Anemometer Interface Board V1.0
User Manual

14/3/2010 - Revision 3

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1 Overview

The Anemometer Interface Board performs the following functions:

- Provides power to, and reads from a Gill WindSonic anemometer.
- Distributes wind information to other site devices, through either RS-232, Ethernet, digital IO, or RS-485.
- Logs wind data and device status to a micro SD card.
- Permits the remote extraction of current and logged wind data over the internet.
- Indicates if an antenna should be stowed via a relay driven voltage-free connection.
- Continues to function (log wind data) in the event of a power failure.

The Anemometer Interface Board is designed for placement in a standard 1U rack mount box.

2 Functional Description

Anemometer Interface

The device connects to a Gill WindSonic anemometer via a DB9 connector situated on the back panel. This connector has pins for serial RX and TX, a ground line, and a power line that acts as the supply for the anemometer. Power is always available through this connector to the anemometer under normal operating conditions (including when the device is in safe mode). Details on the pinout of the DB9 connector are provided in Section 3.

Wind Information Distribution

The device features two groups of seven segment displays on the front panel that show the current average wind heading and speed. There are two DB9 connectors on the back panel of the device that transmit an exact copy of the anemometer signal. The current wind information can be retrieved over the Ethernet according to the protocol described in Section 7.

A maximum of 10 clients can connect remotely via Ethernet to the device to poll current wind data and/or extract logged data.

Data Logging

Data is logged on a micro SD card, which can be accessed from the back panel of the device. Cards up to 2GB, formatted with the FAT file system, are supported. Data that is logged to the micro SD card can be read directly from the card by a PC, however the device also supports retrieval of logged data remotely with the provided "AneMonitor" GUI. More information on the "AneMonitor" software is provided in Section 8.

Data is logged at an interval of 10 seconds. Each entry contains the following information:

- Current Date
- Current Time
- Highest instantaneous wind speed in the last 10 seconds
- Average wind speed (averaged over 30 seconds)
- Average wind heading (averaged over 30 seconds)
- Whether the device is in safe mode or not (Y = in safe mode, N = not in safe mode)
- The stow state of the antenna (Y = stowed, N = not-stowed)
- The state of the backup battery (Y = OK, H = high voltage, L = low voltage)

Date	TIME (UTC)	Peak speed last 10s	Average speed (30s)	Heading	Power Failure (Y/N)	Antenna Stowed (Y/N)	Battery Status
16/09/09	01:47:00	1.02	0.81	130	Y	N	L
16/09/09	01:47:10	1.64	0.82	114	Y	N	L
16/09/09	01:47:20	1.43	0.83	113	Y	N	L

In the above example, the device is operating from its backup battery, the battery voltage

is low, and the antenna is not stowed due to wind (confirmed by the average / peak wind speed values).

Safe Mode

If the site power fails the device will switch to an internal backup battery and continue to function until the voltage of the backup battery drops below the cut-off voltage of the primary switching voltage converter (6.5V). In safe mode the front panel seven segment LED displays showing the current average wind heading and speed are disabled, as are the Ethernet components of the device, reducing the power consumption of the device. Power is continually provided to the anemometer during safe mode. As soon as site power is restored, the device will continue to function normally.

Antenna Stow Signal

A two pin socket on the back panel of the device serves as the stow signal terminal, and will indicate to an antenna control unit whether or not the antenna should be stowed.

The antenna will be commanded to stow when either:

- The 30 second average wind speed rises above 56km/h, or
- The instantaneous (1 second sample) wind speed exceeds 70km/h.

When the antenna is commanded to stow, it will not be allowed to un-stow until neither of the above conditions are exceeded for a full 5 minutes.

The stow signal is a relay driven voltage free connection, an open circuit between the two pins indicates that the antenna does not need to be stowed, and a closed circuit indicates that the antenna should be stowed.

3 Enclosure and External Connections

Front Panel

The front panel of the device features seven segment displays, arranged in two sets of three for displaying the current average wind heading and wind speed.

The left set of displays show the current average wind heading as a three digit whole number, in the range 000 to 359 degrees.

The right set of displays show the current wind speed in the range 0-999km/h. This value can be of the form X.YZ for wind speeds up to 9.99km/h, XY.Z for wind speeds up to 99.9km/h, and XYZ for wind speeds up to 999km/h.

*Front panel indicators – Heading, Speed, and battery/connection LED*

A single LED between the two sets of seven segment displays is a multi-purpose indicator of device status.

- If the LED is blinking, and the seven segment displays are ON (i.e. the site power has not failed), the device is operating but is not logging data as it does not have an accurate time reference. The site control PC must connect to the device to update the device time. More information on these requirements is given in Section 7.

- If the LED is ON, the backup battery voltage is either too low or too high, both states indicating that the battery is no longer fit for service, and that it should be replaced.

- If the LED is blinking, and the seven segment displays are OFF (i.e. the site power has failed), the device has shut off non-essential peripherals (Ethernet, LED display) and is continuing to log data in safe mode. More information on safe mode is presented in Section 2.

Back Panel

All external connections are fixed on the back panel of the device. The connections on the back panel are:

- A 15V DC regulated supply input socket.

- 3 female DB9 sockets – for the anemometer and ACU connections.

- A socket for mounting the micro SD card for data logging.

- A RJ45 Ethernet socket.

- A two pin socket for the voltage free connection to the telescope.
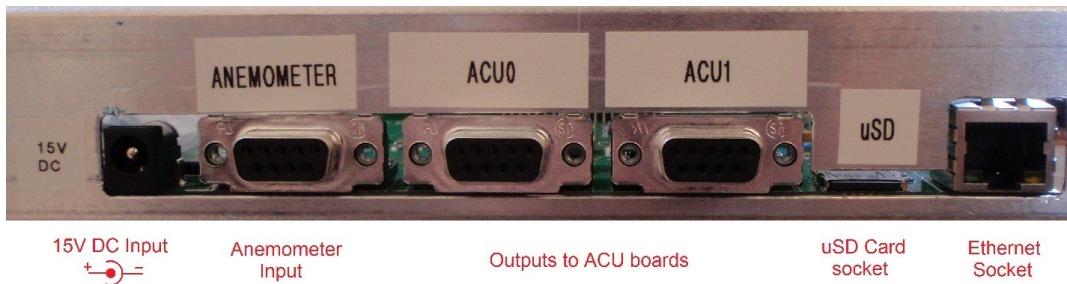
The pinouts for the three DB9 connectors are shown below. The pinouts are drawn from same perspective as the image above, i.e. looking at the back panel. All serial RX/TX labels are referenced to the connected device, i.e. ANEM_TX is the signal transmitted FROM the anemometer TO the interface device, and so on.
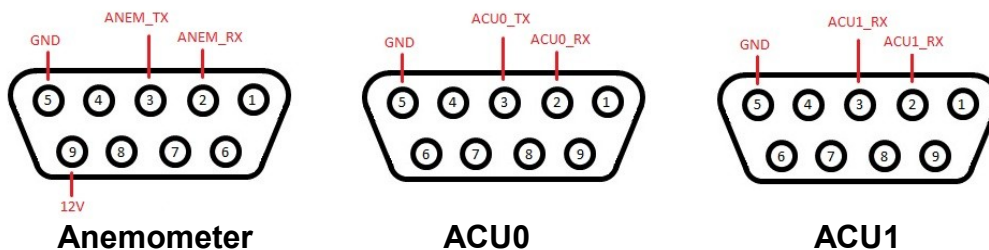
Note that the '12V' pin on the anemometer connector will present a voltage in the range 6.5V to 15.5V in normal operation (including safe mode). This is within the WindSonic supply voltage range of 5V to 30V.

The micro SD card can be released from the device by pushing it in (push-pull socket). This device supports FAT formatted micro SD cards up to 2GB.

On the right side of the back panel there is a two pin socket for the stow signal. The polarity of these pins is unimportant as it is a voltage free connection – the pins will be open-circuit when the device believes it is safe for the antenna to be operational, and closed-circuit when the device believes the wind conditions are too severe.

Device Identification

On the right side of the device enclosure is the name of the site for which the device is configured, and the device's MAC address.
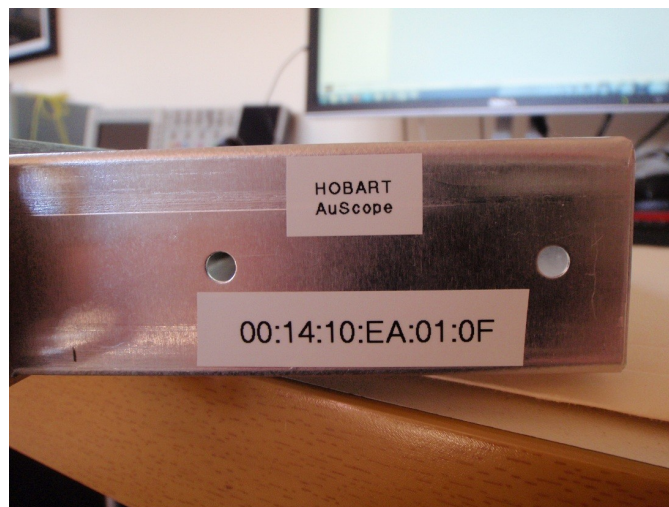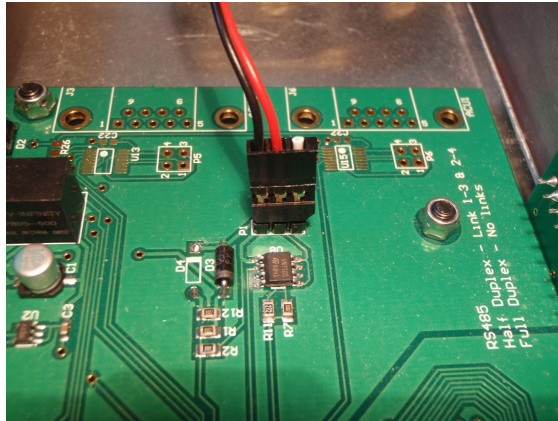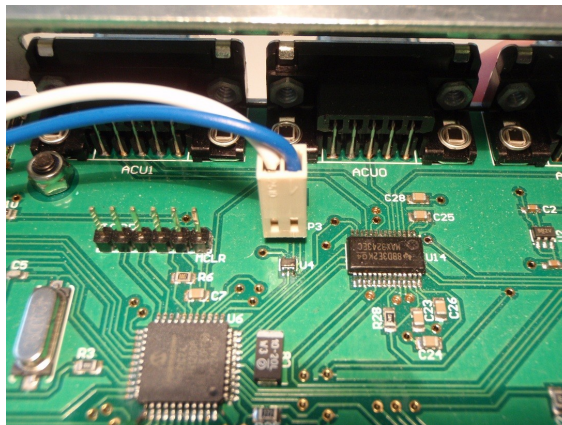
4 Internal Connections

Before mounting the device, it is important to verify the two internal connections:

- The backup battery, which connects to a three pin connector on the right side of the PCB. The centre pin (red wire in image) is positive, the two end pins are connected to ground.

Backup battery connected to PCB

- The stow signal relay connection, a 2 pin connector on the PCB that drives the voltage free connection and manages antenna stowing. The left pin (white wire in image) is the stow signal, and the right pin (blue wire in image) is ground.

Relay coil connected to PCB

The image below shows the device in its final internal configuration.
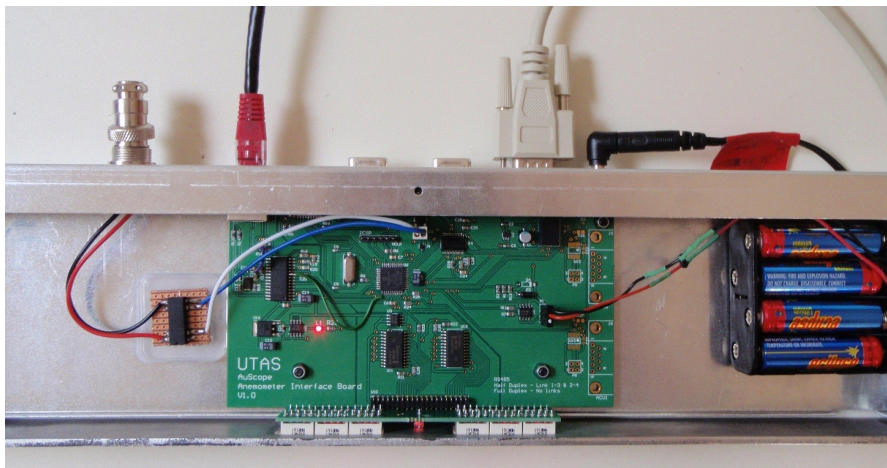
Note that once the backup battery is connected, the device is on – there is no power switch. If for any reason a hard reset of the device is required, both the primary power and backup battery must be disconnected.

5 Operational Considerations

Ensure the device has an accurate internal time

The Anemometer Interface Board does not have a dedicated internal real time clock – the current time and date must be supplied by the control PC at the site. When the connection to the control PC is lost (i.e. in a power failure situation), the device clock will continue to function based on the device's internal high speed oscillator, which is accurate to within a few seconds per hour.

During normal operation, it is recommended that the control PC update the time base on the device regularly (every minute or so) to prevent disjointed log data.

When the device is powered for the first time, it will not log data as it has no time reference to work from. The front panel LED indicator on the enclosure will blink at 1Hz to indicate that the time has not yet been set, and any clients that are connected remotely to the device will see that the time reported by the device is incorrect. As soon as the time is updated by the control PC, the device will begin to log wind data and will continue logging indefinitely until a hard reset occurs.

Battery Health

The backup battery is made of 8 AA lithium primary cells. These cells were not designed for recharging, however the interface circuit for the battery pack will "top-up" the battery continually during normal operation. This is not damaging to the battery as long as it has not been significantly discharged during a site power failure.

The same mechanism that "tops-up" the backup battery would overcharge it under normal circumstances, so a zener diode and resistor combination are used to cap the maximum voltage of the backup battery. There is some reverse leakage through the zener diode – if the backup battery is disconnected from the board for an extended period of time, one of the AA cells should be removed to break the circuit through the zener.

Rules of thumb for replacing the backup battery:

- If the device has been running in safe mode for more than 1 hour (i.e. site power failure for more than 1 hour) – replace the battery.

- If the front panel LED turns on, the battery is unhealthy and must be replaced (alternatively this could indicate that the battery is not connected)

Note: The battery voltage is checked once every hour, so any physical changes to battery may not be reflected on the battery status indicator LED or in the GUI for up to 1 hour after the time of the change.

6 Technical Specifications

Device weight including enclosure and batteries: 725g

Nominal power supply voltage: 15V DC

Backup battery: 8 x AA 1.5V lithium primary cell

Logging time with fresh batteries in safe mode: > 72hrs

Operating current:

- **Normal Operation:** 175mA
- **Transferring files, Normal Operation:** 190mA
- **Safe Mode:** 40mA (including 20mA required for anemometer)

7 Ethernet Communications Protocol

This section describes the UDP Ethernet protocol used to connect to the device, poll the device for wind data and site name, and update the device time.
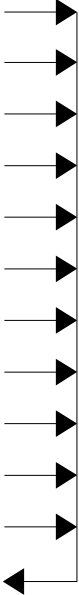
To Connect to the Device

To connect to the device, you must send a connection request ("CRSQT") to UDP port 7754.

Note that all transmissions are conducted using unsigned bytes only!

The packet structure is described below:

Byte	Contents
0	'C'
1	'R'
2	'Q'
3	'S'
4	'T'
5	Client IP byte 1
6	Client IP byte 2
7	Client IP byte 3
8	Client IP byte 4
9	Port MSB
10	Port LSB
11	XOR Checksum

The CRQT packet contains the IP of the machine that is connecting to the anemometer interface (i.e. a control PC) as it would be seen by the device (i.e. use the internet IP of the site at which the control PC is located.)

The checksum is calculated by evaluating the exclusive OR of all other elements of the packet.

An example packet sent by a client to the device, where the client IP is 123.156.78.90, wishing to use port 7757, is:

Byte	Contents
0	'C' <0x43>
1	'R' <0x52>
2	'Q' <0x51>
3	'S' <0x53>
4	'T' <0x54>
5	123 <0x7B>
6	156 <0x9C>
7	78 <0x4E>
8	90 <0x5A>
9	… <0x1E>
10	7757 <0x4D>
11	XOR Checksum <0xE7>

Sending this command successfully will register a dedicated client spot, which has a lifetime of 10 seconds. There is no response from the device to indicate if CRQST was successful.

To Maintain/Verify the Connection

To maintain the connection, the ASCII string "PING" must be sent to the device on the specified port at regular intervals (~0.3Hz). Each time the anemometer interface receives a PING, the 10 second client timeout is reset and the device responds, quite unimaginatively, with an ASCII "PONG".

There is no checksum byte for PING/PONG transmissions.

To Poll Data

A single command, <0x01>, retrieves all relevant data from the device.

Client sends:

– "Poll Data" command byte

Byte	Contents
0	Poll Data <0x01>

Device responds:
– "Poll Data" response byte
– Three ASCII digits describing the wind heading (in this example, 245 degrees)
– Five ASCII digits describing the instantaneous wind speed (in this example, 101.45 km/h)
– Five ASCII digits describing the 30 seconds average of the wind speed (in this example, 089.12 km/h)
– One byte describing the battery level as a percentage (this value is usually between 0 and 140, different battery packs have different starting charges) (in this example, 98%)
– One byte describing the stow state of the antenna. If the anemometer interface device is commanding the antenna to stow, this value will be <0x01>, else <0x00> (in this example, antenna is stowed)
– XOR Checksum

The checksum for the data packet is the exclusive OR of all packet elements EXCEPT the first byte, as shown in the table below:

Byte	Contents	Example	
0	Poll Data <0x01>	<0x01>	
1	Heading X--	'2'	→
2	Heading -X-	'4'	→
3	Heading --X	'5'	→
4	Inst Speed X--.--	'1'	→
5	Inst Speed -X-.--	'0'	→
6	Inst Speed --X.--	'1'	→
7	Inst Speed ---.X-	'4'	→
8	Inst Speed ---.-X	'5'	→
9	Avg Speed X--.--	'0'	→
10	Avg Speed -X-.--	'8'	→
11	Avg Speed --X.--	'9'	→
12	Avg Speed ---.X-	'1'	→
13	Avg Speed ---.-X	'2'	→
14	Battery Charge %	<0x98>	→
15	Stow State	<0x01>	→
16	XOR Checksum	<exercise for reader!>	←

To Set Device Time

The anemometer interface device does not come equipped with a real-time clock. On first power-up of the device, the site control PC must send the accurate time at least once to begin data logging on the uSD card. Ideally, this should be done by the site control software regularly – the drift of the on-board clock is on the order of ~10 seconds every hour, which is suitable for logging data during a typical power failure.

The time is set on the device by sending a <0x0F> command followed by the time and data parameters as described below:

Byte	Contents	Example	
0	Set Time <0x0F>	<0x0F>	
1	Year (2XXX)	"2009" <0x09>	→
2	Month	"November" <0x0B>	→
3	Date	"21st" <0x15>	→
4	Hour	"20 (8pm)" <0x14>	→
5	Minute	"6" <0x06>	→
6	Second	"55" <0x37>	→
7	XOR Checksum	<SOMETHING>	←

In this example, the time is set to: 20:06:55 on 21/11/2009 UTC Note: All times in UTC.
Again, the checksum is calculated as the XOR of all elements except for the command byte.

To Retrieve Device Name

The name of the device (i.e. the name of the site at which the device is based) can be retrieved by sending it a <0x0D>.
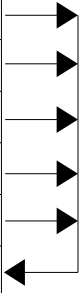
The device will respond with the command code followed by a byte describing the length of the name, followed in turn by the name itself. The final byte is an XOR checksum.
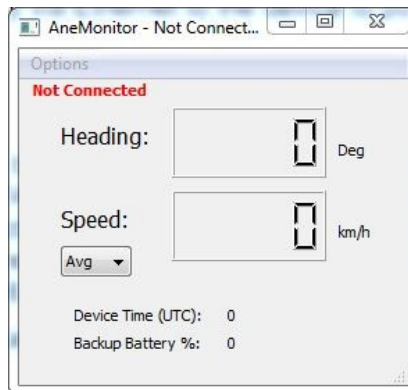
Client sends:

Byte	Contents
0	Send name <0x0D>

Device replies:

| Byte	Contents	Example	
0	Send name <0x0D>	<0x0D>	
1	Size of name	<0x04>	→
2	Name byte 1	'U'	→
3	Name byte 2	'T'	→
4	Name byte 3	'A'	→
5	Name byte 4	'S'	→
6	XOR Checksum	<SOMETHING>	←

8 AneMonitor Remote Access Software

The AneMonitor application can be used to read the current wind information and extract logged data from a remote site.

When the program is first run, the first step is to connect to a remote device. The 'Connect To Device' dialogue can be accessed from the 'Options' menu on the top left of the interface.


In this dialogue, enter the IP address of the remote site, the IP address of the site at which the PC running this application is based (as it would be seen externally), and the desired port. The only port that must not be used (other than ports in the reserved range, i.e. below 1024) is 7754, as this port is used by the device to negotiate connections with new clients. Note that the setting you enter will be saved for use next time the program is run.
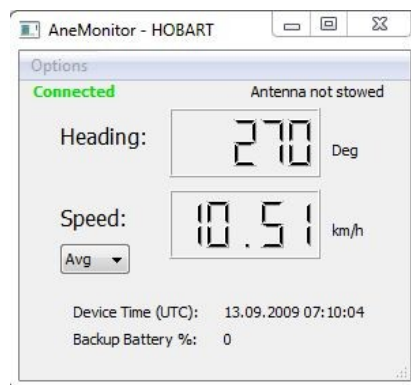

When the connection to the device is open, the indicator in the top left will change to 'Connected' and a new line on the right will show the antenna stow status. The time stored on the device will be shown next to 'Device Time (UTC)', and the battery charge as a % of nominal will be updated hourly. The batteries should be replaced if this value ever approaches 0%, or after a site power failure longer than 1 hour.

Data can be extracted from the device using the 'Extract Data' dialogue, accessible through the 'Options' menu.
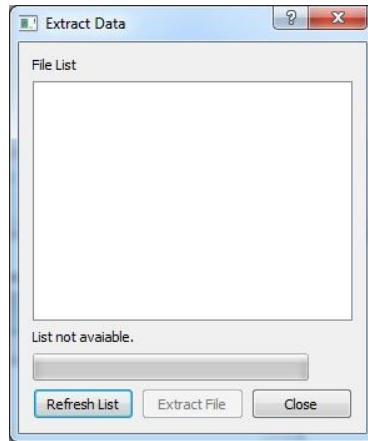
Click 'Refresh List' to bring up a list of files currently stored on the device.
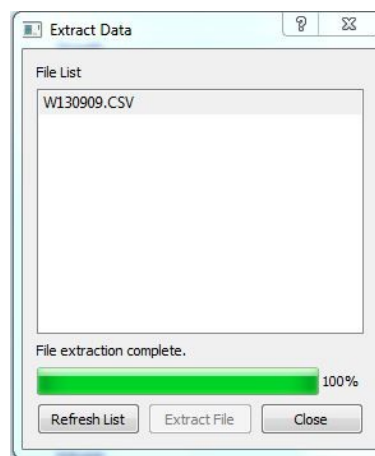
In this example, the device hasn't been running for very long so there is only one log file available. The date on which the wind data was logged is included in the file name, in the format W*DDMMYY*.CSV. Clicking on a file, and then clicking 'Extract File', will download the file and store it in the same directory as the AneMonitor executable.
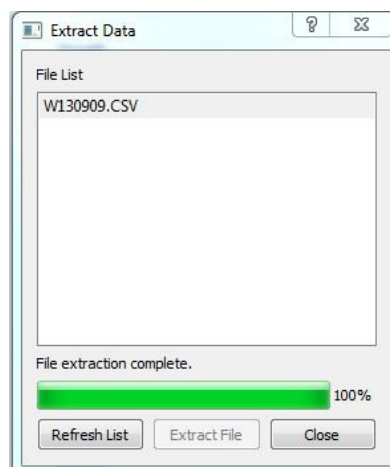
When the 'Extract Data' dialogue is open, the device goes in to a special data transfer mode, in which the heading and speed to do not get polled. When the 'Extract Data' dialogue is closed the heading and speed will continue to update.

9 Adjusting device IP settings

Each device is pre-loaded with the relevant network information (IP address, gateway address, subnet mask, and device name), which is stored in a file named *SITE.SET* in the root directory of the uSD card.

To alter the device's IP information, remove the uSD card from the device (push the card in to release it) and open *SITE.SET* in a text editor on a PC.

```
HOBART!             Name, 6 characters or less
131.217.63.191!     IP Address for this device
255.255.255.128!    Subnet mask for this site
131.217.63.129!     Gateway address

Ensure each parameter is terminated by an exclamation mark. All characters on a line after the exclamation
mark are ignored (comments).
```

IP addresses must be entered as shown above. The number of digits defining each octet of an address can be 1, 2 or 3. All parameters must be followed by an exclamation mark (no white space).

Revision History

Revision 1 (15/9/09) – Document Created

Revision 2 (5/1/10) – Updated to reflect changes to stow time out (changed from 10 minutes to 5 minutes) and reversed operation of voltage free connection (closed circuit indicates antenna should stow).

Revision 3 (14/3/10) – Updated to reflect addition of IP settings file.