User Guide

Vaisala Indigo compatible
dew point and temperature probes

DMP5, DMP6, DMP7, DMP8

VAISALA

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1. About this document

1.1 Version information

This document provides instructions for installing, using, and maintaining Vaisala DRYCAP®
Dew Point and Temperature Probes DMP5, DMP6, DMP7, and DMP8.

Table 1   Document versions (English)

Document code	Date	Description
M212357EN-A	June 2020	First version.

1.2 Related manuals

Table 2   Related manuals

Document code	Name
M212356EN	*DMP5, DMP6, DMP7, and DMP8 Quick Guide*

1.3 Documentation conventions

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

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

Note highlights important information on using the product.

Tip gives information for using the product more efficiently.

Lists tools needed to perform the task.

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

1.4 Trademarks

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

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

2. **Product overview**

DMP series probes are dew point and temperature measurement probes with a digital output (Modbus protocol). The probes are designed for demanding dew point measurement applications. The probes have a two-part structure, with measurement electronics contained in the probe body and sensor(s) in the probe head. The probe body and the probe head are connected by a cable. Length options for this connecting cable depend on the probe model.

The probes are compatible with Vaisala Indigo transmitters. They can also be connected to Vaisala Insight software for configuration, calibration, diagnostics, and temporary online monitoring.

2.1 Probe structure
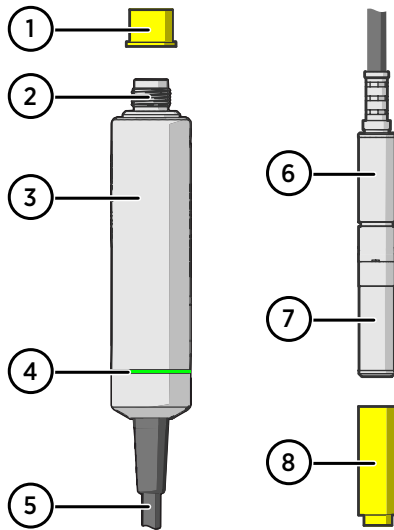
Figure 1   Probe parts

1   Protection cap (remove before use)
2   5-pin M12 connector
3   Probe body with type label
4   Status indicator:

Green	Power on and probe online, flashes when communicating
Red	Error
Off	Power off or indicator disabled

5   Probe cable (do not cut)
6   Probe head (DMP7 model shown)
7   Location of sensors on the probe head. DMP series probes have a removable filter over the sensors that can be replaced if it gets dirty or damaged.
8   Protection cap (remove before use)

2.2 Basic features and options

- Comprehensive list of output parameters. For example: relative humidity, temperature, dew point temperature, wet-bulb temperature, absolute humidity, mixing ratio, water vapor pressure, enthalpy. See Output parameters (page 8).
- Sensor purge provides superior chemical resistance
- Sensor warming function minimizes condensation on sensor
- Traceable calibration certificate
- Standalone Modbus RTU over RS-485
- Compatible with Indigo series of transmitters

• Can be connected to Vaisala Insight PC software for configuration, calibration, diagnostics, and temporary online monitoring

2.3 Output parameters

> ℹ️ Values of all available output parameters are locked (showing the latest valid value) when chemical purge, autocalibration, or extra heating functions are active.

●   Output parameter is available
◑   Output parameter is unavailable during sensor warming unless temperature is written to register 0334_{hex} from an external source
−   Output parameter is not available on this model

Table 3   Availability of output parameters

Output parameter	Output unit	DMP5	DMP6	DMP7	DMP8
Relative humidity	%RH	◑	−	◑	◑
Temperature	°C	◑	−	◑	◑
Dew point temperature	°C	●	●	●	●
Dew/frost point temperature	°C	●	●	●	●
Dew/frost point temperature at 1 atm	°C	●	●	●	●
Dew point temperature at 1 atm	°C	●	●	●	●
Absolute humidity	g/m^3	◑	−	◑	◑
Mixing ratio	g/kg	●	●	●	●
Water concentration	ppm_v	●	●	●	●
Water vapor pressure	hPa	●	●	●	●
Water vapor saturation pressure	hPa	◑	−	◑	◑
Enthalpy	kJ/kg	◑	−	◑	◑
Dew point temperature difference	°C	◑	−	◑	◑
Absolute humidity at NTP	g/m^3	◑	−	◑	◑
Water mass fraction	ppm_w	●	●	●	●

2.4 Additional features with Indigo transmitters

Connecting the probe to an Indigo transmitter provides a wide range of additional options for outputs, measurement viewing, status monitoring, and configuration interface access.

Examples of additional features available with Indigo 500 series transmitters:

- Touchscreen display for real-time data viewing and configuration
- Support for 2 probes simultaneously
- 4 configurable analog outputs
- 2 configurable relays
- Ethernet connection with web interface for remote access
- Modbus TCP/IP protocol

Examples of additional features available with Indigo 200 series transmitters:

- 3.5" TFT LCD color display or non-display model with LED indicator
- Digital output or 3 analog outputs (depending on the transmitter model)
- 2 configurable relays
- Wireless browser-based configuration interface for mobile devices and computers (IEEE 802.11 b/g/n WLAN)

> ℹ️ Available features vary depending on the Indigo transmitter model. For more information on Indigo transmitters, see www.vaisala.com/indigo.

2.5 Safety

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

> ⚠️ **CAUTION!** Do not attempt to open the probe body. There are no user serviceable parts inside the probe body.

> ⚠️ **CAUTION!** Do not touch the probe head with your bare hands. Touching will deposit impurities on the probe head.

2.6 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 an electrostatic discharge when touching, removing or inserting any objects inside the equipment housing.

Avoid touching component contacts or connectors when working with the device.

2.7 Regulatory compliances

The probes are in conformity with the provisions of the following EU directives:

- RoHS Directive
- EMC Directive

Conformity is shown by compliance with the following standards:

- EN 50581: Technical documentation for the assessment of electrical and electronic products with respect to the restriction of hazardous substances.
- EN 55032: Information technology equipment – Radio disturbance characteristics – Limits and methods of measurement.
- EN 61326-1: Electrical equipment for measurement, control, and laboratory use – EMC requirements – intended for use in industrial locations.

2.7.1 FCC Part 15 compliance statement

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that the interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

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

> ⚠ **CAUTION!** Changes or modifications to this equipment not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

2.7.2 Canada ICES-003 compliance statement

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

Cet appareil numerique de la classe B est conforme a la norme NMB-003 du Canada.

3. Functional description

3.1 DRYCAP technology

Vaisala DRYCAP® dew point measurement technology ensures accurate measurement with excellent long term stability. Its unrivalled performance is based on two innovations: the proven capacitive thin-film polymer sensor and the self-diagnostic functions that the software performs automatically as needed.

The sensor's thin-film polymer absorbs or releases water vapor as the surrounding humidity increases or decreases. The dielectric properties of the polymer change as the humidity around the sensor changes, as does the capacitance of the sensor. Capacitance is converted into a humidity reading. The capacitive polymer sensor is bonded together with a temperature sensor, and dew point is calculated from the humidity and temperature readings.

The automatic sensor functions are called autocalibration, chemical purge, and sensor warming. They are a key element in achieving the stability, rapid response time, and condensation resistance of the DRYCAP® sensors.

3.1.1 DRYCAP sensor models in DMP series probes

Table 4   DRYCAP sensor models in DMP series probes

Probe model	Sensor variant	Suitable applications
DMP5	DRYCAP® 180S	Humid applications such ovens and refrigeration dryers
DMP6		
DMP7	DRYCAP® 180M	Standard dry gas and desiccant dryer applications
DMP8		

3.2 Autocalibration

Autocalibration function of the DRYCAP sensor optimizes measurement stability in dry environments. During autocalibration the sensor is warmed for a short period (< 1 min) and the sensor capacitance values are evaluated at the elevated temperature. The possible dry end drift is then corrected to correspond to the calibrated values. During autocalibration the values of all available output parameters are locked (showing the latest valid value).

DMP series probes perform autocalibration at 1-hour intervals, and whenever the chemical purge is performed. When measuring very dry conditions, the probe performs the autocalibration at shorter intervals. A significant change in dew point or temperature may also trigger the autocalibration.

Autocalibration is carried out only if several criteria for the measurement environment are fulfilled. This ensures the reliability of the adjustments, and maintains the excellent long term stability that the patented technology offers. These criteria include for example a stable enough moisture level in the measured atmosphere. If the conditions are not fulfilled, the autocalibration function is postponed until satisfactory conditions are reached.

Sometimes autocalibration fails to complete successfully due to changes in measurement conditions. This is normal, and is not a problem as autocalibration will be reattempted automatically. However, autocalibration should eventually succeed to maintain the accuracy of the probe.

3.3 Chemical purge

Chemical purge is also an automatic procedure that minimizes the drift at the wet end readings of the dew point measurement. The sensor is heated to a high temperature which evaporates all excess molecules out of the sensor polymer. This, together with autocalibration, results in a very small drift of the sensor due to the very linear behavior of the polymer technology.

By default DMP probes perform a chemical purge when they are powered on (known as **startup purge**), and at one day intervals (known as **interval purge**). If necessary, the purge settings can be configured using Insight software. However, Vaisala recommends leaving the chemical purge settings at their default values.

As with autocalibration, during chemical purge the values of the measurement parameters are frozen at their last measured values prior to the procedure.

3.4 Sensor warming

Sensor warming improves the sensor's performance in high humidities and freezing conditions:

- In high humidity, sensor warming prevents the sensor and filter from becoming wet (which would lead to a measured dew point equal to ambient temperature). When the humidity in the measured gas increases to a level where dew can start to form, sensor warming is switched on automatically.
  If in spite of sensor warming the sensor gets soaked, it will recover fully back to normal operation after it dries out.
- In freezing conditions, sensor warming is used to maintain the sensor temperature above 0 °C (+32 °F).

When sensor warming is active, all temperature-dependent output parameters (such as relative humidity and temperature itself) are unavailable. Sensor warming does interrupt dew point measurement.

3.5 Extra heat

Extra heat is an optional sensor heating feature that prevents the sensor from becoming saturated at very high humidities. Its purpose is similar to sensor warming, but the heating target is higher and triggered only when the sensor is very close to saturation. Typically sensor warming is enough, but some measurement environments are too humid for sensor warming to handle and extra heating is needed. Extra heat is disabled by default, but can be enabled using Insight software.

Values of the measurement parameters are frozen at their last measured values when extra heat is active.

4. Installation

When you choose the installation location for the probe, consider the following:

- Verify the operating environment specification of the probe model. The probe head typically has a much wider operating temperature range than the probe body.
- If the temperature of the measured environment differs greatly from ambient temperature, the entire probe head and preferably plenty of cable must be inside the measured environment. This prevents measurement inaccuracy caused by heat conduction along the cable.
- Probe mounting options are model-specific.
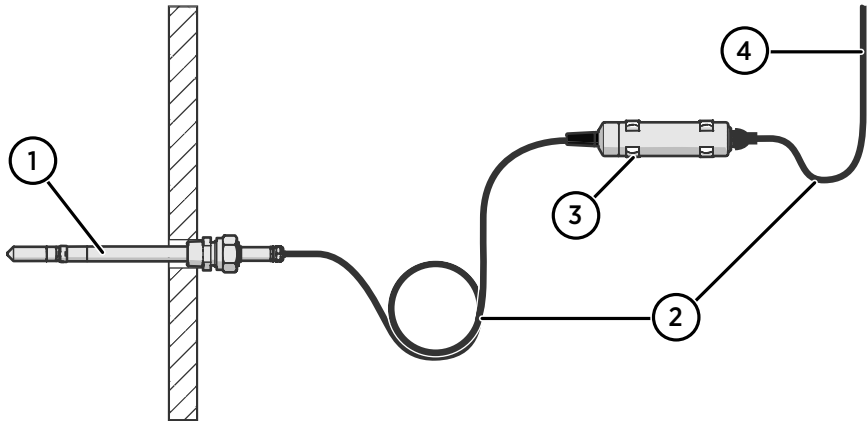
Figure 2   Example installation

1   Mount the probe head horizontally to prevent any water condensing on the probe head from running to the sensors.
2   Let the cable hang loosely to prevent condensed water from running along the cable to the probe body or probe head.
3   Attach the probe body to a wall or other surface using the two mounting clips (Vaisala item 243257SP) supplied with the probe. Each clip attaches to the installation surface with one screw (screw hole Ø 4.2 mm).
4   Cable to Modbus master or Indigo transmitter.

> ⚠️ **CAUTION!** The supplied mounting clips are not designed to withstand strong vibration. Use other methods to secure the probe body if necessary. For example, attach the probe body using a cable tie.

4.1 DMP5 probe
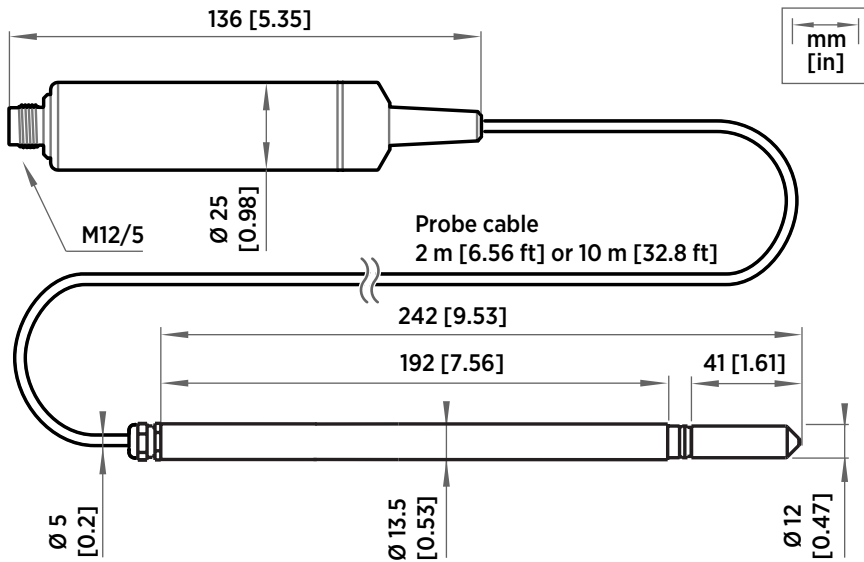
Figure 3   DMP5 dimensions

Vaisala DRYCAP® Dew Point and Temperature Probe DMP5 is designed for humidity measurement in applications with high temperatures. The long and robust steel probe and an optional installation flange allow easy installation with adjustable depth through insulation, for example, in ovens.

DMP5 is built for direct measurement in hot and dry processes, up to +180 °C (+356 °F). As the probe can be directly placed in the process, there is no need for a sampling system or trace heating. As a result, high measurement accuracy and constancy are maintained. DMP5 provides unmatched dry-end measurement accuracy at temperatures up to 140 °C; however, it can operate safely at temperatures up to 180 °C.

- Operating temperature of probe body −40 ... +80 °C (−40 ... +176 °F)
- Operating temperature of probe head −40 ... +180 °C (−40 ... +356 °F)

4.1.1 Installing with Mounting Flange 210696

Mounting Flange 210696 is designed for attaching Ø13.5 mm probe heads through the wall of a process chamber or duct. The flange kit includes a flange, a sealing ring, and screws.
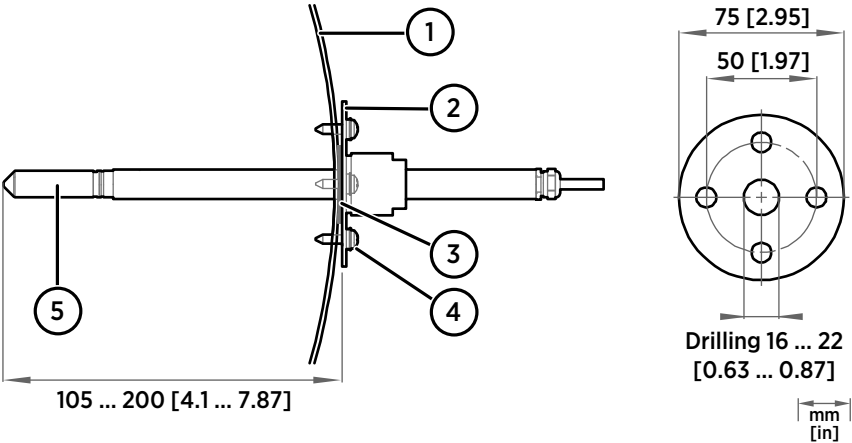
1   Wall of chamber or duct
2   Flange
3   Sealing ring
4   Self-tapping screws (B 4.2×16 DIN 7981)
5   Probe

> When the temperature difference between the process or duct and the surroundings is large, insert the probe head as deep in the process or duct as possible. This prevents errors caused by heat conduction along the probe cable.

4.2 DMP6 probe
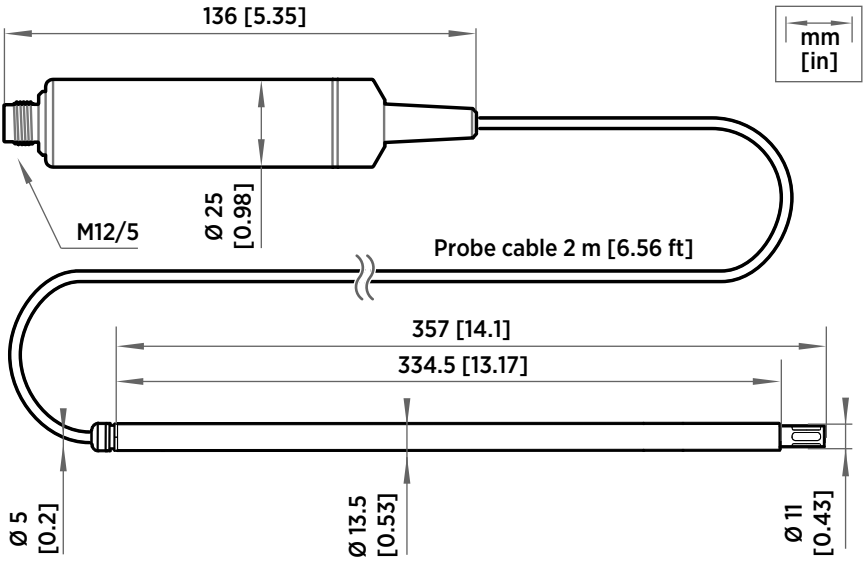
Figure 4   DMP6 probe dimensions
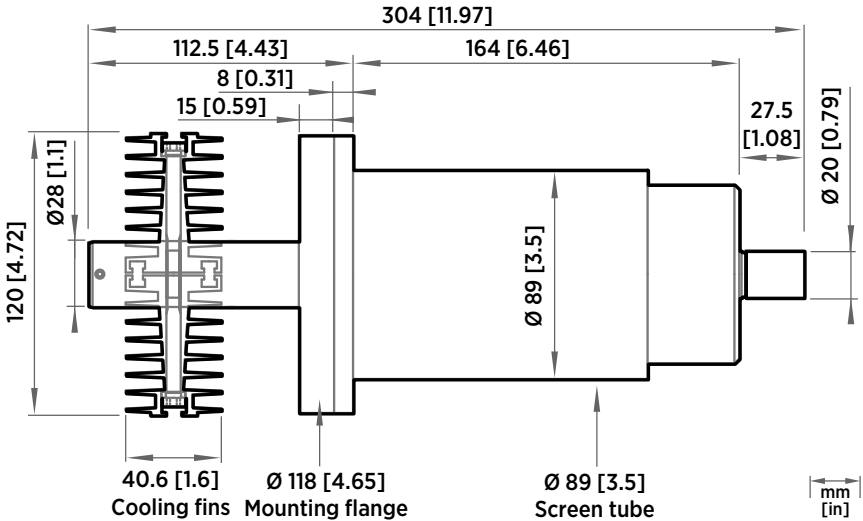
Figure 5   Cooling Set DMP246CS dimensions

Vaisala DRYCAP® Dew Point Probe DMP6 is designed for humidity measurement in industrial applications with very high temperatures. High temperature tolerance is achieved using a passive cooling set that conducts heat away from the probe and reduces temperature to optimal range for the sensor.

- Operating temperature of probe head 0 ... +350 °C (+32 ... +662 °F)
- Operating temperature of probe body −40 ... +80 °C (−40 ... +176 °F)

DMP6 is built for direct measurement in temperature range 0 ... +350 °C (+32 ... +662 °F). There is no need for a sampling system or trace heating. To tolerate these high temperatures the probe head is inserted inside a cooling set that provides passive cooling. The cooling set has removable cooling fins that allow the operating temperature profile of the probe to be adjusted so that adequate cooling is provided for each application. The cooling system has no moving parts, and requires no additional power or cooling utilities, so there is no risk of sensor damage due to mechanical cooling failure.
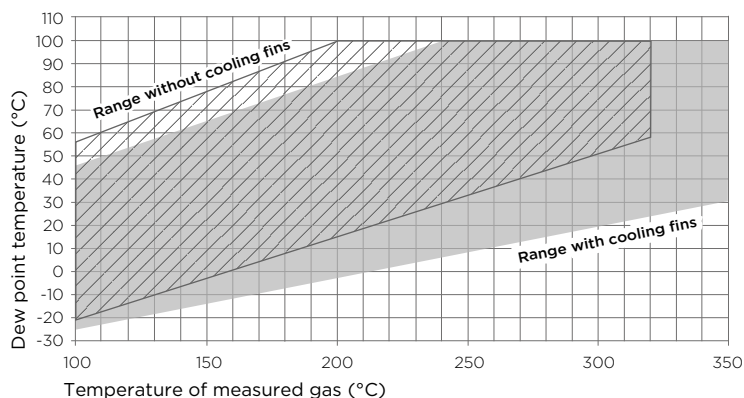
Figure 6   Operating range of DMP6 probe head

> ℹ️ Make sure that the upper limit of the dew point measurement range is not exceeded in low temperatures as this will lead to condensation.

> 💡 You can read diagnostic measurement data from the probe using Insight software (**Diagnostics** page) or Modbus protocol (diagnostic data registers) and use it to verify your installation:
> - **Sensor temperature** must never exceed +180 °C (+356 °F) even in exceptional process conditions.
> - Allow the probe to stabilize after installation in the cooling set, and check the **Sensor saturation ratio**. If the value is below 20 %, install the cooling fins on the cooling set (unless already installed).

4.2.1 Installing probe head with Cooling Set DMP246CS

- Welding equipment
- Equipment for making a hole to the process wall
- 5-mm Allen key
- 2-mm Allen key
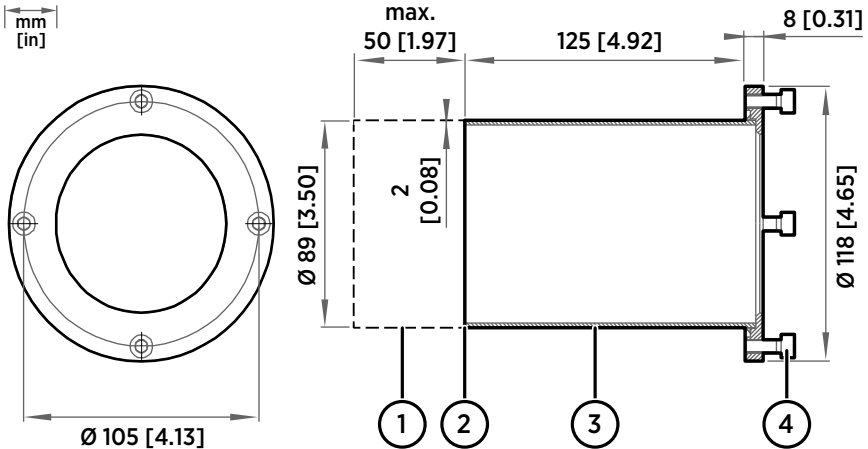
Figure 7   DMP246CS Cooling Set mounting flange

1   Lengthening piece for thick walls (not included)
2   Welding point
3   Mounting tube
4   Mounting screws (4 pcs, M6×16 DIN 912)

22 [0.87]   172 [6.77]   104.5 [4.11]

mm
[in]
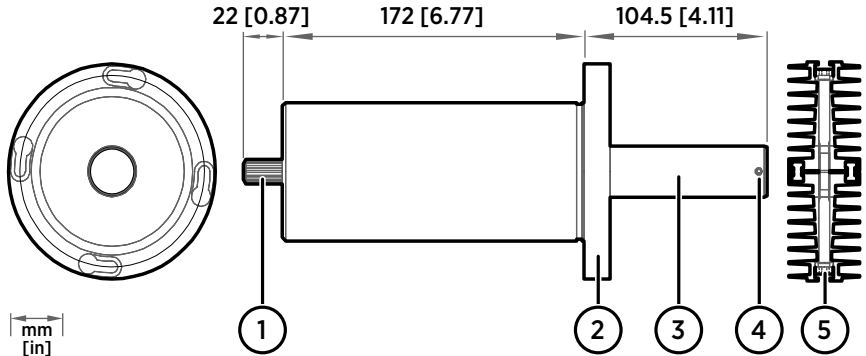
Figure 8   DMP246CS Cooling Set without mounting flange

1   Cooling bush
2   Flange
3   Cooling bar
4   Locking screws (4 pcs, M4×6 DIN 916)
5   Mounting screws of the cooling fins (M6×60 DIN 912)

1. Make a round 89.5 + 0.5 mm (3.52 + 0.02 in) hole in the process wall. Install the cooling set horizontally whenever possible to ensure the best possible cooling performance.

2. If the process wall is more than 125 mm (4.92 in) thick, weld a lengthening piece (max. 50 mm (1.97 in)) to the mounting tube.

3. Weld the tube of the mounting flange tightly to the inner metal plate of the process wall.

4. Attach the cooling set to the mounting flange and use a 5-mm Allen key to tighten the mounting screws. Proper tightening of the mounting screws is important for good thermal contact.

5. If the process chamber is in use or otherwise warmer than ambient temperature, let the cooling set warm up before inserting the probe to avoid condensation:

    a. Plug the hole of the cooling bar tightly with the plug that is attached to the cooling set.

    b. If installation of the cooling fins is required, attach them at this point to let them warm up as well. See step 9.

    c. Wait for a few hours.

    d. Unplug the cooling bar and continue the installation.

6. Use a 2-mm Allen key to loosen the locking screws on the cooling bar.

7. Push the probe head into the cooling bar until it meets the other end and cannot be pushed farther. Approximately 7.5 cm (2.95 in) of the probe head will remain outside the cooling bar.

> ⚠️ **CAUTION!** Do not push or pull from the probe cable.

8. Tighten the locking screws to lock the probe head in place.
9. If installation of cooling fins is required, attach them around the cooling bar using a 5-mm Allen key. Place the cooling fins so that the locking screws are not obstructed. Tighten the two mounting screws so that the fins have good thermal contact with the cooling bar.

4.2.2 Cooling Set installation example
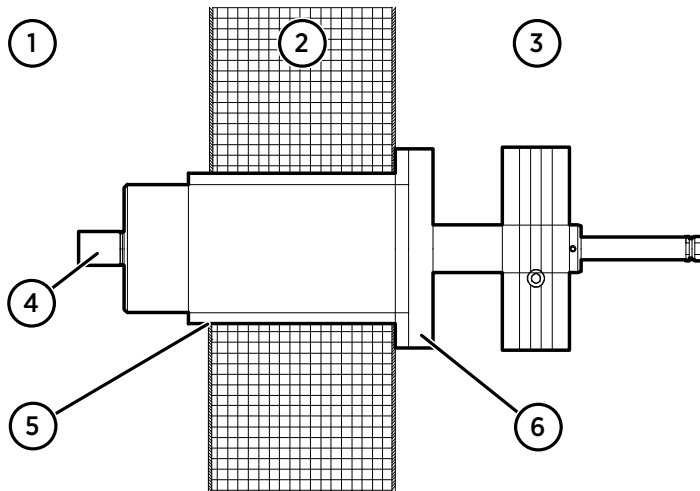
Figure 9   Example installation with Cooling Set DMP246CS

1   Process chamber, maximum temperature +350 °C (+662 °F)
2   Mineral wool or other insulation, total wall thickness is < 125 mm (4.92 in) so no lengthening piece is welded to mounting tube
3   Space outside process chamber, in ambient temperature
4   Location of dew point sensor when probe head is installed in the cooling set (under sintered filter)
5   Tube of the mounting flange welded to inner plate of process wall
6   Cooling set attached to mounting flange using mounting screws (4 pcs)

4.3 DMP7 probe
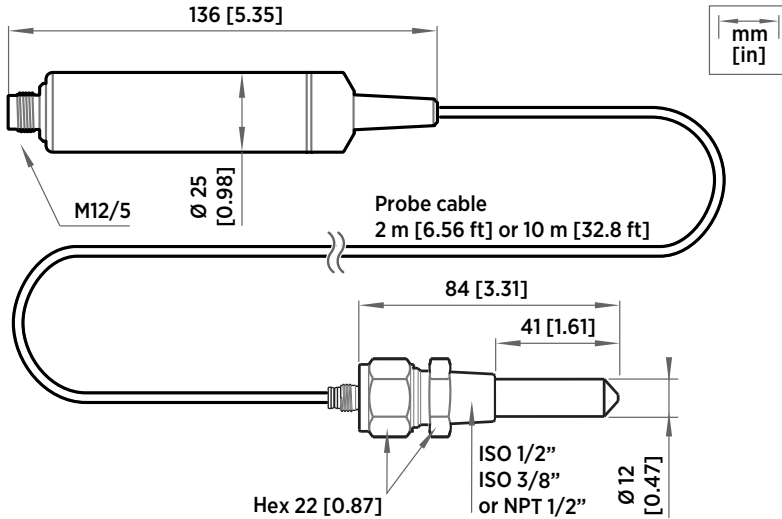
Figure 10   DMP7 dimensions

Vaisala DRYCAP® Dew Point and Temperature Probe DMP7 is designed for low-humidity applications. Thanks to its short probe length, it fits in installations with limited space such as semiconductor manufacturing equipment. Other applications include industrial drying, compressed air systems, dry rooms, and blanket gases in metal heat treatment.

- Operating temperature of probe head −40 ... +80 °C (−40 ... +176 °F)
- Operating temperature of probe body −40 ... +80 °C (−40 ... +176 °F)
- Operating pressure of probe head 0 ... 10 bar (0 ... 145 psia)

See installation instructions provided with the Swagelok installation kit.
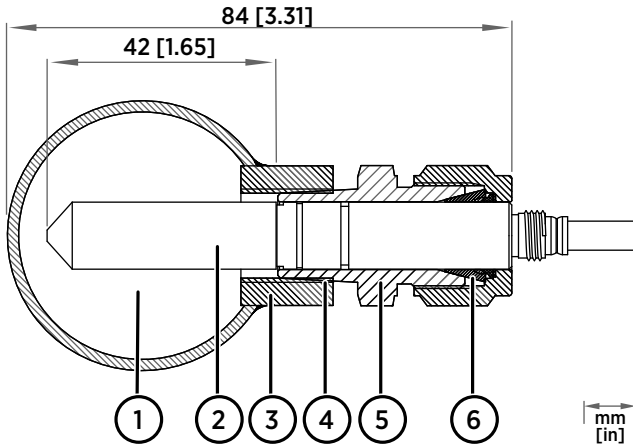
Figure 11   DMP7 installation to pipeline using a Swagelok® installation kit

1   Max. process pressure 10 bar (145 psi), max temperature +80 °C (+176 °F)
2   Probe head
3   Duct connector
4   ISO1/2″, ISO3/8″ or NPT1/2″ thread
5   Swagelok connector
6   Ferrules

> When installed in a process with a pressure differing from normal atmospheric pressure, input the correct pressure into the pressure compensation setpoint register of the probe. This allows the probe to apply the appropriate pressure compensation into its measurement results.

4.4 DMP8 probe
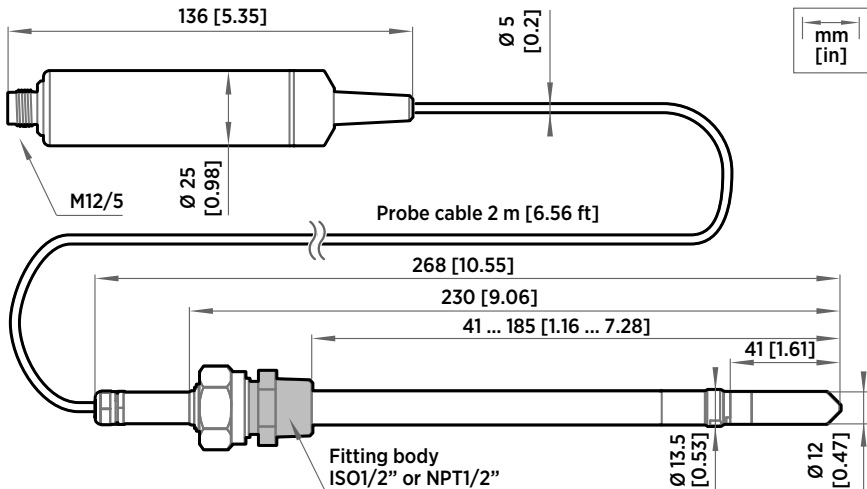
Figure 12   DMP8 dimensions

Vaisala DRYCAP® Dew Point and Temperature Probe DMP8 is designed for industrial low-humidity applications such as industrial drying, compressed air systems, and semiconductor industry. It can be installed in a 1/2″ NPT or ISO thread with adjustable insertion depth.

An optional ball-valve installation kit allows for inserting or detaching the probe from a pressurized line.

- Operating temperature of probe head −40 … +80 °C (−40 … +176 °F)
- Operating temperature of probe body −40 … +80 °C (−40 … +176 °F)
- Operating pressure of probe head 0 … 4 MPa (0 … 40 bar)
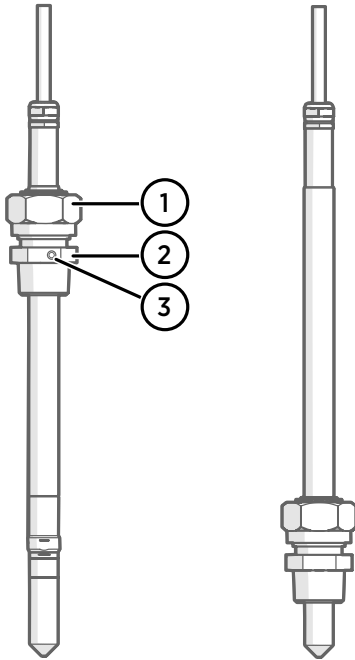
Figure 13   DMP8 probe head

1   Clasp nut, 24 mm hex nut
2   Fitting body, 27 mm hex head
3   Leak screw (on ISO 1/2″ fitting body
      HM47432 only)

Fitting body with a leak screw can be useful when the probe head cannot be
installed directly in the pressurized process or process pipe. The leak screw allows
a small sample flow to escape from the process out to atmospheric pressure,
enabling a fast response time although the probe is not installed in the process.
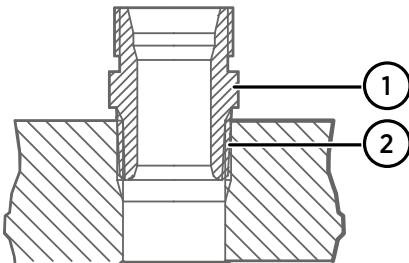
**Figure 14   Sealing of fitting body into
process**

1   Fitting body with 24 mm hex nut and
      tapered thread
2   Seal with a suitable thread sealant. For
      example, LOCTITE® No. 542 with
      activator No. 7649, MEGA-PIPE EXTRA
      No. 7188, or PTFE tape.

> ℹ️ Follow the instructions of the sealant manufacturer.
> PTFE tape does not lock the parts together. Use two fork wrenches (24 mm and 27 mm) when tightening and opening the clasp nut of the probe.

4.4.1 Tightening the clasp nut

1. Adjust the probe to a suitable depth according to the type of installation.
2. Tighten the clasp nut to finger tightness.
3. Draw a line on the fitting screw and the clasp nut to mark their position.
4. Tighten the nut a further 50 ... 60º (1/6 turn) with a wrench. If you have a suitable torque wrench, tighten the nut to max 45 ±5 Nm (33 ±4 ft-lbs).
   Do not overtighten the clasp nut.

> ⚠️ **CAUTION!** Take care not to damage the probe body. A damaged body makes the probe less tight and may prevent it from going through the clasp nut.

> ⚠️ **CAUTION!** In pressurized processes it is essential to tighten the supporting nuts and screws very carefully to prevent loosening of the probe by the action of pressure.

> ℹ️ When installed in a process with a pressure differing from normal atmospheric pressure, input the correct pressure into the pressure compensation setpoint register of the probe. This allows the probe to apply the appropriate pressure compensation into its measurement results.

4.4.2 Attaching ball valve kit to process
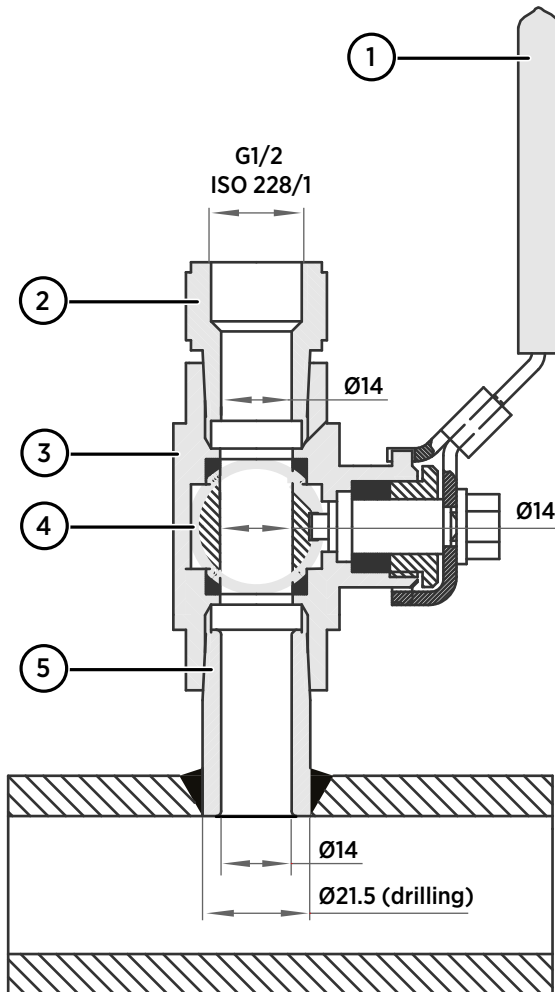
1   Ball valve handle: must point to the same direction as the ball valve body when installing.
2   Extension nipple, threads G1/2 ISO228/1 and R1/2 ISO7/1.
3   Ball valve body. When tightening the assembly, turn only from the ball valve body.
4   Ball of the ball valve.
5   Welding joint, threads R1/2 ISO7/1.

▶ 1. Attach the welding joint to the process pipe or chamber.

2. Apply a sealant (MEGA-PIPE EXTRA No. 7188 or LOCTITE® No. 542 with activator No. 7649) on the threads of the welding joint and screw the bottom of the ball valve onto the welding joint.

3. Tighten the ball valve assembly by turning from the ball valve body.

> ⚠ **CAUTION!** Tightening the ball valve kit by turning the extension nipple can break the sealing. Tighten the ball valve assembly only from the ball valve body.

4. If you need to cap the ball valve assembly before installing or after removing the probe, attach a blanking nut to close the top of the valve.

4.4.3 DMT242SC sampling cell

DMT242SC is a basic sampling cell with only the main sampling cell body. The inlet and outlet are female threaded sample connectors (inlet G3/8″, outlet G1/4″ ISO).

DMT242SC is suitable for users requiring only a sampling cell to fit the measurement into and doing further assembly (piping into inlet and outlet, valves, possible flow meter) by themselves.

4.4.4 DMT242SC2 sampling cell with Swagelok connectors
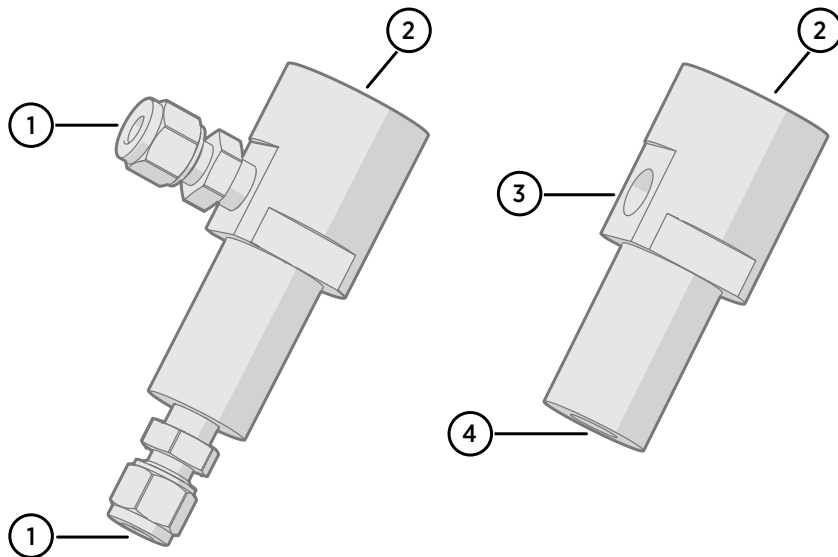
Figure 15   Sampling cells DMT242SC2 (left) and DMT242SC (right)

DMT242SC2 is similar to DMT242SC, but connections are made easy. The sampling cell includes welded Swagelok connectors at both the inlet and outlet that fit directly to 1/4″ tubing.

To fit 6 mm tubing to the connectors, an adapter such as Swagelok® Reducer SS-6M0-R-4 (not supplied by Vaisala) can be used.

DMT242SC2 is the suitable choice in, for example, plastics drying systems, where the measurement is made by tapping off the dryer system and bringing a small air stream to the sensor.

The Swagelok connectors of DMT242SC2 connect easily to a cooling coil or tubing, providing the essential function of cooling the dry air to ambient temperature before it reaches the sensor.

1   Male pipe welded connector Swagelok 1/4″
2   G1/2″
3   G1/4″
4   G3/8″

4.5 Wiring
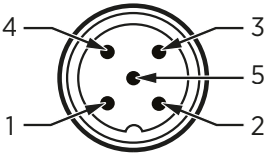
Figure 16   M12 5-pin A-coded male connector pinout

Pin #	Function	Notes	Wire colors in Vaisala cables
1	Power supply	Operating voltage: 15 ... 30 VDC Current consumption: 10 mA typical, 500 mA max.	Brown
2	RS-485 -		White
3	Power GND and RS-485 common		Blue
4	RS-485 +		Black
5	Not connected		Gray
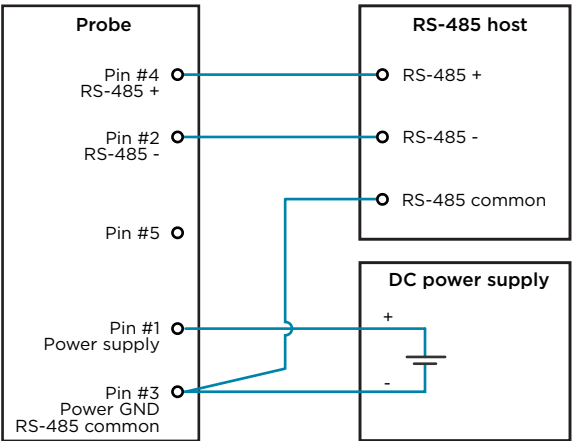
Figure 17   RS-485 wiring

Recommended maximum length of the RS-485 line is 30 m (98 ft).

5. Configuration with Insight software

5.1 Vaisala Insight software

Vaisala Insight software is a configuration software for Indigo-compatible devices. With the Insight software, you can:

- See probe information and status
- See real-time measurement
- Record data up to 48 hours and export in CSV format
- Calibrate and adjust the probe
- Configure probe features such as measurement filtering, chemical purge, and serial communication

Microsoft Windows® operating system and Vaisala USB cable (no. 242659) required.

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

5.2 Connecting to Insight software

- Computer with Microsoft Windows® operating system and Vaisala Insight software installed
- USB connection cable (no. 242659)

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.
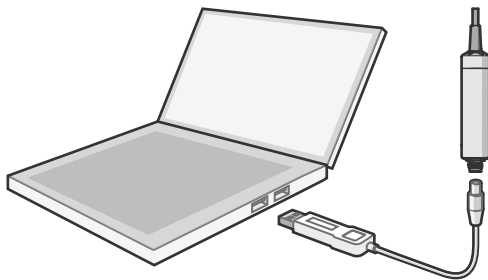
Figure 18   Connecting probe to Insight

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

3. Connect the probe to the USB cable.

4. Wait for Insight software to detect the probe.

5.3 Configuration options

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

Available configuration options include all of the Modbus configuration registers and several additional options. Insight software is the recommended way to change the probe configuration.

> You can restore the probe back to its default settings using the **Factory default settings > Restore settings** function. Doing this will also revert the latest entered calibration information to the information that was stored with the factory calibration.
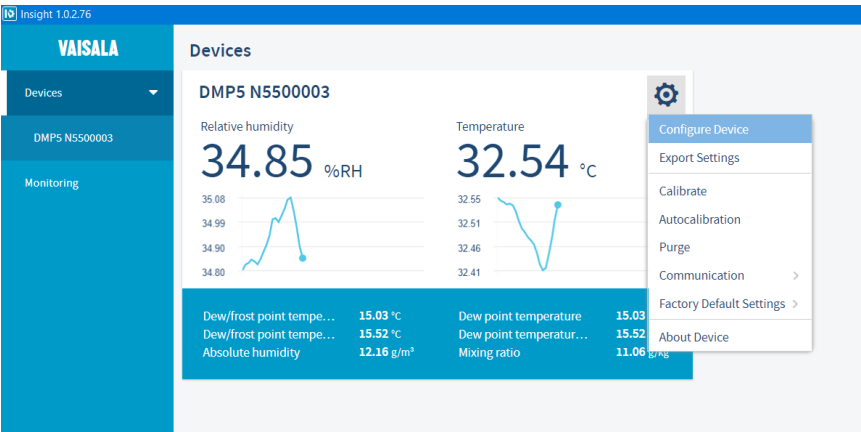
Figure 19   DMP5 in Insight software

More information

‣ Configuration registers (page 66)

5.4 Diagnostics in Insight

Messages sent by the connected devices are shown automatically in Insight. Additional diagnostic data is available on the **Diagnostics** page. The data available depends on the probe model and Insight operating mode (basic or advanced). The data can be very useful when diagnosing issues together with Vaisala support, particularly the diagnostic files.

Diagnostic files

If Insight is in **Advanced Mode**, you can retrieve the following diagnostic files from the connected probe:

- **SSR/T histogram**: Table of humidity and temperature conditions measured by the probe
- **Error log**: Cumulative total of the error and status events tracked by the probe

Both files contain data from since the probe was manufactured, or since the files were last cleared. Clearing the files is not recommended unless instructed by Vaisala support. The buttons to clear the files are located at the bottom of the **Diagnostics** page.

The files are in comma separated value (CSV) format. They can be opened for viewing in spreadsheet programs such as Microsoft Excel or in text editors.
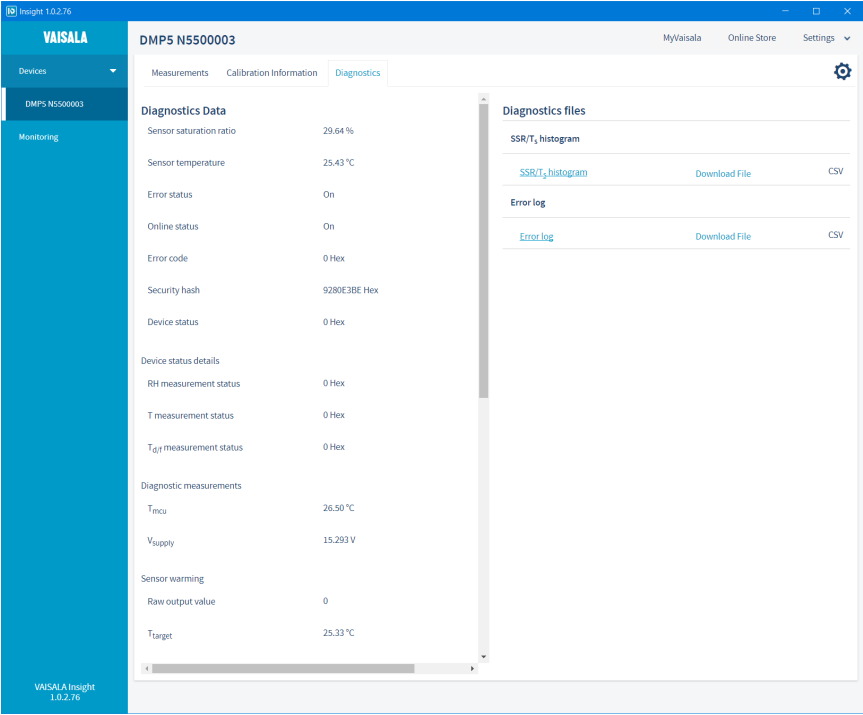
Figure 20   DMP5 diagnostics in Insight (advanced mode)

6. Using probe with Indigo transmitters

Indigo transmitters are host devices that extend the feature set of connected probes with a range of additional options for outputs, configuration access, measurement viewing, and status monitoring.

Available features vary depending on the transmitter model. Models without display use a LED indicator for notifications.

6.1 Indigo 200 series transmitters

Indigo 200 series transmitters have a probe connector where compatible probes can be attached directly. A cable may also be used to connect the probe.

After connecting the probe, use the wireless configuration interface to configure the transmitter.
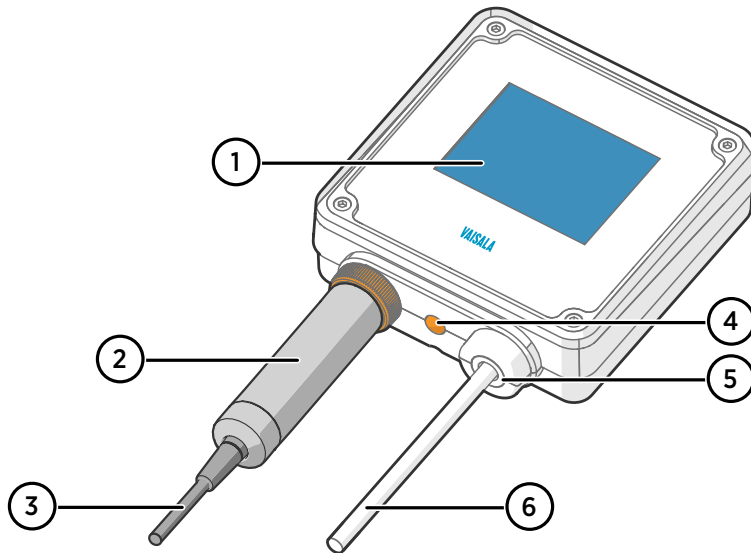
Figure 21   Probe attached to Indigo 200 series transmitter directly

1   3.5" TFT LCD color display: non-display option with LED available for certain models
2   Locking wheel: insert probe, hold in place, and turn the wheel counterclockwise
3   Cable to probe head
4   Wireless configuration interface (WLAN) activation button
5   Rubber lead-through with strain relief. Cable feedthrough option also at back of transmitter.
6   Input/output cable
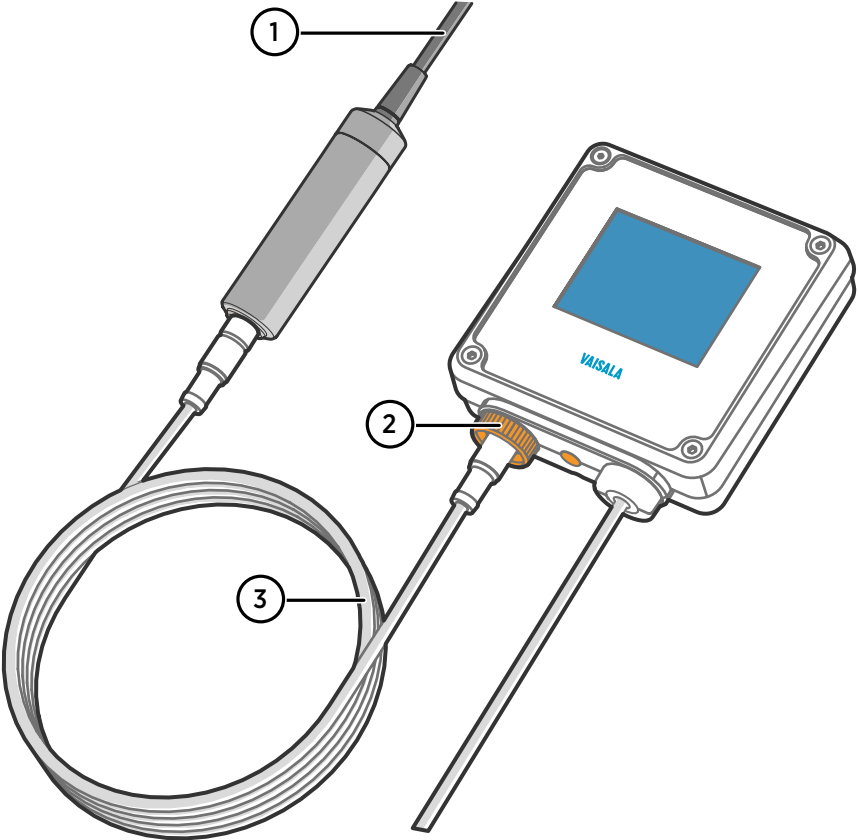
Figure 22   Probe attached to Indigo 200 series transmitter with a cable

1   Cable to probe head
2   Locking wheel: insert cable, hold in place, and turn the wheel counterclockwise
3   Connection cable

6.1.1 Attaching probe to Indigo 200 series transmitter
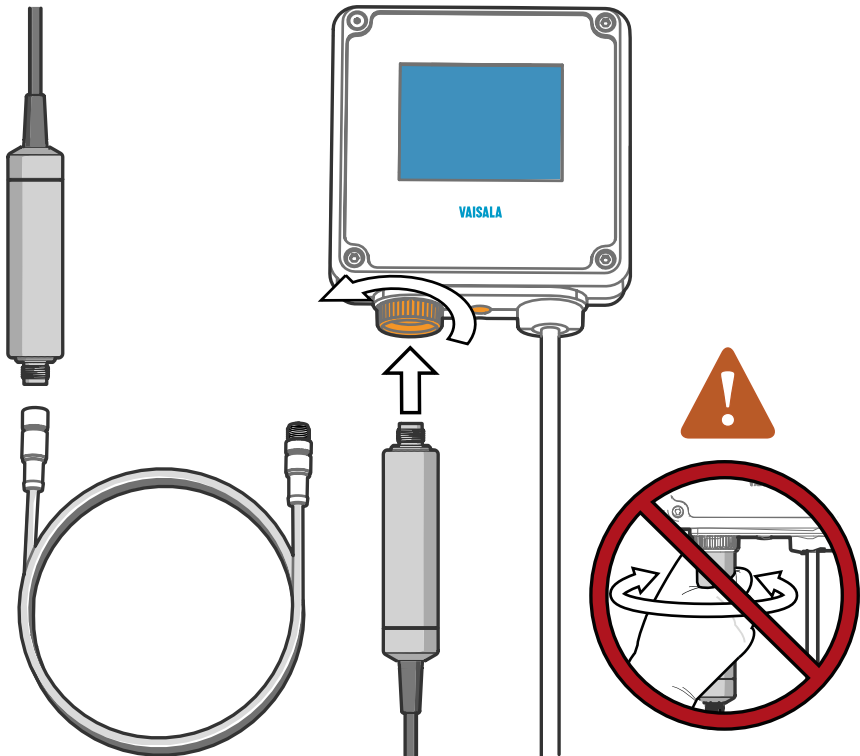
Figure 23   Attaching the probe to Indigo 200 series transmitter

▶ 1. Insert the probe or the connection cable into the transmitter's connector. Use of connection cable is recommended for strain relief.

2. Turn the locking wheel of the transmitter to lock the probe or cable in place.
   Do not turn the probe or the cable itself, as that will damage the connectors.

3. If you are using a connection cable, connect the probe to the cable.

4. When the transmitter recognizes the connected probe, it shows a notification message on the display.

6.2 Indigo 500 series transmitters

Probes are connected to Indigo 500 series transmitters using a cable. Connections are made to the screw terminals inside the housing. Indigo 520 model allows two probes to be connected.

After connecting a probe, use the touchscreen interface or the web user interface to configure the transmitter.
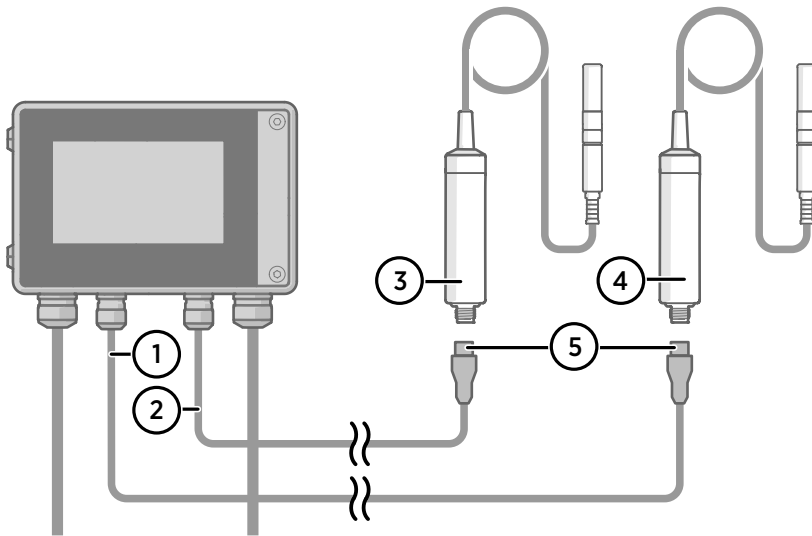
Figure 24   Attaching probes to Indigo 500 transmitter

1   Probe connection cable, probe 1
2   Probe connection cable, probe 2
3   Probe to be connected as probe 2
4   Probe to be connected as probe 1
5   Probe cable connector (5-pin M12)

7. Maintenance

7.1 Cleaning the probe

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

> ℹ️ Do not spray anything directly on the probe head, since that may deposit impurities on the sensors.

You can clean the probe, probe body, and cable by wiping them with a soft, lint-free cloth moistened with water or a suitable cleaning agent, such as isopropyl alcohol. Do not wipe the filter: wiping the filter may block its pores and/or deposit residue on the filter. If the filter is heavily contaminated, replace it.

When cleaning, follow these precautions:

- Avoid touching the filter. If you need to touch the filter, always wear clean gloves (cotton, rubber or similar material). Keep the filter free of any grease or oil.
- Do not scrape the probe or the probe body.
- Do not immerse the probe or the probe body in liquid to clean them.
- Wipe cleaning agents off the probe, probe body, and the cable after cleaning.

7.1.1 Chemical tolerance

> ℹ️ Avoid exposing the probe to cleaning agents for unnecessarily long periods of time.

Table 5   Suitability of cleaning agents

Cleaning Agent	Suitability
Acetone	Suitable
Chlorine disinfectants	Suitable
Ethanol	Suitable
Heptane	Suitable
Isopropyl alcohol	Suitable

7.2 Changing the probe filter

- New compatible filter
- Clean lint-free gloves

CAUTION! Sensors are easily damaged when the filter is not in place. Handle the probe head carefully.

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

7.3 Calibration and adjustment

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

When adjustment is necessary, have Vaisala calibrate and adjust the probe. To order calibration services from Vaisala, visit store.vaisala.com.

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

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

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

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

8.　Troubleshooting

8.1　Problem situations

Table 6　Troubleshooting table

Problem	Possible cause	Solution
Measurement output seems incorrect	Installation location is not representative of actual conditions you want to measure	Verify the installation location and reinstall or relocate the probe if necessary.
	Heat conduction along probe head and cable is interfering with measurement accuracy	Follow the installation recommendations for cases when temperature of measured environment differs greatly from ambient. See Installation (page 15).
	Probe is in need of adjustment	Have the probe adjusted by Vaisala. See Calibration and adjustment (page 40).
Probe status indicator LED is red	Probe is in error state	Connect the probe to Insight software or an Indigo transmitter and read the error message(s). See Vaisala Insight software (page 32) and Error messages (page 42).
Values of measurement parameters stop changing for a few minutes	Probe is performing a sensor heating function such as chemical purge or waiting for the sensor to cool down	Wait for the function to complete and measurement parameters to be available again

8.2　Error messages

The error messages are categorized according to the severity of the status:

- **Critical errors** are fatal to the operation of the device. It may not be able to respond to communication at all, and will not measure correctly.
- **Errors** prevent normal operation of the device. Depending on the problem, errors may resolve themselves. For example, a completely wet humidity sensor may cause a humidity measurement error.
- **Warnings** do not prevent normal operation but may indicate possible problems.
- **Status** indicates a known state of the device.

Error message	Description	Recommended action
Critical errors		
Firmware checksum mismatch	Firmware is corrupted	Contact Vaisala technical support
Factory default settings corrupted	Parameter memory is corrupted	
Main configuration settings corrupted		
Additional configuration settings corrupted		
Device settings corrupted		
Sensor coefficients corrupted		
Non-volatile memory read write failure	Hardware fault	
Errors		
Temperature measurement error	Readings from sensors missing or out of range	Inspect probe head and sensors visually. If the probe is completely wet, allow it to dry out.
Humidity measurement error		
Humidity sensor failure		If the sensors are damaged or missing and the error message(s) stay active, contact Vaisala to have the probe repaired.
Capacitance reference error	Hardware fault	Contact Vaisala technical support
Ambient temperature out of range	Probe body too hot or cold	Relocate the probe body so that its ambient temperature is within the specified operating range
Supply voltage out of range	Supply voltage too high or low	Check supply voltage
Sensor heater error	Hardware fault	Contact Vaisala technical support
Warnings		
Autocalibration failed	Measurement environment not suitable for autocalibration	Autocalibration can only be performed successfully in dry and stable conditions. This warning is expected if operating in normal room humidity.

Warnings		
Calibration certificate checksum mismatch	Certificate stored in the probe has an invalid checksum	Contact Vaisala technical support
Calibration has expired	Shown by calibration reminder functionality	Calibrate the probe and update the calibration date information
Software restart	Device has automatically restarted itself	Check that supply voltage is stable and operating environment is within specification
Unexpected device restart		
Status messages		
Calibration is about to expire	Shown by calibration reminder functionality	Calibrate the probe and update the calibration date information
Purge in progress	Chemical purge of the humidity sensor ongoing	Wait for chemical purge to complete
The readings stay frozen until the sensor cools down	Probe is waiting for its sensors to cool down	Wait for measurement readings to become available

9. Technical data

9.1 DMP5 specifications

Table 7   DMP5 measurement performance

Property	Description/Value
Dew point	
Sensor	DRYCAP® 180S
Measurement range	−40 ... +100 °C (−40 ... +212 °F) $T_{d/f}$
Accuracy	±2 °C (±3.6 °F) $T_{d/f}$ See accuracy graph
Response time 63 % [90 %] [1]	
From dry to wet	5 s [10 s]
From wet to dry	45 s [5 min]
Temperature	
Measurement range	0 ... +180 °C (+32 ... +356 °F) [2]
Accuracy at +100 °C (+212 °F)	±0.4 °C (±0.72 °F)
Temperature sensor	Pt100 RTD Class F0.1 IEC 60751
Mixing ratio	
Measurement range (typical)	0 ... 1000 g/kg (0 ... 7000 gr/lbs)
Accuracy (typical)	±12 % of reading
Absolute humidity	
Measurement range	0 ... 600 g/m^3
Accuracy	±10 % of reading (typical)

1)   Tested with sintered filter.
2)   If sensor warming is enabled, temperature measurement is locked when humidity rises above 80 %RH and warming is switched on.

Figure 25   DMP5 dew point accuracy vs. measurement conditions

Table 8   DMP5 operating environment

Property	Description/Value
Operating temperature range for probe head	−40 ... +180 °C (−40 ... +356 °F)
Operating temperature range for probe body	−40 ... +80 °C (−40 ... +176 °F)
Storage temperature	−40 ... +80 °C (−40 ... +176 °F)
Measurement environment	For air, nitrogen, hydrogen, argon, helium, and oxygen [1]
IP rating for probe body	IP66
EMC compliance	EN61326-1, Industrial environment

1)   Consult Vaisala if other chemicals are present. Consider safety regulations with flammable gases.

Table 9   DMP5 inputs and outputs

Property	Description/Value
Operating voltage	15 ... 30 VDC
Current consumption	10 mA typical, 500 mA max.
Digital output	RS-485, non-isolated
Protocols	Modbus RTU
Output parameters	
Relative humidity, temperature, dew point temperature, absolute humidity, mixing ratio, water concentration, water vapor pressure, water vapor saturation pressure, enthalpy	

Table 10   DMP5 mechanical specifications

Property	Description/Value
Connector	M12 5-pin A-coded male
Weight	436 g (15.37 oz)
Probe cable length	2 m (6.56 ft) or 10 m (32.8 ft)
Materials	
Probe	AISI316L
Probe body	AISI316L
Cable jacket	FEP
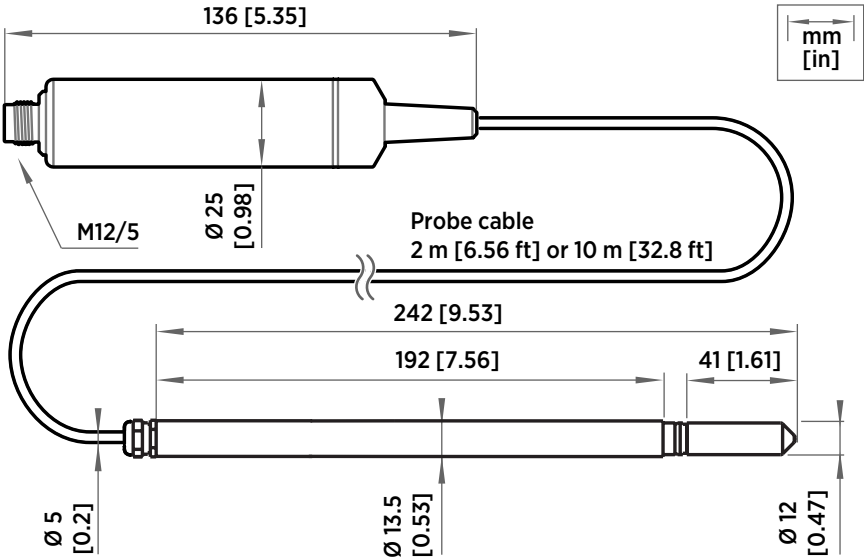
Figure 26   DMP5 dimensions

9.2 DMP6 specifications

Table 11   DMP6 measurement performance

Property	Description/Value
Dew point	
Sensor	DRYCAP® 180S

Property	Description/Value
Measurement range	−25 ... +100 °C (−13 ... +212 °F) $T_{d/f}$
Accuracy	±2 °C (±3.6 °F) $T_{d/f}$
Response time 63 % [90 %]	
From dry to wet	5 s [10 s]
From wet to dry	45 s [5 min]
Mixing ratio	
Measurement range (typical)	0 ... 1000 g/kg (0 ... 7000 gr/lbs)
Accuracy (typical)	±12 % of reading

Table 12   DMP6 operating environment

Property	Description/Value
Operating temperature range of probe head [1]	0 ... +350 °C (+32 ... +662 °F)
Operating temperature range of probe body	−40 ... +80 °C (−40 ... +176 °F)
Storage temperature	−40 ... +80 °C (−40 ... +176 °F)
Measurement environment	For air, nitrogen, hydrogen, argon, helium, and oxygen [2]
IP rating	IP66
EMC compliance	EN61326-1, Industrial environment

[1]   *Installation of cooling fins on the cooling set affects the operating temperature range. See the operating range graph.*

[2]   *Consult Vaisala if other chemicals are present. Consider safety regulations with flammable gases.*
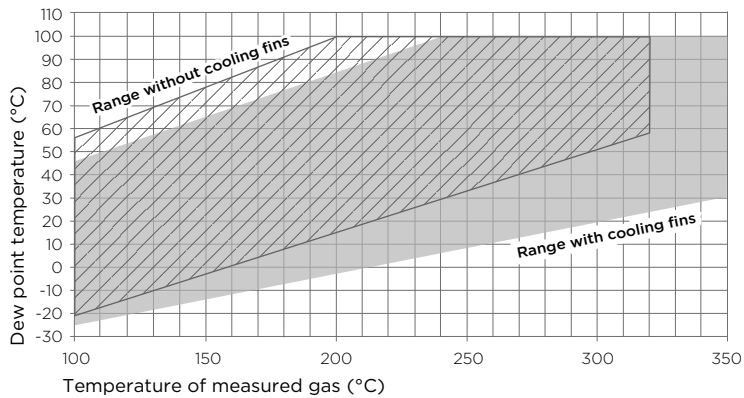
Figure 27   Operating range of DMP6 probe head

Table 13   DMP6 inputs and outputs

Property	Description/Value
Operating voltage	15 ... 30 VDC
Current consumption	10 mA typical, 500 mA max.
Digital output	RS-485, non-isolated
Protocols	Modbus RTU
Output parameters	
Dew point temperature, mixing ratio, water concentration, water vapor pressure, water mass fraction	

Table 14   DMP6 mechanical specifications

Property	Description/Value
Connector	M12 5-pin A-coded male
Probe weight	500 g (1.10 lb)
Cooling set weight	3.50 kg (7.72 lb)
Probe cable length	2 m (6.56 ft)
Materials	
Probe	AISI316L
Probe body	AISI316L
Cable jacket	FEP

Property	Description/Value
Cooling set	Stainless steel and aluminum
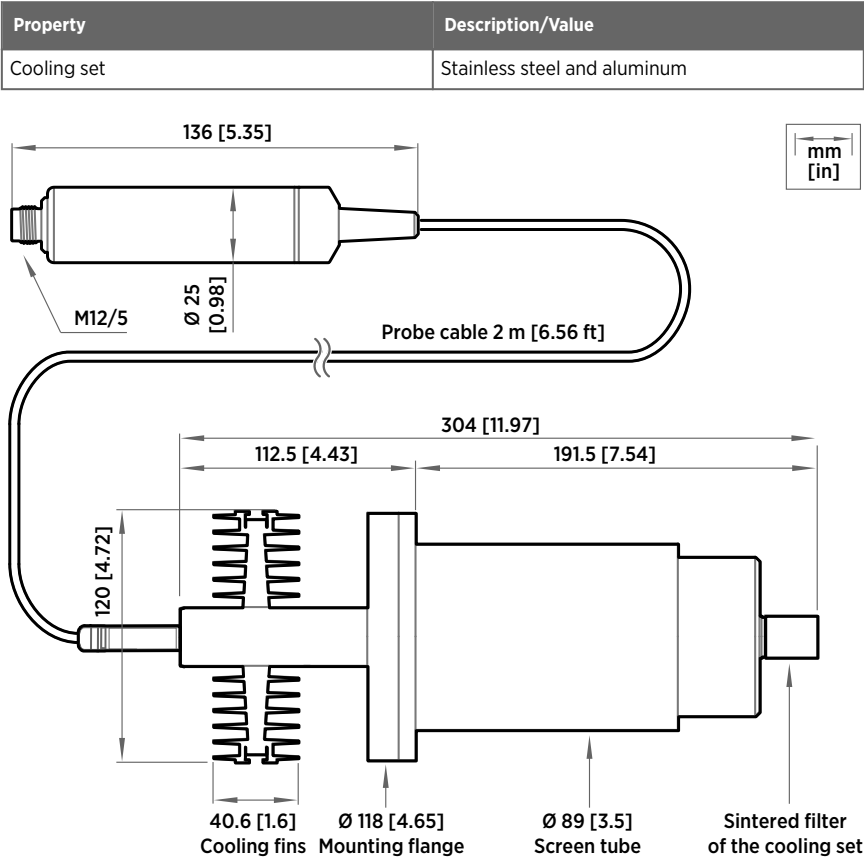
Figure 28   DMP6 dimensions with Cooling Set DMP246CS
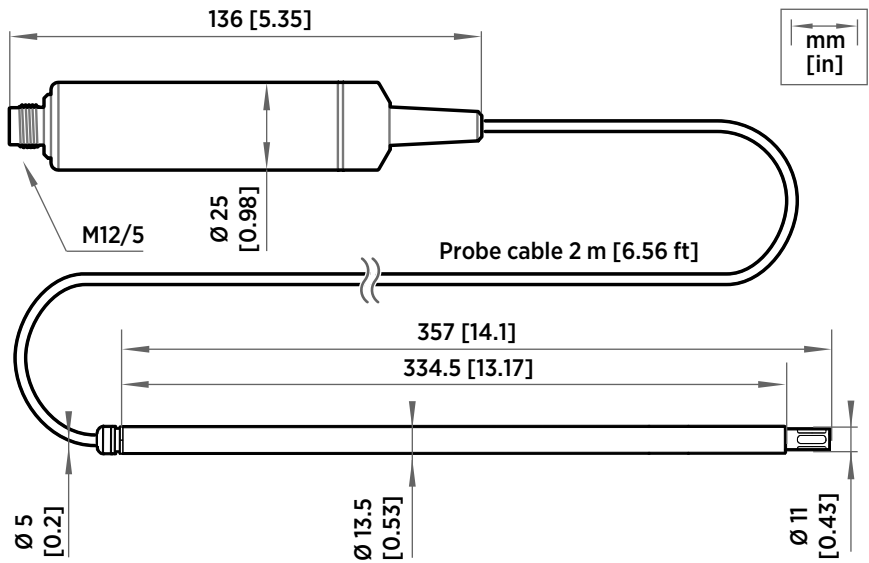
Figure 29   DMP6 probe dimensions
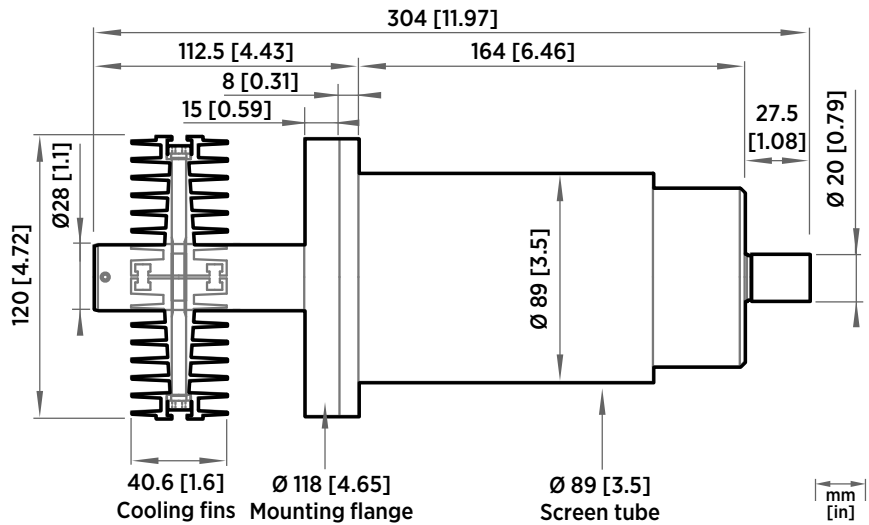
Figure 30   Cooling Set DMP246CS dimensions

9.3 DMP7 specifications

Table 15   DMP7 measurement performance

Property	Description/Value
Dew point	
Sensor	DRYCAP® 180M
Measurement range	−70 ... +80 °C (−94 ... +176 °F) $T_{d/f}$
Measurement range for continuous use	−70 ... +45 °C (−94 ... +113 °F) $T_{d/f}$
Accuracy	Up to ±2 °C (±3.6 °F) $T_{d/f}$
	See accuracy graph
Response time 63 % [90 %] [1]	
From dry to wet	5 s [15 s]
From wet to dry	45 s [8 min]
Temperature	
Measurement range	0 ... +80 °C (+32 ... +176 °F)
Accuracy	±0.2 °C at room temperature
Temperature sensor	Pt100 RTD Class F0.1 IEC 60751
Relative humidity	
Measurement range	0 ... 70 %RH
Accuracy (RH <10 %RH, at + 20 °C)	±0.004 %RH + 20% of reading
Concentration by volume (ppm)	
Measurement range (typical)	10 ... 2500 ppm
Accuracy (at + 20 °C, 1 bar)	1 ppm + 20% of reading

1)   *Tested with sintered filter.*
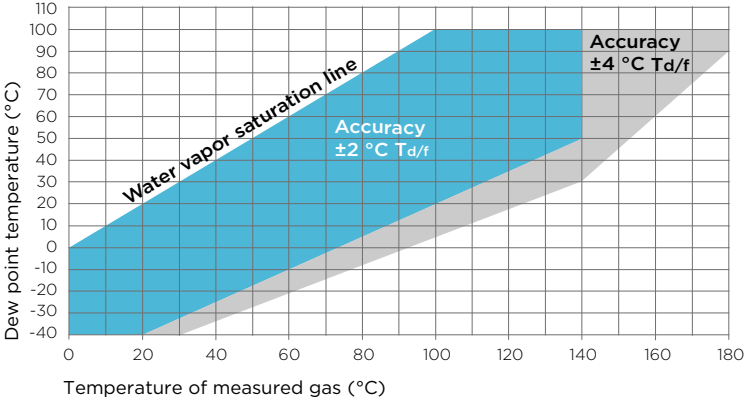
Figure 31   DMP7 dew point accuracy vs. measurement conditions

Table 16   DMP7 operating environment

Property	Description/Value
Operating temperature for probe head	−40 ... +80 °C (−40 ... +176 °F)
Operating temperature for probe body	−40 ... +80 °C (−40 ... +176 °F)
Storage temperature	−40 ... +80 °C (−40 ... +176 °F)
Operating pressure for probe head	0 ... 10 bar (0 ... 145 psia)
Measurement environment	For air, nitrogen, hydrogen, argon, helium, oxygen [1], and vacuum
IP rating for probe body	IP66
EMC compatibility	EN61326-1, Industrial environment
Mechanical durability of probe head	Up to +180 °C (+356 °F) Up to 10 bar/145 psia

1) Consult Vaisala if other chemicals are present. Consider safety regulations with flammable gases.

Table 17   DMP7 inputs and outputs

Property	Description/Value
Operating voltage	15 ... 30 VDC
Current consumption	10 mA typical, 500 mA max.
Digital output	RS-485, non-isolated

Property	Description/Value
Protocols	Modbus RTU
Output parameters	
Relative humidity, temperature, dew point temperature, absolute humidity, mixing ratio, water concentration, water vapor pressure, water vapor saturation pressure, enthalpy	

Table 18   DMP7 mechanical specifications

Property	Description/Value
Connector	M12 5-pin A-coded male
Weight	310 g (10.9 oz) with 2 m (6.56 ft) cable
Probe cable length	2 m (6.56 ft) or 10 m (32.8 ft)
Materials	
Probe	AISI316L
Probe body	AISI316L
Cable jacket	FEP
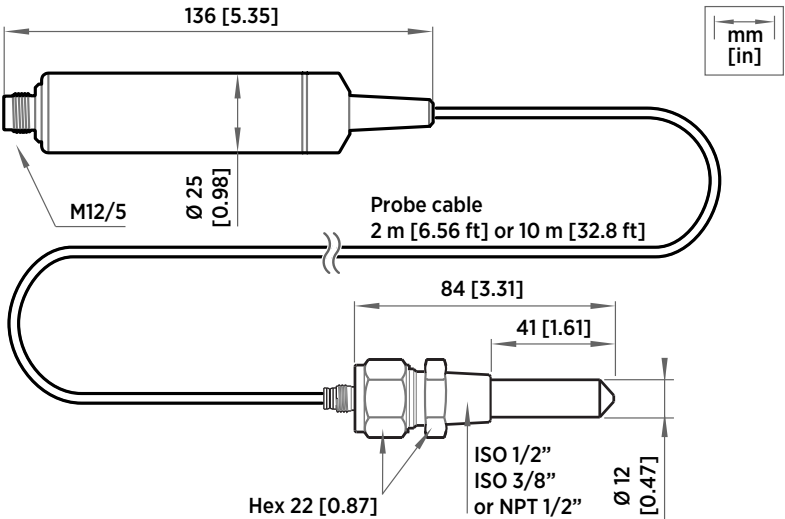
Figure 32   DMP7 dimensions

9.4 DMP8 specifications

Table 19   DMP8 measurement performance

Property	Description/Value
Dew point	
Sensor	DRYCAP® 180M
Measurement range	−70 … +80 °C (−94 … +176 °F) $T_{d/f}$
Measurement range for continuous use	−70 … +45 °C (−94 … +113 °F) $T_{d/f}$
Accuracy up to 20 bar/290 psia	±2 °C/±3.6 °F $T_{d/f}$ See accuracy graph
Accuracy, 20 … 40 bar/290 … 580 psia	Additional inaccuracy +1 °C $T_{d/f}$
Response time 63 % [90 %] [1]	
From dry to wet	5 s [15 s]
From wet to dry	45 s [8 min]
Temperature	
Measurement range	0 … +80 °C (+32 … +176 °F)
Accuracy	±0.2 °C at room temperature
Temperature sensor	Pt100 RTD Class F0.1 IEC 60751
Relative humidity	
Measurement range	0 … 70 %RH
Accuracy (RH <10 %RH, at + 20 °C)	±0.004 %RH + 20% of reading
Concentration by volume (ppm)	
Measurement range (typical)	10 … 2500 ppm
Accuracy (at + 20 °C, 1 bar)	1 ppm + 20% of reading

1)   Tested with sintered filter.

Figure 33   DMP8 dew point accuracy vs. measurement conditions

Table 20   DMP8 operating environment

Property	Description/Value
Operating temperature for probe head	−40 ... +80 °C (−40 ... +176 °F)
Operating temperature for probe body	−40 ... +80 °C (−40 ... +176 °F)
Storage temperature	−40 ... +80 °C (−40 ... +176 °F)
Operating pressure for probe head	0 ... 40 bar (0 ... 580 psia)
Measurement environment	For air, nitrogen, hydrogen, argon, helium, oxygen [1], and vacuum
IP rating	IP66
EMC compatibility	EN61326-1, Industrial environment
Mechanical durability of probe head	Up to +180 °C (+356 °F) Up to 70 bar/1015 psia

[1]   *Consult Vaisala if other chemicals are present. Consider safety regulations with flammable gases.*

Table 21   DMP8 inputs and outputs

Property	Description/Value
Operating voltage	15 ... 30 VDC
Current consumption	10 mA typical, 500 mA max.
Digital output	RS-485, non-isolated

Property	Description/Value
Protocols	Modbus RTU
Output parameters	
Relative humidity, temperature, dew point temperature, absolute humidity, mixing ratio, water concentration, water vapor pressure, water vapor saturation pressure, enthalpy	

Table 22   DMP8 mechanical specifications

Property	Description/Value
Connector	M12 5-pin A-coded male
Weight	512 g (18.1 oz)
Probe cable length	2 m (6.56 ft)
Materials	
Probe	AISI316L
Probe body	AISI316L
Cable jacket	FEP
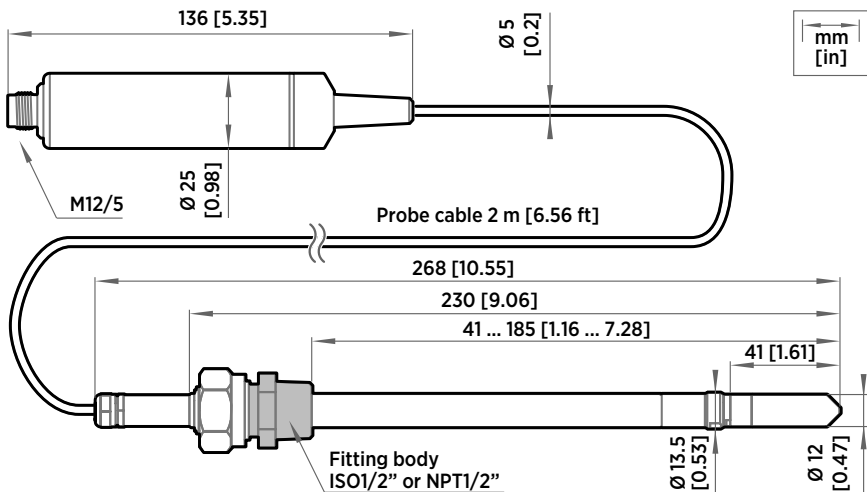
Figure 34   DMP8 dimensions

9.5 Accessories and spare parts

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

Connection cables

Table 23 Connection cables

Description	Item code
Connection cable, M12-5F - M12-5M, 1 m	INDIGOCABLE1M
Connection cable, M12-5F - M12-5M, 3 m	INDIGOCABLE3M
Connection cable, M12-5F - M12-5M, 5 m	INDIGOCABLE5M
Connection cable, M12-5F - M12-5M, 10 m	INDIGOCABLE10M
Connection cable, M12-5F - open wires, 1.5 m	223263SP
Connection cable, M12-5F - open wires, 10 m	216546SP
Connection cable, M12-5F 90° - open wires, 0.6 m	244669SP
Flat cable, M12-5F - M12-5M, 1 m	CBL210493SP
USB PC connection cable [1]	242659

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

DMP5

Table 24 DMP5 accessories

Description	Vaisala item code
Mounting flange	210696

Table 25 DMP5 spare parts

Description	Vaisala item code
Sintered stainless steel filter	HM47280SP

DMP6

Description	Vaisala item code
Cooling set	DMP246CS

Description	Vaisala item code
Sintered stainless steel filter (Ø 20 mm) for cooling set	HM46780

DMP7

Description	Vaisala item code
Swagelok ISO 3/8"	SWG12ISO38
Swagelok ISO 1/2"	SWG12ISO12
Swagelok NPT 1/2"	SWG12NPT12

Description	Vaisala item code
Sintered stainless steel filter	HM47280
Stainless steel filter for vacuum	HM47453

DMP8

Description	Vaisala item code
Fitting body R 1/2" ISO with leak screw	ISOFITBODASP
Fitting body R 1/2" ISO (no leak screw)	DRW212076SP
Fitting body NPT1/2" (no leak screw)	NPTFITBODASP
Sampling cell	DMT242SC
Sampling cell with Swagelok connectors	DMT242SC2

Description	Vaisala item code
Ball valve set for pressurized pipelines	BALLVALVE-1
Duct installation flange for R1/2" ISO thread	DM240FASP
Thread adapter ISO 1/2" to NPT 1/2"	210662SP
Blind plug ISO 1/2"	218773

Table 31   DMP8 spare parts

Description	Vaisala item code
Sintered stainless steel filter	HM47280
Stainless steel filter for vacuum	HM47453

Appendix A. Modbus reference

A.1 Default communication settings

Table 32   Default Modbus serial communication settings

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

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

A.2 Function codes

Table 33   Modbus function codes

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

A.3 Data encoding

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

> For values that have both 32-bit and 16-bit register available, use of the 32-bit register is recommended. Some values may exceed the signed 16-bit range even in normal operation.

A.3.1 32-bit floating point or integer format

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

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

Despite the specification, some Modbus masters may expect a "big-endian" word order (most significant word first). In such case, you must select "word-swapped" floating point format in your Modbus master for the Modbus registers of the device.

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

> Reading the measurement data registers with incorrect floating point format setting may occasionally result in correct-looking values. It is highly recommended to verify that you have configured the floating point format correctly on your Modbus host system by reading a floating point value from a test value register.

A.3.2 16-bit integer format

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

Table 34   Interpretation of 16-bit signed integer values

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

A.4 Modbus registers

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

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

A.4.1 Measurement data registers

Table 35   Floating point measurement data registers (read-only)

Register number	Address	Register description	Data format	Unit
1	0000_{hex}	Relative humidity	32-bit float	%RH
	0001_{hex}			
3	0002_{hex}	Temperature	32-bit float	°C
	0003_{hex}			
7	0006_{hex}	Dew point temperature	32-bit float	°C
	0007_{hex}			
9	0008_{hex}	Dew/frost point temperature	32-bit float	°C
	0009_{hex}			
11	$000A_{hex}$	Dew/frost point temperature at 1 atm	32-bit float	°C
	$000B_{hex}$			
13	$000C_{hex}$	Dew point temperature at 1 atm	32-bit float	°C
	$000D_{hex}$			
15	$000E_{hex}$	Absolute humidity	32-bit float	g/m^3
	$000F_{hex}$			
17	0010_{hex}	Mixing ratio	32-bit float	g/kg
	0011_{hex}			

Register number	Address	Register description	Data format	Unit
21	0014$_{hex}$	Water concentration	32-bit float	ppm$_v$
	0015$_{hex}$			
23	0016$_{hex}$	Water vapor pressure	32-bit float	hPa
	0017$_{hex}$			
25	0018$_{hex}$	Water vapor saturation pressure	32-bit float	hPa
	0019$_{hex}$			
27	001A$_{hex}$	Enthalpy	32-bit float	kJ/kg
	001B$_{hex}$			
31	001E$_{hex}$	Dew point temperature difference	32-bit float	°C
	001F$_{hex}$			
33	0020$_{hex}$	Absolute humidity at NTP	32-bit float	g/m^3
	0021$_{hex}$			
65	0040$_{hex}$	Water mass fraction	32-bit float	ppm$_w$
	0041$_{hex}$			

Table 36 Integer measurement data registers (read-only)

Register number	Address	Register description	Data format	Scale factor	Offset	Unit
257	0100$_{hex}$	Relative humidity	16-bit signed integer	100	0	%RH
258	0101$_{hex}$	Temperature	16-bit signed integer	100	0	°C
260	0103$_{hex}$	Dew point temperature	16-bit signed integer	100	0	°C
261	0104$_{hex}$	Dew/frost point temperature	16-bit signed integer	100	0	°C
262	0105$_{hex}$	Dew/frost point temperature at 1 atm	16-bit signed integer	100	0	°C
263	0106$_{hex}$	Dew point temperature at 1 atm	16-bit signed integer	100	0	°C
264	0107$_{hex}$	Absolute humidity	16-bit signed integer	100	0	g/m^3

Register number	Address	Register description	Data format	Scale factor	Offset	Unit
265	0108$_{hex}$	Mixing ratio	16-bit signed integer	100	0	g/kg
267	010A$_{hex}$	Water concentration	16-bit signed integer	1	0	ppm$_v$
268	010B$_{hex}$	Water vapor pressure	16-bit signed integer	10	0	hPa
269	010C$_{hex}$	Water vapor saturation pressure	16-bit signed integer	10	0	hPa
270	010D$_{hex}$	Enthalpy	16-bit signed integer	100	0	kJ/kg
272	010F$_{hex}$	Dew point temperature difference	16-bit signed integer	10	0	°C
273	0110$_{hex}$	Absolute humidity at NTP	16-bit signed integer	100	0	g/m^3
289	0120$_{hex}$	Water mass fraction	16-bit signed integer	1	0	ppm$_w$

A.4.2 Diagnostic data registers

Table 37   Floating point diagnostic data registers (read-only)

Register number	Address	Register description	Data format	Unit
37	0024$_{hex}$	Sensor saturation ratio	32-bit float	%
	0025$_{hex}$			
39	0026$_{hex}$	Sensor temperature	32-bit float	°C
	0027$_{hex}$			

Table 38   Integer diagnostic data registers (read-only)

Register number	Address	Register description	Data format	Scale factor	Offset	Unit
275	0112$_{hex}$	Sensor saturation ratio	16-bit signed integer	100	0	%
276	0113$_{hex}$	Sensor temperature	16-bit signed integer	100	0	°C

A.4.3 Configuration registers

Table 39   Modbus configuration data registers (writable)

Register number	Address	Register description	Data format	Unit / Valid range
Compensation setpoints				
769	0300_{hex}	Pressure compensation setpoint	32-bit float	Unit: hPa
	0301_{hex}			Default: 1013.25 hPa
821	0334_{hex}	Temperature compensation setpoint. If a value is written to this register, probe uses it instead of its own temperature measurement.	32-bit float	Unit: °C
	0335_{hex}			
General				
1287	0506_{hex}	Extra heat on/off. Enables heating of humidity sensor when close to saturation. Measurement is disabled for the duration of heating and cooling.	16-bit boolean	0 = off (default) 1 = on
2561	$0A00_{hex}$	User information	Text	Text string of 24 bytes in UTF-8 encoding
	$0A01_{hex}$			
	$0A02_{hex}$			
	$0A03_{hex}$			
	$0A04_{hex}$			
	$0A05_{hex}$			
	$0A06_{hex}$			
	$0A07_{hex}$			
	$0A08_{hex}$			
	$0A09_{hex}$			
	$0A0A_{hex}$			
	$0A0B_{hex}$			

Purge				
773	0304$_{hex}$	Purge interval	32-bit float	Unit: min
	0305$_{hex}$			10 ... 14400
1283	0502$_{hex}$	Interval purge on/off	16-bit boolean	0 = Off 1 = On
1284	0503$_{hex}$	Startup purge on/off	16-bit boolean	0 = Off 1 = On
Filtering				
795	031A$_{hex}$	Measurement filtering factor	32-bit float	Range: 0.000 ... 1.000
	031B$_{hex}$			1.000 = Reading shows 100% of the most recent measured value (no filtering, default)
				0.01 ... 0.99 = Reading shows 1 ... 99% of the most recent measured value and part of the previous reading (filtering is applied). For example, "0.9" means that the filtered measurement reading = 90% of the most recent measured value + 10% of the previous reading.
1282	0501$_{hex}$	Enable or disable measurement filtering using the user-defined filtering factor (register 031A$_{hex}$)	16-bit boolean	0 = Off 1 = On
Communication				
1537	0600$_{hex}$	Modbus address	16-bit integer	1 ... 247 Default: 240

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

A.4.4 Status registers

Table 40   Modbus status data registers (read-only)

Register number	Address	Register description	Data format	Note
513	0200$_{hex}$	Error status	16-bit boolean	**0000$_{hex}$**: One or more errors active
				0001$_{hex}$: No errors

Register number	Address	Register description	Data format	Note
514	0201_{hex}	Online status	16-bit boolean	**0000_{hex}**: Output locked **0001_{hex}**: Online data available
516	0203_{hex} 0204_{hex}	Error code	32-bit signed integer	See Table 41 (page 69).
518	0205_{hex} 0206_{hex}	Security hash	32-bit signed integer	Security hash changes when any change is made to device settings or adjustments.
520	0207_{hex}	RH measurement status	16-bit signed integer	**0000_{hex}**: Status OK **0002_{hex}**: Reading is not reliable
521	0208_{hex}	T measurement status	16-bit signed integer	**0004_{hex}**: Under range
522	0209_{hex}	$T_{d/f}$ measurement status	16-bit signed integer	**0008_{hex}**: Over range **0020_{hex}**: Value locked **0080_{hex}**: Sensor failure **0100_{hex}**: Measurement not ready
523	$020A_{hex}$	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

Table 41   Error codes in register 0203_{hex}

Bitmask	Error message	Severity
0000_{hex}	Status OK	
0001_{hex}	Temperature measurement error	Error
0002_{hex}	Humidity measurement error	Error
0004_{hex}	Humidity sensor failure	Error
0008_{hex}	Capacitance reference error	Error

Bitmask	Error message	Severity
0010$_{hex}$	Ambient temperature out of range	Error
800000$_{hex}$	Sensor heater failure	Warning

A.4.5 Test value registers

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

Table 42   Modbus test registers (read-only)

Register number	Address	Register description	Data format	Test value
7937	1F00$_{hex}$	Signed integer test	16-bit integer	-12345
7938	1F01$_{hex}$	Floating point test	32-bit float	-123.45
	1F02$_{hex}$			
7940	1F03$_{hex}$	Text string test	text	Text string "-123.45"
	1F04$_{hex}$			
	1F05$_{hex}$			
	1F06$_{hex}$			

A.5 Device identification objects

Table 43   Device identification objects

Object ID	Object ID (hexadecimal)	Object name	Example contents
0	00$_{hex}$	VendorName	"Vaisala"
1	01$_{hex}$	ProductCode	"DMP7"
2	02$_{hex}$	MajorMinorVersion	"1.2.3" Software version of the device.
3	03$_{hex}$	VendorUrl	"http://www.vaisala.com/"
4	04$_{hex}$	ProductName	"Dew Point and Temperature Probe DMP7"

Object ID	Object ID (hexadecimal)	Object name	Example contents
5	05_{hex}	ModelName	"7E2A2A0A000" Configuration code of the device. Length and content of the code are model-specific.
6	06_{hex}	UserApplicationName	User definable information text (see configuration register $0A00_{hex}$)
128	80_{hex}	SerialNumber [1]	"K0710040"
129	81_{hex}	CalibrationDate [1]	"2020-01-31" Calibration date in YYYY-MM-DD format. Empty string if not set/valid.
130	82_{hex}	CalibrationText [1]	"Vaisala/HEL" Calibration information text. Empty string if not set/valid.

1) *Vaisala-specific device identification object.*

A.6 Exception responses

Table 44   Modbus exception responses

Code	Name	Reason
01	ILLEGAL FUNCTION	Unsupported function code
02	ILLEGAL DATA ADDRESS	Register address or Object ID out of valid ranges
03	ILLEGAL DATA VALUE	Otherwise invalid request

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

A.7 Modbus communication examples

Reading dew point temperature value

Device address used in the following examples is 240 (F0$_{hex}$).
Measurement values returned by the device change depending on ambient conditions and/or device settings.

Request		Response	
Bytes on the line (hexadecimal)	**Description**	**Bytes on the line (hexadecimal)**	**Description**
(silence for 3.5 bytes)	Start of Modbus RTU frame	(silence for 3.5 bytes)	Start of Modbus RTU frame
F0$_{hex}$	Probe address	F0$_{hex}$	Probe address
03$_{hex}$	Function (Read Holding Registers)	03$_{hex}$	Function (Read Holding Registers)
00$_{hex}$	Register address	04$_{hex}$	Number of data bytes
06$_{hex}$		FD$_{hex}$	Value of first register (least significant word)
00$_{hex}$	Number of 16-bit registers to read (2)	F9$_{hex}$	
02$_{hex}$		41$_{hex}$	Value of second register (most significant word)
31$_{hex}$	Modbus RTU checksum	72$_{hex}$	
2B$_{hex}$		4B$_{hex}$	Modbus RTU checksum
(silence for 3.5 bytes)	End of Modbus RTU frame	14$_{hex}$	
		(silence for 3.5 bytes)	End of Modbus RTU frame

Communication description	
Register address	7 (1-based Modbus documentation format) = 0006$_{hex}$ (0-based format used in actual communication).
Data format	Two 16-bit Modbus registers interpreted as IEEE 754 binary32 floating point value, least significant word first.
Returned value	4172FDF9$_{hex}$, which is binary32 representation of 15.187 (°C T$_d$).

Writing pressure compensation value

Request		Response	
Bytes on the line (hexadecimal)	**Description**	**Bytes on the line (hexadecimal)**	**Description**
(silence for 3.5 bytes)	Start of Modbus RTU frame	(silence for 3.5 bytes)	Start of Modbus RTU frame
F0$_{hex}$	Probe address	F0$_{hex}$	Probe address
10$_{hex}$	Function (Write Multiple Registers)	10$_{hex}$	Function (Write Multiple Registers)
03$_{hex}$	Register address	03$_{hex}$	Register address
00$_{hex}$		00$_{hex}$	
00$_{hex}$	Number of registers to write (2)	00$_{hex}$	Number of 16-bit registers written (2)
02$_{hex}$		02$_{hex}$	
04$_{hex}$	Number of data bytes	54$_{hex}$	Modbus RTU checksum
6E$_{hex}$	Value for first register (least significant word)	AD$_{hex}$	
14$_{hex}$			
44$_{hex}$	Value for second register (least significant word)	(silence for 3.5 bytes)	End of Modbus RTU frame
75$_{hex}$			
4E$_{hex}$	Modbus RTU checksum		
AB$_{hex}$			
(silence for 3.5 bytes)	End of Modbus RTU frame		

ℹ The response to a write function informs that the function was correctly received by the device. It does not guarantee that the written value was accepted by the device (for example, in case out-of-range values).

To verify that the value was really accepted by the device, read the register value after writing.

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

Communication description	
Data format	Two 16-bit Modbus registers interpreted as IEEE 754 binary32 floating point value, least significant word first.
Value to write	$44756E14_{hex}$ = 981.72 (hPa)

Maintenance and calibration

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

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

Warranty

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

Technical support

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

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

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

Recycling

Recycle all applicable material.

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

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