About this document

Version information

This document provides information for installing, operating, and maintaining Vaisala Humidity and Temperature Probes HMP60 and HMP110 Series devices.

Table 1. Document versions (English)

Document code	Date	Description
M211060EN-J	October 2020	This document. New content in this version: • Information on new supported calculated parameters: wet bulb temperature, absolute humidity, mixing ratio, and enthalpy • Vaisala Insight software • Error messages in Insight software • Error codes in MI70 Handheld Meter Updated content: • Filter options • Calibration procedure • Technical data chapters • Modbus communication Document format and layout update, quality improvements, and content reorganization.
M211060EN-H	August 2017	Previous version. • Removed the separate HMP110D digital output model: digital output is now a selectable option when ordering the HMP110 model (either analog or digital only HMP110 selected when ordering). • Added information on HUMICAP® 180V sensor option. • Added instructions on wiring multiple devices to the RS-485 interface and updated Modbus specification with information on maximum number of connected probes. • Replaced plastic grid spare part DRW236214SP with DRW240185SP and membrane filter spare part 230727SP with ASM210856SP. • Added new porous sintered PTFE filter DRW244938SP to spare parts. • Updated relative humidity accuracy specifications updated.
M211060EN-G	January 2016	• Added Modbus protocol. • Updated instructions for switching the probe to serial mode from analog or Modbus mode. • Updated relative humidity factory calibration uncertainty specification. • Added information about using HMP110 with an MI70 indicator when in analog mode. • Added instructions for entering calibration information with the CDATE and CTEXT commands.

Related manuals

Table 1. Related manuals

Document code	Name
M211059EN	*Vaisala Humidity and Temperature Probes HMP60 and HMP110 Series Multilingual Quick Guide*
M210297EN	*Vaisala Handheld Humidity and Temperature Meter HM70 User Guide*
M211080EN	*Vaisala Mounting Flange for Humidity Probes Quick Reference Guide*
M211106EN	*Vaisala Loop Power Converter Quick Reference Guide*

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.

Trademarks

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

Modbus® is a registered trademark of Schneider Automation Inc.

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

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Product overview

Introduction to HMP60 and HMP110 series

Vaisala Humidity and Temperature Probes HMP60 and HMP110 Series are simple and cost-effective humidity transmitters suitable for various volume applications:

- Integration into other manufacturers' equipment
- Incubators
- Glove boxes
- Greenhouses
- Fermentation chambers
- Data loggers
- Handheld meters

HMP60 series probes use the interchangeable Vaisala INTERCAP® sensor. No recalibration is required after sensor replacement.

HMP110 series probes use the Vaisala HUMICAP® 180R sensor for increased accuracy. For applications where H_2O_2 (for example, vaporized hydrogen peroxide (VHP)) is present, HMP110 series probes can also be ordered with the HUMICAP® 180V catalytic sensor. HMP110 series probes require calibration after sensor replacement. This can be done with Vaisala Insight PC software or on the serial line using the optional Vaisala USB cable.

Table 1. Parameters measured by HMP60 and HMP110 series

Parameter	Abbreviation	Metric unit	Non-metric unit
Measured parameters			
Relative humidity	RH	%RH	%RH
Temperature	T	°C	°F
Calculated parameters			
Dew point/frost point temperature [1]	$T_{d/f}$	°C	°F
Wet bulb temperature	T_w	°C	°F
Absolute humidity	a	g/m^3	gr/ft^3
Mixing ratio	x	g/kg	gr/lb
Enthalpy	h	kJ/kg	Btu/lb

Figure 1. HMP60 and HMP110 series probes

1 HMP60
IP65 rated stainless steel probe with INTERCAP® sensor. Rugged probe for demanding applications. Two analog output channels.

2 HMP110
IP65 rated stainless steel probe with HUMICAP® 180R sensor. Rugged probe with higher accuracy for demanding applications. Analog and digital output options (selected in order configuration). Note that when HMP110 is ordered as a digital probe, analog output channels are not available.

3 HMP110T
IP65 rated stainless steel probe with temperature sensor only. Has the same temperature measurement performance as HMP110. One analog output channel.

4 HMP110REF
IP65 rated stainless steel probe. Does not measure; instead, outputs constant humidity and temperature readings on serial line. Useful for validating installations of HMT120 and HMT130 transmitters, for example. Digital output only.

5 HMP63
IP54 rated probe with PC/ABS plastic housing and INTERCAP® sensor. Lightweight probe with faster thermal response time. Not for permanent outdoor use. Two analog output channels.

6 HMP113
IP54 rated probe with PC/ABS plastic housing and HUMICAP® 180R sensor. Lightweight probe with higher accuracy and faster thermal response time. Not for permanent outdoor use. Two analog output channels.

Used with the Vaisala HM40 handheld meter (requires special software configuration).

[1] When the dew point is below 0 °C, the probe outputs frost point for T_d.

Basic features and options

- Analog and digital output options:
  - HMP60, HMP63, HMP110, and HMP113 analog output mode: 2 analog output channels, selectable from 0 ... 1 V / 0 ... 2.5 V / 0 ... 5 V / 1 ... 5 V
  - HMP110 digital output option (Modbus, RS-485, or VDIGI, selected when ordering): for permanent digital output installations, no analog output
  - HMP110T analog output mode: single analog output channel (CH1), selectable from 0 ... 1 V / 0 ... 2.5 V / 0 ... 5 V / 1 ... 5 V
  - RS-485 interface available for all models (Modbus RTU and temporary service access with Vaisala Industrial Protocol serial line communication)
- Small size
- Low power consumption
- IP65 stainless steel body on HMP60 and HMP110 models
- IP54 lightweight plastic body on HMP63 and HMP113 models
- Options and accessories:
  - Several filter options
  - Probe mounting clamp
  - Probe mounting flange
  - Duct installation kit for HMP60, HMP110, and HMP110T
  - 1-channel loop power converter 4 ... 20 mA (separate module, compatible with humidity accuracy only)
  - Shielded 0.3-m and 3.0-m (1-ft and 9.8-ft) connection cables with threaded connector for probe connection, open end wires on the other end
  - Plastic M12 installation nuts for HMP60, HMP110, and HMP110T
  - Plastic locking bushing for HMP63 and HMP113 (for use with Vaisala products, for example the HM40 handheld meter)

Output options

All HMP60 series probes and HMP110 series probes, with the exception of the HMP110REF reference probe, can be ordered with analog output channels. Probes that use analog output can also use the RS-485 interface for temporary service access (Vaisala Industrial Protocol serial line commands) and Modbus RTU communication.

For installations where permanent digital output is required, the HMP110 model can be ordered as a digital-only probe (select either Modbus, RS-485 or Interface for Vaisala devices (VDIGI) as the output when ordering).

When you order HMP110 as a digital probe, analog output channels are not available.

Table 1. HMP60 and HMP110 series output options

	HMP60	HMP63	HMP110 Analog	HMP110 Digital	HMP110T	HMP113	HMP110REF
Analog output channels	2	2	2	None	1	2	None
Voltage output (0 ... 1/2.5/5 VDC, 1 ... 5 VDC)	Yes	Yes	Yes	No	Yes	Yes	No
Current output	Yes [1]	Yes [1]	Yes [1]	No	Yes [1]	Yes [1]	No
RS-485 digital output	No [2]	No [2]	No [2]	Yes	No [2]	No [2]	Yes
Modbus RTU	Yes	Yes	Yes	Yes	Yes	Yes	Yes

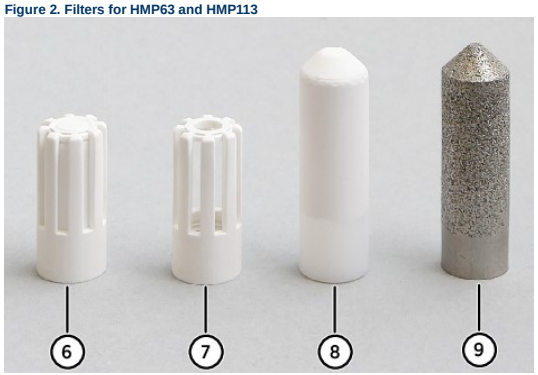
[1] 4 ... 20 mA with separate loop power converter, compatible with humidity accuracy only.
[2] Temporary service access with serial line only.

Filter options

Figure 1. Filters for HMP60, HMP110, and HMP110T

1 Plastic grid filter (fastest response time)
2 Membrane filter, pore size 0.2 µm
3 Stainless steel sintered filter, pore size 38 µm
4 PTFE membrane filter with stainless steel grid, pore size 0.2 µm
5 PTFE sintered filter, pore size 20 µm

Figure 2. Filters for HMP63 and HMP113



6 Plastic membrane filter, pore size 0.2 µm
7 Plastic grid filter for (portable use only, fastest response time)
8 Porous PTFE filter, pore size 8 µm
9 Stainless steel sintered filter, pore size 38 µm

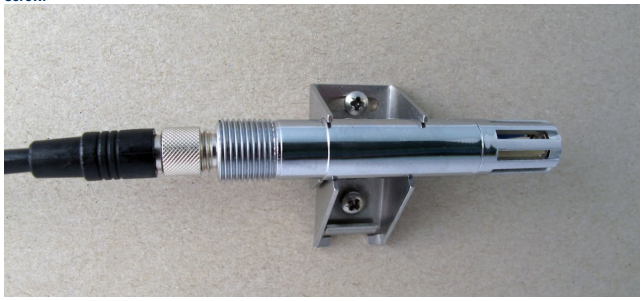
All filters are 12 mm in diameter.

Installation accessories (optional)

For item codes, see Spare parts and accessories.

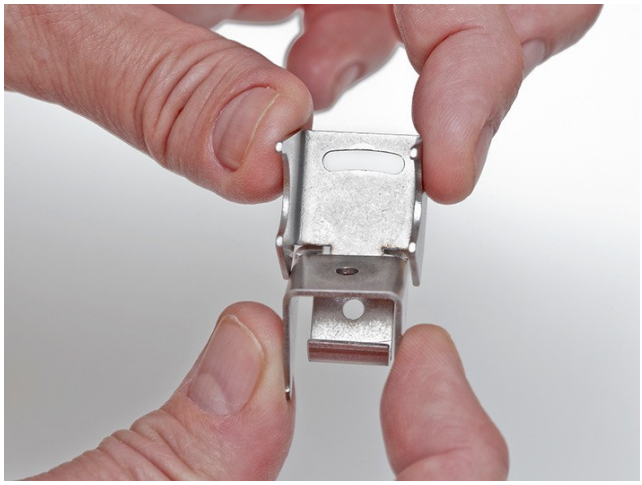
Probe mounting clamp

Figure 1. Probe mounting clamp in use. The optional mounting clamp makes it easy to install the probe on the wall of the measurement environment. The probe can be detached for calibration simply by loosening the lower screw.



The probe mounting clamp is delivered in 2 parts that must be connected when it is used:

1. Align the slots on the clamp parts.



2. Slide the lower clamp part over to the bottom end of the upper part.

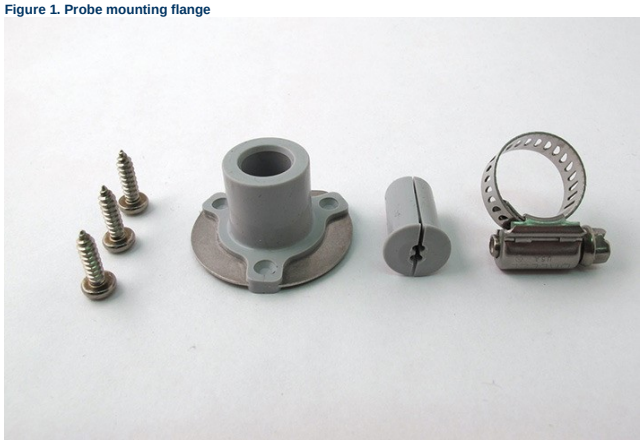
3. Place the clamp to the intended location and secure the upper clamp part with a screw.

4. Place the probe in the clamp.
5. Tighten the lower clamp part with a screw.

Probe mounting flange

The probe mounting flange is a silicone flange that you can use to hold the probe in a through-wall installation. The flange is a general purpose mounting accessory for Ø 12 mm probes, and comes with a sealing plug for coaxial cables that is not needed when you use the flange with HMP60 and HMP110 series probes. For more information, see *Mounting Flange for Humidity Probes Quick Reference Guide* (M211080EN).

Figure 1. Probe mounting flange



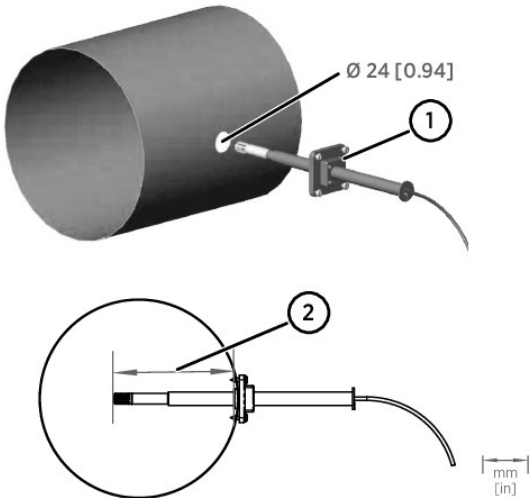
Plastic locking bushing for HMP63 and HMP113

You can connect HMP63 and HMP113 to compatible Vaisala instruments using a plastic locking bushing that is placed over the probe. The bushing has a M15×1 thread. It is compatible with HMT120 and HMT130 transmitters, and HM40 handheld meter.

Figure 1. HMP113 with plastic locking bushing

Duct installation kit for HMP60, HMP110, and HMP110T

Figure 1. Probe installation with the duct installation kit. The duct installation kit includes a plastic pipe with a flange (Vaisala item code 215619). To install the probe with the duct installation kit, drill a hole to the duct wall, assemble the probe to the duct installation kit, slide the probe head through the hole, and attach the flange to the duct wall with 4 screws.



1 Tension screw
2 Installation depth. Adjust the depth and lock in place with the tension screw.

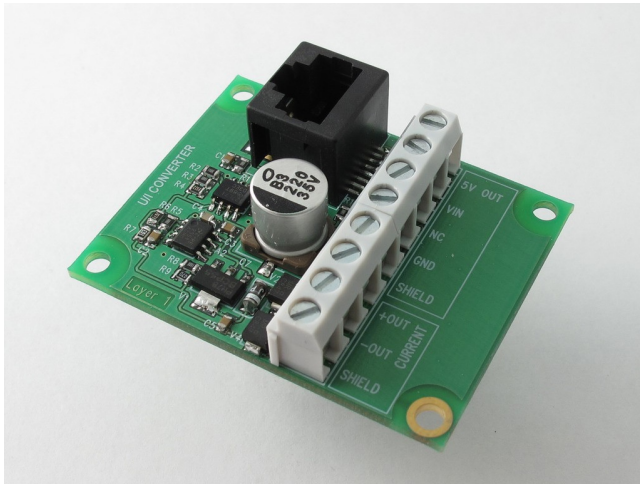
Related concepts

- Mounting HMP60, HMP110, and HMP110T probes

Loop power converter

Figure 1. Loop power converter.

The loop power converter is an open frame module that converts one 0 ... 2.5 VDC voltage output to a 4 ... 20 mA current output. To use the loop power converter module, the probe must be in the analog output mode. The desired parameter is on channel 1, which must be scaled to 0 ... 2.5 V.



Related concepts

- Wiring with the loop power converter

Cables

Figure 1. Cable with threaded connector. Connection cables have a straight, threaded female M8 connector on one end and open wires on the other end. You can use other compatible M8 series cables.

Figure 2. USB cable for PC connection. The Vaisala USB cable (item code 219690) has a straight, threaded female M8 connector on one end, and a USB Type A male plug on the other. The USB cable is intended for maintenance purposes only, not for permanent installation.

Related concepts

- Spare parts and accessories

Safety

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

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

Before you connect an HMP60 or HMP110 series probe to a device, it is recommended to power off the device.

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.

Regulatory compliance

HMP60 and HMP110 series probes are in conformity with the provisions of the following EU directive(s):

- ROHS Directive
- EMC Directive

The electromagnetic compatibility of HMP60, HMP110, HMP110T, and HMP110REF has been tested according to the following product family standards:

- EN 61326-1: Electrical equipment for measurement, control and laboratory use - EMC requirements – for use in industrial locations.
- EN 55022 Class B: Information technology equipment - Radio disturbance characteristics - Limits and methods of measurement.

The electromagnetic compatibility of HMP63 and HMP113 has been tested according to the following product family standards:

- EN 61326-1: Electrical equipment for measurement, control and laboratory use - EMC requirements – Basic immunity test requirements.
- EN 55022 Class B: Information technology equipment - Radio disturbance characteristics - Limits and methods of measurement.

Installation

Mounting HMP60, HMP110, and HMP110T probes

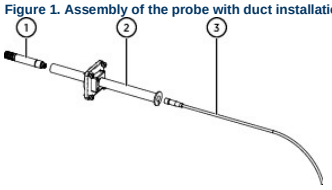
HMP60, HMP110, and HMP110T are designed to be mounted from the M12 thread on the probe body or from the smooth part of the probe body. For a convenient installation, use the optional installation accessories:

- Use the plastic mounting nuts to hold the probe in a through-wall installation
- Use the probe mounting clamp to hold the probe on a wall
- Use the probe mounting flange to hold the probe in a through-wall installation

Avoid placing the probe in a place where condensation can run onto the sensor.

Probe assembly with duct installation kit

Figure 1. Assembly of the probe with duct installation kit

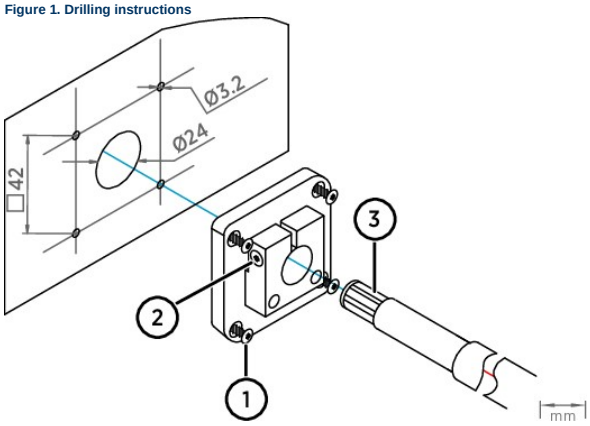


1 HMP60, HMP110, or HMP110T probe
2 Duct installation kit
3 Probe cable

1. Slide the probe cable through the duct installation kit plastic pipe.
2. Attach the cable to the probe.
3. Attach probe assembly to the duct.

Drilling instructions for duct installation kit

Figure 1. Drilling instructions



1 Mounting screw
2 Tension screw
3 Probe assembled in duct installation kit plastic pipe

1. Use a 24-mm drill bit to drill a hole to the duct wall for the humidity probe.
2. Drill holes for the duct installation kit mounting screws around the hole in a square arrangement, 42 mm apart from each other. Use a 3.2-mm drill bit to drill the holes for the mounting screws (four ST4.2×16-C-Z DIN 7981 screws).

Mounting HMP63 and HMP113 probes

HMP63 and HMP113 probes do not have a thread on the probe body. For a convenient installation, use the optional installation accessories:

- Use the probe mounting clamp to hold the probe on a wall
- Use the probe mounting flange to hold the probe in a through-wall installation
- If you are using the probe with HMT120 or HMT130 transmitter, or HM40 handheld meter, use the plastic locking bushing

Avoid placing the probe in a place where condensation can run onto the sensor.

Related concepts

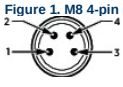
- Installation accessories (optional)

Wiring

Before you connect an HMP60 or HMP110 series probe to a device, it is recommended to power off the device.

For a secure connection to the probe, connect to the 4-pin M8 connector using a threaded connector.

Figure 1. M8 4-pin male connector



Pin-out of HMP60 / HMP63 / HMP110 analog / HMP113 / HMP110T

1 5 ... 28 VDC (V_{out} 0 ... 1 / 0 ... 2.5 V)

8 ... 28 VDC (V_{out} 0 ... 5 / 1 ... 5 V)

2 Channel 1: RH / Td / T

0 ... 1 / 2.5 / 5 V, 1 ... 5 V

3 GND / AGND
4 Channel 2: RH / Td / T

0 ... 1 / 2.5 / 5 V, 1 ... 5 V

(HMP110T has no output on channel 2)

Pin-out of HMP110REF / HMP110 digital

1 5 ... 28 VDC
2 RS-485: - / B
3 GND
4 RS-485: + / A

Table 1. Grounding methodsThe grounding method depends on the probe and the installation type.

Probe	Grounding method
HMP63	Vaisala recommends to use a shielded cable and connect the shield to ground.
HMP113	In the shielded cables supplied by Vaisala, the threaded connector connects the shield to the probe housing.
HMP60 HMP110 HMP110T HMP110REF	There are two ways to ground the probe depending on installation type. Choose only one of these methods: • Grounding is provided by the metal cover of the probe. If using shielded cables, shield is NOT connected to ground. • A shielded cable is used, and the shield is connected to ground. In the shielded cables supplied by Vaisala, the threaded connector connects the shield to the probe housing.

When the probe is connected to a power supply, there is a delay as the probe starts up and the analog output stabilizes. The delay depends on the output type, and on the operating voltage that is supplied to the probe:
- Probes with analog output:
  - 4 s at operating voltage 13.5 ... 16.5 VDC
  - 2 s at other valid operating voltages
- Probes with digital output: 2 s

Wiring multiple digital devices

The maximum number of HMP60/HMP110 probes that you can connect to a system over the RS-485 interface is 32 when the communication speed is 19200 bps or lower. Do not use RS-485 termination with HMP60/HMP110 series probes.

Connecting other devices can decrease the maximum number of HMP60/HMP110 probes. If other devices require the use of termination, connect HMP60/HMP110 probes using an RS-485 repeater.

Figure 1. Wiring multiple devices using local power supply. The following figures show the recommended wiring when connecting multiple devices to the RS-485 interface using either a separate local power supply for each device or a common power supply.

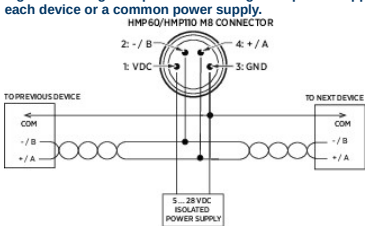
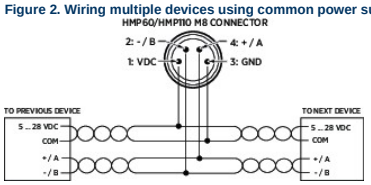


Figure 2. Wiring multiple devices using common power supply



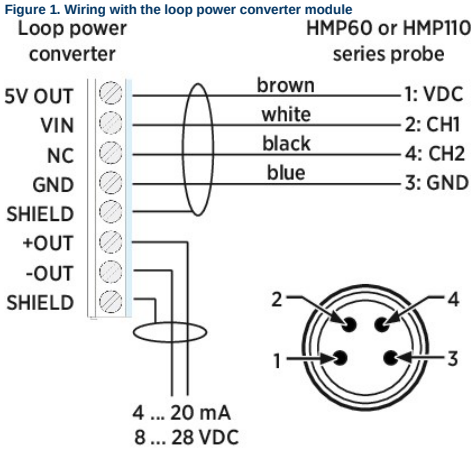
Wiring with the loop power converter

To use the loop power converter module with an HMP60 or HMP110 series probe, the probe must be in the analog output mode. The desired parameter is on channel 1, which must be scaled to 0 ... 2.5 V.

You cannot use the loop power converter with the digital-only HMP110.

When using the loop power converter module, power the module with 8 ... 28 VDC. The operating voltage for the probe (5 VDC) is delivered by the module.

Figure 1. Wiring with the loop power converter module



For more information, see the *Loop Power Converter Quick Reference Guide* (M211106EN).

Related concepts

- Output options

Power supply requirements

The operating voltage for the HMP60 and HMP110 series probes must be in the following range:

Table 1. Operating voltage ranges

HMP60 / HMP63 / HMP110 analog / HMP113 / HMP110T	HMP110REF / HMP110 digital
5 ... 28 VDC (V_{out} 0 ...1 / 0 ... 2.5 V)	5 ... 28 VDC
8 ... 28 VDC (V_{out} 0 ... 5 / 1 ... 5 V)	

Current consumption is 1 mA on average, which makes the probes well suited for running on battery power. The maximum peak consumption is 5 mA.

Recommendations

- Continuous use over high operating voltage may cause heating. To conserve power and minimize the warming of the probe, use the lowest operating voltage in the allowed range.
- Using low impedance loads on the signal outputs increase the current consumption by up to 0.5 mA. High impedance loads are recommended to minimize warming of the probe.
- Frequent interrogation of the probe using the RS-485 interface will also increase current consumption from the average value. More frequent interrogation than once per second is not recommended.

Modbus communication

The Modbus variant used in HMP60 and HMP110 series probes is Modbus RTU. Modbus support was added to HMP60 and HMP110 probes in 2016 for probe software version 2.1.4. The following table lists the default communication settings used when Modbus is enabled at the factory (chosen when ordering).

Table 1. Default Modbus communication settings

Description	Default value
Serial bit rate	19200
Parity	None
Number of data bits	8
Number of stop bits	2
Flow control	None
Modbus device address	240
Serial delay	0
Communication mode	Modbus RTU

Use Vaisala Insight software to change the Modbus serial communication settings if needed. Download Vaisala Insight software at www.vaisala.com/insight.

The instrument must be switched off and on before the communication setting changes take effect.

Related concepts

- Accessing serial line command interface from analog or Modbus mode
- Modbus reference

Using multiple devices over RS-485

When you use HMP60/HMP110 series probes for Modbus communication over the RS-485 interface, the maximum number of HMP60/HMP110 probes that can be connected to a system is 32 (with a communication speed of 19200 bps or lower).

RS-485 termination must not be used with HMP60/HMP110 series probes.

Connecting other devices can decrease the maximum number of HMP60/HMP110 probes that can be connected. If other devices require the use of termination, HMP60/HMP110 series probes must be connected using an RS-485 repeater.

Related concepts

- Wiring multiple digital devices

Vaisala Insight software

Vaisala Insight PC software is a configuration software for Indigo compatible probes. 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 data.
- Configure serial communication settings, filtering factor, and analog output parameters and scaling.
- Calibrate and adjust the device.

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

The probe can be connected to Vaisala Insight software using a Vaisala USB cable (item code 219690).

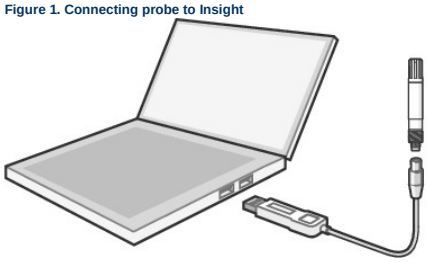
HMP60 and HMP110 probes support Insight from probe software version 2.1.4 onwards.

Connecting to Insight software

- Computer with Microsoft Windows® operating system and Vaisala Insight software installed
- USB connection cable (item code 219690)

CAUTION! When connecting several devices at the same time, note that your computer may not be able to supply enough power through its USB ports. Use an externally powered USB hub that can supply >2 W for each port.

Figure 1. Connecting probe to Insight



1. Open the Insight software.
2. Connect the USB cable to a free USB port on the PC.
3. Connect the probe to the USB cable.
4. Wait for Insight software to detect the probe.

Serial line communication

In analog probes, serial line communication is intended for service use only.

HMP60 and HMP110 series probes support 2-wire RS-485 communication. The RS-485 interface is non-isolated and offers a maximum communications rate of 57600 bps.

There is no internal termination for the RS-485 on the probe. Use of termination resistors is not recommended. If the resistors are used, the possible increase in current consumption should be taken into account.

Connecting to serial interface

Connection to the serial interface is through the 4-pin connector on the probe.

For temporary use of the serial interface (for example, calibration), you can use the optional Vaisala USB cable (item code 219690). Before you can use the cable, you must install the provided USB driver on your PC.

The Vaisala USB cable is not designed for permanent installations. When using the USB cable, no separate power unit is needed. The probe is powered through the USB port.

For permanent interfacing to a host system, use a shielded cable with a threaded connector.

The probe does not echo typed characters back to the terminal screen. To see the commands you type, you need to enable the "local echo" setting in your terminal program.

A new command cannot be received while the probe is sending data out. Wait until the instrument has completed its response before entering the next command.

Table 1. Default serial communication settings

Property	Description/Value
Baud rate	19200
Parity	None
Data bits	8
Stop bits	1
Flow control	None

You can change the serial settings and operate in RUN, STOP, POLL, and MODBUS modes.

After power-up the probe (in STOP mode) outputs the software version and the command prompt.

- In RUN mode, a measurement output starts immediately after power-up.
- In POLL mode, the probe does not output anything after power-up. It must be accessed with an addressed command.
- In MODBUS mode, the probe does not output anything after power-up: serial line commands are not in use and the probe must be used with the Modbus protocol.

Related concepts

- Wiring
- Installing the driver for the USB cable
- Accessing serial line command interface from analog or Modbus mode
- Set serial interface mode

Installing the driver for the USB cable

Before taking USB cable 219690 into use, you must install the provided USB driver on your PC. When installing the driver, you must acknowledge any security prompts that may appear.

1. Check that the USB cable is not connected. Disconnect the cable if you have already connected it.
2. Insert the media that came with the cable, or download the latest driver from www.vaisala.com/software.
3. Execute the USB driver installation program (setup.exe), and accept the installation defaults. The installation of the driver may take several minutes.
4. After the driver has been installed, connect the USB cable to a USB port on your PC. Windows detects the new device, and uses the driver automatically.
5. The installation has reserved a COM port for the cable. Select Start > Vaisala > Vaisala USB Instrument Finder, and verify the port number, and the status of the cable. The reserved ports are also visible in the Ports of the Windows Device Manager.

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

There is no reason to uninstall the driver for normal use. However, if you wish to remove the driver files and all Vaisala USB cable devices, you can do so by uninstalling the entry for Vaisala USB Instrument Driver from the Programs and Features menu in the Windows Control Panel. In Windows XP and earlier Windows versions the menu is called Add or Remove Programs.

Terminal application settings for digital probes

The following steps describe how to connect to digital probes using the PuTTY terminal application for Windows (available for download at http://www.vaisala.com/software) and the USB serial interface.

If you have an analog probe, you can still connect to the serial line by following the instructions in Accessing serial line command interface from analog or Modbus mode.

1. Connect Vaisala USB cable 219690 between your PC and the probe.
2. Start the PuTTY application.
3. Select the Serial settings category, and check that the correct COM port is selected in the Serial line to connect to field.

   To check which port the USB cable is using, select Start > Vaisala > Vaisala USB Instrument Finder.

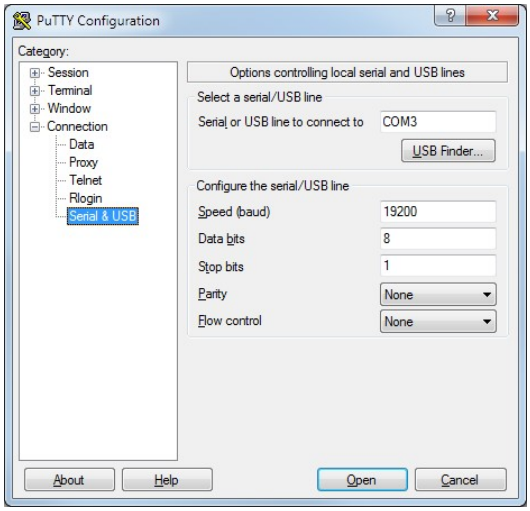
4. Check that the other serial settings are correct for your connection, and change if necessary.
5. To open the connection window and start using the serial line, select Open.

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

6. You may need to adjust the Local echo setting in the Terminal category to see what you are typing on the serial line. To access the configuration screen while a session is running, right-click over the session window, and select Change Settings.

If the probe is in Modbus mode, to access the serial port command interface, follow the instructions in Accessing serial line command interface from analog or Modbus mode.

Figure 1. PuTTY terminal application



Accessing serial line command interface from analog or Modbus mode

Follow the steps below to connect to the serial line when the probe is in analog or Modbus mode. You can also use the procedure to retrieve the communication settings of your device, if you do not know them. You must use the Vaisala USB cable (Vaisala item code 219690) in this case.

1. Connect the USB cable to the PC and install the driver, if necessary. Do not connect the cable to the probe yet.
2. Open the terminal program and open a connection to the corresponding COM port using the default settings 19200, 8, N, 1, no flow control.
3. Select the Serial settings category, and check that the Serial line to connect to field contains the correct COM port.

   To check which port the USB cable is using, select Start > Vaisala > Vaisala USB Instrument Finder.

4. To open the connection window and start using the serial line, select Open.
5. Keep the ENTER key pressed down and connect the other end of the USB cable to the probe. This causes the probe to start in RS-485 mode, using the default serial settings. You can now use the probe with the terminal program.
6. To prevent the analog or Modbus mode from being restored on the next power-up, select a different serial mode with the `smode` command.
7. To switch back to analog mode or Modbus mode from a serial mode, use the smode analog or smode modbus command to select analog or Modbus mode. Reset or power cycle the probe to restart in the selected mode.

The probe cannot be used with the MI70 handheld indicator or the HM40 meter when the probe is in analog mode. To use the probe with MI70 or HM40, enable a serial mode (for example, STOP) as instructed above.

Related concepts

- List of serial commands
- Set serial interface mode

List of serial commands

You can issue all commands 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). Press ESC to clear the command buffer before starting to enter commands.

Table 1. List of serial commands (software version 2.4.0)

Command	Description
?	Output information about the device
AERR	Set analog output error level
AMODE	View or set the analog output mode
AOVER [ON/OFF]	Allow analog outputs to exceed their range 10 %
ASEL	Set analog output parameters and scaling
CDATE	View or set the calibration date
CODE	View the order code of the probe
CRH	Calibrate and adjust RH measurement
CRHCLR	Clear adjustment of RH measurement
CT	Calibrate and adjust T measurement
CTCLR	Clear adjustment of T measurement
CTEXT	View or set the calibration information field
ERRS	List present probe errors
FILT [0.001 ... 1]	Set the result filtering
FRESTORE	Restore factory settings
HELP	List available commands
INTV [0 ... 255 S/MIN/H]	Set the continuous output interval (for RUN mode)
L	Displays user adjustment parameters
R	Start the continuous outputting
RESET	Reset the probe
RHLIMIT	Extend maximum RH reading
S	Stop the continuous outputting
SDELAY [0 ... 255]	View or set serial line answer minimum delay
SEND [0 ... 255]	Output the reading once
SNUM	View the serial number of the probe
UNIT	Select metric or non-metric output units
VERS	View software version of the probe

Table 2. Additional commands for probes with RS-485 output

Command	Description
??	Output information about the device in POLL mode
ADDR [0 ... 255]	Set the probe address (for POLL mode)
CLOSE	Close the temporary connection (Back to POLL mode)
OPEN [0 ... 255]	Open a temporary connection to a POLL mode device
SERI [baud p d s]	User Port settings (Default: 19200 N 8 1) baud: 300 ... 57600
SMODE [STOP/RUN/POLL/MODBUS/VDIGI /ANALOG]	Set the serial interface mode

Device information and status

View device information

The ? command outputs a listing of device information.

?<cr>

Example (output from HMP63):

```
?
HMP63 / 1.0.4
Serial number  : H3640004
Batch number   : T0001109
Sensor number  : H0000322
Sensor model   : Intercap
Order code     : A12A0A2B0
Cal. date      : 20120907
Cal. info      : VAISALA/HEL
Time           : 00:21:05
Serial mode    :   ANALOG
Baud P D S     :    19200 N 8 1
Output interval:        1 S
Serial delay   :       30
Analog delay   :       10 S
Address        :        0
Filter         :    1.000
Ch1 output     :  0 ... 1 V
Ch2 output     :  0 ... 1 V
Ch1 RH   lo    :     0.00 %RH
Ch1 RH   hi    :   100.00 %RH
Ch2 T    lo    :   -40.00 'C
Ch2 T    hi    :    60.00 'C
```

If the probe is in POLL mode, but a connection has not been opened using the OPEN command, issue the ?? command.

??<cr>

Related concepts

- Set serial line settings

View calibration information

Use the CDATE command to view the calibration date and CTEXT to view the calibration info text. Date format for CDATE is YYYYMMDD.

CDATE<cr>

CTEXT<cr>

Examples:

```
cdate
Cal. date      : 20150109

ctext
Cal. info      : VAISALA/HEL
```

Enter calibration information

To enter the calibration date, use the CDATE command (cdate [YYYYMMDD]). To enter a text string with information about the calibration, use the CTEXT command (ctext [string]).

CDATE [yyyymmdd] <cr>

CTEXT [text string] <cr>

Example:

```
cdate 20151125

Cal. date      : 20151125
ctext Calibrated in Room 1
Cal. info      : Calibrated in Room 1
```

View order code

Use the CODE command to view the order code that has been stored in the probe. This command is useful if you need to order a new probe with the same options.

CODE<cr>

Example:

```
code
Order code     : A12A0A2B0
```

View serial number

Use the SNUM command to view the serial number of the probe.

SNUM<cr>

Example:

```
snum
Serial number  : H3640004
```

View software version

Use the VERS command to display the software version of the probe.

VERS<cr>

Example:

```
vers
HMP63 / 1.0.4
```

Serial line output commands

Start measurement output

Use the R command to start the continuous outputting of measurement values as an ASCII text string to the serial line.

For HMP60 and HMP110, the output always includes readings for temperature, RH and Td. For HMP110T, the output includes only temperature.

R<cr>

Example (HMP60 and HMP110):

```
r
T= 22.6 'C RH= 22.8 %RH Td=  0.3 'C
T= 22.6 'C RH= 22.5 %RH Td=  0.2 'C
T= 22.6 'C RH= 22.5 %RH Td=  0.2 'C
…
```

Example (HMP110T):

```
r
T= 22.6 'C
T= 22.6 'C
T= 22.6 'C
…
```

Outputting the results continues in intervals issued with the command INTV. You can stop the output by entering the S command.

Stop measurement output

Use the S command or press the ESC key to stop the continuous measurement output.

S<cr>

Output the measurement message once

Use the SEND command to output the measurement values once. If the probe is in POLL mode and the line is not open for commands, specify the address of the probe to receive the measurement message.

SEND [aaa]<cr>

Syntax	Description
aaa	Address of the probe, range 0 ... 255. Set with the ADDR command.

Example (probe in STOP mode, no address needed):

```
send
T= 22.7 'C RH= 20.0 %RH Td= -1.5 'C
```

Example (probe in POLL mode, with address 10):

```
send 10
T= 22.8 'C RH= 20.1 %RH Td= -1.3 'C
```

Configuring serial line operation

Set serial line settings

Use the SERI command to show or set the serial line settings. The new settings will be taken into use when the probe is reset or powered up.

SERI [b p d s]

Syntax	Description
b	baud rate (300, 600, 1200, 2400, 4800, 9600, 19200, 38400, 57600)
p	parity (n = none, e = even, o = odd)
d	data bits (7 or 8)
s	stop bits (1 or 2)

Example (shows default settings):

```
seri
Baud P D S     :    19200 N 8 1
```

Set serial interface mode

Use the SMODE command to set the operation mode of the serial interface. The new mode is applied when probe is reset.

SMODE [xxx]<cr>

Syntax	Description
xxx	Operation mode of the serial interface.

Table 1. Serial interface modes

Mode	Description
STOP	Probe outputs only when a command is issued. Any command can be used.
RUN	Probe automatically outputs measurement messages on the serial line. Only command S or the ESC key can be used to stop the output.
POLL	Probe outputs only when a command is issued. Probes communicate one at a time when the specific address is called on the serial line, which is useful when more than one probe is connected to one serial bus. Any command can be used after the line has been opened using the OPEN command. See descriptions of the commands ADDR and OPEN.
MODBUS	Measurement outputs must be read from the transmitter using the Modbus protocol. For more information, see Modbus communication and Modbus reference.
VDIGI	Special serial interface mode that is only used for interoperability with Vaisala devices such as HMT120, HMT130, and HM40. This mode is set at Vaisala for probes that are ordered for such use.
ANALOG	No serial line, analog outputs active. For instructions on how to enter the serial line when in analog mode, see Accessing serial line command interface from analog or Modbus mode. Note that analog output channels are not available in the digital-only HMP110. See Output options.

Example (check current mode):

```
smode
Serial mode    :     STOP     ?
```

Example (change mode to POLL mode):

```
smode poll
Serial mode    :     POLL
```

In the RUN mode, the probe may send the measurement data message right as you are typing the S command to stop the sending. Therefore, you may need to repeat the S command. This must be noted especially when designing computer programs to access the probe.

The digital-only HMP110 probe option cannot be set to analog mode.

Set output interval

Use the INTV command to show or set the output interval of the serial line measurement messages (applies when R command or RUN mode is used). The shortest output interval is 1 second. This command has no effect on the operation of the analog output.

INTV [n xxx]<cr>

Syntax	Description
n	Time interval in range 1 ... 255
xxx	Time unit = "S", "MIN", or "H"

Example:

```
intv 1 s
Value               : 1
Unit                : S
```

Set measurement filtering

Use the FILT command to view or set the speed at which the latest measurement result is integrated into the humidity and temperature readings. The command affects both analog output and serial line output.

FILT [a.aaa]<cr>

Syntax	Description
a.aaa	Range 0.001 ... 1.0. 1.0 = No filtering, the latest measurement is output without averaging 0.5 = Average of the last 2 measurements 0.1 = Average of approximately 16 measurements

Example (default setting, no filtering):

```
filt
Filter         :    1.000     ?
```

Example (set filtering to 0.5):

```
filt 0.5
Filter         :    0.500
```

Set probe address

Use the ADDR command to view or set the probe address. To operate in the POLL mode, the probe must have an address. If multiple probes share the same serial line, each probe must have a different address.

ADDR [nn]<cr>

Syntax	Description
nn	Address (0 ... 255)

Example:

```
addr
Address        :       0
```

Related concepts

- Set serial line settings

Set serial interface delay

Use the SDELAY command to view or set the serial interface answer minimum delay.

SDELAY [delay]<cr>

Syntax	Description
delay	Range 0 ... 255. Value corresponds to 4 milliseconds (for example, 5 = 0.020 second minimum answer delay)

Example:

```
sdelay
Serial delay   :      30

sdelay 50
Serial delay   :      50
```

Set measurement units

Use the UNIT command to view or set the measurement units that are used in the serial line measurement messages.

UNIT [M/N]<cr>

M is for metric units, N is for non-metric units.

Parameter	Metric unit	Non-metric unit
RH	%RH	%RH
T_d	°C	°F
T	°C	°F

Examples:

```
unit
Units          : Metric

unit n
Units          : Non metric
```

Calibration commands

Calibrate humidity measurement

Use the CRH command to perform a 1-point or 2-point correction to the capacitance measurement of the probe. This command changes the offset and/or gain of the humidity measurement, depending on the calibration and reference:

- 1-point calibration with a single < 50 %RH reference will adjust the offset of the capacitance measurement
- 1-point calibration with a single > 50 %RH reference will adjust the gain of the capacitance measurement
- 2-point calibration will adjust both offset and gain. The first point requires a < 50 %RH humidity reference, the second point must be > 50 %RH. There must also be at least 30 percentage point difference between the references.

CRH [reference]<cr>

This command is not available on the HMP110T.

When performing a 1-point calibration, you need to place the probe in the reference humidity and wait for 20 … 40 minutes for the humidity to stabilize. To apply the adjustment, enter the CRH command with the reference %RH as a parameter.

Example: 1-point calibration (LiCl reference, 11 %RH):

```
crh 11
OK
```

Example: 1-point calibration with NaCl reference (75 %RH):

```
crh 75
OK
```

Giving the command without parameters starts the 2-point calibration. Remember to allow the humidity to stabilize for 20 … 40 minutes after changing the reference.

Example: 2-point calibration with LiCl (11 %RH) and NaCL (75 %RH) references:

```
crh
RH  :  11.2684 1. ref ? 11
 Press any key when ready ...
RH  :  75.0612 2. ref ? 75
OK
```

Clear adjustment of RH measurement

Use the CRHCLR command to clear the adjustment of RH measurement that has been done using the CRH command. This command is not available on the HMP110T.

CRHCLR<cr>

Example:

```
crhclr
OK
```

Calibrate temperature measurement

Use the CT command to perform a 1-point or 2-point temperature (T) calibration. 1-point calibration adjusts the offset for the measurement, 2-point calibration adjusts offset and gain.

CT [reference]<cr>

When performing a 1-point calibration, you need to place the probe in a single temperature reference and wait for 20 … 40 minutes for the temperature to stabilize. To apply the adjustment, enter the CT command with the reference temperature as a parameter.

Example: 1-point calibration

```
ct 23.5
OK
```

Giving the command without parameters starts the 2-point calibration. Remember to allow the temperature to stabilize for 20 … 40 minutes after changing the reference. The first reference point must be smaller than the second point, and the difference between the reference points must be more than 30 °C. To update the measured value while the command is running, press enter without inputting a value.

Example: 2-point calibration

```
ct
T : 22.03 Ref1 ? 22
Press any key when ready ...
T : 55.12 Ref2 ? 55
OK
```

Clear adjustment of T measurement

Use the CTCLR command to clear the adjustment of temperature measurement that has been done using the CT command.

CTCLR<cr>

Example:

```
ctclr
OK
```

View user adjustment parameters

Use the L command to view the current user adjustment parameters. This command is useful for checking the currently applied customer calibration.

L<cr>

The output values are as follows:

- Cp offset and gain: capacitance, calibrated using the CRH command
- T offset and gain: calibrated using the CT command

Example (shows default values, no user calibration done):

```
l
Cp offset :   0.00000000E+00
Cp gain   :   1.00000000E+00
T  offset :   0.00000000E+00
T  gain   :   1.00000000E+00
```

Other commands

Set analog output mode

Use the AMODE command to show or set the operation mode of the analog output. This command is not in use in the digital-only HMP110 probe option.

AMODE [ch1] [ch2]<cr>

Syntax	Description
ch1	Analog output mode for channel 1, range 0 ... 3. The options are: 0 (0 ... 1 V) 1 (0 ... 2.5 V) 2 (0 ... 5 V) 3 (1 ... 5 V)
ch2	Analog output mode for channel 2, range 0 ... 3. The options are the same as for channel 1.

Example (show current output modes):

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

Example (set channel 1 to 0 ... 1 V and channel 2 to 0 ... 5 V):

```
amode 0 2
Ch1 output     :  0 ... 1 V
Ch2 output     :  0 ... 5 V
```

Set analog output parameters and scaling

Use the ASEL command to show or set the output parameters and scaling of the analog outputs. This command is not in use in the digital-only HMP110 probe option.

ASEL [ch1 ch2] [ch1low ch1high ch2low ch2high]<cr>

Syntax	Description
ch1	Output parameter for channel 1. The options are: • RH = Relative humidity • T = Temperature • Td = Dew point temperature • Tw = Wet bulb temperature • a = Absolute humidity • x = Mixing ratio • h = Enthalpy
ch2	Output parameters for channel 2. The options are same as for channel 1.
ch1low	Low limit for channel 1 output scaling.
ch1high	High limit for channel 1 output scaling.
ch2low	Low limit for channel 2 output scaling.
ch2high	High limit for channel 2 output scaling.

Example (show current output parameters and scaling):

```
asel ?
Ch1 RH lo : 0.00 %RH ?
Ch1 RH hi : 100.00 %RH ?
Ch2 T lo : -20.00 'C ?
Ch2 T hi : 80.00 'C ?
```

Example (change channel 1 to output dew point temperature, adjust scaling to -40 ... 60 °C for channel 1 and to -20 ... 80 °C for channel 2):

```
asel td t -40 60 -20 80
Ch1 Td   lo    :   -40.00 'C
Ch1 Td   hi    :    60.00 'C
Ch2 T    lo    :   -20.00 'C
Ch2 T    hi    :    80.00 'C
```

Example (change channel 1 to output temperature and channel 2 to output relative humidity, adjust scaling for channel 1 to -40 ... 60 °C when prompted):

```
asel t rh
Ch1 T    lo    :   -20.00 'C ? -40
Ch1 T    hi    :    80.00 'C ? 60
Ch2 RH   lo    :     0.00 %RH ?
Ch2 RH   hi    :   100.00 %RH ?
```

Set analog output error indication level

If the device is malfunctioning, the analog output is set to a specified level. This overrides the normal measurement output of the channel. The default error level is 0 V, or another value predefined by the customer when ordering the device. You can set the level using the AERR command. This command is not in use in the digital-only HMP110 probe option.

AERR [ch1 ch2] <cr>

Syntax	Description
ch1	Error level of the analog output for channel 1. The available range depends on the output mode (check with AMODE command).
ch2	Error level of the analog output for channel 2. The available range depends on the output mode (check with AMODE command).

Example (show present output modes):

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

Example (check present analog output error level):

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

Example (set analog output error level to 1 V on both channels):

```
aerr 1 1
Ch1 error out: 1.000V ?
Ch2 error out: 1.000V ?
```

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 shown.

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 wet end. This command is not in use in the digital-only HMP110 probe option.

AOVER [ON/OFF]<cr>

The following example illustrates how the analog output is affected. Channel 1 outputs T_d with voltage output 0 … 5 V (−40 °C … +60 °C). After giving the AOVER ON command, the range is 0 … 5.5 V (−40 °C … +70 °C). Note that the +60 °C T_d point is still at 5 V.

Example:

```
aover on
AOVER              :       ON
```

Extend maximum RH reading

With digital output, use the RHLIMIT command to set the maximum RH reading from 100 % (default) up to 120 %.

With analog output, the RHLIMIT command allows you to extend the high limit of the analog output scaling up to 120 %. This command does not change the scaling automatically. To change the scaling, use the ASEL command.

RHLIMIT [max_rh]<cr>

Syntax	Description
max_rh	Maximum reading of the RH parameter. Possible values are 100.0 … 120.0. The default value is 100.0.

Example (extend the maximum RH reading to 120 %):

```
rhlimit 120
Max. RH %      :    120.0 %RH
```

Example (on analog output, extend the maximum RH reading to 120 % and scale the RH output on channel 2 from (0 … 1 V) 0 … 100 % to (0 … 1 V) 0 … 120 %):

```
rhlimit 120
Max. RH %      :    120.0 %RH
asel ?
Ch1 T    lo    :   -20.00 'C ?
Ch1 T    hi    :    80.00 'C ?
```

```
Ch2 RH   lo    :     0.00 %RH ?
Ch2 RH   hi    :   100.00 %RH ? 120
```

Related concepts

- Set analog output parameters and scaling

Display command list

Use the HELP command to display a list of the currently available commands.

HELP<cr>

Display the currently active errors

Use the ERRS command to display the currently active error codes.

ERRS<cr>

Example (no active errors):

```
errs
0000h
No errors
```

Table 1. Error messages on ERRS command

ERRS command response	Corresponding error
T MEAS error	Temperature measurement error. [44]
F meas error	Humidity measurement error. [45]
RH sensor failure	Humidity sensor failure. [46]
Frequency measurement outside the permissible value range	Capacitance reference error. [47]
Ambient temperature error	Ambient temperature out of range. [48]
Program flash check sum error	Firmware checksum mismatch. [49]
Parameter flash check sum error	Device settings corrupted. [50]
INFOA check sum error	Additional configuration settings corrupted. [51]
SCOEFS check sum error	Sensor coefficients corrupted. [52]
CURRENT check sum error	Main configuration settings corrupted. [53]
Voltage error	Supply voltage out of range. [55]
General flash failure w/r	Non-volatile memory read/write failure. [57]
Calibration certificate check sum failure	Calibration certificate checksum mismatch. [58]

Refer to Error messages in Insight software for more information about the error states.

Related concepts

- Solving typical problems

Connect to the probe in POLL mode

Use the OPEN command to connect to a probe that is in POLL mode.

OPEN [aa]<cr>

Syntax	Description
aa	address (0 ... 255)

Example:

```
open 1
HMP110   1 line opened for operator commands
```

Close the connection in POLL mode

The CLOSE command closes the connection to the probe.

CLOSE<cr>

Example:

```
close
line closed
```

Reset the probe

Use the RESET command to reset the probe. Upon reset or power-up, the probe enters the serial mode that has been set with the SMODE command.

RESET<cr>

Example (probe set to serial mode STOP, will output probe model and software version at reset):

```
reset
HMP60 / 1.00.0
```

Example (probe set to serial mode RUN, will start to output measurement messages at reset):

```
reset
T= 23.6 'C RH= 20.2 %RH Td= -0.5 'C
T= 23.6 'C RH= 20.2 %RH Td= -0.5 'C
T= 23.3 'C RH= 20.2 %RH Td= -0.8 'C
...
```

Restore factory settings

Use the FRESTORE command to restore the factory settings to the probe. All user settings, including the user-performed calibration corrections, will be lost. The probe will revert back to the factory calibrated settings.

FRESTORE<cr>

Example:

```
frestore
Factory settings restored
```

Maintenance

Periodic maintenance

The humidity measurement accuracy of the HMP60 and HMP110 series probes should be calibrated yearly. When calibration indicates that accuracy is not within specification:

- HMP60 and HMP63: change the INTERCAP® sensor.
- HMP110 and HMP113: adjust the measurement yourself, or have it adjusted at Vaisala.

Light cleaning of the probe and replacement of the filter should be done only when necessary.

Cleaning

The probe body can be wiped clean with a soft, lint-free cloth moistened with mild detergent. Do not use solvents or compressed air.

Note that wiping the membrane filter or stainless steel sintered filter may block its pores and/or deposit residue on the filter. If the filter is heavily contaminated, replace it.

Replacing filter

The filter on the probe should be replaced when it is damaged or dirty.

1. Turn the filter counter-clockwise to loosen it.
2. Remove the filter from the probe. Be careful not to touch the sensors with the filter. Without the filter in place, the sensors are easily damaged – handle the probe carefully.
3. Install a new filter on the probe, and tighten it so it is finger-tight. Make sure the filter sits straight and meets the threads properly.

Order new filters from Vaisala.

Related concepts

- Filter options
- Spare parts and accessories
- Maintenance and calibration services

Calibration procedure

To calibrate your HMP60 or HMP110 series probe, you need a known stable humidity or temperature reference, and a way to read the output of the probe (Vaisala Insight software, analog output, serial output, the MI70 indicator, or the HM40 meter). As a humidity reference you can use, for example, the Vaisala Humidity Calibrator HMK15.

The probe can be connected to a PC with Vaisala USB cable 219690, and to the MI70 indicator with connection cable 219980. The HM40 meter does not need a specific connection cable.

For other cable options, see Cables and Spare parts and accessories.

> The probe cannot be used with the MI70 handheld indicator or the HM40 meter when the probe is in analog mode. To use the probe with MI70 or HM40, enable a serial mode (for example, STOP) in Vaisala Insight software. Use Insight also to return the probe to analog mode.

1. Connect the MI70 connection cable, the HM40 meter, or the USB cable to the HMP60/HMP110 probe.
   - With MI70: Connect the other end of the connection cable to the MI70 indicator.
   - With Insight: Leave the other end of the USB cable unconnected at this point. You can connect it to the PC after the stabilization period (4).
2. Remove the filter from the probe and place the probe in the reference environment. For example, you can use a NaCl salt chamber (75 %RH) as the humidity reference.
3. Wait for 20 ... 40 minutes for the reading to stabilize. Do not touch the probe or breathe in its direction during this time.
   - If you are using the MI70 indicator or the HM40 meter, you can follow the stabilization using the graph functionality.
   - If you are using the USB cable, do not keep the cable connected to the PC during the stabilization period for best calibration accuracy.
4. After the stabilization period:
   - With MI70/HM40: Switch MI70/HM40 off and on to start a blank graph.
   - With Insight: Connect the USB cable to the PC and start the Insight application.
5. Wait for 1 minute and make sure the graph showing the measurement reading is stable.
6. Check the measurement reading, and compare it with the reading shown by the humidity or temperature reference.

Related concepts

- Vaisala Insight software

Adjustment procedure using serial line (HMP110 and HMP113)

> If you are adjusting a probe that is in the analog output mode, start the probe in RS-485 mode. For instructions, see Accessing serial line command interface from analog or Modbus mode.

1-point adjustment of RH measurement (HMP110 and HMP113)

> You can also use Vaisala Insight software for performing calibration and adjustment. See Vaisala Insight software.

To perform a 1-point adjustment to the capacitance measurement of the HMP110 or HMP113 using serial line, you need:

- Vaisala USB cable (item code 219690)
- PC with a terminal application
- One humidity reference. 1-point adjustment with a single < 50 %RH reference adjusts the offset parameter of the measurement. 1-point adjustment with a single > 50 %RH reference adjusts the gain parameter of the measurement.

The following procedure uses the HMK15 Humidity Calibrator. LiCl salt (11 %RH) is used as the reference point.

1. Connect the USB cable to the PC, but do not connect it to the probe yet.
2. Remove the filter from the probe and insert the probe in the LiCl salt chamber of the humidity calibrator (11 %RH).
3. Start a terminal application and set the correct connection settings. The default serial settings are 19200 8 N 1. Remember to check which COM port the USB cable is using.
4. Wait for 20 … 40 minutes for the humidity to stabilize.
5. Start the terminal session and connect the USB cable to the probe. If your probe is in the analog output mode, press ENTER a few times to start it in RS-485 mode.
6. Verify that the connection works by giving the ? command.

   ```
   ?
   ```

   If the probe does not respond with device information:

   - Disconnect the USB cable from the probe and retry. If your probe is in the analog output mode, press ENTER a few times immediately after connecting the USB cable.
   - Try the ?? command in case the probe is in POLL mode, open the line using OPEN command if necessary.
   - Check your serial line settings and cable connections.
7. When your serial connection is working, use the L command to see the current user adjustment parameters.

   ```
   l
   ```

8. Use the ERRS command to see that no errors are active.

   ```
   errs
   ```

9. Give the CRH command, with the %RH value of the reference as a parameter (in this case 11 for LiCl).

   ```
   crh 11
   OK
   ```

10. Check with the L command that the user adjustment parameters have changed.

Related concepts

- Clear adjustment of RH measurement

2-point adjustment of RH measurement (HMP110 and HMP113)

You can also use Vaisala Insight software for performing calibration and adjustment. See Vaisala Insight software.

To perform a 2-point adjustment to the capacitance measurement of the HMP110 or HMP113 using serial line you need:

- Vaisala USB cable (item code 219690)
- PC with a terminal application
- Two humidity references. The first point requires a < 50 %RH humidity reference, the second point must be > 50 %RH. There must also be at least 30 %RH difference between the references.

The following procedure uses the HMK15 Humidity Calibrator. LiCl salt (11 %RH) is used as the first reference point, NaCl (75 %RH) as the second.

1. Connect the USB cable to the PC, but do not connect it to the probe yet.
2. Remove the filter from the probe and insert the probe in the LiCl salt chamber of the humidity calibrator (11 %RH).
3. Start a terminal application and set the correct connection settings. The default serial settings are 19200 8 N 1. Remember to check which COM port the USB cable is using.
4. Wait for 20 … 40 minutes for the humidity to stabilize.
5. Start the terminal session and connect the USB cable to the probe. If your probe is in the analog output mode, you need to press ENTER a few times to start it in RS-485 mode.
6. Verify that the connection works by giving the ? command.

   ```
   ?
   ```

   If the probe does not respond with device information:

   - Disconnect the USB cable from the probe and retry. If your probe is in the analog output mode, press ENTER a few times immediately after connecting the USB cable.
   - Try the ?? command in case the probe is in POLL mode, open the line using the OPEN command if necessary.
   - Check your serial line settings and cable connections.
7. When your serial connection is working, use the L command to see the current user adjustment parameters.

   ```
   l
   ```

8. Use the ERRS command to see that no errors are active.

   ```
   errs
   ```

9. Use the SEND command to verify the currently measured RH value.

   ```
   send
   T= 22.9 'C RH= 11.1 %RH Td= -8.0 'C
   ```

10. Give the CRH command with the RH value of the humidity reference as a parameter.

    ```
    crh 11
    OK
    ```

11. After entering the correction, unplug the USB cable from the probe. Insert the probe in the NaCl salt chamber (75 %RH) and wait for 20 … 40 minutes for humidity and temperature to stabilize.
12. Connect the USB cable to the probe and use the SEND command to see the currently measured value.
13. Give the CRH command with the RH value of the humidity reference as a parameter.

    ```
    crh 75
    OK
    ```

14. Check with the L command that the user adjustment parameters have changed. If you wish to remove the effects of RH calibration (returning the RH measurement of the probe to the factory calibrated state).

Related concepts

- Clear adjustment of RH measurement

1-point adjustment of T measurement (HMP110, HMP113, and HMP110T)

You can also use Vaisala Insight software for performing calibration and adjustment. See Vaisala Insight software.

To perform a 1-point adjustment to the temperature measurement of the HMP110, HMP113, or HMP110T using serial line, you need:

- Vaisala USB cable (item code 219690)
- PC with a terminal application
- One known and stable temperature reference

1. Connect the USB cable to the PC, but do not connect it to the probe yet.
2. Remove the filter from the probe and insert the probe in the temperature reference.
3. Start a terminal application and set the correct connection settings. The default serial settings are 19200 8 N 1. Remember to check which COM port the USB cable is using.
4. Wait for 20 … 40 minutes for the temperature to stabilize.
5. Start the terminal session and connect the USB cable to the probe. If your probe is in the analog output mode, you need to press ENTER a few times to start it in RS-485 mode.
6. Verify that the connection works by giving the ? command.

   ```
   ?
   ```

   If the probe does not respond with device information:
   - Disconnect the USB cable from the probe and retry. If your probe is in the analog output mode, press ENTER a few times immediately after connecting the USB cable.
   - Try the ?? command in case the probe is in POLL mode, open the line using OPEN command if necessary.
   - Check your serial line settings and cable connections.
7. When your serial connection is working, use the L command to see the current user adjustment parameters.

   ```
   l
   ```

8. Use the ERRS command to see that no errors are active.

   ```
   errs
   ```

9. Give the CT command, with the temperature value of the reference as a parameter.

   ```
   ct 23.5
   OK
   ```

10. Check with the L command that the user adjustment parameters have changed.

    If you wish to remove the effects of T calibration (returning the T measurement of the probe to the factory calibrated state).

Related concepts

- Clear adjustment of T measurement

Adjustment procedure using MI70 indicator (HMP110 and HMP113)

The probe cannot be used with the MI70 handheld indicator when the probe is in analog mode. To use the probe with MI70, enable a serial mode (for example, STOP) in Vaisala Insight software. Use Insight also to return the probe to analog mode. See Vaisala Insight software.

For more information on the MI70 indicator and the HM70 meter, see the *HM70 Handheld Humidity and Temperature Meter User Guide* (M210297EN).

1-point adjustment of RH measurement using MI70 indicator (HMP110 and HMP113)

If you want to perform a 2-point adjustment instead of a 1-point adjustment, use Vaisala Insight software or the serial line. See Vaisala Insight software and 2-point adjustment of RH measurement (HMP110 and HMP113).

To perform a 1-point adjustment to the capacitance measurement of the HMP110 or HMP113 using the MI70 indicator, you need:

- MI70 indicator
- Connection cable for MI70 indicator (Vaisala item code 219980)
- One humidity reference. 1-point adjustment with a single < 50 %RH reference will adjust the offset parameter of the measurement. 1-point adjustment with a single > 50 %RH reference will adjust the gain parameter of the measurement.

The following procedure uses the HMK15 Humidity Calibrator. LiCl salt (11 %RH) is used as the reference point.

1. Connect the probe to Port I of the MI70 indicator.
2. Turn on the MI70 indicator.
3. Start the adjustment sequence from Main menu > Functions > Adjustments.
4. MI70 notifies you that automatic power off is disabled during adjustment mode, press OK to acknowledge.
5. Select the RH parameter when prompted.
6. Now the adjustment mode is on, press ADJUST to select the adjustment method.
7. Select 1-point adjustment, press SELECT. Press OK to continue.
8. Insert the probe in the LiCl salt chamber of the humidity calibrator (11 %RH).

   You can follow the stabilization from the GRAPH display. Press READY when the reading is stabilized.

9. Give the reference humidity value by using the arrow buttons. Press OK.
10. Confirm the adjustment, press YES (by pressing NO you return to adjustment mode display and no changes are made).
11. Adjustment has been carried out. Press BACK to exit the adjustment mode, and press EXIT to return to the basic display.

Related concepts

- 2-point adjustment of RH measurement (HMP110 and HMP113)

1-point adjustment of temperature measurement using MI70 indicator (HMP110 and HMP113)

Temperature adjustment can be done if there is reason to believe that the adjustment is changed. In a 1-point adjustment, make sure the reference condition represents the measuring environment.

To perform a 1-point adjustment to the temperature measurement of the HMP110 or HMP113 using the MI70 indicator, you need:

- MI70 indicator
- Connection cable for MI70 indicator (Vaisala item code 219980)
- One known and stable temperature reference

1. Connect the probe to Port I of the MI70 indicator.
2. Turn on the MI70 indicator.
3. Start the adjustment sequence from Main menu > Functions > Adjustments.
4. MI70 notifies you that automatic power off is disabled during adjustment mode, press OK to acknowledge.
5. Select the T parameter when prompted.
6. Now the adjustment mode is on, press ADJUST to select the adjustment method.
7. Select 1-point adjustment, press SELECT.
8. Set the probe to a reference temperature. You can follow the stabilization from the GRAPH display. Press READY when the reading is stabilized in the reference.
9. Give the reference temperature value by using the arrow buttons. Press OK.
10. Confirm the adjustment, press YES (by pressing NO you return to adjustment mode display and no changes are made).
11. Calibration is carried out. Press BACK to exit the adjustment mode and EXIT to return to the basic display.

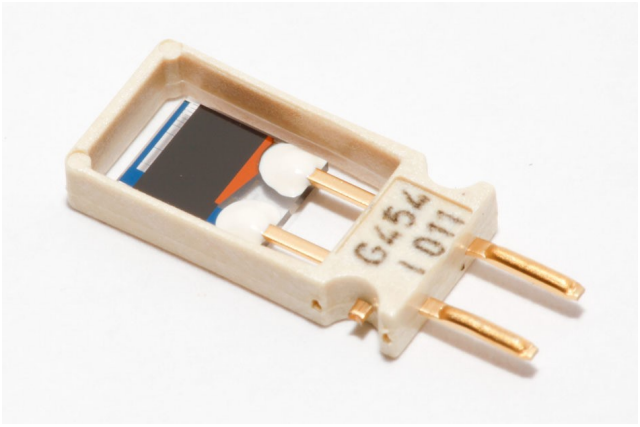
Repair maintenance

Changing the INTERCAP sensor (HMP60 and HMP63)

This procedure restores the humidity measurement accuracy of the probe. No adjustment after the sensor change is needed.

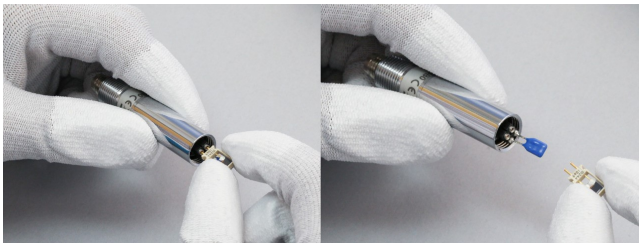
To perform this procedure, you need a new INTERCAP® sensor. It is also recommended that you replace the filter with a new one.

1. Remove the filter from the probe by turning it counter-clockwise.
2. There are 2 sensors under the filter, the INTERCAP® sensor and a temperature sensor. Identify the INTERCAP® sensor. Do not touch the temperature sensor.



3. Pull out the old INTERCAP® sensor and insert a new one. Handle the new sensor by the plastic frame.

   CAUTION! Do not touch the sensor plate.



4. Attach a new filter on the probe.

Changing the HUMICAP 180R/180V sensor (HMP110 and HMP113)

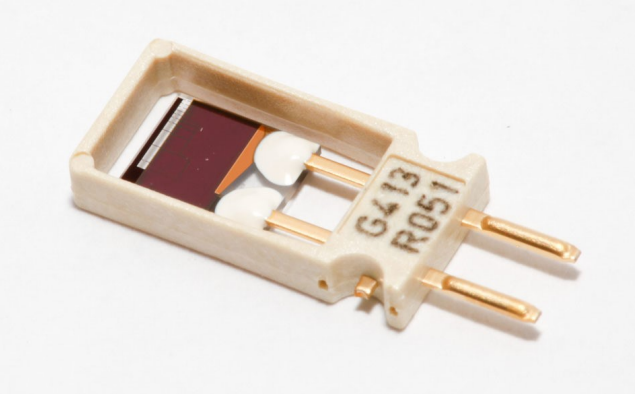
Replacing the humidity sensor of the HMP110 and HMP113 is not necessary in normal operation. If the accuracy of the probe does not seem to be within specification, it is likely that the accuracy can be restored by performing the adjustment procedure.

Follow this procedure to replace the humidity sensor of the HMP110 and HMP113 in case it has been damaged, or normal adjustment is not sufficient to restore the measurement accuracy. Calibration and adjustment of the humidity

measurement is required after the sensor change.

To perform this procedure, you need a new HUMICAP® 180R/180V sensor. It is also recommended that you replace the filter with a new one.

1. Remove the filter from the probe by turning it counter-clockwise.
2. There are 2 sensors under the filter, the HUMICAP® sensor and a temperature sensor. Identify the HUMICAP® sensor. Do not touch the temperature sensor.



3. Pull out the old HUMICAP® sensor and insert a new one. Handle the new sensor by the plastic frame.

> **CAUTION!** Do not touch the sensor plate.

4. Perform a 2-point adjustment of the RH measurement.
5. Attach a new filter on the probe.

Related concepts

- 2-point adjustment of RH measurement (HMP110 and HMP113)

Troubleshooting

Analog output error notification

If the device is unable to measure due to an error, the analog output is set to an error level. The default error level is 0 V, or another value predefined by the customer when ordering the device.

You can change the analog output error level using the AERR command.

Related concepts

- Set analog output error indication level

Solving typical problems

You can check the error message via the serial interface by using the ERRS command. If you are unable to remove the errors, contact Vaisala. For contact information, see Technical support.

Table 1. Troubleshooting table

Problem or message	Likely causes and solutions
Measurement not working. Any of the following errors active: • T meas error • RH meas error	Sensor(s) damaged or missing. Open the filter and check. Check the supply voltage of the probe. Check the output mode of the probe using serial line.
Humidity measurement appears to be wrong.	Check for condensation on the probe and sensor. Use the L command to check the currently applied calibration correction. Calibrate and adjust the probe (HMP110). Calibrate the probe and change the sensor if necessary (HMP60).
The probe is not responding to any serial commands.	Disconnect the USB cable from the probe and retry. If your probe is in the analog output mode, press ENTER a few times immediately after connecting the USB cable. Try the ?? command in case the probe is in POLL mode, open the line using OPEN command if necessary. Check your serial line settings and cable connections.
The following error is active: Voltage error	Operating voltage out of range. Correct voltage and reset probe.
Any check sum error is active. For example: • Program flash check sum error • Parameter flash check sum error	Internal error. Perform the following steps: 1. Return the probe to factory settings using the FRESTORE command. Check again. 2. If the error is still active, contact Vaisala.
The following error is active: Frequency measurement outside the permissible value range	Check for condensation on the probe and sensor. Allow the probe and sensor to dry. If the error is still active, there may be a problem with the electronics. Contact Vaisala.

Related concepts

- Technical support

Error messages in Insight software

Table 1. Error messages in Insight software

Error	Likely cause	Suggested solution
Temperature measurement error. [44]	Temperature sensor is short circuited, damaged, or missing.	Check that the legs of the temperature sensor are not short circuited. Contact Vaisala if the temperature sensor is damaged.
Humidity measurement error. [45]	Humidity sensor is wet.	Wait for the humidity sensor to dry, or remove the filter and gently dry the sensors and the filter with clean instrument air.
Humidity sensor failure. [46]	Humidity sensor is damaged or missing.	Replace the humidity sensor or contact Vaisala.
Ambient temperature out of range. [48]	Ambient temperature is too high.	Lower the temperature at the installation site.
Supply voltage out of range. [55]	Supply voltage is too low.	Check and correct the power supply and wiring.
Capacitance reference error. [47]	Internal transmitter failure.	Power-cycle the device, and if necessary, restore the factory settings. If the error remains, contact Vaisala.
Firmware checksum mismatch. [49]		
Device settings corrupted. [50]		
Additional configuration settings corrupted. [51]		
Sensor coefficients corrupted. [52]		
Main configuration settings corrupted. [53]		
Non-volatile memory read/write failure. [57]		
Calibration certificate checksum mismatch. [58]		

In case of constant error, contact Vaisala.

Related concepts

- Technical support

Error codes in MI70 Handheld Meter

Table 1. Error codes in MI70

If several errors are active at the same time, the MI70 shows the sum of currently active error codes. The label "$_{hex}$" might not be displayed in MI70.

Refer to Error messages in Insight software for more information about the error states.

Transmitter error code in MI70	Corresponding error
1_{hex}	Temperature measurement error. [44]
2_{hex}	Humidity measurement error. [45]
4_{hex}	Humidity sensor failure. [46]
8_{hex}	Capacitance reference error. [47]
10_{hex}	Ambient temperature out of range. [48]
20_{hex}	Firmware checksum mismatch. [49]
40_{hex}	Device settings corrupted. [50]
80_{hex}	Additional configuration settings corrupted. [51]
100_{hex}	Sensor coefficients corrupted. [52]
200_{hex}	Main configuration settings corrupted. [53]
800_{hex}	Supply voltage out of range. [55]
2000_{hex}	Non-volatile memory read/write failure. [57]
4000_{hex}	Calibration certificate checksum mismatch. [58]

Unknown serial settings

You can check the current serial settings of your probe by connecting to the serial line, or with Vaisala Insight software.

Related concepts

- Vaisala Insight software
- Accessing serial line command interface from analog or Modbus mode

Technical data

HMP60 specifications

Table 1. HMP60 measurement performance

Property	Description/Value
Relative humidity	
Measurement range	0 … 100 %RH
Typical accuracy:	
at 0 … +40 °C (+32 … +140 °F)	±3 %RH (0 … 90 %RH) ±5 %RH (90 … 100 %RH)
at −40 … 0 °C and +40 … +60 °C (−40 … +32 °F and +104 … +140 °F)	±5 %RH (0 … 90 %RH) ±7 %RH (90 … 100 %RH)
Humidity sensor	Vaisala INTERCAP®
Temperature	
Measurement range	−40 … +60 °C (−40 … +140 °F)
Accuracy:	
at +10 … +30 °C (+50 … +86 °F)	±0.5 °C (±32.9 °F)
at −40 … +10 and +30 … +60 °C (−40 … +50 and +86 … +140 °F)	±0.6 °C (±33.08 °F)
Dew point temperature	
Measurement range	−40 … +60 °C (−40 … +140 °F)
Typical accuracy:	
at +32 … +40 °C (0 … +140 °F) when dew point depression [1] < +15 °C (< +59 °F)	±2 °C (±35.6 °F)
at −40 … 0 °C and +40 … +60 °C (−40 … +32 °F and +104 … +140 °F) when dew point depression < +10 °C (< +50 °F)	±3 °C (±37.4 °F)
Analog outputs	
Accuracy at +20 °C (+68 °F)	±0.2 % of FS
Temperature dependence	±0.01 % of FS/°C (±0.006 % of FS/°F)

Table 2. HMP60 calculated parameters

Property	Description/Value
Measurement ranges	
Dew point temperature	−40 … +60 °C (−40 … +140 °F)
Wet bulb temperature	−40 … +60 °C (−40 … +140 °F)
Absolute humidity	0 … 130 g/m^3 (0 … 57 gr/ft^3)
Mixing ratio	0 … 153 g/kg (0 … 1069 gr/lb)
Enthalpy	−40 … 459 kJ/kg (−9.6 … 207 BTU/lb)

Table 3. HMP60 operating environment

Property	Description/Value
Operating temperature	−40 … +60 °C (−40 … +140 °F)
EMC compliance	EN 61326-1, industrial environment

Table 4. HMP60 inputs and outputs

Property	Description/Value
Power consumption	1 mA average, max. peak 5 mA
Operating voltage [2]	
With 1 V / 2.5 V output	5 … 28 VDC
With 5 V output	8 … 28 VDC
With loop power converter	8 … 28 VDC
With digital output	5 … 28 VDC
Start-up time	
Probes with analog output	4 s at operating voltage 13.5 … 16.5 VDC 2 s at other valid operating voltages
Probes with digital output	1 s
Outputs	
2 channels	0 … 1 VDC / 0 … 2.5 VDC / 0 … 5 VDC / 1 … 5 VDC
1-channel loop-power converter (separate module, compatible with humidity accuracy only)	4 … 20 mA
Digital output (optional)	RS-485 2-wire half duplex, supports Modbus RTU
External loads	
0 … 1 V	R_L min. 10 kΩ
0 … 2.5 V /0 … 5 V	R_L min. 50 kΩ
Output parameters	
Relative humidity, temperature, dew point temperature, wet bulb temperature, absolute humidity, mixing ratio, enthalpy	

Table 5. HMP60 mechanical specifications

Property	Description/Value
IP rating	IP65 [3]
Body thread	MI2x1 / 10 mm (0.4 in)
Cable connector	4-pin M8 (IEC 60947-5-2)
Materials	
Body	Stainless steel (AISI 316)
Grid filter	Chrome coated ABS plastic
Cable	Polyurethane or FEP
Weight	
Probe	17 g (0.6 oz)
Probe with 0.3 m (1 ft) cable	28 g (1 oz)

[1] Dew point depression = ambient temperature − dew point.
[2] Use lowest available operating voltage to minimize heating.
[3] Applicable with stainless steel sintered filter and PTFE sintered filter only.

HMP63 specifications

Table 1. HMP63 measurement performance

Property	Description/Value
Relative humidity	
Measurement range	0 … 100 %RH
Typical accuracy:	
at 0 … +40 °C (+32 … +140 °F)	±3 %RH (0 … 90 %RH) ±5 %RH (90 … 100 %RH)
at −40 … 0 °C and +40 … +60 °C (−40 … +32 °F and +104 … +140 °F)	±5 %RH (0 … 90 %RH) ±7 %RH (90 … 100 %RH)
Humidity sensor	Vaisala INTERCAP®
Temperature	
Measurement range	−40 … +60 °C (−40 … +140 °F)
Accuracy:	

Property	Description/Value
at +10 … +30 °C (+50 … +86 °F)	±0.5 °C (±32.9 °F)
at −40 … +10 and +30 … +60 °C (−40 … +50 and +86 … +140 °F)	±0.6 °C (±33.08 °F)
Dew point temperature	
Measurement range	−40 … +60 °C (−40 … +140 °F)
Typical accuracy:	
at 0 … +40 °C (+32 … +140 °F) when dew point depression[1] < 15 °C	±2 °C (±35.6 °F)
at −40 … 0 °C and +40 … +60 °C (−40 … +32 °F and +104 … +140 °F) when dew point depression < 10 °C [1]	±3 °C (±37.4 °F)
Analog outputs	
Accuracy at 20 °C (+68 °F)	±0.2 % of FS
Temperature dependence	±0.01 % of FS/°C (±0.006 % of FS/°F)

Table 2. HMP63 calculated parameters

Measurement ranges	
Dew point temperature	−40 … +60 °C (−40 … +140 °F)
Wet bulb temperature	−40 … +60°C (−40 … +140°F)
Absolute humidity	0 … 130 g/m^3 (0 … 57 gr/ft^3)
Mixing ratio	0 … 153 g/kg (0 … 1069 gr/lb)
Enthalpy	−40 … 459 kJ/kg (−9.6 … 207 BTU/lb)

Table 3. HMP63 operating environment

Property	Description/Value
Operating temperature	−40 … +60 °C (−40 … +140 °F)
EMC compliance	EN 61326-1, basic immunity test requirements

Table 4. HMP63 inputs and outputs

Property	Description/Value
Power consumption	1 mA average, max. peak 5 mA
Operating voltage[2]	
With 1 V / 2.5 V output	5 … 28 VDC
With 5 V output	8 … 28 VDC
With loop power converter	8 … 28 VDC
With digital output	5 … 28 VDC
Start-up time	
Probes with analog output	4 s at operating voltage 13.5 … 16.5 VDC 2 s at other valid operating voltages
Probes with digital output	1 s
Outputs	
2 channels	0 … 1 VDC / 0 … 2.5 VDC / 0 … 5 VDC / 1 … 5 VDC
1-channel loop-power converter (separate module, compatible with humidity accuracy only)	4 … 20 mA
Digital output (optional)	RS-485 2-wire half duplex, supports Modbus RTU
External loads	
0 … 1 V	R_L min. 10 kΩ
0 … 2.5 V /0 … 5 V	R_L min. 50 kΩ
Output parameters	
Relative humidity, temperature, dew point temperature, wet bulb temperature, absolute humidity, mixing ratio, enthalpy	

Table 5. HMP63 mechanical specifications

Property	Description/Value
IP rating	IP54 [3]
Cable connector	4-pin M8 (IEC 60947-5-2)
Materials	
Body	PC/ABS blend
Grid filter	PC (glass reinforced)
Cable	Polyurethane or FEP
Weight	
Probe	9 g (0.3 oz)
Probe with 0.3 m (1 ft) cable	20 g (0.7 oz)

[1] Dew point depression = ambient temperature − dew point
[2] Use lowest available operating voltage to minimize heating.
[3] Not applicable with the plastic grid filter.

HMP110 specifications

Table 1. HMP110 measurement performance

Property	Description/Value
Relative humidity	
Measurement range	0 … 100 %RH
Accuracy: [1] [2]	
at 0 … +40 °C (+32 … +104 °F)	±1.5 %RH (0 … 90 %RH) ±2.5 %RH (90 … 100 %RH)
at −40 … 0 °C (−40 … +32 °F) and +40 … +80 °C (+104 … +176 °F)	±3.0 %RH (0 … 90 %RH) ±4.0 %RH (90 … 100 %RH)
Factory calibration uncertainty at +20 °C (+68 °F)	±1.1 %RH (0 … 90 %RH) ±1.8 %RH (90 … 100 %RH)
Humidity sensor types	HUMICAP® 180R HUMICAP® 180V
Stability	±2 %RH over 2 years
Temperature	
Measurement range	−40 … +80 °C (−40 … +176 °F)
Accuracy (probes with analog output):	
at 0 … +40 °C (+32 … +104 °F)	±0.2 °C (±0.36 °F)
at −40 … 0 °C (−40 … +32 °F) and +40 … +80 °C (+104 … +176 °F)	±0.4 °C (±0.72 °F)
Accuracy (probes with digital output):	
at +15 … +25 °C (+59 … +77 °F)	±0.1 °C (±0.18 °F)
at 0 … +15 °C (+ 32 … +59 °F) and +25 … +40 °C (+77 … +104 °F)	±0.15 °C (±0.27 °F)
at −40 … 0 °C (−40 … +32 °F) and +40 … +80 °C (+104 … +176 °F)	±0.4 °C (±0.72 °F)
Temperature sensor	Pt1000 RTD Class F0.1 IEC 60751
Dew point temperature	
Measurement range	−40 … +80 °C (−40 … +176 °F)
Accuracy (at 20 °C (68 °F) and 80 %RH [1]):	
at 0 … +40 °C (+32 … +104 °F) when dew point depression < +15 °C (+59 °F) [3]	±1 °C (±33.8 °F)
when dew point depression +15 … +25 °C (+59 … +77 °F)	±2 °C (±35.6 °F)
at −40 … 0 °C (−40 … +32 °F) and +40 … +80 °C (+104 … +176 °F), when when dew point depression < +15 °C (+59 °F)	±2 °C (±35.6 °F)
Analog outputs	
Accuracy at +20 °C (+68 °F)	±0.2 % of FS
Temperature dependence	±0.01 % of FS/°C (±0.006 % of FS/°F)

Table 2. HMP110 calculated parameters

Property	Description/Value
Measurement ranges	
Dew point temperature	−40 … +80 °C (−40 … +176 °F)
Wet bulb temperature	−40 … +80°C (−40 … +176 °F)
Absolute humidity	0 … 291 g/m^3 (0 … 127 gr/ft^3)
Mixing ratio	0 … 548 g/kg (0 … 3836 gr/lb)
Enthalpy	−40 … 1530 kJ/kg (−9.6 … 674 BTU/lb)

Table 3. HMP110 operating environment

Property	Description/Value
Operating temperature	−40 … +80 °C (−40 … +176 °F)
EMC compliance	EN 61326-1, industrial environment

Table 4. HMP110 inputs and outputs

Property	Description/Value
Power consumption	1 mA average, max. peak 5 mA
Operating voltage [4]	
With 1 V / 2.5 V output	5 … 28 VDC
With 5 V output	8 … 28 VDC
With loop power converter	8 … 28 VDC
With digital output	5 … 28 VDC
Start-up time	
HMP110 probes with analog output	4 s at operating voltage 13.5 … 16.5 VDC 2 s at other valid operating voltages
HMP110 probes with digital output	1 s
Outputs	
2 channels	0 … 1 VDC / 0 … 2.5 VDC / 0 … 5 VDC / 1 … 5 VDC
1-channel loop-power converter (separate module, compatible with humidity accuracy only)	4 … 20 mA
Digital output (HMP110 probes with digital output)	RS-485 2-wire half duplex, supports Modbus RTU
External loads	
0 … 1 V	R_L min 10 kΩ
0 … 2.5 V /0 … 5 V	R_L min 50 kΩ
Output parameters	
Relative humidity, temperature, dew point temperature, wet bulb temperature, absolute humidity, mixing ratio, enthalpy	

Table 5. HMP110 mechanical specifications

Property	Description/Value
IP rating	IP65 [5]
Body thread	MI2x1 / 10 mm (0.4 in)
Cable connector	M8 4-pin female (IEC 60947-5-2)
Materials	
Body	Stainless steel (AISI 316)
Grid filter	Chrome coated ABS plastic
Cable	Polyurethane or FEP
Weight	
Probe	17 g (0.6 oz)
Probe with 0.3 m (1 ft) cable	28 g (1 oz)

[1] Including non-linearity, hysteresis, and repeatability.
[2] With HUMICAP® 180V sensor, accuracy is not specified below −20 °C (−4 °F) operating temperature.
[3] Dew point depression = ambient temperature − dew point.
[4] Use lowest available operating voltage to minimize heating.
[5] Applicable with stainless steel sintered filter and PTFE sintered filter only.

HMP113 specifications

Table 1. HMP113 measurement performance

Property	Description/Value
Relative humidity	
Measurement range	0 … 100 %RH
Accuracy (incl. non-linearity, hysteresis, and repeatability):	
at 0 … +40 °C (+32 … +104 °F)	±1.5 %RH (0 … 90 %RH) ±2.5 %RH (90 … 100 %RH)
at −40 … 0 °C (−40 … +32 °F) and +40 … +60 °C (+104 … +140 °F)	±3.0 %RH (0 … 90 %RH) ±4.0 %RH (90 … 100 %RH)
Factory calibration uncertainty at +20 °C (+68 °F):	±1.1 %RH (0 … 90 %RH) ±1.8 %RH (90 … 100 %RH)
Humidity sensor	HUMICAP® 180R
Stability	±2 %RH over 2 years
Temperature	
Measurement range	−40 … +60 °C (−40 … +140 °F)
Accuracy:	
at 0 … +40 °C (+32 … +104 °F)	±0.2 °C (±0.36 °F)
at −40 … 0 °C (−40 … +32 °F) and +40 … +60 °C (+104 … +140 °F)	±0.4 °C (±0.72 °F)
Temperature sensor	Pt1000 RTD Class F0.1 IEC 60751
Dew point temperature	
Measurement range	−40 … +60 °C (−40 … +140 °F)
Accuracy (incl. non-linearity, hysteresis, and repeatability):	
at 0 … +40 °C (+32 … +104 °F)	
when dew point depression < +15 °C (+59 °F) [1]	±1 °C (±33.8 °F)
when dew point depression +15 … +25 °C (+59 … +77 °F)	±2 °C (±35.6 °F)
at −40 … 0 °C (−40 … +32 °F) and +40 … +60 °C (+104 … +140 °F), when dew point depression < +15 °C (+59 °F)	±2 °C (±35.6 °F)
Analog outputs	
Accuracy at +20 °C (+68 °F)	±0.2 % of FS
Temperature dependence	±0.01 % of FS/°C (±0.006 % of FS/°F)

Table 2. HMP113 calculated parameters

Property	Description/Value
Measurement ranges	
Dew point temperature	−40 … +60 °C (−40 … +140 °F)
Wet bulb temperature	−40 … +60 °C (−40 … +140 °F)
Absolute humidity	0 … 130 g/m^3 (0 … 57 gr/ft^3)
Mixing ratio	0 … 153 g/kg (0 … 1069 gr/lb)
Enthalpy	−40 … 459 kJ/kg (−9.6 … 207 BTU/lb)

Table 3. HMP113 operating environment

Property	Description/Value
Operating temperature	−40 … +60 °C (−40 … +140 °F)
EMC compliance	EN 61326-1, basic immunity test requirements

Table 4. HMP113 inputs and outputs

Property	Description/Value
Power consumption	1 mA average, max. peak 5 mA
Operating voltage [2]	
With 1 V / 2.5 V output	5 … 28 VDC
With 5 V output	8 … 28 VDC
With loop power converter	8 … 28 VDC
With digital output	5 … 28 VDC
Start-up time	
Probes with analog output	4 s at operating voltage 13.5 … 16.5 VDC 2 s at other valid operating voltages
Probes with digital output	1 s
Outputs	
2 channels	0 … 1 VDC / 0 … 2.5 VDC / 0 … 5 VDC / 1 … 5 VDC
1-channel loop-power converter (separate module, compatible with humidity accuracy only)	4 … 20 mA
Digital output (optional)	RS-485 2-wire half duplex, supports Modbus RTU
External loads	
0 … 1 V	R_L min 10 kΩ
0 … 2.5 V /0 … 5 V	R_L min 50 kΩ
Output parameters	
Relative humidity, temperature, dew point temperature, wet bulb temperature, absolute humidity, mixing ratio, enthalpy	

Table 5. HMP113 mechanical specifications

Property	Description/Value
IP rating	IP54 [3]
Cable connector	4-pin M8 (IEC 60947-5-2)
Materials	
Body	PC/ABS blend
Grid filter	PC (glass reinforced)
Cable	Polyurethane or FEP
Weight	
Probe	9 g (0.3 oz)
Probe with 0.3 m (1 ft) cable	20 (0.7 oz)

[1] Dew point depression = ambient temperature − dew point
[2] Use lowest available operating voltage to minimize heating.
[3] Not applicable with the plastic grid filter.

Probe dimensions

HMP60, HMP110, and HMP110T dimensions

Figure 1. HMP60, HMP110, and HMP110T dimensions in mm [in]

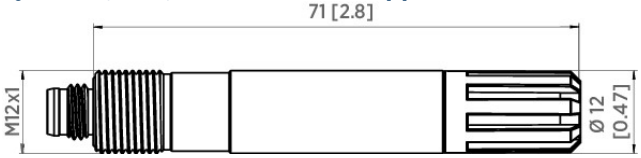
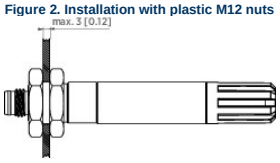


Figure 2. Installation with plastic M12 nuts



HMP63 and HMP113 dimensions

Figure 1. HMP63 and HMP113 dimensions in mm [in]

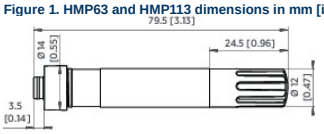
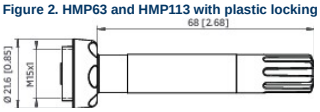


Figure 2. HMP63 and HMP113 with plastic locking bushing



Spare parts and accessories

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

Table 1. HMP60, HMP63, HMP110, and HMP113 spare parts and accessories

Item	Item code
Sensors	
For HMP60 and HMP63:	
Vaisala INTERCAP® sensor, 1 pc	15778HM
Vaisala INTERCAP® sensor, 10 pcs	INTERCAPSET-10PCS
For HMP110 and HMP113:	
Vaisala HUMICAP® 180R	HUMICAP180R
Vaisala HUMICAP® 180V	HUMICAP180V
Sensor protection	
For HMP60 and HMP110:	
Plastic grid filter	DRW010522SP
Membrane filter	DRW010525SP

Item	Item code
Stainless steel sintered filter	HM46670SP
PTFE membrane filter with stainless steel grid	ASM212652SP
PTFE sintered filter	DRW244938SP
For HMP63 and HMP113:	
Plastic grid filter	DRW240185SP
Plastic grid with membrane filter	ASM210856SP
Stainless steel sintered filter	HM47280SP
Porous PTFE filter	219452SP
Probe installation	
For HMP60 and HMP110:	
Probe mounting clamp set, 10 pcs	226067
Probe mounting flange	226061
Probe holder, 5 pcs	ASM213382SP
Plastic M12 installation nuts, 1 pair	18350SP
Flat extension cable 1 m (3 ft) [1]	CBL210649SP
For HMP63 and HMP113:	
Probe mounting clamp set, 10 pcs	226067
Probe mounting flange	226061
Probe holder, 5 pcs	ASM213382SP
Plastic locking bushing (3 pcs) for attaching the probe to HM40 indicator	DRW238590SP
Connection adapters [2]	
4 … 20 mA loop power converter	UI-CONVERTER-1CB
Mounting bracket for converter	225979
USB cable for PC connection	219690
Connection cable for MI70 indicator	219980SP
Connection cables with open wires	
+60 °C 0.3 m (+140 °F 1 ft)	HMP50Z032SP
+60 °C 1.2 m (+140 °F 4 ft)	HMP50Z120
+60 °C 3 m (+140 °F 9.8 ft)	HMP50Z300SP
+80 °C 1.5 m (+176 °F 5 ft)	225777SP
+80 °C 3 m (+176 °F 10 ft)	225229SP
+180 °C 1.5 m (+356 °F 5 ft) FEP	238025
+180 °C 3 m (+356 °F 10 ft) FEP	226902SP

[1] Connection cable 219980SP is also needed if this cable is used with MI70 indicator.
[2] No separate adapter is needed for HM40 compatibility.

Modbus reference

Communication settings

The following table lists the default Modbus serial settings of devices ordered with the Modbus configuration option.

Table 1. Modbus 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
Serial delay	0
Communication mode	Modbus RTU

You can use up to 32 probes on the same RS-485 line when the communication speed is 19200 bps or lower. You must configure each probe on the line to have a different Modbus address.

RS-485 termination must not be used with HMP60/HMP110 series probes.

After power-up, it may take up to 2 seconds before the probe responds to any Modbus request.

Function codes

Table 1. Supported Modbus function codes

Function code	Function code (hexadecimal)	Name
03	03_{hex}	Read Holding Registers
16	10_{hex}	Write Multiple Registers
43 / 14	$2B_{hex}$ / $0E_{hex}$	Read Device Identification

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.

For values that have both 32-bit and 16-bit register available, use of the 32-bit register is recommended.

32-bit floating point or 32-bit integer format

Registers using 32-bit float data format are encoded using the binary32 encoding defined in IEEE 754. The format is also known as "single-precision floating point format".

The least significant 16 bits of a floating point number are placed at the Modbus register listed in the table, while the most significant 16 bits are placed in the register with number/address + 1, as specified in Open Modbus TCP Specification, Release 1.0. This is also known as "little-endian" or "Modicon" word order.

Despite the specification, some Modbus masters may expect a "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 complete 32-bit floating point or 32-bit integer value should be read and written in a single Modbus transaction.

CAUTION! Reading the measurement data registers with incorrect floating point format setting may occasionally result in correct-looking, but nevertheless incorrect values.

It is highly recommended to verify that you have configured the floating point format correctly on your Modbus host system by reading a floating point value from a test value register.

Related concepts

- Test value registers

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 1. Interpretation of 16-bit signed integer values

Value (decimal)	Value (hexadecimal)	Description
0 … 32766	0000_{hex} … $7FFE_{hex}$	Value in range 0 … 32766
32767	$7FFF_{hex}$	Value is 32767 or larger
32768	8000_{hex}	Value is not available
32769	8001_{hex}	Value is −32767 or smaller
32770 … 65535	8002_{hex} … $FFFF_{hex}$	Value in range −32766 … −1 (2's complement)

Modbus registers

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. Register number 1 corresponds to address 0_{hex} in the actual Modbus message.

CAUTION! Reading the wrong register(s) may result in correct-looking values. Check the reference documentation of your Modbus host (PLC) to verify which notation it uses for Modbus register addresses.

Measurement data registers

Table 1. Modbus measurement data registers (read-only)

Register number	Address	Register description	Data format	Unit
Floating point values				

Register number	Address	Register description	Data format	Unit
1	0000_{hex} 0001_{hex}	Relative humidity	32-bit float	%RH
3	0002_{hex} 0003_{hex}	Temperature [1]	32-bit float	°C
9	0008_{hex} 0009_{hex}	Dew/frost point temperature	32-bit float	°C
15	$000E_{hex}$ $000F_{hex}$	Absolute humidity	32-bit float	g/m^3
17	0010_{hex} 0011_{hex}	Mixing ratio	32-bit float	g/kg
19	0012_{hex} 0013_{hex}	Wet-bulb temperature	32-bit float	°C
27	$001A_{hex}$ $001B_{hex}$	Enthalpy	32-bit float	kJ/kg
Integer values				
257	0100_{hex}	Relative humidity	16-bit integer	%RH * 10
258	0101_{hex}	Temperature [1]	16-bit integer	°C * 10
261	0104_{hex}	Dew/frost point temperature	16-bit integer	°C * 10
264	0107_{hex}	Absolute humidity	16-bit integer	g/m^3 * 10
265	0108_{hex}	Mixing ratio	16-bit integer	g/kg * 10
266	0109_{hex}	Wet-bulb temperature	16-bit integer	°C * 10
270	$010D_{hex}$	Enthalpy	16-bit integer	kJ/kg * 10

[1] Only temperature output is available in probe model HMP110T.

Configuration registers

Table 1. Modbus configuration data registers (writable)

Register number	Register address	Register description	Data format	Unit / Valid range
Filtering				
785	0310_{hex} 0311_{hex}	Measurement filtering factor	32-bit float	0.001 (maximum filtering) … 1.000 (no filtering)
Communication				
1537	0600_{hex}	Modbus address	16-bit integer	1 … 247
1538	0601_{hex}	Bit rate [1]	16-bit integer	5 = 9600 6 = 19200 7 = 38400 8 = 57600
1539	0602_{hex}	Parity, data, stop bits [1]	16-bit integer	0 = None, 8, 1 1 = None, 8, 2 2 = Even, 8, 1 3 = Even, 8, 2 4 = Odd, 8, 1 5 = Odd, 8, 2
1540	0603_{hex}	Response delay	16-bit integer	0 … 1020 ms
1541	0604_{hex}	Protocol	16-bit integer	6 = Modbus RTU
1542	0605_{hex}	Restart device	16-bit integer	When writing to register: 1 = Restart the device

If incompatible settings/protocol are selected and the probe is then restarted, it might no longer be possible to communicate with the probe using Modbus. You can override invalid communication settings in Vaisala Insight software, Settings menu. See Vaisala Insight software.

[1] Changed setting will be activated on device restart.

Status registers

Table 1. Modbus status data registers (read-only)

Register number	Address	Register description	Data format	Note
513	0200_{hex}	Error status	16-bit integer	0000_{hex}: One or more errors active 0001_{hex}: No errors
516	0203_{hex} 0204_{hex}	Error code	32-bit integer	
518	0205_{hex} 0206_{hex}	Security hash	32-bit integer	Security hash changes when any change is made to device settings or adjustments, but also returns back to the previous value if such changes are reverted completely.

Table 2. Error codes on Modbus interface

Error code register value	Corresponding error
1	Temperature measurement error. [44]
2	Humidity measurement error. [45]
4	Humidity sensor failure. [46]
8	Capacitance reference error. [47]
16	Ambient temperature out of range. [48]
32	Firmware checksum mismatch. [49]
64	Device settings corrupted. [50]
128	Additional configuration settings corrupted. [51]
256	Sensor coefficients corrupted. [52]
512	Main configuration settings corrupted. [53]
2048	Supply voltage out of range. [55]
8192	Non-volatile memory read/write failure. [57]
16384	Calibration certificate checksum mismatch. [58]

If several errors are active at the same time, the Modbus error code register contains the sum of currently active error codes.

Refer to Error messages in Insight software for more information about the error states.

Test value registers

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

Table 1. Modbus test registers (read-only)

Register number	Register address	Register description	Data format	Test value
7937	$1F00_{hex}$	Signed integer test	16-bit integer	-12345
7938	$1F01_{hex}$ $1F02_{hex}$	Floating point test	32-bit float	-123.45

Register number	Register address	Register description	Data format	Test value
7940	$1F03_{hex}$ 1F04hex 1F05hex 1F06hex	Text string test	text	Text string "-123.45"

Device identification objects

Table 1. Device identification objects

Object ID	Object ID (hexadecimal)	Object name	Example contents
0	00_{hex}	VendorName	"Vaisala"
1	01_{hex}	ProductCode	"HMP113"
2	02_{hex}	MajorMinorVersion	"2.4.0" Software version of the device.
3	03_{hex}	VendorUrl	"http://www.vaisala.com"
4	04_{hex}	ProductName	"Vaisala HUMICAP(R) Humidity and Temperature Probe HMP113"
5	05_{hex}	ModelName	"R00A0C1A0" Configuration code of the device. Length and content of the code are model-specific.
128	80_{hex}	SerialNumber [1]	"J1140501"
129	81_{hex}	CalibrationDate [1]	"2020-06-01" Calibration date in YYYY-MM-DD format. Empty string if not set/valid.
130	82_{hex}	CalibrationText [1]	"Vaisala/HEL" Calibration information text. Empty string if not set/valid.

[1] Vaisala-specific device information object

Modbus communication examples

Reading relative humidity value

The device address used in the following examples is 240 ($F0_{hex}$).

The values returned by the device change depending on ambient conditions and/or device settings.

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
$F0_{hex}$	Probe address		$F0_{hex}$	Probe 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}	Value of second register (most significant word)
$D1_{hex}$	Modbus RTU checksum		$F4_{hex}$	
$2A_{hex}$			62_{hex}	Modbus RTU checksum
(silence for 3.5 bytes)	End of Modbus RTU frame		05_{hex}	
			(silence for 3.5 bytes)	End of Modbus RTU frame

Communication description	
Register number	1 (1-based Modbus register number) = address 0000hex (0-based address 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 filtering factor 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
$F0_{hex}$	Transmitter address		$F0_{hex}$	Transmitter address
10_{hex}	Function (Write Multiple Registers)		10_{hex}	Function (Write Multiple Registers)
03_{hex}	Register address		03_{hex}	Register address
10_{hex}			10_{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		55_{hex}	Modbus RTU checksum
CC_{hex}	Value for the first register (least significant word)		68_{hex}	
CD_{hex}			(silence for 3.5 bytes)	End of Modbus RTU frame
$3E_{hex}$	Value for the second register (most significant word)		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). To verify that the value was really accepted by the device, read the register value after writing.	
$4C_{hex}$				
$5E_{hex}$	Modbus RTU checksum			
96_{hex}				
(silence for 3.5 bytes)	End of Modbus RTU frame			

Communication description	
Register number	785 (1-based Modbus register number) = address 0310_{hex} (0-based address used in actual communication).
Data format	Two 16-bit Modbus registers interpreted as IEEE 754 binary32 floating point value, least significant word first.
Value to write	0.2, in binary32 format $3E4CCCCD_{hex}$.

Maintenance and calibration services

Vaisala offers comprehensive customer care throughout the life cycle of our measurement instruments and systems. Our factory services are provided worldwide with fast deliveries. For more information, see www.vaisala.com/calibration.

- Vaisala Online Store at store.vaisala.com is available for most countries. You can browse the offering by product model and order the right accessories, spare parts, or maintenance and calibration services.
- To contact your local maintenance and calibration expert, see www.vaisala.com/contactus.

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.