FT702LT Wind Sensor Manual

Digital Pipe Mount Variant

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A4205-4-EN
JULY 2017

Contents

Product Symbols

The following symbols are used upon the product and throughout the manual.

Meaning / Description	Symbol	Signification / Description
Warning/ Caution An appropriate safety instruction should be followed or caution to a potential hazard exists		**Avertissement / Attention** Une instruction de sécurité doit être suivie ou attention portée à un danger potentiel qui existe.
DC Current only Equipment operates under Direct Current (DC) supply only.		**Courant continu uniquement** L'équipement fonctionne sous une alimentation en courant continu (CC) uniquement.
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.		**Élimination du produit** Conformément à la directive européenne 2012/19/EU relative aux déchets d'équipements électriques et électroniques (DEEE), ces composants du produit doivent être recyclés. Cela doit être fait par le retour du produit à FT Technologies ou en utilisant une entreprise d'élimination de déchets. Ce produit ne doit pas être éliminé avec les ordures ménagères ou en décharge.
Recognized Component Sensors marked with the ETL label indicate that the product conforms to UL Standard 61010-1 and is certified to CSA Standard C22.2 No. 61010-1.		**Composant Reconnu** Les capteurs marqués avec l'étiquette ETL indiquent que le produit est conforme à la norme UL 61010-01 et est certifié à la norme CSA22.2 61010-01.
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.		**Marquage CE** Déclaration de conformité CE de la compatibilité électromagnétique (EMC) et marquage CE conformément à la directive CE 2014/30/EU.

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 the electrical safety requirements of the UL / CSA 61010-1 standards, the equipment must be:
    - Connected to an appropriately approved isolated power supply (for example UL/CSA IEC 60950-1:2005 + A1:2009 + A2:2013) rated 20-30VDC and be current limited (6A Max)
    - Protected by UL 1449 listed surge protective 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.

Consignes de sécurité – Français

- Pour assurer la sécurité de l'installation et le fonctionnement de ce produit, l'équipement doit être installé et intégré :
    - À l'aide de personnel qualifié et formé
    - Conformément à tous les codes électriques régionaux
    - Conformément aux instructions figurant dans ce manuel et en observant toutes les informations, avertissements et instructions
    - Conformément à d'autres instructions ou directives que FT Technologies fournit
- Pour garantir que le produit reste compatible avec les exigences de sécurité électrique de l'UL/CSA 61010-1 normes, l'équipement doit être :
    - Connecté à une alimentation agréée convenablement isolée (par exemple UL/CSA IEC 60950-1:2005 + A1:2009 + A2:2013) de tension nominale 20-30 VCC et avec courant limité (6 A max)
    - Protégé par des dispositifs de protection UL 1449 contre les surtensions
    - Connecté avec un câble d'interface (par exemple UL/CSA reconnu AWM style 21198, de valeur nominale 300 V, 80°C)
- L'équipement doit être utilisé uniquement dans la plage des données techniques spécifiées et utilisé aux fins pour lesquelles il a été conçu.
- L'équipement doit toujours être transporté dans un emballage qui est approprié, qui permettra d'éviter qu'un quelconque dommage accidentel ne survienne.
- En toutes circonstances, garantir que les défaillances ou les erreurs du produit ne puissent pas causer des dommages à d'autres équipements ou autres biens ou provoquer d'autres effets indirects.

1 INTRODUCTION

1.1 Product Overview

The FT702LT is a solid-state ultrasonic wind sensor which uses a patented Acoustic Resonance airflow sensing technique to measure accurately both wind speed and direction. The FT702LT has been specifically designed to operate in harsh environments such as offshore and lightning and ice-prone areas. The wind sensor has no moving parts to degrade or wear-out and is designed for applications requiring high reliability. The FT702LT helps reduce costly down-time and unscheduled maintenance visits.

Mounting and aligning the sensor is very straightforward. The sensor is designed to mount on top of a pipe using the FT Pipe Mount Adapter. The interconnecting cable runs from the sensor's base, through the pipe mount adaptor and pipe and then to the data acquisition system, protecting it from environmental effects.

For operation in ice-prone areas, the FT702LT is fitted with a highly effective thermostatically controlled 'all-body' heating system. A three element heater (one element located in the top of the sensor and two in the bottom) is used to ensure that the heating is evenly distributed over the entire surface area.

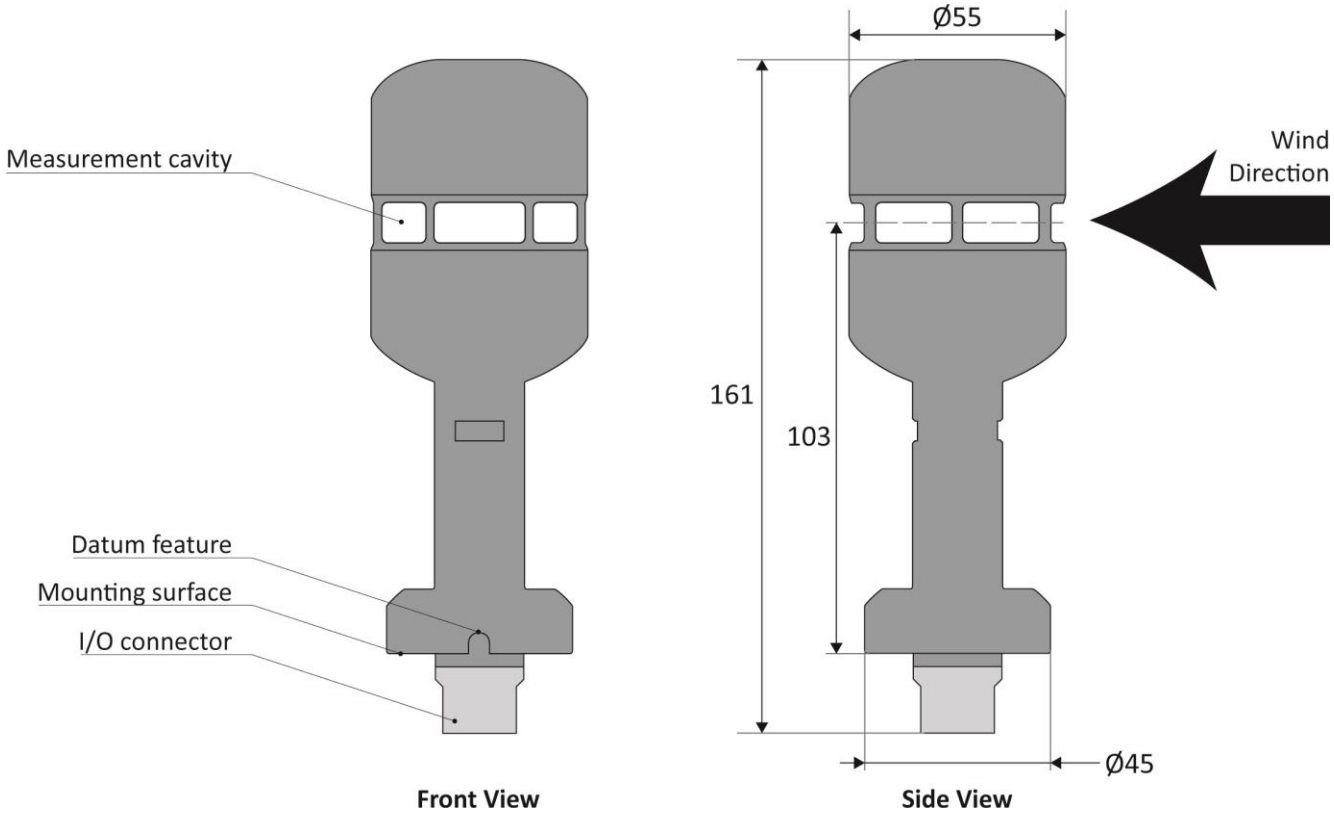


Figure 1: FT702LT Pipe Mount Sensor

1.2 Labelling

Figure 2 shows the main FT702LT wind sensors labels. These allow each sensor to be individual identified by its serial number and build version.

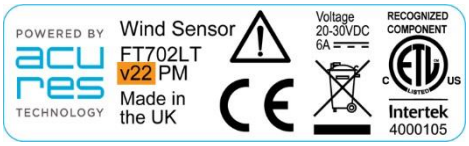
Serial Number Build version	Main Product Label Key*	
Build version 22 or above		
*Additional labels may also be attached		

Figure 2: Main Sensor Labels

1.3 Scope of Use

The FT702LT is designed, manufactured and optimised for high availability. The FT702LT wind sensor often attains 99.9% or better availability of wind speed and wind direction readings.

No promise in part or full can be given to guarantee an FT702LT wind 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

Typically higher levels of wind speed and wind direction data availability are achieved through the use of an additional FT sensor or an additional mechanical or ultrasonic sensor. Control strategies or controller algorithms, which compensate in whole or in part, for any temporary interruption of data from individual sensors, should also be applied. The choice and implementation of such methods is entirely the Purchaser's responsibility.

1.4 Disclaimer

There are no warranties, representations or conditions, expressed or implied of any kind given in this manual for any particular 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 direct 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.

2 FUNCTIONAL DESCRIPTION

2.1 Sensor Performance[1]

Measurement Principle Acoustic Resonance (compensated against variations in temperature, pressure and humidity)

Wind speed Measurement

Range	0-50m/s
Accuracy	±0.5m/s (0-15m/s), ±4% (>15m/s)
Resolution	0.1m/s

Wind Direction Measurement

Range	0 to 360°
Accuracy	±2° (within ±10° of 0° datum), ±4° (beyond $\pm 10^0$ of 0^0 datum)
Resolution	1°

Environment

Temperature Range	-40° to +85°C (operating and storage)
Humidity	0-100%

Data I/O

RS485 Option	
Interface	Digital RS485, galvanically isolated from power supply lines and case
Format	ASCII data, polled or continuous output modes
Data Update Rate	5 measurements per second

Power Requirements[3]

Supply Voltage	20V to 30V DC (24V DC nominal)
Supply Current (Heater off)	30mA
Supply Current (Heater on)	6A (max) – 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 heater and sensor power consumption is limited by default to 99W[2].

Physical

Weight	350g (max)
Material	Aluminium alloy, hard anodised
I/O Connector	5 way (RS485 option)
Mounting Method	Self aligning notch, pipe mount fixture
Pipe Sizes	40-51mm outer diameter

Notes:

1. All specifications subject to change without notice
2. The heater set point and current limit can be configured by programming the sensor's internal parameter settings
3. See safety instruction requirements (page 4)

2.2 Wind Speed Calibration

All FT702LT wind sensors are built and then calibrated in the same wind tunnel before dispatch. There is no need to recalibrate a sensor over its lifetime as the sensor has no moving parts and so no measurement degradation will occur. The sensor's compact strong monolithic shape is designed to prevent accidental transducer movement or damage. FT Technologies' calibration procedure and wind tunnel are designed to give a calibration profile that is within the accuracy limits set in the product technical specification (see section 2.1). Every 3 months the accuracy of FT's wind tunnel is compared with the accuracy of an independent wind tunnel to ensure that no drift has occurred.

However, in exceptional circumstances users may wish to apply additional calibration factors. The sensor has the option to set a User Calibration Table, which can modify the wind sensor's wind speed output (see section 6.4.19).

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 wind sensor should be fitted.

The FT702LT 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 6.4.8 and 6.4.9).

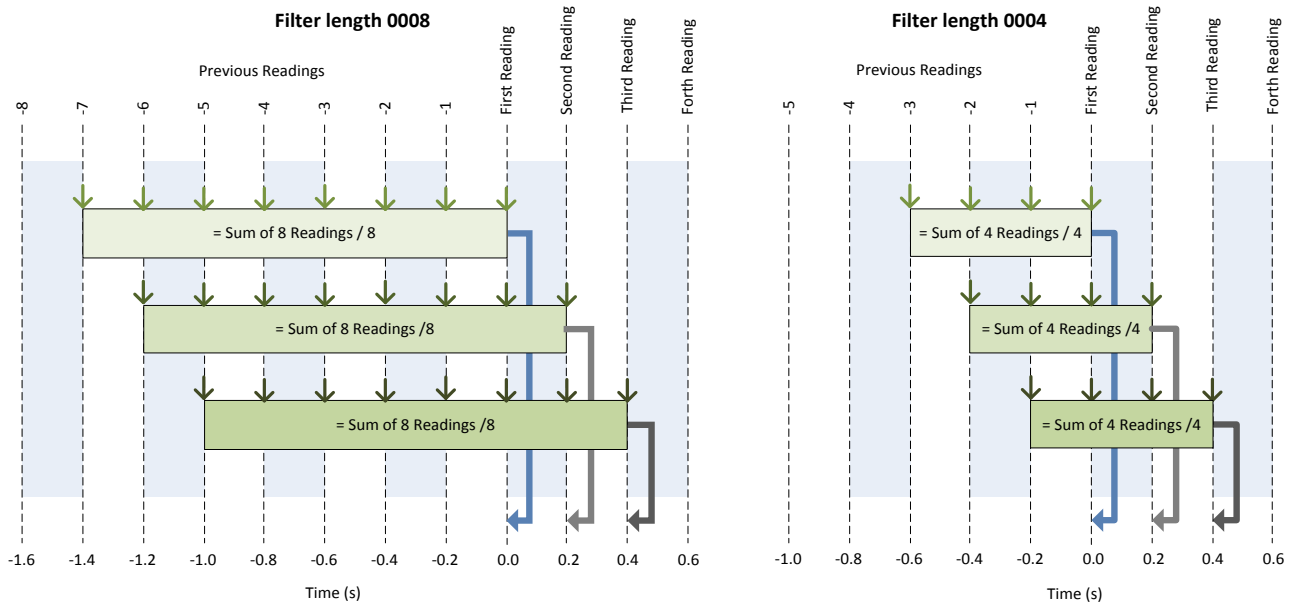


Figure 3: Examples of FIR Filtering

Always use an average of several readings for any calculations or control decisions because single readings can accidentally become corrupted.

2.4 Electronic Rotation of the Datum Direction

The datum direction of the FT702LT can be offset electronically by using the CF command (Section 6.4.2). 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. Once the offset has been set it will be retained in the FT702LT Flash memory.

2.5 Error Detection

The FT702LT 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 6.4.25 & 6.4.26). 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.

2.6 Heater Setup

The FT702LT 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 FT702LT using a user programmable 'set point' temperature. The FT702LT uses a control scheme which dynamically changes the current supplied to each individual heater to maintain the programmed set point temperature.

It is important to consider the resistive losses in the cable and rate the cable appropriately. In general, power losses in the cable should be minimised in order to maximise the available heating power to the sensor.

The recommended heater set point temperature for most applications is 30°C, however by default the heater is disabled. To enable the heater or change the heater set point temperature, use the FT702LT Acu-Vis software (see section 4.2).

Since the heater circuit is thermostatically controlled the actual power being drawn from the supply will depend on the programmed set point and the prevailing environmental conditions (i.e. ambient temperature, wind speed, precipitation etc). The maximum power that the FT702LT heater and sensor can consume is by default limited to 99W. 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 – 6 Amps. To change the current limit of the sensor, please refer to section 6.4.12.
The sensor can detect when the supply voltage drops below 9 VDC, when this occurs the heaters are automatically switched off.
In low temperature environments where a wind sensor may have accumulated ice prior to power being applied, it is recommended that a User Reset Command (see section 6.4.16) is sent after the sensor has been powered for a de-icing period of 30mins. This is to ensure that the sensor initialises correctly with the sensing area clear.

3 INSTALLATION

- See safety instruction requirements on page 4.
- 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.

3.1 Connectivity

3.1.1 Connector Details

All electrical connections are made to the FT702LT via a 5-way multipole connector located in the base of the wind sensor housing. The connector pin designations are shown in Figure 4 and the connector/mating connector manufacturer's part numbers in Figure 5.

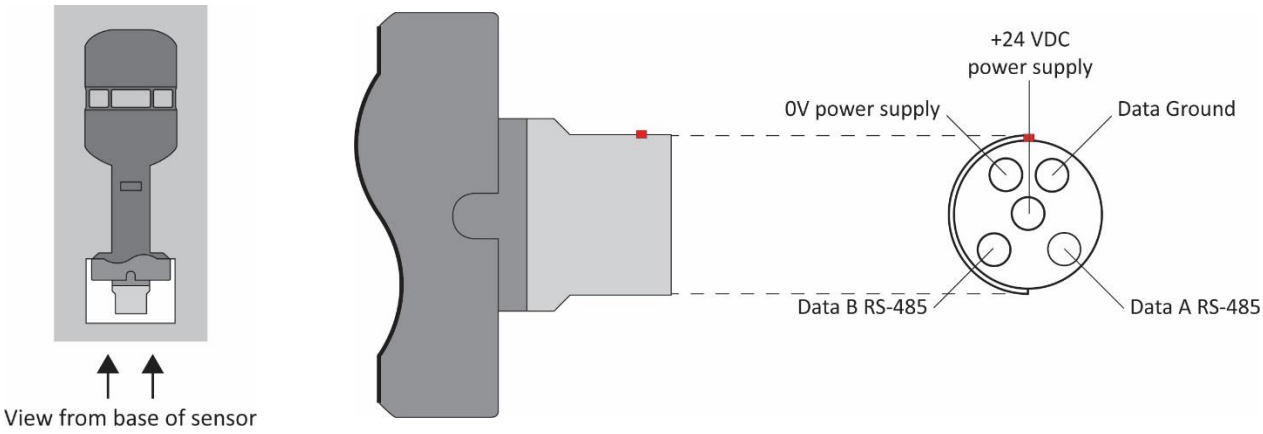


Figure 4: Sensor Connector Pins

Connector Type	Connector Description	Manufacturers Part Number	FT Sensor Type	Maximum Outer Cable Diameter	Manufacturer
FT702LT Cable Side Connector	5 way plug	SE104Z053-130/8.7	FT702LT RS-485 Option	8.0mm	W.W.Fischer
FT702LT Cable Side Connector	5 way plug	SX2F1C-P05NJH9-0001	FT702LT RS-485 Option	9.2mm	ODU

Figure 5: Connector Sourcing Options

3.1.2 Cable Details

The mating connectors for the FT702LT are suitable for use with cables with overall diameters of up to 9mm 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 will not provide sufficient protection. In this case the cable will require further shielding such as being enclosed in a metal pipe or conduit (see section 3.3).

3.1.3 RS-485 Protocol

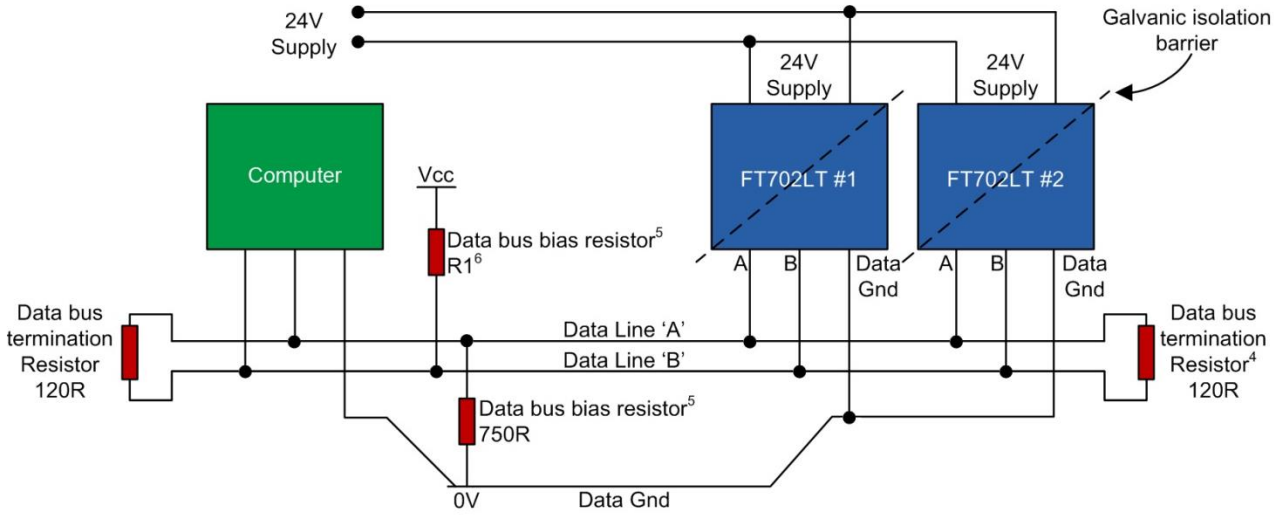
The FT702LT is fitted with an RS485 half-duplex serial interface. Slew-rate limited drivers are used to reduce EMI, and minimize reflections from improperly terminated transmission lines and stubs. The signal state definitions for the serial interface data lines are as follows:

- 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.

Figure 6 shows the recommended wiring diagram for connecting the FT702LT to the computer.
If 2 or more wind sensors are to be installed it is possible to use the same 2-wire data link to connect all the FT702LT units to the computer.

Before using an FT702LT in a multi-device system, the Listener identifier of each FT702LT must be set to a unique value. Use the ID command (Section 6.4.13) to set the Listener identifier for each FT702LT. If the Listener identifiers are being set in the final host system, then it is important that only one FT702LT 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 FT702LT 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 FT702LT units to transmit data resulting in bus contention.



Notes:
1. Data lines A & B should be twisted pair type. Cable should incorporate overall screening braid which should be connected to chassis at each circuit node.
2. All resistors should be anti-surge type, such as Tyco CCR resistors rated at 1W or similar.
3. Surge protection not shown.
4. Subject to testing, one or both termination resistors may be omitted, if computer makes use of slew-rate limited RS485 drivers.
5. Subject to testing, the bias resistors may be omitted, if computer makes use of fail-safe RS485 receivers.
6. For Vcc = 5V use 750R for R1, For Vcc = 24V use 6800R for R1.

Figure 6: RS-485 Connection Diagram for 2 Wind Sensors

3.2 Mounting the FT702LT

The pipe mount sensor is designed to fit onto the FT Pipe Mount Adaptor (FT089 or FT090). The adapter can be fitted on top of a wide variety of pipe sizes (OD 40-51mm). The system ensures that the base of the sensor and connector/cable are sealed inside the pipe and adaptor. This helps to protect against environmental degradation, as well as against indirect lightning strikes (See section 3.3).

The adapter can be secured tightly to the pipe using 4 M8 bolts. The sensor is secured to the adapter, using a spring clip and 3 more M8 bolts (all parts are supplied with the Pipe Mount System). The sensor is always

repeatedly aligned to the adapter as it is orientated on a datum feature. The adapter and spring clip are made from LM25/LM5 series aluminium-magnesium alloy and 5052/5454 grade 'A' aluminium respectively. The M8 bolts have a hot dip galvanised steel finish. All are designed to last more than 20 years in marine and industrial environments.

The vertical pipe should be made of low cost hot dip galvanised steel. A minimum galvanising thickness of 50µm should be used to ensure the pipe has adequate long term corrosion protection. The galvanising quality should conform to ASTM A123, Standard Specification for Zinc (Hot-Dip Galvanised) Coatings on Iron & Steel Products. Aluminium components of the appropriate grade could be used as an alternative.

The pipe should have a direct connection to ground and its top surface should be flat. A liberal amount of electrical joint compound should be applied to this surface before the adaptor is fitted so that a long term low impedance connection to ground is maintained. An example of this could be AFL Global's Electrical Joint Compound # 2.

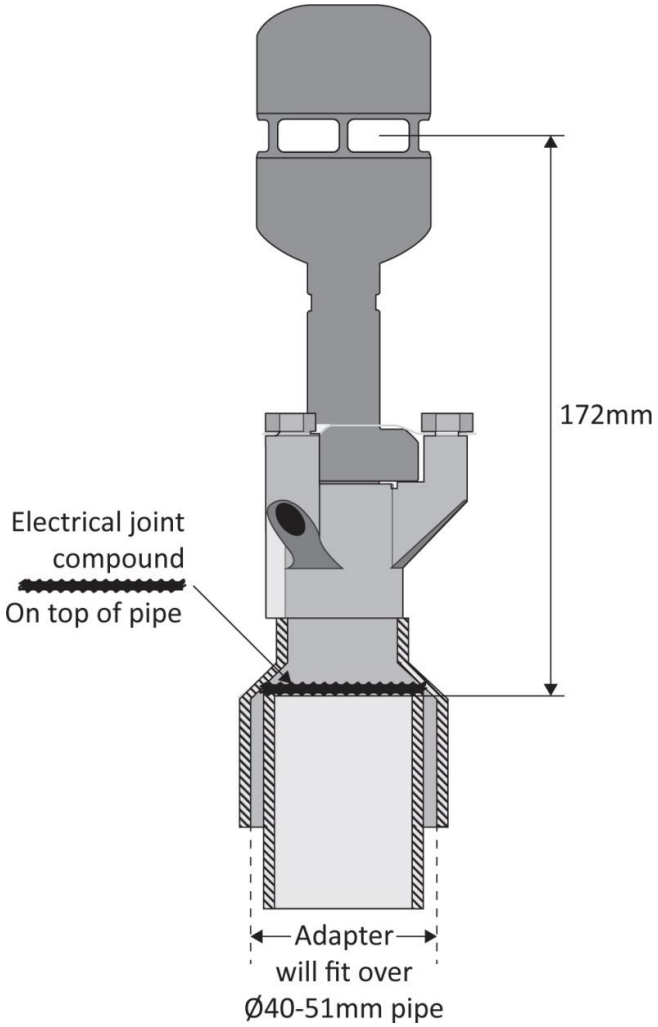


Figure 7: Pipe Mount Sensor and Adapter (all dimensions in mm)

3.2.1 Alignment

The FT702LT measures the wind direction relative to the datum feature (see Figure 8). The pipe mount system is designed for fitting to a vertical pipe. The datum feature can be used in combination with a laser tool to ensure correct alignment and spirit level to ensure that the top of the adapter is flat. The position of the adapter can be adjusted to remove any misalignment if the pipe is constructed slightly off vertical. Once the adapter is aligned correctly the 4 bolts at the bottom of the adapter are used to lock it securely to the pipe, preventing further movement.

The sensor can only fit on top of the adapter in one orientation. If the sensor needs replacing, this can be done without having to realign the adapter. Please contact FT Technologies if you would like further information on alignment tools and accessories available from FT Technologies.

When the wind sensor is correctly aligned the wind direction measurements will be as shown in Figure 8.

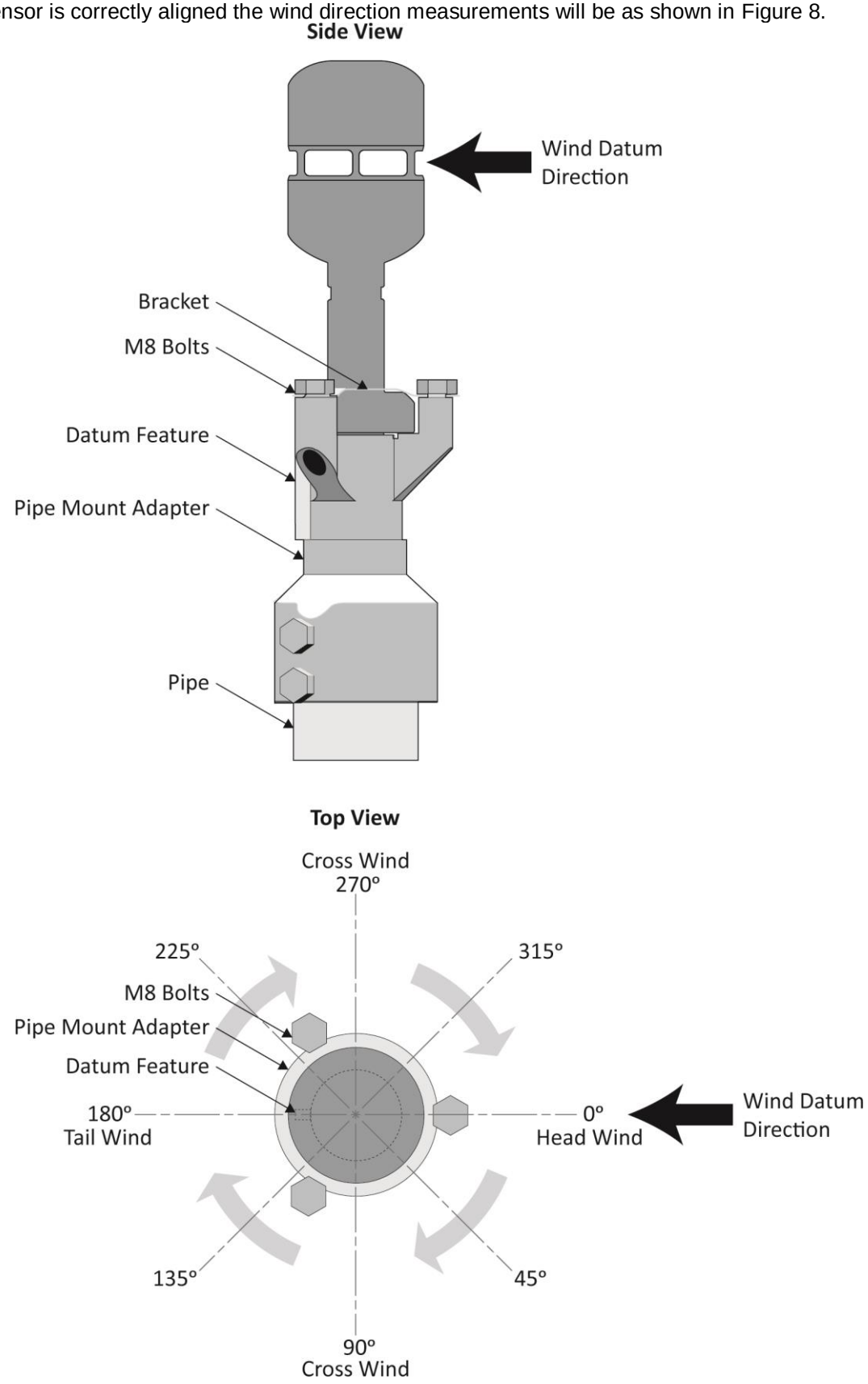


Figure 8: Correct Sensor Alignment

3.2.2 Securing the Pipe Mount Adapter

1.1 The adapter should be fitted onto a pipe with an outer diameter of 40-51mm.
1.2 The pipe end is to be 172 mm below the desired measuring point; the mid-point of the sensor's measurement cavity.
1.3 Run the sensor cable up through the pipe and through the adapter (which should not be fitted to the pipe yet) and secure it so that it cannot fall back down inside.

Figure 9: Preparing the Adapter

2.1 Apply a liberal amount of electrical joint compound to the top surface of the pipe
2.2 Place the adapter on top of the pipe. A spirit bubble can be used to ensure the installation is flat.
2.3 Rotate the adapter to align the datum feature as required. The datum feature should be at the back of the wind sensor, with respect to the wind direction, as shown in Figure 8. A laser alignment tool could be used to ensure accuracy of alignment.
2.4 Tighten the 4 M8 bolts to fix the adapter securely in position (see section 4.2.1 for advice on alignment of the datum feature).
2.5 If a gap exists between the side of the pipe and the bottom edge of the adaptor, sealing can be further improved by applying silicone sealant. Suitable sealants could be either Dow Corning 790 Silicone Building or Pecora 864 Silicone Sealant.

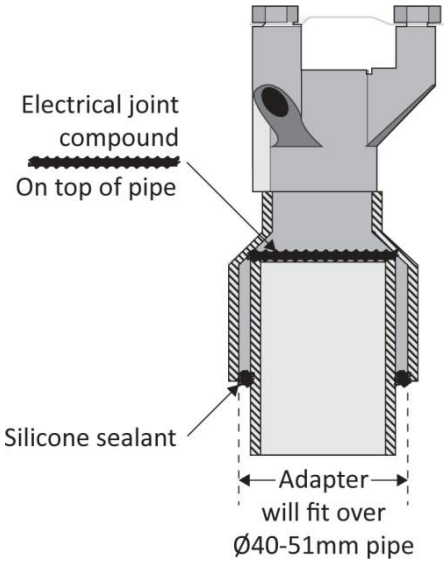


Figure 10: Installing the Adapter

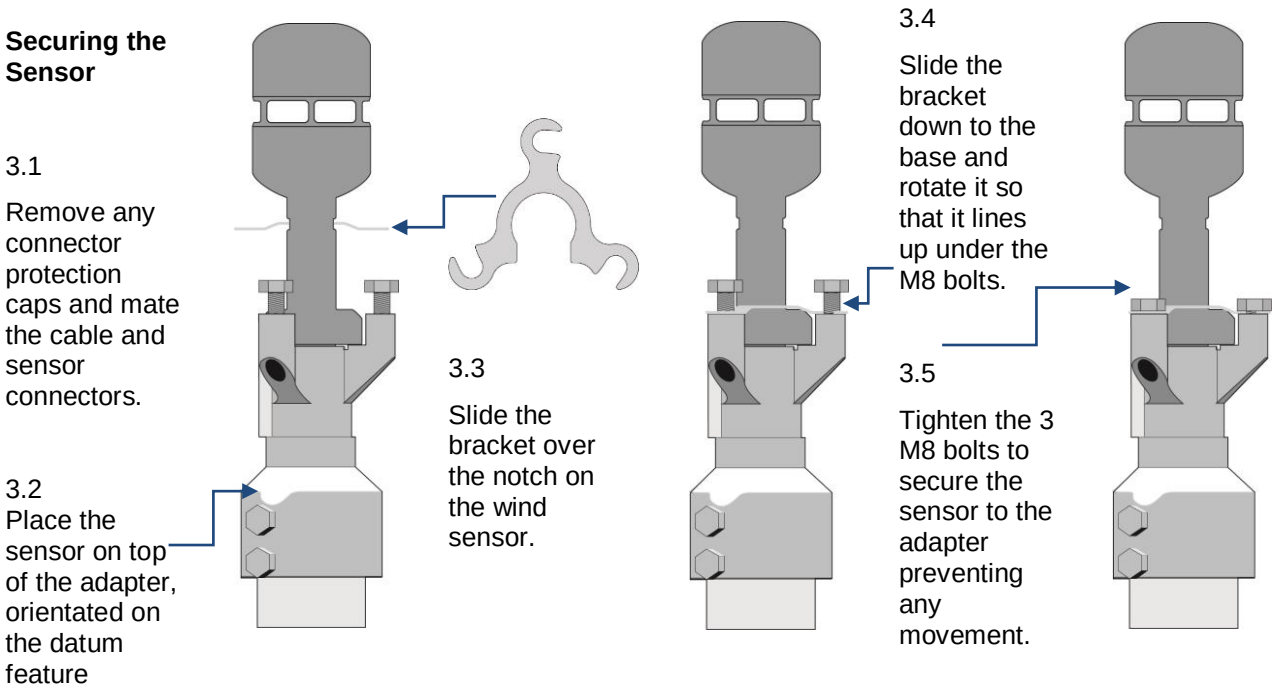


Figure 11: Sensor Installation Instructions

3.3 Lightning protection and EMC

It is important to install the sensor with appropriate protection against lightning and other sources of electromagnetic interference in order to maximise its chance of survival and continued operation during and after exposure.

3.3.1 Protection against direct lightning effects

The sensor installation must be designed in such a way that a protection zone is created around the sensor so that its body can never be subjected to a direct lightning strike.

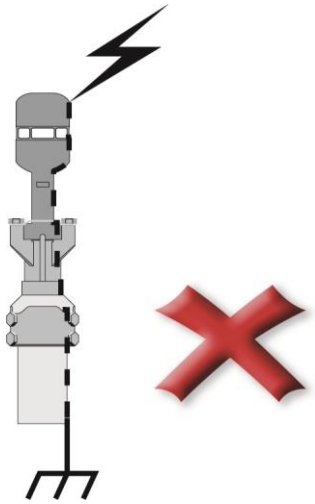


Figure 12: Direct lightning strike

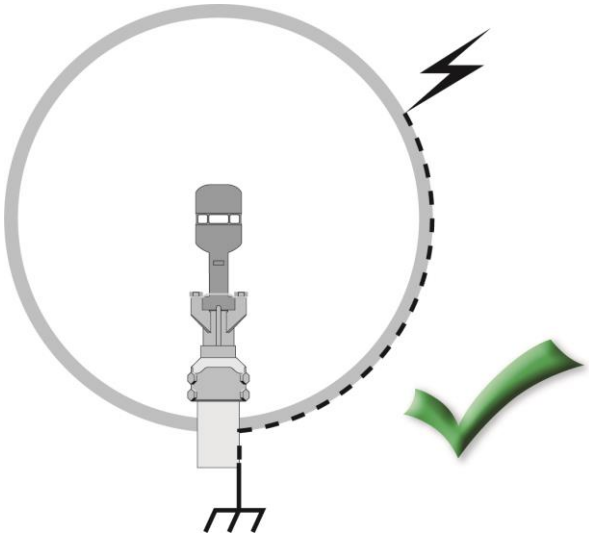


Figure 13: Indirect lightning strike

This level of protection is achievable through the use of conductive structural parts known as “lightning interceptors”. These help to create the protection zone and to divert the majority of the lightning current away to ground.

The pipe which the Pipe Mount Adapter is fixed to must have a direct connection to ground and the lightning interceptor must have a direct connection to the pipe. All connections should be through metal parts with minimum cross-sectional area of 50mm^2. The length of any grounding wire or strap used must be kept to a minimum. This will help to provide the lowest possible impedance path to the ground reference.

Figure 14 below shows examples of lightning interceptors* and how they can be used to create a protection zone around the sensor. It is recommended that the interceptor is made from hot dipped galvanised steel or aluminium in order to prevent corrosion. This will ensure a long-term low impedance connection to ground.

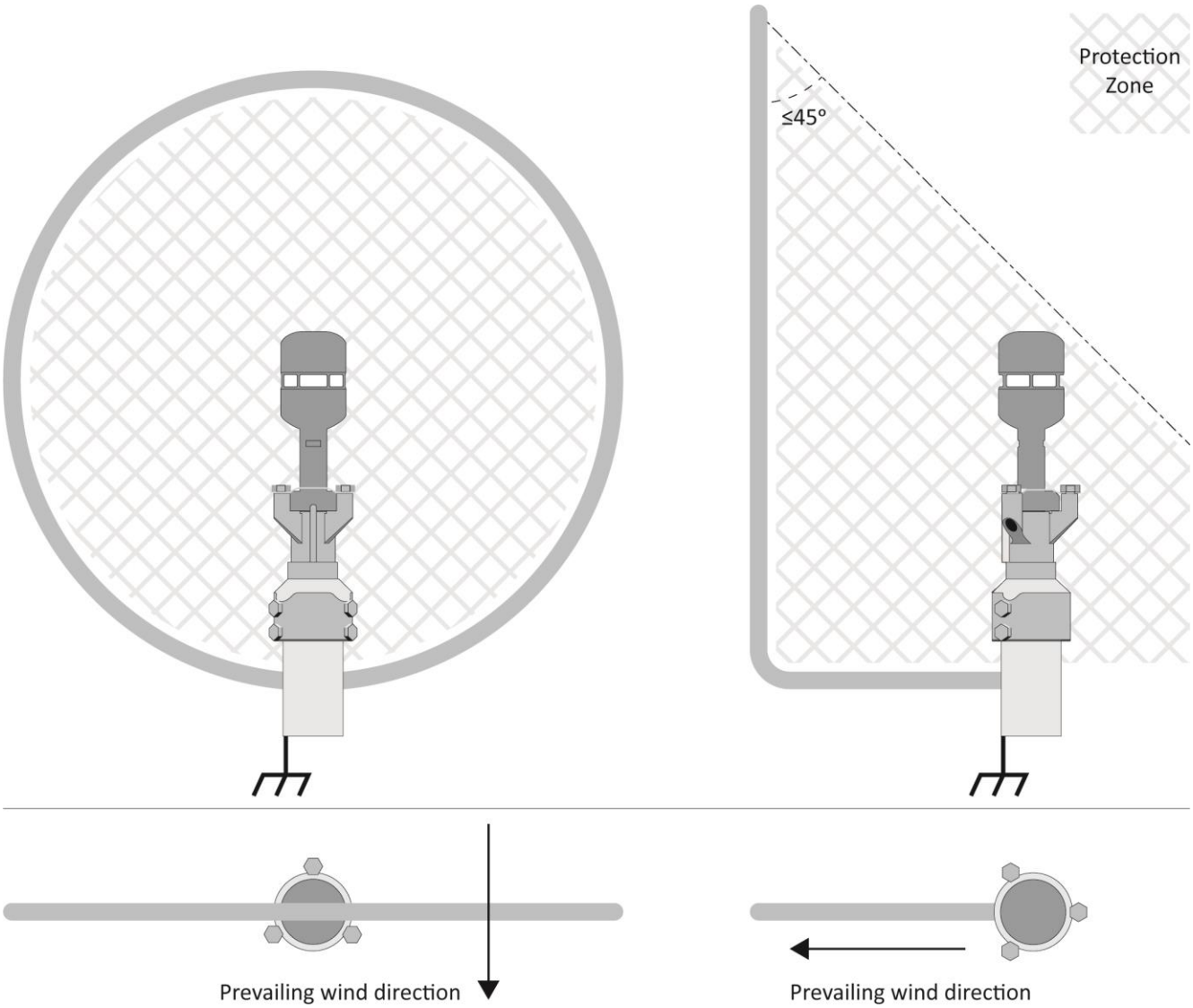


Figure 14: Ring and Rod interceptors

*The standards for Lightning Protection of Wind Turbines are described in IEC 61400-24. The installation instructions in this manual should be sufficient to ensure that the lightning protection zone around the sensor will achieve a lightning protection level of LPZ0B as described in the standard.

3.3.2 Protection against indirect lightning effects and electromagnetic interference

Objects within the protection zone described above can still be subject to very high electromagnetic field 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 data acquisition and power supply cabinet.

This can be in the form of continuous pipe between the Pipe Mount Adapter and the data acquisition and power supply cabinet. If the pipe is not continuous, then metal conduit surrounding any exposed sections of the shielded cable is a good way of providing this additional protection and will also help to prolong the life of the cable. The impedance of this 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 HellermannTyton's HelaGuard steel conduit with plastic coating and steel overbraid.

All cable shielding must be continuous and 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 15 below shows the principle of the protection scheme.

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

② Any pipe or shielding conduit must be terminated at both ends

③ Shielded cable must either be terminated using an 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

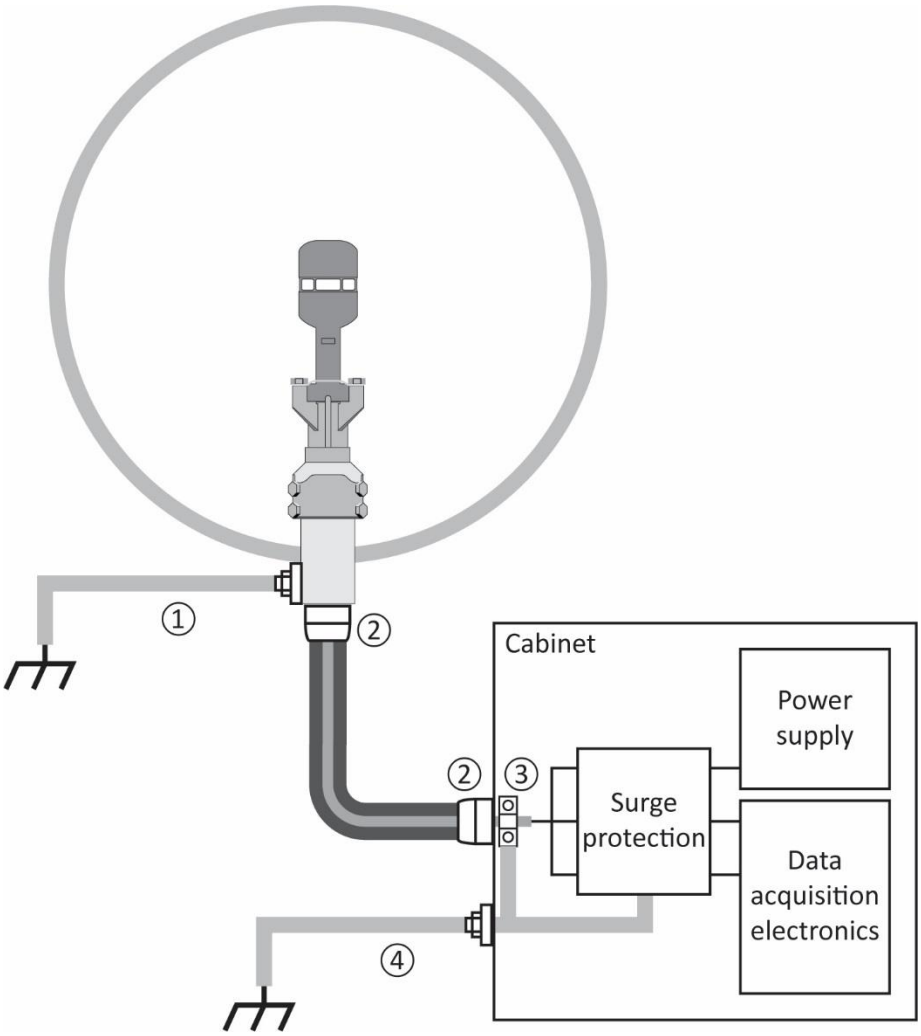


Figure 15: Protection of equipment against indirect effects

3.3.3 Surge protection

All connections from the wind sensor to any computer equipment and power supply should run through Surge Protection Devices (SPDs). This will suppress any unwanted overvoltage transients present on the signal or power lines. The surge suppression devices are to 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 our 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 16 shows how the SPDs should be installed.

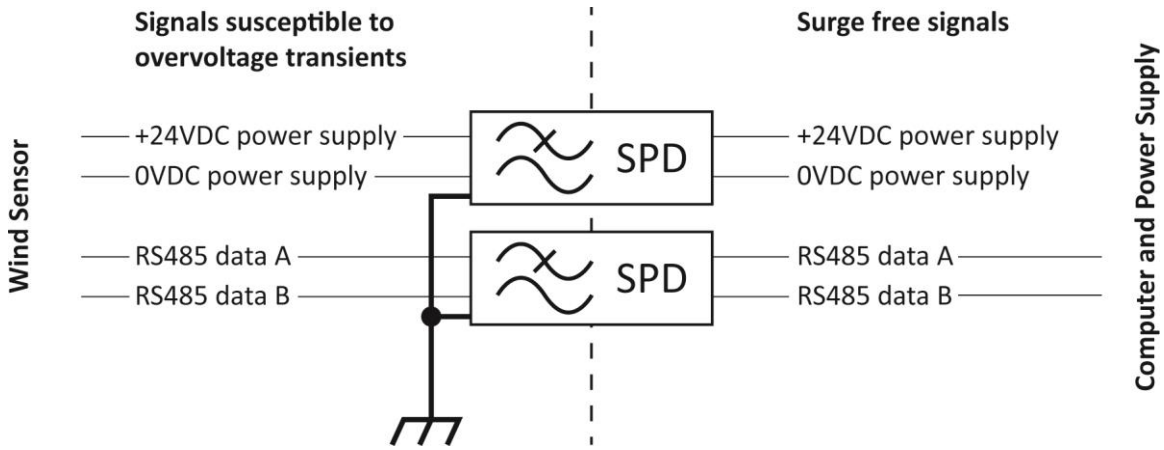


Figure 16: FT702LT digital interface surge protection

The supply pair [24V / 0v] 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 on the control cabinet.
Some examples of SPDs suitable for this protection are given below in Figure 17, from manufactures DEHN & Söhne GmbH www.dehn.de and Phoenix Contact www.phoenixcontact.com.

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 17: Typical SPD configuration used to protect sensor

Figure 18 shows an example of how the wires are up the SPD's inside a Phoenix Contact controller cabinet. The termination of the cable shield at the wall of the controller cabinet using a cable gland is not shown.

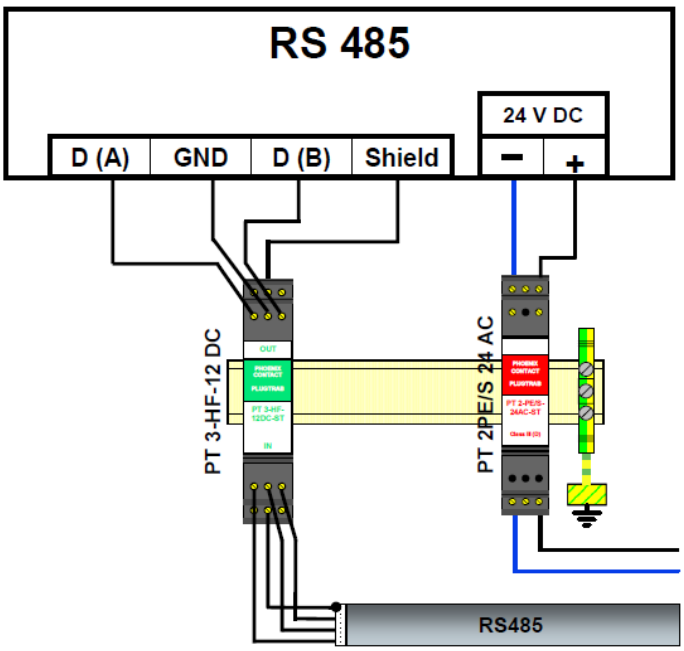
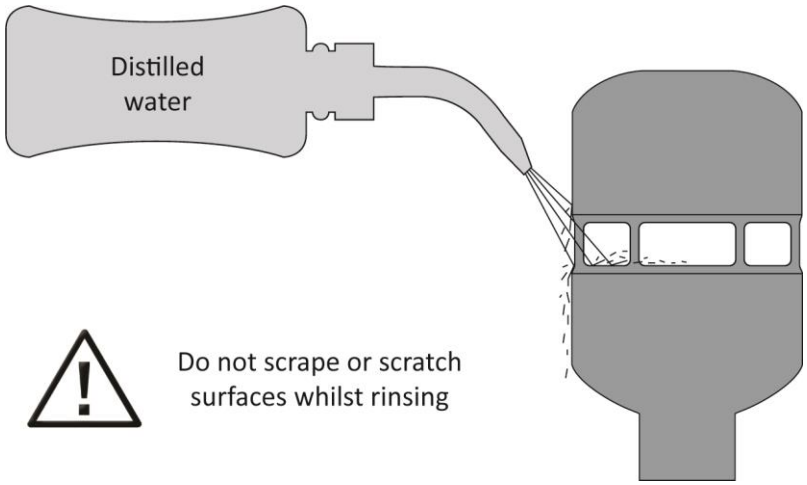


Figure 18: Example of wiring inside a Phoenix Contact controller

3.4 Inspection of the FT702LT

The following checks are required to identify any signs of damage to the sensor which may hinder its performance. 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. 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.



Cleaning: The measurement cavity has a special coating 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.

3.5 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
- Test that the sensor is communicating properly using the Evaluation Pack (see section 4.1)
- 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 3.6).

Warning – do not attempt disassembly as damage may result and product warranties will be invalidated.

If there are no signs of physical damage or problems with communication but sensor downtime or incorrect readings have been intermittently recorded, the following steps should be taken to ensure the highest levels of data availability from the sensor:

- Using the Evaluation Pack (see section 4);
  - 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 at least 30°C (see section 4.2)
  - Ensure that the internal filtering in the sensor is enabled (see section 6.4.8)
- Check that the wind sensor data and status flag errors are being processed as per the advice in sections 6.4.25 & 6.4.26.
- Ensure the sensor has been installed with adequate lightning and EMC protection (see section 3.3)
- Check that the measurement cavity's special coating is in a satisfactory condition (see section 3.4)
- Use the highest build version available as this may have features which resolve the specific problem being experienced

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

3.6 Returns

If a sensor appears to be faulty, please contact FT Technologies and 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.

4 EVALUATION

4.1 Evaluation Pack

To help users carry out a test bench assessment of the FT702LT, FT Technologies sells an Evaluation Pack. This includes Acu-Vis software and the FT054 cable to connect the sensor to an external power supply and to a PC through a USB connector. The sensor's communication settings can then be checked, the heater set point configured and the wind speed and wind direction displayed.

Warning: Live connection/disconnection of the power and/or sensors during live operation, or miswiring of the power leads could damage the equipment and is not covered by FT's standard warranty terms.

4.2 Acu-Vis Software

The Acu-Vis software automatically detects the FT054 cable and wind sensor. The program will detect the wind sensor as long as it is powered up and working. The dials then show the real time wind speed and direction from the wind sensor as shown in Figure 19.

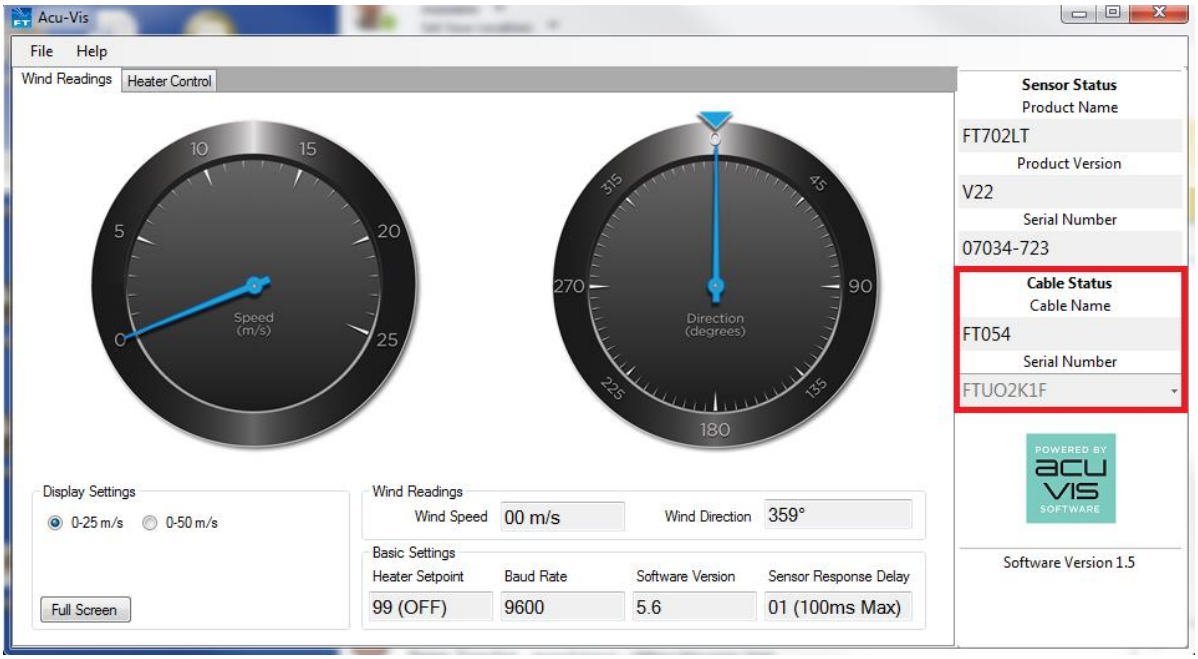


Figure 19: Acu-Vis Dials

The program also shows the communication settings that the sensor is using as well as its 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 20.

The Acu-Vis software will work on a PC running Microsoft® Windows XP, Windows Vista and Windows 7 and 8.

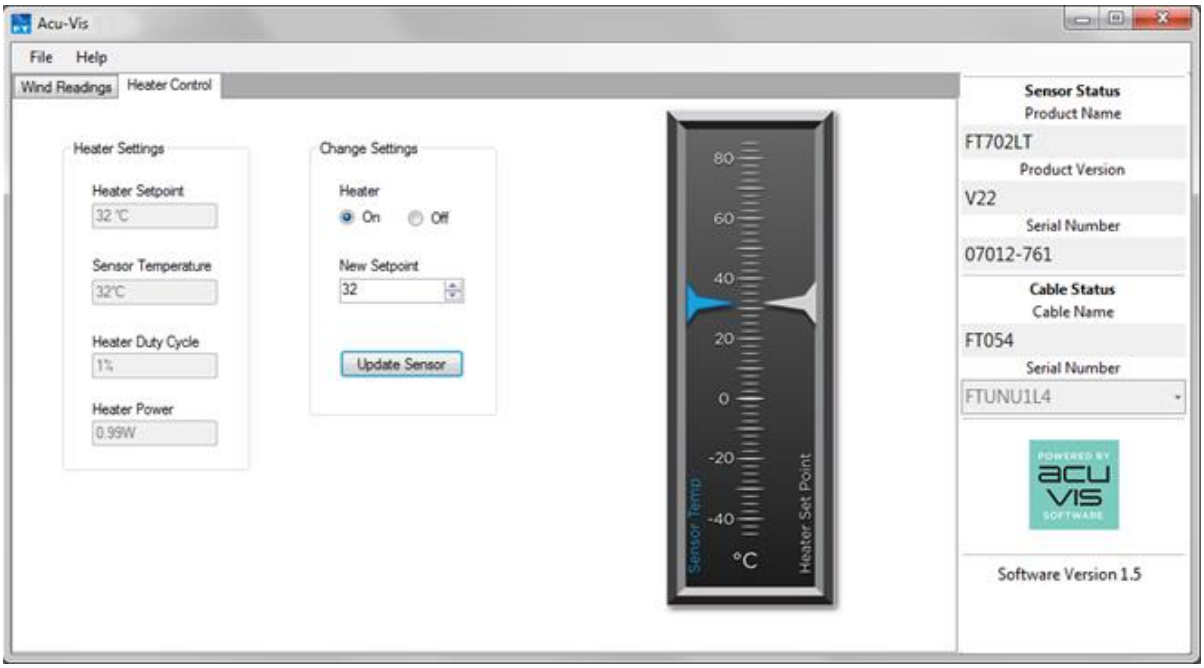


Figure 20: Acu-Vis Heater Controls

4.3 FT054 Evaluation Cable

The FT702LT can be tested by connecting it to a computer. Figure 21 shows how the Evaluation Pack can be quickly set up to evaluate the sensor using Acu-Vis.

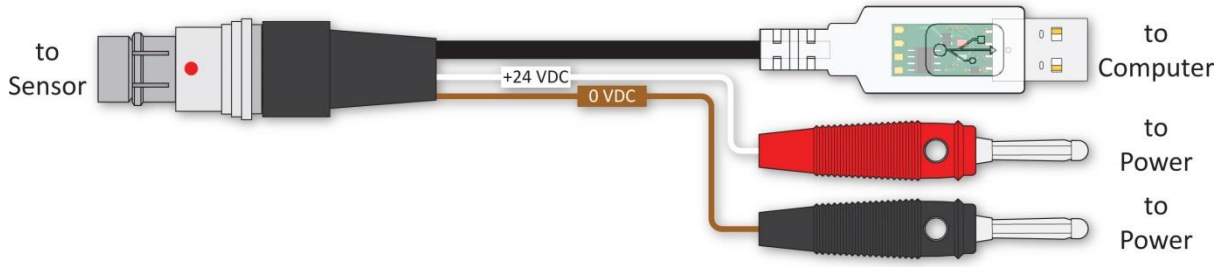


Figure 21: Evaluation Cable

4.4 Quick Start Steps

1. Insert the Acu-Vis CD in to the PC and install Acu-Vis, by running the setup.exe file.

Figure 22: Acu-Vis Install Files

2. Remove the FT702LT sensor and FT054 cable from their packaging and mate the connectors together.

3. Connect the +24 VDC terminal of the power supply (current limit set to 6A) to the white wire (Red test plug) and 0V terminal to the brown wire (black test plug). Then switch on the power supply.

4. Connect the USB cable to the Computer and allow Windows to detect the cable and install any drivers.

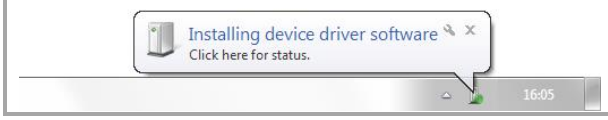
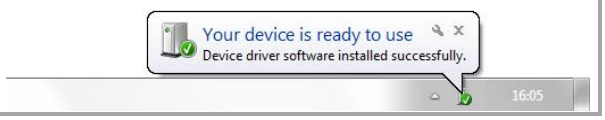
Please wait for Windows to install the hardware	Ready for use
	

Figure 23: Windows driver installation sequence

5. Once the above sequence is complete, wait approximately 10 seconds and then run Acu-Vis by selecting the shortcut icon on the desktop or from the start menu in the FT Technologies folder.

Figure 24: Acu-Vis Shortcut Icon

6. If you need to change over the evaluation cable it is recommended to firstly close the program, replace the cable and allow enough time for Windows to recognise the new cable and install its drivers. Then restart Acu-Vis.

5 SENSOR COMMUNICATION

5.1 Introduction

The FT702LT 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 FT702LT can output the common NMEA 0183 MWV (Wind Speed and Angle) sentence.

5.2 Configuring the FT702LT

All user parameter settings are stored in non-volatile memory and are retained when the FT702LT is switched off. When the FT702LT is next switched on (or a user reset command is sent) the FT702LT will revert to these settings. The FT702LT can therefore be configured as required prior to final installation if required.

The FT702LT settings can be returned to the factory values (see Figure 29 for factory default settings) at any time by sending the factory reset command.

5.3 Communication

5.3.1 Conventions used in this manual

All examples of FT702LT 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 25 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 / Line feed ┐— End of message delimiter
<lf>		0A	
<name>			placeholder for data

Figure 25: Symbols used in this Handbook

5.3.2 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 26: Data Transmission Parameters

To set the FT702LT baud rate use the BR command (Section 6.4.1)

The FT702LT 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.

5.3.3 Message Format

Data communication between the FT702LT and the host computer is performed by the transmission of ASCII messages. Figure 27 shows the composition of the message. The same message format is used for both received and transmitted messages.

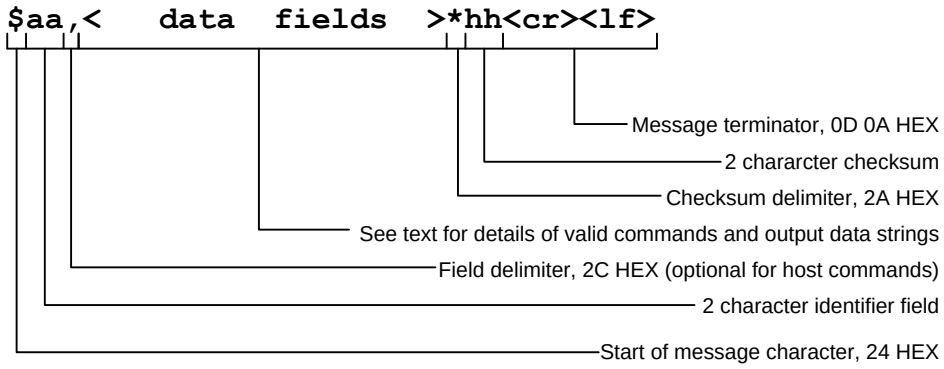


Figure 27: Message Format

All messages start with the '$' start of message character, followed by the 2 character talker/listener identifier field (see section 5.3.4).

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 FT702LT will contain a command in <data fields> and messages transmitted from the FT702LT 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 5.3.5 for information on how to compute the checksum and Section 5.3.6 if checksum message validation is not required.

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

5.3.4 Listener and Talker Identifiers

The FT702LT is assigned with both a Listener and Talker identifier address that allows an individual FT702LT to be uniquely identified in a system comprising more than one FT702LT.

Whenever a message is sent to the FT702LT, the identifier field of the message (the 2 characters immediately following the '$' start of message character) must correspond to the FT702LT Listener identifier address, otherwise the FT702LT will ignore the message. In applications where more than one FT702LT is connected to the RS485 bus, you should assign each FT702LT in the system a unique Listener ID. The host computer will then be able to address individually each FT702LT. 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 FT702LT, irrespective of its Listener ID setting, to respond to the message.

Whenever a message is transmitted from the FT702LT, 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 FT702LT 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 6.4.13.

5.3.5 Calculating the Message Checksum

All messages sent to, or received from, the FT702LT include a checksum field. Messages that are transmitted from the FT702LT always include a checksum value in the checksum field. Messages sent to the FT702LT by the host computer can either contain a checksum value or an 'ignore checksum identifier' in the checksum field.

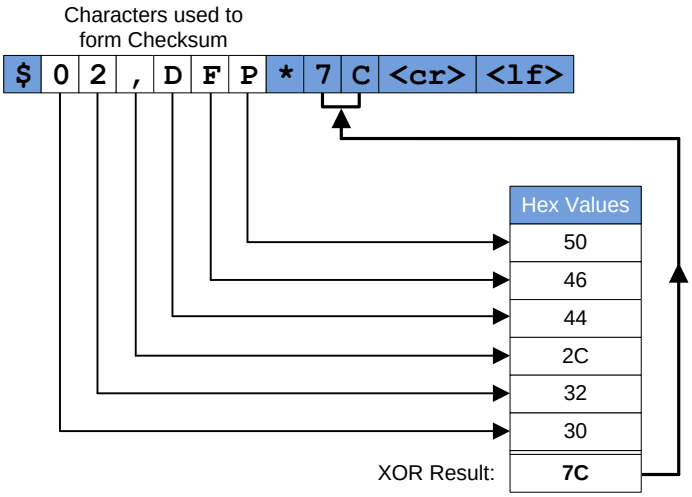


Figure 28: Checksum Example

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.

5.3.6 Disabling the Checksum

All messages which are sent to the FT702LT must contain a valid checksum value in the checksum field, otherwise the FT702LT will not process the incoming message. Although it is recommended that a checksum value be computed for all messages which are sent to the FT702LT, in some cases this may not be convenient (i.e. when communicating with the FT702LT with a terminal). To prevent the FT702LT 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 FT702LT Listener ID in this example is set to 02)

With a checksum (FT702LT checksum validation automatically enabled):

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

Without a checksum (FT702LT checksum validation automatically disabled):

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

A checksum value is always transmitted by the FT702LT 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

6.1 Command Types

6.1.1 Set Commands

Figure 29 lists the commands that may be sent to the FT702LT from the host computer that are used to SET configuration options for the wind sensor.

Command	Mnemonic	Configuration Options	Factory Default	Section
Serial interface baud rate	BR	1200, 2400, 4800, 9600, 19200, 38400	9600	6.4.1
Datum offset	CF	000.0° to 359.9°	0.000°	6.4.2
Continuous Update	CU	Enable or Disable Update interval, 0.2-12000 seconds	Disabled	6.4.3
Wind velocity data format	DF	Polar or NMEA	Polar	6.4.4
Command delay interval	DL	00 to 20	01	6.4.6
Clear Error Report	ER	Reset	000000000000	6.4.7
Wind velocity filter	FL	Enable or Disable, Speed filter length Direction filter length	Enabled 0008 0008	6.4.8 & 6.4.10
Heater settings	HT	Setpoint Temperature Heater Start Delay Time Current Limit Undervoltage Limit	Heater Disabled 4 seconds delay 4 Amps 9 Volts	6.4.9 & 6.4.11 & 6.4.12
Listener and talker identifiers	ID	Listener ID = xx Talker ID = xx	Listener ID = 01 Talker ID = WI	6.4.13
Min/Max wind speed	MM	Reset	999.9,000.0	6.4.14
Reset	RS	Load Factory Default, Load Current Settings, Load Saved Parameters	NA	6.4.16
User Calibration Table	UC	Enable or Disable, Clear Wind speed table record Save wind speed table Table label	Disabled NA NA NA	6.4.19 & 6.4.20 & 6.4.21 & 6.4.22 & 6.4.23
Save User Parameters	US	copies current Parameters	NA	6.4.24

Figure 29: Set Commands

When a valid message is recognised by the FT702LT, the FT702LT 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 30 lists the commands that may be sent to the FT702LT from the host computer that are used to QUERY the wind sensor's latest readings or configuration.

Command	Mnemonic	Sensor Data Returned	Section
Serial interface baud rate	BR	1200, 2400, 4800, 9600, 19200, 38400	6.4.1
Datum offset	CF	000.0° to 359.9°	6.4.2
Continuous update	CU	Enabled or Disabled Update interval, 0.2-12000 seconds	6.4.3
Wind velocity data format	DF	Polar or NMEA	6.4.4
Runtime Counter	DG	Number of hours of runtime	6.4.5
Command delay interval	DL	00 to 20	6.4.6
Error report	ER	Factory Report	6.4.7
Wind velocity filter	FL	Enable or Disable Speed filter length, 1-64 Direction filter length, 1-64	6.4.8 & 6.4.9
Heater settings	HT	Setpoint Temperature, 0°C to 44°C Setpoint Temperature, 44°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, 9V to 17V	6.4.9 & 6.4.11 & 6.4.12
Listener and talker identifiers	ID	Listener ID = xx Talker ID = xx	6.4.13
Min/Max wind speed	MM	Min & Max Speeds Recorded	6.4.14
Parameter Report	PR	Factory Report	6.4.15
Serial Number	SN	Serial Number	6.4.17
Software Version	SV	Software Version	6.4.18
User Calibration Table	UC	Enabled or Disabled Wind speed table record Table label	6.4.19 & 6.4.20 & 6.4.21 & 6.4.22 & 6.4.23
Saved User Parameters	US	Matches Saved to Current User Parameters	6.4.24
Wind velocity reading	WV	Wind Speed, Direction and Sensor Status	6.4.25 & 6.4.26

Figure 30: 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 6.4.20).
2. Each pair of table row values is entered into a RAM copy of the User Calibration Table (See section 6.4.21)
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 6.4.23)
4. The RAM copy of the User Calibration Table is saved into Flash memory (See section 6.4.22)

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 6.4.19 - 6.4.23 for further details.

6.3 Timing Constraints

When a valid command is received by the FT702LT 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 FT702LT internal processing cycle. The FT702LT can process only one SET or QUERY command at a time.

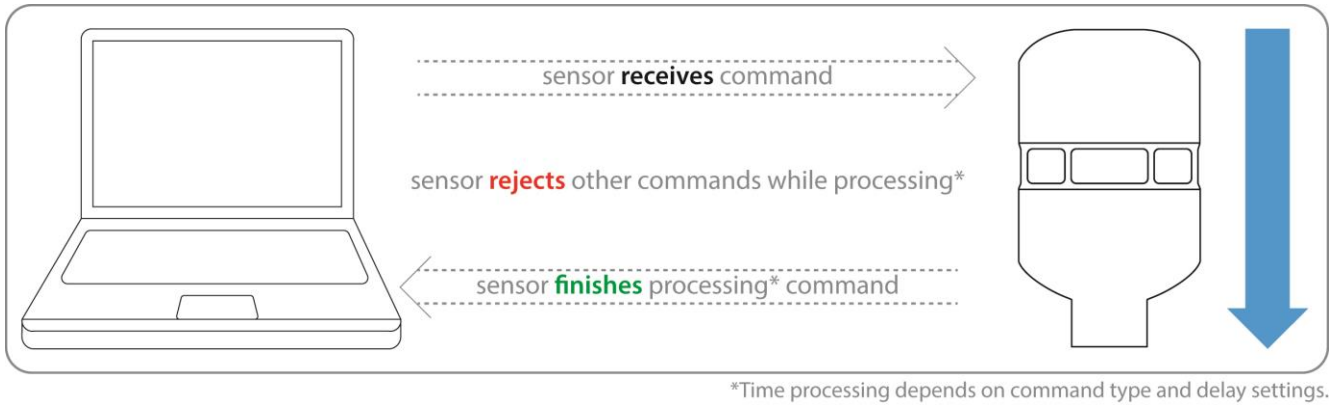


Figure 31: Command Processing

Once a SET command has been received by the FT702LT, 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 6.4.16).

Once a QUERY command has been received by the FT702LT, 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 6.4.6 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 5Hz, i.e. 5 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 FT702LT

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 FT702LT 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 FT702LT Listener ID is set to 01, and the FT702LT TalkerID is set to WI, (Weather Instrument).

6.4.1 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>*
	FT702LT 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

Example 1

Set the baud rate to 19200 baud, verify the new setting and send a user reset command to activate the new baud rate

Message	Comment
$01,BR1//<cr><lf>*	Set baud rate to 19200
$01,BR?//<cr><lf>*	Query baud rate setting
*$WI,BR=1*2E<cr><lf>*	FT702LT output
$01,RSU//<cr><lf>*	Send user reset

Description

Use the BR command to change the FT702LT serial interface baud rate. The new baud rate setting will only come into effect when the FT702LT 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 FT702LT 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 FT702LT baud rate is you will need to try each baud rate in turn until you establish communication.

6.4.2 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>*
	FT702LT output:	*$<talkerID>,CF=<mode>,<status>,<offset>,<offset>* <checksum><cr><lf>* *$aa,CF=c,c,xxx.x,xxx.x*hh<cr><lf>* Note: for compatibility with other models in the FT702 range the offset setting is returned twice.

Parameters	<offset>	
	000.0 to 359.9	Applying an offset electronically rotates the datum direction of the FT702LT in a counter clockwise direction (when looking down from above).
	<mode>	
	D	Always returns D
	<status>	
	D	Always returns D

Examples	Example 1 The datum direction of the FT702LT is rotated by 5deg to the left with respect to the sensor's mounting flat (as per).	
	Message	Comment
	$01,CF355.0//<cr><lf>*	Set offset angle to 5deg
	$01,CF?//<cr><lf>*	Query parameters
	*$WI,CF=D,D,355.0,355.0*26<cr><lf>*	FT702LT output
	Example 2 The datum direction of the FT702LT is rotated 5deg to the right with respect to the sensor's mounting flat (as per).	
	Message	Comment
	$01,CF005.0//<cr><lf>*	Set offset angle to 5deg
	$01,CF?//<cr><lf>*	Query parameters
	*$WI,CF=D,D,005.0,005.0*26<cr><lf>*	FT702LT output

Description	Use the CF command to set the FT702LT 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.

6.4.3 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>*
	FT702LT 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 0.2s increments, between outputs in continuous mode

Examples

Example 1

Set the FT702LT to output readings automatically every 10 seconds. Verify that the command has been accepted.

Message	Comment
$01,CUE00050//<cr><lf>*	Enable CU mode, rate = 0.1Hz

Example 2

Disable the continuous updating. 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).

Message	Comment
$01,CUD//<cr><lf>*	Disable CU mode
$01,CU?//<cr><lf>*	Query CU mode setting
*$WI,CU=D,00050*44<cr><lf>*	FT702LT response

Description

Use the CU command to enable or disable the continuous update mode of operation. When continuous update is enabled, the FT702LT 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 FT702LT previously).

When the continuous update mode is enabled, if the FT702LT is switched-off, when power is reapplied the FT702LT will automatically resume outputting readings.

Once the FT702LT 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 FT702LT.

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

6.4.4 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>* *$aa,DF?*hh<cr><lf>*
	FT702LT output:	*$<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

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>*	FT702LT 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)
$01,DF?//<cr><lf>*	Query format setting
*$WI,DF=NN*0D<cr><lf>*	FT702LT response

Description

Use the DF command to set the required format of the wind velocity readings. See command WV (Sections 6.4.25 & 6.4.26) for a description of the FT702LT 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.

Polar Format: The FT702LT returns the magnitude of the wind speed (m/s only) and the wind direction (0-359 degrees).

NMEA 0183 Format: The FT702LT returns the wind angle (0-359 degrees, Relative) and wind speed (m/s, knots or km/h). The FT702LT TalkerID is always set to WI when NMEA format is selected irrespective of any value that may have been set with the ID command.

6.4.5 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>*
	FT702LT 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-Timer Counter.	
	Message *$01,DG?T*//<cr><lf>* *$WI,DG=012897*CF<cr><lf>*	Comment Query Run-Time Counter FT702LT 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.

6.4.6 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>*
	FT702LT 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>*	FT702LT response

Description	Use the DL command to set the delay interval from when the FT702LT 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 FT702LT will commence outputting the wind velocity data between 250-300ms after receiving a WV query command. If any further commands are sent to the FT702LT before the delay interval has elapsed they will be discarded.

6.4.7 ER: Query the error report

Command Parameter	ER

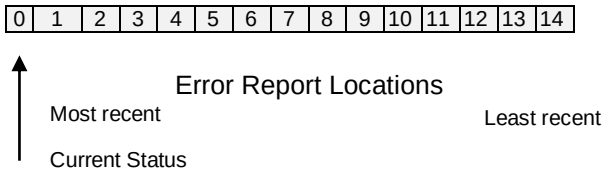
Command Syntax	SET Sensor:	*$<listenerID>,ER<reset>*<checksum><cr><lf>* *$aa,ERc*hh<cr><lf>*
	QUERY Sensor:	*$<listenerID>,ER?*<checksum><cr><lf>* *$aa,ER?*hh<cr><lf>*
	FT702LT output:	*$<talkerID>,ER=<error report>*<checksum><cr><lf>* *$aa,ER=xxxxxxxxxxxxxxx*hh<cr><lf>*

Parameters	<reset>	
	R	Resets the historical log section of the error report to all 0's
	<error report>	
	<error report>	FT702LT error report string

Examples	Example 1	
	Query the error report	
	Message	Comment
	$01,ER?//<cr><lf>*	Query error report
	*$WI,ER=000000000000000*28<cr><lf>*	FT702LT response

Description

The error report contains information on errors that have occurred during the operation of the FT702LT. The output string is always comprised of 15 ASCII characters (all shown as '0', ASCII 30(HEX) in the above example).



The first character in the data field represents the current operational status of the FT702LT. '0' (ASCII 30(HEX)) indicates that the FT702LT 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.

6.4.8 FL.1: General 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>*
	FT702LT 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: *$01,FLE*//<cr><lf>* — Comment: Enable filtering Message: *$01,FL?*//<cr><lf>* — Comment: Query filter setting Message: *$WI,FL=E*40<cr><lf>* — Comment: FT702LT response
	Example 2 Disable the filter. Verify that the command has been accepted.
	Message: *$01,FLD*//<cr><lf>* — Comment: Disable filtering Message: *$01,FL?*//<cr><lf>* — Comment: Query filter setting Message: *$WI,FL=D*41<cr><lf>* — Comment: FT702LT 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).

6.4.9 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>*
	FT702LT 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 = 0008)
	<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 = 0008)

Examples		
	Example 3 Modify the filter's dimensions. Verify that the command has been accepted.	
	Message	Comment
	$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>*	FT702LT 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 12.8 seconds.

6.4.10 HT.1: 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>*
	FT702LT 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 centigrade)
	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 FT702LT, In ºC, in range 00 to ±99ºC

Examples	
	Example 1 Set the FT702LT set point temperature to 5°C. Verify that the command has been accepted.
	Message: *$01,HT05*//<cr><lf>* — Comment: Set heater set point temp
	Message: *$01,HT?*//<cr><lf>* — Comment: Query heater setting
	Message: *$WI,HT=05,00,+24*3B<cr><lf>* — Comment: FT702LT response
	Example 2 Turn off the FT702LT heater. Verify that the command has been accepted.
	Message: *$01,HT99*//<cr><lf>* — Comment: Disable heater
	Message: *$01,HT?*//<cr><lf>* — Comment: Query heater setting
	Message: *$WI,HT=99,00,+24*3E<cr><lf>* — Comment: FT702LT response

Description	
	Use the HT command to set the FT702LT 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.

6.4.11 HT.2: 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>*
	FT702LT 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 FT702LT 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>*	FT702LT response

Description	Use the HT command to set the FT702LT heater parameters, including setting a delay time which specifies how many seconds will elapse after powering on the sensor before the heater is enabled.

6.4.12 HT.3: Limit heater 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>*
	FT702LT 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 = 4.0 Amps.)
	<UVoltLimit> *09 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 is 09 = 9 VDC.)

Examples		
	Example 4 Set the FT702LT heater current limit to 3.3A and set the under voltage limit to 10 VDC. Verify that the command has been accepted.	
	Message	Comment
	$01,HTL33,10//<cr><lf>*	Set current and voltage Limit
	$01,HT?L//<cr><lf>*	Query heater settings
	*$WI,HT=3.3,10*10<cr><lf>*	FT702LT response

Description	
	The HT command may be used to set the FT702LT heater parameters such as the maximum current and under voltage limit of the heaters.

6.4.13 ID: Set or query the listener and 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>*
	FT702LT output:	*$<talkerID>,ID=<RxID><TxID>*<checksum><cr><lf>* *$aa,ID=cccc*hh<cr><lf>*

Parameters	<RxID>	
	00 to ZZ	The FT702LT 2 digit listener address identifier (Factory Default RxID = 01)
	<TxID>	
	00 to ZZ	The FT702LT 2 digit talker address identifier (Factory Default TxID = WI)

Examples

Example 1

Set the FT702LT 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>*	FT702LT 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 5.3.4 for information on listener and talker address identifiers.

6.4.14 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>*
	FT702LT 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	Comment
	$01,MM?//<cr><lf>*	Query the min/max readings
	*$WI,MM=005.1,034.2*22<cr><lf>*	FT702LT response

Description	Use the MM command to query the minimum and maximum wind speed readings that the FT702LT 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.

6.4.15 PR: Query the parameter report

Command Parameter	PR

Command Syntax	SET Sensor:	NA
	QUERY Sensor:	$<listenerID>,PR?*<checksum><cr><lf> *$aa,PR?*hh<cr><lf>*
	FT702LT output:	$<talker id>,PR=<RFU>,<diagnostic flags>,<material temperature>,<RFU>,<RFU>*<checksum><cr><lf> $aa,PR=xxxxxx,xxxx,xx,xx,xx*hh<cr><lf>

Parameters	<RFU>	
	NA	Reserved for Factory Use
	<diagnostic flags >	
	NA	These flags should normally be 0000
	<material temperature>	
	00 to FF	The material temperature is given as a hexadecimal value. The HT Query command is the recommended method for obtaining material temperature readings.

Examples	Example 1	
	Query the parameter report	
	Message	Comment
	$01,PR?//<cr><lf>*	Get the parameter report
	*$WI,PR=076B63,0000,19,29,BF*7C<cr><lf>*	FT702LT response

Description	Use the PR command to generate a sensor report. This report can be sent back to the FT factory for analysis if there are problems with the sensor

Currently the parameter report is only used for factory diagnostic purposes.

6.4.16 RS: Reset the FT702LT

Command Parameter	RS

Command Syntax	SET Sensor:	*$<listenerID>,RS<mode>*<checksum><cr><lf>* *$aa,RSc*hh<cr><lf>*
	QUERY Sensor:	*NA*
	FT702LT output:	*None*

Parameters	<mode>	
	F	reset the FT702LT, loading the factory default settings
	S	reset the FT702LT, loading saved parameters settings
	U	reset the FT702LT, reloading the user parameter settings

Examples	Example 1	
	Reset the FT702LT, reloading the last parameter settings	
	Message	Comment
	$01,RSU//<cr><lf>*	Reset sensor, reloading last settings

Description	Use the RS command to reset the FT702LT 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, but continue to use the previous user parameter settings use the RSU command. To restart the software, but load the saved parameter settings use the RSS command. To restart the software, but load the factory default parameter settings use the RSF command. The user parameters can be saved or backed up into the flash memory of the sensor. See command US (Section 6.4.24) for a description for setting or querying these Saved Parameters.

6.4.17 SN: Query the serial number and build version

Command Parameter	SN

Command Syntax	SET Sensor:	NA
	QUERY Sensor:	*$<listenerID>,SN?*<checksum><cr><lf>* *$aa,SN?*hh<cr><lf>*
	FT702LT output:	*$<talkerID>,SN=<SerialNumber>,<BuildVersion>*<checksum><cr><lf>* *$aa,SN=xxxxx-xxx,xxsss*hh<cr><lf>*

Parameters	<SerialNumber> *00000-000 to 99999-999*	Unique serial number of the sensor
	<BuildVersion> *00-99*	Build 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 build version	
	Message	Comment
	$01,SN?//<cr><lf>*	Query serial number
	*$WI,SN=02350-130,06 *33<cr><lf>*	FT702LT response

Description	The SN command returns the serial number of the sensor and also the build 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. The build version is a 2 digit number which identifies the design version of the sensor. For example, this will be 22 for all version 22 sensors.

6.4.18 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>*
	FT702LT output:	*$<talkerID>,SV=<SoftwareVersion>*<checksum><cr><lf>* *$aa,SV=sssx.xss*hh<cr><lf>*

Parameters	<SoftwareVersion>	
	1.0 to 9.9	Software version of the sensor. The spaces are reserved for future use.

Examples	Example 1 Read the software version number	
	Message	Comment
	$01,SV?//<cr><lf>*	Query software version
	*$WI,SV= 2.0 *06<cr><lf>*	FT702LT response

Description	The SV command returns the software version of the sensor.

6.4.19 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>* $aa,UC?*hh<cr><lf>
	FT702LT output:	*$<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

Example 1

Enable the user calibration table and verify new setting

Message	Comment
*$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 FT702LT 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.

When the User Calibration facility is enabled, the uncorrected wind speed indication of the FT702LT is calibrated according to the stored calibration records, using linear interpolation.

6.4.20 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	Comment
	*$01,UCCLEAR*62<cr><lf>*	Erase calibration tables
	*$01,UC?*04<cr><lf>*	Query user calibration table status
	*$WI,UC=00,D,0000,0000*71<cr><lf>*	FT702LT 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 6.4.21). The user calibration table label is also cleared to 32 ASCII spaces when the UCCLEAR command is sent (see section 6.4.23).

6.4.21 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>* $aa,UC?W*hh<cr><lf>
	FT702LT output:	*$<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		
	Example 1 Enter user calibration table record and verify	
	Message	Comment
	*$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>*	FT702LT 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 6.4.20) 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 6.4.22).

6.4.22 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>* $aa,UC?Rnn*hh<cr><lf>
	FT702LT output:	*$<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: *$01,UCS*68<cr><lf>* — Comment: Save calibration table
	Message: *$01,UC?*04<cr><lf>* — Comment: Query user calibration table status
	Message: *$WI,UC=55,E,5174,5174*70<cr><lf>* — Comment: Typical FT702LT response
	Example 2 Read calibration data stored in row 5 of the Flash calibration table
	Message: *$01,UC?R05*53<cr><lf>* — Comment: Query Flash user calibration record
	Message: *$WI,UC=05,06.00,06.03*1F<cr><lf>* — Comment: Typical FT702LT response

Description	
	Use the UCS command to save a new user calibration table into Flash memory. A user calibration query (see section 6.4.19) 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.

6.4.23 UC.5: Set and 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>* $aa,UC?T*hh<cr><lf>
	FT702LT output:	*$<talkerID>,UC=<label32>*<checksum><cr><lf>* *$aa,UC=xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx*hh<cr><lf>*

Parameters	*<text string>* *xxxxxxxxxxxxxxxxx* *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> *xxxxxxxxxxxxxxxxx* *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>*	FT702LT 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 6.4.20) 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.

6.4.24 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>*
	FT702LT 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>*	FT702LT 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.

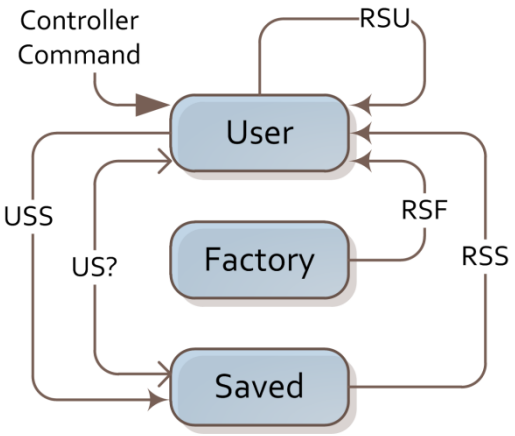


Figure 32: Relationship between the 3 flash copies of Parameter Settings

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, but can be used to replace the User Parameter, by using the RSF command (see section 6.4.16)

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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 6.4.16) for the details of the RSS command. After RSF and 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.

6.4.25 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>*
	FT702LT output:	*$<talkerID>,WVP=<speed>,<angle>,<status>*<checksum><cr><lf>* *$aa,WVP=xxx.x,xxx,x*hh<cr><lf>*

Parameters		
	<speed> *000.0 to 050.0*	measured wind speed in meters per second
	<angle> *000 to 359*	measured wind direction in degrees relative to FT702LT datum
	< 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 '0' (ASCII 30(HEX)) = error

Examples		
	Example 1 The following example illustrates the polar wind velocity data format. The example shows the FT702LT output with a wind speed of 20m/s and a wind angle of 45deg.	
	Message	Comment
	$01,WV?//<cr><lf>*	Query the wind velocity
	*$WI,WVP=020.0,045,0*73<cr><lf>*	FT702LT polar response

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 6.4.4, to select the required output format. Polar Format: The FT702LT returns the magnitude of the wind speed (m/s) and the wind direction (0-359 degrees). NMEA 0183 Format: The FT702LT returns the NMEA 0183 Wind Speed and Angle sentence MWV (see WV NMEA, Section 6.4.26).

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

6.4.26 WV NMEA: Query the wind velocity reading

Command Parameter	WV (NMEA)

Command Syntax		
	SET Sensor:	N/A
	QUERY Sensor:	*$<listenerID>,WV?*<checksum><cr><lf>* *$aa,WV?*hh<cr><lf>*
	FT702LT output:	*$WIMWV,<angle>,R,<speed>,M,<status>*<checksum><cr><lf>* *$WIMWV,xxx,R,xxx.x,M,A*hh<cr><lf>*

Parameters		
	<angle>	
	000 to 359	measured wind direction in degrees relative to FT702LT datum
	<speed>	
	000.0 to 050.0	measured wind speed (in meters per second)
	000.0 to 097.2	measured wind speed (in knots)
	000.0 to 180.0	measured wind speed (in kilometres per hour)
	<units>	
	M	Indicates the wind speed is presented in metres/second
	N	Indicates the wind speed is presented in knots
	K	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 FT702LT output in m/s with a wind speed of 20m/s and a wind angle of 45deg. Message — Comment *$01,WV?*//<cr><lf>* — Query the wind velocity *$WIMWV,045,R,020.0,M,A*3D<cr><lf>* — FT702LT NMEA response Example 2 The following example illustrates the NMEA wind velocity data format. The example shows the FT702LT output in knots with a wind speed of 30.6 knots and a wind angle of 9deg. Message — Comment *$01,WV?*//<cr><lf>* — Query the wind velocity *$WIMWV,009,R,030.6,N,A*31<cr><lf>* — FT702LT 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 6.4.4, to select the required output format and units. Polar Format: The FT702LT returns the magnitude of the wind speed (m/s) and the wind direction (0-359°) (see WV Polar, Section 6.4.25). NMEA 0183 Format: The FT702LT returns the NMEA 0183 Wind Speed and Angle sentence MWV. The FT702LT returns the wind direction (0-359 degrees) and wind speed (m/s, knots or km/h) using the MWV Wind Speed and Angle sentence. The FT702LT 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.

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

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