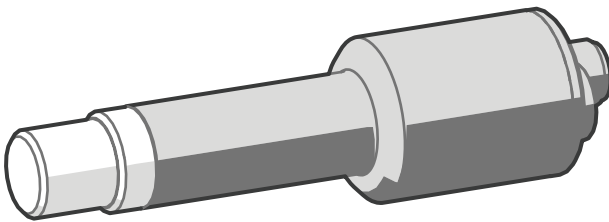


# User Guide

Vaisala PEROXCAP<sup>®</sup> Hydrogen Peroxide Probe

**HPP271**



**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 Probe HPP271.

Table 1 Document Versions

Document Code	Date	Description
M211888EN-C	October 2019	Updated the instructions for using the ATEST output test in Insight PC software and added information on the probe SW version requirements for ATEST. Corrected trademark information.
M211888EN-B	October 2019	Updates and additions: <ul style="list-style-type: none"> <li>• Analog output test (supported by HPP270 probe SW 1.3.0 and above) in Vaisala Insight PC software added</li> <li>• Added analog output accuracy and temperature dependence specifications</li> <li>• Additional through-wall installation accessory dimensions</li> <li>• H<sub>2</sub>O<sub>2</sub> measurement accuracy graph updated</li> <li>• Updated the maintenance limit for sensor vitality value when using the probe in demanding environments</li> <li>• Added troubleshooting information on triggering purge with Modbus register 1283 (0502<sub>hex</sub>) and Insight PC software reset loop issue in SW version 1.0.2.76</li> <li>• Added information on how long calibration remains valid in ambient conditions</li> </ul>
M211888EN-A	October 2018	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>
M211972EN	<i>Hydrogen Peroxide, Humidity and Temperature Probe HPP272 User Guide</i>
M212195EN	<i>HPP271MOUNTINGSET1 / HPP272MOUNTINGSET1 Installation Kit Quick Guide</i>
M212194EN	<i>HPP271MOUNTINGSET2 / HPP272MOUNTINGSET2 Installation Kit Quick Guide</i>

Document Code	Name
M212179EN-A	<i>HPP272WALLMOUNT Installation Kit Quick Guide</i>
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.

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



## 1.5 Regulatory Compliances

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

- RoHS Directive
- EMC Directive

Conformity is shown by compliance with the following standards:

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



## 1.6 Patent Notice

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

**Table 3**   [Applicable Patents or Applications](#)

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

## 2. Product Overview

### 2.1 Introduction to HPP271

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

Hydrogen Peroxide Probe HPP271 provides measurement for vaporized  $\text{H}_2\text{O}_2$  concentration.

The  $\text{H}_2\text{O}_2$  measurement is based on comparing the readings of two composite humidity sensors to determine the vapor concentration of  $\text{H}_2\text{O}_2$ . 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  $\text{H}_2\text{O}_2$  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  $\text{H}_2\text{O}_2$  conditions, maintains measurement performance, and lengthens the probe's lifetime. When the probe is powered off, exposure to  $\text{H}_2\text{O}_2$  condensation can break the PEROXCAP sensor within a day, and the sensor will not recover.

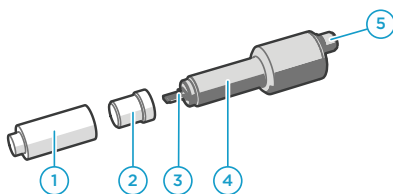


Figure 1 Probe Parts

- 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 Hydrogen peroxide probe.
- 5 5-pin M12 connector

**More Information**

- [Dimensions \(page 57\)](#)
- [Operating Principle of H<sub>2</sub>O<sub>2</sub> Measurement \(page 14\)](#)
- [Installation \(page 18\)](#)
- [Wiring \(page 20\)](#)

## 2.2 Basic Features and Options

- Vaisala PEROXCAP® H<sub>2</sub>O<sub>2</sub> measurement technology with excellent long-term stability.
- Vaporized H<sub>2</sub>O<sub>2</sub> measurement range 0 ... 2000 ppm.
- Robust design allowing the probe to be installed directly in the process environment. When powered on, the probe withstands H<sub>2</sub>O<sub>2</sub> and H<sub>2</sub>O 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 H<sub>2</sub>O<sub>2</sub> and H<sub>2</sub>O concentration measurement.
- Digital output: RS-485 interface for Modbus communication.
- Analog output: 2 x 4 ... 20 mA.
- Easy plug-in, plug-out.
- Field calibration and adjustment with a regular humidity calibrator or with H<sub>2</sub>O<sub>2</sub> 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 \(page 54\)](#)

## 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 <sub>2</sub> O <sub>2</sub>	ppm	Parts per million value is a unit of H <sub>2</sub> O <sub>2</sub> concentration per amount of air in volume fraction in units ppmv or m <sup>3</sup> /m <sup>3</sup> .
Water concentration by volume	H <sub>2</sub> O	ppm	Parts per million value is a unit of water concentration per amount of air in volume fraction in units ppmv or m <sup>3</sup> /m <sup>3</sup> .

The probe provides both digital and analog outputs.

### More Information

- [Measurement Data Registers \(page 63\)](#)
- [Configuration Registers \(page 63\)](#)
- [Connectivity to Vaisala Insight Software \(page 12\)](#)
- [Setting Probe in Analog or Digital Mode \(page 22\)](#)

## 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 \(page 47\)](#)

## 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  $\text{H}_2\text{O}_2$  environments. During the purge,  $\text{H}_2\text{O}_2$  and  $\text{H}_2\text{O}$  measurements are not available.

The purge is automatically performed:

- At probe start-up.
- After an RH for  $\text{H}_2\text{O}_2$  adjustment is made.
- At intervals (default 24 hours, configurable between 1 hour ... 1 week using Vaisala Insight software, Modbus, or Indigo transmitters). Purge is postponed by 30 minutes if  $\text{H}_2\text{O}_2$  is present or ambient humidity is not steady.



If required, you can also enable purge during  $\text{H}_2\text{O}_2$  exposure with the Insight PC software or an Indigo transmitter.

Purge is recommended at least every 24 hours of powered-on time, even if the probe has not been continuously exposed to  $\text{H}_2\text{O}_2$ .

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

### More Information

- [Triggering Purge in Analog Mode \(page 28\)](#)
- [Operation in Analog Mode \(page 24\)](#)

## 2.8 Environmental Compensation for Pressure

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

You can configure the pressure compensation parameters using Vaisala Insight software, Modbus configuration registers, 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).

### More Information

- [Vaisala Insight Software \(page 34\)](#)
- [Configuration Registers \(page 63\)](#)

## 2.9 Measurement Filtering Factor

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

The filtering factor can be set either with Modbus configuration register 0308<sub>hex</sub>, 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 \(page 63\)](#)

## 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:

- 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 \(page 34\)](#)

## 2.11 Additional Features with Indigo Transmitters

HPP271 probes are compatible with Vaisala Indigo 200 transmitters starting from Indigo transmitter software version 1.4.0 or higher. 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](http://www.vaisala.com/indigo).

### More Information

- [Indigo Overview \(page 29\)](#)

## 3. H<sub>2</sub>O<sub>2</sub> Measurement

### 3.1 Operating Principle of H<sub>2</sub>O<sub>2</sub> Measurement



**CAUTION!** When there is H<sub>2</sub>O<sub>2</sub> 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<sub>2</sub>O<sub>2</sub> conditions, maintains measurement performance, and lengthens the probe's lifetime. When the probe is powered off, exposure to H<sub>2</sub>O<sub>2</sub> 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 H<sub>2</sub>O<sub>2</sub> applications in atmospheric pressure.

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

PEROXCAP measurement uses two composite HUMICAP sensors, one with a catalytic layer and one without. The catalytic layer catalyzes H<sub>2</sub>O<sub>2</sub> from the vapor mixture. Therefore, the HUMICAP sensor with this layer only senses water vapor, providing a measurement of partial water pressure. The sensor without the catalytic layer senses both hydrogen peroxide vapor and water vapor in the air mixture. The difference between the readings from these two sensors indicates the vapor concentration of H<sub>2</sub>O<sub>2</sub>.



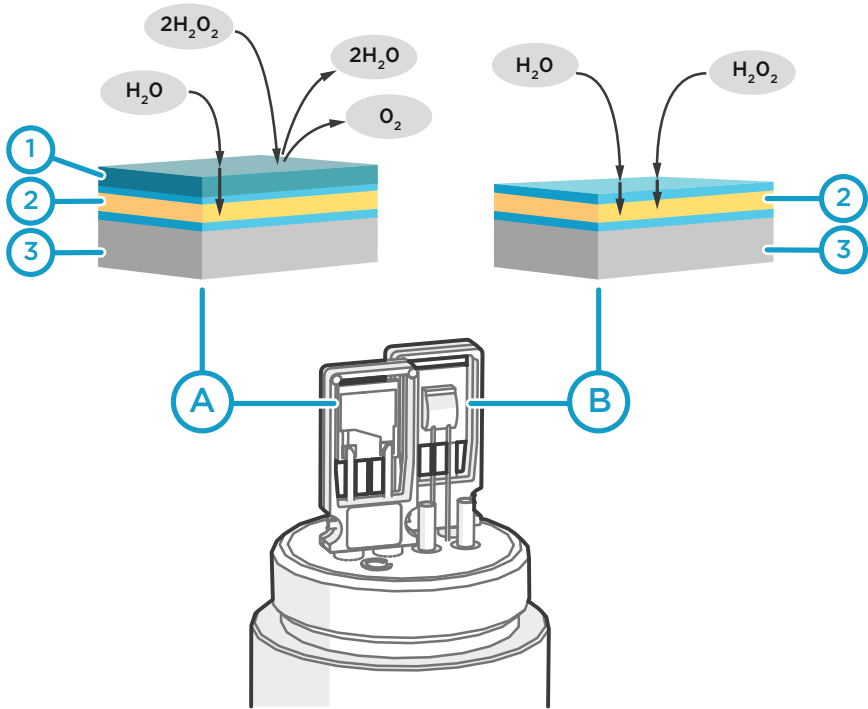


Figure 2 Operating principle of PEROXCAP measurement

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

## 3.2 Typical Applications



The probe is not intended for safety level measurement.



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

Vaporized hydrogen peroxide is used for bio-decontamination in several applications from healthcare and 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  $\text{H}_2\text{O}_2$  bio-decontamination applications include isolators, transfer hatches, closed Restricted Access Barrier Systems, and room bio-decontamination (for example, in hospital environments, cleanrooms, decontamination tents, aircrafts, ships, and shipping containers).

The bio-decontamination process typically has the following phases:

1. Optional dehumidification, where relative humidity is decreased to a desired level, for example, by warming the space.
2. Conditioning, where vaporized  $\text{H}_2\text{O}_2$  mixture is introduced into the space to be bio-decontaminated.
3. Decontamination, where  $\text{H}_2\text{O}_2$  concentration is maintained at a desired level for a certain time.
4. Aeration, where  $\text{H}_2\text{O}_2$  is removed from the bio-decontaminated space.

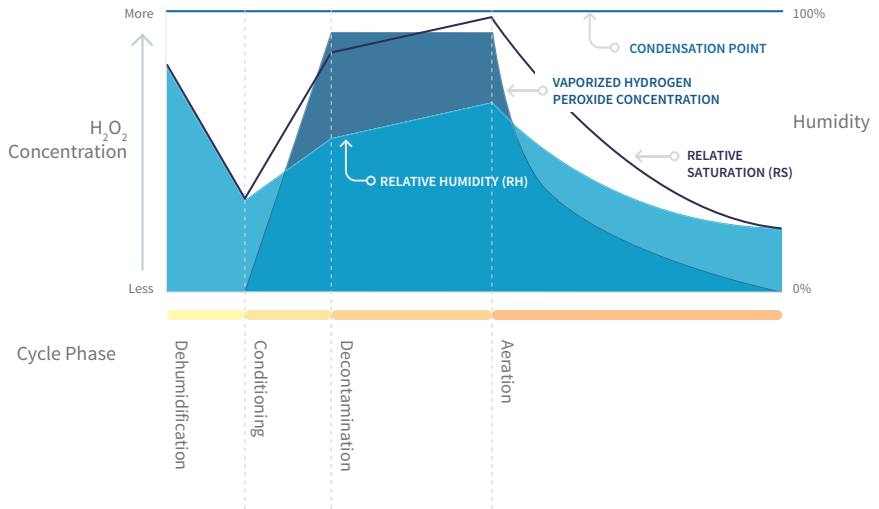


Figure 3 Example behavior of H<sub>2</sub>O<sub>2</sub> concentration, relative saturation (RS), and relative humidity (RH) in a vaporized H<sub>2</sub>O<sub>2</sub> bio-decontamination cycle (non-condensing conditions)

In the non-condensing bio-decontamination cycle example shown in [Figure 3 \(page 17\)](#):

- In the *dehumidification* phase, RH (and RS) decreases.
- When the *conditioning* phase starts, H<sub>2</sub>O<sub>2</sub> concentration rises rapidly. There is also a rapid increase in RS, which indicates the humidity caused by both H<sub>2</sub>O<sub>2</sub> vapor and water vapor. Because the generated H<sub>2</sub>O<sub>2</sub> vapor is typically mixed with water vapor, RH also starts to rise.
- In the *decontamination* phase, H<sub>2</sub>O<sub>2</sub> concentration is steady. However, RS level rises slowly close to 100 %RS, i.e. condensation point, due to rising RH level.
- In the *aeration* phase, H<sub>2</sub>O<sub>2</sub> concentration, RS, and RH all decrease. When H<sub>2</sub>O<sub>2</sub> concentration is zero, RS equals RH.

#### More Information

- [Installation \(page 18\)](#)

## 4. Installation

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

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

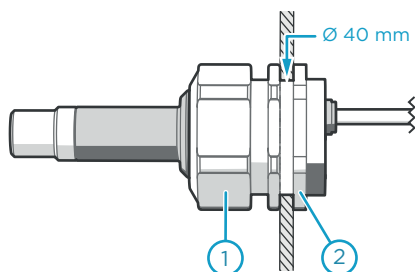
When there is  $H_2O_2$  in the probe's environment, the probe must always be powered on. When powered on, the PEROXCAP sensor is heated, which permits using the probe in condensing  $H_2O_2$  conditions, maintains measurement performance, and lengthens the probe's lifetime.



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

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

### Example: Installation Through a Wall, Gland Option



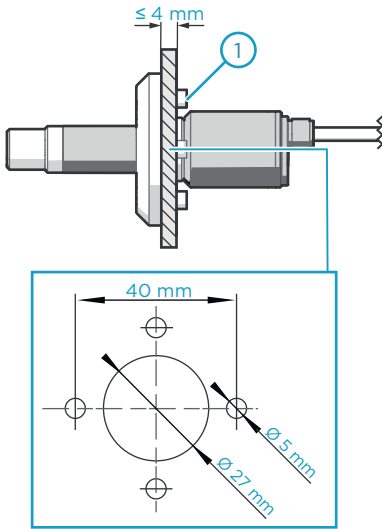
A through-wall installation is recommended especially in very harsh processes.

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

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

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

### Example: Installation Through a Wall, Flange Option

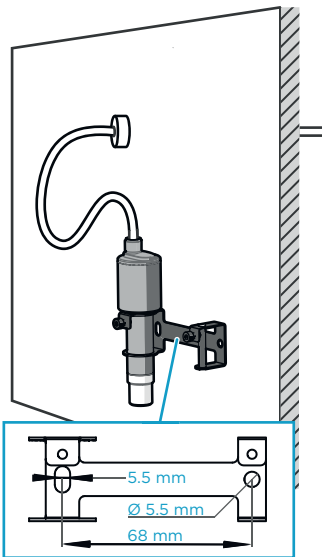


The figure shows an example installation using Vaisala spare part flange (HPP271MOUNTINGSET2), including the drilling dimensions for the flange.

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

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

### Example: Installation Entirely in Process Environment



Mount the H<sub>2</sub>O<sub>2</sub> and humidity probe from the probe body.

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

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



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

### More Information

- [HPP271MOUNTINGSET1/HPP272MOUNTINGSET1 Dimensions \(page 58\)](#)
- [HPP271MOUNTINGSET2/HPP272MOUNTINGSET2 Dimensions \(page 59\)](#)
- [HPP272WALLMOUNT Dimensions \(page 60\)](#)

## 4.1 Wiring

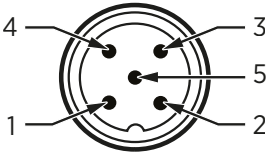


Figure 4 Pins on the Probe M12/5 Male Connector

Pin #	Function	Notes	Wire Color 1)
1	Power supply	With digital output: 15 ... 30 VDC With analog output: 15 ... 25 VDC <sup>2)</sup>	Brown
2	RS-485- or analog output 2	Current output: 4 ... 20 mA <sup>3)</sup>	White
3	Power and signal GND RS-485 common		Blue
4	RS-485+ or analog output 1	Current output: 4...20 mA <sup>3)</sup>	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.

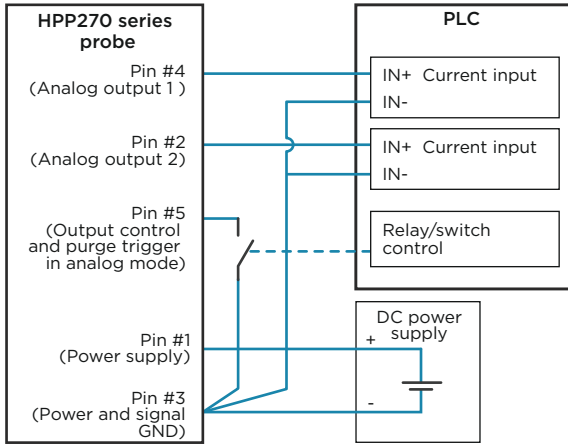


Figure 5 Wiring Example for Connecting the Probe to a PLC in Analog Mode

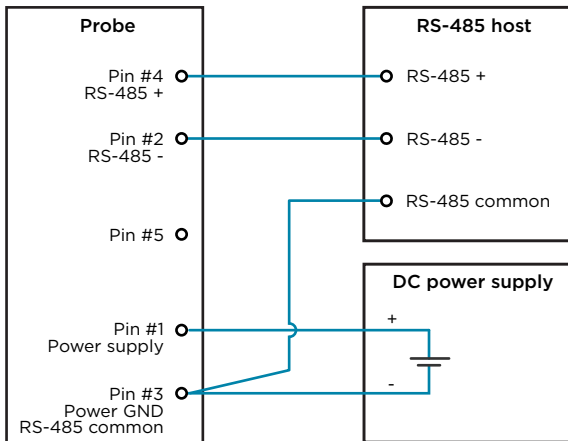


Figure 6 Wiring Example for RS-485 Connection (Modbus Communication)

#### More Information

- [Accessories \(page 56\)](#)
- [Triggering Purge in Analog Mode \(page 28\)](#)
- [Technical Data \(page 54\)](#)

## 4.2 Power Supply

Operating voltage range of the probe:

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

Maximum current consumption at 25 °C:

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

## 4.3 Setting Probe in Analog or Digital Mode

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

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

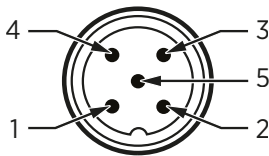


Figure 7 Pins on the Probe M12/5 Male Connector

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



## 5. Operation

### 5.1 Probe Start-Up

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

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

#### More Information

- [Behavior at Exposure to H<sub>2</sub>O<sub>2</sub> \(page 23\)](#)

### 5.2 Behavior at Exposure to H<sub>2</sub>O<sub>2</sub>



**CAUTION!** When there is H<sub>2</sub>O<sub>2</sub> 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<sub>2</sub>O<sub>2</sub> conditions, maintains measurement performance, and lengthens the probe's lifetime. When the probe is powered off, exposure to H<sub>2</sub>O<sub>2</sub> 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 H<sub>2</sub>O<sub>2</sub>, the probe's H<sub>2</sub>O<sub>2</sub> concentration reading changes to > 0 ppm after approximately 20 ... 30 seconds. This time is included in the response time of the probe.

### 5.3 H<sub>2</sub>O<sub>2</sub> Concentration Reading When Not Exposed to H<sub>2</sub>O<sub>2</sub>

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 H<sub>2</sub>O<sub>2</sub> concentration reading may vary slightly (typically 0 ... 3 ppm) when the probe is not exposed to H<sub>2</sub>O<sub>2</sub>. 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<sub>hex</sub>, 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 \(page 34\)](#)
- [Configuration Registers \(page 63\)](#)

## 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 \(page 61\)](#)
- [Setting Probe in Analog or Digital Mode \(page 22\)](#)
- [Wiring \(page 20\)](#)

## 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 \(page 22\)](#)
- [Analog Output Error State \(page 53\)](#)
- [Configuration Registers \(page 63\)](#)
- [Chemical Purge \(page 11\)](#)

### 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.

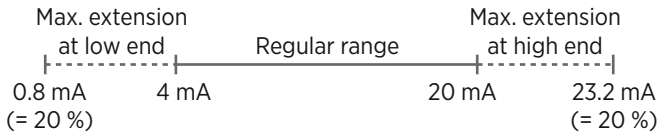


Figure 8 Maximum extensions to analog output range

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 \(page 53\)](#)

## 5.5.2 Analog Output Overrange Examples

Consider a probe with one of the analog output channels (4 ... 20 mA) configured to output  $\text{H}_2\text{O}_2$  concentration, scaled to 0 ... 2000 ppm.

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

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

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

When the measured  $\text{H}_2\text{O}_2$  concentration rises above 2000 ppm, the output rises above 20 mA. The output keeps rising until the measurement is 2100 ppm, at which point the probe outputs 20.8 mA. If the  $\text{H}_2\text{O}_2$  concentration rises above 2100 ppm, the output still remains at 20.8 mA. If the  $\text{H}_2\text{O}_2$  concentration rises above 2200 ppm, the output enters the error state (by default, 3.6 mA).

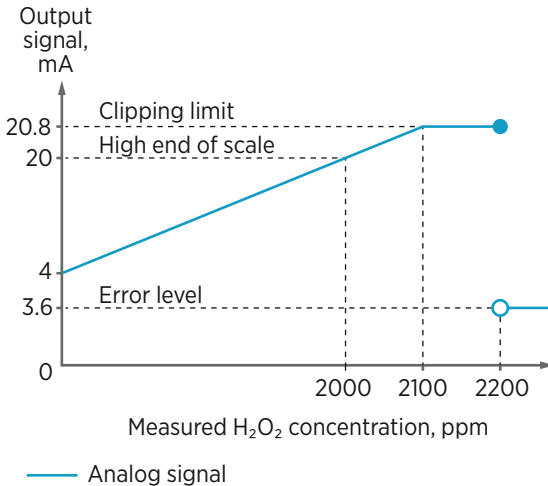


Figure 9 Analog output overrange example with clipping and error limits

**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  $\text{H}_2\text{O}_2$  concentration rises above 2000 ppm, the output rises above 20 mA. The output keeps rising until the measurement is 2100 ppm, at which point the probe outputs 20.8 mA. If the  $\text{H}_2\text{O}_2$  concentration rises above 2100 ppm, the output still remains at 20.8 mA.

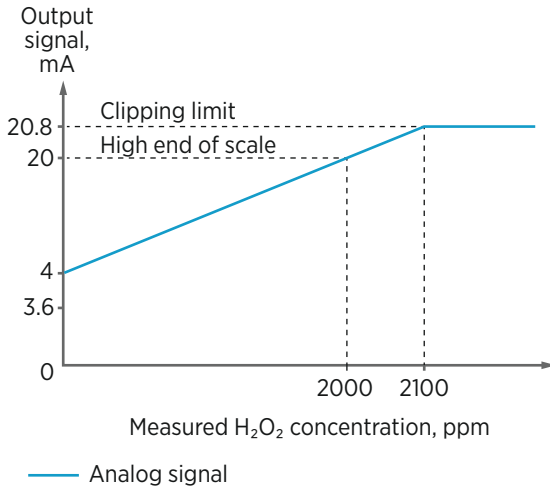


Figure 10 Analog output overrange example with clipping only

**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  $\text{H}_2\text{O}_2$  concentration rises above 2000 ppm, the output rises above 20 mA. The output keeps rising until the measurement exceeds 2200 ppm (21.6 mA), at which point the output enters the error state (by default, 3.6 mA).

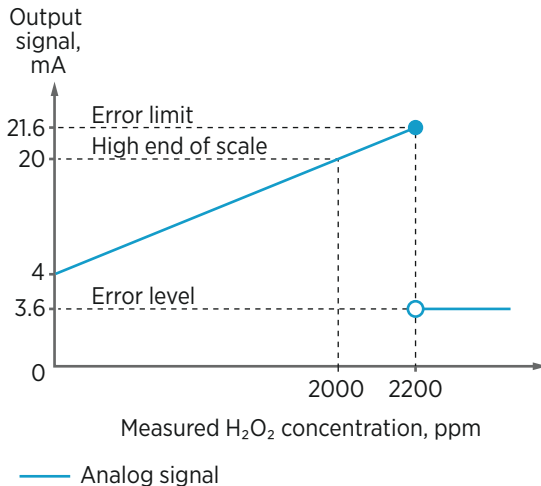


Figure 11 Analog output overrange example with no clipping, only error state when error limit is exceeded

### 5.5.3 Triggering Purge in Analog Mode

In the analog mode, pin #5 in the probe's M12 male connector is connected to ground. Additionally, pin #5 is used to trigger a purge in analog mode. To be able to trigger a purge, do not connect pin #5 to ground permanently, but instead, use a relay or similar to control the pin. For a wiring example, see [Figure 5 \(page 21\)](#).

- ▶ 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.

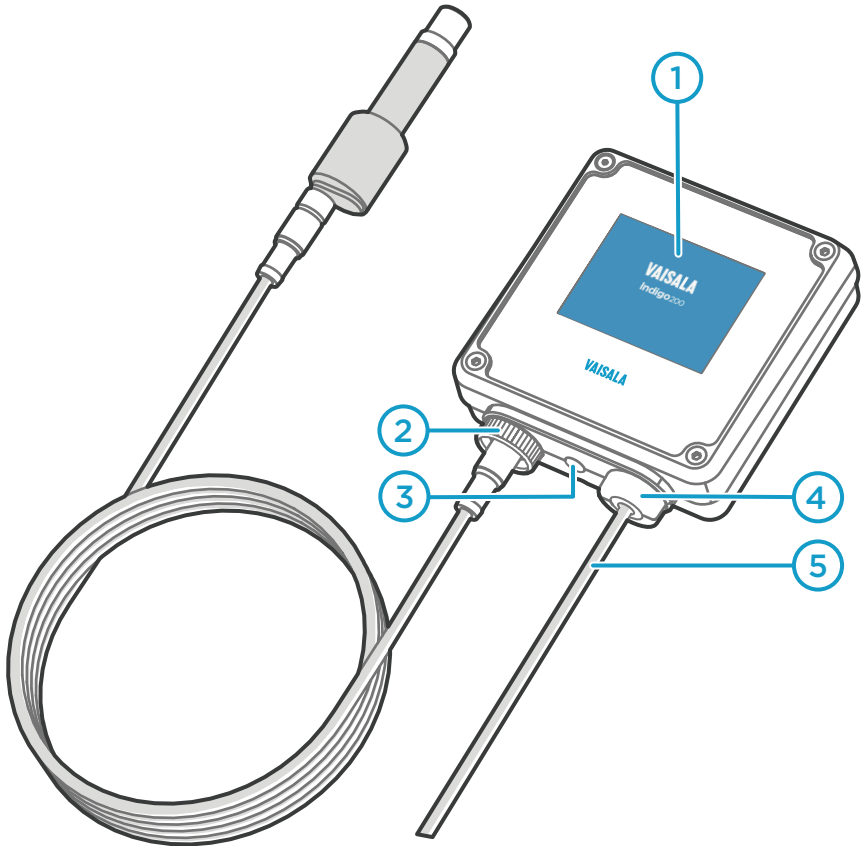
The probe starts performing the purge. The duration of the purge is approximately 4 minutes. During the purge,  $\text{H}_2\text{O}_2$  and  $\text{H}_2\text{O}$  measurements are not available

#### More Information

- ▶ [Chemical Purge \(page 11\)](#)

## 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

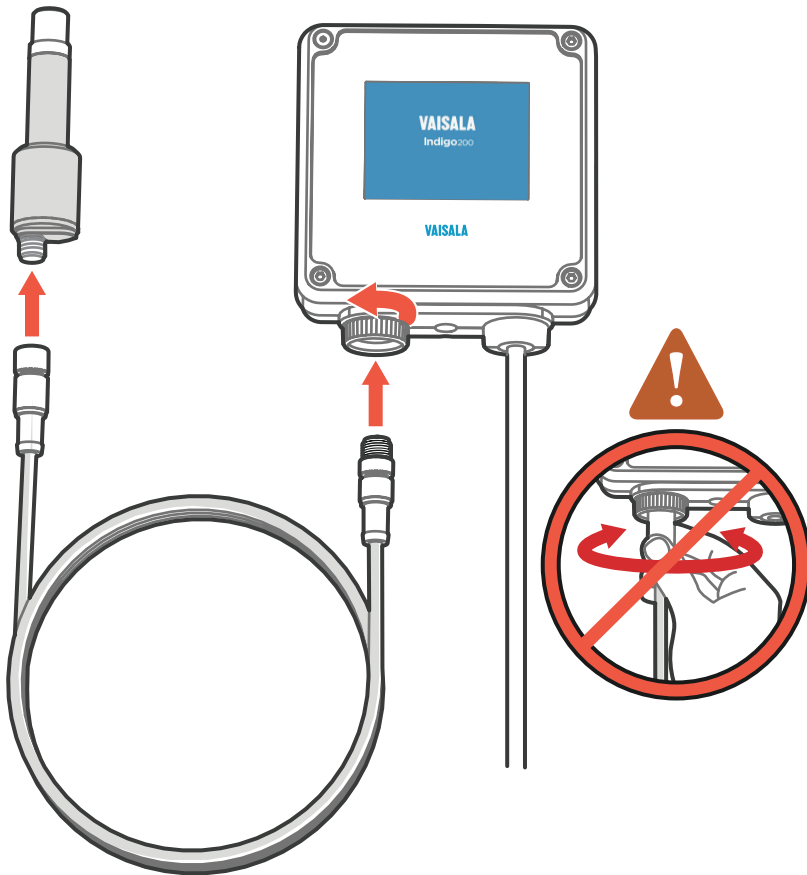


Figure 12 Attaching Probes to Indigo

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

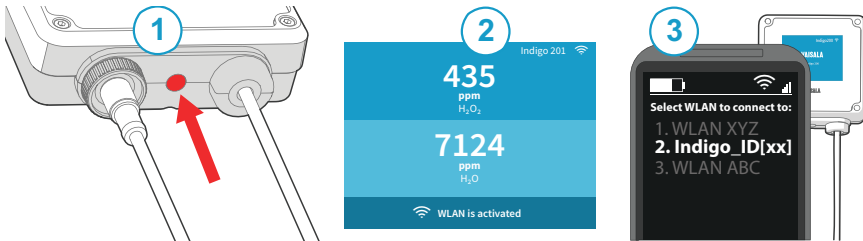


Figure 13 Enabling and Accessing Indigo's Wireless Configuration Interface

- 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 14 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](http://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)

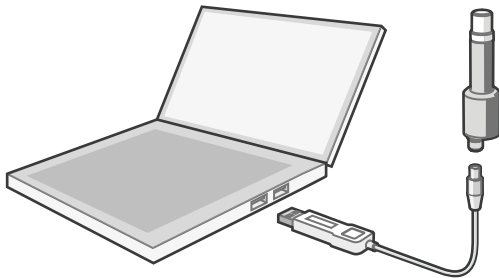


Figure 15 Connecting Probe to Insight

- ▶ 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 **H<sub>2</sub>O<sub>2</sub> probe body** by wiping it with a soft, lint-free cloth moistened with water or mild cleaning agent, such as isopropanol. Do not wipe the filter: wiping the filter may block its pores and/or deposit residue on the filter. If the filter is heavily contaminated, replace it.

When cleaning, follow these precautions:

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

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

After cleaning the probe, it is recommended to perform a 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 C<sub>2</sub>H<sub>6</sub>OS).

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

#### More Information

- [Chemical Purge \(page 11\)](#)
- [Triggering Purge in Analog Mode \(page 28\)](#)

## 7.2 Sensor Vitality Information in Insight

Due to the stresses of the  $\text{H}_2\text{O}_2$  measurement environment, the PEROXCAP sensor will lose its functionality over time. In less demanding conditions, the sensor can remain functional for a considerable number of years. In environments with higher  $\text{H}_2\text{O}_2$  concentrations and longer exposure periods, it is recommended to monitor the condition of the sensor regularly.

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

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

#### More Information

- [Vaisala Insight Software \(page 34\)](#)

## 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](http://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](http://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**.

## Calibration Validity During Storage

When the probe is stored indoors in ambient conditions (not in contact with the  $\text{H}_2\text{O}_2$  environment or other chemicals), a calibration made to the probe will remain valid for several years. For optimal storage conditions, keep the yellow protective cap on the probe filter.

### 7.3.1 Field Calibration and Adjustment Overview

HPP271 has the following field calibration and adjustment options:

- $\text{H}_2\text{O}_2$  measurement calibration and adjustment with relative humidity (RH) references (for example, Vaisala HMK15 Humidity Calibrator)
- $\text{H}_2\text{O}_2$  measurement calibration and adjustment in  $\text{H}_2\text{O}_2$  vapor



The accuracy of field calibration and adjustment, with either RH references or in  $\text{H}_2\text{O}_2$  vapor, is dependent on a number of factors such as sufficient stabilization time, reference quality, and whether the reference instrument and the instrument under adjustment are successfully placed in matching conditions. To ensure fully accurate calibration and adjustment results, use the traceable calibration and adjustment services provided by Vaisala.

#### RH for $\text{H}_2\text{O}_2$ Adjustment

The PEROXCAP sensor comprises 2 HUMICAP humidity sensors that are used to calculate the  $\text{H}_2\text{O}_2$  measurement. Because the  $\text{H}_2\text{O}_2$  measurement is based on humidity calculations, you can use humidity references to adjust the underlying humidity measurement. Improving the accuracy of the underlying humidity measurement also improves the accuracy of the derived  $\text{H}_2\text{O}_2$  measurement.

## H<sub>2</sub>O<sub>2</sub> Adjustment in H<sub>2</sub>O<sub>2</sub> Vapor

You can also calibrate and adjust the probe directly in H<sub>2</sub>O<sub>2</sub> vapor. Note that calibration in H<sub>2</sub>O<sub>2</sub> 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.

### 7.3.2 RH for H<sub>2</sub>O<sub>2</sub> 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.

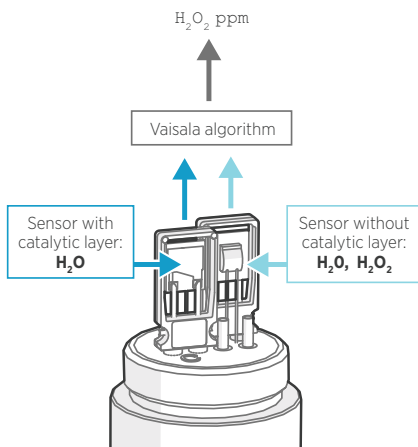


Figure 16 PEROXCAP Operating Principle

Vaisala algorithm transforms the observations from the humidity sensors into a measurement reading of H<sub>2</sub>O<sub>2</sub> concentration. Any drift in the humidity sensors shows as drift in the measurement reading. Therefore, removing the drift from the humidity sensors with calibration and adjustment improves H<sub>2</sub>O<sub>2</sub> measurement performance.



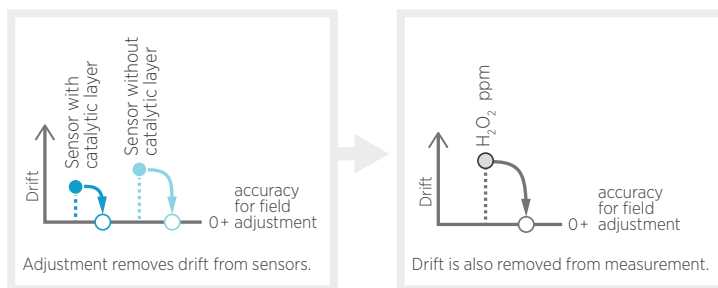


Figure 17 Adjustment removes drift

Even though the probe does not measure relative humidity during normal operation, you can still calibrate and adjust the probe's  $\text{H}_2\text{O}_2$  measurement with relative humidity. To be able to calibrate and adjust relative humidity, which is a temperature-dependent parameter, the PEROXCAP sensor also contains two internal temperature sensors (one for each humidity sensor) that are used for calibrating and adjusting RH for  $\text{H}_2\text{O}_2$  and in certain measurement calculations. In normal measurement, the PEROXCAP sensor is heated to allow it to be used in condensing  $\text{H}_2\text{O}_2$  conditions, which sets limitations for the use of the internal temperature sensors. During RH for  $\text{H}_2\text{O}_2$  calibration, however, the probe switches into a calibration mode that temporarily turns off the sensor heating.



**CAUTION!** Do not expose the probe to  $\text{H}_2\text{O}_2$  vapor when the probe is in calibration mode and sensor heating is off. Exposure to  $\text{H}_2\text{O}_2$  condensation can break the PEROXCAP sensor within a day, and the sensor will not recover.

RH calibration and adjustment for  $\text{H}_2\text{O}_2$  is a two-point adjustment. The two reference points must be at least 40 %RH apart from each other, and the second reference point must be at least 50 %RH. The following RH levels are recommended for optimal results:

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

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

### 7.3.3 Adjusting RH for $\text{H}_2\text{O}_2$ 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  $\text{H}_2\text{O}_2$  vapor when the probe is in calibration mode and sensor heating is off. Exposure to  $\text{H}_2\text{O}_2$  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 \(page 34\)](#).
3. Wait for the start-up purge to finish.
4. Select  > **Calibrate > Yes** to switch the probe to calibration mode.  
In calibration mode, the device will not use functions that may interfere with calibration and adjustment.
5. In the **General** tab, make sure the calibration mode **RH** is selected.
6. Open the tab **RH for  $\text{H}_2\text{O}_2$  adjustment**.
7. Insert the probe head in the reference environment for calibration point 1.
8. Wait for the RH and temperature measurements to stabilize fully. This may take more than 30 minutes. Monitor the readings to see when the measurement has stabilized.
9. Click the **Reference value, point 1** text box and enter the reference value of the calibration point. Press **ENTER** or click outside the text box when done.  
The probe automatically enters the measured value for the calibration point.
10. Repeat steps [step 7](#) ... [step 9](#) for calibration point 2 (wet point, recommendation 65 ... 85 %RH).
11. Select **Activate adjustment > Yes** to store the adjustment in the probe.
12. Check the message that appears at the top of the screen. If the message indicates that the adjustment is activated successfully, your adjustment is stored in the probe.
13. Select the **Calibration information** tab and update the **Calibration date** and **Calibration text**.
14. Select **Close > Yes** to exit the calibration mode.

### 7.3.4 Adjusting RH for H<sub>2</sub>O<sub>2</sub> 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 H<sub>2</sub>O<sub>2</sub> vapor when the probe is in calibration mode and sensor heating is off. Exposure to H<sub>2</sub>O<sub>2</sub> 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 \(page 31\)](#)).
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** from the **Calibration mode** dropdown.

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

### RH for H<sub>2</sub>O<sub>2</sub> 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

H<sub>2</sub>O<sub>2</sub> error @500 ppm  ppm

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Refresh Content **Refresh**


7. Insert the probe head in the first reference environment.
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. 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. Repeat steps [step 7](#) ... [step 9](#) for calibration point 2 (wet point, recommendation 65 ... 85 %RH).
11. Select **Activate adjustment** to store the adjustment in the probe.
12. Close the calibration mode with the **Stop calibration** button.

### 7.3.5 Adjusting H<sub>2</sub>O<sub>2</sub> Measurement with Insight Software



You need the following for the adjustment:

- A reference probe. Vaisala recommends using a Vaisala HPP270 series probe that has recently been factory-calibrated.
- An H<sub>2</sub>O<sub>2</sub> vapor chamber that can produce a stable H<sub>2</sub>O<sub>2</sub> 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 **H<sub>2</sub>O<sub>2</sub>**.



**CAUTION!** It is very important to select **H<sub>2</sub>O<sub>2</sub>** 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<sub>2</sub>O<sub>2</sub> vapor.

6. Open the **H<sub>2</sub>O<sub>2</sub> adjustment** tab.
7. Expose your probe and the reference probe to H<sub>2</sub>O<sub>2</sub> vapor and wait for the ambient H<sub>2</sub>O<sub>2</sub> concentration to reach the desired calibration and adjustment level.
8. Wait for the measurement to stabilize fully. This may take more than 30 minutes. Monitor the H<sub>2</sub>O<sub>2</sub> concentration readings of both probes to see when the measurement has stabilized.
9. When the measurement has stabilized, check the H<sub>2</sub>O<sub>2</sub> 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<sub>2</sub>O<sub>2</sub> 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<sub>2</sub>O<sub>2</sub> 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<sub>2</sub>O<sub>2</sub> vapor chamber that can produce a stable H<sub>2</sub>O<sub>2</sub> 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 \(page 31\)](#)).
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** calibration mode (default mode), the sensor heating is switched off and the sensor will not withstand exposure to H<sub>2</sub>O<sub>2</sub> vapor.

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

**H<sub>2</sub>O<sub>2</sub> adjustment**  
  
Reference value, point 1  ppm  
  
Measured value, point 1  ppm

7. Wait until the ambient H<sub>2</sub>O<sub>2</sub> concentration has reached the desired calibration and adjustment level. Monitor the H<sub>2</sub>O<sub>2</sub> readings of both probes and allow the measurements to stabilize fully.
8. When the measurements have stabilized, check the H<sub>2</sub>O<sub>2</sub> concentration reading of the reference instrument. Enter the value of the reference into the **Reference value, point 1** field.  
The probe automatically enters the measured value for the calibration point.

9. Select **Activate adjustment** to store the adjustment in the probe.
10. Close the calibration mode with the **Stop calibration** button.

## 7.4 Testing Analog Output Level with Insight




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

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

The screenshot shows the 'Configure Device' window for HPP271 555 in Advanced Mode. The left sidebar lists various configuration categories, with 'Analog output 1' and 'Analog output 2' highlighted. The main panel shows the 'Output mode' set to '4...20 mA' and the 'Output parameter' dropdown set to 'ATEST'. The 'Test output level' field is set to '15.000 mA'. The 'Save' button is highlighted.

Figure 18 Setting Current Level for Analog Output Test in Insight Software

1. Connect the probe to Insight. See [Connecting to Insight Software \(page 34\)](#).
2. Wait for the start-up purge to finish.
3. Select > **Configure Device** and then select which output you want to test (either **Analog output 1** or **Analog output 2**).
4. From the **Output parameter** dropdown, select **ATEST**.
5. Enter the current level that you want the probe to output in the **Test output level** field.

6. Take the settings into use by selecting **Save**.
7. Disconnect the probe from the Insight USB cable and connect the probe to the device you are using to read the analog output test value.
8. Read the analog output from the probe in your device and verify that the probe output is correct.
9. After verifying the output, reconnect the probe to the Insight USB cable.
10. Go back to the Insight analog output configuration options in the  > **Configure Device** menu, and change the **Output parameter** selection back to normal output operation. Repeat the configuration for each output as necessary and **Save** the selections.



- ATEST is supported by HPP270 probe SW 1.3.0 and above.
- Insight SW version 1.0.2.76 does not support the ATEST output test functionality. See the related section in [Problems and Their Possible Solutions \(page 47\)](#).



## 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 \(page 70\)](#)).

#### Response time is slower than specified

Problem: Response time is slower than specified.	
Possible Cause:	Solution:
The filter is blocked.	<p>Change the filter.</p> <p>Be careful not to touch the sensors when the filter is off the probe.</p>
The probe has fallen and the filter has hit the floor.	<p>Remove the filter and visually check the sensors.</p> <ul style="list-style-type: none"> <li>• If the sensors are bent, broken, or disconnected, contact Vaisala technical support.</li> <li>• 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.</li> </ul> <p>Be careful not to touch the sensors when the filter is off the probe.</p>
The probe has been exposed to unsuitable chemicals (for example, DMSO).	<p>Change the filter and perform a chemical purge.</p> <p>Be careful not to touch the sensors when the filter is off the probe.</p>
The measurement filtering factor is configured to be too slow.	<p>Use the Vaisala Insight software, Modbus configuration register 030A<sub>hex</sub>, or an Indigo 200 transmitter to disable the filtering factor (set filtering factor to "1"), and check the measurement again. See:</p> <ul style="list-style-type: none"> <li>• <a href="#">Measurement Filtering Factor (page 12)</a></li> <li>• <a href="#">Vaisala Insight Software (page 34)</a></li> <li>• <a href="#">Configuration Registers (page 63)</a></li> </ul>

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

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

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

Problem: Measurement reading does not change during regular use for more than 5 minutes.	
Possible Cause:	Solution:
In analog mode: The scaling of the output is unsuitable, preventing the change from showing.	Check and change the analog output scaling with Insight software (see <a href="#">Vaisala Insight Software (page 34)</a> ).
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 <a href="#">Vaisala Insight Software (page 34)</a> ). Consider changing the analog output error level to be outside the measurement scale.

## Measurement reading appears incorrect

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

Problem: Measurement reading appears incorrect.	
Condensation has formed on the sensor when the probe was powered off.	When the probe is powered off, exposure to H <sub>2</sub> O <sub>2</sub> 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 <sub>2</sub> O <sub>2</sub> conditions.  A sensor damaged with H <sub>2</sub> O <sub>2</sub> condensation during power-off time cannot be repaired.
The filter is not installed on the probe.	Do not use the probe without the filter. Install the filter on the probe.
The yellow transport cap is still on the probe.	Remove the yellow transport cap when measuring with the probe.
The filter is broken.	Do not use the probe if the filter is broken. Remove the filter and visually check the sensors: <ul style="list-style-type: none"> <li>• If the sensors are bent, broken, or disconnected, contact Vaisala technical support.</li> <li>• If the sensors are intact, change the filter.</li> </ul> Be careful not to touch the sensors when the filter is off the probe.
In analog mode: Maximum load has been exceeded.	Check the analog output load, and reduce it to the specified maximum load or less. See output specifications for the permitted maximum load.
Ambient pressure is not normal atmospheric pressure.	Check the ambient pressure. See operating environment specification for the permitted operating pressure.
The PEROXCAP sensor is at the end of its life cycle.	Check the sensor vitality information in the Insight PC software diagnostics view. See <a href="#">Sensor Vitality Information in Insight (page 36)</a> .

## H<sub>2</sub>O<sub>2</sub> concentration reading shows > 0 ppm even though the probe is not exposed to H<sub>2</sub>O<sub>2</sub>

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

## The filter is wet

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>

## The filter is broken

Problem: The filter is broken.	
Possible Cause:	Solution:
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"> <li>• If the sensors are bent, broken, or disconnected, contact Vaisala technical support.</li> <li>• If the sensors are intact, change the filter.</li> </ul> <p>Be careful not to touch the sensors when the filter is off the probe.</p>

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

Problem: The probe does not power on, or there is no communication from the probe after power-on.	
Possible Cause:	Solution:
Power input to the probe is off.	Turn on the power input to the probe.
Probe wiring is incorrect.	Check the probe wiring and correct it if needed. See <a href="#">Wiring (page 20)</a> .
The probe cable is not properly connected.	Check the cable connection and correct it if needed.
The operating voltage is incorrect.	Check the operating voltage and correct if needed. See input and output specifications for the correct voltage.

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

In digital mode: The communication settings (for example the device address) are incorrect either in the probe or in the system where the probe is connected.

Check the communication settings. You can check the probe's communication settings with the Insight software. See [Vaisala Insight Software \(page 34\)](#)

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

**Problem: Insight PC software becomes stuck in a reset loop at start-up**

Possible cause:	Solution:
Insight SW version 1.0.2.76 can become stuck in a reset loop when using the ATEST output test selections or in certain sensor error states.	Uninstall Insight SW version 1.0.2.76 and install either an older or newer Insight SW version. See <a href="http://www.vaisala.com/insight">www.vaisala.com/insight</a> for the latest Insight SW release, or contact Vaisala Support for earlier SW versions.

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

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

Possible Cause:	Solution:
Pin #5 was floating at start-up or reset, which means the probe is in digital mode.	Check pin #5. See <a href="#">Wiring (page 20)</a> .
Analog outputs are configured to be off.	Check the analog output mode with the Insight software or Modbus configuration registers 0700 <sub>hex</sub> and 0800 <sub>hex</sub> . See: <ul style="list-style-type: none"> <li>• <a href="#">Vaisala Insight Software (page 34)</a></li> <li>• <a href="#">Configuration Registers (page 63)</a></li> </ul>
Probe wiring is incorrect.	Check the probe wiring and correct it if needed. See <a href="#">Wiring (page 20)</a> .
The operating voltage is incorrect.	Check the operating voltage and correct if needed. See input and output specifications for the correct voltage.
The probe cable is not properly connected.	Check the cable connection and correct it if needed.
Power input to the probe is off.	Turn on the power input.

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

The analog output error level is configured to be 0 mA, and the probe is performing start-up purge or is in error state.

Wait for 5 minutes for the possible start-up purge to finish. If the output remains 0 mA after 5 minutes, check the probe diagnostics with the Insight software (see [Vaisala Insight Software \(page 34\)](#)).

## Triggering manual purge with Modbus cannot be completed successfully

**Problem:** Triggering manual purge with Modbus (register 1283/0502<sub>hex</sub>) cannot be completed successfully.

Possible Cause:	Solution:
A value is written into the register before the purge has completed.	<p>The manual purge trigger register must only be written into once per purge cycle (write <b>1</b> into the register to start the purge). After starting the purge by writing <b>1</b>, the register value must only be read until the purge cycle has completed.</p> <p>Write into and read from the register in the following order:</p> <ol style="list-style-type: none"> <li>1. Write <b>1</b> to start the purge</li> <li>2. Read the updating progress value (<b>1 ... 100 %</b>)</li> <li>3. When the progress has reached <b>100 %</b>, the value of the register changes either to <b>0</b> (purge completed successfully, purge not in progress) or <b>-1</b> (purge failed, purge not in progress)</li> <li>4. After reading the final value (<b>0</b> or <b>-1</b>), a new purge can again be triggered by writing <b>1</b>.</li> </ol>

## In analog mode, start-up purge is not performed

**Problem:** In analog mode, start-up purge is not performed.

Possible Cause:	Solution:
The probe is in digital mode at start-up (pin #5 is floating).	Check pin #5. See <a href="#">Wiring (page 20)</a> .

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

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

Possible Cause:	Solution:
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Problem: At start-up in analog mode, the probe remains in the error state for over 5 minutes.	
The analog output scaling is unsuitable.	Check the analog output scaling with the Insight software and correct the scaling if needed (see <a href="#">Vaisala Insight Software (page 34)</a> ).
There is a probe or sensor error.	Check the probe diagnostics with the Insight software (see <a href="#">Vaisala Insight Software (page 34)</a> ).

## 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<sub>hex</sub> and 0806<sub>hex</sub>).

### More Information

- [Configuration Registers \(page 63\)](#)

# 9. Technical Data

## HPP271

Table 5 Measurement Performance

Property	Description/Value
<b>Hydrogen Peroxide</b>	
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 <sub>2</sub> O <sub>2</sub>	±10 ppm
up to 1000 ppm H <sub>2</sub> O <sub>2</sub>	±15 ppm
Accuracy (including non-linearity, hysteresis, and repeatability) at +10 ... +25 °C (+50 ... +77 °F) , 10 ... 2000 ppm H <sub>2</sub> O <sub>2</sub>	±10 ppm or 5 % of reading (whichever is greater)
Factory calibration uncertainty, at +25 °C (+77 °F), 500 ppm H <sub>2</sub> O <sub>2</sub> <sup>1)</sup>	±10 ppm
Response time at +23 °C (+73 °F):	
Response time (T <sub>63</sub> )	70 s
Response time (T <sub>90</sub> )	200 s
<b>Other Parameters</b>	
H <sub>2</sub> O ppm by volume	

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



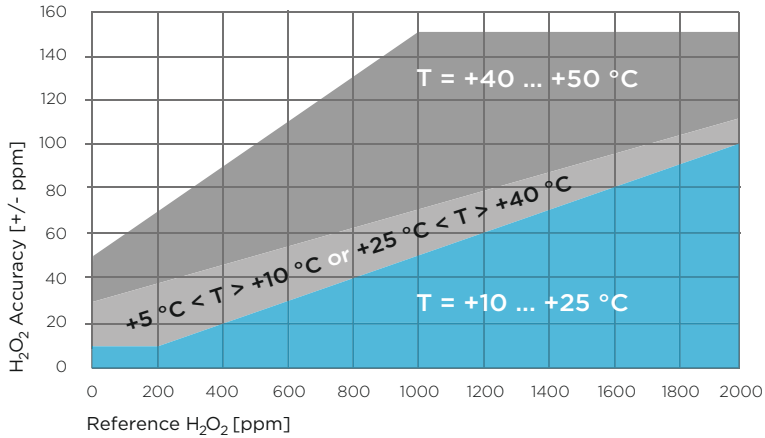


Figure 19 H<sub>2</sub>O<sub>2</sub> Measurement Accuracy in 3 Temperature Ranges as Function of H<sub>2</sub>O<sub>2</sub> Concentration (Including Non-Linearity and Repeatability; Specification Valid for Range 10 ... 2000 ppm H<sub>2</sub>O<sub>2</sub>)

Table 6 Inputs and Outputs

Property	Description/Value
Operating voltage	Digital output: 15 ... 30 VDC Analog output: 15 ... 25 VDC
<b>Current Consumption at +25 °C (+77 °F)</b>	
In digital mode	Max. 10 mA
In analog mode	Max. 50 mA
During purge	Max. 250 mA
<b>Digital Output</b>	
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 v1.02
<b>Analog Output</b>	
Outputs	2 × 4 ... 20 mA 3-wire current outputs

Property	Description/Value
Max. load	500 $\Omega$
Accuracy	$\pm 0.1\%$ of full scale
Analog output temperature dependence	0.005 %/ $^{\circ}\text{C}$ (0.003 %/ $^{\circ}\text{F}$ ) full scale

Table 7 Operating Environment

Property	Description/Value
Operating temperature	+0 ... +70 $^{\circ}\text{C}$ (+32 ... +158 $^{\circ}\text{F}$ )
Storage temperature	-20 ... +70 $^{\circ}\text{C}$ (-4 ... +158 $^{\circ}\text{F}$ )
Ambient pressure	Normal atmospheric pressure
EMC compliance	EN/IEC 61326-1, Industrial Environment

Table 8 Mechanical Specifications

Property	Description/Value
Weight	110 g (3.88 oz)
IP rating	IP65
Connector	M12/5 male
<b>Materials</b>	
Probe body	AISI316L stainless steel
Filter cap	Porous PTFE

## 9.1 Accessories

Table 9 Spare Parts and Accessories

Name	Order Code
USB cable for PC connection <sup>1)</sup>	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

Name	Order Code
Filter	DRW246363SP
Gland set for through-wall installation, HPP271	HPP271MOUNTINGSET1
Flange for through-wall installation, HPP271	HPP271MOUNTINGSET2
Wall mount for HPP271 and HPP272	HPP272WALLMOUNT
<b>Transmitters</b>	
Indigo transmitters	See <a href="http://www.vaisala.com/indigo">www.vaisala.com/indigo</a>
Connection cable to Indigo (1 m)	INDIGOCABLEHD1M5
Connection cable to Indigo (3 m)	INDIGOCABLEHD3M
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](http://www.vaisala.com/insight)



For more information on ordering spare parts and accessories, see <http://store.vaisala.com>.

## 9.2 Dimensions

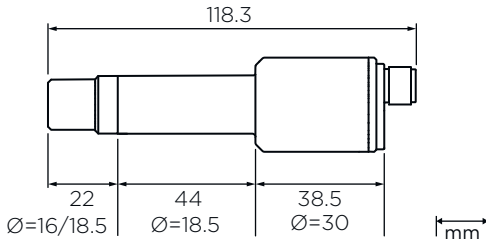


Figure 20 HPP271 Dimensions

### More Information

- [HPP271MOUNTINGSET1/HPP272MOUNTINGSET1 Dimensions \(page 58\)](#)
- [HPP271MOUNTINGSET2/HPP272MOUNTINGSET2 Dimensions \(page 59\)](#)

## 9.2.1 HPP271MOUNTINGSET1/HPP272MOUNTINGSET1 Dimensions

Figure 21 (page 58) shows the dimensions of the gland through-wall installation accessory HPP271MOUNTINGSET1/HPP272MOUNTINGSET1 in millimeters and [inches].

For an installation example, see [Installation \(page 18\)](#).

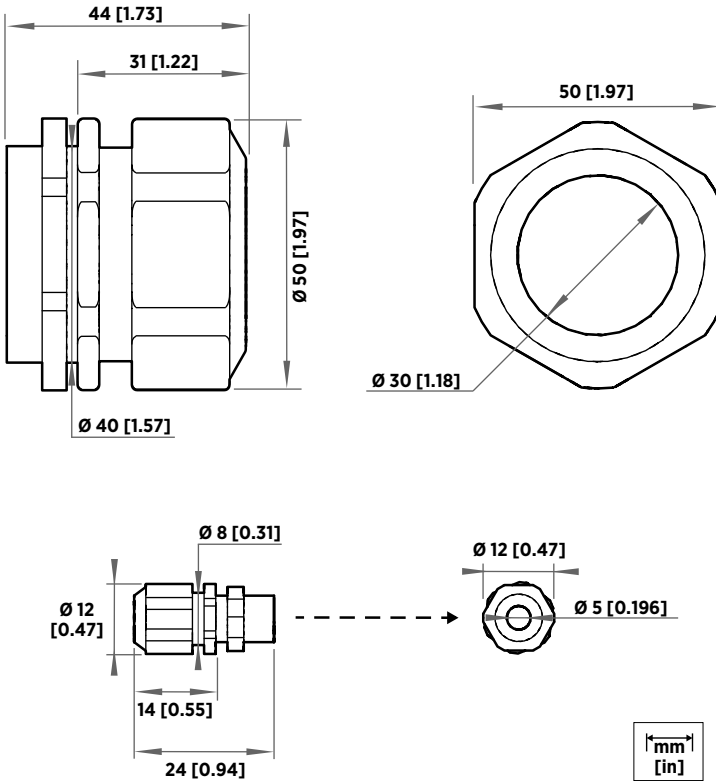


Figure 21 HPP271MOUNTINGSET1/HPP272MOUNTINGSET1 Dimensions



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

### More Information

- [Installation \(page 18\)](#)

## 9.2.2 HPP271MOUNTINGSET2/HPP272MOUNTINGSET2 Dimensions

Figure 22 (page 59) shows the dimensions of the flange through-wall installation accessory HPP271MOUNTINGSET2/HPP272MOUNTINGSET2 in millimeters and [inches].

For an installation example, see [Installation \(page 18\)](#).

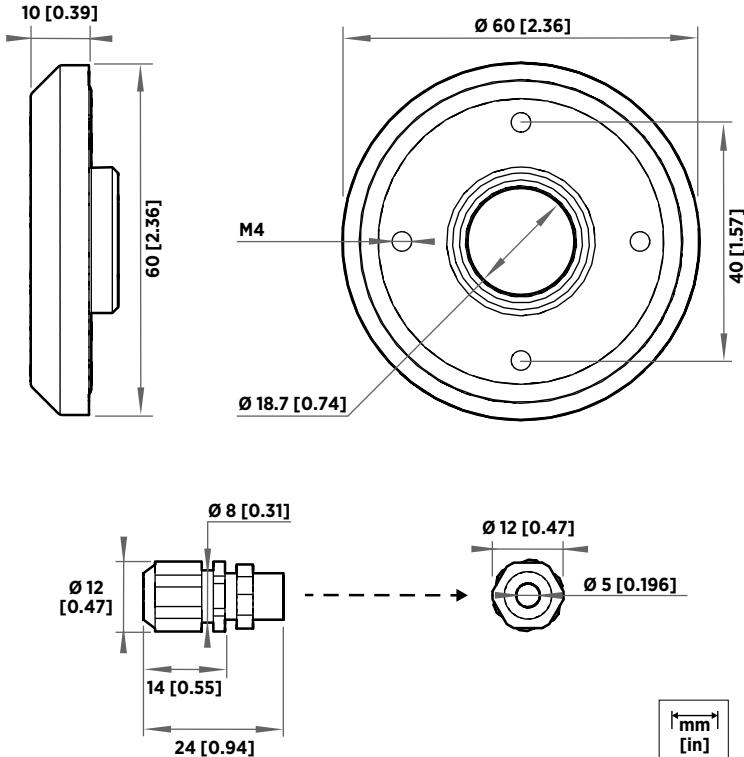


Figure 22 HPP271MOUNTINGSET2/HPP272MOUNTINGSET2 Dimensions



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

### More Information

- [Installation \(page 18\)](#)

### 9.2.3 HPP272WALLMOUNT Dimensions

Figure 23 (page 60) shows the dimensions of the HPP271/HPP272 wall mounting accessory HPP272WALLMOUNT in millimeters and [inches].

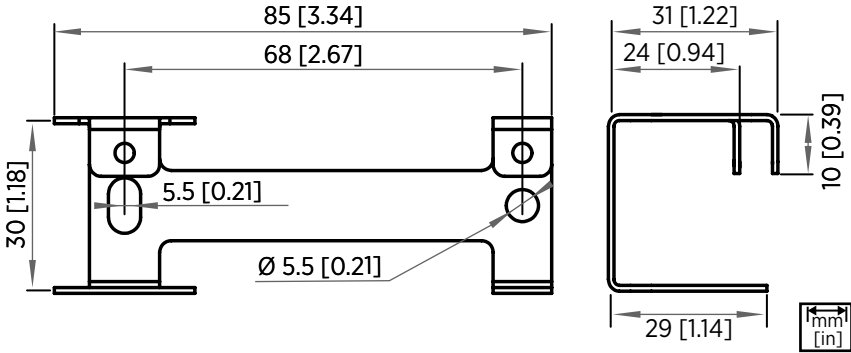


Figure 23 HPP272WALLMOUNT Dimensions



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

#### More Information

- [Installation \(page 18\)](#)

# 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 <sub>hex</sub>	Read Holding Registers	Class 0
16	10 <sub>hex</sub>	Write Multiple Registers	Class 0
43 / 14	2B <sub>hex</sub> / 0E <sub>hex</sub>	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<sub>hex</sub>; 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 <sub>hex</sub> ... 7FFE <sub>hex</sub>	Value in range 0 ... 32766
8002 <sub>hex</sub> ... FFFF <sub>hex</sub>	Value in range -32766 ... -1 (2's complement)
8000 <sub>hex</sub>	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)) 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<sub>hex</sub> 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 <sub>hex</sub>	Vaporized hydrogen peroxide concentration by volume	32-bit float	ppm
15	000E <sub>hex</sub>	Water concentration by volume	32-bit float	ppm
257	0100 <sub>hex</sub>	Vaporized hydrogen peroxide concentration by volume	16-bit signed integer	ppm
264	0107 <sub>hex</sub>	Water concentration by volume	16-bit signed integer	ppm

## A.4.2 Configuration Registers



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

Table 14 Modbus Configuration Data Registers (Writable)

Register Number (Decimal)	Address (Hexadecimal)	Register Description	Data Format	Unit / Valid Range
769	0300 <sub>hex</sub>	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 <sub>hex</sub> ).	32-bit float	hPa 813.25 ... 1213.25 (default 1013.25 hPa) (Init copied from power-up value)
773	0304 <sub>hex</sub>	Power-up value for pressure compensation	32-bit float	hPa 813.25 ... 1213.25 (default 1013.25 hPa)

Register Number (Decimal)	Address (Hexadecimal)	Register Description	Data Format	Unit / Valid Range
777	0308 <sub>hex</sub>	Purge interval	16-bit integer	min 60 ... 10080 (= 1 hour ... 1 week) (default: 1440 (= 24 hours))
779	030A <sub>hex</sub>	Measurement filtering factor (affects only H <sub>2</sub> O <sub>2</sub> concentration measurement)	32-bit float	Range: 0.01 ... 1 1 = Filter is disabled < 1 = Reading is a combination of latest measurement and the earlier reading. The value of the register defines the portion of the latest measurement, for example, 0.9 means the reading consists 90 % of the latest measurement and 10 % of the earlier reading.
781	030C <sub>hex</sub>	Low H <sub>2</sub> O <sub>2</sub> clipping limit	32-bit float	ppm Any numerical value (default: 0)

Register Number (Decimal)	Address (Hexadecimal)	Register Description	Data Format	Unit / Valid Range
1283	0502 <sub>hex</sub>	Purge status / manual start	16-bit function status	<p>When reading from register:</p> <p>1 ... 100 = Purge is in progress (progress shown as 1 ... 100%)</p> <p>0 = Previous purge completed successfully, purge is not in progress</p> <p>... -1 = Previous purge has failed</p> <p>When writing to register:</p> <p>1 = Start purge</p> <p>Note: After starting the purge by writing 1, only read from the register until the purge has completed. See the related section in <a href="#">Problems and Their Possible Solutions</a> (page 47).</p>
1285	0504 <sub>hex</sub>	Pressure compensation on/off	16-bit boolean	<p>1 = On</p> <p>0 = Off</p>
1287	0506 <sub>hex</sub>	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 <sub>hex</sub>	Allow interval purge during H <sub>2</sub> O <sub>2</sub> exposure	16-bit boolean	<p>1 = On</p> <p>0 = Off</p> <p>(default: 0 = Off)</p>
1537	0600 <sub>hex</sub>	Modbus address	16-bit integer	1 ... 255 (default: 240)
1538	0601 <sub>hex</sub>	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 <sub>hex</sub>	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 <sub>hex</sub>	Response delay	16-bit integer	ms 0 ... 1000
1541	0604 <sub>hex</sub>	Restart device	16-bit function status	When writing to register: 1 = Restart the device
<b>Analog Output 1:</b>				
1793	0700 <sub>hex</sub>	Output mode	enum	0 = Off 2 = 4 ... 20 mA (default: 2 = 4 ... 20 mA)
1794	0701 <sub>hex</sub>	Output parameter	16-bit register address	0000 <sub>hex</sub> or 000E <sub>hex</sub> See <a href="#">Table 13 (page 63)</a> for measurement register descriptions.
1795	0702 <sub>hex</sub>	Scale low end	32-bit float	Set the lower limit of the measurement scale for the output parameter chosen in register 0701 <sub>hex</sub> (Output parameter).
1797	0704 <sub>hex</sub>	Scale high end	32-bit float	Set the upper limit of the measurement scale for the output parameter chosen in register 0701 <sub>hex</sub> (Output parameter).
1799	0706 <sub>hex</sub>	Error output	32-bit float	mA 0 ... 25

Register Number (Decimal)	Address (Hexadecimal)	Register Description	Data Format	Unit / Valid Range
1801	0708 <sub>hex</sub>	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 <sub>hex</sub>	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 <sub>hex</sub>	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 <sub>hex</sub>	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
<b>Analog Output 2:</b>				
2049	0800 <sub>hex</sub>	Output mode	enum	0 = Off 2 = 4 ... 20 mA (default: 2 = 4 ... 20 mA)
2050	0801 <sub>hex</sub>	Output parameter	16-bit register address	0000 <sub>hex</sub> or 000E <sub>hex</sub> See <a href="#">Table 13 (page 63)</a> for measurement register descriptions.

Register Number (Decimal)	Address (Hexadecimal)	Register Description	Data Format	Unit / Valid Range
2051	0802 <sub>hex</sub>	Scale low end	32-bit float	Set the lower limit of the measurement scale for the output parameter chosen in register 0801 <sub>hex</sub> (Output parameter).
2053	0804 <sub>hex</sub>	Scale high end	32-bit float	Set the upper limit of the measurement scale for the output parameter chosen in register 0801 <sub>hex</sub> (Output parameter).
2055	0806 <sub>hex</sub>	Error output	32-bit float	mA 0 ... 25
2057	0808 <sub>hex</sub>	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 <sub>hex</sub>	Low error limit	32-bit float	% of scaled range 0 ... 20 = Set the output in error state when the measurement goes this many percent below the low end of the scale NaN = Disable error limit at low end
2061	080C <sub>hex</sub>	High clipping limit	32-bit float	% of scaled range 0 ... 20 = Clip the output when the measurement goes this many percent above the high end of the scale NaN = Disable clipping limit at high end

Register Number (Decimal)	Address (Hexadecimal)	Register Description	Data Format	Unit / Valid Range
2063	080E <sub>hex</sub>	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
<b>Service Agreement:</b>				
2817	0B00 <sub>hex</sub>	Customer name	24-character ASCII string	Read-only
2829	0B0C <sub>hex</sub>	Contract number	24-character ASCII string	Read-only
2841	0B18 <sub>hex</sub>	Start date	three 16-bit integer decimal values (YYYY, M, and D)	Read-only
2844	0B1B <sub>hex</sub>	End date	three 16-bit integer decimal values (YYYY, M, and D)	Read-only
<b>Factory Settings:</b>				
7937	1E00 <sub>hex</sub>	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 <sub>hex</sub>	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 <sub>hex</sub>	Status code low	32-bit	See <a href="#">Table 16 (page 70)</a> . <sup>1)</sup>
516	0203 <sub>hex</sub>	Status code high	32-bit	See <a href="#">Table 17 (page 71)</a> . <sup>1)</sup>
529	0210 <sub>hex</sub>	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)
536	0217 <sub>hex</sub>	Status of Water concentration by volume	16-bit	
547	0222 <sub>hex</sub>	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<sub>hex</sub> (32-bit)

Value of Register 0201 <sub>hex</sub>	Error Message	Severity
0	Status OK.	



Value of Register 0201 <sub>hex</sub>	Error Message	Severity
1	Firmware checksum mismatch.	Critical
2	Device settings corrupted.	Critical
8	Supply voltage too high.	Error
16	Internal voltage too low.	Error
32	Internal voltage too high.	Error
64	Humidity sensor failure (open circuit).	Error
1024	Humidity sensor failure (open circuit).	Error
16384	Temperature sensor failure (open circuit).	Error
32768	Temperature sensor failure (short circuit).	Error
262144	Temperature sensor failure (open circuit).	Error
524288	Temperature sensor failure (short circuit).	Error

Table 17 Error Codes in Register 0203<sub>hex</sub> (32-bit)

Value of Register 0203 <sub>hex</sub>	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 <sub>hex</sub>	VendorName	“Vaisala”

Object Id (Decimal)	Object Id (Hexadecimal)	Object Name	Example Contents
1	01 <sub>hex</sub>	ProductCode	"HPP271"
2	02 <sub>hex</sub>	MajorMinorVersion	Software version (for example "1.2.3")
3	03 <sub>hex</sub>	VendorUrl	"http://www.vaisala.com/"
4	04 <sub>hex</sub>	ProductName	"Hydrogen peroxide probe HPP271"
128	80 <sub>hex</sub>	SerialNumber <sup>1)</sup>	Serial number of the device (for example "K0710040")
129	81 <sub>hex</sub>	CalibrationDate <sup>1)</sup>	Calibration date
130	82 <sub>hex</sub>	CalibrationText <sup>1)</sup>	Calibration information text

1) *Vaisala-specific device identification object.*

## A.4.5 Test Value Registers

Table 19 Test Value Registers

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

## A.5 Modbus Communication Examples

### Reading H<sub>2</sub>O<sub>2</sub> Concentration Value




Device address used in the following examples is 240 (F0<sub>hex</sub>).  
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 <sub>hex</sub>	HPP271 address	F0 <sub>hex</sub>	HPP271 address
03 <sub>hex</sub>	Function (Read Holding Registers)	03 <sub>hex</sub>	Function (Read Holding Registers)
00 <sub>hex</sub>	Register address	04 <sub>hex</sub>	Number of data bytes
00 <sub>hex</sub>		D4 <sub>hex</sub>	Value of first register (least significant word)
00 <sub>hex</sub>	Number of 16-bit registers to read (2)	7A <sub>hex</sub>	
02 <sub>hex</sub>		43 <sub>hex</sub>	Value of second register (most significant word)
D1 <sub>hex</sub>	Modbus RTU checksum	E8 <sub>hex</sub>	
2A <sub>hex</sub>		33 <sub>hex</sub>	Modbus RTU checksum
(silence for 3.5 bytes)	End of Modbus RTU frame	AB <sub>hex</sub>	
		(silence for 3.5 bytes)	End of Modbus RTU frame

Communication Description	
Register address	1 (1-based Modbus documentation format) = 0000 <sub>hex</sub> (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 <sub>hex</sub> , 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 <sub>hex</sub>	HPP271 address	F0 <sub>hex</sub>	HPP271 address
10 <sub>hex</sub>	Function (Write Multiple Registers)	10 <sub>hex</sub>	Function (Write Multiple Registers)
03 <sub>hex</sub>	Register address	03 <sub>hex</sub>	Register address
08 <sub>hex</sub>		08 <sub>hex</sub>	
00 <sub>hex</sub>	Number of registers to write (1)	00 <sub>hex</sub>	Number of 16-bit registers written (1)
01 <sub>hex</sub>		01 <sub>hex</sub>	
02 <sub>hex</sub>	Number of data bytes	95 <sub>hex</sub>	Modbus RTU checksum
0B <sub>hex</sub>	Value for the register	6E <sub>hex</sub>	
40 <sub>hex</sub>		(silence for 3.5 bytes)	End of Modbus RTU frame
9B <sub>hex</sub>	Modbus RTU checksum	<div><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 <sub>hex</sub>			
(silence for 3.5 bytes)	End of Modbus RTU frame		

Communication Description	
Register address	777 (1-based Modbus documentation format) = 0308 <sub>hex</sub> (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 <sub>hex</sub> = 2880 (minutes) (= 48 hours)



## Warranty

For standard warranty terms and conditions, see [www.vaisala.com/warranty](http://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](mailto:helpdesk@vaisala.com). Provide at least the following supporting information as applicable:

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

For more information, see [www.vaisala.com/support](http://www.vaisala.com/support).

## Recycling



Recycle all applicable material.



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







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