

Product Description

Vaisala Air Quality Transmitter
AQT530



VAISALA

PUBLISHED BY

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1. About this document

1.1 Version information

This document provides a description of Vaisala Air Quality Transmitter AQT530.

Table 1 Document versions (English)

Document code	Date	Description
M212296EN-A	December 2021	First version.

1.2 Related manuals

Table 2 AQT530 manuals

Document code	Name
M212573EN	<i>Vaisala Air Quality Transmitter AQT530 Setup Guide</i>
M212572EN	<i>Vaisala Air Quality Transmitter AQT530 Configuration Guide</i>
M212580EN	<i>Vaisala Air Quality Transmitter AQT530 Maintenance 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® is a registered trademark of Vaisala Oyj.

Modbus® is a registered trademark of Schneider Automation Inc.

Microsoft® and Windows® are either registered trademarks or trademarks of Microsoft Corporation in the United States and other countries.

2. Product overview

2.1 Vaisala Air Quality Transmitter AQT530



Vaisala Air Quality Transmitter AQT530 measures the pollution content of ambient air. AQT530 is available in different models for measuring gases, particles, or both.

AQT530 is specifically designed for air quality monitoring networks in areas with traffic, road networks, or around transportation hubs.

Thanks to its small weight, compact size, and good precision it is ideally suited for deployment especially in large air quality networks. The measurement data can be sent wirelessly to a web-based database with a gateway solution and it is also available locally through a serial interface.

AQT530 is available as a standalone instrument for integration to customer system. AQT530 can also be paired with Vaisala Beacon Station BWS500 or Vaisala Road Weather Station RWS200 to provide a professional-grade complete network solution with best-in-class accuracy and reliability.

2.2 AQT530 measurements

The measured variables have been configured to AQT530 at the factory.

Gas measurements are updated once a minute. The particle measurement update interval is user-configurable with a default of 10 minutes.

Table 3 AQT530 measurements

Measurement	Unit	Update interval	Reported value
Nitrogen dioxide (NO ₂)	ppb, µg/m ³	1 minute	
Carbon monoxide (CO)	ppb, µg/m ³		
Ozone (O ₃)	ppb, µg/m ³		
Nitrogen oxide (NO)	ppb, µg/m ³		
Particulate matter PM ₁₀	µg/m ³	User-configurable Default: 10 minutes	1-minute average
Particulate matter PM _{2.5}	µg/m ³		
Particulate matter PM ₁	µg/m ³		
Air temperature	°C/°F	1 minute	Instant
Air pressure	hPa		
Humidity	%RH		

For unit conversions and other details, see *Vaisala Air Quality Transmitter AQT530 Configuration Guide*.

Stabilization period

The stabilization period is relevant for AQT530 devices that have the gas measurement.

When AQT530 is switched on, let the unit stabilize before using the measurement results. The stabilization time depends on usage conditions, but typically 3 - 5 days in enough to ensure optimal performance.

The units take measurements during the stabilization period, but the measurements from the first 24 hours after power-up are marked as invalid.

More information

- [AQT530 ordering options \(page 17\)](#)

2.3 Safety

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



WARNING! Do not replace components when the system is powered up. Disconnect all power sources before performing maintenance procedures.



WARNING! Do not substitute parts or modify the system, or install unsuitable parts in the system. Improper modification can damage the product or lead to malfunction.



WARNING! Assess the risks from the installation work. Consider also the effects of local weather conditions.



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.



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



WARNING! Do not attempt to open the laser particle counter (LPC) for service. Removing the cover may cause exposure to harmful class 3B laser radiation and electrical shock.



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

2.3.1 Eye safety

Vaisala Air Quality Transmitter AQT530 is classified as a Class 1 laser device in accordance with International Standard IEC 60825-1. It complies with 21 CFR 1040.10 and 1040.11 except for conformance with IEC 60825-1 ED. 3., as described in the Laser Notice No. 56, dated May 8, 2019. A Class 1 laser device is safe under all conditions of normal use.

AQT530 incorporates a Class 3B laser. The laser is contained in an enclosure, preventing direct physical access to laser radiation.

Table 4 Incorporated laser module

Property	Description/Value
Laser module	Class 3B
Laser wavelength	658 nm
Maximum power	22 mW

The device is equipped with the following laser product labels.

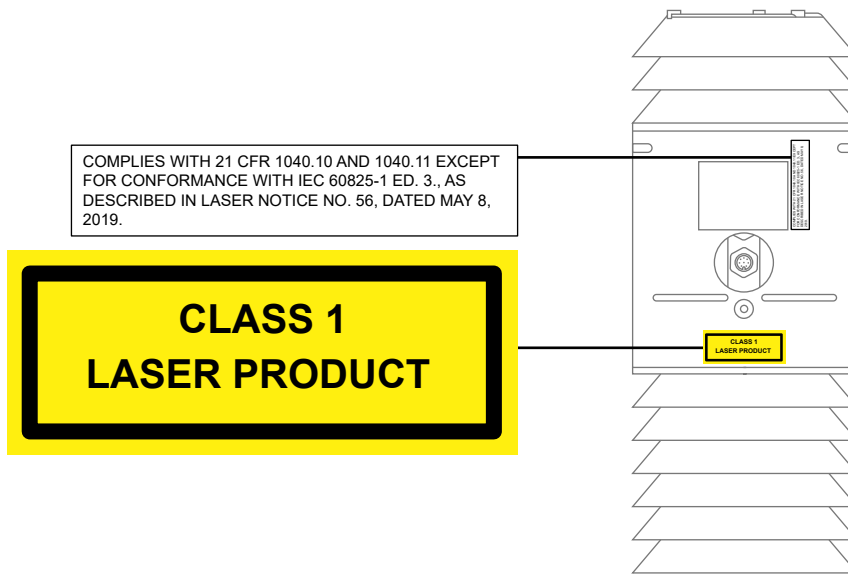


Figure 1 Location of Class 1 laser product labels on AQT530

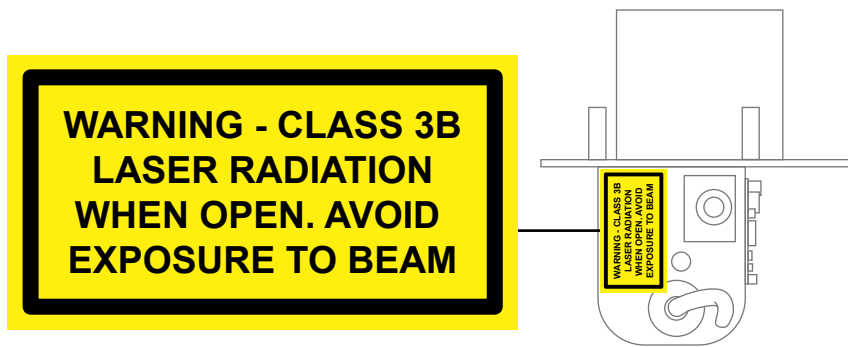


Figure 2 Location of Class 3B laser radiation label on AQT530 inside laser particle counter (LPC)

Follow the safety information to avoid exposure to laser radiation.

2.3.2 ESD protection

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

To avoid delivering high static voltages to the product:

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

3. Functional description

3.1 System overview

When part of a data collection system, AQT530 can be used in Vaisala Beacon Station BWS500 or as part of a customer system.

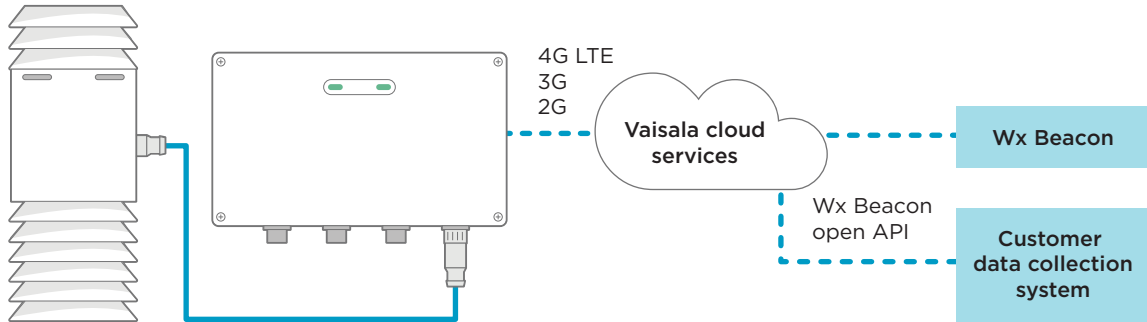


Figure 3 AQT530 in Vaisala Beacon Station BWS500

In Vaisala Beacon Station BWS500, Vaisala Beacon Edge Gateway handles the data transfer wirelessly from the sensor to the cloud.

Data transfer to the customer data collection system requires the implementation of an application programming interface (API). For more information, see *Vaisala Wx Beacon XML API Reference*.

BWS500 offers a range of powering solutions to choose from. For more information, see <https://www.vaisala.com/en/bws500-support>.

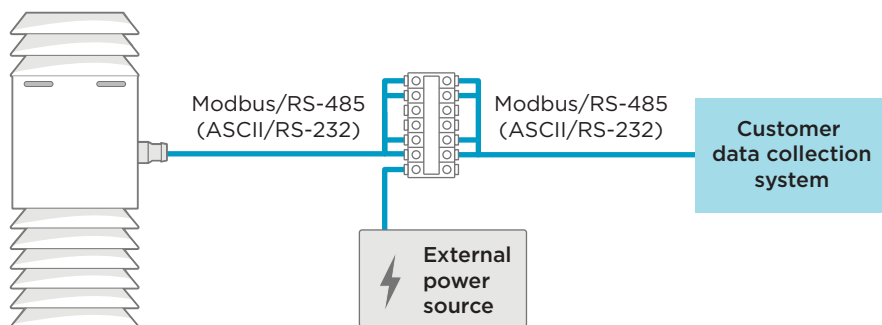


Figure 4 AQT530 in customer system

The connection from AQT530 to the customer data system is either RS-485 or RS-232. For wiring details, see *Vaisala Air Quality Transmitter AQT530 Setup Guide*.

The RS-232 connection is a local connection with a maximum distance between AQT530 and laptop 10 m (3 ft).

As part of a customer system, AQT530 requires an external power source and a system for data transfer.

Data transfer to the customer data collection system requires the implementation of the relevant Modbus interface. For more information, see *Vaisala Air Quality Transmitter AQT530 Configuration Guide*.

3.2 Interface overview

AQT530 data is sent over the RS-485 interface. By default, AQT530 outputs data in the Modbus RTU format. The Modbus interface is an application programming interface (API) for remote connection to AQT530 using the Modbus protocol.

The maintenance connection is established over the RS-232 interface and you can use that, for example, to adjust the RS-485 parameters or change the data output format. For this purpose you need the USB maintenance cable. The commands are typed in the command line interface (CLI) locally at the site.

Alternatively, AQT530 outputs data in ASCII CSV format over the RS-485 interface. ASCII CSV format uses the same physical channel as Modbus format, so only one format can be used at a time.

Table 5 AQT530 data connection specifications

Property	Description/Value
Data output	Modbus® ASCII, Modbus® RTU, ASCII CSV
Serial data interface	RS-485
Maintenance interface ¹⁾	RS-232

¹⁾ Recommended Vaisala USB maintenance cable kit (253163SET).

For details about Modbus ASCII, Modbus RTU, and ASCII CSV, and use of CLI, see *Vaisala Air Quality Transmitter AQT530 Configuration Guide*.

For details about using RS-232 for the maintenance connection, see *Vaisala Air Quality Transmitter AQT530 Setup Guide* and *Vaisala Air Quality Transmitter AQT530 Maintenance Guide*.

3.3 Storage

Table 6 AQT530 storage

Property	Description
Storage time	Max. 3 months If stored for longer periods of time, connect the device to power.
Storage conditions	Indoors <ul style="list-style-type: none"> • In typical office conditions +20 ... +25 °C (+68 ... +77 °F) 20 ... 75 %RH • In shipping package • Away from dust, dirt, and chemicals

3.4 Location requirements

AQT530 is intended for outdoor use.

For the most reliable measurements choose a site that represents the conditions that you wish to measure.

Table 7 AQT530 location requirements

Property	Description
Power supply lines	Available at site, device takes 10 - 25 V DC
Communication lines	Available at site, according to used communication method
Free space	Avoid installing the device next to trees or other vegetation. Large amounts of insects may also obstruct airflow to the device. The device makes a buzzing noise during particle measurement as part of its normal operation. Consider this in urban environment when placing the transmitter.
Away from heat	Avoid mounting the device to direct sunlight or near other heat sources.
Away from radio and electric disturbance	Avoid mounting the device close to high-powered radio transmitters or weather station antennas. Make sure that power lines or generators cannot affect the performance.
Radio communication device	If you use a radio communication device, such as Vaisala Beacon Edge Gateway EGW501, install it to a different height and at least 1 m (3 ft) from the air quality transmitter.



Figure 5 Location requirements

3.5 Installation, use, and maintenance

With the standard mounting kit, AQT530 can be mounted on pole mast with a diameter of 30 ... 120 mm (1.18 ... 4.72 in), sensor support arm, or wall. For mounting to a thicker pole, a spare part is available.

The recommended installation height is 2 ... 4 m (6 ft 7 in ... 13 ft).

For details about how to set up and configure the device for your system, see *Vaisala Air Quality Transmitter AQT530 Setup Guide*.

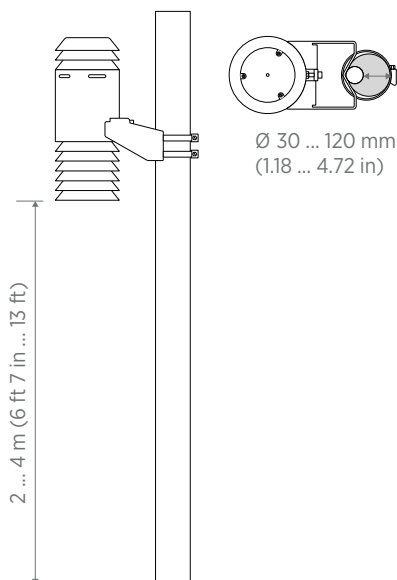


Figure 6 Installation height and installation bracket diameter

AQT530 can be configured over CLI or Modbus. For details about available commands and parameters, and Modbus register addresses, see *Vaisala Air Quality Transmitter AQT530 Configuration Guide*.

AQT530 requires regular maintenance. For details, see *Vaisala Air Quality Transmitter AQT530 Maintenance Guide*.

More information

- [AQT530 ordering options \(page 17\)](#)

4. Operating principle

4.1 Technology and performance

AQT530 product includes 3 different measurement modules:

1. Module measuring particles
2. Module measuring gases
3. Module measuring temperature and humidity

The following sections describe in detail the operating principles used in particle and gas measurement modules. The performance and reliability of the temperature and humidity sensor are important, not only for measuring temperature and humidity, but also because temperature and humidity have an effect on pollutant measurements.

As an example, the humidity level and changes in humidity have a remarkable effect on the measurement results and it is important to be able to both measure the humidity and make deductions of its effect on the results. Temperature and humidity are measured with Vaisala HMP110 temperature and humidity probe, which is integrated into AQT530, ensuring the required reliability and performance.

Electrochemical cell technology for gas sensing

The most widely used technology for ambient pollutant gas sensing in compact air sensors is the amperometric electrochemical technology. Electrochemical gas sensors use the reduction/oxidation reactions at a gas sensitized electrode surface of a galvanic cell to convert gas concentration to an electrical current running through the cell. This signal is converted into pollutant concentration. From a measurement quality standpoint, the advantage of electrochemical gas sensors is their sensitivity. Due to the large absolute number of measurand gas molecules present in ambient air, even in parts per billion (ppb) concentrations, the current from electrochemical reactions due to pollutants can be measured with state-of-the-art electronics. The challenges in using electrochemical gas sensors in field instrumentation is in their susceptibility to environmental conditions such as temperature and humidity, sensitivity to other gases (cross-sensitivity), as well as their limited lifetime.

Electric current is not only dependent on gas concentration, but there is a dependency to temperature and humidity. In AQT530 these dependencies have been taken into consideration by performing compensations in the signal processing algorithms, as well as by calibrating the products. In normal conditions these compensation methods perform quite well. However, the mechanisms are quite complex, especially in extreme conditions, such as in very hot and dry conditions, there are challenges and the technology has its limitations.

Electrochemical gas sensors are consumables and need to be replaced after their service time has ended. The typical maintenance interval is 2 years, but this depends strongly on the usage conditions. AQT530 includes a health index parameter, which indicates when is time for maintenance. When the health index is below 30 %, maintenance is recommended. Maintenance can be carried out as a Vaisala service or alternatively a spare part with new calibrated electrochemical gas sensors can be purchased.

After installing AQT530 to a measurement location, it is essential for the unit to stabilize at least 24 hours before using the measurement results. This stabilization time varies depending on the usage conditions, but typically 3 - 5 days after installation and switching on the device is enough to ensure optimal measurement accuracy. During the first 24 hours, which are the most important, the measurements are marked as invalid. The invalidation takes place also after power breaks and when temperature inside AQT530 is too high to get reliable measurement results.

Optical particle counters for particle measurement

The Vaisala technology used in air quality sensors is based on an optical laser particulate counter (LPC) measuring single particulates. The single particulate measurement principle enables more reliable and accurate measurement than the commonly used photometer technology, which assumes particle size distribution to be known.

In AQT530 the scattered intensity of the light from single particulates is measured. These single pulses define the size of the individual particles and the number of the pulses corresponds to a number of particles. Knowing the number and size of the particulates algorithms are applied to compute particle mass concentrations ($\mu\text{g}/\text{m}^3$) in different size fractions (PM_{10} , $\text{PM}_{2.5}$, PM_{10}). As with all optical methods, certain density for particulates is assumed and calculations to mass concentrations are based on this assumption.

A limitation of optical particle sensing is that the amount of light scattering from particles does not primarily depend on the quantity of interest (that is, particle mass), but there are many factors affecting the way the scattered and detected light signal corresponds to the particle mass. Factors such as color, shape, and size have an effect on the scattering capability.

Due to the physics of the scattering process, the amount of scattered light gets extremely small as the particle size falls below the wavelength of the light used for the measurement. This limits the minimum particle size that can be measured with compact optical particle sensors and with AQT530 this is currently 0.6 μm . For measuring particle sources such as fine particles from car exhaust or smoke from forest fires, where main particle component is smaller than 0.6 μm , AQT530 is not optimally suited.

The other limitation is water uptake of particles. The water uptake of particles increases the optical diameter of a measured particle, enhancing light scattering during the measurements and therefore might result in high readings from the sensor although the dry mass of the particles remains unchanged. In AQT530 the readings that may be compromised by humidity are marked as invalid.

Table 8 Events flagged in AQT530 as invalid and recommended to be left out from analysis

Situation	Description
24 hours after powering on	Gas readings are marked as invalid. This is due to the stabilization of electrochemical gas sensors and the algorithms.
When temperature inside AQT530 unit is too high	Gas readings are marked as invalid. This is due to the electrochemical gas sensor technology used in the product. Operation temperature is limited and performance is known to degrade when temperature is too high.
When humidity may have an effect	Particle readings are marked as invalid. This is due to water uptake of particles causing too high readings.

Field performance and co-location study

The performance values given in the AQT530 datasheet are derived from field tests carried out at major climate zones. The values given are non-corrected using only factory calibration.

To have the best performance for AQT530, Vaisala recommends carrying out a co-location study. By applying a correction based on this study, the sensor output is tuned to match the typical conditions in the area and the absolute difference between the reference grade sensor readings versus the AQT530 sensor can be decreased. This may be particularly relevant for the particulate measurements, where it can be seen as a way to adapt the sensor response to the local particle composition.

Linear correction

AQT530 enables adjusting the linear correction parameters, gain (span) and offset (zero), to Modbus registers, meaning that the sensor data can be corrected based on the co-location study.

For details and instructions, see *Applying Correction Equation to AQT530 Data Application Note*.

5. AQT530 ordering options

AQT530 is available in different models, and configurations can be selected based on the needs.

Table 9 AQT530 product models

Model	Measurements
Gases only	NO ₂ , NO, O ₃ , CO
Particles only	PM ₁₀ , PM _{2.5} , PM ₁
Gas and particles	NO ₂ , PM ₁₀ , PM _{2.5} , PM ₁
Gases and particles	NO ₂ , NO, O ₃ , CO, PM ₁₀ , PM _{2.5} , PM ₁

The default Modbus RTU settings are baud rate 19200, data bits 8, parity E (even), stop bits 1. You can configure the settings using a terminal program on a laptop and a maintenance cable.

An AQT530 product model for Vaisala Road Weather Station RWS200 is also available.

You can select a sensor cable and a mounting kit. The following cable options are available.

Table 10 AQT530 options and accessories

Option	Order code
Cabling	
M12/8(F) - open leads 3.5 m (11 ft 5 in)	220496
M12/8(F) - open leads 5 m (16 ft 4 in)	223283
M12/8(F) - open leads 10 m (32 ft 9 in)	220497
Mounting	
AQT530 mounting kit for pole mast 30 ... 120 mm (1.18 ... 4.72 in), sensor support arm, and wall mounting Includes mounting brackets, steel bands (2 pcs), and accessories	AQT530MKITSP
Steel band (2 pcs) for pole mast 120 ... 400 mm (4.72 ... 15.75 in) Order this in case the default steel band in the mounting kit is not long enough	AQT530CLAMPSP
Accessories	
USB maintenance cable	253163SET

A USB maintenance cable is recommended for each network.

For spare parts, see *Vaisala Air Quality Transmitter AQT530 Maintenance Guide*.

6. AQT530 specifications

For the up-to-date AQT530 specifications, see AQT530 datasheet in www.vaisala.com.

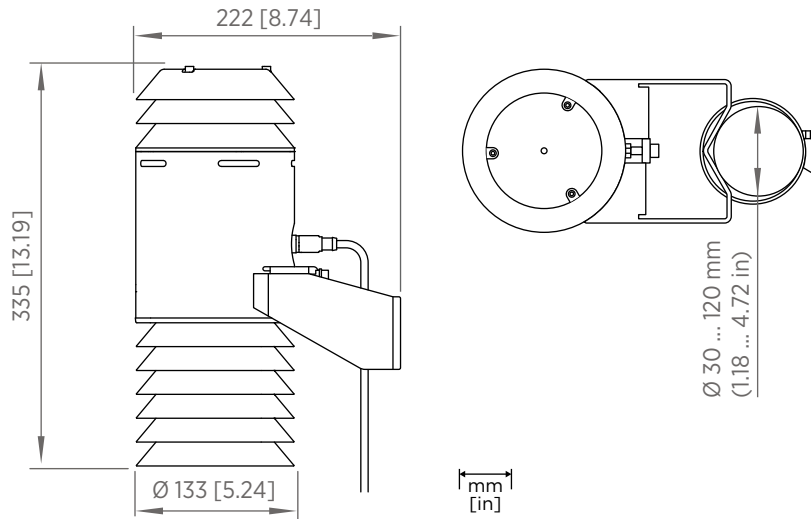


Figure 7 AQT530 dimensions



In case the default steel band in the mounting kit is not long enough, you can order the alternative steel band (2 pcs) for pole mast 120 ... 400 mm (4.72 ... 15.75 in).

Appendix A. Regulatory statements

This product complies with the following:

- EMC Directive (2014/30/EU)
- REACH Regulation (EC 1907/2006)
- RoHS Directive (2011/65/EU) amended by 2015/863
- CE, China RoHS, FCC Chapter 47 Part 15B, RCM, UKCA

A.1 FCC compliance

AQT530 complies with FCC Chapter 47 Part 15B. Operating is subject to the following 2 conditions:

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

A.2 FCC Part 15 compliance statement

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

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



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



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

Warranty

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

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

Technical support



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

Recycling



Recycle all applicable material.



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

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