identicode = f, to provide Output Data and transmits in sequence:

1. *Break Signal* for at least 2ms
2. Command: *Mfmm*

It receives the Output Data with 5 measurement values from the instrument with ID=f:
IIIIMfI& -5.23 19.18 -1.54 16.00 -1.06 &AAAMfAA<CR>

- **H and L commands (digital high frequency enabling and disabling)**

The *RS485 communication program* after sending the command:

H<ID><x><x>

sets the addressed anemometer in *Digital High Frequency* mode. Subsequently, the anemometer can be queried through the *command M* (Output Data) at a maximum frequency of **50 Hz**, under the following conditions:

Baud rate bit/s	*Frequency / measurement quantities*
115200	50Hz / 4

The Digital High Frequency remains active if the instrument is switched off and on again.

The *RS485 communication program* after sending the command:

L<ID><x><x>

sets the anemometer in normal output data sending mode, disabling the *Digital High Frequency* mode.

3.2.3 RS485 Modbus-RTU settings

In Modbus-RTU mode, the anemometer sends the measurements only on a specific request from the PC. This mode is available with the RS485 serial connection.

The PC or data logger communication parameters must be set as follows:

Bits per second	same as the *baud rate* set in the instrument (=115200 bydefault)
Data Bits	8
Parity	equal to the one set in the instrument (=None by default)
Stop Bits	equal to the number set in the instrument (=2 by default)
Flow Control	None

The Modbus protocol is Master-Slave type. There is only a Master device in the network, typically the PC or a PLC or a data logger, while the other units are all Slave type. The Master unit can send commands and requests of data to the Slave devices in the network. A slave device communicates only with the Master unit, in response to a request from the latter. The direct communication between two Slave devices is not allowed and a Slave unit cannot send data unless requested.

If the anemometer does not receive the command correctly, it does not send any response to the PC. If the PC does not receive a response within a given time (time-out), it assumes that the recipient has not received the command and may retry the transmission or generate an error message.

The function of the Modbus protocol that can be requested by the PC to the anemometer, with the corresponding code, is shown in the following table:

Function code	*Function*
04h	Reading of measurements

The address of the instrument (*Identicode*) can be set with the alphanumeric character *1,2,…9, A,B,…Z, a,b,…z* (Par. 3.2.3.10); the correspondence with the Modbus address is the following:

Identicode	*Modbus address*
1,2,…9	*1, 2,…9*
A,B,…Z	10, 11,...35
a,b,...z	36, 37,...61

Example: the Identicode *A* corresponds to 10, *B* corresponds to 11, *a* corresponds to 36, *b* corresponds to 37.
The numbers of the Modbus registers depend on the set of registers configured in the anemometer (see par. *Output quantities* on page 18). Example: the output strings *78012tce* and *78tce* correspond to the following numbers of Modbus registers:

Output string	*Nr. ModBus register*
78012tce	1, 2, 3, 4, 5, 6, 7, 8, 9, 10
78tce	1, 2, 3, 4, 5, 6, 7

Note: the selection **e** corresponds to 3 output values and therefore to 3 registers.

In the Master Modbus command, there is the register address, equal to register number minus one.

The Master device sends the measurements reading command *04h*, indicating:

- the address of the anemometer to which the command is sent;
- the address of the register containing the first quantity to be read;
- the number of consecutive quantities to be read.

The instrument replies with the values of the measured quantities, in the required sequence.

A measurement value is stored by the anemometer as an integer value in a 16-bit register, and therefore it always requires two bytes.

For the quantities with configurable unit of measurement, the measurement value is expressed in the unit of measurement set in the anemometer, taking into account the number of decimals expected for that quantity, which affects the integer value in the register.

Example: setting *st78c59G as* output string, with unit of measurement m/s, and writing hypothetical measured values, the correspondence with the Modbus registers is as follows:

Output quantities	*Nr. Modbus register*	*Measured value*	*Nr. of decimals*	*Value in the Modbus register*
s (Speed of Sound)	1	341.3 [m/s]	1	3413
t (Sonic Temperature)	2	27.3 [°C]	1	273
7 (Speed of Wind)	3	2.45 [m/s]	2	245
8 (Azimuth)	4	56.4 [°]	1	564
c (Compass)	5	612 [/10°]	0	612
5 (U-V-W)	6	1.12 [m/s]	2	112
	7	1.34 [m/s]	2	134
	8	0.27 [m/s]	2	27
9 (Elevation)	9	0.7 [°]	1	7
G (Gust)	10	3.85 [m/s]	2	385

To read all the 9 quantities, the register number 1 (address 0) and 9 consecutive quantities will be indicated in the Master command.
Requests for any register can be sent. In the previous example, the master can also request only the three U-V-W components, by writing in the command the register number 6 and 3 consecutive quantities.

3.3 Analog output mode

As described on page 19, all output quantities can be available as analog outputs, choosing different voltage or current ranges (page 17).

Five quantities are available on the anemometer Analog Outputs terminals (OUTVx or OUTmAx). The default association of the analog outputs is the following:

Analog Out	*Quantity – Versions with additional P/T/RH sensors*	*Quantity – Versions without additional sensors*
OUTV1 / OUTmA1	Speed of Wind	Speed of Wind
OUTV2 / OUTmA2	Wind direction (Azimuth)	Wind direction (Azimuth)
OUTV3 / OUTmA3	Pressure	Sonic temperature
OUTV4 / OUTmA4	Temperature	Compass
OUTV5 / OUTmA5	Relative Humidity	Not used

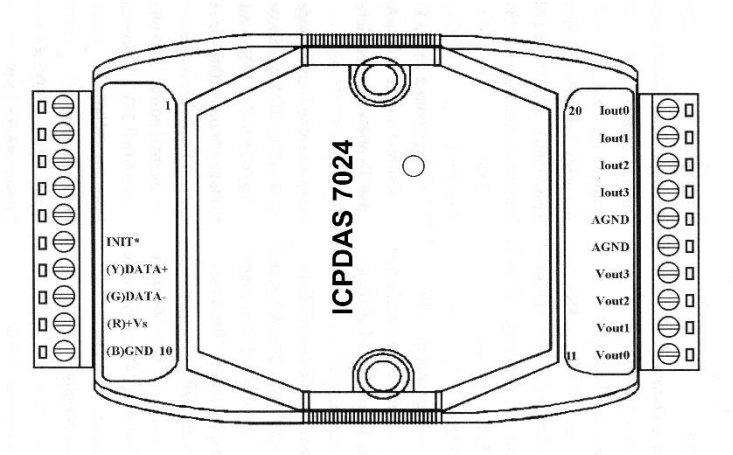
The Analog Output mode is always active together with serial RS232, RS422, RS485 Multidrop and AoXnd communication mode.

3.4 Analog output extended mode (AoXnd)

By using the CP DAS I-7024 ® module (**on request**) with the anemometer in Extended Analog Output mode, 4 additional voltage or current analog outputs are available at the output terminals of the module. Up to 3 ICP DAS I-7024 ® modules can be connected, for a maximum of 12 extended analog outputs. Under this mode, you can have the analog outputs at a considerable distance from the place of installation of the anemometer, up to 1200 m, also in routes where a high electromagnetic interference is present. Analog signals at the output terminals of the module, placed near of the device acquisition (such as the datalogger *HD32MT.1*), are electrically insulated and are not subject to disturbances and electrical interference in the path that do, as in the case of analog signals that come directly from anemometer and walk a long way before reaching acquisition equipment.

3.4.1 ICP DAS I-7024 module setting

Here below reported are the procedures (performed at the factory **on request**) to prepare the ICP DAS I-7024® module, with the correct settings of *baudrate*, *range*, *unit format*, *address*, necessary for the Extended Analog Output operation mode.



Remote interface module ICP DAS I-7024 ®

The module configuration requires a Host computer with RS485 serial interface. Alternatively, use an RS232/RS485 or USB/RS485 converter to be placed between the RS232 or USB port of the host computer and the ICP DAS I-7024 ® module.

1. Connect a 12÷30 Vdc Power Supply to the terminals **(R)+Vs** and **(B)GND**.
2. Connect **DATA+** and **DATA-** terminals to the correspondents of computer RS485 interface.
3. Connect the terminal **INIT*** to the terminal **(B)GND**.

From the Host computer, start a standard serial communication program and set:

Bit per second	9600
Data bit	8
Parity	None
Stop bit	1
Flow Control	None

Send the command: **%01<AA><TT><CC>00 <Enter>**

where:

<AA>	00	01	02
ICP DAS I-7024 ® Modules	first	second	third

<TT>	30	31	32	34
Range	0-20 mA	4-20 mA	0÷10 V	0÷5 V

<CC>	06	07	08	09	0A
Baud rate	9600	19200	38400	57600	115200

Examples:
by choosing a baudrate=19200 and a range=0÷10 V and by using 1 module, the command is:
%0100320700<Enter> Response: *!0000320700*

by choosing a baudrate=115200 and a range=4-20 mA, using 3 modules, the commands are:
%0100310A00<Enter> first module Response: *!0000310A00*
%0101310A00<Enter> second module Response: *!0101310A00*
%0102310A00<Enter> third module Response: *!0202310A00*

Remove the connection referred to in paragraph 3 above.
If the baudrate has been changed, setting it to a different value from *9600* (default module), the settings are operative when the module is re-started.
The module settings for baudrate, range and address (related to the number of modules), must coincide with those of the anemometer.

3.4.2 Anemometer setting

From the Host computer, by the RS232 serial communication, select the quantities to be associated with the extended analog outputs, the updating frequency, the baudrate and the analog range. Select the *Extended Analog Outputs mode* (page 20).

The updating rate of the extended analog outputs can be set by following the instructions on page 21.

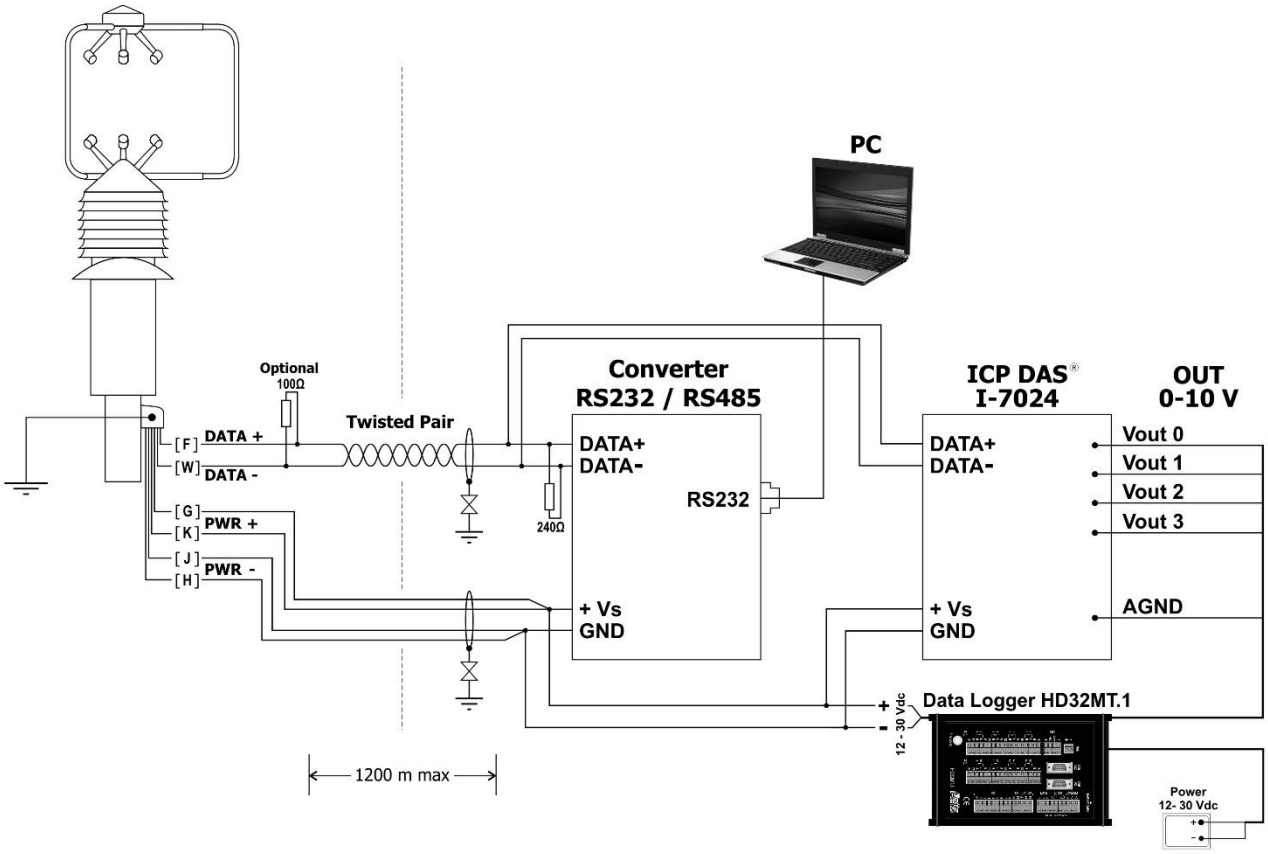
Baudrate, analog range and number of modules (related to the addresses of the modules), must match those set in each ICP DAS I-7024® module (previous paragraph).

Remove the electrical connections of the RS232 communication mode and connect the Anemometer to each ICP DAS I-7024 ® module, by making the electrical connections as described on par. 2.2.1 and 2.2.6.

After powering, the anemometer (*Master*) will operate in measuring mode, sending command strings, with the set frequency, on the RS485 serial line directly connected to each ICP DAS I-7024® remote module (*Slave*).

If the chosen measuring quantities include anemometric quantities, the only speed of wind unit of measurement possible is *m/s*.

3.4.3 Example of analog output extended mode



The Host computer is used only to configure the ICP DAS I-7024 ® modules and the anemometer. The Analog Outputs of the module, converge for storage in the datalogger *HD32MT.1*, placed close to the module. The path of analog signals is very short, so it is not affected by electromagnetic interferences.

4 Maintenance

Wind speed sensors does not generally require maintenance.

In case abnormal measures are detected, verify the cleanliness of the ultrasonic sensors. For cleaning, use a moistened soft cloth. The sensors should be wiped gently: **do not brush or twist the sensors**.

5 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.

6 Safety instructions

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

Do not use the instrument in places where there are:

- Corrosive or flammable gases.
- Direct vibrations or shocks to the instrument.
- High-intensity electromagnetic fields, static electricity.

User obligations

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

- EU directives on workplace safety.
- National law regulations on workplace safety.
- Accident prevention regulations.

7 Accessories ordering codes

The anemometer is supplied with 26-pole female free connector (only if the optional cable is not ordered).

The cable must be ordered separately.

CP2003/... Cable with 26-pole connector on one end, open wires on the other end. Length 5 m (CP2003/5) or 10 m (CP2003/10).

RS2003 Serial connection cable with built-in USB/RS232 converter. USB connector for the PC, 26-pole connector on the instrument side and jack connector for DC power supply.

Attention – The following optional functionalities must be requested when ordering:

- The integrated circuit for RS422 4-wire full duplex communication.
- The extension of the output quantities by using external sensors with 0-1 V analog output, to be connected to the anemometer inputs. Max. 2 external sensors for anemometer versions with integrated P/T/RH additional sensors; Max. 5 external sensors for anemometer versions without integrated additional sensors.

GARANZIA

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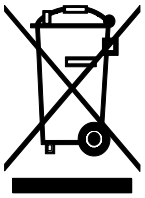
INFORMAZIONI TECNICHE

Il livello qualitativo dei nostri strumenti è il risultato di una continua evoluzione del prodotto. Questo può comportare delle differenze fra quanto riportato nel manuale e lo strumento che avete acquistato.
Ci riserviamo il diritto di modificare senza preavviso specifiche tecniche e dimensioni per adattarle alle esigenze del prodotto.

INFORMAZIONI SULLO SMALTIMENTO



Le apparecchiature elettriche ed elettroniche con apposto specifico simbolo in conformità alla Direttiva 2012/19/UE devono essere smaltite separatamente dai rifiuti domestici. Gli utilizzatori europei hanno la possibilità di consegnarle al Distributore o al Produttore all'atto dell'acquisto di una nuova apparecchiatura elettrica ed elettronica, oppure presso un punto di raccolta RAEE designato dalle autorità locali. Lo smaltimento illecito è punito dalla legge.

Smaltire le apparecchiature elettriche ed elettroniche separandole dai normali rifiuti aiuta a preservare le risorse naturali e consente di riciclare i materiali nel rispetto dell'ambiente senza rischi per la salute delle persone.

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