

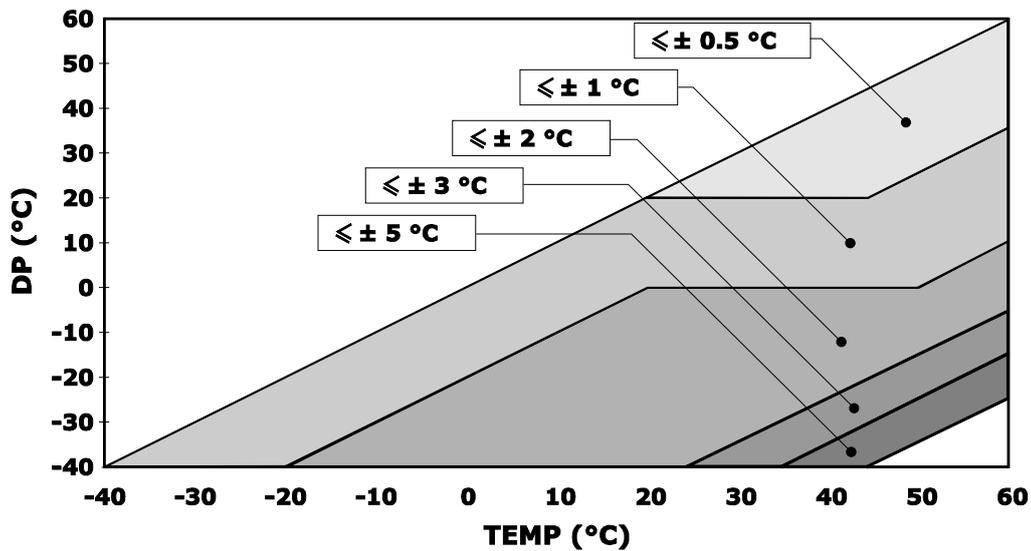
## HD9817TVS

### Humidity and temperature transmitter with analog outputs and RS485 MODBUS-RTU output

Humidity and temperature transmitter for HVAC applications, environmental monitoring, pharmaceutical storage, food transport, greenhouse automation, etc. Equipped with an IP 65 stainless steel AISI 304 housing, it is suitable even for severe environments; besides, its ultra-compact dimensions (Ø 14 x 155 mm) and the 0...1 V analog and RS485 with MODBUS-RTU protocol digital outputs make it ideal for integrating into a variety of OEM applications. It is supplied with 3 m cable terminated with M12 connector.

#### TECHNICAL CHARACTERISTICS

<b>Humidity</b>	
Sensor	Capacitive, with stainless steel grid and PBT filter (P8)
Measuring range	0...100% RH
Resolution	0.1% RH
Accuracy	± 1.5% (0...90% RH) / ± 2% (90...100% RH) @ T=15...35 °C ± (1.5 + 1.5% measure)% @ T= remaining range
Response time at 63% of final variation	< 15 s @ 23 °C (air speed = 1 m/s without filter)
Sensor working temperature	-40...+80 °C
Long term stability	1% / year
<b>Temperature</b>	
Sensor	Pt100 1/3 DIN
Measuring range	-40...+60 °C
Resolution	0.1 °C
Accuracy	± 0.2 °C ± 0.15% of the measured value
Response time at 63% of final variation	< 15 s (without filter)
Long term stability	0.2 °C / year
<b>Dew Point</b>	
Sensor	Parameter calculated from the measurement of temperature and relative humidity
Measuring range	-40...+60 °C
Resolution	0.1 °C
Accuracy	See graph 1
<b>General characteristics</b>	
Outputs	Two 0...1 Vdc analog outputs: one for the relative humidity or the dew point and one for the temperature (RL > 10 kΩ) RS485 output (1 Unit Load) with MODBUS-RTU protocol, not isolated
Power supply	5...30 Vdc
Consumption	4 mA typical @ 12 Vdc
Dimensions	Ø 14 x 155 mm
Degree of protection	IP 65
Operating temperature/humidity	-40...+80 °C for short periods / 0...100% RH



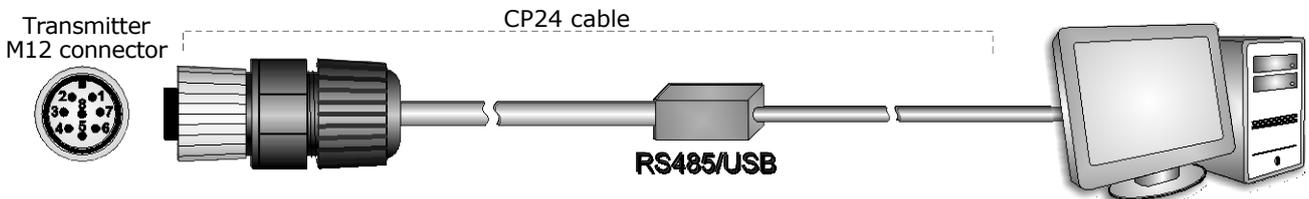
Graph 1 – Accuracy of the Dew Point measurement

### SETTING THE RS485 COMMUNICATION PARAMETERS OF THE TRANSMITTER

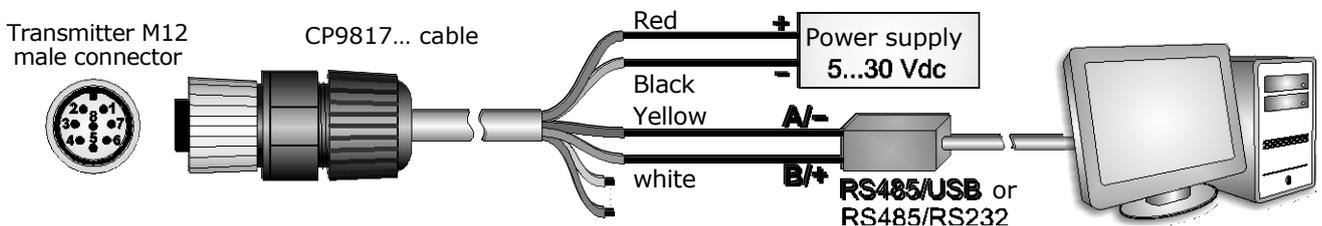
Before connecting the transmitter to the RS485 network, an address must be assigned and the communication parameters be set, if different from the factory preset.

The setting of the parameters is performed by connecting the transmitter to the PC in one of the following two ways:

- A. By using the optional **CP24** cable, with built-in RS485/USB converter. In this connection mode, the transmitter is powered by the PC USB port. To use the cable, it is necessary to install the related USB drivers in the PC.



- B. By using the supplied **CP9817.3** cable and a generic RS485/USB or RS485/RS232 converter. In this connection mode, it is necessary to power the transmitter separately. If a RS485/USB converter is used, it is necessary to install the related USB drivers in the PC.



**NOTES ON THE INSTALLATION OF UNSIGNED USB DRIVER:** before installing unsigned USB driver into operating systems starting from Windows 7, it is necessary to restart the PC by disabling the driver signing request. If the operating system is 64-bit, even after installation the request of driver signing have to be disabled each time the PC is restarted.

## PROCEDURE FOR SETTING THE PARAMETERS

1. Start with the transmitter not powered (if the CP24 cable is used, disconnect one end of the cable).
2. Start a standard serial communication program. Set the COM port number to which the transmitter will be connected, set the Baud Rate to 57600 and the communication parameters as follows:

Data Bits: 8                      Parity: None                      Stop Bits: 2

3. Switch the transmitter on (if the CP24 cable is used, connect both ends of the cable) and wait to receive the **&** character, then send (within 10 s from power on) the **@** command and press **Enter**.

*Note:* if the transmitter does not receive the **@** command within 10 seconds from power on, the RS485 MODBUS mode is automatically activated. In such a case, it is necessary to switch off and on again the transmitter.

4. Send the command **CAL USER ON**.

*Note:* the command CAL USER ON is disabled after 5 minutes of inactivity.

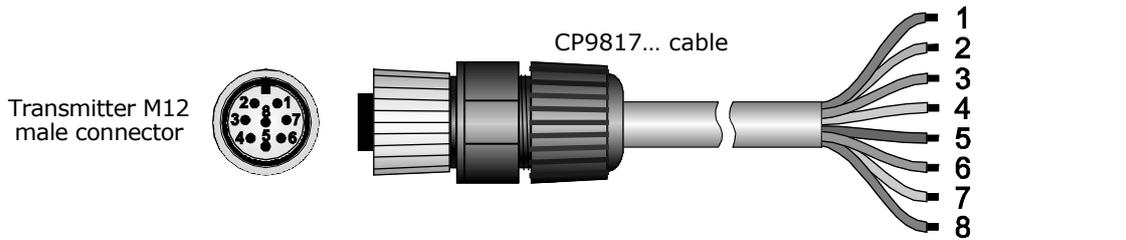
5. Send the serial commands in the following table to set the RS485 MODBUS parameters:

Command	Response	Description
CMA <sub>nn</sub>	&	Set RS485 address to <i>nnn</i> Ranging from 1 to 247. Preset on 1
CMB <sub>n</sub>	&	Set RS485 Baud Rate <i>n</i> =0 ⇒ 9600 <i>n</i> =1 ⇒ 19200 Preset on 1 ⇒ 19200
CMP <sub>n</sub>	&	Set RS485 transmission mode <i>n</i> =0 ⇒ 8-N-1 (8 data bits, no parity, 1 stop bit) <i>n</i> =1 ⇒ 8-N-2 (8 data bits, no parity, 2 stop bits) <i>n</i> =2 ⇒ 8-E-1 (8 data bits, even parity, 1 stop bit) <i>n</i> =3 ⇒ 8-E-2 (8 data bits, even parity, 2 stop bits) <i>n</i> =4 ⇒ 8-O-1 (8 data bits, odd parity, 1 stop bit) <i>n</i> =5 ⇒ 8-O-2 (8 data bits, odd parity, 2 stop bits) Preset on 2 ⇒ 8-E-1
CMW <sub>n</sub>	&	Set receiving mode after RS485 transmission <i>n</i> =0 ⇒ Violate protocol and go in Rx mode right after Tx <i>n</i> =1 ⇒ Respect protocol and wait 3.5 characters after Tx Preset on 1 ⇒ Respect the protocol

6. You can check the parameters setting by sending the following serial commands:

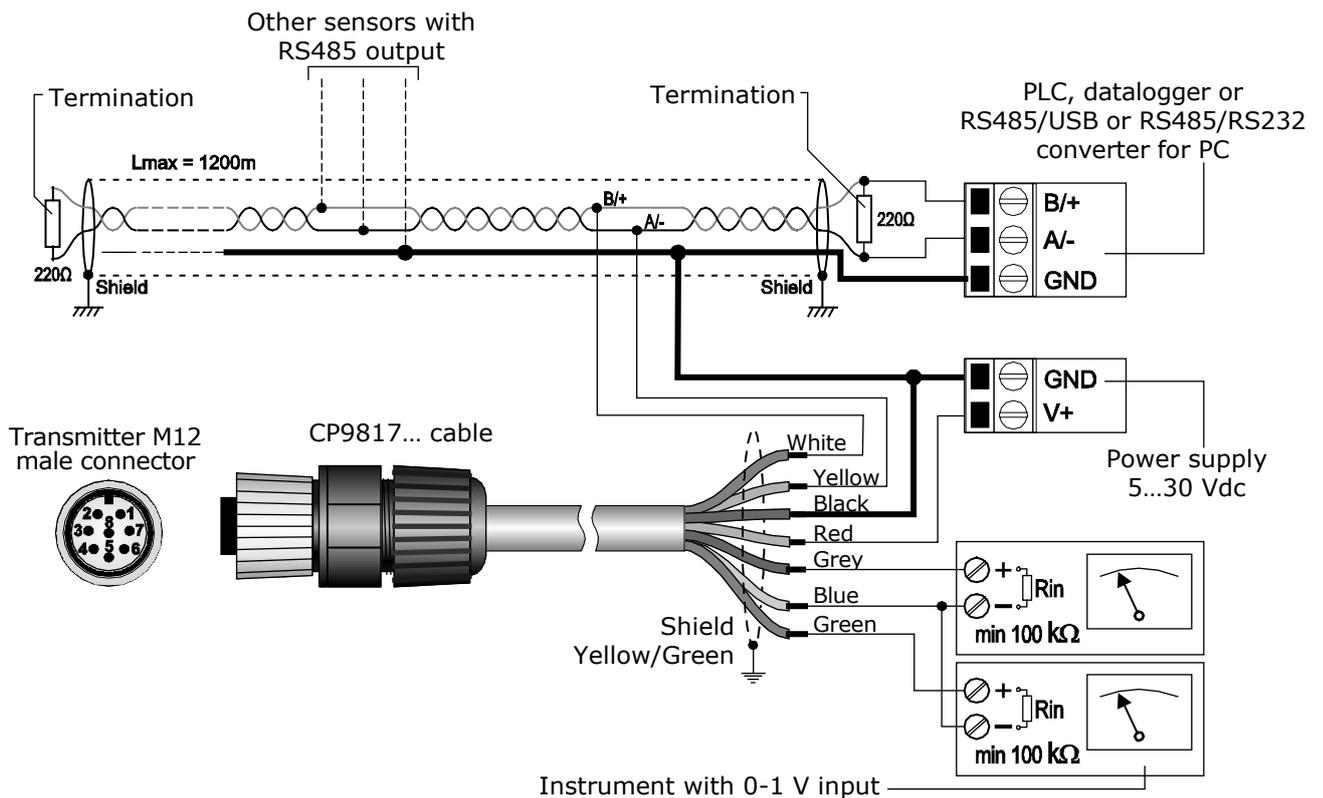
Command	Response	Description
RMA	<i>Address</i>	Read RS485 address
RMB	<i>Baud Rate</i> (0,1)	Read RS485 Baud Rate 0 ⇒ 9600 , 1 ⇒ 19200
RMP	<i>Tx Mode</i> (0,1,2,3,4,5)	Read RS485 transmission mode 0 ⇒ 8-N-1 1 ⇒ 8-N-2 2 ⇒ 8-E-1 3 ⇒ 8-E-2 4 ⇒ 8-O-1 5 ⇒ 8-O-2
RMW	<i>Rx Mode</i> (0,1)	Read receiving mode after RS485 transmission 0 ⇒ Violate protocol and go in Rx mode right after Tx 1 ⇒ Respect protocol and wait 3.5 characters after Tx

## OPERATING MODE CONNECTION



Connector	Function	Color
1	Power supply negative	Black
2	Power supply positive	Red
3	Not connected	
4	RS485 A/-	Yellow
5	RS485 B/+	White
6	Analog output negative	Blue
7	Temperature analog output positive	Grey
8	Humidity analog output positive	Green
	Cable shield (not connected to the M12 connector)	Yellow/Green

Power supply negative and analog output negative are internally shorted.



### Connection of RS485 and 0-1 V voltage analog outputs

In the RS485 connection, the instruments are connected through a twisted-pair shielded cable for signals and a third wire for ground. Line terminations should be placed at the two ends of the network. To polarize the line during non-transmission periods, resistors connected between signal lines and power supply are used. The maximum number of devices that can be connected to the RS485 line (Bus) depends on the load characteristics of the devices to be connected. The RS485 standard requires that the total load does not exceed 32 unit loads. The load of an HD9817TVS transmitter is equal to 1 unit load. If the total load is greater than 32 unit loads, divide the network into segments and add a signal repeater between a segment and the successive one. Line termination should be applied at both ends of each segment.

## OPERATING MODE

The transmitter enters RS485 MODBUS-RTU mode after 10 seconds from power on. In the first 10 seconds from power on the transmitter does not reply to requests from the MODBUS master unit. After 10 seconds, it is possible to send MODBUS requests to the transmitter.

## READING OF THE MEASURES WITH THE MODBUS-RTU PROTOCOL

In MODBUS mode, you can read the values measured by the instrument through the function code 04h (Read Input Registers). The following table lists the information available with the appropriate register address:

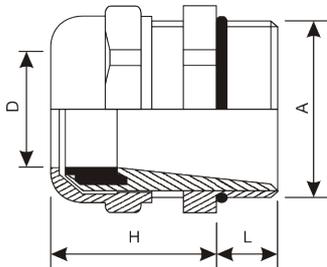
Address	Quantity	Format
0	Temperature in °C (x10)	16-bit Integer
1	Temperature in °F (x10)	16-bit Integer
2	Relative humidity in % (x10)	16-bit Integer
3	Dew Point in °C (x10)	16-bit Integer
4	Dew Point in °F (x10)	16-bit Integer
5	Wet bulb temperature in °C (x10)	16-bit Integer
6	Wet bulb temperature in °F (x10)	16-bit Integer
7	Status register bit 0 = 1 ⇒ temperature measurement error bit 1 = 1 ⇒ humidity measurement error bit 2 = 1 ⇒ dew point calculation error bit 3 = 1 ⇒ configuration data error bit 4 = 1 ⇒ program memory error	16-bit Integer

## INSTALLATION

To fix the probe in a ventilation duct, in a pipe ,etc. you can use the HD9008.31 flange, a PG16 metal cable gland (Ø 10...14 mm) or a 3/8" universal biconical connection.

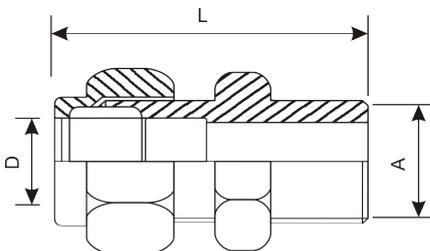


**HD9008.31 Flange**



**PG16.12 metal cable gland**

D = 10...14 mm  
L = 6.5 mm  
H = 23 mm  
A = PG16



**Universal biconical connector**

L = 35 mm  
D = 14 mm  
A = 3/8"

For wall-mounted installation, the HD9008.21.1 (distance from wall 250 mm) and HD9008.21.2 (distance from wall 125 mm) supports are available. Both require the HD9008.26/14 adapter.

## SETTING THE ANALOG OUTPUTS

The analog outputs of the transmitter are preset as follows:

Humidity analog output: 0 V = 0% RH, 1 V = 100% RH  
 Temperature analog output: 0 V = -40 °C, 1 V = +60 °C

It is possible to change the configuration of the transmitter to:

- associate the humidity analog output to the dew point, rather than to the relative humidity;
- change the values of humidity and temperature corresponding to the initial and full scale of the analog outputs;
- add an offset to the analog outputs: 0.2...1 V instead of 0...1 V;
- reverse the direction of the outputs, so that the outputs decrease with the increasing of the corresponding measured quantity.

To configure the analog outputs, proceed as follows:

1. Start with the transmitter not powered.
2. Connect the transmitter to the PC by using the **optional CP24 cable** (as an alternative, use the supplied **CP9817.3** cable and a generic RS485/USB or RS485/RS232 converter; in this connection mode, it is necessary to power the transmitter separately).
3. Start a standard serial communication program. Set the COM port number to which the transmitter will be connected, set the Baud Rate to 57600 and the communication parameters as follows:

Data Bits: 8                      Parity: None                      Stop Bits: 2

4. Switch the transmitter on and wait to receive the **&** character, then send (within 10 s from power on) the **@** command and press **Enter**.

*Note:* if the transmitter does not receive the **@** command within 10 seconds from power on, the RS485 MODBUS mode is automatically activated. In such a case, it is necessary to switch off and on again the transmitter.

5. Send the command **CAL USER ON**.

*Note:* the command CAL USER ON is disabled after 5 minutes of inactivity.

6. Send the serial commands in the following table:

Command	Response	Description
CA1Innn	&	Associates the initial scale of the temperature analog output to the value nnn <i>nnn is the value of the quantity x 10 (ex.: -400 means -40.0). The unit of measurement of the value (°C or °F) is set with commands 00E, 00D</i>
CA1Fnnn	&	Associates the full scale of the temperature analog output to the value nnn <i>nnn is the value of the quantity x 10 (ex.: 600 means +60.0). The unit of measurement of the value (°C or °F) is set with commands 00E, 00D</i>
00E	&	Sets °F as temperature unit of measurement for the values associated to initial and full scale of the analog output
00D	&	Sets °C as temperature unit of measurement for the values associated to initial and full scale of the analog output
CA1oE	&	Adds the offset to the temperature analog output: 0.2...1 V
CA1oD	&	Removes the offset from the temperature analog output: 0...1 V
CA1iE	&	Reverses the direction of the temperature analog output: 1...0 V or 1...0.2 V depending on the presence of the offset
CA1iD	&	Cancel the reversal of the direction of the temperature analog output: 0...1 V or 0.2...1 V depending on the presence of the offset

Command	Response	Description
CA2Innnn	&	Associates the initial scale of the humidity analog output to the value nnnn <i>nnnn is the value of the quantity x 10 (ex.: 100 means 10.0). The quantity associated to the output is set with commands O1E, O1D</i>
CA2Fnnnn	&	Associates the full scale of the humidity analog output to the value nnnn <i>nnnn is the value of the quantity x 10 (ex.: 900 means 90.0). The quantity associated to the output is set with commands O1E, O1D</i>
O1E	&	Associates the humidity analog output to the Dew Point <i>The initial and full scale values of the output are considered in the same unit of measurement as the temperature (O0E and O0D commands)</i>
O1D	&	Associates the humidity analog output to the relative humidity <i>The initial and full scale values of the output are considered in %</i>
CA2oE	&	Adds the offset to the humidity analog output: 0.2...1 V
CA2oD	&	Removes the offset from the humidity analog output: 0...1 V
CA2iE	&	Reverses the direction of the humidity analog output: 1...0 V or 1...0.2 V depending on the presence of the offset
CA2iD	&	Cancels the reversal of the direction of the humidity analog output: 0...1 V or 0.2...1 V depending on the presence of the offset

7. You can check the setting of the outputs by sending the following serial commands:

Command	Response	Description
RA1I	& nnn	Reads the value associated to the initial scale of the temperature analog output
RA1F	& nnn	Reads the value associated to the full scale of the temperature analog output
RA1o	& n	Reads the setting of the offset for the temperature analog output: <ul style="list-style-type: none"> <li>▪ without offset if n=0</li> <li>▪ with offset if n=1</li> </ul>
RA1i	& n	Reads the setting of the direction of the temperature analog output: <ul style="list-style-type: none"> <li>▪ not reversed if n=0</li> <li>▪ reversed if n=1</li> </ul>
RA2I	& nnn	Reads the value associated to the initial scale of the humidity analog output
RA2F	& nnn	Reads the value associated to the full scale of the humidity analog output
RA2o	& n	Reads the setting of the offset for the humidity analog output: <ul style="list-style-type: none"> <li>▪ without offset if n=0</li> <li>▪ with offset if n=1</li> </ul>
RA2i	& n	Reads the setting of the direction of the humidity analog output: <ul style="list-style-type: none"> <li>▪ not reversed if n=0</li> <li>▪ reversed if n=1</li> </ul>
RO	0n	Reads the quantities associated to the analog outputs <ul style="list-style-type: none"> <li>▪ temperature (°C) and UR (%) if n=0</li> <li>▪ temperature (°F) and UR (%) if n=1</li> <li>▪ temperature (°C) and DP (°C) if n=2</li> <li>▪ temperature (°F) and DP (°F) if n=3</li> </ul>

*Note:* it is not required to send the CAL USER ON command to read the settings.

*Note:* if a measurement error occurs or the measured quantity becomes 5% greater than the value set for the full scale of the corresponding analog output, the output is set to 1.1 V fixed value. If the measured quantity is less than the value set for the initial scale of the corresponding analog output, the output is fixed to the low value (0 V or 0.2 V depending on the presence of the offset).

When settings are completed, switch the transmitter off and then back on to activate the RS485 MODBUS-RTU operating mode.

## RELATIVE HUMIDITY CALIBRATION

The transmitter is factory calibrated and ready to use. It is possible to perform the periodical calibration of the relative humidity sensor at the two points 33% and 75% RH.

No calibration is scheduled for the temperature sensor.

Before starting calibration procedure, it is advisable to **verify**, with the aid of 33.0% RH and 75.4% RH saturated solutions, the necessity for a new calibration: perform calibration only if you notice a measurement error of some relative humidity percentage points in at least one of the two checked points.

The calibration must be performed at a temperature ranging between 18 and 30 °C.

The calibration procedure cancels previous calibration data.

For a correct sensor calibration, the first point must be 75% RH and the second point 33% RH.

**Calibration preliminary operations:** make sure that in the chamber containing the saturated saline solutions there are at the same time:

- solid-state salt,
- liquid solution or wet salt, especially for 75% RH solution.

The instrument and the saturated solutions to be used are to be kept in an environment at stable temperature for the entire period of calibration. Wait for at least a couple of hours at stable temperature so that the instrument and the saturated solutions reach thermal equilibrium with the environment before starting the calibration procedure. It is mostly important for a good calibration that the probe and the solution have the same temperature. Please remember that plastic material is a bad conductor of heat.

To configure the analog outputs, proceed as follows:

1. Unscrew the protection grid of the probe and the cap of the saturated solution.  
*Note:* if there is any liquid inside the measurement chamber, dry it with clean absorbent paper. To extend the saturated solutions life, it is important that solutions stay open only for the time necessary to insert the sensor.
2. Screw the M12 X 1 threaded adapter to the measuring probe.
3. Screw threaded adapter with probe to saturated solution container. Do not touch the sensitive element with your hands or other objects or liquids.
4. After inserting the sensor, wait for at least 30÷45 minutes.
5. Connect the transmitter to the PC by using the **optional CP24 cable** (as an alternative, use the supplied **CP9817.3** cable and a generic RS485/USB or RS485/RS232 converter; in this connection mode, it is necessary to power the transmitter separately).
6. Start a standard serial communication program. Set the COM port number to which the transmitter will be connected, set the Baud Rate to 57600 and the communication parameters as follows:  

Data Bits: 8	Parity: None	Stop Bits: 2
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7. Start with the transmitter not powered. Switch the transmitter on and wait to receive the **&** character, then send (within 10 s from power on) the **@** command and press **Enter**.  
*Note:* if the transmitter does not receive the **@** command within 10 seconds from power on, the RS485 MODBUS mode is automatically activated. In such a case, it is necessary to switch off and on again the transmitter.
8. Send the command **S0** to read the temperature measured by the probe.

9. Read the relative humidity value corresponding to the measured temperature in the relative humidity-solution temperature correspondence table. For 75% RH solution the table is the following:

Temp. °C	HD75
10	75.67
15	75.61
20	75.47
25	75.29
30	75.09
35	74.87
40	74.68
45	74.52
50	74.43

10. Send the command **CAL START**.

*Note:* the command CAL START is disabled after 5 minutes of inactivity.

11. Send the serial command **CHAnnnn**, where nnnn is the value previously read in the saturated solution table. The value is written without decimal point (ex.: indicate 7547 if the value read in the table is 75.47%) and must be between 7300 (73.00%) and 7700 (77.00%). The transmitter replies with **&|** if the command is correctly received.
12. Remove the probe from the 75% RH saturated solution and screw it to the 33% RH saturated solution.
13. After inserting the sensor, wait for at least 30÷45 minutes.
14. Send the command **S0** to read the temperature measured by the probe.
15. Read the relative humidity value corresponding to the measured temperature in the relative humidity-solution temperature correspondence table. For 33% RH solution the table is the following:

Temp. °C	HD33
10	33.47
15	33.30
20	33.07
25	32.78
30	32.44
35	32.05
40	31.60
45	31.10
50	30.54

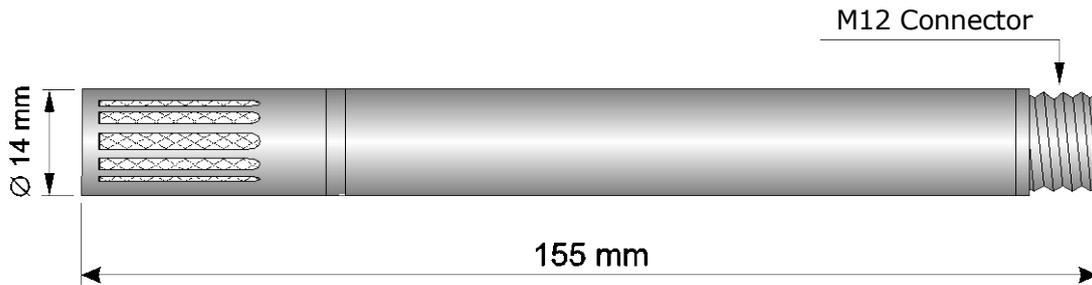
16. Send the command **CAL START**.

*Note:* the command CAL START is disabled after 5 minutes of inactivity.

17. Send the serial command **CHBnnnn**, where nnnn is the value previously read in the saturated solution table. The value is written without decimal point (ex.: indicate 3307 if the value read in the table is 33.07%) and must be between 3000 (30.00%) and 3500 (35.00%). The transmitter replies with **&|** if the command is correctly received.
18. Unscrew M12 X 1 threaded adapter from probe and place again the sensor protection grid, avoiding to touch the sensitive element. After use, immediately close with its cap the saturated solution used.

*Note:* store the salt solutions in the dark at a temperature of about 20 °C.

## DIMENSIONS



## ORDERING CODES

- HD9817TVS** Humidity and temperature transmitter, Pt100 sensor. 0...1 Vdc analog outputs and RS485 MODBUS-RTU output. Temperature measuring range -40...+60 °C. Power supply 5...30 Vdc. AISI 304 housing. IP 65 probe protection degree. Dimensions  $\varnothing 14 \times 155$  mm. Output with 8-pole M12 male connector. Supplied with CP9817.3 cable, length 3 m.
- CP24** PC connecting cable for the MODBUS parameters configuration. With built-in RS485/USB converter. 8-pole M12 connector on instrument side and A-type USB connector on PC side.
- CP9817.3** Spare cable with 8-pole M12 female connector on one side, open wires on the other side. Length 3 m.
- HD75** Saturated solution for calibration at 75% RH, M12 x 1 threaded adapter.
- HD33** Saturated solution for calibration at 33% RH, M12 x 1 threaded adapter.
- HD9008.21.1** Holder for vertical probes. Distance from wall 250 mm. Hole  $\varnothing 26$  mm. HD9007T26.2 adapter is required.
- HD9008.21.2** Holder for vertical probes. Distance from wall 125 mm. Hole  $\varnothing 26$  mm. HD9007T26.2 adapter is required.
- HD9007T26.2** Adapter from  $\varnothing 26$  to  $\varnothing 14$  mm to fit transmitters into the solar radiation protections HD9007A-1 and HD9007A-2.
- HD9008.31** Duct flange with  $\varnothing 14$  mm probe block.
- HD9007A-1** 12-ring protection from solar radiations. Supplied with mounting bracket.
- HD9007A-2** 16-ring protection from solar radiations. Supplied with mounting bracket.
- P6** 10 $\mu$ m sintered stainless steel grid protection, for probes  $\varnothing 14$  mm, thread M12 x 1.
- P7** 20 $\mu$ m PTFE protection, for probes  $\varnothing 14$  mm, thread M12 x 1.
- P8** PBT and 10 $\mu$ m stainless steel grid protection for probes  $\varnothing 14$  mm, thread M12 x 1.

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The quality level of our instruments is the results of the product continuous development. This can bring about differences between the information written in this manual and the instrument that you have purchased. We cannot entirely exclude errors in the manual, for which we apologize.  
Data, figures and descriptions contained in this manual cannot be legally asserted. We reserve the right to make changes and corrections without prior notice.

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