E+E

your partner
in sensor
technology.

User Manual HTP501

Digital Humidity and Temperature Probe up to 120 °C (248 °F)

DNV



Modbus

www.epluse.com

Content

1 General Information ... 3
1.1 Explanation of Warning Notices and Symbols ... 3
1.2 Safety Instructions ... 4
1.2.1 General Safety Instructions ... 4
1.2.2 Intended Use ... 4
1.2.3 Mounting, Start-up and Operation ... 4
1.3 ESD Protection ... 5
2 Scope of Supply ... 5
3 Product Description ... 6
3.1 General ... 6
3.2 Dimensions ... 7
3.3 E+E Shield Technologies ... 8
3.4 Electrical Connection ... 9
4 Mounting and Installation ... 9
4.1 Probe Type T4 ... 9
4.1.1 Non-pressure Installation ... 9
4.1.2 Remote Probe T4 with Optional Cut-in Fitting ... 10
4.2 Probe Type T10 ... 12
4.2.1 Installation Directly in the Process ... 12
4.2.2 Installation with Ball Valve Set ... 12
4.3 Recommendations for Accurate Humidity and Temperature Measurement ... 14
5 Setup and Adjustment ... 14
5.1 PCS10 Product Configuration Software ... 14
5.2 Modbus Setup ... 15
5.3 Modbus Register Map ... 17
5.4 Configurable Custom Modbus Map ... 19
5.5 Device Status Indication ... 20
5.6 Modbus RTU Examples ... 20
6 Maintenance and Service ... 22
6.1 Cleaning ... 22
6.2 Filter Cap Replacement ... 23
6.3 Protection during Site Cleaning Operations ... 23
6.4 RH and T Calibration and Adjustment ... 23
6.5 Repairs ... 24
6.6 Spare Parts ... 24
7 Accessories ... 24
8 Technical Data ... 25
9 Conformity ... 27
9.1 Declarations of Conformity ... 27
9.2 Electromagnetic Compatibility ... 27
9.3 FCC Part 15 Compliance Statement ... 27
9.4 ICES-003 Compliance Statement ... 27
9.5 DNV Type Approval ... 28
10 Recycling of the Device ... 28

1 General Information

This user manual serves for ensuring proper handling and optimal functioning of the device. The user manual shall be read before commissioning the equipment and it shall be provided to all staff involved in transport, installation, operation, maintenance and repair. E+E Elektronik Ges.m.b.H. does not accept warranty and liability claims neither upon this publication nor in case of improper treatment of the described products.

All information, technical data and diagrams included in this document are based on the information available at the time of writing. It may contain technical inaccuracies and typographical errors. The contents will be revised on a regular basis and changes will be implemented in subsequent versions. The described product(s) and the contents of this document may be changed or improved at any time without prior notice.

All rights reserved by E+E Elektronik Ges.m.b.H. No part of this document may be reproduced, published or publicly displayed in any form or by any means, nor may its contents be modified, translated, adapted, sold or disclosed to a third party without prior written permission of E+E Elektronik Ges.m.b.H.

PLEASE NOTE

Find this document and further product information on our website at www.epluse.com/htp501.

1.1 Explanation of Warning Notices and Symbols

Safety precautions

Precautionary statements warn of hazards in handling the device and provide information on their prevention. The safety instruction labeling is classified by hazard severity and is divided into the following groups:

DANGER

Danger indicates hazards for persons. If the safety instruction marked in this way is not followed, the hazard will verly likely result in severe injury or death.

WARNING

Warning indicates hazards for persons. If the safety instruction marked in this way is not followed, there is a risk of injury or death.

CAUTION

Caution indicates hazards for persons. If the safety instruction marked in this way is not followed, minor or moderate injuries may occur.

NOTICE

Notice signals danger to objects or data. If the notice is not observed, damage to property or data may occur.

Informational notes

Informational notes provide important information which stands out due to its relevance.

INFO

The information symbol indicates tips on handling the device or provides additional information on it. The information is useful for reaching optimal performance of the device.

The title field can deviate from “INFO” depending on the context. For instance, it may also read “PLEASE NOTE”.

1.2 Safety Instructions

1.2.1 General Safety Instructions

NOTICE

Improper handling of the device may result in its damage.

- The HTP501 enclosure, the sensing probe and the sensing module shall not be exposed to unnecessary mechanical stress.
- When replacing the filter cap make sure not to touch the sensing elements.
- The device must be operated with the filter cap on at all times.
- For sensor cleaning and filter cap replacement please see “Cleaning Instructions” at www.epluse.com/htp501.
- Installation, electrical connection, maintenance and commissioning shall be performed by qualified personnel only.
- Use the HTP501 only as intended and observe all technical specifications.
- The device is designed for operation with power supply class III (EU) and class 2 supply (NA).
- Do not apply the supply voltage to the RS485 data lines.

1.2.2 Intended Use

The HTP501 is dedicated for reliable and accurate monitoring of humidity (RH) and temperature (T) in applications that require a wide temperature range probe.

The probe can be used in air and non-explosive gases up to 120 °C (248 °F) and 20 bar (290 psi). The mounting and installation methods described in chapter 4 Mounting and Installation shall be used.

⚠ WARNING

Non-compliance with the product documentation may cause safety risks for people and the entire measurement installation.

The manufacturer cannot be held responsible for damages as a result of incorrect handling, installation and maintenance of the device.

- Do not use HTP501 in explosive atmosphere or for measurement of aggressive gases.
- This device is not appropriate for safety, emergency stop or other critical applications where device malfunction or failure could cause injury to human beings.
- The device may not be manipulated with tools other than specifically described in this manual.

NOTICE

Failing to follow the instructions in this user manual may lead to measurement inaccuracy and device failures.

- The HTP501 may only be operated under the conditions described in this user manual and within the specification included in chapter 8 Technical Data.
- Unauthorized product modification leads to loss of all warranty claims. Modification may be accomplished only with an explicit permission of E+E Elektronik Ges.m.b.H.!

1.2.3 Mounting, Start-up and Operation

The HTP501 humidity and temperature probe has been produced under state of the art manufacturing conditions, has been thoroughly tested and has left the factory after fulfilling all safety criteria. The manufacturer has taken all precautions to ensure safe operation of the device. The user must ensure that the device is set up and installed in a way that does not impair its safe use. The user is responsible for observing all applicable local and international safety guidelines for safe installation and operation of the device. This user manual contains information and warnings that must be observed by the user in order to ensure safe operation.

PLEASE NOTE

The manufacturer or his authorized agent can only be held liable in case of willful or gross negligence. In any case, the scope of liability is limited to the corresponding amount of the order issued to the manufacturer. The manufacturer assumes no liability for damages incurred due to failure to comply with the applicable regulations, operating instructions or the specified operating conditions. Consequential damage is excluded from liability.

WARNING

Non-compliance with the product documentation may cause accidents, personal injury or property damage.

- Mounting, installation, commissioning, start-up, operation and maintenance of the device may be performed by qualified staff only. Such staff must be authorized by the operator of the facility to carry out the mentioned activities.
- The qualified staff must have read and understood this user manual and must follow the instructions contained within. The manufacturer accepts no responsibility for non-compliance with instructions, recommendations and warnings.
- All process and electrical connections shall be thoroughly checked by authorized staff before putting the device into operation.
- Do not install or start-up a device supposed to be faulty. Make sure that such devices are not used accidentally by marking them clearly as faulty.
- A faulty device shall be removed from the process.
- Service operations other than described in this user manual may only be performed by the manufacturer.

1.3 ESD Protection



The sensing elements and the electronics board are ESD (electrostatic discharge) sensitive components of the device and must be handled as such. Failure to do so may damage the device by electrostatic discharge when touching exposed sensitive components.

2 Scope of Supply

- HTP501 – Digital Humidity and Temperature Probe according to ordering code
- Inspection certificate according to DIN EN 10204-3.1
- Quick guide

3 Product Description

3.1 General

The HTP501 is a robust probe for humidity and temperature measurement in air and other non-explosive gases. It features a humidity measuring range of 0...100 %RH and a temperature measuring range of -40...+120 °C (-40...+248 °F). The probe calculates all humidity-related quantities. Type T10 ist designed for pressure-tight installation from 0.01 (0.15 psi) up to 20 bar (290 psi).

Its IP66 rating and the E+E shield technologies make the probe ideal for highest requirements in terms of maximum service livetime and measurement performance.

The HTP501 is typically deployed in drying processes with high temperatures like wood, pasta or brick drying.

The HTP501 provides the measured data at its digital RS485 interface via Modbus RTU protocol. The M12x1 connector links the probe to the digital infrastructure.

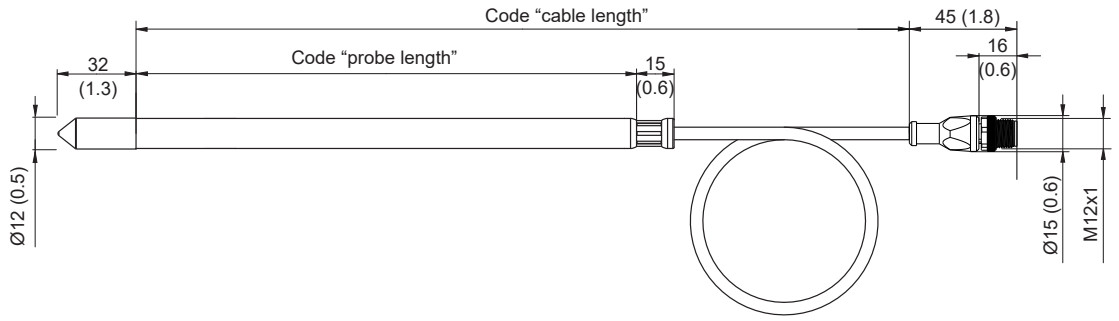


Fig. 1 HTP501 probe

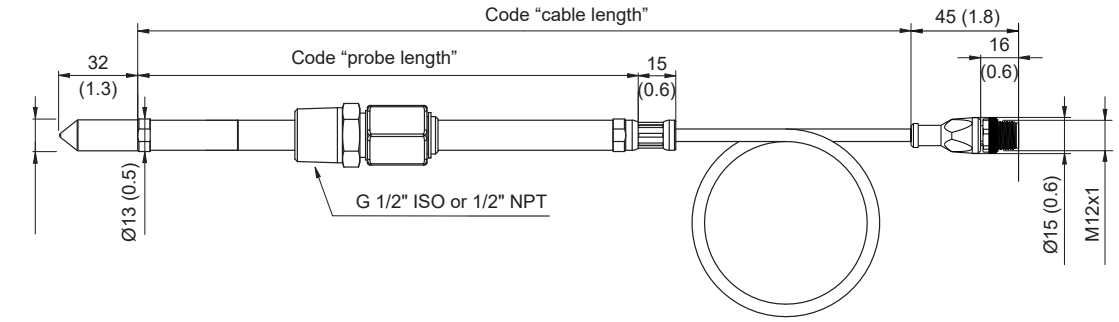
3.2 Dimensions

Values in mm (inch)

Type T4



Type T10



3.3 E+E Shield Technologies

E+E Shield Technologies

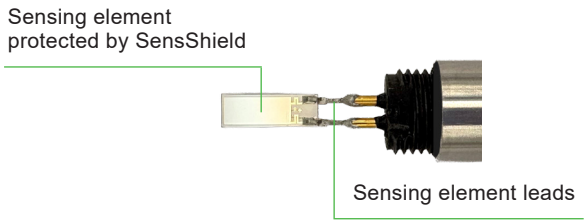
Every application has its own specific protection requirements. To ensure optimum long-term stability, maximum service life and minimum maintenance effort, E+E shield technologies can be combined to meet specific application requirements.

PLEASE NOTE

The use of E+E Shield technologies influences the sensor's temperature working range and RH response times.

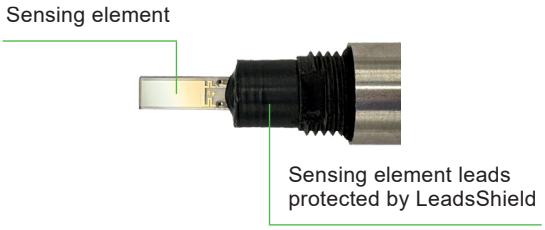
SensShield – Protective Sensing Element Coating

The E+E SensShield is a protective coating applied to the sensing elements, their leads and soldering points. The coating substantially extends sensor lifetime in general industrial applications and ensures optimal measurement performance in moderately corrosive environment (salts, off-shore applications). Additionally, it improves the sensor's long-term stability in dusty, dirty or oily applications by preventing stray impedance caused by deposits on the active sensor surface or on the electrical connections.



LeadsShield – Protective Sensor Leads Encapsulation

In certain highly aggressive environments, the sensing element leads are particularly subject to corrosion. The E+E LeadsShield sensor leads encapsulation can prevent the corrosion process and considerably extend the sensor's lifetime.



ChemShield – Protection Against Chemical Contamination

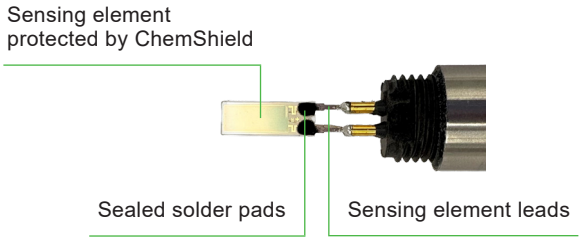
The E+E ChemShield is a protective barrier against chemical contamination of the sensing element. In applications with potential chemical contamination, ChemShield prevents drift effects in the polymer structure of the element. This improves long-term stability and thus reduces maintenance requirements.

INFORMATION

Please observe the minimum temperature of 0 °C (32 °F) when using the ChemShield technology.

PLEASE NOTE

Higher protection levels, including ChemShield, result in longer RH response times.



3.4 Electrical Connection

⚠ WARNING

Incorrect installation, wiring or power supply may cause overheating and therefore personal injuries or damage to property.

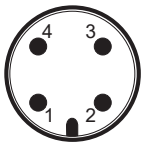
For correct cabling of the device, always observe the presented wiring diagram for the product version used.

The manufacturer cannot be held responsible for personal injuries or damage to property as a result of incorrect handling, installation, wiring, power supply and maintenance of the device.

The relations of electrical potential between a bus system and an HTP501 probe are characterized by the following properties:

- The bus connection is not electrically isolated from the supply connection
- The HTP501 is not electrically isolated from the supply voltage
- Each HTP501 can be supplied separately

Plug for supply and analogue output



M12 device plug
front view

Pin	Assignment
1	Supply voltage 8 - 35 V DC class III ⧫ (Europe) / class 2 (North America)
2	B RS485 (D-)
3	GND
4	A RS485 (D+)

PLEASE NOTE

The sensor tube must always be earthed for DNV EMC.

4 Mounting and Installation

NOTICE

To maintain its integrity, do not route the probe cable over sharp edges. The cable's minimum bend radius is 5x the cable diameter in fixed installations and 10x the cable diameter when occasionally flexing the cable.

4.1 Probe Type T4

4.1.1 Non-pressure Installation

Best measurement performance is achieved when the entire probe is located inside the environment to be monitored.

In such a case, the HTP501 may be for instance fixed onto a wall with the stainless steel mounting clip HA010225 (not included in the scope of supply, see data sheet "Accessories"), or freely hang from the ceiling on the connection cable.

PLEASE NOTE

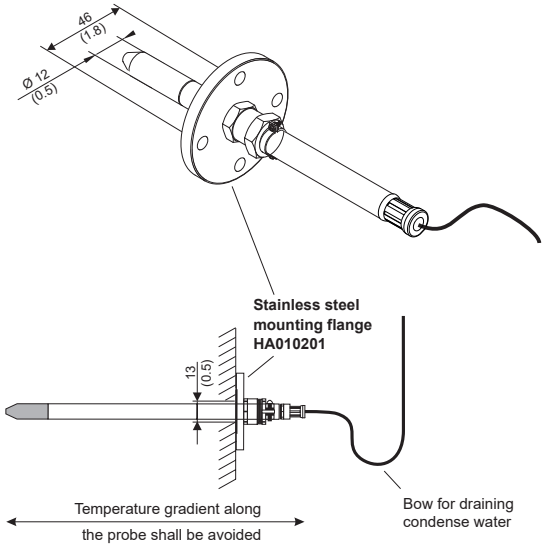
The sensing probe must be mounted horizontally or vertically, pointing downwards. If possible, a drip sheet should be fitted for each mounting.

PLEASE NOTE

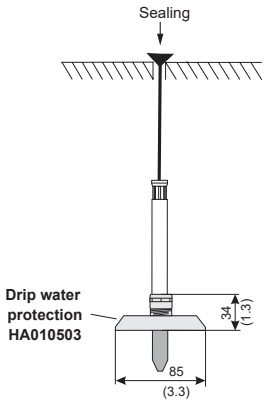
For probe hanging by its cable from the ceiling in applications where condensation is likely to happen it is important to avoid condense water getting from the cable to the probe and into the sensing head. For this purpose, use the drip water protection (see chapter 7 Accessories).

In a non-pressure-tight installation, the probe can be fitted into a duct using the stainless steel flange HA010201 (not included in the scope of supply, see data sheet “Accessories”).

Probe into seperation wall

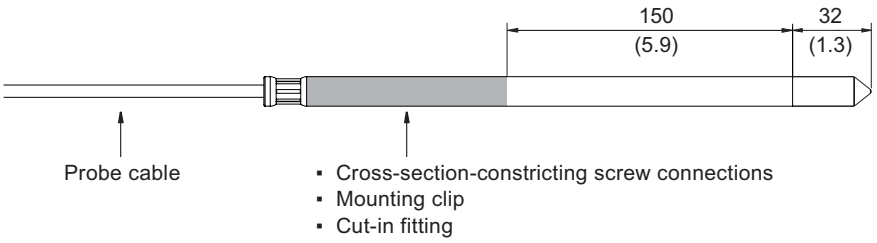


Hanging probe



Dimensions in mm (inch)

Fig. 2 HTP501 mounting



Dimensions in mm (inch)

Fig. 3 HTP501 zone for cross-section-constricting fastening

4.1.2 Remote Probe T4 with Optional Cut-in Fitting

For pressure-tight installation up to 20 bar (290 psi), a pressure-tight feedthrough is available as an accessory (see chapter 7 Accessories).

INFO

Optionally, there is a SWAGElok fitting available.

Order code:

- ISO HA011102
- NPT HA011103

WARNING

Working with pressurised pipes poses a considerable risk of injury and damage to property.

The installation, commissioning and operation of the HTP501 may be performed by qualified staff. When installing a HTP501-T4 in a pressurised system, precautions must be taken to prevent the sensor from being quickly ejected.

Bending over the sensing probe should be avoided under any circumstances!

Make sure that the surface of the probe is not damaged during installation. A damaged probe surface may lead to damaged seals and consequently to leakage and pressure loss.

⚠ WARNING

The internal feed-through (to the electronics) is suitable for up to 20 bar (290 psi). The actual working pressure (<20 bar (<290 psi)) will be determined by the choice of feed-through. In principle, non-cross-section narrowing and cross-section narrowing (cut-in) fittings can be used; cross-section narrowing fittings are only permitted in the rear part, as shown in Fig. 3 (grey area from 32 + 150 mm from the probe tip; applying a mounting clip is also only permitted in the grey marked area).

The probe is rated with leakage rate B according to EN12266-1.

⚠ CAUTION

Safety instructions for pressure-tight feedthrough:

Do not assemble the probe and tighten the feedthrough if the plant is under pressure.

The plant must not be vented by releasing the nut (A).

Use appropriate seal on conical probe threads.

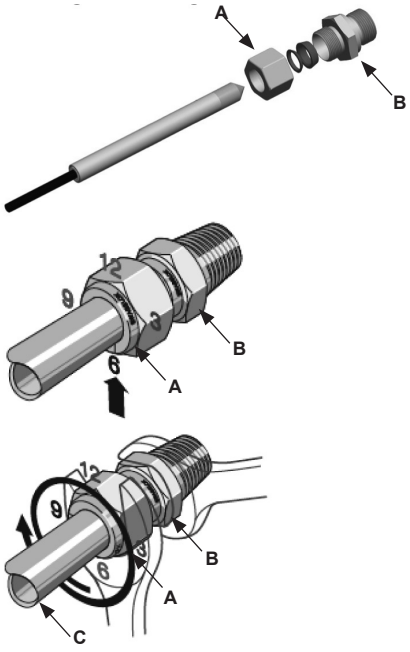
Never rotate the screw connection body (B) but hold the screw connection body (B) securely and turn the nut (A).

Avoid unnecessary disassembly of pipe screw connections.

NOTICE

Please refer to Fig. 3 HTP501 fastening zone for a safe and damage-free installation.

Installation instructions



- Tighten the nut (A) finger-tight.
- Mark the nut (A) at 6 o‘clock position.
- Hold the screw connection body (B) tight and tighten the nut (A) with 1 ¼ turns till 9 o’clock position.

Assembly with high pressure applications and applications with a high security factor:

- Tighten the nut (A) until the probe (C) can no longer be turned by hand and moved axially in the feedthrough.
- Mark the nut (A) at 6 o’clock position.
- Hold the screw connection body (B) tight and tighten the nut (A) with 1 ¼ turns to 9 o’clock position.

Re-mounting:

- Slide the measurement probe with clamping ring into the fitting as far as it goes.
- Tighten the nut finger-tight, then tighten by approx. a ¼ turn using a spanner.

4.2 Probe Type T10

4.2.1 Installation Directly in the Process

NOTICE

For direct probe installation shut-off valves shall be placed on both sides of the probe insert (see Fig. 4 Installation of the HTP501-T10 probe directly into the process). This allows the sensor probe to be easily removed for maintenance and calibration.

For direct installation into a pressure chamber make sure that the pressure in the chamber and the ambient pressure are equal before removing the probe. The temperature during probe installation may deviate by max. ±40 °C (±72 °F) from the regular temperature during normal operation.

Replace the metal sealing ring (see Fig. 4) by a new one every time before re-installing the probe.

Probe installation steps

1. Close both shut-off valves.
2. Place the sensor probe into the probe insert and adjust the immersion depth.
3. Tighten the lock nut with a torque of 30 Nm.
4. Open the shut-off valves.

⚠ WARNING

Observe strictly the tightening torque. A torque lower than 30 Nm results in a smaller retention force of the clamping sleeve. This leads the risk of sudden expulsion of the sensing probe due to the pressure. A torque higher than 30 Nm may lead to permanent deformation of the clamping sleeve and the sensing probe. This would make the removal and re-installation of the probe difficult or even impossible.

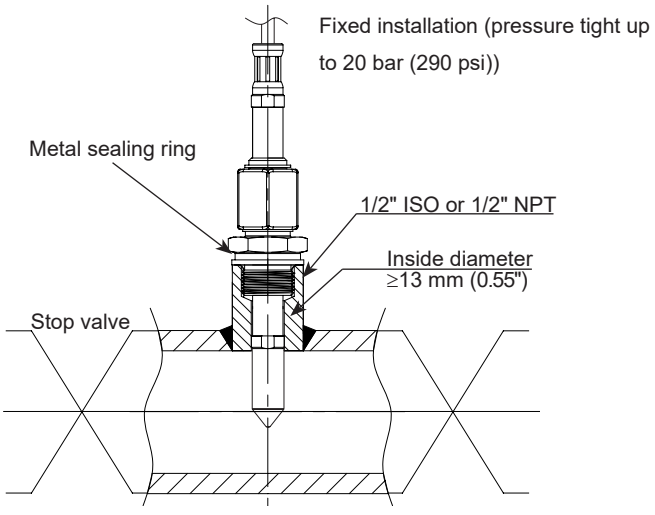


Fig. 4 Installation of the HTP501-T10 probe directly into the process

4.2.2 Installation with Ball Valve Set

The ball valve set allows for installation and removal of the probe without process interruption.
For mounting into a duct, the ball valve shall be installed perpendicular to the flow direction.

NOTICE

The two metal sealing rings (see Fig. 5 Installation of the probe by utilizing the ball valve set) shall be replaced every time prior to re-installing the probe.

The temperature during probe installation may deviate by max. ±40 °C (±72 °F) from the regular temperature during normal operation.

Installation of the probe (see Fig. 5)

1. Install the probe into the ball valve while the ball valve is closed.
2. Open the ball valve.
3. Slide the probe through the ball valve to the desired immersion depth. Depending on the process pressure additional tools may be necessary for pushing the probe into the process. Make sure not to damage the probe and the cable.
4. Tighten the lock nut with a torque of 30 Nm.

⚠ WARNING

Observe strictly the tightening torque. A torque lower than 30 Nm results a smaller retention force of the clamping sleeve. This leads the risk of sudden expulsion of the sensing probe due to the pressure. A torque higher than 30 Nm may lead to permanent deformation of the clamping sleeve and the sensing probe. This would make the removal and re-installation of the probe difficult or even impossible.

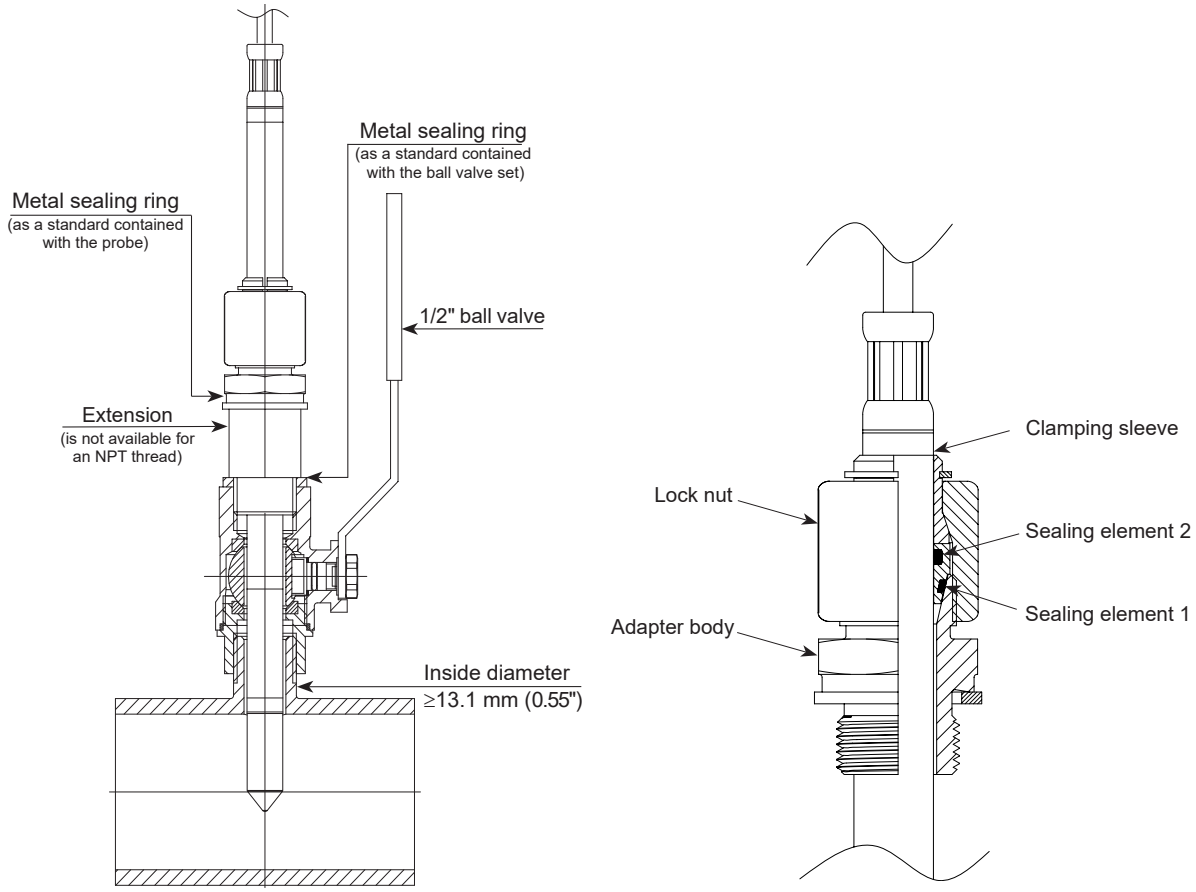


Fig. 5 Installation of the probe by utilizing the ball valve set

Removing the probe

1. Hold firmly the probe to avoid it being suddenly expulsed when releasing the lock. Do not bend damage the probe cable.
2. Loosen slowly the lock nut with a spanner (spanner width 24) only till the probe is pushed out by the overpressure in the process. Do not completely loosen the lock nut, but only as much as necessary for the probe to slide.
3. After the probe has been pushed out of the process up to the stop, close the ball valve.
4. Remove the probe from the ball valve.

NOTICE

Observe the correct positioning of the sealing element 1 before reinstalling the probe.

4.3 Recommendations for Accurate Humidity and Temperature Measurement

- In case the HTP501 probe is not entirely located in the environment to be monitored, large temperature differences along the probe will lead to temperature gradients. These will have an influence on the accuracy. Therefore, it is of paramount importance to minimize the temperature gradients. The biggest part of the probe shall be located in the target environment and the rest shall be thermally well insulated.
- For outdoor applications the HTP501 shall be equipped with a radiation shield (HA010502) which provides protection from rain, snow and ice. This also causes a natural ventilation which largely prevents overheating of the probe in the sun and thus a distortion of the measured values.
- For highest accuracy of the measured humidity and the calculated parameters (e.g. wet bulb temperature, dew point and others), the user can set the barometric pressure at the operating point, using the PCS10 Product Configuration Software or via Modbus protocol (see chapter 5 Setup and Adjustment). The factory setting is 1013.25 mbar.

5 Setup and Adjustment

The HTP501 is ready to use and does not require any configuration by the user. The factory setup of HTP501 corresponds to the specified order code. Please refer to the datasheet at www.epluse.com/htp501. If needed, the user can change the factory setup with the help of the free PCS10 Product Configuration Software and the Modbus configuration adapter (order code HA011018). Refer to chapter 5.1 below.

5.1 PCS10 Product Configuration Software

The PCS10 provides a convenient graphical user interface to the HTP501. To use the software for performing adjustments and changes in settings, please proceed as follows:

1. Download the PCS10 Product Configuration Software from www.epluse.com/pcs10 and install it on the PC.
2. Connect the HTP501 to the PC using the Modbus configuration adapter.
3. Start the PCS10 software.
4. Follow the instructions on the PCS10 opening page for scanning the ports and identifying the connected device.
5. Click on the desired setup or adjustment mode from the main PCS10 menu on the left. Follow the online instructions of the PCS10 which are displayed when clicking the “Tutorial” button.
6. Changes are uploaded to the probe by pressing the “Sync” button.

NOTICE

The HTP501 may not be connected to any additional power supply when using the Modbus configuration adapter HA011018.

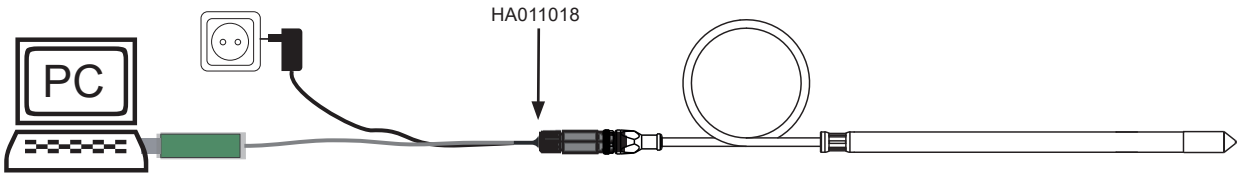


Fig. 6 HTP501 connected to a PC running PCS10

Besides an individual probe naming, the communication parameters may be changed. For the purpose of pressure compensation, the barometric air pressure at the operating site may be set. The custom Modbus map can be configured. Refer to chapter 5.4 Configurable Custom Modbus Map.

A 1- and 2-point adjustment may be carried out and the factory setup may be restored again. See chapter 6.4 RH and T Calibration and Adjustment.

The configuration of an individual probe may be exported and imported.

5.2 Modbus Setup

	Factory settings	Selectable values (via EE-PCS)
Baud rate	9 600	9 600, 19 200, 38 400, 57 600, 76 800, 115 200
Data bits	8	8
Parity	Even	None, odd, even
Stop bits	1	1, 2
Modbus address	69	1...247

Tab. 1 Modbus RTU protocol settings

PLEASE NOTE

- The recommended settings for multiple devices in a Modbus RTU network are 9600, 8, even, 1.
- The HTP501 represents 1 unit load on an RS485 network.

Device address, baud rate, parity and stop bits can be set via:

- PCS10 Product Configuration Software and the Modbus configuration adapter HA011018.
  The PCS10 can be downloaded free of charge from www.epluse.com/pcs10.
- Modbus protocol in the register 1 (0x00) and 2 (0x01).
  See Application Note Modbus AN0103 (available at www.epluse.com/htp501).

The serial number as ASCII-code is located in read-only registers 1 - 8 (0x00 - 0x07).
The firmware version is located in read-only register 9 (0x08) (bit 15...8 = major release; bit 7...0 = minor release).
The sensor name as ASCII-code is located in read-only registers 10 - 17 (0x09 - 0x11).

NOTICE

When reading information that spans multiple registers, it is always necessary to read all registers, even if the desired information requires less.

NOTICE

For obtaining the correct floating point values, both registers have to be read within the same reading cycle. The measured value can change between two Modbus requests, exponent and mantissa may get inconsistent then.

INFO

The Modbus function codes mentioned throughout this document shall be used as described in chapter 6 of of MODBUS APPLICATION PROTOCOL SPECIFICATION V1.1b3, available at https://www.modbus.org/.

Communication settings (INT16)

Parameter	Register number[1] [Dec]	Register address[2] [Hex]	Size[3]
Write register: function code 0x06			
Modbus address[4]	1	00	1
Modbus protocol settings[4]	2	01	1

Device information (INT16)

Parameter	Register number[1] [Dec]	Register address[2] [Hex]	Size[3]
Read register: function code 0x03 / 0x04			
Serial number (as ASCII)	1	00	8
Firmware version	9	08	1
Sensor name (as ASCII)	10	09	8
Device status (bit decoded)[5]	602	259	1

Application Parameter (FLOAT32)

Parameter	Register number[1] [Dec]	Register address[2] [Hex]	Size[3]
Read register: function code 0x03 / 0x04 Write register: function code 0x10			
Air pressure[6]	5001	1388	1

1) Register number (decimal) starts from 1.
2) Register address (hexadecimal) starts from 0.
3) Number of registers
4) For Modbus address and protocol settings see Application Note Modbus AN0103 (available at www.epluse.com/htp501).
5) See chapter 5.5 Device Status Indication.
6) Ambient pressure in mbar, with 2 decimal digits, default value 1 013.25 mbar.

Tab. 2 HTP501 registers for device setup

5.3 Modbus Register Map

The measurement data is saved as 32 bit floating point values (data type FLOAT32) and as 16 bit signed integer values (data type INT16).

FLOAT32

Parameter	Unit	Register number[1)] [DEC]	Register address[2)] [HEX]
Read register: function code 0x03 / 0x04			
Temperature T	°C	1003	3EA
	°F	1005	3EC
	K	1009	3F0
Relative humidity RH, Uw	%RH	1021	3FC
Water vapour partial pressure e	mbar	1101	44C
	psi	1103	44E
Dew point temperature Td	°C	1105	450
	°F	1107	452
	°K	1147	47A
Wet bulb temperature Tw	°C	1109	454
	°F	1111	456
	K	1145	478
Absolute humidity dv	g/m^3	1113	458
	gr/ft^3	1115	45A
Mixing ratio r	g/kg	1121	460
	gr/lb	1123	462
Specific enthalpy h	kJ/kg	1125	464
	ft lbf/lb	1127	466
	BTU/lb	1129	468
Frost point temperature Tf	°C	1131	46A
	°F	1133	46C
	K	1149	47C
Ice bulb temperature Ti	°C	1237	4D4
	°F	1239	4D6
	K	1241	4D8

INT16

Parameter	Unit	Scale[3)]	Register number[1)] [DEC]	Register address[2)] [HEX]
Read register: function code 0x03 / 0x04				
Temperature T	°C	100	4002	FA1
	°F	50	4003	FA2
	K	50	4005	FA4
Relative humidity RH, Uw	%RH	100	4011	FAA
Water vapour partial pressure e	mbar	10	4051	FD2
	psi	1000	4052	FD3
Dew point temperature Td	°C	100	4053	FD4
	°F	100	4054	FD5
	K	100	4074	FE9
Wet bulb temperature Tw	°C	100	4055	FD6
	°F	100	4056	FD7
	K	100	4073	FE8
Absolute humidity dv	g/m^3	10	4057	FD8
	gr/ft^3	10	4058	FD9
Mixing ratio r	g/kg	10	4061	FDC
	gr/lb	10	4062	FDD
Specific enthalpy h	kJ/kg	1	4063	FDE
	ft lbf/lb	1	4064	FDF
	BTU/lb	1	4065	FE0
Frost point temperature Tf	°C	100	4066	FE1
	°F	100	4067	FE2
	K	100	4075	FEA
Ice bulb temperature Ti	°C	100	4119	1016
	°F	100	4120	1017
	K	50	4121	1018

1) Register number (decimal) starts from 1
2) Register address (hexadecimal) starts from 0
3) Examples: For scale 100, the reading of 2550 means a value of 25.5. For scale 50, the reading of 2550 means a value of 51.

Tab. 3 HTP501 FLOAT32 and INT16 measured data registers

5.4 Configurable Custom Modbus Map

It is possible to map measured value/status registers arbitrarily in a block with up to 20 registers provided for this purpose. This means that registers of interest may be mapped in an area with consecutive registers, so that important values can be queried with a single command in one block.

The register block for the configuration of the customisable Modbus map consists of the registers 6001 (0x1770) to 6010 (0x1779). For the blockwise query of the measured values behind Modbus registers 3001 (0xBB8) to 3020 (0xBCB), the firmware accesses this configuration area and thus gets the information which measured value/status registers are to be output. A maximum of 10 user-defined registers can be mapped. The table below shows an example:

Registers ...		**... with these assigned measurands ...**			**... map to registers ...**		**... mirrored from source registers**	
Dec	**Hex**	**Meas.**	**Unit**	**Type**	**Dec**	**Hex**	**Dec**	**Hex**
Function code 0x10					*Function code 0x03/0x04*			
6001	1770	Status	-	INT16	3001	BB8	602	259
6002	1771	RH	%	FLOAT32	3002	BB9	1021	3FC
				FLOAT32	3003	BBA	1022	3FD
6003	1772	T	°C	FLOAT32	3004	BBB	1003	3EA
				FLOAT32	3005	BBC	1004	3EB
6004	1773	Td	°C	FLOAT32	3006	BBD	1105	450
				FLOAT32	3007	BBE	1106	451
6005	1774	Tw	°C	FLOAT32	3008	BBF	1109	454
				FLOAT32	3009	BC0	1110	455
6006	1775	T	°F	FLOAT32	3010	BC1	1005	3EC
				FLOAT32	3011	BC2	1006	3ED
6007	1776	Td	°F	FLOAT32	3012	BC3	1107	452
				FLOAT32	3013	BC4	1108	453
6008	1777	RH	%	INT16	3014	BC5	4011	FAA
6009	1778	T	°C	INT16	3015	BC6	4002	FA1
6010	1779	T	°F	INT16	3016	BC7	4003	FA2
					3017	BC8	65536	FFFF
					3018	BC9	65536	FFFF
					3019	BCA	65536	FFFF
					3020	BCB	65536	FFFF

Tab. 4 Custom Modbus map example

The custom map can be configured via:

- PCS10 Product Configuration Software and the USB configuration cable HA011018.
  The PCS10 can be downloaded free of charge from www.epluse.com/pcs10.
- Modbus protocol commands, refer to the example in chapter 5.6 Modbus RTU Examples.

5.5 Device Status Indication

If a critical error occurs, all Modbus values are set to NaN (according to IEEE754 for data type FLOAT32) or to 0x8000 (INT16). It is possible to read out all status and error information via Modbus register 602 (0x259). Errors are displayed in bit-coded form. If an event is present, the corresponding bit is set to 1.

Measured values outside the measuring range are limited with the corresponding limit value.

Error Bits	Description	Recommended action
Bit 0	Error: Hardware T-sensing	Return the unit to the E+E Customer Service
Bit 1	Error: Short circuit of T sensing element	Clean sensing head acc. to cleaning instructions Return the faulty unit to E+E for service
Bit 2	Error: Open loop of T sensing element	Return the unit to the E+E Customer Service
Bit 3	Error: Short circuit of RH sensing element	Clean sensing head acc. to cleaning instructions Return the faulty unit to E+E for service
Bit 4	Error: Open loop of RH sensing element or heavy pollution	Clean sensing head acc. to cleaning instructions Return the faulty unit to E+E for service
Bit 5	Warning: Polluted RH sensing element	Clean sensing head acc. to cleaning instructions
Bit 6	Warning: Temperature below allowed working range	Observe the lower working range limit
Bit 7	Warning: Temperature above allowed working range	Observe the upper working range limit
Bit 8	Error: T sensing element defective	Return the unit to the E+E Customer Service
Bit 9	Warning: RH below allowed working range	Observe the lower working range limit
Bit 10	Warning: RH above allowed working range	Observe the upper working range limit
Bit 11	Error: RH sensing element defective	Return the unit to the E+E Customer Service
Bit 12	Error: Hardware RH sensing	Return the unit to the E+E Customer Service
Bit 13	-	-
Bit 14	-	-
Bit 15	-	-

Tab. 5 Device status indication

5.6 Modbus RTU Examples

The HTP501's Modbus address is 69 [0x45].

Please refer to

- Chapter 6 of MODBUS APPLICATION PROTOCOL SPECIFICATION V1.1b3, available at https://www.modbus.org/.
- E+E Application Note Modbus AN0103 (available at www.epluse.com/htp501)

Read the temperature (FLOAT32) T = 25.087642669677734375 °C from register address 0x3EA:

Master (e.g. PLC) → **HTP501**

Request [Hex]:

Modbus address	Function code	Starting address Hi	Starting address Lo	Qty. of registers Hi	Qty. of registers Lo	CRC
45	03	03	EA	00	02	EA FF

Response [Hex]:

Modbus address	Function code	Byte count	Register 1 value Hi	Register 1 value Lo	Register 2 value Hi	Register 2 value Lo	CRC
45	03	04	B3	7E	41	C8	89 D6

Floating point values are decoded according to IEEE754, please refer to the example at the end of this chapter.

Read register from custom modbus map

address 0x0BB8-0x0BB9, unconfigured

Request [Hex]:

Modbus address	Function code	Starting address Hi	Starting address Lo	Qty. of registers Hi	Qty. of registers Lo	CRC	
45	03	0B	B8	00	02	49	4E

Response [Hex]:

Modbus address	Function code	Byte count	Register 1 value Hi	Register 1 value Lo	Register 2 value Hi	Register 2 value Lo	CRC	
45	03	04	FF	FF	FF	FF	FF	A3

Mapping custom Modbus map

assign RH (register address 0x3FC) and T [°C] (register address 0x3EA) to the custom Modbus map, starting address 0xBB8

Request [Hex]:

Modbus address	Function code	Starting address Hi	Starting address Lo	Qty. of registers Hi	Qty. of registers Lo	Byte count
45	10	17	70	00	02	04

Register 1 value Hi	Register 1 value Lo	Register 2 value Hi	Register 2 value Lo	CRC	
03	FC	03	EA	1E	81
(RH)		(T [°C])			

Response [Hex]:

Modbus address	Function code	Starting address Hi	Starting address Lo	Qty. of registers Hi	Qty. of registers Lo	CRC	
45	10	17	70	00	02	4A	E3

Poll register address 0xBB8 (RH mapped)

Request [Hex]:

Modbus address	Function code	Starting address Hi	Starting address Lo	Qty. of registers Hi	Qty. of registers Lo	CRC	
45	03	0B	B8	00	02	49	4E

Response [Hex]:

Modbus address	Function code	Byte count	Register 1 value Hi	Register 1 value Lo	Register 2 value Hi	Register 2 value Lo	CRC	
45	03	04	96	15	41	9A	72	40

Poll register address 0xBB8-0xBBD (RH and T mapped, one register empty)

Request [Hex]:

Modbus address	Function code	Starting address Hi	Starting address Lo	Qty. of registers Hi	Qty. of registers Lo	CRC	
45	03	0B	B8	00	06	48	8D

Response [Hex]:

Modbus address	Function code	Byte count	Register 1 value Hi	Register 1 value Lo	Register 2 value Hi	Register 2 value Lo	Register 3 value Hi
45	03	0C	1C	B2	41	9E	6B

Register 3 value Lo	Register 4 value Hi	Register 4 value Lo	Register 5 value Hi	Register 5 value Lo	Register 6 value Hi	Register 6 value Lo	CRC	
28	41	C2	FF	FF	FF	FF	70	6C

Decoding of floating point values:

Floating point values are stored according to IEEE754. The byte pairs 1, 2 and 3, 4 are transformed as follows (numbers taken from T reading Modbus request/response example above):

Modbus response [Hex]

Register 1 Hi [3]	Register 1 Lo [4]	Register 2 Hi [1]	Register 2 Lo [2]
B3	7E	41	C8
MMMMMMMM	MMMMMMMM	SEEEEEEE	EMMMMMMM

Tab. 6 Modbus response

IEEE754

Register 2 Hi [1]	Register 2 Lo [2]	Register 1 Hi [3]	Register 1 Lo [4]
41	C8	B3	7E
0100 0001	1100 1000	1011 0011	0111 1110
SEEE EEEE	EMMM MMMM	MMMM MMMM	MMMM MMMM
Decimal value: 25.087642669677734375			

Tab. 7 Data representation according to IEEE754

6 Maintenance and Service

HTP501 does not require any special maintenance, nevertheless for high accurate measurements especially over wide RH and T ranges it is recommended to calibrate the probe every 12 months. If needed, the enclosure may be cleaned and the device may be re-adjusted as described below.

6.1 Cleaning

Use a damp soft cloth to remove deposits of dust or dirt from the exterior of the probe. Do not use any solvents or abrasive cleaning agents.

In case of dusty, oily and polluted environment:

- Use a damp soft cloth to remove deposits of dust or dirt from the exterior of the probe. Do not use any solvents or abrasive cleaning agents.
- The filter cap shall be replaced once in a while with an E+E original one (see below).
- If needed, the sensing element of the humidity probe can be cleaned by the user (see cleaning instructions - www.epluse.com/cleaning-instructions).

6.2 Filter Cap Replacement

In a dusty, polluted environment it might be necessary to replace the filter cap once in a while. In most of the cases, a clogged filter shows visible contamination or dirt. Longer response time of the measurement also indicates a clogged filter cap. In such cases, replace the filter by a new, original one, see chapter 6.6 Spare Parts.

Procedure:

1. Turn the filter cap counter-clockwise for removing it.
2. Install the new filter cap fingertight by turning it clockwise.

NOTICE

When replacing a filter cap

- ensure that the sensing element and filter cap do not touch each other
- make sure not to touch or rub the sensing elements.

6.3 Protection during Site Cleaning Operations

During site cleaning or sterilization process, if the HTP501 remains on the measuring site the sensing head can be protected with the optional protection cap for 12 mm (0.47”) probe (HA010783, see datasheet “Accessories”).

In case the probe is removed from the site, it is recommended to apply the protection cap for the M12 cable socket (HA010781) and the one for the HTP501 M12 plug of (HA010782).



Fig. 7
Protection cap
for Ø12 mm (0.47") probe
(ordering code HA010783)



Fig. 9
Protection cap
for M12 socket
(ordering code HA010781)



Fig. 10
Protection cap
for M12 plug
(ordering code HA010782)

6.4 RH and T Calibration and Adjustment

Definition

- **Adjustment**
  the specimen is brought in line with the reference.
- **Calibration**
  the specimen is compared with a reference and its deviation from the reference is documented.

Humidity calibration and adjustment

Depending on the application and the requirements of certain industries, there might arise the need for periodical humidity calibration (comparison with a reference) or adjustment (bringing the device in line with a reference).

Calibration and adjustment at E+E Elektronik

Calibration and/or adjustment can be performed in the E+E Elektronik calibration laboratory. For information on the E+E capabilities in ISO or accredited calibration please see www.eplusecal.com and ww.epluse.com/iso9001cal.

Calibration and adjustment by the user

Depending on the level of accuracy required, the humidity reference can be:

- Humidity Calibrator (e.g. Humor 20), please see www.epluse.com/humor20.
- Hand-held Meter (e.g. Omniport 40), please refer to www.epluse.com/omniport40.
- Humidity Calibration Kit (e.g. E+E Humidity Standards), please see www.epluse.com/htp501.
- An appropriate hand-held device.

6.5 Repairs

Repairs may be carried out by the manufacturer only. The attempt of unauthorized repair excludes any warranty claims.

6.6 Spare Parts

Description	Code
PTFE filter cap	**HA010105**
Metal grid filter cap, polycarbonate body, RAL7035	**HA010106**
Stainless steel sintered filter cap for metal probes	**HA010117**

7 Accessories

For further information please refer to the Accessories datasheet.

Accessories	Code
Modbus configuration adapter, M12 4 poles ←→ USB	**HA011018**
E+E Product Configuration Software (Free download: www.epluse.com/pcs10)	**PCS10**
Humidity calibration kit	**See data sheet** Humidity Calibration Kit
Connector, M12x1 socket, 4 poles, for self assembly	**HA010707**
Stainless steel mounting flange Ø12 mm (0.47")	**HA010201**
Stainless steel wall mounting clip, Ø12 mm (0.47")	**HA010225**
SWAGElok fitting for type T4 Pressure-tight feed-hrough, Ø12 mm (0.47") For probe assembly up to 20 bar (290 psi) **G 1/2" ISO** **1/2" NPT**	 **HA011102** **HA011103**
Y-style splitter, M12x1, 1 plug ←→ 2 sockets, 5 poles	**HA030204**
Protection cap for M12 socket	**HA010781**
Protection cap for M12 plug	**HA010782**
Protection cap for Ø12 mm (0.47") probe, RAL6018	**HA010783**
Drip water protection	**HA010503**

8 Technical Data

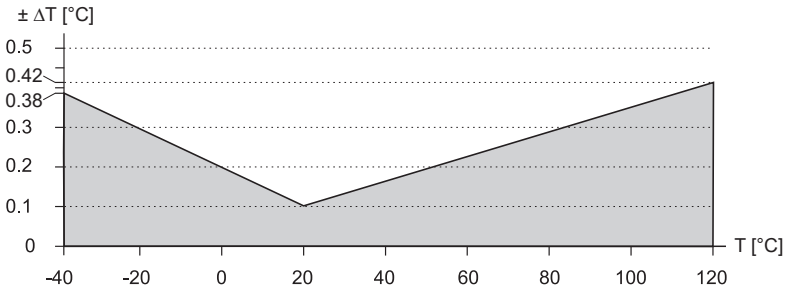
Measurands

Relative humidity (RH)

Measuring range	0...100 %RH
Accuracy[1]	
-15...+40 °C (5…104 °F), RH ≤ 90 %	±(0.95 + 0.0013*mv) %RH
-15...+40 °C (5…104 °F), RH > 90 %	±1.8 %RH
-25...+70 °C (-13…+158 °F)	±(1.05 + 0.0084*mv) %RH
-40...+120 °C (-40…+248 °F)	±(1.15 + 0.013*mv) %RH mv = measured value
Factory calibration uncertainty[2] @ 23 °C (73 °F)	
0...90 %RH	±(0.7 + 0.003*mv) %RH mv = measured value
90...100 %RH	±1 %RH
Response time t_{90} with SensShield and metal grid filter at 20 °C (68 °F)[3]	<15 s

1) Including hysteresis, non-linearity and repeatability.
Defined against E+E calibration reference.
2) Defined with a coverage factor k=2, corresponding to a confidence level of 95 %.
3) Higher protection levels, including ChemShield, result in longer RH response times.

Temperature (T)

Measuring range	-40...+120 °C (-40...+248 °F)
with ChemShield (Options C5, C7)	0...+120 °C (32...248 °F)
Accuracy[1]	
Factory calibration uncertainty[2] @ 23 °C (73 °F)	±0.05 °C (±0.028 °F)

1) Defined against E+E calibration reference.
2) Defined at 23 °C with a coverage factor k=2, corresponding to a confidence level of 95 %.

Calculated quantities[1]

		from		up to		unit	
Dew point temperature	Td	-70	(-94)	130	(266)	°C	(°F)
Frost point temperature[2]	Tf	-70	(-94)	0	(32)	°C	(°F)
Wet bulb temperature	Tw	-10	(14)	100	(212)	°C	(°F)
Ice bulb temperature[3]	Ti	-80	(-112)	0	(32)	°C	(°F)
Water vapour partial pressure	e	0.00001	(0)	1 013[4]	(14.7)	mbar	(psi)
Mixing ratio	r	0	(0)	550	(3 850)	g/kg	(gr/lb)
Absolute humidity	dv	0	(0)	300	(131)	g/m^3	(gr/ft^3)
Specific enthalpy	h	-70	(-30)	2 800	(1 250)	kJ/kg	(BTU/lb)

1) Td accuracy according to RH and T uncertainties, please use the E+E Humidity Caclulator for details.
2) Equals Td above 0 °C (32 °F).
3) Equals Tw above 0 °C (32 °F).
4) Ambient pressure / customer setting.

Output

Digital

Digital interface	RS485 (HTP501 = 1 unit load)
Protocol **Default settings** **Supported baud rates** **Data types for measured values**	Modbus RTU Baud rate 9 600, parity even, 1 stop bit, Modbus address 69 9 600, 19 200, 38 400, 57 600, 76 800 and 115 200 FLOAT32 and INT16

General

Power supply class III USA & Canada: Class 2 supply necessary, max. voltage 30 V DC	8 - 35 V DC
Power consumption, typ. without termination resistor	40 mW
Electrical connection	M12x1, 4 poles
Pressure working range **for pressure-tight probe type T10**	0.01...20 bar (0.15...290 psi)
Temperature working range **Probe** **Cable** **M12 connector**	 -40...+120 °C (-40...+248 °F) -40...+120 °C (-40...+248 °F) -25...+90 °C (-13...+194 °F)
Storage conditions	-40...+80 °C (-40...+176 °F), 0...95 %RH, non-condensing
Probe material	Stainless steel 1.4404
Cable jacket Please mind the mounting and installing instructions included in the user manual.	HFS 125XL, black, oil and fuel resistant
Protection rating	IP66
Elektromagnetic compability	EN 61326-1:2013 — EN 61326-2-3:2013 — Industrial Environment EN IEC 61326-1:2021 — EN IEC 61326-2-3:2021 — Industrial Environment FCC Part15 Class B — ICES-003 Class B — DNV-CG-0339
Shock and vibration	Tested acc. to EN 60068-2-64, EN 60068-2-27 and DNV-CG-0339
Conformity	CE UKCA DNV [1)]
Type approval	DNV Certificate No. TAA00003FA
Configuration and adjustment	PCS10 Product Configuration Software (free download from www.epluse.com/pcs10) and configuration adapter

1) DNV scope of approval: please refer to ordering guide.

Accuracy of E+E Humidity and Temperature Sensors

The measurement accuracy depends both on the performance of the measuring instrument and on the correct installation in the application.

For best accuracy, every E+E RH and T sensor is multipoint factory adjusted and calibrated in a highly stable RH / T reactor. Using a high-precision dew point mirror as reference, the overall uncertainty of the factory calibration U_{cal} is minimal.

The total measurement uncertainty U_{total} for E+E sensors is calculated in accordance with EA-4/02 (European Accreditation, Evaluation of the Measurement Uncertainty in Calibration) and with GUM (Guide to the Expression of Uncertainty in Measurement) as follows:

$$U_{total} = k \bullet \sqrt{\left(\frac{U_{cal}}{2}\right)^2 + \left(\frac{u_{accuracy}}{\sqrt{3}}\right)^2}$$

U_{total} .....total accuracy incl. factory calibration
U_{cal}.....the uncertainty of the factory calibration
$u_{accuracy}$...the accuracy of the measurement device
k.....coverage factor k=2, corresponding to a confidence level of 95 %.

For external calibrations, U_{total} is to be used as the evaluation criterion. The calculation does not include effects due to long-term drift or chemical exposure.

As National Metrological Institute (NMI) / Designated Institute (DI) responsible for maintaining National Standards in Austria, E+E Elektronik represents the highest level in calibration. For further details, please refer to www.eplusecal.com.

9 Conformity

9.1 Declarations of Conformity

E+E Elektronik Ges.m.b.H. hereby declares that the product complies with the respective regulations listed below:

CE European directives and standards.

and

UKCA UK statutory instruments and designated standards.

DNV DNV (Det Norske Veritas) maritime type approval.

Please refer to the product page at www.epluse.com/htp501 for the Declarations of Conformity.

9.2 Electromagnetic Compatibility

EMC for industrial environment.
The probe is a group 1 device and corresponds to class B.

9.3 FCC Part 15 Compliance Statement

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the installation manual, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

9.4 ICES-003 Compliance Statement

This Class B digital apparatus complies with Canadian ICES-003.

Cet appareil numérique de la classe B est conforme à la norme NMB-003 du Canada.

9.5 DNV Type Approval

Approval standard DNV-CG-0339:2021

Location Classes	
Temperature	D
Humidity	B
Vibration	B
EMC	B
Enclosure	B / IP66

10 Recycling of the Device

PLEASE NOTE

Products from E+E Elektronik Ges.m.b.H. are developed and manufactured in compliance with relevant environmental protection requirements. Please observe local regulations for the disposal of the device.

For disposal, the individual components of the device must be separated according to local recycling regulations. The electronics shall be disposed of correctly as electronics waste.



Fig. 8 HTP501

No.	Part	Material	Recycling Type
1	Probe	Various materials	Electrical and Electronics waste

Tab. 8 Recycling of the HTP501 probe

Company Headquarters &
Production Site

E+E Elektronik Ges.m.b.H.
Langwiesen 7
4209 Engerwitzdorf | Austria
T +43 7235 605-0
F +43 7235 605-8
info@epluse.com
www.epluse.com

Subsidiaries

E+E Sensor Technology (Shanghai) Co., Ltd.
T +86 21 6117 6129
info@epluse.cn

E+E Elektronik France SARL
T +33 4 74 72 35 82
info.fr@epluse.com

E+E Elektronik Deutschland GmbH
T +49 6171 69411-0
info.de@epluse.com

E+E Elektronik India Private Limited
T +91 990 440 5400
info.in@epluse.com

E+E Elektronik Italia S.r.l.
T +39 02 2707 86 36
info.it@epluse.com

E+E Elektronik Korea Ltd.
T +82 31 732 6050
info.kr@epluse.com

E+E Elektronik Corporation
T +1 847 490 0520
info.us@epluse.com

your partner
in sensor
technology.

BA_HTP501 | Version v2.1 | 07-2026
© Copyright E+E Elektronik Ges.m.b.H. | All rights reserved.

www.epluse.com