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Easytrak Nexus
2690 Series
Operation Manual

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Revision History

Issue	Change No.	Reason for change	Date
3	848	2682 Calibration Procedure Added Applicable from GUI V2.3.3	01/12/10
4	888	External Depth support added 1000 Series Beacon support added Applicable from GUI V2.3.4	04/03/11
5	1126	Applicable from GUI V2.4.0 Kalman Filter added External Heading support added Overlay Visuals added Advanced User Mode added Pitch & Roll Monitor Added	19/04/12
6	1165	Additional Informational notes to bottom of pages 14, 106 & 107	09/07/12
7	1271	Applicable from GUI V2.4.1 Added 'Ship Referenced' data out mode Allow multiple output data string to be selected Enable engineering tools menu when in advanced mode Added synchronise system time with GPS time Added 'Pseudo GPGGA' output string Added 'AAE V2' output string Added extra vessel trail point options New unified Transceiver Programmer software for ARM and DSP programming Appendix D Added – BIOS POST codes	11/01/13
8	1352	Added 529P Release Beacon Support	12/07/13

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We hope you experience many years of reliable operational use from our products.

If you do encounter any technical issues with any of our products then please don't hesitate to
contact our Technical Team via the following methods.

Tel: +44 (0)1493 440355

Fax: +44 (0)1493 440720

Email: techsupport@appliedacoustics.com

Applied Acoustic Engineering Ltd has made every effort to ensure that the information contained in this
manual is correct at time of print. However our policy of continual product improvement means that we
cannot assume liability for any errors which may occur.

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.

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1. Introduction to the 2690 Easytrak Nexus

This manual provides the user with information on the installation, operation and maintenance of the Easytrak Nexus 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 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. In gating and smoothing modes, 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 transceiver is fitted with internal compass, pitch and roll sensors. The pitch and roll sensors work to $\pm 80°$, more than sufficient for boat work. The transceiver also includes depth and temperature sensors.

i **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 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, the operator can enter two values of VOS into Easytrak, one for the bearing/ depression angle, and a second for the range calculation. An option is available

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[*] Sonar system for seabed mapping
[†] Remotely Operated Vehicle
[‡] Autonomous Underwater Vehicle

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

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

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2. Basic Theory

Easytrak Nexus 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:

$$\textbf{Range} = \underline{\textbf{VOS x Travel-time}}\textbf{ (m)}$$

$$\textbf{2}$$

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:

$$\textbf{Range = VOS x Travel-time (m)}$$

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

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[*] The vertical angle between the horizon and the target
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3. System Description

Easytrak Nexus consists of a console unit, transceiver, deck cable and up to 10 beacons.

Easytrak Nexus Console Unit

Easytrak Nexus 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 consoles 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.

1000 Series Beacon

The 1000 MKII Series Beacon incorporates Spread Spectrum Technology; the wide bandwidth transmissions reducing its susceptibility to interference thus enabling accurate positioning and secure data transmission. The 1000 series retains its flexibility by incorporating tone burst channels and analogue data telemetry options as standard. The 1000 series beacons may be connected to the Nexus console to read and change the beacon configuration if required.

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4. Installation

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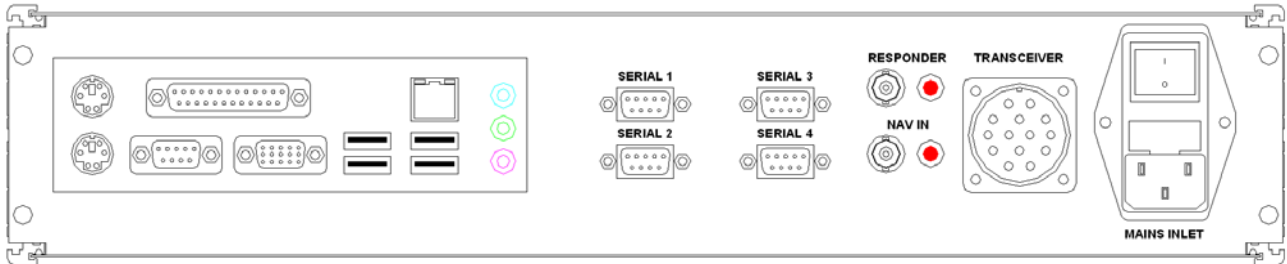
SERIAL PORTS: 4 Serial ports available for external sensor interface and aux inputs.

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.

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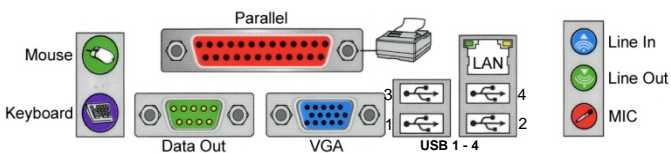
Note: The keyboard and mouse supplied with Nexus are USB interface and should be connected to USB ports 1 and 2 .

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)

Line In, Line Out, Mic, Parallel: May be used for future expansion

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Easytrak Nexus Transceiver Deployment Options

Suspended	Pole Mounted

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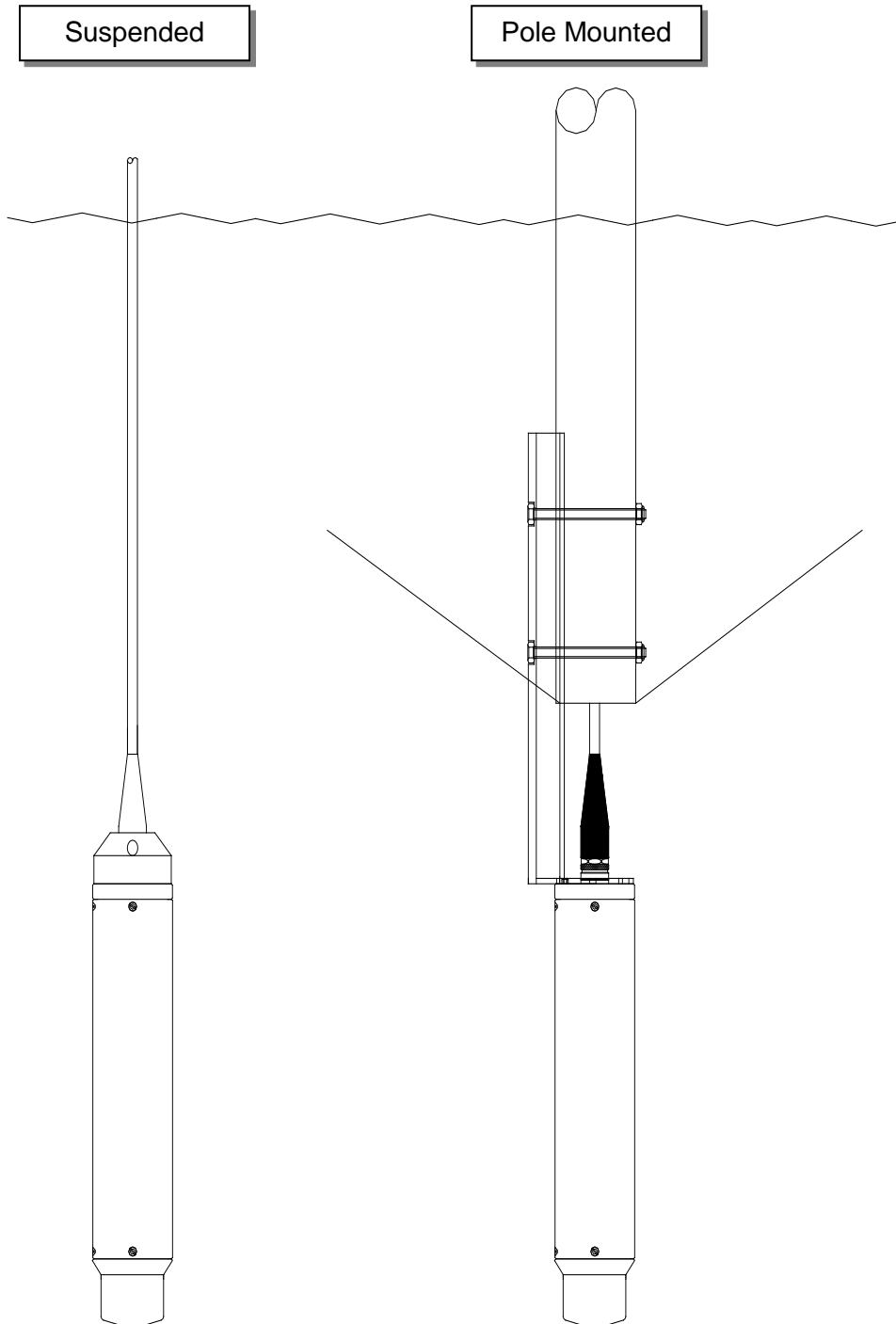
Pole Mounted – Over The Side

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 strumming 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.

Note: Please see Section 8 Calibration.

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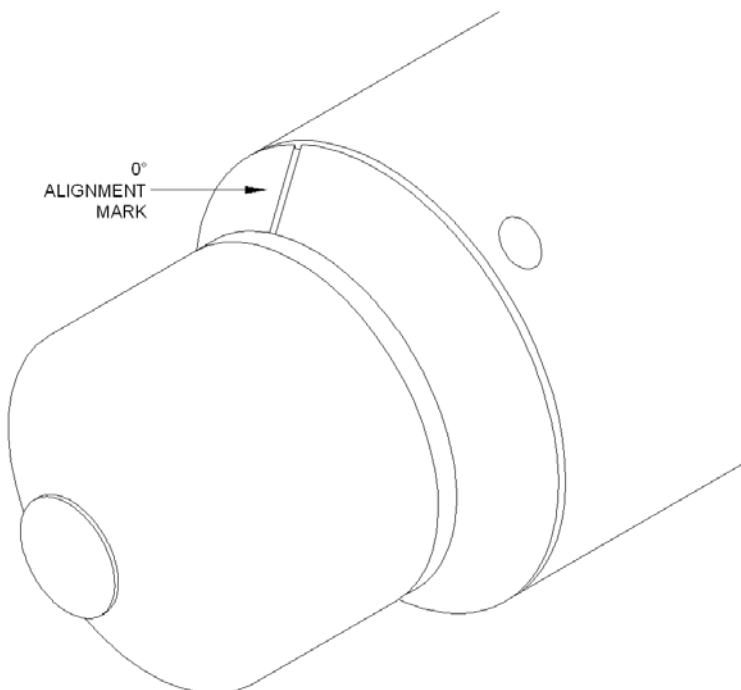
Suspended Over The Side

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:
Email   techsupport@appliedacoustics.com
Tel: +44 (0)1493 440355
Fax: +44 (0)1493 440720

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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.

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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.

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6. Easytrak Nexus Software

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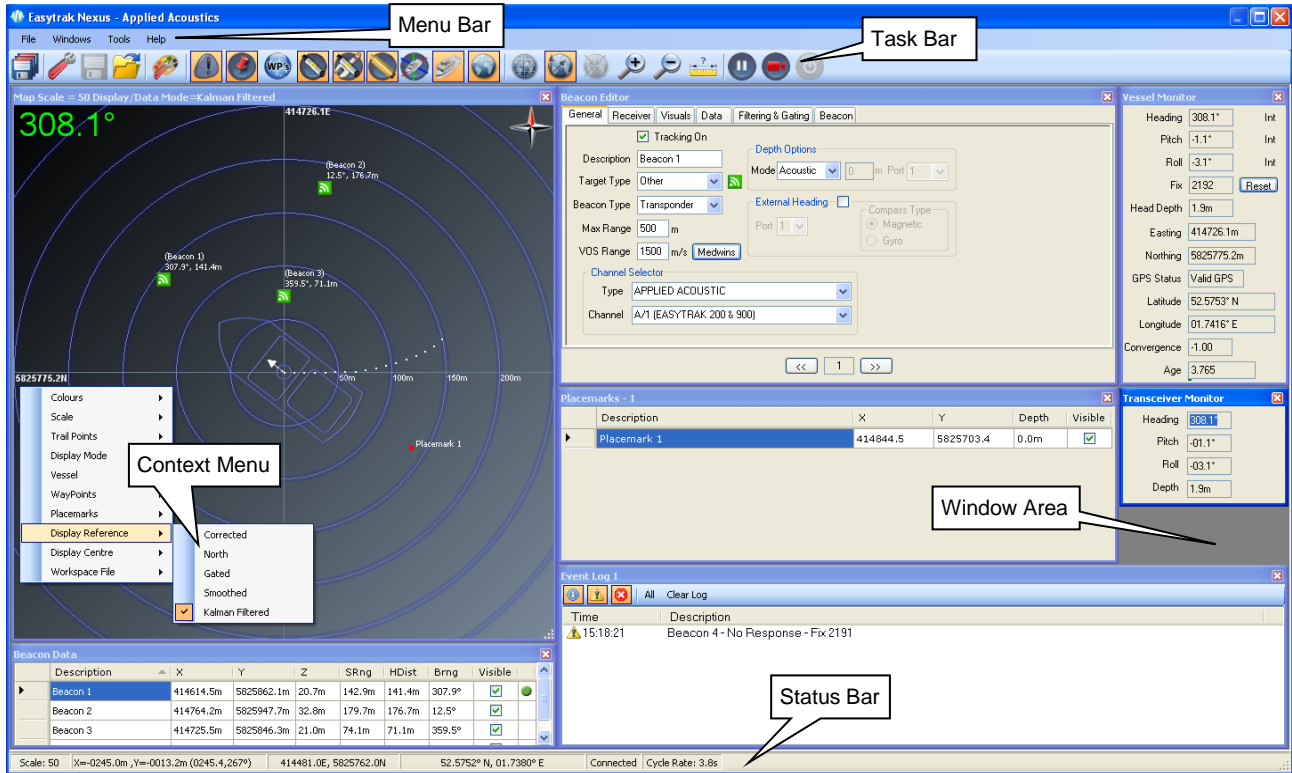
The software provides an intuitive user interface to configure, operate and monitor the Easytrak Nexus USBL Tracking system.

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

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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
WP's	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
	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)

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

Menu bar File Structure

File

Workspace → Open
→ Save
→ Save As

System Setup → Open
→ Save
→ Save As

Beacon Setup → Open
→ Save
→ Save As

Waypoints → Open
→ Save As

Placemarks → Save As

Windows

Plot

Events

Waypoints

Plot

Placemarks

Beacon Editor

Beacon Data

Transceiver Monitor

Vessel Monitor

Gating & Smoothing

Recorder

Pitch & Roll

Auto Position Windows

Windows Snap

Tools

Programming → Nexus Console
→ Transceiver
→ Nexus User Interface

Calibration → USBL Calibrate
→ Compass Calibrate

Engineering Tools ** → Acoustic Monitor

Advanced User → Enable
→ Change Password

GPS Time Sync

Help

About

User Info

Request Support

Add Ons

** Available in advanced user mode only

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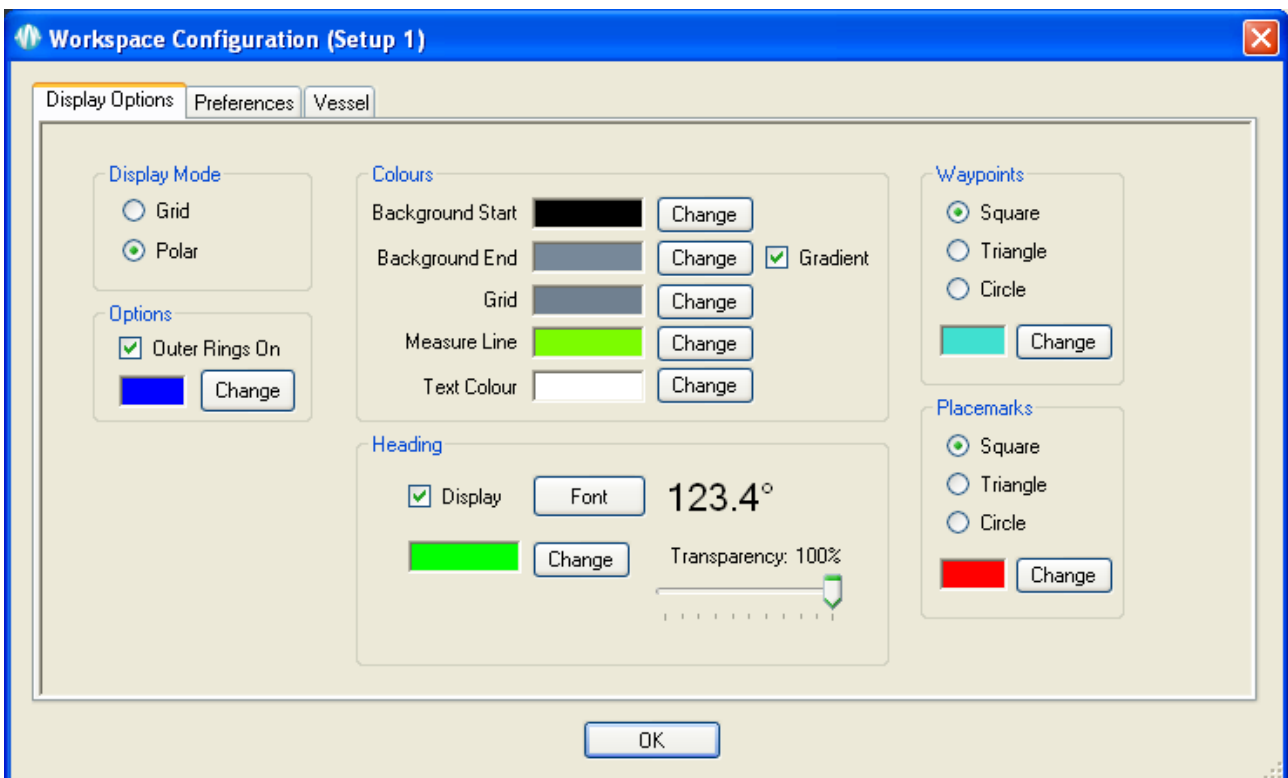
The Display Options tab allows the operator to configure the display to their preference for the local environment. For example - by altering the colour scheme 'workspaces' can be created for day and night operations.

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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.
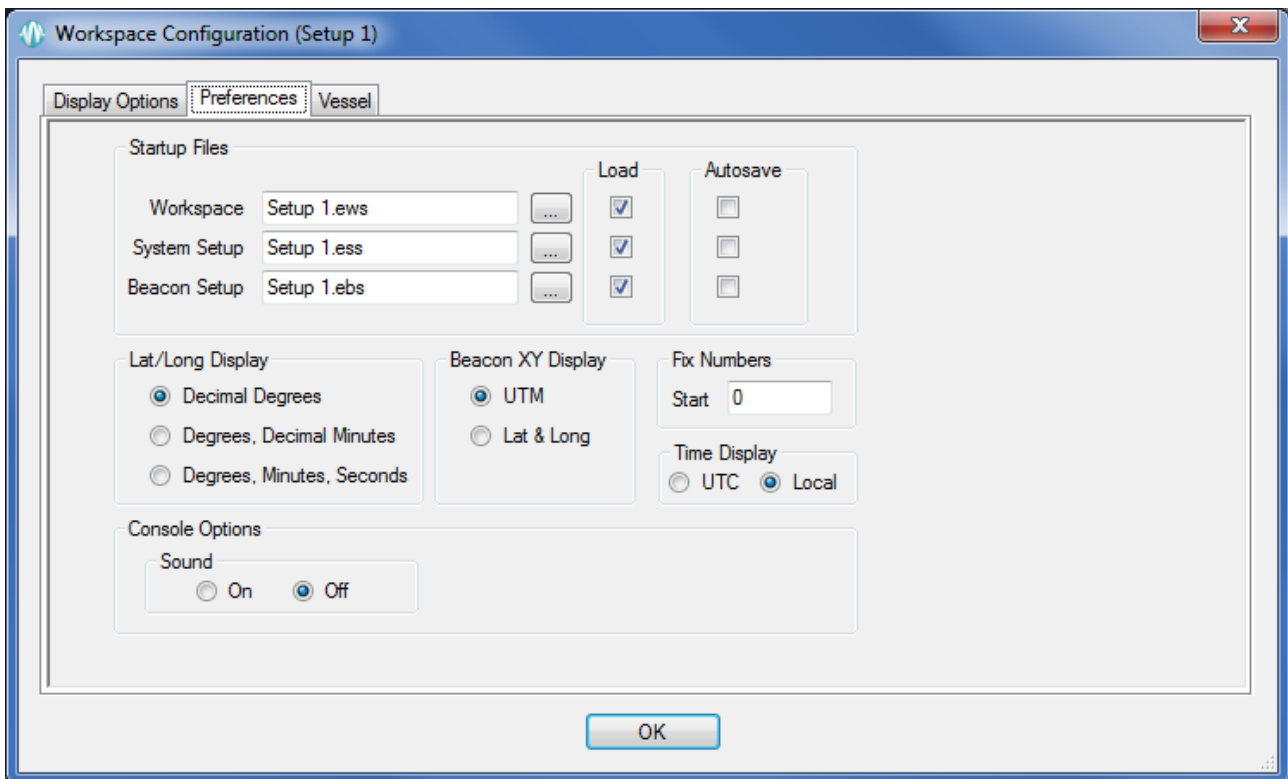
Startup Files

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.

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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.

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Vessel

The Vessel tab allows the operator configure the plot display for the vessel.
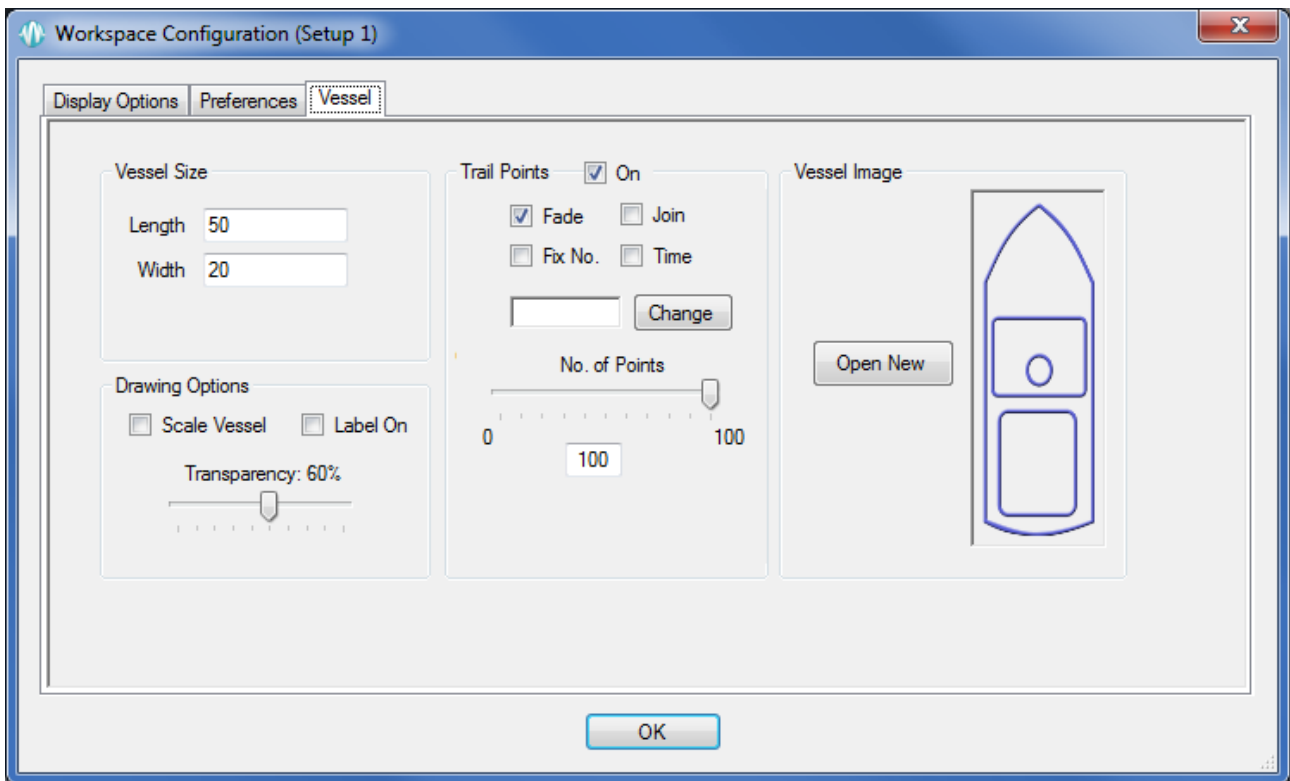
Vessel Size & Drawing Options

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).

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System Configuration

Toolbar Button:

The five 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.

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 series only).
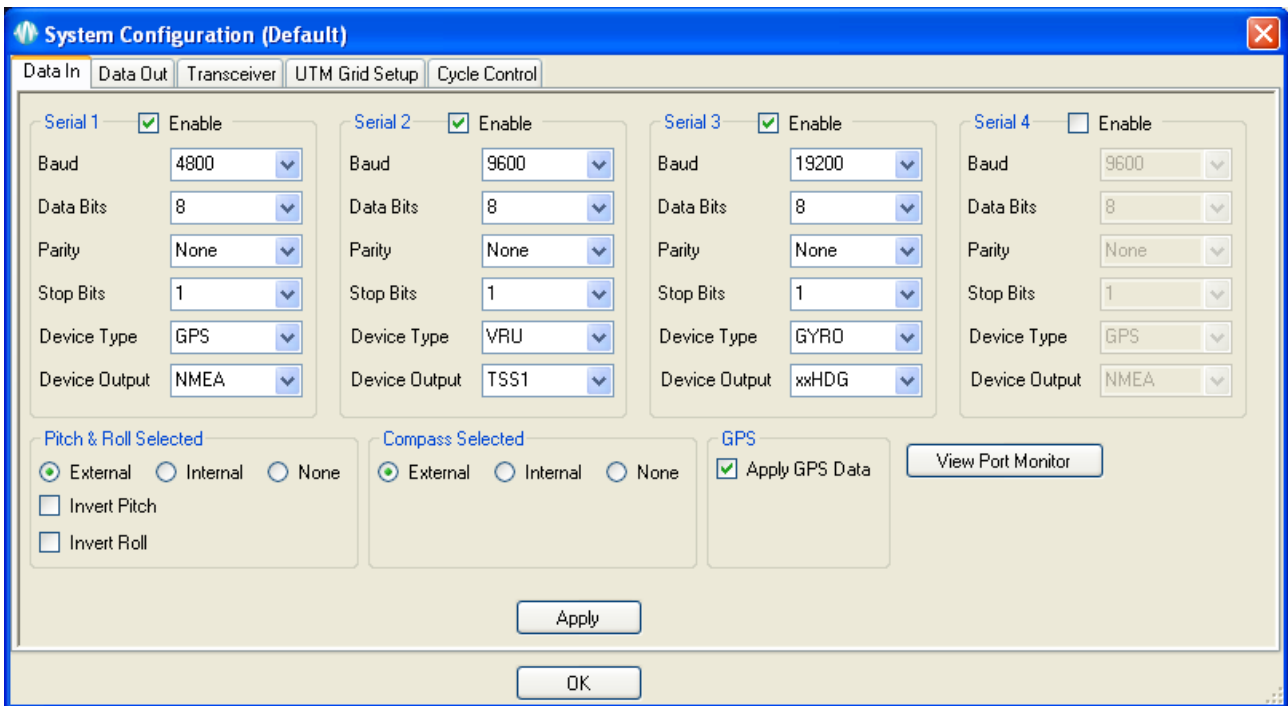
Serial set-up options:

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 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).

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[*] Serial 1 Only
[†] Not Serial 1

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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.

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 **Data Out Port**. Data is outputted after each Fix is processed (not at a pre-defined rate).
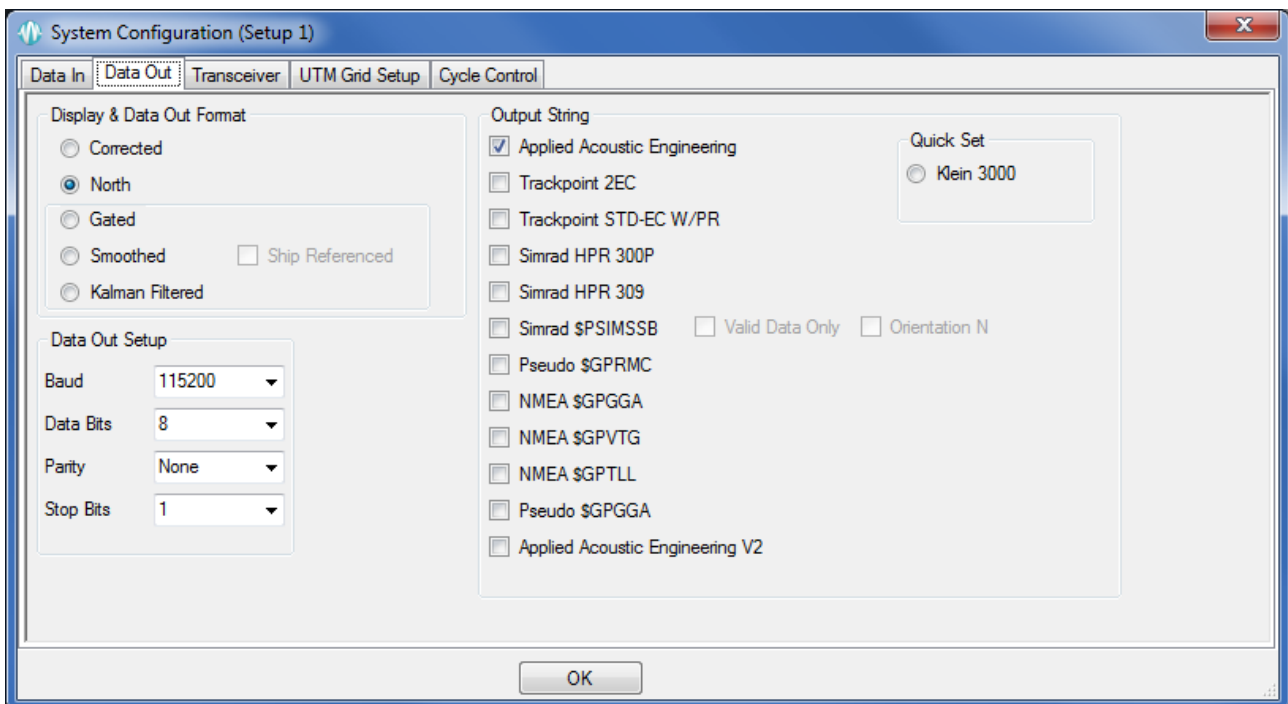
Data Out Setup

The serial communication properties for baud rate, data bits, parity and stop bits may be configured. Please note that there is no hardware or software handshaking in either direction.

Display & Data Out Format

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.

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Display Reference Data Source:

This feature determines the type of data used in calculating the displayed beacon data and the serial output data.

- Corrected
  Positions are referenced to the bow of the SHIP and corrected for pitch, roll and offsets. No adjustments are made for the transceiver compass heading. The positions derived in this mode are not affected by any gating or smoothing setting.

- North Ref
  Positions are referenced to the NORTH. Compass, pitch, roll, and offset values are applied to the computed position. A Compass <u>must</u> be used to be north referenced, otherwise the data will be corrected (bow) referenced. The positions derived in this mode are not affected by any gating or smoothing setting.

- Gated
  Positions are referenced to the NORTH. North referenced values are used except where a value falls outside a user selected 'Gate' or a reply is lost. The lost reply or 'out of gate' position is replaced by an estimated position based on previous positions. This gate can be a maximum velocity, maximum horizontal distance moved etc. Compass, pitch and roll inputs <u>must</u> be used otherwise incorrect positions will be produced.

- Smoothed
  Positions are referenced to the NORTH. The current position is estimated from the last 'N' positions. The degree of smoothing is set in the 'Gate' menu.
  Compass, pitch and roll inputs <u>must</u> be used otherwise incorrect positions will be produced.

- Kalman Filtered
  The North referenced data is passed to the Kalman filter. Please refer to the beacon editor section for further details on the operation of the filter.

- Ship Referenced
  This option is available when either gated, smoothed or Kalman filtered data is selected and enables the data output to be ship referenced AFTER the selected filtering has been applied.

<u>Output String</u>

The output string mode can be selected from a number of pre-defined output formats. Any number of output formats may be selected. If more than one selection is made then each string will be appended. A quick set option for Klein 3000 enables all required output messages to be selected.

String	Description
AAE	Applied Acoustic Engineering's string
TPll-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

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NMEA $GPGGA	NMEA GPGGA format string
NMEA $GPVTG	NMEA GPVTG format string
NMEA $GPTLL	NMEA GPTLL format string
Pseudu $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

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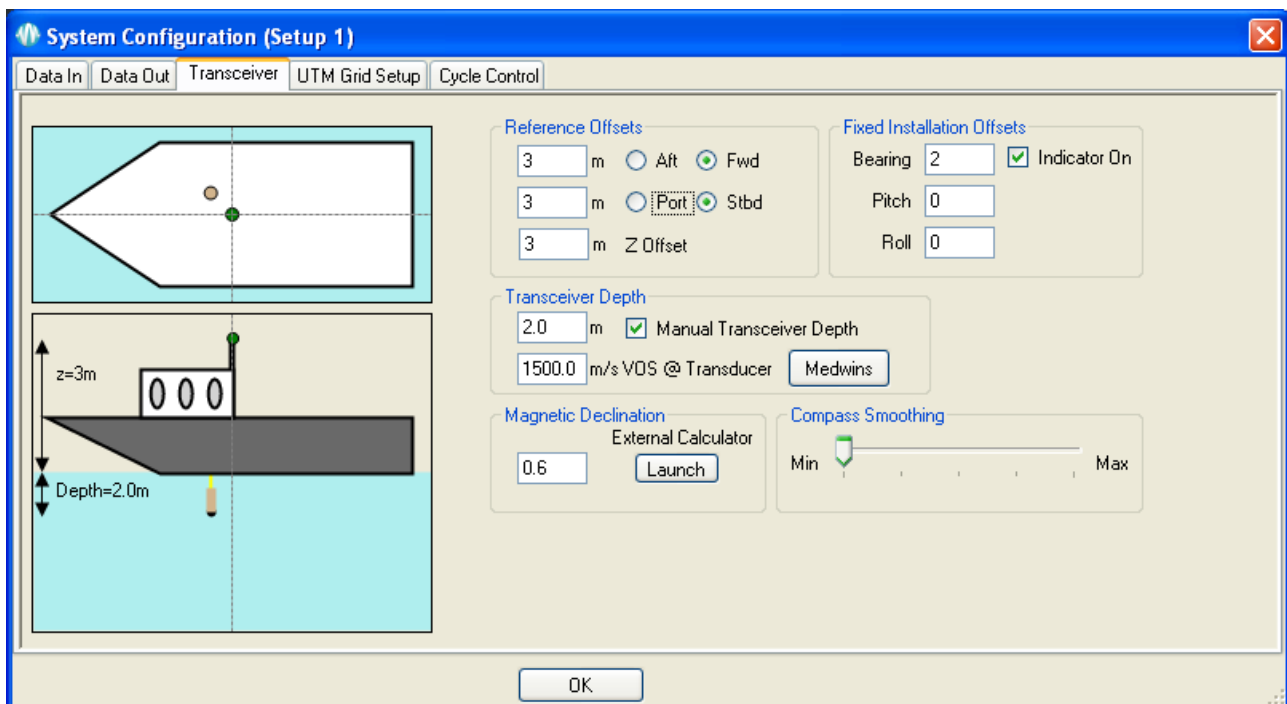
The following offsets are available: Forward/Aft (m), Port/Starboard (m), Z (Height m). Also, Roll offset (degrees), Pitch offset (degrees), Bearing offset (degrees), Magnetic declination and Transducer depth (m) below water line.

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

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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
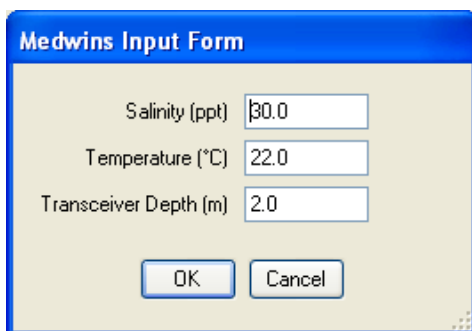
Fixed Installation Offsets
As a result of calibration or measurement the installation offsets can be applied.
A positive value of bearing indicates a clockwise offset.
A positive value of pitch indicates bow up.
A positive value of roll indicates port up.

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.)

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/geomagmodels/Declination.jsp

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Notes on Transducer Depth and Z Offsets

'Z' and Transducer offsets

Z Offset 4m

Navigation Point

Transducer depth | 2m

Transducer

9m (True 'Z' Distance)

(Raw Acoustic depth) 3m

5m (Depth below Sea Level)

Note, N.T.S.

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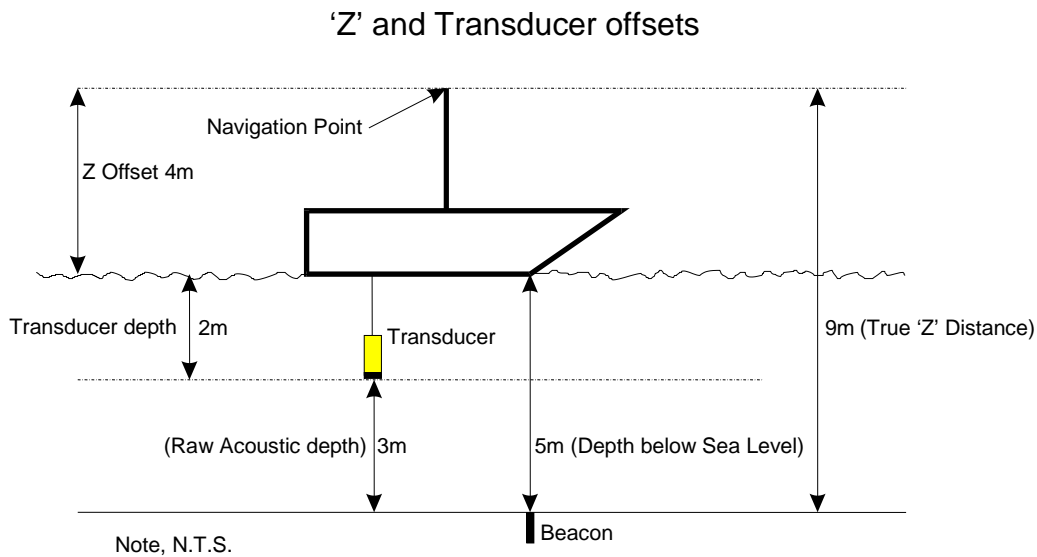
The Navigation Point is the point on the vessel where all navigation measurements are referenced to; in above example, the top of the mast.

- Acoustic depth
  True 'Z' distance = Raw Acoustic Depth (3) + 'Z' Offset (4) + Transducer Depth (2)
  3 + 4 + 2 = 9m

- Manual Depth (Where the depth is entered manually.)
  True 'Z' distance = Manual depth to target (5) + 'Z' Offset (4)
  5 + 4 = 9m

- Depth Beacon (Telemetry etc.)
  True 'Z' distance = Telemetry depth (5) + 'Z' Offset (4)
  5 + 4 = 9m

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UTM Grid Setup

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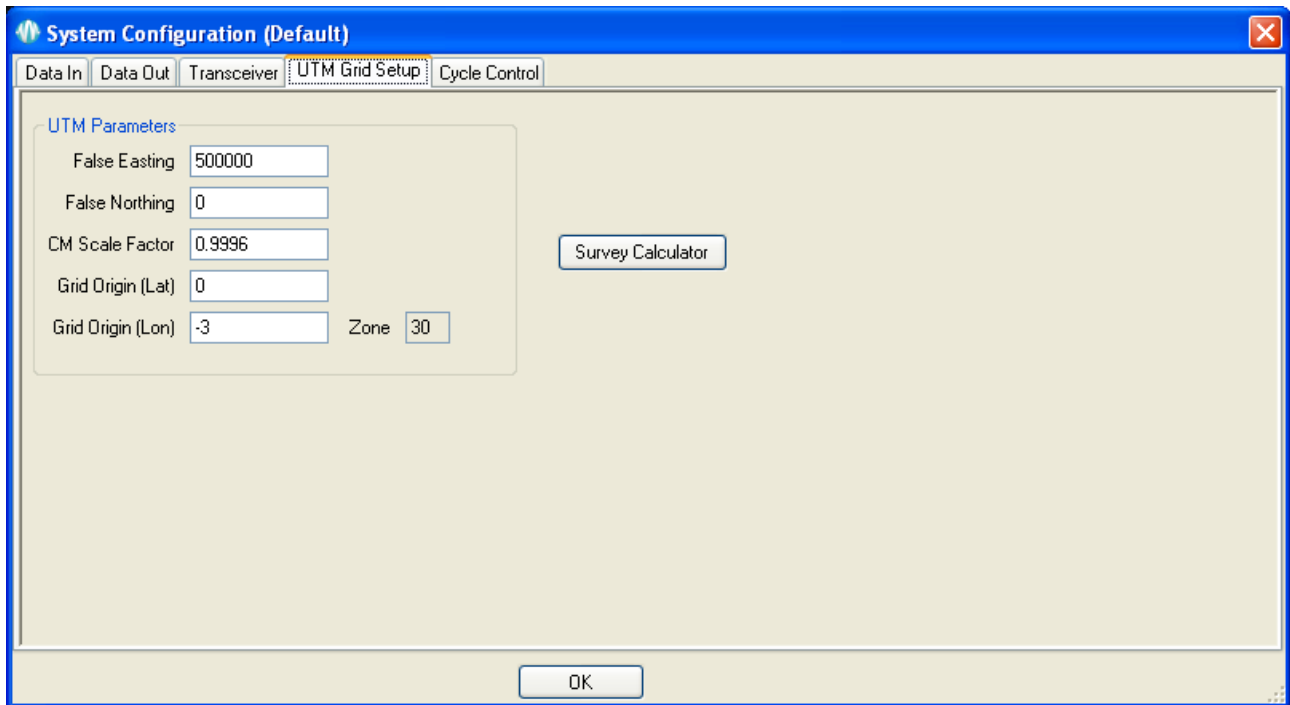
UTM Parameters

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.

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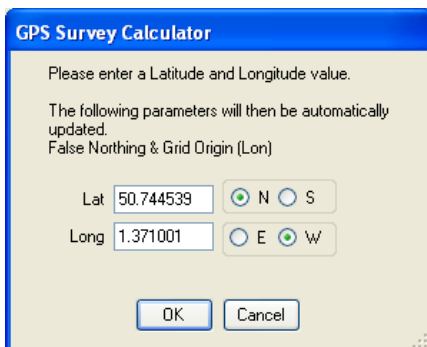
To calculate the UTM zone start the Survey Calculator. Enter the degrees and decimal degrees of your local latitude and longitude. If GPS is available the position is automatically set to the current GPS position. Click OK to apply and exit. The calculator, upon exit, sets the parameters in the UTM Grid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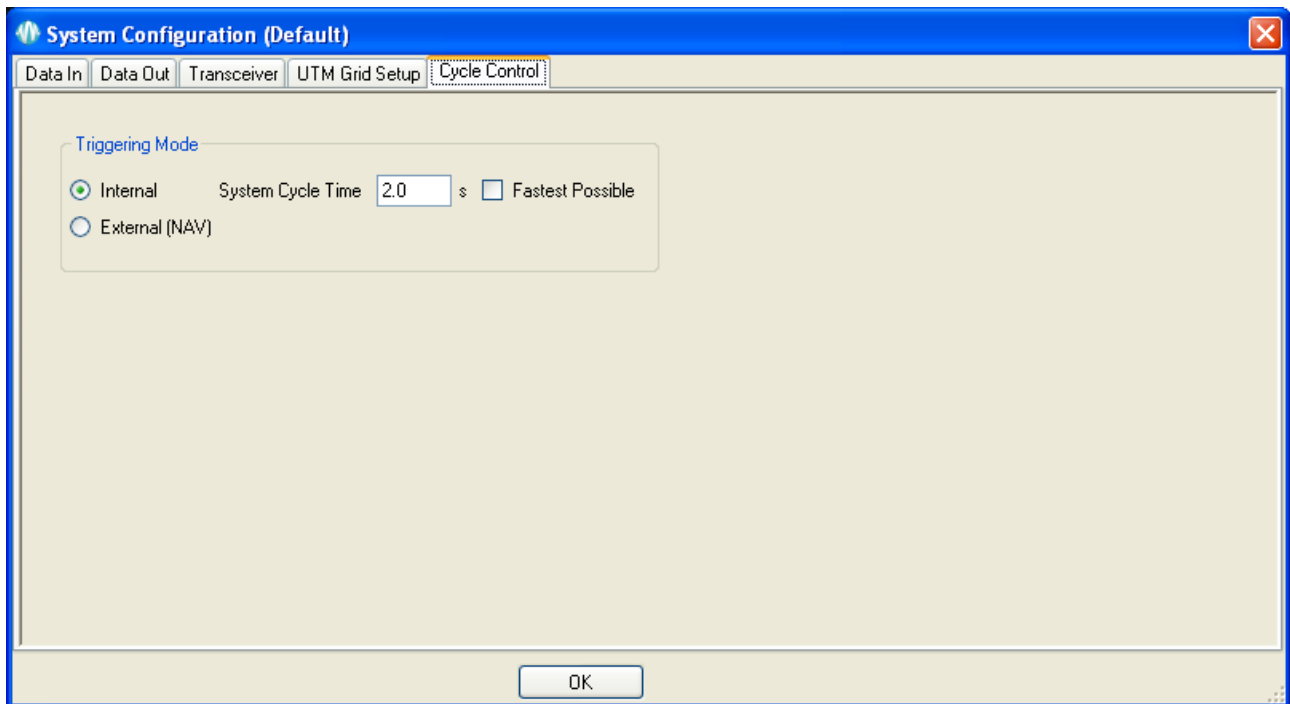
Triggering Mode

- Internal
  The cycle time is controlled internally and is set by the operator using the System Cycle Time parameter.
  Using the Fastest Possible option the system will cycle all enabled targets as fast as possible using the max range variable for each beacon to calculate and dynamically adjust the cycle time.

- External
  System is triggered via the NAV IN connection on the rear panel.
  TTL type 5 volt pulse triggers on rising edge.

i   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).

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Beacon Editor

Toolbar Button: Shortcut Key: Ctlr+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
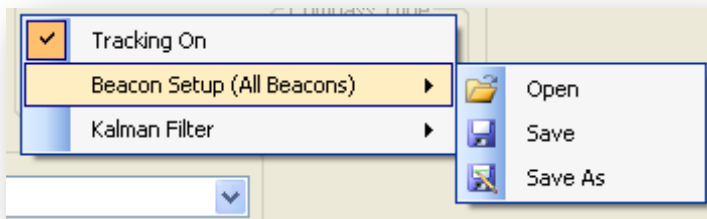
From this menu the following functions can be performed

- 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 10 different beacons. To select the required beacon, use either the mouse wheel or the '<<' and '>>' buttons

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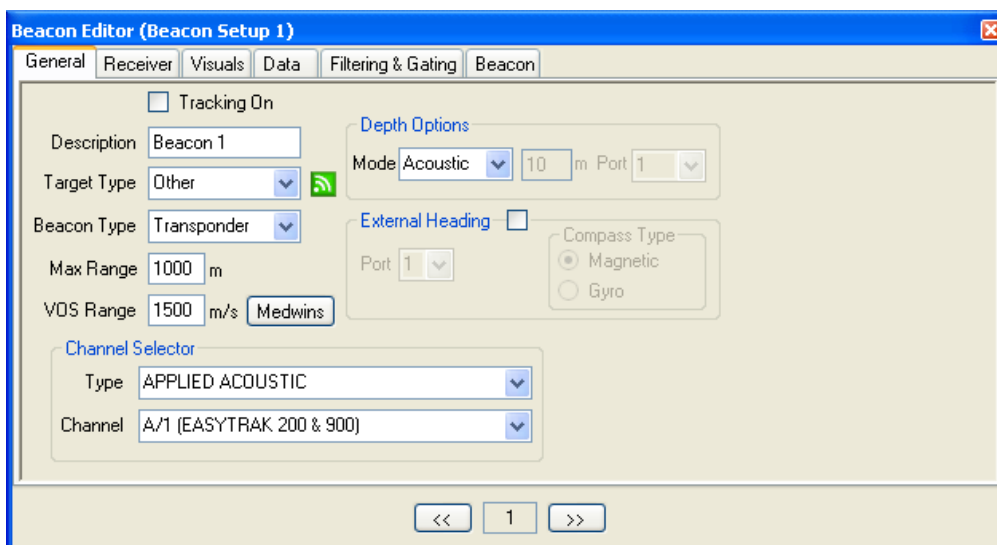
Tracking On
To Enable Tracking on the selected Beacon 'Tick' the 'Tracking On' check box. The 'Context Menu'

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 selcted this will also enable the 'Release' tab in the beacon editor to control release beacon functionality[*]

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 my 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

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[*] Will only be dislayed if release beacons add on feature enabled

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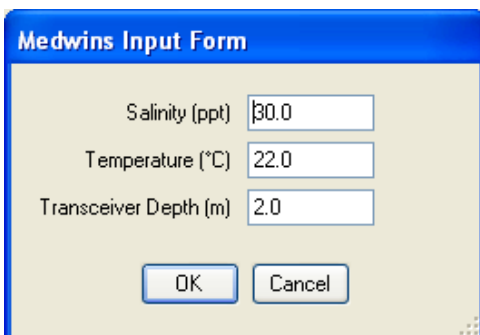
Enter the max range (slant range, not horizontal range) for the target, this allows the system to adjust the cycle rate for fastest possible update rate option or to determine the minimum time required before the next beacon can be fired.

> ℹ️ 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.

Medwins Input Form

Salinity (ppt)	30.0
Temperature (°C)	22.0
Transceiver Depth (m)	2.0

OK   Cancel

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

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Receiver

Each of the beacons receiver settings can be configured for optimal tracking.
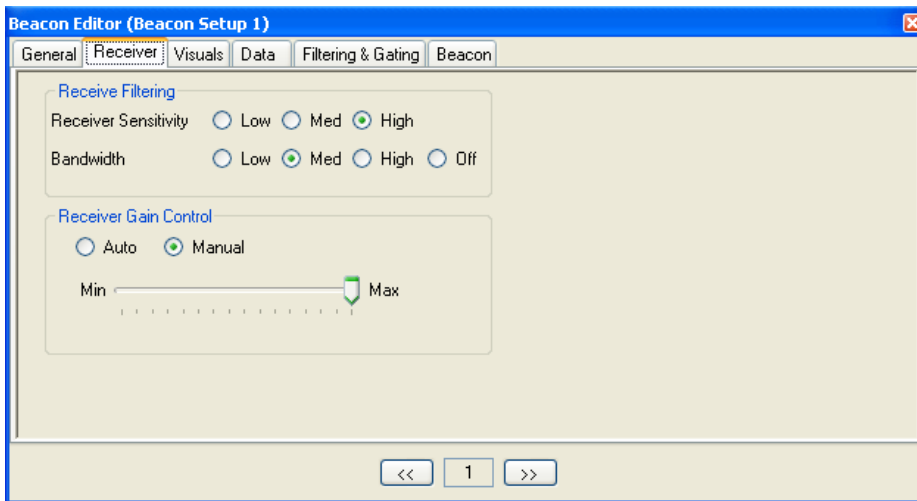
Receive Filtering
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Receiver sensitivity and bandwidth can be adjusted to obtain optimal signal to noise levels. See Data Tab for received signal information.

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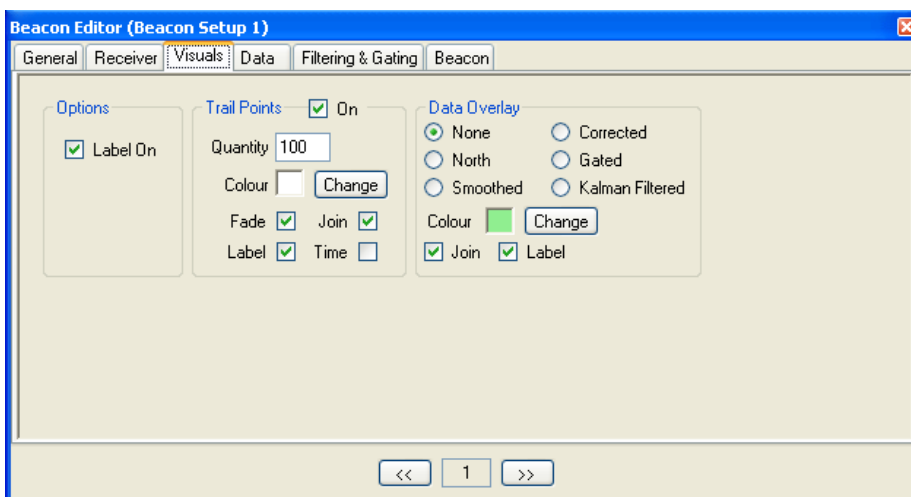
Options
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Within the plot window, each beacon can have a label displayed (showing description, horizontal range and bearing). This may be switched on/off using the 'Label On' check box.

Trail Points
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Trail points may be displayed showing the beacons position history.

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The following options may 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 Overlay

Any of the generated data sets may be overlayed onto the plot window to allow comparison of different data sets. The following options may be selected

- Data type – Corrected, North, Gated, Smoothed, Kalman Filtered or None
- A line drawn between trailpoints
- A label showing the fix number of the point (will be displayed every 5th point)
- The colour of the trail points, lines and labels

Data

The 'Data' tab displays position and signal quality data.
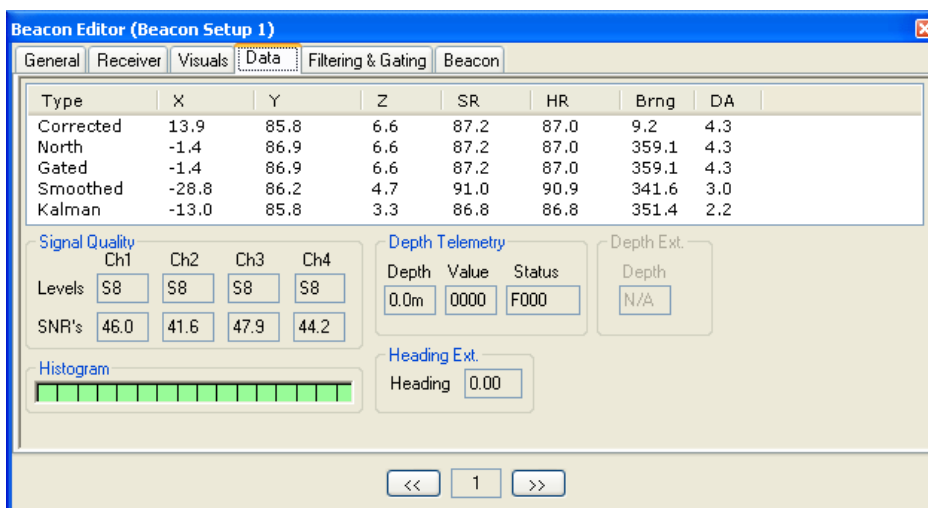
There are 5 data sets continuously calculated by the system from the raw acoustic measurements. Corrected, North, Gated Smoothed and Kalman Filtered. The values of these are displayed in the top section.

Signal Quality

- Levels
  S0 (Minimum) to S9 (Maximum), is an indication of the signal received at each of the receiver elements (channels).

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- 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).

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.

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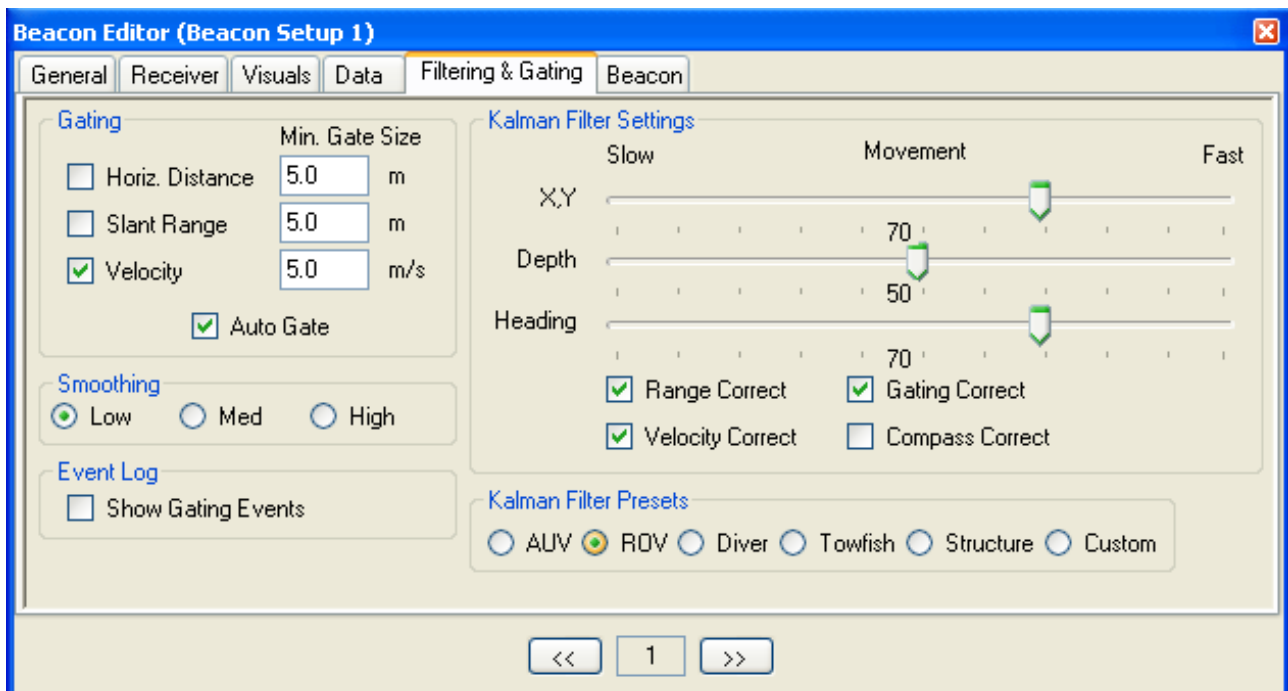
Gating Description

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 based on a number of previous positions (determined by the smoothing setting).

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.

- Smoothing
  Smoothing averages a number of previous positions where:
  Low   -   Average 4 positions
  Med   -   Average 8 positions
  High   -   Average 16 positions

- 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 de-activated.

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

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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

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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 following data sets from the corrected data set - North, Gated, Smoothed and Kalman Filtered. This advanced mode enables the trail point history to show how adjusting gating, smoothing and Kalman filter parameters will affect the output data. Used in conjunction the the 'Data Overlay' feature of 'Beacon -> Visuals' it is possible to *tune* the Kalman Filter to produce the optimum output data for the target being tracked.

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). By overlaying North referenced data onto the display, the lag will be visible and any changes to the filter setup will be immediatley shown in the plot window.

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.

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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.

i 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.
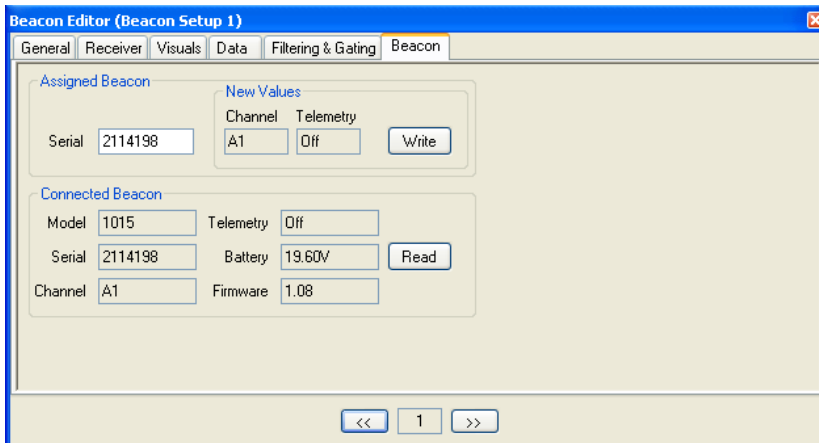
Assigned Beacon

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

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

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Release

The release tab enables control of Applied Acoustics 529P release beacons.

(i)   Release functionality is an add on feature that must be enabled.
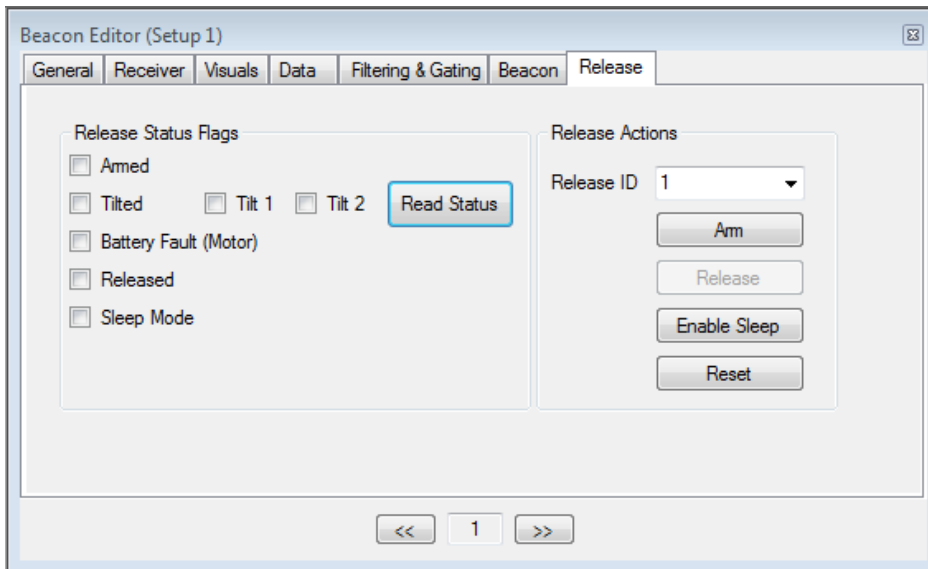
General Operation

The release tab, as shown above, will not be visible until the 'Target Type' is selected as 'Release' in the 'General' tab.

Release ID

The 529P 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.
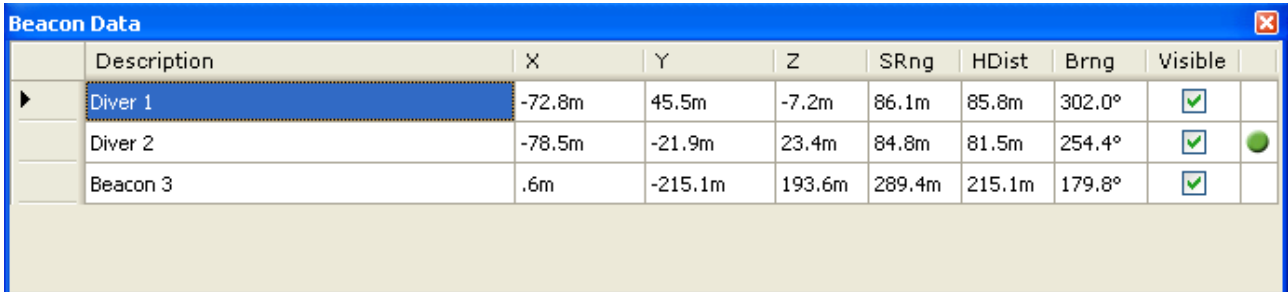
Release Actions

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

- 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

- 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.

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Beacon Data

Toolbar Button   Shortcut Key: Ctrl+D

Beacon Data									
	Description	X	Y	Z	SRng	HDist	Brng	Visible	
▶	Diver 1	-72.8m	45.5m	-7.2m	86.1m	85.8m	302.0°	☑	
	Diver 2	-78.5m	-21.9m	23.4m	84.8m	81.5m	254.4°	☑	●
	Beacon 3	.6m	-215.1m	193.6m	289.4m	215.1m	179.8°	☑	

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.
- Brg is the bearing to the target in degrees.

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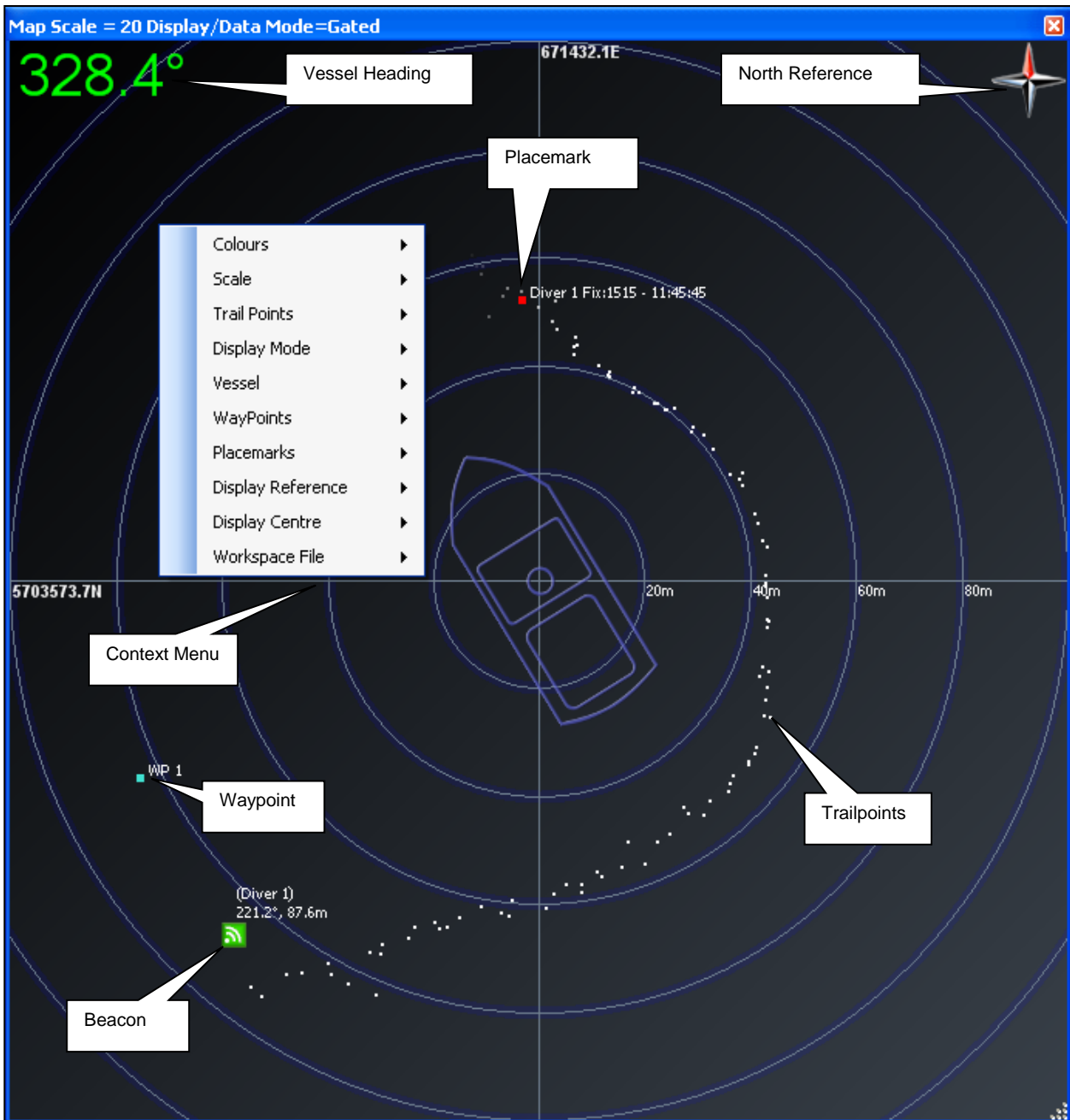
The current data source and scale is displayed in the Title Bar. If (A) is present the scale is in automatic mode.

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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.

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

Colours	→	Background Start Colour
		Background End Colour
		Background Gradient
		Grid colour
		Measure Colour

Scale	→	Auto
		1
		2
		5
		10
		20
		50
		100
		200
		500

Trail Points	→	Select Value
		Enter Value
		Fading
		Turn All On
		Turn All Off
		Clear All

| Display Mode | → | Grid |
| | | Polar |

| Vessel | → | Scale Vessel |
| | | Label On |

Waypoints	→	Add Waypoint
		Delete ALL
		Visibility	→	All On
				All Off

Placemarks	→	Add Placemark
		Delete ALL
		Visibility	→	All On
				All Off

Display Reference	→	Corrected
		North
		Gated
		Smoothed
		Kalman Filtered

Display Centre	→	Vessel
		Waypoint	→	Select
		Beacon	→	Select

Workspace File	→	Open
		Save
		Save As

- 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.

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- 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 Reference
  The current Display and Data Out mode can be set.

- 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.

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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.

Vessel Monitor

Heading	167.8°	Int
Pitch	3.1°	Int
Roll	0.2°	Int
Fix	12	Reset
Head Depth	2.5m	
Easting	614930.4m	
Northing	5622683.1m	
GPS Status	Valid DGPS	
Latitude	50.7445° N	
Longitude	01.3710° W	
Convergence	1.26	
Age	0.440	
SOG	0.0	
COG	0.0	
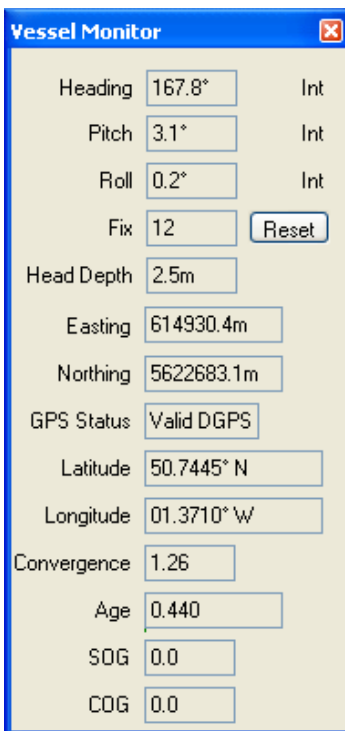
The Vessel Monitor also indicates if internal (Int.) or external (Ext.) heading, pitch and roll are selected.

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.

Transceiver Monitor

Heading	175.4°
Pitch	-05.1°
Roll	01.6°
Depth	0.0m

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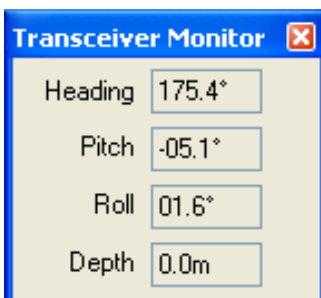
Pitch & Roll Monitor

Toolbar Button Shortcut Key: Ctrl+A

The Pitch & Roll Monitor window show a graphical representation of the current vessel heading, pitch & roll.
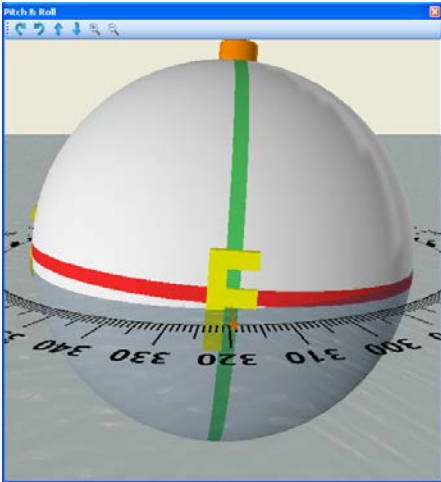
The forward, aft, port and starboard of the vessel are indicated on the model with F,A,P & S respectively. The arrow shows the current vessel heading overlayed on the compass.

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   -   View angle change
Wheel + Alt   -   View elevation change

Shift Key   -   With any above combinations will increase the speed of adjustment

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Event Log

Toolbar Button ⚠ Shortcut Key: Ctrl+V

The event log displays any required system messages.

```
Event Log 1                                                          ⊠
 ⓘ  ⚠  ⊗  | All   Clear Log
 Time            | Description
⚠ 14:26:02        Beacon 2 Out of Gate - Velocity (5.0m/s), Velocity = 10.56m/s
```
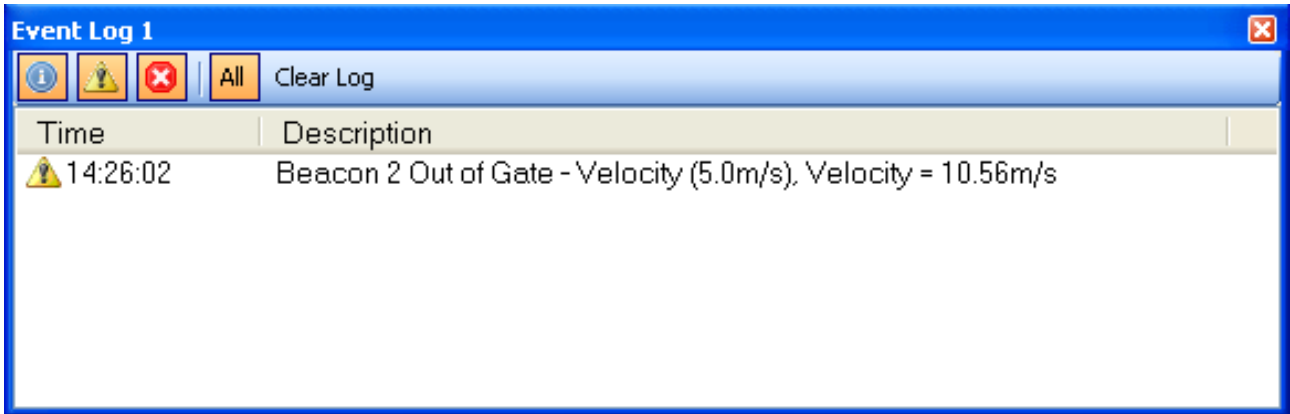
The Event Log records and reports all system events in three levels:

ⓘ   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.

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![Applied Acoustics - Underwater Technology logo]

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Measurement

Toolbar Button ![ruler icon with ?]
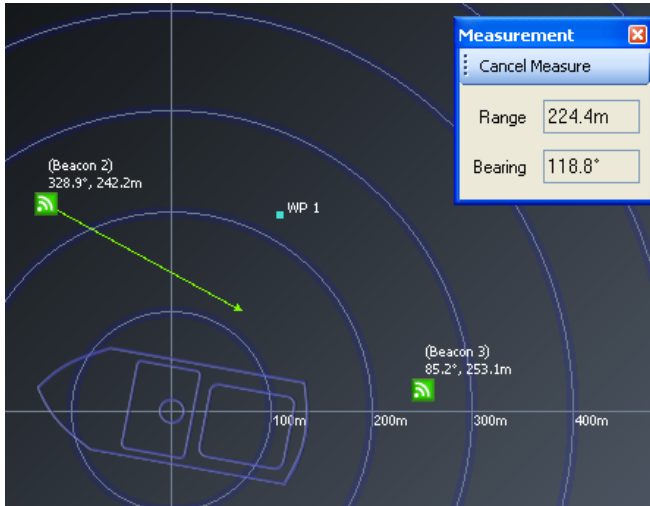
The Measurement Tool can be used to measure between any two points on the plot screen, a range and bearing will be displayed in the measurement window.

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

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Placemarks

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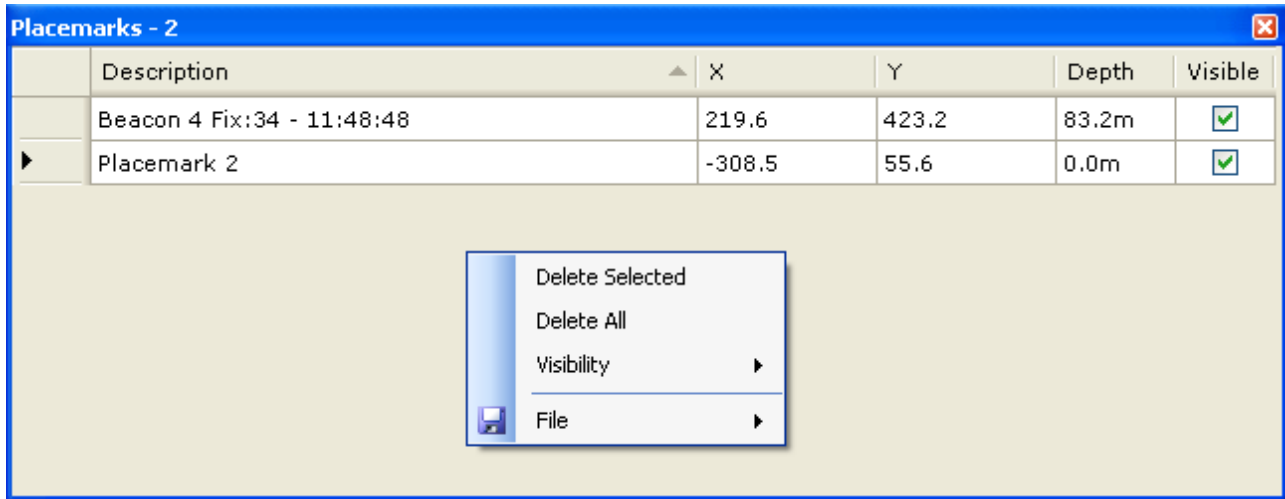
Place marks are designed to offer the operator the ability to mark and record places of interest or events typically in Eastings and Northings (for reference) with the depth of the reading appended. The above example is shown with the context menu displayed (right mouse click).

 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.

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Waypoints

Toolbar Button   (WP's)   Shortcut Key: Ctrl+W
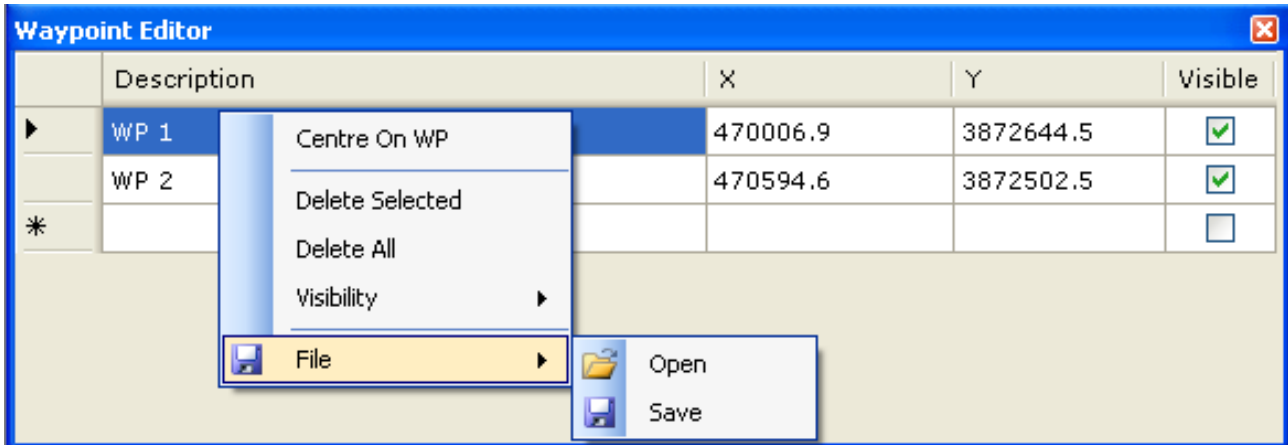
Waypoints are designed to be used as references or markers for navigation purposes. The above example is shown with the context menu displayed (right mouse click).

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.

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Recorder/Playback

Toolbar Button   Shortcut Key: Ctrl+R
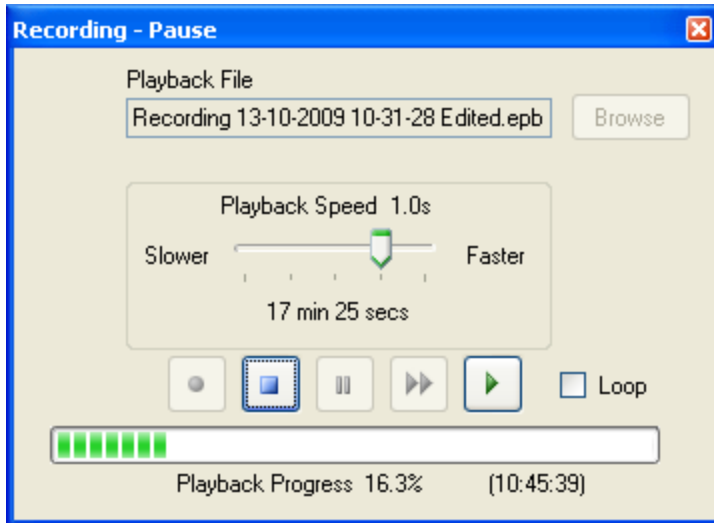
The record and playback function allows the operator to record the tracking and all peripheral interfaces in real time. To have the facility to play back the logged data for review. As the data is recorded in raw format the data sets can be re-created with new offsets, smoothing levels, etc to produce 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.

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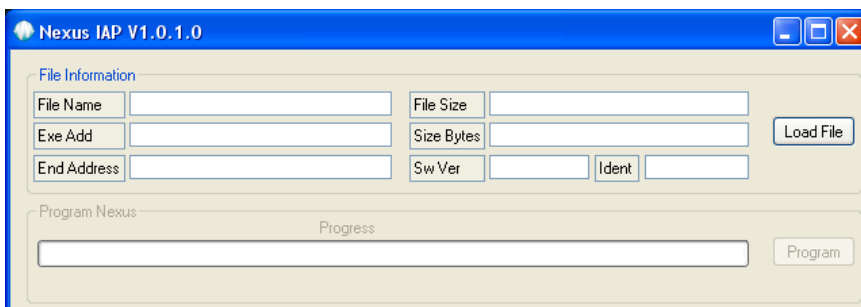
The programming procedure is the same for all updates and is as follows

- Insert a USB memory stick containing the update file.
- Launch the required programming tool.
- Click Load 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.
- Power up the system to complete update and operate as normal.

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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.

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Acoustic Monitor

An acoustic monitor mode is available when in advanced user mode.
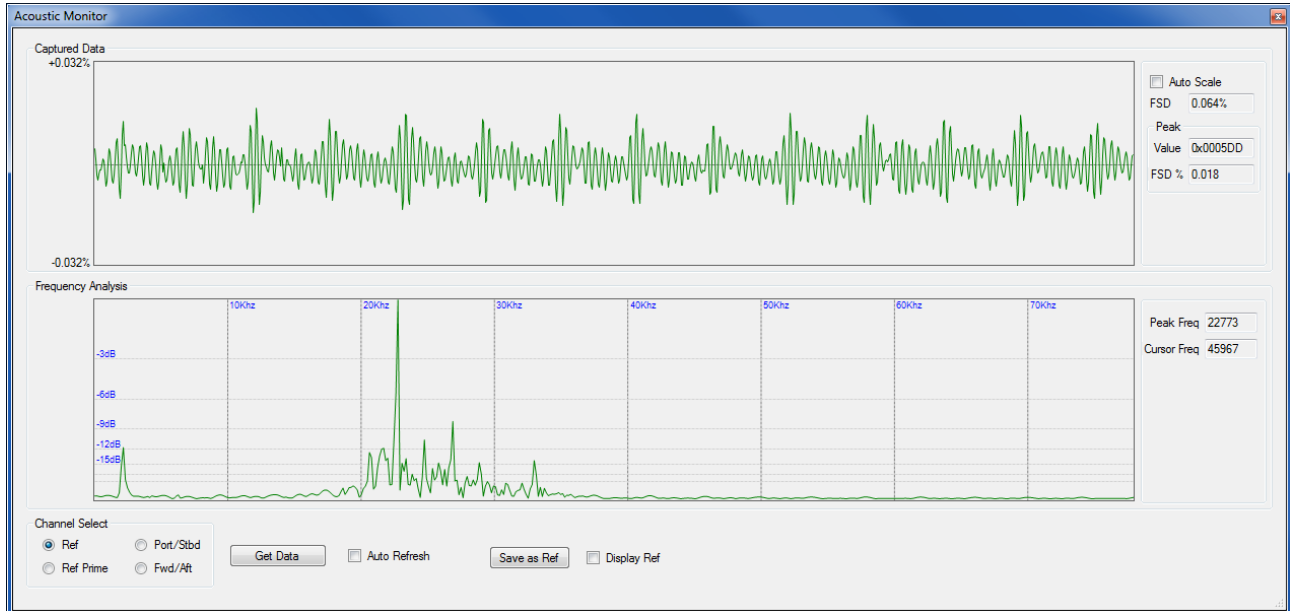
The acoustic monitor mode enables the transceiver to *listen* for ambient noise that may be affecting system performance and ascertain frequencies that may be interfering with the USBL acoustics.

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.

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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

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Help Menu

About

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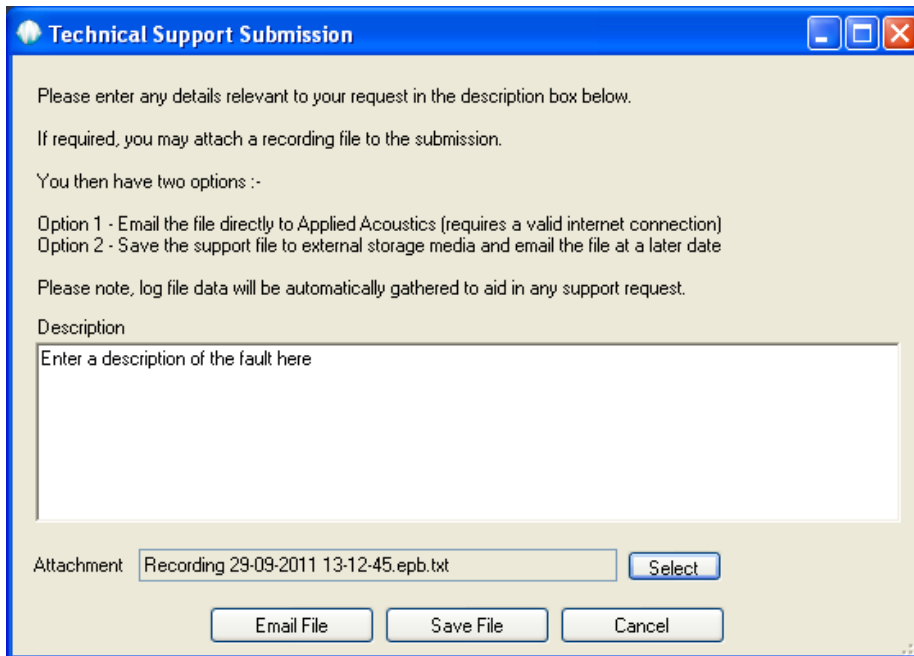
User Information

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

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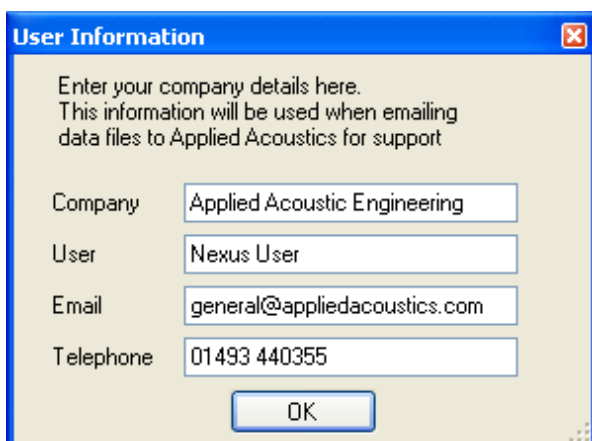
Request Support

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

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.

If you have a valid network connection plugged into the rear of the Nexus console then it is possible to email the support request directly to Applied Acoustics customer support. If no valid internet connection is available then the support request data may be saved to a zip file and saved to an external USB device and then emailed to Applied Acoustics at a later date.

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6. Transceiver Compass Calibration

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.

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- From the 'Tools -> Calibration' menu select 'Compass Calibrate'
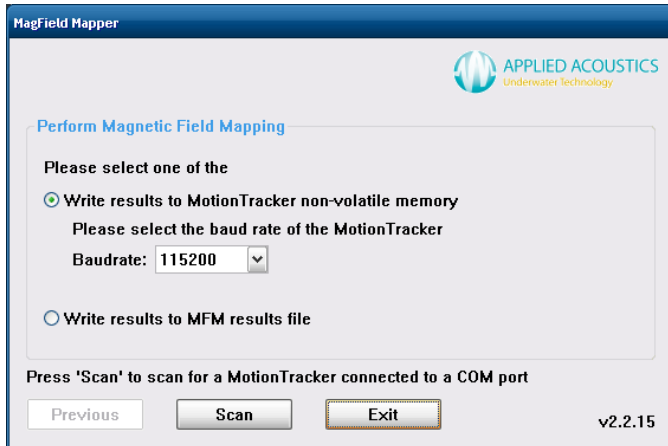
The above screen will be displayed. Press the 'Scan' button to proceed

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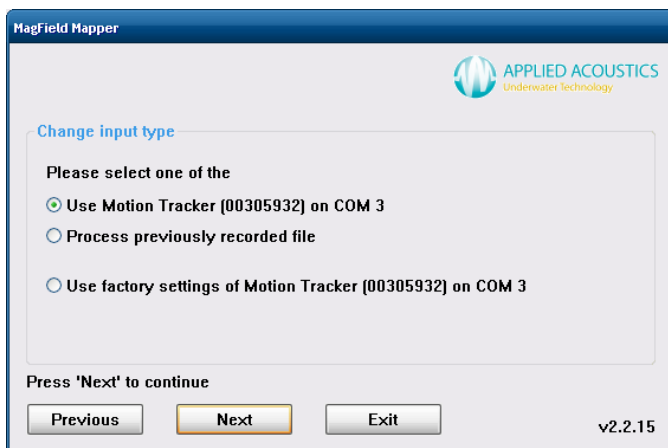
- When the following screen is displayed, press the 'Next' button to proceed

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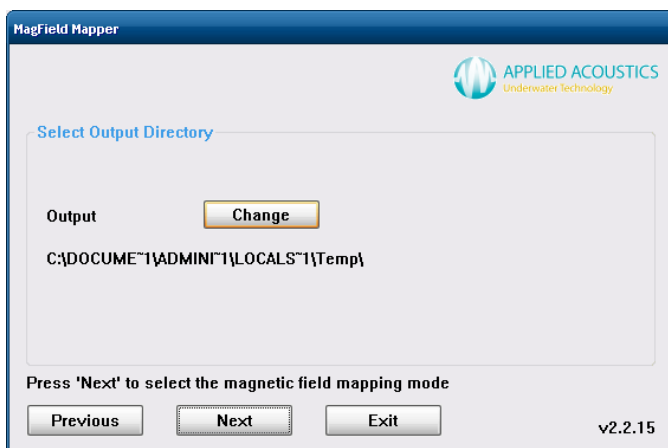
- When the following screen is displayed select '2D' and then press 'Start' to proceed
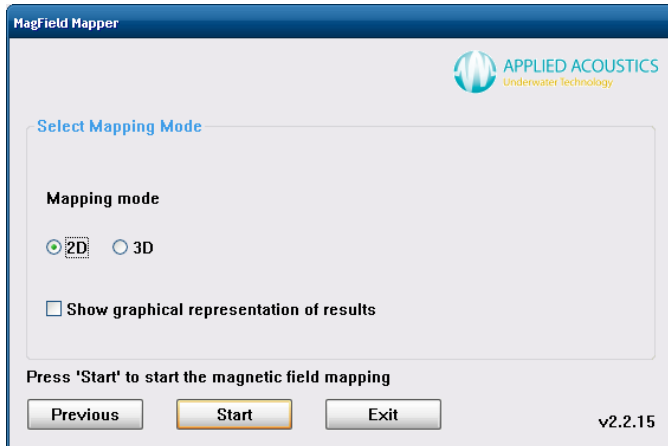
- The following screen will be displayed during the data capture phase. Please ensure the transceiver is rotated a full 360 degrees by navigating the vessel in a complete circle over a period of no less than 2 minutes
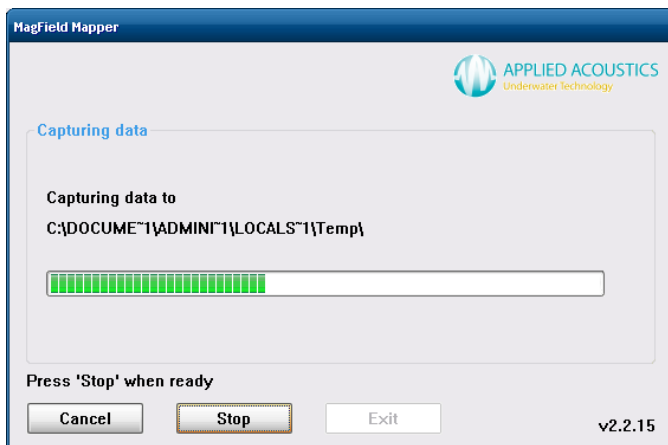
- When the rotation has been completed press the 'Stop' button to proceed. The following screen will be displayed during the analysis phase

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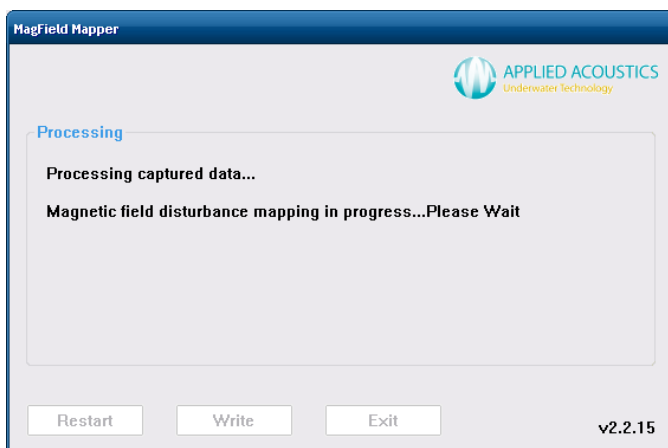
When completed the following results screen will be displayed
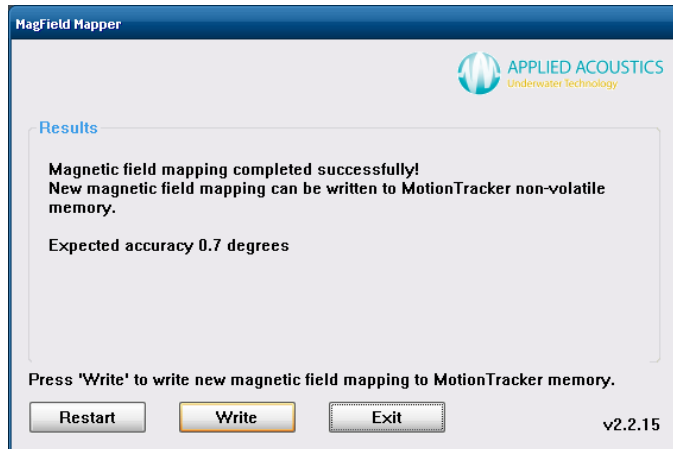
If an acceptable calibration has been completed (see the Expected Accuracy section previously) the results should be written to the transceiver by pressing the 'Write' button. If an acceptable calibration has not been completed the calibration may be restarted by pressing the 'Restart' button. Alternatively, 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)
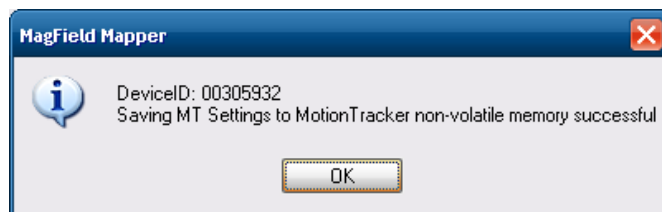
The following screen is then displayed
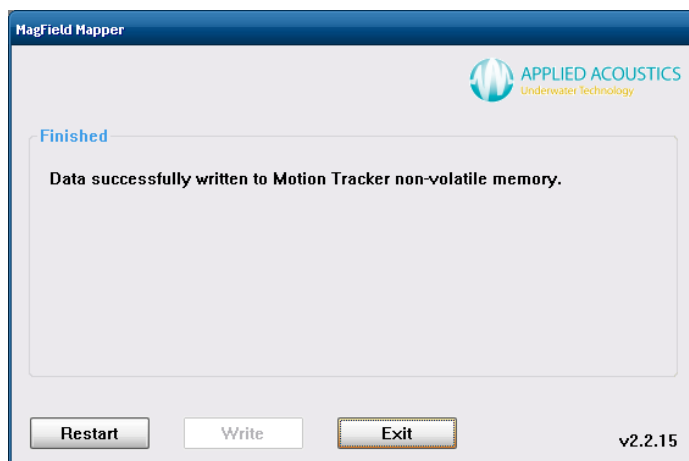
- Press the 'Exit' button to proceed

- The transceiver will be powered down and the power re-applied after a 10 second delay

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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.

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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.)
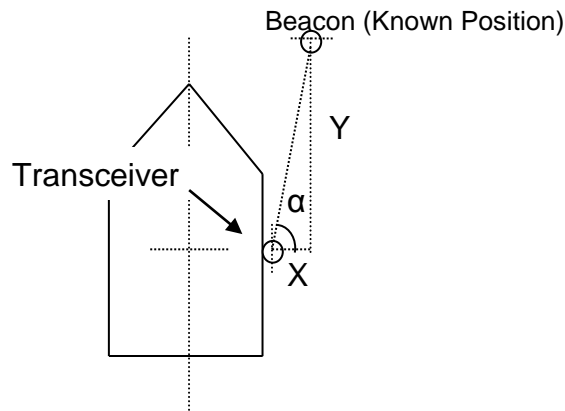
Method 1:

- 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 $\alpha = \text{inv} \tan\left(\dfrac{x}{y}\right)$
- 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.

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8.2 EasyCal USBL Calibration

This program is a collaboration between Applied Acoustics and Ilex Computing Ltd.

The program is an add-in to EasyTrak 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 transducer.

The program is launches directly from Easytrak, offsets and target data are passed automatically from Easytrak to EasyCal. 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 it's configuration.

DISCLAIMER

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EasyCal 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
- 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.

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File		Operation Mode		Database		Help
Load Processed Files		Data Acquisition Mode		Titles		Help Index
Import		Processing Mode		List Database		About EasyCal
Merge				Show Statistics Graph		
Save Current Data						
Save As						
Quit						

Load 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.

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

Import

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

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

Save

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.

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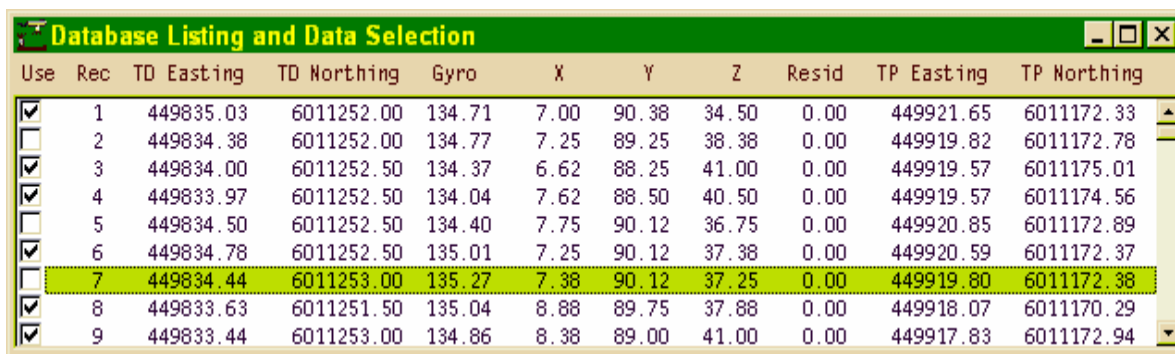
Save As

This items 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.

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 and Data Selection

Use	Rec	TD Easting	TD Northing	Gyro	X	Y	Z	Resid	TP Easting	TP Northing
☑	1	449835.03	6011252.00	134.71	7.00	90.38	34.50	0.00	449921.65	6011172.33
☐	2	449834.38	6011252.00	134.77	7.25	89.25	38.38	0.00	449919.82	6011172.78
☑	3	449834.00	6011252.50	134.37	6.62	88.25	41.00	0.00	449919.57	6011175.01
☑	4	449833.97	6011252.50	134.04	7.62	88.50	40.50	0.00	449919.57	6011174.56
☐	5	449834.50	6011252.50	134.40	7.75	90.12	36.75	0.00	449920.85	6011172.89
☑	6	449834.78	6011252.50	135.01	7.25	90.12	37.38	0.00	449920.59	6011172.37
☐	7	449834.44	6011253.00	135.27	7.38	90.12	37.25	0.00	449919.80	6011172.38
☑	8	449833.63	6011251.50	135.04	8.88	89.75	37.88	0.00	449918.07	6011170.29
☑	9	449833.44	6011253.00	134.86	8.38	89.00	41.00	0.00	449917.83	6011172.94

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 :

Turn Selected Items ON
Turn Selected Items OFF
Reject Using Residuals

Turn All ON

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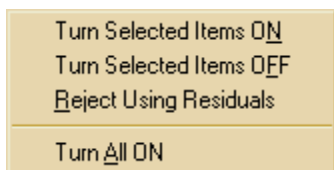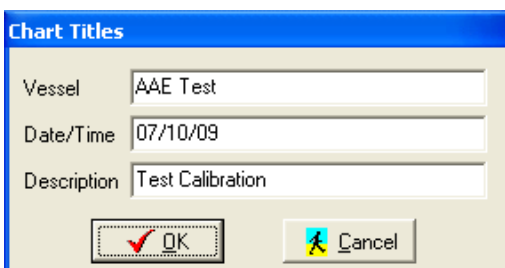
Print Database

Selecting this item will provide a print dialog box allowing the user to select the printer and orientation with which to print the dataset.

With the orientation set to portrait 80 lines will be printed per page and 50 lines per page in landscape.

Titles

This menu items 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.

Histograms & Statistics

This form provides statistical information on the acquired data the two types of graph Histogram and Tiem Series are displayed below. Select the data type you wish to view from th epulldown 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

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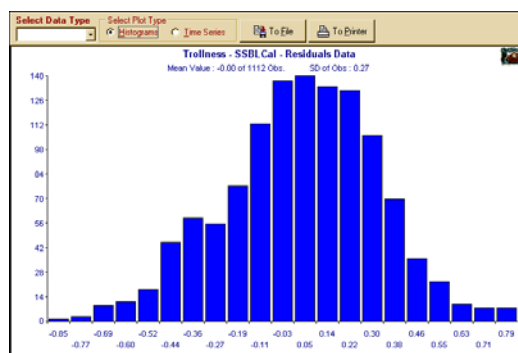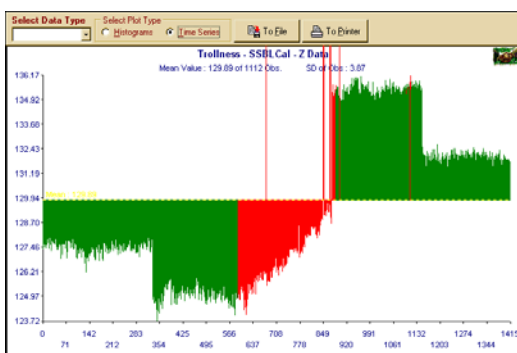
Data Acquisition Mode
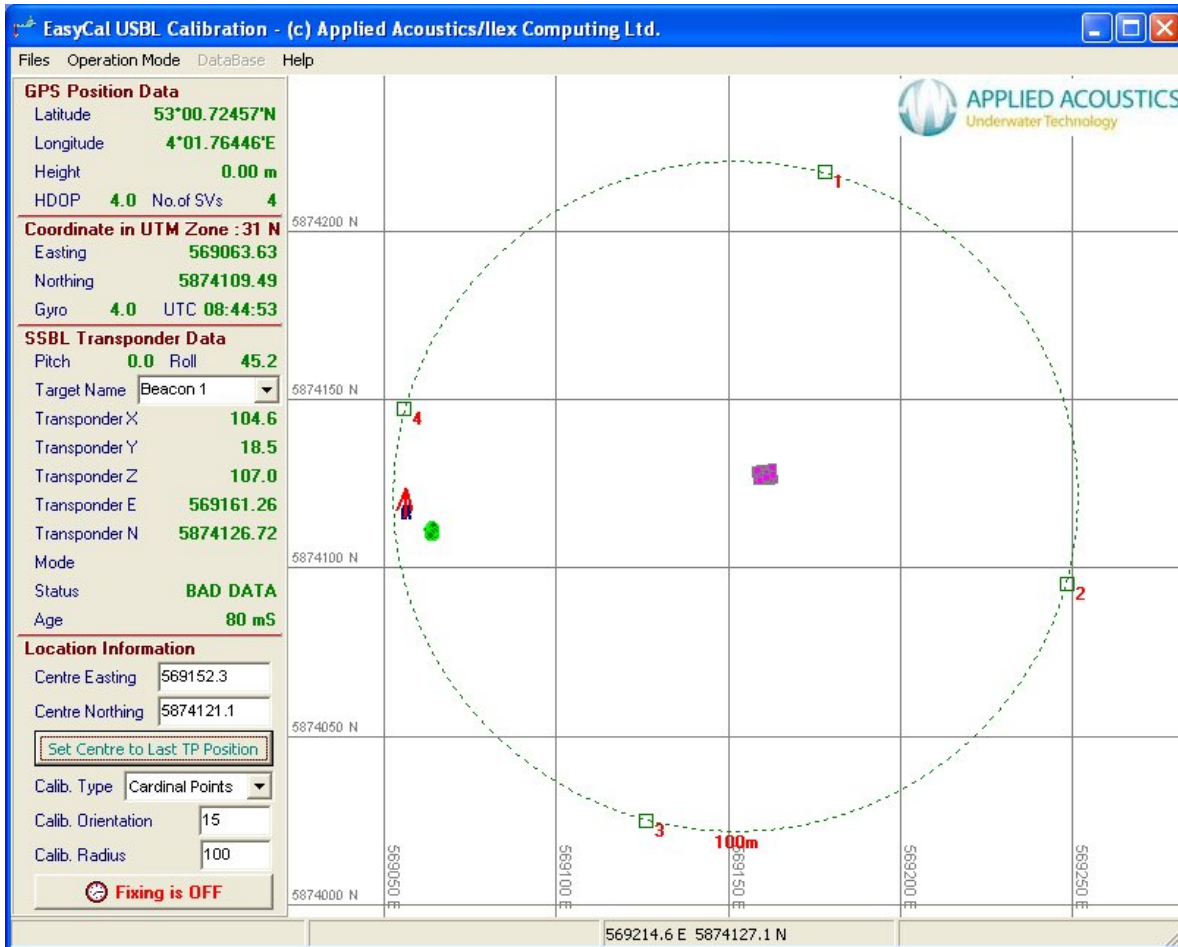
The screen shown here is a typical online acquisition screen showing the vessel antenna position (Green trail), the Ref. position, i.e. Origin for the SSBL system (Navy coloured trail), and the individual fixes from the Transponder (Purple trail). The red arrow head on the screen is positioned such that the tail of the arrow sits on the current transceiver reference position as computed, and points in the direction of the Gyro. This remains a fixed size and does not reflect the size of design of an individual vessel.

The data panel at the left of the screen contains raw data information and status information from the sensors and are described on the following pages.

GPS Data

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This part of the panel shows the Lat & Lon obtained from the GPS receiver and it's conversion to Easting and Northing. There is no geodetic setup in the program, this is done automatically. Depending on your Lat and Lon the relevant UTM zone is selected and the Easting and Northing is derived using WGS 84 spheroid parameters with no datum shift. These coordinates are for the antenna position only, this is the position which is logged to file when fixing is on.

> *(i)* **Note:** Antenna offsets must be entered in the Processing Configuration section to obtain accurate data in On-line Acquisition mode. These are automatically updated from the values entered in Easytrak.

The Gyro reading shown here includes the Gyro C-O value as entered in the Easytrak system and provided to EasyCal at initialisation.

Transponder Data

SSBL Transponder Data

Pitch	0.0 Roll 0.0
Target Name	Beacon 1 ▼
Transponder X	-89.1
Transponder Y	-64.3
Transponder Z	20.8
Transponder E	614383.38
Transponder N	5800502.02
Mode	
Status	Data OK
Age	987 mS

This section lists the raw transponder data from the interfaced device. The Pitch and Roll are derived from the USBL system input. Enter the relevant transponder code e.g. "Beacon 1", in the edit box provided, if there is data apparent for this transponder then the raw data will be shown.

Location Data

Location Information

Centre Easting	569152.3
Centre Northing	5874121.1

Set Centre to Last TP Position

Calib. Type	Cardinal Points ▼
Calib. Orientation	15
Calib. Radius	100

🕒 Fixing is OFF

The Location section allows you to enter a proposed or drop location for the transponder (or click the button to centre on the current TP position), the chart will automatically centre at the location once this is entered. The "Calibration Type" provides positon guides to assist in positioning the vessel during the data acquisition phase. The Cardinal point method is shown in the diagram with it's orientation and radius set by entering the data in the edit boxes provided. Three methods are provided "Cardinal Points", "Figure of 8" and "Triangle".

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Note: When positioning the vessel for data logging, please remember that it shoud be the transducer that is positioned rather than the vessel.
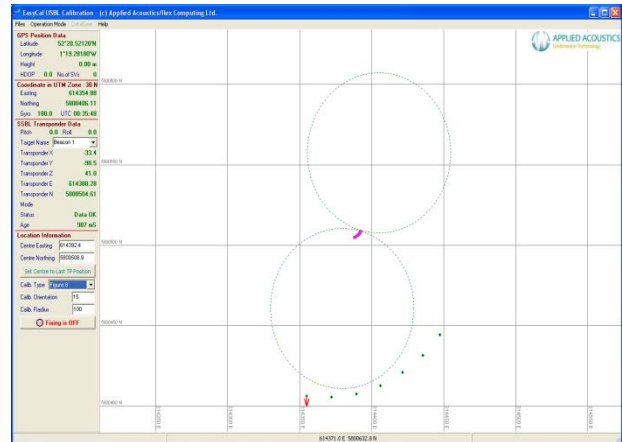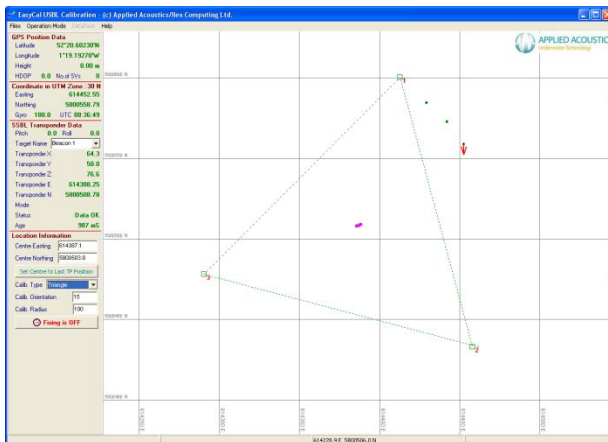
Logging Data (Fixing)

Finally a button is provided to turn the fixing ON/OFF to begin calibration logging.

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.

If 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 a text editor (NOTE : only one header section should be included), or by 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.

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Processing Mode

This provides the main body of the program and incorporates all the relevant details for a particular calibration, as such this can be printed to printer or file as a calibration summary. A typical screen is shown here :
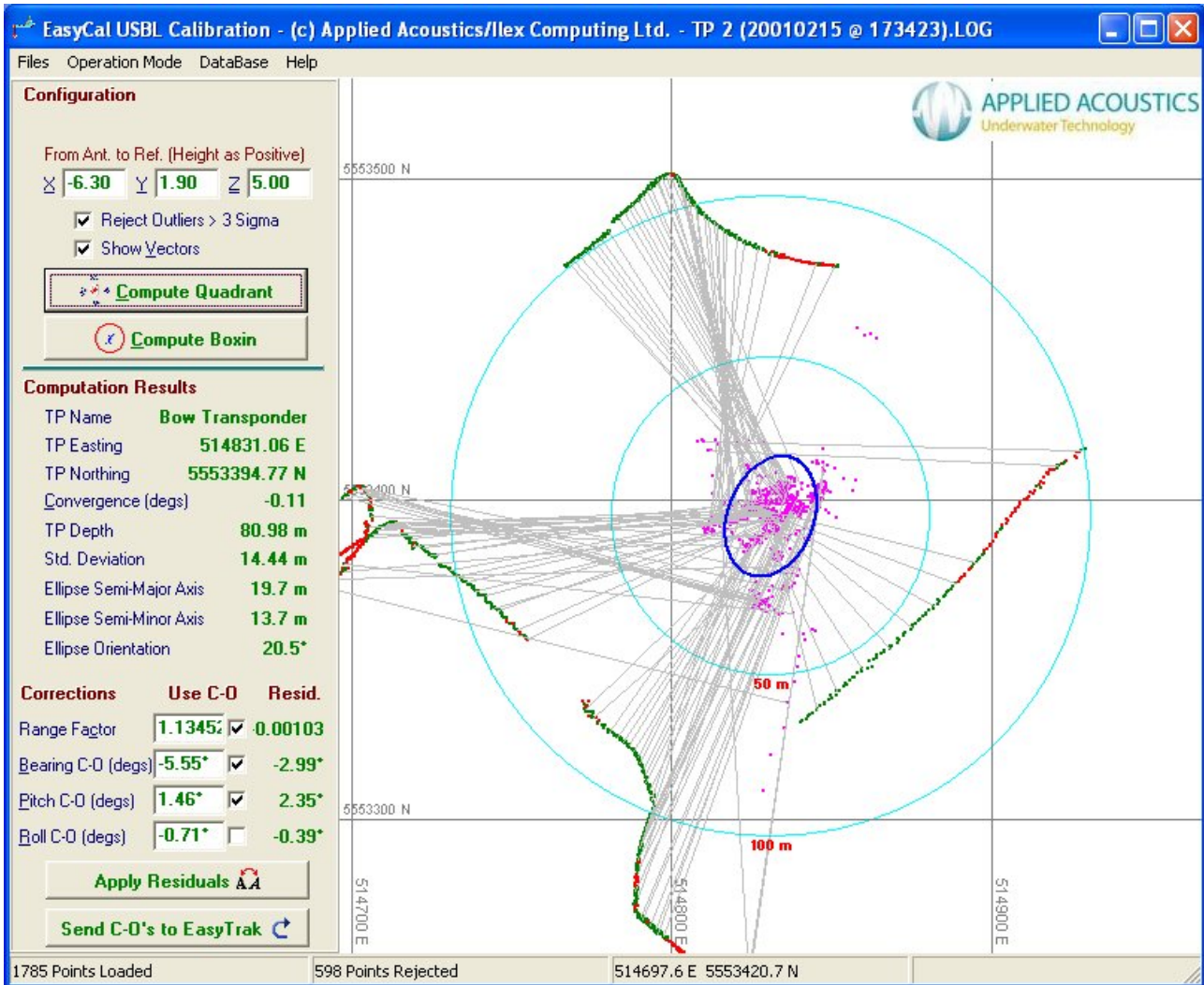
This shows the vessel positions, computed transponder positions, error ellipse and calibration factors. At the left are four areas, discussed separately :

Configuration
Computation Methods
Computation Results
Corrections
Status Bar

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By right clicking on the chart area a context menu is provided :

These are mainly self explanatory, the Lasso functions allow you to "Lasso" a section of chart and reject all the data that falls within the Lasso (whether it is transducer or transponder positions). When selected a Lasso cursor is shown which remains until the action is complete. As data is rejected is becomes red, data that is used in the computation is shown as green and the transponder positions are shown in Purple. The Lasso can be any irregular area, simply select the "Start Lasso Selection" then click on the first defining point on the chart, move successively to points that define the Lasso and click, a dotted line will be drawn joining the points. Once all points have been entered, select "End Lasso Selection", the Lasso will be closed and all points falling inside will be shown in red.

Zoom Window allows you to select a rectangular area of the screen which you wish to fill the screen. Select "Zoom Window" then press and hold the left mouse button at one corner of the required area, hold the button down while dragging (a rubber band box will be shown indicating the selected area), the rubber band area will have an aspect area reflecting that of the overall chart area. On releasing the button the screen will be re-drawn showing only the selected area. The "Zoom Window" cursor will however remain allowing successive zooming to smaller and smaller sections of the data.

The screen shown below is just the transponder data after computation and corrections have been applied (using "Zoom Window" to select the area).

Configuration

This part of the screen defines the basic vessel offsets from GPS antenna to Easytrak transceiver.

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Having imported a data file that has been logged using EasyCal, the convergence is computed based on the UTM zone that the data falls within and the mean position of the data is used as a starting point for the display and the computation. The data is displayed in the results part of the panel - see Computation Results.

The X,Y,Z Offset values should be entered if the coordinate that is imported is not the origin of the X/Y/Z data. e.g. if the Easting and Northing are for the GPS antenna and the X/Y/Z data is from the transducer then enter the X/Y offsets **FROM** the offset point **TO** then Transducer offset. These values are used to compute the transducer position by applying the gyro reading and applying the pitch and roll from the GPS position to obtain the transducer position. Acoustic positions are then computed relative to the transducer and the relative X,Y,Z is added to the transducer position.

If automatic rejection of outliers is to be performed then ensure the box is checked, this causes the program to iterate the solution until all data points fall inside the 3 x Sigma value for the dataset. If this is not checked then the first Least Squares solution will be displayed without any automatic error rejection and if there are wild Easting/Northings in the dataset, it may throw the computation.

The "Show Vectors" check box allows every 25th point to be joined between vessel transducer coordinate and the corresponding computed transponder position. This is a valuable tool for visualising the calibration data as it displays the resultant transponder position with relation to an acquisition location and can visually clarify ambiguities.

Compute Boxin

There are two computation methods provided; Boxin and Quadrant

The main difference is that you select the "Compute Boxin" button to compute a best-fit transponder position, typically by steaming in a circle around a transponder. The corrections section is not shown in this mode as it is not intended to be used to compute C-O's for the system, an error ellipse and residuals are computed and can be viewed in the Statistics page.

Compute Quadrant

EasyCal uses a least squares iteration to compute the 'best-fit' transponder position and provide an indication of the noise levels, or offset errors, inherent in the system. Typically this is carried out by steaming a circle around a seabed transponder (at a radius equal to the water depth) and acquiring a circle's worth of data. The plot on screen should ideally be a small group if the system is correctly calibrated, however there may be noise or some alignment errors but this should provide a good estimate of the transponder position as long as the data gathering is balanced (equal amounts of data from around the circle).

Once computed the data can be viewed in the Stats page.

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 (see corrections), 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 :

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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.

If this occurs use the database viewing screen to turn on/off selected items and reject obviously bad data.

If the "Reject > 3 Sigma" is checked then the above procedure will be iterated, each time rejecting data items whose residuals fall outside the three Sigma value, until all the remaining residuals fall inside the 3 Sigma value. The 3 Sigma value provides a 95% probablitity of data being accetable.

Once a solution has been found the residuals for each of the selected C-O values is computed, and the total C-O for those items which are not selected is computed. These values are then displayed to the right of the C-O edit boxes and can be applied using the button provided. Use the check boxes next to each of the items to use it in the computation, if it is not checked then it is not used, you will quickly see the effect of using some C-Os and not others. If you press the "Apply Residuals" button then the residual will be added to the value in the edit box (where items are checked) and the full value of the residual will be applied to those not checked.

The Range Factor is a multiplier used to correct inaccuracies in the velocity of sound - resulting in a range error. By achieving a best fit solution, the ranges will have residuals attached to each one, the Range Factor is a mean of this correction. i.e. Computed Range / Observed Range = Range Factor. This provides a value by which to mutiply the Velocity of sound. If, for instance, a velocity of sound of 1500m/S was used during acquisition and a range factor of 1.1 resulted from the calibration, it indicates that a VoS value of 1500 * 1.1 should be used to achieve the most accurate acoustic position = 1650m/S.

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

Computation Results

Computation Results	
TP Name	**Bow Transponder**
TP Easting	514831.06 E
TP Northing	5553394.77 N
Convergence (degs)	-0.11
TP Depth	80.98 m
Std. Deviation	14.44 m
Ellipse Semi-Major Axis	19.7 m
Ellipse Semi-Minor Axis	13.7 m
Ellipse Orientation	20.5°

This section of the data panel provides information relating to the transponder used and the solution achieved, as shown above.

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Corrections

Corrections	Use C-O		Resid.
Range Factor	1.13452	☑	0.00103
Bearing C-O (degs)	-5.55°	☑	-2.99°
Pitch C-O (degs)	1.46°	☑	2.35°
Roll C-O (degs)	-0.71°	☐	-0.39°
Apply Residuals			
Send C-O's to EasyTrak			

This part shows the computed corrections to achieve the best results from the data supplied. There is a data entry box for each of the correction parameters, a check box and a residual. We suggest that all items are unchecked initially and a computation carried out. With items un-checked the residual will display the total correction to be applied, this value (or any other value) can then be entered into the edit boxes, the relevant check boxes selected and a further computation carried out.

The results from the previous computation can be entered automatically by selecting the "Apply Residuals" buttons. If the "Use" check box is selected then a correction is made to the existing value in the edit box, otherwise the actual value is entered. The "Apply Residuals" button is disabled if any of the check boxes becomes checked,this prevents multiple applications of the residuals (the button will be re-enabled after the next computation).

When items are checked the residual will show the additional correction to apply to that shown in the edit box. 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.

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

Status Bar

4922 Points Loaded	2607 Points Rejected	449977.8 E 6011029.8 N	5.9m @ 135.0°

The status bar provides information relating to the dataset and the chart coordinates and is divided into 4 sections :

1. The 1st section shows the number of data points currently loaded, this is displayed once a dataset has been imported or loaded.

2. The 2nd shows the number of data items rejected during the computation and appears only after a computation has been performed.

3. The 3rd area tracks the mouse as it moves over the chart area and shows the current position of the mouse pointer.

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4. The 4th area display the distance and bearing of the current or last measure line used. The measure line is activated by simply left clicking and dragging the mouse across the chart area.

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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	**Incorrect Channel.** Check Beacon editor
	Beacon TX power. This may be due to a discharged battery, fouled transducer, or beacon fault. Try with a known working beacon.
	Obstruction. The beacon's signal may be blocked by submerged parts of the vessel, seabed objects – manmade or natural.
	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.
	Damaged responder cable. Check the pulse from Nexus is present at the Responder end of the cable (approx 12VDC pulse on load).
	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.

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

FAULT / SYMPTOM	Short range
POSSIBLE CAUSE	**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.
	Beacon reply insensitivity. This may be due to a fouled transducer, or beacon fault. Clean beacon transducer with fresh water. Try using another beacon.
	Transducer reply insensitivity. Check that the transducer is not damaged or fouled. Clean transducer with fresh water.

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	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.
	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.

FAULT / SYMPTOM	Short range
POSSIBLE CAUSE	**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. **Beacon reply insensitivity.** This may be due to a fouled transducer, or beacon fault. Clean beacon transducer with fresh water. Try using another beacon. **Transducer reply insensitivity.** Check that the transducer is not damaged or fouled. Clean transducer with fresh water. **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. **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.

FAULT / SYMPTOM	Unstable positions - bearing instability but range fairly stable
POSSIBLE CAUSES	**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. **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. **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. **Contaminated Transducer.** Ensure the transducer is clean and uncontaminated prior to installation. Grease can have an adverse affect on the transducer. A lightly damped cloth should be used. Solvents are not recommended. **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

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	<0-5% compared to a 'good' element of '70% at a range of a few tens of metres.

FAULT / SYMPTOM	Unstable positions - bearing instability and range unstable
POSSIBLE CAUSES	**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. **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. **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. **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. **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.

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10. External I/O Connector Pin Outs

• **SERIAL CONNECTORS**
 	
    2   Receive Data (Rx)
    3   Transmit Data (Tx)
    5 Gnd	

• **BNC CONNECTOR**
 	
    Inner   Signal +
    Outer   Signal –
Note the BNC connector is isolated.	

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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

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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.

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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

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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

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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

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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 <u>not</u> 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.

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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.

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APPLIED ACOUSTIC ENGINEERING V2(AAE) DATA STRING

aaaaaa,i,t,o,g,hhmmss.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.

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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*359.9**1234.5*-10000.0*-10000.0*10000.0******0.0*00CL

Note * = space.

Error codes

No error   00
Lost signal   06

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Simrad HPR 300P Data String

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

> **ii*H**B**SSS**ccc.c*xxxx.x*yyyy.y*zzzz.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:-

> **2**1**W***OK**359.9*-999.9**999.9**-1000***0.0CL**

Note * = space.

Error codes

No error   ' OK'
No reply   'NRY'

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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

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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.

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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	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.

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. |
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.

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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 '@'.

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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	1st Additional value	Left empty
,x.x	2nd 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.

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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.

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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,llll.llll,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	l
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.

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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.

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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,llll.llll,N,yyyyy.yy,E,EasytrakAlpha,hhmmss.ss,T,*HHCL

Description	String code
Header	$GPTLL
target number (1 - 4)	nn
Latitude ddmm.mmmm	l
North or South (N/S)	N
Longitude dddmm.mmmm	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

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13. System Specification

Easytrak Nexus Console Model 2690

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° C
Temperature sensor	1 degree resolution between – 10° and +40° 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.

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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; +/- 0.1° resolution/repeatability
Pitch/Roll sensor accuracy	+/- 0.50° rms +/- 0.1° 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

Transceiver Cable

Diameter	12.8 mm nominal
Length	20 – 60 meter standard lengths 100 meter maximum length
Colour	Yellow - Connectors Supplied
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

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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.

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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.

i   The following procedure will return the hard drive within the unit to a copy of when the unit left Applied Acoustics. Any updates, user data and saved configuration files will be lost.

The proceed with a system recovery follow the instructions below.

Reboot System

Power on the system, after a few seconds the following message will be displayed

```
Starting Acronis Loader...
Press F11 for Acronis Startup Recovery Manager...
```

Press F11 whilst this message is displayed.

Launch Acronis Backup & Recovery 10

The following screen will be displayed
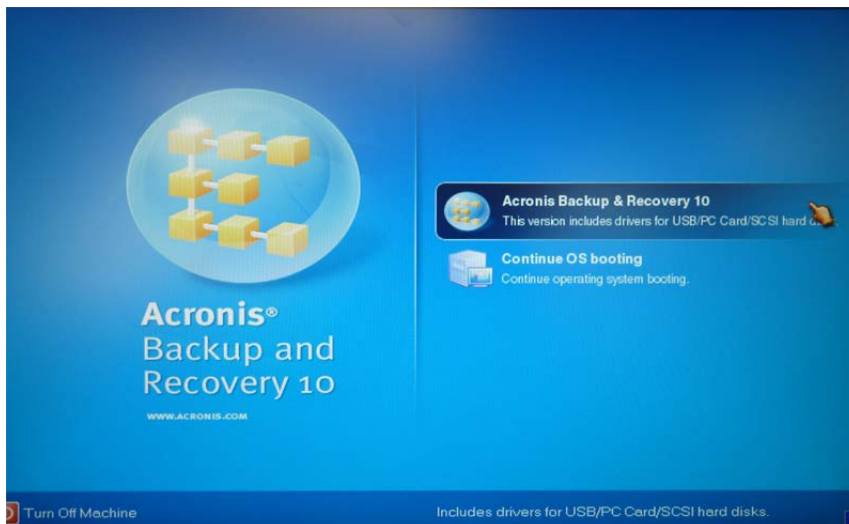
Click on 'Acronis Backup & Recovery 10'. Note that this must be done within approximately 15 seconds otherwise the system will continue with a normal boot into Nexus software.

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After approximately 45 seconds the following screen will be displayed
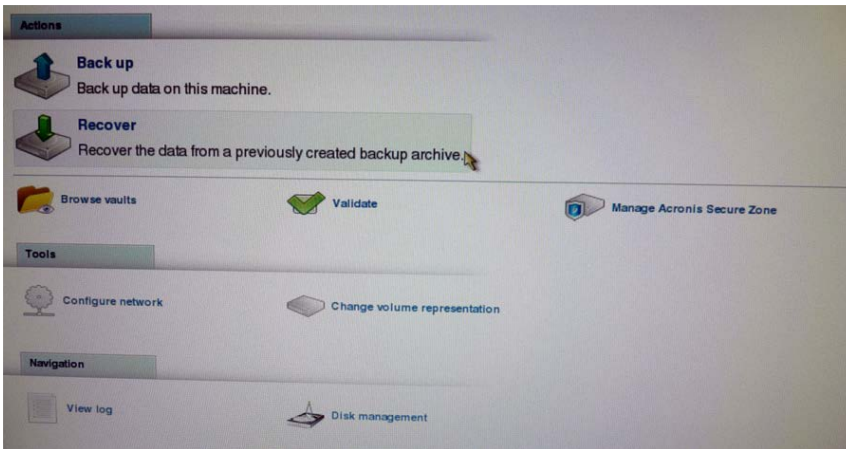
Click on the 'Recover' icon.

Configure Recovery
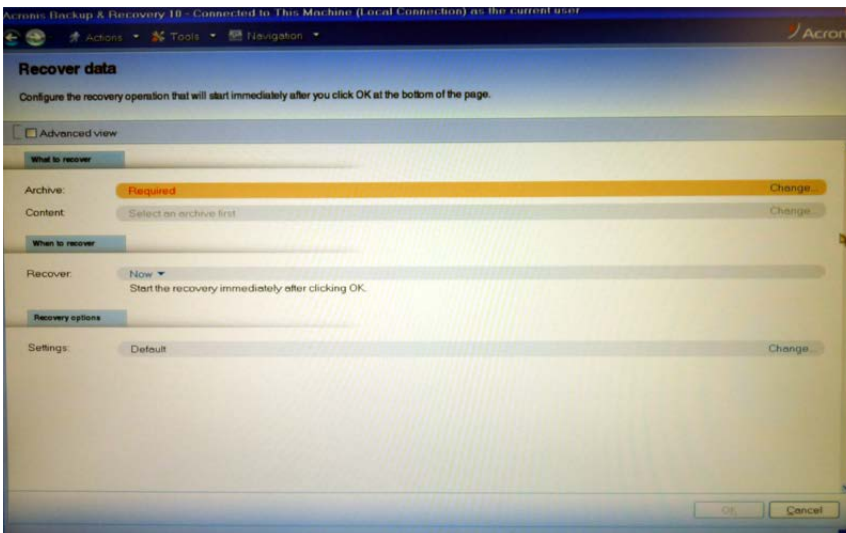
From this page the full recovery will be configured.

Click on 'Change' within the highlighted 'Archive' section

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The following screen will be displayed
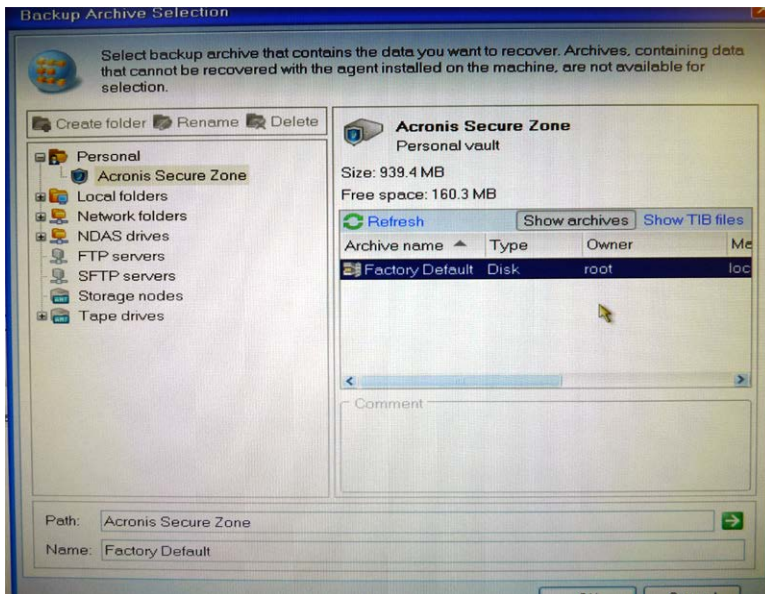
Expand the 'Personal' folder in the left pane (click on the '+') then select 'Acronis Secure Zone'.
In the right hand pane select the 'Factory Default' archive.
Click 'OK' to select this archive.

Within 'Data type' click on the arrow and select 'Disks' as shown below

_____

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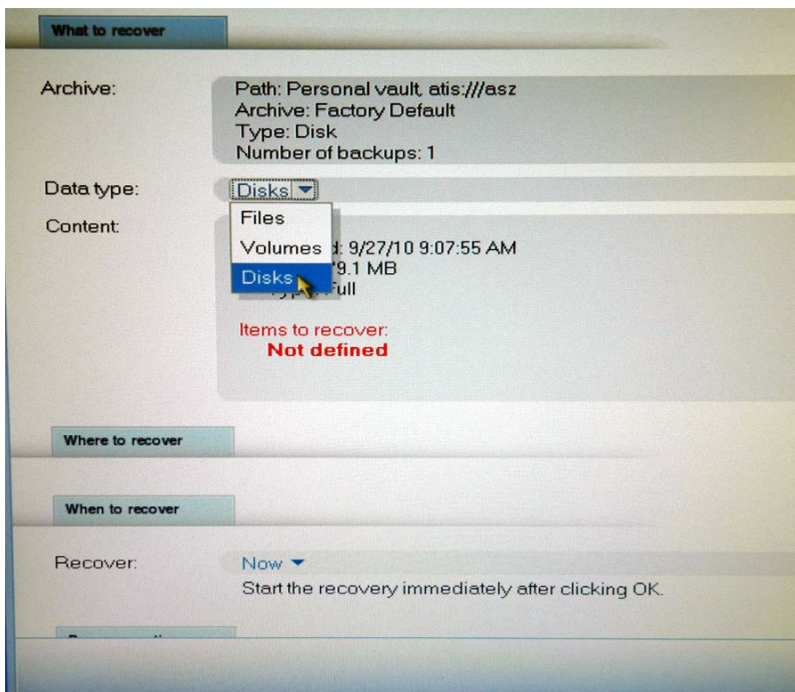
Within 'Content' click on 'Change'. The following screen will be displayed
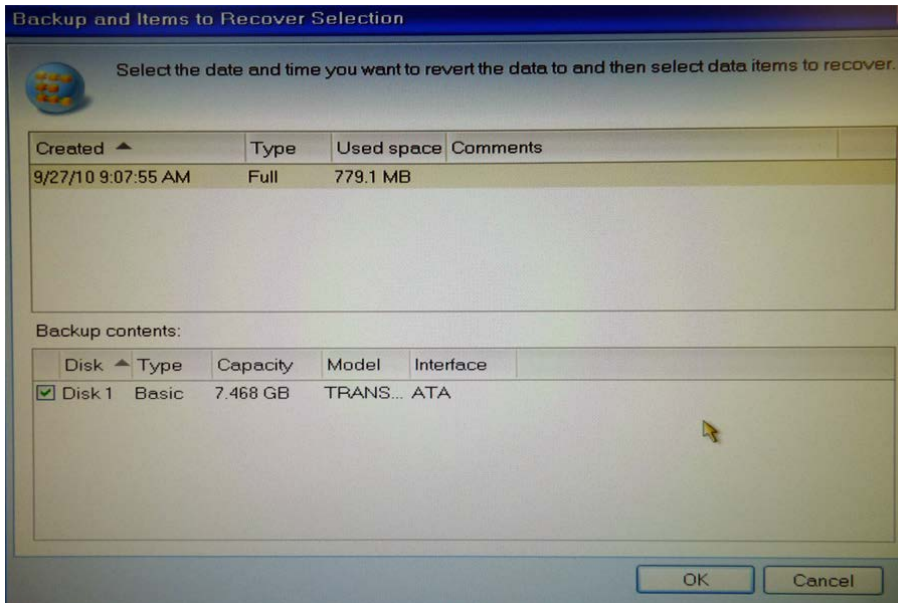
Select 'Disk 1' and then press 'OK'

Within the 'Where to recover' section, click on the 'Change' next to 'Recover Disk 1 to'. The following screen will be displayed
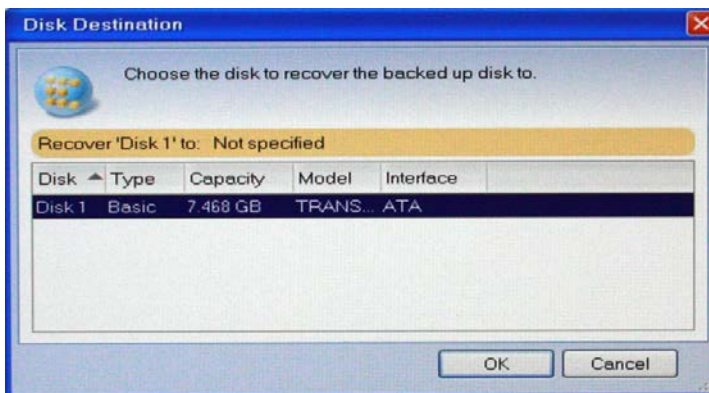
Select 'Disk 1' and then press OK.

Within the 'Where to recover' section, click on 'NT signature' and select 'Recover from archive' as shown below.

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The recovery parameters are now complete and should be as below
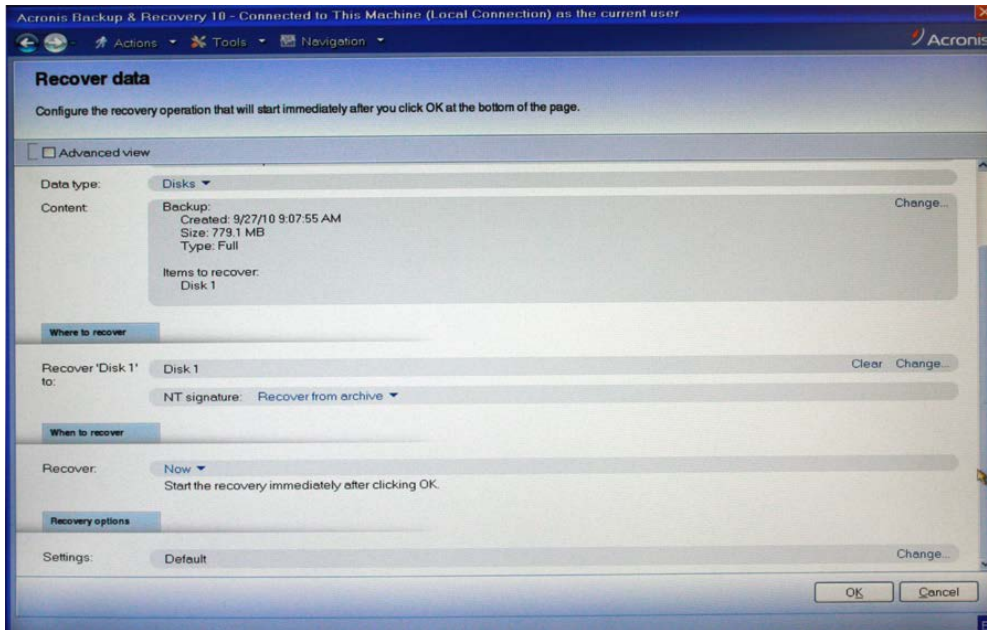
Confirm all setting are correct then press 'OK' to proceed with the recovery.

The following screen will be displayed to show the progress of the recovery.
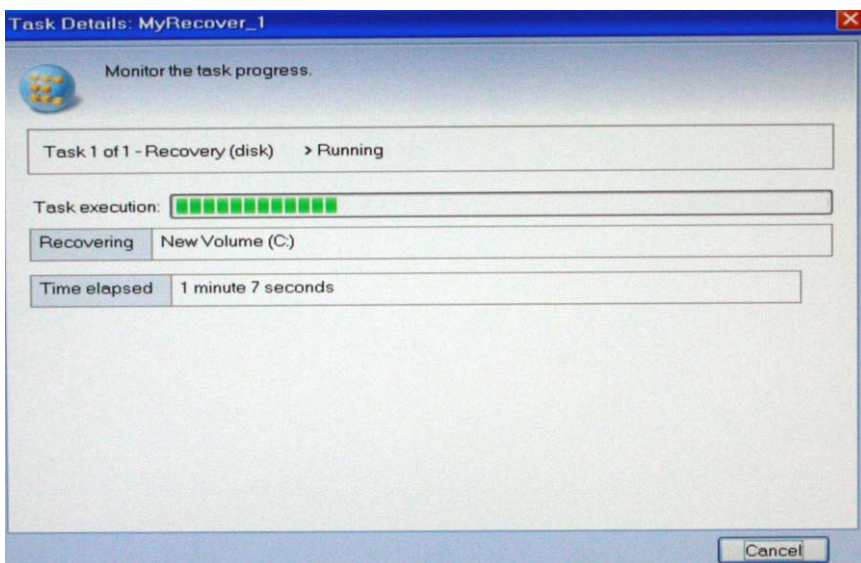
The recovery will take approximately 4 minutes to complete.

> During the recovery process it is critical the power is not removed from the unit. If the recovery is interrupted in any way then it is likely that the unit will be unserviceable. If this occurs, the unit will have to be returned to the factory for repair.

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Upon successful completion of the recovery the following screen will be displayed.
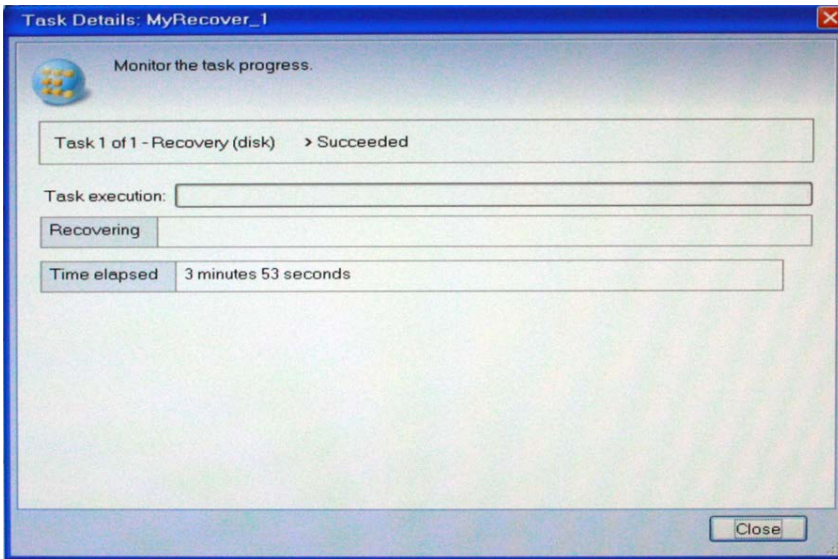
If this screen is displayed then you may press the 'Close' button and then power down the unit.

> *i* — If the 'Succeeded' display above is not shown then **do not power down the unit or exit the Acronis Recovery Software**. In this instance please try the recovery again starting from the 'Configure Recovery' step.

Once the recovery has been completed please apply any previous updates as supplied by Applied Acoustics.

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Appendix A – Transducer Mounting Bracket A

172.40

10.00

Ø152.40

4 x Ø17.50
ON A 114.30 PCD
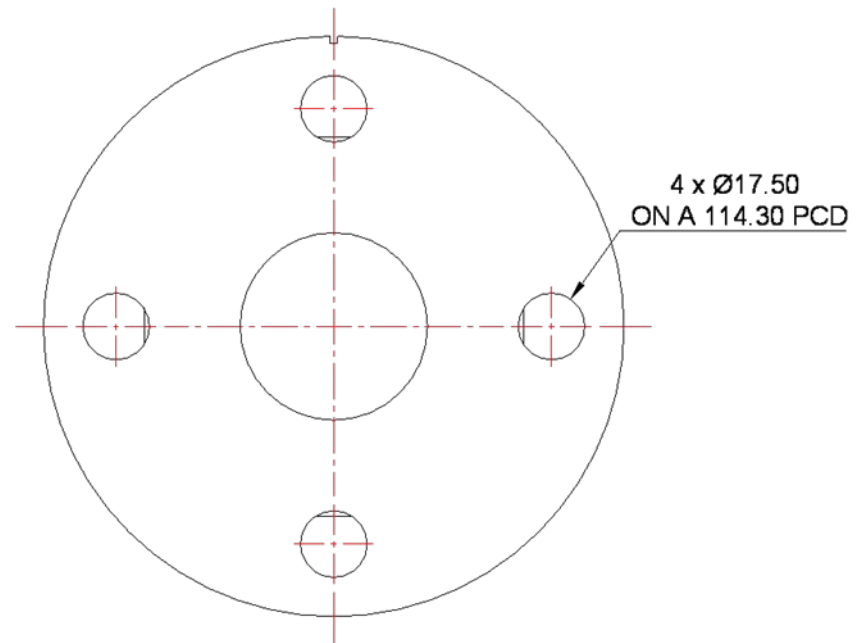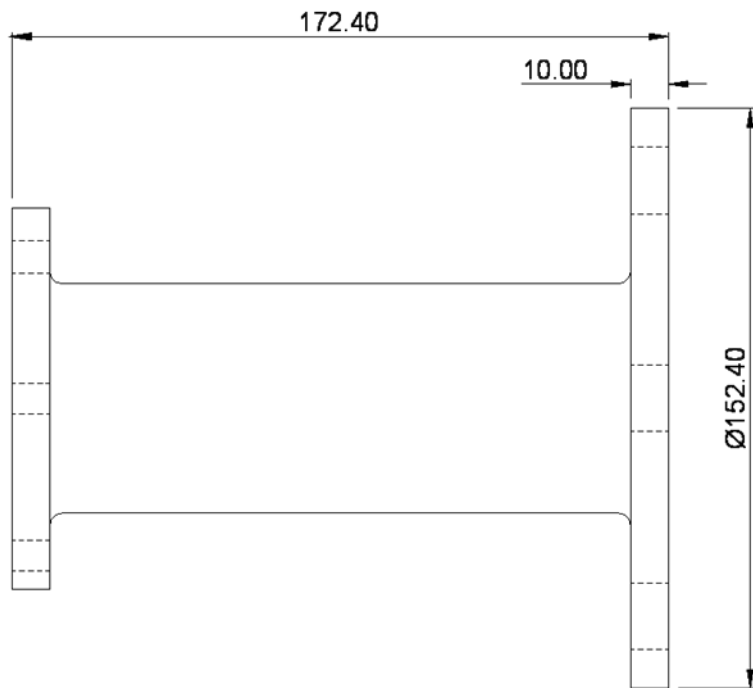
i Transceiver installation is the responsibility of the operator.

Appendix B – Transducer Mounting Bracket B

M12 CLEARANCE

152.00

89.00

131.00

Ø102.00

495.00 ±5.00mm
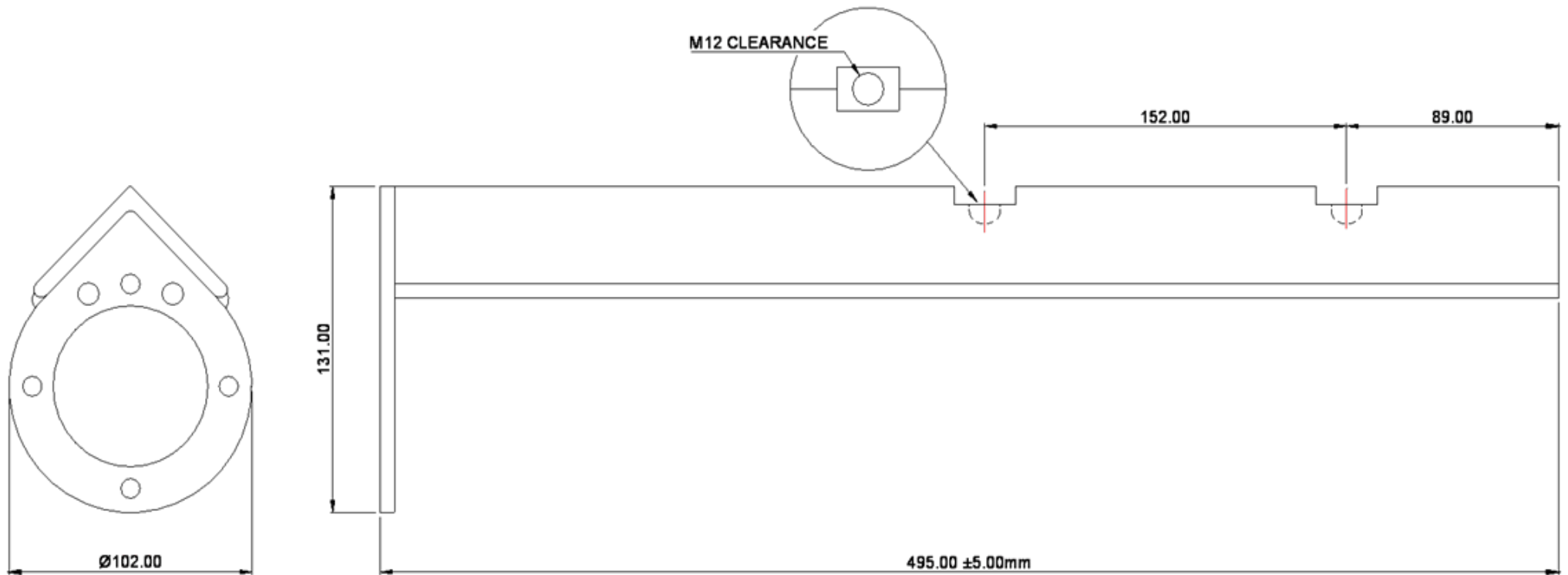
i Bracket rated for typical survey speeds of up to ~5 Knots.
Bracket A is recommended for higher speed applications.
Transceiver installation is the responsibility of the operator.

Appendix C – Transducer Mounting Dimensions

17.75

90°

Ø3.00

CONNECTOR Ø34.00

37.25

24.90

FIXING POINTS
4 HOLES TAPPED M8 x 10mm
EQUI-SPACED ON A 82.50 P.C.D

Ø100.00

**CONNECTOR ENDCAP
REAR VIEW**
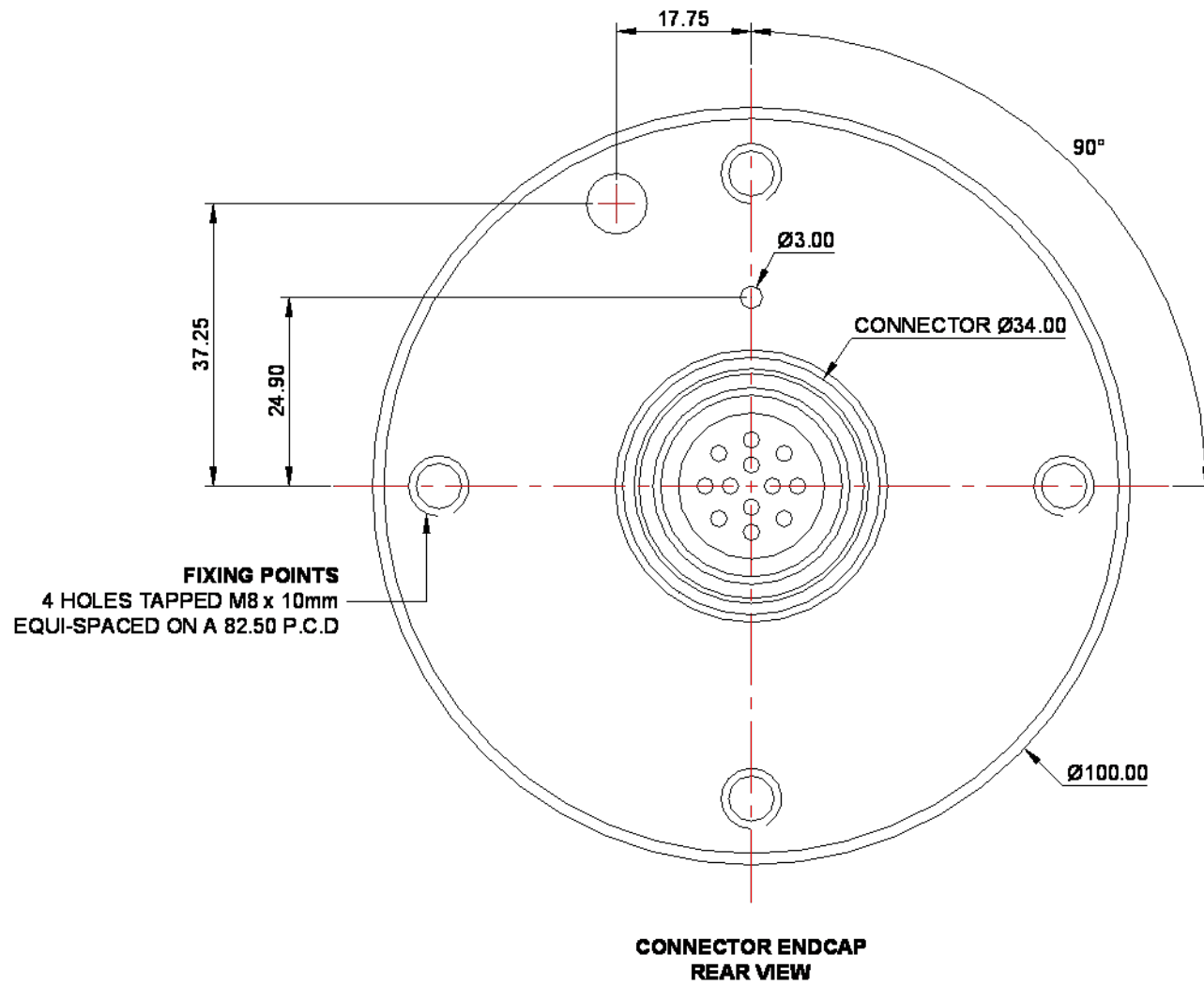
Appendix D - BIOS Error Messages

BIOS Front-panel Power LED Blink Codes

The front-panel power LED is used by the BIOS to display messages. For example, the LED is on when the system is powered on, and blinks off for 0.5 second when processor initialization is complete. In addition, whenever a recoverable error occurs during POST, the BIOS causes the front-panel power LED to blink an error message describing the problem

Type	Pattern
Processor initialization complete	On when system powers up, then off for 0.5 second
POST complete	On when system powers up then off for 0.5 second
BIOS update in progress	Off when update begins then on for 0.5 second then off for 0.5 second; pattern repeats until BIOS update is complete
Video error	On-off (0.5 second each) two times, then 3.0 second pause (off) between on-off blink pattern; repeat entire pattern (two on-off blinks and pause) until system is powered off
Memory error	On-off (0.5 second each) three times, then 3.0 second pause (off) between on-off blink pattern; repeat entire pattern (three on-off blinks and 3-second pause) until system is powered off
Thermal warning	On-off (0.5 second each) four times, then 3.0 second pause (off) between on-off blink pattern; repeat entire pattern (four on-off blinks and 3-second pause) until 16th on blink, then end

BIOS Beep Codes

The BIOS beep codes are listed in the following table. These beep codes can be heard through a speaker attached to the board's line out jack.

Type	Pattern	Frequency
Memory error	Three long beeps	1280 Hz
Thermal warning	Four alternating beeps: High tone, low tone, high tone, low tone	High tone: 2000 Hz Low tone: 1600 Hz

BIOS Error Messages

Whenever a recoverable error occurs during POST, the BIOS displays an error message on the PC monitor that describes the problem. Following table lists the BIOS error messages and a brief description of each.

Error Message	Explanation
CMOS Battery Low	The battery may be losing power.
CMOS Checksum Bad	The CMOS checksum is incorrect. The CMOS memory may have been corrupted. Run Setup to reset values.
Memory Size Decreased	Memory size has decreased since the last boot. If no memory was removed then memory may be bad.
No Boot Device Available	System did not find a device to boot.

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