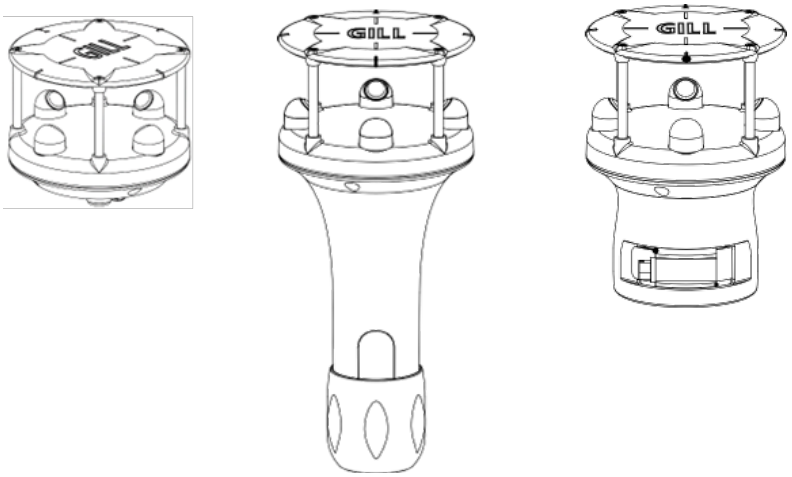
WindUltra

High accuracy, compact anemometer

User Manual



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1. Welcome

1.1. About This Manual

This manual provides essential guidance and information on setting up, installing, and aligning WindUltra to achieve the best results and reliable operation. Read the instructions before setup or installation.

The latest version of this manual is available to download from the gillinstruments.com website.

1.2. Overview of Content

The manual is split into 6 chapters. Each chapter represents an activity in the use of the product. Additional detailed information is contained in the Appendices at the end of the manual.

- Chapter 1 explains how this manual is set out
- Chapter 2 provides a brief overview of the product
- Chapter 3 provides the information needed to set-up the product
- Chapter 4 provides the information needed to install the product
- Chapter 5 provides the information needed to use the product, including resolving faults
- Chapter 6 provides guidance for product maintenance and repair
- The appendices contain details on specification, measurements and derived parameter calculations, and configuration for each protocol

1.3. Description of Icons

The following icons are used in this manual:

Icon	Description
	A note that is important and that should be observed
	Information or a recommendation to ensure best results
	The start of a set of instructions

1.4. Description of WindUltra Component Parts

This manual contains references to WindUltra component parts. These references may form part of an instruction or recommendation. When a component part is referenced, the name of the part starts with capital letters (e.g. Pole Mount, Locking Screw, etc.). The drawing or location of these component parts can be found in drawings in the main sections of the manual.

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1.5. Safety Notices

⚠ Read this manual and all safety warnings and instructions before operating and installing WindUltra.

⚠ Take care when installing and commissioning the device, and follow all guidelines carefully. Take appropriate safety precautions if using live electrical connections.

⚠ Only operate the device within the voltage range specified.

⚠ This device is not designed to operate in explosive atmospheres.

1.6. Designated Use

⚠ Do not operate the device outside of its specified limits. Do not modify or adapt this device.

⚠ Unauthorised modification of the device may affect its operation, and may affect the warranty.

1.7. CE, UKCA and FCC Conformity

This product carries the CE and UKCA marks. A copy of the Declaration of Conformity can be downloaded from gillinstruments.com.

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions:
(1) This device may not cause harmful interference, and
(2) this device must accept any interference received, including interference that may cause undesired operation.

1.8. Legal Information

Gill Instruments reserves the right to change or revise the device without notice and the obligation to notify any person or organisation of such change or revision.

Gill Instruments reserves the right to change or revise the information supplied in this manual without notice or obligation to notify any person or organisation of such change or revision.

While the information in this manual has been compiled with great care, it may not be deemed an assurance of device characteristics. Gill Instruments shall be liable only to the degree specified in the Terms of Sale.

1.9. Software Licenses

The product uses some software developed by third parties. In accordance with the licence agreements, the relevant acknowledgements can be found at gillinstruments.com

1.10. User Manual Revision History

Document Version	Release Date	Key Changes
1.0	June 2023	FIrst Release
1.1	August 2024	New NMEA output rate capabilities

2. Product Overview

2.1. Introduction

The WindUltra 1416 series of 2-axis anemometers utilise Gill's proven ultrasonic technology to provide accurate wind speed and direction data via serial outputs. This highly robust, small, ultra-lightweight device has a built-in ice-prevention system. It is also rated up to IPx9K, meets EN60945 and has a corrosion-free hybrid housing, making this ideal for a broad range of applications. With its new user interface and innovative quick-mounting system, the device is much easier to set up, install and align.

The WindUltra 1416 series offers excellent performance and uptime while providing customers with a very low cost of ownership.

The device:

- measures both wind and gust, speed and direction, up to 75 m/s
- supports Modbus RTU, NMEA 0183, proprietary ASCII, RS-485, RS-422 and SDI-12 interfaces
- can be supplied with either a 25-26 mm (1") or 44-51 mm (1.75 - 2") quick-mounting system
- outputs data at 1, 2, 4 & 8Hz
- can support RS-422 and RS-485 serial data up to 115200 baud
- allows quick and easy configuration via its USB port
- has thermostatically controlled low-power heating available

2.2. Protocol options

Protocol	Notes
MODBUS-RTU over RS-485	Modbus RTU is recommended for network installations. The device can operate on a Modbus RTU network, or in a point-to-point configuration with the Modbus RTU protocol.
Continuous ASCII over RS-422/485	The device can be configured to output serial data at 1 Hz, 2Hz, 4 Hz or 8 Hz. Necessarily, in this mode the device must be in a point-to-point arrangement. The output format is configurable by the user.
Polled ASCII over RS-422/485	In this mode, the device operates in a polled mode, and the output format is configurable by the user.
NMEA-0183 over RS-422	The device can be configured in NMEA-0183 compliant continuous output mode.
SDI-12	The device is capable of SDI-12 v1.3 compliant communications, for low baudrate applications.

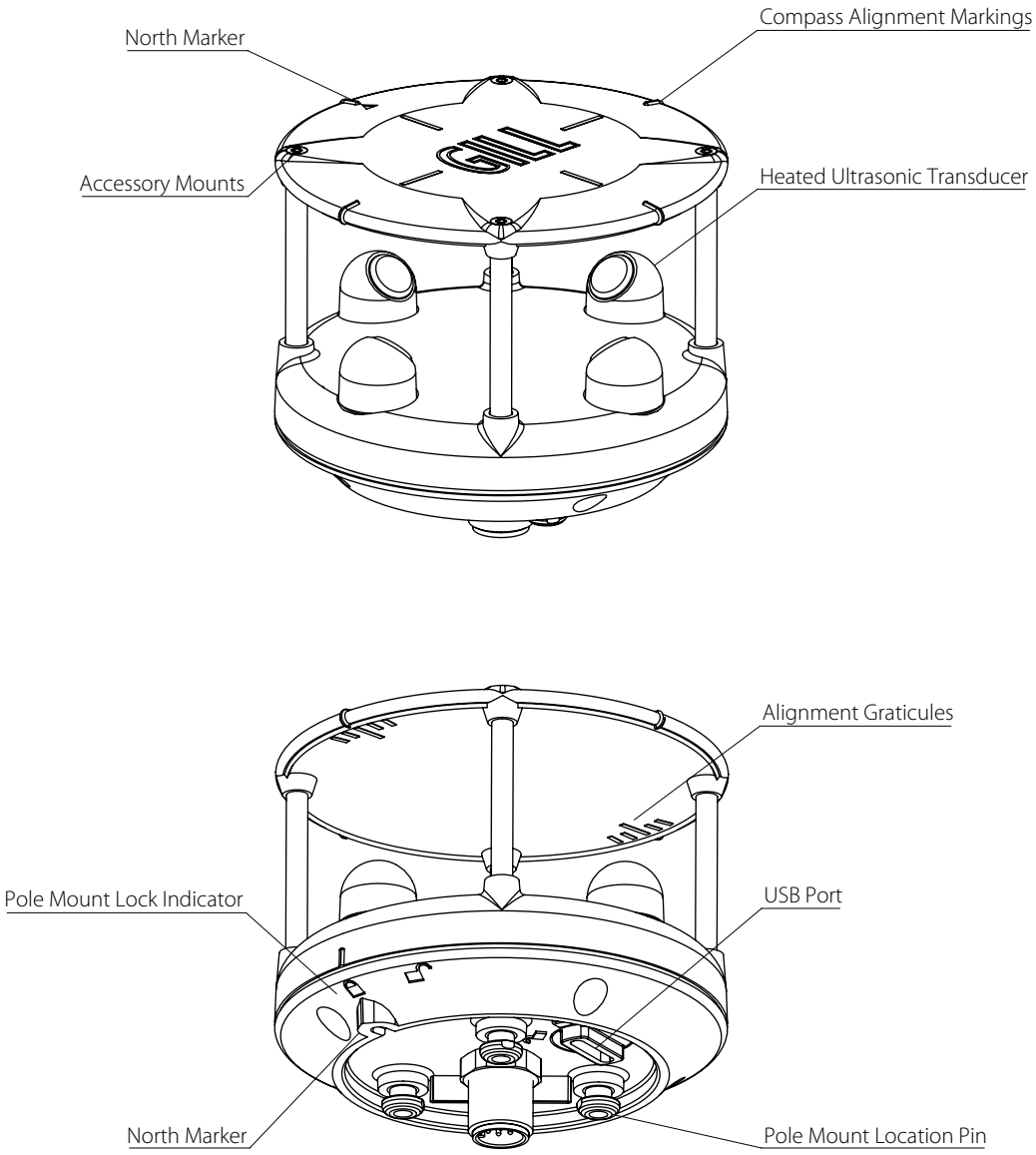

Figure 1 - Main components of the anemometer sensor unit

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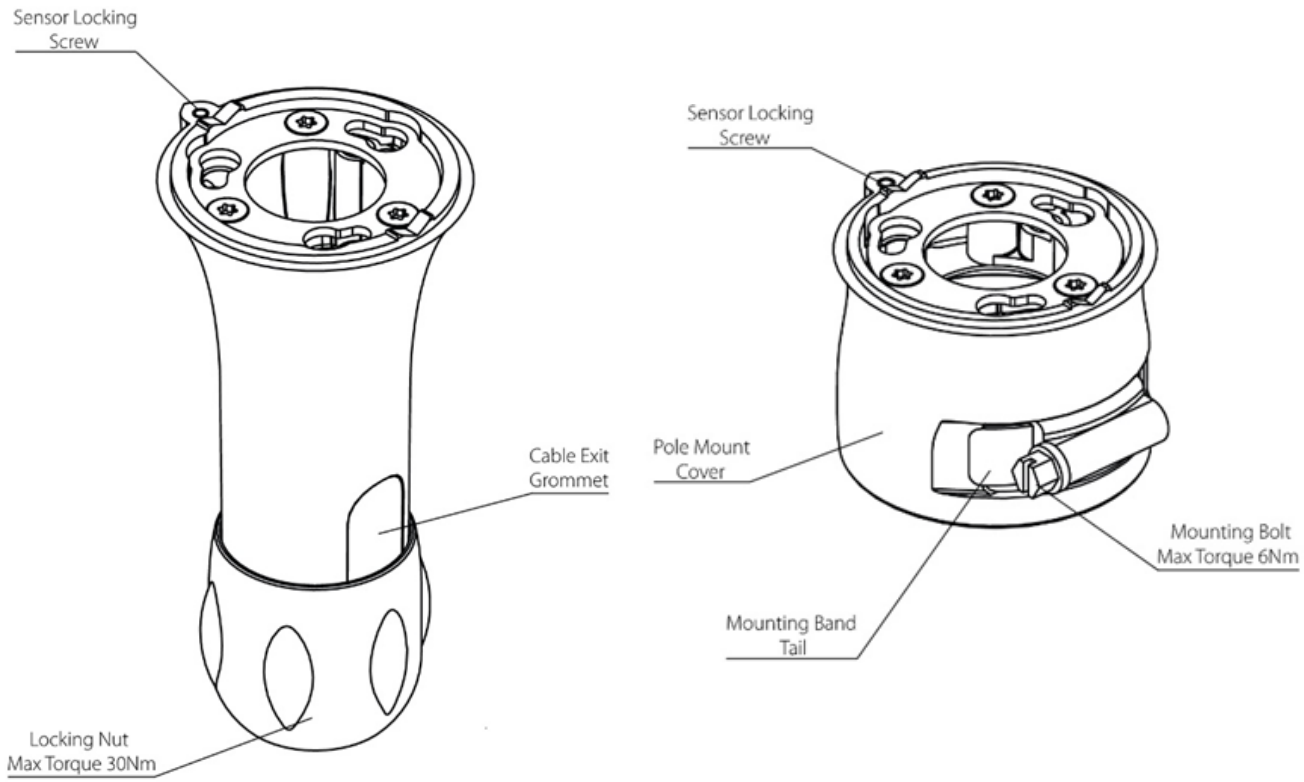

Figure 2 - Main components of the 1" (left) and 2" (right) pole mounts

2.3. WindUltra Product Range

WindUltra is available in a number of configurations. The components included in each configuration/part number are shown below.

Part Number	Sensor Unit	25-26 mm (1") Mount	44-51 mm (1.75-2") Mount	M12 Connector	M12 2m Cable
1416-PK-210-00	✔				
1416-PK-210-01	✔			✔	
1416-PK-210-02	✔				✔
1416-PK-210-10	✔	✔			
1416-PK-210-11	✔	✔		✔	
1416-PK-210-12	✔	✔			✔
1416-PK-210-20	✔		✔		
1416-PK-210-21	✔		✔	✔	
1416-PK-210-22	✔		✔		✔

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2.4. Downloadable Software

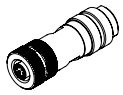
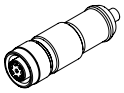
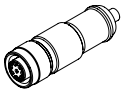
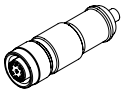
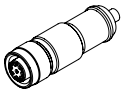
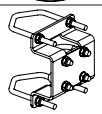
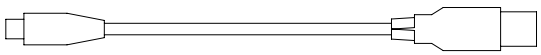
Two software packages are available to help customers use WindUltra.

- WindSet - this software can be used to set-up the product before installation
- WindView - this software can be used to view the data provided by the product

Both software packages can be downloaded from gillinstruments.com.

2.5. WindUltra Accessories

A range of accessories is available to support WindUltra. A list of accessories is shown below.
More information, and the most up to date list of accessories can be found at gillinstruments.com.

Part Number	Part Description	
1416-PK-002	Field Wireable 8-way M12 female connector	
1416-PK-011	2 metre 8-core cable with M12 female connector	
1416-PK-012	5 metre 8-core cable with M12 female connector	
1416-PK-013	10 metre 8-core cable with M12 female connector	
1416-PK-014	20 metre 8-core cable with M12 female connector	
1416-PK-021	25-26 mm (1") pole mount (black)	
1416-PK-022	44-51 mm (1.75-2") pole mount (black)	
1416-PK-023	Pole mount adapter kit	
1416-PK-031	USB device programming lead (Type A to Micro-B)	

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3. Set up WindUltra

3.1. Introduction

WindUltra is designed as a flexible product able to support a range of user definable options. This chapter provides:

- An overview of the configurable features
- Information about connecting WindUltra to WindSet so WindUltra can be set-up
- An introduction to the WindSet set-up software

3.2. Configurable features

WindUltra is designed to allow the following features to be configured:

- Measurement output Interface, e.g. RS422, RS485, SDI-12
- Measurement output frequency e.g. 1Hz, 2Hz, polled
- Measurement units e.g. m/s, mph, kph, knots
- The data, and the order of data, contained in the output message
- The heater operation

WindUltra should be set-up before installation to enable the unit to be tested and the set-up confirmed. More details of WindSet can be found in the next sections of this manual.

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3.3. Methods of configuration

For initial setup, it is recommended that WindUltra is connected to WindSet using the USB to USB, power and data cable available as an accessory (Gill Instruments part no. 1733-PK-031).
It is also possible to connect WindUltra to a PC using the M12 connector on WindUltra, this connection should be used for the installation itself.

To connect WindUltra to a PC USB port follow the instructions below.

1. Turn the USB Port Cover on WindUltra counter clockwise to open it (Figure 3)
2. Allow the USB Port Cover to rise upwards (Figure 4)
3. Remove the USB Port Cover
4. Connect a USB power and data cable to WindUltra and to a PC (Note: Some USB cables are Power only. To connect to WindSet the USB cable must be able to support power AND data)
5. When WindUltra is set-up, replace the USB Port Cover and turn clockwise until the slot aligns with the locked padlock symbol

The USB (Type A) to USB (Micro B) cable can power WindUltra unit for configuration.
The USB cable should not be used to power WindUltra in normal operation.

WindUltra can only be configured via the USB cable or via RS485 2-wire via the M12 connector.
Configuration via RS422 connection is not possible.

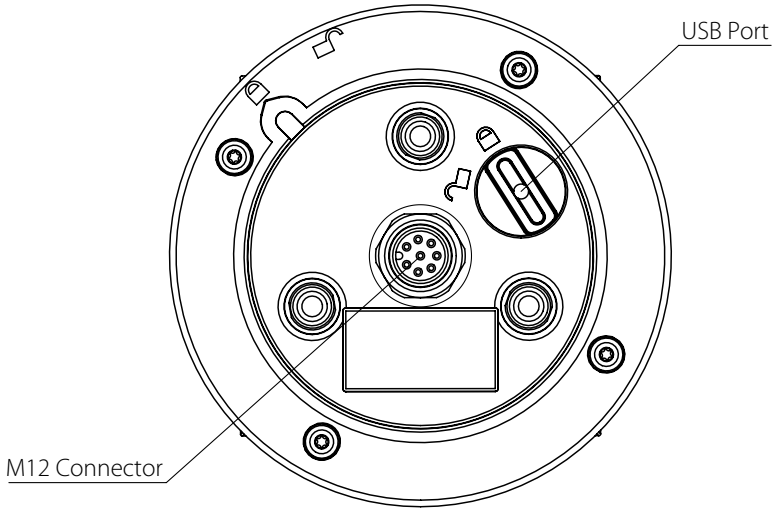

Figure 3 - Locating the USB access hatch and M12 connector

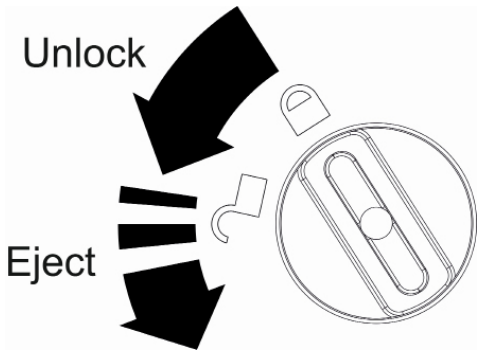

Figure 4 - Opening the USB cover. Twist and allow the hatch to rise upwards from the housing

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3.4. Configuration using WindSet

A free-to-download software package called WindSet is available to enable WindUltra to be set-up. WindSet is compatible with Windows 10 & 11. WindSet software, and the WindSet User Manual can be downloaded fromgillinstruments.com

To use WindSet:

1. Connect WindUltra to the PC running WindSet using an appropriate cable
2. Open WindSet on the PC
3. Allow WindSet to identify the appropriate COM port
4. Use the drop down menu to select the appropriate COM port
5. Click on the CONFIGURE DEVICE button
6. The WindSet Home screen will now be displayed
7. If a copy of the original configuration is required, click on the EXPORT TO FILE button * Optional Step
8. Select the appropriate screen at the top of the page and make the required change (see the WindSet User Manual for further details)
9. Return to step 7 to change additional settings
10. When all required setting have been changed click on the WRITE TO DEVICE button
11. Click on the EXPORT TO FILE button * Optional Step
12. Measurement & protocol changes will be applied when the 'write to unit' button is pressed
13. Once configuration is complete, click on DISCONNECT FROM DEVICE before unplugging the cable

As shown above, it is recommended that the EXPORT TO FILE button is used to save the set-up before writing it to WindUltra. This will ensure that a copy of the set-up is available if it needs to be checked, or if the set-up needs to be written to another WindUltra.

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3.4.1. Communications Settings

The 'Communications' section of WindSet allows you to select the active communications protocol and alter any modifiable aspects of that protocol's configuration (these vary per protocol).

Communications Protocols

Name	Options	Description
Selected Protocol	Modbus, NMEA 0183, SDI-12, Gill ASCII	The protocol to be used (Modbus, NMEA 0183, Gill ASCII, or SDI-12). Gill ASCII is the default protocol.

Modbus-RTU Protocol

Name	Options	Description
Slave Address	1 to 247	The Modbus slave address of the device. Default is 1.
Baud Rate	1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200 baud	The RS-485 interface baud rate. Note that low baud rates can affect device performance due to the time required for serial data transfers. Default is 19200.
Parity & Stop Bits	8/E/1, 8/0/1, 8/N/2	The combination of data bits, parity bits, and stop bits for the RS-485 interface. Default is 8/E/1.

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NMEA 0183 Protocol

Name	Options	Description
Talker Ident	WI (Weather Instruments), II (Integrated Instrumentation)	The 'talker' identification letters used in transmitted sentences. Default is WI. (4800 baud, no parity, 1 stop bit.)
Baud Rate	1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200 baud	The serial interface baud rate. Note that low baud rates can affect device performance due to the time required for serial data transfers. Default is 19200.
Units of speed	m/s (Metres per second), kn (Knots), mph (Miles per hour), km/h (Kilometres per hour), fpm (Feet per minute)	The units of speed in which the NMEA 0183 protocol reports speed.

SDI-12 Protocol

Name	Options	Description
Address Character	0 to 9 (standard range), a-z or A-Z (extended range)	The address character of the device. 1200 baud, even parity, 1 stop bit.

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Gill ASCII Prototcol

Name	Options	Description
Interface	RS-422 or RS-485	Sets the physical communications interface. Defaullt is RS-485.
Fixed Field Mode	Omit Non-Computed-Data (NCD) Values, Show NCD Values	Controls how field values are displayed when outputting non-computed data, either the NCD value can be displayed (e.g. '999.999') or the value can be omitted. Field delimiter characters are displayed in either case. Default is omit.
Speed Threshold to Freeze Wind Direction	0.01 to 5.00 m/s	The wind speed threshold below which the reported wind direction will be frozen. This functionality is disabled when threshold is '0' (default).
Message Mode	Continuous Output, Polled Output	The message output mode. Default is Continuous.
Baud Rate	1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200 baud	The RS-XXX interface baud rate. Note that low baud rates can affect device performance due to the time required for serial data transfers. Default is 38400. (No parity, 1 stop bit.)
Message Terminator	<CR>, <CR><LF>	The terminator characters that should be appended to messages. Default is <CR><LF>.
Node Address	1 to 8 alphanumeric characters (excluding symbols)	The device's node address string. Default is 'Q'.
Power-Up Messages	Disabled, Enabled	Controls if the device outputs a power-up message. Enabled by default.
Report String Items	A variable length list where list items can be any of: Wind Speed, Wind Direction, Speed Units Letter, Node Address, Status Code, Wind U-Vector, Wind V-Vector, Max. Gust Speed, Max. Gust Direction, Min. Gust Speed, Min. Gust Direction, User-defined strings, Heating status code, Supply voltage, Long-term Vector-average Flow Speed, Long-term Vector-average Flow Direction, Long-term Scalar-average Flow Speed, Long-term Scalar-average Flow Direction	Controls the items included in the report string, and their order. Default is Node Address, Wind Direction, Wind Speed, Speed Units, Status Code.
Units-of-Speed	m/s (Metres per second), kn (Knots), mph (Miles per hour), km/h (Kilometres per hour), fpm (Feet per minute)	The units-of-speed used in reporting string items. Default is m/s.

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3.4.2. Measurements Settings

The 'Measurements' section of WindSet allows you to configure the way measurements behave.

Relative Wind Measurement

Name	Options	Description
North Alignment Offset	0 - 359 °	Used to change the device's North reference to be offset from the physical North marker by this amount. Affects both polar and Cartesian outputs. Measured clockwise from above in degrees.
Wind Sample Rate	1 Hz, 2 Hz, 4 Hz, 8 Hz	How many times per second the device transmits an output string in continuous output modes.

Derived Measurements

Name	Options	Description
Gust Interval	1 to 60 minutes	The interval after which the reported minimum wind speed and gust wind speed values are reset. See "B.ii. Derived Parameters" on page 41.
Long-term average period	2-min, 10-min or custom	Configure the settings for the WMO long-term average derived parameters - see "B.ii. Derived Parameters" on page 41. The average sample period, ***N***, is configurable using Block Size and Block Count, and computed as ***N*** = BlockSize x BlockCount seconds.

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3.4.3. System

In the 'System Settings' section, device-wide settings (including heating settings) can be configured.

User Settings

Name	Options	Description
User-Defined Strings (3)	Any alphanumeric string up to 16 characters	Intended to describe an attribute of the installed device, e.g. its location

Heater Control

Name	Options	Description
Heating Mode	Disabled / Enabled (Thermostatic)	Selects the heating mode.
Lower temperature limit	-40 °C to +10 °C	The temperature at which the heating will be enabled when in themostatic mode. **Set to 5 °C by default.**
Upper temperature limit	-40 °C to +10 °C	The temperature at which the heating will be disabled when in themostatic mode. **Set to 10 °C by default.**

Please note that the ice-prevention heating system is designed to turn on before ice has built up on the anemometer. We recommend leaving the default heating setpoints for best performance.

If heating is enabled, the heaters are turned on for 15 seconds after a power-on reset regardless of the ambient temperature.

The operation of the heating system is dependent on the device's body temperature and supply voltage being within certain ranges, these parameters are monitored continuously by the device. If the supply voltage is outside of the allowable range then the heating will be disabled until the required supply is restored.

The device's green LED, located under the translucent USB connector cap, is lit when the heaters are switched on. See Appendix I on page 63 for more details.

WARNING: HOT SURFACE
When heating is activated, the heated ultrasonic transducers will get very hot and should not be touched.

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3.5. Firmware Updates and Maintenance

The WindSet User manual contains additional details on how the Instrument Firmware can be updated. This should not usually be required.

3.6. Status LEDs

The device contains three LEDs that are visible through the USB socket cover, which indicate the device's status. See Appendix I on page 63 for details.

3.7. Troubleshooting

If you encounter problems with the WindUltra, see Appendix H on page 61.

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4. Install WindUltra

To install WindUltra, it is recommended that the following steps are taken:

- Select an appropriate site
- Prepare the equipment
- Install the unit

4.1. Select an appropriate site

When selecting a site three attributes need to be considered:

- Physical location and obstructions
- Electromagnetic interference
- Power and communications cable

4.1.1. Physical location and obstructions

Mount the device in a location that will allow a measurement that is representative of the wind conditions of interest. The World Meteorological Organisation (WMO) makes the following recommendations:

On Land

- For anemometers over land, the standard exposure of wind instruments over level, open terrain is 10 metres above the ground.
- Open terrain is defined as an area where the distance between the device and any obstruction is at least 10 times (ideally: 30 times) the obstruction's height.
- For uneven terrain, contains obstacles, or is non-homogeneous in surface cover, both wind speed and direction can be affected considerably.

On Sea

- For anemometers at sea (fixed platforms and ships), it is of the utmost importance that wind sensors be exposed sufficiently high above the platform and its superstructure to avoid the often extensive influence of the platform on the local wind structure.
- In general, it is never safe to assume that a wind sensor is unaffected by the platform structure, even if it is exposed at least 10 metres above the height of the tallest obstruction on the platform unless the platform is relatively small.

Height

- The choice of height at which wind measurements should be taken in urban areas can be a challenge. However, applying these basic principles can help to attain meaningful results.
- In urban districts with low element height and density, it may be possible to use a site where the 'open country' standard exposure guidelines can be met. The closest obstacles should be at least 10 times their height distant from the anemometer (see Figure 5) and not be more than about 6 metres tall on average.

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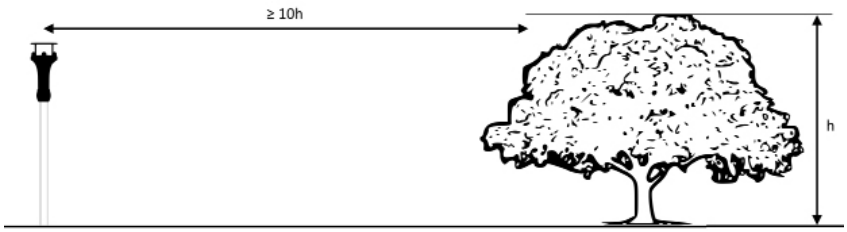

Figure 5 - Recommended minimum distance to obstacles

- In more densely built-up districts, with relatively uniform element height and density (buildings and trees), wind speed and direction measurements should be taken with the anemometer mounted on a mast of open construction at a minimum height of 1.5 times the mean height of the elements. The same recommendations apply to urban districts with scattered tall buildings, but with special attention to avoid the wake zone of the tall structures.
- To take wind speed measurements in densely built areas with multiple high-rise structures, a very tall tower should be used.

Towers and masts

- Anemometers on towers with open construction should be mounted on booms (cross-arms) that are long enough to keep the devices at least two (preferable three) tower diameters' distance from the side of the mast. Devices should be mounted so that the least frequent wind direction passes through the tower. If this is not possible, or if the tower construction is not very open, two or three booms with duplicate devices may have to be installed to avoid wake effects and upwind stagnation produced by the tower itself.
- If anemometer masts are to be mounted on tall or isolated buildings, the effects of the dimensions of that structure on the wind must be considered.

4.1.2. Electromagnetic Interference

- Avoid mounting in the plane of any radar scanner – try to establish a vertical separation of at least 2 metres.
- We suggest the following minimum separations (all round) for radio transmitting antennas.
  - VHF IMM – 1 metre.
  - MF/HF – 5 metres.
  - Satcom – 5 metres (avoid likely lines of sight).
- EMC performance may be compromised if cable screen integrity is not maintained.
- Earth loops should not be created – wire the device following the installation guidelines.
- The anemometer power/communications cable shield should be bonded to the system earth only at the host end of the cable, not the anemometer end.
- Ensure the power supply operates to the WindUltra specification at all times.
- Do not install the device on the same communications network as a Medium Wave or Long Wave Transmitter, as this may affect the accuracy of measurements.

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Immunity test requirements for equipment intended to be used in an industrial electromagnetic environment have been applied. These test levels are above the levels expected to be experienced in normal use due to the above recommended siting conditions, but disturbances may be expected 150 to 200kHz. If any interruption to performance is experienced due to external electromagnetic signals the product will automatically return to specification once the signals levels have diminished.

4.1.3. Power and Communications Cable

Gill Instruments can supply cable suitable for connecting to the product to power and data collection systems. It is recommended that any cable used meets the specification shown below.

Cable feature	Recommendation
Sheath material	Polyurethane
Wire gauge	24 AWG / 0.25 mm^2 / 0.51 mm Ø
Strand gauge	7 x 32 AWG / 0.032 mm^2 / 0.20 mm Ø
Pairing	Twisted pairs with drain wire
Screening	Screened with aluminium tape
Outer diameter	6 - 8 mm
RS-422 number of pairs and max cable length	4 pairs, max length = 1000 m
RS-485 number of pairs and max cable length	3 pairs, max length = 1000 m
SDI-12 number of pairs and max cable length	2 pairs, max length = 90 m

The power required to be supplied **at the unit** is shown below. Any voltage drop between the power supply and the unit should be considered.

Heating	Supply Voltage	Average current (12VDC)	Peak current (12VDC)	Power
Inactive	5-30 V at the unit	<20 mA	<100 mA	<1 watt
Active	10-30 V at the unit	<300 mA	<800 mA	<7.6 watts

WARNING: HOT SURFACE
When heating is activated, the heated ultrasonic transducers will get very hot and should not be touched.

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4.2. Prepare the equipment

To install the product the following additional equipment will be required:

- Power and Communications Cable
- Power Supply
- Data Communications (for example computor, data logger, PLC)

4.2.1. Connector wiring - pre-moulded cable

Gill Instruments can provide the recommended halogen-free polyurethane-sheathed shielded 8 x 0.25mm^2 (24AWG) cables with the M12 connector pre-moulded, to connect power and communications to your device.

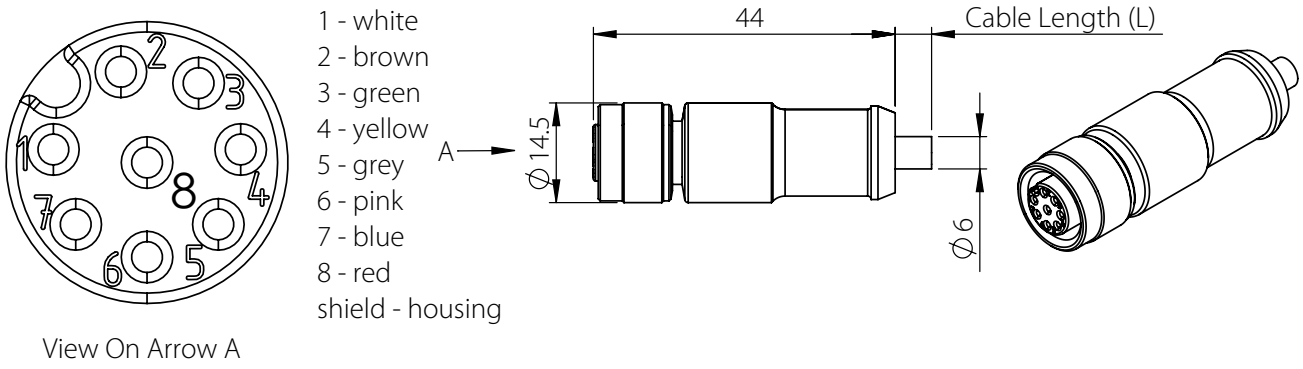

Figure 6 - Pre-moulded cable and specifications

The pre-moulded cable uses the wire colours shown. Use this table to connect to your data-logging equipment.

	Wire colour	RS-422	RS-485	SDI-12
1	White	Voltage supply (V-)	Voltage supply (V-)	Voltage supply (V-)
2	Brown	RX-	-	-
3	Green	RX+	-	-
4	Yellow	TX-	Data-	-
5	Grey	TX+	Data+	-
6	Pink	Voltage supply (V+)	Voltage supply (V+)	Voltage supply (V+)
7	Blue	Signal Ground	Signal Ground	Signal Ground
8	Red	-	-	SDI-12 Signal

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4.2.2. Connector wiring - manual assembly with field-wireable connector

If you are using a field-wireable connector, you will need to provide the required length of cable to the specification in Section 4.1.3 on page 24 to connect power and communications to your device. Please contact your distributor or Gill Instruments for cable options.

The field-wireable connector is designed to be straightforward to wire up to a suitable cable.

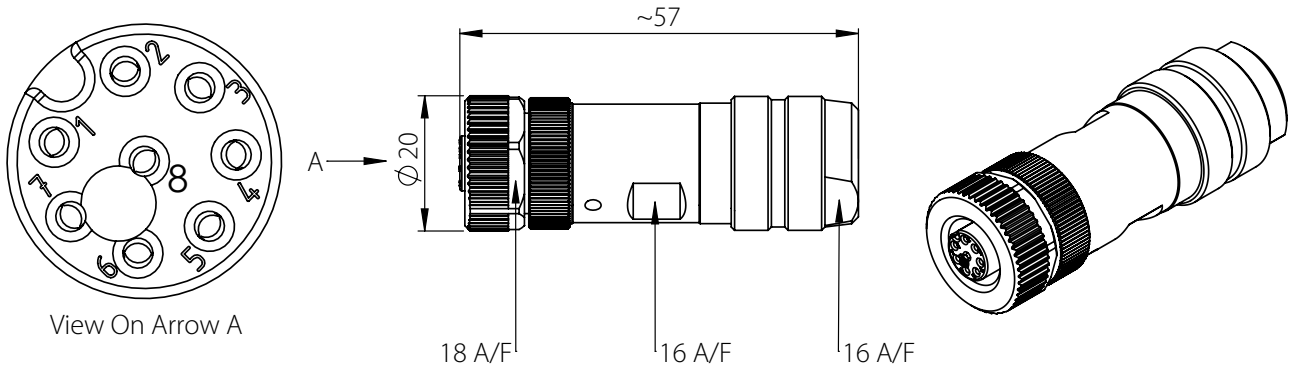

Figure 7 - Field-wireable connector and pin numbering, as seen from the front of the connector

Fold the screen back over the collar with the o-ring. Push the collar into the body. The shield should be gripped between the collar and connector body.

Open up each required terminal with a screwdriver. Strip the amount (indicated in Figure 8) of each insulated core, and insert it into the correct terminal (note that the diagram does ***not*** show the view as seen when tightening the terminal screws). Tighten up the terminal screw until the wire is secure. Then reassemble the connector, tightening the back shell to compress the grommet against the cable.

A standard wire colour reference is provided in the table on page 25.

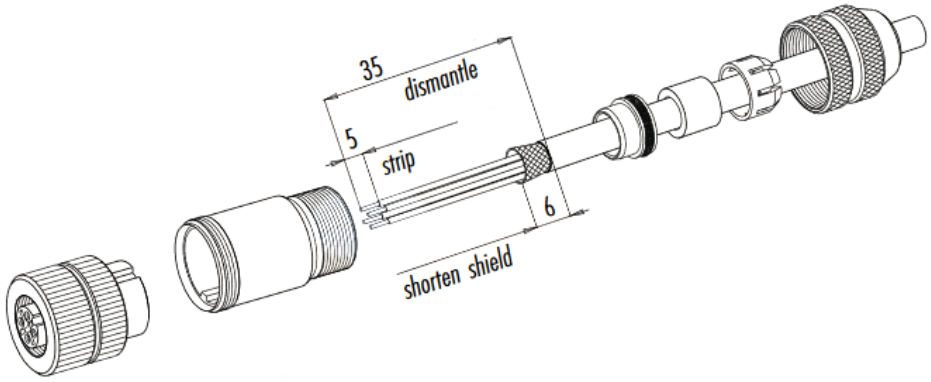

Figure 8 - Field-wireable connector, exploded view, dimensions in mm

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4.2.3. RS-485 / RS-422 Wiring and Termination

The device supports serial point-to-point over all physical layers, and multi-drop network capability over RS-485. Follow these recommendations:

Do not connect (i.e. do not wire) unused pins to the output of the device.

Shielding

Point-to-point Earthing: Bond the shield of the anemometer power/communications cable to the system earth only at the host end.

Multi-drop network: All shields should be connected, and earthed only at the host end of the cable.

Biasing

If using RS-485 or RS-422, the data lines should be appropriately biased if required by 3rd party equipment installed on the network - the anemometer operates in hi-impedance mode while inactive.

The device's transceiver contains fail-safe circuitry (i.e. the receiver ignores invalid input voltage levels) so bus biasing is not mandatory.

Termination

Note that the end nodes in any serial network (including point-to-point) should include a 120 Ω termination resistance placed across the data lines when the cable length is ~ 10m or more.

4.2.4. SDI-12 Wiring

This protocol allows the device to communicate with a device acting as an SDI-12 Data Recorder following the SDI-12 version 1.3 specification. The device implements the 'Sensor' role described in the spec.

The command/response messages are transferred via a bidirectional tri-state serial line which is part of the three-wire (serial, ground, and +12V) SDI-12 interface. UARTs connected to the serial line should have the following configuration: 1200 baud, 7 data bits, 1 stop bit, even parity.

4.3. Install the WindUltra

This section provides information on how to connect, install and align the device. To install WindUltra the steps below should be followed:

- Select the cable route
- Select alignment method
- Preparing the mounting pole
- Install the Pole Mount
- Align and Install the Sensor Unit

4.3.1. Select the cable route

Both the 25-26 mm (1") and the 44-51 mm (1.75-2") pole-mount allow the cable to be run down the inside of the mounting pole.

The 25-26 mm (1") pole-mount also allows the cable to run outside of the pole (e.g. if a solid pole is being used). If the 25-26 mm (1") pole mount is to be used and the cable to be run externally, carefully punch out the circular insert in the cable exit grommet using a suitable tool, and feed the cable through the hole, reassembling the cable exit grommet into the pole mount.

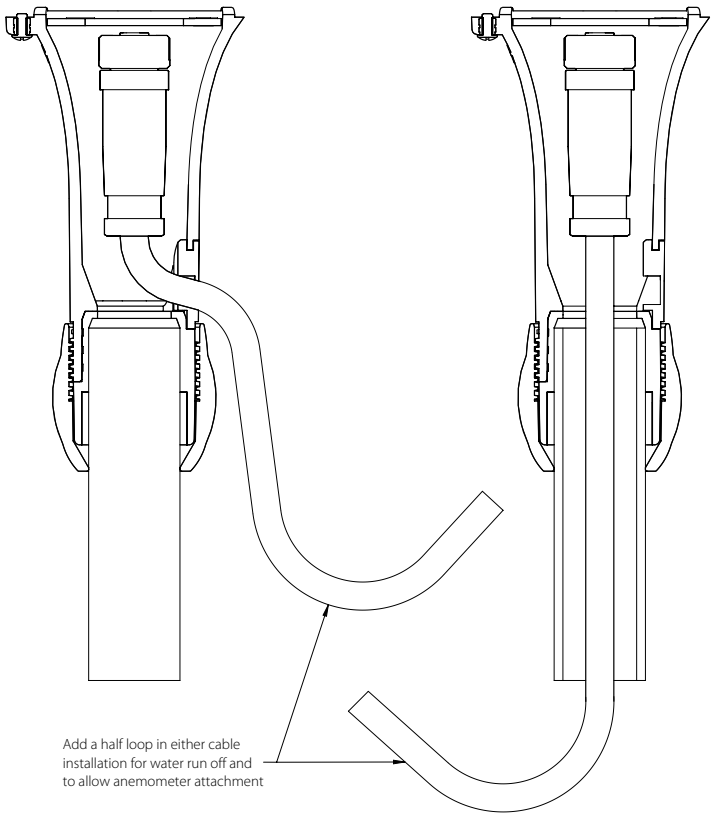

Figure 9 - External (left) and internal (right) cable routing options

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Connect the cable to the sensor part. The cable connector is keyed: align the connector in the base of the sensor, and then tighten the metal tightening nut of the cable connector.

4.3.2. Prepare the mounting pole

The device is designed to fit onto a pole with outer diameter of 25-26 mm (1″) or 44-51 mm (1.75″ - 2″) depending on the pole mount purchased. Figure 10 provides details of how to prepare the pole. Composite or metal poles may be used, but take care to consider potential resistance to corrosion depending on the local conditions.

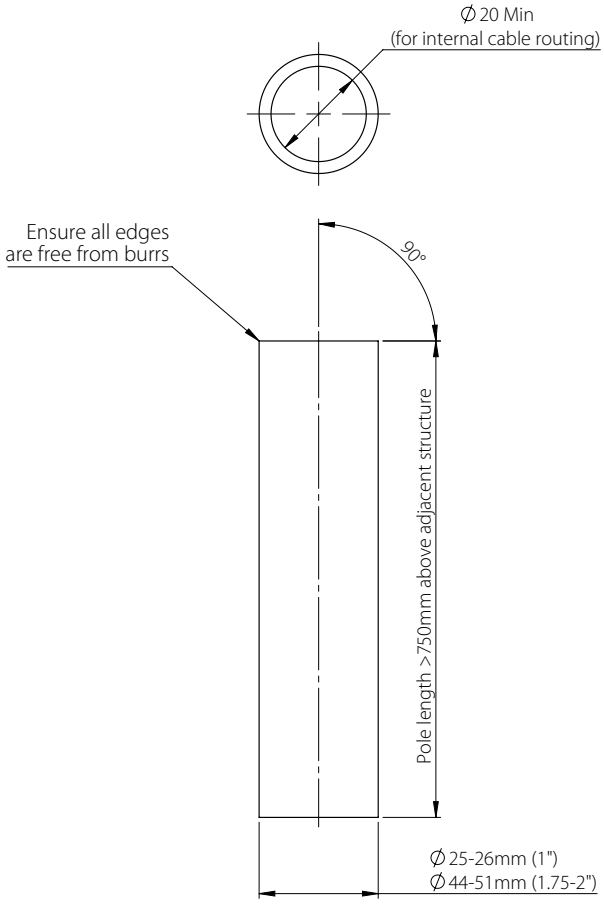

Figure 10 - Diagram showing details for the preparation of the mounting pole

Always take great care when using tools to cut the mounting pole to length, or seek expert advice if you do not feel confident.

Cut the mounting pole to the desired length, and ensure that the ends are cut square to the axis. De-burr the edges of the pole using a file once it has been cut to prevent damage to cabling and the mount. Align the pole with the aid of a spirit level.

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4.3.3. Install the Pole Mount

1. Ensure the pole is securely fixed and vertical
2. Push the Pole Mount firmly onto the pole and check it is pushed fully onto the pole and level
3. Secure the Pole Mount into place using:

- **the Locking Nut for the 1 inch pole mount.** The Locking Nut can be tightened by hand or by using a 42mm A/F spanner. The maximum torque used should not exceed 30Nm.
- **the Mounting Bolt for the 2 inch mount.** The Mounting Bolt can be tightened using a 7mm hex socket or a flat blade screwdriver. If possible the Mounting Band Tail should be fed inside the Pole Mount Cover. The maximum torque used should not exceed 7Nm

4. Align the Pole Mount – see next section

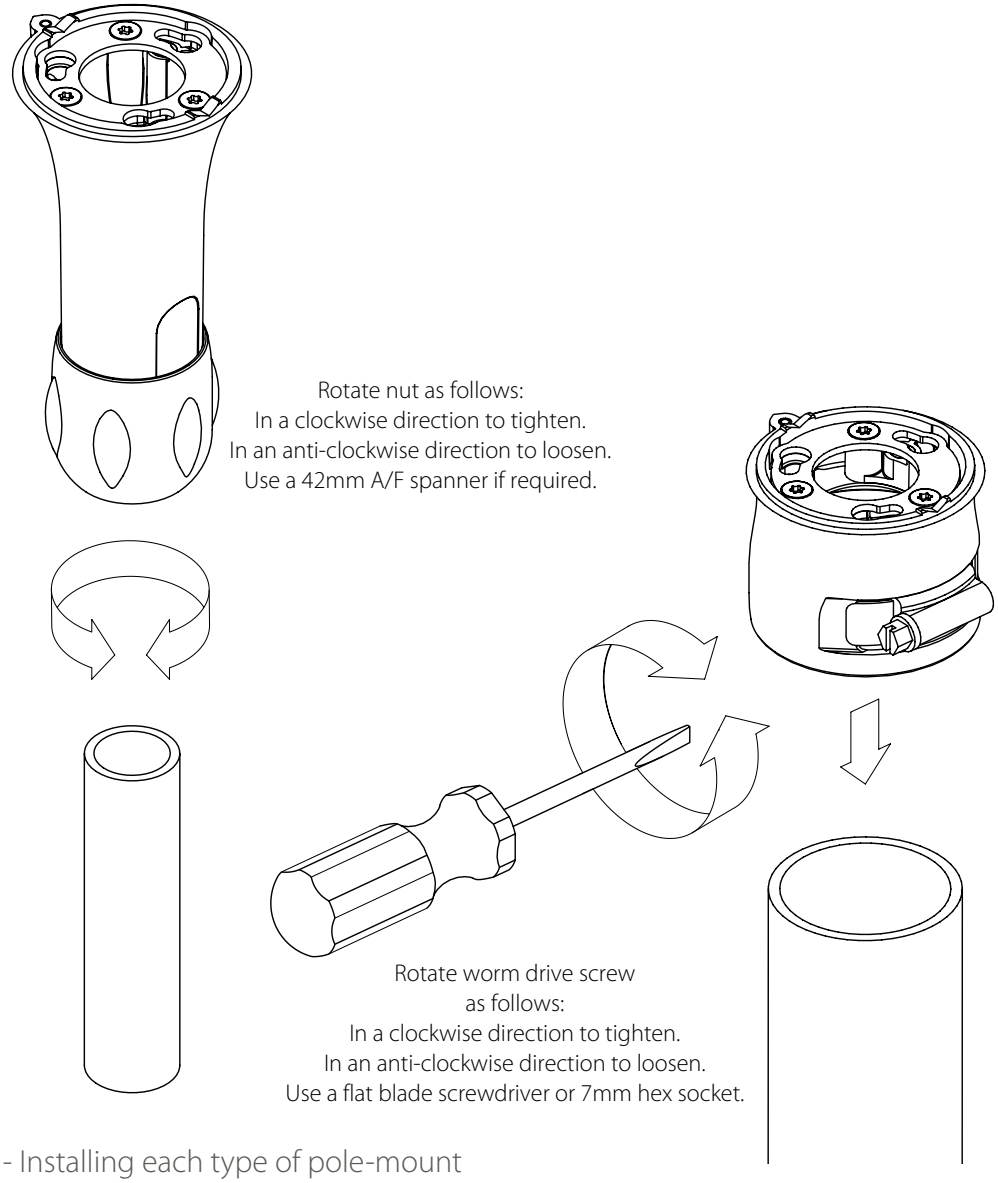

Figure 11 - Installing each type of pole-mount

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4.3.4. Align the Pole Mount

The sensor can be aligned in any direction, but is by default configured to be aligned to North. To aid in this operation, several features are available for use. Figure 12 shows how a compass can be used to aid alignment, and how a pointing device allows a distant feature to be used (e.g. with the aid of a map). Once aligned, tighten the fastener until the pole-mount is secured to the pole:

- 25-26mm (1") Pole Mount Max torque 30 Nm
- 44-51mm (1.75"-2") Pole Mount Max torque 6 Nm

If the sensor is not aligned to North, then the direction of the North Alignment Marker on the Sensor Unit should be measured and loaded into the product using WindSet. (e.g. if the north marker is pointing due East then the angle to enter into WindSet is 90°).

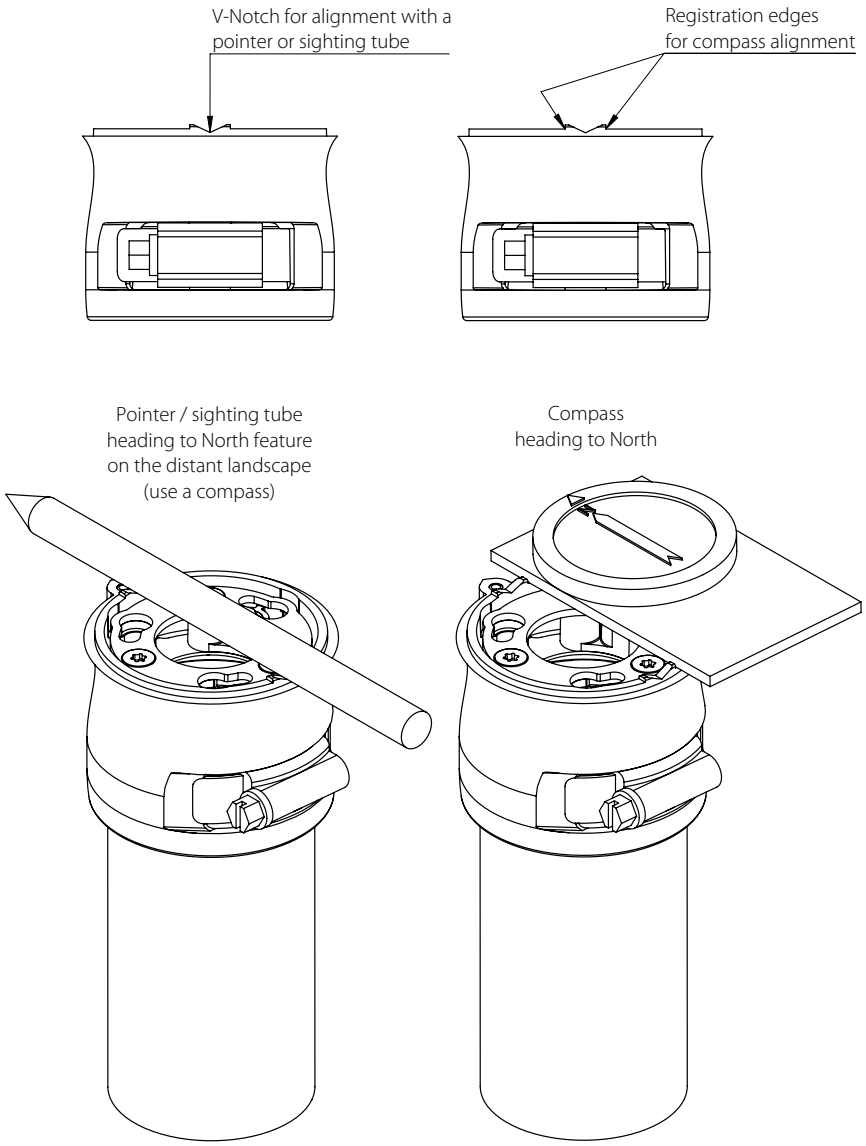

Figure 12 - Aligning pole-mount using a pointer or a compass

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4.3.5. Install the Sensor Unit

The WindUltra Sensor Unit can now be installed

1. If not already in place, route the power and communications cable through the Pole Mount
2. Connect the cable to the Sensor Unit
3. Place the Sensor Unit onto the Pole Mount and turn counter clockwise to secure in place, as shown in Figure 13
4. Tighten the Sensor Locking Screw. The maximum torque used should not exceed 0.55Nm.
5. Adjust the cable to an appropriate length/tension
6. Secure the cable in place, and install additional cable support as appropriate

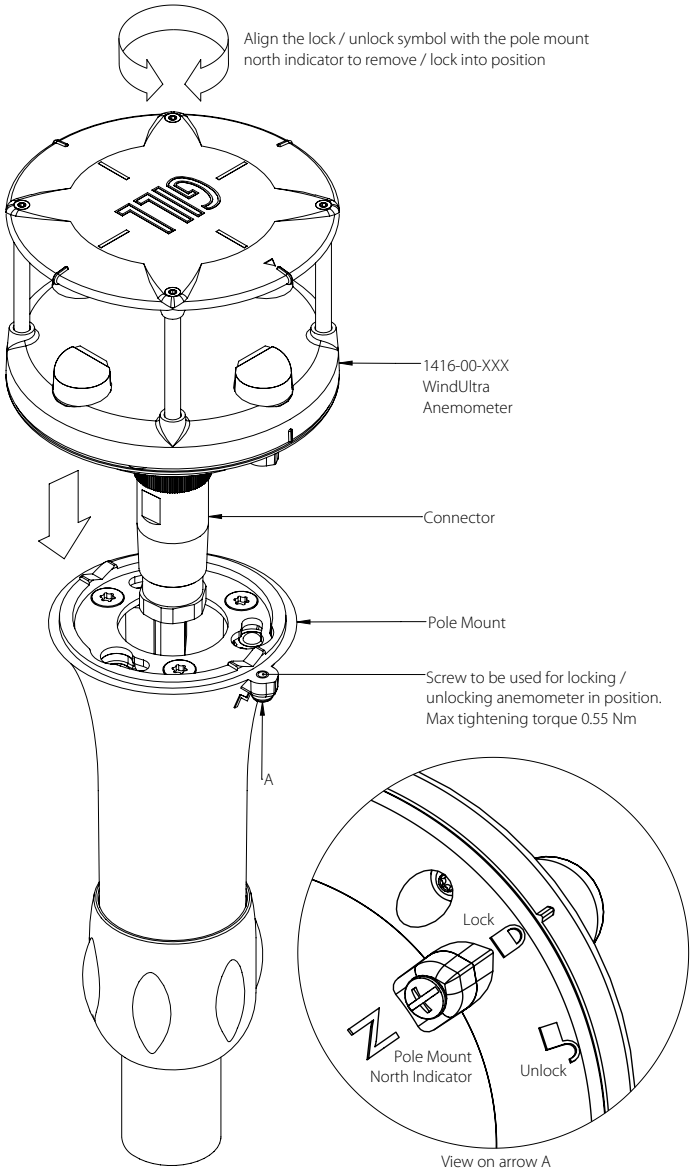

Figure 13 - Connecting the sensor to the pole mount

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4.3.6. Other mounting options

To panel-mount the anemometer, remove 3 off pole-mount location pins with an 8mm spanner, and fasten to panel using 3 off M4 screws into blind holes, ensuring a maximum tightening torque of no more than 1.3 Nm, and maximum 5mm deep full thread from the base of the anemometer. Figure 13 provides details for panel-mounting.
The pole can be mounted to an existing pole, or to a vertical surface, using the pole mount adapter kit, which can be used in a flexible variety of different configurations, shown in Figure 16 on page 35.

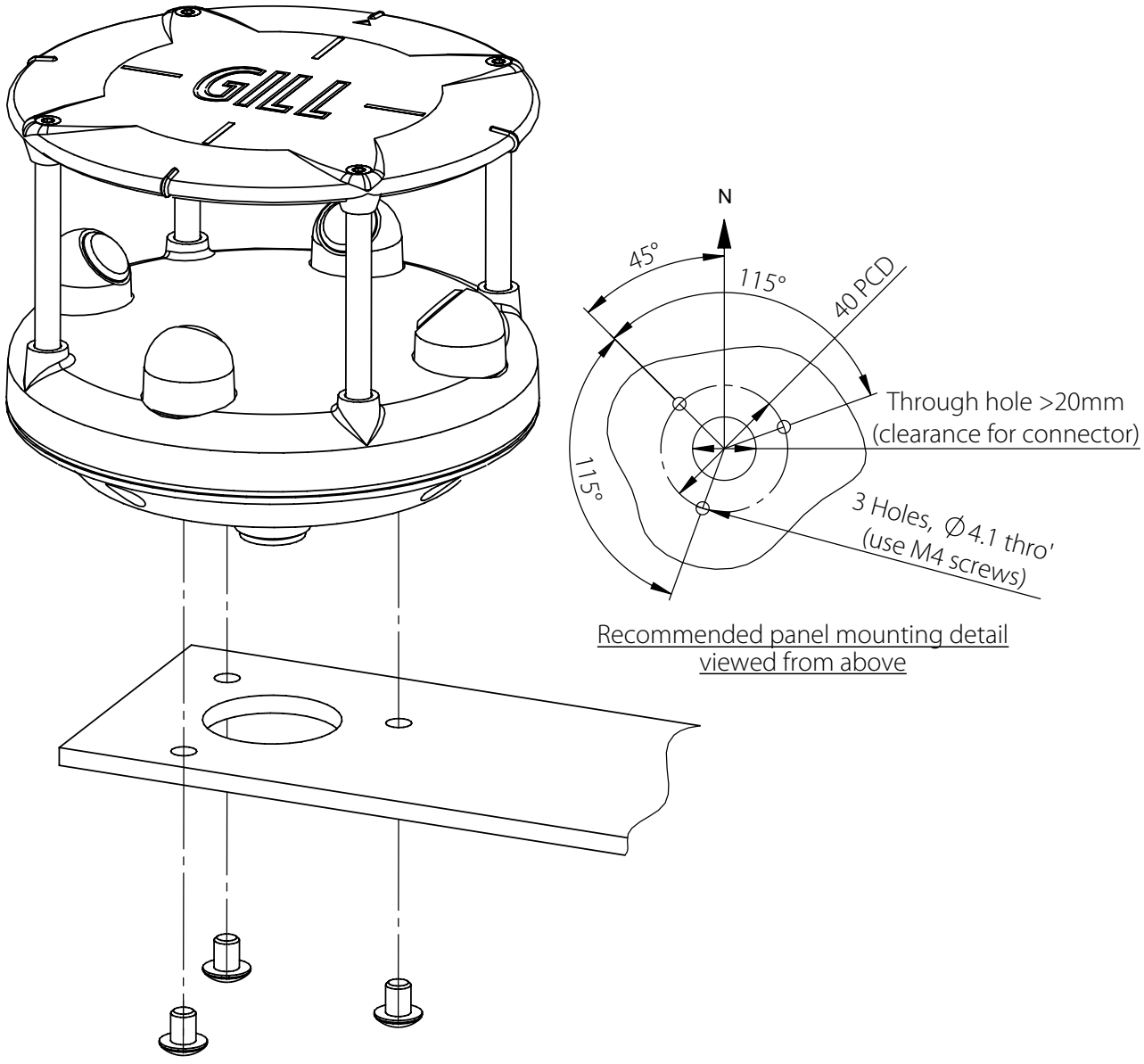

Figure 14 - Details for panel-mounting the WindUltra

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Use the drilling guide shown in Figure 15 if you are fixing the pole mount adapter kit to a vertical surface.

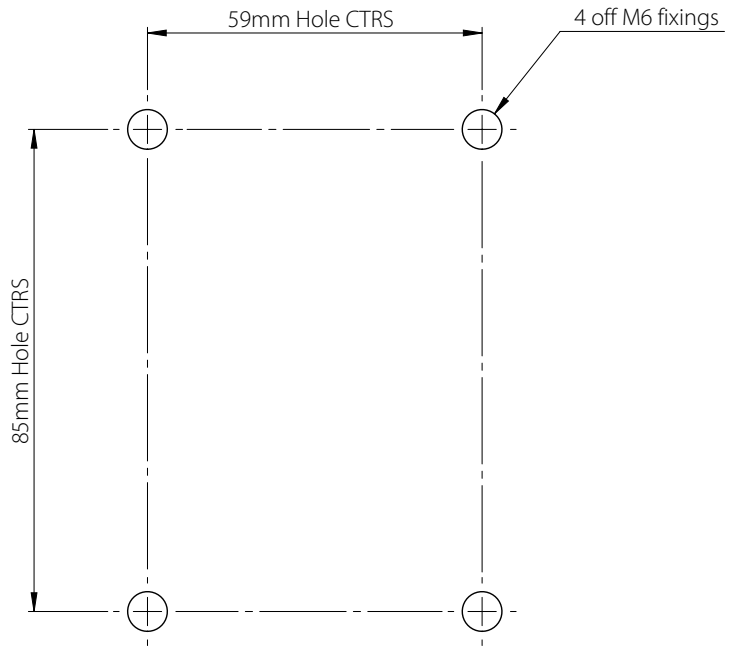

Figure 15 - Drilling guide for affixing the pole mount adapter kit to a vertical surface (NOT TO SCALE)

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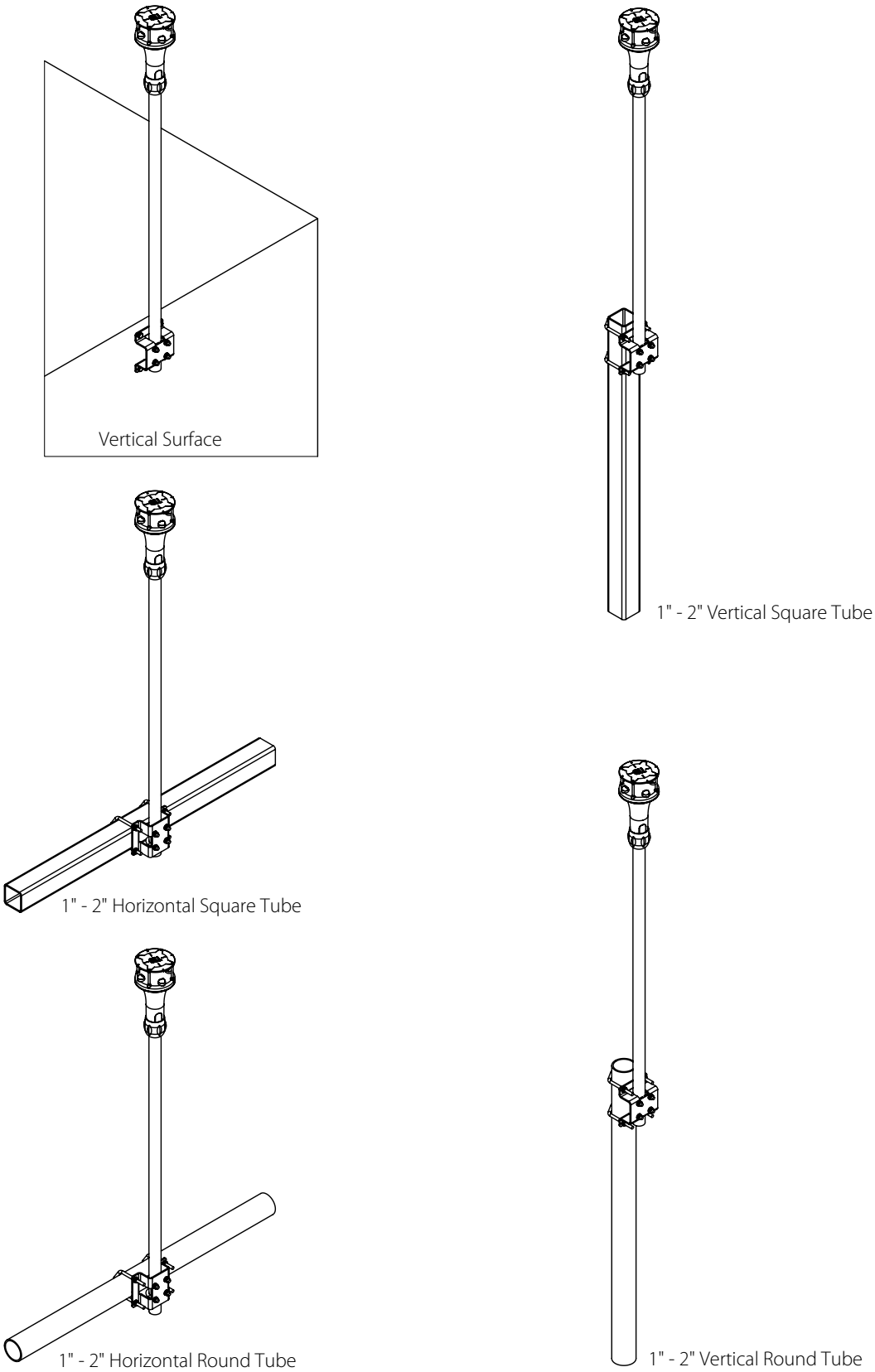

Figure 16 - Different mounting configurations using the pole mount adapter kit

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5. Use WindUltra

5.1. Introduction

Once installed, WindUltra will provide data in the format selected during the set-up process described earlier. This chapter provides an overview of where to find information on:

- Maintenance of WindUltra
- The data provided by WindUltra
- The status codes provided by WindUltra
- The WindView software package
- How to troubleshoot in the event of abnormal operation of the WindUltra

5.2. Maintenance

The WindUltra requires minimal maintenance. Details can be found in Section 6 on page 37.

5.3. WindUltra data

The data output records provided by WindUltra contains two types of data:

- Measurement data - this contains the measurements taken by the sensor
- Status data - this contains information about the status of the sensor

More details of the measurement data that is available and how to set-up WindUltra to report that data is contained in the appendices.

5.4. Status Codes

WindUltra is designed to provide a measurement status code with each measurement. The status code indicates if the sensor has experienced any difficulty in making a measurement. The status code can be included in the data reported by the unit.

5.5. WindView software

Gill Instruments recommends use of WindView to view and log the data provided by WindUltra. WindView is compatible with Windows 10. WindView, and the WindView User Manual can be downloaded from: gillinstruments.com

5.6. Fault Finding

If any difficulty is experienced when using WindUltra, the following sections may be of assistance:

- Fault Finding in Appendix H on page 61
- Status codes in Appendix B.iii on page 43
- Heating status codes in Appendix B.v on page 44
- Status LEDs in Appendix I on page 63

If the solutions listed do not clear the fault, please contact Gill Instruments Technical Support. The contact details for Gill Instruments Technical support can be found at gillinstruments.com

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6. Maintenance and Support

WindUltra does not normally require regular maintenance however, to help ensure the best results from the product this chapter provides information on:

- Cleaning and Handling
- Safety and Care
- Warranty & Returns
- Product Repair
- Disposal

6.1. Cleaning and Handling

While care should be taken when handling the product, it has been designed and tested to withstand knocks and drops which can happen during the install process.

Gently clean the unit with a cloth, moistened with soft detergent.

⚠ **Solvents should NOT be used, and care should be taken to avoid scratching any surfaces.**

6.2. Safety and Care

⚠ **Do NOT remove black "rubber" transducer caps, as this will damage the device!**

⚠ **Do NOT attempt to remove accumulated ice or snow with a tool. Heated devices should clear themselves in most cases.**

It is recommended that any mounting bracket, mounting bolts, connector fixings and cable clamps are checked periodically. It is recommended that these checks are carried out when other checks are scheduled. The product should not require calibration under normal circumstances.

Declarations of conformity to mandatory international safety standards are published on the website page gillinstruments.com/data/documents.htm

6.3. Product Repair

If the product is damaged, a range of spare parts can be supplied by your local distributor or directly from Gill Instruments.

6.3.1. Minor Repairs

Gill Instruments offers a range of accessories such as replacement pole mounts and cables that can be replaced by the user. A list of these parts, and their part numbers, is available on gillinstruments.com.

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6.3.2. Major Repairs

If the sensor unit is damaged it can be returned for repair via a local distributor or directly to Gill Instruments.

The unit should be carefully packed in the original packaging or similar packaging to avoid any further damage. Where possible, a description of the fault, and a list of any fault codes seen, should be included.

Contact details to return a unit to Gill Instruments can be found at gillinstruments.com.

6.4. Warranty

If the product experiences issues during the warranty period, please contact Gill Instruments. If necessary the unit can be returned to Gill Instruments together with a copy of the original invoice.

The unit should be carefully packed in the original packaging or similar packaging to avoid any further damage. Where possible, a description of the fault, and a list of any fault codes seen, should be included.

Instructions on how to return a unit to Gill Instruments can be found at gillinstruments.com.

Any attempt to open the sensor assembly will invalidate the warranty.

6.5. Disposal

All packaging is made from recyclable cardboard to meet REACH guidelines. Either retain the packaging, or dispose of it in a suitable cardboard-recycling facility. The packaging complies with the regulation provisions transposed in France in the articles R543-44 and R543-45 of the Environmental Code (Art. R543-48).

The device contains small amounts of Lead (Pb). If it is necessary to dispose of the device, either return the unit to your local distributor, or Gill Instruments, or consult your local waste disposal facilities and dispose of responsibly.

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Appendix A. Technical Details

A.i. Specifications

Wind Performance	
Wind range	0 - 75 m/s (168 mph, 270 km/h)
Zero wind speed error	< 0.02 m/s
Wind speed accuracy (20 °C)	0 to 20 m/s: < 2% RMSE or 0.1 m/s RMSE (whichever greater) over 20 m/s: < 3% RMSE
Wind speed resolution	0.01 m/s
Min speed threshold for direction	Configurable from 0 m/s
Direction range	0 to 359°
Direction accuracy (20 °C - 40 °C)	< 2° RMSE
Direction resolution	1°
Response time	0.125 seconds

Protocols & Interfaces	
Modbus RTU	RS-485, 32-bit float, 32-bit and 16-bit int registers all measurements
Polled ASCII	RS-422/485 configurable string
Broadcast ASCII	RS-422/485 configurable string
NMEA 0183 v4.10	RS-422 selectable talker identity
SDI-12 v1.3	SDI-12
Configuration	USB

Electrical	
Voltage Input Range	5 V** to 30 V (12V - 24V for heating) & power via USB
Power Consumption (without heating)	< 100 mW (calm conditions, may be higher depending on network and termination resistors) across the voltage range. < 800 mW (at top windspeeds, the unit draws more power, up to this maximum, requires at least 9 V supply). < 1500 mW (maximum peak instantaneous power consumption across working input voltage range)
Power Consumption	2.4 - 7.6 W steady state (with heating).
Protection	Over voltage to 38V and reverse supply. Duration limit 24 h. Mis-wiring protection up to 26 V.

**It is not recommended to run the unit at 5V - long cable runs, low network termination resistance, and extreme conditions may cause the device to reset when powered by 5V.

Measurement Parameters	
Output rate	Polled or 1, 2, 4 or 8Hz in broadcast
Baud rate	1200* to 115200
Parameters	Speed, direction, signed speed on U & V transducer axis, max and min gust, and average speed and direction, supply voltage
Wind speed units	m/s, knots, mph, kph, ft/min (ASCII)
Wind direction units	Degrees
Status reporting	3 codes, user selectable

*Very low baud rates make certain communications impossible, e.g. high polling rates, high sampling rates, and long response strings may be incompatible with low baud rates.

Device Performance	
Sample speed	16 Hz
Update Rate	1, 2, 4 or 8Hz
Start Time	< 3 seconds
Wind algorithm	V4.0
Calibration System	6 speeds with linear interpolation

Mechanical	
Primary materials	Thermoplastic and marine-grade stainless steel
Size	Sensor: 84mm (diameter) x 62mm (height) Including 1" base mount: 190mm (height) Including 2" base mount: 107mm (height)
Weight	Sensor: 150g 25-26mm (1") base mount: 120g 44-51mm (1.75-2") base mount: 110g

Environmental Standards	
Operating Temperature	EN 60945, EN 60068-2-14 Change of temperature
Operating Humidity	EN 60068-2-78 Damp heat
Ingress Protection	IP6x Cat 1, IPx6, IPx8 and IPx9k EN 60529:1992 +A2:22013
EMC	BS EN 61326 : 2013 & BS EN 60945 : 2002 & FCC, EN 60945:2002 + AC1:2008 (EMC) EN 61326-1:2013 (EMC Requirements) EN 61000-6-2:2019 (Immunity) EN 61000-6-3:2007 + A1:2011 (Emissions)
Compass Safe Distance	< 100 mm (EN-60945)
Impact	EN 60068-2-75:2014 Hammer Impact Testing EN 60068-2-27:2009 Shock Testing
Vibration	BS EN-60945 : 2002+ Corrigendum 1:2008 This device is classified as "Exposed to the weather" (formerly class X).
Wind Blown Dust & Sand	DEF-STAN 00-35, Prt3, Iss4, Chpt 3-25
Pressure range	EN 60068-2-13 Altitude Testing
Rainfall	EN 60945:2002 - IEC 60529 Rain and Spray 200 mm/h conducted to DEF-STAN 00-35, Prt3, Iss4, Chpt 3-27 300mm/h (modified tests)

Environmental Performance	
Operating temperature	-40 °C to +70 °C
Operating humidity	< 5% to 100% RH
Operating Rainfall	In 200±50 mm/h of driving rain, over 95% of measurements within ±0.3 m/s.
Rainfall up to 300 mm/h	Over 95% of all driving rain test data has a measurement error of 1.0 m/s or less.
Working pressure range	sea-level to 105 mb
Storage temperature range	-40 °C to +80 °C
Wind blown dust & sand	30 m/s, 1.1 g/m3, 3 hrs in 1 direction at 25 °C

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A.i. Device Dimensions

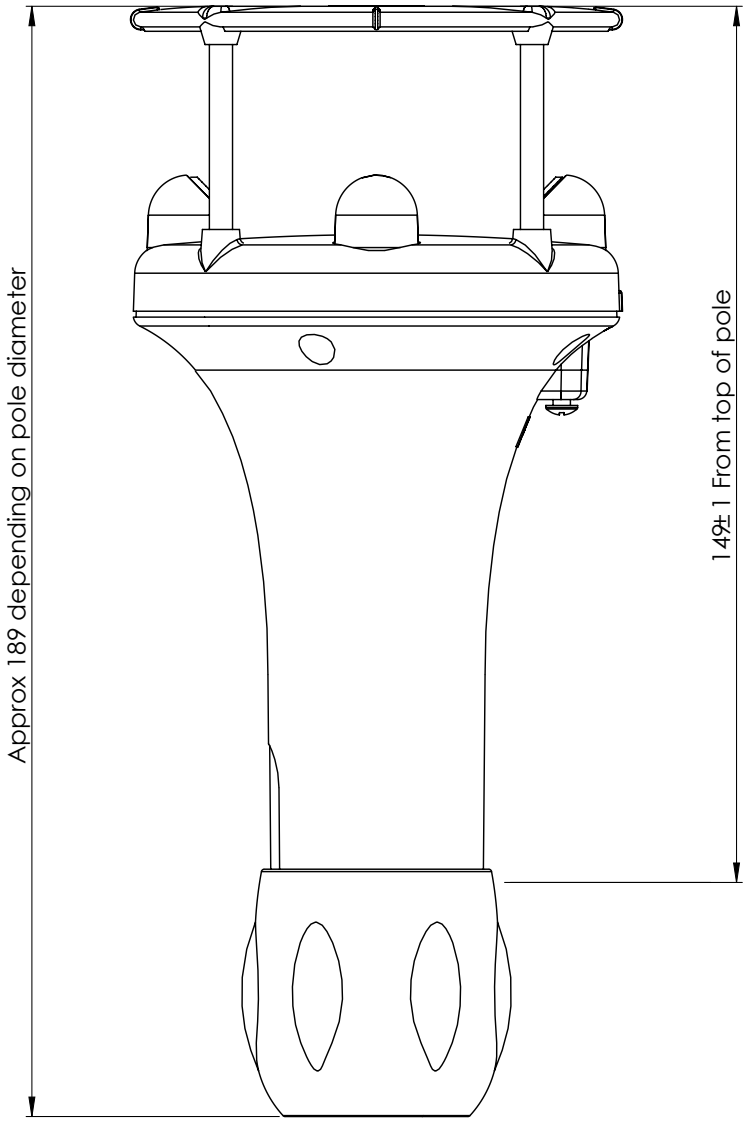

Figure 17 - Side view of sensor with 25-26 mm (1") pole-mount, with dimensions

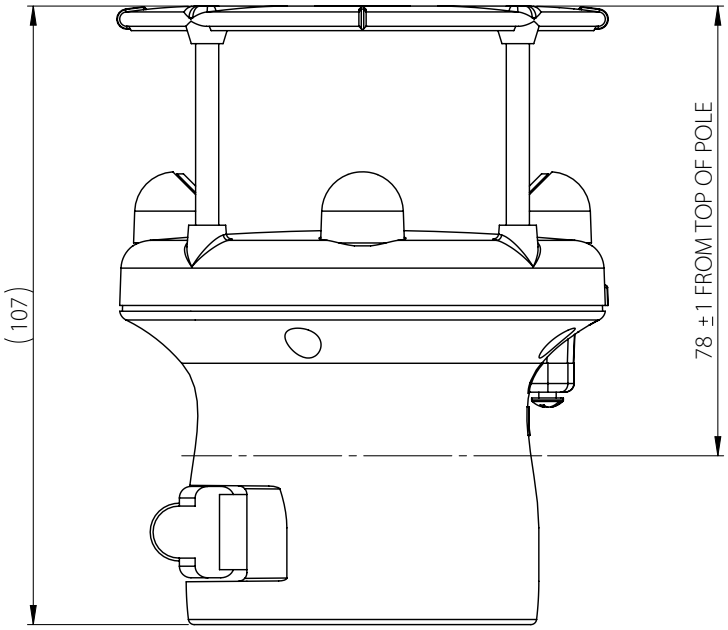

Figure 18 - Side view of sensor with 44-51 mm (1.75-2") pole mount, with dimensions

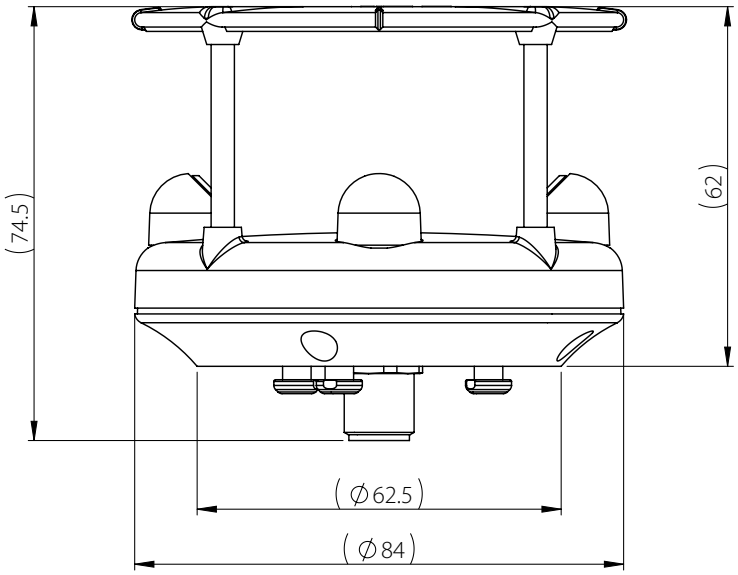

Figure 19 - Sensor side view with dimensions

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Appendix B. Measurement, Derived and Status Output Variables

B.i. Measurements

Here we provide a list of the basic measurements that are available over the digital protocols, and a detailed description of each.

Parameter	Description
Relative wind direction (°)	Wind direction (polar), relative to the alignment marker in the device and referencing the direction from which the wind is blowing. When the device is installed with the alignment marker pointing towards Magnetic North, then 0°, 90°, 180° and 270° represent winds from North, East, South and West, respectively. Average of ***N*** complete headset measurements over sample period.
Relative wind speed	Wind speed (polar magnitude). 0 - 359 °
Relative wind U vector	Signed wind speed magnitude (vectorial). When the device is installed with the alignment marker pointing towards Magnetic North, this represents the South-North wind component. For U-Axis polarity see Figure 20 on page 43.
Relative wind V vector	Signed wind speed magnitude (vectorial). When the device is installed with the alignment marker pointing towards Magnetic North, the V-axis represents the East-West wind component. For V-Axis polarity see Figure 20 on page 43.
Supply voltage	The supply voltage input.

B.ii. Derived Parameters

A list of the output variables derived from the basic measurements.

Parameter	Description
Max gust speed	The maximum 3-second average updated at 4Hz (as per WMO spec), i.e. K=12. Will be reset every gust interval. Gust interval can be different from averaging period (e.g. can configure 10-minute wind average, and a 1-minute gust interval). Gust interval can be specified. Also called Peak Gust.
Max gust direction	The wind direction of the Max gust speed measurement within the gust interval.
Min gust speed	The minimum 3-second average updated at 4Hz (as per WMO spec), i.e. K=12. Will be reset every gust interval. Gust interval can be different from averaging period (e.g. can configure 10-minute wind average, and a 1-minute gust interval). Gust interval can be specified.
Min gust direction	The wind direction of the Min gust speed measurement within the gust interval.

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Long-term Vector-average Flow Speed	Vector Average speed is computed as $\sqrt{\bar{u}^2 + \bar{v}^2}$ where $\bar{u} = \frac{\sum_{n=1}^{N} U_n}{N}$, $\bar{v} = \frac{\sum_{n=1}^{N} V_n}{N}$ and U_n and V_n are the u and v vector one-second average measurements of all instantaneous measurements acquired in one second.
Long-term Vector-average Flow Direction	Vector Average direction is computed using $\bar{d} = \arctan 2\frac{\bar{v}}{\bar{u}}$ Computed by using the same $\bar{u}$ and $\bar{v}$ used for the Wind Speed Vector Average calculation.
Long-term Scalar-average Flow Speed	Scalar Average speed is computed from N 1Hz samples S_n as $\hat{s} = \frac{\sum_{n=1}^{N} S_n}{N}$
Long-term Scalar-average Flow Direction	Scalar Average direction is computed from N 1Hz samples as $\hat{d} = \arctan 2\left(\frac{\bar{V}}{-\bar{U}}\right)$ where $\hat{U} = \frac{\sum_{n=1}^{N} U_n}{N}$, $\hat{V} = \frac{\sum_{n=1}^{N} V_n}{N}$ and $U_n = \cos(\theta_n)$, $V_n = \sin(\theta_n)$ and θ_n = *n*th 1Hz direction sample

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B.iii. Status codes

Status codes available for reporting:

Parameter	Description
Status	Windsonic codes are used here '00' Wind measurement ok '04' Wind measurement invalid '08' Configuration Data Error
Heating Status Code	Hexadecimal codes describing the status of the heating. See the heating status flags below.
Extended Status	Provide information to support regarding these status codes.

B.iv. U-V Axis Definition

Figure 20 shows the U-Axis and V-Axis polarity. The arrows indicate the direction of the flow of the wind.

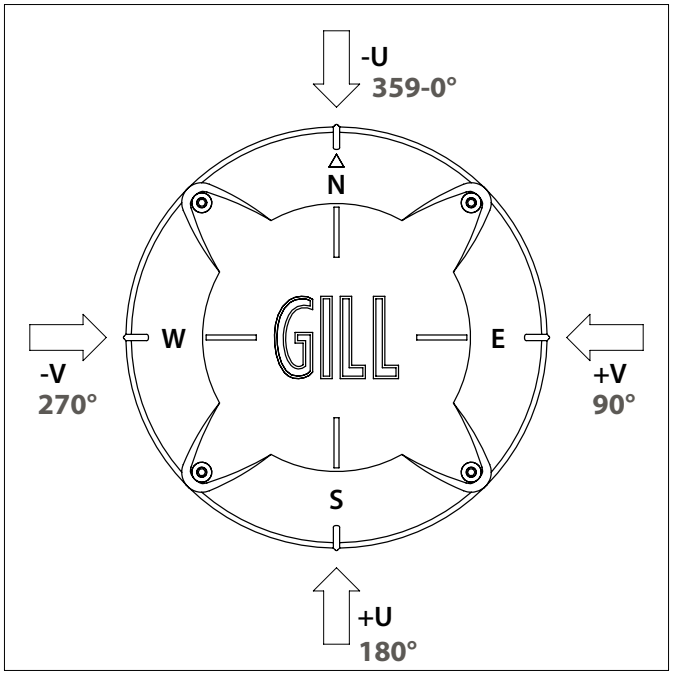

Figure 20 - Polarity diagram

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B.v. Heating Status Flags

The heating status flags consists of 8 hexadecimal digits. The bit values shown in the following tables are the constituent parts of each hexadecimal digit.

		Hexadecimal Value			
		8	4	2	1
Status Digit	Digit 1 (left-most)	Reserved	Reserved	Reserved	Reserved
	Digit 2	Reserved	Reserved	Reserved	Reserved
	Digit 3	Reserved	Reserved	Heater hardware fault – Contact Gill Technical Support	Heater hardware fault – Contact Gill Technical Support
	Digit 4	Supply voltage is above safe maximum	Heater comms fault – Contact Gill Technical Support	Configuration Error – Contact Gill Technical Support	Supply voltage is below minimum required
	Digit 5	Reserved	Reserved	Reserved	Reserved s
	Digit 6	Reserved	Reserved	Reserved	Reserved
	Digit 7	Heater controller power-up test timer is active	Reserved	Reserved	Reserved
	Digit 8 (right-most)	Heating is inhibited due to supply voltage out-of-range	Heater is active (i.e. the heater circuit is drawing current)	Heating enabled in set-up but may not be active	Device has heating capability

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Appendix C. WindSet Software

Gill Instruments provide a free of charge software package called WindSet to enable the WindUltra to be configured.

WindSet software, and the WindSet User Manual can be downloaded from gillinstruments.com

WindUltra can only be configured via the USB cable or via RS485 2-wire via the M12 connector. Configuration via RS422 connection is not possible.

C.i. Using WindSet to set up WindUltra

Once the current WindUltra set-up has been downloaded, WindSet can be used to change the set-up as required. WindSet can be used to:

- Change the communications set-up
- Change the data output rate, the data included in the output and the order of data provided
- Control the sensor and change the measurement units

C.ii. Using WindSet to change the communications protocol

The COMMUNICATIONS screen can be used to select the protocol used by WindUltra. To select one of the protocols available:

1. Click the Selected Protocol drop down list
2. A list of the protocols available in the connected WindUltra will appear
3. Click on the required protocol
4. The variables associated with the selected protocol will be displayed in the lower section of the screen. These variables can now be entered as required. More information about the variables available is contained in the relevant protocol appendix.

C.iii. Using WindSet to change the wind measurement settings

The **MEASUREMENTS** screen can be used to change the wind measurement settings used by WindUltra. To select one of the protocols available:

1. **North Alignment Offset** can be used if the WindUltra is not going to be aligned to the north. An offset, measured in degrees, can be entered to allow for any difference in alignment. For example, if the North Marker on the WindUltra is going to be aligned with East, a North Alignment Offset of +90° should be entered.

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2. **Wind Sample Rate** is the rate at which data messages will be sent when WindUltra is set to Continuous mode. The Wind Sample Rate can be selected from the drop down menu.

3. **Gust Interval** is the interval over which the minimum and maximum gust will be observed. A gust is defined as a 3 second running average of measured wind speed. The maximum and minimum gust in a specific gust interval can be reported by WindUltra. The gust interval can be set between 1-60 minutes. For example, if the gust interval is set to 10 minutes then the maximum average wind speed recorded over a 3 second period during each 10 minute interval will be reported.

4. **Long-Term Average Period** is the average of all the readings taken at one second intervals over the average period. The 2-min and 10-min presets update every one minute. A "Custom" option allows setting the update interval (1 to 600 seconds) as well as the averaging period.

C.iv. Using WindSet to change User Defined Strings

The **SYSTEM** screen can be used to change the User Defined Strings used by WindUltra in ASCII mode.

User Defined Strings can be used for a number of purposes including:

- Additional identification information (e.g. longitude and latitude information, site name, etc.)
- Additional device information (e.g. last inspection date)
- Additional set-up explanation (e.g.

Each User Defined String can contain up to 16 characters.

C.v. Using WindSet to change the heater control settings

The **SYSTEM** screen can be used to change the Heater Control Settings used by WindUltra. There are two type of heater settings:

Heating Mode
This setting selects the way the heater will work. The options are

- Disabled – this mode disables the heater until the heater setting is changed
- Enabled (Thermostatic) – this mode switches on the heater at the Lower Temperature Limit (e.g. 5°C) and switches the heater off at the Upper Temperature Limit (e.g. 10°C).

Lower and Upper Temperature Limits
If the Enabled (Thermostatic) mode is selected, it is possible to set the temperature at which the heating will be switched on and off.

- The Lower Temperature Limit should be set to the temperature at which the heater will switch on.
- The Upper Temperature Limit should be set to the temperature at which the heater will switch off.

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Appendix D. Modbus RTU Protocol

Ideal for any networked installation of devices, the Modbus RTU protocol provides data in a number of different formats.

D.i. RS-485 Networking

Multiple units can be connected on the same 2-wire RS-485 network.
Note that:

- each unit must be configured with a different Modbus slave address
- the typical response time of the unit to a Modbus poll is in the order of 10 milliseconds
- the maximum response time of the unit to a Modbus poll is in the order of 3 seconds
- a delay of at least 2 milliseconds must be respected between consecutive Modbus polls

D.ii. Function Code Support

The following Modbus Function Codes are supported in order to return data from the unit:

- 03: Read Holding Registers - to return measurements
- 17: Report Server (slave) ID - to return unit information

D.iii. Requesting Measurement Data

Modbus Function code 03 Read Holding Registers is used to return measurements from the unit.

D.iii.a. Register Numbering And Ranges

Note - in Modbus terminology the first register is referred to as number 1, but 'on-the-wire' the address of that register is 0.

The register ranges used in this device are as follows:

- 2,000+ for 32-bit IEEE 754 floating point data format.
- 4,000+ for 32-bit integer data format.
- 6,000+ for 16-bit integer data format.

D.iii.b. Available Registers

The complete list of available registers, their location, format and units is shown below. Note that SI units are used for all available data items.

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Item	Units	32-bit float register address	32-bit integer registers address	16-bit integer register address	Definition
Speed	m/s	2000	4000	6000	Wind speed (polar magnitude), see "B.i. Measurements" on page 41.
Direction	degrees	2002	4002	6001	Wind direction (polar), see "B.i. Measurements" on page 41.
U-axis velocity	m/s	2004	4004	6002	Signed wind speed magnitude (vectorial), see "B.i. Measurements" on page 41.
V-axis velocity	m/s	2006	4006	6003	Signed wind speed magnitude (vectorial), see "B.i. Measurements" on page 41.
Max gust speed	m/s	2008	4008	6004	Maximum gust speed, see "B.ii. Derived Parameters" on page 41.
Max gust direction	degrees	2010	4010	6005	Maximum gust direction, see "B.ii. Derived Parameters" on page 41.
Min gust speed	m/s	2012	4012	6006	Minimum gust speed, see "B.ii. Derived Parameters" on page 41.
Min gust direction	degrees	2014	4014	6007	Minimum gust direction see "B.ii. Derived Parameters" on page 41.
Heater Status Flags	flags	2016	4016	6008	16 bits, see "B.v. Heating Status Flags" on page 44, digits 5-8.
Heater Fault Flags	flags	2018	4018	6009	16 bits, see "B.v. Heating Status Flags" on page 44, digits 1-4.
Extended Status Code	flags	2020	4020	6010	Engineering diagnostics.
System Supply Voltage	volts	2022	4022	6011	The measured input supply voltage.
Long-term vector average speed	m/s	2024	4024	6012	Vector averaged wind speed, see "B.ii. Derived Parameters" on page 41.
Long-term vector average direction	degrees	2026	4026	6013	Vector averaged wind direction, see "B.ii. Derived Parameters" on page 41.
Long-term scalar average speed	m/s	2028	4028	6014	Scalar averaged wind speed, see "B.ii. Derived Parameters" on page 41.
Long-term scalar average direction	degrees	2030	4030	6015	Scalar averaged wind direction, see "B.ii. Derived Parameters" on page 41.

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D.iii.c. Measurement Register Scaling

Available measurements are available in three data formats, with different scaling factors in order to accommodate data that includes decimal fractions:

- 32-bit float - no scaling
- 32-bit integer - scaled x 100 (except status flags)
- 16-bit integer - scaled x 10 (except status flags)

D.iii.d. Invalid Measurement Values

If a valid request is made for a measurement or other value which is unavailable, an "invalid" value will be indicated by:

- 32-bit float - 0x7FC00000 (hexadecimal - NaN)
- 32-bit integer - 0x7FFFFFFF (hexadecimal)
- 16-bit integer - 0x7FFF (hexadecimal)

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D.iv. Requesting Unit Information

Modbus Function code 17 (0x11 hexadecimal) Report Server ID is used to read information specific to a Modbus device.

D.iv.a. Report server (slave) ID

The unit will respond with the following packet structure:

Wire colour (for supplied cables)	Field size (bytes)
Manufacturer string	32
Model string	32
Options string	16
Software version string	16
Serial number	32
Device / Server / Slave address	2
Modbus run status indicator	1
Reserved	1
User-defined string 1	16
User-defined string 2	16
User-defined string 3	16

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Appendix E. ASCII Protocol

E.i. Overview

This protocol provides output of measurement and system data in a configurable ASCII 'report' sentence. This is intended to ease compatibility with pre-existing installation setups.

Messages can be output continuously at the configured wind sample rate (CONTINUOUS MODE), or on demand (POLLED MODE).

E.ii. Configurable Output Mode

E.ii.a. Continuous Mode

In this mode, the device will broadcast a report string message at a rate of 1, 2, 4 or 8Hz, depending on the sample rate setting.

Note that higher output rates may not be compatible with lower baud rates, depending on report string length.

E.ii.b. Polled Mode

In this mode the device transmits a report string message in response to receiving one or more characters which matches the node address characters that are specified as part of the device's configuration data.

Measurements continue to be generated internally at the configured Wind Output Rate when the device is not being addressed.

The returned measurement is the last measurement to be generated internally.

Typical response time is 1ms after receipt of node address.

The device can be polled again immediately after the entire response has been received. However, duplicate readings will be observed if polled faster than the Wind Sample Rate.

The node address can be up to 8 characters in length.

If a multi-character node address is used, the characters must be sent as a continuous stream with a maximum inter-character gap of 10ms.

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E.iii. Power-Up Messages

Following activation of the protocol (in continuous mode only), the device optionally transmits a series of 'power-up' messages.

The messages, which (if enabled) are output in the following order are:

- User-defined strings
- Status
- Report
- Units

An example output is as follows:

```
Ultrasonic Anemometer 4751-00-035 2933 v1.0
User-defined-001
User-defined-002
User-defined-003
STARTUP FROM SOFTWARE RESET
NODE,DIR,SPEED,ULSPEED,STATUS,CHECK
-,DEG,MS,-,-,-
```

Note that within the optional power-up messages it is possible to further control whether the user-defined product info strings are shown.

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E.iv. Report String Message

The device outputs an ASCII 'report' message that contains a CSV portion containing data based on the Measurement Data Items listed below.

The general message format is as follows:

- The 'STX' (start of text) and 'ETX' (end of text) characters are used as the start-of-message and end-of-message characters.
- The " , " (comma) character is used as the field separator in the CSV portion of the message.
- A single byte XOR checksum of the CSV portion of the message is appended after the end-of-message character.
- A user-selectable set of characters is used to terminate the message.
- Numeric fields are output with leading zeros
- Invalid data is indicated either by a full-scale value eg '999.999' or a blank (null) field (configurable)
- Fields that can be negative are preceded with '+' or '-'

The content and order of items in the report string is configurable (see the WindSet User Manual). Note that very low baud rates (e.g. 1200, 2400 baud) make certain communications impossible, e.g. high polling rates, high sampling rates, and long response strings may be incompatible with these low baud rates.

E.v. Example of default output

An example of an ASCII data message is shown below.

```
NODE, DIR, SPEED, STATUS

<STX>Q,014,000.06,00,<ETX>40
```

Where:-

	STX (Start of Text)
Q	Node letter
014	Wind direction
000.06	Wind speed
00	Status code
	ETX (End of Text)
40	Checksum

E.vi. Configurable Message Parameters

The CSV fields that can be included in the message are as shown in the following table.

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Parameter	Example output	Output on error	Description
Node address	'Q'	-	
Relative wind direction (°)	'259'	'999' (1) or blank (2)	See "B.i. Measurements" on page 41.
Relative wind speed	'003.45'	'999.99' (1) or blank (2)	See "B.i. Measurements" on page 41.
Wind speed units letter	'M'	-	Units of speed are configurable. See "E.vii. Units-Of-Speed" on page 55.
Status	'00'	'04' / '08'	See "B.iii. Status codes" on page 43.
Relative wind U vector	'-012.34'	'+999.99' (1) or blank (2)	See "B.i. Measurements" on page 41.
Relative wind V vector	'+001.23'	'+999.99' (1) or blank (2)	See "B.i. Measurements" on page 41.
Max gust speed	'015.27'	'999.99' (1) or blank (2)	See "B.ii. Derived Parameters" on page 41.
Max gust direction	'037'	'999' (1) or blank (2)	See "B.ii. Derived Parameters" on page 41.
Min gust speed	'003.45'	'999.99' (1) or blank (2)	See "B.ii. Derived Parameters" on page 41.
Min gust direction	'354'	'999' (1) or blank (2)	See "B.ii. Derived Parameters" on page 41.
User defined string 1	'Site: Uptown'	-	Intended to allow user to describe a unit's attribute eg location.
User defined string 2	41 24.2028	-	Intended to allow user to describe a unit's attribute eg location.
User defined string 3	10.4418	-	Intended to allow user to describe a unit's attribute eg location.
Heating Status Code	'0047'	'1080' / '8080'	Hexadecimal codes describing the status of the heating. See "B.v. Heating Status Flags" on page 44.
Supply voltage	'09.5'	'99.9' (1) or blank (2)	Shows the supply voltage input.
Extended Status	'0000'	Non-zero	Provide information to support regarding these status codes.
Long-term vector-averaged speed	'012.34'		See "B.ii. Derived Parameters" on page 41.
Long-term vector-averaged direction	'289'		See "B.ii. Derived Parameters" on page 41.
Long-term scalar-averaged speed	'003.21'		See "B.ii. Derived Parameters" on page 41.
Long-term scalar-averaged direction	'127'		See "B.ii. Derived Parameters" on page 41.

(1) format when Fixed Field Enabled = true
(2) format when Fixed Field Enabled = false

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Example of a complete string is as follows:

<STX>Q,288,000.06,M,00<ETX>3E<CR><LF>
Non-printable characters shown in angle brackets.

E.vii. Units-Of-Speed

Units-of-speed are user-configurable.

The corresponding units string, units letter, and field-formatting are as follows:

Name	Units String (see power-up message)	Units letter	Integer digits	Fractional digits
Metres per second	MPS	M	3	2
Knots	KTS	N	3	2
Miles per hour	MPH	P	3	2
Kilometres per hour	KPH	K	3	2
Feet per minute	FPM	F	5	0

E.viii. Direction Processing In Near-zero Wind

At very low wind speeds, wind direction becomes erratic, which may not be desired. To avoid this, the reported direction can be forced to freeze when the wind speed transitions below a configurable threshold.

The threshold may be set from zero to 5m/s.

If set to zero, the reported direction will always reflect the latest measured direction.

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Appendix F. NMEA-0183 Protocol

F.i. Overview

This protocol provides the transmission of ASCII measurement and status data sentences in accordance with the NMEA 0183® Standard ('Standard for Interfacing Marine Electronic Devices'). Parametric sentences for measurement and status data are output continuously at the configured relative flow sample rate.

The device operates as a 'talker' only (an NMEA 0183 term referring to the originator of messages across an NMEA 0183 link), incoming sentences (i.e. query and command sentences) are ignored.

The NMEA-0183 protocol implements v4.10 of the NMEA 0183 Standard.

F.ii. Interface Configuration

The sentences for this protocol are transferred via an RS-422 interface. The interface has the following configuration options:

Option	Description	Options
Talker Ident	Controls the "talker" identity letters in transmitted sentences.	WI (Weather Instruments), II (Integrated Instrumentation)
Baud Rate	The serial output rate.	1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200
Units of speed	The units of measurement for speed.	m/s (metres per second), kn (knots), mph (miles per hour), km/h (kilometres per hour), fpm (feet per minute)

Additionally, the following protocol items are fixed:

- Data Bits: 8
- Stop Bits: 1
- Parity: None

Parametric sentences (for measurement data) are transmitted continuously at the user-selectable wind sample rate - see "C.iii. Using WindSet to change the wind measurement settings" on page 45.

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F.iii. Supported Sentences

In the following sections describing the sentences that are implemented the start of each sentence is shown as '$--', the '--' after the start delimiter ('$') is to be set to the device's talker identifier, by default this will be 'WI' (Weather Instrument).

F.iii.a. MWV – Wind Speed & Angle

$--MWV,x.x,a,x.x,a,A*hh<CR><LF>
Fields:

1. x.x Wind angle, 0 to 359 degrees.
2. a Reference, 'R' = relative, 'T' = theoretical.
3. x.x Wind speed.
4. a Wind speed units, 'K' = km/hour, 'M' = Meters/second, 'N' = Knots, or 'S' = Statute miles/hour.
5. A Status, 'A' = data valid, 'V' = data invalid.
6. hh Checksum

F.iii.b. II – Wind Speed & Angle

$--II,x.x,a,x.x,a,A*hh<CR><LF>
Fields:

1. x.x Wind angle, 0 to 359 degrees.
2. a Reference, 'R' = relative, 'T' = theoretical.
3. x.x Wind speed.
4. a Wind speed units, 'K' = km/hour, 'M' = Meters/second, 'N' = Knots, or 'S' = Statute miles/hour.
5. A Status, 'A' = data valid, 'V' = data invalid.
6. hh Checkshum

F.iii.c. Parameters

Parameter	Example output	Output on error	Description
Relative wind direction (°)	'259'	Omitted	average of N headsets over sample period
Reference	'R'	Omitted	fixed
Relative wind speed	'0.12.34'	Omitted	average of N headsets over sample period
Wind speed unit	'M'	-	fixed
Status	'A'	'V'	indicated invalidity could be a result of the wind measurement being invalid or a configuration data error

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Appendix G. SDI-12 Protocol

G.i. Overview

This protocol allows the device to communicate with a device acting as an SDI-12 Data Recorder in accordance with the SDI-12 specification. The device implements the 'Sensor' role described in the specification. Protocol version 1.3 is implemented.

The command/response messages are transferred via a bidirectional tri-state serial line which is part of the three-wire (serial, ground, and +12V) SDI-12 interface. UARTs connected to the serial line should have the following configuration:

- Baud Rate: 1200
- Data Bits: 7
- Stop Bits: 1
- Parity: Even

G.ii. Supported Commands

Note: for each of the available aMx!, aC!, and aRx! commands, there exists an equivalent aMCx!, aCC!, and aRC! command that provides a 3 character CRC on the associated send data command (aD0!, aD1! ...) immediately before the <CR><LF> characters. The CRC is calculated as per the SDI-12 Standard.

G.ii.a. Continuous Measurement

Name	Command	Reponse	Example
Continuous measurement (polar)	aR0!	a<dir><speed><status><CR><LF>	0+332+000.04+00><CR><LF>
Continuous Measurement (UV)	aR1!	a<U><V><status><CR><LF>	0-000.10-000.20+00<CR><LF>
Gust	aR2!	a<dir><speed><dir_at_ max_gust><max_gust_speed><dir_at_ min_gust><min_gust_speed><status><CR><LF>.	0+332.1+000.201+123+004.12 +321+000.02+00<CR><LF>
Long-term average flow	aR3!	a<dir><speed><vector_avg_dir><vector_ avg_speed><scalar_avg_dir><scalar_avg_ speed><status><CR><LF>	e.g.1+000.201+123.2+004.124+ 321.2+000.024+00<CR><LF>

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G.ii.b. Polled measurement

Name	Command	Reponse	Example
Start measurement (polar)	aM!	atttn<CR><LF>	a0023 ('002' => 2s response time - guarantees a new measurement will have been published.)
Send data (polar)	aD0!	a<dir><mag><status><CR><LF>	e.g. 0+083.2+000.02+0000<CR><LF>
Start measurement (UV)	aM1!	atttn<CR><LF>	a0003
Send data (UV)	aD0!	a<U><V><status><CR><LF>	e.g. 0+000.001+000.023+0000<CR><LF>
Start measurement (gust)	aM2!	atttn<CR><LF>	a0003
Send data (gust)	aD0!	a<dir><speed><dir_at_max_gust><max_gust_speed><dir_at_min_gust><CR><LF>.	+332.1+000.201+123.2+004.124+321.2<CR><LF>
Send data (gust cont.)	aD1!	a<min_gust_speed><status><CR><LF>.	e.g.0+000.024+0000<CR><LF>
Start Measurement (Long-term average flow)	aM3!	atttn<CR><LF>	e.g. a0004
Start Data (Long-term average flow)	aD0!	a<dir><speed><vector_avg_dir><vector_avg_speed><scalar_avg_dir><scalar_avg_speed><status><CR><LF>	e.g. 0+332.1+000.201+123.2+004.124+321.2<CR><LF>
(cont)	aD1!	a<min_gust_speed><status><CR><LF>	e.g.0+000.024+0000<CR><LF>

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G.ii.c. Concurrent Measurement

Name	Command	Reponse	Example
Concurrent measurement	aC!	atttn<CR><LF>	000212<CR><LF>
Send data (polar)	aD0!	a<dir><mag><status><CR><LF>	e.g. 0+083.3+000.024+0000<CR><LF>
Send data (UV)	aD1!	a<U><V><status><CR><LF>	e.g. 0+000.001+000.022+000<CR><LF>
Send data (gust)	aD2!	a<dir><speed><dir_at_max_gust><max_gust_speed><dir_at_min_gust><min_gust_speed><status><CR><LF>.	e.g. 32.1+000.201+123.2+004.124 +321.2+000.024+0000<CR><LF>
Send Data (Long-term average flow)	aD3!	a<dir><speed><vector_avg_dir><vector_avg_speed><scalar_avg_dir><scalar_avg_speed><status><CR><LF>	e.g.0+332.1+000.201+123.2+004.124+321.2+000.024+0000<CR><LF>

G.ii.d. Other Commands

Name	Command	Reponse	Example
Acknowledge Active	a!	a<CR>< LF>	e.g. 0<CR><LF>
Send Identification	aI!	allccccccccmmmmmmmvvvxxxx... xxx<CR><LF> device model number field <mmmmmm> is used for software version optional field <xxx> is used for serial number	e.g. 013GilllInst 2933000GILL0001<CR><LF>
Address Query	?!	a<CR><LF>	e.g. 0<CR><LF>

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Appendix H. Fault Finding

H.i. Connecting WindUltra with a USB-USB cable

Symptom	Possible Solutions
Problem communicating with WindSet software using a USB-USB cable	➢ Check power is available to WindUltra. At least one of the LEDs next to the WindUltra USB port should be lit. ➢ Check WindUltra is operating correctly. The red LED on the WindUltra should be flashing intermittently (0.5Hz) to confirm correct operation. If the red LED is not flashing in this way refer to the WindUltra LED guide below. ➢ Check the USB-USB cable supports power and communications connections. If you are not sure try connecting a different type of device to your PC to confirm a data connection. ➢ Check that the PC has the necessary drivers loaded. If required download the driver from: https://www.st.com/en/development-tools/stsw-stm32102.html 1. Type "Device Manager" into the Windows Search Box 2. Click on "Ports (COM & LPT)" 3. Check for "USB Serial Port (COM x)", if this is not present then the PC requires a USB driver. The driver can be downloaded from the internet using the link above. ➢ If WindSet is still not communicating correctly with WindUltra then contact Gill Instruments Technical Support.

H.ii. Connecting with a Serial to USB cable (USB at host system, M12 at WindUltra)

Symptom	Possible Solutions
Problem communication between a host system using a serial-USB convertor. (Host system with a USB connector, WindUltra with an M12 connector)	➢ Check power is available to WindUltra. At least one of the LEDs next to the WindUltra USB port should be lit. ➢ Check WindUltra is operating correctly. The red LED on the WindUltra should be flashing intermittently (0.5Hz) to confirm correct operation. If the red LED is not flashing in this way refer to the WindUltra LED guide below. ➢ Check that the PC has the necessary drivers loaded. If required download the driver from: https://www.ftdichip.com/Drivers/VCP.htm 1. Type "Device Manager" into the Windows Search Box 2. Click on "Ports (COM & LPT)" 3. Check for "USB Serial Port (COM x)", if this is not present then the PC requires a USB driver. The driver can be downloaded from the internet using the link above. ➢ Check that the signal ground, D+ and D- wires are connected correctly. ➢ Depending on the terminating system, check that the D+ and D- wires are terminated with the correct load. ➢ Depending on the terminating system, check that the D+ and D- wires are biased correctly. ➢ Check that the USB-RS485 convertor is fully compliant.

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H.iii. Operational Fault-Finding

Symptom	Possible Solutions
No output	➢ If the red LED under the USB port cover is off then check the power to the sensor - the red LED should flash at approximately 0.5Hz. ➢ If the red LED is continuously on or flashing at 5Hz, then power cycle the sensor – if the red LED does not start to flash at 0.5Hz the contact Gill Instruments Technical Support. ➢ Check the current available at the sensor is sufficient to power the sensor. ➢ Check the communication settings of the sensor and the host system are correct, including the COM port. ➢ Check the communications wiring to the sensor is correct. ➢ If appropriate, check the sensor is in Continuous mode. ➢ For multi-sensor networks, check other sensors connected to the network are correctly set up. ➢ If the fault persists then contact Gill Instruments Technical Support.
Corrupted output / One way communication	➢ Check communications settings of sensor and host system match. ➢ For multi-sensor networks, check other sensors connected to the network are correctly set up. ➢ Try a slower baud rate. ➢ Check cable lengths and type of cable. ➢ Check for appropriate serial termination resistance for long cable runs. ➢ Check serial biasing is appropriate for other equipment on the network. ➢ If communication problems persist then contact Gill Instruments Technical Support.
Problems with measurements / data invalid flag	➢ If the orange LED is On with a very bright flicker, or the Status Code indicates an Invalid Measurement, check the signal path is not blocked. ➢ If measurement problems persist then contact Gill Instruments Technical Support.
Unit resets	➢ Check that the power supply is within the required limits at the sensor. The sensor voltage can be set to be reported in the output data. ➢ Check the current provided to the sensor is sufficient for the sensor set-up (which may include heating). Allow for any other equipment connected to the same power supply. ➢ If the sensor continues to reset then contact Gill Instruments Technical Support.
Heater does not switch on	➢ Note: If the green LED is on then the heater circuit is being powered – the heaters are lower powered and focused where heating is needed. It may take time before any heating can be felt. ➢ Check power to the sensor is within the required limits at the sensor. The sensor voltage can be set to be reported in the output data. Confirmation that the voltage is within the required limits can be obtained from the Heater Status Code. The Heater Status Code can be set to be reported in the output data. ➢ Check the sensor includes heating capability and has heating enabled. This information can be found in the Heater Status Code. The Heater Status Code can be set to be reported in the output data. ➢ Check the temperature at which the heater is set to be switched on and switched off. These temperatures are set as part of the sensor set-up and can be confirmed and changed using WindSet. ➢ Check the remaining Heater Status Codes. If heater problems persist then contact Gill Instruments Technical Support.
Firmware update fails	➢ If the firmware update fails to install after the new firmware uploads to the sensor, this is likely a result of an incompatible RS485-USB conversion chipset being used.

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Appendix I. Status LEDs

The device contains three LEDs that are visible through the USB socket cover, which indicate the device's status.

Red LED

LED Status	Description	Recommended Action
0.5Hz Pulse	Normal Operation	
Off	Fault	Check power, then contact Gill Instruments Technical Support
5Hz Flash	System Error	Power cycle, then contact Gill Instruments Technical Support
On	Configuration Mode / Start Up Error	On in Configuration Mode. If the Unit is not in Configuration Mode then this indicates an error. Power cycle, then contact Gill Instruments Technical Support

Orange LED

LED Status	Description	Recommended Action
Rapid Flash	Normal Operation	
On, bright flicker	Ultrasonic Error	Inspect transducers for debris, clean carefully, if required. Contact Gill Instruments Technical Support

Green LED

LED Status	Description	Recommended Action
Off	Heaters are Off	
On	Heaters are On	

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Important Notices:

- Gill Instruments Limited can take no responsibility for installation and/or use of its equipment if this is not done in accordance with the appropriate issue and/or amendment of the manual.
- The user of this manual should ensure that it is appropriate in all details to the exact equipment to be installed and/or operated. If in doubt, the user should contact Gill Instruments Limited for advice.
- If further details are required which do not appear in this manual, contact Gill Instruments Limited or one of their agents.
- Install and use the anemometer in accordance with the local regulations.
- Gill Instruments Limited reserve the right to change or revise the information supplied in this document without notice and without obligation to notify any person or organisation of such revision or change.

Feedback:

Every effort has been made to ensure the accuracy in the contents of our documents, however, Gill Instruments Limited can assume no responsibility for any errors or omissions in our documents or their consequences. Gill Instruments Limited would greatly appreciate being informed of any errors or omissions that may be found in the contents of any of our documents.

After Sales Support

Should you require after sales assistance with this device, please go to gillinstruments.com where you can request support by clicking on the "Get Support" button and filling out the form. Alternatively, call us during UK office hours on 01590 613500 (UK). Please have details of the device and serial number whenever possible.

Additionally, you can access further information on the device from the support section of the website at gillinstruments.com

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