USER'S GUIDE

Vaisala HUMICAP® Humidity and Temperature Transmitter Series HMT330

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CHAPTER 1
GENERAL INFORMATION

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

About This Manual

This manual provides information for installing, operating, and maintaining Vaisala HUMICAP® Humidity and Temperature Transmitter Series HMT330.

Contents of This Manual

This manual consists of the following chapters:

- Chapter 1, General Information, provides general notes for the manual and the product.
- Chapter 2, Product Overview, introduces the features, advantages, and the product nomenclature of HMT330.
- Chapter 3, Installation, provides you with information that is intended to help you install the product.
- Chapter 4, Operation, contains information that is needed to operate this product.
- Chapter 5, Modbus, contains information that is needed when operating the transmitter using the Modbus protocol.
- Chapter 6, Maintenance, contains information that is needed in basic maintenance of the product.
- Chapter 7, Calibration and Adjustment, provides information and instructions concerning calibration and adjustment of HMT330.
- Chapter 8, Technical Data, provides the technical data of the product.
- Appendix A, Probe Installation Kits and Installation Examples, presents the installation kits available for HMT330 and provides some installation examples.
- Appendix B, Calculation Formulas, presents the equations used in HMT330 to calculate values of dewpoint, mixing ratio, absolute humidity and enthalpy in normal pressure.
- Appendix C, Modbus Reference, describes the Modbus functions and data of the transmitter.

Version Information

Table 1 **Manual Revisions**

Manual Code	Description
M210566EN-K	December 2013. This manual. Applicable from transmitter software version 5.14 onward. Added description of VHP filter option. Added new command descriptions: ALSEL, AOVER, CON, DSEND, MODS, RGLIMIT, RHLIMIT, and MPC (multipoint RH calibration). Updated FILT command description. Various small corrections.
M210566EN-J	Previous version. Updated Chapter 2 Product Overview. Updated Appendix C Modbus Reference.
M210566EN-I	Applicable from transmitter software version 5.10 onward. Added Modbus protocol. Updated serial line command descriptions. Updated storage temperature range.

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 Vaisala HUMICAP® Humidity and Temperature Transmitter Series HMT330 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, lead to malfunction, or make the product noncompliant with applicable legislation.

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. However, it is possible to damage the product 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 this is not possible, ground yourself to the equipment chassis before touching the boards. Ground yourself with a wrist strap and a resistive connection cord. When neither of the above is possible, touch a conductive part of the equipment chassis with your other hand before touching the boards.
- Always hold the 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

EU Declaration of Conformity

Vaisala HUMICAP® Humidity and Temperature Transmitter Series HMT330 is in conformity with the provisions of the following EU directives:

- Low Voltage Directive
- EMC-Directive
- ROHS Directive

Conformity is shown by compliance with the following standards:

- EN 60950-1: Information technology equipment – Safety – Part 1: General requirements.
- EN 61326-1: Electrical equipment for measurement, control, and laboratory use – EMC requirements – for use in industrial locations.
- EN 550022: Information technology equipment – Radio disturbance characteristics – Limits and methods of measurement.
- EN 61000-3-2: Limits for harmonic current emissions.
- EN 61000-3-3: Limitation of voltage changes, voltage fluctuations and flicker in public low-voltage supply systems.

CE

DNV Type Approval

The Vaisala HUMICAP® Humidity and Temperature Transmitter Series HMT330 is found to comply with Det Norske Veritas' Rules for Classification of Ships, High Speed & Light Craft and Det Norske Veritas' Offshore standards.

Applicable tests carried out according to Standard for Certification No. 2.4, April 2006.

Table 2   Application, Location Classes

Type	HMT330
Temperature	B
Humidity	B
Vibration	A
EMC	B
Enclosure	B/IP65

TYPE APPROVED PRODUCT
CERTIFICATE NO.: A-13529

Transmitters with LAN or WLAN Interface

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

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

Transmitters with WLAN Interface

This equipment has been designed to operate with a 2 dBi half-wave antenna. Antennas with a gain greater than 2 dBi are prohibited for use with this device. The antenna impedance is 50 ohms.

To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (EIRP) is not more than that permitted for successful communication.

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

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

Patent Notice

The Vaisala HUMICAP® Humidity and Temperature Transmitter Series HMT330 is protected by, for example, the following patents and their corresponding national rights:

Finnish patents 98861 and 99164, French patents 6650303 and 9504397, German patents 69418174 and 19513274, Japanese patents 3585973 and 2801156, UK patents 0665303 and 2288465, and U.S. patent 5607564.

Trademarks

HUMICAP® is a registered trademark of Vaisala Oyj.

All other trademarks are the property of their respective owners.

Software License

This product contains software developed by Vaisala. Use of the software is governed by license terms and conditions included in the applicable supply contract or, in the absence of separate license terms and conditions, by the General License Conditions of Vaisala Group.

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 of the Vaisala HUMICAP® Humidity and Temperature Transmitter Series HMT330.

Introduction to HMT330

The HMT330 transmitter provides reliable humidity measurement in a wide range of applications. Analog outputs can be chosen between current and voltage signals. Alternatively, digital outputs RS-232 (standard) or RS-422/485 (optional) can be selected.

The quantities measured and calculated by HMT330 are presented in Table 3 below. The quantities available as an option are presented in Table 4 below.

Table 3   Quantities Measured by HMT330

Quantity	Abbreviation	Metric Unit	Non-Metric Unit
Relative humidity (RH)	RH	%RH	%RH
Temperature (T)	T	ºC	ºF

Table 4   Optional Quantities Measured by HMT330

Quantity	Abbreviation	Metric Unit	Non-Metric Unit
Dewpoint / Frostpoint Temperature ($T_{d/f}$)	TDF	ºC	ºF
Dewpoint Temperature (T_d)	TD	ºC	ºF
Absolute humidity (a)	A	g/m^3	gr/ft^3
Mixing ratio (x)	X	g/kg	gr/lb
Wetbulb temperature (T_w)	TW	ºC	ºF
Humid air volume / dry air volume (by volume or by weight) (H_2O)	H2O	ppm_v/ppm_w	ppm_v/ppm_w
Water vapor pressure (P_w)	PW	hPa	lb/in^2
Water vapor saturation pressure (P_{ws})	PWS	hPa	lb/in^2
Enthalpy (h)	H	kJ/kg	Btu/lb
Difference of T and $T_{d/f}$ (ΔT)	DT	ºC	ºF

Basic Features and Options

- Several probes for various applications
- User-friendly display and keypad interface (optional)
- Calculated output quantities available
- Different probe mounting kits, sensor protection options and probe cable lengths
- Transmitter mounting kits for multiple installation purposes
- Chemical purge for applications where interfering chemicals in the measuring environment pose a risk
- Warmed probe and sensor heating for high humidity conditions (HMT337)
- Additional temperature sensor (HMT337)
- Support for Modbus serial communications protocol
- USB connectivity for service connections via the optional USB-RJ45 cable
- Optional modules:
    - Isolated power supply
    - Power supply module for AC mains power
    - RS-422/485-module
    - LAN and WLAN interfaces
    - Data logger module with real time clock
    - Additional analog output module
    - Relay module

Structure of the Transmitter
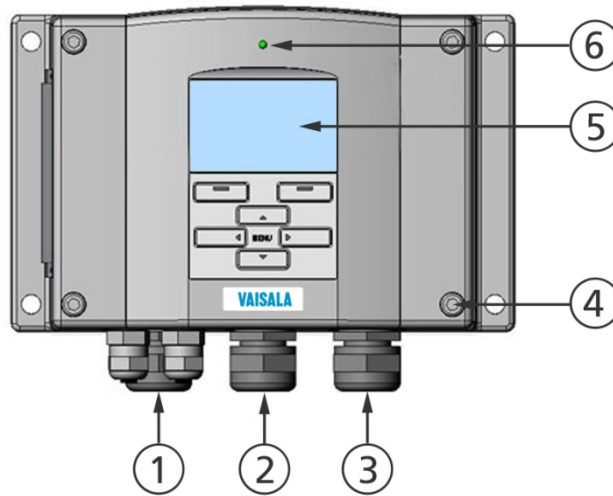
1104-001

Figure 1   Transmitter Body

The following numbers refer to Figure 1 above:

1   =   Signal + powering cable gland
2   =   Cable gland for optional module, or WLAN antenna
              connector
3   =   Cable gland for optional module or AC mains cable
4   =   Cover screw (4 pcs)
5   =   Display with keypad (optional)
6   =   Cover LED
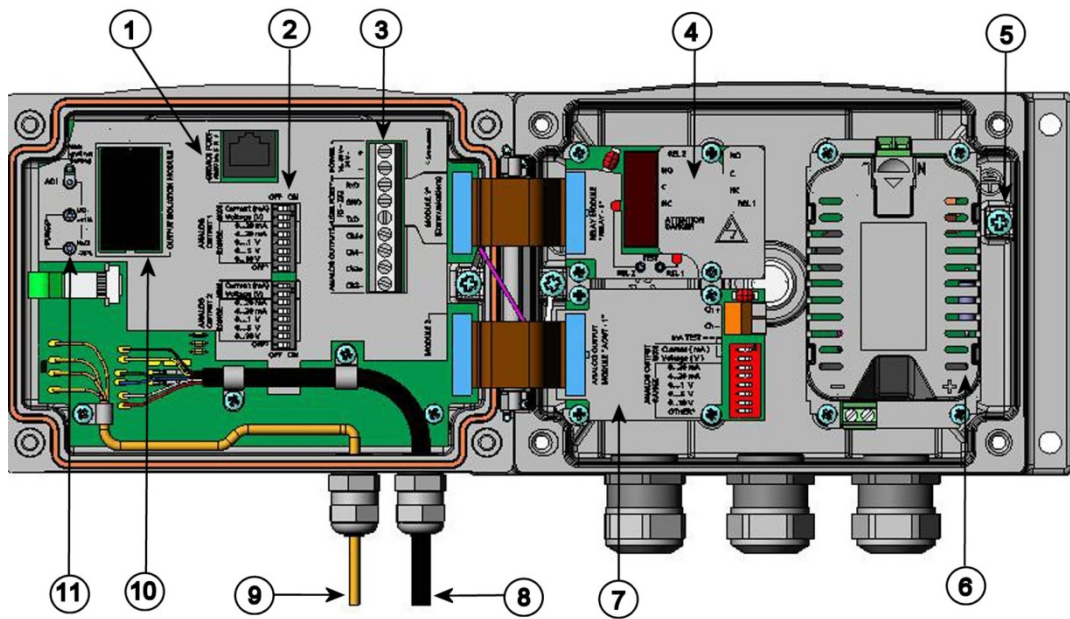
0508-010

Figure 2   Inside the Transmitter

The following numbers refer to Figure 2 above:

1 = Service port (RS-232)
2 = DIP switches for analog output settings
3 = Power supply and signal wiring screw terminals
4 = Relay, data logger, RS-422/485, LAN, or WLAN module (optional)
5 = Grounding connector
6 = Power supply module (optional)
7 = Relay, data logger, or analog output module (optional)
8 = Humidity probe cable
9 = Temperature probe cable (optional)
10 = Galvanic isolation module (optional)
11 = Adjustment buttons (chemical purge buttons) with indicator LED

Probe Options

The HMT331 is intended for demanding wall-mounted applications. The standard version has a fixed probe.

1102-025

Figure 3   HMT331 Fixed Probe

The HMT331 short cable probe is a special version for use with the WLAN module and when LAN module and power supply module are simultaneously installed. It has the HMT333 probe on a short cable (21 cm), and a mounting plate with a probe holder.

1102-024

Figure 4   HMT331 Short Cable Probe
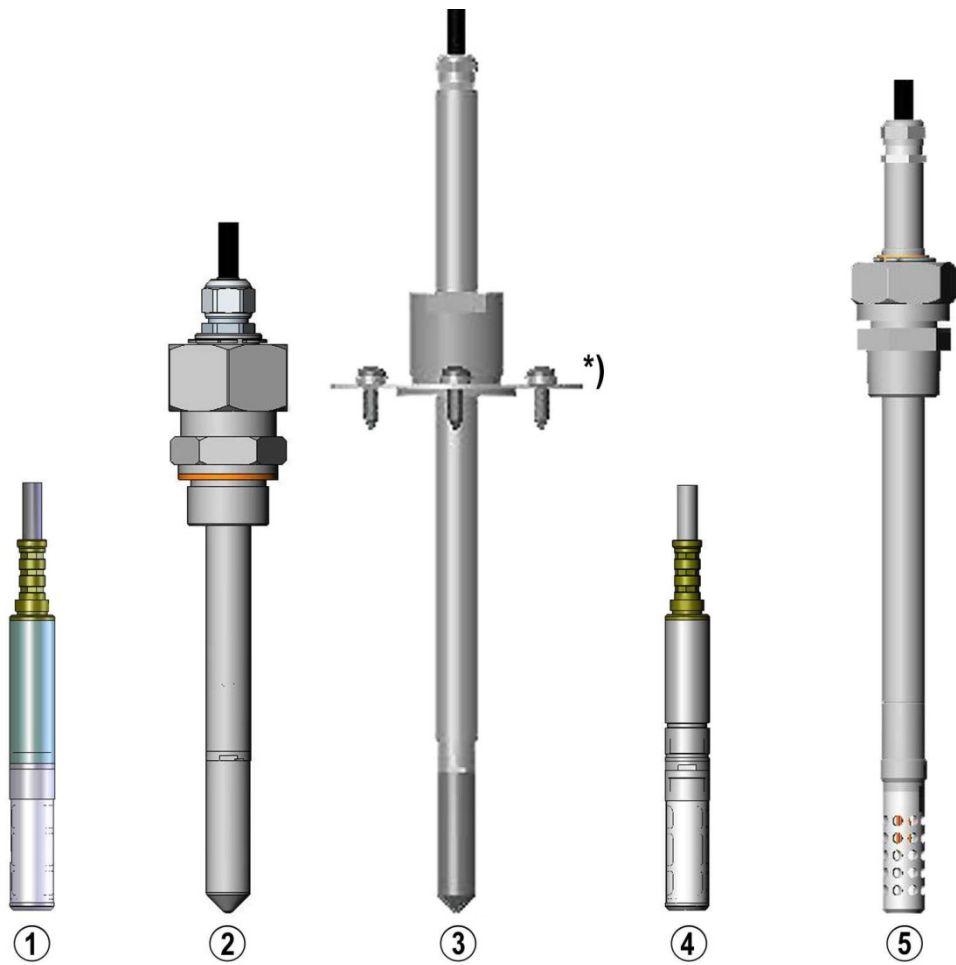
0911-066

Figure 5   Probe Options

The following numbers refer to Figure 5:

1 = HMT333 for ducts and tight spaces
2 = HMT334 for high pressure and vacuum applications
       (up to 100 bars)
3 = HMT335 for high temperatures (up to 180 ºC, vapor tight)
       *) Flange available as an option
4 = HMT337 for high humidity applications
       (optional warmed probe)
5 = HMT338 for pressurized pipelines (up to 40 bar)

For probe cable lengths, see Table 37 on page 175.

Warmed Probe HMT337

Temperature difference between the probe and external environment can cause a risk of condensation on the sensor. A wet probe cannot observe the actual humidity in the ambient air. If the condensed water is contaminated, the life span of the probe may shorten and calibration may change.

HMT337 probe shall be used in applications where condensation can occur due to high humidity and rapid humidity changes. The warmed probe is heated continuously so that its temperature is always higher than in environment. This prevents condensation on the probe. The power consumption of the warmed probe is slightly higher than other probes.

Filter Options

There are several filter types for HMT330. All filters are 12 mm in diameter with a female thread, and are compatible with all HMT330 probe models. The filters recommended for a probe type can be selected on the corresponding HMT330 order form.

Fore more information, see section Spare Parts and Accessories on page 178

Catalytic VHP Filter

Vaporized hydrogen peroxide (VHP) is a gaseous form of hydrogen peroxide that is commonly used in decontamination and sterilization. Hydrogen peroxide has relatively low saturation pressure which increases the possibility of saturation when used in humid conditions. When saturation conditions occur, liquid hydrogen peroxide will form on surfaces in the decontaminated space.

Vaisala HUMICAP® sensor is compatible with direct VHP exposure even at high concentrations and hundreds of VHP cycles up to saturation. The long term performance is very good at concentrations higher than typically used for sterilization. However, for the applications where full saturation is possible, Vaisala recommends using the catalytic VHP filter to protect the sensor and extend the calibration interval.

The catalytic filter is based on a generally known method where the H_2O_2 is split to H_2O and O_2. This reaction is produced by the catalyst layer that has been applied to the filter. As the filter prevents the VHP from reaching the humidity sensor, the sensor responds to humidity only. The catalytic filter affects the reading approximately +1 %RH at 300 pmm VHP, or +3 %RH at 900 ppm VHP (at 23 °C / 73.4 °F).

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CHAPTER 3
INSTALLATION

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

Mounting the Housing

The housing can be mounted either without the mounting plate or with optional mounting plates.

Standard Mounting without Mounting Plate

Mount the housing by attaching the transmitter to a wall with 4 screws, for example, M6 (not provided).
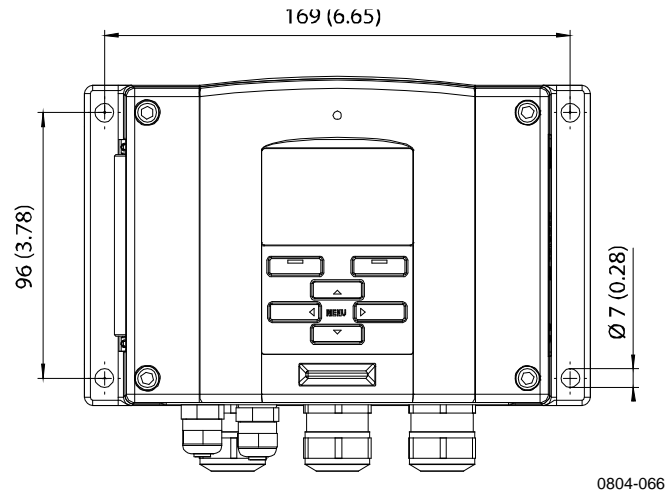
Figure 6   Standard Mounting

Wall Mounting with Wall Mounting Kit

When mounting with wall mounting kit the mounting plate (Vaisala order code 214829) can be installed directly on wall or onto a standard wall box (also US junction box). When wiring through back wall, remove the plastic plug from the wiring hole in the transmitter before mounting.
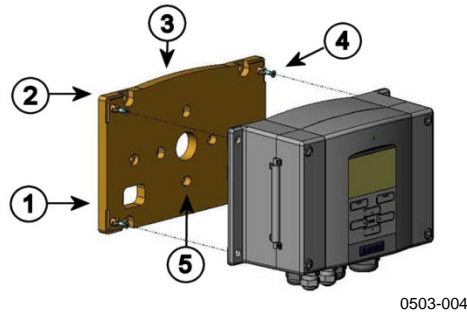
0503-004

Figure 7   Mounting with Wall Mounting Kit

The following numbers refer to Figure 7 above:

1 = Plastic mounting plate
2 = Mount the plate to wall with 4 screws M6 (not provided)
3 = Arched side up
4 = Attach the HMT330 to the mounting plate with 4 fixing screws M3 (provided)
5 = Holes for wall/junction box mounting
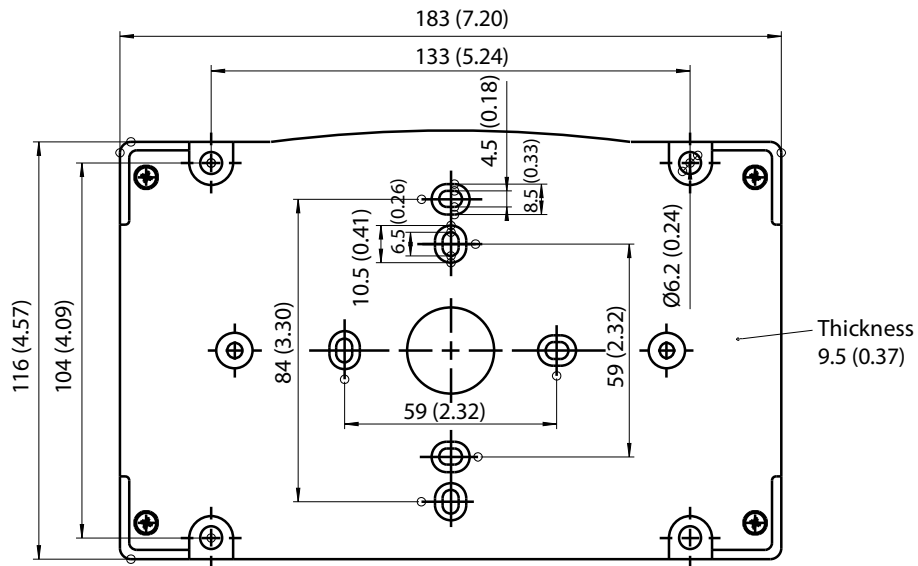
0804-065

Figure 8   Dimensions of the Plastic Mounting Plate (mm/inch)

The HMT331 short cable probe is designed to be wall mounted with the probe holder plate (Vaisala order code 226252). The probe holder plate is similar to the standard mounting plate, except for the probe holder at the bottom.
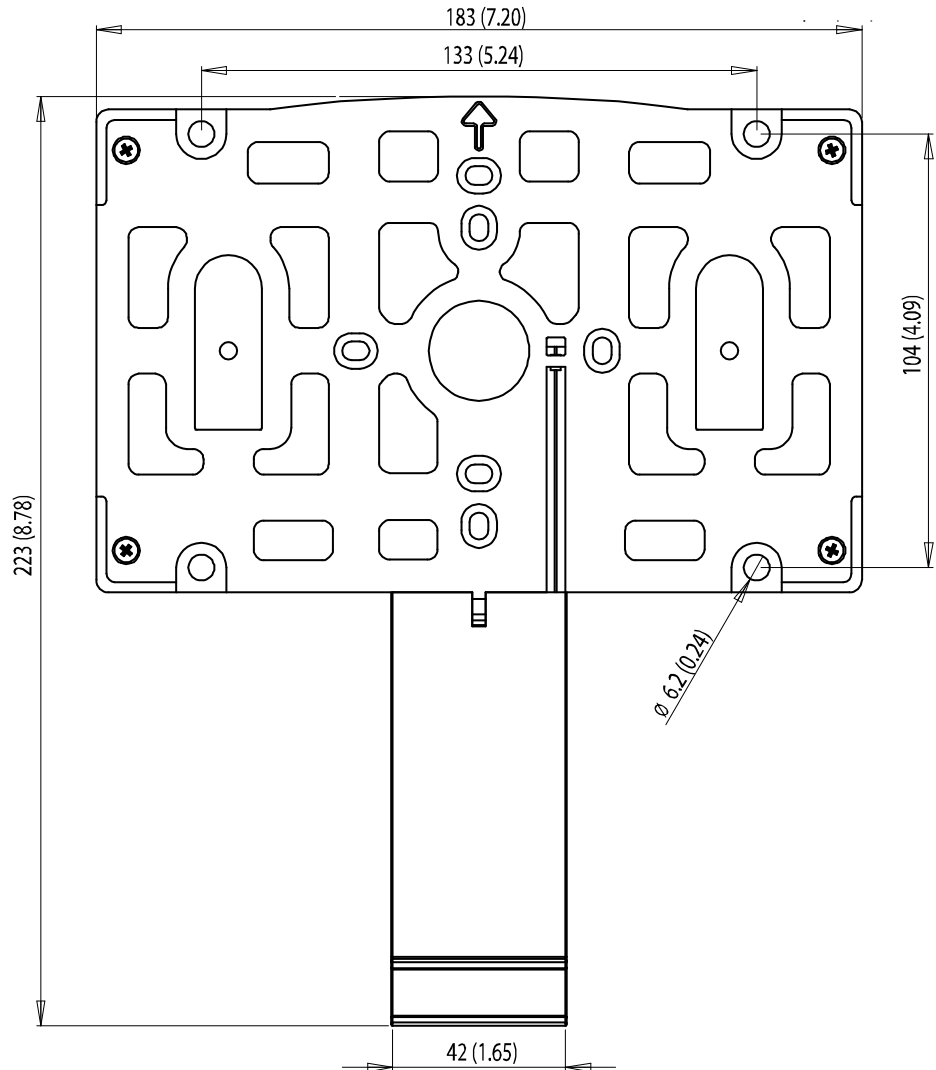
0911-061

Figure 9   Dimensions of the Probe Holder Plate (mm/inch)

Mounting with DIN Rail Installation Kit

DIN rail installation kit includes a wall mounting kit, 2 clip-fasteners and 2 screws M4 × 10 DIN 7985 (Vaisala order code: 215094).

1. Attach two spring holders to the plastic mounting plate by using the screws provided in the installation kit.
2. Attach the HMT330 to the plastic mounting plate with 4 screws (provided).
3. Press the transmitter onto the DIN rail so that the clip-fasteners snap into the rail.
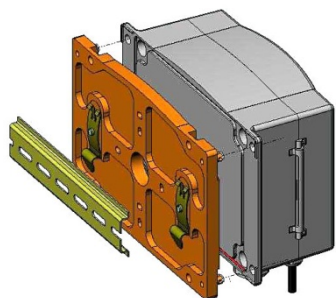
0503-002

Figure 10   Mounting with the DIN Rail Installation Kit

Pole Installation with Installation Kit for Pole or Pipeline

Installation kit for pole or pipeline (Vaisala order code: 215108) includes the metal mounting plate and 4 mounting nuts for pole mounting. When mounting, the arrow in the metal mounting plate must point upward; see Figure 13 on page 31.
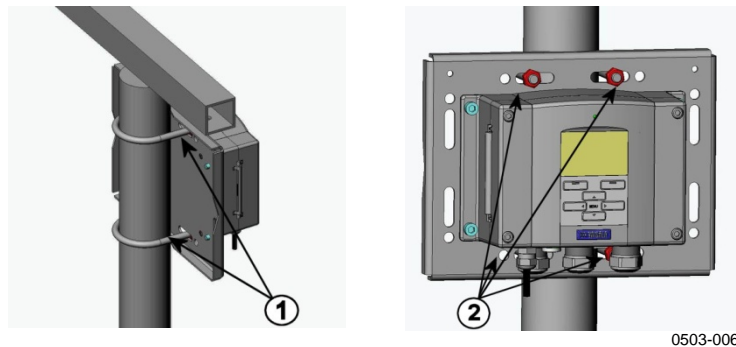
0503-006

Figure 11   Vertical Pole

The following numbers refer to Figure 11 above:

1 = Fixing brackets (2 pcs) M8 (provided) for 30 ... 102 mm poles
2 = Mounting nuts M8 (4 pcs)

0503-007
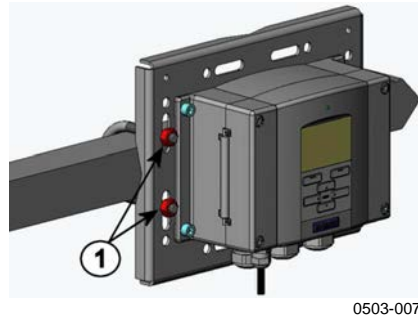
Figure 12   Horizontal Pole

The following number refers to Figure 12 above:

1   =   Mounting nuts M8 (4 pcs)

Metal mounting plate is included in rain shield with installation kit and installation kit for pole or pipeline.

0503-041
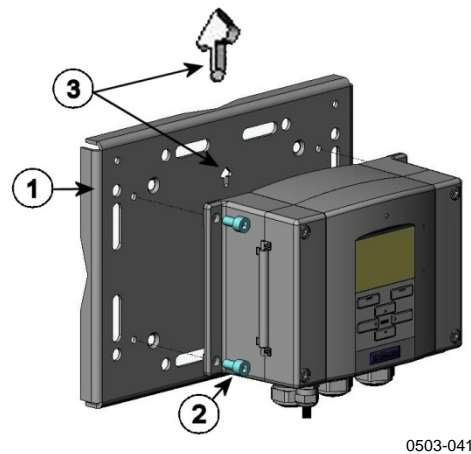
Figure 13   Mounting with Metal Wall Mounting Plate

The following numbers refer to Figure 13 above:

1   =   Mount the plate to wall with 4 screws M8 (not provided)
2   =   Attach the HMT330 to the mounting plate with 4 fixing
          screws M6 (provided)
3   =   Note the position of the arrow when mounting. This side
          must be up when mounting.
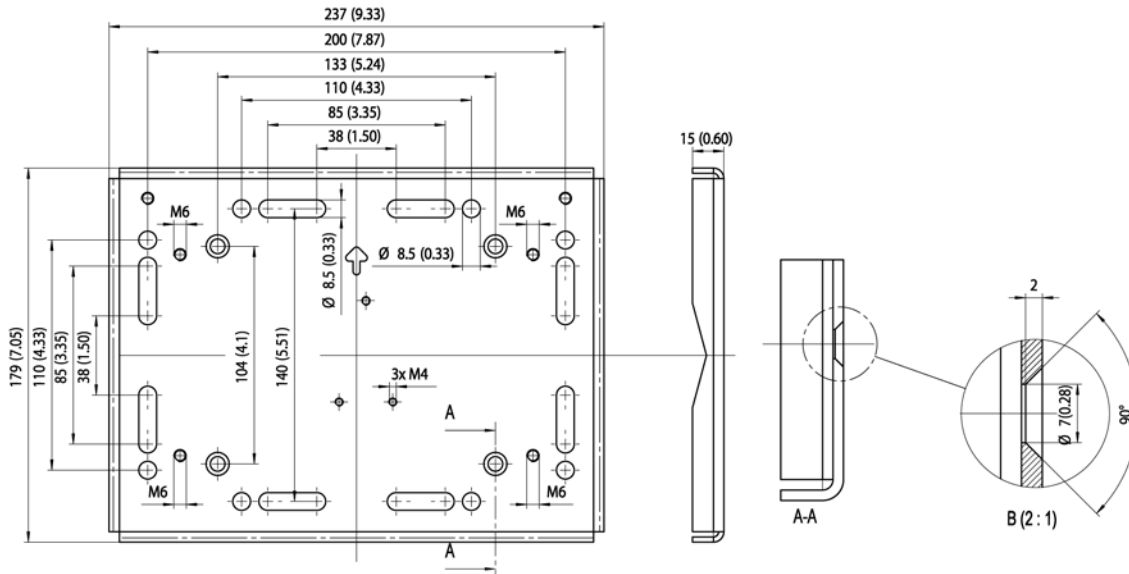
0509-151

Figure 14   **Dimensions of the Metal Mounting Plate (mm/inch)**

Mounting Rain Shield with Installation Kit

The rain shield is highly recommended for outdoor installations, especially for transmitters with the display/keypad option.
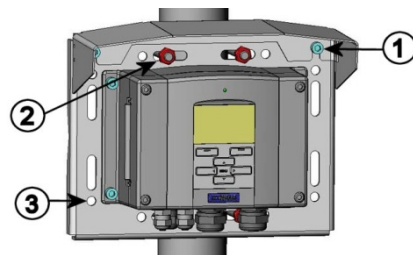
0503-008

Figure 15   **Mounting the Rain Shield with the Installation Kit**

The following numbers refer to Figure 15 above:

1   =   Fasten the rain shield with the installation kit (Vaisala order code: 215109) to the metal mounting plate with 2 (M6) mounting screws (provided)

2   =   Fasten the mounting plate with rain shield with installation kit to the wall or to the pole (see pole installation)

3   =   Fasten the transmitter to the mounting plate with 4 fixing screws (provided)

Panel Mounting Frame

To enable a neat and dirt free embedded installation of the transmitter, a panel mounting frame is available as an option (Vaisala order code: 216038). The frame is a thin, flexible plastic frame for the transmitter, with adhesive tape on one side.

The frame is used to hide any rough edges of the installation hole, and provide a more finished look. Note that the panel mounting frame is not intended to bear the weight of the transmitter, and does not include any mounting supports.

Use the panel mounting frame as follows:

1.   Use the frame as a template to mark the required size for the installation hole in the panel.
2.   Cut the hole in the panel.
3.   Mount the transmitter through the panel with suitable supports.
4.   Remove the paper protecting the adhesive tape on the frame, and attach the frame around the transmitter. Refer to Figure 16 below.

0704-002
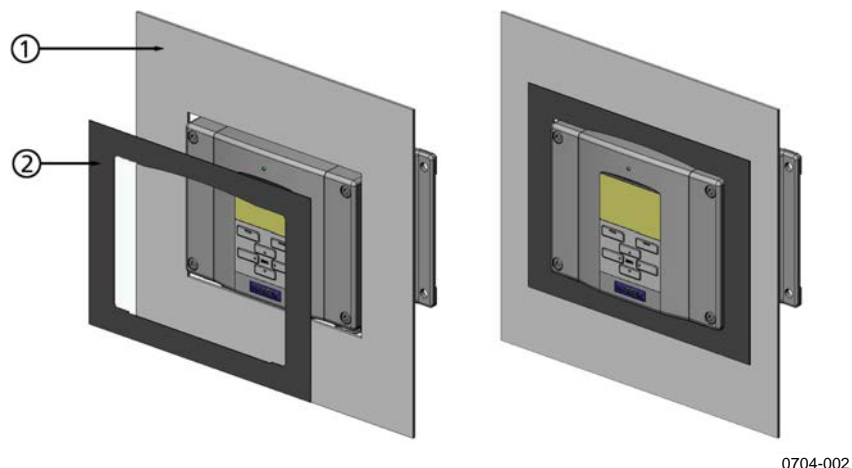
Figure 16   Panel Mounting Frame

The following numbers refer to Figure 16 above:

1   =   Panel (not included)
2   =   Panel mounting frame
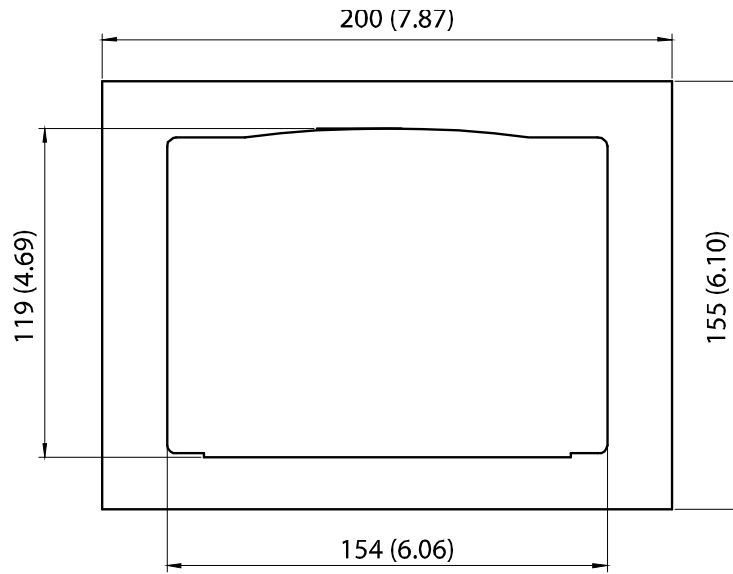
0804-083

Figure 17   Panel Mounting Dimensions (mm/inch)

Wiring

Cable Bushings

A single electrical cable with screen and three to ten wires is recommended for power and analog/serial connections. The cable diameter should be 8 ... 11 mm. The number of cable bushings depends on the transmitter options. See the following recommendations for the cable bushings:
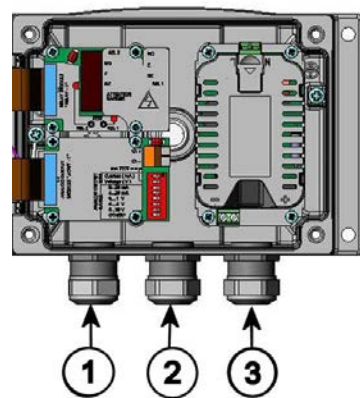
0503-010

Figure 18   Cable Bushings

The following numbers refer to Figure 18 above:

1 = Cable for signal/powering Ø8 ... 11 mm
2 = Cable for optional module Ø8 ... 11 mm
3 = Cable for optional power supply module Ø8 ... 11 mm

NOTE	When there is high electric noise level (for example, near a powerful electric motor) in the operating environment it is recommended to use shielded cable or take care that the signal cables are separated from other cables.

Grounding the Cables

Ground the screen of the electrical cable properly to achieve the best possible EMC performance.
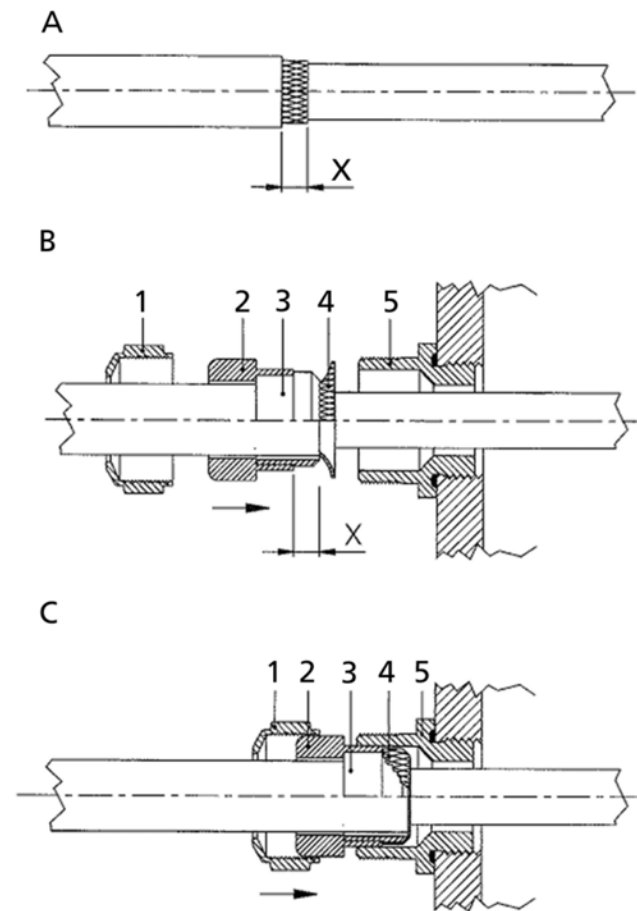
Figure 19   Grounding the Screen of Electrical Cable

Refer to Figure 19 on page 35 when performing the procedure below.

1. Cut back outer sheath to desired length.

2. Cut back screen braiding or screen foil to dimension X.

3. Push the domed cap nut (item 1) and the seal insert with contact socket of the gland (item 2+3) onto the cable as shown in the diagram.

4. Bend over the screen braiding or screen foil by about 90º (item 4).

5. Push the seal insert with the contact socket of the gland (item 2+3) up to the screen braiding or screen foil.

6. Mount the lower part (item 5) on the housing.

7. Push the seal with the contact socket of the gland (item 2+3) into the lower part (item 5).

8. Attach the domed cap nut (item 1) onto the lower part (item 5).

Grounding the Transmitter Housing

In case you need to ground the transmitter housing, the grounding connector is found inside the housing; see Figure 2 on page 22. Note that the probe is connected to the same potential as the housing. Make sure that different groundings are made to the same potential. Otherwise harmful ground currents may be generated.

If it is needed to have galvanic isolation of the power supply line from the output signals, the HMT330 can be ordered with an optional galvanic isolation module. This module prevents harmful grounding loops.

Signal and Power Supply Wiring

When connecting the transmitter with 8-pin connector, see section 8-Pin Connector on page 66. When wiring the power supply module, see section Power Supply Module on page 49.

0506-028
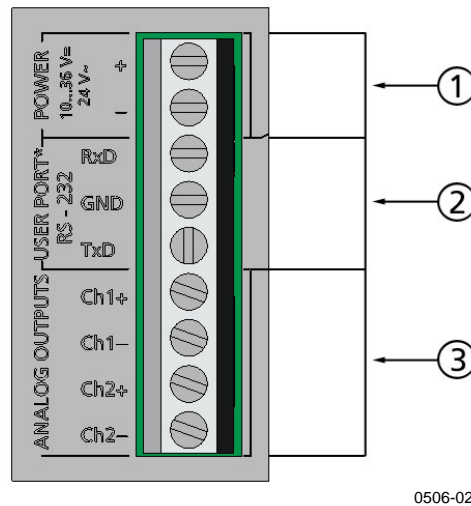
Figure 20   Screw Terminal Block on Motherboard

The following numbers refer to Figure 20 above:

1   =   Power supply terminals 10 ... 35 VDC, 24 VAC
2   =   User port (RS-232 terminals)
3   =   Analog signal terminals

WARNING	Make sure that you connect only de-energized wires.

---

1.   Unfasten the four cover screws and open the transmitter cover.

2.   Insert the power supply wires and signal wires through the cable bushing in the bottom of the transmitter; see the grounding instructions in the previous sections.

3.   Connect the analog output cables to terminals: **Ch1+, Ch1-, Ch2+, Ch2-**. Connect the RS-232 user port cables to terminals RxD, GND and TxD. For more information about the RS-232 connection refer to section Serial Line Communication on page 79.

4.   When wiring the optional modules, see the corresponding section for instructions:

    -    RS-422/485 Interface on page 57

    -    Relays on page 56

    -    Third Analog Output on page 54

    -    LAN Interface on page 62

    -    WLAN Interface on page 63

5.   Connect the power supply wires to the connectors: **POWER 10 ... 35V+ 24V~ (+)** and (-) terminals. If you are using 24 VAC power supply, see the note below before connecting the supply wires.

6.   Turn on the power. The indicator LED on the cover is lit continuously during normal operation.

7.   Close the cover and fasten the cover screws. The transmitter is ready for use.

Connections to a 24 VAC Power Supply

Separate floating supply for each transmitter is recommended (see the upper part of Figure 21 on page 39). If you have to connect several transmitters or other instruments to one AC supply, the phase (~) must always be connected to the (+) connector of each transmitter (see the lower part of Figure 21).

CAUTION	**24 VAC POWER SUPPLY USE** To prevent fire and/or damage, if either 24 VAC wire is grounded or connected to a "-", "0", or "GND" terminal of any other device, you must connect the same wire on the "-" terminal also on this instrument.

No common loop - RECOMMENDED!
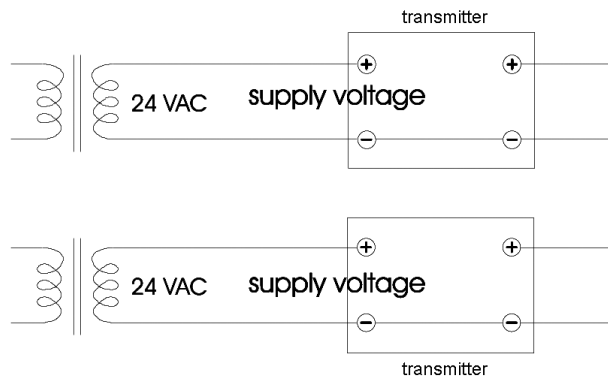
Common loop formed - NOT recommended!
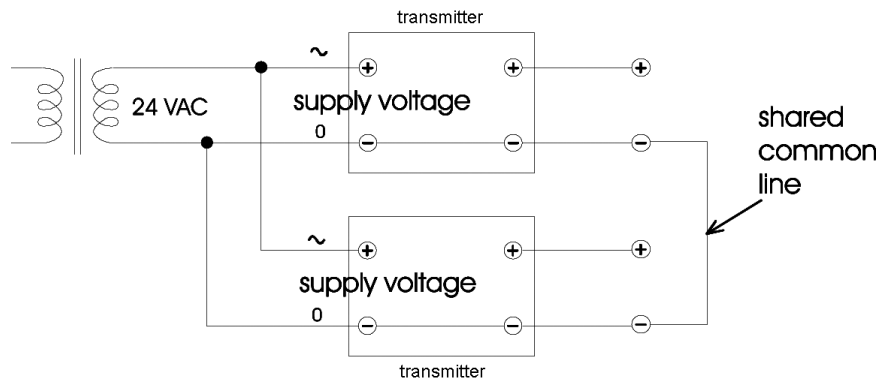
0703-041

Figure 21   Connections to 24 VAC Power Supply

Probe Mounting

In humidity measurement and especially in calibration it is essential that temperature of the probe and measuring environment is the same. Even a small difference in temperature between the environment and the probe causes an error. As the curve 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.

The graph below illustrates the measurement error at 100 %RH when the difference between the ambient and sensor temperature is 1 °C.
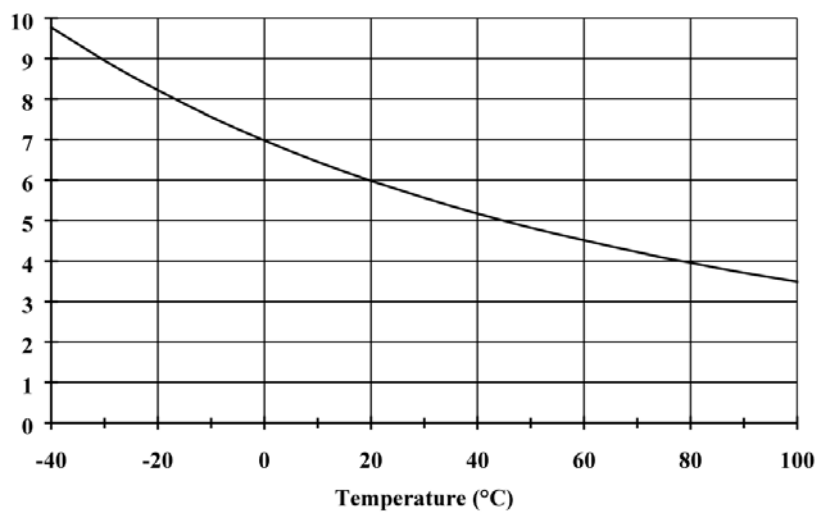
0507-023

Figure 22   Measurement Error at 100 %RH

General Instructions for Probes with a Cable

Mount the probes with a cable **horizontally**; this way, any water condensing on the tube cannot flow onto the sensor.
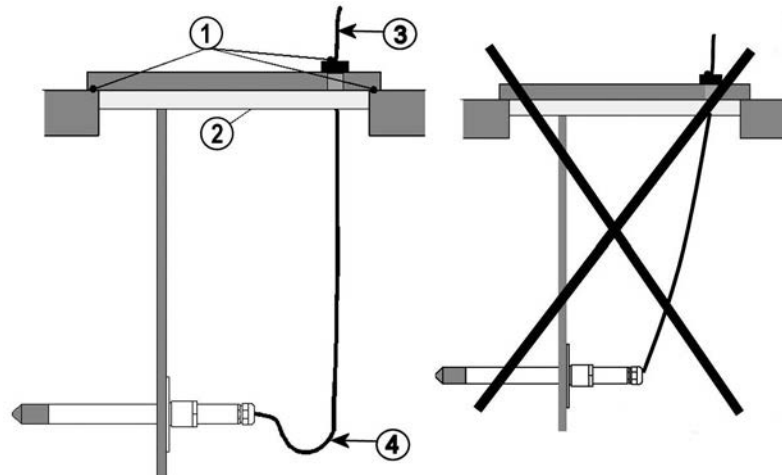
0507-024

Figure 23   Horizontal Mounting of Probe

The following numbers refer to Figure 23 above:

1 = To be sealed
2 = To be insulated
3 = Insulate the cable
4 = Let the cable hang loosely. This prevents condensed water running to the probe 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.
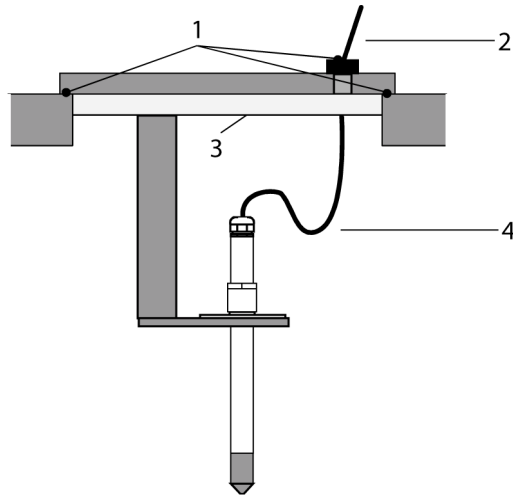
0507-022

Figure 24   Vertical Mounting of Probe

The following numbers refer to Figure 24 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.

NOTE	Please do not attach a heated probe (HMT337) 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 plenty of cable must be inside the process. This prevents measuring inaccuracy 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.

For Vaisala probe installation kits and some installation examples, see Appendix A on page 185.

HMT333 for Ducts and Tight Spaces

The HMT333 is a small size (ø = 12mm) general-purpose probe suitable for ducts and channels with the installation kit available from Vaisala.

The HMT333 provides for two measuring range options. The first probe version is equipped with a flexible cable and can be used when measuring in environments up to 80 °C. The second version is suitable for measuring in environments up to 120 °C.

See Appendix A on page 185 for the following probe installation kits for HMT333 and installation examples.

- Duct mounting kit
- Cable gland

HMT334 for High Pressure and Vacuum Applications

The HMT334 probe is for the dewpoint 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 the 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.
4.   Mark both the fitting screw and the nut hex.
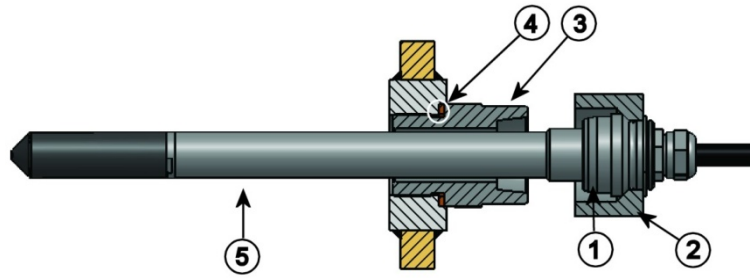
0506-029

Figure 25   HMT344 Probe

The following numbers refer to Figure 25 above:

1   =   Tightening cone
2   =   Nut
3   =   Fitting screw, M22x1.5 or NPT 1/2"
4   =   Sealing washer
5   =   Probe; Ø12 mm

5.   Tighten the nut a further 30º (1/12) turn or if you have a torque
      wrench tighten it with a torque of 80 ± 10 Nm (60 ± 7 ft-lbs).
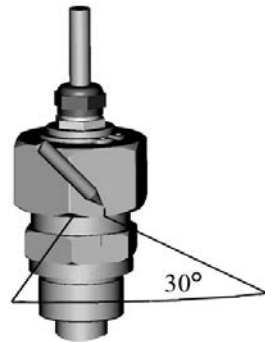
0503-034

Figure 26   Tightening 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 Dow
      Corning) or similar grease.
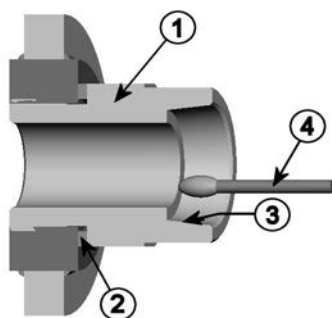
0503-033

Figure 27   Cleaning of Tightening Cone

The following numbers refer to Figure 27 above:

1   =   Fitting screw
2   =   Sealing washer
3   =   Tightening cone
4   =   Clean cotton stick

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 installed in a process with a pressure differing from normal atmospheric pressure, please enter the pressure value of the process (in hPa or mbar) into the transmitter memory using the display/keypad option, using the serial line (see section PRES and XPRES on page 104), or using the Modbus protocol (see Configuration Registers on page 203).

HMT335 for High Temperatures

HMT335 is installed similarly as the HMT333 probe but without the supporting bar. Refer to Appendix A on page 185 for more information on the duct installation kit for HMT335.

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

HMT337 for High Humidity Applications

The HMT337 is designed for environments where relative humidity is very high, near saturation. The warmed probe prevents the saturation of the sensor. An additional temperature probe is also available.

See Appendix A on page 185 for a presentation of the following probe installation kits for HMT337 with installation examples:

- Duct mounting kit
- Cable gland
- Pressure tight Swagelok connector
- Vaisala's Meteorological Installation Kit

The installation kits are available for both humidity and temperature probe.

Temperature Probe (Optional)

An additional temperature probe is available to measure the ambient temperature when the HMT337 (with probe warming) is used. The additional temperature probe allows you to measure other humidity quantities apart from dewpoint and mixing ratio. The temperature probe must be connected to the transmitter at the factory. Do not cut and re-connect the cable yourself.

You must install the additional temperature probe in the same measurement environment as the HMT337 probe. Make sure that heat does not transfer from the warmed probe to the temperature probe. For an example installation, refer to section Example of Installation Through Roof on page 191.

HMT338 for Pressurized Pipelines

Due to the sliding fit the HMT338 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 HMT338 on page 192.

0508-077
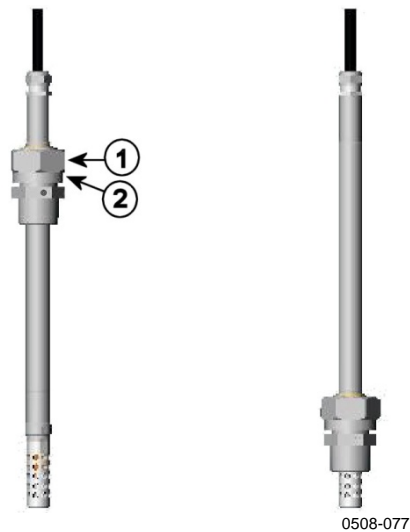
Figure 28   HMT338 Probe

The following numbers refer to Figure 28 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 5   HMT338 Probe Dimensions

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

fitting body
hex = 24 mm
tapered thread

sealing with:
1. LOCTITE®   No 542 + activ. No 7649 (t=-55...+150 °C)
2. MEGA-PIPE EXTRA No 7188 (t=-55...+170 °C)
3. PTFE tape (t=-60...+210 °C) NOTE: the tape does not lock
the parts together. Therefore, use two fork spanners (hex 24 and
27 mm) for tightening and opening the clasp nut of the probe
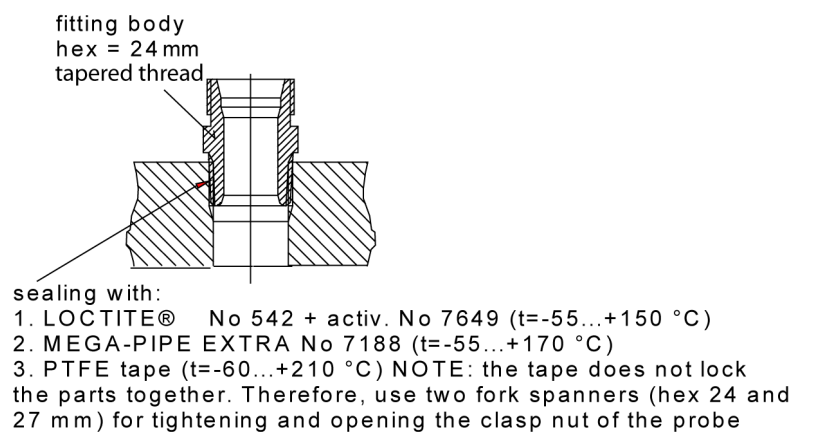
0507-025

Figure 29   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).

0505-276
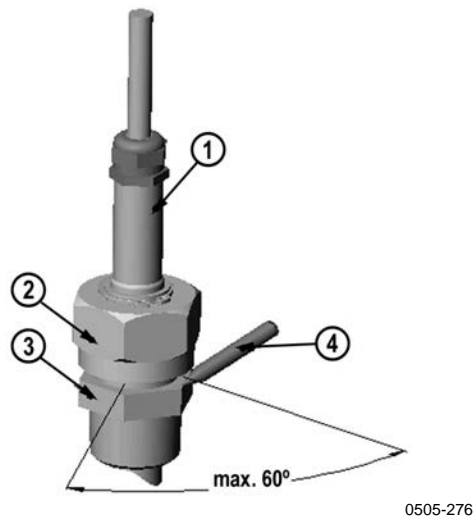
Figure 30　　Tightening the Clasp Nut

The following numbers refer to Figure 30 above:

1　=　Probe
2　=　Clasp nut
3　=　Fitting screw
4　=　Pen

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

NOTE	When installed in a process with a pressure differing from normal atmospheric pressure, please enter the pressure value of the process (in hPa or mbar) into the transmitter memory. You can enter the value using the display/keypad option, using the serial line (see section PRES and XPRES on page 104), or using the Modbus protocol (see Configuration Registers on page 203).

Optional Modules

Power Supply Module

The AC (mains) power connection may be connected to the power supply module only by an authorized electrician. A readily accessible disconnect device shall be incorporated in the fixed wiring.
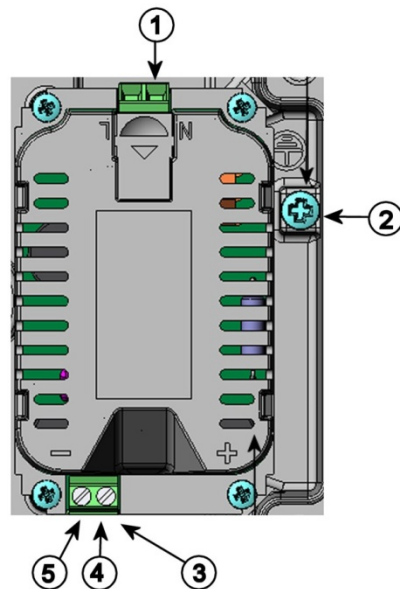
0506-027

Figure 31   Power Supply Module

The following numbers refer to Figure 31 above:

1 = Connect AC (mains) voltage wires to these terminals
2 = Grounding terminal
3 = In case the module is not installed in the factory: Connect wires from these terminals to the POWER 10 ... 35V 24V terminals of the motherboard.
4 = +
5 = -

Installation

1. Disconnect the power and open the transmitter cover.
2. Remove the protective plug from the cable gland and thread the wires. In case the power supply module is installed in the factory, continue with the step 5.
3. Attach the power module to the bottom of the housing with four screws. See the position in Figure 2 on page 22.
4. Connect the wires from the terminals of the power supply module marked with + and - to the terminals **POWER 10 ... 35 V** 24V on the motherboard of the transmitter.
5. Connect the AC mains voltage wires to the power supply module terminals marked with **N** and **L**.
6. Attach the grounding wire to the grounding terminal on the right-hand side of the transmitter.
7. Connect the power. The LED on the cover of the transmitter is lit continuously during normal operation.

WARNING   Do not detach the power supply module from the transmitter when the power is on.

WARNING   Do not connect the mains power to power supply module when it is not installed in the transmitter.

WARNING   Always connect the protective ground terminal.

Warnings

Dieses Produkt entspricht der Niederspannungsrichtlinie (2006/95/EWG).

- Das Netzmodul darf nur von einem dazu befugten Elektriker angeschlossen werden.
- Trennen Sie das Netzmodul nicht vom Messwertgeber, wenn der Strom eingeschaltet ist.
- Verbinden Sie das Netzmodul nur mit der Spannungsquelle, wenn es im Messwertgeber HMT330 montiert ist.
- Das Erdungskabel muss zum Schutz immer angeschlossen sein.

Ce produit est conforme à la Directive relative à la Basse Tension (2006/95/EEC).

- Seul un électricien compétent est habilité à raccorder le module d'alimentation au secteur.
- Ne pas détacher le module d'alimentation du transmetteur lorsqu'il est en service.
- Ne pas raccorder le secteur au module d'alimentation lorsque celui-ci n'est pas installé dans le transmetteur HMT330.
- Toujours raccorder un bornier de protection à la terre.

Tämä tuote on pienjännitedirektiivin (2006/95/EEC) mukainen.

- Vaihtovirtaliitännän saa kytkeä tehonsyöttömoduuliin ainoastaan valtuutettu sähköasentaja
- Älä irrota tehonsyöttömoduulia lähettimestä, kun virta on kytkettynä.
- Älä kytke verkkovirtaa tehonsyöttömoduuliin, jos kyseistä moduulia ei ole asennettu HMT330 lähettimeen.
- Kytke aina maadoitusliittimet.

Denna produkt uppfyller kraven i direktivet om lågspänning (2006/95/EEC).

- Nätanslutningen (växelströmsanslutningen) får bara anslutas till strömförsörjningsmodulen av en behörig elektriker.
- Ta inte loss strömförsörjningsmodulen från mätaren när strömmen är på.
- Anslut inte strömförsörjningsmodulen till nätet när den inte är installerad i HMT330-mätaren
- Anslut alltid en skyddande jordningsplint.

Questo prodotto è conforme alla Direttiva sul basso voltaggio (2006/95/CEE).

- La conduttura elettrica può essere collegata al modulo di alimentazione elettrica soltanto da un elettricista autorizzato.
- Non staccare l'alimentazione elettrica dal trasmettitore quando è acceso.
- Non collegare la corrente elettrica al modulo di alimentazione elettrica se non è installato nel trasmettitore HMT330.
- Collegare sempre il morsetto protettivo a terra!

Dette produkt er i overensstemmelse med direktivet om lavspænding (2006/95/EØS).

- Netstrømskoblingen til må kun tilsluttes strømforsyningsmodulet af en autoriseret elinstallatør
- Strømforsyningsmodulet må ikke løsgøres fra senderen, mens spændingen er sluttet til.
- Slut ikke netspændingen til strømforsyningsmodulet, når det ikke er installeret i HMT330-senderen
- Forbind altid den beskyttende jordklemme!

Dit product voldoet aan de eisen van de richtlijn 2006/95/EEG (Laagspanningsrichtlijn).

- De stroom kan aan de stroomtoevoer module aangesloten worden alleen door een bevoegde monteur.
- Het is niet toegestaan de stroomtoevoer module van de transmitter los te koppelen wanneer de stroom aan is.
- Het is niet toegestaan de stroom aan de stroomtoevoer module aan te sluiten als deze niet in een HMT330-transmitter is gemonteerd.
- Altijd beschermend aardcontact aansluiten!

Este producto cumple con la directiva de bajo voltaje (2006/95/EEC).

- La conexión de la alimentación principal al módulo de alimentación sólo puede realizarla un electricista autorizado.
- No desenchufe el módulo de alimentación del transmisor cuando esté encendido.
- No conecte la alimentación principal al módulo de alimentación cuando no esté instalado en el transmisor HMT330.
- Conecte siempre el terminal de protección de conexión a tierra.

See toode vastab madalpinge direktiivile (2006/95/EEC).

- Voolukaabli võib vooluallika mooduli külge ühendada ainult volitatud elektrik.
- Ärge ühendage vooluallika moodulit saatja küljest lahti, kui vool on sisse lülitatud.
- Ärge ühendage voolukaablit vooluallika mooduli külge, kui seda pole HMT330-tüüpi saatjasse paigaldatud.
- Ühendage alati kaitsev maandusklemm!

Ez a termék megfelel a Kisfeszültségű villamos termékek irányelvnek (2006/95/EGK).

- A hálózati feszültséget csak feljogosított elektrotechnikus csatlakoztathatja a tápegységmodulra.
- A bekapcsolt távadóról ne csatolja le a tápegységmodult.
- Ne csatlakoztassa a hálózati feszültséget a tápegységmodulhoz, ha az nincs beépítve a HMT330 távadóba.
- Feltétlenül csatlakoztasson földelő védőkapcsot!

Šis produktas atitinka direktyvą dėl žemos įtampos prietaisų (2006/95/EB).

- Elektros tinklą su energijos tiekimo moduliu sujungti gali tik įgaliotas elektrikas.
- Niekada neišimkite energijos tiekimo modulio iš siųstuvo, kai maitinimas yra įjungtas.
- Jei energijos tiekimo modulis nėra įmontuotas HMT330 siųstuve, nejunkite jo į elektros tinklą.
- Visada prijunkite prie apsauginės įžeminimo jungties!

Šis produkts atbilst Zemsprieguma direktīvai (2006/95/EEC).

- Strāvas pieslēgumu var pieslēgt pie barošanas avota moduļa tikai autorizēts elektriķis.
- Neatvienot barošanas avota moduli no raidītāja, kad pieslēgta strāva.
- Nepievienot strāvu barošanas avota modulim, ja tas nav uzstādēts HMT330 raidītājā
- Vienmēr pievienot aizsargājošu iezemētu terminālu !

Ten produkt spełnia wymogi Dyrektywy niskonapięciowej (2006/95/EEC).

- Napięcie zasilające powinno zostać podłączone do modułu zasilacza tylko przez wykwalifikowanego elektryka.
- Nie wolno odłączać modułu zasilacza od nadajnika, kiedy zasilanie jest włączone.
- Nie wolno podłączać napięcia zasilającego do modułu zasilacza, kiedy nie jest on zamontowany w nadajniku HMT330.
- Zawsze należy podłączać zabezpieczający zacisk uziemiający!

Tento výrobek vyhovuje Směrnici pro nízké napětí (2006/95/EEC).

- Připojení síťového napájení k napájecímu modulu smí provádět pouze oprávněný elektrikář.
- Neodpojujte napájecí modul od snímače při zapnutém napájení.
- Nepřipojujte síťové napájení k napájecímu modulu, pokud není instalován ve snímači HMT330.
- Vždy zapojte ochrannou zemnící svorku!

Galvanic Isolation of the Power Supply

If galvanic isolation of the power supply line from the output signals is needed, HMT330 can be ordered with optional galvanic isolation module. This module prevents harmful grounding loops.

NOTE	Galvanic isolation module is not needed when using the AC power supply module. Note also that these two modules are physically incompatible to be installed at the same time. If both modules are installed, there is no room to close the transmitter cover completely.

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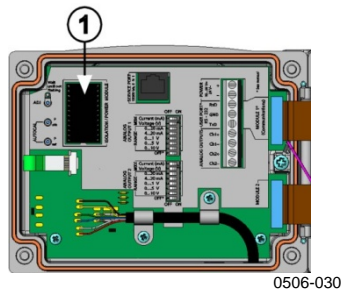
Figure 32   Galvanic Isolation Module

The following number refers to Figure 32 above:

1   =   Galvanic isolation module

Third Analog Output

0503-030
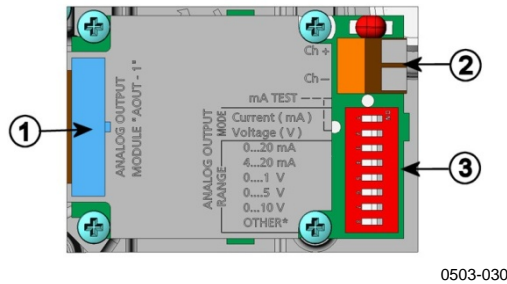
Figure 33   Third Analog Output

The following numbers refer to Figure 33 above:

1   =   Flat cable pins
2   =   Screw terminals for signal line
3   =   DIP switches to select the output mode and range

Installation and Wiring

1. Disconnect the power. In case the analog output module is installed in the factory, continue with the step 4.

2. Open the transmitter cover and fasten the analog output module to the position for MODULE 2 with four screws. Refer to Figure 2 on page 22.

3. Connect the flat cable between the analog output module and the motherboard's connector for MODULE 2.

4. Take out the protective plug from the cable gland and thread the wires.

5. Connect the wires to the screw terminals marked with **Ch+** and **Ch-** .

6. Select the current/voltage output by setting ON either of the switches 1 or 2.

7. Select the range by setting ON one of the switches 3 ... 7.

NOTE	Only one of the switches 1 ... 2 can be ON at a time.
	Only one of the switches 3 ... 7 can be ON at a time.

0508-029

Figure 34   Third Analog Output Selection

8. Connect the power.

9. Select the quantity and scale the channel via the serial line or display/keypad, see section Analog Output Quantities on page 121. For testing the analog output, see section Analog Output Tests on page 123. For fault indication setting, see section Analog Output Fault Indication Setting on page 124.

Relays

HMT330 can be equipped with one or two configurable relay modules. Each module contains two configurable relays. See the contact ratings in section Technical Specifications of Optional Modules on page 176.

Installation and Wiring

1. Disconnect the power and open the transmitter cover. In case the relay-module is installed in the factory, continue with step 5.
2. Attach the relay module to the bottom of the housing with four screws. See the position in Figure 2 on page 22.
3. When the mains power is in use attach the grounding wire to the grounding terminal.
4. Connect the flat cable between the relay module and the **MODULE 1** or **MODULE 2** pins of the motherboard.
5. Take out the protective plug from the cable gland and thread the relay wires.
6. Connect the wires to the screw terminals: NO, C, and NC. Refer to section Selecting the Activation State of the Relay below.

CAUTION	For installations in the USA: If your transmitter has both the relay module and a LAN or WLAN module, the maximum voltage you are allowed to connect to the relay module is 50 V.

7. Connect the power and close the cover.

Selecting the Activation State of the Relay

The middlemost C terminal and either one of the terminals NO/NC must be connected. The polarity can be freely selected.

NO   Normally open
C   Common relay
NC   Normally closed

Relay NOT activated: C and NC outputs are closed, NO is open
Relay IS activated: C and NO outputs are closed, NC is open.

NOTE	For instructions on how to operate the relay (for example, selecting quantity for the relay output and setting the relay setpoints), see section Operation of Relays on page 125.
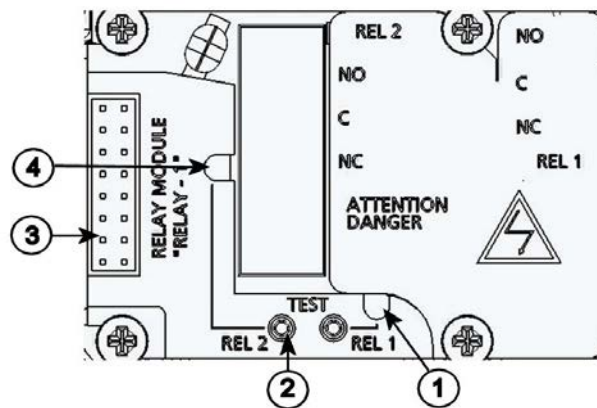
0503-037

Figure 35   Relay Module

The following numbers refer to Figure 35 above:

1   =   Indication led for the relay 1 or 3
2   =   Relay test buttons
3   =   Flat cable pins
4   =   Indication led for relay 2 or 4

WARNING	The relay module may contain dangerous voltages even if the transmitter power has been disconnected. Before opening the transmitter you must switch off **both** the transmitter **and** the voltage connected to the relay terminals.

WARNING	Do not connect the mains power to relay unit without grounding the transmitter.

RS-422/485 Interface

The RS-422/485 interface enables communication between an RS-485 network and the HMT330 transmitter. The RS-485 interface is isolated and offers a maximum communications rate of 115 200 bits/s. (For maximum bus length of 1 km, use bit rate 19200 b/s or less.)

When selecting an RS-232 to RS-485 converter for the network, avoid self-powered converters, as they do not necessarily support the needed power consumption.

NOTE	RS-232 User Port on HMT330 main board cannot be used and connected when RS-485 module is connected. Service port operates normally.
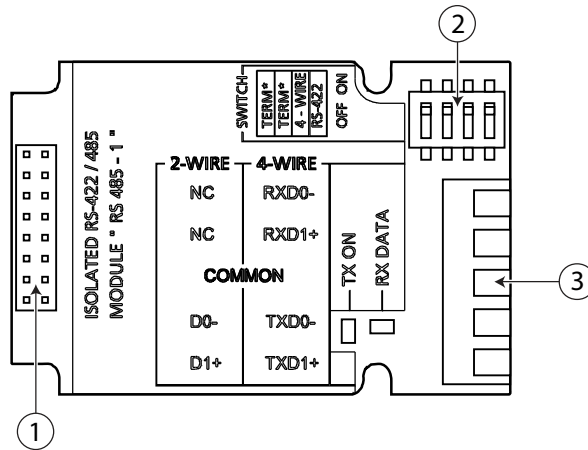
1102-023

Figure 36   RS-422/485 Module

The following numbers refer to Figure 36 above:

1   =   Flat cable pins
2   =   Selection switches
3   =   Screw terminals for wiring

NOTE	The data lines on earlier versions of the RS-422/485 module are marked A and B instead of D1+ and D0-. When the line is idle, D1+ has positive voltage compared to D0-.
	When connecting the module, be prepared to swap the D1+ and D0- wires if you have a communication problem.

Installation and Wiring

1.   Disconnect the power. In case the RS-422/485-module is installed in the factory, continue with the item 4.

2.   Open the transmitter cover and attach the RS-422/485 module to the bottom of the housing with four screws.

3.   Connect the flat cable between the RS-422/485 module and the motherboard's pins **MODULE1 (Communications)**.

4.   Pull the network wirings through the cable gland.

5. Connect the twisted pair wires (1 or 2 pairs) to the screw terminals as presented in Table 6 below:

Table 6   Connecting the Twisted Pair Wires to the Screw Terminals

Screw Terminal	Data Line (2-wire RS-485)	Data Line (4-wire RS-422/485)
1	(not connected)	Rx D0-
2	(not connected)	Rx D1+
3	Common	Common
4	D0-	Tx D0-
5	D1+	Tx D1+

To avoid problems in the RS-422/485 network, the Common terminal should be wired to the corresponding terminals of the other devices.

6. If you use RS-422 or RS-485 to connect just one HMT330 to a master computer, enable the internal termination of HMT330 by switching switches 1 and 2 ON. Make sure that the master's end of the line is also terminated (by using master's internal termination or with a separate terminator).

If you are connecting many transmitters to the same RS-485 bus, make sure that switches 1 and 2 are OFF and terminate the bus with separate terminators at both ends. This allows removing any transmitter without blocking the bus operation.

NOTE	If you use the internal termination of the transmitter at the end of the RS-485 bus (instead of using separate terminators) removing that transmitter will block the bus operation.

7. Use the bus type (4-wire/2-wire) to select the selection switch 3.

In 4-wire mode RS-485 master sends data to the HMT330 through terminals Rx D1+ and Rx D0- and receives data from HMT330 through terminals Tx D1+ and Tx D0-.
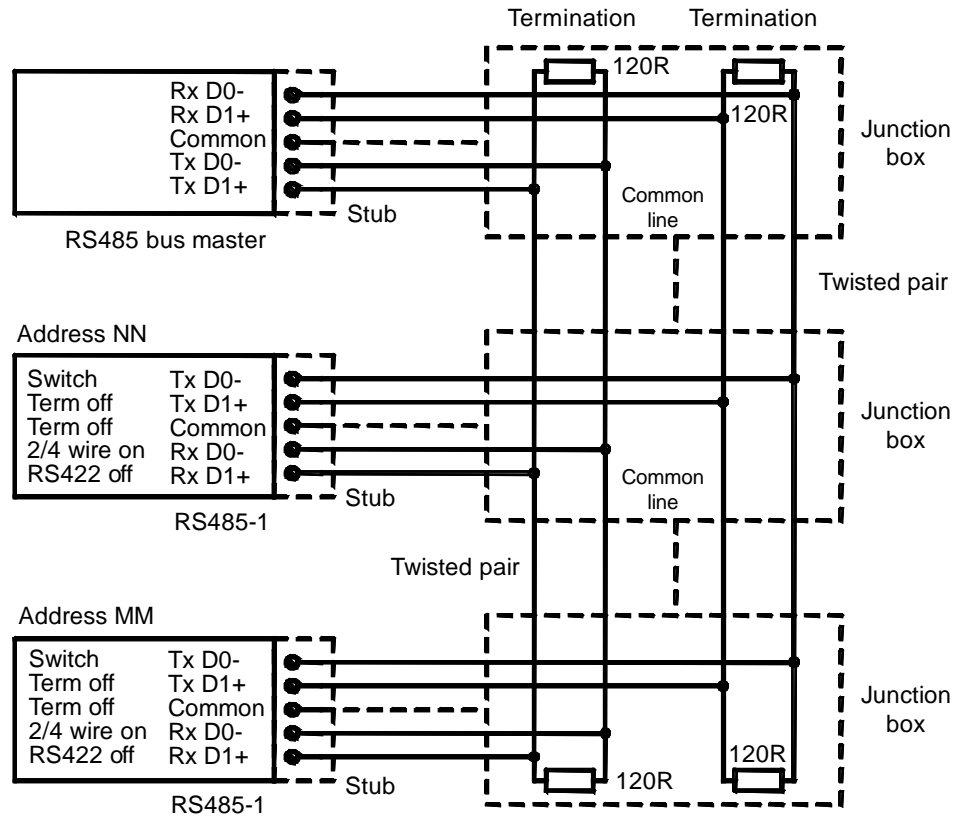
Figure 37   4-Wire RS-485 Bus

Table 7   4-Wire (Switch 3: On)

RS-485 master	Data	HMT330
Tx D1+	→	Rx D1+
Tx D0-	→	Rx D0-
Rx D1+	←	Tx D1+
Rx D0-	←	Tx D0-
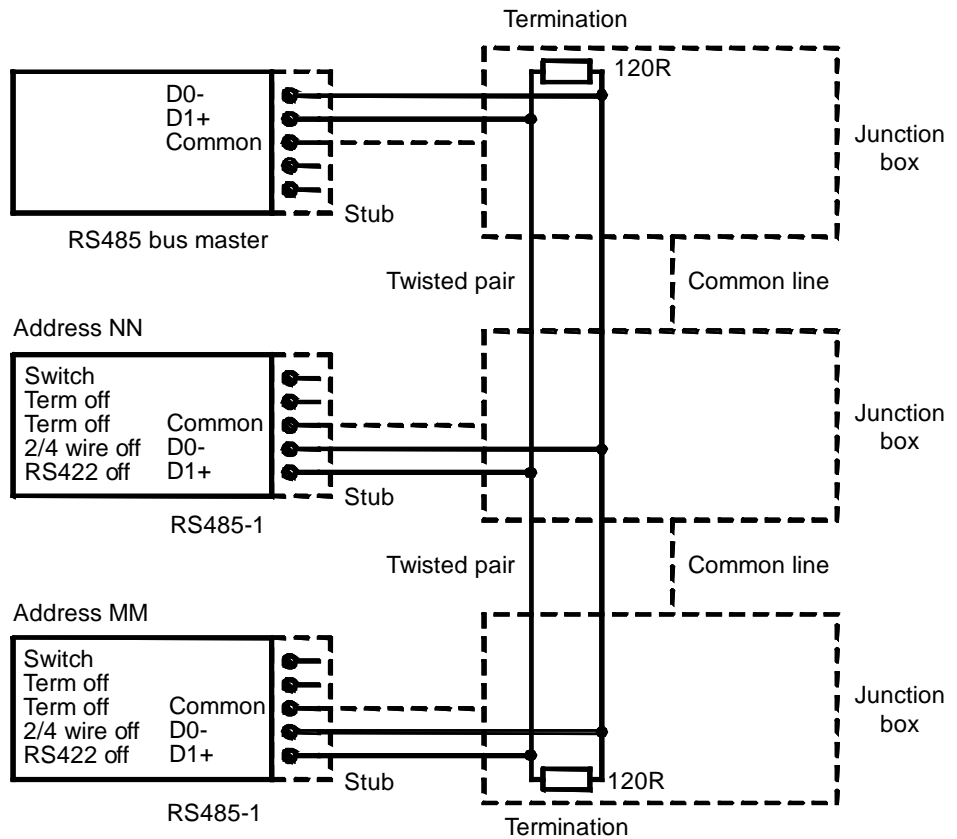
1102-027

Figure 38   2-Wire RS-485 Bus

Table 8   2-Wire (Switch 3: Off)

RS-485 master	Data	HMT330
D1+	↔	D1+
D0-	↔	D0-

8.   When operating in communication mode RS-422, set both switches 3 and 4 to ON position (4-wire wiring is required for RS-422 mode).

9.   Connect the power and close the cover.

LAN Interface

The optional LAN interface enables an Ethernet connection to the transmitter. The user can establish a virtual terminal session using a Telnet client program such as PuTTY or by using Modbus TCP protocol. When the LAN interface is in use, serial communication using the RS-232 User Port is disabled.

The LAN interface module must be installed at the factory (when ordering the transmitter), or by a Vaisala Service Center. Once installed, the module is automatically used by the transmitter. The physical connection to the network is made to the RJ45 connector on the LAN interface module, using a standard twisted pair Ethernet cable (10/100Base-T). Transmitters with the optional LAN interface are delivered pre-installed with a suitable cable and cable gland.

The LAN interface can use both static and dynamic network settings. If the interface is configured to use dynamic settings, the network where the LAN interface is connected must have a DHCP server that provides the settings.

The network configuration can be done using the optional display and keypad, or by using the service port. For instructions, see section LAN Communication on page 82. The LAN interface also provides a web configuration interface, which you can access by entering the IP address of the LAN interface in the address field of a web browser. See section Web Configuration for LAN and WLAN on page 89.

CAUTION	The LAN interface is designed to be used in trusted network environments (trusted corporate LAN or VPN-based connection over internet). Avoid connecting the transmitter directly to a public network because the device can be attacked by a malicious user through the network.

1 = Flat cable connector
2 = RJ45 connector with indicator LEDs for link and activity

0709-003
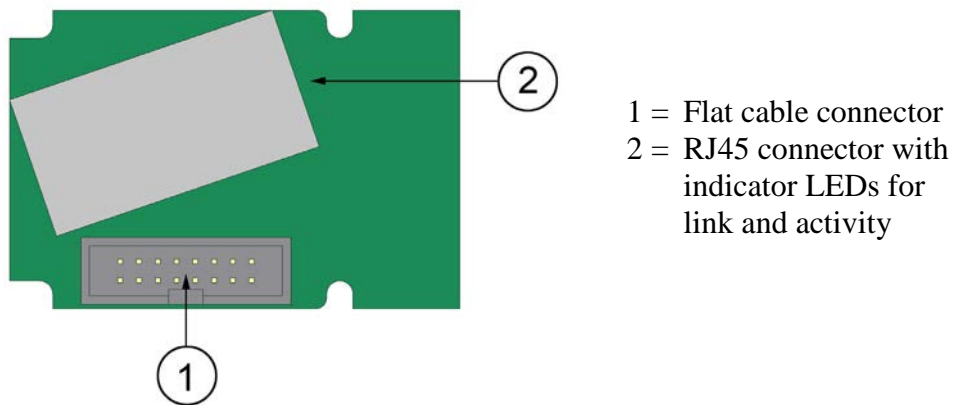
Figure 39   LAN Interface Module

WLAN Interface

The optional WLAN interface enables a wireless Ethernet connection (IEEE 802.11b) to the transmitter. The user can establish a virtual terminal session using a Telnet client program such as PuTTY or by using Modbus TCP protocol. When the WLAN interface is in use, serial communication using the RS-232 User Port is disabled.

The interface supports Wired Equivalent Privacy (WEP) and Wi-Fi Protected Access (WPA, WPA2). For WEP, 64 and 128 bit encryption is supported, with open system or shared key authentication. WPA is used in the Pre-Shared Key (PSK) mode, with either TKIP or CCMP (also known as AES) encryption.

Similarly to the LAN interface, the WLAN interface can use both static and dynamic network settings. If the interface is configured to use dynamic settings, the network where the WLAN interface is connected must have a DHCP server that provides the settings.

The WLAN interface also provides a web configuration interface, which you can access by entering the IP address of the WLAN interface in the address field of a web browser. See section Web Configuration for LAN and WLAN on page 89.

1 = Flat cable connector
2 = Connector for antenna cable (connected to transmitter cover)

0802-103
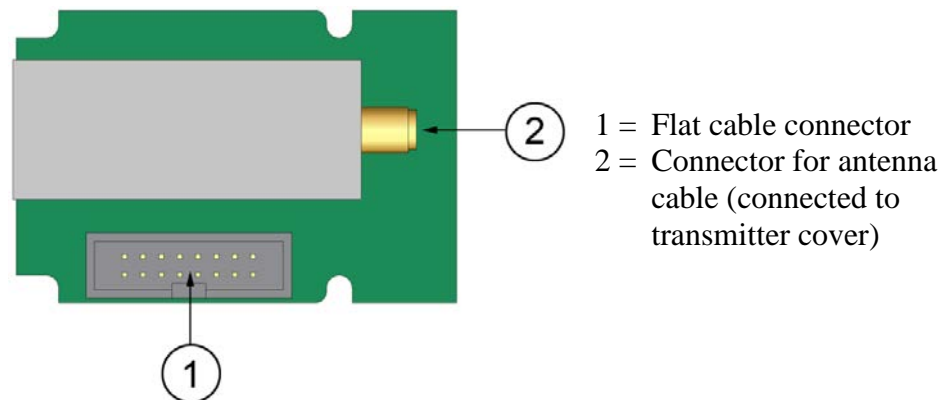
Figure 40   WLAN Interface Module

CAUTION	The WLAN interface is designed to be used in trusted network environments (trusted corporate LAN or VPN-based connection over internet). Avoid connecting the transmitter directly to a public network because the device can be attacked by a malicious user through the network.

NOTE	The default country setting for the WLAN interface is United States, which limits the operation to WLAN channels 1 ... 11. To enable additional channels (12 ... 14), you can change the country setting using the web configuration interface.

NOTE	The WLAN interface is not recommended for use with the HMT331 fixed probe model (for wall-mounted applications). The HMT331 short cable probe is designed to be used with the WLAN interface.

Attaching the WLAN Antenna

The WLAN interface module must be installed at the factory (when ordering the transmitter), or by a Vaisala Service Center. Before taking the transmitter into use, you must attach the antenna of the WLAN interface into the RP-SMA connector on the transmitter cover. The location of the antenna is shown in Figure 83 on page 181.

Data Logger Module

The optional data logger module extends the data storage for the measurement data. When the data logger is present, this storage is automatically used by the transmitter. The stored data can be browsed using the optional display module, and accessed through the serial connections. See sections Graphic History on page 68 and Data Recording on page 116.

The data logger module contains non-volatile flash memory providing 4 years and 5 months of storage for 4 parameters at a 10-second sampling interval. When the memory is full, the data recording will not stop. Instead, the oldest data is overwritten. For each parameter and observation period, the module stores the minimum and maximum values during the interval, as well a data trend value that is averaged from samples taken during the interval (see Table 9 on page 64).

Table 9   Observation Periods and Resolution

Observation Period	Period for Trend/Max/Min Calculations (Resolution)
20 minutes	10 seconds
3 hours	90 seconds
1 day	12 minutes
10 days	2 hours
2 months	12 hours
1 year	3 days
4 years	12 days

The quantities that are logged are the same that have been selected for measurement using the display/keypad or the serial line. When taking the transmitter into use, verify that the desired quantities are selected. If you change the quantities later, the transmitter will start logging the new quantities, and stop logging the quantities that are no longer selected. Changing the quantities does not delete any measurement data that is

already in memory. However, the data of any removed quantity cannot be accessed unless the quantity is re-activated first.

The data logger module has a real time clock with a battery back-up. The clock has been set to the Coordinated Universal Time (UTC) at the factory, and its time cannot be set by the user. The data that is stored in the logger's memory is timestamped using the logger's clock.

When date and time are set on the transmitter, they are stored to the transmitter's memory as an offset from the time on the logger's clock. When browsing the stored data, the time offset is applied to the timestamps shown in the graphical history, and data outputted from the serial port. The timestamps in the data logger's memory remain as they were originally stored.

You can compensate for the clock drift (less than ±2 min/year) by setting the time on the transmitter. This updates the time offset used on the display and the serial port. You can set the time by using the keypad/display or the serial commands.

0706-068
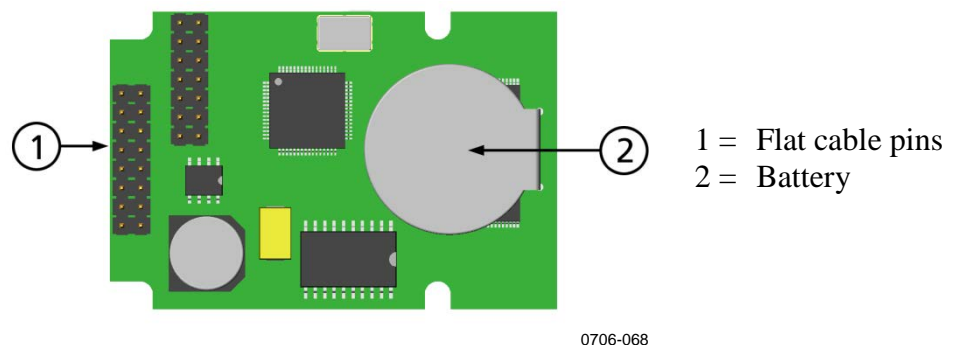
Figure 41   Data Logger Module

After a reset or a power up, it will usually take at least 10 seconds before the data logger module is initialized. The instrument will not start up before the data logger module is ready.

The indicator LED on the module will blink green during normal operation. If the LED is lit in red color, there is a problem with the module. The transmitter will also indicate the problem by activating the "Internal error on add-on module" error. If the module is not operating correctly, the transmitter must be sent to Vaisala for maintenance.

The data logger module must be installed at the factory (when ordering the transmitter), or by a Vaisala Service Center. Once installed, the module is automatically used by the transmitter. When the module requires a new battery, the transmitter must be sent to Vaisala for maintenance.

8-Pin Connector

1104-126
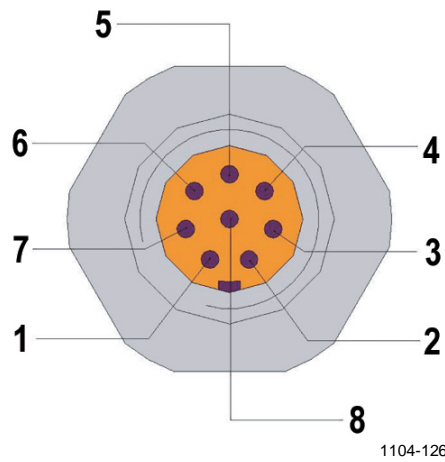
Figure 42   Pinout of the Optional 8-Pin Connector

Table 10   Wiring of the Optional 8-Pin Connector

Pin	Wire	Serial Signal		Analog Signal
		RS-232 (EIA-232)	RS-485 (EIA-485)	
1	White	Data out TX	D1+	-
2	Brown	(Serial GND)	(Serial GND)	Signal GND (for both channels)
3	Green	-	-	Ch 2+
4	Yellow	-	-	Ch 1 +
5	Grey	Supply -	Supply -	Supply -
6	Pink	Supply +	Supply +	Supply +
7	Blue	Data in RX	D0-	-
8	Shield/Red	Cable shield	Cable shield	Cable shield

CHAPTER 4
OPERATION

This chapter contains information that is needed to operate this product.

Getting Started

Within a few seconds after power-up the LED on the cover of the transmitter is lit continuously indicating normal operation. If the data logger module is installed, the startup may take up to 18 seconds.

When using the optional display and turning the transmitter on the first time, the language selection menu window opens. Select the language with ▼ ▲ arrow buttons and press the **SELECT** button (the left-hand ⬜ button).

Pressure has an effect on humidity calculations and accuracy. Therefore, accurate calculations can be achieved only when the ambient pressure is taken into consideration. For instructions on how to set the pressure, see section Pressure Compensation Setting on page 104.

Display/Keypad (Optional)

Basic Display

Display shows you the measurement values of the selected quantities in the selected units. You can select 1 ... 4 quantities for the numerical basic display (see section Changing Quantities and Units on page 100.)
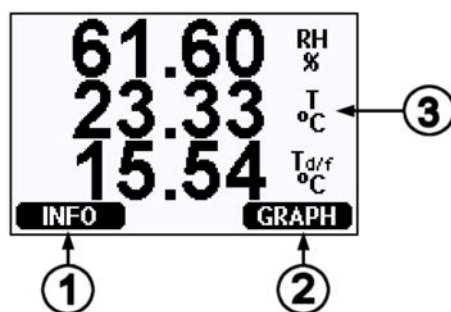
1= **INFO** shortcut button; see section Device Information on page 108

2 = **GRAPH** shortcut button; see section Graphic History on page 68

3 = Quantities selected for display

0705-209

Figure 43   **Basic Display**

NOTE	From any view, even in the absence of an **EXIT** button, a four-second press on the right-hand function button takes you directly to the basic display.

Graphic History

The graphical display shows the data trend or min/max graph of the selected quantities, one at a time. The graph is updated automatically while measuring.

0705-210
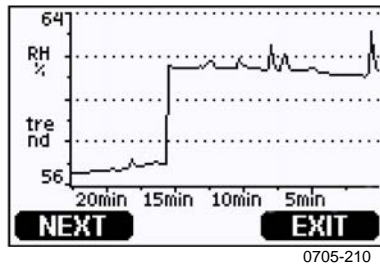
Figure 44   Graphical Display

Trend graph: Shows you a curve of average values. Each value is a calculated average over a period. See Table 11 below.

Max/min graph: Shows you the minimum and maximum values in a form of curve. Each point shows the absolute minimum and maximum observed during the time period represented by the data point. See Table 11 on page 68.

Table 11   Periods for Trend and Max/Min Calculations

Observation Period	Period for Trend/Max/Min Calculations (Resolution)
20 minutes	10 seconds
3 hours	90 seconds
1 day	12 minutes
10 days	2 hours
2 months	12 hours
1 year	3 days
4 year*	12 days

* The maximum logging period of the data logger module (available when data logger module is installed)

Use the following functions in the graphical display:

- Press the **NEXT** button to change between the trend graph and max/min graph for the quantities selected for display.
- Press the **EXIT** button to return to the basic display.
- Press the ▼ ▲ arrow buttons to zoom in and out in the graph window.

- Press the ◄► arrow buttons move the cursor (vertical bar) along the time axis. The cursor mode allows you to observe individual measuring points. The numerical value at the cursor position is shown at the left upper corner. The right upper corner shows the time from the present to the chosen moment (without the logger module), or the date and time at the cursor position (when the logger module is installed).

- If the optional data logger module is installed, you can scroll the cursor off the screen to move to a new point on the time axis. The new date will be displayed, and the cursor will be centered at the date where the cursor scrolled off the screen.

0706-030
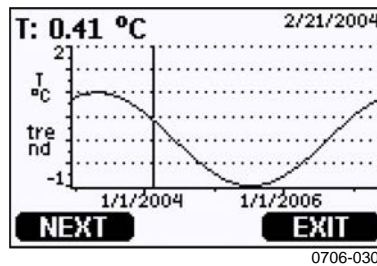
Figure 45   Graphical Display with Data Logger

If the data logger module is installed, you can move quickly on the time axis: zoom out, move the cursor, and zoom back in.

The time that is shown below the graph is adjusted with the current time offset of the transmitter. If you change the transmitter's date and time setting, the displayed timestamps in the history graph change accordingly. For an explanation of the effect of changing the date and time manually, see section Data Logger Module on page 64.

Table 12   Graph Information Messages in Cursor Mode

Message	Interpretation
Power outage	Power failure (marked also with dashed vertical line)
No data	Quantity has not been selected for the display
System error	General device or power supply problem
T meas. error	Temperature measurement/sensor failure
RH meas. error	Humidity measurement/sensor failure
Adj. mode active	Adjustment mode active (data recorded in the adjustment mode is not displayed)

A question mark after time tells you that at least one power failure (dashed vertical line) has occurred after the chosen moment. In this case, the exact time difference between the present and the cursor position is not exactly known. If the data logger module is installed, the time is known and the question marks are not present.

Menus and Navigation

You can change settings and select functions in the menus.

1. Open the **Main Menu** by pressing any of the ▼ ▲ ◄ ► arrow buttons in the basic (numeric) display mode.
2. Move in the menus by using the ▲ ▼ arrow buttons.
3. Open a submenu with ► button.
4. Press ◄ to return to the previous level.
5. Function button **EXIT** returns you back to the basic display.


```
       MAIN MENU ◄♦►
  ▢  ▶Display
  ⚡  ▶Measuring
  ⇄  ▶Interfaces
  ✗  ▶System

                      EXIT
```

```
          DISPLAY
  ▣  ▶Quantities
  ▣  ▶Units
  ▣  ▶Alarms
  ☑  Rounding
     Backlight: Always on
  ◑  Contrast
                      EXIT
```

```
          MEASURING
  ▣  ▶Pressure compensation
  ▣  ▶Chemical purge
  ▢  Sensor heating
     Filtering: Off

                      EXIT
```

```
         INTERFACES
  ▣  ▶Serial interface
  ▣  ▶Analog outputs



                      EXIT
```

```
          SYSTEM
  ▣  ▶Diagnostics
  ▣  ▶Date and time
  ▢  Menu PIN
  ⚑  Language: English
     Clear graph memories
     Factory settings
                      EXIT
```

0705-208, 0802-040

Figure 46   Main Menus

Some menu items, such as **Purge** in the **Measuring** menu, are only shown if supported by the transmitter and the installed options.

Changing the Language

1.   Go back to the basic display by keeping the right-hand ▭ button pressed for four seconds.

2.   Open the **Main Menu** by pressing any of the ▼ ▲ ◄ ► buttons.

3.   Scroll to the **System** menu option, and press the ► button. The menu option is indicated with the wrench ✗ symbol.

4.   Scroll to the **Language** menu option, and press the left-hand ▭ button. The menu option is indicated with the flag ⚑ symbol.

5.   Select the language with the ▼ ▲ buttons, and confirm the selection by pressing the left-hand ▭ button.

6.   Press the right-hand ▭ button to exit to the basic display.

Rounding Setting

Round off one decimal by using the Rounding function. The default setting is rounding on. Rounding has no effect on quantities without decimals.

1.   Open the **Main Menu** by pressing any of the ▼ ▲ ◄ ► arrow buttons.

2.   Select **Display** and confirm by pressing the ►arrow button.

3.   Select **Rounding** and press **ON/OFF** button.

4.   Press **EXIT** to return to the basic display.

Display Backlight Setting

As a default the display backlight is always on. In the automatic mode the backlight stays on for 30 seconds from the last press of any button. When pressing any button, the light turns on again.

1.   Open the **Main Menu** by pressing any of the ▼ ▲ ◄ ► arrow buttons.

2.   Select **Display**, press the ►arrow button.

3.   Select **Backlight**, press the **CHANGE** button.

4.   Select **On/Off/Automatic**, press the **SELECT** button.

5.   Press **EXIT** to return to the basic display.

Display Contrast Setting

Display contrast is automatically adjusted based on the ambient temperature. However, depending on the installation location and viewing direction, it may be necessary to fine-tune the contrast manually.

Using Display/Keypad

1. Open the **Main Menu** by pressing any of the ▼ ▲ ◄ ► arrow buttons.
2. Select **Display**, press the ►arrow button.
3. Select **Contrast**, press the **ADJUST** button.
4. Adjust the contrast by pressing the ◄► arrow buttons.
5. Press **OK** and **EXIT** to return to the basic display.

Using Serial Line

Use the serial line command **CON** to view or set the display contrast.

CON [xxx]<cr>

where

xxx   =   Contrast value for display. Recommended range -9 ... 9, default 0. Negative values make screen lighter, positive values make it darker.

Example (view current contrast setting):

```
>con
Contrast       : 0
>
```

Example (set contrast to 5):

```
>con 5
Contrast       : 5
>
```

Keypad Lock (Keyguard)

This function locks the keypad and prevents unintentional key presses.

1. Keep pressing the left-hand function button for 4 seconds to lock the keypad (at any display).
2. To unlock the keypad, press the **OPEN** button for 4 seconds.

Menu PIN Lock

You can prevent unauthorized changes of the device settings by activating the menu PIN lock. When this function is activated, the basic display, graphical view, and device information displays are available, but access to the menus is locked. The key symbol indicates the activation of this feature.

1. Open the **Main Menu** by pressing any of the ▼ ▲ ◄ ► arrow buttons.
2. Select **System**, press the ► arrow button.
3. Select **Menu PIN**, press the **ON** button.
4. Enter a PIN code by using the ▼ ▲ arrow buttons. Press OK to confirm the setting. Now the PIN lock is on and a key symbol is shown in a display.
5. Press **EXIT** to return to the basic display. Returning to the menu is possible only by entering the correct PIN code.

When you want to turn off the PIN lock, go to the menu by giving the PIN code and select **System, Menu PIN,** press **OFF** button.

In case you have forgotten the PIN code, open the transmitter cover and press the **ADJ** button once. Wait for a few seconds and the adjustment menu opens. Select **Clear menu PIN**, press ▭ **CLEAR.**

NOTE	You can also disable the keypad completely with serial command **LOCK**. See section Locking Menu/Keypad Using Serial Line on page 111.

Factory Settings

Use the display/keypad to restore the factory settings. This operation does not affect the adjustments. Only settings available in the menus are restored.

1. Press any of the arrow buttons to open the **Main Menu**.
2. Select **System** by pressing the ▶ arrow button.
3. Select **Factory settings** and press the **REVERT** button to confirm your selection. Press the **YES** button to reset all settings to the factory defaults.

See section General Settings on page 99 for a description of the other menu options.

Configuring Display Alarms

The Display Alarm feature provides two independently configurable alarms for transmitters with the display/keypad option. Each alarm tracks a selected quantity, with freely configurable limit values. Each alarm also has a configurable hysteresis value to prevent unnecessary triggering when the measurement fluctuates around an alarm limit. The alarms can be configured for any quantity supported by the transmitter. The configuration of the Display Alarms can only be done using the display/keypad option.

You can have the alarm activate inside or outside the specified range by setting the limits correctly:

-   To have the alarm activate when the measured quantity is outside the specified range, set the **Act. above** limit higher than the **Act. below** limit.
-   To have the alarm activate when the measured quantity is inside the range, set the **Act. above** limit lower than the **Act. below** limit.

The alarm limits are shown on the graph display as thicker dotted lines. When a display alarm is activated, the automatic scaling of the graph display always keeps the limits in view.
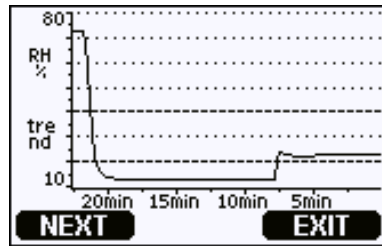
1102-012

Figure 47 **Alarm Limits Shown on Graph Screen**

When an alarm is activated, an alarm note is displayed on the display, and the lights of the display will blink. If the data logger module is installed, the alarm note includes the time and date of the alarm.
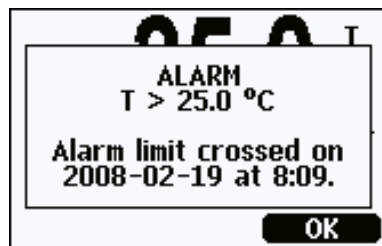
0802-041

Figure 48 **Display Alarm Active**

Multiple alarms can be active at the same time; the alarm that was triggered first will be shown on the display. The next active alarm is revealed when the currently shown alarm is acknowledged by pressing the **OK** button.

Activated alarms are only shown on the screen; there are no alarm messages output to the serial line. After an alarm has been acknowledged, you must refer to the data graphs to see when the measured quantities have exceeded the limits. You may use the optional relay outputs as alarm outputs by configuring them separately; see section Setting Relay Outputs on page 129.

Using Display/Keypad

1. Enter the **Main Menu** by pressing an arrow key on the keypad.
2. Use the arrow keys to select **Display**, followed by **Alarms,** to open the **Display Alarms** menu. The Display Alarms menu shows the currently enabled and disabled alarms.

0802-069

Figure 49   Display Alarms

3.   Use the arrow keys to select an alarm to configure. The alarm
     editing page opens.

NOTE	Changes you do on the alarm editing page will take effect immediately, and may cause an alarm to appear on the screen.

4.   To select a quantity for the alarm, press the **Change** button and
     select the quantity from the list.

5.   To modify or remove the alarm limit values, move the selection
     over the **Act. above** or **Act. below** field and press the **Set** button.
     You will be prompted to **Modify** or **Remove** the value.
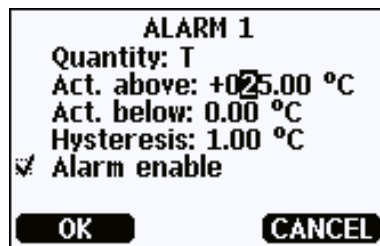
0802-070

Figure 50   Modifying an Alarm Limit

     When modifying the value, use the arrow up and down buttons to
     change the value under the cursor. Left and right arrow buttons
     move the cursor. Select the OK button to accept the modified
     value, or Cancel to undo the modification.

6.   Set a suitable **Hysteresis** value to prevent the alarm from being
     triggered unnecessarily by small measurement changes that pass
     the alarm limit repeatedly.

7.   Set or clear the **Alarm enable** checkbox to enable or disable the
     alarm.

8.   Press the **Exit** button to leave the alarm configuration screen and
     return to the basic view.

Using Serial Line

Use the serial line command **ALSEL** to view or set the display alarms.

ALSEL [quantity1 quantity2]<cr>

where

quantity1 = Quantity for display alarm 1. You can set any quantity
available on your transmitter; see Table 3 on page 19 and
Table 4 on page 19. In addition to quantities, you can also
select the following:

FAULT – Alarm for device errors
ONLINE – Alarm for sensor operations that freeze the
measurement output (for example, chemical purge).

quantity2 = Quantity for display alarm 2. Options are the same as for
quantity1.

Example (view current display alarm settings):

```
>alsel ?
Al1 RH    above: 80.00 %RH
Al1 RH    below: -
Al1 RH    hyst : 1.00 %RH
Al1 RH    enabl: ON
Al2 T     above: 40.00 'C
Al2 T     below: -
Al2 T     hyst : 1.00 'C
Al2 T     enabl: ON
>
```

Table 13   ALSEL Parameters

Name	Description
above	If specified, the alarm goes off when the quantity value rises above the exact value of this setpoint. However, if above < below, the alarm goes off at (above + hyst) and (below – hyst) instead. Cannot be set for fault and online alarms.
below	If specified, the alarm goes off when the quantity value decreases below the exact value of this setpoint. However, if above < below, the alarm goes off at (above + hyst) and (below – hyst) instead. Cannot be set for fault and online alarms.
hyst	Distance from setpoint amount of extra retraction needed in order to regenerate alarm on the next crossing of the setpoint. Cannot be set for fault and online alarms.
enabl	Enable (ON) or disable (OFF) the display alarm.

Example (set Tdf and T as display alarm quantities and configure the alarms as prompted):

```
>alsel tdf t
Al1 Tdf    above: 80.00 'C ? 0
Al1 Tdf    below: - ?
Al1 Tdf    hyst : 1.00 'C ?
Al1 Tdf    enabl: ON ?
Al2 T      above: 40.00 'C ? 30
Al2 T      below: - ?
Al2 T      hyst : 1.00 'C ?
Al2 T      enabl: ON ?
>
```

MI70 Link Program for Data Handling

MI70 Link is a support program that enables you to handle the measurement data of your Vaisala transmitter using a Windows PC. Using the MI70 Link you can, for example:

- Monitor the transmitter's measurement readings directly using the real-time window function.
- Transfer recorded data from the main transmitter memory in numeric or graphical format, for further use in a spreadsheet program (such as Microsoft Excel) or virtually any other application. Note that the maximum amount of data points that can be downloaded in one transfer is 65000.

To use the MI70 Link program, you must connect your Windows PC to the service port of the transmitter with a serial or USB cable. The MI70 Link program, and the optional connection cables, are available from Vaisala. See section Spare Parts and Accessories on page 178.

Follow the steps below to connect your transmitter and start using the MI70 Link:

1. Connect your PC to the service port of the transmitter. Refer to section Service Port Connection on page 81.
2. Check that the HMT330 is powered.
3. Start the MI70 Link program.
4. Start using the program. There is usually no need to select a COM port manually, the MI70 Link software can detect it automatically.

NOTE	For instructions on using the MI70 Link, see the program's online help.

Serial Line Communication

Connect the serial interface by using either the User Port or the Service Port.

For permanent interfacing to host system, use the User Port. You can change the serial settings and operate in RUN, STOP, SEND, POLL, and Modbus modes.

For temporary connections, use the Service Port. The Service Port is always available with fixed serial settings.
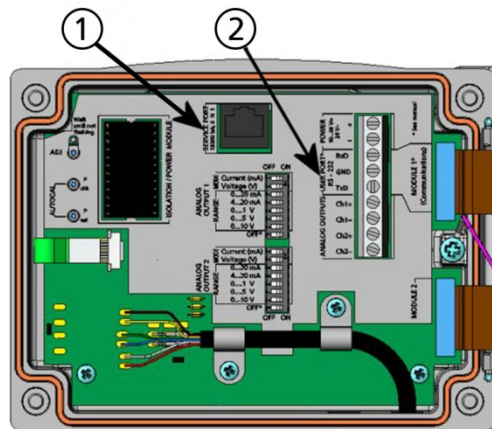
0605-039

Figure 51   Service Port Connector and User Port Terminal on Motherboard

The following numbers refer to Figure 51 above:

1   =   Service port connector
2   =   User port terminals

User Port Connection

Use a suitable serial cable between the user port RxD, GND and TxD
screw terminals and the PC serial port, see Figure 52 below.

Table 14   Default Serial Communication Settings for the User Port

Parameter	Value
Bauds	4800
Parity	Even
Data bits	7
Stop bits	1
Flow control	None
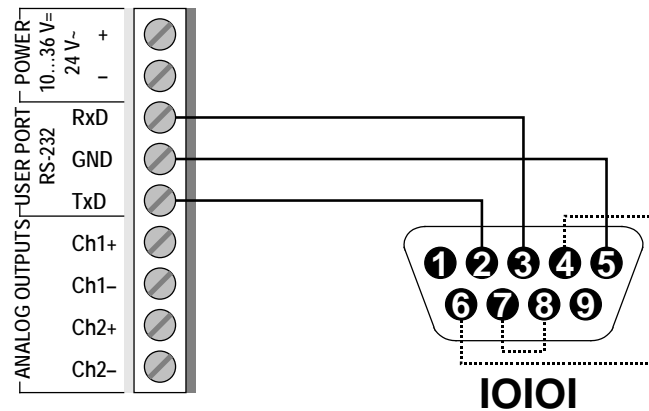
0506-033

**Figure 52   Connection Example between PC Serial Port and User
Port**

Connections to pins 4, 6, 7 and 8 on PC serial port are required only if
you are using software requiring hardware handshaking.

User Port Operating Modes

When the transmitter is powered up, it will behave according to its
configured operating mode:

- In STOP mode, the transmitter outputs the software version and the
  command prompt (if echo is on).

- In RUN mode a measurement output starts immediately.

- In SEND mode one measurement message is printed and command
  prompt is displayed (if echo is on).

- In POLL or Modbus mode, the transmitter does not output anything
  after power-up.

For a description of the modes, see section SMODE on page 114.

NOTE	RS-232 User Port cannot be used when a communication module (LAN, WLAN, or RS-422/485 interface) has been installed.

Service Port Connection

Connection Cables

To connect to the service port, you need a suitable cable with an RJ45 connector. Depending on the connections of your PC, you can either use the Serial Connection Cable (optional accessory 19446ZZ) or the USB-RJ45 Serial Connection Cable (optional accessory 219685). The USB cable enables you to connect the transmitter to a PC via a standard type A USB port. Note that the USB cable does not enable high speed data transfer, since the bit rate is limited by the serial interface of the service port.

Installing the Driver for the USB Cable

If you have not used the Vaisala USB cable before, install the driver before attempting to use the cable. When installing the driver, you must acknowledge any security prompts that may appear.

1. Check that the USB service 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 latest driver from www.vaisala.com.
3. Execute the USB driver installation program (setup.exe), and accept the installation defaults.
4. After the driver has been installed, connect the USB service cable to a USB port on your PC. 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.

Using the Service Port

1. Unfasten the screws on the transmitter cover, and open the transmitter.

2. Connect the desired cable (serial interface cable or USB cable) to your PC and the service port connector on the transmitter. For the location of the service port, refer to Figure 51 on page 79.

3. Open a terminal program and set the communication settings as follows:

    Table 15   Communication Settings for the Service Port

Parameter	Value
Bauds	19200
Parity	None
Data bits	8
Stop bits	1
Flow control	None

    For a detailed explanation of using a terminal program, see section Terminal Program Settings on page 90.

4. Power-up the HMT330.

LAN Communication

To enable LAN communication, a LAN or WLAN interface must be physically connected to the network, and the networking settings must be suitable for your network. For a description of interfaces, see sections LAN Interface on page 62 and WLAN Interface on page 63.

The LAN and WLAN interfaces both operate by accessing the serial interface (User Port) of the transmitter. All commands and protocols that are available using the serial interface are available through the LAN and WLAN interfaces; refer to section List of Serial Commands on page 93. For instructions on how to connect using a terminal program, see section Terminal Program Settings on page 90.

IP Configuration

The IP settings of the LAN and WLAN interfaces are described in Table 16. The current settings can be viewed on the serial line or using the device information display; see section Device Information on page 108.

Table 16   IP Settings for the LAN and WLAN Interfaces

Parameter	Description
Automatic configuration (DHCP)	If enabled, the transmitter will retrieve its network settings (including the IP Address) from a server in the network. If disabled, static network settings are used instead.
Web configuration	If enabled, the settings of the interface can be changed using a web browser. The configuration page can be accessed by browsing to the IP address of the transmitter.
IP Address	The four part network ID of the transmitter. Must be set manually if automatic configuration is not used. Example value: **192.168.0.222**
Netmask	Used together with the IP address to determine which network the transmitter is a part of. Must be set manually if automatic configuration is not used. A common netmask is **255.255.255.0**
Gateway	IP address of the server that enables the transmitter to access other networks. Must be set manually if automatic configuration is not used. Example value: **192.168.0.1**
MAC	The MAC address is the unique hardware address of the LAN or WLAN interface. Cannot be changed.

Using Display/Keypad

You can configure the IP settings of the LAN and WLAN interfaces using the display/keypad as follows:

1. Press any of the arrow buttons to open the **Main Menu**.
2. Press the ► arrow button to select **Interfaces**.
3. Press ► arrow button to select **Network settings**. There will be a delay as the transmitter refreshes the network information.
4. You are now in the **Network Interface** menu. Selecting the **IP configuration** option opens the IP configuration menu.

1102-015

Figure 53   Network Interface Menu

The **Network Interface** menu also allows you to configure the **Communication Protocol**, enable or disable the **Web configuration** option, or **Disconnect all** users that are currently accessing the LAN or WLAN interface.

5. In the IP configuration menu, select **Automatic configuration (DHCP)**, or enter the **IP address**, **Netmask** and **Gateway** manually. If automatic configuration is enabled, manual configuration cannot be done.
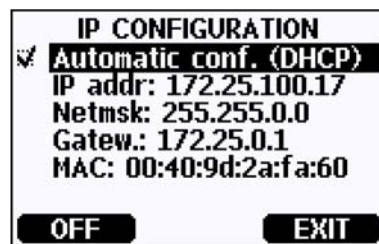
0709-004

Figure 54   IP Configuration Menu

To enter a value manually, use the ▲ ▼ arrow buttons to select the parameter to change, and press **Change**. A cursor will appear in the first digit. Move the cursor using the ◄► arrow buttons, and change the value under the cursor using the ▲ ▼ arrow buttons. Confirm the selection by pressing **OK**.

6. After configuring the desired parameters, press **EXIT** to apply the changes and return to the basic display.

Using Serial Line

Use the serial line command **NET** to view or set the network settings for the LAN and WLAN interfaces. You can also refresh the network information or disconnect all active connections.

NET [REFRESH] [DISCONNECT] [*DHCP WEB*] [*DHCP IP SUBNET GATEWAY WEB*]<cr>

where

REFRESH	=	Updates the network information and displays it
DISCONNECT	=	Disconnects all current sessions
DHCP	=	ON or OFF. Enables or disables the automatic IP configuration.
WEB	=	ON or OFF. Enables or disables the Web Configuration page.
IP	=	The four part network ID of the transmitter. Must be set manually if automatic configuration is not used.
SUBNET	=	Used together with the IP address to determine which network the transmitter is a part of. Must be set manually if automatic configuration is not used.
GATEWAY	=	IP address of the server that enables the transmitter to access other networks. Must be set manually if automatic configuration is not used.

Examples:

```
>net refresh
OK
DHCP            : OFF
IP address      : 192.168.0.101
Subnet mask     : 255.255.255.0
Default gateway: 192.168.0.1
Web config.     : OFF
MAC address     : 00:40:9d:2c:d2:05
Status          : Not connected
>

>net on off
DHCP            : ON
IP address      : 192.168.0.104
Subnet mask     : 255.255.255.0
Default gateway: 192.168.0.1
Web config.     : OFF
MAC address     : 00:40:9d:2c:d2:05
Status          : Connected
OK
>
```

```
        >net off 192.168.0.101 255.255.255.0 192.168.0.1 off
DHCP           : OFF
IP address     : 192.168.0.101
Subnet mask    : 255.255.255.0
Default gateway: 192.168.0.1
Web config.    : OFF
MAC address    : 00:40:9d:2c:d2:05
Status         : Connected
OK
>
```

Wireless LAN Configuration

The settings of the WLAN interface are described in Table 17. The current settings can be viewed on the serial line or using the device information display; see section Device Information on page 108.

- CCMP encryption is called **AES** in some networking products.
- The WLAN interface supports both WPA and WPA2 (also known as 802.11i) security when either WPA-PSK mode is selected.
- If your WLAN network is using some other security method than listed below, you must set up a temporary WLAN network with any of these settings and then use the web configuration to set WLAN security settings for the actual network. See section Web Configuration for LAN and WLAN on page 89.

Table 17   Wireless LAN Settings

Parameter	Description
SSID	The service set identifier (that is, network name) of the wireless network to connect to. 1 … 32 characters.
Security type	The security type of the wireless network. The options are: OPEN OPEN/WEP WPA-PSK/TKIP WPA-PSK/CCMP All other choices except OPEN require a security key; see below.
Security key	The encryption key or passphrase that is used with an encrypted network.

Using Display/Keypad

You can configure the Wireless LAN settings using the display/keypad as follows:

1. Press any of the arrow buttons to open the **Main Menu**.
2. Press the ► arrow button to select **Interfaces**.
3. Press the ► arrow button to select **Network settings**. There will be a delay as the transmitter refreshes the network information.
4. Press the ► arrow button to select **Wireless LAN settings**.
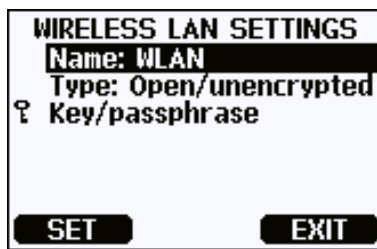
0802-111

Figure 55   Wireless LAN Settings

5. The **Name** entry on the page shows the SSID of the currently selected wireless network. To change the SSID, press the **SET** button. Use the ▲ ▼ arrow buttons to change the character under the cursor, and ◄► arrow buttons to more the cursor. Press the **OK** button when done.
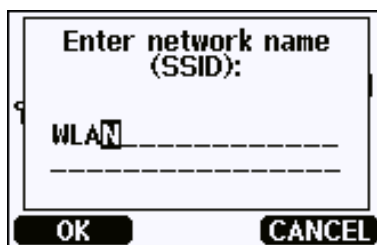
0802-110

Figure 56   Entering Network SSID

6. To change the currently selected Network type, select the **Type** entry and press the **Change** button. Select the new type from the list and press the **Select** button.
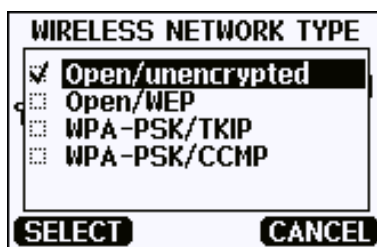
0802-112

Figure 57   Selecting the Wireless Network Type

7. If you have selected an encrypted network type (WEP or WPA), you must enter the security key to be used. Select the **Key/passphrase** entry and press the **Set** button. Enter the key in the same way as the SSID, and press the **OK** button. With the WEP encryption you must enter the encryption key in hexadecimal (10 hexdecimals for 64-bit encryption or 26 hexadecimals for 128-bit encryption). A WPA key must be 8 … 63 ASCII characters.

8. After setting the wireless network parameters, press the **Exit** button in the **Wireless LAN Settings** menu. You will be asked to confirm the new settings. Note that when new settings are saved, all currently active WLAN connections are disconnected.

Using Serial Line

Use the serial line command **WLAN** to view or set the wireless network settings. If you set an encrypted network type, you will be asked to enter the security key. With the WEP encryption you must enter the encryption key in hexadecimal (10 hexdecimals for 64-bit encryption or 26 hexadecimals for 128-bit encryption) or with plain ASCII characters (5 characters for 64-bit encryption or 13 characters for 128-bit encryption). A WPA key must be 8 … 63 ASCII characters.

WLAN [*SSID TYPE*]<cr>

where

SSID   =   Network name in 1 … 32 characters
TYPE   =   Security type of the wireless network. The options are:

            OPEN
            OPEN/WEP
            WPA-PSK/TKIP
            WPA-PSK/CCMP

Examples:

```
>wlan ?
Network SSID   : WLAN-AP
Type           : OPEN
>

>wlan accesspoint wpa-psk/tkip
Network SSID   : accesspoint
Type           : WPA-PSK/TKIP
WPA-PSK phrase ? thequickbrownfox
Save changes (Y/N) ? y
OK
>
```

Communication Protocol

When a connection is established via the LAN or WLAN interface, the session has the same communication mode, run interval, poll address and echo settings as the serial port (User Port) session would have.

These settings can be changed using the display/keypad, using the serial line (User Port or Service Port), or on-the-fly during a Telnet session.

The display menu path to the Communication Protocol settings is: **Main Menu ► Interfaces ► Network Interface ► Communication Protocol**.

The commands for changing the settings are **SMODE**, **INTV**, **ADDR**, and **ECHO**.

Web Configuration for LAN and WLAN

The LAN and WLAN interfaces both have a web configuration page that is accessible using a browser. If you have not disabled the page from the network settings, you can access it with a web browser at the IP address of the interface. You can check the currently assigned IP address of the interface from the device information screens (see Device Information on page 108), or from the serial line by issuing the **net ?** command.

When accessing the web configuration page, you must first log in.

Username: **user**
Password: **vaisala**

The web configuration page provides similar network configuration options as the serial line and the display/keypad. It also has additional options for advanced users. For example, there are more options for securing the wireless network.

If these additional options are used, they will appear as custom configurations when viewed from the serial line or the display/keypad.
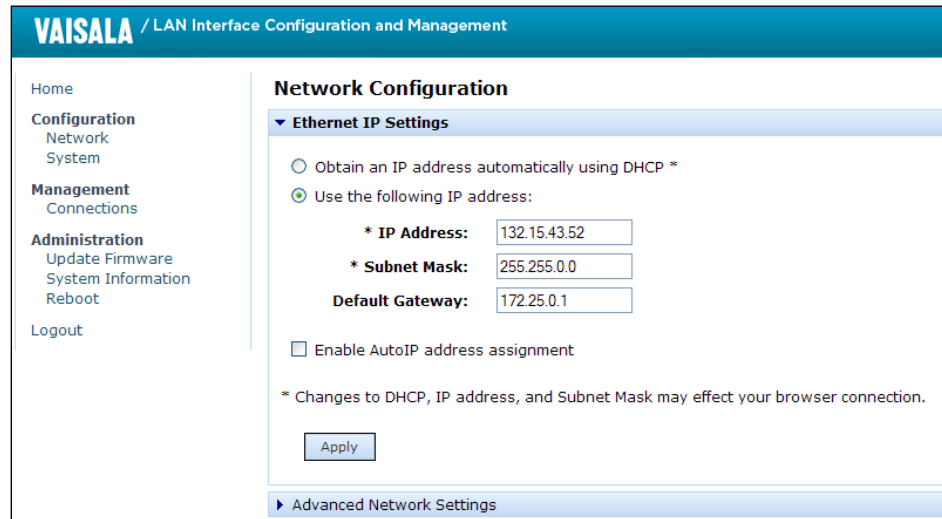
1102-017

Figure 58   Web Configuration Interface for LAN

Terminal Program Settings

The instructions below describe how to connect to the HMT330 using the PuTTY terminal application for Windows. Perform the necessary cabling and configuration of the transmitter before following the instructions.

PuTTY is available for download at www.vaisala.com.

NOTE	PuTTY cannot be used to access the transmitter through the User Port if the transmitter is configured to use the Modbus protocol. However, you can always use PuTTY to access the transmitter through the Service Port.

Opening a Serial/USB connection

1. Power up the HMT330 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. The default settings (shown in Figure 59 on page 91) are used by the Service Port of the HMT330.
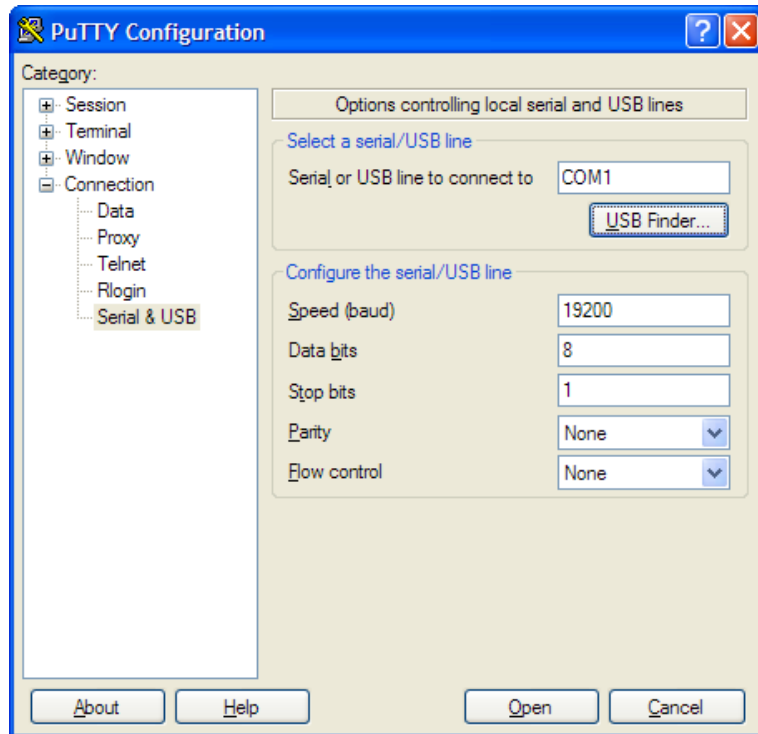
0810-070

Figure 59   Opening a Serial Connection

4.   Click the **Open** button to open the connection window and start
      using the serial line.

      If PuTTY is unable to open the serial port you selected, it will show
      you an error message instead. If this happens, restart PuTTY and
      check the settings.

Opening a Telnet session (LAN/WLAN)

NOTE	The instructions below assume that the LAN/WLAN interface on the transmitter is correctly configured and the network connection is already done.

1.   Power up the instrument and start the PuTTY application. If your
      transmitter acquires a network address using DHCP, wait for a
      minute for this to complete, then verify the address from the
      transmitter.

2.   In the Session window, select the **Telnet** connection type.

3.   Enter the IP address of your transmitter in the **Host Name (or IP
      address)** field. Use the default Telnet port **23**.
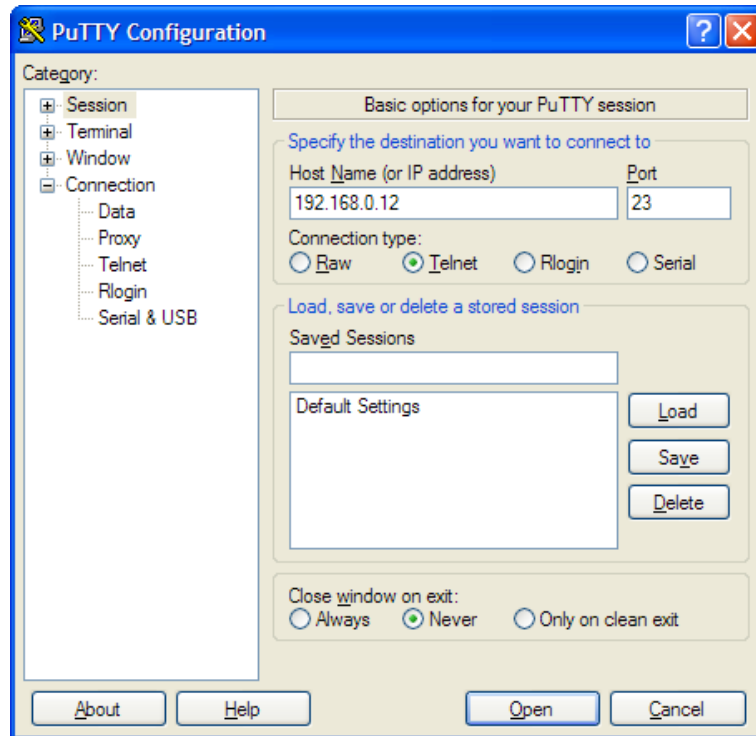
0810-071

Figure 60   Opening a Telnet Connection

4.   Click the **Open** button to open the connection window and start using the Telnet session.

   If PuTTY is unable to connect the IP address you entered, it will show you an error message instead. If this happens, check the IP address and the connections, restart PuTTY, and try again.

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 18   Measurement Commands

Command	Description
R	Start the continuous outputting
S	Stop the continuous outputting
SEND [0 ... 255]	Output the reading once
DSEND	Output the reading once from all connected transmitters (in STOP or POLL mode)

Table 19   Communication Commands

Command	Description
INTV [**0** ... 255 **S**/MIN/H]	Set the continuous output interval (for RUN mode)
SMODE [**STOP**/SEND/RUN/ POLL/MODBUS]	Set the serial interface mode
SDELAY	View or set user port (RS232 or RS485) answer minimum delay
SERI [baud p d s]	User Port settings (Default: 4800 E 7 1) baud: 300 ... 115200
ADDR [**0** ... 255]	Set the transmitter address (for POLL and MODBUS modes)
NET	View or set networking parameters for LAN and WLAN interfaces
WLAN	View or set wireless network parameters for WLAN interface
OPEN [**0** ... 255]	Open a temporary connection to a POLL mode device
CLOSE	Close the temporary connection (Back to POLL mode)

Table 20   Formatting Commands

Command	Description
FORM	Set the output format of SEND and R commands
TIME	Set the time
DATE	Set the date
FTIME [ON/**OFF**]	Add time to SEND and R outputs
FDATE [ON/**OFF**]	Add date to SEND and R outputs
FST [ON/**OFF**]	Add the state of probe heating and chemical purge in connection with SEND and R commands
SCOM	Assign a new command name that works like the SEND command
UNIT	Select the metric or non-metric output units

Table 21   Data Recording Commands

Command	Description
DIR	Display recorded files
PLAY [0 ... 28] [START END]	Output recorded data file. Start and end times can only be specified if the data logger module is installed. The times must be given in the following format: yyyy-mm-dd hh:mm:ss
DSEL	Select data recording and display quantities (1 ... 4).
DELETE	Delete all data files, including the memory of the optional data logger module
UNDELETE	Recover the deleted files that have not been overwritten

Table 22   Chemical Purge Commands

Command	Description
PUR	Set the automatic chemical purge
PURGE	Start the manual chemical purge
RGLIMIT [ON/**OFF**]	Prevent chemical purge if sensor temperature is below 0 °C

Table 23   Calibration and Adjustment Commands

Command	Description
CRH	Relative humidity calibration
CT	Temperature calibration
CTA	Additional temperature probe calibration
FCRH	Relative humidity calibration after sensor change
CTEXT	Give the text to calibration information field
CDATE	Set the calibration date
ACAL	Analog output calibration
MPC	Multipoint relative humidity calibration

Table 24   Setting and Testing the Analog Outputs

Command	Description
AMODE	View the analog output modes
ASEL	Select the parameters for the analog outputs
ITEST	Test the analog outputs
AERR	Change the analog error output values
AOVER [ON/**OFF**]	Extend analog output range by 10%

Table 25   Setting and Testing the Relays

Command	Description
RSEL	Set and view the relays
RTEST	Test the relays

Table 26   Other Commands

Command	Description
?	Output information about the device
??	Output information about the device in POLL mode
ALSEL	Set display alarms
CON	Set display contrast
ECHO [**ON**/OFF]	Turn the serial interface echo ON/OFF
ERRS	List present transmitter errors
FILT	Set the result filtering
FIND	All devices in POLL mode send their addresses
HELP	List the currently available commands
LIGHT	Set the display backlight mode
LOCK	Lock the menu or disable the keypad
MODBUS	View Modbus diagnostic counters
MODS	View information about connected modules
PRES [hPa]	Set the value for pressure compensations
RHLIMIT [ON/**OFF**]	Limit highest value of RH output to 100%
VERS	Display the software version information
XHEAT	Sensor heating
XPRES [hPa]	Set the value for pressure compensations, temporarily

Getting Measurement Message from Serial Line

Starting Continuous Outputting

Use the **R** command to start the continuous output of measurements.

R<cr>

The default output format depends on the quantities your transmitter supports. You can change the output message format and interval with the FORM and INTV commands. See sections FORM on page 101 and INTV on page 115.

Example:

```
>r
RH= 60.5 %RH T= 23.7 'C Tdf= 15.6 'C Td= 15.6 'C a= 13.0
g/m3   x=  11.1 g/kg  Tw= 18.5 'C H2O= 17889 ppmV pw=
17.81 hPa pws=  29.43 hPa h=  52.3 kJ/kg  dT=  8.1 'C
```

If a value is too long to fit to the allocated space in the output, or if there is an error in outputting the quantity, the value is displayed with stars '*'.

Example:

```
>r
RH=***.* %RH T= 31.0 'C
```

Stopping Continuous Outputting

Use the **S** command to end the RUN mode. After this command all other commands can be used. You can also press the Esc button or reset the transmitter to stop the outputting.

S<cr>

See command **SMODE** to change the default (power-up) operation mode.

Outputting Reading Once

Use the **SEND** command to output the reading once in STOP mode.

SEND<cr>

Examples:

```
>send
RH= 98.4 %RH T= 31.1 'C
```

```
>send
RH= 98.4 %RH T= 31.1 'C Td= 36.0 'C Tdf= 36.0 'C a= 42.4
g/m3  x=  38.8 g/kg  Tw= 30.8 'C ppm= 62414 pw=  59.53 hPa
pws=  60.52 hPa h= 130.7 kJ/kg
```

Assign an Alias for the SEND Command

Use the **SCOM** command to assign a new command that works like the **SEND** command. The standard **SEND** command of the transmitter will always function normally whatever the **SCOM** definition may be. Command names are case-insensitive.

SCOM<cr>

Example (assigning the command **MEASURE** as an alias for the **SEND** command):

```
>scom
Send command  :   ? measure
>measure
RH= 23.8 %RH T= 21.4 'C
>
```

You can remove the **SCOM** definition by pressing **Esc** when entering the command name:

```
>scom
Send command  : measure ? <esc>
>
```

Outputting Reading Once From All Transmitters

Use the **DSEND** command to output the reading once from all connected transmitters that are in STOP or POLL modes. In order to avoid data collisions, the transmitters will send their response after a suitable delay. The response includes the transmitters's address, followed by their measurement message.

NOTE	The total execution time of the **DSEND** command depends on the bit rate of the serial port connection. At slow speeds, it will take a considerable amount of time for devices with large address number to respond. The delay will be the same even if there are no other devices at all.

DSEND<cr>

Example (transmitters with addresses 3 and 25 responding):

```
>dsend
  3 RH= 98.4 %RH T= 31.1 'C
 25 RH= 71.1 %RH T= 34.0 'C
>
```

Communicating with a Transmitter in POLL Mode

OPEN

When all transmitters on the RS-485 bus are in POLL mode the **OPEN** command sets one transmitter temporarily to STOP mode so that other commands can be entered.

OPEN [*aa*]

where

aa   =   Address of the transmitter (0 ... 255)

CLOSE

The **CLOSE** command switches the transmitter back to the POLL mode.

Example:

```
>OPEN 2     (opens the line to transmitter 2, other
transmitters stay in POLL mode)

>CRH        (for example, calibration performed)
...
>CLOSE      (line closed)
```

Formatting Serial Line Message

<table>
<tr><td>NOTE</td><td>Instead of using the FTIME, FDATE and FST commands described in this section, you can use the FORM command with modifiers TIME, DATE, and STAT. See section FORM on page 101.</td></tr>
</table>

FTIME and FDATE

FTIME and **FDATE** commands will enable/disable output of time and date to the serial line. To add time to **R** and **SEND** outputs enter:

FTIME [*x*]<cr>

To add date to **R** and **SEND** outputs enter:

FDATE [*x*]<cr>

where

x   =   ON or OFF

Examples:

```
>send
RH= 98.4 %RH T= 31.0 'C
>ftime on
Form. time    : ON
>send
03:47:59 RH= 98.4 %RH T= 31.0 'C
>fdate on
Form. date    : ON
>send
2004-07-05 03:48:03 RH= 98.4 %RH T= 31.0 'C
>
```

FST

To output the state of optional probe heating and chemical purge in connection with **SEND** and **R** commands enter:

FST [*x*]<cr>

where

x = ON or OFF (default)

Examples:

```
>fst on
Form. status   : ON
```

```
>send
N    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
S  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
>
```

where the state of the probe is indicated by the following letters and values:

N ... xxx	=	Normal operation	where h xxx	=	Probe heat power
X ... xxx	=	Sensor heating	where xxx	=	Sensor temperature (ºC)
H ... xxx	=	Chemical purge	where xxx	=	Sensor temperature (ºC)
S ... xxx	=	Sensor cooling after purge	where xxx	=	Sensor temperature (ºC)

For more information on chemical purge, see section Chemical Purge (Optional) on page 133.

General Settings

Changing Quantities and Units

To change quantities and units use serial commands or the optional display/keypad. See Table 3 on page 19 for available quantities and Table 4 on page 19 for optional quantities.

NOTE	Only the quantities selected when ordering the device can be selected as display output quantities.

Using Display/Keypad

Use display/keypad to select the display output quantities.

1. Press any of the arrow buttons to open the **Main Menu**.
2. Press the ► arrow button to select **Display**.
3. Press ► arrow button to select **Quantities**.
4. Select the quantity by using the ▲▼ arrow buttons. Confirm the selection by pressing **SELECT**. You can select 1 ... 4 display quantities at a time.
5. Press **EXIT** to return to the basic display.

To select display units:

1. Press any of the arrow buttons to open the **Main Menu**.
2. Press the ► arrow button to select **Display**.
3. Use the ▲▼ arrow buttons to select **Units**. Confirm the selection by pressing the right-hand arrow button.
4. Use the ▲▼ arrow buttons to select display units. Confirm the selection by pressing **CHANGE**. The unit changes from metric to non-metric or the other way round.
5. Press **EXIT** to return to the basic display.

NOTE	Changing the display quantities/units (by using the display/keypad) has no effect on the serial output data.

Using Serial Line

Use the serial line command **FORM** to change the format, and the command **UNIT** to select metric or non-metric output units.

FORM

Use the serial line command **FORM** to select the output quantities and format for serial line measurement messages.

FORM [*x*]<cr>

where

x = Formatter string

The formatter string consists of quantities and modifiers. If no formatter string is entered, the command will display the currently active formatter string. Note that the hash symbol "#" is shown as a backslash "\" when viewing the current formatter string.

Example:

```
>form
3.1 "RH=" RH " " U4 3.1 "T=" T " " U3 3.1 "Tdf=" Tdf " " U3
3.1 "Td=" Td " " U3 3.1 "a=" a " " U7 4.1 "x=" x " " U6 3.1
"Tw=" Tw " " U3 6.0 "H2O=" H2O " " U5 4.2 "pw=" pw " " U4
4.2 "pws=" pws " " U4 4.1 "h=" h " " U7 3.1 "dT=" dT " " U3
\r \n
>
```

When entering the command, use the abbreviations of the quantities. For more information on quantities, see Table 3 and Table 4 on page 19.

The modifiers are presented in Table 27 on page 102.

Table 27   FORM Command Modifiers

Modifier	Description
x.y	Length modifier (number of digits and decimal places)
#t	Tabulator
#r	Carriage-return
#n	Line feed
""	String constant
#xxx	Special character, code "xxx" (decimal), for example #027 for ESC
U5	Unit field and length (length optional)
ADDR	Transmitter address [00...255]
ERR	Error flags for P, T, Ta, RH [0000 ... 1111], 0 = no error
STAT	Transmitter status in 7 character field, for example: N 0 no heating h 115 probe heating active, power 115/255 H 159.0 purge heating active, temperature 159ºC S 115.0 purge cooling active, temperature 115ºC X 95.0 sensor heating active, temperature 95ºC
SN	Transmitter serial number
TIME	Time [hh:mm:ss]
DATE	Date [yyyy-mm-dd]
CS2	Modulus-256 checksum of message sent so far, ASCII encoded hexadecimal notation
CS4	Modulus-65536 checksum of message sent so far, ASCII encoded hexadecimal notation
CSX	NMEA xor-checksum of message sent so far, ASCII encoded hexadecimal notation

Examples:

```
>form "RH=" 4.2 rh U5 #t "T=" t U3 #r #n
OK
>send
RH=  16.03%RH   T=  74.66'F


>form "Tfrost=" tdf U3 #t "Temp=" t U3 #r#n
OK
>send
Tfrost=   36.0'C        Temp=   31.0'C
>
```

Command '**FORM /**' will return the default output format. The default output format depends on the device configuration.

```
>form /
OK
>send
RH= 98.4 %RH T= 31.1 'C
>
```

UNIT

Use the **UNIT** command to select metric or non-metric output units, and change the unit for the H2O quantity:

UNIT [*x*]<cr>

where

x   =   Unit system to be used. Options are:
          M (metric units)
          N (non-metric units)

UNIT H2O [y]<cr>

where

y   =   Unit to be used for H20. Options are:
          PPMV (parts per million by volume)
          PPMW (parts per million by weight)

NOTE	This command changes both the serial output and display units. When you want to output both metric and non-metric units simultaneously on the display, select the display units later by using the display/keypad.

Examples:

```
>unit m
Output units  : metric
>

>unit h2o ppmv
H2O units     : ppmV
>
```

Pressure Compensation Setting

The pressure has an effect on humidity calculations and accuracy. Therefore, accurate calculations can be achieved only when the process pressure is taken into consideration.

Note that conversions from mmHg and inHg are defined at 0°C and for mmH$_2$O and inH$_2$O at 4°C.

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

Using Display/Keypad

Use display/keypad to set the pressure compensation. To select the pressure unit using display/keypad, see section Changing Quantities and Units on page 100.

1. Press any of the arrow buttons to open the **Main Menu**.
2. Select **Measuring** and press the ▶ arrow button to confirm your selection.
3. Select Pressure compensation and press the ▶ arrow button to confirm you selection.
4. Press **SET** and enter the pressure value in the chosen unit by using the arrow buttons.
5. Press **OK** and **EXIT** to return to the basic display.

Using Serial Line

PRES and XPRES

Command **XPRES** must be used if the value is changed frequently (for example, by an automatic system that updates the value). Its value is not retained at reset, and when set to 0; last value set with **PRES** is used instead. Use the serial line and do the following:

PRES [*aaaa.a*]<cr>

XPRES [*aaaa.a*]<cr>

where

aaaa.a = Absolute process pressure (hPa)

Example:

```
>pres
Pressure       : 1013.00 hPa ?
>pres 2000
Pressure       : 2000.00 hPa
>
```

Table 28   Conversion Factors for Pressure Units

From	To: hPa
mbar	1
Pa N/m2	0.01
mmHg torr	1.333224
inHg	33.86388
mmH$_2$O	0.09806650
inH$_2$O	2.490889
atm	1013.25
at	980.665
bar	1000
psia [1]	68.94757

1) psia = psi absolute.

For example, 29.9213 inHg = 29.9213 × 33.86388 = 1013.25 hPa.

Limit RH Output Range

Use the serial line command **RHLIMIT** if you want to strictly limit the allowed value of the relative humidity (RH) quantity to range 0 ... 100%. The limit is implemented on all outputs and the display. Other quantities are not affected, only RH. Note that seeing values above 100 %RH is useful for detecting condensation on the sensor, and possible measurement drift in very high humidities. For this reason, Vaisala recommends leaving this feature at the default setting (off).

RHLIMIT [*ON/OFF*]<cr>

where

ON   =   Allowed range of RH output is 0 ... 100 %.
OFF =   Allowed range of RH output is -5 ... 110 % (default).

Example (view current setting):

```
>rhlimit ?
RH limit 0...100: OFF
>
```

Example (enable RH limit):

```
>rhlimit on
RH limit 0...100: ON
>
```

Date and Time

Using Display/Keypad

If the optional Data Logger Module is installed, you can change the time and date using the display/keypad.

1. Press any of the arrow buttons to open the **Main Menu**.
2. Select **System** and press the ► arrow button to confirm your selection.
3. Select **Date and time** and press the ► arrow button.
4. Press the **SET** button to enter the adjustment mode, and use the arrow buttons to select and change the values.
5. You can also change the date and time formats that are shown in the graphs. The selected formats are only used in graphical display, they do not change the formats that are used in the serial communication.
6. Press **EXIT** to return to the basic display.

Using Serial Line

To set time enter the **TIME** command. To set date enter the **DATE** command.

TIME<cr>

DATE<cr>

These time and date settings are shown on the timestamps of **PLAY** command. When you want to include time and date in the **R** and **SEND** commands, use the **FTIME** and **FDATE** commands.

Example:

```
>time
Time            : 13:42:49 ?

>date
Date            : 2007-05-31 ?
```

NOTE	If the optional Data Logger Module is not installed, time and date available on the serial ports (only) are cleared to 2000-01-01 00:00:00 at reset or at power failure.

Data Filtering

The averaging data filter calculates an average over a certain period of time. The lowest measurement noise is achieved with the extended filtering. There are three filtering levels available.

Table 29   Filtering Levels

Setting	Filtering Level
OFF	No filtering (default setting).
STANDARD	Standard filtering. Approximately 13 s moving average.
EXTENDED	Extended filtering. Approximately 1 min average by default, but configurable on the serial line.

Using Display/Keypad

1. Press any of the arrow buttons to open the **Main Menu**.
2. Select **Measuring** by pressing the ► arrow button.
3. Select **Filtering** and press **CHANGE** to confirm your selection.
4. Select **Off/Standard/Extended** and press **SELECT** to confirm your selection.
5. Press **EXIT** to return to the basic display.

Using Serial Line

Use the serial line command **FILT** to set the filtering level.

FILT [*level*] [*extfactor*]<cr>

where

level   = Filtering level. The options are:

OFF (no filtering, default setting)
ON (standard filtering, approximately 13 s moving average)
EXT (extended filtering, approximately 1 min average by default but configurable by changing the extfactor)

extfactor = Weighted average factor for extended filtering level. Range 0 ... 1, default 0.030.

In extended filtering mode, the output is calculated based on the following formula:
[(new result * extfactor) + (old result * (1.0 - extfactor))]
This means that with extfactor value 1 the transmitter will take only the latest measurement into account, but with extfactor value 0.1 a new output is a combination of the previous output (90%) and the latest measurement (10%).

Example (enable standard filtering):

```
>filt on
Filter        : ON
>
```

Device Information

Use the display/keypad or the serial line to display the device information.

Press the **INFO** button in the basic display to see the following information:

- Current sensor operation (for example, chemical purge), if any, in progress
- Present or past unacknowledged errors, if any
- Device information
- Current date and time (only shown if data logger module installed)
- Adjustment information fed by the user
- Measuring settings
- Information on chemical purge settings (when applicable)
- Display Alarm settings
- Serial interface information
- Network settings and status of the LAN and WLAN interfaces
- Analog output information
- Relay output information (when applicable)


```
SERIAL INTERFACE
Port type: RS-232
19200 b/s, 8 N 1
Protocol: STOP
Echo is on.
MORE              OK
```
1103-064

Figure 61   Device Information on Display

Proceed in the information views by pressing the **MORE** button repeatedly until you get the desired information. You can browse through the information displays also with arrow buttons. Press **OK** to return to the basic display.

?

Use the serial line command **?** to check the current transmitter configuration. Command **??** is similar but can also be used if the transmitter is in POLL mode.

Example:

```
>?
HMT330 / 5.10.0
Serial number  : D1140055
Batch number   : D0750008
Adjust. date   : 2010-12-17
Adjust. info   : Helsinki / FIN
Date           : 2011-02-09
Time           : 09:29:35
Serial mode    : STOP
Baud P D S     : 19200 N 8 1
Output interval: 10 s
Address        : 0
Echo           : ON
Pressure       : 1013.25 hPa
Filter         : OFF
Module 1       : LOGGER-1       (1024 MB; HW: B; SW: 3)
Module 2       : not installed
>
```

LIGHT

Use the **LIGHT** command to view or set the backlight mode of the display (optional). Issuing the command without specifying a mode shows the current backlight mode.

LIGHT [*mode*]<cr>

where

mode = Operating mode of the display backlight. The options are:

ON (backlight always on)
OFF (backlight always off)
AUTO (backlight automatically turns on and off when keypad is used)

Example:

```
>light
Backlight       : OFF
>light auto
Backlight       : AUTO
>
```

HELP

Use the **HELP** command to list the currently available commands. The available commands are determined by the device configuration and installed options.

Example:

```
>help
?          ACAL       ADDR       AERR       ALSEL
ASEL       CDATE      CLOSE      CON        CRH
CT         CTEXT      DATE       DELETE     DIR
DSEL       DSEND      ECHO       ERRS       FCRH
FILT       FORM       HELP       INTV       ITEST
LIGHT      LOCK       MODBUS     MODS       PLAY
PRES       R          RESET      SCOM       SDELAY
SEND       SERI       SMODE      SYSTEM     TEST
TIME       UNDELETE   UNIT       VERS       XPRES
>
```

ERRS

Use the **ERRS** command to display transmitter error messages, see Table 33 on page 152.

Example (no active errors):

```
>errs
No errors
>
```

Example (showing active error):

```
>errs
Error: E2  Humidity sensor open circuit.
>
```

MODS

Use the **MODS** command to display information about the optional modules that are connected to the transmitter.

Example:

```
>mods
Module 1        : WLAN-1 (POST: release_82000941_J; FW:
Version 82000977_K1 10/16/2008)
Module 2        : LOGGER-1       (1024 MB; HW: B; SW: 5)
>
```

VERS

Use the **VERS** command to display software version information.

Example:

```
>vers
HMT330 / 5.10
>
```

Resetting Transmitter Using Serial Line

RESET

This command resets the device. The user port switches to start-up output mode selected with command **SMODE**.

Locking Menu/Keypad Using Serial Line

LOCK

Use the **LOCK** command to prevent the user from entering the menu using the keypad, or to lock the keypad completely. You can optionally set a 4-digit PIN code, for example 4444.

If a PIN code has been set, the user will be prompted to enter the code when trying to access the menu. Entering the code correctly will disable the lock until the user returns back to the basic view.

LOCK [*x*] [*yyyy*]<cr>

where

x　　=　Keypad locking level, range 0...2. The options are:
　　　　　0 - No lock (enables full access)
　　　　　1 - Menu locked, but graphs are accessible
　　　　　2 - Keypad completely disabled
yyyy =　4-digit PIN code. The code can only be set when keypad locking level is 1.

Examples:

```
>lock 1 4444
Keyboard lock  : 1 [4444]
>
```

```
>lock 1
Keyboard lock  : 1
>
```

Serial Output Settings

The communication settings for the user port can be changed via the serial line or by using the optional display/keypad. The communication settings for the service port are fixed and not changeable.

NOTE	If a communication module (LAN, WLAN, or RS-422/485 interface) has been installed, the user port is not accessible. Any changes to the settings are applied to the interface provided by the module, if applicable.

Using Display/Keypad

1. Press any of the arrow buttons to open the **Main Menu**.
2. Select **Interfaces** and press the ►arrow button to confirm your selection.
3. Select **Serial interface** and press the ►arrow button to confirm your selection.
4. Select **Bit rate** and **Serial format** by pressing the **CHANGE** button. Use the ▲▼ arrow buttons to select and press **SELECT** to confirm your selection.
5. Select the **Protocol** to be used by the serial output by pressing the **CHANGE** button. Select the option using the ▲▼ arrow buttons and press **SELECT.** This is the same serial mode setting that is changed by the **SMODE** serial command.
   - **RUN** mode continuously outputs the measurement message at the set interval. If you select the RUN mode, set the desired **RUN interval** also.
   - **POLL** mode enables multiple transmitters to share the same RS-485 line. If you select the POLL mode, select the **Device address** also, as each transmitter on the line must have an unique address.
   - In **STOP** mode, transmitter outputs the transmitter software version at reset or power-up and remains silent, waiting for commands.
   - The **SEND** mode is almost identical to the STOP mode. The only difference is that the transmitter outputs a measurement message at start-up, instead of software version.
   - In **MODBUS** mode, only Modbus protocol communication is available. See Chapter 5, Modbus, on page 141.
6. Select the **RUN interval** and the unit. Press **OK** to confirm.
7. Select the **Device address** and press **SET** to confirm.
8. Select **ECHO,** and press **ON** to turn to it on, **OFF** to turn it off.
9. Press **EXIT** to return to the basic display.The new user port settings set using the display/keypad are effective immediately.

Using Serial Line

NOTE	You can use the serial commands to change/view the user port settings even if you are currently connected to the service port.

SERI

Use the **SERI** command to set the communication settings for the user port. Changed settings will be activated at next reset or power up.

SERI [*b p d s*]<cr>

where

b   =   Bit rate (110, 150, 300, 600, 1200, 2400, 4800, 9600,19200, 38400, 57600, 115200)
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 (changing all parameters):

```
>SERI 600 N 8 1
600 N 8 1
>
```

Example (changing parity only):

```
>SERI O
4800 O 7 1
```

SMODE

Use the **SMODE** command to set the user port start-up operating mode.

SMODE [*xxxx*]<cr>

where

xxx =   STOP, SEND, RUN, POLL, or MODBUS.

Table 30   Selection of Output Modes

Mode	Measurement Output	Available Commands
STOP	Only with the **SEND** command.	All (default mode).
SEND	One measurement message automatically at start-up, then only with the **SEND** command.	All.
RUN	Automatic output.	Only command **S.**
POLL	Only with the **SEND** [*addr*] command.	**SEND** [*addr*] and **OPEN** [*addr*]. Other commands available after opening a line to the transmitter using the **OPEN** command. Use with RS-485 buses where multiple transmitters can share the same line.
MODBUS	Must be read from the transmitter using Modbus protocol.	Modbus protocol only; see Chapter 5, Modbus, on page 141.

Selected output mode will be activated at next reset or power up.

ADDR

Use the **ADDR** command to set the device address of the transmitter. Addresses are required for POLL mode and MODBUS mode (serial Modbus).

ADDR [*aa*]<cr>

where

aa   =   Device address of the transmitter, range 0 ... 255 (default = 0)

Example (changing the transmitter address from 0 to 52):

```
>addr
Address       : 0 ? 52
>
```

INTV

Use the **INTV** command to set the RUN mode output interval. The time interval is used only when the RUN mode is active. Setting the interval to zero enables the fastest possible output rate.

INTV [*xxx yyy*]<cr>

where

xxx = Delay, range 0 ... 255.
yyy = Unit: S, MIN or H.

Example (setting the output interval to 10 minutes):
```
>intv 10 min
Output interval: 10 min
>
```

SDELAY

With the **SDELAY** command you can set delay (response time) for user port, or view currently set delay value. Adjusting the delay may be needed when half-duplex communication (typically two-wire RS-485) is used.

The delay value corresponds to tens of milliseconds (for example, 5 = 0.050s minimum answer delay). The value can be set between 0 ... 254.

Example:

```
>sdelay
Serial delay   : 0 ? 10

>sdelay
Serial delay   : 10 ?
```

ECHO

Use the **ECHO** command to set the user port echo. The command either enables or disables echo of characters received.

ECHO [*x*]<cr>

where

x = ON (enabled, default) or OFF (disabled)

NOTE	When using the RS-485 interface with a 2-wire connection, always disable echo. When using a RS-232, RS-422/485 4-wire connection, LAN, or WLAN, you can enable or disable it as you wish.

Data Recording

Data recording function is always on and collects data automatically into the memory of the device. If the optional data logger module is installed, the transmitter uses it automatically. Recorded data does not disappear from the memory when the power is switched off. Collected data can be observed in a form of a graph in the graphical view of the display or it can be listed out by using the serial line or MI70 Link program.

Selecting Data Recording Quantities

If the device is provided with the optional display, the recorded quantities are always those selected for the display. Up to four quantities can be recorded at a time. For instructions on how to select the display quantities with the keypad, see section Changing Quantities and Units on page 100.

DSEL

Use the serial line command **DSEL** to select the quantities to be recorded if the transmitter is not equipped with display/keypad.

DSEL [*xxx*]<cr>

where

xxx =   Data recording quantity. See Table 3 on page 19 and Table 4 on page 19 for the quantities.

Example:

```
>dsel rh t tdf
 RH T Tdf
>
```

Enter the command without parameters and press **ENTER** to display the current recording parameters.

View Recorded Data

If the device is provided with the optional display, the graphical display shows the data of the selected quantities, one at a time. See section Graphic History on page 68 for details about graphical display.

You may also dump the logged data to the serial line in numeric form with the following commands.

DIR

Use the serial line and enter the **DIR** command to check the available files.

Without the data logger module, the device records six files (six observation periods) for each selected quantity. The data logger raises the

number of recorded files to seven for each quantity. Thus, the total
amount of the files varies between 6 and 28. See Table 11 on page 68.

Select, for example, three quantities (RH, T, and Tdf). The last column
illustrates the number of data points that has been stored in the file.

Example (data logger module installed):

```
>dir
   File description        Oldest data available    No. of points
1  RH   (10 s intervals)   2007-05-30 08:26:50      13996800
2  RH   (90 s intervals)   2007-05-30 05:25:30      1555200
3  RH   (12 min intervals) 2007-05-29 05:48:00      194400
4  RH   (2 h intervals)    2007-05-19 02:00:00      19440
5  RH   (12 h intervals)   2007-03-23 12:00:00      3240
6  RH   (3 d intervals)    2006-04-20 00:00:00      540
7  RH   (12 d intervals)   2002-12-16 00:00:00      135
8  T    (10 s intervals)   2007-05-30 08:26:50      13996800
9  T    (90 s intervals)   2007-05-30 05:25:30      1555200
10 T    (12 min intervals) 2007-05-29 05:48:00      194400
11 T    (2 h intervals)    2007-05-19 02:00:00      19440
12 T    (12 h intervals)   2007-03-23 12:00:00      3240
13 T    (3 d intervals)    2006-04-20 00:00:00      540
14 T    (12 d intervals)   2002-12-16 00:00:00      135
15 Tdf  (10 s intervals)   2007-05-30 08:26:50      13996800
16 Tdf  (90 s intervals)   2007-05-30 05:25:30      1555200
17 Tdf  (12 min intervals) 2007-05-29 05:48:00      194400
18 Tdf  (2 h intervals)    2007-05-19 02:00:00      19440
19 Tdf  (12 h intervals)   2007-03-23 12:00:00      3240
20 Tdf  (3 d intervals)    2006-04-20 00:00:00      540
21 Tdf  (12 d intervals)   2002-12-16 00:00:00      135
>
```

Example (without data logger module):

```
>dir
   File description        Oldest data available    No. of points
1  RH   (10 s intervals)   2008-04-11 23:41:10      135
2  RH   (90 s intervals)   2008-04-11 20:41:11      135
3  RH   (12 min intervals) 2008-04-10 21:03:41      135
4  RH   (2 h intervals)    2008-03-31 18:03:41      135
5  RH   (12 h intervals)   2008-02-04 12:03:41      135
6  RH   (3 d intervals)    2007-03-04 00:03:41      135
7  T    (10 s intervals)   2008-04-11 23:41:11      135
8  T    (90 s intervals)   2008-04-11 20:41:11      135
9  T    (12 min intervals) 2008-04-10 21:03:41      135
10 T    (2 h intervals)    2008-03-31 18:03:41      135
11 T    (12 h intervals)   2008-02-04 12:03:41      135
12 T    (3 d intervals)    2007-03-04 00:03:41      135
13 Tdf  (10 s intervals)   2008-04-11 23:41:11      135
14 Tdf  (90 s intervals)   2008-04-11 20:41:11      135
15 Tdf  (12 min intervals) 2008-04-10 21:03:41      135
16 Tdf  (2 h intervals)    2008-03-31 18:03:41      135
17 Tdf  (12 h intervals)   2008-02-04 12:03:41      135
18 Tdf  (3 d intervals)    2007-03-04 00:03:41      135
>
```

PLAY

Use the **PLAY** command to output the selected file to the serial line. If
the data logger module is installed, you can specify an interval to be
outputted.

Data in the output is <TAB> delimited. This is compatible with most
spreadsheet programs. Before giving the command, set the local date and
time with **TIME** and **DATE** commands, if needed.

PLAY [*x*] [*start_date start_time end_date end_time*]<cr>

where

x	=	Number of the data file that will be outputted, range 0...21. The numbers correspond to the output of the DIR command; refer to the example on page 116. Selecting number 0 will output all data files.
start_date	=	Starting date of the interval to be outputted. Must be given in the following format: yyyy-mm-dd.
start_time	=	Starting time of the interval to be outputted. Must be given in the format hh:mm:ss or h:mm.
end_date	=	Ending date of the interval to be outputted. Must be given in the following format: yyyy-mm-dd.
end_time	=	Ending time of the interval to be outputted. Must be given in the format hh:mm:ss or h:mm.

Example:

```
>play 3 2007-05-05 00:00:00 2007-05-06 00:00:00
RH   (12 min intervals) 2007-05-05 00:00:00  121
Date          Time        trend   min     max
yyyy-mm-dd  hh:mm:ss      %RH     %RH     %RH
2007-05-05  00:00:00 19.16   18.99   19.33
2007-05-05  00:12:00 19.30   19.09   19.55
2007-05-05  00:24:00 20.01   19.28   21.17
2007-05-05  00:36:00 21.21   20.98   21.44
2007-05-05  00:48:00 19.57   17.72   21.11
2007-05-05  01:00:00 19.09   18.62   19.84
...
```

You can use the <**ESC**> key to interrupt the output listing.

NOTE	Output of large amounts of recorded data can result in huge data files and take a long time, up to several days for the entire memory of the data logger at 10 second resolution. To make it easier to process the data it is recommended to select the largest suitable data interval, and to specify the start and end times carefully.

Deleting the Recorded Files

You can delete the recorded data files using the keypad/display, or the **DELETE** command on the serial line. The deletion is always done for all data; you cannot delete individual files.

Note that the transmitter automatically overwrites the old data when the memory is full, so manual deletion of the recorded files is not necessary in normal use.

To delete the data files using the keypad/display:

1.   Press any of the arrow buttons to open the **Main Menu.**
2.   Select **System** by pressing the ► arrow button.
3.   Select **Clear graph memories** by pressing the **CLEAR** button. Press the **YES** button to confirm the selection.

CAUTION	This function clears the entire data history of the transmitter, including all graphs and the content of the optional data logger module.

UNDELETE

Similarly to the **DELETE** command, the **UNDELETE** command is used without any arguments. It will recover all deleted data that has not been overwritten yet.

Analog Output Settings

The analog outputs are set in the factory according to the order form. In case you want to change the settings, follow these instructions. See section Third Analog Output on page 54.

Changing Output Mode and Range

Both output channels have their own DIP switch module with 8 switches; see the position in Figure 2 on page 22 (DIP switches for analog output settings).

1. Select the current/voltage output; switch ON either of the switches, 1 or 2.

2. Select the range; switch ON one of the switches from 3 to 7.

0503-045
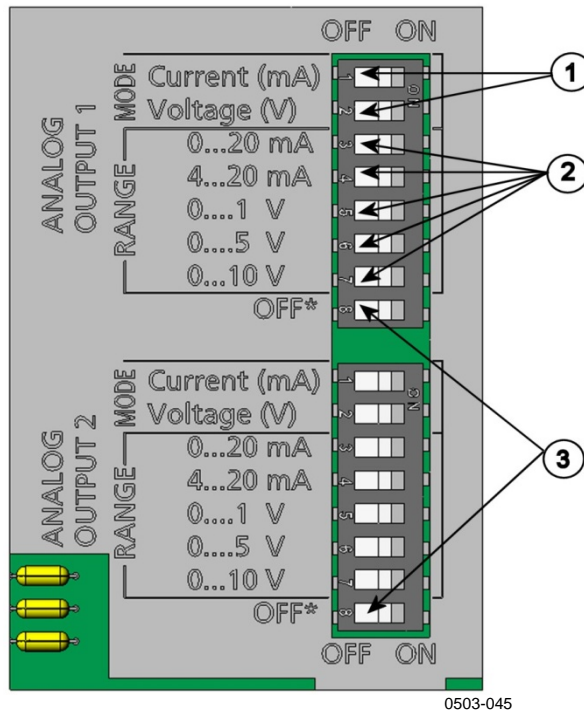
Figure 62   Current/Voltage Switches of Output Modules

The following numbers refer to Figure 62 above:

1 = Current/voltage selection output switches (from 1 to 2)
2 = Current/voltage range selection switches (from 3 to 7) in analog output 1 and 2.
3 = Switches for service use only. Keep in OFF position always.

NOTE	Only set one mode and one range switch to ON for one output channel. The rest of the switches must remain OFF.

Example: 0 ... 5 V voltage output selected for channel 1 and 4 ... 20 mA selected for channel 2.

	OFF	ON	Selection
1	■		
2		■	Voltage output selected
3	■		
4	■		
5	■		
6		■	0 ... 5 V selected
7	■		
8	■		

			Selection
1		■	Current output selected
2	■		
3	■		
4		■	4 ... 20 mA selected
5	■		
6	■		
7	■		
8	■		

NOTE	If you have customized the error output setting (**AERR**), check that the set error values are still valid after changing the output mode/range. See section Analog Output Fault Indication Setting on page 124.

Analog Output Quantities

Use the display/keypad to change and scale the analog output quantities.

1. Press any of the arrow buttons to open the **Main Menu.**
2. Select **Interfaces** by pressing the ► arrow button.
3. Select **Analog outputs** by pressing the ► arrow button.
4. Select **Output 1/2/3** by pressing the ► arrow button.
5. Select **Quantity** by pressing the ▲ ▼ arrow buttons. Confirm your selection by pressing **CHANGE**.
6. Select the quantity by using the arrow buttons. Press **SELECT** to confirm your selection.
7. Select **Scale,** lower limit, by pressing the ▲ ▼ arrow buttons. Press **SET** to confirm your selection. Press **OK** to confirm your setting.
8. Select the upper limit by pressing the ▲ ▼ arrow buttons. Use the arrow buttons to set the upper limit value. Press **SET** to confirm your selection. Press **OK** to confirm your setting.
9. Press **EXIT** to return to the basic display.

AMODE/ASEL

Use the serial line to select and scale the analog output quantities. Check the analog output modes with the **AMODE** command.

AMODE<cr>

Example:

```
>amode
Ch1 output     : 0...1V
Ch2 output     : 0...1V
>
```

Select and scale the quantities for the analog outputs with the command **ASEL**. Note that the optional quantities can be selected only if they have been selected when ordering the device.

ASEL [*xxx yyy zzz*]<cr>

where

xxx = Quantity of channel 1
yyy = Quantity of channel 2
zzz = Quantity of the optional analog output channel 3

Always enter the quantities for all outputs. For quantities and their abbreviations see Table 3 on page 19 and Table 4 on page 19.

Use the **ASEL** [*xxx yyy*] command as shown in the example below when using a device with two analog outputs.

Example:

```
>asel rh t
Ch1 (RH ) low  : 0.00 %RH ? 0
Ch1 (RH ) high : 100.00 %RH ? 100
Ch2 (T  ) low  : -40.00 'C ? -50
Ch2 (T  ) high : 60.00 'C ? 80
>
```

Analog Output Tests

Use the display/keypad to test the operation of the analog output s by forcing the outputs to known values. Measure then the outputs with a current/voltage meter.

1. Press any of the arrow buttons to open the **Main Menu.**
2. Select **System** by pressing the ► arrow button.
3. Select **Diagnostics** by pressing the ► arrow button.
4. Select **Analog output tests** by pressing the ► arrow button.
5. Select one of the testing options **Force 0%/50%/100% of scale.** Press **TEST** to confirm your selection. All outputs are tested simultaneously. The actual output value depends on the selected range.
6. Press **OK** to stop testing. Press **EXIT** to return to the basic display.

ITEST

Use the **ITEST** command to test the operation of the analog outputs. The **ITEST** command forces the analog outputs to entered values. The analog outputs remain at these values until you enter the command **ITEST** without parameters or reset the transmitter.

ITEST [*aa.aaa bb.bbb cc.ccc*]<cr>

where

aa.aaa = Current or voltage value to be set for channel 1 (mA or V)
bb.bbb = Current or voltage value to be set for channel 2 (mA or V)
cc.ccc = Current or voltage value to be set for channel 3 (optional) (mA or V)

Examples:

```
>itest 20 5
Ch1 (Td )      :             *        20.000 mA   H'672A
Ch2 (T  )      :             *         5.000 mA   H'34F9

>itest
Ch1 (Td )      :     -23.204 'C       16.238 mA   H'FFFE
Ch2 (T  )      :      22.889 'C        8.573 mA   H'5950
>
```

Analog Output Fault Indication Setting

Factory default state for analog outputs during error condition is 0 V/ 0 mA. Please be careful when selecting the new error value. The error state of the transmitter should not cause unexpected problems in process monitoring.

Use the display/keypad to set the analog output fault indication.

1. Press any of the arrow buttons to open the **Main Menu.**
2. Select **Interfaces** by pressing the ► arrow button.
3. Select **Analog Outputs** by pressing the ► arrow button.
4. Select **Output 1/2/3** by pressing the ► arrow button.
5. Select Fault indication. Press **SET** to confirm your selection. Enter the fault indication value by using the arrow buttons. Press **OK** to confirm your setting. This value is outputted if a transmitter error occurs.
6. Press **EXIT** to return to the basic display.

AERR

Use the serial line **AERR** command to change the error output.

Example:

```
>aerr
Ch1 error out  : 0.000V ? 5.0
Ch2 error out  : 0.000V ? 5.0
>
```

NOTE	The error output value must be within a valid range of the output mode.

NOTE	The error output value is displayed only when there are minor electrical faults such as humidity sensor damage. When there is a severe device malfunction, the error output value is not necessarily outputted.

Extend Analog Output Range

Use the **AOVER** command to allow the analog output channels to exceed their specified range by 10%. The scaling of the parameter remains as before; the extra range is used for additional measurement range in the high end of the scale.

AOVER [*ON/OFF*]<cr>

Example:

```
>aover on
Extended output: ON
>
```

The following example illustrates how the analog output is affected. Channel 1 outputs RH with voltage output 0 … 5 V (0 … 100 %RH). After giving the **AOVER ON** command, the range is 0 … 5.5 V (0 … 110 %RH). Note that the 100 %RH point is still at 5 V.

Operation of Relays

Quantity for Relay Output

A relay monitors the quantity chosen for the relay output. Any of the quantities available can be chosen.

Measurement-Based Relay Output Modes

Relay Setpoints

When the measured value is in between the "above" and "below" values, the relay is passive. When choosing lower value as "above" value and higher value as "below" value, the relay is passive when the measured value is not between the setpoints. You can also set only one setpoint. See Figure 63 on page 126 for illustrative examples of the different measurement-based relay output modes.

Figure 63   Measurement-Based Relay Output Modes

Mode 4 is usually used if an alarm needs to be triggered when the measured value exceeds a safe range. The relay is active when measurement is in range, and is released if the value goes out of range or the measurement fails.

NOTE	If the measurement of the selected quantity fails or the transmitter loses its power, the relay is released.

Hysteresis

Hysteresis function is to prevent the relay switching back and forth when the measured value is near to the setpoint values.

Relay is activated when the measured value passes the **exact** value of the setpoint. When returning and passing the setpoint again relay is not released before the value reaches the setpoint increased/decreased by the hysteresis value.

Hysteresis should be smaller than difference of the setpoints.

Example: When the 'active above' value is 60 %RH and the hysteresis value is 5 %RH, relay activates when the relative humidity reaches 60 %RH. As the humidity decreases, relay releases at 55 %RH.

NOTE	If both setpoints are specified and "above" setpoint is lower than "below" setpoint, the hysteresis works in the opposite direction, that is, relay is **released** when the measured value passes the exact value of the setpoint.

Relay Indicating Transmitter Error Status

You can set a relay to follow the operation status of the device. By selecting FAULT/ONLINE STATUS for output quantity a relay changes state on the basis of the operation status as follows:

<u>FAULT STATUS</u>

Normal operation: relay active (C and NO outputs are closed)

Not measuring state (error state or power off): relay released (C and NC outputs are closed)

<u>ONLINE STATUS</u>

Live measurement (data available): relay active (C and NO outputs are closed)

No live data (for example: error state, chemical purge or adjustment mode): relay released (C and NC outputs are closed)

See Figure 64 on page 128 for illustrative examples of the FAULT/ONLINE STATUS relay output modes.

Analog output vs. "FAULT STATUS" relay
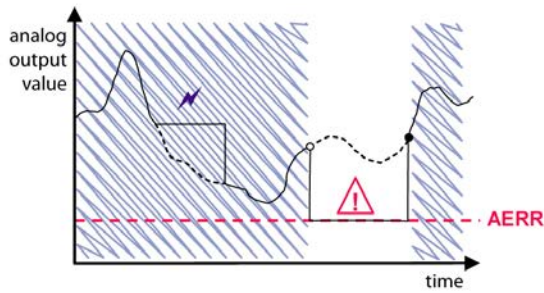
Relay is released in case of a measurement failure only.

Analog output vs.   "ONLINE STATUS"   relay
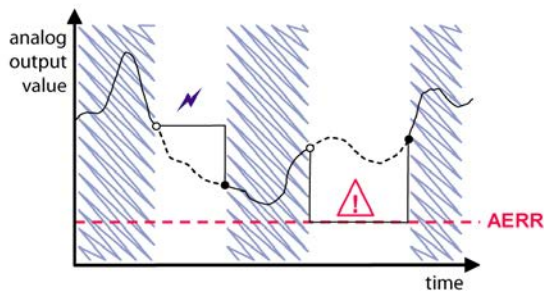
Relay is released when the output values are frozen, the adjustment mode is activated, or an instrument failure is detected

1102-040

Figure 64   FAULT/ONLINE STATUS Relay Output Modes

FAULT/ONLINE STATUS relays are usually used in conjunction with an analog output to obtain validity information for the output value.

NOTE	If transmitter loses its power, all status-based relays are released similarly to the case of an instrument failure.

Table 31   Relay State Examples

Criterion for Relay Activation	Transmitter Operation Status	NC-C Connected	NO-C Connected
Not chosen		—o—o—	—o⁄o—
	Power off	—o—o—	—o⁄o—
RH below 50 %*	Measured RH above 50 %	—o—o—	—o⁄o—
	Measured RH below 50 %	—o⁄o—	—o—o—
RH above 50 %*	Measured RH above 50 %	—o⁄o—	—o—o—
	Measured RH below 50 %	—o—o—	—o⁄o—
Fault status	Measurement OK	—o⁄o—	—o—o—
	Error active	—o—o—	—o⁄o—
Online status	Measurement live	—o⁄o—	—o—o—
	Purge or sensor heating active	—o—o—	—o⁄o—

* Hysteresis has an effect when relay switching is based on live measurement.
See section Hysteresis on page 127.

Enabling/Disabling Relays

You can deactivate the relay outputs for example for service purposes of your system.

Setting Relay Outputs

NOTE	When you have only one relay module installed, its relays are called "relay 1" and "relay 2".
	When you have two relay modules, the relays of the module connected to slot **MODULE 1** are called "relay 1" and "relay 2" and relays connected to slot **MODULE 2** are called "relay 3" and "relay 4".
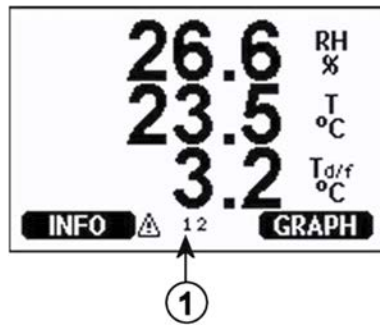
0706-003

Figure 65   Relay Indicators on Display

The following number refers to Figure 65 above:

1   =   Lists enabled relays. Activation state shown in black.
            Disabled relays are not shown.

Use the display/keypad to set the relay outputs.

1.   Press any of the arrow buttons to open the **Main Menu**.
2.   Select **Interfaces**, confirm by pressing the ►arrow button.
3.   Select **Relay outputs**, confirm by pressing the ►arrow button.
4.   Select **Relay 1/2/3/4**, confirm by pressing the ►arrow button.
5.   Select the **Quantity**, confirm by pressing **Change**. Select the
       Quantity by using the arrow buttons. Confirm your selection by
       pressing **Select**.
6.   Select **Act. above / Act. below**. Press SET to confirm your
       selection. (If asked, select **MODIFY** if you want to set the setpoint
       by using the arrow buttons. Select **REMOVE** if you want to
       remove the setpoint.)
7.   Select **Hysteresis** by using the arrow buttons. Press **SET** to set the
       hysteresis. Press **OK**.
8.   Select **Relay enable** by using the arrow buttons, press **ON/OFF** to
       enable/disable the relay.

RSEL

Use the serial line to select the quantity, setpoints and hysteresis or
enable/disable the relay outputs. Enter the **RSEL** command.

RSEL [*q1 q2 q3 q4*]<cr>

where

q1 =   Quantity for the relay 1 or Fault/Online
q2 =   Quantity for the relay 2 or Fault/Online
q3 =   Quantity for the relay 3 or Fault/Online
q4 =   Quantity for the relay 4 or Fault/Online

Factory setting: All relays disabled.

Use the quantity abbreviations presented above. See Table 3 on page 19 and Table 4 on page 19.

Example of window limit switch: Selecting relay 1 to follow relative humidity measurement and relay 2 to follow temperature measurement. Two relay setpoints are set for both relays.

```
>rsel rh t
Rel1 RH    above: 0.00 %RH ? 30
Rel1 RH    below: 0.00 %RH ? 40
Rel1 RH    hyst : 0.00 %RH ? 2
Rel1 RH    enabl: OFF ? ON
Rel2 T     above: 0.00 'C ? 30
Rel2 T     below: 0.00 'C ? 40
Rel2 T     hyst : 0.00 'C ? 3
Rel2 T     enabl: OFF ? ON
>
```

Example of normal limit switch: Selecting relay 1 to follow relative humidity, relay 2 to follow temperature, relay 3 to follow dewpoint and relay 4 to follow dewpoint. One setpoint is chosen for all the outputs.

```
>rsel rh t td td
Rel1 RH    above: 60.00 %RH ? 70
Rel1 RH    below: 70.00 %RH ? -
Rel1 RH    hyst : 2.00 %RH ? 2
Rel1 RH    enabl: ON ? on
Rel2 T     above: 50.00 'C ? 60
Rel2 T     below: 40.00 'C ? -
Rel2 T     hyst : 2.00 'C ? 2
Rel2 T     enabl: ON ? on
Rel3 Td    above: 5.00 'C ? 10
Rel3 Td    below: 0.00 'C ? -
Rel3 Td    hyst : 1.00 'C ? 1
Rel3 Td    enabl: OFF ? on
Rel4 Td    above: 0.00 'C ? 20
Rel4 Td    below: 0.00 'C ? -
Rel4 Td    hyst : 0.00 'C ? 2
Rel4 Td    enabl: OFF ? on
>
```

Example of using relay 1 as fault alarm: selecting relay 1 to follow the fault status and relay 2 to follow the temperature measurement.

```
>rsel fault t
Rel1 FAUL above: -
Rel1 FAUL below: -
Rel1 FAUL hyst : -
Rel1 FAUL enabl: ON ?
Rel2 T     above: 0.00 'C ? 30
Rel2 T     below: 0.00 'C ? -
Rel2 T     hyst : 0.00 'C ? 2
Rel2 T     enabl: OFF ? ON
>
```

Testing Operation of Relays

Testing activates relays even if they are disabled.

Use the module push buttons to activate the relays. Press the **REL 1** or **REL 2** button to activate the corresponding relay.

Relay is activated: led is lit
Relay is not activated: led is not lit

Use the display/keypad to test the operation of relays.

1.   Open the **Main Menu** by pressing any of the arrow buttons.
2.   Select **System**, press the ▶ arrow button.
3.   Select **Diagnostics**, press the ▶ arrow button.
4.   Select **Relay tests**, press the ▶ arrow button.
5.   Select **Invert relay 1... ,** press **TEST**. Now the selected relay output is forced to opposite state. Press **OK** to return to normal operation.
6.   Press **EXIT** to return to the basic display.

RTEST

Use the serial line command **RTEST** to test the operation of the relays.

RTEST [*x1 x2 x3 x4*]<cr>

where

x   =   ON/OFF

Example: Activate and then release all four relays.

```
>rtest on on on on
 ON ON ON ON
>
>rtest off off off off
 OFF OFF OFF OFF
>
```

Enter the command **RTEST** without parameters to stop testing.

Sensor Functions

Chemical Purge (Optional)

In some specific applications the sensor gain may decrease gradually due to an interference caused by a particular chemical present in the measured gas, for example. The decrease of sensor gain due to an interfering chemical and the effect of the chemical purge process are illustrated below, see Figure 66 below. The sensor polymer absorbs the interfering chemical, and this reduces the ability of the polymer to absorb water molecules. Consequently the sensor gain decreases. In chemical purge, heating the humidity sensor to a temperature level of approximately +160 °C for several minutes evaporates the interfering chemical.

The purge function starts with heating stage, continues with settling and when the temperature of the sensor is decreased the transmitter returns to normal mode. The whole cycle takes about 6 minutes.

NOTE	Chemical purge function locks the output values for about 6 minutes.
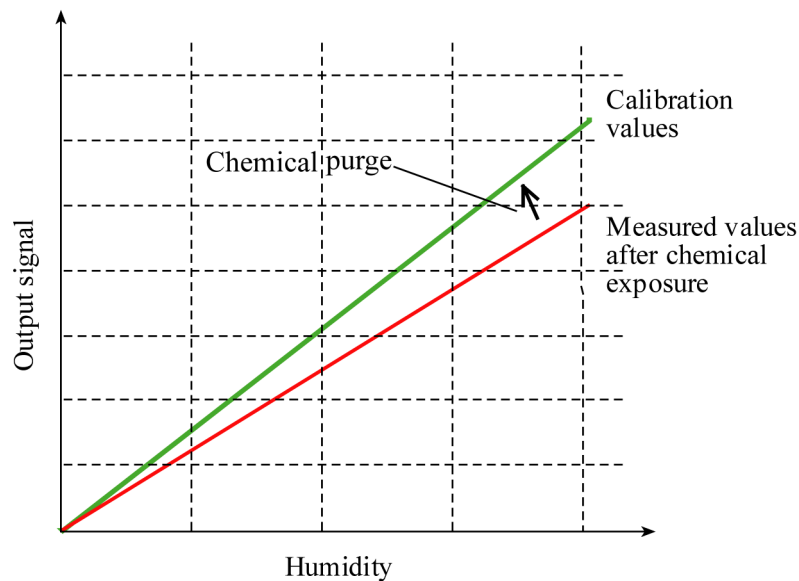
Figure 66   Decrease of Sensor Gain

Before starting the chemical purge, note the following:

- The sensor is protected with a PPS grid with stainless steel netting, a stainless steel sintered filter or with membrane SST filter.
- The sensor temperature must be below 100 °C. At higher temperatures the chemicals evaporate spontaneously from the sensor and the chemical purge is not necessary.
- Subzero temperatures slow down the recovery of the sensor after the chemical purge. The sensor is completely dry after the purge, and in very cold temperatures it can take more than two hours for it to reach ambient humidity again.

Automatic Chemical Purge (Interval Purge)

When HMT330 leaves the factory the automatic chemical purge (if chosen) takes place repeatedly with the time intervals set in the factory. User can change the interval in which the purge takes place by using serial commands or with the optional display/keypad. This can be needed if the measuring environment contains high concentrations of interfering chemicals. The automatic chemical purge can also be turned off if necessary.

Manual Chemical Purge

The chemical purge should be performed always before calibration (see section Calibration and Adjustment on page 155) or when there is a reason to believe that a sensor has become exposed to an interfering chemical. Make sure that the temperature of the sensor has come down to normal temperature before starting a calibration.

Chemical Purge in Power Up

Chemical purge (start-up purge) can be set to start within 10 seconds from the power-up of the device.

Starting and Configuring Chemical Purge

Using Buttons on Motherboard

Start manual chemical purge by pressing simultaneously two PURGE buttons on the motherboard inside the transmitter for a few seconds. Indicator LED flashes until purge is complete (up to 6 minutes).

0508-011
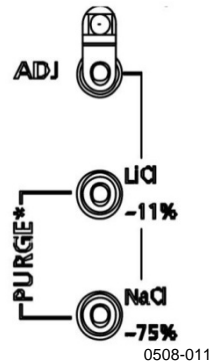
Figure 67   Purge Buttons on Motherboard

Using Display/Keypad (Optional)

1.   Open the **Main Menu** by pressing any of the ▼ ▲ ◄ ► arrow buttons.

2.   Select ►**Measuring**, press ►button.

3.   Select ►**Chemical purge**, press ► button.

1102-016
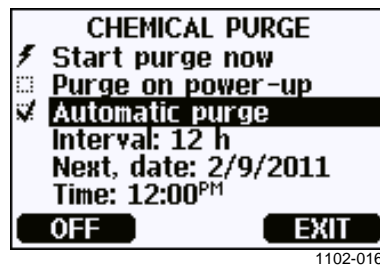
Figure 68   Chemical Purge Settings

-    Start the chemical purge manually by selecting **Start purge now** and pressing START.

-    Select **Purge on power-up** by using the arrow buttons. Press On/Off to turn the start-up purge on/off.

-    Turn on/off the automatic purge by selecting **Automatic purge,** press ►**ON/OFF** button.

-    Set the automatic purge interval by selecting **Interval: ...**, press **SET.** Set the purge interval and the unit (hour/day) by using the arrow buttons. The interval must be 1 hour ... 10 days. Press **OK.**

- If you have the data logger module installed, you can also specify the **Date** and **Time** when the purge is performed next.

4. Press **EXIT** to return to the basic display.

0706-004
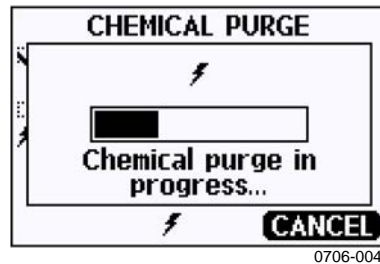
Figure 69   Performing Chemical Purge

Using Serial Line

PURGE

Use the **PURGE** command to start chemical purge immediately.

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

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

PUR

With **PUR** command you can enable or disable automatic and power-up chemical purge and set the interval for automatic purge. 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 can be longer.

If the transmitter has a data logger module installed, you can also set the starting date and time for the interval purge. After the set time has been reached, the interval purge will be performed at the set interval. This functionality can be used to make sure the chemical purge starts at a specific time of the day.

Do not change the settings for duration, settling, temperature or temperature difference unless instructed by Vaisala personnel.

Type **PUR** and press ENTER to proceed. Skip unchanged values by pressing ENTER. Input changed values in the format shown by the current value (for example, date and time). The maximum interval is 14400 minutes (=10 days).

Example (no data logger module installed):

```
>pur
Interval Purge : OFF ?
Interval       : 720 min ?
Power-up Purge : OFF ?
Duration       : 120 s ?
Settling       : 240 s ?
Temperature    : 160 'C ?
Temp. diff.    : 0.5 'C ?
>
```

Example (with data logger module installed):

```
>pur
Interval Purge : OFF ?
Interval       : 720 min ?
Next Purge date: 2011-02-09 ?
Next Purge time: 12:00:00 ?
Power-up Purge : OFF ?
Duration       : 120 s ?
Settling       : 240 s ?
Temperature    : 160 'C ?
Temp. diff.    : 0.5 'C ?
>
```

NOTE	To activate the new interval settings immediately, reset the transmitter.

NOTE	When chemical purge in power-up is enabled, wait about 6 min after power up before taking measurements. The output channels are locked for the first operation minutes to the initial measured values

RGLIMIT

Use the **RGLIMIT** command to prevent the chemical purge in subzero temperatures.

RGLIMIT [*ON/OFF*]<cr>

where

ON = Chemical purge disabled in < 0 °C temperatures.
OFF = Chemical purge allowed in < 0 °C temperatures.

Example (turn on the limiter and prevent purge in subzero temperatures):

```
>rglimit on
No purge if <0'C: ON
>
```

Sensor Heating

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

The sensor heating is recommended for the high humidity environments where even 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 a 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.

Setting Humidity Sensor Heating

When the HMT330 leaves the factory the sensor heating follows the factory default values. You can enable/disable the function, change the RH-limit and define the heating temperature and duration of this function.

XHEAT

Enables/disables the sensor heating.

XHEAT [*xx*]<cr>

where:

xx =   ON / OFF

Example:

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

To configure the sensor heating use the **XHEAT** command without parameters. Enter the values after question mark. The available ranges include the following:

Extra heat RH -limit (heating function starts-up above the setpoint)	0 ... 100 %RH (default: 95 %RH)
Extra heating temperature	0 ... 200 ºC (default: 100 ºC)
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
MODBUS

This chapter contains information that is needed when operating the transmitter using the Modbus protocol.

Overview of Modbus Protocol Support

The HMT330 transmitter can be accessed using the Modbus serial communication protocol. Support for Modbus protocol is available on all HMT330 transmitters as a standard feature from software version 5.10 onward. The supported Modbus variants and the connections they use are listed in Table 32 below.

Table 32   Supported Modbus Variants

Supported Modbus Variant	Connections
Modbus RTU (Serial Modbus)	RS-232 (standard User Port) RS-422/485 interface (optional module)
Modbus TCP (Ethernet Modbus)	LAN interface (optional module) WLAN interface (optional module)

The supported Modbus functions, registers, configuration options, and diagnostics are described in Appendix C, Modbus Reference, on page 199.

Note the following limitations of the Modbus implementation:

- Modbus TCP mode accepts only one TCP connection at a time. Design the system so that only one Modbus TCP client accesses the transmitter.
- Modbus TCP can process reliably only one Modbus transaction at a time. Reduce the polling rate of the client to avoid nested transactions.

Taking Modbus into Use

To take the Modbus protocol into use on the HMT330, you must perform some configuration tasks using the built-in display and keypad (optional) or a PC connected to the serial line. For example, you can connect to the service port using the USB service cable (Vaisala order code: 219685). The transmitter must be powered from a suitable power supply during configuration.

Instructions for performing the configuration are provided in the following sections:

- Enabling Serial Modbus on page 143
- Enabling Ethernet Modbus on page 144

After configuring the transmitter, perform the transmitter installation and wiring according to the instructions in Chapter 3, Installation, on page 27.

The configuration instructions assume you are familiar with the use of the transmitter. Additional details on the display/keypad, service port use, and serial commands are available in other sections of this manual:

- The use of the display/keypad option is described in section Display/Keypad (Optional) on page 67.
- If this is the first time you are using the USB service cable, you can find detailed instructions in section Service Port Connection on page 81. You must install the required driver before using the service cable.
- Configuration of the LAN and WLAN interfaces is decribed in section LAN Communication on page 82.
- The serial commands available through the service port are described beginning from section List of Serial Commands on page 93.

Enabling Serial Modbus

In addition to enabling the Modbus protocol in the device, Modbus over RS-232 or RS-485 needs the following software settings: serial bit rate, parity, number of stop bits, and Modbus device address.

Using Display/Keypad (Optional)

1. Open the **Main Menu** by pressing any of the ▼ ▲ ◄ ► arrow buttons.
2. Navigate to **Interfaces ► Serial Interface**.
3. On the **Serial Interface** settings screen:
    - Enable the Modbus protocol.
    - Change the baud rate and parity if necessary.
    - Set the Modbus device address.
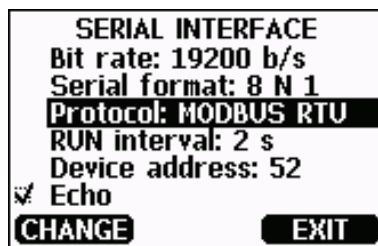
1101-033

Figure 70   Serial Interface Settings

4. After changing the settings, press the **EXIT** button. The Modbus configuration is now complete, as configuration changes made with the display and keypad are effective immediately.

Using Serial Line

1. Open the transmitter cover.
2. Connect power supply wiring (if not using the power supply module) and power up the transmitter.
3. Connect the USB service cable between a computer and the service port of the transmitter.
4. Start the Vaisala USB Instrument Finder program (which has been installed on the computer along with the USB service cable driver), and check the COM port that the cable is using.
5. Open a terminal program, and connect to the service port. The fixed serial line settings of the service port are 19200, 8, 1, N.

6. Use the **SMODE** command to enable the Modbus mode:

```
>smode modbus
Serial mode    : MODBUS
>
```

7. If necessary, use the **SERI** command to check and/or change the serial interface settings for the User Port. For example, to set the User Port serial settings to 19200 N 8 1, issue the following command:

```
>seri 19200 N 8 1
```

NOTE	The number of data bits must always be 8 for Modbus RTU.
	Serial Modbus interface of the HMT330 does not work with baud rates 115, 150, and 300 b/s.

8. Use the **ADDR** command to set the Modbus address of the transmitter. For example, to set the Modbus address to 52, issue the following command:

```
>addr 52
```

You must set a non-zero address or Modbus RTU will not work.

9. The Modbus configuration is now complete. Reset or power cycle the transmitter to enable the Modbus mode, and proceed with the installation of the transmitter and the wiring of the serial interface.

Enabling Ethernet Modbus

In addition to enabling the Modbus protocol in the device, Modbus TCP needs the following software settings: IP address, subnet mask, and default gateway address. Also network name (SSID) and security settings must be configured if wireless network is used.

Using Display/Keypad (Optional)

1. Open the **Main Menu** by pressing any of the ▼ ▲ ◄ ► arrow buttons.
2. Navigate to **Interfaces ► Network Settings ► IP Configuration**.
3. On the **IP Configuration** screen, set the network configuration settings, and exit to save the changes.
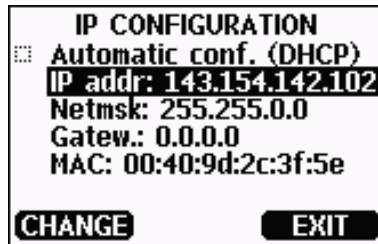
1101-034

Figure 71   IP Configuration

4.   Navigate back to the **Network Settings** menu. If you are using the WLAN interface, select **Wireless LAN Settings**.

5.   On the **Wireless LAN Settings** screen, set the network name (SSID) and security options, and exit to save the changes.

1101-036

Figure 72   Wireless LAN Settings

6.   Navigate back to the **Network Settings** menu. Select **Communication Protocol**.

7.   On the **Communication Protocol** screen, enable the Modbus protocol. Press the **EXIT** button to save the changes.

Note that the device address setting is not relevant for Modbus TCP. In the Modbus mode, the transmitter will respond to all valid Modbus messages with any "unit identifier" value.
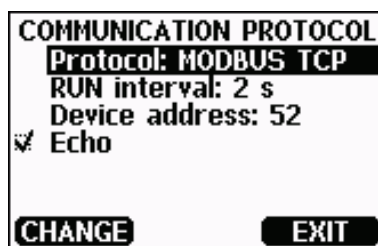
1101-034

Figure 73   Communication Protocol

8.   The Modbus configuration is now complete, as configuration changes made with the display and keypad are effective immediately.

Using Serial Line

1. Open the transmitter cover.
2. Connect power supply wiring (if not using the power supply module) and power up the transmitter.
3. Connect the USB service cable between a computer and the service port of the transmitter.
4. Start the Vaisala USB Instrument Finder program (which has been installed on the computer along with the USB service cable driver), and check the COM port that the cable is using.
5. Open a terminal program, and connect to the service port. The fixed serial line settings of the service port are 19200, 8, 1, N.
6. Use the **SMODE** command to enable the Modbus mode:

    ```
    >smode modbus
    serial mode    : MODBUS
    >
    ```

7. Configure the networking parameters of the interface you are using:

NOTE	After transmitter startup, it may take a few minutes for the network interface to become available for configuration.

      a.   Use the **NET** command to configure the networking parameters of both LAN and WLAN interface. You can, for example, enter the command without parameters and enter the settings as prompted:

```
>net
DHCP            : ON ? OFF
IP address      : 0.0.0.0 ? 143.154.142.102
Subnet mask     : 0.0.0.0 ? 255.255.0.0
Default gateway: 0.0.0.0 ?
Web config.     : ON ? OFF
Save changes (Y/N) ? y
OK
>
```

      b.   If you are using the WLAN interface, use the **WLAN** command to configure the network name (SSID) and security settings. For example:

```
>wlan
Network SSID   : NAME ? NETWORKID
Type           : OPEN ? WPA-PSK/TKIP
WPA-PSK phrase ? thequickbrownfox
Save changes (Y/N) ? y
OK
>
```

           For a description of the available settings, see section Wireless LAN Configuration on page 86.

8.   The Modbus configuration is now complete. Reset or power cycle the transmitter to enable the Modbus mode, and proceed with the installation of the transmitter.

Diagnostic Modbus Counters

HMT330 has diagnostic counters that can be used to pinpoint Modbus problems. The counters are always active when the Modbus protocol is enabled.

Viewing Counters Using Display/Keypad

You can use the display/keypad option to view and clear the counters. Enter the **Main Menu** and navigate to **System ► Diagnostics ► MODBUS Counters**.
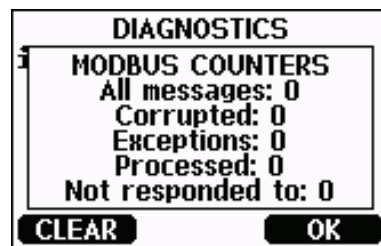
Figure 74   **Modbus Counters**

Viewing Counters Using Service Port

Use the **MODBUS** command to view the counters:

MODBUS<cr>

Example:

```
>modbus
Bus messages    : 0
Bus comm. error: 0
Bus exceptions  : 0
Slave messages  : 0
Slave no resp.  : 0
Last message    :
>
```

In addition to the diagnostic counters, the last message (received or transmitted) is shown in hexadecimal format. If the last message was a broadcast message, the suppressed response message is shown.

The last message displayed may be incomplete if there is active Modbus traffic while using the **MODBUS** command.

Modbus RTU only: If the last received message was rejected because of bad CRC checksum, the **MODBUS** command displays the message with corrected CRC (last two bytes updated).

To clear the counters, select again the Modbus mode with the **SMODE** command:

```
>smode modbus
```

Disabling Modbus

If you stop using Modbus with the transmitter, set the transmitter to some other operating mode using the display/keypad option or the **SMODE** command.

For example, to return the transmitter to the RUN mode where the measurements are output at regular intervals, issue the following command through the service port:

```
>smode run
```

Alternatively, you can enter the **Main Menu** using the display/keypad option, and change the mode from the **Interfaces** submenu.

The other communication settings of the output interface (User Port, LAN interface, or WLAN interface) will remain as configured, but the Modbus protocol will be disabled.

CHAPTER 6
MAINTENANCE

This chapter contains information that is needed in basic maintenance of the product.

Periodic Maintenance

Cleaning

Clean the transmitter enclosure with a soft, lint-free cloth moistened with mild detergent.

Changing the Probe Filter

1.   Turn the filter counter-clockwise to loosen it.
2.   Remove the filter from the probe. Be careful not to touch the sensor with the filter. Without the filter in place, the sensor is easily damaged – handle the probe carefully.
3.   Install a new filter on the probe. When using the stainless steel filter (for fuel cell applications), take care to tighten the filter properly (recommended force 5 Nm).

New filters can be ordered from Vaisala, see section Spare Parts and Accessories on page 178.

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 utilize 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 Calibration and Adjustment on page 155.

To replace the HUMICAP180 or HUMICAP180R sensor:

1. Remove the filter from the probe. See the instructions in section Changing the Probe Filter on page 149.

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 Adjustment after Sensor Change on page 161.

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).

0508-079
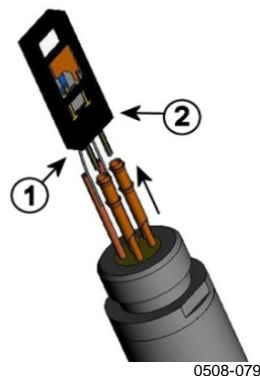
1	=	Pull out the sensor
2	=	Plastic socket

Figure 75   Changing the Sensor

Error States

In error state the affected quantities are not measured and the output is shown as follows:

- Analog channel outputs 0 mA or 0 V (you can use the serial line command **AERR** or display/keypad to change this fault indication value, see section Analog Output Fault Indication Setting on page 124.).
- Serial port outputs stars "***" instead of measurement data.
- Display shows "----" instead of measurement data.
- Cover LED is blinking.
- Error indicator is shown on the display.
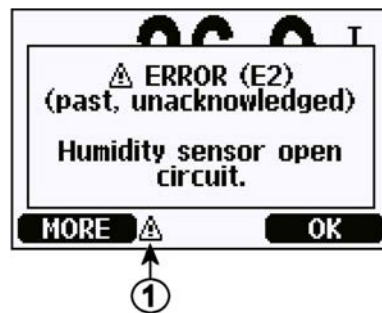
1103-068

Figure 76   Error Indicator and Error Message

The following number refers to Figure 76 above:

1   =   Error indicator

The error indicator disappears when the error state is over and you have checked the error message. Press the **INFO** button to display the error message.

You can also check the error message via the serial interface by using the command **ERRS**. In case of constant error, please contact Vaisala. See section Technical Support on page 153.

Table 33   Error Messages

Error Code	Error Message	Action
E0	Humidity sensor measurement malfunction.	Check the integrity of the humidity probe and the probe cable. Clean the probe from dirt, water, ice or other contaminants.
E1	Humidity sensor short circuit	
E2	Humidity sensor open circuit	Check the integrity of the humidity probe and the probe cable.
E3	Temperature sensor open circuit.	
E4	Temperature sensor short circuit.	Check the integrity of the humidity probe and the probe cable. Clean the probe from dirt water, ice or other contaminants.
E5	Temperature measurement malfunction	
E6	Temperature sensor current leak.	Check the integrity of the humidity probe and the probe cables. Clean the probes from dirt, water, ice or other contaminants.
E7	Internal ADC read error	Internal transmitter failure. Remove the transmitter and return the faulty unit to Vaisala Service.
E8	Additional temperature sensor short circuit	Check the integrity of the temperature probe and the probe cable. Clean the probe cable from dirt, water, ice or other contaminants.
E9	Checksum error in the internal configuration memory	Internal transmitter failure. Remove the transmitter and return the faulty unit to Vaisala Service.
E10	Internal EEPROM read error	
E11	Internal EEPROM write error	
E12 … E13	Add-on module 1 (or 2) connection failure	Turn off the power and check the module connection. Turn on the power.
E14	Device internal temperature out of range	Ensure that the operating temperature is within the valid range.
E15	Internal RAM memory or software checksum error	Internal transmitter failure. Remove the transmitter and return the faulty unit to Vaisala Service.
E18	Internal ADC reference voltage out of range	Internal transmitter failure. Remove the transmitter and return the faulty unit to Vaisala Service.
E19	Internal analog output reference voltage out of range	
E20 … E22	Configuration switches for analog output 1/2/3 set incorrectly	Check and re-set the switches, see page 55.
E24 … E25	Internal error in add-on module 1 (or 2)	Disconnect the power and check the module connection.
E26	Communication module installed in incorrect add-on module slot	Disconnect the power and change the communication module to another module slot.
E28 … E29	Unknown/incompatible module installed in add-on module slot 1 (or 2)	Ensure that the module is compatible with the HMT330.
E30	Internal analog voltage out of range	Internal transmitter failure. Remove the transmitter and return the faulty unit to Vaisala Service.
E31	Internal system voltage out of range	Check that the supply voltage is correct and the power supply can provide enough power for the instrument.

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 7
CALIBRATION AND ADJUSTMENT

The HMT330 is fully calibrated and adjusted as shipped from factory. Typical calibration interval is one year. Depending on the application it may be good to make more frequent checks. Calibration must be done always when there is a reason to believe that the device is not within the accuracy specifications.

It is recommended that calibration and adjustment should be carried out by Vaisala. For contact information of Vaisala Service Centers, see www.vaisala.com/servicecenters.

Calibration and adjustment is carried out either by using the push-keys on the motherboard, through the serial port or with the optional display/keypad.

(Vaisala portable instruments HM70 and HMI41 can also be used).

Opening and Closing the Adjustment Mode

1. Open the transmitter cover. The buttons needed in adjustment are on the left-hand side of the motherboard.
2. If the chemical purge option is available, it should be carried out always before calibration. To start chemical purge press simultaneously two **PURGE** push-keys (on the motherboard) for a few seconds. Red indicator LED flashes with short pulses until purge is complete (up to 6 minutes).
3. Press the **ADJ** key to open the adjustment mode.
4. Press the **ADJ** key again to close the adjustment mode.

0508-013
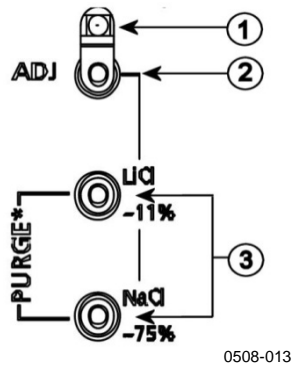
Figure 77   Adjustment and Purge Buttons

The following numbers refer to Figure 77 above:

1   =   Indicator LED
2   =   Adjustment button
3   =   Press the purge buttons simultaneously to start chemical
          purge (if available)

Adjustment menu is displayed only when **ADJ** button (on the
motherboard inside the transmitter) is pressed.

0706-007
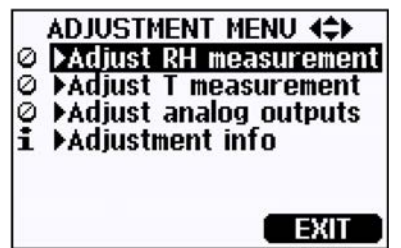
Figure 78   Adjustment Menu

Table 34   Indicator Led Functions

Indicator Led Function	Description
LED off	adjustment locked
LED on	adjustment available
LED blinking evenly	measurement not stabilized
LED blinking with short pulses	performing chemical purge

NOTE	If using a warmed probe (**HMT337 option**), probe heating will be interrupted when **ADJ** key is pressed. Allow sufficient time for the probe to reach ambient temperature before starting the adjustment procedure.

NOTE	Fixed pressure compensation value of 1013.25 hPa is used when in adjustment mode

Relative Humidity Adjustment

Using Push Buttons

A simple push-button adjustment is carried out by using two relative humidity references: 11 %RH (LiCl) and 75 %RH (NaCl).

1.   Carry out the chemical purge (if available).

LiCl reference

2.   Press the **ADJ** button (see Figure 77 on page 156) on the motherboard to open the adjustment mode. The indicator LED starts flashing.

3.   Remove the filter from the probe and insert the probe into a measurement hole of the 11 %RH (LiCl) in the humidity calibrator HMK15. Use the adapter fitting for the probes of HMT334, HMT335, HMT337 and HMT338.

4.   Wait at least 30 minutes for the sensor to stabilize (the indicator LED is lit continuously). Adjustment cannot be done if the conditions are not stabilized (indicator LED is flashing).

5.   When the indicator LED is lit continuously, press the button LiCl~11% to adjust the 11 %RH condition. After adjustment transmitter returns to normal operation mode (indicator LED is unlit).

NaCl reference

6.   When adjusting in the second reference 75 %RH, press the **ADJ** button to open the adjustment mode. The indicator LED starts flashing.

7.   Insert the probe into a measurement hole of the 75 %RH (NaCl) reference chamber of the humidity calibrator HMK15. Use the adapter fitting for the probes of HMT334, HMT335, HMT337 and HMT338.

8.   Wait at least 30 minutes for the sensor to stabilize (the indicator LED is lit continuously). Adjustment cannot be done if the conditions are not stabilized (indicator LED is flashing).

9.   Press the button **NaCl 75 %** to adjust the 75 %RH condition. After adjustment transmitter returns to normal operation mode (indicator LED is unlit).

Using Display/Keypad

Note that the difference between the two humidity references must be at least 50 %RH.

1. Carry out the chemical purge (if available).
2. Press the **ADJ** button (opens the **ADJUSTMENT MENU**).
3. Select **Adjust RH measurement**, press ► button.
4. Select **1-point/ 2-point adjustment**, press **START**.
5. Select the reference as guided by the display, press **SELECT**.

0706-005
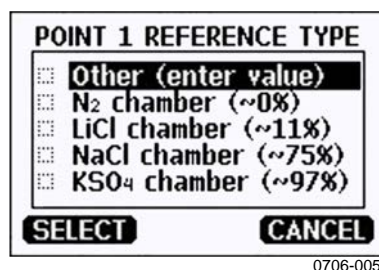
Figure 79   Selecting Point 1 Reference Type

6. Remove the filter from the probe and insert the probe into a measurement hole of the dry end reference chamber (for example, LiCl: 11 %RH in the humidity calibrator HMK15.) Use the adapter fitting for the probes of HMT334, HMT335, HMT337 and HMT338.
7. Wait at least 30 minutes for the sensor to stabilize. Follow the stabilization from the **GRAPH** display.
8. Press **READY** when stabilized. If you have chosen the **Other** reference value, enter now the reference value by using the arrow buttons.

    When carrying out the 2-point adjustment proceed to the next adjustment point and carry out the procedure as described in the previous steps.
9. Press **YES** to confirm the adjustment. Press **OK** to return to the adjustment menu.
10. Press **EXIT** to close the adjustment mode and return to the basic display. Before closing the adjustment mode, feed the adjustment information into the device, see section Feeding Adjustment Information on page 168.

Using Serial Line

Note that the difference between the two humidity references must be at least 50 %RH.

1. Connect the HMT330 to a PC. See section Serial Line Communication on page 79. Open a terminal program.
2. Carry out the chemical purge (if available).
3. Press the **ADJ** button.
4. Remove the filter from the probe and insert the probe into a measurement hole of the dry end reference chamber (for example, LiCl: 11 %RH in the humidity calibrator HMK15). Use the adapter fitting for the probes of HMT334, HMT335, HMT337 and HMT338.
5. Enter the **CRH** command and press **ENTER.**
    ```
    >crh
    ```

6. Wait at least 30 minutes for the sensor to stabilize.
7. Type **C** and press **ENTER** a few times to check if the reading is stabilized.
8. When the reading is stabilized, give 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 ...
    ```

9. Now the device is waiting for the high end reference. 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 for the HMT334, HMT335, HMT337 and HMT338 probes. Press any key when ready.
10. Let the probe stabilize for about 30 minutes. You can follow the stabilization by typing C and pressing **ENTER**.

11. 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
>
```

12. **OK** indicates that the adjustment has succeeded and the new
    calibration coefficients are calculated and stored. Enter the
    adjustment information (date and text) to the memory of the
    transmitter; see the commands **CTEXT** and **CDATE**.

13. Press the **ADJ** button on the motherboard to close the adjustment
    mode.

14. Take the probe out of the reference conditions and replace the
    filter.

Multipoint Adjustment Using Serial Line

You can use the **MPC** command (introduced in software version 5.14) to perform a multipoint adjustment to the relative humidity measurement. Due to the linear response of the HUMICAP® sensor, the standard two point adjustments are recommended for all users. Use multipoint correction only if:

- You have a requirement to adjust the relative humidity measurement in 3 ... 6 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 references points in range 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 (done with CRH command, push-buttons, or display). 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 HMT330 to a PC. See section Serial Line
    Communication on page 79. 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 will not respond to the command.

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

3. Press the **ADJ** button on the component board.

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       :    0.00000000E+00
    RH gain         :    1.00000000E+00
    T offset        :    0.00000000E+00
    T gain          :    1.00000000E+00
    ```

5. If some RH offset or gain is applied, write down the adjustment
    and then clear it by writing zero to RH offset and one to RH gain
    using the LI command:

    ```
    >li
    RH offset       :    0.001300000E+00 ? 0
    RH gain         :    1.040000000E+00 ? 1
    T offset        :    0.00000000E+00 ?
    T gain          :    1.00000000E+00 ?
    ```

6. You must now prepare a list of 3 ... 6 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 35   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. When done preparing the list, remove the probe from the last measurement chamber and re-attach the filter.

8. On the serial 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.

Relative Humidity Adjustment after Sensor Change

Using Display/Keypad

When using the optional display/keypad, follow the instructions in section Using Display/Keypad on page 158 but select **Adj. for new RH sensor** (instead of **1-point**/ **2-point adjustment**).

Using Serial Line

After sensor change, carry out the procedure as described in previous sections. Just replace the **CRH** command with the **FCRH** command.

FCRH

Example:

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

The OK indicates that the calibration has succeeded.

Temperature Adjustment

Using Display/Keypad

1. Press the **ADJ** button on the motherboard to open the **ADJUSTMENT MENU**. If using a warmed probe for measuring, probe heating will be interrupted when **ADJ** key is pressed. Wait some time for the probe to reach ambient temperature.

2. Select ►**Adjust T measurement**, press ►key.

3. Select **1-point/ 2-point adjustment**, press **START**.

4. Remove the filter from the probe and insert the probe into the reference temperature.

5. Wait at least 30 minutes for the sensor to stabilize. Follow the stabilization from the **GRAPH** display.

6. Press **READY** when stabilized. Give the reference temperature using the arrow buttons.

   When carrying out the 2-point adjustment, proceed to the next adjustment point and carry out the procedure as described in the previous item. Note that the difference between the two temperature references must be at least 30 ºC.

7. Press **OK.** Press **YES** to confirm the adjustment.

8. Press **OK** to return to the adjustment menu.

9. Press **EXIT** to close the adjustment mode and return to the basic display.

Using Serial Line

1. Press the **ADJ** key on the motherboard to open the adjustment mode. If using a warmed probe for measuring, probe heating will be interrupted when **ADJ** key is pressed. Wait some time for the probe to reach ambient temperature.

2. Remove the probe filter and insert the probe into the reference temperature.

3. Enter the command **CT** or (**CTA** for additional T probe) and press **ENTER**.

   ```
   >ct
   ```

   or for additional T probe:

   ```
   >cta
   ```

4.   Type **C** and press **ENTER** a few times to check if the reading is stabilized. Let the reading stabilize, give the reference temperature after the question mark and press **ENTER** three times**.**

When using two reference temperatures (2-point calibration) press **ENTER** only twice and insert the probe to the second reference. When the reading is stabilized, give the second reference temperature after the question mark and press **ENTER**. Please, note that the difference between the two temperature references must be at least 30 ºC.

Example (one-point adjustment):

```
>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
>
```

5.   **OK** indicates that the calibration has succeeded. Enter the calibration information (date and text) to the transmitter's memory; see the serial commands **CTEXT** and **CDATE**.

6.   Press the **ADJ** button on the motherboard to close the adjustment mode.

7.   Take the probe out of the reference conditions and replace the filter.

Analog Output Adjustment

In the analog output calibration the analog output is forced to the following values:

- Current output: 2 mA and 18 mA

- Voltage output: 10 % and 90 % of the range

Connect HMT330 to a calibrated current/voltage meter in order to measure either current or voltage depending on the selected output type.

Using Display/Keypad

1. Press the **ADJ** button to open the **ADJUSTMENT MENU**.

2. Select **Adjust analog outputs**, press ► button.

3. Select the output to be adjusted Adjust **analog output 1/2**, press **START**.

4. Measure the first analog output value with a multimeter. Give the measured value by using the arrow buttons. Press **OK.**

5. Measure the second analog output value with a multimeter. Give the measured value by using the arrow buttons. Press **OK.**

6. Press **OK** to return to the adjustment menu.

7. Press **EXIT** to close the adjustment mode and to return to the basic display.

Using Serial Line

Enter the **ACAL** command and type the multimeter reading for each case. Continue by pressing **ENTER**.

ACAL

Example (current outputs):

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

Feeding Adjustment Information

This information is shown on the device information fields. See section Device Information on page 108.

Using Display/Keypad

1.   If you are not in the adjustment menu, press the **ADJ** button on the motherboard (opens the **ADJUSTMENT MENU**).
2.   Select **Adjustment info,** press the ► button.
3.   Select **Date**, press **SET**. Give the date by using the arrow buttons. Press **OK**.
4.   Select **i,** press **SET.** Enter information text including 17 characters at maximum by using the arrow buttons. Press **OK.**
5.   Press **EXIT** to return to the basic display.

Using Serial Line

CTEXT

Use the CTEXT command to enter text to the adjustment information field.

Example:

```
>ctext
Adjust. info   : (not set) ? HMK15
>
```

CDATE

Use the CDATE command to enter date to adjustment information field. Set the adjustment date in format YYYY-MM-DD.

Example:

```
>cdate
Adjust. date   : (not set) ? 2004-05-21
>
```

CHAPTER 8
TECHNICAL DATA

This chapter provides the technical data of the product.

Specifications

Performance

Relative Humidity

Measurement range   0 ... 100 %RH
Accuracy (including non-linearity, hysteresis and repeatability)

with   HUMICAP®180   for typical applications
         HUMICAP®180R   for typical applications
         HUMICAP®180C   for applications with chemical purge and/or
                               warmed probe
         HUMICAP®180RC   for applications with chemical purge and/or
                               warmed probe
         at +15 ... 25 °C $\pm$ 1 %RH (0 ... 90 %RH)
                               $\pm$ 1.7 %RH (90 ... 100 %RH)
         at -20 ... +40 °C $\pm$ (1.0 + 0.008 $\times$ reading) %RH
         at -40 ... + 180 °C $\pm$ (1.5 + 0.015 $\times$ reading) %RH

Factory calibration uncertainty (+20 °C)
                               $\pm$0.6 %RH (0 ... 40 %RH)
                               $\pm$1.0 %RH (40 ... 97 %RH)
                               (Defined as $\pm$ 2 standard deviation limits.
                               Small variations possible, see also calibration
                               certificate.)
Response time (90 %) for HUMICAP®180 and HUMICAP®180C in still air
                               8 s with grid filter
                               20 s with grid + steel netting filter
                               40 s with sintered filter

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 + steel netting filter
                               60 s with sintered filter

Temperature (+ Operating Pressure Ranges)

HMT331	-40 ... +60 °C (-40 ... +140 °F)
HMT333 80 °C	-40 ... +80 °C (-40 ... +176 °F)
HMT333 120 °C	-40 ... +120 °C (-40 ... +248 °F)
HMT334	-70 ... +180 °C (-94 ... +356 °F), 0 ... 10 MPa (0 ... 100 bar)
HMT335 (vapor tight)	-70 ... +180 °C (-94 ... +356 °F)
HMT337 (vapor tight)	-70 ... +180 °C (-94 ... +356 °F)
HMT338	-70 ... +180 °C (-94 ... +356 °F), 0 ... 4 MPa (0 ... 40 bar)

Accuracy at +20 °C (+68 °F)   ± 0.2 °C
Accuracy over temperature range (see graph below):

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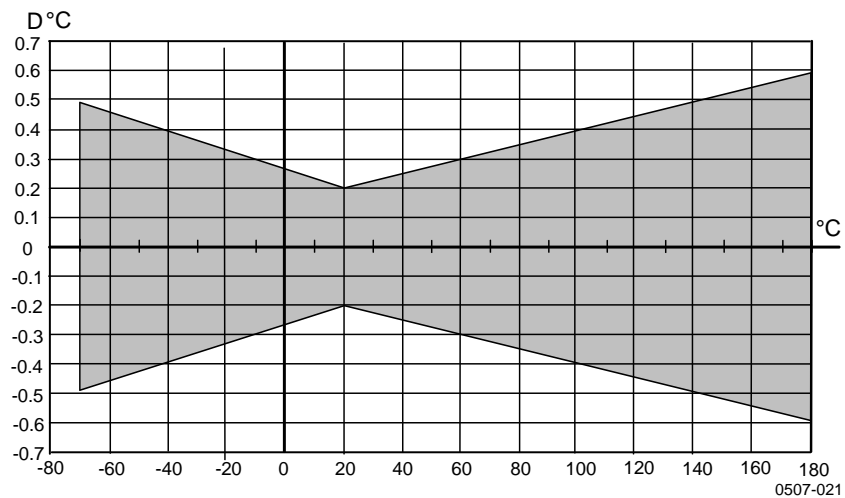
Figure 80   Accuracy over Temperature Range

Temperature sensor   Pt100 RTD Class F0.1 IEC 60751

Optional Temperature Probe

Temperature measurement range:	-70 ... + 180 °C (-94 ... +356 °F)
Typical accuracy:	0.1 °C (0.18 °F)
Sensor:	Pt100 PRT DIN IEC 751 class 1/4 B
Cable length:	2 m, 5 m, and 10 m
Pressure tight:	Up to 7 bar
Probe material:	Stainless steel

Calculated Variables

Table 36   Calculated Variables (Typical Ranges)

Variable	HMT331 Probe	HMT333 Probe	HMT334/335/337/338 Probes
Dewpoint temperature	-20 ... +60 ºC	-20 ... +80 ºC	-20 ... +100 ºC
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 ºC	0 ... +100 ºC	0 ... +100 ºC
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 °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

Relative humidity

Temp.	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

Relative humidity

Temp.	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 (HMT337 Warmed Probe Option)

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.

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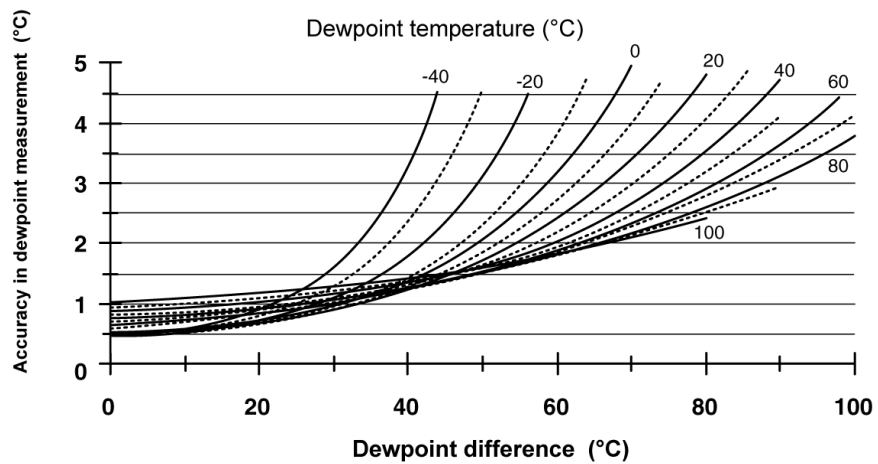
Figure 81   Accuracy in Dewpoint Measurement

Operating Environment

Operating temperature range
     for humidity measurement   -70 ... +180 °C (-94 ... +356 °F)
                                        see probe specifications
     for transmitter body electronics   -40 ... +60 °C (40 ... +140 °F)
     with display   0 ... +60 °C (+32 ... +140 °F)

Storage temperature range
     without display   -55 … +80 °C (-67 … +176 °F)
     with display   -40 … +80 °C (-40 … +176 °F)

Electromagnetic compatibility   EN61326-1: Electrical equipment for measurement, control, and laboratory use – EMC requirements – for use in industrial locations

Inputs and Outputs

Operating voltage	10 ... 35 VDC, 24 VAC
with optional power supply module	100 ... 240 VAC, 50/60 Hz
Start-up time after power-up	3 s
Power consumption at 20 °C (Uin 24VDC)	
RS-232	max 25 mA
Uout 2×0 ... 1V / 0 ... 5V / 0 ... 10V	max 25 mA
Iout 2×0 ... 20 mA	max 60 mA
display and backlight	+ 20 mA
during sensor purge	+ 110 mA max
Analog outputs (2 standard, 3rd optional)	
current output	0 ... 20 mA, 4 ... 20 mA
voltage output	0 ... 1 V, 0 ... 5 V, 0 ... 10 V
Accuracy of analog outputs at 20 °C	± 0.05 % full scale
Temperature dependence of the analog outputs	± 0.005 %/°C full scale
External loads	
current outputs	RL < 500 ohm
0 ... 1V output	RL > 2 kohm
0 ... 5V and 0 ... 10V outputs	RL > 10 kohm
Wire size	0.5 ... 2.5 mm^2 (AWG 20 ... 14) stranded wires recommended
Digital outputs	RS-232
	RS-422/485 (optional)
	LAN (optional)
	WLAN (optional)
Protocols	ASCII commands
	Modbus RTU
	Modbus TCP
Relay outputs (optional)	0.5 A, 250 VAC, SPDT
Display (optional)	LCD with backlight, graphic trend display
Menu languages	Chinese, English, Finnish, French, German, Japanese, Russian, Spanish, Swedish

Mechanics

Cable bushing	M20x1.5 for cable diameter 8 ... 11mm/0.31..0.43"
Conduit fitting	1/2"NPT
User cable connector (optional)	M12 series 8- pin (male)
option 1	with plug (female) with 5 m / 16.4 ft black cable
option 2	with plug (female) with screw terminals
Probe cable diameter	
HMT333 80ºC	6.0 mm
Other probes	5.5 mm
Probe tube material	
HMT331	Chromed ABS plastic
Other probes	AISI 316L
Housing material	G-AlSi 10 Mg (DIN 1725)
Housing classification	
Without display	IP 66 (NEMA 4X)
With display and keypad	IP 65 (NEMA 4X)
Transmitter weight (with probe, cable, and modules)	1.0 ... 3.0 kg (2.2 ... 6.6 lb)

Table 37   Standard Probe Cable Lengths and Approximate Transmitter Weight (in kg/lb)

Probe Type	Probe Cable Length				
	2 m	5 m	10 m	15 m	20 m
HMT333	1.1/2.4	1.2/2.6	1.5/3.3	-	2.1/4.5
HMT334	1.4/3.1	1.6/3.5	1.9/4.2	-	-
HMT335	1.3/2.9	1.4/3.1	1.7/3.7	2.0/4.3	-
HMT337	1.2/2.6	1.3/2.9	1.5/3.3	-	2.1/4.5
HMT338 232 mm	1.3/2.9	1.5/3.3	1.7/3.7	-	-
HMT338 454 mm	1.4/3.1	1.6/3.5	1.9/4.2	-	2.5/5.6

Technical Specifications of Optional Modules

Power Supply Module

Operating voltage	100 ... 240 VAC 50/60 Hz
Connections	screw terminals for 0.5 ... 2.5 mm^2 wire (AWG 20 ... 14)
Bushing	for 8 ... 11 mm diameter cable
Operating temperature	-40 ... +60 °C (-40 ... +140 °F)
Storage temperature	-40 ... +70°C (-40 ... +158 °F)
UL file number	E249387

Analog Output Module

Outputs	0 ... 20 mA, 4 ... 20 mA, 0 ... 1 V, 0 ... 5 V, 0 ... 10 V
Operating temperature range	-40 ... +60 °C (-40 ... +140 °F)
Power consumption	
U_{out} 0 ... 1 V	max 30 mA
U_{out} 0 ... 5V/0 ... 10V	max 30 mA
I_{out} 0 ... 20 mA	max 60 mA
External loads	
current outputs	R_L< 500 ohms
Max load + cable loop resistance	540 ohms
0 ... .1 V	R_L> 2000 ohms
0 ... 5 V and 0 ... 10 V	R_L> 10 000 ohms
Storage temperature range	-55 ... +80 °C (-67 ... +176 °F)
3-pole screw terminal	
max wire size	1.5 mm^2 (AWG16)

Relay Module

Operating temperature range	-40 ... +60 °C (-40 ... +140 °F)
Operating pressure range	500 ... 1300 mmHg
Power consumption at 24 V	max 30 mA
Contacts SPDT (change over), for example,	
Contact arrangement Form C	
Imax	0.5 A 250 VAC
Imax	0.5 A 30 VDC
Safety standard for the relay component	IEC60950 UL1950
Storage temperature range	-55 ... +80 °C (-67 ... +176 °F)
3-pole screw terminal / relay	
max wire size	2.5 mm^2 (AWG14)

RS-485 Module

Operating temperature range	-40 ... +60 ℃ (-40 ... +140 ℉)
Operating modes	2-wire (1-pair) half duplex
	4-wire (2-pair) full duplex
Operating speed max	115.2 kbaud
Bus isolation	300VDC
Power consumption at 24V	max 50 mA
External loads	
standard loads	32 RL> 10kohm
Storage temperature range	-55 ... +80 ℃ (-67 ... +176 ℉)
Max wire size	1.5 mm^2 (AWG16)

LAN Interface Module

Operating temperature range	-40 ... +60 ℃ (-40 ... +140 ℉)
Storage temperature range	-40 ... +85 ℃ (-40 ... +185 ℉)
Operating humidity range	5 … 95 %RH
Power consumption at 24V	max 60 mA
Ethernet type	10BASE-T 100BASE-TX
Connector	8P8C (RJ45)
IPv4 address assignment	DHCP (automatic), static
Protocols	Telnet, Modbus TCP
Max number of Telnet/Modbus clients	1

WLAN Interface Module

Operating temperature range	-20 ... +60 ℃ (-4 ... +140 ℉)
Storage temperature range	-40 ... +85 ℃ (-40 ... +185 ℉)
Operating humidity range	5 … 95 %RH
Power consumption at 24V	max 80 mA
Supported standards	802.11b
Connector	RP-SMA
IPv4 address assignment	DHCP (automatic), static
Protocols	Telnet, Modbus TCP
Max number of Telnet/Modbus clients	1
Security	WEP 64/128, WPA2/802.11i

Data Logger Module

Operating temperature range	-40 ... +60 ℃ (-40 ... +140 ℉)
Storage temperature range	-55 ... +80 ℃ (-67 ... +176 ℉)
Power consumption at 24V	max 10 mA
Logged parameters	up to four with trend/min/max values for each
Logging interval	10 s (fixed)
Maximum logging period	4 years 5 months
Logged points	13.7 million points / parameter
Accuracy of the clock	better than ±2 min/year
Battery lifetime	
at -40 ... +30 ℃ (-40 ... +86 ℉)	7 years
at +30 ... +60 ℃ (+86 ... +140 ℉)	5 years

Spare Parts and Accessories

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

Table 38   Spare Parts and Accessories

| Description	Order Code
MODULES	
Relay Module	RELAY-1
Analog Output Module	AOUT-1
Isolated RS485 Module	RS485-1
Power Supply Module	POWER-1
Galvanic Isolation Module	DCDC-1
SENSORS	
HUMICAP180	15778HM
HUMICAP180R	HUMICAP180R
HUMICAP180C	229011SP
HUMICAP180RC	HUMICAP180RC
PT100 Sensor	10429SP
FILTERS	
PPS Plastic Grid with Stainless Steel Netting	DRW010281SP
PPS Plastic Grid Filter	DRW010276SP
Sintered Filter AISI 316L	HM47280SP
Catalytic VHP Filter	231865
Stainless Steel Filter	HM47453SP
Stainless Steel Filter with Membrane	214848SP
TRANSMITTER MOUNTING ACCESSORIES	
Wall Mounting Kit	214829
Probe Holder Plate	226252
Installation Kit for Pole or Pipeline	215108
Rain Shield with Installation Kit	215109
DIN Rail Clips with Installation Plate	215094
Meteorological Installation Kit	HMT330MIK
Panel Mounting Frame	216038
PROBE MOUNTING ACCESSORIES	
HMT334	
Fitting Body M22x1.5	17223SP
Fitting Body NPT1/2	17225SP
HMT335	
Mounting Flange For HMT335	210696
HMT337	
Swagelok for 12mm Probe 3/8" ISO Thread	SWG12ISO38
Swagelok for 12mm Probe 1/2" ISO Thread	SWG12ISO12
Swagelok for 12mm Probe 1/2" NPT Thread	SWG12NPT12
Swagelok for 6mm Probe 1/2" ISO Thread	SWG6ISO12

Description	Order Code
Swagelok for 6mm Probe 1/8" ISO Thread	SWG6ISO18
Swagelok for 6mm Probe 1/8" NPT Thread	SWG6NPT18
Cable Gland M20x1.5 with Split Seal	HMP247CG
Duct Installation Kit for HMT333 and HMT337	210697
Duct Installation Kit for Temperature Probe	215003
HMT338	
Ball Valve ISO1/2 with Welding Joint	BALLVALVE-1
Fitting Body ISO1/2 Solid Structure	DRW212076SP
Fitting Body NPT1/2 Solid Structure	NPTFITBODASP
Thread Adapter ISO1/2 to NPT1/2	210662SP
Manual Press	HM36854SP
Plug Kit (ISO 1/2)	218773
CONNECTION CABLES	
Serial Interface Cable	19446ZZ
USB-RJ45 Serial Interface Cable	219685
MI70 Connection Cable with RJ45 Connector	211339
HMI41 Connection Cable with RJ45 Connector	25917ZZ
OUTPUT CABLES FOR 8-PIN CONNECTOR	
Connection Cable 5m 8-pin M12 Female, Black	212142
Female Connector 8-pin M12 with Screw Terminals	212416
Male Connector 8-pin M12 with Cable and Adapter	214806SP
CABLE BUSHINGS	
Cable Gland M20x1.5 for 8 ... 11mm Cable	214728SP
Cable Gland M20x1.5 for 11 ... 14mm Cable	214729
Cable Gland M16x1.5 for Wall Mounting Plate Pass-Through	216681SP
Conduit Fitting M20x1.5 for NPT1/2 Conduit	214780SP
Dummy Plug M20x1.5	214672SP
WINDOWS SOFTWARE	
Software Interface Kit	215005
OTHER	
HMK15 Calibration Adapter for 12 mm Probes with >7 mm Sensor Pins	211302SP
HMK15 Calibration Adapter for 12 mm Probes with <3 mm Sensor Pins	218377SP
Enclosure spare kit: hexagonal cover screws (4x) and hinge with attachment screws	238509

Dimensions (mm/inch)
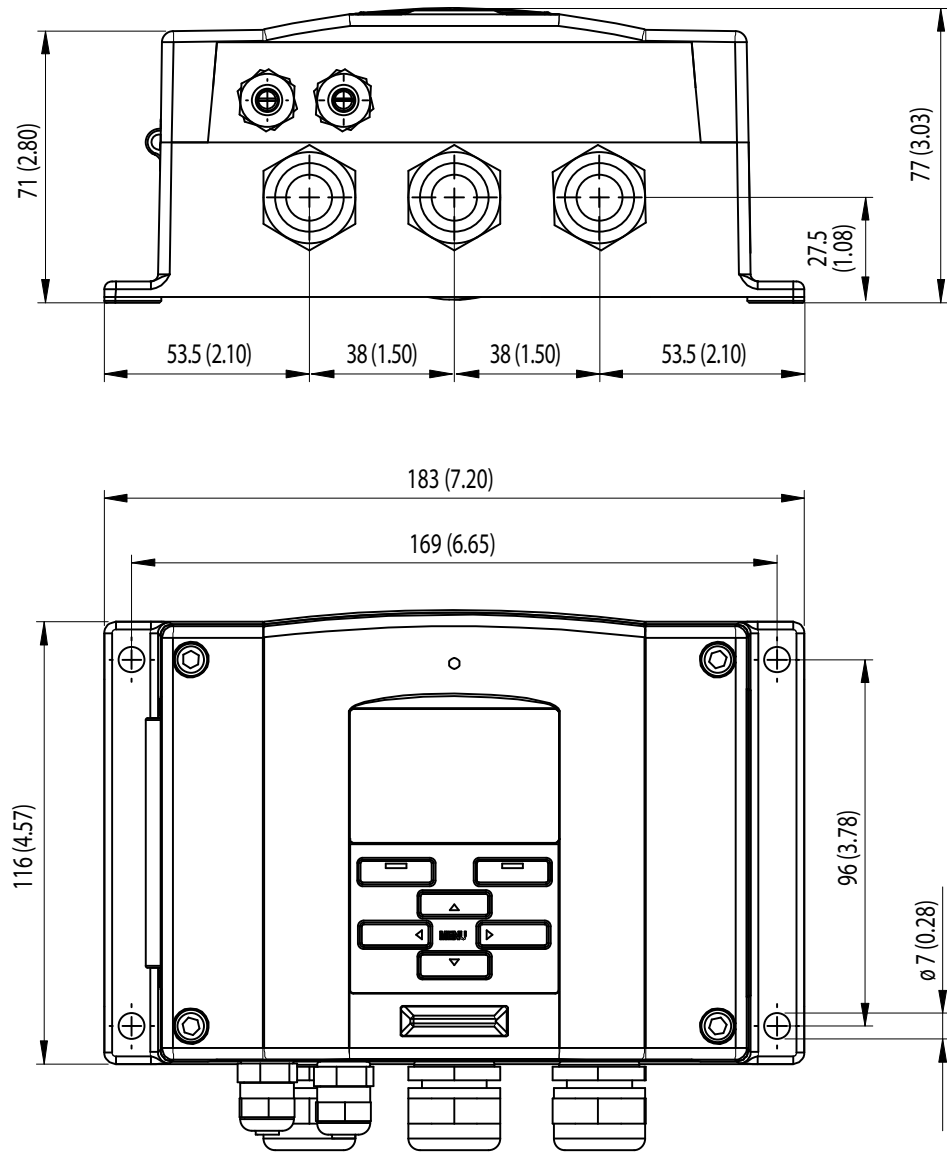
Figure 82   Transmitter Body Dimensions
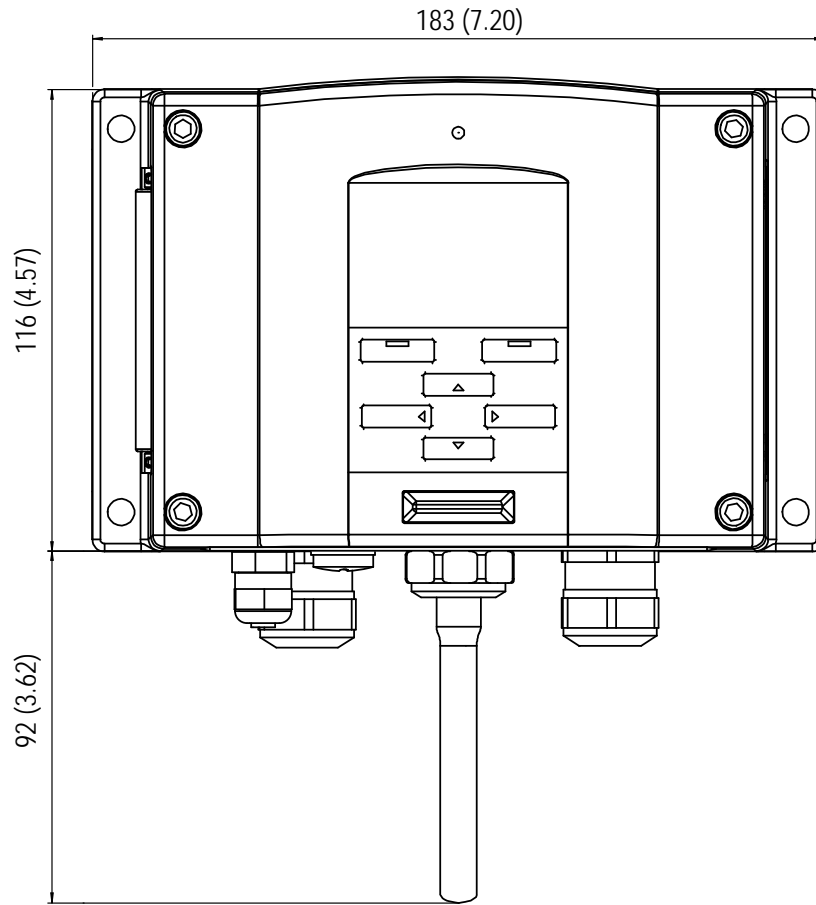
0804-035

Figure 83   WLAN Antenna Dimensions

HMT331

120 (4.72)

12 (0.47)

0508-030
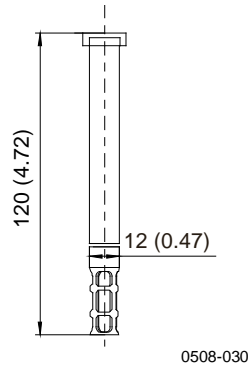
Figure 84   HMT331 Fixed Probe Dimensions

183 (7.20)

116 (4.57)

106 (4.17)

42 (1.65)

0911-060
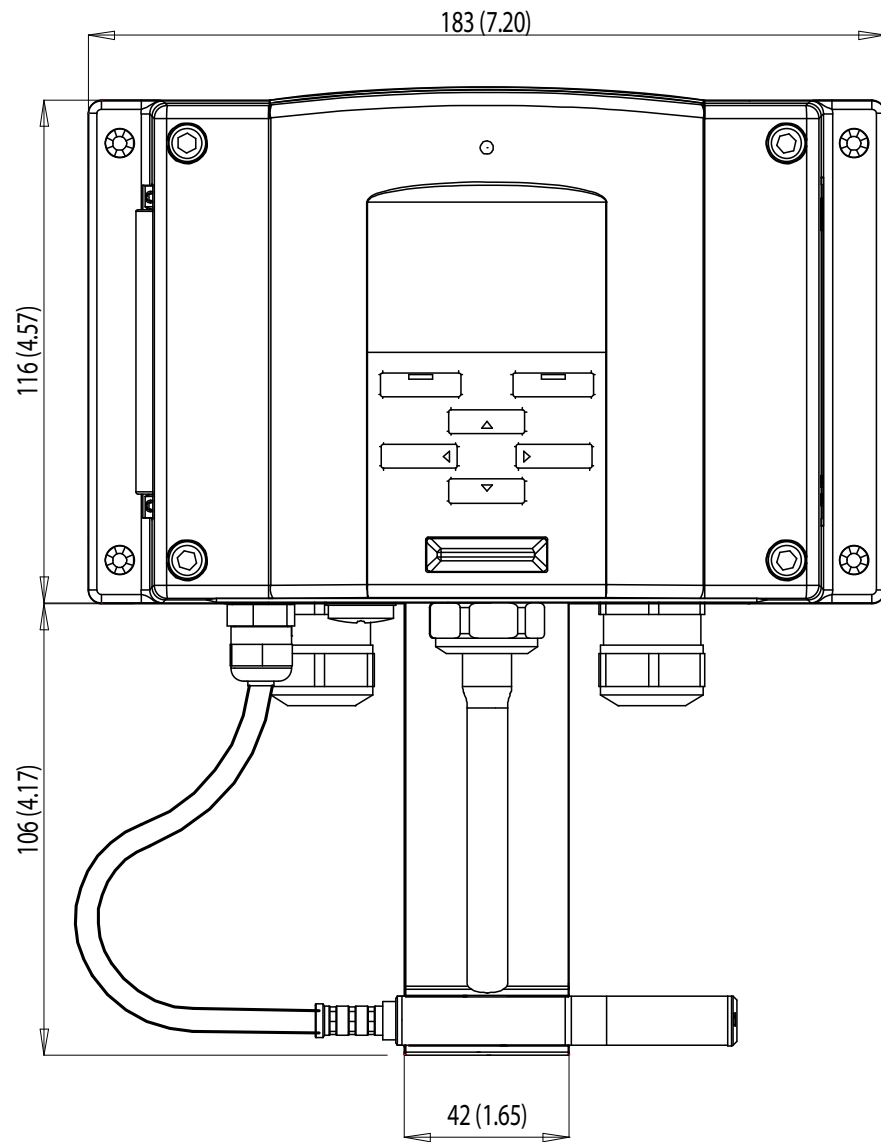
Figure 85   HMT331 Short Cable Probe Dimensions

HMT333
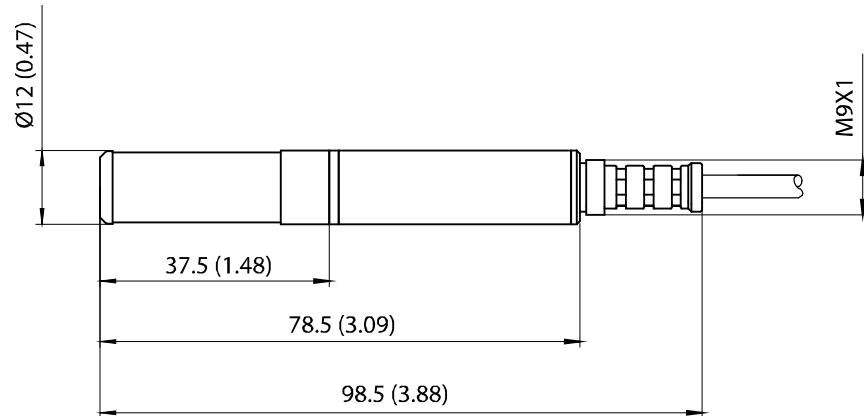
Figure 86   HMT333 Probe Dimensions

HMT334
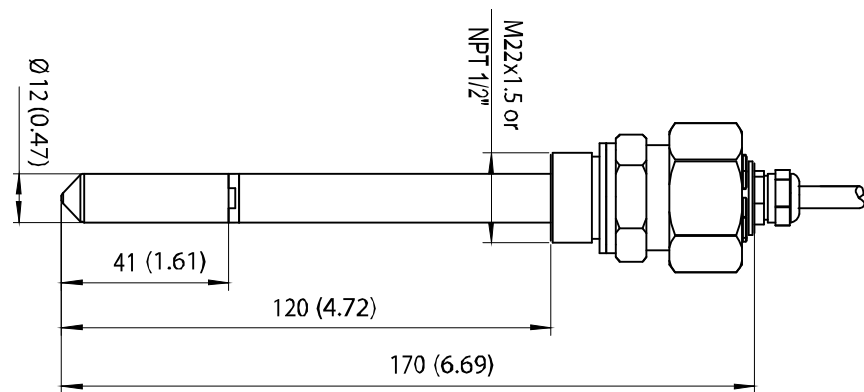
Figure 87   HMT334 Probe Dimensions

HMT335

Figure 88   HMT335 Probe Dimensions

The flange is available as an option for the HMT335 probe.

HMT337
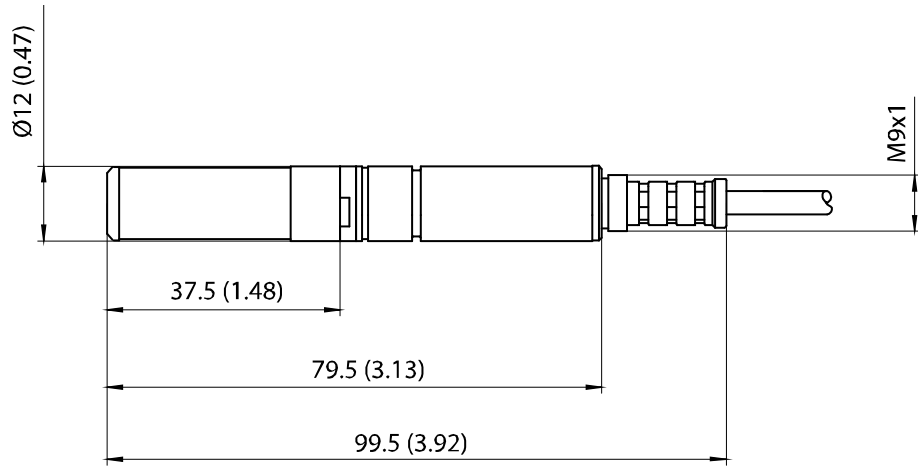
Figure 89   HMT337 Probe Dimensions
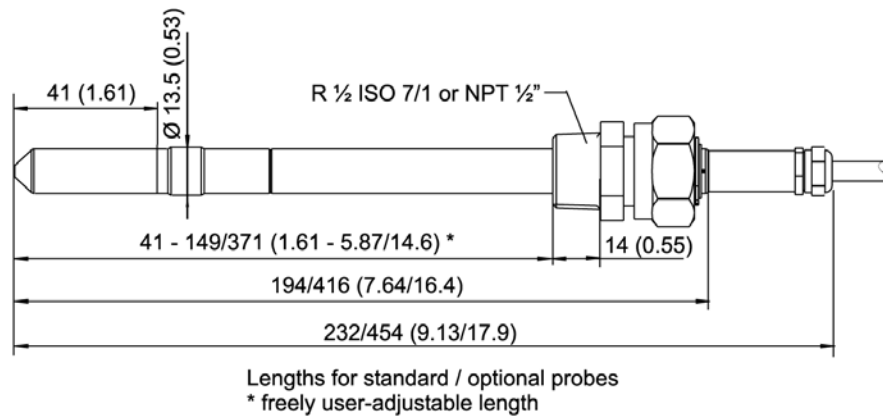
HMT338

Figure 90   HMT338 Probe Dimensions

Temperature Probe
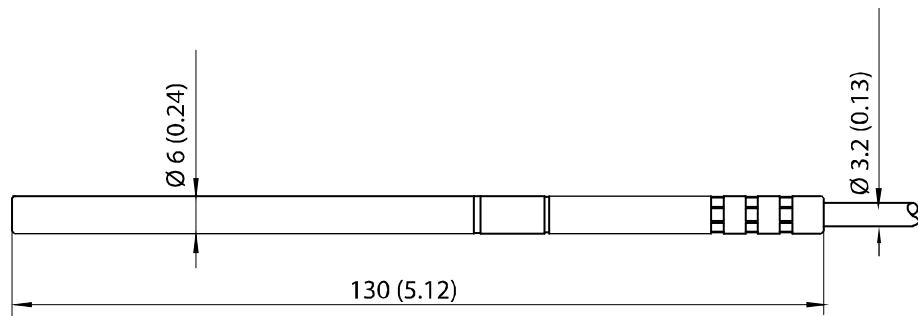
Figure 91   Optional Temperature Probe Dimensions

APPENDIX A

PROBE INSTALLATION KITS AND INSTALLATION EXAMPLES
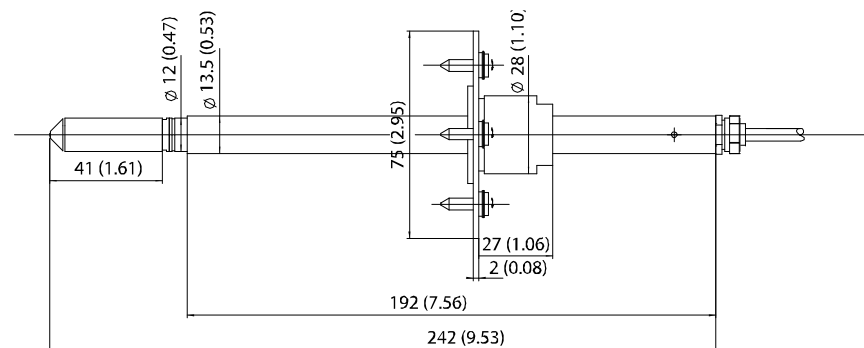
Duct Installation Kits (for HMT333/337/335)

Duct installation kit includes a flange, a sealing ring, a supporting bar, a probe attaching part, and screws for attaching the flange to the duct wall. Vaisala order codes: 210697 (for HMT333 and HMT337), 210696 (for HMT335, no supporting bar), and 215003 for temperature probe.
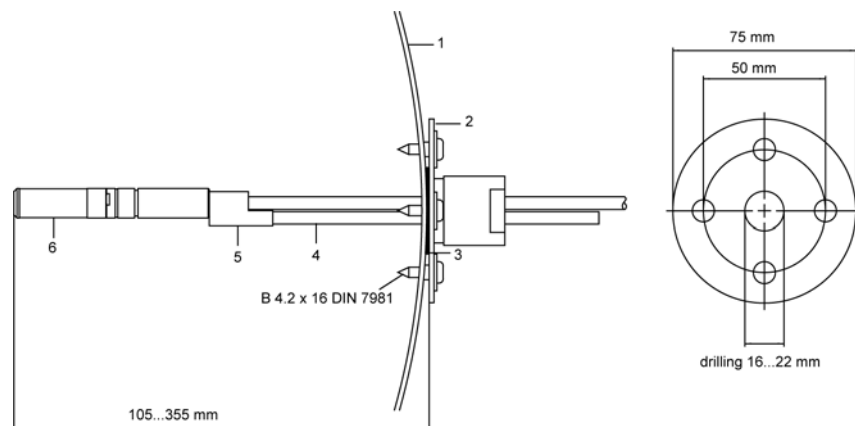
0508-021

Figure 92   Duct Mounting Installation Kit

The following numbers refer to Figure 92:

1 = Duct wall
2 = Flange
3 = Sealing ring
4 = Supporting bar (not included in the kit for HMT335)
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 remarkable, the supporting bar must be installed as deep in the duct as possible. This prevents errors caused by the heat conduction in the bar and cable.

Duct Installation Kit for Temperature Probe (for HMT337)

Vaisala duct installation kit for the T-probe includes flange, supporting bar, probe attaching part, sealing ring and the fixing screws (4 pcs). Vaisala order code: 215003.
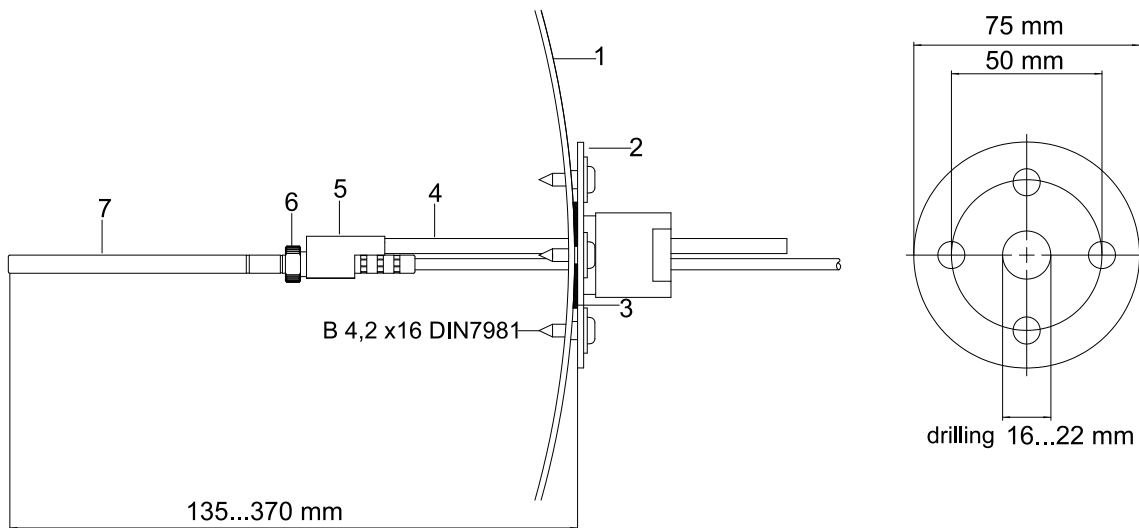
Figure 93 **Duct Mounting Installation Kit for T-Probe**

The following numbers refer to Figure 93:

1 = Duct wall
2 = Flange
3 = Sealing ring
4 = Supporting bar
5 = Probe support (to be fixed to the supporting bar)
6 = Retainer bushing (to be fixed to the probe support)
7 = Temperature probe (to be fixed to the retainer bushing)

Pressure Tight Swagelok Installation Kits (for HMT337)

RH Probe Installation

Swagelok installation kit for the relative humidity probe includes Swagelok connector with ISO3/8" or NPT1/2" thread. Vaisala order codes: SWG12ISO38 or SWG12NPT12.
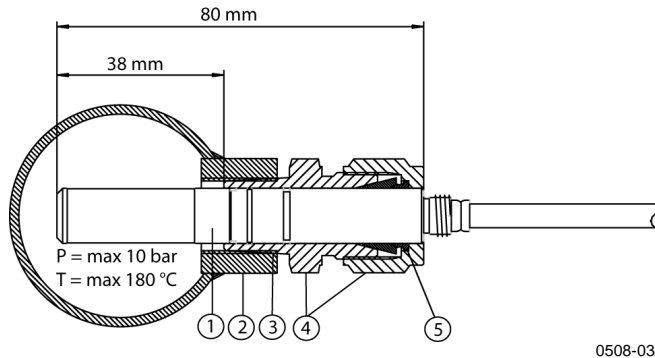
Figure 94   Swagelok Installation Kit for RH-probe

The following numbers refer to Figure 94:
1   =   Relative humidity probe
2   =   Duct connector
3   =   ISO3/8" or NPT1/2" thread
4   =   Swagelok connector
5   =   Ferrules

Temperature Probe Installation

Swagelok installation kit for T-probe includes Swagelok connector with either ISO1/8" or NPT1/8" thread. Vaisala order codes: SWG6ISO18 or SWG6NPT18.
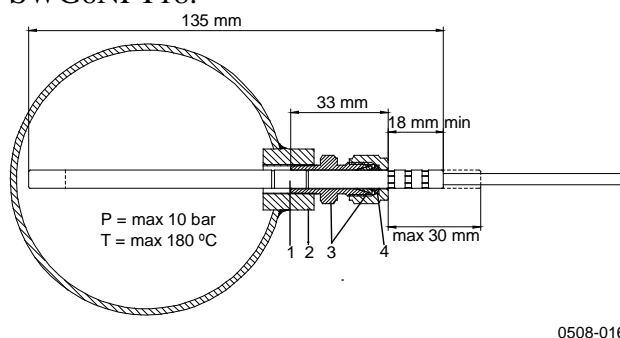
Figure 95   Swagelok Installation Kit for T-Probe

The following numbers refer to Figure 95:
1   =   T-probe
2   =   Duct connector
3   =   Swagelok connector
4   =   Ferrules

Examples of Vapor Tight Installations with Cable Gland

RH-Probe Installations (for HMT333/337)

Cable gland AGRO is available from Vaisala (order code: HMP247CG.)
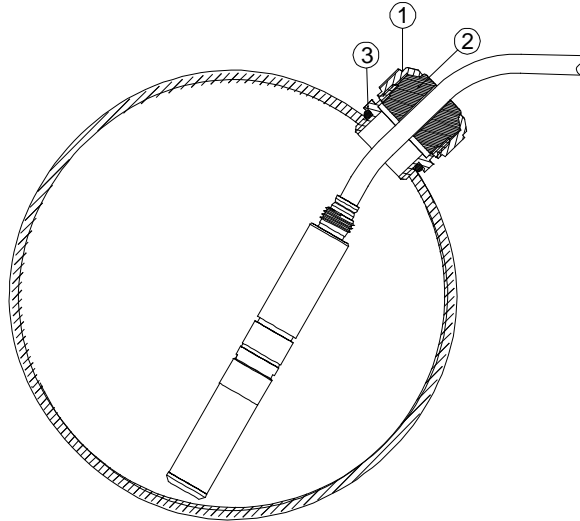
0508-026

Figure 96   Cable Installation with Cable Gland

The following numbers refer to Figure 96:

1   =   Nut (to be tightened to the body)
2   =   Seal
3   =   Body and O-ring
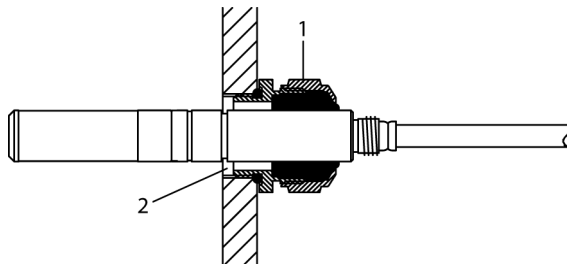
0508-018

Figure 97   Probe Installation with Cable Gland

Probe installation with cable gland is not available from Vaisala.

The following numbers refer to Figure 97:

1   =   AGRO 1160.20.145 (T= -40 ... +100 ºC) Not available from Vaisala.
2   =   In pressurized places, use a locking ring (for example: 11× 1 DIN471).

T- Probe Installations (HMT337)
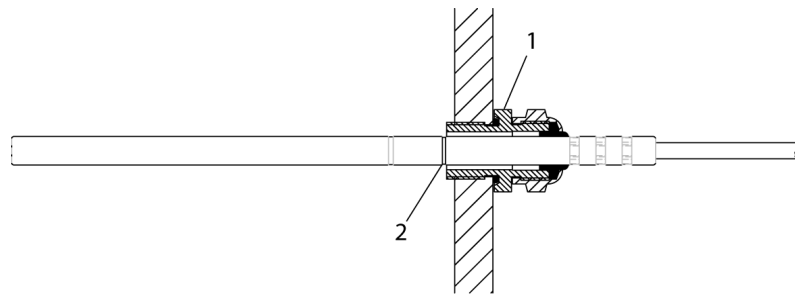
0508-015

Figure 98   Vapor Tight Installation

Vapor Tight Installation is not available from Vaisala.

The following numbers refer to Figure 98:

1   =   Cable gland. For example AGRO 1100.12.91.065
            (T= -25 ... +200 ºC)
2   =   In pressurized processes, use a locking ring
            (example: 6x 0.7 DIN471)
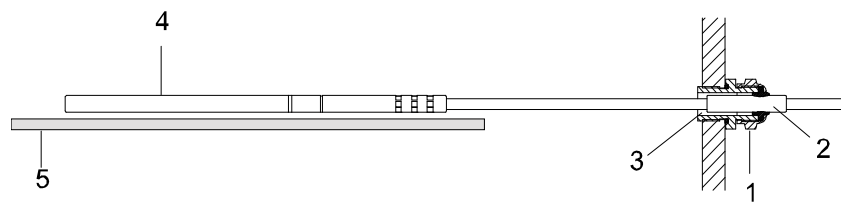
0508-022

Figure 99   Wall Mounting Installation

Wall Mounting Installation is not available from Vaisala.

The following numbers refer to Figure 99:

1   =   Cable gland. For example AGRO 1100.12.91.065
2   =   Compacted PTFE sleeve
3   =   Silicon glue between the PTFE sleeve and the cable
4   =   Temperature probe
5   =   Recommended support to keep the probe in horizontal
            position

Example of Climate Chamber Installation
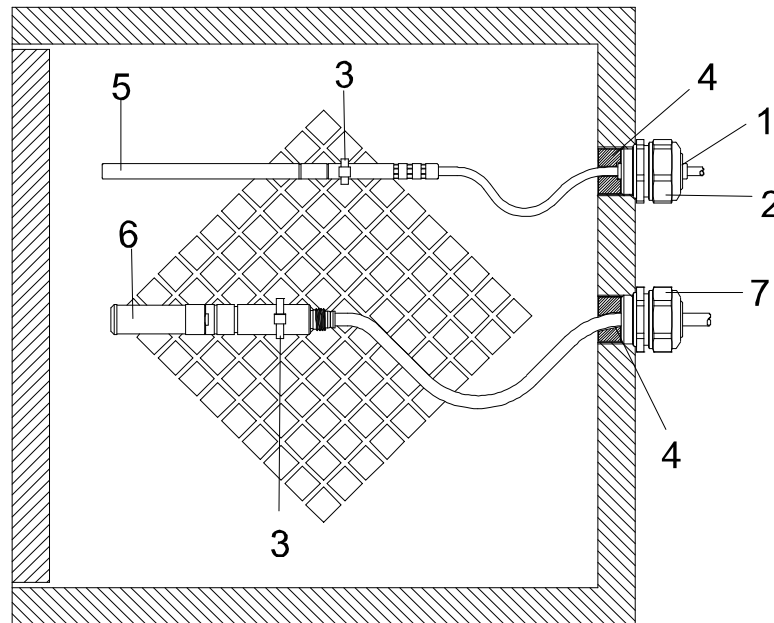
0507-016

Figure 100   Climate Chamber Installation (not Available from Vaisala)

The following numbers refer to Figure 100:

1 = PTFE sleeve
2 = Cable gland, for example: AGRO 1100.12.91.065
3 = Stainless steel cable tie or similar fastener
4 = To be sealed (silicone)
5 = Temperature probe
6 = Relative humidity probe
7 = HMP247CG, Cable gland AGRO (available from Vaisala)

NOTE	Let the cables hang loosely to prevent condensed water running to the probe.

Example of Installation Through Roof
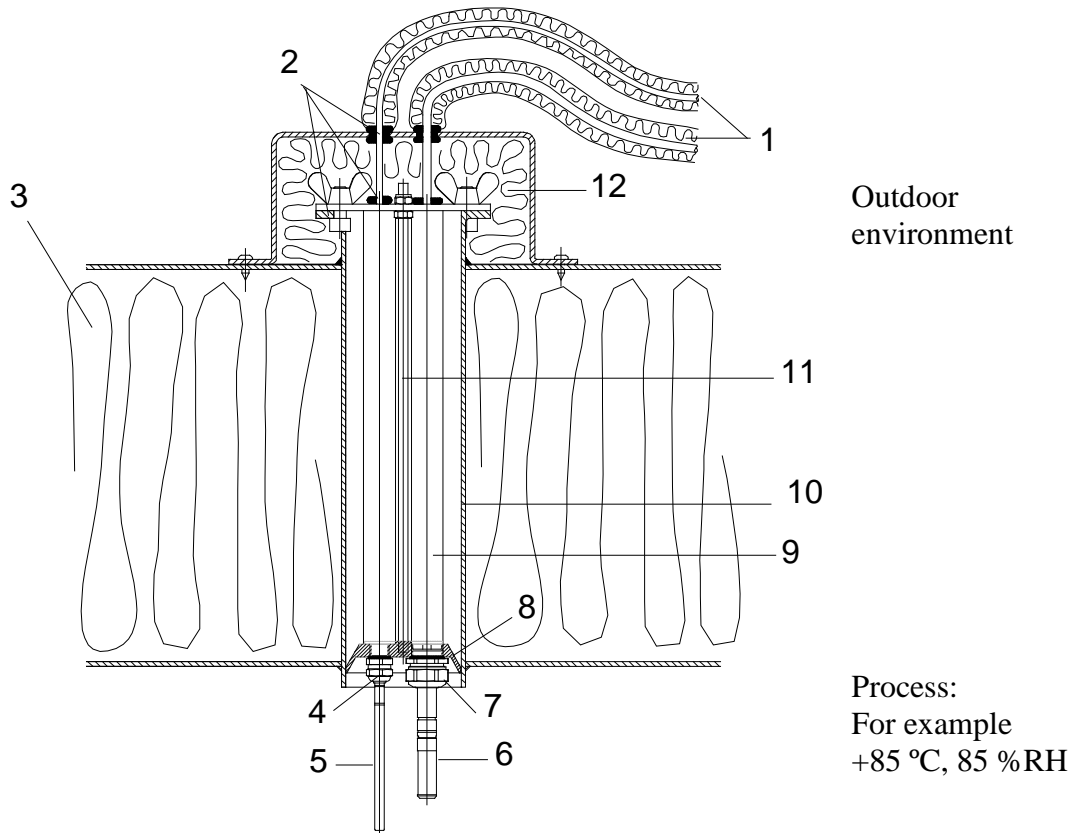
0507-015

Figure 101   Example of Installation through Roof

The following numbers refer to Figure 101:

1 = Insulated probe cables
2 = Sealings
3 = Roof
4 = Cable gland for temperature probe (for example: AGRO 1100.12.91.065)
5 = Temperature probe
6 = Relative humidity probe
7 = Cable gland for relative humidity probe (for example: AGRO 1160.20.145)
8 = Plastic adapter to protect probes from condensation water coming from the pipe. Diameter slightly smaller than tube diameter.
9 = Plastic tube for probe (2 pcs)
10 = Stainless steel tube coming through the roof
11 = Two thread bars holding the plastic adapter
12 = Insulated pipe ending

Ball Valve Installation Kit for HMT338

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 ø14 mm or more. If you install the probe (ø12 mm) in a process pipe, please 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.
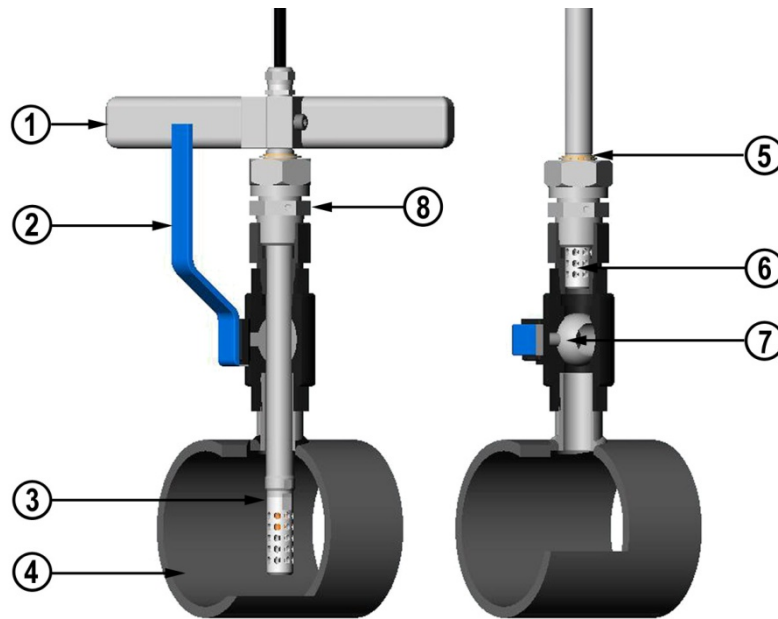
0507-043

Figure 102   Installing the HMT338 Probe Through a Ball Valve Assembly

The following numbers refer to Figure 102:

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 = Fitting screw

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 moisture reading may be incorrect.

Follow the steps below to install the HMT338 probe through a ball valve assembly. After the installation, the probe should be sitting in the process chamber or pipeline as shown in Figure 102 on page 192.

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 29 on page 47.

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 a fork wrench a further 50 ... 60º (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 30 on page 48.

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

If you wish 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.

Meteorological Installation Kit (for HMT337)

The Vaisala Meteorological Installation Kit HMT330MIK (Vaisala order code: HMT330MIK) enables the HMT337 to be installed outdoors to obtain reliable measurements for meteorological purposes. For more information, see HMT330MIK brochure and order form.
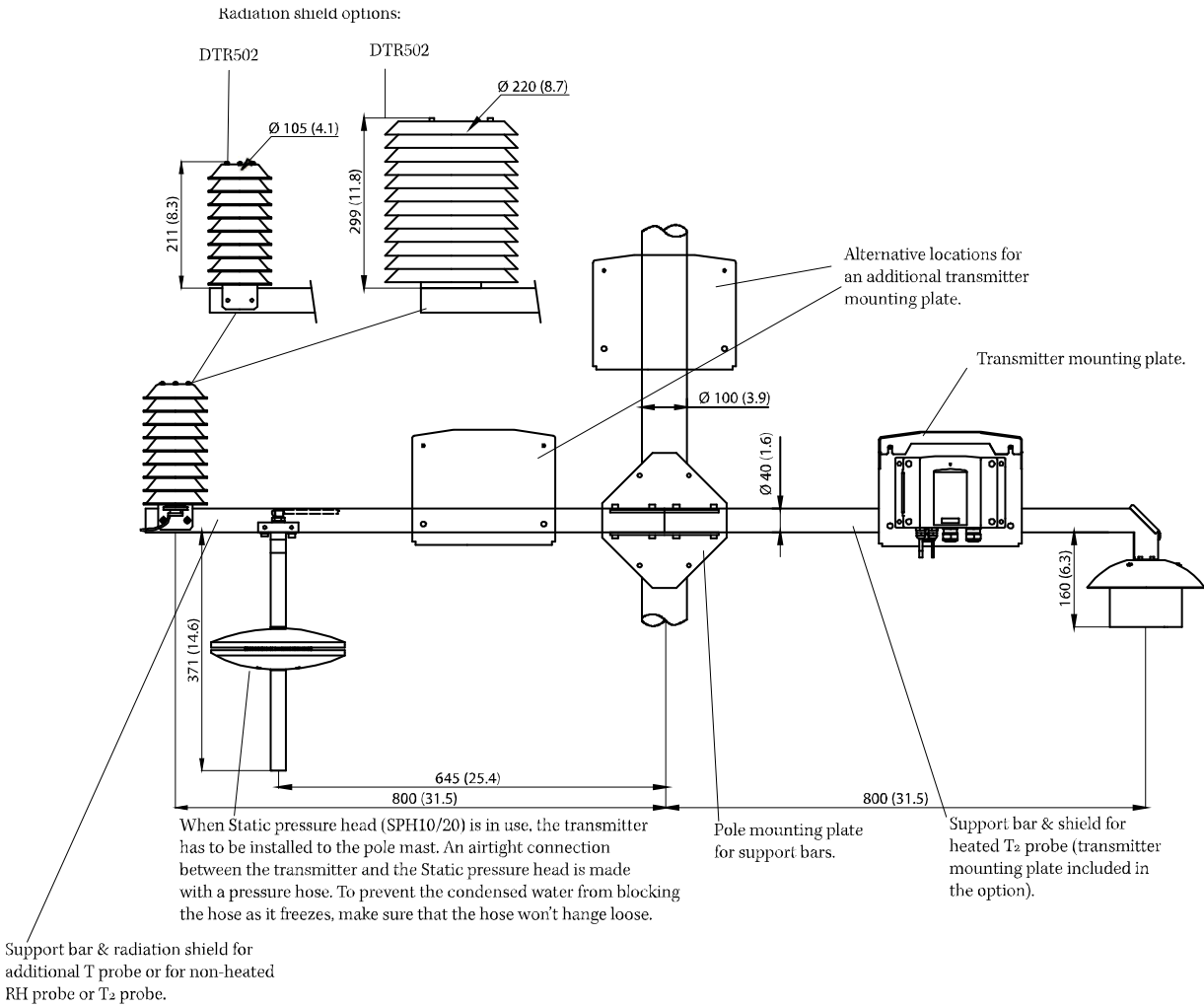
Figure 103   Meteorological Installation Kit for Outdoor Installation

APPENDIX B
CALCULATION FORMULAS

This Appendix contains the formulas used for the calculated output quantities.

The HMT330 series transmitters measure relative humidity and temperature. From these values dewpoint, mixing ratio, absolute humidity and enthalpy in normal pressure are calculated using the following equations:

Dewpoint:

$$T_d = \frac{T_n}{\dfrac{m}{\log\left(\dfrac{Pw}{A}\right)} - 1} \qquad (1)$$

P_w is the water vapor pressure. The parameters A, m, and T_n depend on temperature according to the following table:

t	A	m	Tn
<0 °C[1]	6.1134	9.7911	273.47
0 ... 50 °C	6.1078	7.5000	237.3
50 ... 100 °C	5.9987	7.3313	229.1
100 ... 150 °C	5.8493	7.2756	225.0
150 ... 180 °C	6.2301	7.3033	230.0

1) Used for frostpoint calculation if the dewpoint is negative

Mixing ratio:

$$x = 621.99 \times \frac{P_w}{p - P_w} \tag{2}$$

Absolute humidity:

$$a = 216.68 \cdot \frac{P_w}{T} \tag{3}$$

Enthalpy:

$$h = (T - 273.15) \cdot (1.01 + 0.00189 \cdot x) + 2.5 \cdot x \tag{4}$$

The water vapor saturation pressure P_{ws} is calculated by using two equations (5 and 6):

$$\Theta = T - \sum_{i=o}^{3} C_i T^i \tag{5}$$

where:

T = temperature in K
C_i = coefficients
C_0 = 0.4931358
C_1 = -0.46094296 * 10^{-2}
C_2 = 0.13746454 * 10^{-4}
C_3 = -0.12743214 * 10^{-7}

$$\ln P_{ws} = \sum_{i=-1}^{3} b_i \Theta^i + b_4 \ln \Theta \tag{6}$$

where:

b_i = coefficients
b_{-1} = -0.58002206 * 10^4
b_0 = 0.13914993 * 10^1
b_1 = -0.48640239 * 10^{-1}
b_2 = 0.41764768 * 10^{-4}
b_3 = -0.14452093 * 10^{-7}
b_4 = 6.5459673

The water vapor pressure is calculated using:

$$P_w = RH \cdot \frac{P_{ws}}{100}$$

(7)

Parts per million by volume is calculated using:

$$ppm_v = 10^6 \cdot \frac{P_w}{(p - P_w)}$$

(8)

Symbols:

T_d = dewpoint temperature (°C)
P_w = water vapor pressure (hPa)
P_{ws} = water vapor saturation pressure (Pa)
RH = relative humidity (%)
x = mixing ratio (g/kg)
p = atmospheric pressure (hPa)
A = absolute humidity (g/m3)
T = temperature (K)
h = enthalpy (kJ/kg)

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APPENDIX C
MODBUS REFERENCE

This appendix describes the Modbus functions and data of the transmitter.

Function Codes

HMT330 supports all Modbus conformance class 0 and class 1 function codes defined in Open Modbus/TCP Specification, Release 1.0.

Table 39   Supported Function Codes

Function Code	Name	Notes
01 (0x01)	Read Coils	Class 1
02 (0x02)	Read Discrete Inputs	Class 1
03 (0x03)	Read Holding Registers	Class 0
04 (0x04)	Read Input Registers	Class 1
05 (0x05)	Write Single Coil	Class 1
06 (0x06)	Write Single Register	Class 1
07 (0x07)	Read Exception Status	Class 1
08 (0x08)	Diagnostics	
15 (0x0F)	Write Multiple Coils	Class 2
16 (0x10)	Write Multiple Registers	Class 0
22 (0x16)	Mask Write Register	Class 2
23 (0x17)	Read/Write Multiple Registers	Class 2
43 / 14 (0x2B / 0x0E)	Read Device Identification	

Class 0 function codes are enough to access all measurement data and configuration settings of the HMT330 transmitter. In addition, all class 1 and some class 2 commands are also supported giving better compatibility and allowing more efficient communication when needed.

Modbus diagnostic and device identification data can be read out only with the function codes dedicated for those purposes (08 and 43 / 14).

Register Map

All data available via the Modbus interface is grouped in six contiguous blocks of registers as described in Table 40 below.

Table 40   HMT330 Modbus Register Blocks

Address	Data Format	Description
0001…0068	32-bit IEEE float	Measurement data (read-only)
0257…0290	16-bit signed integer	
0513…0517	Bit field	Status registers (read-only)
0769…0790	32-bit IEEE float	Configuration settings
1025…1035	16-bit signed integer	
1281…1288	Bit field	Configuration flags

The addresses are 1-based decimal Modbus data model addresses without the first digit (e.g. 0xxxx, 1xxxx, 3xxxx, or 4xxxx). Subtract 1 to get address field values used in Modbus Protocol Data Unit (PDU).

The register map is the same for all Modbus function codes. For example, function codes 03 and 04 return exactly same result, as do 01 and 02.

Function codes 01 and 02 return 0 if the corresponding register has value 0x0000 and 1 if the register is non-zero. Writing with function codes 05 or 15 effectively writes value 0x0000 or 0x0001 in the register(s).

Data Encoding

All numeric values are available both in 32-bit IEEE floating point and 16-bit signed integer formats.

32-Bit Floating Point Format

Floating point values are represented in standard IEEE 32-bit floating point format. Least-significant 16 bits of floating point numbers are placed at the smaller Modbus address as specified in Open Modbus TCP Specification, Release 1.0. This is also known as "little-endian" or "Modicon" word order.

NOTE	Despite the specification, some Modbus masters may expect "big-endian" word order (most-significant word first). In such case, you must select "word-swapped" floating point format in your Modbus master for HMT330 Modbus registers.

A "quiet NaN" value is returned for unavailable values. Writing any NaN or infinite value is silently ignored. A quiet NaN is, for example, 0x7FC00000; however, the master should understand any NaN value.

| NOTE | A complete 32-bit floating point value should be read and written in a single Modbus transaction (e.g. function codes 05, 06, and 22 do not have an effect on floating point values). |

16-Bit Integer Format

16-bit integer values are scaled to include the necessary decimals (see corresponding register table for the scaling factor). Negative values (when applicable) are represented in 2's complement (65535 = -1, 65534 = -2, etc.).

| NOTE | Measurement parameters with normally positive values (for example, 0 … 100 %RH) may occasionally return small negative values because of measurement inaccuracy. These negative values are returned as large 16-bit integer values (2's complement). |

If the scaled value does not fit in the range 0…65535 (16-bit range), the value is "wrapped" to the range by adding or subtracting 65536 as many times as needed.

For example, mixing ratio (x) value 658.92 g/kg is returned in 16-bit integer format as 356 (0x0164). You will need to add suitable offset to the 16-bit data in the Modbus master to get valid value out:

356 (16-bit register value) + 65536 (offset) = 65892 --> 658.92 g/kg (scaled by ×0.01).

However, most of the measurement data values do not need any offset.

A zero 16-bit value is returned for unavailable values. There is no way to distinguish missing values from actual zero values if the zero value is included in the valid measurement range of the parameter.

NOTE	If your Modbus master supports 32-bit floating point values, always use them instead of 16-bit integer registers.
	The use of 16-bit integer values is not recommended in critical applications because you cannot distinguish true zero values from zero values generated by measurement failures.
	In addition to this, 2's complement makes negative values look like large positive values, which must be taken into account when utilizing the 16-bit register values.

When writing 16-bit values in configuration registers, they are always processed as signed integers in the range of -32768…+32767. You shall

use the floating point registers to write values outside this 16-bit signed integer range. Maximum writable value is 32767 also for configuration registers that do not accept negative values.

Measurement Data (Read-Only)

Table 41   Measurement Data Registers

Name	Float	Integer	Unit
RH	0001…0002	0257 (×0.01)	%
T	0003…0004	0258 (×0.01)	°C
T_d	0007…0008	0260 (×0.01)	°C
$T_{d/f}$	0009…0010	0261 (×0.01)	°C
a	0015…0016	0264 (×0.01)	g/m³
x	0017…0018	0265 (×0.01)	g/kg
T_w	0019…0020	0266 (×0.01)	°C
H_2O	0021…0022	0267 (×1)	ppm_V
p_w	0023…0024	0268 (×0.1)	hPa
p_{ws}	0025…0026	0269 (×0.1)	hPa
H	0027…0028	0270 (×0.01)	kJ/kg
ΔT	0031…0032	0272 (×0.01)	°C
H_2O	0065…0066	0289 (×1)	ppm_W

Available measurements depend on the instrument configuration. Values may be unavailable also in case of device failure. Read status registers or exception status outputs to check for failures.

NOTE	Only real-time data can be read from the instrument. Data that is recorded in the transmitter's memory (internal memory or data logger module) cannot be read through Modbus.

Status Registers (Read-Only)

Table 42   Status Registers

Name	Address	Description
Fault status	0513	1 = No errors
Online status	0514	1 = Online data available
Error code (bits 15…0)	0516	Bit field that represents the error codes listed in Table 33 on page 152. Active errors are set to 1. For example, if bit 14 is set to 1, error code E14 is active.
Error code (bits 31…16)	0517	

Error information can retrieved also with function code 08, sub-function 02.

NOTE	Basic status information of the HMT330 transmitter is also available with the Read Exception Status function code 07. For details, see section Exception Status Outputs on page 204.

Configuration Registers

Configuration parameter registers are used to configure the measurement. Writing out-of-range values is silently ignored.

Table 43   Configuration Parameter Registers

Name	Float	Integer	Valid Range
Pressure setting default value	0769…0770	1025 (×1)	0…9999 hPa
Pressure setting temporary value	0771…0772	1026 (×1)	0…9999 hPa
Chemical purge interval	0773…0774	1027 (×1)	10…2880 min
Molecular weight for ppm_w calculation	0775…0776	1028 (×0.001)	0…999.999 g/mol

If you modify the pressure setting repeatedly, modify the temporary value at register 0771...0772 (1026) instead of the permanent setting at register 0769…0770 (1025). Set the temporary value to zero to return to the default pressure setting.

Non-metric units are not available on Modbus. If they are needed, calculate the conversion outside the transmitter.

Configuration flags are used to select some basic options of the instrument and to manually start the sensor operations.

Table 44   Configuration Flag Registers

Name	Address	Description
Standard filtering on/off	1281	1 = Filtering on
Extended filtering on/off	1282	1 = Extended filtering on
Automatic chemical purge on/off	1283	1 = Automatic purge on. See configuration register 0773…0774 (1027).
Start-up chemical purge on/off	1284	1 = Start-up purge on
Chemical purge in progress	1285	1 = Purge in progress (write 1 for manual start)
Sensor heating on/off	1287	1 = Sensor heating on (optional feature)

Flags 1281 and 1282 are mutually exclusive.

Some of the configuration registers might not have an effect depending on the instrument model and configuration.

Other configuration settings are not usually needed and are not available using the Modbus interface. The service cable must be used to change other configuration settings if needed.

Exception Status Outputs

Exception status outputs (read with function code 07) tell the summary of the HMT330 transmitter status as described in Table 45 below.

Table 45   HMT330 Exception Status Outputs

Output	Name	Description
0 (0x01)	Fault status	1 = No errors
1 (0x02)	Online status	1 = Online data available

Status information is available also with register access; see section Status Registers (Read-Only) on page 202.

Diagnostic Sub-Functions

HMT330 supports some of the Modbus diagnostic functions described in the Modbus Application Protocol Specification V1.1b. These diagnostic functions are accessed with function code 08. See Table 46 below for details.

Table 46   HMT330 Modbus Diagnostics

Code	Sub-Function Name	Notes
00 (0x00)	Return Query Data	
01 (0x01)	Restart Communications Option	Cancels the "Listen Only" mode. Data field must be set to "00 00" for Restart Communications Option. Sub-Function 01 with data field "FF 00" is rejected.
02 (0x02)	Return Diagnostic Register	Non-zero if there are active transmitter errors. For same error information, see status registers 0516 and 0517. The value of the Diagnostic Register is a logical OR of these two status registers.
04 (0x04)	Force Listen Only Mode	Puts device "off-line"
10 (0x0A)	Clear Counters and Diagnostic Register	Diagnostic Register cannot be cleared
11 (0x0B)	Return Bus Message Count	Total number of messages seen on the bus/interface
12 (0x0C)	Return Bus Communication Error Count	Number of messages with bad Modbus RTU CRC or Modbus TCP frame

Code	Sub-Function Name	Notes
13 (0x0D)	Return Bus Exception Error Count	Number of Modbus exception responses sent
14 (0x0E)	Return Slave Message Count	Number of Modbus messages processed
15 (0x0F)	Return Slave No Response Count	Number of Modbus messages received without sending a response. This happens for received broadcast messages (Modbus RTU only) or when HMT330 is in the "Listen Only" mode.

Although Modbus Diagnostics are standardized only for serial line devices, HMT330 supports the same diagnostic functions also on Modbus TCP.

NOTE	Resetting, powering up the transmitter, or reselecting the Modbus mode (by serial command or with the user interface) resets all Modbus diagnostic counters and cancels any "Listen Only" mode.

Device Identification Objects

HMT330 Modbus conforms to the extended identification level defined in the Modbus Application Protocol Specification V1.1b. Both stream access and individual access to the objects is supported.

Table 47   HMT330 Modbus Device Identification

Object Id	Object Name	Description
0x00	VendorName	"Vaisala"
0x01	ProductCode	Product code (e.g. "HMT330")
0x02	MajorMinorVersion	Software version (e.g. "5.10")
0x03	VendorUrl	"http://www.vaisala.com/"
0x04	ProductName	Product name of the instrument
0x80	SerialNumber	Serial number (e.g. "D0710040")
0x81	CalibrationDate	Date of the last calibration (e.g. "2011-02-07", empty if not available)
0x82	CalibrationText	Information text of the last calibration (empty if not available)

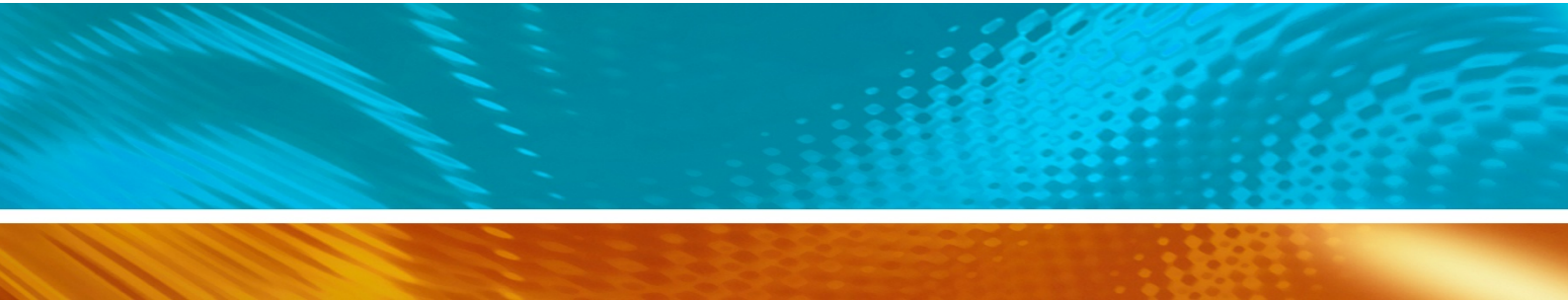# Exception Responses

Exception responses from the transmitter are according to the Modbus Application Protocol Specification V1.1b.

Table 48   HMT330 Modbus Exception Responses

Code	Name	Reason
01	ILLEGAL FUNCTION	Unsupported function code
02	ILLEGAL DATA ADDRESS	Address out of valid ranges
03	ILLEGAL DATA VALUE	Otherwise invalid request

Accessing unavailable (unsupported or temporarily missing) registers inside ranges specified in Table 41 does not generate an exception. "Unavailable" value (a quiet NaN for floating point data or zero for integer data) is returned instead. An exception is generated only for any access outside the register blocks defined in section Register Map on page 200.

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