USER MANUAL

THP[pro]SDI-12

Temperature-Humidity-Pressure Sensor

aem | LAMBRECHT meteo

Content

1 Features

- Combined measuring device for demanding applications
- Capacitive humidity measuring element
- Low maintenance
- For use in all climatic zones
- Appropriate sensor sensor shelter optionally available

2 Function

PROVEN ENVIRONMENTAL MEASUREMENT TECHNOLOGY

The sensor THP[pro]SDI-12 is a combined measuring instrument for measuring relative humidity, air temperature, and air pressure. The sensor is characterized by high reliability and energy-saving electronics. If the device is handled properly the perfect function and long-term stability as well as high accuracy are ensured.

3 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 (false polarity) etc.
4. Damages which are caused by using the device beyond the specified operation conditions.

4 Start-up

For climatic measurements the sensor should be mounted at a representative place. The sensor can be installed in any position. The sensor must be protected against water splashes and rain. As a suitable weather and protection screen we recommend the sensor shelter 8141.6.

Dew formation and splashes do not damage the sensor, although corrupted measurement readings are recorded until all the moisture on the filter has dried up. Inside a room you should avoid a place near heatings, windows, and cold outer walls.

The protective filters should only be screwed off carefully to check functioning with the humidity standard. It is important not to touch the highly sensitive sensor element in the process.

When you screw them back on, please bear in mind that sensors will not measure accurately again until they are completely dry.

5 Mounting

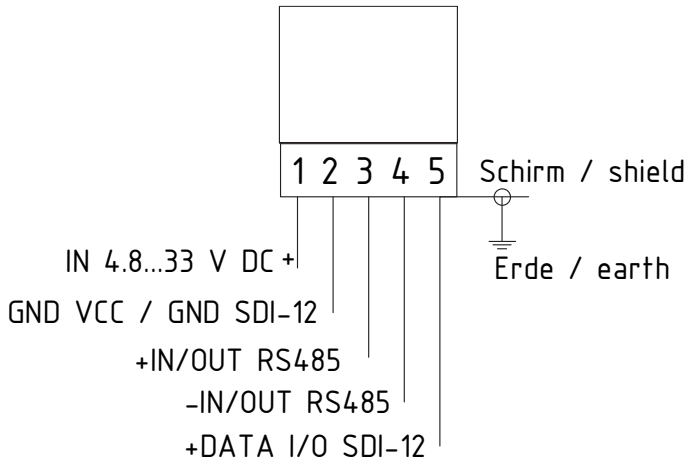
First of all the protective screen has to be mounted without the incorporated sensor at a selected installation place as mentioned before. When having inserted the sensor THP[pro] bottom-up into the big support of sensor shelter 8141.6, the plastic nut must be fastened carefully with a wrench.

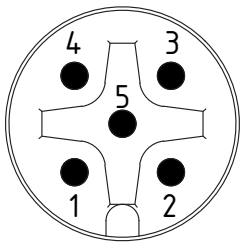
6 Electrical connection

Incorrect voltage supplies and overloading of the outputs can destroy the sensor!

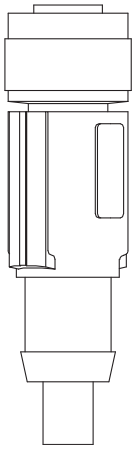
The sensor THP[pro]SDI-12 has to be connected with the end of the cable to an external power supply and signal evaluation (see figure).

7 Wiring diagram





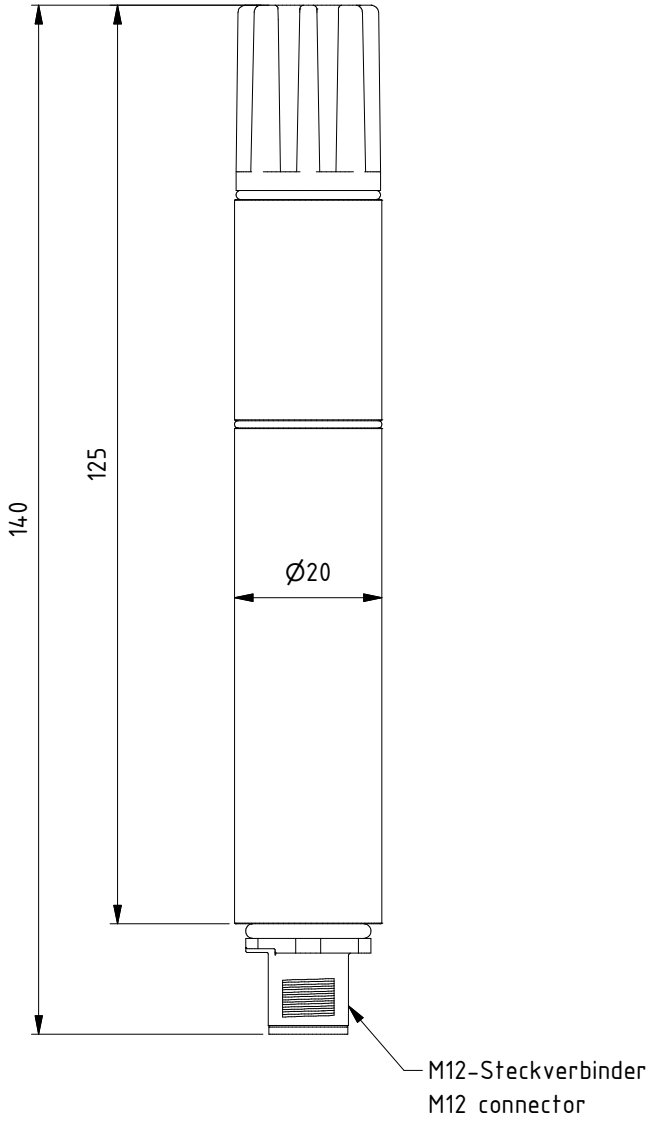
Ansicht Stiftseite
View male side



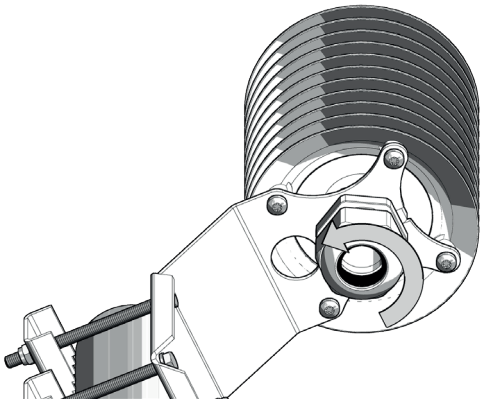
Kabel / cable
32.05005.000500 (5m)
32.05005.001500 (15m)

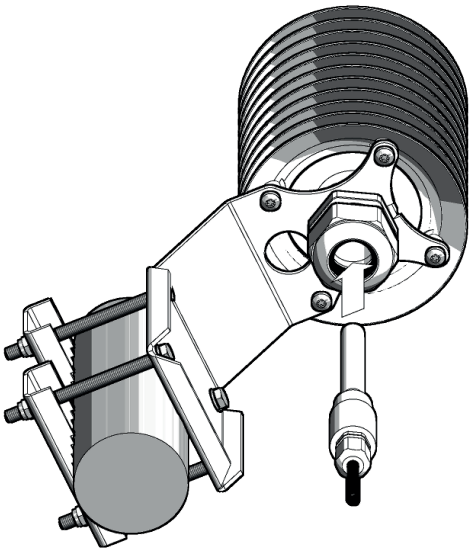
PIN	Color	Farbe
1	br	br
2	wh	ws
3	bu	bl
4	bk	sw
5	gy	gr

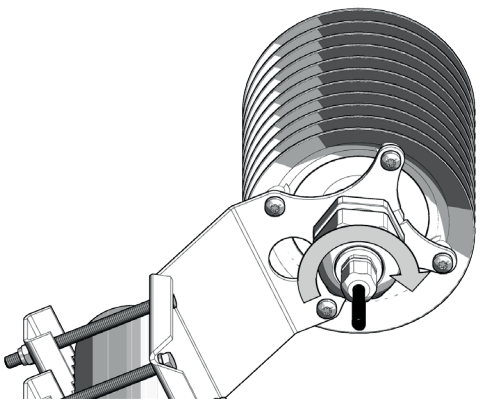
8 Dimensioned drawing



9 Mounting of the sensor into the sensor shelter







10 SDI-12 Interface

Please order the pre-configuration to SDI-12 separately using the ID no. 97.08095.000020.

The communication using the SDI-12 protocol via the SDI-12 interface is based on the "SDI-12 A Serial-Digital Interface Standard for Microprocessor-Based Sensors, Version 1.3, 2016". The THP[pro] sensor can be used in bus operation parallel to other sensors with SDI-12 data protocol.

The following subset of SDI-12 commands is implemented in the THP[pro] sensor. For further information about the SDI-12 protocol please refer to the previously mentioned standard documentation or to the website **www.SDI-12.org**.

IMPLEMENTED SDI-12 COMMANDS

Command	Function	Sensors response
a!	Acknowledge active	a<CR><LF>
?!	Address query	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	atttnn<CR><LF>
aD0! aD1! aD2!	Send data (buffer 0) Send data (buffer 1) Send data (buffer 1)	a<Werte<CR><LF> a<Werte><CRC><CR><LF>
aV!	Start verification	atttn<CR><LF>

a = address of the corresponding sensor; standard sensor address = 0

SDI-12 commands always start with the address of the corresponding sensor. Thus all other sensors on the same bus ignore commands that do not match their own address. SDI-12 commands end with a "! All sensor responses also start with the address (shown below with "a") of the sensor and always 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 is 1200 Baud and has the byte frame format:

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

Acknowledge active – (a!)

This command ensures that the sensor responds to requests. In general, it requests the sensor to confirm that it is connected to the bus. The sensor returns its address and the characters **<CR><LF>**.

Command:	**a!**	(Acknowledge active)
Response:	**a<CR><LF>**	

Example:	Command	Response
	0!	**0<CR><LF>**
	1!	**1<CR><LF>**

Send identification – (aI!)

Provides sensor-specific information such as model number, firmware version, etc.

Command:	**aI!**	(I – Command „Send Identification“)

Antwort: **a13LMGmbH1508095x310871202.0001<CR><LF>**

|	|	|	|	|
|	|	|	|	**871202.0001** – (11 characters) serial number TH/THP
|	|	|	**310** – (3 characters) sensor firmware version (= version 3.10)	
|	|	**08095x** – (6 characters) sensor type (x: T = TH[pro], P = THP[pro])	
|	**LMGmbH15** – (8 characters) manufacturer name (= Lambrecht meteo GmbH)			
13 – (2 characters) SDI-12 - version (13 = version 1.3)				

Example:	Command	Response
	0I!	**013LMGmbH1508095T310871202.0001<CR><LF> (TH[pro])**
	1I!	**113LMGmbH1508095P310871202.0001<CR><LF> (THP[pro])**

Change address – (aAb!)

The factory setting for the address is "**0**". If several sensors are connected to the same bus, the sensor address can be changed with the command **aAb!**. The address is always a single ASCII character. By default, the ASCII characters are used for the numbers between "**0**" to "**9**" (decimal 48 to 57). If more than 10 sensors are connected to one bus, the characters "**A**" to "**Z**" (decimal 65 to 90) as well as **"a"** to **"z"** (decimal 97 to 122) can be used alternatively. The sensor responds with its new address and **<CR><LF>**. After the address has been changed, no further commands should be sent to the sensor for about one second (see also "SDI-12 Standard, Version 1.3, 2016").

Command:	**aAb!**	**A** – function "change address", **b** – new sensor address
Response:	**b<CR><LF>**	**b** – response with new sensor address

Example:	Command	Response
	0A1!	**1<CR><LF>**

Start measurement – (aM!)

The command "**aM!**" requests the sensor to process the available measurement data and to record it in an output string. Unlike the standard sensors as described in the SDI-12 documentation, the THP[pro] sensor measures continuously. The data can be retrieved with the corresponding commands "**aD0!**" to "**aD2!**". The data is saved until the next "**C**", "**M**" or "**V**" command and can be retrieved several times.

Command: **aM!** **M** – function "start measurement"

Response: **a0005<CR><LF>**
| |
| **5** – number of measured values
000 – seconds until the sensor returns the measured data (000 = immediate query possible)

Example:

Command	Response
1M!	**10005<CR><LF>**

The measurement data can then be retrieved with the commands **aD0!**, **aD1!** and **aD2!** (see below under "Send data").

Start measurement and request CRC – (aMC!)

Same command as **"aM!"**, but in addition to the processed measurement data, the sensor sends a 3-digit CRC checksum. For further information on generating this CRC checksum please refer to "SDI-12 Standard, Version 1.3, 2016, Chapter 4.4.12".

Command: **aMC!** **M** – command "start measurement", **C** – request CRC checksum

Response: **a0005<CR><LF>**
| |
| **5** – number of measured values
000 – seconds until the sensor returns the measured data (000 = immediate query possible)

Example:

Command	Response
1MC!	**10005<CR><LF>**

Start concurrent measurement – (aC!)

With "**concurrent measurement**", the data logger can measure concurrently with several THP[pro] sensors connected to the same bus. The command "**aC!**" requests the sensor to process the available measurement data and record them in an output string. Unlike the standard sensors, as described in the SDI-12 documentation, the THP[pro] measures continuously. The data can be retrieved with the corresponding commands "**aD0!**" to "**aD2!**". The data is saved until the next "**C**", "**M**", or "**V**" command and can be retrieved several times.

Command: **aC!** **C** – command "start concurrent measurement"

Response: **a00024<CR><LF>** (THP[pro])
| |
| **24** – number of measured values
000 – seconds until the sensor returns the measured data (000 = immediate query possible)

Example:	Command	Response
	1C!	**100024<CR><LF>**

The measurement data can then be retrieved with the commands **aD0!**, **aD1!** and **aD2!** (see below under "Send data").

Start concurrent measurement and request CRC – (aCC!)

Same command as "**aC!**", but in addition to the processed measurement data, the sensor also sends a 3-digit CRC checksum. For further information on generating this CRC checksum please refer to "SDI-12 Standard, Version 1.3, 2016, Chapter 4.4.12".

Command: **aCC!** **C** – command "start concurrent measurement", **C** –request CRC checksum

Response: **a00024<CR><LF>**
| |
| **24** – number of measured values
000 – seconds until the sensor returns the measured data (000 = immediate query possible)

Example:	Command	Response
	1C!	**100024<CR><LF>**

The measurement data can then be retrieved with the commands **aD0!**, **aD1!** and **aD2!** (see below under "Send data").

Send data – (aD0!), (aD0!), (aD1!)

The data requested from the sensor with the commands "**C**" or "**M**" can be retrieved with the commands "**aD0!**", "**aD1!**" and "**aD2!**". The sensor uses the corresponding characters ("+" or "-") as field separators. If the data were requested with a "**CC**" or "**MC**" command, a CRC checksum will also be returned. For further information on generating this CRC checksum please refer to "SDI-12 Standard, Version 1.3, 2016, Chapter 4.4.12". The output of the measured data is in metric units.

Up to a maximum of 20 measured values can be retrieved from the output telegrams **aD0!**, **aD1!** and **aD2!**. The period "**from retrieval to retrieval**" is limited to max. 70 minutes. Afterwards, average and min/max values are reset and a new time period is automatically started.

If **erroneous data** have been generated during the measurement or if the function of the sensor is permanently disturbed, the corresponding measured data are output with the "sensor error value" **-999.9**. This identification is unambiguous and lies far outside the real measuring range.

Example (error codes):

Command: **1CC!** and following query of block 1 of the measured data with **1D0!**
Response: 1-999.9-999.9-999.9-999.9-999.9-999.9-999.9-999.9GGi<CR><LF>

Data and retrieval description – THP[pro] (24 measured values)

Value no.	Measured values	Range / Formats	Unit
	Air temperature	-40.0...+70.0	°C
1	Instantaneous value		
2	Minimum (from retrieval to retrieval)		
3	Maximum (from retrieval to retrieval)		
4	Mean value (from retrieval to retrieval)		
	Relative humidity	+0.0...+100.0	%
5	Instantaneous value		
6	Minimum (from retrieval to retrieval)		
7	Maximum (from retrieval to retrieval)		
8	Mean value (from retrieval to retrieval)		
	Dew point	-40.0...+70.0	°C
9	Instantaneous value		
10	Minimum (from retrieval to retrieval)		
11	Maximum (from retrieval to retrieval)		
12	Mean value (from retrieval to retrieval)		
	Air pressure	+600.0...+1100.0	hPa
13	Instantaneous value		
14	Minimum (from retrieval to retrieval)		
15	Maximum (from retrieval to retrieval)		
16	Mean value (from retrieval to retrieval)		
	Absolute humidity	+0.0...+200.0	g/m³
17	Instantaneous value		
18	Minimum (from retrieval to retrieval)		
19	Maximum (from retrieval to retrieval)		
20	Mean value (from retrieval to retrieval)		
	Wet bulb temperature	-40.0...+70.0	°C
21	Instantaneous value		
22	Minimum (from retrieval to retrieval)		
23	Maximum (from retrieval to retrieval)		
24	Mean value (from retrieval to retrieval)		

THP[pro] – Output of measured data when queried with aM! or aMC! (with CRC checksum)

Command: **aM!** (aM! = buffering instantaneous values for output)

Response: **10005<CR><LF>** (5 measured values are available for retrieval without delay)

Command: **aD0!** (retrieve measured values from buffer memory)

Response: **a+22.5+41.2+8.7+976.0+8.2<CR><LF>**

- **+8.2** – absolute humidity (value no. 17)
- **+976.0** – air pressure (value no. 13)
- **+8.7** – dew point (value no. 9)
- **+41.2** – relative humidity (value no. 5)
- **+22.5** – air temperature (value no. 1)

Command: **aD1!**

Response: **a+12.3<CR><LF>**

- **+12.3** - wet bulb temperature (value no. 21)

Example:

Command	Response
1MC!	**1+22.2+39.6+7.8+975.1+7.7KNJ<CR><LF>**

THP[pro] – Output of measured data when queried with aC! or aCC! (with CRC checksum)

Command: **aC!** (aC! = buffering all available values for output)

Response: **100024<CR><LF>** (24 measured values are available for retrieval without delay)

Note: **Due to the length limitation to max. 75 bytes, the data are split into 3 data sets!**

Command: **aD0!** (aD0! = call up measured values 1 to 8 from **buffer memory 1**)

Response: **1+22.3+22.2+22.4+22.2+37.6+36.0+37.6+36.8<CR><LF>**

- +36.8 – relative humidity, mean value (value no. 8)
- +37.6 – relative humidity, maximum (value no. 7)
- +36.0 – relative humidity, minimum (value no. 6)
- +37.6 – relative humidity, instantaneous value (value no. 5)
- +22.2 – air temperature, mean value (value no. 4)
- +22.4 – air temperature, maximum (value no. 3)
- +22.2 – air temperature, minimum (value no. 2)
- +22.3 – air temperature, instantaneous value (value no. 1)

Command: **aD1!** (aD1! = call up measured values 9 to 16 from **buffer memory 2**)

Response: **1+7.2+6.5+7.2+6.8+978.5+978.4+978.8+978.5<CR><LF>**

							+978.5 – air pressure, mean value (value no. 16)
						+978.8 – air pressure, maximum (value no. 15)	
					+978.4 – air pressure, minimum (value no. 14)		
				+978.5 – air pressure, instantaneous value (value no. 13)			
			+6.8 – dew point, mean value (value no. 12)				
		+7.2 – dew point, maximum (value no. 11)					
	+6.5 – dew point, minimum (value no. 10)						
+7.2 – dew point, instantaneous value (value no. 9)							

Command: **aD2!** (aD2! = call up measured values 17 to 24 from **buffer memory 3**)

Antwort: **1+7.4+7.1+7.4+7.2+12.2+12.1+12.5+12.3<CR><LF>**

							+12.3 - wet bulb temperature, mean value (value no. 24)
						+12.5 - wet bulb temperature, maximum (value no. 23)	
					+12.1 - wet bulb temperature, minimum (value no. 22)		
				+12.2 - wet bulb temperature, instantaneous value (value no. 21)			
			+7.2 – absolute humidity, mean value (value no. 20)				
		+7.4 – absolute humidity, maximum (value no. 19)					
	+7.1 – absolute humidity, minimum (value no. 18)						
+7.4 – absolute humidity, instantaneous value (value no. 17)							

Start verification – (aV!)

For compatibility reasons, the command "**aV!**" is used to provide extended information if necessary later. The response is always "+1".

Command: **aV!** (Acknowledge Active)

Response: **a<CR><LF>**

Example:	Command	Response
	1V!	**1+1<CR><LF>**

Note on SDI standard commands

In terms of protocol, THP[pro] support the standard command set (see "SDI-12 A Serial-Digital Interface Standard for Microprocessor-Based Sensors, version 1.3, 2016", page 7, chapter 4.4 and table 5).

The sensors respond to all commands with a valid data transfer. The information content of unsupported commands is reduced to pure protocol sequence control, i.e. there is no further activity for these requests (e.g. aD3! etc.) due to the responses sent.

11 Perform measurements

The measuring probe is adjusted by delivery. For putting into operating another readjustment is not required. The probe is ready for use five seconds after being switched on and sends its first data protocol.

Before a reliable measurement can be made, the measuring probe and medium to be measured must be in temperature and humidity equilibrium.

The necessary adjustment time, which can last up to 30 minutes, depends upon several factors:

- Size of the humidity and temperature deviation of probe and medium before start of measurement
- Change of the measured values during the adjustment time

The humidity measurement provides a better picture of the progress of acclimatization since it reacts much more quickly and more sensitively than the temperature measurement. The 1/10 percent display is therefore very suitable as a trend display. If the display oscillates about mean value, then adjustment is completed.

12 General sources of error

Humidity measurements are very sensitive to various influences:

TEMPERATURE ERROR

Due to too short adjustment time, sunshine during the measurement, heating, cold outer wall, air draft (e.g. fans), radiating hand, and/or body heat etc..

HUMIDITY ERROR

Due to steam, water splashes dripping water or condensation on the sensor etc.. Repeatability and long-term stability in operation are not impaired by this even if the probe has been exposed to high humidity or saturation with water vapor over a lengthy period.

STAINING

Staining of the humidity sensor can be largely avoided by using a corresponding filter. The filters must be cleaned or replaced periodically depending upon the degree of contamination of the measuring site.

The sensor is insensitive to chemicals, when they occur in normal concentrations (MAK values = maximum workplace exposure). At higher concentrations or possibilities of contact with liquid chemicals, the manufacturer must always be consulted!

13 Maintenance and service

DEFINITIONS

Calibration = Control measurement with a humidity standard.

Adjustment = Calibration and additional readjustment of the probe to the setpoint value.

TEMPERATURE

The sensor is adjusted before delivery. A temperature readjustment is usually not necessary. If there is any doubt about the correct adjustment, please contact the manufacturer.

HUMIDITY

The sensor is adjusted before delivery so that the results are in optimum accuracy over the full measuring range. We recommend testing the sensor **at least once a year** to maintain this accuracy.

CLEANING

Dirty filters can cause measurement errors and extend the adjustment time. Depending on the degree of contamination of the filters, they must be cleaned periodically or replaced if necessary.

To avoid damaging the measuring elements, unscrew the filter element for cleaning.

Clean the filter with soapy water, alcohol or a cleaning agent suitable for removing contamination and rinse thoroughly with water.

Do not screw the filter back onto the probe until it is completely dry.

Troubleshooting or maintenance and repair work may only be carried out by trained maintenance personnel who have completed appropriate training by the manufacturer.

14 Maintenance and care

REGULAR VISUAL INSPECTIONS

The producer recommends periodical visual checks of the sensor and shelter housing regarding outer damages, watertightness, and the fixing of the mounting screws, at intervals of **four weeks**.

REPLACEMENT OF SPARE PARTS

All spare parts or alternate devices can be replaced with regular tools such as wrenches, screw drivers etc.

ACCESSORIES AND SPARE PARTS LIST

ID	Description
00.08141.600000 00.08141.600004	Sensor shelter with natural ventilation Sensor shelter with artificial ventilation To avoid the effects of radiation and to protect the sensor from dirt, wind, and precipitation, and for mounting on the mast
32.05005.001500	Cable 15 m, 5-pole
37.08093.100001	Membrane filter as sensor protection

ORDER SPARE PARTS

For a quick and correct replacement or exchange delivery, please provide the following data to the manufacturer:

- Name and type number of the device
- Ident no., serial or article number
- Quantity needed

OPTIONAL (IF AVAILABLE)

- Respective description of the connected system components (e.g. data logger variant)
- Type of vessel and country of origin, if applicable
- Reference number of LAMBRECHT wiring diagram designated with the bold letters SKF.... or SWF.... and a 3- or 4-digits running number.

The above mentioned data can be found on the nameplates of the devices, in the order-related circuit diagrams or in the documentation of the complete system.

STORAGE AND DISPATCH

The sensor should be stored in a clean and dust-free area between -40...+70 °C (not condensing) in a cardboard box or similar container. Alternative packing material should be adequate to the standard of the original packing of LAMBRECHT meteo. It must ensure an optimal protection against mechanical or electrical influences as well as against other transport damages caused by liquids or by the weather.

15 Safety instructions

This system is designed according to the state-of-the-art accepted safety regulations. However, please note the following rules:

1. Before set into operation, please read all appropriate manuals!
2. Please take notice of internal and state-specific guidelines and/or rules for the prevention of accidents (e.g. the professional association). If necessary ask your responsible safety representative.
3. Use the system according to the manual's regulations only.
4. Always leave the manual at hand at the place of work of the system.
5. Use the system in technically correct conditions only! You have to eliminate influences immediately, which impair the security .
6. Prevent the ingress of liquids into the devices .
7. Make sure that the system is free of power before cleaning of the devices. Do not use noxious or flammable detergents.

16 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.

17 Technical data

THP[pro]SDI-12	
ID	**00.08095.200030 + 97.08095.000020 Pre-configuration to SDI-12**
Temperature	
Measuring range	-40...+70 °C
Resolution	0.1 °C
Accuracy	± 0.1 K (0…60 °C); ± 0.2 K (-40…0 °C); ± 0.2 K (60…70 °C) [1]
Relative humidity	
Measuring range	0...100 % r. h.
Resolution	0.1 % r. h.
Accuracy	typically at 25 °C: ± 1 % (20...70 %) r. F. ; ± 1.5 % (0...20 %) r. F.; ± 1.5 % (70...90 %) r. F.; ± 3 % (90...100 %) r. F. [1] Response time relative humidity (at v = 1.5 m/s): 30 s [2]
Barometric pressure	
Measuring range	500...1100 hPa
Resolution	0.1 hPa
Accuracy	typically 0.38 hPa (700... 1100 hPa) (15...55 °C)
Further specifications	
Supply voltage	4.8...33 VDC
Power consumption [3]	4 mA at 24 VDC; 6 mA at 12 VDC; 11 mA at 4,8 VDC
Housing	Aluminum specially coated; IP 65 (housing); M12 plug connector (4-pole)
Weight	approx. 80 g
Dimensions	H 140 mm x Ø 20 mm
Interface	SDI-12
Protocol	SDI-12
Accessories (please order separately)	
ID 32.05005.001500	Cable 15 m, 5-pole
ID 00.08141.600000	Sensor shelter with natural ventilation
ID 00.08141.600004	Sensor shelter with artificial ventilation

[1] ventilated sensor shelter recommended [2] with filter membrane [3] without terminating resistor

8095_THPproSDI12_b-de.indd 07.24
Photo copyright: © Franz Pfluegl - Adobe stock

LAMBRECHT meteo GmbH
Friedländer Weg 65-67
37085 Göttingen
Germany

Tel +49-(0)551-4958-0
Fax +49-(0)551-4958-312
E-Mail info@lambrecht.net
Internet www.lambrecht.net