METAL MATERIAL

COMBINED HUMIDITY TEMPERATURE

AIR PRESSURE

SEAWATER RESISTENT

NO MOVING PARTS

WEATHER SENSOR

The perfect weather sensor

- For industrial use as well as under extreme environmental conditions
- **5+1 parameters in one** and at the same time
  - ▷ Wind direction
  - ▷ Wind speed
  - ▷ Air temperature
  - ▷ Air humidity
  - ▷ Barometric pressure
  - ▷ + Dew point temperature (calculated value)
- With independent, integrated sensors for high accuracies of each individual parameter
- Without movable measuring elements, i. e. no abrasion, low maintenance and very easy to service

Applications

- Land applications under any conditions
- Wind turbines
- Railway line monitoring
- Traffic meteorology
- Weather services and Offices for the Environment
- Chemical and industrial facilities
- Power plants, sewage plants and landfills

Advantages at a glance

- Extreme robust, compact weather sensors in the high-quality, pollutant-resistant housing made of anodized aluminium
- All-purpose for application under extreme environmental conditions, like deserts, the tropics, arctic areas and high mountains
- Variety with integrated heating system for icing free operation all-the-year
- Lamella shelter for accurate measurements of the temperature-humidity sensors
- ASCII data protocol according to NMEA 0183
- Power supply 6...60 V_{DC} with integrated overvoltage protection
- Simple visualization of the measured values via Meteo-LCD indicators
- Storage, evaluation and display of the measured values by means of evaluation software "MeteoWare CS3"
- Simple, space-saving assembly on 50 mm standard pipe

1 Introduction

The sensors of the u[sonic] family are very robust, compact and extremely reliable.

The sensors embody the experience of more than 150 years of development and production of LAMBRECHT wind sensors.

The system acquires the horizontal air flow and processes the measuring data to the meteorological parameters wind speed and wind direction. Furthermore the weather-module of the u[sonic]WS6 acquires the meteorological parameters air temperature, relative humidity and barometric pressure. Based on the measured data u[sonic]WS6 calculates the dew point temperature and provides for its serial output along with the measuring data.

The sensors and further system components are mounted in a splash water- and dust proof metal housing.

The measuring data are automatically transmitted via serial interface RS-485 in talker mode, when power supply is switched on.

Due to their shock- and vibration proof construction the sensor u[sonic]WS6 is particularly qualified for use under severe environmental conditions. The housing is made of anodised seawater resistant aluminium.

An electronically controlled heating device enables the sensor to operate in between the wide range of -40 up to 70 °C.

1.1 Warranty advices

Please note the loss of warranty and non-liability by unauthorised manipulation of the system. You need a written permission of the LAMBRECHT meteo GmbH for changes of system components. These activities must be operated by a qualified technician.

The warranty does not cover:

1. Mechanical damages caused by external impacts (e. g. icefall, rockfall, vandalism).

2. Impacts or damages caused by over-voltages or electromagnetic fields which are beyond the standards and specifications in the technical data.

3. Damages caused by improper handling, e. g. by wrong tools, incorrect installation, incorrect electrical installation (false polarity) etc.

4. Damages which are caused by using the device beyond the specified operation conditions.

Static measuring principle for wind measurements means:

- Determination of data works without moving measuring elements, i.e. none abrasion, least maintenance and none recalibration because of this method.

- The wind parameter can be measured also in winter time accurate and precise, because of the electronic controlled heating for the immovable measuring elements. This heating is particularly effective against ice and snow in all climatic zones.

- The measuring principle allows very low starting valuesand high repeat accuracy.

- The sensor rapidly can be installed. Due to the special measuring principle minor changes from the angle of pitch can be disregarded.

Advantages of the sensor:

- Apart from the sensors for wind speed and direction the compact housing also contains built-in sensors for air temperature, relative humidity and barometric pressure.

- The built-in test function of the station, enabled by the tight integration of the meteorological sensors into the enclosure, can perform cyclic self-testing and notify the user of erroneous data or failure.

- The compact design of this sensor with 5 meteorological parameters is eliminating the traditional cabling and installation work significantly. Distribution boxes, power supply units and other accessories can be reduced to a minimum expense.

2 Setting to work

Wind can be represented by a vector quantity. For a complete description of the wind it is necessary to specify its speed and direction. The two components are subject to spatial and temporal variations; thus, strictly speaking, they are valid only for the site where the measuring instrument is installed. We therefore recommend selecting the place of installation very carefully.

2.1 Installation conditions

2.1.1 Generally

For professional wind measurements according to meteorological standards (e. g. VDI 3786, Part 2) location and height of the wind sensor are important for representative and accurate results. Generally, wind measuring instruments should not measure the specific wind conditions of a limited area, but indicate the typical wind conditions of a wider area. To obtain results which are representive for a wider area and comparable to values measured at different places, the sensor must not be mounted under the lee of higher obstacles. The distance to any obstacle should be at least 10 times the obstacle's height (corresponding to the definition of an undisturbed area). In general a measuring height of 10 m above ground is regarded ideal.

If an undisturbed terrain of this kind does not exist the sensor have to be put up at an height of at least 6 m above the obstacle height.

If the above mentioned requirements are not feasible e. g. on mobile measurements at vehicles or at measuring containers compromises have to be found and documented.

If the sensor must be installed on a roof top the place of installation must be in the middle of the roof to avoid predominant wind directions.

The place of installation should <u>not</u> be in the operation fields of radar devices (radar scanners or radar transmitters), generators or antennas. We recommend a minimum distance of 2 m to these installations. Furthermore a minimum distance of 5 m to MF-/ HF- and Satcom- (e. g. Inmatsat, VSat) antennas has to be kept. The maximum electric field intensity may not exceed 10 V/m (tested according to EMC standard). When indicated a greater distance should be kept.

To avoid possible measurement errors due to heat sources as hot or warm fumes, hot surfaces etc. next to the sensor, the mounting site should be chosen accordingly.

2.2 Tools and installation aids

There are no special tools or materials required for the installation works. All work can be carried out with commercially available tools such as screwdrivers and in-hex wrenches.

2.3 Unpacking the sensor

The sensor is packed in a separate box, carefully protected against mechanical influences during transport.

Please verify that the following parts and documents are enclosed:

· 1 sensor u[sonic]WS6

· 1 operating manual

Accessories: (depend on order size, in all cases separately packed)

Connecting cable with plug and core cable ends

2.4 Goods inspection

Please thoroughly check the delivery with regard to completeness and eventual transport damages. In case of eventual claims please contact us in writing immediately.

2.5 Power supply

The u[sonic]WS6 has a supply voltage range of 6...60 V_{DC}. The sensor heater is supplied with 24 V_{DC} and can be factory configured to 60 W, 120 W or 240 W. 240 W assuming the default setting.

2.6 Installation procedure (short instruction)

The installation of the sensor involves 3 steps:

(1) Mounting the cable at the sensor and if necessary draw the cable through the mast.

(2) Mounting the sensor at the mast, but before tightening the screws you must align the sensor to the north.

(3) Attaching the cable to the power supply and the signal acquisition system.

2.7 Mounting

The sensor can be installed on a standard pipe with an outer diameter of 50 mm and an inner diameter of maximum 40 mm. Before tightening the two M8x12 grub screws and attaching the sensor you have to draw the cable through the pipe and align the sensor into driving direction.

For this purpose the housing is marked accordingly (see drawing). Before the screws of the sensor are tightened, the sensor is adjusted to north. Please pay attention to a firm mounting of the sensor at the mast!

Use only the supplied fixing screws and do not tighten the north screw tightly. Please pay attention to a firm mounting of the sensor at the mast!

2.7.1 North alignment of wind sensor

For wind direction measurements the north mark on the sensor must be aligned with the geographical north direction.

To adjust the wind sensor in a firm and correct manner into the north direction this item is equipped with an integrated mounting aid. Inside the inner bottom of the sensor a small bolt pointing to the north is integrated to be set into a corresponding slot of the mounting pipe (if available). Thus the sensor is safely attached. If needed you can turn in or unscrew the pin by means of in-hex wrenche.

To set up the sensor's north orientation select a landmark which is as far as possible up north with regard to the final position of the wind direction sensor.

The reference point can be selected using a topographical map (1:25000). The exact position of the reference point is determined using an amplitude compass that can be adjusted horizontally on a stand.

Compass declination has to be considered!

To align the sensor ahead (on ships) locate a point outside the ship in the landscape which is located in the ship ahead direction respectively in the centre line or in case of the sensor is mounted far away from the middle line a line parallel to the centre line.

Once the sensor is adjusted, it can be fixed with the two grup screws. Finally the earth screw has to be connected to the ship's ground. Acid-free contact grease is recommended to protect contact surfaces against corrosion.

Note: Follow all safety instructions while setting up the sensor onto a mast.

2.7.2   Power and signal connection

The u[sonic]WS6 sensor requires a 8-pole M16 plug connector. The cable shield should be connected with both ends at the ground wire (PE).

To reduce the risk of inductive interference the sensor must be properly grounded (screening on both sides).

The external connection is via central connector which is located in housing base. For further details about electrical connection please see chapter „Connecting diagrams".

If the sensor is mounted in correct manner and connected with the right cable (accessory), you can attach the wires to power supply and signal outputs to data acquisition equipment (computer).

The typical power supply requirements of the u[sonic]WS6 sensor are 24 Volts with a maximum current drain of 50 mA. The input range is max. 6... 60 V_{DC}. The heating of the u[sonic] WS6 is supplied with 24 V_{DC}. When the heating is activated, the current consumption increases to a maximum of 10 A.

The serial digital output of the sensor uses differential line drivers with high common mode noise rejection. The signal levels and timings conform to the requirements of EIA/RS-485 / Talker. The line drivers are capable of transmitting data over cable lengths up to 1,220 meters (4,000 feet). This maximum distance will vary depending upon the ope-rational environment, the wire gauge used, and the baud- rate of the attached devices.

When the power supply of the sensor is switched on, after 5 seconds the sensor cyclically starts sending data protocols.

2.7.3   Safety regulations

Because the wind sensor often is mounted on exposed locations in dangerous heights the installation personnel has to pay attention to the relevant safety regulations for such works. During the electrical installation and termination works the external circuit-breaker must be switched off. - It is not permitted to open those housings by unauthorized persons!

3   Maintenance

3.1   Regular maintenance and calibration

The sensor u[sonic]WS6 is service reduced and designed for a very long lifetime. Recommended is a regular visual check regarding dirt of surface caused by the weather and if so, to clean up.

If reference measurements should be necessary stringently must be noted that a comparability of the measured values is given only if the measurements take place under same conditions. I.e. the reference equipment must be used very close to the sensor!

The sensor is a measuring instrument and thus apply user specific standards regarding period of recalibration.

Recommendation: 2 years.

We recommend to have the filter cap of the humidity-temperature sensor every two years exchanged in our plant. Depending on the application shorter maintenance cycles could be necessary.

3.2   Visual check and cleaning

The use of the sensor under the respective environmental conditions requires certain steps. It is thus recommendable to clean the outside of the housing and shelter within specific intervals. The intervals are dependant on the environmental conditions and the degree of soiling. We recommend a regular sight and functional check.

In case you should be faced with any specific problems please contact the LAMBRECHT meteo service under:
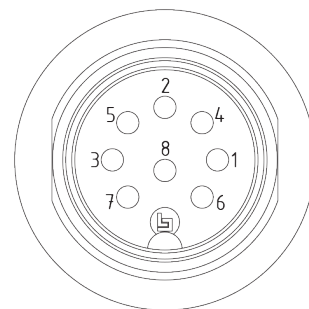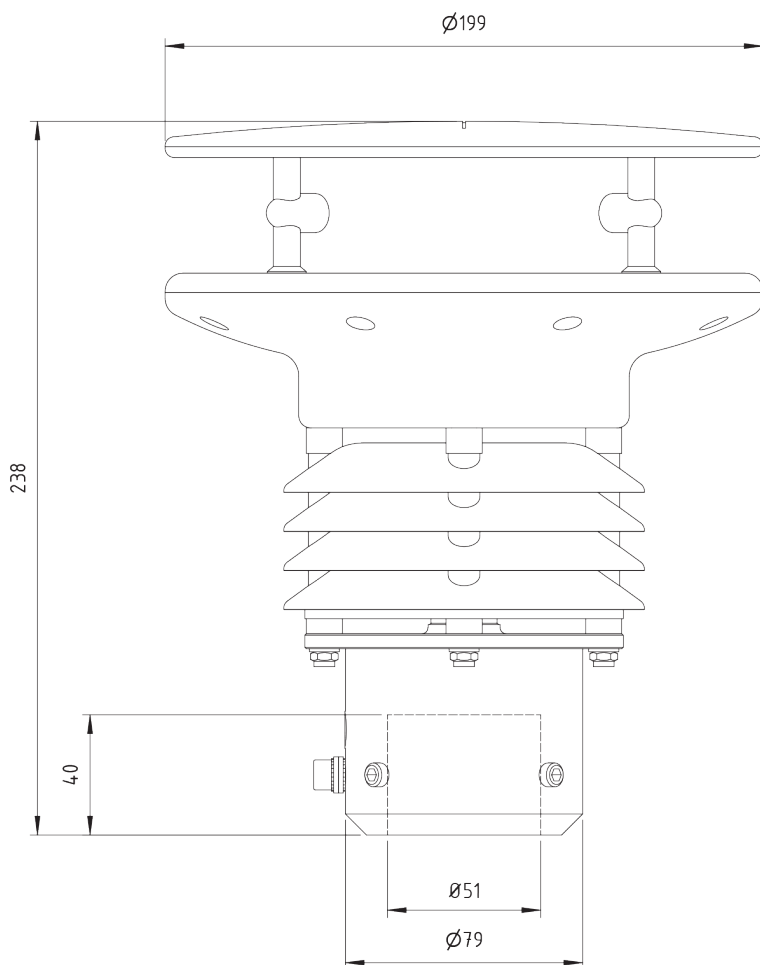
Tel.:   +49-(0)551-4958-0

Fax: +49-(0)551-4958-327

E-Mail: support@lambrecht.net

4   Transports

In case it is necessary to ship or to transport the sensor must be carefully packed to prevent damages during transport.

5 Dimensional drawings and electrical connections u[sonic]WS6

Ø199

238

40

Ø51

Ø79

2
5   4
3   8   1
7   6

Ansicht Steckerseite
view male side

Stecker Pinbelegung			
Pin	Pinbelegung RS 485	Pinbelegung SDI-12	Kabelfarbe 32.16470.060000
1	n.c.	n.c.	schwarz
2	Data –	SDI-12 Data	braun
3	Configuration	Configuration	rot
4	n.c.	n.c.	orange
5	Data +	SDI-12 GND	gelb
6	n.c.	n.c.	grün
7	24V AC/DC nominal	24V AC/DC nominal	blau
8	24V AC/DC nominal	24V AC/DC nominal	lila

Male side pin assignment			
Pin	Pin assignment RS 485	Pin assignment SDI-12	Cable color 32.16470.060000
1	n.c.	n.c.	black
2	Data –	SDI-12 Data	brown
3	Configuration	Configuration	red
4	n.c.	n.c.	orange
5	Data +	SDI-12 GND	yellow
6	n.c.	n.c.	green
7	24V AC/DC nominal	24V AC/DC nominal	blue
8	24V AC/DC nominal	24V AC/DC nominal	violet

6 Data protocols u[sonic]WS6

Wind direction and wind speed

Example of data sequence with comma separated fields: $WIMWV,357.0,R,5.2,M,A*CS<CR><LF>

field delimiter: , (comma)

header: $WIMWV

wind direction: 0.0...360.0

R: relative wind direction

wind speed: 0.1...85.0

M metric units m/s

status A (valid) / V (not valid)

stop delimiters: <CR><LF>

error code: WD 999.9

error code: WS 999.9

Message string WIMTA air temperature

Example of data sequence with comma separated fields: $WIMTA,-25.0,C*CS<CR><LF>

field delimiter: , (comma)

header: $WIMTA

temperature: -40.0...+70.0

C: °C

stop limiters: <CR><LF>

error code: 999.9

Message string WIMHU relative humidity

Example of data sequence with comma separated fields: $WIMHU,100.0,,-40.0,C*CS<CR><LF>

field delimiter: , (comma)

header: $WIMHU

rel. humidity: 000.0...100.0

dew point temp.: -40.0...+70.0

C: °C

stop limiters: <CR><LF>

error code: 999.9

Message string WIMMB barometric pressure

Example of data sequence with comma separated fields: $WIMMB,,,1050.0,B*CS<CR><LF>

field delimiter: , (comma)

header: $WIMMB

barometric pressure: 600.0...1100.0

B: air pressure in hPa

stop limiters: <CR><LF>

error code: 9999.9

Important! Please note:

Field length

The development of a NMEA decoder should not be proceeded from firm field lengths. The NMEA definition proceeds from a variable field length. The comma character (",") serves as field disconnecting switch. Numeric values in a field can be presented differently. In case a field is not sent, it has a length of 0 characters (,,) [comma-comma].

Check sum

The check sum "CS" is covered to two ASCII characters hexadecimal value. "CS" calculated by XOR operation of each character in the sentence between "$" and "*", but excluding "$" and "*".

Error code

In case, that the sensor cannot generate a measuring value because e.g. a sensor element is defect or implausible (raw) values are collected the sensor outputs in the corresponding data protocol the above mentioned error code (e.g. 999.9) and sets the status from "A" (valid) to "V" (not valid).

Example: $WIMWV,999.9,R,999.9,M,V*37<CR><LF>

Particular characteristics wind direction value

Theoretically the value for the wind direction can take any value between 0.0° and 360.0°. It should be noted, that in a full circle the values "0.0" and "360.0" are describing the same direction. According to the international valid recommendations of the WMO (World Meteorological Organization) in the "Guide to Meteorological Instruments and Methods of Observation" (WMO-No.8) the wind direction value 0.0° just has to be output at calm. The u[sonic]WS6 follows the recommendation of the WMO and outputs at wind from the north the value "360.0" respectively "0.0" at calm (lull).

7 Modbus data protocols u[sonic]WS7

Note: Modbus must be configured in default.

This manual covers the general Modbus specification common to all Modbus sensors from LAMBRECHT meteo. The manual allows easy operation of all LAMBRECHT meteo Modbus sensors. Some sensors of the Modbus family offer additional registers and functions, which are described in separate documents via the registers and functions described here. The registers and functions described in this manual are sufficient for general operation of Modbus sensors in a weather station or PLC.

7.1 Modbus-protocols

The Lambrecht meteo Modbus sensors and the met[LOG] follow the specification of the Modbus organization: "MODBUS APPLICATION PROTOCOL SPECIFICATION V1.1b3".

(See www.modbus.org).

7.2 Data encoding

MODBUS uses the "big-endian" format for addresses and data. This means that if a value is transmitted with a number format that is larger than a single byte, the "most significant byte" is sent first. For values that go beyond one register (e.g. 32 bit) this is not clearly specified for the Modbus. In these cases (32 bit or 64 bit) the LAMBRECHT Modbus sensors follow the big-endian number format.

Example Big-Endian:

Register size value

16 - bits 0x1234 is transmitted in the order: 0x12 0x34.

Example big-endian (32 bit or 64 bit):

Register size value

32 - bits 0x12345678 is transmitted in the order: 0x12 0x34 0x56 0x78.

7.3 Device-adress

The addresses 1...247 are permitted for Modbus.

7.4 Standard configuration - default

Baud rate: 19200 Baud
Address: Each sensor type (or family) has its own default address.
Default addresses of the LAMBRECHT sensors:

Adress	Sebsor
5	EOLOS IND / u[sonic]WS6

Byte frame according to MODBUS standard for RTU mode:
8E1 (1 start bit, 8 data bits, 1 parity bit (even parity), 1 stop bit)

7.5 Modbus command set

The LAMBRECHT Modbus sensors support the following commands:
- • Read Input Register" command: 0x04 (measured data)
- • Write Multiple Register" command: 0x10 (Write sensor data)

7.6 Measured value and parameter register LAMBRECHT sensors

The register ranges 30001 to 35000 are intended for measured values.

The following measured values are provided by LAMBRECHT meteo sensors.

Register adress	Parameter name	Unit	Factor	Description	
30001	Wind speed instantaneous value	m/s	10	1 decimal place	INT
30201	Wind direction instantaneous value	°	10	1 decimal place	INT
30401	Air temperature instantaneous value	°C	10	1 decimal place	INT
30601	Humidity instantaneous value	%r.h.	10	1 decimal place	INT
30701	Dew point instantaneous value	°C	10	1 decimal place	INT
30801	Air pressure instantaneous value	hPa	10	1 decimal place	INT

The registers Addresses 30001 to 35000 apply to all LAMBRECHT meteo Modbus sensors, but are only available or valid if the respective sensor supports the corresponding values. (e.g. a pure wind sensor does not provide any air humidity).

The LAMBRECHT sensors give 0xD8F1 (0xFF676981) as error code or invalid value.

7.7 Holding register

Register address 40001 to 49000

Register address 40001 to 46000 contains the configuration parameters of the sensor.

Registers Address 46001-49000 contain for each sensor the available registers with measured values and sensor data from the range 30001-35000.

7.8 Sensor parameters / configuration-parameters

Register adress	Parameter name	Unit	Factor	Description	
40001	Modbus device address		1	The addresses 1...247 are allowed.	
40200	Baud rate		0,01	96=9600 192=19200 384=38400	
46000	Number of mapping-registers		1	Contains the number of occupied mapping registers for the autoconfiguration	INT

7.9 Mapping-Register for autoconfiguration

Registers Address 46001-49000 containing for each sensor the available registers with measured values and sensor data from the range 30001-35000.

The registers can only be read out as a block! The length of the block or the number of available mapping registers is in holding register 46000

For example, in the Modbus Pro WG, registers 46001 to 46004 contain valid addresses. The holding register 46000 contains the number of registers 4, all 4 registers must be read out in the block with the instruction 0x04. Too many registers or too few lead to an error message.

7.10 Autoconfiguration

Note: Detailed description of the autoconfiguration, see "General Manual for LAMBRECHT meteo Modbus Sensors".

8 Technical data

(16480) Weather Sensor u[sonic]WS6

Id-No. 00.16480.000000

Range of application:-40...+70 °C (heated: -50...+70 °C) •
0...100 % r. h.

Parameters:

Wind direction
Meas. principle:	ultrasonic
Measuring range:	0...359.9°
Accuracy:	< 2° (>1 m/s) RMSE
Resolution:	0.1°

Wind speed
Meas. principle:	ultrasonic
Measuring range:	0...65 m/s
Accuracy:	± 0.2 m/s RMSE(v < 10 m/s) •
	± 2 % RMSE(10 m/s < v < 65 m/s)
Resolution:	0.1 m/s

Temperature
Meas. principle:	digital temperature sensor
Measuring range:	-40...+70 °C
Accuracy:	± 0.1 K (0...60 °C) [1] •
	± 0.2 K (-40...0 °C) [1]
Resolution:	0.1 °C

Relative humidity
Meas. principle:	capacitive, digital
Measuring range:	0...100 % r. h.
Accuracy:	± 1.5 % (0...80 %) r. h. [2][3]
	± 2 % (>80 %) r. h.
Resolution:	0.1 % r. h.

Barometric pressure
Meas. principle:	piezoresistive
Measuring range:	300...1100 mbar
Accuracy:	± 0.5 mbar
Resolution:	0.1 mbar

Dew point temperature
Meas. principle:	passive • calculated from air temperature and humidity
Measuring range:	-40...+70 °C
Resolution:	0.1 °C

Trigger threshold:	0.1 m/s
Interface:	RS 485 / 422 • SDI-12 (optional)
Protocols:	NMEA 0183 (default) • MODBUS and SDI-12 (optional)
Measuring rate:	0.1...10 Hz
Supply voltage:	6...60 V_{DC} heating: 24 $V_{AC/DC}$ ± 20 %
Current Consumption:	Sensor: typ. 50 mA at 24 V_{DC} with heating: max. 10 A at 24 $V_{AC/DC}$
Heating data:	factory configurable: 60 W / 120 W / 240 W (standard)
Dimensions:	H 238 mm • Ø 199 mm • mast adapter Ø 50 mm for mounting on standard pipe
Housing:	seewater resistent aluminium IP 66, IP 67
Weight:	Approx. 3.1 kg

Standards

- NMEA 0183
- Standard of construction: VDE 0100
- Low voltage guide line: 72/23 EWG
- EMC/ EMI: DIN EN 60945 and DIN EN 61000-4-2, 3, 4, 6, 11
- Salt fog: EN 60945
- Protection class: DIN EN 60529

Accessories: *(please order separately)*

32.16420.066100	Sensor cable, 15 m, 8 pole M16 plug

Options: *(please order separately)*

36.09340.000000	Visualization and evaluation software MeteoWare-CS3
00.95800.010000	Data logger met[LOG]
00.14742.401002	Display unit METEO-LCD/IND

[1] Temperature influence of the shelter: accuracy +1.5 °C at v < 2 m/s and intensive solar radiation
[2] Temperature influence of the shelter: ± < 0.1 % r.h. at +10…+40 °C
[3] Shelter inaccuracy: < 4 % r.h. dependant on v > 2 m/s and solar radiation