M211888EN-E

User Guide

Vaisala PEROXCAP® Hydrogen Peroxide Probe

HPP271

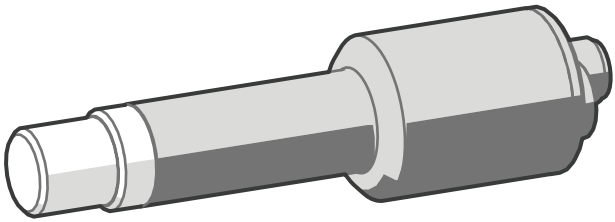

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Table of contents

List of figures

List of tables

1. About this document

1.1 Version information

This document provides instructions for installing, using, and maintaining Vaisala PEROXCAP® Hydrogen Peroxide Probe HPP271.

Table 1 Document versions

Document code	Date	Description
M211888EN-E	April 2023	This document. Added information on the Indigo80 handheld indicator. Updated information on Indigo series transmitter models and added instructions on calibration and adjustment with Indigo200 series transmitters using the new USB-C (Insight) interface. $H_2O + H_2O_2$ dew point temperature added to available parameters. Added information on the use of filter in calibration and adjustment. Added information on thermal insulation and use of shielded cables when installing. Modbus register descriptions and accessories list updated. **Added sections:** • Attaching HPP270 probes to Indigo300 transmitter (page 41) • Indigo80 handheld indicator (page 45) • Probe compatibility (page 46) • Connecting probes to Indigo80 (page 47) • Configuring probe features with Indigo80 handheld indicator (page 49) • Configuring environment settings with Indigo80 handheld indicator (page 50) • Adjusting RH for H 2 O 2 with Indigo80 handheld indicator (page 60) • Adjusting H 2 O 2 with Indigo80 handheld indicator (page 65) • Restoring factory adjustment with Indigo80 handheld indicator (page 70) **Updated sections:** • Related manuals (page 11) • Basic features and options (page 15) • Measured parameters (page 16) • Additional features with Indigo transmitters (page 19) • Installation (page 25) • Wiring (page 27) • Using probe with Indigo transmitters (page 40) • Attaching HPP270 probes to Indigo200 transmitter (page 40) • Attaching probes to Indigo500 transmitters (page 43) • Calibration and adjustment (page 55) • Field calibration and adjustment overview (page 56) • Adjusting RH for H 2 O 2 with Indigo200 transmitter (page 62) • Adjusting H 2 O 2 with Indigo200 transmitter (page 67) • Accessories and spare parts (page 81) • HPP271MOUNTINGSET1/HPP272MOUNTINGSET1 dimensions (page 82) • HPP271MOUNTINGSET2/HPP272MOUNTINGSET2 dimensions (page 84) • Measurement data registers (page 88) • Configuration registers (page 88) • Status registers (page 96)

Document code	Date	Description
M211888EN-D	March 2020	Previous version. Low H_2O_2 threshold functionality (available starting from probe SW version 1.3.6) added.
M211888EN-C	October 2019	Updated the instructions for using the ATEST output test in Insight PC software and added information on the probe SW version requirements for ATEST. Corrected trademark information.

1.2 Related manuals

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

Table 2 Related manuals

Document code	Name
M211887EN	Hydrogen Peroxide, Humidity and Temperature Probe HPP270 Series Quick Guide
M211972EN	Vaisala PEROXCAP® Hydrogen Peroxide, Humidity and Temperature Probe HPP272 User Guide
M212287EN	Vaisala Indigo510 and Indigo520 Transmitters User Guide
M212848EN	Vaisala Indigo300 Transmitter Quick Guide
M212842EN	Vaisala Indigo201 Analog Output Transmitter User Guide
M212843EN	Vaisala Indigo202 Digital Transmitter User Guide
M212722EN	Vaisala Indigo80 Handheld Indicator User Guide

1.3 Documentation conventions

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

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

Note highlights important information on using the product.

Tip gives information for using the product more efficiently.

Lists tools needed to perform the task.

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

1.4 Trademarks

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

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

1.5 Regulatory compliances

The probe is in conformity with the provisions of the following EU directives:

- RoHS Directive
- EMC Directive

Conformity is shown by compliance with the following standards:

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

1.6 Patent notice

This product is protected by the following patents and patent applications and their corresponding national rights:

Table 3 Applicable patents or applications

Issuing office	Publication number
European Patent Office	EP 3004868
State Intellectual Property Office of the P.R.C.	CN 105229463A
United States Patent and Trademark Office	US 20160084811

2. Product overview

2.1 Introduction to HPP271

Vaisala PEROXCAP® Hydrogen Peroxide, Humidity and Temperature Probe HPP270 series is designed for demanding hydrogen peroxide bio-decontamination processes. The probes are suitable for a variety of applications such as isolator, material transfer hatch, and room bio-decontamination.

Hydrogen Peroxide Probe HPP271 provides measurement for vaporized H_2O_2 concentration.

The H_2O_2 measurement is based on comparing the readings of two composite humidity sensors to determine the vapor concentration of H_2O_2. The probes are easy to install with a plug-in/plug-out M12/5 connection. The digital and analog output options include an RS-485 interface for Modbus communication and two current output channels (4 ... 20 mA).

The probe is not intended for safety level measurement.

The probe is not intended to be used in vacuum applications.

CAUTION! When there is H_2O_2 in the probe's environment, the probe must always be powered on. When powered on, the PEROXCAP sensor is heated, which permits using the probe in condensing H_2O_2 conditions, maintains measurement performance, and lengthens the probe's lifetime. When the probe is powered off, exposure to H_2O_2 condensation can cause the PEROXCAP sensor to fail within a day, and the sensor will not recover.

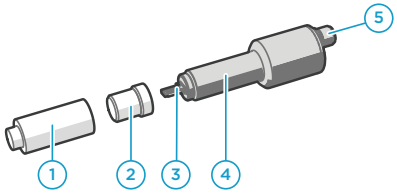


Figure 1 Probe parts

1 Yellow transport cap. Remove this cap before using the probe.
2 Filter covering the sensor. The filter is an essential part of the measurement technology: do not remove the filter. Filters are available as spare parts.
3 PEROXCAP sensor under the filter.
4 Hydrogen peroxide probe.
5 5-pin M12 connector

More information

- Operating principle of H2O2 measurement (page 21)
- Installation (page 25)
- Wiring (page 27)
- Dimensions (page 82)

2.2 Basic features and options

- Vaisala PEROXCAP® H_2O_2 measurement technology with excellent long-term stability.
- Vaporized H_2O_2 measurement range 0 ... 2000 ppm.
- Robust design allowing the probe to be installed directly in the process environment. When powered on, the probe withstands H_2O_2 and H_2O condensation. The probe also withstands nitrogen gas.
- Protective filter over the sensors designed to withstand high air flow rates and turbulence.
- Sensor heating to avoid condensation on the sensors.
- Sensor purge for optimized performance and lifetime.
- Pressure compensation for H_2O_2 and H_2O concentration measurement.
- Digital output: RS-485 interface for Modbus communication.
- Analog output: 2 x 4 ... 20 mA.
- Easy plug-in, plug-out.
- Field calibration and adjustment with a regular humidity calibrator or with H_2O_2 vapor.
- Can be used as a stand-alone probe or with Vaisala Indigo transmitters and the Indigo80 handheld indicator.
- Can be connected to Vaisala Insight PC software for calibration and adjustment, configuration, diagnostics, and temporary online monitoring.

More information

- Technical data (page 78)

2.3 Safety

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

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

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

2.4 ESD protection

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

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

2.5 Measured parameters

Table 4 Available parameters

Parameter	Abbreviation	Unit	Description
Vaporized hydrogen peroxide concentration by volume	H_2O_2	ppm	Parts per million value is a unit of H_2O_2 concentration per amount of air in volume fraction in units ppmv or m^3/m^3.
Water concentration by volume	H_2O	ppm	Parts per million value is a unit of water concentration per amount of air in volume fraction in units ppmv or m^3/m^3.

Parameter	Abbreviation	Unit	Description
$H_2O + H_2O_2$ dew point temperature	T_d ($H_2O + H_2O_2$)	°C	Dew point is the temperature to which a gas sample must be cooled to reach condensation. At this point, measured water vapor pressure equals to water vapor saturation pressure. At the presence of H_2O_2 vapor, the actual dew point is dependent on the amount of both water and H_2O_2 vapor, and it differs from the dew point measured with a traditional humidity sensor.

The probe provides both digital and analog outputs.

More information

- Connectivity to Vaisala Insight software (page 19)
- Setting probe in analog or digital mode (page 29)
- Measurement data registers (page 88)
- Configuration registers (page 88)

2.6 Probe filter

The white filter on the probe covers the PEROXCAP sensor. The filter is made of porous PTFE that allows ambient air to reach the PEROXCAP sensor while protecting the sensor in strong or turbulent air flow.

CAUTION! The filter is an essential part of the measurement. If the filter is broken, dirty, or removed altogether, measurement does not work as intended.

- Do not touch the filter with bare hands. If you need to touch the filter, always use clean gloves (rubber, cotton or similar material).
- Keep the filter free of any grease or oil.
- Do not touch any parts under the filter. Touching parts under the filter may damage the sensors.

More information

- Problems and their possible solutions (page 71)

2.7 Sensor purge

Sensor purge is a 4-minute process where the sensors are heated to remove possible contamination. The purge is essential for the long-term performance and accuracy of the probe in demanding H_2O_2 environments. During the purge, H_2O_2 and H_2O measurements are not available.

The purge is automatically performed:

- At probe start-up.
- After an RH for H_2O_2 adjustment is made.
- At intervals (default 24 hours, configurable between 1 hour ... 1 week using Vaisala Insight software, Modbus, or Indigo transmitters). Purge is postponed by 30 minutes if H_2O_2 is present or ambient humidity is not steady.

If required, you can also enable purge during H_2O_2 exposure with the Insight PC software or an Indigo transmitter.

Purge is recommended at least every 24 hours of powered-on time, even if the probe has not been continuously exposed to H_2O_2.

Optional: if needed, you can also trigger a purge at any time with Vaisala Insight software, Modbus (in digital mode) or pin #5 on the M12 connector (in analog mode).

More information

- Triggering purge in analog mode (page 39)
- Operation in analog mode (page 35)

2.8 Environmental compensation for pressure

When necessary, you can apply pressure compensation to improve the measurement accuracy of the probe. The probe does not have on-board pressure measurement, but a pressure reading from an external source can be used as a setpoint value for compensation.

You can configure the pressure compensation parameters using Vaisala Insight software, Modbus configuration registers, Indigo200 transmitter, or Indigo80 handheld indicator.

By default, the pressure compensation is turned off. When the compensation is off, the probe uses the default compensation value (1013.25 hPa).

More information

- Vaisala Insight PC software (page 52)
- Configuration registers (page 88)
- Configuring environment settings with Indigo80 handheld indicator (page 50)

2.9 Measurement filtering factor

You can set a filtering factor that affects the speed at which the latest measurements are integrated into the output of the probe. This allows averaging the output if the measuring environment produces occasional exceptionally high or low readings.

The filtering factor can be set either with Modbus configuration register 0308_{hex}, Vaisala Insight software, Indigo200 transmitter or Indigo80 handheld indicator.

By default, the filtering factor is set to 1.0, which means the latest measurement is shown directly in the output, without any filtering. To apply filtering, enter a lower filtering factor to include previous measurements in the calculation of measurement output. For example, changing the filtering factor to 0.9 results in an output that is a combination of the latest measurement (90%) and the previous measurement output (10%).

More information

- Configuration registers (page 88)
- Example of configuring filtering factor with Indigo80 handheld indicator (page 50)

2.10 Connectivity to Vaisala Insight software

The probe can be connected to Vaisala Insight software using a Vaisala USB cable (item code 242659) or Vaisala Indigo USB adapter (item code USB2). With the Insight software, you can:

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

More information

- Connecting to Insight software (page 52)

2.11 Additional features with Indigo transmitters

HPP271 probes are compatible with Vaisala Indigo200 series transmitters starting from Indigo200 transmitter software version 1.4.0 or higher.

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

Examples of additional features available with Indigo520 transmitters:

- Touchscreen display for real-time data viewing and configuration
- Support for 2 probes simultaneously
- 4 configurable analog outputs
- 2 configurable relays
- 2-wire current loop analog input
- Barometer module for barometric pressure measurement (optional module)

- Ethernet connection with web interface for remote access
- Modbus TCP/IP protocol

Examples of additional features available with Indigo200 series transmitters:

- 3.5” TFT LCD color display or non-display model with LED indicator
- Digital output or 3 analog outputs (depending on the transmitter model)
- 2 configurable relays
- USB-C connection to Vaisala Insight PC software for easy configuration access

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

3. H_2O_2 measurement

3.1 Operating principle of H_2O_2 measurement

CAUTION! When there is H_2O_2 in the probe's environment, the probe must always be powered on. When powered on, the PEROXCAP sensor is heated, which permits using the probe in condensing H_2O_2 conditions, maintains measurement performance, and lengthens the probe's lifetime. When the probe is powered off, exposure to H_2O_2 condensation can cause the PEROXCAP sensor to fail within a day, and the sensor will not recover.

PEROXCAP® sensor technology works using measurements from two Vaisala HUMICAP® sensors. HUMICAP sensors guarantee quality and reliability, with their reputation for repeatability, accuracy, excellent long-term stability, and negligible hysteresis – even in the most demanding high-concentration H_2O_2 applications in atmospheric pressure.

HUMICAP sensor is a thin-film polymer sensor consisting of a substrate on which a thin polymer film is deposited between two electrodes. The film absorbs or releases vapor according to humidity changes in the environment. As the humidity changes, the dielectric properties of the polymer film change, and so does the capacitance of the sensor. The instrument's electronics measure the capacitance of the sensor and convert it into a humidity reading.

PEROXCAP measurement uses two composite HUMICAP sensors, one with a catalytic layer and one without. The catalytic layer catalyzes H_2O_2 from the vapor mixture. Therefore, the HUMICAP sensor with this layer only senses water vapor, providing a measurement of partial water pressure. The sensor without the catalytic layer senses both hydrogen peroxide vapor and water vapor in the air mixture. The difference between the readings from these two sensors indicates the vapor concentration of H_2O_2.

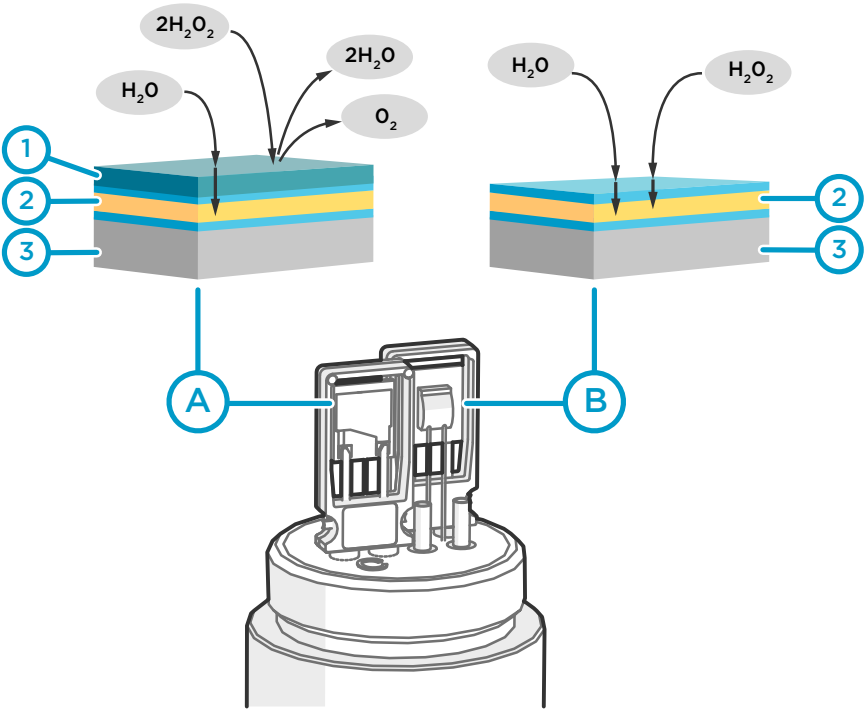


Figure 2 Operating principle of PEROXCAP measurement

A HUMICAP sensor with a catalytic layer (under the probe filter). This sensor only senses water vapor.
B HUMICAP sensor without a catalytic layer (under the probe filter). This sensor senses the air mixture with both hydrogen peroxide vapor and water vapor.
1 Catalytic layer over the thin film polymer. This layer catalyzes hydrogen peroxide into water and oxygen and prevents it from entering the sensing polymer.
2 Thin film polymer between two electrodes.
3 Alumina substrate.

3.2 Typical applications

The probe is not intended for safety level measurement.

The probe is not intended to be used in vacuum applications.

Vaporized hydrogen peroxide is used for bio-decontamination in several applications from healthcare and pharmaceutics to food and beverage industry. Vaporized hydrogen peroxide is an easy-to-use and effective bio-decontaminating agent that destroys the full spectrum of biological contaminants including micro-organisms such as bacterial spores, mycobacteria, and non-enveloped, non-lipid viruses. Bio-decontamination with vaporized hydrogen peroxide is a low-temperature, environmentally friendly process that leaves no real residues, only water vapor and oxygen. One of the benefits also is that the bio-decontamination process can be validated.

Common vaporized H_2O_2 bio-decontamination applications include isolators, transfer hatches, closed Restricted Access Barrier Systems, and room bio-decontamination (for example, in hospital environments, cleanrooms, decontamination tents, aircrafts, ships, and shipping containers).

The bio-decontamination process typically has the following phases:

1. Optional dehumidification, where relative humidity is decreased to a desired level, for example, by warming the space.
2. Conditioning, where vaporized H_2O_2 mixture is introduced into the space to be bio-decontaminated.
3. Decontamination, where H_2O_2 concentration is maintained at a desired level for a certain time.
4. Aeration, where H_2O_2 is removed from the bio-decontaminated space.

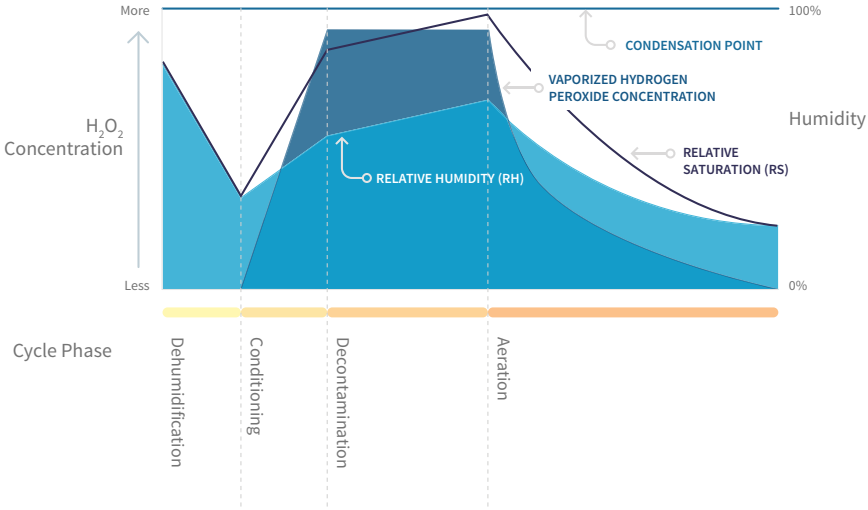


Figure 3 Example behavior of H_2O_2 concentration, relative saturation (RS), and relative humidity (RH) in a vaporized H_2O_2 bio-decontamination cycle (non-condensing conditions)

In the non-condensing bio-decontamination cycle example shown in Figure 3 (page 23):

- In the *dehumidification* phase, RH (and RS) decreases.
- When the *conditioning* phase starts, H_2O_2 concentration rises rapidly. There is also a rapid increase in RS, which indicates the humidity caused by both H_2O_2 vapor and water vapor. Because the generated H_2O_2 vapor is typically mixed with water vapor, RH also starts to rise.
- In the *decontamination* phase, H_2O_2 concentration is steady. However, RS level rises slowly close to 100 %RS, i.e. condensation point, due to rising RH level.
- In the *aeration* phase, H_2O_2 concentration, RS, and RH all decrease. When H_2O_2 concentration is zero, RS equals RH.

More information

- Installation (page 25)

4. Installation

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

- Choose a location that represents the environment and process you want to measure. Some factors may make a location unrepresentative of the process:
  - Materials that absorb H_2O_2, such as several plastics, rubbers, and sealing materials
  - Limited air flow
- The probes withstand bio-decontamination process conditions. For signal cables, you must verify their suitability in the installation environment.
- The probes withstand high air flow rates.
- The probe is intended for use in atmospheric pressure. Do not install the probe in a vacuum.

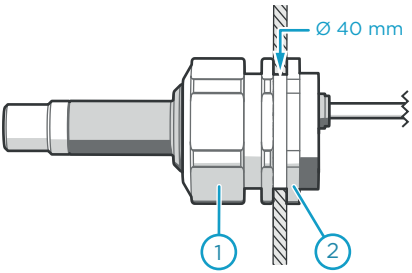
CAUTION! Note that in installations where only part of the probe is installed inside the process, the temperature outside of the process can have an effect on the probe measurement accuracy, especially if the temperature difference is significant. In installations where part of the probe is outside of the process that is measured, apply adequate thermal insulation around the probe part and cable outside the process.

When there is H_2O_2 in the probe's environment, the probe must always be powered on. When powered on, the PEROXCAP sensor is heated, which permits using the probe in condensing H_2O_2 conditions, maintains measurement performance, and lengthens the probe's lifetime.

CAUTION! The filter is an essential part of the measurement. If the filter is broken, dirty, or removed altogether, measurement does not work as intended.

- Do not touch the filter with bare hands. If you need to touch the filter, always use clean gloves (rubber, cotton or similar material).
- Keep the filter free of any grease or oil.
- Do not touch any parts under the filter. Touching parts under the filter may damage the sensors.

Example: Installation through a wall, gland option



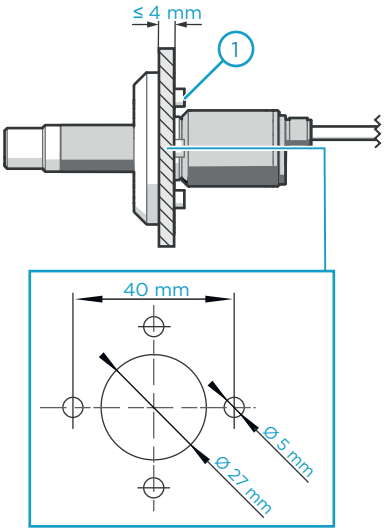
A through-wall installation is recommended especially in very harsh processes.

Seal the lead-through on the metal body of the probe.

The figure shows an example installation using Vaisala spare part gland HPP271MOUNTINGSET1.

1 Nut for tightening the probe in place
2 Nut for mounting the gland

Example: Installation through a wall, flange option

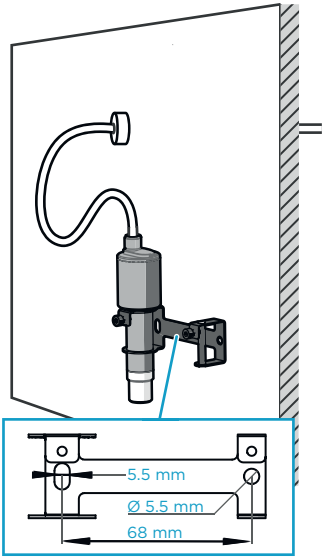


The figure shows an example installation using Vaisala spare part flange (HPP271MOUNTINGSET2), including the drilling dimensions for the flange.

Seal the lead-throughs on the metal body of the probes.

1 Screws for tightening the flange in place (4 pcs, Ø 5 mm)

Example: Installation entirely in process environment



Mount the H_2O_2 and humidity probe from the probe body.

The figure shows an example installation using Vaisala spare part wall mounting set (HPP272WALLMOUNT).

Let the signal cable hang loosely so that it makes a bend. This prevents condensing water from running to the probe along the cable. Do not hang the probe by the signal cable.

Make sure the signal cable you use is suitable for your bio-decontamination process.

More information

- HPP271MOUNTINGSET1/HPP272MOUNTINGSET1 dimensions (page 82)
- HPP271MOUNTINGSET2/HPP272MOUNTINGSET2 dimensions (page 84)
- HPP272WALLMOUNT dimensions (page 85)

4.1 Wiring

Use shielded cables and ground the cable shield.

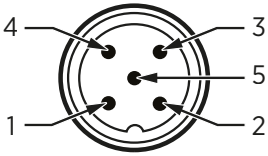


Figure 4 Pins on the probe M12/5 male connector

Pin #	Function	Notes	Wire color [1]
1	Power supply	With digital output: 15 ... 30 V DC With analog output: 15 ... 25 V DC [2]	Brown
2	RS-485- or analog output 2	Current output: 4 ... 20 mA [3]	White
3	Power and signal GND RS-485 common		Blue
4	RS-485+ or analog output 1	Current output: 4...20 mA [3]	Black

Pin #	Function	Notes	Wire color 1)
5	Output control and purge trigger in analog mode	Floating = RS-485 Grounded = Analog outputs If you want to be able to trigger a purge manually in the analog mode, do not connect pin #5 permanently to ground, but instead, use a relay or similar to control the pin.	Grey

1) *Wire colors apply to the following cables: 254294SP, 254295SP, 254296SP, 254297SP, 244669SP*
2) *When using analog outputs, it is recommended to use a low supply voltage to minimize self-heating.*
3) *The ordered parameters and scaling are shown in the calibration certificate delivered with the probe.*

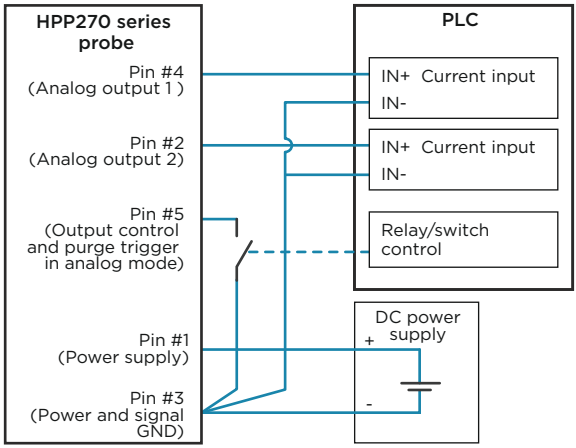


Figure 5 Wiring example for connecting the probe to a PLC in analog mode

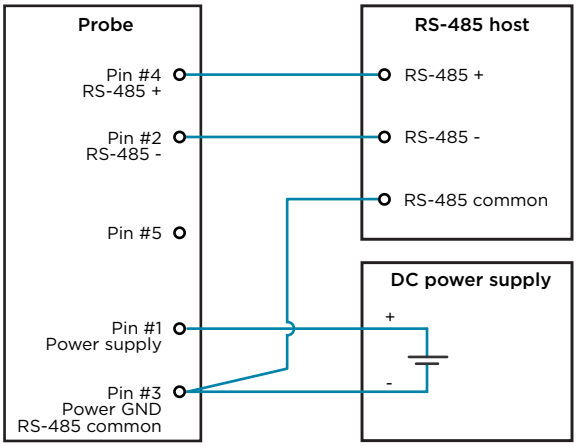


Figure 6 Wiring example for RS-485 connection (Modbus communication)

More information

- Accessories and spare parts (page 81)
- Triggering purge in analog mode (page 39)
- Technical data (page 78)

4.2 Power supply

Operating voltage range of the probe:

- With digital output: 15 ... 30 VDC
- With analog output: 15 ... 25 VDC

Maximum current consumption at 25 °C:

- With digital output: 10 mA
- With analog output: 50 mA
- During purge: 250 mA

4.3 Setting probe in analog or digital mode

The probe has two output modes: digital mode (RS-485 using Modbus) and analog mode (current output).

Both the digital output and analog output use the same pins in the M12 male connector (pins #2 and #4), but only one of the output modes can be active at the same time. You select which output mode is active with the output control pin #5.

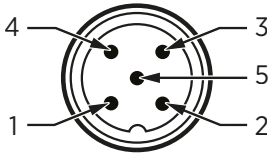


Figure 7 Pins on the probe M12/5 male connector

1. If the probe is powered on, power off the probe.
2. Select the output mode with pin #5:
   a. To set the probe in **analog** mode, connect pin #5 to ground.
   b. To set the probe in **digital** mode, leave pin #5 floating.
3. Power on the probe. The probe checks the state of pin #5 (grounded or floating) and goes in the selected output mode.

5. Operation

5.1 Probe start-up

When powered on, the probe starts up within 2 seconds and the digital/analog outputs are activated. The probe performs a start-up purge, which takes approximately 4 minutes. During the purge, hydrogen peroxide measurements are not available. If the probe is in analog mode, analog outputs are in the error state (default: 3.6 mA) during the purge.

Measurements from the outputs (digital and analog) will reach specified accuracy after a 8½-minute warm-up period. For this reason, you should design your system so that it does not rely on measurements from the probe during this time.

More information

- Behavior at exposure to H2O2 (page 31)

5.2 Behavior at exposure to H_2O_2

CAUTION! When there is H_2O_2 in the probe's environment, the probe must always be powered on. When powered on, the PEROXCAP sensor is heated, which permits using the probe in condensing H_2O_2 conditions, maintains measurement performance, and lengthens the probe's lifetime. When the probe is powered off, exposure to H_2O_2 condensation can cause the PEROXCAP sensor to fail within a day, and the sensor will not recover.

When the bio-decontamination process starts and the probe is exposed to H_2O_2, the probe's H_2O_2 concentration reading changes to > 0 ppm after approximately 20 ... 30 seconds. This time is included in the response time of the probe.

5.3 H_2O_2 concentration reading when not exposed to H_2O_2

The PEROXCAP sensor used in HPP270 probes consists of 2 humidity sensors that have a minor difference in behavior when the humidity level changes. Because of this difference, the H_2O_2 concentration reading may vary slightly (typically 0 ... 3 ppm) when the probe is not exposed to H_2O_2.

If necessary, the variation in low level output can be hidden by enabling the Low H_2O_2 threshold feature (available starting from probe SW version 1.3.6) that forces the output to 0 when the measurement falls below a set level (for example, 3 ppm), and the configured activation delay ends. The output returns to normal operation after the measurement has remained above the set deactivation level (for example, 10 ppm) for a set time. You can configure the Low H_2O_2 threshold activation and deactivation levels and the activation and deactivation delays with Vaisala Insight PC software and Modbus registers.

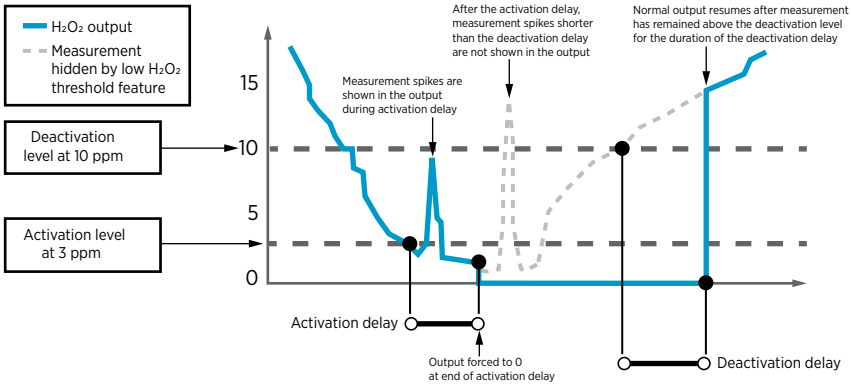


Figure 8 Low H_2O_2 threshold example

Activation level	The level below which the **Activation delay** timer starts (3 ppm in the example).
Activation delay	The activation delay timer starts when the measurement falls below **Activation level**. When the delay ends, the H_2O_2 output is forced to 0 ppm. Note that the deactivation limits apply also during the activation delay.
Deactivation level	The level above which the **Deactivation delay** timer starts (10 ppm in the example).
Deactivation delay	The deactivation delay timer starts when the measurement rises above **Deactivation level**. If the measurement remains above the deactivation level for the duration of the deactivation delay, the output returns to normal operation.

The same deactivation principle applies both before and after the Low H_2O_2 threshold feature activates. That is, both during and after the **Activation delay**, normal measurement output is resumed if the measurement rises above the **Deactivation level** for the duration of the **Deactivation delay**.

More information

- Configuring low H2O2 threshold with Insight (page 33)
- Configuration registers (page 88)

5.3.1 Configuring low H_2O_2 threshold with Insight

- HPP270 probe SW version 1.3.6 or above
- Computer with Vaisala Insight software installed
- Vaisala USB connection cable (item code 242659) or Vaisala Indigo USB adapter (item code USB2)

You can configure the H_2O_2 levels at which the Low H_2O_2 threshold feature is activated and deactivated, and the related delays, with Insight PC software. For an overview of the functionality, see H 2 O 2 concentration reading when not exposed to H 2 O 2 (page 31).

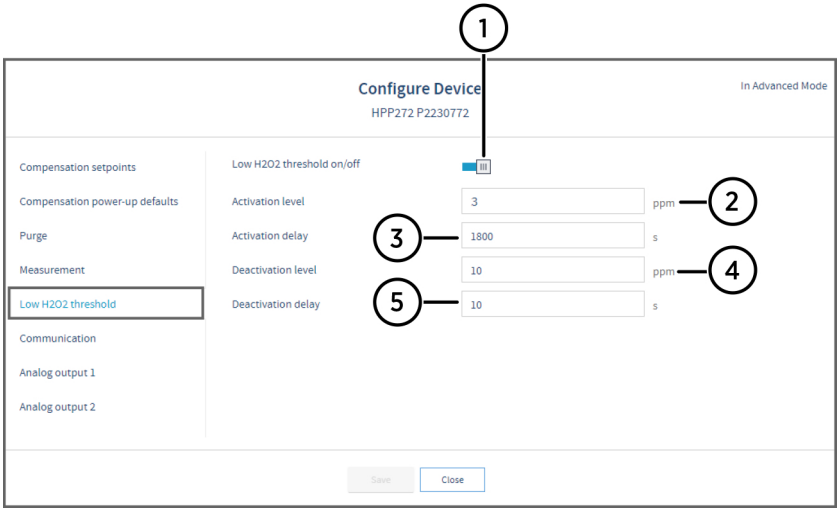


Figure 9 Insight Low H_2O_2 threshold configuration menu

1 Enable or disable the Low H_2O_2 threshold feature (disabled by default).
2 Activation level (in ppmH_2O_2). **Default: 3 ppm**. See H 2 O 2 concentration reading when not exposed to H 2 O 2 (page 31).
3 Activation delay (seconds). **Default: 1800 seconds** (30 minutes).
4 Deactivation level (in ppmH_2O_2). **Default: 10 ppm**. See H 2 O 2 concentration reading when not exposed to H 2 O 2 (page 31).
5 Deactivation delay (seconds). **Default: 10 seconds**.

1. Connect to Insight (for instructions, see Connecting to Insight software (page 52)).
2. Select > **Configure device > Low H_2O_2 threshold**.

3. Enable the Low H_2O_2 threshold feature by sliding the selection switch to the right.

> When enabled, the Low H_2O_2 threshold feature remains in use also after probe reset.

4. In the **Activation level** field, define the H_2O_2 level where the Low H_2O_2 threshold **Activation delay** starts.
5. In the **Activation delay** field, define how long it takes for the output to be forced to zero after the H_2O_2 measurement falls below the **Activation level** value.
6. In the **Deactivation level** field, define the H_2O_2 level where the Low H_2O_2 threshold **Deactivation delay** starts.
7. In the **Deactivation delay** field, define how long the H_2O_2 measurement must remain above the **Deactivation level** before normal measurement output is resumed.
8. Take the settings into use by selecting **Save**.

Example: Low H_2O_2 threshold feature activated at 3 ppm and deactivated at 10 ppm

1. **Activation level** is set as 3 ppm H_2O_2 and **Activation delay** as 1800 seconds (30 minutes).
2. **Deactivation level** is set as 10 ppm H_2O_2 and **Deactivation delay** as 10 seconds.
3. When the measurement falls below the 3 ppm **Activation level**, the **Activation delay** of 30 minutes starts. During the 30-minute Activation delay, all measurements (whether within or outside of the configured activation levels) are output normally.
4. After the 30-minute Activation delay has passed, the H_2O_2 output is forced to 0 ppm.
5. The measurement output stays forced to 0 ppm until the actual measurement remains over the Deactivation level of 10 ppm for the set Deactivation delay of 10 seconds.
6. When the measurement has remained over 10 ppm for 10 seconds, normal output resumes.

> Note that the instant change from the forced 0 ppm output to the actual measurement can cause a quick increase in the measurement output reading.

5.4 Modbus

The probe can be accessed using the Modbus serial communication protocol. The supported Modbus variant is Modbus RTU (Serial Modbus) over RS-485 interface.

More information

- Modbus reference (page 86)
- Setting probe in analog or digital mode (page 29)
- Wiring (page 27)

5.5 Operation in analog mode

In analog output mode, the probe outputs the readings of two measurement parameters (one parameter in each analog output channel). These measurement parameters are chosen when ordering the probe, and you can change them using the Insight software, the Indigo80 handheld indicator, and via Modbus. You can check the chosen parameters in the calibration certificate delivered with the probe.

The default output range for both channels is 4 ... 20 mA.

When using analog outputs, it is recommended to use a low supply voltage to minimize self-heating and maximize measurement performance. The operating voltage range with analog output is 15 ... 25 V.

When the probe performs the sensor purge, the analog outputs have a defined behavior:

- During **start-up purge**, analog output is in the error state (default: 3.6 mA).
- During **interval purge** and **manually triggered purge**, output is frozen to show the last measured value before the purge began.

More information

- Setting probe in analog or digital mode (page 29)
- Analog output error state (page 77)
- Configuration registers (page 88)
- Sensor purge (page 18)

5.5.1 Analog output overrange behavior

The analog output of the probe has a defined behavior when the values measured by the probe are outside the scaled analog output range. At first, the output is clipped when the measurement exceeds a set limit (clipping limit): the measurement continues, but the output does not change from the clipped value.

When the measurement exceeds the second limit (error limit), the analog output switches to the error state defined for the output.

The clipping and error limits are configured separately for the low and the high ends of the measurement scale. By default, the clipping limits are set to 0 %, and the error limits are set to 2 % of the scale.

You can change or disable the clipping and error limits using Vaisala Insight software or Modbus configuration registers. Changing the limits does not affect the scaling of the outputs. The definable range for each limit is 0 ... 20 %. The maximum values for limits extend the analog output range to 0.8 mA at the low end of the scale, and to 23.2 mA at the high end of the scale.

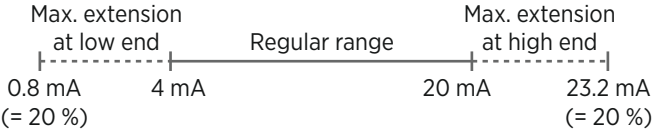


Figure 10 Maximum extensions to analog output range

The same clipping and error limits are applied when the measured value drops back to the scaled range: at first the output returns to the clipped value from the error state, and then to normal output.

More information

- Analog output error state (page 77)

5.5.2 Analog output overrange examples

Consider a probe with one of the analog output channels (4 ... 20 mA) configured to output H_2O_2 concentration, scaled to 0 ... 2000 ppm.

Example: Clip the high end of the output at 2100 ppm, and enter the error state at 2200 ppm

Configure the high-end clipping limit and error limit as follows:

- Clipping limit, high end: 5 % of scale (= 2100 ppm, clipped at 20.8 mA)
- Error limit, high end: 10 % of scale (= 2200 ppm)

When the measured H_2O_2 concentration rises above 2000 ppm, the output rises above 20 mA. The output keeps rising until the measurement is 2100 ppm, at which point the probe outputs 20.8 mA. If the H_2O_2 concentration rises above 2100 ppm, the output still remains at 20.8 mA. If the H_2O_2 concentration rises above 2200 ppm, the output enters the error state (by default, 3.6 mA).

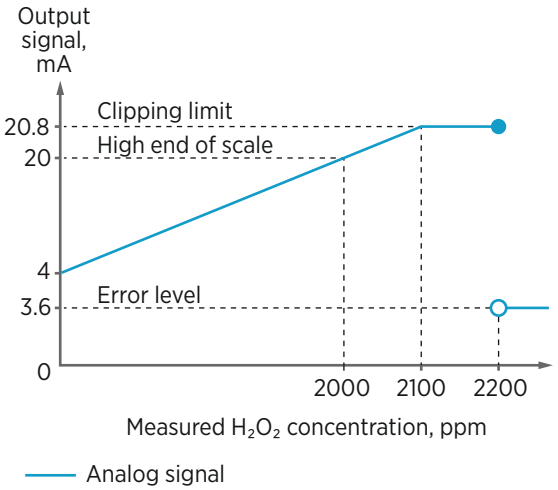


Figure 11 Analog output overrange example with clipping and error limits

Example: Clip the high end of the output at 2100 ppm, but do not enter the error state at all

Configure the high-end clipping limit and error limit as follows:

- Clipping limit, high end: 5 % of scale (= 2100 ppm, clipped at 20.8 mA)
- Error limit, high end: empty (or in Modbus: "NaN")

When the measured H_2O_2 concentration rises above 2000 ppm, the output rises above 20 mA. The output keeps rising until the measurement is 2100 ppm, at which point the probe outputs 20.8 mA. If the H_2O_2 concentration rises above 2100 ppm, the output still remains at 20.8 mA.

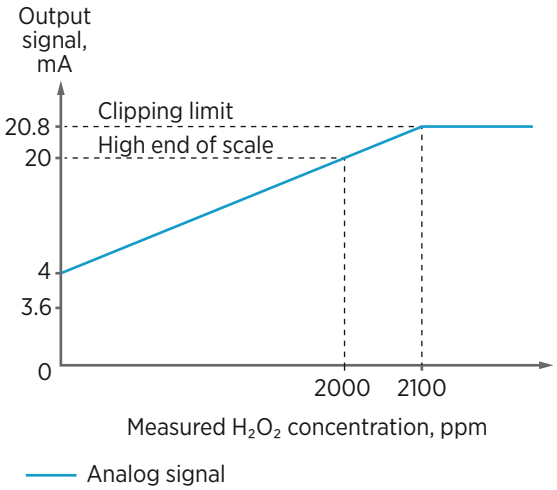


Figure 12 Analog output overrange example with clipping only

Example: Do not clip the output at all, but enter the error state at 2200 ppm

Configure the high-end clipping limit and error limit as follows:

- Clipping limit, high end: empty (or in Modbus: "NaN")
- Error limit, high end: 10 % of scale (= 2200 ppm, 21.6 mA)

When the measured H_2O_2 concentration rises above 2000 ppm, the output rises above 20 mA. The output keeps rising until the measurement exceeds 2200 ppm (21.6 mA), at which point the output enters the error state (by default, 3.6 mA).

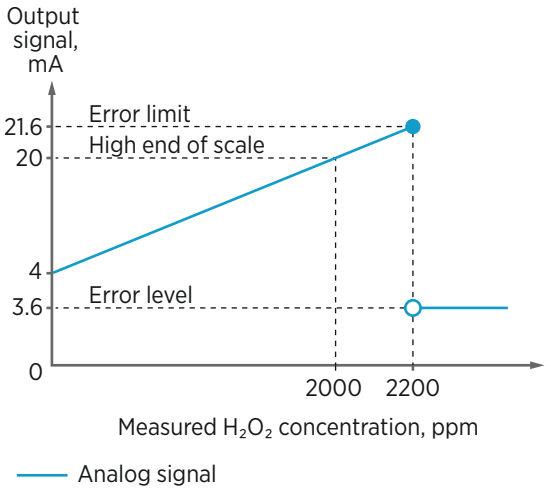


Figure 13 Analog output overrange example with no clipping, only error state when error limit is exceeded

5.5.3 Triggering purge in analog mode

In the analog mode, pin #5 in the probe's M12 male connector is connected to ground. Additionally, pin #5 is used to trigger a purge in analog mode. To be able to trigger a purge, do not connect pin #5 to ground permanently, but instead, use a relay or similar to control the pin. For a wiring example, see Figure 5 (page 28).

1. To trigger the purge, disconnect pin #5 from ground for a minimum of 50 ms, and then reconnect the pin to ground.

> Do not leave pin #5 floating for a long time. If the probe is reset while pin #5 is floating, the probe will go into digital mode instead of analog mode.

The probe starts performing the purge. The duration of the purge is approximately 4 minutes. During the purge, H_2O_2 and H_2O measurements are not available

More information

- Sensor purge (page 18)

6. Using probe with Indigo transmitters

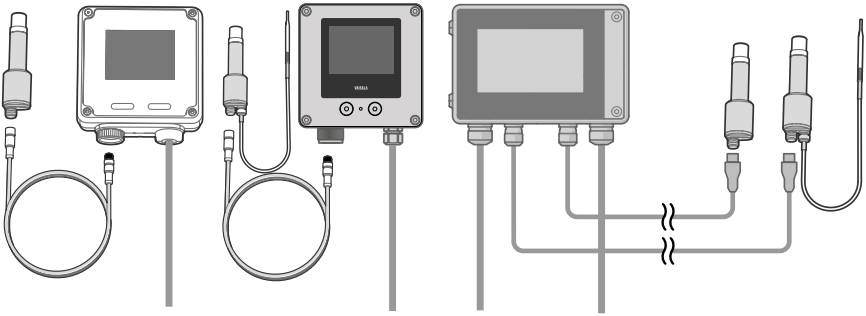


Figure 14 Indigo200, Indigo300, and Indigo500 series transmitters with probe connection examples

HPP270 series probes are compatible with Vaisala Indigo transmitters. Connecting the probe to an Indigo series transmitter provides a range of additional options for outputs, measurement viewing, status monitoring, and configuration interface access.

Depending on the Indigo transmitter model, the available options include, for example, configurable displays and relays, analog or digital output channels, and various options for configuration and monitoring using PC software or the transmitter's local interface.

For more information on the features of different Indigo transmitter models, see www.vaisala.com/indigo.

For instructions on installing and configuring Indigo transmitters, see the applicable Indigo transmitter user documentation available at the Vaisala documentation portal docs.vaisala.com.

Note that Indigo200 transmitters switched from a WLAN configuration interface to a USB-C cable configuration interface (Vaisala Insight PC software) in 2022. For instructions on configuring HPP270 probes with the earlier WLAN interface, see the earlier *HPP271 User Guide* revision *M211888EN-D*, available at docs.vaisala.com.

6.1 Attaching HPP270 probes to Indigo200 transmitter

An accessory cable is required to connect the probe to the transmitter. See spare part and accessory information for available cable options.

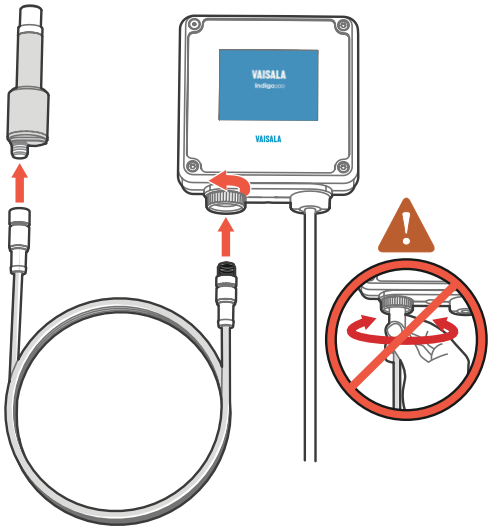


Figure 15 Attaching probes to Indigo

1. Connect the cable to the probe.
2. Insert the other end of the cable in Indigo's cable connector and lock it in place by turning the locking wheel counterclockwise. Do not turn the cable connector when attaching the cable, only the locking wheel on the transmitter.
3. When Indigo recognizes the connected probe, it shows a notification message on the display.

6.2 Attaching HPP270 probes to Indigo300 transmitter

An accessory cable is required to connect the probe to the transmitter. See spare part and accessory information for available cable options.

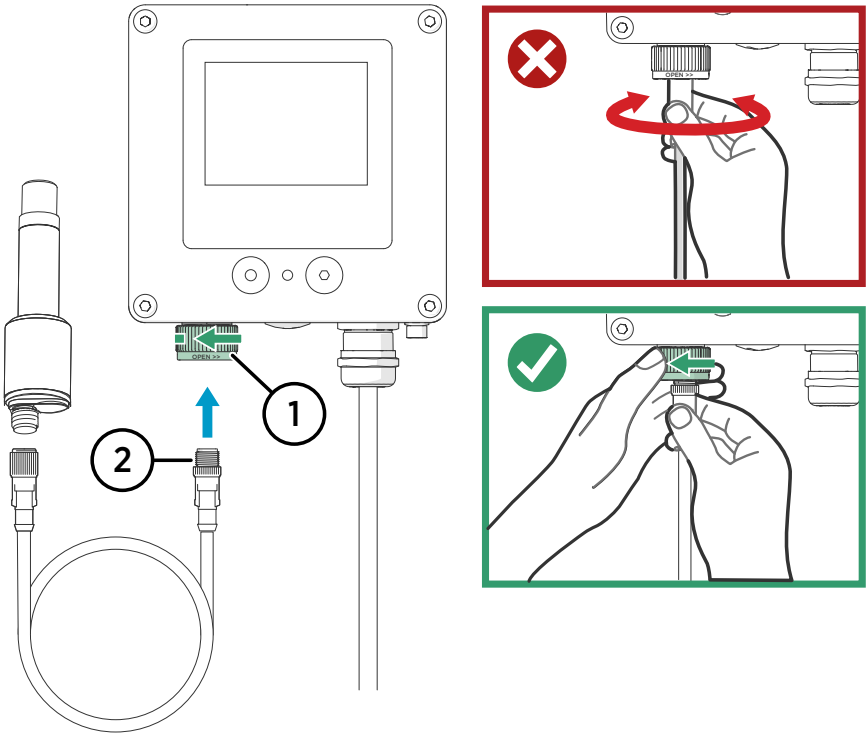


Figure 16 Attaching HPP271 to Indigo300

1 Probes and probe cables are locked in place with the locking wheel. **Never turn from the probe body or the cable connector.**
2 To connect probe cables, insert the cable into the transmitter connector and hold in place while turning the locking wheel.

1. Connect the probe connection cable to the probe.
2. Insert the other end of the cable into Indigo's cable connector, and then lock the connector in place by turning the locking wheel counterclockwise. Do not turn the cable connector when attaching the cable, only the locking wheel on the transmitter.
3. When Indigo recognizes the connected probe, it shows a notification message on the display.

6.3 Attaching probes to Indigo500 transmitters

CAUTION! The IP classification of probes is valid only when the probes are connected to the probe connection cable.

If you want to configure the probe settings, such as purge interval, you must do that before connecting the probe to the transmitter. To configure the probe, you can use the free Vaisala Insight PC software. For more information, see your probe's user guide and visit www.vaisala.com/insight.

If your transmitter was delivered with preconfigured analog outputs, make sure that you connect the measurement devices accordingly. See the label inside the transmitter enclosure for the correct order of the measurement devices.

When the measurement device connection cables have been wired to the transmitter, you can connect and disconnect measurement devices both when the transmitter power is on and when it is off. If the power is on while you connect or disconnect a measurement device, the transmitter shows a notification about the measurement device. If you have configured the transmitter to use outputs, the transmitter also notifies you of the state of the outputs.

Connect only Vaisala Indigo-compatible devices to the transmitter.

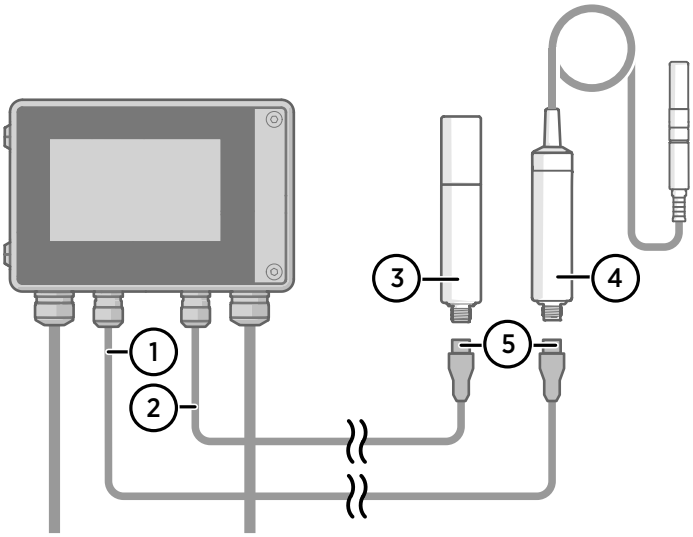


Figure 17 Connecting measurement devices to Indigo500

1 Connection cable, probe 1
2 Connection cable, probe 2 (dual-device support in Indigo520)
3 Measurement device to be connected as probe 2 (GMP252 example)
4 Measurement device to be connected as probe 1 (HMP7 example)
5 The connector of the connection cable (M12 5-pin A-coded female)

7. Using probe with Indigo80 handheld indicator

7.1 Indigo80 handheld indicator

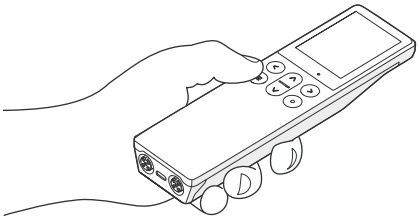


Figure 18 Indigo80 handheld indicator

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
- Calibrate and adjust the probe
- Configure probe features and settings such as compensation setpoints, filtering factor, and serial communication. The available features and settings depend on the probe model and firmware version.

Accessing certain configuration options for your probe requires using the free Insight PC software, downloadable at www.vaisala.com/insight.

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).

More information

- Configuring probe features with Indigo80 handheld indicator (page 49)
- Configuring environment settings with Indigo80 handheld indicator (page 50)

7.1.1 Probe compatibility

The Indigo80 handheld indicator is tested for compatibility with HPP270 probes that have firmware version 1.4.0 or newer. Probes with older firmware versions may have limited compatibility with the indicator.

CAUTION! Do not use Indigo80 in low-power mode if you are logging data in a hydrogen peroxide environment. Using the low-power mode can power off HPP270 probes with a firmware version earlier than 1.4.0, resulting in condensation on the sensor and irreparable sensor damage.
In all hydrogen peroxide measurements, ensure that the **automatic power off function is disabled** and there is enough battery charge to avoid an accidental power-off. Using an AC adapter to power Indigo80 during long-term measurements is highly recommended.

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

7.1.2 Indigo80 keypad

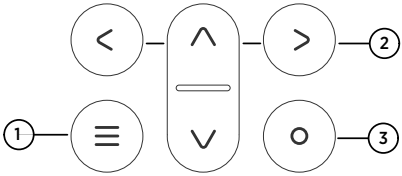


Figure 19 Indigo80 keypad

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

7.1.3 Indigo80 main menu

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

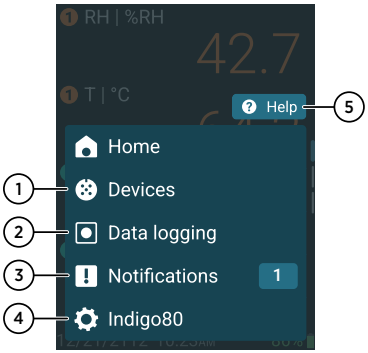


Figure 20 Indigo80 main menu

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.

7.2 Connecting probes to Indigo80

- Probe connection cable (cable 272075SP or flat cable CBL210493SP: see accessory information)

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 probe connection cables provided by Vaisala when connecting devices to the indicator. Cables and other accessories are available to order at store.vaisala.com.

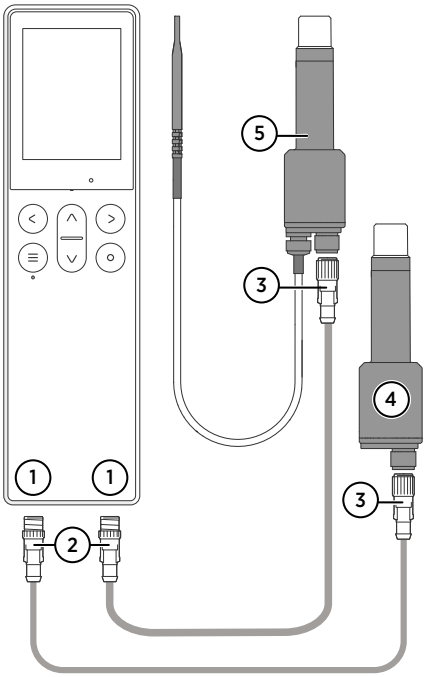
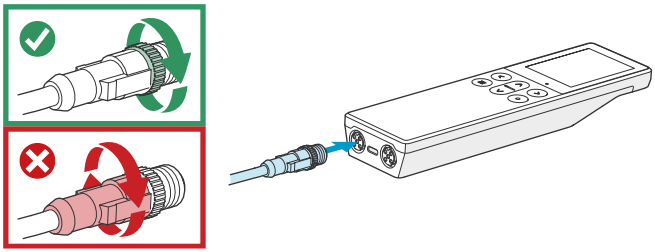


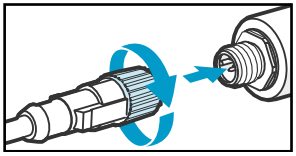
Figure 21 Connecting probes to Indigo80

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 M12-5F A-coded cable connector
4 HPP271 probe, displayed as ❶ by Indigo80
5 HPP272 probe, displayed as ❷ by Indigo80

1. If the indicator is powered and no probes are connected, the text **Please connect a probe** will be shown on the display.
2. Insert the probe connection cable in 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!**



3. Connect the probe to the M12-5F end of the probe connection cable.



When the indicator recognizes the connected probe, it shows a notification on the display (for example, **GMP252 connected**). A probe connected to the leftmost port in the indicator is labeled ❶ on the indicator's display, while the probe in the rightmost port is labeled ❷.

4. To change probes, simply detach the cable from the probe and connect a new probe.

7.3 Configuring probe features with Indigo80 handheld indicator

- Probe connection cable (cable 272075SP or flat cable CBL210493SP: see accessory information)

You can use the Indigo80 handheld indicator to configure probe features such as compensation setpoints, filtering factor, and serial communication. The available features depend on the probe model and firmware version.

Accessing certain configuration options for your probe requires using the free Insight PC software, downloadable at www.vaisala.com/insight.

1. Connect the probe(s) 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 probe.
5. Exit the menu by pressing ⟲ or return to the main menu by pressing ☰.

7.3.1 Example of configuring filtering factor with Indigo80 handheld indicator

- Probe connection cable (cable 272075SP or flat cable CBL210493SP: see accessory information)

The filtering factor allows averaging the output if the measuring environment produces occasional exceptionally high or low readings.

This example shows how to configure the filtering factor as **0.9** using the Indigo80 handheld indicator.

This means that the new measurement output is a combination of the latest measurement (90 %) and the previous measurement (10 %).

1. Connect the probe(s) 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 > Measurement**.
5. Select **H_2O_2 filtering factor**.
   a. Use the arrow buttons to set the value as **0.9**.
   b. Select **Set**.
6. Exit the menu by pressing ⟲ or return to the main menu by pressing ☰.

More information

- Measurement filtering factor (page 19)

7.4 Configuring environment settings with Indigo80 handheld indicator

- Probe connection cable (cable 272075SP or flat cable CBL210493SP: see accessory information)

For optimal measurement accuracy, you can use the Indigo80 handheld indicator to give additional information about the connected probe's measurement environment.

The environment settings available via Indigo80 correspond to the environmental compensation settings of the probe. Therefore, **Environment settings** and **Settings > Compensation setpoints** are interconnected: the configuration set in either menu is applied to both.

1. Connect the probe(s) 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 **Environment settings** to access the settings for your probe.

   The available environment settings depend on the probe and probe firmware version.

   Pressure

   Temporary value for pressure compensation. This value is used instead of the default pressure compensation value (1013.25 hPa) only if **Pressure compensation on/off** is **ON**. At device reset, compensation value changes back to the power-up default value. You can find the power-up defaults in **Devices > Settings** .

   Temperature

   Temporary value of the temperature that is used in the calculation of other measurement parameters. This value is used instead of the temperature probe measurement if **Temperature compensation mode** is **Setpoint**.
   At device reset, compensation value changes back to the power-up default value. You can find the power-up defaults in **Devices Settings**.
5. Select a setting from the list, for example, **Pressure**.
   a. Select the unit, if prompted.
   b. Use the arrow buttons to set the desired value, and then select **OK** or **Set**.

      You can also select to read the value from another probe connected to the indicator, provided that the probe can output the required compensation parameter. Press ◁ to highlight the **Read value from** field, and then press ◎ to select the other probe as the source of the value.
6. Scroll down the **Environment settings** view and check that the following settings apply:
   - For **Pressure**, **Pressure compensation on/off** is set to **On**.
   - For **Temperature**, **Temperature compensation mode** is **Setpoint**.
7. Exit the menu by pressing ◁ or return to the main menu by pressing ☰.

More information

‣ Environmental compensation for pressure (page 18)

8. Vaisala Insight PC software

Vaisala Insight PC software is a configuration software for Indigo-compatible probes and other supported devices. Insight is available for Microsoft Windows® operating systems (64-bit only).

With the Insight software, you can:

- See device information and status.
- See real-time measurement data.
- Configure serial communication settings, purge settings, filtering factor, and analog output parameters and scaling.
- Calibrate and adjust the device.

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

The probe can be connected to Vaisala Insight software using a Vaisala USB cable (item code 242659) or Vaisala Indigo USB adapter (item code USB2).

8.1 Connecting to Insight software

- Computer with Vaisala Insight software installed
- USB connection cable (item code 242659) or Vaisala Indigo USB adapter (item code USB2)

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

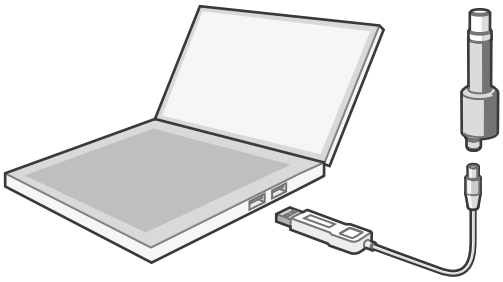


Figure 22 Connecting probe to Insight

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

4. Wait for Insight software to detect the probe.

9. Maintenance

9.1 Cleaning the probe

CAUTION! Do not remove the filter.

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

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

You can clean the **H_2O_2 probe body** by wiping it with a soft, lint-free cloth moistened with water or mild cleaning agent, such as isopropanol. Do not wipe the filter: wiping the filter may block its pores and/or deposit residue on the filter. If the filter is heavily contaminated, replace it.

When cleaning, follow these precautions:

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

If needed, you can spray the probe surfaces with water.

After cleaning the probe, it is recommended to perform a sensor purge.

9.1.1 Chemical tolerance

Avoid exposing the probe to chemicals for unnecessarily long periods of time. Do not immerse the probe in a chemical, and wipe chemicals off the probe after exposure.

You can use mild cleaning agents, such as isopropanol, to wipe the probe body. Avoid exposing the filter to chemicals.

The probe does not withstand DMSO (dimethyl sulfoxide C_2H_6OS).

After exposing the probe to chemicals, it is recommended to perform a sensor purge.

More information

- Sensor purge (page 18)
- Triggering purge in analog mode (page 39)

9.2 Sensor vitality information in Insight

Due to the stresses of the H_2O_2 measurement environment, the PEROXCAP sensor will lose its functionality over time. In less demanding conditions, the sensor can remain functional for a considerable number of years. In environments with higher H_2O_2 concentrations and longer exposure periods, it is recommended to monitor the condition of the sensor regularly.

The status of the sensor can be reviewed from the **Diagnostics Data** view in Vaisala Insight PC software (**Devices > [probe name] > Diagnostics**). In the **Diagnostics Data** view, the condition of the sensor is shown as a percentage (0 ... 100 %) on the **Sensor vitality** row.

A new sensor will have a sensor vitality of 100 %, and a sensor at the end of its life cycle will have a sensor vitality of 0 %. If you are using the probe in a demanding environment, contact Vaisala to arrange sensor maintenance or replacement once the sensor vitality value reaches 40 %.

More information

- Vaisala Insight PC software (page 52)

9.3 Calibration and adjustment

You can have your probe calibrated and adjusted at Vaisala world-class facilities, or perform a field calibration yourself using a suitable reference environment.

For information on Vaisala calibration services, visit www.vaisala.com.

You can adjust the probe using one of the following options:

- Vaisala Insight PC software (with PC and Vaisala USB cable, see www.vaisala.com/insight)
- Indigo transmitters
- Indigo80 handheld indicator

The Indigo200 transmitter calibration and adjustment instructions in this User Guide revision (M211888EN-E) apply to the 2022 transmitter models with a USB-C (Vaisala Insight PC software) user interface. For calibration and adjustment instructions for the earlier WLAN user interface Indigo200 transmitters, see the earlier revision of this document, M211888EN-D, available at docs.vaisala.com.

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

If you think the device is not measuring correctly, calibration and adjustment is not the first thing to do. Check the following first:
- Make sure nothing is interfering with the measurement: heat sources, temperature differences, or condensation.
- Check that there is no moisture on the probe. If the sensor has become wet, wait for it to dry.
- Always wait for the measurement to stabilize.

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

Calibration validity during storage

When the probe is stored indoors in ambient conditions (not in contact with the H_2O_2 environment or other chemicals), a calibration made to the probe will remain valid for several years. For optimal storage conditions, keep the yellow protective cap on the probe filter.

9.3.1 Field calibration and adjustment overview

HPP271 has the following field calibration and adjustment options:
- H_2O_2 measurement calibration and adjustment with relative humidity (RH) references (for example, Vaisala HMK15 Humidity Calibrator)
- H_2O_2 measurement calibration and adjustment in H_2O_2 vapor

The accuracy of field calibration and adjustment, with either RH references or in H_2O_2 vapor, is dependent on a number of factors such as sufficient stabilization time, reference quality, and whether the reference instrument and the instrument under adjustment are successfully placed in matching conditions.
To ensure fully accurate calibration and adjustment results, use the traceable calibration and adjustment services provided by Vaisala.

When using Vaisala Humidity Calibrator HMK15 for calibration, it is not necessary to remove the probe filter when inserting the probe into the calibration chamber. Keeping the filter in place when calibrating the probe with HMK15 protects the sensor from becoming dirty, and does not affect the calibration accuracy.

RH for H_2O_2 adjustment

The PEROXCAP sensor comprises 2 HUMICAP humidity sensors that are used to calculate the H_2O_2 measurement. Because the H_2O_2 measurement is based on humidity calculations, you can use humidity references to adjust the underlying humidity measurement. Improving the accuracy of the underlying humidity measurement also improves the accuracy of the derived H_2O_2 measurement.

H_2O_2 adjustment in H_2O_2 Vapor

You can also calibrate and adjust the probe directly in H_2O_2 vapor. Note that calibration in H_2O_2 vapor is a highly advanced procedure that can be performed reliably only by using another, recently factory calibrated Vaisala HPP270 series probe as a reference instrument and successfully creating matching measurement conditions for both the reference probe and the probe that is being adjusted.

9.3.2 RH for H_2O_2 calibration and adjustment

PEROXCAP sensor technology works using measurements from two HUMICAP humidity sensors: one sensor with a catalytic layer and one without a catalytic layer. The catalytic layer catalyzes hydrogen peroxide from the vapor mixture, preventing it from entering the sensor.

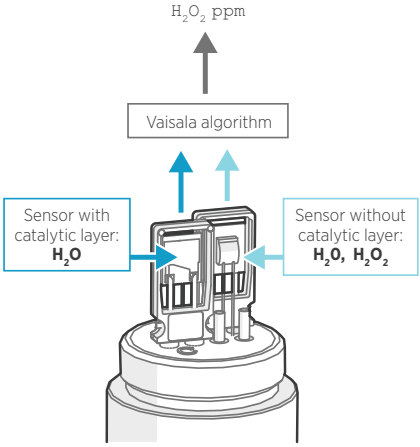


Figure 23 PEROXCAP operating principle

Vaisala algorithm transforms the observations from the humidity sensors into a measurement reading of H_2O_2 concentration. Any drift in the humidity sensors shows as drift in the measurement reading. Therefore, removing the drift from the humidity sensors with calibration and adjustment improves H_2O_2 measurement performance.

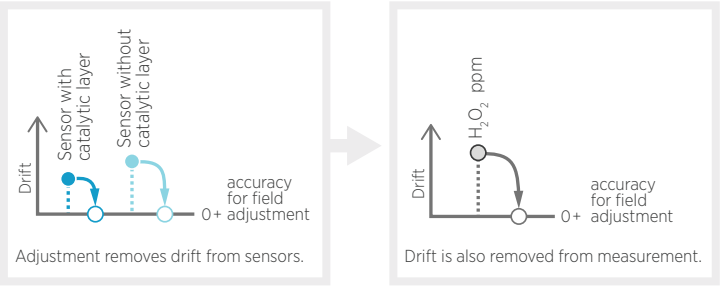


Figure 24 Adjustment removes drift

Even though the probe does not measure relative humidity during normal operation, you can still calibrate and adjust the probe's H_2O_2 measurement with relative humidity. To be able to calibrate and adjust relative humidity, which is a temperature-dependent parameter, the PEROXCAP sensor also contains two internal temperature sensors (one for each humidity sensor) that are used for calibrating and adjusting RH for H_2O_2 and in certain measurement calculations. In normal measurement, the PEROXCAP sensor is heated to allow it to be used in condensing H_2O_2 conditions, which sets limitations for the use of the internal temperature sensors. During RH for H_2O_2 calibration, however, the probe switches into a calibration mode that temporarily turns off the sensor heating.

CAUTION! Do not expose the probe to H_2O_2 vapor when the probe is in calibration mode and sensor heating is off. Exposure to H_2O_2 condensation can cause the PEROXCAP sensor to fail within a day, and the sensor will not recover.

RH calibration and adjustment for H_2O_2 is a two-point adjustment. The two reference points must be at least 40 %RH apart from each other, and the second reference point must be at least 50 %RH. The following RH levels are recommended for optimal results:

- Reference point 1: 0 ... 35 %RH
- Reference point 2: 65 ... 85 %RH

The recommended calibration and adjustment temperature is 20 ... 30 °C.

9.3.3 Adjusting RH for H_2O_2 with Insight software

- Computer with Windows operating system and Vaisala Insight software installed
- Vaisala USB cable (item code 242659) or Vaisala Indigo USB adapter (item code USB2) for connecting the probe
- A humidity calibrator to create two different humidity levels, for example, Vaisala HMK15 Humidity Calibrator. Note that the humidity difference between the dry point and wet point must be at least 40 %RH.

CAUTION! Do not expose the probe to H_2O_2 vapor when the probe is in calibration mode and sensor heating is off. Exposure to H_2O_2 condensation can cause the PEROXCAP sensor to fail within a day, and the sensor will not recover.

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

In order to make a successful adjustment, the humidity of the second calibration point (wet point) must be at least 40 %RH higher than the humidity of the first calibration point (dry point). For example, if point 1 is 10 %RH, the second calibration point must be at least 50 %RH.

1. Prepare the RH calibrator equipment for RH calibration point 1 (dry point, recommendation 0 ... 35 %RH).
2. Connect the probe to Insight. See Connecting to Insight software (page 52).
3. Wait for the start-up purge to finish.
4. Select **> Calibrate > Yes** to switch the probe to calibration mode.

   In calibration mode, the device will not use functions that may interfere with calibration and adjustment.
5. In the **General** tab, make sure the calibration mode **RH** is selected.
6. Open the tab **RH for H_2O_2 adjustment**.
7. Insert the probe head in the reference environment for calibration point 1.
8. Wait for the RH and temperature measurements to stabilize fully. This may take more than 30 minutes. Monitor the readings to see when the measurement has stabilized.
9. Click the **Reference value, point 1** text box and enter the reference value of the calibration point. Press **ENTER** or click outside the text box when done.

   The probe automatically enters the measured value for the calibration point.
10. Repeat steps step 7 ... step 9 for calibration point 2 (wet point, recommendation 65 ... 85 %RH).
11. Select **Activate adjustment > Yes** to store the adjustment in the probe.
12. Check the message that appears at the top of the screen. If the message indicates that the adjustment is activated successfully, your adjustment is stored in the probe.
13. Select the **Calibration information** tab and update the **Calibration date** and **Calibration text**.
14. Select **Close > Yes** to exit the calibration mode.

9.3.4 Adjusting RH for H_2O_2 with Indigo80 handheld indicator

- Indigo80 indicator and probe connection cable (see Accessories and spare parts (page 81)).
- A humidity calibrator to create two different humidity levels, for example, Vaisala HMK15 Humidity Calibrator. Note that the humidity difference between the dry point and wet point must be at least 40 %RH.

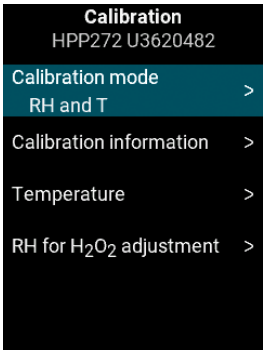
CAUTION! Do not expose the probe to H_2O_2 vapor when the probe is in calibration mode and sensor heating is off. Exposure to H_2O_2 condensation can cause the PEROXCAP sensor to fail within a day, and the sensor will not recover.

In order to make a successful adjustment, the humidity of the second calibration point (wet point) must be at least 40 %RH higher than the humidity of the first calibration point (dry point). For example, if point 1 is 10 %RH, the second calibration point must be at least 50 %RH.

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

1. Prepare the RH calibrator equipment for RH calibration point 1 (dry point, recommendation 0 ... 35 %RH).
2. Connect the probe(s) to the indicator.
3. Perform a sensor purge, or wait for the start-up purge to finish.
4. Open the main menu by pressing ☰.
5. Select **Devices**. If you have more than one device connected to the indicator, make a further selection between the devices.
6. Select **Calibrate / Adjust**.
7. Press **OK** to acknowledge the information shown in the indicator display notifications (such as probe temperature stabilization requirements).

8. Open the **Calibration mode** menu and select the **RH and T** adjustment mode.

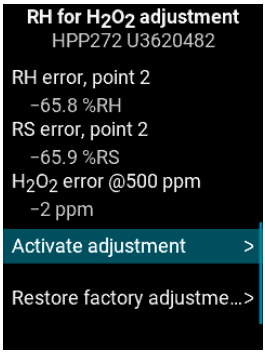


9. Select **RH for H_2O_2 adjustment**.
10. Insert the probe head in the first reference environment and wait for the measurement to stabilize.
11. Select **Reference value, point 1** and set the value of the first RH reference with the arrow buttons.

    The measured values for the calibration point are automatically entered after the reference point is set.
12. Insert the probe head in the second reference environment (wet point, recommendation 65 ... 85 %RH) and wait for the measurement to stabilize.
13. Select **Reference value, point 2** and set the value of the second RH reference with the arrow buttons.

    The difference between the reference point and the measurement is shown for each point (for example, **RH error, point 1**). Very large differences between the reference and the measured value may indicate that the stabilization time was insufficient, or that the calibration setup was not suitable.

14. Select **Activate adjustment** to store the adjustment in the probe.



- To exit without taking the adjustment in use, press ☰ to end calibration.
- To reset the adjustments of this parameter back to factory defaults, select **Restore factory adjustment**.

15. Update the calibration information in **Calibrate / Adjust > Calibration information**. Navigate to the **Calibration information** menu by pressing ⟲.
16. Press ☰ to end calibration.

9.3.5 Adjusting RH for H_2O_2 with Indigo200 transmitter

- Indigo200 transmitter with USB cable (type C to A or type C to C)
- Indigo connection cable (see Accessories and spare parts (page 81))
- A humidity calibrator to create two different humidity levels, for example, Vaisala HMK15 Humidity Calibrator. Note that the humidity difference between the dry point and wet point must be at least 40 %RH.

CAUTION! Do not expose the probe to H_2O_2 vapor when the probe is in calibration mode and sensor heating is off. Exposure to H_2O_2 condensation can cause the PEROXCAP sensor to fail within a day, and the sensor will not recover.

In order to make a successful adjustment, the humidity of the second calibration point (wet point) must be at least 40 %RH higher than the humidity of the first calibration point (dry point). For example, if point 1 is 10 %RH, the second calibration point must be at least 50 %RH.

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

1. Prepare the RH calibrator equipment for RH calibration point 1 (dry point, recommendation 0 ... 35 %RH).

2. Connect the probe to the Indigo transmitter, and then connect the Indigo transmitter to Insight PC software. Wait until Insight detects the probe.
3. Perform a sensor purge, or wait for the start-up purge to finish.
4. To open the Insight PC software calibration menu, select ⚙ to access Insight main menu. In the main menu, select **Calibrate > Yes**.

   In calibration mode, the device will not use functions that may interfere with calibration and adjustment.
5. In the **General** tab, make sure the calibration mode **RH** is selected.
6. Open the tab **RH for H_2O_2 adjustment**.
7. Remove any possible previous adjustments by selecting **Restore factory adjustment**.
8. Insert the probe head in the first reference environment.
9. Wait for the RH and temperature measurements to stabilize fully. This may take more than 30 minutes. Monitor the readings to see when the measurement has stabilized.
10. Enter the value of the first reference into the **Reference value, point 1** field.

    The probe automatically enters the measured values for the calibration point.
11. Repeat steps step 8... step 10 for calibration point 2 (wet point, recommendation 65 ... 85 %RH).
12. Select **Activate adjustment > Yes** to store the adjustment in the probe.
13. Check the message that appears at the top of the screen. If the message indicates that the adjustment is activated successfully, your adjustment is stored in the probe.
14. Select the **Calibration information** tab and update the **Calibration date** and **Calibration text**.
15. Select **Close > Yes** to exit the calibration mode.

9.3.6 Adjusting H_2O_2 measurement with Insight software

You need the following for the adjustment:

- A reference probe. Vaisala recommends using a Vaisala HPP270 series probe that has recently been factory-calibrated.
- An H_2O_2 vapor chamber that can produce a stable H_2O_2 vapor concentration level and where you can install your probe and the reference probe at the same time in such a location that their readings are comparable.
- Computer with Windows operating system and Vaisala Insight software installed (Insight software is available for download at http://www.vaisala.com).
- Vaisala USB cable (item code 242659) or Vaisala Indigo USB adapter (item code USB2) for connecting the probes.

1. Install your probe and the Vaisala HPP270 series probe used as reference in the calibration environment. Make sure their installation location is such that the probes' readings are comparable, that is, the environment is identical for both probes.
2. Connect your probe and the reference probe to Insight.
3. Wait for the start-up purge to finish.
4. For your probe only, select **> Calibrate > Yes** to switch the probe to calibration mode. Leave the reference probe in the normal measurement mode (default start-up mode).
5. In the **General** tab, in the **Calibration mode** drop-down list, select **H_2O_2**.

> **CAUTION!** It is very important to select **H_2O_2** as the calibration mode. If you leave the probe in the **RH and T** calibration mode (default mode), the sensor heating is switched off and the sensor will not withstand exposure to H_2O_2 vapor.

6. Open the **H_2O_2 adjustment** tab.
7. Expose your probe and the reference probe to H_2O_2 vapor and wait for the ambient H_2O_2 concentration to reach the desired calibration and adjustment level.
8. Wait for the measurement to stabilize fully. This may take more than 30 minutes. Monitor the H_2O_2 concentration readings of both probes to see when the measurement has stabilized.
9. When the measurement has stabilized, check the H_2O_2 concentration reading of the reference instrument. If you cannot see the reference instrument reading behind the calibration window, close the calibration window but do not exit the calibration mode.
10. Click the **Reference value, point 1** text box and enter the reading from the reference probe. Press **ENTER** or click outside the text box when done.

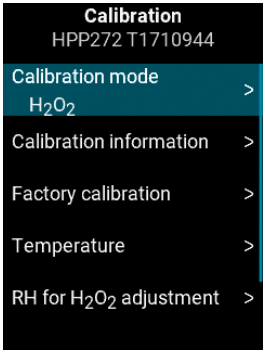
    The probe automatically enters the measured value for the calibration point.
11. Check the difference between the H_2O_2 concentration readings of your probe and the reference probe. A very large difference may be due to insufficient stabilization time or unsuitable calibration setup.
12. Select **Activate adjustment > Yes** to store the adjustment in the probe.
13. Check the message that appears at the top of the screen. If the message indicates that the adjustment is activated successfully, your adjustment is stored in the probe.
14. Select the **Calibration information** tab and update the **Calibration date** and **Calibration text**.
15. Select **Close > Yes** to exit the calibration mode.

9.3.7 Adjusting H_2O_2 with Indigo80 handheld indicator

- Indigo80 indicator and probe connection cable (see Accessories and spare parts (page 81)).
- A reference probe. Vaisala recommends using a Vaisala HPP270 series probe that has recently been factory-calibrated.
- An H_2O_2 vapor chamber that can produce a stable H_2O_2 vapor concentration level and where you can install your probe and the reference probe at the same time in such a location that their readings are comparable.

1. Install your probe and the Vaisala HPP270 series probe used as reference in the calibration environment. Make sure their installation location is such that the probes' readings are comparable, that is, the environment is identical for both probes.
2. Connect the probe that you are adjusting to Indigo80, and the reference probe to the device you are using to monitor the H_2O_2 reference environment.
3. Perform a sensor purge, or wait for the start-up purge to finish.
4. Open the main menu by pressing ☰.
5. Select **Devices**. If you have more than one device connected to the indicator, make a further selection between the devices.
6. Select **Calibrate / Adjust**.
7. Press **OK** to acknowledge the information shown in the indicator display notifications (such as probe temperature stabilization requirements).
8. Open the **Calibration mode** menu and select the **H_2O_2** adjustment mode.

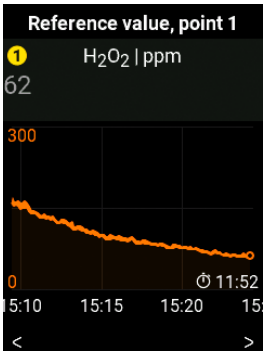
CAUTION! It is very important to select **H_2O_2** as the calibration mode. If you leave the probe in the **RH and T** calibration mode, the sensor heating is switched off and the sensor will not withstand exposure to H_2O_2 vapor.



9. Select **H_2O_2 adjustment**.

10. Select **Reference value, point 1** and wait for the measurements of the reference probe and the probe you are adjusting to stabilize.

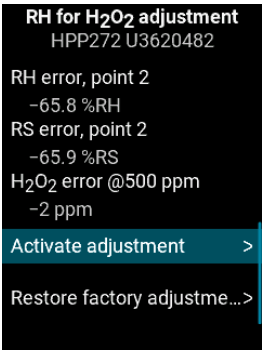
    You can follow the stabilization of the probe that is connected to Indigo80 from the graph view that opens after selecting **Reference value, point 1**.



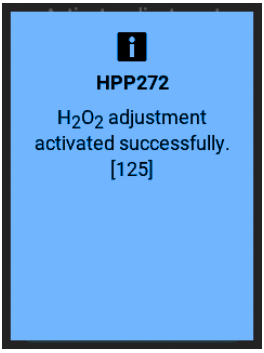
11. When the measurements have stabilized, press ⓞ to move to the next screen. Enter the H_2O_2 value measured by the reference probe with the arrow buttons, and select **Set**.

    The measured value for the calibration point is automatically entered after the reference point is set. If there is a very large difference between the reference and the measured value, that may indicate that the stabilization time was insufficient, or that the calibration setup was not suitable.

12. Select **Activate adjustment** to store the adjustment in the probe.



Indigo80 displays a message about successful activation.



- To exit without taking the adjustment in use, press ☰ to end calibration.
- To reset the adjustments of this parameter back to factory defaults, select **Restore factory adjustment**.

13. Update the calibration information in **Calibrate / Adjust > Calibration information**. Navigate to the **Calibration information** menu by pressing ⟲.
14. Press ☰ to end calibration.

9.3.8 Adjusting H_2O_2 with Indigo200 transmitter

- Indigo200 transmitter with USB cable (type C to A or type C to C)
- Indigo connection cable (see Accessories and spare parts (page 81))
- A reference probe and a display device for viewing the reference measurement. Vaisala recommends using a Vaisala HPP270 series probe that has recently been factory-calibrated.
- An H_2O_2 vapor chamber that can produce a stable H_2O_2 vapor concentration level and where you can install your probe and the reference probe at the same time in such a location that their readings are comparable.

1. Install your probe and the reference probe in the calibration environment. Make sure their installation location is such that the probes' readings are comparable, that is, the environment is identical for both probes.
2. Connect the probe you are adjusting to the Indigo transmitter, and then connect the Indigo transmitter to Insight PC software.Wait until Insight detects the probe.
3. Perform a sensor purge, or wait for the start-up purge to finish.
4. To open the Insight PC software calibration menu, select ⚙ to access Insight main menu. In the main menu, select **Calibrate > Yes**.
5. Open the **H_2O_2 adjustment** tab.

> **CAUTION!** It is very important to select **H2O2** as the calibration mode. If you leave the probe in the **RH** calibration mode (default mode), the sensor heating is switched off and the sensor will not withstand exposure to H_2O_2 vapor.

6. Remove any possible previous adjustments by selecting **Restore factory adjustment**.

7. Wait until the ambient H_2O_2 concentration has reached the desired calibration and adjustment level. Monitor the H_2O_2 readings of both probes and allow the measurements to stabilize fully.
8. When the measurements have stabilized, check the H_2O_2 concentration reading of the reference instrument. Enter the value of the reference into the **Reference value, point 1** field.

   The probe automatically enters the measured value for the calibration point.
9. Select **Activate adjustment** to store the adjustment in the probe.
10. Select **Close > Yes** to exit the calibration mode.

9.4 Testing analog output level with Insight

- HPP270 probe SW version 1.3.0 or above
- Computer with Windows operating system and Vaisala Insight PC software installed
- Vaisala USB cable (item code 242659) or Vaisala Indigo USB adapter (item code USB2) for connecting the probes to Vaisala Insight PC software
- Device for powering the probe and viewing the analog output test current (range: 0.000 ... 25.000 mA) sent by the probe

To test that the analog output of the probe is accurate, you can set the probe to output a fixed level of current (range: 0.000 ... 25.000 mA) and view the reading to verify the output.

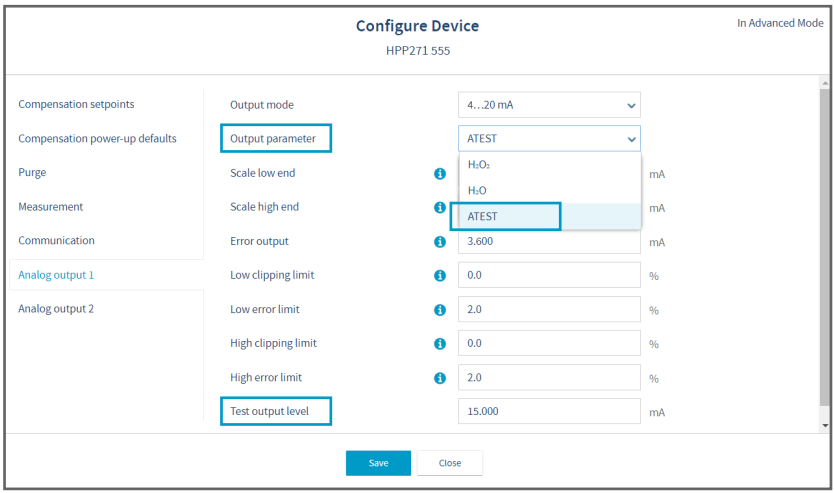


Figure 25 Setting current level for analog output test in Insight software

1. Connect the probe to Insight. See Connecting to Insight software (page 52).
2. Wait for the start-up purge to finish.
3. Select > **Configure device** and then select which output you want to test (either **Analog output 1** or **Analog output 2**).
4. From the **Output parameter** dropdown, select **ATEST**.
5. Enter the current level that you want the probe to output in the **Test output level** field.
6. Take the settings into use by selecting **Save**.
7. Disconnect the probe from the Insight USB cable and connect the probe to the device you are using to read the analog output test value.

8. Read the analog output from the probe in your device and verify that the probe output is correct.
9. After verifying the output, reconnect the probe to the Insight USB cable.
10. Go back to the Insight analog output configuration options in the **> Configure device** menu, and change the **Output parameter** selection back to normal output operation.

    Repeat the configuration for each output as necessary and **Save** the selections.

- ATEST is supported by HPP270 probe SW 1.3.0 and above.
- Insight SW version 1.0.2.76 does not support the ATEST output test functionality. See the related section in Problems and their possible solutions (page 71).

9.5 Restoring factory adjustment with Indigo80 handheld indicator

- Probe connection cable (cable 272075SP or flat cable CBL210493SP: see accessory information)

If needed, you can restore the factory adjustment for your probe using the Indigo80 handheld indicator.

1. Connect the probe(s) 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 **Calibrate / Adjust**.
5. Select any of the available parameters to access the view where you can restore the factory adjustment.
6. Select **Manual adjustment**.
7. Scroll down and select **Restore factory adjustment > OK**.
8. Confirm by selecting **OK**.
9. Press ☰ to end calibration.

10. Troubleshooting

10.1 Problems and their possible solutions

If you have a problem with using the probe, check the following tables before contacting Vaisala. If the problem you have is not listed in the tables, or if the proposed solution does not fix the problem, contact Vaisala technical support.

You can check the probe diagnostics and status with the Insight software and Modbus status registers (see Status registers (page 96)).

Response time is slower than specified

Problem: Response time is slower than specified.	
Possible cause:	**Solution:**
The filter is blocked.	Change the filter. Be careful not to touch the sensors when the filter is off the probe.
The probe has fallen and the filter has hit the floor.	Remove the filter and visually check the sensors. • If the sensors are bent, broken, or disconnected, contact Vaisala technical support. • If the sensors are intact, change the filter. The filter is made of porous material, and if the filter hits the floor, the filter material may get pressed and become less permeable. This reduces the rate at which air flows in and out of the filter, directly affecting the measurement. Be careful not to touch the sensors when the filter is off the probe.
The probe has been exposed to unsuitable chemicals (for example, DMSO).	Change the filter and perform a sensor purge. Be careful not to touch the sensors when the filter is off the probe.
The measurement filtering factor is configured to be too slow.	Use the Vaisala Insight software, Modbus configuration register $030A_{hex}$, or an Indigo200 transmitter to disable the filtering factor (set filtering factor to "1"), and check the measurement again. See: • Measurement filtering factor (page 19) • Vaisala Insight PC software (page 52) • Configuration registers (page 88)

Measurement reading does not change during regular use for less than 5 minutes

Problem: Measurement reading does not change during regular use for less than 5 minutes.	
Possible cause:	**Solution:**
Purge is being performed (duration of the purge is 4 minutes).	No actions required.

Measurement reading does not change during regular use for more than 5 minutes.

Problem: Measurement reading does not change during regular use for more than 5 minutes.	
Possible cause:	**Solution:**
In analog mode: The scaling of the output is unsuitable, preventing the change from showing.	Check and change the analog output scaling with Insight software (see Vaisala Insight PC software (page 52)).
In analog mode: The error level is configured within the measurement output level, and the probe is in error state.	Check the probe diagnostics with the Insight software (see Vaisala Insight PC software (page 52)). Consider changing the analog output error level to be outside the measurement scale.

Measurement reading appears incorrect

Problem: Measurement reading appears incorrect.	
Possible cause:	**Solution:**
The filter is wet.	Remove the filter, pour out any water, and let the filter dry. Depending on air humidity and temperature, drying the filter in ambient air can take from a few hours to a day. Alternatively, you can dry the removed filter with nitrogen gas or dry pressurized air. When the filter is dry, reinstall the filter. Be careful not to touch the sensors when the filter is off the probe. Perform a sensor purge.
The filter is blocked or dirty.	Change the filter. Be careful not to touch the sensors when the filter is off the probe.

Problem: Measurement reading appears incorrect.	
Condensation has formed on the sensor when the probe was powered off.	When the probe is powered off, exposure to H_2O_2 condensation can cause the PEROXCAP sensor to fail within a day, and the sensor will not recover. When the probe is powered on, the heated sensor withstands condensing H_2O_2 conditions. A sensor damaged with H_2O_2 condensation during power-off time cannot be repaired.
The filter is not installed on the probe.	Do not use the probe without the filter. Install the filter on the probe.
The yellow transport cap is still on the probe.	Remove the yellow transport cap when measuring with the probe.
The filter is broken.	Do not use the probe if the filter is broken. Remove the filter and visually check the sensors: • If the sensors are bent, broken, or disconnected, contact Vaisala technical support. • If the sensors are intact, change the filter. Be careful not to touch the sensors when the filter is off the probe.
In analog mode: Maximum load has been exceeded.	Check the analog output load, and reduce it to the specified maximum load or less. See output specifications for the permitted maximum load.
Ambient pressure is not normal atmospheric pressure.	Check the ambient pressure. See operating environment specification for the permitted operating pressure.
The PEROXCAP sensor is at the end of its life cycle.	Check the sensor vitality information in the Insight PC software diagnostics view. See Sensor vitality information in Insight (page 55).

H_2O_2 concentration reading shows > 0 ppm even though the probe is not exposed to H_2O_2

Problem: H_2O_2 concentration reading shows > 0 ppm even though the probe is not exposed to H_2O_2.	
Possible cause:	**Solution:**
Normal variation due to a slight difference in behavior between the two humidity sensors.	No actions required.
If the reading remains > 0 ppm for 2 ... 10 hours, H_2O_2 concentration has drifted.	The intelligent measurement algorithm can correct errors of < 30 ppm by itself when the probe is not exposed to H_2O_2. Keep the probe powered on for a few hours in a stable temperature and RH, not exposed to H_2O_2.

The filter is wet

Problem: The filter is wet.	
Possible cause:	**Solution:**
Sprayed water has entered the filter when cleaning the probe.	Remove the filter, pour out any water, and let the filter dry. Depending on air humidity and temperature, drying the filter in ambient air can take from a few hours to a day. Alternatively, you can dry the removed filter with nitrogen gas or dry pressurized air. When the filter is dry, reinstall the filter. Be careful not to touch the sensors when the filter is off the probe. Perform a sensor purge.

The filter is broken

Problem: The filter is broken.	
Possible cause:	**Solution:**
The probe has fallen or an object has hit the filter.	Do not use the probe if the filter is broken. Remove the filter and visually check the sensors: • If the sensors are bent, broken, or disconnected, contact Vaisala technical support. • If the sensors are intact, change the filter. Be careful not to touch the sensors when the filter is off the probe.

The probe does not power on, or there is no communication from the probe after power-on

Problem: The probe does not power on, or there is no communication from the probe after power-on.	
Possible cause:	**Solution:**
Power input to the probe is off.	Turn on the power input to the probe.
Probe wiring is incorrect.	Check the probe wiring and correct it if needed. See Wiring (page 27).
The probe cable is not properly connected.	Check the cable connection and correct it if needed.
The operating voltage is incorrect.	Check the operating voltage and correct if needed. See input and output specifications for the correct voltage.

Problem: The probe does not power on, or there is no communication from the probe after power-on.	
In digital mode: The communication settings (for example the device address) are incorrect either in the probe or in the system where the probe is connected.	Check the communication settings. You can check the probe's communication settings with the Insight software. See Vaisala Insight PC software (page 52)

Insight PC software resets repeatedly (reset loop) and cannot be started

Problem: Insight PC software becomes stuck in a reset loop at start-up	
Possible cause:	**Solution:**
Insight SW version 1.0.2.76 can become stuck in a reset loop when using the ATEST output test selections or in certain sensor error states.	Uninstall Insight SW version 1.0.2.76 and install either an older or newer Insight SW version. See www.vaisala.com/insight for the latest Insight SW release, or contact Vaisala Support for earlier SW versions.

In analog mode, there is no output signal (signal level is 0 mA)

Problem: In analog mode, there is no output signal (signal level is 0 mA).	
Possible cause:	**Solution:**
Pin #5 was floating at start-up or reset, which means the probe is in digital mode.	Check pin #5. See Wiring (page 27).
Analog outputs are configured to be off.	Check the analog output mode with the Insight software or Modbus configuration registers 0700_{hex} and 0800_{hex}. See: • Vaisala Insight PC software (page 52) • Configuration registers (page 88)
Probe wiring is incorrect.	Check the probe wiring and correct it if needed. See Wiring (page 27).
The operating voltage is incorrect.	Check the operating voltage and correct if needed. See input and output specifications for the correct voltage.
The probe cable is not properly connected.	Check the cable connection and correct it if needed.
Power input to the probe is off.	Turn on the power input.

Problem: In analog mode, there is no output signal (signal level is 0 mA).	
The analog output error level is configured to be 0 mA, and the probe is performing start-up purge or is in error state.	Wait for 5 minutes for the possible start-up purge to finish. If the output remains 0 mA after 5 minutes, check the probe diagnostics with the Insight software (see Vaisala Insight PC software (page 52)).

Triggering manual purge with Modbus cannot be completed successfully

Problem: Triggering manual purge with Modbus (register 1283/0502_{hex}) cannot be completed successfully.	
Possible cause:	**Solution:**
A value is written into the register before the purge has completed.	The manual purge trigger register must only be written into once per purge cycle (write **1** into the register to start the purge). After starting the purge by writing **1**, the register value must only be read until the purge cycle has completed. Write into and read from the register in the following order: 1. Write **1** to start the purge 2. Read the updating progress value (**1** ... **100** %) 3. When the progress has reached **100** %, the value of the register changes either to **0** (purge completed successfully, purge not in progress) or **-1** (purge failed, purge not in progress) 4. After reading the final value (**0** or **-1**), a new purge can again be triggered by writing **1**.

In analog mode, start-up purge is not performed

Problem: In analog mode, start-up purge is not performed.	
Possible cause:	**Solution:**
The probe is in digital mode at start-up (pin #5 is floating).	Check pin #5. See Wiring (page 27).

At start-up in analog mode, the probe remains in the error state for over 5 minutes

Problem: At start-up in analog mode, the probe remains in the error state for over 5 minutes.	
Possible cause:	**Solution:**

Problem: At start-up in analog mode, the probe remains in the error state for over 5 minutes.	
The analog output scaling is unsuitable.	Check the analog output scaling with the Insight software and correct the scaling if needed (see Vaisala Insight PC software (page 52)).
There is a probe or sensor error.	Check the probe diagnostics with the Insight software (see Vaisala Insight PC software (page 52)).

10.2 Analog output error state

The probe sets the analog output channel into a defined error level instead of the measured result in three situations:

- Probe is performing start-up purge (duration 4 minutes).
- Probe detects a measurement malfunction. This means an actual measurement problem, such as sensor damage, or unsuitable environmental conditions.
- Measured value(s) are outside the error limits defined for the outputs.

The default error level for the analog outputs is 3.6 mA. You can change the error level (range 0 … 25 mA) with the Insight software and via Modbus (registers 0706_{hex} and 0806_{hex}).

More information

- Configuration registers (page 88)

11. Technical data

HPP271

Table 5 HPP271 measurement performance

Property	Description/Value
Hydrogen peroxide	
Sensor	PEROXCAP®
Measurement range	0 ... 2000 ppm
Measurement temperature range	+5 ... +50 °C (+41 ... +122 °F)
Repeatability at +25 °C (+77 °F):	
up to 500 ppm H_2O_2	±10 ppm
up to 1000 ppm H_2O_2	±15 ppm
Accuracy at +10 ... +25 °C (+50 ... +77 °F) , 10 ... 2000 ppm H_2O_2 [1)]	±10 ppm or 5 % of reading (whichever is greater)
Factory calibration uncertainty at +25 °C (+77 °F), 500 ppm H_2O_2 [2)]	±10 ppm
Response time at +23 °C (+73 °F):	
Response time (T_{63})	70 s
Response time (T_{90})	200 s
Other parameters	
H_2O ppm by volume, dew point temperature	

1) *Including non-linearity, hysteresis, and repeatability.*
2) *Defined as ±2 standard deviation limits. See also calibration certificate.*

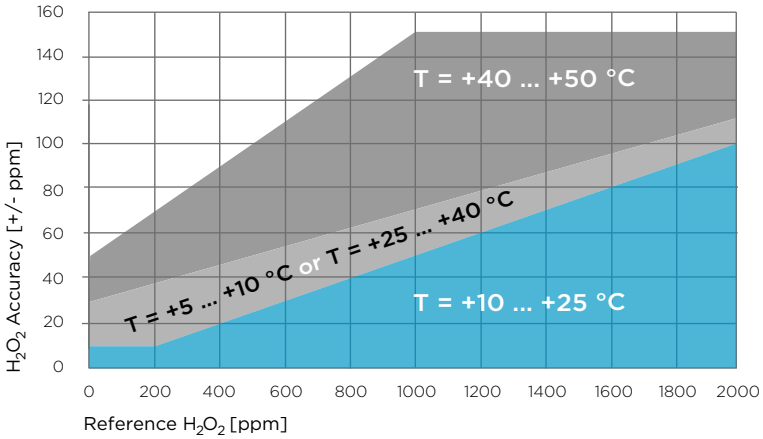


Figure 26 H_2O_2 measurement accuracy in 3 temperature ranges as function of H_2O_2 concentration (including non-linearity and repeatability; specification valid for range 10 ... 2000 ppm H_2O_2)

Table 6 HPP271 inputs and outputs

Property	Description/Value
Operating voltage	Digital output: 15 ... 30 V DC Analog output: 15 ... 25 V DC
Current consumption at +25 °C (+77 °F)	
In digital mode	Max. 10 mA
In analog mode	Max. 50 mA
During sensor purge	Max. 250 mA
Digital output	
Interface	RS-485, not isolated; do not use termination on the RS-485 line
Bit rate	9600, 19200 (default), 38400, 57600, or 115200 bps
Parity	None (default), even, odd
Data bits	8
Stop bits	1, 2 (default)
Communication protocol	Modbus RTU v.1.02
Analog output	
Outputs	2 × 4 ... 20 mA 3-wire current outputs

Property	Description/Value
Max. load	500 Ω
Accuracy (typical)	±0.1 % of full scale
Analog output temperature dependence	0.005 %/°C (0.003 %/°F) full scale

Table 7 HPP271 operating environment

Property	Description/Value
Operating temperature	+0 ... +70 °C (+32 ... +158 °F)
Storage temperature	−20 ... +70 °C (−4 ... +158 °F)
Ambient pressure	Normal atmospheric pressure
IP rating	IP65: Dust-tight. Protected from water jets from any direction.

Table 8 HPP271 compliance

Property	Description/Value
EU directives and regulations	EMC, RoHS
Electromagnetic compatibility (EMC)	EN 61326-1, industrial environment
EMC emissions	CISPR 32 / EN 55032, Class B
Compliance marks	CE, China RoHS, RCM

Table 9 HPP271 mechanical specifications

Property	Description/Value
Weight	110 g (3.88 oz)
Connector	M12-5M
Materials	
Probe body	AISI316L stainless steel
Filter cap	Porous PTFE

11.1 Accessories and spare parts

Table 10 HPP271 spare parts and accessories

Name	Order Code
Indigo USB adapter [1)]	USB2
Probe connection cable with open wires, 1.5 m (4.9 ft)	254294SP
Probe connection cable with open wires, 3 m (9.8 ft)	254295SP
Probe connection cable with open wires, 5 m (16 ft)	254296SP
Probe connection cable with open wires, 10 m (33 ft)	254297SP
Flat cable, M12-5F - M12-5M, 1 m (3.3 ft)	CBL210493SP
Probe connection cable with open wires and 90° plug, 0.6 m (2 ft)	244669SP
Filter	DRW246363SP
Gland set for through-wall installation, HPP271	HPP271MOUNTINGSET1
Flange for through-wall installation, HPP271	HPP271MOUNTINGSET2
Wall mount for HPP271 and HPP272	HPP272WALLMOUNT
Transmitters and handheld indicators	
Indigo transmitters	See www.vaisala.com/indigo
Indigo80 handheld indicator	See www.vaisala.com/indigo80
Indigo80 cable for probes (M12-M12), 1.5 m (4.9 ft)	272075SP
Indigo80 flat cable for probes (M12), 1 m (3.3 ft)	CBL210493SP
Connection cable to Indigo, 1 m (3.3 ft)	INDIGOCABLEHD1M5
Connection cable to Indigo, 3 m (9.8 ft)	INDIGOCABLEHD3M
Connection cable to Indigo, 5 m (16 ft)	INDIGOCABLEHD5M
Connection cable to Indigo, 10 m (33 ft)	INDIGOCABLEHD10M

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

For more information on ordering spare parts and accessories, visit store.vaisala.com.

11.2 Dimensions

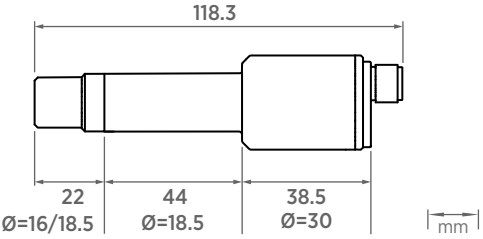


Figure 27 HPP271 dimensions

More information

- HPP271MOUNTINGSET1/HPP272MOUNTINGSET1 dimensions (page 82)
- HPP271MOUNTINGSET2/HPP272MOUNTINGSET2 dimensions (page 84)

11.2.1 HPP271MOUNTINGSET1/HPP272MOUNTINGSET1 dimensions

Figure 28 (page 83) shows the dimensions of the gland through-wall installation accessory HPP271MOUNTINGSET1/HPP272MOUNTINGSET1 in millimeters and [inches].

For an installation example, see Installation (page 25).

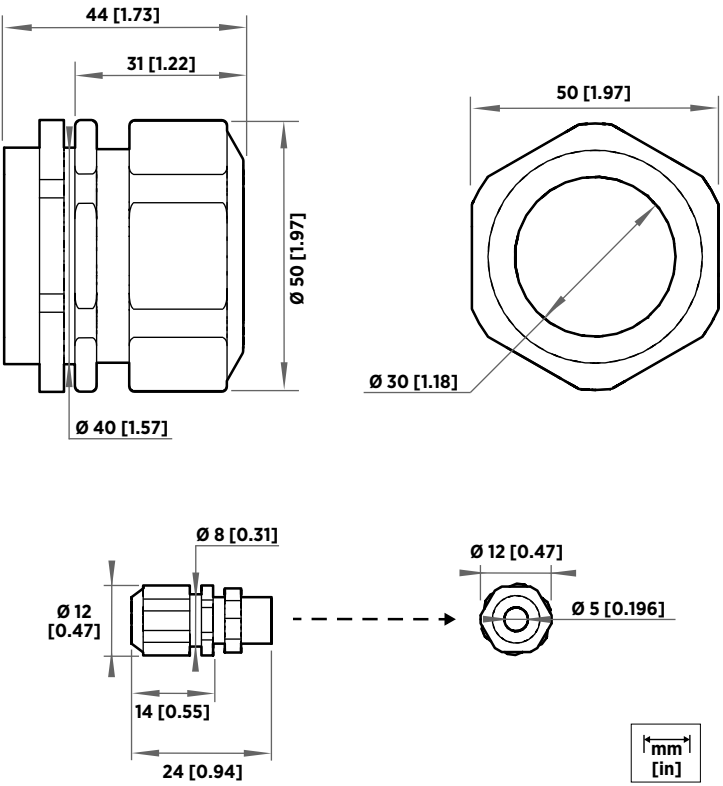


Figure 28 HPP271MOUNTINGSET1/HPP272MOUNTINGSET1 dimensions

For more information on using the gland through-wall installation accessory, see the accessory Quick Guide *M212195EN*.

CAUTION! Note that in installations where only part of the probe is installed inside the process, the temperature outside of the process can have an effect on the probe measurement accuracy, especially if the temperature difference is significant. In installations where part of the probe is outside of the process that is measured, apply adequate thermal insulation around the probe part and cable outside the process.

More information

- Installation (page 25)

11.2.2 HPP271MOUNTINGSET2/HPP272MOUNTINGSET2 dimensions

Figure 29 (page 84) shows the dimensions of the flange through-wall installation accessory HPP271MOUNTINGSET2/HPP272MOUNTINGSET2 in millimeters and [inches].

For an installation example, see Installation (page 25).

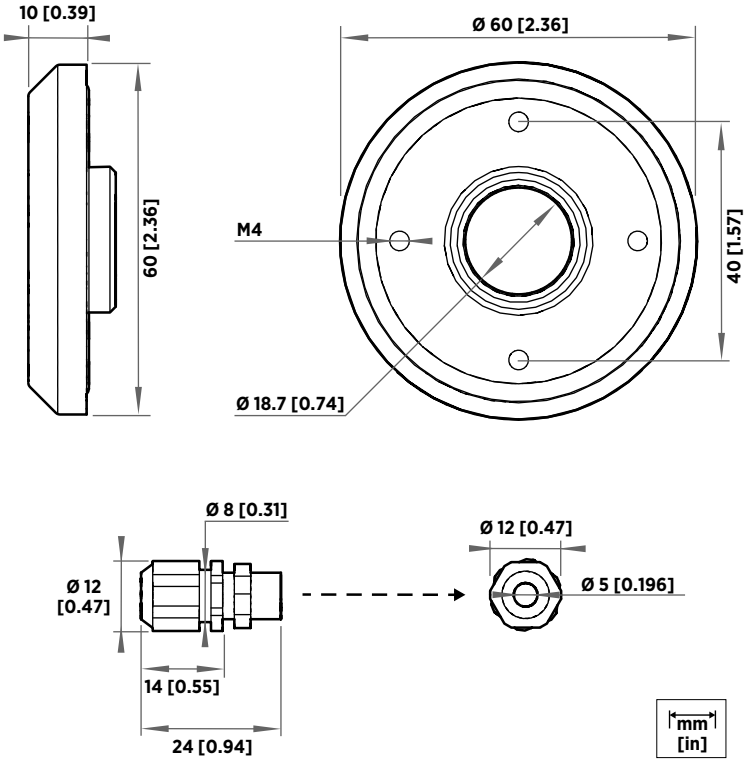


Figure 29 HPP271MOUNTINGSET2/HPP272MOUNTINGSET2 dimensions

For more information on using the flange through-wall installation accessory, see the accessory Quick Guide *M212194EN*.

CAUTION! Note that in installations where only part of the probe is installed inside the process, the temperature outside of the process can have an effect on the probe measurement accuracy, especially if the temperature difference is significant. In installations where part of the probe is outside of the process that is measured, apply adequate thermal insulation around the probe part and cable outside the process.

More information

- Installation (page 25)

11.2.3 HPP272WALLMOUNT dimensions

Figure 30 (page 85) shows the dimensions of the HPP271/HPP272 wall mounting accessory HPP272WALLMOUNT in millimeters and [inches].

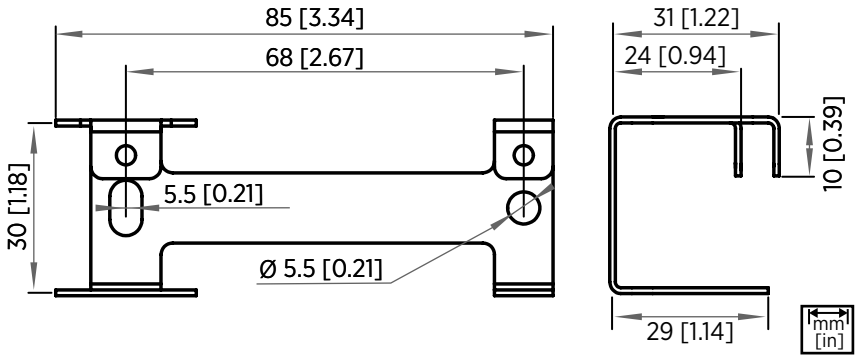


Figure 30 HPP272WALLMOUNT dimensions

For more information on using the wall mounting accessory, see the accessory Quick Guide *M212179EN*.

More information

- Installation (page 25)

Appendix A. Modbus reference

A.1 Default communication settings

Table 11 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

A.2 Function codes

Table 12 Modbus function codes

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

A.3 Data encoding

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

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

A.3.1 32-bit floating point or 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 13 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 14 Modbus measurement data registers (read-only)

Register number	Address	Description	Data format	Unit
1	0000_{hex}	Vaporized hydrogen peroxide concentration by volume	32-bit float	ppm
11	$000A_{hex}$	$H_2O+H_2O_2$ dew point temperature	32-bit float	°C
15	$000E_{hex}$	Water concentration by volume	32-bit float	ppm
257	0100_{hex}	Vaporized hydrogen peroxide concentration by volume	16-bit signed integer	ppm
262	0105_{hex}	$H_2O+H_2O_2$ dew point temperature	16-bit signed integer	°C * 100
264	0107_{hex}	Water concentration by volume	16-bit signed integer	ppm

A.4.2 Configuration registers

CAUTION! Default power-up values (register 773) are written into non-volatile EEPROM memory. The EEPROM memory implementation has a limit of 30000 writes, and is intended to be used only when saving long-term or permanent configurations. Use the volatile memory (register 769, values cleared on power-up) for non-permanent configurations (for example, if the probe is used in a system that regularly updates the given values).

Table 15 Modbus configuration data registers (writable)

Register number	Address	Description	Data format	Unit/Valid range
769	0300_{hex}	Volatile value for pressure compensation (value cleared at probe reset). Used for compensating the measurement for pressure if pressure compensation is turned ON (register 0504_{hex}).	32-bit float	hPa 813.25 ... 1213.25 (default 1013.25 hPa) (Init copied from power-up value)
773	0304_{hex}	Power-up value for pressure compensation	32-bit float	hPa 813.25 ... 1213.25 (default 1013.25 hPa)
777	0308_{hex}	Purge interval	16-bit integer	min 60 ... 10080 (= 1 hour ... 1 week) (default: 1440 (= 24 hours))
779	$030A_{hex}$	Measurement filtering factor (affects only H_2O_2 concentration measurement)	32-bit float	Range: 0.01 ... 1 1 = Filter is disabled < 1 = Reading is a combination of latest measurement and the earlier reading. The value of the register defines the portion of the latest measurement, for example, 0.9 means the reading consists 90 % of the latest measurement and 10 % of the earlier reading.

Register number	Address	Description	Data format	Unit/Valid range
783	$030E_{hex}$	Low H_2O_2 threshold on/off	16-bit boolean	0 = Off 1 = On (default: 0 = Off) When enabled, the Low H_2O_2 threshold feature remains in use also after probe reset.
785	0310_{hex}	Low H_2O_2threshold activation level	32-bit float	ppmH_2O_2 (default: 3) See H 2 O 2 concentration reading when not exposed to H 2 O 2 (page 31)
787	0312_{hex}	Low H_2O_2 threshold activation delay	32-bit integer	Seconds (default: 1800) See H 2 O 2 concentration reading when not exposed to H 2 O 2 (page 31)
789	0314_{hex}	Low H_2O_2 threshold deactivation level	32-bit float	ppmH_2O_2 (default: 10) See H 2 O 2 concentration reading when not exposed to H 2 O 2 (page 31)
791	0316_{hex}	Low H_2O_2 threshold deactivation delay	32-bit integer	Seconds (default: 10) See H 2 O 2 concentration reading when not exposed to H 2 O 2 (page 31)

Register number	Address	Description	Data format	Unit/Valid range
1283	0502_{hex}	Purge status / manual start	16-bit function status	When reading from register: 1 ... 100 = Purge is in progress (progress shown as 1 ... 100%) 0 = Previous purge completed successfully, purge is not in progress ... -1 = Previous purge has failed When writing to register: 1 = Start purge Note: After starting the purge by writing 1, only read from the register until the purge has completed. See the related section in Problems and their possible solutions (page 71).
1285	0504_{hex}	Pressure compensation on/off	16-bit boolean	1 = On 0 = Off
1287	0506_{hex}	Manual purge trigger in analog mode on/off	16-bit boolean	1 = On 0 = Off (default: 1 = On)
1288	0507_{hex}	Allow interval purge during H_2O_2 exposure	16-bit boolean	1 = On 0 = Off (default: 0 = Off)
1537	0600_{hex}	Modbus address	16-bit integer	1 ... 255 (default: 240)
1538	0601_{hex}	Bit rate	enum	5 = 9600 6 = 19200 7 = 38400 8 = 57600 9 = 115200 (default: 6 = 19200)

Register number	Address	Description	Data format	Unit/Valid range
1539	0602_{hex}	Parity, number of data bits, number of stop bits	enum	0 = None, 8, 1 1 = None, 8, 2 2 = Even, 8, 1 3 = Even, 8, 2 4 = Odd, 8, 1 5 = Odd, 8, 2 (default: 1 = None, 8, 2)
1540	0603_{hex}	Minimum delay between request and device response. Increase this if your hardware needs extra time for changing the communication direction. Any extra delay specified here is added on top of the normal maximum 1-second response time of the device.	16-bit integer	ms 0 ... 1000
1541	0604_{hex}	Restart device	16-bit function status	When writing to register: 1 = Restart the device
Analog Output 1:				
1793	0700_{hex}	Output mode	enum	0 = Off 2 = 4 ... 20 mA (default: 2 = 4 ... 20 mA)
1794	0701_{hex}	Output parameter	16-bit register address	0000_{hex}, $000A_{hex}$, or $000E_{hex}$ See Table 14 (page 88) for measurement register descriptions.
1795	0702_{hex}	Scale low end	32-bit float	Set the lower limit of the measurement scale for the output parameter chosen in register 0701_{hex} (Output parameter).
1797	0704_{hex}	Scale high end	32-bit float	Set the upper limit of the measurement scale for the output parameter chosen in register 0701_{hex} (Output parameter).

Register number	Address	Description	Data format	Unit/Valid range
1799	0706_{hex}	Error output	32-bit float	mA 0 ... 25
1801	0708_{hex}	Low clipping limit	32-bit float	% of scaled range 0 ... 20 = Clip the output when the measurement goes this many percent below the low end of the scale NaN = Disable clipping limit at low end
1803	$070A_{hex}$	Low error limit	32-bit float	% of scaled range 0 ... 20 = Set the output in error state when the measurement goes this many percent below the low end of the scale NaN = Disable error limit at low end
1805	$070C_{hex}$	High clipping limit	32-bit float	% of scaled range 0 ... 20 = Clip the output when the measurement goes this many percent above the high end of the scale NaN = Disable clipping limit at high end
1807	$070E_{hex}$	High error limit	32-bit float	% of scaled range 0 ... 20 = Set the output in error state when the measurement goes this many percent above the high end of the scale NaN = Disable error limit at high end
Analog Output 2:				
2049	0800_{hex}	Output mode	enum	0 = Off 2 = 4 ... 20 mA (default: 2 = 4 ... 20 mA)

Register number	Address	Description	Data format	Unit/Valid range
2050	0801_{hex}	Output parameter	16-bit register address	0000_{hex}, $000A_{hex}$, or $000E_{hex}$ See Table 14 (page 88) for measurement register descriptions.
2051	0802_{hex}	Scale low end	32-bit float	Set the lower limit of the measurement scale for the output parameter chosen in register 0801_{hex} (Output parameter).
2053	0804_{hex}	Scale high end	32-bit float	Set the upper limit of the measurement scale for the output parameter chosen in register 0801_{hex} (Output parameter).
2055	0806_{hex}	Error output	32-bit float	mA 0 ... 25
2057	0808_{hex}	Low clipping limit	32-bit float	% of scaled range 0 ... 20 = Clip the output when the measurement goes this many percent below the low end of the scale NaN = Disable clipping limit at low end
2059	$080A_{hex}$	Low error limit	32-bit float	% of scaled range 0 ... 20 = Set the output in error state when the measurement goes this many percent below the low end of the scale NaN = Disable error limit at low end
2061	$080C_{hex}$	High clipping limit	32-bit float	% of scaled range 0 ... 20 = Clip the output when the measurement goes this many percent above the high end of the scale NaN = Disable clipping limit at high end

Register number	Address	Description	Data format	Unit/Valid range
2063	$080E_{hex}$	High error limit	32-bit float	% of scaled range 0 ... 20 = Set the output in error state when the measurement goes this many percent above the high end of the scale NaN = Disable error limit at high end
Service Agreement:				
2817	$0B00_{hex}$	Customer name	24-character ASCII string	Read-only
2829	$0B0C_{hex}$	Contract number	24-character ASCII string	Read-only
2841	$0B18_{hex}$	Start date	three 16-bit integer decimal values (YYYY, M, and D)	Read-only
2844	$0B1B_{hex}$	End date	three 16-bit integer decimal values (YYYY, M, and D)	Read-only
Factory Settings:				
7937	$1E00_{hex}$	Restore factory settings	16-bit function status	When writing to register: 1 = Restore factory settings (cancel all changes made by the user) and remove all field adjustments. Resets the device.

A.4.3 Status registers

Table 16 Modbus device status registers (read-only)

Register number	Address	Description	Data format	Notes
513	0200_{hex}	Device status	16-bit	0 = Status OK. 1 = Critical error, maintenance needed. 2 = Error, device may recover automatically. 4 = Warning. 8 = Notification. 16 = Calibration enabled. 1)
514	0201_{hex}	Status code low	32-bit	See Table 19 (page 98) .1)
516	0203_{hex}	Status code high	32-bit	See Table 20 (page 98) .1)

*1) Multiple statuses can be present simultaneously. In those cases, the value of the status register is the sum of the status values. For example, the value of the device status register is **6** if a warning (**4**) and an error (**2**) are present simultaneously.*

Table 17 Modbus measurement status registers (read-only)

Register number	Address	Description	Data format	Notes
529	0210_{hex}	Status of Hydrogen peroxide concentration by volume	16-bit	0 = Status OK. 2 = Reading is not reliable. 32 = Reading is locked during purge. 64 = Calibration has expired. 128 = Sensor failure. 256 = Measurement not ready 1)
534	0215_{hex}	Status of H_2O +H_2O_2 dew point temperature	16-bit	
536	0217_{hex}	Status of Water concentration by volume	16-bit	

1) *Multiple statuses can be present simultaneously. In those cases, the value of the status register is the sum of the status values.*

Table 18 Modbus probe maintenance status registers (read-only)

Register number	Address	Description	Data format	Notes
547	0222_{hex}	Sensor vitality. A new sensor will have a sensor vitality of 100 %, and a sensor at the end of its life cycle will have a sensor vitality of 0 %. If you are using the probe in a demanding environment, contact Vaisala to arrange sensor maintenance or replacement once the sensor vitality value reaches 40 %.	32-bit float	Value range: 1 ... 100 (sensor vitality percentage value, for example 75 (%))

Table 19 Error codes in register 0201_{hex} (32-bit)

Value of register 0201_{hex}	Error message	Severity
0	Status OK.	
1	Firmware checksum mismatch.	Critical
2	Device settings corrupted.	Critical
8	Supply voltage too high.	Error
16	Internal voltage too low.	Error
32	Internal voltage too high.	Error
64	Humidity sensor failure (open circuit).	Error
1024	Humidity sensor failure (open circuit).	Error
16384	Temperature sensor failure (open circuit).	Error
32768	Temperature sensor failure (short circuit).	Error
262144	Temperature sensor failure (open circuit).	Error
524288	Temperature sensor failure (short circuit).	Error

Table 20 Error codes in register 0203_{hex} (32-bit)

Value of register 0203_{hex}	Error message	Severity
0	Status OK.	
256	A/D converter failure (external).	Error
512	Non-volatile memory read/write failure.	Error
4096	Humidity sensor failure (short circuit).	Error
8192	Purge in progress.	Info
16384	A/D converter failure (internal).	Error
32768	Calibration is about to expire.	Info
65536	Calibration has expired.	Warning

A.4.4 Device identification objects

Table 21 Device identification objects

Object ID	Object ID (hexadecimal)	Object name	Example contents
0	00_{hex}	VendorName	"Vaisala"
1	01_{hex}	ProductCode	"HPP271"
2	02_{hex}	MajorMinorVersion	"1.2.3" Software version of the device.
3	03_{hex}	VendorUrl	"http://www.vaisala.com/"
4	04_{hex}	ProductName	"Hydrogen Peroxide Probe HPP271"
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.4.5 Test value registers

Table 22 Test value registers

Register number	Address	Description	Data format	Value
7937	$1F00_{hex}$	Signed integer	16-bit integer	-12345
7938	$1F01_{hex}$	Floating point	32-bit float	-123.45
7940	$1F03_{hex}$	Text string	8-character ASCII string	"-123.45"

A.5 Modbus communication examples

Reading H_2O_2 concentration value

Device address used in the following examples is 240 ($F0_{hex}$).
The values returned by the device differ depending on the ambient conditions and/or device settings. Your device might not return exactly same values.

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
$F0_{hex}$	HPP271 address	$F0_{hex}$	HPP271 address
03_{hex}	Function (Read Holding Registers)	03_{hex}	Function (Read Holding Registers)
00_{hex}	Register address	04_{hex}	Number of data bytes
00_{hex}		$D4_{hex}$	Value of first register (least significant word)
00_{hex}	Number of 16-bit registers to read (2)	$7A_{hex}$	
02_{hex}		43_{hex}	Value of second register (most significant word)
$D1_{hex}$	Modbus RTU checksum	$E8_{hex}$	
$2A_{hex}$		33_{hex}	Modbus RTU checksum
(silence for 3.5 bytes)	End of Modbus RTU frame	AB_{hex}	
		(silence for 3.5 bytes)	End of Modbus RTU frame

Communication description	
Register address	1 (1-based Modbus documentation format) = 0000_{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	$43E8D47A_{hex}$, which is binary32 representation of 465.65997 (ppm).

Writing purge interval 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
$F0_{hex}$	HPP271 address	$F0_{hex}$	HPP271 address
10_{hex}	Function (Write Multiple Registers)	10_{hex}	Function (Write Multiple Registers)
03_{hex}	Register address	03_{hex}	Register address
08_{hex}		08_{hex}	
00_{hex}	Number of registers to write (1)	00_{hex}	Number of 16-bit registers written (1)
01_{hex}		01_{hex}	
02_{hex}	Number of data bytes	95_{hex}	Modbus RTU checksum
$0B_{hex}$	Value for the register	$6E_{hex}$	
40_{hex}		(silence for 3.5 bytes)	End of Modbus RTU frame
$9B_{hex}$	Modbus RTU checksum		
$4C_{hex}$			
(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 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	777 (1-based Modbus documentation format) = 0308_{hex} (0-based format used in actual communication).
Data format	One 16-bit Modbus register interpreted as 16-bit integer value.

Communication description	
Value to write	$0B40_{hex}$ = 2880 (minutes) (= 48 hours)

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.

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.

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.

Recycling

Recycle all applicable material according to local regulations.

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