M213308EN-A

User Guide

Moisture and Temperature Transmitter for Oil

MMT143



VAISALA

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1. About this document

1.1 Version information

This document provides instructions for installing, using, and maintaining Vaisala Moisture and Temperature Transmitter for Oil MMT143.

Table 1 Document versions (English)

Document code	Date	Description
M213308EN-A	September 2026	First version.

1.2 Related manuals

For the latest versions of these documents, see docs.vaisala.com.

Table 2 Related manuals

Document code	Name
M212722EN	Vaisala Indigo80 Handheld Indicator User Guide
M213309EN	Vaisala MMT143 Moisture and Temperature Transmitter for Oil Quick Guide

1.3 Documentation conventions

WARNING! Alerts you to a hazardous situation that, if not avoided, could result in death or serious injury.

CAUTION! Alerts you to a hazardous situation that, if not avoided, could result in minor or moderate injury.

NOTICE! Alerts you to a situation that, if not avoided, could result in the product to be damaged, or important data to be lost.



Highlights important information on using the product.

1.4 Trademarks

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

Modbus® is a registered trademark of Schneider Automation Inc.

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

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2. Product overview

2.1 Introduction to MMT143

Vaisala HUMICAP® Moisture and Temperature Transmitter for Oil MMT143 provides reliable moisture measurement in a wide range of applications.

The MMT143 transmitter is a microprocessor-based instrument for the measurement of moisture in terms of relative saturation or water activity, for example in the lubrication of circulation systems or in transformer oil. With the help of internal oil solubility coefficients, MMT143 is also able to output oil moisture in ppm (supported for most insulating liquid types, including mineral transformer oil).

MMT143 incorporates a capacitive thin film sensor. The operation of the sensor is based on changes in its capacitance as the thin polymer film absorbs water molecules.

MMT143 is an easy-to-install transmitter that provides for accurate temperature measurement of liquids. It is available in two versions: standard range and extended range.

Table 3 MMT143 versions

Version	Pressure range	Temperature measurement range
Standard range	0–50 bar	−20 ... +80 °C (−4 ... +176 °F)
Extended range	0–200 bar	−40 ... +80 °C (−40 ... +176 °F)

MMT143 has one analog current output and one digital output (RS-485). It can be configured in many ways: the analog output signal can be scaled, the measurement ranges can be changed within certain limits, and there are two mechanical connection options, ISO G1/2″ and 1/2″-14 NPT.

MMT143 is compatible with Vaisala Indigo80 Handheld Indicator, and it can also be connected to Vaisala Insight PC software for configuration and temporary online monitoring.

Table 4 Output parameters of MMT143

Parameter	Abbreviation	Metric unit	Non-metric unit
Water activity	A_w	A_w	A_w
Relative saturation	%RS	%RS	%RS
Temperature	T	°C	°F
Water content	H_2O	ppm	ppm

The ppm output is only applicable for transformer insulating liquids.

More information

- MMT143 transmitter parts (page 12)
- Vaisala Insight PC software (page 30)
- Indigo80 handheld indicator (page 32)
- MMT143 specifications (page 62)
- MMT143 spare parts and accessories (page 66)

2.2 Basic features and options

- One analog output
- One digital output: RS-485 with Vaisala Industrial Protocol or Modbus RTU protocol
- USB connectivity for service connections via the optional USB M8 cable
- Different cable lengths available
- Available with two different thread options: ISO G1/2″ and NPT 1/2″
- Low maintenance requirements due to excellent long-term stability
- Two versions available:
  - standard range
  - extended range
- Two filter types available: stainless steel filter and stainless steel filter for high flow (> 1 m/s)
- Compatible with Indigo80 handheld indicator and Vaisala Insight PC software

2.3 MMT143 transmitter parts

NOTICE! The transmitter body does not have user serviceable parts inside, and is not designed to be opened. Opening the transmitter voids the warranty.

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.

2.3.1 MMT143 with ISO G1/2" thread

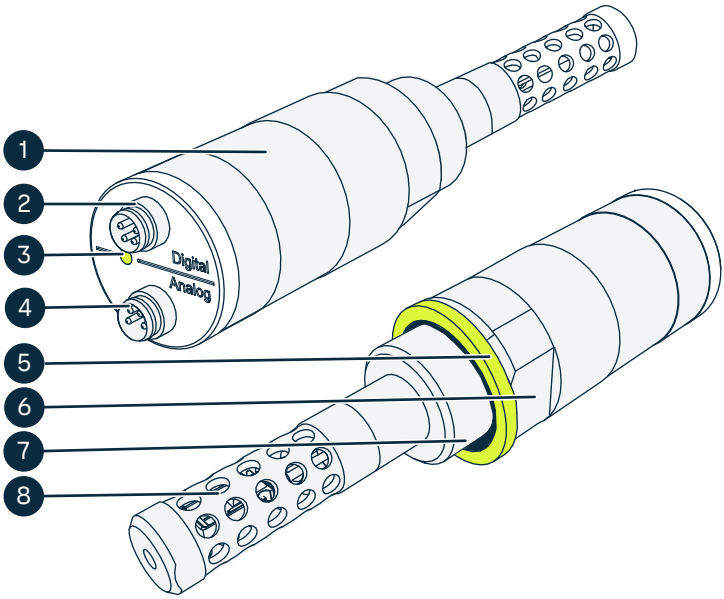


Figure 1 MMT143 with ISO G1/2″ thread

1 Transmitter body. Type label is applied here.
2 Digital output: non-isolated RS-485
3 Status LED
4 Analog output
5 Sealing ring. Must be used with the ISO G1/2″ connection thread.
6 24-mm nut
7 Connection thread: ISO G1/2″
8 HUMICAP 180L2 sensor protected with stainless steel filter (standard filter)

2.3.2 MMT143 with 1/2"-14 NPT thread

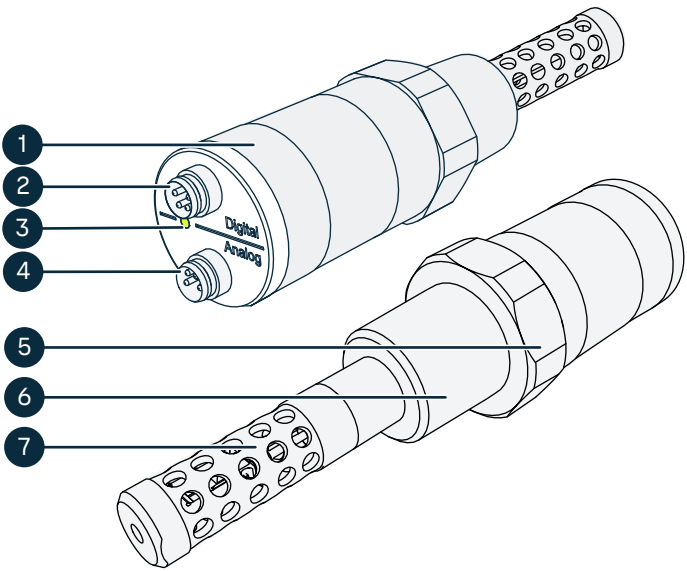


Figure 2 MMT143 with 1/2″-14 NPT thread

1 Transmitter body. Type label is applied here.
2 Digital output: non-isolated RS-485
3 Status LED
4 Analog output
5 30-mm nut
6 Connection thread: 1/2″-14 NPT
7 HUMICAP 180L2 sensor protected with stainless steel filter (standard filter)

2.3.3 Filter options

The transmitter can be ordered with the following filter options.

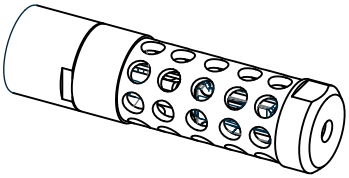


Figure 3 Stainless steel filter (Vaisala order code HM47453SP)

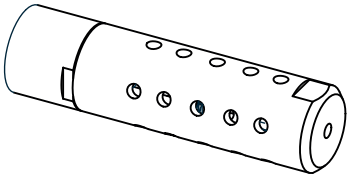


Figure 4 Stainless steel filter for high flow (> 1 m/s) (Vaisala order code 220752SP)

More information

- MMT143 spare parts and accessories (page 66)

2.4 HUMICAP technology

Vaisala HUMICAP® is a capacitive thin-film polymer sensor consisting of a substrate on which a thin film of polymer is deposited between two conductive electrodes. The sensing surface is coated with a porous metal electrode to protect it from contamination and exposure to condensation. The substrate is typically glass or ceramic.

The thin-film polymer either absorbs or releases water vapor as the relative humidity of the measurement environment rises or falls. The dielectric properties of the polymer film depend on the amount of absorbed water. As the relative humidity around the sensor changes, the dielectric properties of the polymer film change, and so does the capacitance of the sensor. Capacitance is converted into a humidity reading. The HUMICAP sensor is complemented by a temperature sensor.

2.5 Safety

If any instructions in this document conflict with your local or state legislation or regulations, always follow the local or state legislation or regulations.

If the product is used in a manner not specified by Vaisala, the protection provided by the product may be impaired. Follow the instructions.

Only qualified maintenance personnel may perform maintenance procedures.

Make sure that unauthorized persons cannot access the work area during maintenance procedures.



CAUTION! Modification of the product can result in injury or damage the product. Do not modify the product or substitute parts unless instructed to do so. Improper modification voids your warranty.



CAUTION! Using components that do not meet Vaisala specifications can result in injury or damage the product. Use only accessories and spare parts that meet the specifications.



Failure to comply with the warnings and cautions in these instructions violates safety standards of design, manufacture, and intended use of the product. Vaisala assumes no liability for the failure to comply with these requirements.

2.5.1 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. Installation

3.1 Configuring transmitter before installation

You may wish to configure your transmitter before physically installing it. For easy access to configuration options, use Vaisala Insight PC software with the USB service cable (item code 219690) or Indigo80 handheld indicator.

Examples of configurable settings for analog output:

1. Analog output parameter and scaling.
2. Analog output error level.

Examples of configurable settings for Vaisala Industrial Protocol output:

1. By default, MMT143 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.

Examples of configurable settings for Modbus output:

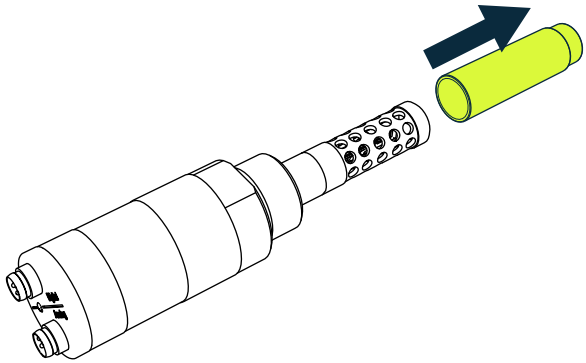
1. The default serial settings for devices ordered for Modbus use are 19200,N,8,2. You may need to change them to match your Modbus system.
2. The default Modbus device ID is 240. You must change it to a unique value (range 1–247) if multiple devices are connected on the same bus.

More information

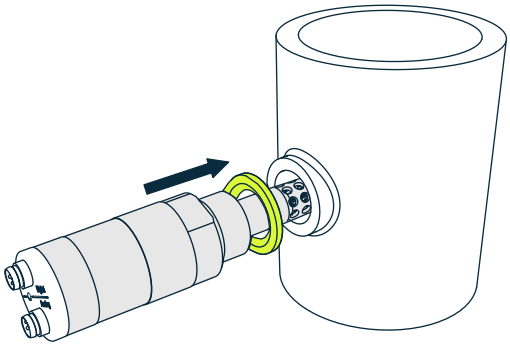
- Vaisala Insight PC software (page 30)
- Indigo80 handheld indicator (page 32)

3.2 Installing MMT143 with ISO 228-1 G1/2" thread

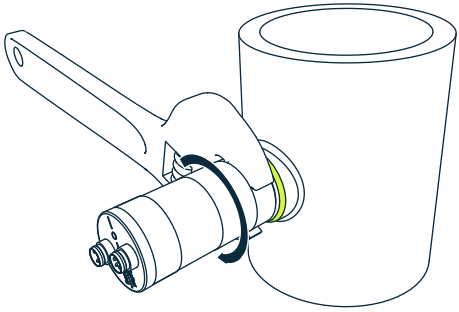
1. Remove the yellow transport protection cap from the transmitter.



2. Use the sealing ring that is provided with the transmitter. Make sure the threads on the mounting point match your transmitter.



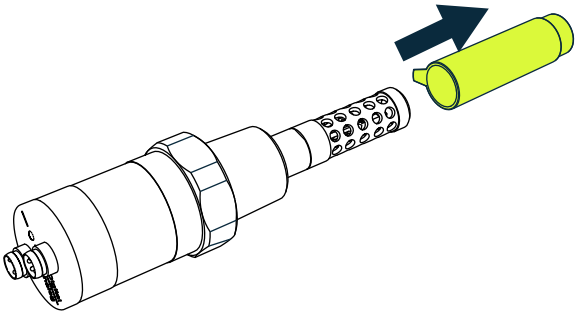
3. Use a 24-mm wrench to tighten the connection (max. torque 25–50 Nm depending on the material of the internal thread).



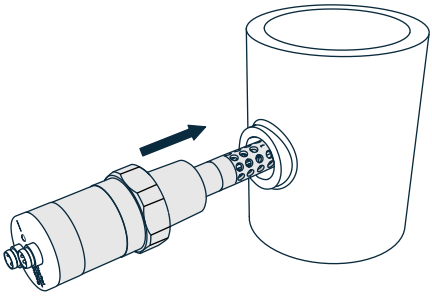
4. Connect the signal and power cable to the transmitter.

3.3 Installing MMT143 with 1/2"-14 NPT thread

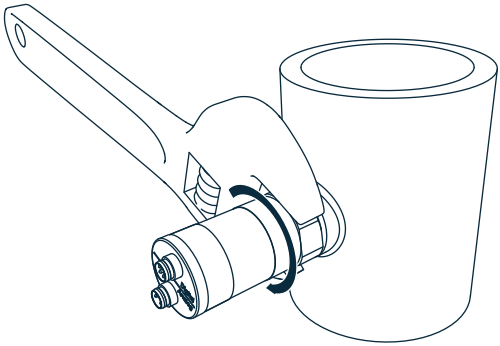
1. Remove the yellow transport protection cap from the transmitter.



2. Apply PTFE tape or suitable paste sealant to the thread. Follow the application instructions of the sealant.



3. Use a 30-mm wrench to tighten the connection.



4. Connect the signal and power cable to the transmitter.

3.4 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 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

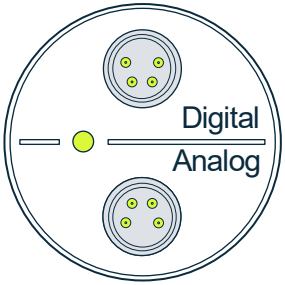


Figure 5 MMT143 digital and analog connectors

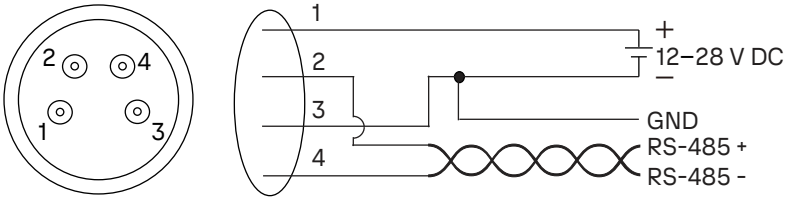


Figure 6 Wiring the digital connector

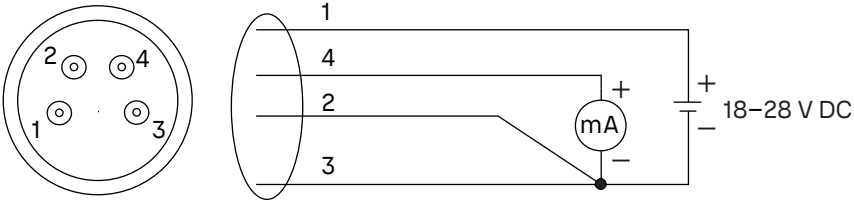


Figure 7 Wiring the analog connector

3.4.1 Connection cables

Vaisala supplies shielded cables with M8 male straight threaded connector, heavy duty cables, and cables for service use. For more information, see the product offering at store.vaisala.com.

More information

- MMT143 spare parts and accessories (page 66)

3.4.2 Power supply requirements

The minimum supply voltage required by the MMT143 transmitter is 18–28 V DC for current output and 6–28 V DC for digital output.

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

Current consumption during normal operation is < 10 mA.

MMT143 can be powered by Indigo80 indicator or USB service cable. You can plug in Indigo80 or the USB service cable to the digital port while the transmitter is powered from the analog port.

3.5 Sampling accessories

3.5.1 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 ISO G3/8″, outlet ISO G1/4″). The flow direction can be reversed, if needed. Figure 8 (page 22) shows the default direction.

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

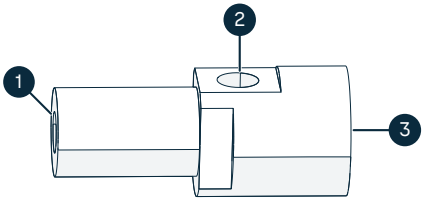


Figure 8 DMT242SC sampling cell

1 Inlet, ISO G3/8″
2 Outlet, ISO G1/4″
3 Connection point for probe/ transmitter, ISO G1/2″

3.5.2 DMT242SC2 sampling cell with Swagelok connectors

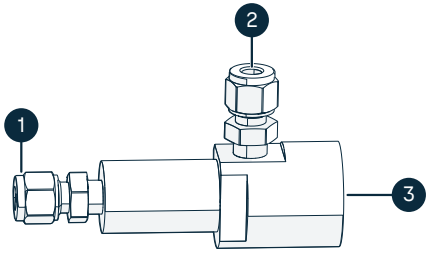


Figure 9 DMT242SC2 sampling cell

1 Inlet, 1/4″ Swagelok connector (two-ferrule)
2 Outlet, 1/4″ Swagelok connector (two-ferrule)
3 Connection point for probe/ transmitter, ISO G1/2″

For easy installation, the DMT242SC2 sampling cell includes welded Swagelok connectors at both the inlet and outlet. The connectors fit directly to 1/4″ tubing with Swagelok's two-ferrule mechanical grip design.

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.

4. Operation

4.1 MMT143 startup sequence

When the transmitter is connected to power supply, there is a delay of five seconds as the transmitter starts up. After the start-up is complete, the measurement data is available from the analog outputs or serial line.

If RS-485 output is used, note that the transmitter will behave according to the configured interface mode:

- In STOP mode, the transmitter outputs the transmitter model and software version.
- In RUN mode, measurement output starts immediately.
- In POLL mode, the transmitter does not output anything after power-up.
- In MODBUS mode, the transmitter does not output anything after power-up.

4.2 Method used for measuring moisture in oil

The MMT143 transmitter measures water in oil in terms of relative saturation (%RS) and water activity (a_w) . With the help of internal oil solubility coefficients, MMT143 is also able to output oil moisture in ppm (supported by default for most insulating liquid types, including mineral transformer oil).

Relative saturation indicates the amount of water in oil in the scale of 0–100 %RS. In this scale, 0 %RS is an indication of completely water free oil and 100 %RS an indication of oil fully saturated with water. Water is present in free form.

Water activity indicates the amount of oil in the scale of 0–1 a_w. In this scale, 0 a_w is an indication of completely water free oil, and 1 a_w is an indication of oil fully saturated with water. Water is present in free form.

The most advanced feature which distinguishes the measurement of relative saturation (%RS) and water activity (a_w) from the traditional measurement of absolute water content (in ppm) is that the saturation point remains stable regardless of the oil type, aging of oil, or additives used. As relative saturation exceeds 90 %RS or water activity exceeds 0.9 a_w in any system, there is a risk for segregation especially if the temperature decreases.

Relative saturation and water activity are used for alarming at the point of > 0.9 a_w or 90 %RS that the risk for free water in the system is obvious.

This system has important advantages: relative saturation is immune to the aging of oil and to additives, and the MM143 transmitter can be used for continuous online measurements.



To avoid self-heating of the transmitter and consequential measurement errors, make sure there is some flow (more than 0.2 m/s) in the application process.

4.3 Lubrication oil

In many industrial plants, like paper mills, hydro power plants, and off-shore wind turbines, there is a certain amount of free moisture constantly present. This means that there is a high risk of the free moisture coming into contact with the machine bearings. The most common reasons for the entrance of water are inadequate sealing of the housing or moisture absorption from ambient air. Accidental leakages from oil coolers and other equipment can also cause damage.

Free water in lubrication oil prevents oil from forming a uniform layer on the metal surfaces and deteriorates its lubrication properties. This can cause, for example, spot heating, cavitation, corrosion, and micro pitting. Free water also ruins additives like AW (antiwear) and EP (extreme pressure). Note that bearings should never be exposed to oils that have high water content; this is also important during standstill because the risk for corrosion increases as the oil temperature decreases. It is essential to monitor the water content and to keep it at a suitable level, that is, below saturation.

When measuring the water content in oil, it is best to measure the relative saturation or water activity before an oil reservoir and from a pressure line flow. This way the performance of dehumidifiers can be kept under control to ensure that no free water reaches the bearings.

4.4 Transformer oil

The determination of moisture in oil is an essential part of a comprehensive transformer maintenance program. Aging and deterioration increase the capacity of oil to absorb water. The primary interest in transformers is to measure the water not in oil but in the cellulosic insulation around the transformer windings. The MMT143 method provides for a reliable detection of the aging of oil and possible leakages.

Moisture level in oil is a true indicator of moisture present in the paper insulation. Heating and cooling have a considerable effect on moisture levels in oil. The paper insulation around the transformer windings tends to lose moisture as temperature rises. This moisture is absorbed by the oil surrounding it.

Oil-immersed transformers rely on the oil for cooling, protection from corrosion, and as an important component of their insulation. Excessive moisture content in oil causes accelerated aging of the insulation materials and reduces their dielectric strength. In extreme cases, this can result in arcing and short circuits within the windings. Accurate moisture measurements can also warn about leaks in the oil system, as water is absorbed from the surrounding air.

The water solubility of oil is also temperature-dependent. In general, water solubility increases as temperature rises. For more information, see the following figure.

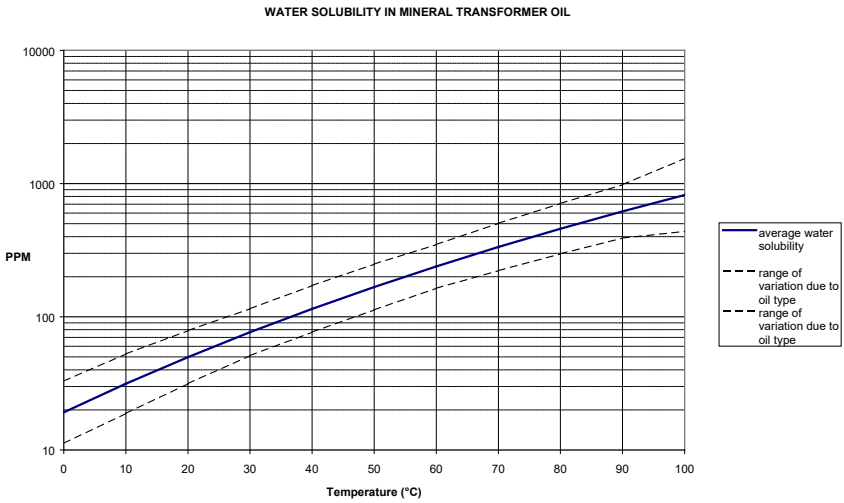


Figure 10 Water solubility of transformer oils versus temperature. The margins show the range of variation of water solubility found in mineral oils.

In addition, note that the capacity of oil to absorb water depends both on the chemical structure of the oil and the additives.

4.5 ppm conversion for transformer oils

Traditionally, moisture in transformer oil is measured by using ppm units. The ppm output shows the average mass concentration of water in oil.

MMT143 has an option for ppm output provided that this has been notified when placing the order for the transmitter. Vaisala has this conversion readily available for most insulating liquid types, including mineral transformer oil.

4.5.1 Conversion model with average coefficients

The conversion model of the MMT143 is based on the average water solubility behavior of transformer oils. The ppm output is calculated as follows:

$$ppm = a_w \times 10^{(A/(T + 273.16) + B)}$$

where

aw = water activity

A,B = coefficients (average/oil-specific)

T = temperature (ºC)

Generally, measurements with MMT143 give accuracy better than 10 % of the reading.

4.5.2 Conversion model with oil-specific coefficients

For additional accuracy, an oil-specific conversion model can be used both for mineral and silicon-based oils. An oil sample has to be sent to Vaisala for modeling. As a result, the specific coefficients (A and B) for the transformer oil are determined by Vaisala. For additional information, please contact Vaisala.

The determined coefficients of the transformer oil can be programmed to MMT143 by Vaisala or by a user using Indigo80 handheld indicator or Insight PC software.

More information

- Determining oil-specific coefficients (page 27)
- Configuring coefficients using Insight (page 29)
- Configuring coefficients using Indigo80 (page 29)

4.6 Determining oil-specific coefficients

Follow this procedure to use your own apparatus for determining oil-specific coefficients for Vaisala moisture in oil measurement devices, such as the MMP8 probe or the MMT143 transmitter.

- Apparatus for determining water content, for example, coulometric titrator and magnetic stirrer
- Oil test station:
  - Temperature test chamber
  - For example, a conical flask (1 L) sealed by a PTFE stopper with an inlet for a moisture in oil measurement probe/transmitter
  - Moisture in oil measurement probe/transmitter
  - Magnetic stirrer

The equation of the ppm calculation is:

$$ppm_W = a_W \times 10^{(B + A \div T)}$$

where:
- a_w = Water activity
- A, B = Coefficients
- T = Temperature (K)

Follow this procedure to define the coefficients A and B for the equation:

$$LOG(ppm_{sat}) = B + A \div T$$

1. Define the water content of the oil sample with the titration. Use the oil moisture level that is close to real conditions in the process.
2. Measure the water activity of this sample with the probe/transmitter at two temperatures that differ at least by 20 °C. Follow the measurement stabilization of the probe/transmitter from the interface it is connected to (for example, Vaisala Insight PC software).

   You must seal the sample very carefully. If the sample is in contact with ambient air, its water content will be affected.

   If the oil sample is very dry and the temperatures are close to each other, it may cause inaccuracy to the calculation model. To get the best possible performance, it is recommended to use oil conditions that represent real conditions in the application. Recommended values for the sample are approx. a_w 0.5 at 20 °C.

3. Define the correlation between a_w, T and ppm (w/w) from the measured values. Calculate A and B according to the following example.

$$A = \frac{LOG(ppm_{sat}[T2]) - LOG(ppm_{sat}[T1])}{1 \div (T2) - 1 \div (T1)}$$

$$B = LOG(ppm_{sat}[T1]) - A \div T1$$

Table 6 Example: Measured water content 213 ppm

T (K)	a_w	$ppm_{saturation}$
24.1	0.478	213/0.478 = 445.6067
57.6	0.188	213/0.188 = 1132.979

$$A = \frac{LOG(1132.98) - LOG(445.607)}{1 \div (57.6 + 273.15) - 1 \div (24.1 + 273.15)} = -1189.4581$$

$$B = LOG(445.607) - (-1189.4581) \div (24.1 + 273.15) = 6.6503583$$

Assumptions: The isotherm of water activity versus water concentration is linear and the solubility curve has the form of the given equation.

4.7 Configuring coefficients

If the ppm conversion and oil-specific coefficients have been programmed at Vaisala, you do not have to set the conversion coefficients.

If you have defined the coefficients or separately received from Vaisala the oil-specific coefficients A and B, related to your own oil type, the coefficients can be set to the software of MMT143 with Insight PC software or Indigo80 handheld indicator.

4.7.1 Configuring coefficients using Insight

You can configure coefficients for the MMT143 transmitter using the Insight PC software.

1. Connect the transmitter to the Insight software.
2. Select ⚙ and open the **Configure device** menu.
3. Select **Calculation coefficients**.
4. Enter the desired oil type.
   - In the **Oil type** field, select the desired oil type.
   - In the **Oil A** and **Oil B** fields, enter the values of the required coefficients.
5. Select **Save**.

4.7.2 Configuring coefficients using Indigo80

After installation, you can configure coefficients for the MMT143 transmitter using the Indigo80 handheld indicator.

1. Connect the transmitter to the indicator.
2. Open the indicator 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. Select **Calculation coefficients**.
6. Enter the desired oil type.
   - Select **Oil type** and use the arrow buttons to select the desired oil type.
   - • Select **Oil A** and use the arrow buttons to set the required value.
     • Select **Oil B** and use the arrow buttons to set the required value.

5. Vaisala Insight PC software

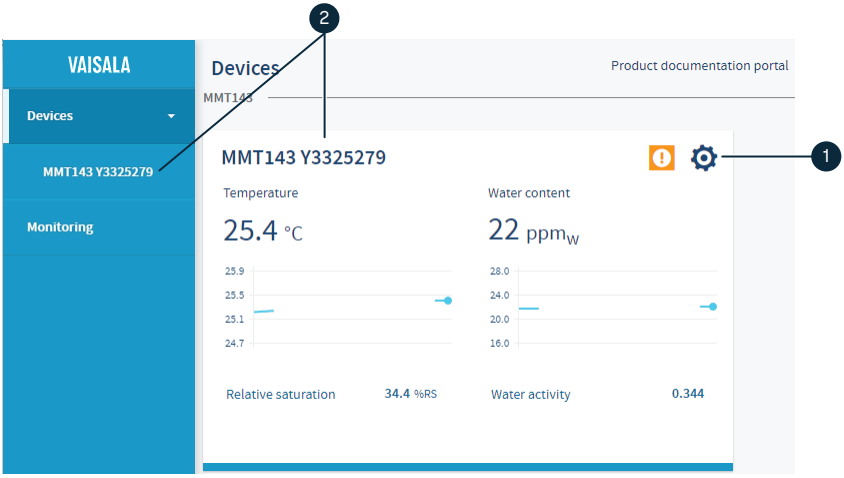
5.1 Vaisala Insight PC software

Vaisala Insight PC software is a configuration and calibration software for Vaisala devices. Insight is available for the Windows operating system (64-bit only). For a full list of supported operating system versions, see vaisala.com/insight.

With the Insight software, you can:

- See device status and information, for example, serial number.
- See real-time measurement.

To ensure support for your device, download the latest version of Insight at vaisala.com/insight.



1 MMT143 settings are available through the settings wheel in the Insight **Devices** view.
2 Serial number

5.2 Connecting to Insight PC software

- Computer with a Microsoft Windows® operating system (64-bit version) and Vaisala Insight PC Software installed
- M8-4F USB service cable (Vaisala item code 219690)

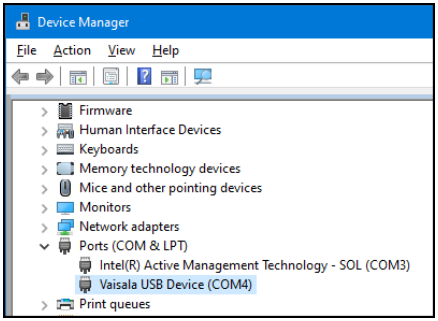
1. Open the Insight software on your computer.
2. Connect the USB cable to a free USB port on the computer.
3. Connect the USB cable to the digital port of the transmitter.
4. Wait for the Insight software to detect the transmitter.

   If the transmitter is not detected, check that the USB driver is installed.

5.3 Installing driver for USB service cable

Only Windows® operating systems are supported by the driver of the USB service cable.

1. Connect the USB service cable to a USB port on your computer. Windows detects the new device and installs the appropriate driver.
2. Open **Device Manager** from the Windows **Start** menu. Use search to find it if necessary (search for "device").
3. Locate the cable in the list of devices:
   - If the device is listed as **Vaisala USB Device** with a COM port number in brackets, the cable is ready for use.
   - If the device is listed as **Vaisala USB Instrument Cable** without a COM port number listed, you must install the driver manually.



4. To install the driver manually:
   a. Disconnect the USB service cable from the computer.
   b. Download the Vaisala USB driver at vaisala.com/software (select the appropriate USB Instrument Driver Setup for your cable).
   c. Extract the driver zip file and run the USB driver installation program ***`Vaisala USB Device Driver Setup.exe`***. Accept the installation defaults.
   d. Go back to step 1 and verify that the driver installation works as expected.

6. Using transmitter with Indigo80 handheld indicator

6.1 Indigo80 handheld indicator

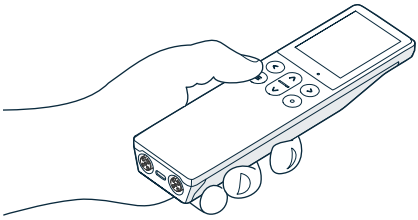


Figure 11 Indigo80 handheld indicator

Vaisala Indigo80 handheld indicator is a portable diagnostics tool that accommodates up to two compatible Vaisala devices 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

6.1.2 Indigo80 keypad

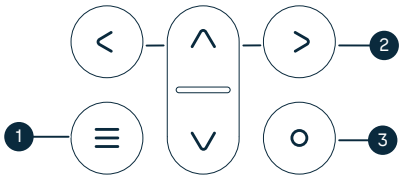


Figure 12 Indigo80 keypad

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.

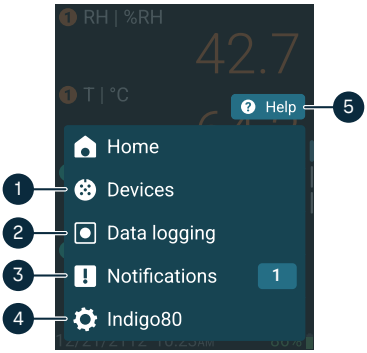


Figure 13 Indigo80 main menu

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 tours 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 measurement devices 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.

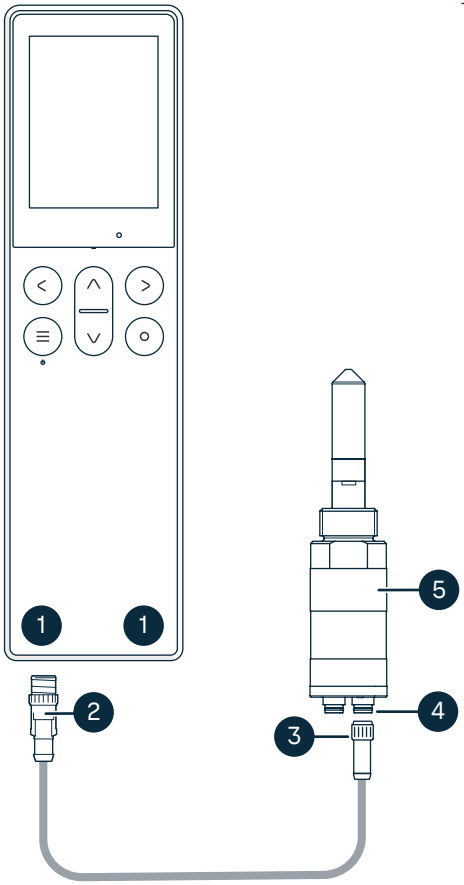
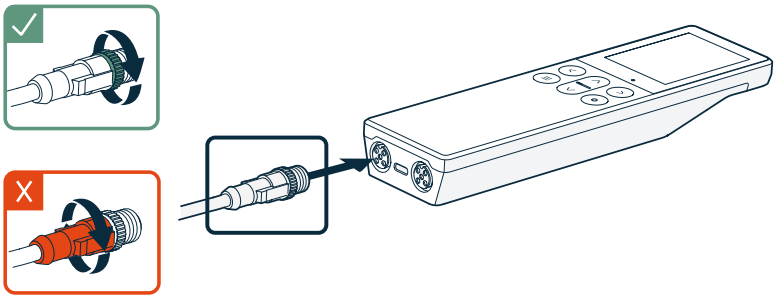


Figure 14 Connecting MMT143 transmitter to Indigo80 handheld indicator

1 M12-5F ports on the bottom of Indigo80 for connecting compatible Vaisala devices. Ports are labeled ❶ (left) and ❷ (right) on Indigo80.
2 M12-5M cable connector
3 M8-4F cable connector
4 Port labeled **Digital**
5 MMT143 transmitter, displayed as ❶ by Indigo80

1. If the indicator is powered and no devices are connected to it, the text **Please connect a measurement device** will be shown on the display.
2. Connect the M8 end of the service cable to the port labeled **Digital** on the bottom of MMT143.

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.

> If you have altered the MMT143 serial line settings and start using the Indigo80 indicator, always switch off the other power supply (disconnect "Analog" cable if in use) before powering up Indigo80.

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 serial communication and analog output.

1. Connect the transmitter to the indicator.
2. Open the indicator 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. Confirm by selecting **OK**.
6. Exit the menu by pressing ⟨ or return to the main menu by pressing ☰.

7. Modbus communication

You can use the Modbus serial communication protocol to access transmitters ordered with the Modbus configuration option.The supported Modbus variant is Modbus RTU (Serial Modbus) over RS-485 interface.

The supported Modbus functions and registers are described in *Appendix A: Modbus reference*.

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

Table 7 Default Modbus serial communication settings

Description	Default value
Serial bit rate	19200
Parity	N
Number of data bits	8
Number of stop bits	1 or 2 (depending on the ordered configuration)
Modbus device address	240
Serial delay	0
Communication mode	Modbus RTU

Use Vaisala Insight PC software or Indigo80 handheld indicator to change the Modbus serial communication settings, if needed. Download Insight software at vaisala.com/insight.

8. Serial communication

8.1 Connecting to the serial interface

To interface with MMT143 using Vaisala Industrial Protocol with a terminal application, the transmitter can be connected to a PC using the RS-485 line on the transmitter's digital port. Vaisala recommends using 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 Vaisala USB instrument driver from vaisala.com/software.

More information

- Installing driver for USB service cable (page 31)

8.2 Terminal application settings

Table 8 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 MMT143 using the PuTTY terminal application for Windows (available for download at vaisala.com/software) and a USB serial interface cable:

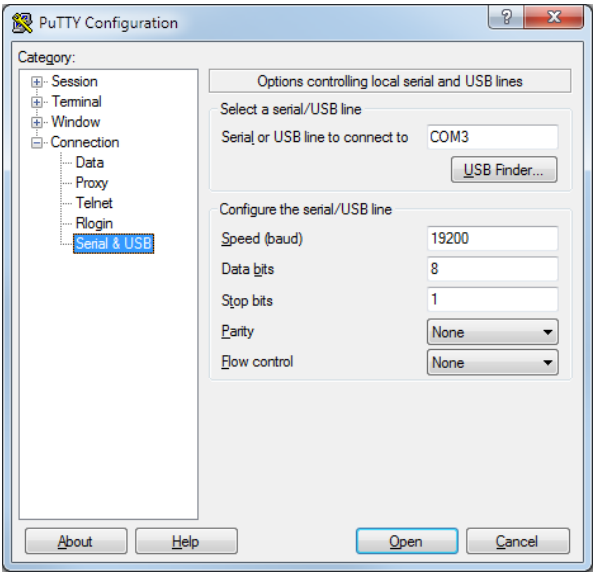
1. If you have not used the Vaisala USB cable before, install the driver before attempting to use the cable.
2. Connect the USB serial interface cable between your PC and the digital port of MMT143.
3. Start the PuTTY application.
4. Select the **Serial** settings category, and check that the correct COM port is selected in the **Serial or USB line to connect to** field.

   To check which port the USB cable is using, open **Device Manager** from the Windows® Start menu and check under the **Ports** category.
5. 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.

6. 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.

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



8.3 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.

   The driver is available from vaisala.com/software.

2. Open the terminal program and open a connection to the corresponding COM port using the default settings **19200**, **8**, **N**, **1** or **2** (depending on the ordered configuration), 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.

8.4 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 9 List of serial commands

Command	Description
?	Show device information
ADDR [0 ... 255]	Show or set transmitter address
AERR	Set analog output error level
AMODE	Show analog output mode
AOUT	Show analog output status
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

Command	Description
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)
OIL	Display oil parameters (available if ordered)
OILI	Set new oil parameters (available if ordered)
OPEN	Stop POLL mode
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
TIME	Set time for transmitter clock
UNIT [m/n]	Select metric or non-metric units
VERS	Show transmitter firmware version

8.5 Device information

8.5.1 Show device information

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

Table 10 ? command

Syntax	Description
?<cr>	Display device information.

Syntax	Description
Example: **?** MMT143 1.7.4 Serial number : Y3249445 Batch number : X5020715 Sensor number : D01Y281 Sensor model : HumicapL2 Cal. date : 20260817 Cal. info : Vaisala / Helsinki Time : 00:00:02 Serial mode : MODBUS SCI Baud P D S: 19200 N 8 1 Output interval: 5 S Serial delay : 0 Address : 100 Filter : 1.00000 Ch1 output : 4 ... 20 mA Ch1 error out : 3.600 mA Ch1 RS lo : 0.00 % Ch1 RS hi : 100.00 %	

8.5.2 Show analog output mode

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

AMODE<cr>

Example:

amode
Ch1 output : 4 ... 20 mA

8.5.3 Show firmware version

Table 11 VERS command

Syntax	Description
VERS<cr>	Display the transmitter firmware version number.
Example: **vers** MMT143 1.7.4	

8.5.4 Show firmware information

SYSTEM<cr>

Example:

```
system
Device Name          : MMT143
Copyright            : Copyright (c) Vaisala Oyj 2026. All rights reserved.
SW Name              : DMT143
SW date              : 2026-08-17
SW version           : 1.7.4
```

8.5.5 Show currently active errors and warnings

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

ERRS<cr>

Example:

```
errs
No errors
```

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

```
errs
T MEAS error
```

Table 12 Error messages and warnings on ERRS command

ERRS command response	Corresponding error/warning
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]
Voltage is too low for mA output	Supply voltage too low for analog output. [56]
General flash failure w/r	Non-volatile memory read/write failure. [57]

ERRS command response	Corresponding error/warning
Analog output test active	Analog output test active. [743]
Invalid communication settings	Invalid communication settings. [944]

8.5.6 Show serial number

SNUM<cr>

Example:

```
snum
Serial number  : G4060003
```

8.5.7 Show command list

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

HELP<cr>

Example:

```
help
?
ADDR
AERR
AMODE
AOVER
AOUT
ASEL
ATEST
CLOSE
ERRS
FILT
FORM
FRESTORE
HELP
INTV
OIL
OILI
R
RESET
SDELAY
SEND
SERI
SMODE
SNUM
SYSTEM
TIME
UNIT
VERS

OPEN
SEND
```

8.6 Configuring analog output

8.6.1 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. The available parameters are • water activity (a_w) • relative saturation (%RS) • temperature (T) • ppm (H_2O)
lowlimit	Lower limit of parameter scaling.

Syntax	Description
`highlimit`	Higher limit of parameter scaling.

Example (show current settings):

```
asel *
Ch1 RS   lo    :     0.00 %
Ch1 RS   hi    :   100.00 %
```

8.6.2 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 are 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 sensor damage. When there is a severe device malfunction, the error output value is not necessarily shown.

8.6.3 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 at 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. After giving the **AOVER ON** command, the range is 4–20 mA (0–100 %RS), 4–21.6 mA (0–110 %RS), 100 %RS point still at 20 mA.

8.6.4 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.

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
```

8.6.5 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
```

8.7 Serial line output commands

8.7.1 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.

R<cr>

Example (measurement message in default format):

```
r
aw=   0.335 T= 25.2 'C H2O=    22 ppm
aw=   0.335 T= 25.2 'C H2O=    22 ppm
aw=   0.335 T= 25.2 'C H2O=    22 ppm
aw=   0.335 T= 25.2 'C H2O=    22 ppm
aw=   0.334 T= 25.2 'C H2O=    22 ppm
```

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

8.7.2 Stop measurement output

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

8.7.3 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
```

8.7.4 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:

```
sendaw=   0.350 T= 24.8 'C H2O=    21 ppm
```

8.8 Configuring measurement parameters

8.8.1 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. Maximum length may be shorter when text strings are used.

Table 13 FORM command parameters

Measured parameter	Abbreviation in FORM command
Temperature	T
Water activity	aw
Relative saturation	RS
Water content	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
`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):

```
aw=   0.335 T= 25.2 'C H2O=    22 ppm
aw=   0.335 T= 25.2 'C H2O=    22 ppm
aw=   0.335 T= 25.2 'C H2O=    22 ppm
aw=   0.335 T= 25.2 'C H2O=    22 ppm
aw=   0.334 T= 25.2 'C H2O=    22 ppm
```

Command to set output format as aw 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:

Output example (ASCII control characters 002 and 003 shown here as **<stx>** and **<etx>**, respectively):

```
<stx>aw=   0.33 T= 24.9 'C H2O=    21 ppm  <etx><stx>aw=   0.33 T= 24.9 'C
H2O=    21 ppm  <etx>
```

8.8.2 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
```

8.8.3 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
```

8.9 Configuring serial line operation

8.9.1 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 15 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
```

8.9.2 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.

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
```

8.9.3 Set transmitter address

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

Syntax	Description
[address]	Device address, range 0–255 (POLL mode) or Modbus address (unit ID), range 1–247 (Modbus mode).

Example:

```
addr
Address : 0 ?
```

8.9.4 Set serial line response time

Use the **SDELAY** command to set the delay (response time) of the serial line, or to view the currently set delay value. Increasing the response delay can help to avoid message corruption on RS-485 buses with repeaters and converters.

SDELAY [delay]<cr>

Syntax	Description
[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
```

8.10 Set oil coefficients

If the ppm conversion and oil-specific coefficients have been programmed at Vaisala, you do not have to set the conversion coefficients. If you have defined the coefficients or separately received from Vaisala the oil-specific coefficients A and B, related to your own oil type, the coefficients can be set to the software of MMT143 by using serial line.

Use the serial line command **OIL** to display oil-specific parameters for ppm conversion.

OIL<cr>

Set new oil parameters with the **OILI** command.

OILI<cr>

Example:

```
oil
Oil[0]    :  -1.50450001E+03
Oil[1]    :   6.86000013E+00
```

where

Oil[0] corresponds to parameter A

Oil[1] corresponds to parameter B

8.11 Other commands

8.11.1 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
MMT143   5 line opened for operator commands
```

8.11.2 Closing the connection to a transmitter in POLL mode

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

CLOSE<cr>

Example:

```
close
line closed
```

8.11.3 Set time

Use the **TIME** command to view and set the transmitter clock. The clock does not have a battery backup – it is reset to 00:00:00 when the transmitter is powered up or reset.

TIME [hh mm ss]<cr>

Table 16 TIME command

Syntax	Description
hh	Hours (24-hour clock)
mm	Minutes
ss	Seconds

Examples:

```
time 12 30 00
 12:30:00
```

```
time
 12:30:00
```

8.11.4 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.

8.11.5 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.

9. Maintenance

9.1 Cleaning

- Instrument air
- Soft, lint-free cloth
- Purified gasoline or heptane liquid
- Isopropyl alcohol



Wear protective eyewear and gloves.

This procedure describes how to clean the transmitter after detaching it from its measurement location. Clean the transmitter using these instructions before storage or shipping.

Cleaning the transmitter and its sensor is important to prevent oxidation of the oil on the sensor. Oxidized oil residue on the sensor may lead to extended response times and measurement drift.

- Do not scrape the transmitter or the transmitter body.
- Do not immerse the transmitter body in liquid.

1. Wipe the transmitter head with a soft, lint-free cloth to remove any oil on the surface.
2. Immerse the tip of the transmitter head in purified gasoline or heptane liquid. Make sure the filter is completely immersed. Move the tip of the transmitter head in the liquid to clean the filter and the sensor.
3. Blow on the transmitter head with instrument air.
4. Wipe the transmitter body, cable, and transmitter head with a soft, lint-free cloth moistened with isopropyl alcohol.

9.2 Calibration

MMT143 is fully calibrated as shipped from the factory. The typical calibration interval is 2 years. If there is a reason to believe that the device is not within the accuracy specifications, contact a Vaisala Service Center or your local Vaisala representative to have MMT143 adjusted.

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

- Make sure that the installation location of the transmitter represents well the area of interest, and nothing interferes with the measurement: heat sources, temperature differences, or condensation.
- Check that there is no moisture on the transmitter. If the sensor has become wet, wait for it to dry.
- Always wait for the measurement to stabilize.

Factory calibration leads to highest accuracy and lowest uncertainty. After factory calibration the instrument performs as new. For up-to-date information about calibration points and offering, visit store.vaisala.com.

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

9.3 Changing filter

CAUTION! If you have an MMT143 transmitter that is designed for 0–50 bar pressure range, do not attempt to change the filter yourself. The device can break. If the filter needs to be changed, contact a Vaisala Service Center or your local Vaisala representative.

You can change the filter of an MMT143 transmitter that is designed for an extended pressure range of 0–200 bar (upcoming).

10. Troubleshooting

10.1 Solving typical problems

Some problems can be solved by simply resetting the transmitter. You can reset the transmitter by disconnecting the power.

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 Vaisala Industrial Protocol 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.

More information

- Show currently active errors and warnings (page 43)
- Restore factory settings (page 56)

10.2 Error and warning messages

Measurement devices can communicate with error messages when they are connected to Indigo80 handheld indicator or Insight software. The messages are categorized according to the severity of the status.

MMT143 has the following states that indicate a problem with the transmitter:

- Analog current output is at error level (default 3.6 mA, alternatively 0 mA can be selected when ordering the transmitter)
- Vaisala Industrial Protocol outputs asterisk characters (*** **)
  The asterisk characters on the serial line may also appear during the start-up procedure. You can also check the error message via the serial interface by using the **ERRS** command.

- Measurement results are missing from the Modbus output. Read the Modbus Status code register for more information.
- The status LED is blinking red when there is an active error or warning. Check the reason for the error or warning with Insight PC software or Indigo80 handheld indicator.

In case of constant error, contact Vaisala.

Table 18 MMT143 error messages displayed in Indigo80 and Insight software

Error message and code	Description	Recommended action
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 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]		

Table 19 MMT143 warning messages displayed in Indigo80 and Insight software

Warning message and code	Description	Recommended action
Supply voltage too low for analog output. [56]	Supply voltage is too low for reliable current output.	You need to connect a separate power supply of 18–28 VDC for accurate analog output signal. Alternatively, if the analog output is not needed, switch it off with Insight or Indigo80 by changing the analog output mode setting. If the analog output is enabled but the device is temporarily powered **only** from a USB cable or from Indigo80, this warning is normal and can be ignored.
Analog output test active. [743]	Analog output test has been activated.	Shut down the analog output test on the diagnostics view of Insight or Indigo80 or power-cycle the device.
Invalid communication settings. [944]	Modbus protocol selected with zero device address, baud rate of 4800 or less, and/or 7 data bits.	Modbus RTU protocol requires 8 data bits and a non-zero device address. In addition, MMT143's Modbus protocol works only at 9600 or 19200 bit/s.
Calibration is about to expire. [352]	Less than 30 days to the calibration expiration date.	Contact Vaisala for calibration services. If you want to ignore the calibration reminder, you can switch the reminder off with Insight or Indigo80 in the Calibration menu.
Calibration has expired. [353]	The selected calibration expiration date has been reached.	

The status LED blinks in red if any of these errors or warnings are active, except for "Calibration is about to expire."

More information

- Technical support (page 69)
- Status registers (page 73)

11. Technical data

11.1 MMT143 specifications

Table 20 MMT143 measurement performance

Property	Description/Value
Sensor	HUMICAP® 180L2
Sensor protection	Stainless steel filter (standard / high flow)
Water activity and relative saturation [1)]	
Measurement range	0–100 %RS (0–1 a_w)
Accuracy (including non-linearity, hysteresis, and repeatability):	
0–90 %RS (0–0.9 a_w)	±2 %RS (-±0.02 a_w)
90–100 %RS (0.9–1 a_w)	±3 %RS (±0.03 a_w)
Response time in oil flow (typical)	< 1 min (dry-wet)
Temperature [1)]	
Measurement range	–20 ... +80 °C (–4 ... +176 °F) for standard range version –40 ... +80 °C (–40 ... +176 °F) for extended range version
Accuracy at +20 °C (+68 °F)	±0.2 °C (±0.36 °F)
Moisture	
Calculates moisture content in ppm for most insulating liquid types, including mineral transformer oil.	

1) *Measurement performance is specified for an oil flow greater than 0.2 m/s.*

Table 21 MMT143 operating environment

Property	Description/Value
Pressure range	0–50 bar for standard range version 0–200 bar for extended range version
Operating temperature	
Standard range	–20 ... +60 °C (–4 ... +140 °F)
Extended range	–40 ... +60 °C (–40 ... +140 °F)

Property	Description/Value
Storage temperature	−40 … +80 °C (−40 … +176 °F)
Oil flow	Min. 0.2 m/s
IP rating	IP66

Table 22 MMT143 inputs and outputs

Property	Description/Value
Digital outputs (1 port)	RS-485, non-isolated Modbus RTU protocol Vaisala Industrial Protocol
Analog current output (1 port)	4–20 mA
Resolution for current output	0.002 mA
Accuracy for current output at +20 °C (68 °F)	±0.05 mA
Load for current output	Max. 500 Ω
Temperature dependency	0.0008 mA / °C
Operating voltage	
With digital output	6–28 V DC
With current output	18–28 V DC

Table 23 MMT143 mechanical specifications

Property	Description/Value
Cable connections (2 ports)	M8 4-pin male Separate connectors for analog output and digital output (one of each).
Mechanical connections	ISO G1/2″ or 1/2″-14 NPT
Weight	Model with ISO G1/2″ thread: 90 g (3.2 oz) Model with 1/2″-14 NPT thread: 100 g (3.5 oz)
Housing	
Transmitter body material	Stainless steel (AISI 316L)

Table 24 MMT143 compliance

Property	Description/Value
EU directives and regulations	EMC Directive (2014/30/EU) RoHS Directive (2011/65/EU) as amended by 2015/863
Electromagnetic compatibility (EMC)	IEC/EN 61326-1, industrial environment [1)] FCC part 15 B, Class B CAN ICES-3(B)/NMB-3(B)
Compliance marks	CE, China RoHS, KC, RCM

1) *Water activity and relative saturation measurement output may deviate up to ±4 %RS (0.04 aw) in industrial environments < 100 MHz and 900–1000 MHz.*

Table 25 MMT143 spare parts and accessories

Spare part	Order code
Stainless steel filter	HM47453SP
Stainless steel filter for high flow (> 1 m/s)	220752SP
Connection cable for Indigo80 handheld meter	262195SP
USB serial interface cable / cable for PC connection	219690
Sealing ring set (U-seal, 3 pcs) ISO G1/2″	221525SP
Sealing ring set (copper, 3 pcs) ISO G1/2″	221524SP
Sampling cell	DMT242SC
Sampling cell with Swagelok connectors	DMT242SC2
Connection cables	
1.5 m (4 ft 11 in) heavy duty cable	225777SP
3.0 m (9 ft 10 in) heavy duty cable	225229SP
5.0 m (16 ft 5 in), shielded, M8 threaded	HMP50Z500SP
10 m (32 ft 10 in), shielded, M8 threaded	HMP50Z1000SP
3 m (9 ft 10 in), shielded, connector 90° angle	231520SP
5 m (16 ft 5 in), shielded, connector 90° angle	231521SP

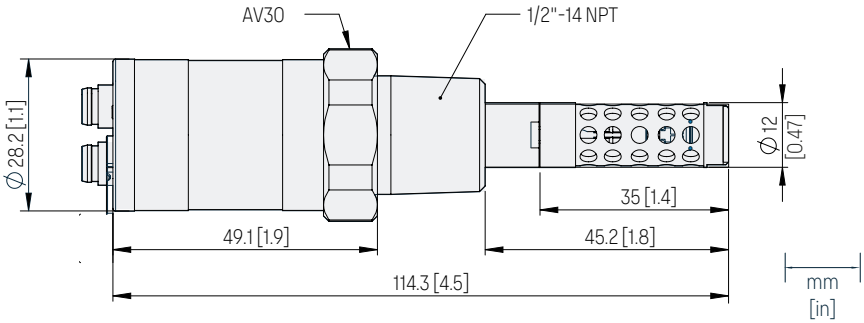


Figure 15 MMT143 dimensions, 1/2"-14 NPT thread, standard filter

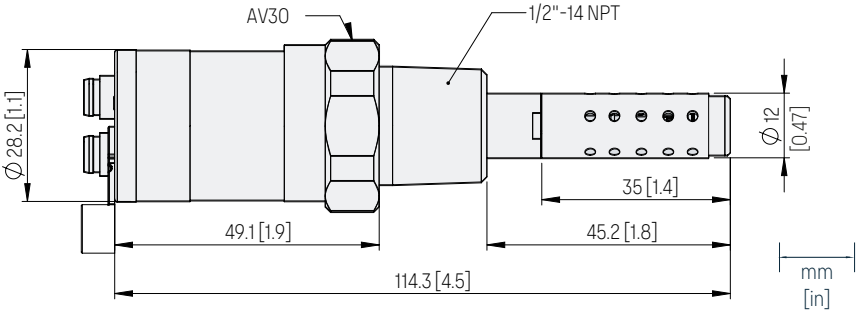


Figure 16 MMT143 dimensions, 1/2"-14 NPT thread, high flow filter

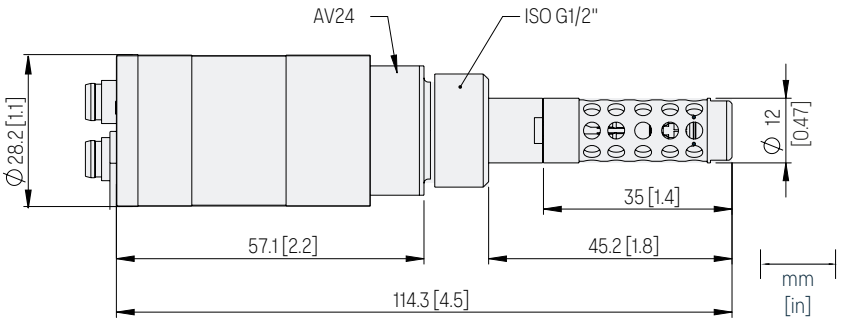


Figure 17 MMT143 dimensions, ISO G1/2" thread, standard filter

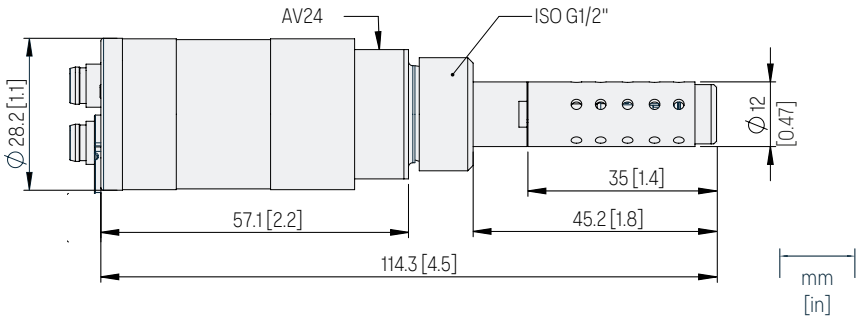


Figure 18 MMT143 dimensions, ISO G1/2" thread, high flow filter

11.2 MMT143 spare parts and accessories

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

Table 26 MMT143 spare parts and accessories

Spare part	Order code
Stainless steel filter	HM47453SP
Stainless steel filter for high flow (> 1 m/s)	220752SP
Connection cable for Indigo80 handheld meter	262195SP
USB serial interface cable / cable for PC connection	219690
Sealing ring set (U-seal, 3 pcs) ISO G1/2"	221525SP
Sealing ring set (copper, 3 pcs) ISO G1/2"	221524SP
Sampling cell	DMT242SC
Sampling cell with Swagelok connectors	DMT242SC2
Connection cables	
1.5 m (4 ft 11 in) heavy duty cable	225777SP
3.0 m (9 ft 10 in) heavy duty cable	225229SP
5.0 m (16 ft 5 in), shielded, M8 threaded	HMP50Z500SP
10 m (32 ft 10 in), shielded, M8 threaded	HMP50Z1000SP
3 m (9 ft 10 in), shielded, connector 90° angle	231520SP
5 m (16 ft 5 in), shielded, connector 90° angle	231521SP

11.3 MMT143 dimensions

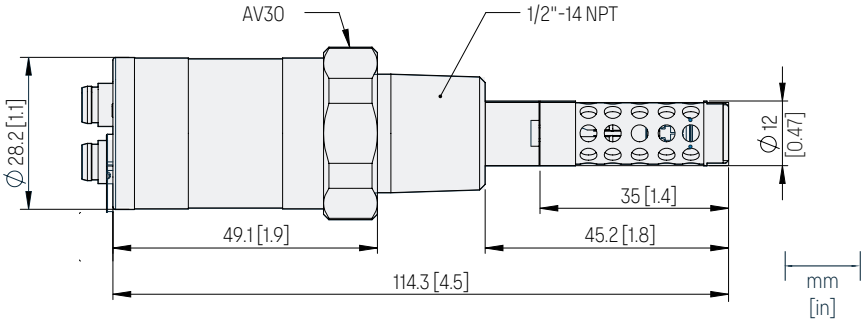


Figure 19 MMT143 dimensions, 1/2"-14 NPT thread, standard filter

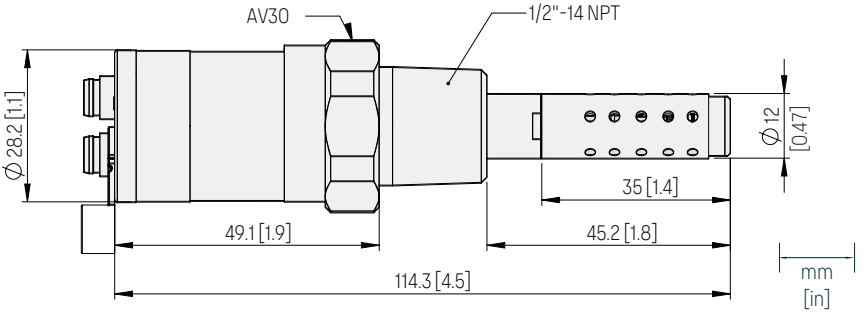


Figure 20 MMT143 dimensions, 1/2"-14 NPT thread, high flow filter

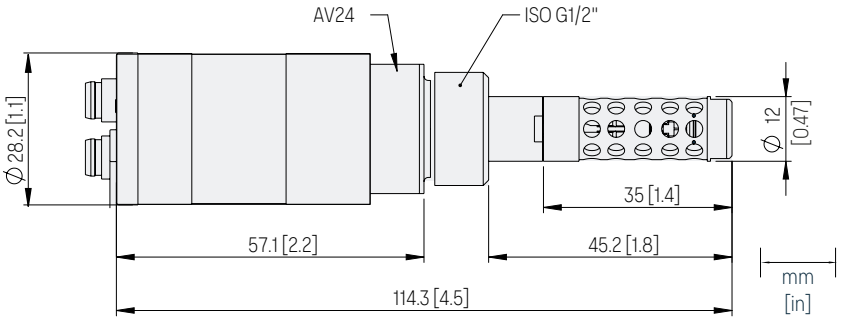


Figure 21 MMT143 dimensions, ISO G1/2" thread, standard filter

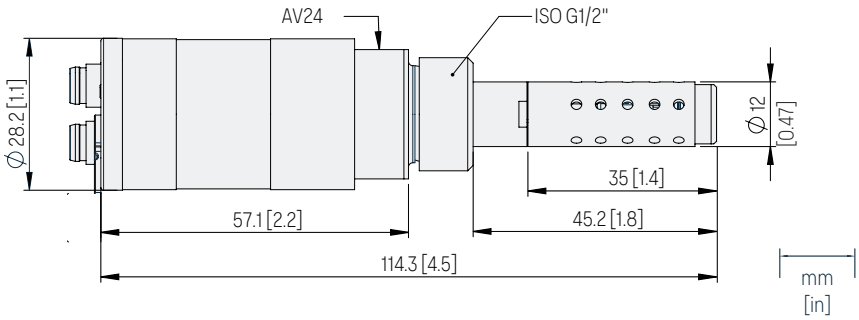


Figure 22 MMT143 dimensions, ISO G1/2" thread, high flow filter

12. Vaisala services

12.1 Service centers

Vaisala offers comprehensive customer care throughout the life cycle of our products. Our service centers offer maintenance, calibration, upgrade, and repair services. All the services are provided worldwide with fast deliveries. For more information, go to vaisala.com/services.

The services are available from:

- Vaisala Online Store, store.vaisala.com
- Vaisala Services, helpdesk@vaisala.com

The provided services vary product by product.

12.2 Technical support



You can contact Vaisala technical support at vaisala.my.site.com/myvaisala or helpdesk@vaisala.com. You can find all our support channels at vaisala.com/support.

When contacting technical support, provide the following 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
- Diagnostics package for the application

If applicable, also provide the following details:

- What failed (what worked / did not work)?
- Where did it fail (location and environment)?
- When did it fail (date, immediately / after a while / periodically / randomly)?
- How many failed (only one defect / other same or similar defects / several failures in one unit)?
- What was done when the failure was noticed?
- What was connected to the product and to which connectors?
- What is the input power source type, voltage, and what else (such as lighting, heaters, and motors) was connected to the same power output?
- Are all parts connected and grounded properly? Take a photo to help the troubleshooting.

12.3 Warranty

For warranty terms and conditions and the warranty claim process, see vaisala.com/warranty.

Note that warranty coverage may not apply if the product is damaged due to normal wear and tear, exceptional operating conditions, negligent handling or installation, or unauthorized modifications. See the applicable supply contract or Conditions of Sale for details of the warranty for each product.

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 27 Default Modbus serial communication settings

Property	Description / Value
Serial bit rate	19200
Parity	N
Number of data bits	8
Number of stop bits	1 or 2 (depending on the ordered configuration)
Modbus device address	240
Serial delay	0
Communication mode	Modbus RTU

A.2 Function codes

Table 28 Modbus function codes

Function code (decimal)	Function code (hexadecimal)	Name
03	0x03	Read Holding Registers
16	0x10	Write Multiple Registers
43 / 14	0x2B / 0x0E	Read Device Identification

A.3 Data encoding

A.3.1 32-bit floating point format

Registers using "32-bit float" data format are encoded using the "binary32" encoding defined in IEEE 754 (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 "big-endian" word order (most significant word first). In such a case, you must select "word-swapped" floating point format in your Modbus master for the Modbus registers of the device.

Reading the measurement data registers with incorrect floating point format setting may occasionally result in correct-looking values. It is highly recommended to first try reading the register number 7938 (floating point test) to see that you have configured the floating point format correctly on your Modbus host system.

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

A.3.2 16-bit integer format

Most 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 29 Interpretation of 16-bit signed integer values

Value (decimal)	Value (hexadecimal)	Description
0–32766	0x0000–0x7FFE	Value in range 0–32766
32767	0x7FFF	Value is 32767 or larger
32768	0x8000	Value is not available
32769	0x8001	Value is −32767 or smaller
32770–65535	0x8002–0xFFFF	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 0x0 in the actual Modbus message.

NOTICE! 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 30 Modbus measurement data registers (read-only)

Register number	Address	Description	Data format	Unit
3	0x0002	Temperature	32-bit float	°C
29	0x001C	Water activity	32-bit float	-
35	0x0022	Water content	32-bit float	ppm_w
41	0x0028	Relative saturation	32-bit float	%RS
Integer values				
258	0x0101	Temperature	16-bit integer	°C * 10
271	0x010E	Water activity	16-bit integer	* 1000
274	0x0111	Water content	16-bit integer	ppm_w
277	0x0114	Relative saturation	16-bit integer	%RS * 10

A.4.2 Status registers

Table 31 Modbus status registers (read-only)

Register number	Address	Description	Data format	Notes
513	0x0200	Error status	16-bit boolean	1 = No errors
515	0x0203	Status code	32-bit integer	0 = No errors or warnings
518	0x0205	Security hash	32-bit integer	Security hash changes on any change to device settings/adjustments

Table 32 Status codes on Modbus interface

Status code register value (decimal)	Status code register value (hexadecimal)	Corresponding error
0	0x00000000	No errors.

Status code register value (decimal)	Status code register value (hexadecimal)	Corresponding error
1	0x00000001	Temperature measurement error. [44]
2	0x00000002	Humidity measurement error. [45]
64	0x00100000	Device settings corrupted. [50]
128	0x00000080	Additional configuration settings corrupted. [51]
256	0x00000100	Sensor coefficients corrupted. [52]
512	0x00000200	Main configuration settings corrupted. [53]
2048	0x00000800	Supply voltage out of range. [55]
32768	0x00008000	Supply voltage too low for analog output. [56]
65536	0x00010000	Non-volatile memory read/write failure. [57]
131072	0x00020000	Firmware checksum mismatch. [49]
1048576	0x00100000	Analog output test active. [743]
2097152	0x00200000	Invalid communication settings.[944]
4194304	0x00400000	Calibration is about to expire. [352]
8388608	0x00800000	Calibration has expired. [353]

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

More information

- Error and warning messages (page 59)

A.4.3 Configuration registers

Table 33 Modbus configuration data registers (writable)

Register number	Address	Description	Data format	Unit / Valid range
Settings				
771	0x0302	Oil type	16-bit integer	0 = Custom (specify A and B on the subsequent registers) 1 = Mineral oil 2 = Synthetic ester (Midel 7131) 3 = Natural ester (FR3) 4 = Silicone liquid (Dow Corning 561)
777	0x0308	Oil A	32-bit float	-100000 ... 0
779	0x030A	Oil B	32-bit float	-100 ... 100
795	0x031A	Measurement filtering factor	32-bit float	0.00001–1
Communication				
1537	0x0600	Address	16-bit integer	1–247
1538	0x0601	Bit rate (b/s)	16-bit integer	5 = 9600 6 = 19200
1539	0x0602	Parity, data, stop bits	16-bit integer	0 = N81 1 = N82 2 = E81 3 = E82 4 = O81 5 = O82
1540	0x0603	Response delay	16-bit integer	0–1020 ms
1541	0x0604	Interface mode	16-bit integer	6 = MODBUS

Communication				
1542	0x0605	Restart device	16-bit integer	1 = Restart device
Factory settings				
7681	0x1E00	Restore settings	16-bit integer	1 = Restore factory settings

A.4.4 Test value registers

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

Table 34 Modbus test registers (read-only)

Register number	Address	Description	Data format	Value
7937	0x1F00	Signed integer	16-bit integer	-12345
7938	0x1F01	Floating point	32-bit float	-123.45
7940	0x1F03	Text string	7-character ASCII string	"-123.45"

A.4.5 Identification registers

This register provides only the most important identification data. For all available device identification data, use the Modbus standard Read Device Identification function instead.

Table 35 Modbus identification registers (read-only)

Register number	Address	Description	Data format	Value
7425	0x1D00	Vendor name	16-character ASCII string	"Vaisala"
7433	0x1D08	Product code	16-character ASCII string	"MMT143"
7441	0x1D10	Serial number	16-character ASCII string	For example, "K0710040"
7449	0x1D18	Firmware version	16-character ASCII string	For example, "1.7.4"

A.5 Device identification objects

Table 36 Device identification objects

Object ID	Object ID (hexadecimal)	Object name	Example contents
0	0x00	VendorName	"Vaisala"
1	0x01	ProductCode	"MMT143"
2	0x02	MajorMinorVersion	"1.7.4" Software version of the device.
3	0x03	VendorUrl	"https://www.vaisala.com/"
4	0x04	ProductName	"Vaisala HUMICAP(R) Moisture in Oil Transmitter MMT143"
5	0x05	ModelName	"7E2A2A0A000" Configuration code of the device. Length and content of the code are model-specific.
128	0x80	SerialNumber [1)]	"K0710040"
129	0x81	CalibrationDate [1)]	"2026-04-24" Calibration date in YYYY-MM-DD format. Empty string if not set/valid.
130	0x82	CalibrationText [1)]	"Vaisala/HEL" Calibration information text. Empty string if not set/valid.
132	0x84	CalibrationExpiry [1)]	Calibration expiry in YYYY-MM-DD format. Empty string if not set/valid.

1) Vaisala-specific device information.

A.6 Exception responses

Table 37 Modbus exception responses

Code	Name	Reason
01	Illegal function	Unsupported function code
02	Illegal data address	Register address or Object ID out of valid ranges
03	Illegal data value	Otherwise invalid request

Accessing unavailable (temporarily missing) measurement data does not generate a Modbus exception. “Unavailable” value (a quiet NaN for floating point data or 0x8000 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 relative saturation value

Device address used in the following examples is 240 (0xF0).
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
0xF0	Transmitter address	0xF0	Transmitter address
0x03	Function (Read Holding Registers)	0x03	Function (Read Holding Registers)
0x00	Register address	0x04	Number of data bytes
0x28		0xFC	Value of first register (least significant word)
0x00	Number of 16-bit registers to read (2)	0x05	
0x02		0x42	Value of second register (most significant word)
0x51	Modbus RTU checksum	0x21	
0x22		0xCA	Modbus RTU checksum
(silence for 3.5 bytes)	End of Modbus RTU frame	0x15	
		(silence for 3.5 bytes)	End of Modbus RTU frame

Communication description	
Register address	29 (1-based Modbus register number) = address 0x0028 (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.

Communication description	
Returned value	0x4221FC05, which is binary32 representation of 40.5 (%RS).

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
0xF0	Transmitter address	0xF0	Transmitter address
0x10	Function (Write Multiple Registers)	0x10	Function (Write Multiple Registers)
0x03	Register address	0x03	Register address
0x1A		0x1A	
0x00	Number of registers to write (2)	0x00	Number of 16-bit registers written (2)
0x02		0x02	
0x04	Number of data bytes	0x75	Modbus RTU checksum
0xCC	Value for the first register (least significant word)	0x6A	
0xCD		(silence for 3.5 bytes)	End of Modbus RTU frame
0x3E	Value for the second register (most significant word)		
0x4C			
0xDE	Modbus RTU checksum		
0xE9			
(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 register number) = address 0x031A (0-based format used in actual communication).

Communication description	
Data format	Two 16-bit Modbus registers interpreted as IEEE 754 binary32 floating point value, least significant word first.
Value to write	0.2, in binary32 format 0x3E4CCCCD.

Appendix B. Regulatory statements

B.1 Korean conformity information

Company name: Vaisala Oyj

Name of equipment: MOISTURE IN OIL TRANSMITTER MMT143

Country of manufacture: Finland

Link to RRA registration information: https://www.rra.go.kr/selform/rws-mmt143/

B.2 FCC Part 15 compliance statement

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

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

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

CAUTION! This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

B.3 Canada ICES-3 / NMB-3 compliance statement

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

Cet appareil numérique de classe B est conforme à la norme canadienne NMB-003.

B.4 China RoHS information table

Information table on names and contents of hazardous substances in products						
Hazardous substances 		**Component name**				
		Housing	**Cabling**	**Electronics**	**Accessories**	**Packaging**
Lead (Pb)		O	X	X	X	O
Mercury (Hg)		O	O	O	O	O
Cadmium (Cd)		O	O	O	O	O
Hexavalent chromium (Cr (VI))		O	O	O	O	O
Polybrominated biphenyls (PBB)		O	O	O	O	O
Polybrominated diphenyl ethers (PBDE)		O	O	O	O	O
Dibutyl phthalate (DBP)		O	O	O	O	O
Diisobutyl phthalate (DIBP)		O	O	O	O	O
Butyl benzyl phthalate (BBP)		O	O	O	O	O
Bis(2-ethylhexyl) phthalate (DEHP)		O	O	O	O	O

This table is prepared in accordance with the provisions of GB 26572-2025.

NOTE 1:

O: Indicates that the content of the hazardous substance in all homogeneous materials of the component does not exceed the requirements of the national standard for the restricted use of hazardous substances in electrical and electronic products.

X: Indicates that the content of the hazardous substance in at least one homogeneous material of the component exceeds the requirements of the national standard for the restricted use of hazardous substances in electrical and electronic products.

NOTE 2: Components not listed above indicate that the content of the hazardous substances in these components does not exceed the requirements of the national standard for the restricted use of hazardous substances in electrical and electronic products.

产品中有害物质的名称及含有的信息表						
有害物质		部件名称				
		外壳	线缆	电子部件	附件	包装
铅（Pb）		O	X	X	X	O
汞（Hg）		O	O	O	O	O
镉（Cd）		O	O	O	O	O
六价铬（Cr (VI)）		O	O	O	O	O
多溴联苯（PBB）		O	O	O	O	O
多溴二苯醚（PBDE）		O	O	O	O	O
邻苯二甲酸二正丁酯（DBP）		O	O	O	O	O
邻苯二甲酸二异丁酯（DIBP）		O	O	O	O	O
邻苯二甲酸丁苄酯（BBP）		O	O	O	O	O
邻苯二甲酸二（2-乙基）己酯（DEHP）		O	O	O	O	O

本表依据 GB 26572-2025 的规定编制。

注 1：

O：表示该有害物质在该部件所有均质材料中的含量均不超出电器电子产品有害物质限制使用国家标准要求。

X：表示该有害物质至少在该部件的某一均质材料中的含量超出电器电子产品有害物质限制使用国家标准要求。

注 2：

以上未列出的部件,表明其有害物质含量均不超出电器电子产品有害物质限制使用国家标准要求。

Recycling instructions

These recycling instructions guide you on the end-of-life treatment of this Vaisala product. As waste regulations and infrastructure vary in each country, these instructions only indicate the different components to be separated and common ways to handle them. Always follow local requirements when disposing of the product. Vaisala encourages to use the best available recycling practices to minimize related environmental impacts.



Vaisala is committed to meeting the requirements of the EU Waste Electrical and Electronic Equipment (WEEE) Directive. This directive aims to minimize the impact of electrical and electronic goods on the environment, by increasing reuse and recycling, and reducing the amount of WEEE going to landfill. This symbol indicates that the product should be collected separately from other waste streams and treated appropriately.

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