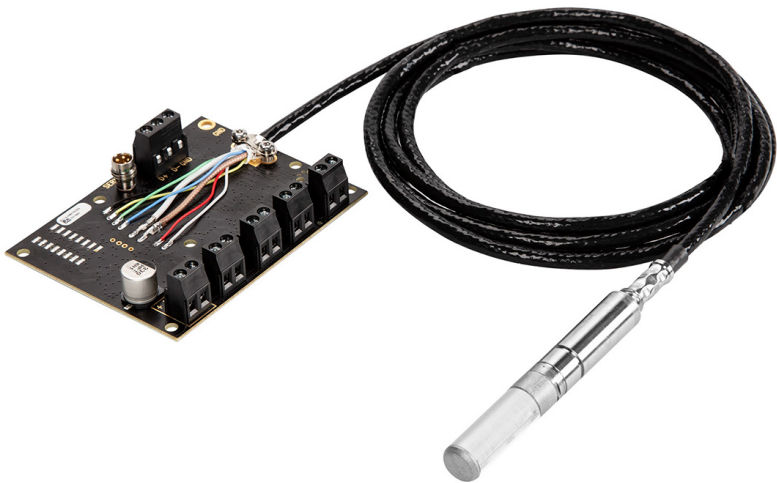


User Guide

Vaisala HUMICAP[®] Humidity and Temperature
Module
HMM170



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1. About This Document

1.1 Version Information

This document provides instructions for installing, operating, and maintaining Vaisala HUMICAP® Humidity and Temperature Module HMM170.

Table 1 Document Versions (in English)

Document Code	Date	Description
M212259EN-B	October 2019	This version. Updated section Output Parameters (page 9) . Updated technical specification. Removed content related to MI70 handheld indicator.
M212259EN-A	June 2019	First version.

1.2 Related Manuals

Table 2 Related Manuals

Document Code	Name
M212260EN	HMM170 Quick Guide
M210185EN	HMK15 User guide

1.3 Documentation Conventions



WARNING! Warning alerts you to a serious hazard. If you do not read and follow instructions 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 highlights important information on using the product.



Tip gives information for using the product more efficiently.



Lists tools needed to perform the task.



Indicates that you need to take some notes during the task.

1.4 Trademarks

Vaisala® and HUMICAP® are registered trademarks of Vaisala Oyj.

All other product or company names that may be mentioned in this publication are trade names, trademarks, or registered trademarks of their respective owners.

2. Product Overview

2.1 Introduction to HMM170

Vaisala HUMICAP® Humidity and Temperature Module HMM170 is an open frame OEM module for integration into demanding environmental chambers and harsh conditions. The module provides a digital RS-485/Modbus RTU output and three freely configurable analog output channels. The module provides relative humidity, temperature, dew point, and other calculated parameters.

HMM170 probe covers the full temperature range $-70 \dots +180 \text{ }^{\circ}\text{C}$ ($-94 \dots +356 \text{ }^{\circ}\text{F}$) used in climate chambers and the whole humidity range up to condensation. The small probe and compact component board offer easy and flexible installation. The probe cable options (2, 5, or 10 m (6.5, 16.4, or 32.8 ft)) offer excellent cost optimization and flexibility to any OEM application. By ordering HMM170 with the appropriate sensor, you can use the module in environments that are frequently sterilized with vaporized hydrogen peroxide (H_2O_2) or to measure humidity in oil medium, for example, for transformer and engine monitoring applications.

The latest general purpose HUMICAP® R2 sensor has improved corrosion resistance. The sensor can tolerate typical chemicals, such as cleaning agents used in climate chambers. The automatic sensor chemical purge function keeps the sensor clean from typical chemical fumes and the additional probe warming function prevents condensation. In case HMM170 gets in contact with water, the automatic heating rapidly dries the sensor to enable fast and accurate humidity measurement.

HMM170 is easy to install and convenient to use. It provides both digital and analog outputs for multiple needs. An integrated service port enables a quick and simple way to configure, check, and calibrate the module with the help of a USB cable and Vaisala Insight PC software.

2.2 Basic Features and Options

- Three humidity sensor types:
 - Vaisala HUMICAP® R2C (general use)
 - Vaisala HUMICAP® 180VC (for H_2O_2 use)
 - Vaisala HUMICAP® 180L2 (for moisture in oil)
- Sensor purge provides superior chemical resistance
- Probe and sensor warming functions minimize condensation on probe
- Analog output options:
 - 0/4 ... 20 mA
 - 0/1 ... 5 V
 - 0 ... 5/10 V
- Probe cable lengths:
 - 2, 5, or 10 m (6.5, 16.4, or 32.8 ft)
- Various filter types

- Service port for maintenance
 - Optional USB cable for easy connection to Vaisala Insight software for configuration, diagnostics, and temporary online monitoring

2.3 Sensor Types

HMM170 is available with three different sensor types.

Table 3 HMM170 Sensor Types

Sensor Type	Description
HUMICAP® R2C	A general purpose industrial humidity sensor with high humidity durability, good long term stability, and good tolerance against chemical exposure.
HUMICAP® 180L2	<p>A sensor that is optimized for measurement of humidity in oil medium. It has good tolerance against chemicals and moderate humidity durability.</p> <p>HUMICAP® 180L2 sensor measures moisture in oil in terms of the water activity (a_w) and temperature (T). Water activity indicates directly whether there is a risk of free water formation. The measurement is also independent of oil type and age. In addition to water activity, HMM170 can output ppm, the average mass concentration of water in oil.</p> <p>HUMICAP® 180L2 sensor does not support probe heating or chemical purge.</p>
HUMICAP® 180VC	<p>A composite humidity sensor with catalytic surface for use in applications where the sensor is exposed to H₂O₂ (hydrogen peroxide).</p> <p>Catalytic HUMICAP® 180VC sensor is a good choice when you want to measure RH between bio-decontamination cycles and you are not interested in saturation level of the air mixture during the bio-decontamination phase. Catalytic layer protects the sensor during the bio-decontamination phase. Catalytic layer catalyzes H₂O₂ into water vapor and oxygen. Therefore, the sensing polymer detects only water vapor and shows correct Relative Humidity value.</p>

2.4 Output Parameters

- Output parameter is available
- ◐ Output parameter is unavailable unless real temperature is written to Modbus register 0334_{hex} from an external source
- Output parameter is locked (value stays at latest valid reading) until measurement is possible again
- Output parameter is not valid for sensor type

Table 4 Availability of Output Parameters

Output Parameter	Output Range	HUMICAP® R2C and 180VC Sensor			HUMICAP® 180L2 Sensor
		Normal Operation	During Heating	During Purge	
Relative humidity	0 ... 100 %RH	●	◐	○	–
Temperature	-70 ... +180 °C	●	◐	○	●
Dew point temperature	-80 ... +100 °C	●	●	○	–
Dew/frost point temperature	-80 ... +100 °C	●	●	○	–
Dew/frost point temperature at 1 atm	-80 ... +100 °C	●	●	○	–
Dew point temperature at 1 atm	-80 ... +100 °C	●	●	○	–
Absolute humidity	0 ... 600 g/m ³	●	◐	○	–
Mixing ratio	0 ... 500 g/kg	●	●	○	–
Wet-bulb temperature	0 ... +100 °C	●	◐	○	–
Water concentration	0 ... 10 ⁶ ppm	●	●	○	–
Water vapor pressure	0 ... 1000 hPa	●	●	○	–
Water vapor saturation pressure	0 ... 1000 hPa	●	◐	○	–
Enthalpy	-40 ... 1500 kJ/kg	●	◐	○	–
Water activity	0 ... 1	–	–	–	●
Dew point temperature difference	-10 ... +50 °C	●	◐	○	–
Absolute humidity at NTP	0 ... 600 g/m ³	●	◐	○	–
Water concentration in oil	0 ... 10 ⁶ ppm	–	–	–	●

Output Parameter	Output Range	HUMICAP® R2C and 180VC Sensor			HUMICAP® 180L2 Sensor
Relative saturation	0 ... 100 %RS	-	-	-	●
Water mass fraction	0 ... 10 ⁶ ppm _w	●	●	○	-

2.5 Probe Head

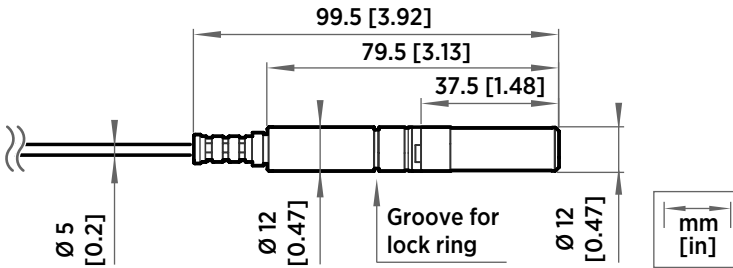


Figure 1 HMM170 Probe Head Dimensions

HMM170 is designed for applications that involve constant high humidity or rapid changes in humidity, such as drying and test chambers, combustion air, and other humidifiers and meteorological measurements, where measurement performance and chemical tolerance are essential.

- Temperature measurement range -70 ... +180 °C (-94 ... +356 °F)
- Operating temperature range for probe -70 ... +180 °C (-94 ... +356 °F)
- Probe and sensor warming functions minimize condensation on probe
- Vapor and pressure proof construction
- Stainless steel mesh filter standard in delivery

Probe Heating

HMM170 supports probe heating. Probe heating heats up not only the sensor, but the entire probe head. When probe temperature is heated above dew point temperature, condensation on the probe can be avoided while measuring the dew point temperature of the process.

Probe heating is normally disabled. If you select to enable probe heating, output parameters that are dependent on temperature measurement (such as relative humidity) are disabled, unless the true temperature of the measured environment is updated to the temperature compensation register of the probe from another measurement instrument. Output parameters that can be measured or calculated without this external temperature information (such as dew point temperature) are available even without the temperature input.

2.6 Chemical Purge

Chemical purge is a process where sensors are heated to remove possible contamination. Purge is essential for long-term performance and accuracy of the probe. Purge takes up to 6 minutes to complete, during which time measurements are not available.

Depending on the selected sensor, the purge is automatically performed:

- At probe start-up
- At probe start-up and after every 24 hours




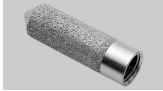


HUMICAP® 180L2 sensor does not support chemical purge.

You can trigger a purge manually at any time with Vaisala Insight software or Modbus, or by closing the external purge trigger on the component board.

2.7 Filter Types

All filters available for HMM170 are 12 mm (0.47 in) in diameter. Note the operational temperature range of each filter.

Table 5 Filter Types and Properties

	Filter Type	Diameter	Pore Size	Temperature Range
	PPS plastic grid with stainless steel mesh	12 mm (0.47 in)	15 µm	-70 ... +180 °C (-94 ... +356 °F)
	Stainless steel sintered	12 mm (0.47 in)	38 µm	-70 ... +180 °C (-94 ... +356 °F)
	Stainless steel filter for moisture in oil	12 mm (0.47 in)	3.15 mm	-70 ... +180 °C (-94 ... +356 °F)
	Porous PTFE (general purpose)	12 mm (0.47 in)	8 µm	-70 ... +180 °C (-94 ... +356 °F)

More Information

- [Accessories and Spare Parts \(page 27\)](#)

2.8 LED Indicator

The LED indicator on the component board provides a visual indication of the status of HMM170. The alarm LED functionality is preset at the factory according to order form.

Table 6 LED Indicator States

LED Color	Meaning
Not lit	Module is powered off or LED functionality is disabled.
Green	Module is powered on and ready for operation.
Green and blinking	Module is powering up or communicating using Modbus.
Red	Module is in error state.



You can use Vaisala Insight software to disable the LED indicator.

2.9 Safety

This product has been tested for safety. Note the following precautions:



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



CAUTION! Do not modify the unit or use it in ways not described in the documentation. Improper modification may lead to safety hazards, equipment damage, failure to perform according to specification, or decreased equipment lifetime.

2.9.1 ESD Protection

Electrostatic Discharge (ESD) can damage 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 in the equipment housing.

To avoid delivering high static voltages to the product:

- Handle ESD-sensitive components on a properly grounded and protected ESD workbench or by grounding yourself to the equipment chassis with a wrist strap and a resistive connection cord.

- If you are unable to take either precaution, touch a conductive part of the equipment chassis with your other hand before touching ESD-sensitive components.
- Hold component boards by the edges and avoid touching component contacts.

2.10 Regulatory Compliances

HMM170 is in conformity with the provisions of the following EU directive(s):

- RoHS Directive
- WEEE Directive

Electromagnetic compatibility of HMM170 has been tested according to the following product family standard:

EN61326-1 Electrical equipment for measurement, control and laboratory use - EMC requirements - for use in light industrial environments.

The Electrostatic Discharge test (EN 61000-4-2) was not applied to the open frame module. In the final product the module PC-board should be installed in a user restricted location / enclosure for continued ESD protection.

3. Installation

3.1 Installing Module



The measurement probe with cable is attached to the component board at Vaisala. Do not disconnect and reconnect the cable.

- 1. Attach the module securely using the mounting holes on the corners of the component board.



CAUTION! The module is delivered with a set of standoffs. Use these or other applicable standoffs to attach the module to the minimum height of 6 mm (0.24 in).

- 2. Make sure that the module has a good earth connection from the plated mounting hole.

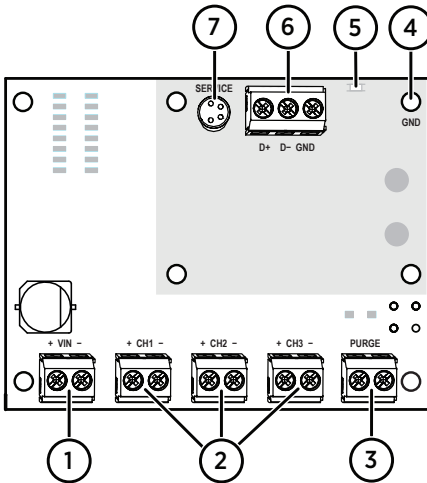


Figure 2 HMM170 Component Board

- 1 Power input (12 ... 35 VDC)
- 2 Active analog outputs (0/4 ... 20 mA, 1 ... 5 V, 0 ... 5/10 V)
- 3 External purge trigger (closing activates purge)
- 4 Grounding point
- 5 LED Indicator
- 6 Digital RS-485 (Modbus) port
- 7 Service port (temporary connection, USB cable with Vaisala Insight Software)



If you are replacing HMM100, the mounting holes in the gray area are compatible with HMM100.

3.2 Installing Probe

In humidity measurement and especially in calibration it is essential that the temperature of the probe and the measuring environment are the same. Even a small difference in temperature between the environment and the probe causes error in humidity measurement. For example, if the temperature is +20 °C (68 °F) and the relative humidity 100 %RH, a difference of ± 1 °C (± 1.8 °F) between the environment and the probe causes an error of ± 6 %RH.

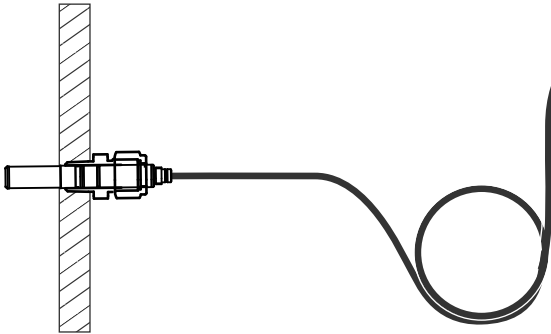


Figure 3 HMM170 Probe Installation

- ▶ 1. Select the mounting location for the probe.
 - The probe should be entirely in the measurement environment, with sufficient distance to the outer walls of the chamber or duct. Air should flow freely around the probe.
 - The probe location should represent well the environmental or process conditions, and it should be as clean as possible.
2. Remove the yellow protection cap from the probe.
3. Mount the probe head horizontally to prevent any water condensing on the probe head from running to the sensors.
4. Let the cable hang loosely to prevent condensed water from running along the cable to the probe head.
5. Seal the cable pass-through using Vaisala installation accessories.



If the temperature of the measured environment differs greatly from ambient temperature, the whole probe and preferably plenty of cable must be inside the process. This prevents measurement inaccuracy caused by heat conduction along the cable.

More Information

- [Accessories and Spare Parts \(page 27\)](#)

3.3 Vaisala Insight Software

Vaisala Insight software is a configuration software for Indigo-compatible devices. The supported operating systems are Windows 7 (64-bit), Windows 8.1 (64-bit), and Windows 10 (64-bit).

With the Insight software, you can:

- See device information and status
- See real-time measurement
- Calibrate and adjust the device
- Configure device features such as measurement filtering, chemical purge, heating, and serial communication

Download Vaisala Insight software at www.vaisala.com/insight.

HMM170 can be connected to Vaisala Insight software using a Vaisala USB cable (no. 219690).

3.3.1 Connecting to Insight Software



- Computer with Vaisala Insight software installed
- USB connection cable (order code 219690)

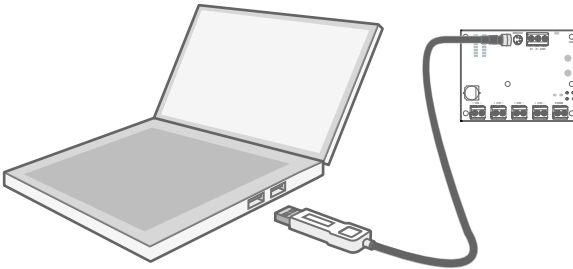



Figure 4 Connecting Module to Insight

1. Open the Insight software.
2. Connect the USB cable to a free USB port on the PC.
3. Connect the USB cable to the service port of the module. The USB cable powers up the module.

3.3.2 Configuration Options

Select  > **Configure Device** to access configuration options in Insight software.

The available configuration options correspond to the Modbus configuration registers. Insight software is the recommended way to change the device configuration.



You can restore the device back to its default settings using the **Factory Default Settings > Restore Settings** function. Doing this will also clear any user adjustment and restore the latest factory calibration.

More Information

- [Modbus Reference \(page 28\)](#)

4. Operation

4.1 Using Service Port

HMM170 has a 4-pin M8 service port connector on the component board. Vaisala offers an optional USB cable (Vaisala order code 219690) for connecting the module to your PC.



The service port is intended for short-term use such as calibration. For permanent installation, use the permanent digital Modbus and/or analog terminals.

If you have not used the HMM170 USB cable before, first install the driver.

More Information

- ▶ [Installing the Driver for the USB Service Cable \(page 18\)](#)

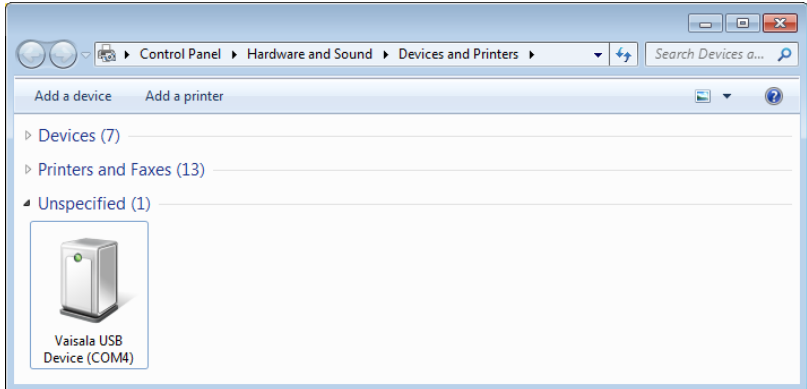
4.1.1 Installing the Driver for the USB Service Cable



Only Windows® operating systems are supported by the driver of the USB service cable.

- ▶ 1. Connect the USB service cable to a USB port on your computer. Windows® detects the new device and installs the appropriate driver.
2. Open **Devices and Printers** from the Windows® Start menu. Use search to find it if necessary (search for "devices").

3. Locate the cable in the list of devices:
 - If the device is listed as **Vaisala USB Device** with a COM port number in brackets, the cable is ready for use. **Note the COM port number, you will need it later.**
 - If the device is listed as **Vaisala USB Instrument Cable** without a COM port number listed, you must install the driver manually.



4. To install the driver manually:
 - a. Disconnect the USB service cable from the computer.
 - b. Download the Vaisala USB driver at <http://www.vaisala.com/software> (select the appropriate USB Instrument Driver Setup for your cable).
 - c. Run the USB driver installation program *Vaisala USB Device Driver Setup.exe*. Accept the installation defaults.
 - d. Go back to [step 1](#) and verify that the driver installation works as expected.

4.2 Modbus

The module can be accessed using the Modbus serial communication protocol. The supported Modbus variant is Modbus RTU (Serial Modbus) over RS-485 interface.

More Information

- [Modbus Reference \(page 28\)](#)

5. Maintenance

5.1 Cleaning Probe



- Lint-free cloth
- Isopropyl alcohol (70 %)



CAUTION! Do not attempt to clean the sensors under the filter in any way.

- ▶ 1. Moisten a lint-free cloth with isopropyl alcohol (70 %).
2. Wipe the probe head and cable with the lint-free cloth.



Do not spray anything directly on the probe head or immerse the probe head in liquid, since that may deposit impurities on the sensors.



Do not wipe the filter: wiping the filter may block its pores and/or deposit residue on the filter. If the filter is heavily contaminated, replace it.

3. After cleaning the probe, it is recommended to perform a chemical purge.

More Information

- [Chemical Purge \(page 11\)](#)
- [Replacing Filter \(page 20\)](#)

5.2 Replacing Filter



- New compatible filter
- Clean lint-free gloves



CAUTION! Without the filter in place, the sensor is easily damaged - handle the probe head carefully.

- ▶ 1. Put on clean gloves before touching the filter.
2. Turn the filter counter-clockwise to loosen it.
3. Remove the filter from the probe head. Be careful not to touch the sensor with the filter.
4. Install a new filter on the probe head. Tighten the filter properly (recommended force 5 Nm).

More Information

- ▶ [Filter Types \(page 11\)](#)
- ▶ [Accessories and Spare Parts \(page 27\)](#)

5.3 Calibration and Adjustment

The module is fully calibrated and adjusted as shipped from the factory. To maintain the accuracy of the measurement, calibrate and adjust the module as needed. Typical calibration interval is one year, but depending on the application it may be necessary to check the accuracy more frequently.

When adjustment is necessary, you can have Vaisala calibrate and adjust the module. To order calibration services from Vaisala, visit store.vaisala.com. You can also do the adjustment yourself using the Insight software.



WARNING! When returning a product for calibration or repair, make sure it has not been exposed to dangerous contamination, and is safe to handle without special precautions.



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

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



Calibration means comparing the measurement output of the device to a known reference, such as a known environment in a calibration chamber or the output of a reference instrument. Correcting the reading of the device so that it measures accurately is referred to as **adjustment**.

5.3.1 Adjustment Points and Requirements

You can adjust the humidity measurement in 1 ... 5 points, and temperature measurement in 1 ... 2 points. Note the following:

- Humidity adjustment in more than two points is available when using Insight software in **Advanced Mode**.
- If you are adjusting in more than one humidity point, make sure the first two points are at least 10 %RH apart.
- The module will reject adjustments that are too large, that is, greater than 10 %RH for humidity and 0.5 °C (0.9 °F) for temperature. If the module appears to need such a large correction, perform a sensor purge and repeat the adjustment procedure. Make sure the measurement has stabilized and the reference environment is reliable. If the required adjustment is still too large, the module needs to be serviced by Vaisala.



When adjustment of humidity measurement is necessary, Vaisala recommends adjusting in two points, 11 %RH and 75 %RH. These humidities can be produced using the Vaisala HMK15 Humidity Calibrator. Adjustment of temperature measurement is typically not necessary.



5.3.2 Adjusting Measurement with Insight Software



- Computer with Windows operating system and Vaisala Insight software installed
- Vaisala USB cable 219690 for connecting the module
- Reference environment(s) for producing the desired humidity and/or temperature

This procedure can be used to adjust the module's humidity or temperature measurement. If you want to adjust both, repeat the procedure.

Because stabilization of temperature and humidity takes time, you should expect the adjustment procedure to take at least 30 minutes for each adjustment point.

- ▶ 1. Connect the module to Insight. See [Connecting to Insight Software \(page 16\)](#).
2. If you intend to adjust humidity measurement, first select  > **Purge** to perform a chemical purge to condition the sensor. Wait a few minutes for purge to complete.
3. Select  > **Calibrate** > **Yes** to switch the module to calibration mode.
In calibration mode, the device will not use functions that may interfere with calibration and adjustment.
4. Select the type of adjustment to perform: **RH adjustment** or **T adjustment**.

5. Define the needed adjustment for the first measurement point:
 - a. Insert the probe head in the reference environment for the first calibration point.
 - b. Wait for the measurement to stabilize fully.
 - c. Click the **Reference value, point 1** text box and enter the reference value of the calibration point. Press **ENTER** or click outside the text box when done.
 - d. The module automatically enters the measured values for the calibration point.
6. If you want to adjust in more than one point, repeat [step 5](#) for all desired calibration points.



You can adjust humidity measurement in up to five points when Insight is set to **Advanced mode**.

7. Select **Activate adjustment > Yes** to store the adjustment in the module.
8. Check the message that appears at the top of the screen. If the message indicates that the adjustment is activated successfully, your adjustment is stored in the module.
9. Select the **Calibration information** tab and update the **Calibration date** and **Calibration text**.
10. Select **Close > Yes** to exit the calibration mode.

6. Technical Data

6.1 HMM170 Specifications

Table 7 Measurement Performance

Property	Description/Value
Relative Humidity	
Measurement range	0 ... 100 %RH
Accuracy ^{1) 2)}	
at +15 ... +25 °C (59 ... +77 °F)	±1 %RH (0 ... 90 %RH) ±1.7 %RH (90 ... 100 %RH)
at -20 ... +40 °C (-4 ... +104 °F)	± (1.0 + 0.008 × reading) %RH
at -40 ... +180 °C (-40 ... +356 °F)	± (1.5 + 0.015 × reading) %RH
Factory calibration uncertainty at +20 °C (+68 °F) ³⁾	±0.6 %RH (0 ... 40 %RH) ±1.0 %RH (40 ... 90 %RH) ±1.1 %RH (90 ... 95 %RH)
Humidity sensor types	HUMICAP® R2C HUMICAP® 180L2 HUMICAP® 180VC
T ₉₀ response time ⁴⁾	50 s with steel mesh filter 60 s with sintered filter
Temperature	
Measurement range	-70 ... +180 °C (-94 ... +356 °F)
Temperature sensor	Pt100 RTD Class F0.1 IEC 60751
Typical accuracy at +20 °C (+68 °F)	±0.2 °C (± 0.36 °F)

- 1) Including non-linearity, hysteresis and repeatability.
- 2) With HUMICAP® 180VC sensor, accuracy is not specified below -20 °C (-4 °F) operating temperature.
- 3) Defined as ±2 standard deviation limits. Small variations possible; see also calibration certificate.
- 4) At +20 °C (+68 °F) in 0.1 m/s air flow with Vaisala HUMICAP® R2C sensor.

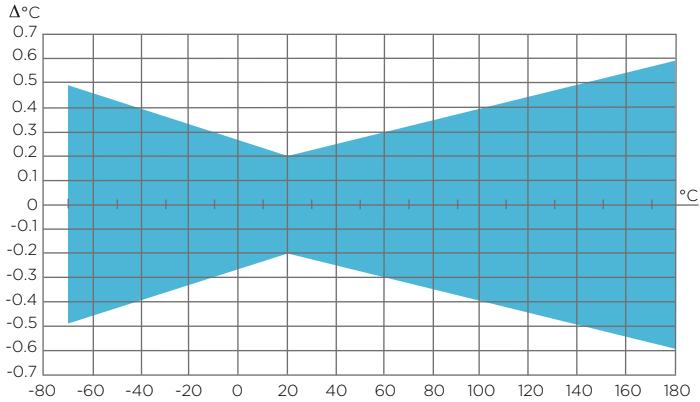


Figure 5 Temperature Measurement Accuracy over Temperature Range

Table 8 Operating Environment

Property	Description/Value
Operating temperature for component board	-40 ... +60 °C (-40 ... +140 °F)
Operating humidity range for component board	0 ... 100 %RH, non-condensing
Storage temperature	-55 ... +80 °C (-67 ... +176 °F)
Operating pressure	0 ... 10 bar

Table 9 Inputs and Outputs

Property	Description/Value
Three analog outputs (selectable and scalable)	0 ... 20 mA, 4 ... 20 mA 0 ... 1 V, 0 ... 5 V, 1 ... 5 V, or 0 ... 10 V
Typical accuracy of analog output at +20 °C (+68 °F)	±0.05 % full scale
Typical temperature dependence of analog output	0.005 %/°C (0.003 %/°F) full scale
External load	$R_L < 500 \Omega$
Digital output	RS-485 serial, Modbus
Service port	M8 connector for USB cable
Operating voltage	15 ... 35 VDC
Start-up time	3 s at power-up
Maximum wire size	0.5 ... 1.5 mm ² (AWG)

Property	Description/Value
Power Consumption	
Analog outputs	12 mA (voltage) 50 mA (current)
Chemical purge at 24 VDC	+220 mA
Warmed probe at 24 VDC	+240 mA

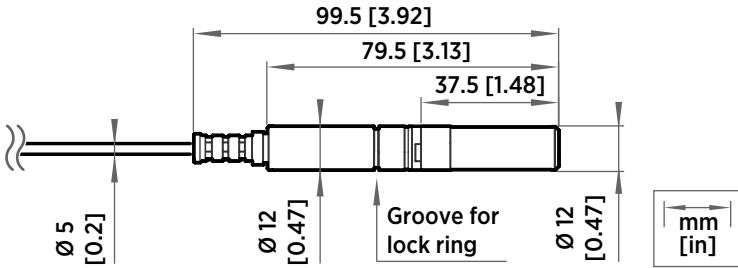


Figure 6 Probe Head Dimensions

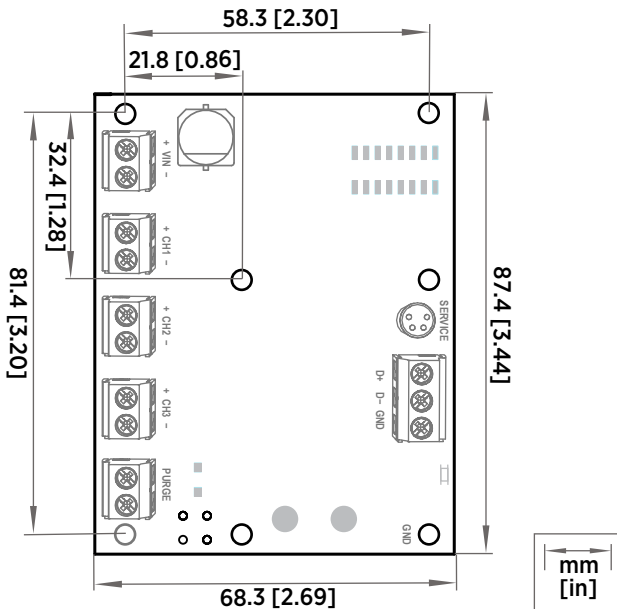


Figure 7 Component Board Dimensions

6.2 Accessories and Spare Parts

Table 10 Accessories

Item	Order Code
USB cable for PC connection ¹⁾	219690
Cable gland M20×1.5 for probe cable	HMP247CG
Swagelok NPT 1/2" adapter for probe	SWG12NPT12
Swagelok ISO 1/2" adapter for probe	SWG12ISO12
Duct installation kit for probe	210697

1) *Vaisala Insight software for Windows available at www.vaisala.com/insight*

Table 11 Spare Parts

Item	Order Code
PPS plastic grid and stainless steel mesh filter	DRW010281SP
Stainless steel sintered filter	HM47280SP
Sintered PTFE filter with 20 µm pore size	219452SP
Stainless steel filter	HM47453SP

Appendix A. Modbus Reference

A.1 Default Communication Settings

Table 12 Default Modbus Serial Communication Settings

Property	Description/Value
Serial bit rate	19200
Parity	None
Number of data bits	8
Number of stop bits	2
Flow control	None
Modbus device address	240

You can use up to ten probes on the same RS-485 line. You must configure each probe on the line to have a different Modbus address.

A.2 Function Codes

Table 13 Modbus Function Codes

Function Code (Decimal)	Function Code (Hexadecimal)	Name	Notes
03	03 _{hex}	Read Holding Registers	Class 0
16	10 _{hex}	Write Multiple Registers	Class 0
43 / 14	2B _{hex} / 0E _{hex}	Read Device Identification	

A.3 Data Encoding

In the data registers, the numeric values are available in one or two formats with separate register addresses: 32-bit IEEE floating point format and/or 16-bit signed integer format.

A.3.1 32-Bit Floating Point or Integer Format

Least significant 16 bits of floating point or integer 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. Floating point values are represented in standard IEEE 32-bit floating point format.



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 the Modbus registers of the device.

A "quiet NaN" value is returned for unavailable values. A quiet NaN is, for example, 7FC00000_{hex}; however, the master should understand any NaN value.



A complete 32-bit floating point or integer value should be read and written in a single Modbus transaction.

A.3.2 16-Bit Integer Format

Some 16-bit integer values in the data registers are scaled to include the necessary decimals. The scaling factors for those values are shown in the register tables.

Table 14 16-bit Signed Integer Format Details

Value	Description
0000 _{hex} ... 7FFE _{hex}	Value in range 0 ... 32766
8002 _{hex} ... FFFF _{hex}	Value in range -32766 ... -1 (2's complement)
8000 _{hex}	Value is not available (quiet NaN)



Some values may exceed the signed 16-bit range even in normal operation. To access such values, use the floating point registers instead.

A.4 Modbus Registers



CAUTION! Registers are numbered in decimal, starting from 1. Register addresses in actual Modbus messages (Modbus Protocol Data Unit (PDU) are in hexadecimal and start from zero. Subtract 1 from the register number presented in this manual to get the address used in the Modbus message (for example, register number 1 corresponds to address 0_{hex} in the actual Modbus message).

Accessing unavailable (temporarily missing) measurement data does not generate an exception. “Unavailable” value (a quiet NaN for floating point data or 8000_{hex} for integer data) is returned instead. An exception is generated only for any access outside the applicable register ranges.

A.4.1 Measurement Data Registers

Table 15 Modbus Measurement Data Registers (Read-Only)

Register Number (Decimal)	Address (Hexadecimal)	Register Description	Data Format	Metric Unit
Floating Point Values				
1	0000 _{hex}	Relative humidity	32-bit float	%RH
3	0002 _{hex}	Temperature	32-bit float	°C
7	0006 _{hex}	Dew point temperature	32-bit float	°C
9	0008 _{hex}	Dew/frost point temperature	32-bit float	°C
11	000A _{hex}	Dew/frost point temperature at 1 atm	32-bit float	°C
13	000C _{hex}	Dew point temperature at 1 atm	32-bit float	°C
15	000E _{hex}	Absolute humidity	32-bit float	g/m ³
17	0010 _{hex}	Mixing ratio	32-bit float	g/kg
19	0012 _{hex}	Wet-bulb temperature	32-bit float	°C
21	0014 _{hex}	Water concentration	32-bit float	ppm _v
23	0016 _{hex}	Water vapor pressure	32-bit float	hPa
25	0018 _{hex}	Water vapor saturation pressure	32-bit float	hPa
27	001A _{hex}	Enthalpy	32-bit float	kJ/kg
29	001C _{hex}	Water activity	32-bit float	a _w
31	001E _{hex}	Dew point temperature difference	32-bit float	°C
33	0020 _{hex}	Absolute humidity at NTP	32-bit float	g/m ³
35	0022 _{hex}	Water concentration in oil	32-bit float	ppm _w

Register Number (Decimal)	Address (Hexadecimal)	Register Description	Data Format	Metric Unit
Floating Point Values				
41	0028 _{hex}	Relative saturation	32-bit float	%
65	0040 _{hex}	Water mass fraction	32-bit float	ppm _w
Integer Values				
257	0100 _{hex}	Relative humidity	16-bit signed integer	%RH * 100
258	0101 _{hex}	Temperature	16-bit signed integer	°C * 100
260	0103 _{hex}	Dew point temperature	16-bit signed integer	°C * 100
261	0104 _{hex}	Dew/frost point temperature	16-bit signed integer	°C * 100
262	0105 _{hex}	Dew/frost point temperature at 1 atm	16-bit signed integer	°C * 100
263	0106 _{hex}	Dew point temperature at 1 atm	16-bit signed integer	°C * 100
264	0107 _{hex}	Absolute humidity	16-bit signed integer	g/m ³ * 100
265	0108 _{hex}	Mixing ratio	16-bit signed integer	g/kg * 100
266	0109 _{hex}	Wet-bulb temperature	16-bit signed integer	°C * 100
267	010A _{hex}	Water vapor concentration	16-bit signed integer	ppm _v
268	010B _{hex}	Water vapor pressure	16-bit signed integer	hPa * 10
269	010C _{hex}	Water vapor saturation pressure	16-bit signed integer	hPa * 10
270	010D _{hex}	Enthalpy	16-bit signed integer	kJ/kg * 100
271	010E _{hex}	Water activity	16-bit signed integer	a _w
272	010F _{hex}	Dew point temperature difference	16-bit signed integer	°C * 10

Integer Values				
273	0110 _{hex}	Absolute humidity at NTP	16-bit signed integer	g/m ³ * 100
274	0111 _{hex}	Parts per million in oil	16-bit signed integer	ppm _w
277	0114 _{hex}	Relative saturation	16-bit signed integer	% * 100
289	0120 _{hex}	Water mass fraction	16-bit signed integer	ppm _w

A.4.2 Configuration Registers

Table 16 Modbus Configuration Data Registers (Writable)

Register Number (Decimal)	Register Address (Hexadecimal)	Register Description	Data Format	Unit / Valid Range
General				
1287	0506 _{hex}	Extra heat on/off. Enables heating of humidity sensor when close to saturation. Measurement is disabled for the duration of heating and cooling.	16-bit boolean	0 = Off (default) 1 = On
1289	0508 _{hex}	Probe heating on/off. When on, output parameters that depend on temperature measurement (for example, relative humidity) are disabled unless temperature is written to register 0334 _{hex} from an external source.	16-bit boolean	0 = Off (default) 1 = On
2561	0A00 _{hex}	User information	Text	Text string of 24 bytes in UTF-8 encoding

Compensation Setpoints				
769	0300 _{hex}	Pressure compensation setpoint	32-bit float	Unit: hPA Default: 1013.25 hPa
821	0334 _{hex}	Temperature compensation setpoint. If a value is written to this register, the device uses it instead of its own temperature measurement. When probe heating is in use, temperature must be written to this register to enable output parameters that depend on temperature measurement (for example, relative humidity).	32-bit float	Unit: °C
Purge				
773	0304 _{hex}	Purge interval	32-bit float	Unit: min 10 ... 14400
1283	0502 _{hex}	Interval purge on/off	16-bit boolean	0 = Off 1 = On
1284	0503 _{hex}	Startup purge on/off	16-bit boolean	0 = Off 1 = On

Filtering				
795	031A _{hex}	Measurement filtering factor	32-bit float	<p>Range: 0.000 ... 1.000</p> <p>1.000 = Reading shows 100 % of the most recent measured value (no filtering, default).</p> <p>0.01 ... 0.99 = Reading shows 1 ... 99 % of the most recent measured value and part of the previous reading (filtering is applied). For example, "0.9" means that the filtered measurement reading = 90 % of the most recent measured value + 10 % of the previous reading.</p>
1281	0500 _{hex}	Filtering on/off	16-bit boolean	<p>0 = Off</p> <p>1 = On</p>
1282	0501 _{hex}	Enable or disable measurement filtering using the user-defined filtering factor (register 031A _{hex})	16-bit boolean	<p>0 = Off</p> <p>1 = On</p>
Communication				
1537	0600 _{hex}	Modbus address	16-bit integer	<p>1 ... 247</p> <p>Default: 240</p>

Communication				
1538	0601 _{hex}	Bit rate	enum	0 = 300 1 = 600 2 = 1200 3 = 2400 4 = 4800 5 = 9600 6 = 19200 7 = 38400 8 = 57600 9 = 115200
1539	0602 _{hex}	Parity, data, stop bits	enum	0 = None, 8, 1 1 = None, 8, 2 2 = Even, 8, 1 3 = Even, 8, 2 4 = Odd, 8, 1 5 = Odd, 8, 2 (default: 1 = None, 8, 2)
1540	0603 _{hex}	Response delay	16-bit integer	Unit: ms Range: 0 ... 1000
Functions				
1285	0504 _{hex}	Purge	16-bit function status	When writing to register: 1 = Activate purge
1542	0605 _{hex}	Restart device	16-bit function status	When writing to register: 1 = Restart the device

A.4.3 Device Identification Objects

Table 17 Device Identification Objects

Object Id (Decimal)	Object Id (Hexadecimal)	Object Name	Example Contents
0	00 _{hex}	VendorName	"Vaisala"
1	01 _{hex}	ProductCode	"HMM170"
3	03 _{hex}	VendorUrl	"http://www.vaisala.com/"
4	04 _{hex}	ProductName	"Vaisala HUMICAP(R) Humidity and Temperature Module HMM170"
128	80 _{hex}	SerialNumber	"NOT SET"
129	81 _{hex}	CalibrationDate	
130	82 _{hex}	CalibrationText	

A.4.4 Test Value Registers

Read the known test values from the test registers to verify the functionality of your Modbus implementation.

Table 18 Modbus Test Registers (Read-Only)

Register Number (Decimal)	Register Address (Hexadecimal)	Register Description	Data Format	Test Value
7937	1F00 _{hex}	Signed integer test	16-bit integer	-12345
7938	1F01 _{hex}	Floating point test	32-bit float	-123.45
7940	1F03 _{hex}	Text string test	text	Text string "-123.45"

A.4.5 Modbus Communication Examples

Reading Relative Humidity Value




Device address used in the following examples is 240 (F0_{hex}).
 The values returned by the device differ depending on the ambient conditions and/or device settings. Your device might not return exactly the same values.

Request		Response	
Bytes on the Line (Hexadecimal)	Description	Bytes on the Line (Hexadecimal)	Description
(silence for 3.5 bytes)	Start of Modbus RTU frame	(silence for 3.5 bytes)	Start of Modbus RTU frame
F0 _{hex}	Device address	F0 _{hex}	Device address
03 _{hex}	Function (Read Holding Registers)	03 _{hex}	Function (Read Holding Registers)
00 _{hex}	Register address	04 _{hex}	Number of data bytes
00 _{hex}		7A _{hex}	Value of first register (least significant word)
00 _{hex}	Number of 16-bit registers to read (2)	E1 _{hex}	
02 _{hex}		41 _{hex}	
D1 _{hex}	Modbus RTU checksum	F4 _{hex}	Modbus RTU checksum
2A _{hex}		05 _{hex}	
(silence for 3.5 bytes)	End of Modbus RTU frame	06 _{hex}	End of Modbus RTU frame
		(silence for 3.5 bytes)	

Communication Description	
Register address	1 (1-based Modbus documentation format) = 0000 _{hex} (0-based format used in actual communication).
Data format	Two 16-bit Modbus registers interpreted as IEEE 754 binary32 floating point value, least significant word first.
Returned value	41F47AE1 _{hex} , which is binary32 representation of 30.56 (%RH).

Writing Pressure Compensation Value

Request		Response	
Bytes on the Line (Hexadecimal)	Description	Bytes on the Line (Hexadecimal)	Description
(silence for 3.5 bytes)	Start of Modbus RTU frame	(silence for 3.5 bytes)	Start of Modbus RTU frame
F0 _{hex}	Device address	F0 _{hex}	Device address
10 _{hex}	Function (Write Multiple Registers)	10 _{hex}	Function (Write Multiple Registers)
03 _{hex}	Register address	03 _{hex}	Register address
00 _{hex}		00 _{hex}	
00 _{hex}	Number of registers to write (2)	00 _{hex}	Number of 16-bit registers written (2)
02 _{hex}		02 _{hex}	
04 _{hex}	Number of data bytes	AD _{hex}	Modbus RTU checksum
6E _{hex}	Value for first register (least significant word)	54 _{hex}	
14 _{hex}			
44 _{hex}	Value for second register (least significant word)	(silence for 3.5 bytes)	End of Modbus RTU frame
75 _{hex}			
AB _{hex}	Modbus RTU checksum	<div style="display: flex; align-items: flex-start;"> <div style="margin-right: 10px;">  </div> <div> <p>The response to a write function informs that the function was correctly received by the device. It does not guarantee that the written value was accepted by the device (for example, in case of out-of-range values).</p> <p>To verify that the value was really accepted by the device, read the register value after writing.</p> </div> </div>	
4E _{hex}			
(silence for 3.5 bytes)	End of Modbus RTU frame		

Communication Description	
Register address	769 (1-based Modbus documentation format) = 0300 _{hex} (0-based format used in actual communication).

Communication Description	
Data format	Two 16-bit Modbus registers interpreted as IEEE 754 binary32 floating point value, least significant word first.
Value to write	44756E14 _{hex} = 981.72 (hPa)

Warranty

For standard warranty terms and conditions, see 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.

Technical Support



Contact Vaisala technical support at helpdesk@vaisala.com. Provide at least the following supporting information as applicable:

- Product name, model, and serial number
- Software/Firmware version
- Name and location of the installation site
- Name and contact information of a technical person who can provide further information on the problem

For more information, see www.vaisala.com/support.

Recycling



Recycle all applicable material.



Follow the statutory regulations for disposing of the product and packaging.

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