FT742 – Digital (RS485HD) Wind Sensor Manual

DM50 (Direct Mount 50mm) variant

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Contents

Product Symbols

The following symbols may be used upon the product and within the manual.

Meaning / Description	Symbol
Warning/ Caution An appropriate safety instruction should be followed or caution to a potential hazard exists	
DC Current only Equipment operates under Direct Current (DC) supply only.	⎓
Product Disposal In accordance with European directive 2012/19/EU on Waste Electrical and Electronic Equipment (WEEE), these product components must be recycled. This should be done by returning the product to FT Technologies or by using an appropriate waste disposal company. This product should not be disposed of in general waste of landfill. This product complies with the RoHS2 (2011/65/EU) directive.	
CE Mark The EU Declaration of Conformity complies with the essential requirements of the following applicable EMC Directive 2014/30/EU, and carries the CE Marking accordingly.	

Safety Instructions

English

- To ensure the safe installation and operation of this product the equipment must be installed and integrated:
    - Using suitably qualified and trained personnel
    - In accordance with any regional electrical codes
    - In accordance with the instructions set out in this manual, observing all information, warnings and instructions
    - In accordance with any other instructions or guidance FT Technologies provide
- To ensure that the product remains compliant with electrical safety requirements:
    - Connect to an appropriately approved isolated power supply (for example UL/CSA IEC 60950-1:2013) rated 12-30VDC and be current limited (6A Max)
    - Protected by surge protection devices
    - Connected with an approved interface cable (for example UL/ CSA recognised AWM style 21198, rated 300V, 80°C)
- The equipment must only be operated within the range of the specified technical data and used for the purposes for which it was designed.
- The equipment should always be transported in packaging which is appropriate, that will prevent any accidental damage from occurring.
- Always ensure that any failures or errors from the product cannot cause any damage to any other equipment or property or cause any other consequential effects.
- Ensure the wind sensor has been configured with the correct settings for the application. Failure to ensure this may result in hazardous operation and/or missing data.

1 INTRODUCTION

1.1 Product Overview

The FT742-D-DM50 sensor is a solid-state ultrasonic sensor designed for measuring wind speed, direction and temperature. It has been designed to operate in harsh environments (including cold temperature, offshore and dusty climates) and includes enhanced surge protection. The wind sensor uses acoustic resonance airflow sensing techniques, has no moving parts to degrade or wear-out and is designed for applications requiring high reliability.

Mounting and aligning the sensor is simple. A compass (not supplied) can be used to align the sensor with magnetic North using the datum marking feature (see Figure 4 and Figure 5). See Section 3 for information on the FT range of laser alignment mounting accessories, for use with devices like the Laserboy II.

For operation in ice-prone areas, the FT742 is fitted with a highly-effective thermostatically controlled heating system. A three-element heater is used to ensure heat is evenly distributed over the entire surface area.

FT sensors are configurable and factory programmed to the required customer settings, contact FT Technologies for further details. For example, the baud rate, heater setpoint and current can be modified. Contact FT Technologies for further details.

1.2 Build Versions and Labelling

Figure 1 shows how to identify a sensor, the serial number and calibration code (if applicable):

Additional labels may be attached.

Figure 1: Examples of Main Sensor Labels

1.3 Scope of Use

The sensor is designed, manufactured and optimised for high data availability.

No promise in part or full can be given to guarantee a sensor's continuous operation, as exceptional circumstances can occur that may result in the failure of the output from a sensor. Exceptional circumstances can include:

- Poor installation
- Inadequate inspection
- Power supply failures
- Poor quality electrical connections
- Lightning exposure
- Problematic environmental conditions or combination of conditions
- Physical Damage

1.4 Disclaimer

There are no warranties, representations or conditions, expressed or implied of any kind given in this manual for any design application. The Purchaser should independently undertake sufficient testing to confirm validity and suitability of any design. The Purchaser assumes all risks and liability in conjunction with the use of the information given.

Any warranty given by FT Technologies in respect of the equipment is conditional upon the sensor being handled, installed, integrated and operated in accordance within the guidelines given in this manual.

FT Technologies can take no responsibility for the effectiveness of any sensor lightning protection scheme implemented. The wind sensor has passed a wide range of EMC tests, but FT Technologies does not warrant the sensor to survive lightning strikes.

Information supplied by FT Technologies Ltd. shall not be construed as permission to license to operate under, or recommendation to infringe any existing or pending patent, patent applications or trademarks.

FT Technologies reserves the right to change product specifications, designs and functionality without notice or obligation.

The warranty does not cover failure resulting from mechanical damage or damage from lightning.

2 FUNCTIONAL DESCRIPTION

2.1 Technical Performance

Sensor Performance[1 & 2]

Measurement Principle	Acoustic Resonance (compensated against variations in temperature, pressure and humidity)
Wind Speed Measurement	
Range	0-75m/s
Resolution	0.1m/s
Accuracy	±0.3m/s (0-16m/s) ±2% (16m/s-40m/s) ±4% (40m/s-75m/s) Knots and km/h options available.
Wind Direction Measurement	
Range	0 to 360°
Accuracy	2° RMS (within ±10° of 0°) 4° RMS (beyond ±10° of 0°)
Resolution	1°
Acoustic Temperature Measurement[5]	
Units	Celsius, Fahrenheit or Kelvin
Resolution	0.1°
Accuracy	±2°C under the following conditions: Wind speed between 5m/s and 60m/s Temperature Difference < 10°C (Sensor Temp. vs Air Temp.) Operating (air) temperature between -20°C and +60°C
Environment	
Temperature Range	-40 to +85°C (operating and storage)
Humidity	0-100%
Altitude	0-4000m

Data I/O

RS485 Interface	Digital RS485 (half-duplex), galvanically isolated from power supply lines and case
Format	ASCII data, polled or continuous output modes
Data Update Rate	Up to 10 measurements per second (10Hz)

Power Requirements[3]

Supply Voltage	24VDC nominal (12-30VDC range)
Supply Current (Heater off)	31mA (typical)
Supply Current (Heater on)	6A (max [4]) – The heater is thermostatically controlled. Heater power consumption will depend on the heater energy required to keep the sensor's temperature at a user determined set point. The sensor is limited to 4A and 99W [4] by the default software settings (the heater current and voltage limits can be modified, see Sections 6.4.14 & 6.4.16 for further details or contact FT Technologies).

Physical

Sensor Weight	535g
Material	Aluminium alloy (hard-anodised), water-repellant coating in cavity
I/O Connector	5 way (RS485HD option)
Mounting Method	Fits onto a 47.9 to 51mm (outer diameter) mast secured with 3x M10 self-locking socket set-screws (3x part FT037)

Notes:

1. All specifications subject to change without notice.
2. Specifications calculated with the default settings and filters enabled.
3. See safety instruction requirements (page 5).
4. The heater set point, current limit and maximum power limits can be pre-configured in the factory or adjusted using the FT Acu-Test Digital kit.
5. Acoustic Temperature accuracy can be affected by the wind sensor heater – user calibration may be required

2.2 Wind Speed Calibration

All FT742-DM50 wind sensors get calibrated in the FT production wind tunnel before dispatch. As the sensor has no moving parts, there is no need to recalibrate the sensor over its lifetime. The sensor's compact strong monolithic shape is designed to prevent accidental transducer movement or damage. FT Technologies' calibration procedure and wind tunnels are designed to give a calibration profile that is within the accuracy limits set in the product technical specification (see Section 2.1). Periodically the accuracy of FT's wind tunnels are compared with the accuracy of an independent wind tunnel to ensure that no drift has occurred.

In exceptional circumstances users may wish to apply additional calibration factors. The sensor has an option to set a User Calibration Table, which can modify the wind sensor's wind speed output (see Section 6.4.23).

The User Calibration Table can be programmed with up to 64 correction factors which are maintained in non-volatile memory. When enabled, the uncorrected wind speed output is adjusted according to the stored User Calibration Table records using linear interpolation. The adjustments are applied to wind speed readings regardless of wind direction.

2.3 Wind Speed and Direction Filtering

It is important that the system does not rely exclusively on a single wind reading for any control decision. A single reading may be inaccurate due to measurement error, turbulence, corruption or interference. It is recommended that an average of wind readings is used. In addition if 100% data availability is required then a second FT sensor or alternative wind sensors should be fitted in addition.

The sensor has optional internal filtering available. This is a digital finite impulse response (FIR) filter, which works by calculating the moving average of a fixed number of previous readings. If filtering is being applied externally, the sensor's output filters can be disabled. If filtering inside the sensor is preferred, the length of the averaging for both wind speed and direction can be independently set (see Sections 6.4.11 and 6.4.12).

Averaging can be performed on 1 to 64 readings (0.1 to 6.4 seconds of data). Contact FT if the user would like to consider longer averaging periods (this can result in smoother data output that is less affected by factors like turbulence and spinning rotor blades). The default setting is 1.6 seconds (FT may be instructed to use other settings during the initial customer development).

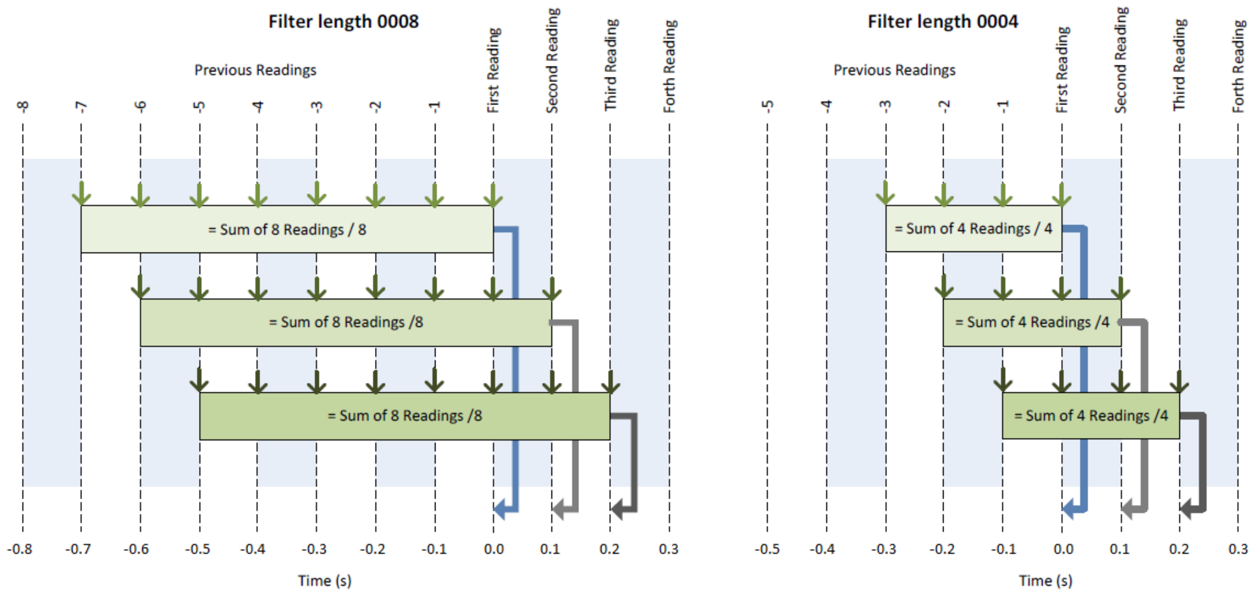


Figure 2: Examples of FIR Filtering

⚠ It is recommended to use average readings to reduce the effects of air turbulence.

2.4 Electronic Rotation of the Datum Direction

The datum direction of the sensor can be offset electronically by using the CF command (Section 6.4.5). This facility can be used to adjust the datum direction in case of any mechanical misalignment within the mounting arrangement. To offset the datum direction, in either the clockwise or anticlockwise direction, use the CF command (Section 6.4.5). Once the offset has been set it will be retained in the sensor Flash memory.

2.5 Selective Filter Scheme

In addition to the averaging filter described in Section 2.3, the sensor has a feature called the Selective Filter. The scheme allows the user to set a “validity period”, during which the sensor will exclude invalid readings from entering the averaging filter (see Section 6.4.11). The output will freeze on the last previous “good” reading and only raise an error flag once the number of bad readings exceeds the validity period. This scheme can be enabled by factory configuration or using the FL command (see Section 6.4.13).

FT would typically recommend using a 10 second filter to improve data quality. This can be set to filter bad readings for between 1 to 255 readings (0.1 to 25.5 seconds).

2.6 Error Detection

The sensor has a self-checking mechanism which can detect if a reading is invalid. On very rare occasions where an invalid reading may have been detected, this is signalled to the computer or data logger by setting an error flag character within the wind velocity output message (see Sections 6.4.29 and 6.4.30).

When an error is detected, the error flag character is set to a value of: 1.

Note: An optional Overspeed Warning Scheme can be enabled (but is disabled by default). See Section 6.4.19 for further details.

It is important that error flags are not ignored. Data associated with an error flag should **not** be processed as valid wind data. The system should be capable of riding through rare periods when data may be temporarily unavailable. If errors are ongoing (more than several seconds), a reset of the sensor should be applied (see Section 6.4.20 for instructions on sending an RSU command).

It is recommended that errors are monitored and logged. If the frequency of errors has recently increased, then inspection of the sensor for physical blockages may be required (see Section 4.1).

2.7 Overspeed Warning Scheme

During periods where the sensor detects wind speed beyond the rating of the sensor, the sensor will (by default) indicate a general error flag status.

An additional overspeed warning scheme can be enabled where in the event of wind speeds beyond the rating of the sensor, the error flag character will be set to 2 (see Sections 6.4.29 and 6.4.30) unless a general error condition is also detected and the flag will be set to 1.

To comply with legacy behaviour, this scheme is disabled by default.

The Overspeed Warning Scheme can be enabled by software commands (see Section 6.4.19), using the Acu-Test Digital kit (see Section 4.4) or enabled in the factory before despatch.

2.8 Heater Setup

The sensor is fitted with an integral three-element distributed heater that can be used to prevent icing-up of the sensor in freezing temperatures. The heater is controlled automatically by the sensor using a user programmable ‘set point’ temperature. The sensor uses a control scheme which dynamically changes the current supplied to each individual heater element in order to maintain the programmed set point temperature.

We recommend selecting a suitable set-point temperature for the sensor environment. Factors to consider include ambient temperature, relative humidity, wind speed and ice/snow conditions. This setting can be programmed by the factory, by using the Acu Vis Test software (see Section 4.4) or the heater software commands (see Section 6.4.14).

It is important to consider cable resistance losses and use a suitably rated cable of an appropriate length. FT recommends cable types in Section 3.5 and the FT cable design does not exceed 15m. If longer cables runs are required, consider the use of a junction box and heavy-gauge cable. Regional electronic regulations may require consideration (efficiency, voltage insulation, surge protection, thermal losses, voltage drop, fire risk etc.)

Since the heater circuit is thermostatically controlled, the actual power being drawn from the supply will depend on the programmed set-point and the environmental conditions (i.e. ambient temperature, wind speed, precipitation etc.). The maximum power that the sensor can consume is by default limited to 99W (4A with the heater enabled). The power supply must be rated to provide the maximum power that the sensor can consume.

The maximum current limit of the sensor can be adjusted in software from 0.1 – 6A (from the default of 4A and in increments of 0.1A). The current limit can be programmed at the factory, modified using the Acu-Test PC software (see Section 4.4), or by using the software command (see Section 6.4.16). By default, the heater requires a minimum of 11VDC for operation, see Section 6.4.16 for further details.

2.9 Low Power Operation

The sensor is designed for typical operation at 24VDC, however the sensor can operate below this (12-30VDC) with reduced heating performance. By default, the heater will shut down at approximately 11VDC. Below approximately 8V the sensor may power down. Lower voltages reduce the overall power consumption and heater performance.

For further advice on power and heater management strategies, see Sections 6.4.14, 6.4.15 and 6.4.16, or contact FT Technologies.

2.10 Acoustic Temperature

The Acoustic Temperature feature takes a measurement of the ambient temperature via measurable acoustic properties of the airflow. Sections 6.4.1, 6.4.2 and 6.4.3 describe related software commands.

Averaged data should be used. The averaging system can be performed for 0 to 50 seconds (in increments of 10 seconds), or between 1 to 10 minutes (in increments of 1 minute).

See Section 2.1 for details regarding operating specifications. Operation with high temperature gradients (between sensor body and ambient airflow, for example when the heater is warming the sensor body and the local environment), extreme humidity levels and low wind conditions (below 5m/s) may result in reduced accuracy. User testing is strongly recommended to confirm suitability for the application.

Software version 7.5.1 introduced the DFC (combined data format) mode that includes AT Temperature data within the CU data output and WV Query commands. See Sections 6.4.6, 6.4.7, 6.4.29 and 6.4.30 for further information.

3 MECHANICAL & ELECTRICAL INSTALLATION

The wind sensor has no moving parts to degrade or wear-out and is designed for applications requiring high reliability and cold weather operation.

Figure 3: The DM50 (Direct Mount 50mm) Sensor

FT742-D-DM50 sensors are mounted vertically with the cable routed down through the base. The sensor body is manufactured from hard-anodised aluminium and the cavity has a water-repellent coating.

The mounting base is designed to fit onto circular masts with an external diameter of 47.9 to 51mm, secured with the supplied 3x M10 self-locking socket set screws (for spare parts 3x part FT037). FT recommends the use of the FT037 screws, these are self-locking socket set screws coated in aluminium-zinc flake (Geoblack PLUS ML) providing superior corrosion resistance and galvanic compatibility.

A suitable compass (not supplied) can be used to align the sensor with magnetic North using the convenient North alignment marking. North (0°) is marked by the V-shaped notch on the base of the sensor. The North datum in the base indicates 0° and rotates clockwise when viewed from above (see Figure 6). It is intended for use as an alignment feature that can be integrated into the OEM mounting structure or an alternative alignment process.

See Section 3 for details of the laser alignment options and accessories designed for the FT742-DM50 sensor. Users should evaluate and implement a suitable alignment process for their application.

Ensure the airflow into the sensor is not obstructed or influenced by nearby objects.

In order to keep the pressure within the sensor equalised with the atmospheric pressure, a small breather hole is located within the connector housing compartment that should not be fully blocked (for example, by an applied sealant).

- See safety instruction requirements on page 5

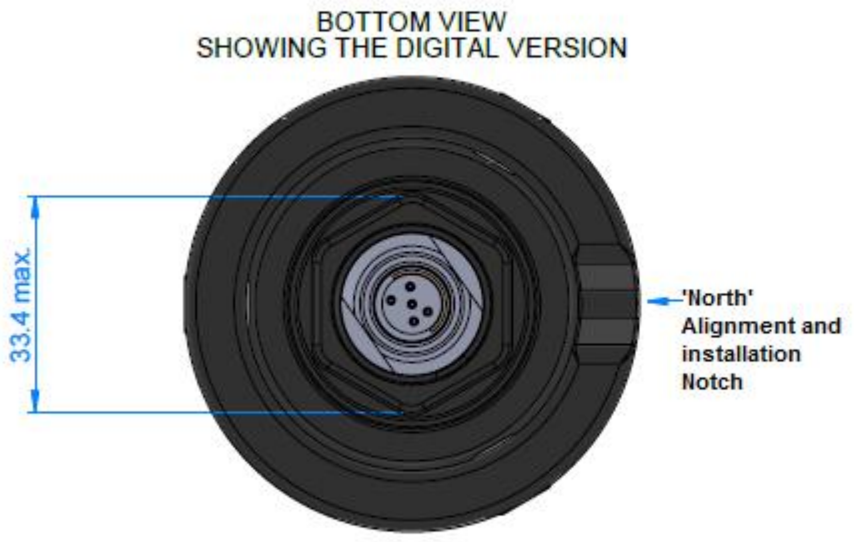
- The wind sensor installation must be properly designed to ensure the correct operation of the sensor. This section is for guidance only. It is the responsibility of the designer and installer to ensure that the installation and its design is fit for purpose. Please see Disclaimer Section 1.4.

- CAUTION: Always ensure the DM50 is securely mounted as intended. The O-ring fit can require moderate force to mate properly. Make sure the sensor is firmly mounted and is not at risk of falling from height

- Several accessories may be required for long-term reliability. Ensure the FT026 O-ring is fitted in the base of the sensor (for water ingress protection), the grounding accessory is fitted in the base of the sensor (for lightning ground protection) and the Tapered Pipe Insert is considered for the top of the mounting pipe (for easy mechanical attachment and reduced O-ring damage)

The mounting pipe should have a minimum galvanising thickness of 50µm to ensure long-term protection against corrosion (a relevant galvanising design standard should be considered, for example ASTM A123 or ISO 1461). Aluminium components of the appropriate grade could be used as an alternative.

At the base of the sensor the mounting pipe mates with the sensor support. The upper surface is hard-anodised and unsuitable for electrical grounding. Figure 4 displays the grounding feature that facilitates a grounding path between the sensor and a conductive external face at the top of the mast. Please note that if the mast is coated with non-conductive materials, this will increase the electrical resistance and severely reduce the ability to ground induced surge currents (higher resistance causes higher voltage surges during surge events).



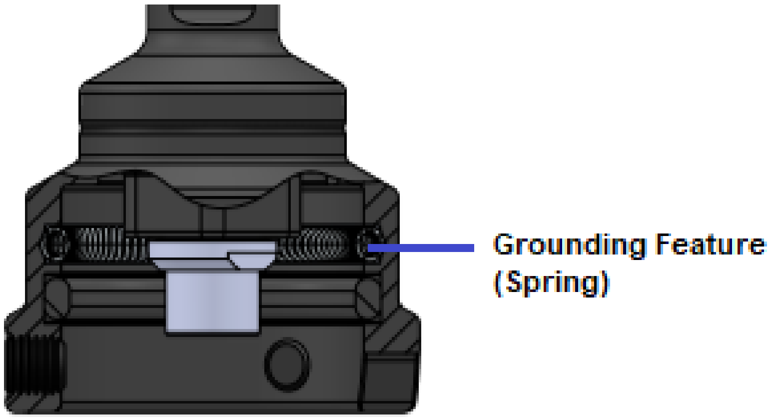
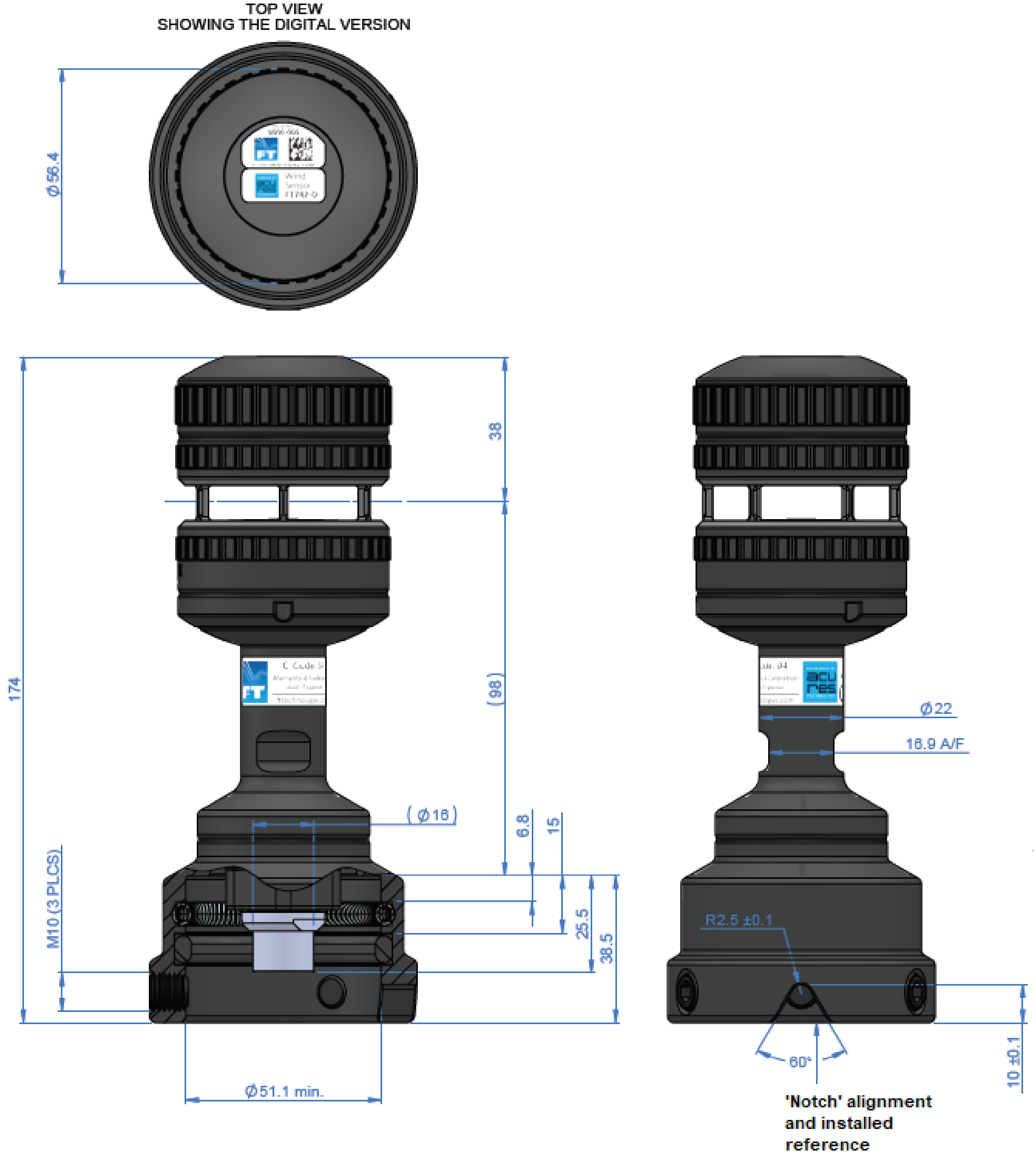
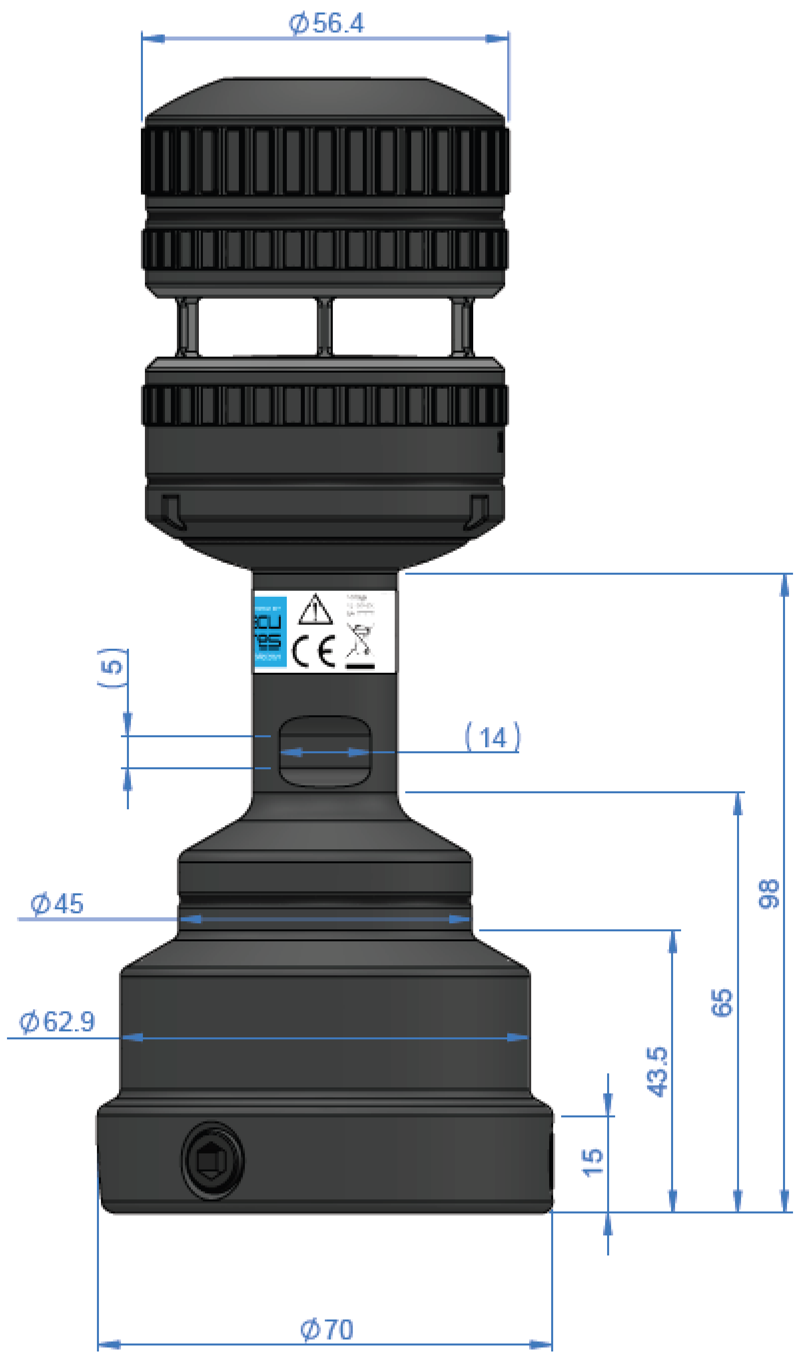


Figure 4: DM50 – Connector (View from Below and Through) – mm units


TOP VIEW
SHOWING THE DIGITAL VERSION
Ø56.4
174
38
(98)
(Ø16)
6.8
15
25.5
38.5
M10 (3 PLCS)
Ø51.1 min.
Ø22
16.9 A/F
R2.5 ±0.1
60°
10 ±0.1
'Notch' alignment
and installed
reference


Ø56.4
(5)
(14)
Ø45
Ø62.9
98
65
43.5
15
Ø70

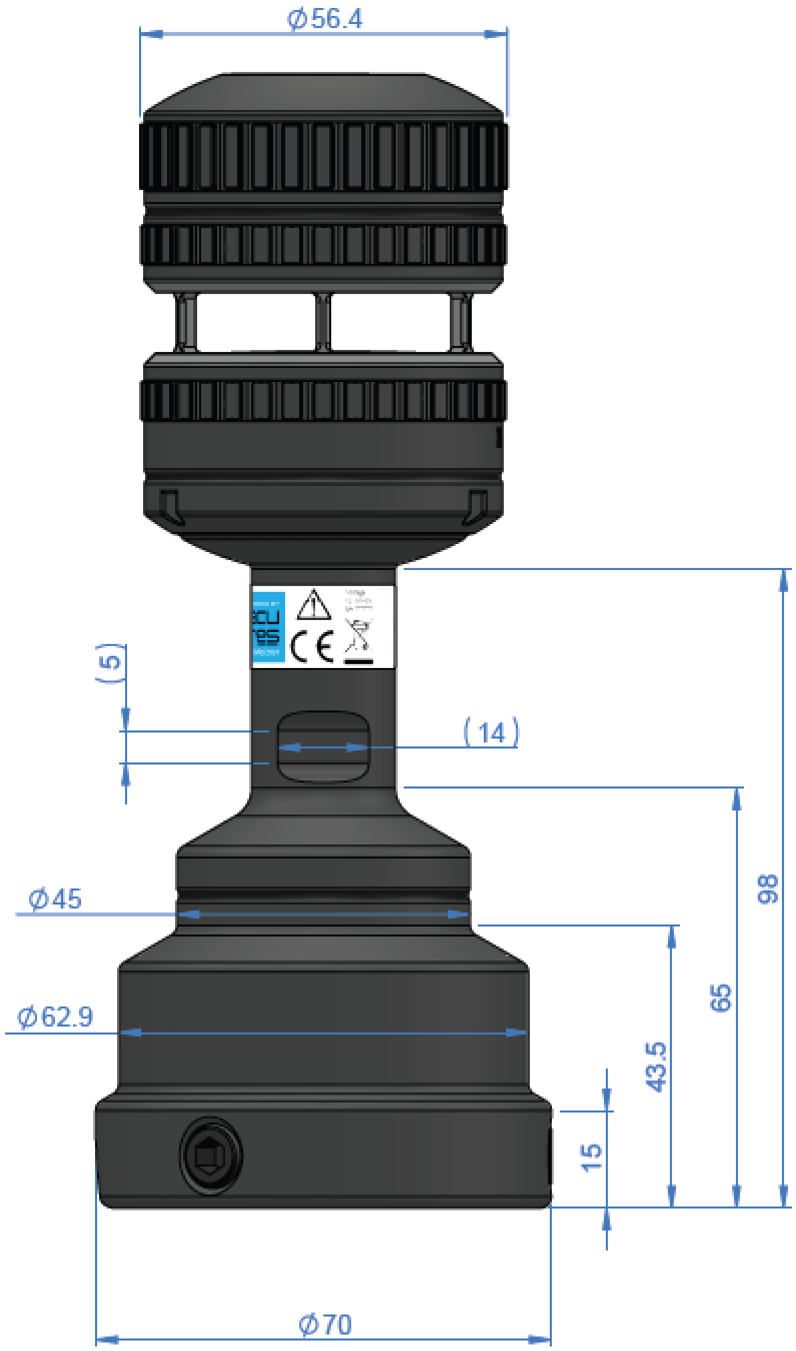


Figure 5: DM50 Wind Sensor Dimensions (all units in mm)

The sensor measures the wind direction relative to the alignment flat and the central datum feature. When the wind sensor is correctly aligned the wind direction measurements will be as shown in Figure 6.

With the sensor in the 'normal' vertical orientation, wind blowing towards the V-shaped notch is considered 'North' will report 0°.

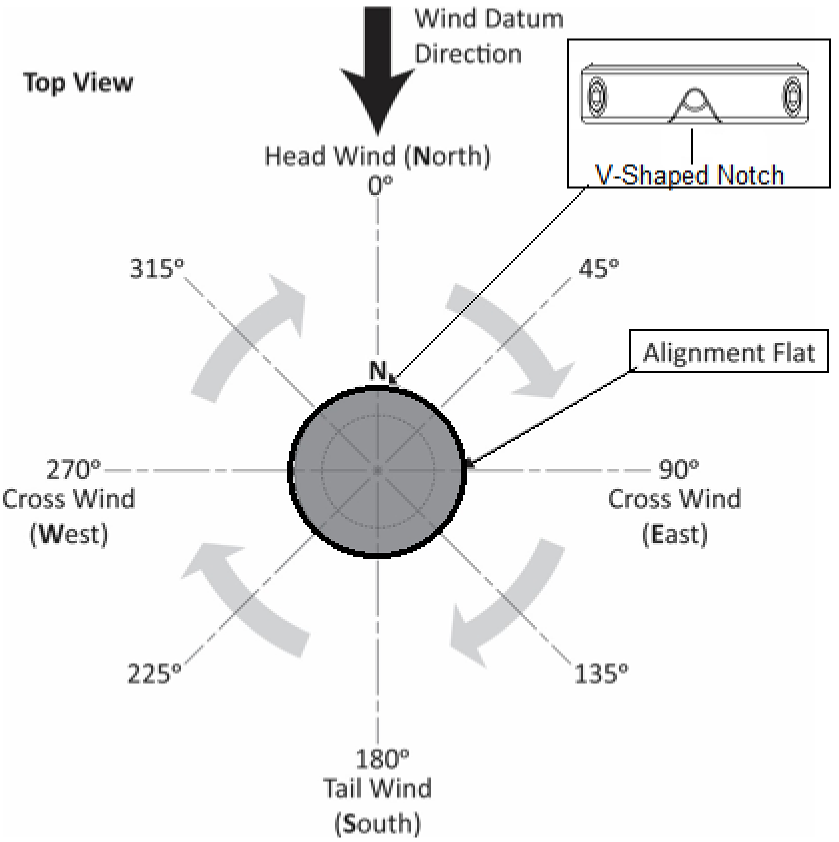


Figure 6: Wind Direction (view from above)

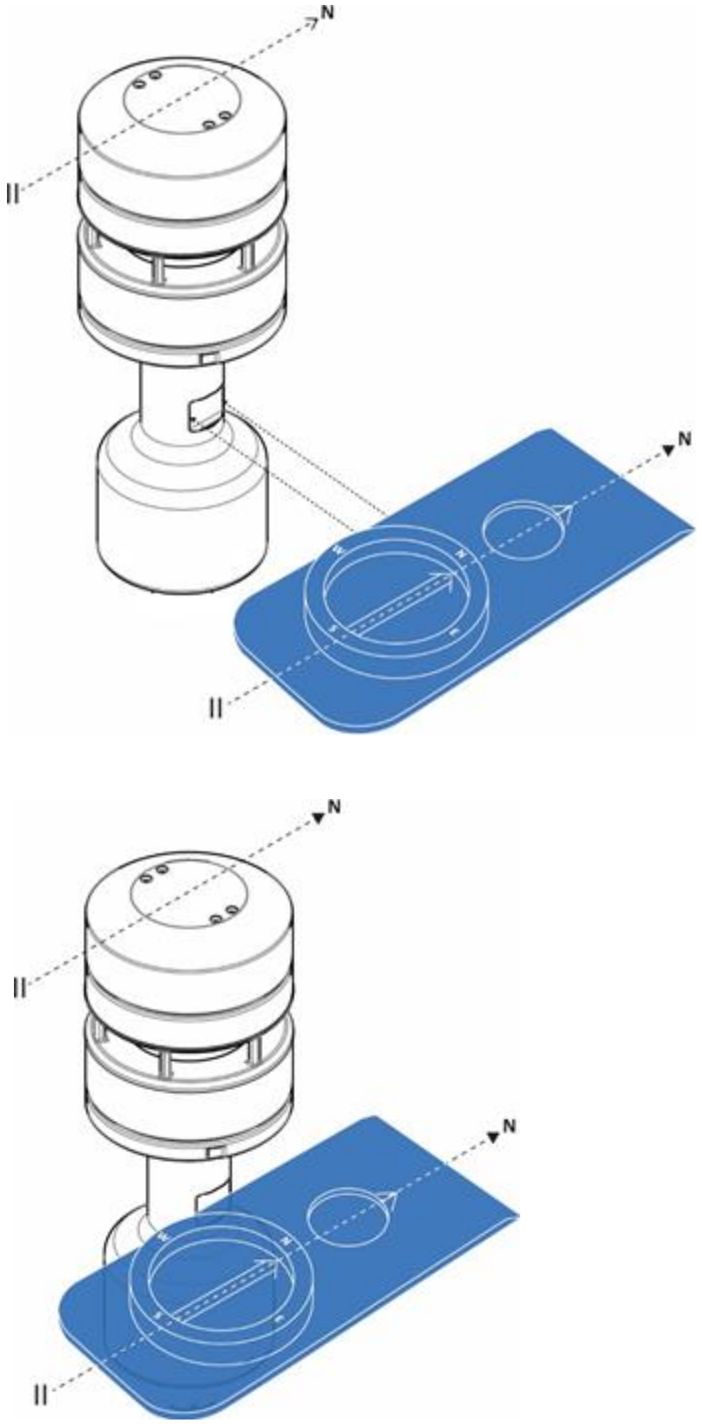


Figure 7: DM50 Compass Alignment

The alignment flat surfaces are embedded in the side of the sensors (on the column).

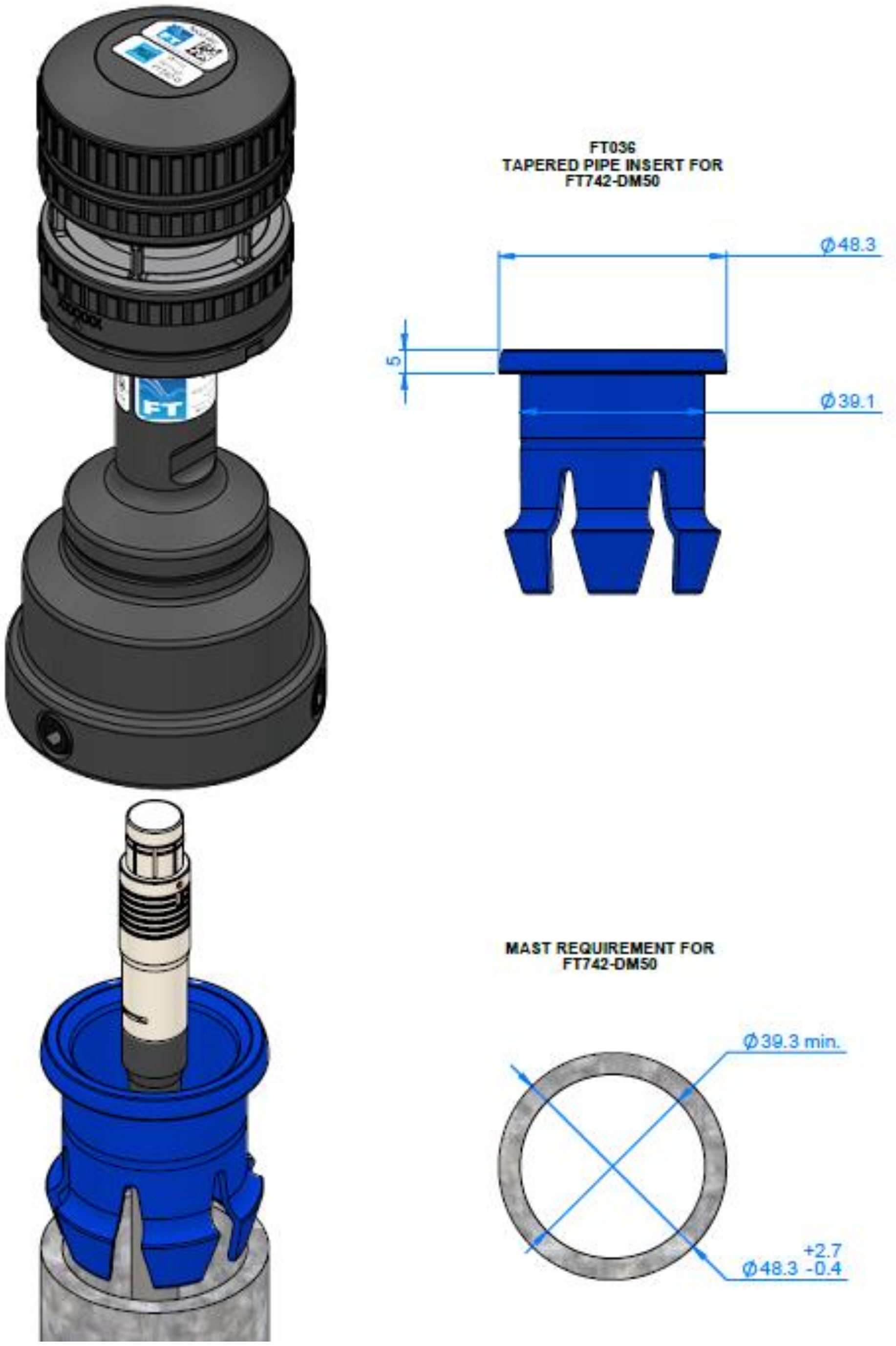


Figure 8: DM50 Mounting Installation and using the FT036 Tapered Pipe-Insert

3.1 Mechanical Alignment

The V-shaped notch in the base of the DM50 can be used as an alignment feature, to ensure sensors are repeatedly mounted in a fixed orientation. Design engineers may incorporate a mating alignment feature into their own mount, or utilise the accessories designed by FT for sensor alignment. Wind blowing towards the V-shaped notch will be reported as 0° ("North").

Ensure any training documents clearly instruct technicians how to perform the alignment process. Consider any mechanical tolerances in the design and how this will impact operation.

FT has designed a range of mechanical accessories that can be used in conjunction with the Laserboy II (or similar) laser alignment devices.

CAUTION: Please read the LaserBoy II user manual before operation. There are health and safety considerations involved in the use of laser devices, including potential eye damage, when used inappropriately. The LaserBoy II is a battery-powered forward-facing laser activated by a side-mounted power switch. A spirit level is embedded in the side of the unit.

Note: Be aware that installing the FT sensor on a rotating machine will result in variable definitions of geographic "North"

Figure 9: The V-shaped Alignment Notch – Potential for Direct Integration with the Mounting Mast

3.2 Sensor-Mounted Alignment (LaserBoy II & FT041 Sensor Mounted Alignment Accessory)

The FT041 sensor-mounted alignment tool allows the technician to mount the laser device directly onto the FT sensor, for new production or service alignment.

Figure 10: DM50 Alignment Using the FT039, FT040 and the 'LaserBoy II' Device

A suitable alignment reference must be designed and available for technician use. The FT041 alignment tool can be secured to the flat face on the side of the support column.

Using the FT041 Sensor-Mounted Accessory:

1. Attach the DM50 sensor into an approximate alignment position on top of the mounting pipe using the V-shaped alignment notch
2. Fit the FT041 alignment accessory onto the column of the DM50 wind sensor. Attach, secure and enable the LaserBoy II and adjust the cam lever to align the Laser direction. Clamp the arm in position
3. Rotate the wind sensor to align the laser point with the defined alignment reference (consider an X marking in a suitable location).
4. Detach the FT041 alignment accessory from the wind sensor
5. The DM50 sensor with the alignment feature in the base can now be quickly aligned on installation, by engaging the base with the alignment collar

CAUTION: Please read the LaserBoy II user manual before operation. There are health and safety considerations involved in the use of laser devices, including potential eye damage, if used inappropriately.

The LaserBoy II is a battery-powered forward-facing laser activated by a side-mounted power switch. A spirit level is embedded in the side of the unit.

Please contact FT Technologies for further details regarding the alignment tools.

3.3 Mast-Mounted Alignment (FT039 Collar & FT040 Mast-Mounted Alignment Accessory)

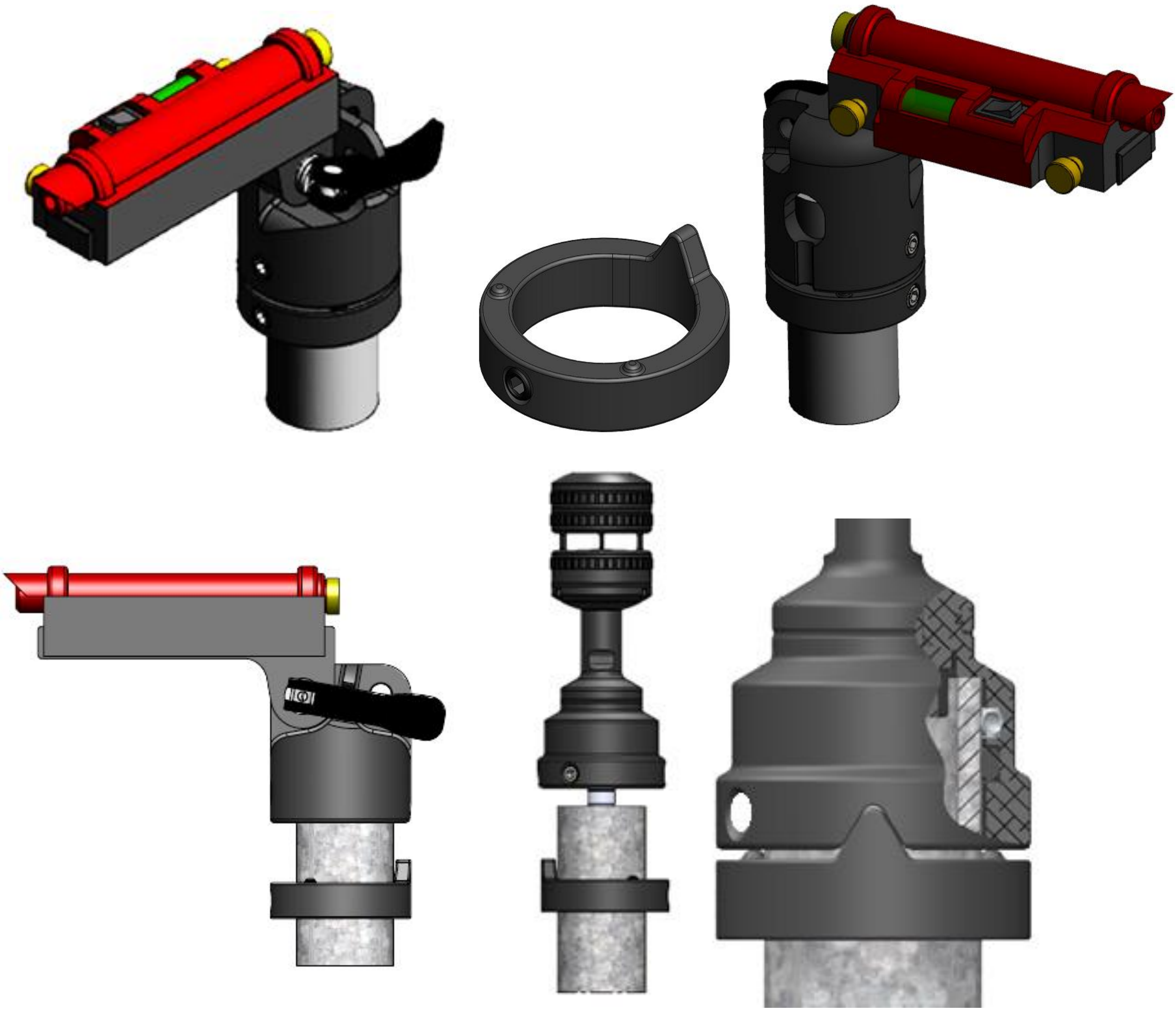


Figure 11: DM50 Alignment Using the FT039, FT040 and the 'LaserBoy II' Device

With the FT mounting adaptors fitted onto the mounting mast the LaserBoy II laser device can be installed on top of the pole and used to project a red laser dot onto a suitable reference point to confirm a repeatable installation alignment.

Using the FT040 Mast-Mounted Accessory:

1. First attach the FT039 alignment collar, alignment feature upper most, onto the mast. Giving clearance for the alignment accessory (~60mm), gently tighten the 1x M10 self-locking clamp screws (1x FT037) to hold the collar in place (allowing some rotational movement). Ensure the clamp screw is fitted into the "South" position on the alignment accessory
2. Fit the FT040 alignment accessory onto the top of the mast. Slide the alignment collar up to engage with the V-shaped notch, ensuring the clamp screw is in the "South" position (matching the alignment accessory). Attach and enable the LaserBoy II. Adjust the cam lever to set the arm height to suit the datum feature. Clamp the arm position with the cam lever at the correct laser point height
3. Rotate the alignment collar and accessory to align the laser point with the centre of the datum feature. Tighten the clamp screw to hold the alignment accessory in position.
4. Raise up the alignment collar so the alignment feature engages with the base of the alignment accessory. Fix the alignment collar in position with the clamp screw
5. Remove the FT040 alignment accessory, leave the collar on the mounting pipe for FT sensor alignment

6. The DM50 sensor can now be aligned on installation by engaging the V-shaped base with the alignment collar

CAUTION: Please read the LaserBoy II user manual before operation. There are health and safety considerations involved in the use of laser devices, including potential eye damage, if used inappropriately.

The LaserBoy II is a battery-powered forward-facing laser activated by a side-mounted power switch. A spirit level is embedded in the side of the unit.

3.4 Connector Details

All electrical connections are made to the sensor via a 5-way multipole connector located in the base of the wind sensor housing. The connector pin designations are shown in Figure 12 and the connector/mating connector manufacturer's part numbers in Figure 13.

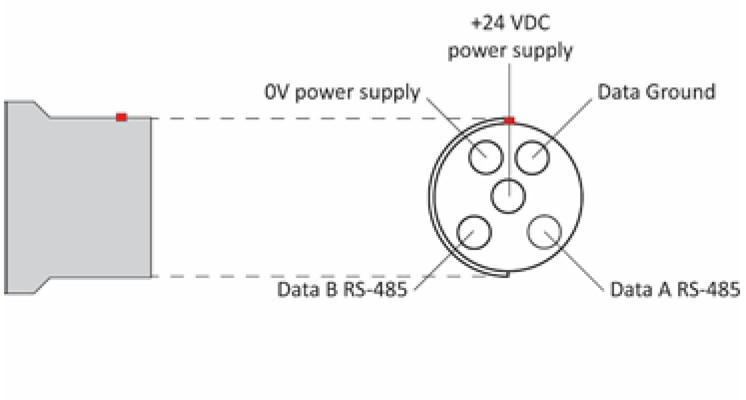


Figure 12: Sensor Connector Pins

Manufacturer	Connector Type	Connector Description	Manufacturers Part Number	Maximum Outer Cable Diameter
W.W.Fischer	Cable Side Connector	5 way plug	SE104Z053-130/8.7	8.0mm
ODU	Cable Side Connector	5 way plug	SX2F1C-P05NJH9-0001	9.2mm

Figure 13: Connector Sourcing Options

3.5 Cable Details

The mating connectors for the sensor are suitable for use with cables with overall diameters as described in the table above and for individual cores of diameters of up to 1.2mm. Cable such as SD980CPTP 3x2x0.5mm² from SAB Brockskes or similar types may be used. Care must be taken to ensure that the cable is suitable for the environment it will be used in and is adequately approved, for example AWM Style 21198.

In an area with a moderate or severe lightning strike exposure the cable shield may not provide sufficient protection. In this case the cable will require double-shielding, for example enclosure in a grounded metal pipe or conduit (an example of metal conduit could be Hellermann Tyton's HelaGuard product, steel conduit with plastic coating and steel overbraid).

FT can supply cables with a mating connector at one end leading to bare wires for connection to user systems. The digital version of the DM50 uses either the FT001 (15m) or FT007 (5m) digital cable.

Note: 4-20mA sensors use a different connector and will require an alternative cable.

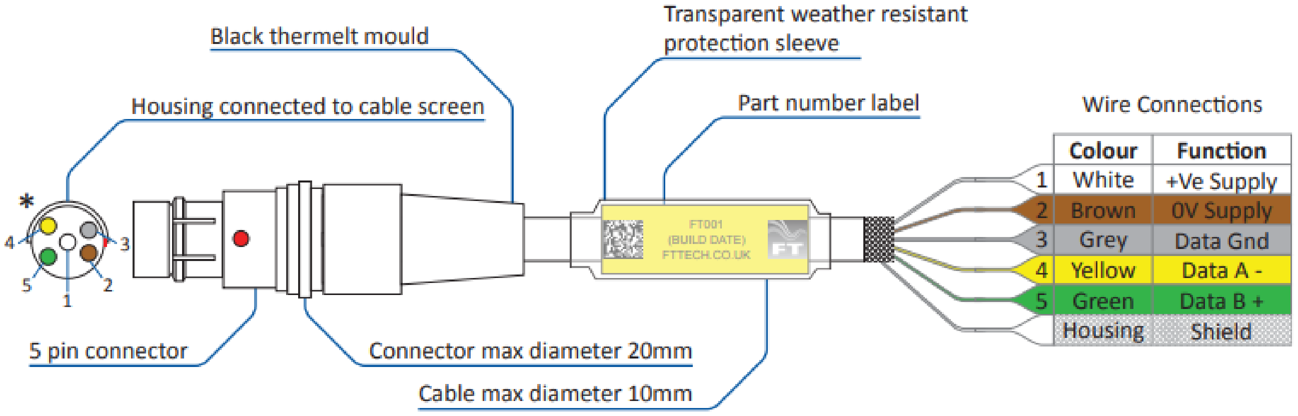
Please ensure that when sourcing cables from alternative sources that the cables are suitable for the requirements and the cable wiring is equivalent. Consider practical design factors, for example cable length, voltage drop, thermal losses, voltage insulation, EMC/surge protection, shielding, grounding, 360°C EMC cable glands, maximum bend radius, fire risk evaluation etc.).

The sensor is protected against common miswiring events within the intended operating range of the sensor.

For further details of cables and accessories please visit the FT website at https://www.fttechnologies.com/Wind-Sensors/Accessories

FT can also provide Acu-Test cables allowing operators to view wind speed and direction data with the Acu Vis software. These cables are intended for short testing periods and are not suitable for long-term datalogging. Please see Section 4.4 for further details.

FT001 and FT007



Specification

Part No.	FT001	FT007
Length	15 m	5 m
Weight	1.3 kg	0.5 kg
Use with	RS485 wind sensors FT702LT, FT722-D & FT742-D	
Temp. Range	-40 to +85°C	
Min. bend radius	57 mm	
Max. Cable Rating	6 A	
Wire thickness	0.5mm² / AWG21	

Please contact info@fttechnologies.com for further details.

Figure 14: Cable Specifications

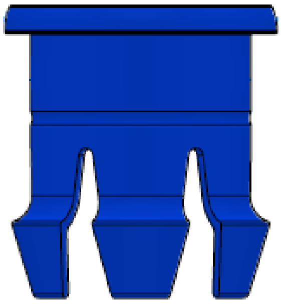
Review suitable cable routing from the FT sensor to the turbine controller. Avoid high-power areas and electrical switching devices to minimise electro-magnetic disturbances. FT recommends using double-shielded, grounded metallic conduit along the route with 360°C EMC cable glands terminated into a suitable grounding point.

RS485HD communicates using a voltage-based transmission, high levels of electro-magnetic noise can interrupt data packets and result in poor quality communication.

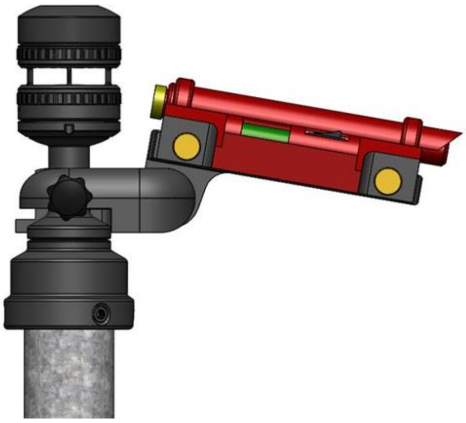
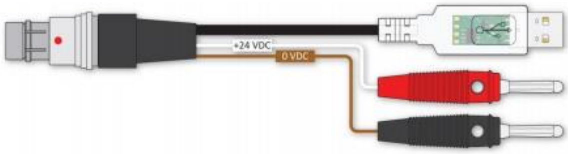
Cable Length: Review cable length for voltage drops and thermal losses. The typical customer configuration is 5-15m, longer cable lengths will require the use of thicker gauge cables or the use of junction boxes, for example on tall meteorological masts or large offshore wind turbines.

Caution: FT cables always use the same wiring colour conventions, however cables designed and sourced from alternative suppliers may use different colour conventions, probably resulting in the appearance of a failed sensor.

3.6 Spare Parts & Accessories

FT036 Tapered pipe insert for FT742-DM50 (48.3mm OD) This fits on top of the mounting pipe and allows easy and smooth insertion of the FT sensor onto the mount.	
FT037 1x Self-locking Fastener for FT742-DM50 (with aluminium-zinc flake coating (Geoblack PLUS ML) for enhanced corrosion resistance and galvanic compatibility). Use 3x FT037 screws to secure the DM50 onto the mounting. An additional 1x FT037 will be required for the FT039 alignment collar.	 Caution: FT do not recommend using alternative fasteners due to the risk of corrosion damage. Where this cannot be avoided, consider sealing over or around the fasteners
FT038 Grounding Accessory for FT742-DM50 Provides a lightning grounding path between the sensor and the external face of the mounting pipe.	
FT039 Alignment Collar for FT742-DM50. For use with the FT040. For spare parts: 1x FT037 screw will be required	

FT040 Mast Mounted Alignment Accessory for FT742-DM50 Note: The Alignment collar, corrosion resistant screws and the Laserboy II device are not included	 
FT001 – 15m cable for RS485HD digital wind sensors only (5-pin connector) **FT007** – 5m cable for RS485HD digital wind sensors only (5-pin connector)	
FT026 O-ring	
FT041 Sensor Mounted Alignment Accessory Note: Only the sensor-mounting alignment adaptor is provided. The Laserboy II is not provided.	

	
FT054 Acu-Test cable for RS485HD digital sensors (5-pin connectors). Connects to a Windows PC and the Acu-Vis 2.0 test software (or command line terminals like 'Teraterm'.	
FT062 24VDC 4A PSU for use with the Acu-Vis 2.0 test software and TeraTerm. A regional IEC C13 mains adaptor (capable of supplying 4A) will be required for connection to regional mains power plugs.	
V086 Female connector assembly parts for creation of a cable that connects to FT. Caution: A qualified engineer should review suitable design requirements. For example: voltage drop, current rating, communication stability, tolerances, flexibility, cable insulation, double shielding/conduit, surge protection etc.	

3.7 Lightning, Surge & EMI protection

The FT742-DM50 is fitted with enhanced surge protection and is designed for use with a lightning mast.

When installing the sensor, it is essential to do so in a way that protects the sensor in the event of a lightning strike (if the site is deemed to be at risk). Since current levels during a lightning strike can be in the order of 200kA, applying the correct grounding technique is critical, so that the current is diverted to ground in a controlled manner.

The sensor should survive a properly diverted lightning strike, so lightning interceptors and secondary protection should be used. The sensor should be positioned beneath the lighting interceptor rod, within a 45° protection zone. The recommended clearance between sensor and interceptor is a minimum of 30x diameter of the interceptor material.

At the base of the sensor the mounting pipe mates with the sensor support. The top surface is hard-anodised and unsuitable for electrical grounding. Figure 15 displays the grounding feature (a metallic spring) that allows a grounding path between the sensor and the metallic outer-face of the mast. Please note that if the mast is coated with non-conductive materials (for example paint coatings or corrosion) this will inhibit conductivity and severely reduce its ability to ground induced surge currents.

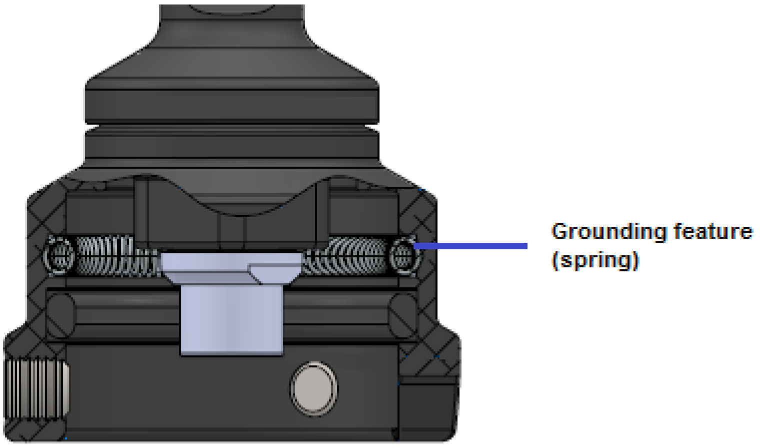


Figure 15: DM50 Grounding Feature

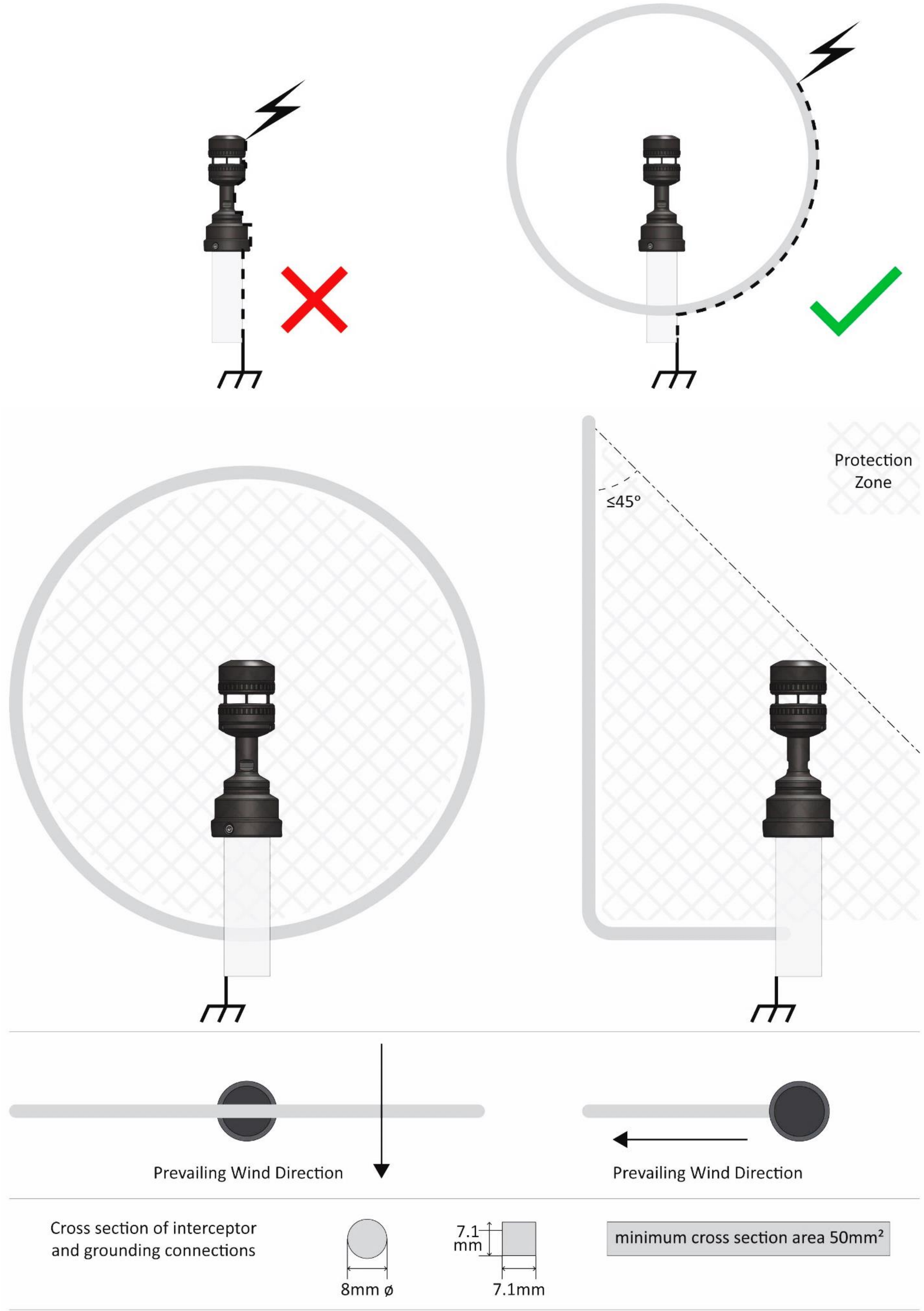
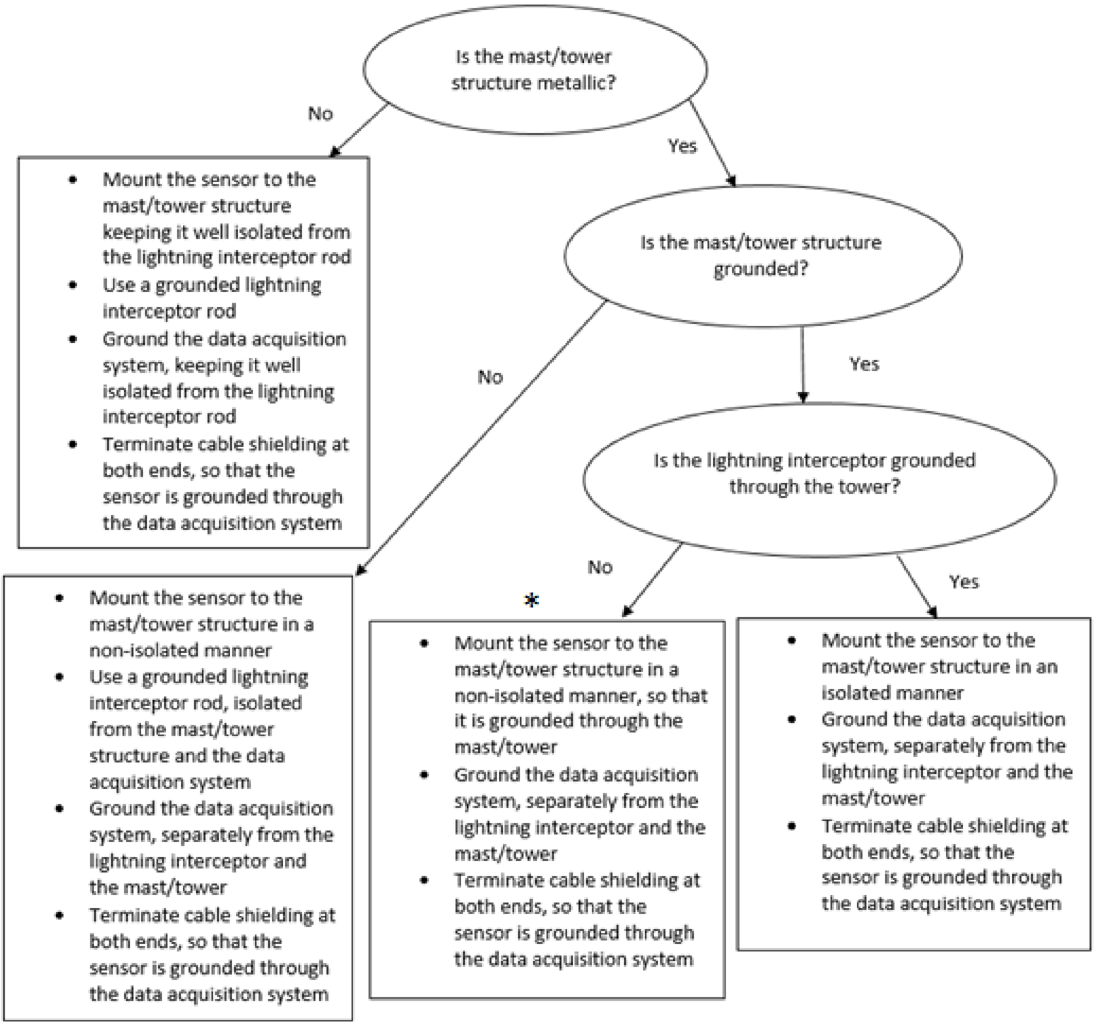


Figure 16: Ring and Rod Lightning Interceptors

The correct grounding method to apply will depend on how the rest of the equipment has been installed (for example, isolated or grounded protection). The following flow chart can help determine which sort of grounding should be applied for the application:



* The recommended FT solution.

Ideally the data acquisition system should be enclosed within a grounded metal enclosure and the data acquisition system's ground connected to the enclosure chassis. Where termination of cable shielding at the data acquisition end has been recommended above, it should be done so using 360° termination via EMC cable glands within the wall of the enclosure before the signal wires are allowed to enter. This helps to protect the sensor and data acquisition system against surge currents and voltages, and helps to prevent interference from being induced onto the signal lines.

The use of Surge Protection Devices (SPD) is recommended. These devices should be located as close as possible to where the signals enter the enclosure (within the metal enclosure) and their ground connections connected to the enclosure chassis. All connections from the sensor to the data acquisition system and to power should pass through the SPD's. This will suppress any unwanted overvoltage transients present on the signal or power lines. The SPD's should be UL 1449 listed and have a minimum surge current rating of 20kA (8/20μs waveform).

All structural grounding connections should have a minimum cross-sectional area of 50mm^2, while mating surfaces should be uncoated and free of corrosion. All cabling should have a minimum bend radius of 57mm to prevent flashover and interference.

Installing the sensor as described in this section can help achieve a lightning protection zone level of LPZ 0B (in accordance with IEC 62305-4). It is recommended that the installation is reviewed by a lightning design engineer.

Protection Against Indirect Lightning Effects & Electromagnetic Interference

Objects within the protection zone described above can still be subject to very high electromagnetic fields and partial lightning surge currents. It is therefore critical that appropriate shielding and termination is used throughout the system to reduce these effects. A shielded signal cable will offer some protection, however it is recommended that double shielding is employed between the sensor and the chassis of the computer and power supply cabinet.

A metal conduit surrounding the shielded cable is a good way of providing this additional protection and will also help to prolong the life of cables and connectors. The impedance of the metal conduit needs to be as low as possible since a substantial proportion of the lightning current will flow in it. An example of metal conduit could be Hellermann Tyton's HelaGuard steel conduit with plastic coating and steel overbraid. Regulatory standards may recommend double-shielding (grounded metallic conduit) is used for internal cable routing, ideally avoiding high-voltage equipment and sensitive components that might be affected by surges or inductive pickup.

All cable shielding must be continuous and 360° terminated at both ends using EMC glands or cable clamps with a direct connection to the cabinet chassis. There must also be a direct connection from the cabinet chassis to the grounding reference. Any metal conduit used must also be continuous and terminated at both ends with appropriate fittings. Figure 17 below shows the principle of the protection scheme. The cabinet should be protected with a metallic grounded housing.

① Preferably this connection is established using structural aluminium parts or alternatively by use of a copper cable with a cross section of min. $50mm^2$

② Any shielding conduit must be terminated at both ends

③ Shielded cable must either be 360° terminated using a EMC cable gland in the cabinet wall -or alternatively using a cable clamp in direct connection with the cabinet chassis

④ The chassis of the cabinet must have a direct connection to ground

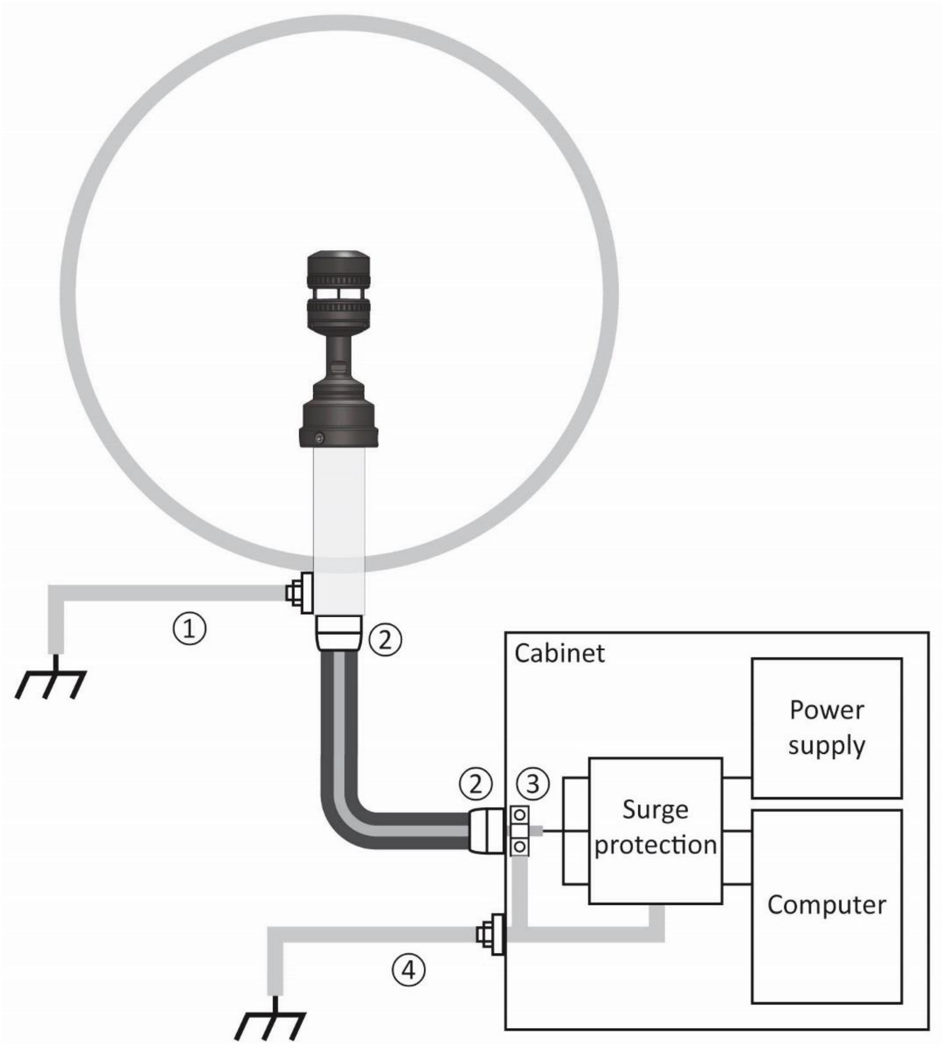


Figure 17: Protection of equipment against indirect effects

Surge Protection

All connections from the wind sensor to any computer equipment and power supply should run through Surge Protection Devices (SPDs). These will suppress any unwanted overvoltage transients present on the signal or power lines. The surge suppression devices should be UL 1449 listed.

The ratings of the SPDs must be suitable for the surge conditions. Assuming that appropriate shielding and termination has been used throughout, then the SPDs used with the sensor should have a minimum surge current rating of 20kA (8/20µs) and be capable of clamping the output below the maximum input voltage accepted by the electronic systems they are connected to. This will prevent any surges or large voltage differences being present at the inputs to the wind sensor, data acquisition electronics or power supply.

The SPDs should be installed as close as possible to the point where the signals enter the cabinet in order to prevent noise propagating to other electronics. The SPDs should also be grounded appropriately. Figure 18 shows how the SPDs should be installed.

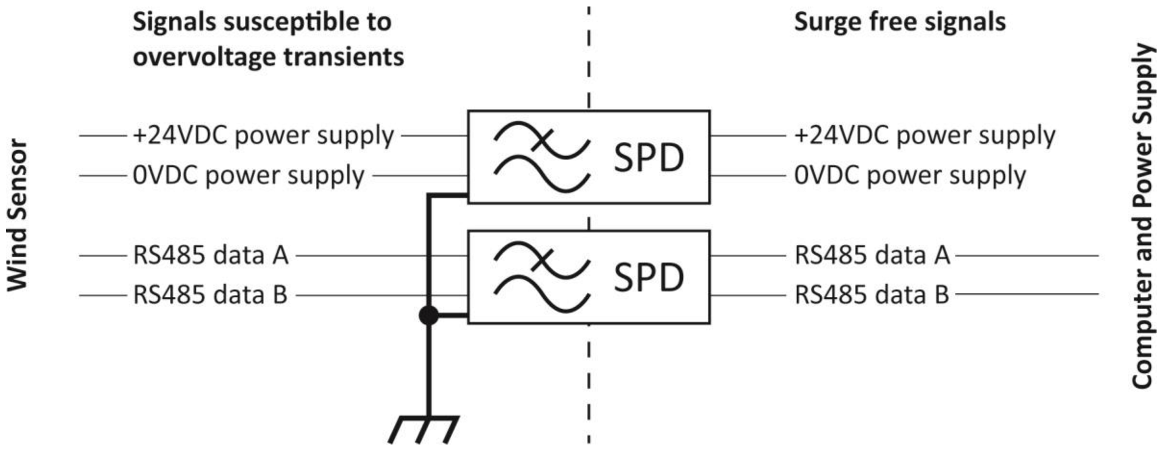


Figure 18: Digital sensor - Interface Surge Protection

The supply pair [24VDC / 0VDC] is electrically isolated from the other lines and the chassis. The triple RS-485 signal wires [Data ground, Data A, Data B] are isolated from the other lines and the chassis. The data ground can be directly connected to the chassis of the data acquisition cabinet.

Some examples of SPDs suitable for this protection are given in Figure 19 below from manufacturers, DEHN & Söhne GmbH. (www.dehn.de) and Phoenix Contact (www.phoenixcontact.com). Users are responsible for ensuring the suitability of these components for their application.

Manufacturer	Type	Manufacturers part number
	PSU lines	
Phoenix Contact	Module (x1)	PT 2PE/S 24 AC
	RS485 lines	
Dehn	Module (x1) - BCT MOD BE 5 & BCT BAS	919 620 & 919 506
Phoenix Contact	Module (x1)	PT 3-HF-12 DC

Figure 19: Typical SPD configuration used to protect sensor

Figure 20 shows an example of how the wires are up the SPD's inside a Phoenix Contact control cabinet. The termination of the cable shield at the wall of the control cabinet using a cable gland is not shown.

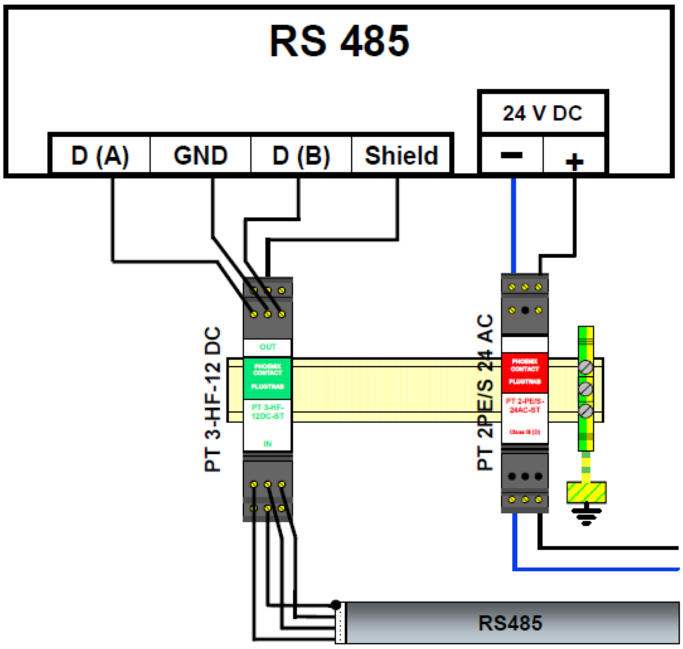


Figure 20: Example of wiring inside a Phoenix Contact control cabinet

For further details contact FT Technologies.

4 SERVICE, CONFIGURATION & TESTING

4.1 Inspection

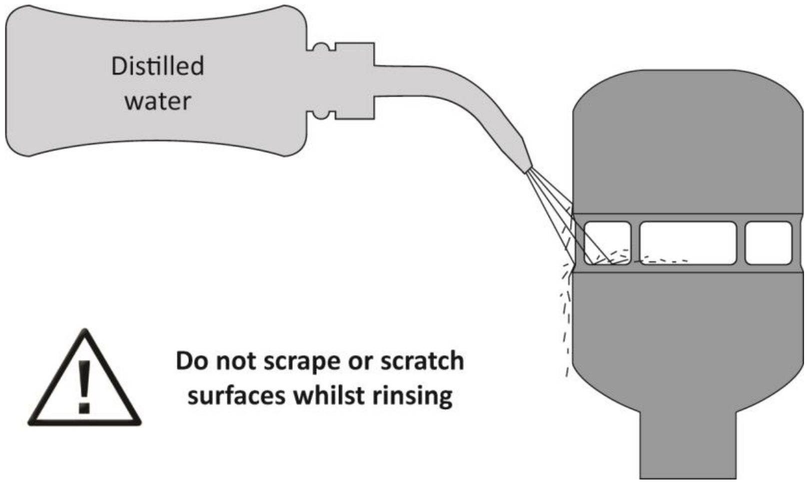
The following checks are required to identify any signs of corrosion or damage on the sensor which may hinder its performance or result in misalignment. It is recommended that these checks be carried out annually.

Mechanical damage: Check the sensor body for signs of damage, paying particular attention to the seals, screws and spring. Also inspect for signs of lightning damage which may appear as burns or scorch marks (or burnt smells). If damage has occurred replace the sensor immediately. Inspect the hydrophobic cavity coating for wear, corrosion and damage.

Corrosion; Inspect the mounting surface of the sensor and the surfaces of other mounting parts for signs of corrosion. If corrosion is present on any surface, it should be removed using an abrasive cloth. Check that any mechanical fixings are in good condition with no signs of corrosion and tighten as necessary. If corrosion is present replace with parts of the appropriate finish (see Section 3). Corrosion of mating surfaces may result in decreased lightning protection, review the lightning advice provided in Section 3.6 if lightning failure is considered an issue.

Caution: The FT742-DM50 is intended for use with the supplied corrosion-resistant self-locking fasteners (3x part FT037). Failure to use these fasteners may result in serious corrosion. Ensure field technicians are aware of this requirement.

Interconnection cable: Inspect the condition of the cable. If any part has become frayed or damaged in any way, it should be replaced immediately. Intermittent cable faults may not be visible, but may show up as errors in data. Confirm the intended network component values. Electrical noise from power equipment can be reduced through the use of grounded metallic conduit and may improve data integrity (see Section 3.6).



Cleaning: The measurement cavity has a special hydrophobic coating (water repelling) which helps to prevent water building up. When water enters the measurement cavity the surface helps to wash away dust and debris which may have settled. If any debris is present this can be removed by gently rinsing the measurement cavity surface with distilled water using a laboratory wash bottle or similar. Please note excess water droplets can be removed by lightly blowing or shaking the sensor.

Do not scrape or scratch the surfaces whilst rinsing. **Under no circumstances** should objects be inserted inside the measurement cavity, as this can cause irreparable damage. If the coating has been damaged then it may need to be reapplied. The body of the sensor can be washed if required using the same method as described above. Whilst washing the sensor care must be taken not to get water in the breather hole or into the connector at the base of the sensor.

Do not use cleaning chemicals to clean the sensor. If washing a nearby item protect the sensor with a suitable cover. Ensure the cover is removed before re-enabling the wind data survey.

4.2 Fault Finding & Troubleshooting

To determine whether a sensor has a fault carry out the following steps:

- Follow the inspection procedure above to identify signs of physical damage
- Remove any objects or insects lining the cavity or blocking the airflow
- Reset the sensor (disable/enable the power, or send the RSU command)
- Test that the sensor is communicating properly using the Acu-Test Evaluation Pack (see Section 4.4)

If there are signs of physical damage and/or the sensor is failing to communicate properly, it should be replaced. Sensors may be returned to FT Technologies for further analysis if required (see Section 4.3).

Warning – The sensor contains no user serviceable components. Do not attempt disassembly as damage may result and product warranties will be invalidated.

During extreme weather conditions, there may be periods where data is temporarily unavailable. However, there are ways to mitigate against these affects. The following steps should be taken to ensure the highest levels of data availability from the sensor:

- Using the Acu-Test Evaluation Pack:

- Check that the sensor has the latest version of software (please contact FT Technologies for more information on latest software releases)

- Check that the heater set point is at least 30˚C

- Ensure that a suitable method of averaging is applied. Either using the internal filtering on the sensor (see Section 6.4.11) or using an external data controller

Check that the wind sensor data and status flag errors are being processed as per the advice in Sections 6.4.29 and 6.4.30.

- Check that the measurement cavity's special coating is in a satisfactory condition and no debris is present. Debris can be blown out or washed out with distilled water spray.

Please contact FT Technologies for further information and advice if required.

4.3 Returns

If a sensor appears to be faulty, compile a detailed fault description for each sensor, then contact FT Technologies to request a Returns Materials Authorisation (RMA) form. Please complete the form and return as instructed. Returns cannot be accepted without prior approval via this authorisation form.

Units damaged by lightning or disassembled by the customer cannot typically be repaired, however an inspection fee may still apply.

4.4 The Acu-Vis 2 PC Test Cable & Software

The Acu-Vis 2.0 Test Cable & software kit includes a USB test cable and Acu-Vis 2.0 PC software.

An external power supply capable of 6-30VDC and 4A is necessary, the FT062 power supply may be used where the use of a benchtop electronics power supply is unsuitable.

The Acu-Vis 2.0 test software has a separate user manual. Contact FT Technologies for technical assistance or a copy of this user manual.

Note: The FT062 power supply requires a regional C13-style adaptor for mains connection. Some FT sensors are technically capable of greater than 4A current consumption, in this case please ensure the power supply is capable of supplying the required current

CAUTION: The Acu-Test software and cable are not designed for long-term datalogging reliability or production connection.

4.4.1 The Acu Vis PC Software

The Acu-Vis 2.0 software can be installed on PCs running Windows XP, Vista, 7, 8, 8.1 and 10. Contact FT Technologies for a download link.

The Acu-Vis 2.0 software automatically detects the FT054 USB test cable and wind sensor. The program will detect the wind sensor when it is powered up and functional. The dials then show the real-time wind speed and direction from the wind sensor as shown in Figure 21.

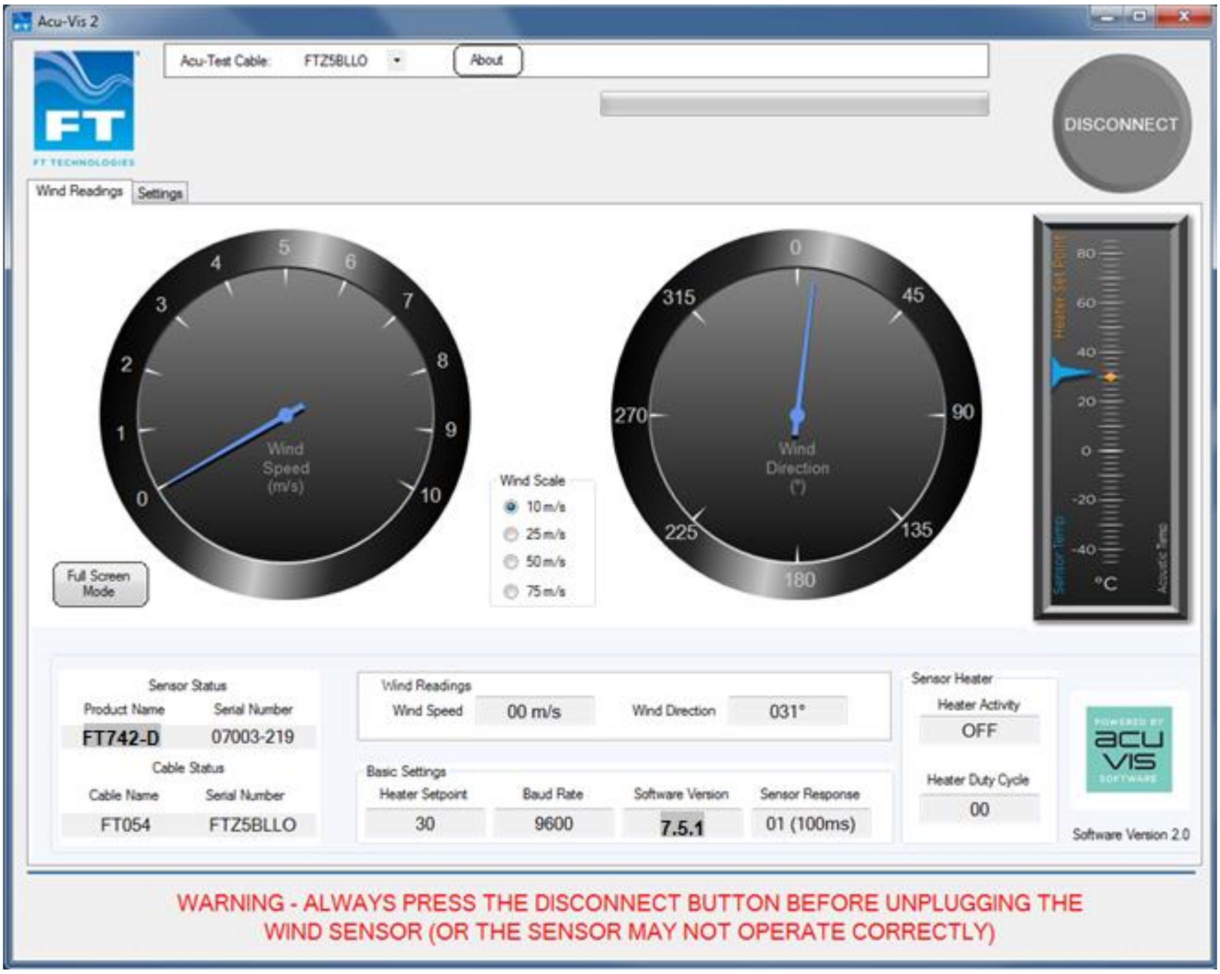


Figure 21: Acu-Vis 2.0 Main Display

The program also shows the communication settings, software version and serial number.

The Heater Control tab can be used to monitor the sensor's heaters and to change the sensor's heater set point temperature as shown in Figure 24.

4.4.2 FT054 Evaluation Cable

FT can provide Acu-Test Evaluation Kits and power supplies to assist users with connection, development and test of the FT sensors. The kit connects the sensor to a power supply and a Windows PC using virtual COM ports. The USB test cables converts RS485HD to USB.

The models described in this user manual use the FT054 Acu-Test cable:

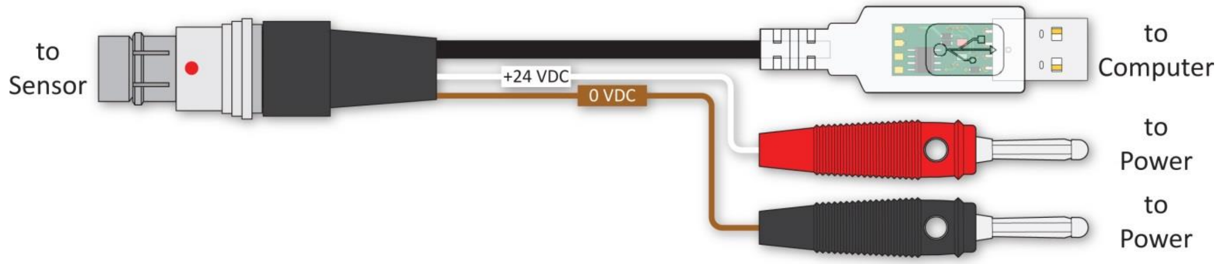


Figure 22: The FT054 Acu-Test Evaluation Cable

Figure 23: The FT062 Power Supply (left) & Benchtop Electronic PSU Example (right)

Note: The FT062 power supply requires a regional C13-style adaptor for mains connection. See Figure 23.

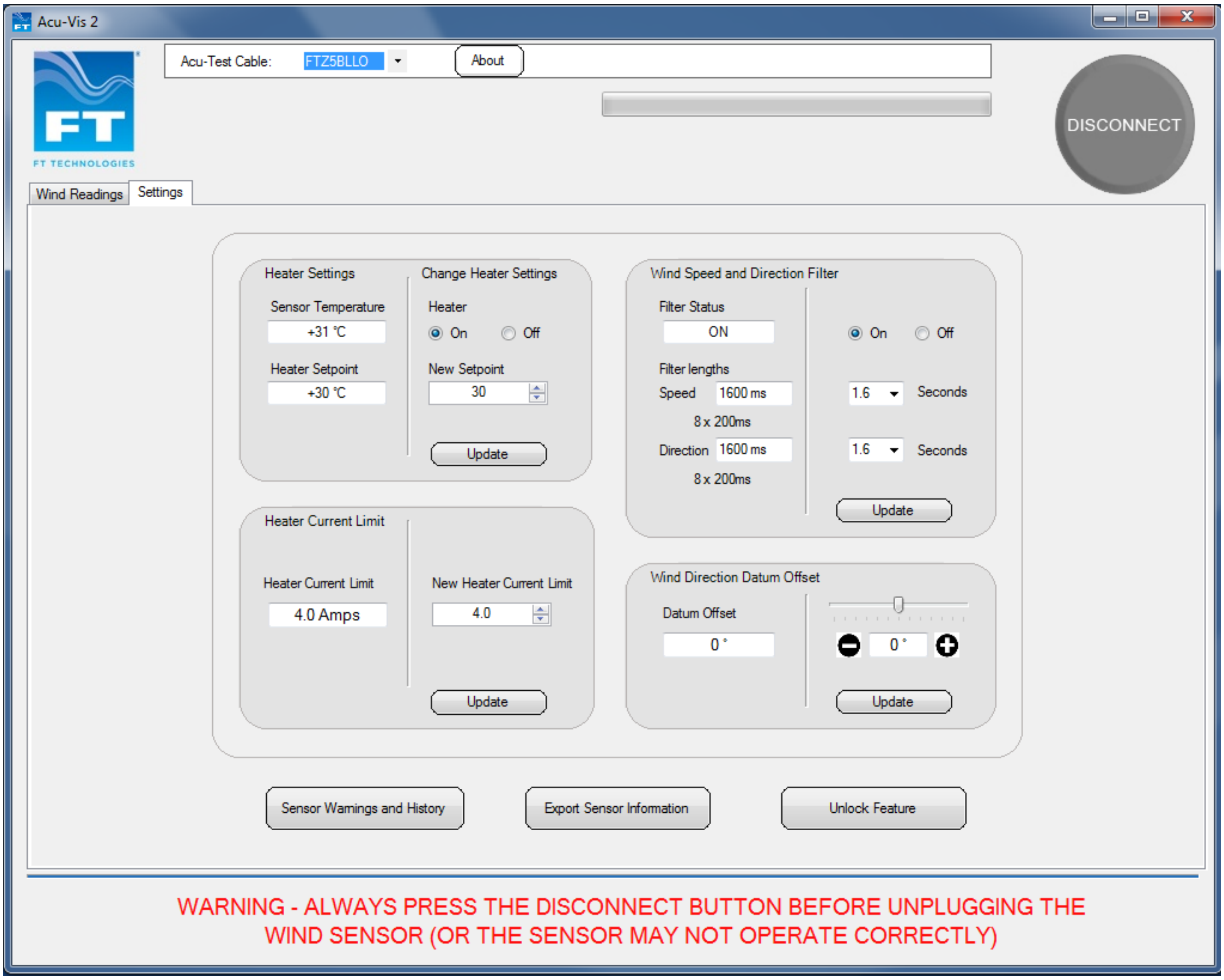


Figure 24: Acu-Vis Settings Window (Heater, Averaging Filters & Datum Offsets)

Heater Settings: Displays the Heater setpoint value (°C).
Heater Current Limit: Displays the heater current limit (Amps)
Wind Speed & Direction Filter: Displays the status and length of the wind data averaging filter (seconds)
Wind Direction Datum Offset: Displays the direction offset (°)

- The ‘Sensor Warnings and History’ button will provide a history of the connected sensor settings where it has been connected to the PC

- The ‘Export Sensor Information’ button creates an encrypted file containing current user settings and diagnostic information. This feature will export a file in .fff format that can be forwarded to the FT Technologies support teams

- The ‘Unlock Feature’ button is used to unlock advanced features in Acu-Vis 2.0, including the ‘Commands’ and the ‘User Calibration Table’ tabs. Contact FT Technologies for further details

4.4.3 Command Line Terminal Programs (Including Tera Term)

The FT054 Acu-Test cable can also be used to communicate via command line terminal programs, including 'HyperTerminal' and 'TeraTerm'. This provides the user with a visible method of communication with digital wind sensors without building an RS485HD network.

To begin a TeraTerm connection click 'New Connection…' in the File Menu:

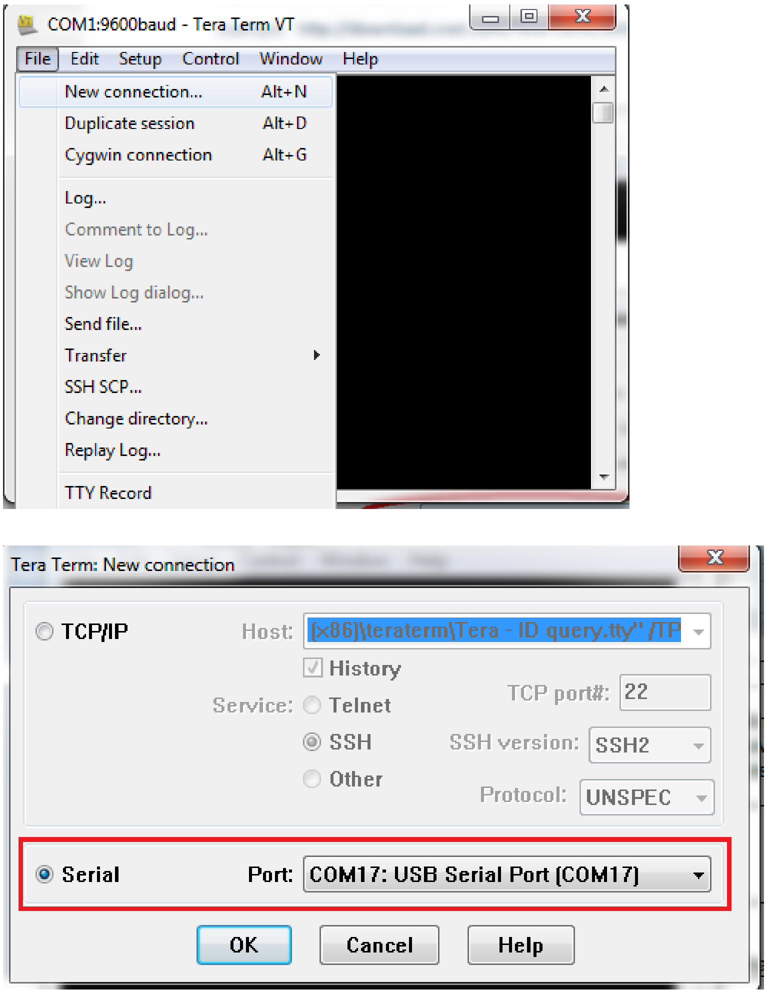


Figure 25: Creating a Connection in Tera Term

Create a new Serial connection - the COMx channel will be dynamically assigned by the computer, but should typically be recognised as a 'USB Serial Port (COMxx)'.

It is necessary to modify several settings to view the data and simplify the end-of-line character requirements of software commands (i.e. remove the requirement to type <cr><lf> at the end of all commands).

From the Setup menu click: Terminal… Set the New-Line Transmit to CR+LF and enable local echo. Local Echo makes typed characters visible on the display.

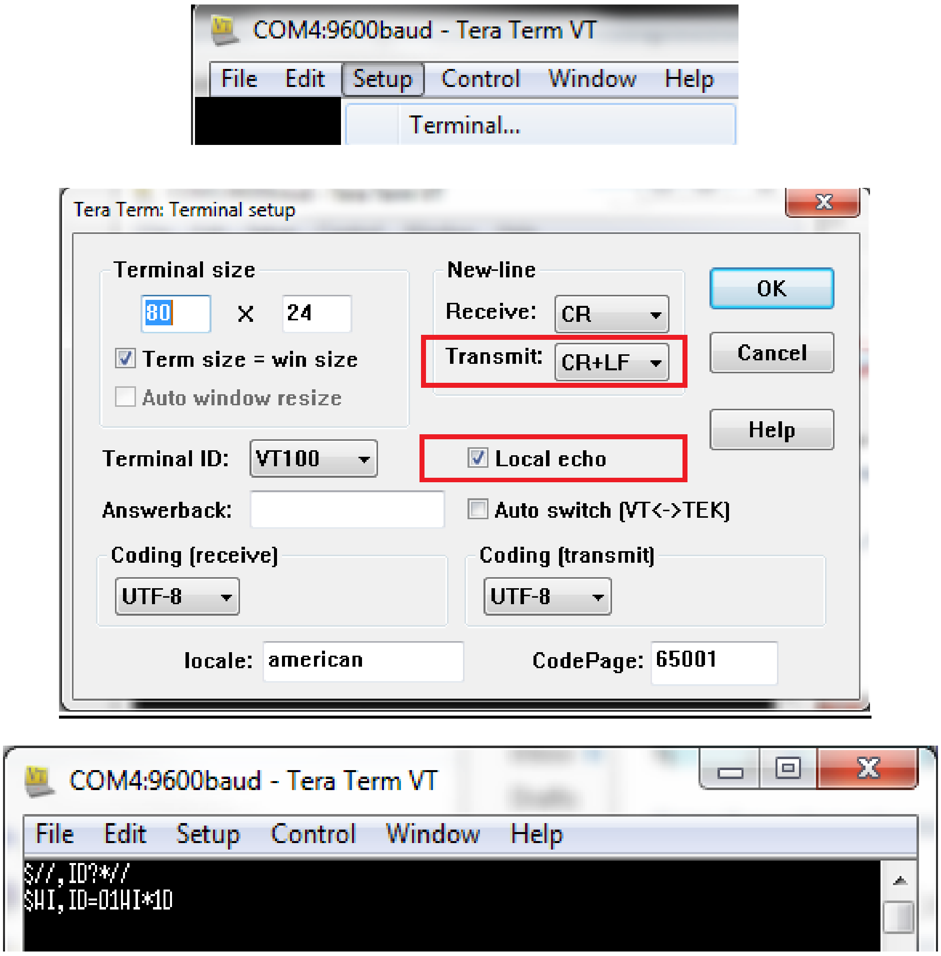


Figure 26: Modifying Terminal Settings in Tera Term

TeraTerm defaults to a baud rate of 9600, it may be necessary to configure this setting via the Setup menu → Serial Port… settings window.

With connection enabled with the settings configured as described above, send commands to the sensor to confirm successful connection. Please note that in half-duplex communication protocols the sensor cannot receive commands while simultaneously transmitting information, therefore it may be necessary to repeat the command and confirm it was accepted using a QUERY command. This can be an issue when using CU mode at high frequencies.

Below are some useful commands:

$01,ID?*//	Query the sensor ID setting
$01,CU?*//	Query the CU mode setting
$01,CUD*//	Disable CU mode
$01,CUE00010*//	Enable CU mode at 1 second intervals (1Hz). Note: Command is for FT742 sensors only.

The // line bypasses the checksum validation. Checksum validation is recommended for production datalogging to improve data integrity. See Section 5 and Section 6 for further details regarding command structures and replies.

Note: If a sensor is set to an ID setting other than 01, replace $01 with the alternative ID. Starting a command with $// will perform the relevant command on all connected sensors.

5 SENSOR COMMUNICATION

5.1 Introduction

The sensor features an easy to use ASCII-based communication protocol transmitted over an RS485 serial link. The protocol incorporates checksum validation to ensure the integrity of all data transmissions. In addition to the FT Technologies proprietary protocol the sensor can output the common NMEA 0183 MWV (Wind Speed and Angle) sentence.

5.2 RS485 Protocol

The sensor is fitted with an RS485 half-duplex serial interface. Slew-rate limited drivers are used to reduce EMI, and minimize reflections from improperly terminated transmission lines and stubs. The signal state definitions for the serial interface data lines are as follows:

- The idle, marking, logical “1”, OFF or stop bit state is defined by a negative voltage on line A with respect to line B.
- The active, spacing, logical “0”, ON or start bit state is defined by a positive voltage on line A with respect to line B.
-

The circuit below (Figure 27) shows the recommended wiring diagram for connecting the sensor to the PC.
If two or more wind sensors are to be installed it is possible to use the same 2-wire data link to connect all the sensor units to the computer.

Before using a sensor in a multi-device system, the Listener identifier of each sensor must be set to a unique value. Use the ID command (Section 6.4.17) to set the Listener identifier for each sensor. If the Listener identifiers are being set in the final host system, then it is important that only one sensor be connected at a time to the RS485 bus until all devices have been assigned a unique Listener ID. Great care should be exercised when using the ‘//’ characters for addressing. The ‘//’ address characters can be used to send a SET command simultaneously to all sensor units (for example, to enable or disable filtering). Under no circumstances should the ‘//’ characters be used with any QUERY commands since this will cause all sensor units to transmit data resulting in bus contention.

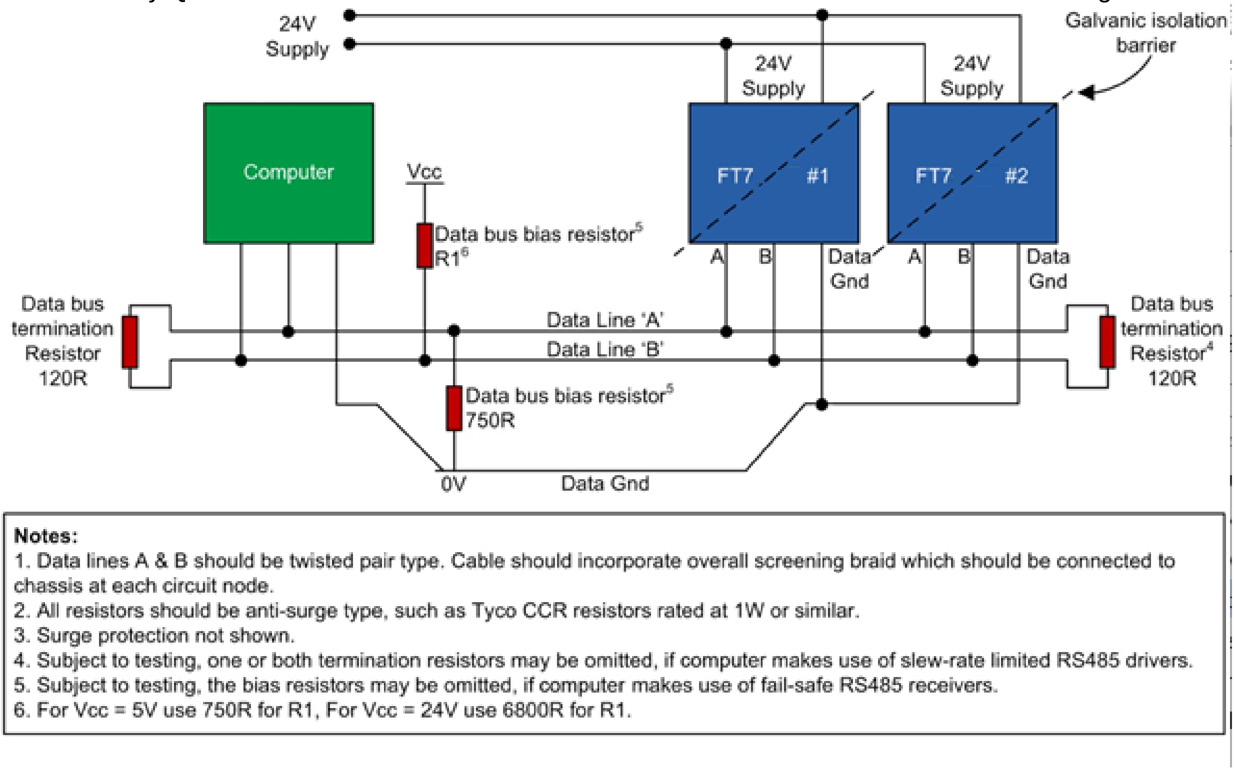


Figure 27: RS-485 Connection Diagram for 2 Wind Sensors

5.3 Configuring the Sensor

All user parameter settings are stored in non-volatile memory and are retained when the sensor is switched off. When the sensor is next switched on (or a user reset command is sent) the sensor will revert to these settings. The sensor can therefore be configured prior to final installation if required.

The sensor settings can be returned to the factory values (see Figure 32 for factory default settings) at any time by sending the factory reset command.

5.4 Communication

5.4.1 Conventions used in this manual

All examples of sensor transmitted and received messages are printed in italic courier monospace font, e.g.

$<listenerID>,DFP<checksum><cr><lf>*

Angle brackets are used as placeholders for data (e.g. <wind speed>) or for non-printable ASCII characters (e.g. <cr> for carriage return).

Figure 28 lists the various special characters and symbols which are used in the examples given in this Handbook.

Symbol	Valid Characters	HEX Values	Definition
a	{A to Z} {0 to 9} {/}	41-5A, 30-39, 2F	Talker/listener address field characters
c	{A to Z} {0 to 9}	41-5A, 30-39	Fixed length field of alpha (upper case only) and numeric characters
h	{A to F} {0 to 9} {/}	30-39, 41-46, 2F	Checksum field validation characters
s	{ }	20	Space
x	0 to 9	30-39	Fixed length field of numeric characters
x.x	{0 to 9} {.}	30-39, 2E	Fixed point numeric field (i.e. always with leading and trailing zeros)
±	{+ -}	2B, 2D	Polarity indicator. Where a value can take on both positive and negative values a polarity indicator (either + or -) is always sent as the first character in the field. The field length therefore remains fixed for both positive and negative values.
	{$}	24	Start of message delimiter
	{*}	2A	Checksum field delimiter
	{,}	2C	Field delimiter
-	{-}	2D	Dash
<cr>		0D	Carriage return End of message delimiter
<lf>		0A	Line feed
<name>			Placeholder for data

Figure 28: Symbols used in this Handbook

5.4.2 Data Transmission

Data is transmitted and received via an asynchronous serial communication interface using ASCII characters. The interface operates with the following parameters:

Parameter	Setting
Baud Rate	1200, 2400, 4800, 9600 (factory default), 19200, 38400
Data Bits	8
Start Bits	1
Stop Bits	1
Parity	None

Figure 29: Data Transmission Parameters

To set the sensor baud rate use the BR command (Section 6.4.4)

The sensor does not use handshaking (either hardware or software) to control the flow of data to and from the host computer. It is important, therefore, that the serial interface of the host computer is set with handshaking/flow control disabled.

5.4.3 Message Format

Data communication between the sensor and the host computer is performed by the transmission of ASCII messages. Figure 30 shows the composition of the message. The same message format is used for both received and transmitted messages.

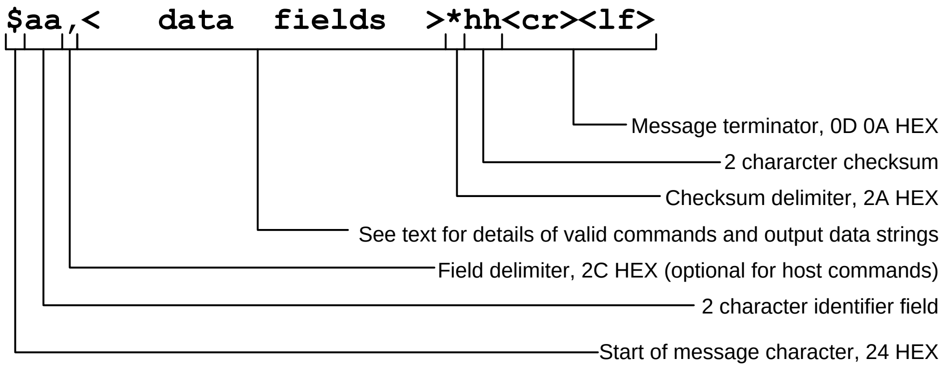


Figure 30: Message Format

All messages start with the '$' start of message character, followed by the 2 character talker/listener identifier (Section 5.4.4) field.

Following the first delimiter is the main body of the message which comprises a variable number of data fields (dependent on the message being transmitted), each separated by the field delimiter character (','). Data fields may contain alpha, numeric, or alphanumeric data depending on the information content of the field.

Messages sent to the sensor will contain a command in <data fields> and messages transmitted from the sensor will contain output data in <data fields>.

The data field section of the message is terminated by the checksum delimiter character '*'. Following the checksum delimiter is the two-character checksum field. See Section 5.4.5 for information on how to compute the checksum and Section 5.4.6 if checksum message validation is not required.

All messages are terminated with a carriage return <cr> and line feed <lf>.

5.4.4 Listener and Talker Identifiers

The sensor is assigned with both a Listener and Talker identifier address that allows an individual sensor to be uniquely identified in a system comprising more than one sensor.

Whenever a message is sent to the sensor, the identifier field of the message (the 2 characters immediately following the '$' start of message character) must correspond to the sensor Listener identifier address, otherwise the sensor will ignore the message. In applications where more than one sensor is connected to the RS485 bus, you should assign each sensor in the system a unique Listener ID. The host computer will then be able to address individually each sensor. If you do not wish to use the Listener ID in messages sent from the host computer, you can replace the Listener ID with '//'. Sending '//' in place of the Listener ID will allow any sensor, irrespective of its Listener ID setting, to respond to the message.

Whenever a message is transmitted from the sensor, the identifier field of the message (the 2 characters immediately following the '$' start of message character) will contain the Talker ID. The Talker ID is used as a message tag to identify which sensor has transmitted the message.

The factory default value for the Listener ID is 01 and for the Talker ID it is WI (Weather Instrument). To change the Listener and/or Talker ID use the ID Command, Section 6.4.17.

5.4.5 Calculating the Message Checksum

All messages sent to, or received from, the sensor include a checksum field. Messages that are transmitted from the sensor always include a checksum value in the checksum field. Messages sent to the sensor by the host computer can either contain a checksum value or an 'ignore checksum identifier' in the checksum field.

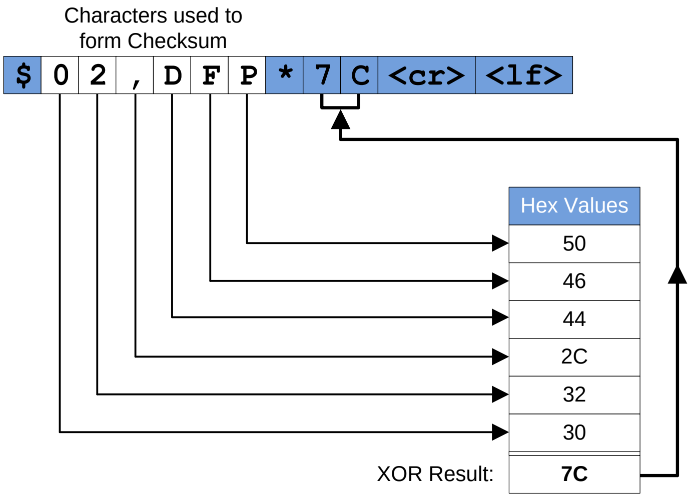


Figure 31: Checksum Example

The checksum value is calculated by Exclusive OR'ing (XOR'ing) all the bytes between (but not including) the '$' and the '*' characters of the message. The resulting single byte value is then represented by 2 HEX characters in the message string. The most significant character is transmitted first.

Note: Since a message only contains ASCII characters (which have values in the range 0-7F) the checksum value will always be between 0 and 7F.

5.4.6 Disabling the Checksum

All messages which are sent to the sensor must contain a valid checksum value in the checksum field, otherwise the sensor will not process the incoming message. Although it is recommended that a checksum value be computed for all messages which are sent to the sensor, in some cases this may not be convenient (i.e. when communicating with the sensor with a terminal). To prevent the sensor from performing checksum validation of incoming messages, send the ASCII characters '//' in place of the checksum value.

Example:

Send a message to set the data output format to Polar using the DFP command (the sensor Listener ID in this example is set to 02)

With a checksum (sensor checksum validation automatically enabled):

*$02DFP*50<cr><lf>*

Without a checksum (sensor checksum validation automatically disabled):

$02DFP//<cr><lf>*

A checksum value is always transmitted by the sensor with every outgoing message. However the checksum field can be ignored by the host computer if checksum validation for received messages is not required.

6 PARAMETER SETTINGS

FT sensors are configurable. The factory default settings can be modified on despatch to the required customer settings.

6.1 Command Types

6.1.1 Set Commands

Figure 32 lists the commands that may be sent to the sensor from the host computer that are used to SET configuration options for the wind sensor.

Command	Mnemonic	Configuration Options	Factory Default	Section
Acoustic Temperature Units	AT	C (Celsius) F (Fahrenheit) K (Kelvin) Filter Length	C (Celsius) 1 minute	6.4.1 6.4.2 6.4.3
Serial interface baud rate	BR	1200, 2400, 4800, 9600, 19200, 38400	9600	6.4.4
Datum offset	CF	000.0° to 359.9°	000.0°	6.4.5
Continuous Update	CU	Enable or Disable Update interval, 0.1-6000 seconds	Disabled	6.4.6
Wind velocity data format	DF	Polar or NMEA 0183 Combined DFC mode	Polar	0
Command delay interval	DL	00 to 20	01	6.4.9
Clear Error Report	ER	Reset	000000000000	6.4.10
Wind velocity filter	FL	Enable or Disable, Speed filter length Direction filter length	Enabled 0016 0016	6.4.11 6.4.12
Selective Filter	FL	Enable or Disable Selective filter length	Disabled 010	6.4.13
Heater settings	HT	Setpoint Temperature Heater Start Delay Time Current Limit Undervoltage limit	Heater Disabled 4 seconds delay 4A 11V	6.4.14 6.4.15 6.4.16
Listener and talker identifiers	ID	Listener ID = xx Talker ID = xx	Listener ID = 01 Talker ID = WI	6.4.17
Min/Max wind speed	MM	Reset	999.9,000.0	6.4.18
Overspeed Warning Scheme	OS	Enabled or disable	Disabled	6.4.19
Reset	RS	Load Factory Default, Load Current Settings, Load Saved Parameters	NA	6.4.20
User Calibration Table	UC	Enable or Disable Clear Wind speed table record Save wind speed table Table label	Disabled NA NA NA	6.4.23 6.4.24 6.4.25 6.4.26 6.4.27
Save User Parameters	US	Copies current Parameters	NA	6.4.28

Figure 32: Set Commands

When a valid message is recognised by the sensor, the sensor will carry out the command contained in the message. To verify that the command has been successfully carried out, an associated QUERY command can be sent after most SET commands (see Section 6.1.2 for the list of parameters which may be queried).

6.1.2 Query Commands

Figure 33 lists the commands that may be sent to the sensor from the host computer that are used to QUERY the wind sensor's latest readings or configuration.

Command	Mnemonic	Sensor Data Returned	Section
Acoustic Temperature	AT	Temperature Temperature Units (°C, °F, K) Filter time period	6.4.1 6.4.2 6.4.3
Serial interface baud rate	BR	1200, 2400, 4800, 9600, 19200, 38400	6.4.4
Datum offset	CF	000.0° to 359.9°	6.4.5
Continuous update	CU	Enabled or Disabled Update interval (0.1 - 6000 seconds)	6.4.6
Wind velocity data format	DF	Polar, NMEA 0183 or Combined DFC mode	6.4.7
Runtime Counter	DG	Number of hours of runtime	6.4.8
Command delay interval	DL	00 to 20	6.4.9
Error report	ER	Factory Report	6.4.10
Wind velocity filter	FL	Enabled or Disabled Speed filter length, 1-64 Direction filter length, 1-64	6.4.11 6.4.12
Selective Filter	FL	Enabled or Disabled Validity Period	6.4.13
Heater settings	HT	Setpoint Temperature, 0°C to 55°C. Percentage of heater current, 0% to 100% Internal sensor temperature, 00°C to ±99°C, Heater Delay Time, 4s to 999s Current Limit, 0.1A to 6.0A Undervoltage Limit, 11V to 17V	6.4.14 6.4.15 6.4.16
Listener and talker identifiers	ID	Listener ID = xx Talker ID = xx	6.4.17
Min/Max wind speed	MM	Min & Max Speeds Recorded	6.4.18
Overspeed Warning Status	OS	Enabled or Disabled	6.4.19
Serial Number	SN	Serial Number	6.4.21
Software Version	SV	Software Version	6.4.22
User Calibration Table	UC	Enabled or Disabled Wind speed table record Table label	6.4.23 6.4.24 6.4.25 6.4.26 6.4.27
Saved User Parameters	US	Matches Saved to Current User Parameters	6.4.28
Wind velocity reading	WV	Wind Speed, Direction and Sensor Status Acoustic Temperature (DFC mode only)	6.4.29 6.4.30

Figure 33: Query Commands

6.2 User Calibration Table

The User Calibration Table includes up to 64 user programmable records. Each record comprises a pair of values representing the corrected speed (wind tunnel speed) and the corresponding uncorrected wind sensor speed. In addition to the calibration table, there is provision for a user-defined text string of up to 32 characters which is stored together with the table.

The User Calibration Table records must be entered in ascending order of wind sensor speed. The minimum allowable difference between wind sensor speed values in consecutive records is 0.5m/s.

To load the User Calibration Table with data, the following steps need to be taken:

1. The Table must first be cleared (See Section 6.4.24).
2. Each pair of table row values is entered into a RAM copy of the User Calibration Table (See Section 6.4.25)
3. A text string linked to the table may be entered if desired. This can be entered at any point after the table is cleared and before the RAM copy of the table is saved into Flash memory. (See section 6.4.27)
4. The RAM copy of the User Calibration Table is saved into Flash memory (See Section 6.4.26

At any point in the above procedure (or at any other time) commands can be sent to the wind sensor to:

- Verify that the table has been cleared;
- Verify the last row of data written to the table;
- Read the number of table entries and the table checksum;
- Read out a selected row of table data,
- Read out the User Calibration Table label.

See Sections 6.4.23 - 6.4.27 for further details.

6.3 Timing Constraints

When a valid command is received by the sensor input buffer, there will be a time delay whist the command is being processed. The actual command latency depends on exactly when the last character of the command is received within the sensor internal processing cycle. The sensor can process only one SET or QUERY command at a time.

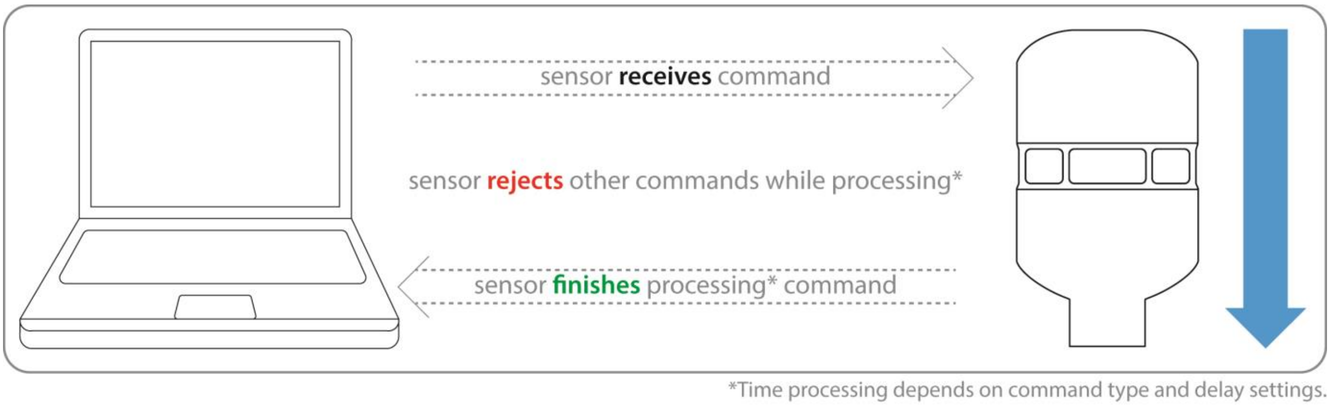


Figure 34: Command Processing

Once a SET command has been received by the sensor, it can take approximately 400ms for the command to be processed and any setting change implemented. If other commands are sent during this period, they may be ignored by the wind sensor. Therefore all SET commands must be separated by a period of at least 500ms before further commands are sent. (Or longer in the case of a Reset command being sent See Section 6.4.20).

Once a QUERY command has been received by the sensor, it takes up to 50ms for the command to be processed. The sensor will then wait for a predefined delay before sending a response. This delay time is programmable in increments of 50ms.

See Section 6.4.9 for details of how the delay between the sensor receiving a command and transmitting a reply can be adjusted. An additional latency is recommended depending on the time taken for the computer to switch between transmit and receive modes.

If the delay time has been extended using the DL command, then the next QUERY command sent to the wind sensor must be separated by the maximum QUERY command processing time (50ms) and at least the DL interval (50ms default.) It is therefore recommended that the frequency of any QUERY command does not exceed 10Hz, i.e. 10 commands per second.

Message Example:
For example, to set the wind velocity output to Polar format and verify that the command has been accepted, send the following commands:

Set the wind reading format to polar:
$//DFP//<cr><lf>*

Then wait 500ms for the SET command to be implemented by the sensor.

A QUERY can then be sent to confirm command has been carried out:
$//DF?//<cr><lf>*

Then wait 50-100ms for the sensor to send a response:
*$WI,DF=P*5D<cr><lf>*

Please note the above example assumes the sensor has a factory default time delay of 50-100ms (DL01).

6.4 Command Parameters

Each command, and its usage, is described in the following Sections. All examples, other than where stated, assume that the sensor Listener ID is set to 01, and the sensor TalkerID is set to WI, (Weather Instrument).

6.4.1 AT.1: Query the Acoustic Temperature

Command Parameter	AT

Command Syntax	SET Sensor:	*N/A*
	QUERY Sensor:	*$<listenerID>,AT?*<checksum><cr><lf>* *$aa,AT?*hh<cr><lf>*
	AT? Sensor output:	*$<talkerID>,AT=<temp>,<units>,<status>*<checksum><cr><lf>* *$aa,AT=±xxx.x,c,c*hh<cr><lf>*
	CU Enabled DFC Mode:	*$<talkerID>,WVC=<speed>,<angle>,<status>,<temperature>,<temp.units>,<temp.status>*<checksum><cr><lf>* *$aa,WVC=www.w,xxx,y,zzzz.z,a,b*hh<cr><lf>*

Parameters	<temp> *-077.8 to +368.3*	Read only parameter that returns the current acoustic temperature reading in the range: -61.0°C to +95.1°C -77.8°F to +203.2°F 212.2K to 368.3K
	<units> C F *K*	 The acoustic temperature is output in degrees Celsius The acoustic temperature is output.in degrees Fahrenheit The acoustic temperature is output in Kelvin
	<status> *V* *A*	 The acoustic temperature reading is valid. An acoustic temperature reading is being acquired. The output may not be valid during this time.

Examples	Example 1 Query the latest acoustic temperature reading – a valid reading in degrees Celsius. Message *$01,AT?*//<cr><lf>* *$WI,AT=+023.9,C,A*15<cr><lf>*	 Comment Query acoustic temperature Sensor response
	Example 2 Query the latest acoustic temperature reading. A valid reading in Kelvin is being acquired. Message *$01,AT?*//<cr><lf>* *$WI,AT=+297.2,K,V*0C<cr><lf>*	 Comment Query acoustic temperature Sensor response
	Example 3 - CU AT DFC Mode *$WI,WVC=000.0,333,0,+026.4,C,A*4B*	Comment CUE mode with AT (DFC Mode)
	Example 4 - WV DFC Mode *$WI,WVC=000.0,323,0,+026.3,C,A*4D*	Comment WV response (DFC Mode)

Description	The AT query command returns the current acoustic temperature reading in the selected units. An acoustic temperature reading will be returned even if the sensor is in the process of trying to acquire a valid reading. The acoustic temperature reading is filtered with a one-minute time constant by default. The accuracy of the acoustic temperature reading may be affected by the relative humidity of the air surrounding the sensor. See Section 2.10 for further details. Software version V7.5.1 introduced the option for AT (Acoustic Temperature) data to be inserted within the CU command wind vector data. A new DF command option (see Section 6.4.7) controls this mode. Caution: The acoustic temperature feature requires calibration at FT Technologies. If the sensor has had a software upgrade to 7.5 (or above) then the data will be uncalibrated and may not comply with the official specification.

6.4.2 AT.2: Set or Query the Acoustic Temperature Units

Command Parameter	AT (units)	
Command Syntax	SET Sensor:	$<listenerID>,ATU<units>*<checksum><cr><lf> $aa,ATUc*hh<cr><lf>
	QUERY Sensor:	$aa,AT?U*hh<cr><lf>
	Sensor output:	$<talkerID>,AT=<units>*<checksum><cr><lf> $aa,AT=c*hh<cr><lf>

Parameters	<units>	
	C	The acoustic temperature is to be output in degrees Celsius
	F	The acoustic temperature is to be output.in degrees Fahrenheit
	K	The acoustic temperature is to be output in Kelvin

Examples	Example 1 Set the Acoustic Temperature reading output units to degrees Fahrenheit.	
	Message	Comment
	$01,ATUF*//<cr><lf>	Set units to Fahrenheit
	$01,AT?U*//<cr><lf>	Query temperature units
	$WI,AT=F*5C<cr><lf>	Sensor response

Description	Use this command to change the measurement units of the acoustic temperature output readings. The available measurement units are degrees Celsius, Fahrenheit and Kelvin.

6.4.3 AT.3 Set or Query the Acoustic Temperature Filter Length

Command Parameter	AT (filter length)

Command Syntax	SET Sensor:	*$<listenerID>,ATF<filter length>*<checksum><cr><lf>* *$aa,ATFxxc*hh<cr><lf>*
	QUERY Sensor:	*$<listenerID>,AT?F*<checksum><cr><lf>* *$aa,AT?F*hh<cr><lf>*
	Sensor output:	*$<talkerID>,AT=<filter length>*<checksum><cr><lf>* *$aa,AT=xxc*hh<cr><lf>*

Parameters	<filter length> *00S to 50S,* *01M to 10M*	Time constant of the acoustic temperature filter in seconds (S) or minutes (M). Supported settings are 00S (to disable the filter), then ten second increments from 10S up to 50S, then one minute increments from 01M to 10M. (Factory Default Setting = 01M)

Examples	Example 1 Set the filter time constant to 40 seconds. Verify that the command has been accepted.	
	Message	Comment
	$01,ATF40S//<cr><lf>*	Set 40s time constant
	$01,AT?F//<cr><lf>*	Query filter time constant
	*$WI,AT=40S*4D<cr><lf>*	Sensor response
	Example 2 Set the filter time constant to 2 minutes. Verify that the command has been accepted.	
	Message	Comment
	$01,ATF02M//<cr><lf>*	Set 2 minute time constant
	$01,AT?F//<cr><lf>*	Query filter time constant
	*$WI,AT=02M*55<cr><lf>*	Sensor response

Description	Use this command to alter the time constant of the acoustic temperature filter. The filter can be disabled by setting the time constant to zero (00S). Valid time constants are ten second steps from 10S to 50S and then one-minute steps from 01M to 10M.

6.4.4 BR: Set or Query the Serial Interface Baud Rate

Command Parameter	BR

Command Syntax	SET Sensor:	*$<listenerID>,BR<baudrate>*<checksum><cr><lf>* *$aa,BRx*hh<cr><lf>*
	QUERY Sensor:	*$<listenerID>,BR?*<checksum><cr><lf>* *$aa,BR?*hh<cr><lf>*
	Sensor Output:	*$<talkerID>,BR=<baudrate>*<checksum><cr><lf>* *$aa,BR=x*hh<cr><lf>*

Parameters	<baudrate>	
	0	Set the baud rate to 38400 baud
	1	Set the baud rate to 19200 baud
	2	Set the baud rate to 9600 baud (Factory Default Setting)
	3	Set the baud rate to 4800 baud
	4	Set the baud rate to 2400 baud
	5	Set the baud rate to 1200 baud

Examples	<u>Example 1</u> Set the baud rate to 19200 baud, verify the new setting and send a user reset command to activate the new baud rate	
	<u>Message</u>	<u>Comment</u>
	$01,BR1//<cr><lf>*	Set baud rate to 19200
	$01,BR?//<cr><lf>*	Query baud rate setting
	*$WI,BR=1*2E<cr><lf>*	Sensor Output
	$01,RSU//<cr><lf>*	Send user reset

Description	Use the BR command to change the sensor serial interface baud rate. The new baud rate setting will only come into effect when the sensor is next powered-up or after a Reset command (RSU) has been received. If the baud rate is changed, you will only be able to communicate with the sensor if the host computer's baud rate is set to the same baud rate. If you do not know what the current setting of the sensor baud rate is you will need to try each baud rate in turn until you establish communication.

6.4.5 CF: Set or Query the Wind Datum Offset Angle

Command Parameter	CF

Command Syntax	SET Sensor:	*$<listenerID>,CF<offset>*<checksum><cr><lf>* *$aa,CFxxx.x*hh<cr><lf>*
	QUERY Sensor:	*$<listenerID>,CF?*<checksum><cr><lf>* *$aa,CF?*hh<cr><lf>*
	Sensor Output:	*$<talkerID>,CF=<mode>,<status>,<offset>,<offset>*<checksum><cr><lf>* *$aa,CF=c,c,xxx.x,xxx.x*hh<cr><lf>*

Parameters	<offset> *000.0 to 359.9*	Applying an offset electronically rotates the datum direction of the sensor in a counter clockwise direction (when looking down from above). (000.00 is Factory Default Setting)
	<mode> *D*	Always returns D
	<status> *D*	Always returns D

Examples	Example 1 The datum direction of the sensor is rotated by 5° to the left with respect to the sensor's mounting surface (as per Section 3).	
	Message	Comment
	$01,CF355.0//<cr><lf>*	Set offset angle to 5°
	$01,CF?//<cr><lf>*	Query parameters
	*$WI,CF=D,D,355.0,355.0*26<cr><lf>*	Sensor output
	Example 2 The datum direction of the sensor is rotated 5° to the right with respect to the sensor's mounting surface (as per Section 3).	
	Message	Comment
	$01,CF005.0//<cr><lf>*	Set offset angle to 5°
	$01,CF?//<cr><lf>*	Query parameters
	*$WI,CF=D,D,005.0,005.0*26<cr><lf>*	Sensor output

Description	Use the CF command to set the sensor wind datum direction offset.

WARNING: Once set, the offset value is retained within the non-volatile memory. If the sensor's location is changed then the offset value must be changed to suit the new installation or set to zero otherwise incorrect wind direction readings will be obtained.

6.4.6 CU: Set or Query the Continuous Update Setting

Command Parameter	CU

Command Syntax	SET Sensor:	*$<listenerID>,CU<cont.update>,<interval>*<checksum> <cr> <lf>* *$aa,CUcxxxxx*hh<cr><lf>*
	QUERY Sensor:	*$<listenerID>,CU?*<checksum><cr><lf>* *$aa,CU?*hh<cr><lf>*
	Sensor Output:	*$<talkerID>,CU=<cont.update>,<interval>*<checksum>< cr> <lf>* *$aa,CU=c,xxxxx*hh<cr><lf>*

Parameters	<continuous update>	
	E	Enabled
	D	Disabled (Factory Default Setting)
	<interval>	
	1 to 59999	interval, in 0.1s increments, between outputs in continuous mode

Examples	<u>Example 1</u> Set the sensor to output readings automatically every 10 seconds. Verify that the command has been accepted.	
	<u>Message</u>	<u>Comment</u>
	$01,CUE00100//<cr><lf>*	Enable CU mode, rate = 0.1Hz
	<u>Example 2</u> Disable the continuous update mode. Verify that the command has been accepted. (Note: This command must only be sent during the first four seconds after power-up – for more information see below).	
	<u>Message</u>	<u>Comment</u>
	$01,CUD//<cr><lf>*	Disable CU mode
	$01,CU?//<cr><lf>*	Query CU mode setting
	*$WI,CU=D,00100*40<cr><lf>*	Sensor response
	<u>Example 3</u> CU Mode data example (DFC enabled)	<u>Comment</u> See Section 6.4.7
	$01,CUE00010//*	Enable CU mode (1Hz)
	*$WI,WVC=000.0,333,0,+026.4,C,A*4B*	CU DFC Response (1Hz)

Description	Use the CU command to enable or disable the continuous update mode of operation. When continuous update is enabled, the sensor will output wind velocity readings at a rate determined by the <interval> setting. Each time the continuous update mode is enabled, the required <interval> setting must be sent (even if this has been sent to the sensor previously). When the continuous update mode is enabled, if the sensor is switched-off, when power is reapplied the sensor will automatically resume outputting readings. Ensure the control system is configured for the correct data format. Ensure the sensor is installed with the correct data format. Once the sensor has been put into continuous update mode, then it becomes a talker only and will not respond to any further commands. To be able to send commands again the continuous mode must be disabled. To achieve this, the CUD (disable continuous update mode) command must be sent within the first four seconds of the power being applied to the sensor.

WARNING: Do not use the continuous update mode if there are other talkers connected to the data bus. Only one active talker is allowed on the data bus at any one time otherwise bus contention will occur

6.4.7 DF: Set or Query the Wind Velocity Data Format

Command Parameter	DF

Command Syntax		
	SET Sensor:	*$<listenerID>,DF<format>*<checksum><cr><lf>* *$aa,DFc*hh<cr><lf> or* *$aa,DFcc*hh<cr><lf>*
	QUERY Sensor:	*$<listenerID>,DF?*<checksum><cr><lf>* *$aa,DF?*hh<cr><lf>*
	Sensor output:	*$<talkerID>,DF=<format>*<checksum><cr><lf>* *$aa,DF=c*hh<cr><lf>*

Parameters	<format>	
	P	Set the data format to Polar (wind speed and direction) (Factory Default Setting)
	N	Set the data format to NMEA 0183 with wind speed in m/s
	NN	Set the data format to NMEA 0183 with wind speed in knots
	NK	Set the data format to NMEA 0183 with wind speed in km/h
	C	Set the data format to Combined (Polar data & acoustic temperature)

Examples

Example 1

Set the wind velocity output data format to NMEA with wind speed in m/s and verify the new setting.

Message	Comment
$01,DFN//<cr><lf>*	Set format to NMEA (m/s)
$01,DF?//<cr><lf>*	Query format setting
*$WI,DF=N*43<cr><lf>*	Sensor response

Example 2

Set the wind velocity output data format to NMEA with wind speed in knots and verify the new setting.

Message	Comment
$01,DFNN//<cr><lf>*	Set format to NMEA (knots)
$01,DF?//<cr><lf>*	Query format setting

Example 3

Set the wind velocity output data format to 'Combined'

Message	Comment
$01,DFC//<cr><lf>*	Set format to Combined
$01,DF?//<cr><lf>*	Query format setting
*$WI,DF=C*4E<cr><lf>*	Sensor Response = C

Example 4

WV? Command with DFC enabled

	Comment
$01,WV?//*	Query WV wind data
*$WI,WVC=000.0,323,0,+026.3,C,A*4D*	Sensor Response

Example 5

CU Mode example with DFC enabled

	Comment
$01,CUE00010//*	Enable CU mode (1Hz)
*$WI,WVC=000.0,333,0,+026.4,C,A*4B*	CU DFC Response (1Hz)

Description	Use the DF command to set the required format of the wind velocity readings. See command WV (Sections 6.4.29 and 6.4.30) for a description of the sensor output for each of the format types. When a DF Set command is sent to the sensor, a reset of the minimum and maximum readings to their default values is automatically performed. Software version V7.5.1 introduced the new C mode ("Combined data") including wind data and Acoustic Temperature data. See Sections 2.10, 6.4.1, 6.4.2, 6.4.3 and 6.4.6 for further details. Polar Format: The sensor returns the magnitude of the wind speed (m/s only) and the wind direction (0-359 degrees). NMEA 0183 Format: The sensor returns the wind angle (0-359 degrees, Relative) and wind speed (m/s, knots or km/h). The sensor TalkerID is always set to WI when NMEA 0183 format is selected irrespective of any value that may have been set with the ID command. Note: Be aware that supporting the NMEA 0183 messaging data structure, the FT sensor does not necessarily meet the electrical and network requirements of the NMEA 0183 (EIA-422) standard.

6.4.8 DG: Query the Run-time Counter

Command Parameter	DG

Command Syntax	SET Sensor:	*N/A*
	QUERY Sensor:	*$<listenerID>,DG?T*<checksum><cr><lf>* *$aa,DG?T*hh<cr><lf>*
	Sensor output:	*$<talkerID>,DG=<counter>*<checksum><cr><lf>* *$aa,DG=xxxxxx*hh<cr><lf>*

Parameters	<counter>	
	000000 to 999999	Holds the number of hours that the anemometer has been in operation during its lifetime.

Examples	Example 1 Query the Run-Time Counter.	
	Message	Comment
	$01,DG?T//<cr><lf>*	Query Run-Time Counter
	*$WI,DG=012897*CF<cr><lf>*	Sensor response (12897 hours = 1 year, 5 months, 21 days and 9 hours)

Description	Use the DG command to query the number of operational hours that the anemometer has been in use. The Run-Time Counter is incremented on completion of each full hour that the anemometer has been in use.

6.4.9 DL: Set or Query the Command Delay Interval

Command Parameter	DL	
Command Syntax	SET Sensor:	*$<listenerID>,DL<delay>*<checksum><cr><lf>* *$aa,DLxx*hh<cr><lf>*
	QUERY Sensor:	*$<listenerID>,DL?*<checksum><cr><lf>* *$aa,DL?*hh<cr><lf>*
	Sensor output:	*$<talkerID>,DL=<delay>*<checksum><cr><lf>* *$aa,DL=xx*hh<cr><lf>*
Parameters	<delay> *00 to 20*	(delay interval, in 50ms increments) (Factory Default Setting = 01)

Examples	Example 1 Set the command delay interval to 250ms and verify the new setting.	
	Message	Comment
	$01,DL05//<cr><lf>*	Set delay to 250ms
	$01,DL?//<cr><lf>*	Query delay setting
	*$WI,DL=05*02<cr><lf>*	Sensor response

Description	Use the DL command to set the delay interval from when the sensor receives a command to when the command is executed. The DL command is primarily intended for use where a time delay may be required to allow the RS485 interface to switch from transmit to receive mode. For example, if the delay interval is set to 250ms then the sensor will commence outputting the wind velocity data between 250-300ms after receiving a WV query command. If any further commands are sent to the sensor before the delay interval has elapsed they will be discarded.

6.4.10 ER: Query or Reset the Error Report

Command Parameter	ER	

Command Syntax	SET Sensor:	*$<listenerID>,ER<reset>*<checksum><cr><lf>* *$aa,ERc*hh<cr><lf>*
	QUERY Sensor:	*$<listenerID>,ER?*<checksum><cr><lf>* *$aa,ER?*hh<cr><lf>*
	Sensor output:	*$<talkerID>,ER=<error report>*<checksum><cr><lf>* *$aa,ER=xxxxxxxxxxxxxxx*hh<cr><lf>*

Parameters	<reset> *R*	 Resets the historical log section of the error report to all 0's
	<error report> *<error report>*	 Sensor error report string

Examples	<u>Example 1</u> Query the error report <u>Message</u> *$01,ER?*//<cr><lf>* *$WI,ER=000000000000000*28<cr><lf>*	 <u>Comment</u> Query error report Sensor response

Description

The error report contains information on errors that have occurred during the operation of the sensor. The output string is always comprised of 15 ASCII characters (all shown as '0', ASCII 30(HEX) in the above example).

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14

Error Report Locations

Most recent

Least recent

Current Status

The first character in the data field represents the current operational status of the sensor. '0' (ASCII 30(HEX)) indicates that the sensor is functioning correctly any other character indicates that an error condition exists. The status is cleared once the ER command is executed.

The next 14 locations contain an historical log of the last 14 errors with the most recent error being recorded in the leftmost position. Each error condition is assigned an ASCII character. The historical log is stored in Flash and is retained when the power is switched off or the sensor software reset.

This report can be sent back to the FT factory for analysis if there are problems with the sensor.

> Currently the historical error log is only used for factory diagnostic purposes.

6.4.11 FL.1: Set or Query the Wind Data Averaging Filter Settings

Command Parameter	FL (enable/ disable)	
Command Syntax	SET Sensor:	*$<listenerID>,FL<filter>*<checksum><cr><lf>* *$aa,FLc*hh<cr><lf>*
	QUERY Sensor:	*$<listenerID>,FL?*<checksum><cr><lf>* *$aa,FL?*hh<cr><lf>*
	Sensor output:	*$<talkerID>,FL=<filter>*<checksum><cr><lf>* *$aa,FL=c*hh<cr><lf>*
Parameters	<filter>	
	E	Filter enabled (Factory Default Setting)
	D	Filter disabled
Examples	Example 1 Enable the filter. Verify that the command has been accepted.	
	Message	Comment
	$01,FLE//<cr><lf>*	Enable filtering
	$01,FL?//<cr><lf>*	Query filter setting
	*$WI,FL=E*40<cr><lf>*	Sensor response
	Example 2 Disable the filter. Verify that the command has been accepted.	
	Message	Comment
	$01,FLD//<cr><lf>*	Disable filtering
	$01,FL?//<cr><lf>*	Query filter setting
	*$WI,FL=D*41<cr><lf>*	Sensor response
Description	Use the FL command to enable or disable moving average filtering of the wind speed and wind direction readings (see Section 2.3). Note: The AT command has a separate averaging filter used for the Acoustic Temperature data.	

6.4.12 FL.2: Set or Query Filter Lengths

Command Parameter	FL (lengths)

Command Syntax	SET Sensor:	*$<listenerID>,FLL<speedLen>,<dirLen>*<checksum><cr><lf>* *$aa,FLLxxxx,xxxx*hh<cr><lf>*
	QUERY Sensor:	*$<listenerID>,FL?L*<checksum><cr><lf>* *$aa,FL?L*hh<cr><lf>*
	Sensor output:	*$<talkerID>,FL=<speedLen>,<dirLen>*<checksum><cr><lf>* *$aa,FL=xxxx,xxxx*hh<cr><lf>*

Parameters	<speedLen> *0001 to 0064*	Sample size of the wind speed filter. Number of previous readings# used to calculate the latest wind speed reading, 0001 is equivalent to disabling the filter (Factory Default Setting = 0016)
	<dirLen> *0001 to 0064*	Sample size of the wind direction filter. Number of previous readings# used to calculate the latest wind direction reading, 0001 is equivalent to disabling the filter; (Factory Default Setting = 0016)

Examples	<u>Example 3</u> Modify the filter's dimensions. Verify that the command has been accepted.	
	<u>Message</u>	<u>Comment</u>
	$01,FLL0001,0032//<cr><lf>*	Set speed filter length to 1 and direction filter length to 32.
	$01,FL?L//<cr><lf>*	Query filter's length settings.
	*$WI,FL=0001,0032*29<cr><lf>*	Sensor response.

Description	Use this command to modify the speed and direction filter lengths. When the filter is enabled, speed and direction readings are independently averaged by calculating the mean of the previous number of readings# set by the filter lengths <speedLen> and <dirLen>. # Please note the previous readings filter length by definition includes the most up to date wind reading at position 1. So setting a filter to a length of 0001 gives just the current reading (see Section 2.3). The sensor's internal memory is large enough to retain 64 previous speed and direction readings, allowing for maximum filter length of 6.4 seconds.

6.4.13 FL.3: Set or Query the Selective Filter

Command Parameter	FL (selective filter)

Command Syntax	SET Sensor:	*$<listenerID>,FLS<FilterStatus><period>*<checksum><cr><lf>* *$aa,FLScxxx*hh<cr><lf>*
	QUERY Sensor:	*$<listenerID>,FL?S*<checksum><cr><lf>* *$aa,FL?S*hh<cr><lf>*
	Sensor output:	*$<talkerID>,FL=<FilterStatus>,<period>*<checksum><cr><lf>* *$aa,FL=c,xxx*hh<cr><lf>*

Parameters	<FilterStatus>	
	E	Enabled
	D	Disabled
	<Period>	
	000 to 255	Length of validity period (in increments of 0.1 seconds): 000 A single error will trigger the error flag 001 2 consecutive errors will trigger the error flag (0.2 seconds)

Examples	Example 1 Query the Selective Filter Status.	
	Message	Comment
	$01,FL?S//<cr><lf>*	Query the Selective Filter status.
	*$WI,FL=E,005*hh<cr><lf>*	Sensor reports it is enabled with a 5 reading (0.5 second) filter.
	Example 2 Enable or Disable the Selective Filter Status.	
	$01,FLSE010//<cr><lf>*	Enable the Selective Filter for up to 10 readings (1 second).
	$01,FLSD//<cr><lf>*	Disable the Selective Filter.

Description	In addition to the averaging filter described in Section 2.5, the sensor has a feature called the Selective Filter. The scheme allows the user to set a "validity period", during which the sensor will exclude invalid readings from entering the averaging filter. The output will freeze on the last previous "good" reading and only raise an error flag once the number of bad readings exceeds the validity period. This scheme can be enabled by factory configuration. The filter is turned off by default to match legacy behaviour. Depending on the control system used, this may improve data quality.

6.4.14 HT.1: Set or Query General Heater Settings

Command Parameter	HT (enable/ disable)

Command Syntax	SET Sensor:	*$<listenerID>,HT<tsp>*<checksum><cr><lf>* *$aa,HTxx*hh<cr><lf>*
	QUERY Sensor:	*$<listenerID>,HT?*<checksum><cr><lf>* *$aa,HT?*hh<cr><lf>*
	Sensor output:	*$<talkerID>,HT=<tsp>,<%>,<temp>*<checksum><cr><lf>* *$aa,HT=xx,xx,±xx*hh<cr><lf>*

Parameters	<tsp>	
	00-55	Heater control circuit set point temperature (degrees Celsius)
	99	Disables the heater (factory default setting)
	<%>	
	00-99	Read only parameter that returns the % of full scale heater current limit 0% (heater off) to 99% (heater fully on)
	<temp>	
	-99 to +99	Read only parameter that returns the current internal temperature of the sensor, In ºC, in range 00 to ±99ºC

Examples	Example 1 Set the sensor set point temperature to 5°C. Verify that the command has been accepted.	
	Message	Comment
	$01,HT05//<cr><lf>*	Set heater set point temp
	$01,HT?//<cr><lf>*	Query heater setting
	*$WI,HT=05,00,+24*3B<cr><lf>*	Sensor response
	Example 2 Turn off the sensor heater. Verify that the command has been accepted.	
	Message	Comment
	$01,HT99//<cr><lf>*	Disable heater
	$01,HT?//<cr><lf>*	Query heater setting
	*$WI,HT=99,00,+24*3E<cr><lf>*	Sensor response

Description	Use the HT command to set the sensor heater parameters, including switching the heater on or off and configuring the heater set point. It is possible to query the sensor's internal temperature. It is also possible to query the duty cycle of the heater, which specifies the percentage of the current being drawn by the heaters. By default the heater requires a minimum voltage of 11VDC, see Section 6.4.16 for further details.

6.4.15 HT.2: Set or Query Delay Heater Settings

Command Parameter	HT (delay)

Command Syntax	SET Sensor:	*$<listenerID>,HTD<delay>*<checksum><cr><lf>* *$aa,HTDxxx*hh<cr><lf>*
	QUERY Sensor:	*$<listenerID>,HT?D*<checksum><cr><lf>* *$aa,HT?D*hh<cr><lf>*
	Sensor output:	*$<talkerID>,HT=<delay>*<checksum><cr><lf>* *$aa,HT=xxx*hh<cr><lf>*

Parameters	<delay> *004 to 999*	Heater Delay in seconds. This is the period after sensor power on before the heater will be enabled. (Factory Default is 004 = 4 seconds)

Examples	Example 3 Set the sensor heater delay to 010. Verify that the command has been accepted.	
	Message	Comment
	$01,HTD010//<cr><lf>*	Set heater delay to 010
	$01,HT?D//<cr><lf>*	Query heater delay setting
	*$WI,HT=010*22<cr><lf>*	Sensor response

Description	Use the HT command to set the sensor heater parameters, including setting a delay time which specifies how many seconds will elapse after powering on the sensor before the heater is enabled.

6.4.16 HT.3: Set or Query the Heater Current Limit Settings

Command Parameter	HT (current and under-voltage limit)

Command Syntax		
	SET Sensor:	$<listenerID>,HTL<CurrentLimit>,<UVoltLimit>*<checksum><cr><lf> $aa,HTLxx,xx*hh<cr><lf>
	QUERY Sensor:	$<listenerID>,HT?L*<checksum><cr><lf> $aa,HT?L*hh<cr><lf>
	Sensor output:	$<talkerID>,HT=<CurrentLimit>,<UVoltLimit>*<checksum> <cr><lf> $aa,HT=x.x,xx*hh<cr><lf>

Parameters		
	<CurrentLimit> *01 to 60*	Heater Current Limit in steps of 100mA. Valid values of the current limit are in the range 01 to 60. That is, 100mA to 6.0A. (Factory default is 40 = 4.0A)
	<UVoltLimit> *11 to 17*	Heater Under Voltage Limit in Volts. If the supply voltage falls below the under voltage limit, the heater will be turned off, until the supply returns above the limit. (Factory default 11 = 11VDC.)

Examples		
	Example 4 Set the sensor heater current limit to 3.3A and set the under voltage limit to 12VDC. Verify that the command has been accepted.	
	Message	Comment
	$01,HTL33,12//<cr><lf>*	Set current and voltage Limit
	$01,HT?L//<cr><lf>*	Query heater settings
	*$WI,HT=3.3,12*12<cr><lf>*	Sensor response

Description	The HT command may be used to set the sensor heater parameters such as the maximum current and under voltage limit of the heaters.

6.4.17 ID: Set or Query the Listener & Talker Identifiers

Command Parameter	ID

Command Syntax	SET Sensor:	*$<listenerID>,ID<RxID><TxID>*<checksum><cr><lf>* *$aa,ID=cccc*hh<cr><lf>*
	QUERY Sensor:	*$<listenerID>,ID?*<checksum><cr><lf>* *$aa,ID?*hh<cr><lf>*
	Sensor output:	*$<talkerID>,ID=<RxID><TxID>*<checksum><cr><lf>* *$aa,ID=cccc*hh<cr><lf>*

Parameters	<RxID> *00 to ZZ*	The sensor 2 digit listener address identifier (Factory Default RxID = 01)
	<TxID> *00 to ZZ*	The sensor 2 digit talker address identifier (Factory Default TxID = WI)

Examples	Example 1 Set the sensor listener address identifier to A1 and the talker address identifier to B1. Verify that the command has been accepted.	
	Message	Comment
	$01,IDA1B1//<cr><lf>*	Set address ID's
	$A1,ID?//<cr><lf>*	Query ID settings
	*$B1,ID=A1B1*6C<cr><lf>*	Sensor response
	Note: the ID? command must use the new listener ID otherwise the command will not be recognised.	

Description	Use the ID command to set the listener and talker address identifiers. See Section 5.4.4 for information on listener and talker address identifiers. From software V7.5.1 the ID command can also be used to modify the Talker ID for the NMEA 0183 data format (see Section 6.4.30). Please note that the NMEA 0183 data standard format does not officially support alternative talker IDs and may result in failure to communicate or interpret data.

6.4.18 MM: Reset or Query the Min/Max Recorded Wind Speed

Command Parameter	MM	
Command Syntax	SET Sensor:	*$<listenerID>,MM<setting>*<checksum><cr><lf>* *$aa,MMc*hh<cr><lf>*
	QUERY Sensor:	*$<listenerID>,MM?*<checksum><cr><lf>* *$aa,MM?*hh<cr><lf>*
	Sensor output:	*$<talkerID>,MM=<MinSpeed>,<MaxSpeed>*<checksum><cr><lf>* *$aa,MM=xxx.x,xxx.x*hh<cr><lf>*

Parameters	<setting> *R*	Resets the min/max readings to their default (<MinSpeed> to 999.9 and <MaxSpeed> to 000.0) until the first reading
	<MinSpeed> *000.0 to 999.9*	Minimum detected wind speed in current unit (m/s, knots or km/h)
	<MaxSpeed> *000.0 to 999.9*	Maximum detected wind speed in current unit (m/s, knots or km/h)

Examples	Example 1 Query the min/max wind speed readings Message *$01,MM?*//<cr><lf>* *$WI,MM=005.1,034.2*22<cr><lf>*	 Comment Query the min/max readings Sensor response

Description	Use the MM command to query the minimum and maximum wind speed readings that the sensor has recorded since it was last switched on. The minimum and maximum readings are set to their default values when an MMR, an RS or a DF set command is executed.

6.4.19 OS: Set or Query the Overspeed Warning Scheme

Command Parameter	OS	
Command Syntax	SET Sensor:	*$<listenderID>,OS<mode>*<checksum><cr><lf>* *$aa,OSm*hh<cr><lf>*
	QUERY Sensor:	*$<listenerID>,OS?*<checksum><cr><lf>* *$aa,OS?*hh<cr><lf>*
	Sensor output:	*$<talkerID>,OS=<mode>*<checksum><cr><lf>* *$aa,OS=m*hh*

Parameters	<Mode>	
	D	Overspeed Warning Disabled
	E	Overspeed Warning Enabled

Examples	Example 1	
	Enable the Overspeed Warning scheme. Verify that the command has been accepted.	
	Message	Comment
	$01,OSE//<cr><lf>*	Enable the scheme
	$01,OS?//<cr><lf>*	Query Overspeed Warning scheme
	*$WI,OS=E*56<cr><lf>*	Sensor response
	Example 2	
	Disable the Overspeed Warning scheme. Verify that the command has been accepted.	
	Message	Comment
	$01,OSD//<cr><lf>*	Disable the scheme
	$01,OS?//<cr><lf>*	Query Overspeed Warning scheme
	*$WI,OS=D*57<cr><lf>*	Sensor response
Description	Use this command to query, enable or disable the Overspeed Warning Scheme (See Section 2.7).	

6.4.20 RS: Reset the Sensor

Command Parameter	RS	

Command Syntax	SET Sensor:	*$<listenerID>,RS<mode>*<checksum><cr><lf>* *$aa,RSc*hh<cr><lf>*
	QUERY Sensor:	*NA*
	Sensor output:	*None*

Parameters	<mode>	
	S	Reset the sensor, loading saved parameters settings
	U	Reset the sensor, reloading the user parameter settings

Examples	Example 1 Reset the sensor, reloading the last parameter settings	
	Message	Comment
	$01,RSU//<cr><lf>*	Reset sensor, reloading last settings

Description	Use the RS command to reset the sensor software. The sensor will be ready to receive new commands or take readings from a maximum of 2 seconds after any reset command is sent. To restart the software, using the existing user settings: use the RSU command. To restart the software, loading the saved (MCON) settings: use the RSS command. See the US command (Section 6.4.28) for details on querying or changing the Saved Parameters.

6.4.21 SN: Query the Serial Number and Platform Version

Command Parameter	SN

Command Syntax	SET Sensor:	NA
	QUERY Sensor:	*$<listenerID>,SN?*<checksum><cr><lf>* *$aa,SN?*hh<cr><lf>*
	Sensor Output:	*$<talkerID>,SN=<SerialNumber>,<PlatformVersion>*<checksum><cr><lf>* *$aa,SN=xxxxx-xxx,xxsss*hh<cr><lf>*

Parameters	<SerialNumber> *00000-000 to 99999-999*	Unique serial number of the sensor
	<PlatformVersion> *00-99*	Platform version (issue) of the sensor design. The 3 spaces after the 2 digit number are reserved for future use.

Examples	Example 1 Read the sensor serial number and platform version	
	Message	Comment
	$01,SN?//<cr><lf>*	Query serial number
	*$WI,SN=09000-130,24 *3E<cr><lf>*	Sensor response

Description	The SN command returns the serial number of the sensor and the platform version of the sensor. The serial number format starts with a 5-digit batch code, followed by a 3 digit number which identifies a sensor within a particular batch. The overall number is the unique serial number identifier for the sensor.

6.4.22 SV: Query the Software Version

Command Parameter	SV

Command Syntax	SET Sensor:	*NA*
	QUERY Sensor:	*$<listenerID>,SV?*<checksum><cr><lf>* *$aa,SV?*hh<cr><lf>*
	Sensor Output:	*$<talkerID>,SV=<SoftwareVersion>*<checksum><cr><lf>* *$aa,SV=sssx.xss*hh<cr><lf>* *or* *$<talkerID>,SV=<SoftwareVersion>*<checksum><cr><lf>* *$aa,SV=sssx.x.x*hh<cr><lf>*

Parameters	<SoftwareVersion> *0.0 to 9.9* *or* *1.0.0 to 9.9.9*	Sensor software version

Examples	<u>Example 1</u> Read the software version number <u>Message</u> *$01,SV?*//<cr><lf>* *$WI,SV= 7.5 *16<cr><lf>* *$WI,SV= 7.5.1*19<cr><lf>*	<u>Comment</u> Query software version Sensor response V7.5 format Sensor response V7.5.1 format

Description	The SV command returns the software version of the sensor. There are three blank spaces between $WI,SV= and the beginning of the software version. For software versions using the format 7.5 two blank spaces will follow. FT may release incremental software versions with the numbering format 7.5.1, in this case there will be no blank spaces following the software version.

6.4.23 UC.1: General User Calibration Settings

Command Parameter	UC (enable/ disable)

Command Syntax	SET Sensor:	*$<listenerID>,UC<table>*<checksum><cr><lf>* *$aa,UCx*hh<cr><lf>*
	QUERY Sensor:	*$<listenerID>,UC?*<checksum><cr><lf>* $aa,UC?*hh<cr><lf>
	Sensor output:	*$<talkerID>,UC=<entries>,<table>,<UCRAMChecksum>, <UCFlashChecksum>*<checksum><cr><lf>* *$aa,UC=nn,x,yyyy,zzzz*hh<cr><lf>*

Parameters	*<table>*	
	E	User Calibration Table enabled
	D	User Calibration Table disabled (Factory Default Setting)
	<entries>	
	nn	Number of calibrated table entries
	<UCRAMChecksum>	
	yyyy	User calibration table RAM copy checksum
	<UCFlashChecksum>	
	zzzz	Saved user calibration table Flash copy checksum

Examples	<u>Example 1</u> Enable the user calibration table and verify new setting	
	<u>Message</u>	<u>Comment</u>
	*$01,UCE*7E<cr><lf>*	Enable calibration table
	*$01,UC?*04<cr><lf>*	Query user calibration table status
	*$WI,UC=55,E,5174,5174*70<cr><lf>*	Typical sensor response

Description	Use the UC command to enable or disable the implementation of the user calibration table for calibrating wind speed readings. The four-digit user calibration table checksum is calculated by summing all table entries over the number of table rows present. The least significant 4 digits of the resulting sum are retained as the table checksum. The user-defined text string is not included in the checksum. Each xx.xx speed value is treated as an integer by ignoring the decimal point. For example, the table row: 15.00, 14.97 is summed as 1500 + 1497 = 2997. A table sum of 55174 results in the checksum 5174. If the user calibration table has not been loaded, the number of calibrated table entries (nn) will be 00 and the saved user calibration table Flash copy checksum (zzzz) will be 5535. Acu-Vis 2.0 provides an easy UI to modify the user calibration table (see Section 4.4).

When the User Calibration facility is enabled, the uncorrected wind speed indication of the sensor is calibrated according to the stored calibration records, using linear interpolation.

6.4.24 UC.2: Clear User Calibration Table Record

Command Parameter	UC (Erase table)	
Command Syntax	SET Sensor:	*$<listenerID>,UC<erase>*<checksum><cr><lf>* *$aa,UCCLEAR*hh<cr><lf>*
Parameters	<erase> *CLEAR*	 Erases both Flash and RAM copies of user calibration table
Examples	Example 1 Erase the user calibration tables and verify Message *$01,UCCLEAR*62<cr><lf>* *$01,UC?*04<cr><lf>* *$WI,UC=00,D,0000,0000*71<cr><lf>*	 Comment Erase calibration tables Query user calibration table status Sensor response
Description	Use the UCCLEAR command to erase the RAM and saved FLASH copies of the user calibration table. A UCCLEAR is performed before a new user calibration table is loaded (see Section 6.4.25). The user calibration table label is also cleared to 32 ASCII spaces when the UCCLEAR command is sent (see Section 6.4.27).	

6.4.25 UC.3: Set User Calibration Table Record

Command Parameter	UC (set & verify record)

Command Syntax		
	SET Sensor Calibration Record:	*$<listenerID>,UCW<Cspeed>,<Uspeed>*<checksum><cr><lf>* *$aa,UCWxx.xx,yy.yy*hh<cr><lf>*
	Verify Last Record:	*$<listenerID>,UC?W*<checksum><cr><lf>* $aa,UC?W*hh<cr><lf>
	Sensor output:	*$<talkerID>,UC=<error code>*<checksum><cr><lf>* *$aa,UC=n*hh<cr><lf>*

Parameters		
	<Cspeed> *xx.xx*	Corrected speed
	<Uspeed> *yy.yy*	Uncorrected speed
	<error code>	
	0	Table entry accepted
	1	Error: Sensor speed out of order (latest row speed <previous row speed)
	2	Error: Sensor speed increment less than 0.5ms than previous record
	3	Error: Data entry not allowed (table has not been cleared first)
	4	Error: Bad argument (data format not valid)
	5	Error: User calibration table is full (all 64 rows have been entered)

Examples		
	<u>Example 1</u> Enter user calibration table record and verify	
	<u>Message</u>	<u>Comment</u>
	*$01,UCW00.90,01.11*48<cr><lf>*	Set a wind speed correction
	*$01,UC?W*53<cr><lf>*	Query if table entry was accepted
	*$WI,UC=0*29<cr><lf>*	Sensor response

Description	
	Use the UCW command to set and verify individual user calibration table records. New records can only be entered if the Calibration table is cleared first (see Section 6.4.24) Up to 64 records can be entered sequentially into the sensor's RAM and verified. Once sufficient records have been loaded, these can be saved to the Flash using the user calibration save command (see Section 6.4.26).

6.4.26 UC.4: Save and Read User Calibration Table

Command Parameter	UC (save and read)

Command Syntax		
	Save Sensor Calibration Record:	*$<listenerID>,UCS*<checksum><cr><lf>* *$aa,UCS*hh<cr><lf>*
	QUERY Saved Sensor Calibration Record:	*$<listenerID>,UC?R<row>*<checksum><cr><lf>* $aa,UC?Rnn*hh<cr><lf>
	Sensor output:	*$<talkerID>,UC=<row>,<Cspeed>,<Uspeed>*<checksum><cr><lf>* *$aa,UC=nn,xx.xx,yy.yy*<cr><lf>*

Parameters		
	<row> *01 – 64*	Calibration table row number
	<Cspeed> *xx.xx*	Corrected speed
	<Uspeed> *yy.yy*	Uncorrected speed

Examples		
	Example 1 Save a new user calibration table from RAM into Flash memory and verify	
	Message	Comment
	*$01,UCS*68<cr><lf>*	Save calibration table
	*$01,UC?*04<cr><lf>*	Query user calibration table status
	*$WI,UC=55,E,5174,5174*70<cr><lf>*	Typical sensor response
	Example 2 Read calibration data stored in row 5 of the Flash calibration table	
	Message	Comment
	*$01,UC?R05*53<cr><lf>*	Query Flash user calibration record
	*$WI,UC=05,06.00,06.03*1F<cr><lf>*	Typical sensor response

Description	
	Use the UCS command to save a new user calibration table into Flash memory. A user calibration query (see Section 6.4.23) command can then be used to verify that the checksum of the RAM and Flash copies are equal. This demonstrates that the table has been saved without error. Use the UC?R command to verify the data stored in an individual Flash calibration record.

Once the table has been saved into Flash memory, new data and the text string can only be written to it by first clearing the table.

6.4.27 UC.5: Set & Query User Calibration Table Label

Command Parameter	UC (label)	
Command Syntax	SET Sensor label:	*$<listenerID>,UCT<text string>*<checksum><cr><lf>* *$aa,UCTxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx*hh<cr><lf>*
	QUERY Sensor label:	*$<listenerID>,UC?T*<checksum><cr><lf>* $aa,UC?T*hh<cr><lf>
	Sensor output:	*$<talkerID>,UC=<label32>*<checksum><cr><lf>* *$aa,UC=xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx*hh<cr><lf>*

Parameters	*<text string>* *xxxxxxxxxxxxxxxxxx xxxxxxxxxxxxxx*	Up to 32 upper or lower case alphanumeric ASCII characters (can also include ASCII space, underscore and hyphen characters). Factory default is 32 ASCII spaces.
	<label32> *xxxxxxxxxxxxxxxxxx xxxxxxxxxxxxxx*	32 ASCII characters, Note: ASCII spaces will be added to entered ASCII string if it is less than 32 characters to form a string of 32 characters.

Examples	Example 1 Set the User Calibration label to “speed offset V03” and verify	
	Message	Comment
	*$01,UCTspeed offset V03*50<cr><lf>*	Set Calibration table label
	*$01,UC?T*0C<cr><lf>*	Query Calibration table label
	*$WI,UC=speed offset V03 *26<cr><lf>*	Sensor response

Description	Use the UCT command to set a User calibration table label. The label can be up to 32 ASCII characters long and include ASCII space, underscore and hyphen characters. The user calibration table label can be cleared by using the UCCLEAR command. (see Section 6.4.24) This resets the label to 32 ASCII spaces. UC?T query command will only return a response after the user calibration table has been initialised.

6.4.28 US: Set or Query Saved Parameters

Command Parameter	US

Command Syntax	SET Sensor:	*$<listenerID>,US<setting>*<checksum><cr><lf>* *$aa,USS*hh<cr><lf>*
	QUERY Sensor:	*$<listenerID>,US?*<checksum><cr><lf>* *$aa,US?*hh<cr><lf>*
	Sensor output:	*$<talkerID>,US=<match>*<checksum><cr><lf>* *$aa,US=c*hh<cr><lf>*

Parameters	<setting>	
	S	Copies the User Parameters and saves them as the Saved Parameters.
	<match>	
	P	indicates the User Parameters are the same as the Saved Parameters
	F	indicates the User Parameters are not the same as the Saved Parameters

Examples	Example 1 Set and Verify new user saved parameters	
	Message	Comment
	$01,USS//<cr><lf>*	Set saved parameters
	$01,US?//<cr><lf>*	Query the saved parameters
	*$WI,US=F*4F<cr><lf>*	Sensor response

Description

There are three copies of Parameters stored in Flash memory namely, User Parameters, Factory Parameters, Saved Parameters respectively. All three copies are initially loaded with the same default settings.

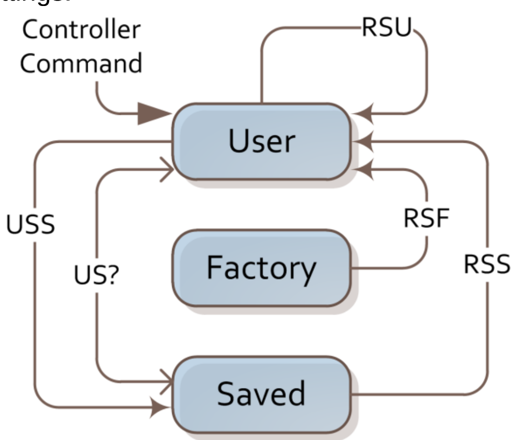


Figure 35: Relationship between the 3 flash copies of Parameter Settings

The User Parameters is the copy that the sensor operates from, at all times. When sending a command to the sensor, it is the User Parameter copy which is updated. The user parameters copy is non volatile so the sensor will keep the last settings when it is powered up again.

The Factory Parameters retain the original default settings and cannot be modified.

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Description continued	The Saved Parameters are created by means of the USS command. This command copies the User Parameters and saves them into a separate area in Flash reserved for the Saved Parameters. The query US command compares item by item the Saved Parameters against the User Parameters and reports any discrepancy; this command could be used after USS to confirm that all of User Parameters have been copied correctly in Saved Parameters. A reset command can be used to load the Saved Parameters back to the User Parameters. See command RSS (Section 6.4.20) for the details of the RSS command. After RSS commands are executed the restored parameters are loaded into RAM, so it is imperative to execute any one of the Set Commands described in Section 6.1.1; executing any one of these commands instructs the sensor to make a non-volatile copy of the newly created User Parameters.

The Command USS should never be done outside of a laboratory or controlled environment. This then ensures that the Saved Parameters copy is not corrupted. Then in the field when changing a User parameter, if a lightning strike occurs exactly at the same time as an attempted change and the User version becomes corrupt there is always a 'clean' back up Saved copy of the parameters that can be used to recover the sensor.

6.4.29 WV Polar: Query the Wind Velocity Reading

Command Parameter	WV (Polar)

Command Syntax		
	SET Sensor:	N/A
	QUERY Sensor:	*$<listenerID>,WV?*<checksum><cr><lf>* *$aa,WV?*hh<cr><lf>*
	Sensor output:	*$<talkerID>,WVP=<speed>,<angle>,<status>*<checksum><cr><lf>* *$aa,WVP=xxx.x,xxx,x*hh<cr><lf>* For DFC Mode (see Section 6.4.7): *$<talkerID>,WVP=<speed>,<angle>,<status>,<temperature>,<temp.units>,<temp.status>*<checksum><cr><lf>* *$aa,WVP=www.w,xxx,y,zzzz.z,a,b*hh<cr><lf>*

Parameters		
	<speed> *000.0 to 075.0*	Measured wind speed in metres per second
	<angle> *000 to 359*	Measured wind direction in degrees relative to sensor datum
	< status > *0 to Z*	Indicates whether an error condition was detected by the sensor operating system. A status value of 0 indicates no issues have been detected (ASCII 30(HEX)). If the sensor detects an error condition, the status character will be set to 1. If the Overspeed Warning Scheme (see Section 2.7) is enabled and if the sensor detects wind speed above the maximum range, the status flag will be set to 2.

Examples		
	Example 1 The following example illustrates the polar wind velocity data format. The example shows the sensor output with a wind speed of 20m/s and a wind angle of 45°.	
	Message	Comment
	$01,WV?//<cr><lf>*	Query the wind velocity
	*$WI,WVP=020.0,045,0*73<cr><lf>*	Sensor polar response
	Example 2 The following examples illustrates the DFC (Combined) wind velocity data format. The example shows the sensor output with a wind speed of 0m/s, a wind angle of 323° and acoustic temperature of +26.3°C.	
	Message	Comment
	*$01,WV?*13<cr><lf>*	Query the wind velocity
	*$WI,WVC=000.0,323,0,+026.3,C,A*4D*	Sensor Response (DFC)

Description	The WV command returns the wind velocity value in the currently selected format. Polar or NMEA formats are available. Use the DF command, Section 6.4.7, to select the required output format. Polar Format: The sensor returns the magnitude of the wind speed (m/s) and the wind direction (0-359°). NMEA 0183 Format: The sensor returns the NMEA 0183 Wind Speed and Angle sentence MWV (see WV NMEA, Section 6.4.30).

It is important that the status is always monitored. Readings associated with errors should not be treated as valid. It is important that the host computer is able to cope with occasional periods when valid data may be temporarily unavailable.

The status is cleared once the WV command is executed, provided that the error condition does not persist.

6.4.30 WV NMEA: Query the Wind Velocity Reading

Command Parameter	WV (NMEA 0183)

Command Syntax	SET Sensor:	N/A
	QUERY Sensor:	*$<listenerID>,WV?*<checksum><cr><lf>* *$aa,WV?*hh<cr><lf>*
	Sensor output:	*$WIMWV,<angle>,R,<speed>,<units>,<status>*<checksum><cr><lf>* *$WIMWV,xxx,R,xxx.x,c,A*hh<cr><lf>*

Parameters	<angle> *000 to 359*	Measured wind direction in degrees relative to sensor datum
	<speed> *000.0 to 075.0* *000.0 to 145.8* *000.0 to 270.0*	Measured wind speed (in metres per second). Measured wind speed (in knots). Measured wind speed (in km per hour).
	<units> *M* *N* *K*	Indicates the wind speed is presented in metres/second Indicates the wind speed is presented in knots Indicates the wind speed is presented in kilometres/hour
	< status > *0 to Z*	Indicates whether an error condition was detected by the operating system, such as out of range wind speed or incorrect signal level. Any character other than 'A' (ASCII 41(HEX)) = error.

Examples

Example 1

The following example illustrates the NMEA wind velocity data format. The example shows the sensor output in m/s with a wind speed of 20m/s and a wind angle of 45°.

Message	Comment
$01,WV?//<cr><lf>*	Query the wind velocity
*$WIMWV,045,R,020.0,M,A*3D<cr><lf>*	Sensor NMEA response

Example 2

The following example illustrates the NMEA wind velocity data format. The example shows the sensor output in knots with a wind speed of 30.6 knots and a wind angle of 9°.

Message	Comment
$01,WV?//<cr><lf>*	Query the wind velocity
*$WIMWV,009,R,030.6,N,A*31<cr><lf>*	Sensor NMEA response

Description

The WV command returns the wind velocity value in the currently selected format and units. Polar or NMEA formats are available. Use the DF command, Section 6.4.7, to select the required output format and units.

Polar Format: The sensor returns the magnitude of the wind speed (m/s) and the wind direction (0-359°) (see WV Polar, Section 6.4.29).

NMEA 0183 Format: The sensor returns the NMEA 0183 Wind Speed and Angle sentence MWV. The sensor returns the wind direction (0-359°) and wind speed (m/s, knots or km/h) using the MWV Wind Speed and Angle sentence. The sensor Talker ID is always set to WI when NMEA format is selected, irrespective of any setting that may have been set with the ID command.

Be aware that while supporting the NMEA 0183 messaging data structure, this FT sensor does not necessarily meet the electrical and network requirements of the NMEA 0183 (EIA-422) standard.

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