USER MANUAL

# u[sonic]

## Ultrasonic Wind Sensor

00.16470.100000 (with heating)
00.16470.100001 (without heating)

aem | LAMBRECHT meteo

# Contents


| | | |
|---|---|---|
| 1 | u[sonic] - Key benefits at a glance | 3 |
| 2 | Warranty | 3 |
| 3 | Introduction | 3 |
| 4 | Start-up | 4 |
| 4.1 | Installation conditions | 4 |
| 4.1.1 | General | 4 |
| 4.2 | Tools and installation material | 5 |
| 4.3 | Unpacking the sensor | 5 |
| 4.4 | Incoming inspection | 5 |
| 4.5 | Energy supply | 6 |
| 4.5.1 | Current consumption | 6 |
| 4.6 | Installation work (short description) | 6 |
| 4.7 | Mounting the sensor | 6 |
| 4.7.1 | Sensor northing | 6 |
| 4.7.2 | Power supply and signal cables | 7 |
| 4.7.3 | Safety regulations | 7 |
| 4.7.4 | Heating control | 8 |
| 4.7.5 | Download of updates | 8 |
| 5 | Maintenance | 9 |
| 5.1 | Regular maintenance and calibrations | 9 |
| 5.2 | Visual inspections and cleaning | 9 |
| 6 | Transports | 9 |
| 7 | Disposal | 9 |
| 8 | Pin assignment | 10 |
| 9 | Dimensional drawing and side view male connector | 11 |
| 10 | Wiring diagrams | 12 |
| 10.1 | Wiring diagram RS-485 (with heating) | 12 |
| 10.2 | Wiring diagram RS-422 (with heating) | 13 |
| 10.3 | Wiring diagram SDI-12 (with heating) | 14 |
| 10.4 | Wiring diagram RS-485 (without heating) | 15 |
| 10.6 | Wiring diagram SDI-12 (without heating) | 16 |
| 11. | Grounding | 17 |
| 12 | NMEA data protocols | 18 |
| 13 | Modbus protocol | 19 |
| 13.1 | General | 19 |
| 13.2 | Data encoding | 19 |
| 13.3 | Standard configuration - Default | 19 |
| 13.4 | Available Modbus commands | 20 |
| 13.5 | Instantaneous values / real-time values ( Input Registers) | 20 |
| 13.6 | Period data - Average, maximum and minimum (Input Registers) | 21 |
| 13.7 | Descriptive sensor parameter registers ( Holding Registers) | 22 |
| 13.8 | Configuration registers (Holding Registers) | 22 |
| 13.9 | Autoconfiguration | 23 |
| 14 | SDI-12 Interface | 24 |
| 15 | Technical data | 31 |

# 1 u[sonic] - Key benefits at a glance

The ultrasonic wind sensor u[sonic] meets the highest requirements for meteorological measurements and provides a reliable, durable solution for use in demanding environmental conditions, with flexible configuration options for a wide range of applications.

- Meets WMO requirements for accurate and standardized measurements
- Wear-free, low-maintenance operation with no moving parts
- Reliable performance even under extreme conditions thanks to intelligent heating
- Available in heated and unheated versions for different application needs
- Fast and easy installation with high serviceability
- Multiple measurement parameters in one device reduce installation and maintenance effort

**Wherever reference is made to heating in this manual, it applies exclusively to the heated version of the u[sonic].**

# 2 Warranty

**Please note the loss of warranty and non-liability by unauthorized 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 (e.g. false polarity) etc.
4. Damages which are caused by using the device beyond the specified operation conditions.

# 3 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 anodized 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.

#### 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.
- Wind parameters are measured reliably and accurately even in winter, as the ultrasonic transducers of the heated u[sonic] sensor (ID 00.16470.100000) are kept effectively free of ice and snow in all climate zones by means of an electronically controlled heating system.
- 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 three meteorological parameters is eliminating the installation work significantly.

# 4 Start-up

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.

## 4.1 Installation conditions

### 4.1.1 General

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.

## 4.2 Tools and installation material

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.

## 4.3 Unpacking the sensor

The sensor is delivered in separate packaging, carefully protected against mechanical impact, to avoid damage during transport.

The package contains the following items:

- Sensor u[sonic]
- User manual

Accessories: (depending on the scope of delivery, packed separately if necessary)
Connection cable with cable plug

## 4.4 Incoming inspection

Please check the scope of delivery for completeness and possible transport damage. Please report any complaints immediately to us in writing.

## 4.5 Energy 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.

### 4.5.1 Current consumption

The power input of the u[sonic] is around approx. 50 mA at 24 VDC. The following table shows the maximum power input according to configured heating power.

| Heating power | Max. current consumption at 24 VDC |
|---|---|
| 60 W | 2.5 A |
| 120 W | 5 A |
| 240 W (standard) | 10 A |

By default, the maximum heating power is set to 240 W. The other heating power levels can be factory-set upon request.

## 4.6 Installation work (short description)

The sensor is installed in three 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.

## 4.7 Mounting the sensor

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. 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.

Please pay attention to a firm mounting of the sensor at the mast!

### 4.7.1 Sensor northing

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 securely attached. If needed, you can tighten or loosen the pin using an 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.

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

## 4.7.2 Power supply and signal cables

An 8-pin M16 cable connector is required for the electrical connection of the sensor. The cable shield must be clamped to the protective earth (PE) at both ends

**The warranty for the device is excluded if damage occurs due to improper handling. This particularly includes the absence of proper grounding. Correct grounding according to DIN VDI/VDE 0100 is essential for the safety and functionality of the device. If you have any questions regarding installation, please contact us.**

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).

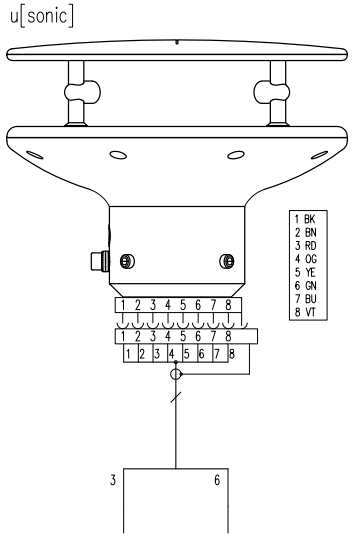
The typical power supply requirements of the u[sonic] sensors are 24 VDC with a typical current drain of 50 mA. The input range is 6...60 VDC or 12...42 VAC. The heater of the u[sonic] has to be supplied with 24 V AC/DC. In standard configuration the heating power is 240 W with a current drain of 10 A at 24 VDC. The signal output of the sensors is conform to the requirements of RS-422 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.

## 4.7.3 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!

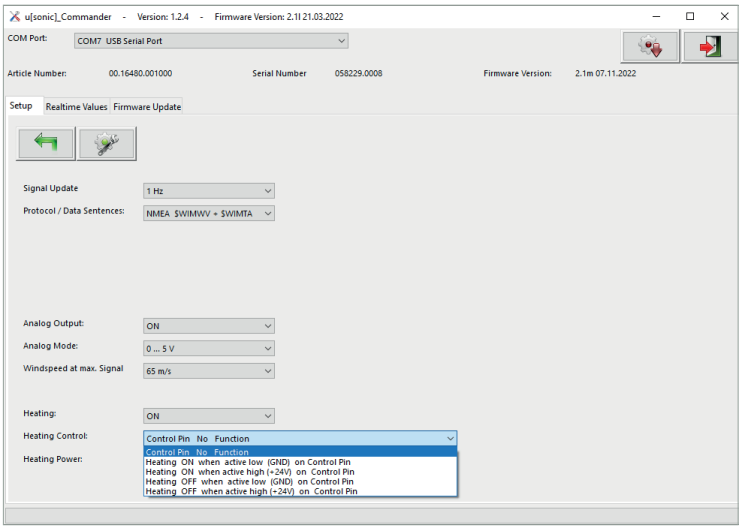
## 4.7.4 Heating control

The integrated, intelligent heating of the u[sonic] **ID 00.16470.100000** also ensures that the sensor is kept free of ice and snow during winter operation and in locations with critical ambient conditions.
On default, the heating status of the sensor is set to **“On”** and **“Control PIN No Function”**.




| Heating <A> when <B> | | | | |
|---|---|---|---|---|
| <A> \ <B> | Activ low | | Activ high | |
| On | Heating Off | Heating On | Heating Off | Heating On |
| Off | Heating On | Heating Off | Heating On | Heating Off |

Different operating modes are available for controlling and monitoring the heating under moderate temperature conditions. The respective function can be set in the “u[sonic] Commander” configuration software.




## 4.7.5 Download of updates

On our website (https://www.lambrecht.net), the ***Free Software Tools & Firmware*** category can be found under ***Service*** in the ***Resources*** section. There you can easily download the latest firmware and software tools for your product and benefit from ongoing improvements and new features.

# 5 Maintenance

## 5.1 Regular maintenance and calibrations

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.

## 5.2 Visual inspections 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 49580** or **E-Mail: support-lambrecht@aem.eco**

# 6 Transports

In case the sensor should be shipped or transported by you, it has to be packed securely to avoid mechanical impact or other damages.

# 7 Disposal

LAMBRECHT meteo GmbH is listed and registered at the Stiftung Elektro-Altgeräte Register ear under:

**WEEE-Reg.-Nr. DE 45445814**

In the category of monitoring and control instruments, device type: “Monitoring and control instruments for exclusively commercial use”.

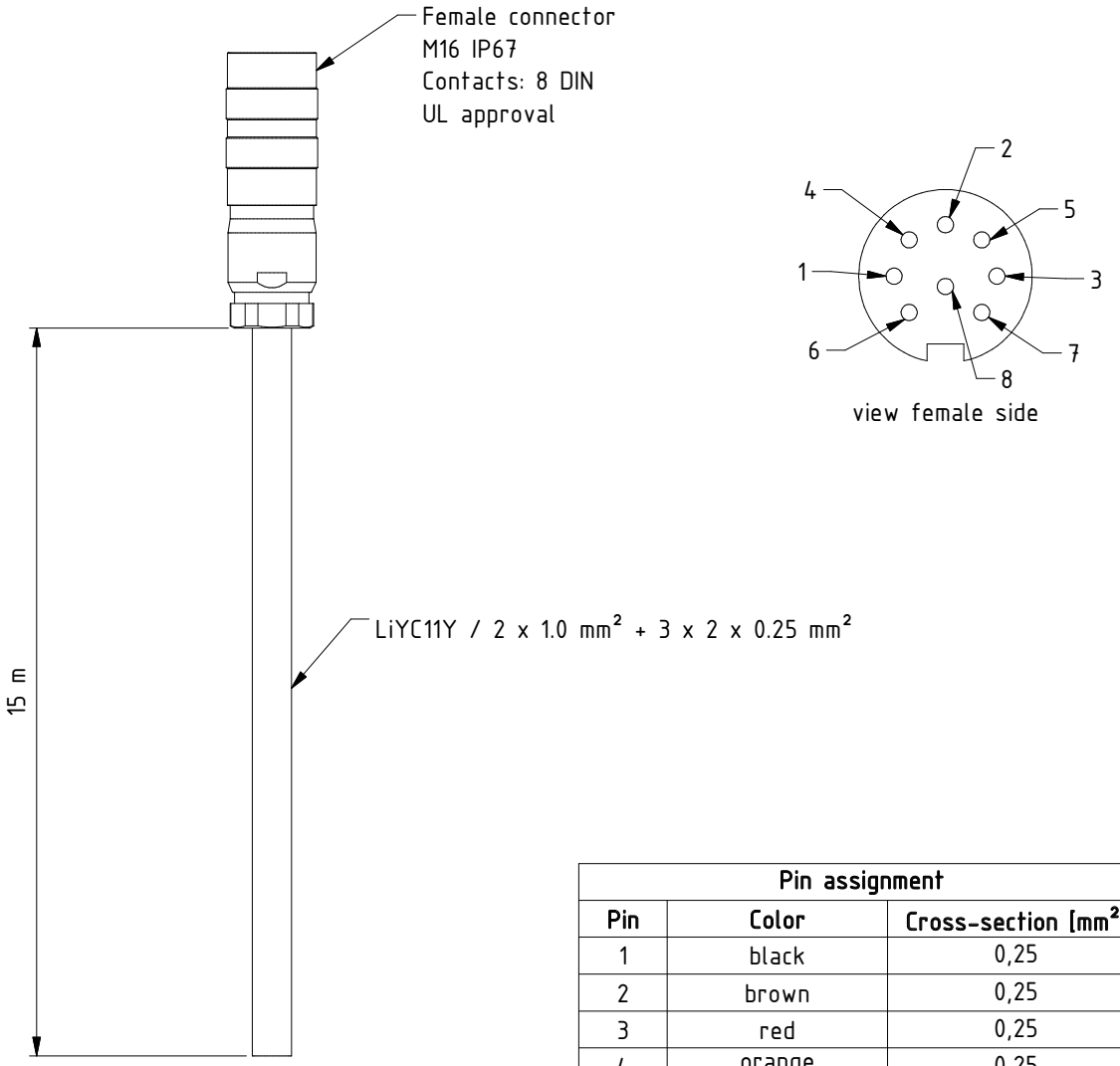
**Within the EU**

The device has to be disposed according to the European Directives 2002/96/EC and 2003/108/EC (Waste Electrical and Electronic Equipment). Do not dispose the old device in the household waste! For an environmentally friendly recycling and disposal of your old device, contact a certified disposal company for electronic waste.

**Outside the EU**

Please follow the regulations in your country regarding the appropriate disposal of waste electronic equipment.

# 8 Pin assignment



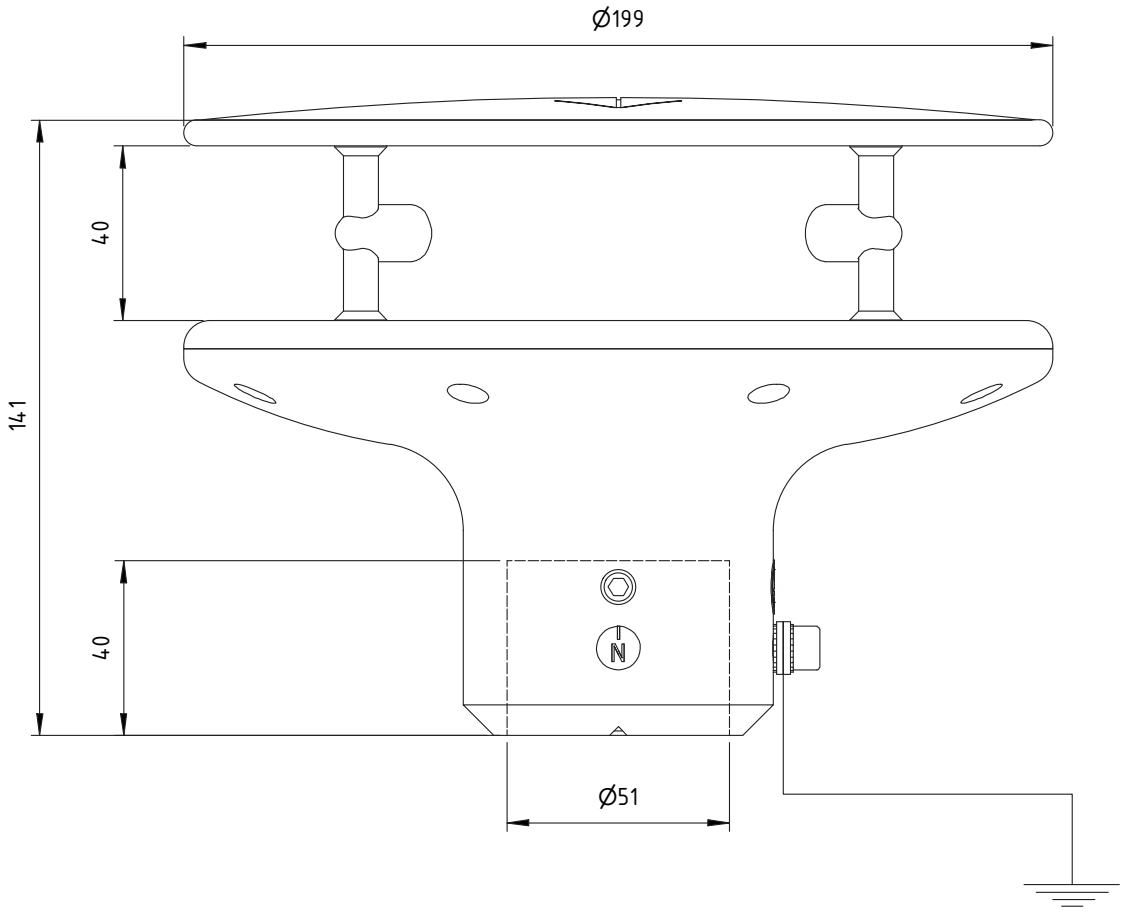

| Pin assignment | | |
|---|---|---|
| **Pin** | **Color** | **Cross-section [mm²]** |
| 1 | black | 0,25 |
| 2 | brown | 0,25 |
| 3 | red | 0,25 |
| 4 | orange | 0,25 |
| 5 | yellow | 0,25 |
| 6 | green | 0,25 |
| 7 | blue | 1 |
| 8 | violet | 1 |

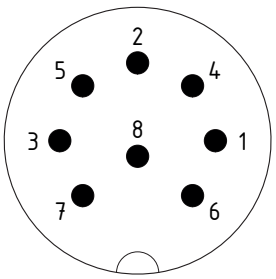
**For use in environments with high electromagnetic interference (e.g. caused by motors/generators, frequency converters, or high-voltage power lines), the use of a galvanically isolated DC/DC converter (24 V DC → 24 V DC)* in combination with the u[sonic] is recommended in order to further ensure interference-free operation of the u[sonic].**

*) **Note:** As an example reference, a galvanically isolated DC/DC converter from a third-party manufacturer may be used, e.g. **Orion-Tr Smart 24/24-12 by Victron Energy (MPN ORI242428120)**.

The product reference is provided for information purposes only and does not constitute an approval, recommendation, or warranty. The selection, suitability assessment, and responsibility for the use of the third-party product rest solely with the user.

# 9 Dimensional drawing and side view male connector

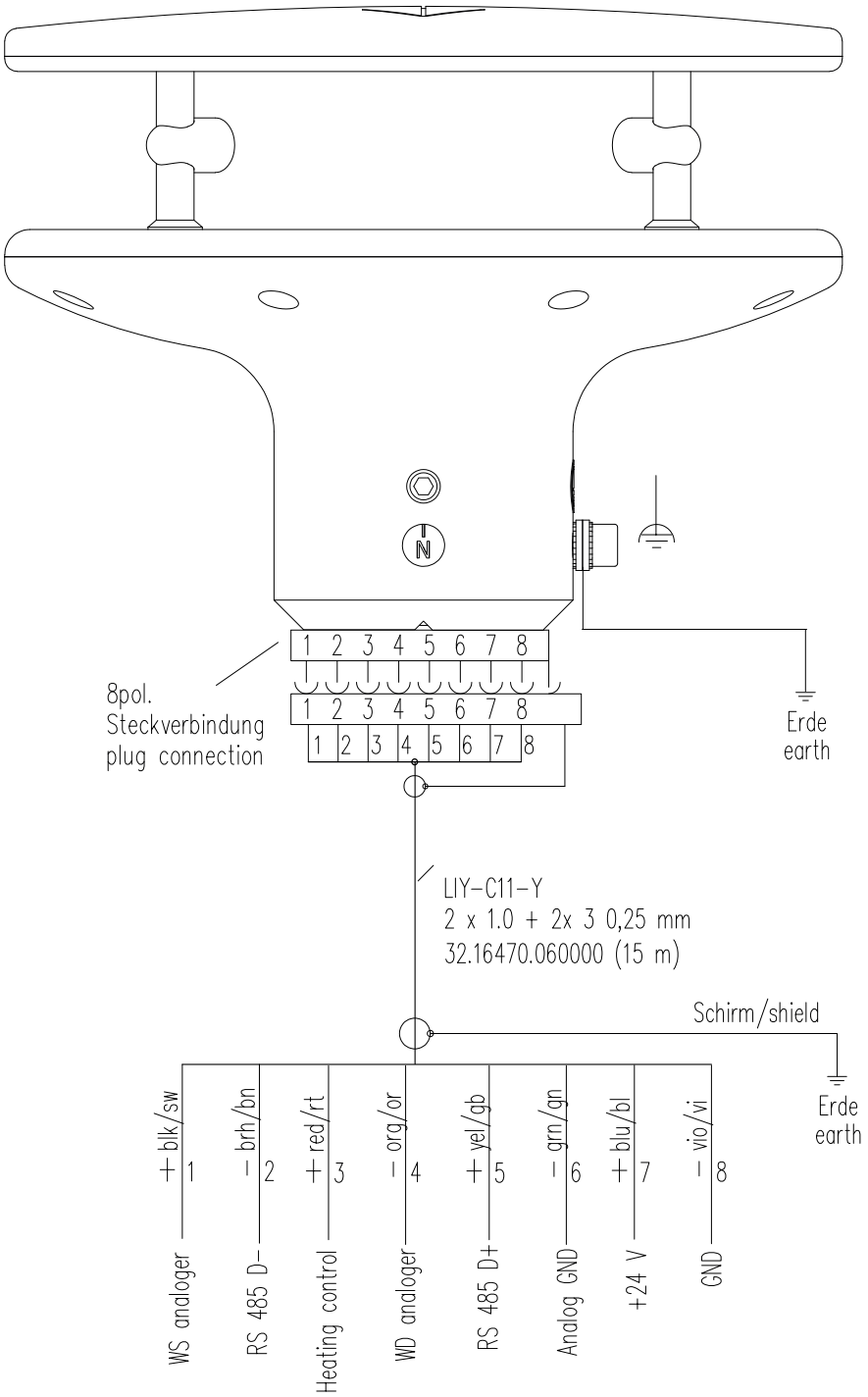


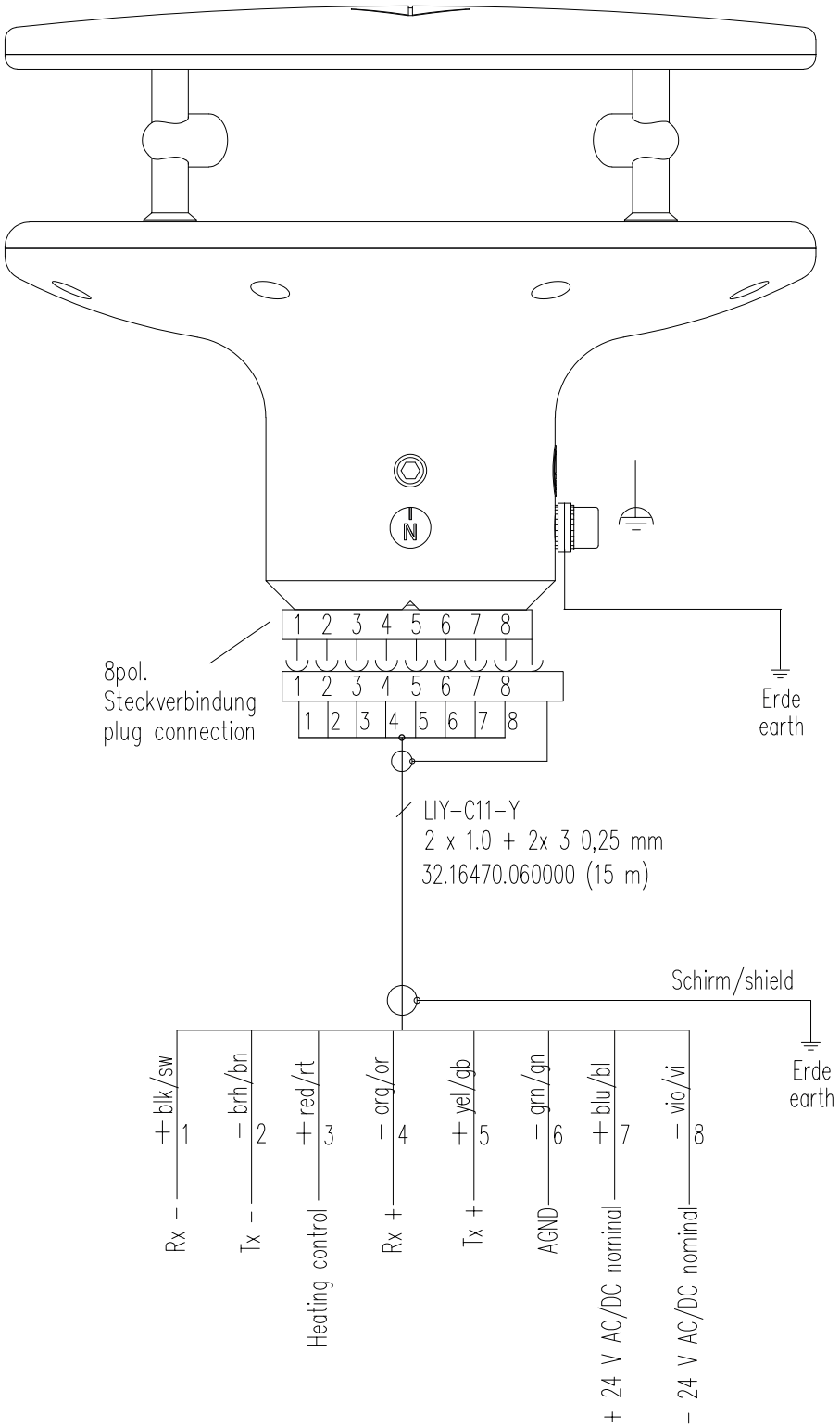

Ansicht Steckerseite
view male side

# 10 Wiring diagrams

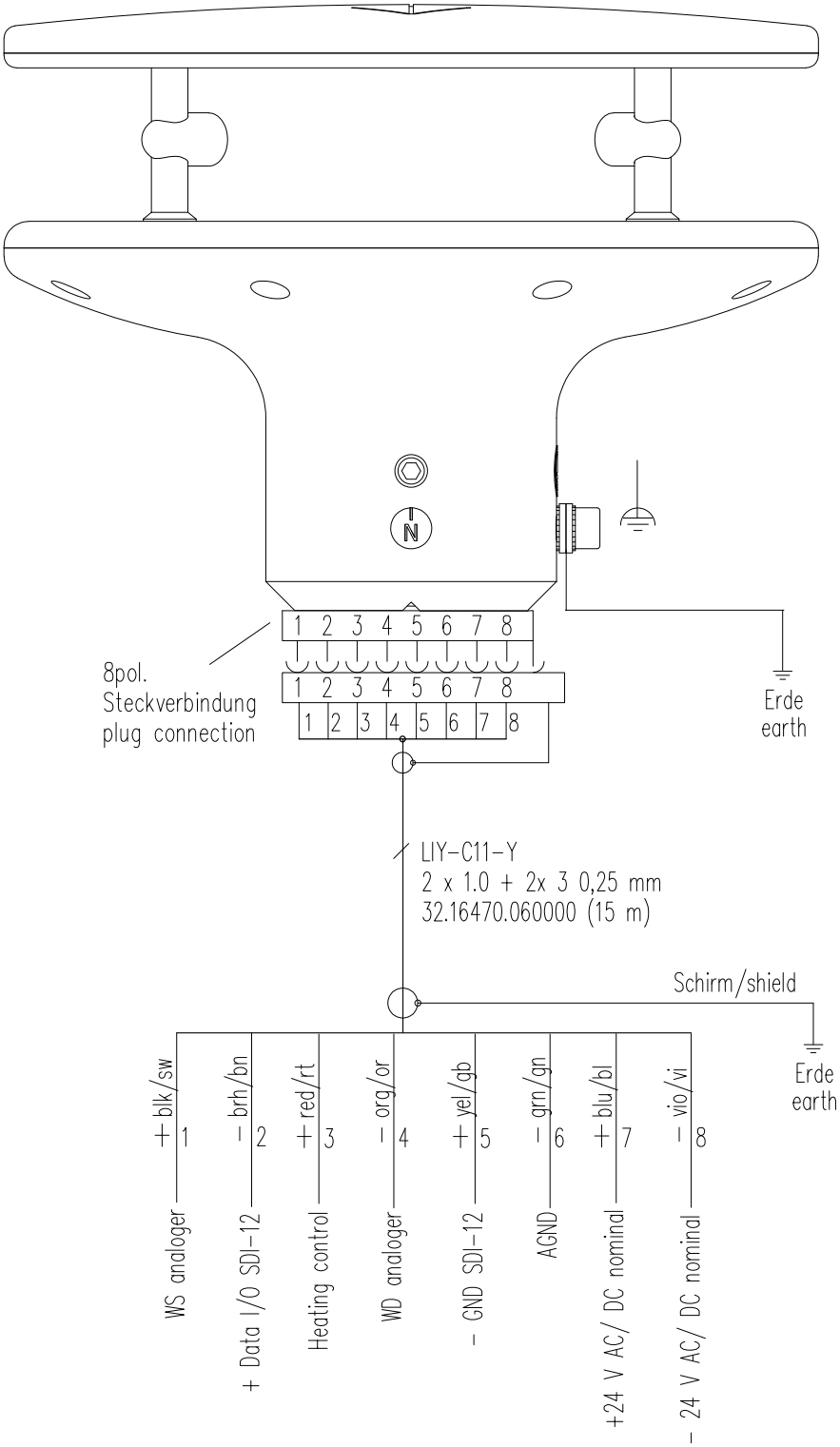
## 10.1 Wiring diagram RS-485 (with heating)



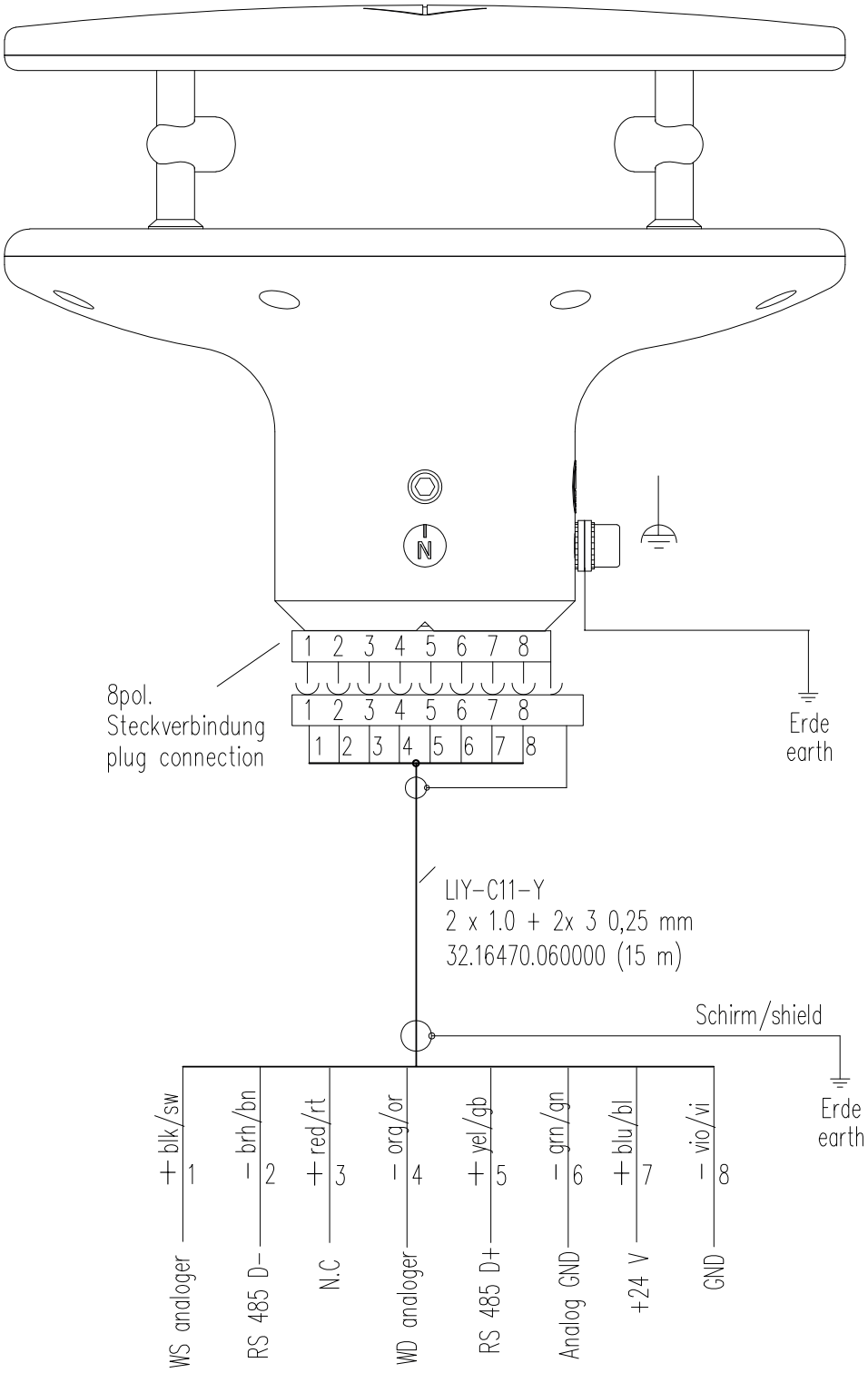
## 10.2 Wiring diagram RS-422 (with heating)



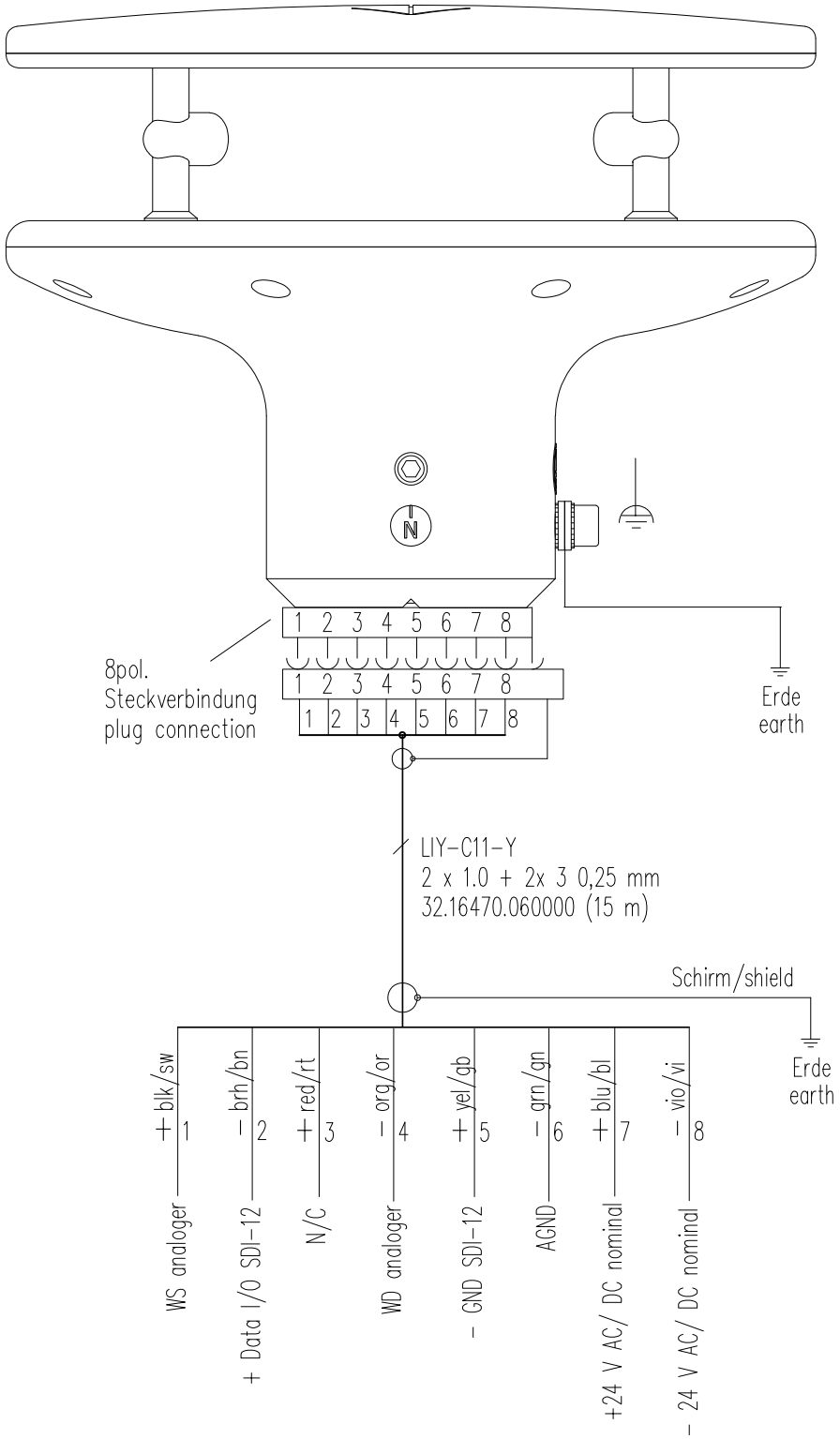
# 10.3 Wiring diagram SDI-12 (with heating)



## 10.4 Wiring diagram RS-485 (without heating)



# 10.6 Wiring diagram SDI-12 (without heating)



# 11. Grounding

To ensure the functional operating safety of the sensor, it must be grounded through the integrated grounding screw. This is especially important in areas with:

- Strong electrical fields (e.g., near high-voltage power lines)
- High electrostatic charge
- Increased lightning risk

**The warranty for the device is excluded if damage occurs due to improper handling. This particularly includes the absence of proper grounding. Correct grounding according to DIN VDI/VDE 0100 is essential for the safety and functionality of the device. If you have any questions regarding installation, please contact us.**

The following figure shows the sequence for installing a grounding wire with a lug through the grounding screw on the sensor.

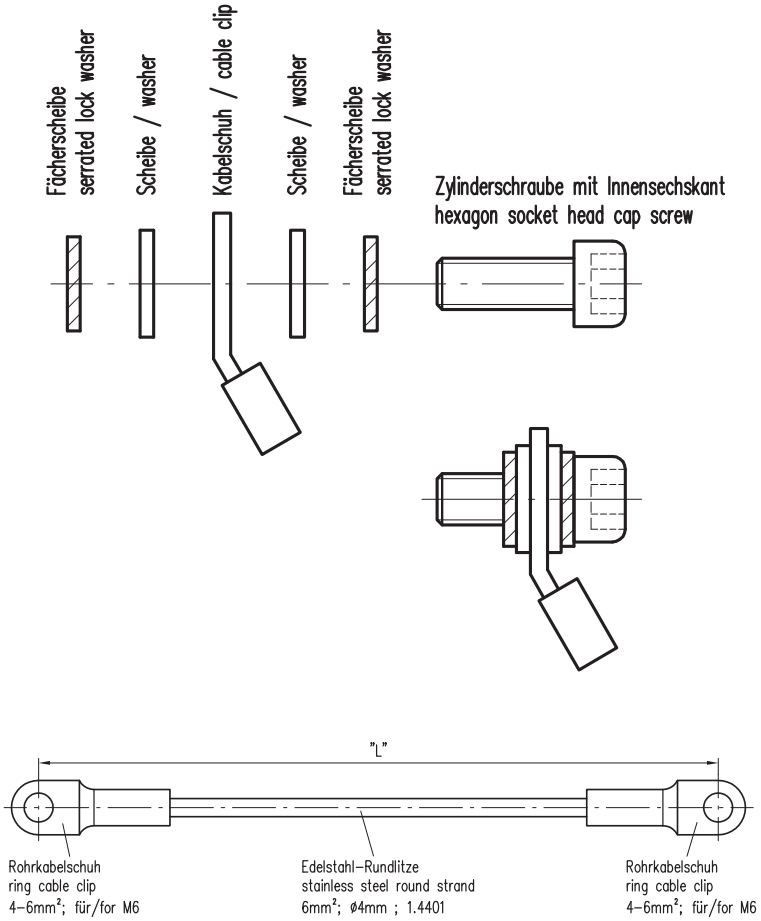



Figure: Example of an grounding cable

# 12 NMEA data protocols

### NMEA COMMUNICATION PARAMETERS

| | |
|---|---|
| Baud rate: | 4800 Baud |
| Data Bits: | 8 |
| Parity Bit: | None (none) |
| Stop Bits: | 1 (or more) |
| Handshake: | without |

### 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.

# 13 Modbus protocol

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.

## 13.1 General

The LAMBRECHT meteo Modbus sensors follow the specification of the Modbus organization: "MODBUS APPLICATION PROTOCOL SPECIFICATION V1.1b3" (see www.modbus.org).

## 13.2 Data encoding

MODBUS uses the "Big-Endian" format for addresses and data. This means that if a value is transmitted with a number format which is larger than a single byte, that the "most significant byte" is sent first.

Example Big-Endian:

Register size value 16 - bits

0x1234 is transmitted in the sequence: 0x12 0x34.

To obtain the real measuring value, divide the received register value by the divisor.
Values of -9999 indicate an internal sensor error.

## 13.3 Standard configuration - Default

| | |
|---|---|
| Baud rate: | 19200 Baud |
| Byte frame: | 8E1 (1 start bit, 8 data bits, 1 parity bit (even parity), 1 stop bit) |
| RTU Sensor address: | 9 |

### DEFAULT ADDRESSES OF THE LAMBRECHT SENSORS

| Address | Sensor |
|---|---|
| 1 | Wind speed |
| 2 | Wind direction |
| 3 | Precipitation rain[e] |
| 4 | THP |
| 5 | EOLOS IND; u[sonic]WS6 |
| 6 | com[b] |
| 7 | PREOS |
| 8 | ARCO |
| 9 | u[sonic] |
| 10 | Pyranometer 2nd Class |
| 11 | Secondary standard Pyranometer |
| 12 | PT100 ot Modbus converter (temperature) |
| 13 | u[sonic]WS7 |

## 13.4 Available Modbus commands

The LAMBRECHT Modbus sensors support the following commands:

- "Read Holding Register" command: 0x03 (descriptive sensor data registers)
- "Read Input Register" command: 0x04 (measured values registers)
  (every measured value is to be requested individually)
- "Write Multiple Register" command: 0x10 (Write to configuration registers)

## 13.5 Instantaneous values / real-time values ( Input Registers)

The following measured values are provided by the LAMBRECHT meteo sensors.

| Register address | Parameter name | Unit | Divisor | Quantity of registers | Access type |
|---|---|---|---|---|---|
| 30001 | Wind speed | m/s | 10 | 1 | Read only |
| 30201 | Wind direction | ° | 10 | 1 | Read only |

**Example:** Retrieving the wind speed

| 0D | 04 | 75 | 31 | 00 | 01 | 7A | C5 | 0D | 04 | 02 | 00 | 1F | E8 | F9 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|

| | | | | | | |
|---|---|---|---|---|---|---|
| LEN 6 | Transmission Query => | Source Master | Dest Slave 13 | Function Read Input Register (4) | Func Desk Address=30001, Quantity of Register=1 | Checksum OK:C57A |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| LEN 5 | Transmission Response <= | Source Slave 13 | Dest Master | Function Read Input Register (4) | Func Desk Byte count=2 | Data 00 1F | Checksum OK:F9E8 |

## 13.6 Period data - Average, maximum and minimum (Input Registers)

| Register | Parameter name | Unit | Divisor | Quantity of registers | Access type |
|---|---|---|---|---|---|
| 30002 | Wind speed average | m/s | 10 | 1 | Read only |
| 30003 | Wind speed maximum | m/s | 10 | 1 | Read only |
| 30004 | Wind speed minimum | m/s | 10 | 1 | Read only |
| 30202 | Wind direction average | ° | 10 | 1 | Read only |
| 30203 | Wind direction maximum | ° | 10 | 1 | Read only |
| 30204 | Wind direction minimum | ° | 10 | 1 | Read only |

The data are valid for the period between the current request and the previous request. The maximum range of a period is 1 hour. Recalling the average value of a minimum, maximum and average group will erase the appropriate registers.

Retrieve the values of a group in the sequence minimum, maximum, average.
Use command: 0x03

**Example**: Retrieve wind speed (min. max. avr.) and erase the register content

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 01 | 04 | 75 | 34 | 00 | 01 | 6A | 08 | 01 | 04 | 02 | 00 | 00 | B9 | 30 | 01 |
| 04 | 75 | 33 | 00 | 01 | DB | C9 | 01 | 04 | 02 | 00 | D6 | 38 | AE | 01 | 04 |
| 75 | 32 | 00 | 01 | 8A | 09 | 01 | 04 | 02 | 00 | 14 | B9 | 3F | | | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| LEN 6 | Transmission Query => | Source Master | Dest Slave 1 | Function Read Input Register (4) | Func Desk Address=30004, Quantity of Register=1 | | Checksum OK:86A |
| LEN 5 | Transmission Response <= | Source Slave 1 | Dest Master | Function Read Input Register (4) | Func Desk Byte count=2 | Data 00 00 | Checksum OK:30B9 |
| LEN 6 | Transmission Query => | Source Master | Dest Slave 1 | Function Read Input Register (4) | Func Desk Address=30003, Quantity of Register=1 | | Checksum OK:C9DB |
| LEN 5 | Transmission Response <= | Source Slave 1 | Dest Master | Function Read Input Register (4) | Func Desk Byte count=2 | Data 00 D6 | Checksum OK:AE38 |
| LEN 6 | Transmission Query => | Source Master | Dest Slave 1 | Function Read Input Register (4) | Func Desk Address=30002, Quantity of Register=1 | | Checksum OK:98A |
| LEN 5 | Transmission Response <= | Source Slave 1 | Dest Master | Function Read Input Register (4) | Func Desk Byte count=2 | Data 00 14 | Checksum OK:3FB9 |

## 13.7 Descriptive sensor parameter registers ( Holding Registers)

| Register | Parameter name | Quantity of registers | Remark | Access type |
|---|---|---|---|---|
| 40050 | Device identification number<br>(15 characters) | 8 (2 characters in each register) | The returned data are in form of a 16 byte null terminated string | Read only |
| 40100 | Serial number<br>(11 characters) | 6 (2 characters in each register) | The returned data are in form of a 12 byte null terminated string | Read only |
| 40150 | Firmware version<br>(up to 25 characters) | 13 (2 characters in each register) | The returned data are in form of a 26 byte null terminated string | Read only |

**Example**: Retrieve the device identification number

(The identification number shown in the example is sensor-dependent. It is only used here for demonstration purposes).

| 0D | 03 | 9C | 72 | 00 | 08 | CA | 8B | 0D | 03 | 10 | 30 | 30 | 2E | 31 | 36 | □□□□□□□□□□□□□□□□ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 34 | 38 | 30 | 2E | 30 | 30 | 31 | 31 | 33 | 30 | 00 | E8 | 6B | | | | 00.16480.000130□□□ |

| LEN 6 | Transmission Query => | Source Master | Dest Slave 13 | Function Read Holding Register (3) | Func Desk Address=40050, Quantity of Register=8 | Checksum OK:8BCA |
|---|---|---|---|---|---|---|

| LEN 19 | Transmission Response <= | Source Slave 13 | Dest Master | Function Read Holding Register (3) | Func Desk Byte count=16 | Data 30 30 2E 31 36 34 38 30 2E 30 30 31 31 33 30 00 | Checksum OK:6BE8 |
|---|---|---|---|---|---|---|---|

## 13.8 Configuration registers (Holding Registers)

| Register | Parameter name | Allowed values | Quantity of registers | Access type |
|---|---|---|---|---|
| 40001 | Modbus device address | | 1 | Write only |
| 40200 | Baud rate | 96 = 9600<br>192 = 19200<br>384 = 38400 | 1 | Write only |
| 40201 | Parity | 1 = even<br>0 = none | 1 | Write only |

The device must be restarted after each change of a setting!

**Example:** Changing the RTU address from 4 to 1

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 05 | 10 | 9C | 41 | 00 | 01 | 02 | 00 | 01 | 06 | 48 | 05 | 10 | 9C | 41 | 00 |
| 01 | 7E | 09 | | | | | | | | | | | | | |

| LEN | | | | | | | |
|---|---|---|---|---|---|---|---|
| 9 | Transmission<br>Query => | Source<br>Master | Dest<br>Slave 5 | Function<br>Write Multiple Register (16) | Func Desk<br>Address=40001, Quantity=1 | Byte count<br>2 | Register values<br>00 01 | Checksum<br>OK:4806 |

| LEN | | | | | | |
|---|---|---|---|---|---|---|
| 6 | Transmission<br>Response <= | Source<br>Slave 5 | Dest<br>Master | Function<br>Write Multiple Register (16) | Func Desk<br>Address=40001, Quantity=1 | Checksum<br>OK:097E |

## 13.9 Autoconfiguration

All LAMBRECHT Modbus sensors offer the experienced user the possibility to implement an auto-configuration in his Modbus master based on additional information stored in the sensor. The necessary information can be found in the document “Lambrecht_Modbus_Autoconfiguration”.

# 14 SDI-12 Interface

**SDI-12 has to be preconfigured ex works.**
**Please specify when ordering: Id-No. 97.16470.000002 Configuration SDI-12**

The communication using SDI-12 protocol via SDI-12 interface is based on the 'SDI-12 A Serial-Digital Interface Standard for Microprocessor-Based Sensors, Version 1.4, 2017'. The u[sonic] can be used in bus mode parallel to other u[sonic].

The following subset of SDI-12 commands were implemented into the u[sonic].

For more information on the SDI-12 protocol, please refer to the standard documentation mentioned above or the website www.SDI-12.org.

### IMPLEMENTED SDI-12 COMMANDS

| Command | Function | Sensor response |
|---|---|---|
| a! | Acknowledge Active | a<CR><LF> |
| aI! | Send Identification | allccccccccmmmmmmvvvxx...xx<CR><LF> |
| aAb! | Change Address | b<CR><LF> |
| aM! | Start Measurement | atttn<CR><LF> |
| aMC! | Start Measurement and Request CRC | atttn<CR><LF> |
| aC! | Start Concurrent Measurement | atttnn<CR><LF> |
| aCC! | Start Concurrent Measurement and Request CRC checksum | atttnn<CR><LF> |
| aD0! | Send Data (Buffer 0) | a<Werte<CR><LF><br>a<Werte><CRC><CR><LF> |
| aV! | Start Verification | atttn<CR><LF> |
| aX! | Resetting the Addresses | a<CR><LF> |

a = Address of the corresponding sensor
Standard sensor addresses = 0

SDI-12 commands always start with the address of the appropriate sensor. Therefore all other sensors on the same bus will ignore these commands. SDI-12 commands end with '!'. All answers from sensors start with its address, too, but end with the ASCII characters 'Carriage Return' <CR> and 'Line Feed' <LF>.

The SDI-12 protocol is based on the ASCII character set. The baud rate of the SDI-12 protocol is 1200 Bd and has the byte frame format:

- 1 start bit
- 7 data bits (least significant bit transmitted first)
- 1 parity bit (even parity)
- 1 stop bit

**Acknowledge Active – a!**

This command ensures that the sensor responds to requests. Basically it asks the sensor to confirm that it is connected to the bus.

The sensor returns its address and **<CR><LF>**.

**Syntax**

| Command | Answer |
|---|---|
| **a!**<br>**a** – Sensor address<br>**!** – End of command | **a<CR><LF>**<br>**a** – Sensor address<br>**<CR><LF>** – End of answer |

**Example:**

| Command | Answer |
|---|---|
| **0!** | **0<CR><LF>** |
| **1!** | **1<CR><LF>** |

**Send Identification – aI!**

The command **aI!** is used to ask the sensor for its model number and firmware version.

**Syntax**

| Command | Answer |
|---|---|
| **aI!**<br>**a** – Sensor address<br>**I** – Command "Send Identification"<br><br><br><br><br>**!** – End of command | **a14LMGmbH151647011.1<CR><LF>**<br>**a** – Sensor address<br><br>**a14LMGmbH151647011.1**<br>**14** – 2 characters SDI-12 version no. 14 = version 1.4<br>**LMGmbH15** – 8 characters manufacturer's name (= Lambrecht meteo GmbH)<br>**164701** – 6 characters sensor type<br>**1.1** – Firmware version<br>**<CR><LF>** – End of answer |

**Example:**

| Command | Answer |
|---|---|
| **0I!** | **014LMGmbH1514582S1.1<CR><LF>** |
| **1I!** | **114LMGmbH1514582D1.1<CR><LF>** |

**Change address – aAb!**

The factory setting for the address is "**0**".If there are several sensors connected to one bus, the sensor address can be changed with the command "**aAb!**". The address is always a single ASCII character. Standard for addresses are the ASCII characters "**0**" to "**9**" (decimal 48 to 57). If there are more than 10 sensors connected to one bus, using the characters "**A**" to "**Z**" (decimal 65 to 90) and "**a**" to "**z**" (decimal 97 to 122) is allowed. The sensor answers with its new address and **<CR><LF>**. After the address is changed, one should not send further commands to the sensor for a period of one second (see also "SDI-12 Standard, Version 1.4, 2017").

**Syntax**

| Command | Answer |
|---|---|
| **aAb!**<br>**a** – Old sensor address<br>**A** – Command "Change Address"<br>**b** – New sensor address<br>**!** – End of command | **b<CR><LF>**<br>**b** – New sensor address<br><br><**CR><LF>** – End of answer |

**Example:**

| Command | Answer |
|---|---|
| **0A1!** | **1<CR><LF>** |

**Start Measurement – aM!**

The command **aM!** requests that the sensor processes the returning string and provide the available measured data. In contrast to standard sensors described in the SDI-12 documentation the [u]sonic measures continuously. Thus the measured values from the continuous measurement are stored in a buffer while the string is being processed. These values are processed after the string processing. Therefore the [u]sonic always responds with "**a000**". This is also the reason why the [u]sonic does not send a "**Service Request**" and ignores signals to interrupt the measurement. Prior to the returned waiting time the data logger must not send further commands. After expiration of the waiting time the data can be requested with the commands **aD0!** and **aD1!** (see "**Send Data**"). The data will not be overwritten until the next **C**, **M**, or **V** command and can be read several times until then.

**Syntax**

| Command | Answer |
|---|---|
| **aM!**<br>**a** – Sensor address<br>**M** – Command "Start Measurement"<br><br>**!** – End of command | **a0003<CR><LF>**<br>**a** – Sensor address<br>**000** – Seconds the sensor needs until the measured data can be returned<br>**3** – Number of provided measured data<br>**<CR><LF>** – End of answer |

**Example:**

| Command | Answer |
|---|---|
| **1M!** | **10003<CR><LF>** |

The measured data can be requested with the commands **aD0!** and **aD1!** (see "**Send Data**").

**Start Measurement and Request CRC – aMC!**

Same command as **aM!** but in addition to the generated data the sensor returns a 3-digit CRC checksum. For information on how the CRC checksum is generated, please consult "SDI-12 Standard, Version 1.3, 2012, chapter 4.4.12".

**Syntax**

| Command | Answer |
|---|---|
| **aMC!**<br>**a** – Sensor address<br>**M** – Command "Start Measurement and Request CRC"<br>**C** – Request for transmission of the CRC checksum<br>**!** – End of command | **a0003<CR><LF>**<br>**a** – Sensor address<br>**000** – Seconds the sensor needs until the measured data can be returned<br>**3** – Number of provided measured data<br>**<CR><LF>** – End of answer |

**Example:**

| Command | Answer |
|---|---|
| **2MC!** | **20003<CR><LF>** |

**Start Concurrent Measurement – aC!**

The "Concurrent Measurement" enables the data logger to measure simultaneously with multiple sensors on the same bus. The "**aC!**" command requests the sensor to process the available measurement data and write them to an output string. Unlike the standard sensors described in the SDI-12 documentation, the u[sonic] measures continuously. This is why the u[sonic] always responds with "**a000**". The data is therefore immediately available. This is also the reason why the u[sonic] does not send a "service request" and ignores measurement interruption commands. The data can be retrieved with the command "**aD0!**" (see under "**Send Data**"). The data is not overwritten until the next "**C**" or "**M**" command and can be retrieved several times.

**Syntax**

| Command | Answer |
|---|---|
| **aC!**<br>**a** – Sensor address<br>**C** – Command "Start Concurrent Measurement"<br>**!** – End of command | **a00014<CR><LF>**<br>**a** – Sensor address<br>**000** – Seconds the sensor needs until the measured data can be returned (= 0 s – Data immediately available)<br>**14** – Number of provided measured data<br>**<CR><LF>** – End of answer |

**Example:**

| Command | Answer |
|---|---|
| **1C!** | **100014<CR><LF>** |

The measured data can be requested with the command "**aD0!"** (see "**Send Data"**).

**Start Concurrent Measurement with CRC – aCC!**

Same command as "**aC!**" but in addition to the generated data the sensor returns a 3-digit checksum. For information on how the CRC checksum gets generated, please consult 'SDI-12 Standard Version 1.4, 2017, chapter 4.4.12'.

**Syntax**

| Command | Answer |
|---|---|
| **aCC!**<br>**a** – Sensor address<br>**C** – Command "Start Concurrent Measurement"<br><br>**C** – Request to send a CRC checksum<br>**!** – End of command | **a00014<CR><LF>**<br>**a** – Sensor address<br>**000** – Seconds the sensor needs until the measured data can be returned with "CRC" (= 0 s – Data immediately available)<br>**14** – Number of provided measured data<br>**<CR><LF>** – End of answer |

**Example:**

| Command | Answer |
|---|---|
| **1CC!** | **100014<CR><LF>** |

**Send Data – aD0!**

The data requested by the sensor with the commands "**C**" or "**M**" can be retrieved with the command "**aD0!**". The sensor uses the corresponding signs ("**+**" or "**–**") as field separators. If the data was requested with a "**CC**" or "**MC**" command, a CRC checksum is also returned. For more information on how to generate this CRC checksum, please see "SDI-12 Standard, Version 1.4, 2017, chapter 4.4.12".

After the measurement, the data is stored in the buffer "**D0**" and retrieved with the command "**aD0!**".

| Command | Answer |
|---|---|
| **aD0!**<br>**a** – Sensor address<br>**D** – Command "Send Data"<br>**0** – Request for the data in buffer 0<br>or<br>**1** = buffer 1<br>**2** = buffer 2<br>**!** – End of command | **a<values><CR><LF>**<br>**a** – Sensor address<br>**<values>** – Requested data separated by respective sign ("+" or "-")<br><br>**<CR><LF>** – End of answer |

**Example:**

| Command | Answer |
|---|---|
| **0C!** | **000004<CR><LF>** |
| **0D0!** | **0+0.1+0.1+0.1+0.1<CR><LF>** |

**Syntax for measurements with aCC! or aMC!**

| Command | Answer |
|---|---|
| **aD0!**<br>**a** – Sensor address<br>**D** – Command "Send Data"<br>**0** – Request for the data in buffer 0<br>or<br>**1** = buffer 1<br>**!** – End of command | **a<values><CRC><CR><LF>**<br>**a** – Sensor address<br>**<values>** – Requested data separated by respective sign ("+" or "–")<br><br>**<CRC>** – 3-digit CRC checksum<br>**<CR><LF>** – End of answer |

**Definition SDI-12 u[sonic]** C! and CC!

| | Nr. | Parameter | Description | Unit |
|---|---|---|---|---|
| **D0!** | 1 | Wind speed | Instantaneous value | m/s |
| | 2 | Wind speed | Minimum value | m/s |
| | 3 | Wind speed | Maximum value | m/s |
| | 4 | Wind speed | Average value | m/s |
| | 5 | Wind direction | Instantaneous value | deg |
| | 6 | Wind direction | Minimum value | deg |
| | 7 | Wind direction | Maximum value | deg |
| | 8 | Wind direction | Average value | deg |
| **D1!** | 9 | Acoustic virtual temperature | Instantaneous value | °C |
| | 10 | Acoustic virtual temperature | Minimum value | °C |
| | 11 | Acoustic virtual temperature | Maximum value | °C |
| | 12 | Acoustic virtual temperature | Average value | °C |
| **D2!** | 13 | Status code | 16 bit value | |
| | 14 | Error code | 16 bit value | |

**Minimal, maximum and average value refer to the time since last C! or CC! command.**
**Syntax for measurements with command "aC!" or "aM!"**

## Error/status code

The returned value is a decimal format of an originally binary number.
In binary notation, the digits correspond to the following error messages.

Error:

```
XXXXXXXX XXXXXXXX  Bit:    Dec:   Hex:    Meaning:
|||||||| ||||||||_ 0       1      00 01   Supply voltage error (with inactive heating)
|||||||| |||||||__ 1       2      00 02   Supply quality (power good)
|||||||| ||||||___ 2       4      00 04   Supply voltage error (with active heating)
|||||||| |||||____ 3       8      00 08   Measuring section disturbed
|||||||| ||||_____ 4       16     00 10   RTC initialization error
|||||||| |||______ 5       32     00 20   Electronic overload protection
|||||||| ||_______ 6       64     00 40   Electronics error
|||||||| |________ 7       128    00 80   Error in backup SRAM
||||||||__________ 8       256    01 00   NTCs defective
|||||||___________ 9       512    02 00   Heating control temperature not available
```

Status:

```
XXXXXXXX XXXXXXXX  Bit:    Dec:   Hex:    Meaning:
|||||||| ||||||||_ 0       1      00 01   Restart (reset) (is output 5 times)
|||||||| |||||||__ 1       2      00 02   Watchdog triggered (is output 5 times)
|||||||| ||||||___ 2       4      00 04   Heating active (heats)
|||||||| |||||____ 3       8      00 08   Reflection detection
|||||||| ||||_____ 4       16     00 10   Gain adjusted in case of signal interference
|||||||| |||______ 5       32     00 20   Measurement quality (less than 50% on average)
```

## Description for aM! and aMC!

| | No. | Description |
|---|---|---|
| **D0** | 1 | windspeed.mom |
| | 2 | winddirection.mom |
| | 3 | virtual_temperature.mom |

# 15 Technical data

| Combined Ultrasonic Wind Sensor u[sonic] heated | |
|---|---|
| **ID** | **00.16470.100000 (with heating)**<br>Modbus and SDI-12 are pre-configured ex-works.<br>Please specify when ordering:<br>**ID 97.16470.000001** Configuration Modbus<br>**ID 97.16470.000002** Configuration SDI-12 |
| Measuring principle | Ultrasound |
| Measuring range | Wind direction: 0...359.9°; wind speed: 0...75 m/s |
| Survival wind speed | 100 m/s |
| Accuracy | Wind direction: < 2° (> 1 m/s) RMSE<br>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°<br>Wind speed: 0.1 m/ |
| Response threshold | 0.1 m/s (adjustable for wind direction) |
| Outputs | RS 485; analog: 4...20 mA; (0...65 m/s); (other scalings on request)<br>(Outputs on request: RS-422; SDI-12; analog: 0...20 mA; 0...5 V; 0...10 V) |
| Protocols | NMEA 0183, WIMWV, WIMTA<br>(Protocols on request: SDI-12, Modbus RTU) |
| Measuring rate | 0.1...10 Hz; (internal measuring rate 50 Hz) |
| Operating conditions | -40...+70 °C (with heating -50...+70 °C); 0...100 % RH |
| Supply voltage | Without heating: 6...60 VDC or 12...42 VAC; with heating: 24 V AC/DC ± 20 % |
| Current consumption | Sensor: typically 50 mA at 24 VDC and deactivated analog output;<br>Heating: maximal 10 A at 24 V AC/DC |
| Heating data | Factory configurable: 60 W / 120 W / 240 W (standard) |
| Dimensions | Ø 199 mm; height 149 mm |
| Housing | Seawater resistant aluminum; IP66, IP67 |
| Weight | Approx. 2 kg |
| Standards | • NMEA 0183<br>• VDE 0100<br>• Low voltage guide line: 72/23 EWG<br>• EMC/EMI: DIN EN 60945 and DIN EN 61000-4-2, -3, -4, -5, -6, -11<br>• Protection class: DIN EN 60529 |
| **Accessories** (please order separately) | |
| **ID 32.16470.060000** | Sensor cable, 15 m, 8-pin, M16 connector |

| Combined Ultrasonic Wind Sensor u[sonic] unheated | |
|---|---|
| **ID** | **00.16470.100001 (without heating)**<br>Modbus and SDI-12 are pre-configured ex-works.<br>Please specify when ordering:<br>**ID 97.16470.000001** Configuration Modbus<br>**ID 97.16470.000002** Configuration SDI-12 |
| Measuring principle | Ultrasound |
| Measuring range | Wind direction: 0...359.9°; wind speed: 0...75 m/s |
| Survival wind speed | 100 m/s |
| Accuracy | Wind direction: < 2° (> 1 m/s) RMSE<br>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°<br>Wind speed: 0.1 m/ |
| Response threshold | 0.1 m/s (adjustable for wind direction) |
| Outputs | RS 485; analog: 4...20 mA; (0...65 m/s); (other scalings on request)<br>(Outputs on request: RS-422; SDI-12; analog: 0...20 mA; 0...5 V; 0...10 V) |
| Protocols | NMEA 0183, WIMWV, WIMTA<br>(Protocols on request: SDI-12, Modbus RTU) |
| Measuring rate | 0.1...10 Hz; (internal measuring rate 50 Hz) |
| Operating conditions | -40...+70 °C; 0...100 % RH |
| Supply voltage | 6...60 VDC or 12...42 VAC |
| Current consumption | Typically 50 mA at 24 VDC and deactivated analog output |
| Dimensions | Ø 199 mm; height 149 mm |
| Housing | Seawater resistant aluminum; IP66, IP67 |
| Weight | Approx. 2 kg |
| Standards | • NMEA 0183<br>• VDE 0100<br>• Low voltage guide line: 72/23 EWG<br>• EMC/EMI: DIN EN 60945 and DIN EN 61000-4-2, -3, -4, -5, -6, -11<br>• Protection class: DIN EN 60529 |
| **Accessories** (please order separately) | |
| **ID 32.16470.060000** | Sensor cable, 15 m, 8-pin, M16 connector |

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