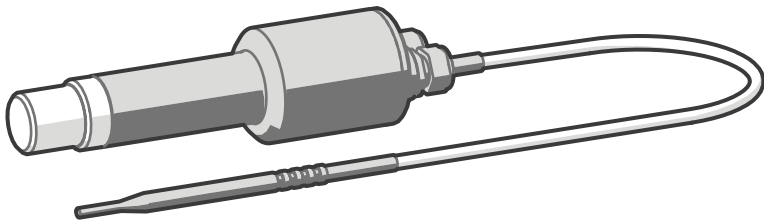


User Guide

Vaisala PEROXCAP[®] Hydrogen Peroxide,
Humidity and Temperature Probe

HPP272



VAISALA

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1. About This Document

1.1 Version Information

This document provides instructions for installing, using, and maintaining Vaisala PEROXCAP® Hydrogen Peroxide, Humidity and Temperature Probe HPP272.

Table 1 Document Versions

Document Code	Date	Description
M211972EN-C	October 2018	<p>Documentation updated to include the following new functionalities and accessories:</p> <ul style="list-style-type: none"> • New calculated parameters (water vapor saturation pressure ($H_2O + H_2O_2$), $H_2O + H_2O_2$ dew point temperature, and H_2O_2 vapor pressure) • Field calibration and adjustment with Insight and Indigo • Sensor vitality monitoring • Option to enable purge during H_2O_2 exposure • New installation accessories for mounting and through-wall installation <p>Updated power supply and wiring instructions with new current consumption specification and RS-485 wiring example. Analog output overrange behavior updated. Updated accuracy specifications and included graphs for RS and H_2O_2 measurement accuracies. Modbus register tables updated to include new parameters and functionalities.</p>
M211972EN-B	December 2017	<p>Added description and Modbus registers for pressure compensation, removed restriction not to perform a purge during H_2O_2 exposure, clarified operating system requirements for Vaisala Insight software, clarified Indigo 200 transmitter compatibility with HPP272.</p>
M211972EN-A	September 2017	First version.

1.2 Related Manuals

Table 2 Related Manuals

Document Code	Name
M211887EN	<i>Hydrogen Peroxide, Humidity and Temperature Probe HPP270 Series Quick Guide</i>
M211888EN	<i>Hydrogen Peroxide Probe HPP271 User Guide</i>

Document Code	Name
M211877EN	<i>Indigo 201 Analog Output Transmitter User Guide</i>
M211966EN	<i>Indigo 202 Digital Transmitter User Guide</i>

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.

Indigo™ is a trademark 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 HPP272

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, Humidity and Temperature Probe HPP272 provides measurement for vaporized H_2O_2 concentration, relative saturation, relative humidity, and temperature.

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 break the PEROXCAP sensor within a day, and the sensor will not recover.

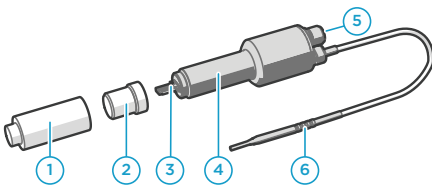


Figure 1 Probe Parts

- 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 H_2O_2 and humidity probe.
- 5 5-pin M12 connector
- 6 Temperature probe.

More Information

- [Dimensions \(page 64\)](#)
- [Operating Principle of H₂O₂ Measurement \(page 17\)](#)
- [Installation \(page 23\)](#)
- [Wiring \(page 25\)](#)

2.2 Basic Features and Options

- Vaisala PEROXCAP® H₂O₂ measurement technology with excellent long-term stability.
- Vaporized H₂O₂ measurement range 0 ... 2000 ppm.
- Relative saturation (RS) measurement range 0 ... 100 %RS.
- Relative humidity (RH) measurement range 0 ... 100 %RH.
- Temperature (T) measurement range +5 ... +70 °C.
- Robust design allowing the probe to be installed directly in the process environment. When powered on, the probe withstands H₂O₂ and H₂O 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.
- Chemical purge for optimized performance and lifetime.
- Pressure compensation for H₂O₂ concentration (ppm), H₂O concentration (ppm), and relative saturation (%RS) 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 H₂O₂ vapor.
- Can be used as a stand-alone probe or with Vaisala Indigo 200 series transmitters.
- Can be connected to Vaisala Insight software for calibration and adjustment, configuration, diagnostics, and temporary online monitoring.

More Information

- [Technical Data \(page 60\)](#)

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 ₂ O ₂	ppm	Parts per million value is a unit of H ₂ O ₂ concentration per amount of air in volume fraction in units ppmv or m ³ /m ³ .
Relative saturation (RS) (H ₂ O + H ₂ O ₂)	RS	%RS	Relative saturation is a parameter that indicates the humidity value derived from the combination of water and hydrogen peroxide vapor. Relative saturation tells how close the measured environment is from the condensation point at given H ₂ O ₂ vapor concentration.
Relative humidity (RH) (H ₂ O)	RH	%RH	Relative humidity is a measure of water vapor only.
Temperature	T	°C	

Parameter	Abbreviation	Unit	Description
Absolute hydrogen peroxide	a (H ₂ O ₂)	mg/m ³	Absolute H ₂ O ₂ concentration is defined as the mass of H ₂ O ₂ vapor in a certain volume.
Absolute humidity (H ₂ O)	a	g/m ³	Absolute humidity is defined as the mass of water vapor in a certain volume.
Water concentration by volume	H ₂ O	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 .
H ₂ O + H ₂ O ₂ dew point temperature	T _d (H ₂ O + H ₂ O ₂)	°C	Dewpoint 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 ₂ O ₂ vapor, the actual dewpoint is dependent on the amount of both water and H ₂ O ₂ vapor, and it differs from the dewpoint measured with a traditional humidity sensor.
H ₂ O ₂ vapor pressure	P (H ₂ O ₂)	hPa	Hydrogen peroxide vapor pressure is a partial pressure of a gas that is a measure of thermodynamic activity of the gas's molecules.
Water vapor pressure	P _w	hPa	Water vapor pressure is a partial pressure of a gas that is a measure of thermodynamic activity of the gas's molecules.

Parameter	Abbreviation	Unit	Description
Water vapor saturation pressure	P_{ws}	hPa	Water vapor saturation pressure tells the maximum vapor pressure of pure water at certain temperature. At saturation vapor pressure, water is in thermodynamic equilibrium, hence its liquid and solid phases are in equilibrium.
Water vapor saturation pressure ($H_2O + H_2O_2$)	$P_{ws} (H_2O + H_2O_2)$	hPa	Water vapor saturation pressure in H_2O_2 environment tells the maximum water vapor pressure when H_2O_2 vapor is present. This parameter is dependent on temperature and H_2O_2 vapor concentration.

The probe provides both digital and analog outputs.

- In digital output mode, the probe outputs all the measurement parameters.
- 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 Insight software and via Modbus. The probe is also compatible with Vaisala Indigo transmitters, which provide the option of three analog output channels.

More Information

- [Understanding Relative Humidity and Relative Saturation \(page 12\)](#)
- [Measurement Data Registers \(page 68\)](#)
- [Configuration Registers \(page 70\)](#)
- [Connectivity to Vaisala Insight Software \(page 15\)](#)
- [Setting Probe in Analog or Digital Mode \(page 27\)](#)

2.5.1 Understanding Relative Humidity and Relative Saturation

Water and hydrogen peroxide have a very similar molecular structure, and they both affect the humidity of the air in which they are present. HPP272 measurement makes a difference between the humidity caused by both H_2O_2 vapor and water vapor, and the humidity caused only by water vapor:

- *Relative saturation* is a parameter that indicates the humidity of the air caused by both H_2O_2 vapor and water vapor. When relative saturation reaches 100 %RS, the vapor mixture starts to condense.
- *Relative humidity* is a parameter that indicates the humidity of the air caused only by water vapor.

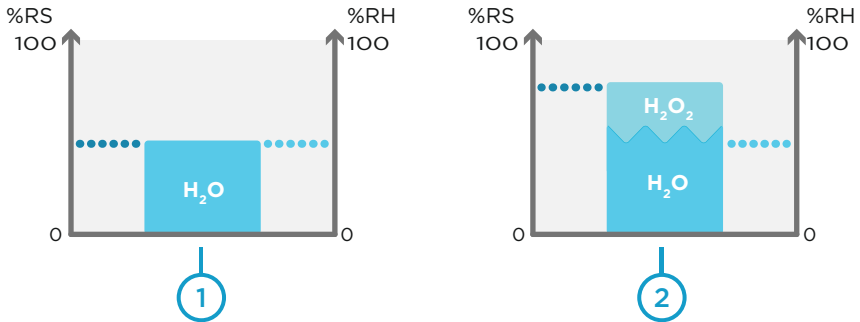


Figure 2 Effect of H_2O and H_2O_2 on relative saturation (RS) and relative humidity (RH)

- 1 Space without H_2O_2 vapor. When H_2O_2 vapor is not present, relative saturation equals relative humidity.
- 2 Same space with H_2O_2 vapor introduced. Relative saturation is higher than relative humidity.

During H_2O_2 bio-decontamination processes, it is often important to monitor the possibility of condensation. For this purpose, it is not enough to know the level of relative humidity (RH), because RH only indicates the humidity caused by water vapor. The possibility of condensation is affected by the combined humidity of H_2O_2 vapor and water vapor, which is why you need to monitor relative saturation (RS).

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 \(page 54\)](#)

2.7 Chemical Purge

Chemical 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 H₂O₂ environments. During the purge, H₂O₂ and H₂O measurements are not available.

The purge is automatically performed:

- At probe start-up.
- After an RH for H₂O₂ 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 H₂O₂ is present or ambient humidity is not steady.



If required, you can also enable purge during H₂O₂ 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 H₂O₂.

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 \(page 34\)](#)
- [Operation in Analog Mode \(page 30\)](#)

2.8 Environmental Compensation for Pressure

When necessary, you can apply pressure compensation to improve the measurement accuracy of the probe (probe software v.1.1.0 and later). 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, or an Indigo 200 transmitter.

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

Pressure compensation affects the following parameters:

- H₂O₂ concentration (ppm)
- H₂O concentration (ppm)
- Relative saturation (%RS)

More Information

- [Vaisala Insight Software \(page 40\)](#)
- [Configuration Registers \(page 70\)](#)

2.9 Measurement Filtering Factor

You can set a filtering factor that affects the speed at which the latest H₂O₂ and RS 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, or an Indigo 200 transmitter.

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 \(page 70\)](#)

2.10 Connectivity to Vaisala Insight Software

The probe can be connected to Vaisala Insight software using a Vaisala USB cable (no. 242659). With the Insight software, you can:

- Calibrate and adjust the measurement.
- 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 \(page 40\)](#)

2.11 Additional Features with Indigo Transmitters

HPP272 probes starting from serial number P3940796 require Vaisala Indigo transmitter software version 1.4.0 or above. HPP272 probes with an earlier serial number are compatible with Indigo transmitters starting from Indigo software version 1.3.2. Connecting the probe to an Indigo transmitter provides a range of additional options for outputs, measurement viewing, status monitoring, and configuration interface access.

Examples of additional features available with Indigo transmitters include:

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

The selection of available additional features (for example, output and connectivity options) varies depending on the Indigo transmitter model. For more information on Indigo transmitters, see www.vaisala.com/indigo.

More Information

- [Indigo Overview \(page 35\)](#)

3. H₂O₂ Measurement

3.1 Operating Principle of H₂O₂ Measurement



CAUTION! When there is H₂O₂ 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 H₂O₂ conditions, maintains measurement performance, and lengthens the probe's lifetime. When the probe is powered off, exposure to H₂O₂ condensation can break the PEROXCAP sensor 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 H₂O₂ 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 H₂O₂ from the vapor mixture. Therefore, the HUMICAP sensor with this layer only senses water vapor, providing a measurement of partial water pressure, i.e. relative humidity (RH). 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 H₂O₂.

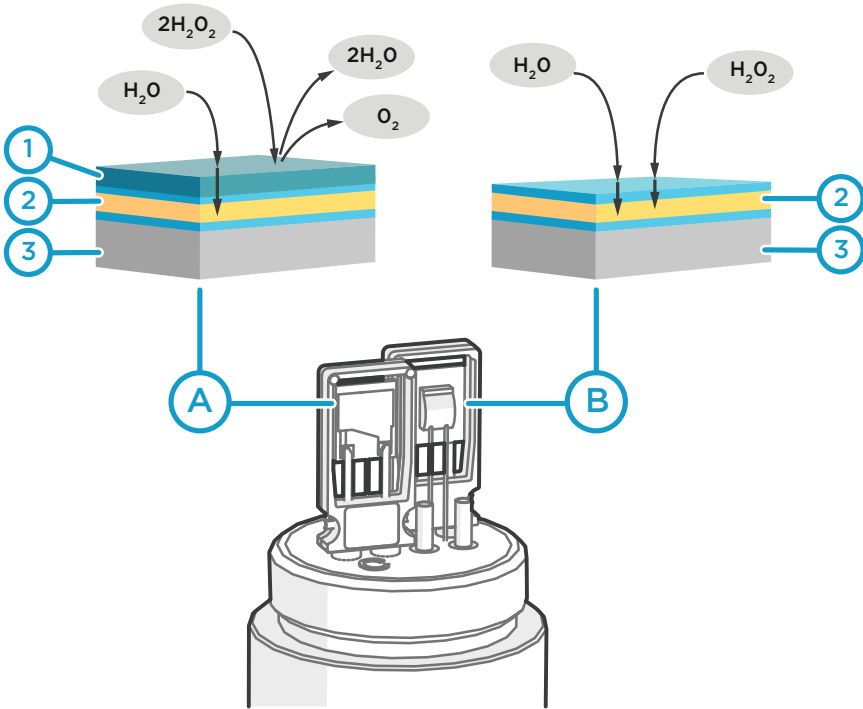


Figure 3 Operating principle of PEROXCAP measurement

- 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.

In addition to measuring vaporized H_2O_2 concentration, HPP272 provides measurement for relative saturation, relative humidity, and temperature. Relative humidity (RH) is a parameter that indicates the humidity value derived from water vapor only, whereas relative saturation (RS) indicates the humidity percentage derived from water vapor and H_2O_2 vapor together.

When relative saturation reaches 100 %RS, the vapor mixture starts to condense.

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 pharmaceuticals 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 H₂O₂ 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 H₂O₂ mixture is introduced into the space to be bio-decontaminated.
3. Decontamination, where H₂O₂ concentration is maintained at a desired level for a certain time.
4. Aeration, where H₂O₂ is removed from the bio-decontaminated space.

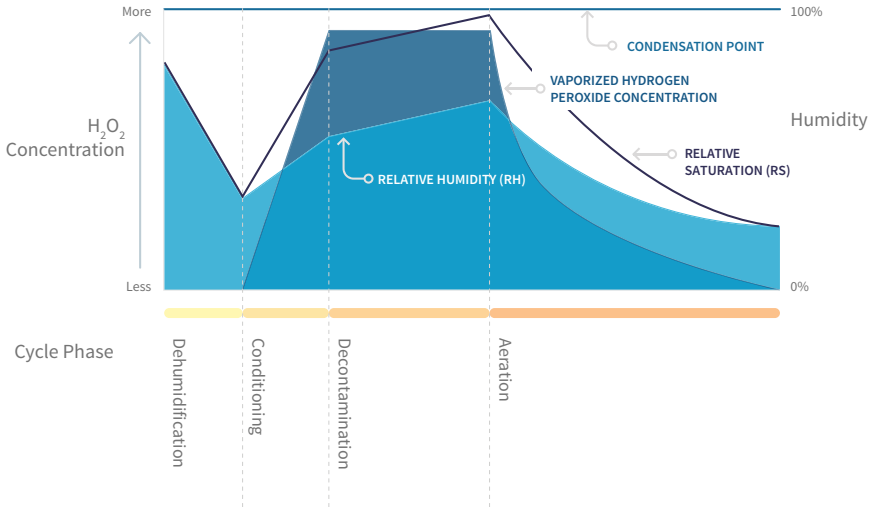


Figure 4 Example behavior of H₂O₂ concentration, relative saturation (RS), and relative humidity (RH) in a vaporized H₂O₂ bio-decontamination cycle (non-condensing conditions)

In the non-condensing bio-decontamination cycle example shown in [Figure 4 \(page 20\)](#):

- In the *dehumidification* phase, RH (and RS) decreases.
- When the *conditioning* phase starts, H₂O₂ concentration rises rapidly. There is also a rapid increase in RS, which indicates the humidity caused by both H₂O₂ vapor and water vapor. Because the generated H₂O₂ vapor is typically mixed with water vapor, RH also starts to rise.
- In the *decontamination* phase, H₂O₂ 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, H₂O₂ concentration, RS, and RH all decrease. When H₂O₂ concentration is zero, RS equals RH.

The way your bio-decontamination process is designed affects which parameters you want to measure in different phases.

Depending on your bio-decontamination process, you may also want to either create or avoid condensation during the conditioning and decontamination phases. In these phases, the air in the bio-decontaminated space always contains both water and H₂O₂ vapor, which both affect the possibility of condensation. To monitor and control whether and when condensation forms, it is useful to know the *combined* humidity level of water vapor and H₂O₂ vapor: relative saturation (RS). When relative saturation reaches 100 %RS, the vapor mixture starts to condense.

For condensation monitoring, choosing the right measurement location is very important. If the bio-decontaminated space has surfaces with a lower temperature than where RS is measured, condensation may start to form on those surfaces even before RS reaches 100 %RS in the exact measurement location. To monitor the possibility of condensation, consider installing the probe close to a surface where you suspect condensation may form.

More Information

- [Understanding Relative Humidity and Relative Saturation \(page 12\)](#)
- [Installation \(page 23\)](#)

3.3 Condensation Monitoring

H₂O+H₂O₂ vapor mixture starts to condense when relative saturation (RS) reaches 100 %RS.

RS level is strongly affected by temperature: decreasing the temperature increases RS. If there are temperature differences in the bio-decontaminated space, RS varies in different parts of that space even if the H₂O+H₂O₂ vapor is evenly distributed.

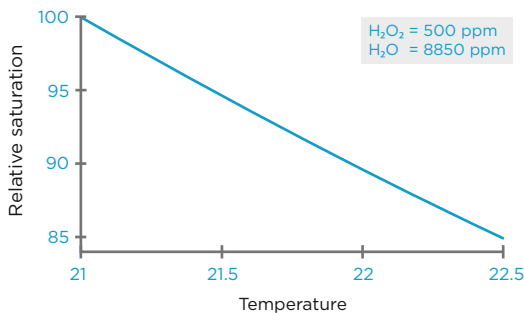


Figure 5 Example: RS behavior in different temperatures when H₂O₂ concentration (500 ppm) and H₂O concentration (8850 ppm) are constant

For condensation monitoring, this means that even if you measure < 100 %RS in one point, RS may be 100 %RS in another, cooler point. The following figure shows an example of how RS can vary in a decontaminated space according to temperature differences.

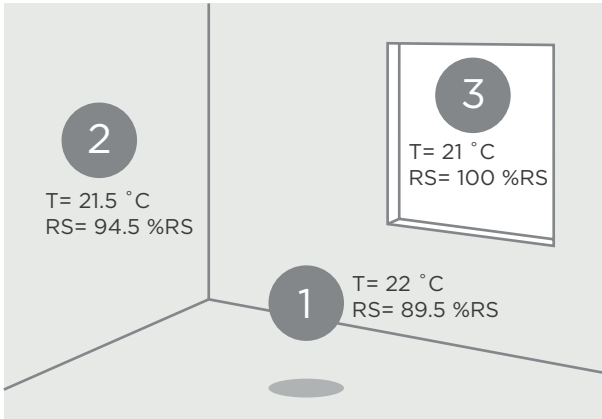


Figure 6 Decontaminated space with different temperatures and RS levels (H_2O_2 and H_2O concentration evenly distributed)

- 1 Center of the decontaminated space. The center is **warmer** than the wall and the window, and the RS level is lower.
- 2 Wall of the decontaminated space. Because the wall is 0.5 °C **cooler** than the center of the space, RS level is higher than in the center.
- 3 Window of the decontaminated space. The window is 1 °C **cooler** than the center of the space, and RS = 100 %RS. Condensation starts to form on the window surface.

Condensation forms typically on surfaces, and first on surfaces that are cooler than the surrounding air, such as:

- Walls
- Windows
- Supplies that have just been brought in the decontaminated space

To monitor the possibility of condensation by measuring RS, it is recommended to measure as close as possible to places where condensation might occur.

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:
 - Heat sources
 - 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.

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.

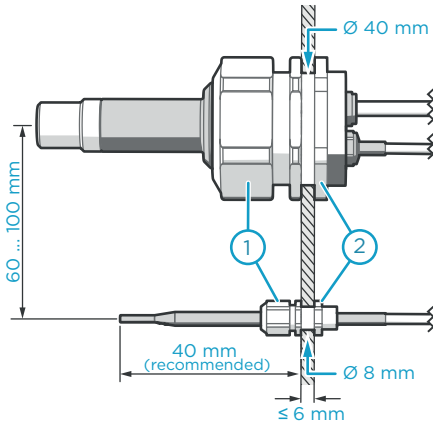
Accurate relative humidity (RH) and relative saturation (RS) measurement requires both humidity and temperature data from the same environment. Install the main body of the probe (H_2O_2 and humidity measurement) and the attached temperature probe in the same measurement environment, approximately 6 ... 10 cm apart from each other, so that the conditions are the same for both elements. Do not install the temperature probe directly above the H_2O_2 and humidity probe, as moderate heat rising up from the H_2O_2 and humidity probe body may affect the ambient temperature around the temperature probe.



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



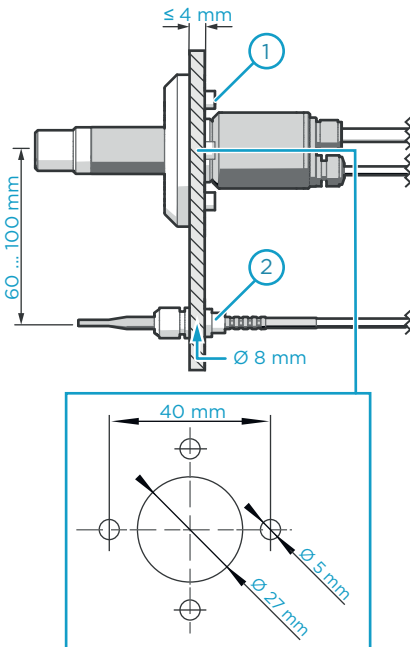
A through-wall installation is recommended especially in very harsh processes.

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

The figure shows an example installation using Vaisala spare part glands (HPP272MOUNTINGSET1).

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

Example: Installation Through a Wall, Flange Option

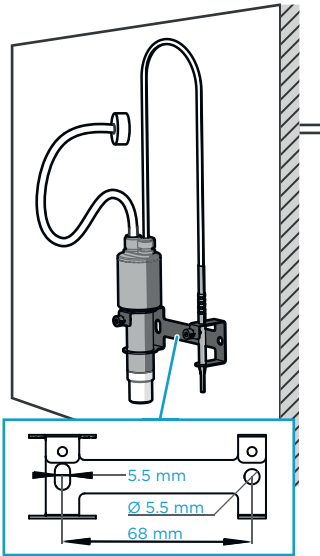


The figure shows an example installation using Vaisala spare part flange (HPP272MOUNTINGSET2), including the drilling dimensions for the flange.

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

- 1 Screws for tightening the flange in place (4 pcs, \varnothing 5 mm)
- 2 Nut for mounting the gland

Example: Installation Entirely in Process Environment



Mount the H₂O₂ and humidity probe from the probe body.

Mount the temperature probe from the metal body. Note that the temperature sensor is at the tip of the temperature probe.

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.

4.1 Wiring

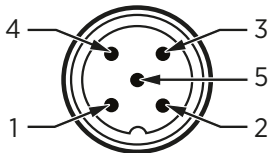


Figure 7 Probe M12/5 Pins

Pin #	Function	Notes	Wire Color ¹⁾
1	Power supply	With digital output: 15 ... 30 VDC With analog output: 15 ... 25 VDC 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

Pin #	Function	Notes	Wire Color ¹⁾
4	RS-485+ or analog output 1	Current output: 4...20 mA ³⁾	Black
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.

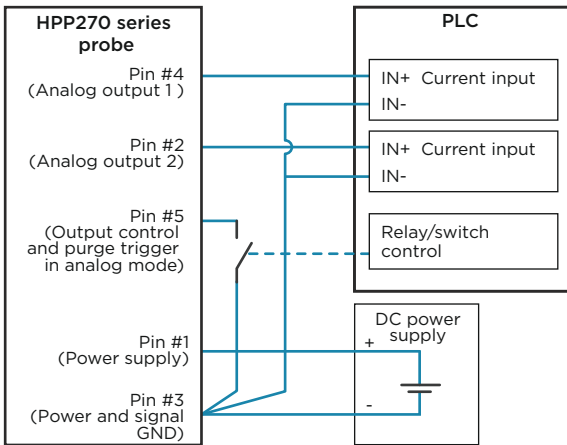


Figure 8 Wiring Example for Connecting the Probe to a PLC in Analog Mode

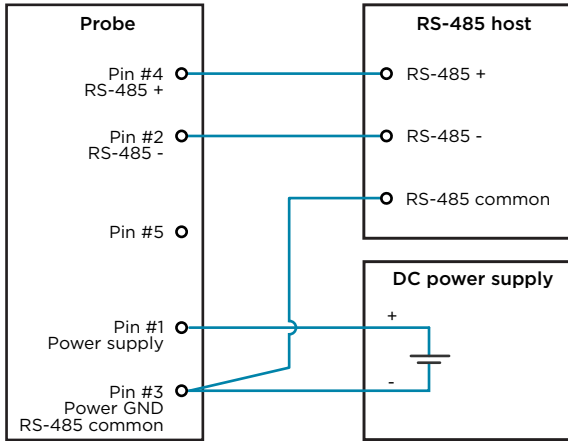


Figure 9 Wiring Example for RS-485 Connection (Modbus Communication)

More Information

- [Accessories \(page 64\)](#)
- [Triggering Purge in Analog Mode \(page 34\)](#)

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.

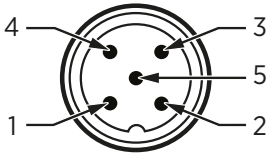


Figure 10 Pins on the M12 male connector

- ▶ 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, relative humidity, and relative saturation 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 \(page 29\)](#)

5.2 Behavior at Exposure to H₂O₂



CAUTION! When there is H₂O₂ 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 H₂O₂ conditions, maintains measurement performance, and lengthens the probe's lifetime. When the probe is powered off, exposure to H₂O₂ condensation can break the PEROXCAP sensor within a day, and the sensor will not recover.

When the bio-decontamination process starts and the probe is exposed to H₂O₂, the probe's H₂O₂ concentration reading changes to > 0 ppm after approximately 20 ... 30 seconds. This time is included in the response time of the probe.

5.3 H₂O₂ Concentration Reading When Not Exposed to H₂O₂

The PEROXCAP sensor consists of two humidity sensors that have a minor difference in behavior when the humidity level changes. Because of this difference, the H₂O₂ concentration reading may vary slightly (typically 0 ... 3 ppm) when the probe is not exposed to H₂O₂. This variation is normal and does not require any actions. If needed, you can hide the variation by setting a low clipping limit with the Vaisala Insight software, Modbus configuration register 030C_{hex}, or an Indigo 200 transmitter. For example, if you set the low clipping limit to 3 ppm, any reading < 3 ppm is clipped to show 0 ppm.

More Information

- [Vaisala Insight Software \(page 40\)](#)
- [Configuration Registers \(page 70\)](#)

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 \(page 66\)](#)
- [Setting Probe in Analog or Digital Mode \(page 27\)](#)
- [Wiring \(page 25\)](#)

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 Insight software 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 chemical 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 \(page 27\)](#)
- [Analog Output Error State \(page 58\)](#)
- [Configuration Registers \(page 70\)](#)
- [Chemical Purge \(page 14\)](#)

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.

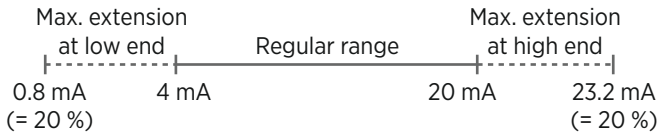


Figure 11 Maximum extensions to analog output range

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 \(page 58\)](#)

5.5.2 Analog Output Overage Examples

Consider a probe with one of the analog output channels (4 ... 20 mA) configured to output H₂O₂ 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 H₂O₂ 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 H₂O₂ concentration rises above 2100 ppm, the output still remains at 20.8 mA. If the H₂O₂ concentration rises above 2200 ppm, the output enters the error state (by default, 3.6 mA).

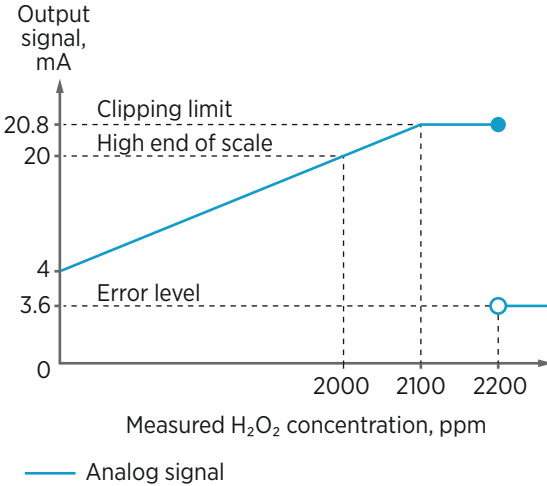


Figure 12 Analog output overrange example with clipping and error limits

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 H₂O₂ 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 H₂O₂ concentration rises above 2100 ppm, the output still remains at 20.8 mA.

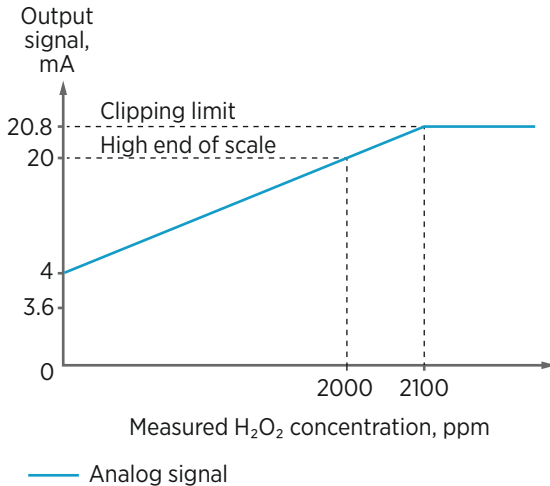


Figure 13 Analog output overrange example with clipping only

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 H₂O₂ 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).

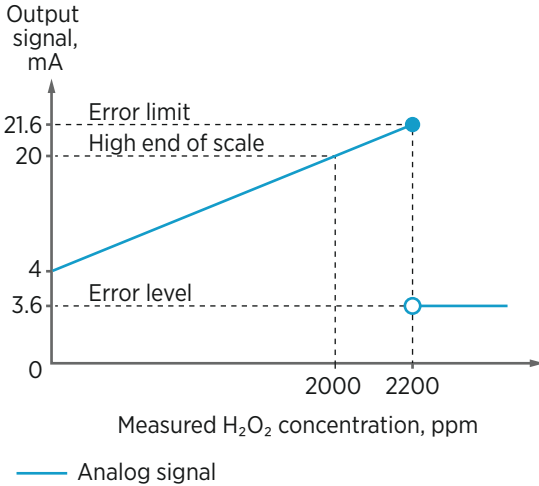



Figure 14 Analog output overrange example with no clipping, only error state when error limit is exceeded

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 8 \(page 26\)](#).

- ▶ 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.

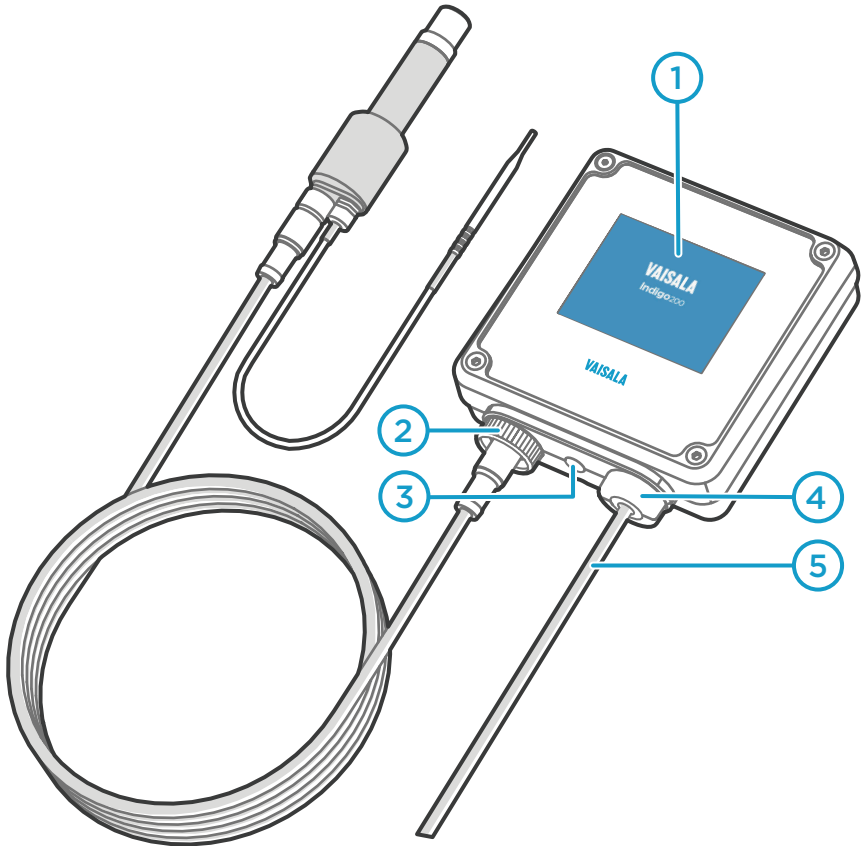
The probe starts performing the purge. The duration of the purge is approximately 4 minutes. During the purge, hydrogen peroxide, relative saturation, and relative humidity measurements are not available.

More Information

- ▶ [Chemical Purge \(page 14\)](#)

5.6 Using Probe with Indigo Transmitters

5.6.1 Indigo Overview



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

The probe can be connected to Vaisala Indigo transmitters by using a cable.

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

The selection of available additional features (for example, output and connectivity options) varies depending on the Indigo transmitter model. Depending on the model, a display is available as an optional selection or as a standard feature. In the non-display model, an LED indicator is used for notifications.

5.6.1.1 Wireless Configuration Interface Overview

The wireless configuration interface has two user levels:

- All users have view-only access (no configuration rights, not password protected).
- Personnel that carry out configuration tasks can log in with an administrative password that allows changing the transmitter and probe settings.

To use the wireless configuration interface to modify the settings of your Indigo transmitter and the connected probe, you must first enable the transmitter's wireless connection and then connect to Indigo with your mobile device or computer. Most major browsers (for example, Firefox, Chrome, Safari, and Internet Explorer) are supported: using the most recent version is recommended.

5.6.2 Attaching Probes

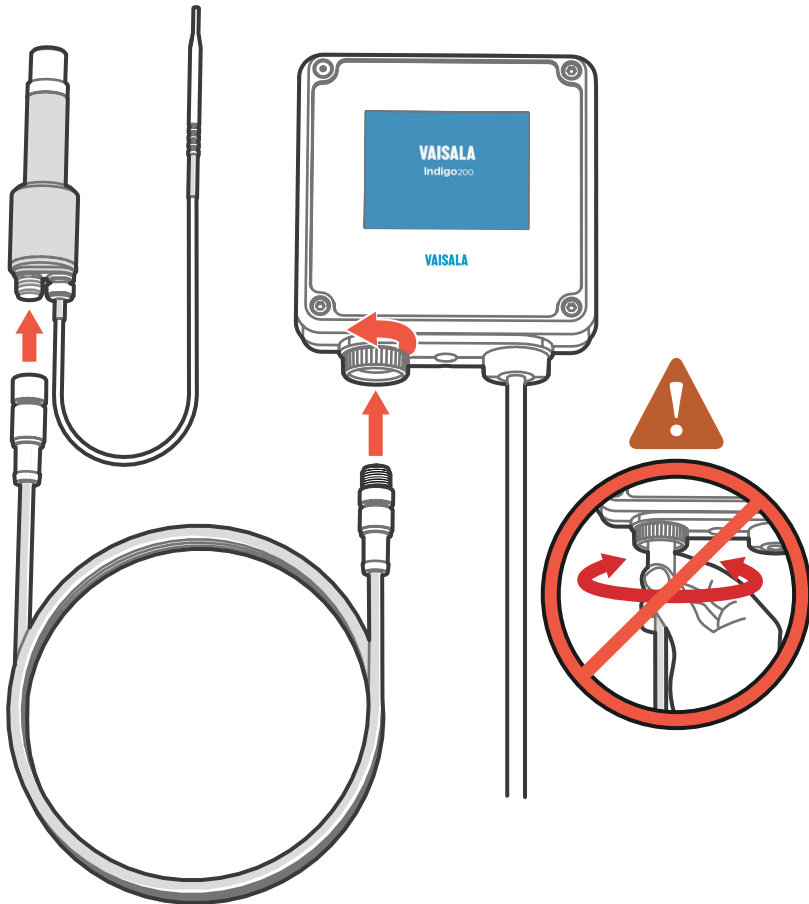


Figure 15 Attaching Probes to Indigo

- ▶ 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.

5.6.3 Connecting to Wireless Configuration Interface



Figure 16 Enabling and Accessing Indigo's Wireless Configuration Interface

- 1 Wireless connection activation button
- 2 Wireless connection indicator (WLAN symbol) on the Indigo display
- 3 Choose Indigo (**Indigo_ID[xx]**) from your wireless device's list of available connections

To connect to the wireless configuration interface:

- ▶ 1. Press the wireless connection activation button on the bottom of the transmitter.
2. When the wireless configuration interface becomes available, the Indigo display shows a connection notification. In the Indigo models with an LED indicator, the LED blinks green when the connection is active.
3. Open the wireless connection menu in your mobile device or computer and select **Indigo_ID[xx]** (transmitter-specific SSID) from the list of available connections.
4. Depending on your device, the wireless configuration interface either launches automatically in your browser after you connect to Indigo, or you may need to start your browser application manually.
5. When you open the Indigo interface in your browser, you are prompted to log in.



Only one device can be connected to the wireless configuration interface at a time.

5.6.4 Logging in to Wireless Configuration Interface

Figure 17 Indigo Login View

When you open Indigo’s wireless configuration interface in your browser, you are prompted to log in. There are 2 available user levels:

- **User:** view-only access available for all users. Does not require a password.
- **Admin:** password-protected access. To change settings, you must log in as admin.

To log in:

- ▶ 1. Enter the user name and password:
 - a. To log in as user (view-only access, no configuration rights), select **User** from the **User name** dropdown. Leave the **Password** field empty.
 - b. To log in as admin (required for configuration), select **Admin** in the **User name** dropdown and type the admin password (default: **12345**) in the **Password** field.
2. Select **Log in** after entering the login credentials. The wireless configuration interface opens in the **Measurements** view.



The user level (**User** or **Admin**) is shown in the upper right corner of all menu views.
Select the user/admin icon in the upper right corner to change the user level.

6. Vaisala Insight Software

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

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.
- 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 (no. 242659).

6.1 Connecting to Insight Software



- Computer with Vaisala Insight software installed
- USB connection cable (no. 242659)

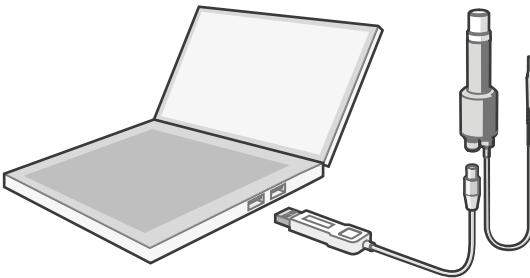


Figure 18 Connecting Probe to Insight

- ▶ 1. Open the 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.

7. Maintenance

7.1 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 **H₂O₂ and humidity probe body and temperature probe body and cable** by wiping them 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 chemical purge.

7.1.1 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 C₂H₆OS).

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

More Information

- [Chemical Purge \(page 14\)](#)
- [Triggering Purge in Analog Mode \(page 34\)](#)

7.2 Sensor Vitality Information in Insight

Due to the stresses of the H₂O₂ 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 H₂O₂ 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 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 30 %.

More Information

- [Vaisala Insight Software \(page 40\)](#)

7.3 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



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**.

7.3.1 Field Calibration and Adjustment Overview

HPP272 has the following field calibration and adjustment options:

- H₂O₂ measurement calibration and adjustment with relative humidity (RH) references (for example, Vaisala HMK15 Humidity Calibrator)
- H₂O₂ measurement calibration and adjustment in H₂O₂ vapor
- Temperature measurement calibration and adjustment using 1 or 2 references



The accuracy of field calibration and adjustment, with either RH references or in H₂O₂ 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.

RH for H₂O₂ Adjustment

The PEROXCAP sensor comprises 2 HUMICAP humidity sensors that are used to calculate the H₂O₂ measurement. Because the H₂O₂ 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 H₂O₂ measurement.

H₂O₂ Adjustment in H₂O₂ Vapor

You can also calibrate and adjust the probe directly in H₂O₂ vapor. Note that calibration in H₂O₂ 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.

Temperature Adjustment

Temperature calibration and adjustment for the probe is a simple 1- or 2-point adjustment.

7.3.2 RH for H₂O₂ 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.

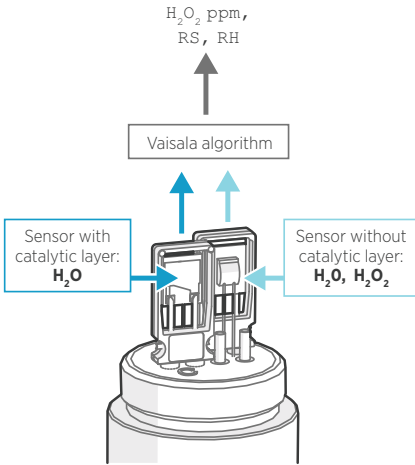


Figure 19 PEROXCAP Operating Principle

Because the PEROXCAP sensor consists of humidity sensors, you can calibrate and adjust the probe's H₂O₂ and humidity measurements with relative humidity. Vaisala algorithm transforms the observations from the humidity sensors into measurement readings: H₂O₂ concentration, relative humidity (RH), and relative saturation (RS). Any drift in the humidity sensors shows as drift in the measurement readings. Therefore, removing the drift from the humidity sensors with calibration and adjustment improves H₂O₂ measurement performance.

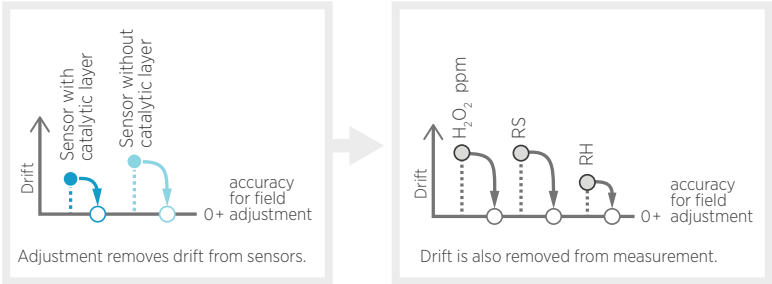



Figure 20 Adjustment removes drift

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 H₂O₂ and in certain measurement calculations. In normal measurement, the PEROXCAP sensor is heated to allow it to be used in condensing H₂O₂ conditions, which sets limitations for the use of the internal temperature sensors. For this reason, HPP272 uses an external temperature sensor for temperature-dependent RH and RS measurements. During RH for H₂O₂ calibration, however, the probe switches into a calibration mode that temporarily turns off the sensor heating.

 **CAUTION!** Do not expose the probe to H₂O₂ vapor when the probe is in calibration mode and sensor heating is off. Exposure to H₂O₂ condensation can break the PEROXCAP sensor within a day, and the sensor will not recover.


Calibrating and adjusting relative humidity also calibrates and adjusts H₂O₂ measurement (H₂O₂ concentration and relative saturation).

RH calibration and adjustment for H₂O₂ 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.

7.3.3 Adjusting RH for H₂O₂ with Insight Software

 • Computer with Windows operating system and Vaisala Insight software installed

- Vaisala USB cable 242659 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 break the PEROXCAP sensor 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 \(page 40\)](#).
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 and T** is selected.
6. Open the tab **RH for H2O2 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. Check the measurement errors of RH, RS and H_2O_2 concentration.
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.

7.3.4 Adjusting RH for H₂O₂ with Indigo 200 Transmitter



- Indigo 200 transmitter and connection cable
- 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 H₂O₂ vapor when the probe is in calibration mode and sensor heating is off. Exposure to H₂O₂ condensation can break the PEROXCAP sensor 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 (see [Attaching Probes \(page 37\)](#)).
3. Perform a chemical purge, or wait for the start-up purge to finish.
4. Start the calibration mode with the **Start calibration** button.
5. Select **RH and T** from the **Calibration mode** dropdown.

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

RH for H₂O₂ adjustment

Reference value, point 1 %RH

Measured value, point 1 %RH

Reference value, point 2 %RH

Measured value, point 2 %RH

Activate adjustment

Restore factory adjustment

Measured temperature, point 1 °C

Measured temperature, point 2 °C

RH error, point 1 %RH

RS error, point 1 %RS

RH error, point 2 %RH

RS error, point 2 %RS

H₂O₂ error @500 ppm ppm


- Insert the probe head in the first reference environment.
- 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.
- 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.
- Repeat steps [step 7](#) ... [step 9](#) for calibration point 2 (wet point, recommendation 65 ... 85 %RH).
- Check the measurement errors of RH, RS and H₂O₂ concentration.
- Select **Activate adjustment** to store the adjustment in the probe.
- Close the calibration mode with the **Stop calibration** button.

7.3.5 Adjusting H₂O₂ 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 H₂O₂ vapor chamber that can produce a stable H₂O₂ 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 242659 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 **H2O2**.



CAUTION! It is very important to select **H2O2** 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 H₂O₂ vapor.

6. Open the **H2O2 adjustment** tab.
7. Expose your probe and the reference probe to H₂O₂ vapor and wait for the ambient H₂O₂ 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 H₂O₂ concentration readings of both probes to see when the measurement has stabilized.
9. When the measurement has stabilized, check the H₂O₂ 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.

7.3.6 Adjusting H_2O_2 with Indigo 200 Transmitter



- Indigo 200 transmitter and connection cable
- 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 (see [Attaching Probes \(page 37\)](#)).
3. Perform a chemical purge, or wait for the start-up purge to finish.
4. Open the calibration menu and start the calibration with the **Start calibration** button.
5. Select **H2O2** from the **Calibration mode** dropdown.



CAUTION! It is very important to select **H2O2** 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.

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

H₂O₂ adjustment

Reference value, point 1 ppm

Measured value, point 1 ppm

- Wait until the ambient H₂O₂ concentration has reached the desired calibration and adjustment level. Monitor the H₂O₂ readings of both probes and allow the measurements to stabilize fully.
- When the measurements have stabilized, check the H₂O₂ 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.
- Select **Activate adjustment** to store the adjustment in the probe.
- Close the calibration mode with the **Stop calibration** button.


7.3.7 Adjusting Temperature with Insight Software



- Computer with Windows operating system and Vaisala Insight software installed
- Vaisala USB cable 242659 for connecting the probe
- One or two known and stable temperature references



CAUTION! Do not expose the probe to H₂O₂ vapor when the probe is in calibration mode and sensor heating is off. Exposure to H₂O₂ condensation can break the PEROXCAP sensor within a day, and the sensor will not recover.

- Make sure you have completed the RH for H₂O₂ calibration and adjustment.
- Prepare the temperature calibrator equipment for temperature calibration point 1.
- Connect the probe to Insight. See [Connecting to Insight Software \(page 40\)](#).
- Wait for the start-up purge to finish.
- 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.
- Open the tab **Temperature adjustment**.

7. Insert the probe head in the reference environment for calibration point 1.
8. Wait for the measurement to stabilize fully. This may take more than 30 minutes. Monitor the readings to see when the measurement has stabilized.
9. 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.
10. If you want to perform a two-point calibration and adjustment, repeat steps [step 7](#) ... [step 9](#) for calibration point 2.
11. Check the difference between each reference and measured value. Very large differences 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.

7.3.8 Adjusting Temperature with Indigo 200 Transmitter



- Indigo 200 transmitter and connection cable
- One or two known and stable temperature references



CAUTION! Do not expose the probe to H₂O₂ vapor when the probe is in calibration mode and sensor heating is off. Exposure to H₂O₂ condensation can break the PEROXCAP sensor within a day, and the sensor will not recover.

- ▶ 1. Make sure you have completed the RH for H₂O₂ calibration and adjustment.
2. Prepare the temperature calibrator equipment for temperature calibration point 1.
3. Connect the probe to the Indigo transmitter (see [Attaching Probes \(page 37\)](#)).
4. Perform a chemical purge, or wait for the start-up purge to finish.
5. Start the calibration mode with the **Start calibration** button.

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

T adjustment

Reference value, point 1 °C

Measured value, point 1 °C

Reference value, point 2 °C

Measured value, point 2 °C

Activate adjustment

Restore factory adjustment

- Insert the probe head in the first reference environment.
- Wait for the measurement to stabilize fully. This may take more than 30 minutes. Monitor the readings to see when the measurement has stabilized.
- 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.
- If you want to perform a two-point calibration and adjustment, repeat steps [step 7](#) ... [step 9](#) for calibration point 2.
- Check the difference between each reference and measured value. Very large differences may be due to insufficient stabilization time or unsuitable calibration setup.
- Select **Activate adjustment** to store the adjustment in the probe.
- Close the calibration mode with the **Stop calibration** button.

8. Troubleshooting

8.1 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 \(page 77\)](#)).

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. <ul style="list-style-type: none"> • 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 chemical 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 Indigo 200 transmitter to disable the filtering factor (set filtering factor to "1"), and check the measurement again. See: <ul style="list-style-type: none"> • Measurement Filtering Factor (page 15) • Vaisala Insight Software (page 40) • Configuration Registers (page 70)
The ambient temperature has changed quickly, which may result in a slower change in RH reading.	No actions required.

Problem: H ₂ O ₂ or humidity 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.

Problem: H ₂ O ₂ or humidity 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 Software (page 40)).
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 Software (page 40)). Consider changing the analog output error level to be outside the measurement scale.

Problem: Measurement reading appears incorrect.	
Possible Cause:	Solution:
The temperature probe is installed near a heat source or too close to the H ₂ O ₂ and humidity probe.	Change the location of temperature probe. See Installation (page 23) for recommended installation locations.
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 chemical purge.
The filter is blocked or dirty.	Change the filter. Be careful not to touch the sensors when the filter is off the probe.
Condensation has formed on the sensor when the probe was powered off.	When the probe is powered off, exposure to H ₂ O ₂ condensation can break the PEROXCAP sensor within a day, and the sensor will not recover. When the probe is powered on, the heated sensor withstands condensing H ₂ O ₂ conditions. A sensor damaged with H ₂ O ₂ condensation during power-off time cannot be repaired.

Problem: Measurement reading appears incorrect.	
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.	<p>Do not use the probe if the filter is broken. Remove the filter and visually check the sensors:</p> <ul style="list-style-type: none"> • If the sensors are bent, broken, or disconnected, contact Vaisala technical support. • If the sensors are intact, change the filter. <p>Be careful not to touch the sensors when the filter is off the probe.</p>
In analog mode: Maximum load has been exceeded.	Check the analog output load, and reduce it to the specified maximum load or less. See Table 6 (page 62) for the permitted maximum load.
Ambient pressure is not normal atmospheric pressure.	Check the ambient pressure. See Table 8 (page 63) 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 42) .

Problem: The filter is wet.	
Possible Cause:	Solution:
Sprayed water has entered the filter when cleaning the probe.	<p>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.</p> <p>Be careful not to touch the sensors when the filter is off the probe.</p> <p>Perform a chemical purge.</p>

Problem: The filter is broken.	
Possible Cause:	Solution:

Problem: The filter is broken.	
The probe has fallen or an object has hit the filter.	<p>Do not use the probe if the filter is broken. Remove the filter and visually check the sensors:</p> <ul style="list-style-type: none"> • If the sensors are bent, broken, or disconnected, contact Vaisala technical support. • If the sensors are intact, change the filter. <p>Be careful not to touch the sensors when the filter is off the probe.</p>

Problem: H₂O₂ concentration reading shows > 0 ppm even though the probe is not exposed to H₂O₂.	
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 ₂ O ₂ concentration has drifted.	The intelligent measurement algorithm can correct errors of < 30 ppm by itself when the probe is not exposed to H ₂ O ₂ . Keep the probe powered on for a few hours in a stable temperature and RH, not exposed to H ₂ O ₂ .

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 25) .
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 Table 6 (page 62) for the correct voltage.
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.	<p>Check the communication settings. You can check the probe's communication settings with the Insight software. See</p> <ul style="list-style-type: none"> • Vaisala Insight Software (page 40)

Problem: In analog mode, there is no output signal (signal level is 0 mA).	
Possible Cause:	Solution:

Problem: In analog mode, there is no output signal (signal level is 0 mA).	
Pin #5 was floating at start-up or reset, which means the probe is in digital mode.	Check pin #5. See Wiring (page 25) .
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: <ul style="list-style-type: none"> • Vaisala Insight Software (page 40) • Configuration Registers (page 70)
Probe wiring is incorrect.	Check the probe wiring and correct it if needed. See Wiring (page 25) .
The operating voltage is incorrect.	Check the operating voltage and correct if needed. See Table 6 (page 62) 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.
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 Software (page 40)).

Problem: At start-up in analog mode, the probe remains in the error state for over 5 minutes.	
Possible Cause:	Solution:
The analog output scaling is unsuitable. For example, the scale 0 ... 5 %RH is too narrow compared to the full measurement scale of RH.	Check the analog output scaling with the Insight software and correct the scaling if needed (see Vaisala Insight Software (page 40)).
There is a probe or sensor error.	Check the probe diagnostics with the Insight software (see Vaisala Insight Software (page 40)).

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 25) .

8.2 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 \(page 70\)](#)

9. Technical Data

HPP272

Table 5 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 ₂ O ₂	±10 ppm
up to 1000 ppm H ₂ O ₂	±15 ppm
Accuracy (including non-linearity, hysteresis, and repeatability) at +10 ... +25 °C (+50 ... +77 °F), 10 ... 2000 ppm H ₂ O ₂	±10 ppm or 5 % of reading (whichever is greater)
Factory calibration uncertainty, at +25 °C (+77 °F), 500 ppm H ₂ O ₂ ¹⁾	±10 ppm
Response time at +23 °C (+73 °F):	
Response time (T ₆₃)	70 s
Response time (T ₉₀)	200 s
Relative Saturation	
Measurement range	0 ... 100 %RS
Measurement temperature range	+5 ... +50 °C (+41 ... +122 °F)
Repeatability at +25 °C (+77 °F), 500 ppm H ₂ O ₂	±0.5 %RS
Accuracy (including non-linearity, hysteresis, and repeatability) at +25 °C (+77 °F):	±4 %RS
Factory calibration uncertainty, at +25 °C (+77 °F), 500 ppm H ₂ O ₂ ¹⁾	±2 %RS
Relative Humidity	
Measurement range	0 ... 100 %RH
Measurement temperature range	+5 ... +70 °C (+41 ... +158 °F)
Accuracy (including non-linearity, hysteresis, and repeatability):	

Property	Description/Value
at 0 ppm H ₂ O ₂ , 0 ... 90 %RH, +25 °C (77 °F)	±1 %RH
over full H ₂ O ₂ and temperature measurement range:	±2 %RH
Response time (T ₆₃)	20 s
Factory calibration uncertainty, at +25 °C (77 °F), 0 ppm H ₂ O ₂ : ¹⁾	
at 0 ... 40 %RH	±0.6 %RH
at 40 ... 95 %RH	±1 %RH
Temperature	
Sensor	Pt-1000 RTD Class F0.1
Accuracy over temperature range	±0.2 °C (±0.36 °F)
Other Parameters	
Absolute H ₂ O ₂ and H ₂ O, H ₂ O ppm by volume, water vapor saturation pressure (H ₂ O and H ₂ O +H ₂ O ₂), dew point temperature, vapor pressure (H ₂ O and H ₂ O ₂)	

1) Defined as ±2 standard deviation limits. See also calibration certificate.

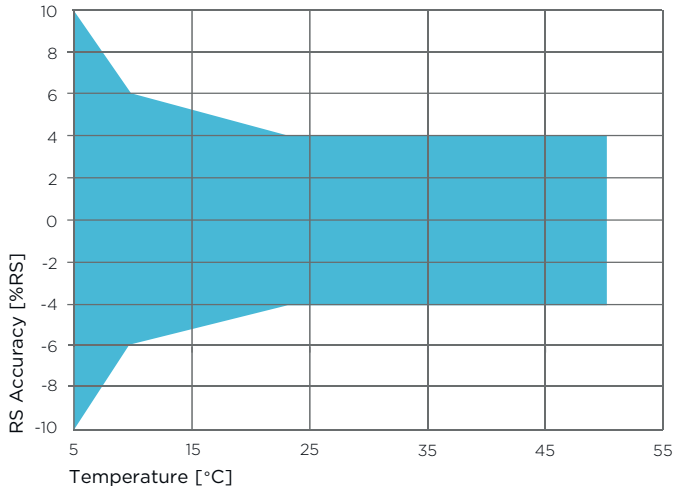


Figure 21 HPP272 RS Measurement Accuracy as Function of Temperature (Including Non-Linearity and Repeatability)

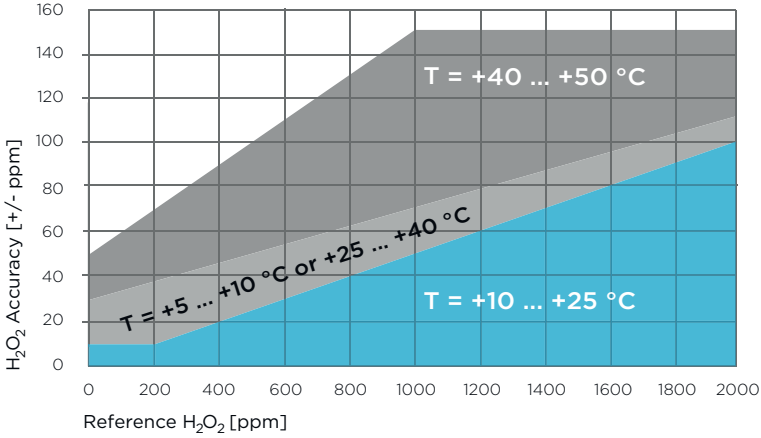


Figure 22 H₂O₂ Measurement Accuracy in 3 Temperature Ranges as Function of H₂O₂ Concentration (Including Non-Linearity and Repeatability; Specification Valid for Range 10 ... 2000 ppm H₂O₂)

Table 6 Inputs and Outputs

Property	Description/Value
Operating voltage	Digital output: 15 ... 30 VDC Analog output: 15 ... 25 VDC
Current Consumption at +25 °C (+77 °F)	
In digital mode	Max. 10 mA
In analog mode	Max. 50 mA
During 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

Table 7 Mechanical Specifications

Property	Description/Value
Weight	130 g (4.58 oz)
IP rating	IP65
Connector	M12/5 male
Materials	
Probe body	AISI316L stainless steel
Filter cap	Porous PTFE
Temperature probe	AISI316L stainless steel
Temperature probe cable	PTFE

Table 8 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
EMC compliance	EN/IEC 61326-1, Industrial Environment

9.1 Dimensions

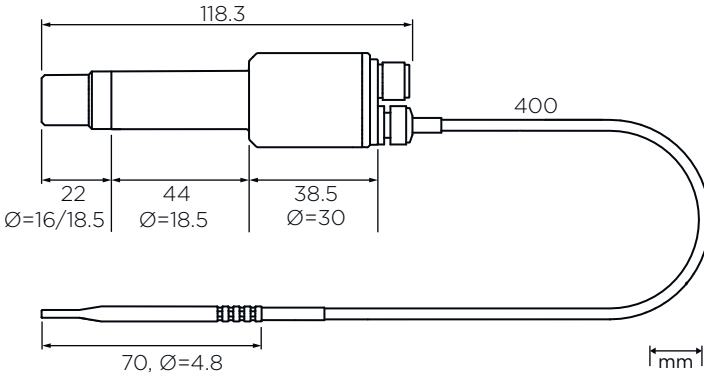


Figure 23 HPP272 Dimensions

9.2 Accessories

Table 9 Spare Parts and Accessories

Name	Order Code
USB cable for PC connection ¹⁾	242659
Probe cable with open wires (1.5 m)	254294SP
Probe cable with open wires (3 m)	254295SP
Probe cable with open wires (5 m)	254296SP
Probe cable with open wires (10 m)	254297SP
Probe cable with open wires and 90° plug (0.6 m)	244669SP
Filter	DRW246363SP
Gland set for through-wall installation, HPP272	HPP272MOUNTINGSET1
Flange for through-wall installation, HPP272	HPP272MOUNTINGSET2
Wall mount for HPP271 and HPP272	HPP272WALLMOUNT
Transmitters	
Indigo transmitters	See www.vaisala.com/indigo
Connection cable to Indigo (1 m)	INDIGOCABLEHD1M5
Connection cable to Indigo (3 m)	INDIGOCABLEHD3M

Name	Order Code
Connection cable to Indigo (5 m)	INDIGOCABLEHD5M
Connection cable to Indigo (10 m)	INDIGOCABLEHD10M

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

Appendix A. Modbus Reference

A.1 Default Communication Settings

Table 10 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 11 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.

A.3.1 32-Bit Floating Point or Integer Format

Least significant 16 bits of floating point or integer numbers are placed at the smaller Modbus address as specified in Open Modbus TCP Specification, Release 1.0. This is also known as "little-endian" or "Modicon" word order. Floating point values are represented in standard IEEE 32-bit floating point format.



Despite the specification, some Modbus masters may expect "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 "quiet NaN" value is returned for unavailable values. A quiet NaN is, for example, 7FC00000_{hex}; however, the master should understand any NaN value.



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

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 12 16-bit Signed Integer Format Details

Value	Description
0000 _{hex} ... 7FFE _{hex}	Value in range 0 ... 32766
8002 _{hex} ... FFFF _{hex}	Value in range -32766 ... -1 (2's complement)
8000 _{hex}	Value is not available (quiet NaN)



Some values may exceed the signed 16-bit range even in normal operation. To access such values, use the floating point registers instead.

A.4 Modbus Registers



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

Accessing unavailable (temporarily missing) measurement data does not generate an exception. "Unavailable" value (a quiet NaN for floating point data or 0000_{hex} for integer data) is returned instead. An exception is generated only for any access outside the applicable register ranges.

A.4.1 Measurement Data Registers

Table 13 Modbus Measurement Data Registers (Read-Only)

Register Number (Decimal)	Address (Hexadecimal)	Register Description	Data Format	Unit
1	0000 _{hex}	Vaporized hydrogen peroxide concentration by volume	32-bit float	ppm
3	0002 _{hex}	H ₂ O+H ₂ O ₂ relative saturation	32-bit float	%RS
5	0004 _{hex}	Temperature used for calculation. By default, shows the temperature from the temperature probe (register 0016 _{hex}). If temperature compensation is turned ON (register 0505 _{hex}), this register shows the volatile value for given temperature reading (register 0302 _{hex}). See Table 14 (page 70) .	32-bit float	°C
7	0006 _{hex}	Relative humidity	32-bit float	%RH
9	0008 _{hex}	Absolute hydrogen peroxide	32-bit float	mg/m ³
11	000A _{hex}	H ₂ O+H ₂ O ₂ dew point temperature	32-bit float	°C
15	000E _{hex}	Water concentration by volume	32-bit float	ppm
17	0010 _{hex}	Water vapor pressure	32-bit float	hPa
19	0012 _{hex}	Absolute humidity (water)	32-bit float	g/m ³
21	0014 _{hex}	Water vapor saturation pressure	32-bit float	hPa
23	0016 _{hex}	Temperature from the temperature probe	32-bit float	°C
25	0018 _{hex}	H ₂ O ₂ vapor pressure	32-bit float	hPa
27	001A _{hex}	Water vapor saturation pressure (H ₂ O +H ₂ O ₂)	32-bit float	hPa
257	0100 _{hex}	Vaporized hydrogen peroxide concentration by volume	16-bit signed integer	ppm
258	0101 _{hex}	H ₂ O+H ₂ O ₂ relative saturation	16-bit signed integer	%RS * 100

Register Number (Decimal)	Address (Hexadecimal)	Register Description	Data Format	Unit
259	0102 _{hex}	Temperature used for calculation. By default, shows the temperature from the temperature probe (register 010B _{hex}). If temperature compensation is turned ON (register 0505 _{hex}), this register shows the volatile value for given temperature reading (register 0302 _{hex}). See Table 14 (page 70) .	16-bit signed integer	°C * 100
260	0103 _{hex}	Relative humidity	16-bit signed integer	%RH *100
261	0104 _{hex}	Absolute hydrogen peroxide	16-bit signed integer	mg/m ³
262	0105 _{hex}	H ₂ O+H ₂ O ₂ dew point temperature	16-bit signed integer	°C * 100
264	0107 _{hex}	Water concentration by volume	16-bit signed integer	ppm
265	0108 _{hex}	Water vapor pressure	16-bit signed integer	hPa
266	0109 _{hex}	Absolute humidity (water)	16-bit signed integer	g/m ³
267	010A _{hex}	Water vapor saturation pressure (H ₂ O)	16-bit signed integer	hPa
268	010B _{hex}	Temperature from the temperature probe	16-bit signed integer	°C * 100
269	010C _{hex}	H ₂ O ₂ vapor pressure	16-bit signed integer	hPa
270	010D _{hex}	Water vapor saturation pressure (H ₂ O +H ₂ O ₂)	16-bit signed integer	hPa

A.4.2 Configuration Registers



CAUTION! Default power-up values (registers 773 ... 775) 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 (registers 769 ... 771, 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 14 Modbus Configuration Data Registers (Writable)

Register Number (Decimal)	Address (Hexadecimal)	Register 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)
771	0302 _{hex}	Volatile value for given temperature reading (value cleared at probe reset). Used for calculations instead of the temperature from the temperature probe if temperature compensation is turned ON (register 0505 _{hex}).	32-bit float	°C -40 ... +80 (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)
775	0306 _{hex}	Power-up value for given temperature reading	32-bit float	°C -40 ... +80
777	0308 _{hex}	Purge interval	16-bit integer	min 60 ... 10080 (= 1 hour ... 1 week) (default: 1440 (= 24 hours))

Register Number (Decimal)	Address (Hexadecimal)	Register Description	Data Format	Unit / Valid Range
779	030A _{hex}	Measurement filtering factor (does not affect temperature, water, or RH 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.
781	030C _{hex}	Low H ₂ O ₂ clipping limit	32-bit float	ppm Any numerical value (default: 0)
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
1285	0504 _{hex}	Pressure compensation on/off	16-bit boolean	1 = On 0 = Off

Register Number (Decimal)	Address (Hexadecimal)	Register Description	Data Format	Unit / Valid Range
1286	0505 _{hex}	Temperature compensation mode	enum	<p>0 = Use temperature measured by temperature probe in the calculation of other measurement parameters.</p> <p>1 = Use a setpoint temperature value in the calculation of other measurement parameters instead of the temperature measured by the temperature probe. Define the setpoint value in registers 0302_{hex} (volatile value) and 0306_{hex} (power-up value).</p> <p>(default: 1 = Use a setpoint value)</p>
1287	0506 _{hex}	Manual purge trigger in analog mode on/off	16-bit boolean	<p>1 = On</p> <p>0 = Off</p> <p>(default: 1 = On)</p>
1288	0507 _{hex}	Allow interval purge during H ₂ O ₂ exposure	16-bit boolean	<p>1 = On</p> <p>0 = Off</p> <p>(default: 0 = Off)</p>
1537	0600 _{hex}	Modbus address	16-bit integer	1 ... 255 (default: 240)
1538	0601 _{hex}	Bit rate	enum	<p>5 = 9600</p> <p>6 = 19200</p> <p>7 = 38400</p> <p>8 = 57600</p> <p>9 = 115200</p> <p>(default: 6 = 19200)</p>

Register Number (Decimal)	Address (Hexadecimal)	Register 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}	Response delay	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	Valid range 0000 _{hex} ... 001A _{hex} . For the available parameters and their register addresses, see Table 13 (page 68) .
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).
1799	0706 _{hex}	Error output	32-bit float	mA 0 ... 25

Register Number (Decimal)	Address (Hexadecimal)	Register Description	Data Format	Unit / Valid Range
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 (Decimal)	Address (Hexadecimal)	Register Description	Data Format	Unit / Valid Range
2050	0801 _{hex}	Output parameter	16-bit register address	Valid range 0000 _{hex} ... 001A _{hex} . For the available parameters and their register addresses, see Table 13 (page 68) .
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

Register Number (Decimal)	Address (Hexadecimal)	Register Description	Data Format	Unit / Valid Range
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
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:				

Register Number (Decimal)	Address (Hexadecimal)	Register Description	Data Format	Unit / Valid Range
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 15 Modbus Status Registers (Read-Only)

Register Number (Decimal)	Address (Hexadecimal)	Register 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 16 (page 79) . 1)
516	0203 _{hex}	Status code high	32-bit	See Table 17 (page 79) . 1)

Register Number (Decimal)	Address (Hexadecimal)	Register 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)
530	0211 _{hex}	Status of H ₂ O+H ₂ O ₂ relative saturation	16-bit	
531	0212 _{hex}	Status of Temperature	16-bit	
532	0213 _{hex}	Status of Relative humidity	16-bit	
533	0214 _{hex}	Status of Absolute hydrogen peroxide	16-bit	
534	0215 _{hex}	Status of H ₂ O+H ₂ O ₂ dew point temperature	16-bit	
536	0217 _{hex}	Status of Water concentration by volume	16-bit	
537	0218 _{hex}	Status of Water vapor pressure	16-bit	
538	0219 _{hex}	Status of Absolute humidity	16-bit	
539	021A _{hex}	Status of Water vapor saturation pressure	16-bit	
540	021B _{hex}	Status of Temperature from the temperature probe	16-bit	
541	021C _{hex}	Status of H ₂ O ₂ pressure	16-bit	
542	021D _{hex}	Status of H ₂ O+H ₂ O ₂ vapor pressure	16-bit	
547	0222 _{hex}	Sensor Vitality	32-bit float	

- 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 16 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
4194304	Temperature sensor failure (open circuit).	Error
8388608	Temperature sensor failure (short circuit).	Error

Table 17 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 18 Device Identification Objects

Object Id (Decimal)	Object Id (Hexadecimal)	Object Name	Example Contents
0	00 _{hex}	VendorName	"Vaisala"
1	01 _{hex}	ProductCode	HPP272
2	02 _{hex}	MajorMinorVersion	Software version (for example "1.2.3")
3	03 _{hex}	VendorUrl	"http://www.vaisala.com/"
4	04 _{hex}	ProductName	Hydrogen Peroxide, Humidity, and Temperature Probe HPP272
128	80 _{hex}	SerialNumber	Serial number of the device (for example "K0710040")
129	81 _{hex}	CalibrationDate	Date of the factory calibration
130	82 _{hex}	CalibrationText	Information text of the factory calibration

A.4.5 Test Value Registers

Table 19 Test Value Registers

Register Number (Decimal)	Address (Hexadecimal)	Register Description	Data Format	Value
7937	1F00 _{hex}	Signed integer	16-bit integer	-12345
7938	1F01 _{hex}	Floating point	32-bit float	-123.45
7940	1F03 _{hex}	Text string	8-character ASCII string	"-123.45"

A.5 Modbus Communication Examples

Reading H₂O₂ 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}	HPP272 address	F0 _{hex}	HPP272 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}	Number of 16-bit registers to read (2)	D4 _{hex}	Value of first register (least significant word)
00 _{hex}		7A _{hex}	
02 _{hex}	Modbus RTU checksum	43 _{hex}	Value of second register (most significant word)
D1 _{hex}		E8 _{hex}	
2A _{hex}	End of Modbus RTU frame	33 _{hex}	Modbus RTU checksum
(silence for 3.5 bytes)		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}	HPP272 address	F0 _{hex}	HPP272 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	<div style="border: 1px solid black; padding: 10px; background-color: #f0f0f0;">  <p>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).</p> <p>To verify that the value was really accepted by the device, read the register value after writing.</p> </div>	
4C _{hex}			
(silence for 3.5 bytes)	End of Modbus RTU frame		

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)

Warranty

For standard warranty terms and conditions, see www.vaisala.com/warranty.

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

Technical Support



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

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

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

Recycling



Recycle all applicable material.



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

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