M211095EN-H

User Guide

Vaisala WINDCAP® Ultrasonic Wind Sensor Series

WMT700

VAISALA

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1. About This Document

1.1 Version Information

Table 1 Document Versions

Document Code	Date	Description
M211095EN-H	April 2017	Added 3 new commands for WS425 F/G ASOS protocol. Added information about the new ASOS adapter.
M211095EN-G	February 2017	Previous version

1.2 Documentation Conventions

DANGER! alerts you to a fatal hazard. If you do not read and follow instructions carefully at this point, death will follow.

WARNING! alerts you to a serious hazard. If you do not read and follow instructions carefully at this point, there is a risk of injury or even death.

CAUTION! warns you of a potential hazard. If you do not read and follow instructions carefully at this point, the product could be damaged or important data could be lost.

Note highlights important information on using the product.

Tip gives information for using the product more efficiently.

1.3 Trademarks

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

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

2. Product Overview

2.1 Introduction to WMT700

WMT700 measures wind speed and direction, and sends the measurement results to data acquisition systems. WMT700 is suitable for systems and stand-alone installations.

The WMT700 series consists of four product types with different measurement ranges: WMT701, WMT702, WMT703, and WMT704. You can select heating functions that shield the array and/or the transducers and the sensor body from ice and snow build-up 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 fully compensated.

Since the 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 your order, and it is ready for operation directly after the installation. You also have a wide range of configuration options and 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.

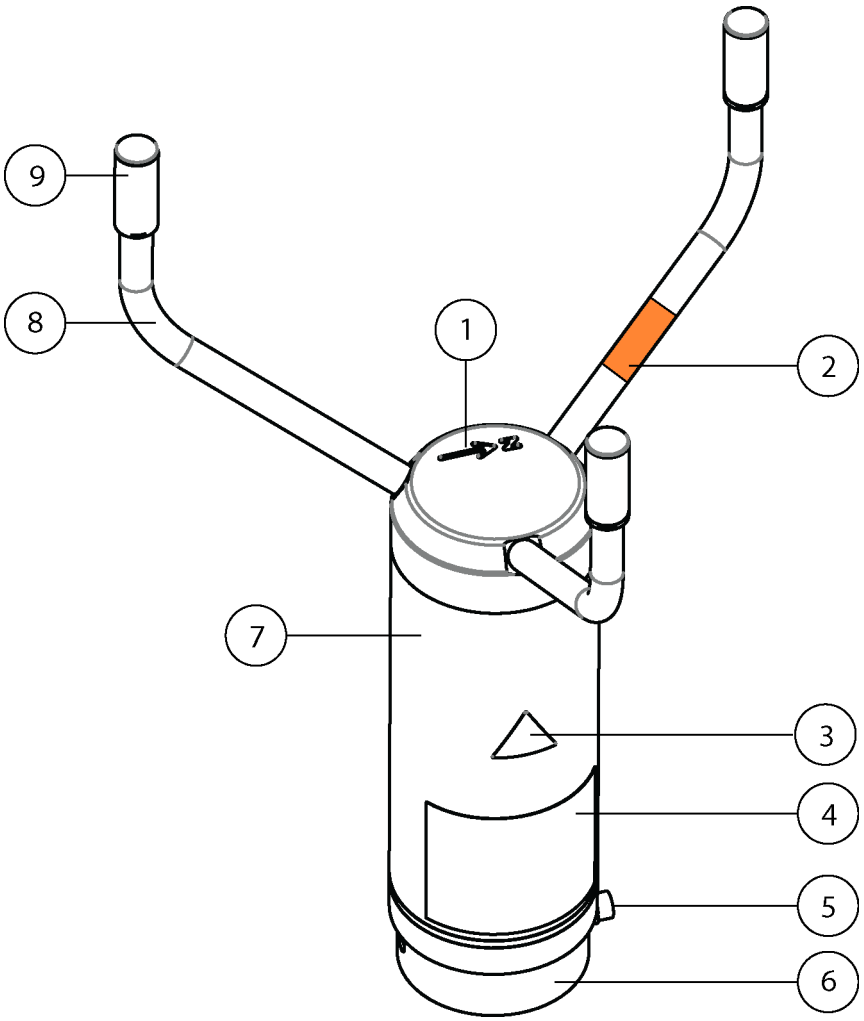


Figure 1 WMT700 Wind Sensor

The array consists of 1, 8, and 9.

1 Top of WMT700 with North arrow
2 Orange sticker marking North arm
3 Hot warning sticker
4 Type label
5 Mounting screw
6 Mounting adapter
7 Body
8 Transducer arms (3 pcs)
9 Transducers (3 pcs)

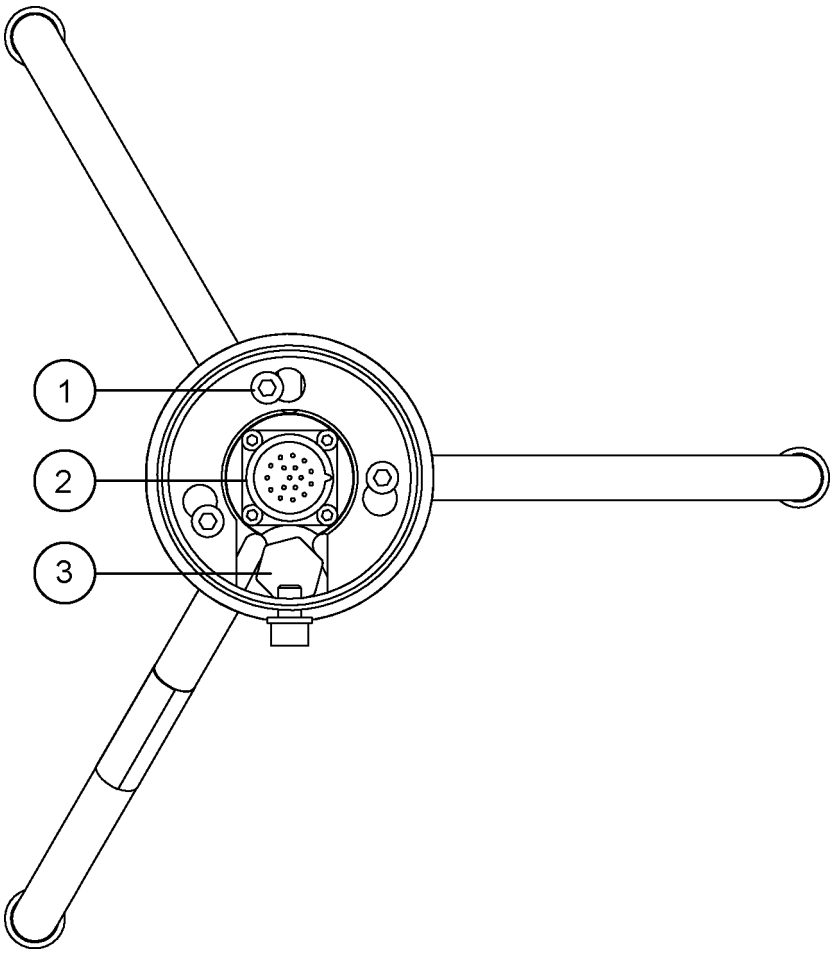


Figure 2 WMT700 from Below

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

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

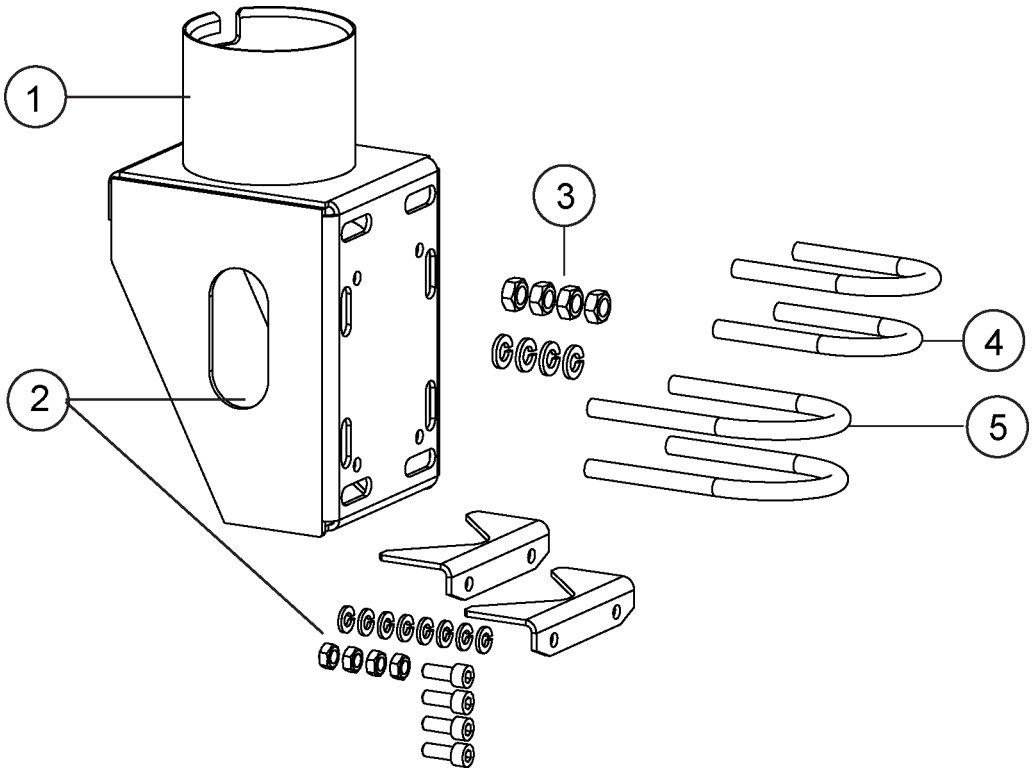


Figure 3 FIX70 Mounting Kit

1 Fix body
2 Removable mast guide with mounting hardware
3 Mounting hardware (M6 nuts, washers)
4 U bolts for Ø 30 mm mast (2 pcs)
5 U bolts for Ø 60 mm mast (2 pcs)

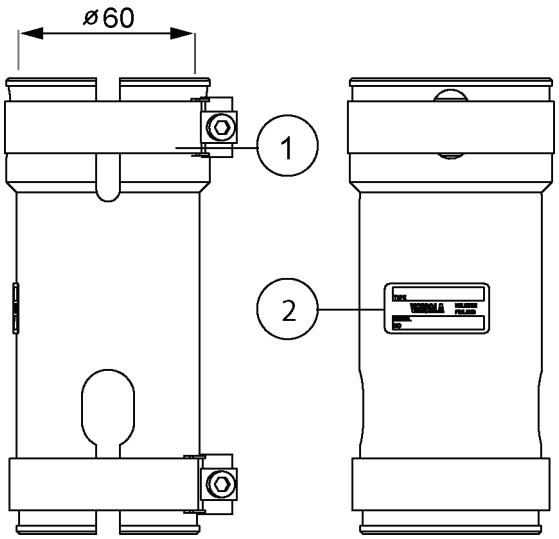


Figure 4 WS425FIX60-POM

1 Clamp
2 Label

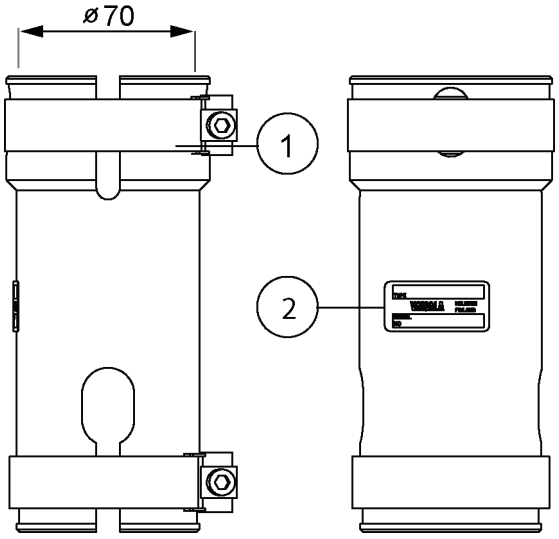


Figure 5 WMT700FIX60-POM

1 Clamp
2 Label

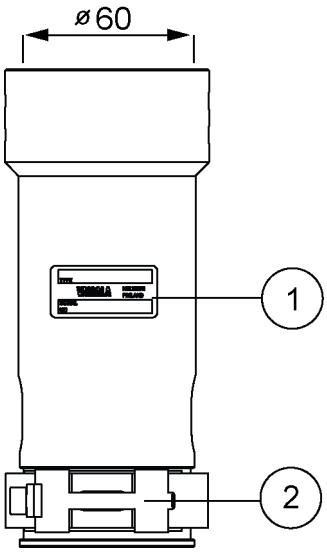


Figure 6 WS425FIX60-RST and WS425FIX60

1 Label
2 Clamp

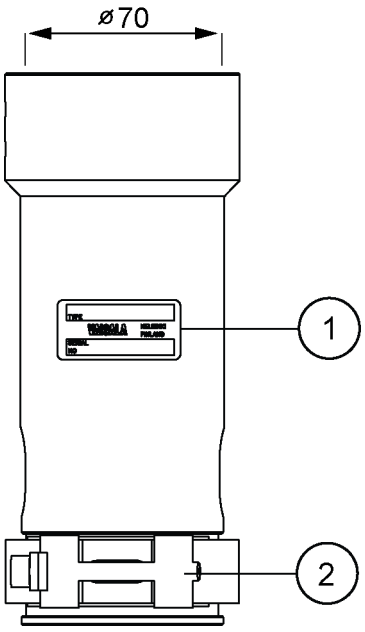


Figure 7 WMT700FIX60-RST

1 Label
2 Clamp

2.2 Regulatory Compliances

Vaisala WINDCAP Ultrasonic Wind Sensor WMT701, WMT702, WMT703, and WMT704 comply with the performance and environmental test standards listed below.

Table 2 Environmental Tests

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

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.

EMC tests are based on a European product family standard: EN 61326-1:2013 (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 3 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

Test	Setup According to
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* *G. Certificate (page 199)*

2.3 Ordering Options

Table 4 Ordering Options

Ordering Option Number	Ordering Option
1	Measurement range
2	Temperature range
3	Heating
4	Digital communication interface
5	Digital communication profile
6	Digital communication unit
7	Analog output signal for wind speed channel
8	Analog output signal for wind direction channel
9	Connection cables
10	Mounting adapters
11	Not in use
12	Accessories
13	Manuals

If required, you can change:

- 2.3.4 Digital Communication Interface (page 20)
- 2.3.5 Digital Communication Profile (page 21)
- 2.3.6 Digital Communication Units (page 21)
- 2.3.7 Analog Output Signal for Wind Speed Channel (page 21)
- 2.3.8 Analog Output Signal for Wind Direction Channel (page 23)

More Information

- Configuration (page 101)

2.3.1 Measurement Range

Ordering option 1 defines the wind speed operation range. The maximum reported value of wind speed 40, 65, 75, or 90 m/s, depending on the selected option. Accredited Wind Calibration according to Measnet procedure.

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
4	WMT704 up to 90 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
D	WMT704 up to 90 m/s + Accredited Wind Calibration

2.3.2 Temperature Range

Ordering option 2 defines the operating temperature range for the sensor.

Table 6 Temperature Range

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

The temperature range is not connected to heating in any way. If you operate in a demanding environment where ice accumulation is expected, Vaisala recommends using a heated sensor.

2.3.3 Heating

Ordering option 3 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.

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. 150 W needed)
4	Heated transducers, arms, and body (Min. 250 W needed)

Vaisala recommends using heated versions of WMT700 in environmental conditions where snow and ice build-up is possible.

2.3.4 Digital Communication Interface

Ordering option 4 defines the serial line physical interface. Four different standard communication interfaces are available. In addition, there is a service port.

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

To change the product version characteristics listed in Table 8 (page 20), contact Vaisala Service Center.

2.3.5 Digital Communication Profile

Ordering option 5 defines the used communication protocol. WS425 options are usable and backwards compatible when replacing a WS425 sensor with a WMT700 unit. Other application or customer-specific user profiles are also available.

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
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

2.3.6 Digital Communication Units

Ordering option 6 offers four different digital communication options.

Table 10 Digital Communication Units

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

2.3.7 Analog Output Signal for Wind Speed Channel

Ordering option 7 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)
	9000 mV = 90 m/s (WMT704 maximum wind speed)
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)
	20 mA = 90 m/s (WMT704, 0.177778 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)
	18 mA = 90 m/s (WMT704 maximum wind speed)
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)
	900 Hz = 90 m/s (WMT704 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)
	1610.4 mV = 201.3 mph (WMT704 maximum wind speed)

Option	Output Configuration
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)
	1006.5 Hz = 201.3 mph (WMT704 maximum wind speed)
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)
	900 Hz = 90 m/s (WMT704 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)
	900 Hz = 90 m/s (WMT704 maximum wind speed)

2.3.8 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.

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
D	Current output 50 uA/degree
	0 uA = 0 degree
	18 mA = 360 degree

Selection	Output Configuration
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

More Information

- Coordinate Systems: Vector and Polar Calculations (page 34)

2.3.9 Connection Cables

Ordering option 9 defines connection cables.

Table 13 Connection Cables

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

2.3.10 Mounting Adapters

Ordering option 10 defines mounting adapters.

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
F	Adapter 228777 with WS425FIX60. WS425-compatible adapter with WS425FIX60
G	Adapter 228869 with ASM212140 (suitable for mounting 4258057). ASOS mounting adapter

Ordering option 11 is reserved for future use.

2.3.11 Accessories

Ordering option 12 defines WMT700 accessories.

Table 15 Accessories

Option	Accessories
A	No accessories
B	Bird cage (WMT70BirdKit)

2.3.12 Manual

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

Table 16 Manual

Option	Manual
1	No manual
2	English manual
3	Japanese manual

Option	Manual
4	Chinese manual
5	Russian manual

2.3.13 Example of WMT703 Configuration

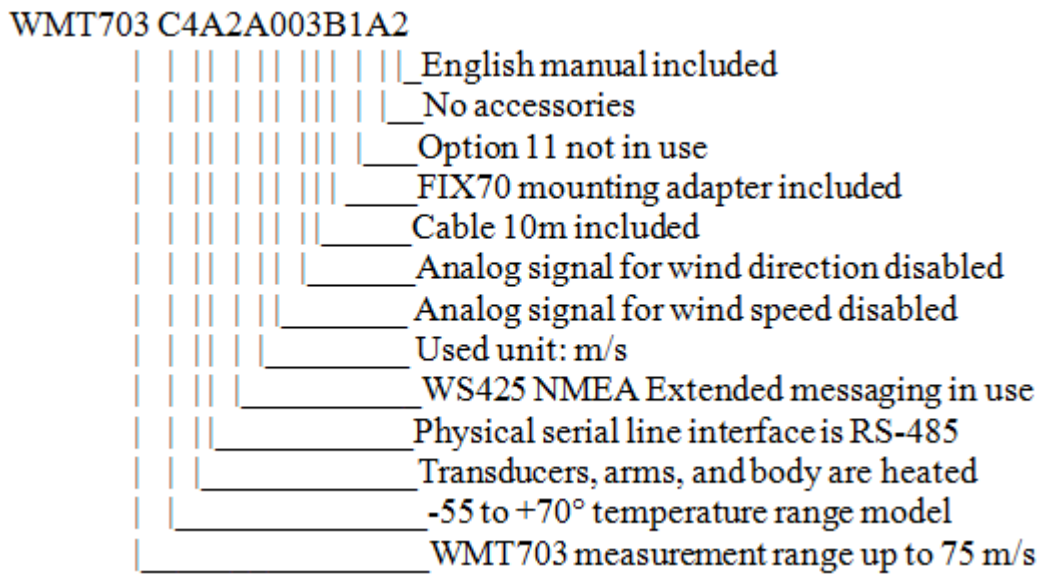


Figure 8 Example of WMT703 Configuration

More Information

- Heating (page 48)

2.4 Accessories

WMT700 can be tailored to your needs with several accessories. The accessories include:

- Mounting adapters for different mast diameters
- Cables for different host systems and preferred communication types
- Bird prevention kit
- Field calibration kit
- Cable tightening tool

2.4.1 Bird Cage

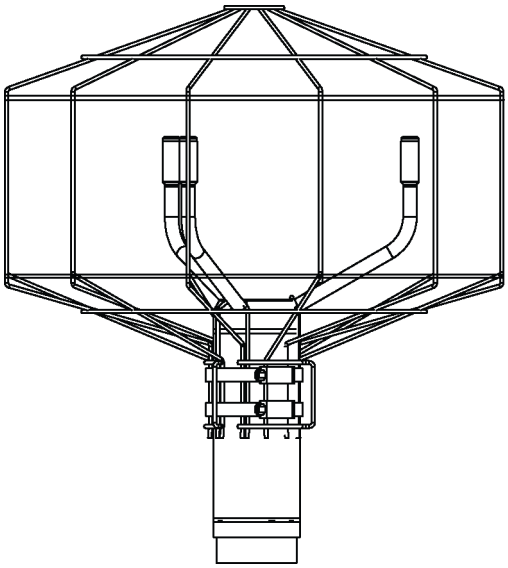


Figure 9 Bird Cage

Vaisala recommends using the optional bird cage (WMT70BirdKit) in areas with large bird populations. The cage is designed to prevent large birds from disturbing the wind speed and direction measurements.

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

2.4.2 Zero Wind Verifier

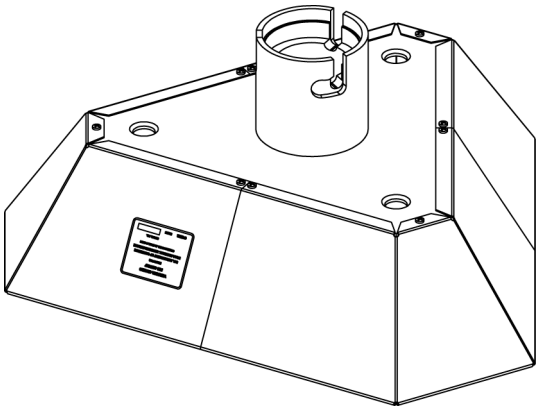


Figure 10 Zero Wind Verifier

The optional WMT700 zero wind verifier (WMT70Verifier) 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 that the transducers are parallel to each other. You can perform the verifier test also in the field.

2.4.3 Cables

Select the 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	RS-485 cable 2 m, cable connector, open leads on one end	Used for serial communication with RS-485 interface.
228260SP	RS-485 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.

2.4.4 Cable Tightening Tool

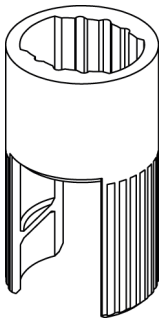


Figure 11 Cable Tightening Tool

WMT700 is shipped with a cable tightening tool (237888SP). When you insert a cable in the cable tightening tool, it is easier to grip and rotate. After tightening, you can leave the cable tightening tool in place.

3. Functional Description

3.1 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. The 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.

The following figure shows how the time shift of the ultrasonic signals is measured and how tail wind and forward wind affect the measurement.

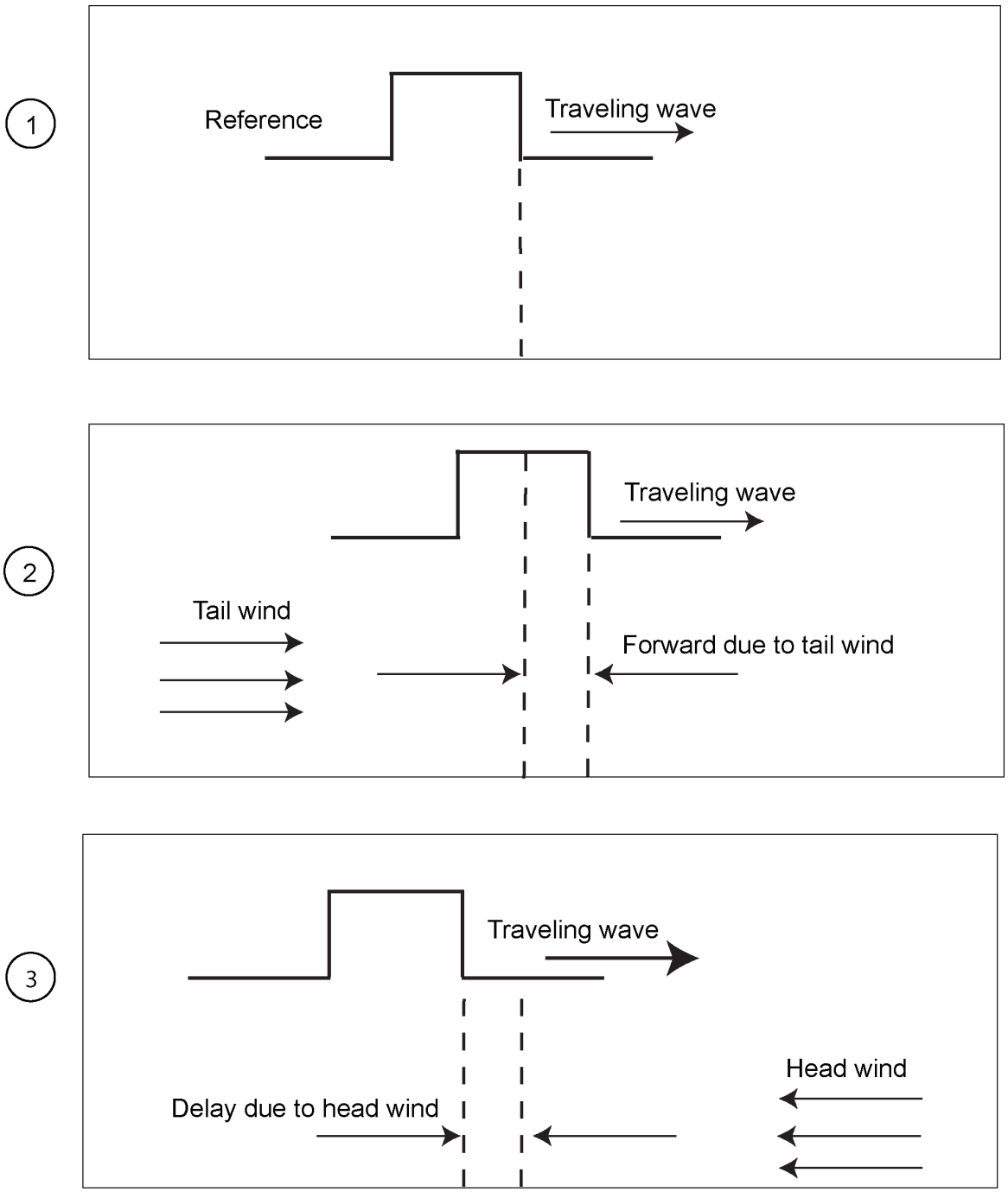


Figure 12 Ultrasonic Measurement Principle

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:

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

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.

The different paths of WMT700 and the vectors provided by the wind sensor:

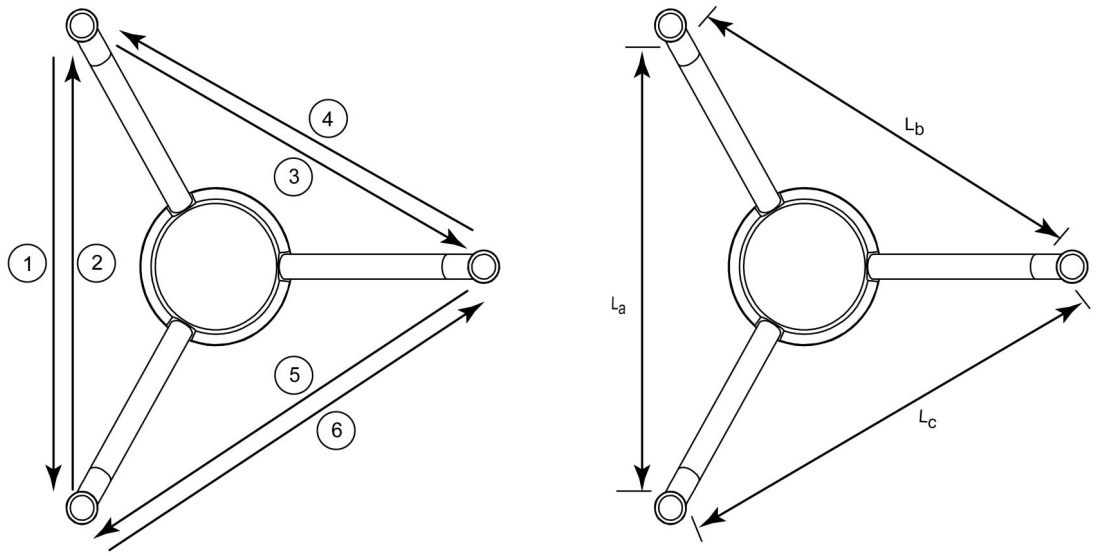


Figure 13 Measurement Paths of WMT700

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.

3.2 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.

$$x = -WS \times \cos(WD)$$
$$y = -WS \times \sin(WD)$$

- 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°.

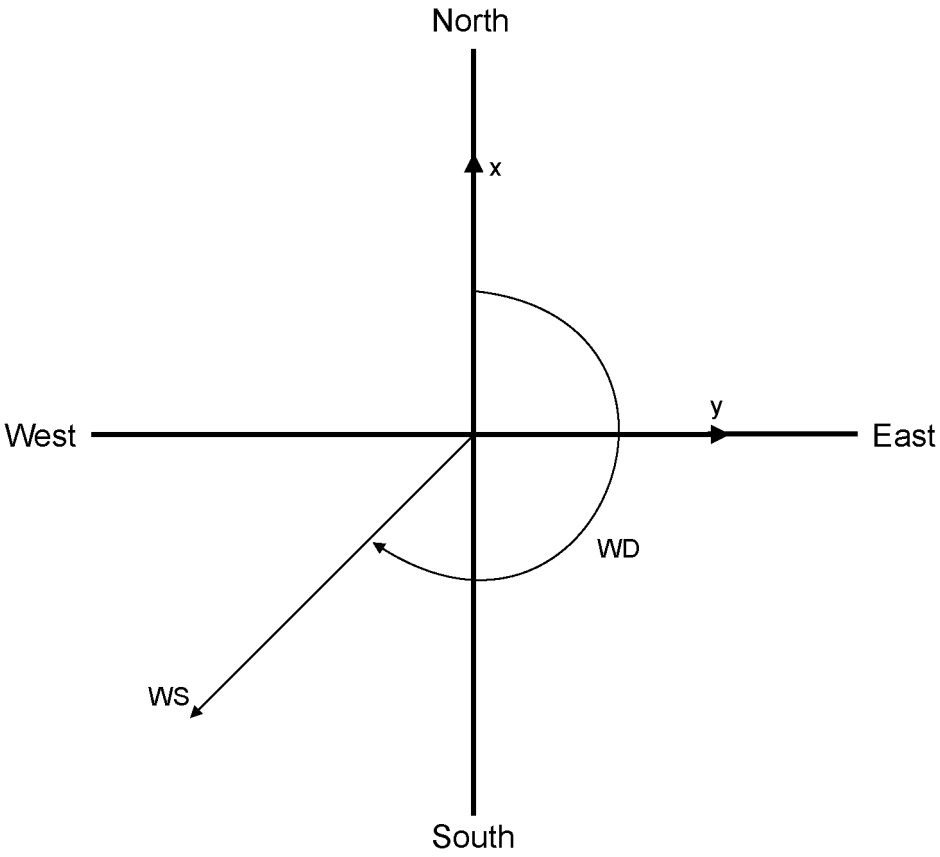


Figure 14 Wind Speed and Direction Presentations (Direction Offset Is 0)

More Information

- Analog Output Signal for Wind Speed Channel (page 21)

3.3 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 you select scalar averaging, you can also enable wind direction coasting to ensure consistent direction measurement results at low wind speeds.

3.3.1 Scalar Averaging

When you select scalar averaging, 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 North, where 360° is equal to 0°. For example:

```
359° + 5° = + 4°
0° – 5° = 355°
```

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

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.

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

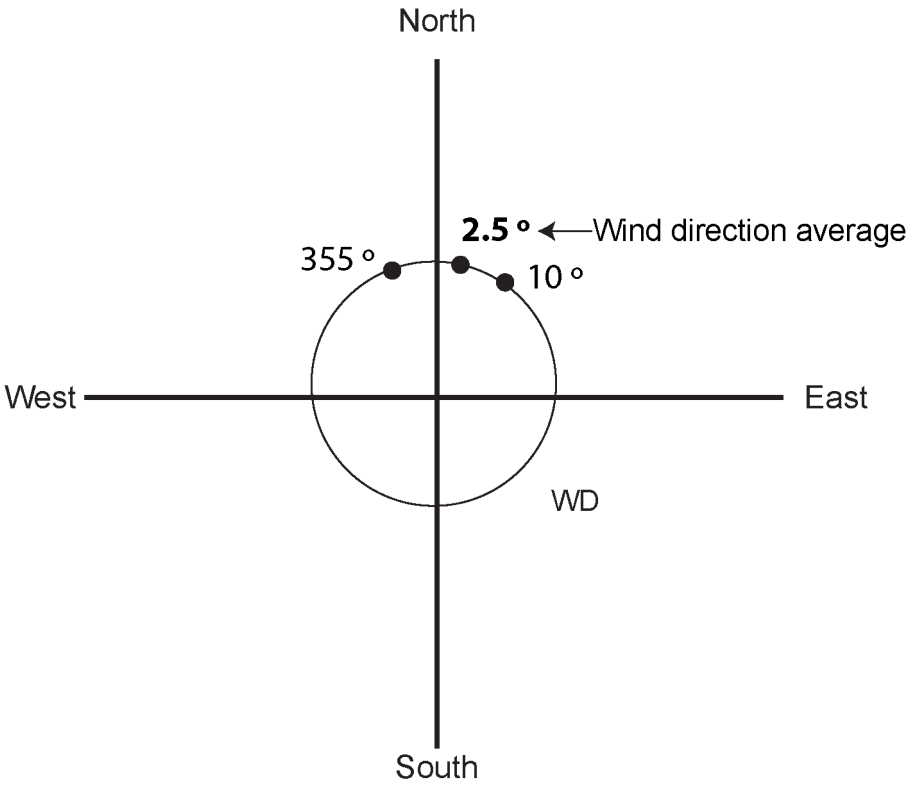


Figure 15 Example of Wind Direction Averaging

3.3.2 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.

3.3.3 Vector Averaging

When you select vector averaging, 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.

3.4 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.

3.4.1 Continuous Measurement

You can set WMT700 to measure wind data continuously and stop the measurement with 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 Message Mode: If the automatic message interval is configured, WMT700 sends automatic data messages at selected intervals. The data message is user-configurable.

More Information

› Serial Interface Timing (page 42)

3.4.2 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.

More Information

› Serial Interface Timing (page 42)

3.5 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 either as analog output or data messages through a serial port, or you can use both outputs simultaneously. You can send operating and configuring commands 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 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.

The following figure shows the main software components and external interfaces of WMT700.

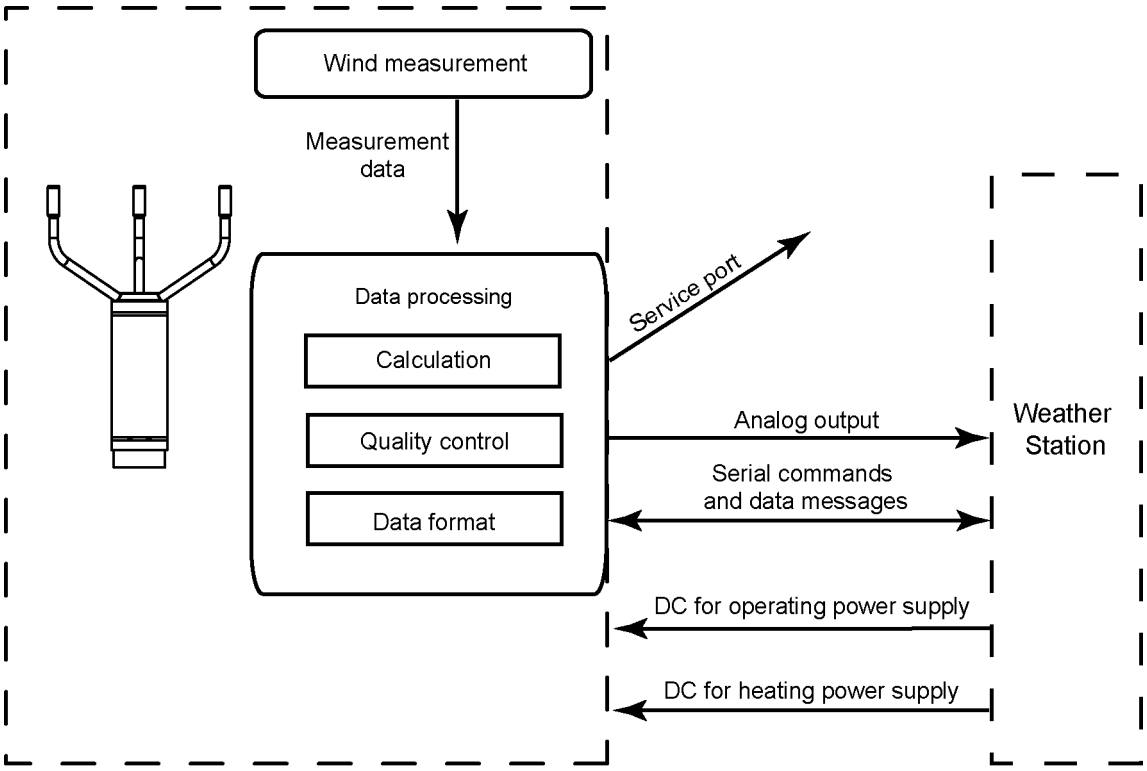


Figure 16 WMT700 External Interfaces

More Information

- Typical System Environments (page 183)

3.6 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)

3.7 Serial Communication

In WMT700, there are two serial communication ports:

- COM1: Service port (RS-485)
- COM2: Configurable digital communication interface

Both ports support the same commands, protocols, operations, and data messages. You can use any computer or data logger with a serial port to send commands to WMT700 and to receive measurement data.

3.7.1 Communication Interface

COM1 is a fixed RS-485 communication interface 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 in point-to-point connection)
- RS-422 (recommended up to 1200 meter distance)
- SDI-12 (recommended up to 60 meter distance)

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, you can change the COM2 interface type by using terminal software.

More Information

- Configuration Parameter Descriptions (page 187)
- Wiring (page 72)

3.7.2 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 can be:

- Communication protocols
- Communication parameters

The preconfigured communication profiles are:

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

- WS425 – ASOS

Vaisala recommends the WMT700 profile for normal operation. The profile offers a wide range of predefined and user-configurable data message formats, and it is developed for WMT700.

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

The WS425 profiles can be used when upgrading from WS425 to WMT700.

More Information

‣ Command Set for WMT700 (page 181)

3.7.3 Protocols

In addition to the protocols preconfigured under standard profiles, there are additional protocols available:

- WMT700
- WMT700 NMEA MWV
- SDI-12
- WS425 - ASOS
- WS425 - ASCII
- WS425 - NMEA Standard
- WS425 - WAT11
- MES12

More Information

‣ Parameter Handling Commands (page 102)

3.7.4 Measurement and Configuration Modes

The serial ports have two operation modes:

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

The following figure shows the configuration and measurement modes of both serial ports provided by WMT700.

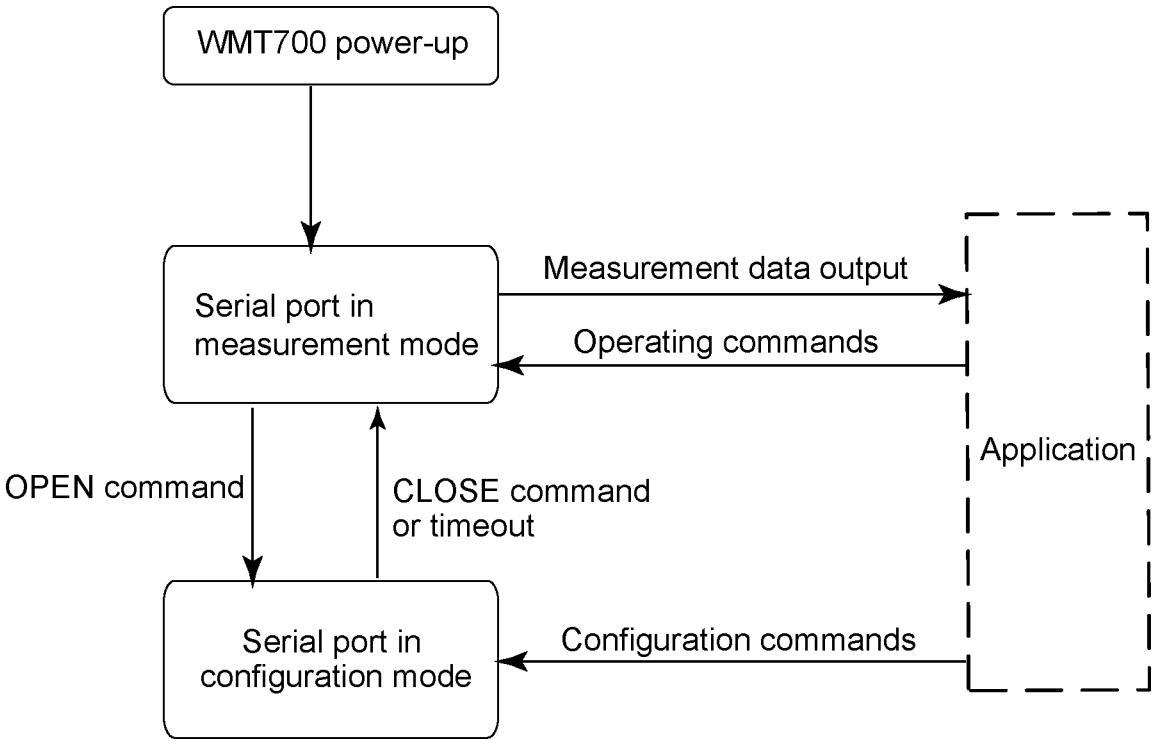


Figure 17 Configuration and Measurement Modes

After power-up, WMT700 is in measurement mode.

More Information

- Command Set for WMT700 (page 181)
- Entering and Exiting Configuration Mode (page 100)
- OPEN — Entering Configuration Mode (page 100)
- CLOSE — Exiting Configuration Mode (page 101)

3.7.5 Serial Interface Timing

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

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

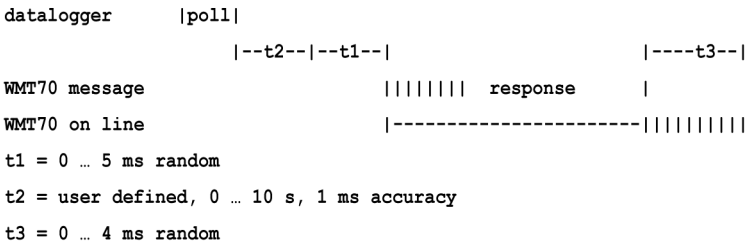


Figure 18 Timing for RS-232, RS-485, and RS-422 Interfaces

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 www.sdi-12.org.

3.8 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 use configuration parameters to change the analog output type, WMT700 scaling or save power by disabling the analog output functionality.

WMT700 provides the following analog outputs:

- Aout1 for wind speed data
- Aout2 for wind direction data

To emulate the WS425 analog output, choose voltage output, frequency output, and potentiometer.

More Information

- Configuration Parameter Descriptions (page 187)
- Operating WMT700 in WS425 Analog Output Mode (page 128)

3.8.1 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

Analog output for Wind Direction (Aout2) can be configured as:

- Voltage output
- Current output
- Potentiometer output

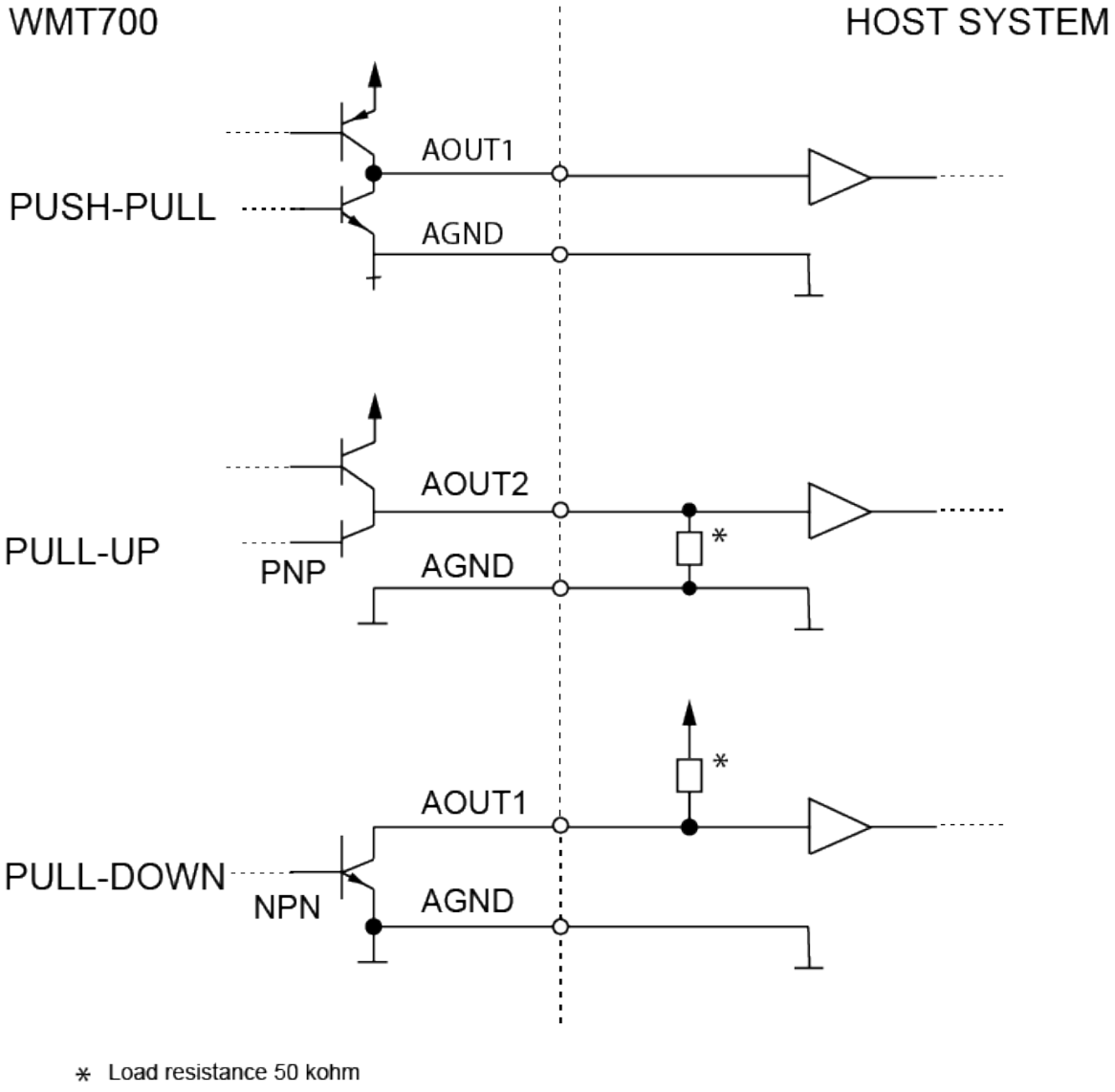


Figure 19 Frequency Output

3.8.2 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.

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
	WMT704	0.00017777777 A/m/s	0.004 A	0.002 A	4 mA = 0 m/s 20 mA = 90 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°

Aout2 Selected Option	Scaling/Gain	Offset	Error Indication	Example
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*Vref /° (0.0027855)	0	Vref (1)	0 V = 0° Vref = 359°

For a different scaling, change the gain and offset settings.

The scaling of the current output 4 ... 20 mA depends on the sensor measurement range (WMT701, WMT702, WMT703, or WMT704), while the 0 ... 20 mA output has 0.2 mA/m/s scaling for all the measurement ranges.

The following tables 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×s
```

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

- 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.

```
Output = 0.0 + 10 × 0.1 = 1.0 V
```

Example

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

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

```
Output = 0.004 + 10 × 0.0002 = 6.0 mA
```

3.8.3 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. Type the following commands:

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

3.8.4 Missing Readings and Error Indication

If WMT700 is unable 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. Use the following command:

```
S aout1err,1
```

More Information

- Configuration Parameter Descriptions (page 187)

3.9 Heating

WARNING! To avoid injury, do not touch the heated parts of the wind sensor when the heating is enabled.

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

Make sure 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.

3.9.1 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 pulse width modulation (PWM) scheme is used to control the average heating power.

3.9.2 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.

3.9.3 Heated Body, Transducers, and Arms

WARNING! To avoid injury, do not touch the heated parts of the wind sensor when the heating is enabled.

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.

4. Installation

4.1 Installing WMT700

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

4.1.1 Maritime Installations

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

When making maritime installations, note the following:

- Do not install WMT700 near a magnetic compass. The compass safe distance is 5 m.
- Do not place WMT700 directly in front of a radar.
- Do not install WMT700 next to a powerful RF-transmitter antenna.

4.2 Placing WMT700

Install WMT700 on one of the following:

- Side of the mast
- Top of the mast
- Sensor support arm or cross arm

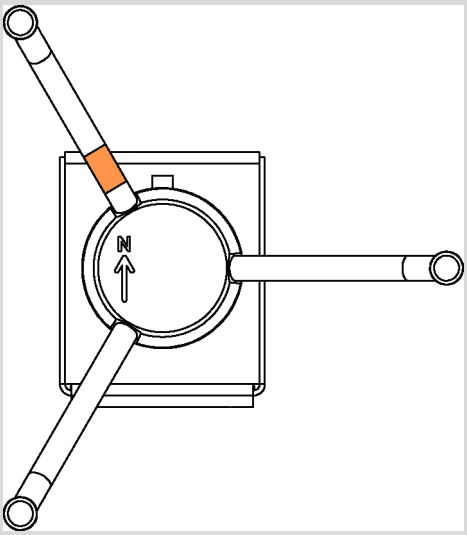
CAUTION! To prevent equipment damage, install an air terminal so that the tip is as high above the instruments and sensors as possible.

When selecting the mounting position and routing the sensor cable, take into account the other equipment installed on the mast (for example, air terminals).

For the most reliable measurements:

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

When deciding where to install the sensor, pay attention to the North arrow printed on top of the sensor. The North arm is marked with an orange sticker.



WARNING! If ice or snow accumulates on the mast, guy wires, or sensors, the ice or snow can fall and cause injury to persons below.

4.3 Unpacking and Handling WMT700

WMT700 is shipped in a custom cardboard container with two plastic transportation dampers. When unpacking WMT700, remove only the bottom damper that protects the sensor body.

CAUTION! Never transport WMT700 without the custom shipping container. Otherwise, the warranty becomes void.

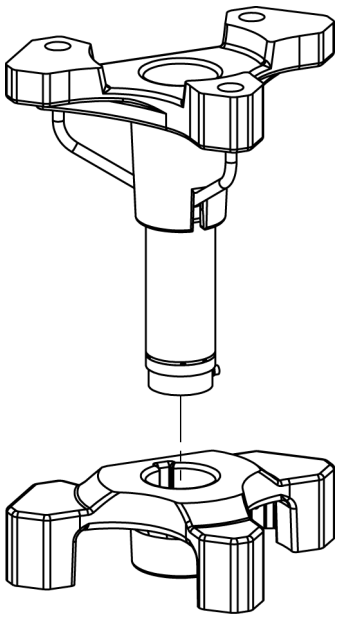


Figure 20 Removing WMT700 Bottom Transportation Damper

CAUTION! Do not remove the upper transportation damper that protects the array until you have installed the sensor.

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

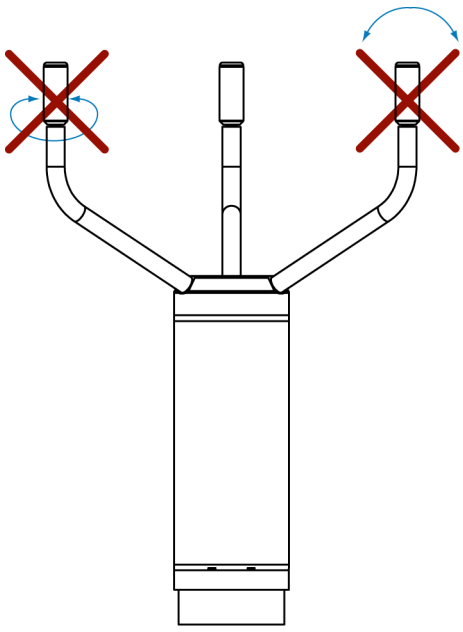


Figure 21 Handling WMT700

4.4 Connecting WMT700 Cable

When installing WMT700, route the cable according to the mounting option. When mounting to a mast, you can the route cable either outside or inside the mast. Cable routing depends on the mast type and other equipment, such as air terminals, installed on the mast.

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

WARNING! Do not perform installation or maintenance procedures when there is a risk of thunderstorm or lightning activity in the area.

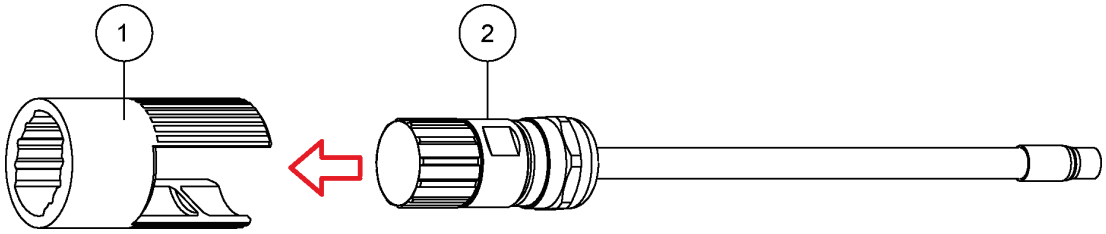
WARNING! A long cable between units (sensors, transmitters, power supplies, and displays) can cause a lethal lightning-induced current surge. Always ground the enclosure to a suitable grounded location with a short, low-resistance cable.

CAUTION! 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.

CAUTION! To avoid strain on the connector, make sure you connect the cable properly. 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.

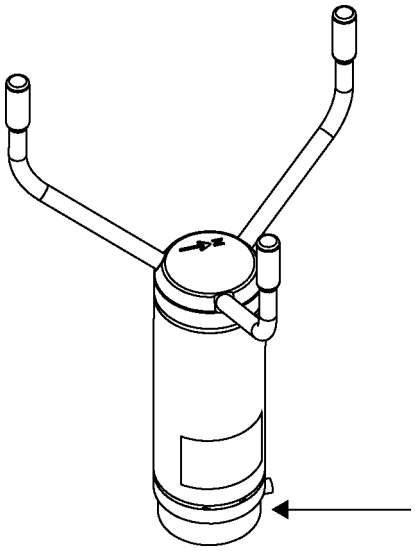
The recommended minimum bending radius for the cable is 70 mm (2.76 in).

1. If you are using the cable tightening tool, insert the cable in the tool.
   Vaisala recommends that you use the cable tightening tool. The ribbed part of the tool offers a better grip of the cable when tightening the connector. You do not need to remove the tool when the connector is tightened.

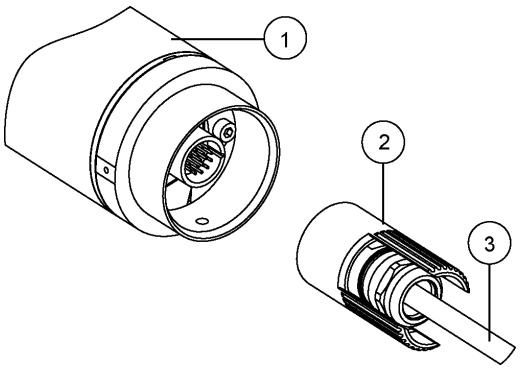


1 Cable tightening tool
2 Cable

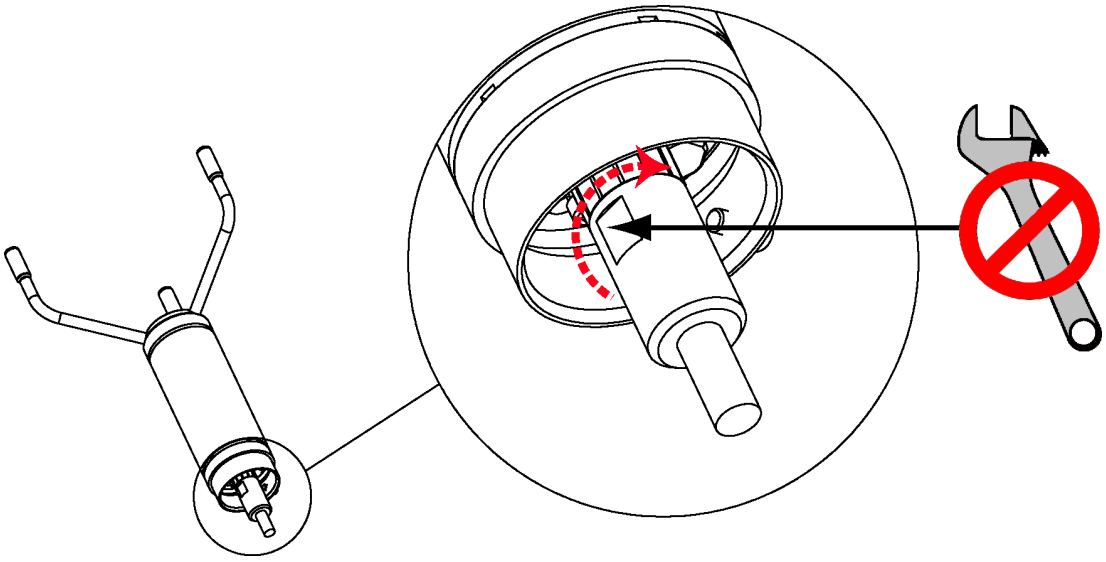
2. If you are not using the cable tightening tool, remove the mounting adapter from the sensor body, and lead the sensor cable through the mounting adapter.



3. Connect the cable to WMT700. Tighten the cable by rotating the tightening tool or the ribbed part of the connector clockwise by hand. Make sure that the connector is properly tightened before proceeding to the next step.



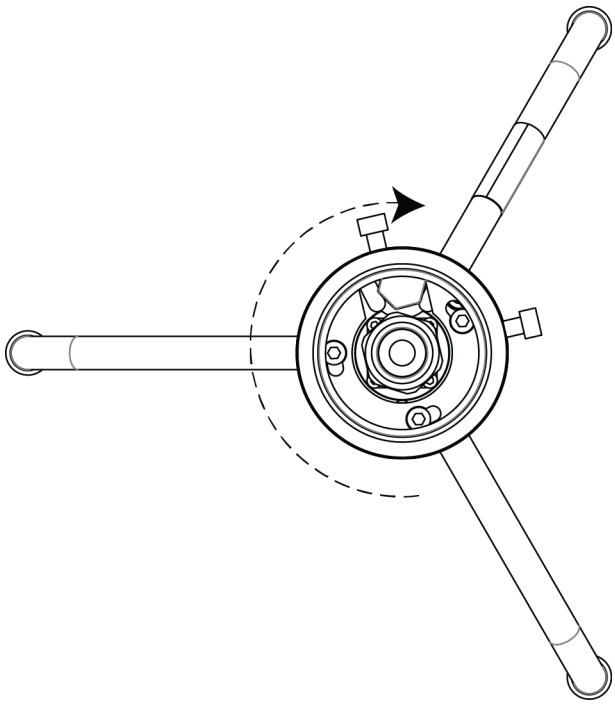
1 WMT700
2 Cable tightening tool
3 Cable



CAUTION! Do not use tools when tightening the connector.

CAUTION! To avoid water leakage and damage to the sensor, verify that the connector is properly tightened. If water leaks into the connector, this voids the warranty for the sensor.

4. If you removed the mounting adapter, fasten it to the sensor by rotating the adapter clockwise. Tighten the three screws at the bottom of the sensor.



4.5 Mounting WMT700 on Vertical Pole Mast

- 5-mm Allen key
- Adjustable wrench

You can mount WMT700 on a 30-mm (1.18-in) or a 60-mm (2.36-in) pole mast. The WMT70FIX mounting kit contains U bolts for both kinds of pole masts (2 pcs each).

You can place WMT700 either on the side or on top of the mast. When selecting the mounting position, take into account:

- Other equipment installed on the mast (for example, air terminal)
- Cable routing (inside or outside the mast)

1. Make sure that the cable is firmly connected to the sensor.

2. Assemble the WMT70FIX mounting kit, and attach it to the mast with the U bolts.

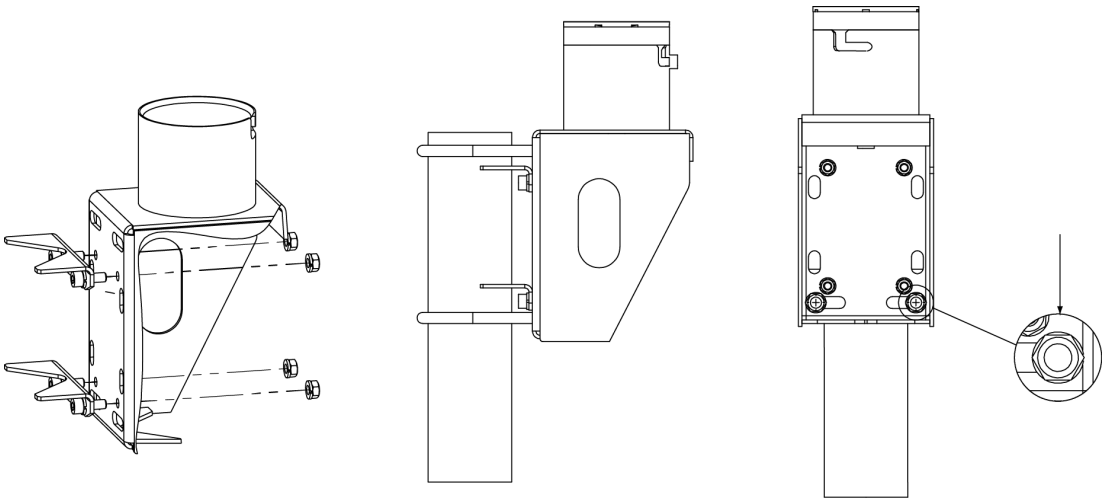


Figure 22 Mounting WMT700 on Side of Mast

When mounting the sensor on the side of the mast, make sure that the mounting kit is positioned at the top level of the mast.

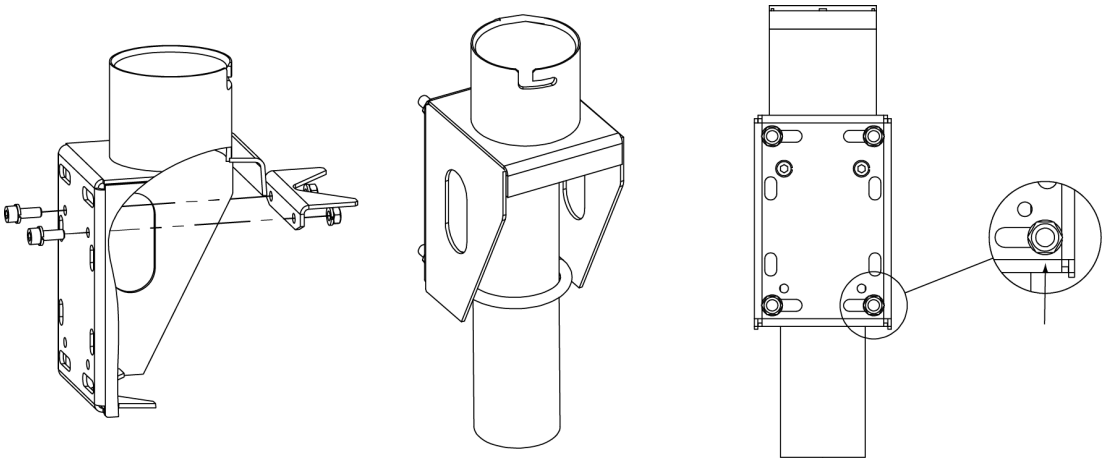


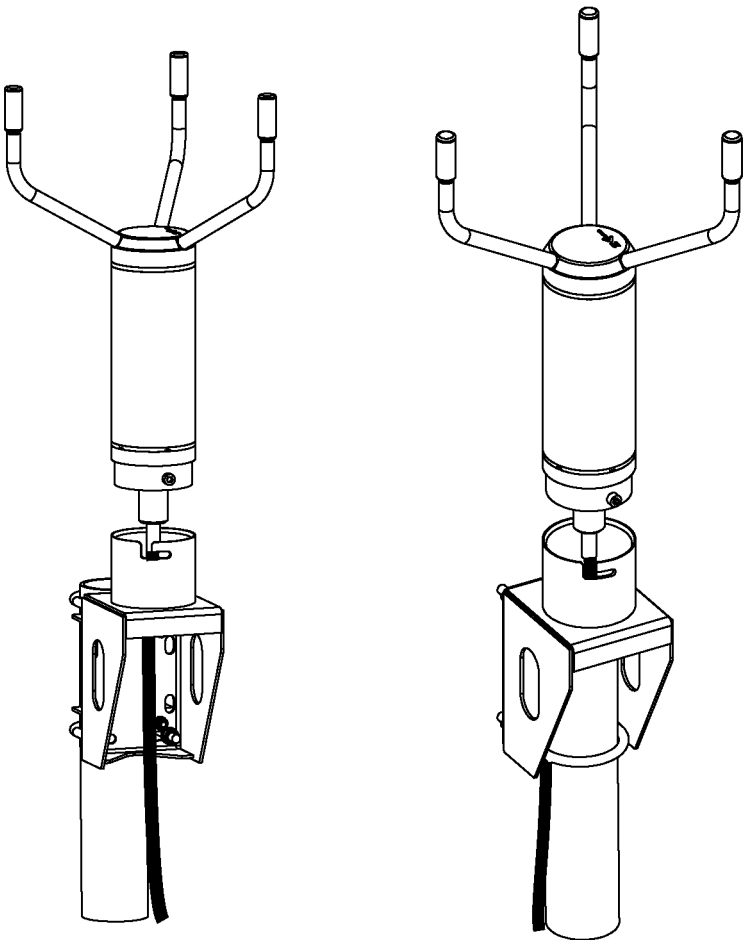
Figure 23 Mounting WMT700 on Top of Mast

3. Check that the mounting kit is level, and tighten the U bolts slightly.

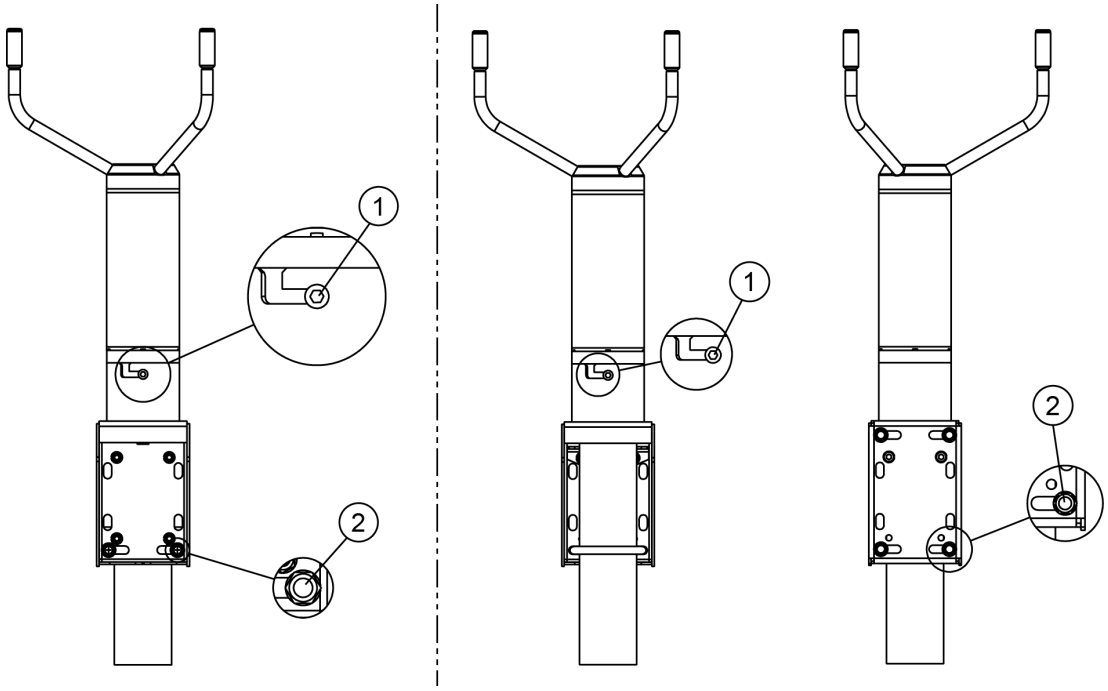
Do not tighten the bolts too much at this stage. You still need to rotate the mounting kit to align the sensor after the installation.

4. Haul the sensor up.

5. Holding the sensor from its body, run the cable through the WMT70FIX mounting kit, and slide the sensor into the mounting kit.



6. To avoid misalignment, turn the sensor until the mounting screw reaches the far end of the slot, and tighten the screw. Tightening torque 5 Nm.



1 WMT700 mounting screw
2 U-bolt and nut (M8 DIN934 A4) in horizontal slot

7. To align the sensor, rotate the mounting bracket.

More Information

- Aligning WMT700 (page 63)

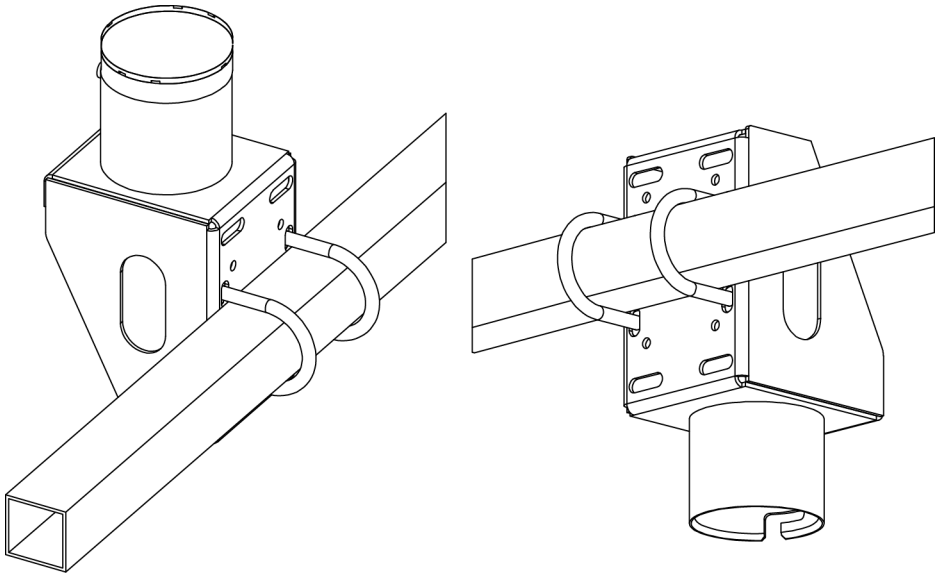
4.6 Mounting WMT700 on Sensor Support Arm or Cross Arm Using WMT70FIX

- 5-mm Allen key
- Adjustable wrench

When mounting WMT700 on a horizontal sensor support arm or cross arm using the WMT70FIX mounting kit, place WMT700 with the array facing up or down.

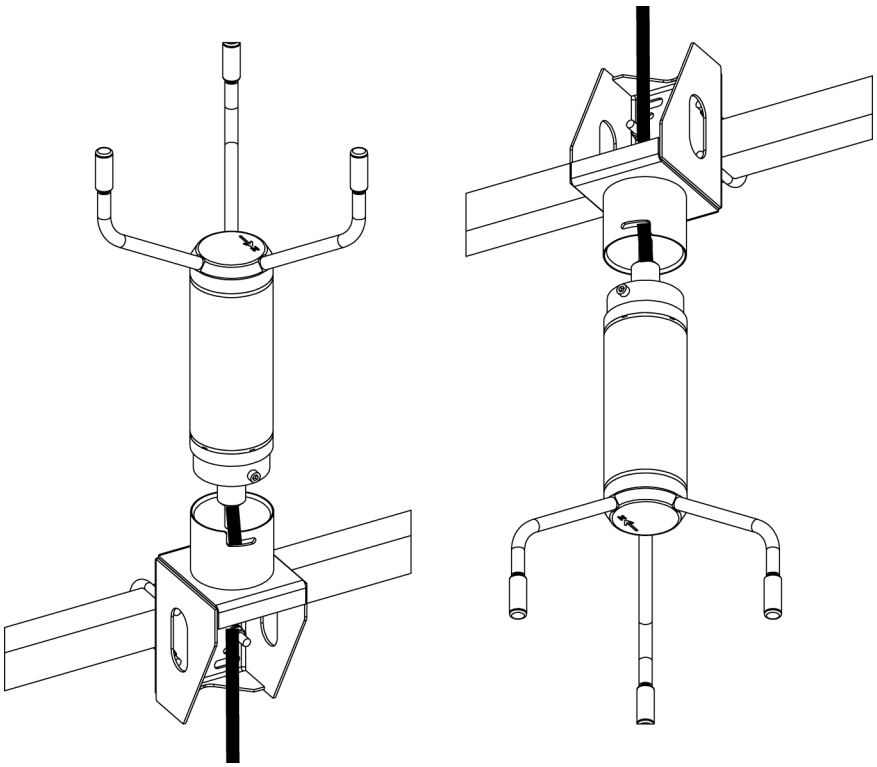
Mounting WMT700 with the array facing down protects the sensor better against the accumulation of snow and interference from birds. The adapter drains located at the bottom of WMT700 prevent water from accumulating inside the mounting adapter.

1. Make sure that the cable is firmly connected to the sensor.
2. Attach the WMT70FIX mounting kit to the sensor support arm or cross arm with the U bolts and insert the U bolts in the slots of the mounting kit.

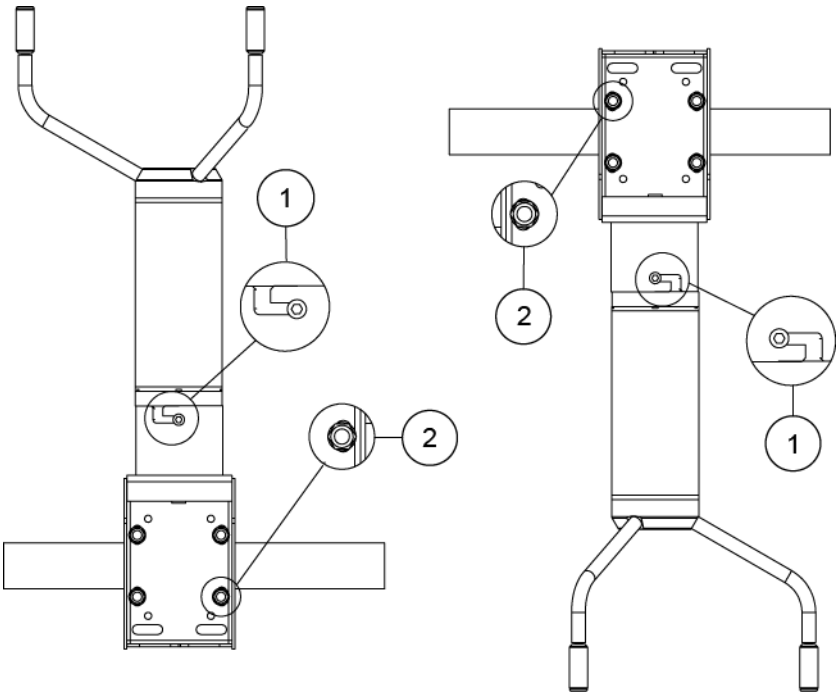


3. Check that the mounting kit is not tilted to either side and tighten the U bolts firmly.
4. Haul the sensor up.

5. Holding the sensor from its body, run the cable through the mounting kit, and slide the sensor into the mounting kit.



6. To avoid misalignment, turn the sensor until the screw reaches the far end of the slot, and tighten the screw.



1 WMT700 mounting screw. Tightening torque 5 Nm.
2 U-bolt and nut (M8 DIN934 A4) in horizontal slot

7. Align the sensor.

If you installed the sensor with the array facing down, configure WMT700 accordingly.

More Information

- Aligning WMT700 (page 63)

4.7 Aligning WMT700

- 5-mm Allen key
- Compass

WMT700 is permanently marked with the letter **N** and a North arrow. The North arm is marked with an orange sticker.

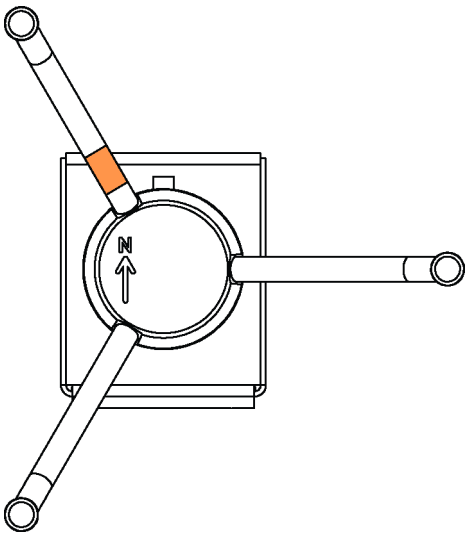
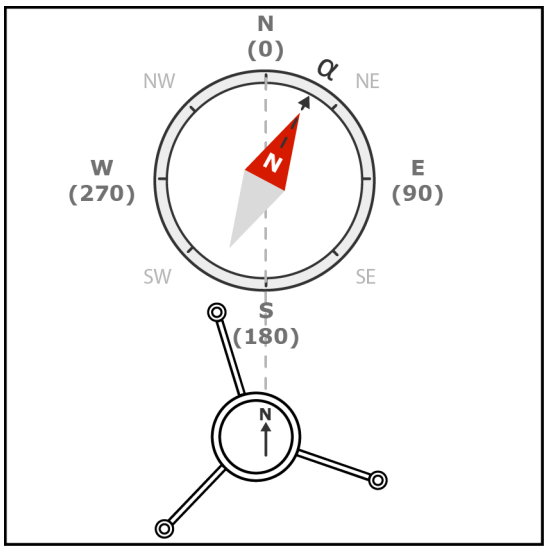


Figure 24 WMT700 North Arrow

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

1. Remove the transportation damper that protects the array and store it for future use.
2. To align the sensor, use a compass or other similar method to rotate the sensor so that the North arrow points North.



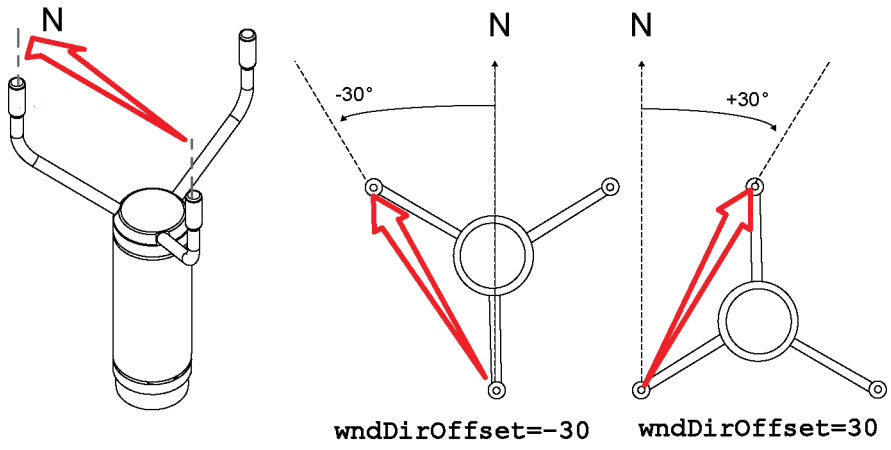
3. Tighten the bolts of the mounting kit. Tightening torque 5 Nm.
4. If you cannot align WMT700, measure the deviation angle from North and configure the wind direction offset error.

Connect the cable to the data acquisition system and power supply.

4.7.1 Configuring Wind Direction Offset

If you cannot align the sensor so that the arrow points North, make a wind direction offset by configuring the deviation angle in the sensor.

1. Mount the sensor to the desired position.
2. Define the deviation angle from the North (zero) alignment.



3. Type the wind message formatting command and the deviation angle **S wndDirOffset,(angle)**. Indicate the direction from the North line with + or −.

The sensor transmits the wind direction data by using the changed zero alignment.

More Information

- Configuration Parameter Descriptions (page 187)

4.7.2 Analog Output Parameter for WMT700 in Tunnels and Cranes

Analog outputs can be used in road and rail tunnel applications as well as crane applications.

You can get horizontal and direction data with the parameter **aout_map**. The **aout_map** parameter defines how analog output signals are used. WMT700 provides the following analog outputs:

- aout1 for wind speed data
- aout2 for wind direction data

Table 22 **aout_map** Values

Parameter	Definition
0	aout1, wind speed aout2, wind direction (default)

Parameter	Definition
1	aout1, North-South, x component aout2, West-East, y component Typically, only the component x is used.
2	aout1, wind speed aout2, wind speed alarm A digital output: hi when wind speed > aout2_0

The following table shows the relationship between polar representation and the x and y vector components.

Table 23 Wind y and x components at Different Wind Direction Angles

Wind Speed	Wind Direction	x Component	y Component
1	0	-1	0
1	90	0	-1
1	180	1	0
1	270	0	1

4.7.2.1 Tunnel Application

In the tunnel application, airflow can be presented with one mA output channel, because airflow goes along the tunnel. Typically, a relatively long average time (time constant) for wind speed parameter is applied.

The sensor must be installed in a tunnel so that the sensor's North is aligned with the tunnel. The Aout1 channel (x component) provides the airflow in the tunnel. The following figure shows a typical WMT700 installation in a tunnel.

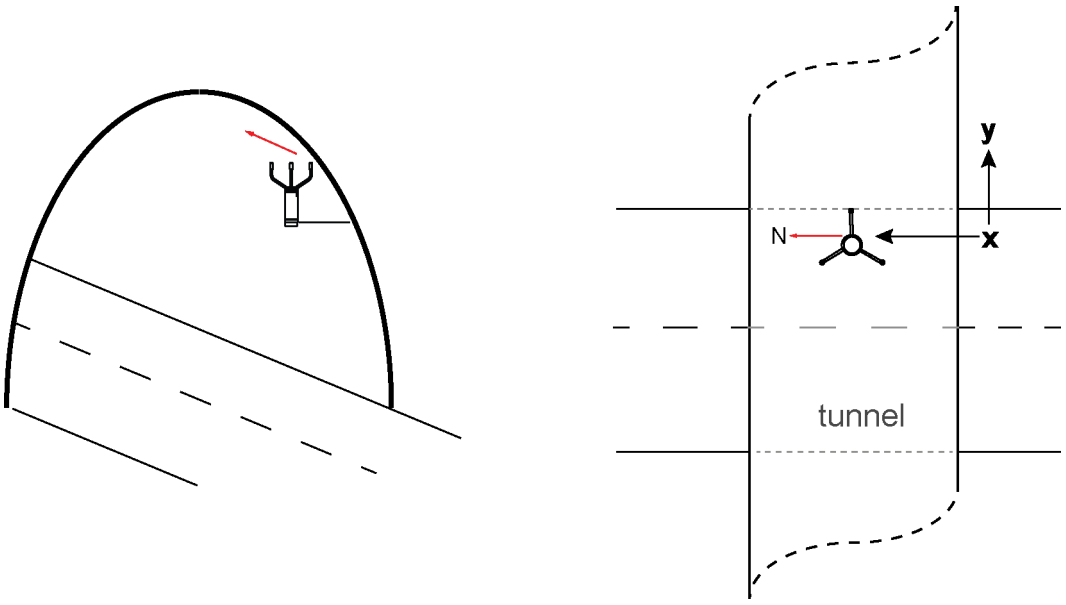


Figure 25 WMT700 in Tunnels

The following figure shows the 4...20 mA output as a function of airflow. The zero value is in the middle of the output scale (12 mA). When airflow increases from 0 m/s towards North, mA output reduces from 12 mA linearly resulting in 4 mA with 20 m/s wind. Similarly, when airflow increases from 0 m/s towards South, mA output increases from 12 mA linearly resulting in 20 mA with 20 m/s wind.

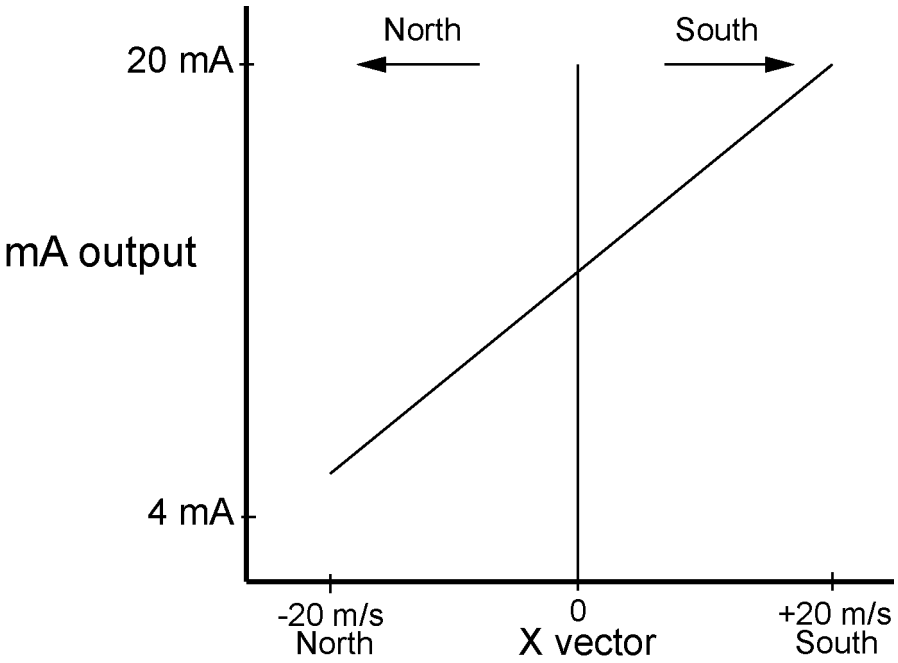


Figure 26 mA Output in Tunnels

The parameter **aout_map** with setting 1 is used to get the North-South component of wind.

```
s aout_map,1
```

The North-South component to Aout1, the current output, -20 ... 20m/s to 4 ... 20mA, Aout2 disabled:

```
s aout1_g,0.0004
s aout1_o,0.012 s
aout1maxv,0.020
s aout1minv,0.004
s aout1mode,0
s aout1err ,0.002 s
aout2mode,7
```

4.7.2.2 Crane Application

In the crane application, WMT700 can provide wind speed value and to drive alarm signals with 2 mA output channels. The WMT00 alarm output signal can be connected to external audible or visible devices to trigger wind speed alarm for user-defined limits.

Two analog channels are required for this application:

- Channel 1 provides the wind speed value
- Channel 2 provides the alarm signal

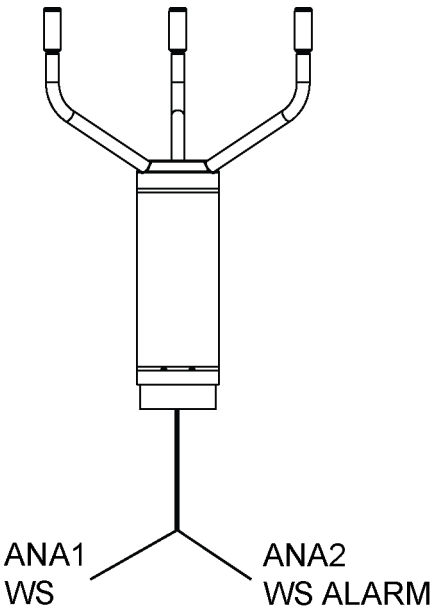


Figure 27 Analog Output for Wind Speed and Wind Speed Alarm

The wind speed value can be scaled according to the sensor's measurement range. The alarm signal operates with on/off-mode. The alarm threshold can be adjusted. The following figure shows the relation of outputs.

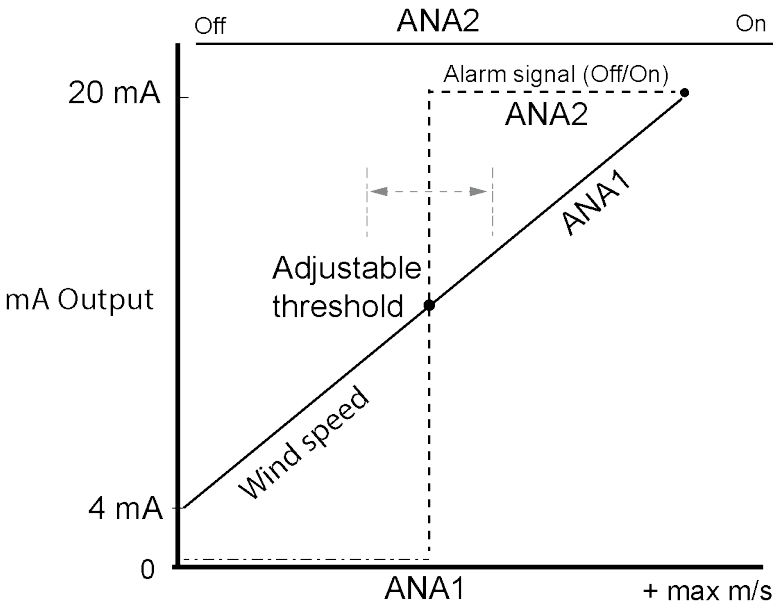


Figure 28 mA Output in Cranes

The **aout_map** with setting 2 is for getting the wind speed value and the alarm signal. The wind speed value in the Aout1 channel activates the wind speed alarm when the wind speed value exceeds the set limit value.

```
s aout_map,2
```

The analog output 2 works as digital output. **aout2_o** sets the threshold wind speed (**ws_tresh, unit [m/s]**) to 20 m/s:

```
s aout2_o,20
```

```
s aout2_g,1
```

To invert the logic signal, type:

```
s aout2_g,-1.
```

aout1 gives wind speed 4 ... 20 mA output. **aout2** gives 0 mA when the wind speed is < 20m/s, otherwise 20 mA.

```
s aout_map,2
s aout1_g,0.000044444
s aout1_o,0.004
s aout1maxv,0.020
s aout1minv,0.004
s aout1mode,0
s aout1err ,0.002
s aout2_g,1
s aout2_o,20
s aout2maxv,0.020
s aout2minv,0.000
s aout2mode,4
s aout2err ,0.00
```

4.8 Installing Bird Cage

Install the bird cage on top of the wind sensor.

In cold climates, take into account that accumulated snow or ice on the bird cage can disturb the measurement. In such conditions, visit the site frequently to clear ice and snow build-up.

CAUTION! Make sure that you do not damage the WMT700 array when installing the bird cage.

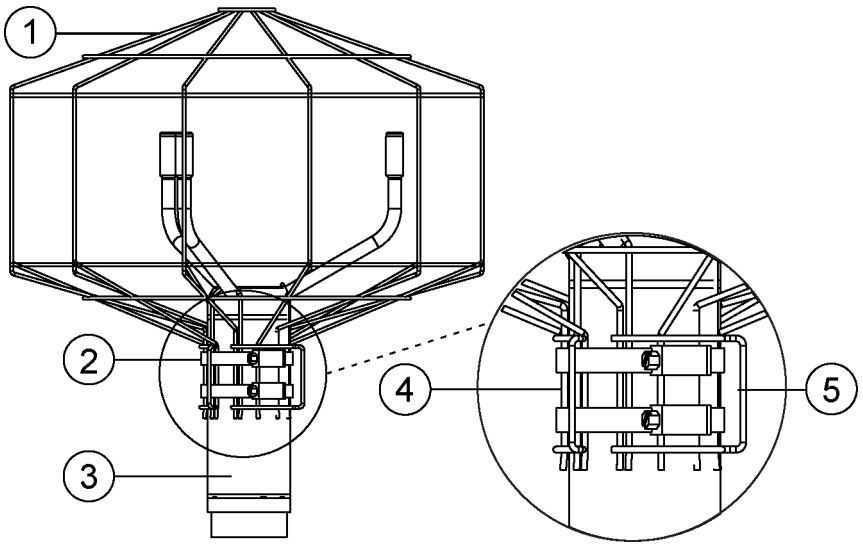


Figure 29 WMT700 Bird Cage and Bird Cage Straps

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

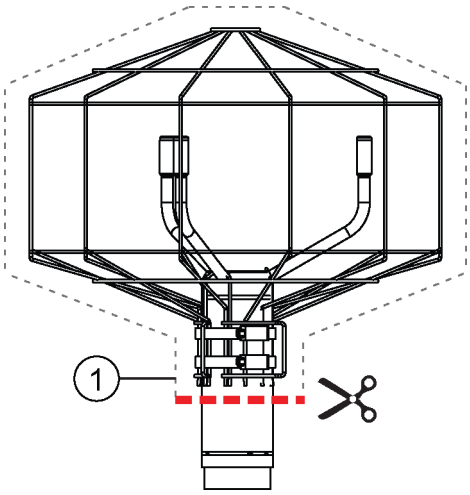
1. Unpack the bird cage and the straps.
2. Position the bird cage on top of the wind sensor and press the kit down until the three hooks are in contact with the transducer arms.
3. Run the lower strap through the three guides in the kit.
4. Lift the latch screw, insert the strap to the latch, and press down the latch screw.
5. To tighten the screw, turn it clockwise with a screw driver or a socket. Do not over-tighten.
6. Run the upper strap through the three guides in the kit, and repeat step 4 and step 5 for it.

4.8.1 Installing Bird Net

In areas with large populations of small birds, you can install a bird net over the bird cage.

1. Cover the bird cage with the bird net.
2. Tighten the bird net with cable ties.

3. Cut off the excess net below the cable ties.



1 Bird net

4.9 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.

More Information

- Upgrading from WS425 to WMT700 (page 88)

4.9.1 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 RS-485 cables are designed for RS-485 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 RS-422 operation but it can be used whenever a connection longer than 10 meters is needed as an entry point for an extension cable.

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

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

4.9.2 Cable 2 m, Cable 10 m, Cable 15 m, and Cable 26 m

The following table shows how to connect:

- Cable 2 m (227567SP)
- Cable 10 m (227568SP)
- Cable 15 m (237890SP)
- Cable 26 m (237889SP)

Table 24 Connecting Cable 2 m, Cable 10 m, Cable 15 m, and Cable 26 m

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

Power Supply		Wire Colors	Pin
COM1(Service Port)	RS-485 –	Black	9
	RS-485 +	Brown-Yellow	16

4.9.3 RS-485 for COM2 with Cable 2 m and 10 m

In the RS-485 mode, the same signals as in the RS-422 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.

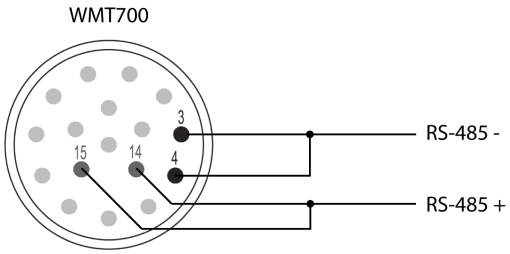


Figure 30 COM2 RS-485 Wiring

Table 25 COM2 RS-485 Wiring

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

To avoid confusion, the RS-485 and RS-422 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.

4.9.4 RS-485 Cable 2 m and RS-485 Cable 10 m

RS-485 Cable 2 m and RS-485 Cable 10 m are designed for the standard connection: operating power, heater power, and RS-485. The two-wire RS-485 loopback connections are preconnected inside the cable.

Table 26 Connecting RS-485 Cable 2 m (228259SP) and RS-485 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

4.9.5 Connector Signals

The following figure and table show the pin-out of the 17-pin M23 connector. The serial output type of COM2 depends on the sensor configuration. Analog outputs are always available from the connector.

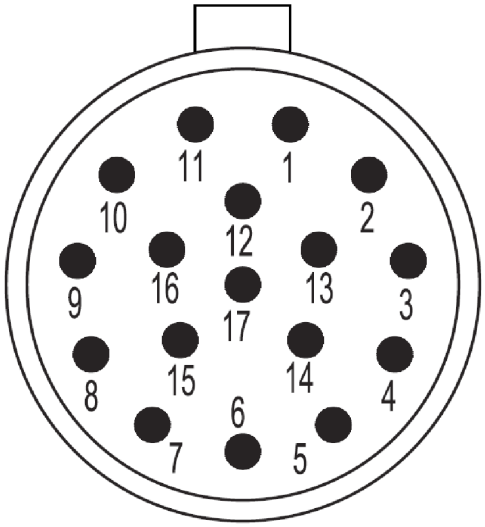


Figure 31 Pins for 17-Pin M23 Connector

Table 27 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-			
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				

4.10 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.

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

Some DC power supplies are based on a chopper circuit that operates at a 100 kHz frequency. Avoid using such power supplies with WMT700. The measurement can be distorted by the ripple in the DC output.

4.10.1 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 the following figures. Note that the selected heating option affects the needed operation voltage when separate powering for operation and heating is used.

Do not use a DC power supply based on a chopper circuit that operates at 100 kHz. The ripple in the DC output can distort the measurement.

Table 28 Operating Power Supply Voltage Requirements

Used Heating Option	Operating Power Supply
Transducers	12 ... 36 VDC 30 W
Transducers and arms	14 ... 36 VDC 150 W
Transducers, arms, and body	16 ... 36 VDC 250 W

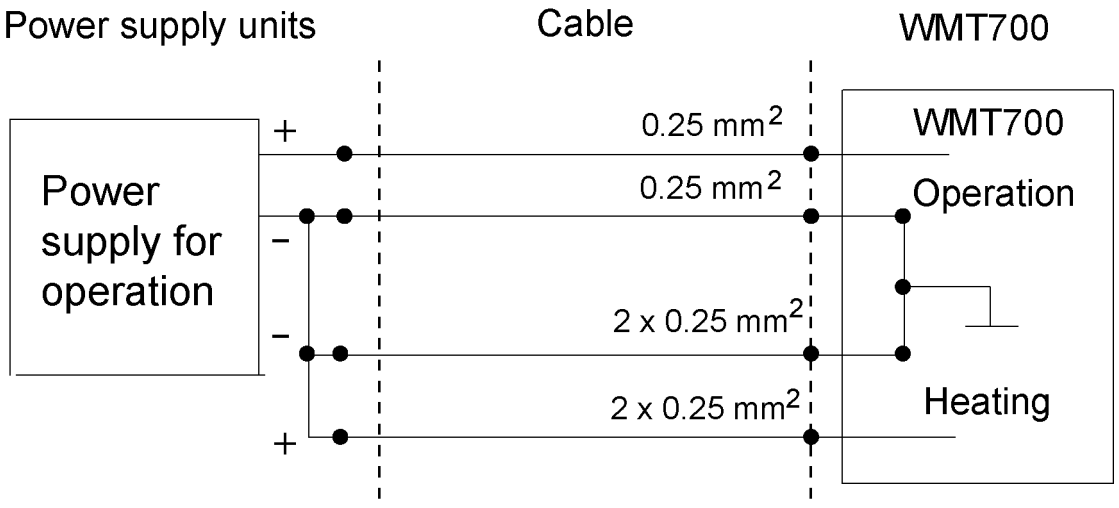


Figure 32 Wiring of Non-heated WMT700 Versions

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.

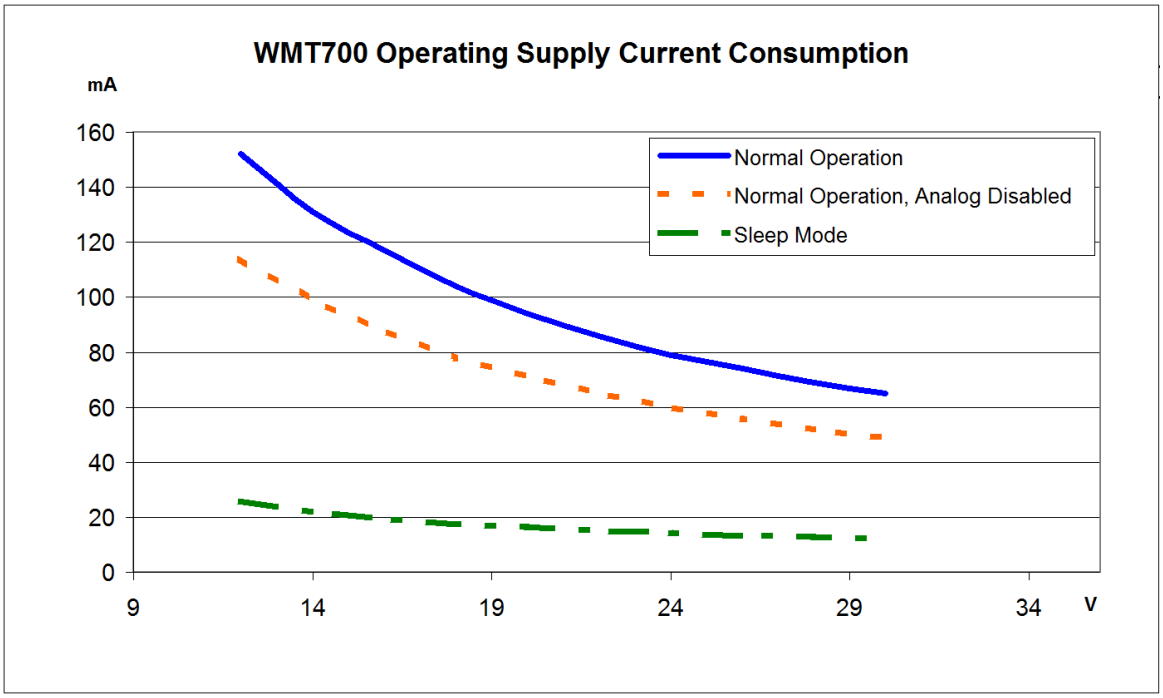


Figure 33 Operating Supply Current Consumption

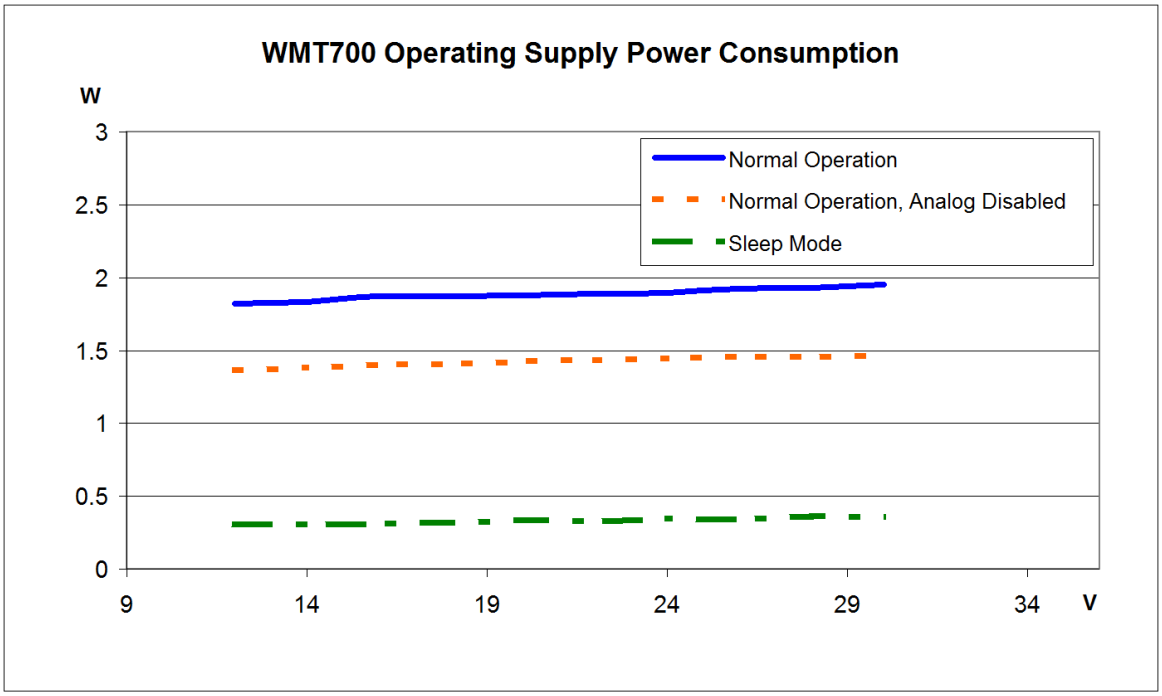


Figure 34 Operating Supply Power Consumption

More Information

- SLEEP — Enter Low-Power Mode (page 127)

4.10.2 Heating Power

The following table shows the minimum power supply requirements of the WMT700 heating options.

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 29 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)

4.10.2.1 Power and Cable Recommendations for Fully Heated WMT700

The following table shows cable and power recommendations. If you need a longer than a 10 meter cable, Vaisala recommends using Junction Box with Cable (WMT70CABLE12) for extending the cable length.

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 30 Heating Power and Extension Cable

Wire Type/ Cable Length	2 m WMT70CABLE[1)]	10 m WMT70CABLE2[1)]	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 [2)]
1.5 mm2/ AWG15	-	-	-	-	30 V 400 W

1) *Vaisala standard connection cable*
2) *Not for maritime use*

The following figures illustrate the wiring of heated WMT700 instruments.

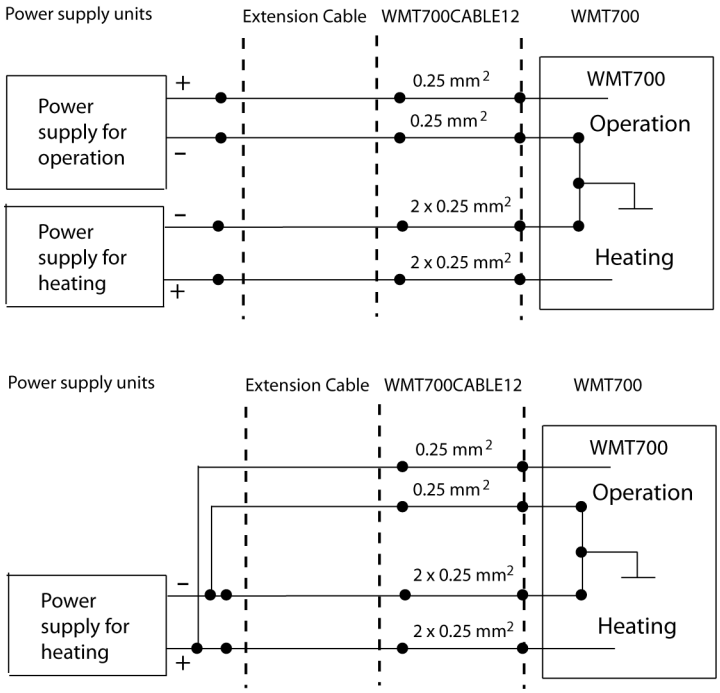


Figure 35 Wiring of Heated WMT700 Versions, Part 1

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.

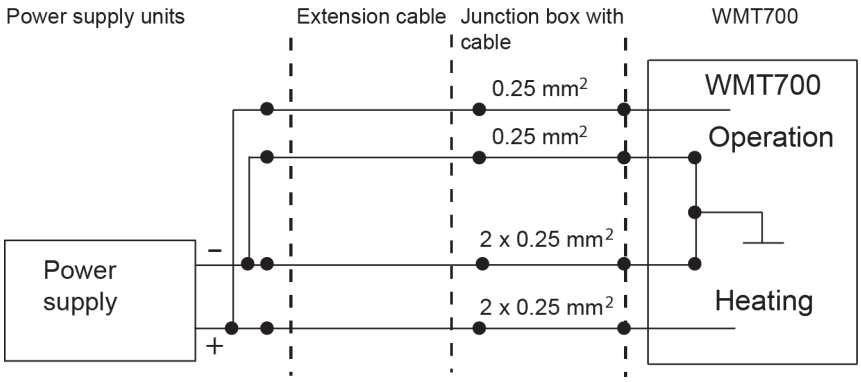


Figure 36 Wiring of Heated WMT700 Versions, Part 2

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.

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.

4.10.2.2 Maximum Peak Power

The **heaPeakPwr** parameter sets WMT700 maximum peak power (in Watts). WMT700 has 3 heater resistors for each arm. The **heaPeakPwr** parameter determines how many resistors are on at the same time. WMT700 measures the supply voltage and calculates the maximum allowed number of heaters from the supply voltage and heater resistance. The **heaPeakPwr** parameter does not limit the power in the body heater of a heated version of WMT700.

Make sure the WMT700 power peak limit is lower than the power supply rating. Setting **heaPeakPwr** value too low reduces heating performance.

Use a power supply that has enough power for WMT700. Part of the power is dissipated in the cables.

Table 31 Sensor Power of Different Heating Options

Heating Option	Required Sensor Power	Parameter Values
Transducers	40 W	0 ... 40
Transducers and arms	200 W	0 ... 200
Transducers, arms, and body	350 W	0 ... 350

4.10.2.3 Body Heating Power Adjustment

The `heaBMaxPower` parameter sets WMT700 maximum body heater power (in Watts).

You can disable WMT700 body heating by setting the `heaBMaxPower` parameter value to 0. The default value is 150.

Table 32 `heaBMaxPower` Parameter Values

Body Heating	Parameter Value
Off	0
On	150

4.11 Upgrade from WS425 to WMT700

When upgrading to WMT700, there are the following installation options:

- Basic installation, which consists of mounting WMT700 with the FIX70 mounting kit and the WMT700 mounting adapter.
  Uninstall the WS425 wind sensor and mounting kit. and follow the installation instructions in 4.1 Installing WMT700 (page 51).
- Retrofit installation, which consists of mounting WMT700 with a WS425 mounting kit and the WMT700 mounting adapter for FIX30/60.

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

After upgrading to WMT700, you can install the optional bird prevention kit available for the wind sensor.

WARNING! To protect personnel and the wind sensor, install an air terminal with the tip at least one meter above WMT700. The air terminal must be properly grounded, compliant with all local applicable safety regulations. Do not install the wind sensor above the top of the air terminal.

WARNING! Do not perform installation or maintenance procedures when there is a risk of thunderstorm or lightning activity in the area.

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

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

4.11.1 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.

If you remove the mounting kit, you must align the wind sensor after mounting. 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 4.7 Aligning WMT700 (page 63).

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. See 5.3 Configuration (page 101).

The following figure shows the mounting procedure to a vertical pole mast.

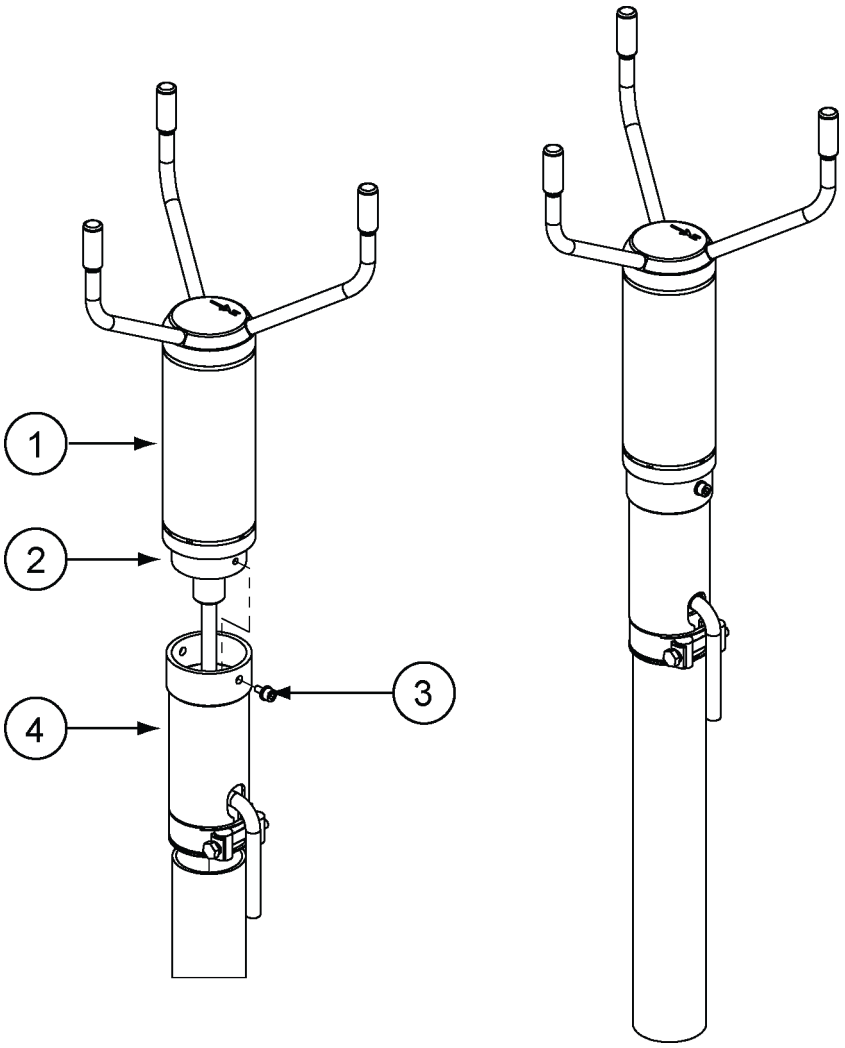


Figure 37 Retrofit Installation to Pole Mast

1 WMT700
2 Mounting adapter for FIX30/60
3 Mounting screw
4 WS425 mounting kit

The following figure shows the mounting procedure to a horizontal cross arm.

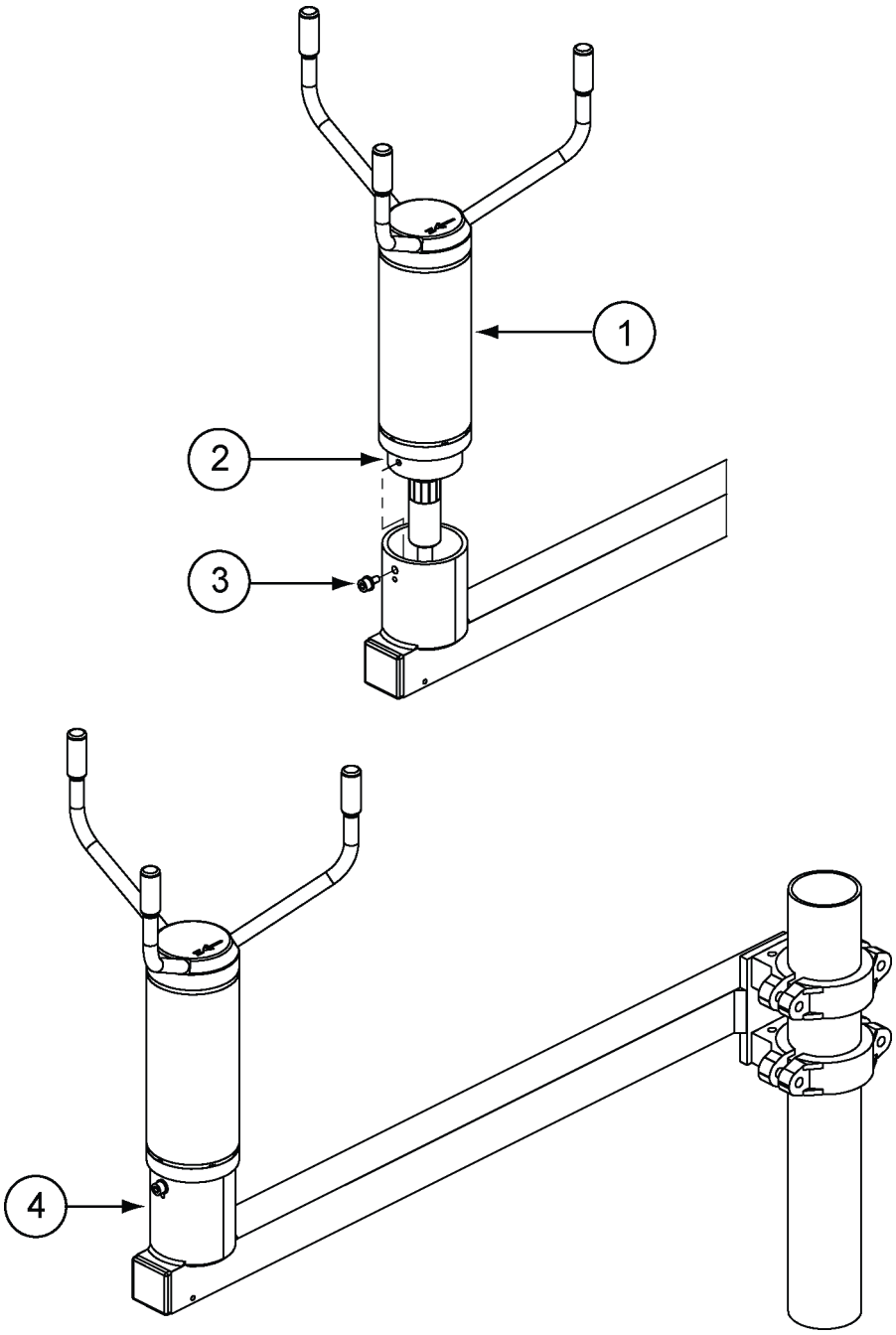


Figure 38 Retrofit Installation to Cross Arm with Array Facing Up

1 WMT700
2 Mounting adapter for FIX30/60
3 Mounting screw
4 WS425 mounting kit

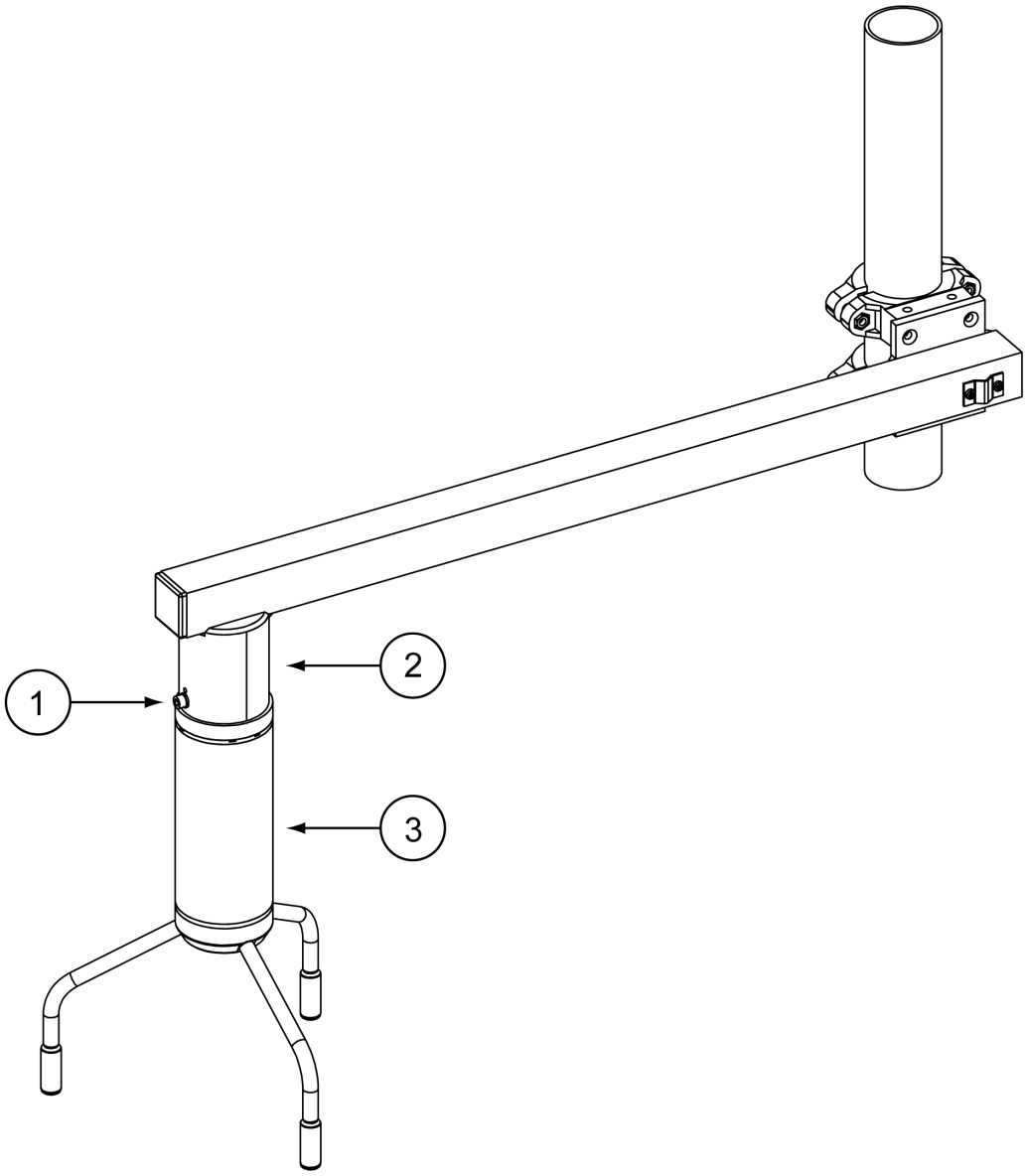


Figure 39 Retrofit Installation to Cross Arm with Array Facing Down

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

4.11.2 Upgrade Prerequisites

You need the following components:

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

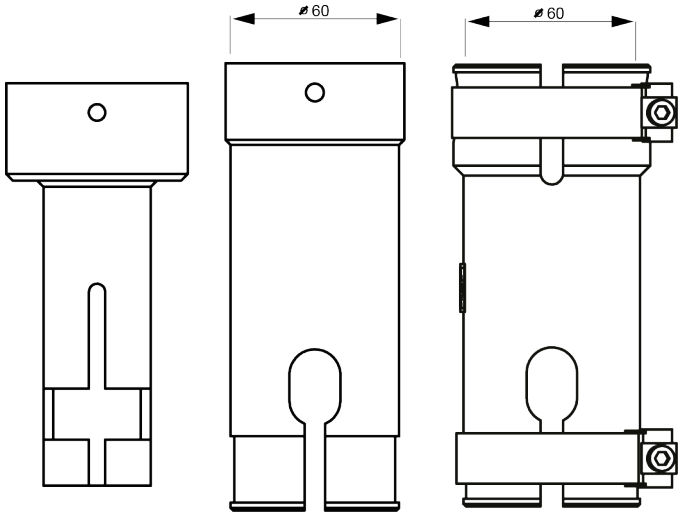


Figure 40 FIX30, WS425FIX60-RST, and WS425FIX60-POM

- Correct mounting adapter for your installation: FIX30, WS425FIX60-POM, or WS425FIX60-POM. 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.

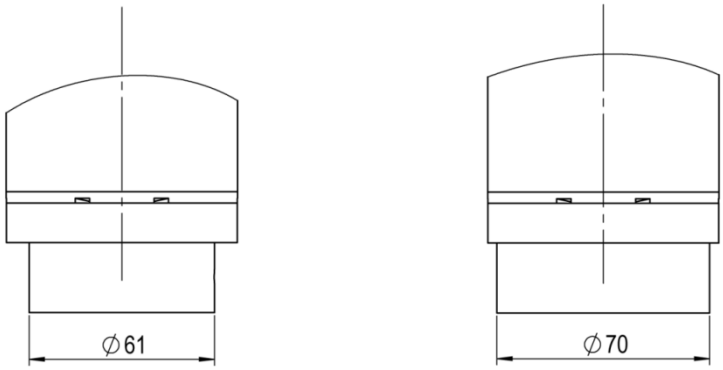


Figure 41 Mounting Adapter for FIX30, WS425FIX60 (Left), and Mounting Adapter for FIX70 (Right)

- Correct cables for the mounting kit and analog output/serial communication. The table 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.

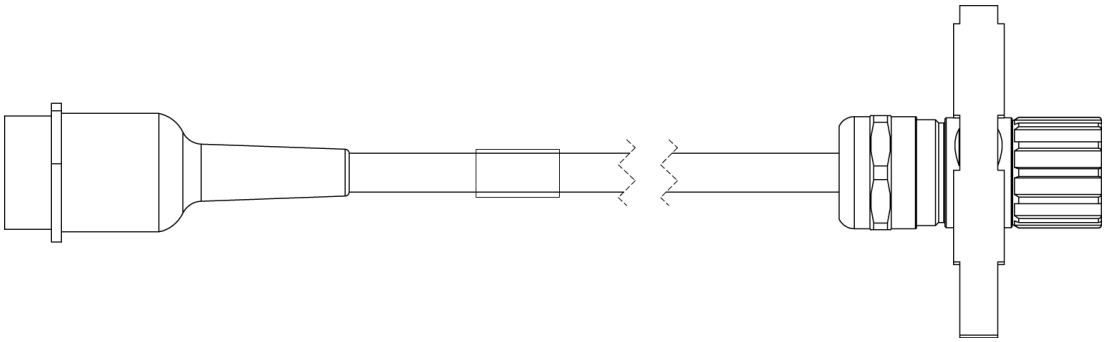
If you have FIX30, do not use the adapter cables but order the appropriate WMT700 cable. The adapter cable does not fit inside the mast.

Table 33 Mounting Kits and Cable Codes

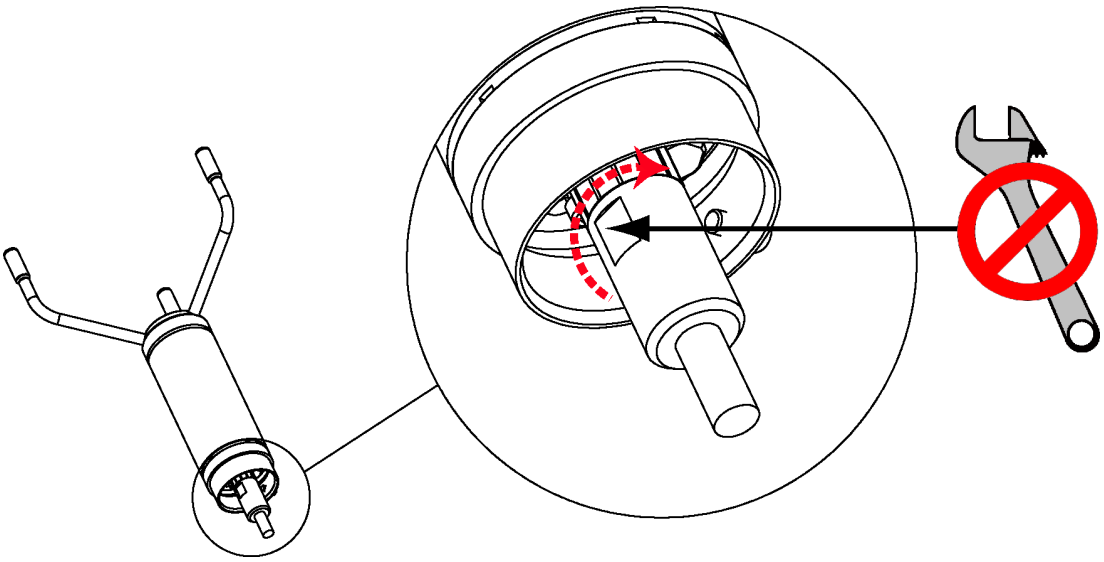
Description	Spare Part Item	FIX70		FIX30		WS425FIX60	
		In	Out	In	Out	In	Out
WMT700 cables with open leads one end (Standard 2 m/ 10 m/15 m/26 m, RS485 2 m/10 m, ROSA analog 10 m)	227567SP	x	x	x		x	x
	227568SP	x	x	x		x	x
	237890SP	x	x	x		x	x
	237889SP	x	x	x		x	x
	231425SP	x	x	x		x	x
	228259SP	x	x	x		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

4.11.3 Upgrading from WS425 to WMT700

1. Uninstall WS425.
2. Depending on your cable type, do one of the following:
   - Run a WMT700 cable through the WS425 mounting kit and connect it to WMT700.
   - If you use a WS425 cable, make sure the pre-installed O-ring seal sits properly in the plastic male connector between the WS425 cable and the adapter cable. Connect the WS425 cable to the WS425 adapter cable, run the adapter cable through the WS425 mounting kit, and connect the cable to WMT700.

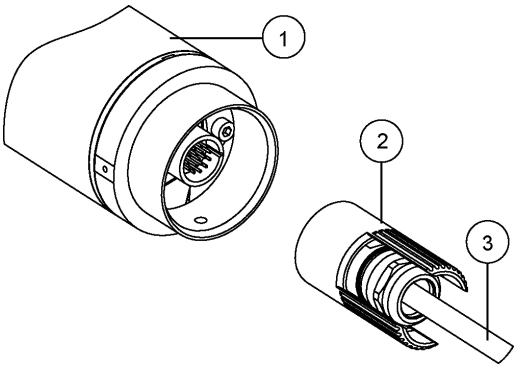


3. Tighten the connector by rotating the connector by hand clockwise.



Make sure that the connector is properly tightened before proceeding to the next step. If you cannot tighten the connector, loosen the mounting adapter fixing screws, remove the mounting adapter, and connect the cable. 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.
   Vaisala recommends that you use the cable tightening tool. 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 and rotate the ribbed part of the connector by hand. You can leave the connector in place.



1 WMT700
2 Cable tightening tool
3 Cable

7. Connect the wires.
   WMT700 is now ready for operation.

More Information

- Wiring (page 72)

4.11.4 Mounting WMT700 with ASOS Mounting Adapter

You can mount WMT700 on your existing 425NWS installation kit (4258057) by using the ASOS mounting adapter (ASM212140).

The following figure shows the parts of the installation.

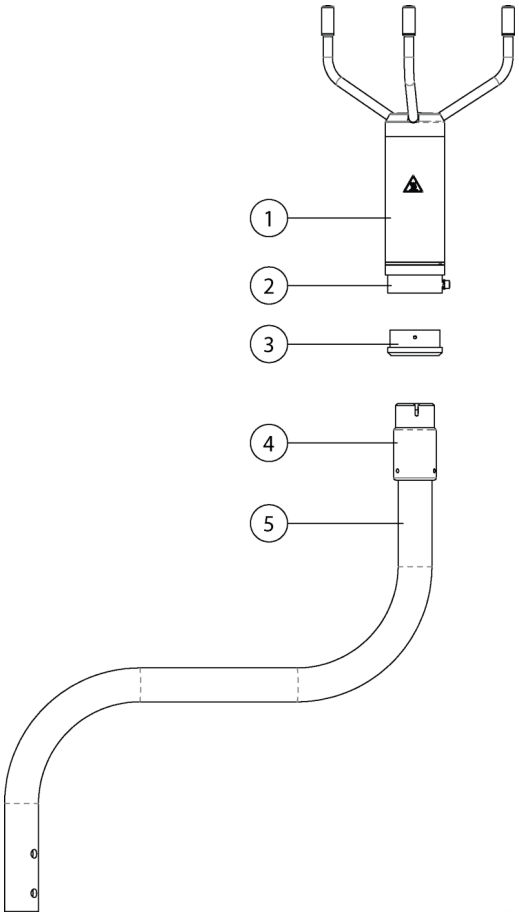
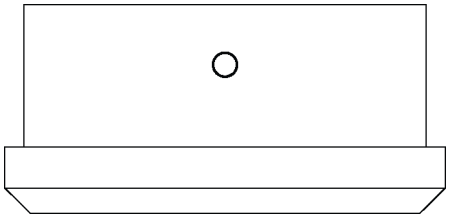


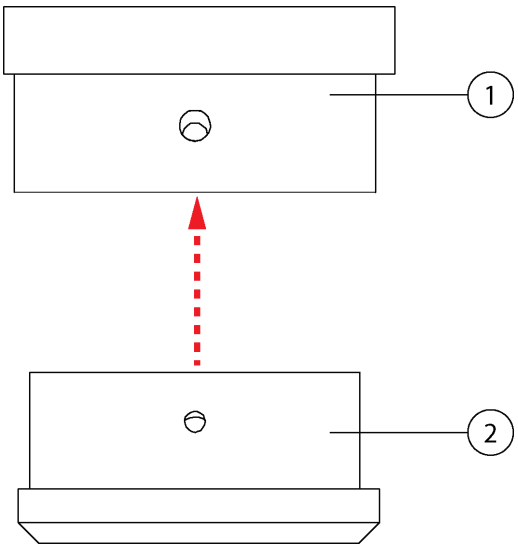
Figure 42 Installing with ASOS Mounting Adapter

1 WMT700
2 Adapter for WMT700FIX, WMT700FIX-POM, and WMT700FIX60-RST (228869)
3 ASOS mounting adapter (ASM212140)
4 425NWS sensor alignment adapter
5 425NWS mounting tube

1. Remove the screw from the ASOS mounting adapter.



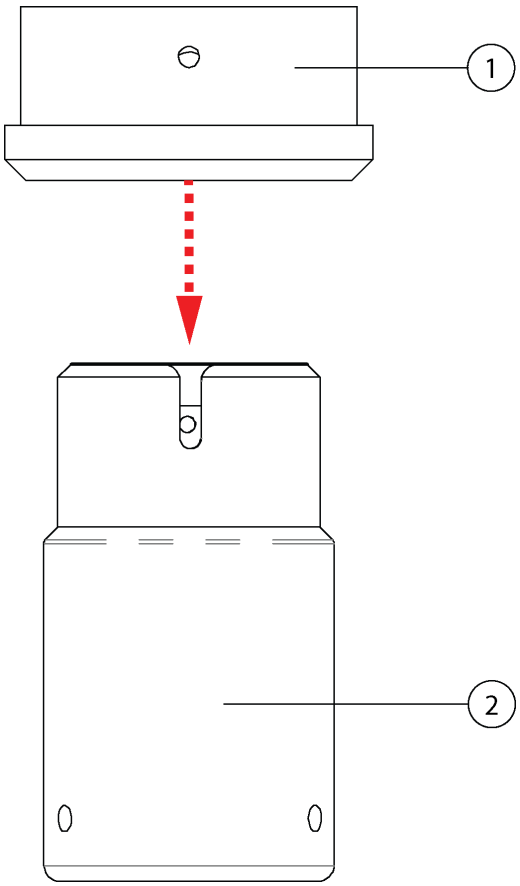
2. Insert the ASOS mounting adapter into the WMT700 adapter (228869). The ASOS adapter slides into position.



1 Adapter for WMT700FIX, WMT700FIX-POM, and WMT700FIX60-RST (228869)
2 ASOS mounting adapter (ASM212140)

3. Rotate the adapter until the screw holes are aligned. Insert the screw and tighten it.

4. Mount WMT700 with the ASOS mounting adapter on the existing sensor alignment adapter.



1 WMT700 mounting adapter
2 Existing 425NWS alignment adapter

5. Align the screw holes, insert the screw, and tighten it.

4.11.5 Connection Cable Prerequisites

When installing WMT700, pay attention to the following issues:

- How to route the cables of your mounting option. When mounting to a mast, the cable can be routed either outside or inside the mast depending on the mast type and other equipment, such as air terminals, 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 prepare or connect only de-energized wires.

WARNING! Do not perform installation or maintenance procedures when there is a risk of thunderstorm or lightning activity in the area.

WARNING! A long cable between units (sensors, transmitters, power supplies, and displays) can cause a lethal lightning-induced current surge. Always ground the enclosure to a suitable grounded location with a short, low-resistance cable.

4.11.6 Wiring in Retrofit Installations

There are two ways of performing WMT700 retrofit installation:

- Using standard WMT700 cables
- Using WS425 cables with adapters

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

4.11.6.1 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)
- RS-485 Cable 2 m (228259SP)
- RS-485 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)

4.11.6.1.1 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. The following table 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 34 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

4.11.6.2 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.

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

4.11.6.2.1 Adapter Cable for WS425 Serial Output

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

The following table lists the adapter pin-outs and signal descriptions as they appear on their user guides for both WMT700 and WS425 connectors.

Table 35 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

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

4.11.6.2.2 Adapter Cable for WS425 Analog Frequency Output

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

Table 36 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

4.11.6.2.3 Adapter Cable for WS425 Analog Voltage Output

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

Table 37 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

4.11.6.3 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.

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

Table 38 WMT700 and WS425 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)

4.11.7 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.

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. Make sure that the solar-powered system has a sufficient power reserve available.

5. Operation

5.1 Communicating with Terminal Software

- PC with a serial port
- Required cables for a serial connection
- Any terminal software, such as Tera Term or 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. Select **File > Properties**.
5. Select the correct COM port and **Configure**.
6. Set the communication parameters according to the configured port settings of WMT700. WMT700 default values are:
   - Bits per second: 9600
   - Data bits: 8
   - Parity: None
   - Stop bits: 1
   - Flow control: None
7. Select **Apply > OK**.
8. Select **Settings > ASCII Setup > ASCII sending - Send line ends with line feed > OK**. Click and close the **New Connection Properties** window.
9. Select **View > Font** and in the **Font** list, select **Terminal**.
10. Select **Call > Call**. Enter a name and select an icon for the connection. Select **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.

11. 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.

More Information

- Configuration Parameter Descriptions (page 187)

5.2 Entering and Exiting Configuration Mode

With the **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.

5.2.1 OPEN — Entering Configuration Mode

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

```
$0OPEN<enter>
```

$	Fixed $ character starts the command.
0	Sensor address. All sensors answer `0` address.
OPEN	The **OPEN** command
<enter>	To activate the command, press **ENTER**.

After a successful **OPEN** command the sensor switches from measurement mode to configuration mode and the following symbol is displayed:

```
>
```

If the port protocol is SDI-12, ("`s comX_protocol,1`"), use the command **0OPEN**<ENTER> without the $ character.

5.2.2 CLOSE — Exiting Configuration Mode

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

```
>CLOSE<enter>
```

>	Configuration mode prompt
CLOSE	The **CLOSE** command.
<enter>	To activate the command, press **ENTER**.

5.3 Configuration

You have chosen the initial settings for WMT700 when placing the order. You can start using WMT700 directly after the installation unless you want to check and/or change the settings.

The initial settings have been configured at the factory according to your specifications when ordering the product.

You can configure WMT700 settings for serial communication or analog output with configuration commands using the serial port. Before starting configuration you must set the port to the configuration mode. You can 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 D. Configuration Parameter Descriptions (page 187)), 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.

You can configure WMT700 by sending individual commands or by loading a configuration file to the sensor.

Table 39 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.

More Information

- ERRORS — Get Error Codes and Counts (page 106)
- Ordering Options (page 18)
- Restoring Serial Port Settings (page 170)

5.4 Parameter Handling Commands

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

```
>CMD x,y<enter>
```

>	Configuration mode prompt
CMD	Command
	Space
x	Any parameter in Table 73 (page 187)

,	Comma
y	Value of the parameter
<enter>	Press **ENTER** to activate the command.

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.

5.4.1 S — Set Parameter

The **S** command defines new data messages and changes values of the WMT700 parameters.

You can also use the **S** command to configure data messages.

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.

Do not switch the power supply off immediately after the **S** command. Power must be on for at least 5 seconds after the **S** command to save the updated parameters.

```
S x,y
```

x	Any parameter in D. Configuration Parameter Descriptions (page 187).
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
```

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
```

More Information

- Configuration Parameter Descriptions (page 187)
- ERRORS — Get Error Codes and Counts (page 106)

5.4.2 G — Get Parameter

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

More Information

- Configuration Parameter Descriptions (page 187)

5.4.2.1 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
```

5.4.2.2 Get Specified Parameters

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

```
G x
```

x	Any parameter in D. Configuration Parameter Descriptions (page 187).

Example

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

```
G wndAvgs wndAvg ,3.00000
```

5.4.3 BAUD — Display or Set Port Settings

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

More Information

- Restoring Serial Port Settings (page 170)

5.4.3.1 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.

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

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

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

The bit rate is set to 115200, data bits to 8, parity to none, and stop bits to 1:

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

5.4.3.2 Display Port Settings

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

```
BAUD
```

5.5 Wind Measurement Control Commands

5.5.1 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
```

5.5.2 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
```

5.5.3 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
```

5.6 Diagnostics and Support Commands

5.6.1 ERRORS — Get Error Codes and Counts

This command fetches error information from WMT700.

```
ERRORS
```

The response:

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

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
```

More Information

› Error and Event Messages (page 169)

5.6.2 CLEARERR — Reset Error Codes and Counts

This command resets the error counters of WMT700.

```
CLEARERR
```

5.6.3 POLL — Get Message

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

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
```

y	Identification number for the data message format.

More Information

- Data Messages (page 119)

5.6.4 RESET — Reset CPU

This command resets WMT700.

```
RESET
```

5.7 Information Commands

5.7.1 ? — Display Command Set

This command displays a list of available configuration commands.

```
?
```

5.7.2 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
```

5.7.3 VERSION — Show Firmware Version

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

```
VERSION
```

5.7.4 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
```

5.8 Configuration Parameters

A number of parameters affect WMT700 functionality.

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

You can configure WMT700 by sending individual commands or by loading a configuration file to the sensor.

In the automatic message mode, to initiate continuous measurement, use the **START** command.

More Information

- Configuration Parameter Descriptions (page 187)
- Upgrading from WS425 to WMT700 (page 88)
- Loading Settings from Configuration Files (page 115)
- START — Start Continuous Measurement (page 106)

5.9 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 the available items for data message strings listed in Table 40 (page 110).

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

More Information

- Data Messages (page 119)

5.9.1 Configuring Data Messages

After you have defined the new data message, you can test the message by polling it in the configuration mode. See 5.6.3 POLL — Get Message (page 107).

More Information

- POLL — Get Message (page 107)
- START — Start Continuous Measurement (page 106)

5.9.1.1 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 the following tables.

Table 40 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
\tz	10 s average of sonic temperature
\va	Validity of the measurement data. The available values are:1 = Valid wind measurement data0 = 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

Item	Description
\ws	Wind speed, average
\wx	Wind speed average, x component
\wy	Wind speed average, y component

Table 41 Control Character

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 42 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 5.9.2 Status Flags (page 113)
\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

Item	Description
\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

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

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\lf
```

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><LF>
```

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

5.9.2 Status Flags

The following list describes 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.

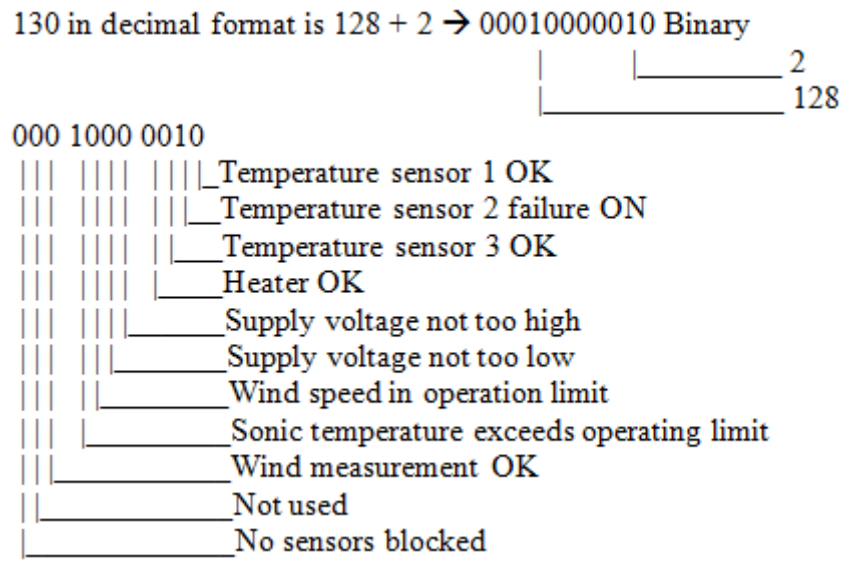
Table 43 Status

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

Bit	Description
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.
11	High noise level
12	Message received correctly. The value is always 1.

The status flags are set when an event is detected. The flags are cleared when a status message is reported. To get the current situation, you must read the status message twice. The first status message shows all events since the last read. The second status message shows the current situation.

Example



5.9.3 Loading Settings from Configuration Files

You can configure configuration of WMT700 settings over the RS-485, RS-422, or RS-232 interface 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.

1. Use the **G** command to fetch the current WMT700 parameters.
2. Disable error messages with the 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 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 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.

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.

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

```
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
```

More Information

- Configuration Parameter Descriptions (page 187)

5.10 Operating WMT700

When WMT700 is installed and configured, you can start operating the wind sensor:

- To receive wind measurement data through a serial connection as data messages, use serial communication.
  - If you use the WMT700 profile, see the following operating instructions.
  - If you use WS425 or SDI-12 profiles, see 5.17 Operating WMT700 with WS425 and SDI-12 Profiles (page 133)
- To receive wind measurement data as current, potentiometer, voltage, or frequency output, use analog output.

For a complete list of the serial commands available for the WMT700 series wind sensors, see A. Command Set for WMT700 (page 181).

More Information

- Analog Output (page 43)
- Operating WMT700 in WS425 Analog Output Mode (page 128)

5.10.1 Operating WMT700 with Terminal Program

- PC with a serial port.
- Required cables for serial connection. See 2.4.3 Cables (page 28).
- Any terminal program, such as Tera Term or 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. Select **File > Properties**.
5. Select the correct COM port and select **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. Select **Apply > OK**.
8. Select **Settings > ASCII setup > ASCII sending - Send line ends with line feed (optional) > OK**. Close the **New Connection Properties** window.
9. Select **View > Font > Terminal**.
10. Select **Call > Call**. Enter a name and select an icon for the connection. Select **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.

More Information

- Measurement Mode Commands (page 125)
- Communicating with Terminal Software (page 99)
- Data Messages (page 119)

5.10.2 Data Messages

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 must 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 the following table.
- `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.

The following table lists the data messages supported by WMT700. You need the data message numbers when you use the WMT700 protocol **POLL** command or the automatic message mode with any protocol.

Table 44 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	

Data Message Number	Description
1	Items defined by the user.
2	
3	
4	

To select a data message when using polling, specify the corresponding data message identification number in the polling command.

To select a data message when using automatic messages, use the configuration parameters.

More Information

- Configuration Parameters (page 109)
- POLL — Poll Data (page 127)

5.10.2.1 WMT700 Data Message 21

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

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

$	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>
```

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

5.10.2.2 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
```

$	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

5.10.2.3 WMT700 Data Message 23

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

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

$	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. See 5.9.2 Status Flags (page 113).
\cr	CR (carriage return)

\lf	LF (line feed)

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

5.10.2.4 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.

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

\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.
\se	Checksum calculation end point, not shown in the message
\sp	Print checksum (to verify message integrity)

Example of WMT700 Data Message 24

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

Interpretation :

- 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

More Information

› Status Flags (page 113)

5.10.2.5 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 following format:

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

\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. See 5.9.2 Status Flags (page 113).
\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

```
$03.22,75.29,03.38,03.07,22.13,0,3E<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

5.10.2.6 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.

5.10.3 Missing Readings

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 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.

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

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

5.10.4 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.
- To check that the wind data is valid, include the \va item in the data message.
- To check other diagnostics-related data, include the required items in the data message.

More Information

- Status Flags (page 113)
- Items for Data Messages (page 110)
- Command Set for WMT700 (page 181)

5.11 Measurement Mode Commands

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

For a list of serial commands available for all the communication profiles supported by WMT700, see A. Command Set for WMT700 (page 181).

More Information

- Command Set for WMT700 (page 181)
- Operating WMT700 with WS425 and SDI-12 Profiles (page 133)

5.11.1 WMT700 Profile Commands

When you select the WMT700 profile, you can operate WMT700 with these commands. In the command descriptions, <CR> is an ASCII carriage return control character and <LF> is an ASCII line feed control character. You can send commands 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 you have enabled response for parameter setting (messages parameter is set to 1), WMT700 responds to an invalid command with an error message.

Table 45 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.

$	Fixed text
a	WMT700 address. If the value is 0, it refers to any WMT700 address.
y	Identification number for the data message format.

5.11.1.1 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>
```

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

5.11.1.2 OPEN — Enter Configuration Mode

This command switches the serial port to the configuration mode.

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

$	Fixed text

a	WMT700 address. If the value is `0`, it refers to any WMT700 address

WMT700 automatically returns to normal operating mode, if it does not receive commands in two minutes, or if it detects multiple unrecognized commands.

5.11.1.3 POLL — Poll Data

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

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

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

$	Fixed text
a	WMT700 address. If the value is `0`, it refers to any WMT700 address.
y	Identification number for the data message format.

Example

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

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

More Information

- Data Messages (page 119)

5.11.1.4 SLEEP — Enter Low-Power Mode

This command switches WMT700 from the normal operating mode to the low-power mode. WMT700 resumes 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.

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

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

More Information

- Configuration Parameters (page 109)

5.11.2 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.

5.11.2.1 M 12 — Poll MES12 Data Message

This command fetches data from WMT700 in the MES12 data message format.

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

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

More Information

- ROSA - MES12 Data Message (page 124)

5.12 Operating WMT700 in WS425 Analog Output Mode

5.12.1 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, you must configure the analog output settings according to the following table using the **S** command.

Table 46 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_oaout2_o	0	-10000 ... 10000	Offset for AOUT1 and AOUT2.Set output offset to 0.

More Information

- S — Set Parameter (page 103)

5.13 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 5.12.1 Analog Output Settings (page 128).
- Wires are connected according to 4.11.6.1.1 ROSA Cable 10 m (Analog Outputs) (page 93).

5.13.1 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.

The following figure 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.

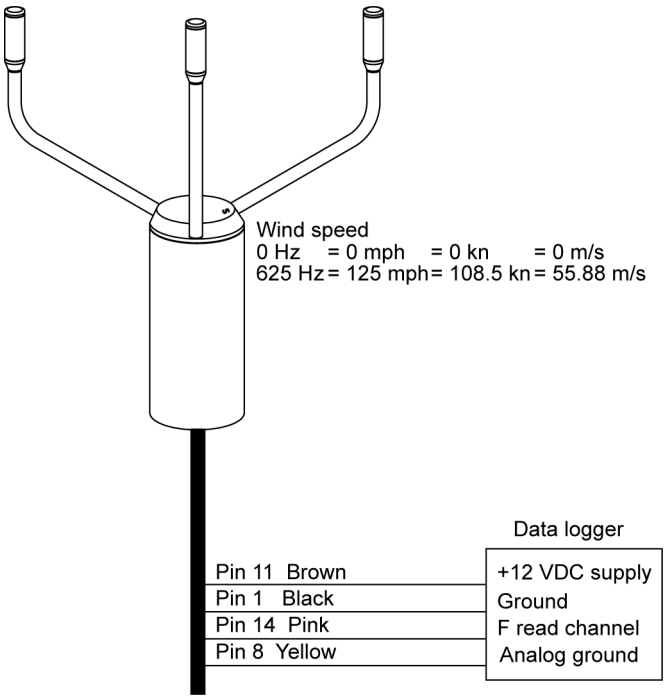


Figure 43 Wind Speed Frequency Analog Output with WS425 Cable and Adapter Cable for Analog Frequency Output

5.13.2 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.

The following figure 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.

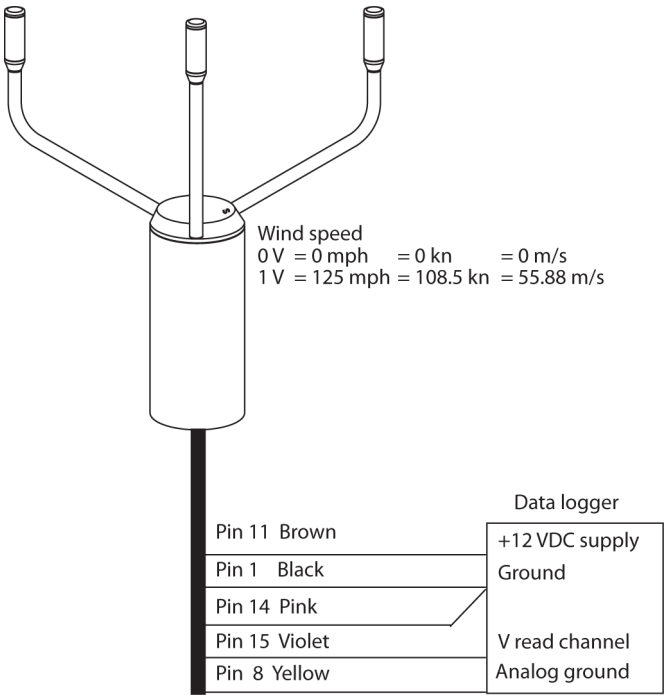


Figure 44 Wind Speed Voltage Analog Output with WS425 Cable and Adapter Cable for Analog Voltage Output

5.14 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 ... 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.

The following figure shows the output for wind direction. With WMT700, the wind direction signal appears at pin 13 (gray) of the adapter cable.

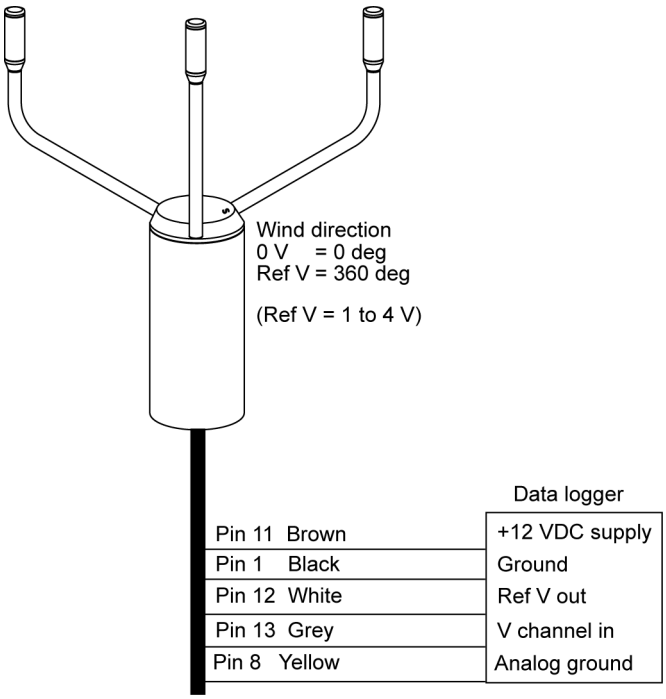


Figure 45 Wind Direction Voltage Output with WS425 Cable and Adapter Cable

5.15 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. Type the following commands:

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

5.16 Missing Readings and Error Indication

If WMT700 is unable 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. Use the following command:

```
S aout1err,1
```

More Information

- Configuration Parameter Descriptions (page 187)

5.17 Operating WMT700 with WS425 and SDI-12 Profiles

Each communication profile has its own section listing the configurable parameters and the available commands and data messages.

5.18 Communication 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.

5.18.1 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.

If you want to change the communication profile, you must change all parameters to match the new profile.

5.19 Operating WMT700 with Terminal Program

- PC with a serial port.
- Required cables for serial connection. See 2.4.3 Cables (page 28).
- Any terminal program, such as Tera Term or 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. Select **File > Properties**.
5. Select the correct COM port and select **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. Select **Apply > OK**.
8. Select **Settings > ASCII setup > ASCII sending - Send line ends with line feed (optional) > OK**. Close the **New Connection Properties** window.
9. Select **View > Font > Terminal**.
10. Select **Call > Call**. Enter a name and select an icon for the connection. Select **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.

More Information

- Measurement Mode Commands (page 125)
- Communicating with Terminal Software (page 99)
- Data Messages (page 119)

5.20 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>
```

$	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

5.21 F/G ASOS Profile

The following table lists the configurable parameters and their allowed and default values for the WS425 F/G ASOS profile.

Table 47 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 [1)]	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 [2)]	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

Parameter	Default Value	Profile-Specific Allowed Values	Description
`wndOrientation`	0	0 = Array facing up 1 = Array facing down	Orientation of the array of WMT700
`wndUnit`	0 [2)]	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

1) *The parameter has no protocol-specific default value. It is determined separately in the configuration code.*
2) *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.

To stop measurement, use the **STOP** command.

5.21.1 WS425 F/G ASOS Commands

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

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

The following commands are available for operating WMT700 with the WS425 F/G ASOS profile.

Table 48 WS425 F/G ASOS Commands

Command	Description
WA	Requests average wind speed and direction message.
WS	Requests the verbose built-in test (BIT) results.
WT	Requests the short response BIT results and status.
WD	Reports the BIT status.
WF	Returns a fixed pattern of data

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.

The following WS425 F/G ASOS commands cannot be used with WMT700: **WB**, **WFIRMWARE**, **WJ**, **WR**, **WCAL**, **WH**, **WCDV**, **WSTK**, **WL**, **WM**, **WN**, **WSST**, and **WATE**. You can only configure WMT700 in the configuration mode. For a list of configuration commands for WMT700, see 5.3 Configuration (page 101).

5.21.1.1 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.

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.

More Information

- WS425 F/G ASOS Data Message (page 140)

5.21.1.2 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

5.21.1.3 WT - Request Short Response BIT Results and Status

The command **WT** requests the short response built-in test (BIT) results and status. The command format:

```
WT CR LF
```

The response:

Byte 1	STX start of text ASCII control character
Byte 2	W sensor ID
Byte 3	T command identifier
Byte 4	P or F for heater voltage pass or fail
Byte 5-8	XX.X format heater voltage (volts RMS)
Byte 9	P or F for array heater resistance pass or fail
Byte 10-12	X.X or XX. (format as required) for array heater resistance (ohms)
Byte 13	P or F for pass or fail on heater off voltage

Byte 14-16	X.X format heater off voltage (volts RMS)
Byte 17	P or F for pass or fail thermistor temperature
Bytes 18-20	Thermistor temperature (degrees Celsius)
Byte 21	P or F for incoming supply voltage pass or fail
Byte 22-25	XX.X format incoming supply voltage (volts DC)
Byte 26	P or F for 5 volt supply pass or fail
Bytes 26-29	X.XX format 5 volt supply voltage (volts DC)
Byte 30	P or F for 10 volt supply pass or fail
Bytes 31-34	XX.X format 10 volt supply voltage (volts DC)
Byte 35	ASCII hyphen character (-)
Bytes 36-40	XXXXX format bad 1 second reading counter
Byte 41	P or F for path 0 Signal Quality Index pass or fail
Bytes 42-43	XX format path 0 Signal Quality Index
Byte 44	P or F for path 1 Signal Quality Index pass or fail
Bytes 45-46	XX format path 1 Signal Quality Index
Byte 47	P or F for path 2 Signal Quality Index pass or fail
Bytes 48-49	XX format path 2 Signal Quality Index
Byte 50	P or F for path 3 Signal Quality Index pass or fail
Bytes 51-52	XX format path 3 Signal Quality Index
Byte 53	P or F for path 4 Signal Quality Index pass or fail
Bytes 54-55	XX format path 4 Signal Quality Index
Byte 56	P or F for path 5 Signal Quality Index pass or fail
Bytes 57-58	XX format path 5 Signal Quality Index
Bytes 59-60	XX hexadecimal ASCII for modulo 256 checksum for Character positions 2 through 58
Byte 61	ETX end of text ASCII control character
Byte 62	ASCII carriage return control character
Byte 63	ASCII line feed control character

5.21.1.4 WD - Report Status of Built-in Tests

The command **WD** reports the status of the built-in tests (BIT). The command offers a concise report on the pass/fail status of all BITs. The command format is:

```
WD CR LF
```

The response:

```
STX WD PPPPPPPPPPP CS ETX CR LF
```

STX	ASCII start of test control character (position 1)
WD	Command identifier (positions 2,3)
P or F	Pass/Fail for 12 built in tests specified in WS command above in the order shown in the WS command text (positions 4-15) except Thermistor temperature.
CS	Modulo 256 hexadecimal checksum of all characters from position 2 through the last P or F (positions 16,17)
EXT	ASCII end of text control character (position 18)
CR	ASCII carriage return control character (position 19)
LF	ASCII line feed control character (position 20)

5.21.1.5 WF - Return Fixed Pattern of Data

The **WF** command returns a fixed pattern of data. This command can be used to verify the communications link. The command format is:

```
WF CR LF
```

The data fields are fixed at the following values:

Status	F
Wind direction	678
Peak wind direction	567
Wind averaging time	21
Peak wind averaging time	09
Wind speed	876.5
Peak wind speed	432.1

Example of **WF** output:

```
WFF6785672109876.5432.1K99xx
```

5.21.2 WS425 F/G ASOS Data Message

WMT700 responds to the **WA** command with a data message.

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

Table 49 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, see 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, see note 3.
28-29	Hex checksum. For further information, see note 4.

Byte	Description
30	End of text
31	Carriage return
32	Line feed

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

5.22 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.

The following table lists configurable parameters and their allowed and default values for the WS425 A/B NMEA Standard profile

Table 50 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

Parameter	Default Value	Profile-Specific Allowed Values	Description
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 [1)]	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 [2)]	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 [2)]	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

1) *The parameter has no protocol-specific default value. It is determined separately in the configuration code.*
2) *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.*

5.22.1 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>
```

$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

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.

5.23 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.

Table 51 WS425 NMEA Extended Profile Parameter Descriptions

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

Parameter	Default Value	Profile-Specific Allowed Values	Description
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 [1)]	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 [2)]	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 [2)]	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

1) *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*
2) *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.*

5.23.1 WS425 A/B NMEA Extended Commands

This command polls data from WMT700.

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

$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

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**.

Table 52 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>**

5.23.2 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>
```

$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.

5.24 WS425 A/B ASCII Profile

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

The following table lists the configurable parameters and their allowed and default values for the 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.

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 [1)]	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 [2)]	• 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 [2)]	• 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

1) *The parameter has no protocol-specific default value. It is determined separately in the configuration code.*
2) *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.*

5.24.1 WS425 A/B ASCII Commands

The following commands are available for operating WMT700 with the WS425 A/B ASCII profile.

Table 53 WS425 A/B ASCII Commands

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

You cannot use the WS425 A/B ASCII command Measurement Unit Change **Ux** with WMT700. For a list of configuration commands for WMT700, see A. Command Set for WMT700 (page 181).

5.24.1.1 I — Identify Sensor

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

`I`

```
VAISALA WMT700 200
```

5.24.1.2 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.

The averaging time supplied in the command (**x**) sets the averaging time for WMT700. When you change the averaging time, it applies to the next new wind value.

```
Wx
```

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.

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

Character	Description
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)

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

```
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.

5.25 WS425 A/B WAT11 Profile

The following table lists the configurable parameters and their allowed and default values for the WS425 A/B WAT11 profile.

Table 54 Configurable Parameters for WS425 A/B WAT11 Profile

Parameter	Default Value	Profile-Specific Allowed Values	Description
com1_protocol	0 [1)]	6 = WS425 A/B WAT11	Profile for serial port COM1
com2_protocol	0	6 = WS425 A/B WAT11	Profile for serial port COM2

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

5.25.1 WS425 A/B WAT11 Commands

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

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

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

Response:

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

<stx>	Start of text character (1 digit)
<id>	WMT700 identification character, for example, A (1 digit)
<spd>	Wind speed (in meters per second) multiplied by 10. For example, **045** is 4.5 meters per second (3 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 Reading

The WS425 A/B WAT11 message reports missing data as slashes (/////).

5.26 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, see the SDI-12 web-site: www.sdi-12.org.

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

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`

The following table lists the configurable parameters and their allowed and default values for the SDI-12 profile.

Table 55 Configurable Parameters

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)]	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)]	2 = SDI-12	Interface for serial port COM2

Parameter	Default Value	Profile-Specific Allowed Values	Description
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 [2)]	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

1) The parameter has no protocol-specific default value. It is determined separately in the configuration code.
2) 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. To stop measurement, use the **STOP** command.

5.26.1 SDI-12 Commands

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

The following table lists the available commands for operating WMT700 with SDI-12 profile.

Table 56 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.

Command	Description
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.

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*!**
- Continuous Measurement **aR0!**

More Information

› Command Set for WMT700 (page 181)

5.26.1.1 ?! — 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.

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

```
?!
```

?	Wildcard
!	Terminates the command

The response:

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

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

5.26.1.2 a! — Acknowledge Active

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

```
a!
```

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

The response:

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

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

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

5.26.1.3 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.

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

```
aAb!
```

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:

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

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

5.26.1.4 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!
```

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:

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

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.

```
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.

5.26.1.5 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 in one response string.

```
aD0!
```

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

More Information

- SDI-12 Data Messages (page 160)

5.26.1.6 aI! — Send Identification

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

```
aI!
```

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

The response:

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

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

5.26.1.7 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!
```

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

The response:

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

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

```
1M! 10025<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.

5.26.1.8 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:

```
aV!
```

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

The response:

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

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 returned verification data fields
<CR><LF>	Terminates the response

Example

```
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.

5.27 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.

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

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

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

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

Example of the command and response when data is missing:

```
7D0! 7+999.9+999.9+999.9+999.9+999.9 <CR><LF>
```

5.27.2 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>
```

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.

5.27.3 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 is appended to the data returned by the **aD0!** command.

The 16-bit Cyclic Redundancy Check value is appended to the response of the **aD0!** command before <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

```
1MC! 10025<CR><LF> 1D0! 1+2.7+85.2-0.2-2.7+770.5CAH<CR><LF>
```

6. Maintenance

6.1 WMT700 Maintenance

WMT700 is a very reliable and rugged sensor. Since no moving or consumable parts are used, only minimal periodic maintenance is required.

Periodic maintenance for WMT700 includes:

- Checking that the transducers are not bent, twisted, or rotated. All transducers must be parallel to each other. Damaged array may cause inaccurate readings.
- Checking that the transducers have not been scraped or touched with sharp objects. The silicon rubber coating must be undamaged. If the transducers or the coating is damaged, send the sensor to Vaisala for repair.
- Verifying functionality by using the optional verifier to check the distance between transducers.

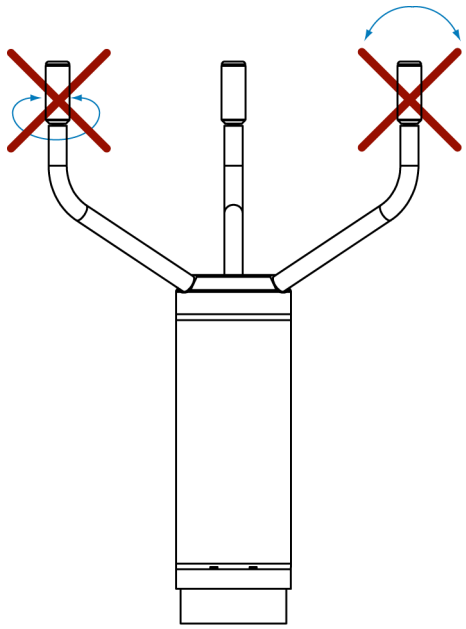
WMT700 has been calibrated at the factory, and recalibration is not required. Periodic calibration of WMT700 is not required for technical reasons. However, some quality management systems may require regular calibration of the measuring instruments. To fulfill these requirements, it is recommended that you recalibrate the sensor every 24 months. For more information, contact Vaisala Service Center.

If the sensor becomes contaminated, cleaning the sensor carefully using a soft, lint-free cloth moistened with mild detergent. Do not use solvents or a pressure washer to clean the sensor, since they may damage the silicon rubber transducer sleeve.

CAUTION! Do not clean the instrument or sensor unless it is clearly contaminated.

WARNING! Some instruments and sensors or versions are heated. To avoid injury, do not touch heated parts when heating is on.

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



CAUTION! Any temporary object (such as snow, ice, or a bird) that blocks the observation path between the ultrasonic transducer heads may lead to inaccurate or incorrect measurements.

CAUTION! Do not open the instrument or sensor. There are no user-serviceable parts inside.

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

6.2 Testing Operation

Optional verifier (WMT70VERIFIER)

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 the verifier from Vaisala as an accessory.

Vaisala recommends that you test the proper operation once a year or if you suspect that the transducers may have been damaged. You can perform the test either in the field or in a laboratory.

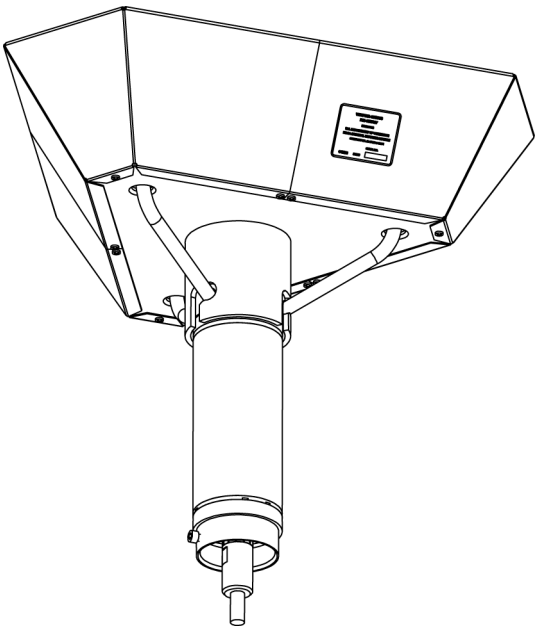
Do not perform the test when the wind speed is more than 10 m/s (22 mph) or when there is a risk of thunderstorm in the area.

Some random data samples may be lost during the verifier test. This does not indicate that sensor or instrument is faulty.

Disable heating before performing the verifier test.

To disable heating, disconnect the heater supply voltage or set the `heaterOn` parameter to `0`.

1. Slip the verifier over the 3 transducers.



2. Start wind measurement. The command depends on the selected communication profile.
3. Make sure that WMT700 reads less than 0.22 m/s (0.5 mph) with the verifier in place.

4. Remove the verifier.

7. Troubleshooting

7.1 Problem Situations

Problem	Probable Cause	Remedy
Connection to WMT700 is lost.	Power supply is not sufficient.	Check that the power supply matches the requirements listed in 4.10 Powering (page 76).
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 4.2 Placing WMT700 (page 51).
	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 4.7 Aligning WMT700 (page 63).
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 D. Configuration Parameter Descriptions (page 187).
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 7.3 Restoring Serial Port Settings (page 170).
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 4.9 Wiring (page 72).
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 5.6.1 ERRORS — Get Error Codes and Counts (page 106).

Problem	Probable Cause	Remedy
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 44 (page 119).
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 5.4 Parameter Handling Commands (page 102).
Configuration commands do not work.	WMT700 is in measurement mode.	Switch from measurement mode to configuration mode. See 5.1 Communicating with Terminal Software (page 99).
WMT700 sends an error message as a response to a command.	For probable causes, see 7.2 Error and Event Messages (page 169).	For remedies, see 7.2 Error and Event Messages (page 169).
No signal is present on analog outputs.	Analog output has been disabled.	Enable analog output with the aout1_mode and aout2_mode parameters. See D. Configuration Parameter Descriptions (page 187).
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 5.5.2 START — Start Continuous Measurement (page 106).
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 D. Configuration Parameter Descriptions (page 187) if reset is required before the parameter is changed.
Inconsistent serial communication or missing data.	Pin contacts of the connector have become oxidized or the connector is not firmly attached.	Change the WMT700 cable.
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. See F. WMT700 Accessories (page 197).

Problem	Probable Cause	Remedy
WMT700 does not work properly after retrofit installation.	Incorrect cables were used in the retrofit installation.	Check that you have used cables listed in 4.11.5 Connection Cable Prerequisites (page 92). 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 4.10 Powering (page 76).

7.2 Error and Event Messages

If the **messages** parameter is set to **1**, WMT700 sends error and event messages. The following table lists the available messages.

Table 57 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 5.1 Communicating with Terminal Software (page 99).
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 E.1 Configurable Parameters (page 193).
11	Error. Parameter used with the **S** command is unknown.	Check that you are using the correct parameter names, see E.1 Configurable Parameters (page 193).
12	Error. Unknown command.	Check the allowed commands in A. Command Set for WMT700 (page 181).
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.
- Include diagnostics-related items in the data message.

More Information

- Parameter Handling Commands (page 102)
- ERRORS — Get Error Codes and Counts (page 106)

7.3 Restoring Serial Port Settings

If you are not familiar with the configured settings of WMT700, 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.

1. Connect a cable between your terminal computer, power supply, and WMT700.
2. Open the Windows HyperTerminal program.

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

3. Cancel the new connection.
4. Select **File > Properties**.
5. Select the correct COM port and then **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 string:

    ```
    Ok
    Restoring COM1 and COM2 settings…
    ```

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

    ```
    Done. Rebooting…
    ```

    WMT700 has now applied the settings and reboots using the new settings. For the restored settings, see the table below.
11. Before you start configuring new values to WMT700, apply the new settings to HyperTerminal. To close the connection, select **Call > Disconnect**.

12. Select **File > Properties**.
13. Select **Properties > Configure**.
14. In **Bits per second**, select **9600**.
15. Close the **Properties** window.
16. Select **Call > Call**.

Table 58 Restored Serial Port Settings

Parameter Name	Default Value	Description
`com1_baudcom2_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 write the **OPEN** command and start configuring WMT700.

More Information

- Configuration (page 101)

8. Technical Data

8.1 Measuring Specifications

Table 59 WMT700 Wind Speed Measuring Specifications

Property	Description/Value
Observation range	WMT701: 0 ... 40 m/s (89 mph) WMT702: 0 ... 65 m/s (145 mph) WMT703: 0 ... 75 m/s (168 mph) WMT704: 0 ... 90 m/s (201 mph)
Starting threshold	0.01 m/s (0.0223 mph)
Resolution	0.01 m/s (0.0223 mph)
Response time	250 ms
Accuracy	0 ... 75 m/s: (168 mph) ±0.1 m/s or 2% of reading, whichever is greater 75 ... 90 m/s (201 mph): ±5% of reading
Available variables	Instant, peak, average, maximum, minimum, gust, lull

Table 60 WMT700 Wind Direction Measuring Specifications

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

CAUTION! Any temporary object (such as snow, ice, or a bird) that blocks the observation path between the ultrasonic transducer heads may lead to inaccurate or incorrect measurements.

In extreme weather conditions, ice or snow accumulation may cause a temporary wind observation blackout even when heating is enabled.

8.2 Electrical Specifications

Table 61 WMT700 Electrical Specifications

Property	Description/Value
Operating voltage	9 ... 36 VDC (absolute maximum 40 VDC) [1]
Heating voltage	24 ... 36 VDC (absolute maximum 40 VDC) [1]
Heating power supply requirement	
No heating	1.50 W at 24 V
Heated transducers	31.50 W at 24 V (peak 40 W) [2]
Heated transducers and arms	151.50 W at 24 V (peak 200 W) [2]
Heated transducers, arms, and body	251.50 W at 24 V (peak 350 W) [2]

1) *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.*
2) *The actual power consumption depends on the temperature.*

Table 62 WMT700 Output Specifications

Property	Description/Value
Readout update interval	Maximum 4 Hz
Units available	m/s, knots, mph, km/h, V, mA, Hz
Operating mode	Automatic message or poll mode
Virtual temperature	Celsius degrees
Digital outputs	
Communication interfaces	COM1: RS-485
	COM2: RS-485, RS-422, RS-232, SDI-12
Communication profiles	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	Maximum 3600 s

Property	Description/Value
Analog outputs for 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 minimum): 0 ... 750 Hz (load 50 kohm ±20 %)
Frequency pull-up	Pulse 1.5 V/V_{in}-4 V (8 V minimum):
Voltage	0 ... 10 V (U = 100 mV /m/s)
Current	0 ... 20 mA (I = 0.2 mA/m/s)
Analog outputs for wind direction	
Voltage	0 ... 10 V (U = 20 mV/°)
Current	0 ... 20 mA (I = 50 uA/°)
Potentiometer	Reference voltage 1 ... 10 VDC, 0 ... V_{ref} represents 0 ... 359°

8.3 Environmental Specifications

Table 63 WMT700 Environmental Specifications

Property	Description/Value
Operating temperature	-10 ... +60 °C (+14 ... +140 °F) -40 °C ... +60 °C (-40 ... +140 °C), or -55 ... +70 °C (-67 ... +158 °F)
Storage temperature	-60 ... +80 °C (-76 ... +176 °F)
Operating humidity	0 ... 100 %RH
IP rating	IP66 and IP67
EMC	IEC 61000-4-2 ... 6
Emissions	CISPR22
Environmental	IEC 60068-2-1,2,6/34, 30, 31, 67, 78, IEC 60529; VDA 621-415
Maritime	DNVGL-CG-0339; Lloyd's Register requirements; IEC 60945

8.4 Mechanical Specifications

Table 64 WMT700 Mechanical Specifications

Property	Description/Value
Dimensions (H × W × D)	350 × 250 × 285 mm (13.78 × 9.84 × 11.22 in)
Weight	
WMT700 wind sensor	1.8 kg (4.0 lb)
Mounting adapter	0.3 kg (0.7 lb)
WMT70FIX mounting kit	1.4 kg (2.2 lb)
Materials	
Body and arms, mounting kit	Stainless steel AISI 316
Transducers	Silicone

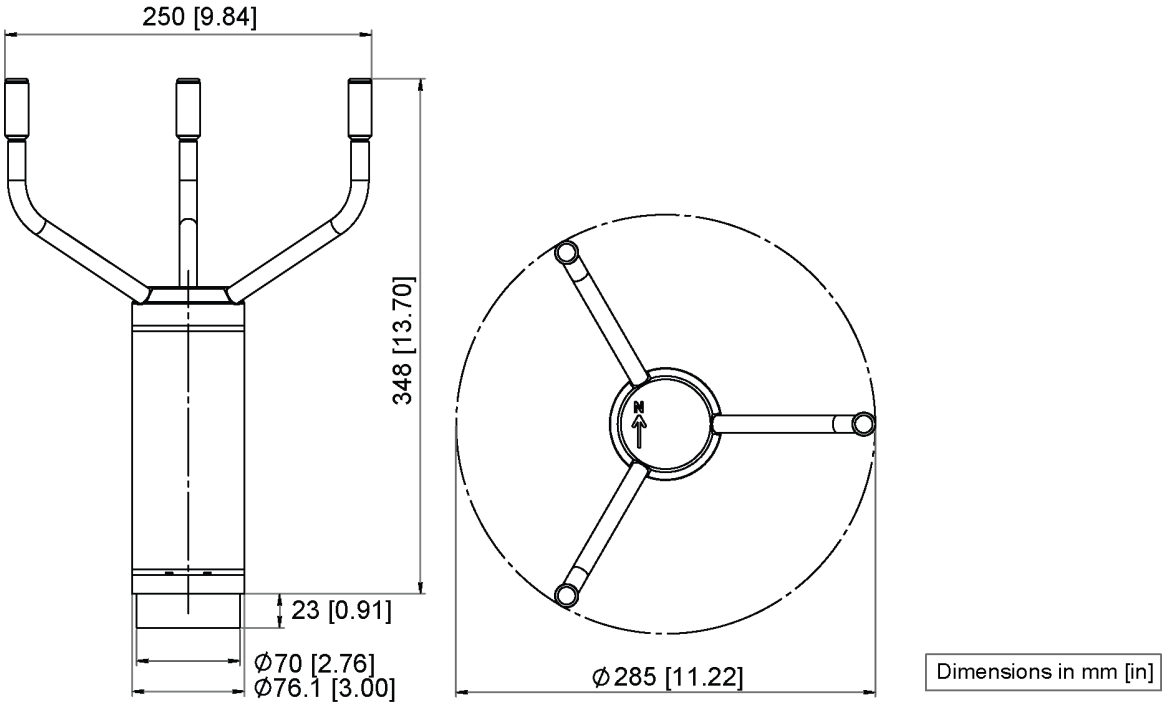


Figure 46 WMT700 Dimensions

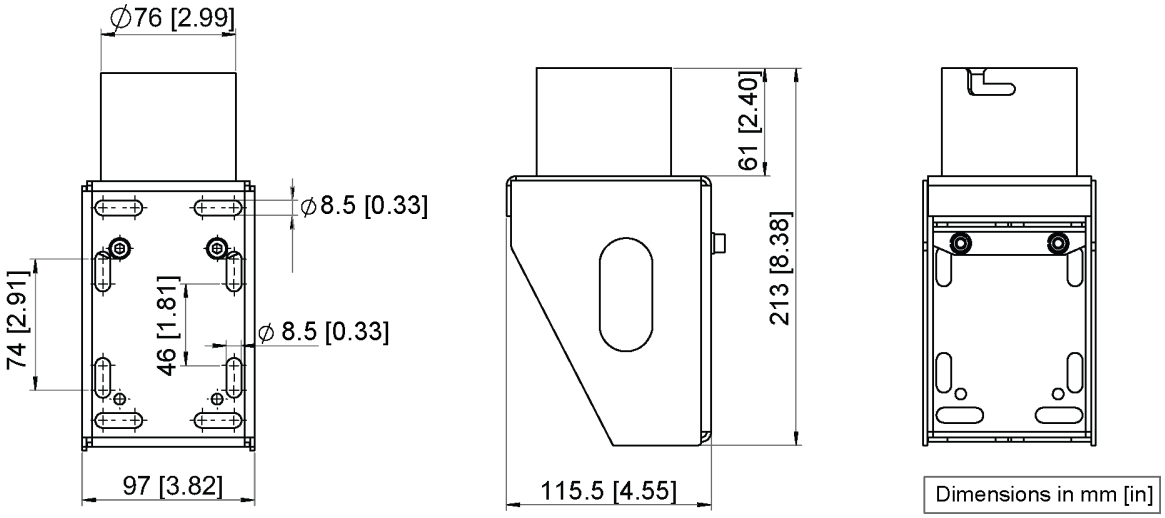


Figure 47 WMT70FIX Mounting Kit Dimensions

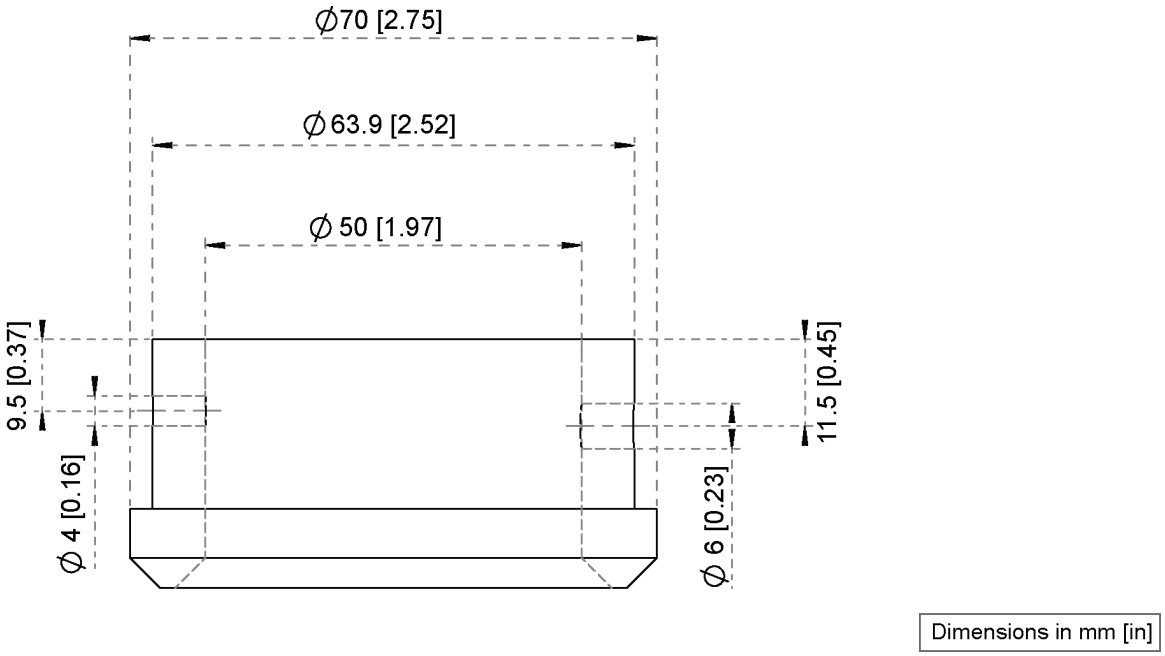


Figure 48 ASOS Mounting Adapter Dimensions

8.5 Accessory List

Table 65 Tools

Item	Order Code
Zero Wind Verifier	WMT70Verifier

Item	Order Code
Cable Tightening Tool	237888SP

Table 66 Bird Obstructions

Item	Order Code
Bird cage	WMT70BirdKit
Bird perch	WS425BirdPerch

Table 67 Cables

Item	Order Code
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	237889SP
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

Table 68 WMT700 Mounting Accessories

Item	Order Code
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

Item	Order Code
Cross-arm (requires WMT70FIX mounting adapter)	WMT70CROSSARM
ASOS mounting adapter	ASM212140

Table 69 WS425 Mounting Accessories

Item	Order Code
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

Appendix A. Command Set for WMT700

The following table lists all the commands available for WMT700.

Table 70 Command Set for WMT700

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.

Configuration Mode / Measurement Mode and Profile	Command	Description
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.
Measurement mode WS425 ASOS F/G profile	**WT**	Requests the short response BIT results and status.
Measurement mode WS425 ASOS F/G profile	**WD**	Reports the BIT status.
Measurement mode WS425 ASOS F/G profile	**WF**	Returns a fixed pattern of data.
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 ASCII 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

The following figure 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.

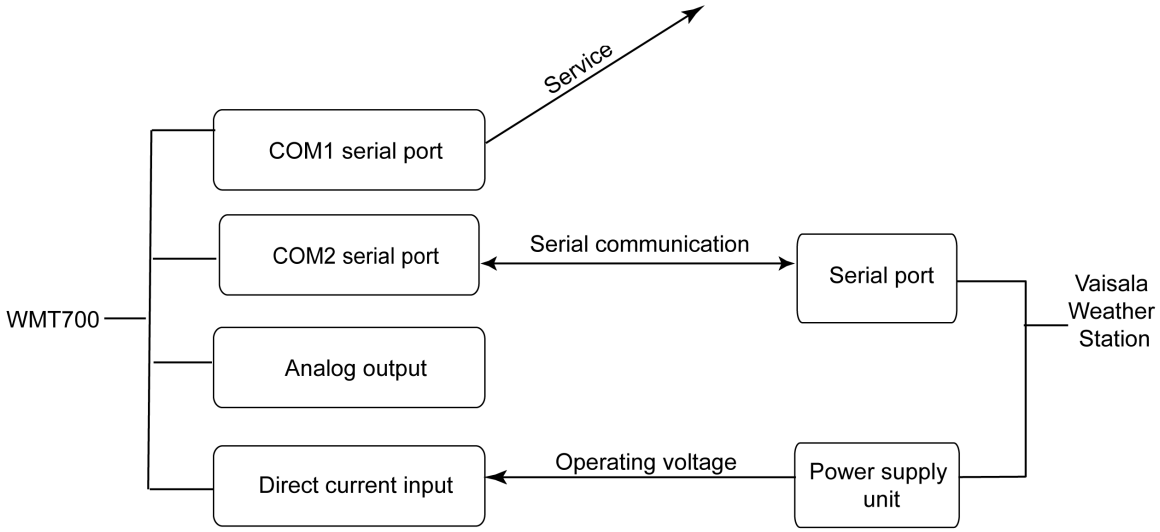


Figure 49 System Environment with Serial Port COM1 Only

The following figure shows a system in which the weather station is only connected to the analog output channel. Serial port COM1 is used for maintenance purposes.

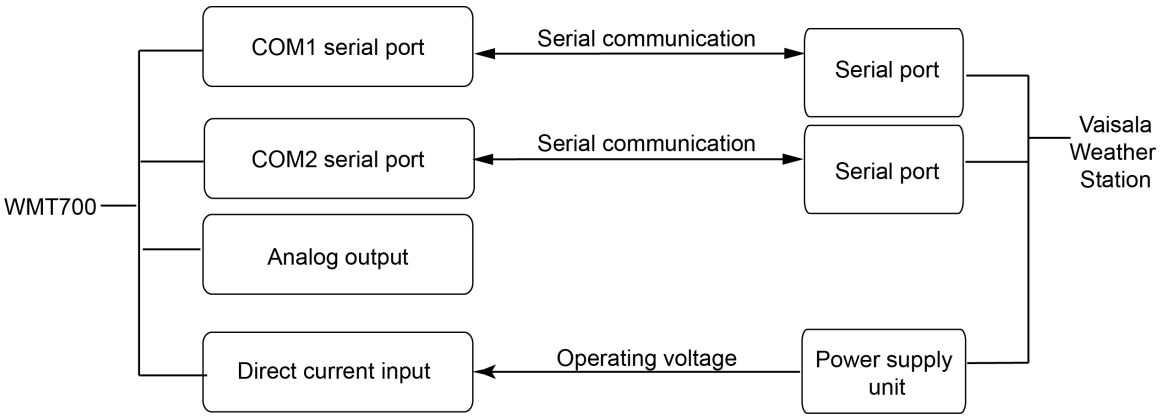


Figure 50 System Environment with Analog Output Only

The following figure 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.

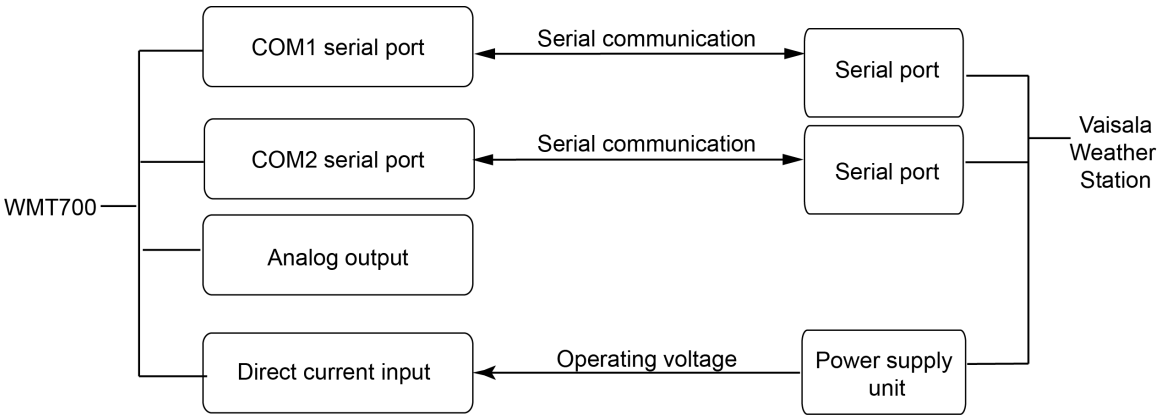


Figure 51 System Environment with Serial Ports COM1 and COM2

The following figure 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.

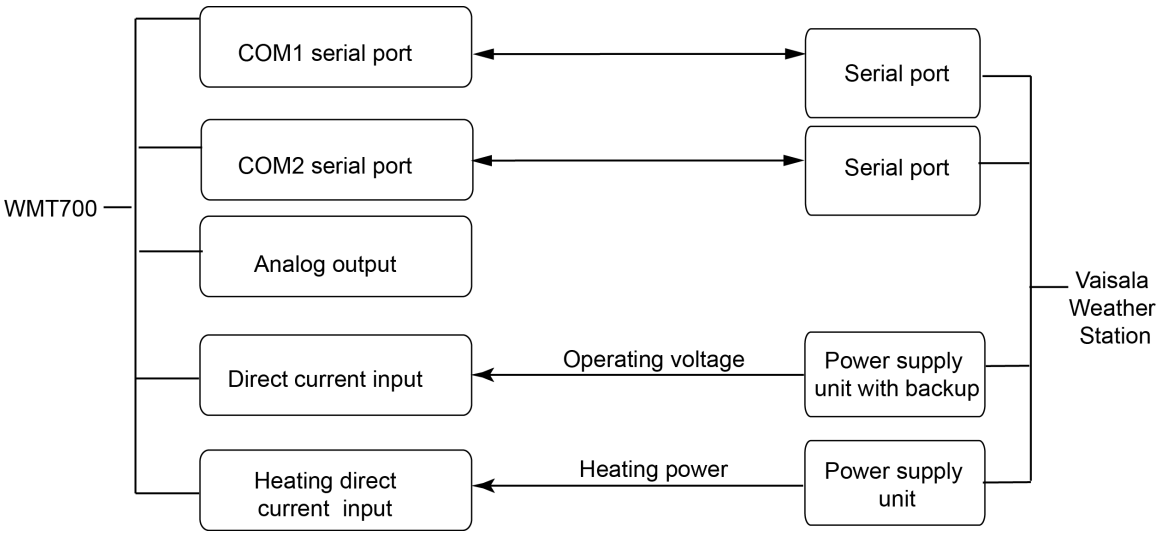


Figure 52 System Environment with Backup Battery

Appendix C. Default Settings for Different Communication Profiles

C.1 Default Settings for Different Communication Profiles

Table 71 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	0	1	12
Automatic message number	autoSend	Disabled (0)	Disabled	15	Disabled	Disabled	Disabled

Setting	Parameter	WMT700	WS425 ASCII	WS425 NMEA Ext	WS425 SDI-12	WS425 F/G ASOS	ROSA MES12
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 measurement averaging method	`wndVector`	Scalar averaging	Scalar averaging	Scalar averaging	Scalar averaging	Scalar averaging	Scalar averaging

The parameters in the following table do not have a protocol-specific default value. They are defined in the configuration code.

Table 72 Parameters with No 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

Appendix D. Configuration Parameter Descriptions

Table 73 Configuration 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 SDI12, ASCII, NMEA Extended, ASOS, and MES12 profiles use the first character only. SDI-12 only uses digits 1 ... 9.
aout1erraout2err	1000	0 ... 32000	V, A, Hz, %	Value for AOUT1 and AOUT2 analog output if wind measurement fails.
aout1_gaout2_g	1	0 ... 100		Gain for AOUT1 (wind speed) and AOUT2 (wind direction)
aout1_oaout2_o	0	-10000 ... 10000		Offset for AOUT1 and AOUT2
aout1maxvaout2maxv	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.
aout1minvaout2minv	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.

Parameter Name	Default Value	Allowed Values	Units	Description
aout_map	0	0 = aout1, wind speed aout 2, wind direction 1 = aout1, North-South, x component aout 2, west-east, y component 2 = aout1, wind speed aout2, wind speed alarm A digital output: hi when wind speed > aout2_o		Parameter for analog outputs in road and rail tunnel applications and crane applications. The parameter provides horizontal and direction data.
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.
com1_baudcom2_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_delaycom2_delay	20	0 ... 10000	ms	COM1 and COM2 Response delay in milliseconds.

Parameter Name	Default Value	Allowed Values	Units	Description
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_paritycom2_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. • 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 = MES 12 • 11 = WMT700 NMEA MWV
com1_stopcom2_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.
heaBMaxPower	150	0 = Off 150 = On	W	`heaBMaxPower` sets maximum body heater power. Setting the parameter value to `0` disables WMT700 body heating.

Parameter Name	Default Value	Allowed Values	Units	Description
heaPeakPwr	200	min … max = 0 … 200 W		heaPeakPwr determines how many resistors are on at the same time. WMT700 has three heater resistors for each arm. heaPeakPwr does not limit the power in the body heater of a heated version.
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.
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.

Parameter Name	Default Value	Allowed Values	Units	Description
`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.
`wndGainLo`	1		%	Wind tunnel tests show that the bird cage systematically lowers the wind speed reading by 1.5 % (cage) or 2.5 % (cage and net). The **`wndGainLo`** parameter can be used to compensate for wind speed gain correction for the bird cage. `S wndGainLo,1.015`
`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.
`wndRate`	1	1 = 4 Hz 2 = 8 Hz	Hz	Wind vector update rate. For best performance in wind speeds over 50 m/s, Vaisala recommends the 4 Hz rate.
`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

Appendix E. WMT700 NMEA MWV Profile

E.1 Configurable Parameters

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.

The following table shows the configurable parameters and their allowed and default values for the WMT700 NMEA MWV profile.

Table 74 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

Parameter	Default Value	Profile-Specific Allowed Values	Description
`wndUnit`	0 [1)]	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

1) *COM1 service port is always by default 0 - WMT700 protocol. You can change this using serial commands if COM1 is needed for protocol-specific communication.[1)]*
2) *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.[2)]*

To start continuous measurement, use the **START** command. You can stop the measurement with the **STOP** command.

E.2 WMT700 NMEA MWV Commands

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

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

$	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

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`**.

E.3 WMT700 NMEA MWV Data Message

WMT700 NMEA MWV data message is as follows:

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

$	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.

E.3.1 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. WMT700 Accessories

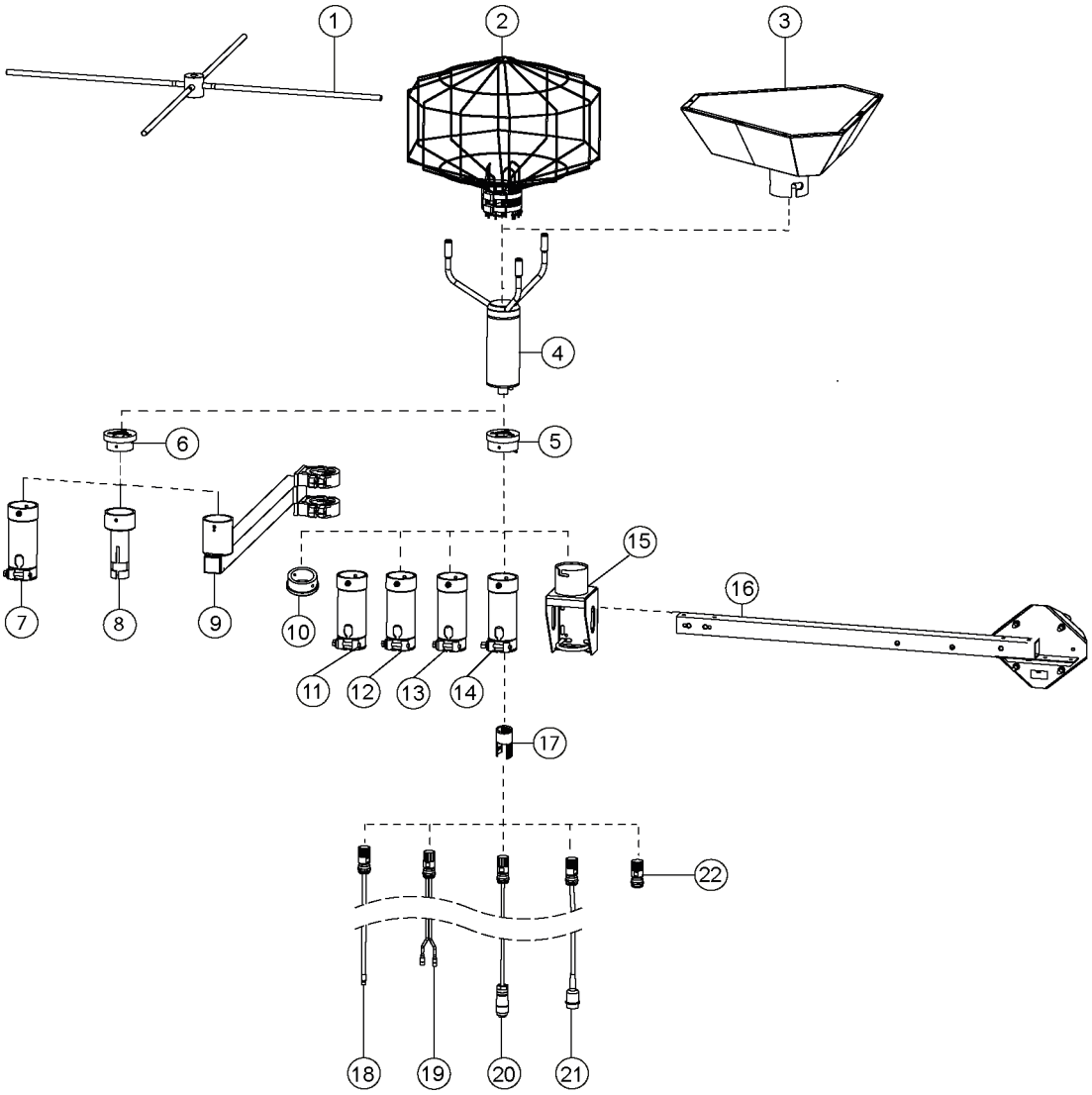


Figure 53 Complete Set of WMT700 Accessories

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 Mounting adapter for 30 mm tube (WS425FIX30)
9 Sensor support arm for 60 mm mast (WAC425)
10 ASOS mounting adapter (ASM212149)
11 Stainless steel mounting adapter for 60 mm tube (WS425FIX60-RST).
12 Aluminum mounting adapter for 60 mm tube (WS425FIX60)
13 Plastic mounting adapter for 60 mm tube (WMT700FIX60-POM)
14 Stainless steel mounting adapter for 60 mm tube (WMT700FIX60-RST)
15 General purpose mounting adapter for WMT700 (WMT70FIX)
16 Cross arm (WMT70CrossArm)
17 Cable tightening tool (237888SP)
18 Cables with open lead (227267SP, 227568SP, 228259SP, 237889SP, 237890SP)
19 Vaisala MAWS cable (227565SP)
20 Vaisala AWS cables (229807SP, 227566SP)
21 Vaisala WS425 adapter cables (227569SP, 227570SP, 227571SP)
22 WMT700 connector DIY kit (WMT70Conn)

Appendix G. Certificate

DNV·GL

Certificate No:
TAA00000U5

TYPE EXAMINATION CERTIFICATE

This is to certify:

That the Bridge instrumentation

with type designation(s)
WMT 700 SERIES ULTRASONIC WIND SENSORS WMT701, WMT702, WMT703 and WMT704

Issued to
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.

Issued at **Høvik** on **2016-10-18**

This Certificate is valid until **2021-10-13**.
DNV GL local station: **Helsinki**

Approval Engineer: **Frederik Tore Elter**

for **DNV GL**
Digitally Signed By: Grimsrud, Jan Tore
Location: DNV GL Høvik, Norway
Signing Date: 18.10.2016

Jan Tore Grimsrud
Head of Section

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.

Index

W

Z

Warranty

For standard warranty terms and conditions, see 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.

Technical Support

Contact Vaisala technical support at helpdesk@vaisala.com. Provide at least the following supporting information:

- Product name, model, and serial number
- Name and location of the installation site
- Name and contact information of a technical person who can provide further information on the problem

For more information, see www.vaisala.com/support.

Recycling

Recycle all applicable material.

Follow the statutory regulations for disposing of the product and packaging.

VAISALA

www.vaisala.com