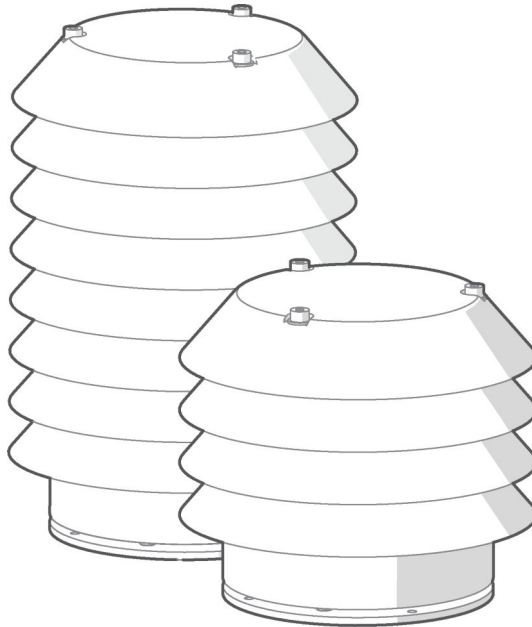


# User Guide

Vaisala Air Quality Transmitter

**AQT400 Series**



PUBLISHED BY

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# 1. About This Document

## 1.1 Version Information

This document provides information about the installation, operation, and maintenance of Vaisala Air Quality Transmitter AQT400 Series: AQT420 and AQT410.

Table 1 Document Versions

Document Code	Date	Description
M211942EN-C	June 2018	<ul style="list-style-type: none"> <li>• Beacon View changed to Beacon Cloud</li> <li>• Service cable update</li> </ul>
M211942EN-B	February 2018	<ul style="list-style-type: none"> <li>• Change of AQ Tool operating system requirements</li> <li>• Change of radiation shield</li> <li>• Change of UI application names:               <ul style="list-style-type: none"> <li>• AQ-View changed to Beacon View</li> <li>• AQT Configuration Tool changed to AQ Tool</li> </ul> </li> </ul>
M211942EN-A	January 2017	First version.

## 1.2 Related Manuals

Table 2 Related Manuals

Document Code	Name
M212059EN	<i>Vaisala Air Quality Transmitter AQT400 Series Configuration Guide</i>
M212056EN	<i>Vaisala Multi-Observation Gateway MOG100 Configuration Guide</i>
M211951EN	<i>Vaisala Multi-Observation Gateway MOG100 User Guide</i>

The documentation is available online at [www.vaisala.com](http://www.vaisala.com).

## 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

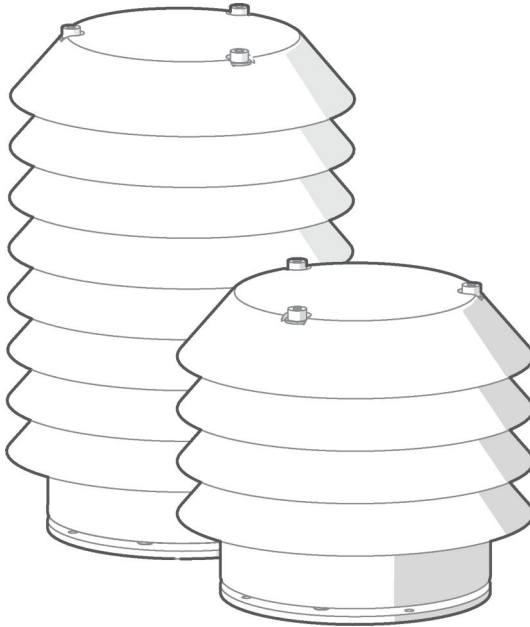
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## 2. Vaisala Air Quality Transmitter AQT400 Series



Vaisala Air Quality Transmitter AQT400 Series measures the pollution content of ambient air. The series consists of two products, AQT420 and AQT410.

The measurement performance of AQT400 series is based on proprietary advanced algorithms that enable parts per billion (ppb) measurements at an affordable price by using electrochemical sensors. The algorithms compensate for the impact of ambient conditions and aging on the sensor elements and remove the need for costly gas sampling and maintenance equipment.

AQT400 series is specifically designed for air quality monitoring networks in urban areas, road networks, or around industrial sites and transportation hubs. Thanks to its small weight and compact size, it is ideally suited for deployment even in large air quality networks.

The measurement data is sent wirelessly to a web-based database with a gateway solution or is available locally through a serial interface. Depending on local conditions, AQT400 series device has a maintenance and calibration interval of 12 ... 24 months.

Table 3 AQT400 Product Comparison

Measurement	AQT420	AQT410
NO <sub>2</sub>	✓	✓
SO <sub>2</sub>	✓	✓
CO	✓	✓
O <sub>3</sub>	✓	✓
PM <sub>2,5</sub>	✓	-
PM <sub>10</sub>	✓	-
Humidity	✓	✓
Temperature	✓	✓
Air pressure	✓	✓

Table 4 AQT400 Product Package Contents

Product Content	Details	Order Code
Installation cable	3.5 m (11 ft 6 in)	220496
	5 m (16 ft 5 in)	223283
	10 m (32 ft 10 in)	220497
Mounting kit	-	ASM211983
Test report	-	-
User guide	-	-

Table 5 AQT400 Optional Accessories

Accessory	Details	Order Code
Calibration adapter	-	ASM212134
Mounting kit for pole mast	For 60 mm (2.36 in) pole	APPKP60-SET1/2
	For 75 mm (2.95 in) pole	APPKP75-SET1/2
	For 86 mm (3.39 in) pole	APPKP86-SET1/2
	For 100 mm (3.94 in) pole	APPKP100-SET1/2
Tripod with mast (Fe/Zn)	1.72 ... 2.13 m (5 ft 8 in ... 6 ft 12 in)	249344

Accessory	Details	Order Code
Tripod with mast (Fe/Zn)	2.74 ... 3.2 m (8 ft 12 in ... 10 ft 6 in)	249343
Service cable kit, including adapter, cable, power supply, and USB-RS-232 converter <sup>1)</sup>	-	253163SET

1) *Recommended to order 1 kit for each AQT site.*

## 2.1 Safety

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



**WARNING!** Do not substitute parts or modify the system, or install unsuitable parts in the system.



**WARNING!** Do not perform installation or maintenance procedures when there is a risk of thunderstorm or lightning activity in the area.



**WARNING!** Follow the risk assessments you have carried out for the installation work. To ensure safety, make sure that all work is organized and planned, and carried out by competent persons.



**WARNING!** Follow local and state legislation and regulations on occupational safety.



**WARNING!** Failure to comply with these precautions or with specific warnings elsewhere in these instructions violates safety standards of design, manufacture, and intended use of the product. Vaisala assumes no liability for the customer's failure to comply with these requirements.



**WARNING!** If the equipment is used in a manner not specified by Vaisala, the protection provided by the equipment may be impaired.



**CAUTION!** Improper modification can damage the product or lead to malfunction. Any modification voids your warranty.

Vaisala Air Quality Transmitter AQT420 Series incorporates a laser particle counter.

AQT420 is classified as a Class 1 laser device in accordance with International Standard IEC/EN 60825-1. The laser is contained in an enclosure, preventing direct physical access to laser radiation. A Class 1 laser is safe under all conditions of normal use.

## 2.1.1 ESD Protection

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

To avoid delivering high static voltages to the product:

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

## 2.2 Regulatory Compliances

This product complies with the following performance and environmental test standards:

- EN/IEC 61326-1
- EN 55032 Class B



### 2.2.1 FCC Compliance

AQT410/420 complies with FCC Chapter 47 Part 15. Operating is subject to the following two conditions:

- This device may not cause harmful interference, and
- This device must accept any interference received, including interference that may cause undesired operation.



This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

### 3. Functional Description

#### 3.1 Structure of AQT400

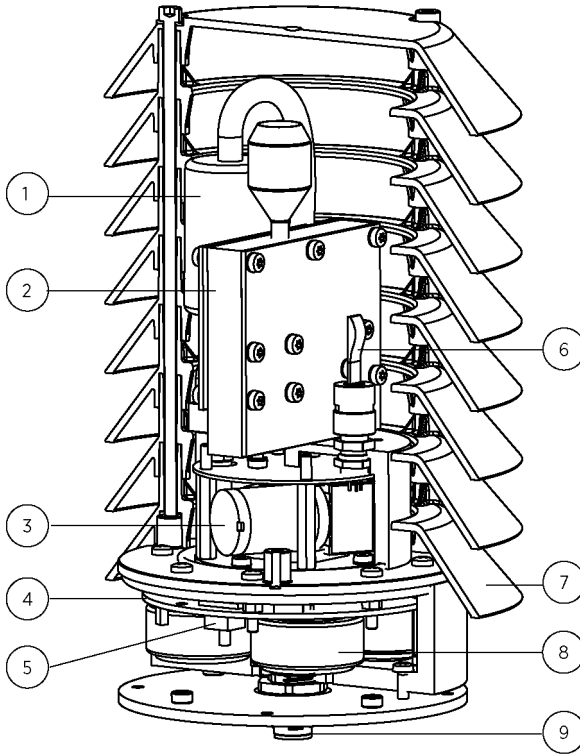


Figure 1 Structure of AQT400

- 1 (AQT420 only) Filter
- 2 (AQT420 only) Laser particle counter (LPC)
- 3 (AQT420 only) Pump
- 4 Main electronics board
- 5 Integrated pressure sensor
- 6 Combined temperature and humidity sensor
- 7 Radiation shield
- 8 Sensor elements (4 sensors per unit)
- 9 M12 connector

## 3.2 AQT400 Measurements



The available measurements depend on the product variant and configuration.

The measured variables have been configured to AQT400 at the factory. When the air quality transmitter is on, it continuously takes measurements, regardless of how often the measurements are sent to the database or printed out from the serial port.

The measurements of the particle counter are based on the number of particles sampled and averaged over a period of 60 seconds and the default measurement interval is 10 minutes.

Table 6 AQT400 Measurements

Measurement	Unit	Measurement Interval	Measurement Output
Nitrogen dioxide (NO <sub>2</sub> )	ppm	1 minute	1-minute average
Sulphur dioxide (SO <sub>2</sub> )	ppm		
Carbon monoxide (CO)	ppm		
Ozone (O <sub>3</sub> )	ppm		
Particulate matter PM <sub>2.5</sub>	µg/m <sup>3</sup>	10 minutes	1-minute average of the last minute of the 10-minute sample
Particulate matter PM <sub>10</sub>	µg/m <sup>3</sup>		
Air temperature	°C/°F	1 minute	1-minute average
Air pressure	mbar		
Humidity	%RH		

Table 7 Conversion from ppb to µg/m<sup>3</sup>

Gas	Conversion Factor <sup>1)</sup>
NO <sub>2</sub>	1 ppb = 1.88 µg/m <sup>3</sup>
SO <sub>2</sub>	1 ppb = 2.62 µg/m <sup>3</sup>
CO	1 ppb = 1.145 µg/m <sup>3</sup>
O <sub>3</sub>	1 ppb = 2.00 µg/m <sup>3</sup>

- 1) The conversion assumes an ambient pressure of 1 atmosphere and a temperature of +25 °C (77 °F).



1 ppb equals 0.001 ppm.

### 3.2.1 Stabilization Period



When AQT400 is switched on, let the unit stabilize for at least 24 hours before using the measurement results. To ensure optimal measuring accuracy, Vaisala recommends a 48-hour stabilization period. The units take measurements during the stabilization period, but they are marked as invalid.

## 3.3 Electrochemical Cells for Gas Measurements

The gas measuring technology in AQT400 is based on proprietary advanced algorithms and electrochemical technology.

The sampled gas causes a reduction or oxidation reaction in an electrochemical cell. Both reactions create a weak electric current. The electric current is directly dependent on the volume of measured gas. By measuring the electric current and using advanced calculation and compensation algorithms, AQT400 calculates the gas content. Most electrochemical cells are highly susceptible to ambient conditions (temperature and humidity), but AQT400 reverses the impact with a proprietary adjustment and compensation system, which guarantees accurate ppb measurements.

The electrochemical cells require a stabilization period of at least 24 hours after switching the device on before using the measurement results. To ensure optimal measuring accuracy, Vaisala recommends a 48-hour stabilization period. The devices take measurements during the stabilization period, but the measurements are marked as invalid. Gas measurement from the past 5 days affect the measurement results.



The gas measurements may show negative results during the startup stabilization period. The negative values are due to variation in the zero-point calibration. The values are shown and saved to make sure that no data is lost and to be able to detect and adjust the data in post-processing.

## 3.4 Laser Particle Counter (LPC)

The particle sensor technology of the laser particle counter in AQT420 is based on the scattering of laser light caused by passing particles. With the help of optics and photosensitive sensors, the laser particle counter measures the angular scattering intensity data and analyzes it with digital signal processing (DSP). The method allows measuring of particles of sizes 0.3 ... 10  $\mu\text{m}$ , and calculating the particle masses  $\text{PM}_{2.5}$  and  $\text{PM}_{10}$ .

The laser particle counter (LPC) is a Class 1 laser product.



The measurements of the particle counter are based on the number of particles sampled over a period of 60 seconds, and the default measurement interval is 10 minutes. You can configure these through a command line interface. During the sampling, the LPC pump in the device emits a sound.

#### More Information

- [Safety \(page 9\)](#)

## 3.5 Impact of Ambient Conditions

The ambient conditions (temperature and relative humidity) can influence and distort the measurement results. AQT400 includes a sophisticated compensation feature for eliminating the distortion in a non-condensing environment. If the conditions change very fast (for example, the relative humidity suddenly drops), there may be some measuring inaccuracy that temporarily exceeds the specifications.

High relative humidity affects the laser particle counter (LPC). To eliminate the effects, AQT400 compensates for this, but spikes may occur in PM<sub>10</sub> measurement results in condensing conditions.

### Temperature

For the operating environment, measurement performance is fully operational and within specifications for  $-30 \dots +40 \text{ }^{\circ}\text{C}$  ( $-22 \dots +104 \text{ }^{\circ}\text{F}$ ) and the limiting parameter is the electrochemical cell for gas measurements. In temperature range  $-40 \dots +50 \text{ }^{\circ}\text{C}$  ( $-40 \dots +122 \text{ }^{\circ}\text{F}$ ), the device stays operational, but the measurements may not be fully within specifications (limited performance).



**CAUTION!** Avoid direct sunlight in high temperatures for long periods of time. For example, exposure to  $+50 \text{ }^{\circ}\text{C}$  ( $+122 \text{ }^{\circ}\text{F}$ ) may damage the air quality transmitter.

### Humidity

With humidity, the limiting factor in low  $<15 \text{ \%RH}$  is related to the electrochemical cell drying and for high humidity values  $>95 \text{ \%RH}$  for the cell water absorption.

High humidity ( $>95 \text{ \%RH}$ ) also affects performance of the laser particle calculator as the particles absorb water from the air and grow in size, affecting the equivalent diameter, division between different size bins, and mass. This effect is compensated to some extent, resulting in limited performance.

### Pressure

AQT400 must be calibrated in the pressure range it is used in. Standard calibration is valid for  $800 \dots 1200 \text{ hPa}$ . Pressure extremes affect the accuracy of calibration because the device measures gas concentration in the air volume.

## 4. Installation

### 4.1 Selecting Location

The compact and weatherproof AQT400 can be installed in a variety of outdoor locations.



To ensure representative ambient measurements, follow these requirements when placing the instrument.

- Do not mount the device close to high-powered radio transmitters or weather station antennas.
- Make sure that other locally operated equipment, such as power lines and generators, cannot affect the performance.
- If you use radio communication, for example MOG100, install it to a different height and away from the air quality transmitter.
- Make sure that power supply and communication lines are available.



**CAUTION!** Avoid direct sunlight in high temperatures for long periods of time. For example, exposure to +50 °C (+122 °F) may damage the air quality transmitter.

### 4.2 Required Tools and Equipment

To install AQT400, you need the following tools:

- Crosshead screwdriver
- (For mast or sensor support arm installation) 5-mm Allen key
- (For wall installation) Screwdriver and 2 screws

### 4.3 Unpacking AQT400

Remove the air quality transmitter from its cardboard package and check that no visible damage has occurred during transport. If you detect any damage, immediately contact your carrier and Vaisala technical support.

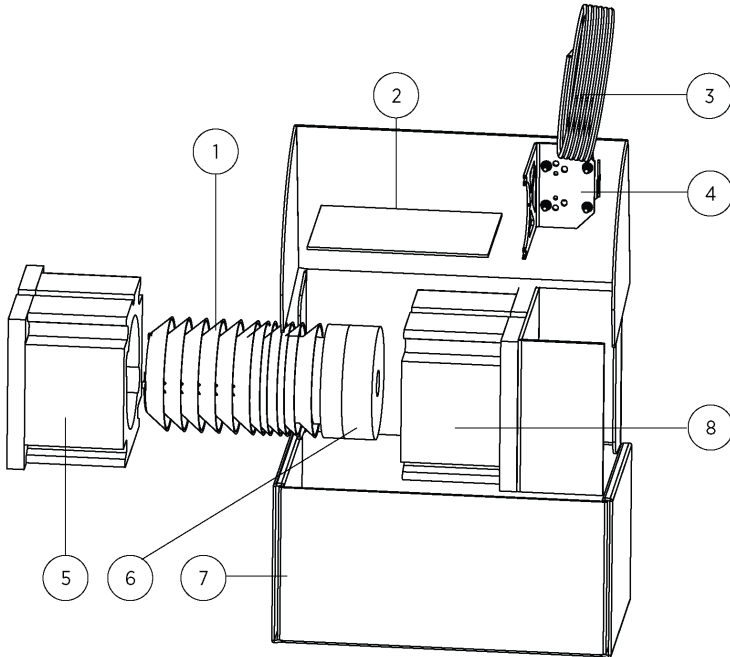


Figure 2 Contents of Shipping Container

- 1 Air quality transmitter
- 2 User guide and test report
- 3 Cable
- 4 Mounting kit
- 5 Protective packaging, top
- 6 (AQT420 only) Protective packaging
- 7 Shipping carton
- 8 Protective packaging, bottom



Save the container and the packaging materials for future transportation or shipping.

## 4.4 Installing AQT400

Install the air quality transmitter to a height of 1.5 ... 4 m (5 ... 13 ft) from the ground. Applicable local standards and guidelines may influence the installation height.

To reduce the build-up of deposits, handle the unit with lint-free gloves and remove all grease from the surface after installation.

First attach the mounting bracket on a mast, sensor support arm, or wall, depending on your choice of installation, and then attach AQT400 on the mounting bracket.

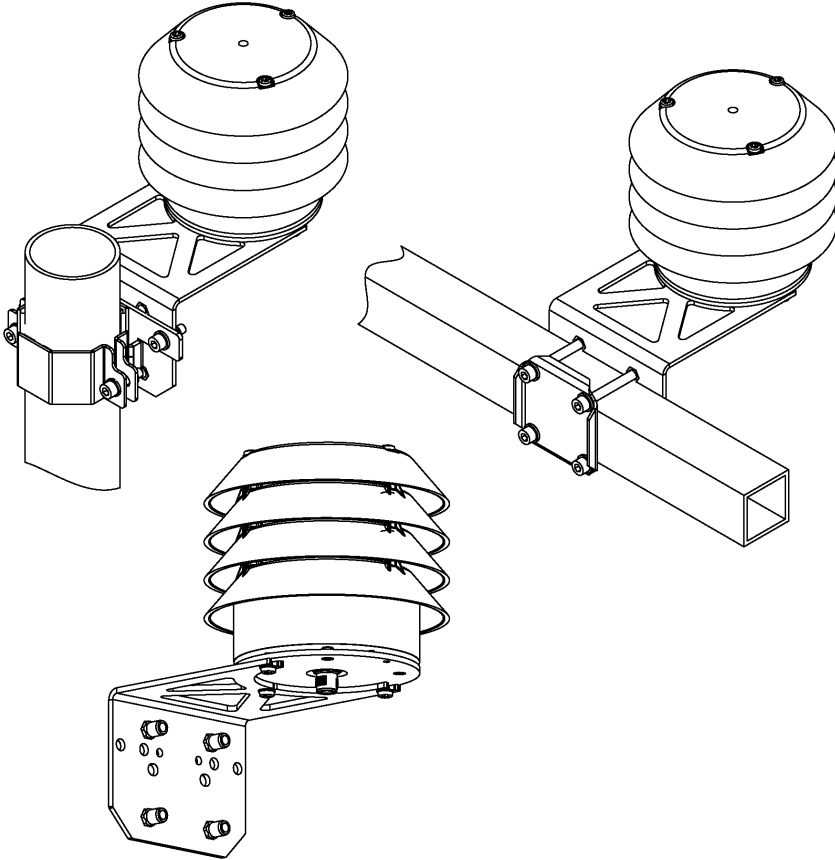


Figure 3 AQT400 Installation Options

#### 4.4.1 Installing Mounting Bracket on 60 ... 100-mm Mast



- 5-mm Allen key

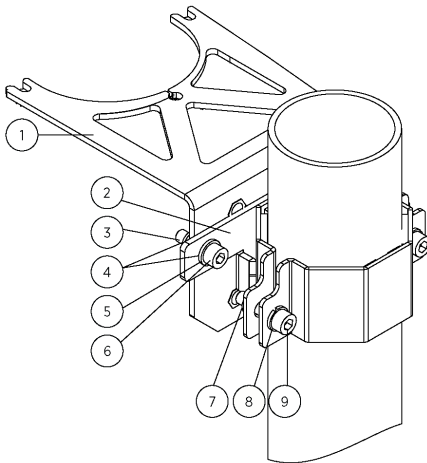


For optimum installation, the material of the tube or mast is a minimum of 3 mm (0.12 in) thick and the outside diameter of the tube or mast is 60 ... 100 mm (2.36 ... 3.94 in).

For masts with a diameter of 60 ... 100 mm (2.36 ... 3.94 in), use the APPKP mounting kit. The options are:

- APPKP60-SET1/2: Ø 60 mm (2.36 in) pole mast
- APPKP75-SET1/2: Ø 75 mm (2.95 in) pole mast
- APPKP86-SET1/2: Ø 86 mm (3.39 in) pole mast
- APPKP100-SET1/2: Ø 100 mm (3.94 in) pole mast

- ▶ 1. Attach the mounting bracket to the clamp and mount the assembly on the mast.



- 1 Mounting bracket
- 2 Clamp
- 3 Nut DIN985 M6 (2 pcs)
- 4 Washer DIN125 M6 (4 pcs)
- 5 Spring washer DIN127 M6 (2 pcs)
- 6 Hex screw DIN912 M6×16 (2 pcs)
- 7 Nut DIN929 M6 (2 pcs)
- 8 Spring washer DIN127 M6 (2 pcs)
- 9 Hex screw DIN912 M6×25 (2 pcs)

#### 4.4.2 Installing Mounting Bracket on Sensor Support Arm or 35 ... 40-mm Mast

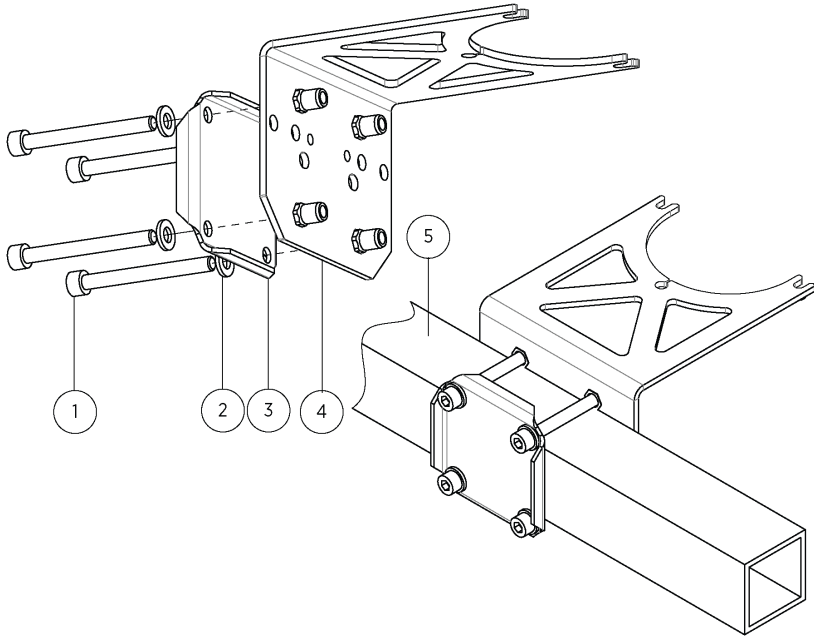


- 5-mm Allen key



For optimum installation, the material of the tube or mast is a minimum of 3 mm (0.12 in) thick and the outside diameter of the tube or mast is 35 ... 40 mm (1.38 ... 1.57 in).

- 1. Attach the mounting bracket on a sensor support arm or mast.



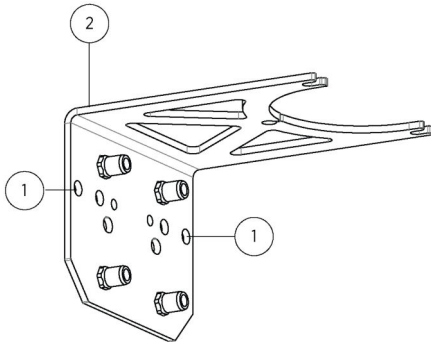
- 1 Sockethead hex screw M6×60 DIN912 A4 (4 pcs)
- 2 Flat washer A6,4 DIN125 A4 (4 pcs)
- 3 Clamp plate
- 4 Mounting bracket
- 5 Sensor support arm

### 4.4.3 Installing Mounting Bracket on Wall



- Screws (2 pcs), suitable for the wall material
- Screwdriver

- ▶ 1. Drill holes into the wall. Use the mounting bracket as a guide.



- 1 Hole for wall mounting (2 pcs)
- 2 Mounting bracket

2. Attach the mounting bracket on a wall.  
Use wall plugs if necessary, and screws that are suitable for the wall material.

### 4.4.4 Installing AQT400 on Mounting Bracket



- Crosshead screwdriver

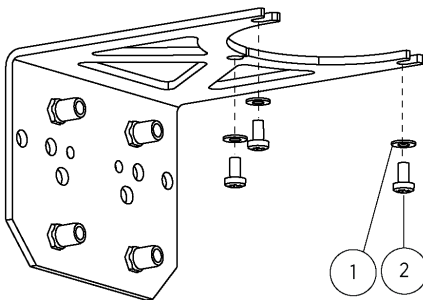
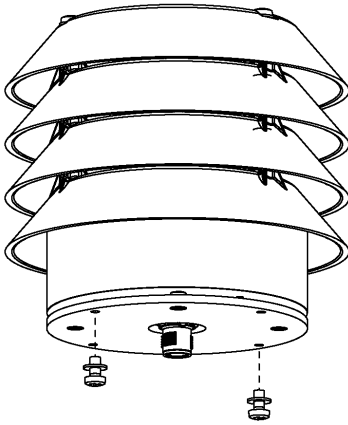


Figure 4 Mounting Bracket Installation Accessories

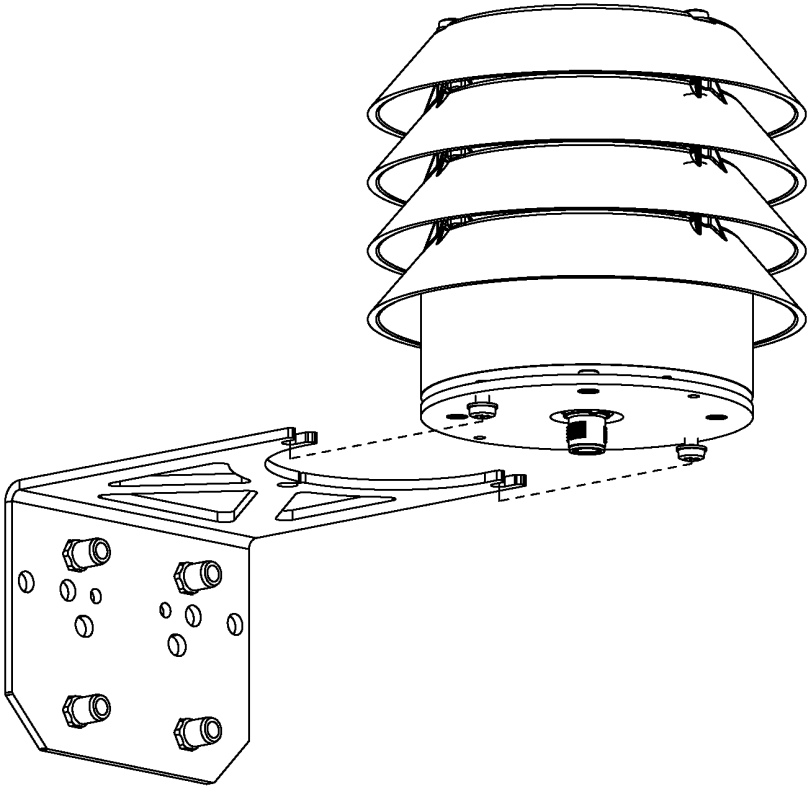
- 1 Flat washer A4,3 DIN125 A4 (3 pcs)
- 2 Crosshead screw M4×8 DIN7985 PZ A4 (3 pcs)

- ▶ 1. Insert 2 screws and washers in the holes on the opposite sides of the bottom plate. Leave the screws about 5 mm (0.20 in) from the surface of the unit.

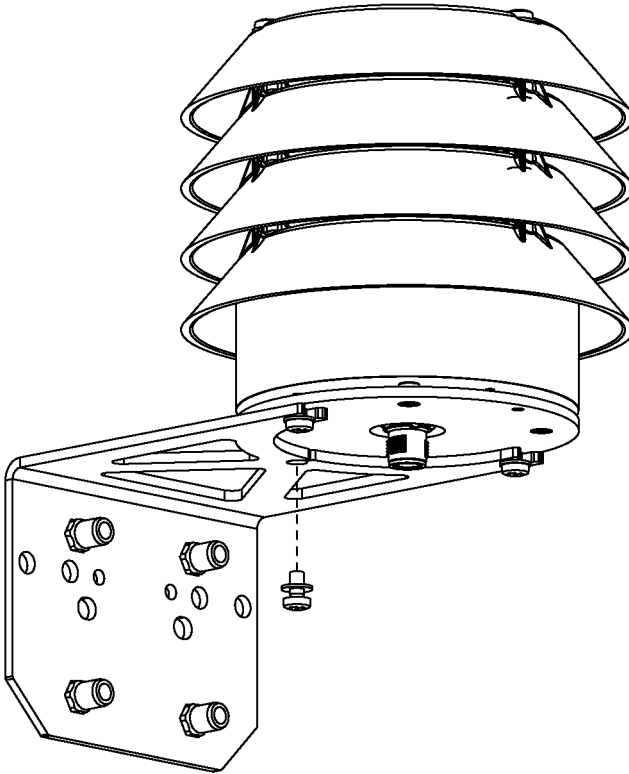




2. Push the screws to the slots in the mounting bracket.  
Make sure that the hole in the mounting bracket aligns with the hole in the bottom plate.



3. Insert the third screw and washer in the hole in the mounting bracket and attach it to unit. Tighten the screw.



4. Tighten the other 2 screws and make sure that unit is firmly attached to the mounting bracket.

## 4.5 Connecting Cables and Powering

AQT400 uses 8 ... 30 V direct-current voltage. Use a power source that complies with this voltage. The power source must be able to supply at least 5 W, although AQT400 normally uses less power than that.



**CAUTION!** Do not exceed the specified input voltage range.



Only use the recommended cable types and lengths.

- ▶ 1. Connect the 8-pin M12 connection cable to the male M12 connector in AQT400, and manually tighten the outer sleeve.
2. Pass the M12 connection cable along the tube and use appropriate strain relief with the cable.
3. Connect the other end of the connection cable to an external power source or to any other necessary systems.

M12 Pin	Wire Color	RS-485
5	Gray	B (-)
6	Pink	A (+)
7	Blue	Power GND
8	Red	Power 8 ... 30 VDC

Isolate any unused cable wires at the terminating equipment. To preserve the EMC performance, maintain the cable screen integrity in places where the cables are cut and reconnected, such as junction boxes, plugs, and sockets.

4. Verify that AQT400 is properly connected to a power source and any other systems. Switch on the power supply.



Let the unit stabilize for at least 24 hours before using the measurement results. To ensure optimal measuring accuracy, Vaisala recommends a 48-hour stabilization period. The units take measurements during the stabilization period, but the measurements are marked as invalid. The gas measurement results (including NO<sub>2</sub>, O<sub>3</sub>, and SO<sub>2</sub>) remain in the memory for 5 days.

Vaisala recommends using a rechargeable battery or an uninterrupted power source (UPS). In case of power failure, losing power for a few seconds may disrupt the measuring for several hours if the power supply is not redundant.

#### More Information

- ▶ [Stabilization Period \(page 14\)](#)

## 5. Configuration and Operation

### 5.1 AQT400 Configuration

You can view the measurement data and change the settings of AQT400 through the RS-232 serial interface. The RS-232 interface is used mainly for the maintenance connection.

Use the service cable kit to connect your computer to AQT400.

You can connect to AQT400 with the following options:

- Vaisala recommends using a graphical user interface tool: AQ Tool.
- For more versatile management and troubleshooting options, use a standard terminal program with a command line interface (CLI).

See *Vaisala Air Quality Transmitter AQT400 Series Configuration Guide*.

### 5.2 Installing AQ Tool

You need a computer with one of the following operating systems:

- Microsoft Windows 7
- Microsoft Windows 8
- Microsoft Windows 10

With AQ Tool, you can configure where AQT400 sends measurement data.

- ▶ 1. Search [www.vaisala.com](http://www.vaisala.com) downloadable files for "AQT" and save the AQ Tool installer on your computer (AQT Configuration Tool + USB Driver).
2. Unpack the files and double-click the EXE file to start the installer. If prompted about trusting the program, select **Run**.
3. Follow the onscreen instructions and accept the default installation location or select **Browse** to select a different location.
4. To complete the installation, select **Finish**.

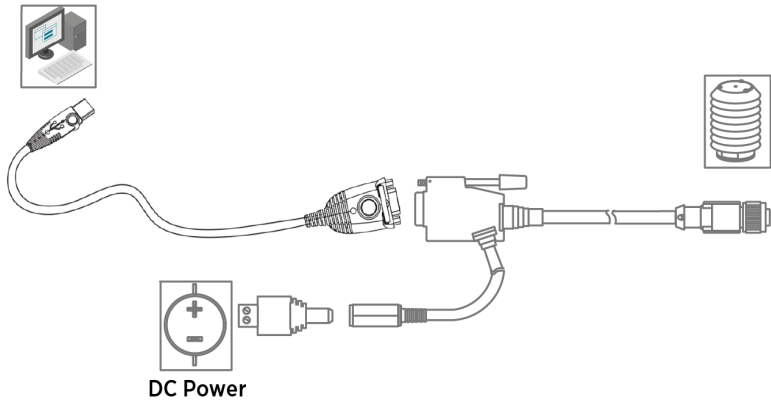
### 5.3 Connecting to AQT400 with RS-232 (AQ Tool)



- Slothead screwdriver

The RS-232 interface is used mainly for the maintenance connection.

1. Use the service cable kit to connect your computer to AQT400.



2. Connect the open-ended cables of the power source to the adapter and attach the adapter to the DC power connector.

Wire Color	Power
Red	+
Black	-

Alternatively, connect your own power source directly to the DC power connector.

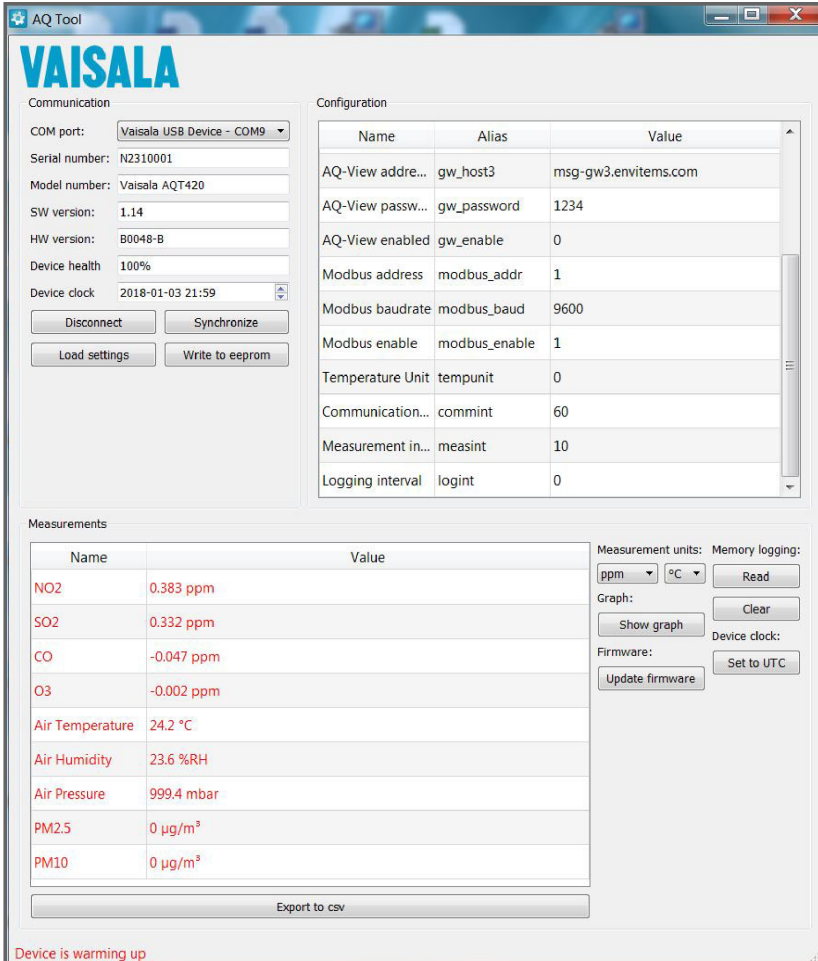
3. On your computer, select **Start > AQ Tool**.
4. To connect to the device, select **Connect** in AQ Tool.

## 5.4 Viewing Measurement Results

You can view the measurement results in AQ Tool.

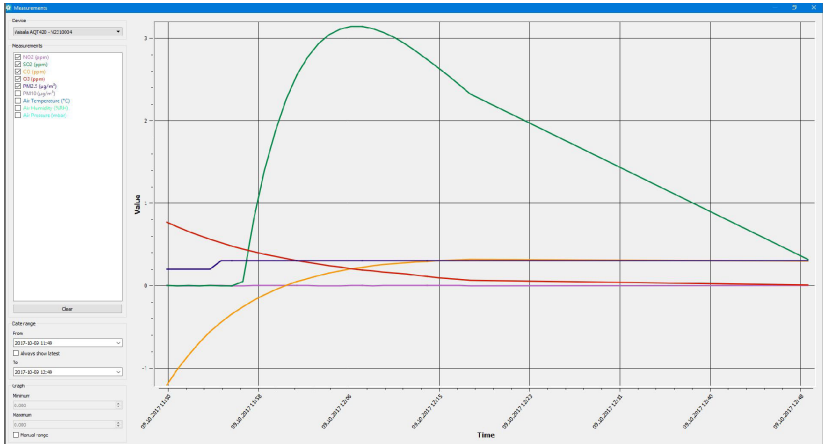
1. Establish a connection to AQT400.  
See [Connecting to AQT400 with RS-232 \(AQ Tool\) \(page 26\)](#).

- 2. AQ Tool displays the retrieved measurements in **Measurements**.
  - The measurements that have not stabilized are displayed in red. During the stabilization period (24 hours), the window displays a red text **Device is warming up**.
  - Once the stabilization period is over and the measurements are reliable, the window displays a green text **Device is ready for measurements**.



- 3. You can change the measurement units of the displayed data. In **Measurement units**, select **ppm** or **µg/m3**, and **°C** or **°F**.

- To view the data in graphical format, select **Show graph**, and in the **Measurements** window, set the following:



### Device

The list shows the devices that have been connected to your computer and for which there is measurement data. Select the device.

### Measurements

Select the measurements to plot on the graph. The graph is adjusted accordingly as soon as you make the selection. To clear all selections, use **Clear**.

### Date range

Define the interval from which you want to view the measurements. Select **Always show latest** to include the most recent measurements.

### Graph

Select **Manual range**, if you want to adjust the X and Y axis of the graph. Otherwise, the values start from 0.

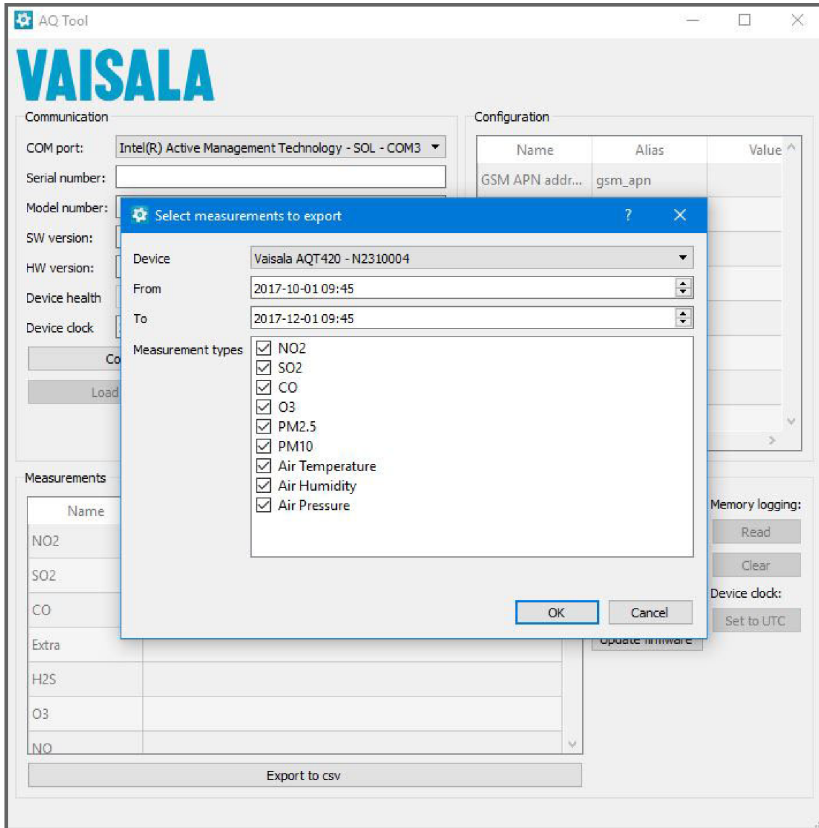
AQ Tool shows the measurements of one device at a time. To view the measurements of another device, select another device.

## 5.5 Exporting Data in CSV Format

You can export measurement data in CSV format using AQ Tool. AQ Tool fetches the data from the database. For export, connection to AQT400 is not needed.

- On your computer, select **Start > AQ Tool**.
- Select **Export to csv**.  
If you want to browse the data to define what to export, select **Show graph**.

3. In the **Select measurements to export** window, set the following:



**Device**

Select the device from the list.

**From**

Define the start date and time for the measurements to export.

**To**

Define the end date and time for the measurements to export.

**Measurement types**

Select the measurements you want to include in the export.

4. Select **OK** and the location where to export the CSV file.



## 6. Data Reporting

### 6.1 Selecting Modbus ASCII/RTU Mode

To change the RS-485 Modbus mode, establish a maintenance connection with RS-232. See [Connecting to AQT400 with RS-232 \(AQ Tool\) \(page 26\)](#).



If you are using MOG100, you do not need to adjust the settings.

The RS-485 interface is used mainly for the data connection.

The interface supports the following data transfer protocols: Modbus ASCII and Modbus RTU.



When using the RS-485 interface, use a protected and twisted pair cable with both ends terminated with a 120  $\Omega$  termination resistor. AQT400 is terminated by default. To remove the termination, contact Vaisala technical support.

- ▶ 1. On your computer, select **Start > AQ Tool**.
2. Define the settings for the RS-485 interface.
  - To use the RS-485 port in Modbus ASCII mode, use the following settings:
    - Bit rate: 9600
    - Mode: ASCII
    - Port settings: 7E1 (7 data bits, even parity, one stop bit)
  - To use the RS-485 port in Modbus RTU mode, use the following settings:
    - Bit rate: 9600
    - Mode: RTU
    - Port settings: 8E1 (8 data bits, even parity, one stop bit)



Modbus RTU mode may give communication errors. This does not affect data transfer or the availability and accuracy of measurement data. You may safely ignore the errors.

### 6.2 Data Format in Modbus Mode

AQT400 complies with Modbus ASCII and Modbus RTU mode. The register is a 16-bit signed integer (- or +). For full specifications, see <http://www.modbus.org/>.

The following table shows the Modbus function codes that AQT400 supports.

Table 8 Modbus Function Codes

Command	Function Code	Description
<b>regread</b>	0x03	Reads holding registers
<b>regwrite</b>	0x06	Writes single register

The following register addresses are available in AQT400. All registers may not be available on your device.



For information about the measurements, see [AQT400 Measurements \(page 13\)](#).

Table 9 Modbus Register Addresses

Register address	Description	Data Range
0x00	NO <sub>2</sub>	Read only, in ppb
0x01	SO <sub>2</sub>	Read only, in ppb
0x02	CO	Read only, in ppb
0x04	H <sub>2</sub> S	Read only, in ppb
0x05	O <sub>3</sub>	Read only, in ppb
0x06	NO	Read only, in ppb
0x08	PM <sub>2.5</sub>	Read only, in $\mu\text{g}/\text{m}^3 \times 10$
0x09	PM <sub>10</sub>	Read only, in $\mu\text{g}/\text{m}^3 \times 10$
0x0A	Air temperature	Read only, in °C $\times 10$ or °F $\times 10$
0x0B	Air humidity	Read only, in %RH $\times 10$
0x0C	Air pressure	Read only in mbar $\times 10$
0x13	Calibration year	Read only, year
0x14	Calibration month	Read only, month
0x15	Calibration day	Read only, day
0x19	Software version	Read only, version $\times 100$
0x1A	Seconds from the latest measurement	Read only, seconds

Register address	Description	Data Range
0x1B	Measurement validity	Read only, 0 or 1 0 = not valid 1 = valid See <a href="#">Stabilization Period (page 14)</a> .
0x1C	Temperature units	Read only, 0 or 1 0 = °C 1 = °F
0x1F	Device health, percentage	Read only, 0 ... 100
0x20	Timestamp, year	Read only, year
0x21	Timestamp, month	Read only, month
0x22	Timestamp, day	Read only, day
0x23	Timestamp, hours	Read only, hours
0x24	Timestamp, minutes	Read only, minutes
0x25	Timestamp, seconds	Read only, seconds
0x29	Air quality index, according to USA Environmental Protection Agency (EPA)	Read only, 0 ... 500
0x2A	Air quality index criteria; tells which pollutant is the main cause for the current air quality index	Read only, 0 ... 7 0 = O <sub>3</sub> 8-hour average 1 = O <sub>3</sub> 1-hour average 2 = PM <sub>2.5</sub> 24-hour average 3 = PM <sub>10</sub> 24-hour average 4 = CO 8-hour average 5 = SO <sub>2</sub> 1-hour average 6 = SO <sub>2</sub> 24-hour average 7 = NO <sub>2</sub> 1-hour average
0xC0	First character in the device serial number	Read only, ASCII value between A - Z
0xC1	First 3 numbers as an integer in the device serial number	Read only, 0 ... 999
0xC2	Last 4 numbers as an integer in the device serial number	Read only, 0 ... 9999



The serial number is a combination of 0xC0, 0xC1, and 0xC2. For example, serial number N1234567 is composed of:

- 0xC0 = N
- 0xC1 = 123
- 0xC2 = 4567

# 7. Maintenance

## 7.1 AQT400 Maintenance

AQT400 requires the following maintenance activities:

- Remove visible obstructions and dust from the device.
- Change electrochemical gas cells every 12 ... 36 months.  
Vaisala offers changing of the gas cells as a service in Vaisala service center. Alternatively a qualified Vaisala representative can perform the operation locally. To support maintenance planning and preventive maintenance, AQT400 provides a service indicator for replacing the electrochemical cells.
- (AQT420) Replace the LPC filter every 6 ... 12 months. Vaisala provides the LPC filter as a spare part.
- Replace the combined humidity and temperature sensor when it is not functioning properly.


After the warranty period, a fixed-price repair service is available.

To purchase the services, visit <https://vaisala.com/store>.

Table 10 AQT400 Spare Parts

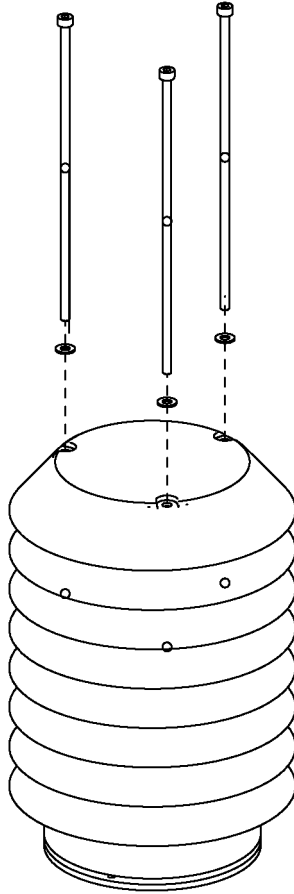
Spare Part	Order Code
AQT400 base module, including new calibrated electrochemical cells Compatible with AQT420 and AQT410	AQT400U-SP
Filter for the AQT420 laser particulate counter (LPC)	AQT420FILTERSP
Combined humidity and temperature sensor	AQT400THSP

## 7.2 Removing Radiation Shield

 • 3-mm Allen key

To replace modules in AQT400, remove the radiation shield.

- ▶ 1. Loosen the 3 screws that hold the radiation shield in place and pull them out. Remove the radiation shield.



- 2. Carry out the needed maintenance.
- 3. To attach the radiation shield, use the 3 washers and screws. Tighten the screws.

## 7.3 Changing Calibrated Electrochemical Cells

AQT400 series uses electrochemical cells for pollution gas measurement. The electrochemical cells are consumables which must be changed at regular intervals. The estimated lifetime of the cells is 12 ... 36 months, depending on the conditions where the cells are operated.

Monitor the service indicator (device health) in Vaisala Beacon Cloud and AQ Tool. When the device health is lower than 30 %, Vaisala recommends changing the electrochemical cells.

To have the electrochemical cells changed, do one of the following:

- (Recommended) Send AQT400 for preventive maintenance to Vaisala service center or to a qualified Vaisala representative. As part of routine maintenance, Vaisala cleans AQT400, changes new calibrated electrochemical cells to the AQT400 base module, and changes the LPC filter.
- Purchase the AQT400 base module including new calibrated electrochemical cells. Replace the base module with the new one according to the provided instructions. See *Vaisala Air Quality Transmitter AQT400 Series Configuration Guide*. Only an experienced electromechanician may perform this maintenance procedure.

## 7.4 Replacing LPC Filter



- 3-mm Allen key

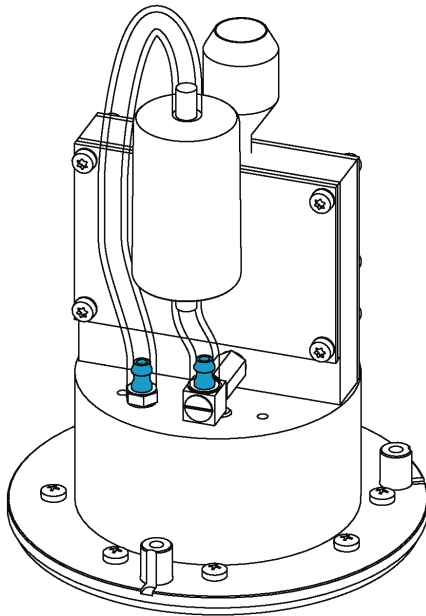
Order the filter for the AQT420 laser particulate counter (LPC) from Vaisala.



**CAUTION!** To avoid damaging the device, carry out the replacement indoors.

- ▶ 1. Remove AQT400 from the mounting bracket at the installation site.
2. Remove the radiation shield. See [Removing Radiation Shield \(page 35\)](#).

3. Remove the filter by pulling the tubes off from their lower attachment point.



4. Replace the filter with a new one.
5. Attach the radiation shield with the 3 screws and tighten the screws.

## 7.5 Replacing Combined Humidity and Temperature Sensor



- 3-mm Allen key

Order a combined humidity and temperature sensor from Vaisala.

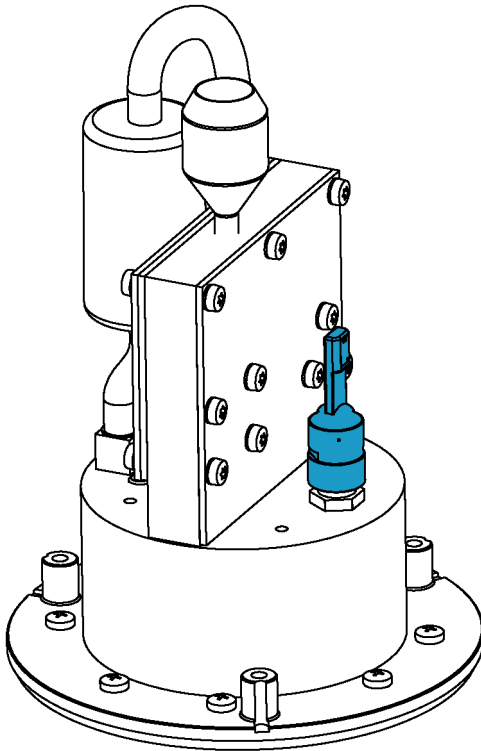
Replace the combined humidity and temperature sensor when there are inaccurate measurements (approx. 120 °C / 248 °F and 99.8 %RH).





**CAUTION!** To avoid damaging the device, carry out the replacement indoors.

- ▶ 1. Remove AQT400 from the mounting bracket at the installation site.
2. Remove the radiation shield. See [Removing Radiation Shield \(page 35\)](#).
3. Remove the sensor by turning the lower metal part and then pull off the sensor.



4. Replace the sensor with a new one.  
Align the pins and turn until the sensor is in place.
5. Attach the radiation shield with the 3 screws and tighten the screws.

## 8. Troubleshooting

If the product does not work as it should, check all cables and connectors for continuity, bad contacts, or corrosion.

Check the maintenance needs.

If the failure persists, contact Vaisala technical support.

Table 11 Troubleshooting AQT400

Problem	Probable Cause	Remedy
Measurement failure or irrelevant data values.	The settings are incorrect.	Contact Vaisala technical support.
	There is a hardware failure.	
No response to any commands.	Wiring is wrong.	Check the wiring. See <a href="#">M12 Pinout and Wiring (page 47)</a> .
	Operational power is not connected.	Check the operating voltage.
	Baud rate or other serial property of the device is different from the host.	Connect the serial cable and check the serial port settings of the device with AQ Tool or a terminal program.

### 8.1 Writing Problem Report

When troubleshooting the product, write a problem report including:

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

## 9. AQT400 Specifications

Table 12 AQT400 Gas Measurement Performance

Gas	Range	Detection Limit	Accuracy in Field Conditions <sup>1)</sup>
NO <sub>2</sub>	2000 ppb	5 ppb	±25 ppb
O <sub>3</sub>	2000 ppb	5 ppb	±60 ppb
CO	10 000 ppb	10 ppb	±200 ppb
SO <sub>2</sub>	2000 ppb	5 ppb	±50 ppb

- 1) 90 % confidence interval in comparing with reference instrument, includes T and %RH dependence in typical field conditions and sensor drift during calibration interval. Electrochemical cell replacement interval 12–24 months, depending on local conditions.



Particle measurement is available in AQT420.

Table 13 AQT420 Particle Measurement Performance

Property	Description/Value
Particle counter channels	PM <sub>2.5</sub> and PM <sub>10</sub>
Particle diameter range	0.3 ... 10 µm (spherical equivalent)
Sampling time	60 s
Sampling interval	10 min
Sample flow rate	0.9 SLM
Measurement range	PM <sub>2.5</sub> : 0 ... 2000 µg/m <sup>3</sup> PM <sub>10</sub> : 0 ... 5000 µg/m <sup>3</sup>
Measurement resolution	0.1 µg/m <sup>3</sup>

Table 14 AQT400 Humidity, Temperature and Pressure Measurement Performance

Property	Description/Value
Humidity accuracy	0 ... 90 %RH: ±5 %RH 90 ... 100 %RH: ±8 %RH
Humidity resolution	0.1 %RH

Property	Description/Value
Temperature accuracy for sensor element at +20 °C (+68 °F)	±0.3 °C (0.17 °F)
Temperature resolution	0.1 °C
Operating temperature	-40 ... +85 °C (-40 ... +185 °F)
Operating humidity	0 ... 100 %RH (non-condensing)
Pressure accuracy	±10 hPa
Pressure resolution	1 hPa
Sampling interval	1 ... 1440 min
Response time	< 60 s
Factory calibration interval	12 ... 24 months, depending on the local measurement conditions

Table 15 AQT400 Inputs and Outputs

Property	Description/Value
Operating voltage	8 ... 30 VDC
Power consumption	AQT420: <ul style="list-style-type: none"> <li>• Typical: 0.7 W</li> <li>• Maximum: 2 W</li> </ul> AQT410: <ul style="list-style-type: none"> <li>• Typical: 0.5 W</li> <li>• Maximum: 1 W</li> </ul>

Table 16 AQT400 Data Connection Specifications

Property	Description/Value
Data protocols	Modbus® ASCII Modbus® RTU ASCII CSV
Serial data interface	RS-485
Maintenance interface	RS-232

Table 17 AQT400 Operating Environment

Property	Description/Value
Operating temperature	-30 ... +40 °C (-22 ... +104 °F) Limited performance: -40 ... +50 °C (-40 ... +122 °F)
Operating humidity	15 ... 95 %RH, non-condensing
Operating pressure	800 ... 1200 hPa
EMC compliance	EN/IEC 61326-1 EN 55032 Class B
IP rating	IP65

Table 18 AQT400 Mechanical Specifications

Property	Description/Value
Dimensions (H × W × D)	AQT420: 185 × 128 × 128 mm (7.28 × 5.04 × 5.04 in) AQT410: 125 × 125 × 128 mm (4.92 × 4.92 × 5.04 in)
Weight	AQT420: 1.25 kg (2.76 lb) AQT410: 0.7 kg (1.52 lb)
Material, base module	Anodized aluminum
Material, radiation shield	Polycarbonate (PC)
Color, radiation shield	White (RAL9003)
Power and data connector	Standard 8-pin M12 male

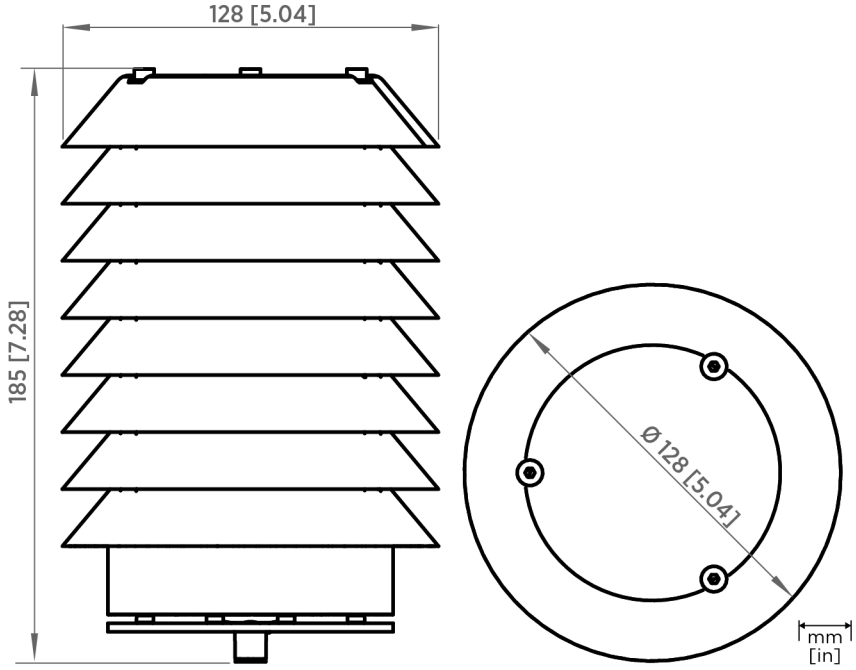


Figure 5 AQT420 Dimensions

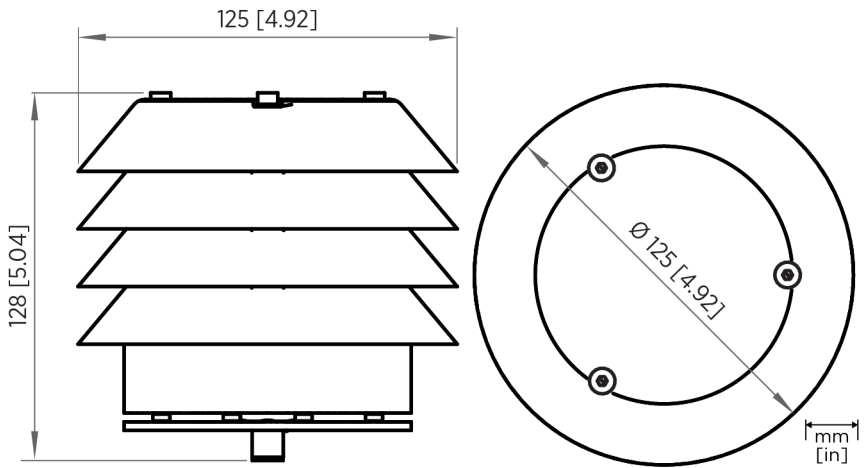


Figure 6 AQT410 Dimensions

## Appendix A. Data Format in ASCII Mode

The CSV data messages are available in the ASCII autosend mode for conveying air quality measurement data.

To use the RS-485 port in ASCII mode:

- Set parameter `rs485_mode` to 0
- Port settings: 7E1 (7 data bits, even parity, one stop bit)

In ASCII mode, the device prints CSV formatted measurements.

```
<dateTtime>,<temp>,<hum>,<pres>,<meas>,<conf>,<uptime>
```

Table 19 CSV Output Format Fields

Field	Description	Example
<code>dateTtime</code>	Date and time in ISO8601 format	2015-07-01T12:34:56
<code>temp</code>	Air temperature in °C or °F ( <code>tempunit</code> parameter, see <i>Vaisala Air Quality Transmitter AQT400 Series Configuration Guide</i> )	23.5
<code>hum</code>	Air humidity in %RH	43.2
<code>pres</code>	Air pressure in mbar	1011
<code>meas</code>	Gas measurements in ppm Particle measurements in µg/m <sup>3</sup>	0.023,0.067,26.2,105.7
<code>conf</code>	Specifies the printing order of the measurements in the <code>meas</code> field. Always includes T:H:P (temperature, humidity, pressure).	T:H:P:NO2:S02:PM2.5:PM10
<code>uptime</code>	Device uptime in seconds. Measurements are considered valid when uptime is more than 86400 seconds (one day).	131422

### Examples of CSV Messages

```
2017-10-31T06:55:36,22.3,14.6,1011.2,-0.003,0.039,0.196,-0.001,0.3,0.5,T:H:P:NO2:S02:C0:03:PM2.5:PM10,58862
```

```
2017-10-31T06:56:37,22.3,15.1,1011.1,-0.002,0.040,0.195,-0.001,0.3,0.5,T:H:P:NO2:S02:C0:03:PM2.5:PM10,58923
```



The actual message does not contain line feeds.



## Appendix B. M12 Pinout and Wiring

The M12 connector provides RS-232 and RS-485 serial interfaces.

The 8-pin M12 connector is located at the bottom of the air transmitter and provides power and data to the transmitter.

Figure 7 Pinout of M12 Connector

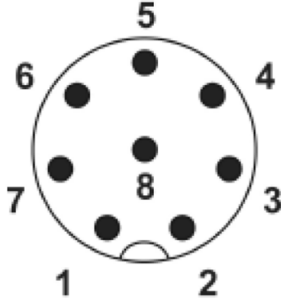


Table 20 Pinout of M12 Connector

M12 Pin	Wire Color	RS-232	RS-485
1	White	GND	GND
2	Brown	RX (input)	-
3	Green	TX (output)	-
4	Yellow	No connection (floating)	
5	Gray	-	B (-)
6	Pink	-	A (+)
7	Blue	Power GND	Power GND
8	Red	Power 8 ... 30 VDC	Power 8 ... 30 VDC

### RS-232 Serial Interface

The RS-232 interface is used mainly for the maintenance connection.

### RS-485 Serial Interface

The RS-485 interface is used mainly for the data connection.

RS-485 supports Modbus ASCII and Modbus RTU, and Modbus ASCII formatted text with comma separated values (CSV).



## 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:

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

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