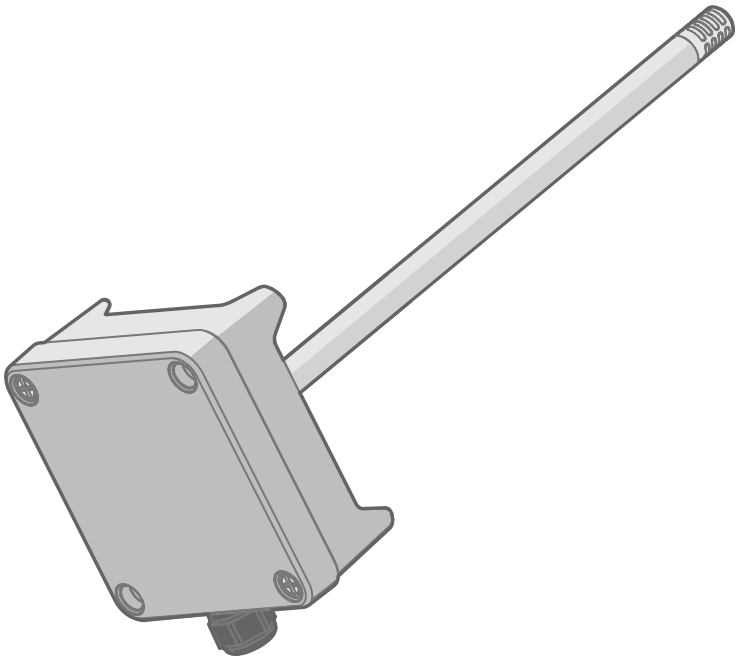
M212243EN-C

User Guide

HMD60 Series Humidity and Temperature Transmitters for Ducts in HVAC

HMD65



VAISALA

PUBLISHED BY

Vaisala Oyj
Vanha Nurmijärventie 21, FI-01670 Vantaa, Finland
P.O. Box 26, FI-00421 Helsinki, Finland
+358 9 8949 1

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1. About This Document

1.1 Version Information

Table 1 Document versions

Document Code	Date	Description
M212243EN-C	February 2020	This manual. Added information on HUMICAP® 180V catalytic sensor option, sintered teflon filter option, and startup surge current. BACnet PICS appendix corrections (firmware version, product models).
M212243EN-B	May 2019	Previous version. Corrected the list of supported protocol services in BACnet Device Object. Firmware version updated in BACnet PICS.
M212243EN-A	September 2018	First version of the document

1.2 Related Manuals

Table 2 Related Manuals

Document Code	Description
M212264EN	HMD65 Multilingual Quick Guide
M212016EN	HMD62 and TMD62 User Guide
M212049EN	HMD62 and TMD62 Multilingual Quick Guide

1.3 Documentation Conventions

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! 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.

1.4 Trademarks

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

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

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

2. Product Overview

2.1 Introduction to HMD60 Series

The duct mounted HMD60 HUMICAP® Humidity and Temperature Transmitters are designed for monitoring humidity and temperature in demanding HVAC and light industrial applications. HMD60 series transmitters provide stable, reliable, and highly accurate (up to ±1.5 %RH and ±0.1 °C (0.18 °F)) measurements, and are resistant to chemicals and dust.

HMD60 series transmitter options include the HMD62 and TMD62 analog output transmitters with loop-powered 4 ... 20 mA current output, and the analog and digital output transmitter HMD65 with analog voltage output (0 ... 10 V) and digital Modbus RTU and BACnet output (RS-485).

Thanks to easy access to electronics also when the transmitter is installed to a duct, configuration and adjustment can be carried out quickly and conveniently. Available configuration and adjustment interface options range from physical trimmers and DIP switches on the transmitter's circuit board to Modbus, BACnet, and Vaisala Insight PC software for Windows®.

2.2 HMD65 Basic Features and Options

- Humidity and temperature measurement:
  - available humidity parameters: RH, T_d, T_{df}, A, X, T_w, H
  - T measurement in °C or °F
- Analog output: 2 analog 0 ... 10 V output channels for humidity and temperature measurements
- Digital output (RS-485): Modbus RTU and BACnet MS/TP
- Power supply input: 15 ... 35 VDC / 16 ... 24 VAC
- Configuration and adjustment options:
  - RH and T measurement field adjustment with trimmers
  - Humidity output parameter selection and Modbus/BACnet serial setting configuration with DIP switches
  - Configuration and adjustment with Vaisala Insight PC software
  - Configuration with Modbus and BACnet
  - Field adjustment with MI70 handheld indicator

2.3 Available Parameters and Default Scaling

HMD65 Measurement Parameters and Default Analog Output Scaling

Table 3 (page 8) shows the available output parameters and the default analog output scaling of the parameters for HMD65.

Table 3 HMD65 Measurement Parameters and Default Scaling

Parameter	Default Scaling for 1 ... 10 V Output Range
Relative humidity (RH)	0 ... 100 %RH
Temperature (T)	-20 ... +80 °C (-4 ... +176 °F)
Dew point temperature (T_d)	-40 ... +80 °C (-40 ... +176 °F)
Dew point/frost point temperature (T_{df})	-40 ... +80 °C (-40 ... +176 °F)
Absolute humidity (A)	0 ... 300 g/m^3 (0 ... 131.1 gr/ft^3)
Mixing ratio (X)	0 ... 600 g/kg (0 ... 4200 gr/lb)
Wet-bulb temperature (T_w)	-40 ... +80 °C (-40 ... +176 °F)
Enthalpy (H)	-40 ... 1600 kJ/kg (-9.5 ... 695.6 Btu/lb)

Changing Measurement Parameter Scaling

If your application requires an analog output scaling that differs from the defaults shown in Table 3 (page 8), you can configure the scaling by connecting the transmitter to Vaisala Insight PC software (requires Vaisala USB cable 219690).

2.4 Connectivity to Vaisala Insight Software

The transmitter can be connected to Vaisala Insight software using a Vaisala USB cable (order code 219690). With the Insight software, you can:

- See device information and status.
- See real-time measurement.
- Configure output parameters and scaling.
- Configure serial communication settings.

More information

- Connecting to Insight software (page 21)

2.5 Transmitter Parts

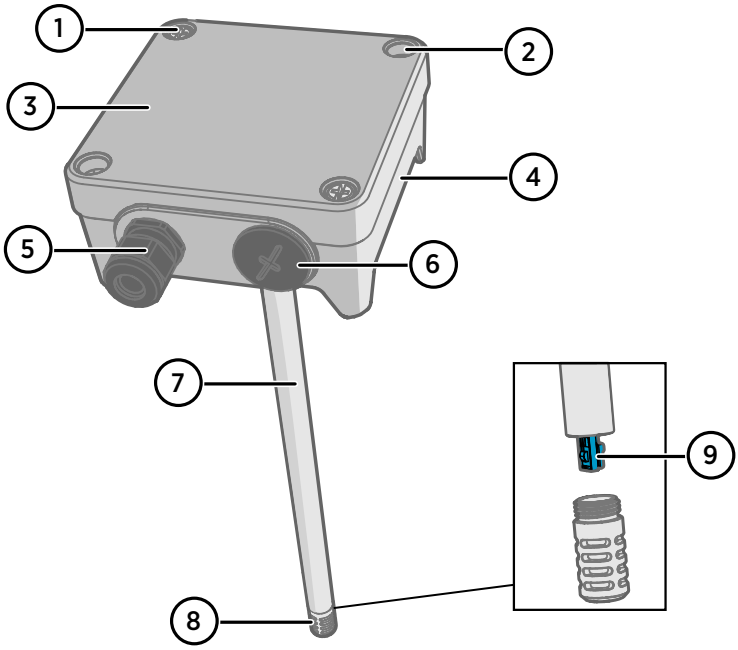


Figure 1 HMD65 Transmitter Parts Overview

1 Captive screw (2 pcs, cross-head) for attaching the lid of the transmitter.
2 Screw (2 pcs) for mounting the transmitter on the installation surface.
3 Transmitter lid. Open the captive screws of the lid to access input and output electronics.
4 Transmitter base. Contains the input and output connectors on the transmitter board: see Transmitter Board (page 12).
5 Cable gland (M16 x 1.5 lead-through) for leading wires into the transmitter.
6 Alternative lead-through (M20 x 1.5) for wiring.
7 Probe body. Long (shown) and short probe options available: see Transmitter Dimensions (page 16).
8 Probe filter (default option: AISI 316L stainless steel).
9 HUMICAP® sensor inside the probe filter.

CAUTION! Do not touch the sensor element.

2.5.1 Cable Gland and Conduit Options

HMD60 has 2 lead-throughs (M16x1.5 and M20x1.5) that can be used with a variety of cable gland and conduit options. Figure 2 (page 10) shows the cable gland and conduit options available from Vaisala.

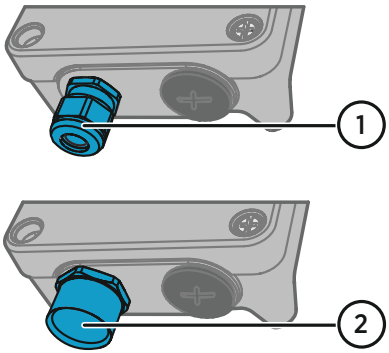


Figure 2 HMD60 Cable Gland and Conduit Options

1 Cable Gland and O-ring M16 x 1.5 (Vaisala order code: 254280SP). This is the default option delivered with HMD60.
2 Conduit fitting and O-ring (M16x1.5 / NPT1/2") (Vaisala order code: 210675SP).

More information

- Spare Parts and Accessories (page 49)

2.5.2 Filter Options

Figure 3 (page 10) shows the filter options available for HMD60.

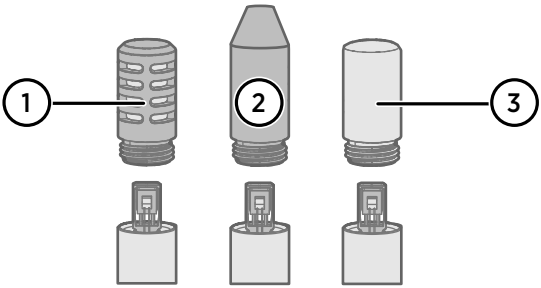


Figure 3 HMD60 Filter Options

1 Metal grid with PTFE membrane (Vaisala order code ASM212652SP). This is the default option delivered with HMD60.
2 Sintered stainless steel filter (Vaisala order code HM46670SP).
3 Sintered teflon filter (Vaisala order code DRW244938SP)

More information

- Spare Parts and Accessories (page 49)

2.5.3 Humidity Sensor Options

HMD60 series humidity transmitters (HMD62 and HMD65) have the following humidity sensor options (selected when ordering):

- HUMICAP® R2: Latest generation industrial humidity sensor with improved corrosion resistance.
- HUMICAP® 180V: Humidity sensor with a catalytic surface for processes with hydrogen peroxide (H_2O_2).

Note that the HUMICAP® 180V and HUMICAP® R2 sensors have a different temperature range for specified accuracy: 180V accuracy has been specified down to -20 °C (-4 °F), and R2 accuracy down to -40 °C (-40 °F).

For full measurement specifications, see Specifications (page 47).

2.5.4 Transmitter Board

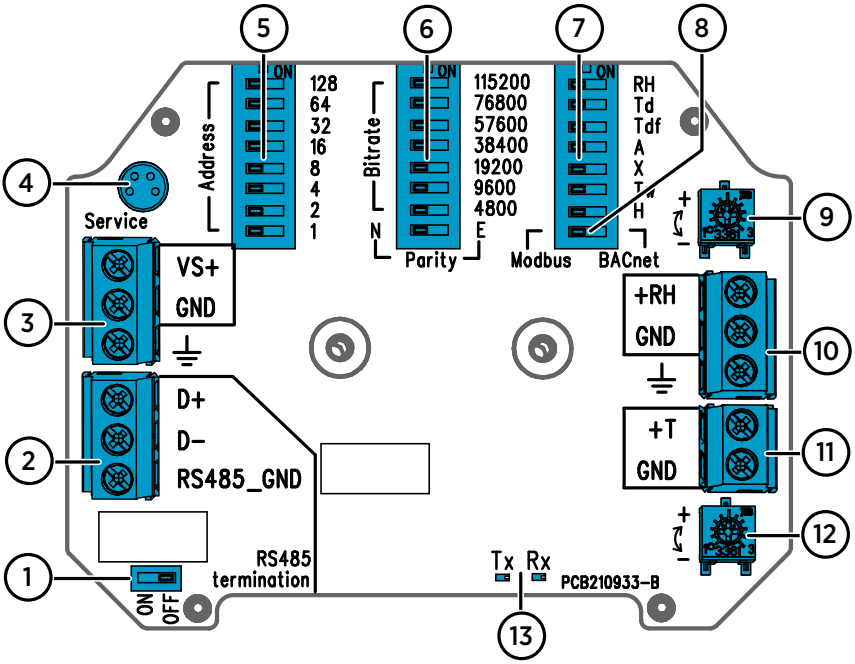


Figure 4 HMD65 Transmitter Board: Service Port, DIP switches, Trimmers, and Screw Terminals

1 RS-485 termination (120 Ω resistor) ON/OFF switch.
2 RS-485 (Modbus/BACnet) screw terminals.
3 Power supply input (15 ... 35 VDC or 16 ... 24 VAC) screw terminals.
4 Service port for MI70 handheld indicator and Insight PC software cable connection.
5 DIP switches for setting the HMD65 Modbus RTU or BACnet MS/TP MAC address.
6 DIP switches for selecting Modbus/BACnet communication bit rate and parity (Modbus only).
7 DIP switches for humidity output parameter selection.
8 DIP switch for selecting either Modbus or BACnet mode.
9 Trimmer for humidity measurement adjustment.
10 Screw terminals for humidity measurement output.
11 Screw terminals for temperature measurement output.
12 Trimmer for temperature measurement adjustment.
13 Indicator LEDs: flash when there is RS-485 transmit (TX) or receive (RX) activity.

More information

- Wiring (page 19)
- Modbus and BACnet Overview (page 29)

2.5.5 Trimmers

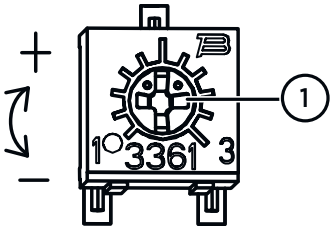


Figure 5 Component Board Adjustment Trimmer

1 Use a Phillips head screwdriver (PH0) to rotate the RH or T adjustment trimmer. To increase the measurement output value, rotate the trimmer clockwise. To decrease, rotate counterclockwise.
Note that there is a slight delay before the measurement output changes after rotating the trimmer.

You can adjust the transmitter's RH or T measurement output with the trimmers on the component board. During trimmer adjustment, the output of the transmitter is corrected using the trimmers until the output matches the known value of a reference.

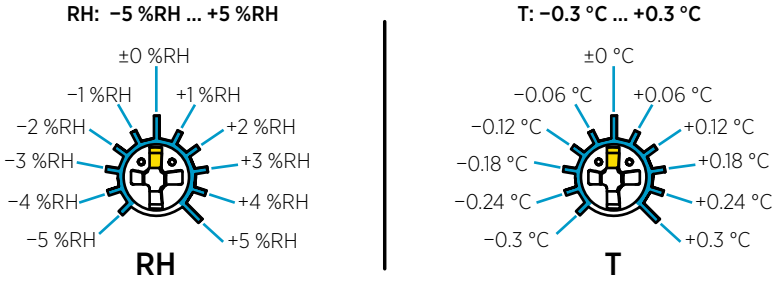


Figure 6 RH and T Trimmer Adjustment Ranges (Indicative)

You can only calibrate the relative humidity measurement (RH) and temperature measurement (T). Other parameters (available for HMD62) are calculated internally based on RH and T. Check that the output selection DIP switch is set to RH when making adjustments with the physical trimmer; when using the Insight PC software, set all DIP switches to the **OFF** position.

CAUTION! If you use the Insight PC software to adjust the measurement or to restore the factory settings, always return the physical trimmer to the middle position before starting. When you make an adjustment with Insight, the position in which the trimmer is at that point is set as the ±0 point.

2.5.6 DIP Switch Humidity Output Selection

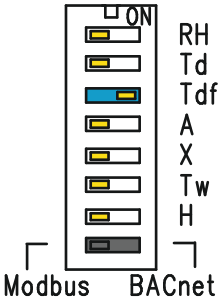


Figure 7 HMD65 DIP Switch Example: T_{df} Output Selected

RH Relative humidity
Td Dew point temperature
Tdf Dew point/frost point temperature
A Absolute humidity
X Mixing ratio
Tw Wet-bulb temperature
H Enthalpy

You can change the humidity parameter that is output on the RH channel of HMD65 with the DIP switches on the component board. Select the parameter you want the transmitter to output by sliding the parameter's DIP switch to the right (**ON**). In the example in Figure 7 (page 14), the selected output parameter is dew point/frost point temperature (T_{df}). Keep the other DIP switches in the **OFF** position (left).

The selected parameter uses the default scaling shown in Table 4 (page 14).

Table 4 HMD65 Default Parameter Scaling

Parameter	Default Scaling for 0 ... 10 V Output Range
RH	0 ... 100 %RH
T_d	-40 ... +80 °C (-40 ... +176 °F)
T_{df}	-40 ... +80 °C (-40 ... +176 °F)
A	0 ... 300 g/m^3 (0 ... 131.1 gr/ft^3)
X	0 ... 600 g/kg (0 ... 4200 gr/lb)
T_w	-40 ... +80 °C (-40 ... +176 °F)
H	-40 ... 1600 kJ/kg (-9.5 ... 695.6 Btu/lb)

CAUTION! Note that the humidity output parameter selected with the DIP switches on the transmitter component board will be used instead of the parameter selected with Insight. When using Insight to configure the output, set all humidity parameter selection DIP switches on the transmitter component board to the **OFF** position (left) to ensure they do not cause a conflict with the Insight settings.

If you use Insight to set both analog output channels to output T measurement, the humidity parameter DIP switches do not have an effect on the output.

2.6 Filtering Factor

If the measuring environment produces occasional exceptionally high or low readings that need to be averaged out in the output, you can apply a filtering factor to the RH or T output (filtering factor range: 0.001 ... 1.000). The filtering factor defines the speed at which the latest measurement is integrated into the transmitter's output. By default, the filtering factor is set to 0.500, which means that the displayed output is a 50%+50% combination of the previous measurement and the most recent measurement. To show the latest measurement directly in the output, set the filtering factor to 1.000 (no filtering).

The following formula is used when calculating the output:

output = [(new (unfiltered) measurement × filtering factor) + (previous output × (1.0 - filtering factor))]

The filtering factor can be configured with the Insight PC software.

More information

- Setting Filtering Factor with Insight (page 28)

2.7 Environmental Compensation

By default, the pressure value used in HMD65 measurement calculation is 1013.2 hPa. If the pressure of your measurement environment differs from this, you can configure the transmitter's pressure compensation value with the Insight PC software.

More information

- Changing Pressure Compensation Settings with Insight (page 27)

3. Installation

3.1 Transmitter Dimensions

The dimensions are given in millimeters and [inches].

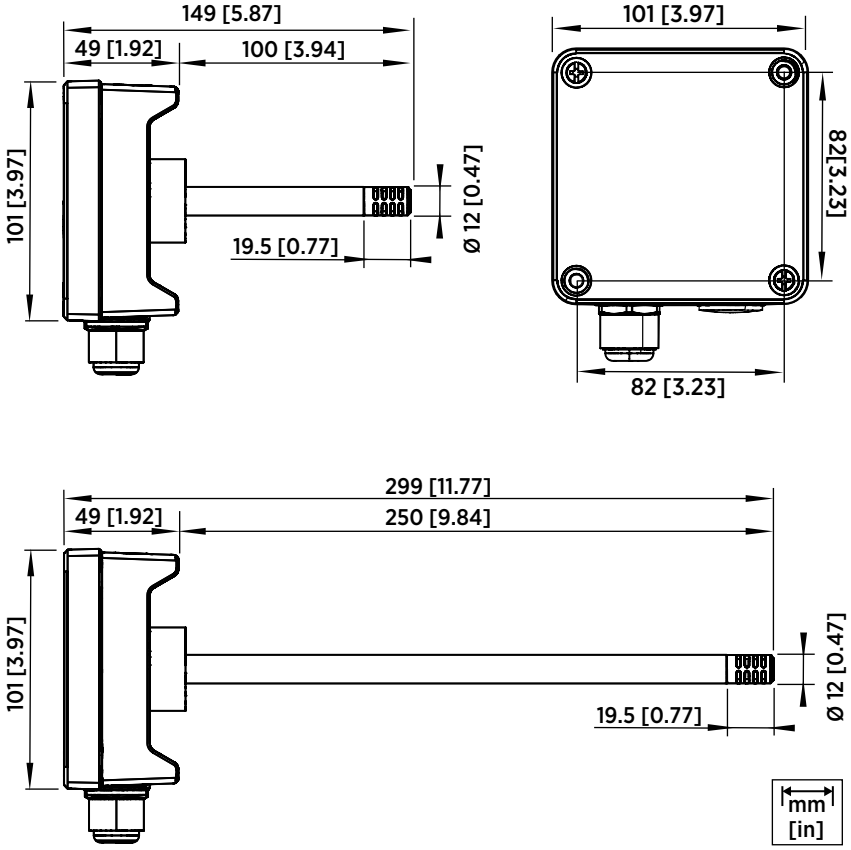


Figure 8 Dimensions with Long and Short Probe

3.2 Duct Mounting Overview

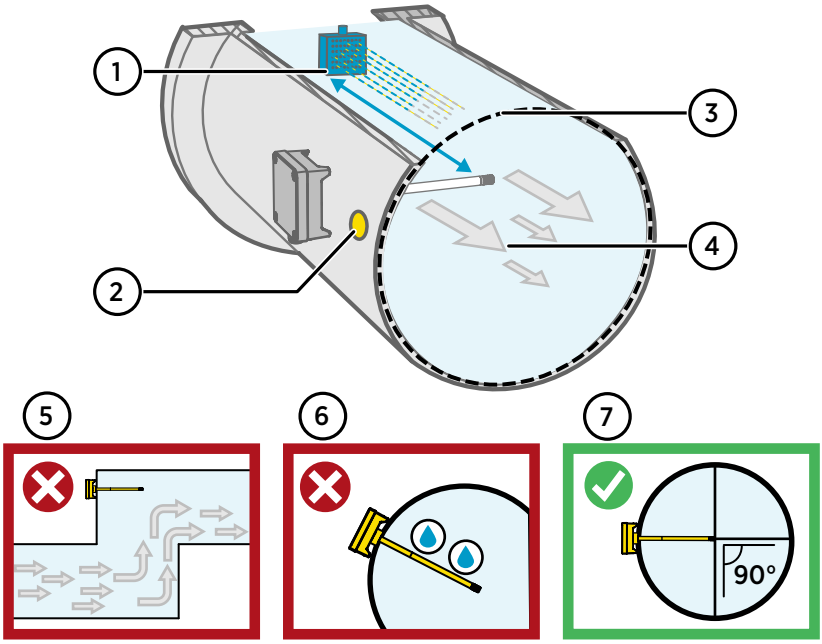


Figure 9 Duct Installation Overview

1 Make sure there is a minimum clearance of 5 m (16.5 ft) between the probe body and any possible humidifier. Avoid installing in a location where condensation can fall on the sensor inside the duct.
2 When installing the transmitter, drill a second hole approximately 30 cm (12 in) from the installation hole, towards the direction of the air flow, and plug it with a removable seal. This second hole is intended for later use in reference measurement with another device when calibrating or adjusting the transmitter.
3 Check that the duct diameter is suitable for the probe body (see Transmitter Dimensions (page 16)). Ideally, the sensor (probe head) should be installed in the middle of the duct.
4 Maximum air flow speed: 50 m/s (with sintered filter).
5 Avoid installing the transmitter in dead legs. Supersaturation can occur in areas where there is no air flow.
6 Do not install the probe in a downward angle. Condensation can travel to the sensor along the probe body if the probe points down.
7 Install the probe in a 90° angle so that the sensor is placed as close to the middle of the duct as possible.

3.3 Installing into Duct

- Medium size crosshead screwdriver for mounting screws and lid screws.
- Small slotted screwdriver for screw terminals.
- Drill with 3.5 mm (0.14 in) and 13 ... 15 mm (0.51 ... 0.59 in) bits for making the installation holes.
- Tools for cutting and stripping wires.

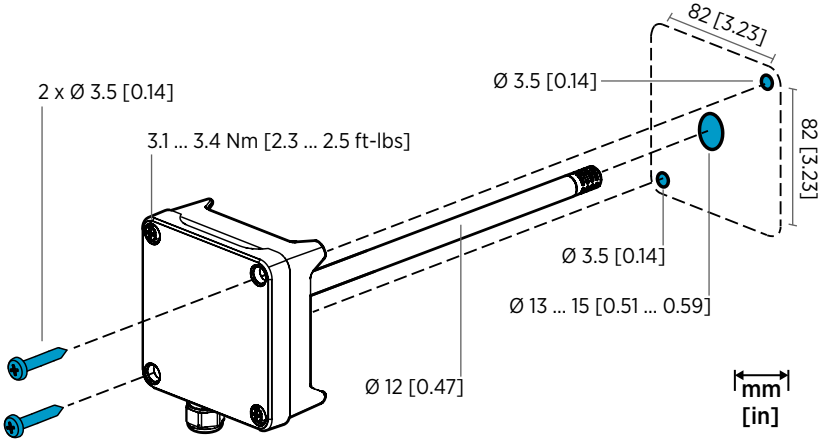


Figure 10 Drilling and Mounting Screws

1. Select an installation location for the transmitter on the duct surface and drill a Ø 13 ... 15 mm (0.51 ... 0.59 in) hole for inserting the probe.
2. Push the probe through the hole on the duct until the transmitter body meets the duct.
3. Attach the transmitter body to the duct with 2 Ø 3.5 mm (0.14 in) screws.

Check that the insulation ring sits tightly over the installation hole. If the duct has a negative pressure, external air can be drawn into the duct and affect the measurement if the installation hole is not sealed tightly.

4. Optional: Drill a second hole for reference measurements approximately 30 cm (12 in) from the transmitter installation hole. See Figure 9 (page 17).
5. Open the 2 captive screws on the transmitter body and remove the lid.
6. Attach the input/output wiring to the screw terminals on the transmitter component board. See Wiring (page 19). Tighten cable glands firmly after wiring.
7. Check that the DIP switches and trimmers are in the correct position. See Transmitter Board (page 12) for more information on DIP switches and trimmers.

8. Close the transmitter lid and switch on the transmitter's power supply input.

3.4 Wiring

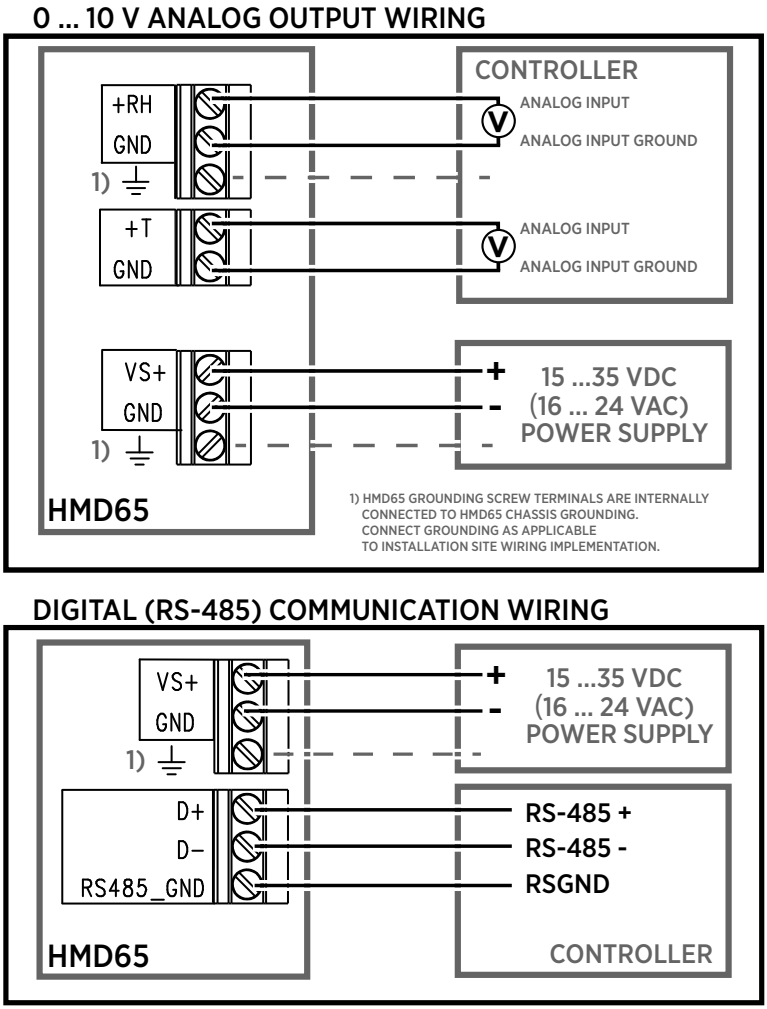


Figure 11 HMD65 Wiring Diagrams (Analog and Digital Output Options)

- Screw terminal wire size: 0.5 ... 2.5 mm^2
- Flat head screwdriver: 0.6×3.5 mm

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

CAUTION! Do not connect any wires to unused terminals (for example, if you are using only analog outputs, do not connect wires to the RS-485 terminals). Connecting unnecessary wires can increase the power consumption and cause heating.

3.4.1 Startup Surge Current

When the transmitter powers up, the startup surge current may rise up to 120 mA. If you are connecting the transmitter to a system that uses a current limiting function, this can cause a startup issue that prevents the transmitter from powering up.

To resolve a startup issue caused by current limiting, try one of the following options:

1. Adjust the current limiting function of the system to which you are connecting the transmitter so that it can accommodate the startup surge current.
2. Add an extra load resistor between the +RH terminal and the power supply. The value of the serial resistor must be calculated based on the supply voltage and shunt resistance value.

4. Operating with Insight PC Software

4.1 Vaisala Insight Software

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

To ensure support for your HMD60 series transmitter, download the latest version of Insight at www.vaisala.com/insight.

With the Insight software, you can:

- See real-time measurements, device information and status.
- Configure outputs and scaling.
- Calibrate and adjust the device.

HMD60 can be connected to Insight using a Vaisala USB cable (order code 219690).

4.2 Connecting to Insight software

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.

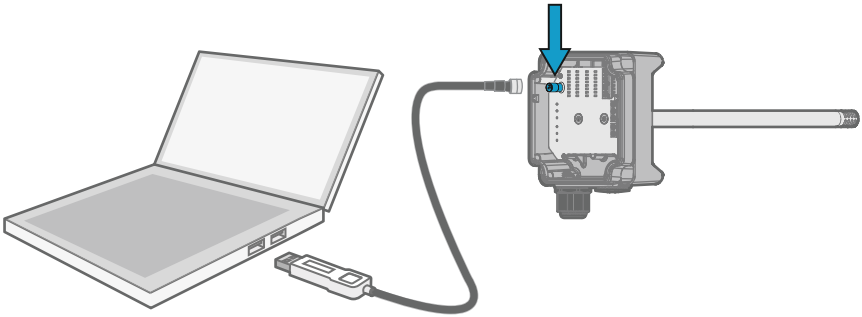


Figure 12 Connecting transmitter to Insight

1. Open the Insight software.
2. Connect the USB cable to a free USB port on the PC.

3. Connect the USB cable to the service port of the transmitter.
4. Wait for Insight software to detect the transmitter.

4.3 Insight Main View

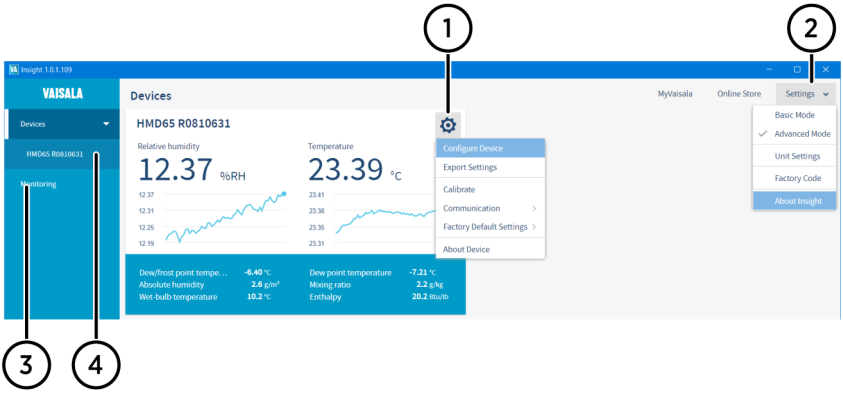


Figure 13 Insight Main Menu and Settings

1 Select ⚙ to access Insight main menu.

- **Configure Device**: environmental compensation settings, analog output 1 and 2 settings, Modbus and BACnet configuration, filtering factor, error limits and general settings.
- **Export Settings**: creates a text file export of the device settings.
- **Calibrate**: options for calibrating and adjusting RH and T output, testing and adjusting voltage (V) output levels, and restoring factory adjustments.
- **Communication**: contains a quick access selection for restarting the device.
- **Factory default settings**: restores the transmitter back to default settings, clears any user adjustments and restores the latest factory calibration.
- **About Device**: general device information such as serial number and software version.

2 Select **Settings** to switch between the **Basic Mode** and **Advanced Mode** user modes, change the units of parameters (metric/non-metric), enter a factory code to access restricted functionalities, or view information about the Insight software.

3 **Monitoring** provides options for monitoring and recording selected parameters, and exporting the monitoring data as a CSV (comma-separated values) file.

4 Device information menu with the following tabs:

- **Measurements**: measurement graph view with parameter drop-down selection.
- **Calibration information**: read-only information about the latest stored calibration.
- **Diagnostics**: troubleshooting and administrative information about the device status. Also includes an option to export the device error log as a text file. When contacting Vaisala support, it is recommended to include an up-to-date export of the error log with the support request.

4.3.1 Basic and Advanced User Modes

You can switch between the **Basic Mode** and **Advanced Mode** user modes with the selections in the **Settings** menu.

Certain functionalities are only available in **Advanced Mode**. The options enabled by switching to **Advanced Mode** are often intended for administrative users: set the user mode according to the requirements of the personnel that use the device.

4.4 Configuring Analog Outputs with Insight

CAUTION! Note that the humidity output parameter selected with the DIP switches on the transmitter component board will be used instead of the parameter selected with Insight. When using Insight to configure the output, set all humidity parameter selection DIP switches on the transmitter component board to the **OFF** position (left) to ensure they do not cause a conflict with the Insight settings.

If you use Insight to set both analog output channels to output T measurement, the humidity parameter DIP switches do not have an effect on the output.

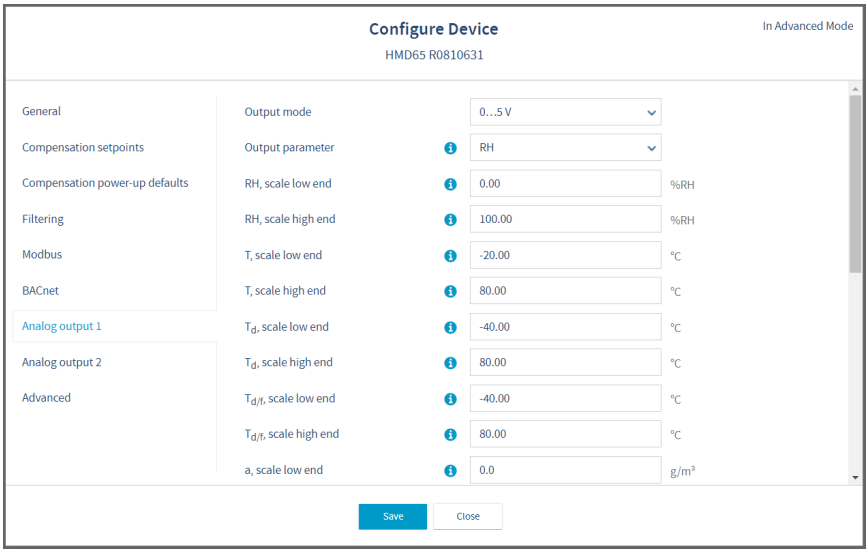


Figure 14 Analog Output Configuration Options in Insight

To configure analog output with Insight:

1. Check that the output parameter selection DIP switches on the transmitter component board are switched to the **OFF** position.
2. Connect to Insight and select **> Configure Device > Analog Output 1[2]**.
3. Select the output mode (either **0 ... 10 V**, **0 ... 5 V**, **1 ... 5 V**, or **Off**).
4. Select the output parameter.

   The default analog output setup for HMD65 is 1 channel for RH and 1 channel for T. Using Insight, you can set any RH and T output combination for the 2 channels (RH+RH, T+T, or RH+T).

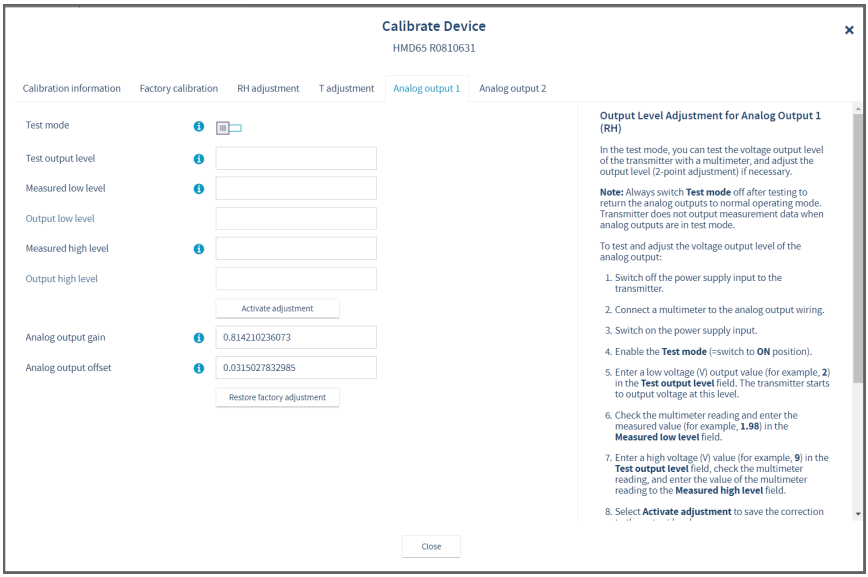
5. Enter the lower and upper limits of the output scale for your selected parameter.
6. Set the error output value and the output clipping and error limits.
7. Select **Save** to store the configuration and exit the menu with **Close** when done.

4.4.1 Testing and Adjusting Analog Output Voltage (V) Level

- Computer with Windows operating system and Vaisala Insight software installed
- Vaisala USB cable 219690 for connecting the probe to Insight
- Multimeter for checking the analog output voltage reading

Note that configuring these settings requires using Insight in **Advanced Mode**.

You can test the voltage (V) output level of the transmitter with a multimeter, and adjust the output level (2-point adjustment) if necessary.



CAUTION! Always switch **Test mode** off after testing to return the analog outputs to normal operating mode. The transmitter does not output measurement data when the analog outputs are in test mode.

1. Switch to **Advanced Mode** in the **Settings** menu.
2. Select **> Calibrate > Yes** to switch the probe to calibration mode.
3. Select the analog output you want to test (**Analog Output 1[2]**).
4. Follow the instructions in the Insight interface to carry out required output tests and adjustments.

4.5 Configuring Minimum and Maximum RH and T Errors with Insight

You can define the minimum and maximum limit that the RH or T measurement output can reach before the output moves to error state.

Note that configuring these settings requires using Insight in **Advanced Mode**.

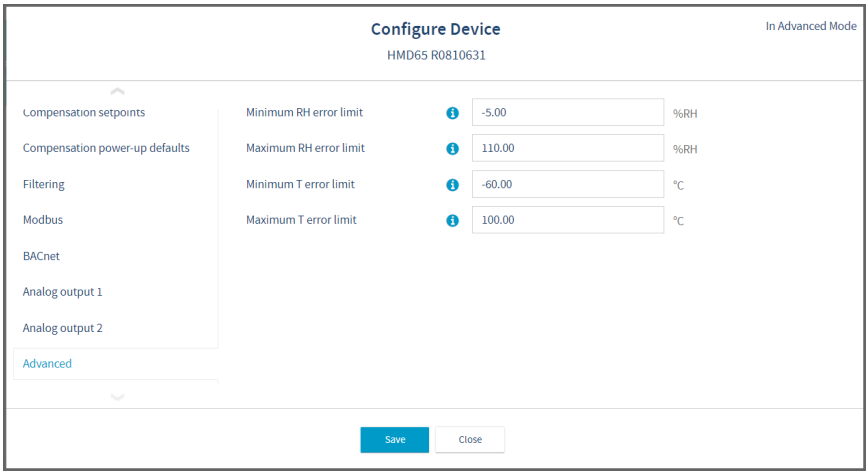


Figure 15 Minimum/Maximum Allowed Measurement Value Before Error

To define the minimum/maximum error limits:

1. Switch to **Advanced Mode** in the **Settings** menu.
2. Select **> Configure Device > Advanced**.
3. Enter the values for minimum and maximum RH and T as applicable, select **Save** and exit the menu with **Close**.

More information

- Basic and Advanced User Modes (page 23)

4.6 Changing Pressure Compensation Settings with Insight

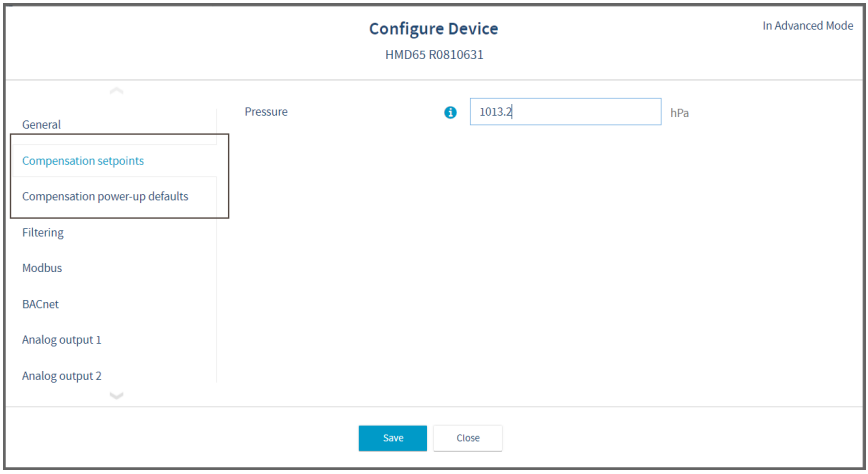


Figure 16 Pressure Compensation Settings

By default, the pressure value used when calculating HMD65 measurements is 1013.2 hPa.

To change the pressure compensation setting:

1. Select > **Configure Device**.
2. To change the volatile compensation value (resets back to power-up default at device restart), select **Compensation setpoints**, enter a value, and select **Save**.
3. To change the default compensation value that stays in use also after device restart, select **Compensation power-up defaults**, enter a value, and select **Save**.
4. Select **Close** to exit the menu after you have saved the compensations.

More information

- Environmental Compensation (page 15)

4.7 Setting Filtering Factor with Insight

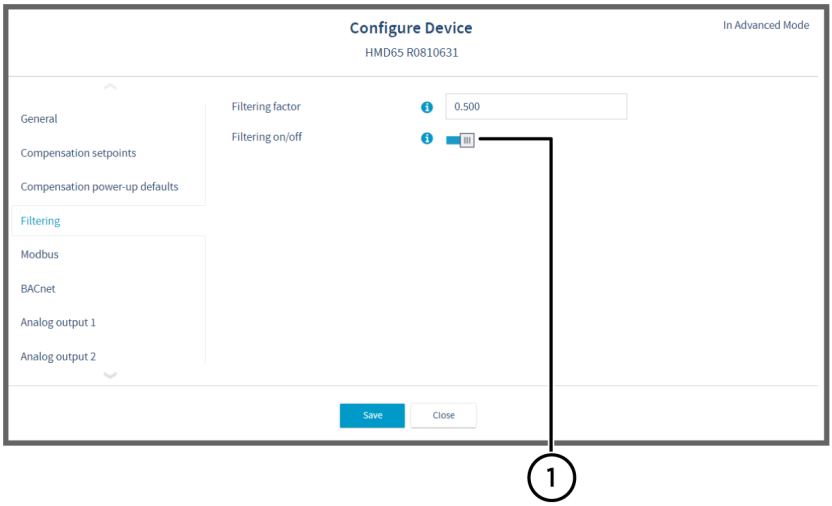


Figure 17 Filtering Factor Configuration View

1 Enable filtering by moving the slider to the right (**ON**)

To set a filtering factor for the transmitter's measurement output:

1. Select > **Configure Device > Filtering**.
2. Enable filtering with the **ON**/**OFF** selections (slide right to enable, left to disable).
3. Enter a filtering factor below 1.000 to apply filtering to the output (range: 0.001 ... 1.000).

   Examples of the effect of filtering on output:
   - Filtering factor 1.000 = No filtering, the latest measurement is output directly without integrating previous measurements.
   - Filtering factor 0.500 = The reading output integrates 50% of the previous measurement with the latest measurement.
   - Filtering factor 0.100 = The reading output integrates 90% of the previous measurement with the latest measurement.

4. Select **Save** when done and exit with **Close**.

More information

- Filtering Factor (page 15)

5. Modbus and BACnet Communication

5.1 Modbus and BACnet Overview

HMD65 can be accessed with the Modbus and BACnet protocols over the RS-485 interface. The protocol selection and communication settings for either protocol are entered with the DIP switches on the HMD65 component board (see Figure 18 (page 29)).

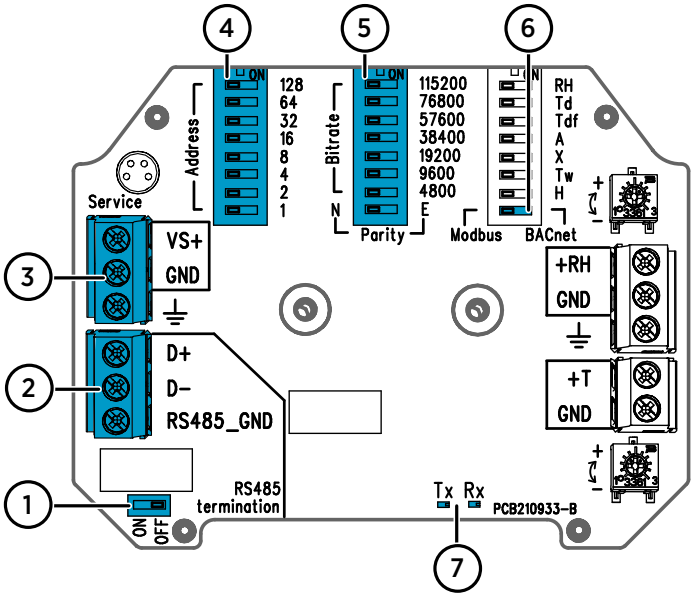


Figure 18 Modbus and BACnet DIP Switches and Screw Terminals on HMD65 Component Board

1 DIP switch for setting RS-485 termination (120 Ω resistor) ON/OFF
2 Screw terminals for RS-485 (Modbus/BACnet) communication
3 Screw terminals for power supply input wiring (15 ... 35 VDC / 16 ... 24 VAC)
4 DIP switches for setting the device MAC address: see Figure 19 (page 30)
5 DIP switches for setting the communication bitrate (4800 ... 115200 bps) and parity (N/E)
6 DIP switch for selecting either Modbus RTU or BACnet MS/TP mode
7 LED indicators for RS-485 transmit/receive activity

Modbus

The Modbus variant used in HMD65 is Modbus RTU. For a list of the Modbus registers available in HMD65, see Modbus Registers (page 51).

BACnet

The BACnet variant used in HMD65 is BACnet MS/TP. For a description of the HMD65 BACnet implementation, see BACnet Reference (page 57).

Setting Device MAC Address with DIP Switches

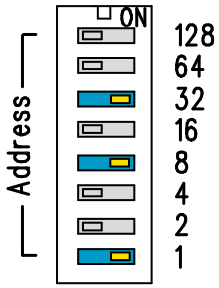


Figure 19 MAC Address DIP Switch Example

DIP switches 32, 8, and 1 set to ON	The MAC address is encoded in eight bit binary form, with each numbered switch representing a single bit. This example shows address 41 selected: DIP switches 32, 8, and 1 (decimal: 41, binary: 00101001) are set to ON.

Modbus and BACnet MAC Address Ranges

The BACnet MS/TP MAC address range for the transmitter is 0 ... 127 (master mode only).

The Modbus RTU MAC address range for the transmitter is 1 ... 247.

Configuring an address above the range maximum results in the address defaulting back to the maximum address (127 or 247). Addresses below the range minimum default to the minimum address (0 or 1).

Bit Rate and Parity Options

- The bit rate 4800 is used only for Modbus RTU (use 9600 and above for BACnet MS/TP).
- If the bit rate DIP switches are all set to OFF (left), the following defaults are used:
  - Modbus RTU: 19200
  - BACnet MS/TP: 38400
- The parity selection (N/E) only has an effect on Modbus RTU communication.

5.2 Modbus and BACnet Configuration with Insight

Modbus and BACnet communication settings are configured with the DIP switches on the HMD65 component board (see Figure 18 (page 29)). In addition to the communication settings available through the DIP switches, you can configure certain Modbus and BACnet settings with Vaisala Insight PC software (requires Vaisala USB cable 219690).

For instructions on connecting HMD65 to Insight, see Connecting to Insight software (page 21).

5.2.1 Configuring Modbus Response Delay with Insight

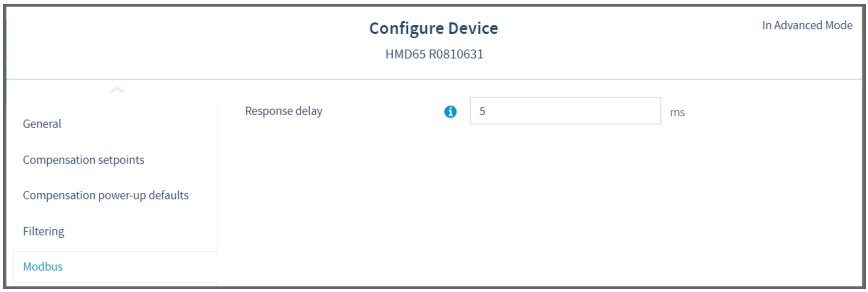


Figure 20 Modbus Response Delay Setting in Insight

To configure Modbus response delay with Insight:

1. Connect to Insight and select > **Configure Device > Modbus RTU**.
2. Enter the **Response delay** value in milliseconds: see the instructions in the Insight interface for allowed ranges and additional information.
3. Select **Save** to store the setting.

5.2.2 Configuring BACnet with Insight

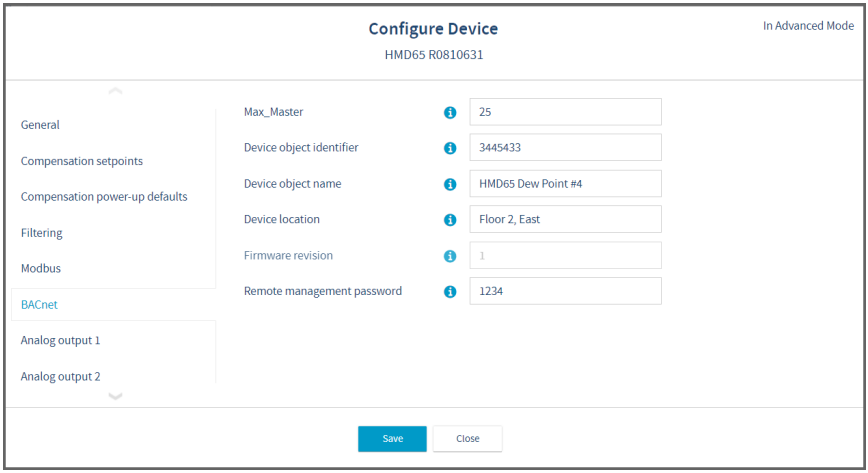


Figure 21 BACnet Device Information, MS/TP Master Address Poll Limit, and Remote Management Password Settings in Insight

You can configure the following BACnet settings with Vaisala PC Insight software:

- **Max_Master** (highest address polled for MS/TP master)
- **Device object identifier** (BACnet ID of the device)
- **Device object name** (max. 40-character name for the device)
- **Device location** (max. 40-character location info for the device)
- **Firmware revision** (read-only version information)
- **Remote management password** (max. 20-character password for remote management, default **1234**)

To configure BACnet settings with Insight:

1. Connect to Insight and select > **Configure Device > BACnet MSTP**.
2. Enter the values for BACnet settings as necessary: see the instructions in the Insight interface for allowed ranges and additional information.
3. Select **Save** to store the settings.

6. Operating with MI70 Indicator

6.1 Overview of MI70 Support

The MI70 handheld indicator is a convenient service tool for viewing the measurement readings and performing calibration and adjustment. MI70 is used as the display and configuration tool in, for example, the HM70 Handheld Humidity and Temperature Meter, and is also compatible with various Vaisala probes and transmitters.

You can use the MI70 indicator for the following tasks with HMD60:

- Measurement viewing and logging
- Calibration and 1-point adjustment (see Calibration and Adjustment with MI70 Handheld Indicator (page 43))
- Viewing information about the transmitter (serial number, SW version, last adjustment date)

To connect HMD60 to an MI70 indicator, you need the optional MI70 connection cable (Vaisala order code 219980SP).

6.1.1 MI70 Indicator Parts

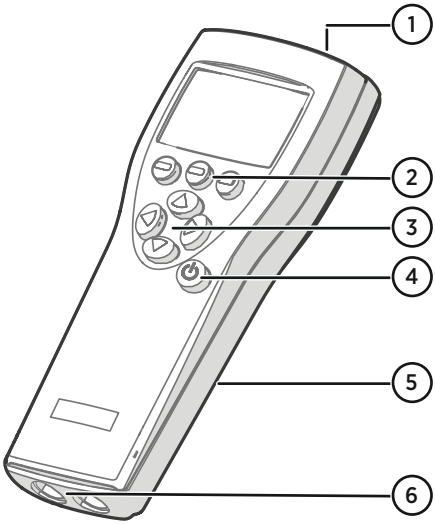


Figure 22 MI70 Indicator Parts

1 Charger socket
2 Function key shortcut buttons ⊖. The functions change according to what you are doing with the indicator.
3 Arrow buttons:
   - ▲ Move up in a menu
   - ▼ Move down in a menu
   - ▶ Enter a sub-menu
   - ◀ Return to previous menu level
4 Power On/Off button
5 Battery compartment at the back of the indicator
6 Two ports (labeled I and II) for connecting probes and instruments.

To open menus, press an arrow button and then press the shortcut buttons. To activate a function shown above the shortcut button, press the shortcut button. To navigate in the menus, press arrow buttons.

6.2 Connecting HMD60 to MI70 Indicator

- MI70 connection cable (Vaisala order code 219980SP).
- Medium size crosshead screwdriver for opening the lid screws.

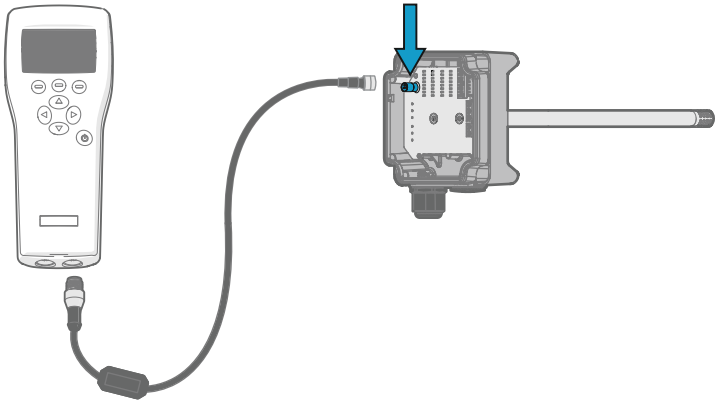


Figure 23 Connecting HMD60 to MI70 Indicator with Cable 219980SP

1. Open the 2 captive screws on the transmitter body and remove the lid.
2. If the MI70 indicator is on, turn it off.
3. Connect the MI70 connection cable 219980SP to HMD60 service port and either of the MI70 connector ports.
4. Turn on the MI70 indicator (time and date are requested at first startup). MI70 detects HMD60 and proceeds to show the measurement screen. MI70 will start to show valid measurement results from HMD60 after a few seconds.

6.3 Basic Display

1 Measured parameter and compensations (up to three items on display simultaneously). You can change the shown items in **Main menu > Display > Quantities and units**.
2 Battery indicator. Shows current status (charge) of the battery.
3 Function key **Graphic** shows the readings as a curve.
4 Function key **Hold/Save** freezes the display and you can save the reading in the MI70 memory.
5 Function key **Record** is a quick access to the **Recording/Viewing** menu.

Figure 24 MI70 Basic Display

You can change the default function key shortcuts (**Graphic**, **Hold/Save**, **Record**) to other menus or functions in **Main menu > Settings > User interface > Program shortcut keys**.

6.4 Graphical Display

The graphical display shows you the measurements as a curve (the curve of the uppermost quantity shown in the basic display). From the curve you can examine the data trend and history of the last minutes.

To open the graphical display, select **Graphic** in the basic display or select **Main menu > Display > Graphic history > Show**.

To get the statistical info on the graph area (minimum, maximum, and average values), press **Info**.

To get the curve of the other selected quantities, press **Next**. To get the curves of all the quantities, press **Next** until the text **All** appears, and then select **All**.

To zoom in and out, press the up/down arrow keys.

To move back and forward in the timeline, use the left/right arrow keys.

6.5 Main Menu

In the main menu, you can configure the MI70 settings and basic display options, view information about the probe, access recordings and clear the memory, set alarms, start adjustments, and use the analog output option of the MI70 indicator.

To open the main menu and navigate in the menus:

1. Go to the basic display.
2. Press any arrow key, then select ⊖ **Open** (must be pressed within 5 seconds or the indicator returns to the basic display).
3. Move in the menus using the ▲ ▼ buttons.
4. Select an item with the ▶ button.

5. To return to the previous level, press ◀.
6. To return to normal operation, press ⊖ **Exit**.

6.6 Holding and Saving the Display

With the **Hold/Save** function, you can freeze a certain display reading. This reading can be saved in the MI70 memory and it will be available even after MI70 is disconnected from the transmitter.

1. In the basic display, select **Hold/Save**. Alternatively, select **Main menu > Display > Hold/Save display > Hold**.
2. Press **Save**.
3. To view the saved display, go to basic display and select **Record > View recorded data**. Alternatively, select **Main menu > Recording/Viewing > View recorded data**.
   A list of saved displays and data recordings appears. The icons on the left of the date and time indicate whether the file is a saved display or a longer recording of data:
   
   Saved display
   
   Data recording
4. Select the saved display based on date and time by pressing the right arrow key.

6.7 Recording Data

With MI70, you can record transmitter measurement data over a certain period at chosen intervals. These recordings are saved in MI70 memory and are available even after MI70 is disconnected from the transmitter. To start recording, select the **Record** function key in the basic display, or navigate to the recording menu: **Main menu > Recording/Viewing > Record data**.

7. Calibration and Adjustment

7.1 Calibration and Adjustment Overview

You can calibrate or adjust the transmitter's measurement output using one of the following options:

- 1-point adjustment with the RH and T trimmers on the HMD60 component board (adjustment range: -5 %RH ... +5 %RH and -0.3 °C ... +0.3 °C (-0.54 °F ... +0.54 °F).
- 1-point or 2-point adjustment by connecting the transmitter to Vaisala Insight PC software (requires USB cable 219690).
- 1-point adjustment by connecting the transmitter to an MI70 handheld indicator (requires MI70 connection cable 219980SP).

7.2 Calibration and Adjustment Using Trimmers

HMD60 transmitters have 2 separate trimmers for RH and T measurement output adjustment mounted on the component board. The trimmers allow for easy 1-point adjustment of the measurement output against a reference with a known value.

The transmitters are shipped with the trimmers centered. Turning the trimmer counter-clockwise decreases the measurement output value, and turning clockwise increases the value. Figure 25 (page 37) shows the trimmer adjustment ranges for RH and T (-5 %RH ... +5 %RH and -0.3 °C ... +0.3 °C (-0.54 °F ... +0.54 °F).

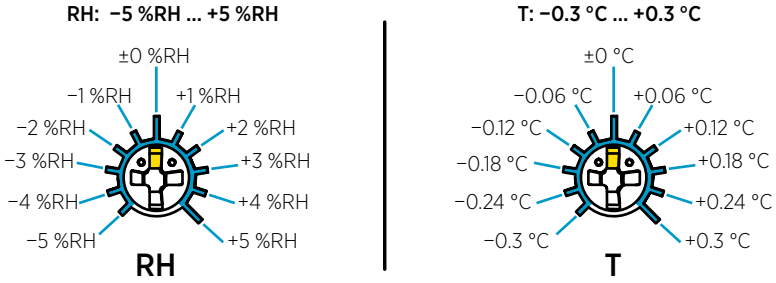


Figure 25 RH and T Adjustment Trimmer Ranges (Indicative)

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

CAUTION! If you use the Insight PC software to adjust the measurement or to restore the factory settings, always return the physical trimmer to the middle position before starting. When you make an adjustment with Insight, the position in which the trimmer is at that point is set as the ±0 point.

7.2.1 1-Point Adjustment Using Trimmers and Reference Calibrator

- Reference environment(s) for producing the desired humidity and/or temperature (for example, Vaisala HMK15 Humidity Calibrator).
- A multimeter for checking the analog output reading (connect in series to measure the current output).
- Small Phillips head screwdriver for turning the trimmers.

To adjust the output:

1. Prepare the reference (for example, a humidity calibrator). Use a reference that matches your normal measurement environment as closely as possible.
2. Connect the multimeter to the analog output (connect in series to measure the current output).
3. Insert the probe head in the reference environment.
4. Wait for the reference measurement to stabilize fully. This may take more than 30 minutes. Monitor the readings to see when the measurement has stabilized.
5. When the measurement has stabilized, adjust the output with the trimmers until it matches the known value of the reference.

Note that there is a small delay before the output value updates after you turn the trimmer.

7.2.2 Adjusting Output Using Trimmers and Reference Transmitter (1-point adjustment)

- A recently calibrated reference device (for example, a second HMD60 transmitter).
- A multimeter for checking the analog output reading (connect in series to measure the current output).
- Small Phillips head screwdriver for turning the trimmers.

It is assumed that a hole was drilled for the reference instrument during installation, the transmitter is powered, and you can view the measurement output value.

To adjust the output:

1. Insert the reference transmitter into the measurement environment next to the transmitter that you are adjusting. The reference transmitter should be inserted approximately 30 cm (12 in) from the HMD60 probe's installation hole, towards the direction of the air flow. See Figure 9 (page 17).
2. Connect a multimeter to the analog output of the reference transmitter (connect in series to measure the current output).
3. Wait for the measurement to stabilize fully. This may take more than 30 minutes. Monitor the readings to see when the measurement has stabilized.
4. When the measurement has stabilized, adjust the output of your transmitter with the trimmers until it matches the output of the reference transmitter.

   Note that there is a small delay before the output value updates after turning the trimmer.

5. When done, plug the installation hole of the reference transmitter.

7.2.3 Resetting Trimmers Back to Zero

- Computer with Windows operating system and Vaisala Insight software installed
- Vaisala USB cable 219690 for connecting the probe
- Small Phillips head screwdriver for turning the trimmer(s)

If you need to reset a trimmer back to zero (±0 point), use the Insight PC software to restore factory adjustments for the parameter the trimmer adjusts (RH or T).

1. Turn the trimmer(s) back to the middle position (±0 point)
2. Connect the transmitter to Insight. See Connecting to Insight software (page 21).
3. Select **> Calibrate > Yes** to switch the probe to calibration mode.
4. Select the parameter you want to reset (**RH adjustment** or **T adjustment**).
5. Select **Restore factory adjustment** and confirm by selecting **Yes**.
6. Reset each parameter (RH or T) separately as needed with the trimmer turned back to the middle position (±0 point). The trimmer adjustment now starts from the ±0 point of the default trimmer adjustment range (see Calibration and Adjustment Using Trimmers (page 37)).

7.3 Calibration and Adjustment with Insight PC Software

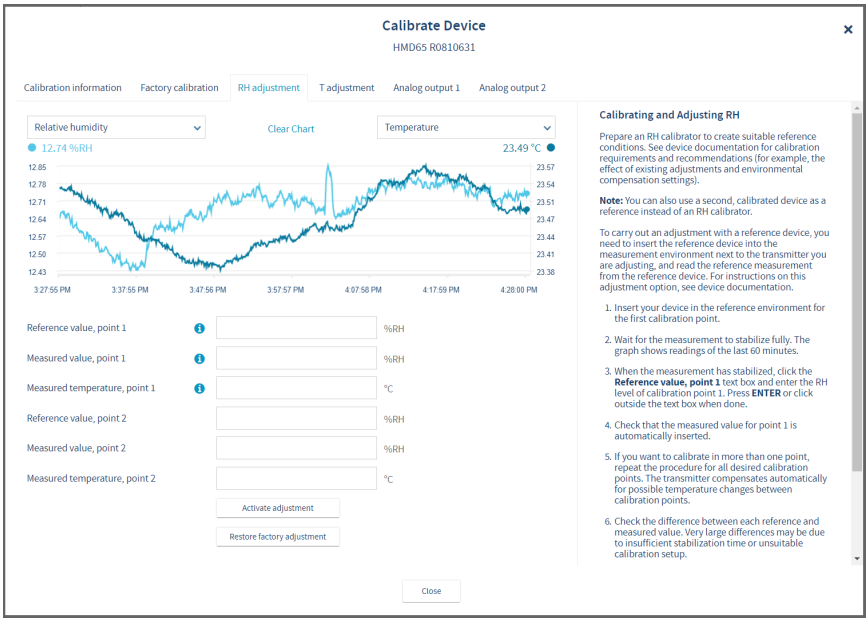


Figure 26 Insight Calibration View

You can use the Insight PC software to calibrate and adjust the RH or T measurement in 1 or 2 points. Either a reference environment (such as a humidity calibrator) or a reference instrument (for example, a second HMD60 transmitter) can be used when adjusting.

CAUTION! When you use the Insight PC software to adjust the measurement or to restore the factory settings, always return the physical adjustment trimmer(s) on the transmitter component board to the middle position before starting. When you make an adjustment with Insight, the position in which the adjustment trimmer is at that point is set as the ±0 point.

More information

- Connecting to Insight software (page 21)

7.3.1 2-Point Adjustment with Insight and Reference Calibrator

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

This procedure can be used to adjust the humidity (RH) or temperature (T) measurement of the transmitter. If you want to adjust both RH and T , repeat the procedure for each parameter.

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

1. Prepare the reference environment (for example, Vaisala HMK15 Humidity Calibrator).
2. Connect the transmitter to Insight. See Connecting to Insight software (page 21).
3. Select > **Calibrate > Yes** to switch the probe to calibration mode.
   In calibration mode, the device will not use functions that may interfere with calibration and adjustment.
4. Select the type of adjustment to perform: **RH adjustment** or **T adjustment**.
5. Define the needed adjustment for the first measurement point:
   a. Insert the probe head in the reference environment for the first calibration point.
   b. Wait for the measurement to stabilize fully.
   c. Click the **Reference value, point 1** text box and enter the reference value of the calibration point. Press **ENTER** or click outside the text box when done.
   d. Insight automatically enters the measured values for the calibration point.
6. Repeat step 5 for the second calibration point.
7. Select **Activate adjustment > Yes** to store the adjustment in the transmitter.
8. Check the message that appears at the top of the screen. If the message indicates that the adjustment is activated successfully, your adjustment is stored.
9. Select the **Calibration information** tab and update the **Calibration date** and **Calibration text**.
10. Select **Close > Yes** to exit the calibration mode.

7.3.2 1-Point Adjustment with Insight and Reference Transmitter

- Computer with Windows operating system and Vaisala Insight software installed
- Vaisala USB cable 219690 for connecting the probe
- A recently calibrated reference transmitter (for example, another HMD60 transmitter) and the required equipment for powering the reference device and viewing its measurements

This procedure can be used to adjust the humidity (RH) or temperature (T) measurement of the transmitter. If you want to adjust both RH and T , repeat the procedure for each parameter.

It is assumed that a hole was drilled for the reference instrument during installation, the reference instrument is powered, and you can view the measurement output value.

1. Insert the reference transmitter into the measurement environment next to the transmitter that you are adjusting. The reference transmitter should be inserted approximately 30 cm (12 in) from the HMD60 probe's installation hole, towards the direction of the air flow. See Figure 9 (page 17).
2. Monitor the measurement of the reference instrument and wait until the measurement has stabilized fully.

   If you are using a second HMD60 transmitter as the reference device, you can connect both transmitters to Insight simultaneously and view the measurement of the reference device from Insight while making the adjustment.

3. Connect the transmitter you are adjusting to Insight. See Connecting to Insight software (page 21).
4. Select **> Calibrate > Yes** to switch the transmitter to calibration mode.
   In calibration mode, the transmitter will not use functions that may interfere with calibration and adjustment.
5. Select the type of adjustment to perform: **RH adjustment** or **T adjustment**.
6. Define the needed adjustment for the first measurement point:
   a. Read the measurement of the reference transmitter (make sure the measurement has stabilized fully).
   b. Click the **Reference value, point 1** text box and enter the reference value of the calibration point. Press **ENTER** or click outside the text box when done.
   c. Insight automatically enters the measured values for the calibration point.
7. Select **Activate adjustment > Yes** to store the adjustment in the transmitter.
8. Check the message that appears at the top of the screen. If the message indicates that the adjustment is activated successfully, your adjustment is stored.
9. Select the **Calibration information** tab and update the **Calibration date** and **Calibration text**.
10. Select **Close > Yes** to exit the calibration mode.
11. When done, plug the installation hole of the reference transmitter.

7.4 Calibration and Adjustment with MI70 Handheld Indicator

You can use the MI70 handheld indicator to make a 1-point adjustment to temperature (T) or relative humidity (RH). To connect the transmitter to MI70, you need the optional MI70 connection cable (Vaisala order code 219980SP). For instructions on connecting the transmitter to MI70 and general information about using MI70, see Overview of MI70 Support (page 33).

Before adjusting the measurement with MI70, turn the adjustment trimmer(s) on the transmitter component board back to the ±0 position. When you adjust the measurement with MI70, the position in which the trimmer is at that moment becomes the new ±0 point.

More information

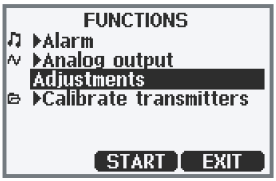
- Connecting HMD60 to MI70 Indicator (page 34)

7.4.1 1-Point Adjustment Using Reference Environment

- A humidity or temperature reference (for example, Vaisala HMK15 Humidity Calibrator) to create the reference condition used in the adjustment.
- MI70 handheld indicator and MI70 connection cable 219980SP

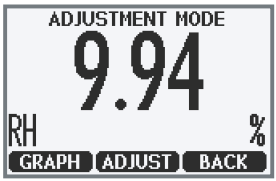
This example describes an RH adjustment with a humidity calibrator. The same steps can be applied to temperature calibration with a temperature reference.

1. Prepare the humidity reference for the adjustment point you are using (for example, 11 %RH).
2. Connect the transmitter to MI70 indicator with the MI70 connection cable 219980SP.
3. Turn on the MI70 indicator.
4. Insert the probe head into the reference environment.
5. Start the adjustment sequence from **Main menu > Functions > Adjustments**.

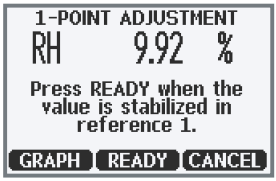


6. MI70 notifies you that automatic power off is disabled during adjustment mode, press **OK** to acknowledge.
7. Select the RH parameter when prompted.

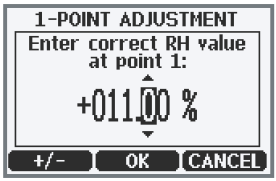
8. The adjustment mode is now active, and you can see the measured RH reading on the screen. To proceed with the adjustment, press **Adjust**.



9. Select **1-point adjustment**.
10. You are now in the 1-point adjustment screen. Wait until the measurement has stabilized fully in the reference environment, and then press **Ready**.



11. Enter the known value of the RH reference with the arrow buttons (for example, 11 %RH) and press **OK**.



12. You will be prompted if you really want to adjust. Select **Yes**.
13. If the adjustment is successful, MI70 will show the text **Adjustment Done**, after which you will return to the adjustment mode. At this point you can press **Back** and **Exit** to leave the adjustment mode. The adjustment is now completed. If the adjustment cannot be applied, MI70 will show the text **Cannot adjust**, possibly followed by a text stating the reason. A possible reason for an adjustment failure is attempting to apply a very large correction to the reading.

8. Maintenance

8.1 Cleaning

You can clean the transmitter and probe body by wiping with a moist cloth. Standard cleaning agents can be used.

CAUTION! Note that the transmitter body is powder coated. Do not use cleaning chemicals that can damage the coating.

When cleaning, follow these precautions:

- Do not immerse the transmitter or probe in liquid to clean it.
- Take care not to damage the PTFE membrane inside the metal grid filter (ASM212652SP) when cleaning. Do not use a pressure washer to clean the filter, and avoid pulling, tearing or puncturing the membrane.
- When changing the filter, you can use clean instrument air to gently blow any loose dirt and filter material from the sensor. Do not attempt to clean the optical surfaces in any other manner.

9. Technical Data

9.1 Specifications

Table 5 Relative Humidity Measurement Performance

Property	Specification
Humidity Sensor Options	
HUMICAP® R2	Latest generation industrial sensor with improved corrosion resistance
HUMICAP® 180V	Humidity sensor with a catalytic surface for processes with H_2O_2
Measurement range	0 ... 100 %RH
Stability	±0.5 %RH/year in typical HVAC applications
Accuracy at 0 ... +40 °C (+32 ... +104 °F) [1]	
0 ... 90 %RH	±1.5 %RH
90 ... 100 %RH	±2.5 %RH
Accuracy at +40 ... +80 °C (+104 ... +176 °F) and -40 ... 0 °C (-40 ... +32 °F) [1] [2]	
0 ... 90 %RH	±2.5 %RH
90 ... 100 %RH	±3.5 %RH
Factory calibration uncertainty	±1.0 %RH
Start-up and Response Time	
Start-up time at +20 °C (+68 °F)	8 s
Response time (T63) at +20 °C (+68 °F)	15 s
Calculated Humidity Parameters (Default Analog Output Scale)	
Dew point	-40 ... +80 °C (-40 ... +176 °F)
Dew point / frost point	-40 ... +80 °C (-40 ... +176 °F)
Absolute humidity	0 ... 300 g/m^3 (0 ... 131.1 gr/ft^3)
Wet bulb temperature	-40 ... +80 °C (-40 ... +176 °F)
Enthalpy	-40 ... 1600 kJ/kg (-9.5 ... 695.6 Btu/lb)
Mixing ratio	0 ... 600 g/kg (0 ... 4200 gr/lb)

1) Including non-linearity, hysteresis, and repeatability

2) With HUMICAP® 180V sensor, accuracy is not specified below -20 °C (-4 °F) operating temperature

Table 6 Temperature Measurement Performance

Property	Specification
Temperature sensor	Pt1000 RTD Class F 0.1 IEC 60751
Measurement range	-40 ... +80 °C (-40 ... +176 °F)
Default analog output scale	-20 ... +80 °C (-4 ... +176 °F)
Accuracy at +20 °C (+68 °F)	±0.1 °C (0.18 °F)
Temperature dependence	±0.005 °C/°C
Factory calibration uncertainty	±0.1 °C (0.18 °F)
Response time (T63) with free convection	8 min

Table 7 Analog Output Performance

Property	Specification
Accuracy at +20 °C (68 °F)	±5 mV
Temperature dependence	±0.2 mV/°C

Table 8 Operating Environment

Property	Specification
Operating temperature, electronics	-40 ... +60 °C (-40 ... +140 °F)
Operating temperature, probe	-40 ... +80 °C (-40 ... +176 °F)
Storage temperature range	-40 ... +80 °C (-40 ... +176 °F)
Maximum flow speed	50 m/s with sintered filter
Electromagnetic compatibility	EN61326-1, Industrial Environment

Table 9 Inputs and Outputs

Property	Specification
Power supply input	15 ... 35 VDC 16 ... 24 VAC
Power consumption	1.0 W (typical, for both AC and DC)
Analog output	1 × RH output 0 ... 10 V, 1 × T output 0 ... 10 V 3 (load resistance: 10 kΩ min.)

Property	Specification
Digital output (RS-485)	Isolated, supports Modbus RTU and BACnet MS/TP protocols
BACnet MS/TP	Address range: 0 ... 127 (master mode only)
Modbus RTU	Address range: 1 ... 247
Service port	M8 4-pin male connector: • MI70 handheld indicator (requires cable 219980SP) • Vaisala Insight PC software (requires USB cable 219690) 4
Screw terminal wire size	0.5 ... 2.5 mm^2

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

Table 10 Mechanical Specification

Property	Specification
Housing material	Cast aluminum
Probe material	Stainless steel
IP rating	IP66 (NEMA 4X)
Weight	511 g (18 oz)

9.2 Spare Parts and Accessories

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

Table 11 Spare Parts and Accessories

Spare Part / Accessory	Vaisala Order Code
USB cable for PC operation (Vaisala Insight software)	219690
Connection cable for HM70 (MI70) handheld meter	219980SP
Membrane filter	ASM212652SP
Sintered filter	HM46670SP
Sintered teflon filter	DRW244938SP

Spare Part / Accessory	Vaisala Order Code
Conduit fitting and O-ring (M16×1.5 / NPT1/2″)	210675SP
Cable Gland and O-ring (M16x1.5): default option delivered with HMD60	254280SP

9.3 Transmitter Dimensions

The dimensions are given in millimeters and [inches].

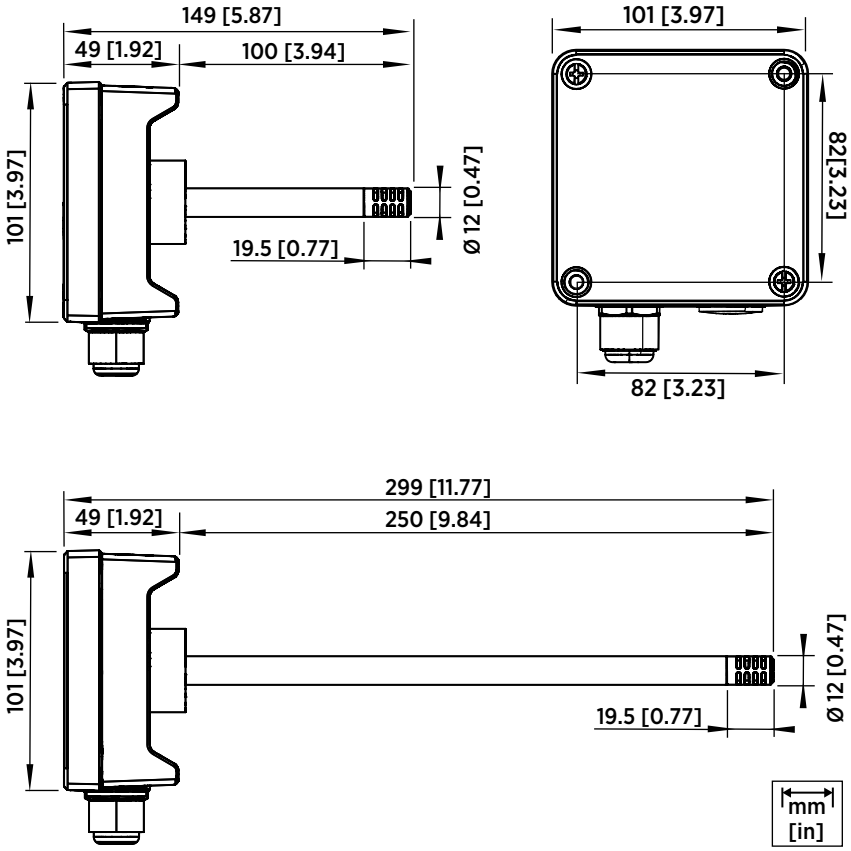


Figure 27 Dimensions with Long and Short Probe

Appendix A. Modbus Registers

The Modbus registers available for HMD65 include measurement output registers in metric and non-metric units, pressure compensation setpoint configuration, status registers, and communication test registers.

The Modbus communication settings are configured using the DIP switches on HMD65 component board: see Modbus and BACnet Overview (page 29).

CAUTION! Registers are numbered in decimal, starting from one. Register addresses in actual Modbus messages (Modbus Protocol Data Unit (PDU)) start from zero.
Please check the reference documentation of your Modbus host (PLC) for the notation of Modbus register addresses.

16-bit integers have a maximum value of +32767. Certain measurement parameters can exceed this value when x100 scaling is used (see measurement registers 0100_{hex} ... 0107_{hex} and 0180_{hex} ... 0187_{hex}). Whenever possible, it is recommended to use 32-bit float values.

A.1 Measurement Data Registers

Table 12 Modbus Measurement Data Registers (Read-Only)

Register Number (Decimal)	Address (Hexadecimal)	Register Description	Data Format	Unit
Floating Point Values (Metric)				
1	0000_{hex}	Relative humidity	32-bit float	%RH
	0001_{hex}			
3	0002_{hex}	Temperature	32-bit float	°C
	0003_{hex}			
5	0004_{hex}	Dew point temperature	32-bit float	°C
	0005_{hex}			
7	0006_{hex}	Dew/frost point temperature	32-bit float	°C
	0007_{hex}			

Register Number (Decimal)	Address (Hexadecimal)	Register Description	Data Format	Unit
Floating Point Values (Metric)				
9	0008_{hex}	Absolute humidity	32-bit float	g/m^3
	0009_{hex}			
11	$000A_{hex}$	Mixing ratio	32-bit float	g/kg
	$000B_{hex}$			
13	$000C_{hex}$	Wet-bulb temperature	32-bit float	°C
	$000D_{hex}$			
15	$000E_{hex}$	Enthalpy	32-bit float	kJ/kg
	$000F_{hex}$			
Floating Point Values (Non-metric)				
129	0080_{hex}	Relative humidity	32-bit float	%RH
	0081_{hex}			
131	0082_{hex}	Temperature	32-bit float	°F
	0083_{hex}			
133	0084_{hex}	Dew point temperature	32-bit float	°F
	0085_{hex}			
135	0086_{hex}	Dew/frost point temperature	32-bit float	°F
	0087_{hex}			
137	0088_{hex}	Absolute humidity	32-bit float	gr/ft^3
	0089_{hex}			
139	$008A_{hex}$	Mixing ratio	32-bit float	gr/lb
	$008B_{hex}$			
141	$008C_{hex}$	Wet-bulb temperature	32-bit float	°F
	$008D_{hex}$			
143	$008E_{hex}$	Enthalpy	32-bit float	Btu/lb
	$008F_{hex}$			

Integer Values (x100, Metric) [1)]				
257	0100_{hex}	Relative humidity	16-bit signed integer	%RH
258	0101_{hex}	Temperature	16-bit signed integer	°C
259	0102_{hex}	Dew point temperature	16-bit signed integer	°C
260	0103_{hex}	Dew/frost point temperature	16-bit signed integer	°C
261	0104_{hex}	Absolute humidity	16-bit signed integer	g/m^3
262	0105_{hex}	Mixing ratio	16-bit signed integer	g/kg
263	0106_{hex}	Wet-bulb temperature	16-bit signed integer	°C
264	0107_{hex}	Enthalpy	16-bit signed integer	kJ/kg
Integer Values (x100, Non-metric) [1)]				
385	0180_{hex}	Relative humidity	16-bit signed integer	%RH
386	0181_{hex}	Temperature	16-bit signed integer	°F
387	0182_{hex}	Dew point temperature	16-bit signed integer	°F
388	0183_{hex}	Dew/frost point temperature	16-bit signed integer	°F
389	0184_{hex}	Absolute humidity	16-bit signed integer	gr/ft^3
390	0185_{hex}	Mixing ratio	16-bit signed integer	gr/lb
391	0186_{hex}	Wet-bulb temperature	16-bit signed integer	°F

Integer Values (x100, Non-metric) [1]				
392	0187_{hex}	Enthalpy	16-bit signed integer	Btu/lb

1) *NOTE: 16-bit integers have a maximum value of +32767. Certain measurement parameters (for example, mixing ratio and enthalpy) can exceed this value in x100 scaling. In such cases, the value of the parameter is cut off at +32767, and measurements above this value are not reported. Verify that the measurement ranges in your application are suitable for the 16-bit integer format with x100 scaling; whenever possible, it is recommended to use 32-bit float values.*

A.2 Status Registers

Table 13 Modbus Status Data Registers (Read-Only)

Register Number (Decimal)	Address (Hexadecimal)	Register Description	Data Format	Bitmask
513	0200_{hex}	Device status	16-bit signed integer	**0000_{hex}**: Status OK **0001_{hex}**: Critical error, maintenance needed. **0002_{hex}**: Error, device may recover automatically **0004_{hex}**: Warning **0008_{hex}**: Notification **0010_{hex}**: Calibration mode active
514	0201_{hex}	Error code	32-bit signed integer	0201_{hex} (status code low): see Table 14 (page 55)
	0202_{hex}			0202_{hex} (status code high): see Table 15 (page 55)
516	0203_{hex}	Security hash	32-bit signed integer	Security hash changes on any change to device settings/ adjustments.
	0204_{hex}			

Register Number (Decimal)	Address (Hexadecimal)	Register Description	Data Format	Bitmask
518	0205_{hex}	RH measurement status	16-bit signed integer	**0000_{hex}**: Status OK **0002_{hex}**: Reading is not reliable **0004_{hex}**: Under range **0008_{hex}**: Over range **0020_{hex}**: Value locked **0040_{hex}**: Calibration expired **0080_{hex}**: Sensor failure **0100_{hex}**: Measurement not ready
519	0206_{hex}	T measurement status	16-bit signed integer	

Table 14 Error Codes in Register 0201_{hex} (Status Code Low)

Bitmask	Error Message	Severity
0000_{hex}	Status OK	
0001_{hex}	T sensor measurement failure	Error
0004_{hex}	RH sensor measurement failure	Error
0008_{hex}	Reference capacitance failure	Error
0010_{hex}	Ambient temperature too high	Error
0040_{hex}	Device settings corrupted	Critical
0400_{hex}	Factory settings corrupted	Critical
8000_{hex}	Calibration has expired	Warning

Table 15 Error Codes in Register 0202_{hex} (Status Code High)

Bitmask	Error Message	Severity
0000_{hex}	Status OK	
0001_{hex}	Calibration is about to expire	Info

A.3 Configuration Registers

Table 16 Modbus Configuration Data Registers (Writable)

Register Number (Decimal)	Address (Hexadecimal)	Register Description	Data Format	Unit
769	0300_{hex}	Pressure compensation setpoint	32-bit float	Unit: hPA Range: 500 ... 5000
	0301_{hex}			

A.4 Communication Test Registers

Table 17 Modbus Communication Test Registers (Read-only)

Register Number (Decimal)	Address (Hexadecimal)	Register Description	Data Format	Unit
7937	$1F00_{hex}$	Signed integer communication test register	16-bit signed integer	Constant value: -123.45×100 ($CFC7_h$)
7938	$1F01_{hex}$	Floating point communication test register	32-bit float	Constant value: -123.45 ($C2F6\ E666_h$)
	$1F02_{hex}$			
7940	$1F03_{hex}$	Text string communication test register	8-byte string	Constant text: "-123.45" ($2D31\ 3233\ 2E34\ 3500_h$)
	$1F04_{hex}$			
	$1F05_{hex}$			
	$1F06_{hex}$			

Appendix B. BACnet Reference

This appendix describes the BACnet protocol implementation of the HMD65 relative humidity and temperature transmitter.

Implementation

The BACnet standard has many options for both physical and data link layers. HMD65 implements the following communication options:

- MS/TP Master

MS/TP Master

Master mode operation means that the HMD65 transmitter is part of a token passing loop. Master can send messages to the MS/TP bus when it has received a token. According to BACnet standard, the master address must be in the range 0 ... 127. For correct operation, Master mode also requires that the parameter MAX_MASTER is set. It must be same in every master node connected to the same bus segment. MAX_MASTER defines highest MAC address used by master nodes. For instructions on configuring the MAX_MASTER parameter with Vaisala Insight PC software, see Configuring BACnet with Insight (page 31).

Master functionality enables automatic network setup. The client can send inquiries such as “who has property XYZ” or “who is device number 12345”. The device replies to inquiries when it is available to talk. When the master mode device has no token it behaves as a slave, that is, it replies to requests.

MAC Address

The MS/TP address for MS/TP master is 0 ... 127. The address is selected by DIP switches: see Modbus and BACnet Overview (page 29).

Communication Parameters

The fixed serial line parameters are: No parity, 8 Databits and 1 Stop bit.

The communication speed is selected by DIP switches. The supported communication speeds are 9600, 19200, 38400, 57600, 76800 and 115200.

If DIP switches are set to select 4800 bps, 38400 is used instead. 4800 bps is not a supported BACnet baud rate.

Physical Interface

The physical interface for using HMD65 through BACnet is galvanic isolated RS-485. There are weak pull-up and pull-down resistors (100k) from data lines to +3.3VDC and GND. A termination resistor (120 ohm) can be connected between data lines with a DIP switch on the HMD65 component board. Three screw terminals are needed: D+ (485+), D- (485-) and GND (RS485_GND). For DIP switch and screw terminal locations, see Figure 18 (page 29).

Configuration

There are several settable parameters for BACnet communication. Some parameters must be set correct before device is connected to the BACnet network. The initial BACnet configuration of the device is selected when ordering the device, and can be configured using Vaisala Insight PC software, DIP switches, or BACnet protocol. Table 18 (page 58) lists the configuration options.

Table 18 BACnet Configuration Options

Parameter	DIP switches	Vaisala Insight PC Software	BACnet
MAC address	✓		
Baud Rate	✓		
Max_Master		✓	✓
Device object: Object Identifier		✓	✓
Device object: Object Name		✓	✓
Device object: Location		✓	✓
Device object: Description		✓	✓
Reinitialize password		✓	

Protocol Services

Services are implemented according to BACnet standard. When there are options or the standard is open for interpretations, HMD65 implementation is explained here.

Table 19 Protocol Services Implementation Notes

Protocol Service	Implementation Note
Write Property	Reply delay is approximately 225 ms and writing to non-volatile memory may take time close to that.
Device Communication Control	Limited functionality. Due to inaccurate internal clock, does not support Device communication control with finite duration.
Unconfirmed COV Notification	Latest_sent_value is initialized on startup. If difference between the sampled Present_Value and latest_sent_value is larger than COV_INCREMENT, then COVU is sent and latest_sent_value set to the sampled value.

Data Persistence

Persistence of writable parameter values in BACnet devices is largely a local matter. Nonvolatile parameters are saved in device Flash memory. Volatile parameters are always initialized to some default value at startup. This is defined in each property definition in this appendix. Saving takes effect during the Write Property function.

Table 20 Data Persistence Classes

Storage Class	Meaning
Nonvolatile	Value stored in Flash data area
Volatile	Value stored in RAM, initial value in Flash
Fixed	Value stored in Flash code area

Additions to BACnet Standard

The BACnet standard allows vendor-specific additions. The following additions are specified for HMD65.

Table 21 BACnetEngineeringUnits

Name	Enumeration
grains-per-cubic-foot	2000
grains-of-water-per-pound	2001

B.1 BACnet Protocol Implementation Conformance Statement

This statement is a part of the BACnet standard and is required for its use.

Vendor name:	Vaisala Oyj
Product Name:	HMD60 Series
Product Model Numbers:	HMD60, HMD65
Application Software Version:	2.0.8 (or greater)
Firmware Version:	2 (Interface version)
BACnet Protocol Revision:	Version 1, Revision 15

BACnet Standardized Device Profile (Annex L):	☐ BACnet Operator Workstation (B-OWS) ☐ BACnet Building Controller (B-BC) ☐ BACnet Advanced Application Controller (B-AAC) ☑ BACnet Application Specific Controller (B-ASC) ☐ BACnet Smart Sensor (B-SS) ☐ BACnet Smart Actuator (B-SA)
List of all BACnet Interoperability Building Blocks Supported (Annex K): See also: BIBBs Supported (page 72)	DS-RP-B, DS-RPM-B, DS-WP-B, DS-COVU-B, DM-DDB-B, DM-DOB-B, DM-DCC-B, DM-RD-B
Segmentation Capability:	☐ Segmentation Requests Supported ☐ Segmentation Responses Supported No segmentation.
Standard Object Types Supported	☑ Analog Input ☐ Analog Output ☑ Analog Value ☐ Averaging ☐ Binary Input ☐ Binary Output ☐ Binary Value ☐ Calendar ☐ Command ☑ Device ☐ Event Enrollment ☐ File ☐ Group ☐ Life Safety Point ☐ Life Safety Zone ☐ Loop ☐ Multistate Input ☐ Multistate Output ☐ Multistate Value ☐ Notification Class ☐ Program ☐ Schedule ☐ Trend Log

Data Link Layer Options	☐ BACnet Internet Protocol (IP) (Annex J) ☐ BACnet IP (Annex J), Foreign Device ☐ ISO 88023, Ethernet (Clause 7) ☐ ANSI/ATA 878.1, 2.5 MB ARCNET® network (Clause 8) ☐ ANSI/ATA 878.1, RS485 ARCNET network (Clause 8), baud rates: _____ ☑ Master-Slave/Token-Passing (MS/TP) master (Clause 9), baud rates: 9600, 19200, 38400, 57600, 76800, 115200 ☐ MS/TP slave (Clause 9), baud rates: _____ ☐ Point-To-Point, EIA 232 (Clause 10), baud rates: _____ ☐ Point-To-Point, modem (Clause 10), baud rates: _____ ☐ LonTalk® protocol (Clause 11), medium: _____ ☐ Other: _____
Device Address Binding:	Is static device binding supported? (required for two-way communication between MS/TP slaves and other devices) ☐ Yes ☑ No
Networking Options	☐ Router, Clause 6: _____ ☐ Annex H, BACnet Tunneling Router over IP ☐ BACnet/IP Broadcast Management Device (BBMD)
	Does the BBMD support registrations by Foreign Devices? ☐ Yes ☐ No

Character Sets Supported:	Indicating support for multiple character sets does not imply that they can all be supported simultaneously. ☑ UTF-8 / ANSI X3.4 ☐ IBM®/Microsoft® DoubleByte Character Set (DBCS) ☐ ISO 8859-1 ☐ ISO 10646 Universal Character Set-2 (UCS2) ☐ ISO 10646 (UCS-4) ☐ Japanese Industrial Standard (JIS) C 6226
Types of non-BACnet equipment /network(s) supported:	None

B.2 Device Object

Table 22 Device Object Properties

Property	Data Type (Application Datatype)	Writable (Conformance Code)	Value or Initial Value	Persistence
Object_Identifier	BACnetObjectIdentifier	Y (R)	02 00 00 00 (hex) Object Type = 8, Instance = xxxxxxx	Nonvolatile
Object_Name	CharacterString[40]	Y (R)	"HMD65_Yxxxxxx"	Nonvolatile
Object_Type	BACnetObjectType (ENUMERATED)	N (R)	8 (Device Object)	Fixed
System_Status	BACnetDeviceStatus (ENUMERATED)	N (R)	0 (Operational)	Volatile
Vendor_Name	Character String	N (R)	"Vaisala"	Fixed
Vendor_Identifier	Unsigned16	N (R)	339	Fixed
Model_Name	CharacterString	N (R)	"HMD65"	Nonvolatile
Firmware_Revision	CharacterString	N (R)	X (BACnet interface)	Fixed
Application_Software_Version	CharacterString	N (R)	X.X.X	Fixed
Location	Character String[40]	Y (O)	"Location"	Nonvolatile

Property	Data Type (Application Datatype)	Writable (Conformance Code)	Value or Initial Value	Persistence
Description	Character String[24]	Y (O)	“Description”	Nonvolatile
Protocol_Version	Unsigned	N (R)	1	Fixed
Protocol_Revision	Unsigned	N (R)	15	Fixed
Protocol_Services	BACnetProtocolServices Supported (BIT STRING)	N (R)	Read Property Read Property Multiple Write Property Device Communication Control Reinitialize Device Who-Is Who-Has	Fixed
Protocol_Object_Types_Supported	BACnetObjectTypesSupported (BIT STRING)	N (R)	Analog Input Analog Value Device	Fixed
Object_List	BACnetARRAY[N]of BACnetObjectIdentifier	N (R)	Device Object **AI1** (Relative Humidity) **AI2** (Temperature) **AI3** (Dewpoint / Td) **AI4** (Dewpoint / Tdf) **AI5** (Wet bulb temperature / Tw) **AI6** (Absolute humidity / A) **AI7** (Mixing ratio / X) **AI8** (Enthalpy / H) **AV1** (Pressure)	Fixed
Max_APDU_Length_Accepted	Unsigned16	N (R)	480	Fixed
Max_Master	Unsigned16 (0 ... 127)	Y (R/O)	127	Nonvolatile

Property	Data Type (Application Datatype)	Writable (Conformance Code)	Value or Initial Value	Persistence
Max_Info_Frames	Unsigned	N (R/O)	1	Fixed
Segmentation_Supported	BACnetSegmentation (ENUMERATED)	N (R)	3 (No segmentation)	Fixed
APDU_Timeout	Unsigned	N (R)	3000 (ms)	Fixed
APDU_Retries	Unsigned	N (R)	3	Fixed
Device_Address_Binding	List of BACnetAddressBinding	N (R)	NULL	Fixed
Database_Revision	Unsigned	N (R)	0	Volatile

Object_Identifier

Must be unique in BACnet network. As Object_Identifier is 22 bits long, it has a value range of 0 ... 4194303. Each device is assigned a random value in this range at Vaisala factory.

Object_Name

Must be unique in BACnet network. Default object name contains the name and serial number of the device. For example:

- Device model is HMD65, with serial number G1234567
- Object_Name is "HMD65_G1234567"

System_Status

System status can be OPERATIONAL (0) or NON-OPERATIONAL (4). Device goes to NON-OPERATIONAL state in case of fatal error.

Protocol_Services

Reinitialize Device and Device Communication Control services must be password protected. According to BACnet protocol, password is a character string of max. 20 characters. The default password is "1234". The password can be changed using Vaisala Insight PC software: for instructions, see Configuring BACnet with Insight (page 31).

Database_Revision

This is changed during operation according to standard 12.11.35 (EN ISO 17848-5).

B.3 Relative Humidity Object

Table 23 Relative Humidity Object Properties

Property	Data Type (Application Datatype)	Writable (Conformance Code)	Value or Initial Value	Persistence
Object_Identifier	BACnetObjectIdentifier	No (R)	00 00 00 01 (hex) Object Type = 0, Instance = 1	Fixed
Object_Name	CharacterString	No (R)	"RH"	Fixed
Object_Type	BACnetObjectType (ENUMERATED)	No (R)	0 (Analog Input)	Fixed
Present_Value	Real	Yes (When Oos) (R)	0.0	Volatile
Description	CharacterString	No (O)	"Relative Humidity"	Fixed
Units	BACnetEngineeringUnits (ENUMERATED)	No (R)	29 (percent-relative-humidity)	Nonvolatile
Status_Flags	BACnet Status Flags (BIT STRING)	No (R)	0 (FAULT == FALSE)	Volatile
Reliability	BACnet Reliability (ENUMERATED)	Yes (when OoS) (O)	0 (NO FAULT DETECTED)	Volatile
Event State	BACnetEventState (ENUMERATED)	No (R)	0 (NORMAL)	Volatile
Out_of_Service	BOOLEAN	Yes (R)	0 (FALSE)	Volatile
COV_Increment	Real	Yes (O)	NaN (COV reporting disabled)	Nonvolatile
Min_Pres_Value	Real	No (O)	0.0 (same as limit for Minimum RH error limit: see Configuring Minimum and Maximum RH and T Errors with Insight (page 25))	Fixed

Property	Data Type (Application Datatype)	Writable (Conformance Code)	Value or Initial Value	Persistence
Max_Pres_Value	Real	No (O)	100.0 (same as limit for Maximum RH error limit: see Configuring Minimum and Maximum RH and T Errors with Insight (page 25))	Fixed

Table 24 Status Flags

Flag	State	Cause
IN_ALARM	FALSE	Event State equals 0 (NORMAL)
	TRUE	Event State not 0
FAULT	FALSE	Reliability equals 0 (NO FAULT DETECTED)
	TRUE	Reliability not 0
OVERRIDDEN	FALSE	Always FALSE
OUT_OF_SERVICE	FALSE	Present Value may NOT be written via BACnet
	TRUE	Present Value may be written via BACnet

Table 25 Reliability

STATE	CAUSE
0 NO_FAULT_DETECTED	
1 NO_SENSOR	Sensor failure detected.
2 OVER_RANGE	RH over Max_Pres_Value
3 UNDER_RANGE	RH under Min_Pres_Value
7 UNRELIABLE_OTHER	Other measurement error

Table 26 Event State

STATE	CAUSE
0 NORMAL	Reliability equals 0 (NO FAULT DETECTED)

STATE	CAUSE
1 FAULT	Reliability not 0

Out of Service

Out of Service value is writeable. By Default = FALSE.

B.4 Temperature Object

Table 27 Relative Humidity Object Properties

Property	Data Type (Application Datatype)	Writable (Conformance Code)	Value or Initial Value	Persistence
Object_Identifier	BACnetObjectIdentifier	Y (R)	00 00 00 02 (hex) Object Type = 0, Instance = 2	Fixed
Object_Name	CharacterString	No (R)	"T"	Fixed
Object_Type	BACnetObjectType (ENUMERATED)	No (R)	0 (Analog Input)	Fixed
Present_Value	Real	Yes (When Oos) (R)	0.0	Volatile
Description	CharacterString	No (O)	"Temperature"	Fixed
Units	BACnetEngineeringUnits (ENUMERATED)	Yes (R)	62 (degrees-Celsius)	Nonvolatile
Status_Flags	BACnet Status Flags (BIT STRING)	No (R)	0 (FAULT == FALSE)	Volatile
Reliability	BACnet Reliability (ENUMERATED)	Yes (when OoS) (O)	0 (NO FAULT DETECTED)	Volatile
Event State	BACnetEventState (ENUMERATED)	No (R)	0 (NORMAL)	Volatile
Out_of_Service	BOOLEAN	Yes (R)	0 (FALSE)	Volatile
COV_Increment	Real	Yes (O)	NaN (COV reporting disabled)	Nonvolatile

Property	Data Type (Application Datatype)	Writable (Conformance Code)	Value or Initial Value	Persistence
Min_Pres_Value	Real	No (O)	-40.0 (same as limit for Minimum T error limit: see Configuring Minimum and Maximum RH and T Errors with Insight (page 25))	Fixed
Max_Pres_Value	Real	No (O)	+80.0 (same as limit for Maximum T error limit: see Configuring Minimum and Maximum RH and T Errors with Insight (page 25))	Fixed

Table 28 Status Flags

Flag	State	Cause
IN_ALARM	FALSE	Event State equals 0 (NORMAL)
	TRUE	Event State not 0
FAULT	FALSE	Reliability equals 0 (NO FAULT DETECTED)
	TRUE	Reliability not 0
OVERRIDDEN	FALSE	Always FALSE
OUT_OF_SERVICE	FALSE	Present Value may NOT be written via BACnet
	TRUE	Present Value may be written via BACnet

Table 29 Reliability

STATE	CAUSE
0 NO_FAULT_DETECTED	
1 NO_SENSOR	Sensor failure detected.
2 OVER_RANGE	T over Max_Pres_Value
3 UNDER_RANGE	T under Min_Pres_Value

STATE	CAUSE
7 UNRELIABLE_OTHER	Other measurement error

Table 30 Event State

STATE	CAUSE
0 NORMAL	Reliability equals 0 (NO FAULT DETECTED)
1 FAULT	Reliability not 0

Units

Unit can be changed using BACnet. Possible units (Celsius or Fahrenheit) are C (62) or F (64).

Out of Service

Out of Service value is writable. By Default = FALSE.

B.5 Calculated Humidity Objects

Table 31 Calculated Humidity Object Instances

Instance	Name	Description	Unit
3	"Td"	"Dewpoint"	62/64 (ºC / ºF)
4	"Tdf"	"Dew/Frostpoint"	62/64 (ºC / ºF)
5	"Tw"	"Wet bulb temperature"	62/64 (ºC / ºF)
6	"a"	"Absolute humidity"	217/2000 grams-per-cubic-meter / grains-per-cubic-foot - Vaisala defined unit
7	"x"	Mixing ratio	28/2001 grams-of-water-per-kilogram-dry-air / grains-of-water-per-pound - Vaisala defined unit
8	"h"	Enthalpy	149/24 kilojoules-per-kilogram-dry-air / btus-per-pound-dry-air

Table 32 Calculated Humidity Object Properties

Property	Data Type (Application Datatype)	Writable (Conformance Code)	Value or Initial Value	Persistence
Object_Identifier	BACnetObjectIdentifier	No (R)	00 00 00 xx (hex) Object Type = 0, Instance = x (see Table 31 (page 69))	Fixed
Object_Name	CharacterString	No (R)	See Table 31 (page 69)	Fixed
Object_Type	BACnetObjectType (ENUMERATED)	No (R)	0 (Analog Input)	Fixed
Present_Value	Real	Yes (When Oos) (R)	0.0	Volatile
Description	CharacterString	No (O)	See Table 31 (page 69)	Fixed
Units	BACnetEngineeringUnits (ENUMERATED)	Yes (R)	See Table 31 (page 69)	Nonvolatile
Status_Flags	BACnet Status Flags (BIT STRING)	No (R)	0 (FAULT == FALSE)	Volatile
Reliability	BACnet Reliability (ENUMERATED)	Yes (when OoS) (O)	0 (NO FAULT DETECTED)	Volatile
Event State	BACnetEventState (ENUMERATED)	No (R)	0 (NORMAL)	Volatile
Out_of_Service	BOOLEAN	Yes (R)	0 (FALSE)	Volatile
COV_Increment	Real	Yes (O)	NaN (COV reporting disabled)	Nonvolatile

Table 33 Status Flags

Flag	State	Cause
IN_ALARM	FALSE	Event State equals 0 (NORMAL)
	TRUE	Event State not 0
FAULT	FALSE	Reliability equals 0 (NO FAULT DETECTED)
	TRUE	Reliability not 0

Flag	State	Cause
OVERRIDDEN	FALSE	Always FALSE
OUT_OF_SERVICE	FALSE	Present Value may NOT be written via BACnet
	TRUE	Present Value may be written via BACnet

Table 34 Reliability

STATE	CAUSE
0 NO_FAULT_DETECTED	
1 NO_SENSOR	Sensor failure detected.
2 OVER_RANGE	Not checked
3 UNDER_RANGE	Not checked
7 UNRELIABLE_OTHER	Other measurement error

Table 35 Event State

STATE	CAUSE
0 NORMAL	Reliability equals 0 (NO FAULT DETECTED)
1 FAULT	Reliability not 0

Out of Service

Out of Service value is writable. By Default = FALSE.

B.6 Operation Pressure Object

Table 36 Operation Pressure Object Properties

Property	Data Type	Writable	Value or Initial Value	Persistence
Object_Identifier	BACnetObjectIdentifier	No	00 80 00 01 (hex) Object Type = 2, Instance = 1	Fixed
Object_Name	Character String	No	"OPER P"	Fixed
Object_Type	BACnet Object Type	No	2 (Analog Value)	Fixed

Property	Data Type	Writable	Value or Initial Value	Persistence
Present_Value	Real	Yes	1013.25	Nonvolatile
Description	Character String	No	"Operation Pressure"	Fixed
Units	BACnet Engineering Units	No	133 (hectopascals)	Fixed
Status_Flags	BACnet Status Flags	No	0 (FAULT == FALSE)	Fixed
Event State	BACnet Event State	No	0 (NORMAL)	Fixed
Out_of_Service	BOOLEAN	No	0 (FALSE)	Fixed

Table 37 Status Flags

Flag	State	Cause
IN_ALARM	FALSE	Always FALSE
FAULT	FALSE	Always FALSE)
OVERRIDDEN	FALSE	Always FALSE
OUT_OF_SERVICE	FALSE	Always FALSE

Event State

Event State value is always NORMAL.

Out of Service

Out of Service value is not writable.

B.7 BIBBs Supported

Table 38 (page 72) lists all the BACnet Interoperability Building Blocks (BIBBs) that, per EN ISO 16484:5-2017 standard, could be supported by a BACnet Application Specific Controller (B-ASC). The checked BIBBs are supported by HMD65.

Table 38 BIBBs Supported

Function	Designation	Supported
Data Sharing - Read Property - A	DS-RP-A	☐
Data Sharing - Read Property - B	DS-RP-B	☑

Function	Designation	Supported
Data Sharing - Read Property Multiple - A	DS-RPM-A	☐
Data Sharing - Read Property Multiple - B	DS-RPM-B	☑
Data Sharing - Write Property - A	DS-WP-A	☐
Data Sharing - Write Property - B	DS-WP-B	☑
Data Sharing - Write Property Multiple - B	DS-WPM-B	☐
Data Sharing - COV - Unsolicited - A	DS-COVU-A	☐
Data Sharing - COV - Unsolicited - B	DS-COVU-B	☑
Alarm and Event - Notification Internal - B	AE-N-I-B	☐
Alarm and Event - ACK - B	AE-ACK-B	☐
Alarm and Event - Information - B	AE-INFO-B	☐
Alarm and Event - Enrollment Summary - B	AE-ESUM-B	☐
Scheduling - External - B	SCHED-E-B	☐
Trending - Viewing and Modifying Trends Internal - B	T-VMT-I-B	☐
Trending - Automated Trend Retrieval - B	T-ATR-B	☐
Device Management - Dynamic Device Binding - A	DM-DDB-A	☐
Device Management - Dynamic Device Binding - B	DM-DDB-B	☑
Device Management - Dynamic Object Binding - A	DM-DOB-A	☐
Device Management - Dynamic Object Binding - B	DM-DOB-B	☑
Device Management - Device Communication Control - B	DM-DCC-B	☑
Device Management - Time Synchronization - B	DM-TS-B	☐
Device Management - UTC Time Synchronization - B	DM-UTC-B	☐
Device Management - Reinitialize Device - B	DM-RD-B	☑
Device Management - Backup and Restore - B	DM-BR-B	☐
Network Management - Connection Establishment - A	NM-CE-A	☐

B.8 Application Services Supported

Table 39 (page 74) lists all the BACnet standard application services. The checked services are supported by HMD65.

Table 39 Application Services Supported

Application Service	Initiates Requests	Executes Requests
AcknowledgeAlarm	☐	☐
AddListElement	☐	☐
AtomicReadFile	☐	☐
AtomicWriteFile	☐	☐
ConfirmedCOVNotification	☐	☐
ConfirmedEventNotification	☐	☐
ConfirmedPrivateTransfer	☐	☐
ConfirmedTextMessage	☐	☐
CreateObject	☐	☐
DeleteObject	☐	☐
DeviceCommunicationControl	☐	☑
Disconnect-Connection-To-Network	☐	☐
Establish-Connection-To-Network	☐	☐
GetAlarmSummary	☐	☐
GetEnrollmentSummary	☐	☐
GetEventInformation	☐	☐
I-Am	☑	☐
I-Am-Router-To-Network	☐	☐
I-Could-Be-Router-To-Network	☐	☐
I-Have	☑	☐
Initialize-Routing-Table	☐	☐
Initialize-Routing-Table-Ack	☐	☐
LifeSafetyOperation	☐	☐
ReadProperty	☐	☑
ReadPropertyConditional	☐	☐
ReadPropertyMultiple	☐	☑
ReadRange	☐	☐
ReinitializeDevice	☐	☑
RemoveListElement	☐	☐
SubscribeCOV	☐	☐

Application Service	Initiates Requests	Executes Requests
SubscribeCOVProperty	☐	☐
TimeSynchronization	☐	☐
UnconfirmedCOVNotification	☑	☐
UnconfirmedEventNotification	☐	☐
UnconfirmedPrivateTransfer	☐	☐
UnconfirmedTextMessage	☐	☐
UTCTimeSynchronization	☐	☐
VT-Close	☐	☐
VT-Data	☐	☐
VT-Open	☐	☐
Who-Has	☐	☑
Who-Is	☐	☑
Who-Is-Router-To-Network	☐	☐
WriteProperty	☐	☑
WritePropertyMultiple	☐	☐

Warranty

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

Technical support

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

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

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

Recycling

Recycle all applicable material.

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

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