VAISALA

USER'S GUIDE

Vaisala WINDCAP© Ultrasonic Wind Sensor Series WMT700

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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, commonly referred to as WMT700.

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 product nomenclature of WMT700.
- Chapter 3, Functional Description, describes the functionality of WMT700.
- Chapter 4, Installation, contains information that is needed to install WMT700.
- Chapter 5, Operation, contains information on WMT700 configuration, operating commands, protocols, and data messages.
- Chapter 6, Maintenance, contains information on performing visual inspection, cleaning, and verifying the operation of WMT700.
- Chapter 7, Troubleshooting, describes common problems, their probable causes and remedies, and provides contact information for technical support.
- Chapter 8, 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 Communication Profiles, lists the default settings for different digital communication profiles.
- Appendix D, Configuration Parameters, lists the WMT700 configuration parameters.
- Appendix E, WMT700 NMEA MWV Profile, lists the configurable parameters, commands, and data messages of the WMT700 NMEA MWV profile.
- Appendix F, Accessories, lists all the accessories available for WMT700.
- Appendix G, Certificates, contains copies of certificates issued for WMT700.

Version Information

Table 1 Manual Revisions

Manual Code	Description
M211095EN-E	August 2013. This manual. Combined User's Guide and Technical Reference. Updated Heating with new fully heated WMT700. Updated Ordering Options and Accessories.
M211095EN-D	Previous version.
M211095EN-A	First version of this manual.

Related Manuals

Table 2 Related Manuals

Manual Code	Manual Name
M211218EN	Vaisala WINDCAP© Ultrasonic Wind Sensor Series WMT700 Quick Reference Guide

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 may damage the device.

CAUTION	The heating power 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 performance and environmental test standards listed in Table 3 below.

Wind tunnel tests have been performed according to Sonic anemometers/thermometers - Acceptance test methods for mean wind measurements ISO 16622:2002 and Measnet Anemometer Calibration Procedure Version 2, October 2009.

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. See Det Norske Veritas Certificate in Appendix G on page 217.

N17728

Trademarks

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.

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

Warranty

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

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

CHAPTER 2

PRODUCT OVERVIEW

This chapter introduces the features, advantages, and product nomenclature of 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 and the sensor body from ice and snow buildups 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 different user-specific needs. The accessories include a bird deterrent solution and a field-usable calibration verifier.

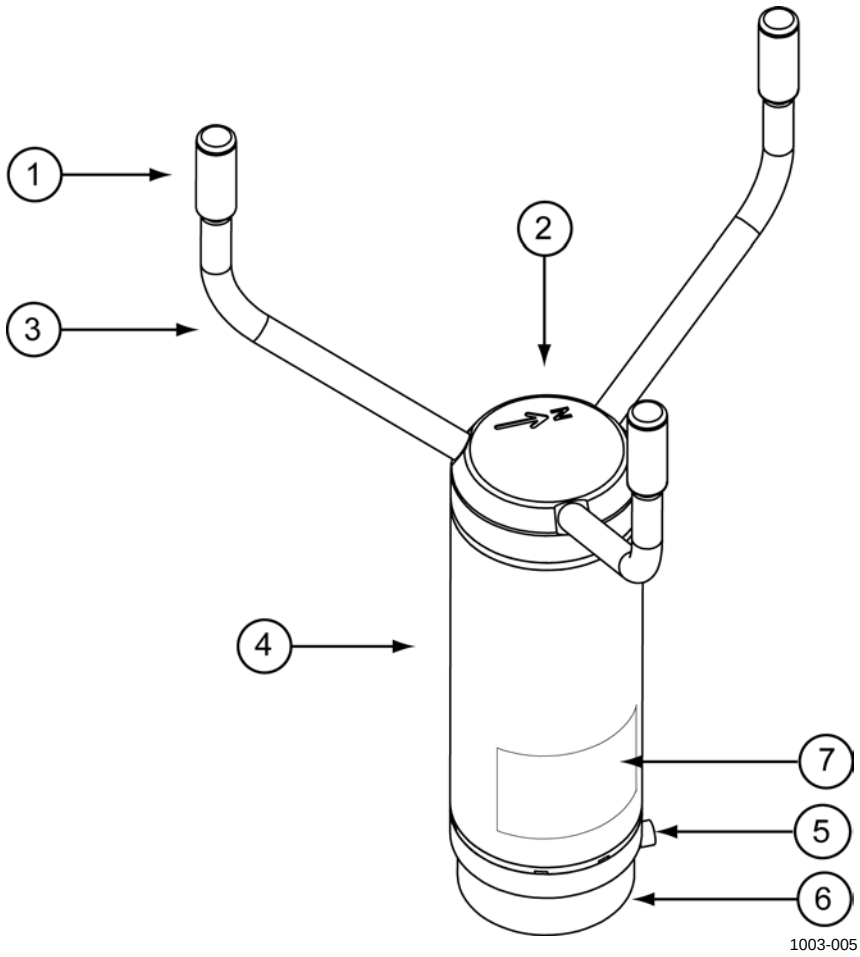


Figure 1 WMT700 Wind Sensor

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

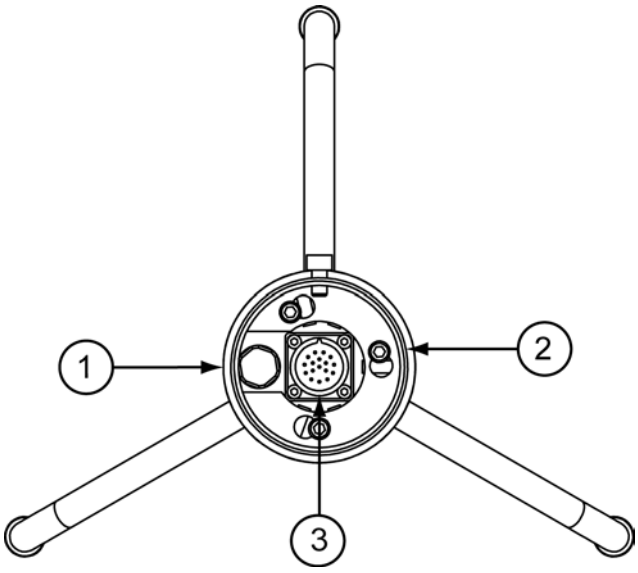


Figure 2 WMT700 Wind Sensor from Below

The following numbers refer to Figure 2 above:

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

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

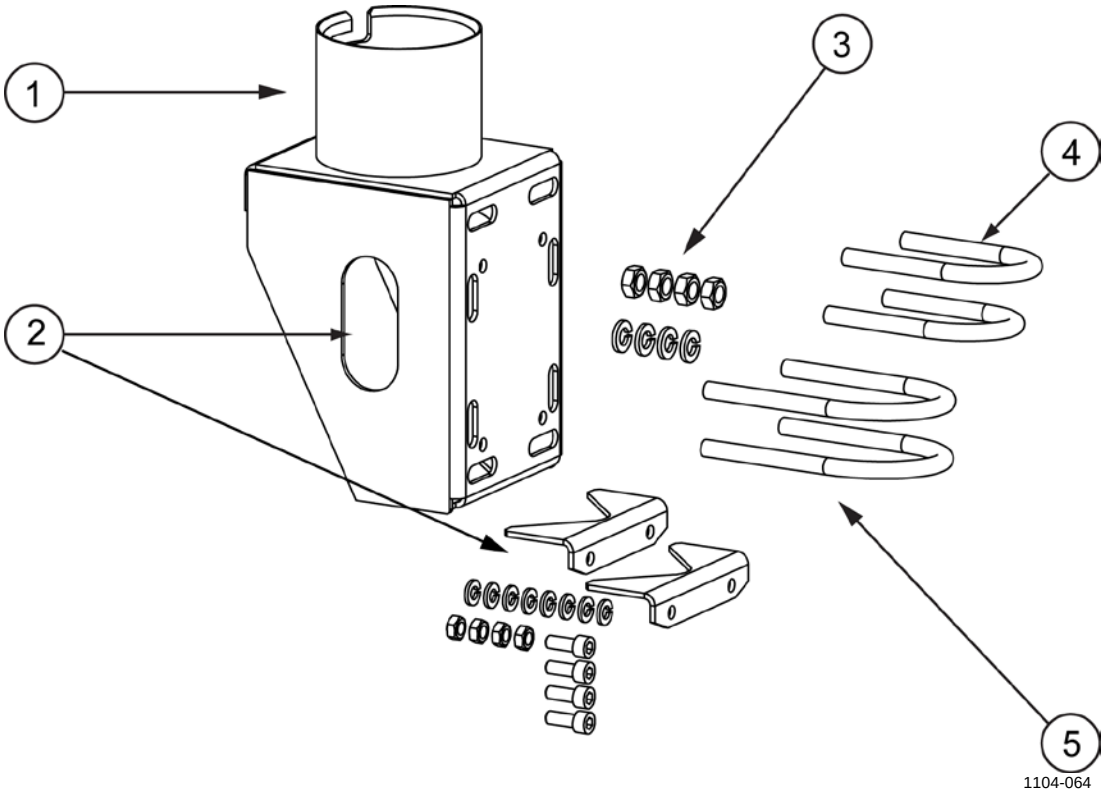


Figure 3 FIX70 Mounting Kit

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)
4 = U bolts for ø30 mm mast (2 pcs)
5 = U bolts for ø60 mm mast (2 pcs)

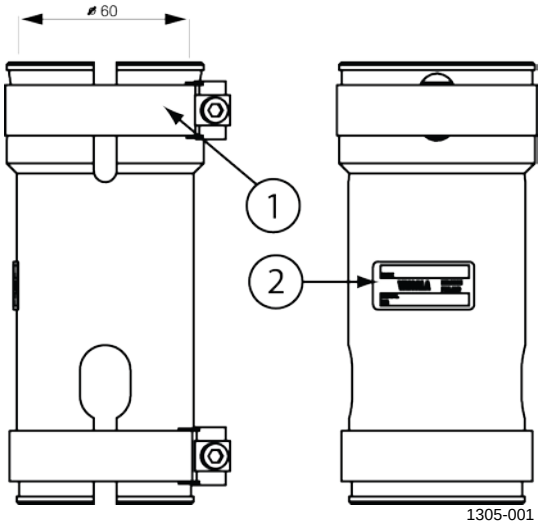


Figure 4 WS425FIX60-POM

The following numbers refer to Figure 4 above:

1 = Clamp
2 = Label

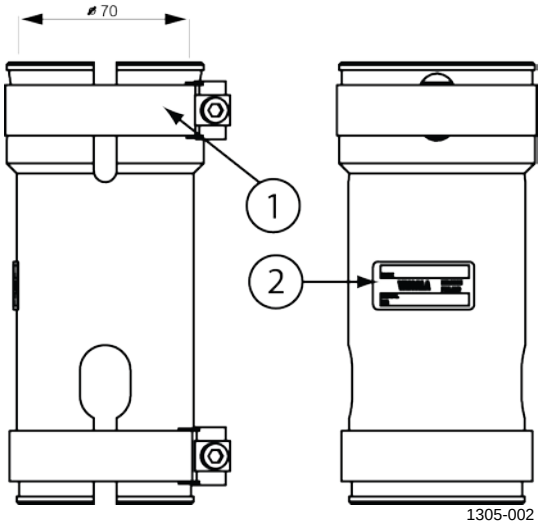


Figure 5 WMT70FIX60-POM

The following numbers refer to Figure 5 above:

1 = Clamp
2 = Label

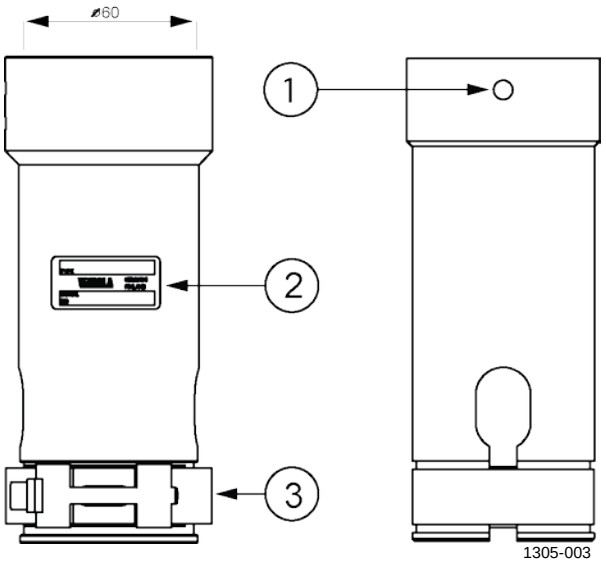


Figure 6 WS425FIX60-RST and WS425FIX60

The following numbers refer to Figure 6 above:

1 = Screw hole
2 = Label
3 = Clamp

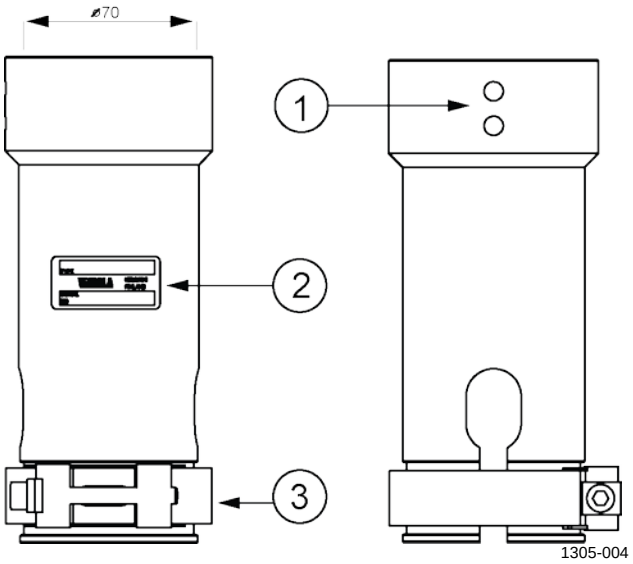


Figure 7 WMT70FIX60-RST

The following numbers refer to Figure 7 above:

1 = Screw holes
2 = Label
3 = Clamp

Ordering Options

A WMT700 unit can be configured by ordering options to suit versatile customer needs. You can reconfigure the following options:

- Digital communication interface
- Digital communication profile
- Digital communication units
- Analog output signals for wind speed channel
- Analog output signals for wind direction channel

Measurement Range

Ordering option 1, Measurement Range, defines the wind speed operation range for the sensor. The maximum reported value of wind speed 40, 65, or 75 m/s, depending on the selected option as shown in Table 5 below.

Table 5 Measurement Ranges of Different Sensor Types

Sensor Type	Measurement Range
1	WMT701 up to 40 m/s
2	WMT702 up to 65 m/s
3	WMT703 up to 75 m/s
A	WMT701 up to 40 m/s + Accredited Wind Calibration
B	WMT702 up to 65 m/s + Accredited Wind Calibration
C	WMT703 up to 75 m/s + Accredited Wind Calibration

Temperature Range

Ordering option 2, Temperature Range, defines the operating temperature range for the sensor as shown in Table 6 below.

Table 6 Temperature Ranges

Option	Temperature Range
A	-10 ... +60 °C
B	-40 ... +60 °C
C	-55 ... +70 °C

Note that the temperature range is not connected to heating in any way. If you operate in a demanding environmental climate where ice accumulation is expected, Vaisala recommends that you use a heated sensor; see Option 4 in Table 7 on page 24.

Heating

Ordering option 3, Heating, defines if the sensor is equipped with extra heating for demanding environmental conditions. Option 4 providing full sensor heating is best suited for most demanding environments. Note that power consumption requirement depends on the selected heating option.

Table 7 Heating

Option	Heating
1	Non-heated
2	Heated transducers (Min. 30 W power supply is needed)
3	Heated transducers and arms (Min. 200 W needed)
4	Heated transducers, arms, and body (Min. 350 W needed)

Digital Communication Interface

Ordering option 4, Digital Communication Interface, defines the serial line physical interface. Four different standard communication interfaces are available.

Table 8 Digital Communication Interface

Option	Hardware Interface
A	RS-485 isolated (1 pair)
B	RS-422 isolated
C	RS-232 isolated
D	SDI-12 isolated

Digital Communication Profile

Ordering option 5, Digital Communication Profile, defines the communication protocol used for the sensor. WS425 options are usable and backwards compatible when replacing WS425 sensor with a WMT700 unit. MARINE and WIND TURBINE options are customer-specific profiles.

Table 9 Digital Communication Profile

Option	Communication Profile		
0	WMT70 - default mode	9600, 8, N, 1	Polled
1	WS425 - ASCII	2400, 8, N, 1	Polled
2	WS425 - NMEA Extended (v 0183)	9600, 8, N, 1	Auto send 1/s
3	WS425 - SDI-12 (v 1.3)	1200, 7, E, 1	Polled
4	WS425 - ASOS	2400, 8, N, 1	Polled
5	ROSA - MES12	9600, 8, N, 1	Polled
6	US AWOS - NMEA Standard	2400, 8, N, 1	Autosend 5/s
7	FAA - Federal	9600, 8, N, 1	Polled
8	AWS520 - NMEA Extended (v 0183)	4800, 8, N, 1	Auto send 1/s
A	MARINE1 (v 0183)	4800, 8, N, 1	Auto send 1/s
B	MARINE2 (v 0183)	9600, 8, N, 1	Auto send 1/s
C	WIND TURBINE1 (default)	9600, 8, N, 1	Polled
D	WIND TURBINE2 (v 0183)	9600, 8, N, 1	Auto send 1/s

Digital Communication Units

Ordering option 6, Unit Definition for Digital Communication, offers four different digital communication options.

Table 10 Digital Communication Options

Option	Unit Used
A	Meters per second
B	Knots
C	Miles per hour
D	Kilometers per hour

Analog Output Signal for Wind Speed Channel

Ordering option 7, Analog Output for Wind Speed, can be disabled or factory-configured for 8 different modes. WS425 options are usable and backwards compatible when replacing WS425 sensor with a WMT700 unit.

Table 11 Output Configuration

Option	Output Configuration
0	Disabled
1	Voltage output 100 mV/m/s 0 mV = 0 m/s 4000 mV = 40 m/s (WMT701 maximum wind speed) 6500 mV = 65 m/s (WMT702 maximum wind speed) 7500 mV = 75 m/s (WMT703 maximum wind speed)
2	Reserved for future use
3	Current output 4…20 mA, offset 4 mA 4 mA = 0 m/s 20 mA = 40 m/s (WMT701, 0.4 mA/m/s) 20 mA = 65 m/s (WMT702, 0.24615 mA/m/s) 20 mA = 75 m/s (WMT703, 0.21333 mA/m/s) Error indication sets output to 2 mA
4	Current output 0.2 mA/m/s 0 mA = 0 m/s 8 mA = 40 m/s (WMT701 maximum wind speed) 13 mA = 65 m/s (WMT702 maximum wind speed) 15 mA = 75 m/s (WMT703 maximum wind speed)
5	Reserved for future use
6	Frequency output 10 Hz/m/s 0 Hz = 0 m/s 400 Hz = 40 m/s (WMT701 maximum wind speed) 650 Hz = 65 m/s (WMT702 maximum wind speed) 750 Hz = 75 m/s (WMT703 maximum wind speed)
7	WS425 voltage output 8 mV/mph 0 mV = 0 m/s 716 mV = 89.5 mph (WMT701 maximum wind speed) 1116 mV = 145 mph (WMT702 maximum wind speed) 1344 mV = 168 mph (WMT703 maximum wind speed)
8	WS425 frequency output 5 Hz/mph 0 Hz = 0 m/s 447.5 Hz = 89.5 mph (WMT701 maximum wind speed) 725 Hz = 145 mph (WMT702 maximum wind speed) 840 Hz = 168 mph (WMT703 maximum wind speed)
9	Reserved for future use
A	Push up output, 10 Hz/m/s 0 Hz = 0 m/s 400 Hz = 40 m/s (WMT701 maximum wind speed) 650 Hz = 65 m/s (WMT702 maximum wind speed) 750 Hz = 75 m/s (WMT703 maximum wind speed)
B	Pull down output 10 Hz/m/s 0 Hz = 0 m/s 400 Hz = 40 m/s (WMT701 maximum wind speed) 650 Hz = 65 m/s (WMT702 maximum wind speed) 750 Hz = 75 m/s (WMT703 maximum wind speed)

Analog Output Signal for Wind Direction Channel

Ordering option 8 defines Analog Output Signal for Wind Direction.WS425 Potentiometer output is backward compatible when replacing WS425 with a WMT700 unit. For different wind speed and direction representations, see Figure 13 on page 39. Note that the wind direction offset must be 0 for the for the readings to correspond with Figure 13.

Table 12 Analog Output Signal for Wind Direction

Selection	Output Configuration
0	Disabled
A	Voltage output 20 mV/degree 0 mV = 0 degree 7200 mV = 360 degree
B	Reserved for future use
C	Reserved for future use
D	Current output 50 uA/degree 0 uA = 0 degree 18 mA = 360 degree
E	Current output 4…20 mA (44.444 uA/degree) 4 mA = 0 degree 20 mA = 360 degree km/h
F	WS425 Potentiometer output 0% of V_{ref} = 0 degree 100% of V_{ref} = 360 degree

Connection Cables

Ordering option 9 defines connection cables. There are several different cables of different lengths for different purposes, as shown in Table 13 on page 28.

Table 13 Analog Output Configuration

Selection	Cable type
1	No cables
2	Cable 2 m, cable connector, open leads on one end
3	Cable 10 m, cable connector, open leads on one end
4	MAWS cable 10 m
5	AWS520 cable 10 m. Shield connected to PE pin
6	Adapter cable for WS425 serial
7	Adapter cable for WS425 analog frequency output
8	RS485 cable 2 m, cable connector, open leads on one end
9	RS485 Cable 10 m, cable connector, open leads on one end
A	Adapter cable for WS425 analog voltage output
B	AWS520 cable 10 m. Shield not connected to PE pin.
C	ROSA analog cable 10 m, cable connector, open leads on one end
D	Junction Box with Cable 2 m
E	Cable 15 m, cable connector, open leads on one end
F	Cable 26 m, cable connector, open leads on one end

Mounting Adapters

Ordering option 10 defines mounting adapters. There are several different mounting adapters for different purposes, as shown in Table 14 below.

Table 14 Mounting Adapters

Option	Adapter Type
A	Adapter 228869 only. Standard adapter, no fix
B	Adapter 228869 with WMT70FIX70 fixing mechanics. Also suitable for inverted mounting. Standard adapter for general purpose
C	Adapter 228869 with WMT700FIX60-POM. Standard adapter with plastic fix for 60 mm pole
D	Adapter 228869 with WMT700FIX60-RST Standard adapter with stainless steel fix for 60 mm pole
E	Adapter 22877 only (used for old WS425 FIX30/WS425FIX60), WS425-compatible adapter, no fix

NOTE Ordering option 11 is reserved for future use.

Accessories

Ordering option 12 defines WMT700 accessories.

Table 15 Accessories

Option	Accessories
A	No accessories
B	Bird cage WMT70BirdKit

Manual

Ordering option 13, Manual, defines available manual version and possible special package design.

Table 16 Manual

Option	Manual
1	No manual
2	English manual
3	Japanese manual
4	Chinese manual
5	Russian manual
6	Deif manual and packing

Example of WMT703 Configuration

WMT703 C4A2A003B1A2

```
|  | || | || ||| | ||_English manual included
|  | || | || ||| | |__No accessories
|  | || | || ||| |___Option 11 not in use
|  | || | || ||| ____FIX70 mounting adapter included
|  | || | || ||_____Cable 10m included
|  | || | || |______Analog signal for wind direction disabled
|  | || | ||_______ Analog signal for wind speed disabled
|  | || | |________ Used unit: m/s
|  | || |_________WS425 NMEA Extended messaging in use
|  | ||___________Physical serial line interface is RS-485
|  | |____________Transducers, arms, and body are heated
|  |_____________-55 to +70° temperature range model
|________________WMT703 measurement range up to 75 m/s
```

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 82.

NOTE If required, you can change the digital communication interface, digital communication profile, digital communication units, analog output signals for wind speed channel, and analog output signals for wind direction channel. To change the product version characteristics listed in Table 9 on page 25, contact Vaisala Service Center.

Accessories

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

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

For the codes of the accessories that you need to order separately, see Table 62 on page 192. For a complete list of accessories, see Appendix F, Accessories, on page 213.

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 the measurement. In such conditions, consider performing frequent visual inspections of WMT700 to avoid ice or snow build-ups.

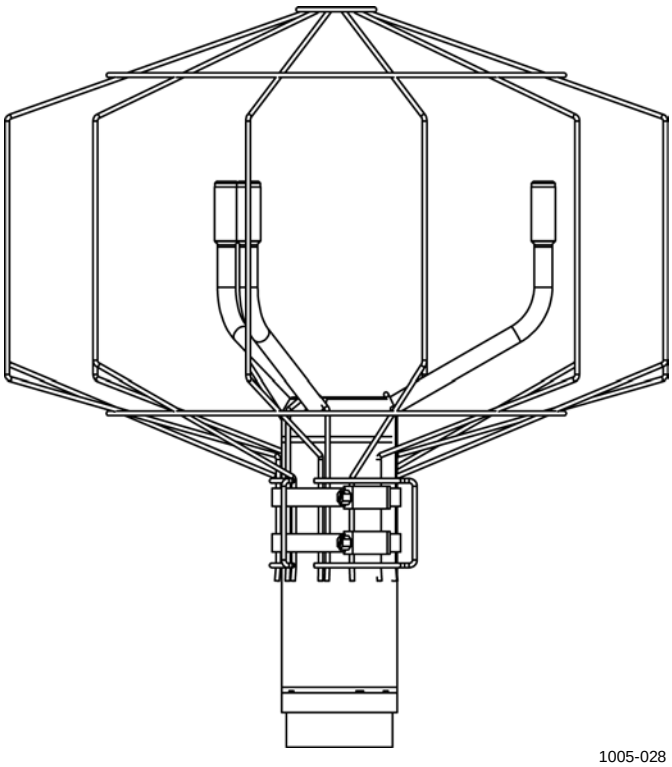
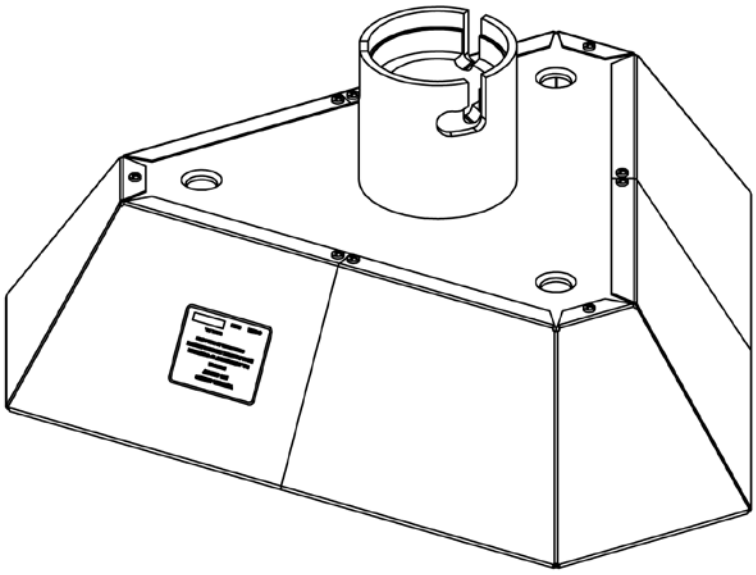


Figure 8 Bird Cage

WM Verifier

The optional WM 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 181.



1004-119

Figure 9 WM Verifier

Cables

Select the required cables according to your operating environment.

Table 17 Cables

Order Code	Description	Purpose
WMT70Conn	Cable connector	Cable
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.
237890SP	Cable 15 m, cable connector, open leads on one end	Used for analog output or serial communication with two serial ports.
237889SP	Cable 26 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.
231425SP	ROSA analog cable 10 m, cable connector, open leads on one end	Used for connecting WMT700 to Vaisala Road Weather System ROSA.
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.
ASM210719SP	Junction Box with Cable 2 meters	Used when a cable longer than 10 meters is needed. Junction Box contains terminal blocks that extend the 2-meter cable to a needed length.

Cable Tightening Tool

WMT700 is shipped with a cable tightening tool (237888SP). When a cable is inserted in the cable tightening tool, it is easier to grip and rotate the cable when connecting it to WMT700. After tightening, the cable tightening tool can be left in place.

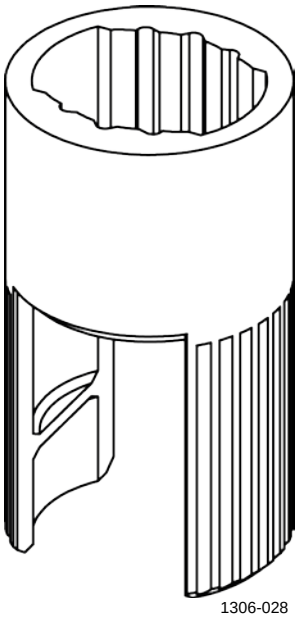


Figure 10 Cable Tightening Tool

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 wind speed along the ultrasonic path. For zero wind speed, both the forward and reverse transit times are the same. With wind along the sound path, the upwind direction transit time increases and the downwind transit time decreases.

Figure 11 on page 36 shows how the time shift of the ultrasonic signals is measured and how tail wind and forward wind affect the measurement.

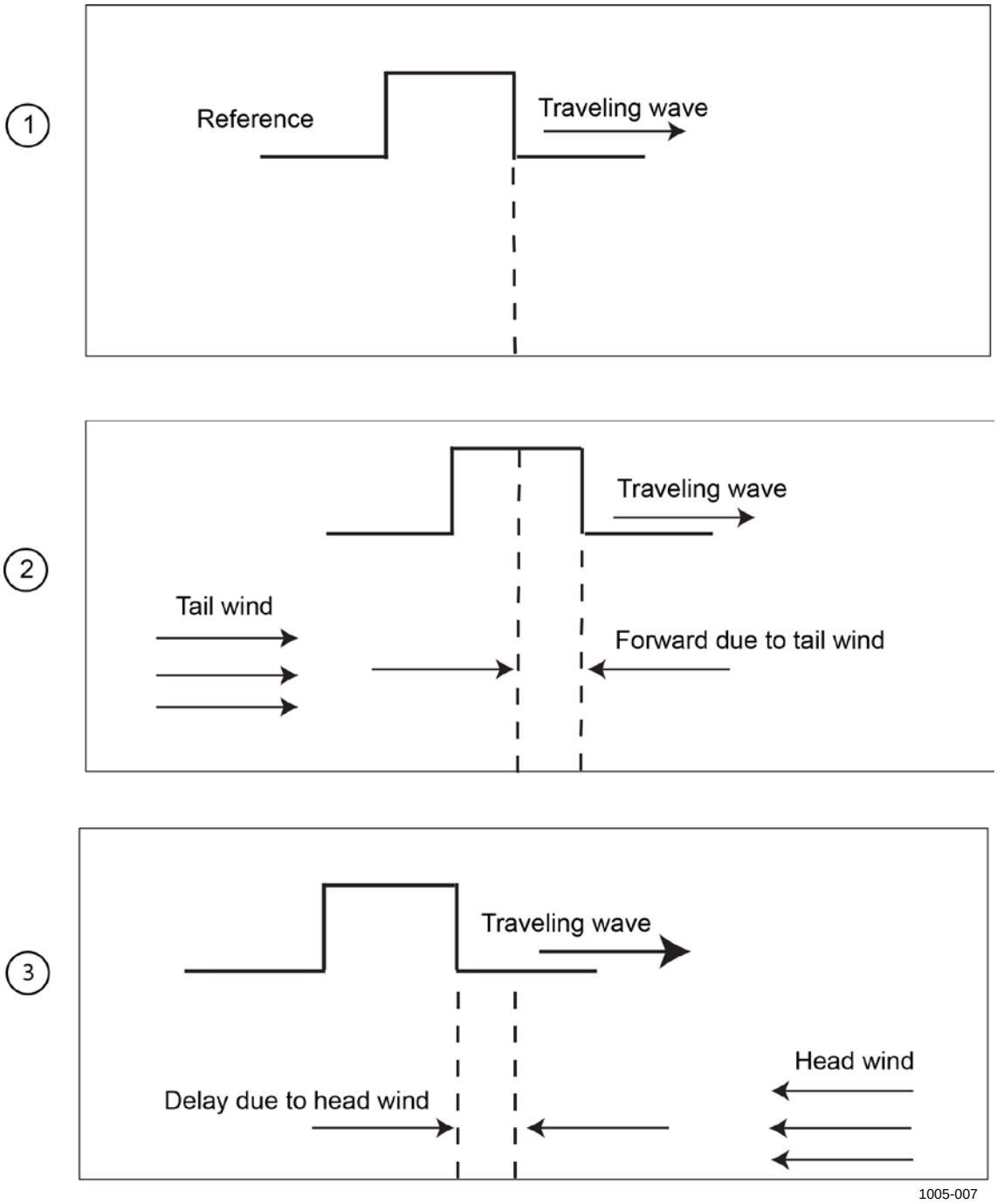


Figure 11 Ultrasonic Measurement Principle

The following numbers refer to Figure 11 above:

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

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	=	Distance between two transducers
t_f	=	Transit time in the forward direction
t_r	=	Transit time in the reverse direction

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

Figure 12 below shows the different paths of WMT700 and the vectors provided by the wind sensor:

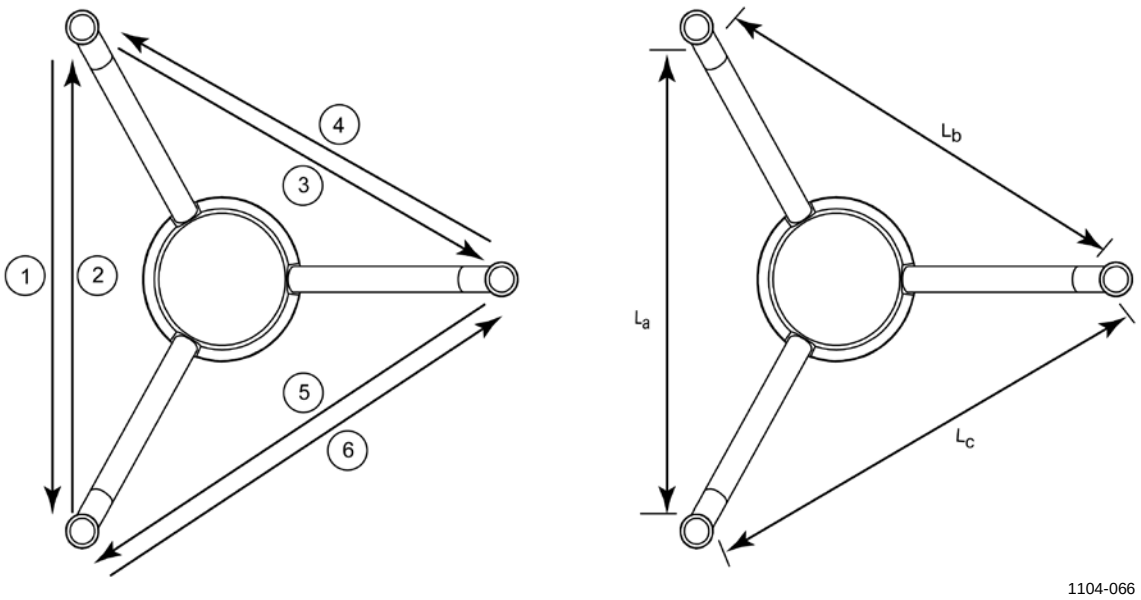


Figure 12 Measurement Paths of WMT700

where

1–6	=	Measurement paths 1 to 6 of WMT700
L_a, L_b, L_c	=	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 canceled 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

The triangular 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 13 below shows examples of wind speed and direction presentations.

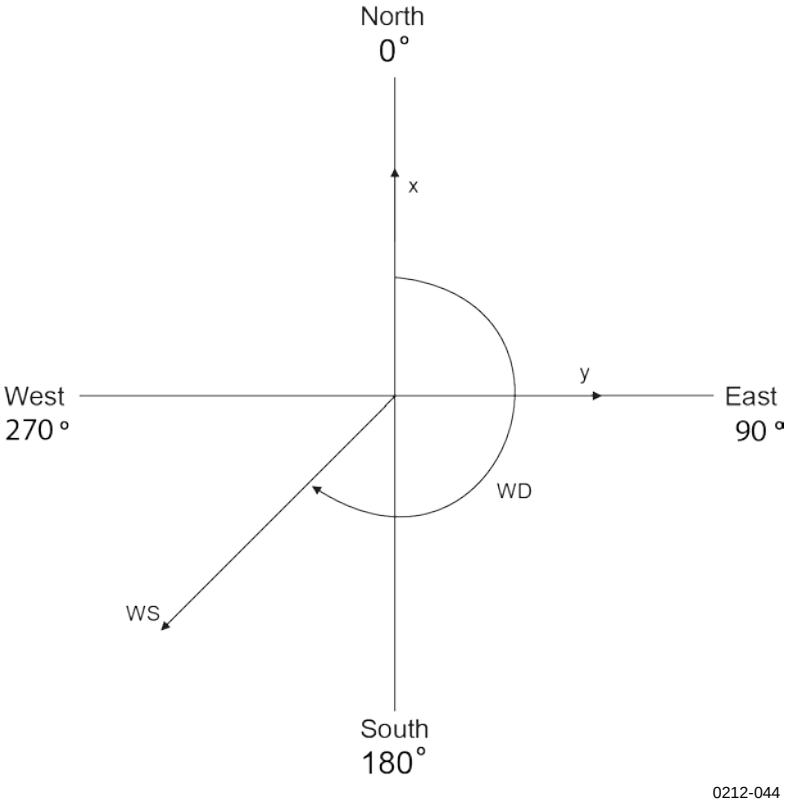


Figure 13 Different Wind Speed and Direction Presentations (Direction Offset Is 0)

Wind Speed and Direction Averaging

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 World Meteorological Organization (WMO).

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

Scalar Averaging

When scalar averaging is selected, WMT700 calculates wind speed and direction averages by adding up each wind measurement from the averaging time and 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 example:

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 14 below shows an example of averaging wind direction when the measured wind values are 355° and 10°. The resulting average is 2.5°.

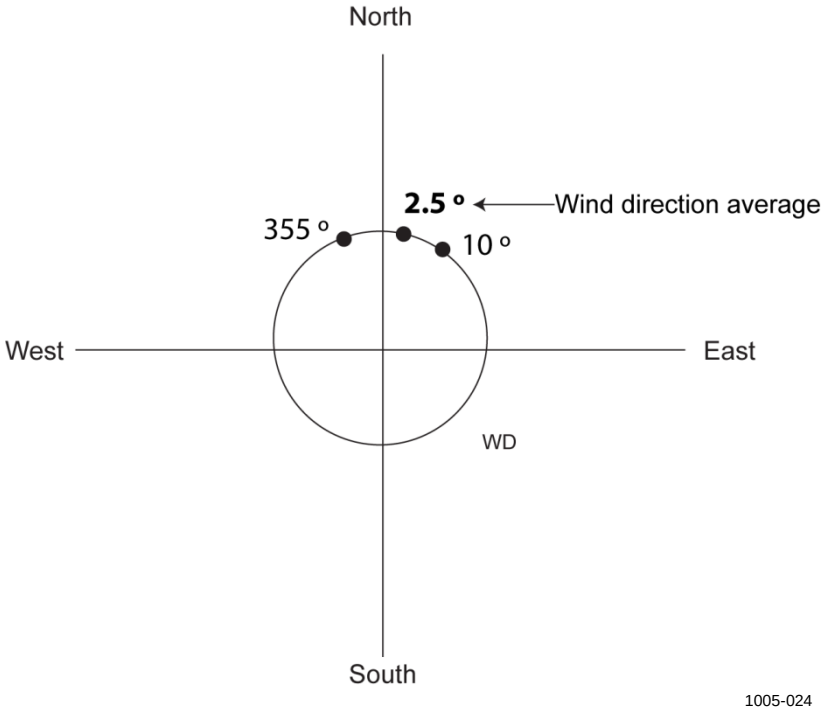


Figure 14 Example of Wind Direction Averaging

Wind Direction Coasting

Accurate wind direction measurement requires that the wind speed is sufficient. 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 is 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 **POLL** command. You must specify the data message identification number in the command.
- Automatic Messaging Mode: If the automatic message interval is 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 49.

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 49.

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 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.

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

Operation and heating power is usually provided from one power supply. You can also use separate power supplies for the heating and operation to prevent the heating function from consuming the operation power. In a split-supply system there can be a separate backup power supply for the operating power supply.

Figure 15 on page 44 shows the main software components and external interfaces of WMT700.

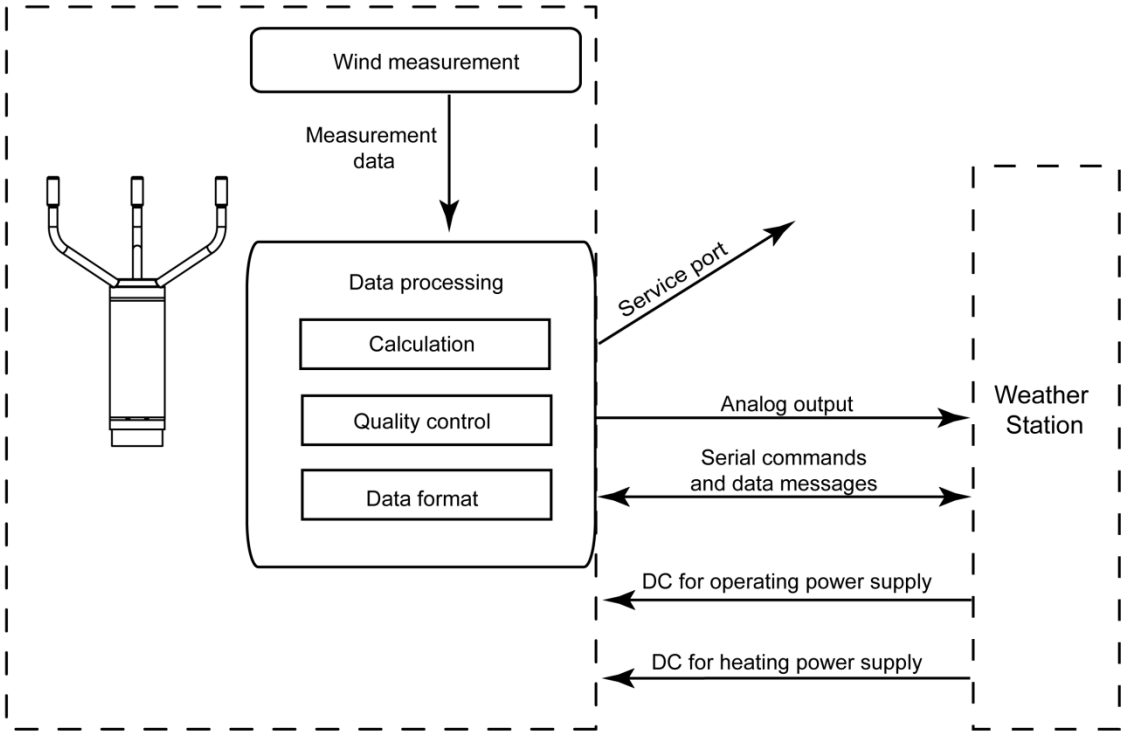


Figure 15 External Interfaces of WMT700

NOTE	For examples of typical system environments for WMT700, see Appendix B, Typical System Environments, on page 197.

Serial Communication and Analog Output

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 section Operation on page 107.

Serial Communication

In WMT700, there are two serial communication ports:

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

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 to receive measurement data.

Digital Communication Interface

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

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

- RS-232 (recommended up to 15 meter distance)
- RS-485 (recommended up to 1200 meter distance when used in point-to-point connection)
- RS-422 (recommended up to 1200 meter distance)
- SDI-12 (recommended up to 60 meter)

Note that the recommendations depend on communication speed and cable type. In optimized environments even longer distances can be considered.

Regardless of the factory configuration, COM2 interface type can be changed by using terminal software. For more information, see section com2_interf in Appendix D, Configuration Parameters, on page 205.

For information on wiring, see section Wiring on page 77.

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, Default Settings for Different Communication Profiles, on page 201 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 Parameter Handling Commands on page 111. For information on predefined data messages, see section Data Messages on page 127.

The ROSA - MES12 profile is intended for connecting WMT700 to the 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 195.

Protocols

In addition to the protocols preconfigured under standard profiles, there are additional protocols available in WMT700. The protocol used is defined by related parameters. For more information, see Parameter Handling Commands on page 111. The full list of supported protocols is:

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

Measurement and Configuration Modes

The serial ports have the following operation modes:

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

For a list of all serial commands supported by WMT700 in the configuration and measurement modes, see Appendix A, Complete Command Set for WMT700, on page 195.

Figure 16 below shows the configuration and measurement modes of both serial ports provided by WMT700.

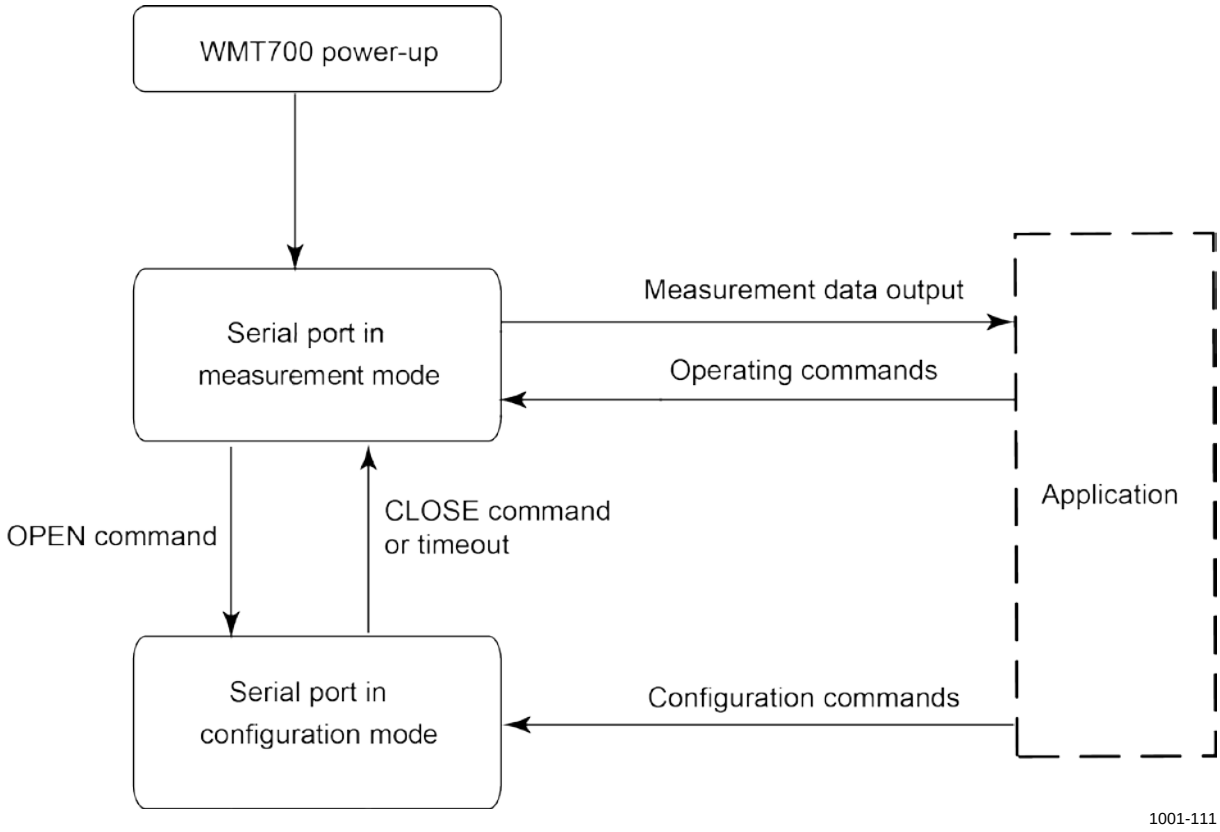


Figure 16 Configuration and Measurement Modes

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

For information on the **OPEN** and **CLOSE** commands, see section Entering and Exiting Configuration Mode on page 109.

Serial Interface Timing

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

- Interfaces RS-232, RS-485, RS-422: Figure 17 below shows timing when WMT700 is polled in the measurement mode.

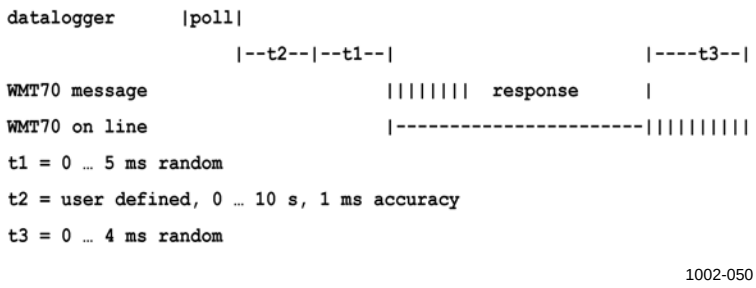


Figure 17 Timing for RS-232, RS-485, and RS-422 Interfaces

The response delay t2 is user-configurable. In the 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 at www.sdi-12.org.

Analog Output

Analog outputs are either enabled or disabled, and the output settings are preconfigured at the factory according to your 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 118.

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 section Operating WMT700 in WS425 Analog Output Mode on page 139.

For information on wiring, see section Wiring on page 77.

Analog Output Types

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

- Voltage output
- Current output
- Frequency output
    - Push-pull output
    - Pull-down output
    - Pull-up output

For an illustration on frequency output, refer to Figure 18 on page 51.

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

- Voltage output
- Current output
- Potentiometer output

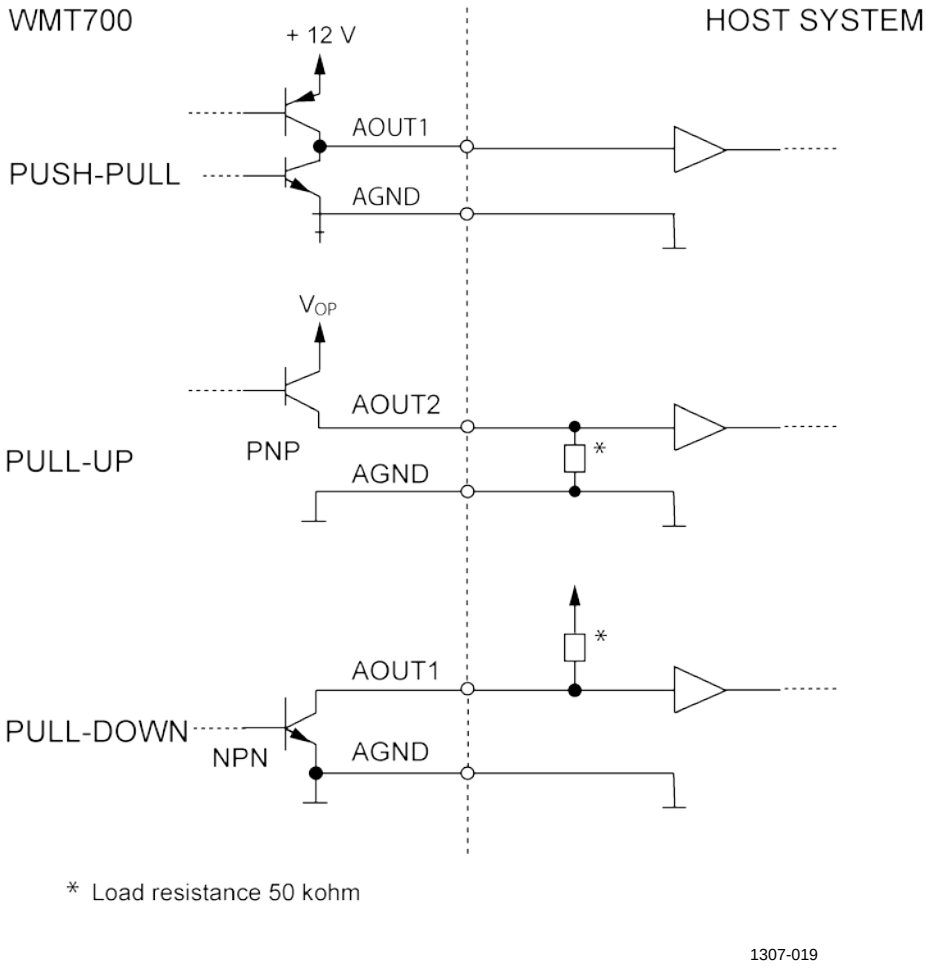


Figure 18 Frequency Output

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 Appendix D, Configuration Parameters, on page 205.

Table 19 below shows the factory default settings for the different analog output modes.

Table 18 Factory Settings for Analog Wind Speed Output

AOUT1 Selected Option		Scaling/Gain	Offset	Error Indication	Example
Voltage		0.1 V / m/s	0 V	10 V	0 V = 0 m/s 7.5 V = 75 m/s
Current 0 ... 20 mA		0.0002 A / m/s	0 A	0.022 A	0 mA = 0 m/s 15 mA = 75 m/s
Current 4 ... 20 mA	WMT701	0.00040000 A / m/s	0.004 A	0.002 A	4 mA = 0 m/s 20 mA = 40 m/s
	WMT702	0.00024615 A / m/s	0.004 A	0.002 A	4 mA = 0 m/s 20 mA = 65 m/s
	WMT703	0.00021333 A / m/s	0.004 A	0.002 A	4 mA = 0 m/s 20 mA = 75 m/s
Frequency Push-Pull		10 Hz / m/s	0 Hz	1000 Hz	0 Hz = 0 m/s 750 Hz = 75 m/s
WS425 - voltage		8 mV / mph (0.017895 V / m/s)	0 mph	2 V	0 mV = 0 mph 1.344 V=168 mph
WS425 - frequency		5 Hz / mph (11.185 Hz / m/s)	0 mph	1000 Hz	0 Hz = 0 mph 840 Hz =168 mph
Frequency Push (PNP)		10 Hz / m/s	0 Hz	1000 Hz	0 Hz = 0 m/s 750 Hz = 75 m/s
Frequency Pull (NPN)		10 Hz / m/s	0 Hz	1000 Hz	0 Hz = 0 m/s 750 Hz = 75 m/s

Table 19 Factory Default Settings for Analog Wind Direction Output

AOUT2 Selected Option	Scaling/Gain	Offset	Error Indication	Example
Voltage	0.02 V / °	0 V	10 V	0 V = 0° 7.2 V = 360°
Current 0 … 20 mA	0.00005 A / °	0 A	0.022 A	0 mA = 0° 18 mA = 360°
Current 4 … 20 mA	000044444 A / °	0.004 A	0.002 A	4 mA = 0° 20 mA = 360°
Potentiometer (WS425)	$1/359*V_{ref}$ / ° (0.0027855)	0	Vref (1)	0 V = 0° Vref = 359°

For a different scaling, change the gain and offset settings, see Configuration Parameters on page 118.

NOTE The scaling of the current output 4…20 mA depends on the sensor measurement range (WMT701, WMT702, or WMT703), while the 0…20 mA output has 0.2 mA / m/s scaling for all the measurement ranges.

Table 20 and Table 21 below list the most common settings for different units.

Table 20 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	0.017895 0.1	0 0
Current	0.2 mA / m/s	0.0002	0
Frequency	5 Hz / mph 10 Hz / m/s	11.185 10	0
WS425 - voltage	8 mV / mph	0.017895	0
WS425 - frequency	5 Hz / mph	11.185	0

Table 21 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	0.0027855	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 speed or direction (in m/s or °)
k = Selected gain value
y0 = Selected offset value

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 Appendix D, Configuration Parameters, on page 205.

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 objects) 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.

Example

To set analog output 1 error indication in current mode to 2 mA, set the analog output error value to 0.002. Enter the following command:

```
S aout1err,0.002
```

For more information, see section Appendix D, Configuration Parameters, on page 205.

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CHAPTER 4

INSTALLATION

This chapter contains information that is needed to install WMT700.

NOTE	If you are upgrading from WS425 to WMT700 and using a WS425 mounting kit, see section Mounting with WS425 Mounting Kit on page 90.

Maritime Installations

In maritime installations according to IEC 60945, WMT700 belongs to the installation category C, which means that it is exposed to weather.

When making maritime installations, pay attention to the following:

- Do not install WMT700 in the vicinity of a magnetic compass. The product is magnetically inert, but the compass-safe distance is not measured.
- Do not place WMT700 directly in front of a radar.
- Do not install WMT700 next to a powerful RF-transmitter antenna.

Selecting Installation Location

Finding a suitable site for WMT700 is important for getting representative ambient measurements. Select a site that represents the general area of interest. Follow the WMO Guide to Meteorological Instruments and Methods of Observation WMO-No. 8, or other application-specific requirements set by various organizations, like the International Civil Aviation Organization (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 a 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 19 on page 59 and follow application-specific installation guidelines.

When mounting two WMT700 wind sensors at the same height, make sure that there is a minimum of 10 meters of distance between the two devices, as shown in Figure 21 on page 61. 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.

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

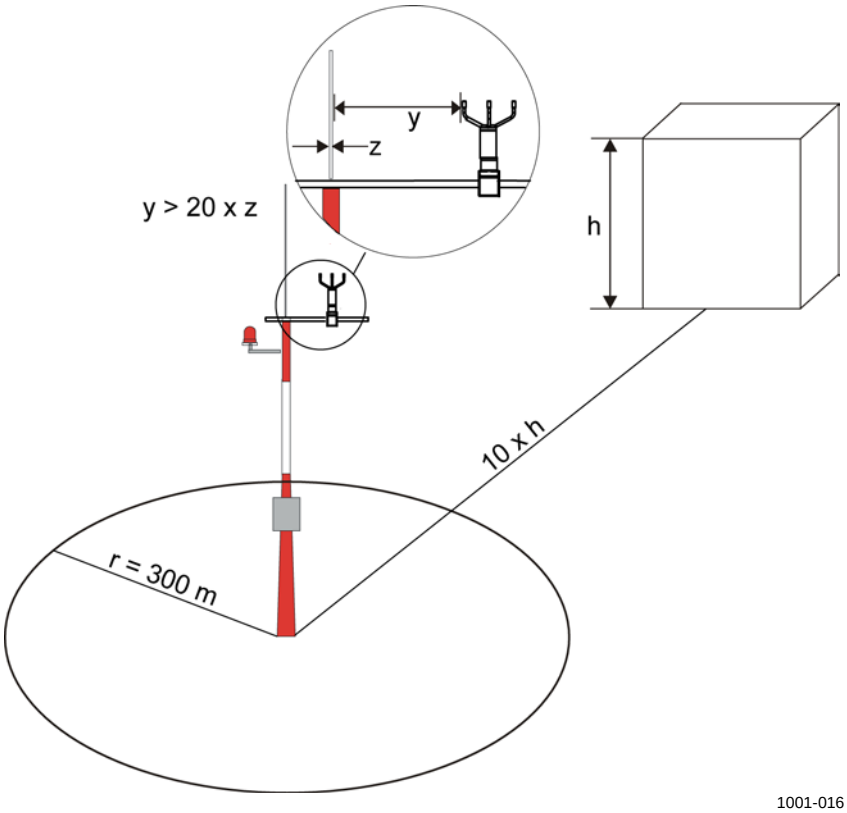

Figure 19 Recommended Location in Open Area

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

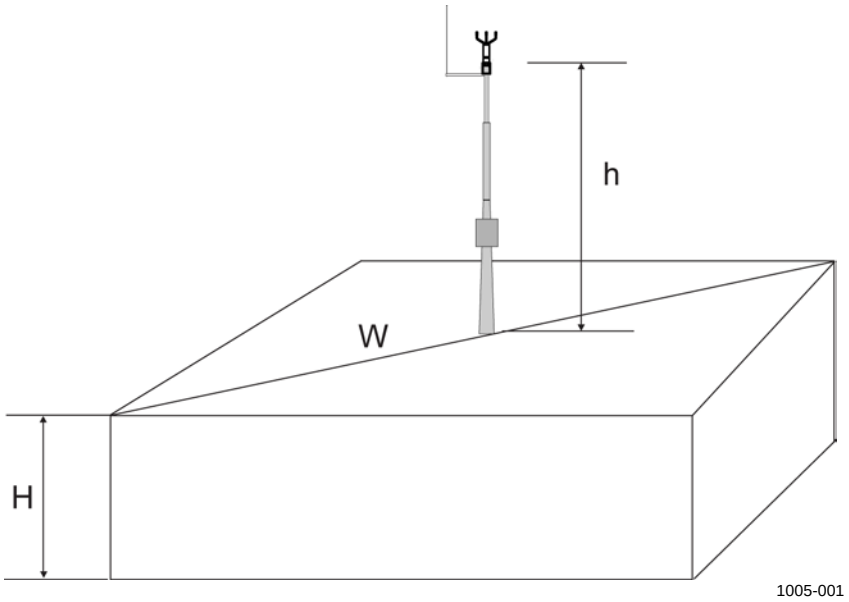

Figure 20 Recommended Mast Length on Top of Building

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), install a lightning rod 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.

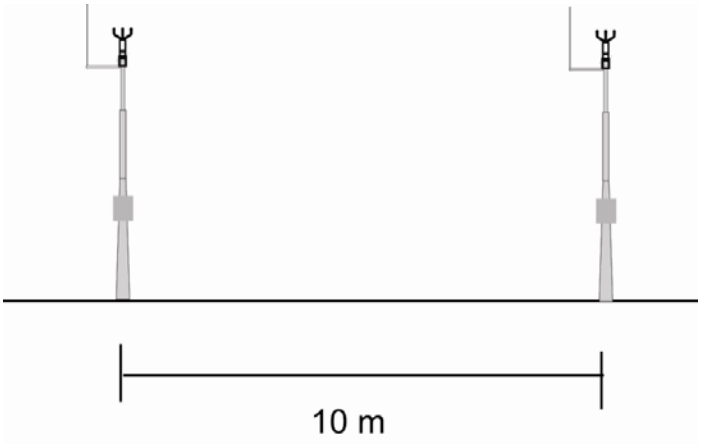

Figure 21 Minimum Distance between Two WMT700 Devices Installed at Same Height

Installation Procedure

At the measurement site, you need to mount, align, and connect WMT700 to the power source and data acquisition system.

You can install the optional bird cage after the wind sensor is mounted and the transportation damper is removed from the sensor. For instructions, see section Installing Bird Cage on page 75.

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 may damage the device.

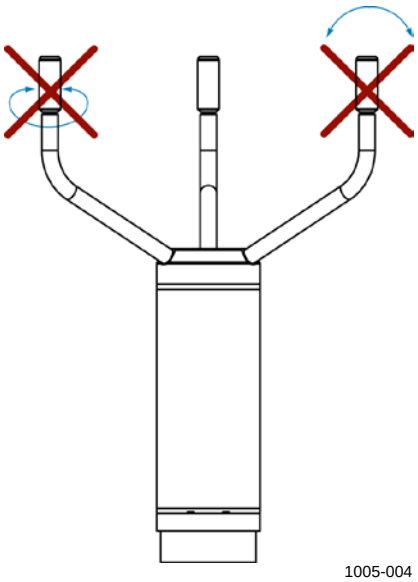

Figure 22 Sensor Handling

Unpacking

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

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, as shown in Figure 23 on page 63.

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 23 below shows the damper protecting the array.

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

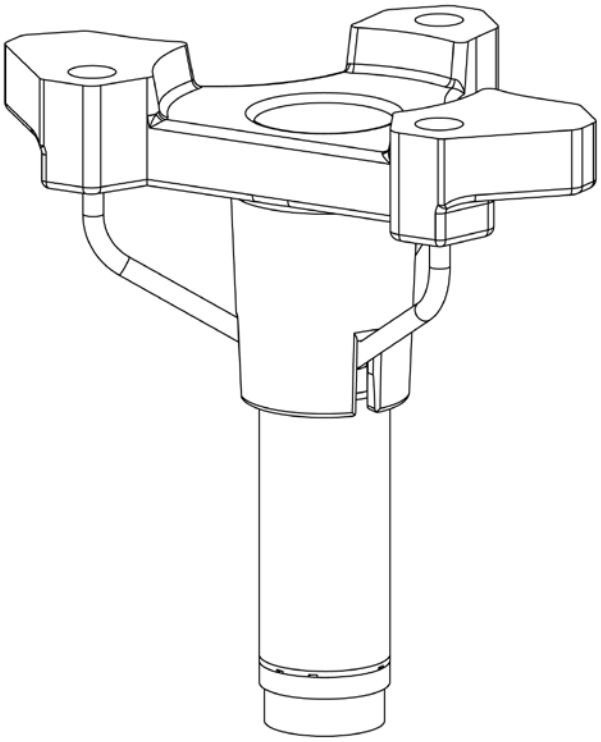

Figure 23 WMT700 and Transportation Damper

Mounting

You can mount WMT700 either on 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 193.

Mounting on Vertical Pole Mast

When mounting WMT700 on a vertical pole mast, you can place it 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 26 on page 66 and Figure 27 on page 67 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 26 on page 66 and Figure 27 on page 67.
2. Check that the mounting kit is not tilted to either side. Tighten the U bolts only slightly.

NOTE	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.
4. Connect the cable to the wind sensor as follows. First, insert the cable in the cable tightening tool as shown in Figure 24 below. When you hear a click, the cable is properly inserted.

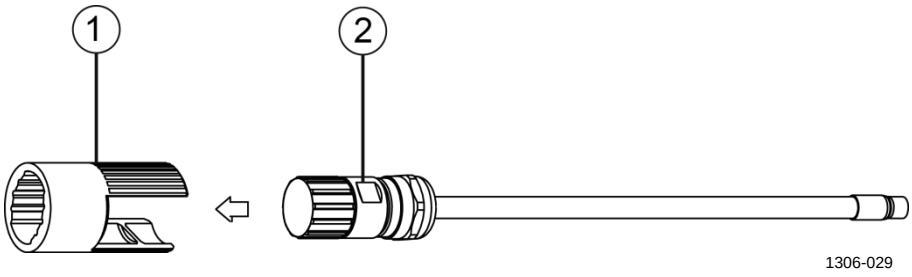

Figure 24 Inserting Cable in Cable Tightening Tool

The following numbers refer to Figure 24 above:

1 = Cable tightening tool
2 = Cable

5. Press the ribbed part of the cable tightening tool lightly and attach the connector to WMT700. Direct the nib of the connector towards the slot in the WMT700 connector. Ensure that the connector is properly tightened before proceeding to the next step.

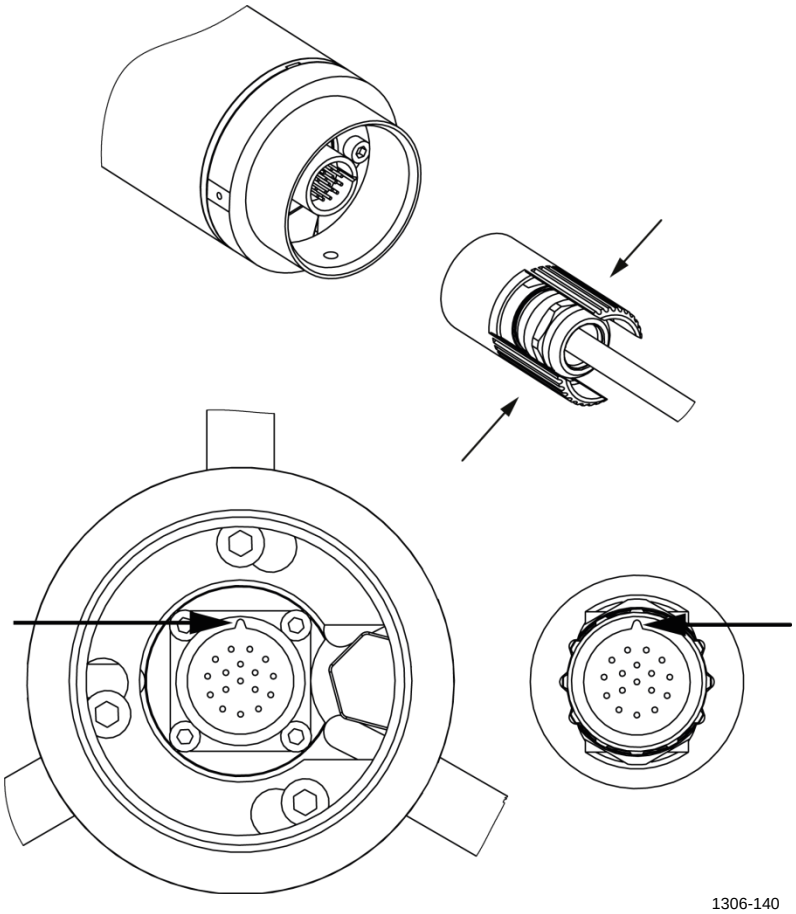

Figure 25 Attaching Connector to WMT700

NOTE	You do not need to remove the cable tightening tool after tightening the connector; you can leave it in place.

6. 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 26 on page 66 or number 2 in Figure 27 on page 67, tighten the screw.
7. Remove the transportation damper protecting the array and store it for future use.
8. Align WMT700. For instructions, see section Alignment on page 74.
9. Connect the cable to the data acquisition system and power supply. For instructions, see section Wiring on page 77.

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 26 below.

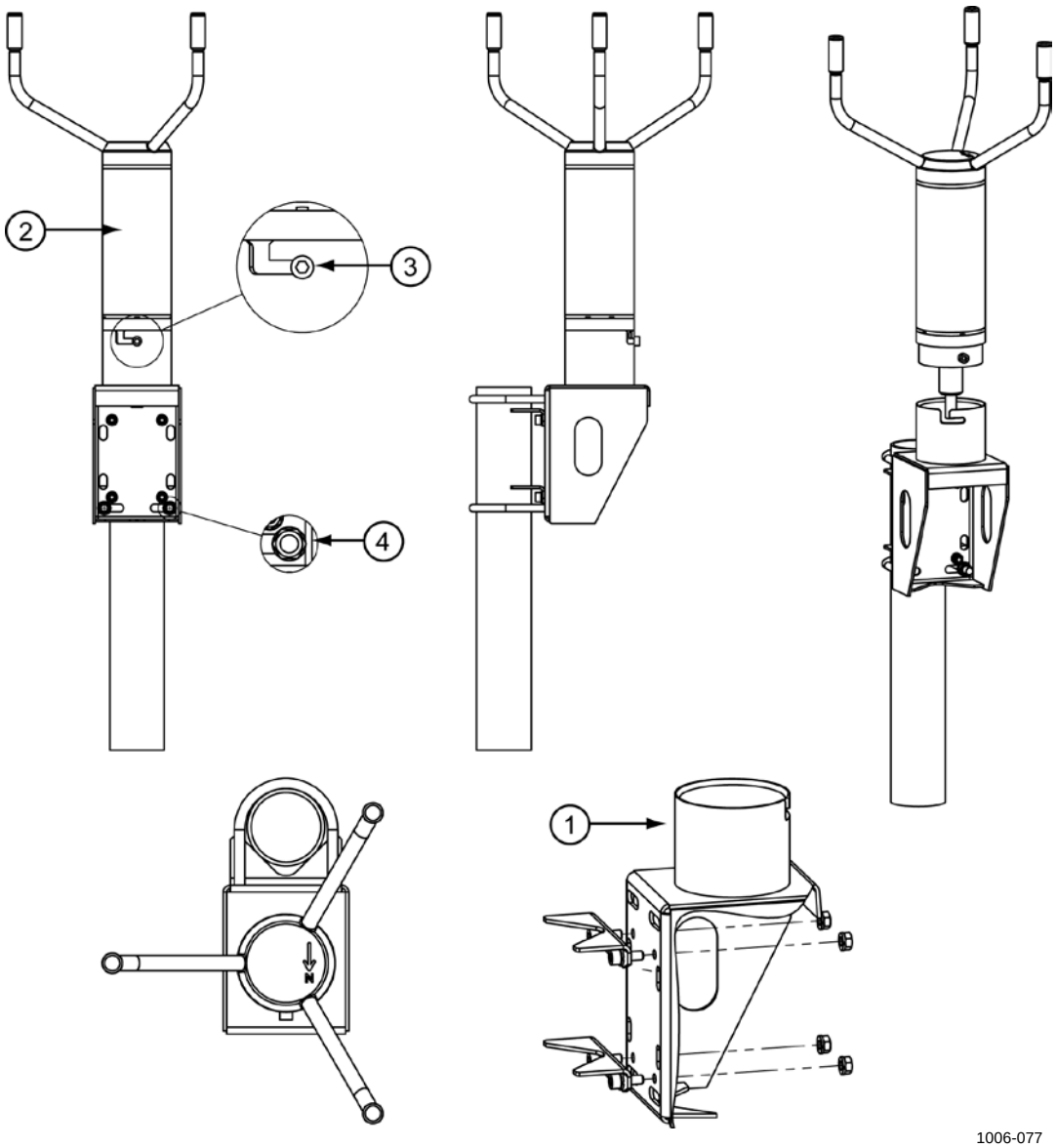

Figure 26 WMT700 on Side of Pole Mast

The following numbers refer to Figure 26 above:

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

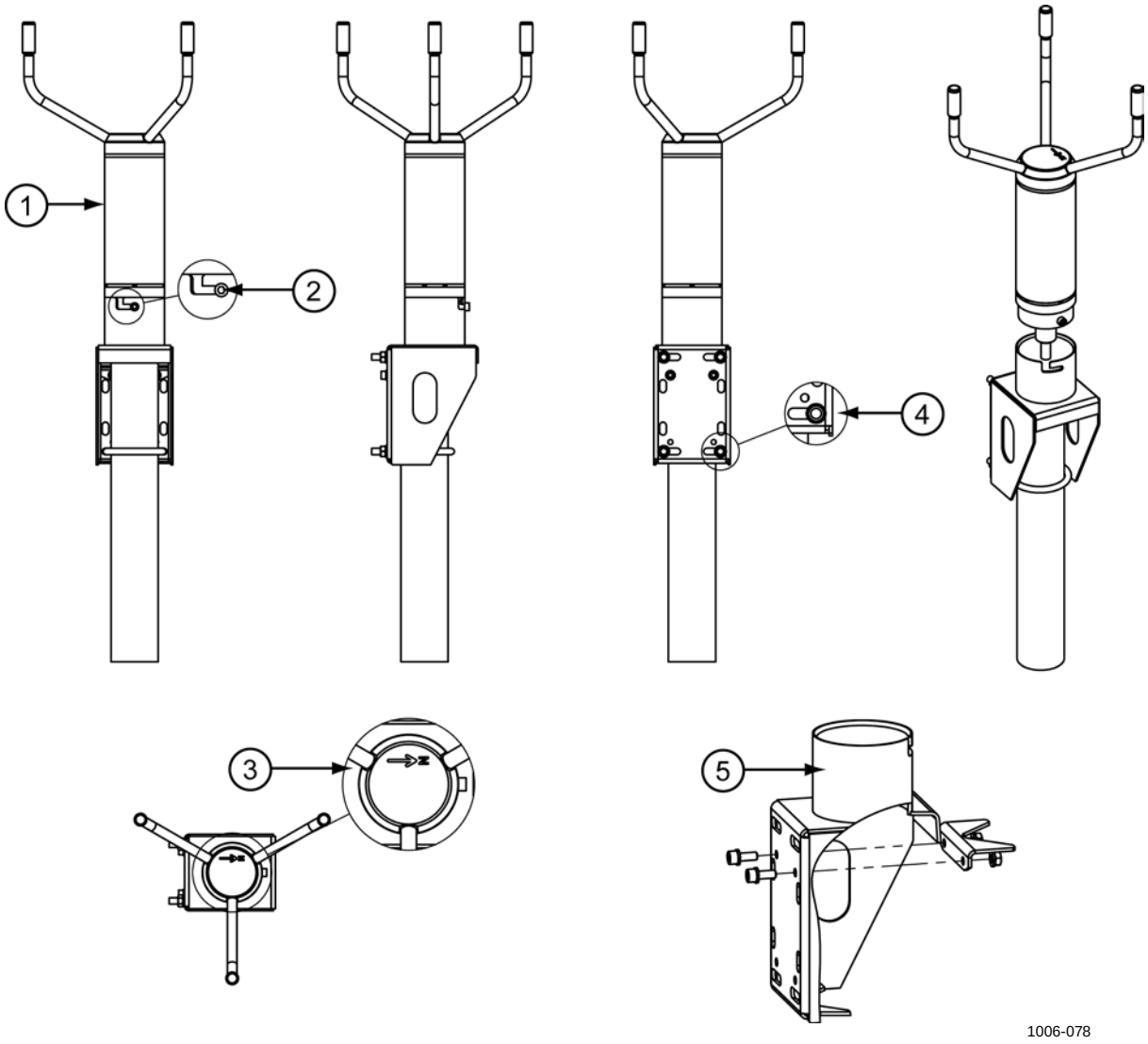

Figure 27 WMT700 on Top of Pole Mast

The following numbers refer to Figure 27 above:

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

Mounting on Horizontal Cross Arm

When mounting WMT700 on 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 118.

Figure 28 on page 69 and Figure 29 on page 70 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 28 on page 69.
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.
4. Insert the cable in the cable tightening tool as shown in Figure 24 on page 64 to connect the cable to the wind sensor. Connect the cable to WMT700 and tighten by rotating the tightening tool clockwise by hand as shown in Figure 31 on page 72. Ensure that the connector is properly tightened before proceeding to the next step.
5. 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 28 on page 69, tighten the screw.

6. Remove the transportation damper protecting the array and store it for future use.
7. Align the horizontal cross arm. For instructions, see section Alignment on page 74.
8. Connect the cable to the data acquisition system and power supply. Connect the wires according to section Wiring on page 77.

WMT700 is now ready for operation.

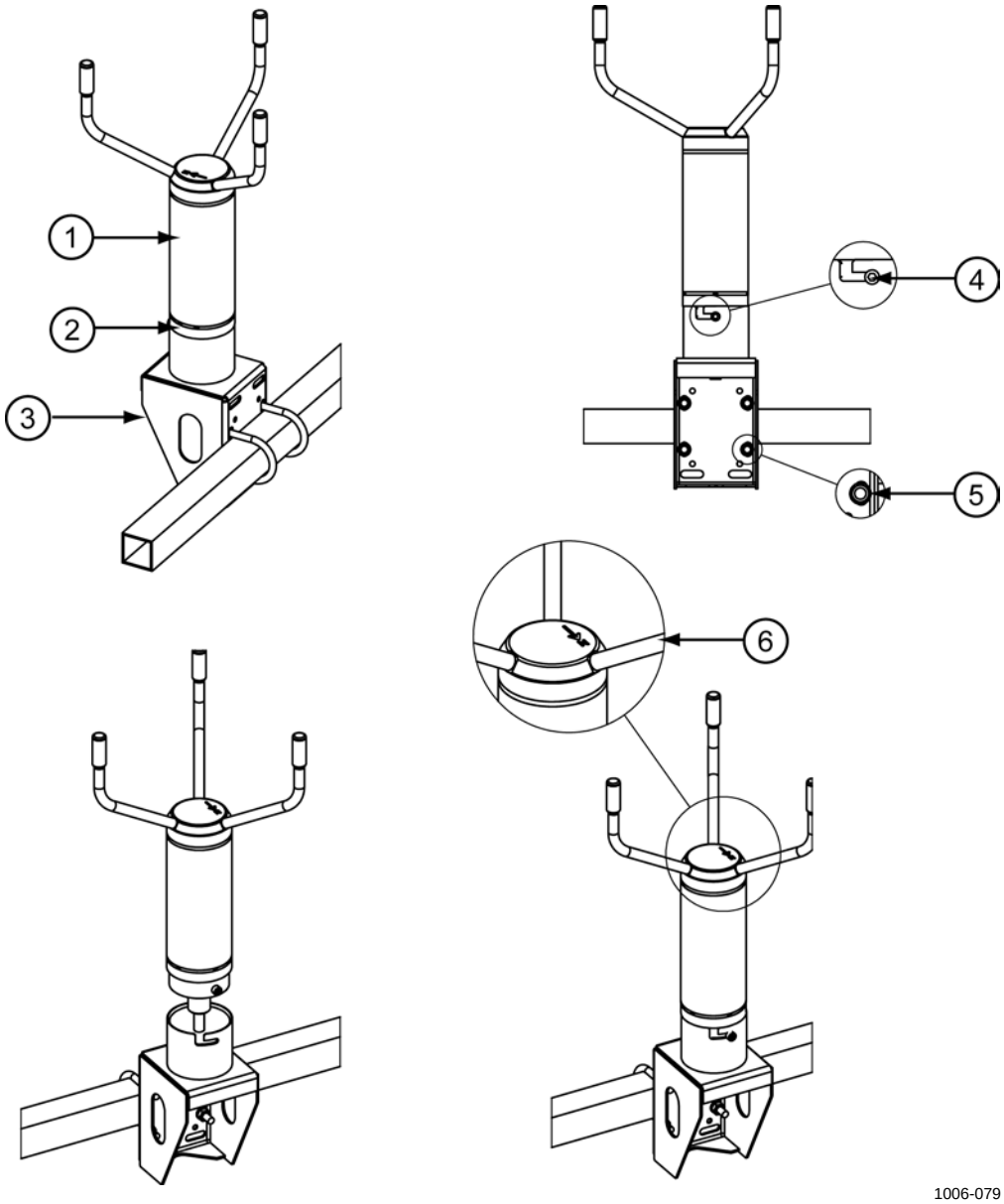

Figure 28 WMT700 on Cross Arm with Array Facing Up

The following numbers refer to Figure 28 above:

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

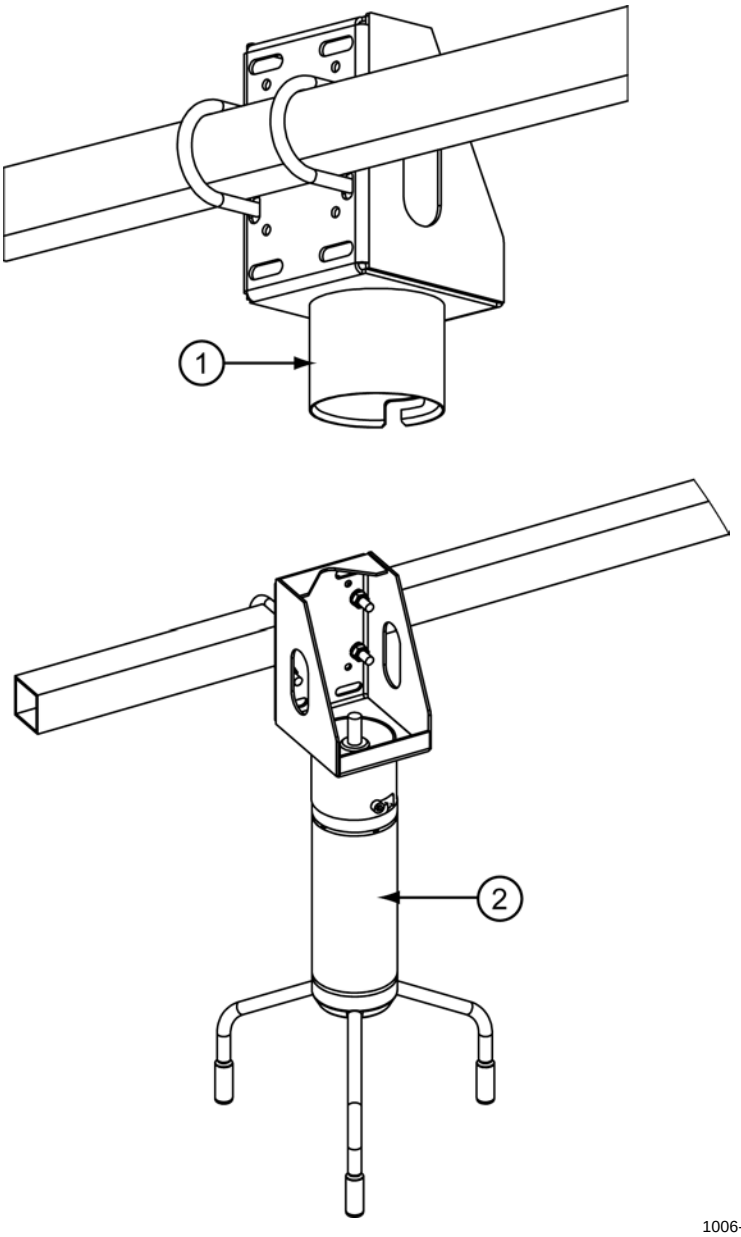

Figure 29 WMT700 on Cross Arm with Array Facing Down

The following numbers refer to Figure 29 above:

1 = FIX70 mounting kit
2 = WMT700 wind sensor

The recommended way to tighten the connector is to use the cable tightening tool shipped with your WMT700. The ribbed part of the tool offers a better grip of the cable when tightening the connector. Insert the cable in the cable tightening tool as shown in Figure 30 below. You do not need to remove the cable tightening tool when the connector is tightened. For detailed instructions, see Figure 25 on page 65.

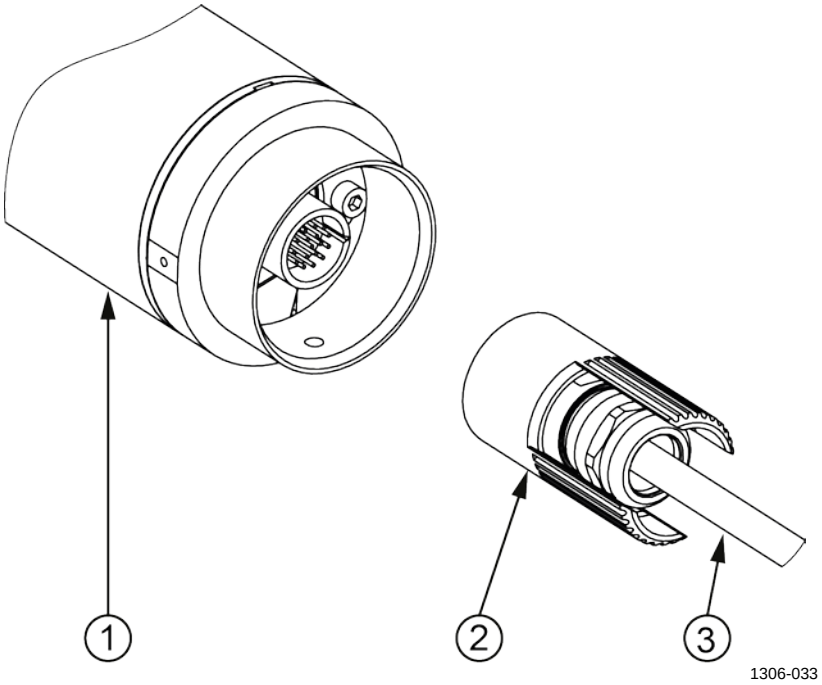

Figure 30 Tightening Connector with Cable Tightening Tool

The following numbers refer to Figure 30 above:

1 = WMT700
2 = Cable tightening tool
3 = Cable

You can tighten the connector without the cable tightening tool by rotating the ribbed part of the connector by hand. However, do not use tools when tightening the connector.

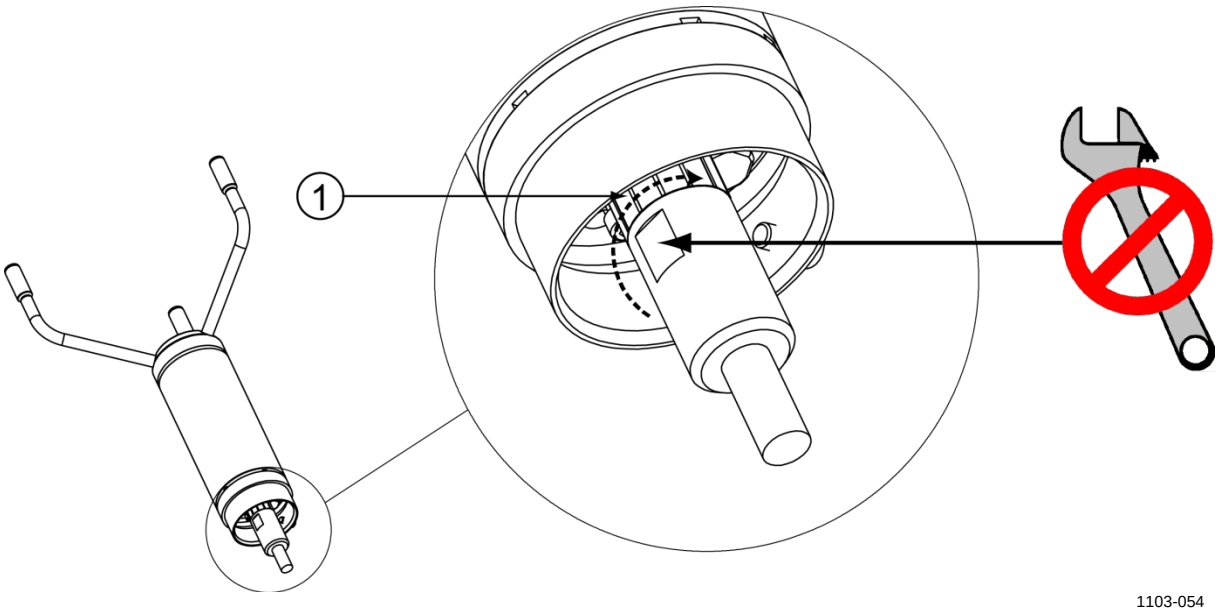

Figure 31 Tightening Connector without Cable Tightening Tool

The following number refers to Figure 31 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:

- How you route the cables depends on the mounting option selected for WMT700. When mounting to a mast, you can route the cable 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.
- Make sure 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. You must align WMT700 in such a way that the arrow points to the north. Misaligning WMT700 causes a wind direction offset error in the measurement results, as shown in Figure 33 on page 75.

To align WMT700:

1. Determine if 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 32 below and Figure 33 on page 75 show the correct alignment and the measurement error caused by the misalignment of WMT700.

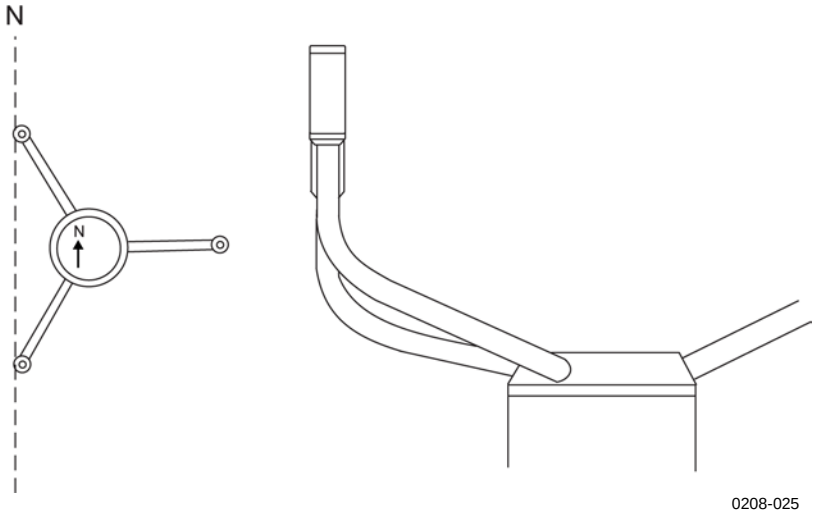

Figure 32 Correctly Aligned WMT700

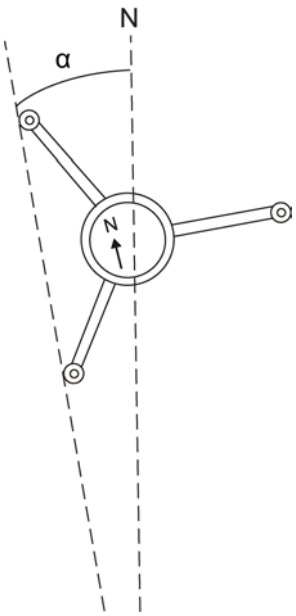

Figure 33 Incorrectly Aligned WMT700 and Resulting Offset Error

where

N = Correct direction for true north
α = 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 by using an offset adjustment command. For instructions, see Appendix D, Configuration Parameters, on page 205.

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 62 on page 192. 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 34 below 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.

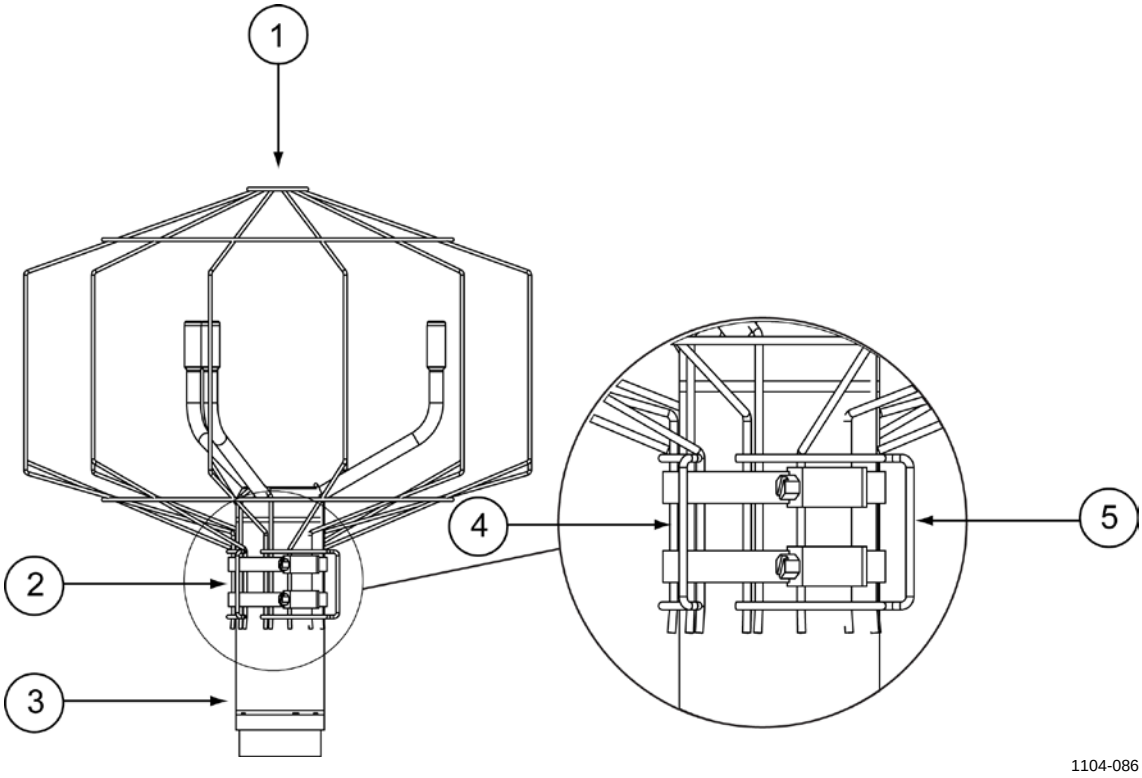

Figure 34 Bird Cage and Bird Cage Straps

The following numbers refer to Figure 34 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 WMT700. 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 retrofit 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 2 m (227567SP)
- Cable 10 m (227568SP)
- RS485 Cable 2 m (228259SP)
- RS485 Cable 10 m (228260SP)
- ROSA Cable 10 m for Analog Outputs (231425SP)
- Junction Box with Cable 2 m (ASM210719SP)

Cable 2 m and Cable 10 m carry through all signals from WMT700 while the RS485 cables are designed for RS485 operation with a limited number of wires. The ROSA Cable is intended for replacing WS425 with WMT700 in the Vaisala ROSA system if WS425 is connected using analog outputs. The Junction Box is designed mainly for maritime RS422 operation but it can be used whenever a connection longer than 10 meters is needed as an entry point for an extension cable.

Table 22 on page 78 shows how to connect Cable 2 m (227567SP) and Cable 10 m (227568SP). Same color coding is also used in Junction Box wiring.

Table 24 on page 80 shows how to connect RS485 Cable 2 m (228259SP) and RS485 Cable 10 m (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 2 m, Cable 10 m, Cable 15 m, and Cable 26 m

Table 22 below shows how to connect Cable 2 m (227567SP), Cable 10 m (227568SP), Cable 15 m (237890SP), and Cable 26 m (237889SP).

Table 22 Connecting Cable 2 m (227567SP), Cable 10 m (227568SP), Cable 15 m (237890SP), and Cable 26 m (237889SP)

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	Rx–	Rx–	-	Green	3
	RS232Tx	Tx–	Tx–	Data	Yellow	4
	-	Tx+	Tx+	-	Brown-Green	14
	-	Rx+	Rx+	-	White-Yellow	15
COM1 and COM2 Communication Ports Ground					Violet	10
COM1 (Service Port)	RS-485 –				Black	9
	RS-485 +				Brown-Yellow	16

RS485 for COM2 with Cable 2 m and 10 m

In RS485 mode, the same signals as in RS422 mode are available at the end of Cable 2 m and Cable 10 m. Make two-wire loop-backs at the end of the cable, as shown in Table 23 and Figure 35 below.

Table 23 COM2 RS485 Wiring

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

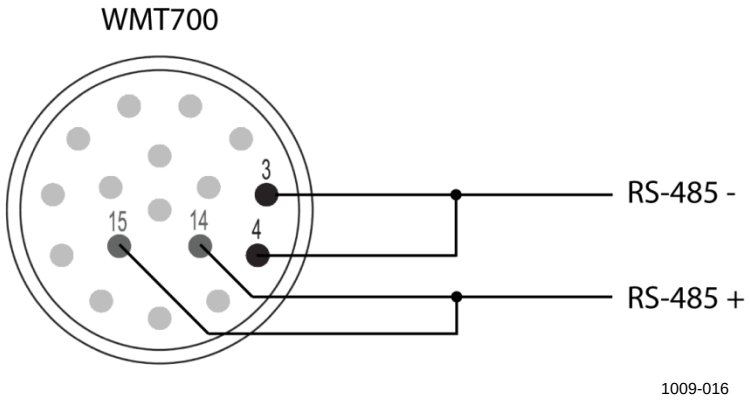

Figure 35 COM2 RS485 Wiring

NOTE

To avoid confusion, the RS485 and RS422 signals of WMT700 are named as follows:
- Inverting: –
- Non-inverting: +

According to the EIA-485 standard, the lines are named as follows:
- Inverting: – <=> A
- Non-inverting: + <=> B

The A/B naming used by some manufacturers is in conflict with the standard. To ensure proper operation, verify the polarity of the signals when using the device on the bus with signals named as A/B. Opposite polarity causes data inversion on the bus, but it does not damage the device.

RS485 Cable 2 m and RS485 Cable 10 m

RS485 Cable 2 m and RS485 Cable 10 m are designed for the standard connection: operating power, heater power, and RS485. The two-wire RS485 loopback connections, as shown in Table 24 below, are preconnected inside the cable.

Table 24 Connecting RS485 Cable 2 m (228259SP) and RS485 Cable 10 m (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 -	Brown	3,4
RS485 +	Red-Blue	14, 15
Communications Ground	Violet	10

Connector Signals

Figure 36 and Table 25 below 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.

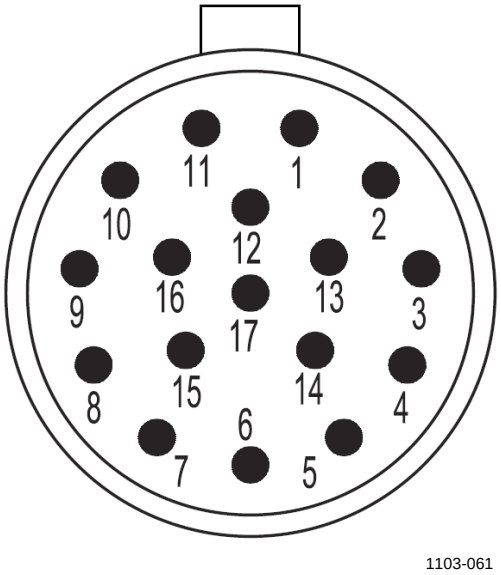

Figure 36 Pins for 17-Pin M23 Connector

Table 25 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	Rx–	Rx–	-
4		RS232Tx	Tx–	Tx–	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	-	Tx+	Tx+	-
15		-	Rx+	Rx+	-
16	COM1 (Service port)	RS-485+			
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
- Heating for body, transducers, and array arms

NOTE	Ensure that the supply output power capacity is high enough especially when transducers, array arms, and sensor body 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. When heating voltage falls below 18 VDC, an alarm is raised. Heating is automatically disabled if heating voltage falls below 15 VDC.

Regardless of heating voltage, the maximum heating power is limited to 40 W and the average heating power is limited to 30 W. 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) scheme 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 200 W and the average heating power is limited to 150 W.

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.

Heated Body, Transducers, and Arms

The fully heated version of WMT700 is suitable for harsh weather conditions. It provides heating for the sensor body, transducers, and arms.

The functional principle is the same with the heated transducers and arms. Body heating is controlled independently of transducer and arm heating. The maximum heating power for the fully heated WMT700 is 350 W and the average heating power is 250 W in harsh weather conditions. The inner temperature of the unit is measured continuously. If the inner temperature starts rising, body heating power automatically reduces to retain the optimum inner temperature of WMT700.

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 a higher supply current. All supply ground terminals are internally connected to each other.

NOTE In a system setup with two separate power supplies, avoid ground potential differences between the supplies. Connect the negative terminals together if necessary.

Operating Power

WMT700 can use any 9 ... 36 V (nominal voltage 24 V) minimum 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 shown in Figure 38 and Figure 39 on page 86. Note that the selected heating option affects the needed operation voltage when separate powering for operation and heating is used.

Table 26 Operating Power Supply Voltage Requirements

Used Heating Option	Operating Power Supply
None	9 … 36 VDC 2 W
Transducers	12 … 36 VDC 2 W
Transducers and arms	14 … 36 VDC 2 W
Transducers, arms and body	16 … 36 VDC 2 W

Figure 37 below shows the wiring of non-heated WMT700 versions.

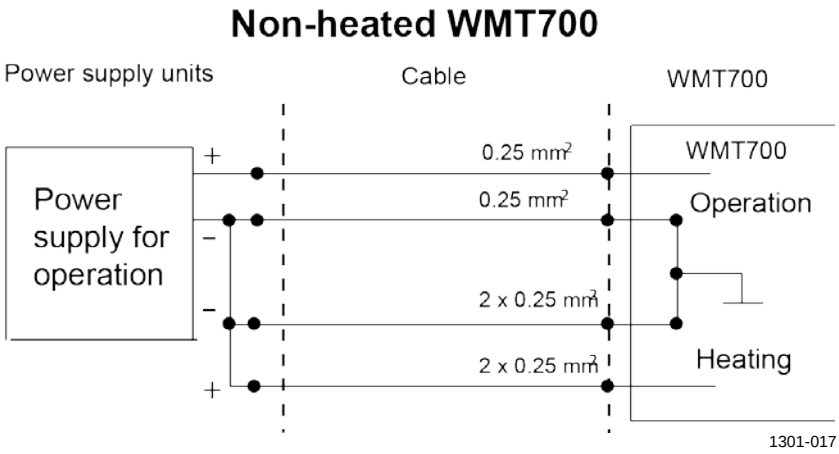

Figure 37 Wiring of Non-heated WMT700 Versions

NOTE	In maritime environments, the normal input voltage ranges are: operating voltage 10 … 30 VDC (-10% … +30%) and heating voltage 24 … 30 VDC (-10% … +30%), as defined in the maritime standard IEC 60945.

For low-power operation using the SLEEP feature, see section SLEEP — Enter Low-Power Mode on page 137.

Figure 38 and Figure 39 below illustrate WMT700 Operating Supply Current Consumption and Operating Supply Power Consumption.

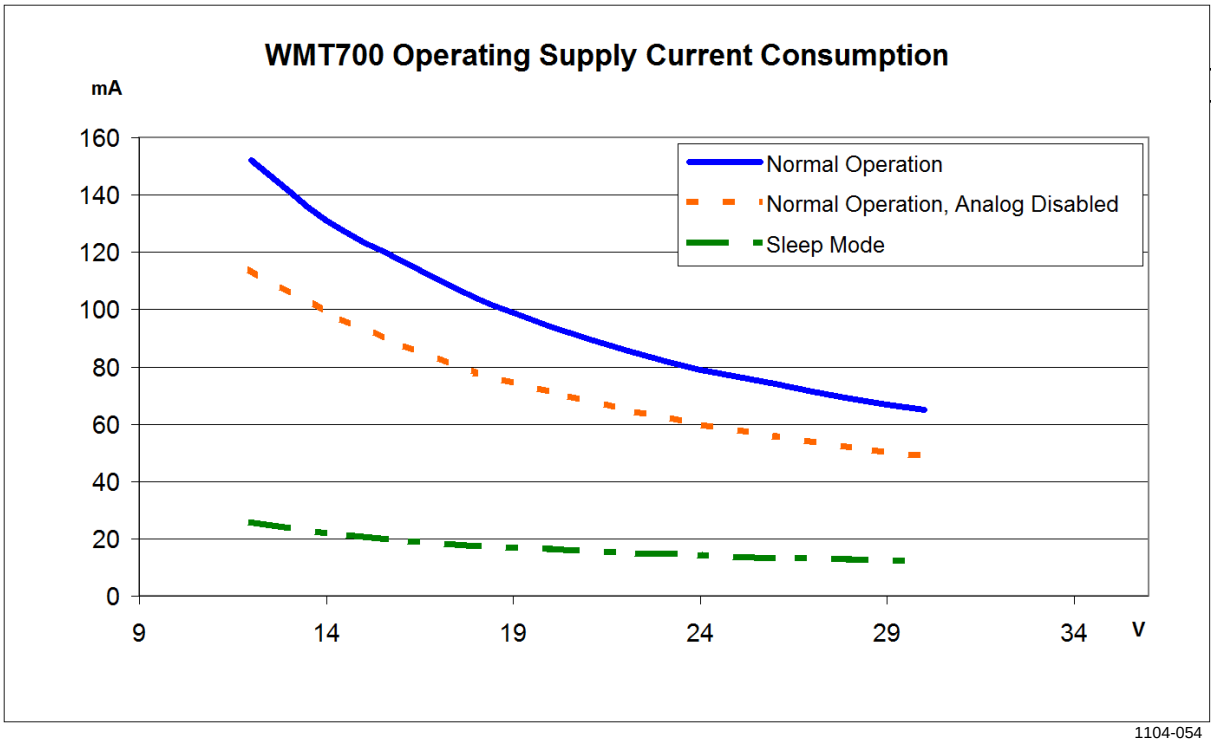

Figure 38 Operating Supply Current Consumption

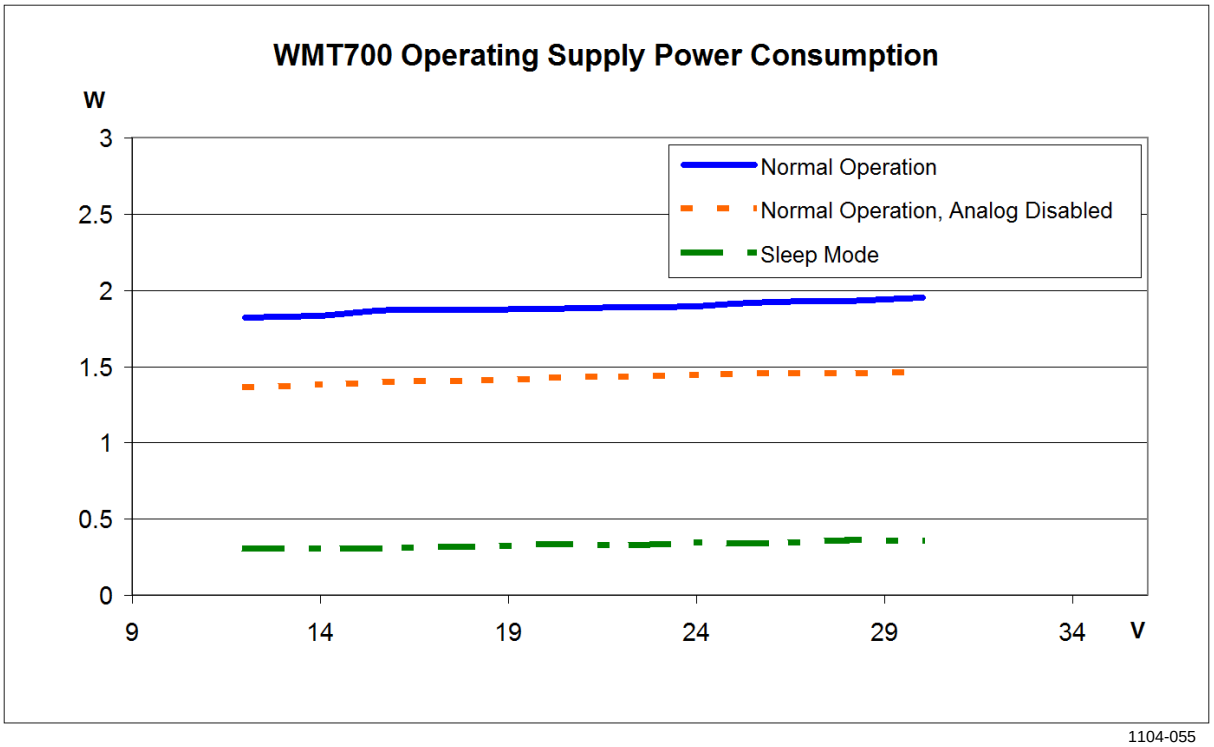

Figure 39 Operating Supply Power Consumption

Heating Power

Table 27 below lists the minimum power supply requirements of each WMT700 heating option.

NOTE In maritime environments, the normal input voltage ranges are: operating voltage 10 … 30 VDC (-10% … +30%) and heating voltage 24 … 30 VDC (-10% … +30%), as defined in the maritime standard IEC 60945.

Table 27 Heating Power Supply Requirements

Heating Option	Heating Voltage	Required Heating Power Supply
None	-	-
Transducers	24 … 36 VDC	40 W
Transducers and arms	24 … 36 VDC	200 W
Transducers, arms and body	24 VDC	350 W (2 m cable)

Power and Cable Recommendations for Fully Heated WMT700

Table 28 below shows cable and power recommendations. If a longer than a 10 meter cable is needed, it is recommended to use Junction Box with Cable (WMT70CABLE12) for extending the cable length.

NOTE The minimum operation voltage for a fully heated WMT700 (transducers, arms, and body heated) is 16 V, if a separate power supply unit is used for operation.

Table 28 Heating Power and Extension Cable

Wire Type/ Cable Length	2 m WMT70CABLE1*	10 m WMT70CABLE2*	20 m	30 m	40 m
0.5 mm2/AWG20	24V 400 W	28 V 400 W	-	-	-
1 mm2/AWG17	-	-	28V 400 W	30 V 400 W	32 V 400 W **
1.5 mm2/AWG15	-	-	-	-	30 V 400 W

* Vaisala standard connection cable.
** Not for maritime use.

Figure 40 and Figure 41 below illustrate the wiring of heated WMT700 instruments.

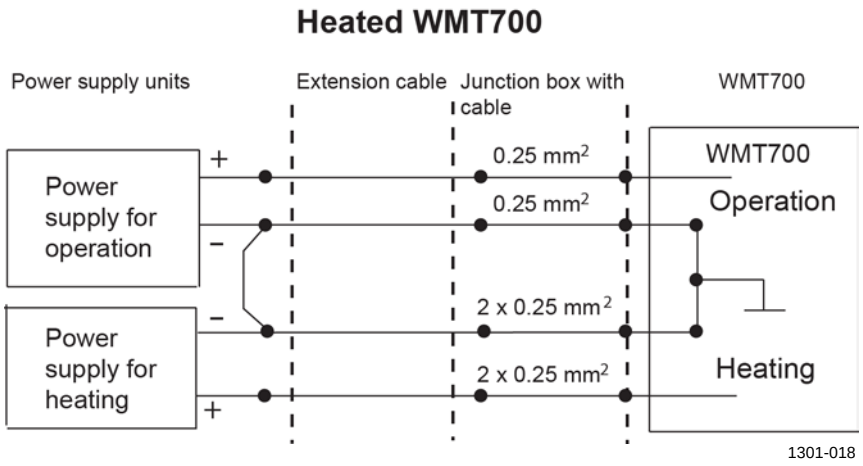

Figure 40 Wiring of Heated WMT700 Versions, Part 1

Note that when using separate power supplies for operating and heating, the minus (-) terminals of the power supplies are connected together by an additional wire. Use a minimum 0.75 mm^2 wire for connecting the (-) terminals together.

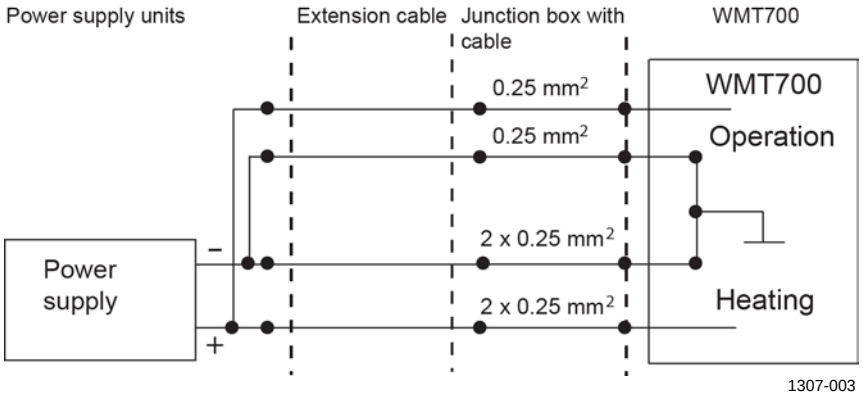

Figure 41 Wiring of Heated WMT700 Versions, Part 2

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.

Loop resistance of 0.15 Ω results in approximately 1 V drop in heating voltage with 200 W heating. You should note this to get proper heating capability. For example, the loop resistance of a 10 m cable (227568SP) is 0.7 Ω resulting in an approximately 4 V drop. It is recommended that you use at least a 28 V supply for the maximum heating capability.

Upgrading from WS425 to WMT700

When upgrading to WMT700, you have the following installation options:

- Basic installation procedure, which consists of mounting WMT700 with the FIX70 mounting kit and the WMT700 mounting adapter.

  To upgrade to WMT700 according to this procedure, uninstall the WS425 wind sensor and mounting kit and follow the installation instructions in section Installation on page 57.
- Retrofit installation procedure, which consists of mounting WMT700 with a WS425 mounting kit and the WMT700 mounting adapter for FIX30/60.

At the measurement site, you need to mount WMT700 and connect it to the power source and data acquisition system.

After upgrading to WMT700, it is possible to install the optional bird prevention kit available for the wind sensor. For more information, see section Bird Cage on page 31.

WARNING To protect personnel (and the wind sensor), install a lightning rod 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.

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.

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

For instructions on unpacking, see section Unpacking on page 62.

Mounting with WS425 Mounting Kit

You can mount WMT700 either on a vertical pole mast or a horizontal cross arm using the WS425 mounting kit. The procedure for both mounting options is identical. Typically you can upgrade from WS425 to WMT700 without removing the mounting kit.

NOTE If you remove the mounting kit, you need to align the wind sensor after the mounting procedure. To facilitate the aligning process, mark both the wind sensor and the mounting kit with a marker pen before removing the mounting kit.

You can use the mark as a rough reference when starting the aligning process described in section Alignment on page 74.

When mounting WMT700 to a cross arm, the wind sensor can be placed with the array facing up or down. If the wind sensor is installed with the array facing down, you must configure WMT700 accordingly. For configuration instructions, see Configuration on page 110.

Figure 42 on page 91 shows the mounting procedure to a vertical pole mast. Figure 43 on page 92 and Figure 44 on page 93 show the mounting procedure to a horizontal cross arm.

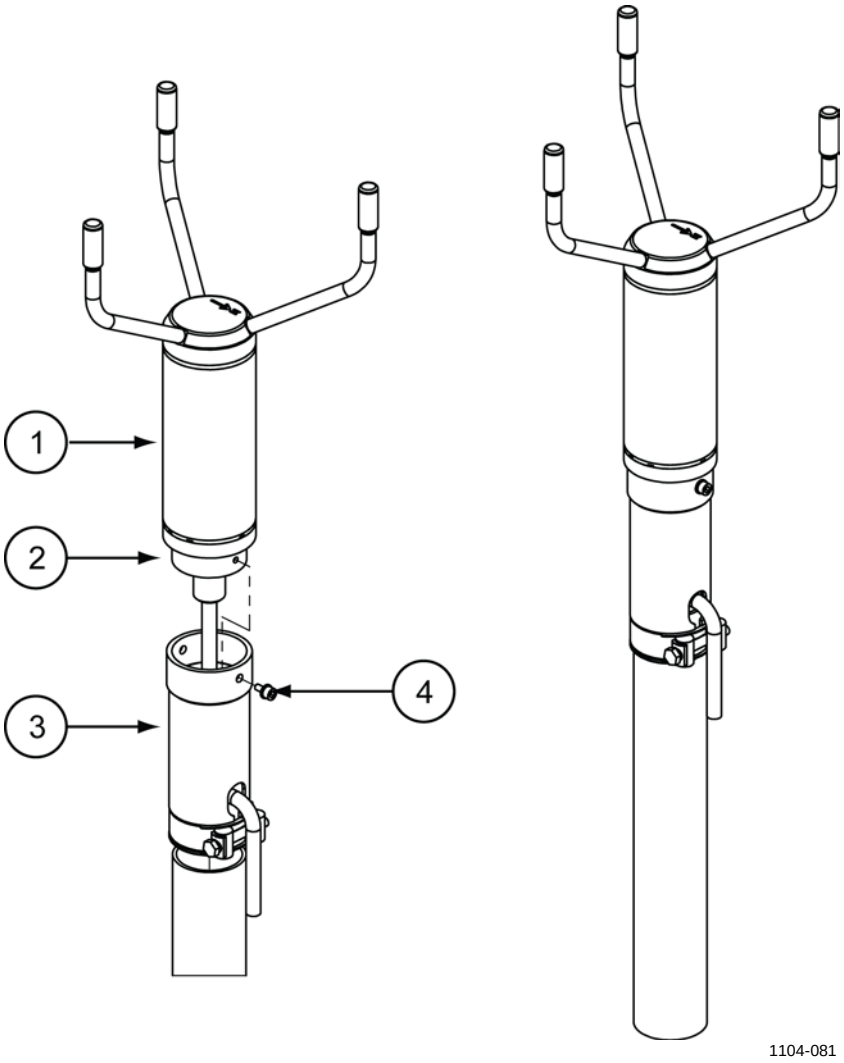

Figure 42 Retrofit Installation to Pole Mast

The following numbers refer to Figure 42 above:
1 = WMT700
2 = Mounting adapter for FIX30/60
3 = WS425 mounting kit
4 = Mounting screw

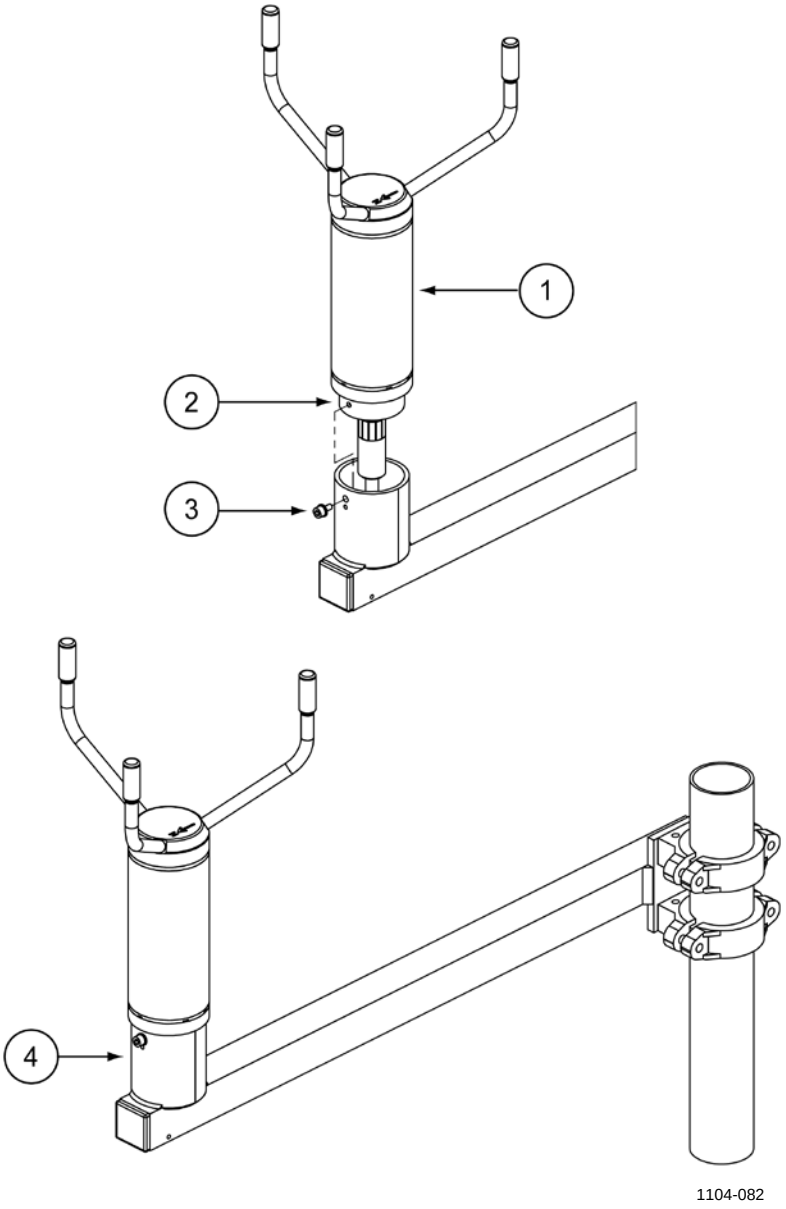

Figure 43 Retrofit Installation to Cross Arm with Array Facing Up

The following numbers refer to Figure 43 above:

1 = WMT700
2 = Mounting adapter for FIX30/60
3 = Mounting screw
4 = WS425 cross arm

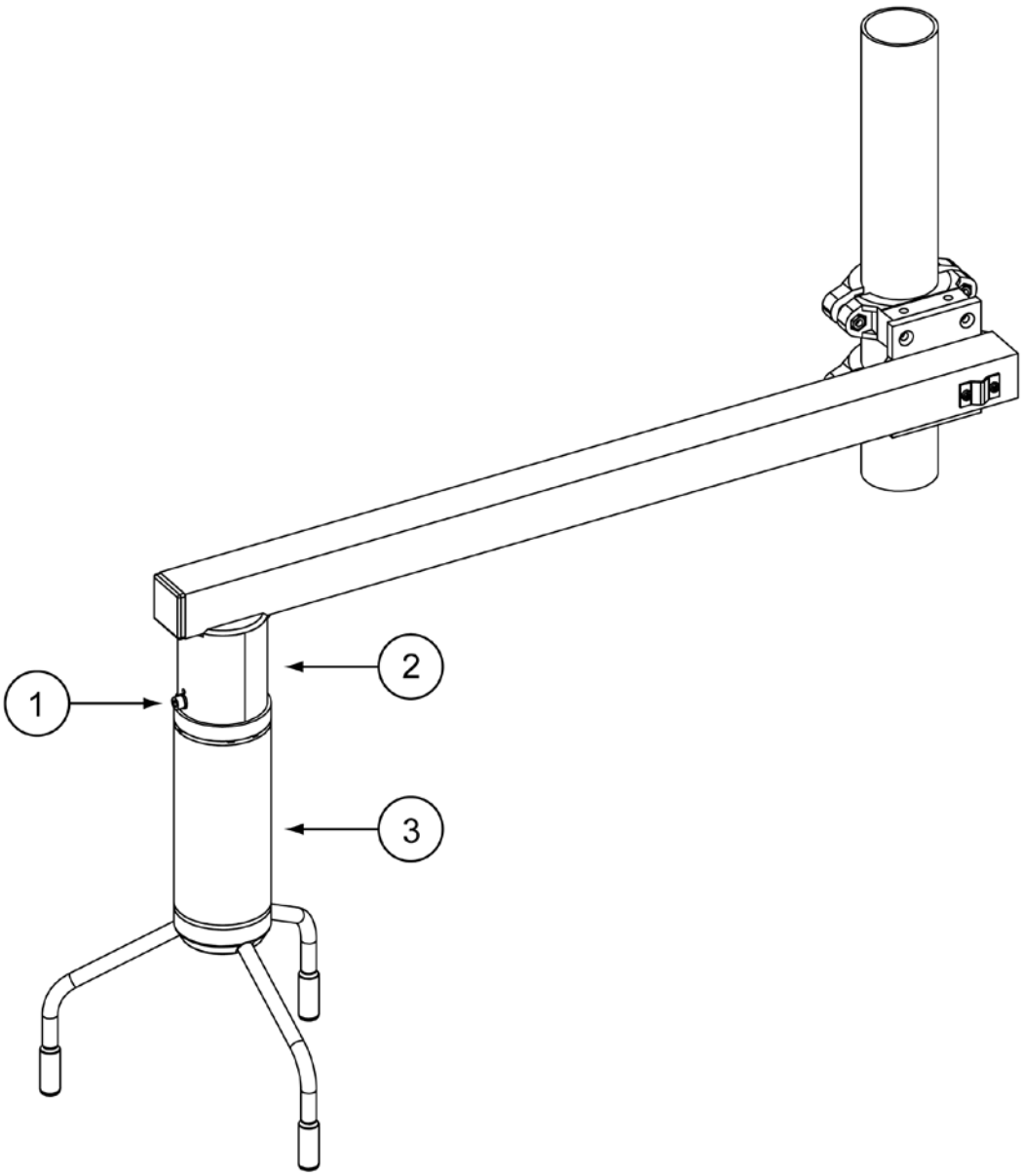

Figure 44 Retrofit Installation to Cross Arm with Array Facing Down

The following numbers refer to Figure 44 above:
1 = Mounting adapter for FIX30/60
2 = WS425 cross arm
3 = WMT700

Before You Start

Before you start the retrofit installation procedure, make sure that you have the correct items:

- Correct mounting kit (already attached to the mast) for a retrofit installation. Figure 45 below shows the available options: FIX30 and WS425FIX60 mounting kits.

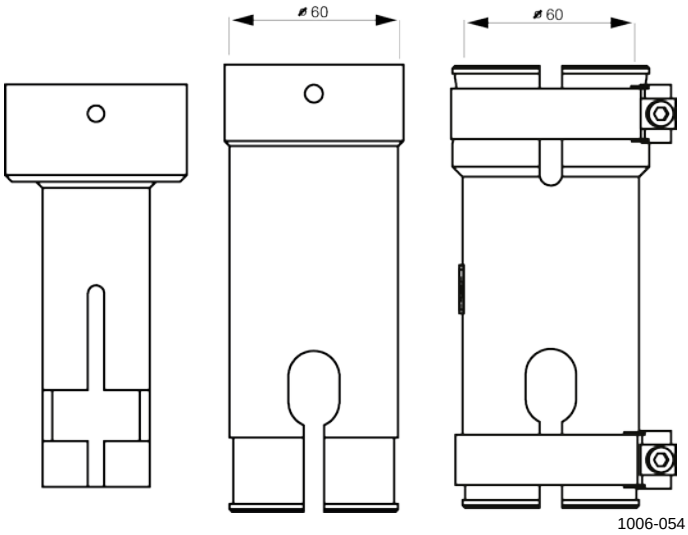

Figure 45 FIX30, WS425FIX60-RST, and WS425FIX60-POM

For information on the FIX70 mounting kit, see Figure 3 on page 20.

- Correct mounting adapter for your installation; FIX30, WS425FIX60-POM, or WS425FIX60-POM, see Figure 46 below. The diameter of the mounting adapter for the adapters is 61 mm. Change the mounting adapter if necessary. If you are not sure that you have the correct mounting adapter, contact Vaisala.

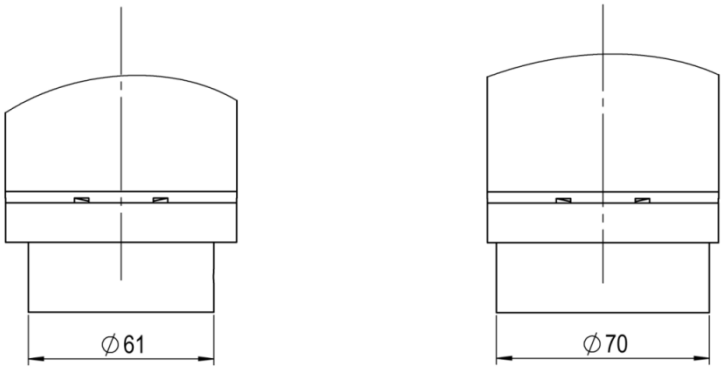

Figure 46 Mounting Adapter for FIX30, WS425FIX60 (Left), and Mounting Adapter for FIX70 (Right)

- Correct cables for the mounting kit and analog output/serial communication. Table 29 below lists the available cables for a retrofit installation. The In/Out stands for the possibility to route the cable either inside or outside of the mast.

NOTE If you have FIX30, do not use the adapter cables but order the appropriate WMT700 cable. The adapter cable will not fit inside the mast.

Table 29 Mounting Kits and Cable Codes

Description	Spare Part Item	FIX70		FIX30		WS425FIX60	
		In	Out	In	Out	In	Out
WMT700 cables with open leads one end (Standard 2 m/10 m/15 m/26 m, RS485 2 m/10 m, ROSA analog 10 m)	227567SP	x	x	x		x	x
	227568SP	x	x	x		x	x
	237890SP	x	x	x		x	x
	237889SP	x	x	x		x	x
	231425SP	x	x	x		x	x
	228259SP	x	x	x		x	x
	228260SP	x	x	x		x	x
WMT700 cables with connectors on both ends (MAWS, AWS520):	227565SP	x	x	x	x	x	x
	229807SP	x	x	x		x	x
	227566SP	x	x	x		x	x

Mounting Procedure

To upgrade from WS425 to WMT700:

1. Uninstall WS425.
2. If you are using a WMT700 cable, run the cable through the WS425 mounting kit. Connect the cable to the WMT700 wind sensor.

   If you are using a WS425 cable, ensure the pre-installed O-ring seal sits properly in the plastic male connector (between the existing WS425 cable and the adapter cable). Connect the WS425 cable to the WS425 adapter cable (see Figure 47 below). Run the adapter cable through the WS425 mounting kit. Connect the cable to the WMT700 wind sensor.

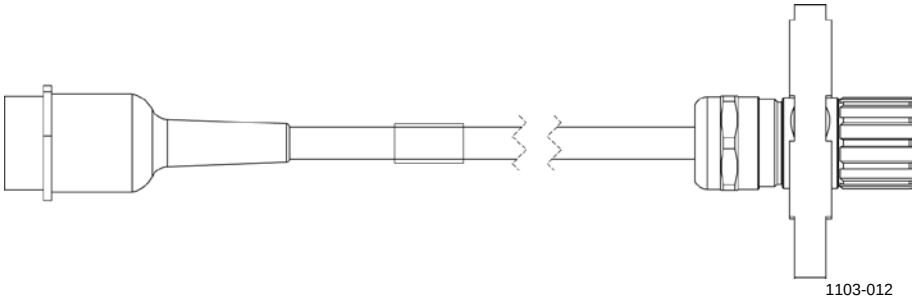

Figure 47 WS425 Adapter Cable

3. Tighten the connector by rotating the connector by hand clockwise; see Figure 31 on page 72.

   Ensure that the connector is properly tightened before proceeding to the next step. If you are unable to tighten the connector, loosen the mounting adapter fixing screws, remove the mounting adapter, and connect the cable. After that, reattach the mounting adapter.

4. Attach the WMT700 sensor body to the WS425 mounting kit and tighten the bolt.
5. Remove the transportation damper protecting the array and store it for future use.
6. Connect the cable to the data acquisition system and power supply. Connect the wires according to section Wiring on page 99.

WMT700 is now ready for operation.

Tightening Connector

When connecting the cable to your WMT700, it is recommended that you tighten the connector with the cable tightening tool shipped with your WMT700. The ribbed part of the tool offers a better grip of the cable when tightening the connector. Insert the cable in the cable tightening tool as shown in Figure 30 on page 71 and Figure 25 on page 65. You do not need to remove the cable tightening tool when the connector is tightened.

You can tighten the connector without the cable tightening tool by rotating the ribbed part of the connector by hand as shown in Figure 31 on page 72. However, do not use tools when tightening the connector.

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:

- How to route 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.
- Make sure 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 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.

Wiring in Retrofit Installations

There are two ways of performing WMT700 retrofit installation:

- Using Standard WMT700 Cables
- Using WS425 Cables with adapters

NOTE	To avoid unnecessary connectors and maximize long-term reliability, Vaisala recommends that you use the WMT700 cable for the retrofit installation.

Using Standard WMT700 Cables

This is the recommended way for the retrofit installation. There are various cables available for the installation:

- Cable 2 m (227567SP)
- Cable 10 m (227568SP)
- Cable 15 m (237890SP)
- Cable 26 m (237889SP)
- RS485 Cable 2 m (228259SP)
- RS485 Cable 10 m (228260SP)
- ROSA Cable 10 m for Analog Outputs (231425SP)
- 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)

ROSA Cable 10 m (Analog Outputs)

The ROSA Cable 10 m (231425SP) is intended for replacing WS425 with WMT700 in the Vaisala ROSA system in case the WS425 has been connected using analog outputs. Table 30 below shows the wire colors and related signals on WMT700.

Note that there are serial port signals available for configuration purposes on the cable even though they are not used as operational. The unused wires must be properly isolated and terminated to avoid unwanted operation or failure.

Table 30 ROSA Cable 10 m (231425SP)

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-485**		
COM2	RS232Rx	Rx-	Green	3
	RS232Tx	Tx-	Yellow	4
	-	Tx+	Brown-Green	14
	-	Rx+	White-Yellow	15
COM1 and COM2 Communication Ports Ground			Violet	10
COM1 (service port)	RS-485, -		Black	9
	RS-485, +		Brown-Yellow	16

Using WS425 Cables with Adapters

If a retrofit installation using WMT700 cables is not possible, there are adapters available for most situations.

- Adapter Cable for WS425 Serial (227569SP)
- Adapter Cable for WS425 Analog Frequency Output (227570SP)
- Adapter Cable for WS425 Analog Voltage Output (227571SP)

The adapter cable specifications in this section apply for both heated and non-heated versions of WMT700.

NOTE FIX30 is not compatible with adapter cables due to the small diameter of the mast.

Adapter Cable for WS425 Serial Output

The Adapter Cable for WS425 Serial (227569SP) can be used with the WS425 cables ZZ45203 and 010411.

Table 31 below lists the adapter pin-outs and signal descriptions as they appear on their user guides for both WMT700 and WS425 connectors.

Table 31 Pin-Outs for WS425 Serial Adapter Cable (227569SP)

WMT700 Connector Pin	WMT700 Signal Description	WS425 Connector Pin	WS425 Signal Description	WS425 Wire Color
1	Operating Power Supply	11	+12 VDC	Brown
3	COM2: Rx-/ RS232RX	10	Data in (RxD) (R-) (RT-)	Blue
4	COM2: Tx-/ RS232TX	9	Data out (TxD) (T-) (RT-)	Red
5	Heater Power Supply	16	+36 VDC	Gray/Pink
7	Heater Power Supply Ground	3	GND	Green
10	COM2: Communications Ground	8	GND	Yellow
11	Operating Power Supply Ground	1	GND	Black
14	COM2: Tx+	12	Data out (T+) (RT+)	White
15	COM2: Rx+	14	Data in (R+) (RT+)	Pink

NOTE The Adapter Cable for WS425 Serial (227569SP) does not support SDI-12 operation.

Adapter Cable for WS425 Analog Frequency Output

The Adapter Cable for WS425 Analog Frequency Output (227570SP) can be with the WS425 cable ZZ45204. Table 32 below lists the adapter pin-outs and signal descriptions as they appear on their user guides for both WMT700 and WS425 connectors.

Table 32 Pin-Outs for WS425 Analog Frequency Output Adapter Cable

WMT700 Connector Pin	WMT700 Signal Description	WS425 Connector Pin	WS425 Signal Description	WS425 Wire Color
1	Operating Power Supply	11	+12 VDC	Brown
2	Analog Output AOUT2, Wind Direction	13	WD Vout	Gray
5	Heater Power Supply	16	+36 VDC	Gray/ Pink
7	Heater Power Supply Ground	3	GND	Green
11	Operating Power Supply Ground	1	GND	Black
12	Analog Output Ground	8	GND	Yellow
13	Analog Output AOUT1, Wind Speed	14	WS Fout	Pink
17	Reference Input for AOUT2	12	WD Vref in	White

Adapter Cable for WS425 Analog Voltage Output

The Adapter Cable for WS425 Analog Voltage Output (227571SP) can be used with the WS425 cable ZZ45204. Table 33 below lists the adapter pin-outs and signal descriptions as they appear on their user guides for both WMT700 and WS425 connectors.

Table 33 Pin-Outs for WS425 Analog Voltage Output Adapter Cable

WMT700 Connector Pin	WMT700 Signal Description	WS425 Connector Pin	WS425 Signal Description	WS425 Wire Color
1	Operating Power Supply	11	+12 VDC	Brown
2	Analog Output AOUT2, Wind Direction	13	WD Vout	Gray
5	Heater Power Supply	16	+36 VDC	Gray/ Pink
7	Heater Power Supply Ground	3	GND	Green
11	Operating Power Supply Ground	1	GND	Black
12	Analog Output Ground	8	GND	Yellow
13	Analog Output AOUT1, Wind Speed	15	WS Vout	Violet
17	Reference Input for AOUT2	12	WD Vref in	White

Differences between WMT700 and WS425 Analog Output Signals

WMT700 pin connections differ from the connections of WS425 in that wind speed signal output, both voltage and frequency signals, appears on WMT700 pin 13.

NOTE WMT700 analog outputs must be configured according to the appropriate analog output mode, which is either voltage, frequency, or potentiometer.

Table 34 below lists the analog output connections for WMT700 and WS425 connector pins.

Table 34 Analog Output Connections

WMT700 Connector Pin	WMT700 Signal Description	Voltage Output	WS425 Connector Pin, Wire Color
13	Analog Output AOUT1, Wind Speed	Voltage	15, Violet (connect pin 14 to ground)
		Current	not available
		Frequency	14, Pink
2	Analog Output AOUT2, Wind Direction	Voltage	13, Gray
		Current	not available
		Potentiometer	13, Gray
17	Reference Input for AOUT2	Potentiometer	12, White
12	Analog Output Ground	All modes	1, Black (common with supply ground)

Powering in Retrofit Installations

WMT700 is designed to operate with the same supply voltages as WS425 and no connection changes are necessary. The power consumption depends on the selected heating options. WMT700 with heated transducers can be used to replace similar WS425 models. When upgrading from WS425 to WMT700 with heated transducers and arms, more capacity is required from the power supply unit.

For information on power supply requirements of each WMT700 product type, see Table 27 on page 87.

NOTE

When WMT700 is in operation, the power consumption is higher than with WS425. This can affect system performance in power-critical applications such as solar-powered or battery-powered systems.

Use solar-power or battery backup only to secure operating voltage. Ensure that the solar-powered system has a sufficient power reserve available.

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CHAPTER 5

OPERATION

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

Note that some of the operations are conducted in the configuration mode and others in the measurement mode. For detailed mode descriptions, see section Measurement and Configuration Modes on page 47.

Serial Connection to WMT700

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

- PC with a serial port.
- Required cables for a serial connection. For more information, see section Cables on page 33.
- 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**.

When a serial line cable is connected to the PC and the terminal setup is correct, switch the sensor power supply on. The following information is displayed to terminal screen:

```
WMT700 v<version number>
```

The sensor goes to measurement mode after four seconds and it is ready to receive measurement mode commands.

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>

Communication baud rate can be configured from 300 baud to 115200 baud. For available baud rates, see Appendix D, Configuration Parameters, on page 205.

Entering and Exiting Configuration Mode

With **OPEN** and **CLOSE** commands you can toggle between configuration mode and measurement mode. In the measurement mode, **OPEN** changes the mode to the configuration mode, and in the configuration mode, **CLOSE** changes the mode to the measurement mode. Note that the configuration mode does not recognize the **OPEN** command and the measurement mode does not recognize the **CLOSE** command.

OPEN — Entering Configuration Mode

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

```
$0OPEN<enter>
||   |     |____To activate the command, press Enter
||   |__________The OPEN command
||______________Sensor address, all sensors answer 0 address
|_______________Fixed $ character starts command
```

After a successful **OPEN** command the sensor switches from measurement mode to configuration mode and 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<enter>
|   |      |____To activate the command, press Enter
|   |___________The CLOSE command
|_______________Configuration mode prompt
```

Configuration

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 section.

Otherwise, you can start using WMT700 directly after the installation.

The initial settings have been configured at the factory according to the customer specifications you have given when ordering the product. For available options, see section Ordering Options on page 23.

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 the configuration mode before starting configuration. It is also possible to use one serial port in the configuration mode while operating WMT700 from the other serial port.

WMT700 provides commands for:

- Parameter handling
- Wind measurement control
- Diagnostics
- Information

If the messages parameter is set to 1 (response for parameter setting is enabled, see Appendix D, Configuration Parameters, on page 205), WMT700 responds to an invalid command with an error message. If the messages parameter is set to 0 (response for parameter setting is disabled), WMT700 does not send any error messages. You can fetch the most recent error data in the configuration mode with the **ERRORS** command, see section ERRORS — Get Error Codes and Counts on page 116.

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 119.

Table 35 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 a 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.

Parameter Handling Commands

All the commands in the configurating mode are in the following form:

```
>CMD x,y<enter>
|   |     |  |||    |___ Press Enter key to activate the command
|   |     |  |||_____Value of the parameter
|   |     |  ||_____ Comma
|   |     |  |_______ Any parameter in Table 66 on page 205
|   |     |__________ Space
|   |________________ Command
|____________________ Configuration mode prompt
```

The parameter name and allowed parameter values depend on the command. For certain commands they are optional. In the following command descriptions, WMT700 configuration mode prompt and enter are left out for clarity.

S — Set Parameter

The S command defines new data messages and changes values of the WMT700 parameters. For parameter names and the allowed and default values, see Appendix D, Configuration Parameters on page 205.

You can also use the **S** command to configure data messages. For instructions, see Appendix D, Configuration Parameters, on page 205.

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 are enabled (messages parameter is set to 1), WMT700 responds with an error message. If the messages parameter has been set to 0, WMT700 does not send any response to set parameter command. You can also fetch the most recent error data in the configuration mode with the **ERRORS** command, see section ERRORS — Get Error Codes and Counts on page 116.

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 Appendix D, Configuration Parameters, on page 205
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. WMT700 needs to be RESET before the communication settings 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. With the **BAUD** command the communication settings take place immediately.

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

The **G** 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 Appendix D Configuration Parameters on page 205.

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 Appendix D Configuration Parameters on page 205

Example:

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

```
G wndAvg
s wndAvg    ,3.00000
```

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 186.

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 the 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 185.

```
ERRORS
```

The response is as follows:

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

where

a	=	Number of events since latest reset
b	=	Code for the first event since latest reset
c	=	Code for the most recent event
d	=	Number of errors since latest reset
e	=	Code for the first error since latest reset
f	=	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
- Code for the first event since latest reset: 3
- Code for the most recent event: 3
- Number of errors since latest reset: 10
- Code for the first error since latest reset: 13
- 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 the 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 40 on page 128

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. Appendix D, Configuration Parameters, on page 205 lists the parameters for configuring WMT700 settings. It includes a detailed description of 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 is 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 124.

For information on configurable parameters and allowed values when using the WS425 and SDI-12 profiles, see section Upgrading from WS425 to WMT700 on page 89.

NOTE	In the automatic message mode, to initiate continuous measurement, use the **START** command. See section START — Start Continuous Measurement on page 115.

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 36 on page 120 that lists the available items for data message strings.

For a list of the predefined data messages, see section Data Messages on page 127.

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 112.

```
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 the configuration mode. For instructions, see section POLL — Get Message on page 117.

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 36 on page 120, Table 37 on page 120, and Table 38 on page 121.

Table 36 Wind Measurement Items for Data Messages

Item	Description
\ad	Address
\dm	Wind direction minimum calculated over the averaging period
\dx	Wind direction maximum calculated over the averaging period
\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 calculated over the averaging period
\wp	Wind speed maximum calculated over the averaging period
\ws	Wind speed, average
\wx	Wind speed average, x component
\wy	Wind speed average, y component

Table 37 Control Character and Checksum 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 checksum
\ss	Checksum calculation start point

Table 38 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 123
\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:

```
$05.00,128,23.4<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 checksum
- CR
- LF

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

WMT700 sends the following message that starts with the SOH character which is excluded from the checksum. The checksum ends before the EOT character. The checksum (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><L
F>
```

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

Status Flags

Table 39 below 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 39 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

Example:

The message contains status flag value 130:

130 in decimal format is 128 + 2 → 00010000010 Binary

```
                                        |       |_________ 2
                                        |_________________ 128
000 1000 0010
|||  ||||  ||||_Temperature sensor 1 OK
|||  ||||  |||__Temperature sensor 2 failure ON
|||  ||||  ||___Temperature sensor 3 OK
|||  ||||  |____Heater OK
|||  ||||_______Supply voltage not too high
|||  |||________Supply voltage not too low
|||  ||_________Wind speed in operation limit
|||  |__________Sonic temperature exceeds operating limit
|||_____________Wind measurement OK
||______________Not used
|_______________No sensors blocked
```

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 Appendix D, Configuration Parameters, on page 205.

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. Disable error messages with the following command:

   ```
   S messages,0
   ```

3. Copy the values from the terminal program to a file. Remove the parameters you do not want to change. Also remove the parameter “messages” to avoid switching messaging on during the transfer.
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 are set correctly (the values are in the allowed range and all parameters are 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 are set correctly.

If the response for parameter setting is not disabled (as instructed in step 3) but the messages parameter is set to 1 instead, 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 response for parameter setting is enabled (messages parameter is set to 1), a simple terminal program cannot be used for loading parameters from file.

Example:

This configuration file contains all the WMT700 parameters that are user-configurable.

```
S wndAvg,1.00000
S wndUnit,0
S wndDirOffset, 0.00000
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 freqType,0
S aout1_o,0.00000
S aout1_g,1.00000
S aout1minv,0.00000
S aout1maxv,32000.0
S aout1err,1000.00
S aout1mode,3
S aout2_g,1.00000
S aout2_o,0.00000
S aout2minv,0.00000
S aout2maxv,32000.0
S aout2err,1000.00
S aout2mode,7
S msg1,\ss$\ws,\wd,\se\sp\cr\lf
S msg2,2
S msg3,3
S msg4,4
S address,A
S messages,1
```

Operating WMT700

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 below.

  For using the WS425 or SDI-12 profiles, see section Operating WMT700 with WS425 and SDI-12 Profiles on page 145.

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

  For general information, see section Analog Output on page 50.

  For instructions on using WMT700 analog output in a system configured for WS425, see section Operating WMT700 in WS425 Analog Output Mode on page 139.

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 195.

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 33.
- Any terminal program, such as Tera Term or Windows® HyperTerminal

To switch on WMT700 in the measurement mode using Windows® HyperTerminal, see section Communicating with Terminal Software on page 107.

For information on operating commands, see section Measurement Mode Commands on page 135.

For information on available data messages, see section Data Messages on page 127.

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, you need to set the following parameters:

- autoInt (defines the message send interval in seconds, 0.25 s resolution)
- autoSend (0 = Automatic message mode disabled, for available messages, see Table 40 on page 128.
- autoPort (defines where the message is sent: 1 = COM1, 2 = COM2)

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

Table 40 on page 128 lists the data messages supported by WMT700. The data message numbers in the table below are needed when the WMT700 protocol **POLL** command is used or the Automatic Message mode is used with any protocol.

Table 40 Data Messages

Data Message Number	Description
WMT700 Data Messages	
20	WMT700 NMEA MWV profile message that reports average wind speed and direction.
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
32	WS425 A/B WAT11 profile message
User-Configurable Data Messages	
1	Items defined by the user. See User-Configurable Data Messages on page 119
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 137.

To select a data message when using automatic messages, use the configuration parameters. See section Configuration Parameters on page 118.

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 119.

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 13 on page 39.

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 13 on page 39.

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, maximum
\wm	=	Wind speed, minimum
\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 123
\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, maximum: 3.34 m/s
- Wind speed, minimum: 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. For the meaning of status flags, see section Status Flags on page 123

WMT700 Data Message 24

WMT700 Data Message 24 reports wind measurement and self-diagnostics data. The checksum is included in the message. WMT700 calculates the checksum by applying 8-bit XOR for all bytes between checksum calculation start point and end point. 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, maximum
\wm	=	Wind speed, minimum
\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 123
\se	=	Checksum calculation end point, not shown in the message
\sp	=	Print checksum (to verify message integrity)
\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, maximum: 3.58 m/s
- Wind speed, minimum: 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 checksum is included in the message. WMT700 calculates the checksum by applying 8-bit XOR for all bytes between checksum calculation start point and end point. 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, maximum
\wm	=	Wind speed, minimum
\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 123
\se	=	Checksum calculation end point, not shown in the message
\sp	=	Print checksum (to verify message integrity)
\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, maximum: 3.38 m/s
- Wind speed, minimum: 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 the WMT700 Data Message 22 is polled, missing readings are indicated with the following response:

```
$999.00,999.00<cr><lf>
```

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:

- WMT700 checks the status of the internal operational software at each reset by verifying the CRC checksum of the software. The software check is not made periodically; it is only made at each reset. If the checksum is incorrect, WMT700 does not start up. If the checksum is correct, WMT700 continues by calculating the CRC checksum of the parameter memory. In case the parameter memory is corrupted, the sensor replies with the text "Parameters crc error" upon startup. In case the parameter memory checksum is correct, WMT700 replies with the text "ready" as shown in the example below.

  ```
  >$WMT700 v<version number>
  ready.
  ```

- 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 123.
- 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 119.
- 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 119.

NOTE	Only a power-off self-test exists. See Appendix A, Complete Command Set for WMT700, on page 195.

Measurement Mode Commands

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

NOTE

For a list of serial commands available for all the communication profiles supported by WMT700, see Appendix A, Complete Command Set for WMT700, on page 195.

For more detailed information on commands of the WS425 and SDI-12 profiles, see section Operating WMT700 with WS425 and SDI-12 Profiles on page 145.

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 response for parameter setting is enabled (messages parameter is set to 1), WMT700 responds to an invalid command with an error message.

Table 41 Measurement Mode Commands

Command	Description
$aMEAS	Starts wind measurement in single measurement mode. The duration of the measurement is based on the user-configurable averaging time.
$aOPEN	Switches the serial port to configuration mode.
$aPOLL,y	Fetches latest measurement 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 40 on page 128

MEAS — Start Measurement

This command starts wind measurement in single measurement mode 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 the configuration mode.

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

where

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

NOTE WMT700 automatically returns to normal operating mode, if no commands are received in two minutes, or multiple unrecognized commands are detected.

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 the 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 40 on page 128

Example:

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

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

SLEEP — Enter Low-Power Mode

This command switches WMT700 from the normal operating mode to the low-power mode. WMT700 will resume normal operation after sleep period determined by the sleepTime parameter has elapsed, or when a character is received on data port COM2. For more information on the sleepTime parameter, see Appendix D, Configuration Parameters, on page 205.

```
$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 133.

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

where

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

Operating WMT700 in WS425 Analog Output Mode

This section provides information on operating WMT700 in analog output mode in a system configured for WS425. For general information on operating WMT700 with analog output, see section Analog Output on page 50.

Analog Output Settings

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. The analog output signal type and range depend on the configured settings.

Normally, analog output is enabled and the output settings are preconfigured at the factory according to your order. WMT700 can be operated using these settings directly after the installation. However, the analog output settings of WMT700 can be changed or the analog output functionality can be disabled at any time to save power over the serial interface.

When operating WMT700 in a system configured for WS425, the analog output settings must be configured according to Table 42 on page 140 using the **S** command. For more information on the **S** command, see section S — Set Parameter on page 112.

Table 42 Required Parameters for WS425 Analog Output Operation Mode

Parameter Name	Default Value	Allowed Values	Description of How to Emulate WS425
aout1err	1000	0 …. 32000	Set 1 for voltage output and 625 for frequency output for similar operation as with WS425.
aout1_g	1	0 …. 100	Gain for AOUT1. Set 0.017895 for compatibility with WS425 voltage output. Set 11.18 for compatibility with WS425 frequency output.
aout2_g	1	0 …. 100	Gain for AOUT2. Set 0.0027855 for compatibility with WS425 potentiometer output.
aout1mode	3	0 = Current 1 = Voltage 2 = Frequency 3 = Disabled	Analog output mode for AOUT1. Set 1 for WS425 voltage output compatibility. 2 for WS425 frequency output compatibility.
aout2mode	7	4 = Current 5 = Voltage 6 = Potentiometer 7 = Disabled	Analog output mode for AOUT2. Set 6 WS425 potentiometer output compatibility.
aout1_o aout2_o	0	-10000 … 10000	Offset for AOUT1 and AOUT2. Set output offset to 0.

For configuration instructions, see section Configuration on page 110.

Wind Speed Output

In a system configured for WS425, you can set WMT700 to measure wind speed and send analog output as frequency or voltage.

These sections describe WMT700 analog output:

- Settings are configured according to Table 42 on page 140.
- Wires are connected according to section ROSA Cable 10 m (Analog Outputs) on page 100.

Frequency

When frequency is selected as the wind speed analog output, WMT700 sends a pulsed signal of 0 to 10 V with a frequency proportional to wind speed through AOUT1. Every mile per hour adds 5 Hz (WS425) to the frequency. In SI units, a change of 0.894 meters per second adds 10 Hz to the frequency.
A frequency counter is required to count the output in Hz and the calculation that scales the result to appropriate units.

Figure 48 below shows the frequency output when an adapter cable for analog frequency output (227570SP) and a WS425 cable are used. With WMT700, the wind speed signal appears at pin 14 (pink) of the adaptor cable.

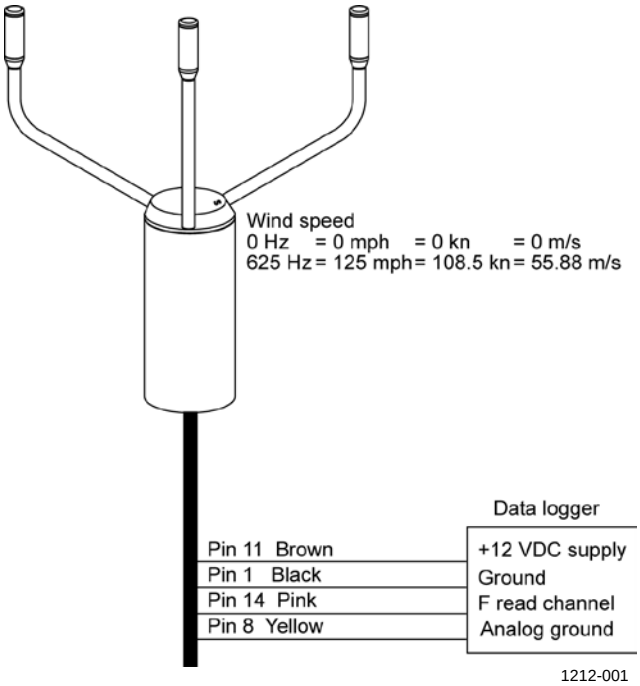

Figure 48 Wind Speed Frequency Analog Output with WS425 Cable and Adapter Cable for Analog Frequency Output

Voltage

When voltage is selected as the wind speed analog output, the output from WMT700 varies linearly from 0 VDC at 0 miles per hour to 1 VDC at 125 miles per hour. In SI units, the voltage varies linearly from 0 VDC at 0 meters per second to 1 VDC at 55.88 meters per second.

Figure 49 below shows the voltage output when an adapter cable for voltage output (227571SP) and a WS425 cable are used. With WMT700, the wind speed signal appears at pin 15 (violet) of the adaptor cable. The violet wire must be connected to V read channel, and the pink wire must be connected to the analog ground.

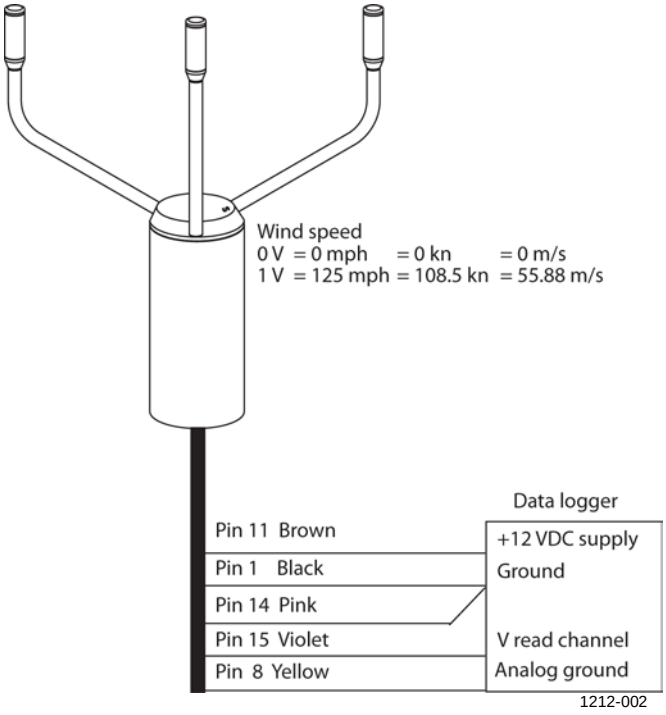

Figure 49 Wind Speed Voltage Analog Output with WS425 Cable and Adapter Cable for Analog Voltage Output

Wind Direction Output

When wind direction is measured, WMT700 sends analog output as simulated potentiometer output voltage referred to as external reference voltage. The output is a proportional signal 0 ... 100 % of the reference voltage representing the wind direction. The reference voltage must be in the range of 1.0 to 4.0 VDC (WMS425) or 0…10 VDC (WMT700). The output is 0 VDC at zero degrees and increases to the reference voltage at 359 degrees.

Figure 50 below shows the output for wind direction. With WMT700, the wind direction signal appears at pin 13 (gray) of the adapter cable.

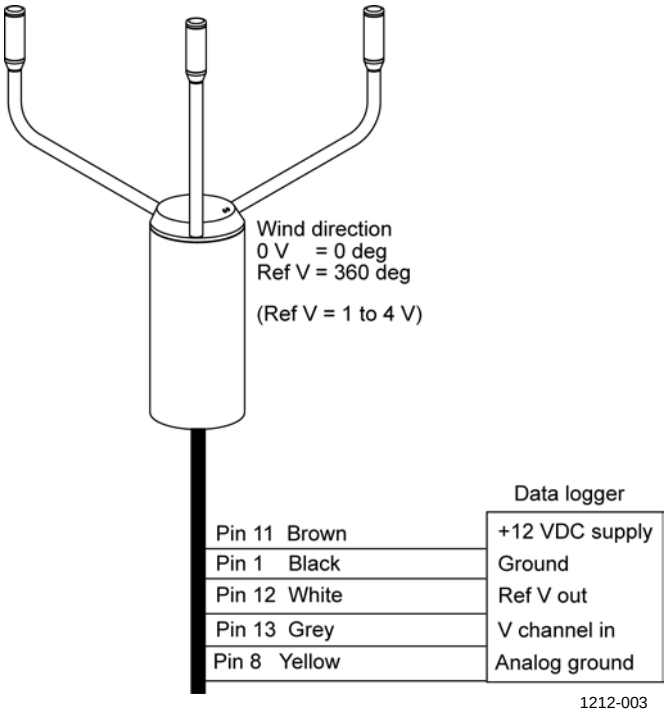

Figure 50 Wind Direction Voltage Output with WS425 Cable and Adapter Cable

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 the 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
```

Missing Readings and Error Indication

If WMT700 is not able to measure the wind, it indicates a missing reading in the output. The most common reasons for measurement problems are foreign objects (such as ice, birds, or other foreign 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 that is more than 10 V or 20 mA but other error settings can also be configured.

Example

To set analog output 1 error indication in voltage mode to 1 V, set the analog output error value to 1. Enter the following command:

```
S aout1err,1
```

Operating WMT700 with WS425 and SDI-12 Profiles

In this section, each communication profile has its own section listing the configurable parameters and the available commands and data messages. For information on available commands and data messages when using the WMT700 profile, see Chapter 5, Operation, on page 107.

NOTE	For a complete list of the serial commands available for WMT700, refer to Appendix A, Complete Command Set for WMT700, on page 195.

Communication Profiles

In addition to the WMT700 and MES12 profiles, WMT700 supports the following communication profiles:

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

The profile has been preconfigured at the factory according to your requirements specified when ordering WMT700. You can change the profile through the serial interface, if necessary. For instructions, see section Changing Communication Profile below.

Changing Communication Profile

The communication profile and other settings have been configured at the factory according your specifications. You can start using WMT700 directly after the installation with these settings.

In case you want to change the communication profile, change manually all needed parameters to match the new profile. The needed configurable parameters are listed separately for each profile in this manual.

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 Before You Start on page 94.
- Any terminal program, such as Tera Term or Windows® HyperTerminal.

To switch on WMT700 in measurement 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**

   For the correct settings for SDI-12 profile, see section SDI-12 on page 165.
7. Click **Apply** and **OK**.
8. On the **Settings** tab, click **ASCII setup**. Select **ASCII sending** - **Send line ends with line feed** (optional). 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**.
11. Switch the sensor power supply on.

    The following information is displayed:

    `WMT700 v<version number>`

12. Wait for 4 seconds. WMT700 enters measurement mode automatically.
13. To test the connection, enter configuration mode with the following command:

    ```
    $0OPEN<CR><LF>
    ```

14. Use the following command to return to measurement mode:

    ```
    CLOSE<CR><LF>
    ```

    You can now start operating WMT700. Note that WMT700 does not send data messages automatically unless configured to do so.

NOTE	In configuration mode, you can use any of the following end-of-line character combinations: <CR><LF>, <CR>, or <LF>.

Entering Configuration Mode

This command switches the serial port to configuration mode. The command works with any communication profile supported by WMT700.

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

where

$	=	Fixed text
a	=	Value of the **address** parameter. If the value is 0, it refers to any WMT700 address
<CR>	=	Carriage return
<LF>	=	Line feed

WS425 F/G ASOS Profile

Configurable Parameters

Table 43 below lists the configurable parameters and their allowed and default values for the WS425 F/G ASOS profile.

Table 43 Configurable Parameters for WS425 F/G ASOS Profile

Parameter	Default Value	Profile-Specific Allowed Values	Description
autoSend	0	0 = Automatic messages disabled	Automatic data message number. Selects the data message format for automatic messages
com1_protocol	0*	2 = WS425 F/G ASOS	Profile for serial port COM1
com2_protocol	2	2 = WS425 F/G ASOS	Profile for serial port COM2
com2_interf	N/A**	0 = RS-485 1 = RS-422 3 = RS-232	Interface for serial port COM2
wndAvg	5	0.25 … 3600 Resolution: 0.25	Averaging time for wind measurement in seconds
wndGustTime	3	0.25 … 3600 Resolution: 0.25	Averaging time for wind minimum and maximum in seconds
wndOrientation	0	0 = Array facing up 1 = Array facing down	Orientation of the array of WMT700
wndUnit	0**	0 = Meters per second (m/s) 1 = Miles per hour (mph) 2 = Kilometers per hour (km/h) 3 = Knots (knot)	Wind speed unit
wndVector	0	0 = Scalar averaging	Wind averaging method

* The parameter has no protocol-specific default value. It is determined separately in the configuration code.
** Wind speed unit and COM2 digital communication interface are defined in the order form. Default setting may be any of the allowed options, and it can be verified from the unit's configuration code.

To start continuous measurement, use the **START** command. You can stop the measurement with the **STOP** command. For instructions, refer to section Wind Measurement Control Commands on page 115.

WS425 F/G ASOS Commands

WMT700 responds to each command with a fixed-length message. In each of the command descriptions below, <CR> is an ASCII carriage return control character and <LF> is an ASCII line feed control character.

NOTE When the WS425 F/G ASOS profile is selected, WMT700 only responds to upper case characters.

Table 44 below lists the available commands for operating WMT700 with the WS425 F/G ASOS profile.

Table 44 WS425 F/G ASOS Commands

Command	Description
WA	Requests average wind speed and direction message
WS	Requests the verbose Built-In Test (BIT) results

The **WA** command is executed by the ASOS at an interval that ranges from 1 to 30 seconds. For the **WA** command, WMT700 responds to the ASOS interrogation poll within 250 milliseconds of receiving the request.

NOTE The following WS425 F/G ASOS commands cannot be used with WMT700: **WB**, **WFIRMWARE**, **WJ**, **WD**, **WF**, **WR**, **WCAL**, **WH**, **WT**, **WCDV**, **WSTK**, **WL, WM, WN, WSST**, and **WATE**.

WMT700 can only be configured in the configuration mode. For a list of configuration commands for WMT700, see section Configuration on page 110.

WA — Fetch Averaged Wind Speed and Direction

This command requests the averaged wind speed and direction message with peak winds.

```
WA <CR><LF>
```

The response to the **WA** command consists of the averaged wind speed and direction data, peak wind speed, and associated direction. The average wind speed is a scalar running average of the fundamental
1-second interval wind speed measurement made by WMT700. For a description of the data message, see section WS425 F/G ASOS Data Message on page 152.

You can set the wind averaging time and gust time with the **wndAvg** and **wndGustTime** parameters. Set the **wndVector** parameter to **0** to use scalar averaging.

The command also fetches the WMT700 status, the averaging time for average and peak wind speed and wind direction, and signal quality.

WS — Fetch Internal Diagnostics Information

This command requests the verbose Built-In Test (BIT) results.

```
WS<CR><LF>
```

The command gives a textual run down of the results of all Built-In Tests (BITs). In every line, except the bad reading counter, the pass/fail indication is given with the single character P or F. This is followed by the description of the measured parameter, which is followed by the actual measured value.

The Bad 1 second readings counter is a running total of the number of fundamental 1-second readings that the sensor flagged as bad. This number rolls over to zero after reaching the count value of 65535. It is initialized to zero on each power-up or any other activity that performs a re-initialization of the sensor. The time measurement quality indices are given for path numbers as follows:

- Path 0 is from south transducer to north transducer
- Path 1 is from north transducer to south transducer
- Path 2 is from north transducer to east transducer
- Path 3 is from east transducer to north transducer
- Path 4 is from east transducer to south transducer
- Path 5 is from south transducer to east transducer

A listing for the command response is given below with representative values.

```
<CR><LF>
P Heater voltage 22.3 Volts <CR><LF>
P Array heater resistance 4.9 Ohms <CR><LF>
P Heaters off voltage 0.1 Volts <CR><LF>
P Incoming supply voltage 12.2 Volts <CR><LF>
P 5.0 volt supply 5.05 Volts <CR><LF>
P 10 volt supply 10.2 Volts CR LF
- Bad 1 second reading counter 0 <CR><LF>
P Path 0 signal quality index 99 <CR><LF>
P Path 1 signal quality index 99 <CR><LF>
P Path 2 signal quality index 99 <CR><LF>
P Path 3 signal quality index 99 <CR><LF>
P Path 4 signal quality index 99 <CR><LF>
P Path 5 signal quality index 99 <CR><LF>
```

The test limits for the various tests are as listed below:

- Heater voltage good in range 18.0 to 26.0 V
- Array heater resistance good in range 4.0 to 6.0 Ω
- Heaters off voltage good if below 0.5 V
- Incoming supply voltage good in range 10.5 to 13.5 V
- 5.0 V supply good in range 4.5 to 5.5 V
- 10 V supply good in range 9.0 to 11.0 V
- Signal Quality Index good above 50

WS425 F/G ASOS Data Message

WMT700 responds to the **WA** command with a data message described in Table 45 below.

Table 45 WS425 F/G ASOS Data Message

Byte	Description
1	Start of text
2	Sensor ID
3	Command identifier
4	Sensor status: P = Pass F = Fail H = Heater failure For further information, refer to notes 1 and 2.
5-7	Averaged wind direction (degrees)
8-10	Wind direction (degrees) @ peak wind speed
11-12	Averaging time for wind speed and direction
13-14	Averaging time for peak wind speed and direction (seconds)
15-19	Averaged wind speed
20-24	Peak wind speed since last WA command
25	Wind speed unit: M = Miles per hour K = Knots L = Kilometers per hour T = Meters per second
26-27	Signal quality. For further information, refer to note 3.
28-29	Hex checksum. For further information, refer to note 4.
30	End of text
31	Carriage return
32	Line feed

Notes:

1. The sensor status (byte 4) indicates the following:
   - P (Pass) indicates that all diagnostic tests have passed and WMT700 is functioning normally.
   - F (Fail) indicates that one or more of the diagnostic tests have failed. You can then request diagnostics and extended tests (WS) to further isolate the problem.
   - H (Heater failure) indicates that the wind reading is valid but one or more built-in heater diagnostic tests have failed.
2. When the status byte is F, the wind direction fields are set to 999 and the wind speed fields are set to 999.9 in the applicable sensor response messages.

3. The signal quality (bytes 26-27) is a numeric value from 0 to 99 representing the data quality of processed data samples during the averaging time.

   For example, a value of 99 signifies that all data samples were determined to be valid and processed during the averaging time. If some samples were determined to be "missing", these samples were not processed and the reported signal quality is a proportional value less than 99.

4. Bytes 28-29 are the modulo 256 hexadecimal checksum of the ASCII values calculated for bytes from 2 to 27.

Example:

```
WAP2131870503012.6014.7K99xx
```

Interpretation of the example message:

- Sensor ID: W
- Command identifier: A
- Sensor status: P = pass
- Averaged wind direction (degrees): 213
- Wind direction (degrees) @ peak wind speed: 187
- Averaging time for wind speed and direction: 05
- Averaging time for peak wind speed and direction (seconds): 03
- Averaged wind speed: 012.6
- Peak wind speed since last WA command: 014.7
- Wind speed units: K = knots
- Signal quality: 99
- Hex checksum (refer to note 4): xx

WS425 A/B NMEA Standard Profile

When the WS425 A/B NMEA Standard profile is configured, WMT700 sends messages based on the configured automatic message interval. There are no operating commands available for the user.

Configurable Parameters

Table 46 below lists the configurable parameters and their allowed and default values for the WS425 A/B NMEA Standard profile.

Table 46 Configurable Parameters for WS425 A/B NMEA Standard Profile

Parameter	Default Value	Profile-Specific Allowed Values	Description
address	1	String with 1 character	Address for WMT700
autoInt	1	0.25 ... 1000 Resolution: 0.25	Automatic message interval in seconds. 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 19 = NMEA automatic data message	Automatic data message number. Selects the data message format for automatic messages
com1_protocol	0*	4 = WS425 A/B NMEA Standard	Profile for serial port COM1
com2_protocol	0	4 = WS425 A/B NMEA Standard	Profile for serial port COM2
com2_interf	N/A**	0 = RS-485 1 = RS-422 3 = RS-232	Interface for serial port COM2
wndAvg	1	0.25 … 3600 Resolution: 0.25	Averaging time for wind measurement in seconds
wndOrientation	0	0 = Array facing up 1 = Array facing down	Orientation of the array of WMT700
wndUnit	0**	0 = Meters per second 1 = Miles per hour 2 = Kilometers per hour 3 = Knots	Wind speed unit
wndVector	1	0 = Scalar averaging	Wind averaging method

* The parameter has no protocol-specific default value. It is determined separately in the configuration code.

** Wind speed unit and COM2 digital communication interface are defined in the order form. Default setting may be any of the allowed options, and it can be verified from the unit's configuration code.

To start continuous measurement, use the **START** command. You can stop the measurement with the **STOP** command. For instructions, refer to sections START — Start Continuous Measurement and STOP — Stop Wind Measurement on page 115.

WS425 A/B NMEA Standard Data Message

The standard variable length, comma-separated, MWV wind message is defined by NMEA 0183 V2.20 as follows:

```
$WIMWV,<dir>,<ref>,<spd>,<uni>,<sta>*<chk><CR><LF>
```

where

$WIMWV	=	Fixed text
<dir>	=	Wind angle: 0 to 359 degrees
<ref>	=	Reference: R = Relative
<spd>	=	Wind speed
<uni>	=	Wind speed unit: K = Kilometers per hour M = Meters per second N = Knots
<sta>	=	Status: A = Data valid V = Invalid data
*	=	Fixed text
<chk>	=	Checksum (8-bit XOR, excluding $ and *)
<CR>	=	Carriage return code, ASCII 0DH
<LF>	=	Line feed code, ASCII 0AH

NOTE When the NMEA Standard profile is selected, the **autoInt** parameter must have a non-zero value since no polling command is defined for this profile.

Missing Readings

If data is missing due to a measurement problem, the NMEA messages show "V" in the status field. Wind speed and wind direction fields are left empty.

WS425 NMEA Extended Profile (v. 0183)

When the WS425 A/B NMEA Extended profile is selected, you can set WMT700 to send messages based on the configured automatic message interval or poll data using the **$WIP** command.

Configurable Parameters

Table 47 below lists the configurable parameters and their allowed and default values for the WS425 A/B NMEA Extended profile.

Table 47 Configurable Parameters for WS425 A/B NMEA Extended Profile

Parameter	Default Value	Profile-Specific Allowed Values	Description
address	A	String with 1 character	Address for WMT700
autoInt	1	0.25 ... 1000 Resolution: 0.25	Automatic message interval in seconds. Do not select a message interval that is shorter than the time it takes to send a data message
autoPort	2	1 = COM1 port 2 = COM2 port	Serial port to which WMT700 sends automatic data messages
autoSend	15	0 = Automatic messages disabled 15 = NMEA automatic data message	Automatic data message number. Selects the data message format for automatic messages
com1_protocol	0*	5 = WS425 A/B NMEA Extended	Profile for serial port COM1
com2_protocol	5	5 = WS425 A/B NMEA Extended	Profile for serial port COM2
com2_interf	N/A**	0 = RS-485 1 = RS-422 3 = RS-232	Interface for serial port COM2
wndAvg	3	0.25 … 3600 Resolution: 0.25	Averaging time for wind measurement in seconds
wndOrientation	0	0 = Array facing up 1 = Array facing down	Orientation of the array of WMT700
wndUnit	0**	0 = Meters per second 1 = Miles per hour 2 = Kilometers per hour 3 = Knots	Wind speed unit
wndVector	0	0 = Scalar averaging	Wind averaging method

* COM1 service port is always by default 0 - WMT700 protocol. This can be changed using serial commands if COM1 is needed for protocol-specific communication.

** Wind speed unit and COM2 digital communication interface are defined in the order form. Default setting may be any of the allowed options, and it can be verified from the unit's configuration code.

To start continuous measurement, use the **START** command. You can stop the measurement with the **STOP** command. For instructions, refer to START — Start Continuous Measurement and STOP — Stop Wind Measurement on page 115.

WS425 A/B NMEA Extended Commands

This command polls data from WMT700.

```
$WIP<id>Q,*<chk><CR><LF>
```

where

$WIP	=	Fixed text
<id>	=	Data ID; A … Z
Q	=	Fixed text
*	=	Fixed text
<chk>	=	Checksum (8-bit XOR, excluding $ and *)
<CR>	=	Carriage return code, ASCII 0DH
<LF>	=	Line feed code, ASCII 0AH

Table 48 Checksum Table

ID Character <id>	Checksum <chk>	Polling String
A	72	$WIPAQ,*72<CR><LF>
B	71	$WIPBQ,*71<CR><LF>
C	70	$WIPCQ,*70<CR><LF>
D	77	$WIPDQ,*77<CR><LF>
E	76	$WIPEQ,*76<CR><LF>
F	75	$WIPFQ,*75<CR><LF>
G	74	$WIPGQ,*74<CR><LF>
H	7B	$WIPHQ,*7B<CR><LF>
I	7A	$WIPIQ,*7A<CR><LF>
J	79	$WIPJQ,*79<CR><LF>
K	78	$WIPKQ,*78<CR><LF>
L	7F	$WIPLQ,*7F<CR><LF>
M	7E	$WIPMQ,*7E<CR><LF>
N	7D	$WIPNQ,*7D<CR><LF>
O	7C	$WIPOQ,*7C<CR><LF>

NOTE To use WMT700 with the NMEA Extended profile, either set the **autoSend** parameter to **0** to enable polling or define a fixed output interval with the **autoInt** parameter. If you are using automatic messages, the value for the **autoSend** parameter must be set to **15**.

WS425 A/B NMEA Extended Data Message

WS425 A/B NMEA Extended data message is as follows:

```
$P<id>MWV,<dir>,<ref>,<spd>,<uni>,<sta>*<chk><CR><LF>
```

where		
$P	=	Fixed text
<id>	=	Data ID; A … Z
MWV	=	Fixed text
<dir>	=	Wind angle: 0 to 359 degrees
<ref>	=	Reference: R = relative
<spd>	=	Wind speed
<uni>	=	Wind speed unit: K = Kilometers per hour M = Meters per second N = Knots
<sta>	=	Status: A = Valid data V = Invalid data
*	=	Fixed text
<chk>	=	Checksum (8-bit XOR, excluding $ and *)
<CR>	=	Carriage return code, ASCII 0DH
<LF>	=	Line feed code, ASCII 0AH

Missing Readings

If data is missing due to a measurement problem, the NMEA messages show "V" in the status field. Wind speed and wind direction fields are left empty.

WS425 A/B ASCII Profile

NOTE In Vaisala WINDCAP® Ultrasonic Wind Sensor WS425 User's Guide, this profile was called the Handar mode.

Configurable Parameters

Table 49 below lists the configurable parameters and their allowed and default values for the WS425 A/B ASCII Profile.

Table 49 Configurable Parameters for WS425 A/B ASCII Profile

Parameter	Default Value	Profile-Specific Allowed Values	Description
autoInt	1	0.25 ... 1000 Resolution: 0.25	Automatic message interval in seconds. 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	Automatic data message number. Selects the data message format for automatic messages
com1_protocol	0*	3 = WS425 A/B ASCII	Profile for serial port COM1
com2_protocol	3	3 = WS425 A/B ASCII	Profile for serial port COM2
com2_interf	N/A**	0 = RS-485 1 = RS-422 3 = RS-232	Interface for serial port COM2
wndOrientation	0	0 = Array facing up 1 = Array facing down	Orientation of the array of WMT700
wndUnit	0**	0 = Meters per second 1 = Miles per hour 2 = Kilometers per hour 3 = Knots	Wind speed unit
wndVector	0	0 = Scalar averaging	Wind averaging method

* The parameter has no protocol-specific default value. It is determined separately in the configuration code.
** Wind speed unit and COM2 digital communication interface are defined in the order form. Default setting may be any of the allowed options, and it can be verified from the unit's configuration code.

To start continuous measurement, use the **START** command. You can stop the measurement with the **STOP** command. For instructions, refer to sections START — Start Continuous Measurement on page 115 and STOP — Stop Wind Measurement on page 115.

WS425 A/B ASCII Commands

Table 50 below lists the available commands for operating WMT700 with the WS425 A/B ASCII profile.

Table 50 WS425 A/B ASCII Commands

Command	Description
I	Requests identification information for WMT700.
Wx	Starts measurement based on averaging time and fetches the data.

NOTE The following WS425 A/B ASCII command cannot be used with WMT700: Measurement Unit Change **Ux**

For a list of configuration commands for WMT700, see Table 63 on page 195.

I — Identify Sensor

This command shows the vendor, model number, and version information of WMT700.

```
I
```

Example of the command and response:

```
I

VAISALA WMT700 200
```

Wx — Start Measurement

This command starts wind measurement based on averaging time and fetches the data automatically when the measurement has finished. You must specify the averaging time in the command.

Averaging time supplied in the command (x) sets the averaging time for WMT700, as if it was set with the **S** command. When you change the averaging time, it applies to the next new wind value.

```
Wx
```

where

x = Time for averaging wind speed and wind direction. The range is from 1 to 9

WMT700 responds to the **Wx** command with a 19-character fixed-length data message. For more information, see Table 51 below.

Table 51 WS425 A/B ASCII Data Message

Character	Description
1	┐ 02H (<STX>, start of transmission)
2	W
3	Averaging in seconds
4	Status: P = Pass F = Fail
5	Wind direction (most significant digit)
6	Wind direction (middle digit)
7	Wind direction (least significant digit)
8	Wind speed (most significant digit)
9	Wind speed (next digit)
10	Wind speed (next digit)
11	Wind speed (least significant digit)
12	. (dot character)
13	Wind speed (tenth digit)
14	Wind speed unit: M = Miles per hour K = Knots L = Kilometers per hour T = Meters per second
15	Checksum (most significant digit). For more information, see the note below
16	Checksum (least significant digit)
17	└ 03H (<ETX>, end of transmission)
18	CR (carriage return)
19	LF (line feed)

NOTE The checksum is calculated from the characters from position 2 to 14. The accumulator initializes at 0 with the addition of the byte value. The checksum has a range of 0H … FFH.

Example of the command and response:

```
W5

W5P1200013.2TDE
```

Interpretation of the example message:

- ┐ 02H (<STX>, start of transmission)
- Sensor ID: W
- Averaging in seconds: 5
- Sensor status: P = pass
- Wind direction: 120
- Wind speed: 0013
- . (dot character)
- Wind speed unit: T = meters per second
- Checksum (most significant digit): D
- Checksum (least significant digit): E
- └ 03H (<ETX>, end of transmission)

Missing Readings

If data is missing due to a measurement problem, the WS425 A/B ASCII message reports 999.9 for wind speed.

WS425 A/B WAT11 Profile

Configurable Parameters

Table 52 below lists the configurable parameters and their allowed and default values for the WS425 A/B WAT11 profile.

Table 52 Configurable Parameters for WS425 A/B WAT11 Profile

Parameter	Default Value	Profile-Specific Allowed Values	Description
com1_protocol	0*	6 = WS425 A/B WAT11	Profile for serial port COM1
com2_protocol	0	6 = WS425 A/B WAT11	Profile for serial port COM2

* The parameter has no protocol-specific default value. It is determined separately in the configuration code.

To start continuous measurement, use the **START** command. You can stop the measurement with the **STOP** command. For instructions, refer to sections START — Start Continuous Measurement and STOP — Stop Wind Measurement on page 115.

WS425 A/B WAT11 Commands

When the WS425 A/B WAT11 profile is selected, you can poll data using the following command:

```
<esc><id>
```

where

<esc> = Escape character ASCII 27H
<id> = WMT700 ID, for example, A

The response is as follows:

```
<stx><id><spd><dir>
```

where

<stx>	=	Start of text character (1 digit)
<id>	=	WMT700 identification character, for example, A (one digit)
<spd>	=	Wind speed (in meters per second) multiplied by 10. For example, 045 is 4.5 meters per second (three digits)
<dir>	=	Wind direction with two octal numbers for 6-bit binary data, for example, 73 corresponds to (**7***8+**3**)/64*360 = 332 degrees

Missing Readings

The WS425 A/B WAT11 message reports missing

SDI-12 Profile (v 1.3)

SDI-12 is a standard for interfacing data recorders with microprocessor-based sensors. The name stands for serial/digital interface at 1200 baud.

The SDI-12 Support Group is an association of companies that produce and use SDI-12 products with the purpose of reviewing requests to enhance, clarify, or modify the SDI-12 architecture and that votes on proposed changes to SDI-12.

For the complete SDI-12 standard text and information on the SDI-12 Support Group, refer to the SDI-12 web-site at the following address: http://www.sdi-12.org.

NOTE SDI-12 sub modes A and B are not supported by WMT700.

NOTE When establishing the terminal connection to WMT700, set the following communication settings for the SDI-12 profile:

Bits per second: 1200

Data bits: 7

Parity: 1

Stop bits: 1

Flow Control: None

Configurable Parameters

Table 53 below lists the configurable parameters and their allowed and default values for the SDI-12 profile.

Table 53 Configurable Parameters for SDI-12 Profile

Parameter	Default Value	Profile-Specific Allowed Values	Description
address	1	1, 2, 3, 4, 5, 6, 7, 8, 9	Address for WMT700
autoPort	1	1 = COM1 port 2 = COM2 port	Serial port to which WMT700 sends automatic data messages
autoSend	0	0 = Automatic messages disabled	Automatic data message number. Selects the data message format for automatic messages
com1_protocol	0*	1 = SDI-12	Profile for serial port COM1
com2_baud	1	1 = 1200	Baud rate for serial port COM2. Changes take effect only after reset or the **RESET** command. Note that low bit rate can affect measurement timing, if WMT700 cannot send the data message before new measurement starts
com2_data	7	7 = 7 data bits	Data bits for serial port COM2. Changes take effect only after reset or the **RESET** command
com2_interf	0**	2 = SDI-12	Interface for serial port COM2
com2_parity	1	1 = Even	Parity for serial port COM2. Changes take effect only after reset or the **RESET** command
com2_protocol	1	1 = SDI-12	Profile for serial port COM2
com2_stop	1	1 = 1 bit	Stop bits for serial port COM2. Changes take effect only after reset or the **RESET** command
wndAvg	1	0.25 … 3600 Resolution: 0.25	Averaging time for wind measurement in seconds
wndOrientation	0	0 = Array facing up 1 = Array facing down	Orientation of the array of WMT700
wndUnit	0**	0 = Meters per second 1 = Miles per hour 2 = Kilometers per hour 3 = Knots	Wind speed unit
wndVector	0	0 = Scalar averaging	Wind averaging method

* The parameter has no protocol-specific default value. It is determined separately in the configuration code.
** Wind speed unit and COM2 digital communication interface are defined in the order form. Default setting may be any of the allowed options, and it can be verified from the unit's configuration code.

To start continuous measurement, use the **START** command. You can stop the measurement with the **STOP** command. For instructions, refer to sections START — Start Continuous Measurement and STOP — Stop Wind Measurement on page 115.

SDI-12 Commands

Table 54 below lists the available commands for operating WMT700 with SDI-12 profile.

NOTE You can only use COM2 serial port for sending commands and receiving data messages with the SDI-12 profile.

Table 54 SDI-12 Commands

Command	Description
?!	Queries WMT700 for its address
a!	Ensures that WMT700 is responding
aI!	Queries WMT700 for its SDI-12 compatibility level, model number, and firmware version number
aAb!	Changes WMT700 address
aC!	Starts concurrent measurement
aCC!	Starts concurrent measurement with CRC calculation
aD0!	Fetches instant data from WMT700
aM!	Starts measurement
aMC!	Starts measurement with CRC calculation
aV!	Starts verification

where

a = Single-digit WMT700 address that corresponds to the first character of the **address** value
! = Terminates the command

NOTE The following SDI-12 commands cannot be used with WMT700: Measurement Unit Change Command **aXUx!,** Heater Control Command **aXHx!**, Check Current Sub mode **aX?!**, Place Sensor in Sub mode B Command **aXQx;c.c;n;yyyy!**, Reset the Sensor to Sub mode A Command **aXS!**, Check Current Measurement Unit Command **aX*!, aR0!** Continuous Measurement.

For a list of configuration commands for WMT700, see Appendix A, Complete Command Set for WMT700, on page 195.

?! — Address Query

This command queries for the WMT700 address.

When you use a question mark (?) as the address character with the **a!** command, WMT700 responds as if it was being addressed on the SDI-12 bus. Regardless of its address, WMT700 responds to the command, which allows you to determine the address for the wind sensor.

NOTE	If more than one WMT700 is connected to the bus, they all respond, causing a bus contention.

```
?!
```

where

?	=	Wildcard
!	=	Terminates the command

The response is the following:

```
a<CR><LF>
```

where

a	=	Single-digit WMT700 address that corresponds to the first character of the **address** value
<CR><LF>	=	Terminates the response.

a! — Acknowledge Active

This command ensures that WMT700 is responding to a data recorder or another SDI-12 device. It asks the WMT700 to acknowledge its presence on the SDI-12 bus.

```
a!
```

where

a	=	Single-digit WMT700 address that corresponds to the first character of the **address** value
!	=	Terminates the command

The response is the following:

```
a<CR><LF>
```

where

a	=	Single-digit WMT700 address that corresponds to the first character of the **address** value
<CR><LF>	=	Terminates the response

Example of the command and response:

```
1!
```

```
1<CR><LF>
```

aAb! — Change Address

This command changes the WMT700 address. After WMT700 has received this command and sent a response, the sensor does not respond to any other command for one second. This gives WMT700 time to write the new address to the non-volatile memory.

NOTE	You can also change the WMT700 address by entering configuration mode and changing the **address** parameter.

```
aAb!
```

where

a	=	Current single-digit WMT700 address that corresponds to the first character of the **address** value
A	=	Change address command
b	=	New address
!	=	Terminates the command

The response is the following:

```
b<CR><LF>
```

where

b	=	New single-digit WMT700 address (or the original address if WMT700 is unable to change the address)
<CR><LF>	=	Terminates the response

aC! — Start Concurrent Measurement

This command starts concurrent measurement. WMT700 does not return measurement data after this command. It sends a response that indicates when the measurement result can be retrieved using the **aD0!** command and the number of parameters.

```
aC!
```

where

a	=	Single-digit WMT700 address that corresponds to the first character of the **address** value
C	=	Start concurrent measurement command
!	=	Terminates the command

The response is the following:

```
atttnn<CR><LF>
```

where

a	=	Single-digit WMT700 address that corresponds to the first character of the **address** value
ttt	=	Period of time, in seconds, after which WMT700 has the measurement ready
nn	=	Number of measurement values WMT700 calculates and returns as a response to one or more subsequent **aD0!** commands
<CR><LF>	=	Terminates the response

Example of the command and response:

```
1C!

100205<CR><LF>
```

Interpretation of the example message:

- Time after which the measurement is ready: 2 seconds
- Number of returned measurement values: 5

To fetch the measurement results, use the **aD0!** command.

aD0! — Send Data

This command fetches instant data from WMT700. **aD0!** must be preceded by a **C!**, **M!**, or **V!** command. WMT700 responds by sending measurement data (after **C!** or **M!**) or verification data (after **V!**).

In a SDI-12 system compliant with the standard, if the expected number of measurements is not returned in response to an **aD0!** command, a data recorder issues **D1!**, **D2!**, and so on, until all measurement values are received. The expected number of measurements is included in the message that WMT700 sends in response to an **aC!**, **aM!** or **aV!** command. Multiple data requests are not needed with WMT700, since all return values fit easily into one response string.

```
aD0!
```

where

a	=	Single-digit WMT700 address that corresponds to the first character of the **address** value
D0	=	Send data command
!	=	Terminates the command

For a description of the data messages, see section SDI-12 Data Messages on page 176.

aI! — Send Identification

This command queries WMT700 for its SDI-12 compatibility level, model number, and firmware version number.

```
aI!
```

where

a	=	Single-digit WMT700 address that corresponds to the first character of the **address** value
I	=	Send identification command
!	=	Terminates the command

The response is the following:

```
allccccccccmmmmmmvvvxxx . . . xxx<CR><LF>
```

where

a	=	Single-digit WMT700 address that corresponds to the first character of the **address** value
11	=	SDI-12 version number, indicating SDI-12 version compatibility; for example, version 1.1 is encoded as 11
cccccccc	=	8-character vendor identification Vaisala_
mmmmmm	=	6 characters specifying the model number of WMT700
vvv	=	3 characters specifying the firmware version 604
xxx ... xxx	=	Optional field, up to 13 characters, used for a serial number or other specific WMT700 information that is not relevant for operation of the data recorder (not used)
<CR><LF>	=	Terminates the response

aM! — Start Measurement

This command starts measurement. WMT700 does not return measurement data after this command. It sends a response that indicates when the measurement result can be retrieved using the **aD0!** command and the number of parameters.

```
aM!
```

where

a	=	Single-digit WMT700 address that corresponds to the first character of the **address** value
M	=	Start measurement command
!	=	Terminates the command

The response is the following:

```
atttn<CR><LF>
```

where

a	=	Single-digit WMT700 address that corresponds to the first character of the **address** value
ttt	=	Period of time, in seconds, after which WMT700 has the measurement ready
n	=	Number of measurement values WMT700 calculates and returns as a response to one or more subsequent **aD0!** commands
<CR><LF>	=	Terminates the response

Example of the command and response:

```
1M!
```

```
10025<CR><LF>
```

Interpretation of the example message:

- Time after which the measurement is ready: 2 second
- Number of returned measurement values: 5

To fetch the measurement results, use the **aD0!** command.

aV! — Start Verification

This command starts verification. However, WMT700 does not return verification data directly after this command. It sends a response that specifies when the verification results can be retrieved using the **aD0!** command and the number of parameters. The WMT700 verification data includes a watchdog count, sensor measurement unit settings, and the current SDI mode setting.

The command is the following:

```
aV!
```

where

a	=	Single-digit WMT700 address that corresponds to the first character of the **address** value
V	=	Starts verification command
!	=	Terminates the command

The response is the following:

```
atttn<CR><LF>
```

where

a	=	Single-digit WMT700 address that corresponds to the first character of the **address** value
ttt	=	Period of time, in seconds, after which WMT700 has the verification data ready
n	=	Number of verification data fields that will be returned
<CR><LF>	=	Terminates the response

Example of the command and response:

```
1V!

10014<CR><LF>
```

Interpretation of the example message:

- Time when the measurement is ready: 1 second
- Number of returned measurement values: 4

To fetch the measurement results, use the **aD0!** command.

SDI-12 Data Messages

When the SDI-12 profile is selected, the data message sent by WMT700 depends on the command that you use before fetching the data with the **aD0!** command.

WS425 A/B SDI-12 Message for C and M Command

When you have given the commands **aC!** or **aM!** followed by **aD0!**, the response is the following:

```
a<WS><WD><x><y><s><CR><LF>
```

where

a	=	Single-digit WMT700 address that corresponds to the first character of the **address** value
<WS>	=	Polar wind speed in selected units Format: +(ss)s.s
<WD>	=	Polar wind direction in degrees Format: +(dd)d.d
<x>	=	x component of wind speed in selected units Format: ±(ss)s.s
<y>	=	y component of wind speed in selected units Format: ±(ss)s.s
<s>	=	Static speed of sound in miles per hour Format: ±(ss)s.s
<CR><LF>	=	Terminates the response

The above are measurement data fields.

Missing Readings

If data is missing due to a measurement problem (for example, blocked paths between transducers), the measurement data is replaced with 999.9.

Example of the command and response when data is missing:

```
7D0!

7+999.9+999.9+999.9+999.9+999.9 <CR><LF>
```

WS425 A/B SDI-12 Message for V Command

When you have given the commands **aV!** and **aD0!**, the response is the following:

```
a<watchdog><WS_unit><SDI-mode><spare><CR><LF>
```

where

a	=	Single-digit WMT700 address that corresponds to the first character of the **address** value
<watchdog>	=	Number of times the watchdog has triggered. Ideally should be zero. Format: +(c)c
<WS_unit>	=	Wind speed unit. The options are: +0 = mph +1 = kt +2 = km/h +3 = m/s
<SDI-mode>	=	Current sub mode setting. The options are: +0 = SDI-12 sub mode A +1 = SDI-12 sub mode B
<spare>	=	1 digit for factory use, format: +c
<CR><LF>	=	Terminates the response

The above are verification data fields.

Requesting Cyclic Redundancy Check

Error detection capability can be enhanced by using the **aCC!** or **aMC!** command to start the measurement. These commands have the same function and send the same response as commands **aC!** and **aM!** respectively. The difference is that Cyclic Redundancy Check will be appended to the data returned by **aD0!** command.

The 16-bit Cyclic Redundancy Check value is appended to the response of **aD0!** command before the <CR><LF>. It is encoded as three ASCII characters using the following algorithm:

```
1st character=0x40 OR (CRC shifted right 12 bits)
2nd character=0x40 OR ((CRC shifted right 6 bits) AND
0x3F)
3rd character=0x40 OR (CRC AND 0x3F)
```

Example of the command and response:

```
1MC!

10025<CR><LF>

1D0!

1+2.7+85.2-0.2-2.7+770.5CAH<CR><LF>
```

CHAPTER 6
MAINTENANCE

This chapter contains information on performing visual inspection, cleaning, and verifying the operation of WMT700.

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

NOTE	In maritime environments, it is not possible to perform WMT700 software updates.

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 a 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 a 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 an optional verifier. You can order WM Verifier from Vaisala as an accessory; see Table 62 on page 192.

Vaisala recommends that you perform the test every 12 months 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. To see how the verifier fits over the transducers, see Figure 51 on page 182.
2. Start wind measurement. The command depends on the selected communication profile.
3. Make sure that WMT700 reads 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.

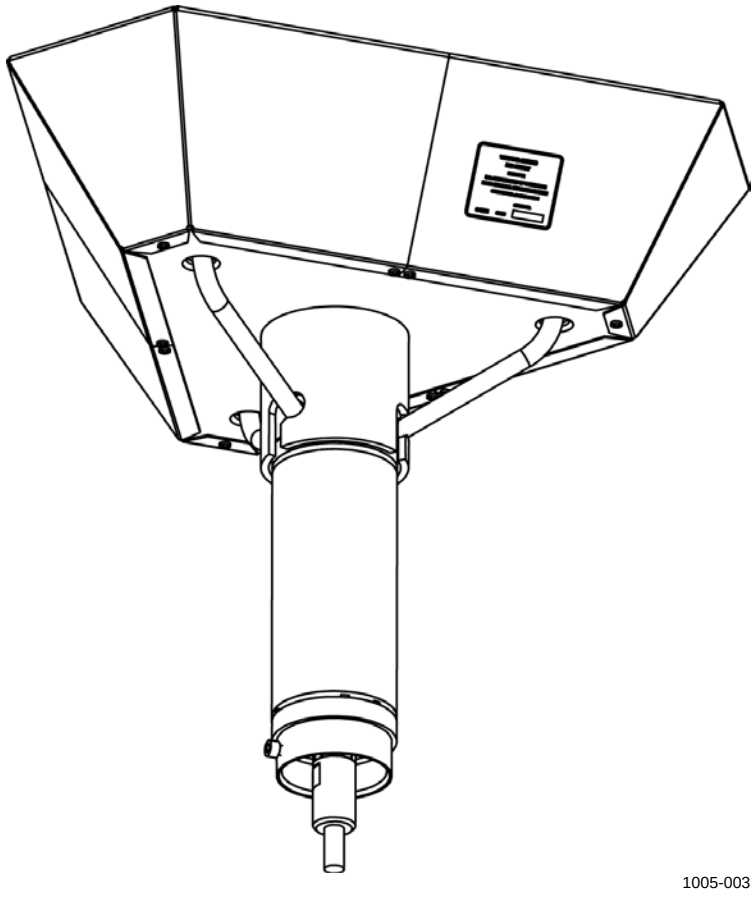

Figure 51 Testing WMT700 with WM Verifier

CHAPTER 7
TROUBLESHOOTING

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

Problem Situations

Table 55 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 84.
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 Installation Location on page 58.
	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 74.
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 118.
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 186.

Problem	Probable Cause	Remedy
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 77
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 116.
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 40 on page 128.
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 Parameter Handling Commands on page 111.
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 107.
WMT700 sends an error message as a response to a command.	For probable causes, see section Error and Event Messages on page 185.	For remedies, see section Error and Event Messages on page 185.
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 118
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 115.
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.
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 Appendix D Configuration Parameters on page 205 if reset is required before the parameter is changed.

Problem	Probable Cause	Remedy
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.
Retrofit installation of WMT700 is not possible.	You do not have the correct mounting kit for the retrofit installation.	Check that you are using the correct mounting adapter with your mounting kit. Refer to Appendix F, Accessories, on page 213.
WMT700 does not work properly after retrofit installation.	Incorrect cables were used in the retrofit installation.	Check that you have used cables listed in Checklist for Connection Cables on page 73. If you do not have the correct cables, contact Vaisala technical support.
Connection to WMT700 is lost.	The power supply is not sufficient, especially if you are using a heated version of WMT700.	Check that the power supply matches the requirements in section Powering on page 105.

Error and Event Messages

If **messages** parameter is set to **1**, WMT700 sends error and event messages. Table 56 below lists the available messages.

Table 56 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 107.
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 Appendix D Configuration Parameters on page 205.
11	Error. Parameter used with the **S** command is unknown.	Check that you are using the correct parameter names, see Appendix D Configuration Parameters on page 205.
12	Error. Unknown command.	Check the allowed commands in Appendix A, Complete Command Set for WMT700, on page 195.
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 116.
- Include diagnostics-related items in the data message. For more information, see section Parameter Handling Commands on page 111.

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, 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. On 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…
    ```

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

    ```
    Done. Rebooting…
    ```

    WMT700 has now applied the settings and will reboot using the new settings. The restored settings are shown in Table 57 below.
11. Before you start configuring new values to WMT700, you need to apply the new settings to HyperTerminal. In the **Call** menu, click **Disconnect** to close the connection.
12. On the **File** menu, click **Properties**.
13. In the Properties dialog, click **Configure**.
14. Select **9600** in the **Bits per second** combo box.
15. Close the **Properties** window.
16. On the **Call** menu, click **Call**.

Table 57 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 on page 110.

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 8
TECHNICAL DATA

This chapter provides the technical data of WMT700.

Table 58 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	±0.1 m/s or 2% of reading, whichever is greater

Table 59 Wind Direction

Property	Description/Value
Measurement range	0 … 360°
Starting threshold	0.1 m/s
Resolution	0.01°
Accuracy	±2°
Response time	250 ms
Available variables	instant, average, maximum, minimum

Table 60 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 push-pull	Pulse 0 V/10 V: 0 ... 2 kHz (f = 10 Hz/m/s) (Load > 10 kohm)
Frequency pull-down	Pulse 0.5 V/V_{in}-2 V (11 V min.): 0 ... 750 Hz (Load 50 kohm ±20%)
Frequency pull-up	Pulse 1.5 V/V_{in}-4 V (8 V min.): 0 ... 750 Hz (Load 50 kohm ±20%)
Voltage	0 ... 10 V (U = 100 mV /m/s)
Current	0 ... 20 mA (I = 0.2 mA/m/s)
Wind direction:	0 ... 10 V (U = 20 mV/°)
Voltage	0 ... 20 mA (I = 50 uA//°)
Current	Reference voltage 1 ... 10 VDC
Potentiometer	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 61 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: 150 W Average transducer, arm, and body heating: 250 W Peak transducer, arm, and body heating: 350 W at 24 VDC
Operating temperature	-10 ... +60 °C -40 ... +60 °C -55 ... +70 °C
Operating voltage: Absolute maximum	9 ... 36 VDC; see details in Table 26 on page 84 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	 348 mm 250 mm 285 mm
Weight	WMT700 Wind Sensor: 1.8 kg Mounting adapter: 0.3 kg Fix70 Mounting Kit 1.4 kg
Connector	Hummel 7.106 series

NOTE In maritime environments, the normal input voltage ranges are: operating voltage 10 … 30 VDC (-10% … +30%) and heating voltage 24 … 30 VDC (-10% … +30%), as defined in the maritime standard IEC 60945.

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 62 Accessories

Group	Description	Order Code
Tool	Zero Wind Verifier	WMT70Verifier
	Cable Tightening Tool	237888SP
Bird	Bird cage	WMT70BirdKit
	Bird perch	WS425BirdPerch
Cable	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
	Cable 15 m, cable connector, open leads on one end	237890SP
	Cable 26 m, cable connector, open leads on one end	228260SP
	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
	ROSA analog cable 10 m, cable connector, open leads on one end	231425SP
	Adapter cable for WS425 serial	227569SP
	Adapter cable for WS425 analog frequency output	227570SP
	Adapter cable for WS425 analog voltage output	227571SP
	Junction Box with Cable 2 meters	ASM210719SP
WMT700 Mounting Accessories	Adapter for FIX70	228869
	General purpose mounting adapter (suitable also for inverted mounting)	WMT70FIXSP
	Plastic mounting adapter for 60 mm tube	WMT700FIX60-POM
	Stainless steel mounting adapter for 60 mm tube	WMT700FIX60-RST
	Cross-arm (requires WMT70FIX mounting adapter)	WMT70CROSSARM
WS425 Mounting Accessories	Adapter for WS425FIX30, WS425FIX60-POM, and WS425FIX60-RST	228777
	Mounting adapter for 30 mm tube	WS425FIX30
	Aluminum mounting adapter for 60 mm tube	WS425FIX60
	Sensor support arm for 60 mm pole (655 mm with integrated fix for item 228777)	WAC425

Dimensions

Figure 52 below and Figure 53 on page 194 show the dimensions of the WMT700 wind sensor and the FIX70 mounting kit.

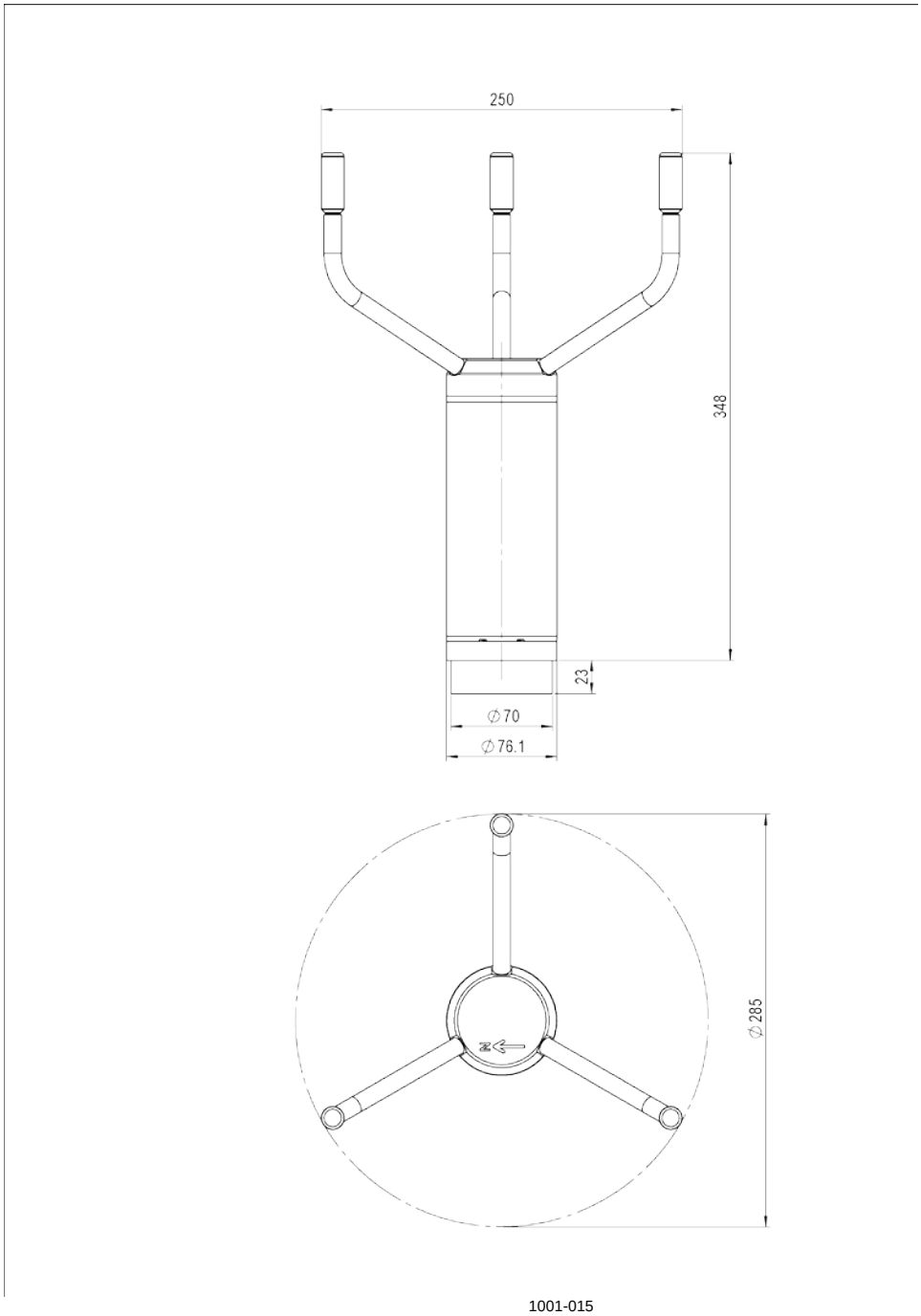

Figure 52 WMT700 Dimensions in Millimeters

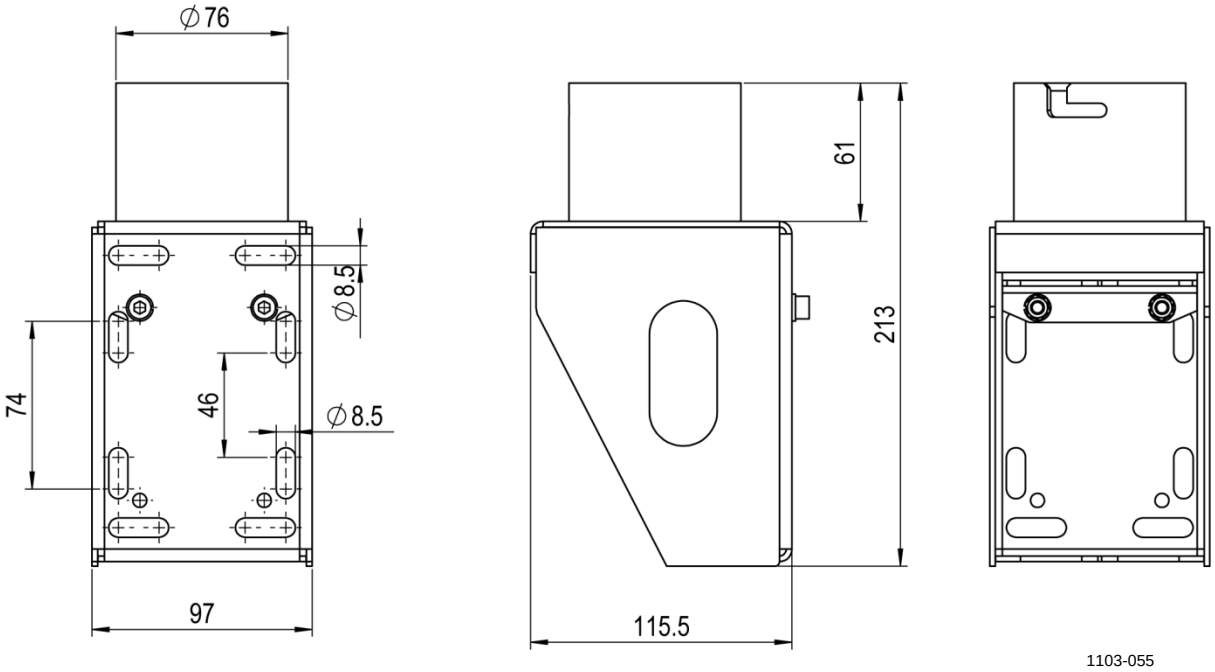

Figure 53 FIX70 Mounting Kit Dimensions in Millimeters

APPENDIX A
COMPLETE COMMAND SET FOR WMT700

Table 63 below lists all the commands available for WMT700.

Table 63 Command Set for All Profiles

Configuration Mode/ Measurement Mode and Profile	Command	Description
Configuration mode	?	Displays a list of configuration commands.
Configuration mode	BAUD	Changes or displays serial port settings.
Configuration mode	CLEARERR	Resets error counters.
Configuration mode	CLOSE	Switches the serial port to measurement mode.
Configuration mode	ERRORS	Displays error codes and counts.
Configuration mode	G	Displays either all or specified parameters.
Configuration mode	H	Displays list of data messages and available values for measurement unit, profile, baud rate, interface, and analog output mode.
Configuration mode	MEAS	Starts wind measurement based on the user-configurable averaging time. WMT700 does not send data messages automatically.
Configuration mode	POLL	Tests data polling.
Configuration mode	RESET	Resets WMT700.
Configuration mode	S	Changes selected parameters or defines new data messages.
Configuration mode	START	Starts continuous measurement.
Configuration mode	STOP	Stops continuous measurement.
Configuration mode	VERSION	Displays the software version.
Configuration mode	WIND_GET	Fetches wind calibration information.
Measurement Mode WMT700 profile	MEAS	Starts wind measurement. The duration of the measurement is based on the user-configurable averaging time.
Measurement mode WMT700 profile	OPEN	Switches the serial port to configuration mode.
Measurement mode WMT700 profile	POLL	Fetches data from WMT700.
Measurement mode WMT700 profile	SLEEP	Switches WMT700 from normal operating mode to low-power mode.
Measurement Mode MES12 profile	@a M 12	Polls data from WMT700 in the MES12 data message format.
Measurement mode WS425 ASOS F/G profile	WA	Requests average wind speed and direction message.
Measurement mode WS425 ASOS F/G profile	WS	Requests the verbose Built-In Test (BIT) results.

Configuration Mode/ Measurement Mode and Profile	Command	Description
Measurement mode WS425 A/B NMEA Extended profile	$WIP	Polls data from WMT700.
Measurement mode WMT700 NMEA MWV profile	$aabbQ,MWV	Polls NMEA MWV message from WMT700.
Measurement mode WS425 A/B ASCII profile	I	Requests identification information from WMT700.
Measurement mode WS425 A/B ASCII profile	Wx	Starts measurement based on averaging time and fetches the data.
Measurement mode WS425 A/B WAT11 profile	<esc><id>	Polls data from WMT700.
Measurement mode SDI-12 profile	?!	Queries WMT700 for its address.
Measurement mode SDI-12 profile	a!	Ensures that WMT700 is responding.
Measurement mode SDI-12 profile	aI!	Queries WMT700 for its SDI-12 compatibility level, model number, and firmware version number.
Measurement mode SDI-12 profile	aAb!	Changes WMT700 address.
Measurement mode SDI-12 profile	aC!	Starts concurrent measurement.
Measurement mode SDI-12 profile	aCC!	Starts concurrent measurement. CRC is included in the response.
Measurement mode SDI-12 profile	aD0!	Fetches instant data from WMT700.
Measurement mode SDI-12 profile	aM!	Starts measurement.
Measurement mode SDI-12 profile	aMC!	Starts measurement. CRC is included in the response.
Measurement mode SDI-12 profile	aV!	Starts verification.

APPENDIX B
TYPICAL SYSTEM ENVIRONMENTS

This appendix lists the most typical WMT700 system environments.

Figure 54 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.

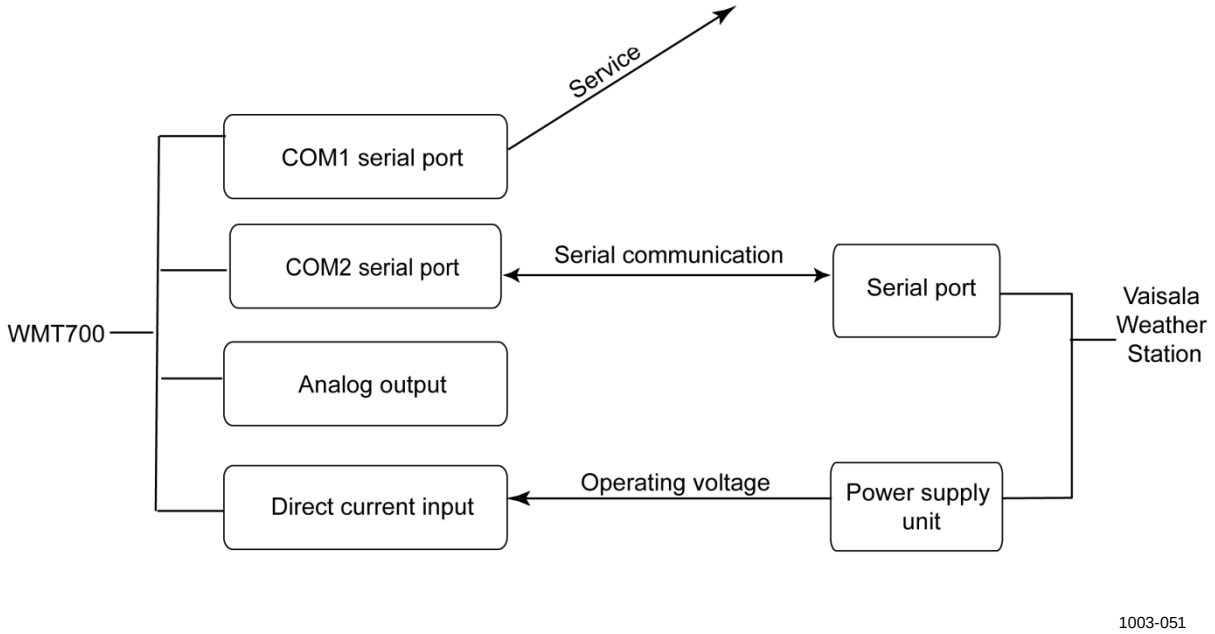

Figure 54 System Environment with Serial Port COM1 Only

Figure 55 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.

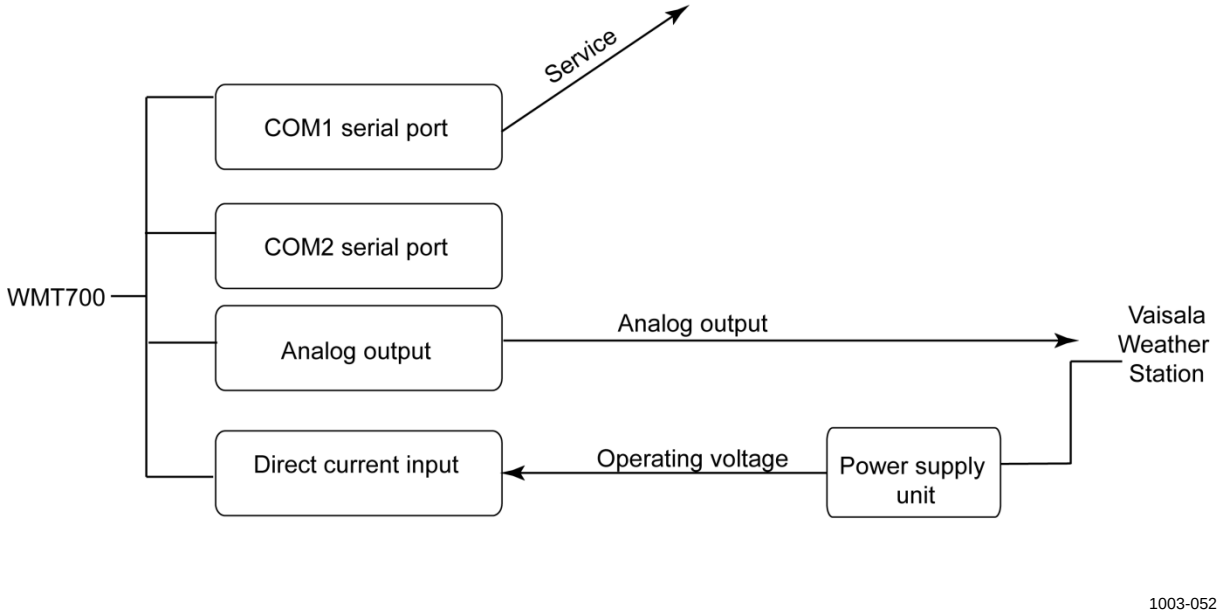

Figure 55 System Environment with Analog Output Only

Figure 56 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.

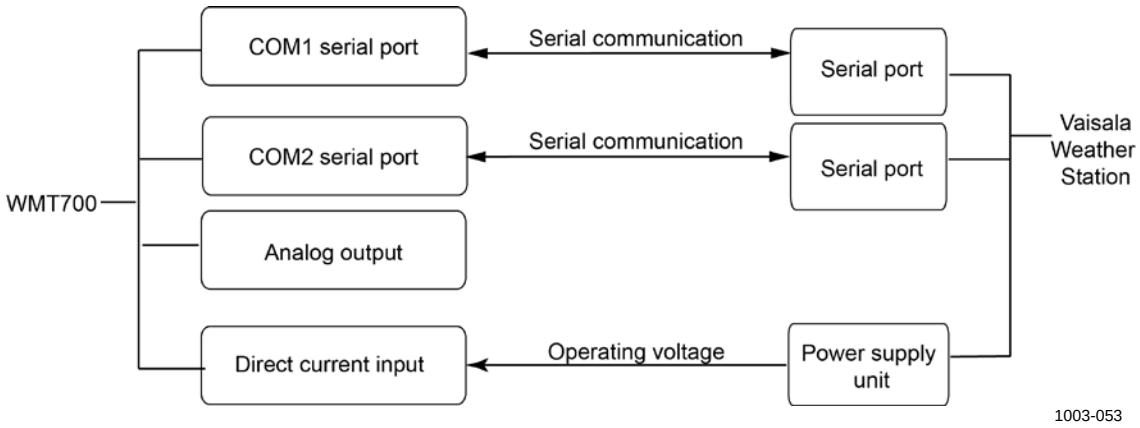

Figure 56 System Environment with Serial Ports COM1 and COM2

Figure 57 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.

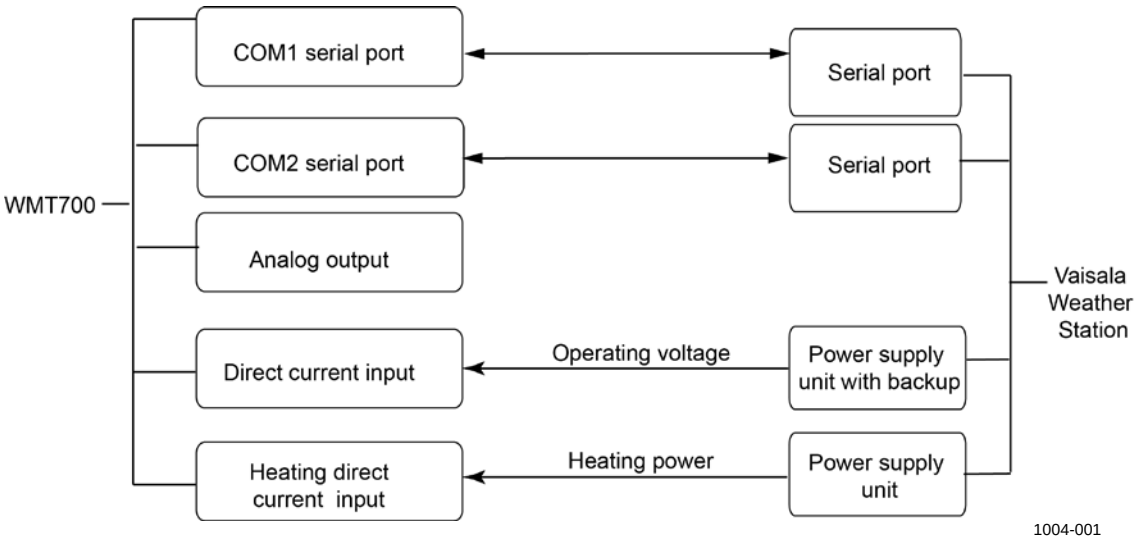

Figure 57 System Environment with Backup Battery

APPENDIX C

DEFAULT SETTINGS FOR DIFFERENT COMMUNICATION PROFILES

This appendix lists the default settings for different digital communication profiles. All the allowed values for different communication profiles are listed in Table 64 on page 202.

Table 64 Default Settings for Different Digital Communication Profiles

Setting	Parameter	WMT700	WS425 ASCII	WS425 NMEA Ext	WS425 SDI-12	WS425 F/G ASOS	ROSA MES12
Service Port							
Protocol	com1_ protocol	WMT700	WMT700	WMT700	WMT700	WMT700	WMT700
Baud rate	com1_baud	9600	9600	9600	9600	9600	9600
Data bits	com1_data	8	8	8	8	8	8
Parity	com1_parity	0 (None)	0 (None)	0 (None)	0 (None)	0 (None)	0 (None)
Stop bits	com1_stop	1	1	1	1	1	1
Response Delay	com1_delay	20 ms	20 ms	20 ms	20 ms	20 ms	20 ms
Data Port							
Protocol	com2_ protocol	WMT700	WS425 ASCII	WS452 NMEA Ext	SDI-12	WS425 F/G ASOS	ROSA MES12
Baud rate	com2_baud	9600	2400	9600	1200	2400	9600
Data bits	com2_data	8	8	8	7	8	8
Parity	com2_parity	0 (None)	0 (None)	0 (None)	1 (Even)	0 (None)	0 (None)
Stop bits	com2_stop	1	1	1	1	1	1
Response Delay	com2_delay	20 ms	20 ms	20 ms	N/A	20 ms	20 ms
Other Parameters							
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
Automatic data message interval	autoInt	1 s	1 s	1 s	1 s	1 s	1 s
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
Installation orientation of WMT700	wndOrientation	Array facing up	Array facing up	Array facing up	Array facing up	Array facing up	Array facing up
Wind measure-ment averaging method	wndVector	Scalar averaging	Scalar averaging	Scalar averaging	Scalar averaging	Scalar averaging	Scalar averaging

The parameters in Table 65 below do not have a protocol-specific default value. They are defined in the configuration code.

Table 65 Parameters without Protocol-Specific Default Value

Setting	Parameter	WMT700	WS425 ASCII	WS425 NMEA Ext	WS425 SDI-12	WS425 F/G ASOS	ROSA MES12
Interface type	com2Interf	N/A	N/A	N/A	N/A	N/A	N/A
Wind speed unit	wndUnit	N/A	N/A	N/A	N/A	N/A	N/A

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APPENDIX D
CONFIGURATION PARAMETERS

This appendix lists the WMT700 configuration parameters.

Table 66 Parameter Descriptions

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.
aout1err aout2err	1000	0 … 32000	V, A, Hz, %	Value for AOUT1 and AOUT2 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.
cal_date				Wind calibration date. This is a read-only parameter.

Parameter Name	Default Value	Allowed Values	Units	Description
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.)
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 … 11		Protocol for serial port COM1. 0 = WMT700 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 11 = WMT700 NMEA MWV
com2_protocol	0	0 … 11		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 11 = WMT700 NMEA MWV
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.
freqType	0	0 = Push-pull 1 = Active pull-down 2 = Active pull-up		AOUT1 frequency output type. Setting 1 requires external pull-up resistor. Setting 2 requires external pull-down resistor.
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		Response for parameter setting.

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	0	0 = Scalar averaging 1 = Vector averaging		Wind averaging method

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APPENDIX E
WMT700 NMEA MWV PROFILE

This appendix lists the configurable parameters, commands, and data messages of the WMT700 NMEA MWV profile.

When the WMT700 NMEA MWV profile is selected, you can set WMT700 to send messages based on the configured automatic message interval or poll MWV message using the NMEA **Query** command.

Configurable Parameters

Table 67 below lists the configurable parameters and their allowed and default values for the WMT700 NMEA MWV profile.

Table 67 Configurable Parameters for WMT700 NMEA MWV Profile

Parameter	Default Value	Profile-Specific Allowed Values	Description
address	N/A	String with 2 characters, for example "WI"	Address for WMT700. The address must consist of two capital letters A … Z
autoInt	1	0.25 ... 1000 Resolution: 0.25	Automatic message interval in seconds. 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 20 = WMT700 NMEA MWV automatic data message	Automatic data message number. Selects the data message format for automatic messages
com1_protocol	0*	11 = WMT700 NMEA MWV protocol	Profile for serial port COM1
com2_protocol	0	11 = WMT700 NMEA MWV protocol	Profile for serial port COM2
com2_interf	N/A**	0 = RS-485 1 = RS-422 3 = RS-232	Interface for serial port COM2
wndAvg	1	0.25 … 3600 Resolution: 0.25	Averaging time for wind measurement in seconds
wndOrientation	0	0 = Array facing up 1 = Array facing down	Orientation of the array of WMT700
wndUnit	0**	0 = Meters per second 1 = Miles per hour 2 = Kilometers per hour 3 = Knots	Wind speed unit
wndVector	0	0 = Scalar averaging	Wind averaging method

* COM1 service port is always by default 0 - WMT700 protocol. This can be changed using serial commands if COM1 is needed for protocol-specific communication.

** Wind speed unit and COM2 digital communication interface are defined in the order form. Default setting may be any of the allowed options, and it can be verified from the unit's configuration code.

To start continuous measurement, use the **START** command. You can stop the measurement with the **STOP** command. For instructions, refer to sections START — Start Continuous Measurement and STOP — Stop Wind Measurement on page 115.

WMT700 NMEA MWV Commands

This command polls data from WMT700 when the WMT700 NMEA MWV protocol is selected.

```
$--<id>Q,MWV*<chk><CR><LF>
```

where

$	=	Message header
--	=	Two-character talker ID of the polling unit
<id>	=	Two -character WMT700 sensor ID; AA … ZZ
Q	=	Query command
,	=	Field delimiter
MWV	=	Sentence formatter
*<chk>	=	Checksum field(8-bit XOR, excluding $ and *)
<CR>	=	Carriage return code, ASCII 0DH
<LF>	=	Line feed code, ASCII 0AH

NOTE To use WMT700 with the WMT700 NMEA MWV profile, either set the **autoSend** parameter to **0** to enable polling or define a fixed output interval with the **autoInt** parameter. If you are using automatic messages, the value for the **autoSend** parameter must be set to **20**.

WMT700 NMEA MWV Data Message

WMT700 NMEA MWV data message is as follows:

```
$<id>MWV,<dir>,<ref>,<spd>,<uni>,<sta>*<chk><CR><LF>
```

where		
$	=	Message header
<id>	=	Two character sensor ID; AA … ZZ
MWV	=	Fixed text
<dir>	=	Wind angle: 0 to 359 degrees
<ref>	=	Reference: R = Relative
<spd>	=	Wind speed
<uni>	=	Wind speed unit: K = Kilometers per hour M = Meters per second N = Knots
<sta>	=	Status: A = Valid data V = Invalid data
*	=	Fixed text
<chk>	=	Checksum (8-bit XOR, excluding $ and *)
<CR>	=	Carriage return code, ASCII 0DH
<LF>	=	Line feed code, ASCII 0AH

Example of the command and response:

```
$IIWIQ,MWV*2F<CR><LF>
```

```
$WIMWV,045,R,011.63,N,A*09<CR><LF>
```

Interpretation of the example message:

- Talker ID "II" queries the WMT700 NMEA MWV message from sensor which has address parameter set to "WI".
- WMT700 responds with talker ID "WI" and the requested MWV message. The reported relative wind direction is 045 degrees and the wind speed is 11.63 knots.

Missing Readings

If data is missing due to a measurement problem, the NMEA messages show "V" in the status field. Wind speed and wind direction fields are left empty.

APPENDIX F
ACCESSORIES

This Appendix lists all the accessories available for WMT700.

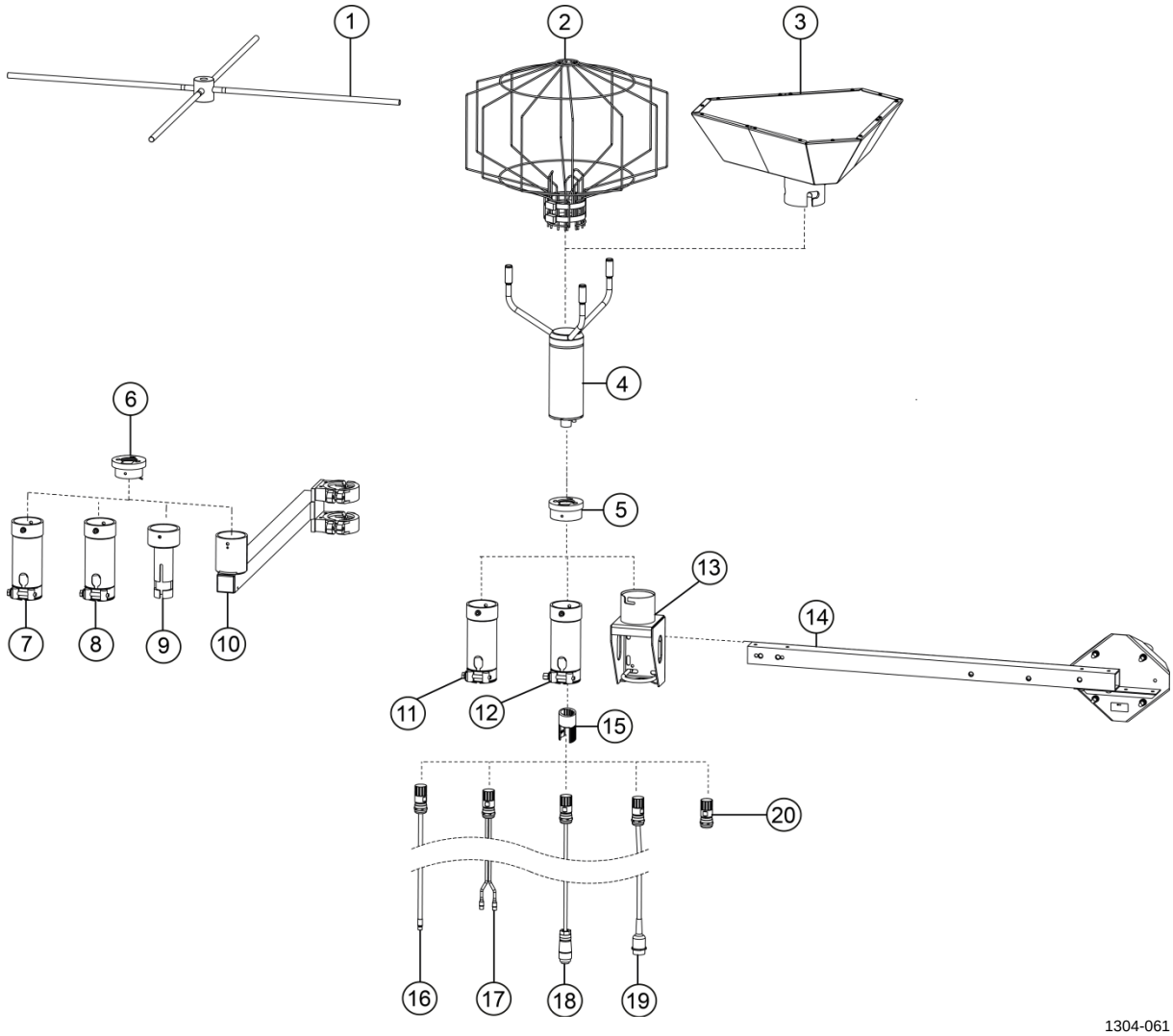

Figure 58 Complete Set of Accessories

The following numbers refer to Figure 58 on page 214:

1 = Bird perch (WMT70BirdPerch)
2 = Bird cage (WMT70BirdKit)
3 = Zero wind verifier (WMT70Verifier)
4 = Vaisala WMT700
5 = Adapter for WMT70FIX, WMT700FIX-POM, and WMT700FIX60-RST (228869)
6 = Adapter for WS425FIX30, WS425FIX60, and WAC425 (228777)
7 = Plastic mounting adapter for 60 mm tube (WS425FIX60-POM)
8 = Stainless steel mounting adapter for 60 mm tube (WS425FIX60-RST). Also available in aluminum (WS425FIX60).
9 = Mounting adapter for 30 mm tube (WS425FIX30)
10 = Sensor support arm for 60 mm mast (WAC425)
11 = Plastic mounting adapter for 60 mm tube (WMT70FIX60-POM)
12 = Stainless steel mounting adapter for 60 mm tube (WMT70FIX60-RST)
13 = General purpose mounting adapter for WMT700 (WMT70FIX)
14 = Cross arm (WMT70CrossArm)
15 = Cable tightening tool (237888SP)
16 = Cables with open lead (227267SP, 227568SP, 228259SP, 237889SP, 237890SP)
17 = Vaisala MAWS cable (227565SP)
18 = Vaisala AWS cables (229807SP, 227566SP)
19 = Vaisala WS425 adapter cables (227569SP, 227570SP, 227571SP)
20 = WMT700 connector DIY kit (WMT70Conn)

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APPENDIX G
CERTIFICATES

This appendix contains copies of certificates issued for WMT700.

DET NORSKE VERITAS

TYPE EXAMINATION CERTIFICATE

CERTIFICATE NO. A-12621
This Certificate consists of 2 pages

This is to certify that the

WMT 700 SERIES ULTRASONIC WIND SENSORS

with type designation(s)

WMT701, WMT702, WMT703

Manufactured by

Vaisala Oyj
Vantaa, Finland

is found to comply with

IEC 60945 Ed. 4 (2002-08) Maritime navigation and radiocommunication equipment and systems - General requirements - Methods of testing and required test results

Application
See page 2

Place and date
Høvik, 2012-03-27
for DET NORSKE VERITAS AS

Jan Tore Grimsrud
for Head of Section

Local Office
Helsinki

This Certificate is valid until
2016-06-30

Steinar Kristensen
Surveyor

Notice: This Certificate is subject to terms and conditions overleaf. Any significant change in design or construction may render this Certificate invalid. The validity date relates to the Type Examination Certificate and not to the approval of equipment/systems installed.

If any person suffers loss or damage which is proved to have been caused by any negligent act or omission of Det Norske Veritas, then Det Norske Veritas shall pay compensation to such person for his proved direct loss or damage. However, the compensation shall not exceed an amount equal to ten times the fee charged for the service in question, provided that the maximum compensation shall never exceed USD 2 million.In this provision "Det Norske Veritas" shall mean the Foundation Det Norske Veritas as well as all its subsidiaries, directors, officers, employees, agents and any other acting on behalf of Det Norske Veritas.

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Form No.: 20.93a Issue: December 2002
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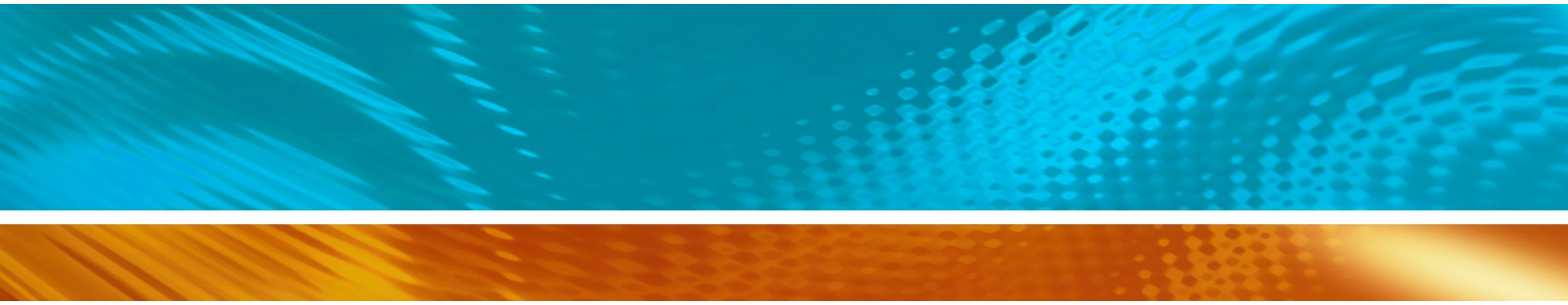

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