



APPLIED ACOUSTICS
Underwater Technology

Easytrak Nexus 2 2692 Series Operation Manual

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These written instructions must be followed fully for reliable and safe operation of the equipment that this manual refers to. Applied Acoustic Engineering Ltd cannot be held responsible for any issues arising from the improper use or maintenance of equipment referred to in this manual or failure of the operator to adhere to the instructions laid out in this manual. The user must be familiar with the contents of this manual before use or operation.

1. Introduction to the 2692 Easytrak Nexus

This manual provides the user with information on the installation, operation and maintenance of the Easytrak Nexus 2 Ultra-Short Base Line (USBL) underwater acoustic positioning system.

USBL systems are used to position underwater items including Side Scan Sonars*, ROVs†, AUVs‡, and divers.

With no compass input, a position will be SHIP (bow) referenced, e.g. 123m 'X' means 123m from the starboard side of the ship, whereas, with a compass, a position would be NORTH referenced; 123m 'X' means 123m from the ship East.

A position can either be 'relative' for example 123m 'X' and 234m 'Y' from the vessel, or 'absolute' for example 412789m East 5823456m North if a GPS receiver and compass is enabled.

A common complaint of many USBL systems is the long time and complexity in 'getting going'. Easytrak Nexus 2 has been designed so that it requires the minimum of user intervention; the system can be ranging to beacons as soon as the transducer touches the water. Favourite system and beacon setups can be saved. Visual elements can also be saved, for example day / night colour schemes.

The display not only gives positioning data in text form, but also graphically. Beacons are individually identified and colour-coded, **GREEN** – position OK, **ORANGE** – caution, prediction being used, and **RED** – signal lost and cannot predict safely.

Because of multi-path reflections and other types of acoustic interference, the position can occasionally be corrupted. Easytrak has the facility to 'gate-out' wild values of velocity. The 'out of gate' positions are replaced by predicted values. Note the compass must be enabled.

The Easytrak Nexus 2 transceiver is fitted with internal compass, pitch and roll sensors. The pitch and roll sensors work to $\pm 80^\circ$, more than sufficient for boat work. The transceiver also includes depth and temperature sensors.



Note: Strong magnetic anomalies can be beyond the calibration range of the internal compass. It is advisable, that a bearing check be performed prior to use.

Easytrak Nexus 2 is ideal for surveys. With a Global Positioning System (GPS) receiver interfaced absolute positioning of divers, sonar fish, ROVs, or seabed objects in UTM (Universal Transverse Mercator) co-ordinates can be achieved. With GPS, Easytrak Nexus can also be used to navigate to and from the worksite indicated by an entered waypoint. Place marks can also be added to log items of interest.

The necessity of determining an accurate velocity of sound (VOS) through water is critical. VOS accuracy is important in two areas, (1) across the face of the transducer (used for measuring the bearing and depression angle to a target), and (2), the distance to and from the target (the range). To help overcome this source of error, a sound velocity profile may be loaded into Nexus. Alternatively, if a sound velocity profile is not available, the operator can enter two values of VOS into Easytrak, one for the bearing/ depression angle, and a second for the range calculation. An

* Sonar system for seabed mapping

† Remotely Operated Vehicle

‡ Autonomous Underwater Vehicle

option is available where the velocity of sound can be calculated using Medwin's formula by entering water temperature, salinity, and depth.

Depth beacons can be used to provide greater positioning accuracy, particularly appropriate at low depression angles where the slightest change can result in a significant shift in the target's vertical position.



Note: When using GPS, bearings are relative to GRID North; without GPS, bearings are relative to TRUE North or with the compass switched off, the vessel's Bow.

Though Easytrak Nexus 2 is simple to use, the system provides a very powerful and flexible tool for survey use.



Note: Easytrak Nexus 2 takes about 30 seconds to initialise from power up.

2. Basic Theory

Easytrak Nexus 2 is an Ultra Short Base Line (USBL) Acoustic Navigation System. The system uses a single compact transducer containing multiple receiving ceramics and an interrogate ceramic.

The receiving ceramics are so arranged that each can detect an acoustic signal from a target's transmission. The acoustic signals may arrive at slightly different times due to their different signal paths. From these time differences, the bearing and depression angle* to the target are computed.

For a TRANSPONDER, time taken from the vessel's interrogating transmission through the water to the reception of the target acoustic signal provides the range:

$$\text{Range} = \frac{\text{VOS} \times \text{Travel-time (m)}}{2}$$

The divide by 2 is because sound has to travel to and from the target i.e. twice the distance.

For a RESPONDER, time taken from the vessel electrical interrogate signal through a cable to the reception of the target acoustic signal provides the range:

$$\text{Range} = \text{VOS} \times \text{Travel-time (m)}$$

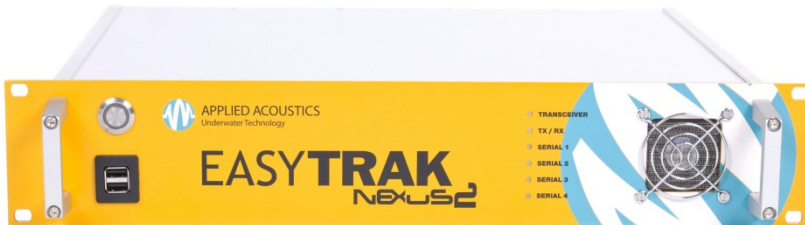
Given range, bearing, and the depression angle, the relative position of the target beacon to the vessel transducer can be determined.

* The vertical angle between the horizon and the target

3. System Description

Easytrak Nexus 2 consists of a console unit, transceiver, deck cable and up to 16 beacons.

Easytrak Nexus 2 2692 Console Unit



Easytrak Nexus 2 is an advanced Ultra Short Baseline (USBL) positioning and tracking system which incorporates Spread Spectrum Technology to provide a secure acoustic link. The Easytrak Nexus Console provides control and peripheral interfaces for the system. The console's embedded operating system provides an intuitive user interface and dedicated hardware for precise external sensor integration. The console also provides power and communications to the Easytrak Nexus Transceiver.

Easytrak Nexus Transceiver



The Easytrak Transceiver transmits and receives acoustic signals using a multi-element ceramic transducer. It determines the position of dynamic subsea targets through the transmission and reception of acoustic signals between the submerged transceiver and the target beacon. The transceiver is fitted with integral depth, temperature, compass, pitch, and roll sensors to automatically compensate external dynamic forces.

1100 Series Beacon

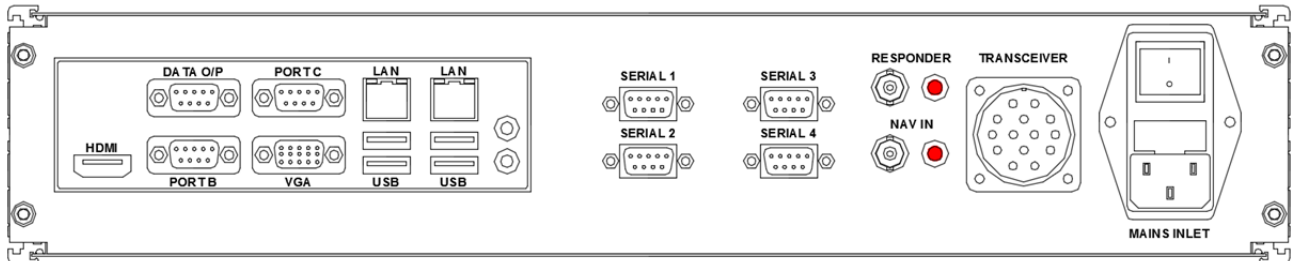


The 1100 Series Beacon incorporates Spread Spectrum Technology; the wide bandwidth transmissions reduce its susceptibility to interference, thus enabling accurate positioning and secure data transmission. The 1100 series retains its flexibility by incorporating tone burst channels and analogue data telemetry options as standard. The 1100 series beacons may be connected to the Nexus console to read and change the beacon configuration if required.

4. Installation

Easytrak Nexus 2692 Console Unit

Ensure the console is secured to prevent falling or sliding due to vessel movement. The console can be mounted in a standard 19' rack.



SERIAL PORTS: 4 Serial ports available for external sensor interface and aux inputs.

TRANSCEIVER: Connection to the Nexus Transceiver using the Nexus Deck Cable.

RESPONDER: BNC connection to beacon to triggered as a responder. LED will flash in synch indicating activity.

NAV IN: BNC connection for external synchronisation key for system. LED will flash in synch indicating activity.

MAINS INLET: The power supply is auto-ranging (115 – 230VAC 50/60Hz) and doesn't require user intervention. Plug into the nearest power outlet socket.



Note: The keyboard and mouse supplied with Nexus are USB interface and should be connected to USB ports 1 and 2 .

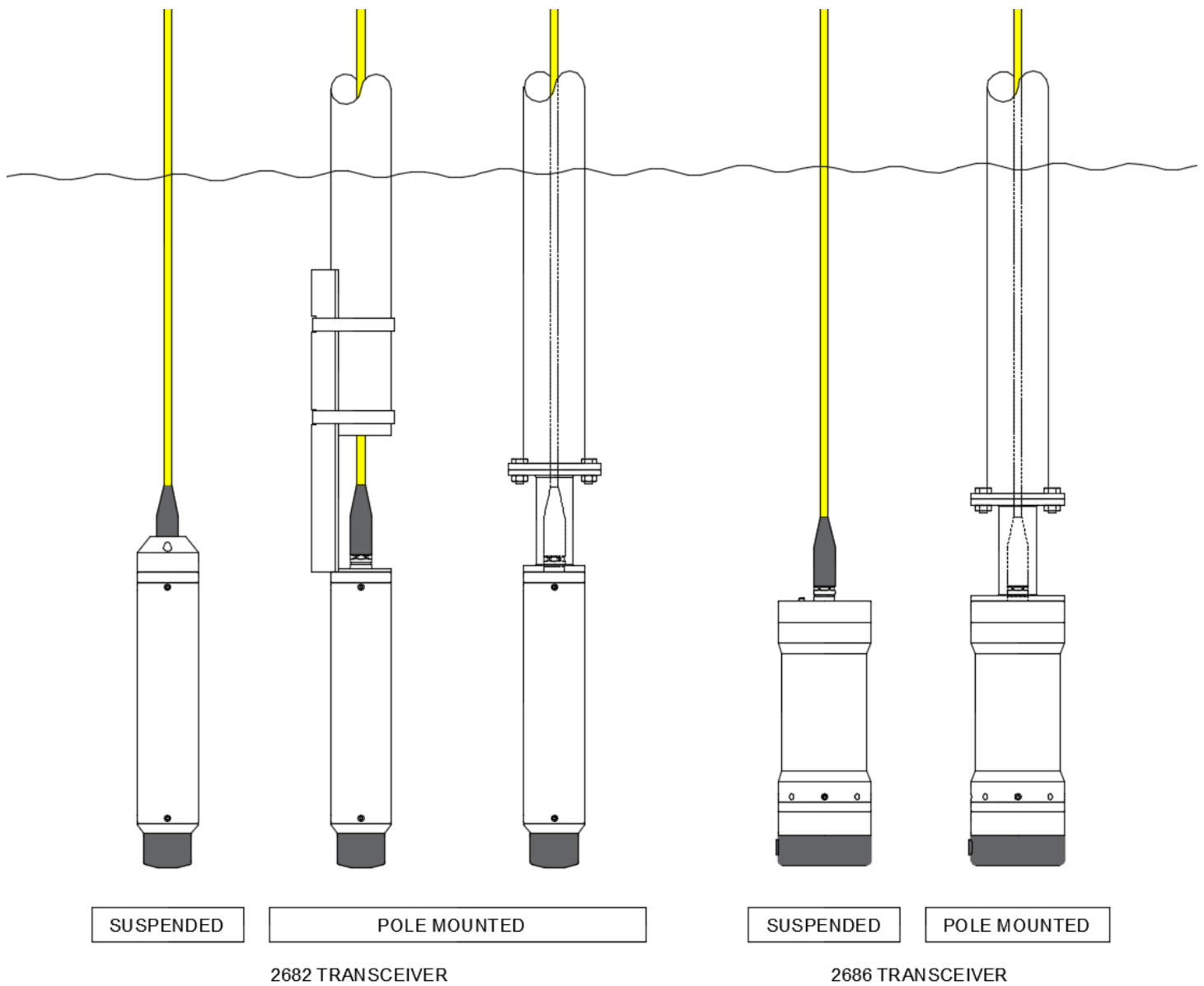
Data Out: This is the main data output port from Nexus

VGA: Connect the supplied monitor to the VGA port

LAN: The unit may be connected to an Ethernet network. If connected, the user may send technical support questions directly from the software, via email (internet access is required from the network, some firewalls may block communication). Also UDP broadcasts of output data are enabled (see Appendix F). Remote support is also possible (contact technical support for details)

Port B, C, Line In, Line Out, Mic: May be used for future expansion

Easytrak Nexus Transceiver Deployment Options



Pole Mounted – Over the Side

The Easytrak transducer can be fixed over the side of a ship with a suitable pole. Ensure the transducer is aft of the pole and that the pole doesn't protrude beyond the face of the transducer. The diameter of the pole will depend on the length required and the anticipated maximum speed of the ship. It is recommended that the pole be secured by cables fore and aft to prevent bending and strutting when the ship is underway.

Ensure that when deployed the transducer is at least 1 metre below the draft of the vessel and that it has clear horizontal visibility through 360°. Ensure the alignment mark on the transducer is inline (forward) with the forward / aft line of the vessel. Extreme care has to be taken in shallow water that the transducer does not strike the seabed.

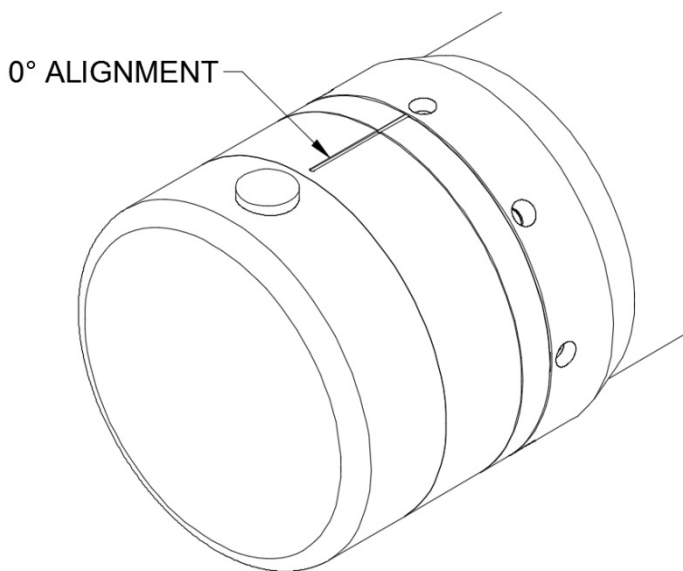
See appendix A and B for mounting bracket dimensions.

Pole Mounted – Through a Gate Valve

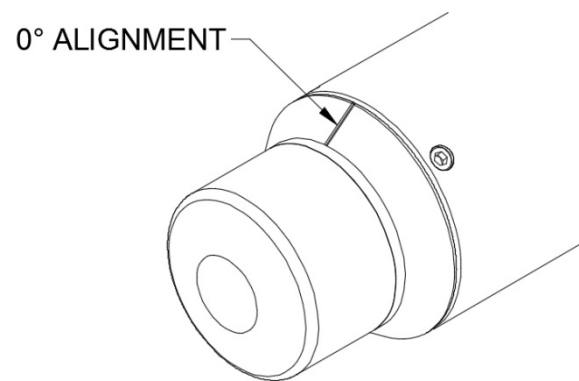
Ensure the gate valve is of a suitable diameter to take the transducer and any mounting hardware. The transducer should be mounted on a suitable shaft; see appendix C for transceiver mounting dimensions.

Ensure that when deployed, the transducer's black potted end is below the draft of the vessel by at least 1 meter and that it has clear horizontal visibility through 360°.

The gate valve's deployment system must be designed to ensure that the alignment mark on the transducer is inline (forward) with the forward / aft line when positioned through the gate valve.



2686 TRANSCEIVER



2682 TRANSCEIVER



Note: Please see Section 8 Calibration.

Suspended Over the Side

This is the simplest method of deployment; however, the transducer is prone to relative movement with respect to the vessel. Care must be taken that the transducer does not spin as the internal compass, pitch and roll sensors have a limited dynamic response. Ensure that when deployed the transducer is below the draft of the vessel by at least 1 metre and has clear horizontal visibility through 360°.



Note: the *suspended over the side* method cannot be used if the compass is not enabled, as the system would have no orientation reference. Also, if GPS positioning is required, the antenna must be directly over the transducer, otherwise offset errors can occur.



System installation is the responsibility of the operator.
For advice and assistance please contact:
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Deck Cable

Connects the **NEXUS TRANSCEIVER** to the **NEXUS CONSOLE**. To prevent damage to the cable and minimise potential problems, please ensure the following points are observed:

- Ensure personnel cannot step on, or trip over, the deck cable.
- Keep the cable away from sources of electrical noise such as electrical generators, sonar sources (bang boxes etc).
- Avoid trapping the cable in doorways, hatches and alike.
- Ensure the cable is not bent less than the minimum bend radius of **150mm**.
- Ensure the cable is not laid over sharp edges.
- When deployed over the side of a vessel, ensure that the cable is secured to any mounting pole to prevent chaffing, strumming, and excessive movement.
- Ensure the polyurethane outer jacket of the cable is not breached allowing water ingress.

5. Operation

Power Up

- Ensuring connections are made as Section 4; the Easytrak Nexus can be powered up.
- Switch the main power button on the rear panel and press the momentary switch on the front panel. The switch will indicate green.
- The system will automatically launch and set the configuration to the selected setup.
- To power down the system briefly press the power button the front panel. This will perform a controlled shut down of the system.
- The mains power can be isolated by the rear switch.

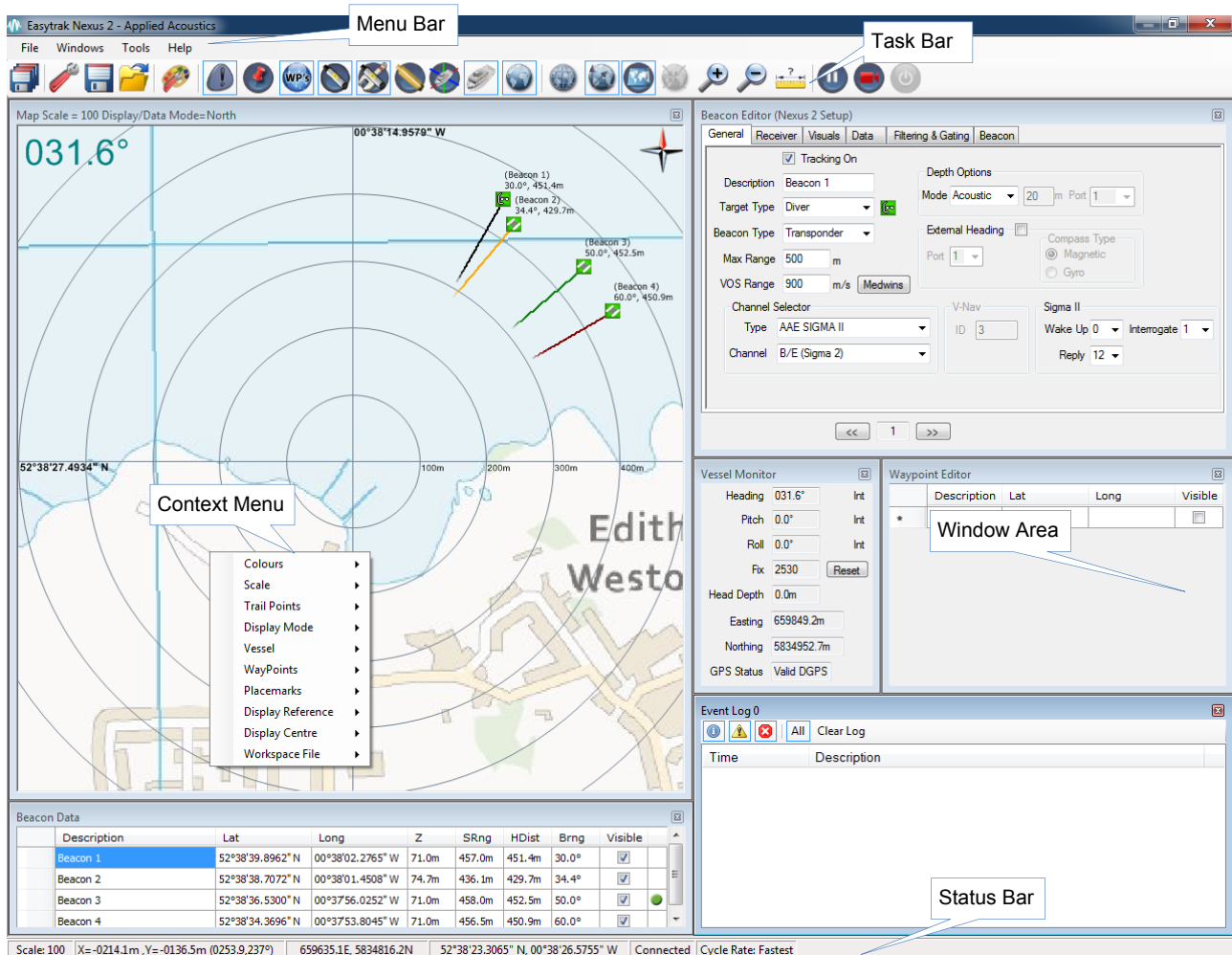


Front Panel Indicators

- Mains Power will indicate Green when ON.
- TRANSCEIVER will indicate Green when power is ON.
- TX / RX will indicate Green upon a beacon interrogation and valid reply received.
- SERIAL 1,2,3,4 will flash Green indicating valid activity on the serial ports.

6. Easytrak 2 Nexus Software

Overview



The software provides an intuitive user interface to configure, operate and monitor the Easytrak Nexus 2 USBL Tracking system.

The system setup, beacon setup and visual preferences can all be saved into individual configuration files. A startup configuration may be selected from any combination of these files for quick startup of the system. Previously saved files can be reloaded for easy reconfiguration of the system. There is no limit to the number of setup files that may be saved on the system so multiple setups can be pre-configured.


Each of the display windows can be accessed from either the Menu bar, from the Tool Bar or via a keyboard shortcut. Each window can be resized and positioned as required or auto-positioned within the window area. There is a Status Bar, with system and positional information.



Many windows also have 'Context Menus', with functions available that are appropriate to the window that the mouse is currently over. The context menus are available by pressing the right mouse button

Task & Menu Bar

Most commonly used tools and windows are accessible through the following short cuts

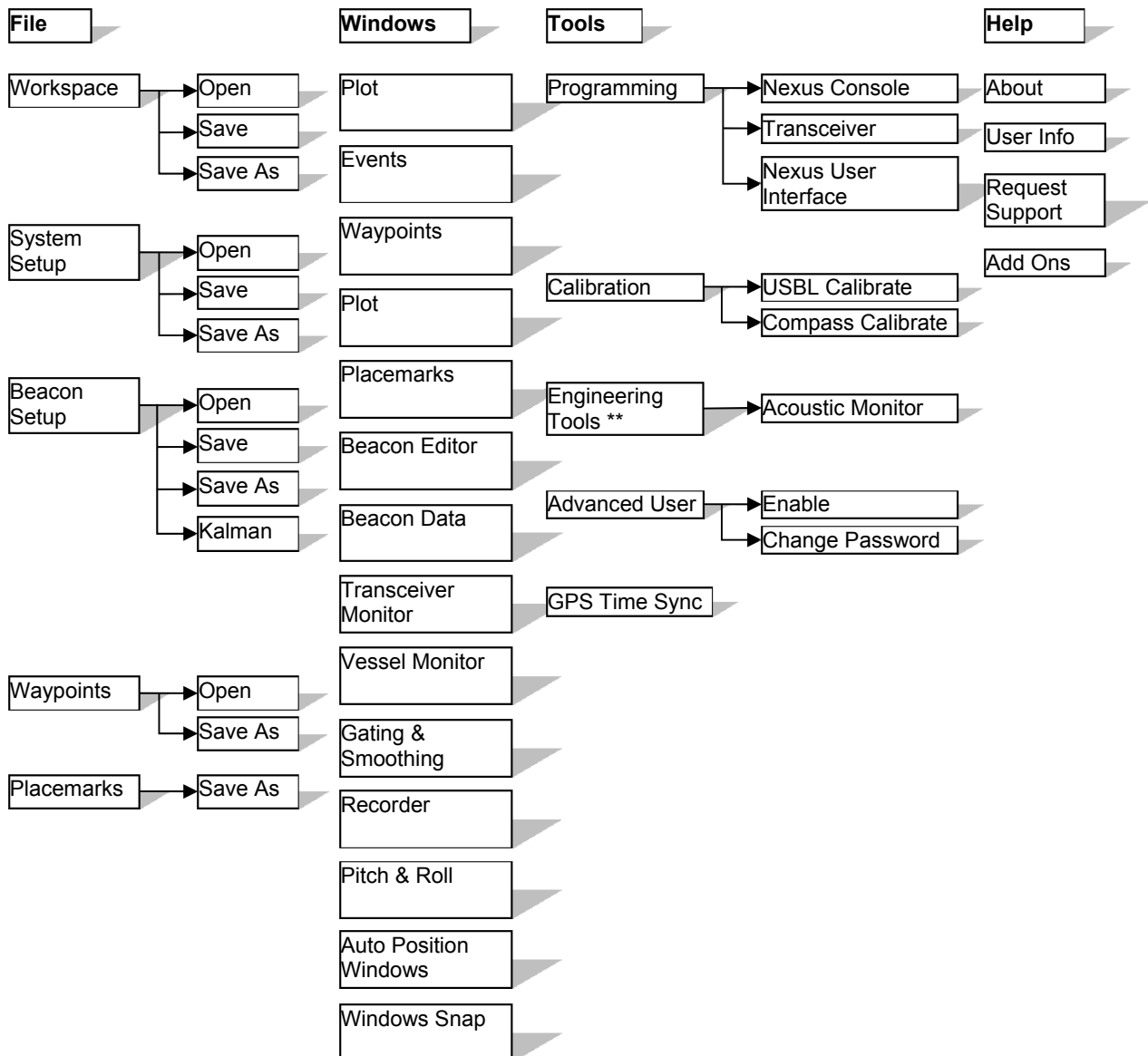
	Save All Configuration Files
	Edit System Configuration
	Save System Configuration
	Open System Configuration
	Edit Workspace Configuration
	Display/Hide Event Log Window
	Display/Hide Placemarks Window
	Display/Hide Waypoints Window
	Display/Hide Beacon Data Window
	Display/Hide Beacon Editor Window
	Display/Hide Transceiver Monitor Window
	Display/Hide Vessel Pitch & Roll Window
	Display/Hide Vessel Monitor Window
	Display/Hide Plot Window
	Set Plot Window to Grid Display Mode
	Set Plot Window to Polar Display Mode
	Revert to previously selected centralize mode
	Enable Map Overlay on Plot Window
	Plot Window – Zoom In
	Plot Window – Zoom Out
	Enable Measurement Mode
	Pause ALL beacon tracking
	Display/Hide Recorder Window



Power Up Transceiver (only enabled if auto power down has occurred)

From the Menu Bar additional functions for system configuration and tools can be found

Menu bar File Structure



** Available in advanced user mode only, not supported with 2686 Transceiver

Nexus 2 Configuration

The Nexus configuration is divided into three areas:

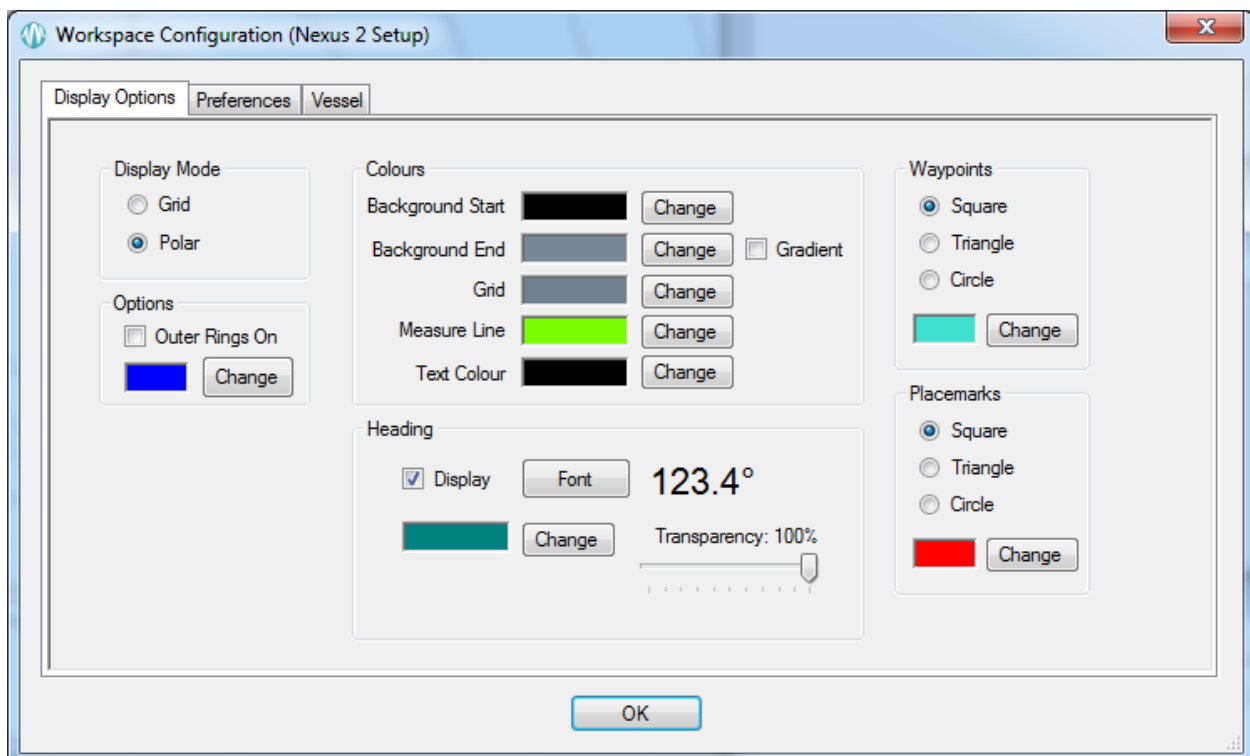
- **Workspace**
This is where visual elements of the setup are defined. This includes the visibility and position of windows, visual preferences such as text colour and other visual options.
- **System**
The setup of external inputs such as GPS, Gyro, VRU. Data output and operating modes may be setup within this area.
- **Beacon**
The setup of beacons, such as frequencies, ranges, types etc. are configured within the beacon editor. 1000 Series beacons may be connected to display and set beacon properties.

Workspace Configuration

Toolbar Button: 

The three tabs contained within the workspace configuration are described below. Note that the title bar of this window shows the name of currently loaded workspace file in brackets.

Display Options



The Display Options tab allows the operator to configure the display to their preference for the local environment. For example - by altering the colour scheme 'workspaces' can be created for day and night operations.

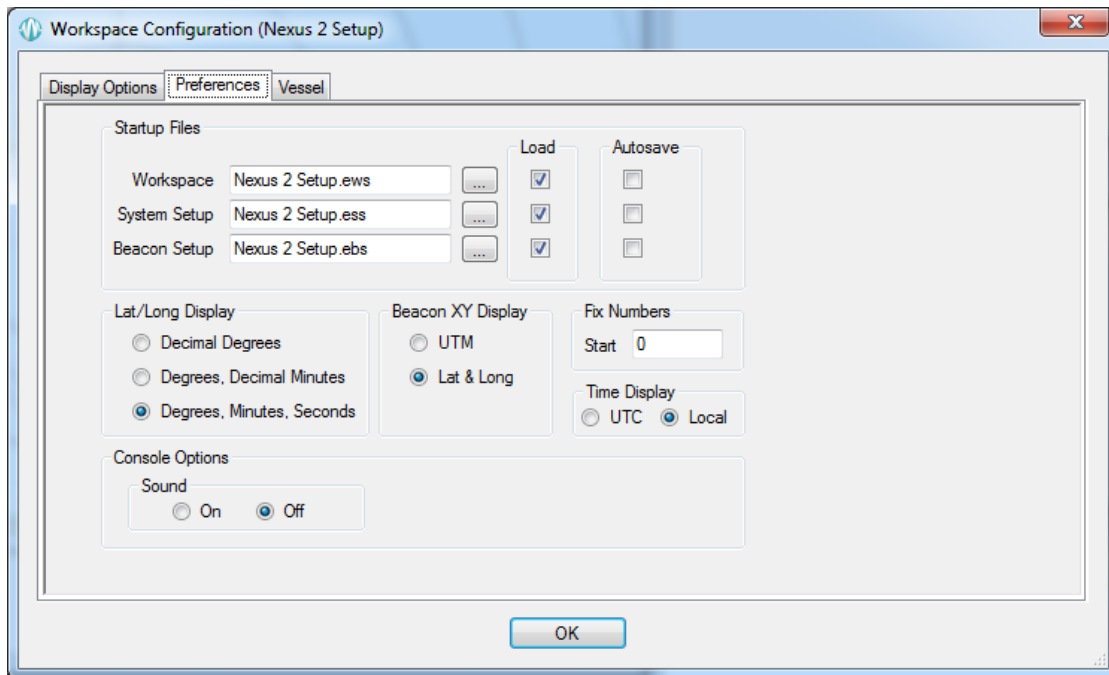
Display Mode

The Plot data can be controlled from this tab, the mode either Grid or Polar can be selected. This is also controlled from shortcuts on the tool bar.



Preferences

The Preferences tab allows the operator to set the Nexus configuration files that will be automatically loaded on startup of the system.



Startup Files

Any combination of startup files may be selected. The auto loading of individual files may be enabled/disabled using the 'Load' checkbox. If 'Autosave' is checked then the file will automatically be saved when closing down the unit.

Lat/Long Display

The positions of beacons and vessel may be displayed in either UTM's or Lat & Long mode. If Lat & Long mode is selected then the format can be either decimal degrees, degrees and decimal minutes or degrees, minutes and seconds

Fix Numbers

The start value of the vessel fix number may be set. A zero will result in the first beacon interrogation being fix number one.

Time Display

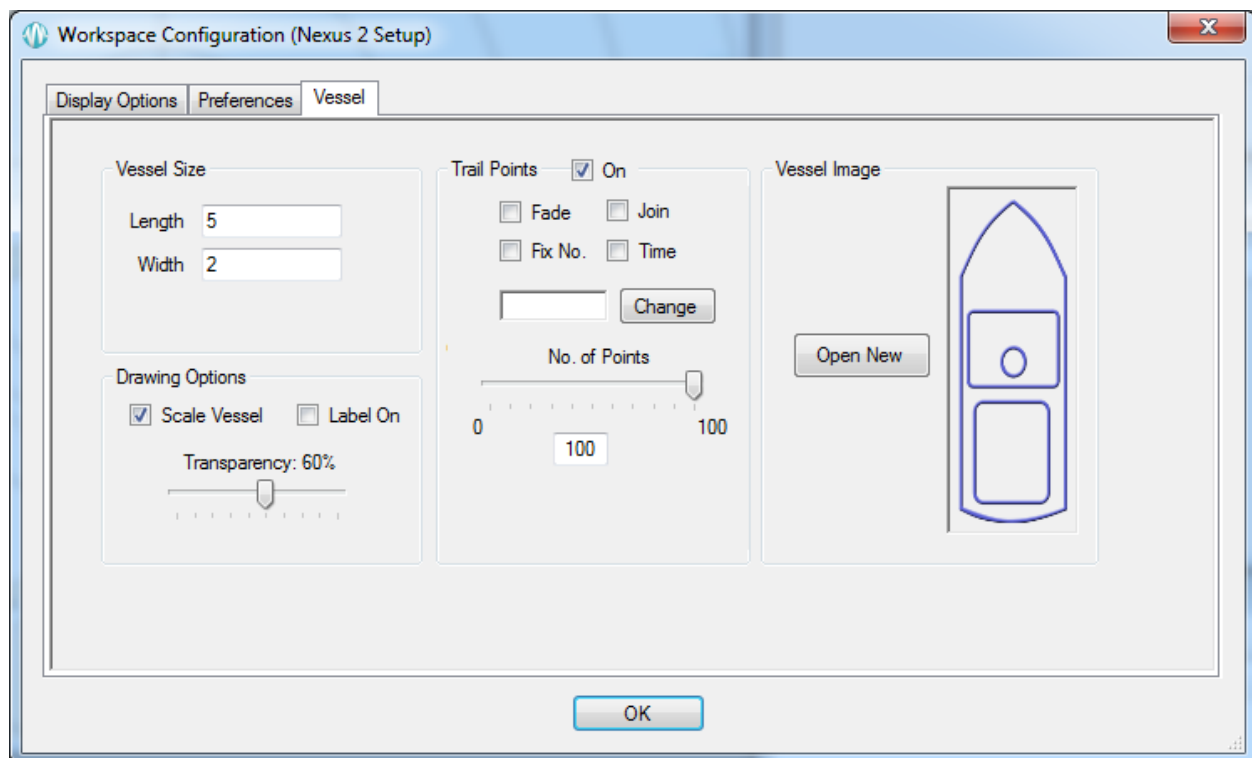
Time and date values within the system may be displayed as either UTC or local time.

Console Options

The console sounds may be turned on or off.

Vessel

The Vessel tab allows the operator configure the plot display for the vessel.



Vessel Size & Drawing Options

Drawing options allow the vessel to be scaled, to display a label showing the heading and position and to set the transparency of the vessel on the plot window.


Trail Points

Trail points for the vessel can be configured, including the number of points, the colour of the trail points and whether the end of the trail fades away. The points may be joined and also the fix number and time can be displayed at fixed intervals.

Vessel Image

The vessel image option allows the user to select the vessel image that will be used for the plot window. The user can select from a number of predefined vessel images to suit the display. If required the user can add their own vessel image (this must be in a .png format).

System Configuration

Toolbar Button: 

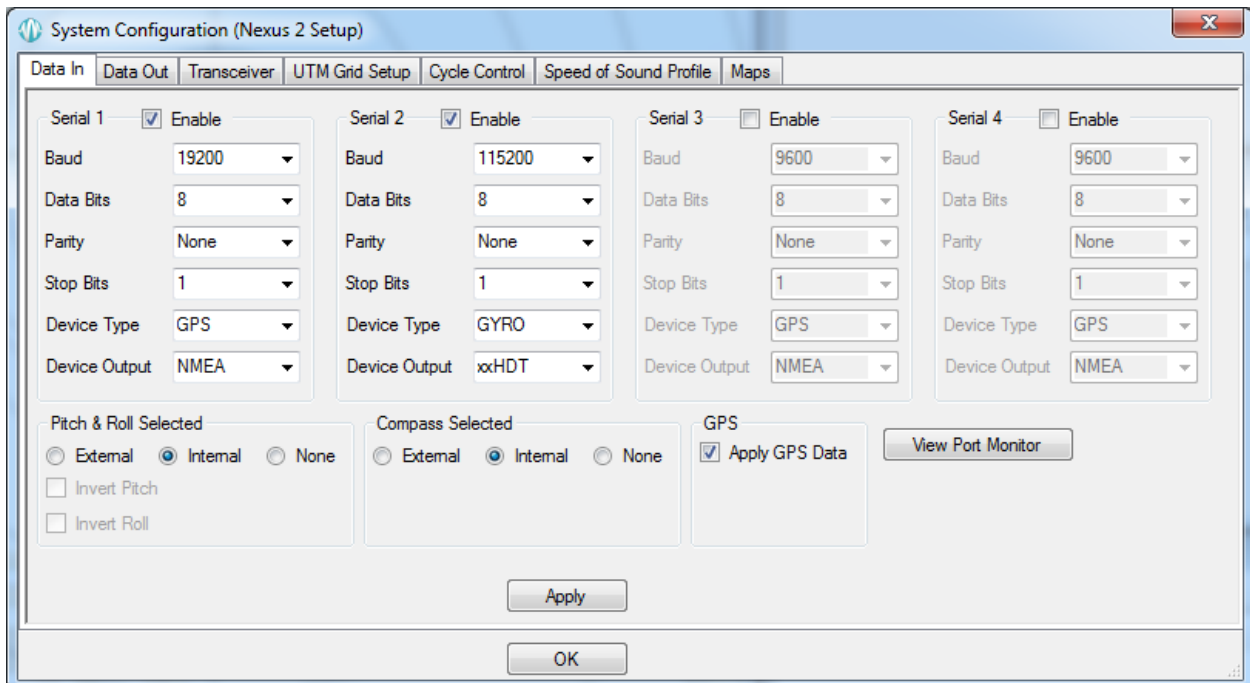
The six tabs contained within the 'System Configuration' area are described below. Note that the title bar of this window shows the name of currently system configuration file in brackets.



All system configuration settings can be saved to file for quick setup. The system can load any saved configuration on startup (configured in Workspace -> Preferences).

Data In

The 'Data In' tab of the system configuration allows the Serial Ports to be configured for external inputs GPS, VRU, Gyro, Target Depth, Target Heading & Beacon (AAE 1000 and 1100 series only). A device type of 'Multiple' may also be selected, in this mode heading (gyro) and GPS data may be input on a single port.



Serial set-up options:

Baud rate: 2400[†], 4800, 9600, 19200, 38400, 57600, 115200, 230400, 460800, 921600^{*}
Data bits: 6[†], 7[†], or 8.
Stop bits: 1, or 2[†].
Parity: None, Even[†], or Odd[†].



Serial 1 is a high speed port and is limited on Data Bits, Parity & Stop Bits. See footnotes for details

^{*} Serial 1 Only

[†] Not Serial 1

Serial port settings changed on this tab will only be applied to the system upon clicking 'Apply' or 'OK'. A validity check will be performed before applying the settings and a warning will be displayed if the check shows a potentially invalid setup (i.e. more than one port configured for Gyro input).

Compass Selected/Pitch & Roll Selected

There are controls for the source of the Compass, Pitch and Roll sensors. These can be set to internal, external or none, depending on the desired configuration. If external pitch and roll is selected, then the pitch and roll values may be inverted if required.

GPS

If GPS is interfaced, the external positional data can be applied to the calculated position to give an absolute position of the target. Tick 'Apply GPS Data' to calculate absolute positions. Go to the UTM Grid Setup tab to configure the local grid origins.

For GPS time synch only, configure a serial port and do not apply GPS data.

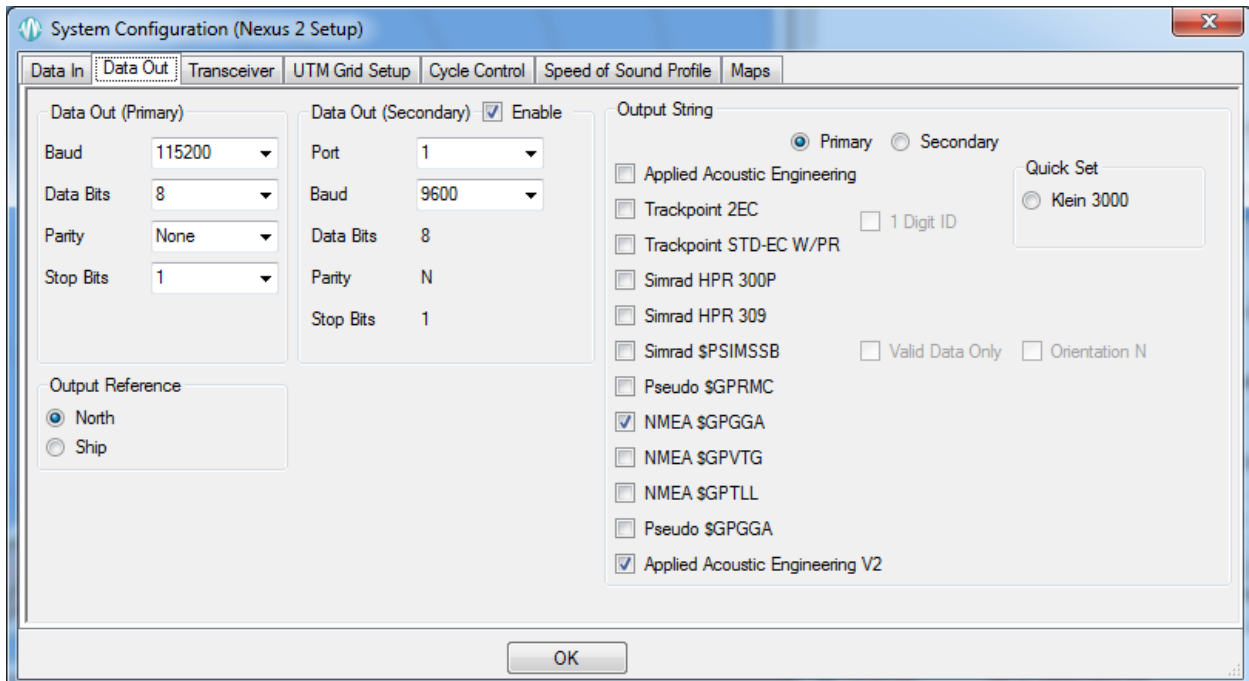
View Port Monitor

The 'View Port Monitor' button may be used to view valid data being received on each serial port in real time.

Data Out

The Data Out tab is the RS232C communications set-up for the output of serial data from the Nexus console. Nexus has a primary output port (Data Out) and a secondary output, the secondary output may be selected as any one of the 4 serial ports (Serial 1 – Serial 4).

Data is output after each Fix is processed (not at a pre-defined rate).



The screenshot shows the 'System Configuration (Nexus 2 Setup)' window with the 'Data Out' tab selected. The window has several tabs: Data In, Data Out (selected), Transceiver, UTM Grid Setup, Cycle Control, Speed of Sound Profile, and Maps. The 'Data Out' tab is divided into three main sections: 'Data Out (Primary)', 'Data Out (Secondary)', and 'Output String'.

- Data Out (Primary):** Baud rate is set to 115200, Data Bits to 8, Parity to None, and Stop Bits to 1.
- Data Out (Secondary):** The 'Enable' checkbox is checked. Port is set to 1, Baud rate to 9600, Data Bits to 8, Parity to N, and Stop Bits to 1.
- Output String:** There are radio buttons for 'Primary' (selected) and 'Secondary'. A list of protocols is shown with checkboxes: Applied Acoustic Engineering, Trackpoint 2EC, Trackpoint STD-EC W/PR, Simrad HPR 300P, Simrad HPR 309, Simrad \$PSIMSSB, Pseudo \$GPRMC, NMEA \$GPGGA (checked), NMEA \$GPVTG, NMEA \$GPTLL, Pseudo \$GPGGA, and Applied Acoustic Engineering V2 (checked). There are also checkboxes for 'Valid Data Only' and 'Orientation N'. A 'Quick Set' button is present with a radio button for 'Klein 3000'.

At the bottom left, there is an 'Output Reference' section with radio buttons for 'North' (selected) and 'Ship'. An 'OK' button is at the bottom center.

Data Out Setup

Baud rate, data bits, parity and stop bits may be configured for the primary output. For the secondary output port, only the selected port and the baud rate may be adjusted. Please note that there is no hardware or software handshaking in either direction.

Output Reference

The data type viewed on the Plot window is linked to the data out port, the data type can be controlled from this tab or via the Plot Window \ Context Menu. The link between viewed data and exported data is for QC purposes.

- **North Ref**
Positions are referenced to the NORTH. Compass, pitch, roll, and offset values are applied to the computed position. A Compass must be used to be north referenced, otherwise the data will be ship (bow) referenced.
- **Ship Referenced**
Positions are referenced to the bow of the vessel. Compass, pitch, roll, and offset values are applied to the computed position if available.

Output String

The output string mode can be selected from a number of pre-defined output formats. The primary and secondary output strings may be configured independently by selecting the required output string destination radio button. Any number of output formats may be selected. If more than one selection is made then each string will be appended, each individual string will be terminated with a carriage return and line feed.

A quick set option for Klein 3000 enables all required output messages to be selected.

String	Description
AAE	Applied Acoustic Engineering's string
TPII-2EC	Simplified version of the ORE Trackpoint 2EC string
TP-EC W/PR	ORE Trackpoint string including pitch & roll
Simrad 300P	Simplified version of the Simrad string
Simrad 309	Simplified version of the Simrad string *
Simrad \$PSIMSSB	HiPAP NMEA format strings
Pseudo \$GPRMC	Pseudo GPS format string
NMEA \$GPGGA	NMEA GPGGA format string
NMEA \$GPVTG	NMEA GPVTG format string
NMEA \$GPTLL	NMEA GPTLL format string
Pseudo \$GPGGA	A custom GPGGA string with target position instead of vessel position in standard GGA message
Applied Acoustic Engineering V2	Applied Acoustic Engineering's V2 \$AADS1 string
Klein 3000 (Quick Set)	Requirements for the Klein 3000 SSS. The strings \$GPGGA, \$GPVTG, & \$GPTLL are selected

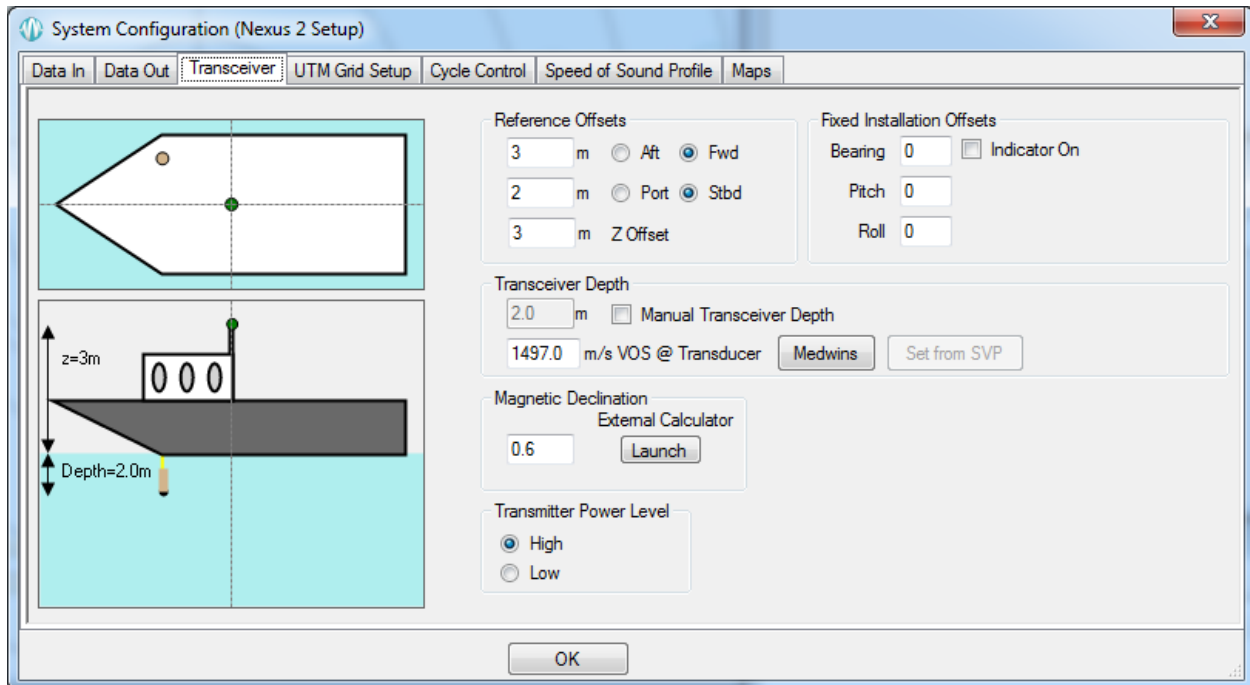
* Only available on primary output port



If GPS data is available, the data output strings \$PSIMSSB, \$PSIMSNS, \$GPRMC use GPS UTC time and date. If not available Easytrak's internal date and time is used

Transceiver

The position calculated by Easytrak Nexus is referenced to the transducer, by entering the installation offsets the position can be referenced to another part of the vessel, for example, the navigation antenna or CRP.



The following offsets are available: Forward/Aft (m), Port/Starboard (m), Z (Height m). Also, Roll offset (degrees), Pitch offset (degrees), Bearing offset (degrees), Magnetic declination and Transducer depth (m) below water line.

Note: the Bearing offset is fixed installation offset and does not affect the compass heading. Magnetic declination offset will affect the compass heading.

Reference Offsets

Offsets are the measured distances from the reference point to the transceiver.

The vessel plan diagrams update with an indication of the transceiver position referenced to the desired point.

Fixed Installation Offsets

Fixed Installation Offsets

As a result of calibration or measurement the installation offsets can be applied.

A positive value of bearing indicates a clockwise offset.

A positive value of pitch indicates bow up.

A positive value of roll indicates port up.

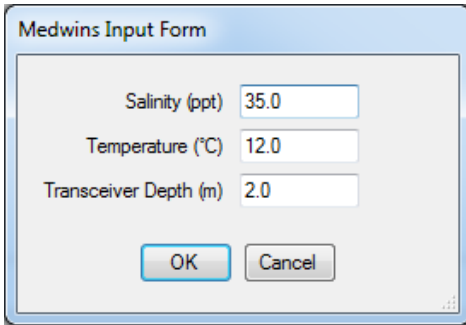
Transceiver Depth

This value can be read automatically from the transceiver or entered manually.

Velocity of Sound at Transducer Face (VOS)

Enter the Velocity of Sound (VOS) for transmission through water used in phase measurements at the transducer face.

VOS can be entered manually or can be calculated by using Medwin's method of calculation. (Click on 'Medwins' button to open the calculator.)

A screenshot of a software dialog box titled "Medwins Input Form". It contains three input fields: "Salinity (ppt)" with the value "35.0", "Temperature (°C)" with the value "12.0", and "Transceiver Depth (m)" with the value "2.0". At the bottom of the dialog are two buttons: "OK" and "Cancel".

Enter the parameters. The result is automatically placed in the VOS text box.

Compass Smoothing (Internal PNI Compass Only)

Compass smoothing will reduce jitter and can be set between MIN and MAX depending upon the operating circumstances. Should the transducer be deployed in a static or near static situation, MAX damping can be used; in a very dynamic situation, MIN can be chosen for a quicker compass response time.

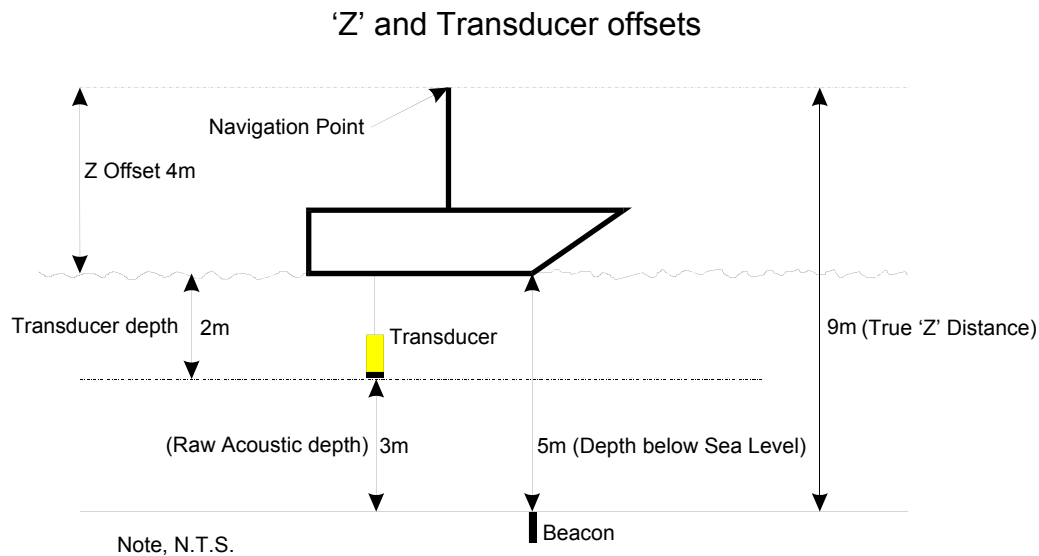
Magnetic Declination

Magnetic declination is the angle between magnetic north and true north. Declination is considered positive when the angle measured is east of true north and negative when west. Magnetic declination varies throughout the world changing slowly over time. Magnetic declination is entered into Easytrak Nexus in the following format: - SDDD.DD, where 'S' is the sign + (East) or – (West), and 'D' are degrees and decimal degrees. The transducer internal compass and external compass strings other than \$HCHDT are affected by the declination offset.

To calculate the declination launch the external NOAA calculator, enter your position to calculate. Follow the Help instructions if required.

Declination values can also be obtained online at
<http://www.ngdc.noaa.gov/geomag-web/#declination>

Notes on Transducer Depth and Z Offsets

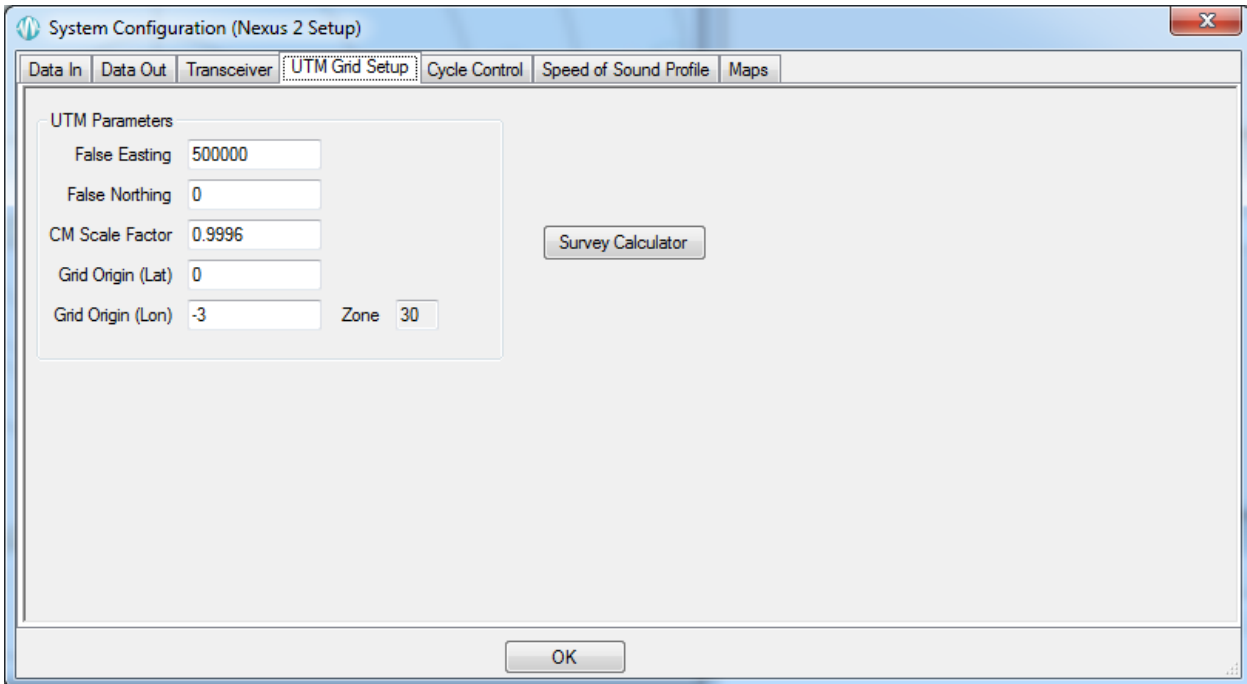


The Navigation Point is the point on the vessel where all navigation measurements are referenced to; in above example, the top of the mast.

- Acoustic depth
True 'Z' distance = Raw Acoustic Depth (3) + 'Z' Offset (4) + Transducer Depth (2)
 $3 + 4 + 2 = 9\text{m}$
- Manual Depth (Where the depth is entered manually.)
True 'Z' distance = Manual depth to target (5) + 'Z' Offset (4)
 $5 + 4 = 9\text{m}$
- Depth Beacon (Telemetry etc.)
True 'Z' distance = Telemetry depth (5) + 'Z' Offset (4)
 $5 + 4 = 9\text{m}$

UTM Grid Setup

UTM Grid Setup allows the operator to enter UTM set-up parameters:



The image shows the 'System Configuration (Nexus 2 Setup)' dialog box with the 'UTM Grid Setup' tab selected. The dialog has several tabs: 'Data In', 'Data Out', 'Transceiver', 'UTM Grid Setup', 'Cycle Control', 'Speed of Sound Profile', and 'Maps'. The 'UTM Parameters' section contains the following fields and values:

Parameter	Value
False Easting	500000
False Northing	0
CM Scale Factor	0.9996
Grid Origin (Lat)	0
Grid Origin (Lon)	-3
Zone	30

A 'Survey Calculator' button is located to the right of the 'UTM Parameters' section. An 'OK' button is at the bottom center of the dialog.

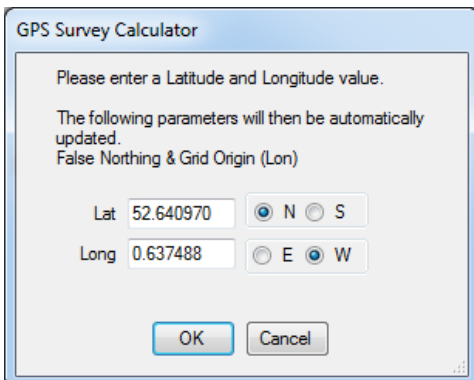
UTM Parameters

The following values may be manually entered

- False Easting
- False Northing
- Central Meridian Scale Factor
- Grid Origin – Latitude
- Grid Origin – Longitude

Survey Calculator

Longitude Grid Origin and False Northing can be calculated by pressing the 'Survey Calculator' button. The UTM Zone determined alongside the Longitude Grid Origin is for reference only.



The image shows the 'GPS Survey Calculator' dialog box. It contains the following text and fields:

Please enter a Latitude and Longitude value.
The following parameters will then be automatically updated.
False Northing & Grid Origin (Lon)

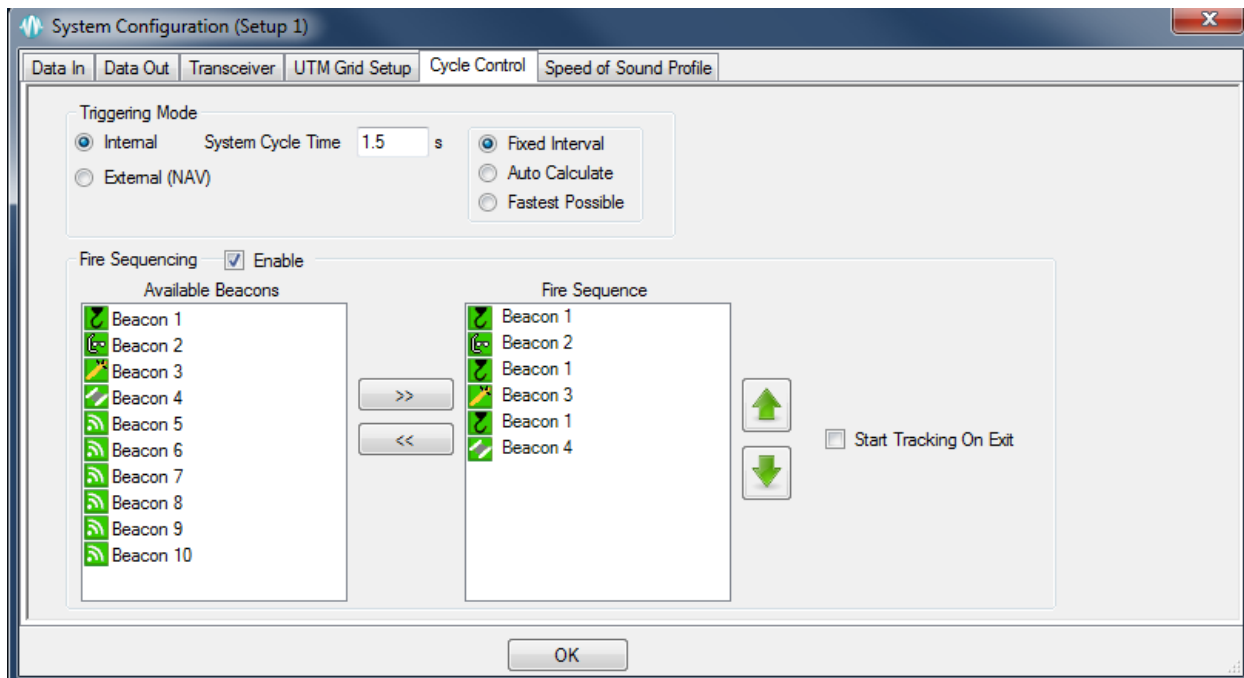
Lat: 52.640970 ☒ N ☐ S
Long: 0.637488 ☐ E ☒ W

Buttons: OK, Cancel

To calculate the UTM zone start the Survey Calculator. Enter the degrees and decimal degrees of your local latitude and longitude. If GPS is available the position is automatically set to the current GPS position. Click OK to apply and exit. The calculator, upon exit, sets the parameters in the UTM Grid Setup.

Cycle Control

The Cycle Control tab allows the operator to set the system cycle time between beacon interrogations or select an external trigger source.



Triggering Mode

- **Internal**
The cycle time is controlled internally and is set by the operator. Internal triggering modes are described below
- **External**
System is triggered via the NAV IN connection on the rear panel.
TTL type 5 volt pulse triggers on rising edge.

Before the triggering modes are described it is important to understand the factors within the system that can effect the system cycle times possible.

The expected maximum range of each enabled beacon has the largest effect, as the maximum range parameter of a beacon increases, then the fastest possible cycle time of the system will increase. Also the beacon channel and type will effect the cycle time, different beacons have different internal turnaround times (the time taken from the beacon receiving an acoustic interrogation to sending an acoustic response) and therefore effect the total time taken to receive a response from a beacon at range.

Internal Triggering Modes

Other factors such as interrogation pulse length and internal system delays all effect the system cycle times possible. These are all taken into account in determining if the cycle time required can be achieved.

Fixed Interval

When in fixed interval mode the unit will attempt to complete the fire sequence in the time set within the 'System Cycle Time' parameter. If this is not possible a message will be displayed.

Auto Calculate

In this mode the system will automatically determine the fastest possible cycle time based on all the the relevant parameters described at the beginning of this section.

Fastest Possible

In this mode the system will automatically interrogate the next beacon in the fire sequence as soon as the previous acoustic response is received. This mode will result in a much faster cycle time if beacons are at close range and will automatically adjust the cycle time as the range of the beacons increases or decreases.

Fire Sequencing

Fire sequencing can be used to define custom fire sequences rather than a sequential order of beacon interrogation. With fire sequencing the system may be configured, for example, to fire one particular beacon more frequently than others.

A sequence of up to 30 entries may be defined.

Available Beacons may be added to the fire sequence by 'Double Clicking' on the available beacon or by selecting the available beacon and pressing the '>>' button.

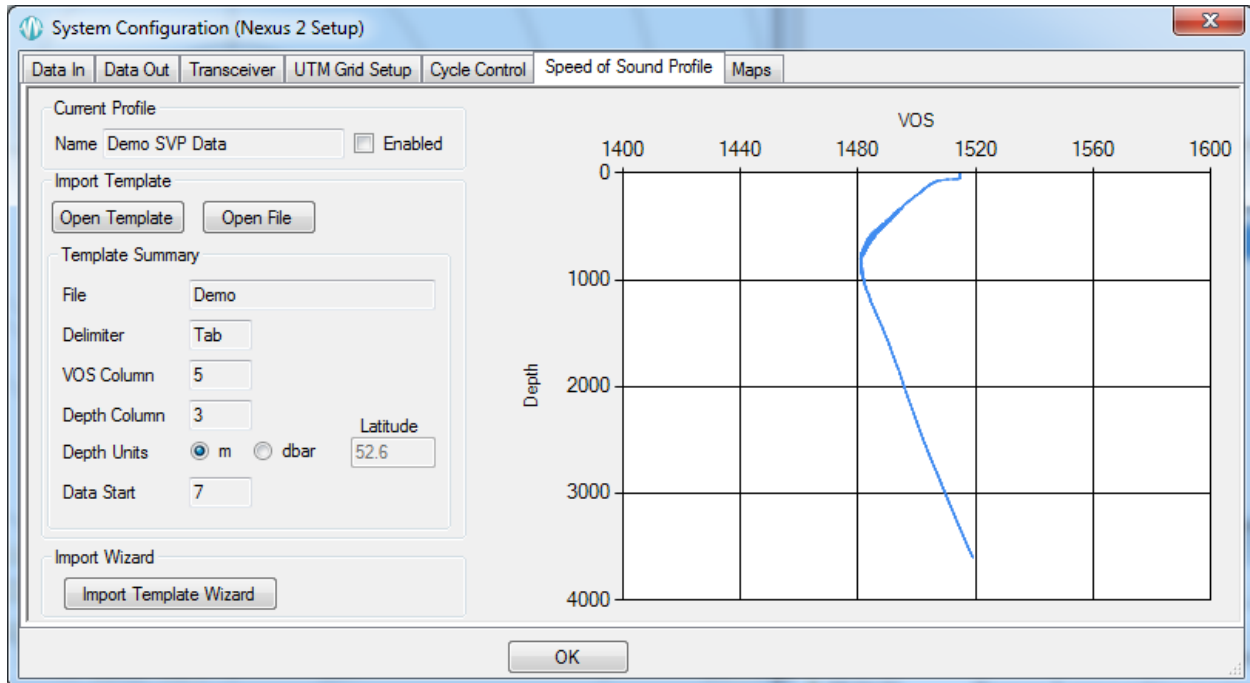
Beacons may be removed from the fire sequence by 'Double Clicking' on them or by selecting them and then pressing the '<<' button or by clicking the right mouse button and selecting 'Remove'.

Beacons in the fire sequence may be moved up and down the sequence with the up and down arrows to the right of the fire sequence section.

If the 'Start Tracking On Exit' checkbox is selected, all of the beacons in the fire sequence will be automatically enabled and interrogation started upon exit from the system configuration window.

Speed of Sound Profile

The Speed of Sound Profile tab enables data gathered from any profiling hardware to be imported into Nexus.



Once a Sound Velocity Profile has been loaded and enabled, the system will automatically calculate the optimum velocity of sound value for each beacon, based on the current depth of the beacon. This value will be continually updated as the beacon depth changes.



Ensure that the 'Enabled' check box is selected in the 'Current Profile' to use the loaded speed of sound profile within the system.

Loading a new Speed of Sound Profile

There are two possible ways of loading a new speed of sound profile from a data file into the system.

If a previously created import template has been loaded, then once the data file has been selected, the import can continue without any user intervention.

If a template for the data file to import has not been loaded, then the 'Import Wizard' may be used. The wizard enabled the user to select the position of the first line of data, the columns containing the depth and velocity of sound data and also if the depth units are meters or decibars.

Load Profile using Import Template

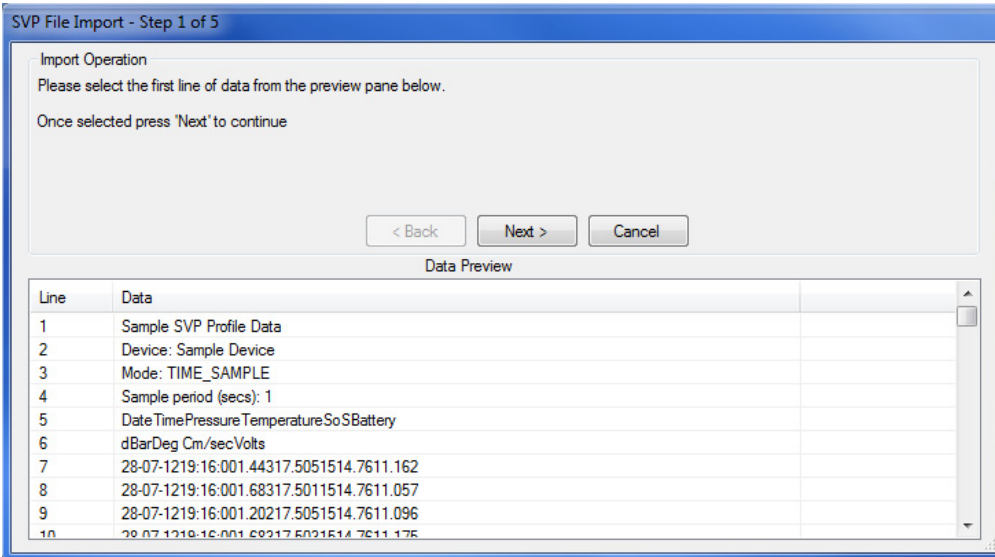
If no template is loaded press the 'Open Template' button to select a previously saved import template (note that the system will automatically remember the last template used and load this on startup). When a template is loaded it will be summarised in the 'Template Summary' section.

Once a template is loaded, the 'Open File' button will be enabled. Press this button to select the SVP data file to load into the system.

Load Profile using Import Wizard

To start the wizard press the 'Import Template Wizard' button. After selecting the data file to import the following screen will be displayed

Step 1 of 5



SVP File Import - Step 1 of 5

Import Operation
Please select the first line of data from the preview pane below.
Once selected press 'Next' to continue

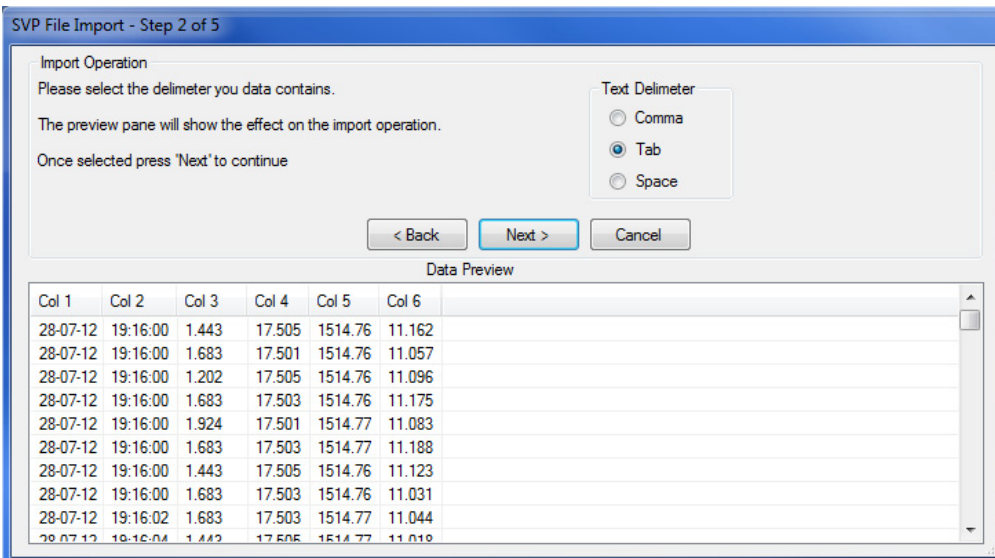
< Back Next > Cancel

Data Preview

Line	Data
1	Sample SVP Profile Data
2	Device: Sample Device
3	Mode: TIME_SAMPLE
4	Sample period (secs): 1
5	Date Time Pressure Temperature SoS Battery
6	dBar Deg Cm/sec Volts
7	28-07-12 19:16:00 1.443 17.505 1514.76 11.162
8	28-07-12 19:16:00 1.683 17.501 1514.76 11.057
9	28-07-12 19:16:00 1.202 17.505 1514.76 11.096
10	28-07-12 19:16:00 1.683 17.503 1514.76 11.175

In the data preview window, select the line that contains the first line of sound velocity data. Once selected, press 'Next' to continue.

Step 2 of 5



SVP File Import - Step 2 of 5

Import Operation
Please select the delimiter you data contains.
The preview pane will show the effect on the import operation.
Once selected press 'Next' to continue

Text Delimiter
☐ Comma
☒ Tab
☐ Space

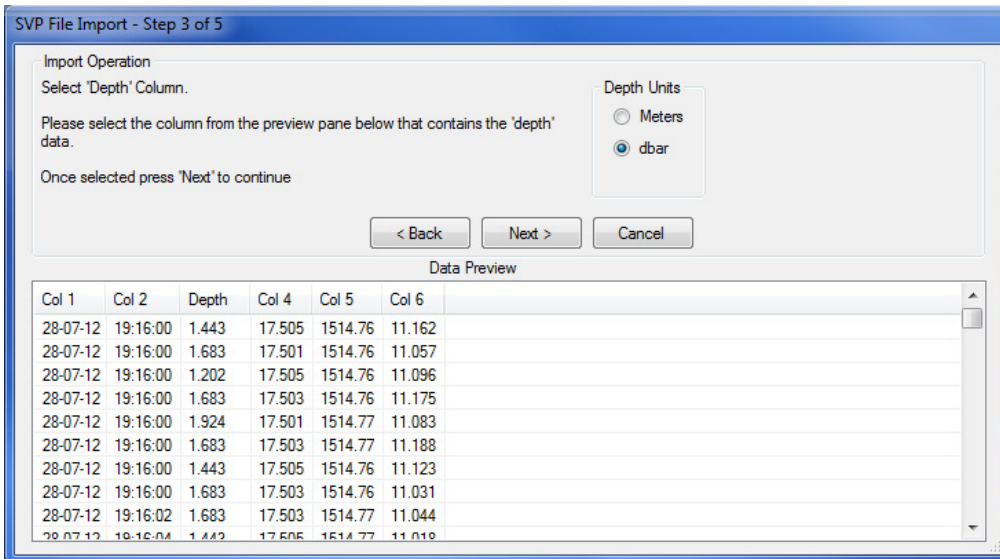
< Back Next > Cancel

Data Preview

Col 1	Col 2	Col 3	Col 4	Col 5	Col 6
28-07-12	19:16:00	1.443	17.505	1514.76	11.162
28-07-12	19:16:00	1.683	17.501	1514.76	11.057
28-07-12	19:16:00	1.202	17.505	1514.76	11.096
28-07-12	19:16:00	1.683	17.503	1514.76	11.175
28-07-12	19:16:00	1.924	17.501	1514.77	11.083
28-07-12	19:16:00	1.683	17.503	1514.77	11.188
28-07-12	19:16:00	1.443	17.505	1514.76	11.123
28-07-12	19:16:00	1.683	17.503	1514.76	11.031
28-07-12	19:16:02	1.683	17.503	1514.77	11.044
28-07-12	19:16:04	1.443	17.505	1514.77	11.019

Select the column delimiter. The wizard will have automatically chosen the text delimiter that it thinks is used in the file. The delimiter may be changed if required, the results of the change will be displayed in the 'Data Preview' window. Once selected, press 'Next' to continue.

Step 3 of 5



SVP File Import - Step 3 of 5

Import Operation
Select 'Depth' Column.

Please select the column from the preview pane below that contains the 'depth' data.

Once selected press 'Next' to continue

Depth Units
☐ Meters
☒ dbar

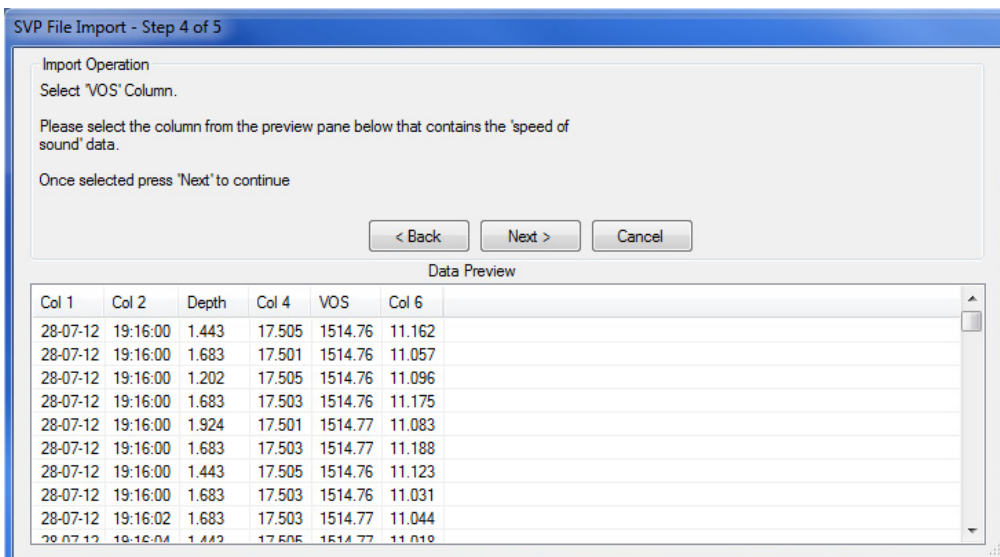
< Back Next > Cancel

Data Preview

Col 1	Col 2	Depth	Col 4	Col 5	Col 6
28-07-12	19:16:00	1.443	17.505	1514.76	11.162
28-07-12	19:16:00	1.683	17.501	1514.76	11.057
28-07-12	19:16:00	1.202	17.505	1514.76	11.096
28-07-12	19:16:00	1.683	17.503	1514.76	11.175
28-07-12	19:16:00	1.924	17.501	1514.77	11.083
28-07-12	19:16:00	1.683	17.503	1514.77	11.188
28-07-12	19:16:00	1.443	17.505	1514.76	11.123
28-07-12	19:16:00	1.683	17.503	1514.76	11.031
28-07-12	19:16:02	1.683	17.503	1514.77	11.044
28-07-12	19:16:04	1.442	17.505	1514.77	11.019

In the data preview window, select the column that contains the depth value by clicking on the relevant column header. The depth units will default to meters, if the data is in decibars then ensure the Depth Units is set accordingly. Once selected, press 'Next' to continue.

Step 4 of 5



SVP File Import - Step 4 of 5

Import Operation
Select 'VOS' Column.

Please select the column from the preview pane below that contains the 'speed of sound' data.

Once selected press 'Next' to continue

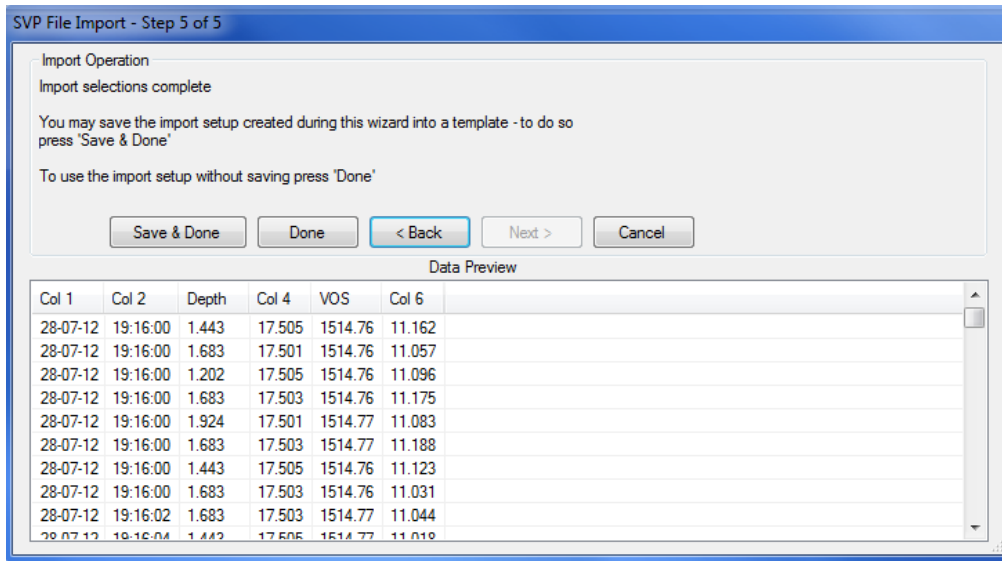
< Back Next > Cancel

Data Preview

Col 1	Col 2	Depth	Col 4	VOS	Col 6
28-07-12	19:16:00	1.443	17.505	1514.76	11.162
28-07-12	19:16:00	1.683	17.501	1514.76	11.057
28-07-12	19:16:00	1.202	17.505	1514.76	11.096
28-07-12	19:16:00	1.683	17.503	1514.76	11.175
28-07-12	19:16:00	1.924	17.501	1514.77	11.083
28-07-12	19:16:00	1.683	17.503	1514.77	11.188
28-07-12	19:16:00	1.443	17.505	1514.76	11.123
28-07-12	19:16:00	1.683	17.503	1514.76	11.031
28-07-12	19:16:02	1.683	17.503	1514.77	11.044
28-07-12	19:16:04	1.442	17.505	1514.77	11.019

In the data preview window, select the column that contains the velocity of sound value by clicking on the relevant column header. Once selected, press 'Next' to continue.

Step 5 of 5



Please confirm that the correct columns have been selected.

If required, the results of the import wizard may be saved into an SVP template to enable any future imports of data files in the same format to be quickly processed. To save as a template and complete the import press 'Save & Done'

If a template is not required for future data file imports, press the 'Done' button to complete the import.

About SVP Templates

A template file contains the following information:-

- Position of first line of sampled data

- The data column delimiter

- The data column containing the depth value

- The data column containing the velocity of sound value

- A value indicating if the depth value is represented in meters or decibars

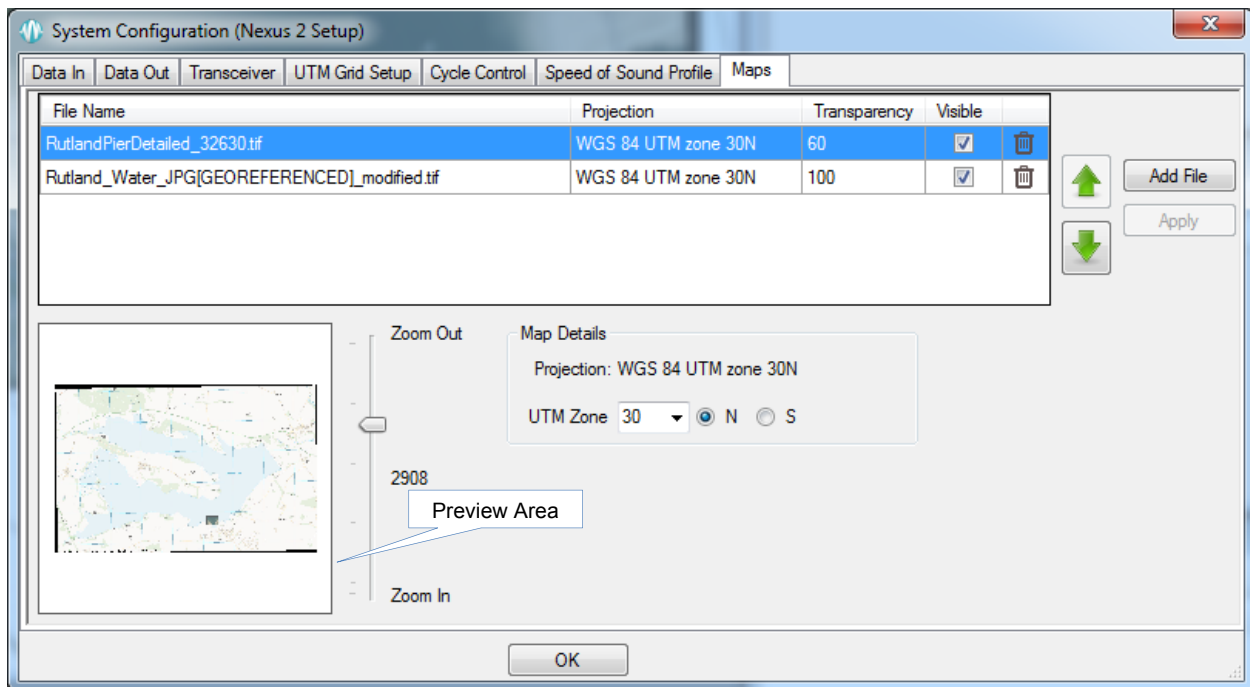
About Decibar Depth Values

When a depth value is in decibars, Nexus will convert the dbar value into a depth value using the standard Unesco pressure to depth formula*. To accurately convert decibars to depth a latitude value is required. The latitude used when importing may be entered into the 'Latitude' text box. If a valid GPS position is being received by the Nexus system then the latitude value will be automatically set to the current latitude from the GPS data.

* Refer to N. P. Fofonoff and R. C. Millard (1983) Algorithms for Computations of Fundamental Properties of Seawater, Unesco Technical Papers in Marine Science No. 44


Maps

Nexus 2 can overlay user supplied georeferenced images on the plot window



Multiple overlay files may be added. Each file can be moved up or down the overlay order and can be set to the required transparency to enable optimal viewing.

The preview area shows the images selected and may be zoomed in or out using the slider. Changes are not applied to the system until the 'Apply' or 'OK' button is pressed.

The map overlay will only be displayed in the plot window when the 'Map Overlay' button is selected on the toolbar 

Add File

Click the 'Add File' button to select a georeferenced image. Nexus 2 supports the following file formats, .tif, .jpg, .dxf, .shp



All overlay files must be in the projection that is selected in 'Map Details'

Transparency

The transparency of any image may be set from 0 to 100

Visible

Tick the checkbox to enable or disable the visibility of the selected layer

Delete

Click on the dustbin image to remove an image from the overlay. Note the file will not be deleted from the system

Up/Down

Any image may be moved up or down the display overlay by selecting the layer and pressing the green up/down arrows

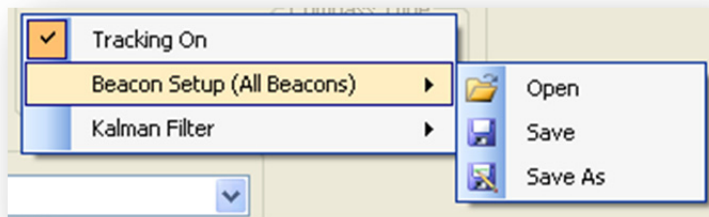
Beacon Editor

Toolbar Button:  Shortcut Key: Ctrl+B

The tabs contained within the 'Beacon Editor' window are described below. Note that the title bar of this window shows the name of currently loaded beacon setup file in brackets.

Beacon Editor Context Menu

Pressing the right mouse button when over the beacon editor window will show the 'Context Menu' as below

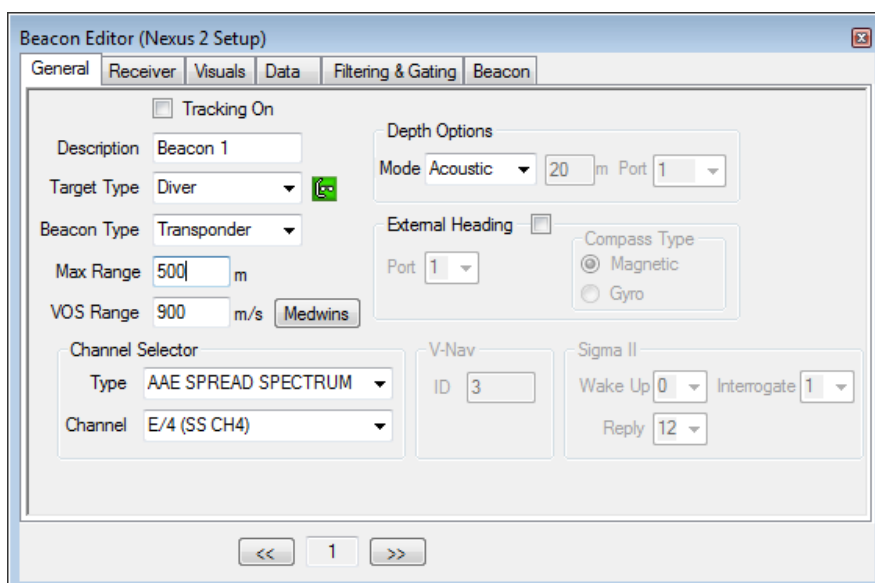


From this menu the following functions can be performed

- Turn Tracking On
- Load or Save a Beacon Setup File – This will load or save the values for ALL beacon setups (including the Kalman Filter configuration for each beacon)
- Load or Save a Kalman Filter Configuration File
This save the Kalman Configuration for ONLY the individual beacon selected
A Kalman Configuration may be loaded for the currently selected beacon or for ALL beacons

General

The General tab allows the operator to set the individual beacon parameters for up to 16 different beacons. To select the required beacon, use either the mouse wheel or the '<<' and '>>' buttons



Tracking On

To Enable Tracking on the selected Beacon 'Tick' the 'Tracking On' check box.

Description

A Description can be added, for example Beacon S/N or Diver 1. This is an aid for display, event log messages and place mark reference and will have no effect on the data or output.

Target Type

The type of target may be selected. This will display an appropriate graphic in the plot window. If a 'Release' target type is selected this will also enable the 'Release' tab in the beacon editor to control release beacon functionality*. If V-Nav is selected then this will also enable the V-Nav section of the configuration (and disable the channel selector section).

Depth Options

- Acoustic Depth is calculated from measured acoustic depression angle.
- Manual Depth is entered manually in the text box provided.
- Telemetry Depth is measured and transmitted from a telemetry beacon to Easytrak
- External Depth is received from an external source

External Depth Mode (NMEA Input Format)

If external depth mode is selected, a depth value for any beacon may be input on a nexus serial port. Depth strings accepted are NMEA \$..DBT, \$..DBS, \$..DBK, \$..DPT. If this mode is selected a port must be selected that will receive the depth string for this particular beacon. If the selected port is not configured for external depth input a warning message will be displayed.

External Depth Mode (Custom AAE Format)

Nexus can also accept beacons depths in a custom AAE format. The data can contain depth information for any number of beacons in a single string and hence requires only one serial port to be used for multiple beacon depth values.

\$AADBM,B,V.V[,B, V.V]*HHCL

Data between [] may be repeated as required

Where

Header	\$AADBM
Beacon number (1 - 10)	B
Depth Value (m)	V
Check Sum	H
Carriage return (CR)	C
Line feed	L

External Heading

If the target being tracked has a known heading (such as an ROV) then this heading may be input (via a serial port). This value can then be used within the Kalman filter to aid in the prediction algorithm of the filter. The serial port receiving the heading data should be selected (and also

* Will only be displayed if release beacons add on feature enabled

configured within the System Configuration) and the type of compass should be defined to ensure the Kalman filter uses an appropriate Standard Error figure for the heading.

Beacon Type

Transponder - Beacons that receive an acoustic interrogate signal and then reply after a set time (turn around delay) on a different frequency.

Responder - Beacons that reply (transmit) after a set time (turn around delay) upon receiving an electrical key (trigger) rather than acoustic signal.

Max Range

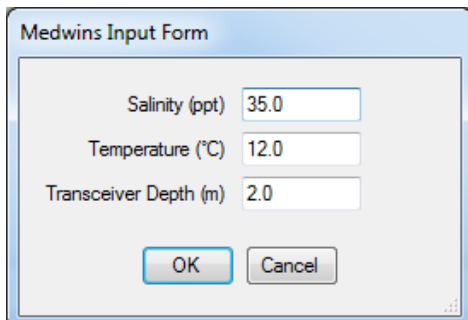
Enter the max range (slant range, not horizontal range) for the target, this allows the system to adjust the cycle rate for fastest possible update rate option or to determine the minimum time required before the next beacon can be fired.



Ensure Max Range value is set correctly, if true acoustic range > max range value then tracking will be lost if system cycling is in fast as possible mode. A warning message will be displayed in the event log if acoustic range is approaching the maximum entered range

Velocity of Sound (VOS) Range

Enter the Velocity Of Sound (VOS) for transmission through water to be used in the range calculation. This is the mean velocity. VOS can be entered manually or can be calculated by using Medwin's method of calculation. Click on 'Medwins' to open the calculator.



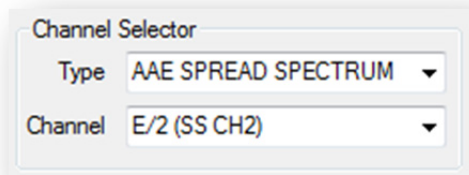
The 'Medwins Input Form' dialog box contains three input fields: 'Salinity (ppt)' with a value of 35.0, 'Temperature (°C)' with a value of 12.0, and 'Transceiver Depth (m)' with a value of 2.0. At the bottom are 'OK' and 'Cancel' buttons.

Enter the parameters for the calculation and click 'OK' to perform. The result is automatically placed in the VOS variable.

If a VOS profile is known for the working area, the average VOS can be entered.

Channel Selector

To select the desired channel



The 'Channel Selector' dialog box has two dropdown menus. The 'Type' dropdown is set to 'AAE SPREAD SPECTRUM' and the 'Channel' dropdown is set to 'E/2 (SS CH2)'.

1. Select the Beacon Manufacturer from the 'Type' drop down menu
2. Select the channel, from the 'Channel' drop down menu

V-Nav ID

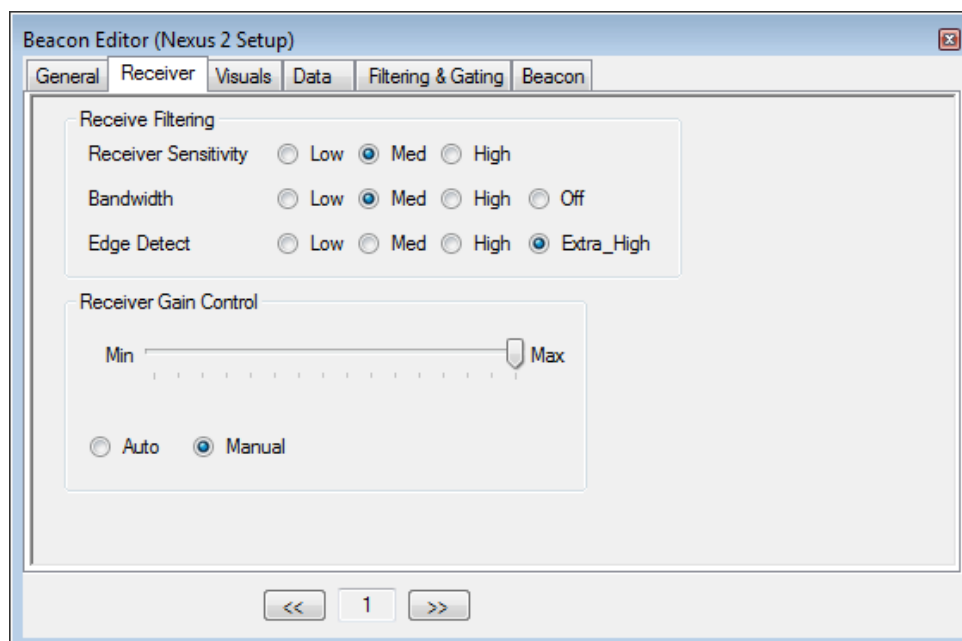
Enter the ID of the V-Nav beacon here. Valid values are 0 - 7199

Sigma 2

If a Sigma 2 channel is selected the the Sigma 2 parameters section will be enabled. The 'Wake Up', 'Interrogate' and 'Reply' parameters may then be configured as required

Receiver

Each of the beacons receiver settings can be configured for optimal tracking.



Receive Filtering

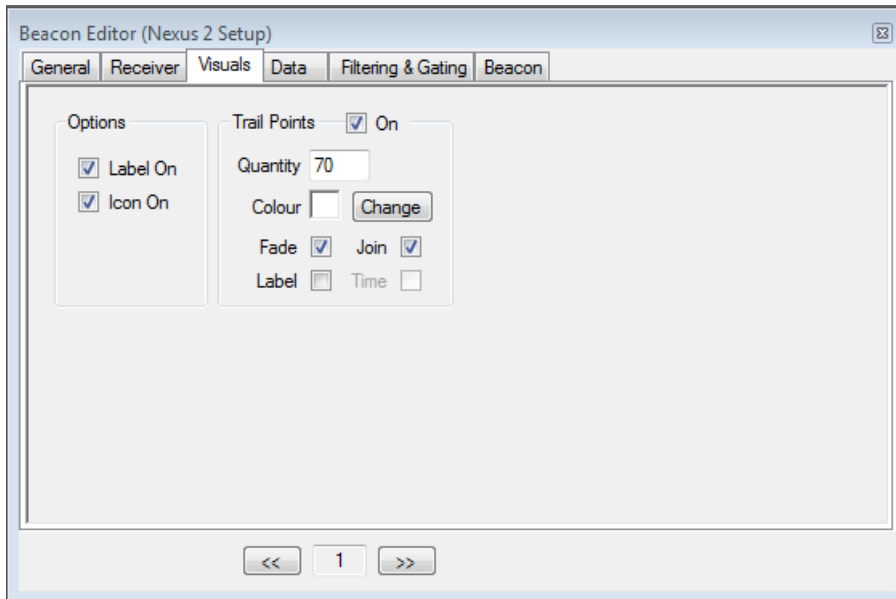
Receiver sensitivity and bandwidth can be adjusted to obtain optimal signal to noise levels. See Data Tab for received signal information.

Receiver Gain Control

The gain of the beacon can be set to Auto or Manual. In Manual mode the gain can be adjusted using the slider bar.

Visuals

The display properties for each beacon can be set by the user.



Options

Within the plot window, each beacon can have a label displayed (showing description, horizontal range and bearing). This may be switched on/off using the 'Label On' check box.

The Icon graphic representing the target type can be switched on or off using the 'Icon On' check box

Trail Points

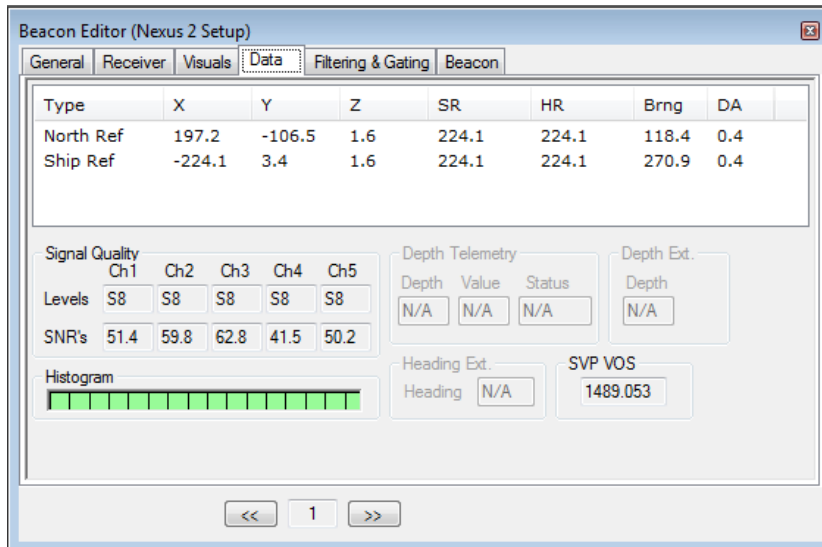
Trail points may be displayed showing the beacons position history.

The following options may be selected

- Trail points On/Off
- The number of points
- Fading out of the end of the trail point
- A line drawn between trailpoints
- A label showing the fix number of the point (will be displayed every 5th point)
- Show the time of the data after the fix number
- The colour of the trail points, lines and labels

Data

The 'Data' tab displays position and signal quality data.



There are 2 data sets continuously calculated by the system from the raw acoustic measurements. North referenced and ship referenced. The values of these are displayed in the top section.

Signal Quality

- **Levels**
S0 (Minimum) to S9 (Maximum), is an indication of the signal received at each of the receiver elements (channels).
- **Signal to Noise Ratio (SNR's)**
This is the signal to noise ratio measured at each of the receiver channels.

Depth Telemetry

This is the depth telemetry data received from a depth telemetry enabled beacon.

Depth Ext.

This displays the depth data received from an assigned external serial port (see System Configuration -> Data In).

Heading Ext.

This displays the heading data received from an assigned external serial port (see System Configuration -> Data In).

SVP VOS

This displays the velocity of sound value used from the loaded sound velocity profile (see System Configuration -> Speed of Sound Profile)

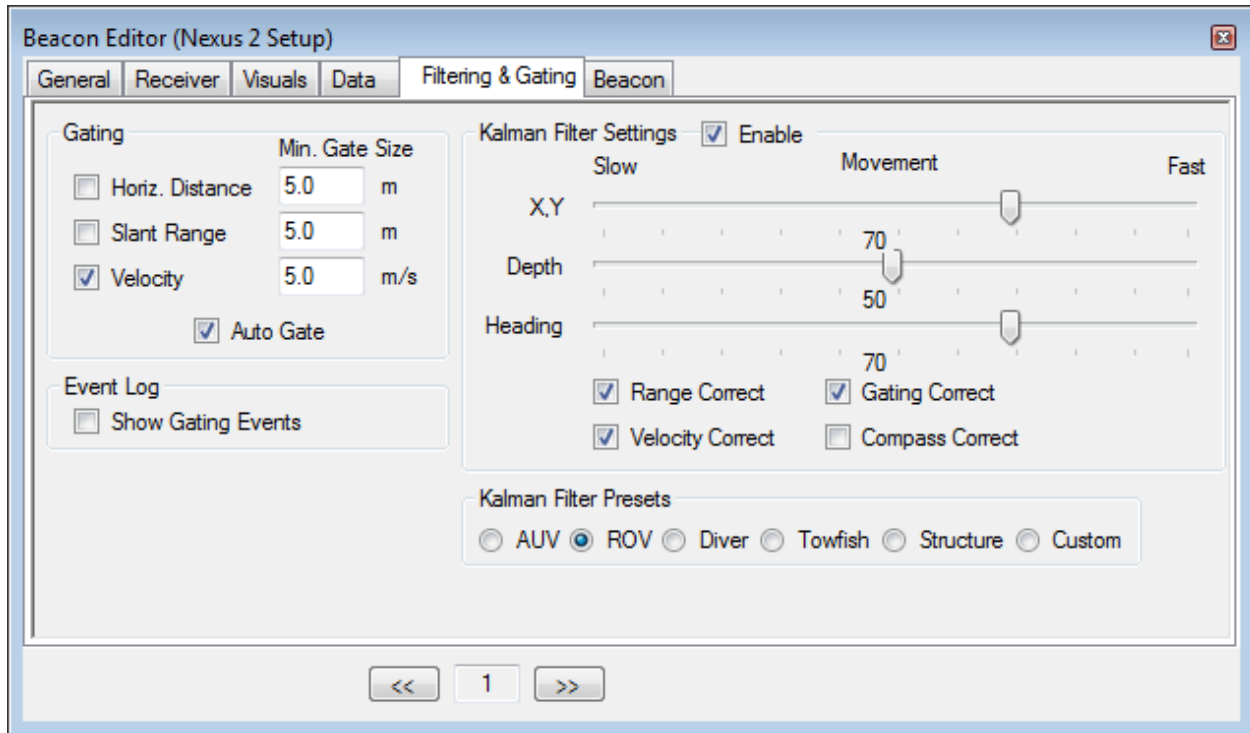
Histogram

This shows the status of last 16 interrogations of the displayed beacon.

- Green - Good
- Amber - Gated Position (only shows if gated or smoothed data is selected)
- Red - No response from beacon

Filtering & Gating

All gating and filtering parameters may be setup in this tab. Each beacon can be controlled individually to allow the optimum setup that is appropriate for the type of target being tracked.



Gating Description

Gating can be used to remove spurious positions made with Easytrak Nexus due to signal reflections, excessive environmental noise etc. Any position that is deemed to be 'out of gate' will be replaced with a predicted position.

Parameters that can be gated include Distance (horizontal), Range and Velocity. Gating limits the deviation a particular parameter may change between interrogations. A value can be entered in a text box to define the gate size, or, in the case of automatic gating mode, the minimum size of the gate.

- **Auto Gating**
In automatic gating mode, a gate starts at the minimum value. Should there be five "out of gate" readings, the gate doubles in size until stable "in gate" readings are obtained. The gate then halves in size as a set of ten good readings is obtained. The gate shrinks until the user defined minimum gate size is reached.
- **Show Gating Events**
Any out of gate events will be displayed in the 'Event Log' window when this option is selected.

Gating Search Mode

When any gating mode is enabled, if any beacon is out of gate for the number of positions, defined in the smoothing parameter, a search mode is activated. In this mode the last known good position of the beacon will be outputted and the gate values will be set to maximum. This ensures that when a valid response is received from the beacon, it will automatically be accepted as a valid position. The gate values will then return to their previous values and the search mode will be deactivated.

Kalman Filter Introduction

The Kalman filter was developed by Rudolf E. Kalman and presented in a paper in 1960. Although not initially attracting much interest, the Kalman filter was soon adopted by NASA for use in its Apollo project, and today can be found in many navigation systems.

The Kalman filter helps to remove random noise contained within data. In this case the data is the raw position received (the observation) from the Nexus transceiver. The Kalman filter models the system and based on previous observations the Kalman filter predicts the next expected position. When the new Nexus observation arrives, the positions are merged together based on the weighting (confidence) of the filter prediction and the weighting of the new observation.

Kalman Filter Settings

The XY, Depth and Heading Movement Sliders

The XY, Depth and Heading sliders affect the dynamics of the Kalman filter. With the sliders set to slow the filter will smooth the track more (more confidence in the prediction than the observation), but will be slower to respond to any real change in direction or velocity of the target. Conversely, with the sliders set to fast, the filter output will follow the observed data track more (has more confidence in the observation), but will be more responsive to noise and rapid changes of direction of the target.

Range Correct

The greater the slant range of any USBL system the greater the standard error of an observation will become – mainly functions of the bearing and depression angle. To help compensate for this, turn range correct on. This adjusts the standard error as a function of range. In this instance the standard error is based on 1% of slant range rather than a fixed standard error of 1m. It is recommended that this button is selected.

Velocity Correct

The velocity check box should be selected ON where the target is moving along a track relative to the vessel rather than static; for example tracking an Autonomous Underwater Vehicle (AUV) running survey lines.

An example where the velocity option is not recommended is if a towfish is being positioned relative to the vessel; in this case the towfish will appear virtually stationary to the vessel other than slight lateral and vertical movements.

Gating Correct (Spurious Observation)

This option allows the observations to be analysed prior to going into the Kalman filter by using the special gating facilities within Nexus. If the observed position is deemed to be especially poor (spurious – outside any selected gate), the weights of the Kalman filter are adjusted to rely more heavily on the filter's predicted rather than observed position. It is recommended that this button is selected.

Compass Correct

Compass compensation is where the target has an internal compass that can be interfaced to Nexus. This will aid the Kalman filter in changes of target orientation. A typical target would be a Remotely Operated Vehicle (ROV) which commonly has an internal compass to help the pilot with orientation and navigation.

Kalman Filter Presets

A number of Kalman Filter setups are defined within the system that are suitable for typical types of targets being tracked. These setups may be selected by clicking any one of the radio buttons

Saving Kalman Filter Setups

Any Kalman filter setup may be saved to file from the context menu (right mouse). A Kalman setup may be loaded into just the currently selected beacon or into all beacons

Advanced User Mode

Nexus has an 'Advanced User Mode' which can be enabled from the Tools menu.

When in advanced user mode the system will recalculate the currently received acoustic data points. This advanced mode enables the trail point history to show how adjusting gating and Kalman filter parameters would have affected the output data.

This feature may be of use, for example, if the output data appears to be *lagging* behind the actual target position. This may happen if the Kalman Filter is tuned incorrectly for the target type (such as Velocity Correct turned off).

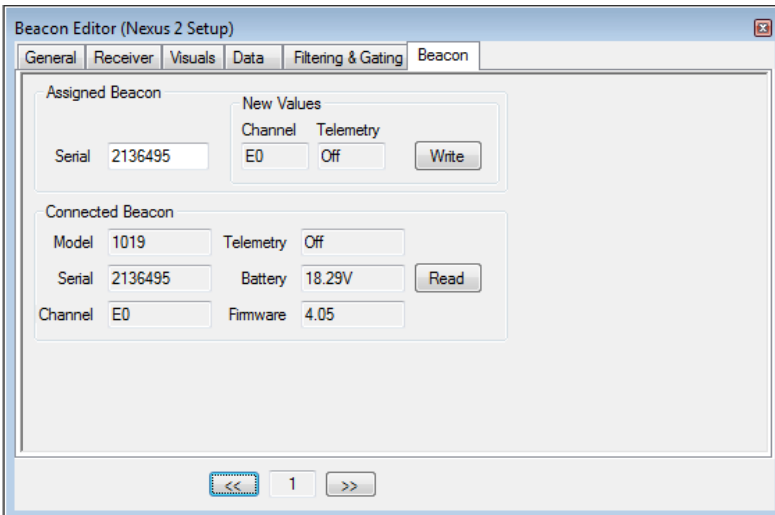
Advanced user mode also adds extra functionality to the 'Beacon Editor -> Filtering & Gating' tab. A 'Kalman Display Options' section enables the current Kalman Data Set to be saved as a *reference* so that when tuning the filter this reference may be compared to the current Kalman Filter setup.

Beacon

The beacon tab is used to display the details of a 1000 series beacon that may be connected to a Nexus serial port. The connected beacon can also be configured to match the current channel number and depth telemetry mode of the current beacon setup.



To communicate with a beacon, a serial port must be configured as 'Beacon' in the System Configuration setup.
A standard 1082 Smart Switch lead plus cross over (null modem) lead must be used to allow communication between the 101X Beacon and Nexus.



Assigned Beacon

By assigning a beacon setup to a particular beacon serial number, the system will ensure that the current configuration may only be written to the desired beacon. This ensures that the user cannot accidentally configure the wrong beacon with the wrong setup.

Enter the serial number of a beacon you wish to assign to this beacon setup.

The 'Write' button will set the channel number and telemetry mode (if selected and available) to the values that have been previously selected. The values that will be written to the beacon are displayed in the 'New Values' area for confirmation.

Connected Beacon

The 'Read' button will interrogate the connected beacon to read configuration data.

The configuration of the currently connected beacon will be displayed in this area. The following information is displayed:

- Model Number
- Serial Number
- Channel Number
- Telemetry On/Off
- Battery Voltage
- Firmware Revision Number



Beacon communication is only supported from Console Nexus Firmware V1.2.7 and newer

Release

The release tab enables control of Applied Acoustics 5xx or 15xx release beacons.

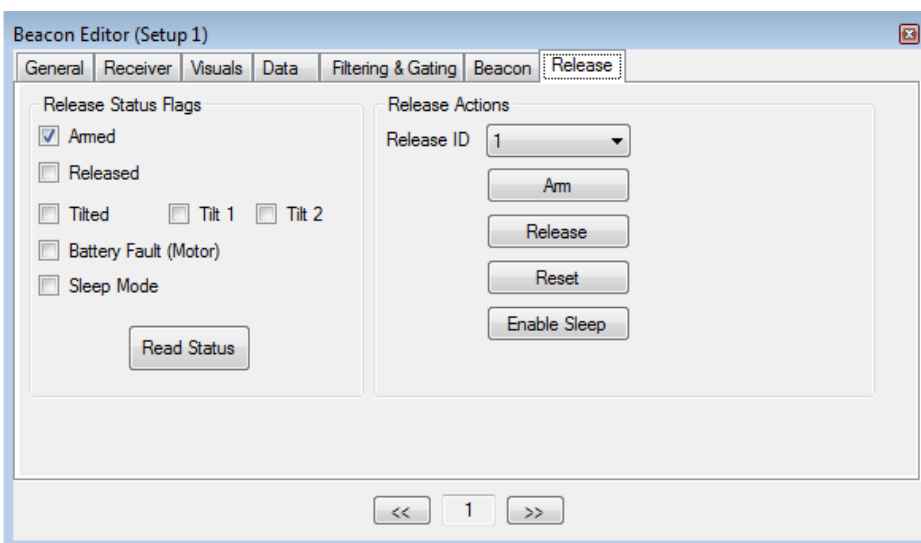


Release functionality is an add on feature that must be enabled.

General Operation

The release tab, will not be visible until the 'Target Type' is selected as a release type in the 'General' tab.

5xx Release Operation



Release ID

The 5xx release beacon will have an ID (0 – 15), determined by the release beacon switch settings. To communicate with the beacon, the ID must be set from the 'Release ID' drop down selection box.

Release Status Flags

This area displays the operational status of the release beacon. The 'Read Status' button may be pressed to interrogate the release beacon and obtain the current operational status.

Please refer to the release beacon manual for a detailed description of each of the status flags.

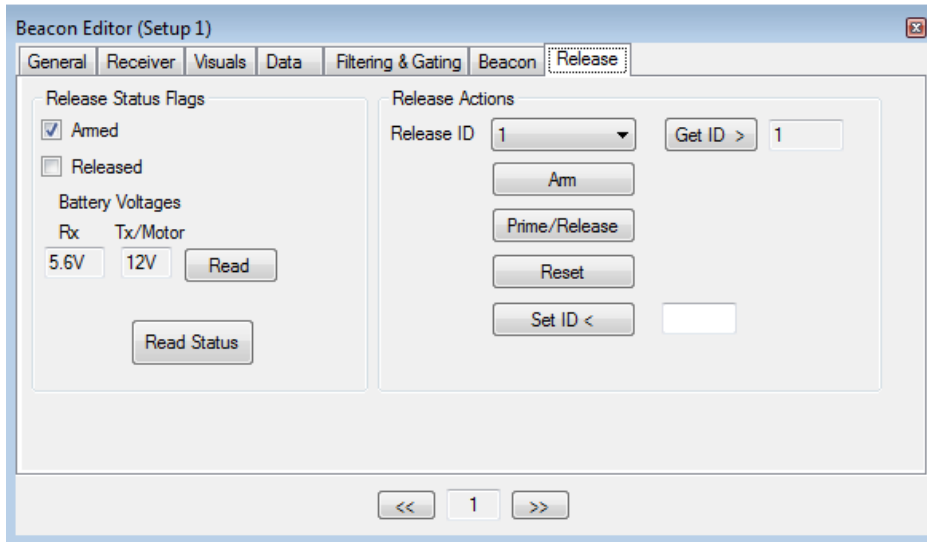
Release Actions

A number of actions may be performed with a release beacon.

- **Arm** – A release beacon must be armed prior to release. Once the beacon is armed (as indicated by the status flags) the 'Release' button will become active
- **Release** – Once armed, a release operation may be performed. The user will be prompted to confirm that a release operation is required prior to actioning the release
- **Reset** – This will reset the release status flags to their default conditions. Note however that if any fault condition remains this will be indicated in the status flags.

- Enable/Disable Sleep – A release beacon may be put into a sleep mode. In this mode the beacon will only respond to release commands and not to normal acoustic interrogations

15xx Release Operation



The 15xx release beacons may be operated from this tab. Each beacon has an ID, in order to communicate with the release beacon, the correct 'Release ID' must be selected from the drop down box to match the release beacons ID. The 'Get ID' button may be used to interrogate the release beacon, the ID read from the beacon will be displayed in the text box next to the button.

Release Status Flags

This area displays the operational status of the release beacon. The 'Read Status' button may be pressed to interrogate the release beacon and obtain the current operational status flags.

- Armed – This flag indicates that the beacon is in an armed condition and may be released or primed
- Released – Indicates that a prime/release action has just completed

The 15xx battery voltages may be read by pressing the 'Read' button.

The nominal battery pack voltages are 6.0V RX and 18.0V TX/Motor.

Release Actions

A number of actions may be performed with a release beacon.

- Arm – press this button to arm the beacon
- Prime/Release – **This button will only be enabled if the beacon is in an armed condition.** Pressing this button will move the release motor to the next position, either primed or released
- Reset – Pressing this button will clear all status flags within the release beacon

- **Set ID** – A new release beacon ID may be programmed into the beacon by entering a new ID value into the text box and pressing the 'Set ID' button.


Important: Please ensure that after a new ID has been programmed successfully, the 'Release ID' value is changed to match the newly programmed ID




The Set ID function may only be performed when the transceiver is out of the water. The Set ID function will be disabled if the transceivers depth is greater than 1.0m

Beacon Data

Toolbar Button  Shortcut Key: Ctrl+D

Beacon Data									
	Description	Lat	Long	Z	SRng	HDist	Brng	Visible	
▶	Beacon 1	00°00'04.6051" N	07°29'16.8368" W	71.0m	178.5m	163.8m	30.0°	<input checked="" type="checkbox"/>	
	Beacon 2	00°00'04.0871" N	07°29'16.0713" W	71.0m	179.0m	164.3m	40.0°	<input checked="" type="checkbox"/>	
	Beacon 3	00°00'03.4067" N	07°29'15.4451" W	71.0m	178.0m	163.2m	50.0°	<input checked="" type="checkbox"/>	

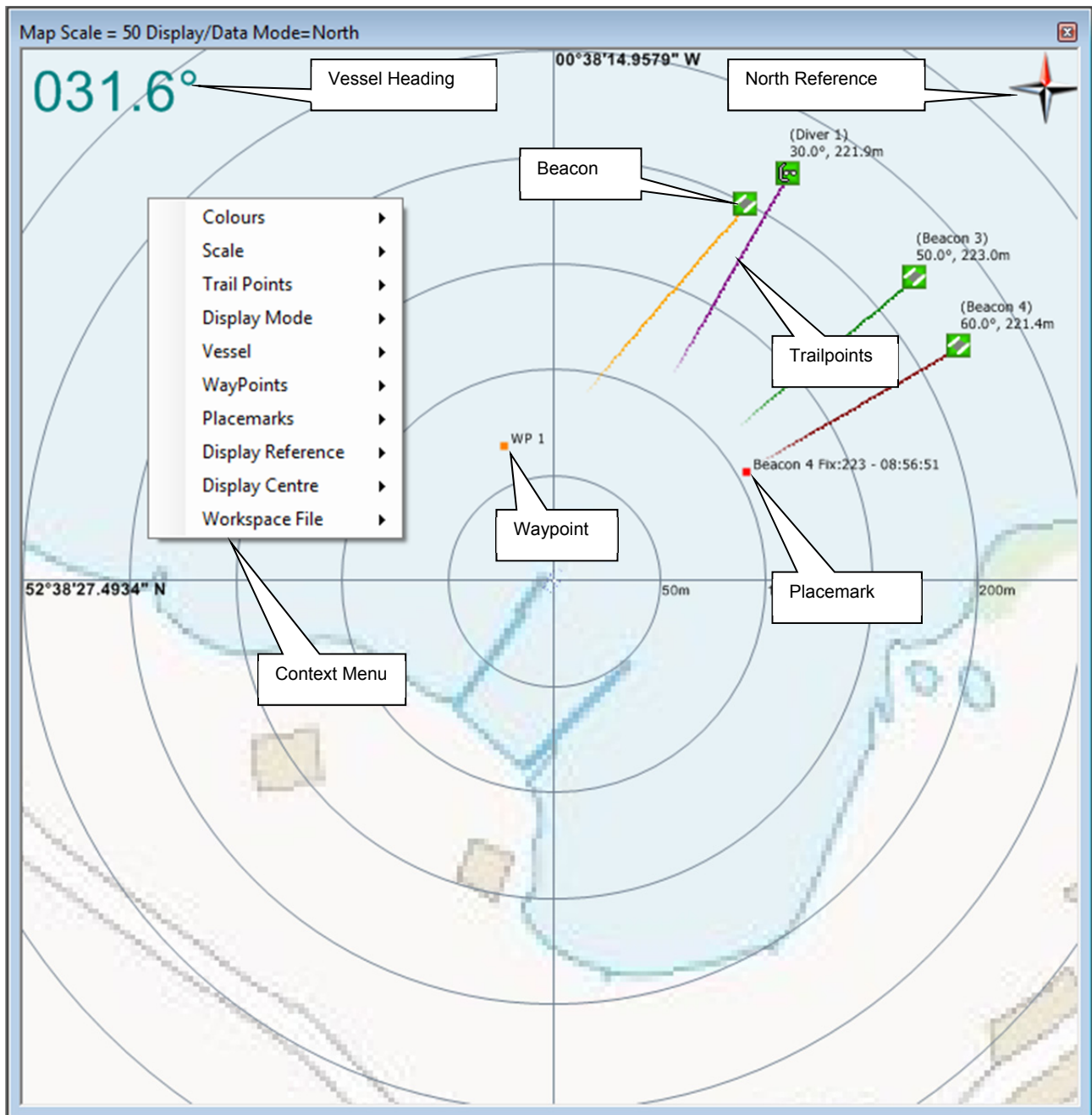
This window displays all of the beacons that are being interrogated.

- The  shows the last beacon that was interrogated.
- The 'Visible' check box determines if the beacon is displayed in the plot window.
- The beacons description is displayed here. The description may also be edited from here.
- X and Y (or Eastings and Northings) indicate the relative or absolute co-ordinates on the horizontal plane in meters.
- Z is the distance of the target below the transducer or reference point in meters.
- SRng is the slant range to the target in meters.
- HDist is the horizontal distance to the target in meters.
- Brng is the bearing to the target in degrees.

Plot Window


Toolbar Button  Shortcut Key: Ctrl+D

This is the main plotting window where the vessel and the target positions are plotted. Waypoints and place-marks can also be viewed on the window.

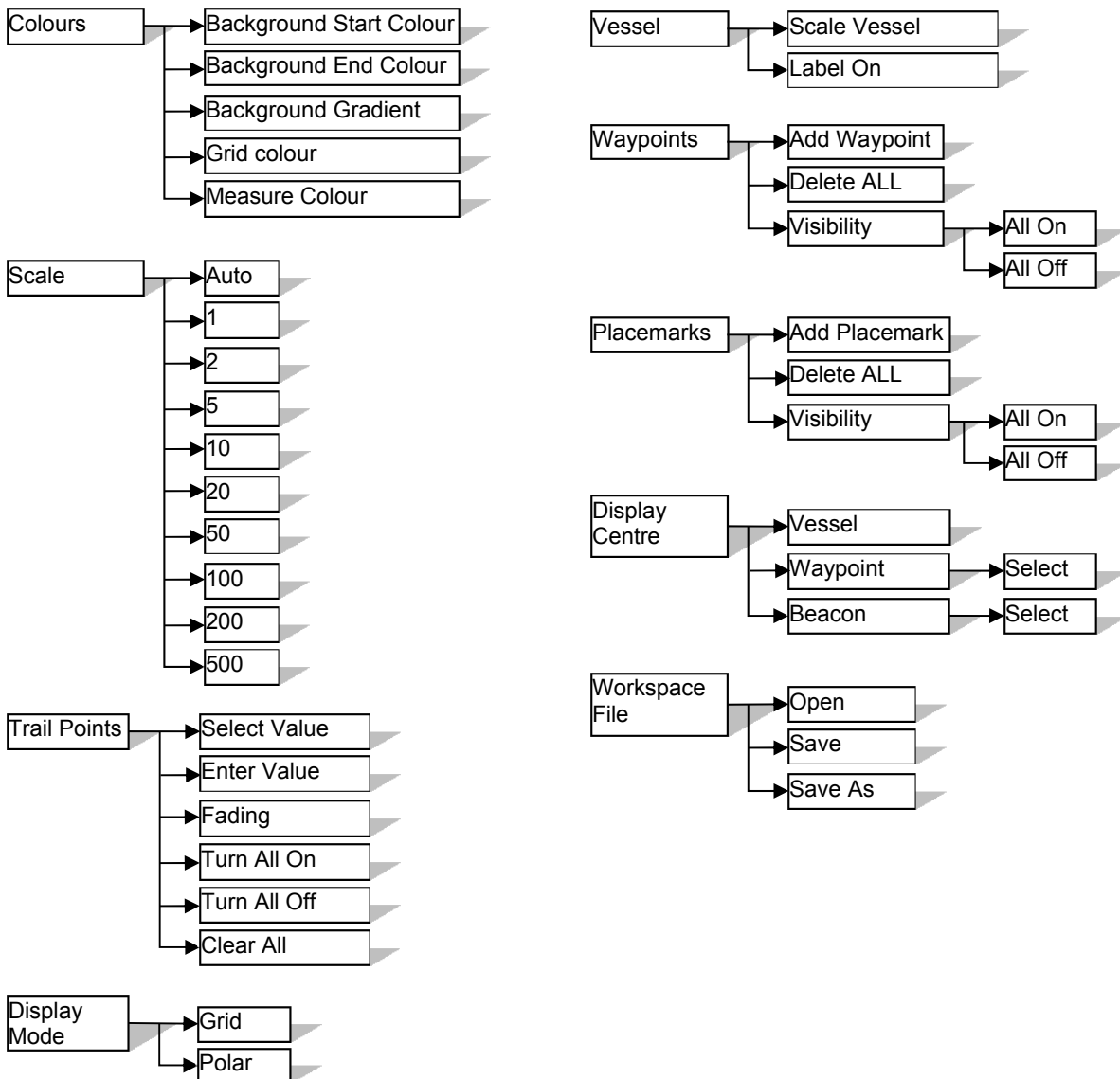


The current data source and scale is displayed in the Title Bar. If (A) is present the scale is in automatic mode.

The Display Mode can either be Grid or Polar (as above). This can be controlled from the context menu, system preferences or shortcuts on the tool bar.

If maps have been loaded then the overlay may be switched on or off via the 'Map Overlay' toolbar button 

The Context Menu is accessed by a Right Mouse Click when the Plot Window is active.



- **Colours**
The colours of the plot window may user defined for operating conditions. These may also be adjusted from Edit Workspace - Display Options.
- **Scale**
The scaling of the plot window may be adjusted or set to automatic if required. In automatic mode the plot window will be adjusted to display all active (visible) targets.
- **Trail Points**
Values for ALL beacons trail points can be adjusted.

- **Display Mode**
The display mode can be set to grid or polar.
- **Vessel**
The label and vessel scaling can be toggled on // off. This along with other vessel settings may also be adjusted from Edit Workspace – Vessel.
- **Waypoints**
A waypoint can be added (its position will be the point at which the right mouse was clicked from the plot window).
All waypoints can be deleted (a confirmation prompt will be displayed).
All waypoints visibility may be turned on or off.
- **Placemarks**
A placemark can be added (its position will be the point at which the right mouse was clicked from the plot window).
All placemarks can be deleted (a confirmation prompt will be displayed).
All placemarks visibility may be turned on or off.
- **Display Centre**
The current centre of the plot window can be selected. Options are Vessel, any waypoint or any active beacon.
- **Workspace File**
A workspace file may be loaded or saved from this menu.

The plot window scale may be changed by zooming in and out. This may be achieved using the wheel mouse when the plot window is active. Alternatively the 'Zoom In' and 'Zoom Out' buttons on the toolbar can be used.



The plot window may also be '*panned*' by pressing and holding the left mouse button whilst dragging the display (please note the display will not change until the left mouse button is released). This effectively *fixes* the plot window centre point to a specific x/y (or Easting/Northing) value.

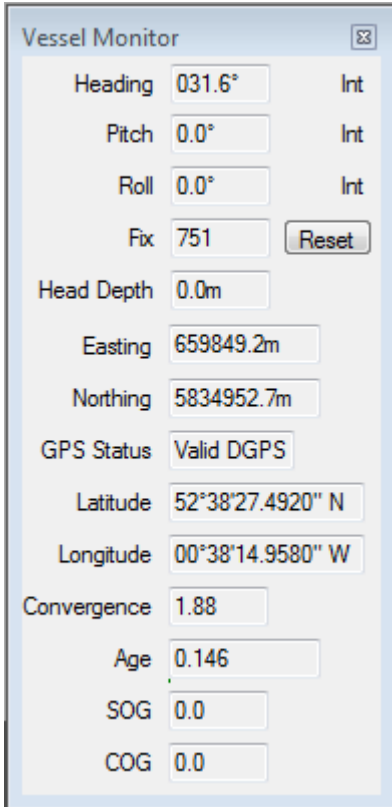
If panning has been applied, the centre point may be set back to vessel, waypoint of active beacon as previously described. Alternatively the 'Centralize' button on the toolbar will revert the centre point of the window to the previously selected centre mode before any panning was carried out.



Vessel Monitor

Toolbar Button  Shortcut Key: Ctrl+V

The Vessel Monitor will display the all vessel's parameters including Heading, Pitch, Roll, GPS Position, Speed Over Ground (SOG) and Course Over Ground (COG) and the age of the GPS position relative to the last received beacon response.



The Vessel Monitor window displays the following parameters:

Parameter	Value	Unit/Type
Heading	031.6°	Int
Pitch	0.0°	Int
Roll	0.0°	Int
Fix	751	Reset
Head Depth	0.0m	
Easting	659849.2m	
Northing	5834952.7m	
GPS Status	Valid DGPS	
Latitude	52°38'27.4920" N	
Longitude	00°38'14.9580" W	
Convergence	1.88	
Age	0.146	
SOG	0.0	
COG	0.0	

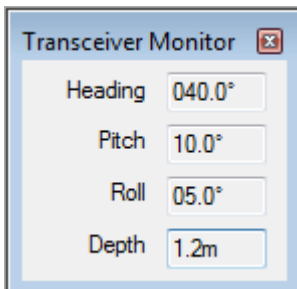
The Vessel Monitor also indicates if internal (Int.) or external (Ext.) heading, pitch and roll are selected.

The fix number may be reset by pressing the 'Reset' button.

Transceiver Monitor

Toolbar Button  Shortcut Key: Ctrl+T

The Transceiver Monitor window displays the heading, pitch, roll and depth of the transceiver.



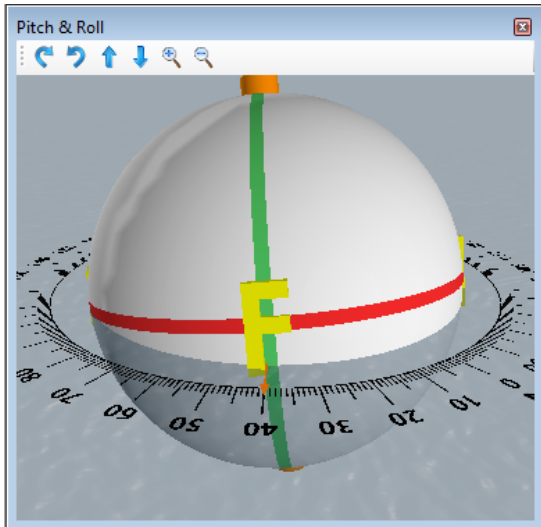
The Transceiver Monitor window displays the following parameters:

Parameter	Value
Heading	040.0°
Pitch	10.0°
Roll	05.0°
Depth	1.2m

Pitch & Roll Monitor

Toolbar Button  Shortcut Key: Ctrl+A

The Pitch & Roll Monitor window show a graphical representation of the current vessel heading, pitch & roll.



The forward, aft, port and starboard of the vessel are indicated on the model with F,A,P & S respectively. The arrow shows the current vessel heading overlayed on the compass.

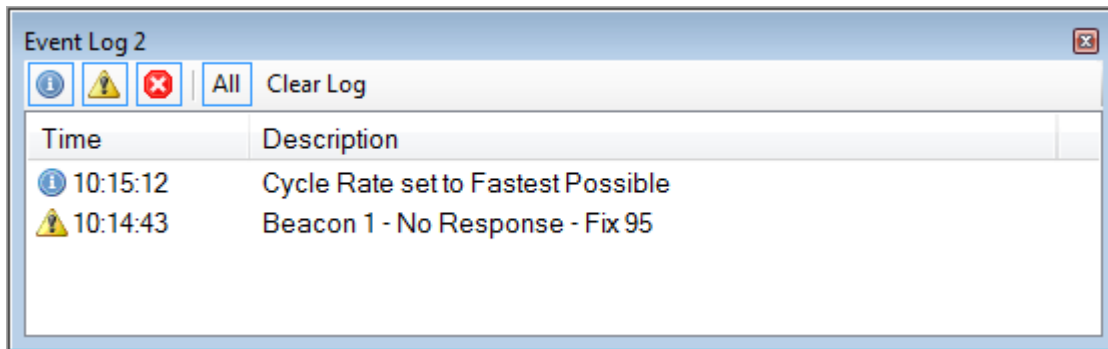
The current view of the model can be changed via the buttons on the toolbar or via the mouse wheel, the mouse wheel mode of adjustment can be altered using a combination of the Ctrl, Alt and Shift buttons as below.

Wheel	-	Zoom In/Out
Wheel + Ctrl	-	Change viewing angle
Wheel + Alt	-	Change view elevation
Shift Key	-	With any above combinations, holding will increase the speed of adjustment




Event Log

Toolbar Button  Shortcut Key: Ctrl+V

The event log displays any required system messages.



The Event Log records and reports all system events in three levels:

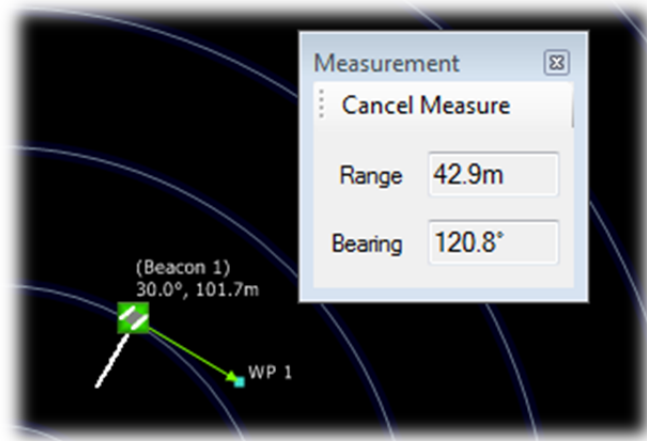
	Information:	Information Only Messages
	Warning:	System Warning Messages
	Critical:	Critical System Messages

The Event Log can be filtered to display only the desired level messages. By selecting one or more of the message type icons in the tool bar to view messages. Filters can be removed to display all messages.

The 'Clear Log' button clears the event log window of all messages.

Measurement

Toolbar Button



The Measurement Tool can be used to measure between any two points on the plot screen, a range and bearing will be displayed in the measurement window.

A measurement may be 'attached' at one or both ends to an object such as the vessel, a beacon, a waypoint or a placemark.

Select the measurement tool from the task bar and move the cursor to the plot window. The cursor will change to a crosshair on a valid attachment point, select this point by left clicking. The second point for the measurement can then be selected in the same manner. If no end measurement point is selected the measurement will be to the current cursor position.

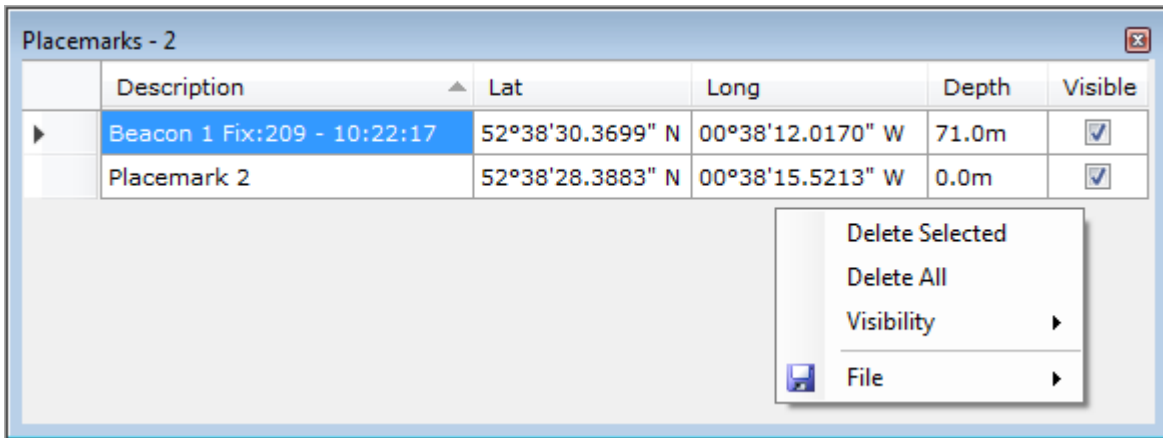
To cancel the measurement click 'cancel measurement' to close

Placemarks

Toolbar Button



Shortcut Key: Ctrl+M



Place marks are designed to offer the operator the ability to mark and record places of interest or events typically in Eastings and Northings (for reference) with the depth of the reading appended. The above example is shown with the context menu displayed (right mouse click).



F5 adds a Place mark at the last received beacon position

Place marks can be added by positioning the cursor over the place to be marked on the plot window and double clicking the left button.

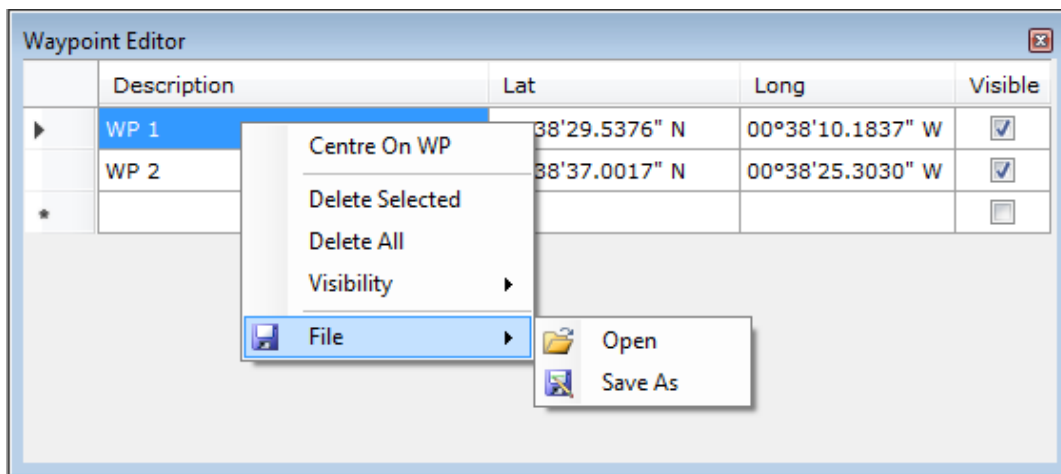
Place mark descriptions can be user defined to refer to a particular event or area.

Place marks can be visible / invisible on the plot window by ticking the visible check box.

A place mark file can be saved to disc and exported. Please note that placemarks saved to a file will be saved as a Lat/Long position, therefore please ensure that GPS data is being received and applied.

Waypoints

Toolbar Button  Shortcut Key: Ctrl+W



Waypoints are designed to be used as references or markers for navigation purposes. The above example is shown with the context menu displayed (right mouse click).

Waypoints can be added by positioning the cursor over the place to be marked on the plot window and right clicking selecting add waypoint. Waypoints can also be manually configured by entering the co-ordinates of the waypoint. This may be specified in either Eastings and Northings or as Lat and Long values.

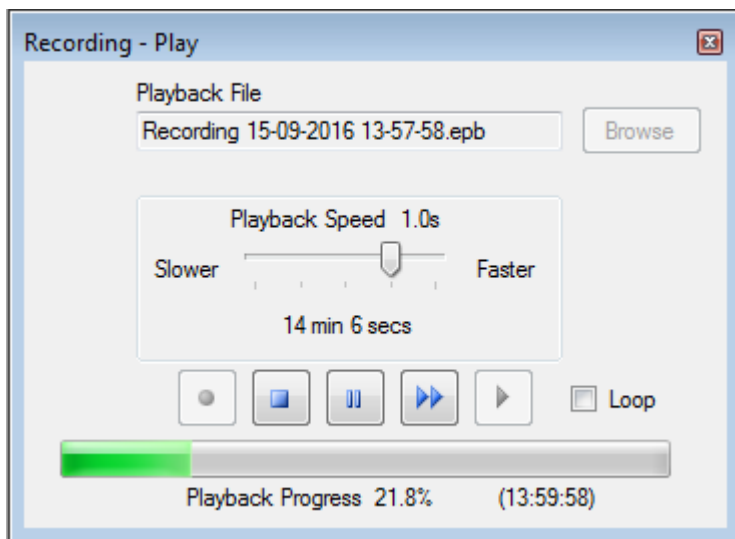
Waypoint descriptions may be any text required by the user to easily identify the waypoint.

Waypoints can be visible / invisible on the plot window.

A waypoint file can be saved to file, and re-loaded.

Recorder/Playback

Toolbar Button  Shortcut Key: Ctrl+R



The record and playback function allows the operator to record the tracking and all peripheral interfaces in real time. To have the facility to play back the logged data for review. As the data is recorded in raw format the data sets can be re-created with new offsets, smoothing levels, etc to produce a different final data set.

To record a file click on the record button, the system will automatically assign a file name with reference to the date and time. The filename will be displayed in the text box and a message will be displayed in the event log.

To stop recording click Stop.

To playback a file, browse to the file location (default location) and select.

Select desired playback speed and click Play. The playback speed can also be adjusted during playback, pausing and fast forward is also supported.

Tools Menu

A number of tools/utilities are available via the tools menu such as system programming, calibration etc.

Programming

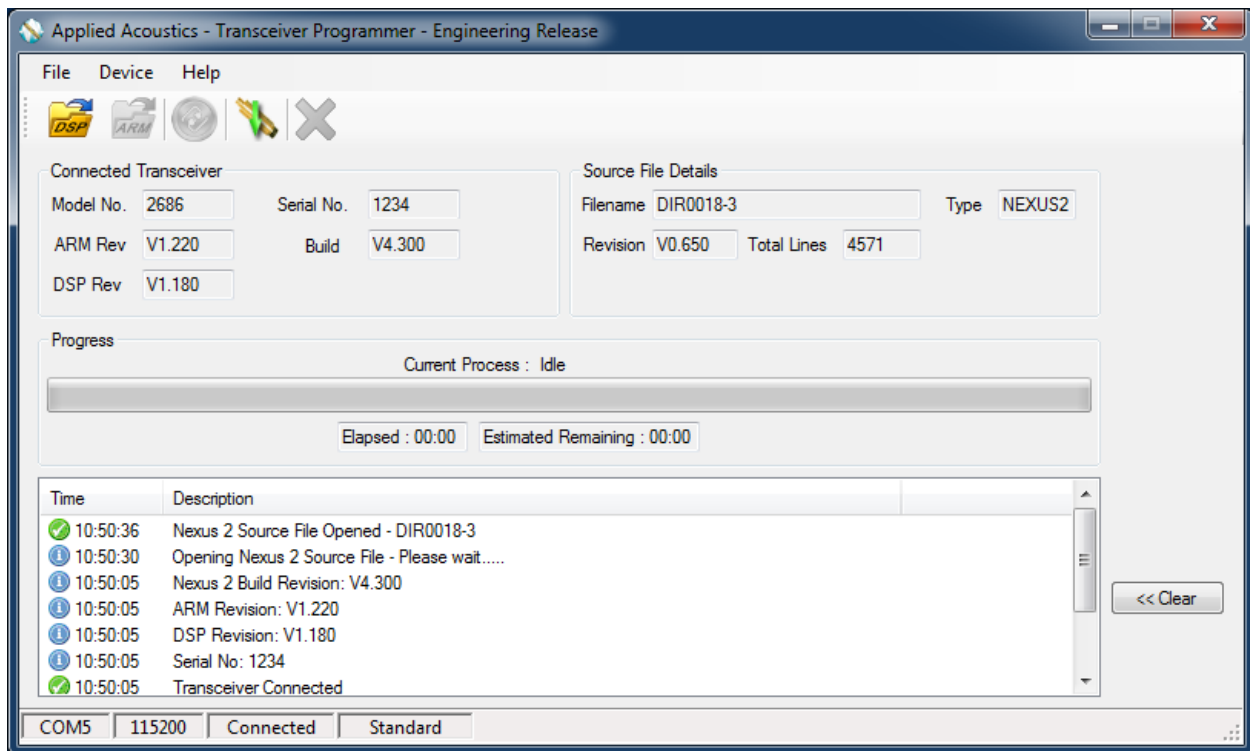
From the programming menu the software in both the console and the transceiver may be updated with data files supplied from Applied Acoustics.

The transceiver contains both ARM and DSP firmware, these may both be reprogrammed from the utilities accessible from this menu.

The Nexus console firmware may also be updated.

The Nexus User Interface software may be updated via the programming menu.

Below is an example of the Nexus Transceiver programming utility



The programming procedure is the same for all updates and is as follows

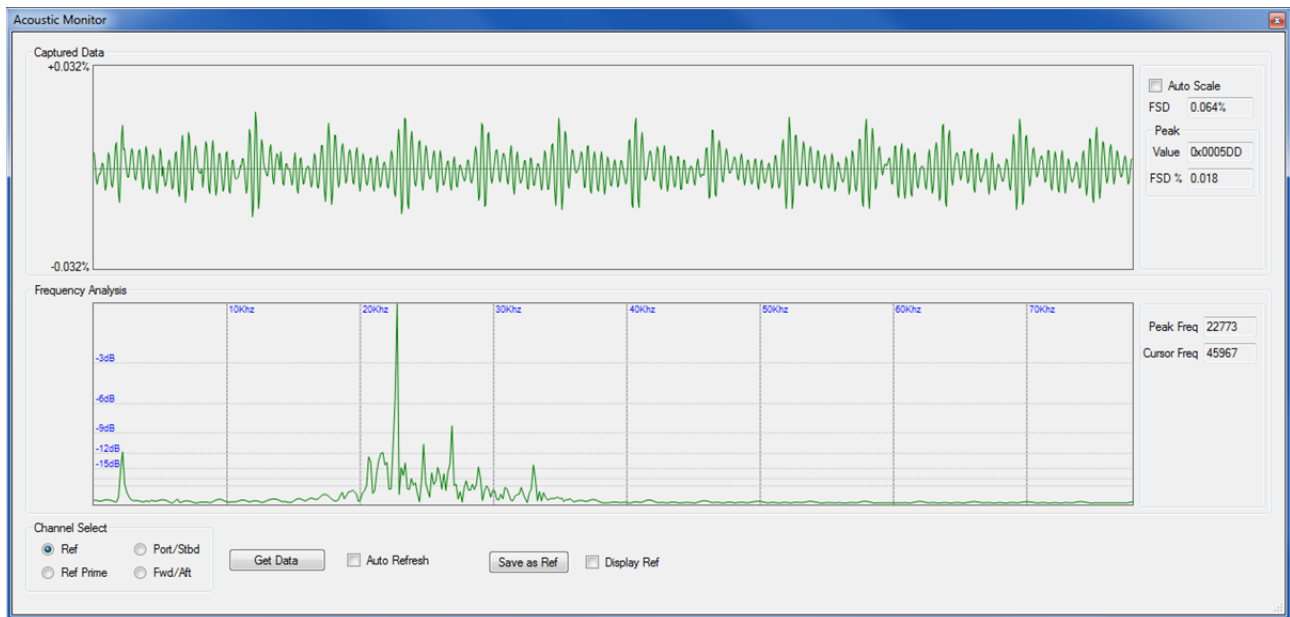
- Insert a USB memory stick containing the update file.
- Launch the required programming tool.
- Open a source file – the browser automatically selects the external drive and sets the file filters to the correct type depending on the application. Select the desired file.
- Click Program, the progress bar then indicates the state of the update.
- If required, the system will prompt to shut down the unit.
- If required, power up the system to complete update and operate as normal.

Advanced User Mode

Advanced user mode may be enabled from the Tools menu. A password may also be entered to restrict access to this mode if required.

Acoustic Monitor (not supported with 2686 Transceiver)

An acoustic monitor mode is available when in advanced user mode.



The acoustic monitor mode enables the transceiver to *listen* for ambient noise that may be affecting system performance and ascertain frequencies that may be interfering with the USBL acoustics.



The transceiver does not continually listen, but takes a 'snapshot' of approx 6.5ms. Therefore, the tool is most suited to detect acoustic data that is continually present in the water and not intermittent acoustic noise.

The acoustic monitor window has two plot areas. A captured data area and a frequency analysis area.

The Captured Data plot displays the 'raw' data as received by the transceiver.

The Frequency Analysis plot displayed the frequency content of the raw data by applying a Fast Fourier Transform (FFT) to the received data.

The display of the two plot areas may be adjusted via the mouse wheel.

Using the wheel, the zoom factor and center frequency of the FFT window may be adjusted. The FFT window will zoom in/out with the center frequency being the current position of the mouse.

The zoom factor of the Captured Data window may be adjusted via the mouse wheel. To increase the step size when using the wheel mouse the 'Ctrl' key and/or the 'Alt' key as follows

Mouse wheel	-	Normal step size
Mouse wheel + Ctrl	-	Medium step size
Mouse wheel + Ctrl + Alt	-	Maximum step size

The 'Auto Scale' check box, when ticked, will scale the captured data plot area after each sample window to display the peak value of the sample window as the limit of the plot area.

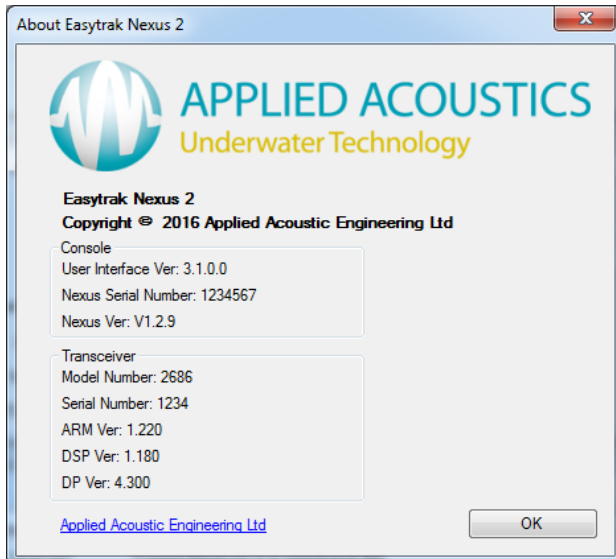
The following controls are also available

- **Get Data**
To take a noise sample, press this button. This will gather a single sample window period
- **Auto Refresh**
Check box may be selected to continuously refresh the sample.
- **Save as Ref**
This button saves the current sample data to a data file. This data may then be overlayed to compare with the current sample data
- **Display Ref**
Overlay the reference data previously saved
- **Channel Select**
The transceiver has 4 receive elements. Any of these may be selected to monitor

Help Menu

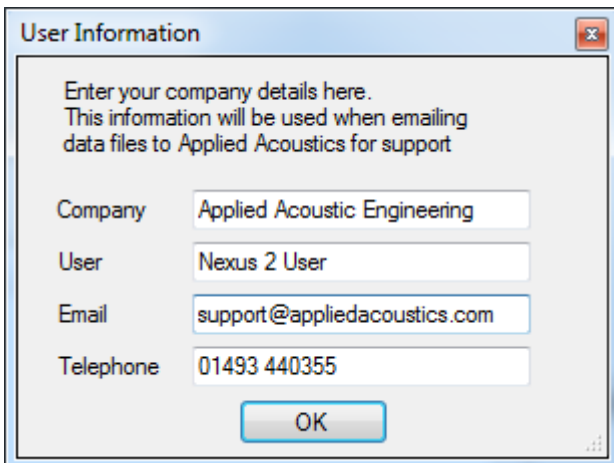
About

The about box displays system information about the console and the transceiver including software/firmware revisions and serial numbers.



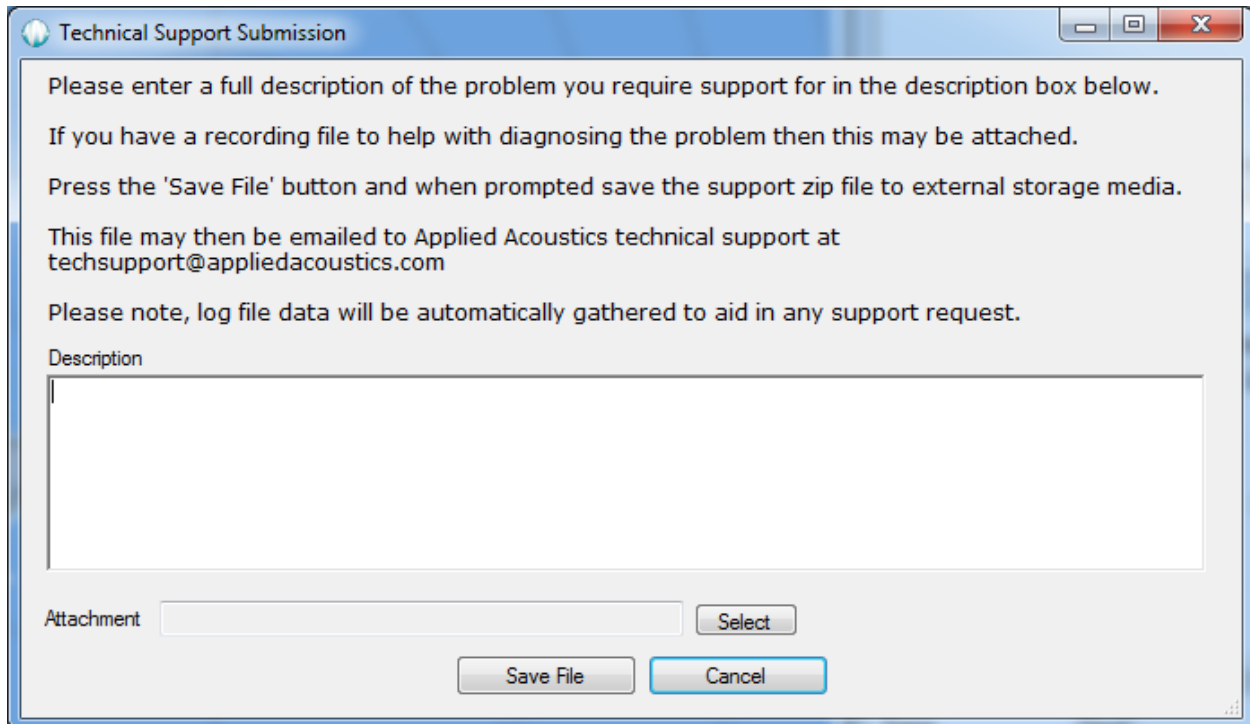
User Information

The user information window allows the user to input contact details which will be sent to Applied Acoustics when sending a technical support request.

The image shows a Windows-style dialog box titled "User Information". It contains a text area with the instruction: "Enter your company details here. This information will be used when emailing data files to Applied Acoustics for support". Below this, there are four input fields: "Company" (containing "Applied Acoustic Engineering"), "User" (containing "Nexus 2 User"), "Email" (containing "support@appliedacoustics.com"), and "Telephone" (containing "01493 440355"). An "OK" button is located at the bottom center.

Request Support

If you require any technical support you may request this via the help menu.



The image shows a Windows-style dialog box titled "Technical Support Submission". It contains the following text: "Please enter a full description of the problem you require support for in the description box below. If you have a recording file to help with diagnosing the problem then this may be attached. Press the 'Save File' button and when prompted save the support zip file to external storage media. This file may then be emailed to Applied Acoustics technical support at techsupport@appliedacoustics.com Please note, log file data will be automatically gathered to aid in any support request." Below the text is a large text area labeled "Description". At the bottom, there is an "Attachment" label next to a text input field, a "Select" button, a "Save File" button, and a "Cancel" button.

Technical Support Submission

Please enter a full description of the problem you require support for in the description box below.

If you have a recording file to help with diagnosing the problem then this may be attached.

Press the 'Save File' button and when prompted save the support zip file to external storage media.

This file may then be emailed to Applied Acoustics technical support at techsupport@appliedacoustics.com

Please note, log file data will be automatically gathered to aid in any support request.

Description

Attachment

Please enter a brief description of the problem or request in the area provided. It is also possible to attach a previously recorded file that may help customer support.

The support request data should be saved to a zip file on an external USB device and then emailed to Applied Acoustics at a later date.

7. Transceiver Compass Calibration

7.1 Transceiver Model 2682

Overview

The Nexus 2682 transceiver contains a gyro-enhanced Attitude and Heading Reference System (AHRS) to measure heading, pitch and roll of the transceiver in real time. The sensor measures the earth's magnetic field and because of this, any local disturbances of the earth's magnetic field will affect the performance and accuracy of the AHRS. This will occur when the AHRS is mounted close to any object that contains ferromagnetic materials, permanent magnetic or strong currents (several amperes).

The AHRS may undergo a calibration procedure in situ to *minimize* the local magnetic disturbances. It is important to understand that the calibration will only *minimize* errors (not totally remove) introduced from local magnetic anomalies. Therefore, these disturbances should be avoided as much as possible, by mounting the transceiver as far away from such disturbances as is practically possible.

A calibration of the AHRS need only be carried out once for each deployment position. A new calibration will be required if the transceiver deployment position is changed or any new sources of magnetic disturbance exist near the transceiver.

Expected Accuracy

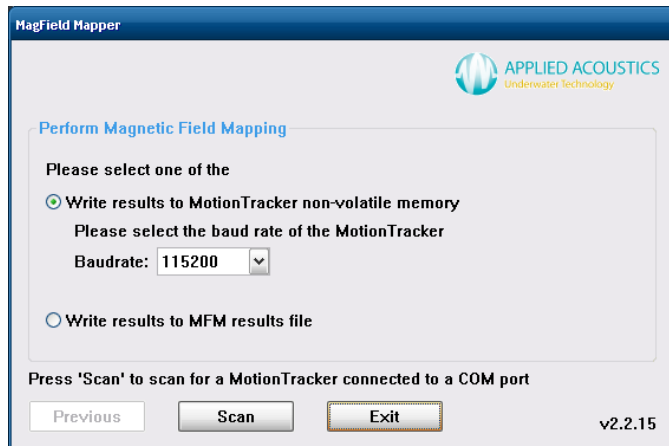
Calibrating the AHRS is a complex procedure with many possible variables that can effect the calibration results. Ideally the transceiver should be positioned in a totally benign magnetic environment, in practice of course this is not possible. Consequently, the expected accuracy results achieved from a calibration process are impossible to predict. The following may be used as a guideline

- An expected accuracy of 1.0 degrees or less is a *very good* result
- An expected accuracy of between 1.0 and 2.5 is realistic
- An expected accuracy greater than 2.5 indicates extreme local anomalies that will affect system performance

Procedure

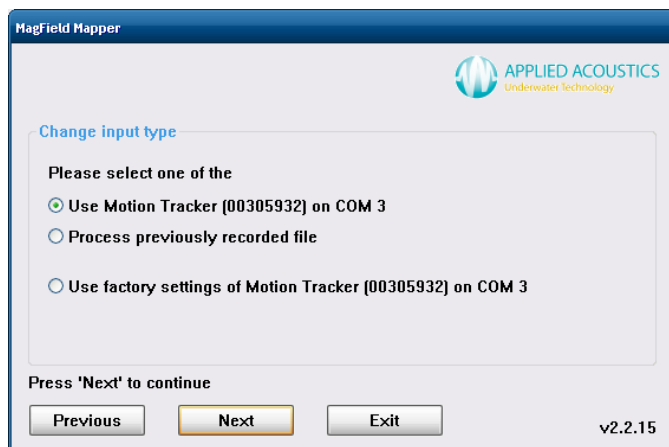
The transceiver must be mounted in its deployment position and the vessel must then be navigated a complete circle over a period of no less than 2 minutes. During this period measurements will be taken from the AHRS. Upon completion of this, measurements will be stopped and the calibration algorithm will correct for local disturbances and then the results may be written back to the compass.

- From the 'Tools -> Calibration' menu select 'Compass Calibrate'



The above screen will be displayed. Press the 'Scan' button to proceed

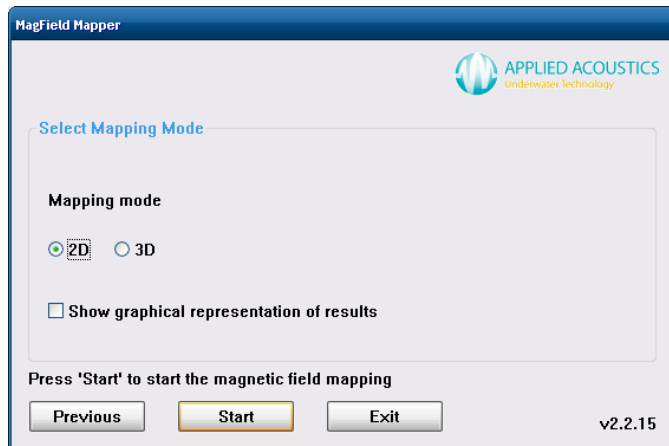
- When the AHRS has been found the following screen will be displayed. Press the 'Next' button to proceed



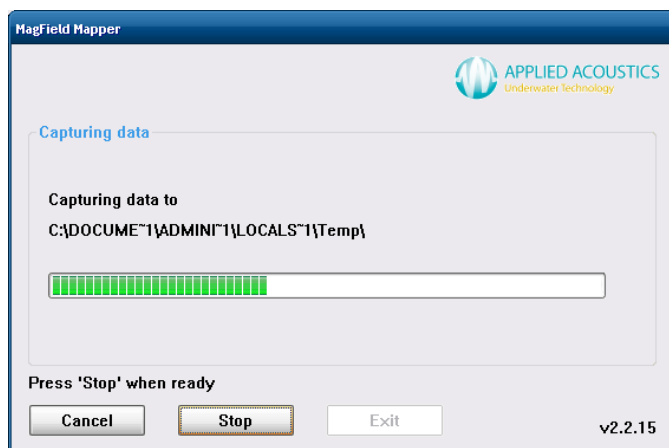
- When the following screen is displayed, press the 'Next' button to proceed



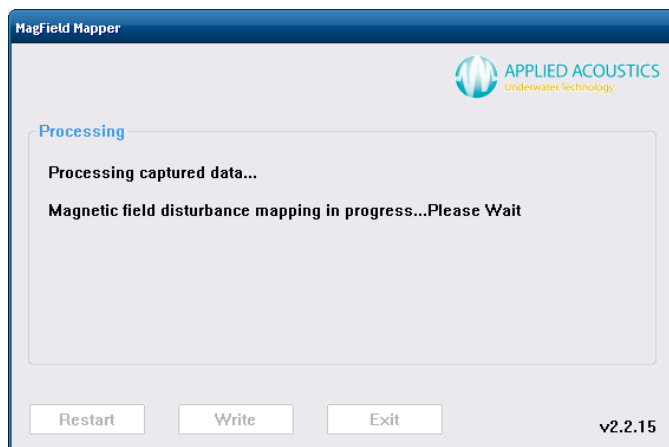
- When the following screen is displayed select '2D' and then press 'Start' to proceed



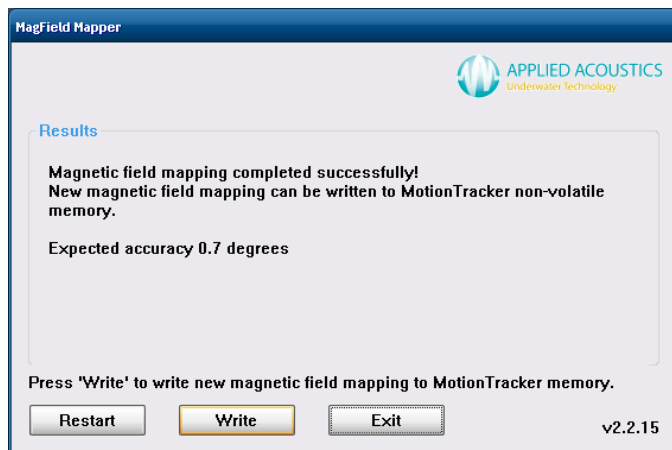
- The following screen will be displayed during the data capture phase. Please ensure the transceiver is rotated a full 360 degrees by navigating the vessel in a complete circle over a period of no less than 2 minutes



- When the rotation has been completed press the 'Stop' button to proceed. The following screen will be displayed during the analysis phase

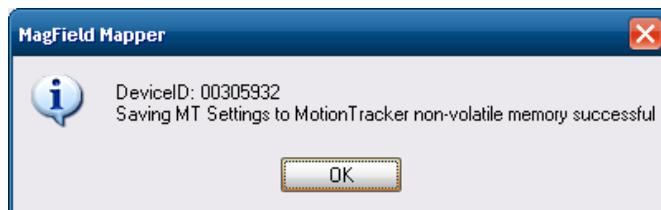


When completed the following results screen will be displayed



If an acceptable calibration has been completed (see the Expected Accuracy section previously) the results should be written to the transceiver by pressing the 'Write' button. If an acceptable calibration has not been completed the calibration may be restarted by pressing the 'Restart' button. Alternatively, the whole calibration process may be terminated by pressing the 'Exit' button, this will not save the calibration results to the transceiver

- If 'Write' is pressed to following screen will confirm calibration data has been successfully saved to the transceiver (note DeviceID will be different to that shown)



The following screen is then displayed



- Press the 'Exit' button to proceed
- The transceiver will be powered down and the power re-applied after a 10 second delay

7.2 Transceiver Model 2686

If utilising the internal compass of a 2686 transceiver please contact Applied Acoustics for calibration instructions.

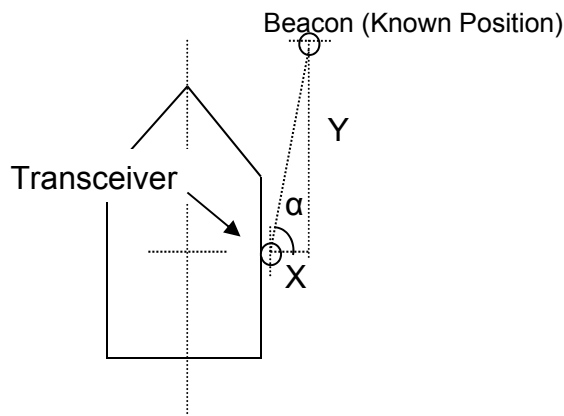
8. Calibration

Upon pole mount installation on a vessel a USBL system should be perfectly aligned with the vessel's bow and with no angular offsets in the pitch and roll axis if external sensors are utilized. The internal sensors are factory aligned and calibrated. External dedicated survey grade sensors offer greater accuracy and performance.

As it is generally impractical to perfectly align the transceiver with the vessel's bow / center line mechanically a calibration procedure is required. Easytrak Nexus includes the Easycal dynamic calibration tool to perform a USBL calibration. Depending on the vessel and local factors a dynamic calibration may not be practical therefore a static (less accurate) calibration / verification of the head alignment can be performed.

8.1 Static Calibration

A static calibration can only calculate the transducer alignment error and not any pitch or roll offsets. Therefore it is recommended that the internal pitch and roll sensor is used and the internal compass is disabled – Corrected data. (For all Pole mounted applications.)



Method 1:

- Place a transponder at a known position with the aid of a navigation pack / electronic chart. Calculate the range and bearing.
- Using Easytrak Nexus measure the acoustic range and bearing. In shallow waters manual or telemetry depth will assist with measurement. Ensure the VOS is entered.
- Alignment Error = Calculated Bearing – Acoustic Bearing.
- Enter offset into Fixed Installation Offsets.

Method 2:

- Place a transponder at a known position and measure the x, y offsets away from the transceiver.
- Calculate the bearing $\alpha = \text{inv tan}\left(\frac{x}{y}\right)$
- Using Easytrak Nexus measure the acoustic range and bearing. In shallow waters manual or telemetry depth will assist with measurement. Ensure the VOS is entered.
- Alignment Error = Calculated Bearing – Acoustic Bearing.
- Enter offset into Fixed Installation Offsets.

8.2 EasyCal 2 USBL Calibration

The program is an add-in to the Easytrak Nexus 2 acoustic positioning system and provides the facility to calibrate the acoustic system to eliminate any alignment errors which may have occurred during the vessel installation of the transceiver.

The program is launched directly from Easytrak Nexus 2, offsets and target data are passed automatically from Easytrak to EasyCal 2. Once the program is running, GPS position and USBL data, or import USBL data from logged ASCII files, and process using least squares techniques to provide Heading, Pitch, Roll and Scaling corrections. Histograms and Time-Series graphs are provided for reporting and C-O values can be automatically sent back to Easytrak to update its configuration.

EasyCal 2 Procedure

The following procedure can be used to measure dynamically any offsets between the Easytrak Nexus Transceiver Head and the external sensors interfaced. This is to enable accurate operation of the Easytrak Nexus tracking system when pole mounted onto a vessel with external VRU and gyro.

With the below configured the vessel is navigated around a fixed beacon in predefined patterns either logging data continuously or taking readings at the cardinal points depending on the capabilities of the vessel.

Easytrak Nexus Configuration:

The following interfaces are required to perform an EasyCal calibration:

- GPS Input. (DGPS) Recommended GPRMC @ 1Hz min
- External Gyro / Compass Input and / or
- External Pitch and Roll Input

The following parameters are required to be set to perform an EasyCal calibration:

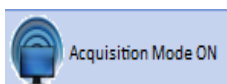
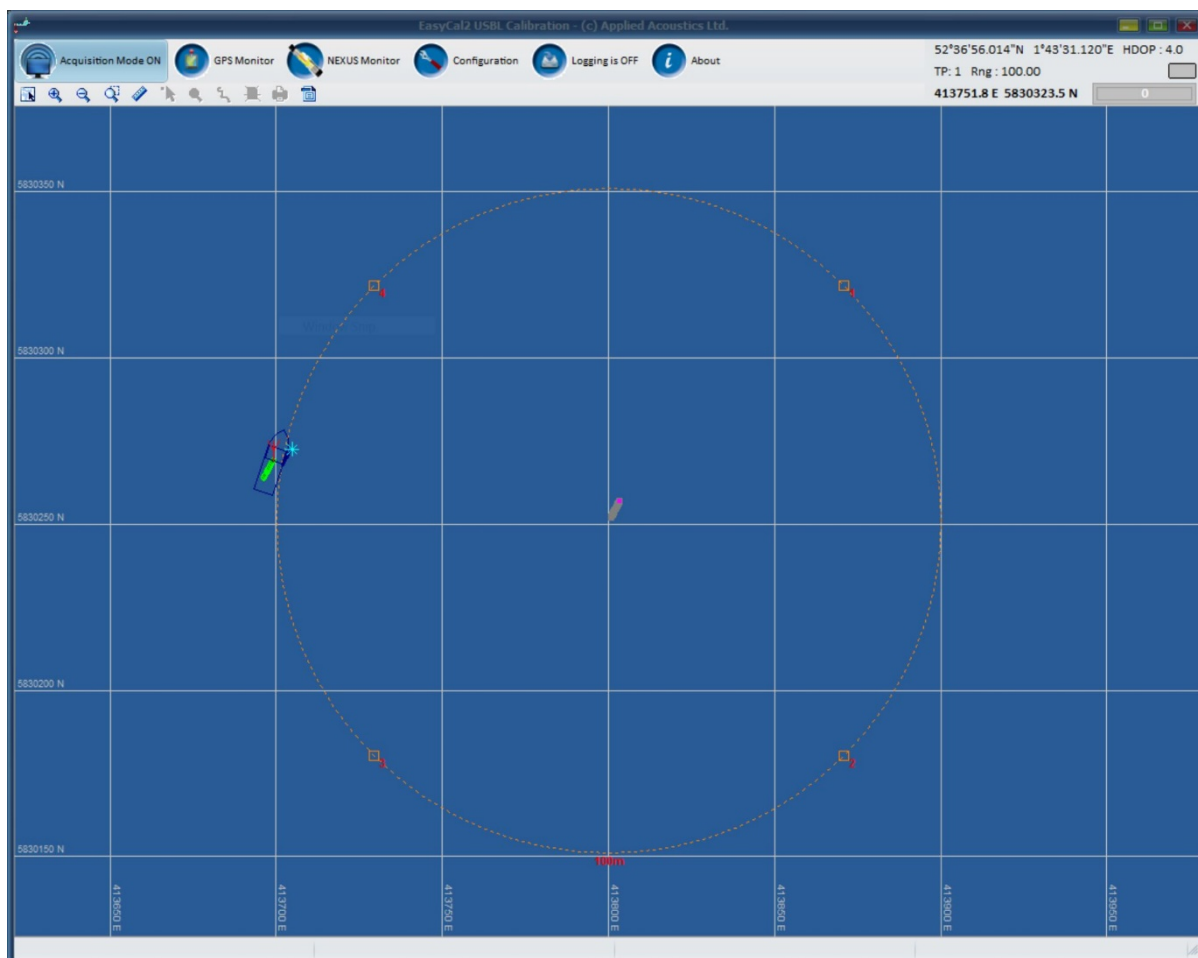
- Offsets from the GPS to the Transceiver head.
- Velocity of sound at the transceiver face.
- The mean velocity of sound should be entered into the beacon configuration.
- Typical cycle rate of 2-4 seconds.

A single beacon is deployed, securely fixed to the seabed at a fixed height (known) from the seabed – typically minimum 1M. The calibration water depth should be close to the operational water depth.

The beacon should be configured and if not a depth telemetry beacon the manual depth can be entered to assist in positional computations.

A **Wizard** is provided for new users, enabled on the “Configuration” form. This guides the user through the process of acquiring data and processing it to provide corrections for entry into the NEXUS. It is recommended that this is read in conjunction with the manual guidelines prior to start of calibration.

Acquisition Mode

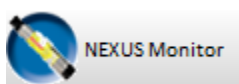


Upon launch Acquisition Mode is enabled by default. To toggle between acquisition mode and processing mode click this button to select.

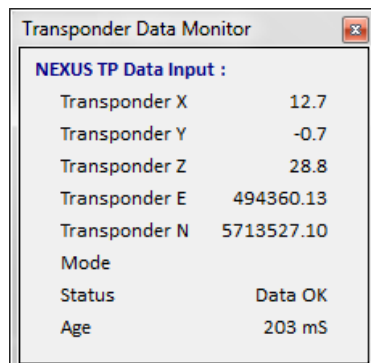


When in acquisition mode the GPS Monitor button is displayed, when active the below pop up window is enabled. This can be placed on the display for QC monitoring.

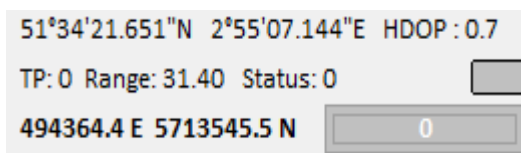
GPS & Attitude Data Monitor	
WGS84 Data Input :	
Latitude	51°34'21.670"N
Longitude	2°55'06.993"E
Height (m)	0.00 m
No. of SVs	11
HDOP	0.7
UTC	08:34:01
UTM Coordinate in Zone : 31 N	
Easting	494359.43
Northing	5713516.01
Attitude Data :	
Gyro	244.1
Pitch	-1.1
Roll	-0.1



When in acquisition mode the Nexus Monitor button is displayed, when active the below pop up window is enabled. This can be placed on the display for QC monitoring



A data summary is displayed in the menu bar



Vessel Position is displayed
Beacon (TP) number, range and status displayed
Activity indicator of connection to Nexus 2
Current cursor position on plot window in UTM.
Status histogram of logged fixes

Plot Window tool bar

Icons Only:



Icons and Text:



Note, processing functions are not available in acquisition mode and are greyed out.

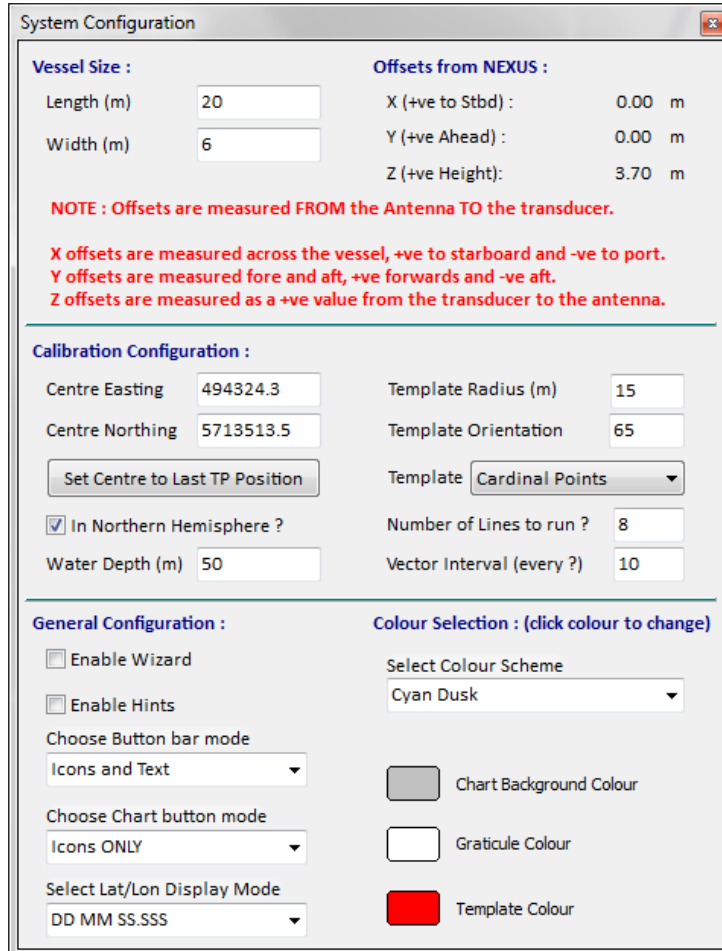
Plot Window Context Menu

Drag Display	Ctrl+D
Zoom In	Ctrl+I
Zoom Out	Ctrl+O
Zoom Window	Ctrl+W
Range & Bearing	Ctrl+B
Centre at TP Solution	Ctrl+T
Zoom Extents	Ctrl+E
Start Lasso Selection	Ctrl+L
Turn All Data ON	Ctrl+N
Dump to Printer	Ctrl+P
Dump to File	Ctrl+F

By right clicking the mouse in the chart area a short cut context menu is available for ease of functionality.



Clicking on the Configuration button launches the system configuration window. The acquisition settings for the calibration can be defined as appropriate for the vessel / application.



System Configuration

Vessel Size :
 Length (m)
 Width (m)

Offsets from NEXUS :
 X (+ve to Stbd) : m
 Y (+ve Ahead) : m
 Z (+ve Height): m

NOTE : Offsets are measured FROM the Antenna TO the transducer.
X offsets are measured across the vessel, +ve to starboard and -ve to port.
Y offsets are measured fore and aft, +ve forwards and -ve aft.
Z offsets are measured as a +ve value from the transducer to the antenna.

Calibration Configuration :
 Centre Easting Template Radius (m)
 Centre Northing Template Orientation
 Template
☒ In Northern Hemisphere ? Number of Lines to run ?
 Water Depth (m) Vector Interval (every ?)

General Configuration :
☐ Enable Wizard
☐ Enable Hints
 Choose Button bar mode

 Choose Chart button mode

 Select Lat/Lon Display Mode

Colour Selection : (click colour to change)
 Select Colour Scheme

Vessel Size: The vessel graphic on the plot window can be scaled to be representative of the vessel. Note this is for display only.

Offsets from Nexus: Check that the offsets are correct, these are configured in the Nexus application. When processing the user can enter different values on the Processing form to verify solutions.

Calibration Configuration:

The Centre Easting and Northing allows you to enter a proposed or drop location for the transponder (or click the button to centre to last TP position), the chart will automatically centre at the location once this is entered.

The in Northern Hemisphere check box is to apply correct convergence calculation, click if in the northern hemisphere else leave un ticked when in southern.

The water depth parameter can be user configured, it is calculated when a new dataset is opened, it is then updated when a computation is made and is used for rejection when turned on.

Calibration templates:

1. **Cardinal Points** – this is the preferred method as it exercises all facets of the NEXUS transducer and provides a balanced solution, it also provides better separation of the X and Y elements of the data allowing a more precise Pitch and Roll calculation to be made. This method does rely on station keeping by the vessel which can be achieved with DP vessels but may not be practicable for smaller vessels or those without DP (Dynamic Positioning).
2. **Figure of 8** – this method can be used in situations where it is difficult to maintain station, the vessel can sail a figure of eight pattern around the transponder to once again exercise all elements of transducer.
3. **Triangle** – Some companies prefer the triangle method although this tends not to provide definitive data due to a continual variation of X and Y readings.
4. **Parallel Lines** – This is another commonly used method, when this is selected the user can enter the number of lines to run, the line spacing is then made such that they are equally spaced and cover the Template Radius specified and of the orientation specified. It is recommended that an even number of lines is selected to avoid passing directly over the transponder. Passing directly over the transponder causes azimuth ambiguities as a small change of position causes a large change of azimuth. A filter is provided should this be the case to reject ranges $< 0.01 \times$ water depth, this equates to 14m radius in 100m of water.
5. **Star of Lines** – This mode generates a star of lines centred on the target location, the lines are equally spaced and length is determined by the radius value.

General Settings:

Colour schemes can be changed to suit user's preferences, the buttons on the tool bars can include text or be just text.

Hints can be enabled to provide info / help when the mouse is hovering over a button.

A **Wizard** is provided for new users, enabled on the "Configuration" form. This guides the user through the process of acquiring data and processing it to provide corrections for entry into the NEXUS. It is recommended that this is read in conjunction with the manual guidelines prior to start of calibration.

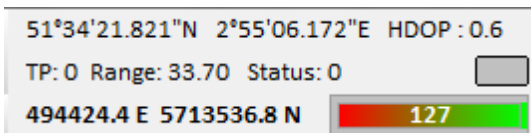


WARNING: Ensure correct velocities are entered in Easytrak Nexus prior to acquisition.

Logging Data



The Logging ON / OFF button is provided to turn the data logging ON/OFF to begin calibration logging.



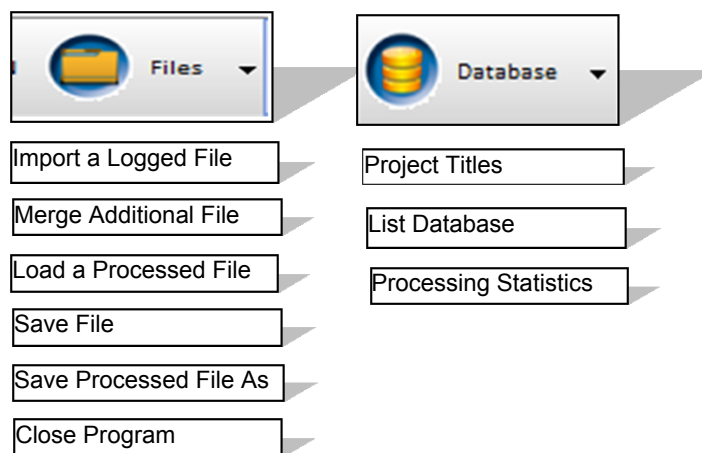
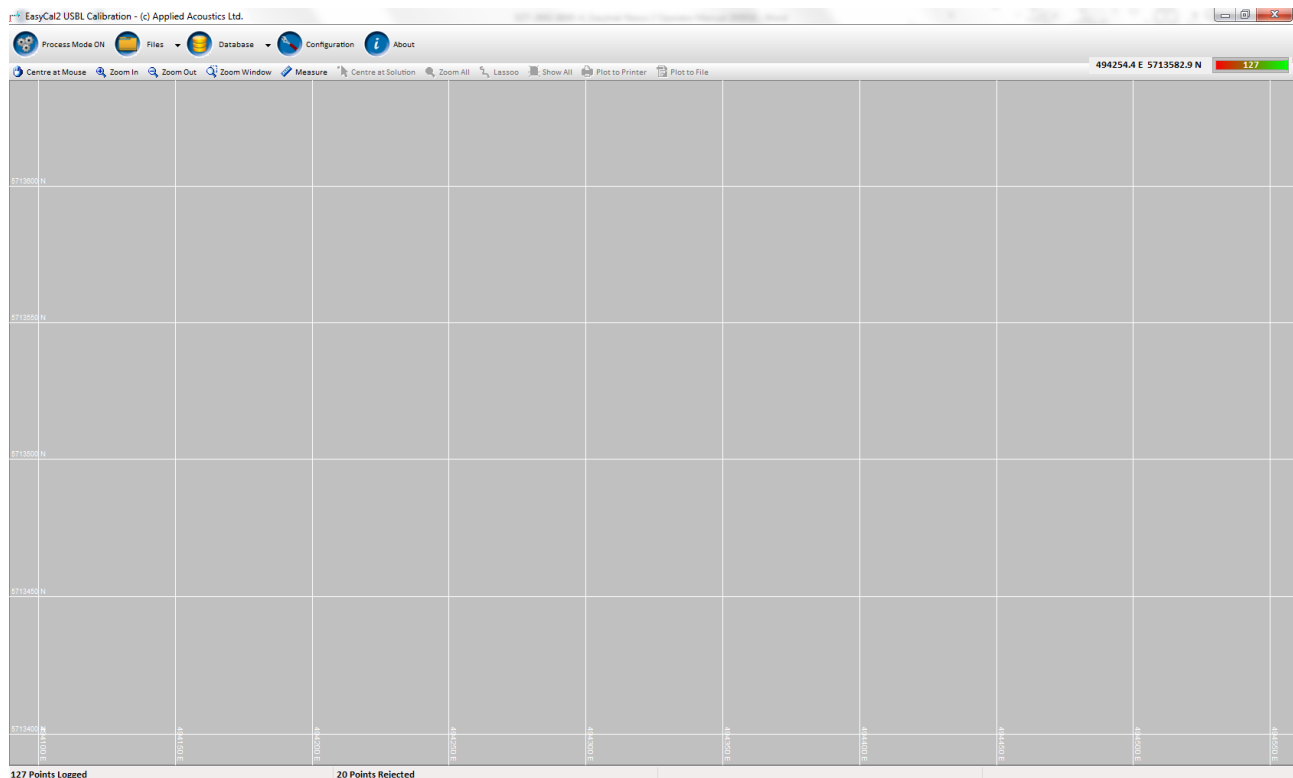
As data is logged a histogram is updated as an indicator of a minimum number of fixes required for processing.

The data is logged to files whose names reflect the TP used and the date it was logged, e.g. "TP 1 (19990728 @ 102234).LOG". A header section is now included at the start of the file to automatically recall the Title information, Convergence, Gyro C-O and offset values in use when the calibration was performed. The header data in the data file is prefixed with "****" on each line

f different calibrations of the same transponder are done on the same day each time logging is turned on a new file will be created, these files can either be merged together using the "MERGE" option in the processing menu.

Fix files are saved as Comma Separated Value (.CSV), files which can easily be edited or viewed using either a text editor or EXCEL.

Processing Mode



Files:

Import a Logged File

This menu item imports an initial logged dataset, all current data is deleted, after the initial import you can merge in other datasets to create a complete data set for processing. This may be from several different logging sessions as typically logging is switched off between cardinal points.

Once imported the program computes the mean of the eastings, northings and depths imported and sets the current TP Easting/Northing/Depth on the main screen to these values, these provide a trial point for the start of the computation and re-centres the screen at the coordinate. Any data that falls on the chart area will now be plotted.

Merge Additional File

Merge works in the same way as Import but rather than replace the data in memory it adds to the data already imported. This command is used to compile files recorded separately together, for example when acquiring data at the 4 cardinal points and fixing is turned off during the transit between locations.

Load a Processed File

This menu item allows you to load a file that has been processed previously. This will load all the parameters that were used when the file was processed, and results that were achieved including turning off/on the relevant observations.

When selected the standard Windows file dialog will be shown using a filter of "*.PRO", locate the required file and click OK the file will then be loaded.



This should be used only for processed files, use Import for un-processed data files.

Save File

This item allows you to save a dataset (whether processed or not), to a file on disc. If the data has previously been saved then selecting this item provides no prompts but simply updates the previously saved file with any revised data. If the file has not been previously saved (this is reset each time a set of data is imported), then you will first be prompted for a file name.

Selecting "OK" will save the file, if any errors occur during the save you will be notified.

Save As

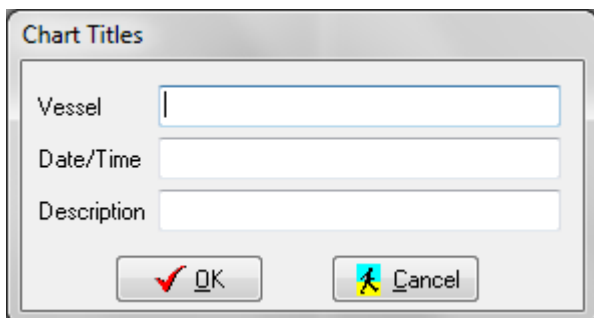
This item allows you to save the current dataset using a different name from the current file name. You may wish to do this if processing different sections of the dataset and comparing results.

A file dialog box is provided and a warning will be issued if the save is unsuccessful.

Database

Titles

This menu item allows you to enter three titles to be used in printouts, Vessel will be printed at the left, Date/Time will be printed at the right and the Description printed centrally on the page. To change the titles simply type in the relevant details, these will be saved with a processed file and the current settings are saved when the program exits.



List Database

Selecting this item provides a listing of the dataset. The height and width of the displayed form can be dragged to suit your screen requirements, once resized the settings will be saved so that when the form is opened next the size and position will be the same (this can still be changed to suit).

Database Listing

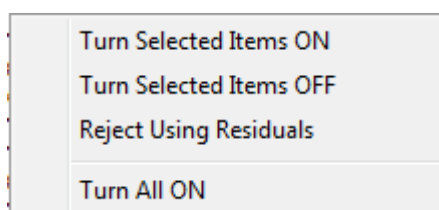
		Observed Data									Calculated						
Used	Rec	Ant East	Ant North	Gyro	Slant	Dep@	Azim	X	Y	Z	Comp Rng	Slant Res	TP East	TP North	DataSet		
<input checked="" type="checkbox"/>	1	494343.79	5713521.47	243.9	31.80	65.51	178.83	0.27	-13.18	28.94	31.80	2.85	0.00	0.00	1		
<input checked="" type="checkbox"/>	2	494343.79	5713521.29	243.7	33.50	56.51	174.54	1.76	-18.40	27.94	33.50	2.30	494360.57	5713530.41	1		
<input checked="" type="checkbox"/>	3	494343.90	5713521.10	243.7	31.80	62.95	180.63	-0.16	-14.46	28.32	31.80	2.14	494357.77	5713526.99	1		
<input checked="" type="checkbox"/>	4	494343.90	5713520.92	243.5	32.71	67.52	178.35	0.36	-12.50	30.22	32.71	3.67	0.00	0.00	1		
<input checked="" type="checkbox"/>	5	494343.79	5713520.92	243.5	32.00	61.98	172.05	2.08	-14.89	28.25	32.00	1.84	494357.14	5713529.06	1		
<input checked="" type="checkbox"/>	6	494343.67	5713520.73	243.5	32.10	59.65	176.08	1.11	-16.18	27.70	32.10	0.53	494358.67	5713528.32	1		
<input checked="" type="checkbox"/>	7	494343.55	5713520.55	243.5	32.20	57.81	172.60	2.21	-17.01	27.25	32.20	0.67	494358.93	5713529.44	1		
<input checked="" type="checkbox"/>	8	494343.32	5713520.36	243.5	32.20	57.81	172.60	2.21	-17.01	27.25	32.20	0.59	494358.66	5713529.27	1		
<input checked="" type="checkbox"/>	9	494343.21	5713520.55	243.3	32.31	51.95	164.62	5.28	-19.20	25.44	32.31	4.56	0.00	0.00	1		
<input checked="" type="checkbox"/>	10	494343.21	5713520.55	243.3	32.80	61.00	187.70	-2.13	-15.76	28.69	32.80	3.52	0.00	0.00	1		
<input checked="" type="checkbox"/>	11	494343.21	5713520.55	243.4	32.20	60.04	188.08	-2.26	-15.92	27.90	32.20	3.68	0.00	0.00	1		
<input checked="" type="checkbox"/>	12	494343.32	5713520.73	243.3	36.20	53.47	166.58	5.00	-20.96	29.09	36.20	5.69	0.00	0.00	1		
<input checked="" type="checkbox"/>	13	494343.44	5713521.10	242.9	33.00	62.37	198.08	-4.75	-14.55	29.24	33.00	5.84	0.00	0.00	1		
<input checked="" type="checkbox"/>	14	494343.67	5713521.29	242.6	31.90	66.18	186.37	-1.43	-12.80	29.18	31.90	3.97	0.00	0.00	1		
<input checked="" type="checkbox"/>	15	494343.90	5713521.66	242.5	31.70	61.17	178.88	0.30	-15.28	27.77	31.70	0.77	494358.25	5713528.47	1		
<input checked="" type="checkbox"/>	16	494344.02	5713521.84	242.3	31.70	65.73	174.50	1.25	-12.97	28.90	31.70	2.96	0.00	0.00	1		
<input checked="" type="checkbox"/>	17	494344.02	5713522.03	242.2	31.70	61.32	181.09	-0.29	-15.21	27.81	31.70	0.71	494358.34	5713528.42	1		
<input checked="" type="checkbox"/>	18	494344.02	5713522.03	242.3	31.60	62.90	168.05	2.98	-14.08	28.13	31.60	3.62	494356.09	5713530.97	1		
<input checked="" type="checkbox"/>	19	494343.90	5713521.84	242.5	32.61	62.30	178.64	0.36	-15.15	28.87	32.61	0.80	494358.17	5713528.64	1		
<input checked="" type="checkbox"/>	20	494343.79	5713521.84	242.8	33.00	67.82	173.96	1.31	-12.39	30.56	33.00	3.56	0.00	0.00	1		
<input checked="" type="checkbox"/>	21	494343.67	5713521.66	242.9	31.80	53.91	180.80	-0.26	-18.73	25.70	31.80	2.43	494361.37	5713529.12	1		
<input checked="" type="checkbox"/>	22	494343.56	5713521.47	243.3	32.70	63.53	174.13	1.49	-14.50	29.27	32.70	2.23	494356.74	5713528.92	1		
<input checked="" type="checkbox"/>	23	494343.44	5713521.47	243.7	33.40	52.28	174.02	2.13	-20.32	26.42	33.40	3.96	494361.69	5713531.63	1		
<input checked="" type="checkbox"/>	24	494343.55	5713521.10	244.1	36.00	44.56	166.77	5.87	-24.97	25.26	36.00	9.57	0.00	0.00	1		
<input checked="" type="checkbox"/>	25	494343.55	5713521.10	244.4	32.10	64.86	186.06	-1.44	-13.56	29.06	32.10	4.02	0.00	0.00	1		
<input checked="" type="checkbox"/>	26	494343.55	5713521.10	244.6	32.00	50.86	189.52	-3.34	-19.92	24.82	32.00	5.71	0.00	0.00	1		
<input checked="" type="checkbox"/>	27	494343.67	5713521.10	244.6	32.70	61.56	175.84	1.13	-15.53	28.75	32.70	0.83	494358.28	5713528.30	1		
<input checked="" type="checkbox"/>	28	494343.79	5713521.29	244.3	31.70	64.34	178.16	0.44	-13.72	28.57	31.70	2.51	494357.00	5713527.20	1		
<input checked="" type="checkbox"/>	29	494343.79	5713521.47	243.9	31.70	60.64	185.46	-1.48	-15.47	27.63	31.70	2.44	494359.13	5713526.34	1		
<input checked="" type="checkbox"/>	30	494343.79	5713521.66	243.7	31.80	55.76	177.63	0.74	-17.88	26.29	31.80	1.56	494360.30	5713529.57	1		
<input checked="" type="checkbox"/>	31	494343.90	5713521.66	243.5	31.80	59.86	156.49	6.37	-14.64	27.50	31.80	6.02	0.00	0.00	1		
<input checked="" type="checkbox"/>	32	494343.90	5713521.84	243.2	31.60	68.15	182.34	-0.48	-11.75	29.33	31.60	4.00	0.00	0.00	1		
<input checked="" type="checkbox"/>	33	494344.02	5713521.84	242.9	31.60	68.13	169.92	2.06	-11.59	29.33	31.60	4.32	0.00	0.00	1		
<input checked="" type="checkbox"/>	34	494344.02	5713522.03	242.7	31.50	64.12	179.71	0.07	-13.75	28.34	31.50	2.03	494357.05	5713528.07	1		
<input checked="" type="checkbox"/>	35	494344.02	5713522.21	242.4	34.70	64.86	181.17	-0.30	-14.74	31.41	34.70	0.92	494358.10	5713528.42	1		

The list (shown above), contains all the data from the import/computation, the last 3 columns are only completed once a computation has been performed on the dataset. If data is to be used in the computation then ensure the check box at the left edge is checked. Un-check these boxes to manually reject data items, when rejected the transponder coordinates will be set to 0.

Multiple selections of data can be effected using the standard Windows selection techniques :

1. Select the first item, hold shift and select the last item, all items between will be highlighted.
2. Hold CTRL and successively select individual items.
3. Click the left mouse on the first item, then drag the mouse down to the last item.

Once selected, click the **RIGHT** mouse button to access the pop-up menu, this enables you to turn all the selected items either ON or OFF, turn ALL data on or disable data items with residuals greater than a user entered value. The pop-up is shown here :

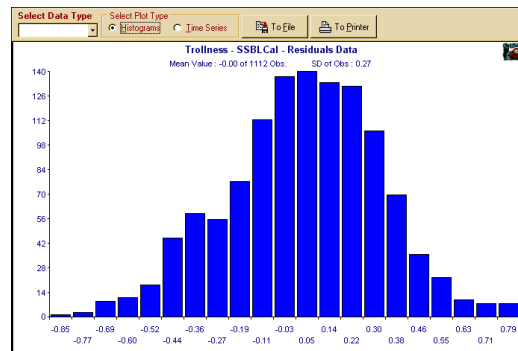
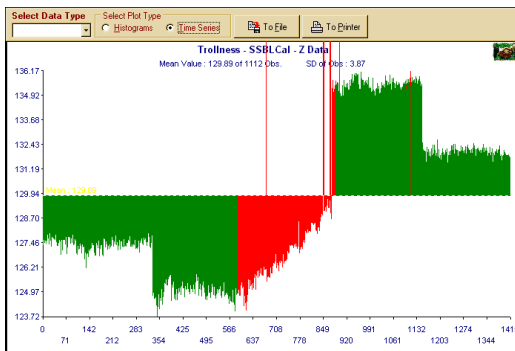


Processing Statistics

This form provides statistical information on the acquired data the two types of graph Histogram and Time Series are displayed below. Select the data type you wish to view from the pulldown list at the top left then select either "Histograms" or "Time Series" using the radio-buttons provided. Any graph can be printed to the current printer or dumped to a .BMP file for inclusion in reports.



Data shown green is valid, data shown in red is rejected data



Plot Window tool bar

Icons Only:



Icons and Text:



Note, processing functions are not available in acquisition mode and are greyed out.

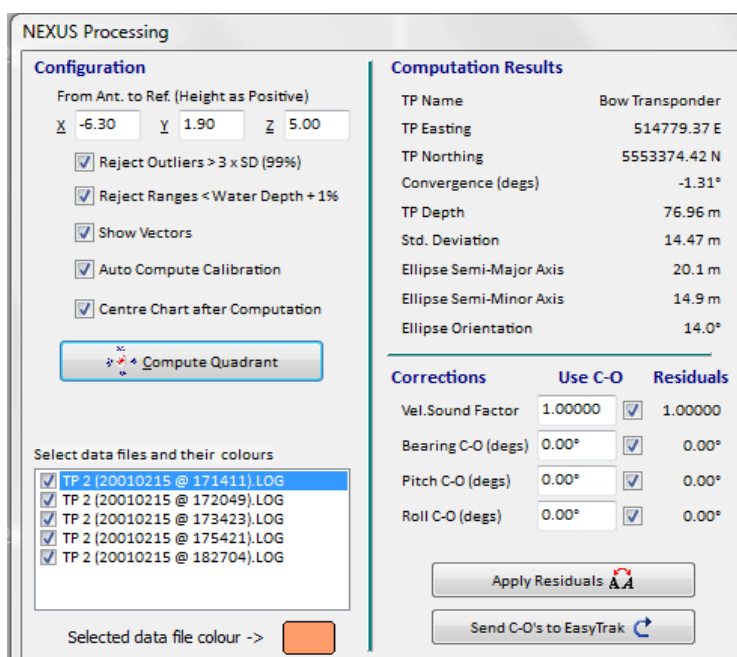
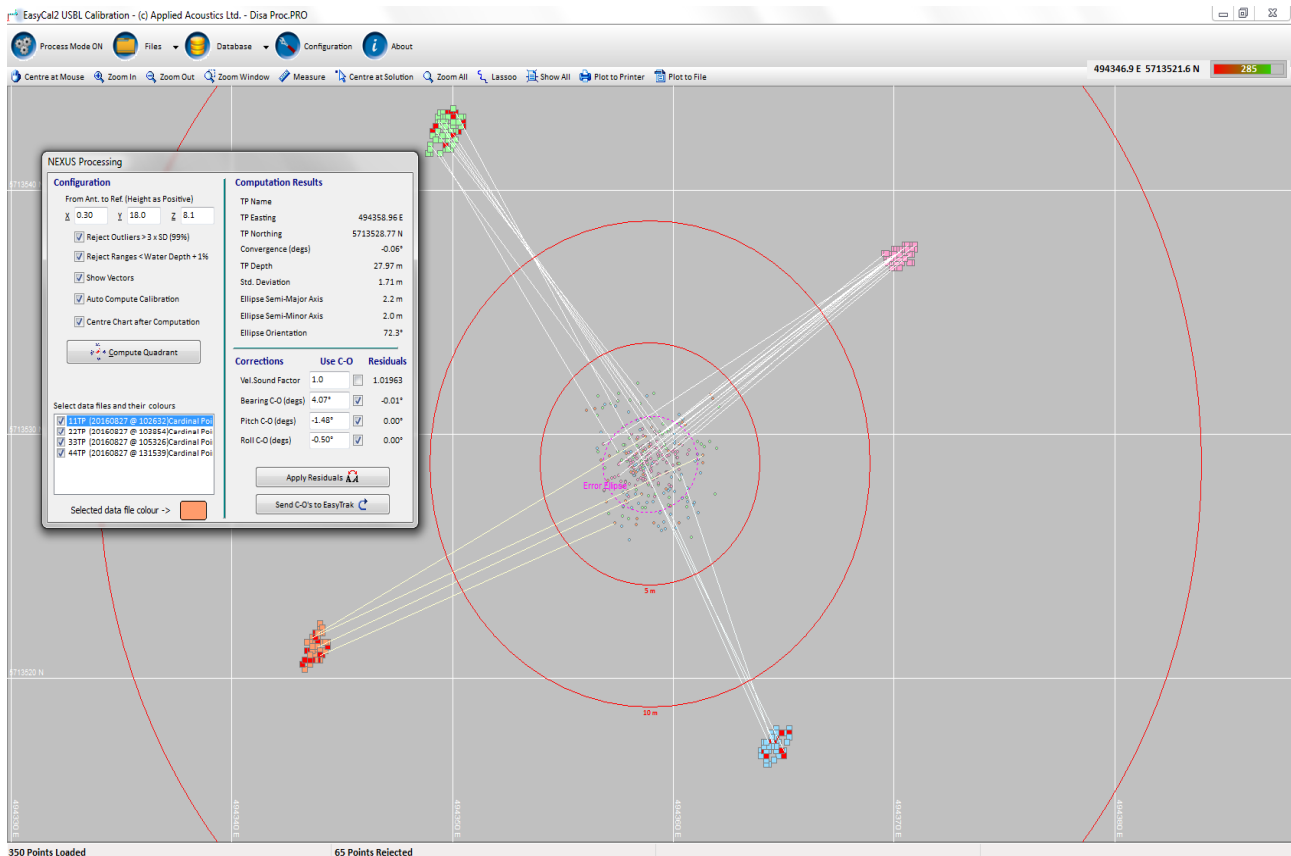
Plot Window Context Menu

Drag Display	Ctrl+D
Zoom In	Ctrl+I
Zoom Out	Ctrl+O
Zoom Window	Ctrl+W
Range & Bearing	Ctrl+B
Centre at TP Solution	Ctrl+T
Zoom Extents	Ctrl+E
Start Lasso Selection	Ctrl+L
Turn All Data ON	Ctrl+N
Dump to Printer	Ctrl+P
Dump to File	Ctrl+F

By right clicking the mouse in the chart area a short cut context menu is available for ease of functionality.

Processing

This provides the main body of the program and incorporates all the relevant details for a particular calibration. A typical screen is shown here following the import and merging of the log files from 4 cardinal points:



As logged data files are imported / merged to the current processing solution the Nexus Processing window is displayed.

Initially the un-processed data is also plotted to the chart window.

Each data file is colour coded and can be enabled / disabled.

Each log file contains the offset data which is displayed.

The vectors can be enabled or disabled

The chart centre can be auto set to solution centre.

Configuration.

The initial offset values are those read from Nexus or as logged in a processed file. These can be updated during processing if in error.

As each dataset is loaded it is displayed at the bottom left of the form and a checkbox next to each datasets allows the user to easily enable/disable a complete dataset. The colours for the datasets can be defined by selecting the dataset then clicking the coloured rectangle below to select.

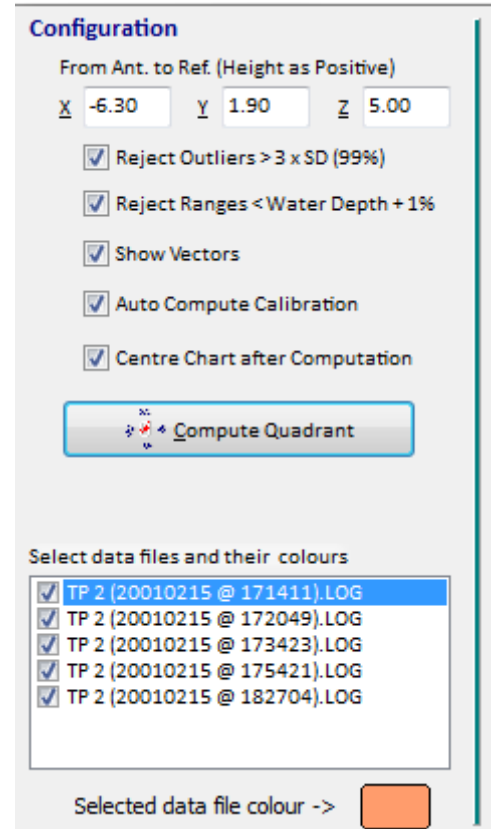
The Auto Compute option performs several iterations of the computation, applying computed C-Os and rejecting each time based on the previous iteration until the residuals are minimal. The user selects which C-Os to apply in this mode by enabling Velocity / Bearing / Pitch / Roll C-Os (1 or more).

In Auto mode the residuals are applied each time in the process until the residuals are minimal whereas in Manual (Auto unticked) mode the 'Apply Residuals' button needs to be pressed to apply the C-Os, in this way it provides flexibility when processing as more/less corrections can be computed or applied.

Compute Quadrant, performs a least squares iteration to calculate the position of the transponder and calculate any C-Os.

Processing Options for spurious data

- Reject Outliers; when a computation is made the standard deviation is computed and if this box is ticked all ranges that have residuals > 3x SD will be rejected.
- Reject Ranges; this will use the water depth to reject all range data that is < 1% greater than the depth, this rejects data that is directly under the vessel as this is an ambiguous area for determining heading information.



Configuration

From Ant. to Ref. (Height as Positive)

X: -6.30 Y: 1.90 Z: 5.00


☒ Reject Outliers > 3 x SD (99%)

☒ Reject Ranges < Water Depth + 1%

☒ Show Vectors

☒ Auto Compute Calibration

☒ Centre Chart after Computation

 **Compute Quadrant**

Select data files and their colours


☒ TP 2 (20010215 @ 171411).LOG

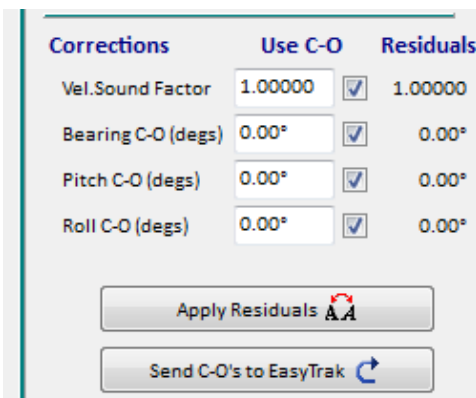
☒ TP 2 (20010215 @ 172049).LOG

☒ TP 2 (20010215 @ 173423).LOG


☒ TP 2 (20010215 @ 175421).LOG


☒ TP 2 (20010215 @ 182704).LOG

Selected data file colour -> 



Corrections	Use C-O	Residuals
Vel. Sound Factor	1.00000 <input checked="" type="checkbox"/>	1.00000
Bearing C-O (degs)	0.00° <input checked="" type="checkbox"/>	0.00°
Pitch C-O (degs)	0.00° <input checked="" type="checkbox"/>	0.00°
Roll C-O (degs)	0.00° <input checked="" type="checkbox"/>	0.00°

Apply Residuals 

Send C-O's to EasyTrak 

Corrections:

Enable / Disable each of the computed corrections to achieve the best results from the data supplied.

Each correction can be applied individually or collectively.

Apply Residuals, this is to manually apply the selected residuals to the C-O prior to Computing Quadrant.

The button at the bottom provides the facility to send the correction values directly to Easytrak and thus update it with the calibrated values.

With C-Os un-checked the residual will display the total correction to be applied, this value can then be entered into the edit boxes, the relevant check boxes selected and a further computation carried out in manual mode.

When in manual mode (auto unticked) items that are checked, the residual will show the additional correction to apply to that shown in the data window. By selecting these one at a time as each item will affect the computation results and thereby change the residual slightly. Correction values can readily be entered and checked in this way to ensure the correct sign is being applied and the result of applying the corrections is correct.

Computation Results:

Summarises the computed solution with the positional error (Std. Deviation) for the transponder with the currently applied corrections.

Computation Results	
TP Name	Bow Transponder
TP Easting	514779.37 E
TP Northing	5553374.42 N
Convergence (deg)	-1.31°
TP Depth	76.96 m
Std. Deviation	14.47 m
Ellipse Semi-Major Axis	20.1 m
Ellipse Semi-Minor Axis	14.9 m
Ellipse Orientation	14.0°

The number of observations and rejected data is summarised on the status bar at the bottom of the main chart view.

11866 Points Loaded **17 Points Rejected**

The progress bar at the top right of the main screen also indicates the number of acceptable ranges.

514744.2 E 5553434.3 N **1866**

EasyCal uses a least squares iteration to compute the transponder position and the relevant C-O values. Initially all the selected data are corrected using the C-O values which have been selected, these values are corrected as the least squares solution is built up. The solution attempts to find the least squares solution using a variation of coordinates method and iterates up to 15 times in finding the solution. If no solution is found in the 15 iterations then an error message will be displayed. A solution may not be found due to one of the following reasons :

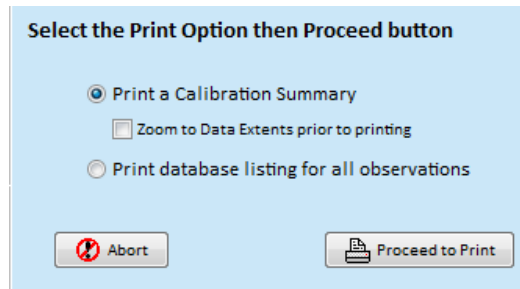
1. Too few observations.
2. A one sided set of observations.
3. Selected data items which are very distant from the real coordinate.
4. Very noisy acoustic environment.

Reporting:

Upon processing a logged file or opening a processed file, the plot to file and plot to printer buttons are active –



To generate a Calibration report click on Plot to Printer, the following window is displayed



1) Summary report on a single page which summarises the input data, the computation and errors and provides two plots, one of the main chart view and the other showing a histogram of the residuals.

2) This is a multi-page listing of all the range data which includes residuals and rejection status, typically used to fault find.

Plot to file takes a screen shot of the plot window and saves it to the \Data directory.

Summary Report:

EasyCal2 - Dataset Summary

Bow Transponder (TP 2)



15/02/2001 at 17:20:49

Parameters & Results Bow Transponder Std Deviation of Slant Range Residuals : 4.08 m

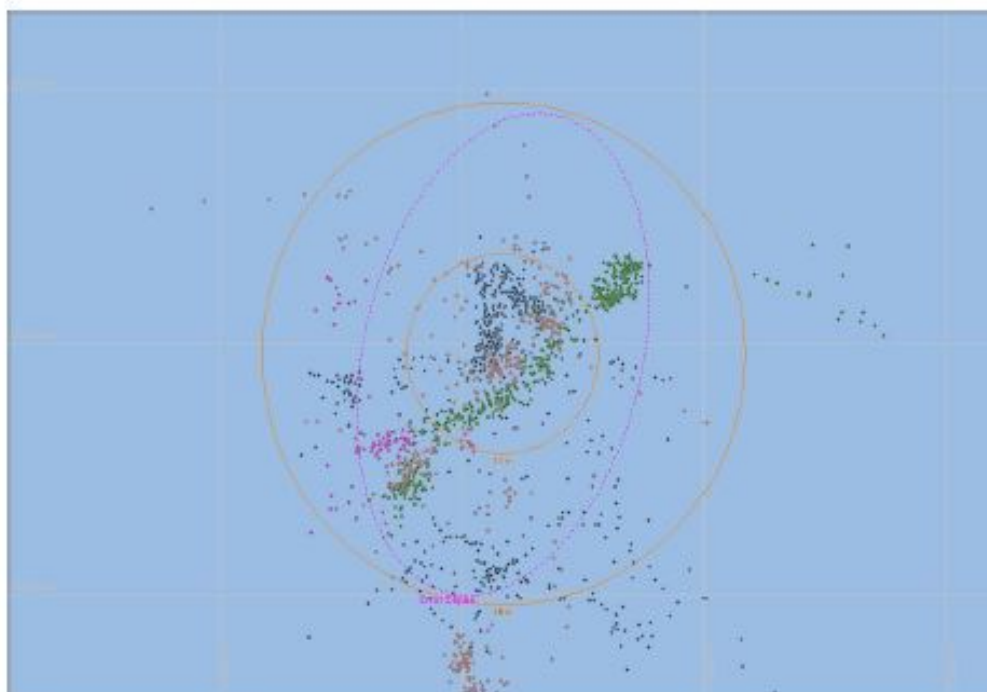
Offsets	Solution	Error Ellipse	C-O Values
Ant to TD, XOffset : -6.30	514829.39 E	Semi Minor : 14.4 m	Velocity Factor : 1.12789
Ant to TD, YOffset : 1.9	5553398.85 N	Semi Major : 24.4 m	Bearing C-O : -10.57°
Ant height above TD : 5.0	Calc Depth : 84.30 m	Orientation : 13.7°	Pitch C-O : 0.0
			Roll C-O : 0.0

Coordinates are computed using WGS84 and UTM Projection (North). Convergence computed as : 0.16°

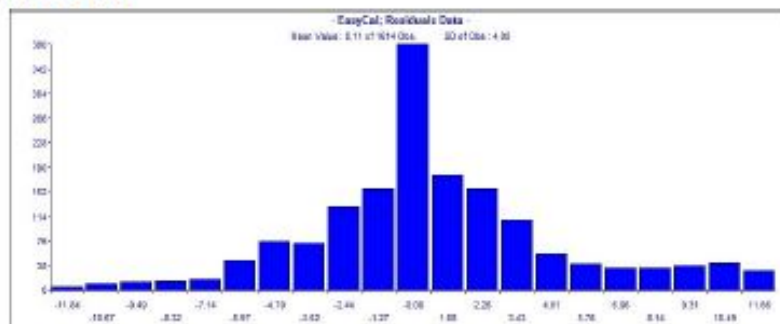
Scatterplot of Solution

1785 Points Loaded

171 Points Rejected



Histogram of Residuals



Complete Listing of Dataset:

EasyCal2 - Dataset Listing

Bow Transponder (TP 2)

 **APPLIED ACOUSTICS**
Underwater Technology
15/02/2001 at 17:20:49

Parameters & Results Bow Transponder

Std Deviation of Slant Range Residuals

Offsets		Solution		Error Ellipse		C-O Values	
Ant to TD, XOffset :	-6.30	514829.39 E		Semi Minor :	14.4 m	Velocity Factor :	1.12789
Ant to TD, YOffset :	1.9	5553398.85 N		Semi Major :	24.4 m	Bearing C-O :	-10.57°
Ant height above TD :	5.0	Calc Depth :	84.30 m	Orientation :	13.7°	Pitch C-O :	0.0
						Roll C-O :	0.0

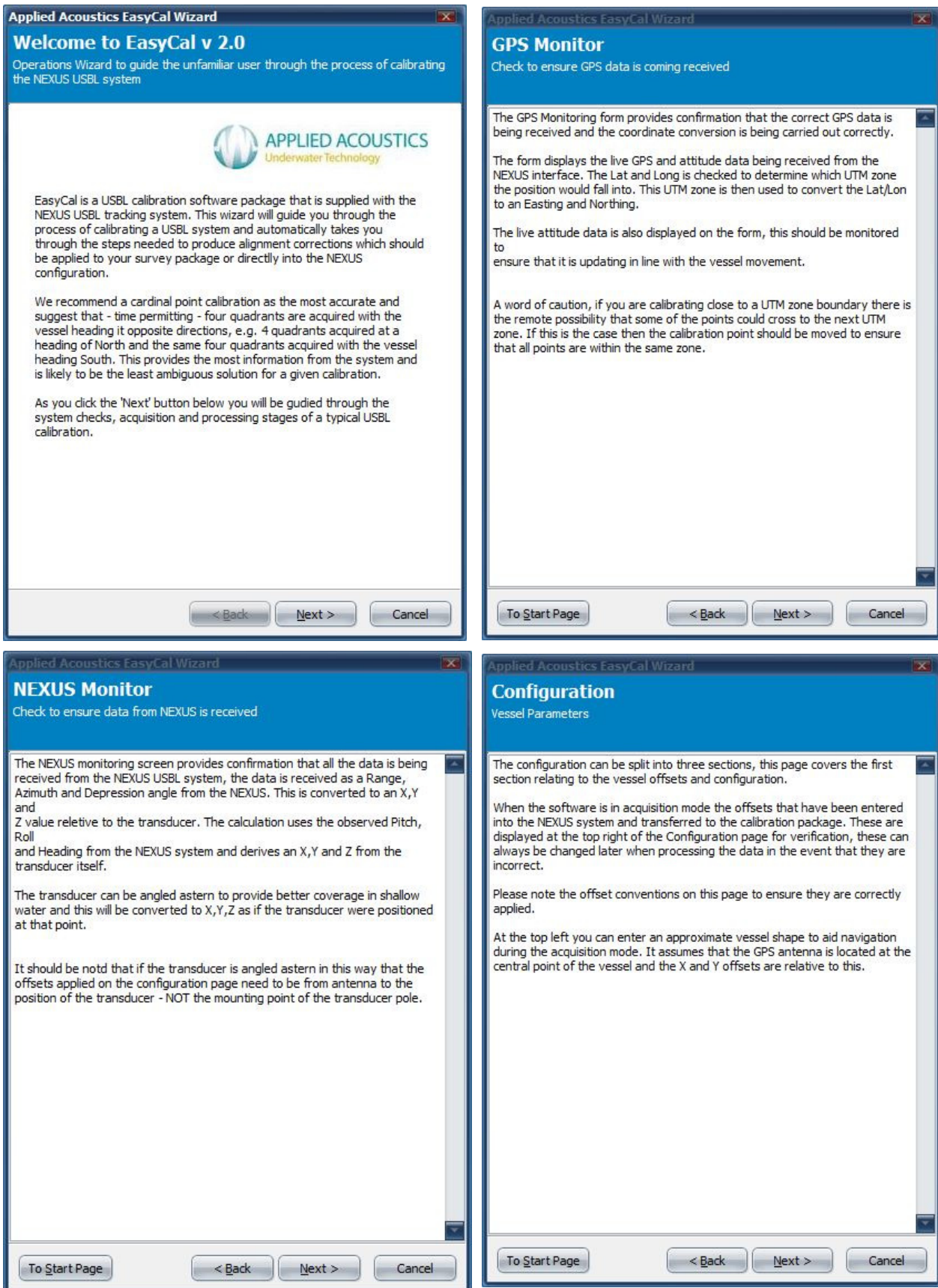
Coordinates are computed using WGS84 and UTM Projection (North), Convergence computed as : 0.16°

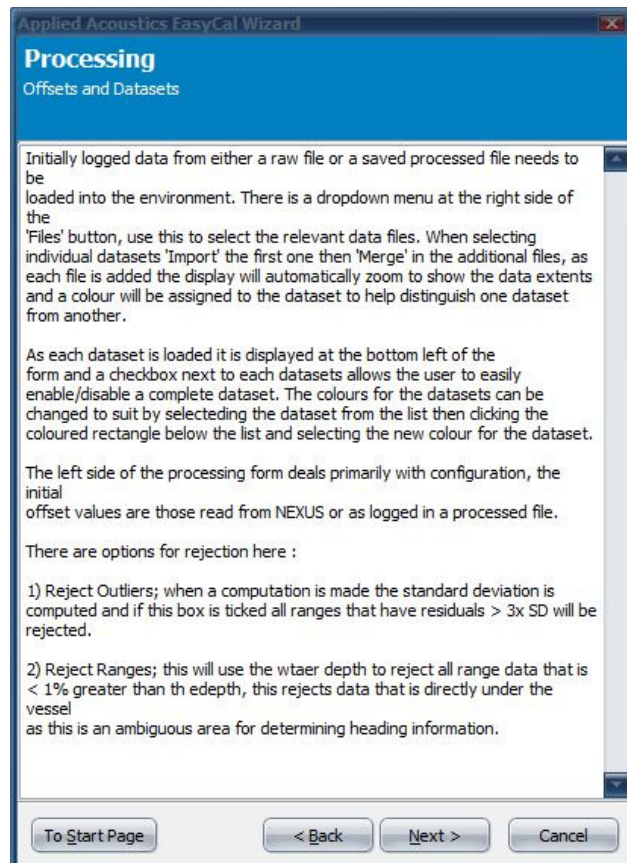
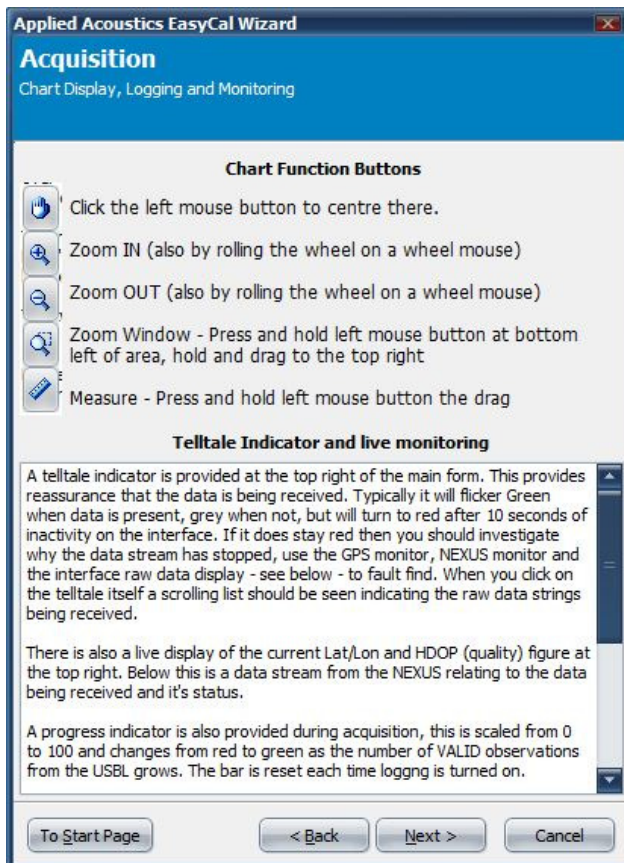
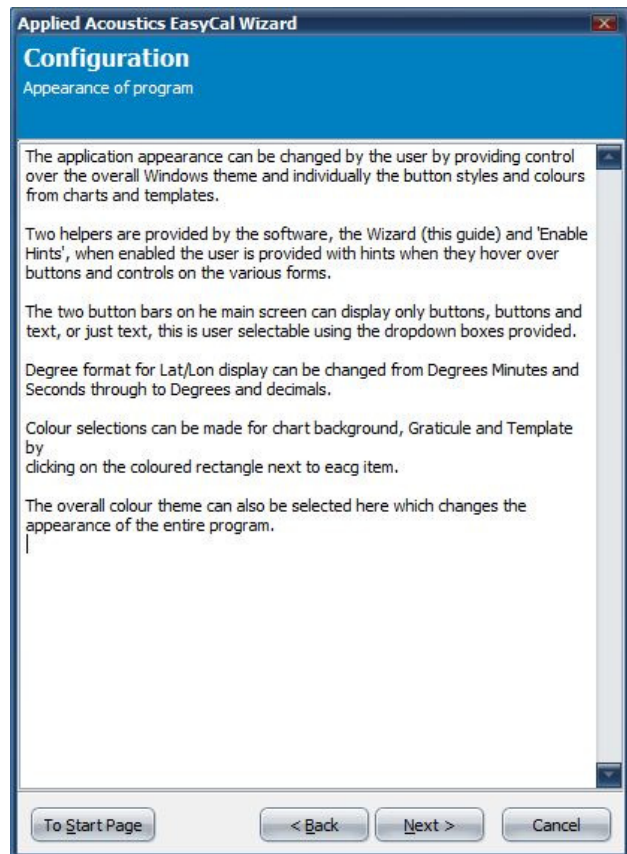
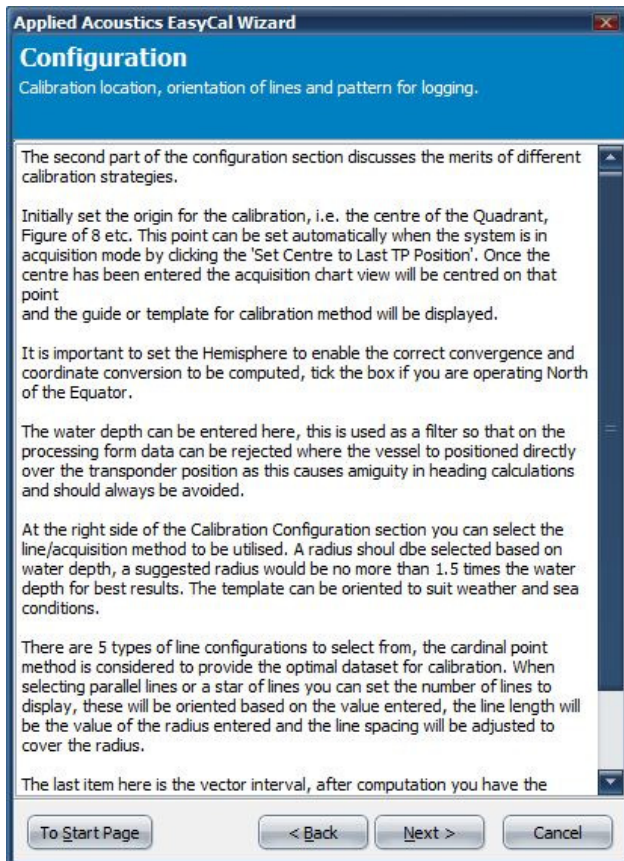
ID	Ant East	Ant North	Gyro	Pitch	Roll	Slant	Depr@	Azim	X	Y	Z	Used ?	TP East	TP North	Res
1	514823.10	5553243.38	7.2	1.97	-0.45	-163.01	-1.00	-1.00	22.80	145.00	70.90	Y	514845.95	5553404.76	-4.79
2	514823.27	5553243.30	7.2	1.57	-0.46	-163.20	-1.00	-1.00	22.60	145.20	71.00	Y	514846.01	5553404.84	-4.90
3	514822.85	5553243.27	7.4	3.69	-0.52	-163.42	-1.00	-1.00	20.90	145.60	71.20	Y	514844.20	5553405.35	-5.25
4	514821.83	5553243.28	7.5	5.79	-0.50	-163.46	-1.00	-1.00	20.20	145.20	72.30	Y	514843.11	5553405.14	-5.41
5	514821.91	5553243.13	7.7	4.88	-1.20	-163.53	-1.00	-1.00	20.80	145.00	72.70	Y	514844.34	5553404.71	-5.31
6	514822.79	5553242.86	7.6	2.92	-1.16	-163.55	-1.00	-1.00	22.30	143.30	75.60	Y	514847.15	5553402.81	-4.98
7	514823.53	5553242.77	7.9	1.68	-0.57	-163.86	-1.00	-1.00	23.80	144.30	73.90	Y	514849.86	5553403.40	-5.20
8	514823.10	5553242.75	7.8	3.32	-0.05	-164.16	-1.00	-1.00	22.20	145.10	73.50	Y	514847.52	5553404.32	-5.60
9	514822.64	5553242.65	8.0	4.21	-0.38	-164.26	-1.00	-1.00	22.30	145.20	73.50	Y	514847.73	5553404.32	-5.67
10	514822.64	5553242.54	8.0	4.31	-0.76	-164.35	-1.00	-1.00	20.70	144.30	75.90	Y	514846.52	5553403.49	-5.68
11	514822.75	5553242.36	8.2	4.36	-1.43	-164.49	-1.00	-1.00	20.30	144.20	76.50	Y	514846.74	5553403.21	-5.69
12	514822.79	5553242.25	8.2	4.17	-1.35	-164.52	-1.00	-1.00	18.60	145.60	74.30	Y	514844.62	5553404.33	-5.60
13	514823.15	5553242.19	8.6	2.84	-0.62	-164.64	-1.00	-1.00	17.70	145.90	74.20	Y	514845.15	5553404.30	-5.63
14	514823.41	5553242.17	8.5	2.87	-0.03	-164.51	-1.00	-1.00	18.90	150.50	63.70	Y	514844.57	5553408.15	-5.49
15	514823.22	5553241.97	8.6	3.20	-0.21	-164.83	-1.00	-1.00	18.50	152.40	60.00	Y	514843.80	5553409.57	-5.67
16	514823.08	5553241.69	8.9	4.42	-0.73	-165.48	-1.00	-1.00	17.80	155.40	54.00	N	514842.68	5553411.89	-6.06
17	514823.46	5553241.54	9.1	3.34	-0.52	-165.95	-1.00	-1.00	14.20	157.50	50.30	N	514839.38	5553413.47	-6.38
18	514823.62	5553241.38	9.3	3.56	-0.68	-167.02	-1.00	-1.00	12.70	160.40	44.80	N	514837.83	5553415.81	-7.42
19	514823.23	5553241.23	9.4	4.51	-0.80	-168.20	-1.00	-1.00	11.40	163.00	39.90	N	514836.49	5553421.60	-10.52
20	514823.89	5553241.04	9.5	3.04	-0.67	-169.77	-1.00	-1.00	9.80	166.00	34.20	N	514833.64	5553429.70	-17.70
21	514823.71	5553241.04	9.9	3.77	-0.36	-171.44	-1.00	-1.00	8.50	168.70	29.30	N	514825.83	5553424.61	-12.08
22	514824.12	5553240.86	9.9	3.67	-1.19	-174.62	-1.00	-1.00	6.30	173.20	21.30	N	514824.10	5553429.25	-15.56
23	514824.11	5553240.88	10.3	3.98	-0.30	-178.16	-1.00	-1.00	4.10	177.60	13.50	N	514822.98	5553434.03	-19.45

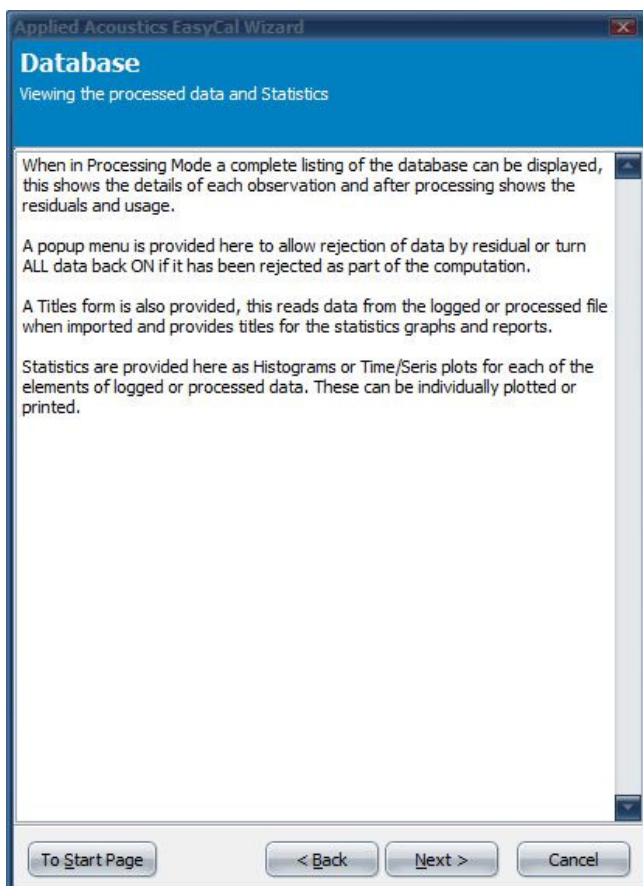
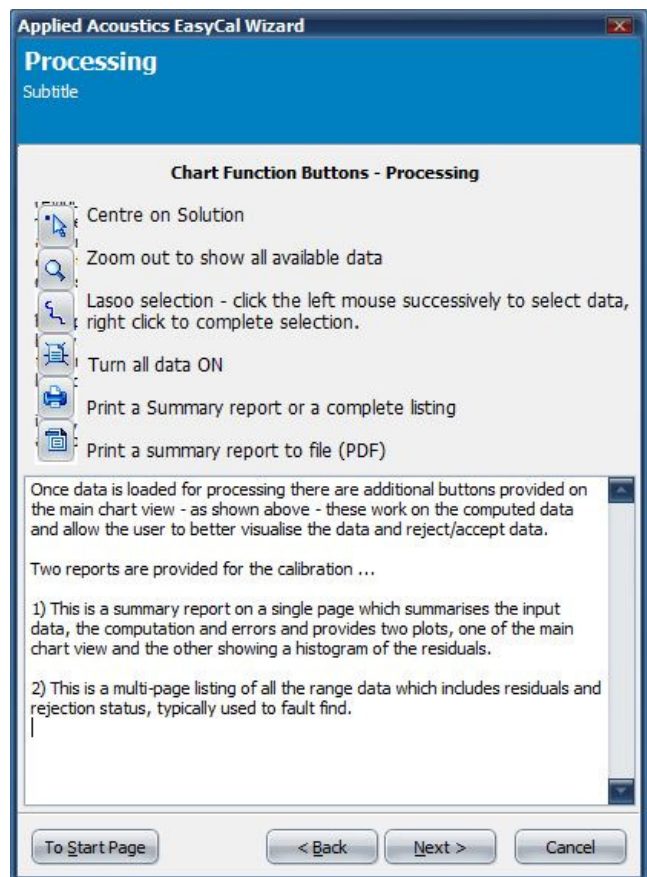
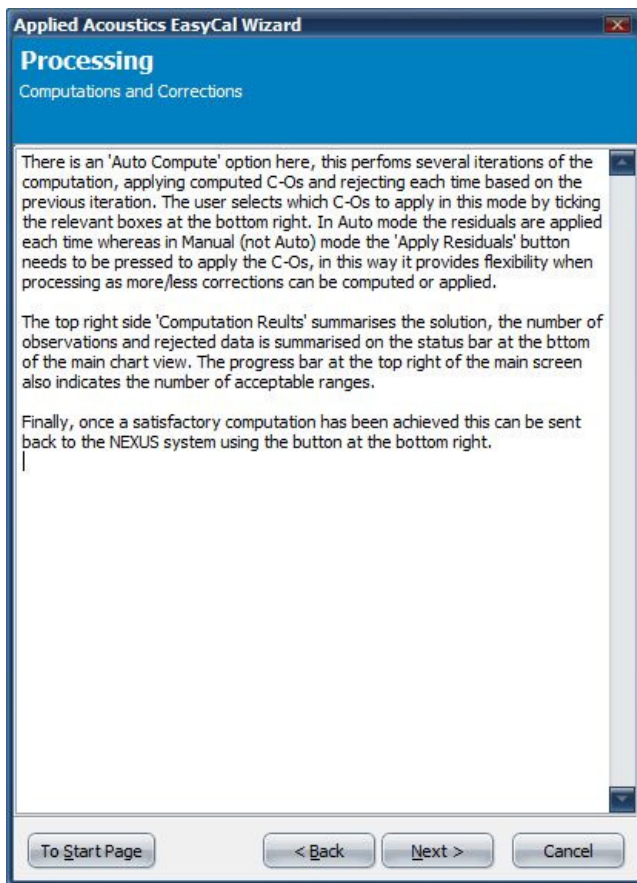
Page 1 of 100

Operation:

A Wizard is provided for new users, enabled from the “Configuration” form.







9. Troubleshooting

FAULT / SYMPTOM	No Power light on the front panel of Easytrak Nexus
POSSIBLE CAUSES	The Power supply. Is there power to the socket? The Power supply is not plugged into Alpha, or the Wall socket, or not switched on.

FAULT / SYMPTOM	No Signal return at any range
POSSIBLE CAUSES	<p>Incorrect Channel. Check Beacon editor</p> <p>Beacon TX power. This may be due to a discharged battery, fouled transducer, or beacon fault. Try with a known working beacon.</p> <p>Obstruction. The beacon's signal may be blocked by submerged parts of the vessel, seabed objects – manmade or natural.</p> <p>Deck Cable. Check that the deck cable or connectors have not been damaged. Look for cuts, splits or abrasions. Check there is no corrosion on the connector pins.</p> <p>Damaged responder cable. Check the pulse from Nexus is present at the Responder end of the cable (approx 12VDC pulse on load).</p> <p>Confirmation. Temporarily locate the transducer and a suitable beacon on-deck. Try interrogating the beacon. Is the transducer transmitting (clicking)? Is the beacon transmitting (clicking)? No, try another transducer / beacon. Is Easytrak Nexus receiving the beacon's transmission? If there is still no response the transducer is suspect.</p>

FAULT / SYMPTOM	Incorrect Range
POSSIBLE CAUSES	<p>Incorrect Velocity of Sound. Enter correct value.</p> <p>Turn around delay. Is the turn around delay set correctly in the beacon? Correct turn around delay.</p> <p>Another beacon in the water set to the same channel.</p> <p>Another sonar system transmitting at the beacon's reply frequency.</p>

FAULT / SYMPTOM	Short range
POSSIBLE CAUSE	<p>Excessive range for conditions. Range is dependent on local conditions such as in-band noise from man-made or marine sources. If possible reduce noise or work at a shorter range.</p> <p>Beacon reply insensitivity. This may be due to a fouled transducer, or beacon fault. Clean beacon transducer with fresh water. Try using another beacon.</p> <p>Transducer reply insensitivity. Check that the transducer is not damaged or fouled. Clean transducer with fresh water.</p> <p>Obstruction. The beacon's signal may be blocked by submerged</p>

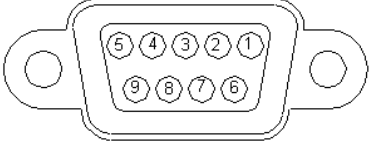
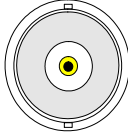
	<p>parts of the vessel, seabed objects – man-made and natural. Bubbles of air and gas produced by the vessel's propeller.</p> <p>Thermoclines. This is due to abrupt changes of velocity of sound in water due to variances of water temperature and / or salinity. The effect of this can be to 'tunnel' or bend the acoustic signal away from either the target or the transducer. If possible try adjusting the height of the transducer in the water.</p>
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FAULT / SYMPTOM	Short range
POSSIBLE CAUSE	<p>Excessive range for conditions. Range is dependent on local conditions such as in-band noise from man-made or marine sources. If possible reduce noise or work at a shorter range.</p> <p>Beacon reply insensitivity. This may be due to a fouled transducer, or beacon fault. Clean beacon transducer with fresh water. Try using another beacon.</p> <p>Transducer reply insensitivity. Check that the transducer is not damaged or fouled. Clean transducer with fresh water.</p> <p>Obstruction. The beacon's signal may be blocked by submerged parts of the vessel, seabed objects – man-made and natural. Bubbles of air and gas produced by the vessel's propeller.</p> <p>Thermoclines. This is due to abrupt changes of velocity of sound in water due to variances of water temperature and / or salinity. The effect of this can be to 'tunnel' or bend the acoustic signal away from either the target or the transducer. If possible try adjusting the height of the transducer in the water.</p>

FAULT / SYMPTOM	Unstable positions - bearing instability but range fairly stable
POSSIBLE CAUSES	<p>Transducer depth. Transducer may not be deep enough in the water. It is recommended the transducer be below the draft of the vessel by at least 1 metre.</p> <p>Multipath interference. This may be due to multipath interference close to the transducer or close to the target. It may be due to vessel movement especially if no form of compass compensation is being used. Adjust the height of the transducer in the water.</p> <p>Movement. If the transducer is free hanging over the side of the vessel, is the transducer being adversely affected by bow thrusters or alike? Relocate transducer. Tether transducer with rope forward and aft to reduce movement and rotation.</p> <p>Contaminated Transducer. Ensure the transducer is clean and uncontaminated prior to installation. Grease can have an adverse affect on the transducer. A lightly dampened cloth should be used. Solvents are not recommended.</p> <p>Damaged receive element. Select Beacon editor data tab, check the relative signal levels and see if one (or more) element is very low relative to the other elements. Typically the faulty element would be <0-5% compared to a 'good' element of '70% at a range of a few tens of metres.</p>

FAULT / SYMPTOM	Unstable positions - bearing instability and range unstable
POSSIBLE CAUSES	<p>Transducer depth. Transducer may not be deep enough in the water. It is recommended the transducer be below the draft of the vessel by at least 1 metre.</p> <p>Interrogation rate too fast. If the interrogation rate is too quick, it is possible that reflections from previous signals may not have reduced sufficiently, and are picked up first rather than the new signal.</p> <p>Multipath interference. This may be due to multipath interference away from the transducer e.g. pipelines, underwater structures, and thermoclines. If the sea is flat calm, it is common for the water / air interface to give strong reflections. If possible try adjusting the height of the transducer in the water.</p> <p>Acoustic noise. The noise can be vessel borne such as from the propeller (try running at different revs), sonar systems (try synchronising so that the sonar's transmission does not overlap Easytrak's receive time. It is known in certain parts of the world for marine animals to generate quite loud acoustic noise. Select the dropdown menu Help/diagnostics (option 2) and check the in-water noise level.</p> <p>Electrical noise. This can be conducted or radiated from generators, welding kits, radio communications, sonar systems etc. If possible, switch off equipment one system at a time until the offending piece of equipment can be identified. Select the dropdown menu Help/diagnostics (option 2) and check the in-water noise level.</p>

10. External I/O Connector Pin Outs

<ul style="list-style-type: none">SERIAL CONNECTORS 2 Receive Data (Rx) 3 Transmit Data (Tx) 5 Gnd	
<ul style="list-style-type: none">BNC CONNECTOR Inner Signal + Outer Signal – Note the BNC connector is isolated.	

11. Easytrak Nexus Channels

AAE Spread Spectrum Channels

ID	Channel	Transponder TAT (ms)	Responder TAT (ms)	Description
E0	SS CH 0	100	100	AAE Spread Spectrum
E1	SS CH 1	100	100	AAE Spread Spectrum
E2	SS CH 2	100	100	AAE Spread Spectrum
E3	SS CH 3	100	100	AAE Spread Spectrum
E4	SS CH 4	100	100	AAE Spread Spectrum
E5	SS CH 5	100	100	AAE Spread Spectrum
E6	SS CH 6	100	100	AAE Spread Spectrum
E7	SS CH 7	100	100	AAE Spread Spectrum
E8	SS CH 8	100	100	AAE Spread Spectrum
E9	SS CH 9	100	100	AAE Spread Spectrum
EA	SS CH 10	100	100	AAE Spread Spectrum
EB	SS CH 11	100	100	AAE Spread Spectrum
EC	SS CH 12	100	100	AAE Spread Spectrum
ED	SS CH 13	100	100	AAE Spread Spectrum
EE	SS CH 14	100	100	AAE Spread Spectrum
EF	SS CH 15	100	100	AAE Spread Spectrum
F0	SS CH 16	100	100	AAE Spread Spectrum
F1	SS CH 17	100	100	AAE Spread Spectrum
F2	SS CH 18	100	100	AAE Spread Spectrum
F3	SS CH 19	100	100	AAE Spread Spectrum
F4	SS CH 20	100	100	AAE Spread Spectrum
F5	SS CH 21	100	100	AAE Spread Spectrum
F6	SS CH 22	100	100	AAE Spread Spectrum
F7	SS CH 23	100	100	AAE Spread Spectrum
F8	SS CH 24	100	100	AAE Spread Spectrum
F9	SS CH 25	100	100	AAE Spread Spectrum
FA	SS CH 26	100	100	AAE Spread Spectrum
FB	SS CH 27	100	100	AAE Spread Spectrum
FC	SS CH 28	100	100	AAE Spread Spectrum
FD	SS CH 29	100	100	AAE Spread Spectrum
FE	SS CH 30	100	100	AAE Spread Spectrum
FF	SS CH 31	100	100	AAE Spread Spectrum

Digital Depth telemetry available if depth sensor fitted to beacon

AAE Easytrak Channels

Channel	RXF1 (Hz)	RXF2 (Hz)	TXF1 (Hz)	TXF2 (Hz)*	Transponder TAT (ms)	Responder TAT (ms)	Pulse Width (ms)
A0	17500	-	30000	29000	30	30	2
A1	18500	-	28000	27000	30	30	2
A2	19500	-	26000	25000	30	30	2
A3	20500	-	29000	28000	30	30	2
A4	21500	-	27000	26000	30	30	2
A5	22500	-	30000	29000	30	30	2
A6	18000	20000	27000	26000	60	30	2
A7	18000	21000	28000	27000	60	30	2
A8	18000	22000	30000	29000	60	30	2
A9	18000	23000	29000	28000	60	30	2
B0	20000	18000	30000	29000	60	30	2
B1	20000	21000	29000	28000	60	30	2
B2	20000	22000	28000	27000	60	30	2
B3	21000	18000	27000	26000	60	30	2
B4	21000	20000	26000	25000	60	30	2
B5	21000	22000	28000	27000	60	30	2
B6	21000	23000	30000	29000	60	30	2
B7	22000	18000	26000	25000	60	30	2

*Depth telemetry transponders only.

Simrad HPR Channels

Channel	Simrad Channel	RXF1 (Hz)	TXF1 (Hz)	TXF2 (Hz)*	Transponder TAT (ms)	Responder TAT (ms)	Pulse Width (ms)
01	1	20492	29762	32468	30	30	10
02	2	21552	30488	29762	30	30	10
03	3	22124	31250	30488	30	30	10
04	4	22727	31847	31250	30	30	10
05	5	23364	32468	31847	30	30	10
06	6	24038	27173	29070	30	30	10
07	7	24510	27777	27173	30	30	10
08	8	25000	28409	27777	30	30	10
09	9	26042	29070	28409	30	30	10
11	11 Square	21552	27173	32468	30	30	10
22	22 Circle	22727	28409	27173	30	30	10
33	33 Delta	23923	29762	28409	30	30	10
44	44 X	25126	31250	29762	30	30	10
55	55 Y	26455	32468	31250	30	30	10

*Depth telemetry transponders only.

Simrad HiPAP Channels

Channel	RXF1 (Hz)	RXF2 (Hz)	TXF1 (Hz)	TXF2 (Hz)*	Transponder TAT (ms)	Responder TAT (ms)	Pulse Width (ms)
12	21000	21500	29250	29750	60	30	10
13	21000	22000	29750	30250	60	30	10
14	21000	22500	30250	28750	60	30	10
15	21000	23000	30750	27250	60	30	10
16	21000	23500	27250	27750	60	30	10
17	21000	24000	27750	28250	60	30	10
18	21000	24500	28250	30750	60	30	10
21	21500	21000	28500	29000	60	30	10
23	21500	22000	29500	30000	60	30	10
24	21500	22500	30000	28500	60	30	10
25	21500	23000	30500	27000	60	30	10
26	21500	23500	27000	27500	60	30	10
27	21500	24000	27500	28000	60	30	10
28	21500	24500	28000	30500	60	30	10
31	22000	21000	28750	29250	60	30	10
32	22000	21500	29250	29750	60	30	10
34	22000	22500	30250	28750	60	30	10
35	22000	23000	30750	27250	60	30	10
36	22000	23500	27250	27750	60	30	10
37	22000	24000	27750	28250	60	30	10
38	22000	24500	28250	30750	60	30	10
41	22500	21000	28500	29000	60	30	10
42	22500	21500	29000	29500	60	30	10
43	22500	22000	29500	30000	60	30	10
45	22500	23000	30500	27000	60	30	10
46	22500	23500	27000	27500	60	30	10
47	22500	24000	27500	28000	60	30	10
48	22500	24500	28000	30500	60	30	10
51	23000	21000	28750	29250	60	30	10
52	23000	21500	29250	29750	60	30	10
53	23000	22000	29750	30250	60	30	10
54	23000	22500	30250	28750	60	30	10
56	23000	23500	27250	27750	60	30	10
57	23000	24000	27750	28250	60	30	10
58	23000	24500	28250	30750	60	30	10
61	23500	21000	28500	29000	60	30	10
62	23500	21500	29000	29500	60	30	10
63	23500	22000	29500	30000	60	30	10
64	23500	22500	30000	28500	60	30	10
65	23500	23000	30500	27000	60	30	10
67	23500	24000	27500	28000	60	30	10
68	23500	24500	28000	30500	60	30	10

Simrad HiPAP Channels Continued

Channel	RXF1 (Hz)	RXF2 (Hz)	TXF1 (Hz)	TXF2 (Hz)*	Transponder TAT (ms)	Responder TAT (ms)	Pulse Width (ms)
71	24000	21000	28750	29250	60	30	10
72	24000	21500	29250	29750	60	30	10
73	24000	22000	29750	30250	60	30	10
74	24000	22500	30250	28750	60	30	10
75	24000	23000	30750	27250	60	30	10
76	24000	23500	27250	27750	60	30	10
78	24000	24500	28250	30750	60	30	10
81	24500	21000	28500	29000	60	30	10
82	24500	21500	29000	29500	60	30	10
83	24500	22000	29500	30000	60	30	10
84	24500	22500	30000	28500	60	30	10
85	24500	23000	30500	27000	60	30	10
86	24500	23500	27000	27500	60	30	10
87	24500	24000	27500	28000	60	30	10

ORE Trackpoint Channels

Channel	LXT Channel	RXF1 (Hz)	TXF1 (Hz)	TXF2 (Hz)*	Transponder TAT (ms)	Responder TAT (ms)	Pulse Width (ms)
0A		18000	24000	23000	15	15	1.5
0B		17000	24000	23000	15	15	1.5
10	LXT Code 1	17000	23000	22000	15	15	1.5
09		18000	25000	24000	15	15	1.5
0A		16000	25000	24000	15	15	1.5
1B		21500	26000	25000	15	15	1.5
20	LXT Code 2	19000	25000	24000	15	15	1.5
29		18000	26000	25000	15	15	1.5
2A		17500	28500	27500	15	15	1.5
2B		18500	26500	25500	15	15	1.5
30	LXT Code 3	17000	27000	26000	15	15	1.5
40	LXT Code 4	19000	29000	28000	15	15	1.5
50	LXT Code 5	17000	30000	29000	15	15	1.5
60		18000	28000	27000	15	15	1.5
69		16000	23000	22000	15	15	1.5
6A		18000	23000	22000	15	15	1.5
6B		20500	23000	22000	15	15	1.5
70		18000	30000	29000	15	15	1.5
79		17000	24000	23000	15	15	1.5
7A		19000	24000	23000	15	15	1.5
7B		17000	25000	24000	15	15	1.5
80		21000	29000	28000	15	15	1.5
89		17000	26000	25000	15	15	1.5
8A		21000	33000	32000	15	15	1.5
8B		18000	31000	30000	15	15	1.5

12. Easytrak Nexus Data Output formats

APPLIED ACOUSTIC ENGINEERING (AAE) DATA STRING

The AAE string has 76 characters including carriage return and line feed when not in GPS mode.

i,t,hhmmss,xxxxx.x,yyyyy.y,zzzzz.z,rrrr.r,bbb.b,dd.d,ccc.c,RRR.R,ppp.p,SSSCL

Description	String code
Beacon identification (1 to 4)	i
Data type: Ship ref (0), North ref (1), Smoothed (3)	t
Hour	h
Minute	m
Second	s
X (or Eastings)	x
Y (or Northings)	y
Z (Depth)	z
Slant range	r
Bearing to target	b
Depression angle	d
Compass	c
Roll	R
Pitch	p
Status (see overleaf)	S
Carriage return (CR)	C
Line Feed (LF)	L

All ranges and positions are in metres and angles are in degrees.

Note fields are comma separated. Leading 0's (except time) and empty fields are space filled. When in GPS mode, the X, Y and Z fields automatically expand to take the full GPS data value.

Example strings

"Normal" string

1,0,115906,**111.1,*-222.2,**333.3,*415.7,153.4,53.3,123.5,**0.4,*-0.6,000CL

"GPS" string

1,0,115906,**111.1,500000.0,6500000.0,*415.7,153.4,53.3,123.5,**0.4,*-0.6,000CL

Note * = space.

Error codes

Any error code is constructed by adding the following.

Interrogation has timed out	001
Outside velocity gate	032
GPS error	064
Reply signal overload	256

An error code of '000' means no error.

APPLIED ACOUSTIC ENGINEERING V2(AAE) DATA STRING

aaaaaa,i,t,o,g,h,hmmss.s,xxxxx.x,yyyyy.y,zzzzz.z,rrrr.r,bbb.b,dd.d,ccc.c,RRR.R,ppp.p,SSS*eeCL

Description	String code
Message Identifier: \$AADS1	a
Beacon identification (1 to 10)	i
Data type: Ship ref(0), North ref(1), Gated(2),Smoothed(3),Kalman(5)	t
Orientation: Heads Up(H), North Referenced(N)	o
GPS Position: GPS On(Y), GPS Off(N)	g
Hour	h
Minute	m
Second (output to 1 decimal place)	s
X (or Eastings)	x
Y (or Northings)	y
Z (Depth)	z
Slant range	r
Bearing to target	b
Depression angle	d
Compass	c
Roll	R
Pitch	p
Status	S
Checksum	ee
Carriage return (CR)	C
Line Feed (LF)	L

All ranges and positions are in metres and angles are in degrees.

Note fields are comma separated. Leading 0's (except time) and empty fields are space filled.
When in GPS mode, the X, Y and Z fields automatically expand to take the full GPS data value.

ORE Trackpoint 2EC Data string

The **simplified TP-2EC** string has 68 characters including carriage return and line feed.

i*hh:mm:ss*ccc*bbb.b*rrrrr.r*xxxxxx.x*yyyyyy.y*zzzzz.z*-ttttt.t*EECL

Description	String code
Beacon identification	i
Hour	h
Minute	m
Second	s
Compass	c
Bearing	b
Slant range	r
X (or Eastings)	x
Y (or Northings)	y
Z	z
Telemetry	t (always 0.0)
Error	E
Carriage return (CR)	C
Line Feed (LF)	L

Note * = space.

Note fields are space separated. Leading 0's (except time) are space filled. When in GPS mode, the X, Y and Z fields automatically expand to take the full GPS data value.

Example:-

2*23:59:59*359*359.91234.5*-10000.0*-10000.0*10000.0*****0.0*00CL**

Note * = space.

Error codes

No error	00
Lost signal	06

Simrad HPR 300P Data String

The **simplified HPR 300P** string has 48 characters including carriage return and line feed.

ii*HB**SSS**ccc.c*x*xxx.x*y*yyy.y*z*zzz.z**QQ.QCL**

Description	String code (above)
Beacon identification	i (Beacon number rather than channel number)
Transducer number	H (Always 1)
Beam	B (Always 'W')
Status	S
Compass	c (Note compass heading rather than course)
X (or Eastings)	x
Y (or Northings)	y
Z	z
Quality	Q (Always 0.0)
Carriage return (CR)	C
Line Feed (LF)	L
Note * = space.	

Note fields are space separated. Leading 0's are space filled. When in GPS mode, the X, Y and Z fields automatically expand to take the full GPS data value. For figures larger than 999.9 the decimal point is removed i.e. 1001 meters.

Example:-

21**W***OK**359.9*-999.9**999.9**-1000***0.0CL**

Note * = space.

Error codes

No error	'OK'
No reply	'NRY'

ORE Trackpoint STD-EC W/PR Data string

The **simplified STD-EC W/PR** string has **80** characters including carriage return and line feed.

i*hh:mm:ss*ccc*bbb.b*rrrrr.r*xxxxxx.x*yyyyyy.y*zzzzz.z*-ttttt.t*EE*RRR.R*PPP.PCL

Description	String code
Beacon identification	i
Hour	h
Minute	m
Second	s
Compass	c
Bearing	b
Slant range	r
X (or Eastings)	x
Y (or Northings)	y
Z	z
Telemetry	t (always 0.0)
Error	E
Roll	R
Pitch	P
Carriage return (CR)	C
Line Feed (LF)	L
Note * = space.	

Note fields are space separated. Leading 0's (except time) are space filled. When in GPS mode, the X, Y and Z fields automatically expand to take the full GPS data value.

Example:-

2*23:59:59*359*359.91234.5*-10000.0*-10000.0*10000.0*****0.0*00**1.2* 2.1CL**

If the signal is lost, the following string is outputted.

2*23:59:59*359*-_*-*****_*-*****_*-*****_*-*****_*-*****_*-06***_*-***_*-CL**

Note * = space.

Error codes

No error	00
Lost signal	06

Simrad HPR 309 Data Telegram

The **simplified HPR 309** telegram has 32 bytes including the '@' terminator.

Field Name	Size (bytes)	Byte Offset	Comment
Header	1	0	Currently set to 1
Roll	2	1	Used
Pitch	2	3	Used
Heading	2	5	Used
Transponder index	1	7	Beacon No. (1-4)
X Position	3	8	Used
Y Position	3	11	Used
Depth	3	14	Used
Position Status	1	17	Good = 0, bad = 1
Time out	1	18	Not used (0)
Transponder sequence	3	19	Not used (0)
Tracking TD angle	2	22	Not used (0)
Test	1	24	Not used (0)
Transponder type	1	25	Not used (0)
Transponder specification	1	26	Set to 1 (mobile transponder)
Transducers	1	27	Not used (0)
Transducer status	1	28	Not used (0)
Kalman filter window	1	29	Not used (0)
Checksum	1	30	Used
End of telegram	1	31	Hex 0x40 ('@')

Note the X, Y and depth values in the Simrad 309 telegram will be dependent on the data mode selected.

Comments on the Simrad HPR309 Telegram

Header	Currently set to 1
Roll	Roll is a 12 bit, 2's complement scaled integer. Positive direction is when port side is up. Resolution is 360.0/4096 degrees. Minimum value = 800H (-2048) = -180.0°. 0 = 0°, and 7ffH = 2047 = (180° - resolution) °. The first byte in this field contains the 6 most significant bits and the next byte the six least significant bits.
Pitch	Pitch is a 12 bit, 2's complement scaled integer. Positive direction is when bow is up. Resolution is 360.0/4096 degrees. Minimum value = 800H (-2048) = -180.0°. 0 = 0°, and 7ffH = 2047 = (180° - resolution) °. The first byte in this field contains the 6 most significant bits and the next byte the six least significant bits.
Heading	Roll is a 12 bit, 2's complement scaled integer. Positive direction is clockwise. Resolution is 360.0/4096 degrees. Minimum value = 800H (-2048) = -180.0°. 0 = 0°, and 7ffH = 2047 = (180° - resolution) °. The first byte in this field contains the 6 most significant bits and the next byte the six least significant bits.
Transponder index	1 for beacon 1, 2 for beacon 2, 3 for beacon 3, and 4 for beacon 4.
X, Y and Depth position	<p>The X, Y and Depth positions are with respect to the ship's datum point. X is positive when Starboard of the datum, Y is positive when Forward of the datum, Depth is positive when down from the datum.</p> <p>X, Y and Depth are 16 bit, 2's complement scaled integers. (Note the integer is sign extended to 18 bits) Resolution is 8192.0/65536 meters. Minimum value = 8000H (-4096) = -4096.0. 0 = 0 meters, and 7fffH = (4096.0 - resolution) meters. The first byte in this field contains the 6 most significant bits, the next byte the six 'middle' significant bits, and the last byte the six least significant bits.</p>
Position status	Good fix bit 0 = 0 and bad fix bit 0 = 1
Time out	Not used, bit 0 = 0.
Transponder sequence	Not used, bit 0 = 0.
Tracking TD angle	Not used, bit 0 = 0.

Comments on the Simrad HPR309 Telegram cont'd

Test	Not used, bit 0 = 0.
Transponder type	Not used, bit 0 = 0.
Transponder specification	Mobile transponder, bit 0 = 1.
Transducers	Not used, bit 0 = 0.
Transducer status	Not used, bit 0 = 0.
Kalman Filter window	Not used, bit 0 = 0.
Checksum	The checksum results in the exclusive Oring of all bytes of the telegram up to but not including the checksum byte.
End of telegram	The end byte of the telegram is always HEX 0x40, the character '@'.

Simrad \$PSIMSSB Data String

The **simplified Simrad \$PSIMSSB** string is of variable length and is terminated by a carriage return and line feed.

Field	Name	Comment
\$PSIMSSB	Start character and address	
,hhmmss.ss	Time	Real time of measurement
,cc	Beacon code	E.g. D50, D66
,A	Status	A = OK, V not OK
,cc	Error code	Left empty
,a	Coordinate system	Set to 'C' for Cartesian or 'U' for UTM coordinates.
,a	Orientation	Set to 'H' for heading up, or 'N' for North referenced.
,a	SW Filter	Set to M for measured
,x.x	X coordinate	X depends on data format set.
,x.x	Y coordinate	Y depends on data format set.
,x.x	Depth	Depth depends on data format set.
,x.x	Expected accuracy	Always 0.0
,a	Additional information	Set to 'N'
,x.x	1 st Additional value	Left empty
,x.x	2 nd Additional value	Left empty
*HH	Checksum	Checksum
CL	Terminators	Carriage return / line feed

Example string

\$PSIMSSB,161618.00,B50,A,,C,H,M,10.0,20.0,30.3,0.0,N,,*5FCL

Note, providing GPS \$GPRMC is available, the data output string \$PSIMSSB uses GPS UTC time and date. If GPS is not available, or \$GPRMC is not selected, Easytrak's internal date and time is used.

Simrad \$PSIMSNS Data string

The **simplified Simrad \$PSIMSNS** string is of variable length and is terminated by a carriage return and line feed.

Field	Name	Comment
\$PSIMSNS	Start character and address	
,hhmmss.ss	Time	Real time of measurement
,cc	Beacon code	E.g. D50, D66
,xx	Transceiver number	Always 1
,xx	Transducer number	Always 1
,x.x	Roll	Roll in degrees
,x.x	Pitch	Pitch in degrees
,x.x	Heave	Always 0.0
,x.x	Heading	Between 0° and 360°
,x	Tag	Left empty
,x	Parameters	Bits (0,1) = 1 (SSBL) Bit (4) = 1 (Mobile) Bit (5) = 1 (UTM Time) Other bits = 0
,x.x	Time age	Always 0.0
,x	Spare	Empty field
,axx	Master Slave	Always M121
*HH	Checksum	Checksum
CL	Terminators	Carriage return / line feed

Example string

\$PSIMSNS,161618.00,B50,1,1,0.0,0.0,0.0,86.2,,1,0.00,,M121*69CL

Note, providing GPS \$GPRMC is available, the data output string \$PSIMSSB uses GPS UTC time and date. If GPS is not available, or \$GPRMC is not selected, Easytrak's internal date and time is used.

Pseudo \$GPRMC Data string

RMC - Recommended Minimum Navigation Information.

The **pseudo \$GPRMC** string is terminated by a carriage return and line feed.

\$GPRMC,hhmmss.sss,A,IIII.IIII,N,yyyyy.yy,E,k.k,c.c,DDMMYY,v.v,V*HHCL

Description	String code
Header	\$GPRMC
Hour	h
Minute	m
Second	s
Status	A = OK, V = Warning
Latitude ddmm.mmmm	I
North or South (N/S)	N
Longitude dddmm.mmmm	y
East or West (E/W)	E
Speed over ground, knots	k
Course over ground, degrees true	c
Day	D
Month	M
Year	Y
Magnetic Variation, degrees	v
Magnetic Variation, east / west (E/W)	V
Check Sum	H
Carriage return (CR)	C
Line feed	L

Example String

\$GPRMC,092204.999,A,5250.5589,S,00142.5084,E,0.00,89.68,210206,0.0,E*44

Note, providing GPS \$GPRMC is available, the data output string \$PSIMSSB uses GPS UTC time and date. If GPS is not available, or \$GPRMC is not selected, Easytrak's internal date and time is used.

KLEIN 3000 SSS Data strings

An output is provided for various Side Scan Sonars. This selection outputs three strings one immediately after the other - \$GPGGA, \$GPVTG, and \$GPTLL.

The strings \$GPGGA and \$GPVTG provide the position and course over ground of the vessel, and string \$GPTLL provides the position of the towfish.

Vessel Position

\$GPGGA,hhmmss.ss,ddmm.mmm,N,dddmm.mmm,E,q,xx,p,p,a,b,M,c,d,M,x.x,nnnn*HHCL

Description	String code
Header	\$GPGGA
UTC of position	hhmmss.ss
Latitude	ddmm.mmm
North or South (N/S)	N
Longitude	dddmm.mmm
East or West (E/W)	E
GPS Quality indicator	q
(Varies with which D/GPS receiver is used)	
Number of satellites in use	xx
Horizontal dilution of precision	p.p
Antenna altitude above mean-sea-level	a.b
Units of antenna altitude, metres	M
Geoidal height	c.d
Units of geoidal height, metres	M
Age of Differential GPS data	x.x
(seconds since last valid RTCM transmission)	
Differential reference station ID, 0000 to 1023	nnnn
Check Sum	H
Carriage return (CR)	C
Line feed	L

Note some of the fields may be left blank; this will vary depending upon the D/GPS receiver used.

Note, providing GPS \$GPRMC is available, the data output string \$PSIMSSB uses GPS UTC time and date. If GPS is not available, or \$GPRMC is not selected, Easytrak's internal date and time is used.

Klein 3000 Data strings / Continued

Vessel track made good and ground speed

\$GPVTG,ttt.t,T,mmm.m,M,nnn.n,N,kkk.k,K*HHCL

Description	String code
Header	\$GPVTG
True track made good (Degrees)	t
True	T
Magnetic track made good (Degrees)	m
Magnetic	M
Ground speed (Knots)	n
Knots	N
Ground speed (Km/h)	k
Km/h	K
Check Sum	H
Carriage return (CR)	C
Line feed	L

Note some of the fields may be left blank; this will vary depending on the GPS receiver used.

Target position

\$GPTLL,nn,IIII.IIII,N,yyyyy.yy,E,EasytrakAlpha,hhmmss.ss,T,*HHCL

Description	String code
Header	\$GPTLL
target number (1 - 4)	nn
Latitude ddm.dddmm	I
North or South (N/S)	N
Longitude dddmm.dddmm	y
East or West (E/W)	E
System ID string	EasytrakAlpha
Hour	h
Minute	m
Second	s
Status (T=tracking, L= Lost)	T
Check Sum	H
Carriage return (CR)	C
Line feed	L

Pseudo \$GPGGA Data string

The output string contains original data as received from GPS input message apart from the fields highlighted in **blue** below.

1. Latitude and Longitude contain target position (not vessel position)
2. GPS Quality Indicator field contains acoustic quality where 1 = good response, 0 = no response
3. Antenna altitude contains Target Depth (Z), with offsets applied. If Z offset is 0 depth below sea level.
4. Differential Station ID contains Target (beacon) number of data transmitted

\$GPGGA,hhmmss.ss,ddmm.mmm,N,dddmm.mmm,E,q,xx,p,p,a,b,M,c,d,M,x,x,nnnn*HHCL

Description	String code
Header	\$GPGGA
UTC of position	hhmmss.ss
Latitude	ddmm.mmm
North or South (N/S)	N / S
Longitude	dddmm.mmm
East or West (E/W)	E / W
GPS Quality indicator	1 / 0
Number of satellites in use	xx
Horizontal dilution of precision	p.p
Antenna altitude above mean-sea-level	a.b
Units of antenna altitude, metres	M
Geoidal height	c.d
Units of geoidal height, metres	M
Age of Differential GPS data (seconds since last valid RTCM transmission)	x.x
Differential reference station ID	1 to 16*
Check Sum	H
Carriage return (CR)	C
Line feed	L

Note some of the fields may be left blank; this will vary depending upon the D/GPS receiver used.

* Number of supported targets dependent on transceiver model number

13. System Specification

Easytrak Nexus Console Model 2692

Dimensions	19" Rack mount. 2U. 482 x 88 x 345mm Weight 5.4kg
Power requirements	90 – 250 VAC at 250 VA maximum.
Built-in PC	Intel Atom running embedded Windows XP. Solid state hard disk
Front panel Indicators	LED indicators for power and serial status.
Serial Communications	5 x RS-232 Ports All RS232C inputs must comply with EIA (Electronics Industry Association) RS232C standard.
Compass Input	TCM-2.X , SGB-HTDS, SGB-HTDt, \$HEHDT, \$HDHDM, \$HDHDT, \$HDHDG
VRU Input	TCM-2.X, \$HCXDR , TSS1
GPS / DGPS Input	NMEA; GLL, GGA, RMC
External Depth	NMEA; DBS, DBT, DBK, DPT, AAE Custom
Responder Output Positive	12v pulse 5mS long
USB	4 ports available
Ethernet	Rear panel standard RJ45 jack.

Easytrak Nexus Transceiver Model 2682

Material	Aluminum Silicon Bronze
Size	500 mm long x 100 mm diameter
Weight in air/water	11kg / 8.5 kg
Depth rating	50 meters
Depth sensor (Pressure Sensor)	5 bar, accuracy 0.25% between -10° to $+40^{\circ}$ C
Temperature sensor	1 degree resolution between -10° and $+40^{\circ}$ C
Power requirements	Powered from Nexus Console.
Transducer	Multi-element transducer head molded in polyurethane
Receiver	24 bit receiver capable of detecting Spread Spectrum and tone burst signals.

Accuracy / Performance

Accuracy is based on the correct speed of sound being entered, no ray bending and an acceptable S/N ratio

Slant Range accuracy	10 cm. (Accuracy dependent on correct speed of sound)
Position accuracy	0.60° drms 1.0% of slant range (Acoustic accuracy excluding heading errors)
Bearing Resolution	0.1° displayed. Internally calculated to 0.01°
Heading sensor accuracy	1.0° rms standard; $\pm 0.1^{\circ}$ resolution/repeatability
Pitch/Roll sensor accuracy	$\pm 0.50^{\circ}$ rms $\pm 0.1^{\circ}$ resolution/repeatability
Frequency Band (MF)	Reception 22 - 30 kHz Transmission 17 – 26 kHz Transmitter Nominally 190 dB SPL
Tracking Beam Pattern	> Hemispherical
Beacon Types	Transponders and Responders Digital Depth Transponders AAE Release and Telemetry beacons
Interrogation Rate	Internally set or external key

Easytrak Nexus Transceiver Model 2686

Factory calibrated multi-element transceiver head complete with integral AHRS, depth sensor and temperature sensor.

Material	Stainless steel standard (optional aluminium silicon bronze)
Weight in air/water	16kg/11kg
Dimensions	152mm Ø x 432mm
Temperature	Operating: -10° to +40°C Storage: -20° to +50°C
Depth rating	30m
Electrical supply	48Vdc (from Nexus console)
Depth sensor (Pressure Sensor)	5 bar, accuracy 0.25% between -10° to +40° C
Temperature sensor	1° resolution between -10° and +40° C

Accuracy / Performance

Accuracy is based on the correct speed of sound being entered, no ray bending and an acceptable S/N ratio

Position accuracy	0.25° at > 10° depression angle Acoustic accuracy excluding heading correction errors
Range resolution	Calculated to 0.01m resolution
Max range	Up to 2500m, range limited version available (995m)
Frequency band (MF)	18 - 32 kHz
Tracking beam pattern	180°
Transmitter	Variable, typical max 192dB re 1µPa at 1m
Integrated AHRS:	
Bearing resolution	0.1° displayed. Internally calculated to 0.01°
Heading sensor accuracy	0.5° rms standard; +/- 0.1° resolution/repeatability
Pitch/Roll sensor accuracy	+/- 0.10° rms +/- 0.1° resolution/repeatability
Beacon types	AAE Sigma 1, Sigma 2 Digital Spread Spectrum and AAE Tone channels. AAE V-NAV channels. HPR 400 channels 1100, 1000, 1200A, 1300A Series Beacons, Digital Depth Transponders, AAE Release and Telemetry Beacons.
Interrogation rate	>2Hz refresh rate. Internally set or external key

Transceiver Cable

Diameter	Ø 12.8 mm nominal
Length	50m standard (20-100m options) with connectors
Colour	Yellow
SWL	20 kg (Allows Transceiver to be deployed from cable)

System externally assessed for immunity and emissions; conforms to 89/336/EEC. RoHS compliant

Environment

Operating Temperature	-5 to 30°C
Storage Temperature	-5 to 45°C



Note: Specification is subject to change without notice

Handling

There are no special handling conditions with this product. For beacons, please see their specific manuals.

End of Life Recycling / Disposal



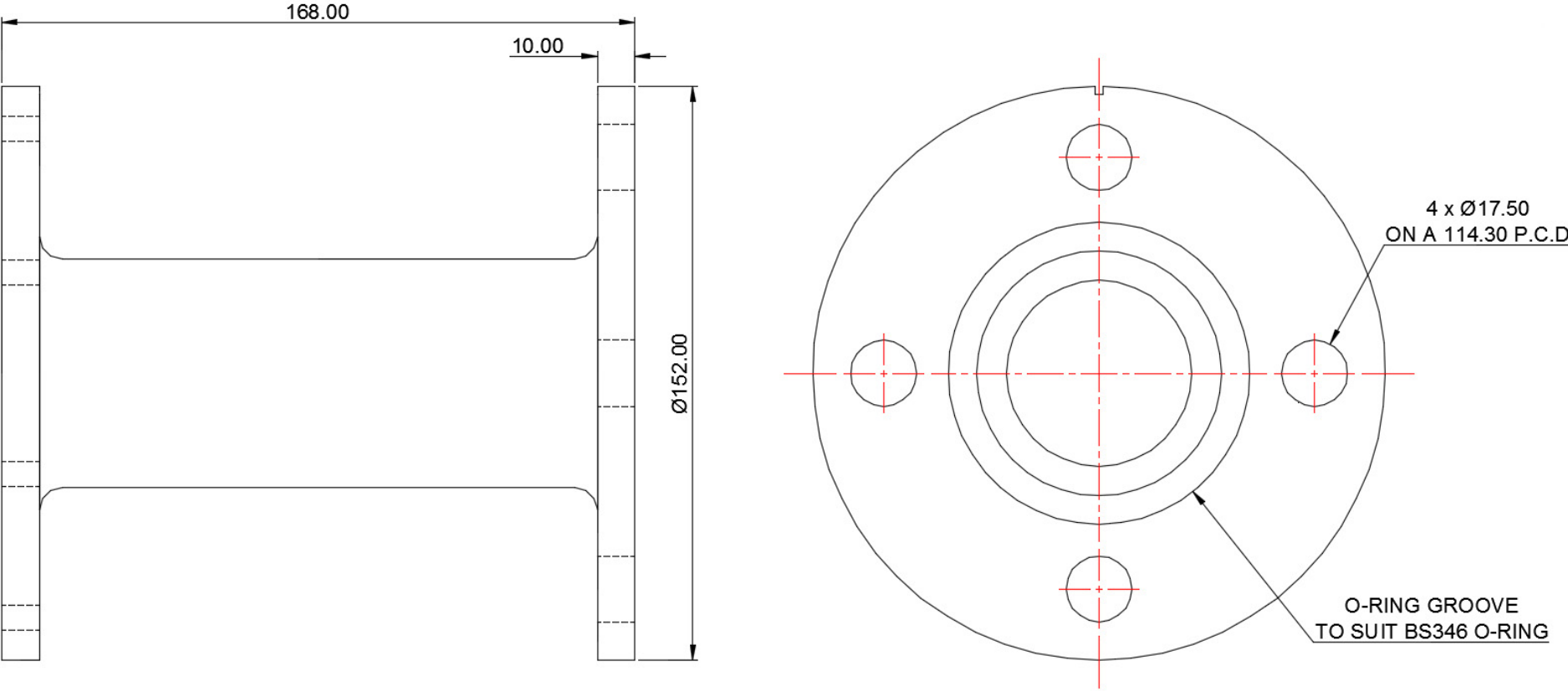
Within the EU all electronic components and batteries must be taken for separate collection at the end of their working life under EU WEEE directives. Applied Acoustics as a manufacturer within the EU will responsibly dispose of any returned end of life Applied Acoustics components / batteries through a registered WEEE scheme. In order to prevent uncontrolled waste disposal and promote re-cycling please return any end of life Applied Acoustic components postage paid by sender to our UK head office. Please contact Tech Support for a RMA number prior to shipping.

14. System Recovery

The Nexus Console has a built in system recovery tool. This may be used to recover the system to the condition when delivered.

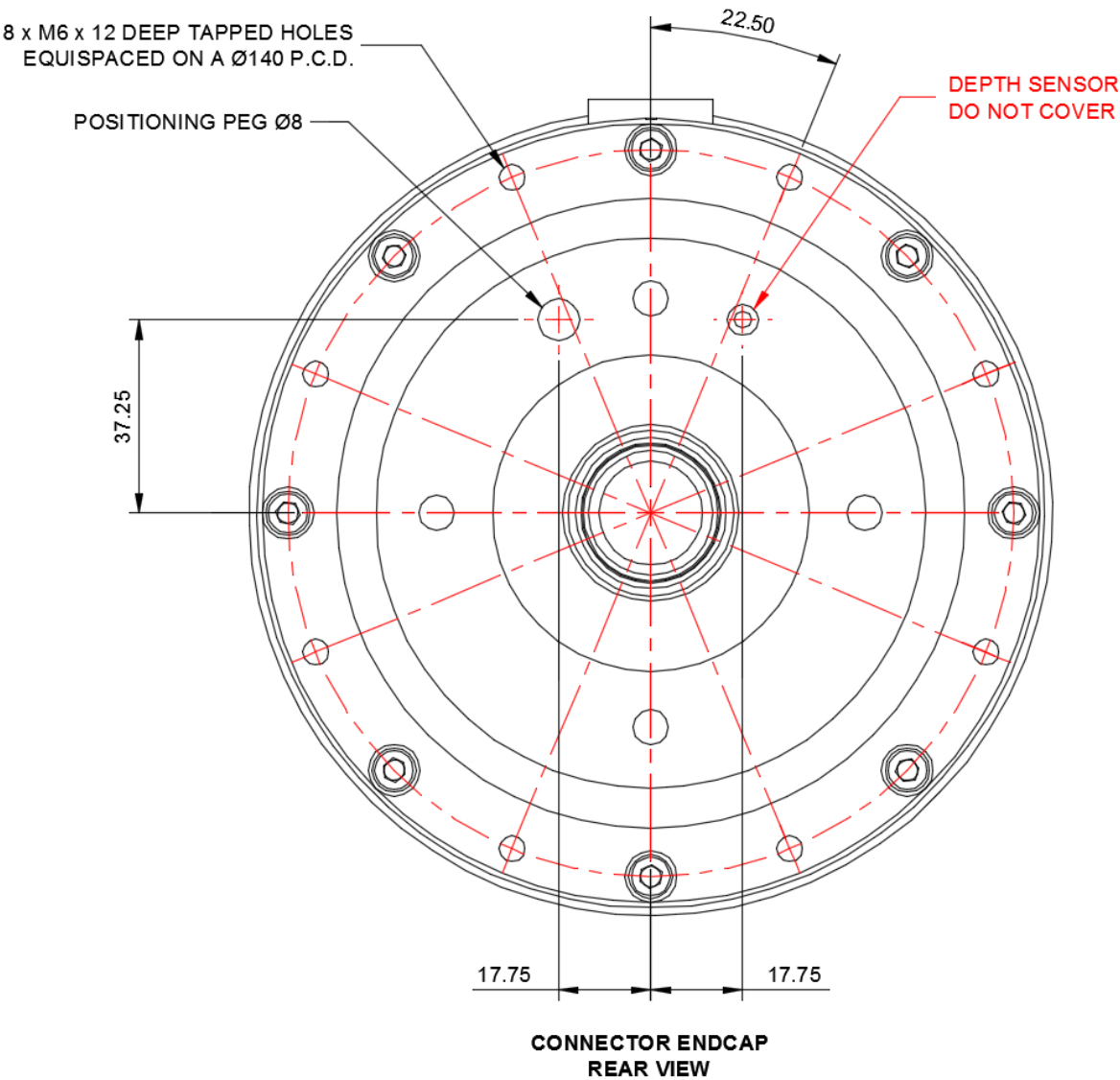
Please contact Applied Acoustics Technical Support for details

Appendix A – 2686 Transceiver Mounting Bracket

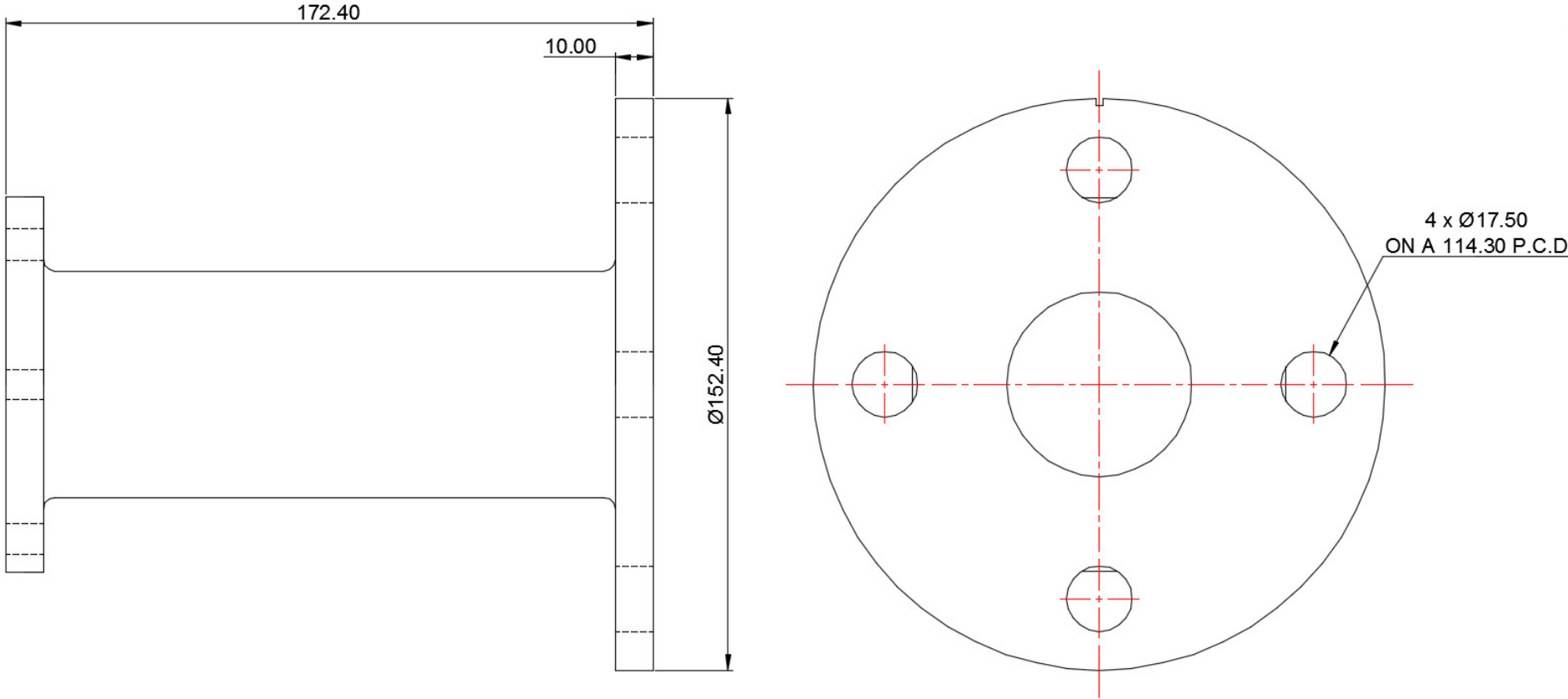


Transceiver installation is the responsibility of the operator.

Appendix B – 2686 Transceiver Mounting Dimensions

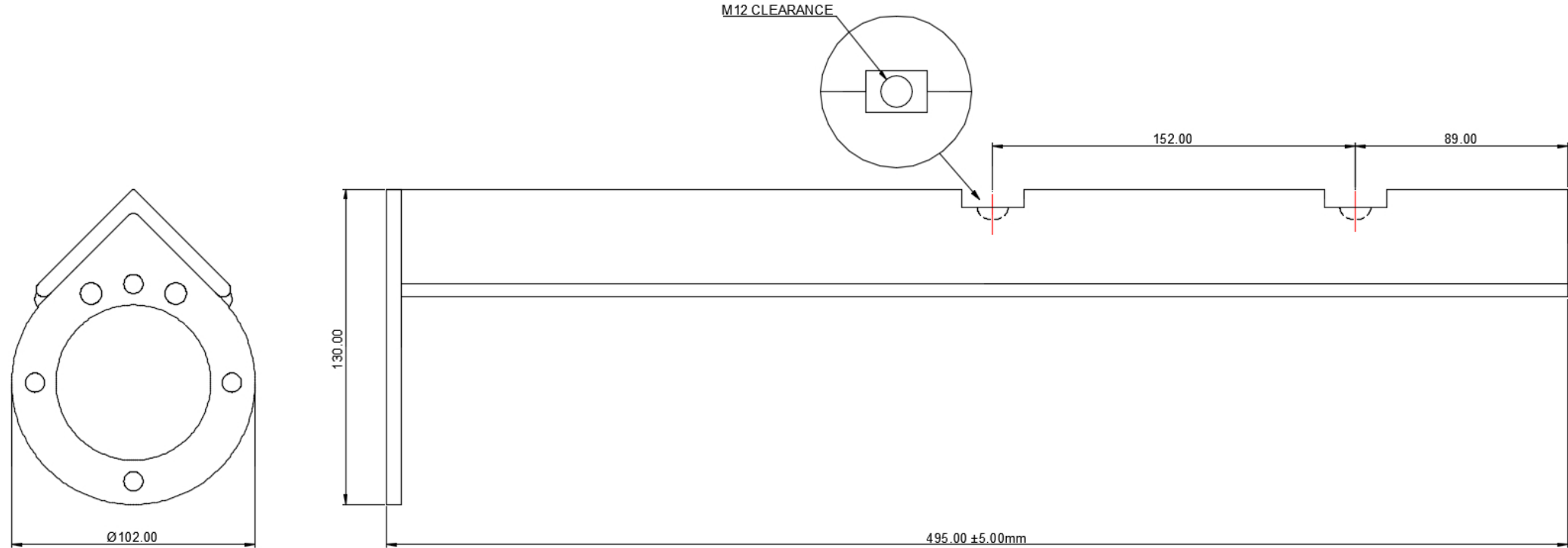


Appendix C – 2682 Transceiver Mounting Bracket A



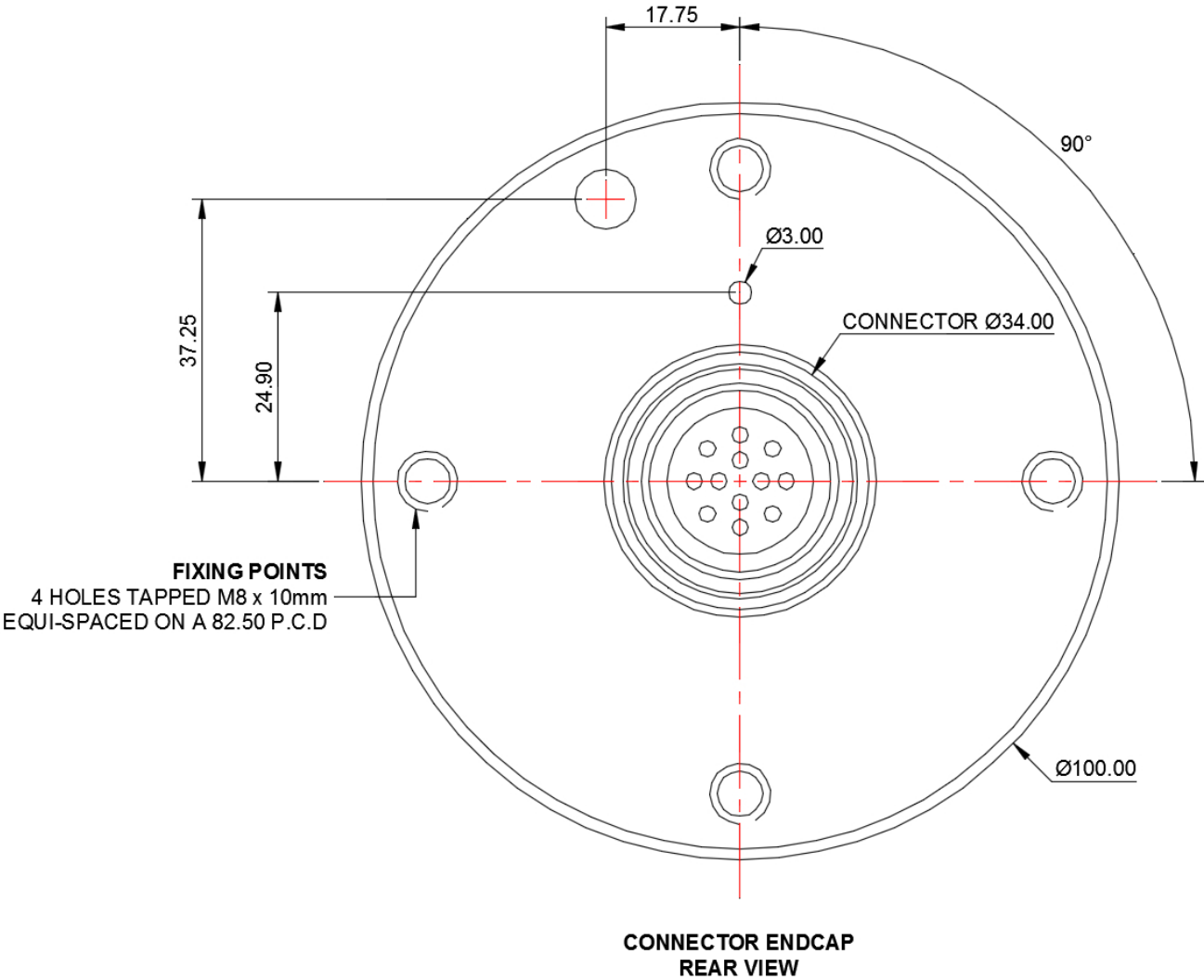
Transceiver installation is the responsibility of the operator.

Appendix D – 2682 Transceiver Mounting Bracket B

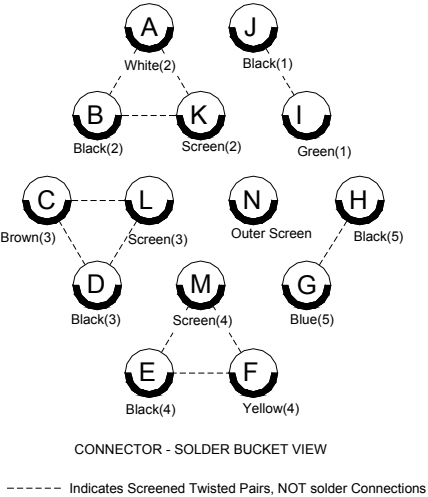
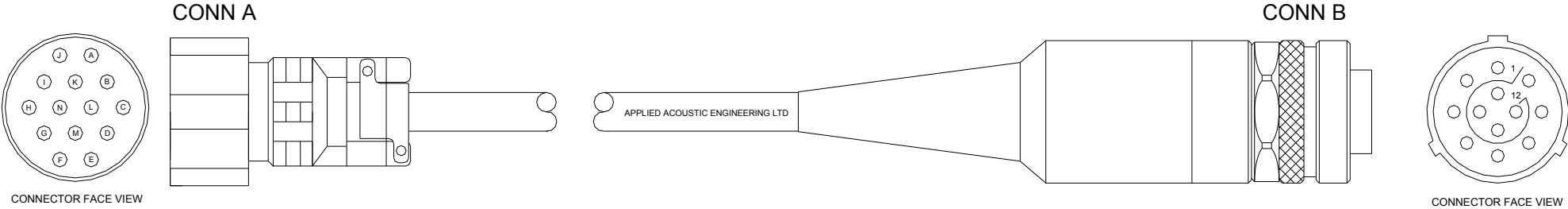


Bracket rated for typical survey speeds of up to ~5 Knots.
Bracket A is recommended for higher speed applications.
Transceiver installation is the responsibility of the operator.

Appendix E – 2682 Transceiver Mounting Dimensions



Appendix F – Deck Cable Wiring



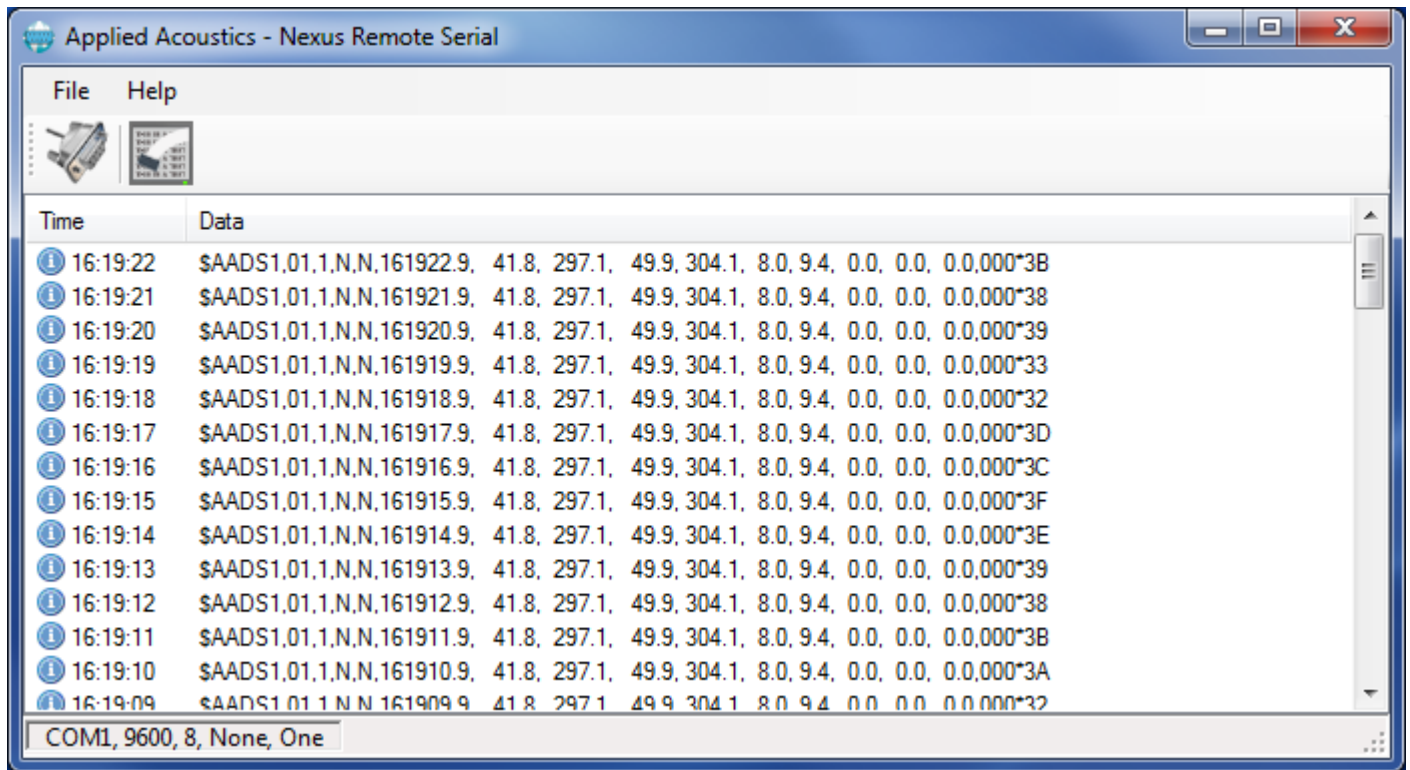
	A	B	C	D
1	Conn A	Function	Cable Screened Twisted Pairs (x)	Conn B
2	I	1033;1033;(A) POWER SUPPLY +	1033;1033;GREEN (1)	8
3	J	(A) POWER SUPPLY +	BLACK (1)	8
4	Cut down and Insulate	SCREEN (N/C)	1033;1033;SCREEN (1)	9
5	A	1033;1033;RS422 UP+	1033;1033;WHITE (2)	2
6	B	RS422 UP -	1033;1033;BLACK (2)	3
7	K	SCREEN	1033;1033;SCREEN (2)	10
8	C	RS422 DOWN +	1033;1033;BROWN (3)	4
9	D	RS422 DOWN -	1033;1033;BLACK (3)	5
10	L	SCREEN	1033;1033;SCREEN (3)	11
11	E	1033;1033;RESPONDER OUT +	1033;1033;BLACK (4)	6
12	F	1033;1033;RESPONDER OUT -	1033;1033;YELLOW (4)	7
13	M	RESPONDER SCREEN	1033;1033;SCREEN (4)	12
14	G	1033;1033;(B) POWER SUPPLY -	1033;1033;BLUE (5)	1
15	H	(B) POWER SUPPLY -	1033;1033;BLACK (5)	1
16	Cut down and Insulate	1033;1033;SCREEN (N/C)	1033;1033;SCREEN (5)	N/C
17				
18	N	1033;1033;OUTER SCREEN	1033;1033;OUTER SCREEN	N/C
19				
20	Cut down and Insulate	N/C	ORANGE (6)	N/C
21	Cut down and Insulate	1033;1033;N/C	BLACK (6)	N/C
22	Cut down and Insulate	1033;1033;N/C	SCREEN (6)	N/C
23	Cut down and Insulate	1033;1033;N/C	RED (7)	N/C
24	Cut down and Insulate	1033;1033;N/C	1033;1033;BLACK (7)	N/C
25	Cut down and Insulate	1033;1033;N/C	1033;1033;SCREEN (7)	N/C

AAE DRAWING REF: EZT-2690-4005/1

Appendix G – Remote Serial Application

The Nexus system may be connected to a network via the LAN port on the rear panel. When connected, the system broadcasts a UDP message on port 17003 containing the currently selected output message, as selected in the system configuration.

An application is available that may be installed on a Windows PC. The application listens for the UDP broadcast from a Nexus unit and then outputs the received data from a local serial port.



The application may be configured to output on any available serial port and at any required baud rate and data format.

Please contact Applied Acoustics for more details.

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