USER'S GUIDE

Vaisala HUMICAP® Humidity Module HMM100

M211024EN-C

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CHAPTER 1
GENERAL INFORMATION

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

About This Manual

This manual provides information for installing, operating, and maintaining Vaisala HUMICAP® Humidity Module HMM100.

Contents of This Manual

This manual consists of the following chapters:

- Chapter 1, General Information, provides general notes for the manual and the product.
- Chapter 2, Product Overview, introduces the features, advantages, and the product nomenclature of the HMM100.
- Chapter 3, Installation, provides you with information that is intended to help you install the HMM100.
- Chapter 4, Operation, contains information that is needed to operate the HMM100.
- Chapter 5, Maintenance, provides information that is needed in basic maintenance of the HMM100.
- Chapter 6, Troubleshooting, describes the analog output error notification behavior, some common problems, their probable causes and remedies, and provides contact information for technical support.
- Chapter 7, Technical Data, provides the technical data of the HMM100.

Version Information

Table 1   Manual Revisions

Manual Code	Description
M211024EN-C	November 2013. Removed RHCAL command. Added information on which parameter changes must be saved separately and which are saved automatically.
M211024EN-B	October 2012. Previous version. Added VHP filter option and new pictures to the installation instructions, edited commands and technical specifications.

Related Manuals

Table 2   Related Manuals

Manual Code	Manual Name
M211002EN	HMM100 Quick Reference Guide
M211078EN	Module Housing for Humidity Module HMM10 Quick Reference Guide
M211079EN	Mounting Bracket for Humidity Module HMM10 Quick Reference Guide
M211080EN	Mounting Flange for Humidity Probes Quick Reference Guide

Documentation Conventions

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

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

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

NOTE	Note highlights important information on using the product.

Safety

The HMM100 module delivered to you has been tested for safety and approved as shipped from the factory. Note the following precautions:

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

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

ESD Protection

Electrostatic Discharge (ESD) can cause immediate or latent damage to electronic circuits. Vaisala products are adequately protected against ESD for their intended use. However, it is possible to damage the product by delivering electrostatic discharges when touching exposed components.

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

- Handle ESD sensitive components on a properly grounded and protected ESD workbench. When this is not possible, ground yourself to the equipment chassis before touching the boards. Ground yourself with a wrist strap and a resistive connection cord. When neither of the above is possible, touch a conductive part of the equipment chassis with your other hand before touching the boards.
- Always hold the boards by the edges and avoid touching the component contacts.

Recycling

	Recycle all applicable material.

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

Regulatory Compliances

The HMM100 is in conformity with the provisions of the following EU directive(s):

- RoHS Directive
- WEEE Directive

The electromagnetic compatibility of the HMM100 has been tested according to the following product family standard:

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

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

Patent Notice

The HMM100 is protected by the following patents and patent applications and their corresponding national rights:

Finnish patent 98861, French patent 6650303, German patent 69418174, Japanese patent 3585973, UK patent 0665303, U.S. patent 5607564.

Trademarks

Vaisala HUMICAP® is a registered trademark of Vaisala Oyj.

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

License Agreement

All rights to any software are held by Vaisala or third parties. The customer is allowed to use the software only to the extent that is provided by the applicable supply contract or Software License Agreement.

Warranty

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

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CHAPTER 2
PRODUCT OVERVIEW

This chapter introduces the features, advantages, and the product nomenclature of the HMM100.

Introduction to HMM100 Series Humidity Modules

The HMM100 series humidity measurement modules are open frame modules intended for integration into environmental chambers and other chambers where high temperature tolerance is important. The modules provide a single analog output channel for relative humidity (RH) or dewpoint (T_d). Dewpoint is the recommended quantity if the measurement environment has significant temperature differences.

Table 3   Quantities Measured by HMM100

Quantity	Range
Relative humidity (RH)	0 ... 100%
Dewpoint (Td)	-20 ... +100 ºC (-4 ... +212 ºF)

All HMM100 modules include automatic temperature compensation across the operating temperature range using an integrated PT1000 sensor. No external temperature compensation should be applied to the output.

HMM100 modules do not incorporate probe heating or chemical purge functionality. If the measurement environment is prone to condensation, or likely to cause chemical contamination of the sensor, other Vaisala instruments may be more suitable to the application.

The cable and probe of the HMM100 are attached at the factory. They should remain connected to the module at all times; do not cut and re-connect the cable.
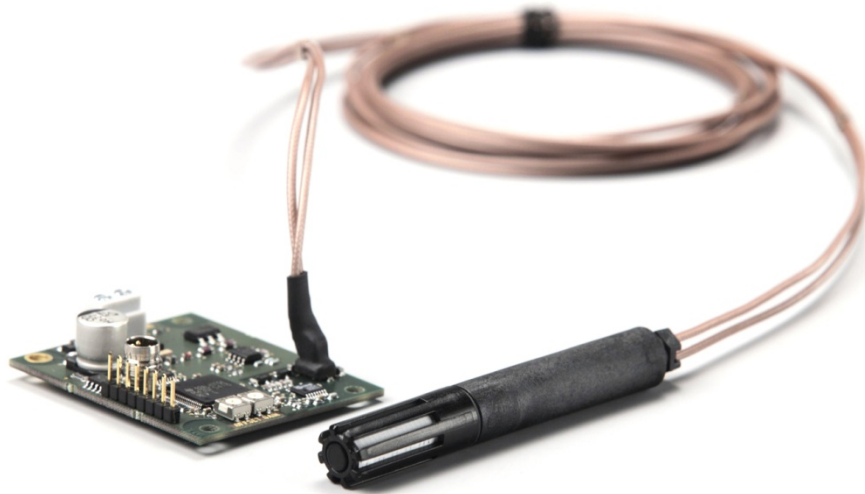
0905-042

Figure 1   HMM100 Humidity Module with Probe

Basic Features and Options

- Vaisala HUMICAP® 180R humidity sensor
- Plastic or stainless steel probe
- Analog output options:
    - 4 ... 20 mA loop powered (2-wire output model)
    - 0 ... 20 mA or 0 ... 1 / 5 / 10 V (3-wire output model, user-configurable using service port)
- Cable lengths:
    - 0.65 m, 1.55 m, or 2.9 m for plastic probe
    - 1.55 m or 2.9 m for stainless steel probe
- Various filter types: see section Filter Types on page 14
- Optional installation accessories:
    - Probe mounting flange
    - Probe mounting clamp
    - Mounting bracket with lid
    - Module housing (IP65)
- Service port for maintenance
    - Optional USB cable for easy access

Probe Types

The HMM100 can be ordered with a plastic or stainless steel probe. The plastic probe is suitable for most applications.

Both probe types have the same operational temperature range. Note that the operational temperature range is also affected by the filter; see section Filter Types on page 14.

Figure 2 below shows the plastic probe with a membrane filter (top), and the stainless steel probe with a sintered stainless steel filter (bottom).

0909-021

Figure 2   Probe Types

Filter Types

The available filters for HMM100 are shown in Figure 3 below. All filters are 12 mm in diameter, and can be used in both the plastic and stainless steel probe. Note the operational temperature range of each filter.

For order codes, see section Options and Accessories on page 68.
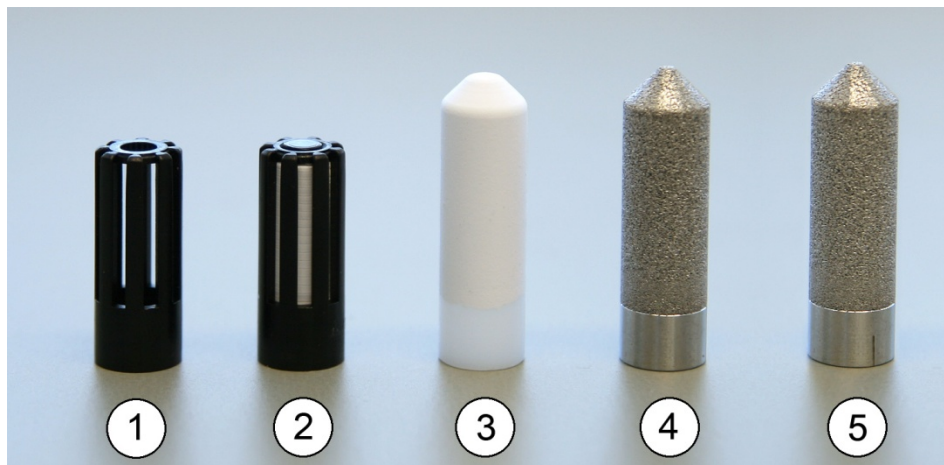
1204-001

Figure 3   Filter Types

Table 4   Filter Properties

No.	Filter	Diameter	Pore Size	Temperature Range
1	Plastic grid filter (fastest response time)	12 mm	-	-20 ... +80 ºC (-4 ... +176 ºF)
2	Membrane filter	12 mm	0.2 µm	-20 ... +80 ºC (-4 ... +176 ºF)
3	Porous PTFE filter (general purpose)	12 mm	8 µm	-70 ... +180 ºC (-94 ... +356 ºF)
4	Stainless steel sintered filter	12 mm	38 µm	-70 ... +180 ºC (-94 ... +356 ºF)
5	Catalytic VHP filter (VHP applications)	12 mm	38 µm	-70 ... +180 ºC (-94 ... +356 ºF)

The catalytic VPH filter is recommended for environments where vaporized hydgoren peroxide (VHP) is used. It is mechanically similar to the stainless steel sintered filter, but it can be identified by the line that has been machined to its base; see Figure 3 above. For more information, see section Catalytic VHP Filter on page 15.

Catalytic VHP Filter

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

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

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

Installation Accessories

For order codes of the installation accessories, see section Options and Accessories on page 68.

Probe Mounting Flange

The probe mounting flange is used to seal the cable pass-through in the chamber wall. The flange can also be used to hold the probe itself, in case the probe cannot be mouted on the chamber wall otherwise. This mounting is not ideal since leaving the probe cable completely outside the measurement environment may cause heat conduction that affects the measurement.

0911-109

Figure 4   Optional Probe Mounting Flange

Mounting Bracket with Lid

The optional mounting bracket includes a metal backplate and a plastic lid for the component board. The bracket does not provide IP rated protection. The bracket can be installed on a DIN rail.

0911-105

Figure 5   Mounting Bracket with Lid

Module Housing (IP65)

The optional module housing is an IP65 rated housing. The module is installed inside the housing in a mounting bracket (provided with the housing). The housing has two cable glands. A coaxial plug is provided for sealing the gland for the probe cable.
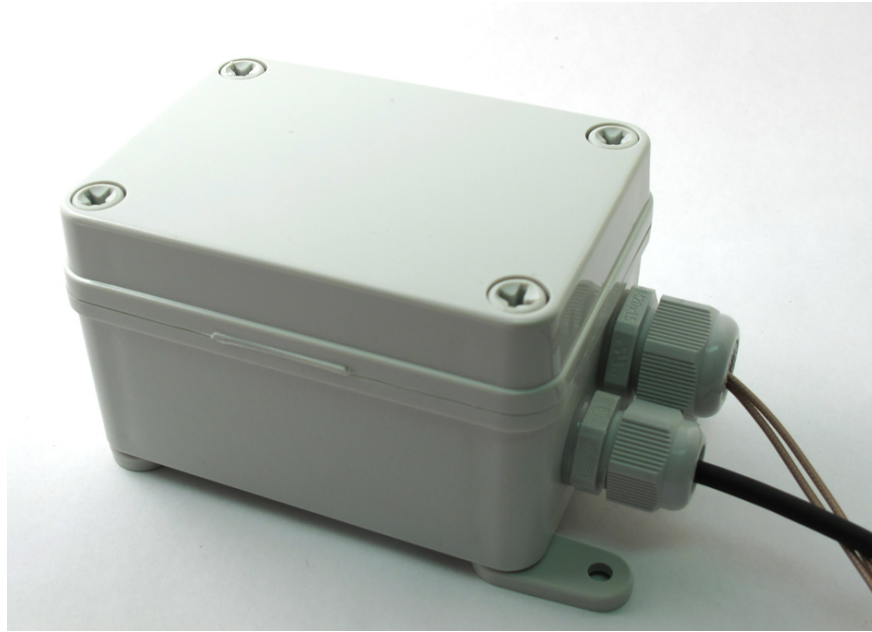
0911-096

Figure 6   Optional Module Housing

Probe Mounting Clamp

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.

Installing the entire probe in the measurement environment prevents heat conduction to the sensor, and is the recommended installation method.

To mount the HMM100 probe to the mounting clamp:

1.   Align the slots on the clamp parts as shown in Figure 7 below.

1209-001

Figure 7   Aligning Mounting Clamp Slots

2.   Slide the lower clamp part over to the bottom end of the upper part as shown in Figure 8 below.

1209-002

Figure 8   Sliding the Lower Clamp Part

3. Place the clamp to the intended location and secure the upper clamp part with a screw. See Figure 9 below.

1209-003

Figure 9   Securing the Upper Clamp Part

4. Place the probe in the clamp.
5. Tighten the lower clamp part with a screw as shown in Figure 10 below.

1209-004

Figure 10   Tightening the Lower Clamp Part

CHAPTER 3
INSTALLATION

This chapter provides you with information that is intended to help you install the HMM100.

Dimensions
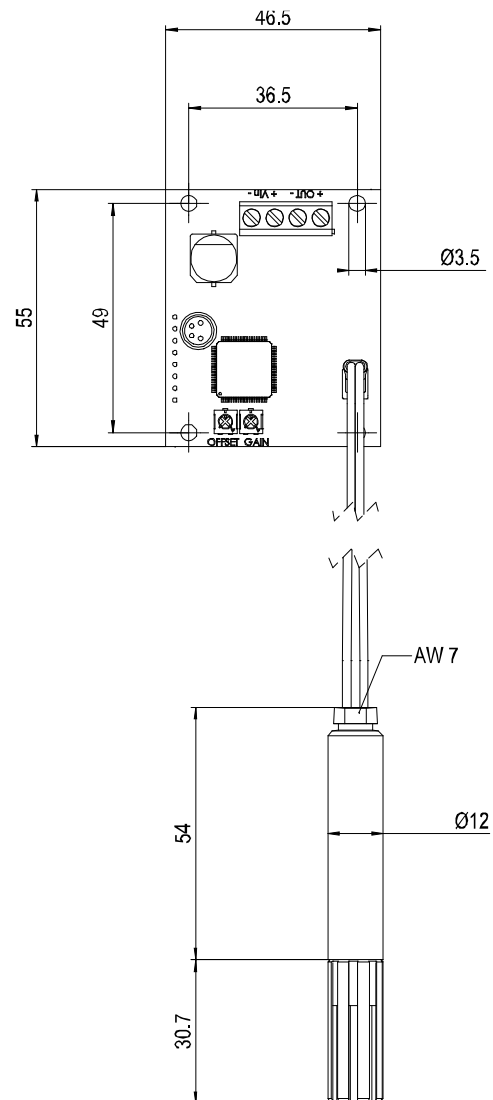
0905-044

Figure 11   HMM100 Dimensions

Installing the Module

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

1. Attach the module securely using the mounting holes on the corners of the component board. Use the optional mounting bracket (Vaisala order code 225979) if needed.
2. Make sure that the module has a good earth connection from the plated mounting hole. See Figure 12 below.

NOTE	The installation holes on the component board are compatible with Vaisala HMM22 and HMM30 humidity modules. Remember to disable temperature compensation (if any) in the measurement system when replacing an old module with the HMM100. The temperature compensation in the HMM100 is always enabled.

0905-043
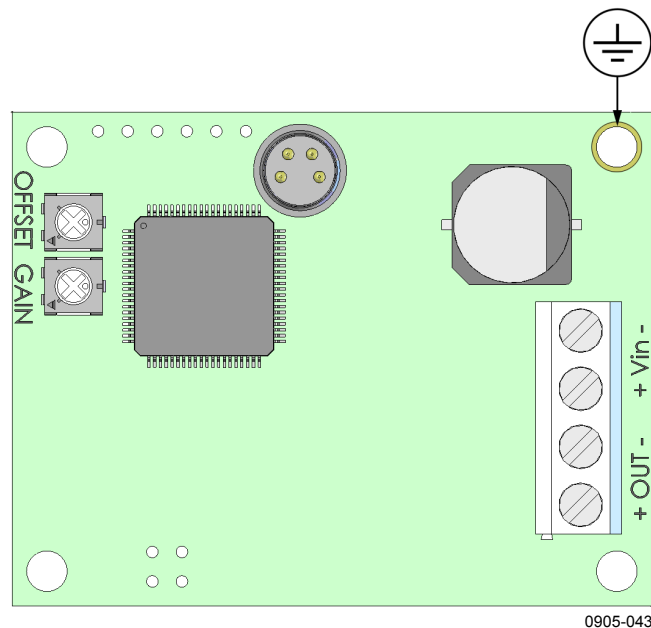
Figure 12   Component Board (3-wire version)

Installing the Probe

1.   Select the mounting location for the probe:

     -   The probe should be entirely in the measurement environment, with sufficient distance to the outer walls of the chamber or duct. Air should flow freely around the probe.

     -   The probe location should represent well the environmental or process conditions, and it should be as clean as possible.

2.   Install the probe in the location. Use the probe mounting clamp (Vaisala order code 226067) if needed. Insert enough cable to the same space with the probe in order to prevent heat conduction, and to make it easy to move the probe when performing a calibration.

     If you cannot install the probe entirely in the measurement environment, you can use the probe mounting flange (Vaisala order code 226061) to mount the probe through the chamber wall. This installation method is not recommended due to possible heat conduction.

3.   Seal the cable pass-through using the probe mounting flange or silicone sealant.

CAUTION	If you seal the cable pass-through using silicone sealant, do not use a sealant that releases acetic acid when curing. Acetic acid may damage the HUMICAP® sensor in the probe.

Wiring

2-wire Output

See Figure 13 below. Provide a 24 VDC supply voltage (see Figure 18 on page 67).
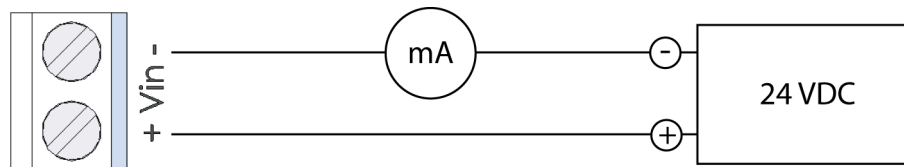
0905-047

Figure 13   **Wiring for 2-wire Output**

3-wire Output

See Figure 14 below. Provide the required supply voltage according to the output type:

10 ... 35 VDC or 19.2 ... 28.8 VAC for 0 ... 20 mA, 1 / 5 V output

15 ... 35 VDC or 19.2 ... 28.8 VAC for 0 ... 10 V output
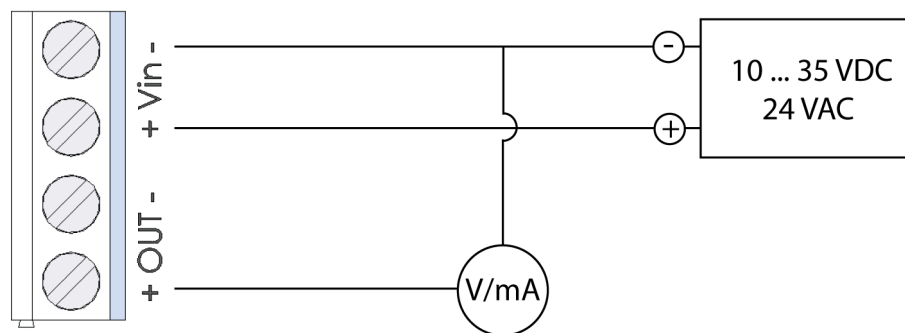
0905-048

Figure 14   **Wiring for 3-wire Output**

When using the 3-wire output module, you may also connect a fourth wire to the "Out -" terminal. It is internally connected to the "Vin -" terminal. This connection is recommended when using the 0 ... 1 V output.

Verifying the Installation

To verify that the module has been installed correctly:

- Power up the module and check the output reading, preferably using a humidity reference.
- Optional: connect to the service port and use the **ATEST** command to set the analog output to desired voltage or current. Verify that your measurement system shows the correct reading. See section Select Analog Output Quantity and Scaling on page 45.

Note that **ATEST** is one of the advanced serial commands that must be activated using the **PASS** command.

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CHAPTER 4
OPERATION

This chapter contains information that is needed to operate the HMM100.

Using the Service Port

The HMM100 has an RS-232 interface on the component board for service use. You can connect to it through the 4-pin M8 service port connector on the module. Vaisala offers an optional USB cable (Vaisala order code 226068) for connecting the module to your PC.

NOTE	The service port is intended for short-term use such as calibration. For permanent installation, use the analog output.

The cable does not provide operation power to the module; you must power it normally through the screw terminals.

If you have not used the HMM100 USB cable before, install the driver that came with the cable. Refer to section Installing the Driver for the USB Cable below for detailed instructions.

Installing the Driver for the USB Cable

Before taking the USB cable 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 driver from www.vaisala.com.
3. Execute the USB driver installation program (setup.exe), and accept the installation defaults. The installation of the driver may take several minutes.
4. After the driver has been installed, connect the USB cable to a USB port on your PC. Windows will detect the new device, and use the driver automatically.

5.   The installation has reserved a COM port for the cable. Verify the port number, and the status of the cable, using the **Vaisala USB Instrument Finder** program that has been installed in the Windows Start menu.

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

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 **Add or Remove Programs** (**Programs and Features** in Windows Vista) in the Windows Control Panel.

Terminal Application Settings

The default settings of the HMM100 serial interface are presented in Table 5.

Table 5   HMM100 Default Serial Interface Setting

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

The steps below describe how to connect to the HMM100 using the PuTTY terminal application for Windows and a USB serial interface cable:

1.   Connect the USB cable between your PC and the service port of the HMM100.
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.

        Note: You can check which port the USB cable is using with the **Vaisala USB Instrument Finder program** that has been installed in the Windows Start menu.

4.   Check that the other serial settings are correct for your connection, and change if necessary. **Flow control** should be set to **None** unless you have a reason to change it.

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

        Note: If PuTTY is unable to open the serial port you selected, it

will show you an error message instead. If this happens, restart PuTTY and check the settings.

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, click the right mouse button over the session window, and select **Change Settings...** from the pop-up menu.
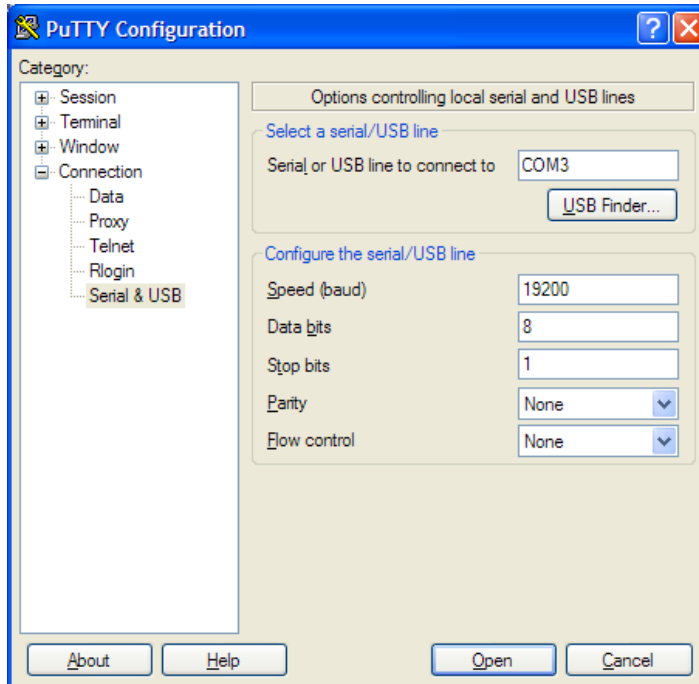
0807-004

Figure 15   PuTTY Terminal Application

List of Serial Commands

All commands can be issued either in uppercase or lowercase.

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

Table 6   Basic Serial Commands

Command	Description
?	Show module information
??	Show module information (when in poll mode)
ADDR **[0** ... 99]	Set the module address (for POLL mode)
CALCS	Show measured quantities
CLOSE	Close the temporary connection (returns to POLL mode)
ECHO [ON/OFF]	Set terminal echo
ENV	Set environmental parameters
ERRS	Display active errors
HELP	List available commands
INTV [**0** ... 255 **S**/MIN/H]	Set the continuous output interval (for RUN mode)
OPEN **[0** ... 99]	Open a temporary connection to a POLL mode device
PASS [passcode]	Access advanced commands (requires passcode)
R	Start the continuous outputting
RESET	Resets the module
RESTORE	Restores the latest saved settings (overwrites unsaved settings)
S	Stop the continuous outputting
SAVE	Save changed settings to memory
SEND [0 ... 99]	Output the reading once
SERI [baud p d s]	User Port settings (Default: 19200 N 8 1) baud: 300 ... 115200
STATUS	Show analog output status
SYSTEM	Show module information and build date
VERS	Show software version of the module
XPRES	Set the value for pressure compensations, temporarily

Table 7   Advanced Serial Commands

Command	Description
ACAL	Calibrate analog output
AMODE	Set/show analog output mode
ASEL [RH/TD]	Set/show analog output quantities and scaling
ATEST	Test analog output; forces the output ot the given value
CALINFO	Set/show calibration info
CRH	Calibrate humidity measurement after
CT	Calibrate temperature measurement
FRESTORE	Restore all module settings to factory defaults
L	Show user adjustment parameters
LI	Set user adjustment parameters
SMODE **[STOP**/RUN/POLL]	Set the serial interface mode
ZERO	Set correction by trimmers to zero

Device Information and Status

Show Device Information

The **?** command outputs a listing of device information.

?<cr>

Example:

```
>?
Device Name        : HMM100
SW Name            : HM100
SW model           : VAISALA
SW version         : 1.1.10.3031
Serial number      :
Calibrated         :
Address            : 0
Operating mode     : 3W
Status             : ON
>
```

If the module is in poll mode, but a connection has not been opened using the **OPEN** command, issue the **??** command. For a description of the serial interface modes, see section Set Serial Interface Mode on page 41.

??<cr>

Show Quantities

The **CALCS** command shows the abbreviations of the quantities measured by HMM100:

CALCS<cr>

Example:

```
>calcs
RH Td T
>
```

Show Calibration Info

Use the **CALINFO** command to show or set the calibration info field.

CALINFO [*"location"]*

Examples:

```
>calinfo
Calibration location: "VAISALA HELSINKI"
>

>calinfo "Calibration lab 2"
Calibration location: "Calibration lab 2"
>
```

Show Analog Output Status

The **STATUS** command shows the following information:

-   Current analog output state (ON for normal, ERROR if an error is active)
-   Status of analog channel error notification (ON for enabled, OFF for disabled). See section Analog Output Error Notification on page 61.
-   Scaling of the selected output quantity (low and high values)
-   Error notification level for the current analog output mode

STATUS [*notification*] [*level*]<cr>

where

notification	=	If specified, enables or disables the analog output error notification. Allowed values ON and OFF.
level	=	Error notification level. Allowed values are 0 … 30.

Example (analog output in error state, output quantity RH, analog output mode 0 ... 10V):

```
>status
Channel 0:
Status             : ERROR
Notification       : ON
Level Lo           : 0
Level Hi           : 100
Error level        : 0.000000
```

Show Firmware Version

VERS<cr>

Example:

```
>vers
HMM100 / HM100 / VAISALA / 1.1.10.3031
>
```

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. The output always includes the readings of the currently selected analog output quantity (RH or Td) and temperature. The format is fixed.

R<cr>

Example:

```
>r
RH= 25.10% T= 24.77'C
RH= 25.12% T= 24.96'C
RH= 25.17% T= 25.20'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 to stop the continuous measurement output:

S<cr>

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 one second. This command has no effect on the operation of the analog output.

NOTE	Remember to save the changes!

INTV [*n xxx*]<cr>

where

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

Example:

```
>intv 1 s
Value                  : 1
Unit                   : S
>save
Saving settings...done
>
```

Output a Reading Once

Use the **SEND** command to output a single measurement reading from the module.

SEND [*aa*]<cr>

where

aa   =   Module address (0 ... 99). Must be specified if the module is
         in POLL mode, and a line has not been opened using the
         OPEN command.

Example:

```
>send
RH= 25.12 % T= 24.91 'C
>
```

Calibration Commands

Commands that have to do with calibration on the serial line are described below. For the calibration procedures, see section Calibration on page 53.

Calibrate Temperature Measurement

Use the **CT** command to perform a one-point or two-point temperature (T) calibration.

CT<cr>

When performing a one-point calibration, you need to place the probe in a single temperature reference. Run the command and enter the exact temperature of the reference after the measurement has stabilized. Exit the command by pressing the ESC key before proceeding to the second point (see example 1 below). To update the value, press ENTER without inputting a value.

For two-point calibration, the second reference point must be at least 20 ºC warmer than the first. The measurement reading for the second point will appear when this requirement is met.

NOTE	Remember to save the changes!

Example: one-point calibration

```
>ct
T  21.9827 Ref1 ? 22
Press any key when ready
OK
>
```

Example: two-point calibration

```
>ct
T  22.0007 Ref1 ? 22
Press any key when ready ...
T  44.9847 Ref2 ? 45
OK
>
```

Calibrate Humidity Measurement

Use the **CRH** command to perform a one-point or two-point correction to the humidity measurement of the module. This command changes the offset and gain of the measured capacitance, and therefore affects humidity measurement over the entire temperature range. Take care when making this adjustment, and ensure you make a note of the existing values before adjusting them.

CRH<cr>

When performing a one-point calibration, you need to place the probe in a single humidity reference with RH < 50%. Run the command and enter the exact RH of the reference after the measurement has stabilized. Exit the command by pressing the ESC key before proceeding to the second point (see example 1 below).

For two-point calibration, the first point requires a RH < 50% humidity reference, the second point must be RH > 50%. There must also be at least 30 percentage points of difference between the references.

Example: one-point calibration

```
>crh
RH:      11.29915720 Ref1 ? 11.3
Press any key when ready
>
```

Example: two-point calibration

```
>crh
RH:      11.29915720 Ref1 ? 11.3
Press any key when ready
RH:      75.04306440 Ref2 ? 75
OK
>
```

View User Adjustment Parameters

Use the **L** command to view the current user adjustment parameters and trimmer adjustment. This command is useful for checking the currently applied correction.

L<cr>

The output values are as follows:

- Cp offset and gain: capacitance, calibrated using the **CRH** command
- RH trimmer offset and gain: correction by the trimmers
- RH offset and gain: 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
Cp gain            : 1
RH offset trimmer  : 0
RH gain trimmer    : 1
RH offset          : 0
RH gain            : 1
T offset           : 0
T gain             : 1
>
```

Set User Adjustment Parameters

Use the **LI** command to set the user adjustment parameters directly. This command is useful for restoring the desired adjustments, and removing the effects of calibration without having to perform the factory reset.

LI<cr>

After entering the command, you will be prompted to enter new values one at a time. Press ENTER without giving a value to move to the next parameter.

NOTE	Remember to save the changes!

Example (shows default values):

```
>li
Cp offset          : 0 ?
Cp gain            : 1 ?
RH offset          : 0 ?
RH gain            : 1 ?
T offset           : 0 ?
T gain             : 1 ?
>save
Saving settings...done
>
```

Zero the Trimmers

After physically turning the trimmers to zero, use the **ZERO** command to set the correction by trimmers to exactly zero. It is easy to introduce a small, unwanted correction even if trying to zero the trimmers exactly. This command eliminates the unwanted correction.

ZERO<cr>

NOTE	Remember to save the changes!

Example:

```
>zero
Trimmer positions set to zero.
>save
Saving settings...done
>
```

Calibrate Analog Output

Use the **ACAL** command to calibrate the currently active analog output mode. You must use this command if you change the analog output mode using the **AMODE** command.

ACAL<cr>

After you give this command, the analog output of the module is set to the low limit of the selected output (voltage or current). Measure the output and enter the measured value. After entering the low limit, you must measure and enter the high limit also.

Example (analog output in 4 ... 20 mA mode):

```
>acal
I1 (mA)  ? 3.981
I2 (mA)  ? 20.002
  2.00985160E+03 a0
  1.12789450E+03 a1
  0.00000000E+00 a2
OK
>
```

Example (analog output in 0 ... 1 V mode):

```
>acal
V1 (V)   ? 0
V2 (V)   ? 0.998
  5.45999950E+02 a0
  1.64128260E+03 a1
  0.00000000E+00 a2
OK
>
```

Configuring Serial Line Operation

Set Serial Line Settings

Use the **SERI** command to show or set the serial line settings. Use the
SAVE command after changing the settings to store them. The new
settings will be taken into use when the module is reset or powered up.

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

where

B	=	baud rate (9600, 19200, 38400, 76800, 115200)
P	=	parity (n = none, e = even, o = odd)
D	=	data bits (7 or 8)
S	=	stop bits (1 or 2)

Examples:

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

>seri 9600 e 7 1
Baud rate          : 9600
Parity             : E
Data bits          : 7
Stop bits          : 1
>save
Saving settings...done
>
```

Set Terminal Echo

To show or set the terminal echo status, use the **ECHO** command.

ECHO [ON/OFF]<cr>

NOTE	Remember to save the changes!

Examples:

```
>echo
Echo               : ON ?
>

>echo on
Echo               : ON
>save
Saving settings...done
>
```

Set Module Address

To operate in the POLL mode, the module must have an address. If multiple modules share the same serial line, each module must have a different address.

For a description of the serial interface modes, see section Set Serial Interface Mode below.

ADDR [*nn*]<cr>

where

nn   =   address (0 ... 99)

NOTE	Remember to save the changes!

Example:

```
>addr 1
Address       :         1
>save
Saving settings...done
>
```

Set Serial Interface Mode

Use the **SMODE** command to show or set the serial interface mode. Note that a separate **SAVE** command is not needed to store the new serial interface mode setting.

SMODE [*xxx*]<cr>

where

xxx   =   STOP, RUN, or POLL

In STOP mode: outputting only when command is issued, any command can be used.

In RUN mode: outputting automatically, only command **S** can be used.

In POLL mode: outputting only when command is issued, any command can be used after the line has been opened using the **OPEN** command.

The polling mode can be used when more than one module is connected to one serial bus. When set to POLL state, the modules communicate one at a time when the specific module address is called on the serial line. See descriptions of the commands **ADDR** on page 41 and **OPEN** on page 48.

Examples:

```
>smode stop
Output mode    : STOP
>

>smode run
Output mode    : RUN
>

>smode poll
Output mode    : POLL
>
```

Configuring Measurement Parameters

Set Environmental Compensation Values

Use the **ENV** command to show or set the environmental compensation values. In HMM100, the humidity measurement can be compensated for ambient pressure. The value set using **ENV** command is a permanent value which will survive a restart. Use the command **XPRES** instead if the value is changed frequently; see section Set Temporary Pressure Compensation Value on page 43.

ENV [*x.xxxx*]<cr>

where

x.xxxx   =   Absolute pressure in the measuring environment.
                   The default is **1.013**. The pressure unit is bar.

Example:

```
>env
Pressure (bar)      : 1.013
>

>env 0.980
Pressure (bar)      : 0.98
>save
Saving settings...done
>
```

NOTE	You can use the Vaisala Humidity Calculator to simulate the effect of pressure change to dewpoint.

Set Temporary Pressure Compensation Value

Use the **XPRES** command to show or set the temporary ambient pressure value for pressure compensation. This value is cleared to 0.0 at reset.

XPRES [*x.xxxx*]<cr>

where

x.xxxx　　　　=　　Absolute pressure in the measuring environment.
　　　　　　　　　　The pressure unit is bar.

NOTE	Remember to save the changes!

Example:

```
>xpres
Pressure (bar)      : 0
>

>xpres 1.029
Pressure (bar)      : 1.029
>save
Saving settings...done
>
```

Configuring Analog Output

Set Analog Output Mode

Use the **AMODE** command to show or set the operation mode of the analog output. This command is only useful with the 3-wire output module, as the output on the 2-wire model is always 4 ... 20 mA (loop powered).

NOTE	If you change the analog output mode, you must calibrate the new mode using the **ACAL** command. See section Calibrate Analog Output on page 39.

AMODE [*mode*]<cr>

where

mode = Analog output mode. Modes for 3-wire output model:
        0..1V
        0..5V
        0..10V
        0..20mA
        4..20mA

        Modes for 2-wire output model:
        4..20mA

NOTE	Remember to save the changes!

Example (show current mode):

```
>amode
Ch1 :   0..10V
>save
Saving settings...done
>
```
Example (set mode to 0...20 mA):

```
>amode 0..20ma
Ch1 :   0..20MA
>save
Saving settings...done
>
```

Select Analog Output Quantity and Scaling

Use the **ASEL** command to show or select the quantity output by the analog channels, and the scaling that is used. If you do not enter scaling limits, default values are used.

ASEL [*xx*] [*low high*]<cr>

Where

xx   =   Analog channel output quantity
low   =   Low limit of scaling
high =   High limit of scaling

NOTE	Remember to save the changes!

Examples:

```
>asel
Quantity              : RH
Level Lo              : 0
Level Hi              : 100
>save
Saving settings...done
>

>asel td
Quantity              : TD
Level Lo              : -40
Level Hi              : 60
>save
Saving settings...done
>

>asel td -10 60
Quantity              : TD
Level Lo              : -10
Level Hi              : 60
>save
Saving settings...done
>
```

Test the Analog Output

Use the **ATEST** command to test the analog output. The **ATEST** command will force the output to the given value, which can then be measured with a calibrated multimeter. The command uses the currently

selected analog output mode (voltage or current) so you do not have to specify the unit.

Before testing, check the currently set analog output mode using the **AMODE** command. After testing the output, give the **ATEST** command again to exit the test mode.

ATEST [*xxx*]<cr>

where

xxx   =   Analog channel output value (V or mA)

Example:

```
>atest 2.5
2.500000, 587f
>

>atest
>
```

Other Commands

Display Command List

Use the **HELP** command to display a list of the currently available commands. If the **PASS** command has not been used, only the basic commands are available.

HELP<cr>

Enable Advanced Commands

Use the **PASS** command to enable the advanced commands.

PASS [*passcode*] <cr>

where

passcode   =   Use "1300" to enable the advanced commands.

Example:

```
>pass 1300
>
```

Display the Currently Active Errors

Use the **ERRS** command to display the currently active error codes. For troubleshooting active errors, see Table 9 on page 62.

ERRS<cr>

Example (no active errors):

```
>errs
No errors.
>
```

Connecting to the Module in POLL Mode

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

OPEN [*aa*]<cr>

where

aa   =   address (0 ... 99)

Example:

```
>open 1
HMM100: 1 line opened for operator commands
>
```

Closing the Connection in POLL Mode

The **CLOSE** command closes the connection to the module.

CLOSE<cr>

Example:

```
>close
line closed
>
```

Save Changed Settings

Use the **SAVE** command to save changed settings to the module memory. Most settings have to be saved or the changes are lost at the next reset or power down.

NOTE	The **SMODE** command saves the new serial mode immediately; a separate **SAVE** command is not needed.

SAVE<cr>

Example:

```
>save
Saving settings...done
>
```

Restore Saved Settings

Use the **RESTORE** command to restore saved settings to the module. All unsaved changes will be lost.

RESTORE<cr>

Example:

```
>restore
Restoring default settings...done
>
```

Reset the Module

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

RESET<cr>

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

```
>reset
HMM100 / VAISALA / 1.1.10.3031
>
```

Restore Factory Settings

Use the **FRESTORE** command to restore the factory settings to the module. All user settings, including the analog output mode and user-performed calibration corrections, will be lost. The module will revert back to the factory calibrated settings.

FRESTORE<cr>

Example:

```
>frestore
Restoring factory defaults...done
>
```

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CHAPTER 5
MAINTENANCE

This chapter provides information that is needed in basic maintenance of the HMM100.

Changing the Filter

The filter on the probe should be replaced when it is damaged or dirty. Do not attempt to clean the filter using compressed air, solvents, or mechanical action. Wiping the filter may block its pores and/or deposit residue on the filter.

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.   Check that the O-ring is undamaged and in place.
4.   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.

New filters can be ordered from Vaisala. For available filters, see section Filter Types on page 14. The order codes of the filters are listed in section Options and Accessories on page 68.

Changing the Sensor

The user can replace the HUMICAP180R sensor with a new one. The new sensor must be of the HUMICAP180R type. Do not attempt to use a different sensor type.

NOTE	Replacing the sensor is repair maintenance, and it is not necessary in normal operation. If the accuracy of the module does not seem to be within specification, it is more likely that the module is in need of calibration and adjustment, and not sensor replacement. Refer to section Calibration on page 53.

1. Remove the filter from the probe by turning it counter-clockwise.

2. Remove the damaged sensor and insert a new one. Handle the new sensor by the plastic socket. DO NOT TOUCH THE SENSOR PLATE.

3. Perform a calibration and adjustment using the **CRH** command as instructed in section Humidity Calibration (CRH) on page 58.

4. Attach a new filter on the probe. When using the stainless steel filter, take care to tighten the filter properly (recommended force 5 Nm).
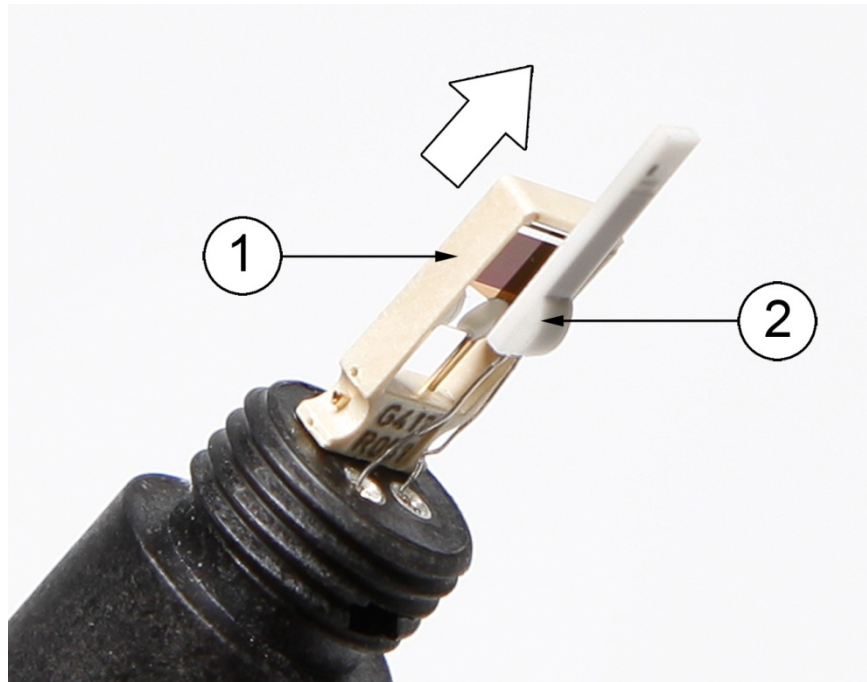
1209-033

Figure 16   Changing the Sensor

The following numbers refer to Figure 16 above:

1 = The HUMICAP 180R sensor
2 = Pt1000 sensor (do not touch)

Calibration

The recommended calibration interval is one year. You should also perform a calibration if the HMM100 does not appear to be within the specified accuracy.

The HMM100 can be adjusted in two ways:

- Using the onboard trimmers. This method requires no serial connection, only a small Phillips head screwdriver and a suitable humidity reference. The trimmers can adjust up to ± 5% of reading.
- Using serial commands. This method requires a connection to the service port of the HMM100 module. For this, you need the USB cable (Vaisala order code: 226068) and a PC with a terminal application. You also need a humidity reference and a Phillips head screwdriver for zeroing the trimmers.

As a humidity reference, you can use, for example, the Vaisala Humidity Calibrator HMK15.

Installing the probe properly will also help with the calibration. Ideally the probe should be placed completely in the environment, with enough cable to prevent heat conduction, and to allow the probe to be moved during calibration (placed in the HMK15 calibrator, for example).

NOTE	If you have changed the HUMICAP® sensor, center the trimmers, and perform a calibration and adjustment using the serial command **CRH**.

| **NOTE**	You can only calibrate the humidity measurement (RH) and temperature measurement (T). The module calculates the dewpoint using RH and T values.

Calibration and Adjustment Using Trimmers

HMM100 series modules have two trimmers mounted on the component board. These trimmers allow for easy adjustment of the offset and gain of the humidity measurement.

The modules are shipped with the trimmers centered. Turning the trimmer counter-clockwise will decrease the offset or gain, and turning clockwise will increase it. The adjustment range is ± 5% for both offset and gain.

Offset correction requires a < 50 %RH reference. Offset and gain correction requires additionally a > 50 %RH reference, with over 30 %RH difference between the two points.

NOTE	The trimmers will only turn 135 degrees each way, less than half a rotation. Do not force the trimmer past the stopping point.
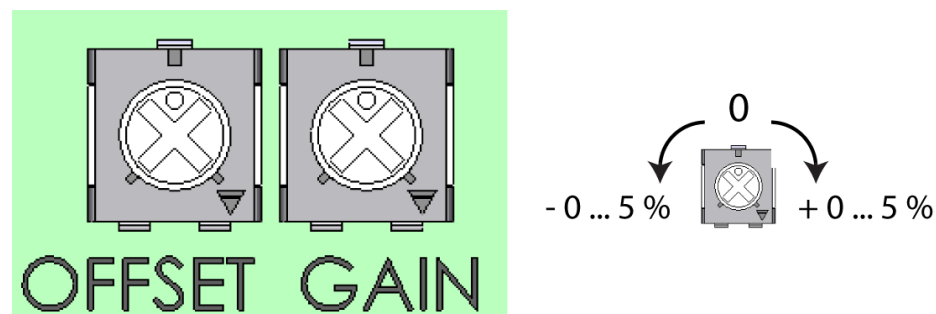
0905-045

Figure 17   Trimmers for Offset and Gain

The procedure on page 55 provides an example adjustment of offset and gain using the Vaisala Humidity Calibrator HMK15, which is a saturated salt calibrator. It is assumed that the module is powered and you can measure the analog output reading.

NOTE	For best results, use the **ACAL** command to calibrate the currently active analog output mode before using the trimmers. For instructions on how to do this, see section Calibrate Analog Output on page 39.

1. Note the current position of the trimmers.
2. Insert the probe in the LiCl salt chamber of the humidity calibrator (11 %RH), and wait for 20 – 40 minutes for the reading to stabilize.
3. If necessary, adjust the offset trimmer using a small Phillips head screwdriver to achieve the output reading that corresponds to 11 %RH.

    For 4 ... 20 mA output, the reading should be 5.76 mA.
    For 0 ... 5 V output, the reading should be 0.55 V.
4. Insert the probe in the NaCl salt chamber (75 %RH) and wait for the reading to stabilize.
5. If necessary, adjust the gain trimmer to achieve the output reading that corresponds to 75 %RH.

    For 4 ... 20 mA output, the reading should be 16 mA.
    For 0 ... 5 V output, the reading should be 3.75 V.
6. Optional: repeat steps 2 – 4 to check the adjustment result. If you want to undo the adjustment, return the trimmers to their original position.

Calibration and Adjustment Using Serial Line

The following provide steps for performing calibrations on the serial line.

NOTE	It is assumed that the module is powered and you can measure the analog output reading. Note that the USB cable does not supply operation power to the module. You must power it normally through the screw terminals.

NOTE	For detailed information on using the service port, USB cable, and the serial line commands, see Chapter 4 on page 27.

Temperature Calibration (CT)

The procedure below describes a temperature (T) measurement calibration using serial line commands. You can use the procedure to do a one-point calibration (offset) or a two-point calibration (offset and gain). For two-point calibration, the second reference point must be at least 20 ºC warmer than the first.

Temperature measurement is not controlled by the trimmers, so do not adjust them during temperature calibration.

1. Connect the USB cable to the service port on the module, and to a USB port on your PC.
2. 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.
3. Verify that the connection works by giving the **?** command:

    ```
    >?
    ```

    If the module does not respond with device information:
    -   Check that the module is powered
    -   Try the **??** command in case the module is in POLL state, open the line using **OPEN** command if necessary
    -   Check your serial line settings and cable connections
    -   Power off the module, unplug the USB cable, restart the terminal application, and try again.
4. When your serial connection is working, use the **L** command to see the current user adjustment parameters and the status of the trimmers. Write down the T offset and gain values so you can restore them manually using the **LI** command, if necessary.

    ```
    >l
    ```
5. Use the **ERRS** command to see that no errors are active:

    ```
    >errs
    ```
6. Use the **PASS** command to enable the advanced commands:

    ```
    >pass 1300
    ```
7. Insert the probe in the temperature reference and wait for 20 – 40 minutes for the reading to stabilize.

8.   Give the **CT** command. The output from the command shows the currently measured T value, and prompts you to enter the value of the reference 1. This is the reference on the colder end, which produces the offset correction for the measurement.

9.   You now have three choices:
   -   To apply the correction, type the temperature of the reference in degrees celcius and press ENTER.
   -   To exit the **CT** command without adjusting the measurement, press the ESC key and exit this procedure.
   -   To refresh the measured value without typing in the correction, press ENTER.

10.   If you only want to perform a one-point calibration (offset correction), press the ESC key after entering the correction. The **CT** command will exit, and you can move to step 14.

```
>ct
T  21.9847 Ref1 ? 22
Press any key when ready
OK
>
```

To continue with the calibration of the warmer end (gain correction), press ENTER.

11.   Insert the probe in the second temperature refence and wait for 20 – 40 minutes for the reading to stabilize. The measurement reading for the second point will appear when the measured temperature is at least 20 ℃ warmer than the first reference point.

12.   Type the temperature of the second reference point and press ENTER to apply the correction.

```
T  44.9847 Ref2 ? 45
OK
>
```

The **CT** command is now finished and both adjustments have been applied.

13.   Use the **L** command to verify that the new user adjustment parameters are in use:

```
>l
```

14.   Measure the value of the analog output to verify that the measurement is OK.

Humidity Calibration (CRH)

Adjusting the capacitance measurement affects humidity measurement accuracy across the entire temperature range. Take care when making this adjustment.

CAUTION	Be sure to write down the current capacitance adjustment parameters (visible with the **L** command) so that you can restore them manually if necessary.

The procedure below provides a calibration procedure using the serial line commands and the Vaisala Humidity Calibrator HMK15. You can use the procedure to do a one-point calibration (offset) or a two-point calibration (offset and gain).

- One-point calibration requires a < 50 %RH reference
- Two-point calibration requires additionally a > 50 %RH reference, with over 30 %RH difference between the two points.

1. Connect the USB cable to the service port on the module, and to a USB port on your PC.
2. 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.
3. Verify that the connection works by giving the **?** command:

    ```
    >?
    ```

    If the module does not respond with device information:
    - Check that the module is powered
    - Try the **??** command in case the module is in POLL state, open the line using **OPEN** command if necessary
    - Check your serial line settings and cable connections
    - Power off the module, unplug the USB cable, restart the terminal application, and try again.
4. When your serial connection is working, use the **L** command to see the current user adjustment parameters and the status of the trimmers. Write down the Cp offset and gain values so you can restore them manually using the **LI** command, if necessary.

    ```
    >l
    ```
5. Use the **ERRS** command to see that no errors are active:

    ```
    >errs
    ```

6. Use the **PASS** command to enable the advanced commands:

```
>pass 1300
```

7. Turn both trimmers to zero using the Phillips head screwdriver, and use the **ZERO** command to set their correction to exactly zero:

```
>zero
```

8. Insert the probe in the LiCl salt chamber of the humidity calibrator (11 %RH), and wait for 20 – 40 minutes for the reading to stabilize.

9. Give the **CRH** command. The output from the command shows the currently measured RH value, and prompts you to enter the value of the reference 1. This is the reference on the dry end, which produces the offset correction for the measurement.

```
>crh
RH:      10.97112003 Ref1 ?
```

10. You now have three choices:
   - To apply the correction, type 11 and press ENTER (assuming you are using the HMK15 and the LiCl salt).
   - To exit the **CRH** command without adjusting the measurement, press the ESC key and exit this procedure.
   - To refresh the measured value without typing in the correction, press ENTER.

11. If you only want to perform a one-point calibration (offset correction), press the ESC key after entering the correction. The **CRH** command will exit, and you can move to step 14.

```
RH:      11.0800360 Ref1 ? 11
Press any key when ready
>
```

   To continue with the calibration of the wet end (gain correction), press ENTER.

12. Insert the probe in the NaCl salt chamber (75 %RH) and wait for 20 – 40 minutes for the reading to stabilize.

13. Type 75 and press ENTER to apply the correction (assumes you are using the HMK15 and the NaCl salt).

```
RH:      75.00134550 Ref2 ? 75
OK
>
```

   The **CRH** command is now finished and both adjustments have been applied.

14. Use the **L** command to verify that the new user adjustment parameters are in use:

    ```
    >l
    ```

15. Measure the value of the analog output to verify that the measurement is OK.

CHAPTER 6
TROUBLESHOOTING

This chapter describes the analog output error notification behavior, some common problems, their probable causes and remedies, and provides contact information for technical support.

Analog Output Error Notification

If the module is unable to measure due to an error, the analog output will be set to an error level. The error level depends on the currently selected analog output mode; see Table 8 below.

Table 8   **Error Levels for Analog Output Modes**

Analog Output Mode	Default Error Level	Maximum Value
0 ... 1 V	0 V	2 V
0 ... 5 V	0 V	6 V
0 ... 10 V	0 V	12 V
0 ... 20 mA	0 mA	30 mA
4 ... 20 mA	3.8 mA	30 mA

You can check the current status of the analog output via the serial interface by using the **STATUS** command. You can also disable this error notification behavior; see section Show Calibration Info on page 32.

NOTE	If the error state voltage exceeds the normal output range, the minimum required supply voltage is higher. As a rule, add one volt to the supply voltage to get one additional volt from the signal. See Table 10 on page 66.
	For example, for a 0 … 5 V output, a 6 V error state needs an 11 V supply voltage.

Solving Typical Problems

You can check the error message via the serial interface by using the **ERRS** command. In case of constant error, please contact Vaisala technical support. See section Technical Support on page 63.

Table 9   Troubleshooting Table

Problem or Message	Likely Causes and Solutions
Measurement not working, any of the following errors active: - Temperature sensor open circuit/not calibrated - Humidity sensor open circuit/not calibrated - Temperature sensor values out of range	- Sensor(s) damaged or missing. Open the filter and check. - Calibration is not done. Calibrate the module. - Check the supply voltage of the module. - Check the analog output mode using the **AMODE** command.
Humidity measurement appears to be wrong. The following errors may be active: - RH reading too high - RH reading too low	- Check for condensation on the probe and sensor. - Check that you are not applying temperature compensation in the measurement system (HMM100 has its own). - Check for heat conduction through the cable. Place more cable in the chamber if needed. - Check the position of the trimmers. - Use the **L** command to check the currently applied calibration correction. - Calibration is not done. Calibrate the module.
The following error is active: - Capacitance out of range	- Sensor broken - Sensor disconnected - Sensor pins twisted and touching - Wrong sensor type inserted - Sensor replaced but capacitance not adjusted. Perform a humidity adjustment using **CRH** command.
Measurement stops, with following errors active: - Analog output test on, no measurements done - MeasTask not calculating (ATEST)	You are testing the analog output using **ATEST** command. This is normal; type **ATEST** to stop the test and remove this error.
Serial line command not working, outputs "Unknown command."	- Mistyped or unknown command - Command not available without using the **PASS** command first

Problem or Message	Likely Causes and Solutions
Cannot connect to serial line, current serial settings of the module are unknown.	Perform the following steps to connect: 1. Set your terminal settings to 19200 8 N 1 (the default settings of the module). 2. Connect to the service port of the module. 2. Power up the module, and type "z" on the serial line at least five times. 4. The module will come online with the default settings, and with the text SERVICE MODE. 5. Use the **SERI** command to set the desired serial settings, and use the **SAVE** command to save them.
Any of the following errors is active: - Program checksum error - Parameter storage checksum error - Sensor coefficient checksum error - Current settings checksum error - Default settings checksum error - Log corrupted - Resistance measurement	Internal error. Perform the following steps: 1. Reset or power cycle the module. Check if the error is gone. 2. Return the module to factory settings using the **FRESTORE** command. Check again. 3. If the error is still active, contact a Vaisala service center.

Technical Support

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

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CHAPTER 7
TECHNICAL DATA

This chapter provides the technical data of the HMM100.

Specifications

Performance

Relative Humidity

Measurement range	0 ... 100 %RH

Accuracy (including non-linearity,
hysteresis, and repeatability)

Temperature range	-20 ... +40 ºC (-4 ... +104 ºF)
0…90 %RH	±2 %RH
90…100 %RH	±3 %RH
Temperature range	-40 ... -20 ºC (-40 ... -4 ºF),
	+40 ... +180 ºC (+104 ... +356 ºF)
0…90 %RH	±2.5 %RH
90…100 %RH	±3.5 %RH

Factory calibration uncertainty (+20 °C)	±1.5 %RH

Humidity sensor	Vaisala HUMICAP 180R

Dewpoint Temperature

Measurement range	-20 ... +100 ºC (-4 ... +212 ºF) T_d

Accuracy (including non-linearity,
hysteresis, and repeatability) when
dewpoint depression <20 °C

(Ambient temperature - dew point)	±2 °C T_d

Operating Environment

Operating temperature range
Component board	-5 ... +55 ºC (+23 ... +131 ºF)
Plastic probe	-70 ... +180 ºC (-94 ... +356 ºF)
Stainless steel probe	-70 ... +180 ºC (-94 ... +356 ºF)
Plastic grid filter	-20 ... +80 ºC (-4 ... +176 ºF)
Membrane filter	-20 ... +80 ºC (-4 ... +176 ºF)
Porous PTFE filter	-70 ... +180 ºC (-94 ... +356 ºF)
Stainless steel sintered filter	-70 ... +180 ºC (-94 ... +356 ºF)
Probe mounting flange	-70 ... +180 ºC (-94 ... +356 ºF)

Electromagnetic compatibility   Complies with EMC standard EN61326-1, light industrial level

Inputs and Outputs

Analog output types (1 output selectable)
2-wire model	4 ... 20 mA (loop powered)
3-wire model	0 ... 20 mA, 0 ... 1V/5V/10V

Service port   M8 connector for USB cable

Operating voltage
2-wire model	24 VDC with 800 ohm load resistance (see Figure 18 on page 67).
3-wire model	10 ... 35 VDC or 19.2 ... 28.8 VAC 15 ... 35 VDC or 19.2 ... 28.8 VAC when 0 ... 10 V output is used.

Typical power consumption   6 mA, see Table 10 below.

Table 10   HMM100 3-wire Model Current Consumption

Output DC	Supply Voltage DC	Supply Voltage AC	Load Resistance	Typ. Current Consumption	Max. Current Consumption
0 ... 1 V	10 ... 35 VDC	9 ... 24 VAC	≥ 10 kΩ	6 mA	10 mA
0 ... 5 V	10 ... 35 VDC	9 ... 24 VAC	≥ 10 kΩ	6 mA	10 mA
0 ... 10 V	15 ... 35 VDC	14 ... 24 VAC	≥ 10 kΩ	6 mA	10 mA
0 ... 20 mA	10 ... 35 VDC	9 ... 24 VAC	0 Ω	6 ... 26 mA*	10 ... 30 mA*
0 ... 20 mA	20 ... 35 VDC	17 ... 24 VAC	500 Ω	6 ... 26 mA*	10 ... 30 mA*

* Current consumption depends on the output current.
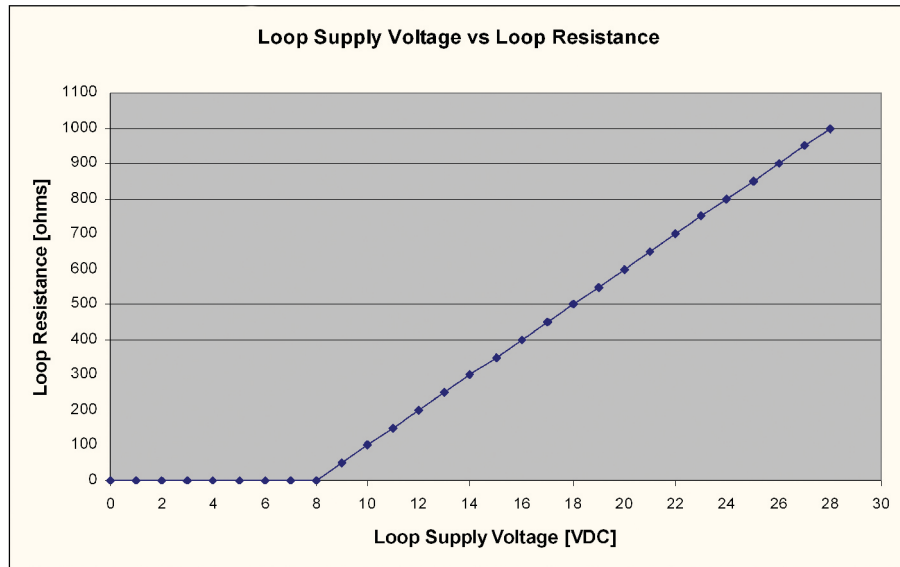
Figure 18 **Loop Supply Voltage Versus Loop Resistance**

Mechanics

Service cable connector   M8 series 4-pin (male)
Wire size for screw terminals   0.5 ... 1.5 mm^2
Probe cable lengths
   Plastic probe   0.65 m, 1.55 m, 2.9 m
   Stainless steel probe   1.55 m, 2.9 m
Materials
   Plastic probe   PPS
   Stainless steel probe   AlSI316/PPS
   Probe mounting clamp   AISI316
   Probe mounting flange   Silicone/ AISI316
   Mounting bracket bottom plate Al
   Mounting bracket lid   ABS/PC
   Module housing   ABS/PC

Options and Accessories

Description	Item code
Humidity sensor	HUMICAP180R
Membrane filter	10159HM
Plastic grid filter	6221
Porous PTFE filter	219452SP
Stainless steel sintered filter	HM47280SP
Catalytic VHP filter	231865
Mounting bracket with lid	225979
Module housing (IP65)	226060
Probe mounting flange	226061
Probe mounting clamp set (10 pcs)	226067
USB cable	226068

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