VAISALA

USER'S GUIDE

Vaisala Weather Transmitter WXT530 Series

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CHAPTER 1
GENERAL INFORMATION

This chapter provides general notes for the product.

About This Manual

This manual provides information for installing, operating, and maintaining Vaisala Weather Transmitter WXT530 Series transmitters.

General Safety Considerations

Throughout the manual, important safety considerations are highlighted as follows:

WARNING	Warning alerts you to a serious hazard. If you do not read and follow instructions very 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	Note highlights important information on using the product.

ESD Protection

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

To make sure you are not delivering high static voltages yourself:

- Handle ESD sensitive components on a properly grounded and protected ESD workbench. When this is not possible, ground yourself with a wrist strap and a resistive connection cord to the equipment chassis before touching the boards. When neither of the above is possible, at least touch a conductive part of the equipment chassis with your other hand before touching the boards.

- Always hold the boards by the edges and avoid touching the component contacts.

Recycling

Recycle all applicable material.

Dispose of batteries and the unit according to statutory regulations. Do not dispose with regular household refuse.

Trademarks

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License Agreement

All rights to any software are held by Vaisala or third parties. The customer is allowed to use the software only to the extent that is provided by the applicable supply contract or Software License Agreement.

Regulatory Compliance

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)

Warranty

Visit our Internet pages for standard warranty terms and conditions: www.vaisala.com/warranty.

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

CHAPTER 2
PRODUCT OVERVIEW

This chapter introduces the features of the WXT530 series weather transmitters.

WXT530 Series Weather Transmitters

The WXT530 product family consists of six transmitters.

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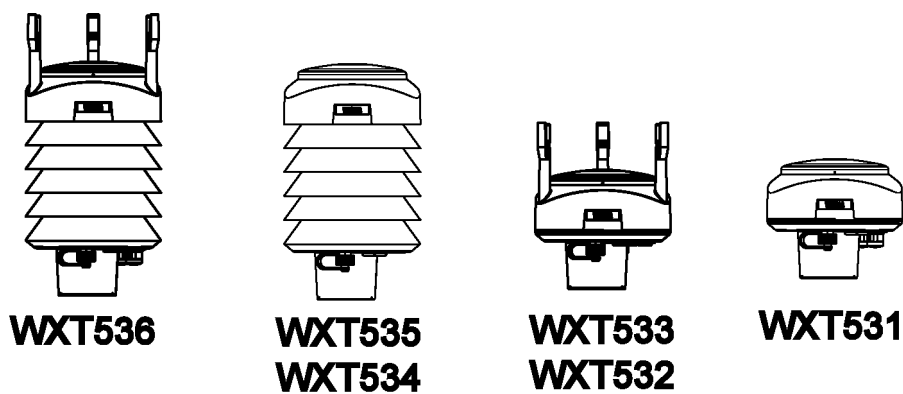
Figure 1   Vaisala Weather Transmitter WXT530 Series

The WXT530 series transmitters are suitable for, for example:

- Agro-meteorological applications

- Building control systems

- Cruisers

- Energy applications

- Environmental monitoring

- Fire weather

- Meteorological test beds

- Noise monitoring

- Researchers

- Sport events

- Weather stations

The WXT530 product family offers a variety of weather parameters. The measurement combinations of each model are listed below.

	WXT536	WXT535	WXT534	WXT533	WXT532	WXT531
P	●	●	●	□	□	□
T	●	●	●	□	□	□
U	●	●	●	□	□	□
R	●	●	□	●	□	●
W	●	□	□	●	●	□
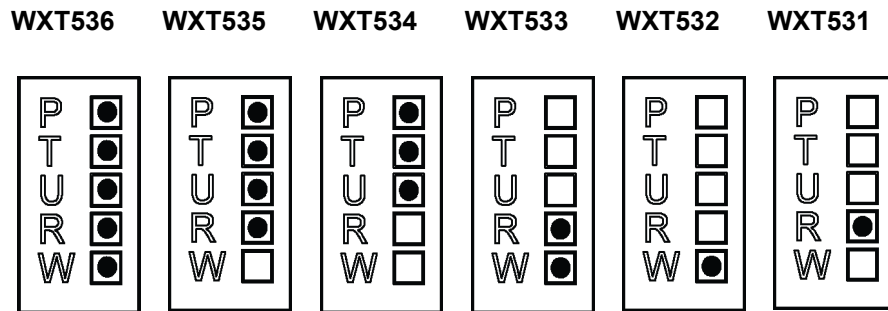
P = Pressure
T = Temperature
U = Humidity
R = Rain
W = Wind

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

- SDI-12

- ASCII automatic and polled

- NMEA 0183 with query option

There WXT530 series provides four serial interface options:

- RS-232

- RS-485

- RS-422

- SDI-12

The transmitter is equipped with a 8-pin M12 connector for installation, and a 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 1   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)	X	X	X	X	X	X
USB RS-232/RS-485 cable (1.4 m)	X	X	X	X	X	X
Mounting kit	X	X	X	X	X	X
Surge protector	X	X	X	X	X	X
Bird kit	X	X	X	X	X	X
Shielded cables (2 m, 10 m, 40 m)	X	X	X	X	X	X
Bushing and grounding kit	X	X	X	X	X	X
Heating	X	X		X	X	X
Analog input option	X					
mA output option					X	

WXT536

WXT536 measures pressure, temperature, humidity, rain, wind speed, and wind direction. It offers an analog input option.
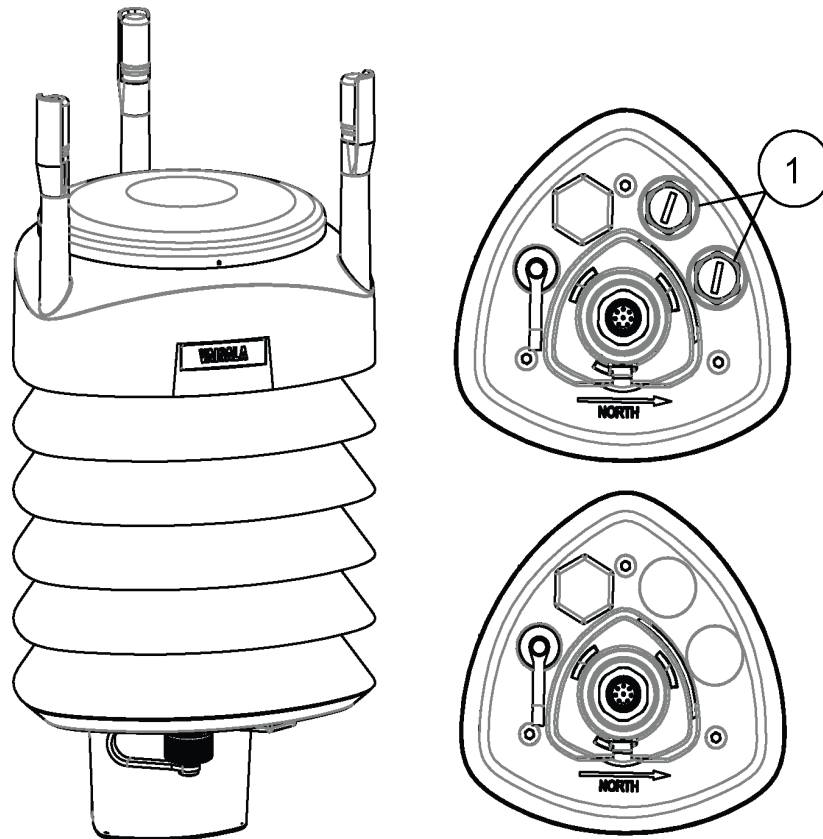
Figure 2   **WXT536**

1   =   Analog input

WXT535 and WXT534

WXT535 measures pressure, temperature, humidity, and rain.

WXT534 measures pressure, temperature, and humidity.
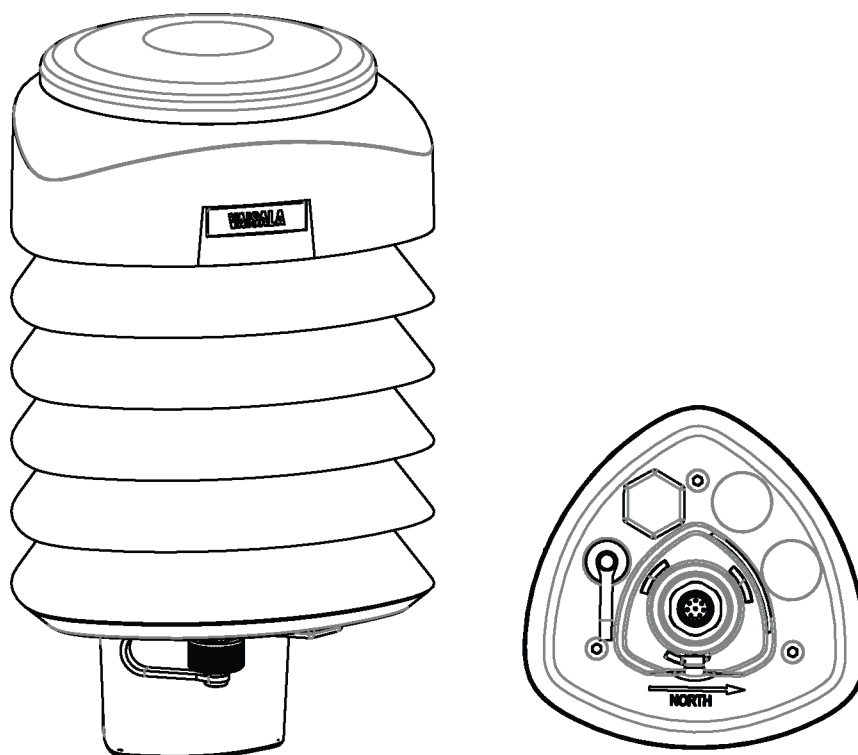
Figure 3   WXT535 and WXT534

WXT533 and WXT532

WXT533 measures rain and wind.

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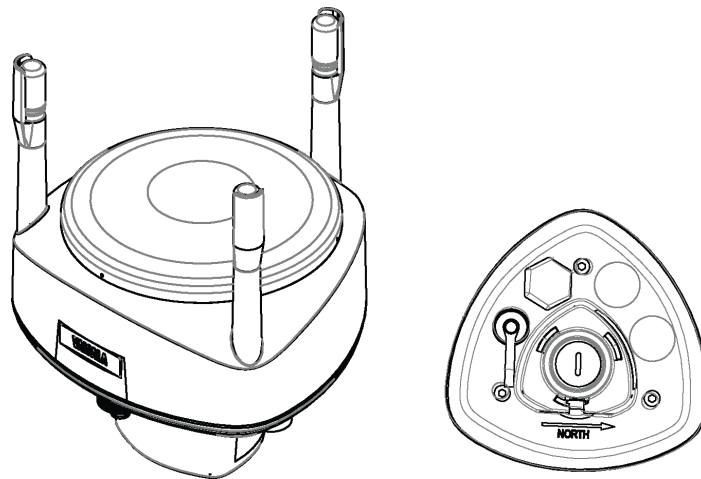
Figure 4   WXT533 and WXT532

WXT531

WXT531 measures rain.
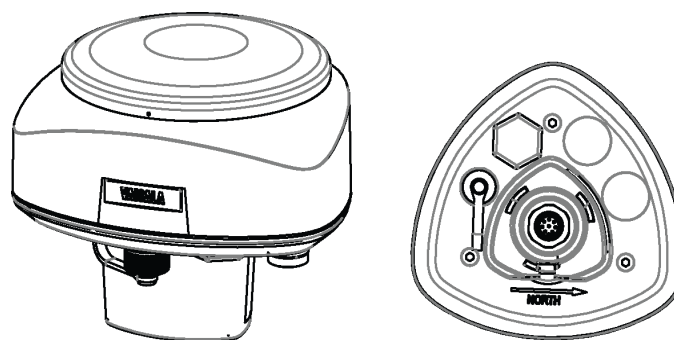
Figure 5   WXT531

Components
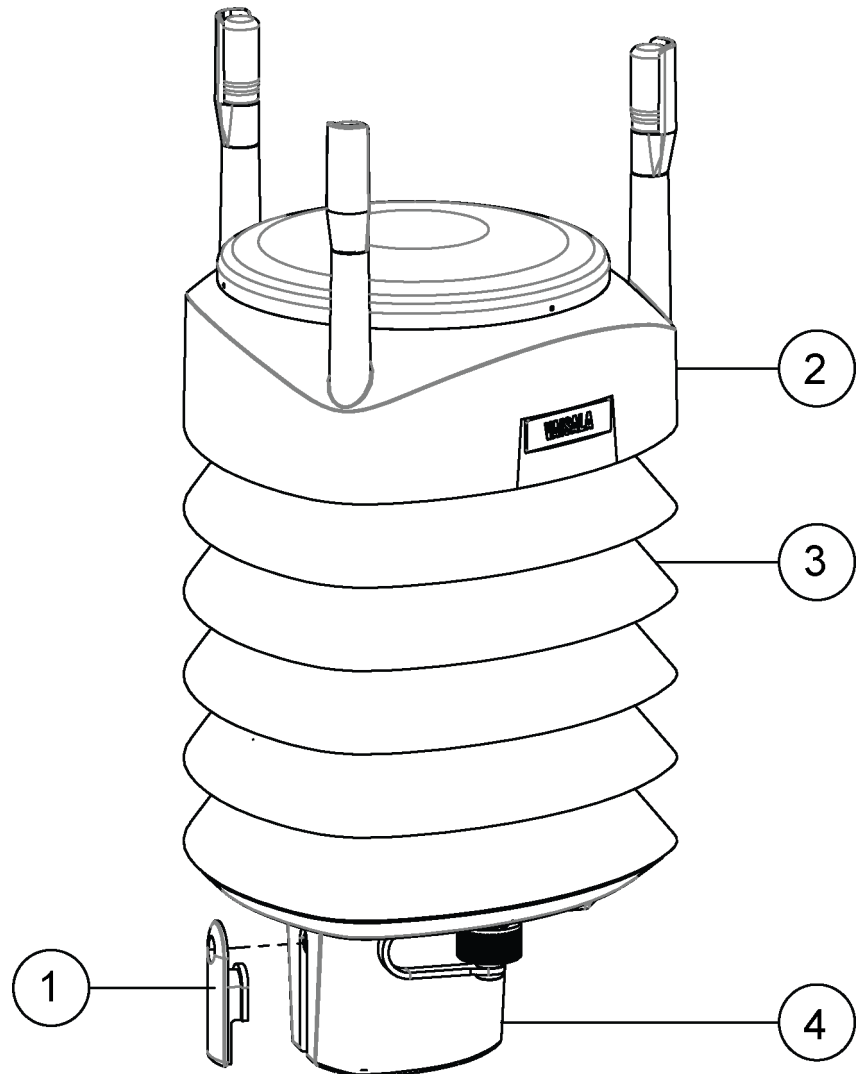
Figure 6   WXT536 Components

1 = Screw cover

2 = Top of the transmitter

3 = Radiation shield

4 = Bottom of the transmitter
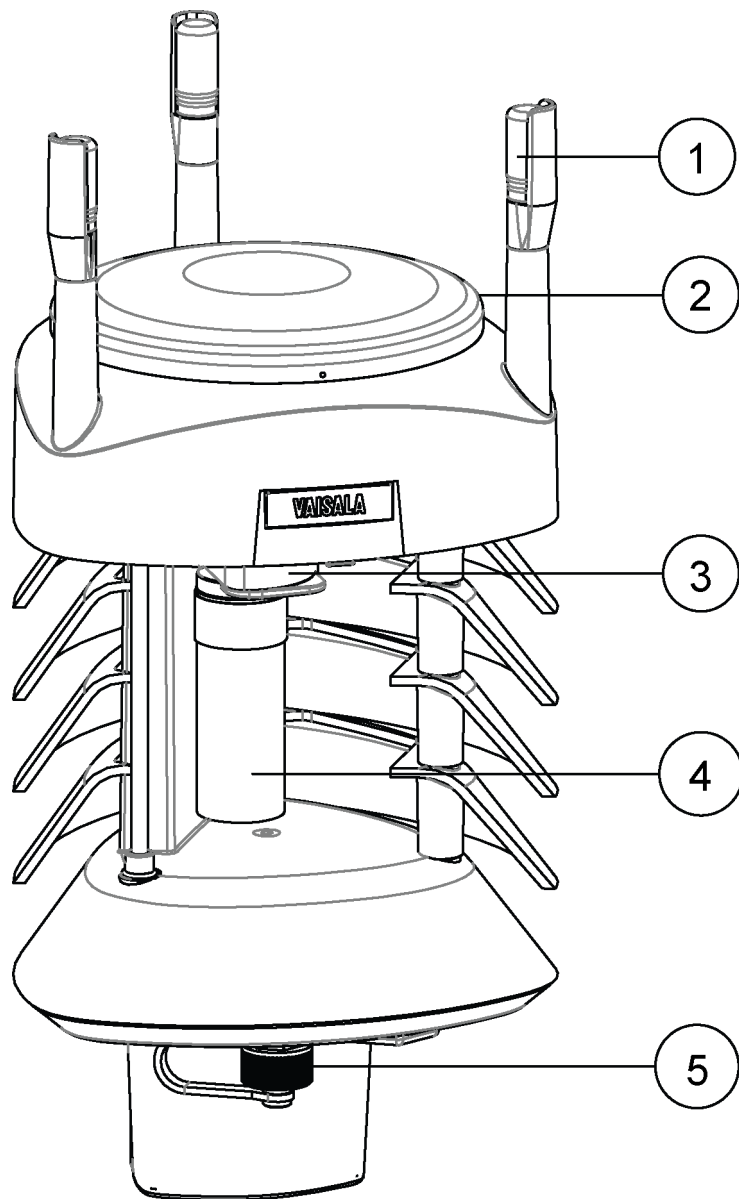
Figure 7   Cut-Away View of WXT536

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
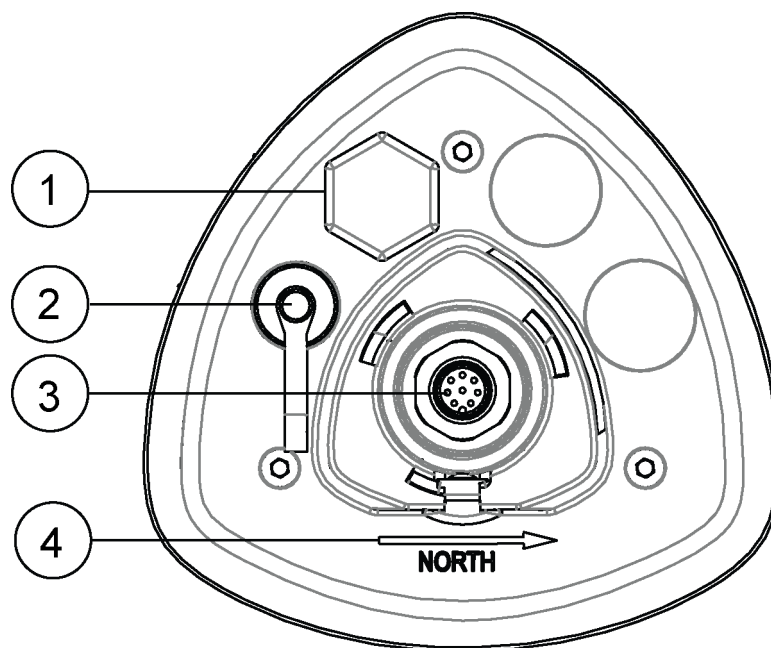
Figure 8   Bottom of WXT536

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

Optional features

The WXT530 series includes the following optional features. For a complete list, see Table 42 on page 183. Note that you must select these options when placing the order.

USB Cables
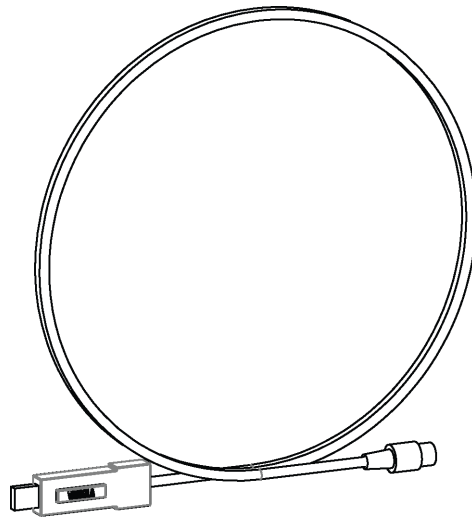
Figure 9   **USB Cable**

1   =   USB RS-232/RS-485 cable with 8-pin M12 threaded connector (1.4 m)

2   =   USB service cable with 4-pin M8 snap-on 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. Note that you need a driver for the USB cable.

Mounting Kit
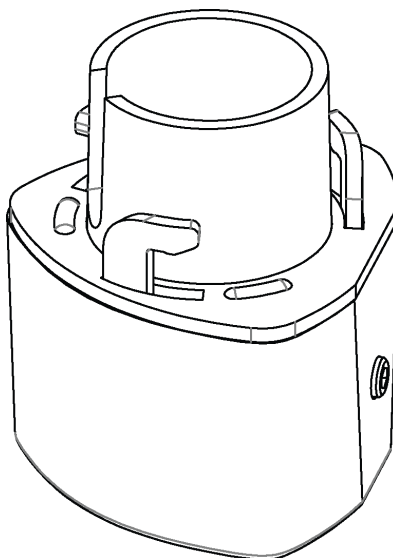
Figure 10   Mounting Kit

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

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

Surge Protector
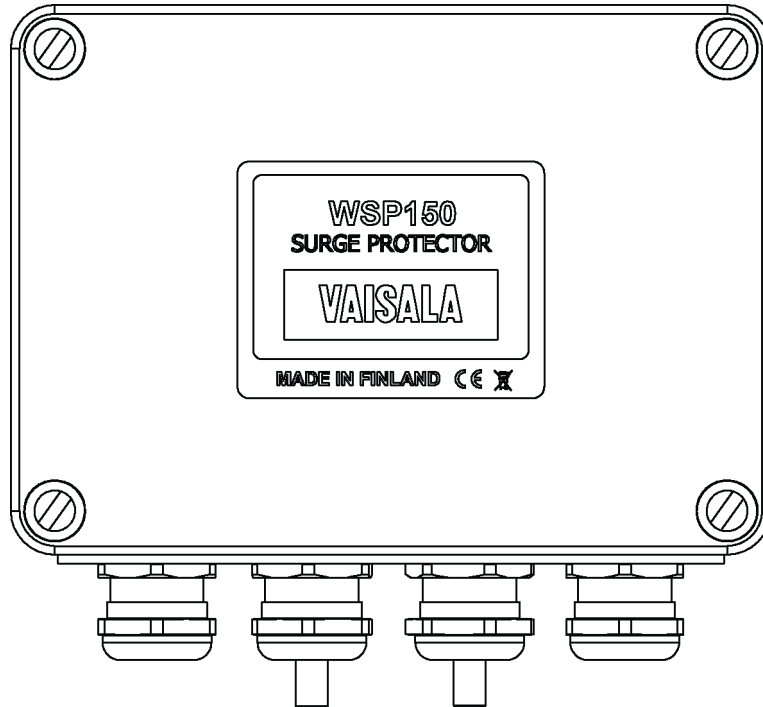
Figure 11   Surge Protector

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.

Surge protectors are also recommended if your cable length exceeds 10 m or 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).

Bird Spike Kit
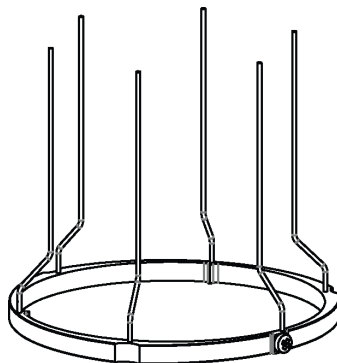
Figure 12   Bird Spike Kit

The optional Bird Spike 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.
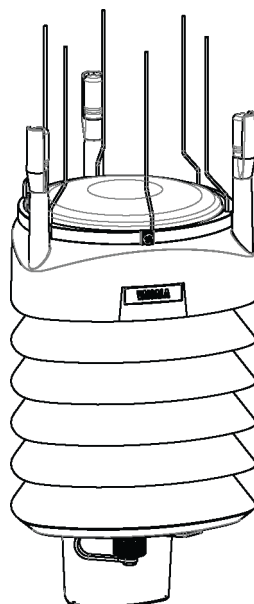
Figure 13   WXT536 with Bird Spike Kit

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.

Note that when the kit is in place, more snow can accumulate on the transmitter, and the snow can melt away more slowly.

Vaisala Configuration Tool

Vaisala Configuration Tool is a Windows-based, user-friendly parameter setting software for the WXT530 Series transmitters. It has a USB adapter.

Using this software tool, you can change the device and sensor settings easily in Windows environment.

Sensor Heating

Heating helps to improve the measurement accuracy. See Heating on page 34.

CHAPTER 3
FUNCTIONAL DESCRIPTION

This chapter describes the functions of the WXT530 series transmitters.

Wind Measurement Principle

WXT536	WXT535	WXT534	WXT533	WXT532	WXT531
X			X	X	

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:

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

where

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. See Appendix D Wind Measurement Averaging Method, on page 205.

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

-    Traditional minimum/maximum calculation

-    3-second gust & lull 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).

Precipitation Measurement Principle

WXT536	WXT535	WXT534	WXT533	WXT532	WXT531
X	X		X		X

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.

For details about the precipitation sensor operation, see Precipitation
Sensor on page 140.

PTU Measurement Principle

WXT536	WXT535	WXT534	WXT533	WXT532	WXT531
X	X	X			

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.

Heating

WXT536	WXT535	WXT534	WXT533	WXT532	WXT531
X	X		X	X	X

NOTE	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 sensor (Th) 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 2   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 (5s) 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. See Supervisor Message on page 146.

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

Analog Input Interface

WXT536	WXT535	WXT534	WXT533	WXT532	WXT531
X					

WXT536 offers an analog input option for solar radiation, external temperature, level measurement, and tipping bucket.
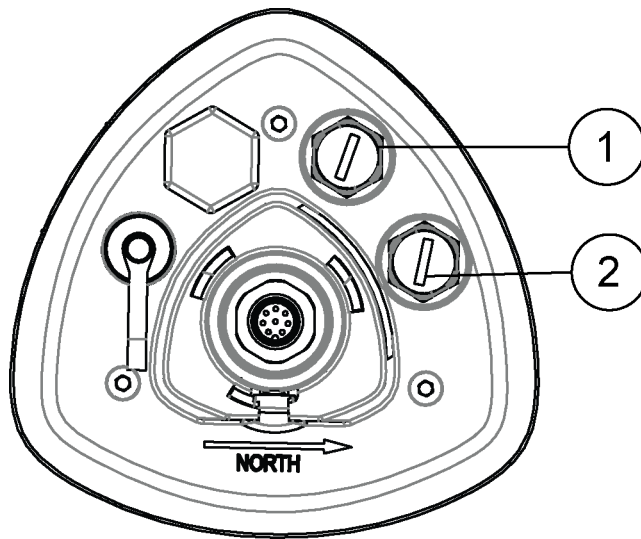
Table 3   Analog Inputs for External Sensors

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

Analog Output Interface

WXT536	WXT535	WXT534	WXT533	WXT532	WXT531
				X	

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.

CHAPTER 4
INSTALLATION

This chapter provides instructions on installing the transmitter.

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

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 the transmitter in the vicinity of a magnetic compass. The product is magnetically inert, but the compass-safe distance is not defined
- Do not place the transmitter directly in front of a radar.
- Do not install the transmitter next to a powerful RF-transmitter antenna.

Selecting the Location

Following WMO guidelines, 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. In general, any object of height (h) does not significantly disturb wind measurement at a minimum distance of 10 times the height of the object. Make sure there is at least 150 m open area in all directions from the mast.
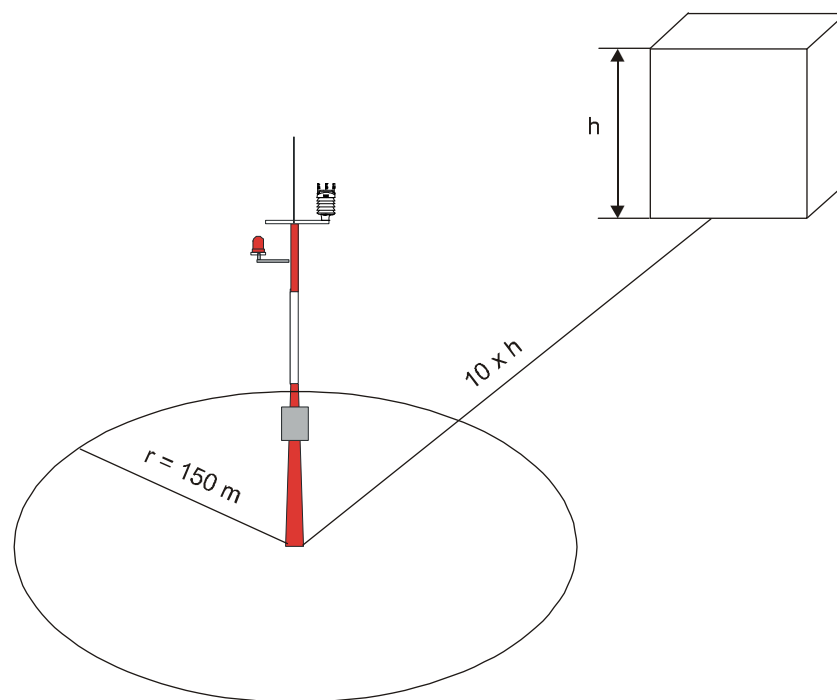
Figure 14   Recommended Mast Location in Open Area
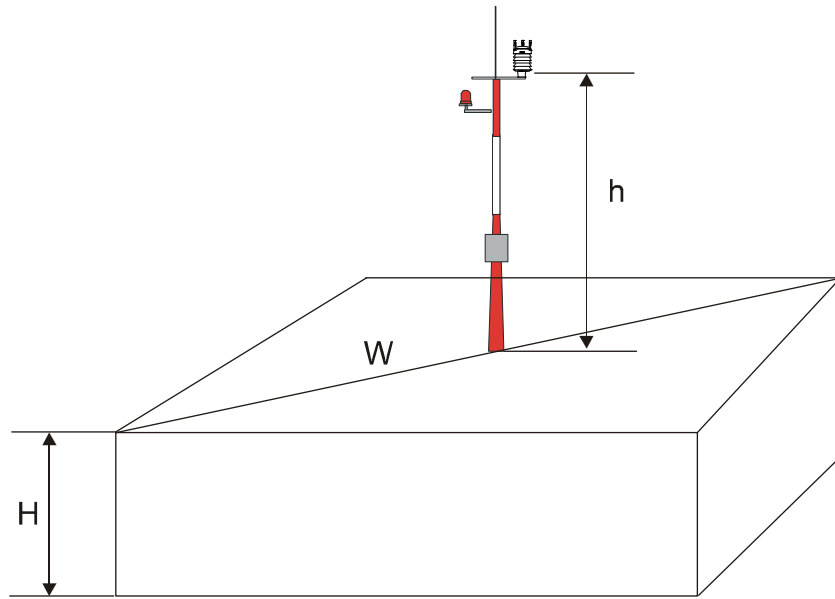
Figure 15   Recommended Mast Length on Top of Building

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.

WARNING	To protect personnel and the transmitter, install a lightning rod with the tip at least one meter above the transmitter. The rod 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.

Unpacking

The transmitter comes in a custom shipping container. The figure below shows the contents of the carton.
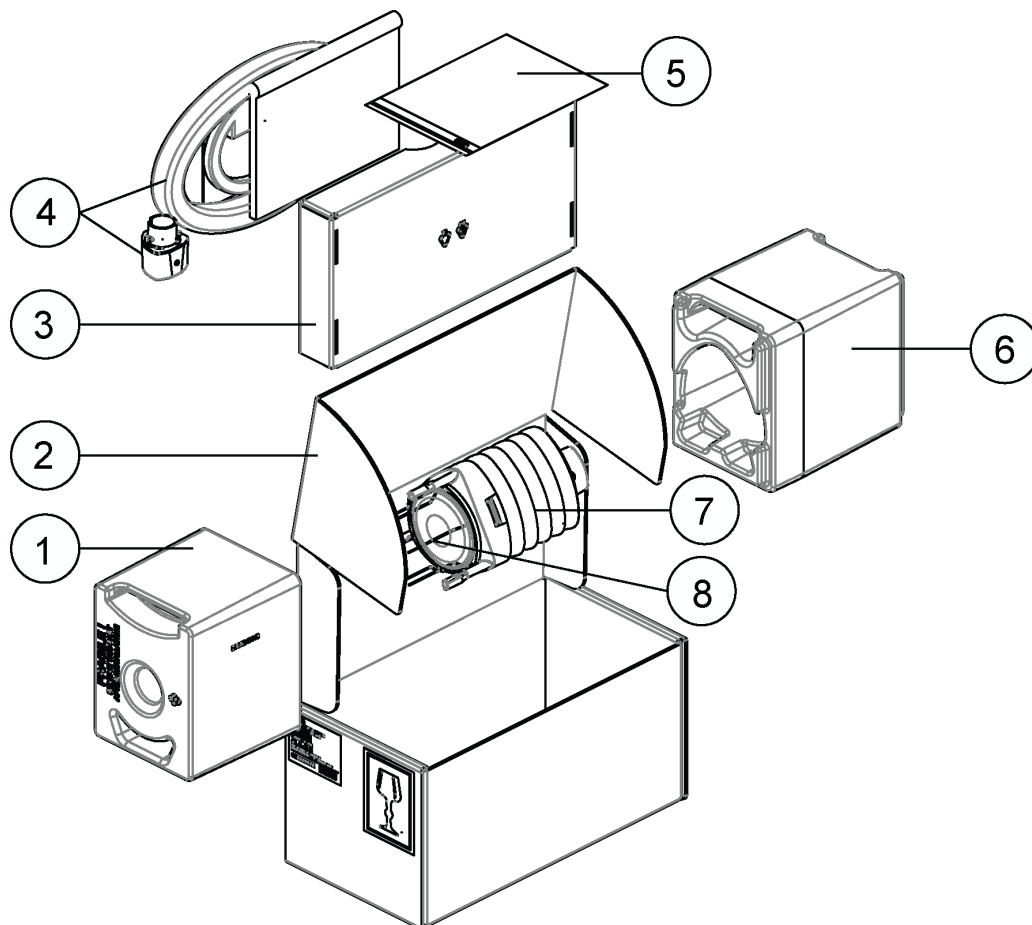
Figure 16   Contents of Shipping Container

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)

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.
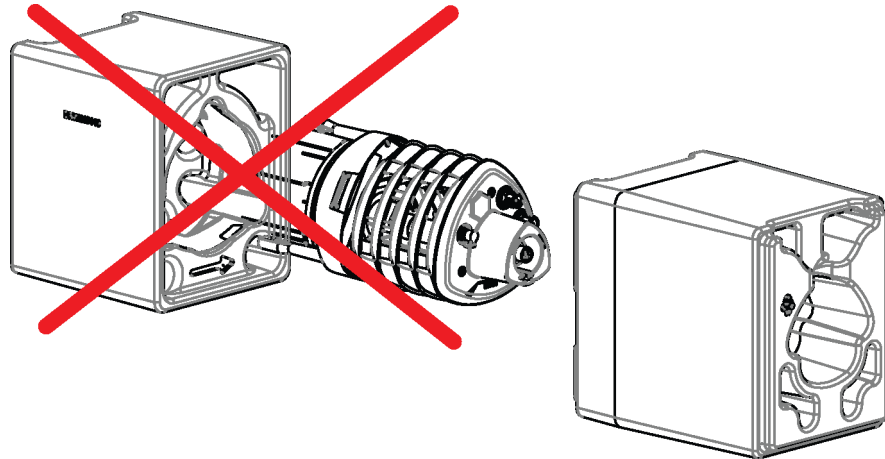
Figure 17   Installing with Protective Packaging

CAUTION

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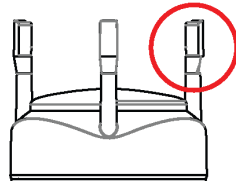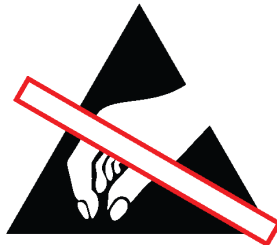
Dropping the device can break or damage the transducers. If the antenna bends or twists, re-aligning can be difficult or impossible.

NOTE

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

Installing the Transmitter

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

WARNING	To protect personnel and the device, install a lightning rod with the tip at least one meter above the transmitter. The rod must be properly grounded, compliant with all applicable local safety regulations.

Mounting

The transmitter is easy to install as it does not have any moving parts. The transmitter can be mounted onto

- vertical pole mast

- horizontal cross arm

NOTE	Install the transmitter upright.

NOTE	The transmitter radiation shield reflects light. If you install the transmitter next to a pyranometer, the pyranometer can give incorrect measurements. Install the transmitter on the same level with the pyranometer so that the distance between the units is 70 ... 80 cm (27 ... 31 in).

[31.5]
800
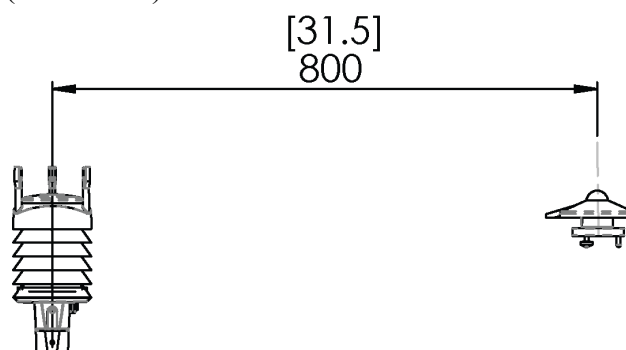
Mounting on Vertical Pole Mast

To mount a transmitter on a vertical pole mast:

1. Remove the screw cover and insert the transmitter to the pole mast.
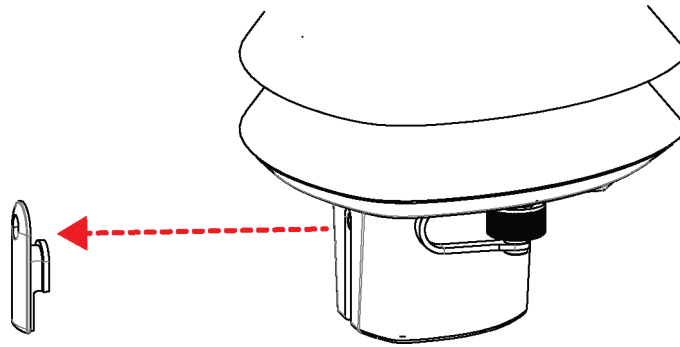
Figure 18   Removing Screw Cover

2. Align the transmitter so that the arrow points to north.
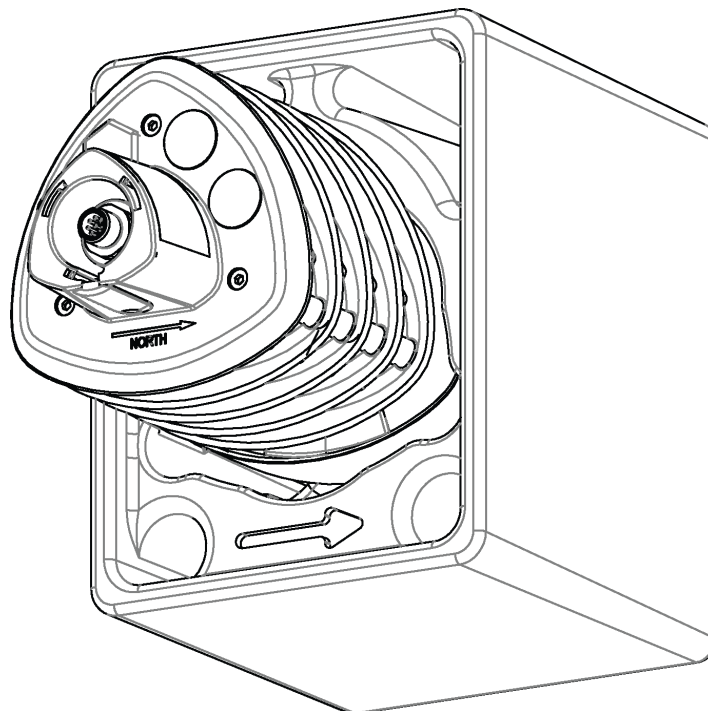
Figure 19   North Arrow

3. Tighten the fixing screw and replace the screw cover.

Mounting on Vertical Pole Mast with Mounting Kit

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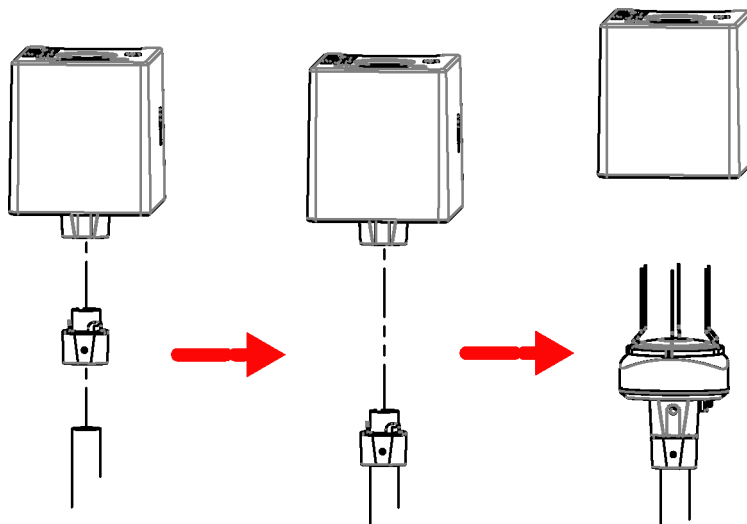
Figure 20   Mounting WXT531 on Vertical Pole Mast

To mount a transmitter on a vertical pole mast with the mounting kit:

1.   Insert the mounting kit adapter to the transmitter bottom.
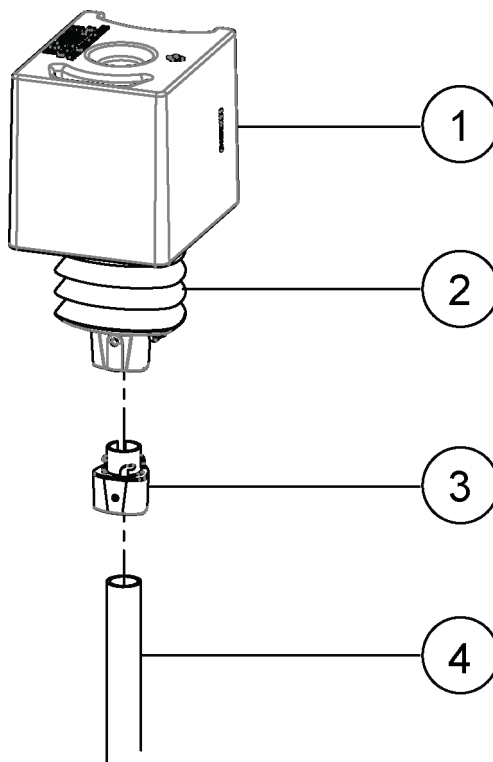
Figure 21   Mounting Transmitter with Mounting Kit

1   =   Protective cushion

2   =   Transmitter

3   =   Mounting kit

4   =   Pole

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

3. Mount the adapter to the pole mast but do not tighten the fixing screw.

4. Align the transmitter so that the arrow on the bottom of the transmitter points north.

5. Tighten the fixing screw of the mounting adapter to attach the adapter firmly to the pole mast.

6. Remove the protective cushion.
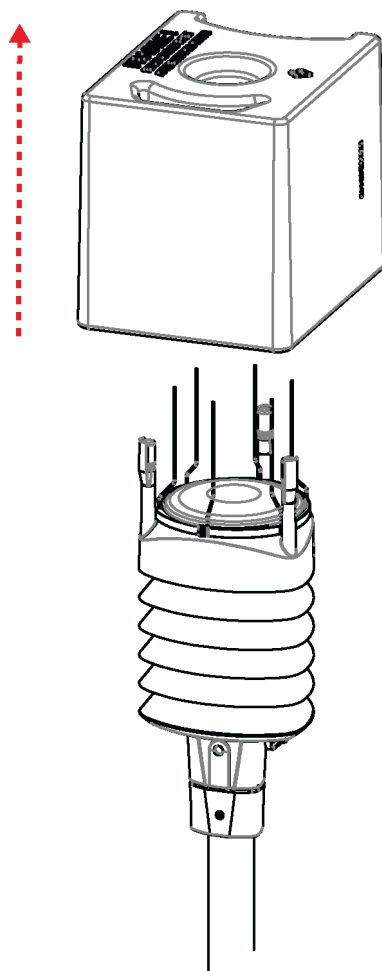
Figure 22   Removing Protective Cushion after Installation

NOTE	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.

Mounting on Horizontal Cross Arm

When using the optional mounting kit, alignment is needed only when mounting for the first time.

To mount a transmitter on a horizontal cross arm:

1. Remove the screw cover.

2. Align the horizontal cross arm in south-north direction. See Aligning on page 50.

   If you cannot align the cross arm, adjust the wind direction offset as instructed in Wind Direction Offset on page 52.

3. Mount the transmitter on the cross arm using a mounting bolt (M6 DIN933) and a nut (M6 DIN934).
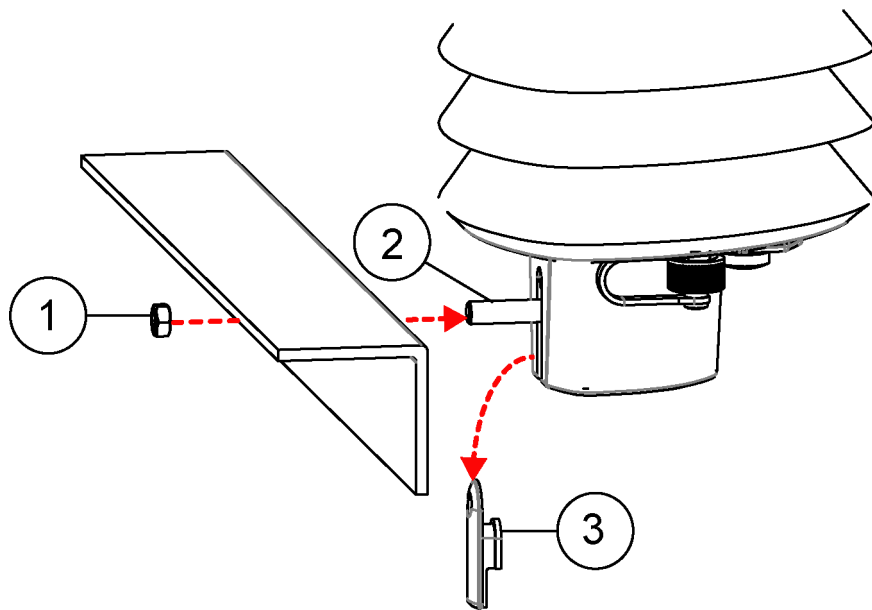
Figure 23   Mounting Transmitter to Cross Arm (L-Profile)

1 = Nut (M6 DIN934)

2 = Mounting bolt (M6 DIN933)

3 = Screw cover
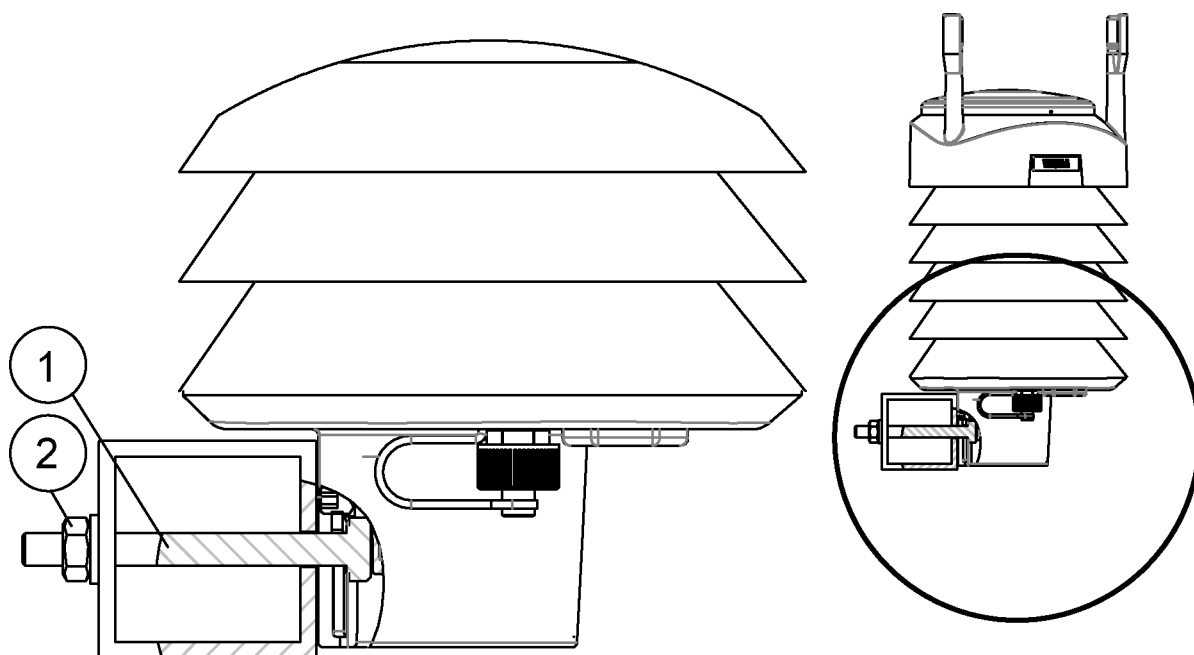
Figure 24   Mounting Bolt Location in Cross Arm

1   =   Nut (M6 DIN934)

2   =   Mounting bolt (M6 DIN933)

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.

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 and a cable to ensure ground connection.

Use the Bushing and Grounding Kit (222109) to run a cable from the fixing screw to a grounding point. The kit includes:

- A longer fixing screw

- Two nuts and washers

- Abiko connector for the grounding cable

The kit does not include the grounding cable. The minimum grounding conductor size is 4 mm^2 (AWG 11). Use a 16 mm^2 conductor to achieve a good ground connection.

shows how to assemble and install the kit.
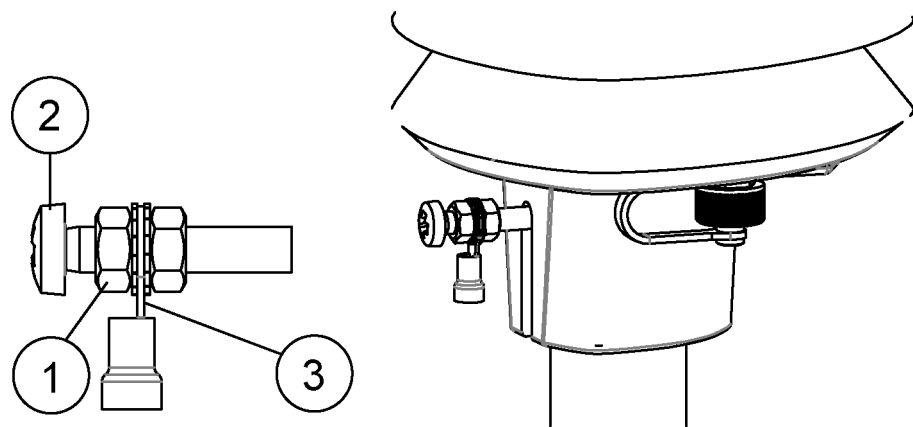
Figure 25   Grounding with Bushing and Grounding Kit

1   =   Nut

2   =   Fixing screw

3   =   Abiko connector between two washers

Aligning

WXT536	WXT535	WXT534	WXT533	WXT532	WXT531
X			X	X	

To help the alignment, there is an arrow and the text "North" on the bottom of the transmitter. Align the transmitter so that this arrow points north.

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.
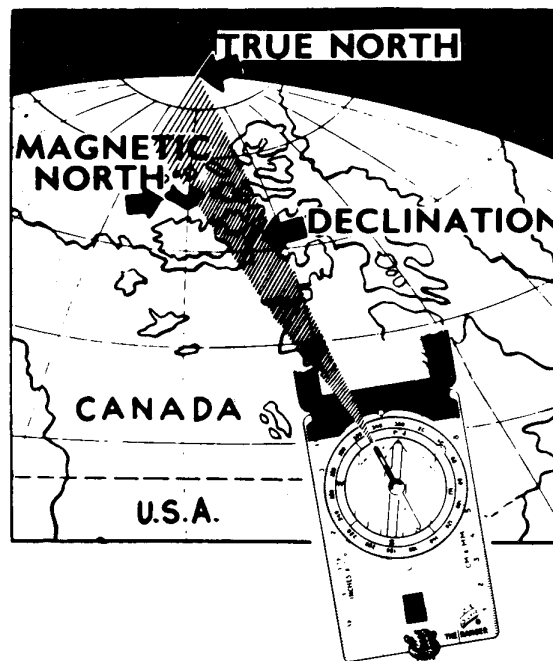
Figure 26   Sketch of Magnetic Declination

Compass Alignment

To align a transmitter:

1.   If the transmitter is already 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.

Wind Direction Offset

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

1. Mount the transmitter to a desired position. See Mounting on page 43.

2. Define the deviation angle from the north-zero alignment. Use the ± sign indication to express the direction from the north line.
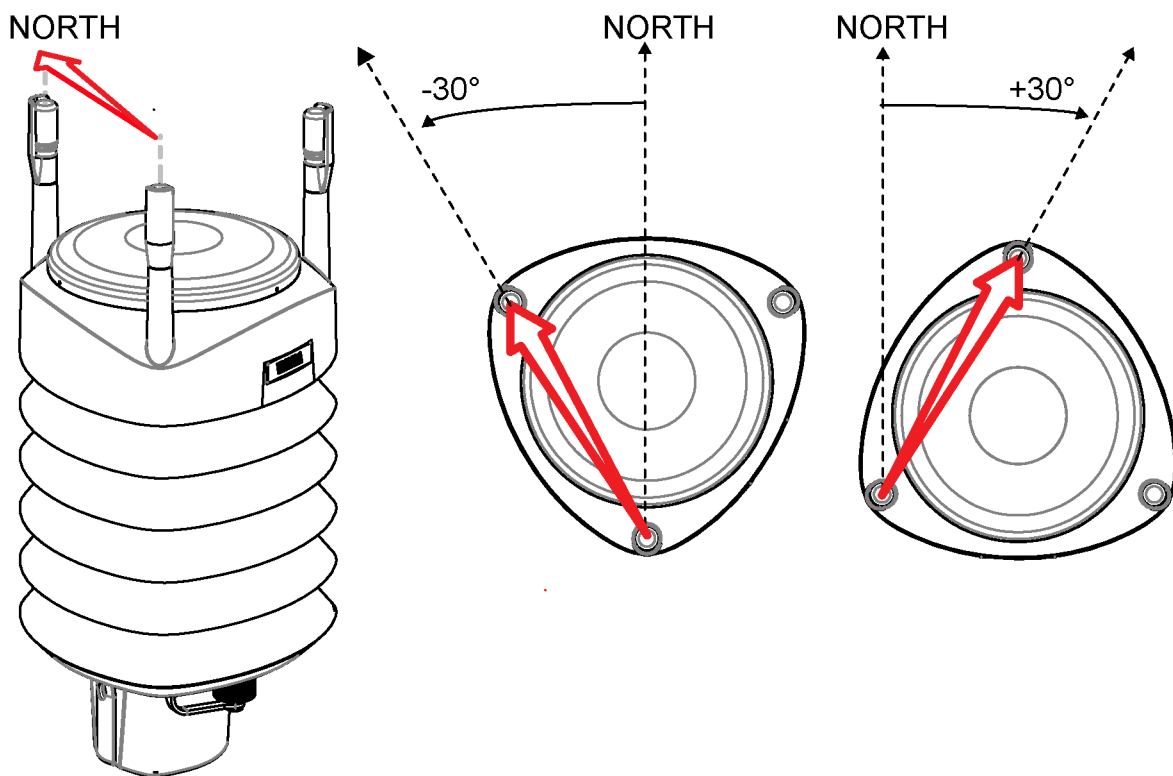
Figure 27   Wind Direction Offset

3. Enter the deviation angle in the device using the wind message formatting command **aWU,D** (direction offset). See Checking the Settings (aWU) on page 129.

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

CHAPTER 5
WIRING AND POWER MANAGEMENT

This chapter provides instructions on connecting the power supply and the serial interfaces as well as managing and estimating power consumption.

The transmitter can be accessed through four different 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. Only one serial interface can be used 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.

Power Supplies

Operating voltage Vin+: 5 ... 32 VDC.

NOTE	In maritime environments, the normal input voltage ranges are: operating voltage 6 ... 27 VDC (-10 % ... +30 %) and heating voltage 12 ... 27 VDC (-10 % ... +30 %), as defined in the maritime standard IEC 60945.

Note the average current consumption shown in . The minimum consumption graph is for SDI-12 standby mode.
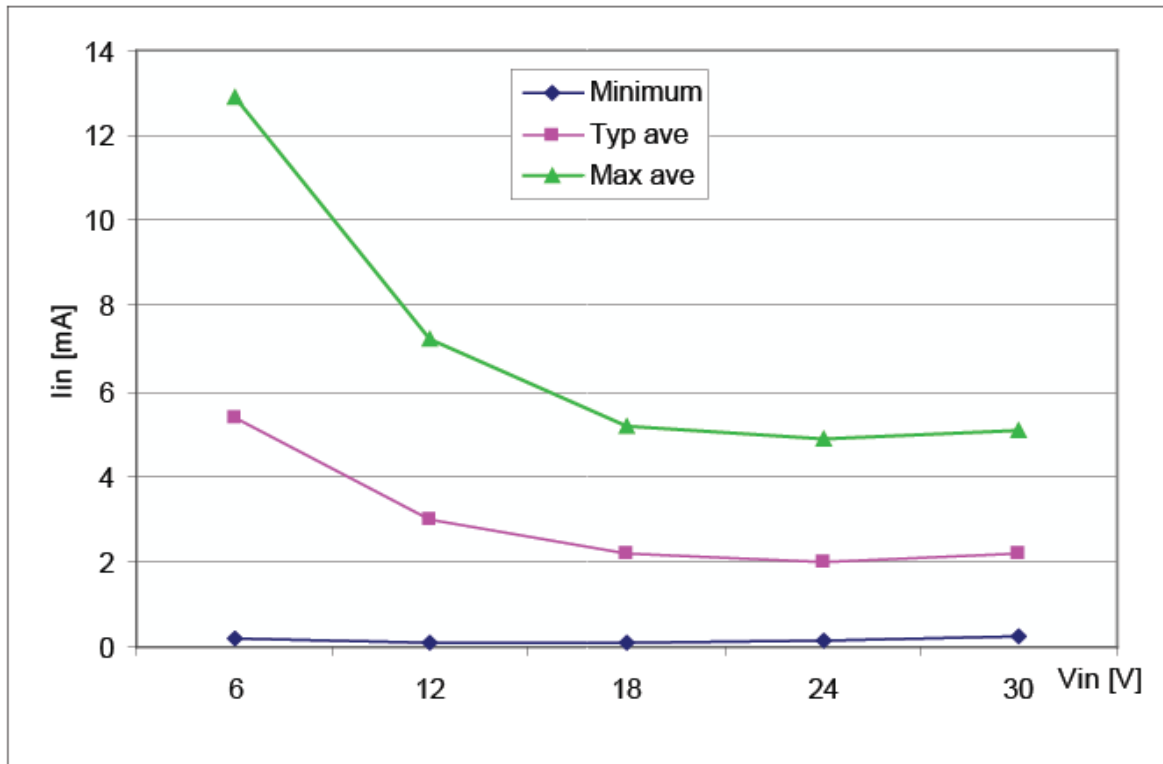
Figure 28   Average Operational Current Consumption (with 4Hz Wind Sensor Sampling)

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. See .

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):

-    5 ... 32 VDC

-    AC, max $V_{peak\text{-}to\text{-}peak}$ 66 V

-    Full-wave rectified AC, max V_{peak} 33 V

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 ranges for AC or full-wave rectified AC are:

-    55 $V_{p\text{-}p}$ ±20% (max 0.6 A) for AC

-    27.5 V_p ±20% (max 0.6 A) for f/w rectified AC
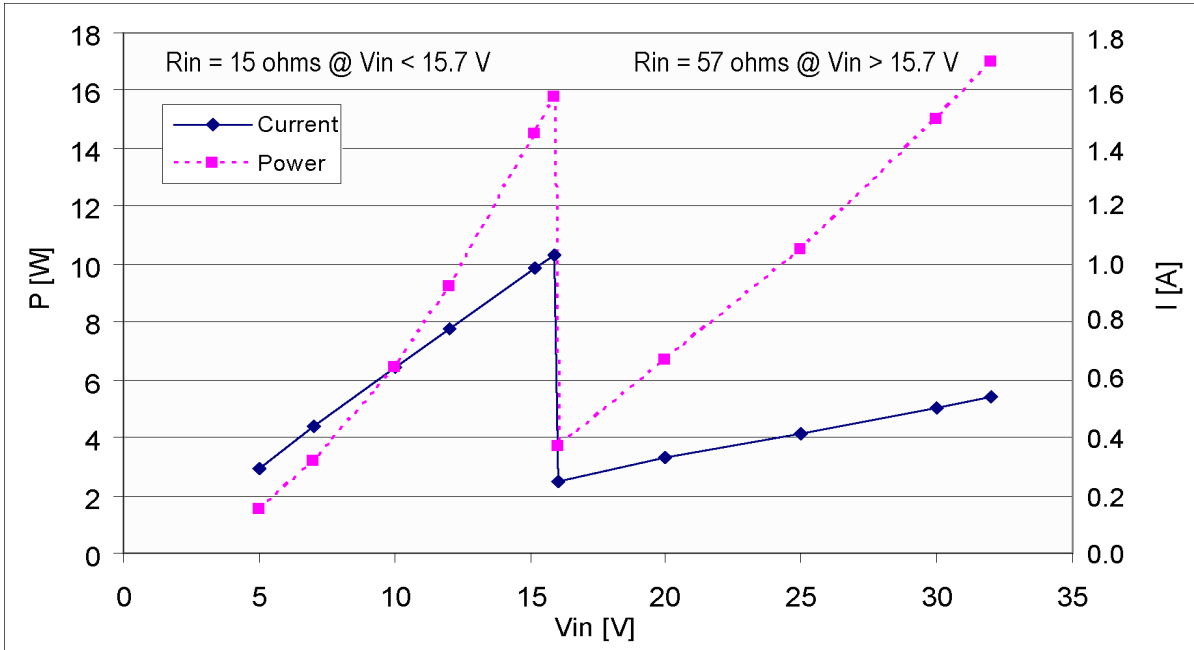
Figure 29   Heating Instant Current and Power vs Vh (WXT536, WXT535, WXT533, and WXT532)
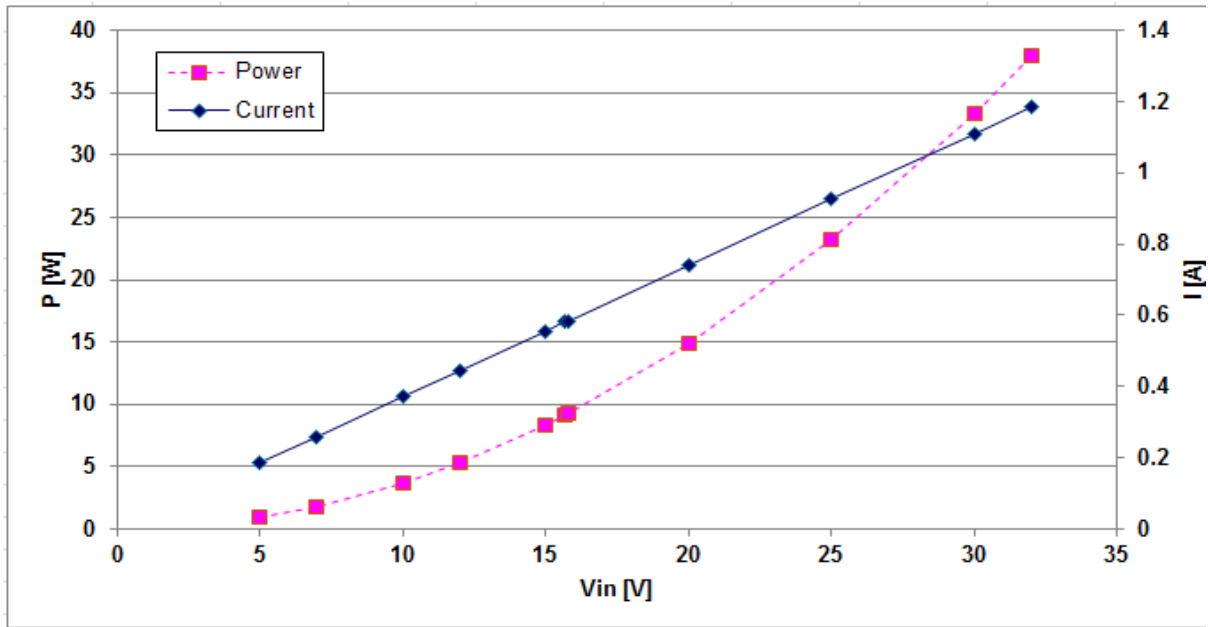
Figure 30   Heating Instant Current and Power vs Vh (WXT531)

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.

Wiring with 8-pin M12 Connector

External Wiring

The 8-pin M12 connector is located on the bottom of the transmitter. The following figure shows the pins of the 8-pin M12 connector as seen from outside the transmitter.
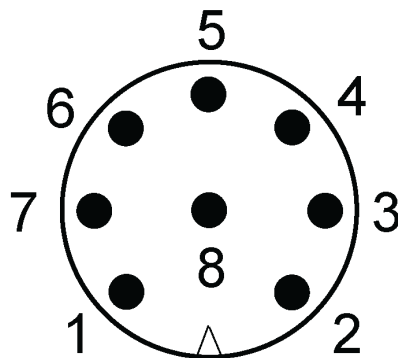
Figure 31   Pins of 8-pin M12 Connector

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

Table 4   Pin-outs for WXT530 Series Serial Interfaces and Power Supplies

		Available for all WXT530 Series models				WXT532 additional option
Wire Color	M12 Pin#	RS-232	SDI-12	RS-485	RS-422	mA Output
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)

Table 5   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-)
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.

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

NOTE	Short circuit loops are required between terminals 3 and 5, and 4 and 6 for RS-485. See Figure 32 on page 64.

**Table 6   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	-
2 VIN-	Vin- (operating)
1 VIN+	Vin+ (operating)

The terms "Default wiring" and "RS-422 wiring" refer to the two
internal wiring options, see Figure 32 on page 64.

Internal Wiring

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

- RS-232

- RS-485

- SDI-12

- RS-422

- mA output

Table 7   RS-232 Wiring

Internal Wiring				External Wiring	
Pin Number	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 8   RS-485 Wiring

Internal Wiring				External Wiring	
Pin Number	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 9   SDI-12 Wiring

Internal Wiring				External Wiring	
Pin Number	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 10   RS-422 Wiring

Internal Wiring				External Wiring	
Pin Number	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 11   mA Output Wiring

Internal Wiring				External Wiring	
Pin Number	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.
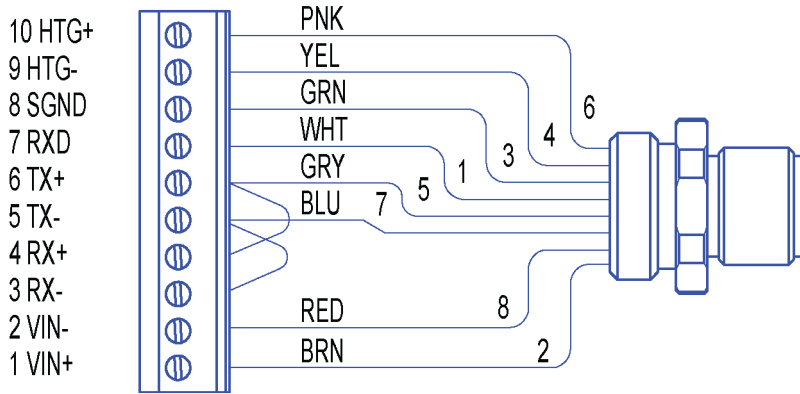
Internal wiring for RS-422
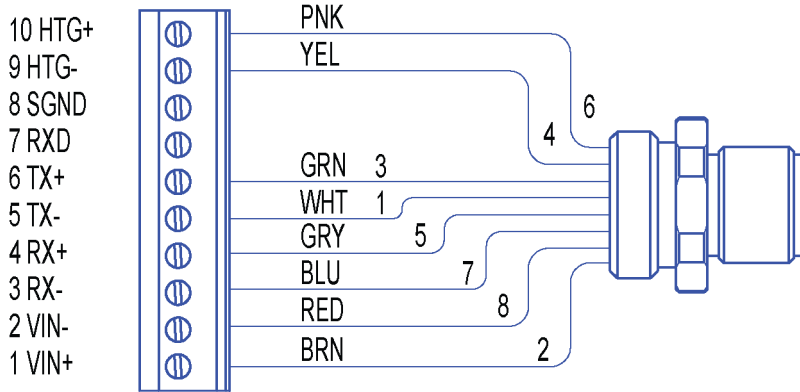
Internal wiring for mA output.
Note the different electronics in the mA output version.
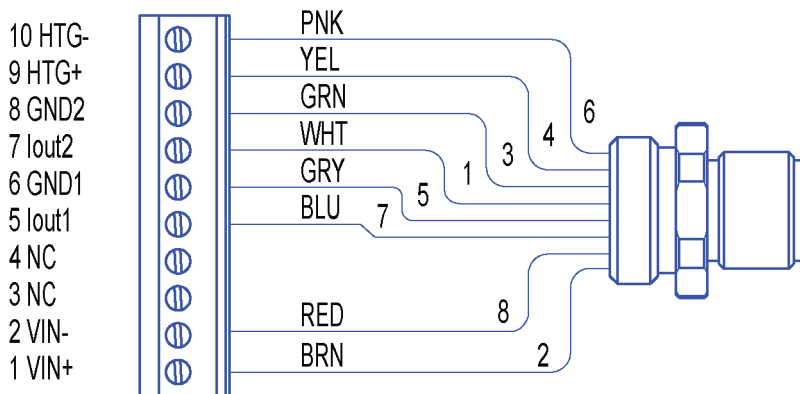
Figure 32   Internal Wiring for RS-232, SDI-12, and RS-485

Wiring Using Screw Terminals

To wire using the screw terminals:

1. Loosen the three long screws at the bottom of the transmitter.

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 according to Table 12 on page 66.

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.
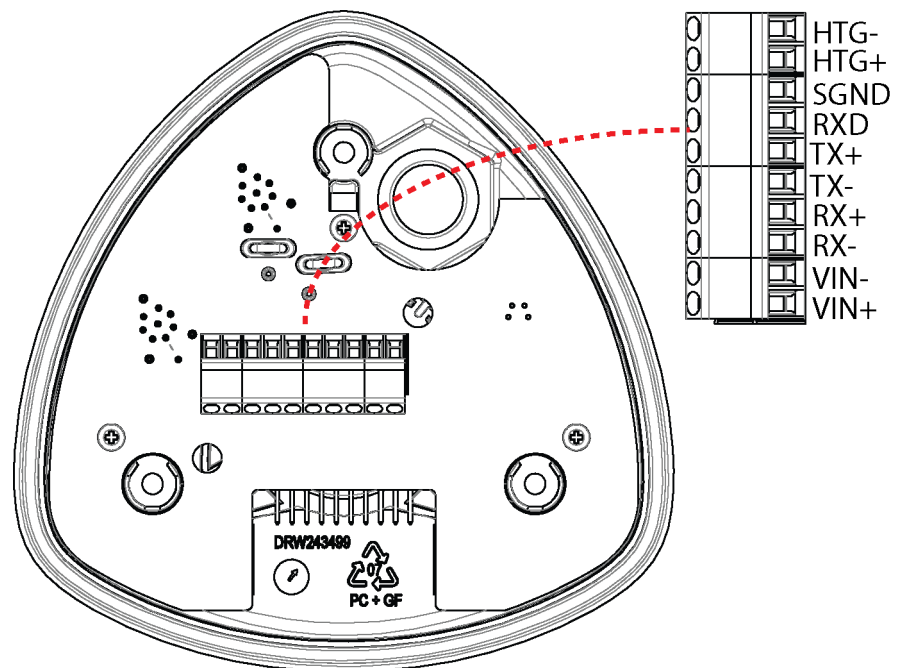
Figure 33   Screw Terminal Block

Table 12   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
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)

> **NOTE**
>
> 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.

> **NOTE**
>
> 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 jumpers are required between pins 3-5 and 4-6.
> 3 = RX- Data- Loop with Blue
> 4 = RX- Data- Blue
> 5 = RX+ Data+ Loop with Gray
> 6 = TX+ Data+ Gray
> The transmitter has by default factory-installed loops in all serial communication options except RS-422.

Data Communication Interfaces

RS-232

```
10 HTG-    ⦿        M12    D9 pin number
 9 HTG+    ⦿
 8 SGND    ⦿  ←———————— PC GND (5)
 7 RXD     ⦿  ←———————— PC TD (3)
 6 TX+     ⦿
 5 TX-     ⦿  ————————→ PC RD (2)
 4 RX+     ⦿
 3 RX-     ⦿
 2 VIN-    ⦿
 1 VIN+    ⦿
```

RS-485

```
10 HTG-    ⦿        M12
 9 HTG+    ⦿
 8 SGND    ⦿                    Internal
 7 RXD     ⦿                    looping
 6 TX+     ⦿
 5 TX-     ⦿
 4 RX+     ⦿  ————————→ Data +
 3 RX-     ⦿  ————————→ Data -
 2 VIN-    ⦿
 1 VIN+    ⦿
```

SDI-12

```
10 HTG-    ⦿        M12
 9 HTG+    ⦿
 8 SGND    ⦿  ———————— GND
 7 RXD     ⦿                 External
 6 TX+     ⦿  Rx            looping
 5 TX-     ⦿  ————————→ Data in/out
 4 RX+     ⦿  Tx
 3 RX-     ⦿
 2 VIN-    ⦿
 1 VIN+    ⦿
```

At this point, with separate Rx and Tx, the interface can be accessed with a PC (1200.7/E/1)

RS-422

```
10 HTG-    ⦿        M12
 9 HTG+    ⦿
 8 SGND    ⦿
 7 RXD     ⦿
 6 TX+     ⦿  ————————→ Data out +
 5 TX-     ⦿  ————————→ Data out -
 4 RX+     ⦿  ←———————— Data in +
 3 RX-     ⦿  ←———————— Data in -
 2 VIN-    ⦿
 1 VIN+    ⦿
```

Figure 34   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 a 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.

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).
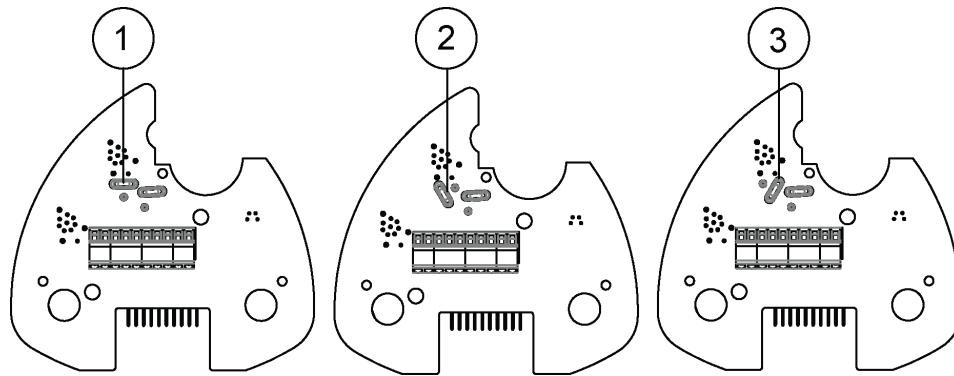
Figure 35   Termination Jumper Positions

1   =   NC, no termination

2   =   R, 121 ohm termination

3   =   RC, 121 ohm 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.

NOTE	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>**.

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 (see).

Table 13   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 **2 … 5 mA** to the standby current, depending on the wind and some other climatic conditions. A 10-second average requested every 2 minutes consumes 12 times less. 1 Hz sampling rate decreases it to one fourth
PTU measurement	Adds approximately **0.8 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 **0.07 mA** to the standby consumption. A single, isolated raindrop causes an additional 0.04 mA to the standby consumption, this condition lasting about 10 seconds (continued, if more raindrops are detected within the 10-second period).
ASCII RS-232 Standby consumption	With baud rates 4800 and higher is typically **0.24 mA**. With a low baud rate selection (1200 or 2400 Bd), this is reduced to less than **0.19 mA**. The jumper wires across TX+/RX+ and TX-/RX- (only necessary in 2-wire RS-485) add an extra 0.02 mA.
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, take care when selecting the Precipitation Autosend mode, where the submodes M=R and M=C can cause extra consumption in rainy conditions due to triggers for sending messages about rain incidents.
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. Thus 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 Figure 34 on 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.

NOTE	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.

NOTE	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.

CHAPTER 6
CONNECTION OPTIONS

This chapter provides instructions on configuring the communication with the transmitter.

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 14   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.

	NOTE	The RS-485 and RS-422 interfaces cannot be directly accessed with a standard PC terminal. They require a suitable converter. To access the RS-485 interface, use the USB RS-232/RS-485 Cable. See Connection Cables on page 74.

	NOTE	RS-232 and SDI-12 can be accessed with a standard PC terminal, if for SDI-12, the Data in/out lines have not been combined inside the transmitter.

Connection Cables

The table below 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 15   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 RS232/RS485 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

	NOTE	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.

Installing the USB Cable Driver

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

To install the USB cable driver:

1. Make sure that the USB cable is not connected.
2. Insert the CD that came with the cable, or download the driver from www.vaisala.com.
3. Click **setup.exe** to launch the installation and security prompts. The driver installation can take several minutes.
4. Once the installation is complete, connect the USB cable to a USB port on your PC. Windows detects the new device and uses the driver automatically.
5. The installation has reserved a COM port for the cable. Verify the port number, and the status of the cable, using the **Vaisala USB Instrument Finder** program on the Windows Start menu. The reserved ports are also visible in the **Ports** section of the Windows Device Manager.

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, you can do so by uninstalling the entry for **Vaisala USB Instrument Driver** from the program manager tool in the Windows Control Panel.

Service Cable Connection

The USB Service Cable has a 4-pin M8 connector for Service Port. The service cable connection is recommended for checking and changing device settings. When making the changes, use the Vaisala Configuration Tool or a standard PC terminal program.
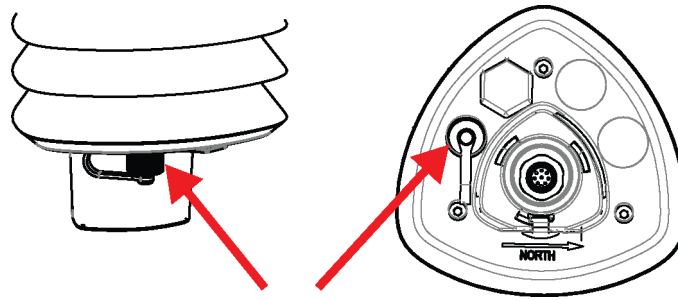
Figure 36   **Service Cable Connection**

The USB service cable is included in the Service Pack 2, see Table 43 on page 184. For a picture of the service cable, see Figure 9 on page 24.

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. See Figure 8 on page 23.

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. When working with a terminal program, see Communication Setting Commands on page 78.

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.

NOTE	Changes to the serial interface/communication protocol/baud settings take place when disconnecting the service cable or when resetting 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 as soon as the service cable is disconnected from either end.

Connection through M12 Bottom Connector or Screw Terminal

Checking or changing the device settings can be done through the 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 table below shows the factory default settings:

Table 16   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
RS-485 ASCII	19200 baud, 8, N, 1
RS-422 ASCII	19200 baud, 8, N, 1
RS-422 NMEA	4800 baud, 8, N, 1

Communication Setting Commands

NOTE	In this section, the commands to be typed by the user are presented in normal text while the responses of the transmitter are presented in *italic*.

Checking the 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!**

where

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>*

NOTE

You can add the Id information field in the supervisor data message to provide identifying information in addition to the transmitter address. See Supervisor Message on page 146.

The information field is set as part of the factory settings. See General Unit Settings on page 208. You can only modify it with the Vaisala Configuration Tool.

Setting Fields

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
[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

NOTE	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. See Chapter 8 Sensor and Data Message Settings, on page 129.

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>

Changing the Communication Settings (aXU)

Use this command to change communication settings. For details on the available values, see the examples below and Setting Fields on page 80.

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!

where

A, M, C, I, B, D, P, S,L	=	The communication setting fields, see Setting Fields on page 80.
x	=	Input value for the setting
<cr><lf>	=	Command terminator in ASCII and NMEA 0183
!	=	Command terminator in SDI-12

NOTE	When changing the serial interface and communication protocol, note the following:
	Each serial interface requires its specific wiring and/or jumper settings described in Chapter 5 Wiring and Power Management, on page 53.
	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).

NOTE	Reset the transmitter to validate the changes of communication parameters by disconnecting the service cable or using the **Reset (aXZ)** command. See Reset (aXZ) on page 86.

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:

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>

NOTE	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>

CHAPTER 7
RETRIEVING DATA MESSAGES

This chapter presents the general and data message commands.

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

For details on changing the message parameters, units, and other settings, see Chapter 8 Sensor and Data Message Settings, on page 129.

NOTE	Type commands in CAPITAL letters.

NOTE	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.

General Commands

With general commands you can reset the transmitter.

NOTE	If error messaging is disabled, the general commands given in ASCII and NMEA formats do not work. See Supervisor Message on page 146.

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!**

where

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*

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!**

where

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>*

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!**

where

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

NOTE	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\>*

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!**

where

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>*

ASCII Protocol

This section lists the data commands and data message formats for the ASCII communication protocols.

Abbreviations and Units

Table 17   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
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.

For changing the units, see Chapter 8 Sensor and Data Message Settings, on page 129.

Device Address (?)

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

Command format: **?<cr><lf>**

where

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

The response:

b<cr><lf>

where

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 Appendix A Networking, on page 191.

For information on changing the device address, see Changing the Communication Settings (aXU) on page 82.

Acknowledge Active Command (a)

This command checks that a device is responding to a data recorder or another device by asking a device to acknowledge its presence on the bus.

Command format: **a<cr><lf>**

where

a	=	Device address
<cr><lf>	=	Command terminator

The response:

a<cr><lf>

where

a	=	Device address
<cr><lf>	=	Response terminator

Example:

0<cr><lf>

0<cr><lf>

Wind Data Message (aR1)

This command requests the wind data message.

Command format: **aR1<cr><lf>**

where

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>

where

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

For information on changing the parameters and units in the response message, see Wind Sensor on page 129.

Pressure, Temperature and Humidity Data Message (aR2)

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

Command format: **aR2<cr><lf>**

where

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>

where

a	=	Device address
R2	=	Pressure, temperature and humidity query command
Ta	=	Air temperature (C = °C)
Ua	=	Relative humidity (P = % RH)
Pa	=	Air pressure (H = hPa)
<cr><lf>	=	Response terminator

For information on changing the parameters and units in the response message, see Pressure, Temperature, and Humidity Sensors on page 136.

Precipitation Data Message (aR3)

This command requests the precipitation data message.

Command format: **aR3<cr><lf>**

where

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>

where

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

For information on changing the parameters or the units in the response message, see Precipitation Sensor on page 140.

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>**

where

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
>*

where

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

For information on changing the parameters and units in the response
message, see .

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

Combined Data Message (aR)

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

Command format: **aR<cr><lf>**

where

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 >

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>**

where

a	=	Device address
R0	=	Composite data 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>

For information on selecting the parameter set in the response message, see Chapter 8 Sensor and Data Message Settings, on page 129.

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. For more information on CRC computation, see Appendix C CRC-16 Computation, on page 203.

Requesting a wind data message with a CRC:

Command format: **ar1xxx<cr><lf>**

where

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>*

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

NOTE	To request the correct CRC for each command by typing 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>**

where

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

Response:

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

where

a	=	Device address
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):

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>.

For information on selecting the parameters to include in the response messages, changing the units and making other configurations of the measured parameters, see Chapter 8 Sensor and Data Message Settings, on page 129.

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. See Chapter 8 Sensor and Data Message Settings, on page 129.

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>

NOTE	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.

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 Chapter 8 Sensor and Data Message Settings, on page 129.

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

SDI-12 Protocol

There are two 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 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.

For changing the message parameters, units and other settings, see Chapter 8 Sensor and Data Message Settings, on page 129.

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.

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: **?!**

where

?	=	Address query command
!	=	Command terminator

The response:

a<cr><lf>

where

a   =   Device address (default = 0)

<cr><lf>   =   Response terminator

Example (device address 0):

?!0<cr><lf>

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!**

where

a   =   Device address

!   =   Command terminator

The response:

a<cr><lf>

where

a   =   Device address

<cr><lf>   =   Response terminator

Example:

0!0<cr><lf>

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 time in order to ensure writing the new address to the non-volatile memory.

Command format: **aAb!**

where

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

The response:

b<cr><lf>

where

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>*

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!**

where

a	=	Device address
I	=	Send identification command

| ! | = | Command terminator |

The response:

a13ccccccccmmmmmmvvvxxxxxxxx<cr><lf>

where

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>

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**, see the next sections.

See .

Command format: **aMx!**

where

a	=	Device address
M	=	Start 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 one command. See Examples of aM, aC and aD Commands on page 110.
!	=	Command terminator

The response is sent in two parts:

The response part one:

atttn<cr><lf>

The response part two (indicates that the data is ready to be requested):

a<cr><lf>

where

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

NOTE

For information on changing the message parameters, units and other settings, see Chapter 8 Sensor and Data Message Settings, on page 129.

NOTE	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.

NOTE	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). See and

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**, see .

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 nine (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**. See .

Command format: **aCx!**

where

a	=	Device address
C	=	Start concurrent measurement command
x	=	The desired measurement 1 = Wind 2 = Temperature, humidity, and pressure 3 = Precipitation 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 examples below.
!	=	Command terminator

The response:

atttnn<cr><lf>

where

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

NOTE	For information on changing the message parameters, units and other settings, see to Chapter 8 Sensor and Data Message Settings, on page 129.

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**.

Send Data Command (aD)

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

NOTE	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!**

where

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. See .
!	=	Command terminator

The response:

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

where

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

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

NOTE	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 value(s) happen to be updated between the commands.

Examples of aM, aC and aD Commands

NOTE	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.

The device address is 0 in all examples.

Example 1:

Start a wind measurement and request the data (all six 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 nine (9) parameters are available. Thus start measurement command **aM** can be used. Due to the 35-character

limit in response message, **aD0** returns only six 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>*

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** + **aD**.

In this case the obtained parameter values are those from the latest internal updating. For details on setting update intervals, see Chapter 8 Sensor and Data Message Settings, on page 129).

NOTE	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** + **aD** commands, only the precipitation data can be retrieved continuously (using **aR3** command).

Command format: **aRx!**

where

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

The response:

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

where

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>

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

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.

For changing the message parameters, units and other settings, see Chapter 8 Sensor and Data Message Settings, on page 129.

A two-character checksum (CRC) field is transmitted in all data request sentences. For definition of the CRC, see Appendix C CRC-16 Computation, on page 203.

Device Address (?)

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

Command format: **?<cr><lf>**

where

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

The response:

b<cr><lf>

where

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 Appendix A Networking, on page 191.

For information on changing the device address, see Changing the Communication Settings (aXU) on page 82.

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>**

where

a	=	Device address
<cr><lf>	=	Command terminator

The response:

a<cr><lf>

where

a	=	Device address
<cr><lf>	=	Response terminator

Example:

0<cr><lf>

0<cr><lf>

MWV Wind Speed and Direction Query

Use a MWV query command to request the wind speed and direction data. To use MWV query the NMEA Wind formatter parameter in the wind sensor settings must be set to W. See Wind Sensor on page 129.

The MWV command only queries only wind speed and direction average values. For details on obtaining minimum and maximum data for speed and direction, see XDR Transducer Measurement Query on page 118.

Command format: **$--WIQ,MWV*hh<cr><lf>**

where

$	=	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

The response format:

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

where

$	=	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:

Typing 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 of the MWV Query:

$--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)

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. See Wind Sensor on page 129.

Command format: **$--WIQ,XDR*hh<cr><lf>**

where

$	=	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. See Chapter 8 Sensor and Data Message Settings, on page 129.

NOTE	The parameter order in the output is as shown in the parameter selection setting field. See Chapter 8 Sensor and Data Message Settings, on page 129.

The response format:

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

where

$	=	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. For changing the address, see Checking the Current Communication Settings (aXU) on page 78 (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

1. NMEA-format transmits only numbers as transducer ids. If the transmitter address is given as a letter, it is shown as a number (0 ... 9, A = 10, B = 11, a = 36, b = 37 etc.)

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 below), 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 18   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
Rain accumulation	0	V
Rain duration	0	Z
Rain current intensity	0	R
Hail accumulation	1	
Hail duration	1	
Hail current intensity	1	
Rain peak intensity	2	
Hail peak intensity	3	
Heating temperature	2	
Supply voltage	0	U
Heating voltage	1	U
3.5 V reference voltage	2	
Information field	4	
Aux. rain (tipping bucket)	1	V
Solar radiation	3	
Snow level	4	
Aux. temperature (pt1000)	3	C

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:

where

$	=	Start of the message
WI	=	Device type (WI = weather instrument)
XDR	=	Transducer measurement response identifier
A	=	Transducer id 0 type (wind direction), see the following Transducer table
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 0 units (m/s, min wind speed)
0	=	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:

where

$	=	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:

where

$	=	Start of the message
WI	=	Device type (WI = weather instrument)
XDR	=	Transducer measurement response identifier
V	=	Transducer id 0 type (Accumulated rainfall), see the following Transducer table
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/cm^2, 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/cm^{2}h, 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/cm^2, 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:

where

$	=	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[1], 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 (3.5V reference voltage)
V	=	Transducer id 2 units (V, 3.5V reference voltage)
2	=	Transducer id for 3.5V 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

1. See Chapter 8, Supervisor Message, Setting Fields for definitions of the Heating voltage field.

Table 19   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-standardized1
Time (duration)	Z	S = seconds	non-standardized1
Intensity (flow rate)	R	M = mm/h, I = in/h, H = hits/h for rainfall M = hits/cm²h, I = hits/in²h, H = hits/h for hails	non-standardized1
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.

TXT Text Transmission

The text transmission response format:

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

where

$	=	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:

$WItXT,01,01,01,Unable to measure error*6D<cr><lf> (wind data request when all the wind parameters were disabled from the wind message).

$WITXT,01,01,03,Unknown cmd error*1F (unknown command 0XO!<cr><lf>).

$WITXT,01,01,08,Use chksum 2F*72 (wrong checksum used in MWV query command)

shows the short text messages and their interpretation.

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.

For information message formatting the messages, refer to Chapter 8 Sensor and Data Message Settings, on page 129.

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, refer to Chapter 8 Sensor and Data Message Settings, on page 129.

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

CHAPTER 8
SENSOR AND DATA MESSAGE SETTINGS

This chapter lists the sensor configuration and data message formatting commands for all communications protocols: ASCII, NMEA 0183 and SDI-12.

Sensor and data message settings can also be done using the Vaisala Configuration Tool software. See Table 43 on page 184.

Wind Sensor

WXT536	WXT535	WXT534	WXT533	WXT532	WXT531
X			X	X	

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!**

where

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, see the following sections.

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>*

Setting Fields

[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.

The parameter order is shown in the following table:

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 Bits 9-16 determine the wind parameters in the composite data message obtained with the following commands: -**ASCII:** aR0, ar0 -**NMEA 0183:** aR0, ar0 -**SDI-12:** aM, aMC, aC, and aCC -**SDI-12 continuous:** aR and aRC		
	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
	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

[I]   =   Update interval: 1 ... 3600 seconds

[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 205 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. For more detailed definitions of max/min and gust & lull calculations, see Wind Measurement Principle on page 29.
[U]	=	Speed unit: M = m/s, K = km/h, S = mph, N = knots
[D]	=	Direction offset: -180 ... 180°, see Wind Direction Offset on page 52.
[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

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

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

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, and
- NMEA wind formatter.

Change the settings with the following command. For details on the value or letters for the setting fields, see the examples and Setting Fields on page 131.

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!

where

R, I, A, G, U, D, N, F	=	Wind sensor setting fields. See Setting Fields on page 131.
x	=	Value for the setting
<cr><lf>	=	Command terminator in ASCII and NMEA 0183
!	=	Command terminator in SDI-12

NOTE	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>

NOTE	Several parameters can be changed with the same command as long as the command length does not exceed 32 characters, see below.

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>

NOTE	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 content.

Pressure, Temperature, and Humidity Sensors

WXT536	WXT535	WXT534	WXT533	WXT532	WXT531
X	X	X			

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!**

where

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>

Setting Fields

[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 **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	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
	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

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

[I] = Update interval: 1 ... 3600 seconds

[P] = Pressure unit: H = hPa, P = Pascal, B = bar, M = mmHg, I = inHg

[T] = Temperature unit: C = Celsius, F = Fahrenheit

<cr><lf> = Response terminator

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. For details on the values or letters for the setting fields, see the examples and Setting Fields on page 137.

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!

where

R, I, P, T	=	The pressure, temperature and humidity sensor setting fields. See Setting Fields on page 137.
x		Value for the setting
<cr><lf>	=	Command terminator in ASCII and NMEA 0183
!	=	Command terminator in SDI-12

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>

NOTE	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>*

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

Precipitation Sensor

WXT536	WXT535	WXT534	WXT533	WXT532	WXT531
X	X		X		X

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!**

where

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, see the following section.

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>

Setting Fields

[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.

The parameter order is shown in the following table:

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 **Bits 9-16 determine the precipitation parameters included in the composite data messages obtained with the following commands:** -**ASCII:** aR0 and ar0 -**NMEA 0183:** aR0, ar0 -**SDI-12:** aM, aMC, aC, aCC -**SDI-12 continuous:** aR and aRC	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
	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

[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/cm^2, Hail event duration in s, Hail intensity in hits/cm^{2}h) **I** = imperial (the corresponding parameters in units hits/in^2, s, hits/in^{2}h), H = hits (hits, s, hits/h) Changing the unit resets the precipitation counter.
[M]	=	Autosend 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 autosend mode tipping bucket in polled protocols as it decreases the resolution of the output (quantized to tipping bucket tips).
[Z]	=	Counter reset: M = manual, A = automatic, L=limit Y = immediate **M** = manual reset mode: The counter is reset with aXZRU command. See Precipitation Counter Reset (aXZRU) on page 87. **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/cm^2. If the unit is imperial, the equivalent range varies between 100 … 65535 hits/in^2. 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

NOTE	The autosend mode parameter is significant only in ASCII automatic (+CRC) and NMEA 0183 automatic protocols.

NOTE	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.

Changing the Settings (aRU)

You can change the following settings:

- parameters included in the precipitation data message,

- update interval in the time based autosend mode,

- precipitation units,

- hail units,

- autosend mode,

- counter reset,

- rain accumulation limit and

- hail accumulation limit.

Make the desired setting with the following command. Select the correct value/letter for the setting fields, see Setting Fields on page 141. See the examples.

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!

where

R, I, U, S, M, Z, X, Y	=	Precipitation sensor setting fields. See Setting Fields on page 141.
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 autosend 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>*

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

Supervisor Message

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!**

where

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>

Setting Fields

[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	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, ar0 -**SDI-12:** aM, aMC, aC, and aCC -**SDI-12 continuous:** aR and aRC	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

[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>*

Changing the Settings (aSU)

You can change the following settings:

- parameters included in the supervisor data message,

- update interval,

- error messaging on/off, and

- heating control.

Make the desired setting with the following command. Select the correct value/letter for the setting fields. See the examples and Setting Fields on page 147.

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!

where

R, I, S, H	=	The supervisor setting fields. See Setting Fields on page 147.
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.

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**). See parameter tables of each sensor in the previous sections. See the following examples.

NOTE	When changing the bits 9-16 of the parameter selection of any sensor, the command 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>

Analog Input

The following table lists all analog input parameters.

Table 20   Analog Input Parameters

Parameter	Default	Range	Command	Details
Update interval (defines measurement interval and message interval in seconds)	60	0.5 ... 3600	aIU,I=60	Does not affect auxiliary rain input measuring interval, all incoming pulses are counted regardless of this setting
Auxiliary input averaging	3	0.25 ... 3600	aIU,A=3	Temperature and auxiliary rain inputs are not affected.
Auxiliary rain				
Gain	0.2	0.000000001 ... 1000000	aIA,G=0.2	
Reset mode (cumulative rain amount resetting)	M	M, L, A	aIA,M=M	**M** = Resets rain when pulse amount exceeds 65535. When gain is 0.2, resets at 65536*0.2 = 13107 **L** = Resetting when reaching Limit value **A** = Cumulative rain value is reset every time rain information is sent out from the transmitter (user counts cumulative rain amount)
Limit	1000	0.000000001 ... 1000000	aIA,L=1000	
Solar radiation				
Gain	100000	0.000000001 ...1000000	aIB,G=100000	max. 25 mV input
Auxiliary level sensor				
Gain	1		aIS,G=1	
Range (operating area)	1	0.000000001 ... 1000000	aIS,M=1	0 = 0 to 2.5 V range 1 = 0 to 5.0 V range 2 = 0 to 10.0 V range
Temperature				
Averaging time	1	0.5 ... 3600	aIP,A=1	

The following table describes analog input signal names and descriptions.

Table 21   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	Water/snow level sensor

The pins of analog input connectors are shown below.
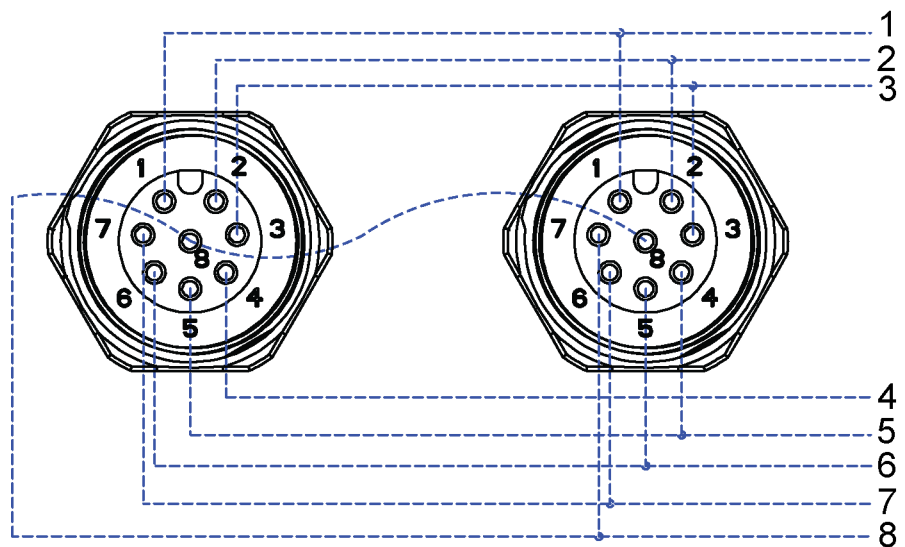

Figure 37   Analog Input Connector Pins

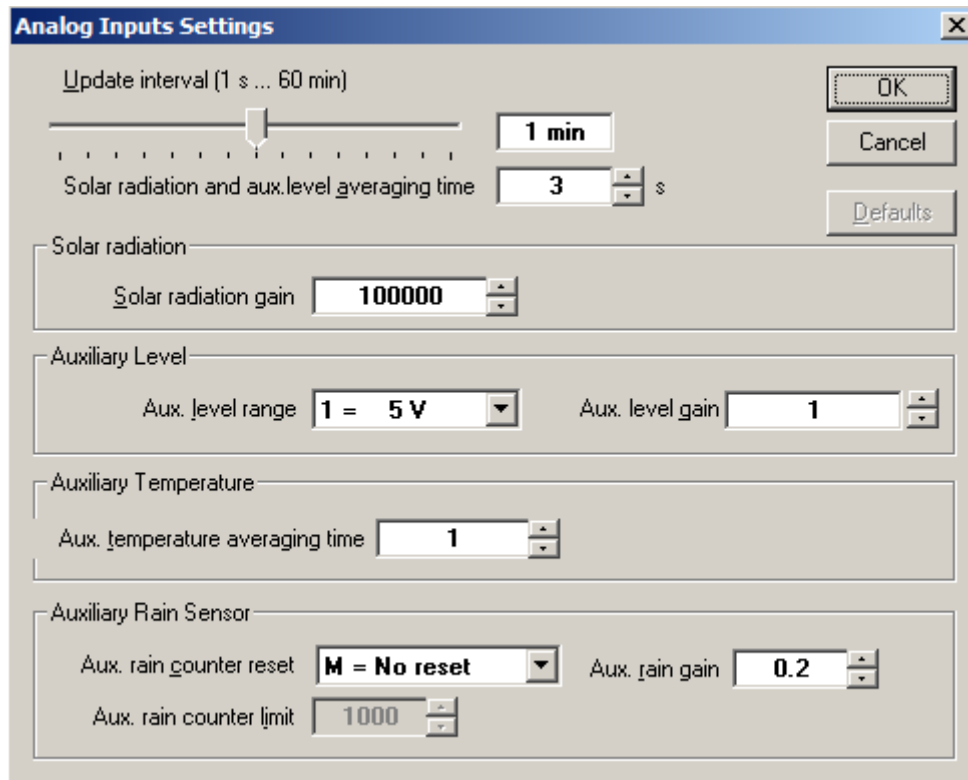The figure below shows the analog input settings in the Configuration Tool.

Figure 38   Analog Input Settings in Configuration Tool

Table 22   Analog Input Setting Definitions

Setting	Default value	Definition
Update interval	1 min	Defines analog input measurment interval. A shorter interval and a longer averaging time increase power consumption.
Solar radiation and aux. level averaging time	3 s	Defines averaging times for solar radiation and aux level 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
Aux. level range	0 ... 5 V	Selects voltage measurement range. Available ranges: 0 ... 2.5 V, 0 ... 5 V, 0 ... 10 V
Aux. level 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.
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.

The factory default settings for analog input:

- All measurement messages enabled

- Update interval 60 s

- Solar radiation and aux level averaging time 3 s

- Solar radiation gain 100 000

- Aux level range 5 V

- Aux level gain 1

- Aux temperature avg 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
```

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 output with the **aIU,R=** command.

For example, PT1000 temperature enabled, all other disabled:

```
aIU,R=1000000010000000
```

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

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

Aux Input Averaging Time [A]

The Aux Input averaging time in seconds. This parameter defines the averaging time for snow level 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.

Parameter Selection [R]

[R] defines the active measurements.

Table 23   aIU Setting Fields [R]

Normal message	1	st bit (most left)	Tr pt1000 temperature
	2	nd bit	Ra Aux rain amount
	3	rd bit	SI snow level
	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	SI Aux level
	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

Getting Data Messages

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

An example response:

```
0R4,Sr=0.5V,Ra=0.0M,Tr=13.2C,Sl=0.0V
```

Sr	Solar radiation (V = volts at input * gain)
Ra	aux rain accumulation (M = mm)
Tr	pt1000 (C = Celsius, F = Fahrenheit)
Sl	Snow level (V = volts at input * gain)

You can set the gain for Sr and Sl.

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

Reset Mode [M]

[M] defines the reset mode.

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.

Solar Radiation Sensor Settings [aIB]

Gain [G]

[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 $1/\mu V = 200\ 000$, 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.

Aux 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 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.

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.

Parameter Order for SDI-12 Mode

The parameter order for SDI-12 mode is:

Analog in (M4): Tr Ra Sl Rt Sr

Analog Output

You can change the analog output type and scaling of WXT532. For instructions, see Analog Output Scaling on page 163.

WXT532 provides the following analog outputs:

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

For instructions on wiring, see Wiring and Power Management on page 53.

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

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

```
aSU,
{'a',upd_aout1_gain},
{'b',upd_aout1_offset},
{'c',upd_aout1_min},
{'d',upd_aout1_max},
{'e',upd_aout1_err},
{'f',upd_aout2_gain},
{'g',upd_aout2_offset},
{'h',upd_aout2_min},
{'j',upd_aout2_max},
{'k',upd_aout2_err},aSU,
```

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.

The factory defaults:

```
// g              o   min   max err [mA]

  {0.4            ,4  ,0  , 20, 24 },// aout1 ; //typically
wind speed. offset=4mA ,g= 0.4mA /m/s

  {0.0444444    ,4  ,0  , 20, 24 },// aout2 ; //typically
wind direction  4..20mA = 0..360deg
```

Analog Output Operation

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

The analog current outputs are factory-calibrated:

- Aout1 is wind speed

- Aout2 is wind direction

The output scaling can be set with commands:

```
aSU,

{'a',upd_aout1_gain},
{'b',upd_aout1_offset},
{'c',upd_aout1_min},
{'d',upd_aout1_max},
{'e',upd_aout1_err},
{'f',upd_aout2_gain},
{'g',upd_aout2_offset},
{'h',upd_aout2_min},
{'j',upd_aout2_max},
{'k',upd_aout2_err},
```

The output o in mA is
o = i * gain + offset

o is clamped between minimum and maximum. In wind measurement fails, the output value is err. They have factory defaults:

```
// g            o   min   max err [mA]
{0.4           ,4  ,0  , 20, 24 },// aout1 ; //typically wind speed. offset=4mA ,g= 0.4mA /m/s
{0.0444444    ,4  ,0  , 20, 24 },// aout2 ; //typically wind direction  4..20mA = 0..360deg
```

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 table below.

Table 24   Analog Output Scaling

AOUT1 Wind Speed Selected Option	Scaling / Gain	Offset	Error Indication	Example	AOUT1 Wind Speed Selected Option
Current 0 ... 20 mA	0.33333 mA / m/s	0 mA	0.022 mA	20 mA = 60 m/s	Current 0 ... 20 mA
Current 4 ... 20 mA	0.26667 mA / m/s	0.004 mA	0.002 mA	4 mA = 0 m/s 20 mA = 60 m/s	Current 4 ... 20 mA
AOUT2 Wind Direction Selected Option	**Scaling / Gain**	**Offset**	**Error Indication**	**Example**	**AOUT2 Wind Direction Selected Option**
Current 0 ... 20 mA	0.05 mA / °	0 mA	0.022 mA	0 mA = 0° 18 mA = 360°	Current 0 ... 20 mA
Current 4 ... 20 mA	0.04444 mA / °	0.004 mA	0.002 mA	4 mA = 0° 20 mA = 360°	Current 4 ... 20 mA

The tables below list the most common settings for different units.

Table 25   Common Transfer Function Settings for AOUT1 (Wind Speed)

Scaling/Units	Setting for Gain	Setting for Offset
0.3 mA / m/s	0.00033333	0
0.26667 mA / M/s	0.00026667	4

Table 26   Common Transfer Function Settings for AOUT2 (Wind Direction)

Scaling/Units	Setting for Gain	Setting for Offset
50 µA / degree	0.00005	0
0.4444 mA / degree	0.0004444	4

You can configure output scaling or transfer function settings in many ways 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

where

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

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 (0,26667 mA/m/s)

Error indication sets output to 2 mA.

The analog interfaces setup, configuration 2:

Current output 0.33333mA/m/s

0 mA = 0 m/s

20 mA = 60 m/s

Error indication sets output to 22 mA.

Analog Output Signal for Wind Direction Chanel

Analog interfaces setup default configuration:

Current output 4 ... 20 mA (44.444 uA/degree)

4 mA = 0 degree

20 mA = 360 degree

Error indication sets output to 2 mA

Analog interfaces setup, configuration 2:

Current output 50 uA/degree

0 uA = 0 degree

18 mA = 360 degree

Error indication sets output to 22 mA

Messaging with Configurator Tool

Send the numeric parameters to the transmitter as decimal values, do not use e-notation. The Configurator has space for 12 digits.

You can set the averaging time to any value, but the transmitter measures with 0.25 s interval.

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=111111111111**1**0000

- Analog output disabled at the factory:
  0XF,f=111111111111**0**0000

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

- To enable analog output: Change bit 7 to 1.
  0WU,R=1111111**1**111111100

- To disable analog output: Change bit 7 to 0.
  0WU,R=1111110**0**111111100

Table 27   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

CHAPTER 9
MAINTENANCE

This chapter contains instructions for basic maintenance of the WXT530 Series transmitters.

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.

CAUTION	Be very careful when cleaning the wind sensors. Do not rub or twist the sensors.

Replacing the PTU Module

WXT536	WXT535	WXT534	WXT533	WXT532	WXT531
X	X	X			

To replace the PTU module:

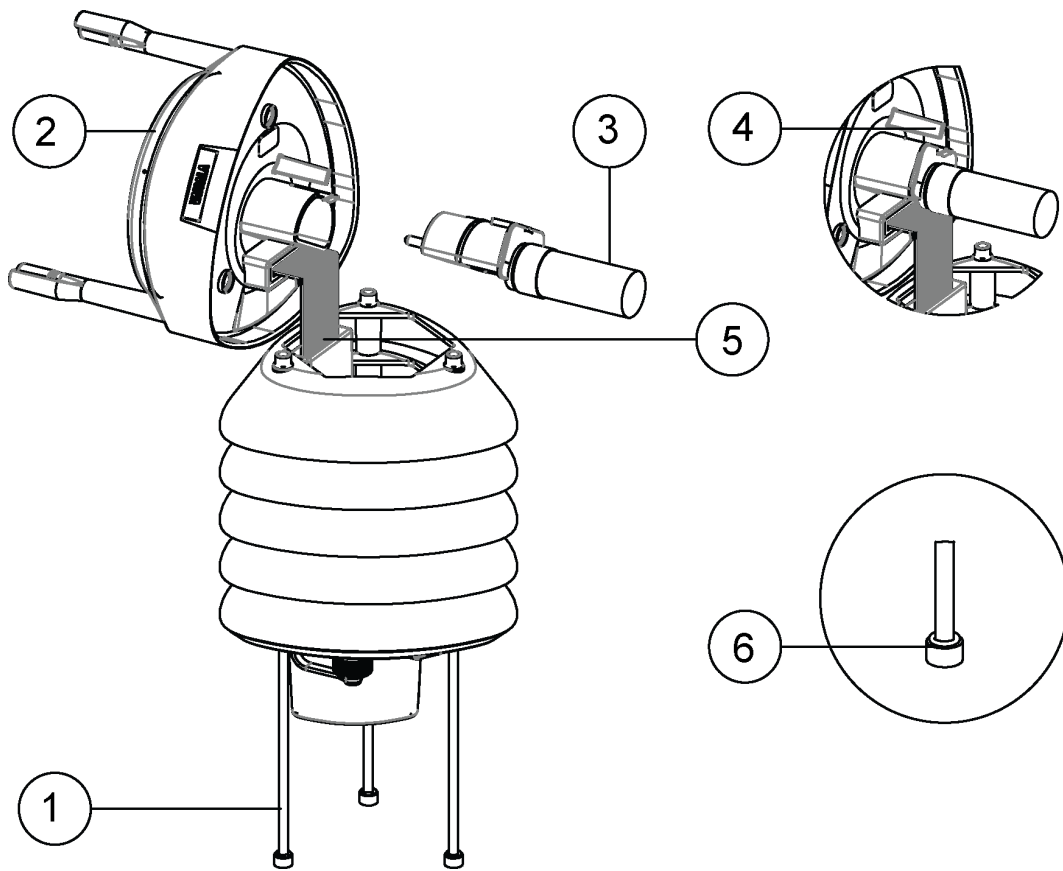1. Turn the power off. Loosen the three mounting screws at the bottom assembly of the transmitter and pull them out.

Figure 39   Replacing PTU Module

1   =   Fixing screws

2   =   Top of transmitter

3   =   PTU module

4   =   Latch

5   =   Flat cable

6   =   O-ring

2. Turn out the top of the transmitter.

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

4. Remove the vacuum bag protecting the PTU module. Connect the new PTU module. Avoid touching the white filter cap with your hands.

5. 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.

6. If the O-rings are damaged, replace them with new ones. Tighten the mounting screws.

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

Technical Support

For technical questions, contact the Vaisala technical support by e-mail at helpdesk@vaisala.com. Provide at least the following supporting information:

- Name and model of the product in question

- Serial number of the product

- Name and location of the installation site

- Name and contact information of a technically competent person who can provide further information on the problem.

For Vaisala Service Center contact information, see www.vaisala.com/ servicecenters

CHAPTER 10
TROUBLESHOOTING

This chapter describes common problems, their probable causes and remedies, and includes contact information for technical support.

Table 28   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 spike 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.

<div align="center">**Table 29**   **Communication Problems**</div>

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 Chapter 5 Wiring and Power Management, on 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 Chapter 7 Retrieving Data Messages, on page 85. Enable the error messaging using the Vaisala Configuration Tool or any terminal by setting **aSU,S=Y**, then try the command again.

Table 29   Communication Problems (Continued)

Problem	Possible causes	Action(s)
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. See Chapter 6 Connection Options, on page 73.
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. See Chapter 8 Sensor and Data Message Settings, on page 129.
An error message as a response to a command.	Refer to Error Messaging/Text Messages on page 174.	Refer to Error Messaging/Text Messages on page 174.
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 need to 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 Enabling or Disabling Analog Output, on page 165
Precipitation messages missing.	No precipitation measurement in models WXT534 and WXT532.	

Self-Diagnostics

Error Messaging/Text Messages

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

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 30   Error Messaging/Text Messages Table

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. See Chapter 8 Sensor and Data Message Settings, on page 129.
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 Chapter 7 Retrieving Data Messages, on page 85.
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.

See also Chapter 10 Troubleshooting, on page 171.

NOTE	When a WXT530 Series transmitter is used on an RS-485 bus with other polled devices, the error messaging feature must be disabled using the command: **0SU,S=N<crlf>**.

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). See Supervisor Message on page 146.

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.

NOTE	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 x V_p in case of AC voltage
	- 0.70 x V_p in case of full-wave rectified AC voltage

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. See .

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.

CHAPTER 11
TECHNICAL SPECIFICATIONS

This chapter provides the technical data of the WXT530 Series transmitters.

Performance

Table 31   Barometric Pressure

Property	Description/Value
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 32   Air Temperature

Property	Description
Range	-52 ... +60 °C (-60 ... +140 °F)
Accuracy (for sensor element) at +20 °C (+68 °F)	±0.3 °C
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 33   Relative Humidity

Property	Description
Range	0 ... 100 %RH
Accuracy (for sensor element)	±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 one second steps

1. A naturally aspirated radiation shield is applied which can affect readings in calm wind.

Table 34   Precipitation

Property	Description
Rainfall	Cumulative accumulation after the latest auto or manual reset
Collecting area	60 cm^2
Output resolution	0.01 mm (0.001 in)
Field accuracy for daily accumulation	better than 5 % weather dependent
Units available	mm, in
Rain duration	Counting each 10-second increment whenever droplet detected
Output resolution	10 s
Rain intensity	Running one minute average in 10-second steps
Range	0 ... 200 mm/h (broader range with reduced accuracy)
Units available	mm/h, in/h
Hail	Cumulative amount of hits against collecting surface
Output resolution	0.1 hit/cm^2, 1 hit/in^2, 1 hit
Units available	hits/cm^2, hits/in^2, hits
Hail duration	Counting each 10-second increment whenever hailstone detected
Output resolution	10 s
Hail intensity	One-minute running average in 10-second steps
Output resolution	0.1 hit/cm^{2}h, 1 hit/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 35   Wind

Property	Description
Wind speed	
Range	0 ... 60 m/s
Response time	0.25 s
Available variables	average, maximum, and minimum
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	
Azimuth	0 ... 360°
Response time	0.25 s
Available variables	average, maximum, and minimum
Accuracy	±3.0°
Output resolution	1°
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 condition applied for wind tunnel testing. In other conditions, the results can deviate.

Inputs and Outputs

Table 36   Inputs and Outputs

Property	Description/Value
Operating voltage	5 ... 32 VDC (absolute values)
Average current consumption	
Minimum	0.1 mA @ 12 VDC (SDI-12 standby)
Typical	3 mA @ 12 VDC (with default measuring intervals)
Maximum	15 mA @ 5 VDC (with constant measurement of all parameters)
Heating voltage	Options: DC, AC, full-wave rectified AC
Typical ranges	12 VDC ± 20 %, 1.1 A max
	24 VDC ± 20 %, 0.6 A max
	55 V_{p-p} ± 20 % (AC), 0.6 A_{rms} max
	27 V_p ± 20 % (f/w rect. AC), 0.6 A_{rms} max
Absolute maximum	66 V_{p-p} (AC)
	33 V_p (f/w rect. AC)
Digital outputs	SDI-12, RS-232, RS-485, RS-422
Communication protocols	SDI-12 v1.3, ASCII automatic & polled, NMEA 0183 v3.0 with query option

1. Below 5.3 V the measurement performance for high wind speeds may be degraded.
2. In maritime environments, the normal input voltage ranges are: operating voltage
6 ... 27 VDC (-10 % ... +30 %) and heating voltage 12 ... 27 VDC (-10 % ... +30 %), as defined
in the maritime standard IEC 60945.

Table 37   Analog Input Options

Parameter	Element	Range	Input	Excitation	Resolution
Temperature PT1000	Resistor	800 ... 1330 Ω	2-wire 4-wire	2.5 V	16 bits
Solar Radiation K&Z CMP3	Thermopile	0 ... 30 mV	4 Ω	-	12 bits
Level measurement IRU	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 38   Analog mA Output Options

Parameter	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 input option is applied, digital communication is not available.

General Conditions

Table 39   General Conditions

Property	Description/Value
Housing protection class	IP65 (without mounting kit) IP66 (with mounting kit)
Temperature	-52 ... +60 °C (-60 ... +140 °F)
Relative humidity	0 ... 100 %RH
Pressure	600 ... 1100 hPa
Wind	0 ... 60 m/s
Storage temperature Storage humidity	-60 ... +70 °C (-76 ... +158 °F) 0 ... 90 %RH

1. Due to the measurement frequency used in the sonic transducers, RF interference in the 200 ... 400 kHz range can disturb wind measurement.
2. Any temporary element or object, such as snow, ice or a bird, blocking the measurement path between the ultrasonic transducer heads can affect the wind measurement accuracy or even invalidate the output data.
3. Make sure that you power up the sensor after installation. Storing the sensor outdoors without a proper package, or not powering up after installation can affect the sensor's expected lifetime.
4. Combination of extreme operating conditions can alter sensor performance temporarily.

NOTE	If you operate the sensor in high humid conditions or in temperatures near or below 0 °C (+32 °F), select a heated sensor model.

Table 40   **Electromagnetic Compatibility**

Applicable Standard	Description	Level tested	Performance
CISPR 22	Radiated emissions	30 MHz - 2 GHz	Class B
CISPR 22	Conducted emissions DC	150 kHz - 30 MHz	Class B
IEC 61000-4-2	Electrostatic discharge	6 kV con / 8 kV air	B
IEC 61000-4-3	RF field immunity	10 V/m and 3 V/m	A
IEC 61000-4-4	Electric fast transient	2 kV	B
IEC 61000-4-5	Surge	2 kV	B
IEC 61000-4-6	Conducted RF immunity	3 V_{emf}	A
IEC 60945	Conducted emissions		
IEC 60945	RF field immunity		
IEC 60945	Electric fast transient Conducted low frequency interference immunity		
IEC 60945	Power supply excessive		
IEC 60945	Power supply failure		

1. Performance:

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.

Materials

Table 41   Materials

Property	Description/Value
Radiation shield, top, and bottom parts	Polycarbonate + 20 % glass fiber
Precipitation sensor plate	Stainless steel (AISI 316)
Weight	650 g (1.43 lbs.)

General

Table 42   General

Property	Description/Value
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

Options and Accessories

Table 43   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

Type Label

All WXT530 Series transmitters can be identified from the type label.

Figure 40   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
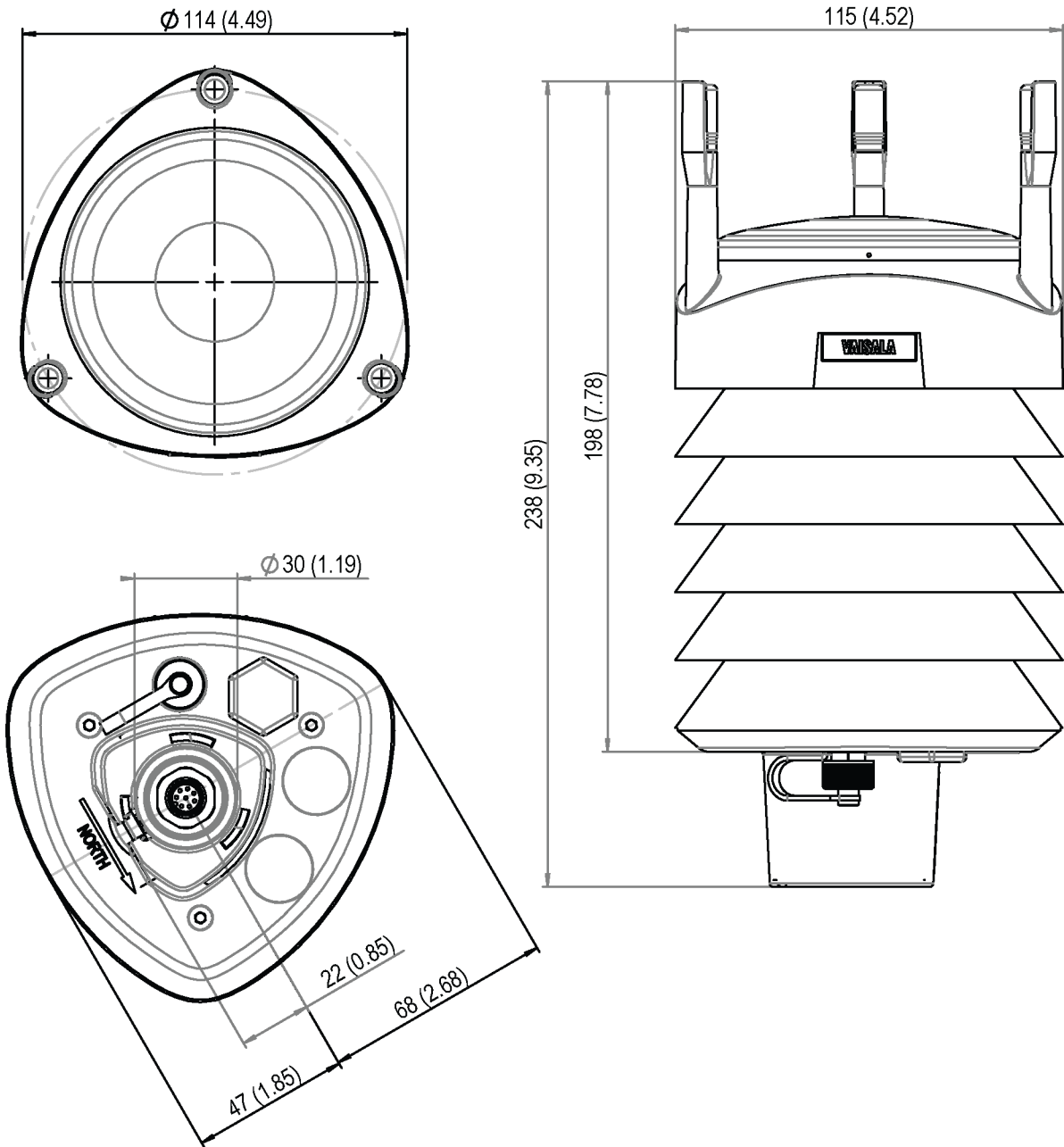U = humidity
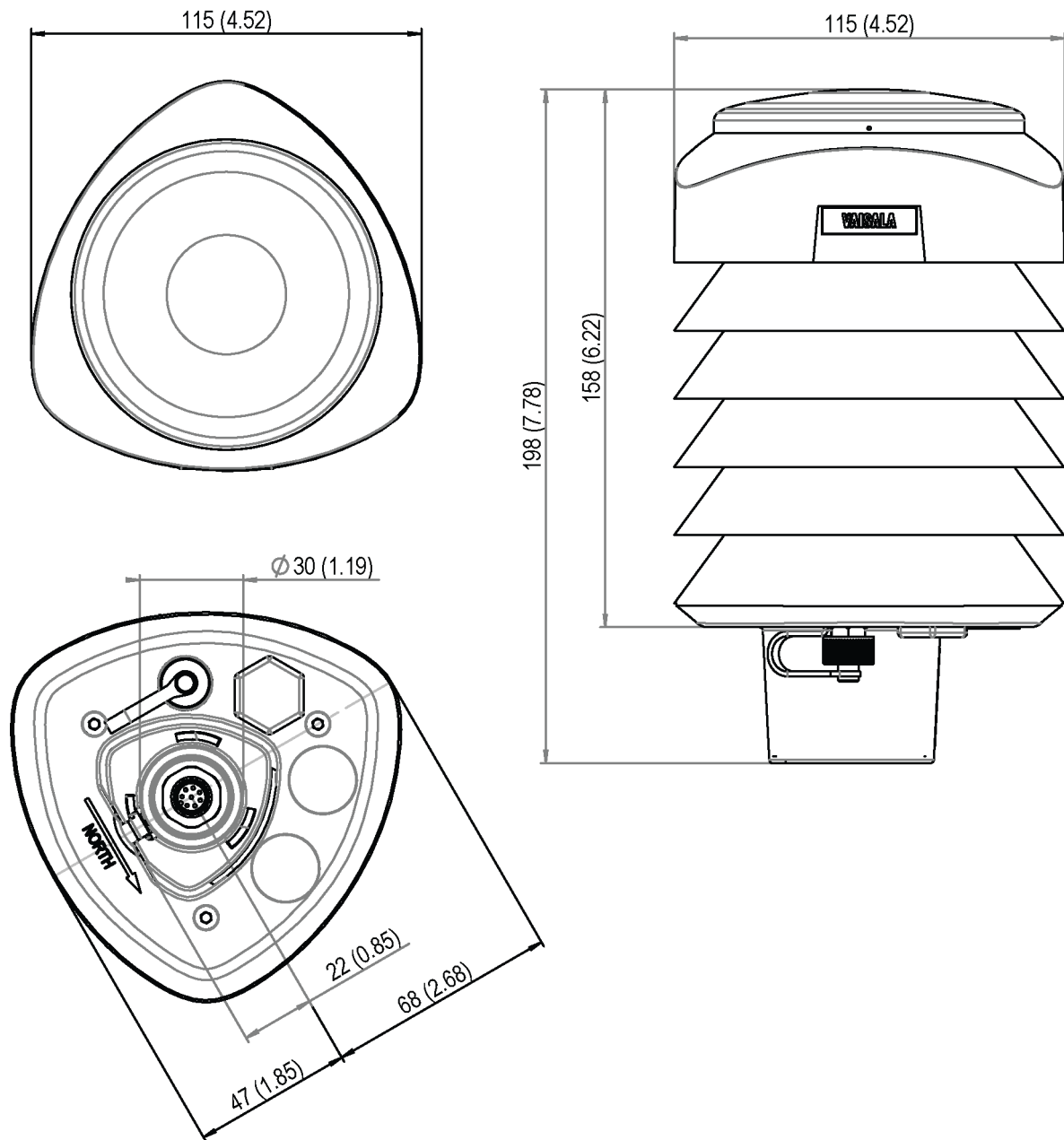R = precipitation
W = wind

Dimensions (mm/inch)

Ø 114 (4.49)

115 (4.52)

238 (9.35)

198 (7.78)

Ø 30 (1.19)

NORTH

22 (0.85)

68 (2.68)

47 (1.85)

Figure 41   WXT536 Dimensions

Figure 42   WXT535 and WXT534 Dimensions
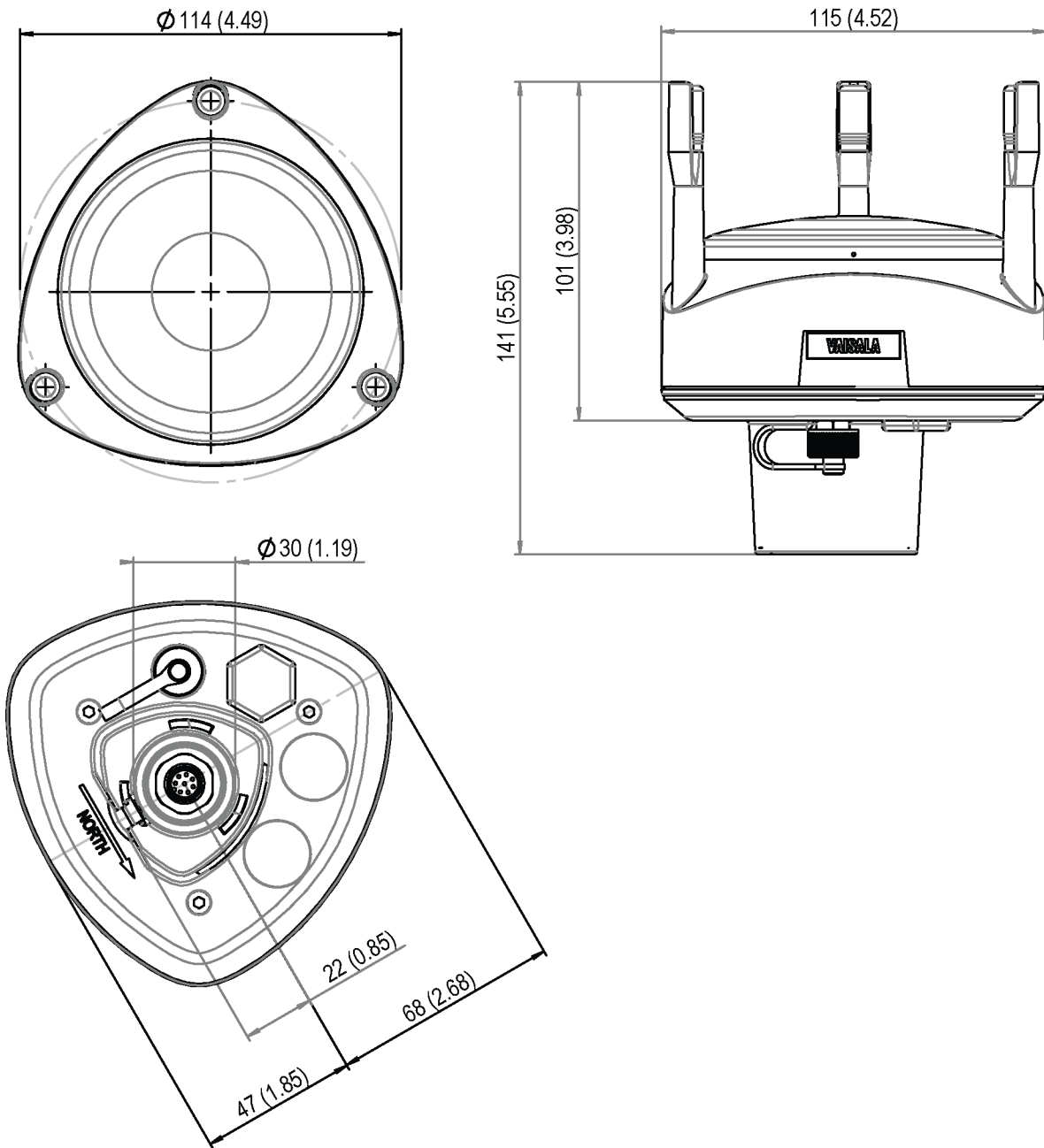
Figure 43   WXT533 and WXT532 Dimensions
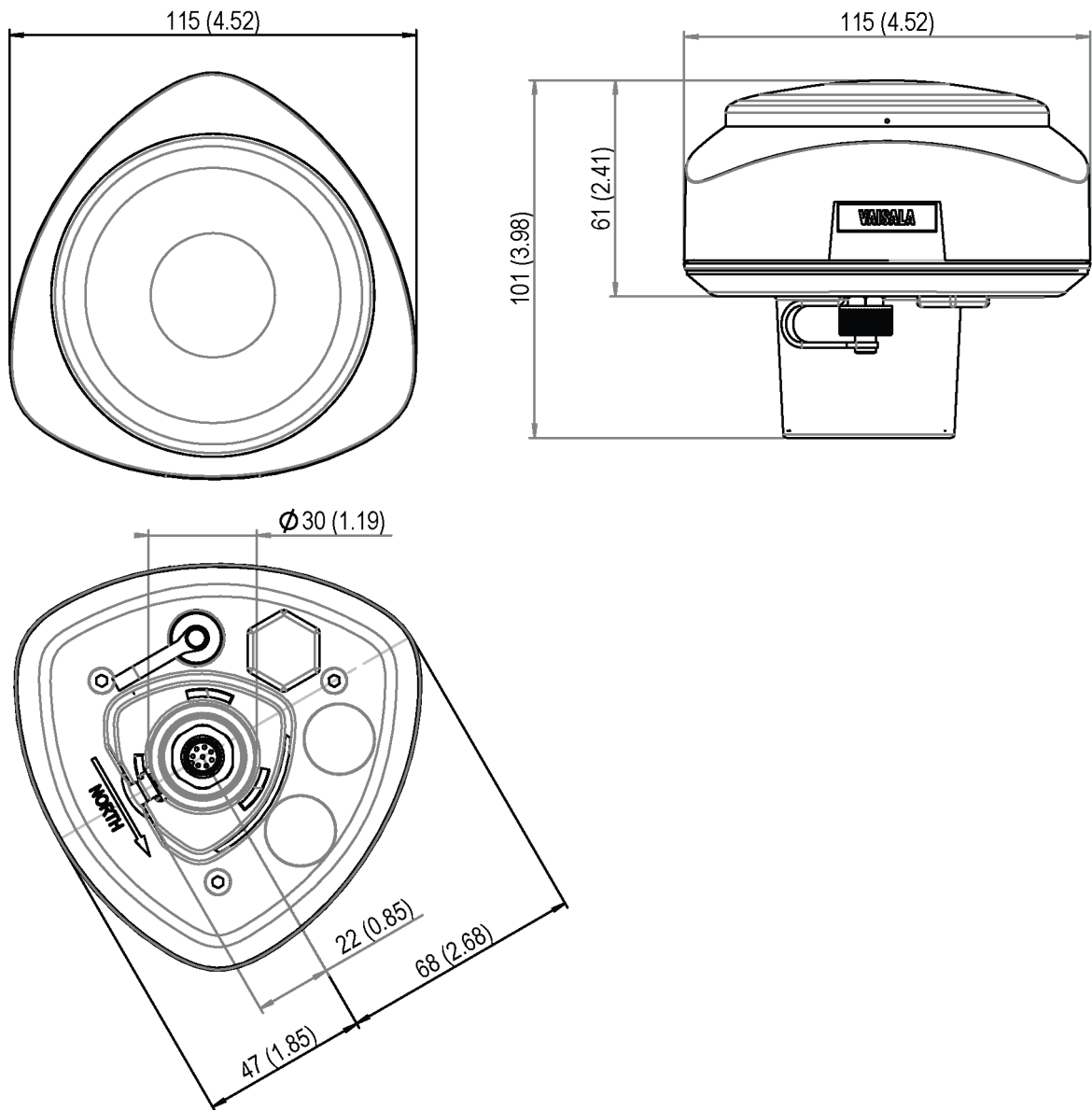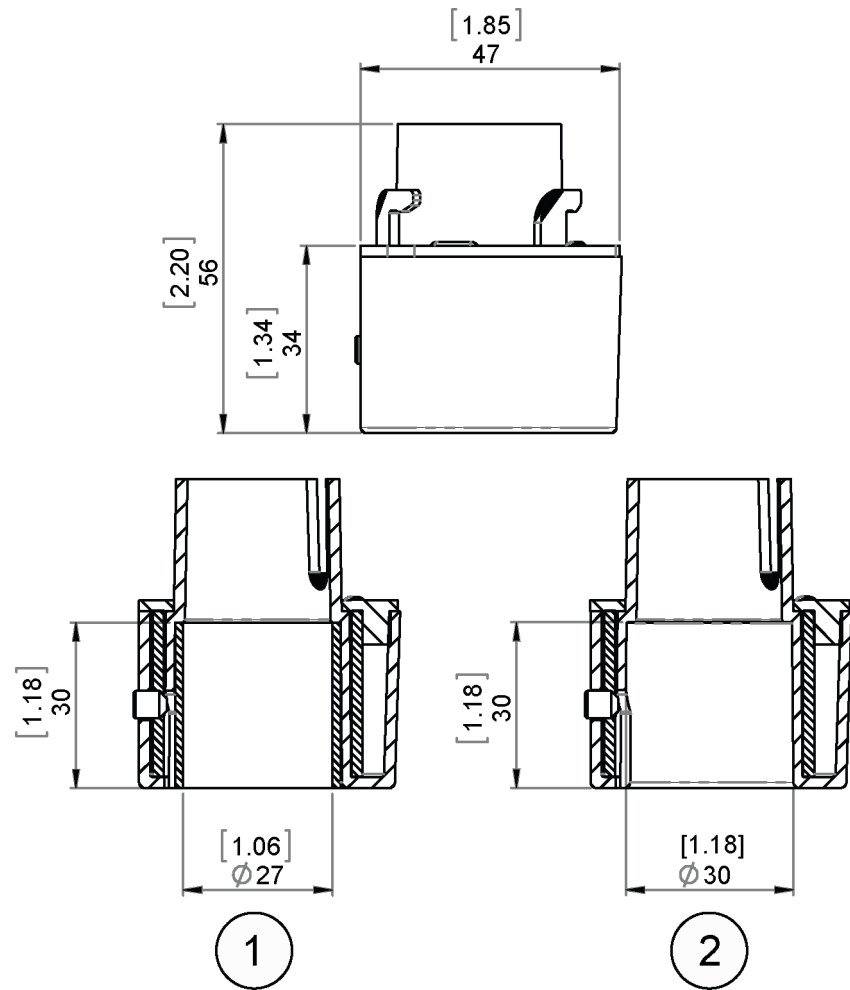
Figure 44   WXT531 Dimensions

Figure 45   Mounting Kit Dimensions

1 = Mounting kit with adapter sleeve for Ø26.7 mm mast tube

2 = Mounting kit without adapter sleeve for Ø30 mm mast tube

APPENDIX A
NETWORKING

Connecting Several Transmitters on Same Bus

There are two options for connecting several transmitters on the same bus:

1. Using SDI-12 serial interface and communication protocol, and

2. Using RS-485 serial interface and one of the following communication protocols: ASCII or NMEA 0183 v3.0.

SDI-12 Serial Interface

Wiring

1. Make the SDI-12 wiring in transmitter as described in Chapter 5 Wiring and Power Management, on page 53. Remember to 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.

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** should be use for all devices. If the measurements are to be performed consecutively for only one unit at 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. See also SDI-12 Protocol on page 102.

RS-485 Serial Interface

Wiring

1. Make the RS-485 wiring of the transmitter as described in Chapter 5 Wiring and Power Management, on 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.

Communication Protocol

Set the communication protocol to ASCII polled (with or without CRC) or NMEA query. When using NMEA query, the wind message should be set to XDR (**aWU,N=T**).

NOTE	No matter which communication protocol, ASCII polled or NMEA query is chosen, the error messaging parameter of the supervisor message must be unactivated with **aSU,S=N** for each transmitter on the bus in order to prevent the units responding to the commands not assigned to them.

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>

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

Now, 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. Hence the data logger, after sending the query, shall sort 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>** will be like:

$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 NMEA 0183 V3.0 Protocol on page 115.

The maximum transducer ID is three when the transmitter address is 0. Hence, 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.

NOTE	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 will show in the transducer IDs in the following way: transmitter address = A => transducer ID = 10, B => 11, a => 36, b => 37 etc.

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: www.sdi-12.org.

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. This is a cable with three conductors:

- a serial data line,

- a ground line, and

- a 12-volt 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.

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:

1. The data recorder wakes all sensors on the SDI-12 bus with a break.

2. The recorder transmits a command to a specific, addressed sensor, instructing it to make a measurement.

3. 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.

4. 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.

5. The sensor responds, returning one or more measurements.

SDI-12 Timing

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.
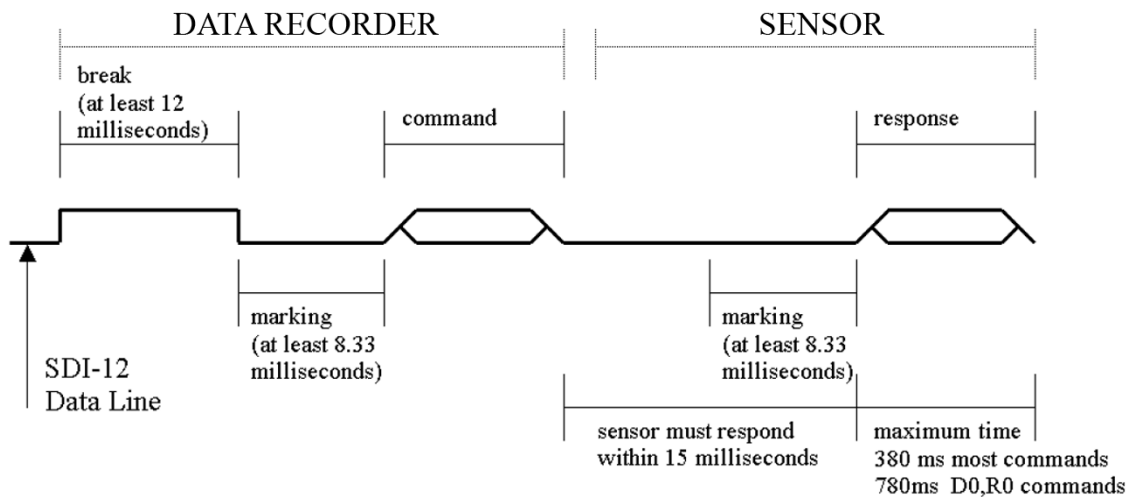

Figure 46   Timing Diagram

- 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.

NOTE	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
    }
  }
}
```

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.

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 three 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.

| **NOTE**	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.
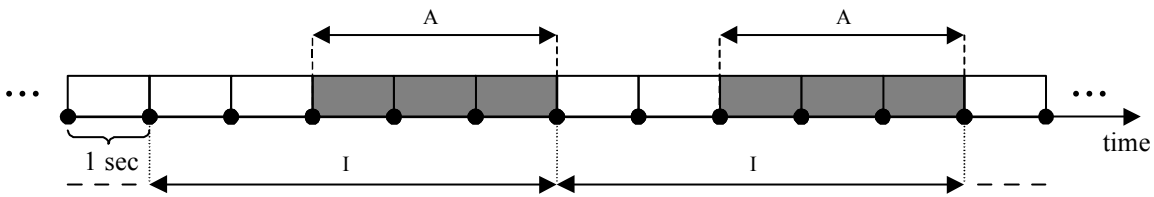
Case 2   I < A, all communication protocols other than SDI-12 (aXU,M=S). In this example I=2 sec and A=5 sec.
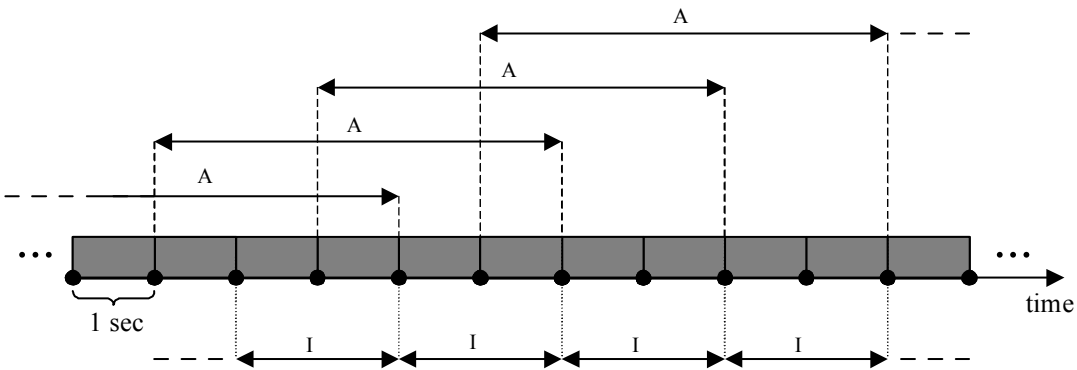
Case 3   Communication protocol SDI-12 (aXU,M=S). In this example A=3 sec. I does not have any function in this protocol.
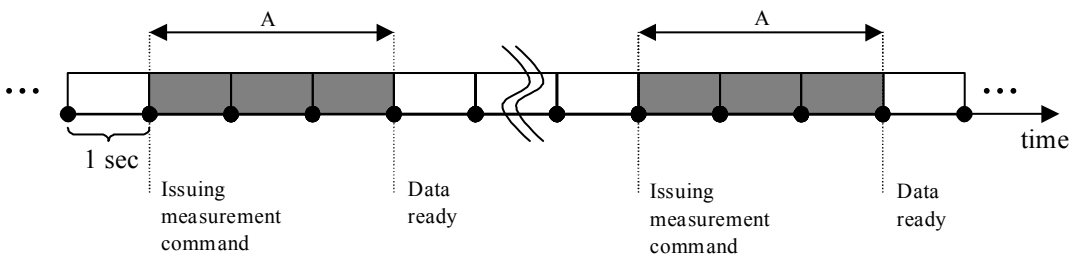

Figure 47   Wind Measurement Averaging Method

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

General Unit Settings

0XF!0XF,f=11111111&11100010,o=AAC1DB1A,c=A263,
i=HEL___,n=A3430012,2=2528,3=3512 <cr><lf>

Table 44   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	2500mV (default)
3	3.5 V reference	3500mV (default)

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><lf>

Table 45   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 %)

PTU Configuration Settings

0TF!0TF,n=A0430432 <cr><lf>

Table 46   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

Rain Configuration Settings

0RF!0RF,p=1.0,n=3.0,d=N,f=0<cr><lf>

Table 47   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=(default) Disabled
f	Wind filter bypass	0,1...4 (0=wind depended, 1,2,3,4=threshold level)

Supervisor Settings

0SF!0SF,t=19.8,b=17159,l=-4.0,m=0.0,h=4.0<cr><lf>

Table 48   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
WIRING EXTERNAL SENSORS TO WXT536

This appendix provides you with information on connecting external sensors to WXT536.
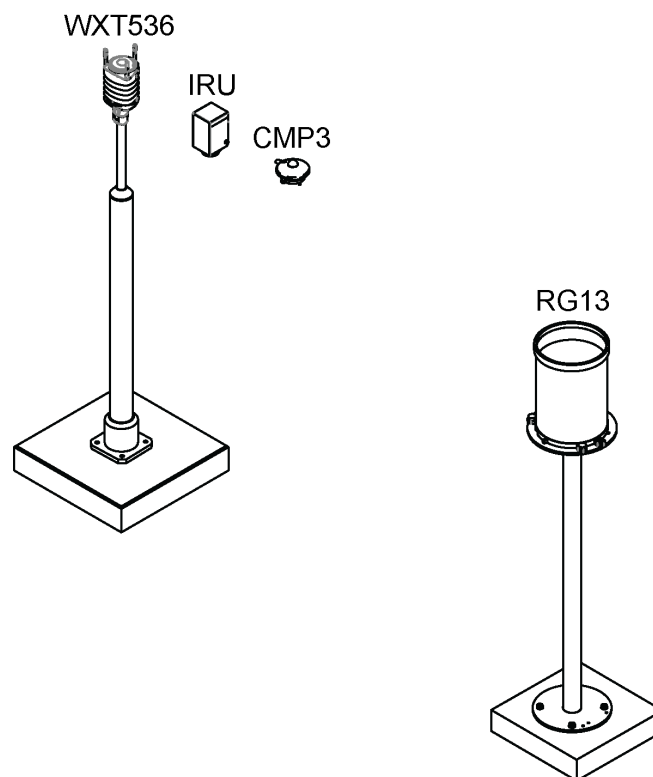

Figure 48   Connecting External Sensors to WXT536

Connecting Snow Depth Sensor to WXT536

The following figure shows how to wire a snow depth sensor to the transmitter.

Note that IRU94x9 needs excitation voltage set to a 5 V level to get readings out to the WXT536 input.
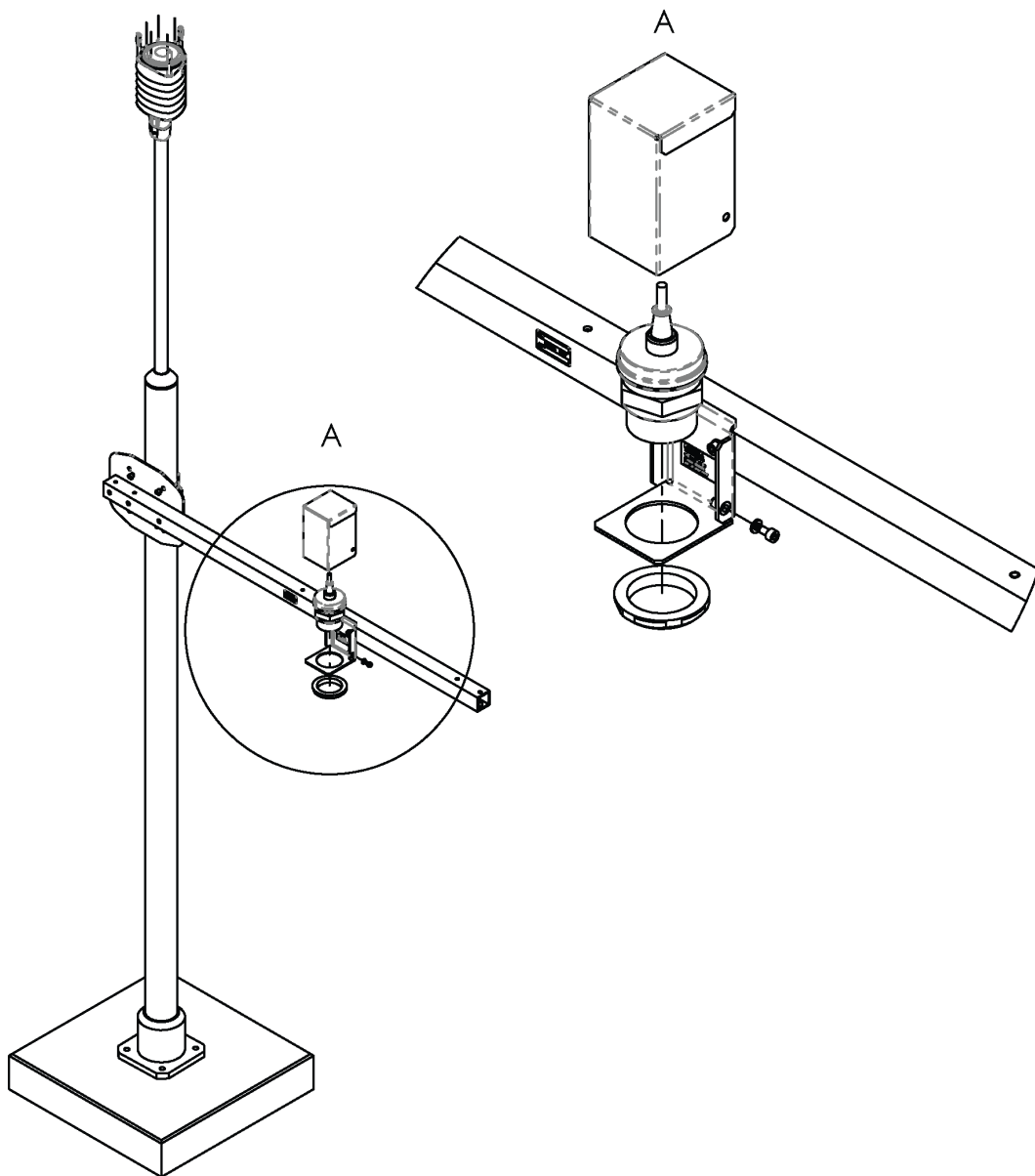

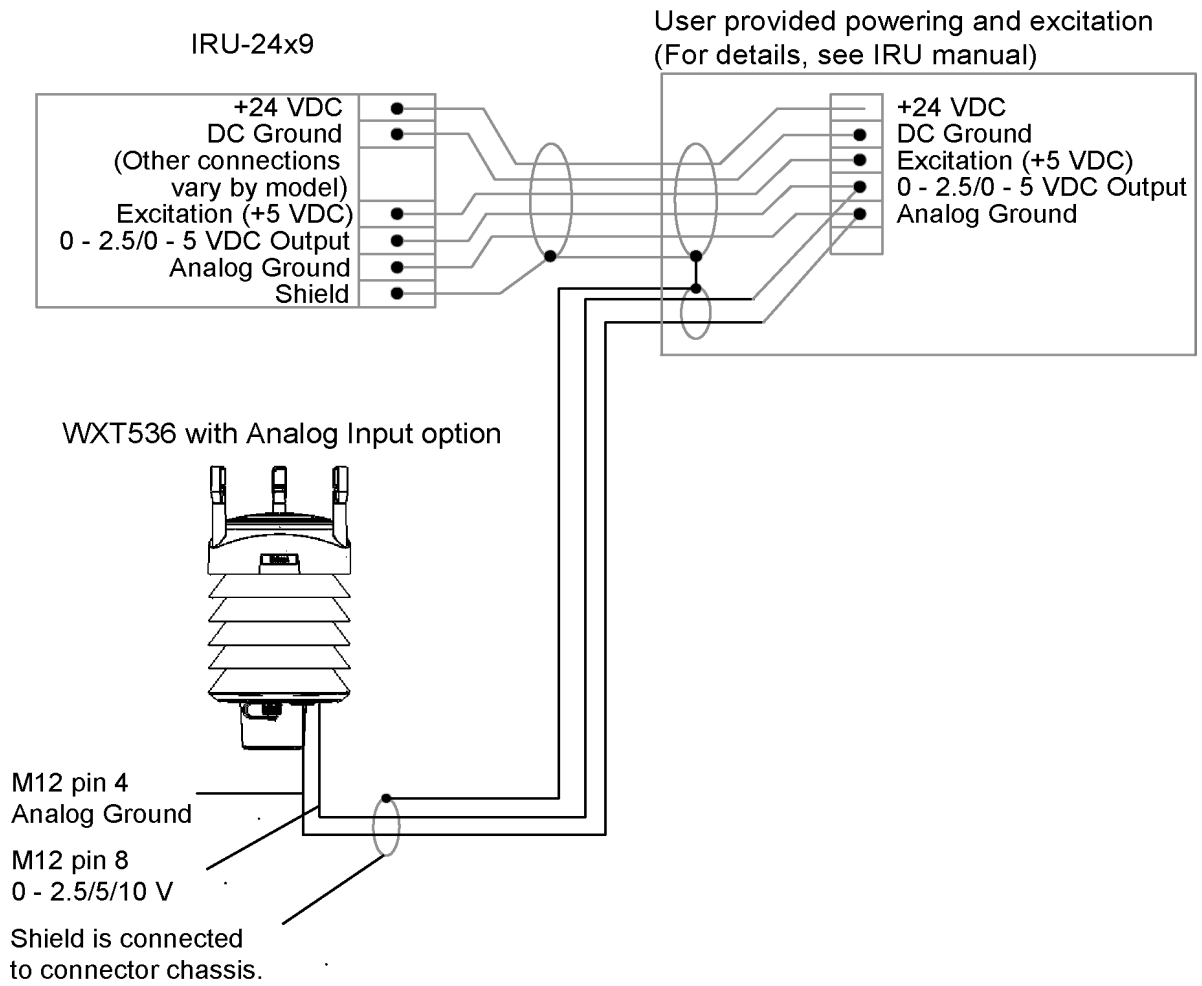**Figure 49   Connecting Snow Depth Sensor to WXT536**

Figure 50   Wiring External Sensor to WXT536

Table 49   IRU9429S Connections

Level sensor connector				IRU 9429S	
Additional sensor connector pin number		**Pin function for additional sensor connector**		**Wire color**	**Function**
1					
2					
3					
4	AGND	Common analog ground for PT, TIP and WS		Green	Analog ground
5					
6					
7					
8	WSIN	Water/Snow Level Sensor input + (AGND= -)	0 ... 2.5 V / 0 ... 5 V / 0 ... 10 V	White	0 ... 5 VDC

Connecting Pyranometer to WXT536

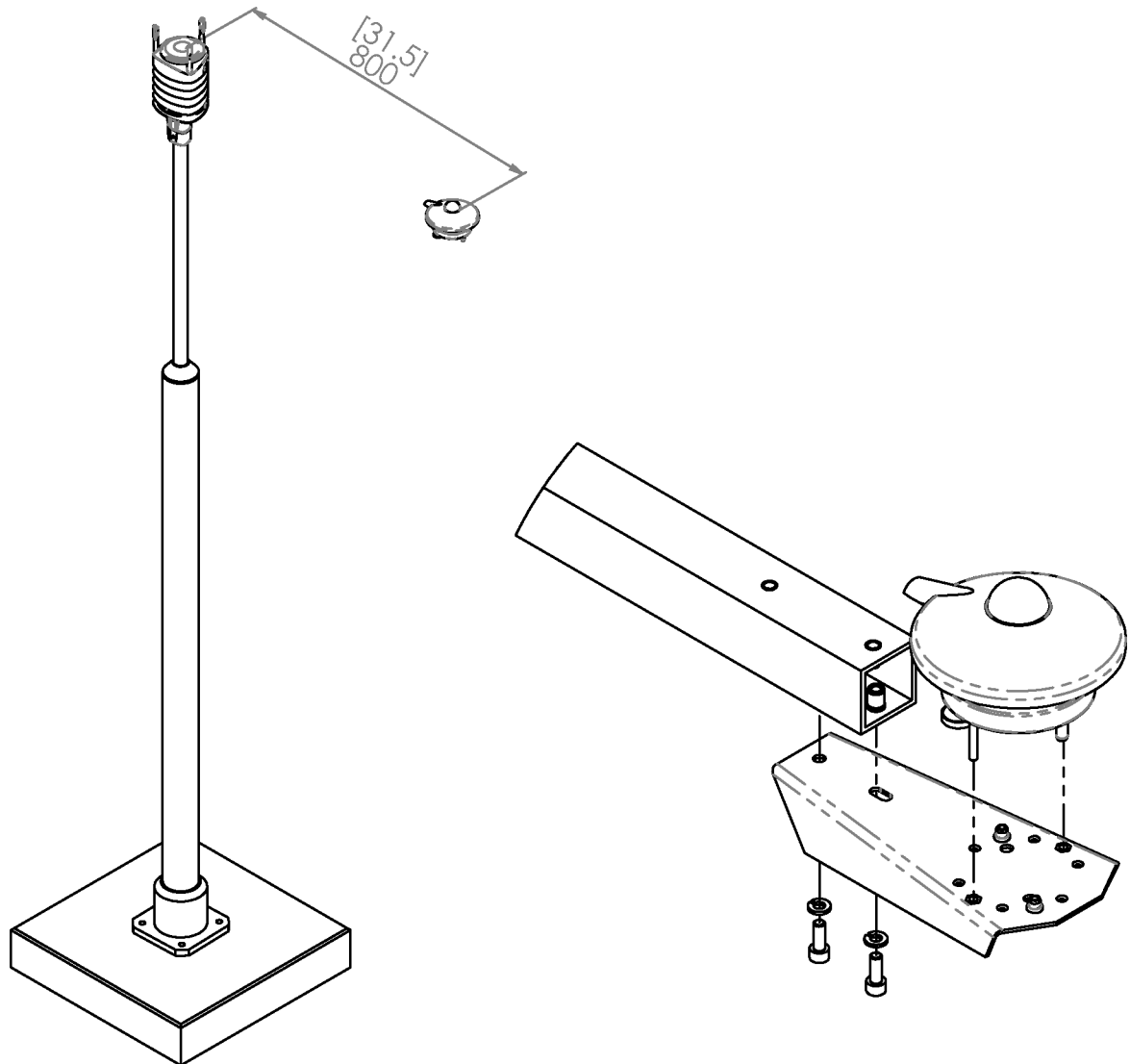The following figure shows pyranometer CMP3 connected to WXT536.

Figure 51   Connecting CMP3 to WXT536

Table 50   CMP3 Connections

Solar radiation connector				CMP3	
Additional sensor connector pin number		Pin function for additional sensor connector		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					

Connecting Rain Gauge to WXT536

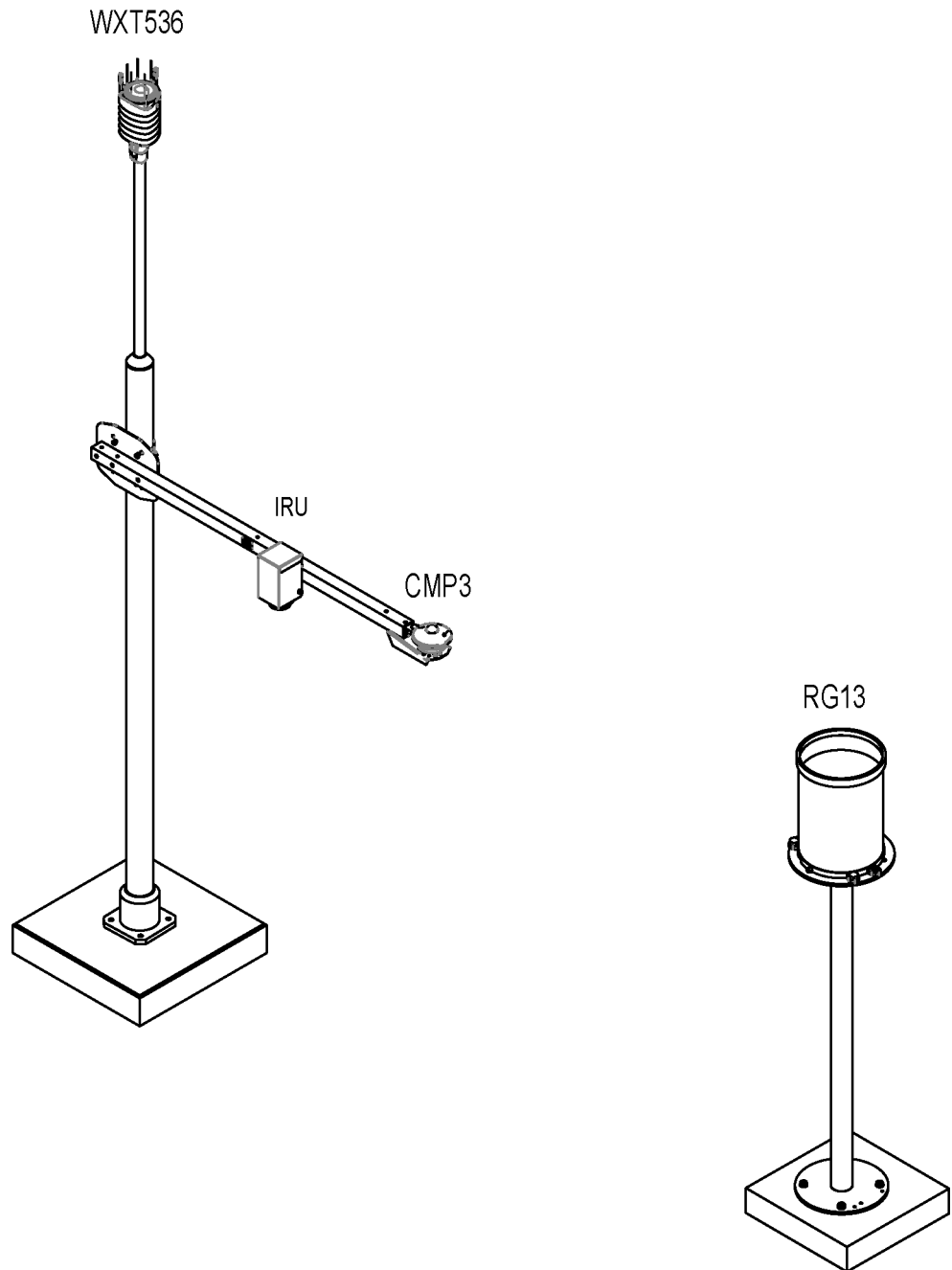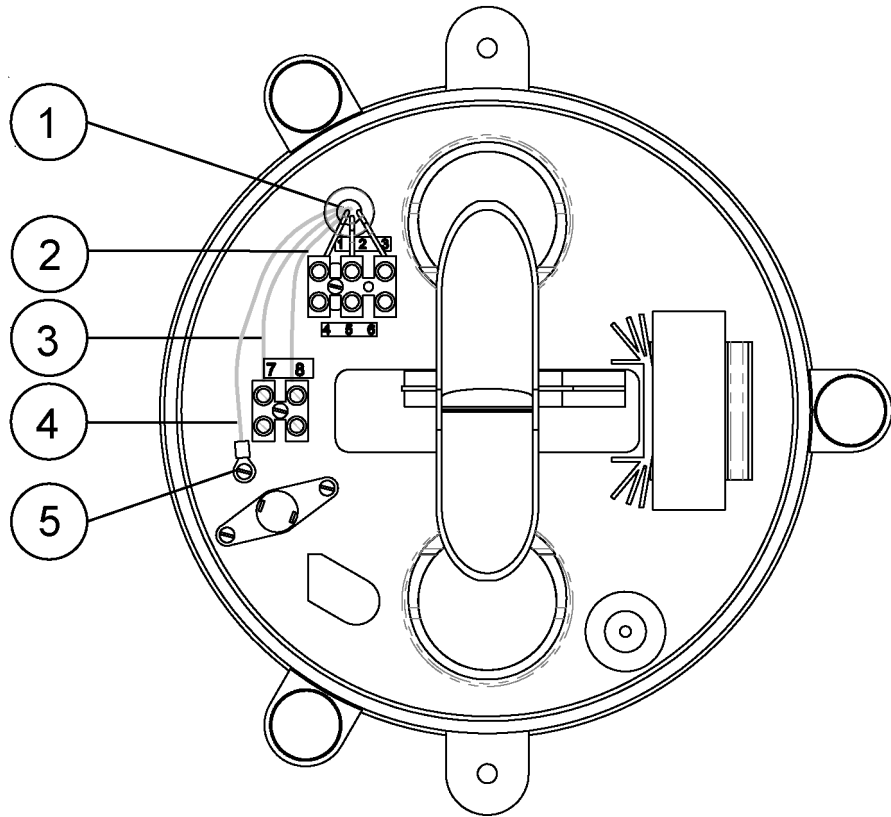The following figure shows rain gauge RG13 connected to WXT536.

Figure 52   Connecting RG13 to WXT536

Connect the green cable of WXT536 to screw terminal 7 and the grey cable to screw terminal 8.

1 = Cable tie

2 = Screw terminal 8

3 = Screw terminal 7

4 = Cable shield

5 = Grounding point

Table 51   RG13/RG13H Connections

Tipping bucket rain sensor connector				RG13/RG13H connector X4	
Additional sensor connector pin number		**Pin function for additional sensor connector**		**Pin number**	**Function**
1					
2					
3					
4	AGND	Common analog ground for PT, TIP and WS		7	Normally open contact
5	TIP IN	Tipping bucket digital input connect to AGND for pulse		8	Normally open contact
6					
7					
8					

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