User Guide

Vaisala Weather Transmitter

WXT530 Series

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1. About This Document

1.1 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.

1.2 Trademarks

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

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

1.3 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.

1.4 Version Information

Table 1   Document Versions

Document Code	Date	Description
M211840EN-D	April 2017	Added information about external sensors. Updated technical drawings. Added grounding information. Added index.
M211840EN-C	February 2016	Previous version

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2. Product Overview

2.1 WXT530 Series Weather Transmitters

The WXT530 product family consists of the following transmitters.

WXT536 WXT535 WXT534 WXT533 WXT532 WXT531
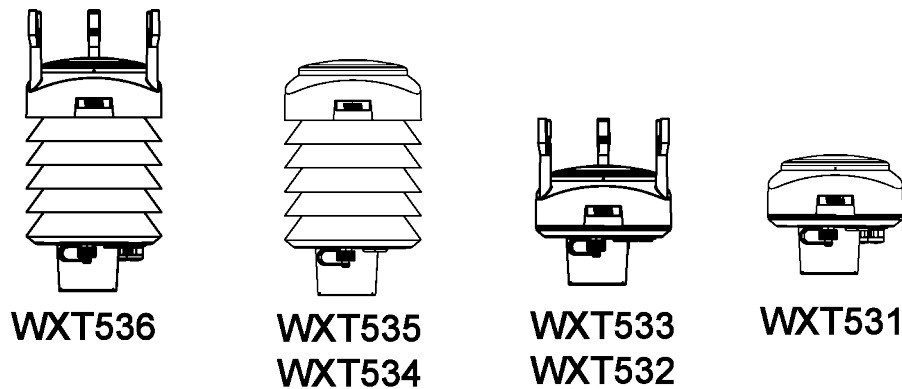
Figure 1   Vaisala Weather Transmitter WXT530 Series

The WXT530 series transmitters are suitable for several purposes, such as:

- Agro-meteorological applications
- Building control systems
- Cruisers
- Energy applications
- Environmental monitoring
- Fire weather
- Meteorological test beds
- Noise monitoring
- Researchers
- Sport events
- Weather stations

The product family offers a variety of weather parameters. The following table lists the measurement combinations of each model.

WXT536	WXT535	WXT534	WXT533	WXT532	WXT531
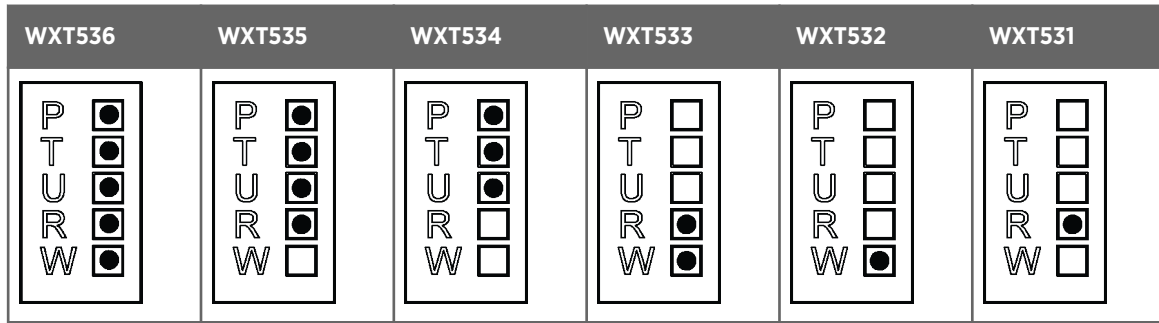
Parameter	Description
P	Pressure
T	Temperature
U	Humidity
R	Rain
W	Wind

The transmitters power up with 5 … 32 VDC and output serial data with a selectable communication protocol:

- SDI-12
- ASCII automatic and polled
- NMEA 0183 with query option

The WXT530 series has four serial interface options:

- RS-232
- RS-485
- RS-422
- SDI-12

The transmitter is equipped with the following connectors:

- 8-pin M12 connector for installation
- 4-pin M8 connector for service use

The transmitter housing is IP65/66 rated.

The following table shows different options available for the product family.

Table 2   Available Options

Available options	WXT536	WXT535	WXT534	WXT533	WXT532	WXT531
Service Pack 2: Windows-based Vaisala Configuration Tool software with USB service cable (1.4 m)	✔	✔	✔	✔	✔	✔
USB RS-232/RS-485 cable (1.4 m)	✔	✔	✔	✔	✔	✔

Available options	WXT536	WXT535	WXT534	WXT533	WXT532	WXT531
Mounting kit	✔	✔	✔	✔	✔	✔
Surge protector	✔	✔	✔	✔	✔	✔
Bird kit	✔	✔	✔	✔	✔	✔
Shielded cables (2 m, 10 m, 40 m)	✔	✔	✔	✔	✔	✔
Bushing and grounding kit	✔	✔	✔	✔	✔	✔
Heating	✔	✔		✔	✔	✔
Analog input option	✔					
mA output option					✔	

2.1.1 WXT536

WXT536 measures:

- Pressure
- Temperature
- Humidity
- Rain
- Wind speed
- Wind direction

It offers an analog input option.
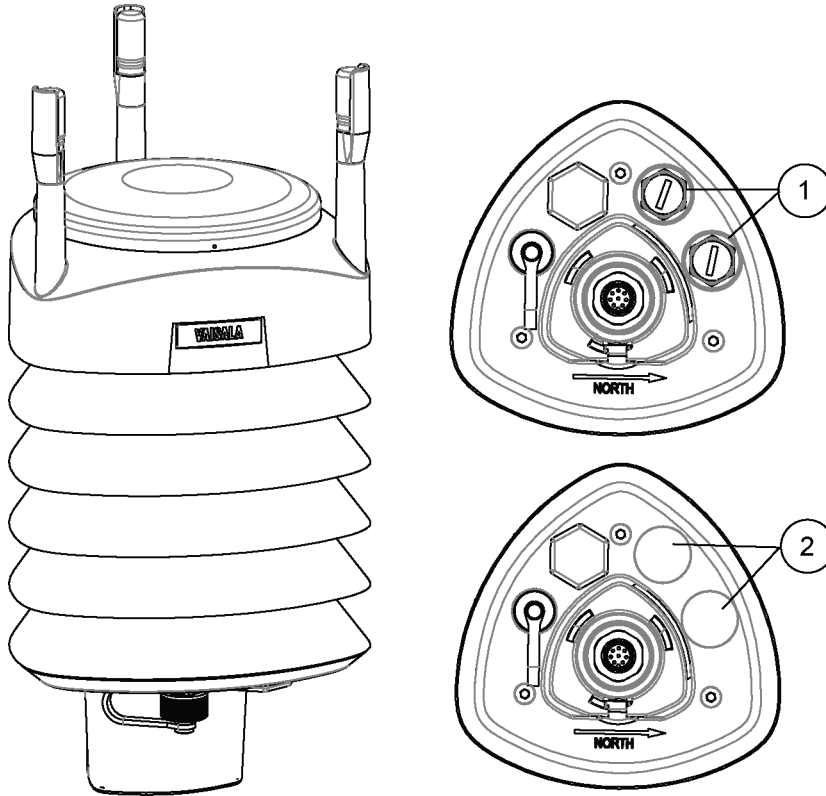
Figure 2   WXT536

1   Analog input option
2   Analog input option not ordered

2.1.2 WXT535 and WXT534

WXT535 measures:

- Pressure
- Temperature
- Humidity
- Rain

WXT534 measures:

- Pressure
- Temperature
- Humidity
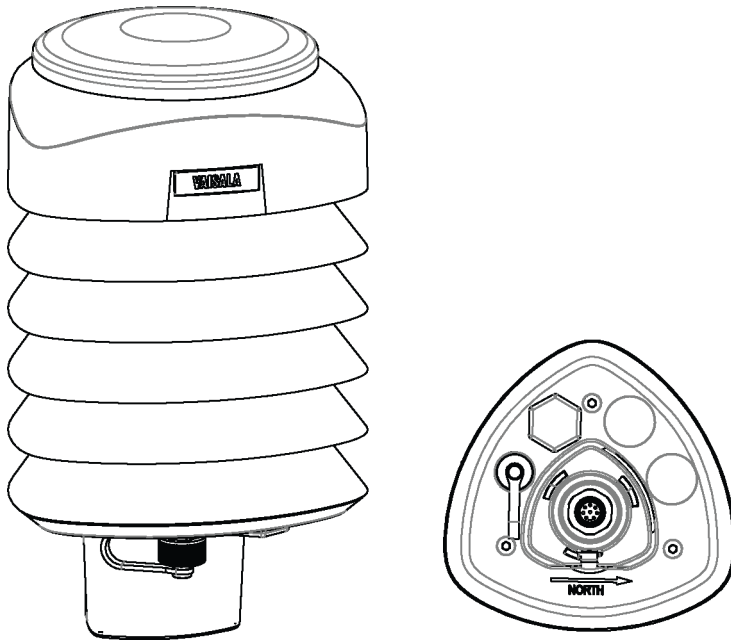
Figure 3   WXT535 and WXT534

2.1.3 WXT533 and WXT532

WXT533 measures:

  • Rain
  • Wind

WXT532 measures wind and offers an mA output option.
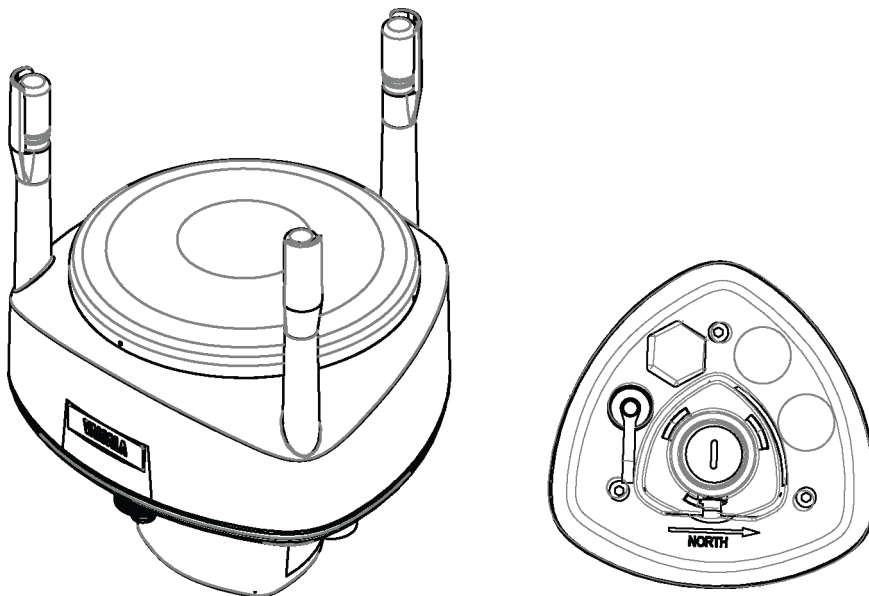
Figure 4   WXT533 and WXT532

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2.1.4 WXT531

WXT531 measures rain.
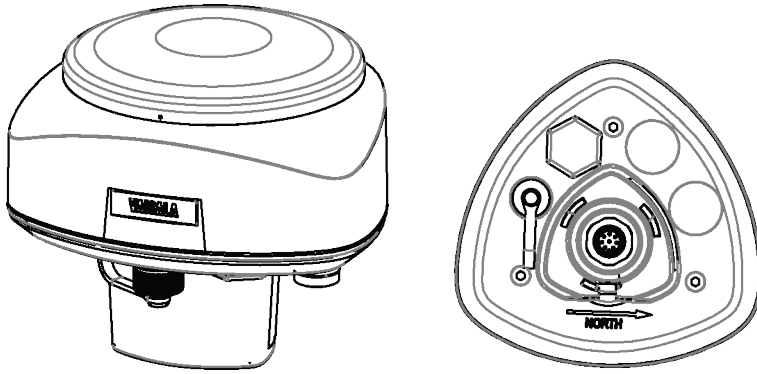
Figure 5   WXT531

2.2 Components
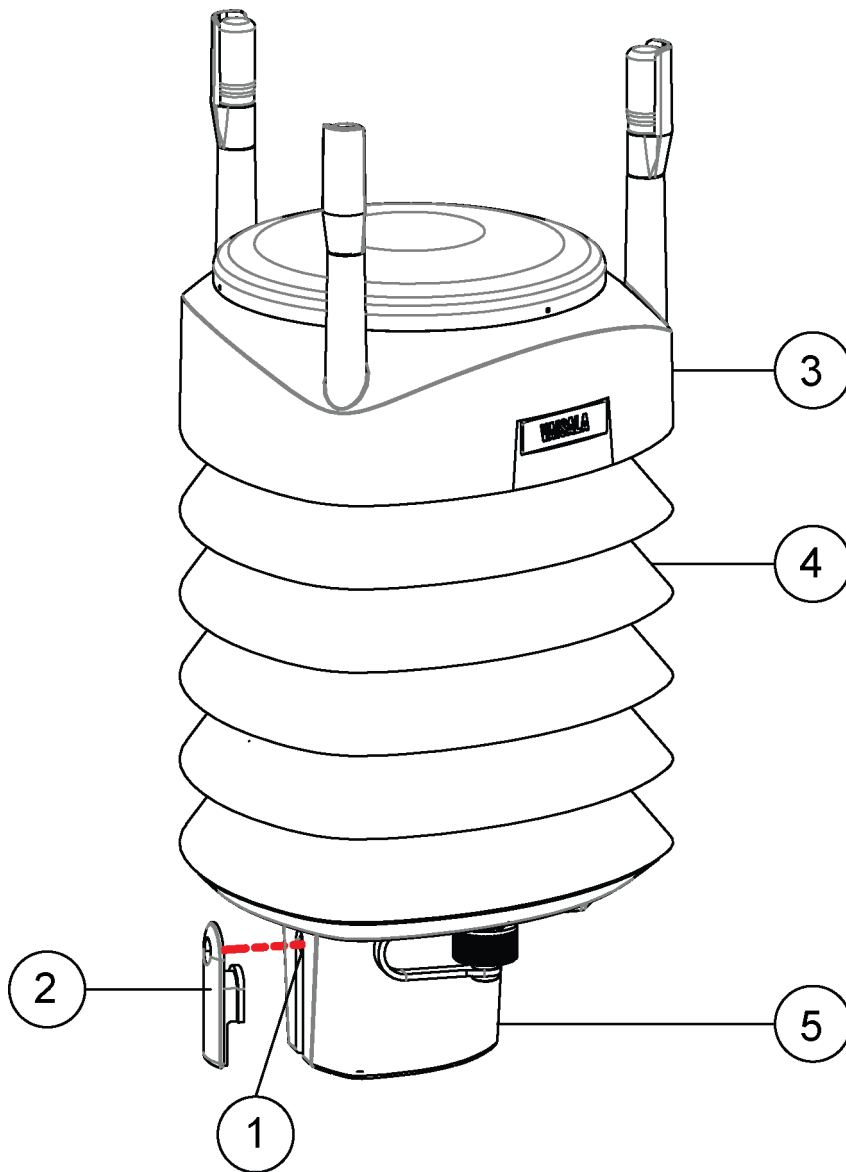
Figure 6   WXT536 Components

1   Fixing screw and chassis grounding point
2   Screw cover
3   Top of the transmitter
4   Radiation shield
5   Bottom of the transmitter
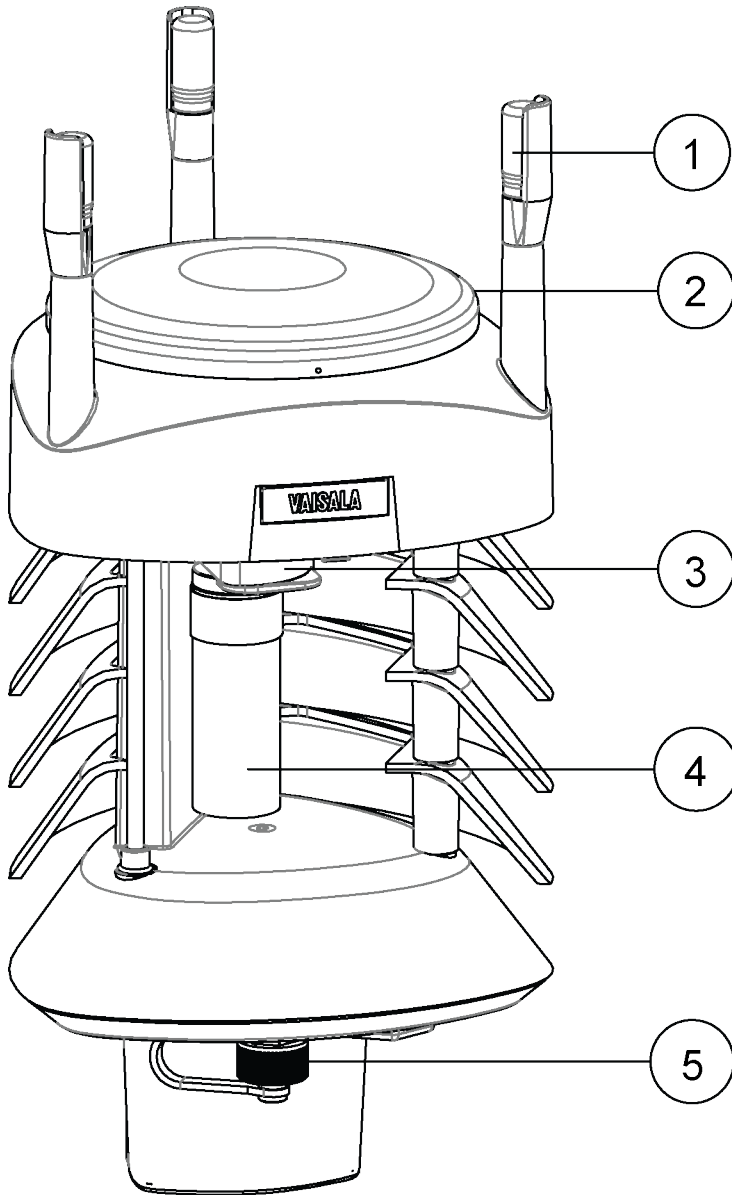
Figure 7   Cut-Away View of WXT536

1   Wind transducers (3 pcs)
2   Precipitation sensor
3   Pressure sensor inside the PTU module
4   Humidity and temperature sensors inside the PTU module
5   Service port
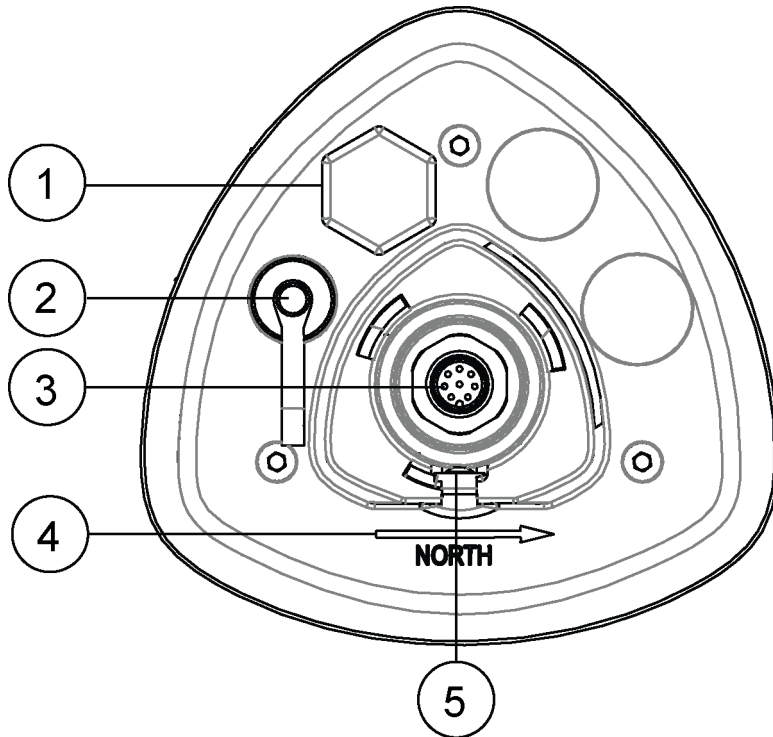
Figure 8   Bottom of WXT536

1   Opening for cable gland (if unused, cover with a hexagonal plug).
     Watertight cable gland (optional, included in the Bushing and Grounding Kit)
2   4-pin M8 connector for service port
3   8-pin M12 connector for power or data communications cable
4   Alignment direction indicator arrow
5   Fixing screw and chassis grounding point

2.3 Optional Features

The WXT530 series includes the following optional features:

- USB cables
- Mounting kit
- Surge protector
- Bird kit
- Vaisala Configuration Tool
- Heating

> **i** You must select these options when placing the order.

More Information

‣ Options and Accessories (page 163)

2.3.1 USB Cables
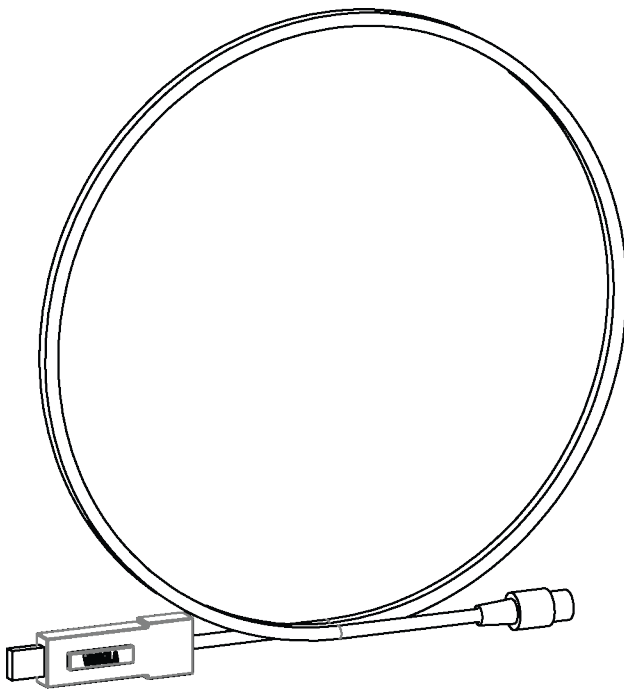
Figure 9   USB Cable

- USB RS-232/RS-485 cable with 8-pin M12 threaded connector (1.4 m)
- USB service cable with 4-pin M8 threaded connector (1.4 m)

The service cable, while connected between the service port and PC, forces the service port to RS-232 / 19200, 8, N, 1.

> ℹ️ You need a driver for the USB cable.

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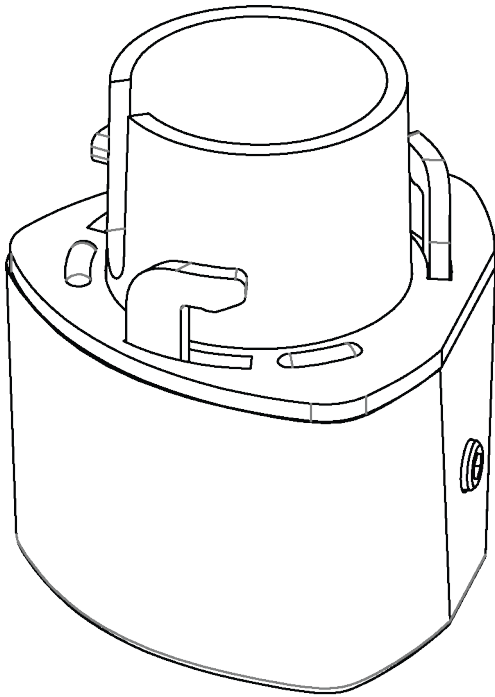
2.3.2 Mounting Kit

Figure 10   Mounting Kit

The optional mounting kit helps mounting the transmitter on a pole mast. When using the mounting kit, alignment is needed only when mounting for the first time.

Using the mounting kit improves the transmitter IP classification to IP66. Without the mounting kit, the WXT530 series transmitters are rated IP65.

2.3.3 Surge Protector
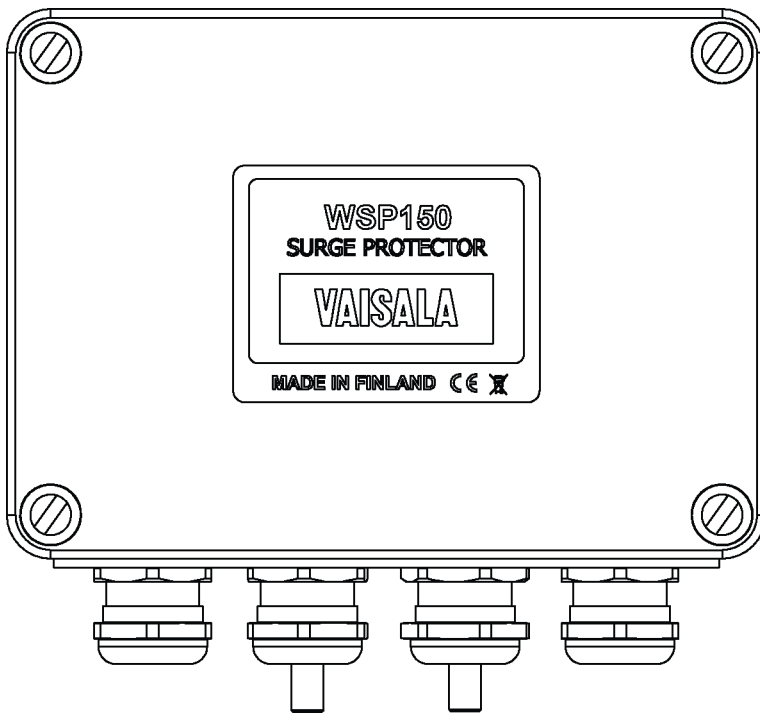
Figure 11   Surge Protector

Vaisala recommends using surge protectors:

- When weather instruments are installed in areas with an elevated risk of lightning strike, such as on top of high buildings or masts, or in open areas.
- If your cable length exceeds 10 m.
- If you have unshielded, open-wire lines.

Vaisala provides the following surge protectors:

- Vaisala Surge Protector WSP150. A compact transient overvoltage suppressor designed for outdoor use. It can be used with all Vaisala wind and weather instruments. Install WSP150 close to the protected instrument (maximum 3 m).
- Vaisala Surge Protector WSP152. Designed for use with Vaisala WXT transmitters and WMT sensors. WSP152 protects the host PC against surges entering through the USB port. Install WSP152 close to the PC, no further than the USB cable can reach (1.4 m).

2.3.4 Bird Kit
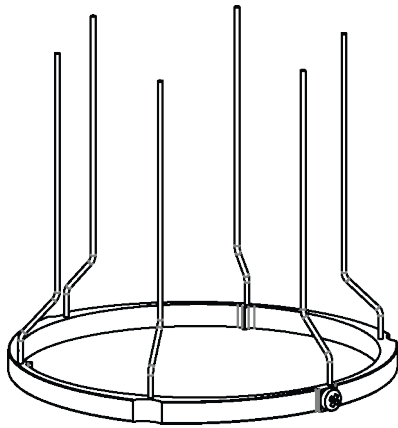
Figure 12   Bird Kit

The optional bird kit reduces the interference that birds cause to the wind and rain measurement.

The kit consists of a metallic band with spikes pointing upward. The kit is installed on top of the transmitter. The shape and location of the spikes has been designed so that the interference with wind and rain measurement is minimal.
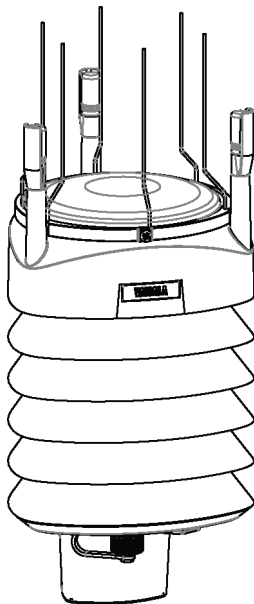
Figure 13   WXT536 with Bird Kit

The spikes do not hurt the birds; they are simply a barrier that makes it difficult for birds to land on top of the transmitter. The bird spike kit does not provide complete protection against birds, but it does render the transmitter unsuitable for roosting and nest building.

> ℹ️ When the kit is in place, more snow can accumulate on the transmitter, and the snow can melt away more slowly.

2.3.5 Vaisala Configuration Tool

Vaisala Configuration Tool is a Windows-based, user-friendly parameter setting software for WXT530 transmitters. It is also fully compatible with WMT52 and WXT520.
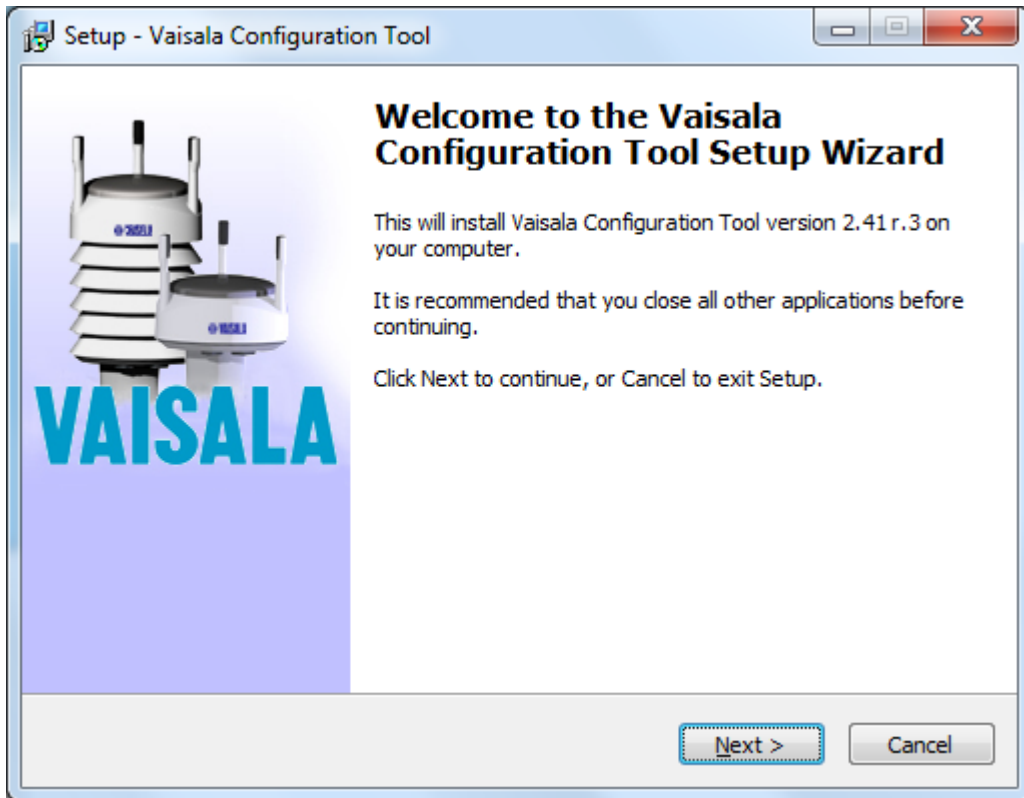
Figure 14   Vaisala Configuration Tool

2.3.6 Sensor Heating

Heating helps to improve the measurement accuracy.

More Information

‣ Heating (page 30)

2.4 Backward Compatibility

> **i** Always use the latest version of WXT530 Configuration Tool.

The WXT530 series transmitters are fully compatible with WXT520 and WMT52. This applies to mounting, cable options, and communication.

When you upgrade from WMT52 to WXT532 or from WXT520 to WXT536, you must use the same profile and communication option as you had before. Regenerate the setup files (WXC files) for WXT530 with the latest version of WXT530 Configuration Tool .

Because the WXT530 series has several product variants, the old configuration code does not apply to the new WXT530 sensor. You must generate and apply a new order code for it.

More Information

‣

2.5 Regulatory Compliances

The electromagnetic compatibility of the WXT530 series has been tested according to the following product family standard:

- EN 61326-1 Electrical equipment for measurement, control and laboratory use - EMC requirements - for use in industrial locations.
- The WXT530 series has been enhanced for marine use according to the appropriate sections of the IEC 60945 Maritime Navigation and Radiocommunication Equipment and Systems - General requirements - Methods of testing.
- The WXT530 series is in conformance with the provisions of the RoHS directive of the European Union:

    - Directive on the Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment (2002/95/EC)

3. Functional Description

3.1 Wind Measurement Principle

WXT536	WXT535	WXT534	WXT533	WXT532	WXT531
✔			✔	✔	

The transmitters use Vaisala WINDCAP sensor technology for wind measurement.

The wind sensor has an array of three equally spaced ultrasonic transducers on a horizontal plane. The unit determines wind speed and wind directions by measuring the time it takes the ultrasound to travel from one transducer to the other two.

The wind sensor measures the transit time (in both directions) along the three paths established by the array of transducers. The transit time depends on the wind speed along the ultrasonic path. For zero wind speed, both the forward and reverse transit times are the same. With wind along the sound path, the up-wind direction transit time increases and the down-wind transit time decreases.

The unit calculates wind speed from the measured transit times using the following formula:

$$V_w = 0.5 \times L \times (1/t_f - 1/t_r)$$

V_w	Wind speed
L	Distance between the two transducers
t_f	Transit time in forward direction
t_r	Transit time in reverse direction

Measuring the six transit times allows V_w to be computed for each of the three ultrasonic paths. The computed wind speeds are independent of altitude, temperature, and humidity, which are cancelled out when the transit times are measured in both directions, although the individual transit times depend on these parameters.

The V_w values of two array paths are enough to compute wind speed and wind direction. A signal processing technique ensures that wind speed and wind direction are calculated from the two array paths with the best quality.

The wind speed is represented as a scalar speed in selected units (m/s, kt, mph, km/h). The wind direction from which the wind comes is expressed in degrees (°). North is represented as 0°, East as 90°, South as 180°, and West as 270°.

The wind direction is not calculated when the wind speed drops below 0.05 m/s. In this case, the last calculated direction output remains until the wind speed increases to the level of 0.05 m/s.

The average values of wind speed and direction are calculated as a scalar average of all samples over the selected averaging time (1 ... 3600 s) with a selectable updating interval. The sample count depends on the selected sampling rate: 4 Hz (default), 2 Hz, or 1 Hz. The minimum and maximum values of wind speed and direction represent the corresponding extremes during the selected averaging time.

You can select the computation of the wind speed extreme values in one of two ways:

- Traditional minimum/maximum calculation
- 3-second gust & calm calculation recommended by the World Meteorological Organization (WMO). In this case the highest and lowest 3-second average values (updated once a second) replace the maximum and minimum values in reporting of wind speed, while the wind direction variance is returned in the traditional way.

The transmitter constantly monitors the wind measurement signal quality. If poor quality is detected, the wind values are marked as invalid. If over half of the measurement values are considered invalid, the last valid wind values are returned as missing data. However, in the SDI-12 protocol, the invalid values are marked as zero (0).

More Information

‣ Wind Measurement Averaging Method (page 181)

3.2 Precipitation Measurement Principle

WXT536	WXT535	WXT534	WXT533	WXT532	WXT531
✔	✔		✔		✔

The transmitter uses Vaisala RAINCAP Sensor 2-technology in precipitation measurement.

The precipitation sensor comprises of a steel cover and a piezoelectrical sensor mounted on the bottom surface of the cover.

The precipitation sensor detects the impact of individual raindrops. The signals from the impact are proportional to the volume of the drops. The signal of each drop can be converted directly to accumulated rainfall. An advanced noise filtering technique filters out signals originating from other sources than raindrops.

The measured parameters are:

- Accumulated rainfall
- Rain current and peak intensity
- Duration of a rain event

Detecting each drop enables the computing of rain amount and intensity with high resolution.

Precipitation current intensity is internally updated every 10 seconds and represents the intensity during the one minute period before requesting/automatic precipitation message sending (for fast reactions to a rain event, during the first minute of the rain event, the intensity is calculated over the period rain has lasted in 10-second steps instead of a fixed period of one minute). Precipitation peak intensity represents the maximum of the calculated current intensity values since last precipitation intensity reset.

The sensor can also distinguish hail stones from raindrops. The measured hail parameters are the cumulative number of hail stones, current and peak hail intensity and the duration of a hail shower.

The precipitation sensor operates in four modes:

- Precipitation Start/End mode:
  Transmitter automatically sends a precipitation message 10 seconds after the recognition of the first drop. The messages are sent continuously as the precipitation proceeds and stop when the precipitation ends.
- Tipping bucket mode:
  This mode emulates tipping bucket type precipitation sensors. Transmitter sends automatically a precipitation message when the counter detects one unit increment (0.1 mm/0.01 in).
- Time mode:
  Transmitter sends automatically a precipitation message in the update intervals defined by the user.
- Polled mode:
  Transmitter sends a precipitation message whenever requested by the user.

More Information

‣ Precipitation Sensor (page 127)

3.3 PTU Measurement Principle

WXT536	WXT535	WXT534	WXT533	WXT532	WXT531
✔	✔	✔			

The PTU module contains separate sensors for pressure, temperature, and humidity measurement.

The measurement principle of the transmitter is based on an advanced RC oscillator and two reference capacitors against which the capacitance of the sensors is continuously measured. The microprocessor of the transmitter performs compensation for the temperature dependency of the pressure and humidity sensors.

The PTU module includes:

- Capacitive silicon BAROCAP sensor for pressure measurement,
- Capacitive ceramic THERMOCAP sensor for air temperature measurement
- Capacitive thin film polymer HUMICAP180 sensor for humidity measurement.

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3.4 Heating

WXT536	WXT535	WXT534	WXT533	WXT532	WXT531
✔	✔		✔	✔	✔

> ℹ When operating the sensor in temperatures below 0 °C (32 °F), select a model with an internal heater and enable the heater for operation.

The heating elements located below the precipitation sensor and inside the wind transducers help keeping the sensors clean from snow and ice. A heating temperature (**Th**) sensor underneath the precipitation sensor controls the heating. Note that **Th** is measured inside the equipment, where temperature is much higher than the ambient temperature (**Ta**).

The heating control tries to keep **Th** at +15 °C by adjusting the heating power. The heater control switches heating resistors on and off based on heating voltage and **Th**.

Table 3   Heater Resistance

Transmitter model	Heater resistance when Vh < 15 V	Heater resistance when Vh > 15 V
WXT536, WXT535, WXT533, WXT532	15	57
WXT531	27	

The instant current depends on the heater voltage. You must select the power supply with the instant current in mind. The average heating power and heater performance do not depend on the heating voltage.

When the heating function is disabled, the heating is off in all conditions.

> ℹ Snow accumulation can cause temporary wind measurement problems even when heating is enabled.

More Information

3.5 Analog Input Interface

WXT536	WXT535	WXT534	WXT533	WXT532	WXT531
✔					

WXT536 offers an analog input option for solar radiation, external temperature, level measurement, and tipping bucket.
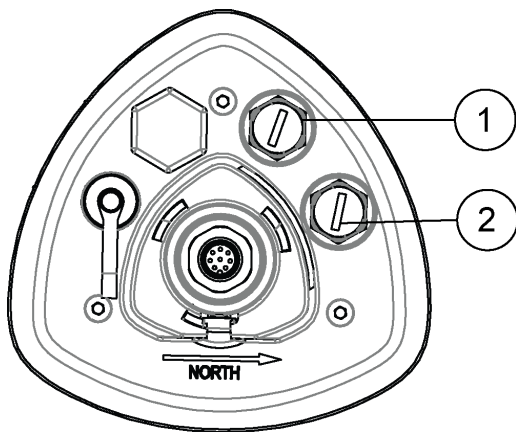
Figure 15   Analog Inputs for External Sensors

1   Analog input 1
     Sensor A: Solar radiation
2   Analog input 2
     Sensor B: Temperature
     Sensor C: Level sensor
     Sensor D: Tipping bucket

3.6 Analog Output Interface

WXT536	WXT535	WXT534	WXT533	WXT532	WXT531
				✔	

WXT532 offers an analog output option for wind speed and wind direction measurement.

The output settings are preconfigured at the factory according to your order. WXT532 takes measurements according to the configured averaging time and synthesizes the analog outputs of wind speed and wind direction with an update interval of 0.25 seconds.

4. Installation

> ℹ️ Do not store the transmitter outdoors. Make sure you switch on the transmitter right after installation.

4.1 Installing WXT530

At the measurement site, you must mount, ground, align, and connect the transmitter to the data logger and the power source.

You can install the instrument on top of a pole mast or on a sensor support arm.

For the most reliable measurements:

- Avoid trees or other objects nearby which could disturb wind flow.
- Install the sensor to the height that best represents the prevailing wind conditions on site.

> ⚠️ **CAUTION!** To prevent equipment damage, install an air terminal so that the tip is as high above the instruments and sensors as possible.

> 💡 To prevent corrosion and oxidation, use copper paste or equivalent on screws and connector threads.

4.1.1 Maritime Installations

In maritime installations according to IEC 60945, the WXT530 series belongs to the installation category C, which means that it is exposed to weather. When making maritime installations, pay attention to the following:

- Do not install WXT530 near a magnetic compass. The compass safe distance is 5 m. The transmitter must be installed in open space to avoid disturbance in measurements.
- Do not place WXT530 directly in front of a radar.
- Do not install WXT530 next to a powerful RF-transmitter antenna.

4.2 Placing WXT530

Select a site that represents the general area of interest to ensure representative ambient measurements. Make sure that the site that is free from turbulence caused by nearby objects, such as trees and buildings.

Following World Meteorological Organization (WMO) guidelines, a general recommendation is that there is at least 150 m open area in all directions from the mast. Any object of height (h) does not significantly disturb wind measurement at a minimum distance of 10 times the height of the object.

The recommended minimum length (h) for the mast that is installed on top of a building is 1.5 times the height of the building (H). When the diagonal (W) is less than the height (h), the minimum length of the mast is 1.5 W. However, follow the application specific instructions and local regulations when placing WXT530.
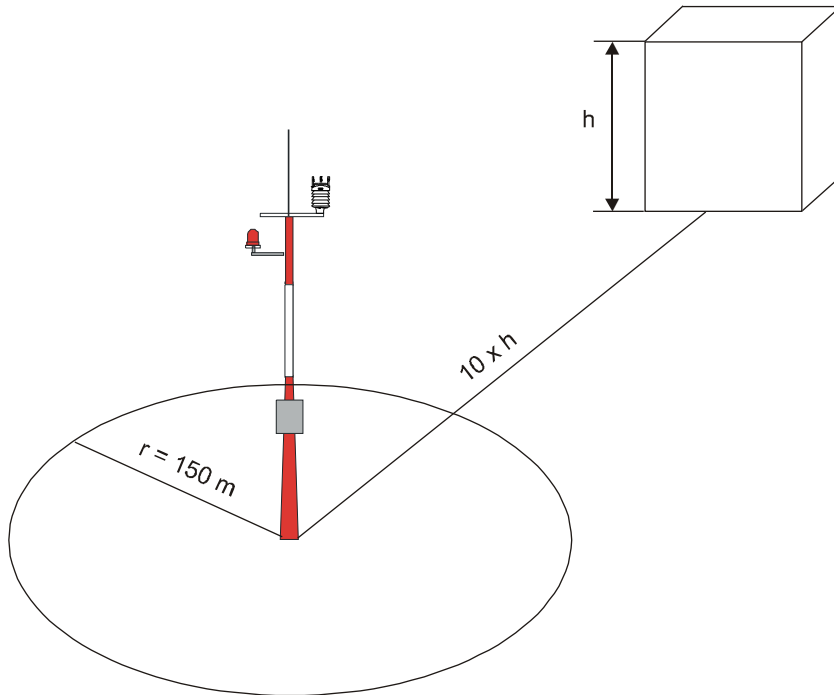
Figure 16   Recommended Mast Location in Open Area
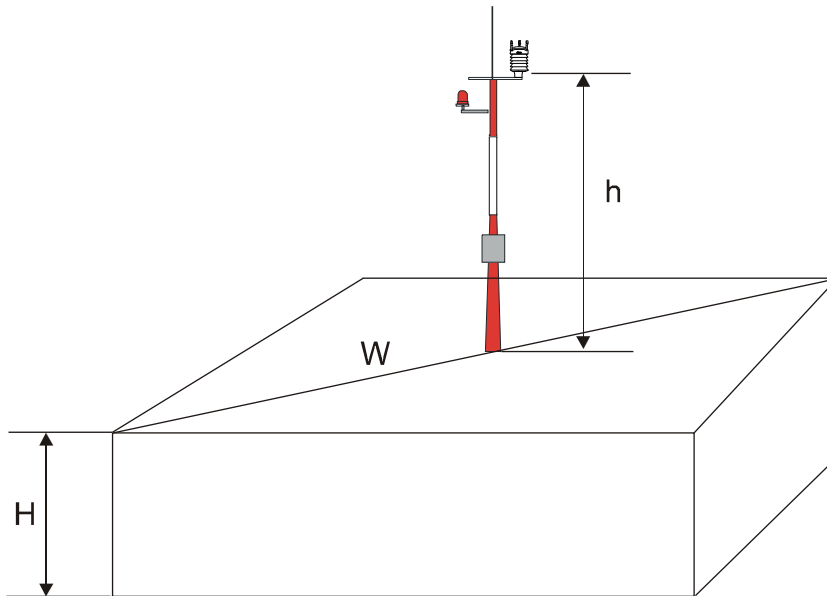
Figure 17   Recommended Mast Length on Top of Building

⛔ **WARNING!** To protect personnel and the transmitter, install an air terminal with the tip at least one meter above the transmitter. It must be properly grounded, compliant with all applicable local safety regulations.

⚠️ **CAUTION!** Installations on top of high buildings or masts and in sites on open grounds are vulnerable to lightning strikes. A nearby lightning strike can induce a high-voltage surge not tolerable by the internal surge suppressors of the instrument.
Additional protection is needed in regions with frequent, severe thunderstorms, especially when long line cables (> 30 m) are used. Vaisala recommends using a surge protector, such as WSP150 and WSP152, in all sites with an elevated risk of lightning strike.

4.3 Unpacking WXT530

The transmitter comes in a custom shipping container. The following figure shows the contents of the carton.
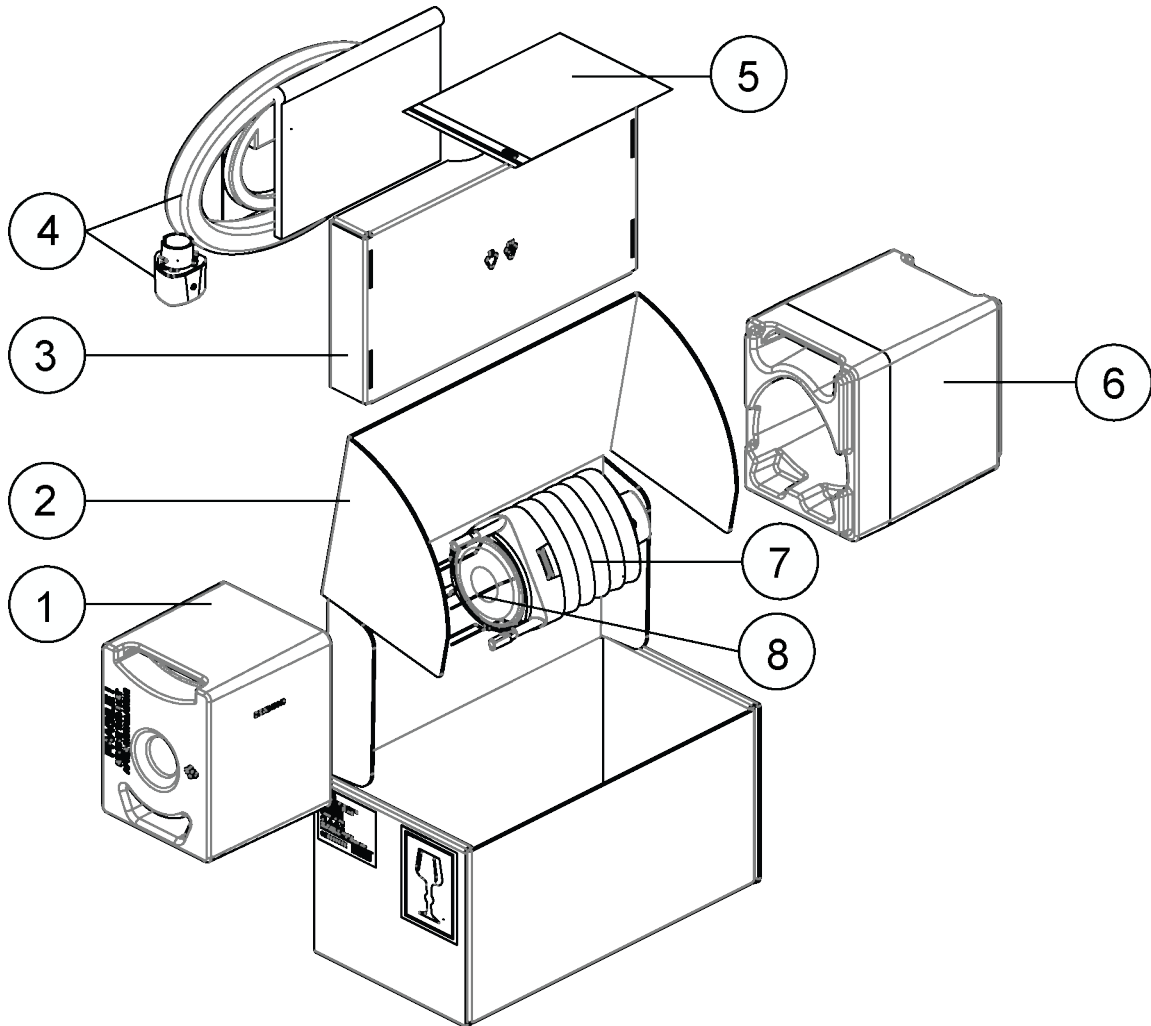
1   Protective packaging top
2   Shipping carton
3   Inner box
4   Manual, cables, mounting kit (optional)
5   Installation note
6   Protective packaging bottom
7   Transmitter
8   Bird kit (optional)

> **CAUTION!** Be careful not to damage the wind transducers located at the top of the three antennas. Dropping the device can break or damage the transducers. If the antenna bends or twists, re-aligning can be difficult or impossible.

Do not remove the top of the package protecting the transducer until you have installed the transmitter. The polypropylene cushion protects the transducers during installation.
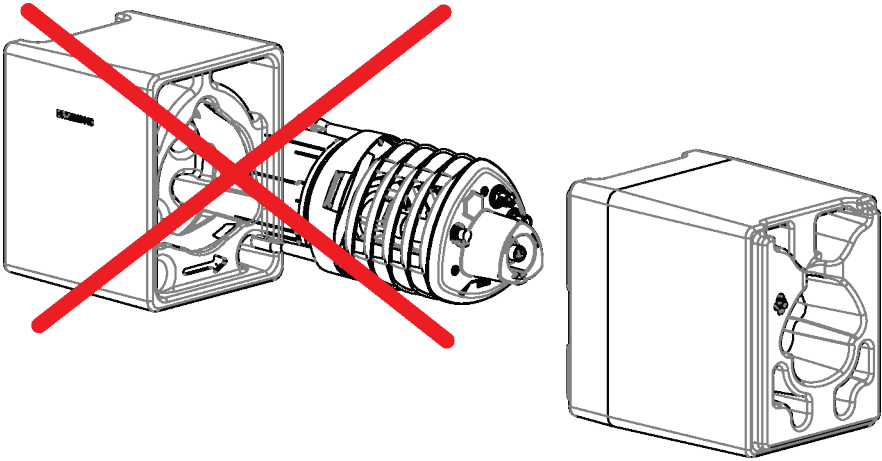
Figure 19   Installing with Protective Packaging

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

4.4 Mounting WXT530

The transmitter is easy to install as it does not have any moving parts.

The transmitter can be mounted on:

- Vertical pole mast
- Sensor support arm

> ℹ️ Install the transmitter upright.

> ℹ️ The transmitter radiation shield reflects light. If you install the transmitter next to a pyranometer or a temperature and humidity sensor, the pyranometer or temperature and humidity sensor can give incorrect measurements. Install the transmitter on the same level with the pyranometer or temperature and humidity sensor so that the distance between the units is approximately 800 mm (31.5 in).

80 cm [31.5 in]
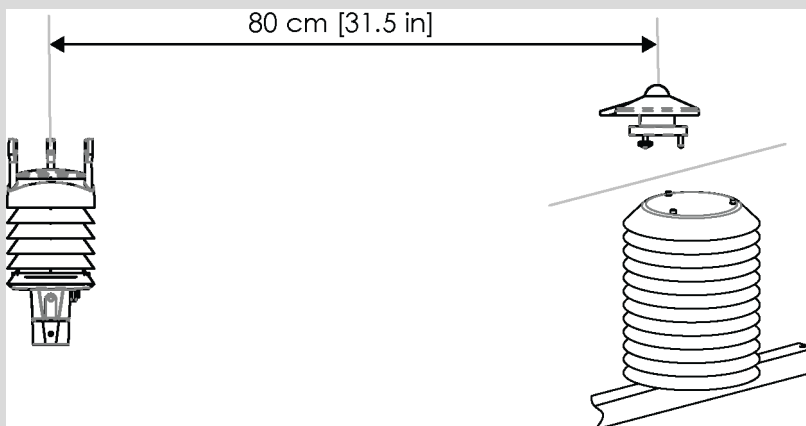
4.4.1 Mounting WXT530 on Vertical Pole Mast without Mounting Kit

▶ 1. Remove the screw cover and insert the transmitter to the pole mast.
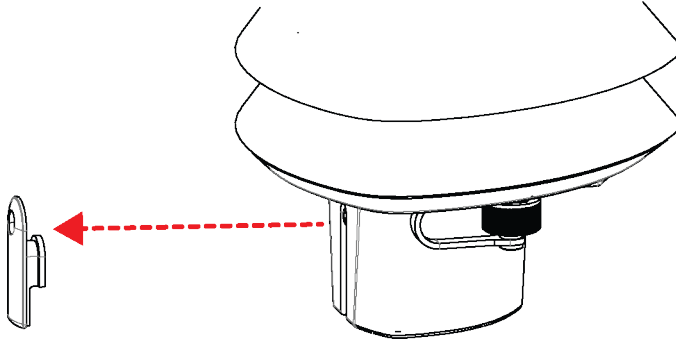
2. Align the transmitter so that the arrow points to North.
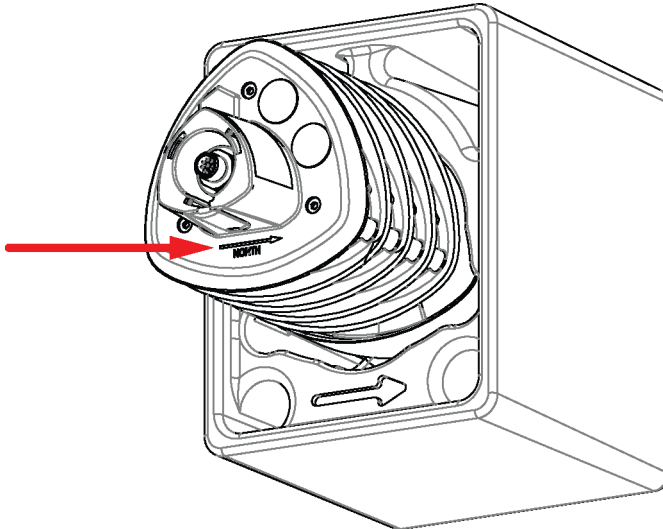
3. Tighten the fixing screw and replace the screw cover.

4.4.2 Mounting WXT530 on Vertical Pole Mast with Mounting Kit

2.5-mm and 5-mm Allen keys

When mounting a transmitter on a pole mast, you can use an optional mounting kit to ease mounting.
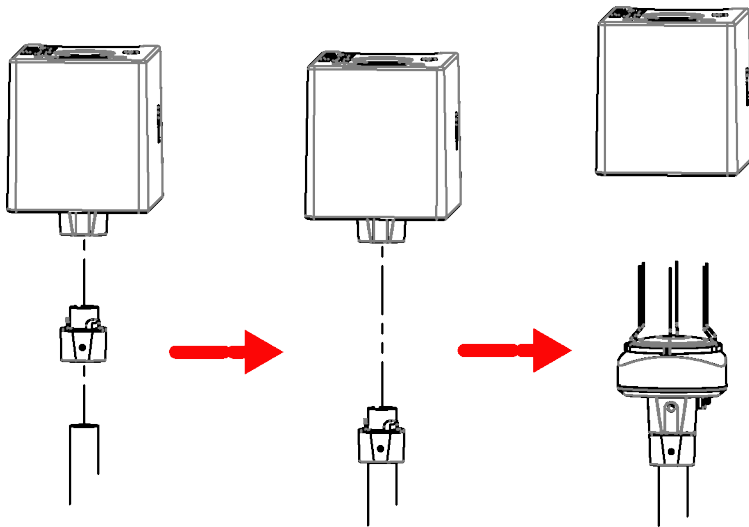
Figure 20   Mounting WXT531 on Vertical Pole Mast

⚠ **CAUTION!** Handle with care. Any impact on the instrument or sensor array may cause damage and lead to incorrect measurements.

▶ 1. Remove the adapter sleeve from the mounting kit.

2. Lead the sensor cable through the mounting kit, and connect the cable to the bottom part of the sensor.

3. Insert the mounting kit adapter to the transmitter bottom.
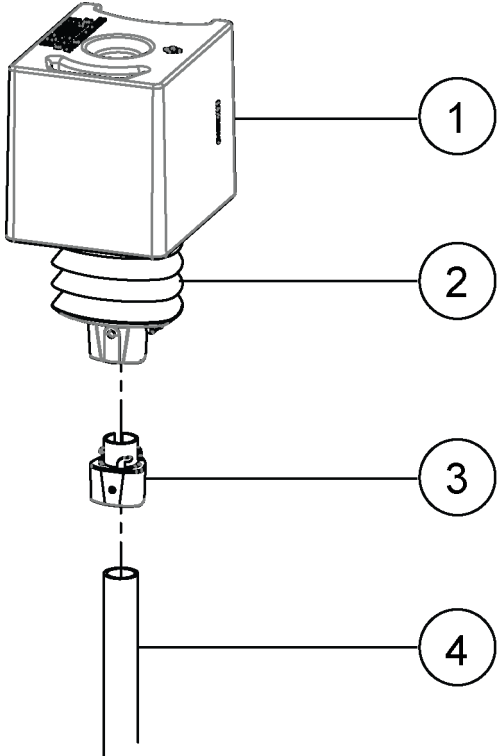
1	Protective cushion
2	Transmitter
3	Mounting kit
4	Pole

4. Turn the kit firmly until you feel the adapter snap into the locked position.

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5. Holding the sensor from its body, run the sensor cable through the mounting adapter, and slide the sensor onto the adapter. Do not tighten the fixing screw yet.
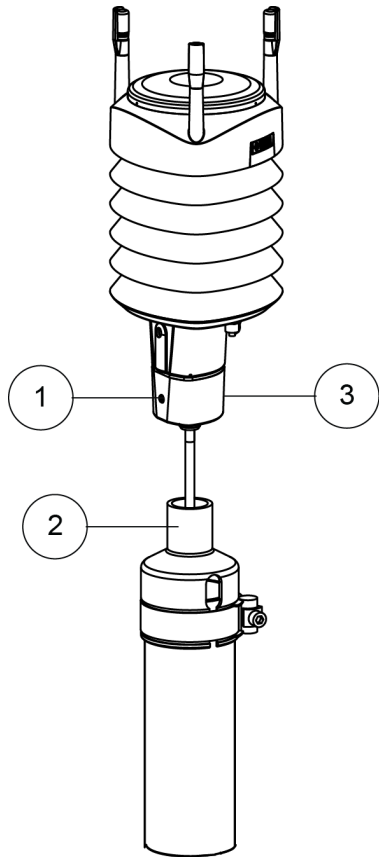
1	Fixing screw. Tightening torque 1.5 Nm.
2	Mounting accessory between mounting kit and 60 mm tube (WMSFIX60)
3	Mounting kit (212792)

6. Align the transmitter so that the arrow on the bottom of the transmitter points North.

7. To attach the adapter to the pole mast, tighten the fixing screw of the mounting adapter.

8. Remove the protective cushion.
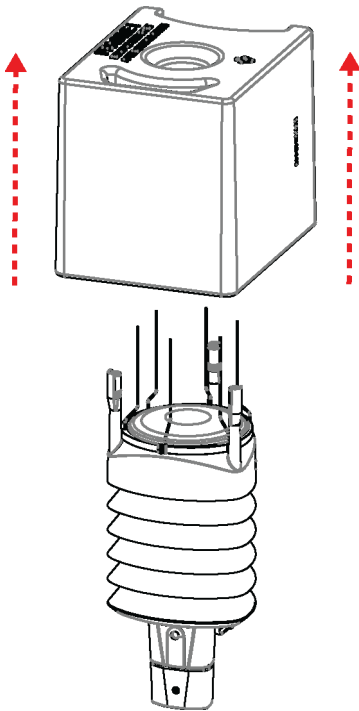
> ℹ️ When removing a transmitter from the pole, turn the transmitter so that it snaps out from the mounting kit. Realignment is not needed when replacing the device.

4.4.3 Mounting WXT530 on Sensor Support Arm

> ✖️ 10-mm wrench

If you use the optional mounting kit, you only need to align the sensor when mounting it for the first time.

> ⚠️ **CAUTION!** Handle with care. Any impact on the instrument or sensor array may cause damage and lead to incorrect measurements.

▶ 1. Remove the screw cover.

2. Align the sensor support arm in South–North direction.
   If you cannot align the sensor support arm, adjust the wind direction offset.

3. Mount the transmitter on the sensor support arm.
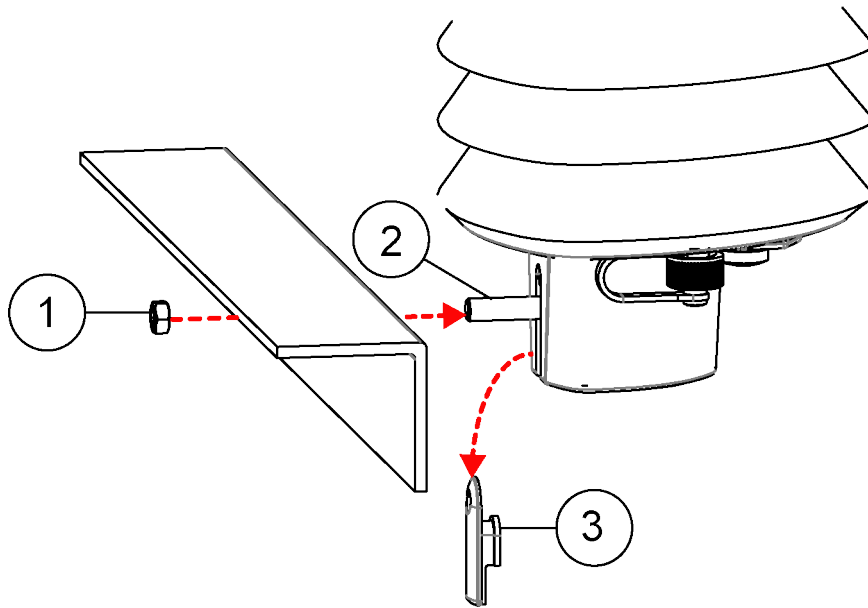
1   Nut M6 DIN 934
2   Mounting bolt M6 DIN 933
3   Screw cover
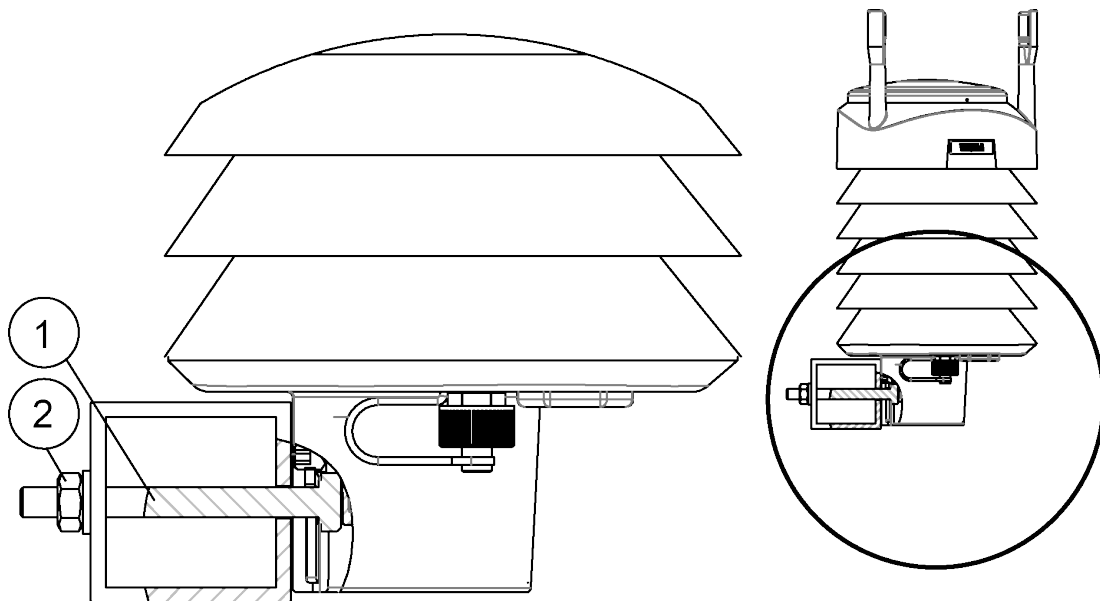
1   Nut M6 DIN 934
2   Mounting bolt M6 DIN 933

4.5 Grounding

A transmitter is typically grounded by installing it on a mast or a cross arm that provides a good connection to earth ground.

As grounding is provided through the fixing screw (or mounting bolt), it is important that it makes a good ground connection.

4.5.1 Grounding with Bushing and Grounding Kit

If the surface of the mounting point is painted or has some other finishing that prevents a good electrical connection, consider using the Bushing and Grounding Kit (222109) and a cable to ensure ground connection.

Use the Bushing and Grounding Kit to run a cable from the fixing screw to a grounding point. The kit does not include a grounding cable. The minimum grounding conductor size is 4 mm^2 (AWG 11).

▶ 1. Assemble the grounding kit so that the connector for the grounding cable is between the washers and nuts.
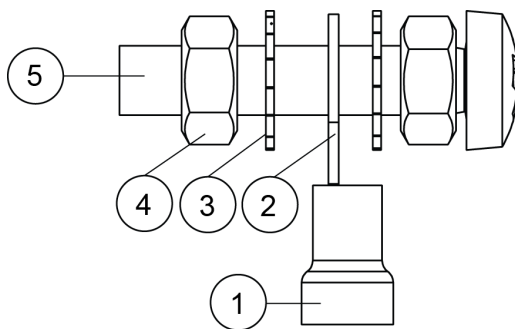
1	Connector for grounding cable
2	Abiko connector
3	Washer (2 pcs)
4	Nut (2 pcs)
5	Fixing screw

2. Connect a grounding cable to the connector. Use a 16 mm^2 conductor to achieve a good ground connection.

3. Remove the transmitter fixing screw.

sales@streamlinemeasurement.co.uk   01457-864334   www.streamlinemeasurement.co.uk

4. Insert the grounding kit through the hole in the seal. Make sure the nuts are tight so that the connector has a good connection.
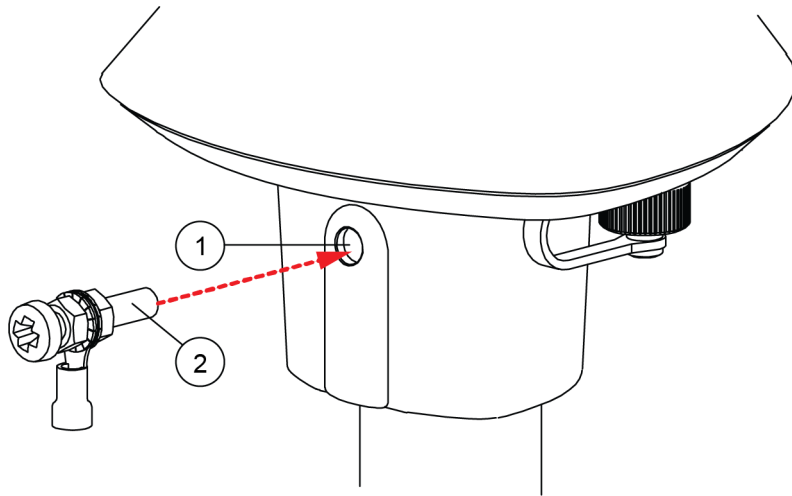
1   Seal
2   Fixing screw

5. Connect the other end of the cable to a good grounding point.
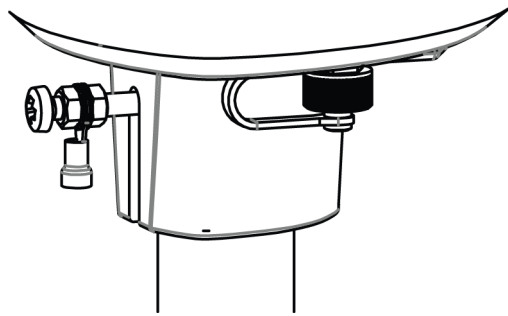
4.6 Aligning WXT530

WXT536	WXT535	WXT534	WXT533	WXT532	WXT531
✔			✔	✔	

To help the alignment, there is an arrow and the text **North** on the bottom of the transmitter. Align the transmitter so that the arrow points North.
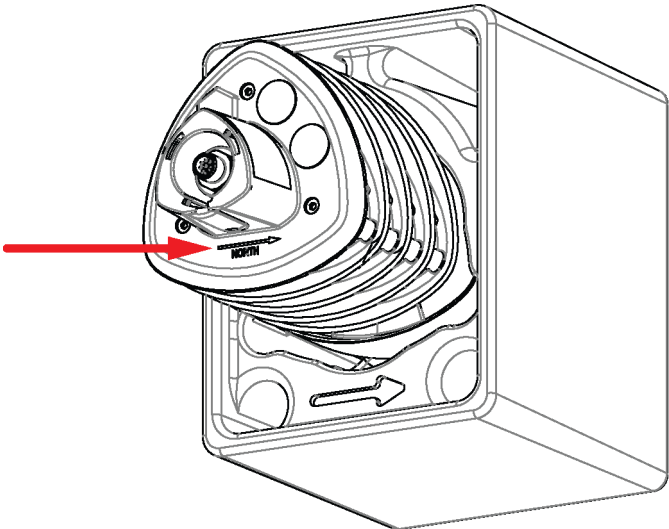
Figure 21   WXT530 North Arrow

Wind direction can be referred either to true North, which uses the Earth's geographic meridians, or to the magnetic North, which is read with a magnetic compass. The magnetic declination is the difference in degrees between the true North and magnetic North. The source for the magnetic declination should be current as the declination changes over time.
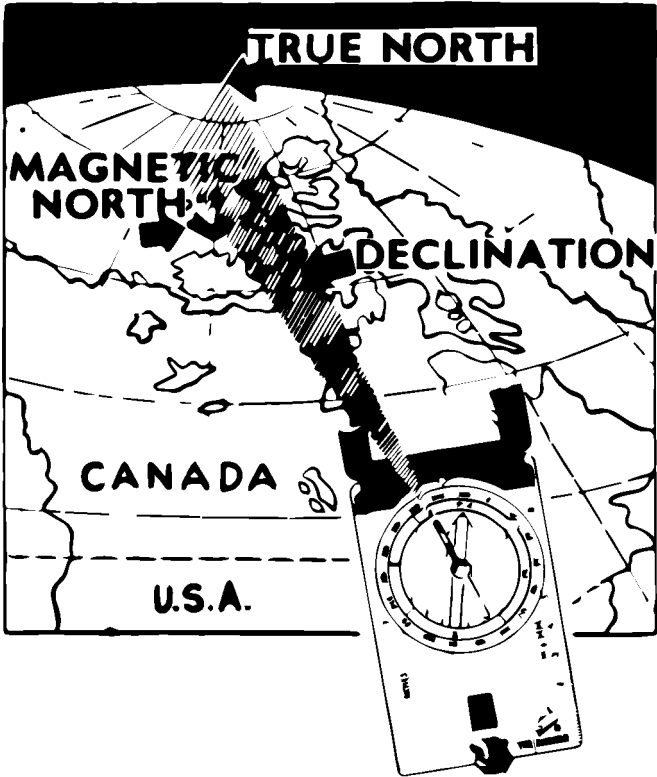
Figure 22   Sketch of Magnetic Declination

4.6.1 Aligning WXT530 with Compass

- 2.5-mm Allen key
- Compass

ℹ️ Do not remove the instrument or sensor from the mounting kit during alignment.

▶ 1. If the transmitter is mounted, loosen the fixing screw on the bottom of the transmitter so that you can rotate it.

2. Use a compass to determine that the transducer heads of the transmitter are exactly in line with the compass and that the arrow on the bottom of the transmitter points North.

3. Tighten the fixing screw. Tightening torque 1.5 Nm.

4.6.2 Configuring Wind Direction Offset

If the transmitter cannot be aligned so that the arrow on the bottom points North, make a wind direction offset by configuring the deviation angle in the transmitter.

▶ 1. Mount the transmitter to a desired position.

2. Define the deviation angle from the North (zero) alignment. Use the ± sign indication to express the direction from the North line.
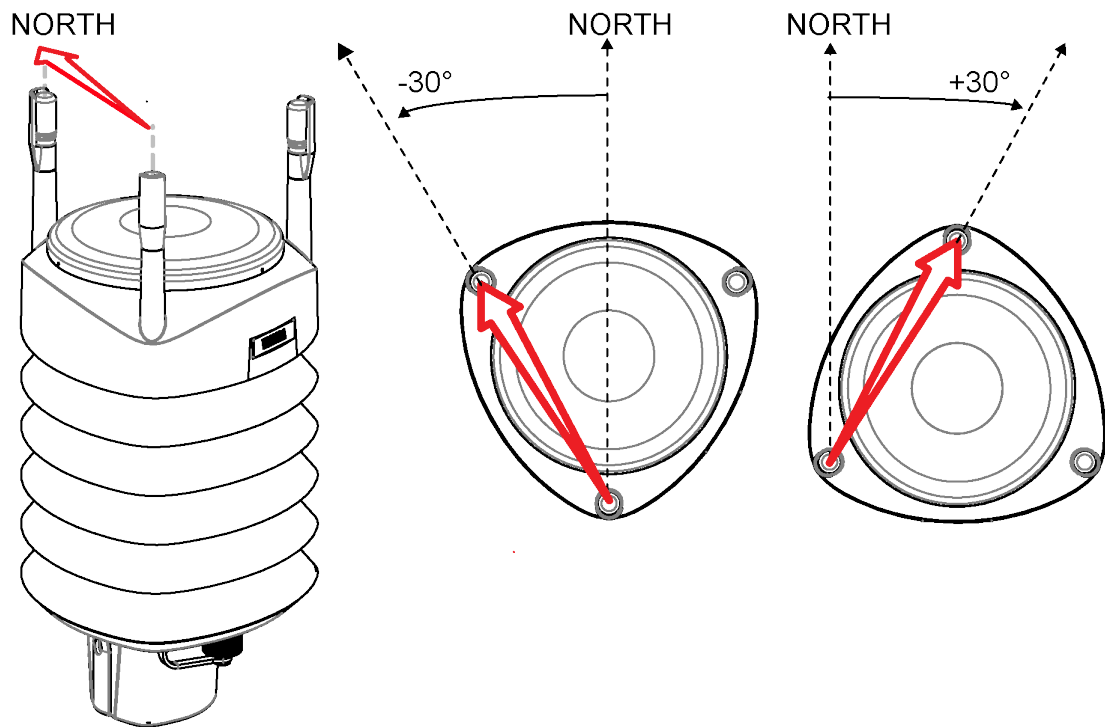
3. Enter the deviation angle in the device using the wind message formatting command **aWU,D** (direction offset).

Now the transmitter transmits the wind direction data using the changed zero alignment.

More Information
‣ Mounting WXT530 (page 38)
‣ Mounting WXT530 on Sensor Support Arm (page 43)

4.7 Installing Vaisala Configuration Tool

1. Insert the WXT530 driver memory stick in the USB port.

2. Go to the **WXT_Series_Conf_Tool** folder and run **WXTConf-2.41 r.3Setup.exe**.

3. When Vaisala Configuration Tool Setup Wizard opens, select **Next**.

4. In the **User Information** window, fill in the **User Name**, **Organization**, and **License Key** fields. The license key is shown on the sticker on the memory stick. Select **Next**.
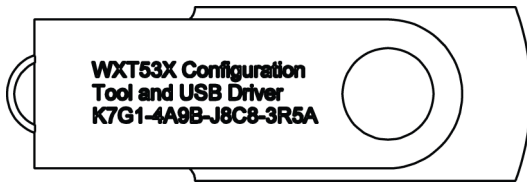
5. In the **Select Destination Location** window, select a folder and select **Next**.

6. In the **Select Start Menu Folder** window, select a folder for shortcuts and select **Next**.

7. In the **Select Additional Tasks** window, select **Additional Tasks** and select **Next**.

8. In the **Ready to Install** window, select **Install**. **Installing** window opens.

9. Select **Launch Vaisala Configuration Tool** and select **Finish** to launch the tool.
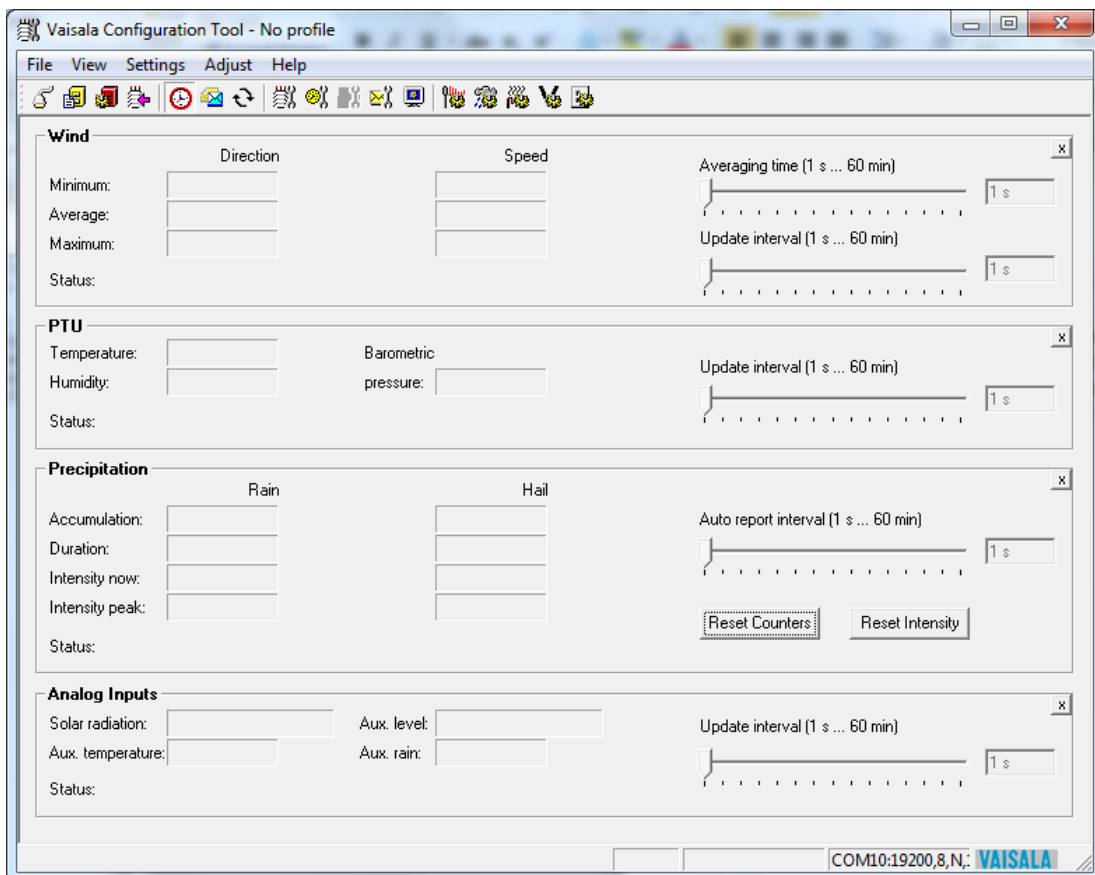
More Information

‣ Backward Compatibility (page 25)

4.8 Installing USB Cable Driver

Before taking the USB cable into use, you must install the USB cable driver on your PC. The driver is compatible with Windows 7, Windows 8, and Windows 10.

1. Make sure that the USB cable is not connected.

2. Insert the WXT530 driver memory stick in the USB port.

3. Go to the **USB-driver** folder and start installation by running **setup.exe**.
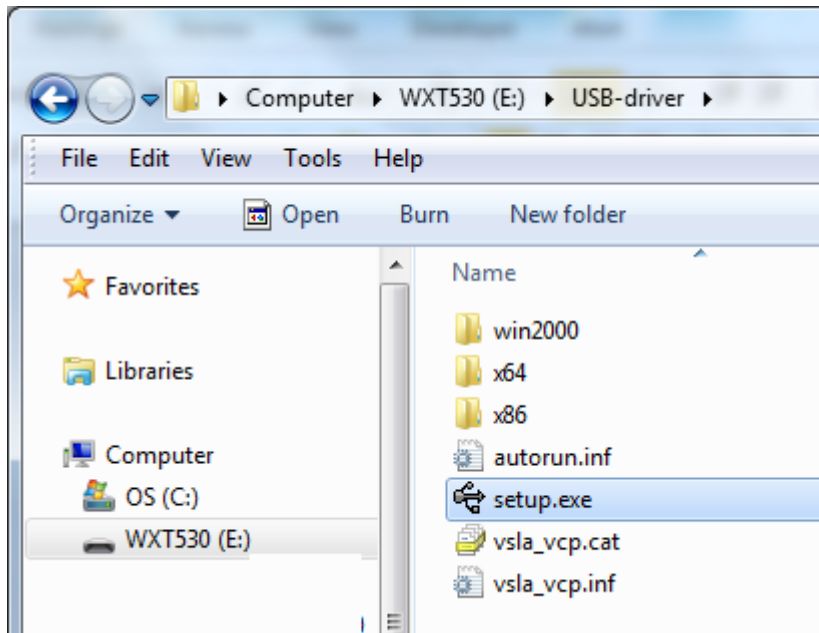
4. When Vaisala USB Device Driver Setup Wizard opens, select **Next**.

5. In the **Select Additional Tasks** window, select the tasks you want to perform and select **Install**.

6. Select **Display Vaisala USB Device Finder > Finish**. The driver is started.
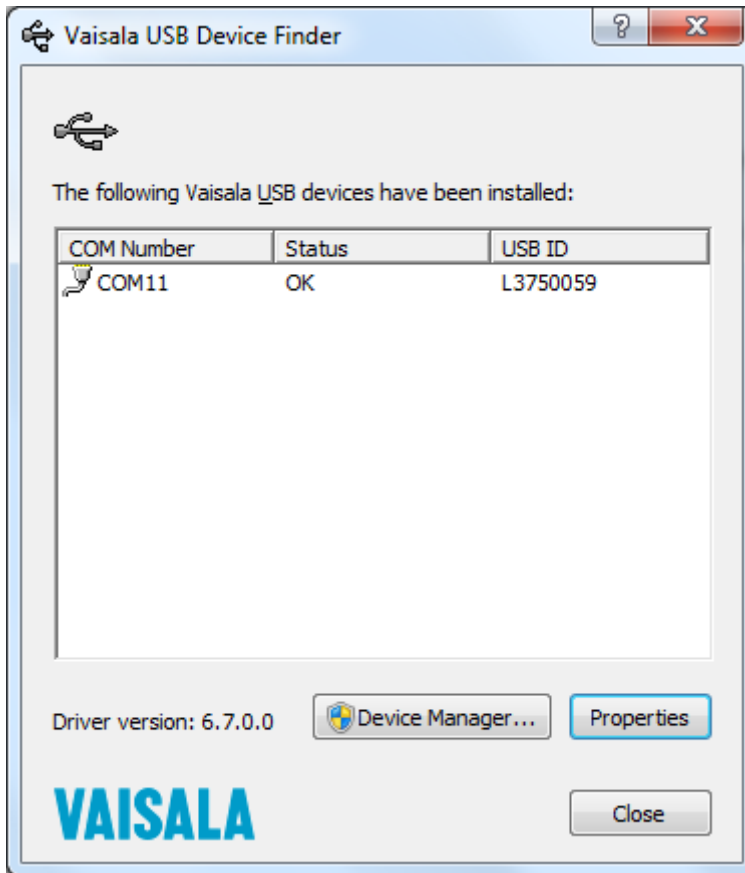
7. Plug in the cable.

Remember to use the correct port in the settings of your terminal program. Windows recognizes each individual cable as a different device, and reserves a new COM port.

There is no reason to uninstall the driver for normal use. However, if you wish to remove the driver files and all Vaisala USB cable devices, uninstall the entry for Vaisala USB Instrument Driver from the program manager tool in the Windows Control Panel.

5. Wiring and Power Management

This chapter describes how to connect the power supply and the serial interfaces and how to manage and estimate power consumption.

You can access the transmitter through the following serial interfaces:

- RS-232
- RS-485
- RS-422
- SDI-12
- mA output (WXT532)

You can wire them either through the internal screw terminal or the 8-pin M12 connector. You can use only one serial interface at a time.

> ⚠ **CAUTION!** The cable opening in the transmitter bottom assembly is covered with hexagonal rubber plugs. If you are not using the cable gland (included in the Bushing and Grounding Kit), keep the opening covered.

More Information

‣ Wiring SDI-12 (page 171)

5.1 Power Supplies

The minimum consumption graph is for SDI-12 standby mode.
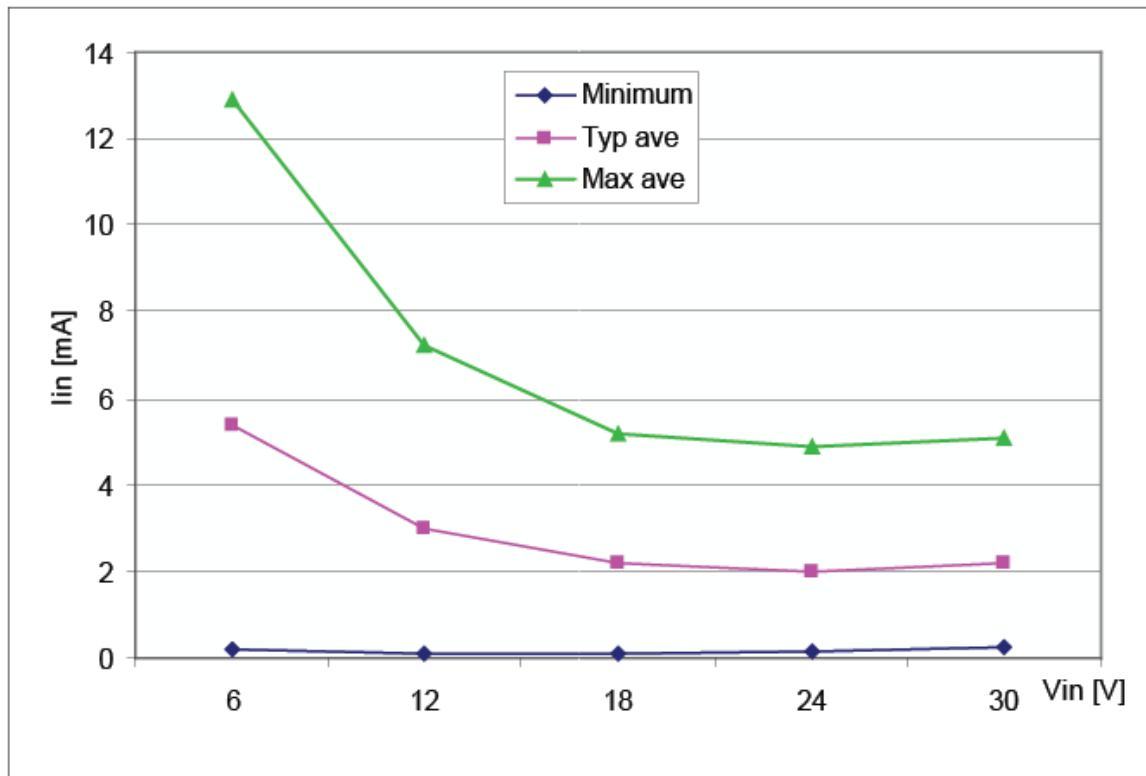
Figure 23   Average Operational Current Consumption (with 4Hz Wind Sensor Sampling)

The input power supply must be capable of delivering 60 mA (at 12 V) or 100 mA (at 6 V) instant current spikes with duration of 30 ms. These are drawn by the wind sensor (whenever enabled) at 4 Hz rate, which is the default value for wind sampling. Wind sampling at 2 Hz and 1 Hz rate is also available.

Because wind measurement is the most consuming operation in the system, the average current consumption decreases almost in proportion to the sampling rate.

Typically, the average consumption is less than 10 mA. The higher the voltage, the lower the current.

Heating voltage Vh+ (one of the following three alternatives):

- 12 ... 24 VDC (-10 % ... + 30 %)
- 12 ... 17 VAC$_{rms}$ (-10 % ... +30 %)

The typical DC voltage ranges are:

- 12 VDC ± 20 % (max 1.1 A)
- 24 VDC ± 20 % (max 0.6 A)

Nominally at 15.7 V heating voltage level, the transmitters automatically change the heating element combination to reduce instant current. The input resistance (R_{in}) is radically increased with voltages above 16 V as shown in the following graph. The average (5s) power does not depend on the input voltage.

The recommended range for AC is:

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• 12 … 17 VAC$_{rms}$ (-10 % … +30 %) max 1.1 A for AC
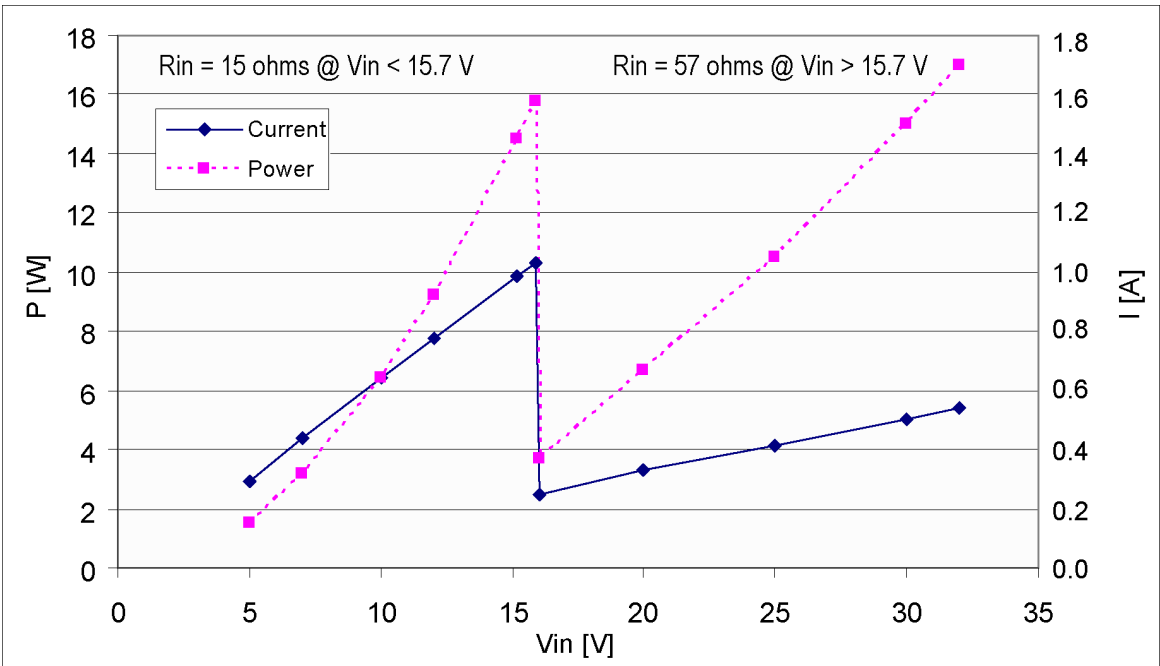
Figure 24   Heating Instant Current and Power vs Vh (WXT536, WXT535, WXT533, and WXT532)
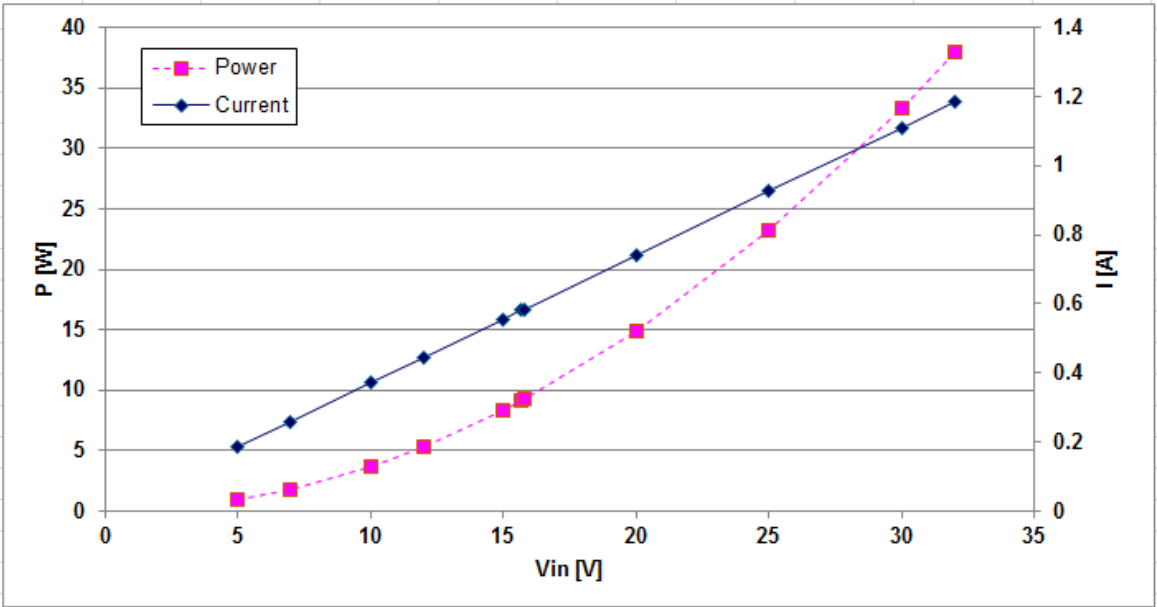
Figure 25   Heating Instant Current and Power vs Vh (WXT531)

The power supply must meet the values shown above.

> **WARNING!** Make sure that you connect only de-energized wires.

> **CAUTION!** To avoid exceeding the maximum ratings in any condition, the voltages must be checked with no load at the power supply output.

More Information

‣ Power Management (page 56)

5.2 Power Management

The power consumption varies significantly, depending on the selected operating mode or protocol, the data interface type, the sensor configuration, and the measurement and reporting intervals.

Lowest consumption is achieved with the Native SDI-12 mode, typically about 1 mW in standby (0.1 mA at 12 V), while with ASCII RS-232 or Continuous SDI-12 modes it is about 3 mW in standby. Any activated sensor measurement adds its own extra consumption to the standby power.

Some hints for economic power management are given below. The consumption values are all defined for 12 V supply. For 6 V supply, multiply the values by 1.9. For 24 V supply, multiply the values by 0.65.

Table 4   Standby Power Consumption

Mode	Standby	Wind			
		4 Hz sampling rate Continuous measurement	4 Hz sampling rate 10 s average every 2 min	1 Hz sampling rate Continuous measurement	1 Hz sampling rate 10 s average every 2 min
RS-232 RS-485 RS-422 SDI-12 continuous	1.5 mA	+4.5 mA	+ 0.6 mA	+1.3 mA	+0.2 mA
SDI-12 native	0.1 mA	N/A	+1 mA	N/A	+0.7 mA
Analog output (mA)	N/A	16 ... 90 mA	16 ... 90 mA	16 ... 90 mA	16 ... 90 mA

Mode	Standby	PTU	PT1000	Level	Tipping bucket	Solar radiation	Precipitation
							Continuous rain
RS-232 RS-485 RS-422 SDI-21 continuous	1.5 mA	+0.9 mA	+0.1 mA	+0.4 mA	+0.1 mA	+0.4 mA	+0.4 mA
SDI-12 native	0.1 mA	+0.9 mA (interval 5 s)	+0.1 mA (interval 5 s)	+0.4 mA (interval 5 s)	+0.1 mA (interval 1 s)	+0.4 mA (interval 5 s)	+0.4 mA (interval 5 s)
Analog output (mA)	N/A	N/A	N/A	N/A	N/A	N/A	N/A

> ℹ️ SDI-12 native mode power save is based on measurements only when requested. Due to SDI-12 polling mode operation, only periodic wind measurement results are comparable with other communication modes. Continuous measurement is not relevant for SDI-12 mode. Every measurement request increases power consumption for the first time measurement. The total SDI-12 power consumption can be changed by changing measurement request intervals.

Table 5   Economic Power Management

Measurement	Consumption
Wind measurement	The most consuming operation in the system, with extra variations depending on how the wind is reported. If you need long time averages and measure wind constantly, there are no large differences between requesting periods or modes. Fully continuous wind measurement with a 4 Hz sampling rate adds about 4.5 mA to the standby current, depending on the wind and some other climatic conditions. A 10-second average requested every 2 minutes consumes 8 times less. 1 Hz sampling rate decreases it to about one fourth.
PTU measurement	Adds approximately 0.9 mA to the standby consumption. Each single measurement takes 5 seconds (including the warm-up period). This can be used for estimating the average consumption of the PTU.
Continuous precipitation	Adds approximately 0.4 mA to the standby consumption. A single, isolated raindrop increases current consumption for about 10 seconds (continued, if more raindrops are detected within the 10-second period).
ASCII RS-232 Standby consumption	Typically 1.5 mA. The jumper wires across TX+/RX+ and TX-/RX- (only necessary in 2-wire RS-485) increase consumption slightly.
ASCII RS-232 Polling mode and Automatic mode	Equal consumption. The Automatic mode is a little more economic, since interpreting the poll takes more processing time than starting the Automatic message. However, note that when selecting the Precipitation Auto-send mode, the sub-modes M=R and M=C can cause extra consumption in rainy conditions due to triggers for sending messages about rain incidents.

Measurement	Consumption
ASCII RS-232 Data transmission	Adds 1 ... 2 mA to the standby consumption during the message sending time. Note that the host device's input (data logger or PC) can constantly draw some current from the TX line.
RS-485 and RS-422 Data interfaces	Consume about the same amount of power as RS-232. With long data cables the data consumption during data transmission can be much higher, especially when termination resistors are used. On the other hand, the RS-485 driver is in high impedance state when not transmitter. In idle state, no current can be drawn by the host input.
NMEA modes	They consume about the same as ASCII modes.
SDI-12 Native mode	M=S, C=1 has the lowest stand by consumption, about 0.1 mA. Note that it can also be used with RS-232 terminals. See the SDI-12 connection diagram in 5.5 Data Communication Interfaces (page 67). In this case, the commands must be in SDI-12 format, but no special line break signals are required. The SDI-12 mode is for polling only.
SDI-12 Continuous mode	M=R consumes about the same as the ASCII RS-232 mode.

> ℹ️ If the optional sensor heating is enabled, SDI-12 Native mode consumes the same as ASCII RS-232 mode.
> When heating is on (or the temperature is such that it should be on), some `0.08 mA` additional current is drawn from the operational power supply.

> ℹ️ While in Service mode and/or while supplied through the service port the transmitter consumes `0.3 ... 0.6 mA` more than in normal mode, when supplied through the main port (M12 connector or screw terminals). When supplied through the service port the minimum voltage level for reliable operation is 6 V. This can also be seen in the supply voltage reading of the Supervisor message - the Vs value is 1 V lower than the actual input voltage.

5.3 Wiring with 8-pin M12 Connector

5.3.1 External Wiring

The 8-pin M12 connector is located on the bottom of the transmitter.
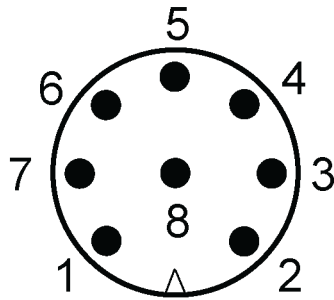
Figure 26   Pins of 8-pin M12 Connector

The following table shows the pin connections for the 8-pin M12 connector and the wire colors of the respective M12 cable (optional, 2/10 m).

Table 6   Pin-outs for WXT530 Series Serial Interfaces and Power Supplies

Wire Color	M12 Pin#	RS-232[1]	SDI-12[1]	RS-485[1]	RS-422[1]	mA Output[2]
White	1	Data in (RxD)	Data in/out (Rx)	-	Data out (TX-)	Iout2
Brown	2	Vin+ (operating)	Vin+ (operating)	Vin+ (operating)	Vin+ (operating)	Vin+ (operating)
Green	3	GND for data	GND for data	GND for data	Data out (TX+)	GND Iout2
Yellow	4	Vh+ (heating)	Vh+ (heating)	Vh+ (heating)	Vh+ (heating)	Vh+ (heating)
Gray	5	-	-	Data+	Data in (RX+)	GND Iout1
Pink	6	Vh- (heating)	Vh- (heating)	Vh- (heating)	Vh- (heating)	Vh- (heating)
Blue	7	Data out (TxD)	Data in/out (Tx)	Data-	Data in (RX-)	Iout1
Red	8	Vin- (operating)	Vin- (operating)	Vin- (operating)	Vin- (operating)	Vin- (operating)

1)   Available for all models
2)   WXT532 option

Table 7   Screw Terminal Pin-outs

Screw terminal	RS-232	SDI-12	RS-485	RS-422
10 HTG-	Vh- (heating)	Vh- (heating)	Vh- (heating)	Vh- (heating)
9 HTG+	Vh+ (heating)	Vh+ (heating)	Vh+ (heating)	Vh+ (heating)
8 SGND	GND for data	GND for data	GND for data	GND for data
7 RXD	Data in (RxD)	Data in (Rx)	-	-
6 TX+	-	-	Data+	Data out (TX-)

Screw terminal	RS-232	SDI-12	RS-485	RS-422
5 TX-	Data out (TxD)	Data out (Tx)	Data -	Data out (TX+)
4 RX+	-	-	-	Data in (Rx+)
3 RX-	-	-	-	Data in (Rx-)
2 VIN-	Vin- (operating)	Vin- (operating)	Vin- (operating)	Vin- (operating)
1 VIN+	Vin+ (operating)	Vin+ (operating)	Vin+ (operating)	Vin+ (operating)

The signal names Data in (RxD) and Data out (TxD) in the table describe the direction of data flow as seen from the transmitter.

> **i** Ground the external wiring shield. The shield is not connected inside WXT.

> **i** In true SDI-12, Data in (Rx) and Data out (Tx) lines must be combined.

> **i** Short circuit loops are required between terminals 3 & 5, and 4 & 6 for RS-485. See 5.3.2 Internal Wiring (page 61).

> **i** Do not use operating power supply ground (VIN-) for communication (RS-232, RS-485, SDI-12, RS-422). Use SGND communication ground (GND).

Table 8   WXT532 mA Output Option Screw Terminal Pin-outs

Screw terminal	mA Output
10 HTG-	Vh- (heating)
9 HTG+	Vh+ (heating)
8 GND2	GND Iout2
7 Iout2	Iout2 (direction)
6 GND1	GND Iout1
5 Iout1	Iout1 (wind)
4 NC	-
3 NC	-

Screw terminal	mA Output
2 VIN-	Vin- (operating)
1 VIN+	Vin+ (operating)

The terms "Default wiring" and "RS-422 wiring" refer to the internal wiring options.

5.3.2 Internal Wiring

By default, the 8-pin M12 connector is wired for:

- RS-232
- RS-485
- SDI-12
- RS-422
- mA output

> ℹ Ground the external wiring shield. The shield is not connected inside WXT.

Table 9   RS-232 Wiring

Internal Wiring				External Wiring	
Pin #	Internal Connector Pin	Internal Connector Pin function for RS-232	Internal Wiring for RS-232	M12 Pin	External Wiring for RS-232
1	VIN+	Vin+ (Operating)	Brown	2	Brown
2	VIN-	Vin- (Operating GND)	Red	8	Red
3	RX-				
4	RX+				
5	TX-	Data out (TxD)	Blue	7	Blue
6	TX+		Gray	5	Gray
7	RXD	Data in (RxD)	White	1	White
8	SGND	Communication ground (GND)	Green	3	Green
9	HTG+	Vh+ (Heating)	Yellow	4	Yellow
10	HTG-	Vh- (Heating)	Pink	6	Pink
					Shield

Table 10   RS-485 Wiring

Internal Wiring				External Wiring	
Pin #	Internal Connector Pin	Internal Connector Pin function for RS-485	Internal Wiring for RS-485	M12 Pin	External Wiring for RS-485
1	VIN+	Vin + (Operating)	Brown	2	Brown
2	VIN-	Vin- (Operating GND)	Red	8	Red
3	RX-	Data-	Loop with Blue		
4	RX+	Data+	Loop with Gray		
5	TX-	Data-	Blue	7	Blue
6	TX+	Data+	Gray	5	Gray
7	RXD		White	1	White
8	SGND	Communication ground (GND)	Green	3	Green
9	HTG+	Vh+ (Heating)	Yellow	4	Yellow
10	HTG-	Vh- (Heating)	Pink	6	Pink
					Shield

Table 11   SDI-12 Wiring

Internal Wiring				External Wiring	
Pin #	Internal Connector Pin	Internal Connector Pin function for SDI-12	Internal Wiring for SDI-12	M12 Pin	External Wiring for SDI-12
1	VIN+	Vin+ (Operating)	Brown	2	Brown
2	VIN-	Vin- (Operating GND)	Red	8	Red
3	RX-				
4	RX+				
5	TX-	Data in/out (Tx)	Blue	7	Blue
6	TX+		Gray	5	Gray
7	RXD	Data in/out (Rx)	White	1	White
8	SGND	Communication ground (GND)	Green	3	Green
9	HTG+	Vh+ (Heating)	Yellow	4	Yellow
10	HTG-	Vh- (Heating)	Pink	6	Pink
					Shield

Table 12   RS-422 Wiring

| Internal Wiring | | | | External Wiring | |
Pin #	Internal Connector Pin	Internal Connector Pin function for RS-422	Internal Wiring for RS-422	M12 Pin	External Wiring for RS-422
1	VIN+	Vin+ (Operating)	Brown	2	Brown
2	VIN-	Vin- (Operating GND)	Red	8	Red
3	RX-	Data in (RX-)	Blue	7	Blue
4	RX+	Data in (RX+)	Gray	5	Gray
5	TX-	Data out (TX-)	White	1	White
6	TX+	Data out (TX+)	Green	3	Green
7	RXD				
8	SGND				
9	HTG+	V+ (Heating)	Yellow	4	Yellow
10	HTG-	Vh- (Heating)	Pink	6	Pink
					Shield

Table 13   mA Output Wiring

| Internal Wiring | | | | External Wiring | |
Pin #	Internal Connector Pin	Internal Connector Pin function for mA Output	Internal Wiring for mA Output	M12 Pin	External Wiring for mA Output
1	VIN+	Vin+ (Operating)	Brown	2	Brown
2	VIN-	Vin- (Operating GND)	Red	8	Red
NC	NC				
NC	NC				
Iout1	Iout1	Iout1	Blue	7	Blue
GND	GND	GND	Gray	5	Gray
Iout2	Iout2	Iout2	White	1	White
GND	GND	GND	Green	3	Green
9	HTG+	Vh+ (Heating)	Yellow	4	Yellow
10	HTG-	Vh- (Heating)	Pink	6	Pink
					Shield

Internal wiring for RS-232, SDI-12, and RS-485.
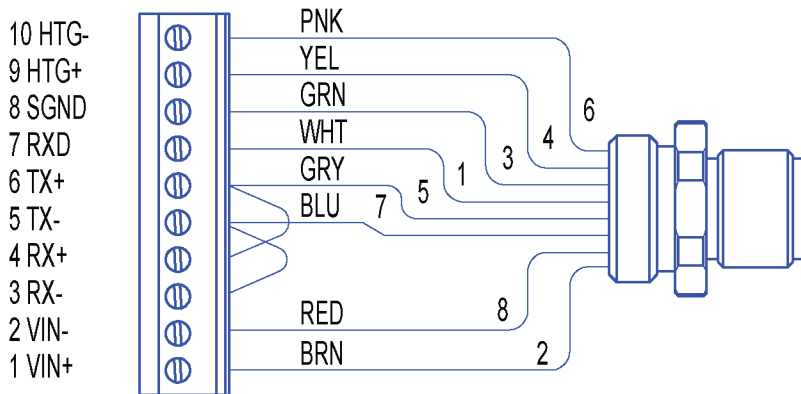
Internal wiring for RS-422
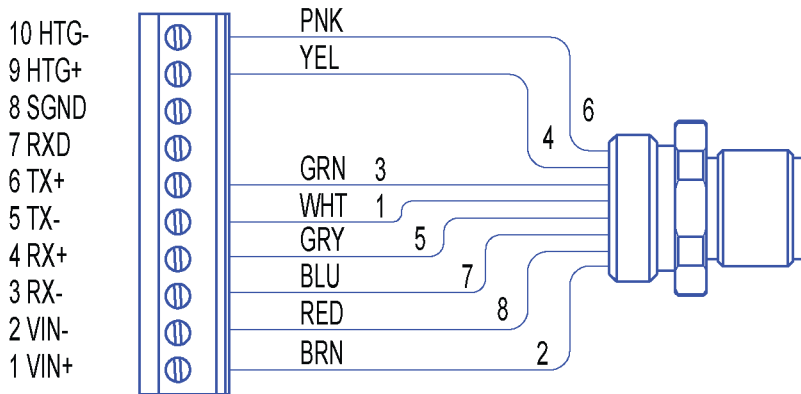
Internal wiring for mA output.
Note the different electronics in the mA output version.
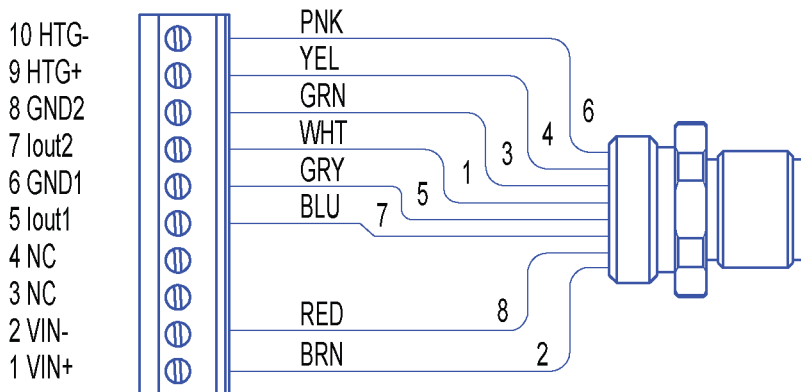
Figure 27   Internal Wiring for RS-232, SDI-12, and RS-485

5.4 Wiring Using Screw Terminals

▶   1. Loosen the 3 long screws at the bottom of the transmitter.

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2. Pull out the bottom part of the transmitter.

3. Insert the power supply wires and signal wires through the cable gland(s) in the bottom of the transmitter. Cable glands are included in the optional Bushing and Grounding Kit (222109).

4. Connect the wires as shown in the following table.

5. Replace the bottom part and tighten the three screws. Make sure that the flat cable does not get squeezed or stuck between the top and the funnel for the flat cable and it is properly connected. To make sure that the radiation shield stays straight, do not tighten the screws all the way in one go. Do not overtighten.
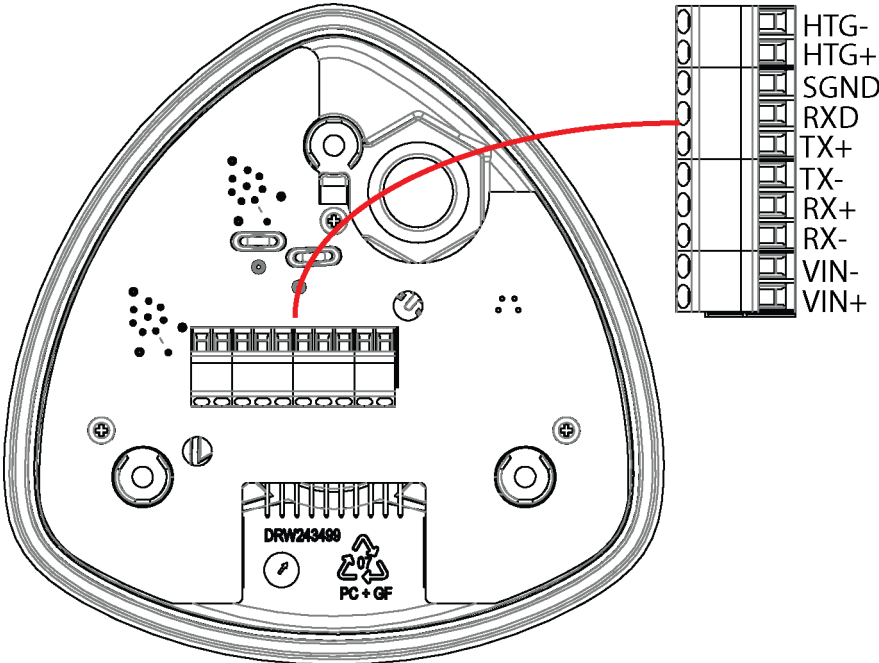
Figure 28   Screw Terminal Block

Table 14   Screw Terminal Pin-outs for Serial Interfaces and Power Supplies

Screw Terminal PIN	RS-232	SDI-12	RS-485	RS-422	mA Output
1 VIN+	Vin+ (Operating)	Vin+ (Operating)	Vin+ (Operating)	Vin+ (Operating)	Vin+ (Operating)
2 VIN-	Vin- (Operating GND)	Vin- (Operating GND)	Vin- (Operating GND)	Vin- Operating GND)	Vin- (Operating GND)
3 RX-			Data-	Data in (RX-)	
4 RX+			Data+	Data in (RX+)	
5 TX-	Data out (TxD)	Data in/out (Tx)	Data-	Data out (TX-)	Iout1
6 TX+			Data+	Data out (TX+)	GND

Screw Terminal PIN	RS-232	SDI-12	RS-485	RS-422	mA Output
7 RXD	Data in (RxD)	Data in/out (Rx)			Iout2
8 SGND	Communication ground (GND)	Communication ground (GND)	Communication ground (GND)		GND
9 HTG+	Vh+ (Heating)	Vh+ (Heating)	Vh+ (Heating)	Vh+ (Heating)	Vh+ (Heating)
10 HTG-	Vh- (Heating)	Vh- (Heating)	Vh- (Heating)	Vh- (Heating)	Vh- (Heating)

Use a shielded cable and ground the external wiring shield.

For the SDI-12 mode, the Data in/out (Tx) and Data in/out (Rx) signals must be connected internally by looping pins 5 and 7, or, externally by looping the M12 pins 1 and 7.

If the transmitter was ordered with any other serial communication than RS-422, the internal wiring has loops between pins 3 and 5, and between 4 and 6. For RS-422 operation, you must remove the loops. For the RS-485 communication mode, short-circuit loops are required between pins 3-5 and 4-6.
3 = RX Data-, Loop with Blue
4 = RX Data+, Loop with Gray
5 = TX Data-, Blue wire
6 = TX Data+, Gray wire
The transmitter has by default factory-installed loops in all serial communication options except RS-422.

5.5 Data Communication Interfaces
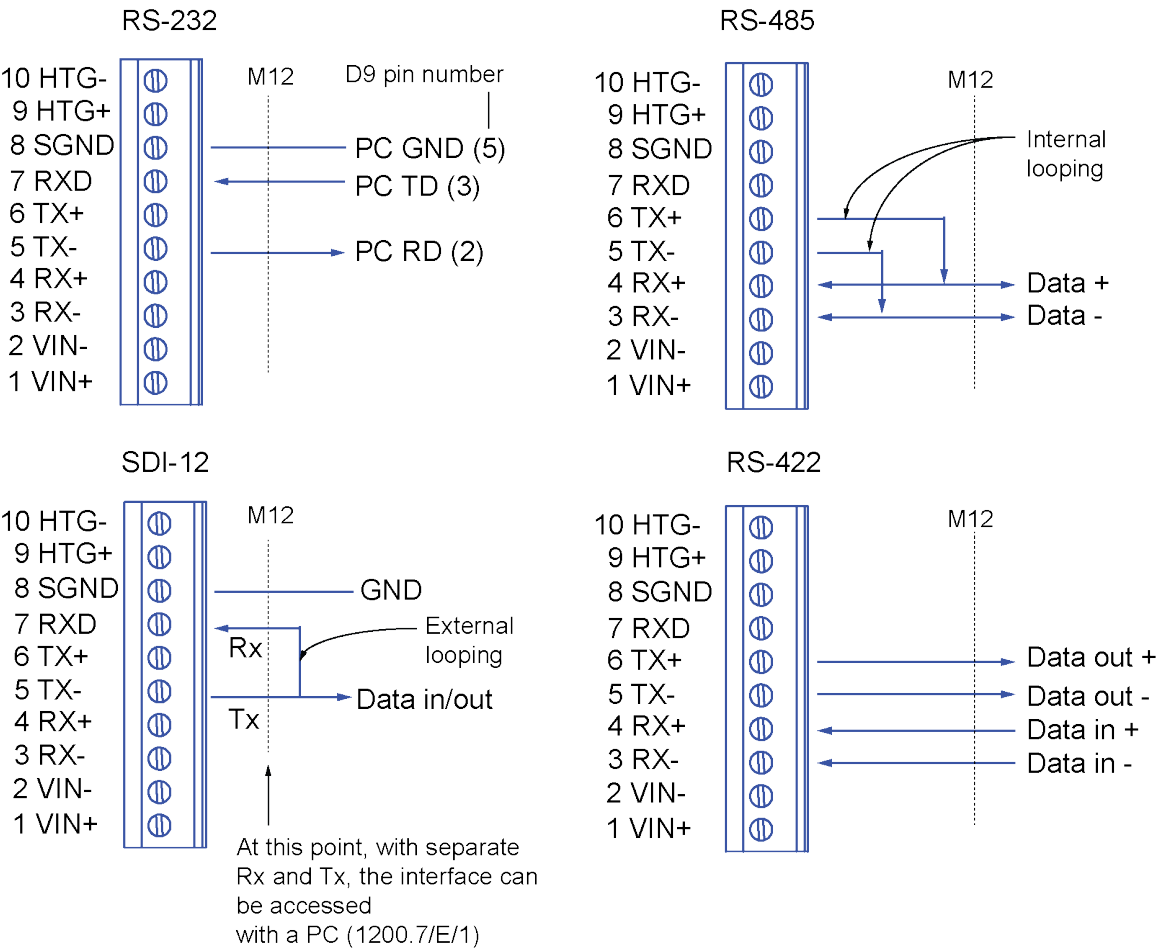
Figure 29   Data Communication Interfaces

With RS-485 and RS-422 interfaces, if the data rate is 9600 Bd or higher and the cabling from the transmitter to the host is 600 m (2000 ft) or longer, you must use termination resistors at both ends of the line.

The WXT530 series transmitters with serial communication interface have built-in termination options. Plain resistor (R) termination or termination with resistor connected series with capacitor can be selected with jumpers. By default, no termination is selected. In RS-422 mode, built-in termination is only between RX- and RX+ lines.

If external line termination is used, resistor range 100 ... 180 Ω is suitable for twisted pair lines. Resistors are connected across RX- to RX+ and across TX- to TX+ (with RS-485 only one resistor needed).
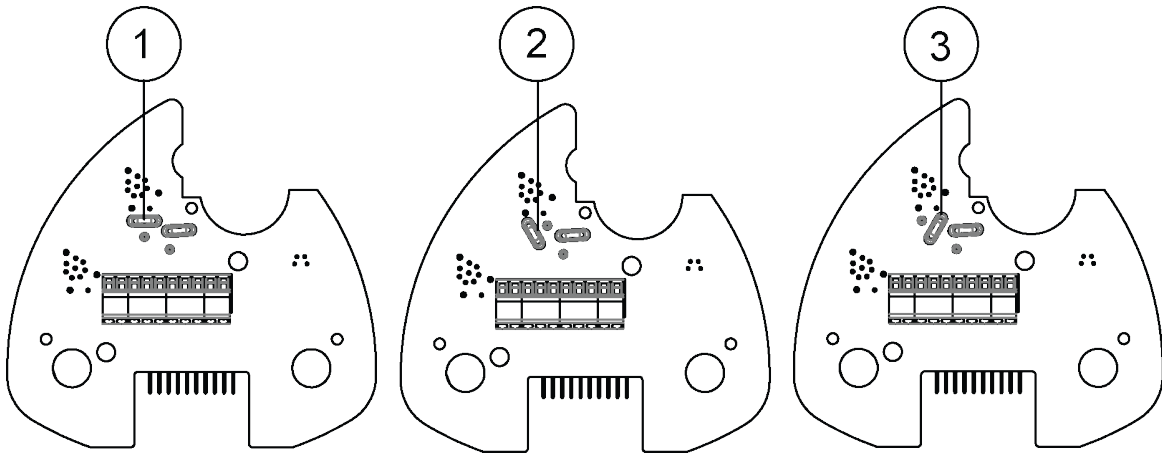
Figure 30   Termination Jumper Positions

1   NC, no termination
2   R, 121 Ω termination
3   RC, 121 Ω series with 4.7 nF capacitor termination

The termination resistors increase power consumption significantly during data transmission. If low power consumption is a must, connect a 0.1 uF capacitor in series with each external termination resistor or use internal RC termination.

Note that the RS-485 interface can be used with four wires (as RS-422).

The main difference between the RS-485 and RS-422 interfaces is their protocol:

 • In the RS-422 mode the transmitter is constantly enabled
 • In the RS-485 mode the transmitter is enabled only during transmission (for allowing the host's transmission in the two-wire case).

The RS-232 output swings only between 0 ... +4.5 V. This is enough for modern PC inputs. The recommended maximum for the RS-232 line length is 100 m (300 ft) with 1200 Bd data rate. Higher rates require shorter distance, for instance, 30 m (100 ft) with 9600 Bd.

> If you use the transmitter on an RS-485 bus with other polled devices, always disable the error messaging feature with the command: **0SU,S=N<crlf>**.

6. Connection Options

6.1 Communication Protocols

Once the transmitter is properly connected and powered up, the data transmission can start. The following table shows the communication protocols available in each serial interface.

Table 15   Available Serial Communication Protocols

Serial Interface	Communication Protocols Available
RS-232	ASCII automatic and polled NMEA 0183 v3.0 automatic and query SDI-12 v1.3 and SDI-12 v1.3 continuous measurement
RS-485	ASCII automatic and polled NMEA 0183 v3.0 automatic and query SDI-12 v1.3 and SDI-12 v1.3 continuous measurement
RS-422	ASCII automatic and polled NMEA 0183 v3.0 automatic and query SDI-12 v1.3 and SDI-12 v1.3 continuous measurement
SDI-12	SDI-12 v1.3 and SDI-12 v1.3 continuous measurement

You chose the communication protocol (ASCII, NMEA 0183, or SDI-12) when placing your order. To check the communication settings, see and/or change the protocol or other communication settings, see the following sections.

> **i** You cannot access the RS-485 and RS-422 interfaces directly with a standard PC terminal. They require a suitable converter.

> **i** You can access RS-232 and SDI-12 with a standard PC terminal, if for SDI-12, the Data in/out lines have not been combined inside the transmitter.

6.2 Connection Cables

The following table shows the connection cable options for the WXT530 series transmitters. The USB cables connect the transmitter to a PC using a standard USB port. The USB cables also provide operation power to the transmitter when connected. Note that the USB cables do not provide power to the sensor heating.

Table 16   Connection Cable Options

Cable Name	Connector on Sensor End	Connector on User End	Order Code
USB service cable (1.4 m)	M8 female	USB type A	220614 (includes Vaisala Configuration Tool)
USB RS-232/RS-485 cable (1.4 m)	M12 female	USB type A	220782
2-meter cable	M12 female	No connector; open end wires	222287
10-meter cable	M12 female	No connector; open end wires	222288
10-meter extension cable	M12 male	M12 female	215952
40-meter cable	No connector; open end wires	No connector; open end wires	217020

> ℹ️ If you use the USB RS-232/RS-485 cable for a permanent installation, Vaisala recommends that you use the WSP152 surge protector to protect the host PC against surges entering through the USB port.

6.3 Connecting with Service Cable

The USB service cable has a 4-pin M8 connector for service port. Use the service cable connection for checking and changing device settings. When making the changes, use the Vaisala Configuration Tool or a standard PC terminal program.
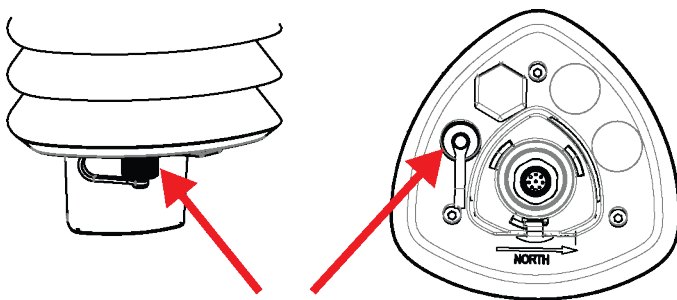
Figure 31   Service Cable Connection

The USB service cable is included in the Service Pack 2.

When you connect the USB service cable between the service connector and PC USB port, the service port settings are forced automatically to RS-232 / 19200, 8, N, 1, and the main serial port at the M12 connector at the screw terminals is disabled.

▶ 1. Use the USB service cable to establish a connection between the USB port of your PC and the M8 service port connector on the bottom plate of the transmitter.

2. Open the Vaisala Configuration Tool or a terminal program.

3. Select the COM port reserved for the USB cable and select the following default communication settings:

```
19200, 8, N, 1.
```

4. Use the Vaisala Configuration Tool or a terminal program to make the configuration changes.

5. When removing the service cable, support the transmitter while pulling the 4-pin M8 connector for service port. The connection is tight, and it is possible to change the alignment of the transmitter if you pull too hard.

> **i** Changes to the serial interface/communication protocol/baud settings take place when you disconnect the service cable or reset the transmitter.
> If these settings are not changed during the service connection session, the original main port settings (at M12 and screw terminals) are returned when the service cable is disconnected from either end.

More Information

‣ Communication Setting Commands (page 72)

6.3.1 Connecting through M12 Bottom Connector or Screw Terminal

You can check and change the device settings through the 8-pin M12 bottom connector or screw terminal.

To do this, you must know the device communication settings, have a suitable cable between the device and the host, and, if needed, use a converter (for example, RS-485/422 to RS-232, if the host is a PC). The following table shows the factory default settings:

Table 17   Default Serial Communication Settings for M12/Screw Terminal Connection

Serial Interface	Serial Settings
SDI-12	1200 baud, 7, E, 1
RS-232 ASCII	19200 baud, 8, N, 1

Serial Interface	Serial Settings
RS-485 ASCII	19200 baud, 8, N, 1
RS-422 ASCII	19200 baud, 8, N, 1
RS-422 NMEA	4800 baud, 8, N, 1

6.4 Communication Setting Commands

In this section, the commands the user types are presented in normal text while the responses of the transmitter are presented in *italic*.

6.4.1 Checking Current Communication Settings (aXU)

Use this command to request the current communication settings.

Command format in ASCII and NMEA 0183:

```
aXU<cr><lf>
```

Command format in SDI-12:

```
aXXU!
```

a	Device address, which can consist of the following characters: 0 (default) ... 9, A ... Z, a ... z.
XU	Device settings command in ASCII and NMEA 0183
XXU	Device settings command in SDI-12
`<cr><lf>`	Command terminator in ASCII and NMEA 0183
!	Command terminator in SDI-12

Example response in ASCII and NMEA 0183:

```
aXU,A=a,M=[M],T=[T],C=[C],I=[I],B=[B],D=[D],P=[P],S=[S],
L=[L],N=[N],V=[V]<cr><lf>
```

Example response in SDI-12:

```
aXXU,A=a,M=[M],T=[T],C=[C],I=[I],B=[B],D=[D],P=[P],S=[S],
L=[L],N=[N],V=[V]<cr><lf>
```

> ℹ️ You can add the **Id** information field in the supervisor data message to provide identifying information in addition to the transmitter address. The information field is set as part of the factory settings. You can only modify it with the Vaisala Configuration Tool.

More Information

‣ Supervisor Message (page 132)
‣ General Unit Settings (page 183)

6.4.2 Settings Fields

Parameter	Description
a	Device address
XU	Device settings command in ASCII and NMEA 0183
XXU	Device settings command in SDI-12
[A]	Address: 0 (default) … 9, A … Z, a … z
[M]	Communication protocol:
	A = ASCII, automatic
	a = ASCII, automatic with CRC
	P = ASCII, polled
	p = ASCII, polled, with CRC
	N = NMEA 0183 v3.0, automatic
	Q = NMEA 0183 v3.0, query (= polled)
	S = SDI-12 v1.3
	R = SDI-12 v1.3 continuous measurement
[T]	Test parameter (for testing use only)
[C]	Serial interface:
	1 = SDI-12
	2 = RS-232
	3 = RS-485
	4 = RS-422
[I]	Automatic repeat interval for Composite data message: 1 … 3600 s, 0 = no automatic repeat

Parameter	Description
[B]	Baud rate: 1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200
[D]	Data bits: 7/8
[P]	Parity:
	O = Odd
	E = Even
	N = None
[S]	Stop bits: 1/2
[L]	RS-485 line delay: 0 ... 10000 ms. Defines the delay between the last character of the query and the first character of the response message from the transmitter. During the delay, the transmitter is disabled. Effective in ASCII, polled and NMEA 0183 query protocols. Effective when RS-485 is selected (C = 3).
[N]	Name of the device: WXT536 (read-only)
[V]	Software version: for example, 1.00 (read-only)
[H]	Parameter locking
	0 = Parameters can be changed
	1 = Parameters locked. Vaisala recommends that you set this parameter to 1 after you have configuration. This prevents accidental changes, for instance, in RS- 485 use when there is interference.
<cr><lf>	Response terminator

There are two SDI-12 modes available for providing the functionality of the SDI-12 v1.3 standard.
The lowest power consumption is achieved with the Native SDI-12 mode (`aXU,M=S`), as it makes measurements and outputs data only on request.
In the continuous SDI-12 mode (`aXU,M=R`) internal measurements are made at a user-configurable update interval. The data is outputted on request.

Example (ASCII and NMEA 0183, device address 0):

```
0XU<cr><lf>
0XU,A=0,M=P,T=0,C=2,I=0,B=19200,D=8,P=N,S=1,L=25,
N=WXT530,V=1.00<cr><lf>
```

Example (SDI-12, device address 0):

```
0XXU!0XXU,A=0,M=S,T=0,C=1,I=0,B=1200,D=7,P=E,S=1,L=25,
N=WXT530,V=1.00<cr><lf>
```

6.4.3 Changing the Communication Settings (aXU)

Use this command to change communication settings.

Command format in ASCII and NMEA 0183:

```
aXU,A=x,M=x,C=x,I=x,B=x,D=x,P=x,S=x,L=x<cr><lf>
```

Command format in SDI-12:

```
aXXU,A=x,M=x,C=x,I=x,B=x,D=x,P=x,S=x,L=x!
```

A, M, C, I, B, D, P, S,L	The communication setting fields.
x	Input value for the setting
<cr><lf>	Command terminator in ASCII and NMEA 0183
!	Command terminator in SDI-12

> **i** When changing the serial interface and communication protocol, note the following:
> Each serial interface requires its specific wiring and/or jumper settings.
> Change first the serial interface field C and then the communication protocol field M.
> Changing the serial interface to SDI-12 (C=1) automatically changes the baud settings to 1200, 7, E, 1 and the communication protocol to SDI-12 (M=S).

> **i** Reset the transmitter to validate the changes of communication parameters by disconnecting the service cable or using the reset command **aXZ**.

Example (ASCII and NMEA 0183, device address 0):

Changing the device address from 0 to 1:

```
0XU,A=1<cr><lf>

1XU,A=1<cr><lf>
```

Checking the changed settings:

sales@streamlinemeasurement.co.uk   01457-864334   www.streamlinemeasurement.co.uk

```
1XU<cr><lf>

1XU,A=1,M=P,T=1,C=2,I=0,B=19200,D=8,P=N,S=1,L=25, N=WXT530V=1.00<cr><lf>
```

Example (ASCII, device address 0):

Changing RS-232 serial interface with ASCII, polled communication protocol and baud settings 19200, 8, N, 1 to RS-485 serial interface with ASCII, automatic protocol and baud settings 9600, 8, N, 1.

Checking the settings:

```
0XU<cr><lf>

0XU,A=0,M=P,C=2,I=0,B=19200,D=8,P=N,S=1,L=25,N=WXT530, V=1.00<cr><lf>
```

> You can change several parameters in the same command as long as the command length does not exceed 32 characters (including command terminator characters ! or <cr><lf>).You do not have to type setting fields you do not wish to change.

Changing several settings with one command:

```
0XU,M=A,C=3,B=9600<cr><lf>

0XU,M=A,C=3,B=9600<cr><lf>
```

Checking the changed settings:

```
0XU<cr><lf>

0XU,A=0,M=A,T=1,C=3,I=0,B=9600,D=8,P=N,S=1,L=25, N=WXT530,V=1.00<cr><lf>
```

More Information
‣ Wiring and Power Management (page 53)
‣ Settings Fields (page 73)

7. Retrieving Data Messages

Each communication protocol has its own section for data message commands.

> **i** Type commands in CAPITAL letters.

> **i** The parameter order in messages is as follows:
> `Wind (M1)`: Dn Dm Dx Sn Sm Sx
> `PTU (M2)`: Ta Tp Ua Pa
> `Rain (M3)`: Rc Rd Ri Hc Hd Hi Rp Hp
> `Supv (M5)`: Th Vh Vs Vr Id
> `Comp (M)`: Wind PTU Rain Supv (parameters in above order)
> The order of the parameters is fixed, but you can exclude any parameter from the list when configuring the transmitter.

7.1 General Commands

With general commands you can reset the transmitter.

> **i** If error messaging is disabled, the general commands given in ASCII and NMEA formats do not work.

7.1.1 Reset (aXZ)

This command performs software reset on the device.

Command format in ASCII and NMEA 0183:

```
aXZ<cr><lf>
```

Command format in SDI-12:

```
aXZ!
```

a	Device address
XZ	Reset command

`<cr><lf>`	Command terminator in ASCII and NMEA 0183
`!`	Command terminator in SDI-12

The response depends on the communication protocol as shown in the examples.

Example (ASCII):

```
0XZ<cr><lf>

0TX,Start-up<cr><lf>
```

Example (SDI-12):

```
0XZ!0<cr><lf> (=device address)
```

Example (NMEA 0183):

```
0XZ<cr><lf>

$WITXT,01,01,07,Start-up*29
```

7.1.2 Precipitation Counter Reset (aXZRU)

This command resets the rain and hail accumulation and duration parameters **Rc**, **Rd**, **Hc**, and **Hd**.

Command format in ASCII and NMEA 0183:

```
aXZRU<cr><lf>
```

Command format in SDI-12:

```
aXZRU!
```

a	Device address
XZRU	Precipitation counter reset command
`<cr><lf>`	Command terminator in ASCII and NMEA 0183
`!`	Command terminator in SDI-12

Example (ASCII):

```
0XZRU<cr><lf>

0TX,Rain reset<cr><lf>
```

Example (SDI-12):

```
0XZRU!0<cr><lf> (= device address)
```

Example (NMEA 0183):

```
0XZRU<cr><lf>

$WITXT,01,01,10,Rain reset*26<cr><lf>
```

7.1.3 Precipitation Intensity Reset (aXZRI)

This command resets the rain and hail intensity parameters Ri, Rp, Hi, and Hp.

Command format in ASCII and NMEA 0183:

```
aXZRI<cr><lf>
```

Command format in SDI-12:

```
aXZRI!
```

a	Device address
XZRI	Precipitation intensity reset command
`<cr><lf>`	Command terminator in ASCII and NMEA 0183
!	Command terminator in SDI-12

> The precipitation counter and precipitation intensity parameters are reset also when the supply voltage is disconnected, the command **aXZ** is issued, precipitation counter reset mode is changed, or when the precipitation/surface hits units are changed.

Example (ASCII):

```
0XZRI<cr><lf>

0TX,Inty reset<cr><lf>
```

Example (SDI-12):

```
0XZRI!0<cr><lf> (= device address)
```

Example (NMEA 0183):

```
0XZRI<cr><lf>

$WITXT,01,01,11,Inty reset*39<cr><lf>
```

7.1.4 Measurement Reset (aXZM)

This command interrupts all ongoing measurements except rain measurement and restarts them.

Command format in ASCII and NMEA 0183:

```
aXZM<cr><lf>
```

Command format in SDI-12:

```
aXZM!
```

a	Device address
XZM	Measurement break command
`<cr><lf>`	Command terminator in ASCII and NMEA 0183
!	Command terminator in SDI-12

Example (ASCII):

```
0XZM<cr><lf>

0TX,Measurement reset<cr><lf>
```

Example (SDI-12):

```
0XZM!0 (= device address)
```

Example (NMEA 0183):

```
0XZM<cr><lf>

$WITXT,01,01,09,Measurement reset*50<cr><lf>
```

7.2 ASCII Protocol

7.2.1 Abbreviations and Units

Table 18   Abbreviations and Units

Abbreviation	Name	Unit	Status [1]
Sn	Wind speed minimum	m/s, km/h, mph, knots	#, M, K, S, N
Sm	Wind speed average	m/s, km/h, mph, knots	#, M, K, S, N
Sx	Wind speed maximum	m/s, km/h, mph, knots	#, M, K, S, N
Dn	Wind direction minimum	deg	#, D
Dm	Wind direction average	deg	#, D
Dx	Wind direction maximum	deg	#, D
Pa	Air pressure	hPa, Pa, bar, mmHg, inHg	#, H, P, B, M, I
Ta	Air temperature	°C, °F	#, C, F
Tp	Internal temperature	°C, °F	#, C, F
Ua	Relative humidity	%RH	#, P
Rc	Rain accumulation	mm, in	#, M, I
Rd	Rain duration	s	#, S
Ri	Rain intensity	mm/h, in/h	#, M, I
Rp	Rain peak intensity	mm/h, in/h	#, M, I
Hc	Hail accumulation	hits/cm^2, hits/in^2, hits	#, M, I, H
Hd	Hail duration	s	#, S
Hi	Hail intensity	hits/cm^{2}h, hits/in^{2}h, hits/h	#, M, I, H

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Abbreviation	Name	Unit	Status [1]
Hp	Hail peak intensity	hits/cm^{2}h, hits/in^{2}h, hits/h	#, M, I, H
Th	Heating temperature	°C, °F	#, C, F
Vh	Heating voltage	V	#, N, V, W, F [2]
Vs	Supply voltage	V	V
Vr	3.5 V ref. voltage	V	V
Id	Information field	alphanumeric	

1)   The letters in the status field indicate the Unit, the # character indicates invalid data.

2)   For heating # = heating option is not available (has not been ordered).

   N = heating option is available but have been disabled by user or the heating temperature is over the high control limit.

   V = heating is on at 50% duty cycle and the heating temperature is between the high and middle control limits.

   W = heating is on at 100% duty cycle and the heating temperature is between the low and middle control limits.

   F = heating is on at 50% duty cycle and the heating temperature is below the low control limit.

7.2.2 Device Address (?)

This command queries the address of the device on the bus.

Command format:

```
?<cr><lf>
```

?	Device address query command
<cr><lf>	Command terminator

Response:

```
b<cr><lf>
```

b	Device address (default = 0)
<cr><lf>	Response terminator.

Example:

```
?<cr><lf>
0<cr><lf>
```

If more than one transmitter is connected to the bus, see A.1 Connecting Several Transmitters on Same Bus (page 171).

7.2.3 Acknowledge Active Command (a)

This command checks that a device responds to a data recorder or another device. It asks a sensor to acknowledge its presence on the bus.

Command format:

```
a<cr><lf>
```

a	Device address
<cr><lf>	Command terminator

Response:

```
a<cr><lf>
```

a	Device address
<cr><lf>	Response terminator

Example:

```
0<cr><lf>
0<cr><lf>
```

7.2.4 Wind Data Message (aR1)

This command requests the wind data message.

Command format:

```
aR1<cr><lf>
```

a	Device address
R1	Wind message query command

`<cr><lf>`	Command terminator

Example of the response (the parameter set is configurable):

```
0R1,Dn=236D,Dm=283D,Dx=031D,Sn=0.0M,Sm=1.0M, Sx=2.2M<cr><lf>
```

a	Device address
R1	Wind message query command
Dn	Wind direction minimum (D = degrees)
Dm	Wind direction average (D = degrees)
Dx	Wind direction maximum (D = degrees)
Sn	Wind speed minimum (M = m/s)
Sm	Wind speed average (M = m/s)
Sx	Wind speed maximum (M = m/s)
`<cr><lf>`	Response terminator

7.2.5 Pressure, Temperature and Humidity Data Message (aR2)

This command requests a pressure, temperature, and humidity data message.

Command format:

```
aR2<cr><lf>
```

a	Device address
R2	Pressure, temperature and humidity message query command
`<cr><lf>`	Command terminator

Example of the response (the parameter set is configurable):

```
0R2,Ta=23.6C,Ua=14.2P,Pa=1026.6H<cr><lf>
```

a	Device address
R2	Pressure, temperature and humidity message query command
Ta	Air temperature (C = °C)

Ua	Relative humidity (P = % RH)
Pa	Air pressure (H = hPa)
<cr><lf>	Response terminator

7.2.6 Precipitation Data Message (aR3)

This command requests the precipitation data message.

Command format:

```
aR3<cr><lf>
```

a	Device address
R3	Precipitation message query command
<cr><lf>	Command terminator

Example of the response (the parameter set is configurable):

```
0R3,Rc=0.0M,Rd=0s,Ri=0.0M,Hc=0.0M,Hd=0s,Hi=0.0M,Rp=0.0M,Hp=0.0M<cr><lf>
```

a	Device address
R3	Precipitation message query command
Rc	Rain accumulation (M = mm)
Rd	Rain duration (s = s)
Ri	Rain intensity (M = mm/h)
Hc	Hail accumulation (M = hits/cm^2)
Hd	Hail duration (s = s)
Hi	Hail intensity (M = hits/cm^{2}h)
Rp	Rain peak intensity (M = mm/h)
Hp	Hail peak intensity (M = hits/cm^{2}h)
<cr><lf>	Response terminator

7.2.7 Supervisor Data Message (aR5)

This command requests a supervisor data message containing self-check parameters of the heating system and power supply voltage.

Command format:

```
aR5<cr><lf>
```

a	Device address
R5	Supervisor message query command
<cr><lf>	Command terminator

Example of the response (the parameter set is configurable):

```
0R5,Th=25.9C,Vh=12.0N,Vs=15.2V,Vr=3.475V,Id=HEL___<cr><lf>
```

a	Device address
R5	Supervisor message query command
Th	Heating temperature (C = °C)
Vh	Heating voltage (N = heating is off)
Vs	Supply voltage (V = V)
Vr	3.5 V reference voltage (V = V)
<cr><lf>	Response terminator
Id	Information field

The content of the parameter **Id** is a text string which you can modify with the Vaisala Configuration Tool. The field can include customer-specific, additional information. For more information on changing the settings, see the Vaisala Configuration Tool online help for the **Info** field in the **Device Settings** window.

More Information

7.2.8 Combined Data Message (aR)

This command requests all individual messages **aR1**, **aR2**, **aR3**, and **aR5** with one command.

Command format:

```
aR<cr><lf>
```

a	Device address (default = 0)
R	Combined message query command
`<cr><lf>`	Command terminator

Example of the response:

```
0R1,Dm=027D,Sm=0.1M<cr><lf>

0R2,Ta=74.6F,Ua=14.7P,Pa=1012.9H<cr><lf>

0R3,Rc=0.10M,Rd=2380s,Ri=0.0M,Hc=0.0M,Hd=0s, Hi=0.0M<cr><lf>

0R5,Th=76.1F,Vh=11.5N,Vs=11.5V,Vr=3.510V,Id=HEL___<cr><lf>
```

7.2.9 Composite Data Message Query (aR0)

This command requests a combined data message with user-configurable set of wind, pressure, temperature, humidity, precipitation, and supervisor data.

Command format:

```
aR0<cr><lf>
```

a	Device address (default = 0)
R0	Combined message query command
`<cr><lf>`	Command terminator

Example of the response (you can select the parameters included from the full parameter set of the commands aR1, aR2, aR3, and aR5):

```
0R0,Dx=005D,Sx=2.8M,Ta=23.0C,Ua=30.0P,Pa=1028.2H,
Rc=0.00M,Rd=10s,Th=23.6C<cr><lf>
```

7.2.10 Polling with CRC

Use the same data query commands as in the previous sections but type the first letter of the command in lower case and add a correct three-character CRC before the command terminator. The response also contains a CRC.

Requesting a wind data message with a CRC:

Command format:

```
ar1xxx<cr><lf>
```

a	Device address
r1	Wind message query command
xxx	Three-character CRC for **ar1** command
<cr><lf>	Command terminator

Example of the response (the parameter set is configurable):

```
0r1,Dn=236D,Dm=283D,Dx=031D,Sn=0.0M,Sm=1.0M,Sx=2.2MLFj<cr><lf>
```

The three characters before <cr><lf> are the CRC for the response.

> To request the correct CRC for each command, type the command with an arbitrary three-character CRC.

Example of asking the CRC for the wind data message query ar1:

Command format:

```
ar1yyy<cr><lf>
```

a	Device address
r1	Wind message query command
yyy	Arbitrary three-character CRC
<cr><lf>	Command terminator

Response:

```
atX,Use chksum GoeIU~<cr><lf>
```

a	Device address (default = 0)
tX,Use chksum	Text prompt

`Goe`	Correct three-character CRC for the **ar1** command
`IU~`	Three-character CRC for the response message
`<cr><lf>`	Response terminator

Example of the other data query commands with CRC (when the device address is 0):

Parameter	Description
Pressure, humidity and temperature message query	0r2Gje<cr><lf>
Precipitation query	0r3Kid<cr><lf>
Supervisor query	0r5Kcd<cr><lf>
Combined message query	0rBVT<cr><lf>
Composite data message query	0r0Kld<cr><lf>

In every case the response contains a three-character CRC before the <cr><lf>.

More Information

7.2.11 Automatic Mode

When the automatic ASCII protocol is selected, the transmitter sends data messages at user-configurable update intervals.

The message structure is the same as with data query commands **aR1**, **aR2**,**aR3** , and **aR5**. You can choose an individual update interval for each sensor.

Example:

```
0R1,Dm=027D,Sm=0.1M<cr><lf>

0R2,Ta=74.6F,Ua=14.7P,Pa=1012.9H<cr><lf>

0R3,Rc=0.10M,Rd=2380s,Ri=0.0M,Hc=0.0M,Hd=0s,Hi=0.0M<cr><lf>

0R5,Th=76.1F,Vh=11.5N,Vs=11.5V,Vr=3.510V<cr><lf>
```

Example (with CRC):

```
0r1,Sn=0.1M,Sm=0.1M,Sx=0.1MGOG<cr><lf>

0r2,Ta=22.7C,Ua=55.5P,Pa=1004.7H@Fn<cr><lf>

0r3,Rc=0.00M,Rd=0s,Ri=0.0MIlm<cr><lf>

0r5,Th=25.0C,Vh=10.6#,Vs=10.8V,Vr=3.369VO]T<cr><lf>
```

> **ℹ** Stop the automatic output by changing the communication protocol to polled mode (**aXU,M=P**). You can also use polling commands **aR1**, **aR2**, **aR3**, and **aR5** in ASCII automatic protocol for requesting data.

7.2.12 Automatic Composite Data Message (aR0)

When automatic composite data messaging is selected, the transmitter sends composite data messages at user-configurable intervals. The message structure is the same as with the composite data query command **aR0** and contains a user-configurable set of wind, pressure, temperature, humidity, precipitation, and supervisor data.

Example of the response (you can select the parameters included from the full parameter set of the commands aR1, aR2, aR3, and aR5):

```
0R0,Dx=005D,Sx=2.8M,Ta=23.0C,Ua=30.0P,Pa=1028.2H,
Hd=0.00M,Rd=10s,Th=23.6C<cr><lf>
```

For selecting the parameter set in the response message, see 8.1 Sensor Configuration and Data Message Formatting (page 117).

Automatic composite data messaging is a concurrent, not an alternate mode to either the polled or automatic modes.

7.3 SDI-12 Protocol

There are two modes available for providing the functionality of the SDI-12 v1.3 standard.

The Native SDI-12 profile (**aXU,M=S**) offers the lowest power consumption as it makes measurements and outputs data only when requested. In this mode all the commands presented in this chapter are available except those for the continuous measurement.

In the Continuous mode (**aXU,M=R**) measurements are made at user-configurable update intervals. The data is outputted on request. In this mode all the commands presented in this chapter are available.

In the Native SDI-12 mode (**aXU,M=S**) the transmitter is in idle state most of the time (power consumption < 1 mW). More power is consumed only during the measurements and data transmit requested by the host device.

In particular, wind measurement typically consumes 60 mW average power (with 4 Hz sampling rate), throughout the averaging period. In the Continuous mode (**aXU=M,R**) the power consumption is determined by the internal update intervals of the sensors and wind averaging time. These have certain limits, so very long measurement intervals cannot be achieved with this mode. Also the power consumption between the measurements is about three times that of the Native mode.

More Information

‣ Sensor Configuration and Data Message Formatting (page 117)

7.3.1 Address Query Command (?)

This command queries the address of the device on the bus.

If more than one sensor is connected to the bus, they all respond, causing a bus collision.

Command format:

```
?!
```

?	Address query command
!	Command terminator

Response:

```
a<cr><lf>
```

a	Device address (default = 0)
<cr><lf>	Response terminator

Example (device address 0):

```
?!0<cr><lf>
```

7.3.2 Acknowledge Active Command (a)

This command checks that a device responds to a data recorder or another SDI-12 device. It asks device to acknowledge its presence on the SDI-12 bus.

Command format:

```
   a!
```

a	Device address
!	Command terminator

Response:

```
   a<cr><lf>
```

a	Device address
<cr><lf>	Response terminator

Example:

```
   0!0<cr><lf>
```

7.3.3 Change Address Command (aAb)

This command changes the device address. After the command has been issued and responded to, the sensor is not required to respond to another command for one second to ensure writing the new address to the non-volatile memory.

Command format:

```
   aAb!
```

a	Device address
A	Change address command
b	Address to change to
!	Command terminator

Response:

```
   b<cr><lf>
```

b	Device address = the new address (or the original address, if the device is unable to change it)
`<cr><lf>`	Response terminator

Example (changing address from 0 to 3):

```
0A3!3<cr><lf>
```

7.3.4 Send Identification Command (aI)

This command queries the device for the SDI-12 compatibility level, model number, firmware version, and serial number.

Command format:

```
aI!
```

a	Device address
I	Send identification command
!	Command terminator

Response:

```
a13ccccccccmmmmmmvvvxxxxxxxx<cr><lf>
```

a	Device address
13	The SDI-12 version number, indicating SDI-12 version compatibility; for example, version 1.3 is encoded as 13
cccccccc	8-character vendor identification Vaisala_
mmmmmm	6 characters specifying the sensor model number
vvv	3 characters specifying the firmware version
xxxxxxxx	8-character serial number
`<cr><lf>`	Response terminator

Example:

```
0I!013VAISALA_WXT530103Y2630000<cr><lf>
```

7.3.5 Start Measurement Command (aM)

This command asks the device to make a measurement. The measured data is not sent automatically. You must request it with the Send data command **aD**.

The host device is not allowed to send any commands to other devices on the bus until the measurement is completed.

When several devices are connected to the same bus and simultaneous measurements from the many devices are needed, use start concurrent measurement **aC** or start concurrent measurement with CRC **aCC**.

Command format:

```
aMx!
```

a	Device address
M	Start measurement command
x	The desired sensor to make the measurement
	1 = Wind
	2 = Temperature, humidity, pressure
	3 = Precipitation
	4 = Analog input
	5 = Supervisor
	If x is left out, the query refers to the combined data message used for requesting data from several sensors with one command.
!	Command terminator

> For analog input measurements, the measurement completing time is the bigger one of the **aUI,A** and **aIP,A** values (averaging times for solar radiation, ultrasonic level sensor and Aux.temperature).

The response is sent in two parts.

Part one:

```
atttn<cr><lf>
```

Part two (indicates that the data is ready to be requested):

```
a<cr><lf>
```

a	Device address
ttt	The measurement completing time in seconds
n	The number of the measured parameters available (maximum number is 9)
<cr><lf>	Response terminator

> ℹ️ When the measurement takes less than one second, part two of the response is not sent. This is the case in the precipitation measurement **aM3**.

> ℹ️ The maximum number of parameters that can be measured with **aM** and **aMC** commands is nine. If more parameters must be measured, use Start concurrent measurement commands **aC** and **aCC** (for which the maximum number of parameters to be measured is 20).

More Information
- Examples of aM, aC and aD Commands (page 98)
- Sensor Configuration and Data Message Formatting (page 117)
- Start Concurrent Measurement (aC) (page 96)
- Start Concurrent Measurement with CRC (aCC) (page 97)

7.3.6 Start Measurement Command with CRC (aMC)

Command format:

```
aMCx!
```

This command asks the device to make a measurement and a three-character CRC is added to the response data strings before <cr><lf>.

To request the measured data, use the Send data command **aD**.

More Information
- Send Data Command (aD) (page 97)

7.3.7 Start Concurrent Measurement (aC)

Use this command when there are several devices on the same bus and simultaneous measurements are needed from the devices, or if more than 9 measurement parameters are requested from a single device.

The measured data is not sent automatically. You must request it with the Send data command **aD**.

Command format:

```
aCx!
```

a	Device address
C	Start concurrent measurement command
x	The desired measurement
	1 = Wind
	2 = Temperature, humidity, and pressure
	3 = Precipitation
	4 = Analog input
	5 = Supervisor
	If x is left out, the query refers to combined data message in which the user can request data from several sensors with just one command. See the following example.
!	Command terminator

Response:

```
atttnn<cr><lf>
```

a	Device address
ttt	The measurement completing time in seconds
nn	The number of the measured parameters available (maximum number is 20)
<cr><lf>	Response terminator

For information on changing the message parameters, units and other settings, see 8.1 Sensor Configuration and Data Message Formatting (page 117).

7.3.8 Start Concurrent Measurement with CRC (aCC)

Command format:

```
aCCx!
```

Use this command when there are several devices on the same bus and simultaneous measurements are needed from the devices but a three-character CRC is added to the response data strings before <cr><lf>.

To request the measured data, use the Send data command **aD**.

7.3.9 Send Data Command (aD)

Use this command to request the measured data from the device.

> Start measurement command indicates the number of parameters available. The number of the parameters that can be included in a single message depends on the number of characters in the data fields. If not all the parameters are retrieved in a single response message, repeat the Send data commands until all the data is obtained.

Command format:

```
aDx!
```

a	Device address
D	Send data command
x	The order of consecutive Send data commands. Make sure the first Send data command is addressed with x=0. If all the parameters are not retrieved, send the next Send data command with x=1 and so on. The maximum value for x is 9.
!	Command terminator

Response:

```
a+<data fields><cr><lf>
```

a	Device address
`<data fields>`	The measured parameters in selected units, separated with '+' marks (or - marks in case of negative parameter values).

<cr><lf>	Response terminator

> **ℹ** **aD0** command can also be used to break the measurement in progress started with commands **aM**, **aMC**, **aC**, or **aCC**.

> **ℹ** In SDI-12 v1.3 Continuous measurement mode (**aXU,M=R**) the sensor makes measurements at configurable update intervals. The **aD** command following the **aM**, **aMC**, **aC,** or **aCC** command always returns the latest updated data. Thus in **aXU,M=R** mode issuing consecutive **aD** commands can result in different data strings if the values are updated between the commands.

7.3.10 Examples of aM, aC and aD Commands

> **ℹ** The parameter order in messages:
> **Wind (M1)**: Dn Dm Dx Sn Sm Sx
> **PTU (M2)**: Ta Tp Ua Pa
> **Rain (M3)**: Rc Rd Ri Hc Hd Hi Rp Hp
> **Supv (M5)**: Th Vh Vs Vr Id
> **Comp (M)**: Wind PTU Rain Supv (parameters in above order)
> The order of the parameters is fixed, but you can exclude any parameter from the list when configuring the transmitter.

> **ℹ** The parameter order in SDI-12 mode:
> **Analog in (M4)**: Tr Ra Sl Rt Sr

The device address is 0 in all examples.

Example 1:

Start a wind measurement and request the data (all 6 wind parameters are enabled in the message):

```
0M1!00036<cr><lf>
```

(measurement ready in 3 seconds and 6 parameters available)

```
0<cr><lf>
```

(measurement completed)

```
0D0!0+339+018+030+0.1+0.1+0.1<cr><lf>
```

Example 2:

Start a concurrent pressure, humidity and temperature measurement and request the data:

```
0C2!000503<cr><lf>
```

(measurement ready in 5 seconds and 3 parameters available, for **aC** command device address not sent as a sign of a completed measurement)

```
0D0!0+23.6+29.5+1009.5<cr><lf>
```

Example 3:

Start a precipitation measurement and request the data:

```
0M3!00006<cr><lf>
```

(6 parameters available immediately, thus the device address is not sent)

```
0D0!0+0.15+20+0.0+0.0+0+0.0<cr><lf>
```

Example 4:

Start a supervisor measurement with CRC and request the data:

```
0MC5!00014<cr><lf>
```

(measurement ready in one second and 4 parameters available)

```
0<cr><lf>
```

(measurement completed)

```
0D0!0+34.3+10.5+10.7+3.366DpD<cr><lf>
```

Example 5:

Start a composite measurement and request the data. The configuration of the parameter set is such that 9 parameters are available. Thus start measurement command **aM** can be used. Due to the 35-character limit in response message, **aD0** returns only 6 parameters. The remaining parameters are retrieved with **aD1**.

```
0M!00059<cr><lf>
```

(measurement ready in 5 seconds and 9 parameters available)

```
0<cr><lf>
```

(measurement completed)

```
0D0!0+340+0.1+23.7+27.9+1009.3+0.15<cr><lf>

0D1!0+0.0+0+0.0<cr><lf>
```

Example 6:

Start a composite measurement and request the data. The configuration of the parameter set is such that 20 parameters are available. Thus Start concurrent measurement command **aC** is used. Due to the 75-character limit in response message, **aD0** returns only 14 parameters. The remaining parameters are retrieved with **aD1**.

```
0C!000520<cr><lf>
```

(measurement ready in 5 seconds and 20 parameters available, for **aC** command device address not sent as a sign of a completed measurement))

```
0D0!0+069+079+084+0.1+0.6+1.1+21.1+21.7+32.0+1000.3+0.02+20+0.0+0.0<cr><lf>

0D1!0+0+0.0+1.3+0.0+0+77.1<cr><lf>
```

7.3.11 Continuous Measurement (aR)

The device can be configured so that all the parameters can be requested instantly with the command **aR** instead of the two-phase request procedure of commands **aM**, **aMC**, **aC**, **aCC**, and **aD**.

In this case the obtained parameter values are those from the latest internal updating. For details on setting update intervals, see 8.1 Sensor Configuration and Data Message Formatting (page 117).

For using Continuous measurement commands for all WXT530 series parameters (wind, PTU, precipitation, and supervisor) the select the respective protocol (**aXU,M=R**). The **M=S** selection requires use of **aM**, **aMC**, **aC**, **aCC**, and **aD** commands, only the precipitation data can be retrieved continuously (using **aR3** command).

Command format:

```
aRx!
```

a	Device address
R	Start continuous measurement command:
x	The desired sensor to make the measurement:
	1 = Wind
	2 = Temperature, humidity, pressure
	3 = Precipitation
	5 = Supervisor
	If x is left out, the query refers to the combined data message used for requesting data from several sensors with just one command.
!	Command terminator

Response:

```
a+<data fields><cr><lf>
```

a	Device address
`<data fields>`	The measured parameters in selected units, separated with '+' marks (or '-' marks in case of negative parameter values). The maximum number of parameters to be measured with one request is 15.
`<cr><lf>`	Response terminator

Examples (device address 0):

```
0R1!0+323+331+351+0.0+0.4+3.0<cr><lf>

0R3!0+0.15+20+0.0+0.0+0+0.0+0.0+0.0<cr><lf>

0R!0+178+288+001+15.5+27.4+38.5+23.9+35.0+1002.1+0.00+0+0.0+23.8<cr><lf>
```

7.3.12 Continuous Measurement with CRC (aRC)

Command format:

```
aRCx!
```

The device can be configured so that all the parameters can be requested instantly with the command **aRC** but a three-character CRC is added to the response data strings before `<cr><lf>`.

Example (device address 0):

```
0RC3!0+0.04+10+14.8+0.0+0+0.0INy
```

7.4 NMEA 0183 v3.0 Protocol

This section lists the data query commands and data message formats for the NMEA 0183 v3.0 query and automatic protocols.

A two-character checksum (CRC) field is transmitted in all data request sentences.

More Information

‣ Sensor Configuration and Data Message Formatting (page 117)
‣ CRC-16 Computation (page 179)

7.4.1 Device Address (?)

This command queries the address of the device on the bus.

Command format:

```
?<cr><lf>
```

?	Device address query command
`<cr><lf>`	Command terminator

Response:

```
b<cr><lf>
```

b	Device address (default = 0)
<cr><lf>	Response terminator.

Example:

```
?<cr><lf>
0<cr><lf>
```

If more than one transmitter is connected to the bus, see .

7.4.2 Acknowledge Active Command (a)

This command checks that a device responds to a data recorder or another device. It asks a sensor to acknowledge its presence on the bus.

Command format:

```
a<cr><lf>
```

a	Device address
<cr><lf>	Command terminator

Response:

```
a<cr><lf>
```

a	Device address
<cr><lf>	Response terminator

Example:

```
0<cr><lf>
0<cr><lf>
```

7.4.3 MWV Wind Speed and Direction Query

Use the **MWV** query command to request the wind speed and direction data. To use the **MWV** query, the NMEA Wind formatter parameter in the wind sensor settings must be set to **W**.

The **MWV** command only queries only wind speed and direction average values.

Command:

```
$--WIQ,MWV*hh<cr><lf>
```

$	Start of the message
--	Device identifier of the requester
WI	Device type identifier (WI = weather instrument)
Q	Defines the message as Query
MWV	Wind speed and direction query command
*	Checksum delimiter
hh	Two-character checksum for the query command.
<cr><lf>	Command terminator

Response:

```
$WIMWV,x.x,R,y.y,M,A*hh<cr><lf>
```

$	Start of the message
WI	Talker identifier (WI = weather instrument)
MWV	Wind speed and direction response identifier
x.x	Wind direction value [1]
R	Wind direction unit (R = relative)
y.y	Wind speed value
M	Wind speed unit (m/s)
A	Data status: A = valid, V = Invalid

*	Checksum delimiter
hh	Two-character checksum for the response
`<cr><lf>`	Response terminator

1) *Wind direction is given in relation to the devices north-south axis. An offset value to the measured direction can be set, see Chapter 8.*

The checksum typed in the query depends on the device identifier characters. To find the correct checksum in the WXT530 series transmitters, type any three characters after the **`$--WIQ,MWV`** command.

Example

If you type the command **`$--WIQ,MWVxxx<cr><lf>`**(xxx arbitrary characters) , the transmitter responds:

    $WITXT,01,01,08,Use chksum 2F*72<cr><lf>

which indicates that **2F** is the correct checksum for the **`$--WIQ,MWV`** command.

Example

    $--WIQ,MWV*2F<cr><lf>

    $WIMWV,282,R,0.1,M,A*37<cr><lf>

(Wind angle 282 degrees, Wind speed 0.1 m/s)

More Information

‣ XDR Transducer Measurement Query (page 105)

7.4.4 XDR Transducer Measurement Query

The **XDR** query command outputs the data of all sensors except wind.

To request wind data with the **XDR** command, set the NMEA Wind formatter parameter in the wind sensor settings to T.

Command:

    $--WIQ,XDR*hh<cr><lf>

$	Start of the message

--	Device identifier of the requester
WI	Device type identifier (WI = weather instrument)
Q	Defines the message as Query
XDR	Transducer measurement command
*	Checksum delimiter
hh	Two-character checksum for the query command.
<cr><lf>	Command terminator

The response includes the parameters activated in the data messages.

> The parameter order in the output is as shown in the parameter selection setting field. See
> 8.1 Sensor Configuration and Data Message Formatting (page 117).

Response:

```
$WIXDR,a1,x.x1,u1,c--c1, ... ... ..an,x.xn,un,c--cn*hh<cr><lf>
```

$	Start of the message
WI	Device type identifier (WI = weather instrument)
XDR	Transducer measurement response identifier
a[1]	Transducer type for the first transducer, see the following transducer table.
x.x[1]	Measurement data from the first transducer
u[1]	Units of the first transducer measurement, see the following transducer table.
c--c[1]	First transducer identification (id). The transmitter's address aXU,A is added as a base number to the transducer id. (command aXU,A= [0 ... 9/A ... Z/a ... z]. [1]
an	Transducer type for the transducer n, see the following transducer table.
x.xn	Measurement data from the transducer n
un	Units of the transducer n measurement, see the following transducer table.
c--cn	Transducer n id. the transmitter's address **aXU,A** is added as a base number to the Transducer #ID. The address is changeable, see command **aXU,A= [0 ... 9/A ... Z/ a ... z]**. [1]
*	Checksum delimiter
hh	Two-character checksum for the response

`<cr><lf>`	Response terminator

The checksum to be typed in the query depends on the device identifier characters and can be asked from the WXT530 Series, see example below.

Example:

Typing the command **$--WIQ,XDRxxx<cr><lf>** (xxx arbitrary characters) the transmitter responds

```
$WITXT,01,01,08,Use chksum 2D*72<cr><lf>
```

indicating that 2D is the correct checksum for the **$--WIQ,XDR** command.

If there are several distinct measurements of the same parameter (according to the transducer table), they are assigned different transducer ids.

For example, minimum, average and maximum wind speed are measurements of the same parameter (wind speed) so if all three are configured to be shown in the XDR message, they get transducer ids A, A+1 and A+2, respectively, where A is the transmitter address **aXU,A**. The same applies for the wind direction. Temperature, internal temperature and heating temperature have the same unit, thus they are assigned with transducer ids A, A+1 and A+2, respectively. Accumulation, duration and intensity for rainfall and hails are measurements of the same parameters so they get transducer ids A for rainfall and A+1 for hails. Rain and hail peak intensities are assigned with transducer ids A+2 and A+3, respectively.

For example, for a transmitter with device address 0 the transducer ids of all the measurement parameters are as follows:

Table 19   Transducer IDs of Measurement Parameters

Measurement	Transducer ID	Type
Wind direction min	0	A
Wind direction average	1	A
Wind direction max	2	A
Wind speed min	0	S
Wind speed average	1	S
Wind speed max	2	S
Pressure	0	P
Air temperature	0	C
Internal temperature	1	C
Relative humidity	0	H

Measurement	Transducer ID	Type
Rain accumulation	0	V
Rain duration	0	Z
Rain current intensity	0	R
Hail accumulation	1	V
Hail duration	1	Z
Hail current intensity	1	R
Rain peak intensity	2	R
Hail peak intensity	3	R
Heating temperature	2	C
Supply voltage	0	U
Heating voltage	1	U
3.5 V reference voltage	2	U
Information field	4	G
Aux. rain (tipping bucket)	1	V
Solar radiation	3	U
Ultrasonic level sensor	4	U
Aux. temperature (pt1000)	3	C

To ensure correct XDR response, activate either hail accumulation or Aux. rain (tipping bucket), not both at the same time.

Example of the XDR Query (all parameters of each sensor enabled and NMEA wind formatter set to T):

```
$--WIQ,XDR*2D<cr><lf>
```

Example of the response when all the parameters of each sensor are enabled (NMEA wind formatter set to T):

Wind sensor data

```
$WIXDR,A,302,D,0,A,320,D,1,A,330,D,2,S,0.1,M,0,S,0.2,M,1,S,0.2, M,2*57<cr><lf>
```

P, T, and RH data

```
$WIXDR,C,23.3,C,0,C,24.0,C,1,H,50.1,P,0,P,1009.5,H, 0*75<cr><lf>
```

Precipitation data

```
$WIXDR,V,0.02,M,0,Z,30,s,0,R,2.7,M,0,V,0.0,M,1,Z,0,s,1,R,0.0,M,1, R,6.3,M,2,R,
0.0,M,3*51<cr><lf>
```

Supervisor data

```
$WIXDR,C,20.4,C,2,U,12.0,N,0,U,12.5,V,1,U,3.460,V,2,G,HEL/___,,4*2D
```

The structure of the wind sensor response message:

$	Start of the message
WI	Device type (WI = weather instrument)
XDR	Transducer measurement response identifier
A	Transducer id 0 type (wind direction)
302	Transducer id 0 data (min wind direction)
D	Transducer id 0 units (degrees, min wind direction)
0	Transducer id for min wind direction
A	Transducer id 1 type (wind direction)
320	Transducer id 1 data (average wind direction)
D	Transducer id 1 units (degrees, average wind direction)
1	Transducer id for average wind direction
A	Transducer id 2 type (wind direction)
330	Transducer id 2 data (max wind direction)
D	Transducer id 2 units (degrees, max wind direction)
2	Transducer id for max wind direction
S	Transducer id 0 type (wind speed)
0.1	Transducer id 0 data (min wind speed)
M	Transducer id for min wind speed
S	Transducer id 1 type (wind speed)
0.2	Transducer id 1 data (average wind speed)
M	Transducer id 1 units (m/s, average wind speed)

1	Transducer id for average wind speed
S	Transducer id 2 type (wind speed)
0.2	Transducer id 2 data (max wind speed)
M	Transducer id 2 units (m/s, max wind speed)
2	Transducer id for max wind speed
*	Checksum delimiter
57	Two-character checksum for the response
<cr><lf>	Response terminator

The structure of the pressure, temperature and humidity sensor response message:

$	Start of the message
WI	Device type (WI = weather instrument)
XDR	Transducer measurement response identifier
C	Transducer id 0 type (Temperature), see the following Transducer table
23.3	Transducer id 0 data (Temperature)
C	Transducer id 0 units (C, Temperature)
0	Transducer id for Temperature
C	Transducer id 1 type (temperature)
23.3	Transducer id 1 data (Tp internal temperature)
C	Transducer id 1 units (C, Tp internal temperature)
1	Transducer id for Tp internal temperature
H	Transducer id 0 type (Humidity)
50.1	Transducer id 0 data (Humidity)
P	Transducer id 0 units (%, Humidity)
0	Transducer id for Humidity
P	Transducer id 0 type (Pressure)
1009.1	Transducer id 0 data (Pressure)
H	Transducer id 0 units (hPa, Pressure)
0	Transducer id for Pressure
*	Checksum delimiter
75	Two-character checksum for the response
<cr><lf>	Response terminator

The structure of the precipitation sensor response message:

$	Start of the message
WI	Device type (WI = weather instrument)
XDR	Transducer measurement response identifier
V	Transducer id 0 type (Accumulated rainfall)
0.02	Transducer id 0 data (Accumulated rainfall)
I	Transducer id 0 units (mm, Accumulated rainfall)
0	Transducer id for Accumulated rainfall
Z	Transducer id 0 type (Rain duration)
30	Transducer id 0 data (Rain duration)
s	Transducer id 0 units (s, Rain duration)
0	Transducer id for Rain duration
R	Transducer id 0 type (Rain intensity)
2.7	Transducer id 0 data (Rain intensity)
M	Transducer id 0 units (mm/h, Rain intensity)
0	Transducer id for Rain intensity
V	Transducer id 1 type (Hail accumulation)
0.0	Transducer id 1 data (Hail accumulation)
M	Transducer id 1 units (hits/cm2, Hail accumulation)
1	Transducer id for Hail accumulation
Z	Transducer id 1 type (Hail duration)
0	Transducer id 1 data (Hail duration)
s	Transducer id 1 units (s, Hail duration)
1	Transducer id for Hail duration
R	Transducer id 1 type (Hail intensity)
0.0	Transducer id 1 data (Hail intensity)
M	Transducer id 1 units (hits/cm2h, Hail intensity)
1	Transducer id for Hail intensity
R	Transducer id 1 type (Rain peak intensity)
6.3	Transducer id 1 data (Rain peak intensity)
M	Transducer id 1 units (mm/h, Rain peak intensity)
2	Transducer id for Rain peak intensity
R	Transducer id 1 type (Hail peak intensity)
0.0	Transducer id 1 data (Hail peak intensity)
M	Transducer id 1 units (hits/cm2, Hail peak intensity)

3	Transducer id for Hail peak intensity
*	Checksum delimiter
51	Two-character checksum for the response
<cr><lf>	Response terminator

The structure of the supervisor response message:

$	Start of the message
WI	Device type (WI = weather instrument)
XDR	Transducer measurement response identifier
C	Transducer id 2 type (temperature), see the following Transducer table
20.4	Transducer id 2 data (Heating temperature)
C	Transducer id 2 units (C, Heating temperature)
2	Transducer id for Heating temperature
U	Transducer id 0 type (voltage)
12.0	Transducer id 0 data (Heating voltage)
M	Transducer id 0 units (N = heating disabled or heating temperature too high Heating voltage)
0	Transducer id for Heating voltage
U	Transducer id 1 type (Supply voltage)
12.5	Transducer id 1 data (Supply voltage)
V	Transducer id 1 units (V, Supply voltage)
1	Transducer id for Supply voltage
U	Transducer id 2 type (voltage)
3.460	Transducer id 2 data (3.5 V reference voltage)
V	Transducer id 2 units (V, 3.5 V reference voltage)
2	Transducer id for 3.5 V reference voltage
G	Transducer id 4 type (generic)
HEL/___	Transducer id 4 data (info field)
	Transducer id 4 units (none, null)
4	Transducer id for generic field
*	Checksum delimiter
2D	Two-character CRC for the response.
<cr><lf>	Response terminator

Table 20   Transducer Table

Transducer	Type	Units Field	Comments
Temperature	C	C = Celsius	
		F = Fahrenheit	
Angular displacement (wind direction)	A	D = degrees	
Wind speed	S	K = km/h M = m/s N = knots	S = mph, non-standardized[1]
Pressure	P	B = bars P = Pascal	H = hPa I = inHg M = mmHg
Humidity	H	P = Percent	
Accumulated precipitation	V	M = mm I = in H = hits	Non-standardized [1]
Time (duration)	Z	S = seconds	Non-standardized [1]
Intensity (flow rate)	R	M = mm/h I = in/h H = hits/h for rainfall M = hits/cm^{2}h I = hits/in^{2}h H = hits/h for hails	Non-standardized [1]
Voltage	U	V = volts (also 50 % duty cycle for heating)	N = not in use F = 50 % duty cycle for heating W = full power for heating
Generic	G	None (null) P=Percent	

1)   Not specified in the NMEA 0183 Standard.

7.4.5 TXT Text Transmission

The text transmission response format:

```
$WITXT,xx,xx,xx,c--c*hh<cr><lf>
```

$	Start of the message

WI	Talker identifier (WI = weather instrument)
TXT	Text transmission identifier.
xx	Total number of messages, 01 to 99
xx	Message number.
xx	Text identifier (see text message table)
c---c	Text message (see text message table)
*	Checksum delimiter
hh	Two-character checksum for the query command.
<cr><lf>	Response terminator

Examples:

Wind data request when all the wind parameters were disabled from the wind message:

```
$WItXT,01,01,01,Unable to measure error*6D<cr><lf>
```

Unknown command **0XO!<cr><lf>**:

```
$WITXT,01,01,03,Unknown cmd error*1F
```

Wrong checksum used in **MWV** query command:

```
$WITXT,01,01,08,Use chksum 2F*72
```

7.4.6 Automatic Mode

When NMEA 0183 v3.0 automatic protocol is selected, the transmitter sends data messages at user-configurable update intervals. The message format is the same as in the MWV and XDR data queries. The NMEA wind formatter parameter in the wind sensor settings determines whether the wind messages are sent in MWV or XDR format.

You can use ASCII data query commands **aR1**, **aR2**, **aR3**, **aR5**, **aR**, **aR0** and their CRC-versions **ar1**, **ar2**, **ar3**, **ar5**, **ar** and **ar0** also in NMEA 0183 protocol. The responses to these commands are in standard NMEA 0183 format.

More Information

‣ Sensor Configuration and Data Message Formatting (page 117)

7.4.7 Automatic Composite Data Message (aR0)

When automatic composite data messaging is selected, the transmitter sends composite data messages at user-configurable intervals. The message structure is the same as with the composite data query command **aR0** and contains a user configurable set of wind, pressure, temperature, humidity, precipitation, and supervisor data.

Example (the parameters included can be chosen from the full parameter set of the commands aR1, aR2, aR3 and aR5):

```
$WIXDR,A,057,D,1,S,0.6,M,1,C,22.6,C,0,H,27.1,P,0,P,1013.6,H,0,V,0.003,I,0,U,
12.0,N,0,U,12.4,V,1*67<cr><lf>
```

Example (rain and voltage parameters removed):

```
$WIXDR,A,054,D,1,S,0.4,M,1,C,22.5,C,0,H,26.3,P,0,P,1013.6,H,0*79<cr><lf>
```

For information on selecting the parameter set in the response message, see 8.1 Sensor Configuration and Data Message Formatting (page 117).

Automatic composite data messaging is in concurrent, not alternate mode to either the polled or automatic modes.

8. Sensor and Data Message Settings

8.1 Sensor Configuration and Data Message Formatting

This chapter lists the sensor configuration and data message formatting commands for all communications protocols:

- ASCII
- NMEA 0183
- SDI-12

You can also modify sensor and data message settings with the Vaisala Configuration Tool.

More Information

8.1.1 Wind Sensor

WXT536	WXT535	WXT534	WXT533	WXT532	WXT531
✔			✔	✔	

8.1.1.1 Checking the Settings (aWU)

With the following command you can check the current wind sensor settings.

Command format in ASCII and NMEA 0183:

```
aWU<cr><lf>
```

Command format in SDI-12:

```
aXWU!
```

a	Device address
WU	Wind sensor settings command in ASCII and NMEA 0183
XWU	Wind sensor settings command in SDI-12
<cr><lf>	Command terminator in ASCII and NMEA 0183

| ! | Command terminator in SDI-12 |

The response in ASCII and NMEA 0183:

```
aWU,R=[R],I=[I],A=[A],G=[G],U=[U],D=[D],N=[N],F=[F]<cr><lf>
```

The response in SDI-12:

```
aXWU,R=[R],I=[I],A=[A],G=[G],U=[U],D=[D],N=[N],F=[F]<cr><lf>
```

where `[R][I][A][G][U][D][N]` are the setting fields.

Example (ASCII and NMEA 0183, device address 0):

```
0WU<cr><lf>

0WU,R=01001000&00100100,I=60,A=10,G=1,U=N,D= -90,N=W,F=4<cr><lf>
```

Example (SDI-12, device address 0):

```
0XWU!0XWU,R=11111100&01001000,I=10,A=3,G=1,U=M,D=0,N=W,F=4<cr><lf>
```

More Information

‣ Configuring Wind Direction Offset (page 48)

8.1.1.2 Setting Fields

Parameter	Description
`[R]`	Parameter selection. This field consists of 16 bits defining the wind parameters included in the data messages. The bit value 0 disables and the bit value 1 enables the parameter.

Bits 1-8 determine the parameters in the data message obtained with the following commands:

- ASCII: **aR1** and **ar1**
- NMEA 0183: **$--WIQ,XDR*hh**
- SDI-12: **aM1**, **aMC1**, **aC1**, and **aCC1**
- SDI-12 continuous: **aR1** and **aRC1**

Table 21   Wind Parameters Bits 1-8

Bit	Description
1st bit (most left)	Dn Direction minimum
2nd bit	Dm Direction average
3rd bit	Dx Direction maximum
4th bit	Sn Speed minimum
5th bit	Sm Speed average
6th bit	Sx Speed maximum
7th bit	output mode
8th bit	spare
&	delimiter

Bits 9-16 determine the parameters in the data message obtained with the following commands:

- ASCII: **aR0, ar0**
- NMEA 0183: **aR0, ar0**
- SD-12: **aM, aMC, aC, and aCC**
- SDI-12 continuous:**aR** and **aRC**

Table 22   Wind Parameters Bits 9-16

Bit	Description
9th bit	Dn Wind direction minimum
10th bit	Dm Wind direction average
11th bit	Dx Wind direction maximum
12th bit	Sn Speed minimum
13th bit	Sm Speed average
14th bit	Sx Speed maximum
15th bit	spare
16th bit (most right)	0

Parameter	Description
[I]	Update interval: 1 … 3600 seconds

Parameter	Description
[A]	Averaging time: 1 … 3600 seconds Defines the period over which the wind speed and direction averaging is calculated. Same period is also used for maximum and minimum calculation. See Appendix D Wind Measurement Averaging Method on page 201 for difference in averaging practices when A<I and A>I.
[G]	Wind speed max/min calculation mode: 1 or 3 seconds G =1: Traditional max/min calculation is performed both for speed and direction. G =3: Gust & lull are calculated for wind speed, while direction calculation is as it is with G =1. In the output messages, gust & lull replace the wind speed max/min values (Sx, Sn), respectively.
[U]	Speed unit: M = m/s, K = km/h, S = mph, N = knots
[D]	Direction offset: -180 … 180°, see Wind Direction Offset on page 51.
[N]	NMEA wind formatter: T = XDR (transducer syntax), W = MWV (wind speed and angle) Defines whether the wind message is sent in XDR or MWV format.
[F]	Sampling rate: 1, 2, or 4 Hz Defines how frequently the wind is measured. Lower sampling rate reduces the power consumption, but it also weakens the measurement representativeness.
<cr><lf>	Response terminator

> **i** When using MWV wind messages in NMEA 0183, one of the [R] field bits 1-6 must be 1.

> **i** For representative wind values, use an averaging time that is long enough in relation to sampling rate (at least four samples per averaging time).

8.1.1.3 Changing the Settings (aWU)

You can change the following settings:

- Parameters included in the wind data message
- Update interval
- Averaging time
- Wind speed max/min calculation mode
- Speed unit
- Direction offset
- NMEA wind formatter

Change the settings with the following command.

Command format in ASCII and NMEA 0183:

```
aWU,R=x,I=x,A=x,G=x,U=x,D=x,N=x,F=x<cr><lf>
```

Command format in SDI-12:

```
aXWU, R=x,I=x,A=x,G=x,U=x,D=x,N=x,F=x!
```

R, I, A, G, U, D, N, F	Wind sensor setting fields.
x	Value for the setting
<cr><lf>	Command terminator in ASCII and NMEA 0183
!	Command terminator in SDI-12

> **i** If averaging time [A] is greater than update interval [I], it is a multiple of the update interval and at maximum 12 times greater. Example: If I = 5 s, A_{max} = 60 s.

Examples (ASCII and NMEA 0183, device address 0):

You need a 20-second averaging time for wind speed and direction both in wind data and composite data message in every 60 seconds. Wind speed is in knots and wind direction offset +10°.

Changing the measurement interval to 60 seconds:

```
0WU,I=60<cr><lf>

0WU,I=60<cr><lf>
```

> **i** Several parameters can be changed with the same command as long as the command length does not exceed 32 characters.

Changing the averaging time to 20 seconds, the wind speed unit to knots, and direction offset to +10°:

```
0WU,A=20,U=N,D=10<cr><lf>

0WU,A=20,U=N,D=10<cr><lf>
```

Changing the wind parameter selection:

```
0WU,R=0100100001001000<cr><lf>
```

```
0WU,R=01001000&00100100<cr><lf>
```

> ℹ️ Character '&' is not allowed in the command.

The wind message response after the change above:

```
0R1<cr><lf>
```

```
0R1,Dm=268D,Sm=1.8N<cr><lf>
```

Example (SDI-12, device address 0):

Changing the measurement interval to 10 seconds:

```
0XWU,I=10!0<cr><lf>
```

In SDI-12 mode a separate enquiry (**0XWU!**) must be given to check the data.

8.1.2 Pressure, Temperature, and Humidity Sensors

WXT536	WXT535	WXT534	WXT533	WXT532	WXT531
✔	✔	✔			

8.1.2.1 Checking the Settings (aTU)

Use this command to check the current pressure, temperature, and humidity sensor settings.

Command format in ASCII and NMEA 0183:

```
aTU<cr><lf>
```

Command format in SDI-12:

```
aXTU!
```

a	Device address
TU	Pressure, temperature and humidity sensor settings command in ASCII and NMEA 0183
XTU	Pressure, temperature and humidity sensor settings command in SDI-12
`<cr><lf>`	Command terminator in ASCII and NMEA 0183
!	Command terminator in SDI-12

The response in ASCII and NMEA 0183:

```
aTU,R=[R],I=[I],P=[P],H=[H]<cr><lf>
```

The response in SDI-12:

```
aXTU,R=[R],I=[I],P=[P],H=[H]<cr><lf>
```

where `[R][I][P][H]` are the setting fields, see the following section.

Example (ASCII and NMEA 0183, device address 0):

```
0TU<cr><lf>

0TU,R=11010000&11010000,I=60,P=H,T=C<cr><lf>
```

Example (SDI-12, device address 0):

```
0XTU!0XTU,R=11010000&11010000,I=60,P=H,T=C<cr><lf>
```

8.1.2.2 Setting Fields

Parameter	Description
[R]	Parameter selection: This field consists of 16 bits defining the PTU parameters included in the data messages. The bit value 0 disables and the bit value 1 enables the parameter.

Bits 1-8 determine the parameters included in the message obtained with the following commands:

- ASCII: **aR2** and **ar2**
- NMEA 0183: **$--WIQ,XDR*hh**
- SDI-12: **aM2**, **aMC2**, **aC**, and **aCC2**
- SDI-12 continuous: **aR2** and **aRC2**

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Table 23   PTU Parameters Bits 1-8

Bit	Description
1st bit (most left)	Pa Air pressure
2nd bit	Ta Air temperature
3rd bit	Tp Internal temperature [1]
4th bit	Ua Air humidity
5th bit	spare
6th bit	spare
7th bit	spare
8th bit	spare
&	delimiter

1)   Tp temperature value is used in pressure calculation, it does not express the air temperature.

Bits 9-16 determine the PTU parameters included in the composite data message obtained with the following commands:

- ASCII: **aR0** and **ar0**
- NMEA 0183:**aR0**, **ar0**
- SDI-12: **aM**, **aMC**, **aC**, and **aCC**
- SDI-12 continuous: **aR** and **aRC**

Table 24   PTU Parameters Bits 9-16

Bit	Description
9th bit	Pa Air pressure
10th bit	Ta Air temperature
11th bit	Tp Internal temperature1
12th bit	Ua Air humidity
13th bit	spare
14th bit	spare
15th bit	spare
16th bit	spare

Parameter	Description
[I]	Update interval: 1 ... 3600 seconds
[P]	Pressure unit: H = hPa, P = Pascal, B = bar, M = mmHg, I = inHg

Parameter	Description
[T]	Temperature unit: C = Celsius, F = Fahrenheit
<cr><lf>	Response terminator
[N]	NMEA formatter: T = XDR (transducer syntax) D =MDA Defines whether the wind message is sent in XDR or MDA format.

8.1.2.3 Changing the Settings (aTU)

You can change the following settings:

- Parameters included in the data message
- Update interval
- Pressure unit
- Temperature unit

Change the setting with the following command.

Command format in ASCII and NMEA 0183:

```
aTU,R=x,I=x,P=x,T=x<cr><lf>
```

Command format in SDI-12:

```
aXTU,R=x,I=x,P=x,T=x!
```

R, I, P, T	The pressure, temperature and humidity sensor setting fields.
x	Value for the setting
<cr><lf>	Command terminator in ASCII and NMEA 0183
!	Command terminator in SDI-12

Example

Selecting how the NMEA message operates: **0TU,N=**

NMEA wind formatting settings:

Wind XDR mode: **aWU,N=T**

Wind MWV mode: **aWU,N=W**

NMEA PTU formatting settings:

PTU XDR mode: **aTU,N=T**

PTU MDA mode: **aTU,N=D**

An example of MDA:

```
$WIMDA,29.88,I,1.0120,B,22.5,C,,C,31.5,,,C,,T,,M,,N,,M*3F
```

Examples (ASCII and NMEA 0183, device address 0)

You need the temperature and humidity data to be available in every 30 seconds

Changing the parameter selection:

```
0TU,R=0101000001010000<cr><lf>

0TU,R=01010000&01010000<cr><lf>
```

> ℹ️ Character '&' is not allowed in the command.

Changing the update interval:

```
0TU,I=30<cr><lf>

0TU,I=30<cr><lf>
```

The response after the change:

```
0R2<cr><lf>

0R2,Ta=23.9C,Ua=26.7P<cr><lf>
```

Example (SDI-12, device address 0)

Changing the temperature unit to Fahrenheit:

```
0XTU,U=F!0<cr><lf>
```

To check the data content in SDI-12 mode, you must type **0XTU!**.

8.1.3 Precipitation Sensor

WXT536	WXT535	WXT534	WXT533	WXT532	WXT531
✔	✔		✔		✔

8.1.3.1 Checking the Settings (aRU)

Use this command to check the current precipitation sensor settings.

Command format in ASCII and NMEA 0183:

```
aRU<cr><lf>
```

Command format in SDI-12:

```
aXRU!
```

a	Device address
RU	Precipitation sensor settings command in ASCII and NMEA 0183
XRU	Precipitation sensor settings command in SDI-12
`<cr><lf>`	Command terminator in ASCII and NMEA 0183
!	Command terminator in SDI-12

The response in ASCII and NMEA 0183:

```
aRU,R=[R],I=[I],U=[U],S=[S],M=[M],Z=[Z],X=[X],Y=[Y]<cr> <lf>
```

The response in SDI-12:

```
aXRU,R=[R],I=[I],U=[U],S=[S],M=[M],Z=[Z],X=[X],Y=[Y]<cr><lf>
```

where [R][I][U][S][M][Z][X][Y] are the setting fields.

Example (ASCII and NMEA 0183, device address 0):

```
0RU<cr><lf>

0RU,R=11111100&10000000,I=60,U=M,S=M,M=R,Z=M,X=100, Y=100<cr><lf>
```

Example (SDI-12, device address 0):

```
0RU!0RU,R=11111100&10000000,I=60,U=M,S=M,M=R, Z=M,X=100,Y=100<cr><lf>
```

8.1.3.2 Setting Fields

Parameter	Description
[R]	Parameter selection: This field consists of 16 bits defining the precipitation parameters included in the data messages. The bit value 0 disables and the bit value 1 enables the parameter.

Bits 1-8 determine the parameters included in the messages obtained with the following commands:

- ASCII: **aR3** and **ar3**
- NMEA 0183: **$--WIQ,XDR*hh**
- SDI-12: **aM3**, **aMC3**, **aC3**, **aCC3**
- SDI-12 continuous: **aR3** and **ar3**

Table 25   Precipitation Parameters Bits 1-8

Bit	Description
1st bit (most left)	Rc Rain amount
2nd bit	Rd Rain duration
3rd bit	Ri Rain intensity
4th bit	Hc Hail amount
5th bit	Hd Hail duration
6th bit	Hi Hail intensity
7th bit	Rp Rain peak
8th bit	Hp Hail peak
&	delimiter

Bits 9-16 determine the precipitation parameters included in the composite data messages obtained with the following commands:

- ASCII:
- NMEA 0183: **aR0**, **ar0**
- SDI-12: **aM**, **aMC**, **aC**, **aCC**
- SDI-12 continuous: **aR** and **aRC**

Table 26   Precipitation Parameters Bits 9-16

Bit	Description
9th bit	Rc Rain amount
10th bit	Rd Rain duration
11th bit	Ri Rain intensity
12th bit	Hc Hail amount
13th bit	Hd Hail duration
14th bit	Hi Hail intensity
15th bit	Rp Rain peak
16th bit (most right)	Hp Hail peak

Parameter	Description
[I]	Update interval: 1 ... 3600 seconds. This interval is valid only if the [M] field is = T
[U]	Precipitation units:
	M= metric (accumulated rainfall in mm, Rain duration in s, Rain intensity in mm/h)
	I= imperial (the corresponding parameters in units in, s, in/h)
[S]	Hail units:
	M = metric (accumulated hailfall in hits/cm2, Hail event duration in s, Hail intensity in hits/cm2h)
	I = imperial (the corresponding parameters in units hits/in2, s, hits/in2h), H = hits (hits, s, hits/h) Changing the unit resets the precipitation counter.
[M]	Auto-send mode: R = precipitation on/off, C = tipping bucket, T = time based
	R = precipitation on/off: The transmitter sends a precipitation message 10 seconds after the first recognition of precipitation. Rain duration Rd increases in 10 s steps. Precipitation has ended when Ri = 0. This mode is used for indication of the start and the end of the precipitation.
	C= tipping bucket: The transmitter sends a precipitation message at each unit increment (0.1 mm/0.01 in). This simulates conventional tipping bucket method.
	T= time based: Transmitter sends a precipitation message in the intervals defined in the [I] field. Do not use the auto-send mode tipping bucket in polled protocols as it decreases the resolution of the output (quantized to tipping bucket tips).

Parameter	Description
[Z]	Counter reset: M = manual, A = automatic, L= limit Y = immediate
	M = manual reset mode: The counter is reset with **aXZRU** command. See 7.1.2 Precipitation Counter Reset (aXZRU) (page 78).
	A = automatic reset mode: The counts are reset after each precipitation message whether in automatic mode or when polled.
	L = overflow reset mode. The rain counter or hail counter is reset, when it reaches the predefined limit. The overflow limits (x, y) are defined with the commands **aRU,X=x** for rain counter and **aRU,Y=y** for hail counter.
	Y = immediate reset: The counts are reset immediately after receiving the command.
[X]	Rain accumulation limit : 100...65535. Sets the rain accumulation counter resetting limit. When the value exceeds the limit, the counter is reset to zero. If the precipitation unit **aRU,U=x** is metric, the limit corresponds the range between 1.00 ... 655.35 mm. If the precipitation unit is imperial, the equivalent range varies between 0.100 ... 65.535 in.
	To enable this feature, set the counter reset to **aRU,Z=L** (overflow reset mode).
[Y]	Hail accumulation limit: 100 ... 65535. Sets the hail accumulation counter resetting limit. When the value exceeds the limit, the counter is reset to zero. If the hail unit **aRU,S=x** is metric, the limit corresponds the range between 10.0 ... 6553.5 hits/ cm2. If the unit is imperial, the equivalent range varies between 100 ... 65535 hits/in2. If the unit is hits, the limit matches directly to the amount of hits: 100 ... 65535 hits.
	To enable this feature, set the counter reset to **aRU,Z=L** (overflow reset mode).
<cr><lf>	Response terminator

The auto-send mode parameter is significant only in ASCII automatic (+CRC) and NMEA 0183 automatic protocols.

Changing the counter reset mode or precipitation/surface hits units also resets precipitation counter and intensity parameters.
The field [Z] defines how the counters are reset. Use "L" to enable the rain overflow reset mode. Now the rain accumulation limit feature (X and Y) becomes particularly useful for systems using an analog interface adapter. Thus, the dataloggers have no serial interface that would enable them to reset the rain counters.

8.1.3.3 Changing the Settings (aRU)

You can change the following settings:

- Parameters included in the precipitation data message
- Update interval in the time based auto-send mode
- Precipitation units
- Hail units
- Auto-send mode
- Counter reset
- Rain accumulation limit

- Hail accumulation limit.

Make the desired setting with the following command. Select the correct value/letter for the setting fields.

Command format in ASCII and NMEA 0183:

```
aRU,R=x,I=x, U=x,S=x,M=x,Z=x, X=x, Y=x<cr><lf>
```

Command format in SDI-12:

```
aXRU,R=x,I=x,U=x,S=x,M=x,Z=x, X=x,Y=x!
```

R, I, U, S, M, Z, X, Y	Precipitation sensor setting fields.
x	Input value for the setting
<cr><lf>	Command terminator in ASCII and NMEA 0183
!	Command terminator in SDI-12

Examples (ASCII and NMEA 0183):

Changing the precipitation units to imperial:

```
0RU,U=I<cr><lf>

0RU,U=I<cr><lf>
```

Changing the auto-send mode to the tipping bucket mode:

```
0RU,M=C<cr><lf>

0RU,M=C<cr><lf>
```

Making the Rain amount `Rc` and Rain intensity `Ri` available both in the precipitation message and composite data message:

```
0RU,R=1010000010100000<cr><lf>

0RU,R=10100000&10100000<cr><lf>
```

The response after the change:

```
0R3<cr><lf>


0R3,Rc=0.00M,Ri=0.0M<cr><lf>
```

Example (SDI-12, device address 0):

Changing the counter reset mode (resets the precipitation counters):

```
0XRU,Z=M!0<cr><lf>
```

More Information

8.1.4 Supervisor Message

8.1.4.1 Checking the Settings (aSU)

Use this command to check the current supervisor settings.

Command format in ASCII and NMEA 0183:

```
aSU<cr><lf>
```

Command format in SDI-12:

```
aXSU!
```

a	Device address
SU	Supervisor settings command in ASCII and NMEA 0183
XSU	Supervisor settings command in SDI-12
<cr><lf>	Command terminator in ASCII and NMEA 0183
!	Command terminator in SDI-12

The response in ASCII and NMEA 0183:

```
aSU,R=[R],I=[I],S=[S],H=[Y]<cr><lf>
```

The response in SDI-12:

```
aXSU,R=[R],I=[I],S=[S],H=[Y]<cr><lf>
```

8.1.4.2 Setting Fields

Parameter	Description
[R]	Parameter selection: This field consists of 16 bits defining the supervisor parameters included in the data messages. The bit value 0 disables and the bit value 1 enables the parameter.

Bits 1-8 determine the parameters included in the message obtained with the following commands:

- ASCII: **aR5** and **ar5**
- NMEA 0183: **$--WIQ,XDR*hh**
- SDI-12: **aM5**, **aMC5**, **aC5**, and **aCC5**
- SDI-12 continuous: **aR5** and **aRC5**

Table 27   Supervisor Parameters Bits 1-8

Bit	Description
1st bit (most left)	Th Heating temperature
2nd bit	Vh Heating voltage
3rd bit	Vs Supply voltage
4th bit	Vr 3.5 V reference voltage
5th bit	Id Information field
6th bit	spare
7th bit	spare
8th bit	spare
&	delimiter

Bits 9-16 determine the supervisor parameters included in the composite data message obtained with the following commands:

- ASCII: **aR0** and **ar0**
- NMEA 0183: **aR0**and **ar0**
- SDI-12: **aM**, **aMC**, **aC**, and **aCC**
- SDI-12 continuous: **aR** and **aRC**

Bit	Description
9th bit	Th Heating temperature
10th bit	Vh Heating voltage
11th bit	Vs Supply voltage
12th bit	Vr 3.5 V reference voltage
13th bit	Id Information field
14th bit	spare
15th bit	spare
16th bit (most right)	spare

Parameter	Description
[I]	Update interval: 1 ... 3600 seconds. When the heating is enabled the update interval is forced to 15 seconds.
[S]	Error messaging: Y = enabled, N = disabled
[H]	Heating control enable: Y = enabled, N = disabled Heating enabled: The control between full and half heating power is on as described in Heating on page 34. Heating disabled: Heating is off in all conditions.
<cr><lf>	Response terminator

Example (ASCII and NMEA 0183, device address 0):

```
0SU<cr><lf>

0SU,R=11110000&11000000,I=15,S=Y,H=Y<cr><lf>
```

Example (SDI-12, device address 0):

```
0XSU!0XSU,R=11110000&11000000,I=15,S=Y,H=Y<cr><lf>
```

8.1.4.3 Changing the Settings (aSU)

You can change the following settings:

- Parameters included in the supervisor data message
- Update interval
- Error messaging on/off
- Heating control

Make the desired setting with the following command. Select the correct value/letter for the setting fields.

Command format in ASCII and NMEA 0183:

```
aSU,R=x,I=x,S=x,H=x<cr><lf>
```

Command format in SDI-12;

```
aXSU,R=x,I=x,S=x,H=x!
```

R, I, S, H	The supervisor setting fields.
x	Value for the setting
<cr><lf>	Command terminator in ASCII and NMEA 0183
!	Command terminator in SDI-12

Example (ASCII and NMEA 0183, device address 0):

Disabling the heating and error messaging:

```
0SU,S=N,H=N<cr><lf>

0SU,S=N,H=N<cr><lf>
```

Example (SDI-12, device address 0):

Changing the update interval to 10 seconds:

```
0XSU,I=10!0<cr><lf>
```

In SDI-12 mode a separate enquiry (0XSU!) must be given to check the data content.

8.1.5 Composite Data Message (aR0)

You can define the parameters to be included in the composite data message **aR0** in the parameter selection fields of each parameter (**aWU,R**, **aTU,R**, **aRU,R**, and **aSU,R**).

> When changing the bits 9-16 of the parameter selection of any sensor, you can shorten the command by replacing the bits 1-8 with a single '&' character, see the examples.

Example (ASCII and NMEA 0183, device address 0):

To format a composite data message with average wind direction, average wind speed, temperature, humidity and pressure data when the original composite data message contains following data: maximum wind direction, maximum wind speed, temperature, humidity, pressure, accumulated rainfall, supply voltage and heating voltage:

```
0R0<cr><lf>


0R0,Dx=009D,Sx=0.2M,Ta=23.3C,Ua=37.5P,Pa=996.8H,
Rc=0.000I,Vs=12.0V,Vh=0.0N<cr><lf>
```

Replace the maximum wind direction (`Dx`) and speed (`Sx`) with average wind direction (`Dm`) and average wind speed (`Sm`):

```
0WU,R=&01001000<cr><lf>

0WU,R=11110000&01001000<cr><lf>
```

Remove the heating voltage (`Vh`) and temperature (`Th`) data from the composite data message, and include the information field (`Id`):

```
0SU,R=&00001000<cr><lf>

0SU,R=11110000&00001000<cr><lf>
```

Remove the accumulated rainfall (`Rc`) from the composite data message:

```
0RU,R=&00000000<cr><lf>

0RU,R=11111100&00000000<cr><lf>
```

The final composite data message query and response in ASCII:

```
0R0<cr><lf>

0R0,Dm=009D,Sm=0.2M,Ta=23.3C,Ua=37.5P, Pa=996.8H,Id=HEL___<cr><lf>
```

8.1.6 Analog Input

The following figure shows the pins of the analog input connectors.
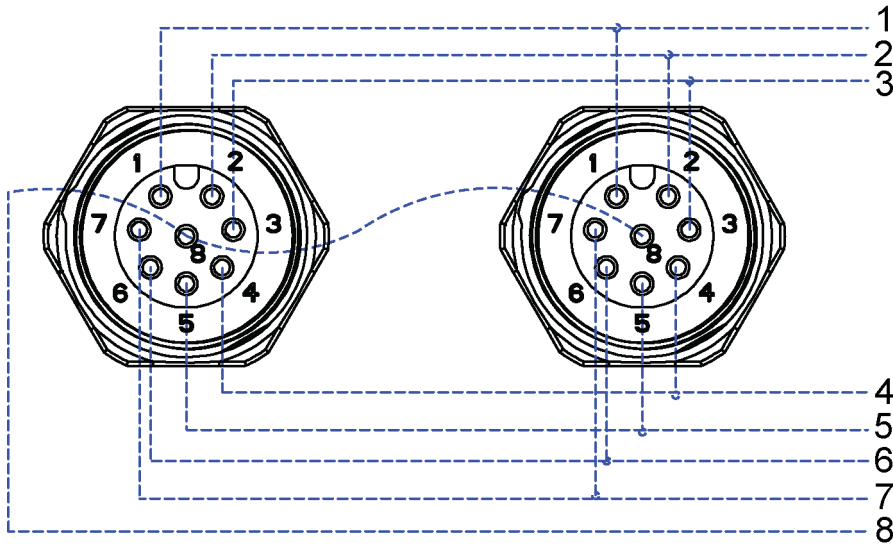
Figure 32   Analog Input Connector Pins

Table 29   Analog Input Signals

Signal name	M12 Pin	Description	Use example
PTI+	1	PT1000 measuring current	PT1000 temperature sensor Current feed
PT+	2	PT1000 input+	PT1000 temperature sensor. Sense+
PT-	3	PT1000 input-	PT1000 temperature sensor Sense-
AGND	4	Analog ground	Common ground for level, tipping bucket, and PT1000
TIP IN	5	Pulse counting input (pulled up with resistor)	Tipping bucket type rain sensor
SR+	6	Differential 0 ... 25 mV input, +	Pyranometer
SR-	7	Differential 0 ... 25 mV input, -	Pyranometer
WS IN	8	0 ... 2.5/0 ... 5/0 ... 10 V input	Level sensor

The following figure shows the analog input settings in Vaisala Configuration Tool.
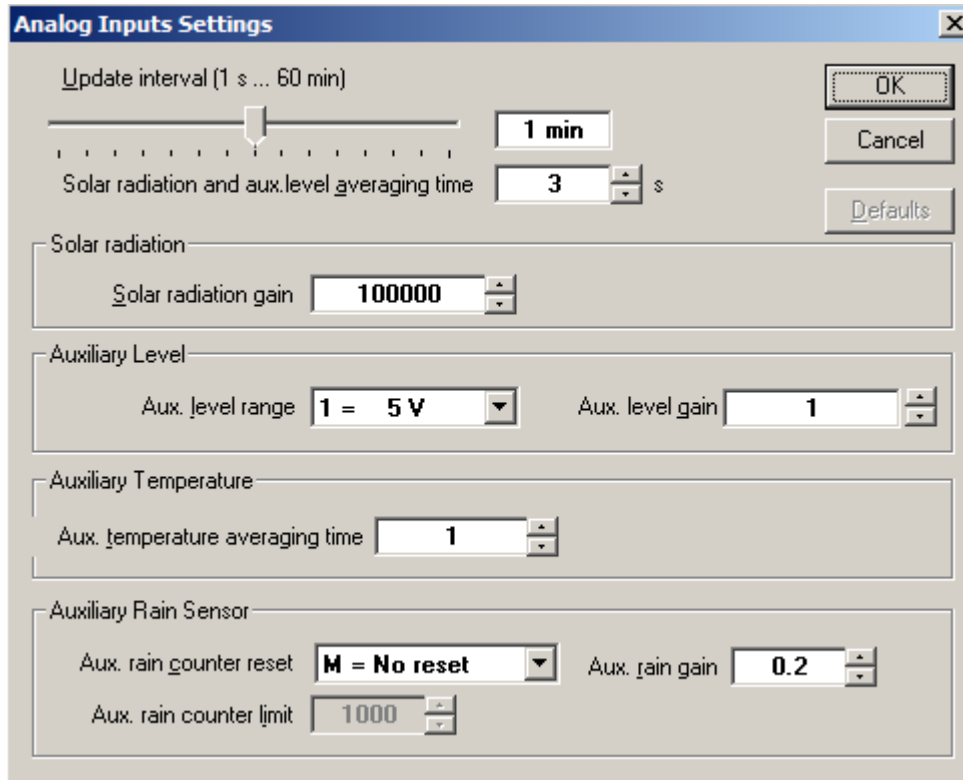
Figure 33   Analog Input Settings in Vaisala Configuration Tool

Table 30   Analog Input Setting Definitions

Setting	Default value	Definition
Update interval	1 min	Defines analog input measurement interval. A shorter interval and a longer averaging time increase power consumption.
Solar radiation and ultrasonic level sensor averaging time	3 s	Defines averaging times for solar radiation and ultrasonic level sensor voltage measurement.
Solar radiation gain	100000	Taken from solar radiation sensor calibration documents provided with the sensor. For example for sensitivity 19.71µV/W/m^2 gain is 1 / 0.00001971V/W/m^2 = 50736
Ultrasonic level sensor range	0 ... 5 V	Selects voltage measurement range. Available ranges: 0 ... 2.5 V, 0 ... 5 V, 0 ... 10 V
Ultrasonic level sensor gain	1	Defines gain factor for auxiliary level voltage measurement. Gain can be used to convert voltage reading directly to distance/height.
Aux. temperature averaging time	1	Defines PT1000 temperature sensor measurement averaging time in seconds. To minimize sensor self-heating effect, make it short.
Aux. rain counter reset	M = No reset	Defines how to reset the rain counter. M means that you have to manually reset the counter.

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Setting	Default value	Definition
Aux. rain gain	0.2 mm	Comes from the rain sensor tipping bucket size. It means pulses / user rain unit (for example, mm). If the aux. sensor has 5 pulses per mm of rain, and the user sets the gain to 0.2, the rain value reported by the transmitter is in mm.
Aux. rain counter limit		Used only when L = based on limit is selected. Resets the rain counter when it reaches this value. The same unit as the gain G has.

- All measurement messages enabled
- Update interval 60 s
- Solar radiation and ultrasonic level sensor averaging time 3 s
- Solar radiation gain 100 000
- Ultrasonic level sensor range 5 V
- Ultrasonic level sensor gain 1
- Aux temperature average time 1 s
- Aux rain counter reset: manual
- Aux rain gain 0.2 (for 0.2 mm per tip)

WXT530 Series settings:

```
0IU,R=11111000&11111000,I=60,A=3.0
0IB,G=100000.0
0IS,M=1,G=1.0
0IP,A=1.0
0IA,M=M,G=0.2
```

8.1.6.1 Enabling and Disabling Analog Input

If the analog input option is selected for WXT536, all analog inputs are enabled by default.

You can enable and disable analog input with the **aIU,R=** command.

For example, PT1000 temperature enabled, all other disabled:

```
aIU,R=1000000010000000
```

You must reset the transmitter to apply the new setting. When analog input is in use, the serial port does not work. The service connector functions.

More Information

‣ Enabling or Disabling Analog Output (page 145)

8.1.6.2 Common Sensor Settings (aIU)

Update Interval [I]

The update interval in seconds. This parameter defines the measurement interval for analog inputs:

- Pt1000
- Solar radiation
- Aux rain

The range: 0.5 ... 3600.

8.1.6.3 Aux Input Averaging Time [A]

The Aux Input averaging time in seconds. This parameter defines the averaging time for ultrasonic level sensor and solar radiation measurement. Pt1000 and the tipping bucket are not affected by this setting.

Make sure the averaging time is smaller than the update interval [I]. The smallest value 0.25 s means single measurement. A longer averaging time can decrease noise. A shorter averaging times gives a slightly smaller current consumption.

8.1.6.4 Parameter Selection [R]

[R] defines the active measurements.

Table 31   aIU Setting Fields [R]

Normal message	1	st bit (most left)	Tr pt1000 temperature
	2	nd bit	Ra Aux rain amount
	3	rd bit	Sl ultrasonic level sensor
	4	th bit	Sr solar radiation
	5	th bit	Rt pt1000 resistance
	6	th bit	
	7	th bit	Analog output mode
	8	th bit	
	&		delimiter
Composite message	9	th bit	Tr pt1000 temperature
	10	th bit	Ra Aux rain amount
	11	th bit	Sl Ultrasonic level sensor
	12	th bit	Sr solar radiation
	13	th bit	Rt pt1000 resistance
	14	th bit	0
	15	th bit	0

	16	th bit (most right)	0

8.1.6.5 Getting Data Messages

You can get data messages with the **aR4** command.

An example response:

```
0R4,Tr=111.3C,Ra=0.0M,Sl=0.001208V,Sr=0.000029V
```

Tr	Pt1000 (C = Celsius, F = Fahrenheit)
Ra	Aux rain accumulation (M = mm)
Sl	Ultrasonic level sensor (V = volts at input * gain)
Sr	Solar radiation (V = volts at input * gain)

You can set the gain for `Sr` and `Sl`.

8.1.6.6 Aux Rain Sensor Settings [aIA]

Gain [G]

[G] defines the pulses per rain unit, for example in mm.

If the Aux sensor has 10 pulses per a millimeter of rain and the user sets the gain to 1/10, the transmitter reports the rain value in mm.

The range: 0.000 000 001 … 1 000 000

For example, you can set aux rain gain for Vaisala RG13 Tipping Bucket Rain Gauge. The resolution is 0.1 mm per tip. Set the gain to 0.1 * 2 = 0.2 so that the `Ra` rain amount WXT reports is in millimeters. The multiplier 2 means that the tipping bucket sends one pulse per 2 tips.

Reset Mode [M]

`M` defines the reset mode.

Parameter	Description
M	No reset
L	Based on limit
A	Automatic (aux rain message sent)

The initial tip counter overflows if it reaches 65536 and it starts from 0. If the tipping bucket resolution is 0.2 mm per tip, the gain is 0.2, and the maximum rain amount before overflow is 65536 × 0.2 = 13107 mm.

Limit [L]

[L] defines the reset limit. The rain counter resets when it reaches this value. The unit is the same as in gain [G].

The range: 0.000 000 001 … 1 000 000

Parameter Selection [aIU,R = bit 2 and bit 10]

Bits 7 and 14 enable normal and composite message for aux rain accumulation. You can select the parameter with the **aIU** command. The maximum value for the rain counter is 65535 * gain.

8.1.6.7 Solar Radiation Sensor Settings [aIB]

Gain

[G] defines the volts / user unit, for example, $\mu V/W/m^2$. WXT reports the voltage at solar radiation input multiplied with gain [G].

For example, if the solar radiation sensor has sensitivity 5 $\mu V/W/m^2$ and you set the gain [G] to 1/ μV = 200 000, the solar radiation value reported by WXT is in W/m^2. WXT reports the value always with six decimals.

The range: 0.000 000 001 … 1 000 000

Parameter Selection [aIU,R= bit 3 and bit 11]

The bits enable normal and composite messages. You can select the parameters with the **aIU** command.

8.1.6.8 Ultrasonic Level Sensor Settings [aIS]

Gain [G]

[G] defines the volts / user unit, for example, V/m. WXT reports the voltage at input multiplied with the gain [G].

For example, if the sensor has gain 2 V/meter and the user sets the gain [G] to 0.5, the value reported by WXT is in meters. WXT reports the value with 6 decimals.

The range: 0.000 000 001 … 1 000 000

Parameter Selection [aIU,R= (bit 3 and bit 11)]

The bits enable normal and composite messages. You can select the parameters with the **aIU** command.

8.1.6.9 Aux.temperature Sensor Settings [aIP]

You can set the temperature settings for the temperature unit with the **aTU,U=** command.

Averaging Time [A]

The averaging time in seconds, resolution 0.5 s. You can set a short averaging time (0.5 s) to reduce the Pt1000 sensor self-heating. The message interval defines how often the measurement starts. The measurement is performed every 0.5 s for averaging time.

The range: 0.5 ... 3600

Parameter Selection [aIU,R= (bit 1 and bit 9)]

The bits 7 and 14 enable normal and composite message for Aux rain accumulation. You can select the parameters with the **aIU** command.

8.1.6.10 Parameter Order for SDI-12 Mode

The parameter order for SDI-12 mode is:

Analog in (M4): `Tr Ra Sl Rt Sr`

8.1.7 Analog Output

You can change the analog output type and scaling of WXT532.

WXT532 provides the following analog outputs:

- AOUT1 for wind speed data
- AOUT2 for wind direction data

The analog output value is updated based on **aWU,I=** settings. Wind measurement uses **aWU** settings, such as Averaging Time.

More Information

‣ Analog Output Scaling (page 144)
‣ Wiring and Power Management (page 53)

8.1.7.1 Analog Output Operation

You can order WXT532 with either 4 ... 20 mA scaling or 0 ... 20 mA scaling.

You can scale the output with the command **aSU**.

Example commands to set 4 ... 20 mA operation:

Parameter	Description
Wind Speed Gain	`aSU,a=0.333333<cr><lf>`
Wind Speed Offset	`aSU,b=4 <cr><lf>`
Wind Speed minimum	`aSU,c=0<cr><lf>`
Wind Speed maximum	`aSU,d=22<cr><lf>`
WS error indication	`aSU,e=2<cr><lf>`
Wind Direction Gain	`aSU,f=0.044444<cr><lf>`

Parameter	Description
Wind Direction Offset	`aSU,g=4<cr><lf>`
WD minimum	`aSU,h=0<cr><lf>`
WD maximum	`aSU,j=22<cr><lf>`
WD error indication	`aSU,k=2<cr><lf>`

The output o in mA is o=i* gain + offset. o is clamped between min and max. If wind measurement fails, the output value is err.

8.1.7.2 Analog Output Scaling

You can specify the transfer function between measured values and output analog values. You can select the analog output gain and offset used in the transfer function.

The factory default settings for the different analog output modes are displayed in the following table.

Table 32   Analog Output Scaling

Parameter	4 ... 20 mA option (max 60 m/s)	0 ... 20 mA option (max 60 m/s)	Command example (4 ... 20 mA)
Aout1, Wind Speed Gain	0.266667 mA / m/s	0.333333 mA / m/s	`aSU,a=0.266667<cr><lf>`
Aout1, Wind Speed Offset	4 mA	0 mA	`aSU,b=4<cr><lf>`
Aout1, Wind Speed Minimum	0 mA	0 mA	`aSU,c=0<cr><lf>`
Aout1, Wind Speed Maximum	22 mA	22 mA	`aSU,d=22<cr><lf>`
Aout1, Wind Speed Error Indication	2 mA	22 mA	`aSU,e=2<cr><lf>`
Aout2, Wind Direction Gain	0.044444 mA / °	0.055556 mA / °	`aSU,f=0.044444<cr><lf>`
Aout2, Wind Direction Offset	4 mA	0 mA	`aSU,g=4<cr><lf>`
Aout2, Wind Direction Minimum	0 mA	0 mA	`aSU,h=0<cr><lf>`
Aout2, Wind Direction Maximum	22 mA	22 mA	`aSU,j=22<cr><lf>`
Aout2, Wind Direction Error Indication	2 mA	22 mA	`aSU,k=2<cr><lf>`

You can configure output scaling or transfer function settings by changing the custom gain and offset. The basic measurement units are m/s and degrees. The physical output unit is A. The following formula shows the impact of gain and offset values on the produced output:

```
o = y0 + k×s
```

o	Produced analog output (A)
s	Measured wind speed or direction (in m/s or °)
k	Selected gain value
y0	Selected offset value

8.1.7.3 Analog Output Signal for Wind Speed Channel

The analog interfaces setup, default configuration:

Current output 4 ... 20 mA, offset 4 mA

4 mA = 0 m/s

20 mA = 60 m/s (0,266667 mA/m/s)

Error indication sets output to 2 mA.

The analog interfaces setup, configuration 2:

Current output 0 ... 20 mA, offset 0 mA

0 mA = 0 m/s 20 mA = 60 m/s (0.333333 mA/m/s)

Error indication sets output to 22 mA.

8.1.7.4 Analog Output Signal for Wind Direction Channel

Analog interfaces setup default configuration:

Current output 4 ... 20 mA, offset 4 mA

4 mA = 0 degree 20 mA = 360 degree (0,044444 mA/°)

Error indication sets output to 2 mA

Analog interfaces setup, configuration 2:

Current output degree 0 ... 20 mA, offset 0 mA

0 uA = 0 degree

20 mA = 360 degree (0,055556 mA/°)

Error indication sets output to 22 mA

8.1.7.5 Enabling or Disabling Analog Output

When changing the analog output setting, the setting is applied after the transmitter reset. When analog output is in use, the serial port does not work but the service connector does.

The 12th bit from left determines if analog output is enabled:

- Analog output enabled at the factory: `0XF,f=1111111111110000`
- Analog output disabled at the factory: `0XF,f=111111111100000`

You can enable or disable analog output with the **aWU,R=** command.

- To enable analog output: Change bit 7 to 1. `0WU,R=111111111111100`
- To disable analog output: Change bit 7 to 0. `0WU,R=1111110111111100`

Table 33   aWU Setting Fields [R]

Normal message	1	st bit (most left)		15
	2	nd bit		14
	3	rd bit		13
	4	th bit		12
	5	th bit		11
	6	th bit		10
	7	th bit	Analog output mode	9
	8	th bit		8
	&		delimiter	
Composite message	1	st bit (most left)		7
	2	nd bit		6
	3	rd bit		5
	4	th bit		4
	5	th bit		3
	6	th bit		2
	7	th bit		1
	8	th bit (most right)	0	0

More Information

‣ Enabling and Disabling Analog Input (page 139)

9. Maintenance

9.1 Cleaning

To ensure the accuracy of measurement results, clean the transmitter when it gets contaminated. Remove leaves and other such particles from the precipitation sensor and clean the transmitter carefully with a soft, lint-free cloth moistened with mild detergent. Wipe with soft cloth or sponge and rinse with clean water.

> **i** Do not use solvents or abrasive sponges when cleaning painted surfaces.

9.1.1 Cleaning the Radiation Shield

Vaisala recommends that you clean the radiation shield once a year.

▶ 1. Clean the radiation shield with a soft cloth.

> **i** Do not paint the radiation shield.

2. If the radiation shield looks worn and yellow, you can replace it with a radiation shield spare part (218817SP).

9.2 Replacing PTU Module

> ✕ • 3-mm Allen key

In demanding customer applications, Vaisala recommends changing the PTU module every two years.

WXT536	WXT535	WXT534	WXT533	WXT532	WXT531
✔	✔	✔			

▶ 1. Turn off the power.

2. Loosen the 3 mounting screws at the bottom assembly of the transmitter and pull them out.
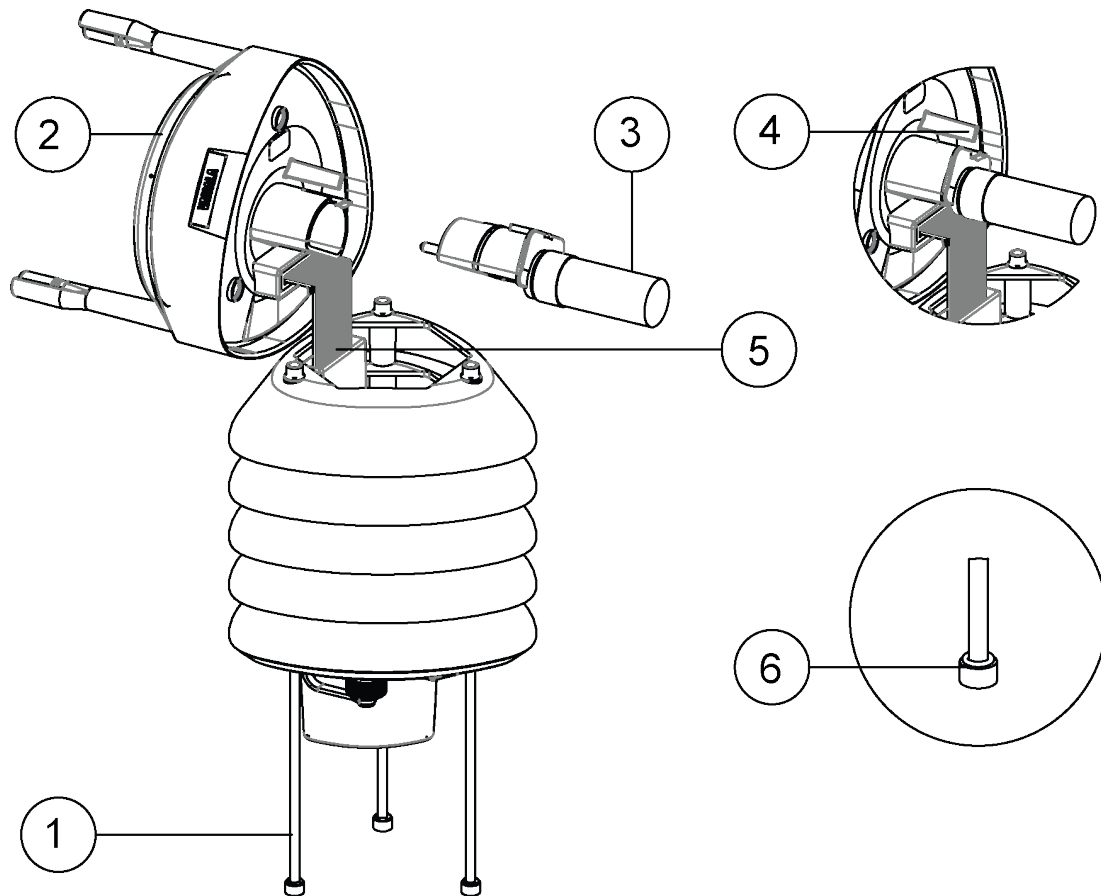
1	Fixing screws
2	Top of transmitter
3	PTU module
4	Latch
5	Flat cable
6	O-ring

3. Turn out the top of the transmitter.

4. Release the small white latch and remove the PTU module.

5. Remove the vacuum bag protecting the PTU module.

6. Connect the new PTU module.

> ⚠ **CAUTION!** Avoid touching the white filter cap.

7. Turn the top back in. Make sure the flat cable does not get stuck or squeezed between the top and the funnel for the flat cable and it is properly connected.

8. If the O-rings are damaged, replace them with new ones.

9. Tighten the fixing screws.

> To make sure that the radiation shield stays straight, do not tighten the screws all the way in one go. Do not overtighten.

10. Troubleshooting

Table 34   Data Validation

Problem	Possible causes	Action(s)
Wind measurement failure. Both the speed and direction units are replaced by a # sign or the data values are irrelevant.	Blockage (trash, leaves, branches, bird, snow, ice) between the wind transducers. Incorrect <cr><lf> settings in the terminal program.	Remove the blockage, and check that the wind transducers are not damaged. If the blockage is ice or snow, it will melt after some time if heating is enabled. Time for clearance depends on the severity of the weather event. If birds are causing the blockage, consider using the bird kit. In ASCII and NMEA protocols both <cr> and <lf> are required after each command. Check that your terminal program sends both when pressing enter. Note: The direction unit is # for the wind speeds less than 0.05 m/s.
Pressure, humidity or temperature measurement failure. The unit is replaced by a # sign or the data values are irrelevant.	The PTU module may not be properly connected. There may be water in the PTU module.	Ensure the proper connection of the PTU module. Remove and dry the module.

Table 35   Communication Problems

Problem	Possible causes	Action(s)
No response to any commands.	Wrong wiring or operation voltage not connected. Baud rate/start bits/parity/stop bit settings do not match between the device and the host.	Check the wiring and operation voltage. See 5. Wiring and Power Management (page 53).Connect the service cable, use the communication settings 19200,8 N,1. Check the serial port settings of the device with Configuration Tool or with terminal program. Use command **aXU!** (SDI-12) or **aXU\<cr>\<lf>** (ASCII/NMEA). Change the values if needed. A software/hardware reset is needed to validate the changes. When you have no service cable, try typing address query commands **?!** and **?\<cr>\<lf>** with different serial settings in terminal program. When the communication parameters match, the device responds with its address. The settings can now be changed using **aXU!** (SDI-12) or **aXU\<cr>\<lf>** (ASCII/NMEA) commands. A software/hardware reset is needed to validate the changes.
	Incorrect \<cr>\<lf> settings in the terminal program.	In ASCII and NMEA protocols both \<cr> and \<lf> are required after each command. Check that your terminal program sends both when pressing enter.
Connection works but data messages not available.	Wrong device address in a SDI-12 command or a mistyped SDI-12 command (in SDI-12 a mistyped command is in no way responded). A command mistyped in ASCII/NMEA mode while error messaging/text messages is disabled (**aSU,S=N**).	Request the device address with **?!** command and then retype the command now with the correct address. Check the data query commands. See 7. Retrieving Data Messages (page 77). Enable the error messaging using the Vaisala Configuration Tool or any terminal by setting **aSU,S=Y**, then try the command again.
Data messages are not in expected format.	The communication protocol may not be the one you want.	Check the communication protocol of the device by using the Vaisala Configuration Tool or any terminal with command **aXU,M!** (SDI-12) **aXU,M\<cr>\<lf>** (ASCII/NMEA) and change it if needed.
Some parameters are missing from the data messages.	The formatting of the data messages is not what you expect.	Format the data messages of the concern by using the Vaisala Configuration Tool or any terminal program.
An error message as a response to a command.	See 10.1.1 Error Messaging/Text Messages (page 153) .	See 10.1.1 Error Messaging/Text Messages (page 153).

Problem	Possible causes	Action(s)
The transmitter keeps sending the message "TX Sync/address error".	The polling address and the transmitter address do not match. The transmitter is on an RS-485 bus with other polled devices and Error Messages are enabled.	Set correct address either for the transmitter or to the polling request. Disable the Error Messages with the command **aSU,S=N <cr><lf>**.
mA messages cannot be found.	No mA output ordered.	You must specify the mA option when you place the order.
Analog input messages are missing.	Analog input messages are not enabled.	Enable analog input messages. See 8.1.7.5 Enabling or Disabling Analog Output (page 145).
Precipitation messages missing.	No precipitation measurement in models WXT534 and WXT532.	

10.1 Self-Diagnostics

10.1.1 Error Messaging/Text Messages

The transmitter sends a text message when certain type of errors occur. The function works in all communication modes except in the SDI-12 mode. You can disable error messaging by using the supervisor message **aSU, S=N**.

Examples:

```
0R1!0TX,Unable to measure error<cr><lf>
```

(request of wind data while all the wind parameters were disabled from the wind message)

```
1XU!0TX,Sync/address error<cr><lf>
```

(wrong device address. Ask the correct address with **?** or **?!** command.)

```
0XP!0TX,Unknown cmd error<cr><lf>
```

```
0xUabc!0TX,Use chksum CCb<cr><lf>
```

(wrong checksum applied to the **0xU** command)

Table 36   Error Messaging/Text Messages

Text message identifier (in NMEA 0183 v3.0 protocol only)	Text Message	Interpretation and action
01	Unable to measure error	The requested parameters are not activated in the message and check the parameter section fields.
02	Sync/address error	The device address in the beginning of the command is invalid. Ask the device address with the **?!** (SDI-12) or **?<cr><lf>** (ASCII and NMEA) command and retype the command with the correct address.
03	Unknown cmd error	The command is not supported, use the correct command format. See 7. Retrieving Data Messages (page 77).
04	Profile reset	Checksum error in configuration settings during power-up. Factory settings used instead.
05	Factory reset	Checksum error in calibration settings during power-up. Factory settings used instead.
06	Version reset	New software version in use.
07	Start-up	Software reset. Program starts from the beginning.
08	Use chksum xxx	Given checksum not correct for the command. Use the proposed checksum.
09	Measurement reset	The ongoing measurement of all the sensors interrupted and started from the beginning.
10	Rain reset	The precipitation sensor counter reset.
11	Inty reset	Precipitation sensor intensity counter reset.

> If you use a WXT530 transmitter on an RS-485 bus with other polled devices, you must disable error messaging with the command: **0SU,S=N<crlf>**.

More Information

‣ Troubleshooting (page 151)
‣ Sensor Configuration and Data Message Formatting (page 117)

10.1.2 Rain and Wind Sensor Heating Control

The supervisor message **aSU** shows you continuously monitored information about rain and wind sensor heating (heating temperature **Th** and heating voltage **Vh**).

The heating temperature should stay above 0 °C when the heating is on (except in extremely cold conditions where the heating power is not sufficient). The heating voltage **Vh** should correspond to the heating voltage supplied. If there is a remarkable deviation, check the wiring. Note that wire gauge should be large enough to avoid remarkable voltage drop in the cable.

> In case AC or full-wave rectified AC is used for the heating, the **Vh** measurement behaves as follows:
> While heating is off, **Vh** indicates the positive peak value (V_p) of the heating voltage waveform.
> While heating is on, **Vh** indicates:
>
> - $0.35 \times V_p$ in case of AC voltage
> - $0.70 \times V_p$ in case of full-wave rectified AC voltage

10.1.3 Operating Voltage Control

The supervisor message **aSU** shows you continuously monitored supply voltage level (Vs). In case of deviations between the supplied voltage and monitored voltage, check the wiring and the power supply.

10.1.4 Missing Readings and Error Indication

If the transmitter is not able to measure the wind, it indicates a missing reading in the output. The most common reasons for measurement problems are foreign objects, such as ice, birds, or other foreign objects, on the line of measurement, or sound reflections from nearby objects, such as wind tunnel walls.

11. Technical Specifications

11.1 Performance

Table 37   WXT530 Series Barometric Pressure Measuring Specifications

Property	Description/Value
Observation range	600 ... 1100 hPa
Accuracy (for sensor element)	±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 / 0.001 bar / 0.1 mmHg / 0.01 inHg
Units available	hPa, Pa, bar, mmHg, inHg

Table 38   WXT530 Series Air Temperature Measuring Specifications

Property	Description/Value
Observation range	-52 ... +60 °C (-60 ... +140 °F)
Accuracy (for sensor element) at +20 °C (+68 °F) [1]	±0.3 °C (±0.17 °F)
Output resolution	0.1 °C (0.1 °F)
Units available	°C, °F

1)   A naturally aspirated radiation shield is applied which can affect readings in calm wind.

Table 39   WXT530 Series Relative Humidity Measuring Specifications

Property	Description/Value
Observation range	0 ... 100 %RH
Accuracy (for sensor element) [1]	±3 %RH at 0 ... 90 %RH
	±5 %RH at 90 ... 100 %RH
Output resolution	0.1 %RH
PTU measuring interval	1 ... 3600 s (= 60 min), at 1 s steps

1)   A naturally aspirated radiation shield is applied which can affect readings in calm wind.

Table 40   WXT530 Series Precipitation Measuring Specifications

Property [1]	Description/Value
Rainfall	Cumulative accumulation after the latest automatic or manual reset.
Collecting area	60 cm^2
Output resolution	0.01 mm (0.001 in)
Field accuracy for daily accumulation [2]	Better than 5 %, weather-dependent
Units available	mm, in
Rain	
Duration	Counting each 10-second increment whenever droplet detected
Output resolution	10 s
Intensity	Running 1-minute average in 10-second steps
Observation range	0 ... 200 mm/h (0 ... 7.87 in/h) (broader range with reduced accuracy)
Units available	mm/h, in/h
Hail	Cumulative amount of hits against collecting surface
Duration	Counting each 10-second increment whenever hailstone detected
Output resolution	0.1 hits/cm^2, (1 hits/in^2), 1 hit
Intensity	1-minute running average in 10-second steps
Units available	hits/cm^2, hits/in^2, hits
Output resolution	10 s
Observation range	0.1 hits/cm^{2}h (1 hits/in^{2}h), 1 hit/h
Units available	hits/cm^{2}h, hits/in^{2}h, hits/h

1)   *Precipitation measurement is performed for liquid precipitation.*
2)   *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.*

Table 41   WXT530 Series Wind Measuring Specifications

Property	Description/Value
Wind speed [1]	
Observation range	0 ... 60 m/s (134 mph)
Response time	0.25 s
Available variables	Average, maximum, and minimum

Property	Description/Value
Accuracy	±3 % at 10 m/s
Output resolution	0.1 m/s (km/h, mph, knots)
Units available	m/s, km/h, mph, knots
Wind direction [1]	
Azimuth	0 … 360°
Response time	0.25 s
Available variables	Average, maximum, and minimum
Accuracy	±3.0° at 10 m/s
Output resolution	1°
Wind measurement frame	
Averaging time	1 … 3600 s (= 60 min), at 1 s steps, on the basis of samples taken at 4, 2, or 1 Hz rate (configurable)
Update interval	1 … 3600 s (= 60 min), at 1 s steps

1) NTP (normal temperature and pressure) condition applied for wind tunnel testing.

11.2 Inputs and Outputs

Table 42   WXT530 Series Electrical Specifications

Property	Description/Value
Operating voltage	6 … 24 VDC (-10 % … +30 %)
Average current consumption	
Minimum	0.1 mA at 12 VDC (SDI-12 standby)
Typical	3.5 mA at 12 VDC with typical measuring intervals[1]
Maximum	15 mA at 6 VDC (with constant measurement of all parameters)
Heating voltage	Options: DC, AC, full-wave rectified AC
	12… 24 VDC (-10 % … + 30 %)
	12 … 17 VACrms (-10 % … +30 %)
Typical heating current	12 VDC: 0.8 A
	24 VDC: 0.4 A
	12 VAC_{rms}: 1.1 A
	17 VAC_{rms}: 0.8 A

Property	Description/Value
Digital outputs	SDI-12, RS-232, RS-485, RS-422
Communication protocols	SDI-12 v1.3, ASCII automatic and polled, NMEA 0183 v3.0 with query option
Self-diagnostic	Separate supervisor message, unit/status fields to validate measurement stability
Start-up	Automatic, < 5 seconds from power on to the first valid output

1)   Wind 10‑second average with 2‑minute interval at 4‑Hz sampling rate, RS‑232 19200 bps with jumper wires, PTU 1 s interval, Pt1000, level, tipping bucket, and solar radiation 5 s interval.

Table 43   WXT536 Analog Input Options

Parameter	Element	Range	Input[1]	Excitation	Resolution
Temperature PT1000	Resistor	800 ... 1330 Ω	2-wire 4-wire	2.5 V	16 bits
Solar Radiation Kipp & Zonen CMP3	Thermopile	0 ... 25 mV	4 MΩ	-	12 bits
Level measurement IRU-9429	Voltage	0 ... 2.5 V 0 ... 5 V 0 ... 10 V	> 10 kΩ	-	12 bits
Tipping Bucket RG13	Frequency	0 ... 100 Hz	18 kΩ	3.5 V	-

1)   The input can be wiring type, input impedance, or pull-up resistor value.

Table 44   WXT532 Analog mA Output Options

Parameter[1]	Description/Value
Wind speed	0 ... 20 mA or 4 ... 20 mA
Wind direction	0 ... 20 mA or 4 ... 20 mA
Load impedance	200 Ω max
Update interval	4 Hz max

1)   When the analog output option is applied, digital communication is not available.

11.3 Environmental Conditions

Table 45   WXT530 Series Environmental Specifications

Property	Description/Value
Operating temperature	-52 ... +60 °C (-60 ... +140 °F)
Storage temperature	-60 ... +70 °C (-76 ... +158 °F)
Relative humidity	0 ... 100 %RH
Pressure	600 ... 1100 hPa
Wind [1]	0 ... 60 m/s (134 mph)
IP rating	IP65 (without mounting kit) IP66 (with mounting kit attached)

1)   *Due to the measurement frequency used in the sonic transducers, RF interference in the 200 ... 400 kHz range can disturb wind measurement.*

ℹ️ Select a heated sensor model if you operate the sensor in humid conditions.

ℹ️ Select a heated model if you operate the sensor in temperatures below 0 °C (+32 °F).

⚠️ **CAUTION!** Make sure that you power the sensor after installation. Storing the sensor outdoors without proper package or not powering up after installation can affect the sensor's expected lifespan.

⚠️ **CAUTION!** Any temporary object (such as snow, ice, or a bird) that blocks the observation path between the ultrasonic transducer heads may lead to inaccurate or incorrect measurements.

Table 46   WXT530 Series Electromagnetic Compatibility

Applicable Standard	Description	Level tested	Performance [1]
CISPR 22	Radiated emissions	30 Hz ... 18 GHz	Class B

Applicable Standard	Description	Level tested	Performance [1]
CISPR 22	Conducted emissions DC	150 Hz ... 30 MHz	Class B
IEC 61000-4-2	Electrostatic discharge	8 kV con / 15 kV air	B
IEC 61000-4-3	RF field immunity [2]	10 V/m and 3 V/m	A
IEC 61000-4-4	Electric fast transient	3 kV	B
IEC 61000-4-5	Surge	2 kV	B
IEC 61000-4-6	Conducted RF immunity	3 V	A
IEC 60945	Radiated emissions	150 kHz ... 2 GHz	All locations including Bridge and Open Deck
IEC 60945	Conducted emissions	10 kHz ... 30 MHz	All locations including Bridge and Open Deck
IEC 60945	Electrostatic discharge	8 kV con / 15 kV air	B
IEC 60945	RF field immunity	10 V/m and 3 V/m	A
IEC 60945	Electric fast transient	3 kV	B
IEC 60945	Surge	2 kV	B
IEC 60945	Conducted RF immunity	3 kV	A
IEC 60945	Conducted low frequency interference immunity	10 %Vnom	B
IEC 60945	Extreme power supply variation	-10 % +30 %	A
IEC 60945	Power supply failure	3 times 60 s	B

1) A = Normal performance

B = Temporary degradation (self-recoverable)

C = Temporary degradation (operator intervention needed)

D = Not recoverable

2) Within frequency range 600 ... 700 MHz immunity for PTU is 8 V/m.

11.4 Mechanical Specifications

Table 47   WXT530 Series Mechanical Specifications

Property	Description/Value
Weight	
WXT534, WXT535, WXT536	0.7 kg (1.54 lbs)
WXT531, WXT532, WXT533	0.5 kg (1.1 lbs)

Property	Description/Value
Materials	
Radiation shield, top, and bottom parts	Polycarbonate +20 % fiberglass
Precipitation sensor plate	Stainless steel (AISI 316)

11.5 Options and Accessories

Table 48 Options and Accessories

Description	Order code
Vaisala Configuration Tool and USB service cable SP	220614
Cable USB RS-232/RS-485 1.4 m USB M12 SP	220782
Cable 2 m shielded 8-pin M12 SP	222287
Cable 10 m shielded 8-pin M12 SP	222288
Cable 10 m shielded 8-pin M12, connectors on both ends SP	215952
Cable 40 m shielded 12-pin, open end wires SP	217020
Bushing and grounding accessory kit	222109
Mounting kit	212792
Mounting accessory between Mounting kit and 60 mm tube	WMSFIX60
Bird Kit	212793
Vaisala surge protector, no connectors	WSP150
Vaisala surge protector with connectors for 220782 and 215952	WSP152
Nokeval converter	229104
Nokeval programming kit	229110
WXT radiation shield set SP	218817SP
WXT PTU module SP	WXTPTUSP
WXT bottom connector kit SP	224171
Analog input connectors SP, IP67, 8P, M12, Shielded	214273
WXT530 bottom assembly with digital board SP	WXT530BOTTOMDIGISP
WXT530 bottom assembly with analog input board SP	WXT530BOTTOMANAINSP
WXT530 bottom assembly with mA output board SP	WXT530BOTTOMMAOUTSP

11.6 Type Label

All WXT530 Series transmitters can be identified from the type label.
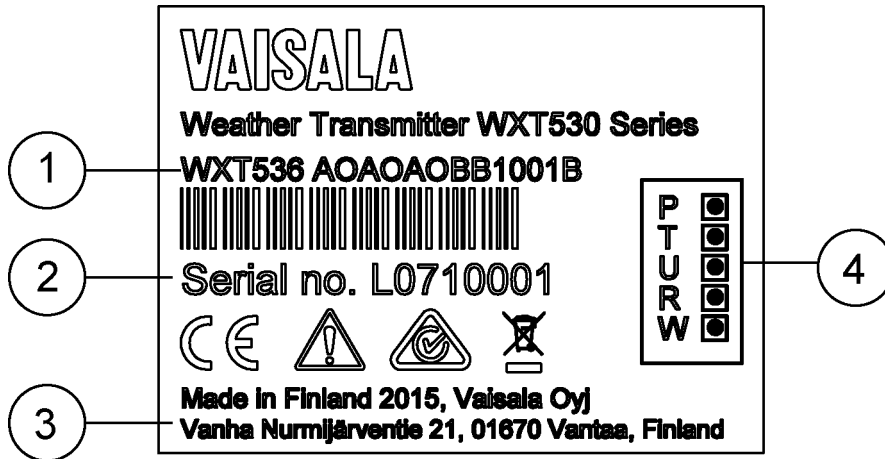
Figure 34   Type Label

1   Product code
2   Serial number in bar code
3   Place of manufacture
4   Symbols indicating measurement options included:

> - P = pressure
> - T= temperature
> - U = humidity
> - R = precipitation
> - W = wind

11.7 Dimensions (mm / inch)
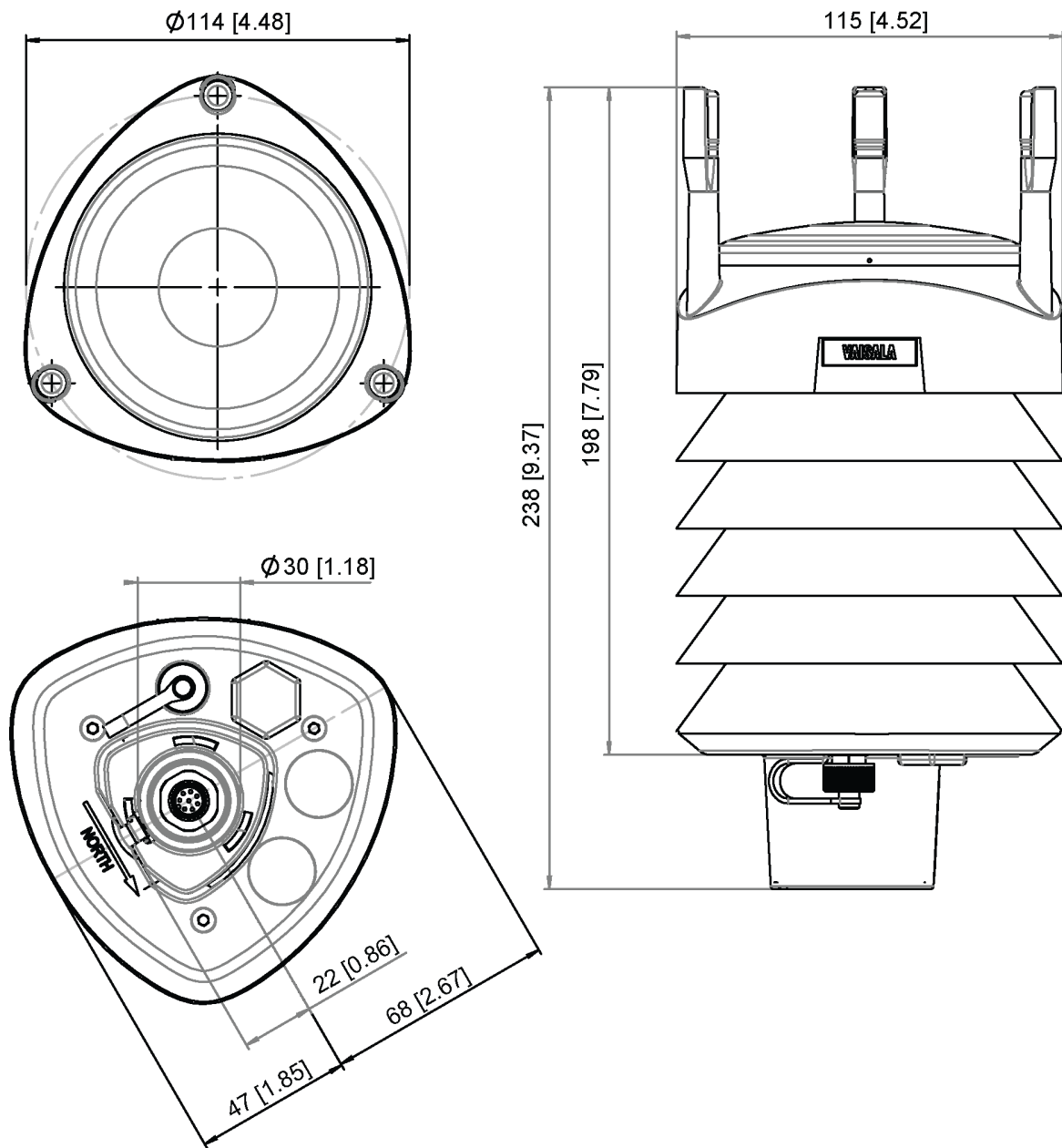
Figure 35   WXT536 Dimensions in mm [in]
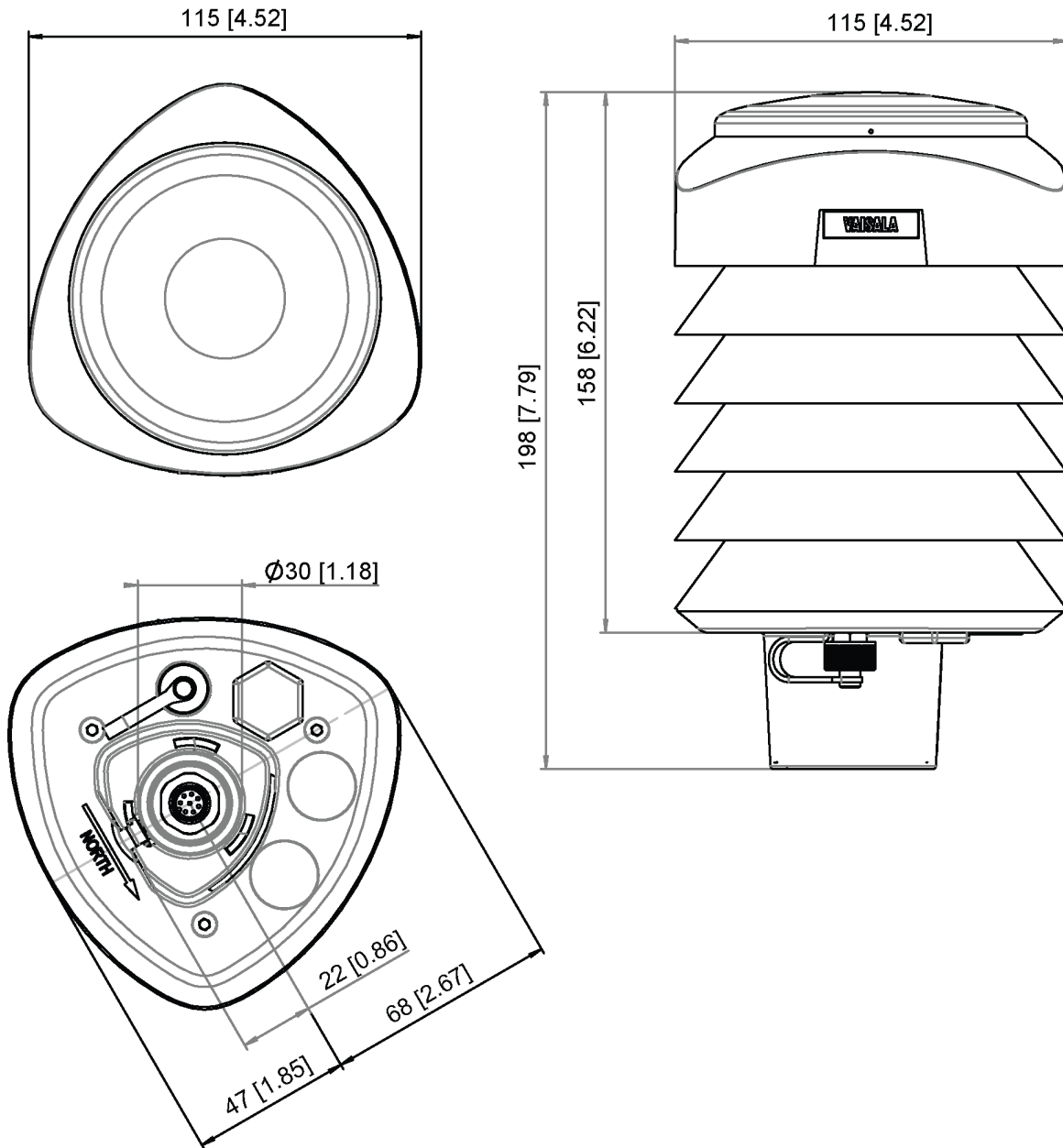
Figure 36   WXT535 and WXT534 Dimensions in mm [in]

Ø114 [4.48]

115 [4.52]

141 [5.55]

101 [3.97]

Ø30 [1.18]

NORTH

VAISALA

22 [0.86]

68 [2.67]

47 [1.85]
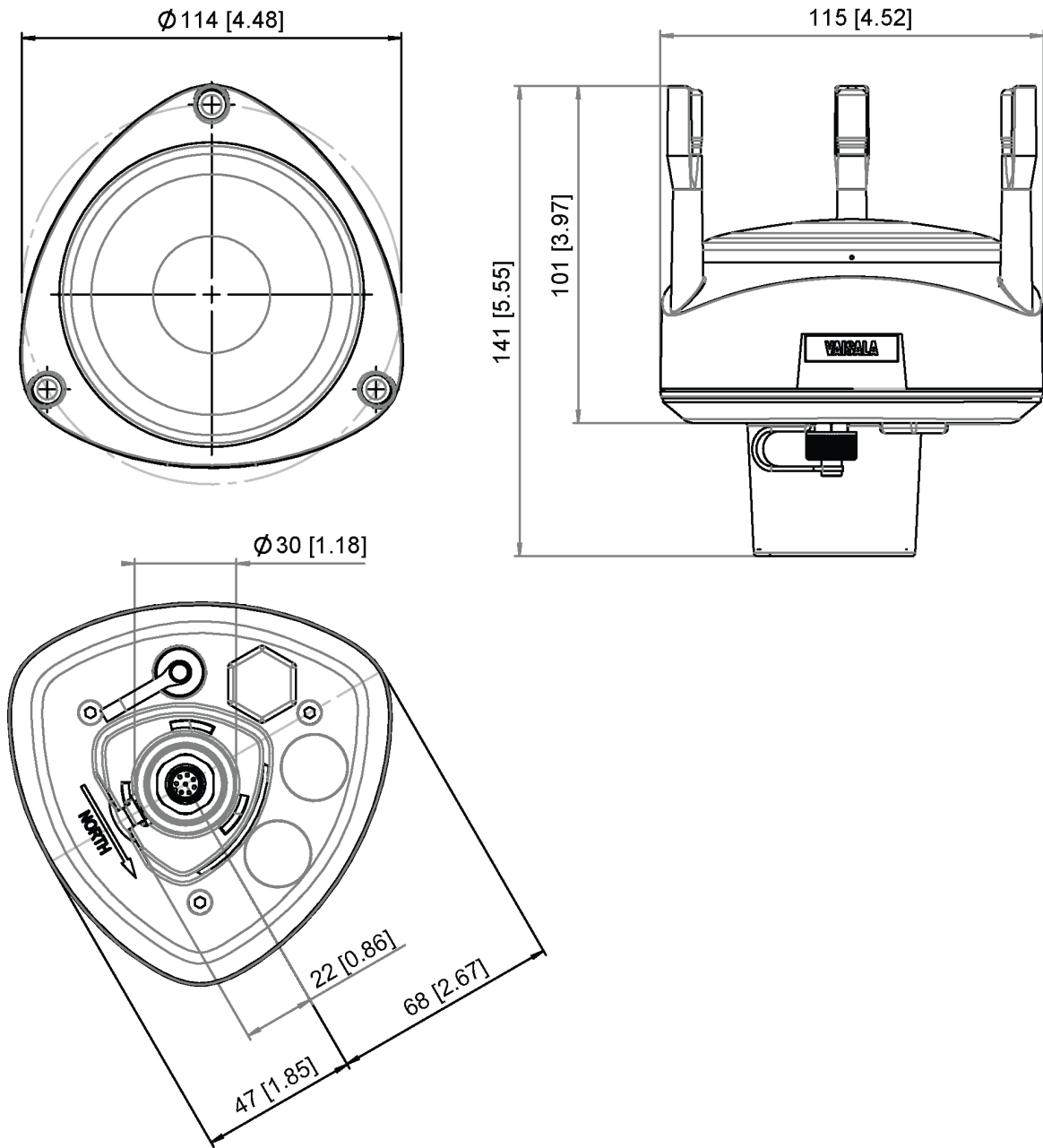
Figure 37   WXT533 and WXT532 Dimensions in mm [in]

115 [4.52]

115 [4.52]

101 [3.97]

61 [2.40]

Ø 30 [1.18]

NORTH

22 [0.86]

68 [2.67]

47 [1.85]
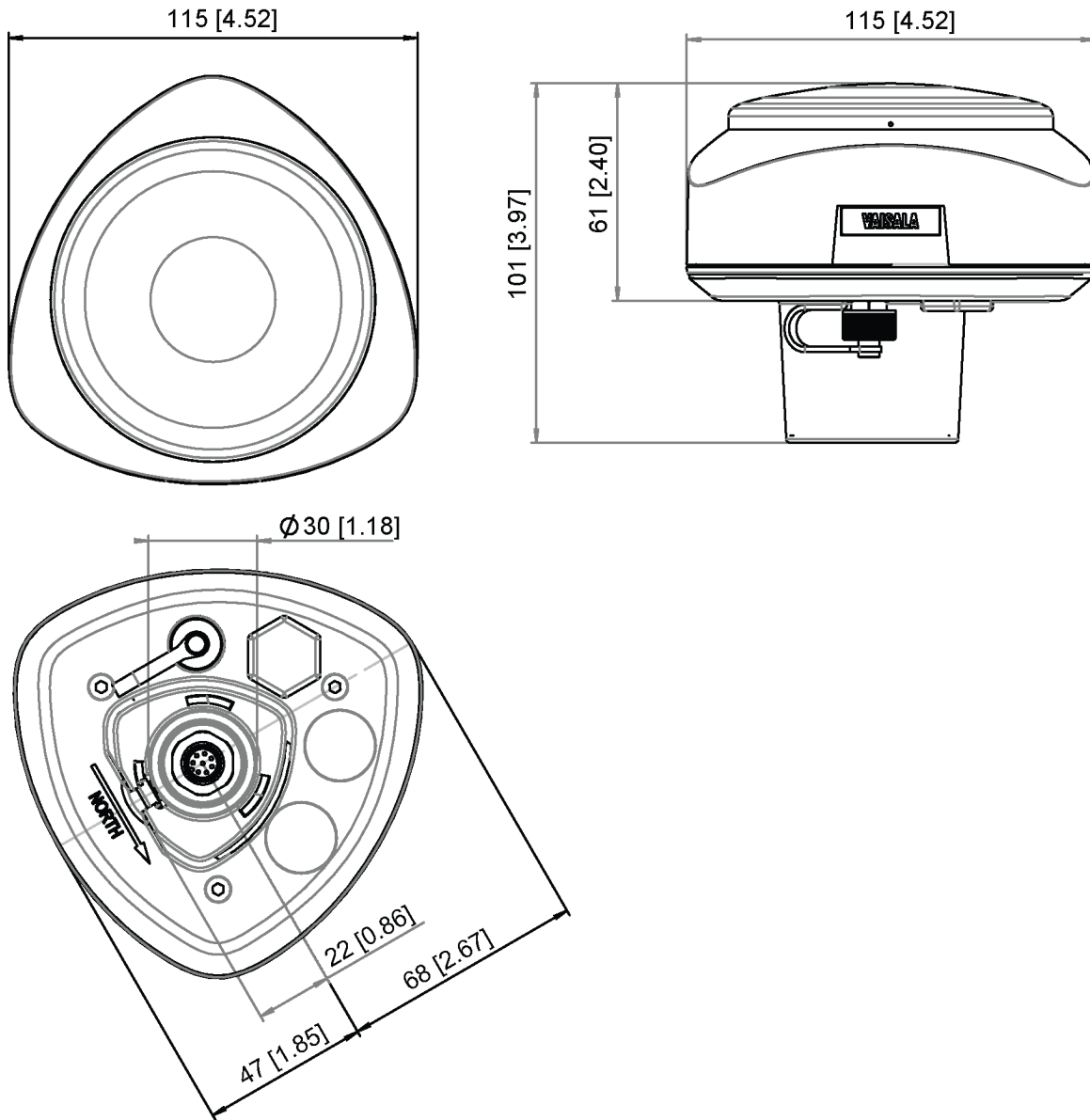
Figure 38   WXT531 Dimensions in mm [in]
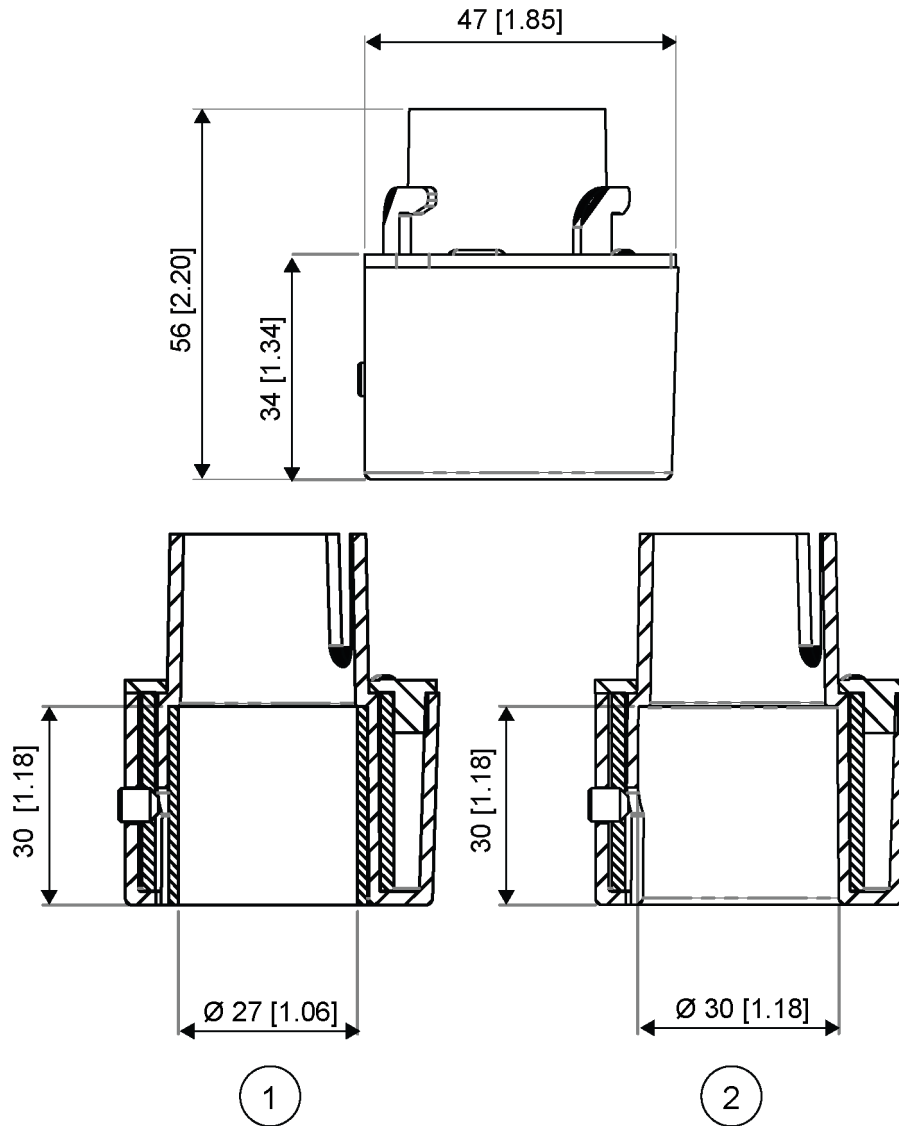
Figure 39   WXT530 Series Mounting Kit (212792) Dimensions

1   Mounting kit (212792) with adapter sleeve for Ø 26.7 mm (1.05 in) mast tube
2   Mounting kit (212792) without adapter sleeve for Ø 30 mm (1.18 in) mast tube
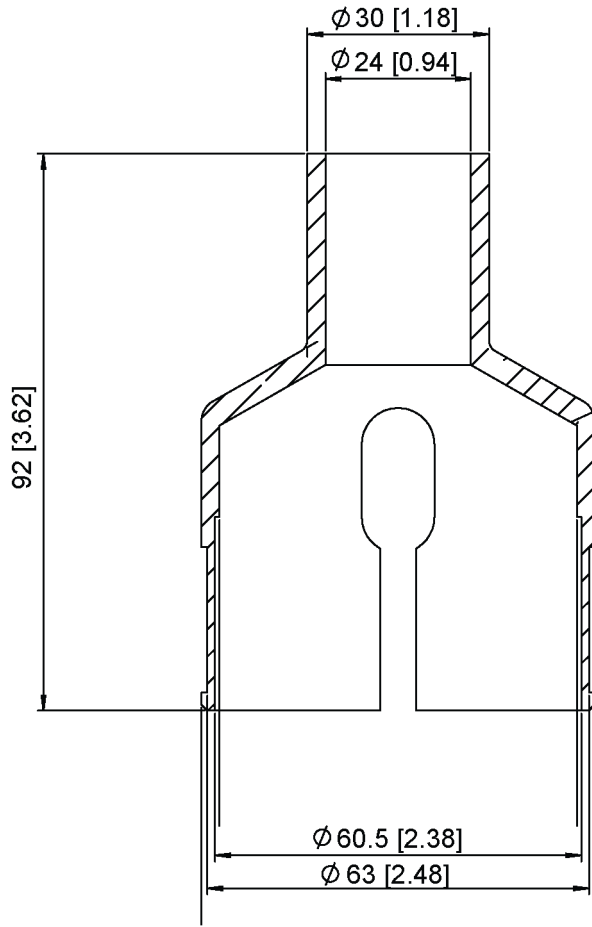
Figure 40   Mounting Accessory (WMSFIX60) for Connecting Mounting Kit (212792) and 60 mm Tube

Appendix A. Networking

A.1 Connecting Several Transmitters on Same Bus

There are two options for connecting several transmitters on the same bus:

- Using SDI-12 serial interface and communication protocol
- Using RS-485 serial interface and one of the communication protocols: ASCII or NMEA 0183 v3.0.

A.2 SDI-12 Serial Interface

A.2.1 Wiring SDI-12

▶ 1. Perform SDI-12 wiring in the transmitter as described in 5. Wiring and Power Management (page 53). Make sure you combine the two "Data in/out" wires of each transmitter either in the internal screw terminal inside or outside the transmitter.

2. In the data logger end, combine the "GND for data" wires of each transmitter to the logger "GND for data" wire. Connect the "Data in/out" wires of each transmitter to the logger "Data" wire.

A.2.2 SDI-12 Communication Protocol

Set the communication protocol SDI-12 v 1.3 (`aXU,C=1,M=S`) or SDI- 12 v1.3 continuous (`aXU,C=1,M=R`).

Assign the transmitters on the bus with different addresses (for example:`aXU,A=0,1,2,`…). After that, the transmitters on the bus do not respond to the commands not assigned to them nor to the data messages sent by the other transmitters.

Example (A bus with three WXT530 Series transmitters):

WXT530 #1 communication settings:

```
0XXU,A=0,M=S,C=1,B=1200,D=7,P=E,S=1, L=25
```

WXT530 #2 communication settings:

```
1XXU,A=1,M=S,C=1,B=1200,D=7,P=E,S=1, L=25
```

WXT530 #3 communication settings:

```
2XXU,A=2,M=S,C=1,B=1200,D=7,P=E,S=1, L=25
```

If simultaneous measurements of the different units are needed, Start concurrent measurement commands **aC** and **aCC** must be used for all devices. If the measurements are to be performed consecutively for only one unit at a time, in addition to these also Start measurement commands **aM** and **aMC** can be used. Start continuous measurement commands **aR1**, **aR2**, **aR3**, **aR5**, **aR**, **aRC1**, **aRC2**, **aRC3**, **aRC5** and **aRC** available only in SDI-12 continuous protocol (`aXU,M=R`) can be used either for simultaneous measurements of the units or consecutive measurements for one unit at time.

A.3 RS-485 Serial Interface

A.3.1 RS-485 Wiring

▶
1. Make the RS-485 wiring of the transmitter. See 5. Wiring and Power Management (page 53).

2. In the data logger end, combine the "Data +" wires of each transmitter to the logger "Data +" wire. Connect the "Data-" wires of each transmitter to the logger "Data -" wire.

A.3.2 RS-485 Communication Protocol

Set the communication protocol to ASCII polled (with or without CRC) or NMEA query. When using NMEA query, the wind message must be set to XDR (`aWU,N=T`).

> ℹ️ No matter which communication protocol, ASCII polled or NMEA query is chosen, the error messaging parameter of the supervisor message must be inactivated with `aSU,S=N` for each transmitter on the bus to prevent the units responding to the commands not assigned to them.

A.3.3 ASCII, Polled

Assign different addresses to the transmitters on the bus (for example, `aXU,A=0,1,2, …`).

Example (a bus with three transmitters):

WXT530 #1 communication settings:

```
0XU,A=0,M=P,C=3,I=0,B=19200,D=8,P=N,S=1,L=25
```

WXT530 #2 communication settings:

```
1XU,A=1,M=P,C=3,I=0,B=19200,D=8,P=N,S=1,L=25
```

WXT530 #3 communication settings:

```
2XU,A=2,M=P,C=3,I=0,B=19200,D=8,P=N,S=1,L=25
```

Example (composite data message queries to the sensors 1 and 3 are assigned as follows):

```
0R0<cr><lf>

1R0<cr><lf>

2R0<cr><lf>
```

A.3.4 NMEA 0183 v3.0, Query

The NMEA 0183 query messages do not contain device address information. Individual query commands can thus not be directed to different transmitters. Instead, a specific time slot method can be used for receiving data from several transmitters on the bus, just with a single query command.

To generate different time slots, each transmitter is given an individual delay for its query response, by using the RS-485 line delay parameter aXU,L. This parameter defines the time (in milliseconds) between the last character of the query and the first character of the response from the transmitter.

Example (a bus with three transmitters):

WXT530 #1 communication settings:

```
0XU,A=0,M=Q,C=3,I=0,B=4800,D=8,P=N,S=1,L=25
```

WXT530 #2 communication settings:

```
0XU,A=0,M=Q,C=3,I=0,B=4800,D=8,P=N,S=1,L=1000
```

WXT530 #3 communication settings:

```
0XU,A=0,M=Q,C=3,I=0,B=4800,D=8,P=N,S=1,L=2000
```

When the XDR query command $--WIQ,XDR*2D<cr><lf> is sent, WXT530 #1 responds after 25 ms, WXT530 #2 after 1000 ms, and WXT530 #3 responds after 2000 ms. The sufficient delays depend on the maximum number of characters in the response messages and the baud rate. Note that all the transmitters are assigned with the same address. The data logger, after sending the query, sorts out the response messages on the basis of the individual response times.

To gain even more addressability transducer ID information provided in the XDR response messages can also be used. If WXT530 address is set to 0 (aXU,A=0) and all parameters are chosen except Rain peak intensity and Hail peak intensity in the precipitation message, the response to the XDR query $--WIQ,XDR*2D<cr><lf> is:

```
$WIXDR,A,316,D,0,A,326,D,1,A,330,D,2,S,0.1,M,0,S,0.1,M,1,S,0.1, M,2*57<cr><lf>

$WIXDR,C,24.0,C,0,C,25.2,C,1,H,47.4,P,0,P,1010.1,H, 0*54<cr><lf>

$WIXDR,V,0.000,I,0,Z,10,s,0,R,0.01,I,0,V,0.0,M,1,Z,0,s,1,R,0.0,M, 1*51<cr><lf>

$WIXDR,C,25.8,C,2,U,10.7,N,0,U,10.9,V,1,U,3.360,V,2*7D<cr><lf>
```

For the transducer IDs, see .

The maximum transducer ID is three when the transmitter address is 0. Assigning address 4 for the second and address 8 for the third transmitter on the bus the following responses to the XDR query $--WIQ,XDR*2D<cr><lf> will be obtained from these transmitters (same message parameter configuration):

The second transmitter (address 4):

```
$WIXDR,A,330,D,4,A,331,D,5,A,333,D,6,S,0.1,M,4,S,0.1,M,5,S,0.2, M,6*55<cr><lf>

$WIXDR,C,23.5,C,4,C,24.3,C,4,H,49.3,P,4,P,1010.1,H, 3*59<cr><lf>

$WIXDR,V,0.000,I,4,Z,0,s,4,R,0.00,I,4,V,0.0,M,5,Z,0,s,5,R,0.0,M, 5*67<cr><lf>

$WIXDR,C,25.8,C,6,U,10.6,N,4,U,10.9,V,5,U,3.362,V,6*78<cr><lf>
```

The third transmitter (address 8):

```
$WIXDR,A,341,D,8,A,347,D,9,A,357,D,10,S,0.1,M,8,S,0.2,M,9,S,0.2,M,10*53<cr><lf>

$WIXDR,C,23.5,C,8,C,24.3,C,9,H,49.3,P,8,P,1010.1,H, 8*5F<cr><lf>

$WIXDR,V,0.000,I,8,Z,0,s,8,R,0.00,I,8,V,0.0,M,9,Z,0,s,9,R,0.0,M, 9*61<cr><lf>

$WIXDR,C,25.8,C,10,U,10.6,N,8,U,10.9,V,9,U,3.360,V, 10*7C<cr><lf>
```

Now the response messages of all three transmitters can be recognized and parsed by the data logger.

> The transmitter address may consist of letter characters but the transducer IDs in the NMEA XDR messages can only be numbers. The addresses given in letters show in the transducer IDs in the following way: transmitter address = A => transducer ID = 10, B => 11, a => 36, b => 37, and so on.

A.3.5 NMEA 0183 v3.0 Query with ASCII Query Commands

You can use ASCII query commands **aR1**, **aR2**, **aR3**, **aR5**, **aR**, **aR0** and their CRC-versions **ar1**, **ar2**, **ar3**, **ar5**, **ar,** and **ar0** also in NMEA 0183 protocol. The responses to these commands will be in standard NMEA 0183 format and the transmitters are assigned with different addresses (for example: `aXU,A=0,1,2,`…). The RS-485 line delays are not needed.

Example (a bus with three transmitters, data requests with combined data message query commands; the same message parameter configuration as in the previous example):

WXT530 #1 communication settings:

```
0XU,A=0,M=Q,C=3,I=0,B=4800,D=8,P=N,S=1,L=25
```

WXT530 #2 communication settings:

```
0XU,A=1,M=Q,C=3,I=0,B=4800,D=8,P=N,S=1,L=25
```

WXT530 #3 communication settings:

```
0XU,A=2,M=Q,C=3,I=0,B=4800,D=8,P=N,S=1,L=25
```

The query for WXT530 #1 and the response:

```
0R<cr><lf>

$WIXDR,A,316,D,0,A,326,D,1,A,330,D,2,S,0.1,M,0,S,0.1,M,1,S,0.1, M,2*57<cr><lf>

$WIXDR,C,24.0,C,0,C,25.2,C,1,H,47.4,P,0,P,1010.1,H, 0*54<cr><lf>

$WIXDR,V,0.000,I,0,Z,10,s,0,R,0.01,I,0,V,0.0,M,1,Z,0,s,1,R,0.0,M, 1*51<cr><lf>

$WIXDR,C,25.8,C,2,U,10.7,N,0,U,10.9,V,1,U,3.360,V,2*7D<cr><lf>
```

The query for WXT530 #2 and the response:

```
1R<cr><lf>

$WIXDR,A,330,D,1,A,331,D,2,A,333,D,3,S,0.1,M,1,S,0.1,M,2,S,0.2, M,3*55<cr><lf>

$WIXDR,C,23.5,C,1,C,24.3,C,2,H,49.3,P,1,P,1010.1,H, 1*59<cr><lf>

$WIXDR,V,0.000,I,1,Z,0,s,1,R,0.00,I,1,V,0.0,M,2,Z,0,s,2,R,0.0,M, 2*67<cr><lf>

$WIXDR,C,25.8,C,3,U,10.6,N,1,U,10.9,V,1,U,3.362,V,2*78<cr><lf>
```

The query for WXT530 #3 and the response:

```
2R<cr><lf>

$WIXDR,A,341,D,2,A,347,D,3,A,357,D,4,S,0.1,M,2,S,0.2,M,3,S,0.2, M,4*53<cr><lf>

$WIXDR,C,23.5,C,2,C,24.3,C,3,H,49.3,P,2,P,1010.1,H, 2*5F<cr><lf>

$WIXDR,V,0.000,I,2,Z,0,s,2,R,0.00,I,2,V,0.0,M,3,Z,0,s,3,R,0.0,M, 3*61<cr><lf>

$WIXDR,C,25.8,C,4,U,10.6,N,2,U,10.9,V,2,U,3.360,V,3*7C<cr><lf>
```

If needed, for making the transducers IDs distinguishable, device addresses 0, 4, 8 can be used as described in the previous section.

Appendix B. SDI-12 Protocol

SDI-12 is a standard for interfacing data recorders with microprocessor-based sensors. The name stands for serial/digital interface at 1200 baud. More information of the complete SDI-12 standard text is available from the SDI-12 website: http://www.sdi-12.org.

B.1 SDI-12 Electrical Interface

The SDI-12 electrical interface uses the SDI-12 bus to transmit serial data between SDI-12 data recorders and sensors. The SDI-12 bus is the cable that connects multiple SDI-12 devices. The cable has three conductors:

- Serial data line
- Ground line
- 12 V line

The SDI-12 bus can have at least 10 sensors connected to it. The bus topology is a parallel connection, where each of the three wires of different sensors are connected in parallel.

B.1.1 SDI-12 Communications Protocol

SDI-12 data recorders and sensors communicate by an exchange of ASCII characters on the data line. The data recorder sends a break to wake up the sensors on the data line. A break is continuous spacing on the data line for at least 12 milliseconds. The data recorder then sends a command. The sensor, in turn, returns the appropriate response. Each command is for a specific sensor. The first character of each command is a unique sensor address that specifies with which sensor the recorder wants to communicate. Other sensors on the SDI-12 bus ignore the command and return to low-power standby mode. When a data recorder tells a sensor to start its measurement procedure, the recorder does not communicate with any other sensor until the data collection from the first sensor is complete.

A typical recorder/sensor measurement sequence proceeds in the following order:

- The data recorder wakes all sensors on the SDI-12 bus with a break.
- The recorder transmits a command to a specific, addressed sensor, instructing it to make a measurement.
- The addressed sensor responds within 15.0 ms returning the maximum time until the measurement data is ready and the number of data values it returns.
- If the measurement is immediately available, the recorder transmits a command to the sensor instructing it to return the measurement(s). If the measurement is not ready, the data recorder waits for the sensor to send a request to the recorder, which indicates that the data is ready. The recorder then transmits a command to get the data.
- The sensor responds, returning one or more measurements.

B.1.2 SDI-12 Timing

The following figure shows a timing diagram for a SDI-12 command and its response. The tolerance for all SDI-12 timing is ±0.40 ms.

The exception to this is the time between the stop bit of one character and the start bit of the next character. The maximum time for this is 1.66 ms, with no tolerance.

- A data recorder transmits a break by setting the data line to spacing for at least 12 ms.
- The sensor does recognize a break condition for a continuous spacing time of less than 6.5 ms. The sensor will always recognize a break when the line is continuously spacing for more than 12 ms.
- When receiving a break, a sensor must detect 8.33 ms of marking on the data line before it looks for an address.
- A sensor must wake up from a low-power standby mode and be capable of detecting a start bit from a valid command within 100 ms after detecting a break.
- After a data recorder transmits the last character of a command, it must relinquish control of the data line within 7.5 ms.
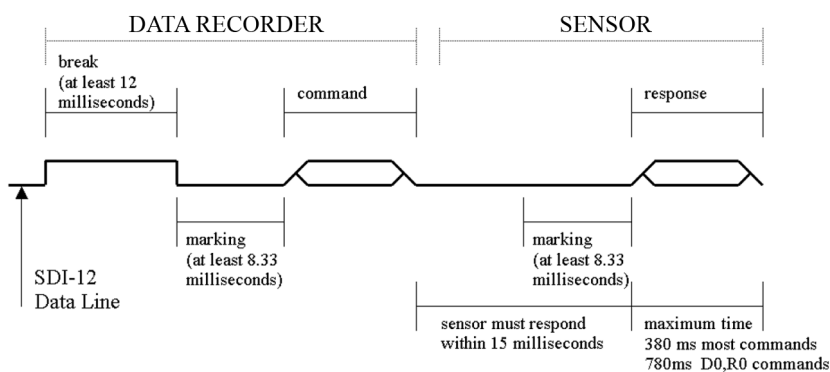
Figure 41   Timing Diagram

- After receiving the break and the command, the addressed sensor sets the data line to marking at 8.33 ms and then sends the response (tolerance: -0.40 ms). The start bit of the first response byte must start within 15 ms after the stop bit of the last byte of the command (tolerance: +0.40 ms).
- After a sensor transmits the last character of a response, it must relinquish control of the data line within 7.5 ms (tolerance: +0.40 ms).
- No more than 1.66 ms of marking are allowed between the end of the stop bit and the start bit (for example between characters) on any characters in the command or the response (no tolerance.) This permits a response to an M command to be sent within a 380 ms window.
- Sensors must return to a low-power standby mode after receiving an invalid address or after detecting a marking state on the data line for 100 ms (tolerance: +0.40 ms).
- When a recorder addresses a different sensor, or if the data line has been in the marking state for more than 87 ms, the next command must be preceded by a break.

> ℹ The low-power standby mode, in addition to being a low-power consumption state, is a protocol state and it takes a moment to leave that state.

Appendix C. CRC-16 Computation

The computation of the CRC is performed on the data response before parity is added. All operations are assumed to be on 16-bit unsigned integers. The least significant bit is on the right. Numbers preceded by 0x are in hexadecimal. All shifts shift in a zero. The algorithm is:

```
Initialize the CRC to zero. For each character beginning with the address, up
to but not including the carriage return (<cr>), do as follows:
{
  Set the CRC equal to the exclusive OR of the character and itself
  for count =1 to 8
  {
    if the least significant bit of the CRC is one
    {
        right shift the CRC one bit set
        CRC equal to the exclusive OR of 0xA001 and
        itself
    }
    else
    {
      right shift the CRC one bit
    }
  }
}
```

C.1 Encoding the CRC as ASCII Characters

The 16-bit CRC is encoded to three ASCII characters by using the following algorithm:

1st character = 0x40 OR (CRC shifted right 12 bits)

2nd character = 0x40 OR ((CRC shifted right 6 bits) AND 0x3F)

3rd character = 0x40 OR (CRC AND 0x3F)

The three ASCII characters are placed between the data and <cr><lf>. Parity is applied to all three characters, if selected for the character frame.

The CRC computation code is added to the end of the response, if the first letter of the command is sent by using lower case.

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C.2 NMEA 0183 v3.0 Checksum Computation

The checksum is the last field in the NMEA sentence and follows the checksum delimiter character "*". It is the 8-bit exclusive OR of all characters in the sentence, including "," and "^" delimiters, between but not including the "$" or "!" and the "*" delimiters. The hexadecimal value of the most significant and least significant four bits of the result is converted to two ASCII characters (0-9,A-F) for transmission. The most significant character is transmitted first.

Appendix D. Wind Measurement Averaging Method

The following figures represent the wind measurement averaging for different selections of communication protocol, wind measurement update interval (I) and averaging time (A). Scalar averaging is used for both wind speed and direction.

> **i** Grey boxes indicate that the measurement is in progress during the corresponding second.
> Update (= internal calculation) is always made in the end of the update interval.
> In the auto sending protocols (ASCII automatic (+ CRC) and NMEA automatic) outputting the data messages is synchronized to take place immediately after the update.
> In ASCII polled (+ CRC), NMEA query and SDI-12 continuous measurement protocols trying to request data before the update interval is completed will result in getting the data from the previous completed update interval.
> Wind measurement sampling rate (4, 2, or 1 Hz) does not have any effect on the averaging scheme. It determines from how many samples the one second values seen in the figures are calculated.

Case 1   I > A, all communication protocols other than SDI-12 (aXU,M=S). In this example I=5 sec and A=3 sec.
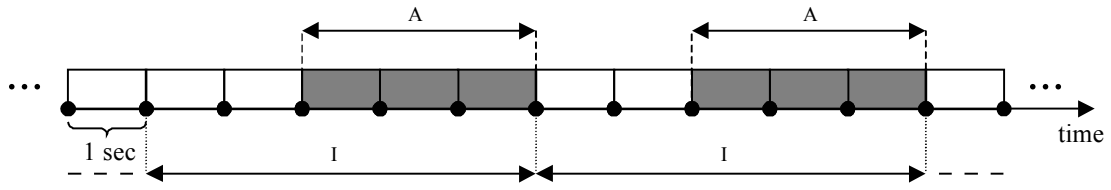
Case 2   I < A, all communication protocols other than SDI-12 (aXU,M=S). In this example I=2 sec and A=5 sec.
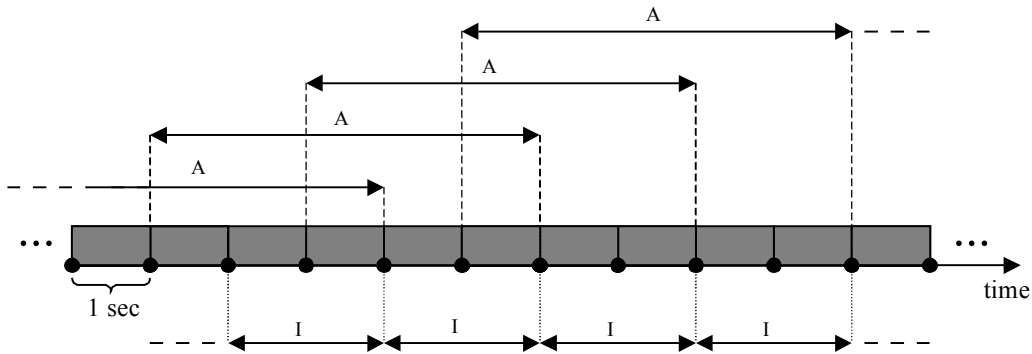
Case 3   Communication protocol SDI-12 (aXU,M=S). In this example A=3 sec. I does not have any function in this protocol.
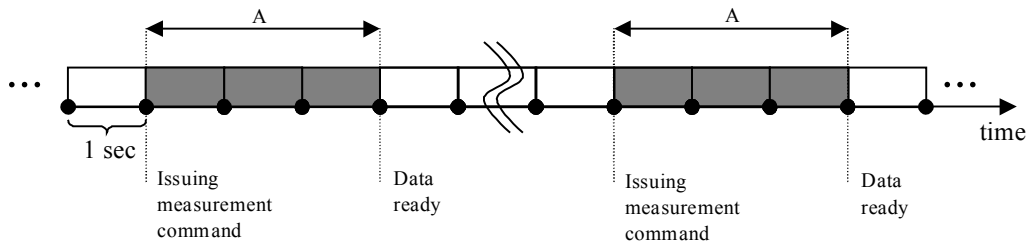
Figure 42   Wind Measurement Averaging Method

Appendix E. Factory Configurations

The factory configurations are read-only settings which cannot be modified. For each settings command, the following information is shown:

- Command to retrieve the settings (ends to ! character)
- Example response from the transmitter
- Table describing the message contents

E.1 General Unit Settings

```
0XF!0XF,f=11111111&11100010,o=AAC1DB1A,c=A263,
i=HEL___,n=A3430012,2=2528,3=3512 <cr><lf>
```

Table 49   General Unit Settings

Field Character	Field Name	Description
f	Factory options	Selection of parameters
o	Order code	Ordering identity as delivered (10 characters)
c	Calibration date	Y=2003, A, B,...=2005, 2006, 1..52 = week, 1 ... 7, weekday
i	Info	Factory signature (10 characters)
n	Device s/n	A,B,...=2005,2006..., 1..52 = week, 1 ... 7 = weekday , 1 ... 9999 = serial number
2	2.5 V reference	2500 mV (default)
3	3.5 V reference	3500 mV (default)

E.2 Wind Configuration Settings

```
0WF!0WF,g=A,l=N,t=A,
0=273.00,1=273.01,2=273.00,3=273.00,4=273.00,5=273.00,a=45.1,b=50.2,u=54.9,v=63
.1,x=65.1,y=65.1<cr><l f>
```

Table 50   Wind Configuration Settings

Field Character	Field Name	Description
g	Strategy	A=All N=North E=East S=South
l	Pulse length	N=Normal, auto A=Adjusted on half S=Short E=Extended T=Test
t	Single transducer mode	A=All N=North E=East S=South
0..5	Zero adjustment	1 ... 655.35 us (default 273.00 us)
a,b	Detect level btw. N and E	0 ... 100 % (default 70 %)
u,v	Detect level btw. E and S	0 ... 100 % (default 70 %)
x,y	Detect level btw. S and N	0 ... 100 % (default 70 %)

E.3 PTU Configuration Settings

```
0TF!0TF,n=A0430432 <cr><lf>
```

Table 51   PTU Configuration Settings

Field Character	Field Name	Description
n	PTU serial number	A,B,... = 2005,2006... 1 ... 52 = week 1 ... 7 = weekday 1 ... 9999 = serial number

E.4 Rain Configuration Settings

```
0RF!0RF,p=1.0,n=3.0,d=N,f=0<cr><lf>
```

Table 52   Rain Configuration Settings

Field Character	Field Name	Description
p, n	Positive and negative gain	0.1 … 25.5 (p=1.0, n=1.0)
d	Bypass all hits	Y=Enabled, N= Disabled (default)
f	Wind filter bypass	0,1 … 4 (0=wind depended, 1,2,3,4=threshold level)

E.5 Supervisor Settings

```
0SF!0SF,t=19.8,b=17159,l=−4.0,m=0.0,h=4.0<cr><lf>
```

Table 53   General Unit Settings

Field Character	Field Name	Description
t	CPU temperature calibration temperature	°C
b	Direct ADC value of CPU temperature diode	0 … 4096
l	Heater control gain	-100.0 …[m] °C (default -4.0 °C)
m	Heating set point	°C
h	Not used	

Appendix F. Connecting External Sensors to WXT536

This section describes how to connect the following external sensors to WXT536:

- Ultrasonic level sensor
- Pyranometer
- Resistance temperature sensor
- Rain gauge
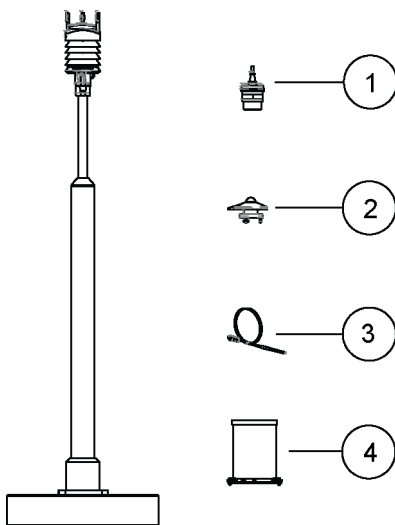
Figure 43   Connecting External Sensors to WXT536

1   Ultrasonic level sensor IRU-9429
2   Pyranometer CMP3
3   Resistance temperature sensor Pt1000
4   Rain gauge RG13

F.1 Connecting Ultrasonic Level Sensor to WXT536

The following figure shows how to connect the ultrasonic level sensor IRU-9429 to WXT536.

> IRU-9429 needs excitation voltage set to a 5 V level to get readings out to the WXT536 input. You need a power box between WXT536 and IRU-9429.
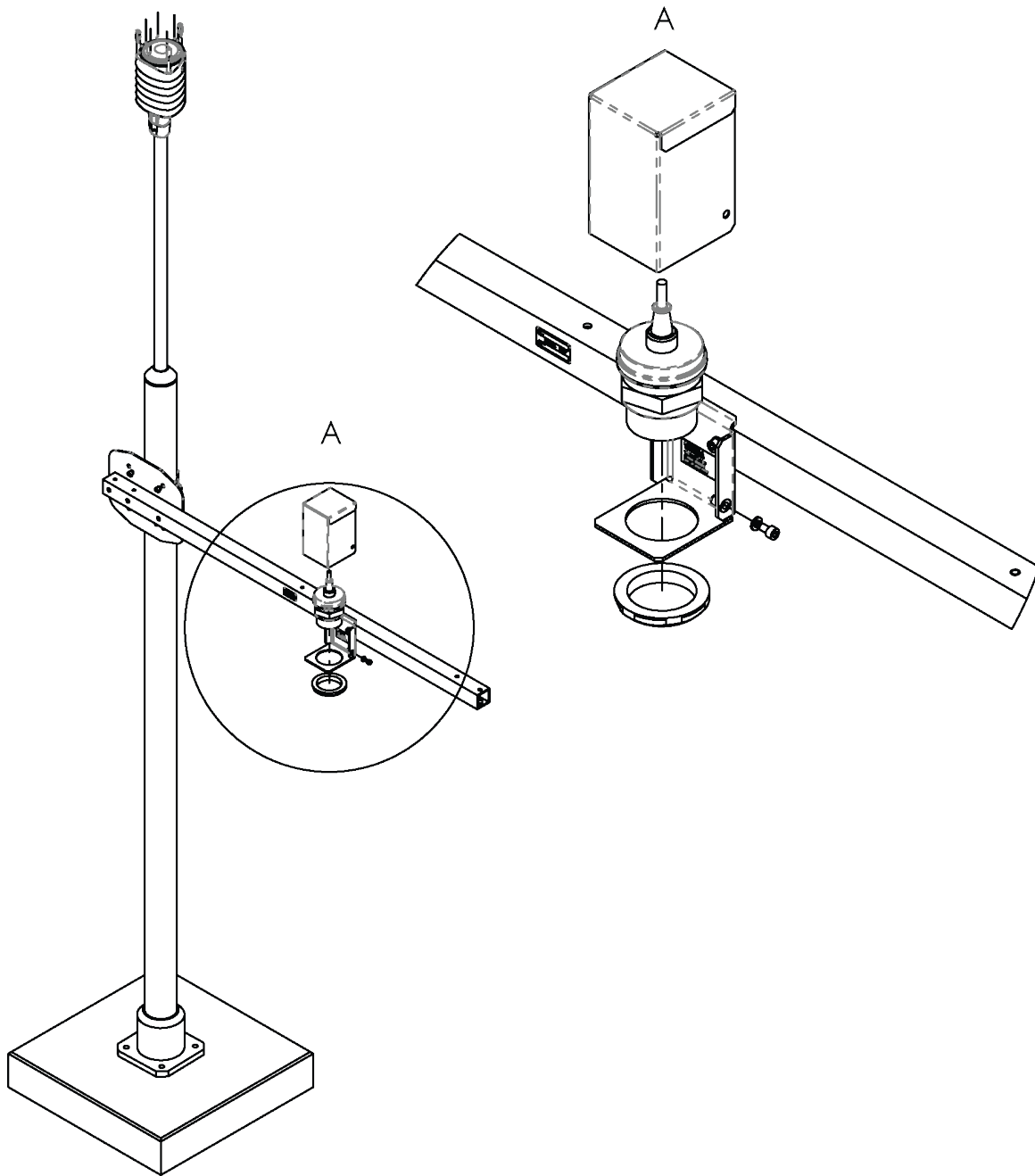
Figure 44   Connecting Ultrasonic Level Sensor to WXT536

The following figure shows how to wire the ultrasonic level sensor to WXT536.

IRU-9429

User provided powering and excitation
(For details, see IRU manual)

+24 VDC
DC Ground
(Other connections
vary by model)
Excitation (+5 VDC)
0 - 2.5/0 - 5 VDC Output
Analog Ground
Shield

+24 VDC
DC Ground
Excitation (+5 VDC)
0 - 2.5/0 - 5 VDC Output
Analog Ground

WXT536 with Analog Input option

M12 pin 4
Analog Ground

M12 pin 8
0 - 2.5/5/10 V

Shield is connected
to connector chassis.
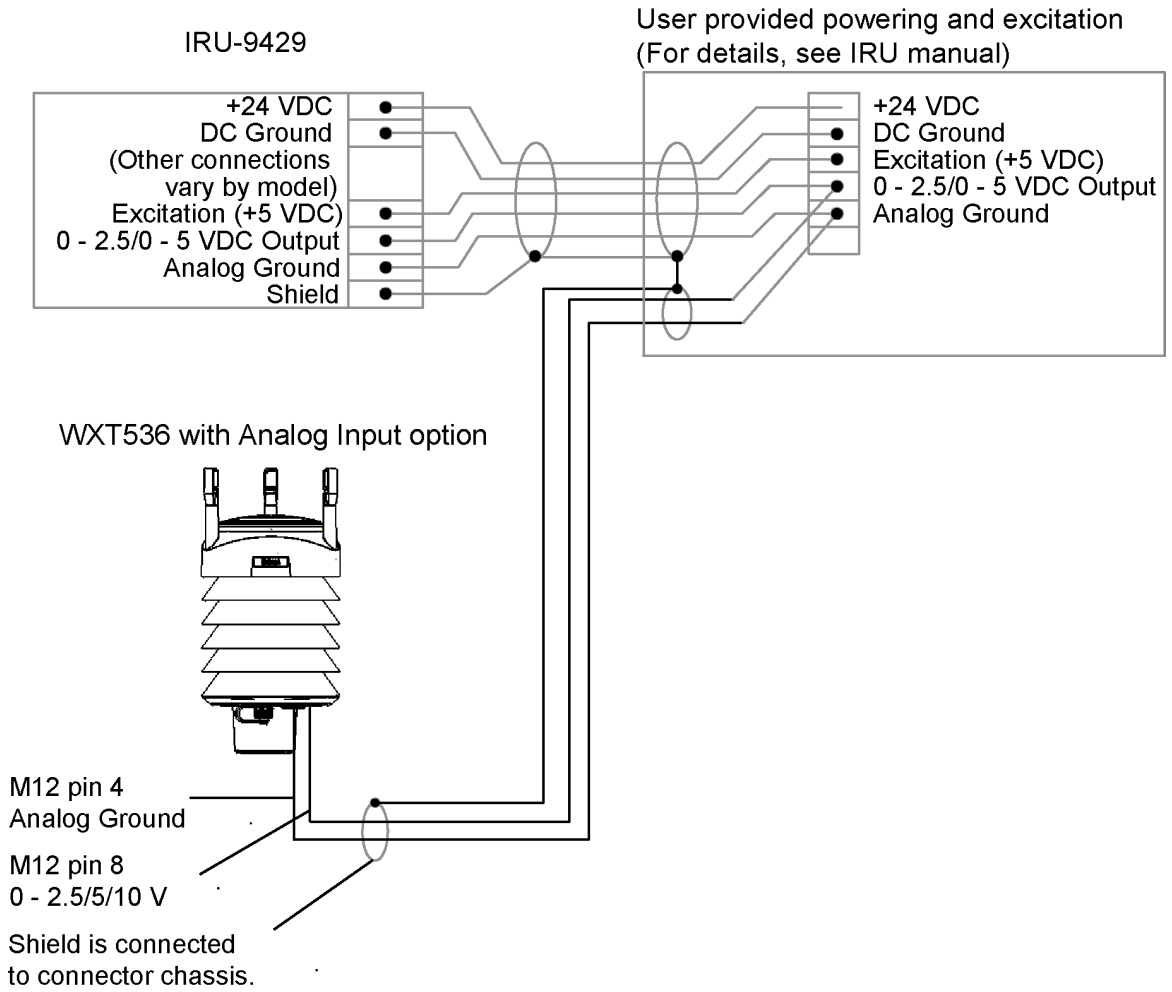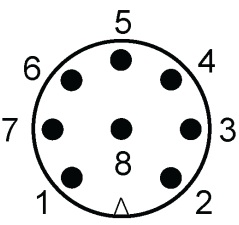
Figure 45   Wiring Ultrasonic Level Sensor to WXT536

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Table 54   Ultrasonic Level Connections

| | Level sensor connections | | IRU-9429 | |
	Pin	Pin function	Wire color	Function
	1	-	-	-
	2	-	-	-
	3	-	-	-
	4	AGND Common analog ground for Pt, TIP, and WS	Green	Analog ground
	5	-	-	-
	6	-	-	-
	7	-	-	-
	8	WSIN Ultrasonic level sensor input+ AGND= - 0 ... 2.5 V 0 ... 5 V 0 ... 10 V	White	0 ... 2.5 VDC

F.2 Connecting Pyranometer to WXT536

The following figure shows how to connect pyranometer CMP3 to WXT536.
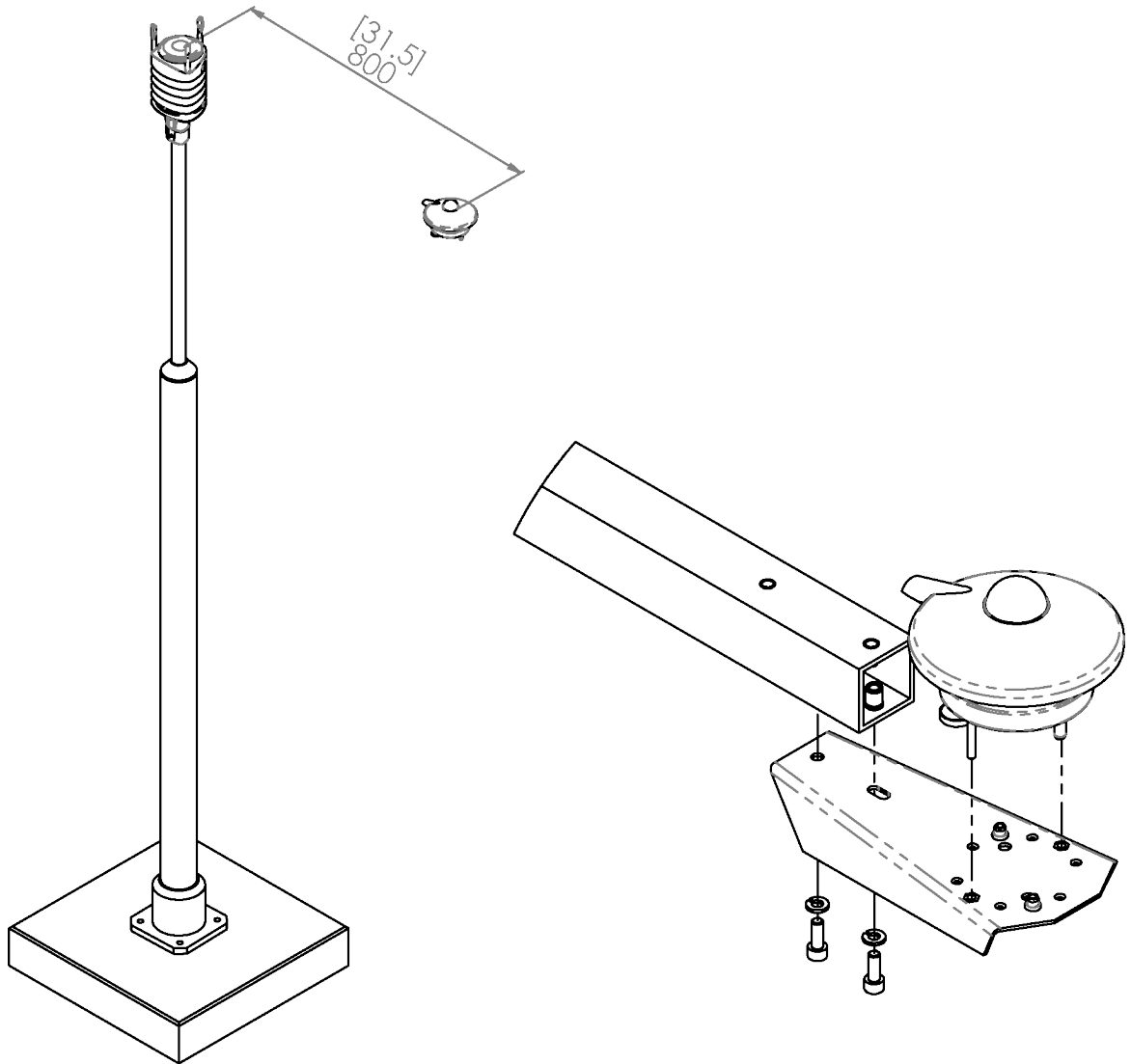
Figure 46   Connecting CMP3 to WXT536

The following figure shows how to peel CMP3 cable sheath.
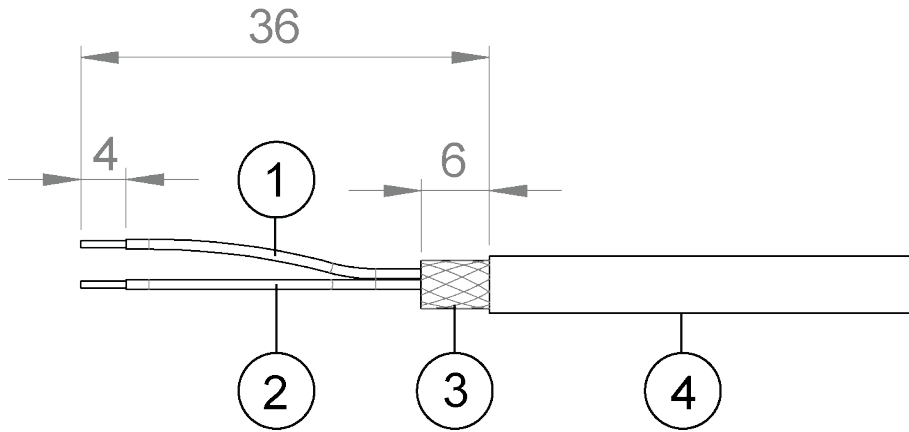
Figure 47   Peeling CMP3 Cable Sheath

1   Red cable
2   Blue cable
3   Cable sheath
4   CMP3 cable

The following figure shows how to wire the pyranometer to WXT536.
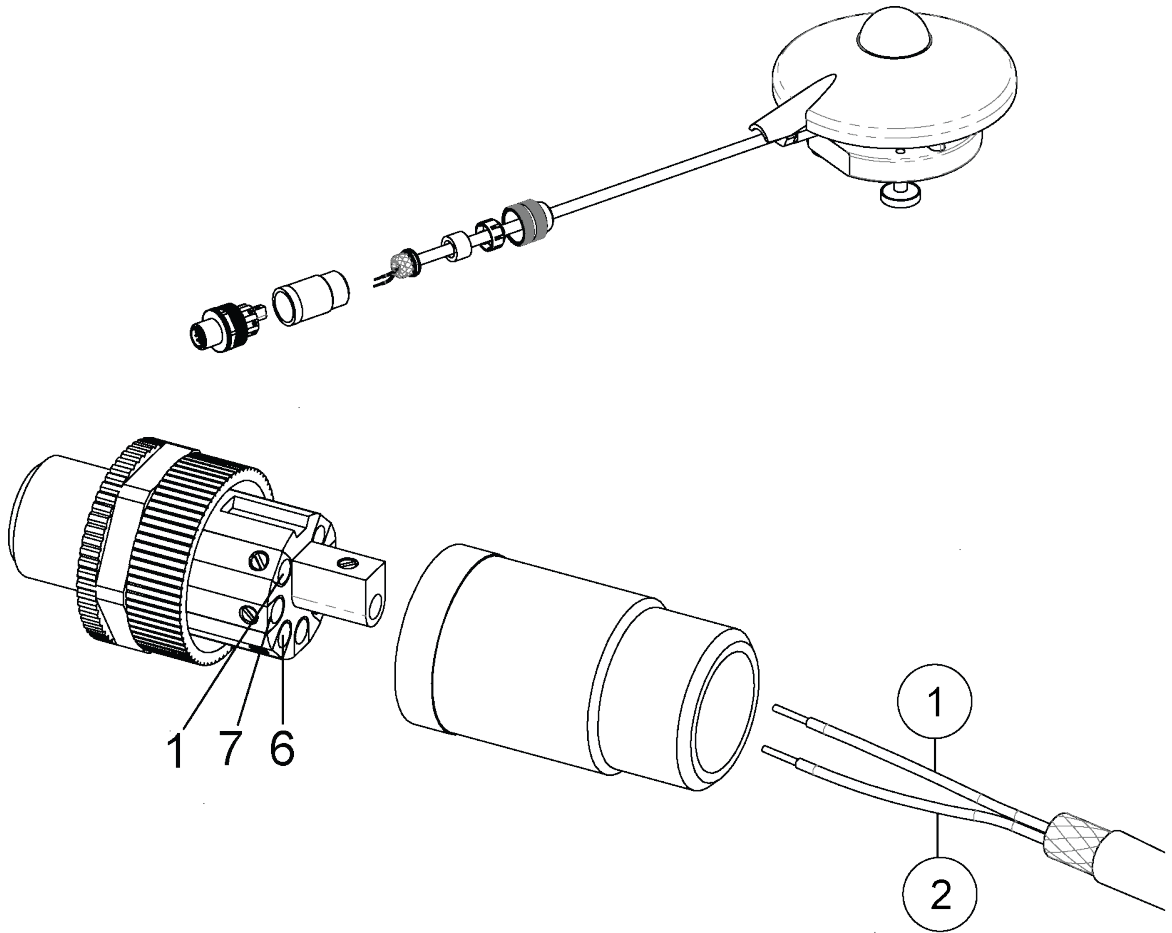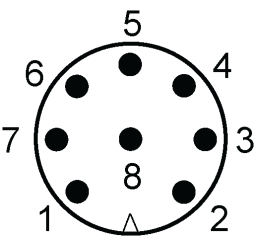
Figure 48   Wiring CMP3 to WXT53

1   Red cable
2   Blue cable

Table 55   Pyranometer Connections

	Solar radiation connections		CMP3	
	Pin	Pin function	Wire color	Function
	1	-	-	-
	2	-	-	-
	3	-	-	-
	4	-	-	-
	5	-	-	-
	6	SR+ Solar radiation sensor input + 0 ... 25 mV	Red	+
	7	SR- Solar radiation sensor input -	Blue	-
	8	-	-	-

F.3 Connecting Resistance Temperature Sensor

Connect the temperature sensor to the M12 connector of the transmitter.
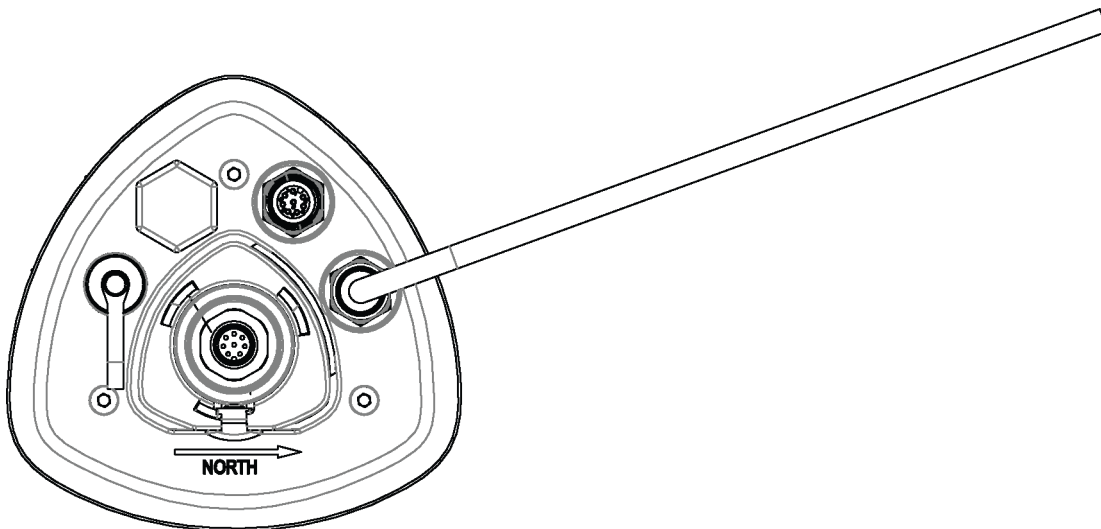
Figure 49   Pt1000 Connected to WXT536 M12 Connector

The following figure shows how to wire a temperature sensor to the transmitter.

4-Wire Connection

M12 connector
Pin number

PT1000
°T

1 PTI+

2 PT+

3 PT-

4 AGND

2-Wire Connection

M12 connector
Pin number

PT1000
°T

1 PTI+

2 PT+

3 PT-

4 AGND
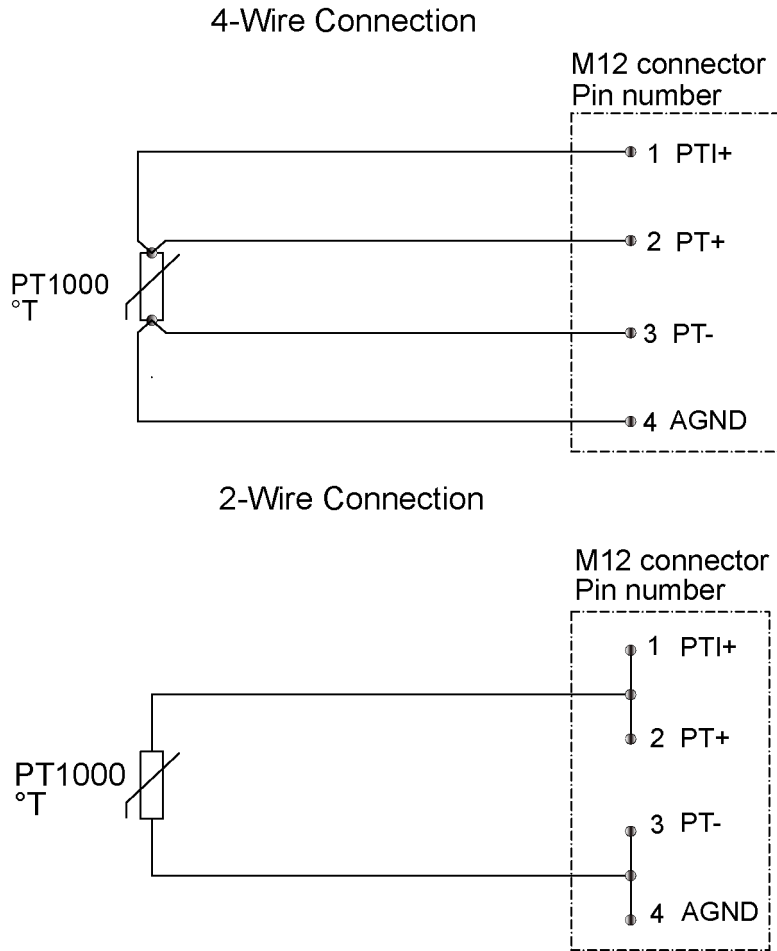
Figure 50   Wiring Temperature Sensor Pt1000 to WXT536

1 WHT

WHT

2

BRN

3

4 BRN

Pt1000
247270

Connector M12/8P Male
247488
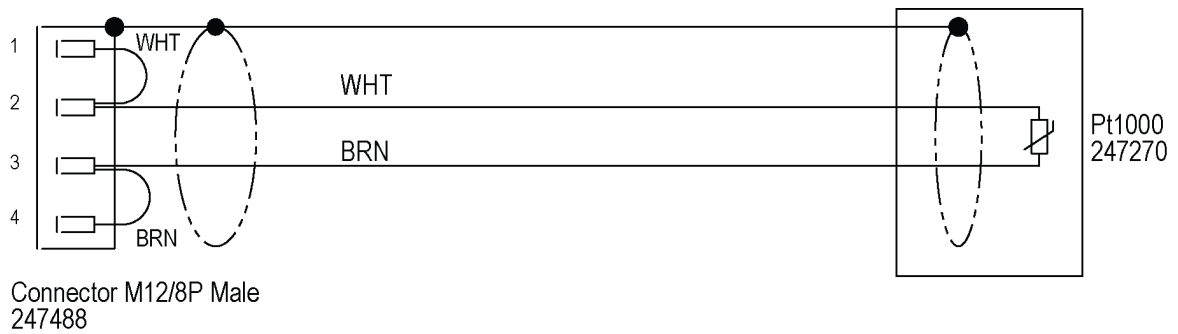
Figure 51   Wiring Temperature Sensor TM-Pt1000 to WXT536
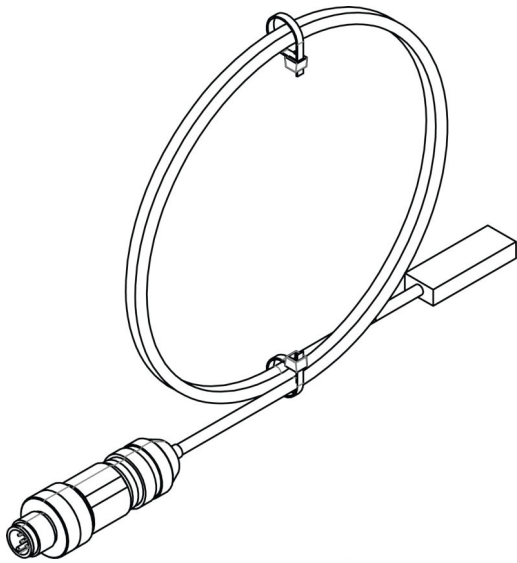
Figure 52   TM-Pt1000 Connector

Table 56   Temperature Sensor Connections

	Sensor connections		TM-Pt1000	
	Pin	Pin function	Wire color	Function
	1	PTI+ PT1000 measuring current. PT1000 temperature sensor current feed.	-	-
	2	PT+ PT1000 input+ PT1000 temperature sensor. Sense +.	White	+
	3	PT- PT1000 input- PT1000 temperature sensor.Sense-.	Brown	-
	4	AGND Common analog ground for PT, TIP, and WS. Common ground for level, tipping bucket, and Pt1000.	-	-
	5	-	-	-
	6	-	-	-
	7	-	-	-
	8	-	-	-

F.4 Connecting Rain Gauge to WXT536

The following figure shows how to wire rain gauge RG13 to WXT536.
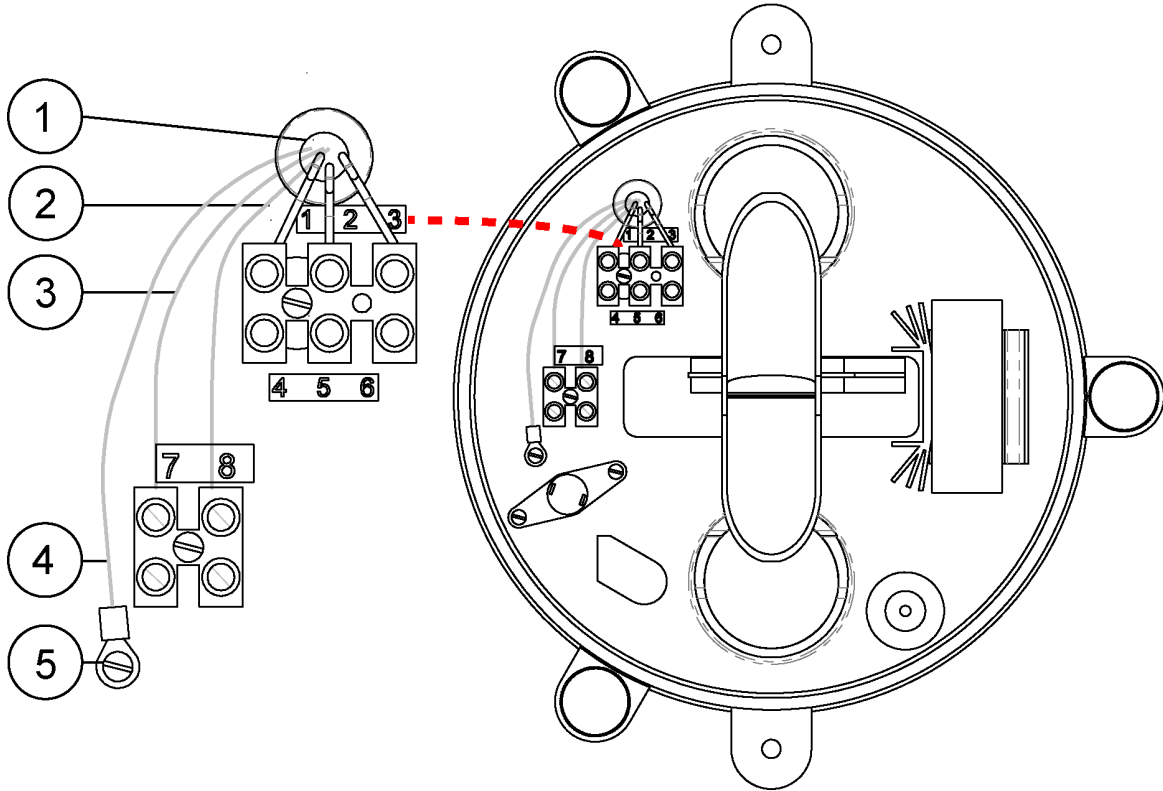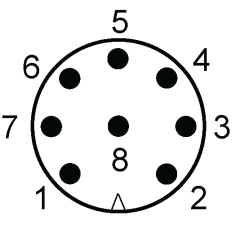
Figure 53   Wiring RG13/RG13H to WXT536

1   Cable tie
2   Screw terminal 8
3   Screw terminal 7
4   Cable shield
5   Grounding point

> Only the heated rain gauge RG13H has terminals 4, 5, and 6 for the heating power. RG13H requires 33 W power to enable heating. You need a power box between WXT536 and RG13H

Table 57   Rain Gauge Connections

| | Sensor connections | | RG13/RG13H | |
	Pin	Pin function	Wire color	Function
	1	-	-	-
	2	-	-	-
	3	-	-	-
	4	AGND Common analog ground for Pt, TIP, and WS	Terminal 7 (Blue wire)	Normally open contact
	5	TIP IN Tipping bucket digital input connect to AGND for pulse	Terminal 8 (Red wire)	Normally open contact
	6	-	-	-
	7	-	-	-
	8	-	-	-

After wiring the sensor and connecting it to WXT536, you can configure the analog input through Vaisala Configuration Tool.

Appendix G. Complete Set of Accessories
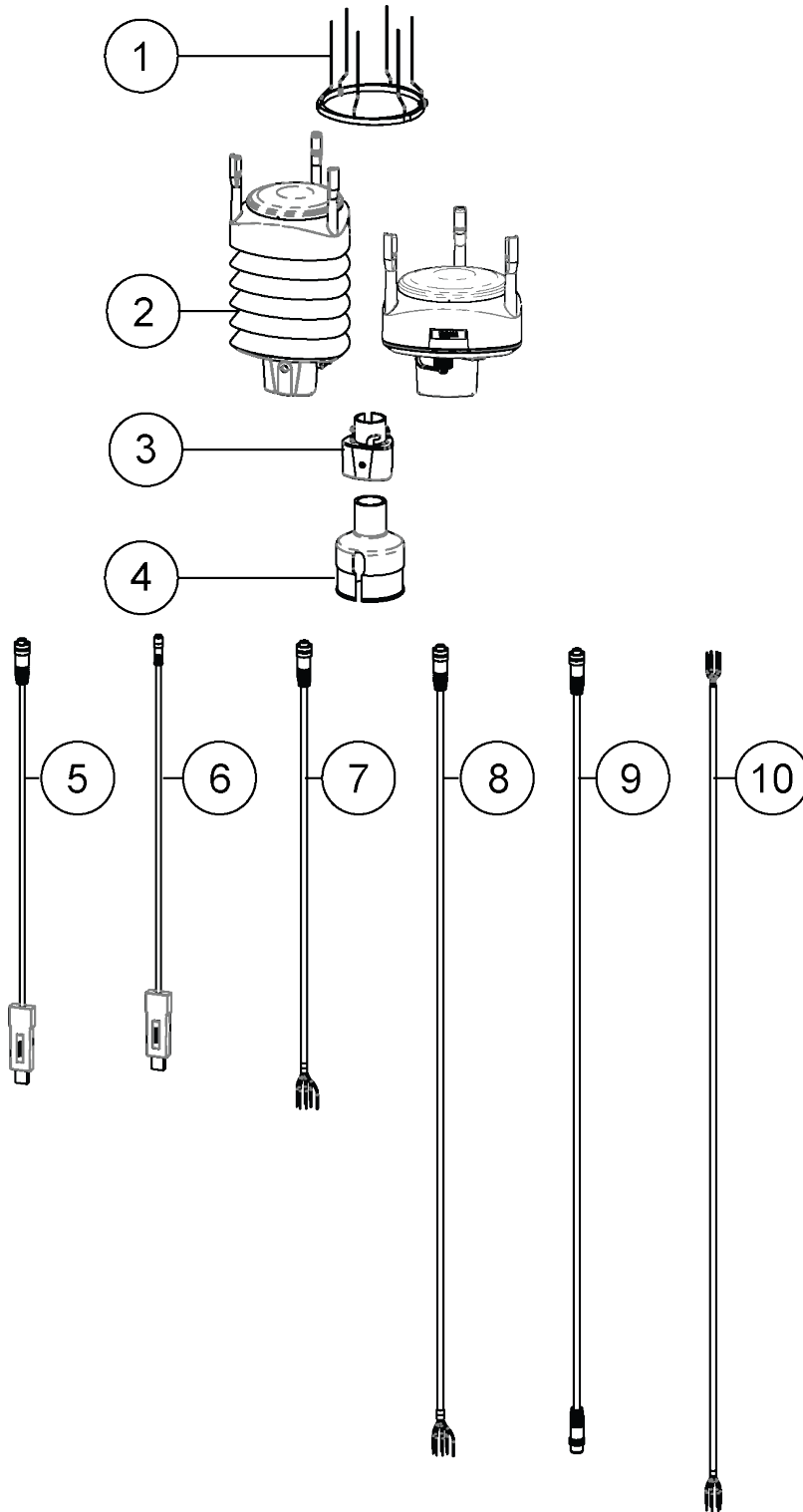
Figure 54   Complete Set of Accessories

1   Bird kit 212793
2   WXT530 Series transmitter
3   Mounting kit 212792
4   Mounting accessory between Mounting kit and 60 mm tube WMSFIX60
5   Cable USB RS-232/RS-485 1.4 m USB M12 SP 220782
6   USB service cable delivered with the Vaisala Configuration Tool 220614
7   Cable 2 m shielded 8-pin M12 SP 222287
8   Cable 10 m shielded 8-pin M12 SP 222288
9   Cable 10 m shielded 8-pin M12 SP, connectors on both ends SP 215952
10 Cable 40 m shielded 12-pin, open end wires SP 217020

The following figure shows how to connect surge protector WSP150 to WXT536.
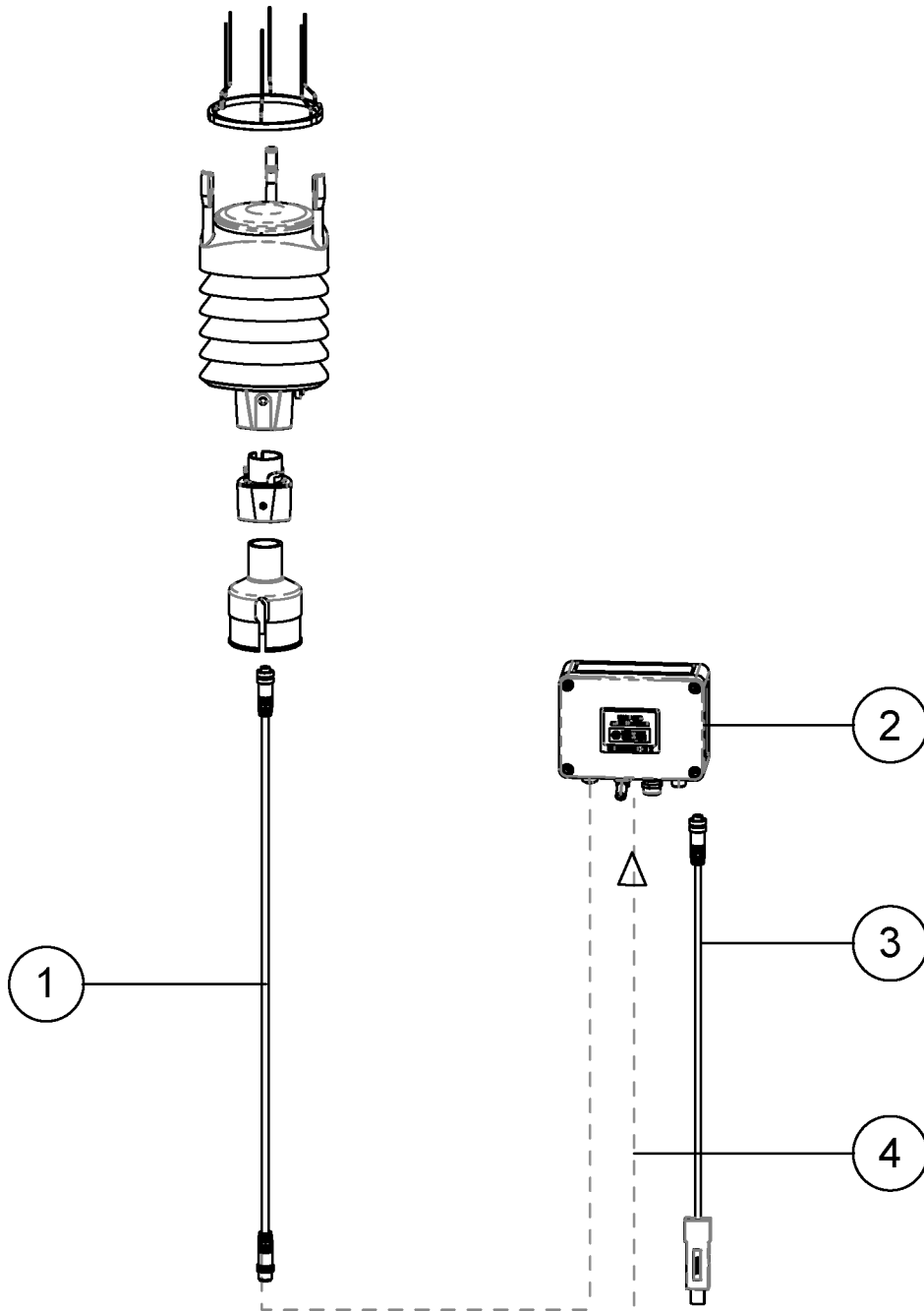
Figure 55   WXT536 with Surge Protector WSP150

1   Cable with open leads 222287 or 222288
2   WSP150 surge protector
3   Data output cable
4   Operating and heating powers
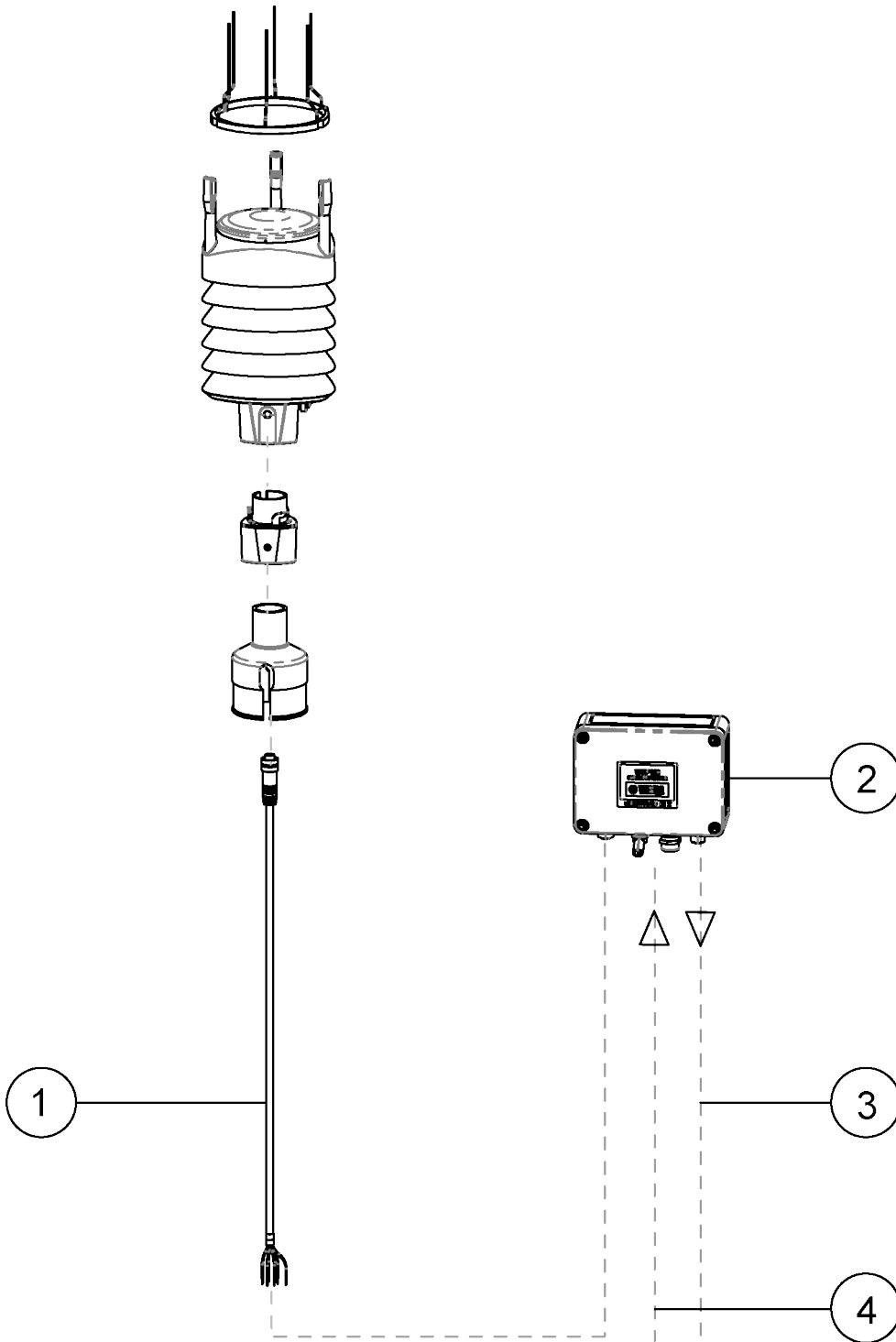
Figure 56   WXT536 with Surge Protector WSP152

1   Cable with connectors on both ends 225952
2   WSP152 surge protector
3   USB cable 220782
4   Operating and heating powers

Appendix H. Configuration Parameters

Table 58   General Parameters

Parameter	Factory	Range	Info	Command
Supervisor settings	Order option defined*	1 = Th Heating temperature	Format:1111000011000000	**SU,R**
		1 = Vh Heating voltage	First 8 are for combined message and last 8 for composite message.	
		1 = Vs Supply voltage	1 = Data is on	
		1 = Vr 3.5 V reference voltage	0 = Data is off	
		1 = Id Information field	Note that you write the parameter format 1111000011000000 but the unit answers: 11110000&11000000	
		0 = Reserved		
		0 = Reserved		
		0 = Reserved [& = Delimiter]	* For the heated unit factory the setting is 1111000011000000and for the non-heated 0000000000000000	
		1 = Th Heating temperature		
		1 = Vh Heating voltage		
		0 = Vs Supply voltage		
		0 = Vr 3.5 V reference voltage		
		0 = Id Information field		
		0 = Reserved		
		0 = Reserved		
		0 = Reserved		
Device address	0	0 ... 9, A. ... Z, a ... z	Address identifier	**XU,A**
Protocol selection	Order option defined	A = ASCII, automatic		**XU,M**
		a = ASCII, automatic w. crc		
		P = ASCII, polled		
		p = ASCII, polled w. crc		
		N = NMEA, automatic		
		Q = NMEA, query		
		S = SDI-12, R		
		R = SDI, continuous meas		
Test message	0		For test purposes	**XU,T**

Parameter	Factory	Range	Info	Command
Serial interface	Order option defined	1 = SDI-12	*Note that RS-422 hardware is wired differently inside the unit.	**XU,C**
		2 = RS-232		
		3 = RS-485		
		4 = RS-422*		
Repeat interval in seconds	0	0 ... 3600 seconds		**XU,I**
Baud rate	Order option defined	1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200 Bauds		**XU,B**
Data bits	Order option defined	7, 8		**XU,D**
Parity	Order option	O = Odd E = Even N = None		**XU,P**
Stop bits	Order option defined	1, 2		**XU, S**
RS-485 delay	25	0 ... 10000 ms		**XU,L**
Device name	Order option defined	WXT531 ... WXT536	Read-only	**XU,N**
Software version	3.xx	3.xx	Read-only	**XU,V**

Table 59   Pressure, Temperature and Humidity Parameters

Parameter	Factory	Range	Info	Command
PTU data controls	Order option defined	1 = Pa Air pressure	Format:1101000011010000 The first 8 are for combined message and the last 8 for composite message. 1 = Data is on 0 = Data is off Note that you write the parameter format: 1101000011010000 but the unit answers 11010000&11010000.	**TU,R**
		1 = Ta Air temperature		
		0 = Tp internal temperature		
		1 = Ua Air humidity		
		0 = Reserved		
		0 = Reserved		
		0 = Reserved		
		0 = Reserved[& = Delimiter]		
		1 = Pa Air pressure		
		1 = Ta Air temperature		
		0 = Tp internal temperature		
		1 = Ua Air humidity		
		0 = Reserved		
		0 = Reserved		
		0 = Reserved		
		0 = Reserved		
PTU update interval	60	1 … 3600 seconds		**TU,I**
Pressure unit	H	H = hPa P = Pascal B = bar I = inHg		**TU,P**
Temperature unit	C	C = Celsius, F = Fahrenheit		**TU,T**

Table 60   Wind Parameters

Parameter	Factory	Range	Info	Command
Wind data controls	Order option defined	1 = Dn Direction minimum	Format:1111110001001000 The first 8 are for combined message and the last 8 for composite message. 1 = Data is on 0 = Data is off Note that you write the parameter format 1111110001001000 but the unit answers 11111100&01001000.	**WU,R**
		1 = Dm Direction average		
		1 = Dx Direction maximum		
		1 = Sn Speed minimum		
		1 = Sm Speed average		
		1 = Sx Speed maximum		
		0 = Reserved		
		0 = Reserved[& = Delimiter]		
		0 = Dn Direction minimum		
		1 = Dm Direction average		
		0 = Dx Direction maximum		
		0 = Sn Speed minimum		
		1 = Sm Speed average		
		0 = Sx Speed maximum		
		0 = Reserved		
		0 = Reserved		
Wind update interval	5	1 … 3600 seconds		**WU,I**
Wind averaging time	3	1 … 3600 seconds		**WU,A**
Wind speed calculation mode	1	1 = Max/min calculation 3 = Gust/lull calculation		**WU,G**
Wind speed unit	M	M = m/s, K = km/h, S = mph, N = knots		**WU,U**
Wind direction offset	0	-180 … 180		**WU,D**
NMEA format	W	T = XDR, W = MWV		**WU,N**
Sampling rate	4	1, 2, 4 Hz		**WU,F**

Table 61   Precipitation Parameters

Parameter	Factory	Range	Info	Command
Precipitation data controls		1 = Rc Rain amount	Format:1111110010000000	**RU,R**
		1 = Rd Rain duration	The first 8 are for combined message and the last 8 for composite message.	
		1 = Ri Rain intensity	1 = Data is on	
		1 = Hc Hail amount	0 = Data is off	
		1 = Hd Hail duration	Note that you write the parameter format 1111110010000000 but the unit answers 11111100&10000000.	
		1 = Hi Hail intensity		
		1 = Rp Rain peak		
		1 = Rp Hail peak[& = Delimiter]		
		1 = Rc Rain amount		
		1 = Rd Rain duration		
		1 = Ri Rain intensity		
		1 = Hc Hail amount		
		1 = Hd Hail duration		
		1 = Hi Hail intensity		
		1 = Rp Rain peak		
		1 = Rp Hail peak		
Precipitation update interval	60	1 ... 3600 seconds		**RU,I**
Precipitation unit	M	M = metric (mm, s, mm/h) I = imperial (in, s, in/h)		**RU,U**

Table 62   Auxiliary Sensor Parameters

Parameter	Factory	Range	Info	Command
Auxiliary sensor controls	Order option defined	1 = Tr pt1000 temperature	Format: 1111100011111000 The first 8 are for combined message and the last 8 for composite message. 1 = Data is on 0 = Data is off Note that you write the parameter format 1111100011111000 but the unit answers 11111000&11111000 Note that Analog output mode is never set when external sensors are in use.	IU,R
		1 = Ra Aux. rain amount		
		1 = Sl Ultrasonic level sensor		
		1 = Sr Solar radiation		
		1 = Rt pt1000 resistance		
		0 = Reserved		
		1 = Analog output mode*		
		0 = Reserved[& = Delimiter]		
		1 = Tr pt1000 temperature		
		1 = Ra Aux. rain amount		
		1 = Sl Ultrasonic level sensor		
		1 = Sr Solar radiation		
		1 = Rt pt1000 resistance		
		0 = Reserved		
		0 = Reserved		
		0 = Reserved		
Auxiliary sensor update interval	60	0.5 ... 3600 seconds		IU,I
Auxiliary sensor averaging time	3	0.25 ... 3600 seconds		IU,A
Auxiliary rain sensor gain	0.2	0.000000001 ... 1000000		IA,G
Reset mode (cumulative rain amount resetting)	M	M = resets rain when pulse amount exceeds 65535. When gain is 0.2, it resets at 65536*0.2 = 13107 (mm) L = resets when reaching limit value A = Cumulative rain value is reset every time rain information is sent out from transmitter (user counts cumulative rain amount).		IA,M
Rain reset limit	1000	0.000000001 ... 1000000		IA,L

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Parameter	Factory	Range	Info	Command
Auxiliary solar sensor gain	100000	0.000000001 ... 1000000		**IB,G**
Auxiliary level sensor gain	1	0.000000001 ... 1000000		**IS,G**
Auxiliary level sensor operating range	1	0 = 0 to 2.5 V range 1 = 0 to 5.0 V range 2 = 0 to 10.0 V range		**IS,M**
Auxiliary temperature averaging	1	0.5 ... 3600		**IP,A**

Table 63   Analog mA Output Parameters

Parameter	Factory	Range	Info	Command
Auxiliary sensor definitions	Order option defined	1 = Tr pt1000 temperature 1 = Ra Aux. rain amount 1 = Sl Ultrasonic level sensor 1 = Sr Solar radiation 1 = Rt pt1000 resistance 0 = Reserved 1 = Analog output mode 0 = Reserved[& = Delimiter] 1 = Tr pt1000 temperature 1 = Ra Aux. rain amount 1 = Sl Ultrasonic level sensor 1 = Sr Solar radiation 1 = Rt pt1000 resistance 0 = Reserved 0 = Reserved 0 = Reserved	Format: 0000001000000000 1 = mA output is in use 0 = mA output is off Note that you write the parameter format 0000001000000000 but the unit answers 00000010&00000000 Note that the analog output mode is used only inWXT532 with the mA output option.	**IU,R**
Wind speed gain	Order option defined	0.000000001 ... 1000000	4 ... 20 mA = 0.266667 (20 mA = 60 m/s) 0..20 mA = 0.333333 (20 mA = 60 m/s)	**SU,a**

Parameter	Factory	Range	Info	Command
Wind speed offset	Order option defined	0 … 24	4 … 20 mA = 4	**SU,b**
			0 … 20 mA = 0	
Wind speed minimum	0	0 … 24	4 … 20 mA = 0	**SU,c**
			0 … 20 mA = 0	
Wind speed maximum	20	0 … 24	4 … 20 mA = 20	**SU,d**
			0 … 20 mA = 20	
Wind speed error indication	22	0 … 24	4 … 20 mA = 22	**SU,e**
			0 … 20 mA = 22	
Wind direction gain	Order option defined	0.000000001 … 1000000	4 … 20 mA = 0.044444	**SU,f**
			0 … 20 mA = 0.055556	
Wind direction offset	Order option defined	0 … 24	4 … 20 mA = 4	**SU,g**
			0 … 20 mA = 0	
Wind direction minimum	0	0 … 24	4 … 20 mA = 0	**SU,h**
			0 … 20 mA = 0	
Wind direction maximum	20	0 … 24	4 … 20 mA = 20	**SU,j**
			0 … 20 mA = 20	
Wind direction error indication	22	0 … 24	4 … 20 mA = 22	**SU,k**
			0 … 20 mA = 22	

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Recycling

Recycle all applicable material.

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

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

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

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

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