User Guide

Vaisala DRYCAP® Dew Point Transmitter
DMT143

VAISALA

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1. About this document

1.1 Version information

This manual provides information for installing, operating, and maintaining Vaisala DRYCAP®
Dew Point Transmitter DMT143.

Table 1   Document versions (English)

Document code	Date	Description
M211435EN-K	May 2023	This manual. Added sections: • Connectivity to Indigo80 handheld indicator (page 14) • Using transmitter with Indigo80 handheld indicator (page 41) • DMT143L specifications (page 82) Updated sections: • Safety (page 19) • Configuring transmitter before installation (page 25) • Wiring (page 27) • DSC74 sampling cell with quick connector and leak screw (page 32) • Set analog output parameters and scaling (page 57) • Set analog output error notification (page 58) • Set measurement output format (page 61) • DMT143 specifications (page 79) • Dimensions (page 85) • Measurement data registers (page 90)
M211435EN-J	February 2019	Previous version. Modbus protocol added. Added information about Vaisala Insight PC software. Removed the TIME command. Added a cautionary note about changing stainless steel filter. Updated section *Troubleshooting*. Updated section *DMT143 Specifications*.
M211435EN-H	June 2017	DRYCAP® 180S sensor option for DMT143L added. Analog output accuracy specification added. Accuracy specification updated for DMT143L variant with DRYCAP® 180M sensor. Filter spare part information updated.

1.2 Related manuals

Table 2   Related manuals

Document code	Name
M212722EN	Vaisala Indigo80 Handheld Indicator User Guide
M010091EN	Vaisala Handheld Dew Point Meter DM70 User Guide
M211434EN	Vaisala DMT143 Dew Point Transmitter Quick Guide
M211634EN	Wiring Nokeval 201/301/302 Loop-Powered Displays with DMT143 and DMT152 Dew Point Transmitters

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.

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 DMT143

Vaisala DRYCAP® Dew Point Transmitter DMT143 is a small and lightweight dew point transmitter suitable for a wide range of OEM applications. DMT143 is easy to install and the mechanics have been designed for harsh environments requiring protection against dust, dirt and splashed water.

There are 2 variants of the DMT143 transmitter, DMT143 and DMT143L. DMT143 and DMT143L offer different sensor, installation, and output options to meet the requirements of varying dew point measurement applications.

- DMT143 with DRYCAP 180D sensor:
  - Either G1/2″ ISO228/1 or NPT1/2″ mechanical connection
  - Measurement range −70 ... +60 °C (−94 ... +140 °F)
  - Operating pressure up to 50 bar_a (725 psi_a)
  - Voltage (V) or current (mA) analog output [1]
  - RS-485 digital output with Modbus RTU support
- DMT143L with DRYCAP 180M sensor:
  - G1/2″ ISO228/1 mechanical connection
  - Measurement range −70 ... + 60 °C° (−94 ... +140 °F)
  - Operating pressure 0 ... 20 bar_a (0 ... 290 psi_a)
  - Current (mA) analog output [1]
  - RS-485 digital output with Modbus RTU support
- DMT143L with DRYCAP 180S sensor:
  - G1/2″ ISO228/1 mechanical connection
  - Measurement range −50 ... + 60 °C° (−58 ... +140 °F)
  - Operating pressure 0 ... 20 bar_a (0 ... 290 psi_a)
  - Current (mA) analog output [1]
  - RS-485 digital output with Modbus RTU support

The accuracies of the different sensors used in DMT143 and DMT143L have been optimized for different parts of the sensors' measurement ranges.

DMT143 transmitters use the Vaisala DRYCAP polymer sensor for dew point measurement. DRYCAP technology has low maintenance needs due to its excellent long term stability and durability against condensation. The calibration interval of DMT143 transmitters is 2 years.

Table 3   Output parameters of the DMT143

Parameter	Abbreviation	Metric unit	Non-metric unit
Dew point/frost point temperature	$T_{d/f}$	°C	°F
Dew point/frost point temperature, converted to atmospheric pressure	$T_{d/f}$atm	°C	°F

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1)   *The analog output is not available in devices ordered with digital output only.*

Parameter	Abbreviation	Metric unit	Non-metric unit
ppm moisture, by volume	H_2O	ppm	ppm

ℹ️ When dew point is below 0 °C, the transmitter outputs frost point for Td.

Dew point temperature in atmospheric pressure ($T_{d/f}$ atm) is a calculated parameter that presents the dew point the gas would have at atmospheric pressure. For this calculation to provide accurate results, it is important to have the correct pressure setting stored in the transmitter. This setting is specified on the order form, and it can be changed using the RS-485 line, the DM70 handheld dew point meter, or the Indigo80 handheld indicator.

More information

2.2 Basic features and options

- Maximum dew point measurement range of −70 ... +60 °C (−94 ... +140 °F)
- Dew point measurement accuracy up to ±2 °C (±5.4 °F) T_d in air or N_2
- Operating pressure range:
    - DMT143: 0 ... 50 bar_a (725 psi_a)
    - DMT143L: 0 ... 20 bar_a (0 ... 290 psi_a)
- Configurable for optimum dew point measurement accuracy: Pressure compensation (fixed pressure setting or live pressure input through RS-485)
- Analog output: one output channel, selectable from the following options when ordering the device:
    - 0 ... 1 V (DMT143 only)
    - 0 ... 5 V (DMT143 only)
    - 1 ... 5 V (DMT143 only)
    - 4 ... 20 mA (DMT143 and DMT143L)
    - None (DMT143 and DMT143L, digital output only)
- Digital output: RS-485 (non-isolated). The following protocols are supported:
    - Modbus RTU
    - Vaisala Industrial Protocol
- LED for dew point level alarm and transmitter diagnostics
- DRYCAP® polymer sensor:
    - Autocalibration ensures accuracy in changing measurement conditions
    - Sensor warming keeps the sensor dry in high humidity
    - Sensor purge ensures long term stability
- NIST traceable (certificate included)
- Field check suitability with DM70 handheld dew point meter or Indigo80 handheld indicator

- Optional accessories:
    - Stainless steel grid filter for vacuum applications
    - Sampling cells with various installation options
    - Loop-powered external display
    - Connection cable for DM70 handheld dew point meter
    - Plastic shipping case to avoid contamination during shipping

More information

2.2.1 Connectivity to Vaisala Insight software

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

- See device information and status.
- See real-time measurement.
- Configure serial communication settings, filtering factor, alarm LED, and analog output parameters and scaling.

More information

2.2.2 Connectivity to Indigo80 handheld indicator

The transmitter can be connected to Vaisala Indigo80 handheld indicator using an M12 - M8 service cable (Vaisala item code 262195SP).

With the indicator, you can:

- See real-time measurements and device and status information
- Log measurement data
- Configure transmitter features and settings such as compensation setpoints, serial communication, and analog output.

More information

2.3 DMT143 and DMT143L transmitter parts

2.3.1 DMT143 with G1/2" ISO228/1 thread
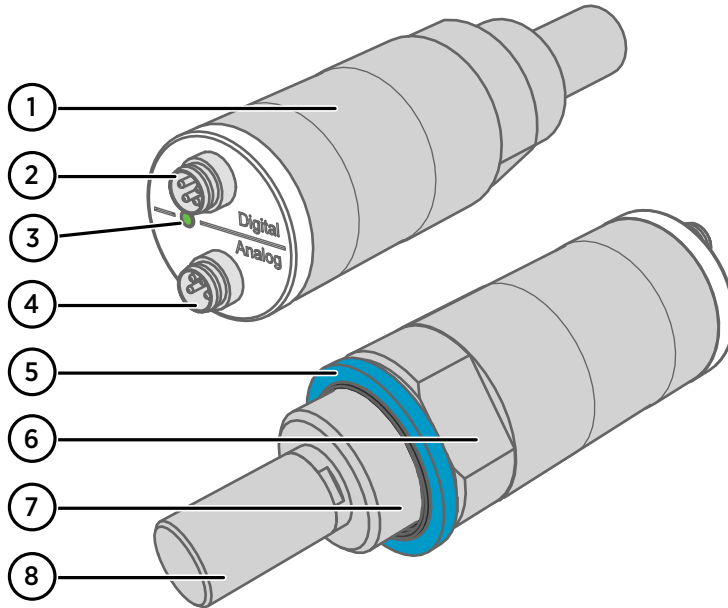
Figure 1   DMT143 parts – model with ISO thread

1   Transmitter body. Type label is applied here.
2   Digital output: non-isolated RS-485
3   Alarm LED
4   Analog output
5   Sealing ring. Must be used with the G1/2" ISO228/1 connection thread.
6   24 mm nut
7   Connection thread: G1/2" ISO228/1
8   DRYCAP® 180D sensor protected with sintered filter

> When the transmitter is delivered, the filter is protected by a yellow transport protection cap that keeps the sensor dry. The transport protection cap should be left on the transmitter during storage. Remove the transport protection cap before installing the transmitter.

2.3.2 DMT143 with NPT thread
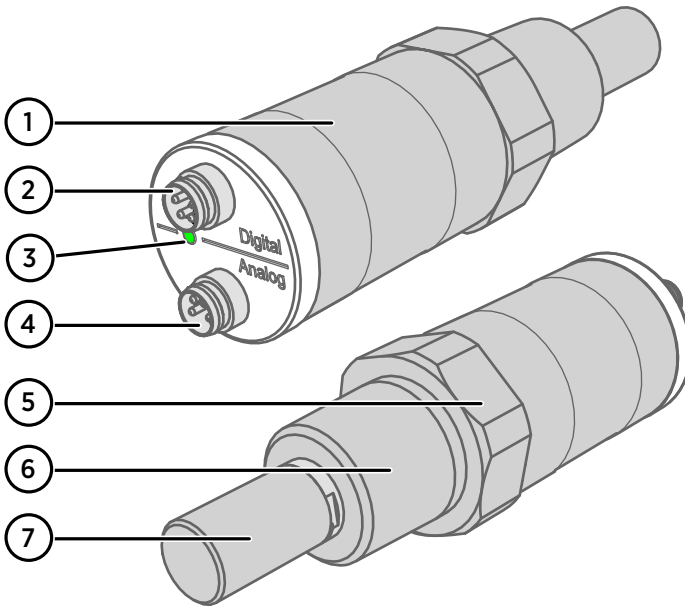
Figure 2   DMT143 parts – model with NPT thread

1   Transmitter body. Type label is applied here.
2   Digital output: non-isolated RS-485
3   Alarm LED
4   Analog output
5   30 mm nut
6   Connection thread: NPT 1/2″
7   DRYCAP® 180D sensor protected with sintered filter

2.3.3 DMT143L with G1/2" ISO228/1 thread
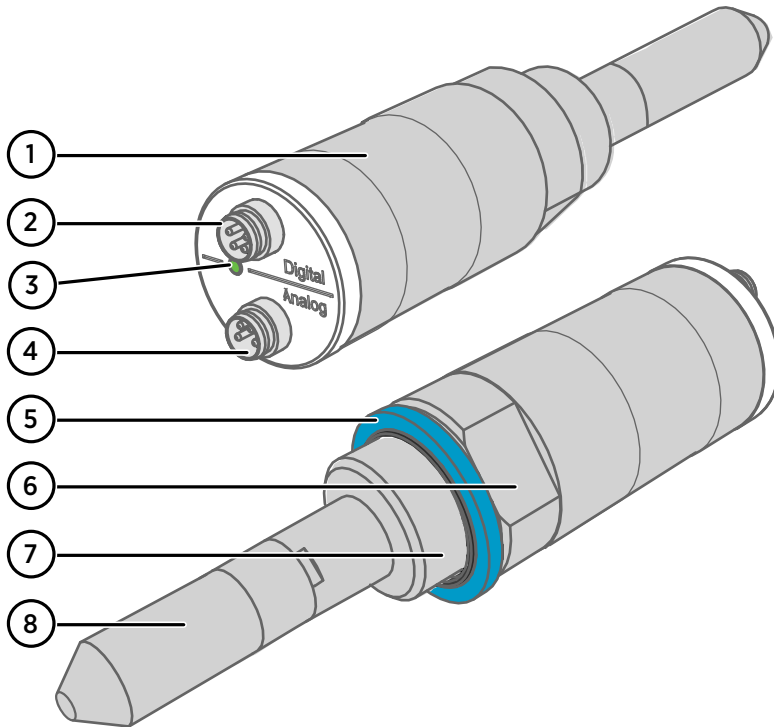
Figure 3   DMT143L parts

1   Transmitter body. Type label is applied here.
2   Digital output: non-isolated RS-485
3   Alarm LED
4   Analog output
5   Sealing ring. Must be used with the G1/2" ISO228/1 connection thread.
6   24 mm nut
7   Connection thread: G1/2" ISO228/1
8   DRYCAP® 180M or DRYCAP® 180S sensor protected with sintered filter

2.4 Loop-powered display

DMT143 can be connected to a loop-powered external LED display. The display provides a reading of the output parameter. The display is powered by the 4 … 20 mA current signal, so there is no need for an external power supply.

Two models are available:

- Nokeval 301
- Nokeval 302 (with alarm relays)

The display is delivered at its default settings. Configure the display functions and scaling according to the documentation delivered with the display. For a wiring example, see Nokeval 301/302 Display Wiring Diagram (document code M211634EN).

Figure 4   Nokeval 301 loop-powered display

> ℹ️ The loop resistance of the display must be included in the loop resistance calculation for the complete current loop. For the loop resistance of the display, refer to the manufacturer's documentation.

More information

‣ Spare parts and accessories (page 86)

2.5 Connection cables

Vaisala supplies shielded cables with M8 female straight threaded connector, heavy duty cables, and cables for service and field check use. For the cable offering, see Spare parts and accessories (page 86) or visit store.vaisala.com.

2.6 Sampling accessories

DMT143 is compatible with various sampling accessories.

More information

2.7 Safety

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

> ⚠ **WARNING!** DMT143 or DMT143L transmitters have not been designed for use in hazardous areas with potentially explosive atmospheres created by gases or ignitable dusts. Make sure no part of the transmitter is placed in a potentially explosive atmosphere.

> ⚠ **CAUTION!** The transmitter has not been tested for leakages, which may occur especially with small-molecule gases such as hydrogen and helium.

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

> ⚠ **CAUTION!** The transmitter body does not have user serviceable parts inside, and is not designed to be opened. Opening the transmitter will void the warranty.

2.7.1 ESD protection

Electrostatic discharge (ESD) can damage electronic circuits. Vaisala products are adequately protected against ESD for their intended use. However, it is possible to damage the product by delivering electrostatic discharges when touching, removing, or inserting any objects in the equipment housing.

To avoid delivering high static voltages to the product:

• Handle ESD-sensitive components on a properly grounded and protected ESD workbench or by grounding yourself to the equipment chassis with a wrist strap and a resistive connection cord.
• If you are unable to take either precaution, touch a conductive part of the equipment chassis with your other hand before touching ESD-sensitive components.

- Hold component boards by the edges and avoid touching component contacts.

3. Functional description

3.1 DRYCAP technology

Vaisala DRYCAP dew point measurement technology ensures accurate measurement with excellent long term stability. This results in very low maintenance requirements for the transmitter. The lasting performance is achieved with microprocessor technology and software that automatically performs self-diagnostic functions in addition to the normal dew point measurement. The self-diagnostic procedures that are conducted are called autocalibration, sensor purge, and sensor warming.

DMT143 and DMT143L use different versions of the Vaisala DRYCAP sensor:

- DMT143 uses the DRYCAP 180D sensor designed for applications such as plastic dryers and small industrial compressed air dryer (sensor filter length 22.5 mm, probe length 91.6 mm).
- DMT143L can be ordered with two versions of the DRYCAP180 sensor: either the 180M sensor designed for standard dry gas and desiccant dryer applications, or the 180S sensor designed for more humid applications such as refrigeration dryers. The sensor filter length of both DMT143L variants is 51 mm, probe length 120 mm.

3.1.1 Autocalibration

The autocalibration feature of the DMT143 transmitter is an automatic procedure which greatly reduces the possible drift in the dry end of the dew point measurement. It is performed at 1-hour intervals, and when the power is switched on. When measuring very dry conditions, the transmitter performs the autocalibration at shorter intervals. A significant change in dew point or temperature may also trigger the autocalibration.

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 the autocalibration the transmitter outputs the T_d value prior to the procedure.

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.

3.1.2 Sensor purge

Sensor purge is also an automatic procedure that minimizes the drift at the wet end readings of the dew point measurement. Sensor purge is performed once a day or when the power is switched on. The sensor is heated for several minutes which will then evaporate 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. During the sensor purge the transmitter outputs the T_d value prior to the procedure.

3.1.3 Sensor warming in high humidities and freezing conditions

DMT143 has a sensor warming feature that improves the sensor's performance in high humidities and freezing conditions. Sensor warming does not interrupt the transmitter's T_d value output.

In high humidity, sensor warming prevents the sensor and filter from becoming wet. High humidity may be present when the dew point temperature rises close to the gas temperature.

Sensor warming is switched on automatically when the humidity in the measured gas increases to a level where dew can start to form. The advantage of sensor warming is the rapid response of dew point measurement. A wet sensor and filter would otherwise result in a dew point equal to ambient temperature (that is, RH = 100 %).

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, DMT143 uses sensor warming to maintain the sensor temperature above 0 °C.

> **i** When measuring in temperatures below 0 °C, the supply voltage must be 24 ... 28 V DC.

More information

‣ Power supply requirements (page 28)

3.2 DMT143 startup sequence

When the transmitter is powered up, it will perform the sequence (applicable from software version 1.1.5 onward) shown in Figure 5 (page 23). After a 2-second startup, the transmitter will measure normally for 40 seconds, after which it will perform the sensor purge and autocalibration functions. This can take up to 5 minutes, during which time the output is frozen: it will display the last measured values before the sensor purge began.

The autocalibration function may be postponed if the measurement environment is not suitable. For example, the environment may be changing rapidly or have too high humidity.

Normal operation and output is typically achieved no later than 6 minutes after startup. The sensor purge repeats every 24 hours (12 h default interval for the DMT143L variant with DRYCAP 180S sensor if used with purge), and autocalibration every hour. The output will again be frozen for their duration.
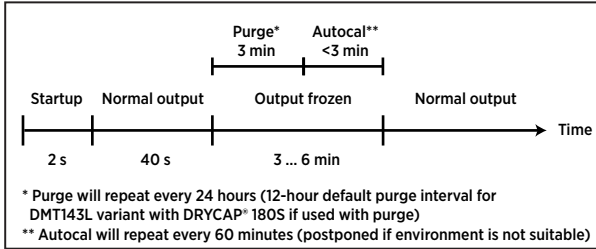
Figure 5   DMT143 startup sequence

ℹ️ The transmitter always performs this sequence when starting up. Keep the transmitter continuously powered to optimize its measurement performance and availability.

ℹ️ The DMT143L variant with DRYCAP 180S sensor can be used as a replacement of the DMT242 transmitter and ordered without the purge functionality. If you use purge with the DMT143L variant with DRYCAP 180S, the default purge interval is 12 hours.

More information

‣ DRYCAP technology (page 21)

3.3 Alarm LED

The alarm LED at the back of the transmitter provides a visual indication of the transmitter's status. The alarm LED functionality is preset at the factory according to order form. You can configure it as follows:

• You can use Vaisala Insight software or the **ALARM** command on the serial line to change the alarm limit, enable/disable the dew point alarm, or turn on/off the LED completely.
• You can change the alarm limit using the DM70 handheld dew point meter.

Table 4   Alarm LED states

LED color	Meaning
Not lit	Power off or LED functionality disabled.
Green	Power on, normal measurement.
Green and blinking	Purge or autocalibration in progress, measurement frozen.
Red	Dew point above limit.
Red and blinking	Transmitter error.

More information

‣ Vaisala Insight PC software (page 39)
‣ Using transmitter with DM70 handheld dew point meter (page 47)
‣ Configure alarm LED (page 69)

4. Installation

4.1 Configuring transmitter before installation

You may wish to configure your transmitter before physically installing it. For easy access to configuration options, use either Vaisala Insight PC software with the USB service cable (item code 219690), or connect to the serial line using the USB service cable and a terminal program on a PC.

Some configuration settings can also be changed using the Indigo80 handheld indicator or the DM70 handheld meter.

Examples of configurable settings for analog output:
1. Analog output parameter and scaling.
2. Analog output error level.

Examples of configurable settings for RS-485 output:
1. By default, DMT143 transmitters are configured for single transmitter operation. Serial operation mode is **STOP** and address is **0**.
   To configure transmitters for operation on a common line, you must give each transmitter a unique address (range 0 … 255) and set their serial operation mode to POLL.
2. The default serial line settings may not be right for your RS-485 line.
3. You may need to change the transmitter's serial output format to suit your needs.

More information

‣ Vaisala Insight PC software (page 39)
‣ Using transmitter with Indigo80 handheld indicator (page 41)
‣ Using transmitter with DM70 handheld dew point meter (page 47)
‣ Connecting to the serial interface (page 50)

4.2 Selecting the location

It is important that the point of installation represents well the gas to be measured. Temperature changes do not affect the dew point measurement, but pressure changes will have an effect on the measurement. All leaks in the system must be eliminated to avoid ambient humidity affecting the measurement.

Direct installation to the measured gas is the recommended installation method if the temperature of the gas is suitable for DMT143 and no additional filtering is needed due to very dusty or oily gas. Oil as such is not harmful for the DRYCAP® sensor, but response time may be slower if there are oil particles in the system, or if oil is collected to the filter over a longer period of time. The maximum measurement pressure is 50 bar$_a$ / 725 psi$_a$ (absolute pressure) for direct measurement.

If the gas temperature is higher than the specified maximum operating temperature of the transmitter, gas sampling and cooling it to ambient temperature (for example, 20 °C / 68 °F) is recommended. Note that the dew point temperature must be clearly lower than the ambient temperature to avoid condensation in the sampling line. Sampling from the process is easy by using Vaisala sampling cell options.

The DMT143 is light in weight, which means that it can be installed in a sample pipeline in the sampling cells without the need of any additional mechanical support. You can use a standard G1/2″ T-shaped pipe fitting (not available from Vaisala) when installing DMT143 into a pipeline.

More information

‣ Sampling accessories (page 31)

4.3 Installing the transmitter

▶ 1. Remove the yellow transport protection cap from the transmitter.
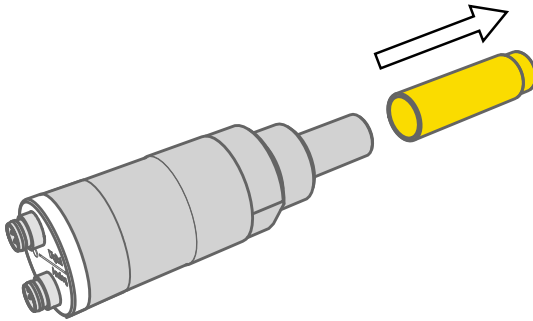
2. The DMT143 models with a parallel thread (G1/2″ ISO 228/1) require a sealing ring for a tight connection. Use the sealing ring that is provided with the transmitter. Make sure the threads on the mounting point match your transmitter.

   For the model with NPT thread, do not use a sealing ring.
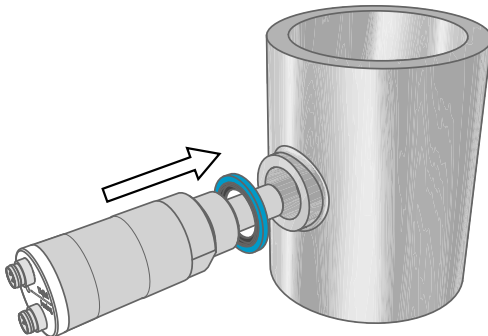
3. Tighten the connection by turning with a wrench (max. 50 Nm). Wrench size is 24 mm for ISO threaded transmitters, 30 mm for NPT threaded model.
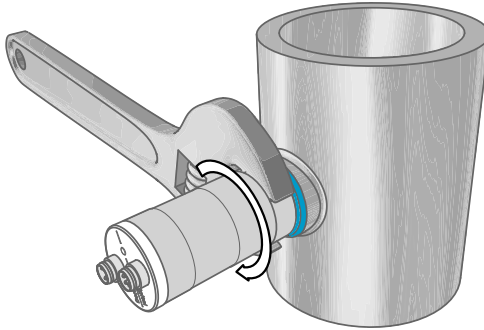
4. Connect the signal and power cable to the DMT143.

More information

‣ Wiring (page 27)
‣ Power supply requirements (page 28)

4.4 Wiring

⚠️ **CAUTION!** The power supply lines are internally connected. You can use either one of them, but do not connect more than one supply voltage in permanent installations. Temporary simultaneous use with the USB service cable, DM70 handheld dew point meter, or Indigo80 handheld indicator (which also supply power) is fine.

Table 5   Connector pinouts

Pin	Analog connector	Digital connector	Wire color
1	V DC supply+	V DC supply+	Brown
2	Ch-	RS-485 D0-	White
3	GND	GND	Blue
4	Ch+	RS-485 D1+	Black
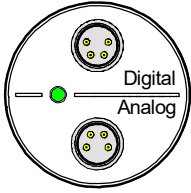
Figure 6   DMT143 digital and analog connectors
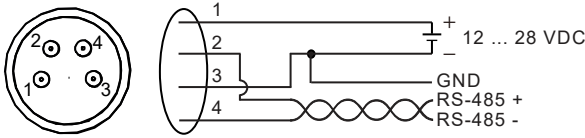
Figure 7   Wiring the digital connector
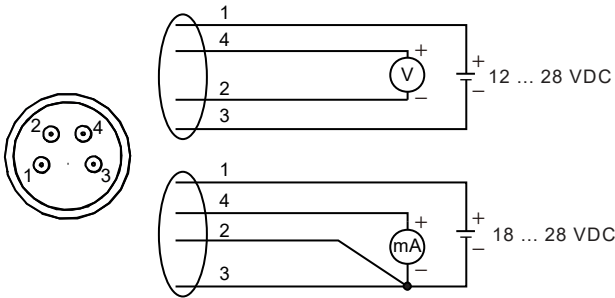
Figure 8   Wiring the analog connector

4.4.1 Power supply requirements

The minimum supply voltage required by the DMT143 transmitter depends on the analog output type that is used:

- For voltage output: 12 ... 28 VDC.
- For current output: 18 ... 28 VDC. The maximum load is 500 Ω.

The power supply should maintain the voltage for all load conditions.

If measuring in pressures above 20 bar_a (290 psi_a) or temperatures below 0 °C, the supply voltage must be 24 ... 28 V DC.

Current consumption during normal operation is <10 mA. The consumption increases during the sensor self-diagnostics (autocalibration and sensor purge). Typical current consumption is 220 mA pulsed current.

ℹ️ The DMT143 can be powered by Indigo80 indicator, MI70 indicator, or USB service cable. You can plug in Indigo80, MI70, or the USB service cable to the digital port while the transmitter is powered from the analog port.

The following figure shows a typical duty cycle during sensor purge at room temperature with 24 V DC supply voltage. Sensor purge current varies with supply voltage and operating temperature. The peak value is the highest in the lowest temperature.
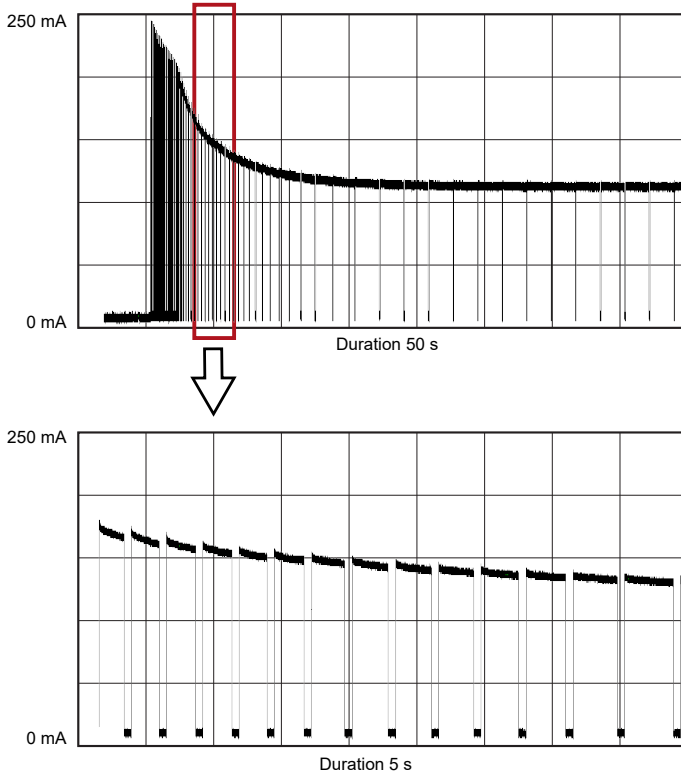
Figure 9   Example of current consumption during purge

The following figure shows a typical duty cycle during autocalibration at room temperature with 24 V DC supply voltage. Also the autocalibration current varies with supply voltage and operating temperature.
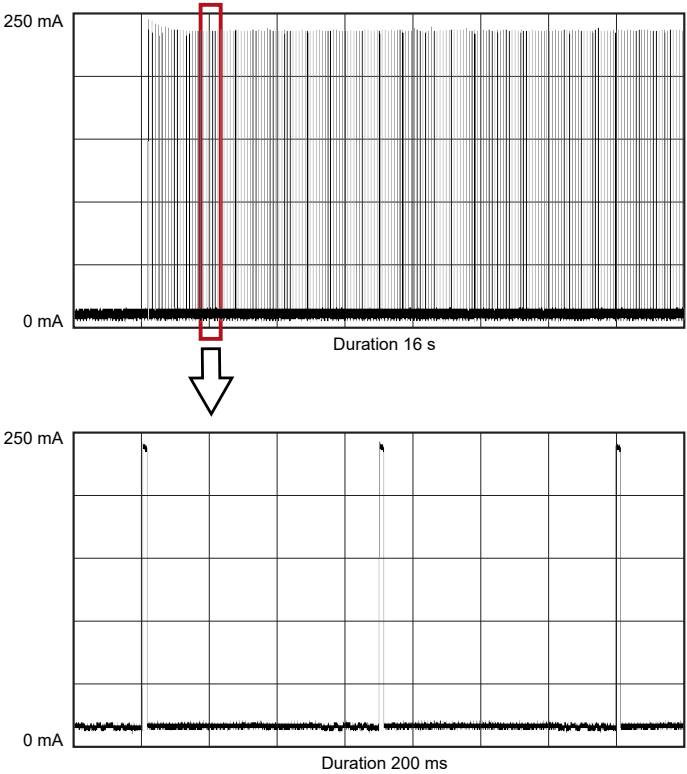
Figure 10   Example of current consumption during autocalibration

4.5 Sampling from a process

Sampling is needed when direct measurement of the air or gas is not possible or desirable. This may be related to, for example, a high process temperature, protecting the sensor from water spikes, the need to easily detach the instrument from a pressurized process without running the whole process down, or wanting to make the measurement at a more convenient location.

It is important to keep in mind that changing the pressure of a gas changes the dew point temperature of the gas. If the sensor is at a different pressure than the process itself, there may be an error of several tens of degrees in the dew point measurement.

Make sure there is sufficient flow of gas to the sensor (for example, 1 l/min) to give a representative sample.

To simulate the effect of pressure change to dew point, you can use the Vaisala Humidity Calculator at: www.vaisala.com/humiditycalculator.

4.6 Sampling accessories

4.6.1 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.

4.6.2 DMT242SC2 sampling cell with Swagelok connectors
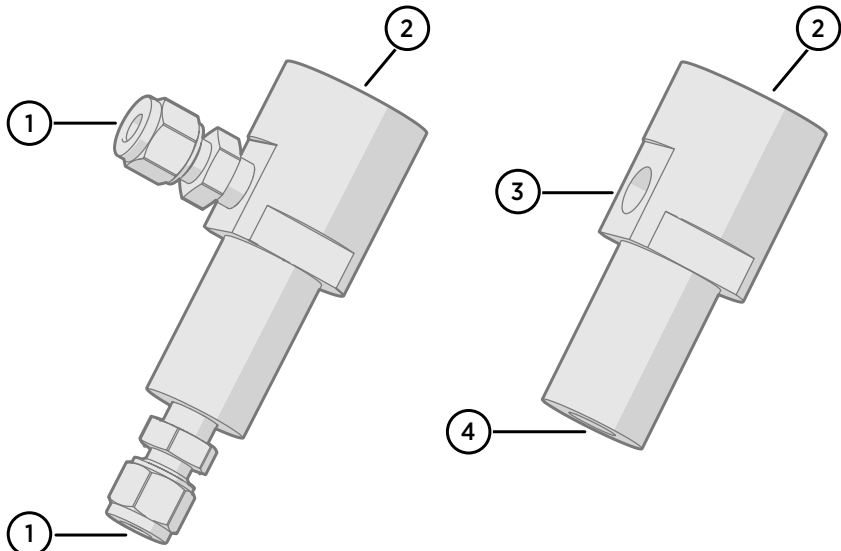
Figure 11   Sampling cells DMT242SC2 (left) and DMT242SC (right)

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

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.

4.6.3 DSC74 sampling cell with quick connector and leak screw

The DSC74 has been designed especially for compressed air lines. The sampling cell contains an adjustable leak screw that allows keeping up the pipeline pressure at the sensor. The leak screw is opened and closed with a screwdriver. The leak screw should be 1/2 turn open. This can be verified by first closing the leak screw, then turning 1/2 turn to open it. Then the air coming out will make a barely audible little hiss and it can be lightly felt when putting a hand in front of the air stream.

> **ℹ** Do not open the leak screw more than 1/2 turn to avoid reducing the pressure in the sampling cell.

The DSC74 comes with a quick connector that fits to industry standard compressed air line connectors (suitable for type D, Quick08, NIP08). This allows for easy installation and detachment of the dew point transmitter without having to shut down the process. Alternative ways to connect are through the two different thread adapters (R3/8″ to R1/2″ and G3/8″ to G1/4″ ISO) that are supplied with each DSC74 unit.

When using the DSC74, seal the threads of the quick connector or thread adapter carefully with PTFE thread seal tape. Tighten with an open-end wrench.
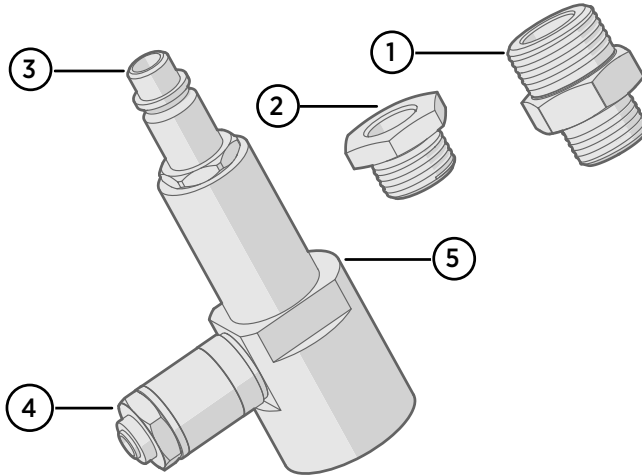
Figure 12   DSC74 sampling cell with accessories

1   Thread adapter type R3/8″ to R1/2″
2   Thread adapter type G3/8″ - G1/4″
3   Quick connector
4   Leak screw
5   Sampling cell body (DMT242SC)

4.6.4 DSC74B two-pressure sampling cell

The DSC74B and DSC74C sampling cells are enhanced versions of the DSC74. The body is designed in a way that it is possible to measure at both system pressure and atmospheric pressure.

The DSC74B limits the flow rate with a fixed leak screw. The flow is optimized for pressures 3 ... 10 barg. The fixed leak screw eliminates the risk of opening the leak screw fully by accident and this way emptying a gas vessel. The maximum flow can be increased, if needed, by removing the leak screw and adjusting the flow manually with the valve. Harmful gases can be recovered by connecting a collection system at the outlet (not available from Vaisala).

In the basic operation of the DSC74B, the gas flows to the sensor from the front and the outlet is on the side. To have the measurement done at atmospheric pressure, the inlet and outlet are reversed. Then the reducing parts supplied (G3/8″ - G1/2″ or G3/8″ - G1/4″) on the outlet side help to protect the sensor from ambient humidity coming in.

DSC74B parts are:
- Sampling cell, thread G3/8″
- Connection part with a needle valve and an integrated leak screw
- Reducing Nipple (thread adapter), G3/8″ - G1/2″
- Reducing Adapter (thread adapter), G3/8″ - G1/4″
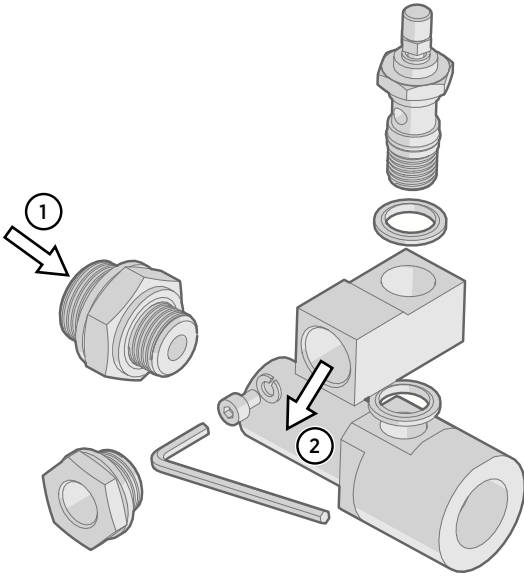
Figure 13   DSC74B

1   Gas goes in
2   Gas comes out

Figure 14   Removing the leak screw

4.6.4.1 DSC74C two-pressure sampling cell with coil

The DSC74C with an outlet coil is designed for the most critical measurements at atmospheric pressure. In the DSC74C, the coil is connected to the sampling cell outlet to protect the sensor from ambient humidity disturbing the measurement. The coil can also be used as a cooling coil for sampling from high temperature processes.

DSC74C parts are:
- Sampling cell, thread G3/8″
- Connection part with a needle valve and an integrated leak screw
- Reducing nipple (thread adapter), G3/8″ - G1/2″
- Reducing adapter (thread adapter), G3/8″ - G1/4″
- Diffusion coil (for measurements in atmospheric pressure)
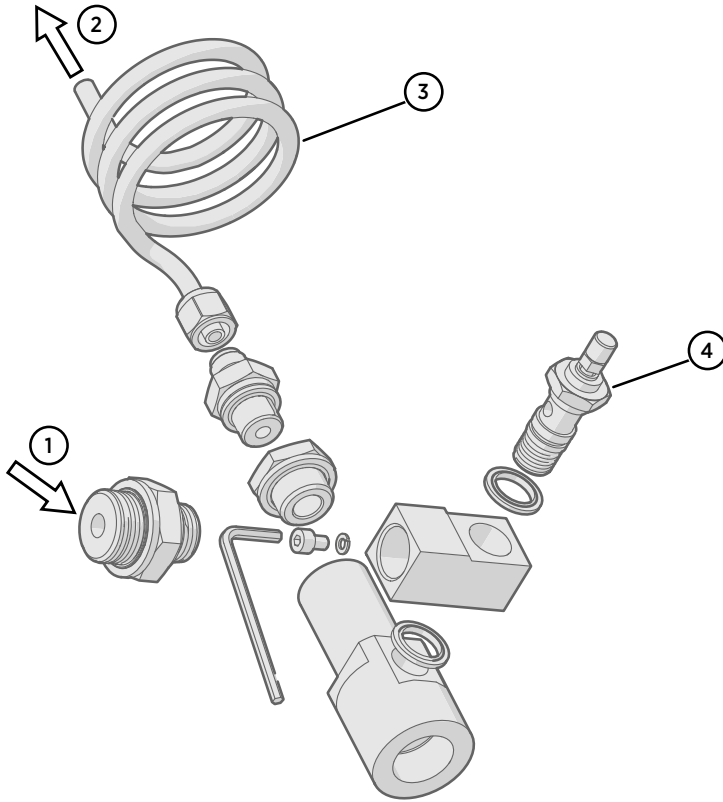
Figure 15   Default assembly of DSC74C

1   Gas goes in. The coil can also be used here.
2   Gas comes out
3   Coil
4   Valve
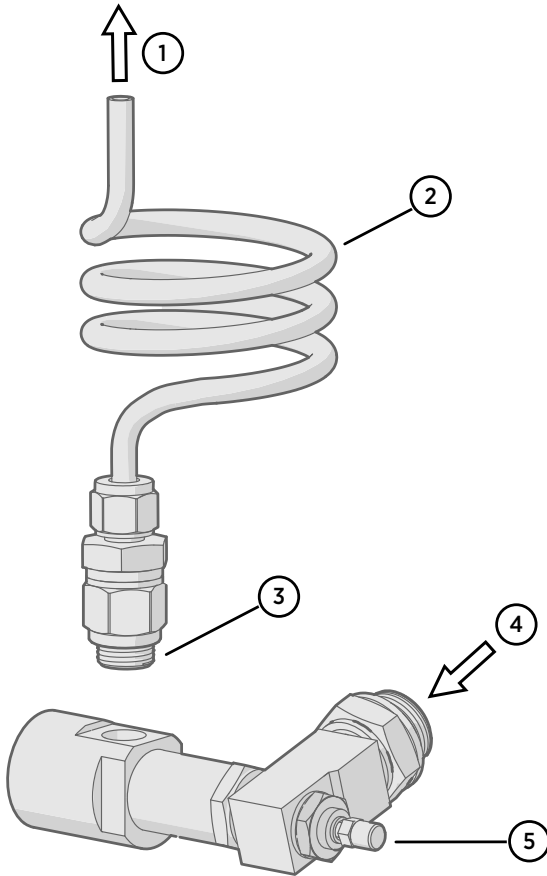
Figure 16   Alternative assembly of DSC74C (for tight spaces)

1   Gas comes out
2   Coil
3   Thread, max. size 7 mm
4   Gas goes in
5   Valve

The thread size cannot exceed 7 mm. Use the provided adapter to avoid damage to the transmitter.

4.6.4.2 DM240FA duct installation flange

DMT143 models with a G1/2" ISO228/1 connection thread can be installed directly in the process wall through a DM240FA duct installation flange. When the transmitter is installed directly on the process wall or pipe, note that a closing valve may be needed on both sides of the installed transmitter so that the sensor head can be removed from the process for calibration or maintenance.
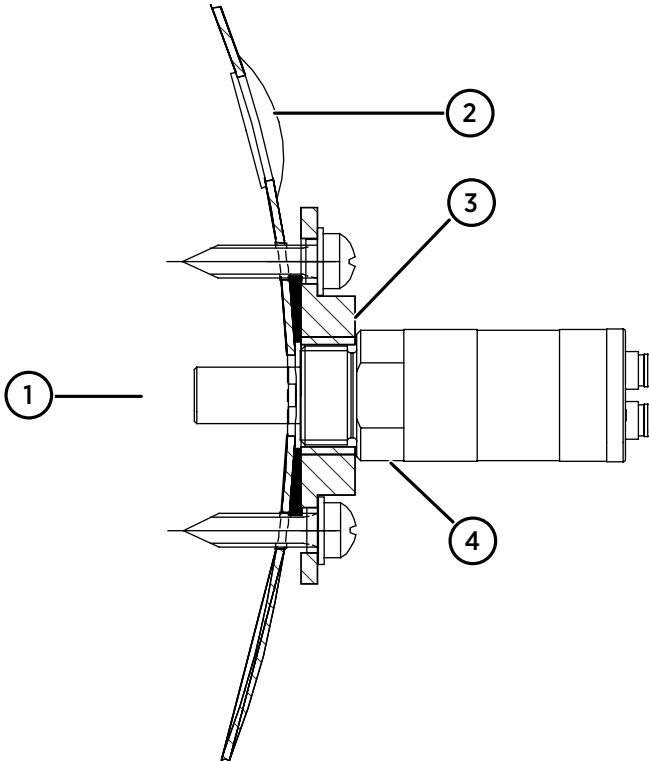
Figure 17   DM240FA with DMT143

1   Measured gas
2   Recommended additional hole (plugged) for T_d field check reference measurement probe (for example, Vaisala DM70)
3   DM240FA flange (thread G1/2" ISO228/1)
4   DMT143 transmitter

5. Vaisala Insight PC software

You can use Vaisala Insight PC software to check and configure DMT143 transmitters intuitively, without typing any serial commands. The software guides you when changing the settings on the transmitter. The transmitter can be connected to Insight software using a Vaisala USB service cable (item code 219690).

With the Insight software, you can:
- See device information and status.
- See real-time measurement.
- Configure serial communication settings, filtering factor, alarm LED, and analog output parameters and scaling.
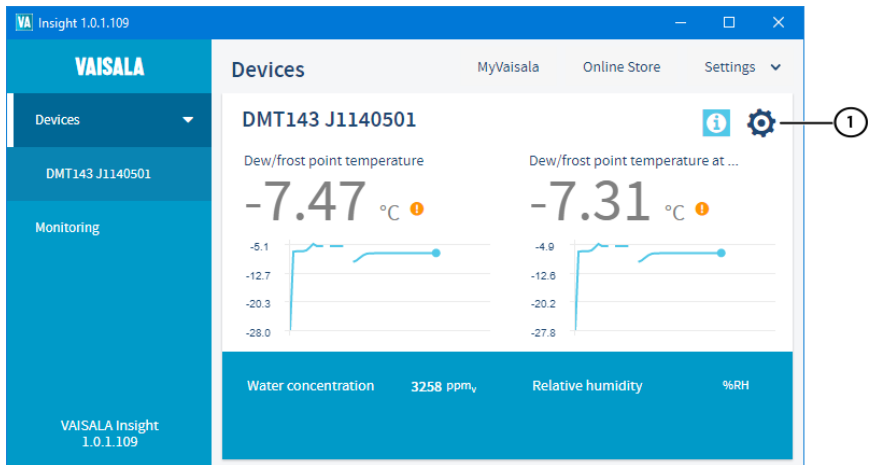
1   DMT143 settings are available through the settings wheel in the Insight **Devices** view.

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

> DMT143 transmitters support Insight from transmitter software version 1.4.4 onwards.

5.1 Connecting to Insight software

> - Computer with Vaisala Insight software installed
> - USB service cable (item code 219690)

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

ℹ Before connecting the transmitter to a PC, disconnect the cables from both the analog and digital ports of the transmitter.

▶ 1. Open Insight software.

2. Connect the USB cable to a free USB port on the PC.

3. Connect the USB cable to the digital port of the transmitter.

4. Wait for Insight software to detect the transmitter.

   If the transmitter is not detected, disconnect and reconnect the Vaisala USB cable to the digital port connector of the transmitter.

6. Using transmitter with Indigo80 handheld indicator

6.1 Indigo80 handheld indicator
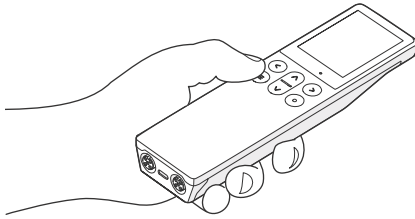
Figure 18   Indigo80 handheld indicator

Vaisala Indigo80 Handheld Indicator is a portable diagnostics tool that accommodates up to two Vaisala Indigo-compatible probes or transmitters for measuring a wide range of parameters.

With the indicator, you can:

- See real-time measurements and device and status information
- Log measurement data
- Configure transmitter features and settings such as compensation setpoints, serial communication, and analog output.

The help tours in the indicator's user interface guide you through the key features of the indicator. You can access the tours in the **Help** menu by pressing the ☰ button.

For more information on using the indicator, for example, editing the measurement views and performing data logging, see Indigo80 User Guide (M212722EN).

6.1.1 Device compatibility

The Indigo80 handheld indicator is tested for compatibility with DMT143 and DMT143L transmitters having firmware version 1.4.4 or newer. Transmitters with older firmware versions may have limited compatibility with the indicator.

For the most up-to-date version compatibility information, see Indigo80-compatible Firmware Technical Note (M212901EN).

6.1.2 Indigo80 keypad
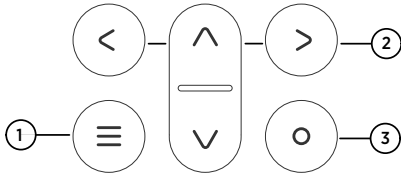
Figure 19   Indigo80 keypad

1   Power on/off and main menu button
2   Arrow buttons for navigating menus
     and scrolling views
3   Select button for selecting items in the
     user interface

6.1.3 Indigo80 main menu

Pressing the ☰ button while navigating the Indigo80 menus and views opens the main menu.
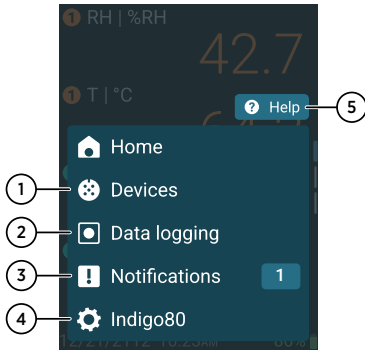
Figure 20   Indigo80 main menu

1   **Devices** menu contains, for example,
     options related to sensor purge,
     calibration, and environment settings
     (depending on the connected device).
2   **Data logging** menu for setting logging
     interval and duration, and browsing
     data files.
3   **Notifications** menu displays
     notifications related to Indigo80 and
     the connected devices.
4   **Indigo80** menu for changing the
     settings of Indigo80 (for example,
     date, time, and language) and viewing
     device information.
5   **Help** menu contains a **Getting started**
     tour showing the key features of
     Indigo80, as well as instructions for
     sending devices to Vaisala for
     calibration and maintenance.

6.2 Connecting to Indigo80 handheld indicator

> • M12 - M8 service cable (Vaisala item code 262195SP)

Up to two Vaisala Indigo-compatible probes or transmitters can be connected to the ports located on the bottom of Indigo80. You can connect and disconnect devices both when the indicator is powered on and when it is off.

Vaisala recommends using cables provided by Vaisala when connecting devices to the indicator. Cables and other accessories are available to order at store.vaisala.com.
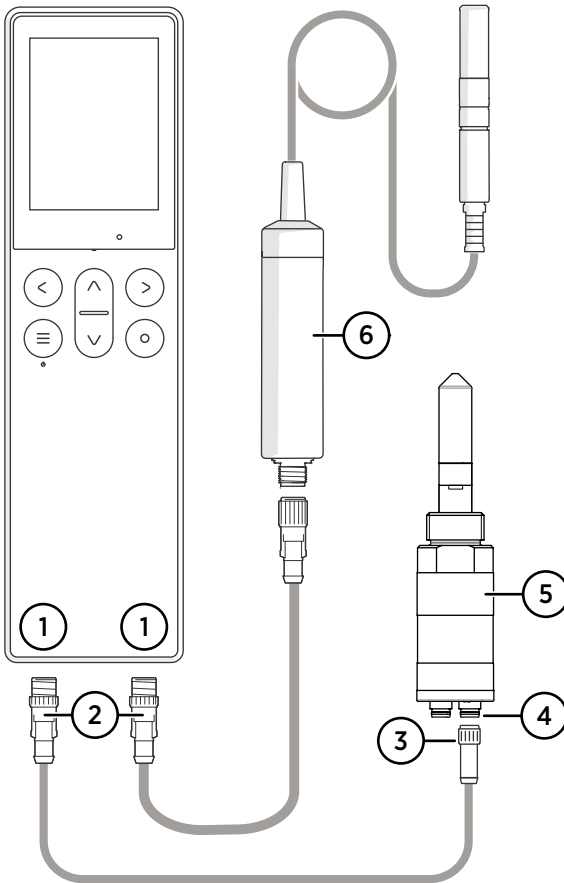
Figure 21   Connecting DMT143 transmitter to Indigo80 handheld indicator

1   M12-5F ports on the bottom of Indigo80 for connecting compatible Vaisala devices. Ports are labeled ❶ and ❷.
2   M12-5M A-coded cable connector
3   M8-4F A-coded cable connector
4   Port labeled **Digital**
5   DMT143 transmitter, displayed as ❶ by Indigo80
6   HMP7 probe, displayed as ❷ by Indigo80

> **i** If you have altered the default communication settings of DMT143, always make sure you switch off the other power supply (disconnect the **Analog** cable if in use) before powering up Indigo80.

▶ 1. If the indicator is powered and no devices are connected to it, the text **Please connect a probe** will be shown on the display.

2. Connect the M8 end of the service cable to the port labeled **Digital** on the bottom of DMT143.

3. Connect the M12 end of the cable to one of the ports on the bottom of the indicator.

   - **Note the orientation of the cable connector when inserting it**
   - **Hold the connector in place while turning its locking ring clockwise – never twist the connector body!**
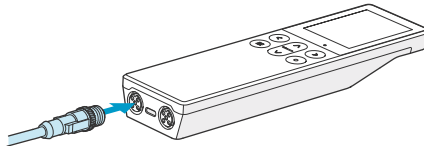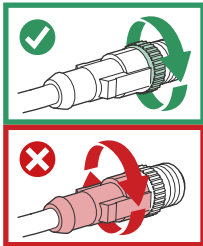
4. Wait for the indicator to detect the transmitter.

   When the indicator recognizes the connected transmitter, it shows a notification on the display. A device connected to the leftmost port in the indicator is labeled ❶ on the indicator's display, while the device in the rightmost port is labeled ❷.

> **i** When DMT143 is powered up, it performs a startup sequence consisting of sensor purge and autocalibration. During the 5-minute sequence measurement output remains frozen. Indigo80 will display the last measured values before the sensor purge began. The texts **Unreliable**, **Value locked**, and **Sensor purge** will alternate on the display during the startup sequence.
> For more information, see DMT143 startup sequence (page 22).

6.3 Accessing transmitter settings with Indigo80 handheld indicator

> • M12 - M8 service cable (Vaisala item code 262195SP)

You can use the Indigo80 handheld indicator to configure transmitter features and settings such as compensation setpoints, serial communication, and analog output.

> ℹ️ Accessing certain configuration options for DMT143 and DMT143L requires using the free Insight PC software, downloadable at www.vaisala.com/insight.

▶ 1. Connect the transmitter to the indicator.

2. Open the main menu by pressing ⊜.

3. Select **Devices**. If you have more than one device connected to the indicator, make a further selection between the devices.

4. Select **Settings** to access and change the features available for your transmitter.

5. Exit the menu by pressing ⊘ or return to the main menu by pressing ⊜.

6.4 Analog output configuration example

The DMT143 analog output channel can be configured with the Indigo80 indicator. You can use Indigo80 to:

- Enable or disable the analog output
- Select the output parameter and its scaling
- Set analog output error level

This example shows how to use Indigo80 to configure the transmitter's analog output 1 to use the following settings:

- 4 ... 20 mA current output enabled
- Dew/frost point temperature measurement scaled to −80 ... +20 °C (−112 ... +68 °F) $T_{d/f}$
- Error output level set to 20 mA

▶ 1. Connect the transmitter to the indicator.

2. Open the main menu by pressing ⊜.

3. Select **Devices**. If you have more than one device connected to the indicator, make a further selection between the devices.

4. Select **Settings**.

5. Scroll down and select **Analog output 1**.

6. In **Output mode**, select **4...20 mA**.

7. In **Output parameter**, select **Dew/frost point temperature**.

8. Select **Scale low end**. Use the arrow buttons to set the value as **−80.00 °C**, then select **Set**.

9. Select **Scale high end**. Use the arrow buttons to set the value as **20.00 °C**, then select **Set**.

10. Select **Error output level**. Use the arrow buttons to set the value as **20.000 mA**, then select **Set**.

    Your configuration is now in use.

11. Exit the menu by pressing ⊙ or return to the main menu by pressing ☰.

7. Using transmitter with DM70 handheld dew point meter

You can connect the DMT143 to the MI70 indicator (the handheld measurement display included in the DM70 package) using the MI70 connection cable (item code 219980SP). This allows you to view and use the measurement data with the MI70 indicator. You can, for example, perform a field check of the measurement accuracy.

When connecting or disconnecting the MI70 indicator, always make sure the MI70 indicator is powered off. Connecting or disconnecting the MI70 when it is powered on may cause incorrect values to be displayed.

If you have altered the default serial port settings of DMT143, always make sure you switch off the other power supply (disconnect the **Analog** cable if in use) before powering up the MI70 indicator.

> When the transmitter's power supply is disconnected, it will carry out the startup sequence when powered on again.

You can adjust the following DMT143 settings in the MI70 **Measurement settings** menu:
- Transmitter address in POLL mode.
- Alarm LED dew point limit (not shown if dew point alarm is disabled or LED is completely turned off).
- Offset correction for dew point measurement. The maximum offset you can set is ±5 °C.

Figure 22   Settings menu
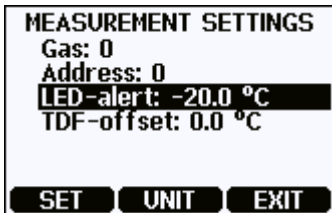
Figure 23   Measurement settings menu

ℹ️ You can also return the DMT143 to its factory configuration by using the **Factory settings** option in the **Settings** menu. This option is equivalent to using the **FRESTORE** command on the serial line. Note that also the MI70 indicator will revert to its factory configuration when using the **Factory settings** option on the MI70.

More information

‣ DMT143 startup sequence (page 22)
‣ Field check using DM70 handheld dew point meter (page 73)

8. Modbus communication

Transmitters ordered with the Modbus configuration option are accessed using the Modbus serial communication protocol. The supported Modbus variant is Modbus RTU (Serial Modbus) over RS-485 interface.

The supported Modbus functions and registers are described in Modbus reference (page 88).

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

Table 6   Default Modbus serial communication settings

Description	Default value
Serial bit rate	19200
Parity	N
Number of data bits	8
Number of stop bits	2
Modbus device address	240
Serial delay	0
Communication mode	Modbus RTU

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

More information

‣ Vaisala Insight PC software (page 39)
‣ Modbus reference (page 88)

9. Serial communication

9.1 Connecting to the serial interface

To interface with DMT143 using Vaisala Industrial Protocol with a terminal application, the transmitter can be connected to a PC using the RS-485 line on the Digital port. It is recommended that you use the USB service cable (item code 219690) for the connection, since the cable also provides the operating power from the USB port. If you have not used the USB service cable before, install first the driver that came with the cable.

9.1.1 Transmitter startup

When the transmitter is connected to power supply, there is a delay of 2 seconds as the transmitter starts up. After the startup is complete, the measurement data is available from the analog output and serial line.

If serial line output is used, note that the transmitter will behave according to the configured serial mode:
  • In STOP mode, the transmitter outputs the transmitter model and software version. This is the default mode.
  • In RUN mode a measurement output starts immediately.
  • In POLL mode the transmitter does not output anything after startup.
  • In MODBUS mode, the device does not output anything after startup.

More information

  ‣ DMT143 startup sequence (page 22)
  ‣ Power supply requirements (page 28)
  ‣ Modbus communication (page 49)
  ‣ Set serial line operating mode (page 66)

9.2 Terminal application settings

Table 7   Default serial interface settings

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

The following steps describe how to connect to DMT143 using the PuTTY terminal application for Windows (available for download at www.vaisala.com/software) and a USB serial interface cable:

1. Connect the USB serial interface cable between your PC and the RS-485 port of DMT143 (Digital port).

2. Start the PuTTY application.

3. Select the **Serial** settings category, and check that the correct COM port is selected in the **Serial line to connect to** field.

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

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

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

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

6. You may need to adjust the **Local echo** setting in the **Terminal** category to see what you are typing on the serial line. To access the configuration screen while a session is running, click the right mouse button over the session window, and select **Change Settings...** from the pop-up menu.
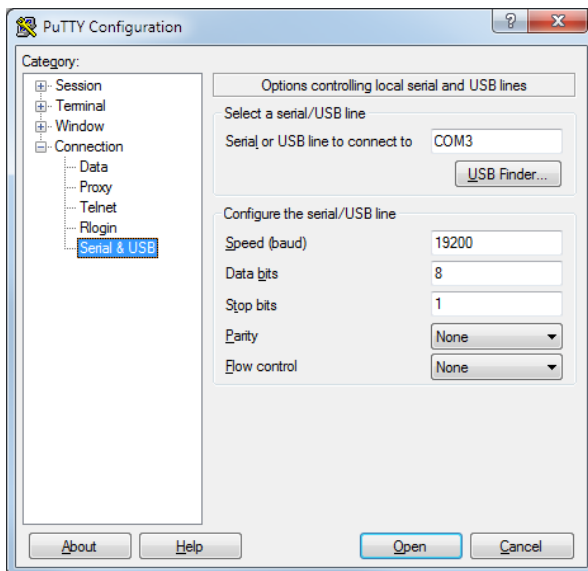
9.3 Accessing serial interface in devices with Modbus output

Follow the steps below to connect to the serial line with a transmitter with Modbus output. You can also use the procedure to retrieve the communication settings of your device, if you do not know them. You must use the Vaisala USB service cable (item code 219690) for the connection.

- Computer with
  - Windows operating system
  - Terminal application
  - Free USB port
  - Driver for Vaisala USB service cable installed
- Vaisala USB service cable (item code 219690)

▶ 1. Connect the USB cable to the PC and install the driver, if necessary. Do not connect the cable to the transmitter yet.

2. Open the terminal program and open a connection to the corresponding COM port using the default settings **19200**, **8**, **N**, **1**, no flow control.

3. Keep the **Enter** key pressed down and connect the other end of the USB cable to the transmitter. This will cause the transmitter to start in serial mode, using the default serial settings.

   You can now use the transmitter with the terminal program.

To prevent Modbus mode from being restored on the next power-up, select a different serial mode with the **smode** command.

9.4 List of serial commands

All commands can be issued either in uppercase or lowercase. In the command examples, the keyboard input by the user is in **bold** type.

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

Table 8   List of serial commands

Command	Description
<ESC>	Stop the continuous outputting of RUN mode or R command
?	Show device information
??	Show device information (overrides poll mode)
ADDR [0 ... 255]	Show or set transmitter address

Command	Description
AERR	Set analog output error level
ALARM	Set dew point level for LED alarm
AMODE	Show analog output mode
AOUT [ON/OFF]	Enable or disable analog output
AOVER [ON/OFF]	Allow analog outputs to exceed their range 10 %
ASEL	Set analog output parameter and scaling
ATEST	Test analog output
CLOSE	Close the temporary connection and return the device to POLL mode
ERRS	Display the currently active errors
FILT [0 ... 1]	Set output filtering level
FORM [modifier string]	Set output format
FRESTORE	Restore factory settings
HELP	Show list of currently available serial commands
INTV [0 ... 255 S/MIN/H]	Set the continuous output interval (for RUN mode and R command)
L	Show user adjustment values
LI	Set user adjustment values
OPEN [0 ... 255]	Open a line to transmitter at defined address
PRES [0.001 ... 50]	Set permanent pressure compensation value
R	Start the continuous outputting
RESET	Reset the transmitter
SDELAY [0 ... 255]	Set response sending delay
SEND [0 ... 255]	Output readings once (specify address for transmitters in POLL mode)
SERI [baud p d s]	Show or set the serial interface settings
SMODE [mode]	Show or set startup serial mode: RUN, STOP, POLL, or MODBUS
SNUM	Display transmitter serial number
SYSTEM	Show transmitter firmware information
UNIT [m/n]	Select metric or non-metric units
VERS	Show transmitter firmware version

Command	Description
XPRES [0.001 ... 50]	Set temporary pressure compensation value

9.5 Device information

9.5.1 Show device information

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

Table 9   ? command

Syntax	Description
?<cr>	Display device information.
??<cr>	Display device information in **POLL** mode.
Example:	

```
?
DMT143 1.0.2
Serial number  : H1220011
Batch number   : H1210003
Sensor number  : G3320000
Sensor model   : DRYCAP180D
Cal. date      : 20120412
Cal. info      : VAISALA/HEL
Time           : 01:38:00
Serial mode    :    STOP
SCI  Baud P D S: 19200 N 8 1
Output interval:      1 S
Serial delay   :     30
Address        :      0
Pressure       :   1.013 bar
Filter         :   0.100
```

Command **??** is similar to the **?** command. It is designed to be used if the transmitter is in POLL mode but its address is unknown. The transmitter will respond to the **??** command even while in POLL mode. Do not use the **??** command if you have more than one transmitter on an RS-485 line.

9.5.2 Show analog output mode

Use the **AMODE** command to show the analog output mode:

AMODE<cr>

Example:

```
amode
Ch1 output     : 4 ... 20 mA
```

9.5.3 Show firmware version

Table 10   VERS command

Syntax	Description
VERS<cr>	Display the transmitter firmware version number.
Example:	

```
vers
DMT143 1.0.2
```

9.5.4 Show firmware information

SYSTEM<cr>

Example:

```
system
Device Name         : DMT143
Copyright           : Copyright (c) Vaisala Oyj 2012. All rights reserved.
SW Name             : DMT143
SW date             : 2012-05-10
SW version          : 1.0.2
```

9.5.5 Show currently active errors

Use the **ERRS** command to display the currently active transmitter error messages.

ERRS<cr>

Example:

```
errs
No errors
```

Example (one active error, caused by physical damage to the sensor):

```
errs
T MEAS error
```

Table 11   Error messages on ERRS command

ERRS command response	Corresponding error
`T MEAS error`	Temperature measurement error. [44]
`F meas error`	Humidity measurement error. [45]
`Flash crc failure`	Firmware checksum mismatch. [49]
`Parameter flash check sum error`	Device settings corrupted. [50]
`INFOA check sum error`	Additional configuration settings corrupted. [51]
`SCOEFS check sum error`	Sensor coefficients corrupted. [52]
`CURRENT check sum error`	Main configuration settings corrupted. [53]
`Voltage error`	Supply voltage out of range. [55]
`General flash failure w/r`	Non-volatile memory read/write failure. [57]

Refer to Error messages in Insight software (page 77) for more information about the error states.

9.5.6 Show serial number

SNUM<cr>

Example:

```
snum
Serial number  : G4060003
```

9.5.7 Show command list

Use the **HELP** command to show a list of serial commands:

HELP<cr>

Example:

```
help
?
ADDR
AERR
ALARM
AMODE
AOVER
AOUT
ASEL
ATEST
CLOSE
ERRS
FILT
FORM
FRESTORE
GAS
HELP
INTV
L
LI
OPEN
PRES
R
RESET
SDELAY
SEND
SERI
SMODE
SNUM
SYSTEM
TIME
UNIT
VERS
XPRES
```

9.6 Configuring analog output

9.6.1 Set analog output parameters and scaling

Use the **ASEL** command to show or set the output parameter and the scaling of the analog output.

ASEL [parameter] [lowlimit highlimit]<cr>

Syntax	Description
parameter	Parameter that is output on analog channel. Available parameters are TDF, TDFA, H2O.
lowlimit	Lower limit of parameter scaling.
highlimit	Higher limit of parameter scaling.

Example (show current settings):

```
asel
Ch1 Tdf  lo   :   -80.00 'C ?
Ch1 Tdf  hi   :    20.00 'C ?
```

Example (change output parameter to H2O, set low and high limits):

```
asel h2o 0 6000
Ch1 H2O  lo   :     0.00 ppm
Ch1 H2O  hi   :  6000.00 ppm
```

9.6.2 Set analog output error notification

If the transmitter is malfunctioning, the analog output is set to a specified level. This overrides the normal measurement output of the channel. The default level and unit is selected when ordering the transmitter. You can change the level using the AERR command.

AERR [level]<cr>

Syntax	Description
level	Error level for the analog output channel. Available range depends on the output type (check with AMODE command).

Example (check settings):

```
amode
Ch1 output    : 4 ... 20 mA

aerr
Ch1 error out :   0.000 mA
```

Example (set analog channel error level to 20 mA):

```
aerr 20
Ch1 error out :   20.000 mA
```

> The error output value is displayed only when there are minor electrical faults such as a sensor damage. When there is a severe device malfunction, the error output value is not necessarily shown.

9.6.3 Extend analog output range

Use the **AOVER** command to allow the analog output channels to exceed their specified range by 10 %. The scaling of the parameter remains as before; the extra range is used for additional measurement range in the high end of the scale.

AOVER [ON/OFF]<cr>

Example (turning AOVER on):

```
aover on
AOVER              :        ON
```

The following example illustrates how the analog output is affected. The channel outputs T_d with voltage output 0 ... 5 V (-80 ... -30 °C). After giving the **AOVER ON** command, the range is 0 ... 5.5 V (-80 ... -25 °C). Note that the -30 °C T_d point is still at 5 V.

9.6.4 Test analog output

You can test the operation of the analog output with the **ATEST** command by forcing the output to a given value. You can then measure the output with a calibrated multimeter. After testing the output, give the **ATEST** command again to exit the test mode.

ATEST [level]<cr>

Syntax	Description
level	Level for analog output channel. Analog output type determines if the value is V or mA.

The command output shows the test value of the analog output as well as diagnostic information that may be useful to Vaisala Service Center if there is a problem with the analog output.

Example (enabling analog output test mode, setting level to 20 mA):

```
atest 20
  20.000    27407
```

Example (disabling analog output test mode, resuming normal output):

```
atest
   0.000    15831
```

9.6.5 Enable or disable analog output

Use the **AOUT** command to enable or disable the analog output channel.

AOUT [ON/OFF]<cr>

Example (turn analog output off):

```
aout off
AOUT : OFF
```

9.7 Serial line output commands

9.7.1 Start measurement output

Use the **R** command to start the continuous outputting of measurement values as an ASCII text string to the serial line. The format of the measurement message is set with the **FORM** command.

Table 12   R command

Syntax	Description
r<cr>	Starts continuous measurement output.
Example (measurement message in default format):	

```
r
Tdf= 17.75 'F Tdfatm= -5.25 'F H2O=   954 ppm
Tdf= 17.23 'F Tdfatm= -5.72 'F H2O=   930 ppm
Tdf= 17.06 'F Tdfatm= -5.88 'F H2O=   922 ppm
Tdf= 16.97 'F Tdfatm= -5.96 'F H2O=   918 ppm
...
```

Outputting the results continues in intervals issued with the command **INTV** until stopped.

9.7.2 Stop measurement output

You can stop the measurement output by pressing the **Esc** key.

9.7.3 Set output interval

Use the **INTV** command to change the output interval of the automatically repeating measurement messages. The measurement messages are repeated in the **RUN** mode, or after the **R** command has been given.

INTV [n xxx]<cr>

Syntax	Description
n	time interval, range 0 ... 255
xxx	time unit = "S", "MIN", or "H"

The shortest output interval (with n = 0) outputs the measurement messages as quickly as the transmitter's internal measurement cycle produces them, without additional delay.

Example:

```
intv 1 min
Output interval:        1 MIN
```

9.7.4 Output a reading once

Use the **SEND** command to output a single measurement message. The output message is sent in the format that has been set using the **FORM** command.

Syntax	Description
SEND [address]<cr>	Address of the transmitter, range 0 ... 255.
	Specifying the address is only necessary if the target transmitter is in POLL mode, and has not been accessed with the **OPEN** command.
Example:	
 ``` send Tdf= 16.71 'F Tdfatm= −6.19 'F H2O= 907 ppm ```	

9.8 Configuring measurement parameters

9.8.1 Set measurement output format

Use the serial line command **FORM** to change the measurement message sent by the transmitter. You can freely define the output message to include the desired parameters, formatting options, text strings, and additional fields.

```
form [modifier string]<cr>
```

Syntax	
modifier string	String of parameters and modifiers that defines the output format, length 1 ... 153 characters. Maximum length may be shorter when text strings are used.

Table 13   FORM command parameters

Measured parameter	Abbreviation in FORM command
Dew point/frost point temperature	Tdf
Dew point/frost point temperature, converted to atmospheric pressure	Tdfa

Measured parameter	Abbreviation in FORM command
ppm moisture, by volume	`H20`

Table 14   FORM command modifiers

Modifier	Description
`x.y`	Length modifier (number of digits and decimal places)
`#t`	Tabulator
`#r`	Carriage return
`#n`	Line feed
`""`	String constant, length 1 ... 15 characters
`#xxx`	ASCII code value (decimal) of a special character; for example, `#027` for **Esc**
`ADDR`	Transmitter address (0 ... 255)
`ERR`	Currently active transmitter errors in a four-bit field: bit0bit1bit2bit3bit4 • bit0 T MEAS error • bit1 N/A • bit2 Fmeas error • bit3 Flash csum error
`SN`	Transmitter serial number
`STAT`	Transmitter status in a one-character field: • h – sensor heating active • H – purge active • A – autocalibration active
`Ux`	Shows the name of the measurement unit using "x" number of characters. For example, **U3** shows the name of the measurement unit with 3 characters
`CS2`	Modulus-256 checksum of message sent so far, ASCII encoded hexadecimal notation
`CS4`	Modulus-65536 checksum of message sent so far, ASCII encoded hexadecimal notation
`CSX`	NMEA xor-checksum of message sent so far, ASCII encoded hexadecimal notation

FORM command examples

You can return to the default format using the "**FORM /**" command.

Example of default output (continuous output from RUN mode):

```
Tdf= -9.80 'C Tdfatm= -9.80 'C H2O=  2618 ppm
Tdf= -9.80 'C Tdfatm= -9.80 'C H2O=  2617 ppm
...
```

Command to set output format as Tdf and ppm with Modulus-256 checksum:

```
form 3.2 "Tdf=" Tdf U3 6.0 "H2O=" H2O " " U5 CS2 \r \n
```

Output example:

```
Tdf= -9.74'C H2O=  2632 ppm  C4
Tdf= -9.72'C H2O=  2636 ppm  C6
...
```

Command to set output format as Tdf and ppm, with **start of text** (ASCII character 002) and **end of text** (003) ASCII codes, and without line feed and carriage return at the end:

```
form #002 3.2 "Tdf="Tdf U3 6.0 "H2O=" H2O " " U5 #003
```

Output example (ASCII codes not visible here):

```
Tdf= -9.57'C H2O=  2671 ppm  Tdf= -9.59'C H2O=  2666 ppm
Tdf= -9.61'C H2O=  2662 ppm  Tdf= -9.62'C H2O=  2660 ppm
...
```

9.8.2 Set measurement filtering

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

FILT [a.aaaaa]<cr>

Syntax	Description
a.aaaaa	Range 0.00001 ... 1.0
	1.0 = No filtering, latest measurement is output without averaging
	0.5 = Average of last two measurements
	0.1 = Average of approx. 16 measurements (default)

Example (show current setting):

```
filt
Filter       :    0.10000    ?
```

Example (set filtering to 0.5):

```
filt 0.5
Filter         :    0.50000
```

9.8.3 Set pressure compensation value

The pressure of the measured system must be known for accurate dew point and ppm measurement. The pressure compensation value has been set at the factory according to the order form. You can view and set a new value using the **PRES** command.

Command **XPRES** should be used if the value is changed frequently. The value set using the **XPRES** command overrides the **PRES** value, but it is not retained at reset. When the **XPRES** is set to 0, the last value set with **PRES** is used instead.

> It is enough to set an approximate pressure value (±1 bar) to meet the accuracy specification of the DMT143.

PRES [pp.ppppp]<cr>

XPRES [pp.ppppp]<cr>

Syntax	Description
pp.ppppp	Absolute pressure (bar_a) in the measuring point.
	Range 0.001 ... 50 bar.

Example (set pressure compensation value to 3 bar):

```
pres 3
Pressure : 3.000 bar
```

The pressure conversion coefficients from other pressure units to bars is given in the table below.

Table 15   Pressure conversion coefficients

From	To bar_a
PaN/m^2	0.00001
mmHg torr	0.001333224
inHg	0.03386388
mmH$_2$O	0.00009806650
inH$_2$O	0.002490889
atm	1.01325

From	To bar$_a$
at	0.980665
psi$_a$	0.06894757

For example: 29.9213 inHg = 29.9213 × 0.03386388 = 1.01325 bar$_a$.

9.8.4 Select unit

Use the **UNIT** command to select metric or non-metric output units.

UNIT [x]<cr>

Syntax	Description
x	Selects the unit type to output:
	m = metric units, for example, Celsius
	n = nonmetric units, for example, Fahrenheit

Example:

```
unit m
Units        : Metric
```

9.8.5 View user adjustment parameters

Use the **L** command to view the current user adjustment parameters that are affected by the **LI** command and the MI70 indicator (Tdf offset only). This command is useful for checking the currently applied correction.

L<cr>

The output values are as follows:
- RH offset and gain
- T offset and gain
- Tdf offset and gain

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

```
l
RH offset :   0.00000000E+00
RH gain   :   1.00000000E+00
T  offset :   0.00000000E+00
T  gain   :   1.00000000E+00
Tdf offset:   0.00000000E+00
Tdf gain  :   1.00000000E+00
```

Example (shows that a -1.2 °C Tdf offset has been applied by the user):

```
l
RH offset :    0.00000000E+00
RH gain   :    1.00000000E+00
T  offset :    0.00000000E+00
T  gain   :    1.00000000E+00
Tdf offset:   -1.20000000E+00
Tdf gain  :    1.00000000E+00
```

9.8.6 Set user adjustment parameters

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

> ⚠ **CAUTION!** This command is provided primarily for applying an offset to the Tdf
> measurement. Do not adjust the other parameters unless instructed to do so by
> a Vaisala Service Center.

LI<cr>

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

Example (shows a +0.8 °C Tdf offset being applied):

```
li
RH offset :    0.00000000E+00   ?
RH gain   :    1.00000000E+00   ?
T  offset :    0.00000000E+00   ?
T  gain   :    1.00000000E+00   ?
Tdf offset:    0.00000000E+00   ?
Tdf gain  :    1.00000000E+00   ?
```

9.9 Configuring serial line operation

9.9.1 Set serial line operating mode

Use the **SMODE** command to set the startup operating mode of the serial line.

SMODE [mode]<cr>

Syntax	Description
mode	STOP, RUN, POLL, or MODBUS.

Table 16   Selection of output modes

Mode	Measurement output	Available commands
STOP	Only with the **SEND** command.	All (default mode).
RUN	Automatic output.	Only command **S**.
POLL	Only with the **SEND** [addr] command.	**SEND** [addr] and **OPEN** [addr]. Other commands available after opening a line to the transmitter using the **OPEN** command. Use with RS-485 buses where multiple transmitters can share the same line.
MODBUS	No automatic output.	Measurement outputs must be read from the transmitter using the Modbus protocol.

Selected output mode will be activated at next reset or power up.

Example:

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

More information

‣ Accessing serial interface in devices with Modbus output (page 52)

9.9.2 Set serial line settings

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

> If you have altered the DMT143 serial line settings and start using the MI70 hand-held indicator, always switch off the other power supply (disconnect "Analog" cable if in use) before powering up the MI70.

SERI [b p d s]<cr>

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

Example (set serial line to 9600 baud, no parity, 7 data bits, and 1 stop bit):

```
seri 9600 e 7 1
SCI  Baud P D S: 9600 E 7 1
```

More information

‣ Using transmitter with DM70 handheld dew point meter (page 47)

9.9.3 Set transmitter address

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

Syntax	Description
ADDR [address]<cr>	**[address]** = address, range 0 ... 255.
Example:	

```
addr
Address : 0 ?
```

More information

‣ Set serial line operating mode (page 66)

9.9.4 Set serial line response time

With the **SDELAY** command you can set the delay (response time) of the serial line, or view the currently set delay value.

SDELAY [delay]<cr>

Syntax	Description
SDELAY [delay]<cr>	**[delay]** = serial line delay, range 0 ... 255. One unit of delay corresponds to 4 milliseconds.

Example (set delay to 120 milliseconds):

```
sdelay 30
Serial delay   :        30
```

9.10 Other commands

9.10.1 Opening the transmitter in POLL mode

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

OPEN [address]<cr>

Syntax	Description
address	Transmitter address, range 0 ... 255.

Example (target transmitter in POLL mode, with address 5):

```
open 5
DMT143   5 line opened for operator commands
```

9.10.2 Closing the connection to a transmitter in POLL mode

The **CLOSE** command closes the connection to a transmitter.

CLOSE<cr>

Example:

```
close
line closed
```

9.10.3 Configure alarm LED

Use the **ALARM** command to configure the alarm LED functionality.

ALARM [LED] [Alarm] [Level]<cr>

Syntax	Description
LED	Enable or disable the entire LED functionality. Allowed values: **ON** - Enable the LED functionality. **OFF** - Turn off the LED completely.
Alarm	Enable or disable the dew point alarm. Allowed values: **ON** - Enable the dew point alarm. **OFF** - Turn off the dew point alarm.

Syntax	Description
Level	Dew point temperature above which the alarm LED will turn red. The LED will turn green when the measured dew point temperature falls below this level. Range -70 ... +60 °C T_{df}.

Example (show current settings):

```
alarm ?
LED display   :        OFF
Alarm display :        OFF
Setpoint Td(°C):  -10.00
```

Example (change values line by line, enter to skip line):

```
alarm
LED display : OFF ? on
Alarm display : OFF ? on
Setpoint Td(°C): -10.00 ? -40
```

Example (change alarm level to -40 °C T_{df}):

```
alarm on on -40
LED display   :        ON
Alarm display :        ON
Setpoint Td(°C):  -40.00
```

Example (turn off the dew point alarm only):

```
alarm on off
LED display : ON
Alarm display : OFF
Setpoint Td(°C): -40.00
```

Example (turn off the LED completely):

```
alarm off
LED display   :        OFF
```

More information

- Alarm LED (page 23)

9.10.4 Reset transmitter

Use the **RESET** command to reset the transmitter.

RESET<cr>

When the **RESET** command is given, the transmitter will restart as if it had just been powered on. All transmitter settings are retained. The serial line mode of the transmitter will be set to the mode that was set using the **SMODE** command.

9.10.5 Restore factory settings

Use the **FRESTORE** command to restore the transmitter to its factory configuration. All user settings will be lost.

FRESTORE<cr>

After using the **FRESTORE** command, reset the transmitter using the **RESET** command.

10. Maintenance

10.1 Periodic maintenance

10.1.1 Cleaning

You can clean the body of the transmitter by wiping with a moistened lint-free cloth. Do not immerse the transmitter in liquid, and do not use cleaning agents or solvents.

10.1.2 Calibration

DMT143 is fully calibrated as shipped from the factory. The recommended calibration interval is 2 years. If there is a reason to believe that the device is not within the accuracy specifications, you can perform a field check using the DM70 handheld dew point meter.

If the field check indicates that the DMT143 is not within its accuracy specifications, contact a Vaisala Service Center or your local Vaisala representative to have the DMT143 adjusted.

10.1.3 Changing the filter

Replace the filter if it is contaminated. New filters are available from Vaisala.

> ⚠ **CAUTION!** Be careful when changing the filter, since it is easy to break the sensor when the filter is removed.

> ⚠ **CAUTION!** If the transmitter has the optional stainless steel filter HM47453SP for vacuum applications installed, note that it has tapered threads and is not meant to be removed on site. Trying to forcefully loosen the filter may damage the transmitter instead. The filter replacement instructions below are for the standard sintered filter DRW010335SP with parallel threads.

> ⚠ **CAUTION!** If the transmitter is installed in a pressurized chamber, always make sure that the pressure of the chamber is equalized with the ambient pressure prior to removing the transmitter. When the transmitter is removed for maintenance, cap the hole with a capped nut. This way, the chamber can be pressurized although the transmitter is not in place.
> Plugs are available from Vaisala for ISO and NPT threaded connections.

When replacing the filter, wear clean gloves to avoid depositing dirt or oil on the filter. Inspect the sealing ring for damage (used with ISO thread only), and replace it if necessary.

Replace the filter as follows:

▶ 1. Turn the filter counterclockwise until it is loose.

   2. Pull the filter straight out carefully.
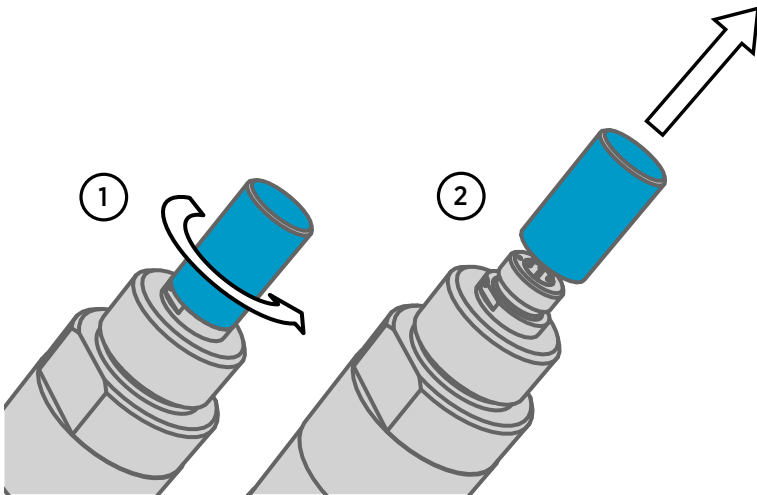
⚠ **CAUTION!** Do not damage the sensor.

   3. Take the new filter, and insert it to the filter thread.

   4. Tighten the new filter to 5 Nm by turning it clockwise.

More information

‣ Spare parts and accessories (page 86)

10.1.4 Field check using DM70 handheld dew point meter

Vaisala recommends the following equipment for field checking:

- A fully charged MI70 indicator (the measurement display that is included in the DM70 package).
- A calibrated reference probe that is suitable for the intended measurement environment and dew point range. The DMP74B probe is recommended for checking the dew point temperature measurement accuracy.
- You also need a connection cable (Vaisala item code 219980SP) to connect the DMT143 to the MI70 indicator.

> ℹ️ In the following procedure, the readings of the transmitter and the reference probe are checked simultaneously. You can also check the reference probe and the DMT143 separately if they cannot be connected at the same time.

> ℹ️ The messages from the transmitter will appear in English even if the MI70 has been set to another language.

Perform the check as follows:

1. Place the reference probe and the DMT143 in the reference environment.

2. Connect the reference probe and the DMT143 to the MI70 indicator:

   - Reference probe to Port I
   - DMT143 to Port II

3. If you have altered the DMT143 serial port settings, switch off the other power supply (disconnect "Analog" cable if in use) before powering up the MI70. Note that this powers off the transmitter, and it will carry out the startup sequence when powered on again.

4. Turn on the MI70 indicator. Never connect or disconnect the MI70 indicator while it is powered on, as this may cause incorrect values to be displayed.

5. Check and adjust the environment settings if prompted. Refer to the *DM70 User's Guide* for the settings of the DMP74B probe.

6. Disable the **Auto power off** function of the MI70 indicator to prevent the indicator from powering off in the middle of the check. Check the setting in the **Settings** - **User Interface** menu, and change if necessary.

7. The MI70 can display three parameters at one time. To compare the readings of the DMT143 and the reference probe, select the desired parameter from the **Display – Quantities and Units** menu of the MI70.

   Select the same parameter from port I and II, and the delta parameter that shows the difference between the two. For example, $\Delta T_{d/f}$ shows the difference in dew point between the two probes.
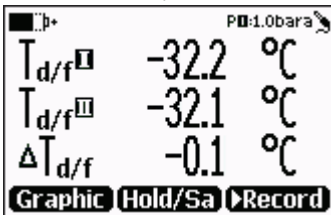
8. After the measurement has stabilized, check the difference between the readings. It will give you an indication of the approximate drift of the DMT143 and its need for calibration. The difference between the readings should be no greater than the combined measurement uncertainty of the DMT143 and the reference probe.

9. Write down the results and repeat the comparison for each parameter you want to check.

10. If adjustment is required, contact a Vaisala Service Center or your local Vaisala representative to have the DMT143 adjusted.

More information

‣ DMT143 startup sequence (page 22)

10.2 Repair maintenance

> ⚠️ **CAUTION!** The transmitter body does not have user serviceable parts inside, and is not designed to be opened. Opening the transmitter will void the warranty.

If there is a problem with your transmitter that you are unable to solve yourself or with the help of Vaisala Helpdesk, contact a Vaisala Service Center. In case of mechanical or electrical failure, the Service Center may replace the transmitter with a new one.

More information

‣ Troubleshooting (page 76)
‣ Technical support (page 97)

11. Troubleshooting

11.1 Solving typical problems

Some problems can be solved by simply resetting the transmitter. You can reset the transmitter by disconnecting the power or issuing the **RESET** command using the service port.

If resetting does not help, and if the problem is related to transmitter software or settings, you can restore the factory configuration of the transmitter by issuing the **FRESTORE** command. If you are unable to solve your problem with the transmitter, contact Vaisala.

Table 17   Troubleshooting table

Problem	Possible causes and solutions
One of the following occurs: • Transmitter outputs stars "****" on serial line instead of measurement data. • Unavailable value in Modbus mode. • Analog signal is at error level.	Possible causes: damaged sensor, incorrect supply voltage, and unsuitable measurement environment. Power cycle or reset the transmitter, and see if the problem continues. Check the active errors using Vaisala Insight PC software or the **ERRS** command. Check the power supply.
Unable to access transmitter on the RS-485 line.	Possible causes: Incorrect wiring, unknown serial settings, transmitter in POLL or MODBUS mode with unknown address. Check wiring. Check communication settings with Vaisala Insight PC software. Try connecting as instructed in section Accessing serial interface in devices with Modbus output (page 52).
Analog output seems to be stuck, the measurement is not changing.	Possible causes: Sensor diagnostics in progress (autocal or purge), malfunction error active. Check the active errors using Vaisala Insight PC software or the **ERRS** command. Wait for the diagnostics to complete.
Dew point alarm LED is red even though the measured dew point is not high.	Possible causes: the alarm limit may be set incorrectly for your application. Check and correct using Vaisala Insight PC software, serial line, or MI70 indicator.

More information

11.2 Error messages in Insight software

Table 18   Error messages in Insight software

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

In case of constant error, contact Vaisala.

More information

‣ Technical support (page 97)

11.3 Error codes in MI70 handheld indicator

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

Refer to Error messages in Insight software (page 77) for more information about the error states.

Table 19   Error codes in MI70

Transmitter error code in MI70	Corresponding error
1_{hex}	Temperature measurement error. [44]
2_{hex}	Humidity measurement error. [45]
40_{hex}	Device settings corrupted. [50]
80_{hex}	Additional configuration settings corrupted. [51]
100_{hex}	Sensor coefficients corrupted. [52]
200_{hex}	Main configuration settings corrupted. [53]
800_{hex}	Supply voltage out of range. [55]
10000_{hex}	Non-volatile memory read/write failure. [57]
20000_{hex}	Firmware checksum mismatch. [49]

11.4 Unknown serial settings

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

More information

‣ Vaisala Insight PC software (page 39)
‣ Accessing serial interface in devices with Modbus output (page 52)

12. Technical data

12.1 DMT143 specifications

Table 20   DMT143 measurement performance

Property	Description/Value
Sensor	DRYCAP® 180D
Sensor protection	Stainless steel sintered filter
Recommended calibration interval to confirm the specified accuracy	2 years
Dew point temperature	
Measurement range (typical)	−70 ... +60 °C (−94 ... +140 °F) T_d
Accuracy in air or N_2 [1]	±2 °C (±3.6 °F) T_d (see graph below)

* > 12 bar, accuracy ±4 °C Td

Analog output scalings:	
Option 1	−80 ... +20 °C (−112 ... +68 °F) T_d
Option 2	−80 ... +20 °C (−112 ... +68 °F) T_d dew point at ambient pressure
Option 3	Free scaling
Response time 63 % [90 %]: [2]	
−70 → −20 °C T_d (−94 → −4 °F T_d)	5 s [15 s] (typical)
−20 → −70 °C T_d (−4 → −94 °F T_d)	45 s [10 min] (typical)

Property	Description/Value
Water concentration by volume (ppm)	
Measurement range (typical)	10 ... 40 000 ppm
Accuracy at +20 °C (+68 °F), 1 bar	1 ppm + 20 % of reading

1)   When the dew point is below 0 °C (32 °F), the transmitter outputs frost point.
2)   At +20 °C gas temperature and 1 bar pressure and 1 liter/min flow rate.

Table 21   DMT143 operating environment

Property	Description/Value
Measurement environment	For air, nitrogen, hydrogen, argon, helium, and oxygen [1] [2]
Temperature [3]	−40 ... +60 °C (−40 ... +140 °F)
Relative humidity	0 ... 100 % RH
Pressure [3]	0 ... 50 bar_a (725 psi_a)
Sample flow rate	No effect for measurement accuracy
Storage temperature	−40 ... +60 °C (−40 ... +140 °F)
IP rating	IP66: Dust-tight. Protected from powerful water jets from any direction.

1)   Consult Vaisala if other chemicals are present. Consider safety regulations with flammable gases. The transmitter is not certified for use in hazardous areas with potentially explosive atmospheres.
2)   The transmitter not tested for leakages, which may occur especially with small-molecule gases such as hydrogen and helium.
3)   For extended temperature below 0 °C (+32 °F) or pressure above 20 bar_a (290 psi_a) the supply voltage must be 24 ... 28 V DC.

Table 22   DMT143 inputs and outputs

Property	Description/Value
Analog output (scalable)	4 ... 20 mA (3-wire), 0 ... 1 V / 5 V, 1 ... 5 V
Resolution for current output	0.002 mA
Resolution for voltage output	0.3 mV
Accuracy for current output at +20 °C	±0.05 mA
Accuracy for voltage output at +20 °C	±0.01 V
Operating voltage with digital output	12 ... 28 V DC

Property	Description/Value
Operating voltage with voltage output	12 ... 28 V DC
Operating voltage with current output	18 ... 28 V DC
Load for current output	Max. 500 Ω
Load for voltage output	Min. 10 kΩ
Typical temperature dependence	0.005 % of span/°C
Digital output	RS-485, non-isolated
Supported protocols	Vaisala industrial protocol Modbus RTU
Connector	4-pin M8 (IEC 60947-5-2)
Supply current at +20 °C (U_{in} 24 V DC)	
Normal measurement	10 mA + load current (typical)
During self-diagnostics	220 mA pulsed (typical)

Table 23   DMT143 mechanical specifications

Property	Description/Value
Mechanical connection	ISO 228-1 G1/2″ 1/2″ NPT 3/4″-16 UNF 5/8″-18 UNF
Housing material	Stainless steel (AISI316L)
Weight:	
G thread and UNF thread models	90 g (3.2 oz)
NPT thread model	100 g (3.5 oz)

Table 24   DMT143 compliance

Property	Description/Value
EU directives and regulations	EMC Directive (2014/30/EU) RoHS Directive (2011/65/EU) amended by 2015/863
Electromagnetic compatibility (EMC)	IEC/EN 61326-1, industrial environment CISPR 32 / EN 55032, Class B
Compliance marks	CE, China RoHS, RCM, UKCA

12.2 DMT143L specifications

Table 25   DMT143L measurement performance

Property	Description/Value
Sensors	DRYCAP® 180M
	DRYCAP® 180S (optimal for refrigeration dryers)
Sensor protection	Stainless steel sintered filter
	Stainless steel filter for vacuum
Recommended calibration interval to confirm the specified accuracy	2 years
Measurement range (typical)	−60 ... +60 °C (−76 ... +140 °F)
Different analog output scalings available. [1]	
Accuracy with DRYCAP® 180M	±2 °C (±3.6 °F) [2]
	(see the graph below)

1)   *For more information, see the DMT143L order form.*
2)   *When the dew point is below 0 °C (32 °F), the transmitter outputs frost point.*
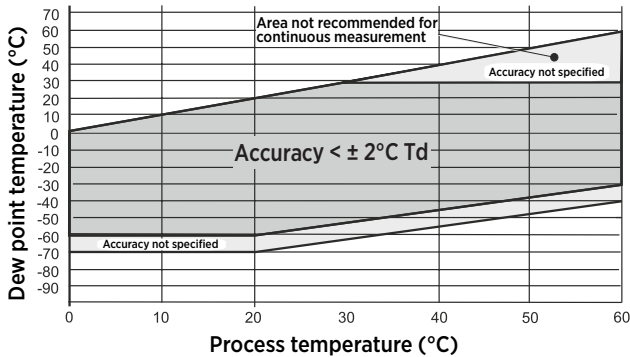
Dew point accuracy vs. measurement conditions	
Response time 63 % [90 %] at +20 °C (+68 °F) gas temperature and 1 bar pressure and 1 liter/min flow rate:	
−60 → −20 °C T_d (−76 → −4 °F T_d)	5 s [10 s] (typical)
−20 → −60 °C T_d (−4 → −76 °F T_d)	45 s [10 min] (typical)

Accuracy with DRYCAP® 180S	±2 °C (±3.6 °F) [1]
	(see the graph below)

1) *When the dew point is below 0 °C (32 °F), the transmitter outputs frost point.*
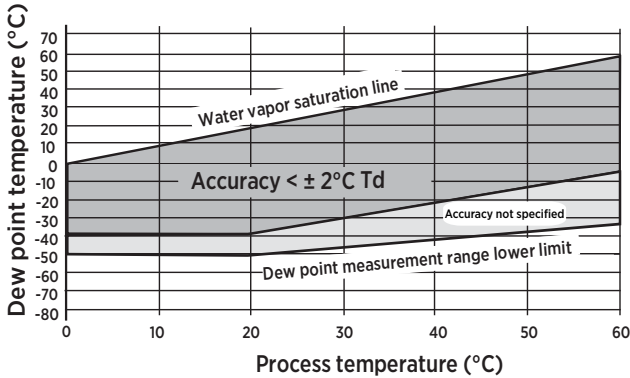
Table 26 DMT143L operating environment

Property	Description/Value
Measurement environment	For air, nitrogen, hydrogen, argon, helium, and oxygen [1] [2]
Temperature	0 ... +60 °C (+32 ... +140 °F)
Higher temperature peaks	Short-term OK
Relative humidity	0 ... 100 %RH
Pressure	0 ... 20 bara (0 ... 290 psia)
Sample flow rate	No effect
Storage temperature	−40 ... +60 °C (−40 ... +140 °F)
IP rating	IP66: Dust-tight. Protected from powerful water jets from any direction.

1) *Consult Vaisala if other chemicals are present. Consider safety regulations with flammable gases. The transmitter is not certified for use in hazardous areas with potentially explosive atmospheres.*
2) *The transmitter not tested for leakages, which may occur especially with small-molecule gases such as hydrogen and helium.*

Table 27   DMT143L inputs and outputs

Property	Description/Value
Analog current output	4 ... 20 mA (3-wire)
Digital output	RS-485, non-isolated
Supported protocols	Vaisala industrial protocol Modbus RTU
Resolution for current output	0.002 mA
Accuracy for current output at +20 °C	±0.05 mA
External load for current output	Max. 500 Ω
Operating voltage with current output	18 ... 28 V DC
Operating voltage with digital output	12 ... 28 V DC
Typical temperature dependence	0.0008 mA/°C
Power consumption at 24 V DC	Max. 220 mA

Table 28   DMT143L mechanical specifications

Property	Description/Value
Mechanical connection	G1/2" ISO228-1 with bonded seal ring (U-seal) or NPT1/2" thread
Housing material	Stainless steel (AISI 316L)
Weight	
G thread model	90 g (3.2 oz)
NPT thread model	100 g (3.5 oz)

Table 29   DMT143L compliance

Property	Description/Value
EU directives and regulations	EMC Directive (2014/30/EU) RoHS Directive (2011/65/EU) amended by 2015/863
Electromagnetic compatibility (EMC)	IEC/EN 61326-1, industrial environment CISPR 32 / EN 55032, Class B
Compliance marks	CE, China RoHS, RCM, UKCA

12.3 Dimensions
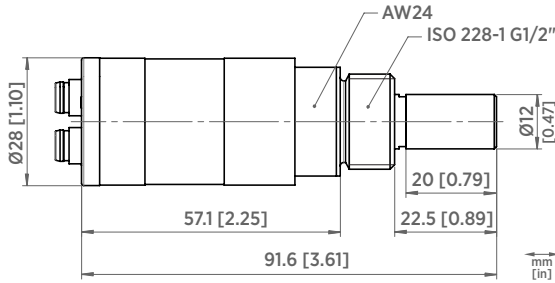
Figure 24   DMT143 with ISO 228-1 G1/2″ thread
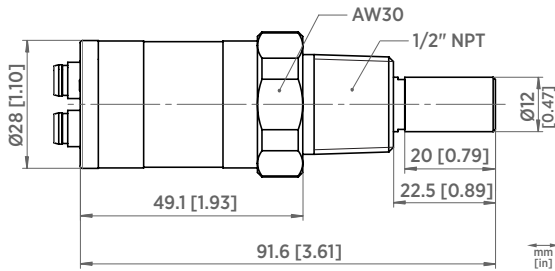
Figure 25   DMT143 with 1/2″ NPT thread
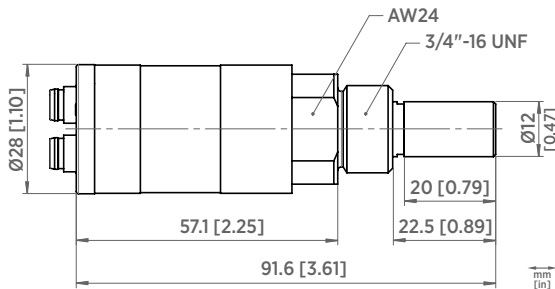
Figure 26   DMT143 with 3/4″-16 UNF thread
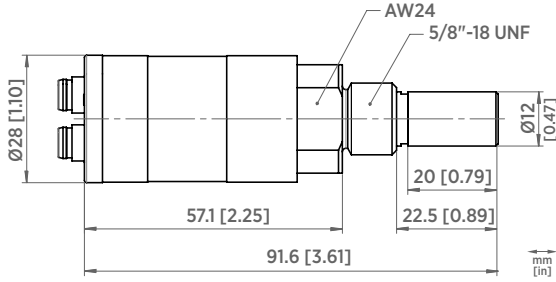
Figure 27   DMT143 with 5/8″-18 UNF thread
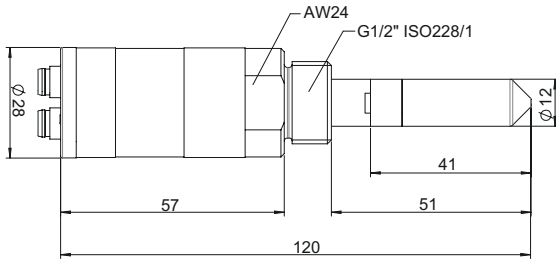
Figure 28   DMT143L dimensions

12.4 Spare parts and accessories

Table 30   DMT143 spare parts and accessories

Item	Item code
USB cable for PC connection [1]	219690
M12 - M8 cable 1.5 m (4.9 ft), for connecting to Indigo80	262195SP
M12 - M8 cable 2 m (6.5 ft), for connecting to DM70	219980SP
Loop powered external display	226476
Loop powered external display with relays	234759
Installation flange ISO ½	DM240FASP

Item	Item code
Sintered filter (DMT143)	DRW010335SP
Stainless steel filter (DMT143, DMT143L)	HM47453SP
Stainless steel sintered filter (38 um) (DMT143L)	HM47280SP
Mounting nut	MOUNTINGNUTSP
Plug kit (ISO 1/2″)	218773
Plug kit (NPT 1/2″)	222507
Sealing ring set (3 pcs)	221525SP
NPT 1/2″ adapter for models with ISO1/2″ thread	210662SP
Output cables	
0.3 m (1.0 ft) shielded output cable M8, threaded connector	HMP50Z032SP
3 m (9.8 ft) shielded output cable M8, threaded connector	HMP50Z300SP
5 m (16.4 ft) shielded output cable M8, threaded connector	HMP50Z500SP
10 m (32.8 ft) shielded output cable M8, threaded connector	HMP50Z1000SP
1.5 m (4.9 ft) heavy duty cable	225777SP
3 m (9.8 ft) heady duty cable	225229SP
Sampling cells	
Basic sampling cell	DMT242SC
With Swagelok 1/4″ male connectors	DMT242SC2
With UNF5/8″-18 thread	DSC74UNF58SP
With quick connector and leak screw	DSC74SP
Two-pressure sampling cell	DSC74BSP
Two-pressure sampling cell with coil	DSC74CSP
Cooling/venting coil	DMCOILSP
See the DSS70A product page at www.vaisala.com for further information about the sampling cells available for DM70.	

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

Appendix A. Modbus reference

A.1 Default communication settings

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

Table 31   Default Modbus serial communication settings

Property	Description / Value
Serial bit rate	19200
Parity	N
Number of data bits	8
Number of stop bits	2
Modbus device address	240
Serial delay	0
Communication mode	Modbus RTU

A.2 Function codes

Table 32   Modbus function codes

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

A.3 Data encoding

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

A.3.1 32-bit floating point or 32-bit integer format

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

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

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

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

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

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

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 33   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

Registers are numbered in decimal, starting from 1. Register addresses in actual Modbus messages (Modbus Protocol Data Unit (PDU)) are in hexadecimal and start from zero. Register number 1 corresponds to address 0_{hex} in the actual Modbus message.

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

A.4.1 Measurement data registers

Table 34   Modbus measurement data registers (read-only)

Register number	Address	Description	Data format	Unit
7	0006_{hex}	Dew/frost point temperature ($T_{d/f}$)	32-bit float	°C
11	$000A_{hex}$	Dew/frost point temperature at 1 atm ($T_{d/fa}$)	32-bit float	°C
21	0014_{hex}	Water concentration (ppm)	32-bit float	ppm
260	0103_{hex}	Dew/frost point temperature ($T_{d/f}*100$)	16-bit signed integer	°C
262	0105_{hex}	Dew/frost point temperature at 1 atm ($T_{d/fa}*100$)	16-bit signed integer	°C
267	$010A_{hex}$	Water concentration (ppm)	16-bit signed integer	ppm

A.4.2 Configuration registers

Table 35   Modbus configuration data registers (writable)

Register number	Address	Description	Data format	Unit / Valid range
Settings				
769	0300_{hex}	Pressure, power-up default value	32-bit float	bar (absolute) 0.001 ... 50
771	0302_{hex}	Pressure	32-bit float	bar (absolute) 0.001 ... 50
795	$031A_{hex}$	Filtering factor	32-bit float	0.00001 ... 1

Communication					
1537	0600$_{hex}$	Address	16-bit integer	1 ... 247
1538	0601$_{hex}$	Bit rate (b/s)	16-bit integer	5 = 9600 6 = 19200
1539	0602$_{hex}$	Parity, data, stop bits	16-bit integer	0 = N81 1 = N82 2 = E81 3 = E82 4 = O81 5 = O82
1540	0603$_{hex}$	Response delay	16-bit integer	0 ... 1020 ms
1541	0604$_{hex}$	Interface mode	16-bit integer	6 = MODBUS
1542	0605$_{hex}$	Restart device	16-bit integer	1 = Restart the device
LED Alarm				
3073	0C00$_{hex}$	Indicator mode	16-bit integer	0 = Off 1 = Status only 2 = Alarm
3074	0C01$_{hex}$	Alarm parameter	16-bit integer	6 = T$_{d/f}$
3075	0C02$_{hex}$	Alarm setpoint	32-bit float	-70 °C ... +60 °C
Factory settings				
7681	1E00$_{hex}$	Restore settings	16-bit integer	1 = Restore factory settings

A.4.3 Status registers

Table 36   Modbus status registers (read-only)

Register number (decimal)	Address (hexadecimal)	Register description	Data format	Notes
513	0200$_{hex}$	Error status	16-bit integer	1 = No errors

Register number (decimal)	Address (hexadecimal)	Register description	Data format	Notes
514	0201$_{hex}$	Online status	16-bit integer	1 = Data available 0 = Outputs frozen due to autocal or purge
515	0203$_{hex}$	Error code	32-bit integer	0 = No errors

Table 37   Error codes on Modbus interface

Error code register value	Corresponding error
0	No errors.
1	Temperature measurement error. [44]
2	Humidity measurement error. [45]
64	Device settings corrupted. [50]
128	Additional configuration settings corrupted. [51]
256	Sensor coefficients corrupted. [52]
512	Main configuration settings corrupted. [53]
2048	Supply voltage out of range. [55]
65536	Non-volatile memory read/write failure. [57]
131072	Firmware checksum mismatch. [49]

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

Refer to Error messages in Insight software (page 77) for more information about the error states.

A.4.4 Test value registers

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

Table 38   Modbus test registers (read-only)

Register number (decimal)	Address (hexadecimal)	Register description	Data format	Value
7937	1F00$_{hex}$	Signed integer	16-bit integer	-12345
7938	1F01$_{hex}$	Floating point	32-bit float	-123.45

Register number (decimal)	Address (hexadecimal)	Register description	Data format	Value
7940	1F03$_{hex}$	Text string	7-character ASCII string	"-123.45"

A.5 Device identification objects

Table 39   Device identification objects

Object ID	Object ID (hexadecimal)	Object name	Example contents
0	00$_{hex}$	VendorName	"Vaisala"
1	01$_{hex}$	ProductCode	"DMT143"
2	02$_{hex}$	MajorMinorVersion	"1.2.3" Software version of the device.
3	03$_{hex}$	VendorUrl	"http://www.vaisala.com/"
4	04$_{hex}$	ProductName	"Vaisala Dew Point Transmitter DMT143"
5	05$_{hex}$	ModelName	"7E2A2A0A000" Configuration code of the device. Length and content of the code are model-specific.
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 information.

A.6 Exception responses

Table 40   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

Code	Name	Reason
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/frost point temperature value

ℹ 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
$F0_{hex}$	Transmitter address	$F0_{hex}$	Transmitter 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}		$F5_{hex}$	Value of first register (least significant word)
00_{hex}	Number of 16-bit registers to read (2)	96_{hex}	
02_{hex}		$C0_{hex}$	Value of second register (most significant word)
31_{hex}	Modbus RTU checksum	$E7_{hex}$	
$2B_{hex}$		$D9_{hex}$	Modbus RTU checksum
(silence for 3.5 bytes)	End of Modbus RTU frame	56_{hex}	
		(silence for 3.5 bytes)	End of Modbus RTU frame

Communication description	
Register address	7 (1-based Modbus documentation format) = address 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	$C0E7F596_{hex}$, which is binary32 representation of -7.25 (°C).

Writing filtering factor value

Request		Response	
Bytes on the line (hexadecimal)	Description	Bytes on the line (hexadecimal)	Description
(silence for 3.5 bytes)	Start of Modbus RTU frame	(silence for 3.5 bytes)	Start of Modbus RTU frame
$F0_{hex}$	Transmitter address	$F0_{hex}$	Transmitter address
10_{hex}	Function (Write Multiple Registers)	10_{hex}	Function (Write Multiple Registers)
03_{hex}	Register address	03_{hex}	Register address
$1A_{hex}$		$1A_{hex}$	
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	75_{hex}	Modbus RTU checksum
CC_{hex}	Value for the first register (least significant word)	$6A_{hex}$	
CD_{hex}		(silence for 3.5 bytes)	End of Modbus RTU frame
$3E_{hex}$	Value for the second register (most significant word)		
$4C_{hex}$			
DE_{hex}	Modbus RTU checksum		
$E9_{hex}$			
(silence for 3.5 bytes)	End of Modbus RTU frame		

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

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

Communication description	
Register address	795 (1-based Modbus documentation format) = address $031A_{hex}$ (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.
Value to write	0.2, in binary32 format $3E4CCCCD_{hex}$.

Maintenance and calibration services

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

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

Warranty

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

Technical support

Contact Vaisala technical support at helpdesk@vaisala.com. Provide at least the following supporting information as applicable:
- Product name, model, and serial number
- Software/Firmware version
- Name and location of the installation site
- Name and contact information of a technical person who can provide further information on the problem

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

Recycling

Recycle all applicable material according to local regulations.

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