Blade Sensor
Technical Manual

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1 Foreword

Thank you for purchasing a Blade Non contact Position Sensor from Gill Sensors. We recommend that you read the whole of this manual before proceeding. Gill Sensors products are in continuous development and therefore specifications may be subject to change and design improvements.

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2   Introduction

The Blade sensor is a two-component non-contact position sensor. The Blade itself is one component, the other being a metallic activator, which is attached to the moving assembly to be measured. The activator can often be engineered as an additional feature of an existing cast or sheet metal assembly, ensuring economy and repeatability. The avoidance of traditional linkages enhances reliability and accuracy.

The concept of the Blade sensor and its operation will be new to you, but by following a few simple steps it is easy to get a feel for any application at a workbench with only a Personal Computer, a battery and voltmeter. In particular, activator material and design can be very easily checked by literally 'cut & try'. With simple techniques the sensor can be extensively characterised before undertaking the engineering work needed for the real application.

The sensor can be treated as a traditional analogue device and tested with a voltmeter. However connecting the sensor to a personal computer will allow the user to have full access to, and control over all the Blade's functions.

Sections 3 & 4 explain how the user can carry out a quick test to familiarise oneself with the basic functionality of the sensors, using both the analogue feature and the BladeCom GUI.

Section 5 gives details of how to design and make an activator for your Blade sensor.

Sections 6 & 7 provide detailed information on setting up a Blade sensor. For simplicity, we have used the parameter numbers relevant to the 25mm Blade Sensor (firmware 2191 version 2.06 and above) and also the blade rotary sensor (Firmware 2300 version 2.00 and above) throughout this document. For default, maximum and minimum parameter numbers of other types of sensors please refer to **Section 7.**

3   Analogue & Switch Output

The Blade sensor can be used in the same way as a traditional potentiometer, with an output that can be measured with a basic voltmeter. By following the simple procedure described below a feel for the operation of the blade sensor can be gained.

3.1   Connection

Two types of connection are shown, the standard 25mm/ 50mm/ 60mm blade connection and the rotary blade sensor connection.

For the 25mm/ 50mm/ 60mm blade sensors, connect the sensor as shown below:

| | Positive DC supply (5V to 32V DC) – Typically 10mA |

Positive DC supply (5V to 32V DC) – Typically 10mA

System & power ground (GND)

Switch output

Serial comms input (Sensor Rx); RS232 compatible

Serial comms output (Tx) – RS232 compatible

Analogue output: Voltage or PWM (Pulse Width Modulation)
        Voltage – All sensors
         PWM – 25mm Blade, 50mm linear Blade and 60mm Blade sensor.
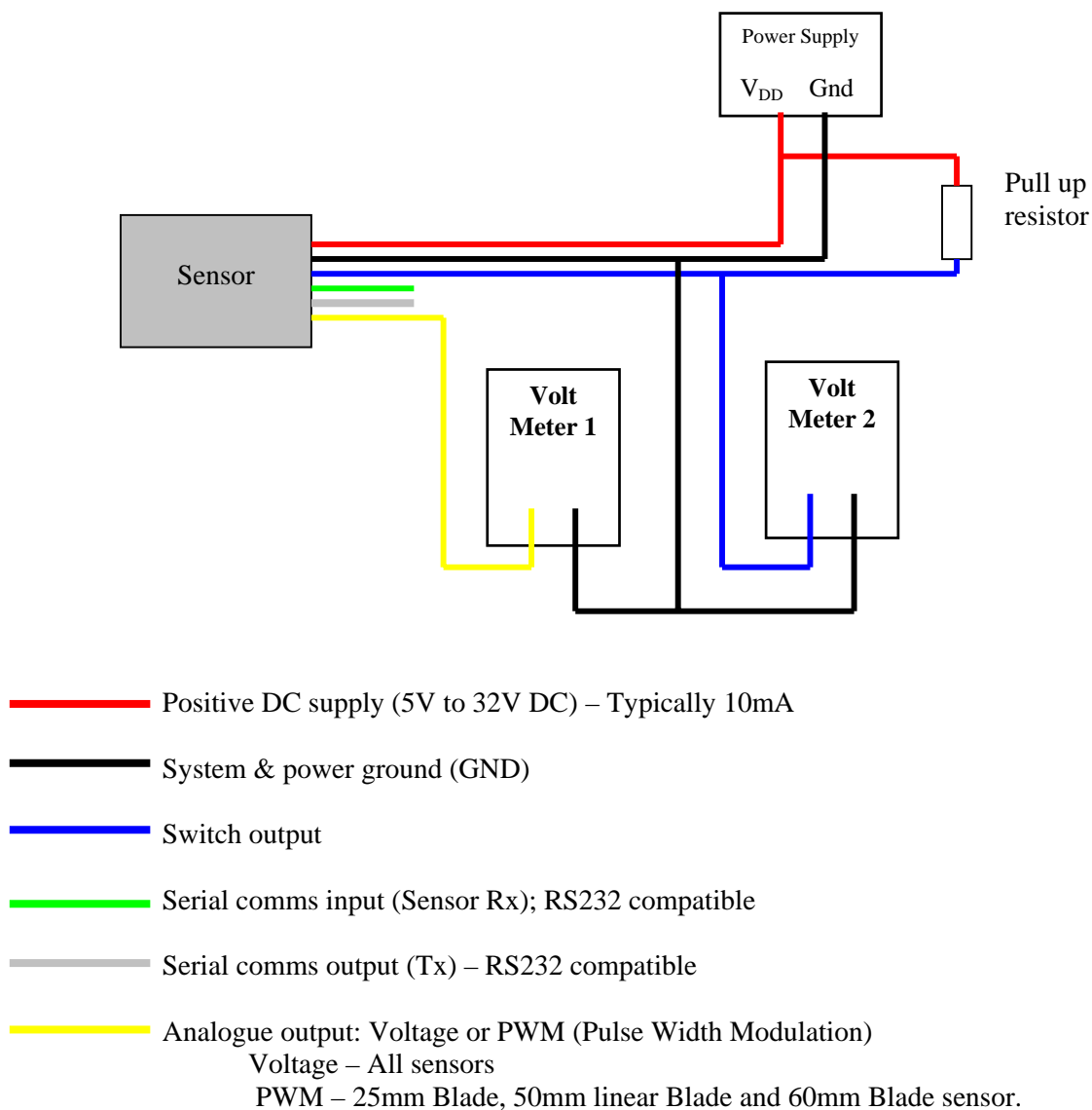
For the rotary blade sensor, connect the sensor as shown below:
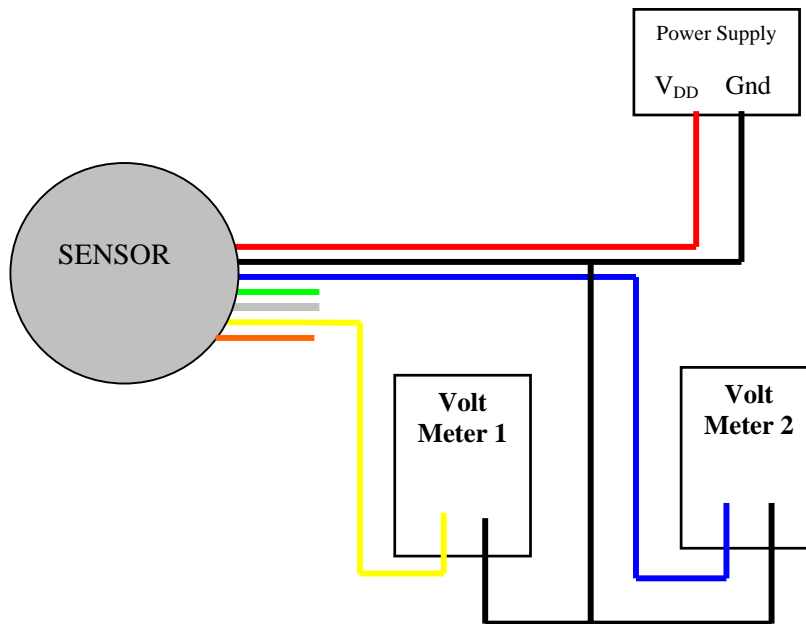
Positive DC supply (5V to 14V DC)
Typically 25mA without comms.

System & power ground (GND)

Switch output

Serial comms input (Sensor Rx); RS485 compatible

Serial comms output (Tx) – RS485 compatible

Analogue output 1: Voltage or PWM (Pulse Width Modulation)

Analogue output 2: Voltage or PWM (Pulse Width Modulation)

3.2 *Analogue Output*

The analogue output is a linear analogue signal, directly proportional to activator position.

Move a standard activator or similar metal object such as a large coin over the sensor (making sure the coin is very close or in contact with the surface of the sensor), a change in voltage on **voltmeter 1** will occur.

The magnitude of the analogue output depends on the specification of the sensor. By default, when an activator is present, the analogue signal is limited between 10% and 90% of the full scale. So, using a standard activator, the analogue output will vary between 0.42V and 3.78V for a 25mm blade (full scale 0V to 4.2V) and 0.55V and 4.95V for the blade rotary (Full scale 0V to 5.5V).

The analogue output will default to a defined state if a sufficiently effective activator is not present. The default is 5% of full scale giving 0.21V analogue signal for a 25mm blade. This is a feature to replicate the behaviour of a contacting potentiometer if the wiper contact is lost; many systems are able to recognise this as an error condition.

For the factory settings of the other type of sensors please refer to **Section 7.**

3.3 Switch Output

25/ 50/ 60mm Blade

For the 25mm / 50mm / 60mm blade sensors, the switch is factory set to change status at the centre of the sensor. The switch point is affected by ±0.2mm of hysteresis. Please see **Section 6.3.3 & 6.3.4** for information on how to change the switch point.

The switched output is an open collector drive and a pull up resistor is required for it to function. The power supply for the switched output is provided by the customer and can be anywhere between 2V and 12V, but for the purposes of this manual, the switched output is powered from the same power supply as the sensor. The output will be:

Output Status	Voltage on switch output
Switch closed	0V
Switch open	V_{DD} (supply voltage)
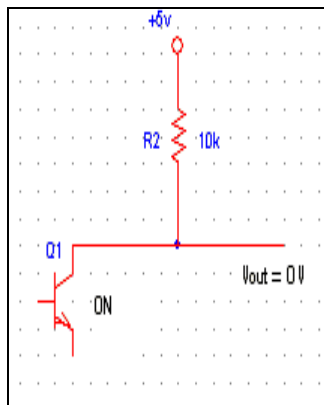
When the switched output is CLOSED (transistor shown as switched ON), the transistor provides a path to ground and the output is measured as 0V.
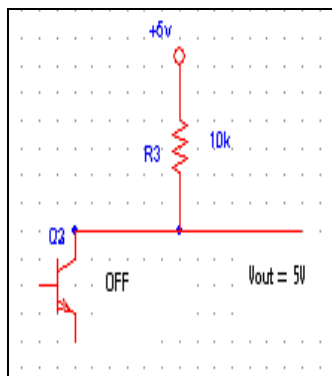
When the switched output is OPEN (transistor shown as switched OFF), the transistor has an extremely high impedance and so draws almost no current. The output is 5V (or very close).

The current limit of the switch output for a 25mm Blade sensor is 8mA. To determine the minimum allowed resistor value for this component please refer to the equation below:

$$R > \frac{V_{DD}}{8mA} \qquad (V_{DD} = \text{Supply Voltage})$$

Typical resistor value: 10kOhm for most applications (not supplied as can vary with power supply voltage).

Move the activator from one end of sensing surface to the other. A change in voltage on **voltmeter 2** from 0V to VDD will indicate that the sensor is operating. The switched output will default to a defined state if a sufficiently effective activator is not present. The default is *open switch* this means that the voltage on **voltmeter 2** will read V_{DD}.

3.3.1 Blade Rotary Sensor

The switched output for the blade rotary sensor is an analogue output switched internally between ground and the power supply voltage and so does not require a pull up resistor in order to function. In this case, the user cannot alter the voltage of the switched output.

The switch is factory set to change status at 180 degrees opposite the zero degrees point of the sensor.

3.3.2 Examples

Examples of applications of the switched output are:
- Provide an indication of the position of a sliding door using a 25 or 60mm blade sensor, to show the point at which the door is safely shut.
- When using a rotary sensor for a 360-degree crane turntable, indicating a rotary position at which the load is no longer safe.

4   BladeCom Graphical User Interface

BladeCom is a GUI (Graphical User Interface) that allows the user to connect a Blade sensor to a personal computer so its settings can be adjusted to suit the users requirements.

BladeCom is compatible with the 25mm Blade, 60mm Blade, 50mm Blade and the 360^0 Rotary Blade sensor, it will automatically identify the type of sensor connected.

BladeCom GUI is designed to run with a minimum of Windows 95 on a 100MHz Pentium processor. A CD drive is required to run the installation software.

BladeCom software may also be installed online via our website www.gillsensors.co.uk.

4.1   Connection

To communicate with the sensor using BladeCom software, connect the sensor as shown below.

4.1.1   Connection for 25mm / 50mm / 60mm blade sensors (RS232)
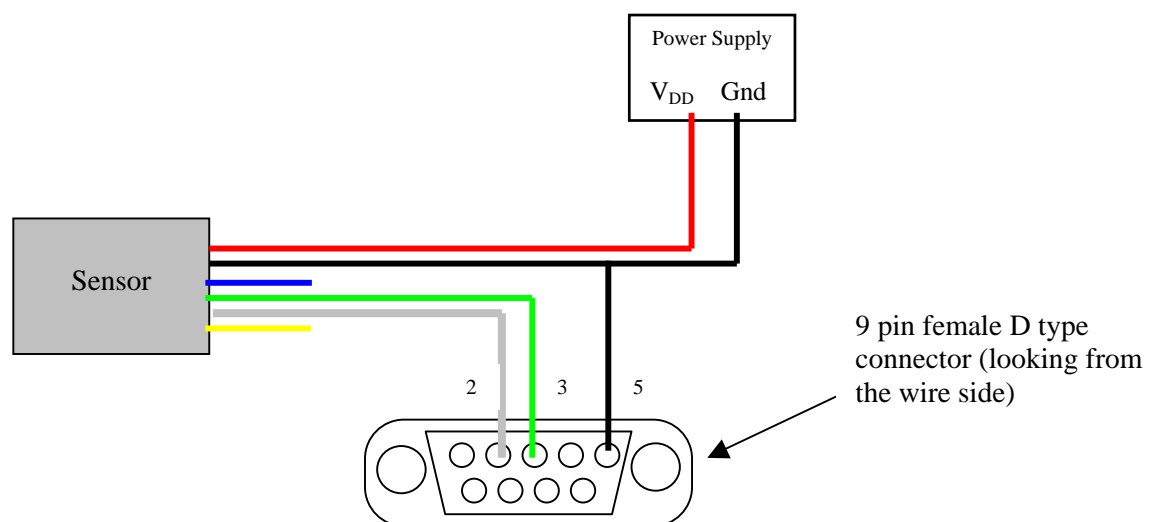
Connect the D type connector to a serial communication port on the computer. For laptops with only USB connectivity an RS232-USB adaptor can be used. Apply power to the sensor.

4.1.2 Connection for Rotary Blade Sensor (RS485)
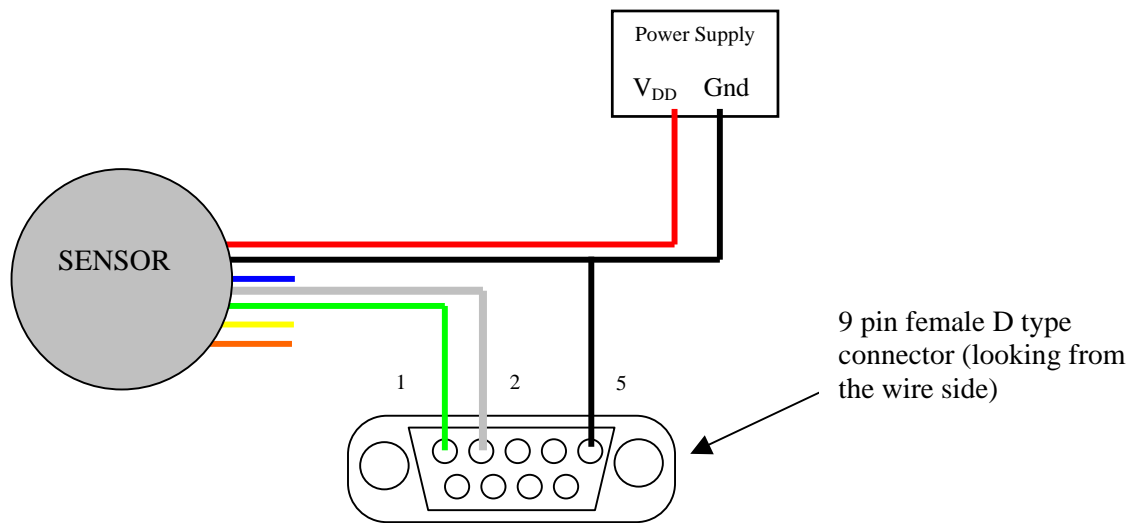
Connect the D type connector via an RS485 to RS232 converter to a serial communication port or USB port on the computer (set DIP switches to half duplex (2 wire), no echo). Apply power to the sensor.

4.2 Install BladeCom GUI

Install the BladeCom GUI software using either a provided installation CD or download it online via our website www.gillsensors.co.uk. After installation an icon (shown below) will appear on the desktop, click this icon to run the application.

BladeCom.
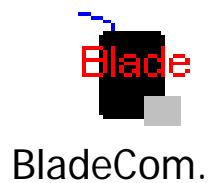
4.3   Sensor Monitoring Using the Graph Display

4.3.1   Graph Display (25mm/ 50mm/ 60mm blades)

Once the software is loaded a window will appear as shown below.
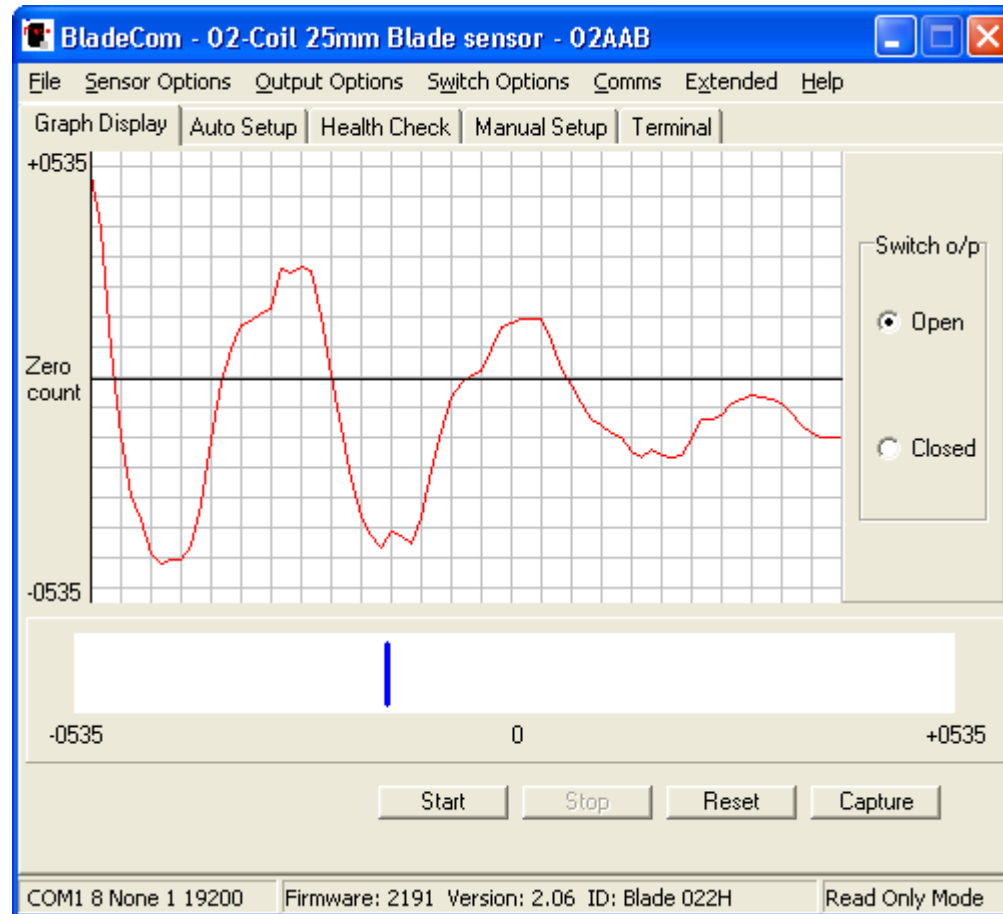
Make sure the voltage supply to the sensor is within +5V to +32V DC and the serial communication wires are connected to the specified pins of the 9 way D type connector and click *Detect Sensor* on the *Sensor Options* menu to communicate with the sensor. If the software cannot communicate with the sensor or loses communication whilst running then an Error message will appear.

Click the *start* button to start a scrolling graph and a graphical representation of the activator's position. When the graph reaches the end of the axis it will automatically scroll back the other way. Move a *standard* activator or similar metal object, such as a large coin, over the sensor to monitor its movement and position (ensuring that the coin is very close to or in contact with the sensors surface). The *Switch o/p* on the right hand side of the window indicates the status of the switched output of the sensor.

Please refer to **Section 6** to configure the sensor.

4.3.2   *Graph Display (Rotary Sensor)*
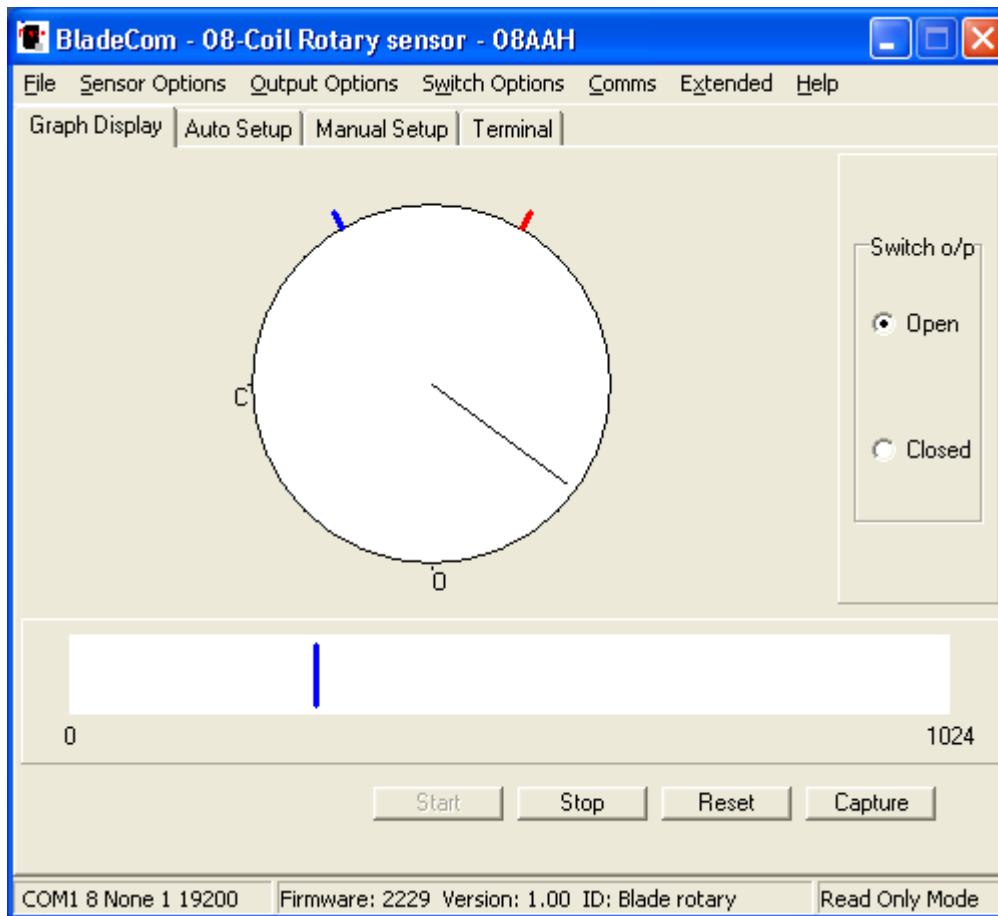
Make sure the voltage supply to the sensor is within +5V to +14V DC and the serial communication wires are connected to the specified pins of the 9 way D type connector and click *Detect Sensor* on the *Sensor Options* menu to communicate with the sensor. If the software cannot communicate with the sensor or loses communication whilst running then an Error message will appear.

Click the *start* button to start a continuously updating 360 degree display. Rotate a *standard* activator or similar metal object, such as a large coin, about the centre of the sensing face to monitor its movement and position (ensuring that the coin is very close to or in contact with the sensors surface). Note that the view of the sensor is shown looking down onto the sensing face (cable pointing away from the user). The *Switch o/p* on the right hand side of the window indicates the status of the switched output of the sensor.

Please refer to Section 6 to configure the sensor.

5 Activator Design Information

5.1 Standard Activator Design for 25mm & 60mm Blade sensors

For evaluation and testing purposes *Gill Sensors* recommend an activator is manufactured to the dimensions shown.

Referring to drawing 1457-G-009 in **5.1.1**,

Start with a 1mm thick, 25mm wide, EN3B mild steel metal sheet and form it into a 'U' shaped channel nominally 10mm wide.

To obtain a linear response the activator should overlap the sensing edge of the Blade by 17mm in the central position.

The parts of the activator used for measurement are the two inside flat surfaces either side of the sensor. The rear of the 'U' channel is not significant, or anything else attached to or extending from the activator provided nothing else comes within 6mm of the sensing area.

The sensor will work with a single sided activator but there will be greater sensitivity to side movement and sensor resolution will be affected.

It can be useful to adapt the shape to optimise sensor characteristics for some applications, please see the picture below. For special applications or custom activator designs please contact *Gill Sensors*.

Above are examples of two different types of activator design, the one on the right is the standard activator and on the left is a custom design for marine applications.

5.1.1 Typical Activator for 25mm & 60mm Blade Sensor
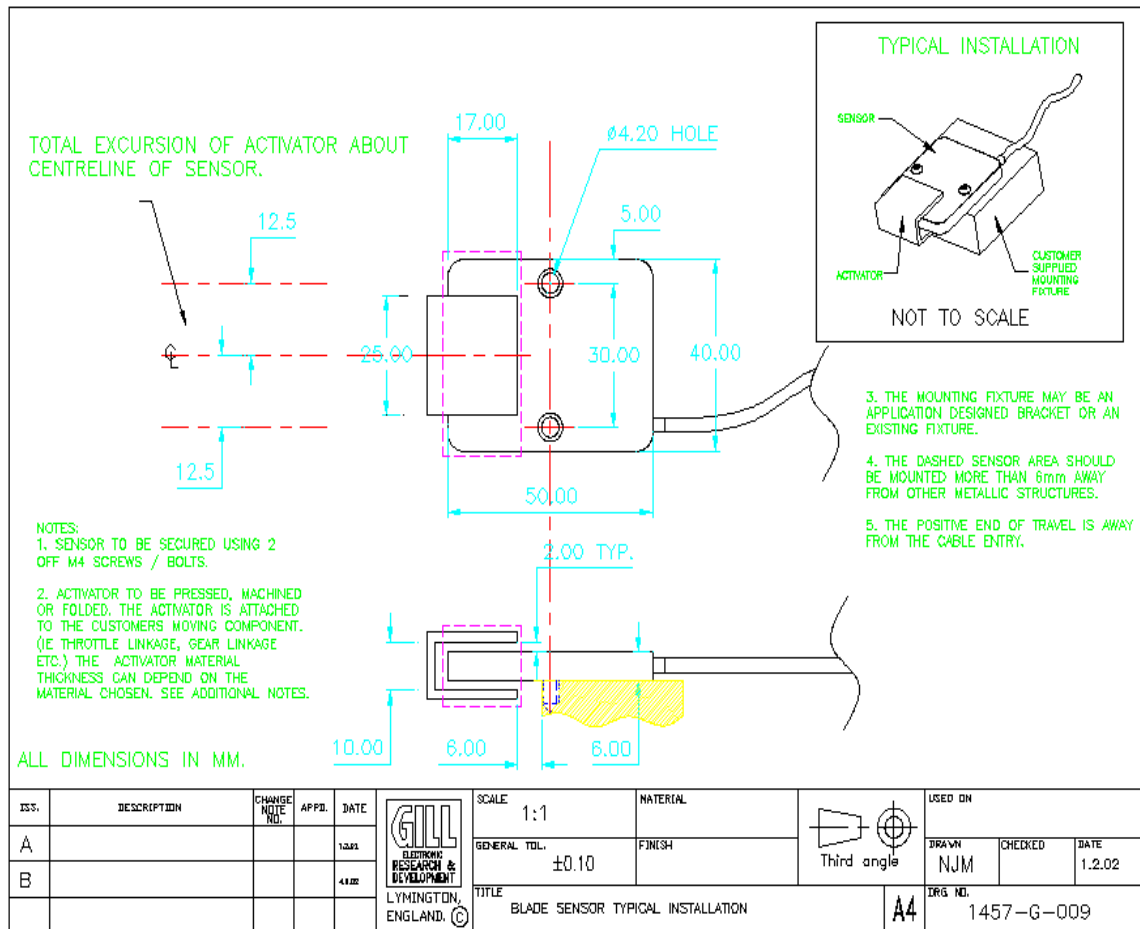
5.2   Standard Activator Design for a Blade Rotary Sensor

This activator design is the optimum size for best performance of the sensor. It is designed to be screwed onto the end of a shaft, which is aligned such that the axis of rotation of the activator is positioned in the centre of the sensor. The sensor itself is mounted from the opposite side using three M3 bolts with 5mm of thread engagement (see datasheet).
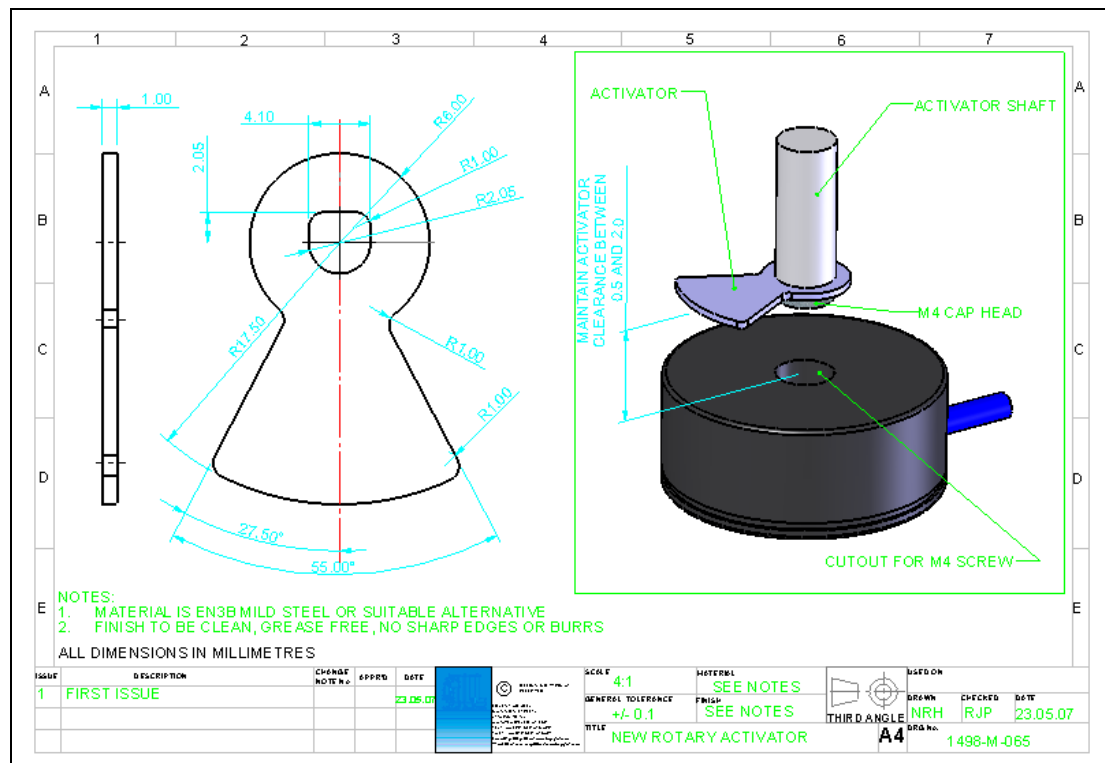
Other activator shapes are feasible, such as a circular post milled into the end of a shaft or a shape similar to the standard activator design but without the circular part of the keyhole shape. Like the 25mm/ 50mm/ 60mm blade sensors, EN3B Mild Steel is the recommended material, though others are possible. Please consult Gill for further details.

5.3   Standard Activator Design for other sensors

To view example activator designs for other sensors in the Blade range please visit our web site www.gillsensors.co.uk and look in the technical section for blade datasheets or the animations in the products section.

6 Configuring your Blade sensor using the BladeCom GUI

In this section you will find information on how to configure your sensor using BladeCom. It is recommended that non-advanced users only read up to **Section 6.4**. Information after this point can be confusing if you are not familiar with the operation of the Blade sensor, as such it is recommended that only advanced users read this information.

6.1 Sensor Write Protection

Important! - On initialisation the sensor parameters cannot be adjusted, the user can only monitor the sensor position in the *auto set up, terminal,* or *graph display*. This is to protect the sensor inadvertently being re-configured during testing.

Clicking on *Allow changes* on the *Sensor Options* menu will enable all user configurable functions in the software.
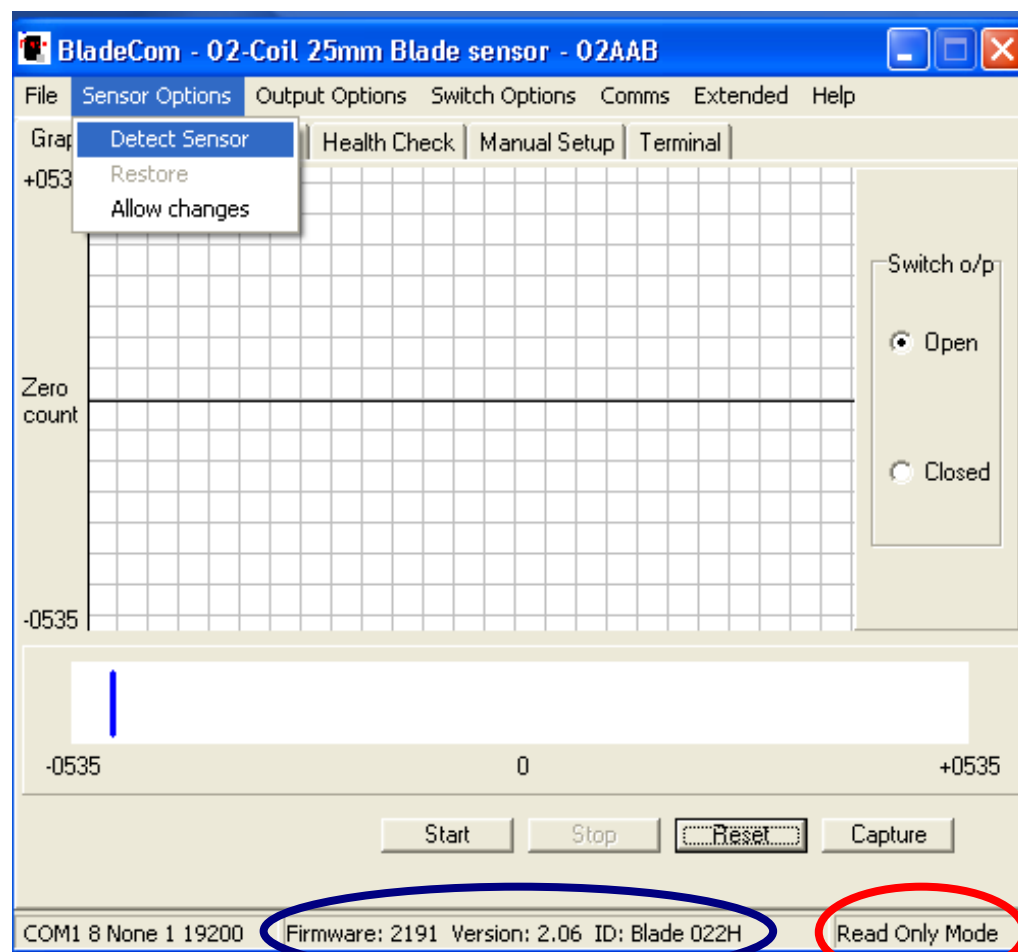
Sensor Firmware number, Version number and Serial ID.

Indicates whether the sensor is in read only mode or not.

6.2   Graph Display

6.2.1   Graph Display (25mm/ 50mm/ 60mm Blade)
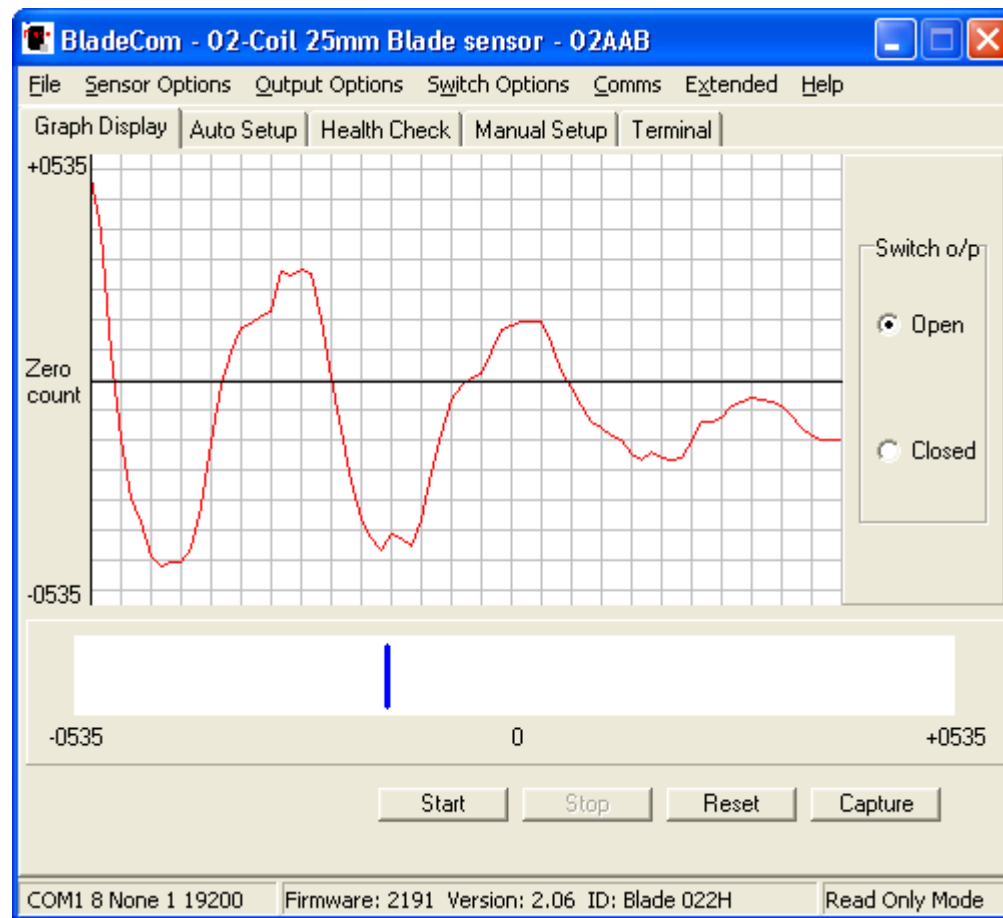
6.2.2   Start

This button allows the user to start a scrolling graph and a graphical representation (vertical blue bar) of the activators position. When the graph reaches the end of the x-axis, the graph will scroll left. **Note** that the graph Y-axis is auto scaling and will depend upon the range selected (see **Section 6.5.1** for more information about range). The current switch output state display is also enabled when the *start* button is clicked.

6.2.3   Stop

This button allows the user to stop the graph from scrolling.

6.2.4   Reset

This button allows the user to clear the screen and reset the graph to the start of the axis.

6.2.5   Capture

This button allows the user to store the current screen to a bitmap file called 'capture.BMP'. This will be stored in the root of the Bladecom Installation Directory.

6.2.6   Graph Display (Rotary Sensors)
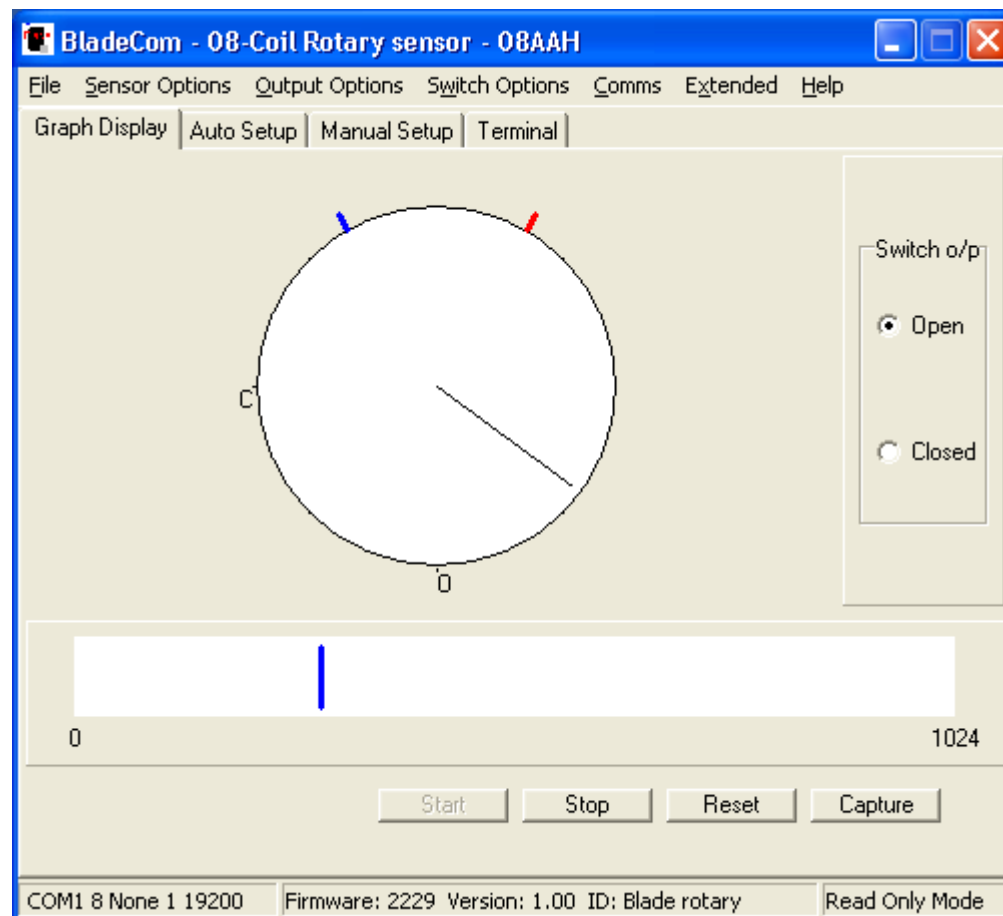
6.2.6.1   Start

This button allows the user to start a scrolling needle and a graphical representation (vertical blue bar) of the activators position. When the needle rotates through 360^0 axis, the graph will scroll left. The button also starts monitoring the current switch output state.

6.2.6.2   Stop

This button allows the user to stop the graph from scrolling.

6.2.6.3   Capture

This button allows the user to store the current screen to a bitmap file called 'capture.BMP'. This will be stored in the root of the Bladecom Installation Directory.

6.3 Auto Setup Screen (25mm/ 50mm/ 60mm blade and Rotary)

This screen provides an easy way to setup a Blade sensor. This is the most practical way for a user to set up a sensor when the sensor is purchased in low/ medium volumes or as a one-off. It involves the user physically moving the activator to the required maximum and minimum positions whilst communicating with the sensor via Bladecom and a PC. This *Auto Setup* process works in the same way for all the compatible Blade sensors, including the rotary sensor.

The user is asked for some simple information that is then used to setup the sensor's analogue/PWM output for a particular application. The blue bar on this screen gives a moving indication of the current activator position.
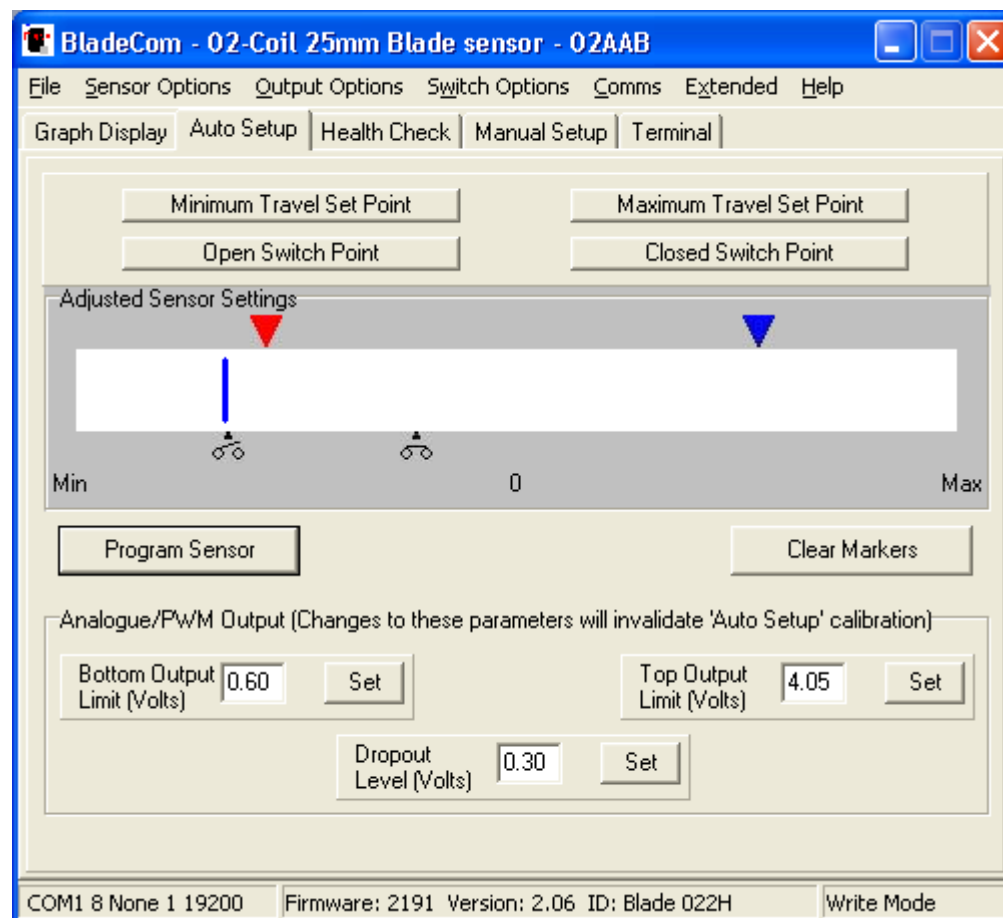
6.3.1 Minimum Travel Set Point

When this button is clicked with the activator at one extreme of movement, a symbol (red triangle) will move to the current marker position (blue bar). This set point is used to mark the furthest point of travel required at one end of the activator movement.

6.3.2 Maximum Travel Set Point

When this button is clicked with the activator at the other extreme of movement, a symbol (blue triangle) will move to the current marker position (blue bar). This set point is used to mark the furthest point of travel required at the other end of the activator movement.

6.3.3 Open Switch Point

Setting this marker with the activator in a certain position will set the point at which the switch turns off. Refer to previous sections regarding the switch output for further information on modes of operation. An *Open switch* symbol will be placed at the point where the blue indicator is currently positioned.

6.3.4   Closed Switch Point

With the activator in a certain position, this marker sets the point at which the switch closes from the open position. A *Closed switch* symbol will be placed at the point where the blue indicator is currently positioned.

6.3.5   Adjusted Sensor Settings (Display)

This is the graphical display that is used to setup the sensor. Triangular markers show the minimum and maximum range of travel required by the user. Placing the mouse cursor over these markers will cause a description of the particular marker to be shown. The switch markers with direction indicators show the switching points.

6.3.6   Program Sensor

This button is disabled by default. Clicking this button will result in the current setup parameters displayed on the graphical display being programmed into the sensor. Note, until this button is pressed, the sensor settings are not updated.

6.3.7   Clear Markers

Removes current set point and switch point marker symbols.

6.3.8   Bottom Output Limit

This is the voltage or percentage that the analogue/PWM output of the sensor will read when it is at the minimum set point.

6.3.9   Top Output Limit

This is the voltage or percentage that the analogue/PWM output of the sensor will read when it is at the maximum set point.

6.3.10   Dropout Level

This is the level, which the sensors output will default to if a sufficiently effective activator is not present.

For a more detailed explanation of the output limits and dropout level please refer to **Section 6.5.9 to 6.5.11.**

The output of the linear and rotary Blade sensors described in this manual will vary linearly between the top and bottom output limit.

6.4   Health Check Screen

The health check screen is available for all blade sensors except the rotary sensor.
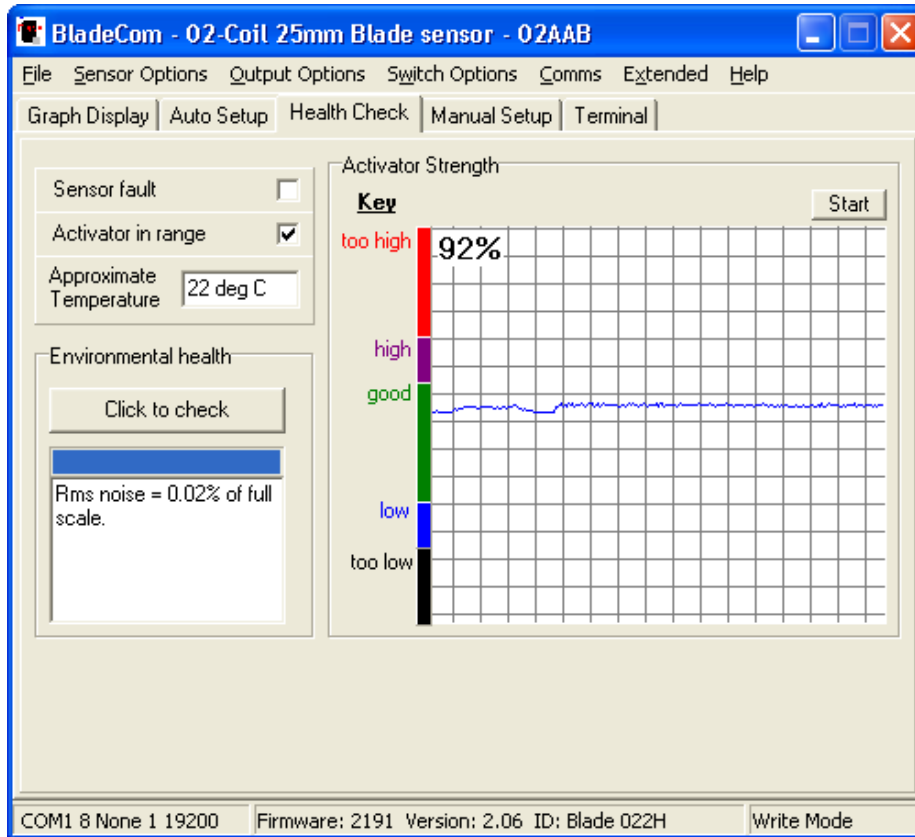
6.4.1 Sensor fault

A tick in this box indicates that the sensor may have developed a fault. The box may also be ticked if the sensor is being magnetically saturated, this may be due to incorrect activator positioning, size and/or material is present.

6.4.2 Activator in range

A tick in this box indicates that the activator is within the defined range.

6.4.3 Approximate temperature

Shows the approximate current sensor temperature, this is a guide only.

6.4.4 Environmental health

If the user clicks the *Click to check* button a process will begin to calculate how much electrical noise is present in the sensors local environment. This process takes a few seconds and gives a result as a percentage of the full-scale sensor output as shown above. This value can aid determination of sensor performance under certain environments. This value should not be greater than 0.1% for best results.

6.4.5 Activator strength

The blue plotted line should be in the 'green' region although the line may be slightly higher or lower for certain materials. The percentage reading in the top left-hand corner gives an indication of the current material response in relation to the optimum sensor response, please

note that this is only a guide. The Pause/ Start button halts the moving graph; it can be resumed by another click of the same button.

6.5 Manual Setup Screen

The manual setup screen would normally be used by customers requiring a particular setup of blade sensor in medium/ high volumes and with a highly repeatable installation. This setup can be done 'blind' as all sensors can be calibrated on a PC prior to installation, but requires a small amount of testing to determine optimum settings for the particular application and installation.
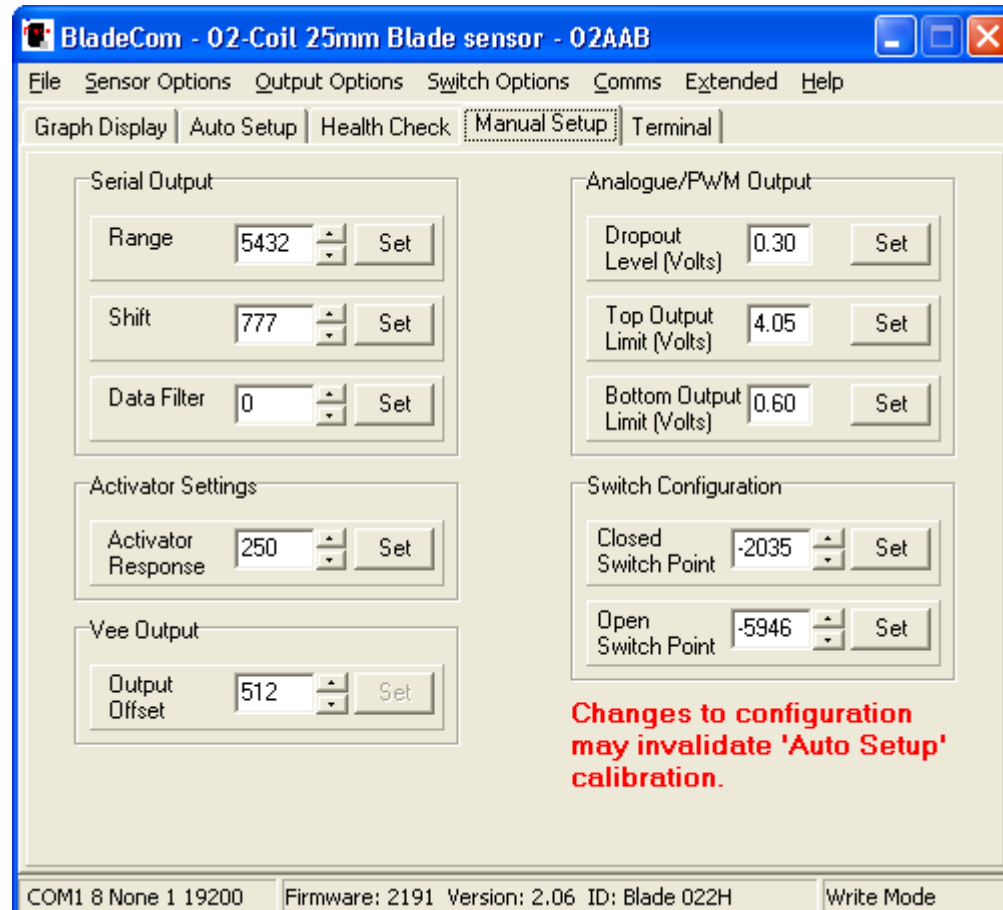
This screen allows the user to configure all the basic parameters defining the output range, scaling and filtering as well as defining the analogue output limits.

The values corresponding to the Analogue/ PWM output are set in volts or % and all other values are set in counts, where one count is the smallest available increment of a range of values. For values set in volts, the range of values depends on the type of blade sensor (See Section 7). Ranges of count values vary depending on the parameter being set and are as follows:

Value	Range of Count Values
Serial Output	-512 to +511 (10 bit range)
Serial Output: Range	200 to 32767
Serial Output: Shift	-8192 to 8191
Serial Output: Data Filter	0 to 3
Activator Settings: Activator Response	0 to 1023
Vee Output: Output Offset	0 to 1023
Switch Configuration: Closed Switch Point	-8192 to 8191
Switch Configuration: Open Switch Point	-8192 to 8191

The actual voltage/ frequency on the Analogue/ PWM serial outputs is directly proportional to the *Serial Output* count values. For a 25mm Blade Sensor the range of count values for the serial output is between –512 and +511.

- –512 counts is 0 volts or 0% PWM.
- 0 counts is just over 2.1volts or 50% PWM.
- +511 counts is 4.20V or 100% PWM

Note: If the *Auto Setup* feature has been used to setup the sensor then values on this screen should not be altered. Any alteration may invalidate the *Auto Setup* calculations.

6.5.1   Serial Output – Range

The user can adjust both the centre position and scaling of the output by changing the Shift and Range parameters. The graph below represents the default output of the sensor, taking the example of the 25mm blade and showing the output both in counts (+511/- 512) and volts (0V to 4.2V).
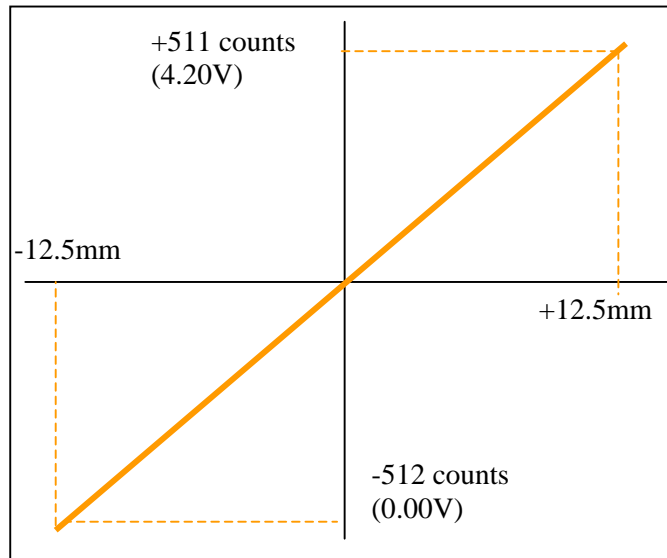
The effect of the range parameter is to change the range of movement measured by the sensor. Mathematically this is done by changing the gradient of the yellow line in the graph above. The default value of 4800 corresponds to the gradient of the line, which exactly matches a measurement range of +/- 12.5mm.

By entering a range value of 9600 (double the default value), the user reduces the range of movement measured by the sensor by half.

For the 25mm/ 50mm/ 60mm Blade sensor (firmware 2191 version 2.06 and above) the default Range value is 4800. This parameter can be adjusted from 200 to 32767. A value of 200 gives approximately 2 counts per mm of travel and 4800 gives 41 counts per mm or ±512 counts over ±12.5mm travel. Almost all users require the resolution to be as high as possible over the measurement range, so it is very unlikely that the range value would ever be set to below 4800 (standard +/- 12.5mm range). The sensor can be configured over a greater measurement range, but this is done at the cost of resolution and linearity.

For the rotary sensor the range variable is called 'full scale' and represents the number of degrees over which the sensor will give an analogue/ PWM output. The zero point always remains the same unless adjusted using the shift parameter.

6.5.2 Serial Output – Shift

The effect of the shift parameter is to change the centre position of the sensor (or the start position in the case of the blade rotary sensor).

Taking the example of a 25mm blade sensor, this might be done in an application where a customer has an installation, which does not allow the sensor to be positioned in such a way that the mechanical centre of the sensor is also the centre of the range of measurement and wishes to compensate for this.

The default value for shift is 0 corresponding approximately to the mechanical centre of the sensor.

For the 25mm Blade sensor a *Shift* of +625 counts gives approximately -1mm of shift. Maximum values are –8192/ + 8191, which allows an offset over the full ±12.5mm of travel. For other sensors, the values are as follows:

Note that the maximum available travel can be reduced as more *Shift* is applied (range can be lost from either side of the sensor, though the sensor is tolerant of a small amount of shift without loss of range).

For the rotary sensor, shift values are adjusted in degrees and represent shift from the mechanical zero point of the sensor.

6.5.3   Examples of Range and Shift

Some examples of shift and range using the 25mm blade sensor:

Shift = 0; Range = 4800

-12.5mm	0mm	+12.5mm
Serial	Serial	Serial
-512	0	+512

Activator travel

Activator

Blade
Sensor

Mechanical centre

Shift = 0; Range = 9600

-6.25mm	0mm	+6.25mm
Serial	Serial	Serial
-512	0	+512

Activator travel

Activator

Blade
Sensor

Mechanical Centre
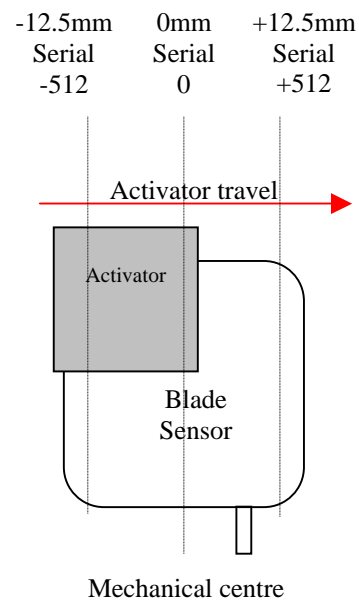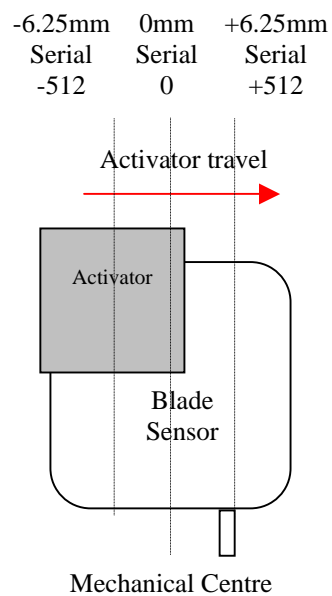
Shift = 2000; Range=9600

-6.25mm   0mm   +6.25mm
Serial   Serial   Serial
-512   0   +512

3.12mm from mechanical zero (Shift value of 2000)

Activator travel

Activator

Blade
Sensor

Mechanical centre
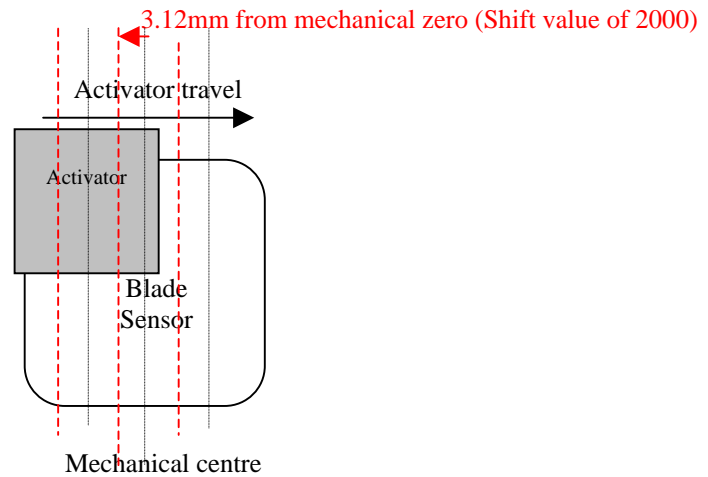
An example using the rotary sensor:

SHIFT = 45DEGREES, RANGE = 180

START 45
DEGREES

Mechanical zero
(0 DEGREES)

MEASUREMENT
RANGE

END 225
DEGREES

CABLE
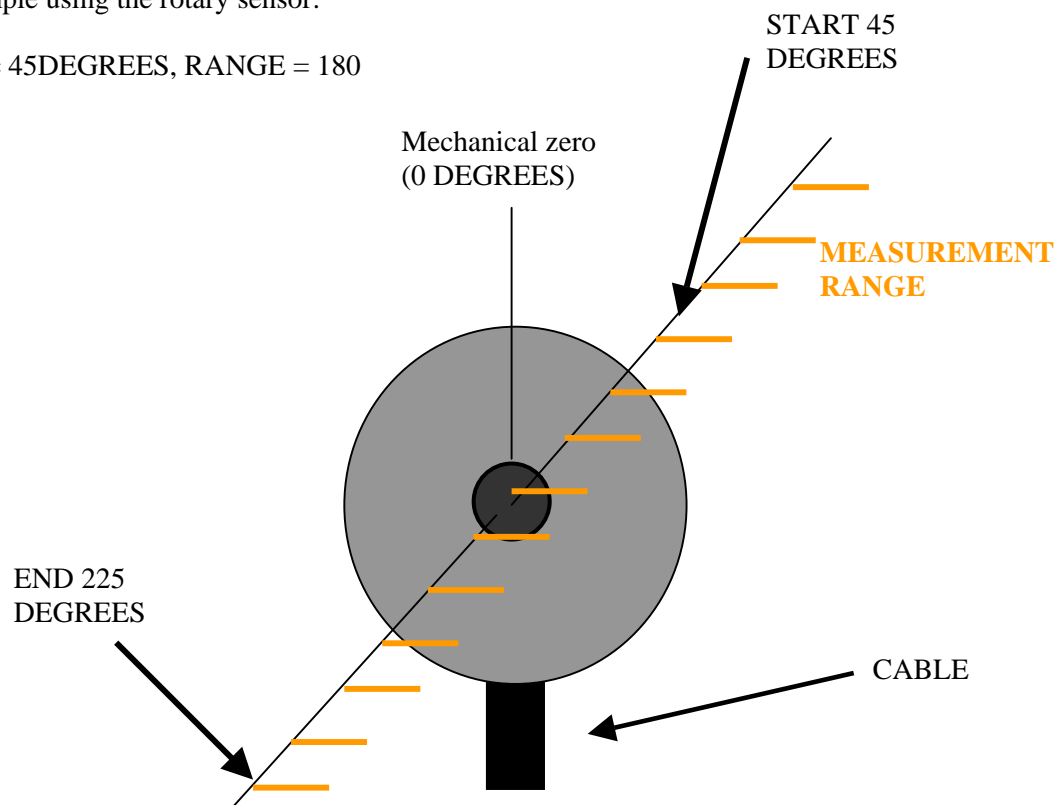
6.5.4   Serial Output - Data Filter

The *Data Filter* setting stabilises the output value by making each reading the average of several consecutive samples with the output data rate maintained at 1kHz. The Data filter has 4 levels as detailed below:

0- No averaging
1- 4 sample average
2- 8 sample average
3- 16 sample average

6.5.5   Activator Settings – Activator Response

The A*ctivator Response* is a measure of signal strength received back from the activator by the sensor. This value will reduce as the activator travels away from the centre of the sensor and will also be affected by different activator materials and designs. The response setting is the minimum value that is considered adequate for full sensor performance. When the *Activator Response* drops below this limit, the serial output data is set to zero counts and the Analogue/PWM output modes will go to their pre-defined Dropout state.

6.5.6   Vee Output – Output Offset

The *Vee* output offset will only be enabled if the *Vee* mode is activated. See 'General Options – Output format' for full details on *Vee* mode operation.

6.5.7 Analogue/PWM Output

The graph below shows an example of the relationship between serial count values and analogue/PWM output values for a 25mm Blade sensor.

Graph of Serial Output Counts vs. PWM/ Analogue Output

Serial output count value (counts)
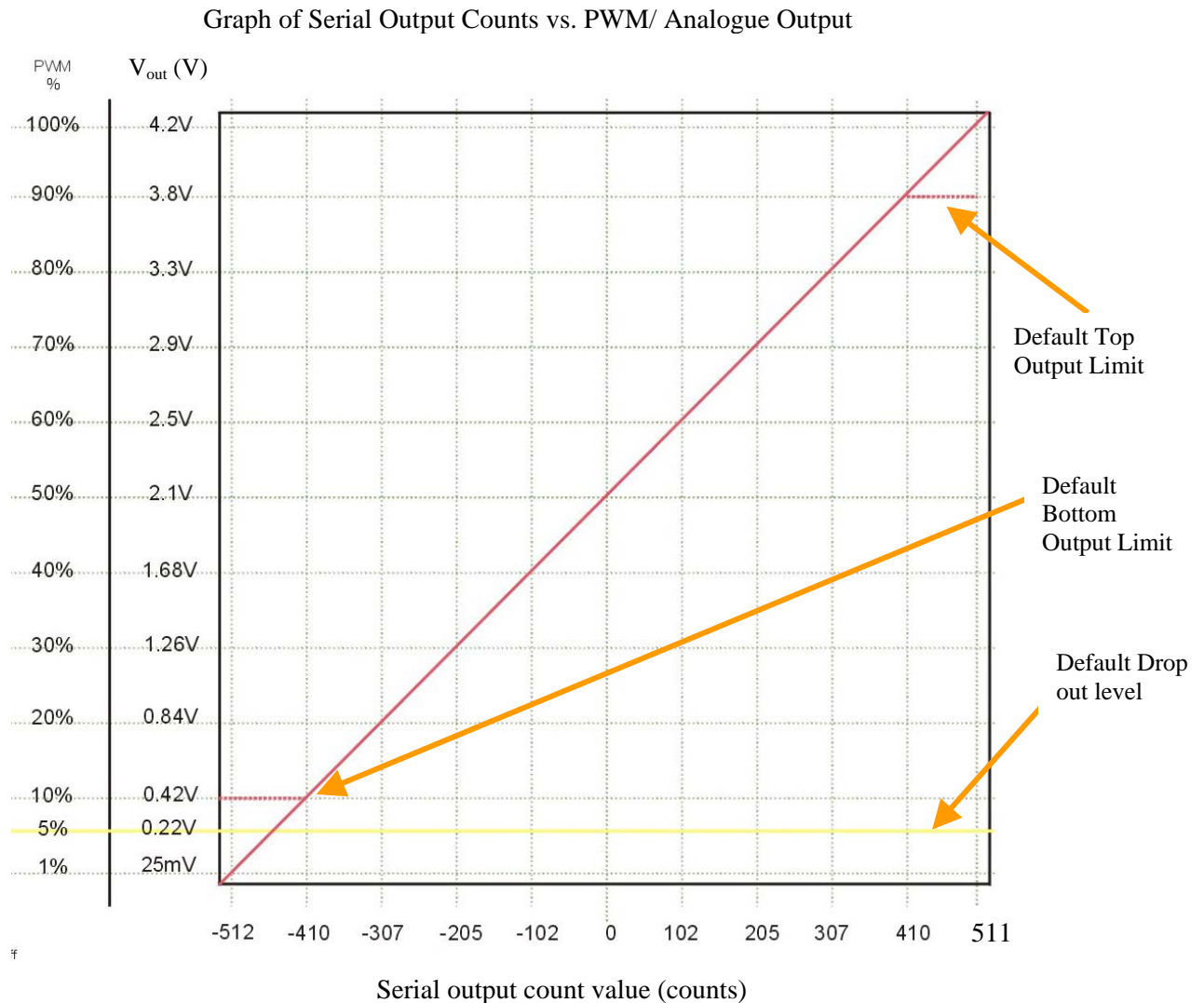
6.5.8 Switch Configuration – Closed/Open switch points

For the 25mm/ 50mm/ 60mm blade sensors, the defaults for the Closed and Open switch points are 128 and –128 respectively. For the 25mm Blade sensor these values set the switching point around the centre of the sensor with ±0.2mm hysteresis. For the rotary sensor, the switch points are set in degrees with 4 degrees of hysteresis.

6.5.9 Dropout level

If there is a complete loss of activator or the activator response falls below the Activator threshold, the analogue output will revert to the analogue/PWM dropout level. The default dropout level voltage for a 25mm Blade sensor is 0.21V or 5% PWM but can be set to anywhere between 0V and 4.20V. This spans the full analogue and PWM output range with 2.1 volts / 50% PWM giving a midrange value. Other types of blade sensor work in the same way, but with different voltage ranges (e.g. rotary is 0V to 5.50V)

6.5.10   Top output limit

The analogue/PWM *Top Output* limit is the maximum value reported as the activator approaches its upper limit of travel. The default top output limit voltage for the 25mm Blade sensor is 3.78V or 90% PWM but can be set to anywhere between the *Bottom Output* limit (see below) and (4.20V). Once the output reaches the *Top Output* limit, the analogue/PWM value will be maintained until the *Dropout Level* condition.

6.5.11   Bottom output limit

The analogue/PWM *Bottom Output* limit is the minimum value reported as the activator approaches its lower limit of travel. The bottom output limit voltage for the 25mm Blade sensor is 0.42V or 10%PWM but can be set to any between (0.00V) and *Top Output* limit. Once the output reaches the bottom limit value, the analogue/PWM value will be maintained until the *Dropout level* condition.

6.6   Terminal Screen
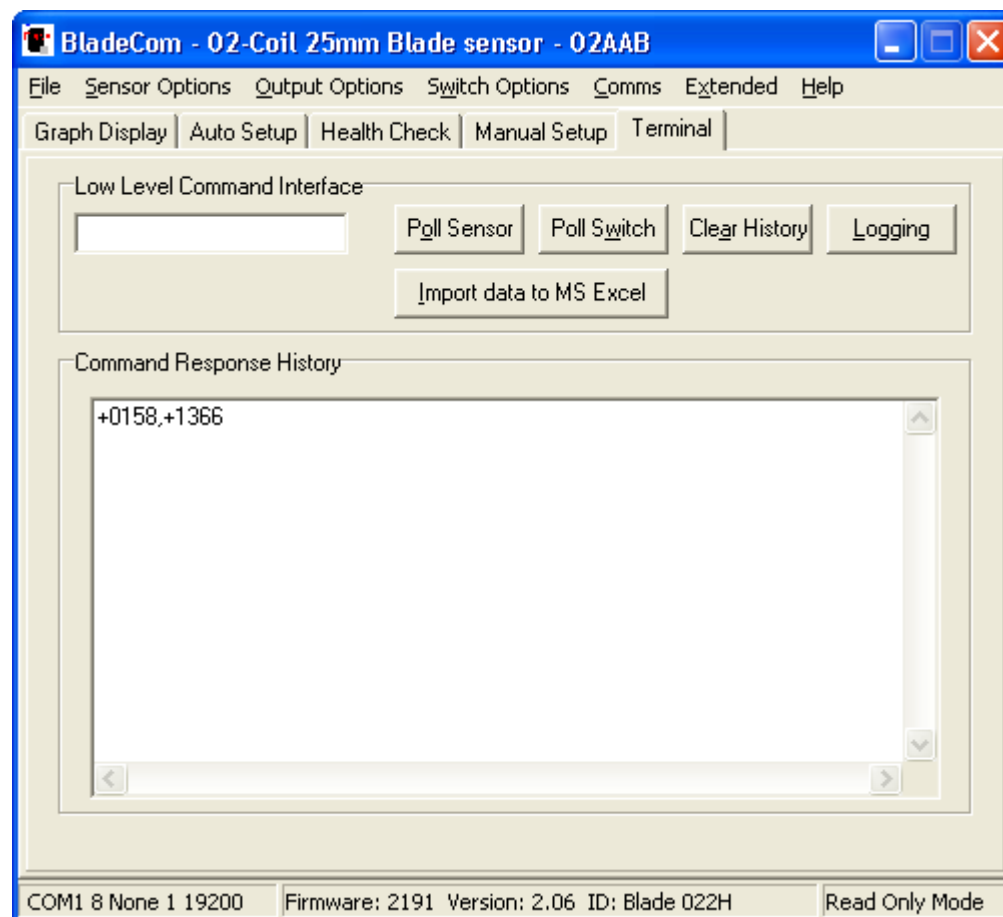
6.6.1   Poll Sensor

This button allows the user to manually poll the sensor and obtain a position and activator response reading. See serial communications and activator design sections above for more information regarding the data returned.

6.6.2   Poll Switch

This button allows the user to manually poll the sensor and obtain a switch position reading. This reading is then used to set the parameters in the *Switch Configuration* screen switch positions.

6.6.3 Clear History

This button allows the user to clear all data within the log history buffer. The user is asked to confirm this command before the data is removed.

6.6.4 Logging

This button allows the user to log all data from within the terminal window. When selected the user is asked for a directory and file name for the data. All data then presented in the terminal window is stored in a simple text file format with date and file information. When the stop log button is pressed, the data is then stored to disk.

6.6.5 Low level command Interface

This line allows low-level communication direct with the sensor and has the same functionality as using the sensor with a terminal emulator. Contact Gill Sensors for a full set of low-level interface commands.

6.6.6 Import data to MS Excel

Any data that appears in the *Command Response History* may be transferred to Microsoft Excel. The data is transferred in a CSV (Comma Separated Value) format so that column<n> will contain a specific data type from the sensor provided the user has sent only one request type (for example *Poll Sensor*) to the sensor. Use the *Clear History* button to remove any old data from the *Command Response History* prior to requesting data from the sensor.

6.7   Output Options
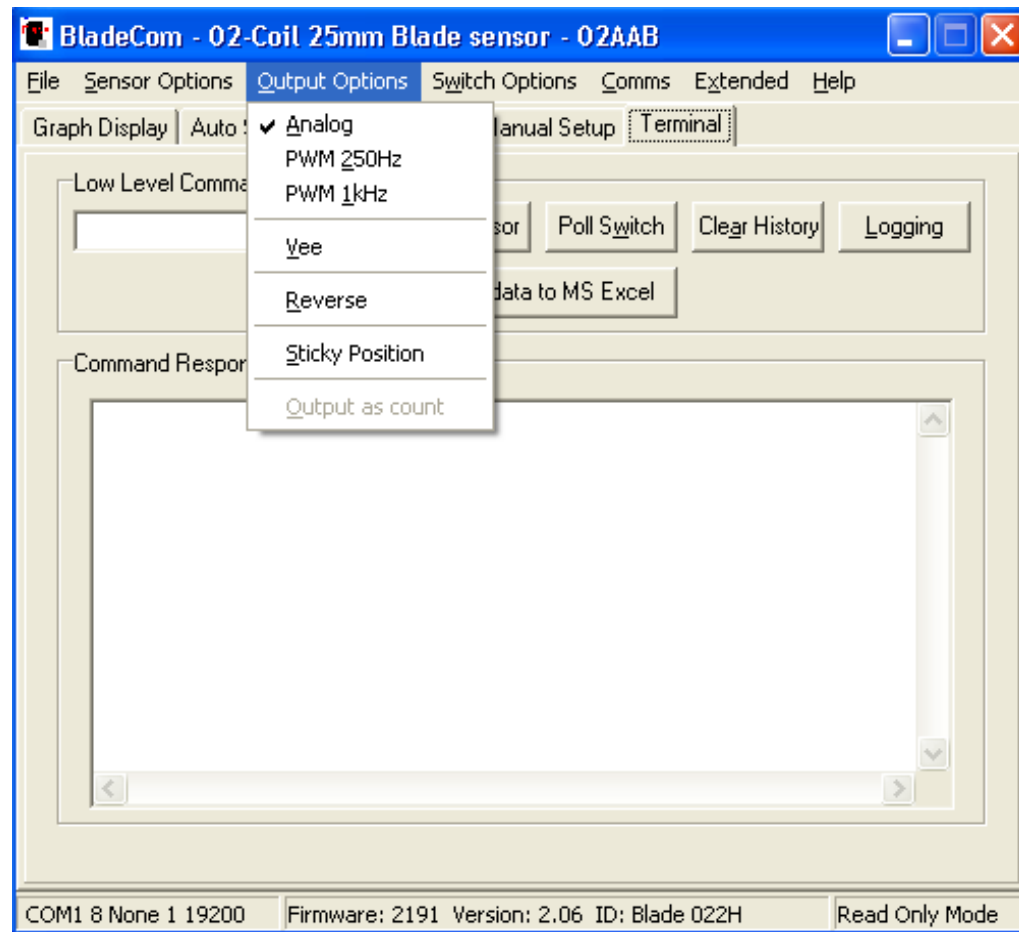
6.7.1   Analogue Output mode

The Blade sensor provides an analogue output as described in **Section 3.2**. The maximum analogue voltage output for the 25mm Blade sensor is 4.2V (varies according to sensor type 0- see section 6).Clicking *Analogue* on the *Output options* drop down menu will select the analogue output mode.

6.7.2   PWM Output mode

All the Blade sensors provide a 1kHz PWM output. PWM is a way of representing the activator position using a switched logic level with a fixed frequency, either 250Hz or 1kHz for 25mm Blade and 1kHz for all other sensor types. It has a variable duty cycle i.e. the proportion of each cycle for which the output is high and is expressed as a percentage. The duty cycle can vary anywhere in between 0% and 100% depending on the sensor setting.

6.7.3 Output Format (Normal or Vee mode)

Vee mode applies to all blade sensors except the blade rotary sensor.

Suggested uses for Vee mode:
- A power boat throttle control where speed needs to be controlled in both forward and reverse.
- A means of precisely locating the zero output point of the sensor when installed into the customer application.
- A means of moving the zero output point of a sensor to a particular activator position.
- An application where an adjustable dead band is required around the centre of the sensor.

There are two output formats - Normal or *Vee* mode with the default output format set to Normal mode. Clicking *Vee* on output options drop down menu will select the *Vee* mode. In normal mode, analogue or PWM output increases linearly as the activator is moved from one end of the sensor to the other, whereas in the Vee mode the output increases either side of the zero point.

With a default calibration and output reverse set to off, the output is always at a minimum at the mechanical zero point of the sensor and will increase with activator movement in either direction. The graph below of output against travel shows this *Vee* shape.

The shift parameter sets the position of the minimum point of the *Vee* on the x axis (range of values +8191/- 8192 as before). By using the shift parameter, the user can measure a certain amount of travel of the activator by changing the value until the output of the sensor goes to its minimum and then performing a quick calculation to work out the distance travelled (shift value divided by number of counts per mm of travel). Another use for the shift parameter would be to set the centre of the measurement range in a certain activator position by changing shift values until the output goes to a minimum with the activator in place.

The *Vee* output offset parameter sets the minimum output at the point of the *Vee* (values between 0 and 1023). A range of values from 0 to 1023 spans the entire output ranges of the sensor as per the top and bottom analogue limits and the minimum point of the *Vee* can be placed anywhere within this range. If the minimum value is set below the bottom output limit then the point of the *Vee* is truncated giving an adjustable dead-band where the output does not vary.

The range parameter sets the gradient of the line either side of the zero point (values between 200 and 32767 with a default of 4800 as before). It is used to determine the distance over which the sensor will give an analogue/ PWM output. The range parameter can be used in conjunction with the output offset parameter to give an adjustable dead band with the output going to its maximum at either extreme as shown below.

The V output can be effectively used in conjunction with the switched output. If the switch point is set to coincide with the point of the *Vee* then the switched output can be used to signal the direction of travel e.g. power boat throttle control lever

6.7.4 Reverse

Output reverse operates in the analogue/PWM output mode. It will reverse the output voltage/PWM value with respect to the position of the activator. The output reverse default is set to OFF which relates to minimum serial counts, voltage and PWM being near to the cable exit side. In Vee mode the point of the Vee will be high when the output reverse is on.

6.7.5 Sticky position

Sticky position operates in analogue/PWM output mode. Sticky position is a feature that retains the last valid position measured prior to the activator response falling to below the minimum activator response level (not applicable to blade rotary sensor). The analogue/PWM sticky position default is set to disabled. This function allows the user to measure a portion of the total travel of the activator e.g. the end of travel of a door. When enabled, the sensor will retain the last valid reading on the output as the activator travels off the sensor. When the activator returns to the sensor, the reading will continue to read from that position. Note that the output reading will revert to the Analogue/PWM dropout level if the power is removed from the sensor.

6.8 Switch Options
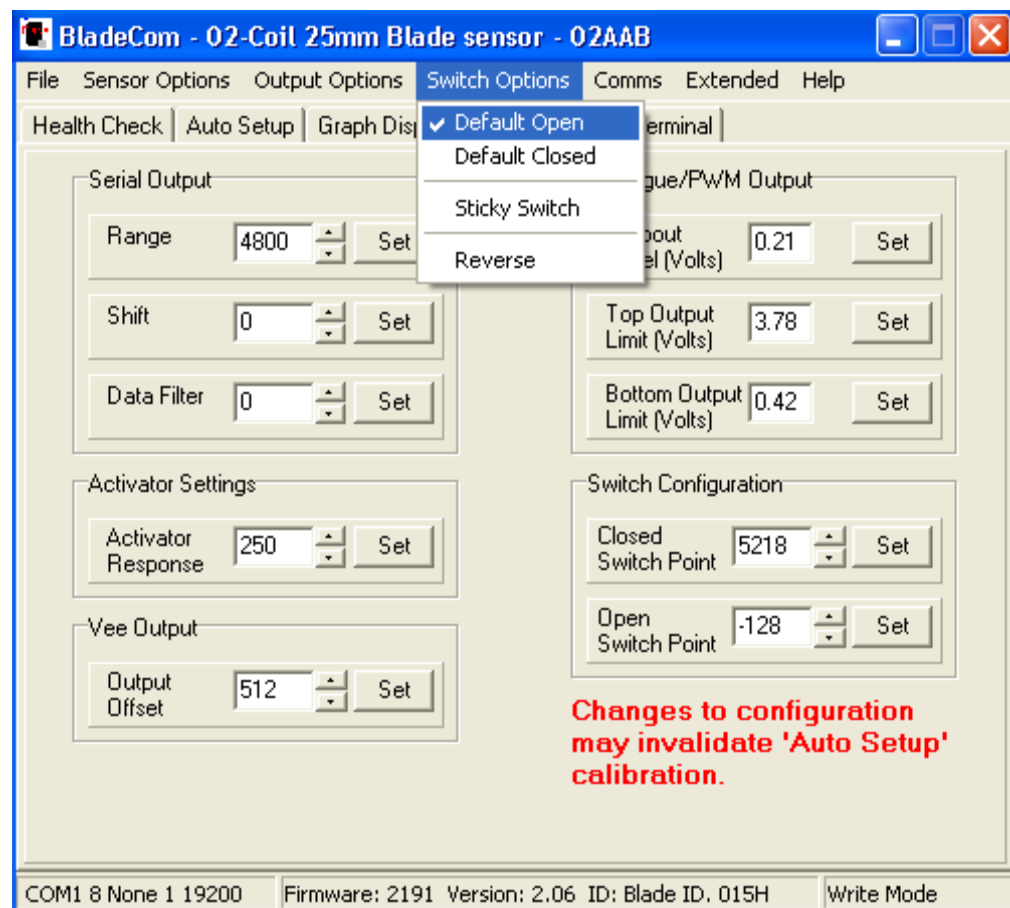
6.8.1 Switch default

This is the state that the switch will default to when to the activator response falls below the minimum activator response level. Switch default can be set to either open or close.

6.8.2   Sticky switch

Sticky switch is a feature that retains the last valid switch state prior to the activator response falling to below the minimum activator response level (not available for rotary blade sensor at present). The default setting is disabled. When enabled, the sensor will retain the last valid switch state as the activator travels off the sensor. When the activator returns to the sensor, the sensor will maintain that switch state until the next switch point is reached. Note that the switch output will revert to open state if the power is removed from the sensor.

6.8.3   Switch reversal

The switch reverse feature, inverts the switch configuration. It allows the user to select at which end of the sensor the switch level is closed.

6.9   Comms

Clicking *Setup* on the *Comms menu* will enable the user to use any comms port from 1 to 5.

7 Default Sensor Parameters

The maximum, minimum and default numbers for the Blade sensors are given below:

Parameters		25mm Blade Up to Version 2191204	25mm Blade Above version 2191204 Blade	50mm Linear	60mm Blade		360 deg Rotary
Range	Default	4300	4800	10500	9800	Default angle	360
	Counts/mm	41	41	20.5	17		
	Max	32767	32767	32767	32767	Max angle	360
Shift	Default	0	0	0	0	Default angle	0
	Max	8192	8192	8192	8192	Max angle	360
	Min	-8192	-8192	-8192	-8192	Min angle	0
Data Filter	Default	0	0	0	0		0
	Max	3- 16 sample average	3- 16 sample average	3- 16 sample average	3- 16 sample average		3- 16 sample average
	Min	0- No average	0- No average	0- No average	0- No average		0- No average
Activator Response	Default	250	250	250	250		20
	Max	1023	1023	1023	1023		1023
	Min	0	0	0	0		0
Vee Output	Default	512	512	512	512		0
	Max	1023	1023	1023	1023		1023
	Min	0	0	0	0		0
Dropout Level (Volts)	Default	0.21	0.21	0.23	0.23		0.30
	Max	4.2	4.2	4.6	4.6		5.5
	Min	0	0	0	0		0
Top Output Level (V)	Default	3.79	3.79	4.14	4.14		4.95
	Max	4.2	4.2	4.6	4.6		5.5
	Min	0	0	0	0		0
Bottom Output Level (V)	Default	0.42	0.42	0.46	0.46		0.55
	Max	4.2	4.2	4.6	4.6		5.5
	Min	0	0	0	0		0
Closed Switch Point	Default	128	128	128	128	Default angle	182
	Max	8191	8191	8191	8191	Max angle	360
	Min	-8191	-8191	-8191	-8191	Min angle	0
Open Switch Point	Default	-128	-128	-128	-128	Default angle	178
	Max	8191	8191	8191	8191	Max angle	360
	Min	-8191	-8191	-8191	-8191	Min angle	0

8 Technical Specification

Below is a representative example of a general blade technical specification. See the individual product datasheets for specific information on each type of blade sensor.

8.1 Power Supply and Protection

Recommended Operating voltage range	5V to 14V DC
Maximum analogue voltage output	4.2V - 25mm Blade Sensor 5.5V - Rotary 4.6V - All other types
PWM output frequency	250Hz or 1kHz - 25mm Blade sensor 1kHz - All other types
Switch output current limit	8mA - 25mm Blade sensor 4mA - All other types
Measuring cycle	1ms
Absolute maximum supply voltage	35V for 1 hour on all sensors, except rotary with 5V to 14V supply, which will withstand 14V indefinitely.
Reversed power supply voltage	Tested to withstand a reversed power supply voltage of 35V for 1 hour except rotary, which will withstand 14V indefinitely.
Resistance to random connection.	Tested to withstand inputs and outputs short circuit towards ground for 30 minutes.
Immunity to electrostatic charge	Tested at 15kV applied with a capacitance of 150pF and a resistor of 330ohm.
Immunity to electromagnetic disturbances	Tested in an electromagnetic field of 100V/m within the frequency range of 14kHz to 1GHz.
Pulse energy absorption	1.0J for Rotary, 1.7J all other types.

8.2 Serial Communication

The serial communication facility of the sensor is used for setting up a new application and analysing activator performance. A logic-level (4.2V or 4.6V depending on the sensor type) output is available but this is found to work directly with most PC or laptop communication ports at short range. For laptops with only USB connectivity an RS232-USB adaptor can be supplied. For the rotary sensor, an RS485 to RS232 converter will be required for connection to a PC.

8.2.1 Wire connections

Wire	RS232 connection	RS485 connection
Sensor WHITE	9 way D-type pin 2	9 way D-type pin 2
Sensor GREEN	9 way D-type pin 3	9 way D-type pin 1
Sensor BLACK	9 way D-type pin 5	9 way D-type pin 5

8.2.2 Communications Settings

The user can also access basic position and activator serial data via a terminal emulator program e.g. *Hyper Terminal* application that is supplied with Win95 or WinXP. Connect the sensor to the PC communications port and configure the terminal settings as follows:

Parameter	Setting
Baud Rate	19200
Flow Control	None
Data Bits	8
Stop Bits	1
Parity	None

8.2.3 Communications Process

Place the cursor inside the terminal window, send a Carriage Return (<CR>) to the sensor. The sensor should now get a response of two number groups. Check and adjust settings if not.

If the terminal emulator program is set up to record data to a file, this file can be imported by a spreadsheet as 'CSV' data, and sensor response graphed and changes compared.
The sensor remains operational during serial communications, but slows during transmission. Each time a <CR> is sent, the sensor will return 2 values. If the activator has not moved between requests then these values will remain constant.

Example sensor output without activator: +0000, +0004
(Position: Activator strength)

Example sensor output with an activator: +0234, +1020
(Position: Activator strength)

The data sets are always in the following order:

First set: Signed position data, where zero is the central position (+511/ - 512)

Second set: Activator response signal (0 to 1023). This is a vital parameter for
                  determining whether an intended activator design will work properly. It is
                  displayed as a signed number but only positive numbers are meaningful. With
                  no activator present the number will register a small positive or zero value.

Place a large coin or similar metal object on the sensor to activate it. Observe the effect on position and activator response by sliding the coin and polling the sensor with <CR>'s. The position reading will stay at zero unless the activator response reading exceeds 256 (the default setting).

[To obtain a copy of the developer's guide on the 25mm Blade sensor please contact Gill Sensors]

8.3 Multiple Sensors

CAUTION keep individual Blade sensors 100mm clear of each other as they are sensitive to each other's operation and will exhibit output jitter.

Sensors can be placed in close proximity to each other with the introduction of Aluminium screen plates between them. If you have an application for multiple sensors in close proximity please contact Gill for more details on screening methods and the various multi-channel format sensors that are becoming available.