u[sonic]

Precision Meets Design

The ultrasonic wind sensor **u[sonic]** was specially designed for extreme environmental conditions. The sensor is without moving measuring elements and for very high wind speeds.

The extreme robust, compact sensor has a high-quality, pollutant-resistant housing made of hard anodized aluminium and stainless steel.

Applications

- ✓ under icing conditions
- ✓ onshore and offshore applications
- ✓ wind turbines
- ✓ railway line monitoring
- ✓ traffic meteorology
- ✓ chemical and industrial facilities
- ✓ power plants, sewage plants and landfills

Advantages at a Glance

- 3 parameter in one instrument:
  - ► wind direction
  - ► wind speed
  - ► virtual temperature
- without movable measuring elements
- no abrasion, low maintenance
- standard RS 485 interface with ESD protection
- ASCII data protocol according to NMEA 0183
- power supply (without heating) 6...60 VDC or 12...42 VAC
- power supply (with heating) 24 V AC/DC ± 20 %
- simple, space-saving assembly on 50 mm standard pipe
- analogue output 0...20 mA · 4...20 mA · 0...5 V or 0...10 V for wind speed and wind direction
- heating power 60 W/120 W/240 W (standard)

1 Introduction

The wind sensor u[sonic] is very robust, compact and extremely reliable. When developing this sensor particular consideration has been given to highest quality for fulfilment of meteorological requirements.

The system acquires the horizontal air flow and processes the measuring data to the meteorological parameters wind speed and wind direction.

The sensor is mounted in a splash water- and dust proof metal housing (IP66 and IP67) and can be immersed temporarily.

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] is particularly qualified for use under severe environmental conditions. The housing is made of anodised seawater resistant aluminium and stainless steel.

An electronically controlled heating device enables the sensor to operate in between the wide range of -40 up to 70 °C (+85 °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.

1.2 Advantages of the static measuring principle

The sensor u[sonic] is a modern system to carry out precise and reliable measurements under hardest application and environmental conditions. The wind measurements take place according to the principle “ultrasonic run-time measurement”, i. e. static, without moving parts.

Static measuring principle for wind measurements means:

- Determination of data works without moving measuring elements, i.e. none abrasion and least maintenance.
- 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 enables very low threshold values, distance- and attenuation constants as well as a very high repetition accuracy.

Advantages of the sensor:

- 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 the sensor u[sonic] with 3 meteorological parameters is eliminating the installation work significantly.

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 location and height of the wind sensor are important for accurate, correct results and representative wind conditions. Ideally, the sensor should be installed in 10 m above the ground on a mast. This may be buildings, trees, tall towers, lifting cranes, moving vehicles, aircrafts, helicopters and other obstructions. In case of mobile measurements at vehicles often above mentioned conditions are not practicable. Then you have to find compromises.

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. The values measured at different places must be comparable. Thus, when installing the sensor you should make sure the place of installation is not under the lee of great obstacles. The distance between the obstacles and the sensor should be 10 times the height of the obstacles (this corresponds to the definition of an undisturbed terrain).

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

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. If you want to measure both wind direction and wind speed, the sensors should be avoided. The sensor u[sonic] easily meets this requirement.

The place of installation should not 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.

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 standard tools, e.g. Allen key size 4.

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]

· 1 operating manual

Accessories: (depend on order size, 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 sensor requires at the input connector a 6...60 VDC or 12...42 VAC nominal power source for operation. For heating mode a 24 V AC/DC power supply is needed.

2.5.1 Power input

The power input of the u[sonic] is around approx. 25 mA at 24 VDC. The following table shows the maximum power input according to configured heating power.

Heating power	max. power input at 24 VDC
60 W	2.5 A
120 W	5 A
240 W (standard)	10 A

Heating power is configured to 240 W as a standard. Other values to be configured at works on request.

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 8 mm-socket 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!

In addition the sensor has a pin for the north direction. You can put this pin into the nick at the mast (if available). If needed you can turn in or unscrew the pin by means of allen key.

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 allen key.

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

To reduce the risk of inductive interference a properly grounding of the sensor is recommended.

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] sensors are 24 VDC with a typical current drain of 35 mA. The input range is 6...60 VDC or 12...42 VAC. The heater of the u[sonic] has to be supplied with 24 V AC/DC. In standard configuration the heating power is 240 W with a current drain of 10 A at 24 VDC.

The signal output of the sensors is conform to the requirements of RS422 standard in talker mode. 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 on the quality of the used cables.

When the power supply of the sensor is switched on, after 2 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] 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.

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 within specific intervals. The intervals are dependant on the environmental conditions and the degree of soiling. We recommend a regular sight check.

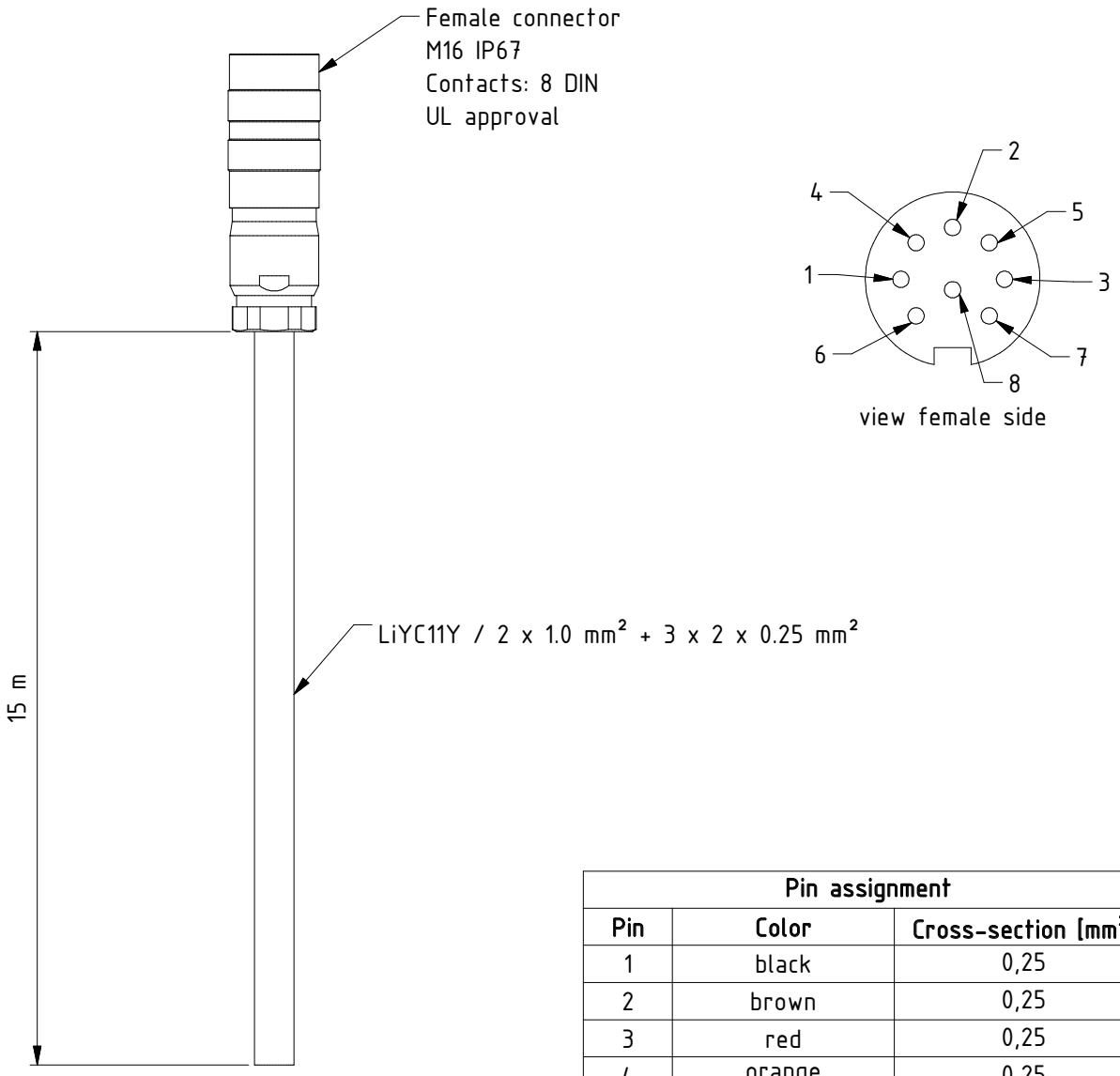
In case you should be faced with any specific problems please contact the LAMBRECHT service under:

Tel.: +49-(0)551-4958-0
Fax: +49-(0)551-4958-327
E-Mail: support@lambrecht.net

4 Transports

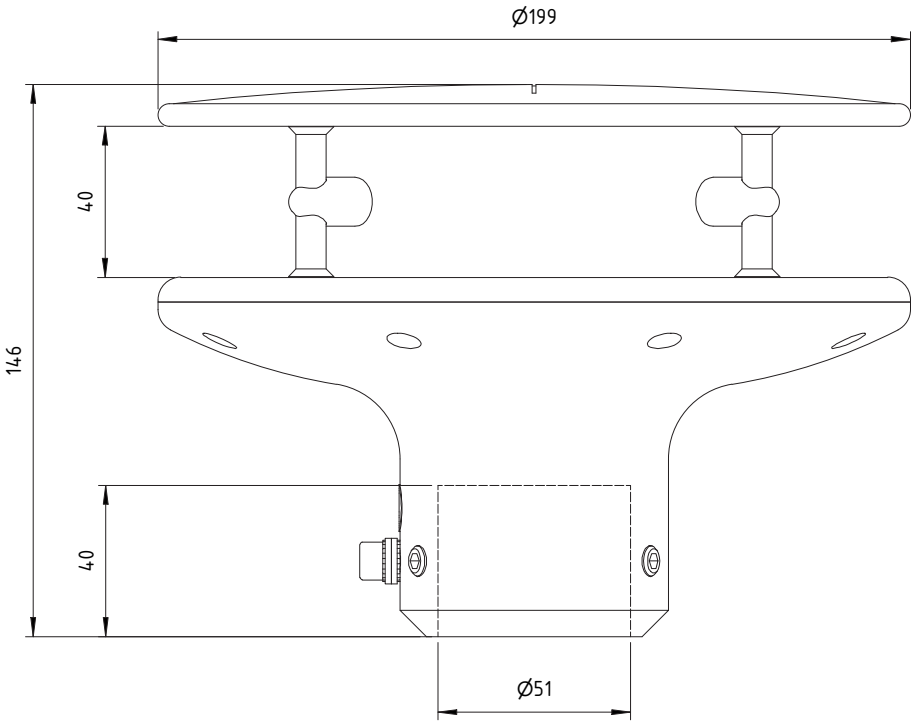
In case it is necessary to ship or to transport the sensor must be carefully packed to prevent damages during transport.

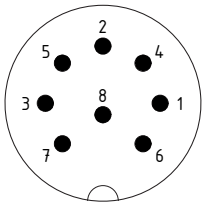
5 Plug connection u[sonic]



Pin assignment		
Pin	Color	Cross-section [mm²]
1	black	0,25
2	brown	0,25
3	red	0,25
4	orange	0,25
5	yellow	0,25
6	green	0,25
7	blue	1
8	violet	1

6 Dimensional drawing and electrical connection u[sonic]





Ansicht Steckerseite
view male side

00.16470.100000			
Pin	Pin assignment RS 485	Pin assignment RS 422	Cable color 32.16470.060000
1	Wind speed (analog)	Rx-	black
2	Data-	Tx-	brown
3	Configuration	Configuration	red
4	Wind direction (analog)	Rx+	orange
5	Data+	Tx+	yellow
6	AGND	AGND	green
7	24 V AC / DC nominal	24 V AC / DC nominal	blue
8	24 V AC / DC nominal	24 V AC / DC nominal	violet

7 NMEA data protocols u[sonic]

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

Remark:

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 represented differently.

In case a field is not sent, it has a length of 0 characters (,,).

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

<CR>...carriage return (hex0D), <LF>... linefeed (hex 0A)

Further protocols available on request!

8 Modbus data protocols u[sonic]

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.

8.1 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).

8.2 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.

8.3 Device-adress

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

8.4 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
9	u[sonic]

Byte frame according to MODBUS standard for RTU mode:

8E1 (1 start bit, 8 data bits, 1 parity bit (even parity), 1 stop bit)

8.5 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)

8.6 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

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.

8.7 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.

8.8 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

8.9 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.

8.10 Autoconfiguration

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

9 Technical Data

(16470) Combined Ultrasonic Wind sensor u[sonic]
Id-No. 00.16470.100000

Measurement range:	wind direction: 0...359.9° • wind speed: 0...65 m/s
Strongest wind impact velocity:	100 m/s
Accuracy:	wind direction: < 2° (> 1 m/s) RMSE • wind speed: ± 0.2 m/s RMSE (v < 10 m/s) • ± 2 % RMSE (10 m/s < v < 65 m/s)
Resolution:	wind direction: 0.1° • wind speed: 0.1 m/s
Response threshold:	0.1 m/s (adjustable for wind direction)
Output:	RS 485 • analogue: 4...20 mA (0...65 m/s · other scalings on request)
Outputs on request:	RS 422 • SDI-12 • analogue: 0...20 mA · 0...5 V · 0...10 V
Protocols:	NMEA 0183 • WIMWV • WIMTA
Protocols on request:	SDI-12 • Modbus RTU
Measuring rate:	0.1...10 Hz • (internal measurement 50 Hz)
Operating conditions:	-40...+70 °C (with heating -50...+70 °C) • 0...100 % r. h.
Supply voltage:	without heating: 6...60 VDC or 12...42 VAC with heating: 24 V AC/DC ± 20 %
Current consumption:	sensor: typ. 45 mA at 24 VDC and deactivated analog output • heater max. 13 A at 24 V AC/DC
Measuring principle:	Ultrasound
Heating data:	configurable (factory-setting): 60 W / 120 W / 240 W (standard)
Dimensions:	Ø 199 mm • height 149 mm
Housing:	seawater resistant aluminium • IP 66 · IP 67
Weight:	approx. 2 kg

Standards

- NMEA 0183
- VDE 0100
- Low voltage guide line: 72/23 EWG
- EMC/ EMI:
  DIN EN 60945 and DIN EN 61000-4-2, -3, -4, -5, -6, -11
- Protection class: DIN EN 60529

Accessories: *(please order separately)*

Sensor Cable, 15 m, 8-pole bayonet plug
Id.-No. 32.16470.060000

Options:

(95800) met[LOG] Serial Data Logger
Id.-No. 00.95800.010000

For integration of u[sonic] into the house-internal network (LAN), incl. web browser

as well as
Indicator unit: (14742) Meteo-LCD
Data logger: (95665) SYNMET-LOG
Mast and power supply unit

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