

Vaisala Weather Transmitter WXT510

The Most Essential of Weather



The Vaisala Weather Transmitter WXT510 makes building weather stations easier than ever. It combines decades of experience and the latest innovations on weather instruments into a compact and durable package.

Features/Benefits

- Six most essential weather parameters combined in one instrument
- Accurate and stable measurement
- Proven Vaisala sensor technology:
 - Vaisala WINDCAP® Ultrasonic Wind Sensor for wind speed and direction
 - Vaisala RAINCAP® Sensor for advanced precipitation measurement
 - Vaisala BAROCAP® Sensor for barometric pressure
 - Vaisala THERMOCAP® Sensor for temperature
 - Vaisala HUMICAP® Sensor for relative humidity
- No moving parts
- Low power consumption
- Compact and light weight
- Fast and simple to install
- Low maintenance
- WXT Configuration Tool for PC

The Vaisala Weather Transmitter WXT510 is a compact and lightweight multi-sensor instrument that measures the most essential weather parameters. It is a configurable product that can measure wind speed and direction, liquid precipitation, barometric pressure, temperature and relative humidity — all in one transmitter.

Affordable weather intelligence

The demand for accurate weather information is constantly increasing. In addition to professional meteorology, there are also numerous businesses that are weather sensitive, even though measuring the environment is not their actual core operation.

To meet the growing needs for easy-to-access weather data, the Vaisala Weather Transmitter WXT510 has been developed. It combines the modern

sensor technology, advanced design and decades of experience in environmental measurements resulting a high quality instrument that reliably measures all essential weather parameters. This makes the WXT510 an optimal building block for dense weather measurement networks, and other weather stations used in multiple applications.

The WXT510 is truly flexible and it can be configured to meet most user requirements. The transmitter is easy to install with its one-bolt-mounting method. Easy and fast installation, as well as low power consumption make it ideal for use in weather stations or applications where light weight and compactness are an advantage. As the WXT510 has no moving parts, it is durable and has long maintenance intervals. The materials used are also highly resistant against UV radiation and corrosion.

Proven Vaisala technology

Accurate measurement begins with the sensors. Vaisala has decades of experience in designing and manufacturing weather sensors with field proven reliability and accuracy.

Accurate and Stable Measurement

Wind measurement

Both wind speed and direction are measured using the advanced Vaisala WINDCAP® Sensor. The sensor uses ultrasound to determine horizontal wind speed and direction. The array of three equally spaced ultrasonic transducers on a horizontal plane is an ideal, Vaisala proprietary design. The design ensures accurate wind measurement from all wind directions, without blind angles or corrupted readings.

The wind sensor has no moving parts, which makes it maintenance free. The measurement range for wind speed is from 0 to 60 m/s and for wind direction from 0 to 360°.

Precipitation measurement

The precipitation measurement is based on the Vaisala RAINCAP® Sensor, which detects the impact of individual rain drops. The signals exerting from the impacts are proportional to the volume of the drops. Hence, the signal from each drop can be converted directly to the accumulated rainfall.

Compared to traditional precipitation gauges, the Vaisala RAINCAP® Sensor gives more detailed information about precipitation. The WXT510 measures accumulated rainfall, rain intensity and duration of the rain — all in real time. Due to the measurement method, flooding, clogging as well as wetting and evaporation losses in rain measurement are eliminated.

The Vaisala RAINCAP® Sensor is the only maintenance-free precipitation sensor on the market.



The WXT510 measures accumulated rain fall, rain intensity and duration of the rain in real time.



The patented ultrasonic based Vaisala WINDCAP® Sensor ensures accurate wind measurement from all wind directions.



Barometric pressure, temperature and humidity sensors are combined in an advanced PTU module placed inside the specially designed radiation shield.

PTU module for barometric pressure, temperature and humidity

Barometric pressure, temperature and humidity measurements are combined in an advanced PTU module utilizing capacitive measurement method for each parameter.

Barometric pressure is measured using the silicon-based Vaisala BAROCAP® Sensor. The sensor has minimal hysteresis and excellent repeatability, as well as outstanding temperature and long-term stability. The measurement range for pressure is from 600 to 1100 hPa.

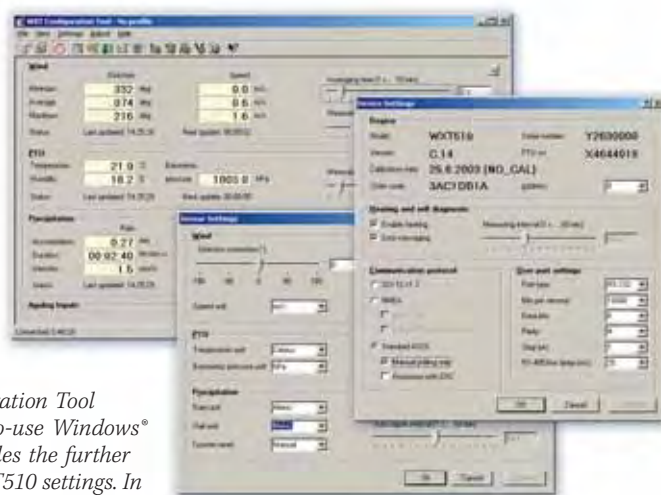
Temperature measurement is based on the ceramic Vaisala THERMOCAP® Sensor. The measurement range is from -52 to +60 °C.

Humidity measurement is based on the Vaisala HUMICAP® technology. The Vaisala HUMICAP® Sensor is highly accurate and it offers excellent long-term stability in a wide range of environments and negligible hysteresis. The measurement range for humidity is 0...100 %RH.

The whole PTU module is replaceable and available as a spare part.

The PTU module is mounted in a specially designed radiation shield. The shield protects the sensors from both scattered and direct solar radiation and precipitation. The plastic material in the plates offers excellent thermal characteristics and UV stabilized construction. The white outer surface reflects radiation, while the black inside absorbs accumulated heat.

Simple to Install, Easy to Integrate



The WXT Configuration Tool includes an easy-to-use Windows® software that enables the further adjustment of WXT510 settings. In addition, the software can be used as a WXT510 user interface / display in a PC environment.

Heating to ensure constant data availability

In order to have measurement data constantly available and ensure correct measurement also during snowfall, the WXT510 offers heating for the wind and rain sensors. The heating circuit is separate from the operational power, which makes it possible to use separate supplies. The nominal input level for heating voltage is 12 V or 24 V (with automatic switch-over), either DC, AC or rectified AC. The WXT510 has an automatic control circuit that switches the heating on only at low temperatures.

Low power consumption and wide input voltage range

The Vaisala Weather Transmitter WXT510 is an excellent choice for applications where power consumption

is a critical factor. During the idle mode the device typically consumes less than 0.1 mA.

The WXT510 has a wide input voltage range. Any 5... 30 VDC power supply can be used as long as it meets all applicable safety regulations.

Easy settings

The WXT510 is supplied pre-configured from the factory. If the factory settings are needed to be altered, the user friendly configuration tool, Windows® based WXT Configuration Tool, is available. Averaging times, output mode settings etc. are easy to change if required. The WXT Configuration Tool can also be used as a display for the WXT510 transmitter.

Flexible output options

The Vaisala Weather Transmitter WXT510 communicates with the host via a bi-directional serial line. It offers a choice of four configurable serial interfaces: SDI-12, RS-232, RS-485 and RS-422.

The screw terminals inside the bottom part of the transmitter are easy to access. For extra convenience an industry standard 8-pin M12 connector at the bottom of the transmitter is available as an option.

Easy installation

The Vaisala Weather Transmitter WXT510 has been designed considering easy installation. After assembling the calibrated PTU module, the WXT510 only needs to be mounted, aligned, and connected to the data logger and the power source.

The WXT510 can be mounted either on top of a pole mast or on to a cross arm. In both cases the mounting procedure is very simple. For facilitating the installation to the pole mast and eliminating the risk of misalignment during the use an optional mounting kit is available. With the mounting kit the north alignment needs to be performed only once.

Negligible maintenance need

The Vaisala Weather Transmitter WXT510 is calibrated at the factory and requires very little maintenance. The only maintenance actions are cleaning the transmitter when necessary and replacing the PTU module. Both rain and wind measurements are practically calibration free. The PTU unit has a recommended calibration interval of two years.

Technical Data

Wind

Wind speed

Range	0...60 m/s
Response time	0.25 s
Available variables	average, maximum and minimum
Accuracy	± 0.3 m/s or ±2% whichever is greater
Output resolution	0.1 m/s (km/h, mph, knots)
Units available	m/s, km/h, mph, knots

Wind direction

Azimuth	0...360°
Response time	250 ms
Available variables	Average, maximum and minimum
Accuracy	± 2°
Output resolution	1°

Measurement frame

Averaging time	1...600 s (= 10 min), at one second steps on the basis of 0.25 second samples
Update interval	1...3 600 s (= 60 min), at one second steps

Liquid Precipitation

Rainfall	cumulative accumulation after latest automatic or manual reset
Collecting area	60 cm ²
Output resolution	0.01 mm (0.001 in)
Accuracy	5% *
Units available	mm, in

Rain duration	counting each ten second increment whenever droplet detected
Output resolution	10 s

Rain intensity	one minute running average in ten second steps
Range	0...200 mm/h (broader range with reduced accuracy)
Output resolution	0.1 mm/h (0.01 in/h)
Units available	mm/h, in/h

Hail	cumulative amount of hits against collecting surface
Output resolution	0.1 hits/cm ² (1 hits/in ²)
Units available	hits/cm ² , hits/in ² , hits

Hail duration	counting each ten second increment whenever hailstone detected
Output resolution	10 s

Hail intensity	one minute running average in ten second steps
Output resolution	0.1 hits/cm ² h (1 hits/in ² h)
Units available	hits/cm ² h, hits/in ² h, hits/h

* Due to the nature of the phenomenon, deviations caused by spatial variations may exist in precipitation readings, especially in short time scale. The accuracy specification does not include possible wind induced error.

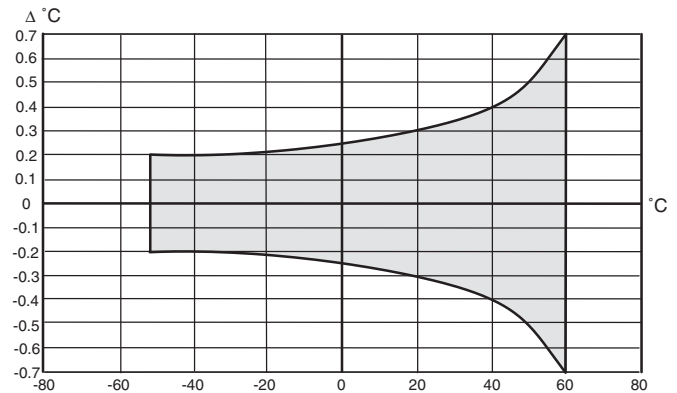
PTU module = Barometric Pressure, Air Temperature and Relative Humidity

Barometric Pressure

Range	600...1 100 hPa
Accuracy	±0.5 hPa at 0...+30 °C (+32...+86 °F) ±1 hPa at -52...+60 °C (-60...+140 °F)
Output resolution	0.1 hPa, 10 Pa, 0.0001 bar, 0.1 mmHg, 0.01 inHg
Units available	hPa, Pa, bar, mmHg, inHg

Air Temperature

Range	-52 ... +60 °C (-60...+140 °F)
Accuracy (for sensor element) at +20 °C (+68 °F)	±0.3 °C (±0.5 °F)
Accuracy over temperature range (see graph)	



Output resolution	0.1 °C (0.1 °F)
Units available	°C, °F

Relative Humidity

Range	0...100 %RH
Accuracy	±3 %RH within 0...90 %RH ±5 %RH within 90...100 %RH
Output resolution	0.1 %RH

PTU Update Interval

Update interval	3...3 600 s (= 60 min), at one second steps
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Technical Data, Dimensions

General

Self-diagnostic	separate supervision message, unit/status fields to validate measurement quality
Start-up	automatic, <10 seconds from power on to the first valid output
Communication protocols	SDI-12 v1.3, ASCII automatic & polled, NMEA-0183 v3.0 with query option
Port H/W	SDI-12, RS-232, RS-485, RS-422
Baud rate	1 200, 2 400...115 200
Operating temperature	-52...+60 °C (-60...+140 °F)
Storage temperature	-60...+70 °C (-76...+158 °F)
Operating humidity	0...100 %RH
Dimensions	
Height	240 mm (9.4 in)
Diameter	120 mm (4.7 in)
Weight	650 g (1.43 lbs)

Power Supply

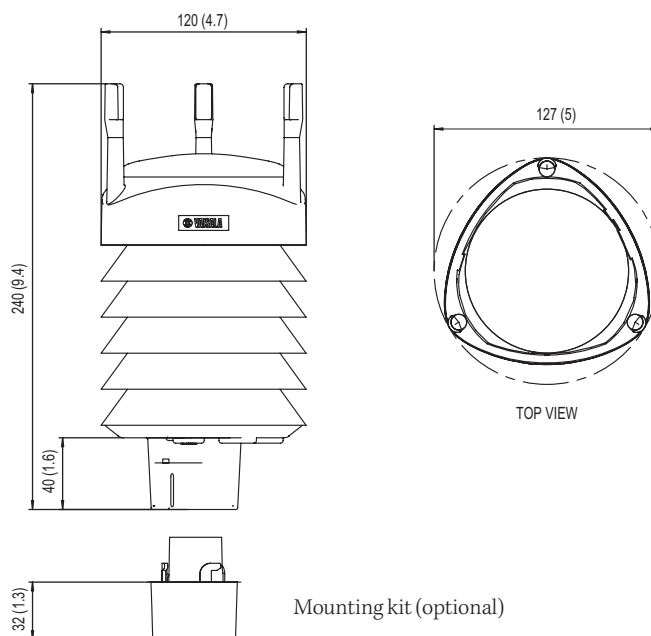
Input Voltage	5...30 VDC
Power consumption on average	
minimum	0.07 mA @ 12 VDC (in SDI-12 mode)
maximum	13 mA @ 30 VDC (with continuous measurement of all parameters)
typical	3 mA @ 12 VDC (with default measuring intervals)
Heating voltage	options: DC, AC, full wave rectified AC
recommended ranges	12 VDC ±20%, 1.1 A max. 24 VDC ±20%, 0.6 A max. 68 V _{p-p} ±20% (AC), 0.6 A _{rms} max. 34 V _p ±20% (f/w rect. AC), 0.6 A _{rms} max.
absolute max	30 VDC 84 V _{p-p} (AC) 42 V _p (f/w rect. AC)

Electromagnetic compatibility

Complies with EMC standard: EN61326-1:1997 + Am1:1998 + Am2:2001; Generic Environment.

Dimensions

Dimensions in mm (inches).



Mounting kit (optional)

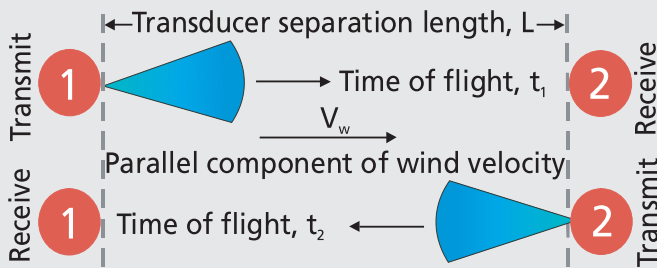
Incorporates Latest Sensor Technology

Operating Principles of Wind and Rain Measurement

Vaisala WINDCAP® Sensor

The Vaisala WINDCAP® Sensor enables wind measurement with no moving or wearing parts. The measurement of wind speed and direction is based on sonic technology.

The Vaisala WINDCAP® Sensor is used in Vaisala Weather Transmitter WXT510 and Vaisala Ultrasonic Wind Sensor WS425.

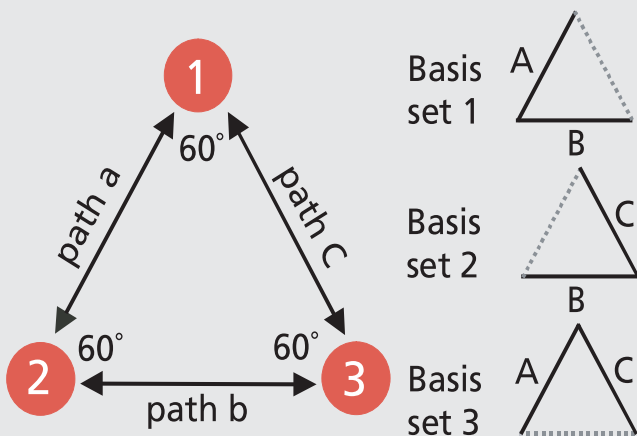


$$\text{For static speed of sound } V_s: \frac{1}{t_1} = \frac{V_s + V_w}{L} \text{ and } \frac{1}{t_2} = \frac{V_s - V_w}{L}$$

$$\text{Combine to remove } V_s: V_w = \frac{L}{2} \left(\frac{1}{t_1} - \frac{1}{t_2} \right)$$

Solve for V_w

Time-of-flight for a sonic impulse from the transmit transducer to the receive transducer is determined for both directions. Simple algebra allows solving for the parallel component of wind velocity independently of the static speed of sound.



The equilateral triangle configuration of the three transducers provides three possible sets of basis vectors. The combinations yield bi-directional measurements on the paths labeled A, B and C. These measurements are used to determine the wind velocity components parallel to each of the three paths.

Vaisala RAINCAP® Sensor

The precipitation measurement used in the Vaisala Weather Transmitter WXT510 is based on Vaisala's proprietary RAINCAP® technology. This acoustic rain measurement technology measures rainfall literally drop by drop, which means that the measurement is not affected by evaporation or wetting losses. In addition, the measurement is immune to flooding induced errors, because the sensor does not collect water.

The Vaisala RAINCAP® Sensor has no moving parts and therefore it requires practically no maintenance.



$$U_j \propto V_j$$

$$\rightarrow P = f(U)$$

The precipitation sensor detects the impact of individual raindrops. The voltage signals U_j resulting from the impacts are proportional to the volume of the drops V_j and therefore, the signal of each drop can be directly converted to accumulated precipitation P .