FT702LT/D Wind Sensor Manual

Analogue Flat Front Variant

FT TECHNOLOGIES LTD.
SUNBURY HOUSE
BROOKLANDS CLOSE
SUNBURY-ON-THAMES
MIDDLESEX TW16 7DX

TEL: +44 (0)20 8943 0801
FAX: +44 (0)20 8943 3283
WEB: www.fttechnologies.com
E-MAIL: info@fttechnologies.com

A4239-6-EN
July 2017

Contents

Safety Instructions 4

1 INTRODUCTION 6

1.1 Product Overview 6

1.1 Build Versions and Labelling 7

1.2 Pipe Mount Sensor 7

1.3 Scope of Use 7

1.4 Disclaimer 8

2 FUNCTIONAL DESCRIPTION 9

2.1 Technical Performance 9

2.2 Current Loops 10

2.2.1 Current Loop Characteristics 10

2.2.2 Wind Speed Loop 10

2.2.3 Wind Direction Loop 12

2.2.4 Changing the wind datum direction 12

2.2.5 Error Detection 13

2.3 Heater Setup 13

3 INSTALLATION 14

3.1 Connectivity 14

3.1.1 Connector Details 14

3.1.2 Cable Details 14

3.2 Mounting the FT702LT/D 15

3.2.1 Alignment 16

3.3 Lightning protection and EMC 17

4.3.1 Protection against direct lightning effects 17

4.3.2 Protection against indirect lightning effects and electromagnetic interference 19

4.3.3 Surge protection 19

3.4 Inspection of the FT702LT/D 21

3.5 Fault Finding & Troubleshooting 22

3.6 Returns 22

4 EVALUATION 23

4.1 Evaluation Pack 23

4.2 Wiring Diagrams 23

4.3 Quick Start Steps 24

5 CHANGING SETTINGS 25

5.1 Installing the Configuration Program 25

5.2 Configuring the FT702LT/D 25

5.3 Change Settings 26

5.4 Sensor Report 26

5.5 Current Loop Test 27

5.6 Reading the Wind Data 28

5.7 Wind Sensor Mode Warning 28

Product Symbols

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

Meaning / Description	Symbol	Significantion/ Description
Warning/ Caution An appropriate safety instruction should be followed or caution to a potential hazard exists		**Advertisement** 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** 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 or 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 remain 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/D 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/D 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/D helps reduce costly down-time and unscheduled maintenance visits.

Mounting and aligning the sensor is very straightforward. The mounting flat on the sensor body defines the 0° wind datum so that the sensor automatically aligns to a reference point. For operation in ice-prone areas the FT702LT/D 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 heat is evenly distributed over the entire surface area.

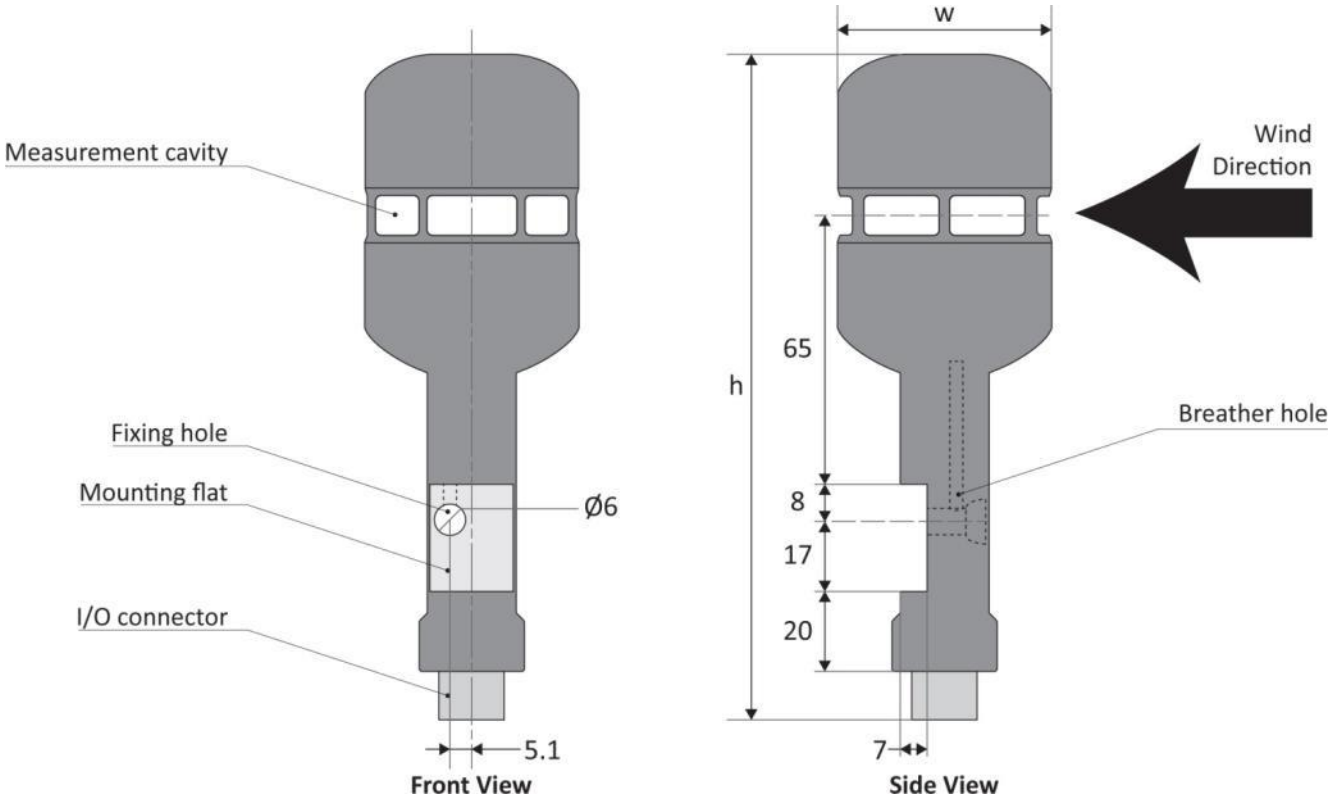


Figure 1: FT702LT/D Flat Front Wind Sensor#

#actual sensor shape varies between build versions

Maximum Sensor Dimensions	h (mm)	w (mm)
Before build version 22	167	50
Build versions 22 and after	161	55

1.2 Build Versions and Labelling

Each time a substantial revision is made to the design of the wind sensor the build version number is incremented. All new variants are backwards compatible with the previous build versions. Each uses the same mounting, connector pin outs and signal characteristics and contains all the original functions.

Where a new function has been introduced the first build version to have it included is stated.

Figure 2 shows examples of how to identify an FT702LT's build version, individual serial number and wind speed scaling (if applicable), depending on which main label is attached. Section 2.2.2 describes how you can use the wind speed scaling reference to identify the calibration of the sensor.

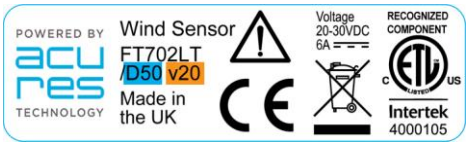
<table>
<tr><td>Serial number
Build version
Wind speed scaling reference</td><td>Product label key*</td></tr>
<tr><td> 
</td><td> 
</td></tr>
<tr><td> 
</td><td> 
</td></tr>
<tr><td> 
</td><td> 
</td></tr>
<tr><td colspan="2">*Additional labels may also be attached. Examples of older labels are included for reference.</td></tr>
</table>

Figure 2: Examples of Main Sensor Labels

Only sensors marked with the Intertek label conform to UL 61010-1 and are certified to CAN/CSAC22.2 No. 61010-1-04. Some early build versions do not have this certification.

1.3 Pipe Mount Sensor

It is possible to mount the wind sensor directly on top of a pipe. Details of the Pipe Mount sensor and system can be found in a separate manual. The Pipe Mount sensor offers enhanced environmental sealing, lightning protection, thermal conductivity and corrosion resistance. The base of the Pipe Mount sensor is different to the Flat Front sensor's described in this manual. Please contact FT Technologies for further information.

1.4 Scope of Use

The FT702LT/D is designed, manufactured and optimised for high availability. The FT702LT/D 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/D 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.

1.5 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 Technical Performance

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 ±10^0 of 0^0 datum)
Resolution	1°
Environment	
Temperature Range	-40° to +85°C (operating and storage)
Humidity	0-100%

Data I/O

Analogue Option	
Interface	4-20mA, galvanically isolated from power supply lines and case
Format	One 4-20mA current loop for wind speed (see Figure 4 for scaling factors available) One 4-20mA current loop for wind direction (4-20mA = 0-360deg) (see Figure 8 for offset options available)
Reading Update Rate	5 per second
4-20mA Configuration Port[2]	RS485 half duplex, non-isolated relative to power ground

Power Requirements[4]

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[3]. *Only 4A (max) power consumption possible for sensors prior to build version 22[3].

Physical

Weight	320g (max)
Material	Aluminium alloy, hard anodised
I/O Connector	8 way (Analogue option),
Mounting Method	Self aligning, single screw fixing

Notes:

1. All specifications subject to change without notice
2. The Configuration Port is provided to allow the user to change the internal settings of the FT702LT/D and to perform diagnostic testing. This interface should only be used for configuration and test purposes. This interface is not intended for permanent connection to the turbine controller.
3. The heater set point and current limit can be configured by programming the sensor's internal parameter settings (only available from build version 22 and above)
4. See safety instruction requirements (page 4)

2.2 Current Loops

2.2.1 Current Loop Characteristics

The FT702LT/D wind sensor incorporates two galvanically isolated 4-20mA current loop outputs, one loop for wind speed and one loop for wind direction. These current loop outputs can be converted into measurable output voltages with the addition of external resistors.

Each loop should be powered from a DC supply in the range 20V to 30V. A positive supply must be provided to one of the current loop wires. The other wire must then be connected through a current meter to ground. This is because the FT702LT/D current loops **sink** current, they do **not** source it. A common supply can be used if required. Loop connections are polarity insensitive so that the +ve or –ve loop supply connection can be made to either of the current loop connection pins. See example wiring in Figure 21.

The current loops are able to operate over long cable distances; however the overall loop resistance should not exceed the values given in Figure 3. It is recommended that twisted pair interconnection cabling should be used. The cable should also include an overall braided screen.

Loop Supply	Maximum Loop Resistance
20V	500 Ω
24V	700 Ω
30V	1000 Ω

Figure 3: Maximum Current Loop Resistance

The wind sensor's current loop outputs are updated at a rate of 5 times per second. An average of several readings should always be used for any calculations or control decisions because single readings can accidentally become corrupted (see section 2.2.5).

The sensor has its own internal filtering enabled by default, which dampens the speed and wind direction outputs by averaging the previous 1.6 seconds of data. It is possible to disabled the internal filter (however not recommended) by using the FT702LT/D Set-Up and Test Program (See Section 4 and 5).

2.2.2 Wind Speed Loop

The default wind speed scaling is such that a change from 4 to 20mA represents 0m/s-50m/s. This corresponds to a scaling factor of 0.32mA per m/s. The measurement scaling factor for the wind speed current loop is set at the factory. Figure 4 shows the wind speed calibrations that are available.

The models with scaling factors above 50m/s are intended for applications such as wind turbine controllers where the wind speed scaling is preset and cannot easily be changed. Because the maximum wind speed range of the FT702LT/D is 50m/s for models with full scale settings above 50m/s the maximum output current is limited to a value equivalent to 50m/s (see Figure 4).

Wind Speed Scaling references	4mA	20mA	Scaling Factor (mA per m/s)	
30	0m/s	30m/s	0.5333	
40	0m/s	40m/s	0.4000	
50	0m/s	50m/s	0.3200	
60	0m/s	60m/s	0.2666	output limited to 17.33mA (50m/s)
70	0m/s	70m/s	0.2286	output limited to 15.43mA (50m/s)
Custom	0m/s	XX	Variable	Only available from build version 22

Figure 4: Wind Speed Scaling Factors

From build version 22 the wind speed loop can also be calibrated with non-linear scaling functions. See example customisable calibration in Figure 5.

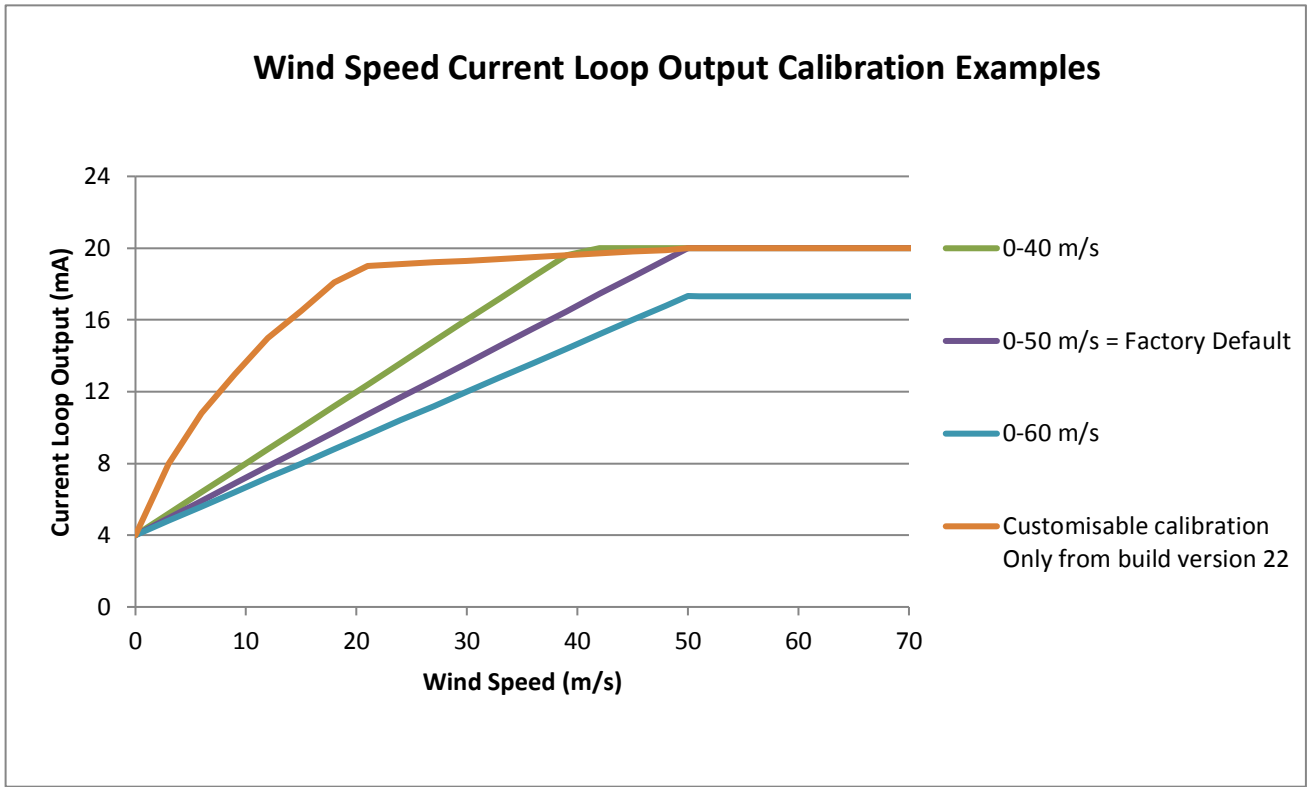


Figure 5: Wind speed output calibrations

If a wind sensor is replaced care must be taken to ensure that the 2 sensors have the same calibration. Otherwise the system processing the wind data might perform differently after the sensors are swapped

The wind speed scaling reference given on the main product labels can be used to identify the wind speed calibration of the sensor. (See section 1.2).

From build version 22 and above a C:Code label might be attached. The C:Code number then indicates the type of calibration applied. 2 examples are shown in Figure 6.

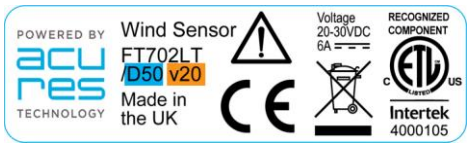
V20 - Standard 0-50m/s = 4-20mA. = Default	V22 - All other calibrations
 The wind speed scaling reference is shown on the part number label as 50 The C-Code:01 label is sometimes also attached 	 No wind speed scaling reference is shown on the part number label The additional C-Code label and number XX is used to identify the type of calibration applied 

Figure 6: Build version 22 sensor calibration label examples

2.2.3 Wind Direction Loop

The wind direction scaling is such that a change from 4 to 20mA represents 360 degrees (with no dead band) which corresponds to a scaling factor of 0.0444mA per degree.

The FT702LT/D measures the wind direction relative to the 0 degree datum. The 0 degrees datum location for the FT702LT/D is shown in Figure 7.

The default setting for the current loop output when the wind is blowing towards the datum direction is 12mA. If required, the direction loop can be set to give an output of 4mA at the datum direction. The output options are shown in Figure 8.

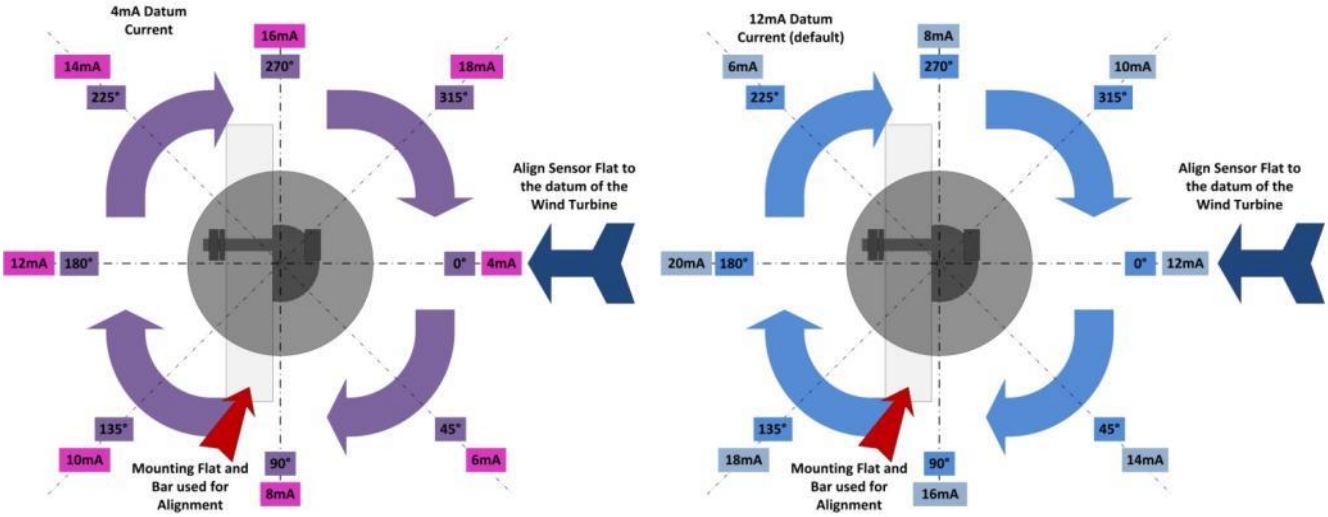


Figure 7: Visualisation of direction with 4mA and 12mA current offsets

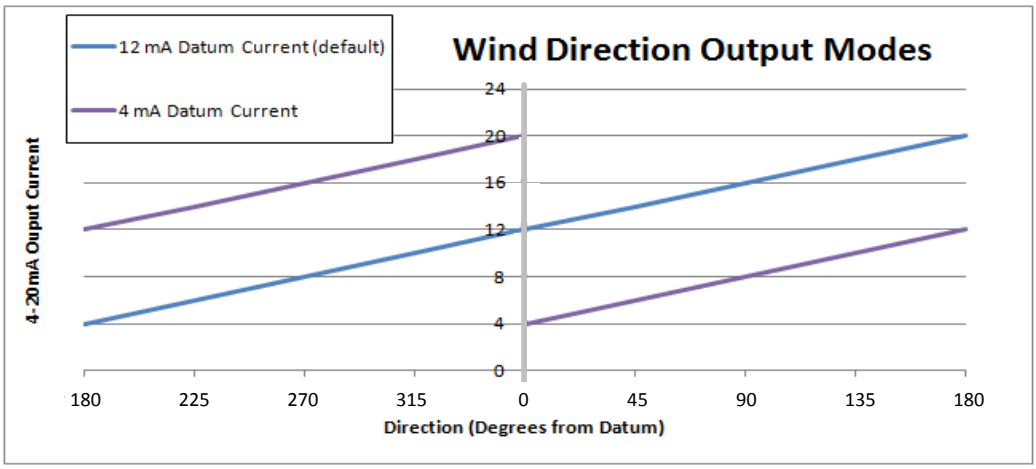


Figure 8: Comparison of wind direction current offsets

When operating in the 4mA datum current mode there is a 16mA transition each time the wind direction crosses the datum. In the 12mA datum current mode the output current varies linearly about the 12mA value as the wind direction moves around the datum.

2.2.4 Changing the wind datum direction

The datum direction can be electronically rotated (either clockwise or counter clockwise) in 1 deg increments using the FT702LT/D Set Up and Test Program (see section 5) to apply this adjustment. Once the datum offset has been set it will be retained in the FT702LT/D Flash memory.

2.2.5 Error Detection

If the FT702LT/D detects that a reading may be invalid this is signalled to the controller or data logger by setting the current of both loops to a value of 1.4mA by default. The error current level can be configured (see Section 5) by the user from 1.4mA up to 3.9mA in steps of 0.1mA (only available from build version 22 and above).

The error condition must occur for more than 1 second for the current loops to be set to this condition. If an error occurs for less than 1 second then the loop outputs will be held at the last valid reading for the duration of the error.

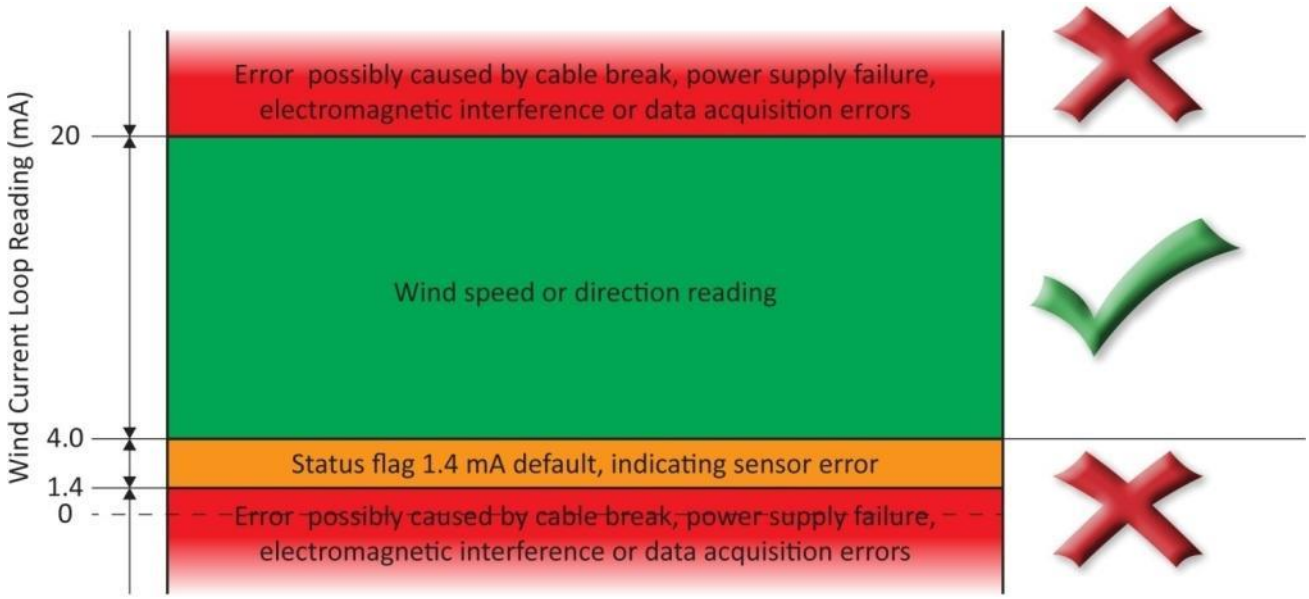


Figure 9: 4-20mA valid readings range

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

The data acquisition system needs to not only sample the 4-20mA measurement range, but also should include logic to process and exclude data if it is outside the measurement range. The data acquisition system should distinguish between a status flag error sent by the wind sensor and other out of range readings in order to help diagnose if a fault has occurred with the power supply, cable or wind sensor.

2.3 Heater Setup

The FT702LT/D 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/D using a user programmable 'set point' temperature. The FT702LT/D 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 factory default setting for the heater set point value is 30° C. This is the recommended setting for most applications. To change the heater set point or to disable the heater use the FT702LT/D Set Up and Test Program (see section 5).

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/D 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.

From build version 22 and above the maximum current limit of the sensor can be adjusted in software from 0.1 – 6 Amps. To change the current limit use the FT702LT/D Set Up and Test Program (see section 5).
From build version 22 and above the sensor can detect when the supply voltage drops below 9 VDC, when this occurs the heaters are automatically switched off.

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 1.5.

3.1 Connectivity

3.1.1 Connector Details

All electrical connections are made to the FT702LT/D via an 8-way multipole connector located in the base of the wind sensor housing. The wind sensor connector pin designations are shown in Figure 10 and the mating connector manufacturer's part numbers in Figure 11.

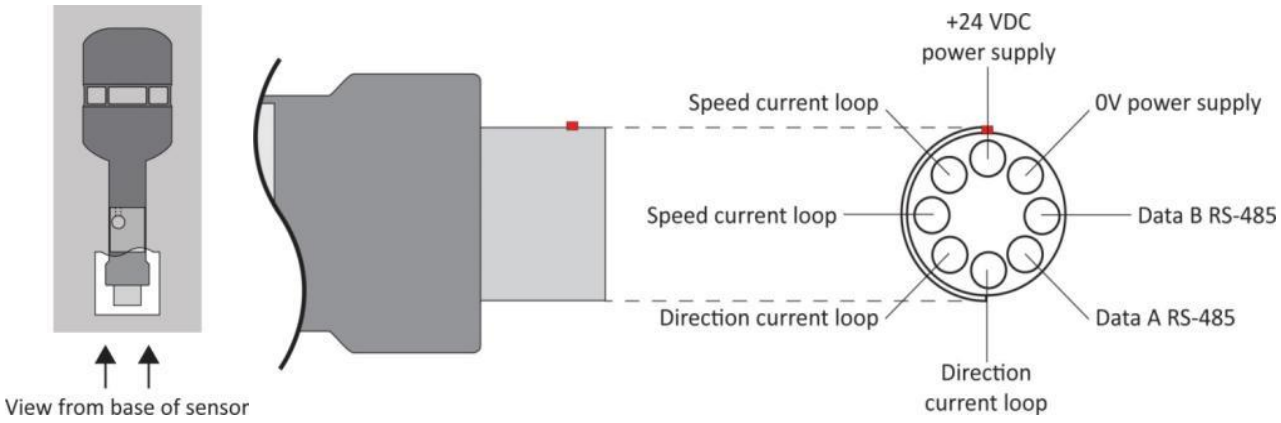


Figure 10: Sensor connector pin out

Connector Type	Connector Description	Manufacturers Part Number	FT Sensor Type	Maximum Outer Cable Diameter	Manufacturer
FT702LT/D Cable Side Connector	8 way plug	SS104Z129-1	FT702LT/D Analogue Option	8.0mm	W.W.Fischer
FT702LT/D Cable Side Connector	8 way plug	SX2F1C-P08NJH9-0001	FT702LT/D Analogue Option	9.2mm	ODU

Figure 11: Cable Connector Sourcing Options

3.1.2 Cable Details

The mating connectors for the FT702LT/D 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).

3.2 Mounting the FT702LT/D

The FT702LT/D is designed to be mounted using an M6 socket head cap screw, nut and washer. The mounting flat on the support tube of the sensor (see Figure 1) allows for firm fitting against a flat surface. The preferred finish of the screw, nut, washer and the mounting bar is hot dipped galvanised steel. The mounting bar should have a minimum galvanising thickness of 50µm to ensure long-term protection against corrosion. 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 mounting flat is provided free of coatings to allow for a good electrical connection between the body of the sensor and ground through the mounting bar. In order to protect the mounting flat against corrosion, a very thin layer (<0.2mm) of electrical joint compound should be applied. An example of this could be AFL Global's Electrical Joint Compound # 2. It should be applied directly to the sensor's mounting flat, whilst avoiding the fixing hole. Use of an electrical joint compound will also help to maintain long-term low impedance connection to ground. This connection should be checked as part of the annual inspection of the sensor as detailed in Section 3.4.

Some electrical joint compounds contain fluoride etchants which may react with certain materials. Material compatibility should therefore be checked prior to application (refer to the electrical joint compound manufacturer's data).

In order to keep the pressure within the sensor equalised with the atmospheric pressure, a small breather hole is located within its support tube. It is therefore important that the airway to this breather hole be kept clear. This can be achievable by cutting a small 3mm channel in the mounting bar as shown (see Figure 12).

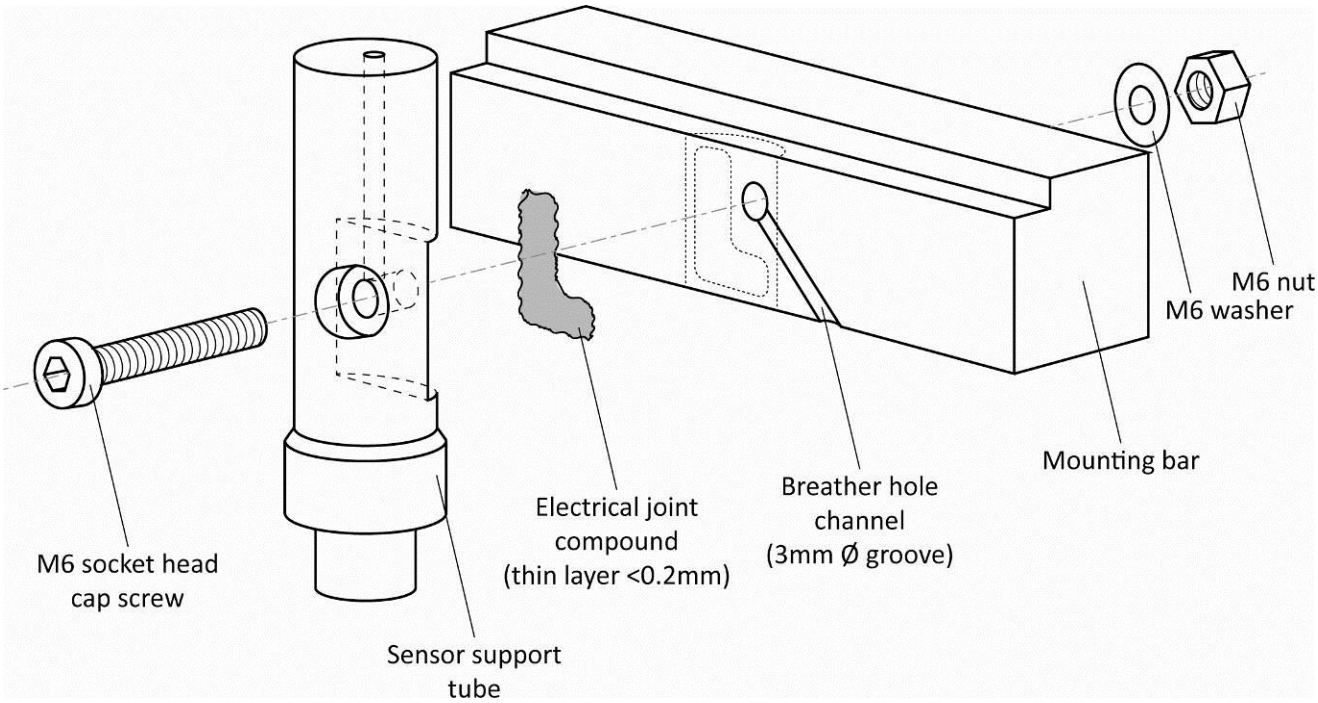


Figure 12: Sensor Installation

It is recommended that a protective sleeve be fitted over the base of the sensor and the connector. This will provide environmental protection as well as stress-relief from vibration. Heat shrink or cold shrink would be suitable for this purpose. FT offer a cold shrink solution which is available on request (part number FT909). The sleeve should cover the lower part of the support tube; the connector itself and at least 25mm of cable (see Figure 13).

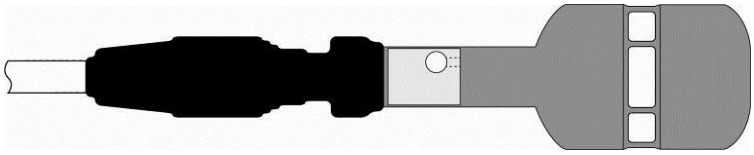


Figure 13: FT702LT/D-FF with protective sleeve

3.2.1 Alignment

The FT702LT/D measures the wind direction relative to the mounting flat and bar. When the wind sensor is correctly aligned the wind direction measurements will be as shown in Figure 14.

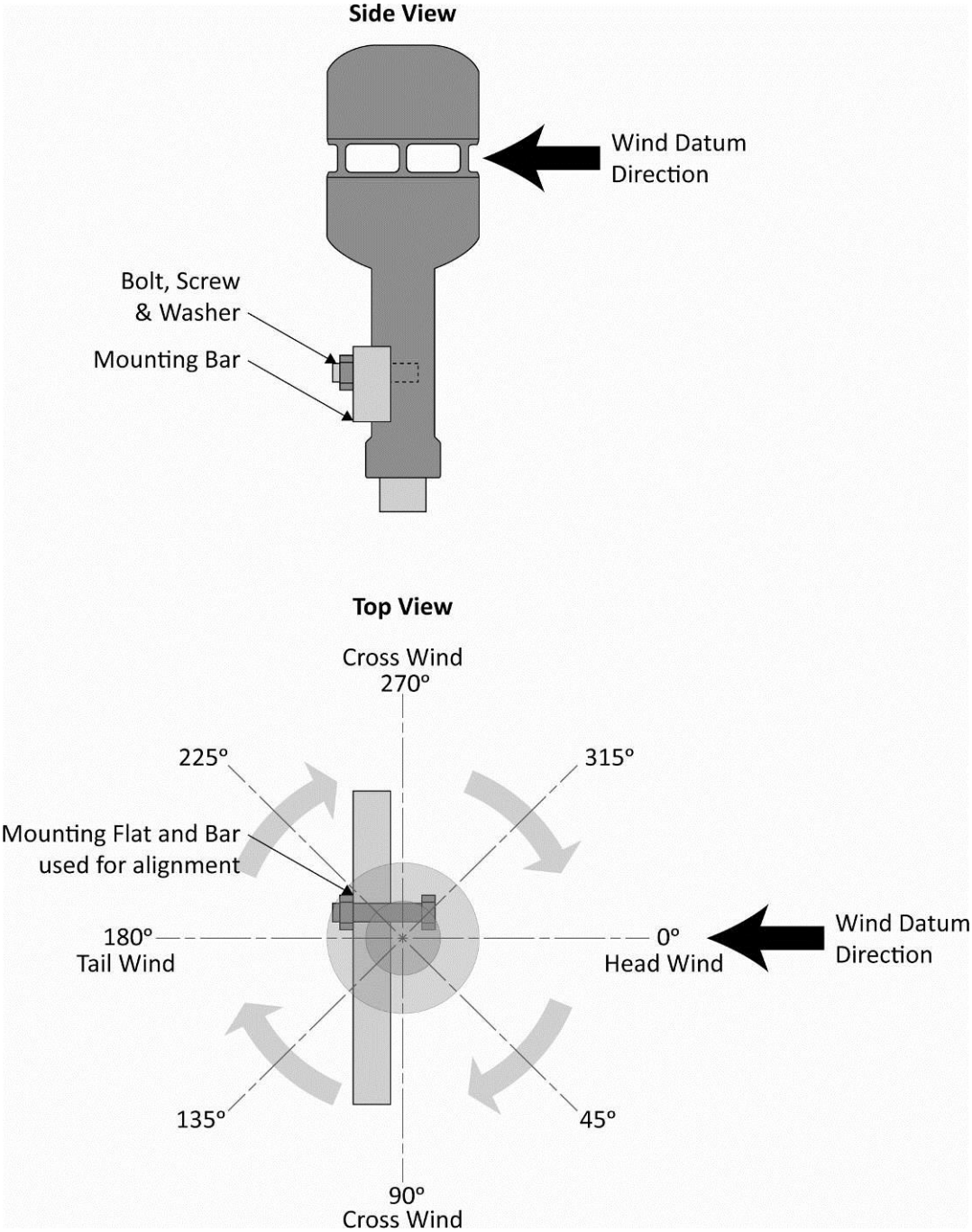


Figure 14: Correct Sensor Alignment

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.

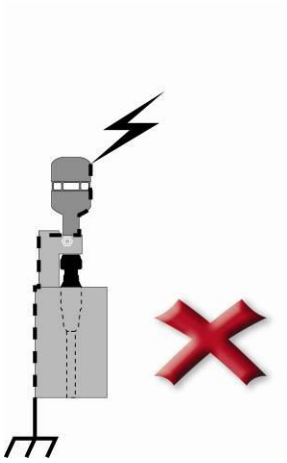


Figure 15: Direct lightning strike

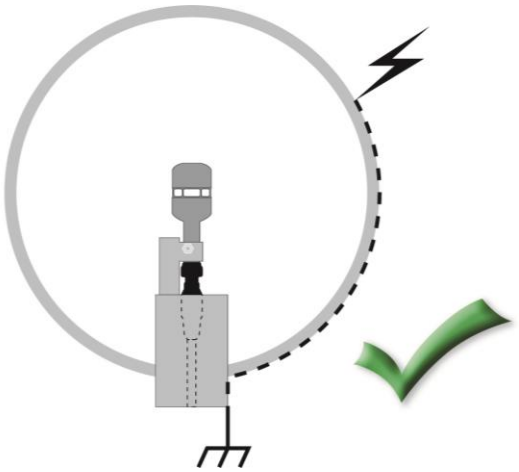


Figure 16: Indirect lightning strike

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 lightning interceptor must have a direct connection to ground through metal parts with a minimum cross-sectional area of 50mm^2 (see Figure 19). The length of any grounding wire or strap must be kept to a minimum. This will help to provide the lowest possible impedance path to the ground reference.

Figure 17 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.

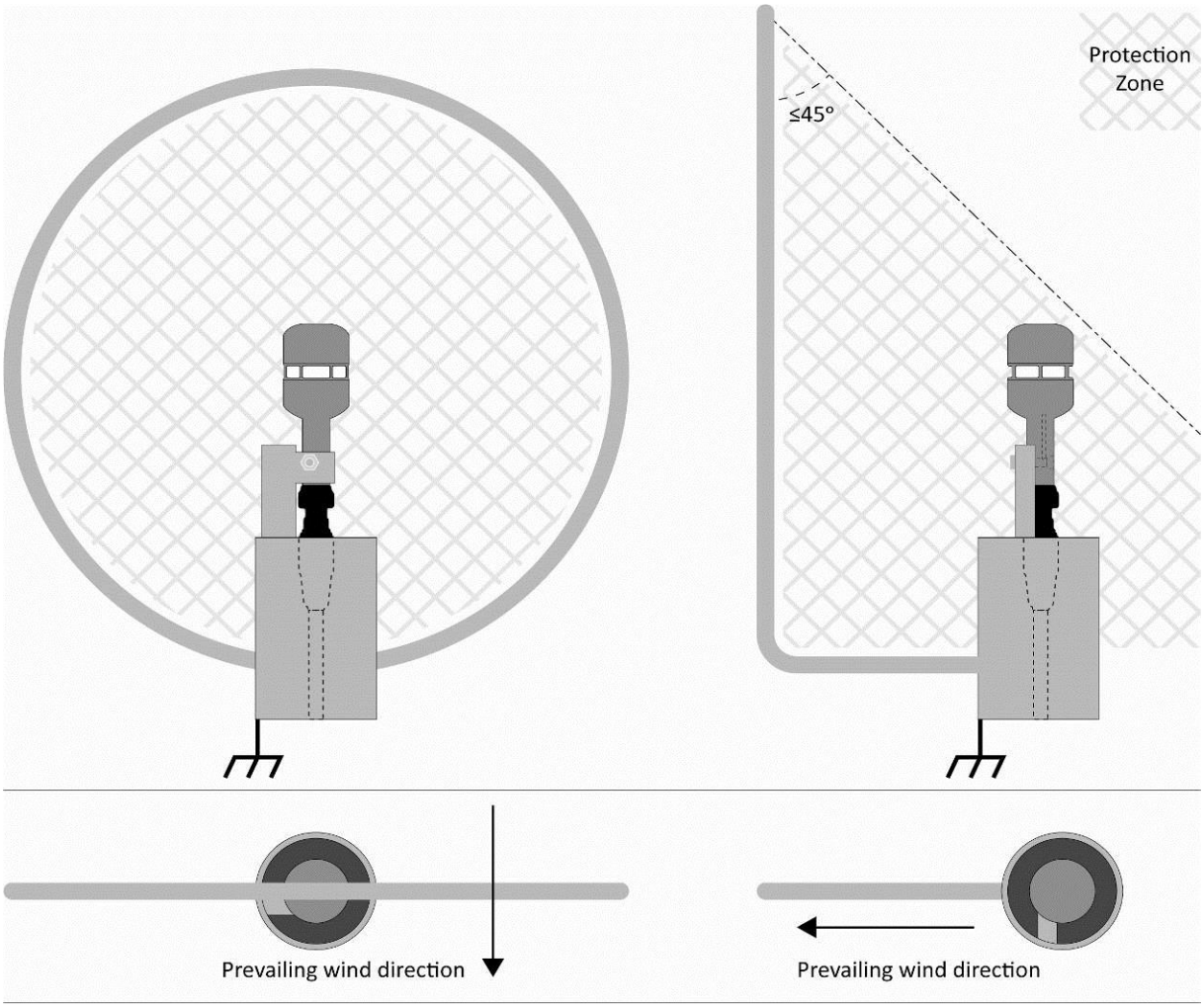


Figure 17: Ring and Rod interceptors

*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.

A metal conduit surrounding the shielded cable is a good way of providing this additional protection and will also help to prolong the life of cables and connectors. The impedance of 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 18 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 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

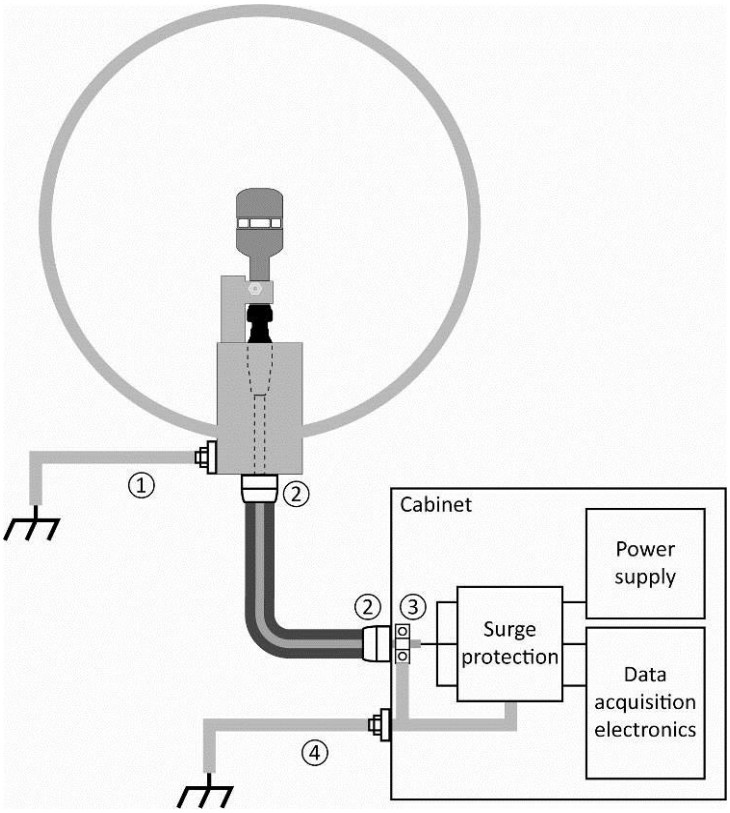


Figure 18: Protection of equipment against indirect effects

3.3.3 Surge protection

All connections from the wind sensor to any data acquisition 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 19 shows how the SPDs should be installed.

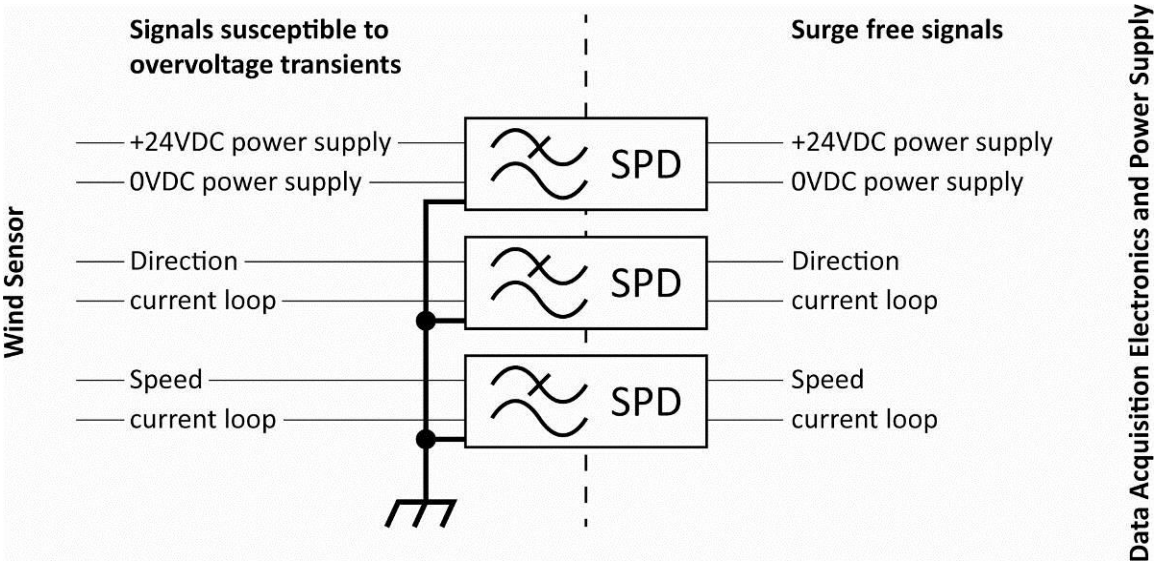


Figure 19: FT702LT/D analogue interface surge protection

The supply pair [24VDC / 0VDC] is electrically isolated from the other lines and the chassis. The four current loop signals are isolated from the power supply lines and the chassis. An example of SPD suitable for this protection can be sourced from Phoenix Contact as shown in Figure 20 below. Users are responsible for ensuring the suitability of these components for their application.

Manufacturer	Type	Manufacturers part number
PSU lines		
Phoenix Contact	Surge protection plug (x1)	2819008 PT PE/S+1X2-24-ST
	Base element (x1)	2856265 PT PE/S+1X2-BE
Current Loop Lines		
Phoenix Contact	Surge protection plug (x2)	2856058 PT 1x2-24AC-ST
	Base element (x2)	2856113 PT 1x2-BE

Figure 20: Typical SPD configuration used to protect sensor

3.4 Inspection of the FT702LT/D

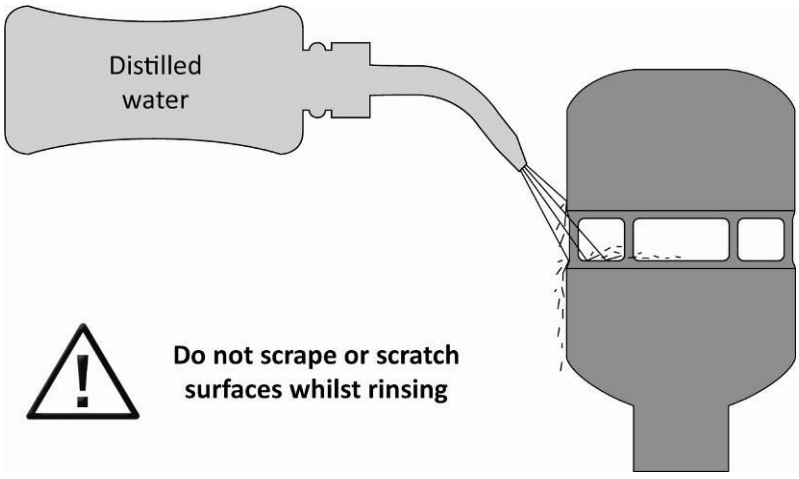
The following checks are required to identify any signs of corrosion or damage on the sensor which may hinder its performance. It is recommended that these checks be carried out annually.

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.

Corrosion; Inspect the sensor's mounting flat and the mounting bar it is fixed to for signs of corrosion. If corrosion is present on either surface, it should be removed using an abrasive cloth. Before reinstalling the sensor, electrical joint compound should be applied to the sensor's mounting flat (see section 3.2). Check that the mounting screw, nut and washer are in good condition with no signs of corrosion and tighten as necessary. If corrosion is present replace with parts of the appropriate finish (see section 3.2).

Interconnection cable; Inspect the condition of the cable. If any part has become frayed or damaged in any way, it should be replaced immediately. Intermittent cable faults may not be visible, but may show up as errors in data. See section 2.2.4 for details on how to identify such faults.

Connector protective sleeve; Check for any signs of damage or degradation. If the sleeve is damaged it should be replaced (see section 3.2).



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 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.

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.

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 sections 4 & 5):
    - Check that the sensor has the latest version of software (please contact FT Technologies for more information on latest software releases)
    - Check that the heater set point is at least 30˚C (see section 2.3)
    - Ensure that the internal filtering in the sensor is enabled (see section 2.2.1)
- Check that the wind sensor data and status flag errors are being processed in accordance with guidelines in section 2.2.1 and 2.2.5.
- 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

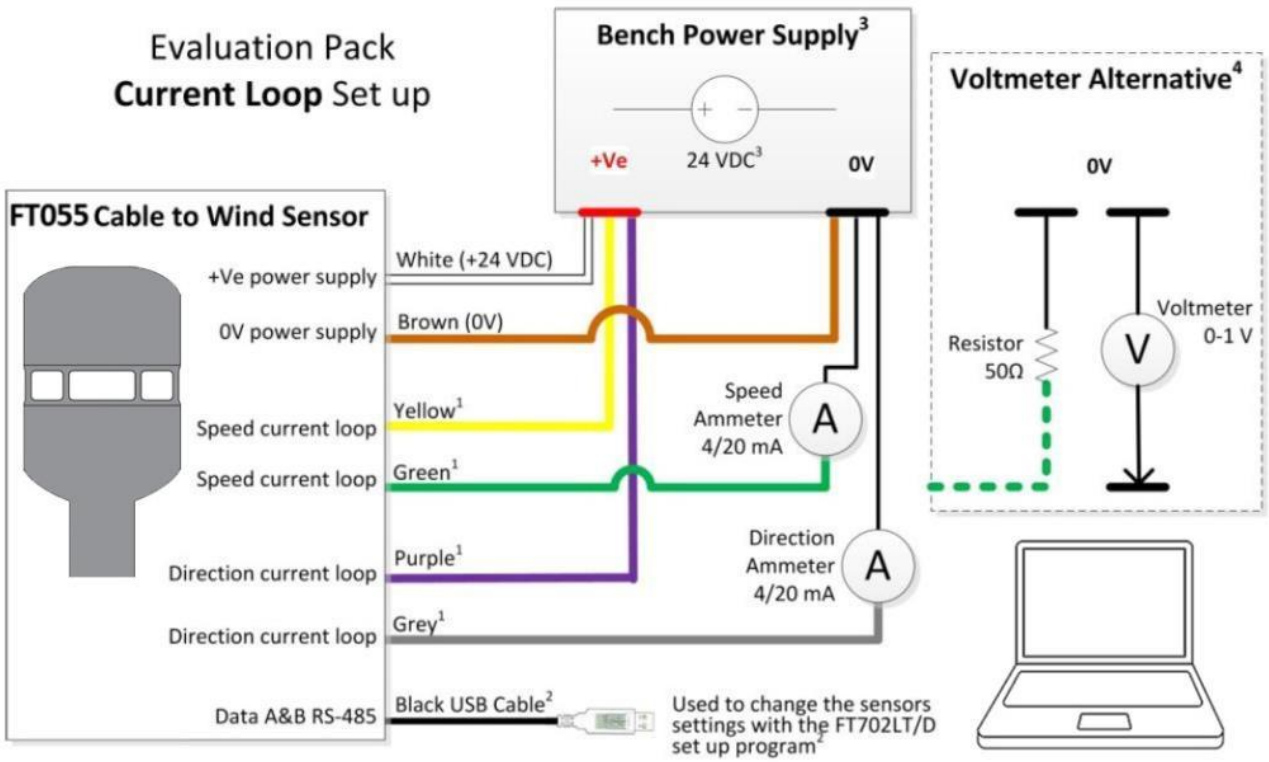
4.1 Evaluation Pack

To help users carry out a test bench assessment of the FT702LT/D FT Technologies sells an Evaluation Pack. The Evaluation Pack includes the FT055 cable to connect the sensor to an external power supply. The cable is also fitted with a USB connector to connect the wind sensor directly to a computer so that its settings can be checked and configured. There are also colour coded wires allowing the current loops to be measured with a multimeter or oscilloscope. (See Figure 21)

The pack also includes the FT702LT/D Set-Up and Test Program for changing a sensor's settings (see section 5).

4.2 Wiring Diagrams

The FT702LT/D can be easily tested by connecting a DC ammeter in series with each current loop. A positive supply must be provided to one of the current loop wires. The other wire must then be connected through an ammeter to ground. This is because the FT702LT/D current loops **sink** current, they do not source it. Figure 21 shows how the Evaluation Pack can be quickly set up to evaluate the current loops.



Note 1) The current loops are polarity insensitive so the yellow wire connection can be swapped with green and purple swapped with grey.

Note 2) The USB connection can only be used with the FT702LT/D set up and test program, see section 5 for more details.

Note 3) The DC power supply must be able to supply the full heater current of up to 6A. The heater will automatically turn-on if the ambient temperature is below the programmed set point (30°C default).

Note 4) Alternatively connect a 50Ω resistor in place of the ammeter and measure the voltage across the resistor with a DC voltmeter or oscilloscope.

Figure 21: Evaluation Pack Current Loop Set Up

4.3 Quick Start Steps

1. Remove the FT702LT/D sensor and FT055 cable from its packaging and mate the connectors together.
2. Connect the +24 VDC terminal of the power supply (current limit set to 6A) to the white wire and 0V terminal to the brown wire.
3. Connect the yellow wire (wind speed 4-20mA output) to the +24 VDC terminal on the power supply.
4. Connect the green wire (wind speed 4-20mA output) to an ammeter and then connect the other terminal on the ammeter to the 0V terminal on the DC power supply.
5. Connect the purple wire (wind direction 4-20mA output) to the +24 VDC terminal on the power supply.
6. Connect the grey wire (wind direction 4-20mA output) to an ammeter and then connect the other terminal on the ammeter to the 0V terminal on the DC power supply.
7. Switch on the power supply and then monitor the air flow measured on the ammeter outputs.

5 CHANGING SETTINGS

The FT702LT/D is fitted with a 2 wire serial interface. This interface is provided to allow the user to change the internal settings of the FT702LT/D and to perform diagnostic testing. This interface should only be used for configuration and test purposes. This interface does not include the same level of lightning and EMC protection as the 4-20mA outputs and power supply connections. It should **not** be permanently connected to the data acquisitions system.

The interface should only be accessed using the FT055 cable and FT702LT/D Set-Up and Test Program provided with the FT702LT/D Evaluation Pack (see Section 4 also). Figure 22 lists the settings that can be modified.

Function	Factory Default Setting	Range	Description
Heater Set Point	30° C	0-55°C & Off^	See Section 2.3
Heater Current Limit	4A	0.1-6.0A*#	See Section 2.3
Wind Velocity Filter	On	On or Off	See Section 2.2.1
Datum Offset	0°	±180°	See Section 2.2.4
Datum Current	12mA	4mA or 12mA	See Section 0
Loop Error Signal	1.4mA	1.4-3.9 mA*	See Section 0

Figure 22: FT702LT/D Configurable Settings

Notes:
^ Set Point above 44^0C only available from build version 22
* Setting only adjustable from build version 22
# Greater than 4A only available from build version 22

In addition to being able to change these settings the FT702LT/D Set-Up and Test Program is also used to run the current loop auto-increment test function (Section 5.5). It is also possible to generate a report listing the sensor's details and its settings (Section 0).

5.1 Installing the Configuration Program

The FT702LT/D Set-Up and Test Program can be installed on any PC running a Windows operating system. To install the FT702LT/D Set-Up and Test Program;

1. Insert the FT Technologies CD provided as part of the FT702LT/D Evaluation Pack into CD drive.
2. Browse to the FT702LT/D Set Up and Test Program installer on the CD and double click on the setup icon.
3. Select a location to install the program to on the PC's local hard drive. Once installed a shortcut icon will be automatically placed on the desktop.

Figure 23: Program Icon on Desktop

5.2 Configuring the FT702LT/D

The FT702LT/D can be connected to any PC with a USB serial port. Connect the wind sensor to the PC using the FT055 evaluation cable. **Then** switch on the power supply. **Then** run the FT702LT/D Set-Up and Test Program.

Never unplug the wind sensor while the Set Up and Test Program is running as this may leave the current loop outputs disabled. Always click on the *Disconnect* button and then exit the Set-Up and Test Program before unplugging or powering down the FT702LT/D.

The FT702LT/D Set-Up and Test Program cannot be used to configure any other FT Technologies products.

5.3 Change Settings

The settings can be changed on a sensor by using the Settings tab. This will show the current sensor settings on the left and options that can be changed on the right. Select any new settings required on the right and then click on the Update Settings button to apply them. The new sensor settings will then be displayed on the left. Clicking on the Factory Defaults button will cause the settings to be reverted to factory default as per Figure 22

Please Note: Some functionality cannot be set for lower build versions of sensors. For example when an older build version of the sensor is connected, some features are automatically deactivated and cannot be adjusted. This is because the features are not available in the sensor.

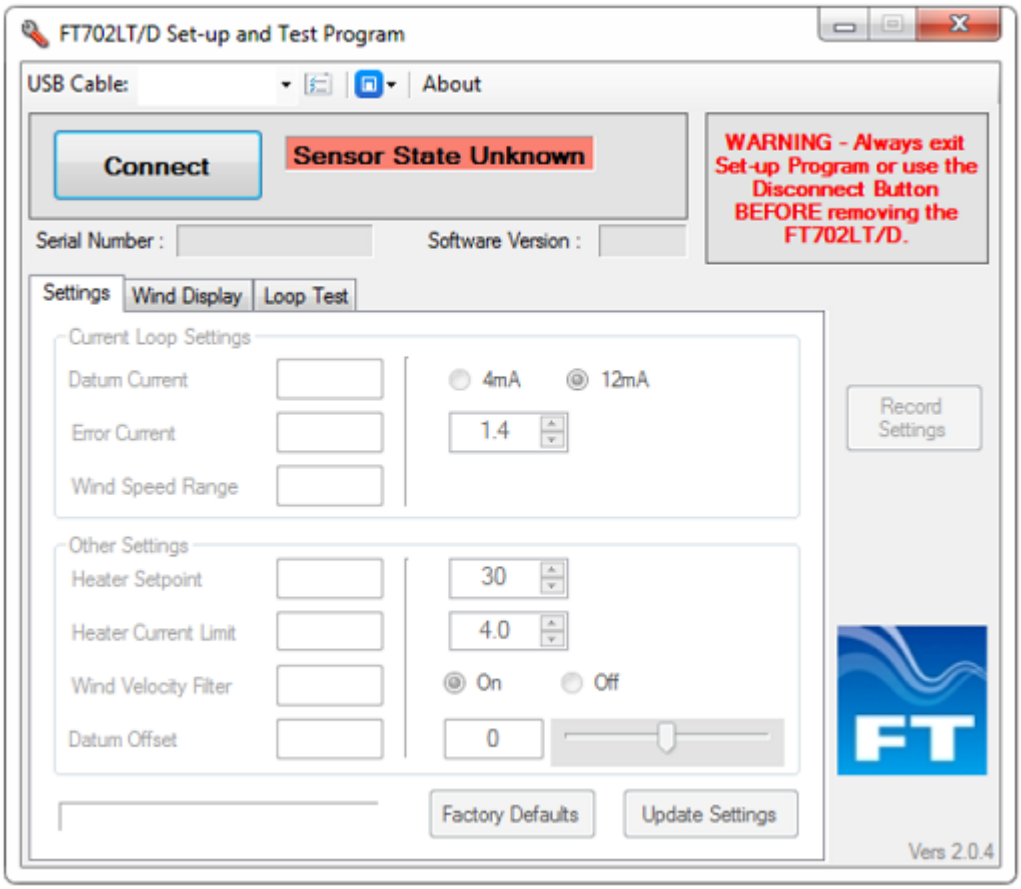


Figure 24: FT702LT/D Set-Up and Test Program Settings

5.4 Sensor Report

The settings applied to a sensor can be reported using the *Record Settings* button. The following parameters are then saved into a file every time the *Record Settings* button is clicked.

- Serial Number

- Software Version
- Wind Velocity Filtering
- Heater Set Point
- Wind Direction Datum Rotation
- Wind Direction Datum Current
- Error Current
- Wind Speed Range
- Heater Current Limit
- Date and Time of Report Generation (based on PC bios clock)

This report can be view or saved as a .CSV file and reviewed later in MS Excel or Notepad.
The location of the report file and its name can be changed by clicking L*og File Settings* button at the top of the application.

5.5 Current Loop Test

Both current loop outputs can be automatically stepped through the 4-20mA range for test purposes. When the loop test command is sent both loops are set to 4mA for a duration of 5 seconds. After 5s the loop current steps by 2mA to 6mA. This process is repeated until the 20mA level is reached whereupon both loops return to the wind measurement mode.

The current loop outputs during the test are shown in Figure 25.

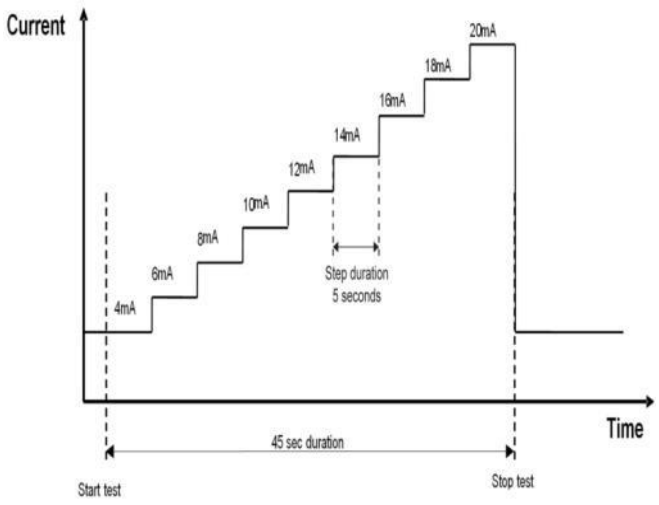


Figure 25: Current Loop Test Waveform

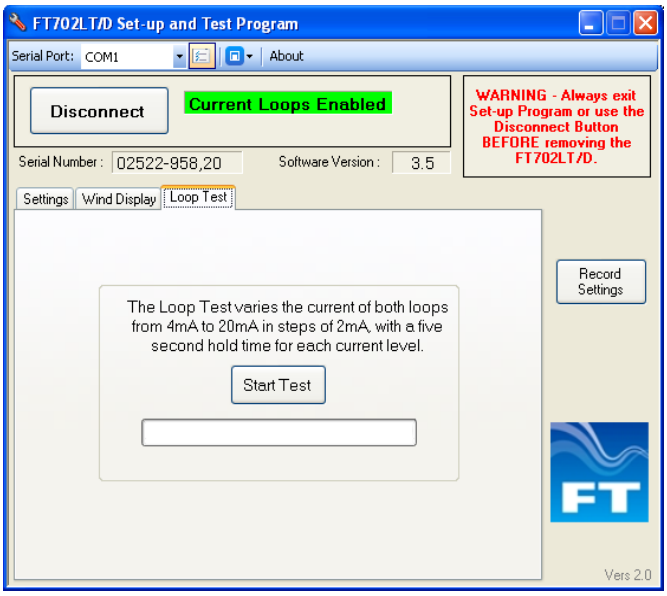


Figure 26: FT702LT/D Set-Up and Test Program Loop Test

To run the test select the Loop Test Tab, and click the *Start Test* button in the FT702LT/D Set-Up and Test Program as shown in Figure 26.

5.6 Reading the Wind Data

Select the *Wind Display* Tab. The wind speed (m/s) and wind direction (degrees) are displayed.

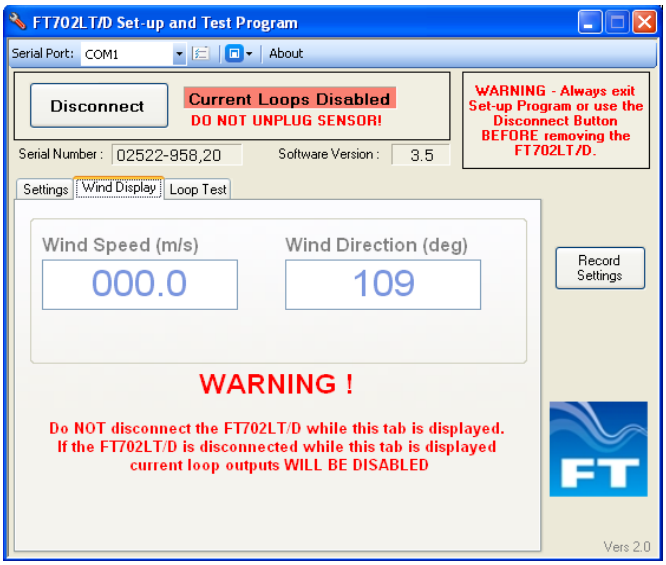


Figure 27: FT702LT/D Set-Up and Test Program Settings Wind Display

5.7 Wind Sensor Mode Warning

The state of the current loops is indicated at all times at the top of the program. When the FT702LT/D is in communication with a computer it is in a digital mode and the current loops are disabled. If the sensor is disconnected from the computer with the current loops disabled, the sensor will remain in this digital mode and the current loops will not work. The FT702LT/D Set-Up and Test Program can be used to change settings and check that the sensor is working but before unplugging the sensor the *Disconnect* button must always be pressed first. The current loops state will then change to be re-enabled as indicated at the top of the program. Once indicated, it is safe to exit the program and disconnect the sensor.

If a sensor has not been taken out of digital mode then open the Set-up and Test Program, re-connect the sensor and click on the *Connect* button. The current loops should now be enabled as indicated at the top of the program. Click the *Disconnect* button, close the Program and then disconnect the sensor. The sensor will now be back in analogue mode.

Never unplug the wind sensor while the Set Up and Test Program is running as this may leave the current loop outputs disabled. Always click on the *Disconnect* button and then exit the Set-Up and Test Program before unplugging or powering down the FT702LT/D.

End of Manual – Back to **Contents**