VAISALA

USER'S GUIDE

Vaisala WINDCAP® Ultrasonic Wind Sensor Series WMT700

M211095EN-C

PUBLISHED BY

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CHAPTER 1

GENERAL INFORMATION

This chapter provides general notes for the manual and the WMT700 series.

About This Manual

This manual provides information for installing, operating, and maintaining Vaisala WINDCAP® Ultrasonic Wind Sensors WMT701, WMT702, and WMT703.

Contents of This Manual

This manual consists of the following chapters:

- Chapter 1, General Information, provides general notes for the manual and the WMT700 series.

  Chapter 2, Product Overview, introduces the features, advantages, and the product nomenclature of WMT701, WMT702, and WMT703.
- Chapter 3, Functional Description, describes the functionality of WMT700.
- Chapter 4, Installation, contains information that is needed to install WMT700 with the FIX70 mounting kit.
- Chapter 5, Serial Communication and Analog Output, contains general information on serial communication and analog output when using WMT700.
- Chapter 6, Configuration, contains information on WMT700 configuration commands and parameters.
- Chapter 7, Operation, contains information on WMT700 operating commands, protocols and data messages.
- Chapter 8, Maintenance, contains information that is needed for performing visual inspection, cleaning, and verifying the operation of WMT700.

- Chapter 9, Troubleshooting, describes common problems, their probable causes and remedies, and provides contact information for technical support.
- Chapter 10, Technical Data, provides the technical data of WMT700.
- Appendix A, Complete Command Set for WMT700, lists all the commands available for WMT700.
- Appendix B, Typical System Environments, lists the most typical WMT700 system environments.
- Appendix C, Default Settings for Different Digital Communication Profiles, lists the default settings for different digital communication profiles.
- Appendix D, Configuration Parameters, lists WMT700 Configuration parameters.

Version Information

Table 1 Manual Revisions

Manual Code	Description
M211095EN-C	April 2011. This manual. Updated structure of chapters for better usability. Added new content to Chapter 4 Installation. Added new Appendices.
M211095EN-B	September 2010. Previous version. Updated mounting instructions and illustrations. Updated names of accessories and cables.
M211095EN-A	June 2010. First version.

Related Manuals

Table 2 Related Manuals

Manual Code	Manual Name
M211097EN	Upgrading from Vaisala WINDCAP® Ultrasonic Wind Sensor WS425 to WMT700 Technical Reference

Documentation Conventions

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.

Safety

Vaisala WINDCAP® Ultrasonic Wind Sensor WMT701, WMT702, or WMT703 delivered to you has been tested for safety and approved as shipped from the factory. Note the following precautions:

WARNING	To protect personnel (and the wind sensor), a lightning rod must be installed with the tip at least one meter above WMT700. The rod must be properly grounded, compliant with all local applicable safety regulations. Do not install the wind sensor above the top of the lightning protection rod.

WARNING	If ice or snow accumulates on WMT700 or the mast, it can fall and cause injury to persons below.

WARNING	Some WMT700 product versions provide heating for transducers and/or array arms. To avoid injury, do not touch the heated parts of the wind sensor when the heating is enabled.

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

WARNING Using a long cable between different units (sensors, transmitters, power supplies, and displays) can cause a lethal surge voltage, if a lightning strike occurs in the vicinity. Always apply proper grounding procedures and follow the requirements of the local Electrical Code.

WARNING Do not install WMT700 when there is a risk of thunderstorm or lightning activity in the area.

CAUTION Do not modify the unit. There are no user-serviceable parts inside. Improper modification can damage the product or lead to malfunction.

CAUTION When handling WMT700, do not rotate, pull, strike, bend, scrape or touch the transducers with sharp objects. Any impact on the wind sensor array damages the device.

CAUTION The heating supply wires of WMT700 are internally connected to each other. If the connection cable has two positive heating supply wires, both must be connected to each other. Leaving one terminal unconnected or connecting it to the ground may cause a WMT700 malfunction or a short circuit in the power supply.

Recycling

Recycle all applicable material.

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

Regulatory Compliances

Vaisala WINDCAP® Ultrasonic Wind Sensor WMT701, WMT702, and WMT703 comply with the following performance and environmental test standards:

Wind tunnel tests have been performed according to Sonic anemometers/thermometers -Acceptance test methods for mean wind measurements ISO16622:2002.

Table 3 Environmental Tests

Test	Setup According to
Wind driven rain	MIL-STD 810G Method 506.5 and Telcordia GR-487-Core
Salt fog	VDA 621 - 415 / IEC 60068-2-52
Leak test (Ingression Protection)	IEC 60529 class IP67
Vibration	IEC 60068-2-6/IEC 60945/Lloyd's test
Shock	MIL-STD-202G, Method 213B, cond. J
Dry heat	IEC 60068-2-2/IEC 60068-2-48
Damp heat cyclic	IEC 60068-2-30, Test Db
Damp heat	IEC 60068-2-78
Low temperature	IEC 60068-2-1 Test Ab/Ad
Free fall (rough handling)	IEC 60068-2-31
Change of temperature	IEC 60068-2-14

EMC tests are based on a European product family standard: EN 61326-1:2006 (Electrical equipment for measurement, control and laboratory use - EMC requirements for use in industrial locations) and EN 60945:2002 (Maritime Navigation and Radiocommunication Equipment and Systems - General Requirements - Methods of Testing and Required Test Results).

Table 4 Electromagnetic Compatibility Tests

Test	Setup According to
Conducted RF immunity	IEC 61000-4-6
EFT immunity	IEC 61000-4-4
Surge immunity	IEC 61000-4-5
ESD immunity	IEC 61000-4-2
High voltage (Dielectric tests)	IEC 60947-2
Conducted emissions [1)]	CISPR 22
Radiated emissions	CISPR 22
RF field immunity	IEC 61000-4-3
Insulation resistance	IEC 60092-504

[1)] Limits according to IEC 60945: Maritime navigation and radiocommunication equipment and systems - General requirements - Methods of testing and required test results. 4th edition, 2002-08.

CE N17728

Trademarks

WINDCAP® is a registered trademark of Vaisala Oyj.

Windows® is a registered trademark of Microsoft Corporation in the United States and/or other countries.

Warranty

For certain products Vaisala normally gives a limited one-year warranty. Visit our Internet pages for more information and our standard warranty terms and conditions: www.vaisala.com/services/warranty.html.

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, advantages, and the product nomenclature of WMT701, WMT702, and WMT703.

NOTE	In this manual WMT700 series wind sensors WMT701, WMT702 and WMT703 are commonly referred to as WMT700.

Introduction to WMT700

Vaisala WINDCAP® Ultrasonic Wind Sensor WMT700 measures wind speed and direction and sends the measurement results to data acquisition systems. WMT700 forms part of the Vaisala weather measurement offering suitable for systems and stand-alone installations.

The WMT700 series consists of three product types with different measurement ranges: WMT701, WMT702, and WMT703. Additionally, you can select heating functions that shield the array and/or the transducers from ice and snow build-ups in cold climates.

The WMT700 series wind sensors are based on the advanced, patented Vaisala WINDCAP® wind measurement technology that ensures accurate results in all wind directions. The effects of temperature, humidity, and pressure are also fully compensated.

Since the WMT700 series wind sensors have no moving parts, they are virtually maintenance-free. The performance of the sensors does not degrade with wear nor is it affected by natural contaminants such as salt, dust or sand.

The WMT700 series wind sensors support a wide range of communication options. You can connect the wind sensors directly to a variety of data acquisition systems without additional converters or adapters.

WMT700 is configured at the factory according to the customer's order, and it is ready for operation directly after the installation. If required, the

user also has a wide range of configuration options for the wind sensor and the measurement settings.

WMT700 can be equipped with accessories to tailor the instrument to match to different user-specific needs. The accessories include a bird deterrent solution and a field usable calibration verifier.

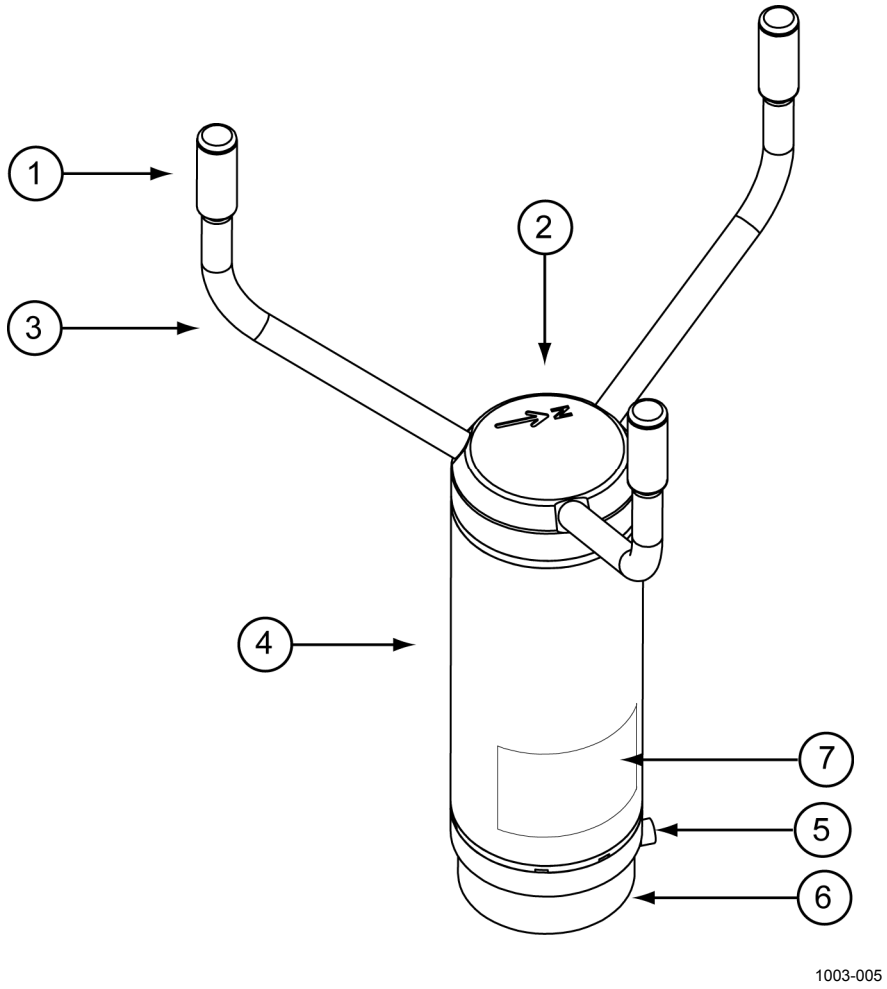


Figure 1 WMT700 Wind Sensor

The following numbers refer to Figure 1 above:

The array consists of 1, 2, and 3:
1 = Transducers (3 pcs)
2 = Top of WMT700. There is a north arrow on top of WMT700
3 = Transducer arms (3 pcs)
4 = Enclosure
5 = Mounting screw
6 = Mounting adapter
7 = Type label

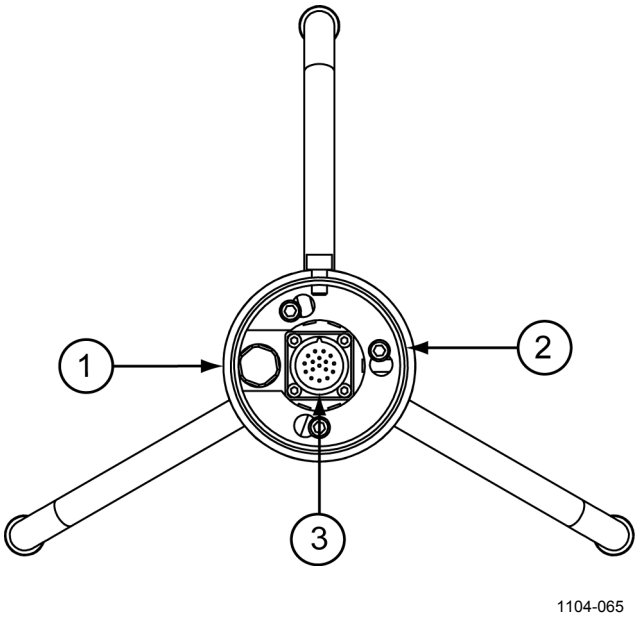


Figure 2 WMT700 Wind Sensor from Below

The following numbers refer to Figure 2 above:

1 = Waterproof vent
2 = Mounting adapter screw (3pcs, 4mm Allen key)
3 = 17-pin M23 male connector

NOTE	Do not open the sensor. There are no user-serviceable parts inside.

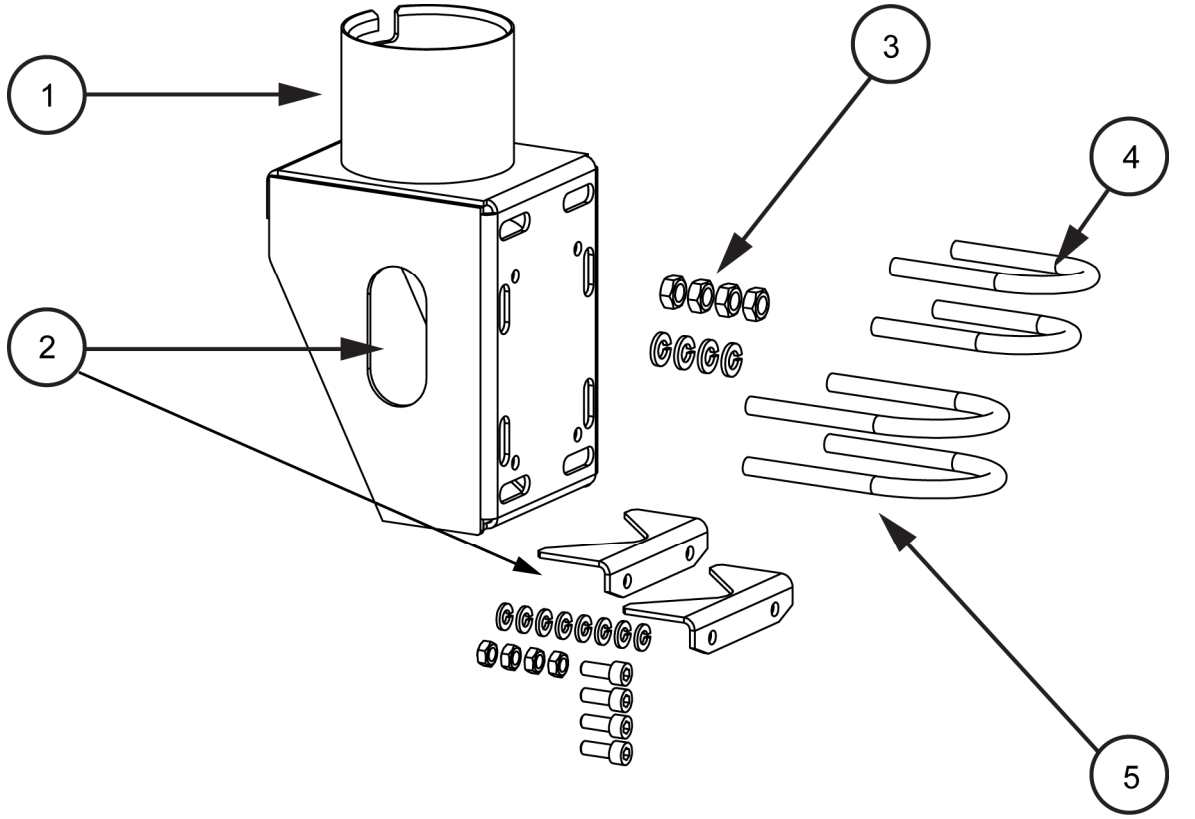


Figure 3 FIX70 Mounting Kit

The following numbers refer to Figure 3 above:

FIX70 consists of :

1 = Fix body
2 = Removable mast guide with mounting hardware
3 = Mounting hardware (M6 nuts, washers type)
4 = U bolts for ø30 mm mast (2 pcs)
5 = U bolts for ø60 mm mast (2 pcs)

Ordering Options for WMT700 Series

When ordering the product, select either WMT701, WMT702, or WMT703 according to your specific measurement needs and operating conditions. Table 5 below lists the main characteristics of WMT701, WMT702, and WMT703.

Table 5 Characteristics of WMT700 Series Wind Sensors

Property	WMT701	WMT702	WMT703
Measurement Range	up to 40 meters per second	up to 65 meters per second	up to 75 meters per second
Temperature Range Option	-10 ... +60 °C -40 ... +60 °C -55 ... +70 °C		
Heating Options	No heating Transducer heating: 30 W (minimum 40 W needed) Transducer and array arm heating: 150 W (minimum 200 W needed)		

NOTE Vaisala recommends using heated versions of WMT700 in environmental conditions where snow and ice build-up is possible. For more information on the heating functionality, see section Heating on page 57.

Table 6 below lists the wind sensor settings that can be selected by the user.

Table 6 Available Settings for WMT700

Setting	Options
Digital communication interface	RS-485, RS-422, RS-232, SDI-12
Digital communication profile	WMT700, WS425 - ASCII, WS425 - NMEA Extended, WS425 - SDI-12, WS425 - ASOS, ROSA - MES12
Digital communication units	m/s, knots, mph, km/h
Analog output signals for wind speed channel	voltage, current, frequency, WS425 - voltage, WS425 - frequency
Analog output signals for wind direction channel	voltage, current, potentiometer (WS425)

NOTE If required, you can change the communication interface, digital message format, and analog output signals for WMT700 after the installation. To change the product version characteristics listed in Table 5 above, contact Vaisala Service Center.

Accessories

WMT700 can be tailored to the need with several accessories. The accessories include, for example, several mounting adapters for different mast diameters, cables for different host systems and preferred communication types, bird prevention and field calibration kits.

When specifying your WMT700, you can order the optional FIX70 universal mounting adapter, a bird cage, WMT700 verifier, and cables as accessories for WMT700.

For order codes for the accessories that need to be ordered separately, see Table 32 on page 118.

Bird Cage

Vaisala recommends using the optional bird cage in areas with large bird populations. The cage is designed to prevent large birds from disturbing the measurement. It has been tested in a wind tunnel with wind speeds of up to 40 m/s without noticeable effects on the wind speed and direction measurement.

You can install the bird cage on a mounted WMT700 series wind sensor without dismounting the wind sensor itself. In cold climates, take into account that accumulated snow or ice on the bird cage can disturb measurement. In such conditions, consider performing frequent visual inspections of WMT700 to avoid ice or snow build-ups.

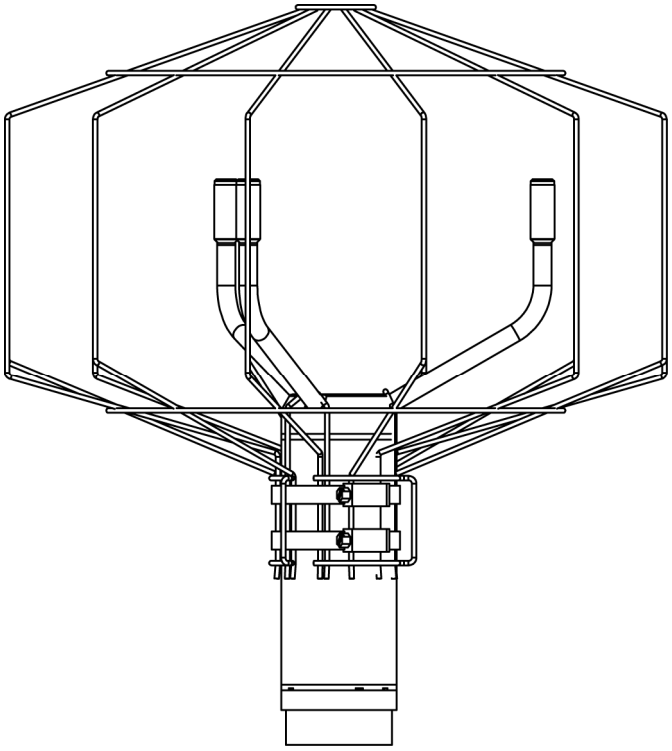
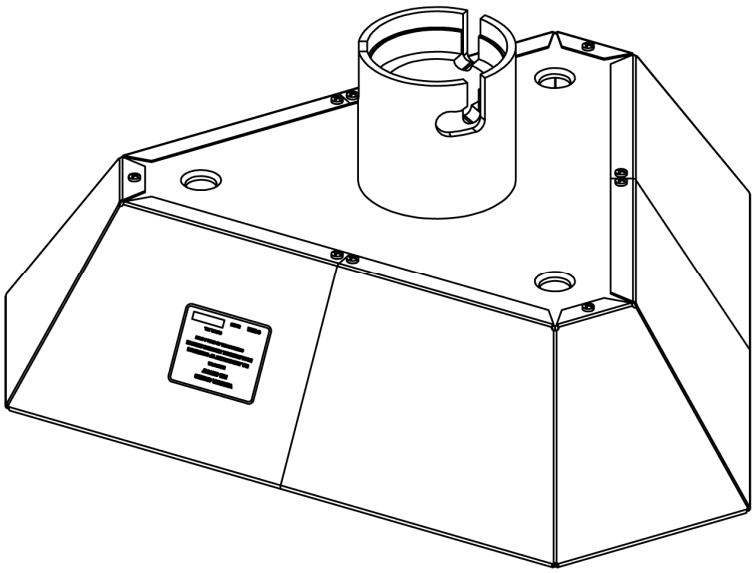


Figure 4 Bird Cage

WM Verifier

The optional verifier is a small echo-free chamber for testing the mechanical integrity of WMT700 and performing one-point calibration. The verifier ensures that the array is undamaged and the transducers are parallel to each other. You can perform the verifier test in a laboratory or in the field.

For instructions on performing the verifier test, see section Testing Proper Operation on page 106.



1004-119

Figure 5 WM Verifier

Cables

Select the required cables according to your operating environment.

Table 7 WMT700 Cables

Order Code	Description	Purpose
227567SP	Cable 2 m, cable connector, open leads on one end	Used for analog output or serial communication with two serial ports.
227568SP	Cable 10 m, cable connector, open leads on one end	Used for analog output or serial communication with two serial ports.
228259SP	RS485 cable 2 m, cable connector, open leads on one end	Used for serial communication with RS-485 interface.
228260SP	RS485 Cable 10 m, cable connector, open leads on one end	Used for serial communication with RS-485 interface.
227565SP	MAWS cable 10 m	Used for connecting WMT700 to Vaisala Automatic Weather Station MAWS.
229807SP	AWS520 cable 10 m, shield connected to PE pin	Used for connecting WMT700 to Vaisala Fixed Site Observation System AWS520.
227566SP	AWS520 cable 10 m, shield not connected to PE pin	Used for connecting WMT700 to Vaisala Fixed Site Observation System AWS520.
227569SP	Adapter cable for WS425 serial	Used for connecting the WS425 cable to WMT700. Only applicable for retrofit installations.
227570SP	Adapter cable for WS425 analog frequency output	Used for connecting the WS425 cable to WMT700. Only applicable for retrofit installations.
227571SP	Adapter cable for WS425 analog voltage output	Used for connecting the WS425 cable to WMT700. Only applicable for retrofit installations.
231425SP	ROSA Analog Retro-Fit Cable 10m, cable connector, open leads on one end.	Used for connecting WMT700 to Vaisala Road Weather System ROSA.

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CHAPTER 3
FUNCTIONAL DESCRIPTION

This chapter describes the functionality of WMT700.

Operating Principle

WMT700 uses the Vaisala WINDCAP® ultrasonic sensor technology in wind measurement. The sensor has an onboard microcontroller that captures and processes data and communicates over serial interfaces.

The wind sensor has an array of three equally spaced ultrasonic transducers on a horizontal plane. Wind speed (WS) and wind direction (WD) are determined by measuring the time it takes the ultrasound to travel from each 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. This transit time depends on WS 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.

Figure 6 on page 26 shows how the time shift of the ultrasonic signals is measured and how tail wind and forward wind affect measurement.

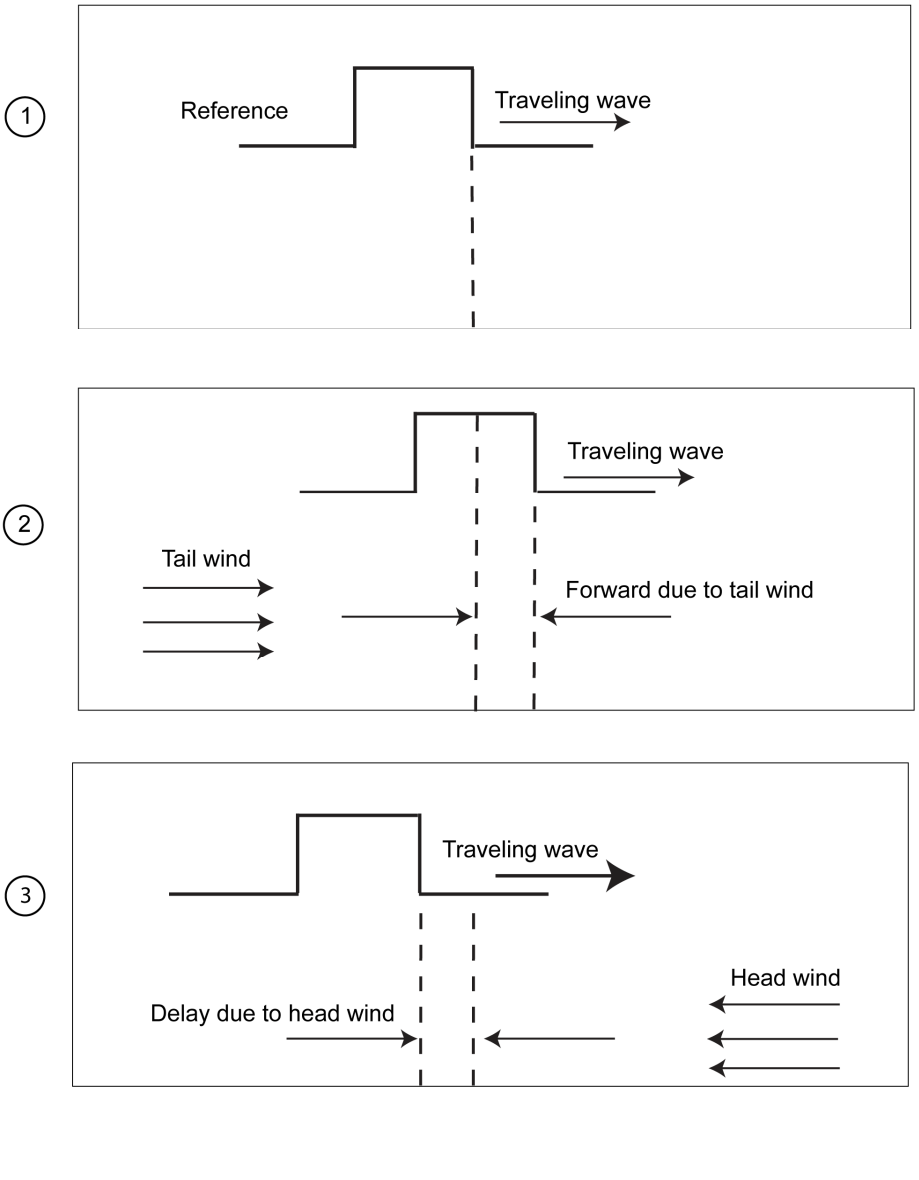

Figure 6 Ultrasonic Measurement Principle

The following numbers refer to Figure 6 above:

1 = Ultrasonic measurement with zero wind.
2 = Impact of tail wind on ultrasonic measurement.
3 = Impact of head wind on ultrasonic measurement.

The microprocessor of the microcontroller calculates WS from the measured transit times using the following formula:

$$V_W = 0.5 \cdot L \cdot (1/t_f - 1/t_r)$$

where

V_w = Wind velocity

L = The distance between two transducers

t_f = The transit time in the forward direction

t_r = The transit time in the reverse direction

Measuring the six transit times allows Vw to be computed for each of the three ultrasonic paths. Using Vw values of two array paths is enough to compute WS and WD.

Figure 7 below shows the different paths of WMT700 and the vectors provided by the wind sensor:

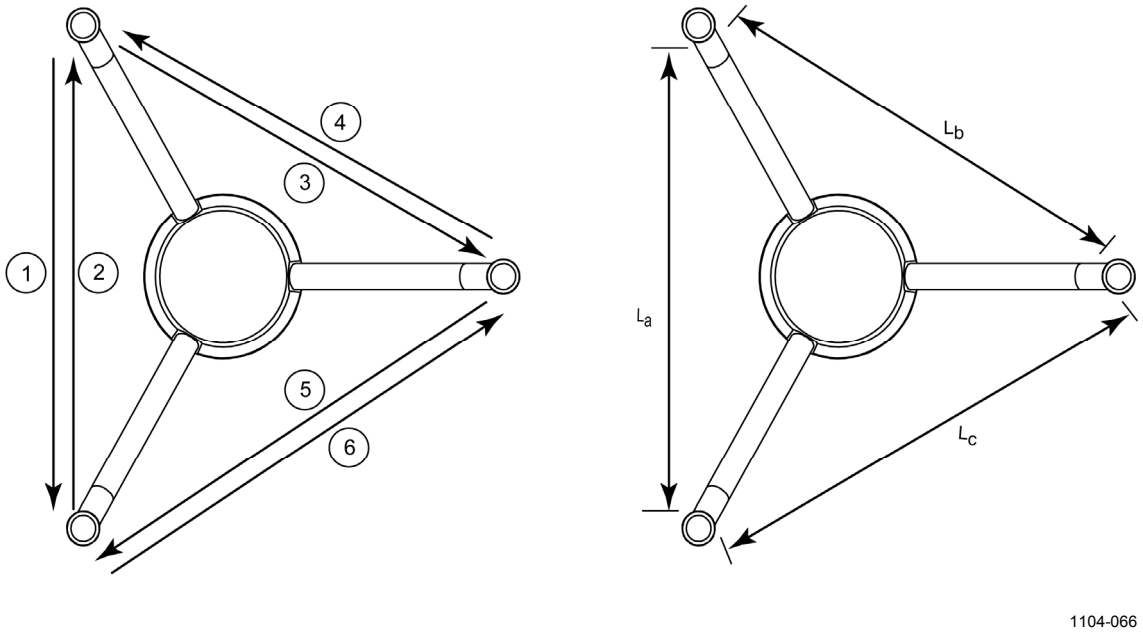

Figure 7 Measurement Paths of WMT700

where:

1-6 = Measurement paths 1 to 6 of WMT700.

L_a, L_b, L_c = The distance between two transducers.

The vectors are calculated as follows:

$$V_a = 0.5 \cdot L_a \cdot (1/A_1 - 1/A_2)$$

$$V_b = 0.5 \cdot L_b \cdot (1/A_3 - 1/A_4)$$

$$V_c = 0.5 \cdot L_c \cdot (1/A_5 - 1/A_6)$$

The equation depends on the accurate distance of the measurement path (L). 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.

Coordinate Systems: Vector and Polar Calculations

Triangle geometry of the sensor is converted to orthogonal coordinates to achieve the x and y components. Then the sensor converts the wind vectors into polar coordinates.

The measurement results are reported as follows:

- WMT700 reports WS (x, y) as two scalar speeds, one parallel to the N-S direction (x) and the other (y) parallel to the W-E direction. The speed unit may be m/s, kt, mph, or km/h.

  x = WS × *cos* (WD)

  y = WS × *sin* (WD)

- WMT700 reports polar wind speed as a scalar speed in selected units (m/s, kt, mph, km/h).

  Polar wind direction is expressed in degrees (°). WMT700 indicates the direction that the wind comes from. North is represented as 0 °, east as 90 °, south as 180 °, and west as 270 °.

Figure 8 below shows examples of wind speed and direction presentations.

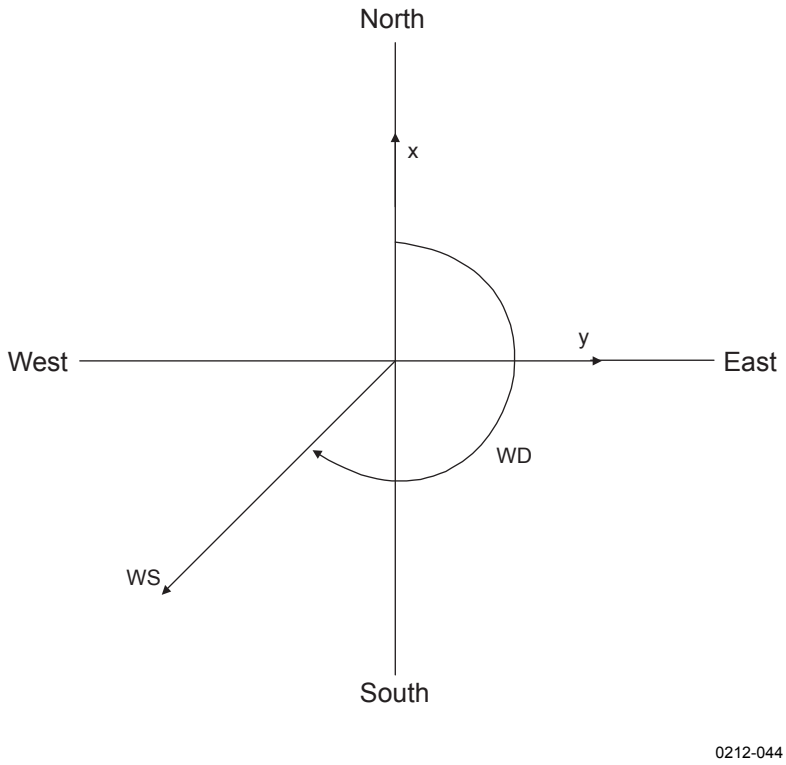

Figure 8 Different Wind Speed and Direction Presentations

Wind Speed and Direction Averaging

Overview

WMT700 provides average values for wind speed and direction using either scalar or vector averaging. With both methods, the average is determined according to the user-configurable averaging time. The averaging time affects serial communication and analog output similarly.

You can also configure the gust averaging time for calculating wind extreme values. The default gust averaging interval is 3 seconds, as recommended by the WMO (World Meteorological Organization).

If scalar averaging has been selected, you can also enable wind direction coasting to ensure consistent direction measurement results at low wind speeds.

Scalar Averaging

When scalar averaging has been selected, WMT700 calculates wind speed and direction averages by adding up each wind measurement from the averaging time and then dividing the sum by the number of measurements. The time between each consecutive wind speed and wind direction measurement is 0.25 seconds.

Wind direction is a circular function with a discontinuity at the north, where 360 degrees is equal to zero degrees. For instance:

359 ° + 5 ° = + 4 °

0 ° - 5 ° = 355 °

WMT700 translates wind direction to a linear function to determine the wind direction average. For instance:

359 ° + 5 ° is translated to 364 °, which is then further converted to +4 ° for output.

0 ° - 5 ° is translated to 355 °.

This ensures that the wind direction average stays representative of the true situation even if individual samples occur on both sides of the zero direction.

If the data acquisition system requests data before the initial averaging time completes, the sensor returns the most recent complete measurement data.

Figure 9 on page 31 shows an example of averaging wind direction when the measured wind values are 355 ° and 10 °. The resulting average is 2.5 °.

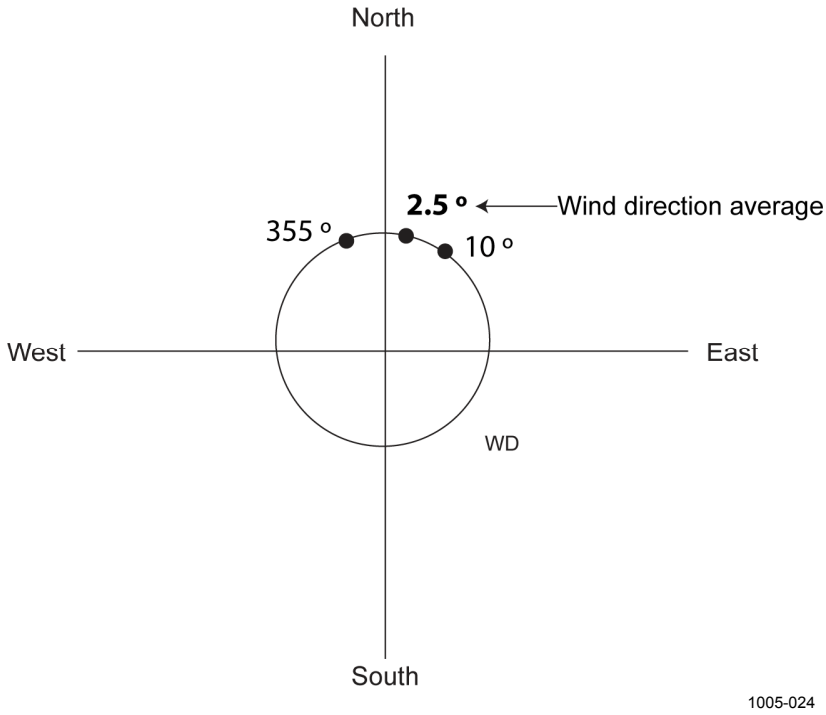

Figure 9 Example of Wind Direction Averaging

Wind Direction Coasting

Accurate wind direction measurement requires that the wind speed is at a sufficient level. If you enable wind direction coasting, WMT700 does not calculate wind direction when the wind speed drops below the selected wind direction coasting threshold. The last calculated direction output remains until the wind speed increases enough to reach the threshold and WMT700 returns to normal operation.

Vector Averaging

When vector averaging has been selected, WMT700 calculates wind speed and direction averages by adding up each x velocity and y velocity measurement from the averaging time and then dividing the sum by the number of measurements. WMT700 converts the resultant average x velocity and average y velocity to polar direction and magnitude, which returns the wind direction average in degrees and wind speed average in the chosen units.

If the data acquisition system requests data before the initial averaging time completes, the sensor returns the most recent complete measurement data.

Measurement Methods

WMT700 measures wind speed and direction either continuously or for the duration of the user-configurable averaging time. You can select the measurement mode over the serial interface.

Continuous Measurement

You can set WMT700 to measure wind data continuously until the sensor receives the **STOP** command.

The following data communication methods are available:

- Poll Mode: You can fetch the most recent data from WMT700 with the polling command. You must specify the data message identification number in the command.
- Automatic Messaging Mode: If the automatic message interval has been configured, WMT700 sends automatic data messages at selected intervals. The data message is user-configurable.

For information on response delay and timing, see section Serial Interface Timing on page 64.

Wind Measurement on Request

You can set WMT700 to measure wind speed and direction for a specified period of time. The duration of the measurement can range from 0.25 seconds to 60 minutes, depending on the configured averaging interval.

You can fetch the required data message from WMT700 in measurement mode with the polling command. You must specify the data message in the command.

For information on response delay and timing, see section Serial Interface Timing on page 64.

Host System Connections and Interfaces

WMT700 always needs a host device for measurement data collection and presentation. The host device is usually an automatic weather station, but other host devices such as data loggers or personal computers can also be easily used.

WMT700 performs calculation, quality control, and data format procedures on the measurement data. The processed data is sent to weather stations using serial ports and/or analog output channels. The most commonly used communications interface is RS-485, but WMT700 has a flexible set of interfaces ranging from RS-232 to voltage and current mode analog signals.

WMT700 can be set to send measurement data as either analog output or data messages via serial port or both outputs can be used simultaneously. Operating and configuring commands are sent to WMT700 through the serial interface.

Operation and heating power are usually provided from one single power supply. Separate power supplies for the heating and operations can also be used to prevent the heating function from consuming the operations power. In a split-supply system there can be a separate backup power supply for the operations power supply.

Figure 10 on page 34 shows the main software components and external interfaces of WMT700.

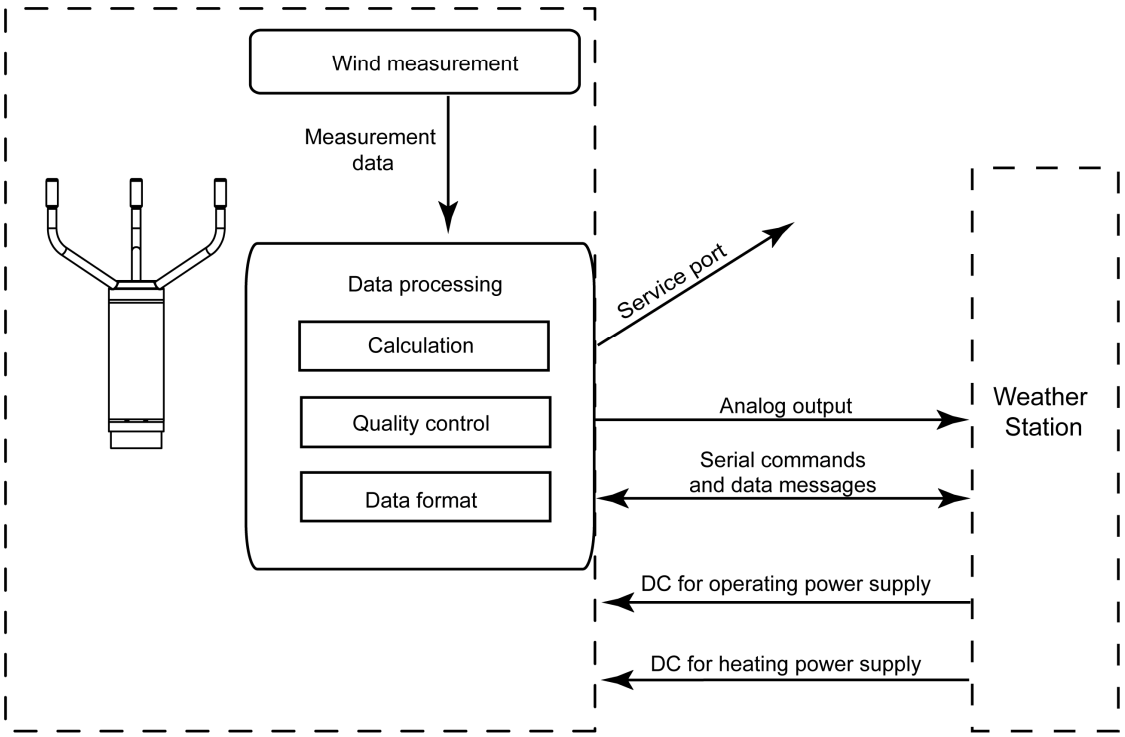

Figure 10 External Interfaces of WMT700

NOTE	For examples of typical system environments for WMT700, see Appendix B, Typical System Environments, on page 123.

CHAPTER 4
INSTALLATION

This chapter contains information that is needed to install WMT700 with the FIX70 mounting kit.

NOTE	If you are upgrading from WS425 to WMT700 and using a WS425 mounting kit, see Upgrading from Vaisala WINDCAP® Ultrasonic Wind Sensor WS425 to WMT700 Technical Reference.

Selecting Location for Representative Measurements

Finding a suitable site for WMT700 is important for getting representative ambient measurements. The site should represent the general area of interest. It is recommended that you follow the WMO Guide to Meteorological Instruments And Methods of Observation WMO-No. 8, or other application-specific requirements set by various organizations, like ICAO.

It is important to take into account the geography and surrounding area to achieve optimum performance. Trees, buildings, or other objects situated in the vicinity of WMT700 disturb free air flow and thus affect the accuracy of the measurement results.

Ideally, WMT700 should be higher than any other object within a horizontal radius of 300 m. In general, any object of height (h) does not remarkably disturb wind measurement at a minimum distance of 10 x h.

When mounting WMT700 on top of a building, the recommended minimum height (h) for the mast is 1.5 × the height of the building (H). When the diagonal (W) is less than the height (H), the minimum height of the mast is 1.5 × W.

When there is a need to ensure free air flow with cross arm installation, the distance (y) between WMT700 and the mast should be more than 20 × the diameter of the vertical mast (z). For more information, see

Figure 11 below. Note that you should follow application-specific installation guidelines.

When mounting two WMT700s at the same height, make sure that there is a minimum of 10 meters of distance between the two devices. If the difference in the height of the sensors is at least 0.5 meters, it is enough to have a minimum distance of 2 meters between the two devices to avoid possible acoustical interference between them. See Figure 13 on page 38.

WARNING If ice or snow accumulates on WMT700 or the mast, it can fall and cause injury to persons below.

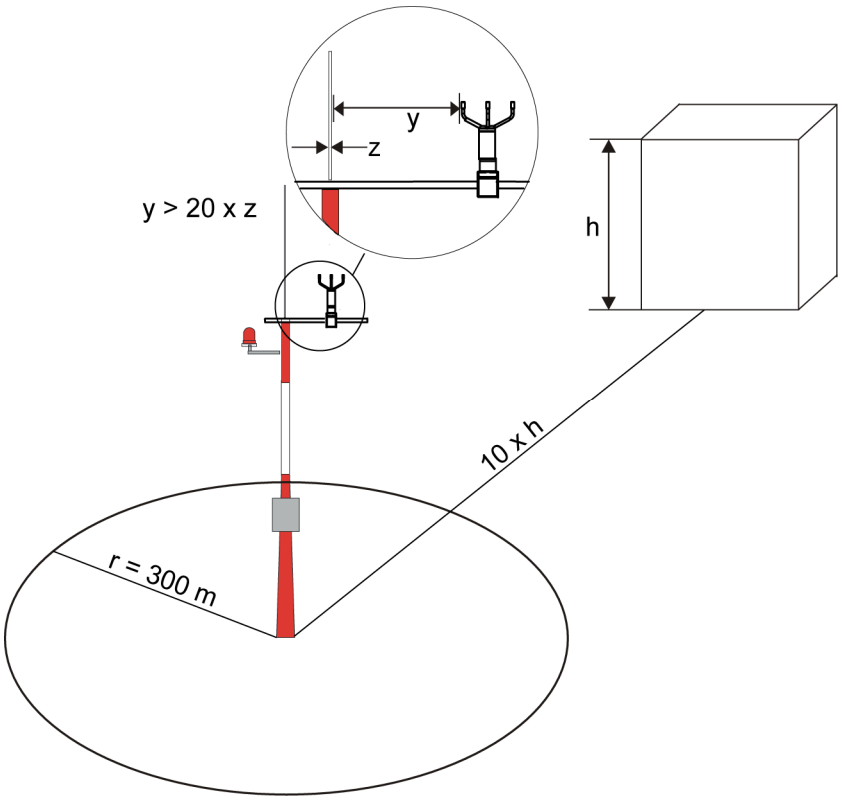

Figure 11 Recommended Location for WMT700 in Open Area

where:

h = Height of a building or other high structure.
r = Distance from a building or other high structure.
y = Distance from the vertical mast.
z = Diameter of the vertical mast.

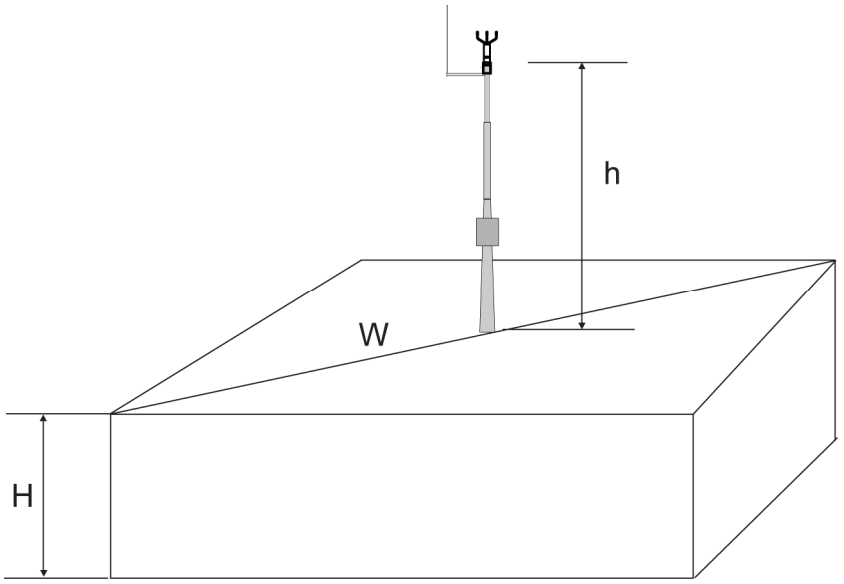

Figure 12 Recommended Mast Length for WMT700 on Top of Building

where:

h = Recommended minimum height for the vertical mast.
H = Height of the building.
W = Diagonal of the building.

WARNING To protect personnel (and the wind sensor), a lightning rod must be installed with the tip at least one meter above WMT700. The rod must be properly grounded, compliant with all local applicable safety regulations. Do not install the wind sensor above the top of the lightning protection rod.

WARNING Do not install WMT700 when there is a risk of thunderstorm or lightning activity in the area.

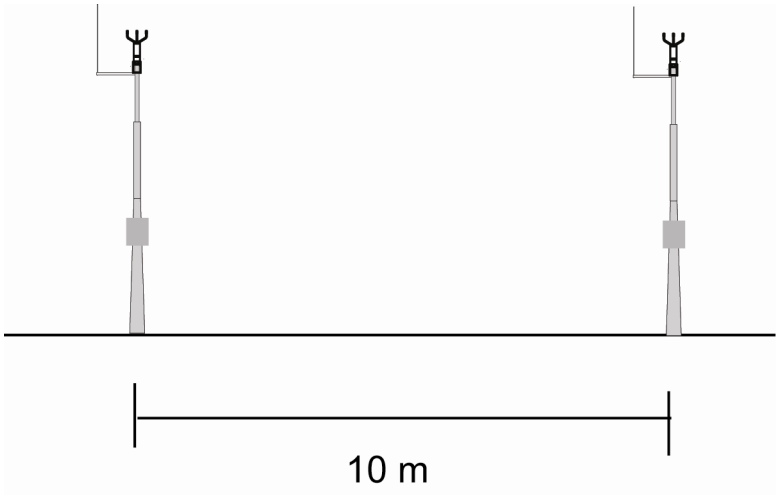

Figure 13 Minimum Distance between two WMT700s Installed at Same Height

Installation Procedure

At the measurement site, WMT700 needs to be mounted, aligned, and connected to the power source and data acquisition system.

You can install the optional bird cage after the wind sensor has been mounted and the transportation damper has been removed from the sensor. For instructions, see section Installing Bird Cage on page 50.

CAUTION	When handling WMT700, do not rotate, pull, strike, bend, scrape or touch the transducers with sharp objects. Any impact on the wind sensor array damages the device.

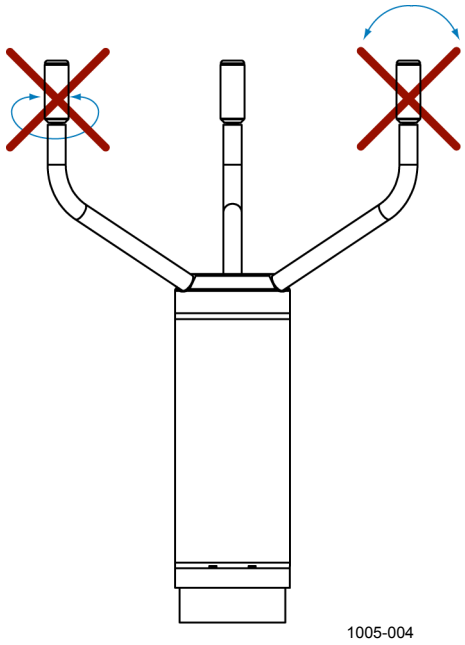

Figure 14 WMT700 Sensor Handling

Unpacking Instructions

WMT700 is shipped in a cardboard custom container with plastic transportation dampers. One of the dampers protects the wind sensor body, while the other shields the array and the transducers. See Figure 15 on page 40.

When unpacking the wind sensor, remove the transportation damper that protects the sensor body. To avoid bending or twisting the array, do not remove the damper protecting the array until you have installed WMT700. Figure 15 on page 40 shows the damper protecting the array.

Retain all original packaging in case you have to return WMT700 to Vaisala Service Center for maintenance purposes. WMT700 is uninstalled by performing the steps of the mounting procedure in reverse order.

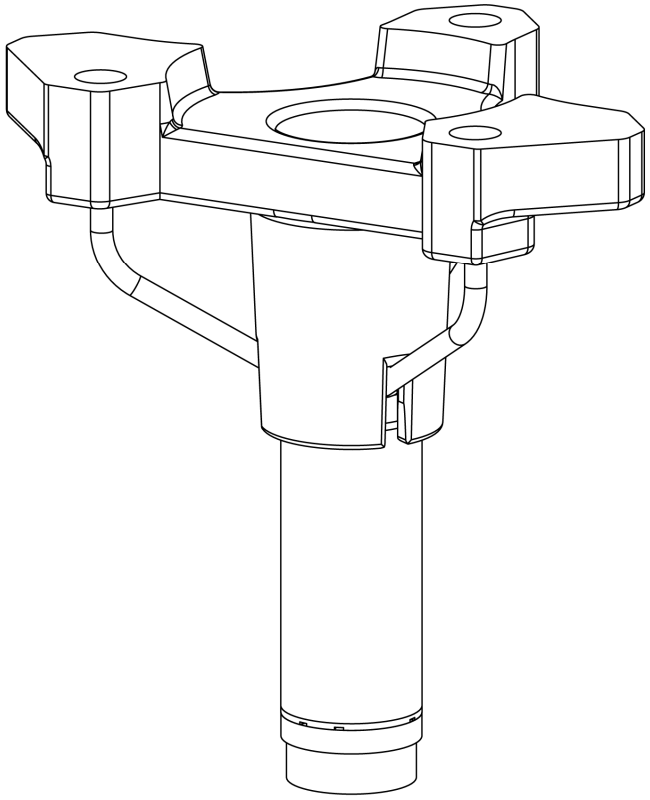

Figure 15 WMT700 and Transportation Damper

NOTE	Save the container and all the packaging materials for future transporting or shipping.

Mounting

You can mount WMT700 either to a vertical pole mast or a horizontal cross arm. Each of the mounting options is further described in the following sections.

For information on the dimensions of WMT700, see Dimensions on page 119.

Mounting on Vertical Pole Mast

When mounting on a vertical pole mast, WMT700 can be placed either on the side or on top of the mast. When selecting the mounting position, take into account the other equipment installed on the mast (for instance, lightning rods) and how the cable has been routed (outside or inside the mast).

Figure 16 on page 42 and Figure 17 on page 43 show the mounting procedure.

To mount WMT700 on a pole mast:

1. Attach the FIX70 mounting kit either to the side or on top of the vertical pole mast with U bolts (provided).

   Insert the U bolts to the horizontal slots of the FIX70 mounting kit, see number 4 in Figure 16 on page 42 and Figure 17 on page 43.

2. Check that the mounting kit is not tilted to either side. Tighten the U bolts only slightly.

   Do not tighten the bolts too much at this stage because you still need to rotate the mounting kit to align WMT700 after the installation.

3. Run the cable through the FIX70 mounting kit. Connect the cable to the wind sensor. Tighten the connector by rotating the connector by hand clockwise as illustrated in Figure 20 on page 47. Ensure that the connector is properly tightened before proceeding to the next step.
4. Hold the wind sensor from the enclosure, and slide the sensor into the mounting kit. Turn the sensor so that the mounting screw slides into the appropriate slot. Do not touch the array when handling WMT700.

   To avoid misalignment, turn the sensor until the screw reaches the far end of the slot. When the screw is in the position indicated with number 3 in Figure 16 on page 42 or number 2 in Figure 17 on page 43, tighten the screw.

5. Remove the transportation damper protecting the array and store it for future use.
6. Align WMT700. For instructions, see section Alignment on page 48.
7. Connect the cable to the data acquisition system and power supply. Connect the wires according to section Wiring on page 52.

WMT700 is now ready for operation.

NOTE When installing WMT700 to the side of a mast, make sure that the mounting kit is positioned at the top level of the mast. See Figure 16 on page 42.

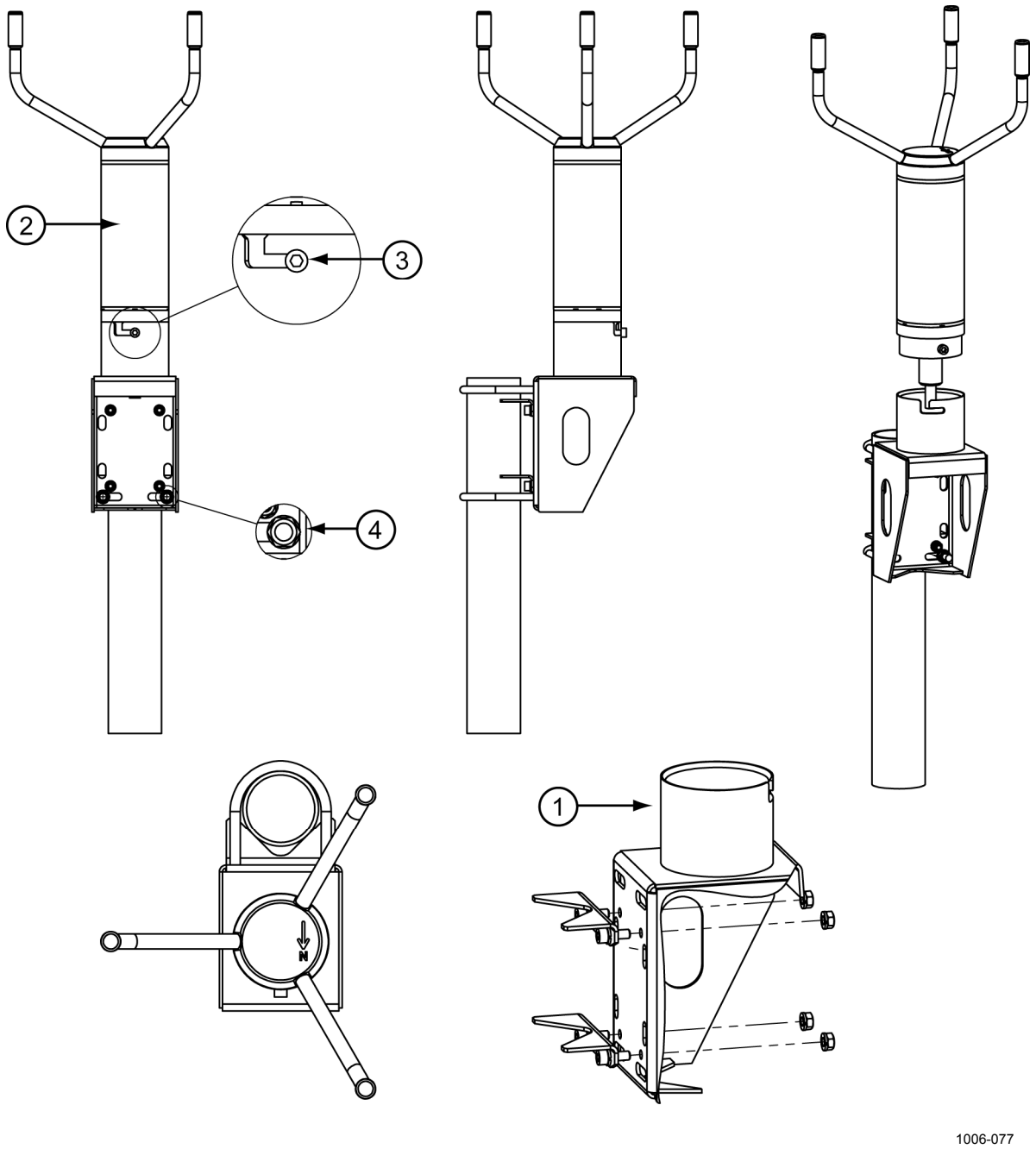

Figure 16 WMT700 on Side of Pole Mast

The following numbers refer to Figure 16 above:

1 = FIX70 mounting kit
2 = WMT700 wind sensor
3 = Mounting screw in final position
4 = U bolt and a nut (M8DIN934-A4) in horizontal slot

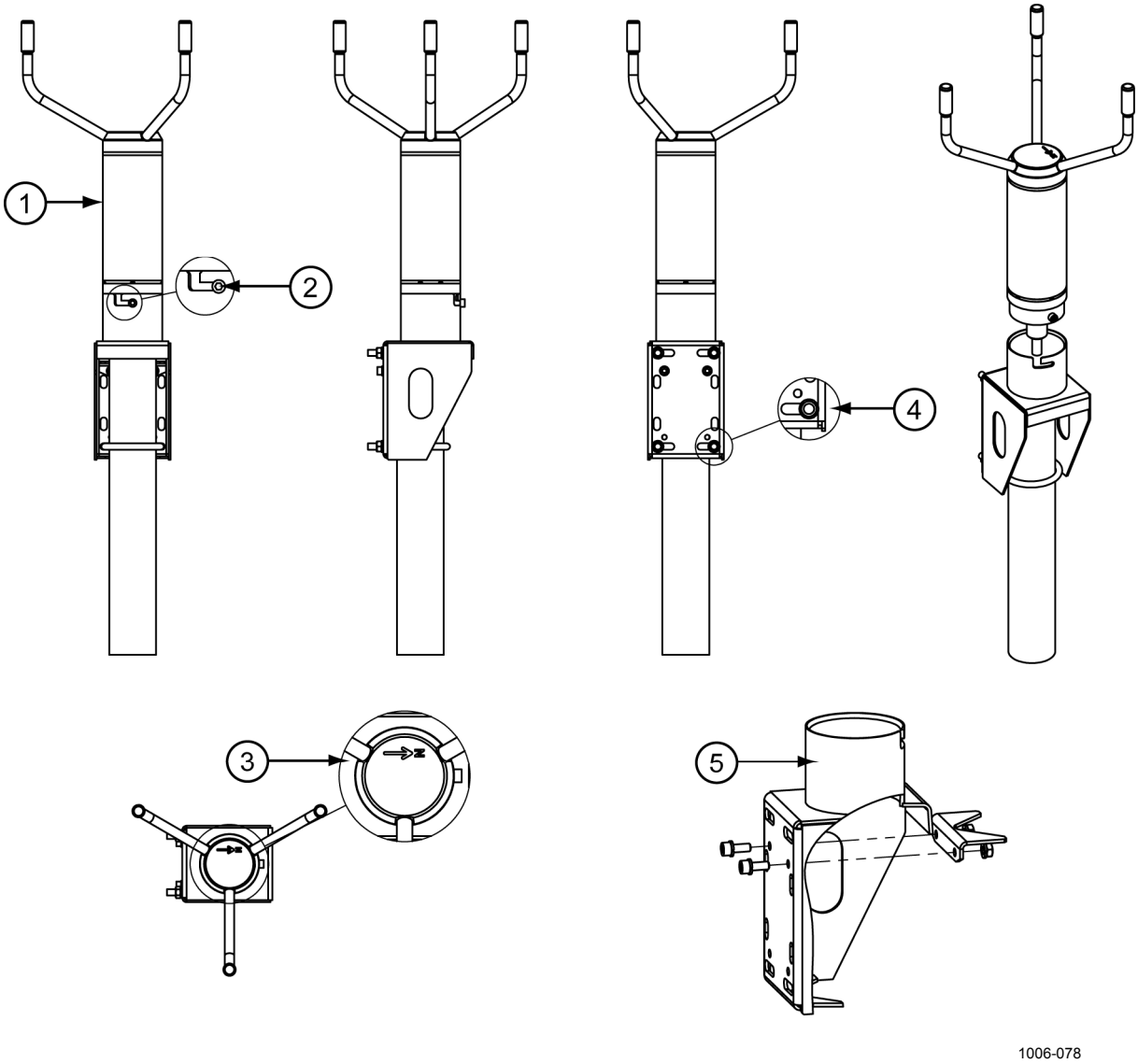

Figure 17 WMT700 on Top of Pole Mast

The following numbers refer to Figure 17 above:

1 = WMT700 wind sensor
2 = Mounting screw in final position
3 = North arrow
4 = U bolt and a nut (M8DIN934-A4) in horizontal slot
5 = FIX70 mounting kit

Mounting on Horizontal Cross Arm

When mounting WMT700 to a cross arm, the wind sensor can be placed with the array facing up or down. Mounting WMT700 with the array facing down provides additional protection against the accumulation of snow and interference from birds. The adapter drains located at the bottom of WMT700 prevent water from accumulating inside the mounting adapter. If the wind sensor is installed with the array facing down, you must configure WMT700 accordingly. For configuration instructions, see section Configuration Parameters on page 81.

Figure 18 on page 45 and Figure 19 on page 46 show the mounting procedure.

To mount WMT700 on a cross arm:

1. Attach the FIX70 mounting kit to the cross arm with U bolts (provided). Insert the U bolts to the vertical slots of the FIX70 mounting kit. See number 3 in Figure 18 on page 45.
2. Check that the mounting kit is not tilted to either side. Tighten the U bolts firmly.
3. Run the cable through the FIX70 mounting kit. Connect the cable to the wind sensor. Tighten the connector by rotating the connector by hand clockwise as shown in Figure 20 on page 47. Ensure that the connector is properly tightened before proceeding to the next step.
4. Hold the wind sensor from the enclosure, and slide the sensor into the mounting kit. Turn the sensor so that the mounting screw slides into the slot. Do not touch the array when handling WMT700.

   To avoid misalignment, turn the sensor until the screw reaches the far end of the slot. When the screw is in the position indicated with number 4 in Figure 18 on page 45, tighten the screw.
5. Remove the transportation damper protecting the array and store it for future use.
6. Align the horizontal cross arm. For instructions, see section Alignment on page 48.
7. Connect the cable to the data acquisition system and power supply. Connect the wires according to section Wiring on page 52.

WMT700 is now ready for operation.

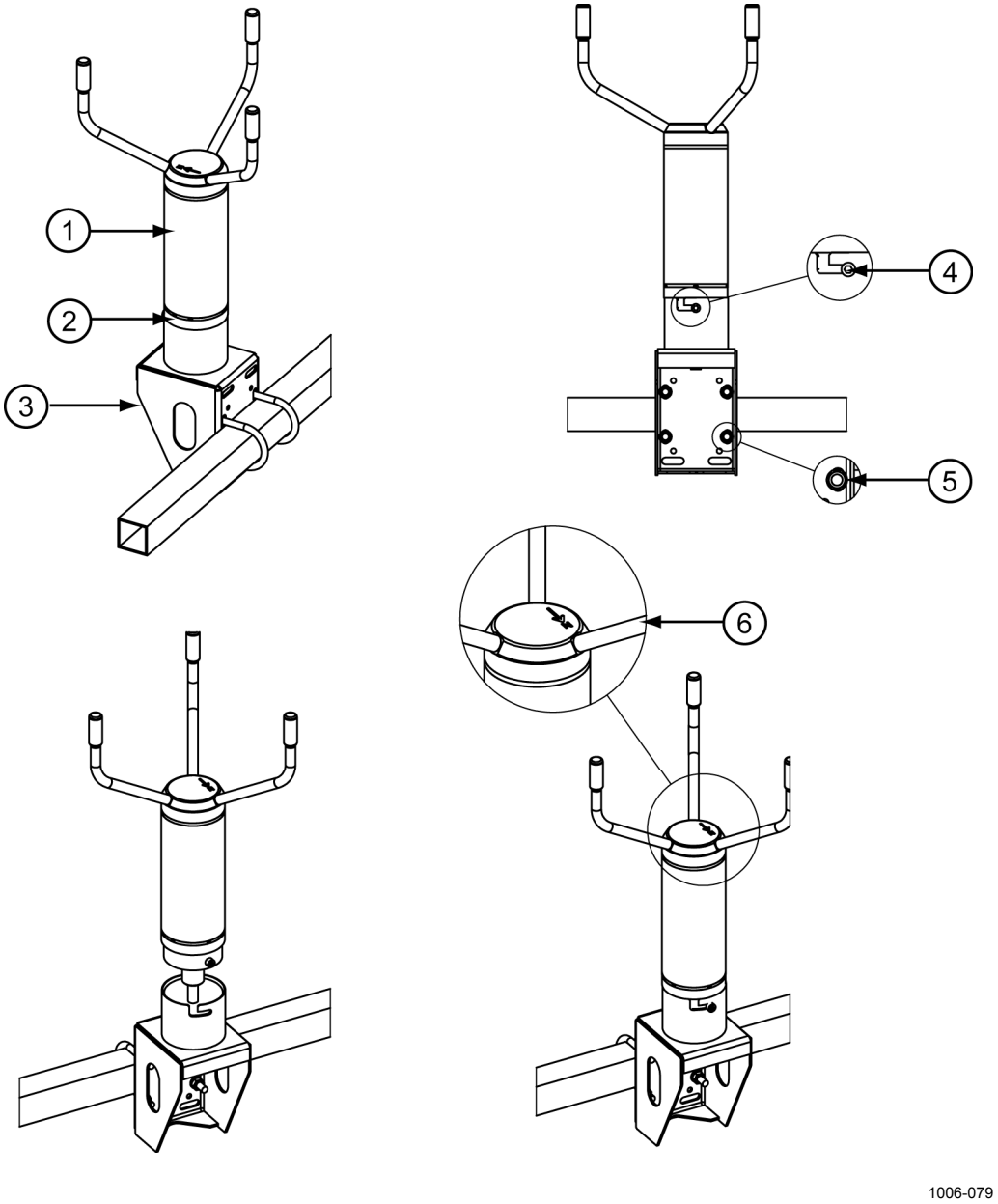

Figure 18 WMT700 on Cross Arm with Array Facing Up

The following numbers refer to Figure 18 above:

1 = WMT700 wind sensor
2 = Mounting adapter
3 = FIX70 mounting kit
4 = Mounting screw in final position
5 = U bolt and a nut (M8DIN934-A4) in vertical slot
6 = North arrow

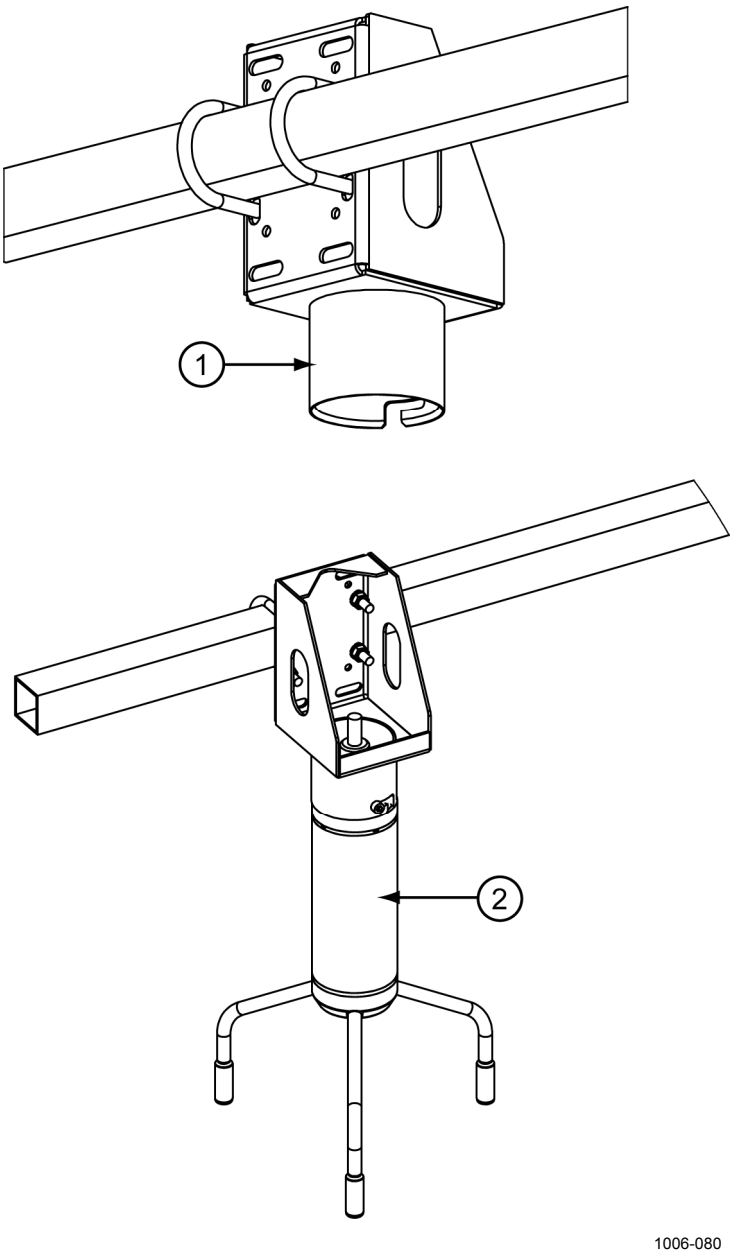

Figure 19 WMT700 on Cross Arm with Array Facing Down

The following numbers refer to Figure 19 above:

1 = FIX70 mounting kit.
2 = WMT700 wind sensor.

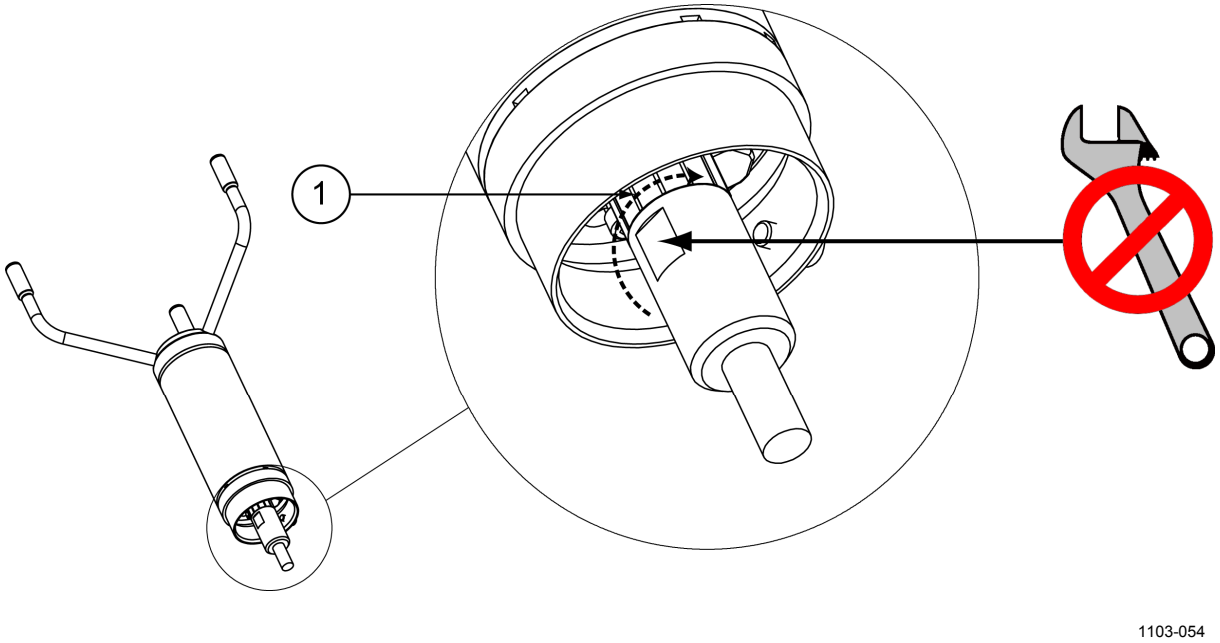

Figure 20 Tightening the Connector

The following number refers to Figure 20 above:

1 = Tighten the connector by rotating the ribbed part of the connector by hand. DO NOT USE TOOLS.

NOTE	Verify that the connector is properly tightened to avoid water leakage and damage to the sensor. If water leaks into the connector, this voids the warranty for WMT700.

Checklist for Connection Cables

Take the following issues into account when installing WMT700:

- Routing of the cables depends on the mounting option selected for WMT700. When mounting to a mast, the cable can be routed either outside or inside the mast depending on the mast type and other equipment (for instance, lightning rods) installed to the mast.
- Make sure that the cable is properly attached to the mast or cross arm before starting the installation. Otherwise it may slip and fall down during the installation procedure.
- It is important to attach the cable properly to avoid strain on the connector. Too much strain may cause the cable to fall off, damage the cable or connector, or make the cable or connector susceptible to water leakage. The recommended minimum bending radius for the cable is 70 mm.

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

WARNING Using a long cable between different units (sensors, transmitters, power supplies, and displays) can cause a lethal surge voltage, if a lightning strike occurs in the vicinity. Always apply proper grounding procedures and follow the requirements of the local Electrical Code.

WARNING Do not install WMT700 when there is a risk of thunderstorm or lightning activity in the area.

Alignment

WMT700 is permanently marked with the letter N and a north arrow. WMT700 needs to be aligned in such a way that this arrow points to the north. Misaligning WMT700 causes a wind direction offset error in the measurement results, see Figure 22 on page 49.

To align WMT700:

1. Determine whether the array of WMT700 is correctly aligned with a compass or other similar method.

2. If the alignment is not correct, readjust the orientation as follows:

   - When installing WMT700 on a vertical mast, rotate the FIX70 mounting kit so that the north arrow and the north transducer point to the north in the measurement location. Do not remove WMT700 from the mounting kit during the alignment process. Tighten the bolts of the FIX70 mounting kit.
   - When installing WMT700 on a horizontal cross arm, rotate the arm so that the north arrow and the north transducer point to the north in the measurement location.

   Figure 21 on page 49 and Figure 22 on page 49 show the correct alignment and the measurement error caused by the misalignment of WMT700.

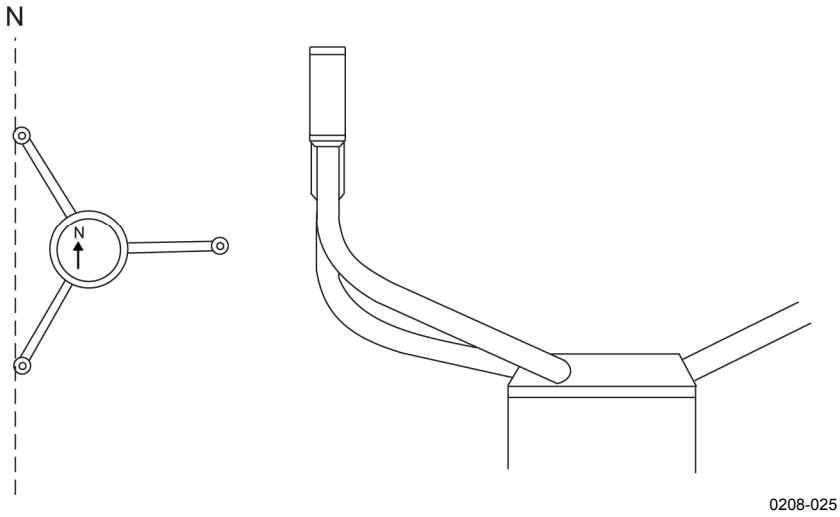

Figure 21 Correctly Aligned WMT700

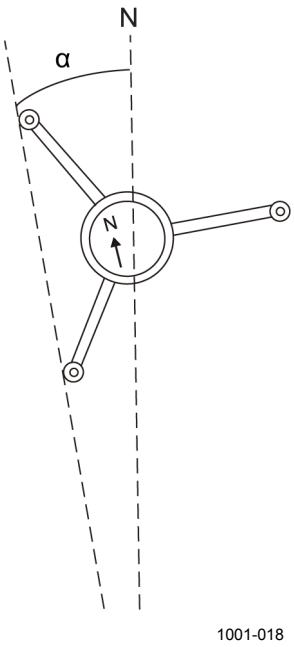

Figure 22 Incorrectly Aligned WMT700 and Resulting Offset Error

where

N = The correct direction for true north.
α = The wind direction offset error caused by the misalignment of WMT700.

Alignment tuning

If mechanical alignment of WMT700 cannot be done, you can correct the wind direction offset error using an offset adjustment command. For instructions, see Configuration Parameters on page 129.

Installing Bird Cage

To install the bird cage, you need to position the bird cage on top of the wind sensor and secure the kit with two straps. You can order the cage as an accessory from Vaisala, see Table 32 on page 118. The required straps are provided with the bird cage.

CAUTION	Make sure that you do not damage the array when installing the bird cage.

To install the optional bird cage:

1. Unpack the bird cage and the bird cage straps.
2. Position the bird cage on top of the wind sensor and press the kit down until the three hooks are in contact with the transducer arms.
3. Run the lower strap through the three guides in the kit. Figure 23 on page 51 shows the correct position.
4. Lift the latch screw.
5. Insert the strap to the latch.
6. Press the latch screw down.
7. Tighten the screw by turning the screw clockwise with a screw driver or a socket.

   Do not over-tighten the screw.
8. Run the upper strap through the three guides in the kit.
9. Repeat the steps 4-7 for the other strap.

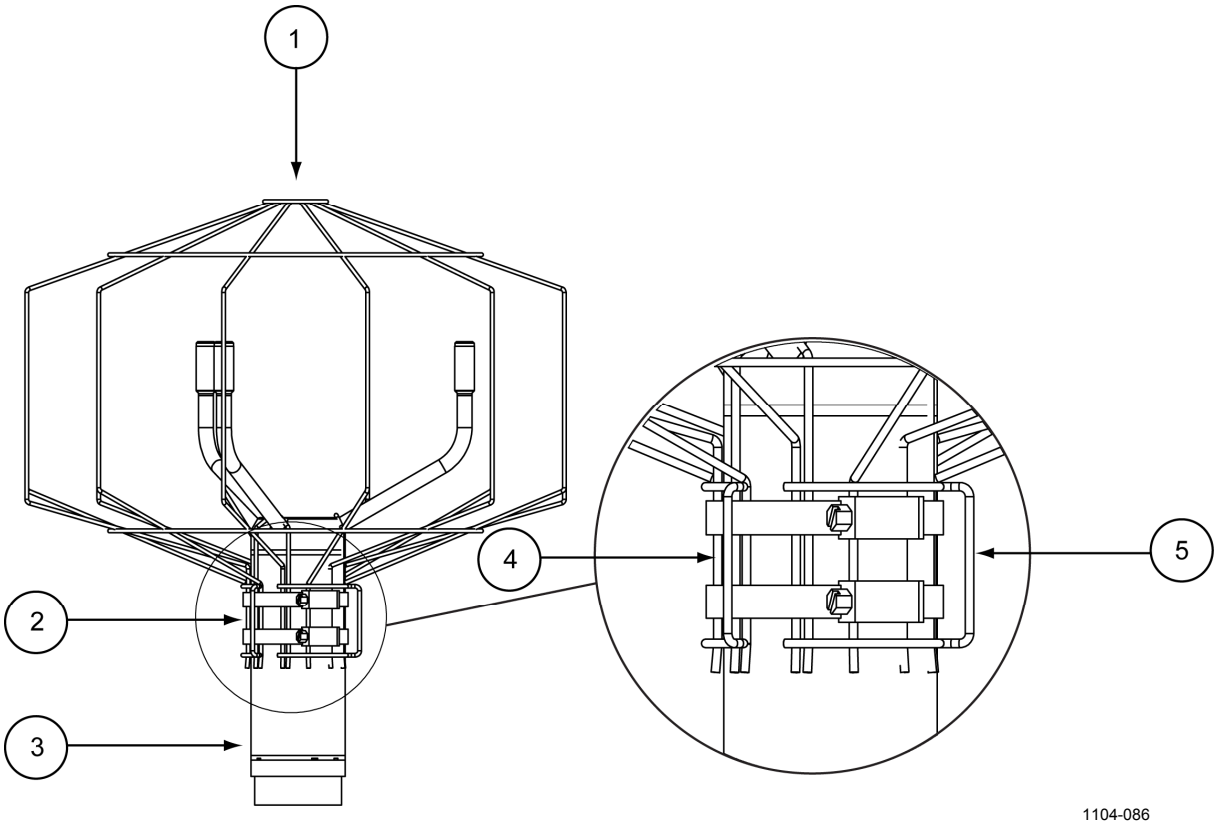

Figure 23 Bird Cage and Bird Cage Straps

The following numbers refer to Figure 23 above:

1 = Bird cage
2 = Bird cage straps
3 = Wind sensor
4 = Guide for attaching the straps
5 = Latch for securing the straps

Wiring

The 17-pin M23 male connector is located at the bottom of the WMT700 sensor. The connector is used for power supply, digital communications, and analog outputs. The signals related to digital communications are galvanically separated from the ground. The connector type is Hummel 7.106 series.

Cables

Ready-made cables are available for use with Vaisala MAWS and AWS520 systems. These cables have connectors on both ends. There is also a retro-fit cable for Vaisala ROSA system in case analog output has been used with WS425.

Vaisala provides open-lead cables for connections to other host systems:

- Cable 2m (Spare part item 227567SP)
- Cable 10m (Spare part item 227568SP)
- RS485 Cable 2m (Spare part item 228259SP)
- RS485 Cable 10m (Spare part item 228260SP)
- ROSA Cable 10m for Analog Outputs (231425SP)

The first two cables carry through all signals from the WMT700 while the RS485 cables are dedicated for RS485 operation with a limited number of wires.

Table 8 on page 53 shows how to connect Cable 2m (227567SP) and Cable 10m (227568SP).

Table 10 on page 55 shows how to connect RS485 Cable 2m (228259SP) and RS485 Cable 10m (228260SP).

NOTE	Wire colors in the tables are not applicable to other cables.

NOTE	If there are unused wires, make sure that they are unconnected and protected. Do not cut off any wires.

Cable 2m and Cable 10m

Table 8 below shows how to connect Cable 2m (227567SP) and Cable 10m (227568SP).

Table 8 Connecting Cable 2m (227567SP) and Cable 10m (227568SP)

Power Supply					**Wire Colors**	**Pin**
Operating Power Supply					White	1
Operating Power Supply Ground					Gray-Pink	11
Heater Power Supply					Gray	5
Heater Power Supply					Pink	6
Heater Power Supply Ground					Blue	7
Heater Power Supply Ground					Red	8
Enclosure Ground					Shield	Shield
Analog Outputs						
Analog Output AOUT2, Wind Direction					Brown	2
Analog Output AOUT1, Wind Speed					White-Green	13
Reference Input for AOUT2 (simulated potentiometer)					White-Gray	17
Analog Output Ground					Red-Blue	12
COM port	**RS-232**	**RS-422**	**RS-485**	**SDI-12**		
COM2	RS232Rx	RxB	RxB	-	Green	3
	RS232Tx	TxB	TxB	Data	Yellow	4
	-	TxA	TxA	-	Brown-Green	14
	-	RxA	RxA	-	White-Yellow	15
COM1 and COM2 Communication Ports Ground					Violet	10
COM1 (service port)	RS-485, B				Black	9
	RS-485, A				Brown-Yellow	16

Note for wiring RS485 for COM2

In RS485 mode, the same signals as in RS422 mode are available at the end of Cable 2m and Cable 10m. Make two-wire loop-backs at the end of the cable, as shown in Table 9 and Figure 24 below.

Table 9 COM2 RS485 Wiring

WMT700 Signals	Wire Colors	Pin	RS485 Signals
RxB	Green	3	TxRx B
TxB	Yellow	4	
TxA	Brown-Green	14	TxRx A
RxA	White-Yellow	15	

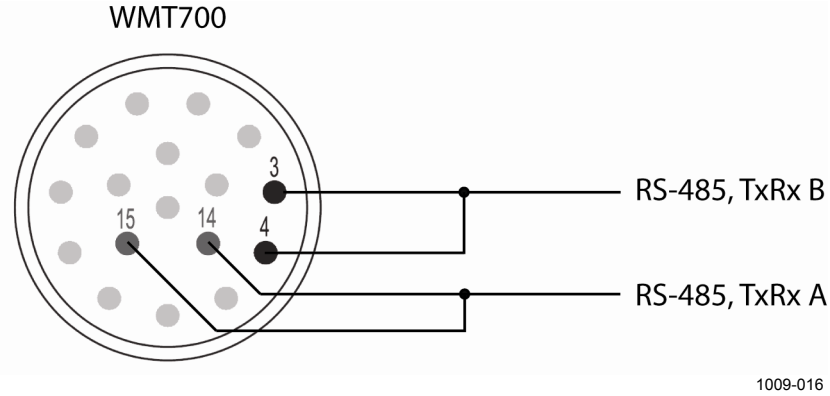

Figure 24 COM2 RS485 Wiring

RS485 Cable 2m and RS485 Cable 10m

These two cables are designed for the standard connection: operating power, heater power, and RS485. The two-wire RS485 loopback connections, as shown in Table 10 on page 55, are pre-connected inside the cable.

Table 10 Connecting RS485 Cable 2m (228259SP) and RS485 Cable 10m (228260SP)

Power Supply	Wire Colors	Pin
Operating Power Supply	White	1
Operating Power Supply Ground	Gray-Pink	11
Heater Power Supply	Gray, Green, Pink	5, 6
Heater Power Supply Ground	Blue, Black, Red, Yellow	7, 8
Enclosure Ground	Shield	Shield
COM2		
RS485, B	Brown	3,4
RS485, A	Red-Blue	14, 15
Communications Ground	Violet	10

Connector Signals

Figure 25 on page 56 and Table 11on page 56 describe the pin-out of the 17-pin M23 connector as seen from the outside. The serial output type of COM2 depends on the sensor configuration. Analog outputs are always available from the connector.

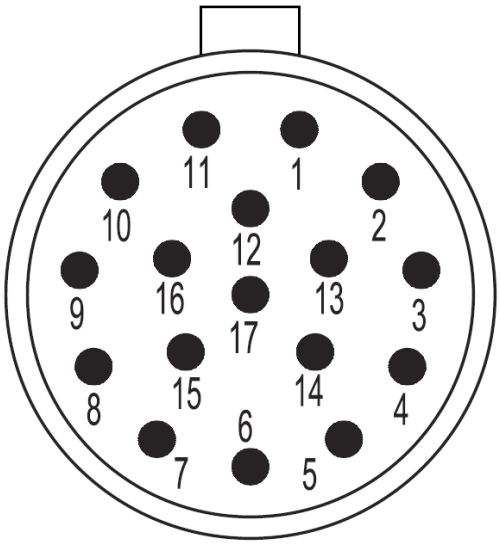

Figure 25 Pins for 17-pin M23 Connector

Table 11 Pin-out for 17-pin M23 Connector

Pin	Description	RS-232	RS-422	RS-485	SDI-12
1	Operating Power Supply				
2	Analog output AOUT2, Wind Direction				
3	COM2	RS232Rx	RxB	RxB	-
4		RS232Tx	TxB	TxB	Data
5	Heater Power Supply				
6	Heater Power Supply				
7	Heater Power Supply Ground				
8	Heater Power Supply Ground				
9	COM1 (Service Port)	RS-485, B			
10	COM1 and COM2 Communication Ports Ground				
11	Operating Power Supply Ground				
12	Analog Output Ground				
13	Analog Output AOUT1, Wind Speed				
14	COM2	-	TxA	TxA	-
15		-	RxA	RxA	-
16	COM1 (Service port)	RS-485, A			
17	Reference Input for AOUT2 (simulated potentiometer)				
Shield	Enclosure Ground				

Heating

WMT700 can include a heating functionality that ensures proper operation in cold environmental conditions or in cases where snow and ice build-up is possible.

In addition to the standard non-heated version, WMT700 can be preconfigured at the factory according to your order:

- Heating for the transducers only
- Heating for both transducers and array arms.

NOTE Ensure that the supply output power capacity is high enough especially when both transducers and array arms are equipped with heaters.

Also, note that there are individual connections for applying the heating voltage.

Heated Transducers

The heating functionality has a thermostatic control with temperature sensors in each transducer. The control function keeps the transducer temperature above 0 °C and adds heating power when necessary. Therefore heating is only activated when there is a risk of ice build-ups. If a sensor is blocked, WMT700 increases the heating power to melt the ice and returns to lower power after a period of time.

You cannot change the heating parameters, but you can enable or disable the heating functionality with configuration parameters. Heating is automatically disabled if the heating voltage falls below 12 VDC.

Regardless of the heating voltage, the maximum heating power is limited to 40W and the average heating power is limited to 30W. The maximum power control is achieved by automatically sequencing the transducer heaters depending on a heating voltage. At low heating voltages, all the transducers are heated simultaneously. At mid-range, two of the transducers are heated. At high voltage end, a single transducer is heated at a time. A PWM (Pulse Width Modulation) is used to control the average heating power.

Heated Transducers and Arms

In addition to heated transducers, the array arms can also be heated, which prevents ice build-up on the arms.

The functional principle is the same as with the heated transducers only, but the maximum heating power is limited to 200W and the average heating power is limited to 150W.

WARNING	Some WMT700 product versions provide heating for transducers and/or array arms. To avoid injury, do not touch the heated parts of the wind sensor when the heating is enabled.

Powering

WMT700 has separate power supply inputs for operating and heating power. The inputs are usually connected to the same 24 VDC power supply unit, but special applications such as battery operation or battery back-up may require separate supplies.

The operating power has one supply terminal and one ground terminal, while the heating power has two supply terminals and two ground terminals allowing higher supply current. All supply ground terminals are internally connected to each other.

NOTE	In a system set-up with two separate power supplies, avoid ground potential differences between the supplies. Connect the negative poles together if necessary.

Operating Power

WMT700 can use any 9 ... 36 V (nominal voltage 24 V) min. 2 W DC power supply that meets applicable safety regulations. Connect heating supply wires to the ground in case heating is not used. The typical current and power consumptions vs. operating voltage are illustrated in Figure 26 on page 59 and Figure 27 on page 59.

For low power operation using the SLEEP feature, see SLEEP — Enter Low-Power Mode.

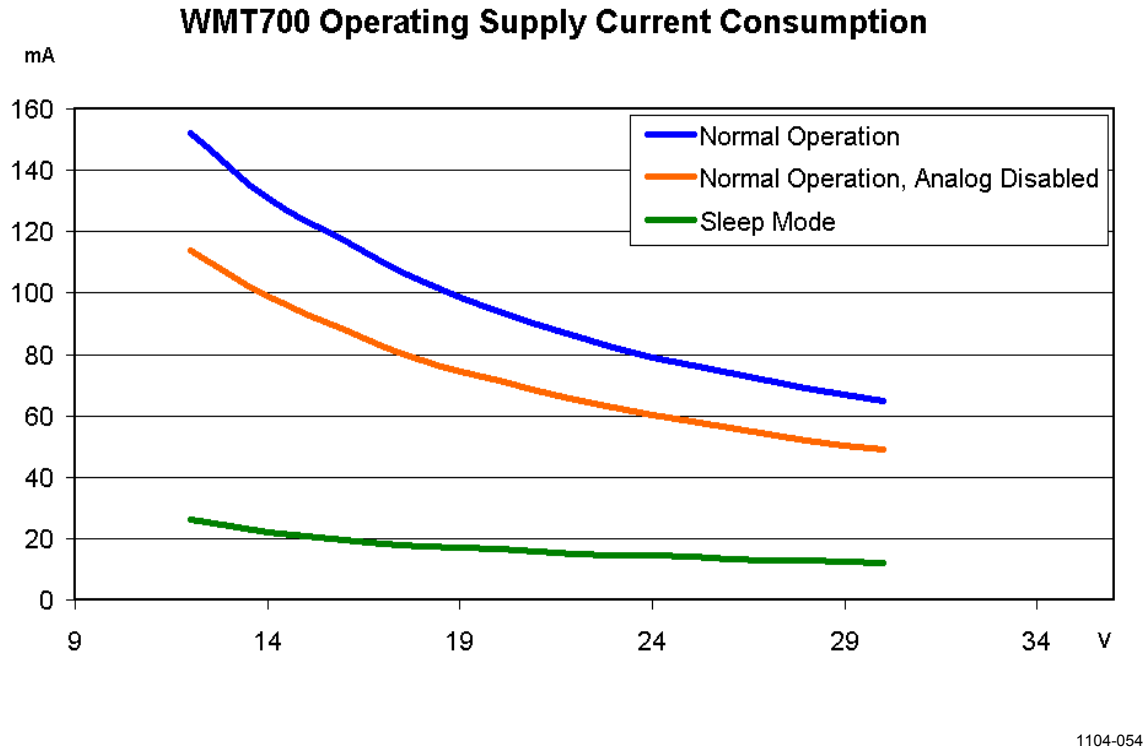

Figure 26 WMT700 Operating Supply Current Consumption

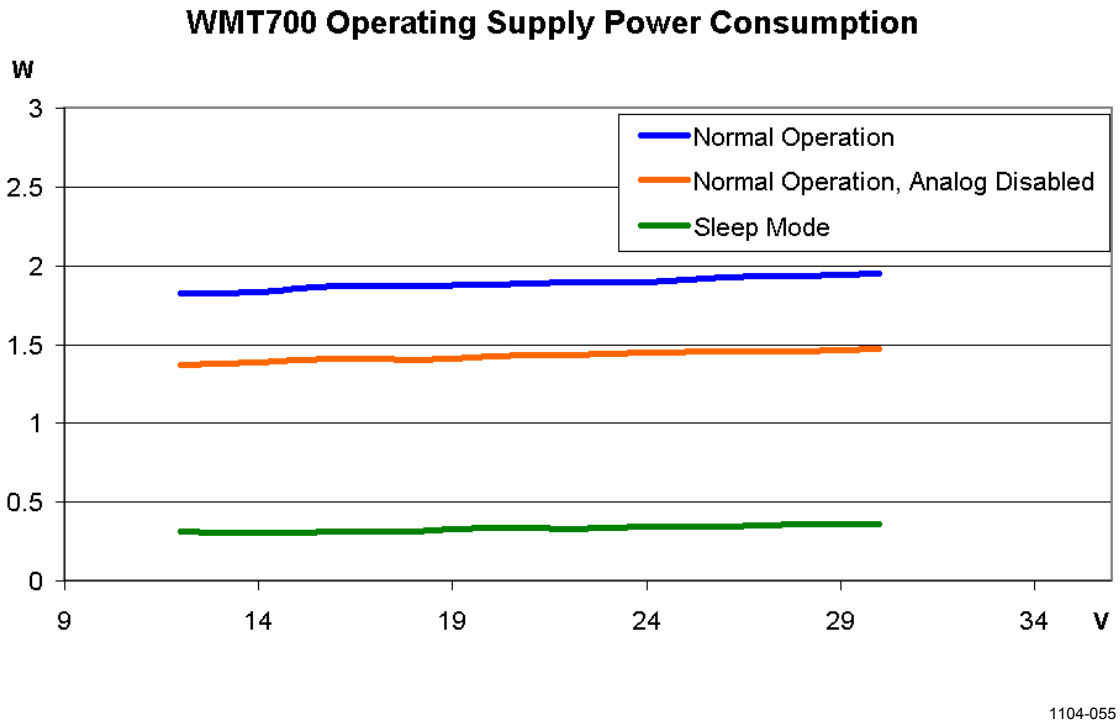

Figure 27 WMT700 Operating Supply Power Consumption

Heating Power

Table 12 below lists the power supply requirements of each WMT700 heating option.

Table 12 Heating Power Supply Requirements for WMT700 Series

Heating Option	Heating Voltage	Required Heating Power Supply
None	-	-
Transducers	24/36 VDC	40 W
Transducers and arms	24 VDC	200 W

Table 13 below lists the required dimensions for the heating supply cabling, if extension is needed.

Table 13 Required Dimensions for Heating Supply Extension Cabling

Cable Length	Minimum Dimensions (Total Cross-Section)
< 3 m/10 ft	0.25 mm^2/AWG23
< 10 m/30 ft	0.5 mm^2/AWG20
>10 m/30 ft	1 mm^2/AWG17

In power-critical environments the power consumption of WMT700 can be significantly reduced by using the low-power mode.

CAUTION There are two terminals connected in parallel for both positive and negative rails of the heating voltage for the maximum current capacity. In case the connection cable has parallel supply wires, they all have to be connected to ensure current capacity. Leaving one terminal unconnected or connecting it to the ground may cause a WMT700 malfunction or a short circuit in the power supply.

NOTE Always use cables that meet the minimum dimension requirements. Long cables with thin wires cause power losses in the cable and significantly decrease the heating capabilities of WMT700.

CHAPTER 5

SERIAL COMMUNICATION AND ANALOG OUTPUT

This chapter contains general information on serial communication and analog output when using WMT700.

The following functionality is preconfigured at the factory according to your order:

- Digital communication interface for COM2
- Digital communication profile for COM2
- Digital communication units
- Analog output signals for wind speed channel (AOUT1)
- Analog output signals for wind direction channel (AOUT2)

For descriptions of serial commands and data messages, see Chapter 7, Operation, on page 91.

Serial Communication

In WMT700, there are two serial communication ports:

- **COM2**: Configurable digital communication interface
- **COM1**: Service port (RS485)

Both ports support the same commands, protocols, operations, and data messages. Any computer or data logger that has a serial port can be used to send commands to WMT700 and receive measurement data.

Digital Communication Interface

COM2 is a flexible digital communication interface that is preconfigured according to your order. The available options are:

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

COM1 is a fixed RS-485 communication interface intended to be used as a service port.

Regardless of the factory configuration, COM2 interface type can be changed by using terminal software. See com2_interf in Appendix D on page 129.

For information on wiring, see section Wiring on page 52.

Digital Communication Profiles

The Digital Communication Profile is used to preconfigure WMT700 according to your order at the factory. Depending on the preconfigured communication profile, the default settings of the following parameters may vary:

- Communication protocols
- Communication parameters

See Appendix C on page 127 for the factory defaults for all communication profiles. The preconfigured communication profiles are:

- WMT700
- ROSA - MES12
- WS425 - ASCII
- WS425 - NMEA Extended (version 0183)
- WS425 - SDI-12 (version 1.3)
- WS425 - ASOS

The **WMT700 profile** is recommended for normal operation. The profile offers a wide range of predefined and user-configurable data message formats and it is specifically developed for WMT700. For information on user-configurable data messages, see section Parameters Handling Commands on page 74. For information on predefined data messages, see section Data Messages on page 92.

The **ROSA - MES12 profile** is intended for connecting WMT700 to Vaisala ROSA system.

The **WS425 profiles** can be used when upgrading from the WS425 wind sensor to WMT700.

For a list of the serial commands available for all communication profiles supported by WMT700, see Appendix A, Complete Command Set for WMT700 on page 121.

Protocols

In addition to the protocols preconfigured under standard profiles, there are more protocols in WMT700. The protocol used is defined by related parameters. For more information, see Parameters Handling Commands on page 74. The full list of supported protocols is:

- WMT700
- SDI12
- WS425 - ASOS
- WS425 - ASCII
- WS425 - NMEA Standard
- WS425 - WAT11
- MES12

Measurement and Configuration Modes

The serial ports have the following operation modes:

- Configuration mode is used for configuring the WMT700 settings over a serial connection. The selected communication profile does not affect the available configuration commands.
- Measurement mode is used for operating WMT700. In measurement mode the available commands depend on the selected profile. The port that is in measurement mode can receive polling commands and respond to them with data messages.

For a list of all serial commands supported by WMT700 in configuration and measurement modes, see Appendix A, Complete Command Set for WMT700, on page 121.

Figure 28 below shows the configuration and measurement modes of both serial ports provided by WMT700.

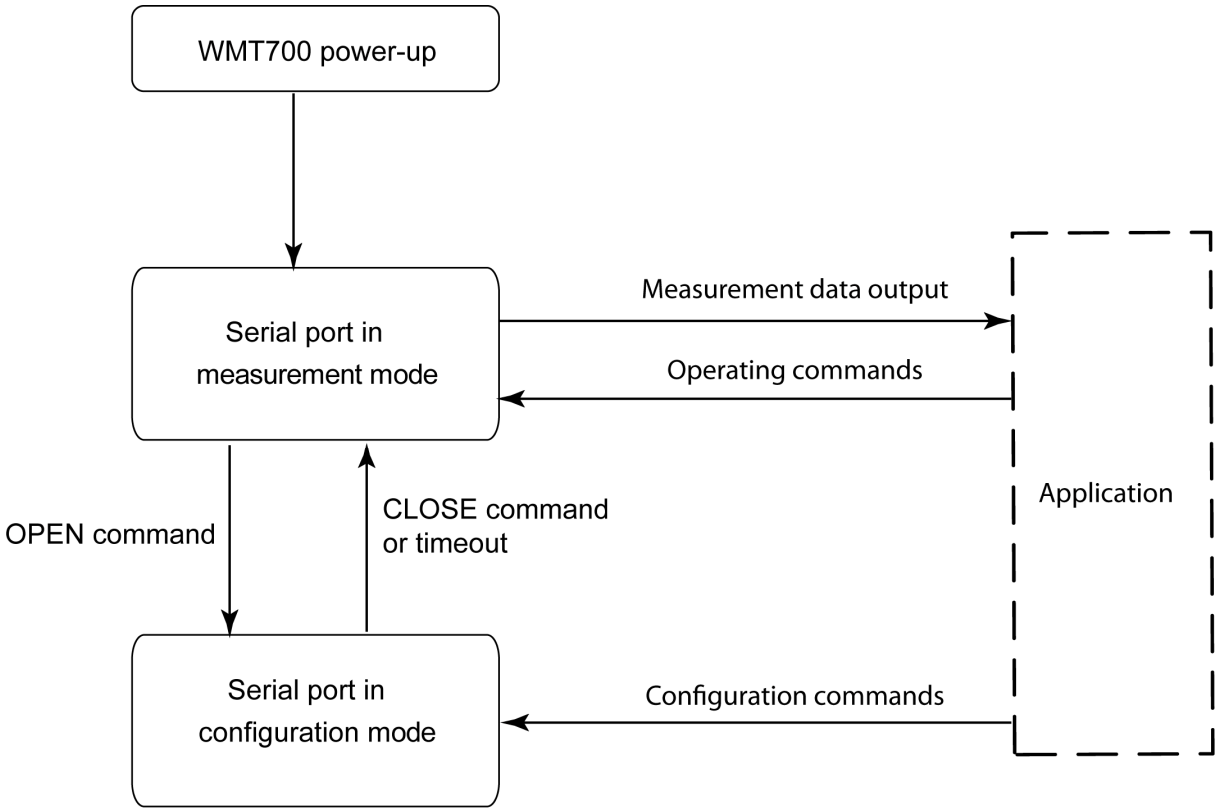

Figure 28 Configuration and Measurement Modes for WMT700

After power-up WMT700 is in measurement mode. To change settings, use the **OPEN** command to enter configuration mode. When you have changed the settings, use the **CLOSE** command to exit configuration mode. WMT700 serial ports also exit configuration mode automatically if they do not receive commands within 2 minutes.

For information on the **OPEN** and **CLOSE** commands, see section Mode Switching Commands on page 74.

Serial Interface Timing

Depending on the selected interface, the serial data interface timing is as follows:

- Interfaces RS-232, RS-485, RS-422: Figure 29 on page 65 shows timing when WMT700 is polled in measurement mode.

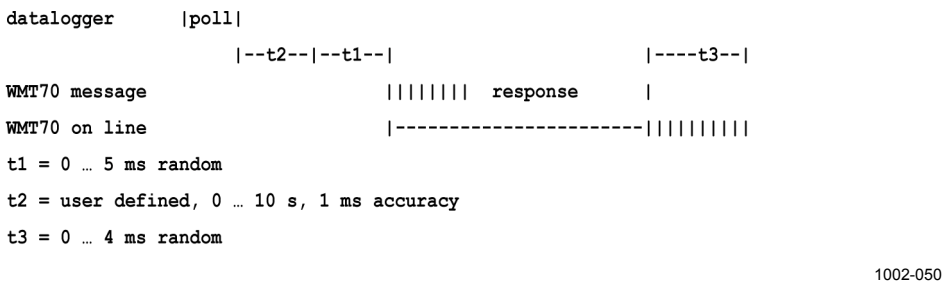

Figure 29 Timing for RS-232, RS-485, and RS-422 Interfaces

The response delay t2 is user-configurable. In configuration mode some commands have a longer response delay.

- SDI-12 interface: The timing is compliant with the SDI-12 standard. For the complete SDI-12 standard text, see the SDI-12 website http://www.sdi-12.org.

Analog Output

Analog outputs are either enabled or disabled and the output settings are preconfigured at the factory according to the customer order. In analog output operation WMT700 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.

You can change the analog output type and scaling of WMT700 according to your needs. You may also need to disable the analog output functionality to save power. For instructions, see Configuration Parameters on page 81

WMT700 provides the following analog outputs:

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

NOTE To emulate the WS425 analog output, choose voltage output, frequency output, and potentiometer. For more detailed instructions, see Upgrading from Vaisala WINDCAP® Ultrasonic Wind Sensor WS425 to WMT700 Technical Reference.

For information on wiring, see section Wiring on page 52.

Analog Output Types

Analog output for Wind Speed (AOUT1) can be configured as:

- Voltage output.
- Current output.
- Frequency output.

Analog output for Wind Direction (AOUT2) can be configured as:

- Voltage output.
- Current output.
- Potentiometer output.

Analog Output Scaling

You can specify the transfer function between measured values and output analog values. You can select the analog output type as well as the gain and offset used in the transfer function. For information on the parameters, see Table 18 on page 82.

Table 14 below shows the factory default settings for the different analog output modes.

Table 14 Factory Default Settings for Analog Output

Output Signal	Output Scaling for AOUT1 (wind speed)	Output Scaling for AOUT2 (wind direction)
Voltage	100 mV / m/s	20 mV /°
Current	0.2 mA / m/s	50 uA /°
Frequency	10 Hz / m/s	-
Potentiometer (WS425)	-	0 … Aout ref = 0 ... 359 °
WS425 - voltage	8 mV / mph	-
WS425 - frequency	5 Hz / mph	-

For a different scaling, change the gain and offset settings, see Configuration Parameters on page 81.

Table 15 below and Table 16 below list the most common settings for different units.

Table 15 Common Transfer Function Settings for AOUT1 (WS)

Output Signal	Scaling/ Units	Setting for Gain	Setting for Offset
Voltage	8 mV / mph 100 mV / m/s	0.01789 0.1	0 0
Current	0.2 mA / m/s	0.0002	0
Frequency	5 Hz / mph 10 Hz / m/s	11.18 10	-
WS425 - voltage	8 mV / mph	0.01789	0
WS425 - frequency	5 Hz / mph	11.18	-

Table 16 Common Transfer Function Settings for AOUT2 (WD)

Output Signal	Scaling/ Units	Setting for Gain	Setting for Offset
Voltage	4 mV / ° 20 mV /°	0.004 0.02	0 0
Current	50 uA / degree	0.00005	0
Potentiometer	359 ° = Aout ref	0.00278	0

You can configure output scaling or transfer function settings in a variety of ways by changing the custom gain and offset. The basic measurement units are m/s and degrees. The physical output units are V, A and Hz. For the potentiometer, an output of 1 means 100 % of the Aout ref voltage.

The following formula illustrates the impact of gain and offset values on the produced output:

$o=y0 + k \times s$

where

o = Produced analog output (V, A, Hz, 100 %)
s = Measured wind direction or speed (in m/s or °).
k = Selected gain value.
y0 = Selected offset value. In frequency mode this value is 0.

Example 1

- Output mode: voltage
- Offset: 0.0
- Gain: 0.1

With the above settings, the analog output voltage range is from 0 V (0 m/s) to 7.5 V (75 m/s). When the measured wind speed is 10 m/s, the output voltage is 1.0 V. See the formula below:

Output = 0.0 + 10 × 0.1 = 1.0 V

Example 2

- Output mode: current
- Offset: 0.004
- Gain: 0.0002

With the above settings, the analog output current range is from 4 mA (0 m/s) to 19 mA (75 m/s). When the measured wind speed is 10 m/s, the output current is 6 mA. See the formula below:

Output = 0.004 + 10 × 0.0002 = 6.0 mA.

Limitations for Output Signals

You can specify the minimum and maximum values for analog output with the configuration parameters. The output is fixed to the specified values, and the unit depends on the selected analog output mode.

Example

To limit analog output 1 in voltage mode to a range of 0.1 … 5 V, set the analog output minimum value to 0.1 and the analog output maximum value to 5. Enter the following commands:

```
S aout1minv,0.1
S aout1maxv,5
```

For more information on the parameters, see Table 18 on page 82.

Missing Readings and Error Indication

If WMT700 is not able to measure the wind, it indicates a missing reading in the output. Most common reasons for measurement problems are foreign objects (such as ice, birds, or other foreign object) on the line of measurement or sound reflections from nearby objects (such as wind tunnel walls).

The default error indication is an out-of-range signal, which is more than 10 V or 20 mA but other error settings can also be configured. You can also disable error indication if necessary.

For more information, see section Configuration Parameters on page 81.

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CHAPTER 6

CONFIGURATION COMMANDS

This chapter contains information on WMT700 configuration commands and parameters.

NOTE	You have chosen the initial settings for WMT700 when placing the order. In case you want to check and/or change the settings, see the instructions in this chapter. Otherwise, you can start using WMT700 directly after the installation. For operating instructions, see Chapter 7, Operation, on page 91.

Initial Settings

The settings have been configured at the factory according to the customer specifications given when ordering the product. For the available options, see section Ordering Options for WMT700 Series on page 19.

Configuration overview

You can configure WMT700 settings for serial communication or analog output with configuration commands using the serial port. However, you must set the port to configuration mode before starting configuration. It is also possible to use one serial port in configuration mode while operating WMT700 from the other serial port.

In WMT700, there are commands for:

- Parameters handling
- Wind measurement control
- Diagnostics
- Information

At the end of each command, press ENTER to execute the command. For a successful execution, the following combinations of Carriage Return <CR> and Line Feed <LF> are accepted:

- <CR>
- <LF>
- <CR><LF>

You can send commands at any Baud rate. The command is executed when end-of-line character is received.

If messages have been enabled, WMT700 responds to an invalid command with an error message. If the messages have been disabled, WMT700 does not send any error messages. You can fetch the most recent error data in configuration mode with the **ERRORS** command, see section ERRORS — Get Error Codes and Counts on page 78.

NOTE You can configure WMT700 by sending individual commands or by loading a configuration file to the sensor. For instructions on configuring all settings at once using configuration files, see section User-Configurable Data Messages on page 83

Table 17 List of Configuration Mode Commands

Command	Description
?	Displays a list of configuration commands.
BAUD	Changes or displays serial port settings.
CLEARERR	Resets error counters.
CLOSE	Switches the serial port to measurement mode.
ERRORS	Fetches the error codes and counter information from WMT700.
G	Displays either all or specified parameters.
H	Displays list of data messages and available values for measurement unit, profile, baud rate, interface, and analog output mode.
MEAS	Starts wind measurement based on the user-configurable averaging time. WMT700 does not send data messages automatically.
POLL	Tests data polling.
RESET	Resets WMT700.
S	Changes selected parameters or defines new data messages.
START	Starts continuous measurement.
STOP	Stops continuous measurement.
VERSION	Displays the software version.
WIND_GET	Fetches wind calibration information.

Prerequisites for Serial Connection

To update WMT700 settings through a serial connection the following prerequisites are needed:

- PC with a serial port.
- Required cables for serial connection. For more information, see section Cables on page 23.
- Any terminal program, such as Tera Term or Windows® HyperTerminal.

Communicating with terminal software

To switch WMT700 to the configuration mode using Windows® HyperTerminal:

1. Connect a cable between your terminal computer, power supply and WMT700.
2. Open the Windows® HyperTerminal program.
3. Cancel the new connection.
4. From the **File** menu, click **Properties**.
5. Select the correct COM port and click **Configure**.
6. Set the communication parameters according to the configured port settings of WMT700.

   The default values for WMT700 are:

   - **Bits per second: 9600**
   - **Data bits: 8**
   - **Parity: None**
   - **Stop bits: 1**
   - **Flow control: None**
7. Click **Apply** and **OK**.
8. On the **Settings** tab, click **ASCII setup**. Select **ASCII sending - Send line ends with line feed**. Click **OK** and close the **New Connection Properties** window.
9. On the **View** menu, click **Font**. In the **Font** list, select **Terminal**.
10. From the **Call** menu, click **Call**. Enter a name and select an icon for the connection. Click **OK**.

Mode Switching Commands

OPEN — Entering Configuration Mode

1. Switch the sensor power supply on. The following information is displayed:

   ```
   wmt700 v.<version number>
   ```

   Wait for 4 seconds. Then use the following command to enter configuration mode:

   ```
   $0OPEN
   ```

2. After a successful **OPEN** command, the following symbol is displayed:

   ```
   >
   ```

CLOSE — Exiting Configuration Mode

To switch WMT700 from the configuration mode to the measurement mode, use the **CLOSE** command.

```
CLOSE
```

Parameters Handling Commands

S — Set Parameter

This command defines new data messages and changes values of the WMT700 parameters. For parameter names and the allowed and default values, see Table 18 on page 82.

You can also use the **S** command to configure data messages. For instructions, see section Configuring Data Messages on page 83.

If you try to set an invalid value for a parameter or an invalid item for a data message, the response depends on the **messages** parameter. If messages have been enabled, WMT700 responds with an error message. If the messages have been disabled, WMT700 does not send any error messages. You can also fetch the most recent error data in configuration

mode with the **ERRORS** command, see section ERRORS — Get Error Codes and Counts on page 78.

NOTE Do not switch the power supply off immediately after the **S** command. Power should be on for at least 5 seconds after the **S** command, or the updated parameters values are not saved.

```
S x,y
```

where

x	=	Any parameter in Table 18 on page 82.
y	=	Value of the parameter.

Example 1

In this example the baud rate is set to 2400 bps, parity to even, data bits to 8 bits, and stop bits to 1 bit. The WMT700 needs to be RESET before communications setting take place.

```
S com1_baud,2

S com1_parity,1

S com1_data,8

S com1_stop,1
```

NOTE You can also change or view the serial port settings with the **BAUD** command.

Example 2

In this example the analog output 1 is set to send measurement data as a current signal, the gain is set to 1 mA/m/s and the offset to 4 mA.

```
S aout1_o,0.004
S aout1_g,0.001
S aout1mode,0
```

Example 3

In this example both analog outputs are disabled to reduce power consumption.

```
S aout1mode,3
S aout2mode,7
```

G — Get Parameter

This command shows the values of the configuration parameters. You can either display all parameter values or only certain values.

For a list of available parameters, see Table 18 on page 82.

Get All Parameters

You can use the **G** command to view all parameter values if you do not specify any parameters in the command.

```
G
```

Get Specified Parameters

You can use the **G** command to view specified parameter values.

```
G x
```

where

x = Any parameter in Table 18 on page 82.

Example:

In this example the averaging time is shown to be 4 seconds.

```
G wndAvg
```

wndAvg=4

BAUD — Display or Set Port Settings

This command shows or changes values of the serial port settings.

Set Port Settings

You can use the **BAUD** command to change the bit rate, parity bit, data bits, stop bit, and communication profile of the selected serial port. To restore default serial port settings, see Restoring Serial Port Settings on page 112.

NOTE	There is a 100-millisecond delay after which WMT700 takes the settings into use. Do not send commands to WMT700 during this time.

```
BAUD x,y,z,w
```

where

x	=	Bit rate (300, 1200, 2400, 4800, 9600, 19200, 38400, 57600, or 115200)
y	=	Data bits (7 or 8)
z	=	Parity (n = none, e = even, o = odd)
w	=	Stop bits (1 or 2)

Example:

In this example the bit rate is set to 115200, data bits to 8, parity to none, and stop bits to 1.

```
BAUD 115200,8,n,1
```

Display Port Settings

You can use the **BAUD** command to display the current serial port settings.

```
BAUD
```

Wind Measurement Control Commands

MEAS — Single Wind Measurement

This command starts wind measurement based on the user-configurable averaging time. WMT700 does not send the data message automatically. Use the polling command to fetch measurement data in the required data message format.

```
MEAS
```

START — Start Continuous Measurement

This command starts continuous wind measurement. Continuous measurement starts when you exit configuration mode or restart WMT700.

You can retrieve data with a polling command or configure WMT700 to send data messages at selected intervals. You can set the interval for automatic messages with the autoInt parameter.

```
START
```

STOP — Stop Wind Measurement

This command stops continuous wind measurement.

To restart measurement, use the **MEAS** or **START** command. You can fetch the most recent measurement data at any time with the polling command.

```
STOP
```

Diagnostics and Support Commands

ERRORS — Get Error Codes and Counts

This command fetches error information from WMT700. For a list of the errors and events, see section Error and Event Messages on page 111.

```
ERRORS
```

The response is the following:

```
a,b,c,d,e,f
```

where

a = Number of events since latest reset.
b = The code for the first event since latest reset.
c = The code for the most recent event.
d = Number of errors since latest reset.
e = The code for the first error since latest reset.
f = The code for the most recent error.

Example:

```
1,3,3,10,13,13
```

Interpretation of the example message:

- Number of events since latest reset: 1
- The code for the first event since latest reset: 3
- The code for the most recent event: 3
- Number of errors since latest reset: 10
- The code for the first error since latest reset: 13
- The code for the most recent error: 13

If no errors or events have occurred yet, the response is the following:

```
0,0,0,0,0,0
```

CLEARERR — Reset Error Codes and Counts

This command resets the error counters of WMT700.

```
CLEARERR
```

POLL — Get Message

This command fetches the latest measurement data from WMT700. You need to specify the data message format in the command.

NOTE	Vaisala recommends that you only use this command for testing data connections. To fetch measurement data for other purposes, switch the serial port to measurement mode. The polling command in the measurement mode depends on the selected profile.

```
POLL y
```

where

y = Identification number for the data message format. For a list of data message formats, see Table 23 on page 93.

RESET — Reset CPU

This command resets WMT700.

```
RESET
```

Information Commands

? — Display Command Set

This command displays a list of available configuration commands.

```
?
```

H — Display Help and Messages

This command displays a list of supported data messages and their identification numbers as well as the available values for wind speed measurement unit, profile, baud rate, interface, and analog output.

```
H
```

VERSION — Show Firmware Version

This command displays the label and version of the WMT700 software.

```
VERSION
```

WIND_GET — Get Calibration Data

This command fetches the WMT700 calibration date and other calibration data. This information is mostly intended for Vaisala technical support.

```
WIND_GET
```

Configuration Parameters

There are a number of parameters affecting WMT700 functionality. Table 18 on page 82 lists the parameters for configuring WMT700 settings. Appendix D, Configuration Parameters on page 129 includes a detailed description and the default values for each parameter and the allowed values when using the WMT700 profile. Unless otherwise stated in the table, the changes take place immediately after the command has been sent.

To view and set parameter values, use the **G** and **S** commands.

NOTE	You can configure WMT700 by sending individual commands or by loading a configuration file to the sensor. For instructions on configuring all settings at once using configuration files, see section Loading Settings from Configuration File on page 87.

For information on configurable parameters and allowed values when using WS425 and SDI-12 profiles, see Upgrading from Vaisala WINDCAP® Ultrasonic Wind Sensor WS425 to WMT700 Technical Reference.

Table 18 List of Parameters for WMT700

Parameter	Description
address	Address
autoInt	Automatic Data message interval (seconds)
autoPort	Serial port for automatic data messages
autoSend	Automatic data message number
startDelay	Automatic messages startup delay
com1_baud	COM1: Baud rate
com1_data	COM1: Data bits
com1_parity	COM1: Parity
com1_stop	COM1: Stop Bits
com1_delay	COM1: Response Delay (ms)
com1_protocol	COM1: Protocol
com2_baud	COM2: Baud rate
com2_data	COM2: Data bits
com2_parity	COM2: Parity
com2_stop	COM2: Stop Bits
com2_delay	COM2: Response Delay (ms)
com2_protocol	COM2: Protocol
com2_interf	COM2: Interface Type
msg1	User-Configurable Data Message 1
msg2	User-Configurable Data Message 2
msg3	User-Configurable Data Message 3
msg4	User-Configurable Data Message 4
heaterOn	Heating control
messages	Confirmation and error message notifications
sleepTime	Duration of the low-power mode in seconds
wndAvg	Averaging time for wind measurement (s)
wndCoast	Wind direction coasting threshold (m/s)
wndCover	Wind reporting cover time in case of failed measurement
wndDirOffset	User-defined wind direction offset
wndGustTime	Averaging time for wind minimum and maximum (s)
wndOrientation	Installation orientation of WMT700
wndUnit	Wind speed units
wndVector	Wind measurement averaging method
aoErrValue	AOUT: Error Value
aout1_g	AOUT1: Gain
aout1_o	AOUT1: Offset
aout1maxv	AOUT1: Maximum value
aout1minv	AOUT1: Minimum value
aout1mode	AOUT1: Mode selection
aout2_g	AOUT2: Gain
aout2_o	AOUT2: Offset
aout2maxv	AOUT2: Maximum value
aout2minv	AOUT2: Minimum value
aout2mode	AOUT2: Mode selection
cal_date	Wind calibration date
serial_n	Device serial number
serial_pcb	Electronics serial number

NOTE	In automatic message mode, to initiate continuous measurement, use the **START** command. See START — Start Continuous Measurement on page 78

User-Configurable Data Messages

You can define new data messages for automatic messaging or polling with the WMT700 profile. Each item in a user-configurable data message string consists of 2 characters after the \ character. For example, the item for wind speed is **\ws**. The maximum number of characters for a string is 80.

The characters are passed to messages as they are. All visible ASCII characters are allowed, except for Table 19 on page 84 lists the available items for data message strings.

For a list of the predefined data messages, see section Data Messages on page 92.

NOTE	You can only use the user-configurable data messages with the WMT700 protocol.

Configuring Data Messages

Use the **S** command to define new data messages for WMT700 with the msg1, msg2, msg3 and msg4 parameters. For more information on the **S** command, see S — Set Parameter on page 74.

```
S y,\xx
```

where

y	=	Parameter for the data message (msg1, msg2, msg3, msg4).
\xx	=	String for the new data message. For the available items, see section Items for Data Messages below.

After you have defined the new data message, you can test the message by polling it in configuration mode. For instructions, see section POLL — Get Message on page 80.

Items for Data Messages

The user-configurable data messages can contain wind measurement, control character, check sum, and monitoring items. Configure new data messages with the msg1, msg2, msg3, and msg4 parameters. All available items are listed in Table 19 below, Table 20 below and Table 21 on page 85.

Table 19 Wind Measurement Items for Data Messages

Item	Description
\ad	Address
\dm	Wind direction minimum
\dx	Wind direction maximum
\gu	Wind gust speed
\lu	Wind lull speed
\rg	Signal quality
\st	Speed of sound
\Ts	Sonic temperature
\va	Validity of the measurement data. The available values are: 1 = valid wind measurement data 0 = unable to measure
\w1	Wind direction when the peak speed (wp) occurred
\wd	Wind direction, average
\wm	Wind speed minimum
\wp	Wind speed, peak
\ws	Wind speed, average
\wx	Wind speed average, x component
\wy	Wind speed average, y component

Table 20 Control Character and Check Sum Items for Data Messages

Item	Description
\01	SOH (start of heading)
\02	STX (start of text)
\03	ETX (end of text)
\04	EOT (end of transmission)
\cr	CR (carriage return)
\lf	LF (line feed)
\se	Checksum calculation end point
\sp	Print check sum
\ss	Checksum calculation start point

Table 21 Monitoring Items for Data Messages

Item	Description
\er	Status code. The code is a decimal number. Each bit corresponds to a status flag. For a list of the bits, see section Status Flags on page 86.
\fb	0 = No error 1 = Blocked sensor
\fh	0 = No error 1 = Heater failure. Incorrect heater resistance.
\fs	0 = No error 1 = Wind speed exceeds operating limits 2 = Sonic temperature exceeds operating limits 3 = Wind speed and sonic temperature exceed operating limits
\ft	This value indicates temperature sensor failures when converted to binary format: Bit 0 = Temperature sensor 1 failure Bit 1 = Temperature sensor 2 failure Bit 2 = Temperature sensor 3 failure
\fv	0 = No error 1 = Supply voltage (Vh or Vi) too high 2 = Supply voltage (Vh or Vi) too low
\pa	Average heating power
\ra	Heater resistance
\ta	Transducer temperature
\ti	Internal temperature
\vh	Heater voltage
\vi	Supply voltage

Example 1:

In this example a new data message with identification number 1 is defined. The items included in the message are average wind speed, average wind direction, and supply voltage.

```
S msg1,$\ws,\wd,\vi\cr\lf
```

When the above message is polled, WMT700 sends the following data if the average wind speed is 5 m/s, the average wind direction is 128 degrees, and the supply voltage is 23.4:

```
$005.00,128,23.4<CR><LF>
```

Example 2:

In this example the data message 2 is set to include the following items:

- SOH
- Checksum calculation start point
- Wind speed, average
- Wind direction, average
- Wind gust speed
- Wind lull speed
- Wind direction minimum
- Wind direction maximum
- Wind direction during the peak speed (wp) occurred
- Checksum calculation end point
- EOT
- Print check sum
- CR
- LF

```
S msg2,\01\ss$\ws,\wd,\gu,\lu,\dm,\dx,\w1\se\04\sp\cr\lf
```

WMT700 sends the following message that starts with SOH character which is excluded from the check sum. The checksum ends before EOT character. The check sum (in this case D8) is printed after the EOT character.

```
┌_$02.66,98.21,02.66,02.60,95.68,99.53,99.34_D8<CR><LF>
```

The non printable characters are shown above as ┌┘ and <CR><LF>.

Status Flags

Table 22 on page 87 lists the status flags included in the data message when the status code item \er has been added to the message. Each bit corresponds to a specific status.

Status flags are coded in decimal number format. To extract each bit from the status code, the decimal number must be converted to binary format.

Table 22 Status Flags

Bit	Description
0	Temperature sensor 1 failure.
1	Temperature sensor 2 failure.
2	Temperature sensor 3 failure.
3	Heater failure. Incorrect heater element resistance.
4	Too high (Vh > 40 V or Vi > 40 V) supply voltage.
5	Too low (Vh < 20 V or Vi <10 V) supply voltage.
6	Wind speed exceeds operating limits.
7	Sonic temperature exceeds operating limits.
8	Wind measurement fails over 80 % of the averaging time. Reported wind is still correct.
9	Not used.
10	Blocked sensor. Reported wind is still correct.

Loading Settings from Configuration File

To facilitate the configuration of WMT700, all settings can be configured at once using configuration files. You can send a text file containing the configuration settings to the sensor with a terminal program, such as Tera Term or Windows® HyperTerminal.

For a list of the parameters and their allowed and default values, see Table 18 on page 82.

To change the parameters over the RS-485, RS-422, or RS-232 interface:

1. Use the **G** command to fetch the current WMT700 parameters.
2. Copy the values from the terminal program to a file. Remove the parameters you do not want to change.
3. Disable error messages with the following command:

```
S messages,0
```

4. Clear the error counters with the following command:

```
CLEARERR
```

5. Send the file to WMT700 to change the settings.
6. To verify that the parameters have been set correctly (the values are in the allowed range and all parameters were valid), read the error counters with the following command:

   ```
   ERRORS
   ```

   If all values are valid, WMT700 sends the following response:

```
0,0,0,0
```

You can also use the **G** command to check that the parameters were set correctly.

If you have not disabled error messages (as instructed in step 3) and the messages parameter is set to 1, WMT700 responds to each **S** command confirming the new parameter values. If an error occurs during the configuration, WMT700 sends a response containing the error messages.

NOTE	RS-485 is a half-duplex interface. If the RS-485 interface is used and error messages have been enabled, a simple terminal program cannot be used.

Example:

The configuration file in this example contains all the WMT700 parameters that are user-configurable.

```
S wndAvg,1.00000
S wndUnit,0
S wndDirOffset,0
S wndOrientation,0
S wndGustTime,3.00000
S wndCover,4
S wndVector,1
S wndCoast,0.00000
S autoInt,1.00000
S autoSend,0
S autoPort,1
S com1_baud,4
S com1_parity,0
S com1_data,8
S com1_stop,1
S com1_protocol,0
S com1_delay,20
S com2_baud,4
S com2_parity,0
S com2_data,8
S com2_stop,1
S com2_protocol,0
S com2_delay,20
S com2_interf,0
S sleepTime,5
S startDelay,5
S heaterOn,1.00000
S aout1_o,0.00000
S aout1_g,1.00000
S aout1minv,0.00000
S aout1maxv,32000.00000
S aout1mode,3
S aout2_g,1.00000
S aout2_o,0.00000
```

```
S aout2minv,0.00000
S aout2maxv,32000.00000
S aout2mode,7
S aoErrValue,1000
S messages,1
S msg1,\ss$\ws,\wd,\se\sp\cr\lf
S msg2,2
S msg3,3
S msg4,4
S address,A
```

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CHAPTER 7
OPERATION

This chapter contains information on WMT700 operating commands, protocols and data messages.

Getting Started

After WMT700 has been installed and configured, you can start operating the wind sensor as follows:

- To receive wind measurement data through a serial connection as data messages, use serial communication.

  When using the WMT700 profile, see the operating instructions in this section.

  When using WS425 or SDI-12 profiles, see the operating instructions in Upgrading from Vaisala WINDCAP® Ultrasonic Wind Sensor WS425 to WMT700 Technical Reference.

- To receive wind measurement data as current, potentiometer, voltage, or frequency output, use analog output.

  For general information, see Analog Output on page 65.

  For instructions on using WMT700 analog output in a system configured for WS425, see Upgrading from Vaisala WINDCAP® Ultrasonic Wind Sensor WS425 to WMT700 Technical Reference.

NOTE	For a complete list of the serial commands available for the WMT700 series wind sensors, see Appendix A, Complete Command Set for WMT700, on page 121.

Operating WMT700 with Terminal Program

To operate WMT700 through a serial connection, the following prerequisites are needed:

- PC with a serial port
- Required cables for serial connection. For more information, see section Cables on page 23.
- Any terminal program, such as Tera Term or Windows® HyperTerminal

To switch on WMT700 in measurement mode using Windows® HyperTerminal, see Communicating with terminal software on page 73:

> For information on operating commands, see section Measurement Mode Commands on page 100.
>
> For information on available data messages, see section Data Messages below.

Data Messages

Depending on the settings, there are two modes in WMT700 for sending data messages to the serial ports

- Poll mode
- Automatic Message mode

The data messages can contain measurement data calculated by WMT700 and information on the status and properties of the wind sensor.

For the Automatic message mode, following parameters are needed to set:

- autoInt
- autoSend
- autoPort

When the WMT700 protocol is used, you can use either one of the predefined message formats or user-configurable data message format.

Table 23 on page 93 lists the data messages supported by WMT700. The Data Message Numbers in the table below are needed when WMT700

protocol POLL command used or Automatic Message mode is used with any protocol.

Table 23 WMT700 Data Messages

Data Message Number	Description
WMT700 Data Messages	
21	WMT700 profile message that reports average wind speed and direction.
22	WMT700 profile message that reports wind speed in x and y components.
23	WMT700 profile message that reports wind speed and direction and self-diagnostics information.
24	WMT700 profile message that reports wind speed and direction and self-diagnostics information, and includes the checksum.
25	WMT700 profile message that reports wind measurement, sonic temperature, and status data, and includes the checksum.
27	ROSA - MES12 Standard profile message.
WS425 and SDI-12 Messages	
15	WS425 A/B NMEA Extended profile message.
16	WS425 A/B ASCII profile message.
17	WS425 A/B SDI-12 profile message for **M** command.
18	WS425 A/B SDI-12 profile message for **V** command.
19	WS425 A/B NMEA Standard profile message.
User-Configurable Data Messages	
1	Items defined by the user. See User-Configurable Data Messages on page 83
2	
3	
4	

To select a data message when using polling, specify the corresponding data message identification number in the polling command. See section POLL — Poll Data on page 103.

To select a data message when using automatic messages, use the configuration parameters. See section Configuration Parameters on page 81.

Each of the predefined data messages of the WMT700 protocol is described in more detail in sections below.

NOTE For more information on user-configurable data messages, see section User-Configurable Data Messages on page 83 in this manual.

For information on data messages of the WS425 and SDI-12 profiles, see Upgrading from Vaisala WINDCAP® Ultrasonic Wind Sensor WS425 to WMT70 Technical Reference.

WMT700 Data Message 21

WMT700 Data Message 21 reports the wind speed and direction in the format described below:

```
$\ws,\wd\cr\lf
```

where

$	=	Fixed text
\ws	=	Wind speed, average
\wd	=	Wind direction, average
\cr	=	CR (carriage return)
\lf	=	LF (line feed)

Example:

```
$00.08,299.20<cr><lf>
```

Interpretation of the example message:

- Wind speed, average: 0.08 m/s
- Wind direction, average: 299.2 °

For examples of different wind speed and direction presentations, see Figure 8 on page 29.

WMT700 Data Message 22

WMT700 Data Message 22 reports the wind speed in x and y components in the format described below:

```
$\wx,\wy\cr\lf
```

where

$	=	Fixed text
\wx	=	Wind speed average, x component
\wy	=	Wind speed average, y component
\cr	=	CR (carriage return)
\lf	=	LF (line feed)

Example:

```
$-00.04,00.07<cr><lf>
```

Interpretation of the example message:

- Wind speed, average, x component: -0.04
- Wind speed, average, y component: 0.07

For examples of different wind speed and direction presentations, see Figure 8 on page 29.

WMT700 Data Message 23

WMT700 Data Message 23 reports wind measurement and self-diagnostics data in the format described below:

```
$\ws,\wd,\wp,\wm,\Ts,\vh,\vi,\ta,\er\cr\lf
```

where

$	=	Fixed text
\ws	=	Wind speed, average
\wd	=	Wind direction, average
\wp	=	Wind speed, peak
\wm	=	Wind speed maximum
\Ts	=	Sonic temperature
\vh	=	Heater voltage
\vi	=	Supply voltage
\ta	=	Transducer temperature
\er	=	Status code. The code is a decimal number. Each bit corresponds to a status flag. For a list of the bits, see section Status Flags on page 86.
\cr	=	CR (carriage return)
\lf	=	LF (line feed)

Example:

```
$03.21,75.83,03.34,03.15,22.37,12.2,23.5,20.0,32<cr><lf>
```

Interpretation of the example message:

- Wind speed, average: 3.21 m/s
- Wind direction, average: 75.83 °
- Wind speed peak: 3.34 m/s
- Wind speed maximum: 3.15 m/s
- Sonic temperature: 22.37 °C
- Heater voltage: 12.2 V
- Supply voltage: 23.5 V
- Transducer temperature: 20.0 °C
- Status code: 32 which corresponds to status bit 5

WMT700 Data Message 24

WMT700 Data Message 24 reports wind measurement and self-diagnostics data. The check sum is included in the message. WMT700 calculates the checksum by applying 8-bit XOR for all bytes. The result is printed as a 2-digit hexadecimal value. The message is in the format described below:

```
\ss$\ws,\wd,\wp,\wm,\Ts,\vh,\vi,\ta,\er,\se\sp\cr\lf
```

where

\ss	=	Checksum calculation start point, not shown in the message
$	=	Fixed text
\ws	=	Wind speed, average
\wd	=	Wind direction, average
\wp	=	Wind speed, peak
\wm	=	Wind speed maximum
\Ts	=	Sonic temperature
\vh	=	Heater voltage
\vi	=	Supply voltage
\ta	=	Transducer temperature
\er	=	Status code. The code is a decimal number. Each bit corresponds to a status flag. For a list of the bits, see section Status Flags on page 86.
\se	=	Checksum calculation end point, not shown in the message
\sp	=	Print checksum
\cr	=	CR (carriage return)
\lf	=	LF (line feed)

Example:

```
$03.45,76.03,03.58,03.37,21.97,23.8,23.6,23.8,0,D4<cr><lf>
```

Interpretation of the example message:

- Wind speed, average: 3.45 m/s
- Wind direction, average: 76.03 °
- Wind speed, peak: 3.58 m/s
- Wind speed, maximum: 3.37 m/s
- Sonic temperature: 21.97 °C
- Heater voltage: 23.8 V
- Supply voltage: 23.6 V

- Transducer temperature: 23.8 °C
- Status code: 0
- Checksum: D4

WMT700 Data Message 25

WMT700 Data Message 25 reports wind measurement, sonic temperature, and status data. The check sum is included in the message. WMT700 calculates the checksum by applying 8-bit XOR for all bytes. The result is printed as a 2-digit hexadecimal value. The message is in the format described below:

```
\ss$\ws,\wd,\wp,\wm,\Ts,\er,\se\sp\cr\lf
```

where

\ss	=	Checksum calculation start point, not shown in the message
$	=	Fixed text
\ws	=	Wind speed, average
\wd	=	Wind direction, average
\wp	=	Wind speed, peak
\wm	=	Wind speed maximum
\Ts	=	Sonic temperature
\er	=	Status code. The code is a decimal number. Each bit corresponds to a status flag. For a list of the bits, see section Status Flags on page 86.
\se	=	Checksum calculation end point, not shown in the message
\sp	=	Print checksum
\cr	=	CR (carriage return)
\lf	=	LF (line feed)

Example:

```
$03.22,75.29,03.38,03.07,22.13,0,A4<cr><lf>
```

Interpretation of the example message:

- Wind speed, average: 3.22 m/s
- Wind direction, average: 75.29 °
- Wind speed, peak: 3.38 m/s
- Wind speed, maximum: 3.07 m/s
- Sonic temperature: 22.13 °C
- Status code: 0
- Checksum: A4

ROSA - MES12 Data Message

The MES12 Data Message 12 is used in the ROSA Surface Analyzer for Roads and Runways system. You can use this data message when WMT700 is connected to the Vaisala ROSA system.

This message contains sensor identifications (sids), corresponding data items and the synchronization characters SOH, STX and ETX. The lines are ended by CR and LF characters.

For more information, see Chapter 5, Operation, section Data Messages, in the Surface Analyzer for Roads and Runways ROSA, DM32 Version User's Guide (M210242EN).

Missing Readings

If WMT700 is not able to measure the wind, it indicates a missing reading in the output. Most common reasons for measurement problems are ice, birds, or other foreign objects on the line of measurement.

When the WMT700 profile is used, WMT700 indicates missing readings by showing 999 in the data messages.

Example:

When WMT700 Data Message 22 is polled, missing readings are indicated with the following response:

$999<cr><lf>

NOTE WMT700 indicates missing readings differently according to the selected profile. For information on how missing readings are indicated in the WS425 or SDI-12 data messages, see Upgrading from Vaisala WINDCAP® Ultrasonic Wind Sensor WS425 to WMT700 Technical Reference.

Error Indication

WMT700 provides advanced self-diagnostics for monitoring the status of the wind sensor and the validity of the measurement data. You can use the diagnostics as follows:

- To check the status of the wind sensor, include the status code item \er in the data message. You need to convert the status code to a binary number to verify the status. An error code does not indicate that the wind data is invalid. For more information, see section Status Flags on page 86.
- To check that the wind data is valid, include the \va item in the data message. For more information, see section Items for Data Messages on page 83.
- To check other diagnostics-related data, include the required items in the data message. For more information, see section Items for Data Messages on page 83.

Measurement Mode Commands

The available commands in measurement mode depend on the selected profile.

NOTE For a list of serial commands available for all communication profiles supported by WMT700, see Appendix A, Complete Command Set for WMT700, on page 121.

For more detailed information on commands of the WS425 and SDI-12 profiles, see Upgrading from Vaisala WINDCAP® Ultrasonic Wind Sensor WS425 to WMT700 Technical Reference.

WMT700 Profile Commands

When the WMT700 profile is selected, you can use the commands listed in this section to operate WMT700. In each of the command descriptions below, <CR> is an ASCII carriage return control character and <LF> is an ASCII line feed control character. Commands may be sent at any speed. The command is executed when end-of-line character is received.

Each measurement mode command must start with the user-configurable WMT700 address. It can be any string of printable ASCII characters, with the maximum length of 30 characters. Characters <CR>, <LF> and $ are not allowed. If you use **0** as the address in the command, WMT700 responds regardless of the configured address.

If messages have been enabled, WMT700 responds to an invalid command with an error message. If the messages have been disabled, WMT700 does not send any error messages. You can fetch the most recent error data in configuration mode with the **ERRORS** command, see section ERRORS — Get Error Codes and Counts on page 78.

Table 24 List of WMT700 Measurement Mode Commands

Command	Description
$aMEAS	Starts wind measurement. The duration of the measurement is based on the user-configurable averaging time.
$aOPEN	Switches the serial port to configuration mode.
$aPOLL,y	Fetches data from WMT700.
$aSLEEP	Switches WMT700 from normal operating mode to low-power mode.

where

$ = Fixed text.
a = WMT700 address. If the value is **0**, it refers to any WMT700 address.
y = Identification number for the data message format. For a list of the data message formats, see Table 23 on page 93.

MEAS — Start Measurement

This command starts wind measurement based on the user-configurable averaging time. WMT700 does not send the data message automatically. Use the polling command to fetch the measurement data in the required format.

```
$aMEAS<CR><LF>
```

Where

$	=	Fixed text.
a	=	WMT700 address. If the value is **0**, it refers to any WMT700 address.

OPEN — Enter Configuration Mode

This command switches the serial port to configuration mode.

```
$aOPEN<CR><LF>
```

Where

$	=	Fixed text.
a	=	WMT700 address. If the value is **0**, it refers to any WMT700 address.

POLL — Poll Data

This command fetches data from WMT700. You need to specify the data message number in the polling command.

NOTE	When WMT700 is in low-power mode, it does not receive the first character in the command. Thus, you must send an extra character (space) before the polling command to receive data.

```
$aPOLL,y<CR><LF>
```

Where

$	=	Fixed text.
a	=	WMT700 address. If the value is **0**, it refers to any WMT700 address.
y	=	Identification number for the data message format. For a list of data message formats, see Table 23 on page 93.

Example:

In this example WMT700 data message 1 is polled from WMT700.

```
$0POLL,1<CR><LF>
```

SLEEP — Enter Low-Power Mode

This command switches WMT700 from normal operating mode to low-power mode. For more information on the sleepTime parameter, see Table 18 on page 82.

```
$aSLEEP<CR><LF>
```

where

$	=	Fixed text.
a	=	WMT700 address. If the value is **0**, it refers to any WMT700 address.

ROSA - MES12 Profile Commands

When the ROSA - MES12 profile is selected, you can poll data in the MES12 data message format. This data message is used in the ROSA Surface Analyzer for Roads and Runways system. You can use this data message when WMT700 is connected to the Vaisala ROSA system.

M 12 — Poll MES12 Data Message

This command fetches data from WMT700 in the MES12 data message format. For more information on the data message, see section ROSA - MES12 Data Message on page 99.

```
@a M 12<CR><LF>
```

where

@	=	Fixed text.
a	=	WMT700 address. The allowed range is from 0 to 99.

CHAPTER 8
MAINTENANCE

This chapter contains information that is needed for performing visual inspection, cleaning, and verifying the operation of WMT700.

WARNING Some WMT700 product versions provide heating for transducers and/or array arms. To avoid injury, do not touch the heated parts of the wind sensor when the heating is enabled.

CAUTION When handling WMT700, do not rotate, pull, strike, bend, scrape or touch the transducers with sharp objects. Any impact on the wind sensor array damages the device.

Periodic Maintenance

WMT700 is a very reliable and rugged sensor. Since no moving or consumable parts are used, no periodic maintenance is required. WMT700 has been calibrated at the factory, and you are not required to perform recalibration.

NOTE Periodic calibration of WMT700 is not required for technical reasons. You can use the WM Verifier to test the mechanical integrity of the device and perform one-point calibration.

However, some quality management systems may require regular calibration of the measuring instruments.

To fulfill these requirements, Vaisala recommends that you recalibrate the wind sensor every 24 months. Contact Vaisala Service Center for more information.

Visual Inspection

Vaisala recommends that you carry out a periodic visual inspection of the wind sensor to ensure correct operation and clean the wind sensor if it becomes contaminated. If necessary, you can also test the operation of WMT700 with an optional verifier, which is a small echo-free chamber.

If any of the transducers have been bent, twisted or rotated, the measurement results might not be accurate.

To avoid errors caused by damaged array, check the following:

- Array has not been hit or bent. All transducers must be parallel to each other.
- Transducers have not been scraped or touched with sharp objects. The silicon rubber transducer sleeve must be undamaged.

Cleaning

Regular cleaning of WMT700 is not required. If the wind sensor becomes contaminated, you can clean it with a soft cloth moistened with some mild detergent. Do not use solvents or a pressure washer to clean WMT700, since they may damage the silicon rubber transducer sleeve.

Testing Proper Operation

WMT700 measures the time it takes for an ultrasonic signal to travel from one transducer to another. Therefore, the accuracy of the sensor depends on the distance between the transducers and the time-of-flight measurement circuit, which uses a crystal oscillator for its time reference.

If necessary, you can verify the distance between the transducer arms with the optional verifier. You can order the verifier from Vaisala as an accessory, see Table 32 on page 118.

Vaisala recommends that you perform the test every 12 month or if you suspect that the transducers may have been damaged. The test can be performed either in the field or in a laboratory. Do not perform the test when the wind speed is more than 10 m/s or when there is a risk of thunderstorm in the area.

NOTE	Disable heating before performing the verifier test. You can do this either by disconnecting the heater supply voltage or by setting the **heaterOn** parameter to **0**.

To perform the test:

1. Slip the verifier over the three transducers. Refer to Figure 30 below to see how the verifier fits over the transducers.
2. Start wind measurement. The command depends on the selected communication profile.
3. WMT700 must read less than 0.5 miles per hour (0.22 m/s) with the verifier in place.
4. Remove the verifier.

NOTE	Some random data samples may be lost during the verifier test. This, however, does not indicate that WMT700 is faulty.

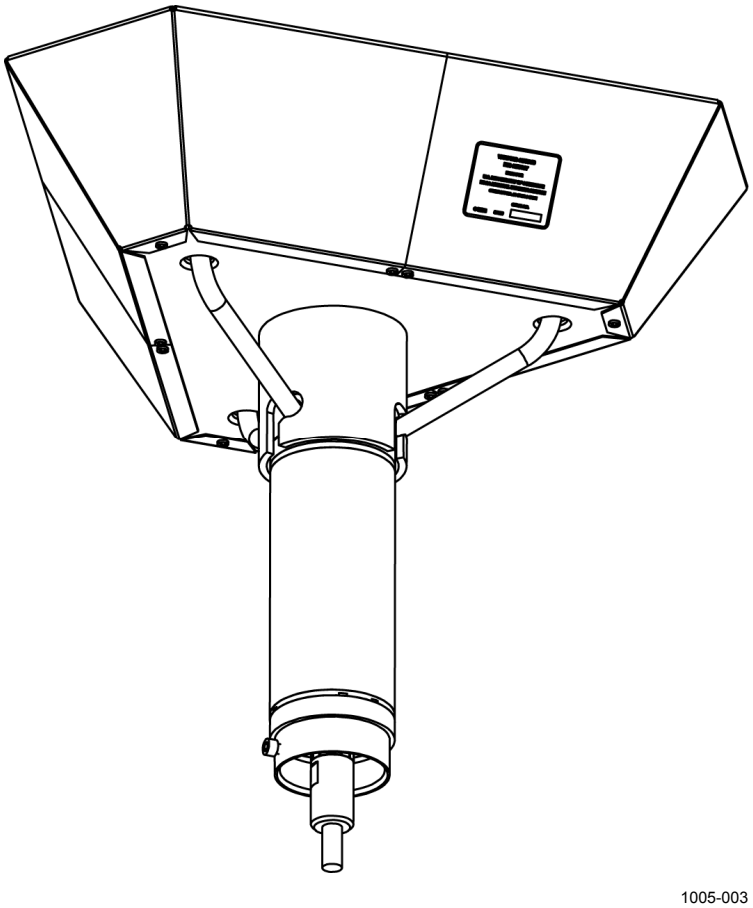

Figure 30 Testing WMT700 with Verifier

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CHAPTER 9
TROUBLESHOOTING

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

Problem Situations

Table 25 Some Problem Situations and Their Remedies

Problem	Probable Cause	Remedy
Connection to WMT700 is lost.	Power supply is not sufficient.	Check that the power supply matches the requirements listed in section Powering on page 58.
Wind measurement failure. WMT700 is sending irregular data values.	The installation site is causing measurement problems.	Check that the installation site matches the requirements listed in section Selecting Location on page 35.
	Snow, ice, a bird, or some other object is blocking the measurement path between the ultrasonic transducers.	Remove the blockage, and check that the wind transducers are not damaged. If the blockage is ice or snow, it melts after some time if you are using a heated version of WMT700. Duration of the blockage depends on the severity of the weather event. If birds are causing the blockage, consider installing a bird cage.
Reported wind direction is not correct.	WMT700 is misaligned, which causes an offset error.	Realign WMT700 according to section Alignment on page 48.
Wind direction indication acts erratically.	Orientation of the sensor does not match the **wndOrientation** parameter value.	Set the **wndOrientation** parameter value according to the actual orientation of the sensor. See section Configuration Parameters on page 81.

Problem	Probable Cause	Remedy
There is no response when you try to switch to configuration mode with the **OPEN** command.	The WMT700 settings are unknown or they have been accidentally changed.	Reset the serial communication settings to default values. See section Restoring Serial Port Settings on page 112.
WMT700 does not respond to any commands.	The communication profile is not correct.	Configure the communication profile to match the host communication profile.
	The wiring might be incorrect.	Check the wiring, see section Wiring on page 52
Connection works but data messages are not available.	The command has been mistyped.	Use the **ERRORS** command to fetch the error messages from WMT700. See section ERRORS — Get Error Codes and Counts on page 78.
Data messages are not in the expected format.	The selected data message is not correct.	If you are using automatic messages: Check the selected data message with the **G** command. If necessary, set a new value for the **autoSend** parameter. If you are using polling: Check that you are using the correct data message number in the polling command, see Table 23 on page 93.
Some items are missing from the data messages.	The configured data message does not contain all the required items.	Define the data message again with the required items. See section Parameters Handling Commands on page 74.
Configuration commands do not work.	WMT700 is in measurement mode.	Switch from measurement mode to configuration mode. See section Communicating with terminal software on page 73.
WMT700 sends an error message as a response to a command.	For probable causes, see section Error and Event Messages on page 111.	For remedies, see section Error and Event Messages on page 111.
No signal is present on analog outputs.	Analog output has been disabled.	Enable analog output with the **aout1_mode** and **aout2_mode** parameters. See Configuration Parameters on page 81
Automatic data messages are not received although parameters have been set correctly.	WMT700 is not in continuous measurement mode.	Initiate continuous measurement with **START** command. See START — Start Continuous Measurement on page 78.
Data from WMT700 is temporarily lost.	The data logger and wind sensor are not in the same operating mode (polling or automatic transmission mode).	Make sure that the data logger and wind sensor are both in either polling or automatic transmission mode.

Problem	Probable Cause	Remedy
Data messages are not received.	Baud rates of the data logger and wind sensor do not match.	Change the baud rate so that it is the same in the data logger and wind sensor.
Parameter does not change after **S** command has been given.	The parameter requires reset before it becomes valid.	Check Table 18 on page 82 whether reset is required before the parameter is changed.
Inconsistent serial communication or missing data.	Pin contacts of the connector have become oxidized or the connector is not firmly attached.	Change the WMT700 cable.

Error and Event Messages

If **messages** parameter is set to **1**, WMT700 sends error and event messages. Table 26 below lists the available messages.

Table 26 Error and Event Messages

Error/Event Code	Probable Cause	Remedy
2	Event. Parameters have been set to factory defaults.	You can change the default settings in configuration mode, see Communicating with terminal software on page 73.
3	Event. Wind calibration data has been lost. WMT700 needs to be calibrated.	Contact Vaisala technical support.
10	Error. You have given an invalid value when using the **S** command.	Check the allowed parameter values, see Table 18 on page 82.
11	Error. Parameter used with the **S** command is unknown.	Check that you are using the correct parameter names, see Table 18 on page 82.
12	Error. Unknown command.	Check the allowed commands in Appendix A, Complete Command Set for WMT700, on page 121.
13	Error. String before the end of command character is too long.	Check the command and parameter names that you are using.

You can also troubleshoot WMT700 as follows:

- Fetch the error and event messages with the **ERRORS** command. For more information, see section ERRORS — Get Error Codes and Counts on page 78.
- Include diagnostics-related items in the data message. For more information, see section Parameters Handling Commands on page 74.

Restoring Serial Port Settings

If you are not familiar with the configured settings of the WMT700 wind sensor or if the settings have been accidentally changed, you may not get any response when you send the **OPEN** command to WMT700. In that case you need to restore the serial port settings to known values.

To restore the default serial port settings using Windows® HyperTerminal:

1. Connect a cable between your terminal computer, power supply and WMT700.
2. Open the Windows® HyperTerminal program.
3. Cancel the new connection.
4. From the **File** menu, click **Properties**.
5. Select the correct COM port and click **Configure**.
6. Regardless of the configured port settings of WMT700, select the following communication settings:
   - **Bits per second: 19200**
   - **Data bits: 8**
   - **Parity: None**
   - **Stop bits: 1**
   - **Flow Control: None**
7. Close the **New Connection Properties** window.
8. Connect to WMT700 using the RS-485 interface.
9. Switch the sensor power supply off and back on.
10. Press # on your keyboard and hold down the key for at least five seconds. WMT700 responds by sending the following string:

```
Ok

Restoring COM1 and COM2 settings…
```

11. Updating the settings will be completed in a few seconds. When the operation is done, WMT700 sends the following response:

    ```
    Done. Rebooting…
    ```

12. WMT700 has now applied the settings and will reboot using the new settings. The restored settings are shown in Table 27 below.
13. Before you start configuring new values to WMT700 you need to apply the new settings to HyperTerminal. From the **Call** menu, click **Disconnect** to close the connection.
14. From the **File** menu, click **Properties**.
15. In the Properties dialog, click **Configure**.
16. Select **9600** in the **Bits per second** combo box.
17. Close the **Properties** window.
18. From the **Call** menu, click **Call**.

Table 27 Restored Serial Port Settings

Parameter Name	Default Value	Description
com1_baud com2_baud	4	4=9600 bauds per second
com1_data com2_data	8	Number of data bits
com1_delay com2_delay	20	Response delay in milliseconds
com2_interf	0	0=RS-485
com1_parity com2_parity	0	0=None
com1_protocol com2_protocol	0	WMT700 protocol
com1_stop com2_stop	1	Number of stop bits

The serial port settings have now been restored to known values. You can send the **OPEN** command and start configuring WMT700. For information on the configuration commands, see section Configuration commands on page 71.

NOTE You can also use other terminal programs such as Tera Term.

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.

Product Returns

If the product must be returned for service, see www.vaisala.com/services/return.html.

For contact information of Vaisala Service Centers, see www.vaisala.com/services/servicecenters.html.

CHAPTER 10
TECHNICAL DATA

This chapter provides the technical data of WMT700.

Table 28 Wind Speed

Property	Description/Value
Measurement range WMT701 WMT702 WMT703	 0 ... 40 m/s 0 ... 65 m/s 0 ... 75 m/s
Starting threshold	0.01 m/s
Resolution	0.01 m/s
Response time	250 ms
Available variables	instant, peak, average, maximum, minimum, gust, lull
Accuracy	+/- 0.2 m/s or 3 % of reading, whichever is greater

Table 29 Wind Direction

Property	Description/Value
Measurement range	0 … 360 °
Starting threshold	0.1 m/s
Resolution	1 °
Accuracy	±2 °
Response time	250 ms
Available variables	instant, average, maximum, minimum

Table 30 Outputs

Property	Description/Value
Digital outputs	
Communication interfaces	COM1: RS-485 COM2: RS-485, RS-422, RS-232, SDI-12
Communication protocols	WMT700, WS425 ASCII, NMEA Standard and Extended (version 0183), SDI-12 (version 1.3), WS425 ASOS, ROSA - MES12, Customized
Bit rate	300, 1200, 2400, 4800, 9600, 19200, 38400, 57600, or 115200
Available averages	Max. 3600 s
Analog outputs	
Wind speed	
Frequency	pulse 0 V/10 V: 0 ... 2 kHz (f = 10 Hz/m/s)
Voltage	0 ... 10 V (U = 100 mV /m/s)
Current	0 ... 20 mA (I = 0.2 mA/m/s)
Wind direction	
Voltage	0 ... 10 V (U = 20 mV/°)
Current	0 ... 20 mA (I = 50 uA//°)
Potentiometer	reference voltage 1 ... 10 VDC 0 ... V_{ref} represents 0 ... 359 °
Readout update interval	Max. 4 Hz
Units available	m/s, knots, mph, km/h, V, mA, Hz
Operating mode	Automatic Message or Poll Mode
Virtual temperature	Celsius degrees

NOTE In extreme weather conditions, ice or snow accumulation may cause a temporary wind measurement blackout even when the heating is enabled. WMT700 indicates this with missing readings or in the data message.

Table 31 General

Property	Description/Value
Heating	No heating: 0 W Average heating power 30 W Peak transducer heating power: 40 W Average transducer and array arm heating: 150W Peak transducer and array arm heating: 200 W
Operating temperature	-10 ... +60 °C -40 ... +60 °C -55 ... +70 °C
Operating voltage Absolute maximum	9 ... 36 VDC 40 VDC
Heating voltage Typical ranges Absolute maximum	 24 ... 36 VDC 40 VDC
IP class	IP66/IP67
Material Body Transducers Mounting kit	 stainless steel AISI316 silicone stainless steel AISI316
Dimensions Height Width Depth	 350 mm 250 mm 285 mm
Weight	WMT700 Wind Sensor: 1.9 kg Mounting adapter: 0.3 kg Fix70 Mounting Kit 1.4 kg
Connector	Hummel 7.106 series

NOTE Any temporary element or object (such as snow, ice, or a bird) blocking the measurement path between the ultrasonic transducer heads may affect the wind measurement accuracy or even invalidate the output data.

Table 32 Accessories

Description	Order Code
Verifier	WMT70Verifier
Bird cage	WMT70BirdKit
Bird perch	WS425BirdPerch
Cable connector	WMT70Conn
Cable 2 m, cable connector, open leads on one end	227567SP
Cable 10 m, cable connector, open leads on one end	227568SP
RS-485 Cable 2 m, cable connector, open leads on one end	228259SP
RS-485 Cable 10 m, cable connector, open leads on one end	228260SP
MAWS cable 10 m	227565SP
AWS520 cable 10 m, shield connected to PE pin	229807SP
AWS520 cable 10 m, shield not connected to PE pin	227566SP
Adapter cable for WS425 serial	227569SP
Adapter cable for WS425 analog frequency output	227570SP
Adapter cable for WS425 analog voltage output	227571SP
ROSA Analog Retro-Fit Cable 10m, cable connector, open leads on one end.	231425SP
FIX70 (suitable also for inverted mounting)	WMT70FixSP
FIX30	WS425Fix30
FIX60	WS425Fix60
Adapter for FIX70	228869
Adapter for FIX30/FIX60	228777
Cross-arm	WMT70CROSSARM

Dimensions

Figure 31 below and Figure 32 on page 120 show the dimensions of WMT700 wind sensor and FIX70 mounting kit.

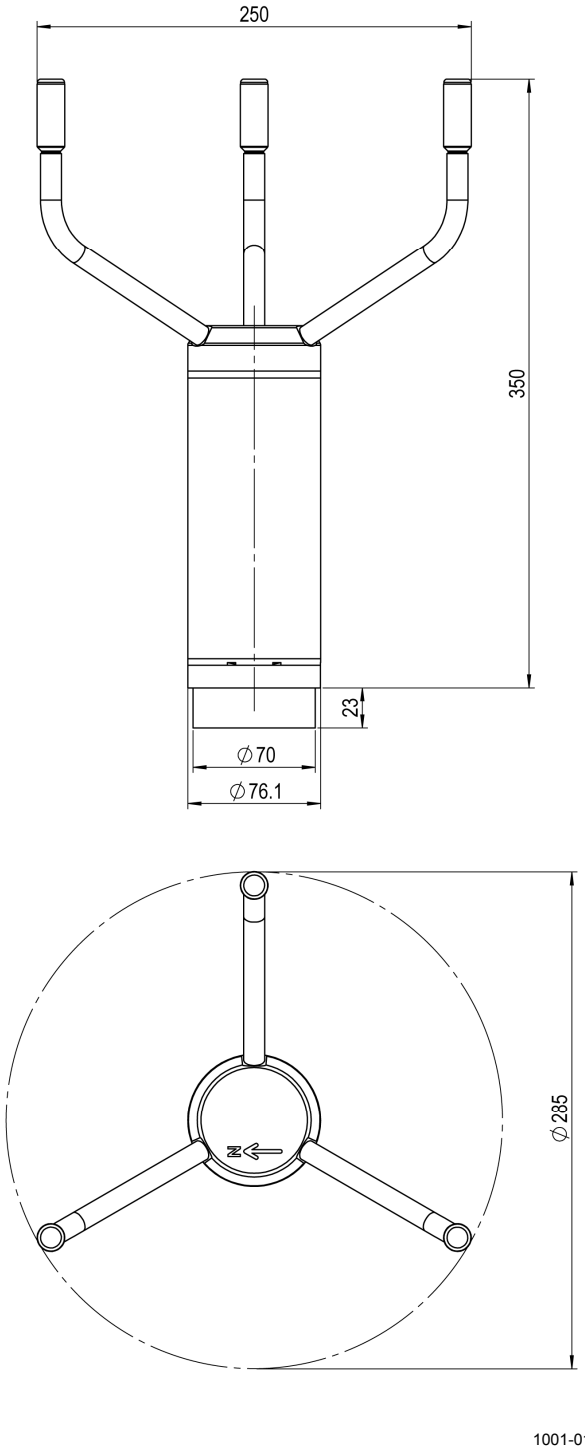

Figure 31 WMT700 Wind Sensor Dimensions in Millimeters

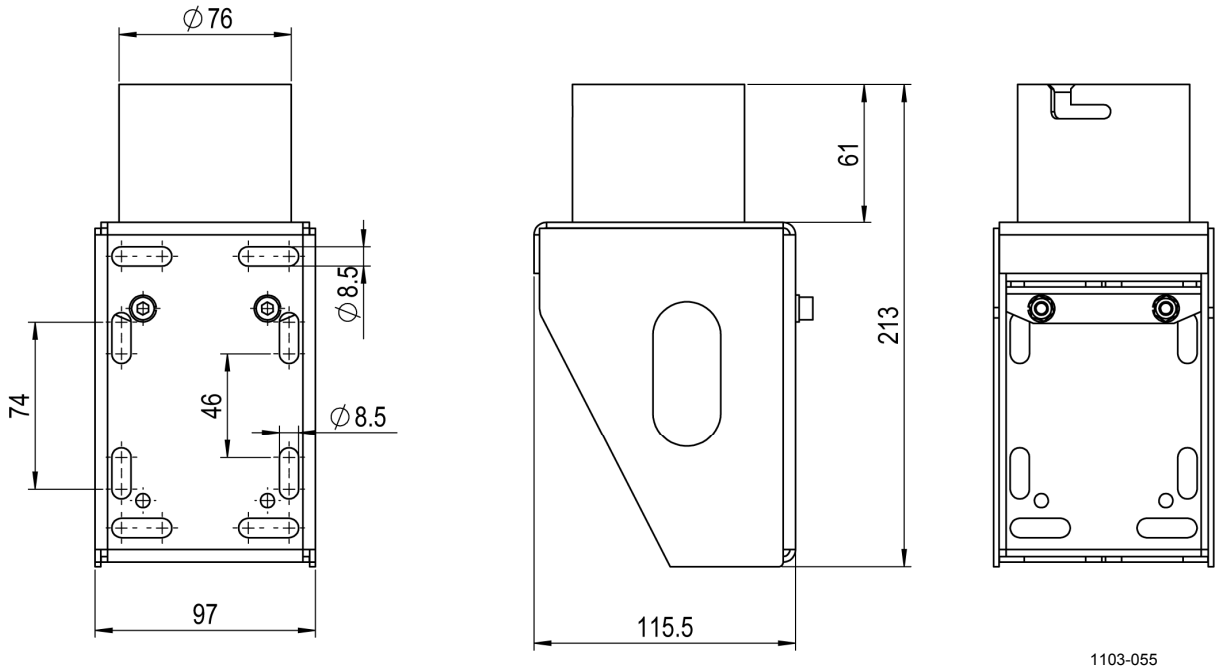

Figure 32 FIX70 Mounting Kit Dimensions in Millimeters

APPENDIX A
COMPLETE COMMAND SET FOR WMT700

Table 33 below lists all the commands available for WMT700.

Table 33 Command Set for All Profiles Supported by WMT700

Configuration Mode/ Measurement Mode and Profile	Command	Description	Further Information[1]
Configuration mode	?	Displays a list of configuration commands.	User's Guide
Configuration mode	BAUD	Changes or displays serial port settings.	User's Guide
Configuration mode	CLEARERR	Resets error counters.	User's Guide
Configuration mode	CLOSE	Switches the serial port to measurement mode.	User's Guide
Configuration mode	ERRORS	Displays error codes and counts.	User's Guide
Configuration mode	G	Displays either all or specified parameters.	User's Guide
Configuration mode	H	Displays list of data messages and available values for measurement unit, profile, baud rate, interface, and analog output mode.	User's Guide
Configuration mode	MEAS	Starts wind measurement based on the user-configurable averaging time. WMT700 does not send data messages automatically.	User's Guide
Configuration mode	POLL	Tests data polling.	User's Guide
Configuration mode	RESET	Resets WMT700.	User's Guide
Configuration mode	S	Changes selected parameters or defines new data messages.	User's Guide
Configuration mode	START	Starts continuous measurement.	User's Guide
Configuration mode	STOP	Stops continuous measurement.	User's Guide
Configuration mode	VERSION	Displays the software version.	User's Guide
Configuration mode	WIND_GET	Fetches wind calibration information.	User's Guide
Measurement Mode WMT700 profile	MEAS	Starts wind measurement. The duration of the measurement is based on the user-configurable averaging time.	User's Guide

[1] In this table, User's Guide refers to this manual, while Technical Reference refers to Upgrading from Vaisala Ultrasonic WS425 to WMT700 Technical Reference.

Configuration Mode/ Measurement Mode and Profile	Command	Description	Further Information[1]
Measurement mode WMT700 profile	OPEN	Switches the serial port to configuration mode.	User's Guide
Measurement mode WMT700 profile	POLL	Fetches data from WMT700.	User's Guide
Measurement mode WMT700 profile	SLEEP	Switches WMT700 from normal operating mode to low-power mode.	User's Guide
Measurement Mode MES12 profile	@a M 12	Polls data from WMT700 in the MES12 data message format.	User's Guide
Measurement mode WS425 ASOS F/G profile	WA	Requests average wind speed and direction message.	Technical Reference
Measurement mode WS425 ASOS F/G profile	WS	Requests the verbose Built-In Test (BIT) results.	Technical Reference
Measurement mode WS425 A/B NMEA Extended profile	$WIP	Polls data from WMT700.	Technical Reference
Measurement mode WS425 A/B ASCII profile	I	Requests identification information for WMT700.	Technical Reference
Measurement mode WS425 A/B ASCII profile	Wx	Starts measurement based on averaging time and fetches the data.	Technical Reference
Measurement mode WS425 A/B WAT11 profile	<esc><id>	Polls data from WMT700.	Technical Reference
Measurement mode SDI-12 profile	?!	Queries WMT700 for its address.	Technical Reference
Measurement mode SDI-12 profile	a!	Ensures that WMT700 is responding.	Technical Reference
Measurement mode SDI-12 profile	aI!	Queries WMT700 for its SDI-12 compatibility level, model number, and firmware version number.	Technical Reference
Measurement mode SDI-12 profile	aAb!	Changes WMT700 address.	Technical Reference
Measurement mode SDI-12 profile	aC!	Starts concurrent measurement.	Technical Reference
Measurement mode SDI-12 profile	aCC!	Starts concurrent measurement. CRC is included in the response.	Technical Reference
Measurement mode SDI-12 profile	aD0!	Fetches instant data from WMT700.	Technical Reference
Measurement mode SDI-12 profile	aM!	Starts measurement.	Technical Reference
Measurement mode SDI-12 profile	aMC!	Starts measurement. CRC is included in the response.	Technical Reference
Measurement mode SDI-12 profile	aV!	Starts verification.	Technical Reference

APPENDIX B
TYPICAL SYSTEM ENVIRONMENTS

This appendix lists the most typical WMT700 system environments.

Figure 33 below shows a system in which the weather station is connected to COM2, while COM1 is left for service and maintenance purposes only. This is the recommended setup for WMT700 serial communications.

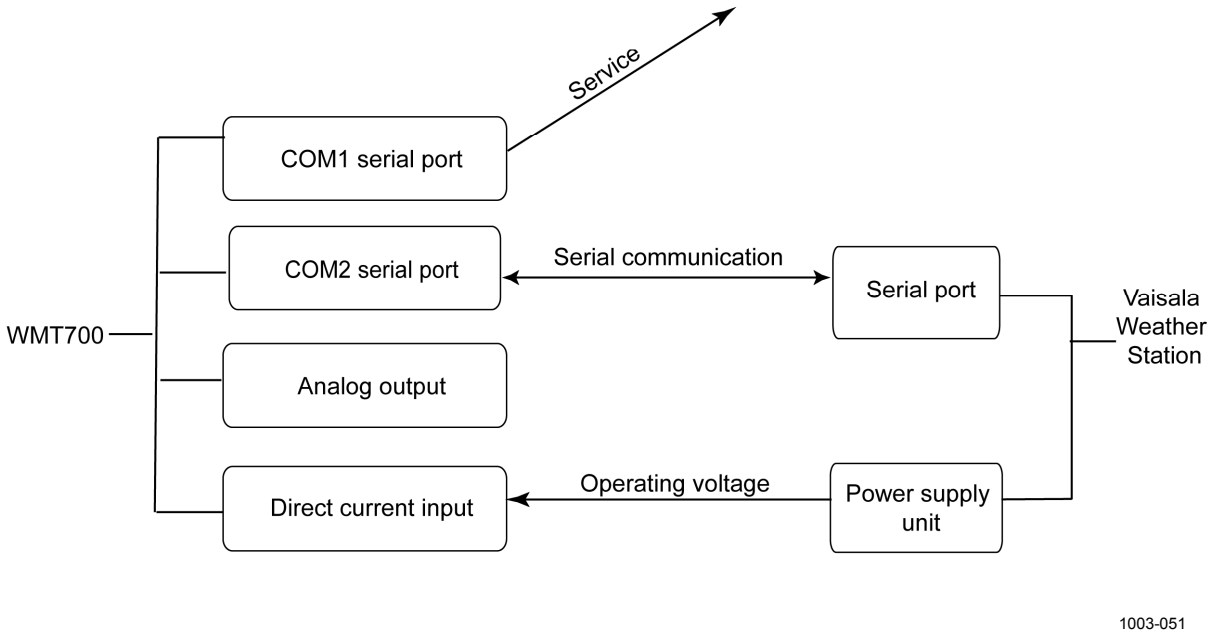

Figure 33 System Environment with Serial Port COM1 Only

Figure 34 below shows a system in which the weather station is only connected to the analog output channel. Serial port COM1 is used for maintenance purposes.

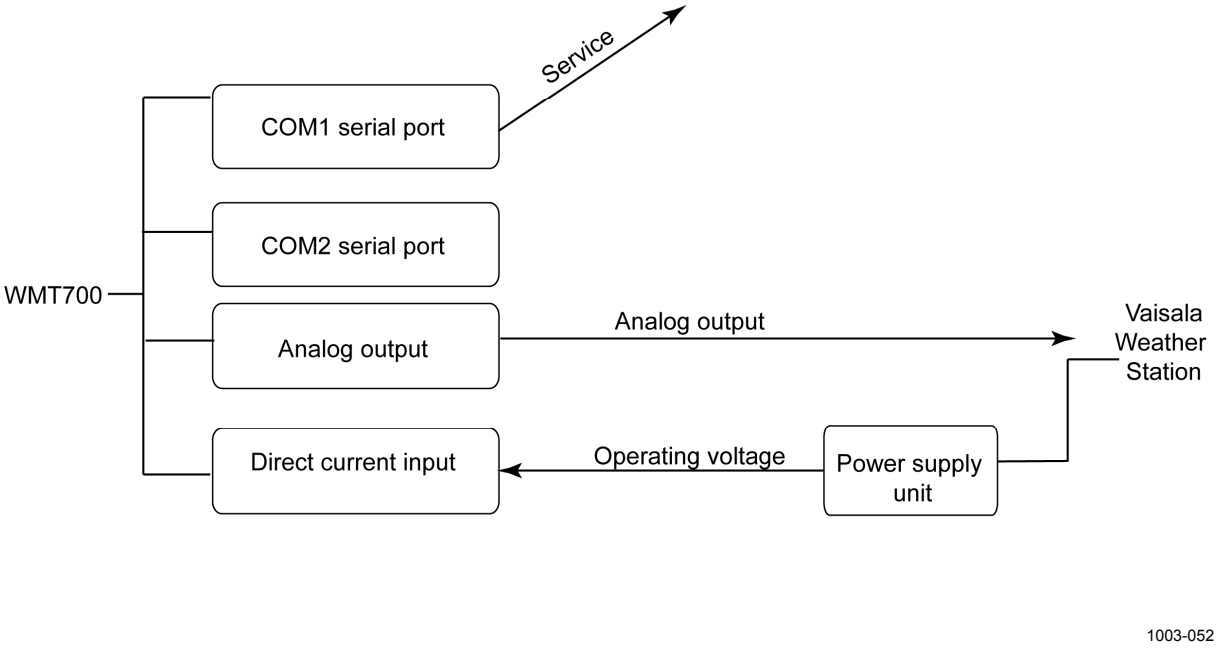

Figure 34 System Environment with Analog Output Only

Figure 35 below shows a system in which serial ports COM1 and COM2 operate independently. Serial port COM1 is used for maintaining WMT700 and monitoring the wind sensor in mission-critical applications while COM2 provides continuous measurement data.

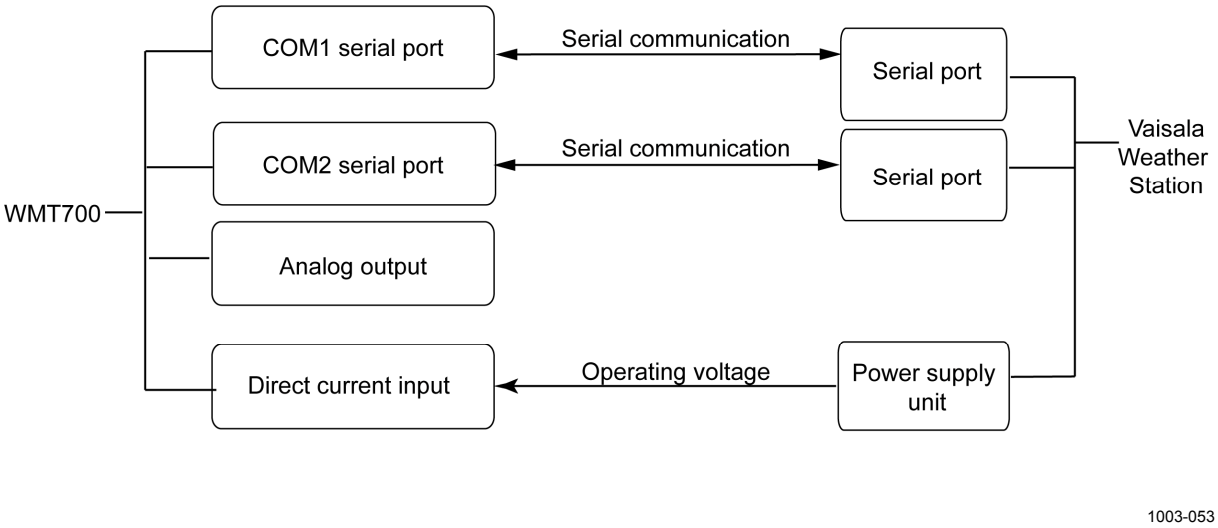

Figure 35 System Environment with Serial Ports COM1 and COM2

Figure 36 below shows a system with a separate back-up battery for operating power. The heating power is supplied with a direct power supply unit that prevents the heating function from consuming the power supply for the operations. This setup is suitable for WMT700 product types that provide heating for the wind sensor.

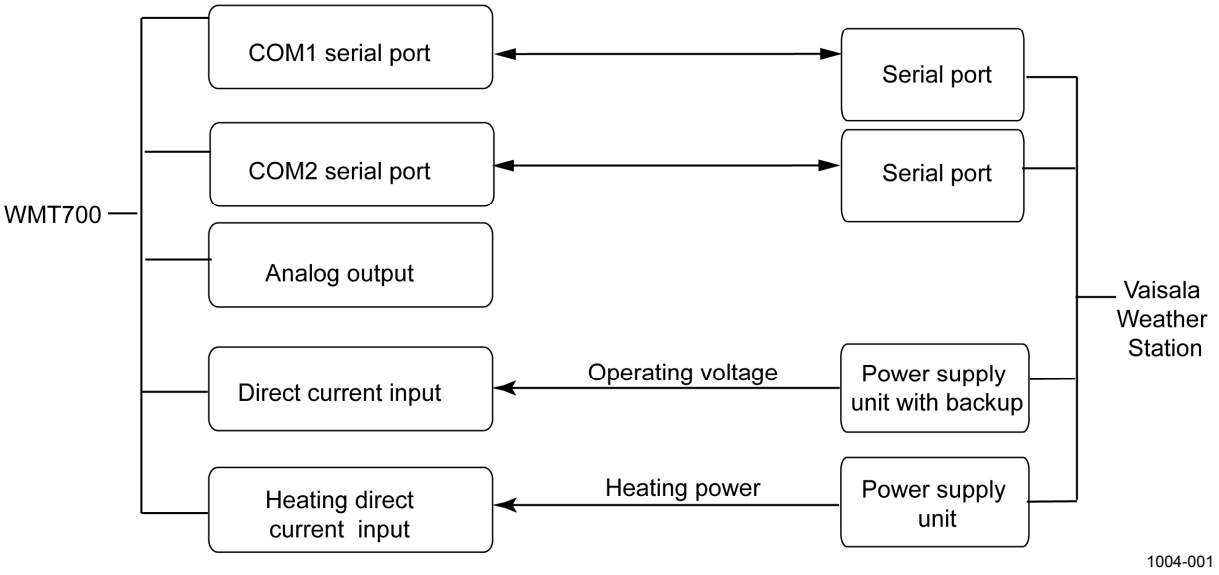

Figure 36 System Environment with Backup Battery

APPENDIX C
DEFAULT SETTINGS FOR DIFFERENT DIGITAL COMMUNICATION PROFILES

This appendix lists the default settings for different digital communication profiles.

Table 34 Default Settings for Different Digital Communication Profiles

Setting	Parameters	WMT700	WS425 ASCII	WS425 NMEA ext	WS425 SDI-12	WS425 ASOS	ROSA MES12
Protocol	com2_protocol	WMT700	WS425 A/B ASCII	WS425 NMEA ext	SDI-12	WS425 ASOS	MES12
Baud rate	com2_baud	9600	2400	9600	1200	2400	9600
Data bits	com2_data	8	8	8	7	8	8
Parity	com2_parity	None	None	None	Even	None	None
Stop bits	com2_stop	1	1	1	1	1	1
Response delay	com2_delay	20 ms	20 ms	20 ms	0	20 ms	20 ms
Address	address	A	A	A	1	1	12
Automatic message number	autoSend	Disabled	Disabled	WS425 NMEA ext	Disabled	Disabled	Disabled
Automatic message port	autoPort	(COM1)	(COM1)	COM2	(COM1)	(COM1)	(COM1)
Wind Averaging Time	wndAvg	1 s	1 s	3 s	1 s	5 s	600 s
Gust Averaging Time	wndGustTime	3 s	3 s	3 s	3 s	3 s	3 s

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APPENDIX D
CONFIGURATION PARAMETERS

This appendix lists WMT700 Configuration parameters.

Parameter Name	Default Value	Allowed Values	Units	Description
address	A	String with a maximum of 40 characters.		Address for WMT700. Note that the SDI-12, ASCII, NMEA Extended, ASOS and MES12 profiles use the first character only. SDI-12 only uses digits 1 … 9.
aoErrValue	1000	0 … 32000	V, mA, Hz	Value for analog output if wind measurement fails.
aout1_g aout2_g	1	0 ... 100		Gain for AOUT1 (wind speed) and AOUT2 (wind direction).
aout1_o aout2_o	0	-10000 … 10000		Offset for AOUT1 and AOUT2.
aout1maxv aout2maxv	32000	0…32000	V, A, Hz	Analog output maximum value for AOUT1 and AOUT2. The output is fixed to this value. The unit depends on analog output mode.
aout1minv aout2minv	0	0…32000	V, A, Hz	Analog output minimum value for AOUT1 and AOUT2. The output is fixed to this value. The unit depends on the analog output mode.
aout1mode	3	0 = current 1 = voltage 2 = frequency 3 = disabled		Analog output mode for AOUT1.
aout2mode	7	4 = current 5 = voltage 6 = potentiometer 7 = disabled		Analog output mode for AOUT2.
autoInt	1	0.25 ... 1000 Resolution: 0.25	s	Automatic message interval in seconds. This parameter affects both serial communication and analog output. Do not select a message interval that is shorter than the time it takes to send a data message.
autoPort	1	1 = COM1 port 2 = COM2 port		Serial port to which WMT700 sends automatic data messages.
autoSend	0	0 = automatic messages disabled 1 … 99		Automatic data message number. Selects the data message format for automatic messages.

Parameter Name	Default Value	Allowed Values	Units	Description
cal_date				Wind calibration date. This is a read-only parameter.
com1_baud com2_baud	4	0 = 300 1 = 1200 2 = 2400 3 = 4800 4 = 9600 5 = 19200 6 = 38400 7 = 57600 8 = 115200		Baud rates for serial ports COM1 and COM2. Changes take effect only after reset or the **RESET** command. Note that a low bit rate can affect measurement timing, if WMT700 cannot send the data message before a new measurement starts.
com1_data com2_data	8	7 = 7 data bits 8 = 8 data bits		Data bits for serial ports COM1 and COM2. Changes take effect only after reset or the **RESET** command.
com1_delay com2_delay	20	0 … 10000	ms	COM1 and COM2 Response delay in milliseconds.
com2_interf	0	0 = RS-485 1 = RS-422 2 = SDI-12 3 = RS-232		Interface for serial port COM2. (The interface for serial port COM1 cannot be changed.) Changes take effect only after reset or the **RESET** command.
com1_parity com2_parity	0	0 = none 1 = even 2 = odd		Parity for serial ports COM1 and COM2. Changes take effect only after reset or the **RESET** command.
com1_protocol	0	0 … 8		Protocol for serial port COM1. 0 = WMT700 1 = SDI-12 2 = WS425 F/G ASOS 3 = WS425 A/B ASCII 4 = WS425 A/B NMEA Standard 5 = WS425 A/B NMEA Extended 6= WS425 A/B WAT11 8 = MES12
com2_protocol	0	0 … 8		Protocol for serial port COM2. 0 = WMT700 1 = SDI-12 2 = WS425 F/G ASOS 3 = WS425 A/B ASCII 4 = WS425 A/B NMEA Standard 5 = WS425 A/B NMEA Extended 6= WS425 A/B WAT11 8 = MES12
com1_stop com2_stop	1	1 = 1 bit 2 = 2 bits		Stop bits for serial ports COM1 and COM2. Changes take effect only after reset or the **RESET** command.
heaterOn	1	0 = heater off 1 = automatic		Heater control. When the value is set to **1**, WMT700 controls the heaters based on the temperature and other conditions.
messages	1	0 = disabled 1 = enabled		Confirmation and error message notifications.

Parameter Name	Default Value	Allowed Values	Units	Description
msg1, msg2, msg3, msg4		String with a maximum of 80 characters.		User-configurable data message formats. Parameters correspond to the message identification numbers from 1 to 4.
serial_n				Serial number for WMT700. This is a read-only parameter
serial_pcb				Circuit board serial number. This is a read-only parameter.
sleepTime	5	0 = disabled 1 … 32000	s	Duration of the low-power mode in seconds. WMT700 returns automatically to normal state after this period of time has elapsed. You can also return to normal state by sending an extra space before the polling command.
startDelay	5	0 … 30	s	Defines how long WMT700 waits before activating automatic messages at startup.
wndAvg	1	0.25 … 3600 Resolution: 0.25	s	Averaging time for wind measurement in seconds. This parameter affects both serial communication and analog output.
wndCoast	0	0 … 100 0 = disabled	m/s	Wind direction coasting threshold in meters per second. When wind speed drops below the limit, wind direction coasting is performed. Only affects the scalar averaging mode.
wndCover	4	0 ... 20 seconds	s	Defines how long WMT700 continues to report the last valid wind value if wind measurement fails (for example due to snow or birds). **0** means that if measurement fails, WMT700 reports missing measurement data immediately.
wndDirOffset	0	-180… 180 degrees	Deg	User-defined wind direction offset.
wndGustTime	3	0.25 … 10 Resolution: 0.25	s	Averaging time for wind minimum and maximum in seconds.
wndOrientation	0	0 = array facing up 1 = array facing down		Orientation of the transducer arms of WMT700.
wndUnit	0	0 = m/s 1 = mph 2 = km/h 3 = knots		Wind speed unit. This parameter affects data messages sent through serial interfaces but has no impact on analog output.
wndVector	1	0 = scalar averaging 1 = vector averaging		Wind averaging method.

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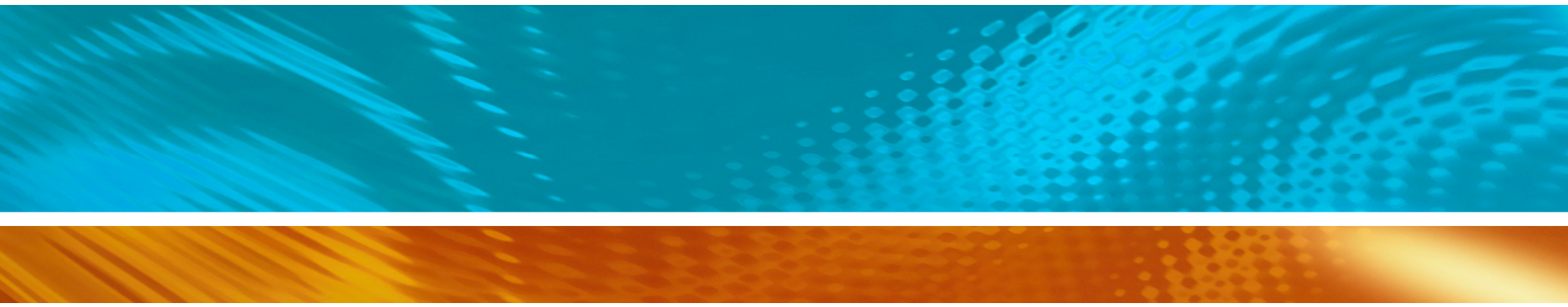

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