

VAISALA

USER'S GUIDE

Vaisala HUMICAP® Humidity and Temperature Transmitter HMT310



M210619EN-E

PUBLISHED BY

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CHAPTER 1

GENERAL INFORMATION

This chapter provides general notes for the manual and the HMT310.

About This Manual

This manual provides information for installing, operating, and maintaining Humidity and Temperature Transmitter HMT310.

This manual consists of the following chapters:

- Chapter 1, General Information, provides general notes for the manual and the HMT310.
- Chapter 2, Product Overview, introduces the features, advantages, and the product nomenclature.
- Chapter 3, Installation, provides you with information that is intended to help you install the HMT310.
- Chapter 4, Operation, contains information that is needed to operate the HMT310.
- Chapter 5, Maintenance, provides information that is needed in basic maintenance of the HMT310.
- Chapter 6, Calibration and Adjustment, describes the relative humidity and temperature adjustment procedures.
- Chapter 7, Technical Data, provides the technical data of the HMT310.
- Appendix A describes the available probe installation kits and provides some installation examples.

Version Information

Table 1 Manual Revisions

Manual Code	Description
M210619EN-E	March 2014. This manual. New software functionality applicable from version 2.0.1 onward. Voltage output added to analog output options, new voltage parameters in the AMODE command. Multipoint calibration instructions and MPC command added. Added information on filter and sensor options, rain shield, MI70 hand-held indicator, and USB connection. Transmitter plastic housing material changed to PPS. Updated serial terminal instructions, list of optional accessories and operating voltage and power consumption specifications. Calculated variables and fuel cell heating information added. Document template version updated, quality improvement updates.
M210619EN-D	November 2009 - Removed HUMICAP® 180, HUMICAP® 180C and HUMICAP® 180L2 from sensor options. Updated Technical Data.
M210619EN-C	September 2007 - Added HUMICAP® 180R and HUMICAP® 180RC as sensor options.

Related Manuals

Table 2 Related Manuals

Manual Code	Manual Name
M210297EN	Vaisala HUMICAP® Hand-Held Humidity and Temperature Meter HM70 User's Guide
M210185EN	Vaisala Humidity calibrator HMK15 User's Guide

Documentation Conventions

Throughout the manual, important safety considerations are highlighted as follows:

WARNING

Warning alerts you to a serious hazard. If you do not read and follow instructions very carefully at this point, there is a risk of injury or even death.

CAUTION

Caution warns you of a potential hazard. If you do not read and follow instructions carefully at this point, the product could be damaged or important data could be lost.

NOTE

Note highlights important information on using the product.

Safety

The Humidity and Temperature Transmitter HMT310 delivered to you has been tested for safety and approved as shipped from the factory. Note the following precautions:

WARNING Ground the product and verify outdoor installation grounding periodically to minimize shock hazard.

CAUTION Do not modify the unit. Improper modification can damage the product or lead to malfunction.

CAUTION Do not touch the sensor plate.

CAUTION In pressurized processes it is essential to tighten the supporting nuts and screws very carefully to prevent loosening of the probe by the action of pressure.

CAUTION Take care not to damage the probe body. A damaged body makes the probe less tight and may prevent it from going through the clasp nut.


ESD Protection


Electrostatic Discharge (ESD) can cause immediate or latent damage to electronic circuits. Vaisala products are adequately protected against ESD for their intended use. It is possible to damage the product, however, by delivering electrostatic discharges when touching, removing, or inserting any objects inside the equipment housing.

To make sure you are not delivering high static voltages yourself:

- Handle ESD sensitive components on a properly grounded and protected ESD workbench.
- When an ESD workbench is not available, ground yourself to the equipment chassis with a wrist strap and a resistive connection cord.
- If you are unable to take either of the above precautions, touch a conductive part of the equipment chassis with your other hand before touching ESD sensitive components.
- Always hold component boards by the edges and avoid touching the component contacts.

Recycling

	Recycle all applicable material.
-----------------------------------------------------------------------------------	----------------------------------

	Dispose of the unit according to statutory regulations. Do not dispose of with regular household refuse.
-----------------------------------------------------------------------------------	----------------------------------------------------------------------------------------------------------

Regulatory Compliances

The Humidity and Temperature Transmitter HMT310 complies with the following performance and environmental test standards:

- EMC standard EN61326-1, Industrial environment.

Emissions

Test	Complies with Standard
Radiated emissions	EN/IEC 55022 / CISPR16/22 Class B

Immunity

Test	Complies with Standard
Electrostatic discharge (ESD)	EN/IEC 61000-4-2
Radiated immunity	EN/IEC 61000-4-3
EFT burst (Electric fast transients)	EN/IEC 61000-4-4
Surge	EN/IEC 61000-4-5
Conducted immunity	EN/IEC 61000-4-6



Trademarks

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Windows[®] is a registered trademark of Microsoft Corporation in the United States and/or other countries.

Software License

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Warranty

Visit our Internet pages for standard warranty terms and conditions:
www.vaisala.com/warranty.

Please observe that any such warranty may not be valid in case of damage due to normal wear and tear, exceptional operating conditions, negligent handling or installation, or unauthorized modifications. Please see the applicable supply contract or Conditions of Sale for details of the warranty for each product.

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CHAPTER 2

PRODUCT OVERVIEW

This chapter introduces the features, advantages, and the product nomenclature.

Introduction to HMT310

The Vaisala HUMICAP[®] Humidity and Temperature Transmitter HMT310 is a small size humidity and temperature transmitter that powers up with 10 ... 35 VDC (mode-dependent power supply requirements). HMT310 uses Vaisala's HUMICAP[®] capacitive thin-film polymer sensor for humidity and temperature measurements: for more information on HMT310 sensors, see section Sensor Options on page 19.

HMT310 supports the following output alternatives:

- Analog outputs 0/4 ... 20 mA and 0 ... 5/10 V (1 ... 5 V available as scaled output: see section Setting, Scaling and Testing Analog Outputs on page 54).
- RS-232 serial line
- USB cable (optional accessory, order code 238607)
- MI70 hand-held indicator connection (optional connection cable DRW216050SP)

The following optional functions are available:

- Several probes for various applications
- Calculated humidity quantities
- Different mounting kits, rain shield, sensor protection options and probe cable lengths
- Warmed probe and sensor heating for high humidity conditions (HMT317)
- Chemical purge for applications where there is a risk of interfering chemicals in the measuring environment

Output Quantities

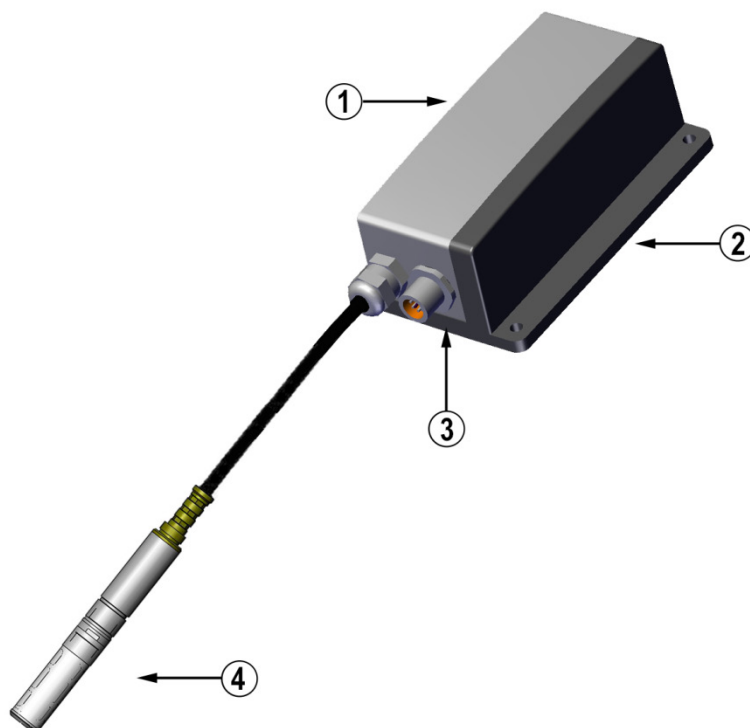
Table 3 HMT310 Output Quantities

Quantity	Abbreviation	Metric Unit	Nonmetric Unit
Relative humidity	RH	%RH	%RH
Temperature	T	°C	°F
Dewpoint/Frostpoint	TDF	°C	°F
Dewpoint	TD	°C	°F
Absolute humidity	A	g/m ³	gr/ft ³
Mixing ratio	X	g/kg	gr/lb
Wet bulb temperature	TW	°C	°F
Humid air volume/ dry air volume	PPM (parts per million)	ppm	ppm
Water vapor pressure	PW	hPa	psi
Saturation water vapor pressure	PWS	hPa	psi
Enthalpy	H	kJ/kg	Btu/lb

NOTE

Only quantities selected when ordering the device can be selected for an output quantity.

HMT310 Transmitter Parts



1403-180

Figure 1 HMT310 Transmitter Parts

The following numbers refer to Figure 1 above:

- 1 = Transmitter unit
- 2 = Mounting plate (smaller mounting plate also available)
- 3 = Connector for signal output and power supply. Available with female connector with 5 m cable or screw terminal connector.
- 4 = Probe

Probe Options

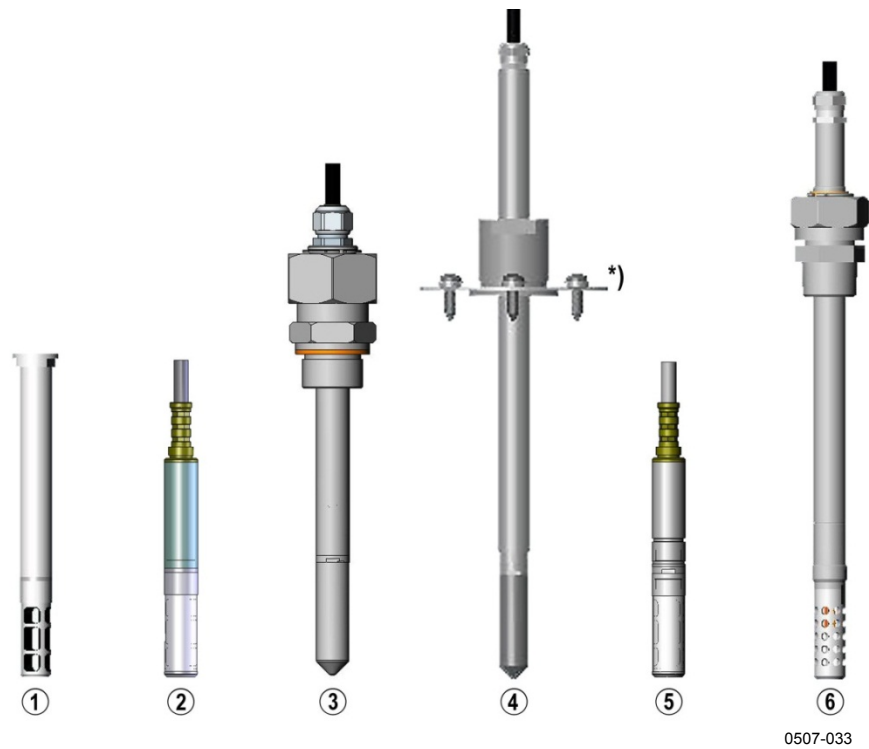


Figure 2 HMT310 Probes

The following numbers refer to Figure 2 above:

- 1 = HMT311 for wall mounting
- 2 = HMT313 for general use
- 3 = HMT314 for pressurized spaces up to 100 bar
- 4 = HMT315 for high temperatures up to 180 °C (242 mm probe length, vapor-tight)
- 5 = HMT317 for demanding processes (warmed and vapor-tight probe)
- 6 = HMT318 for pressurized pipelines (40 bar, ball valve)

*) Flange for HMT315 is available as an option

Probe cable lengths: 2, 5 and 10 m.

Filter Options

There are several filter types for HMT310. All filters are 12 mm in diameter with a female thread, and are compatible with all HMT310 probe models. The filters recommended for a probe type can be selected on the corresponding HMT310 order form.

For a list of the available filters and ordering information, see section Spare Parts and Accessories on page 93.

Sensor Options

HMT310 uses Vaisala's HUMICAP® capacitive thin-film polymer sensor for humidity and temperature measurements. The HUMICAP® sensor options (selected when ordering according to transmitter type and application, also available as accessories) include:

- HUMICAP®180R: general purpose humidity and temperature sensor
- HUMICAP® 180RC: composite sensor for chemical purge and probe heating
- HUMICAP®180VHP: catalytic sensor designed for environments with vaporized hydrogen peroxide (H₂O₂)
- HUMICAP®180VHPC: catalytic sensor with chemical purge for H₂O₂ environments

HMT310 also uses the Pt 100 (Pt 100 RTD Class F0.1 IEC 60751) temperature sensor.

The Vaisala HUMICAP® sensor is compatible with direct H₂O₂ exposure even at high concentrations and hundreds of H₂O₂ cycles up to saturation. The long term performance is very good at concentrations higher than typically used for sterilization. However, for applications where full saturation is possible, Vaisala recommends using either the HUMICAP®180VHP/180VHPC catalytic sensor, or the catalytic filter (order code 231865) for HUMICAP®180R/180RC sensors to protect the sensor and extend the calibration interval.

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CHAPTER 3

INSTALLATION

This chapter provides you with information that is intended to help you install the HMT310.

Measuring at Overpressure

HMT314 and HMT318 are designed for humidity measurement at overpressure. The maximum measurement pressures depend on the probe as follows:

- HMT314: 0 ... 100 bar (10 MPa), for pressurized rooms and processes, probe is provided with a nut, fitting screw and sealing washer
- HMT318: 0 ... 40 bar (4 MPa), for pressurized pipelines, ball valve set available

The actual pressure in the process or sampling cell needs to be set to the transmitter by using the serial line command PRES (Set Ambient Pressure for Calculations).

CAUTION

In pressurized processes it is essential to tighten the supporting nuts and screws very carefully to prevent loosening of the probe by the action of pressure.

Pressure Regulator Recommended

When sampling pressurized processes exceeding the maximum measurement pressure of the probe, the pressure in the measurement chamber must be regulated to acceptable level or below. It is recommended to use a pressure regulator before the measurement chamber to prevent significant pressure variations.

Selecting Location

Finding a suitable site for the Humidity and Temperature Transmitter HMT310 is important for getting representative ambient measurements. The site should represent the general area of interest.

Mounting the Transmitter/Removing the Transmitter Unit

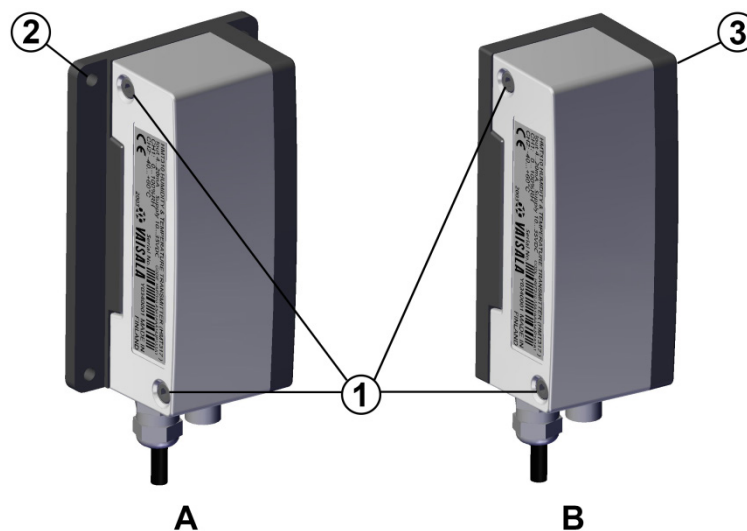
Select a place with stable conditions for mounting the transmitter. Do not expose the transmitter to direct sunlight or rain. Always mount the transmitter housing with the cable bushings pointing downwards.

NOTE

If the transmitter is mounted outdoors cover it with a shelter (purchased by customer). A rain shield designed for HMT310 is available as an optional accessory. For information on ordering accessories, see section Spare Parts and Accessories on page 93.

1. Mount the plate onto the wall with four/two screws (Ø 4.5 mm/6.0 mm).
2. Place the transmitter onto the mounting plate and fasten it with two Allen screws.

The transmitter module can be unfastened for calibration by releasing the two Allen screws on the left side.

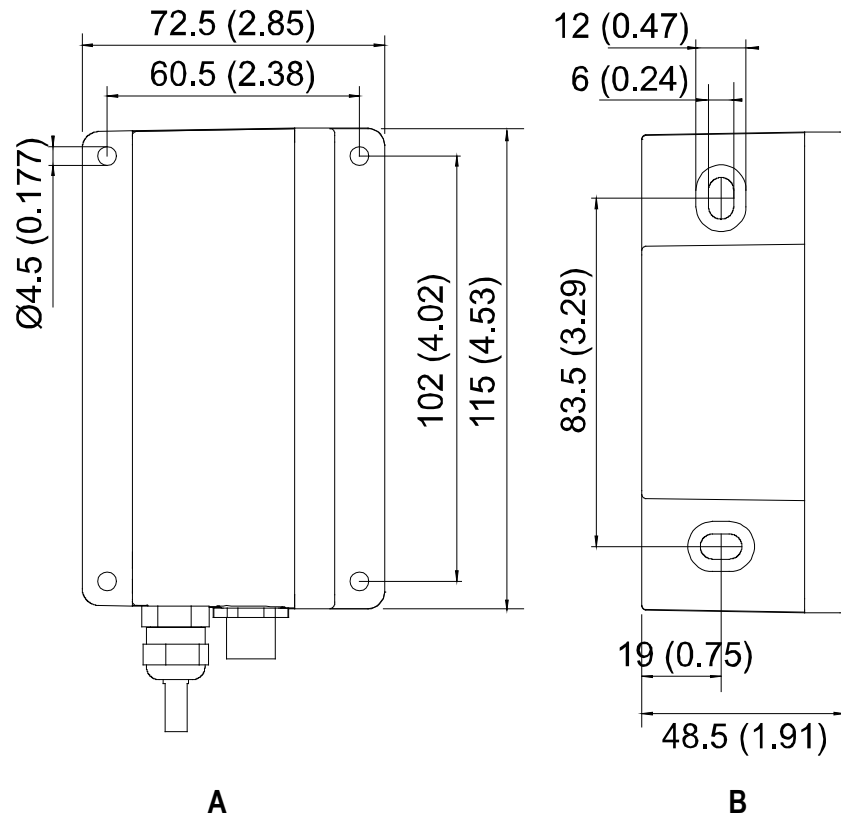


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Figure 3 Mounting with Mounting Plates

The following letters and numbers refer to Figure 3 above:

- A = Mounting with larger mounting plate (mount from flanges)
- B = Mounting with smaller mounting plate (remove the transmitter and mount using the holes in mounting plate base)
- 1 = Two Allen screws for fastening or removing the transmitter module (Allen key provided)
- 2 = Four screw holes (Ø 4.5 mm) for wall mounting (screws not provided)
- 3 = Two screw holes (Ø 6.0 mm) on the base of the plate for wall mounting (screws not provided)



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Figure 4 Mounting Plate Dimensions

The following letters refer to Figure 4 above:

- A = Larger mounting plate dimensions
- B = Smaller mounting plate dimensions

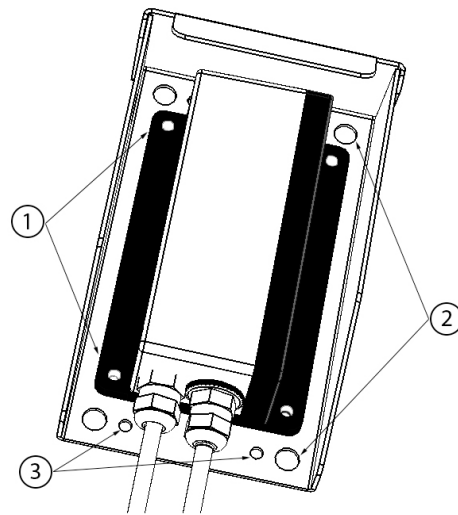
Mounting the Transmitter with Optional Rain Shield

If you mount HMT310 outdoors, use a shelter to protect the transmitter. An HMT310 rain shield is available from Vaisala as an optional accessory (order code ASM211103).

NOTE

Vaisala does not recommend installing the transmitter outdoors with the smaller mounting plate (without flanges). Use the larger mounting plate with flanges for outdoor installations.

Mounting the Rain Shield with Larger Mounting Plate



1311-251

Figure 5 Rain Shield with Larger Mounting Plate

The following numbers refer to Figure 5 above:

- 1 = Transmitter's larger mounting plate: attaches to rain shield from flanges with four $\text{Ø } 4.5$ mm screws (not provided).
- 2 = Rain shield: Four $\text{Ø } 8.5$ mm holes for (U-bolt) mounting. The maximum diameter of the pole in U-bolt mounting is 60 mm.
- 3 = Rain shield: Four $\text{Ø } 4.5$ mm screw holes for mounting.

The transmitter's larger mounting plate (see Figure 3 on page 22) is attached to the rain shield from the mounting plate's flanges using four $\text{Ø } 4.5$ mm screws. The rain shield has $\text{Ø } 4.5$ mm and $\text{Ø } 8.5$ mm holes for mounting with screws or U-bolts.

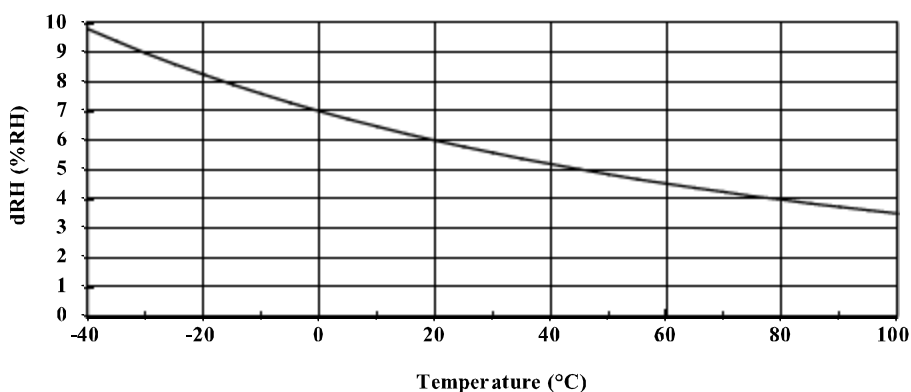
For rain shield measurements, see section Rain Shield Dimensions on page 95.

Mounting the Probes

Do not unsolder and then again resolder the probe cable from the mother board during installation; this may alter the humidity calibration of the transmitter.

Beware of Temperature Differences

In humidity measurement and especially in calibration it is essential that the temperature of the probe and the measuring environment is the same. Even a small difference in temperature between the environment and the probe causes an error. As the curve in Figure 6 below shows, if the temperature is +20 °C and the relative humidity 100 %RH, a difference of ± 1 °C between the environment and the probe causes an error of ± 6 %RH.

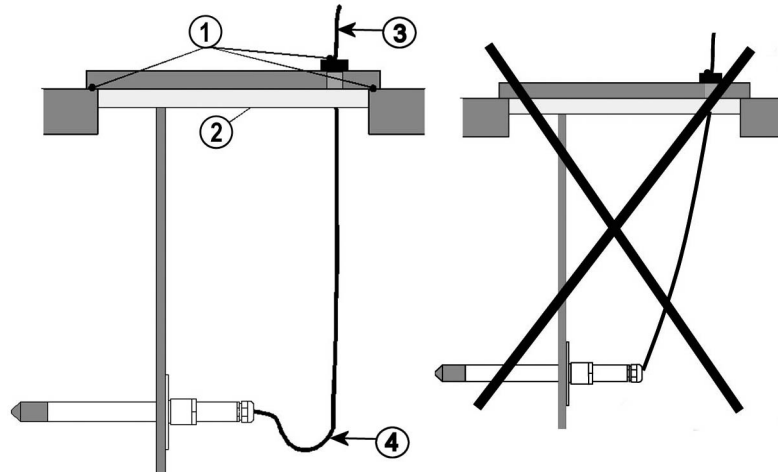


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Figure 6 Measurement Error at 100 %RH when Difference Between Ambient and Sensor Temperature is 1 °C

General Instructions for Probes with Cable

It is recommended that the probes with a cable are mounted with the probe **horizontal**; this way, any water condensing on the tube cannot flow onto the sensor.



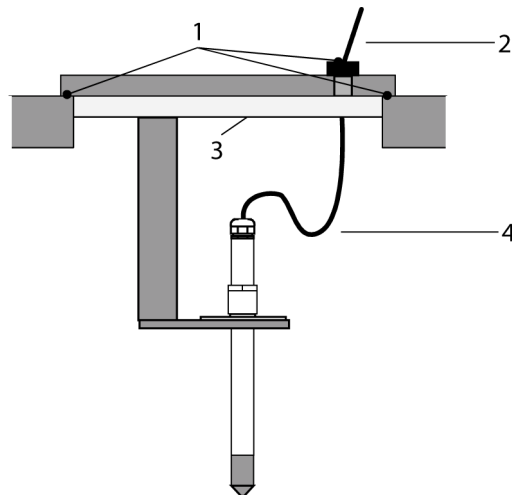
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Figure 7 Horizontal Mounting of Probe

The following numbers refer to Figure 7 above:

- 1 = To be sealed
- 2 = To be insulated
- 3 = Insulate
- 4 = Let the cable hang loosely. This prevents condensed water running to the sensor along the cable.

When there is no alternative but to install the probe in the process **vertically**, the point of entry must be carefully insulated. The cable must also be allowed to hang loosely as this prevents any condensed water from running onto the probe along the cable.



0507-022

Figure 8 Vertical Mounting of Probe

The following numbers refer to Figure 8 above:

- 1 = To be sealed
- 2 = Insulate the cable
- 3 = To be insulated
- 4 = Let the cable hang loosely. This prevents condensed water running to the sensor along the cable.

CAUTION

Do not attach a heated probe (HMT317) to metal structures to avoid condensation problems caused by heat conduction along the metal.

If the process temperature is much higher than that of the environment, the whole probe and preferably a piece of the cable must be inside the process. This prevents measuring inaccuracies caused by heat conduction along the cable.

When mounted on the side of a duct or channel, the probe must be inserted from the side of the duct. If this is not possible and the probe must be inserted from the top, the point of entry must be carefully insulated.

HMT313 for General Use

The HMT313 is a small size ($d = 12\text{mm}$) general-purpose probe suitable for ducts and channels with the installation kit available from Vaisala.

The HMT313 has two probe versions for different measurement environments:

- Probe with a flexible cable, suitable for environments up to $80\text{ }^{\circ}\text{C}$
- Probe for environments up to $120\text{ }^{\circ}\text{C}$

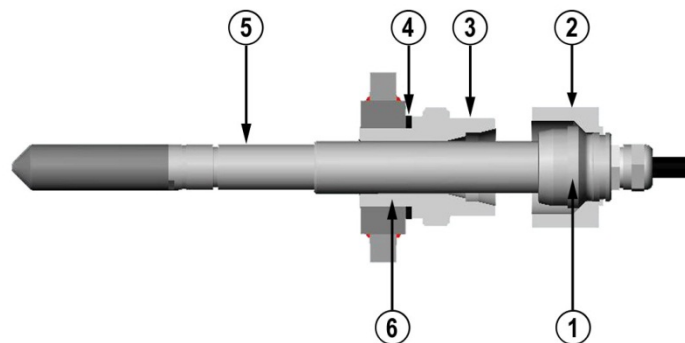
See Appendix A on page 99 for the following probe installation kits for HMT313 and installation examples:

- Duct mounting kit
- Cable gland

HMT314 for Pressurized Spaces

HMT314 probe is for humidity measurements in pressurized rooms and industrial processes. The probe is provided with a nut, a fitting screw and a sealing washer. Keep the fitting screw and nut in place on the body of the probe during handling to prevent damage to the highly polished surface of the probe. Follow the instructions below to achieve a leak-tight assembly:

1. Remove the fitting screw from the nut and the probe.
2. Attach the fitting screw to the chamber wall with a sealing washer. Tighten the fitting screw into the threaded sleeve with a torque wrench. The tightening torque is 150 ± 10 Nm (110 ± 7 ft-lbs).
3. Insert the body of the probe into the fitting screw and attach the nut manually to the fitting screw so that the connection feels tight.



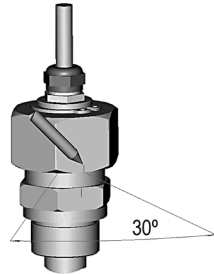
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Figure 9 HMT314 Installation

The following numbers refer to Figure 9 above:

- 1 = Tightening cone
- 2 = Nut
- 3 = Fitting screw
- 4 = Sealing washer
- 5 = Probe; \varnothing 12 mm
- 6 = M22 \times 1.5 or NPT 1/2"

4. Mark both the fitting screw and the nut hex.
5. Tighten the nut a further 30° (1/12 turn) or if you have a torque wrench tighten it with a torque of 80 ± 10 Nm (60 ± 7 ft-lbs).



0505-273

Figure 10 Marking the Nut

NOTE

When re-tightening the nut after detachment the nut must be tightened without increased effort.

6. Clean and grease the tightening cone of the fitting screw after every tenth detachment. Change the sealing washer every time the fitting screw is detached. Use high-vacuum grease (for example; Down Corning, Europe) or a similar grease.

See also section Measuring at Overpressure, on page 21.

CAUTION

In pressurized processes it is essential to tighten the supporting nuts and screws very carefully to prevent loosening of the probe by the action of pressure.

NOTE

When HMT314 is installed in a process with pressure differing from normal atmospheric pressure, enter the pressure value of the process (in hPa or mbar) into the transmitter memory via the serial line (see Set Ambient Pressure for Calculations on page 51).

HMT315 for High Temperatures

HMT315 is installed similarly than the HMT313 probe but without the supporting bar. Refer to Appendix A on page 99 for more information on the duct installation kit for HMT315.

To avoid incorrect humidity readings, the temperature differences between inside and outside of the duct must not be remarkable.

HMT317 for Demanding Processes

The HMT317 is for environments where relative humidity is very high, near saturation. The warmed probe prevents the saturation of the sensor.

See Appendix A on page 99 for a presentation of the following probe installation kits for HMT317 with installation examples:

- Duct mounting kit
- Cable gland
- Pressure tight Swagelok connector

HMT318 for Pressurized Pipelines

Due to the sliding fit the HMT318 is easy to install into and remove from the pressurized process. The probe is especially suitable for the measurements in pipelines. See section Ball Valve Installation kit for HMT318 on page 102.

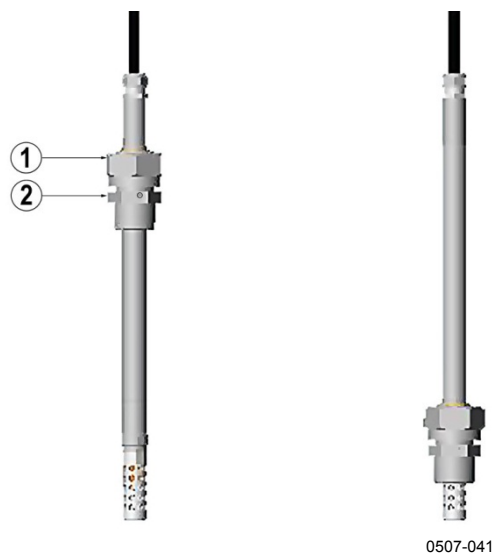


Figure 11 HMT318 Probe Dimensions (in mm)

The following numbers refer to Figure 11 above:

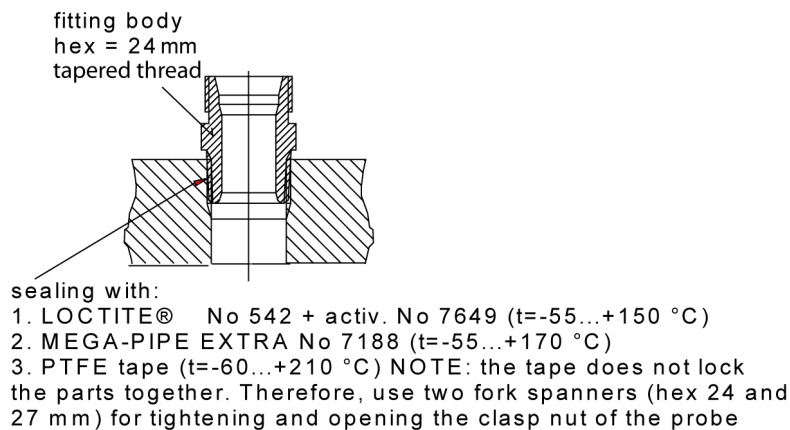
- 1 = Clasp nut; 24 mm hex nut
- 2 = Fitting body; 27 mm hex head

The following two fitting body options are available:

- Fitting Body ISO1/2 solid structure
- Fitting Body NPT1/2 solid structure

Table 4 HMT318 Probe Dimensions

Probe Type	Probe Dimension	Adjustment Range
Standard	178 mm	120 mm
Optional	400 mm	340 mm

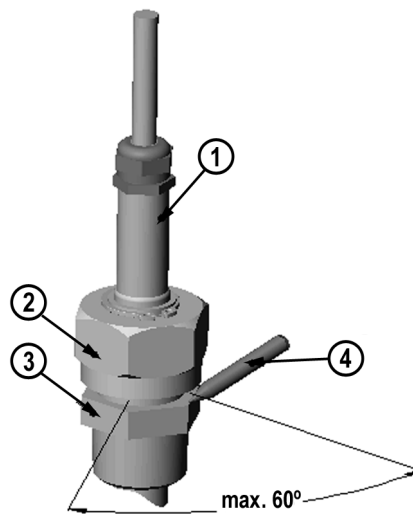


0507-025

Figure 12 Sealing of Fitting Body into Process

Tightening the Clasp Nut

1. Adjust the probe to a suitable depth according to the type of installation.
2. Tighten the clasp nut first manually.
3. Mark the fitting screw and the clasp nut.
4. Tighten the nut a further 50 - 60° (ca. 1/6 turn) with a wrench. If you have suitable torque wrench, tighten the nut to max 45 ± 5 Nm (33 ± 4 ft-lbs).



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Figure 13 Tightening the Clasp Nut

The following numbers refer to Figure 13 above:

- 1 = Probe
- 2 = Clasp nut
- 3 = Fitting screw
- 4 = Pen (for marking)

NOTE

Take care not to overtighten the clasp nut to avoid difficulties when opening it.

CAUTION

Take care not to damage the probe body. A damaged body makes the probe less tight and may prevent it from going through the clasp nut.

CAUTION

In pressurized processes it is essential to tighten the supporting nuts and screws very carefully to prevent loosening of the probe by the action of pressure.

NOTE

When HMT318 is installed in a process with pressure differing from normal atmospheric pressure, enter the pressure value of the process (in hPa or mbar) into the transmitter memory via the serial line (see section Set Ambient Pressure for Calculations on page 51).

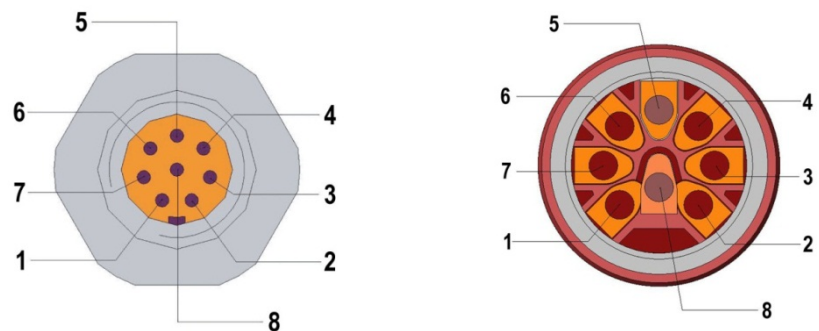
Connections

When the HMT310 leaves the factory, the measurement ranges, output scaling and quantities have already been set according to the customer order. The unit is calibrated at the factory and ready for use.

The transmitter is delivered with either a screw terminal connector or with a detachable 5m cable with eight wires for serial port, analog outputs and 10 ... 35 VDC power supply (requirements vary depending on the operating environment, functions and output type).

The wiring is described in this section. For power supply requirements, see section Power Supply Requirements on page 34.

Cable Wiring



0507-044, 0507-045

Figure 14 8-Pin Connector (Left) and Screw Terminal Connector (Right)

Pin	Wire	Serial Signal RS-232C	Analog Signal
1	White	Data out TX	-
2	Brown	-	Ch 1 - / Ch 2 -
3	Green	-	Ch 2 +
4	Yellow	-	Ch 1 +
5	Grey	Supply - / RS-232 GND	Supply -
6	Pink	Supply +	Supply +
7	Blue	Data in RX	-
8	Red	Not connected	Not connected

Power Supply Requirements

The supply voltage requirements depend on the output type, used functionalities and pressure:

- RS-232 output (without heating and purge): 10 ... 35 VDC.
- Analog output: 15 ... 35 VDC
- Heating and purge: 15 ... 35 VDC.
- Pressures above 10 bara (145 psia): minimum 24 VDC

Table 5 below lists the HMT310 current consumption for different output types and functions.

Table 5 Current Consumption by Output Type/Function

Output/Function	Consumption
RS-232 (@ 35VDC)	12 mA
Uout 10 V (10kOhm) Channel1 & Channel 2 (@ 35VDC)	12 mA
Iout 20mA (load 511Ohm) Channel 1 & Channel 2 (@ 35VDC)	50 mA
Purge @ 24VDC	+ 220 mA*
Warmed probe @ 24VDC	+ 240 mA*
Fuel cell @ 24VDC	+ 350 mA*

*maximum pulsed current

NOTE

HMT310 can also be powered by an MI70 indicator or a USB cable connection to a computer. For information on ordering the optional MI70 and USB connection cables, see section Spare Parts and Accessories on page 93.

NOTE

When the USB connection is used to power the transmitter, the heating and purge functions may not work as intended due to the limited USB powering capability. This depends on the computer used and environmental conditions. Using the USB connection as a permanent power supply is not recommended.

CHAPTER 4

OPERATION

This chapter contains information that is needed to operate the HMT310.

Power Supply

Use a 10 ... 35 VDC power supply (required minimum voltage varies depending on the operating environment, functions and output type). For instructions on selecting the correct operating voltage, see section Power Supply Requirements on page 34.

Transmitter Start-Up

When the transmitter is connected to a power supply, there is a delay of three seconds as the transmitter starts up. After the start-up is complete, the measurement data is available from the analog output and serial line.

If serial line output is used, note that the transmitter will behave according to the configured serial mode:

- In STOP mode, the transmitter outputs the transmitter model and software version. This is the default mode.
- In RUN mode a measurement output starts immediately.
- In POLL mode the transmitter does not output anything after powerup.

For instructions on configuring the serial mode, see section Set Serial Interface Mode on page 43.

Serial Line and Analog Communication Options

HMT310 measurement data can be accessed with the following serial or analog options:

- RS-232 serial port connection to a computer
- Analog output (current or voltage)

For temporary access, you can also connect to the transmitter with the following:

- USB connection to a computer using an optional USB cable (order code 238607).
- Connection with a handheld MI70 indicator using an optional MI70 calibration cable (DRW216050SP)

When using HMT310 with a serial connection (RS-232 serial cable or USB), you need a terminal program to operate the HMT310 command line interface. For instructions on installing and using the PuTTY terminal application for Windows (available from www.vaisala.com), see section Terminal Program Settings on page 39.

For information on using the analog outputs, see section Setting, Scaling and Testing Analog Outputs on page 54.

RS-232 Serial Port Connection

When connecting the HMT310 to a computer with an RS-232 cable, use the following data format settings (factory settings) in the terminal program:

- 1 start bit
- 7 data bits
- 1 stop bit
- Even parity
- 4800 bits per second, programmable to 19200
- Full duplex
- Serial asynchronous
- Configured as Data Terminal Equipment (DTE)

Enter the communication parameters when using this terminal session for the first time; save them for future use.

USB Connection

When performing temporary checks or adjustments, HMT310 can be connected to a computer by using a USB cable (238607). The USB cable is an optional accessory: for more information on ordering optional items, see section Spare Parts and Accessories on page 93.

NOTE

Before starting to use the USB cable, you must install the USB cable driver (requires Windows).

NOTE

When the transmitter is powered by the USB connection, the heating and purge functions may not work as intended due to the limited USB powering capability. This depends on the computer used and environmental conditions. Using the USB connection as a permanent power supply is not recommended.

Installing the Driver for the USB Cable

1. Check that the USB cable is not connected. Disconnect the cable if you have already connected it.
2. Insert the media that came with the cable, or download the driver from www.vaisala.com.
3. Execute the USB driver installation program (setup.exe), and accept the installation defaults. The installation of the driver may take several minutes.
4. After the driver has been installed, connect the USB cable to a USB port on your computer. Windows will detect the new device, and use the driver automatically.
5. The installation has reserved a COM port for the cable. Verify the port number, and the status of the cable, using the Vaisala USB Instrument Finder program that has been installed in the Windows Start menu.

Windows will recognize each individual cable as a different device, and reserve a new COM port. Remember to use the correct port in the settings of your terminal program.

Connection to an MI70 Hand-held Indicator

HMT310 can be connected to the hand-held MI70 indicator by using the MI70 connection cable (DRW216050SP). The MI70 connection cable is an optional accessory: for more information on ordering optional items, see section Spare Parts and Accessories on page 93.

When HMT310 is connected to the MI70 indicator, you can view HMT310 readings and perform HMT310 calibration and adjustment using the MI70 indicator's interface.

For instructions on performing HMT310 calibration and adjustment with the MI70 indicator, see section Adjustment Using an MI70 Indicator on page 81.

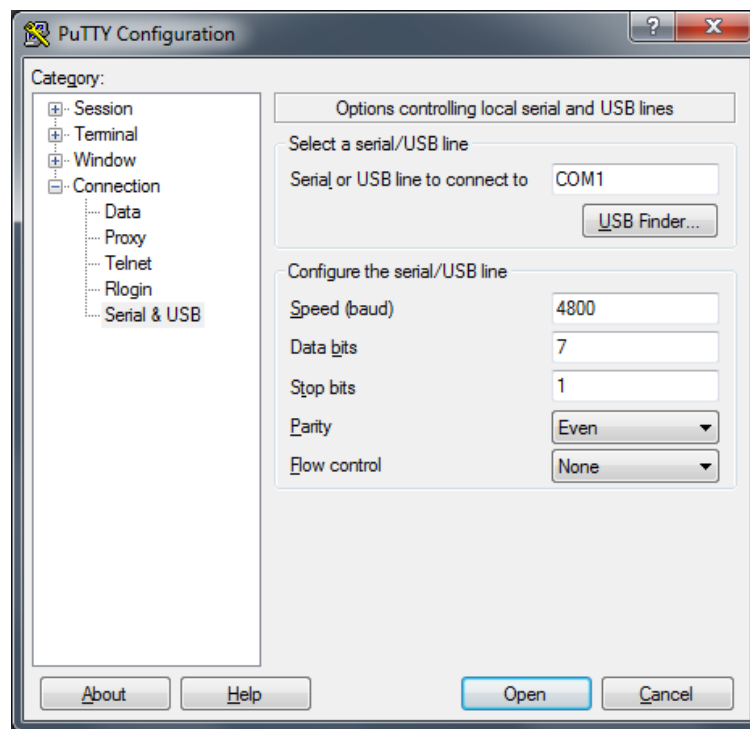
For instructions on using the MI70 handheld indicator to view and log readings and further information on using MI70, see the MI70 user documentation.

Terminal Program Settings

The instructions below describe how to connect to the HMT310 using the PuTTY terminal application for Windows (available for download at www.vaisala.com). Perform the necessary cabling and configuration of the transmitter before following the instructions.

Opening a Serial/USB Connection with PuTTY

1. Power up the HMT310 and start the PuTTY application.
2. Select the Serial & USB settings category, and check that the correct COM port is selected in the Serial or USB line to connect to field. Change the port if necessary.
If you are using a Vaisala USB cable, you can check the port that it uses by clicking the **USB Finder...** button. This opens the Vaisala USB Instrument Finder program that has been installed along with the USB drivers.
3. Check that the other serial/USB line settings are correct for your connection, and change if necessary.



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Figure 15 PuTTY Serial Line Configuration

4. Click the Open button to open the connection window and start using the serial connection command line interface.
If PuTTY is unable to open the serial port you selected, an error message is displayed. If this happens, restart PuTTY and check the settings.

List of Serial Commands

All commands can be issued either in uppercase or lowercase. In the command examples, the keyboard input by the user is in **bold** type.

The notation <cr> refers to pressing the carriage return (**Enter**) key on your computer keyboard. Enter a <cr> to clear the command buffer before starting to enter commands.

In the tables below, the bold text in the brackets is the default setting.

Table 6 Measurement Output

Command	Description
R	Start continuous outputting
S	Stop continuous outputting
INTV [0 ... 255 S /MIN/H]	Set continuous output interval for RUN mode
SEND [0 ... 99]	Output reading once
SMODE [STOP /RUN/POLL]	Set serial interface mode
SERI [baud p d s]	Serial line settings (default: 4800 E 7 1) baud: 300...19200
ADDR [0 ... 99]	Set transmitter address for use in POLL mode
OPEN [0 ... 99]	Temporarily open transmitter from POLL mode to receive commands
CLOSE	Set transmitter in POLL mode

Table 7 Output Formatting

Command	Description
FORM	Set serial output format
TIME	Set time
DATE	Set date
FTIME [ON/OFF]	Add time to SEND and R outputs
FDATE [ON/OFF]	Add date to SEND and R outputs
UNIT	Select metric or nonmetric output units
FST [ON/OFF]	Output state of optional probe heating and chemical purge (with SEND and R commands)

Table 8 Other Commands

Command	Description
?	Check transmitter settings
??	Check transmitter settings in POLL mode
ECHO [ON/OFF]	Serial bus echo
FIND	All devices in POLL mode send their addresses
HELP	List commands
PRES	Set ambient pressure for calculations (non-volatile)
XPRES	Set ambient pressure for calculations
FILT	Set result filtering
RESET	Reset transmitter
ERRS	Display error messages

Table 9 Setting, Scaling and Testing Analog Outputs

Command	Description
AMODE	Set analog outputs (0/4 ... 20 mA and 0 ... 5/10 V, 1 ...5 available through scaling)
ASEL	Select parameter for analog outputs
ASCL	Scale analog outputs
ITEST	Test analog outputs
AQTEST	Test analog outputs for desired readings
AERR	Set error outputs

Table 10 Calibration and Adjustment*

Command	Description
CRH	Relative humidity calibration
CT	Temperature calibration
LI	Revert factory calibration
L	View the currently applied standard user adjustment offset and gain
FCRH	RH calibration after sensor change
CTEXT	Set calibration information text
CDATE	Set calibration date
ACAL	Analog output calibration
MPC	Multipoint RH calibration

*These commands are presented in section Calibration and Adjustment Commands on page 70.

Table 11 Chemical Purge

Command	Description
PUR [ON/OFF]	Enable or disable automatic chemical purge
PURGE	Activate chemical purge
PURR [ON/OFF]	Enable or disable automatic chemical purge in power-up

Table 12 Sensor Heating

Command	Description
XHEAT [ON/OFF]	Enable or disable sensor heating

Measurement Output

Start Continuous Outputting

Syntax: R<cr>

Starts output of measurements to the peripheral devices (RUN mode); the only command that can be used is S (stop).

The output mode can be changed with the **FORM** command.

Example:

```
>r
RH= 28.0 %RH T= 23.3 'C
RH= 28.0 %RH T= 23.3 'C
RH= 28.0 %RH T= 23.3 'C
RH= 28.0 %RH T= 23.3 'C
RH= 28.0 %RH T= 23.3 'C
RH= 28.0 %RH T= 23.3 'C
```

Stop Continuous Outputting

Syntax: S<cr>

Stops the continuous output. Also the **Esc** key (on the computer keyboard) can be used to stop outputting.

Set Continuous Output Interval for RUN Mode

Syntax: INTV xxx yyy<cr>

Where

xxx = Output interval (0 ... 255)
yyy = Unit (s, min or h)

Example:

```
>intv 1
Output interval: 1 S
>intv 1 min
Output interval: 1 MIN
>intv 1 h
Output interval: 1 H
```

Output Reading Once

Syntax in STOP mode: SEND<cr>

Syntax in POLL mode: SEND aa<cr>

Where

aa = Address of the transmitter when more than one transmitter is connected to a serial bus (0 ... 99).

Set Serial Interface Mode

Syntax: SMODE x<cr>

Where

x = STOP/RUN/POLL
STOP mode: Transmitter in standby for serial commands
RUN mode: Transmitter outputs data continuously
POLL mode: Transmitter only responds to addressed command

Example:

```
>smode run
Output mode      : RUN
```

```
>smode stop
Output mode      : STOP
```

Serial Line Settings

Syntax: SERI b p d s<cr>

Where

b = bauds (300, 600, 1200, 2400, 4800, 9600,19200)
p = parity (n = none, e = even, o = odd)
d = data bits (7 or 8)
s = stop bits (1 or 2)

The settings can be changed one parameter at a time or all parameters at once.

Example:

```
>seri o      changing parity only
4800 o 7 1
>seri 600 n 8 1  changing all parameters
600 n 8 1
```

Set Transmitter Address for Use in POLL Mode

Syntax: ADDR aa<cr>

Where

aa = Address (0 ... 99)

Example:

```
>addr
Address      : 0
>addr 1
Address      : 1
```

Temporarily Open Transmitter from POLL Mode to Receive Serial Commands

Syntax: OPEN nn<cr>

Where

nn = Address of the transmitter (0 ... 99)

The **OPEN** command sets the bus temporarily in STOP mode so that the **S.MODE** command can be issued.

Example:

```
>open 4
Device: 4 line opened for operator commands
>
```

Set Transmitter in POLL Mode

Syntax: `CLOSE<cr>`

In **STOP** mode: the command **OPEN** has no effect, **CLOSE** sets the transmitter temporarily in **POLL** mode.

In **POLL** mode: the command **OPEN** sets the transmitter temporarily in **STOP** mode, **CLOSE** returns the instrument to **POLL** mode.

Example:

Relative humidity calibration is performed at transmitter 2, which is in **POLL** mode.

```
>open 2
```

Opens the line to transmitter 2.

```
>crh
```

Calibration started.

```
...
```

```
>close
```

Line closed.

Output Formatting

Set Serial Output Format

Syntax: `FORM x<cr>`

Where

x = Formatter string

The **FORM** command can be used to change the format of the output commands **SEND** and **R**.

The format string entered with the **FORM** command consists of quantities and modifiers: use the quantity abbreviations and modifiers presented in Table 13 and in Table 14 when selecting the output quantities.

Table 13 Quantity Abbreviations for FORM Command

Abbreviation	Quantity
RH	Relative humidity
T	Temperature
TDF	Dewpoint/Frostpoint
TD	Dewpoint
A	Absolute humidity
X	Mixing ratio
TW	Wet bulb temperature
PPM	Humid air volume/dry air volume
PW	Water vapor pressure
PWS	Saturation water vapor pressure
H	Enthalpy

NOTE

Only quantities selected when ordering the device can be selected for an output quantity.

Table 14 Modifiers

Modifier	Description
x.y	Length modifier (whole numbers and decimal places)
#t	Tabulator
#r	Carriage return
#n	Line-feed
""	String-constant
U5	Unit field and length (unit can be changed with command UNIT)

Examples:

```
>form "TD=" 5.2 TD #r#n
TD= -3.65
```

```
>form "TD=" TD U3 #t "TDF=" TDF U3 #r#n
TD= -4.0'C TDF= -3.6'C
>
```

The command **FORM /** returns the default output form:

```
>form /
>send
RH= 28.0 %RH T= 23.3 'C
```

Set Time and Date

Syntax: TIME<cr>

Syntax: DATE<cr>

Sets the time and date to the transmitter.

Example:

```
>time
Current time is 04:12:39
Enter new time (hh:mm:ss) ? 12:24:00
>date
Current date is 2000-01-01
Enter new date (yyyy-mm-dd) ? 2004-06-30
>
```

NOTE

Time and date are cleared to 2000-01-01 00:00:00 at reset.

NOTE

Only about 1% accuracy is obtained with the software clock.

Add Time and Date to SEND and R Outputs

Syntax: FTIME x<cr>

Syntax: FDATE x<cr>

Where

x = ON/OFF

The command enables or disables output of time and date to the serial line.

Select Metric or Nonmetric Output Units

Syntax: UNIT x<cr>

Where

x = M or N
 M = metric units
 N = nonmetric units

Table 15 Output Quantities and their Metric and Nonmetric Units

Quantity	Metric Unit	Nonmetric Unit
RH Relative Humidity	%RH	%RH
T Temperature	°C	°F
TDF Dewpoint/frostpoint	°C	°F
TD Dewpoint	°C	°F
A Absolute humidity	g/m ³	gr/ft ³
X Mixing ratio	g/kg	gr/lb
TW Wet bulb temperature	°C	°F
PPM Humid air volume/dry air volume	ppm	ppm
PW Water vapor pressure	hPa	psi
PWS Saturation water vapor pressure	hPa	psi
H Enthalpy	kJ/kg	Btu/lb

Example:

```
>unit m
Output units   : metric
>unit n
Output units   : non metric
>
```


Output State of Chemical Purge or Sensor Heating (with SEND and R Commands)

Syntax: FST x<cr>

Where

x = ON/OFF (default = OFF)

Example:

>fst on

Form. status : ON

>send

```
1N 0 RH= 40.1 %RH T= 24.0 'C Td= 9.7 'C Tdf= 9.7 'C a=
8.7 g/m3 x= 7.5 g/kg Tw= 15.6 'C ppm= 11980 pw= 12.00
hPa pws= 29.91 hPa h= 43.2 kJ/kg
```

>purge

Purge started, press any key to abort.

>send

```
1S 134 RH= 40.2 %RH T= 24.1 'C Td= 9.8 'C Tdf= 9.8 'C a=
8.8 g/m3 x= 7.5 g/kg Tw= 15.7 'C ppm= 12084 pw= 12.10
hPa pws= 30.11 hPa h= 43.5 kJ/kg
>
```

¹Letters and values indicating the state of the probe:

N ... xxx → normal operation	xxx = probe heat power (W)
X ... xxx → sensor heating	xxx = sensor temperature (°C)
H ... xxx → chemical purge	xxx = sensor temperature (°C)
S ... xxx → sensor cooling after purge	xxx = sensor temperature (°C)

For more information about chemical purge, see pages 57 through 60.

For more information about sensor heating, see pages 61 through 62.

Other Commands

Check Transmitter Settings

Syntax: ?<cr>

Syntax: ??<cr>

Use the command ? to check the current transmitter configuration. The command ?? is similar but can also be used if the transmitter is in POLL state.

Example (factory default settings):

```
>?
HMT310 / 1.07
PRB serial nr   : A0000000
Calibration     : 2004-05-07
Cal. info      : Vaisala/HEL
Output units    : metric
Pressure       : 1013.25 hPa
RS232 settings
Address        : 0
Output interval: 0 S
Baud P D S     : 4800 E 7 1
Serial mode    : STOP
Analog outputs
Ch1 output mode: 0 ...20mA
Ch2 output mode: 0 ...20mA
Ch1 error out  : 0.000mA
Ch2 error out  : 0.000mA
Ch1 RH lo     : 0.00 %RH
Ch1 RH hi     : 100.00 %RH
Ch2 T lo      : -40.00 'C
Ch2 T hi      : 60.00 'C
>
```

Serial Bus Echo

Syntax: ECHO x<cr>

Where

X = ON/OFF (default = ON)

The command enables or disables the echo of characters received over the serial line.

All Devices in POLL Mode Send Their Addresses

Syntax: FIND<cr>

List Commands

Syntax: HELP<cr>

Set Ambient Pressure for Calculations

Syntax: PRES aaaa.a<cr>

Syntax: XPRES aaaa.a<cr>

Where

aaaa.a = Absolute pressure (hPa)

The **XPRES** command should be used if the value is changed frequently. Its value is not retained at reset, and when set to 0, the value set with the **PRES** command is used.

Example:

If the gauge pressure is 1.4 bar, set the pressure value to 2.4 bar (= 2400 hPa)

```
>pres 2400
Pressure   : 2400
>
```

Table 16 Pressure Conversion Chart

TO

FROM	hPa mbar	mmHg Torr	inHg	atm	bar	psi
hPa mbar	1	1.333224	33.86388	1013.25	1000	68.94757
mmHg Torr	0.7500617	1	25.40000	760	750.0617	51.71493
inHg	0.02952999	0.03937008	1	29.921	29.52999	2.036021
atm	0.00098692	0.00131597	0.033422	1	0.98692	0.068046
bar	0.001	0.001333224	0.03386388	1.01325	1	0.06894757
psi	0.01450377	0.01933678	0.4911541	14.6962	14.50377	1

Example:

$$29.9213 \text{ inHg} = 29.9213 \times 33.86388 = 1013.25 \text{ hPa/mbar}$$

NOTE Conversions from mmHg and inHg are defined at 0 °C.

NOTE Pressure compensation is intended to be used in normal air only. When measuring in other gases, contact Vaisala for further information.

Set Result Filtering

Syntax: `FILT xx<cr>`

Enable or disable the filtering or select the extended filter to reduce noise of the measurement.

Where

- x = ON, OFF or EXT
- ON = Short filter of about 15 s (the measurement output will show the average value of the last 15 s measurement data)
- OFF = No filtering (default)
- EXT = Extended filter of about 1 min (the measurement output will show the average value of the last 1 min measurement data)

Reset Transmitter

Syntax: RESET<cr>

This command resets the device, resulting in a short start-up delay. The serial interface mode (STOP, RUN or POLL) selected with the **S.MODE** command is taken into use at restart.

Display Error Messages

Syntax: ERRS<cr>

Display transmitter error messages. If there are no errors present, a PASS will be returned.

Examples:

```
>errs
```

```
PASS
```

```
>
```

```
>errs
```

```
FAIL
```

```
Error: Temperature measurement malfunction
```

```
Error: Humidity sensor open circuit
```

```
>
```

Setting, Scaling and Testing Analog Outputs

Set Analog Output Mode

Syntax: `AMODE ch1 ch2<cr>`

Where

ch1 and ch2 = I0 = 0 ... 20 mA
I1 = 4 ... 20 mA
U1 = 0 ... 5 V *
U2 = 0 ... 10 V *

*) Voltage output applicable from software version 2.0.1 onward.

Example:

```
>amode i1 i1
Ch1 output mode: 4...20mA
Ch2 output mode: 4...20mA
>
```

NOTE

1 ... 5 V output can be selected when ordering the device. The 1 ... 5 V output is based on the 0 ... 5 V output mode, but has been adjusted to 1 ... 5 V by scaling the valid range to 1 ... 5. In the scaled 1 ... 5 V output mode, 0 V is reserved for error output (**AERR** set to 0).

Select Parameter for Analog Outputs

Syntax: `ASEL xxx yyy<cr>`

Where

xxx = Quantity of channel 1
yyy = Quantity of channel 2

After entering the command, the low and high values of each channel are displayed one row at a time and a new value can be entered. Enter a new value and press `<cr>` to move to the next row, or press `<cr>` without entering a value to keep the current setting.

Use the abbreviations shown in Table 17 on page 55.

Table 17 Output Quantities and their Metric and Nonmetric Units

Quantity	Metric Unit	Nonmetric Unit
RH Relative Humidity	%RH	%RH
T Temperature	°C	°F
TDF Dewpoint/frostpoint	°C	°F
TD Dewpoint	°C	°F
A Absolute humidity	g/m ³	gr/ft ³
X Mixing ratio	g/kg	gr/lb
TW Wet bulb temperature	°C	°F
PPM Humid air volume/dry air volume	ppm	ppm
PW Water vapor pressure	hPa	psi
PWS Saturation water vapor pressure	hPa	psi
H Enthalpy	kJ/kg	Btu/lb

NOTE

Only the quantities selected when ordering the device can be selected for an output quantity.

Examples:

```
>asel td tdf
```

```
Ch1 Td lo : -40.00 'C ?
Ch1 Td hi : 100.00 'C ?
Ch2 Tdf lo : -40.00 'C ?
Ch2 Tdf hi : 60.00 'C ?
```

```
>asel x td
```

```
Ch1 x lo : 0.00 g/kg ?
Ch1 x hi : 160.00 g/kg ?
Ch2 Td lo : -40.00 'C ?
Ch2 Td hi : 60.00 'C ?
>
```

Scale Analog Outputs

Syntax: ASCL<cr>

Example:

```
>ascl
```

```
Ch1 Td lo : -40.00 'C ?
Ch1 Td hi : 100.00 'C ?
Ch2 x lo : 0.00 g/kg ?
Ch2 x hi : 500.00 g/kg ?
```

Test Analog Outputs

Syntax: ITEST aa.aaa bb.bbb<cr>

The operation of the analog outputs is tested by forcing the outputs to given values. The values in the analog outputs can then be measured with a current/voltage meter.

Where

aa.aaa = Current/voltage value to be set for channel 1
bb.bbb = Current/voltage value to be set for channel 2

Example:

```
>itest 8.30 6.40
      8.30000mA  2c30    6.40000mA  2278
>
```

The **ITEST** command output includes internal debugging values shown in hexadecimal format (`2c30` and `2278` in the example above).

The set values remain valid until you issue the **ITEST** command without readings or reset the transmitter.

Test Analog Outputs for Desired Readings

Syntax: AQTEST x yyy.yyy<cr>

Using the **AQTEST** command, you can test the analog output by forcing the output to correspond to a chosen value.

Where

x = Output quantity of analog channel (use abbreviations, see Set Serial Output Format on page 45)
yyy.yyy = Value

Example:

```
>aqtest td 30
CH1 Td : 30.0000 'C 12.00000mA
CH2 x  : 2.5304 g/kg 4.08097mA
>
```

The set values remain valid until you give the command **AQTEST** without a value or reset the transmitter.

Set Error Outputs

Syntax: AERR<cr>

The factory default state for analog outputs during error condition is 0 mA. Be careful when selecting the new error value, the error state of the transmitter should not cause problems in process monitoring.

Example:

```
>aerr
Ch1 error out : 0.000mA ?
Ch2 error out : 0.000mA ?
```

NOTE	Error output value needs to be within the valid range of the output type.
-------------	---------------------------------------------------------------------------

NOTE	The error output value is shown only when there are minor electrical faults such as a humidity sensor open circuit. When there is a severe device malfunction, such as an analog output electronics failure or a microprocessor ROM/RAM failure, the error output value is not necessarily shown.
-------------	---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------

Chemical Purge (Optional)

General

In some specific applications the sensor gain may decrease gradually due to an interference caused by some particular chemical present in the ambient (see Figure 16 on page 58). The sensor polymer absorbs the interfering chemical; this reduces the ability of the polymer to absorb water molecules and so decreases the sensor gain. In chemical purge, the humidity sensor is heated to a temperature level of approximately +180 °C for several minutes, which evaporates the interfering chemical.

The purge function starts with a heating stage, continues with a settling stage, and when the temperature of the sensor is decreased, the transmitter returns to normal mode. The whole cycle takes about 8 minutes.

NOTE	The chemical purge function locks the output values for about 8 minutes.
-------------	--------------------------------------------------------------------------

NOTE Using purge is not recommended when the transmitter is powered with USB. For information on HMT310 operating voltages, see section Power Supply Requirements on page 34.

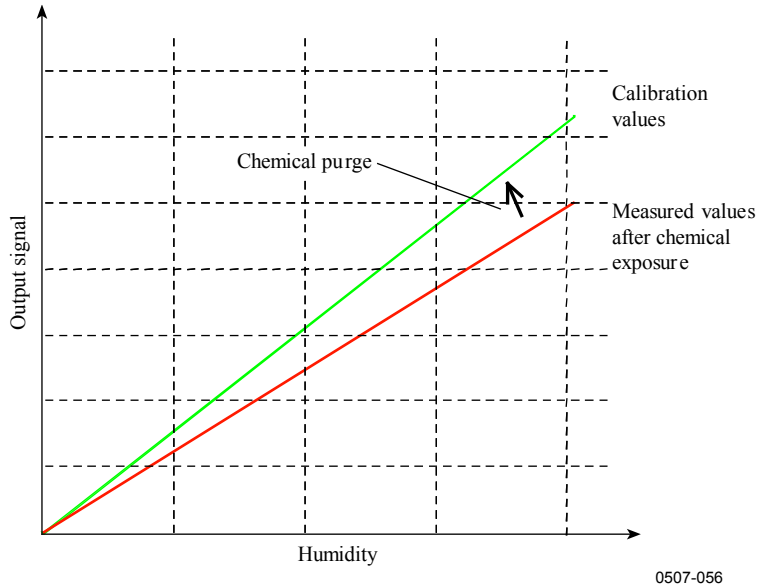


Figure 16 Decrease of Sensor Gain Due to Interfering Chemical and Effect of Chemical Purge Process

Automatic/Manual Chemical Purge

When HMT310 leaves the factory the automatic chemical purge (if selected) takes place repeatedly with the time intervals set in the factory. You can change the interval in which the purge takes place by using serial commands. This may be necessary if the measuring environment contains high concentrations of interfering chemicals. The automatic chemical purge can be also turned off if necessary.

NOTE It is not recommended to alter any other purge settings than the interval.

Automatic Chemical Purge Settings

Turn ON/OFF Automatic Chemical Purge

This command enables or disables automatic chemical purge.

Syntax: PUR x<cr>

Where

x = ON/OFF

Example:

```
>pur off
Chemical Purge : OFF
>pur on
Chemical Purge : ON
>
```

Set Chemical Purge Interval

If the sensor is exposed to chemicals it is recommended to have the chemical purge done at least once in 720 min (= 12 hours). In applications where the chemical exposure is not likely, the interval may be longer.

In normal use, it is not recommended to change other parameters than the purge interval. If changing any other parameters is required, always take note of the current settings before making changes so you are able to restore the configuration.

Syntax: PUR<cr>

Issue the **PUR** command and type the new interval (in minutes). Press **Enter** without entering any values to keep the other parameters in their current configuration and finish the command. The maximum interval is 14400 minutes (= 10 days).

Example:

```
>pur
Chemical Purge : ON          <cr>
Interval min   : 1440 ?     720
Duration s     : 120 ?     <cr>
Settling s     : 240 ?     <cr>
Power          : 160 ?     <cr>
Temp diff      : 0.50 ?     <cr>
>
```

NOTE

To activate the new interval setting immediately, reset the transmitter.

Chemical Purge in Powerup

This command enables or disables the function which turns on chemical purge within 10 seconds from the powerup of the device.

Syntax: PURR x<cr>

Where

x = ON/OFF (default = OFF)

NOTE

When you enable this function, wait about 8 min after powerup before taking measurements. The powerup chemical purge locks the output values for the first operation minutes.

Chemical Purge Activated Manually

Chemical purge needs to be performed always before calibration (see Chapter Calibration and Adjustment on page 69) or whenever there is reason to believe that the sensor has been exposed to an interfering chemical. Make sure that the temperature of the sensor has come down to normal before starting calibration.

Before starting chemical purge note the following:

- The sensor must be protected with a PPS grid with stainless steel netting, a stainless steel sintered filter or with a membrane SST filter.
- The sensor temperature needs to be below 100 °C. At higher temperatures the chemicals evaporate spontaneously from the sensor and the chemical purge is not necessary.

Starting Manual Chemical Purge

Activate chemical purge with the PURGE command.

Syntax: PURGE<cr>

Example:

```
>purge
Purge started, press any key to abort.
>
```

The prompt ">" appears when the heating period is over. However, the transmitter outputs are locked to values measured before chemical purge until the settling time is over.

Sensor Heating (Optional)

General

This function is optionally available only in transmitters with HUMICAP[®]180RC sensor. It should be used only with the warmed probe.

The sensor heating is recommended for the high humidity environments where even a small temperature differences can cause water to condense on the sensor. The sensor heating speeds up the recovery of the humidity sensor from condensation.

Sensor heating starts up when the relative humidity of the measuring environment reaches the RH value set by the user (RH limit). The user can define the RH sensor heating temperature as well as the duration of the heating.

After the heating cycle the humidity conditions are checked and new sensor heating is performed if the predefined conditions are reached again.

NOTE

During the sensor heating the outputs are locked to the values measured before the heating cycle.

NOTE

Using sensor heating is not recommended when the transmitter is powered with USB. For information on HMT310 operating voltages, see section Power Supply Requirements on page 34.

HMT317 Fuel Cell Model Heating Settings

In the HMT317 fuel cell model, the probe heating temperature has been set to the maximum in the factory configuration in order to minimize condensation.

Sensor heating (**XHEAT** command) has also been enabled in the factory configuration for the fuel cell option. See section Setting Heating Parameters on page 62 for instructions on configuring the sensor heating settings.

Setting Humidity Sensor Heating

When HMT310 leaves the factory the sensor heating follows the factory default values. You can enable or disable the function, change the RH limit and define the heating temperature and duration of the heating period.

Sensor Heating ON/OFF

Enables or disables the sensor heating.

Syntax: XHEAT x<cr>

Where

x = ON/OFF (default = OFF)*

* In the HMT317 fuel cell model, XHEAT is enabled in the factory settings.

Example:

```
>xheat on
Extra heat      : ON
>xheat off
Extra heat      : OFF
>
```

Setting Heating Parameters

Whenever the RH value seen by the sensor exceeds the predefined RH limit the humidity sensor is warmed up to the predefined temperature. The duration of the heating can also be defined.

After the heating cycle the humidity conditions are checked and a new sensor heating is activated if the predefined conditions are reached again.

Syntax: XHEAT<cr>

Type the values after the question mark. The ranges available:

- Extra heat RH limit: 0 ... 100 %RH (default: 95 %RH, heating function starts up above the setpoint)
- Extra heating temperature: 0 ... 200 °C (default: 100 °C)
- Extra heating time: 0 ... 255 s (default: 30 s)

Example:

```
>xheat  
Extra heat      : OFF  
Extra heat RH   : 95 ? 90  
Extra heat temp: 100 ? 85  
Extra heat time: 30 ? 10  
>xheat on  
Extra heat      : ON  
>
```

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CHAPTER 5

MAINTENANCE

This chapter provides information that is needed in basic maintenance of the HMT310.

Periodic Maintenance

Calibration Interval

HMT310 is fully calibrated and adjusted as shipped from factory. Typical calibration interval is one year. In certain applications it may be advisable to do more frequent checks. Calibration needs to be done always when there is reason to believe that the device is not within the accuracy specifications.

You can carry out calibration and adjustment by yourself, or you can send the transmitter to Vaisala Service Centers for recalibration. For more information on calibration, see section Calibration and Adjustment on page 69.

Replacing Consumables

Changing the Filter

Replace the filter if it is contaminated. New filters are available from Vaisala; see section Spare Parts and Accessories on page 93.

CAUTION

Be careful when changing the filter, since it is easy to break the sensor when the filter is removed.

CAUTION

If the transmitter is installed in a pressurized chamber, always make sure that the pressure of the chamber is equalized with the ambient pressure prior to removing the transmitter. When the transmitter is removed for maintenance, cap the hole with a capped nut. This way, the chamber can be pressurized although the transmitter is not in place.

Plugs are available from Vaisala for ISO threaded connections.

When replacing the filter, wear clean gloves to avoid depositing dirt or oil on the filter.

Replace the filter as follows:

1. Turn the filter counterclockwise until it is loose.
2. Pull the filter straight out carefully. **Do not damage the sensor.**
3. Take the new filter, and insert it to the filter thread.
4. Tighten the new filter to 5 Nm by turning it clockwise.

Changing the Sensor

NOTE

When replacing the sensor, the new sensor must be of the same type as the old sensor (for example, HUMICAP180R). The sensor type can only be changed at a Vaisala Service Center. Information on Vaisala sensors is available online at www.vaisala.com/sensorinfo.

Changing HUMICAP180 and HUMICAP180R humidity sensors is simple. If the transmitter has the chemical purge and/or warmed probe option which utilizes the HUMICAP180C or HUMICAP180RC sensor, the change is more difficult as soldering is required to attach the pins of the integrated temperature sensor element. Vaisala recommends that you leave the replacement of HUMICAP180C and HUMICAP180RC sensors to Vaisala Service Centers, but spare parts are available if you want do it yourself. Soldering instructions are not provided.

Changing the sensor should be considered corrective maintenance, and it is not necessary in normal operation. If the accuracy of the transmitter does not seem to be within specification, it is more likely that the transmitter is in need of calibration and adjustment, and not sensor replacement. Refer to chapter Maintenance on page 65.

1. Remove the filter from the probe. See the instructions in section Changing the Filter on page 65.
2. Remove the damaged sensor and insert a new one. Handle the new sensor by the plastic socket. **DO NOT TOUCH THE SENSOR PLATE.**
3. Perform a calibration and adjustment as instructed in section Relative Humidity Calibration after Sensor Change on page 71.
4. Attach a new filter on the probe. When using the stainless steel filter, take care to tighten the filter properly (recommended force 5 Nm).

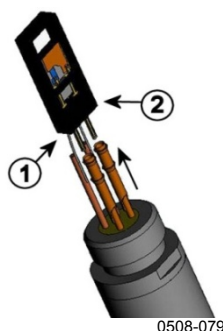


Figure 17 Changing the Sensor

The following numbers refer to Figure 17 above:

- 1 = Pull out the sensor
- 2 = Plastic socket

Technical Support

For technical questions, contact the Vaisala technical support by e-mail at helpdesk@vaisala.com. Provide at least the following supporting information:

- Name and model of the product in question
- Serial number of the product
- Name and location of the installation site
- Name and contact information of a technically competent person who can provide further information on the problem.

Product Returns

If the product must be returned for service, see www.vaisala.com/returns.

For contact information of Vaisala Service Centers, see www.vaisala.com/servicecenters.

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CHAPTER 6

CALIBRATION AND ADJUSTMENT

This chapter describes the relative humidity and temperature adjustment procedures. Note that after adjustment, the original calibration certificate shipped with the product is not valid anymore.

Vaisala recommends using the calibration services offered by Vaisala. Vaisala Service Centers perform calibrations and adjustments as well as repair and spare part services, and offer accredited calibrations and maintenance contracts.

Calibration services can also be ordered online at <http://store.vaisala.com>.

CAUTION

If you think the HMT310 is not measuring correctly, calibration and adjustment is not the first thing to do. Try the following first:

- Make sure nothing is interfering with the measurement: heat sources, temperature differences, or condensation
- Check that there is no moisture on the probe. If the sensor has become wet, you must allow it to dry before you can measure.
- Always wait for the measurement to stabilize.

NOTE

For an introduction to calibration, order or download the free calibration book from Vaisala at the following address:

www.vaisala.com/calibrationbook

Calibration and Adjustment Commands

Revert to Factory Calibration

Syntax: LI<cr>

This command reverts only the **CRH** calibration (see calibration instructions, starting on page 73).

1. Remove the transmitter unit from the mounting plate (see Mounting the Transmitter/Removing the Transmitter Unit on page 22) and press the adjustment button once (see Figure 18 on page 74).
2. Issue the **LI** command and enter value 0 for offset and value 1 for gain.
3. Reset the transmitter by issuing the **RESET** command. The transmitter returns to normal mode.

Example:

```
>li
RH offset :      -0.6000000 ? 0
RH gain   :      1.0000000 ? 1
T  offset :      0.0000000 ? 0
T  gain   :      0.4000000 ? 1
>
```

View Current Offset and Gain Adjustment

View the currently applied standard user adjustment offset and gain using the **L** command.

Syntax: L<cr>

Example:

```
>l
RH offset :      0.0000000
RH gain   :      1.0000000
T  offset :      0.0000000
T  gain   :      1.0000000
>
```

Relative Humidity Calibration after Sensor Change

Syntax: FCRH<cr>

The transmitter asks and measures relative humidity and calculates the calibration coefficients. This two-point adjustment needs to be performed after a sensor change. Follow the more detailed calibration instructions on page 73, but instead of the **CRH** command, use the **FCRH** command.

Example:

```
>fcrh
RH      :    1.82 1. ref  ?    0
Press any key when ready <cr>
RH      :    74.22  2. ref  ? 75
OK
>
```

The OK indicates that the calibration has succeeded.

Set Calibration Information Text

Syntax: CTEXT<cr>

1. Remove the transmitter unit from the mounting plate (see Mounting the Transmitter/Removing the Transmitter Unit on page 22) and press the adjustment button once (see Figure 18 on page 74).
2. Issue the **LI** command and set the offset value to 0 and gain value to 1.
3. Issue command **CTEXT** and enter calibration information text.

Example:

```
>ctext
Cal. info      : Vaisala/HEL ? HMK15
>
```

Set Calibration Date

Syntax: CDATE yyyy mm dd<cr>

1. Remove the transmitter unit from the mounting plate (see Mounting the Transmitter/Removing the Transmitter Unit on page 22) and press the adjustment button once (see Figure 18 on page 74).
2. Issue the **LI** command and set the offset value to 0 and gain value to 1.
3. Issue the **CDATE** command and set the calibration date.

Example:

```
>cdate 2001 12 11
Calibration      : 2001-12-11
>
```

Analog Output Calibration

Syntax: ACAL<cr>

Connect the HMT310 to a multimeter in order to measure either current or voltage depending on the selected output type. Issue the **ACAL** command. Then type the multimeter readings and press **Enter**.

Example (current outputs):

```
>acal
Ch1    I1    (mA) ?    2.046
Ch1    I2    (mA) ?    18.087
Ch2    I1    (mA) ?    2.036
Ch2    I2    (mA) ?    18.071
>
```


Multipoint Relative Humidity Adjustment

Syntax: MPC [*quantity*] [*function*]
<cr>

where

quantity = Quantity to be adjusted. The only available quantity is RH.

function = Desired function. The options are:

ON – Enable multipoint correction.

OFF – Disable multipoint correction.

LIST – Show correction table.

INIT – Start entering values in correction table.

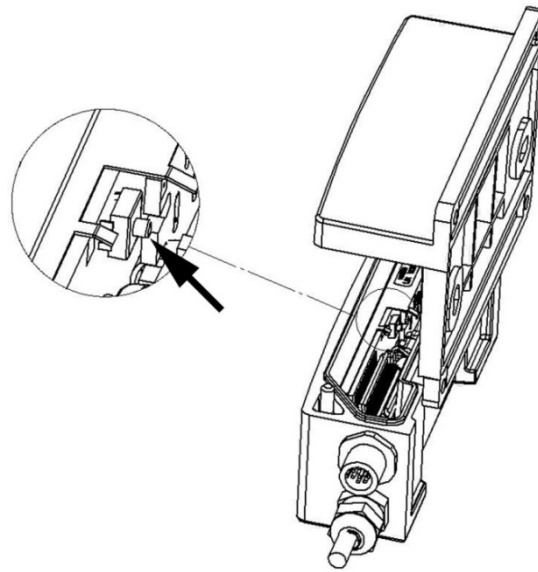
CLEAR – Remove all values from correction table and disable multipoint correction.

Multipoint calibration (applicable from software version 2.0.1 onward) can be used to optimize RH measurement in a narrow range of measurement by using 3-8 adjustment points. For more information and an example multipoint calibration, see section Multipoint Adjustment Using Serial Line on page 78.

Relative Humidity Calibration and Adjustment (in Two Points)

Use two reference humidities over the measurement range. The references need to have a difference of at least 50 %RH.

Before calibration HMT310 needs to be set to adjustment mode by pressing the adjustment button once, see Figure 18 on page 74. To return to normal operation mode, use the **RESET** command: see Reset Transmitter on page 53.



0507-048

Figure 18 Location of Adjustment Button

NOTE

With a warmed probe (HMT317) or sensor heating, heating is interrupted when the adjustment button is pressed. Allow enough time for the probe to reach ambient temperature and then start the calibration procedure.

Low End Adjustment

1. Remove the transmitter unit from the mounting plate (see Mounting the Transmitter/Removing the Transmitter Unit on page 22), and press the adjustment button once (see Figure 18 above).
2. Remove the filter from the probe (see instructions on page 65) and insert the probe into the dry end reference chamber (for example, LiCl: 11 % RH in the humidity calibrator HMK15, use adapter fitting 13.5 mm for HMT314, HMT315, HMT317, and HMT318).
3. Wait at least 30 minutes for the sensor to stabilize.
4. Issue the **CRH** command and press **Enter**.
5. Type **C** and press **Enter** a few times to check if the reading is stabilized.
6. When the reading is stabilized, type the reference humidity after the question mark and press **Enter**.

```
>crh
RH : 11.25 Ref1 ? c
RH : 11.25 Ref1 ? c
RH : 11.25 Ref1 ? c
RH : 11.24 Ref1 ? c
RH : 11.24 Ref1 ? 11.3
Press any key when ready ...
```

Now the device is waiting for the high-end reference.

High End Adjustment

7. After the low end adjustment, insert the probe into the measurement hole of the high end reference chamber (for example, NaCl: 75 % RH chamber in the humidity calibrator HMK15, use the adapter fitting 13.5 mm for HMT314, HMT315, HMT317, and HMT318). Note that the difference between the two humidity references must be at least 50% RH.
8. Let the probe stabilize for at least 30 minutes. You can follow the stabilization by pressing any key, typing C and pressing **Enter**.
9. When stabilized, type the high-end reference value after the question mark and press **Enter**.

>**crh**

```
RH :    11.25  Ref1 ? c
RH :    11.24  Ref1 ? c
RH :    11.24  Ref1 ? 11.3
Press any key when ready ...
```

```
RH :    75.45  Ref2 ? c
RH :    75.57  Ref2 ? c
RH :    75.55  Ref2 ? c
RH :    75.59  Ref2 ? 75.5
```

OK

>

OK indicates that the calibration has succeeded.

10. Take the probe out of the reference conditions and replace the filter. When using the stainless steel filter, take care to tighten the filter properly, recommended force is 130 Ncm.
11. If needed, record the calibration information (text and date) to the memory of the transmitter: see Set Calibration Information Text on page 71 and Set Calibration Date on page 72.
12. Reset the transmitter by issuing the **RESET** command. The transmitter returns to normal mode.

Temperature Calibration and Adjustment (in One Point)

1. Remove the transmitter unit from the mounting plate (see Mounting the Transmitter/Removing the Transmitter Unit on page 22) and press the adjustment button once (see Figure 18 on page 74).
2. Remove the probe filter (see instructions on page 65) and insert the probe into the reference temperature.
3. Let the sensor stabilize.
4. Issue the **CT** command and press **Enter**.
5. Type **C** and press **Enter** a few times to check if the reading is stabilized.
6. When the reading is stabilized, type the `Ref1` reference temperature after the question mark and press **Enter** three times.

```
>ct
T : 16.06 Ref1 ? c
T : 16.06 Ref1 ? c
T : 16.06 Ref1 ? c
T : 16.06 Ref1 ? c
T : 16.06 Ref1 ? c
T : 16.06 Ref1 ? 16.0
Press any key when ready ...
T : 16.06 Ref2 ?
OK
>
```

OK indicates that the calibration has succeeded.

7. Take the probe out of the reference conditions and replace the filter. When using the stainless steel filter, take care to tighten the filter properly (recommended force 130 Ncm).
8. If needed, record the calibration information (text and date) to the memory of the transmitter, see Set Calibration Information Text on page 71 and Set Calibration Date on page 72.
9. Reset the transmitter by issuing the **RESET** command. The transmitter returns to normal mode.

Humidity Calibration and Adjustment (in One Point)

1. Remove the transmitter unit from the mounting plate (see Mounting the Transmitter/Removing the Transmitter Unit on page 22) and press the adjustment button once (see Figure 18 on page 74).
2. Remove the probe filter (see instructions on page 65) and insert the probe into the reference humidity (for example, use a humidity generator such as the HMK 15 Humidity Calibrator or salt solutions).
3. Let the sensor stabilize.
4. Issue the **CRH** command and press **Enter**.
5. Type **C** and press **Enter** a few times to check if the reading is stabilized.
6. When the reading is stabilized, type the reference humidity after the question mark and press **Enter** three times (to set the first RH reference, acknowledge the “Press any key when ready ...” message, and leave the second reference point unset).

```
>crh
RH : 26.00 Ref1 ? c
RH : 26.00 Ref1 ? c
RH : 26.00 Ref1 ? c
RH : 26.00 Ref1 ? c
RH : 26.00 Ref1 ? c
RH : 26.00 Ref1 ? 33
Press any key when ready ...
RH : 26.00 Ref2 ?
OK
>
```

OK indicates that the calibration has succeeded.

7. Take the probe out of the reference conditions and replace the filter. When using the stainless steel filter, take care to tighten the filter properly (recommended force 130 Ncm).
8. If needed, record the calibration information (text and date) to the memory of the transmitter: see Set Calibration Information Text on page 71 and Set Calibration Date on page 72.
9. Reset the transmitter by issuing the **RESET** command. The transmitter returns to normal mode.

Multipoint Adjustment Using Serial Line

You can use the **MPC** command (applicable from software version 2.0.1 onward) to perform a multipoint adjustment to the relative humidity measurement. Due to the linear response of the HUMICAP[®] sensor, it is recommended to use the standard two-point adjustments. Use multipoint correction only if:

- You need to adjust the relative humidity measurement in 3 ... 8 adjustment points.
- You are interested in a narrow range of measurement and want to optimize the RH measurement performance for that range.

Multipoint adjustment works by means of a correction table that holds 2 ... 6 adjustment points. The idea is that for every point, you enter the RH reading that the transmitter shows, and the correct humidity reference value. You can select any reference points from the range of 0 ... 100 % RH, but Vaisala recommends that the difference between the lowest and highest reference point is at least 50 %RH.

NOTE

Multipoint adjustment is applied “on top” of the standard user-made two point adjustment (made using serial line commands or MI70). It is recommended that before you start using the **MPC** command, you clear the existing humidity adjustment. This is done as part of the example multipoint adjustment procedure provided here.

MPC Command Syntax

MPC [*quantity*] [*function*]<cr>

where

quantity = Quantity to be adjusted. The only available quantity is RH.

function = Desired function. The options are:

ON – Enable multipoint correction.

OFF – Disable multipoint correction.

LIST – Show correction table.

INIT – Start entering values in correction table.

CLEAR – Remove all values from correction table and disable multipoint correction.

Example Multipoint Adjustment Procedure

1. Connect the HMT310 to a computer (see section Serial Line and Analog Communication Options on page 36). Open a terminal program.
2. Issue the **PURGE** command to carry out the chemical purge, and wait for six minutes for it to complete. Transmitters without the chemical purge feature (selected when ordering) do not respond to the command.

```
>purge
Purge started, press any key to abort...
```

3. Press the **adjustment** button once (see Figure 18 on page 74).
4. View the currently applied standard user adjustment offset and gain using the **L** command. If offset is zero and gain is one (example shown below), no user correction is applied:

```
>l
RH offset      : 0.00000000
RH gain        : 1.00000000
T offset       : 0.00000000
T gain         : 1.00000000
```

5. If an RH offset or gain is in place, write down the adjustment and then clear it by writing zero to RH offset and one to RH gain using the **LI** command (see section Revert to Factory Calibration on page 70):

```
>li
RH offset      : 0.00130000 ? 0
RH gain        : 1.04000000 ? 1
T offset       : 0.00000000 ?
T gain         : 1.00000000 ?
```

6. You must now prepare a list of 3 ... 8 correction points using a humidity generator or salt solutions (for example, using the HMK15 Humidity Calibrator). You must measure the transmitter's RH reading at each point, and make a note of the reference RH reading. Here is an example list for a four-point correction:

Table 18 Example List for Multipoint Correction

Point Number	Transmitter's Reading	Reference
1	12.2% RH	11% RH
2	34% RH	33% RH
3	75.5% RH	75% RH
4	97.3% RH	97% RH

To start, remove the filter from the probe and insert the probe into a measurement hole of the driest reference chamber you intend to use. Proceed from low to high humidity. Remember to allow at least 30 minutes for the sensor to stabilize at each point.

7. Once you have completed the list, remove the probe from the last measurement chamber and re-attach the filter.
8. Using the serial connection command line, issue the **MPC RH INIT** command and start entering the readings and reference points from the list you prepared in step 6. When you have no more points to enter, press enter to save the points.

```
>mpc rh init
1 Reading : ? 12.2
1 Reference: ? 11
2 Reading : ? 34
2 Reference: ? 33
3 Reading : ? 75.5
3 Reference: ? 75
4 Reading : ? 97.3
4 Reference: ? 97
5 Reading : ?
```

Mpc points saved.

9. Issue the **MPC RH LIST** command to verify the list you entered:

```
>mpc rh list
MPC : OFF
# Reading Reference Correction
1 12.20 11.00 -1.20
2 34.00 33.00 -1.00
3 75.50 75.00 -0.50
4 97.30 97.00 -0.30
```

10. If you are satisfied with the correction list, enable multipoint correction by issuing the command **MPC RH ON**.

```
>mpc rh on
```

11. Multipoint adjustment is now complete. To exit adjustment mode and return to the normal mode, issue the **RESET** command.

The multipoint adjustment can be disabled with the **MPC RH OFF** command, and the correction list can be cleared with the **MPC RH CLEAR** command. Note that using MPC configuration commands requires pressing the adjustment button. The current status can be viewed with the **MPC RH LIST** command also outside of the adjustment mode.

Adjustment Using an MI70 Indicator

You can use the MI70 handheld indicator to adjust the following in HMT310:

- Temperature (T)
- Relative humidity (RH)
- Pressure compensation value for humidity measurement (environment settings)

Note that starting the calibration in MI70 requires pressing the adjustment button on the HMT310 board. See Figure 18 on page 74 for the location of the adjustment button. To return to normal operation mode, use the **RESET** command (see section Reset Transmitter on page 53).

NOTE

When adjusting both relative humidity and temperature, make the temperature adjustment first.

Starting MI70 Adjustment

1. Connect the HMT310 series transmitter to the MI70 handheld indicator using the connection cable (optional accessory, Vaisala order code DRW216050SP).
2. Turn on the MI70.
3. Press the HMT310 adjustment button (see Figure 18 on page 74) to start the adjustment mode. A notification about starting the adjustment mode is displayed on the MI70 screen.
4. Press OK to enter the adjustment menu. The available adjustment options are displayed (RH or T). You can also view the date of last adjustment.

Use the arrow buttons to highlight RH or T and press SELECT to choose the parameter for adjustment.

For RH adjustment instructions, see section Adjusting RH with MI70.

For T adjustment instructions, see section Adjusting T with MI70.

Adjusting RH with MI70

Selecting RH in the main adjustment menu brings up a notification about checking environment settings. Select YES to access the environment settings before performing the RH adjustment, or NO to continue to RH adjustment without changing the current environment settings. Select ADJUST to access the RH adjustment options.

The following RH adjustment options are available:









- 1-point adjustment
- 2-point adjustment
- LiCl – NaCl auto


1-point RH Adjustment

Usually it is recommended to make an adjustment in two reference humidities. If the adjustment is done by using one reference humidity (1-point adjustment), select the reference humidity so that it represents the measuring environment. Make the adjustment in one point as instructed in the 2-point RH Adjustment instructions (select 1-point adjustment instead of 2-point adjustment and follow the display instructions).

2-point RH Adjustment

Select 2-point adjustment in the RH adjustment menu and follow the steps below:

1. Set the probe to a lower reference relative humidity. You can follow the stabilization from the  GRAPH display. Press  READY when the reading is stabilized.
2. Give the lower reference humidity value by using the arrow buttons. Press  OK.
3. Set the probe to the higher reference humidity. Press  READY when the reading is stabilized. You can follow the stabilization from the  GRAPH display.
4. Give the higher reference relative humidity value by using the arrow buttons. Press  OK.
5. To confirm the adjustment, press  YES. To cancel entering the adjustment, press  NO to return to adjustment mode display without making any changes. Note that if the difference between the two references is less than 50 %, adjustment cannot be done.

Once confirmed, the adjustment has been carried out. Press  BACK to exit the RH adjustment mode and return to the main adjustment options.

Press **⊖** EXIT to quit the adjustment mode and return to the basic MI70 view.

LiCl – NaCl automatic adjustment

LiCl-NaCl automatic adjustment is a two-point adjustment in reference humidities of 11.3 % (LiCl) and 75 % (NaCl). You do not have to enter the reference values, the MI70 displays the accurate value based on the measured temperature and the Greenspan table stored into the memory of the MI70.

To make the adjustment, select LiCl – NaCl auto in the RH adjustment menu and follow the steps below:

1. Set the probe to the LiCl reference humidity. You can follow the stabilization from the **⊖** GRAPH display. Press **⊖** READY when the reading is stabilized.
2. Set the probe to the NaCl reference humidity. You can follow the stabilization from the **⊖** GRAPH display. Press **⊖** READY when the reading is stabilized.
3. After the NaCl reference humidity measurement is done, MI70 checks if you want to use this 2-point adjustment. Press **⊖** OK to confirm the adjustment.

Once confirmed, the adjustment has been carried out. Press **⊖** BACK to exit the RH adjustment mode and return to the main adjustment options. Press **⊖** EXIT to quit the adjustment mode and return to the basic MI70 view.

Adjusting T with MI70

Selecting T in the main adjustment menu brings up the current T measurement. Select ADJUST to choose the adjustment type. The following T adjustment options are available:

- 1-point adjustment
- 2-point adjustment

NOTE

Temperature adjustment in one or two points can be done if there is reason to believe that the adjustment is changed. If the adjustment is done only in one point, the reference condition is used to represent the measuring environment.

1-point T adjustment

Select 1-point adjustment in the T adjustment menu and follow the steps below:

1. Set the probe to a reference temperature. You can follow the stabilization from the **GRAPH** display. Press **READY** when the reading is stabilized.
2. Give the reference temperature by using the arrow buttons and press **OK**.
3. To confirm the adjustment, press **YES**. To cancel entering the adjustment, press **NO** to return to adjustment mode display without making any changes.

Once confirmed, the adjustment has been carried out. Press **BACK** to exit the T adjustment mode and return to the main adjustment options. Press **EXIT** to quit the adjustment mode and return to the basic MI70 view.

2-point T adjustment

Select 2-point adjustment in the T adjustment menu and follow the steps below:

1. Set the probe to a lower reference temperature. You can follow the stabilization from the **GRAPH** display. Press **READY** when the reading is stabilized.
2. Give the lower reference temperature by using the arrow buttons and press **OK**.
3. Set the probe to a higher reference temperature. You can follow the stabilization from the **GRAPH** display. Press **READY** when the reading is stabilized.
4. Give the higher reference temperature by using the arrow buttons and press **OK**.
5. To confirm the adjustment, press **YES**. To cancel entering the adjustment, press **NO** to return to adjustment mode display without making any changes.

Once confirmed, the adjustment has been carried out. Press **BACK** to exit the T adjustment mode and return to the main adjustment options. Press **EXIT** to quit the adjustment mode and return to the basic MI70 view.

Environment Settings

When you select RH adjustment for the first time from the adjustment main menu, MI70 asks if you want to check the environment settings (pressure compensation value for humidity measurement). If you need to access the environment settings after this, exit the adjustment mode by selecting EXIT in the main adjustment menu and navigate to the environment menu from the MI70 main menu. To return to the adjustment mode, press the HMT310 adjustment button.

Last Adjustment Date

To see the last adjustment date, select Last adjustment date in the main adjustment menu. You can also view this date from the Device information menu in the MI70 main menu.

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CHAPTER 7

TECHNICAL DATA

This chapter provides the technical data of the HMT310.

Specifications

Table 19 Relative Humidity Specifications

Property	Description / Value
Measuring range	0 ... 100 %RH
Sensor	
Vaisala HUMICAP®180R	for typical applications
Vaisala HUMICAP®180RC	for applications with chemical purge and/or warmed probe
Vaisala HUMICAP®180VHP	catalytic sensor for environments with vaporized hydrogen peroxide (H ₂ O ₂)
Vaisala HUMICAP®180VHPC	catalytic sensor with chemical purge for H ₂ O ₂ environments
Accuracy (including nonlinearity, hysteresis and repeatability)	
at +15 ... +25 C	± 1 % RH (0 ... 90 %RH) ± 1.7 % RH (90 ... 100 %RH)
at -20 ... +40 C at -40 ... +180 C	± (1.0 + 0.008 × reading) %RH ± (1.5 + 0.015 × reading) %RH
Factory calibration uncertainty (+20 °C)	±0.6 % RH (0 ... 40 %RH) ±1.0 % RH (40 ... 97 %RH) (Defined as ± 2 standard deviation limits. Small variations possible, see also calibration certificate.)
Response time (90%) for HUMICAP®180R and HUMICAP®180RC at +20°C in 0.1 m/s air flow	17 s with grid filter 50 s with grid and steel, netting filter 60 s with sintered filter

Table 20 Temperature Specifications and Operating Pressure Ranges

Property	Description / Value
HMT311	-40 ... +60 °C (-40 ... +140 °F)
HMT313 80 °C	-40 ... +80 °C (-40 ... +176 °F)
HMT313 120 °C	-40 ... +120 °C (-40 ... +248 °F)
HMT314	-70 ... +180 °C (-94 ... +356 °F), 0 ... 10 MPa (0 ... 100 bar)
HMT315 (vapor tight)	-70 ... +180 °C (-94 ... +356 °F)
HMT317 (vapor tight)	-70 ... +180 °C (-94 ... +356 °F)
HMT318	-70 ... +180 °C (-94 ... +356 °F), 0 ... 4 MPa (0 ... 40 bar)
Accuracy at +20 °C (+68 °F)	±0.2 °C (±0.36 °F)
Accuracy over temperature range	See Figure 19 below.
Temperature sensor	Pt 100 RTD Class F0.1 IEC 60751

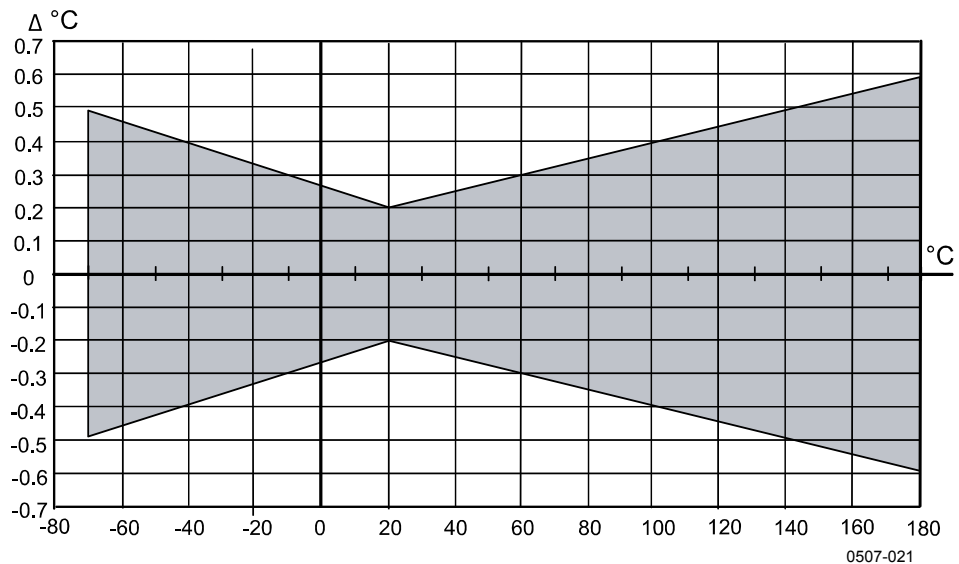


Figure 19 Accuracy over Temperature Range

Table 21 Electrical Connections

Property	Description / Value
Two analog outputs: selectable and scalable	Current: 0...20 mA or 4...20 mA Voltage: 0 ... 5 V, or 0 ... 10 V (1 ... 5 V available through scaling)
Typical analog output accuracy at +20 °C	±0.05% of full scale
Typical temperature dependence of analog output	0.005%/°C (0.003%/°F) of full scale
Serial output	RS232
Cable feed through alternatives	M12 8-pole connector with 5 m cable or Female 8-pin connector screw joint for cable diameter 4 ... 8 mm
Operating voltage	RS232 output 10 ... 35 VDC Analog output 15 ... 35 VDC Purge and heating 15 ... 35 VDC Pressures over 10 bara min 24 VDC
Power consumption (Vsupply=35VDC)	RS232: 12 mA Uout 10 V (10 kOhm) Channel1 & Channel 2: 12 mA Iout 20mA (load 511 Ohm) Channel 1 & Channel 2: 50 mA
Power consumption, maximum pulsed current (Vsupply=24VDC)	Purge: + 220 mA Warmed probe: + 240 mA Fuel cell: + 350 mA
External load	$R_L < 500 \text{ ohm}$
Startup time after powerup	3 s with analog output, 5 s with serial line

Table 22 General

Property	Description / Value
Transmitter housing material	G-AlSi10Mg
Transmitter base material	PPS
Housing classification	IP66
Sensor protection	PPS grid with stainless steel net PPS grid Sintered filter Membrane stainless steel filter Stainless steel grid Catalytic filter
Operating temperature range for electronics	-40 ... +60 °C (-40 ... +140 °F)
Storage temperature	-55 ... +80 °C (-67 ... +176 °F)
Pressure range:	
HMT314	0...100 bar
HMT317	0...10 bar
HMT318	0...40 bar
Probe cable length	2, 5 or 10 m
EMC standard	Complies with EMC standard EN61326-1, Industrial environment.

Calculated Variables

Table 23 Calculated Variables (Typical Ranges)

Variable	HMT331 Probe	HMT333 Probe	HMT334/335/337/338 Probes
Dewpoint temperature	-20 ... +60 °C	-20 ... +80 °C	-20 ... +100 °C
Mixing ratio	0 ... 160 g/kg dry air	0 ... 500 g/kg dry air	0 ... 500 g/kg dry air
Absolute humidity	0 ... 160 g/m ³	0 ... 500 g/m ³	0 ... 500 g/m ³
Wet bulb temperature	0 ... 60 °C	0 ... +100 °C	0 ... +100 °C
Enthalpy	-40 ... +1500 kJ/kg	-40 ... +1500 kJ/kg	-40 ... +1500 kJ/kg
Water vapor pressure	0 ... 1000 hPa	0 ... 1000 hPa	0 ... 1000 hPa

Accuracies of Calculated Variables

Accuracies of the calculated variables depend on the calibration accuracy of the humidity and temperature sensors; here the accuracies are given for $\pm 2\%$ RH and $\pm 0.2\text{ °C}$.

Accuracy of Dewpoint Temperature °C

Temp.	Relative humidity									
	10	20	30	40	50	60	70	80	90	100
-40	1.86	1.03	0.76	0.63	0.55	0.50	0.46	0.43	—	—
-20	2.18	1.19	0.88	0.72	0.62	0.56	0.51	0.48	—	—
0	2.51	1.37	1.00	0.81	0.70	0.63	0.57	0.53	0.50	0.48
20	2.87	1.56	1.13	0.92	0.79	0.70	0.64	0.59	0.55	0.53
40	3.24	1.76	1.27	1.03	0.88	0.78	0.71	0.65	0.61	0.58
60	3.60	1.96	1.42	1.14	0.97	0.86	0.78	0.72	0.67	0.64
80	4.01	2.18	1.58	1.27	1.08	0.95	0.86	0.79	0.74	0.70
100	4.42	2.41	1.74	1.40	1.19	1.05	0.95	0.87	0.81	0.76
120	4.86	2.66	1.92	1.54	1.31	1.16	1.04	0.96	0.89	0.84
140	5.31	2.91	2.10	1.69	1.44	1.26	1.14	1.05	0.97	0.91
160	5.80	3.18	2.30	1.85	1.57	1.38	1.24	1.14	1.06	0.99

Accuracy of Mixing Ratio g/kg (Ambient Pressure 1013 mbar)

Temp.	Relative humidity									
	10	20	30	40	50	60	70	80	90	100
-40	0.003	0.003	0.003	0.003	0.003	0.004	0.004	0.004	—	—
-20	0.017	0.018	0.019	0.021	0.022	0.023	0.025	0.026	—	—
0	0.08	0.09	0.09	0.10	0.10	0.11	0.11	0.12	0.13	0.13
20	0.31	0.33	0.35	0.37	0.39	0.41	0.43	0.45	0.47	0.49
40	0.97	1.03	1.10	1.17	1.24	1.31	1.38	1.46	1.54	1.62
60	2.68	2.91	3.16	3.43	3.72	4.04	4.38	4.75	5.15	5.58
80	6.73	7.73	8.92	10.34	12.05	14.14	16.71	19.92	24.01	29.29
100	16.26	21.34	28.89	40.75	60.86	98.85	183.66	438.56	—	—
120	40.83	74.66	172.36	—	—	—	—	—	—	—

Accuracy of Wet Bulb Temperature °C

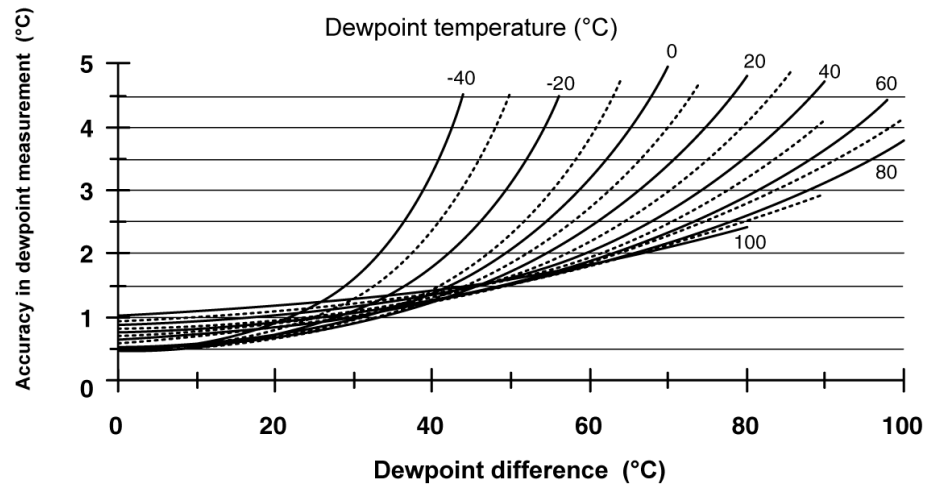
Temp.	Relative humidity									
	10	20	30	40	50	60	70	80	90	100
-40	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	—	—
-20	0.21	0.21	0.22	0.22	0.22	0.22	0.23	0.23	—	—
0	0.27	0.28	0.28	0.29	0.29	0.29	0.30	0.30	0.31	0.31
20	0.45	0.45	0.45	0.44	0.44	0.44	0.43	0.43	0.42	0.42
40	0.84	0.77	0.72	0.67	0.64	0.61	0.58	0.56	0.54	0.52
60	1.45	1.20	1.03	0.91	0.83	0.76	0.71	0.67	0.63	0.60
80	2.23	1.64	1.32	1.13	0.99	0.89	0.82	0.76	0.72	0.68
100	3.06	2.04	1.58	1.31	1.14	1.01	0.92	0.85	0.80	0.75
120	3.85	2.40	1.81	1.48	1.28	1.13	1.03	0.95	0.88	0.83
140	4.57	2.73	2.03	1.65	1.41	1.25	1.13	1.04	0.97	0.91
160	5.25	3.06	2.25	1.82	1.55	1.37	1.24	1.13	1.05	0.99

Accuracy of Absolute Humidity g/m³

Temp.	Relative humidity									
	10	20	30	40	50	60	70	80	90	100
-40	0.004	0.004	0.005	0.005	0.005	0.006	0.006	0.006	—	—
-20	0.023	0.025	0.027	0.029	0.031	0.032	0.034	0.036	—	—
0	0.10	0.11	0.12	0.13	0.13	0.14	0.15	0.15	0.16	0.17
20	0.37	0.39	0.41	0.43	0.45	0.47	0.49	0.51	0.53	0.55
40	1.08	1.13	1.18	1.24	1.29	1.34	1.39	1.44	1.49	1.54
60	2.73	2.84	2.95	3.07	3.18	3.29	3.40	3.52	3.63	3.74
80	6.08	6.30	6.51	6.73	6.95	7.17	7.39	7.61	7.83	8.05
100	12.2	12.6	13.0	13.4	13.8	14.2	14.6	15.0	15.3	15.7
120	22.6	23.3	23.9	24.6	25.2	25.8	26.5	27.1	27.8	28.4
140	39.1	40.0	41.0	42.0	43.0	44.0	45.0	45.9	46.9	47.9
160	63.5	64.9	66.4	67.8	69.2	70.7	72.1	73.5	74.9	76.4

Dewpoint Temperature

Find the intersection of the dewpoint temperature curve and the dewpoint difference reading (process temperature-dewpoint temperature) on the x-axis and read the accuracy in dewpoint measurement on the y-axis.



0508-017

Figure 20 Accuracy in Dewpoint Measurement (°C)

Spare Parts and Accessories



Information on spare parts, accessories, and calibration products is available online at www.vaisala.com and store.vaisala.com.

Table 24 Spare Parts and Accessories

Description	Order Code
Probe accessories	
PPS Plastic Grid with Stainless Steel Netting	DRW010281SP
PPS Plastic Grid Filter	DRW010276SP
Sintered Filter AISI 316L	HM47280SP
Stainless Steel Filter	HM47453SP
Stainless Steel Filter with Membrane	214848SP
Catalytic Filter	231865
Sensors	
Vaisala HUMICAP [®] 180R (general purpose)	HUMICAP180R
Vaisala HUMICAP [®] 180VHP catalytic sensor	HUMICAP180VHP
Vaisala HUMICAP [®] 180VHPC catalytic sensor	HUMICAP180VHPC
PT100 sensor	10429SP
Probe mounting accessories	
Fitting Body M22x1.5	17223
Fitting Body NPT1/2	17225
Mounting Flange For HMT315	210696
Swagelok for 12mm Probe 3/8" ISO Thread	SWG12ISO38
Swagelok for 12mm Probe 1/2" NPT Thread	SWG12NPT12
Cable Gland M20x1.5 with Split Seal	HMP247CG
Duct Installation Kit for HMT313 and HMT317	210697
Ball Valve ISO1/2 with Welding Joint	BALLVALVE-1
Thread Adapter ISO1/2 to NPT1/2	210662
Plug Kit (ISO 1/2)	218773
Other	
HMK15 Calibration Adapter for 12 mm Probes with >7 mm Sensor Pins	211302SP
Connection cable to MI70 indicator/HM70	DRW216050SP
USB cable	238607
Rain shield	ASM211103

Dimensions in mm (inches)

Transmitter Enclosure and Mounting Plate Dimensions

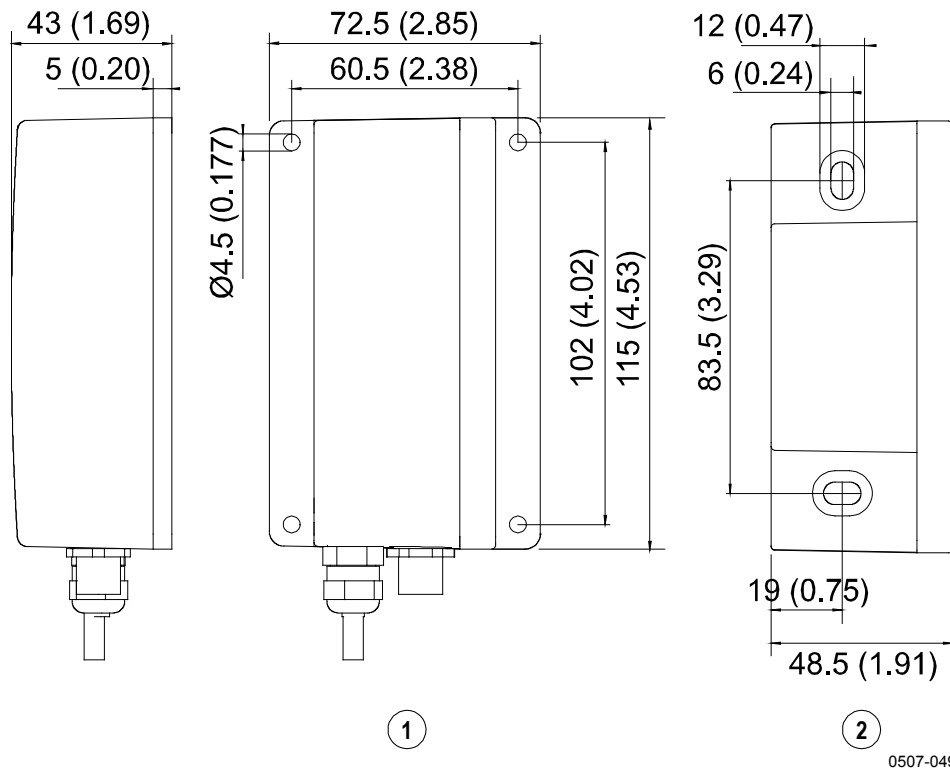
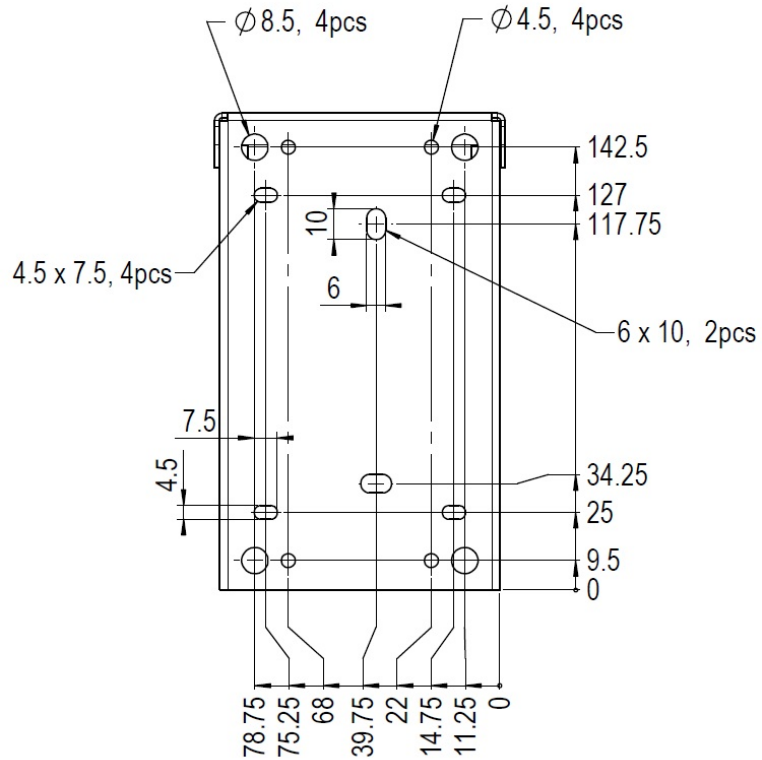


Figure 21 Transmitter Enclosure and Mounting Plate Dimensions

The following numbers refer to Figure 21 above. Mounting plate alternatives:

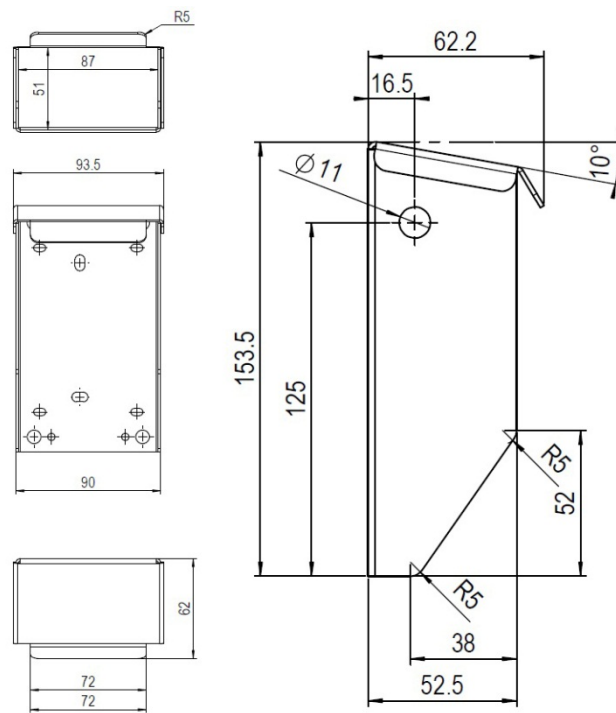
- 1 = Wall Plate/Cover, bigger plate with flange
- 2 = Wall Plate/Cover, smaller plate with no flange

Rain Shield Dimensions



1311-252

Figure 22 Rain Shield Dimensions (Back)



1311-253

Figure 23 Rain Shield Dimensions (Side and Outer)

Probe Dimensions

HMT311

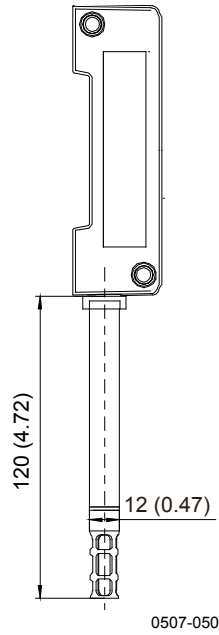


Figure 24 Probe Dimensions

HMT313

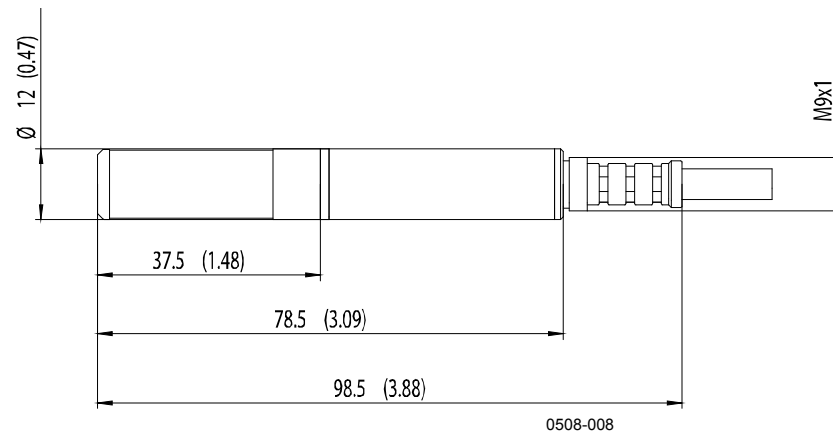
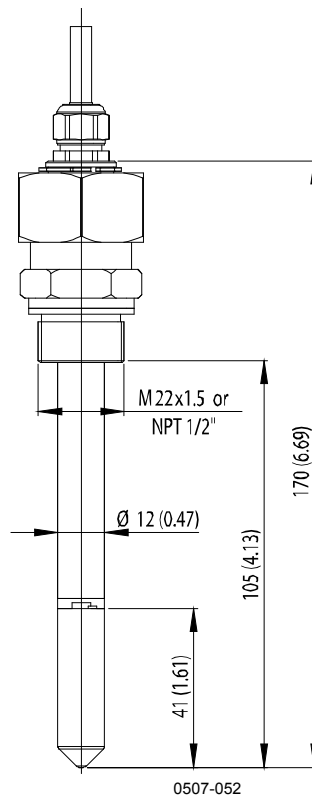
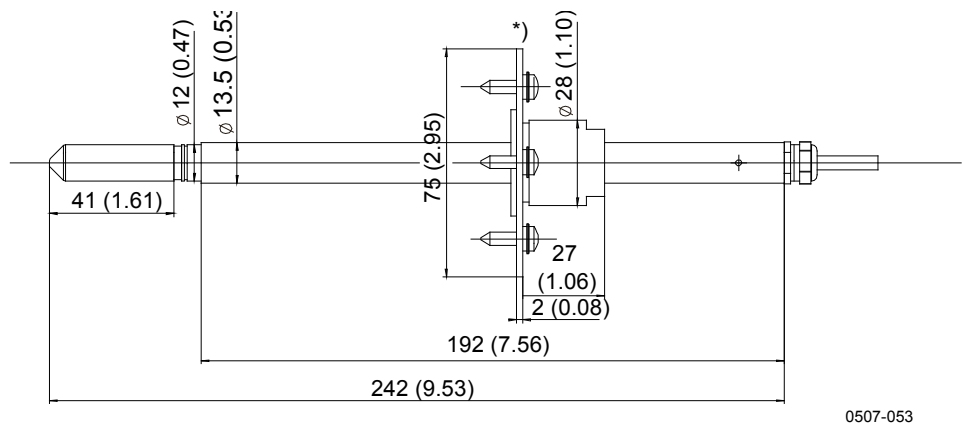


Figure 25 HMT313 Dimensions

HMT314**Figure 26 HMT314 Dimensions****HMT315****Figure 27 HMT315 Dimensions**

*) Flange for HMT315 available as an option

HMT317

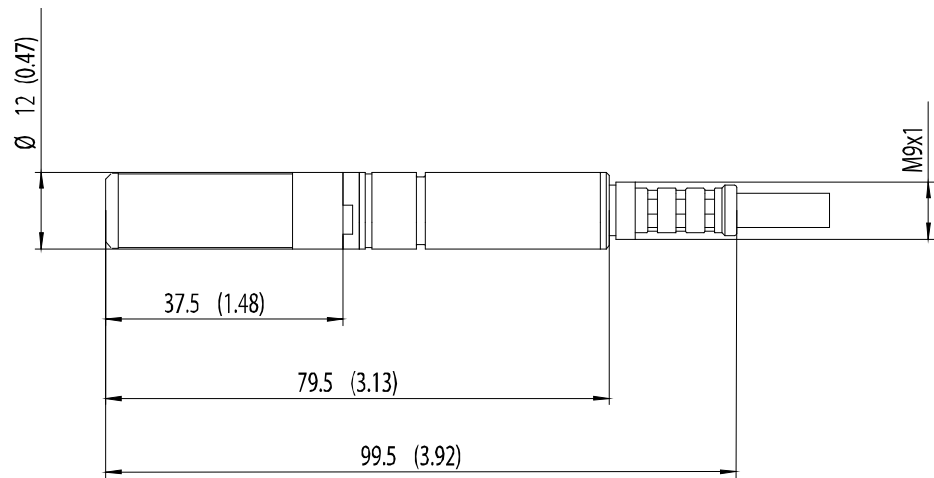


Figure 28 HMT317 Dimensions

HMT318

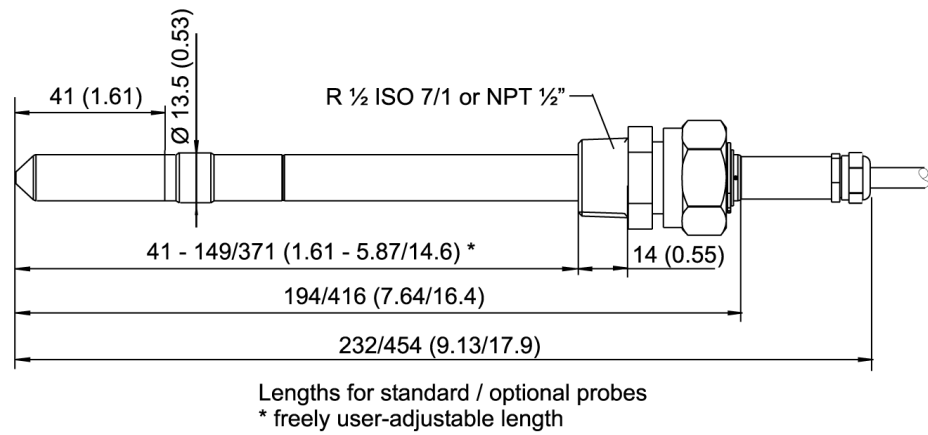


Figure 29 HMT318 Dimensions

APPENDIX A

PROBE INSTALLATION KITS AND INSTALLATION EXAMPLES

This appendix describes the available probe installation kits and provides some installation examples.

Duct Installation Kits (for HMT313/317/315)

Duct installation kit includes a flange, a sealing ring, a supporting bar and probe attaching part for the probe and screws for attaching the flange to the duct wall. Vaisala order codes: 210697 (for HMT313) and 210696 (for HMT315, no supporting bar).

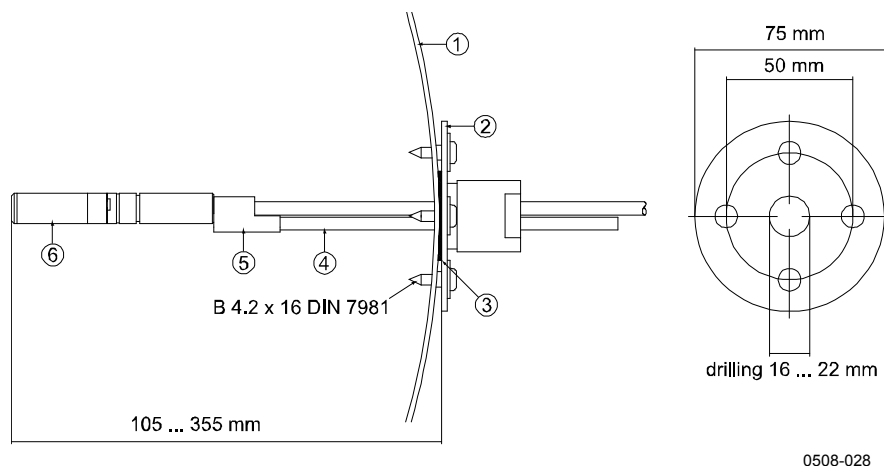


Figure 30 Duct Installation Kit

The following numbers refer to Figure 30 above:

- 1 = Duct wall
- 2 = Flange
- 3 = Sealing ring
- 4 = Supporting bar (not included in the kit for HMT315)
- 5 = Probe attaching part (to be fixed with the supporting bar)
- 6 = Relative humidity probe

NOTE

When the temperature difference between the duct and the air outside the duct is significant, the supporting bar must be installed as deep in the duct as possible. This helps to prevent errors caused by heat conduction in the bar and cable.

Pressure-Tight Swagelok Installation Kits (for HMT317)

RH Probe Installation

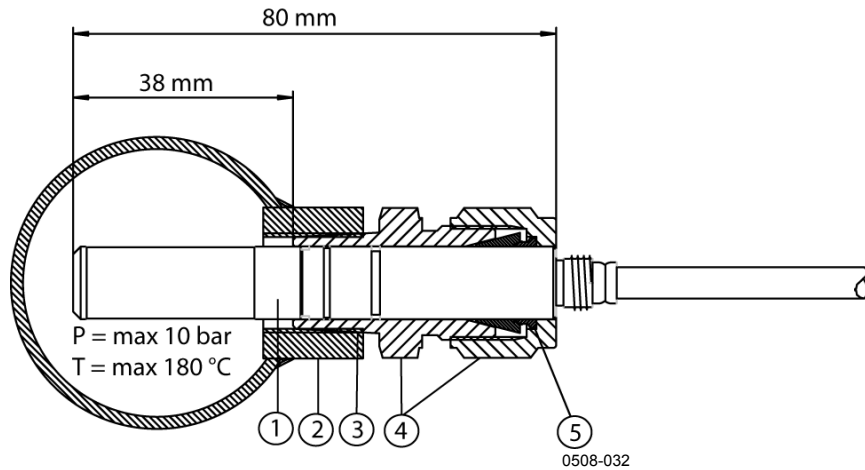


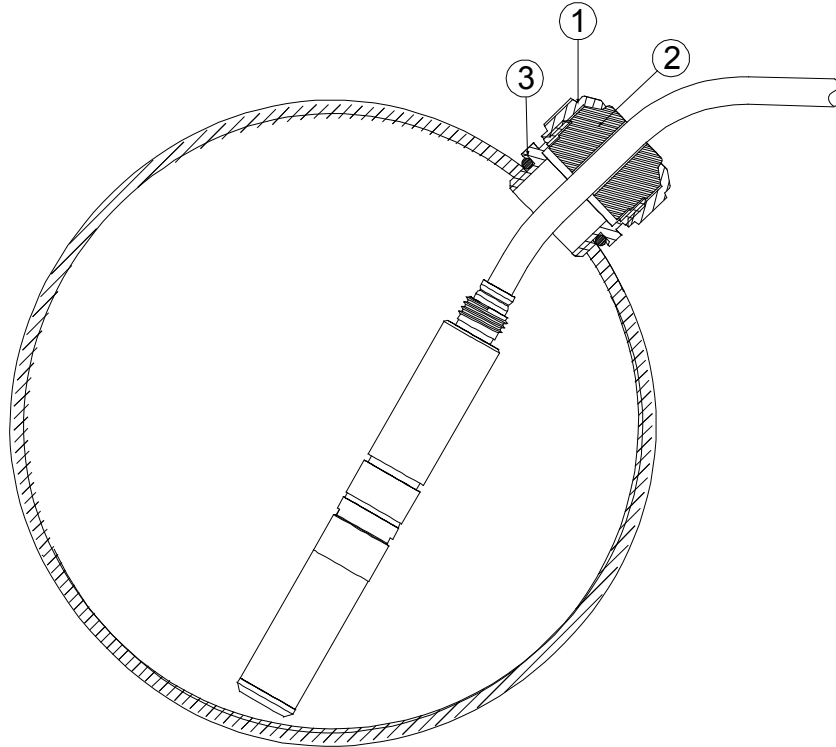
Figure 31 Swagelok Installation Kit for RH Probe

The following numbers refer to Figure 31 above:

- 1 = Relative humidity probe
- 2 = Duct connector
- 3 = ISO3/8" or NPT1/2" thread
- 4 = Swagelok connector
- 5 = Ferrules

Examples of Vapor-Tight Installations with Cable Gland

RH Probe Installations (for HMT313/317)



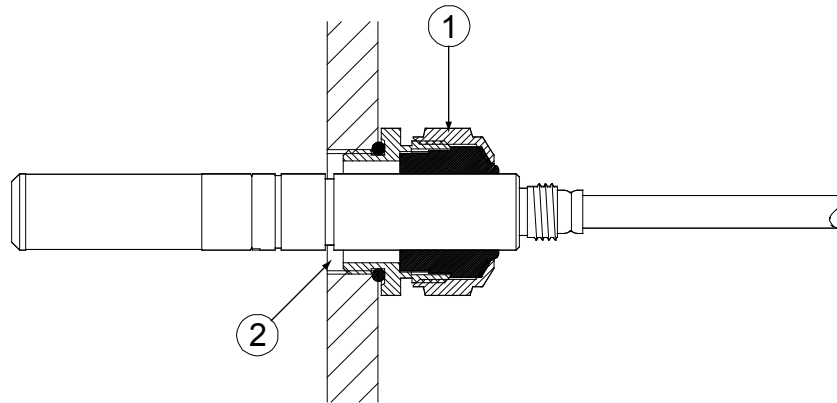
0508-026

Figure 32 Cable Installation with Cable Gland AGRO

The following numbers refer to Figure 32 above:

- 1 = Nut (to be tightened to the body)
- 2 = Seal
- 3 = Body and O-ring

Vaisala order code for the cable gland: HMP247CG (see section Spare Parts and Accessories on page 93).



0508-027

Figure 33 Probe Installation with Cable Gland

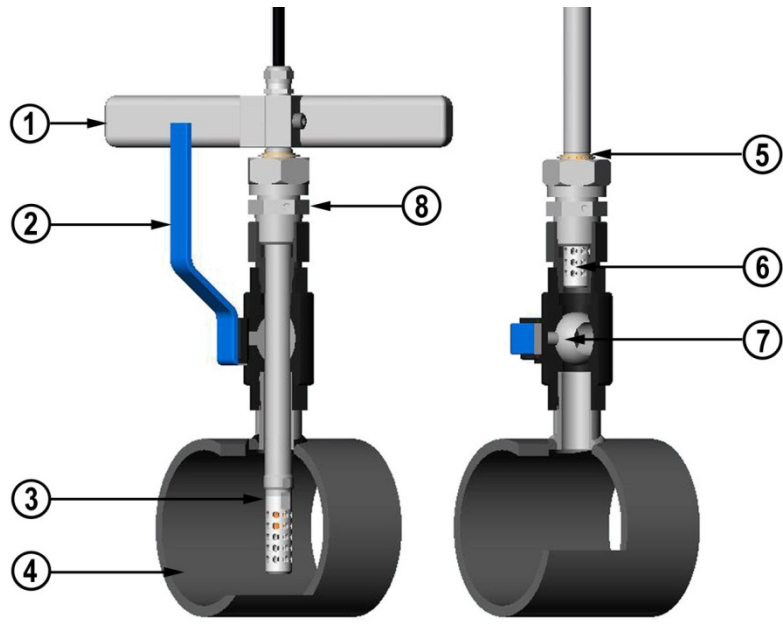
The following numbers refer to Figure 33 above:

- 1 = Cable gland AGRO 1160.20.145 (T = -40 ... +100 °C) (not available from Vaisala)
- 2 = In pressurized conditions, use a locking ring (for example, 11x 1 DIN471)

The installation option in Figure 33 above is not available from Vaisala and is presented here only as an example of how to achieve a vapor-tight installation with HMT313/317 probes.

Ball Valve Installation kit for HMT318

The ball valve installation kit (Vaisala order code: BALLVALVE-1) is preferred when connecting the probe to a pressurized process or pipeline. Use the ball valve set or a 1/2" ball valve assembly with a ball hole of $\varnothing 14$ mm or more. If you install the probe ($\varnothing 12$ mm) in a process pipe, note that the nominal size of the pipe must be at least 1 inch (2.54 cm). Use the manual press handle to press the probe into the pressurized (< 10 bar) process or pipeline.



0507-043

Figure 34 HMT318 Ball Valve Assembly Installation

The following numbers refer to Figure 34 above:

- 1 = Manual press tool
- 2 = Handle of the ball valve
- 3 = Probe
- 4 = Process chamber or pipeline
- 5 = Groove on the probe indicates the upper adjustment limit
- 6 = Filter
- 7 = Ball of the ball valve
- 8 = Clasp nut

NOTE

The probe can be installed in the process through the ball valve assembly provided that the process pressure is less than 10 bars. This way, the process does not have to be shut down when installing or removing the probe. However, if the process is shut down before removing the probe, the process pressure can be max. 20 bars.

NOTE

When measuring temperature dependent quantities make sure that the temperature at the measurement point is equal to that of the process, otherwise the reading may be incorrect.

Follow the steps below to install the HMT318 probe through a ball valve assembly. After the installation, the probe should be sitting in the process chamber or pipeline as shown in Figure 34 on page 103.

1. Shut down the process if the process pressure is more than 10 bars. If the pressure is lower there is no need to shut down the process.
2. Close the ball valve.
3. Seal the threads on the fitting body; refer to Figure 12 on page 31.
4. Attach the fitting body to the ball valve and tighten it.
5. Slide the clasp nut of the probe toward the filter, as far as it will go.
6. Insert the probe to the fitting body, and manually tighten the clasp nut to the fitting body.
7. Open the ball valve.
8. Push the probe through the ball valve assembly into the process. If the pressure is high, use the pressing handle that is provided with the probe. If you push the probe hard without using the handle, you may damage the cable.

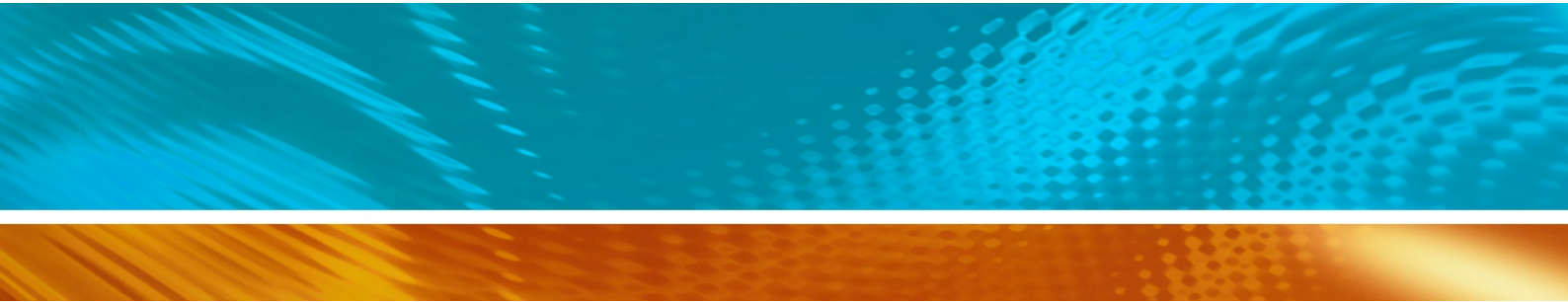
Note that the probe must be pushed so deep that the filter is completely inside the process flow.

9. Mark the fitting screw and the clasp nut.
10. Tighten the clasp nut with an open-end wrench a further 50 ... 60° (ca. 1/6 turn). If you have a suitable torque wrench, tighten the nut to max 45 ± 5 Nm (33 ± 4 ft-lbs). Refer to Figure 13 on page 32.

NOTE

Take care not to tighten the clasp nut more than 60° to avoid difficulties when opening it.

If you want to remove the probe from the process, note that you have to pull the probe out far enough. You cannot close the valve if the groove on the probe body is not visible.



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